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Smart connections.

Operating manual

INVEOR MP Modular

Legal notice

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General note on gender equality

KOSTAL is aware of how language impacts on gender equality and always makes 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.

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Informationen zum Antriebsregler

SCAN ME

Information about the drive controller

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1. General information

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

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
Drives@kostal.com

Website address

www.kostal-industrie-elektrik.com

1.1 Information about documentation

The following information explains how to navigate through the documentation.

Read this manual carefully in its entirety. It contains important information for operating the INVEOR MP Modular.

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 MP 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 https://www.kostal-drives-technology.com/download

A description of parameters is available for download (https://www.kostal-drives-technology.com/download) for parametrising the drive controller.
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 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:

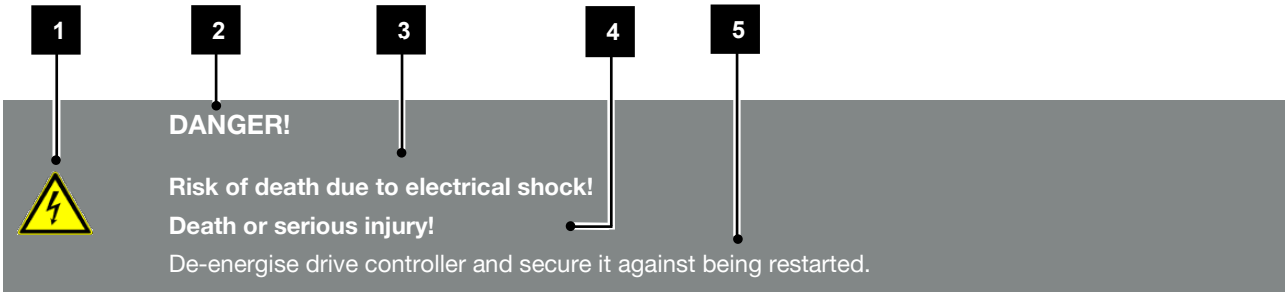


Fig. 1: Structure of the warnings

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	Meaning
	Danger
	Danger due to electrical shock and discharge
	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 the instructions may 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	Meaning
	Important information
	Damage to property possible

Other notes

Symbol	Meaning
	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 Labels on the drive controller

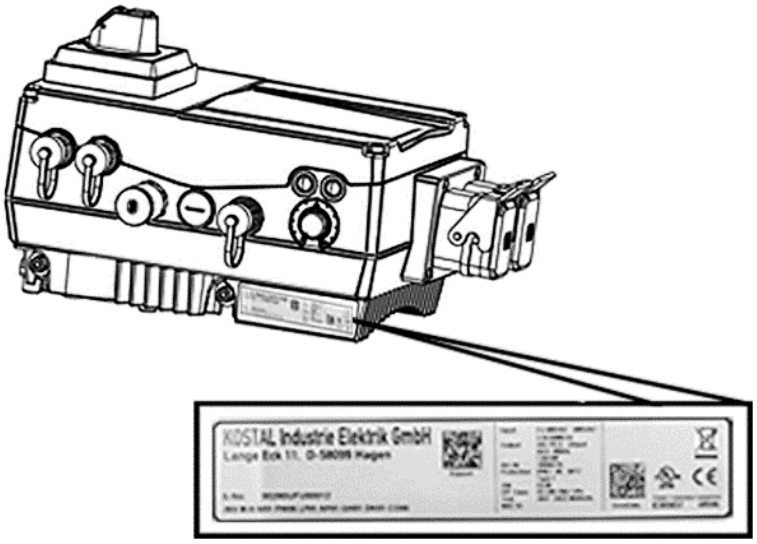


Fig. 4: Labels on the drive controller

Signs and labels are affixed to the drive controller. These may not be altered or removed.

Symbol	Meaning
	Danger due to electrical shock and discharge
	Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down
	Device may not be disposed of with household waste! Observe the local application of disposal requirements

Symbol	Meaning
	Additional earth connection
	Observe and read operating manual

1.5 Qualified staff

In the context of this operating manual, qualified staff refers to electronics specialists who are familiar with the installation, assembly, commissioning and operation of the drive controller and the dangers involved, and whose specialist training and knowledge of relevant standards and regulations provide them with the necessary abilities.

1.6 Proper use

If the device is installed in a machine, drive controllers may not be commissioned (i.e. intended operation may not begin) until it has been determined that the machine complies with the regulations of EC Directive 2006/42/EC (Machinery Directive); DIN EN 60204-1; VDE 0113-1 must be observed.

Commissioning (i.e. beginning intended operation) is only permitted if the EMC Directive (2014/30/EU) is complied with.

The harmonised standards of DIN EN 50178; VDE 0160 must be applied for this drive controller along with DIN EN 61439-1/DIN EN 61439-2; VDE 0660-600.

This drive controller may not be operated in areas where there is a danger of explosion!

Repairs may only be performed by authorised repair bodies.
Independent and unauthorised intervention may result in death, injury or property damage. The warranty provided by KOSTAL will be invalidated in such cases.

IMPORTANT INFORMATION

- External mechanical loads on the housing are not permitted!
- Using drive controllers in equipment that is not fixed is considered as an exceptional environmental condition and is only permitted if allowed by the standards and guidelines applicable on site.

1.7 Responsibility

As a basic principle, electronic devices are not fail-safe. The operator and/or the contractor setting up the machine or system is responsible for ensuring that the drive switches to a safe state if the device fails.

The “Electrical equipment of machines” section in DIN EN 60204-1; VDE 0113-1, “Safety of machinery” describes the safety requirements for electrical control units. These are provided for the safety of people and machines and must be observed in order to retain the functional capability of the machine or system.

An emergency stop feature does not necessarily result in the voltage supply to the drive being switched off. To avoid dangerous situations, it may be useful for individual drives to remain operational or for specific safety procedures to be initiated.
The effectiveness of emergency stop measures is evaluated by means of a risk assessment for the machine or system and its electrical equipment, and is determined by selecting a circuit category according to DIN EN 13849 “Safety of machinery – Safety-related parts of control systems”.

1.8 CE marking

The drive controllers fulfil the basic requirements of the EU Declaration of Conformity (see https://www.kostal-drives-technology.com/download)

1.9 Safety instructions

The following warnings, precautionary measures and information are provided for your safety and serve to prevent damage to the drive controller and the components connected to it.
This chapter contains warnings and information that are universally applicable when handling drive controllers. They are split into General information, Transport & storage and Disassembly & disposal.

Specific warnings and comments that apply to specific activities can be found at the start of the appropriate chapters and are repeated or added to at various critical points in these chapters.

Please read this information carefully as it is provided for your personal safety and will also prolong the life of the drive controller and connected devices.

1.9.1 General information

IMPORTANT INFORMATION

- Carefully read this operating manual and the warning signs affixed to the drive controller before installation and commissioning. Make sure that all warning signs on the drive controller are legible; replace any missing or damaged signs.

  They contain important information on the installation and operation of the drive controller. In particular, note the information in the "Important information" chapter.

  KOSTAL Industrie Elektrik GmbH & Co KG assumes no liability for damages arising from the non-observance of this operating manual.

  This operating manual is an integral part of the product. It applies exclusively to the drive controller from KOSTAL Industrie Elektrik GmbH & Co KG.

  Keep the operating manual close to the drive controller so it is easily accessible to all users.
- The drive controller can only be operated safely if the required environmental conditions listed in the “Suitable environmental conditions” chapter are met.

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

De-energise drive controller and secure it against being restarted.

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

Always ground the device in accordance with DIN EN 61140; VDE 0140, NEC and other relevant standards.

The drive controller must be grounded with the motor according to relevant regulations. Non-compliance may result in death or serious injury.

If spring elements are not used when assembling the adapter plate, there must be an extra connection between the motor and drive controller to produce a correct protective conductor connection.

DANGER!

Risk of death due to revolving mechanical parts!

Death or serious injury!

De-energise drive controller and secure it against being restarted.

DANGER!

Risk of death due to fire or electrical shock!

Death or serious injury!

Always use the drive controller as intended.

Do not modify the drive controller.

Only use spare parts and accessories sold or recommended by the manufacturer.

During assembly, ensure a sufficient distance from neighbouring parts.

CAUTION!

Risk of burns from hot surfaces!

Serious burns to the skin from hot surfaces!

Allow the drive controller's cooling elements to cool sufficiently.

1.9.2 Transport & storage

DAMAGE TO PROPERTY POSSIBLE

- Risk of damage to drive controller!
- Risk of damage to drive controller from improper transport, storage, installation and assembly!
- In general, transport the drive controller correctly in its original packaging on a pallet.
- Always store the drive controller properly.
- Only allow qualified staff to undertake installation and assembly.

1.9.3 Information about commissioning

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

De-energise drive controller and secure it against being restarted.

The following terminals may lead to dangerous currents even when the motor is not running:

- Supply terminals X1: L1, L2, L3
- Motor connection terminals X2: U, V, W
- Connecting terminals X6, X7: Relay contacts for relays 1 and 2

IMPORTANT INFORMATION

- If different voltages are used (e.g. +24 V/230 V), crossing cable runs are not permitted under any circumstances. The operator must also ensure compliance with the applicable regulations (e.g. double or reinforced insulation acc. to DIN EN 61800-5-1).
- The drive controller contains components susceptible to electrical discharge.
  These may be destroyed through improper handling. Therefore, precautionary measures against electrostatic charges must be taken when work is performed on these components.

IMPORTANT INFORMATION

- Only use mains connections with hardwiring.
- Ground the drive controller in accordance with DIN EN 61140; VDE 0140-1.
- The INVEOR may have touch currents of > 3.5 mA.
  In accordance with DIN EN 61800-5-1, an extra protective grounding conductor of the same cross-section as the original protective grounding conductor should therefore be fitted. A second protective grounding conductor can be connected under the mains supply (position marked with a ground symbol) on the outside of the device. A M6 x 12 screw (4.0 Nm torque) suitable for this connection is provided with the adapter plate.
- If three-phase frequency converters are used, the use of conventional type A FI protection switches RCDs (residual current-operated protective devices) are not permissible as protection against direct or indirect contact. According to DIN VDE 0160 and EN 50178, the FI protection switch must be universal current sensitive (RCD type B).

1.9.4 Instructions concerning operation

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.

DANGER!

Risk of death due to revolving mechanical parts!

Death or serious injury!

De-energise drive controller and secure it against being restarted.

IMPORTANT INFORMATION

Observe the following instructions during operation:

- The drive controller runs at high voltages.
- When electrical devices are operated, some of their parts are always subject to dangerous voltage.
- Emergency stop equipment according to DIN EN 60204-1; VDE 0113-1:2007-06 must function in all the control device's operating modes. Resetting the emergency stop equipment may not result in uncontrolled or undefined restarting.
- In order to ensure safe disconnection from the mains, the mains cable has to be fully disconnected from the drive controller in a synchronous manner.
- For devices of size D (11 to 30 kW), a pause of at least 1 to 2 minutes must be observed between consecutive mains activations
- A pause of at least 3 sec. must be observed between consecutive mains activations for devices with three-phase feed-in in sizes A - C (0.55 to 11 kW).
- Certain parameter settings may result in the drive controller restarting automatically after the supply voltage has failed.

DAMAGE TO PROPERTY POSSIBLE

If the information is not observed, the drive controller could be damaged and destroyed during subsequent commissioning.

Observe the following instructions during operation:

- The motor parameters, especially the I^2t settings, have to be configured properly to provide proper motor overload protection.
- The drive controller has internal motor overload protection. See parameters 33.010 and 33.011. I^2t is ON by default. Motor overload protection can also be ensured via an external PTC.
- The drive controller must not be used as "Emergency stop equipment" (see DIN EN 60204-1; VDE 0113-1:2007-06).

1.9.5 Maintenance and inspection

The drive controllers may only be maintained and inspected by electricians with recognised training. Unless explicitly described in this operating manual, changes to hardware and software may only be undertaken by KOSTAL experts or persons authorised by KOSTAL.

Cleaning the drive controllers

Drive controllers are maintenance-free if operated as intended. If the air is dusty, the cooling ribs of the motor and drive controller have to be cleaned regularly. If devices are fitted with integrated fans, we would recommend cleaning with compressed air.

Measurement of insulation resistance on control part

An insulation test on the control card's input terminals is not permitted.

Measurement of insulation resistance on power stack

The power stack of an INVEOR MP Modular is tested with 2.02 kV in the course of series testing.

Should the insulation resistance have to be measured during a system test, this can be done under the following conditions:

- an insulation test can be undertaken for the power stack alone,
- to avoid excessively high voltages, all the INVEOR MP Modular's connection cables must be disconnected before testing.
- a 500 V DC insulation tester should be used.

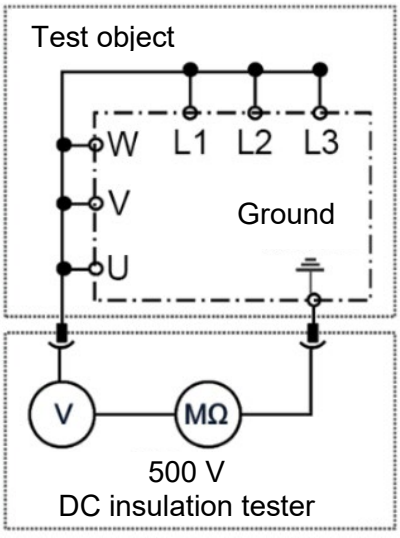


Fig. 5: Insulation measurement on the power stack

Pressure test on an INVEOR MP

IMPORTANT INFORMATION

A pressure test is not permitted on a standard INVEOR.

1.9.6 Repairs

DAMAGE TO PROPERTY POSSIBLE

If the information is not observed, the drive controller could be damaged and destroyed during subsequent commissioning.

- Repairs to the drive controller may only be performed by the KOSTAL Service department.

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.

Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down.

1	2	3	4	5	6	7	8	9	10	11	12

2. Overview of the drive controller

2.1 Model description

Sizes A - B

	INVEOR type	A	B
INV MP	Inverter, motor-integrated, performance	X	X

	Size	A	B
A	Size A	X	
B	Size B		X

Features:

		Model / sector (new feature to differentiate between the sub-variants)	A	B
		VS02 Modular	X	X
		Supply voltage	A	B
		IV01 400 V	X	X
		Recommended motor rating	A	B
		PW03 0.55 kW	X	
		PW04 0.75 kW	X	
		PW05 1.10 kW	X	
		PW06 1.50 kW	X	
		PW07 2.20 kW		X
		PW08 3.00 kW		X
		PW09 4.00 kW		X
		PW46 2.20 kW LD	X	
		PW49 5.50 kW LD		X
		Power-conducting plate	A	B
		LP01 Without brake chopper	X	X
		LP02 With brake chopper	X	X
		Application PCB	A	B
		AP00 Without application, with VO module carrier	X	X
		AP90 Without application	X	X
		Housing type	A	B
		GH01 Pass. cooling, potentiometer, standard version	X	X
		GH02 Pass. cooling, standard version	X	X
		GH44 Pass. cooling, standard version, brake resistor potentiometer	X	X
		GH45 Pass. cooling, standard version, brake resistor	X	X
		GH50 Pass. cooling, Harting, M12 IO, potentiometer	X	X
		GH51 Pass. cooling, Harting, M12 IO	X	X
		GH52 Pass. cooling, Quickon, M12 IO, potentiometer	X	X
		GH53 Pass. cooling, Quickon, M12 IO	X	X
		GH54 Pass. cooling, brake resistor, Harting, M12 IO, potentiometer	X	X
		GH55 Pass. cooling, brake resistor, Harting, M12 IO	X	X
		GH56 Pass. cooling, brake resistor, Quickon, M12 IO, potentiometer	X	X
		GH57 Pass. cooling, brake resistor, Quickon, M12 IO	X	X
		Cover type	A	B
		DK01 Without foil keypad	X	X
		DK05 MMI option	X	X
		DK11 Main switch	X	X
		DK15 Main switch, MMI option	X	X
		Optional module	A	B
		OA00 No option module	X	X
		OA10 Main switch	X	X
		OA13 Main switch, brake module	X	X
		OA30 Brake module	X	X
		IO module	A	B
		IO00 Without IO module	X	X
		IO01 IO module 1	X	X
		IO02 IO module 1 with Bluetooth	X	X
		IO03 IO module 1 with M12 MMI plug	X	X
		IO04 IO module 1 with Bluetooth, M12 MMI plug	X	X
		IO13 IO module with M12 MMI plug + STO	X	X
		IO14 IO module with M12 MMI plug + STO with Bluetooth	X	X
		IO23 IO module 1 with M12 MMI plug + Ethernet fieldbus	X	X
		IO24 IO module 1 with M12 MMI plug, Ethernet fieldbus, Bluetooth	X	X
		IO33 IO module 1 with M12 MMI plug + STO, Ethernet fieldbus	X	X
		IO34 IO module 1 with M12 MMI plug, STO, Ethernet fieldbus, Bluetooth	X	X
		Customer	A	B
		CO00 KOSTAL INVEOR	X	X

INV MP	x	VS02	IVxx	PWxx	LPxx	APxx	GHxx	DKxx	OAxx	IOxx	COxx

1	2	3	4	5	6	7	8	9	10	11	12

Sizes C - D

INVEOR type		C	D
INV MP	Inverter, motor-integrated, performance	X	X
Size		**C**	**D**
C	Size C	X	
D	Size D		X

Features:

Model (new feature to differentiate between the sub-variants)		C	D
VS02	MP Modular	X	X
Supply voltage		**C**	**D**
IV01	400 V	X	X
Recommended motor rating		**C**	**D**
PW10	5.50 kW	X	
PW11	7.50 kW	X	
PW12	11 kW		X
PW13	15 kW		X
PW14	18.50 kW		X
PW15	22 kW		X
PW51	11 kW LD	X	
PW55	30 kW LD		X
Power-conducting plate		**C**	**D**
LP01	Without brake chopper	X	X
LP02	With brake chopper	X	X
Application PCB		**C**	**D**
AP00	Without application, with VO module carrier	X	X
AP90	Without module carrier	X	X
Housing type		**C**	**D**
GH01	Pass. cooling, potentiometer, standard version	X	
GH02	Pass. cooling, standard version	X	
GH06	Active cooling, potentiometer, standard version	X	X
GH09	Active cooling, standard version	X	X
GH44	Pass. cooling, standard version, brake resistor potentiometer	X	
GH45	Pass. cooling, standard version, brake resistor	X	
GH52	Pass. cooling, standard version, Quickon, M12 IO, potentiometer	X	
GH53	Pass. cooling, standard version, Quickon, M12 IO	X	
GH56	Pass. cooling, standard version, brake resistor, Quickon, M12 IO, potentiometer	X	
GH57	Pass. cooling, standard version, brake resistor, Quickon, M12 IO	X	
GH61	Active cooling, standard version, brake resistor potentiometer	X	X
GH62	Active cooling, standard version, brake resistor	X	X
GH63	Active cooling, standard version, M12 IO, potentiometer		X
GH64	Active cooling, standard version, M12 IO,		X
GH65	Active cooling, standard version, brake resistor, M12 IO, potentiometer		X
GH66	Active cooling, standard version, brake resistor, M12 IO	X	X
Cover type		**C**	**D**
DK01	Without foil keypad	X	X
DK05	MMI option	X	X
DK11	Main switch	X	X
DK15	Main switch, MMI option	X	X
Optional module		**C**	**D**
OA00	No option module	X	X
OA10	Main switch	X	X
OA13	Main switch, brake module	X	X
OA30	Brake module	X	X
IO module		**C**	**D**
IO00	Without IO module	X	X
IO01	IO module 1	X	X
IO02	IO module 1 with Bluetooth	X	X
IO03	IO module 1 with M12 MMI plug	X	X
IO04	IO module 1 with Bluetooth M12 MMI plug	X	X
IO13	IO module with M12 MMI plug + STO	X	X
IO14	IO module with M12 MMI plug + STO with Bluetooth	X	X
IO23	IO module 1 with M12 MMI plug + Ethernet fieldbus	X	X
IO24	IO module 1 with M12 MMI plug, Ethernet fieldbus, Bluetooth	X	X
IO33	IO module 1 with M12 MMI plug + STO, Ethernet fieldbus	X	X
IO34	IO module 1 with M12 MMI plug, STO, Ethernet fieldbus, Bluetooth	X	X
Customer		**C**	**D**
CO00	KOSTAL INVEOR MP Modular (standard)	X	X

INV MP	x	VSxx	IVxx	PWxx	LPxx	APxx	GHxx	DKxx	OAxx	IOxx	COxx

2.2 Scope of delivery

2.2.1 Sizes A-C

Compare the scope of delivery of your product with that provided below.

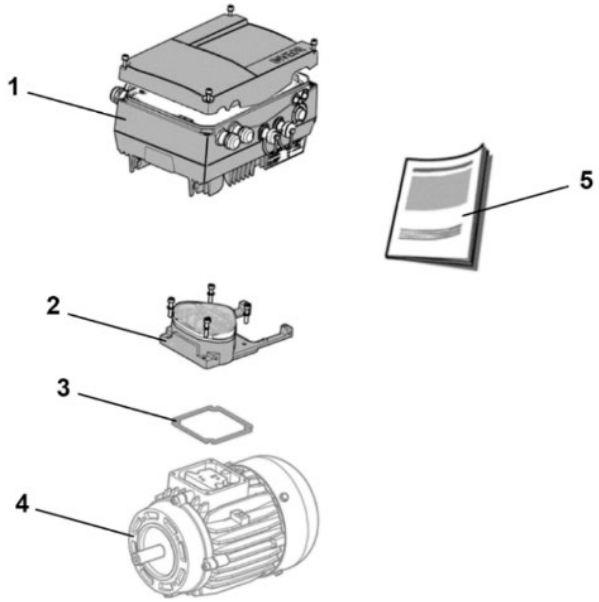


Fig. 6: Scope of delivery

Key	
Drive controller article number	
1	Drive controller (variant)
2	Adapter plate with terminal (not part of the scope of delivery)
3	Seal (not part of the scope of delivery)
Adapter plate article number	
4	Motor (not part of the scope of delivery)
5	Operating manual

2.2.2 Size D

Fig. 7: Scope of delivery, size D

Key	
Drive controller article number	
1	Drive controller (variant)
2	Cup
3	Poly bag containing seals, screws and shims
4	Operating manual

1	2	3	4	5	6	7	8	9	10	11	12

2.3 MMI*/connecting cable PIN assignment

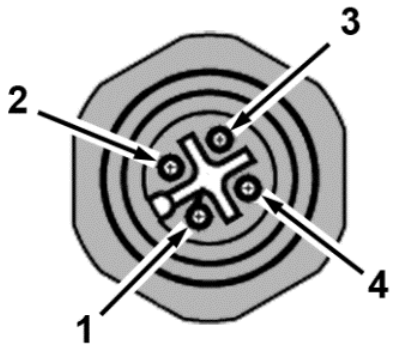


Fig. 8: PIN assignment of M12 socket

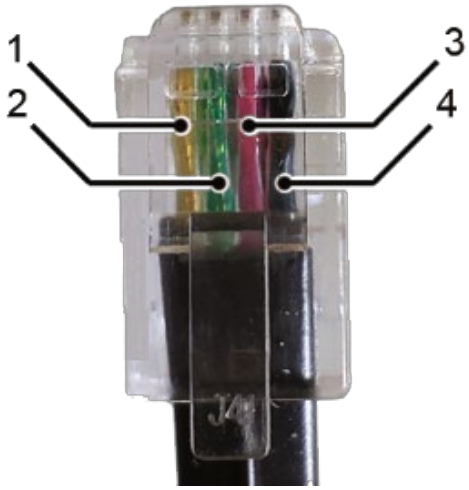


Fig. 9: RJ9 plug connector

Description: Round plug (socket) 4-pin M12
A-coded

Assignment of M12 socket	Signal
1	24 V
2	RS485 - A
3	GND
4	RS485 - B

Pin	Signal
1	yellow
2	green
3	red
4	brown
Attention: The colours may vary!	

*** Man-machine interface**

2.4 Description of INVEOR MP Modular drive controller

The INVEOR MP Modular drive controller is a device for the speed control of three-phase AC motors.

The drive controller can be integrated in the motor (with the standard adapter plate) or fitted close to the motor (with the wall mounting adapter plate).

The permitted ambient temperatures specified in the technical data refer to operation at nominal load.
In many cases, higher temperatures may be permitted after a detailed technical analysis.
These have to be approved by KOSTAL on a case-by-case basis.

3. Installation

3.1 Safety instructions for installation

DANGER!

Risk of death due to revolving mechanical parts!

Death or serious injury!

De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted.

Only allow appropriately qualified staff to install the drive controller.

Only use staff who are trained in mounting, installation, commissioning and handling.

Always ground the device in accordance with DIN EN 61140; VDE 0140, NEC and other relevant standards.

The drive controller must be grounded with the motor according to relevant regulations. Non-compliance may result in death or serious injury.

If spring elements are not used when assembling the adapter plate, there must be an extra connection between the motor and drive controller to produce a correct protective conductor connection

Unused open cable ends in the motor connection box must be insulated.

Use suitable line circuit breakers with the prescribed nominal current between the mains and drive controller.

Mains connections must be hardwired.

3.2 Recommended preliminary fuses / line protection

INVEOR MP Modular	Size A 3 x 400 V AC		Size B 3 x 400 V AC	
Rated motor speed	up to 1.5 kW	2.2 kW LD	up to 4 kW	5.5 kW LD
Line current	3.3 A	3.9 A	7.9 A	9.3 A
Line current (overload 60 s)	4.95 A	4.3 A	11.85 A	10.2 A
Line current (overload 3 s)	6.6 A	5.85 A	15.8 A	14 A
Line circuit breaker - recommendation	C 10		C 16	
	Characteristics C = line circuit breaker tripping between 6 – 10 times In			
	The cross-section of the supply line must be designed according to the transfer category and maximum permitted current. The contractor commissioning the device must ensure protection for the power line.			

1	2	3	4	5	6	7	8	9	10	11	12

INVEOR MP Modular	Size C 3 x 400 V AC		Size D 3 x 400 V AC	
Rated motor speed	up to 7.5 kW	11 kW LD	up to 22 kW	30 kW LD
Line current	13.8 A	18.3 A	38.2 A	49.8 A
Line current (overload 60 s)	20.7 A	20.13 A	57.3 A	54.8 A
Line current (overload 3 s)	27.6 A	27.5 A	76.4 A	74.7 A
Line circuit breaker - recommendation	C 32		C 80	
	Characteristics C = line circuit breaker tripping between 6 – 10 times In			
	The cross-section of the supply line must be designed according to the transfer category and maximum permitted current. The contractor commissioning the device must ensure protection for the power line.			

3.3 Installation requirements

3.3.1 Suitable ambient conditions

Conditions	Values
Altitude of the installation location:	up to 1000 m above sea level / over 1000 m with reduced performance (1% per 100 m) (max. 2000 m), see chapter 8.2
Ambient temperature:	- 40 °C to + 50 °C (different ambient temperatures may be possible in individual cases), see chapter 8.2
Relative air humidity	≤ 96 %, condensation not permitted.
Resistance to vibration and shock:	DIN EN 60721-3-3 3M7 (5 – 200 Hz, 3g)
Electromagnetic compatibility:	Immune to interference acc. to DIN EN 61800-3
Cooling:	Surface cooling: sizes A to C: free convection;

Tab. 1: Ambient conditions

- Ensure that the housing type (protection class) is suitable for the operating environment:
  - Ensure that the seal between the motor and the adapter plate is inserted correctly.
  - All unused cable screw connections must be sealed.
  - Check that the cover of the drive controller is closed and bolted down tightly.
    - Size A – C (4 x M4 x 28) 2 Nm,
    - Size D (4 x M6 x 28) 4 Nm

DAMAGE TO PROPERTY POSSIBLE

Failure to comply with the information may result in damage to the drive controller!

When attaching a cover with integrated foil keypad, be absolutely sure that the flat ribbon cable is not pinched.

Although the drive controller can, in principle, be painted later on, the user must nevertheless check the material compatibility of the intended paint.

DAMAGE TO PROPERTY POSSIBLE

Failure to comply with this requirement may eventually result in the loss of the protection class (particularly in respect to seals and fibre-optic elements).

The INVEOR MP Modular is supplied in RAL 9005 (black) as standard.

Disassembling the circuit boards (even for the purpose of painting the housing sections) renders the warranty void!

Mounting points and sealing surfaces must be kept free of paint for purposes of EMC and grounding!

3.3.2 Suitable installation location for the motor-integrated drive controller

Make sure that the motor with motor-integrated drive controller is mounted and operated indoors and only in the orientations shown in the following image.

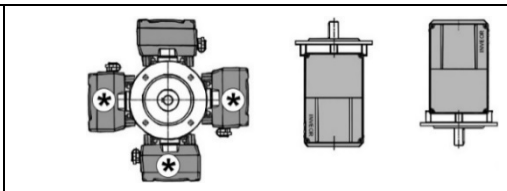
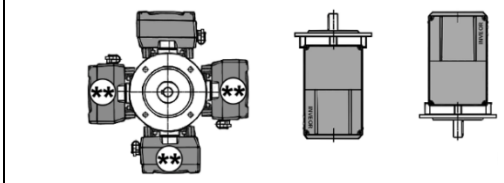
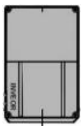
Size, A, B, C Motor installation		**Vibration and shock resistance, standard variants:** See technical data chapter **8.1.1**. Release with standard adapter plate, material number: see order catalog. **A separate evaluation is necessary for applications with high vibrations, such as piston, screw, claw pumps, and compressors. Resonant frequencies caused by installation or application conditions may lead to damage to the devices when mounted laterally or beneath the motor.*
Size D Motor installation		**Vibration and shock resistance, standard variants:** See technical data chapter **8.1.1**. Release with standard adapter plate, material number: see order catalog ****Release only with HD adapter plate (material number: 10145362).** *Only after approval of the present vibration profile of the application.* *A separate evaluation is necessary for applications with high vibrations, such as piston, screw, claw pumps, and compressors.* *Resonant frequencies caused by installation or application conditions may lead to damage to the devices when mounted laterally or beneath the motor.*
Size, A, B, C, D Wall installation		**Vibration and shock resistance, standard variants:** See technical data chapter **8.1.1**. Release with standard adapter plate, material number: see order catalog.

Fig. 10: Motor installation location/permitted alignments

3.3.3 Outdoor area

IMPORTANT INFORMATION

In the event of a deviation from 3.3.2 by installing the drive controller outdoors, the following must be observed to ensure compliance with the IP protection class and humidity/condensation limits specified in the data sheet.
The drive controller must be protected from direct sunlight and condensation. Suitable protection (e.g. enclosure) must be installed.

3.3.4 Distances

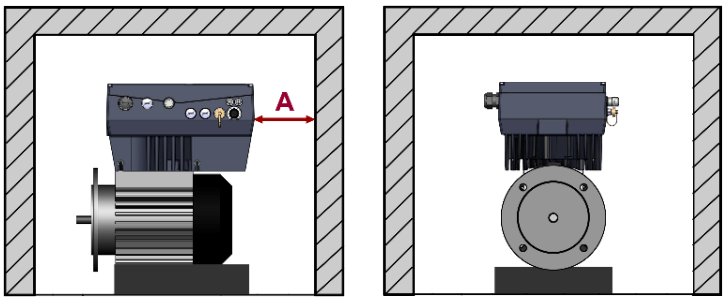


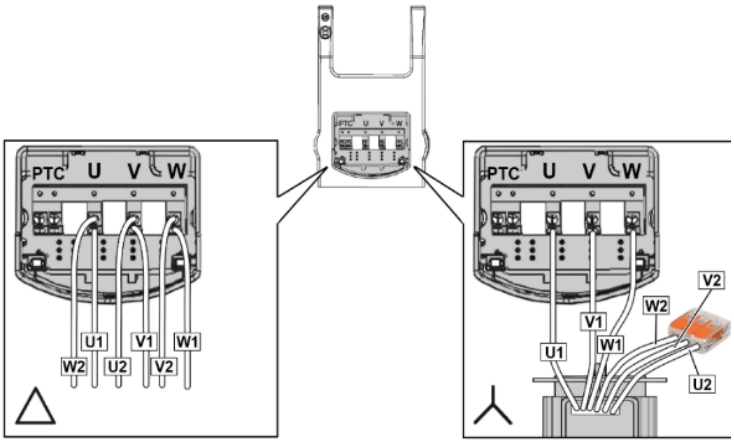
Abb. 11: Distances during assembly

In general, it is important to ensure that there is sufficient convection/cooling air flow around the device.

The maximum ambient temperature indicated in the technical data sheet must not be exceeded, a minimum distance of 20 cm around the drive must be respected.

For devices with active cooling (size D and optionally C), the distance A must be at least 50 cm.

3.3.5 Basic connection versions



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.

Abb. 12: Star or delta connection, size A

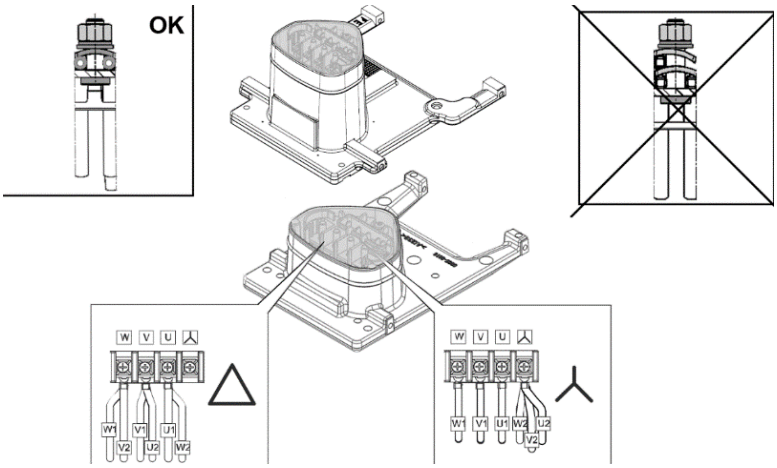
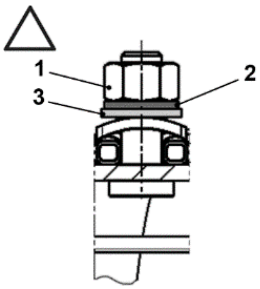
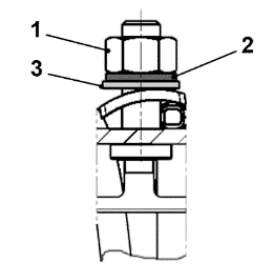
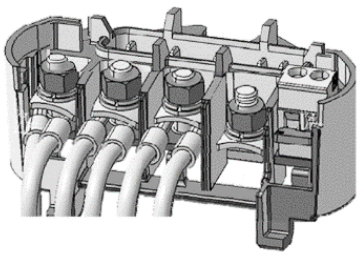


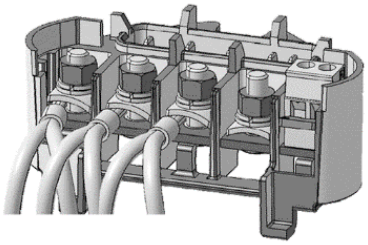
Abb. 13: Star or delta connection, sizes B - C

Delta connection variant , sizes B - C









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.

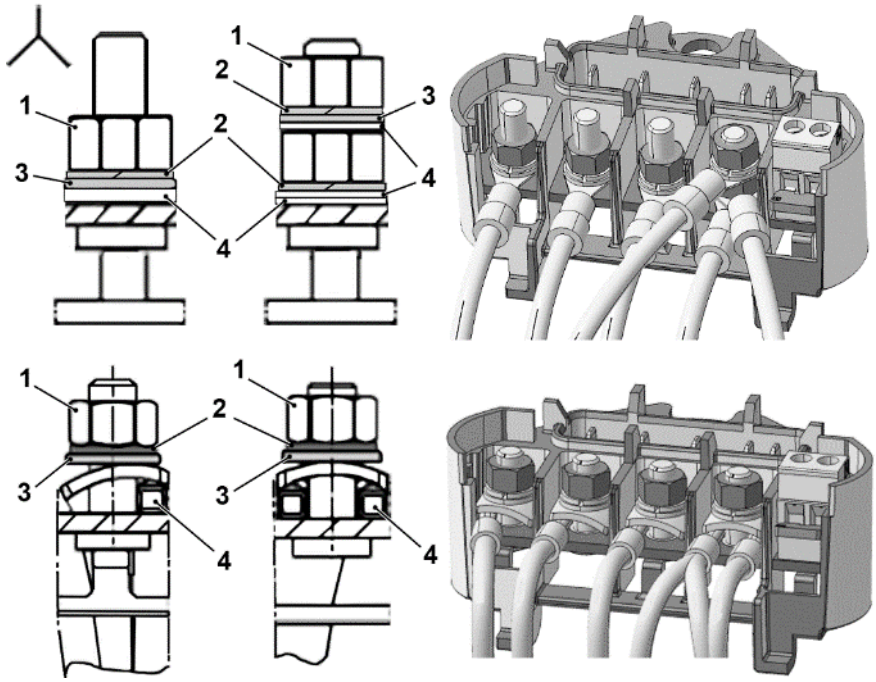
IMPORTANT INFORMATION

Regularly check that the nuts (1) are secure!

1. Nut M_A = 5 Nm 2 Circlip 3 Plain washer

1	2	3	4	5	6	7	8	9	10	11	12

Delta connection variant, sizes B-C



1	Nut M_A = 5 Nm	3	Plain washer
2	Circlip	4	Cable shoe

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.

Unused open cable ends in the motor connection box must be insulated.

IMPORTANT INFORMATION

Regularly check that the nuts (1) are secure!

DAMAGE TO PROPERTY POSSIBLE

Risk of damage to the drive controller.

Correct phase assignment must be observed when connecting the drive controller,

otherwise the motor may be overloaded.

The supplied assembly material can be used to connect core end sleeves and cable shoes.
Fig. 5 shows the different connection options.

IMPORTANT INFORMATION

If a thermal resistor (PTC or Klixon) is used, the bridging contact fitted on the connection terminal for the PTC in the delivery state has to be removed.

The cross-section of the supply line must be designed according to the transfer category and maximum permitted current. The contractor commissioning the device must ensure protection for the power line.

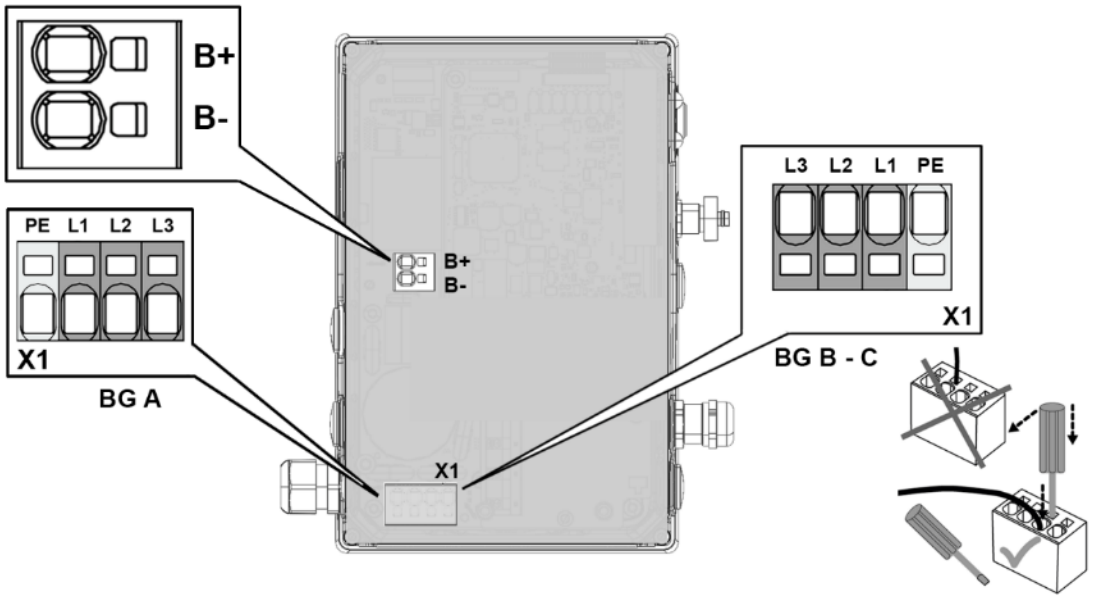
3.3.6 Short circuit and ground protection

The drive controller contains an internal short circuit and ground protection.

1	2	3	4	5	6	7	8	9	10	11	12

3.3.7 Wiring instructions

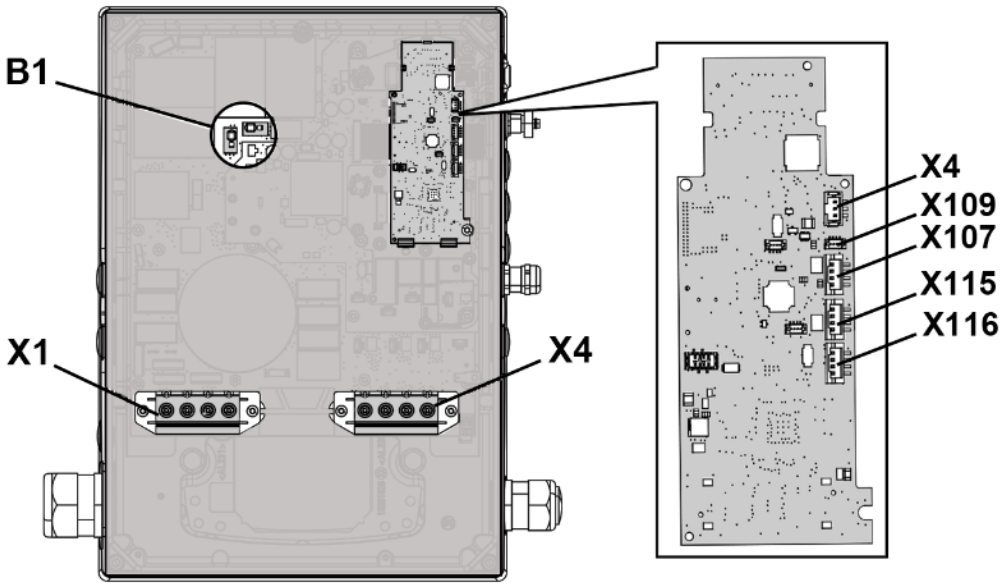
Connection overview (sizes A - C)



Sizes A - C			
X1 mains	The terminals for the mains cable are located inside the drive controller. The INVEOR also has the option of being equipped with terminals for connecting a brake resistor. Depending on the variant, the assignment and position of the terminals may differ.		
	Core end sleeves with plastic collars and lugs are recommended.		
	Terminals:	Spring force connection (slot screwdriver, max. width 2.5 mm)	
	Conductor cross-section, rigid	min. 0.2 mm²	max. 10 mm²
	Conductor cross-section, flexible	min. 0.2 mm²	max. 6 mm
	Conductor cross-section, flexible with core end sleeve without plastic sleeve	min. 0.25 mm²	max. 6 mm
	Conductor cross-section, flexible with core end sleeve with plastic sleeve	min. 0.25 mm²	max. 4 mm
	2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve	min. 0.25 mm²	max. 1.5 mm
	AWG/kcmil conductor cross-section according to UL/CUL	min. 24	max. 8
	Length of stripped insulation:	15 mm	
	Mounting temperature:	-5°C to +100°C	

1	2	3	4	5	6	7	8	9	10	11	12

Connection overview (size D)



Size D		
X1 mains / X4 motor + B - brake resistor	The terminals for the mains cable are located inside the drive controller. The INVEOR also has the option of being equipped with terminals for connecting a brake resistor. The configuration may vary depending on the version.	
	Core end sleeves with plastic collars and lugs are recommended.	
	Torque: < 25 mm² = 2.5 Nm / ≥ 25 mm² = 4.5 Nm	
	Conductor cross-section:	rigid min. 0.5 mm² / rigid max. 35 mm²
	Conductor cross-section, flexible:	min. 0.5 mm² / max. 25 mm²
	Conductor cross-section, flexible with core end sleeve without plastic collar	min. 1 mm² max. 25 mm²
	Conductor cross-section, flexible with core end sleeves with plastic sleeve	min. 1.5 mm² max. 25 mm²
	AWG / kcmil conductor cross-section according to UL/CUL	min 20 max. 2
	2 conductors of the same cross-section, rigid	min. 0.5 mm² max. 6 mm²
	2 conductors of the same cross-section, flexible	min. 0.5 mm² max. 6 mm²
	2 conductors of the same cross-section, flexible with AEH without plastic sleeve	min. 0.5 mm² max. 4 mm²
	2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve	min. 0.5 mm² max. 6 mm²
	AWG according to UL/CUL	min. 20 max. 2

3.3.8 Preventing electromagnetic interferences

To ensure immunity to interference, be sure that control lines run separately from grid and motor cables. Where possible use shielded lines for analogue control circuits. At the line end, the shielding should be fitted with great care. The use of EMC cable screw connections is recommended for this purpose. These are not part of the scope of delivery.

Ensure that no parasitic currents (compensating currents etc.) can flow via an analogue control cable's shielding.

Route the control lines as far away as possible from the power lines. Under certain circumstances, separate power ducts should be used.

If lines do cross, an angle of 90° should be observed as far as possible.

Upstream switch elements, such as protector switches and brake coils or circuit elements that are operated via the outputs of the drive controller have to be interference-suppressed.

RC circuits are suitable as AC voltage protector switches, while free-wheeling diodes or varistors are usually used as DC voltage protector switches. These interference suppression devices are attached directly to the protector switch coils.

IMPORTANT INFORMATION

Where possible, the power for a mechanical brake should be supplied in a separate cable.

Power connections between the drive controller and motor should always be shielded or reinforced, and the shielding must have large-scale grounding at both ends! The use of EMC cable screw connections is recommended. These are not part of the scope of delivery.

Wiring suitable for EMC must be ensured.

3.4 Installing the drive controller integrated in the motor

3.4.1 Mechanical installation

Mechanical installation of sizes A - C

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.

Proceed as follows to mechanically install the drive controller:

1. Open the standard motor connection box.
2. Disconnect the wires from the connection terminals. Memorise or write down the connection sequence.
3. Remove the motor terminal block if necessary.
4. Remove the connection housing's retaining bolts and take the housing off.

DAMAGE TO PROPERTY POSSIBLE

Be careful not to damage the seal.

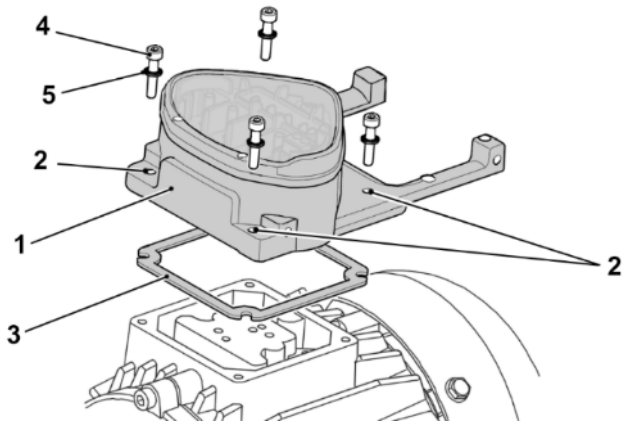


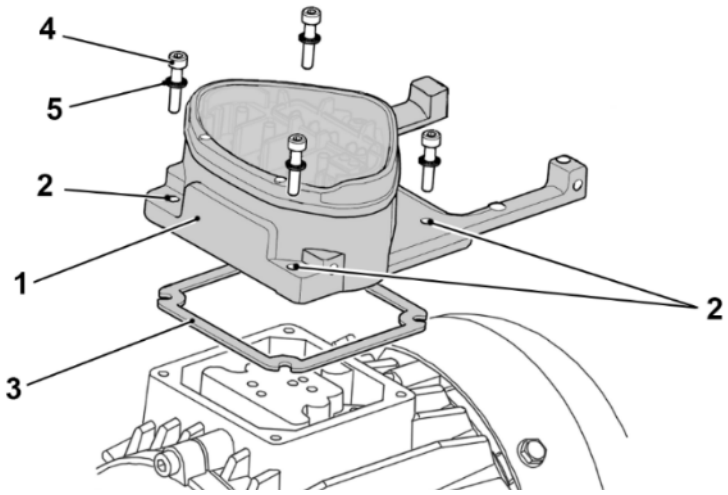
Fig. 14: Assembly sequence:
Connection box – adapter plate (sizes A - C)

INFORMATION

The standard adapter plate is a plate the underside of which is not reworked; i.e. no holes have been produced yet.

You can order individually modified adapter plates from KOSTAL for selected motors.

1	2	3	4	5	6	7	8	9	10	11	12



5. Modify the adapter plate (1) by producing the necessary holes (2) for mounting on the motor.

IMPORTANT INFORMATION

Correct sealing between the adapter plate and motor is of vital importance to compliance with the protection class.

The commissioning technician alone is responsible for this.

When installing the adapter plate, he or she should ensure that water is prevented from entering the system via the screw fastenings.

Appropriate measures should be taken to seal the threads of the screw connections.

If you have any questions, please ask your KOSTAL contact.

6. Fit the seal (3).
7. Lead the motor connection line past the connection terminal and through the adapter plate (1) and screw down to the motor with the four retaining bolts (4) and the four spring elements (torque: 2.0 Nm).

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

The drive controller must be grounded with the motor according to relevant regulations. Non-compliance may result in death or serious injury.

If spring elements (5) are not used when assembling the adapter plate, there must be an extra connection between the motor and drive controller to produce a correct protective conductor connection.

IMPORTANT INFORMATION

When mounting the adapter plates, ensure that all four screws, including the spring elements, are tightened to the necessary torque (2 Nm)!

All contact points must be free of dirt/paint because otherwise a correct protective conductor connection is not ensured!

8. Attach the motor wires in the correct circuit. (see also 3.3.3 Distances during assembly)
   The use of insulated M5 ring cable lugs is recommended.

IMPORTANT INFORMATION

When installing the motor wires, ensure that all bolts on the terminal board are fitted with the nuts provided even if the star point is not connected!

1	2	3	4	5	6	7	8	9	10	11	12

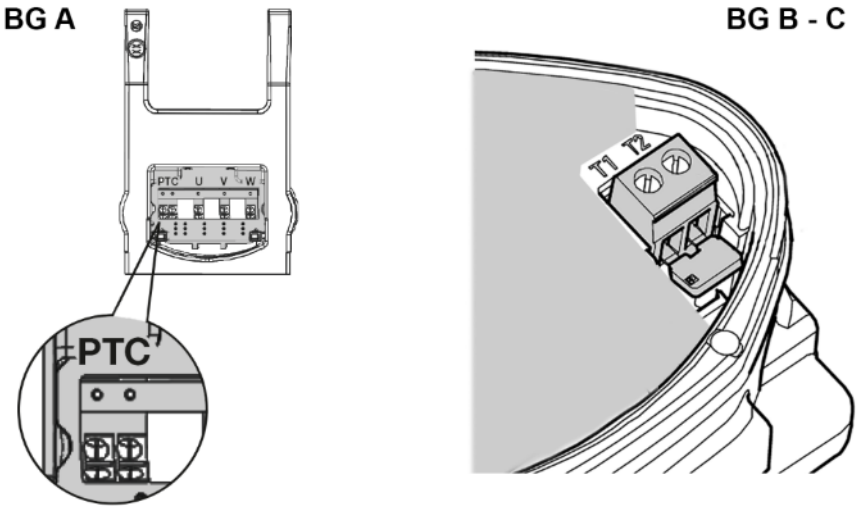
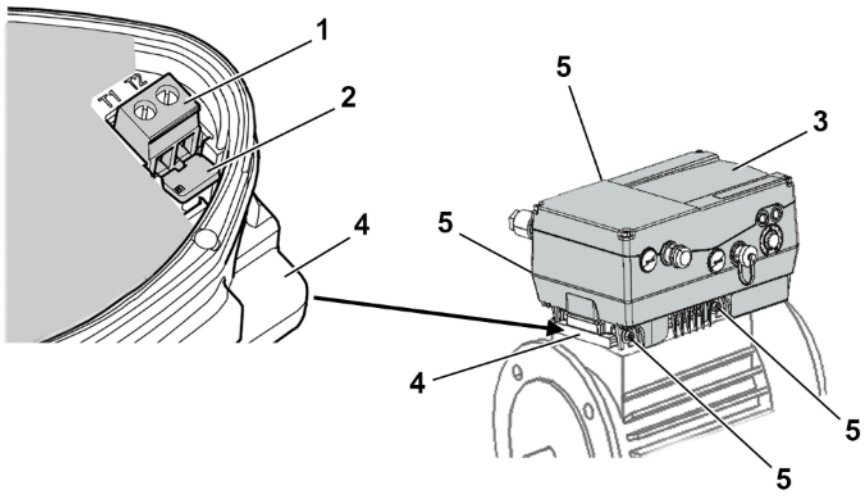


Fig. 15: Bridging contact

9. If present, wire the connection cable of the motor PTC/Klixon to the T1 and T2 terminals (1) (torque: 0.6 Nm).

IMPORTANT INFORMATION

During assembly, ensure that the connection cable is not crushed!



IMPORTANT INFORMATION

If the motor is fitted with a temperature sensor, this is connected to the T1 and T2 terminals (1).

Remove the bridging contact (2) inserted for delivery for this purpose.

When the bridge is in place, the temperature of the motor is not monitored!

Only motor PTCs corresponding to DIN 44081/44082 may be connected!

DANGER!

Risk of death due to electrical shock!
Death or serious injury!
The drive controller must be grounded with the motor according to relevant regulations. Non-compliance may result in death or serious injury.

10. Plug the drive controller (3) onto the adapter plate (4) and secure uniformly using the four lateral bolts (5) (sizes A - C) (torque: 4.0 Nm).

Mechanical installation of size D

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

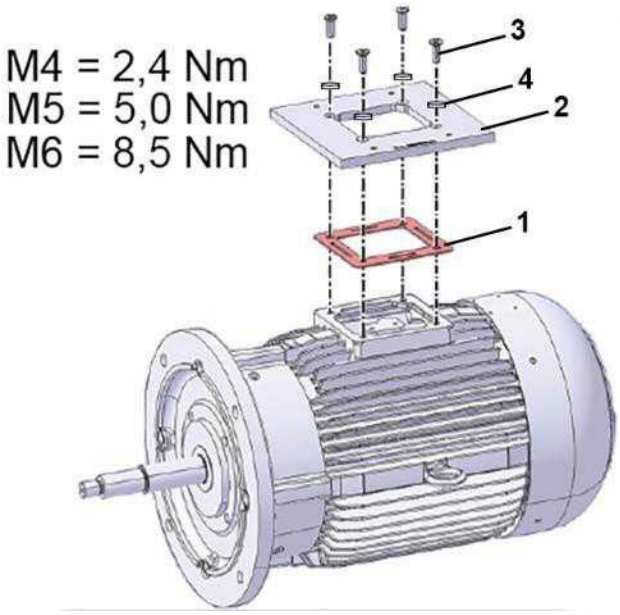
De-energise the drive controller, determine that it is voltage-free and secure it against being restarted.

Proceed as follows to mechanically install the drive controller:

1. Open the standard motor connection box.
2. Disconnect the wires from the connection terminals. Memorise or write down the connection sequence.
3. Remove the motor terminal block if necessary.
4. Remove the connection housing's retaining bolts and take the housing off.

DAMAGE TO PROPERTY POSSIBLE

Be careful not to damage the seal.



5. Fit the seal (1) and adapter plate (2) as shown.
6. Screw adapter plate (2) and seal (1) on to motor with four retaining bolts (3) and spring elements (4).

IMPORTANT INFORMATION

When mounting the adapter plate (2), ensure that all four retaining bolts (3), including the spring elements (4), are tightened to the corresponding torque.

All contact points must be free of dirt/paint because otherwise a correct protective conductor connection is not ensured!

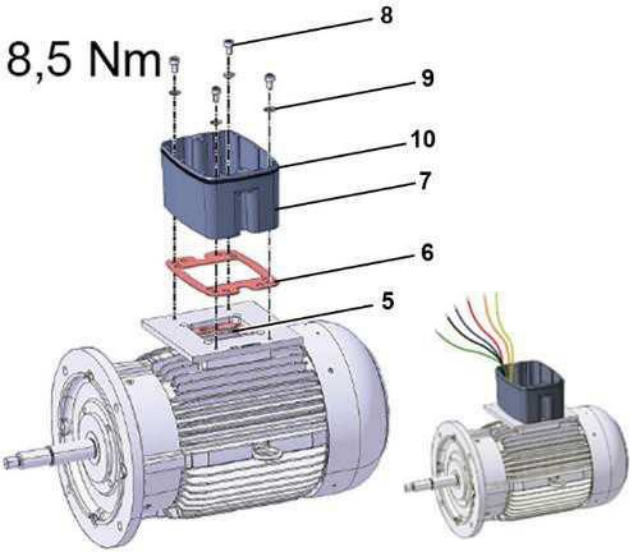
Correct sealing between the adapter plate and motor is of vital importance to compliance with the protection class.

The commissioning technician alone is responsible for this.

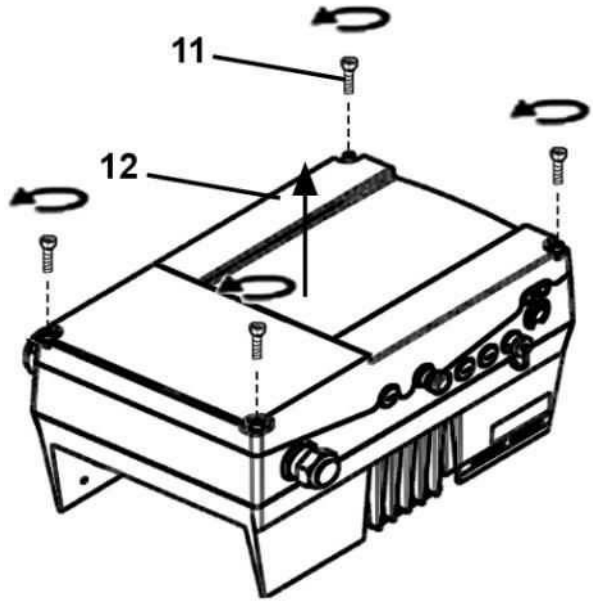
When installing the adapter plate, he or she should ensure that water is prevented from entering the system via the screw fastenings.

Appropriate measures should be taken to seal the threads of the screw connections.

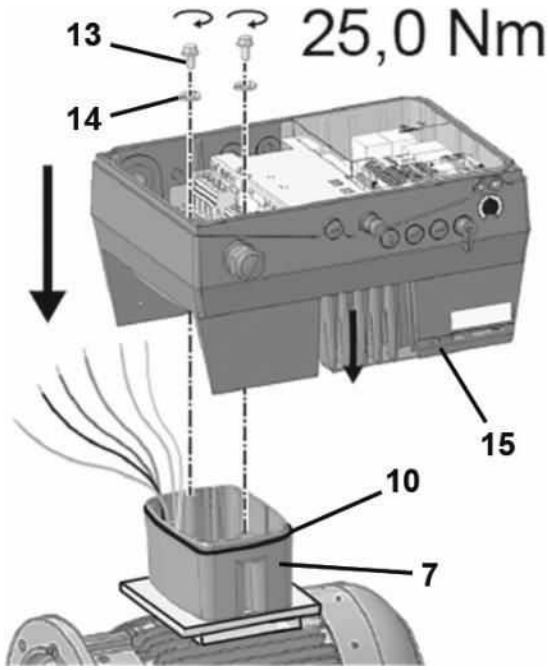
If you have any questions, please ask your KOSTAL contact.



7. Connect the lines (PE, U, V, W) of the corresponding cross-section (depending on rating of INVEOR used) to the original junction plate (5).
8. Fit the seal (6).
9. Screw cups (7) onto adapter plate (2) with four retaining bolts (8) and spring elements (9) (torque 8.5 Nm).



10. Unscrew the four screws (11) from the cover (12) and then take it off.



IMPORTANT INFORMATION

When mounting the INVEOR MP, ensure that the O-ring seal (10) sits perfectly and is not damaged!

11. Carefully place the drive controller (15) onto the cup (7) of the INVEOR MP Modular.

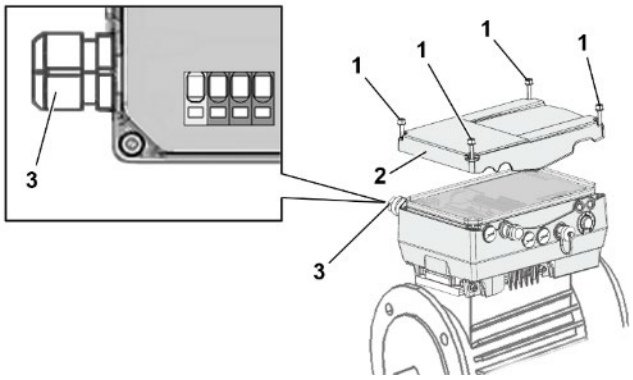
IMPORTANT INFORMATION

During assembly, ensure that the connection cable is not crushed!

12. Evenly screw down drive controller (15) and cup (7) with the M8 screws (13) and spring elements (14) (torque 25 Nm).

3.4.2 Power connection

Power connection for sizes A - C



IMPORTANT INFORMATION

When connecting a brake resistor to an optional brake chopper, cables with shielding and double insulation must be used!

DANGER!

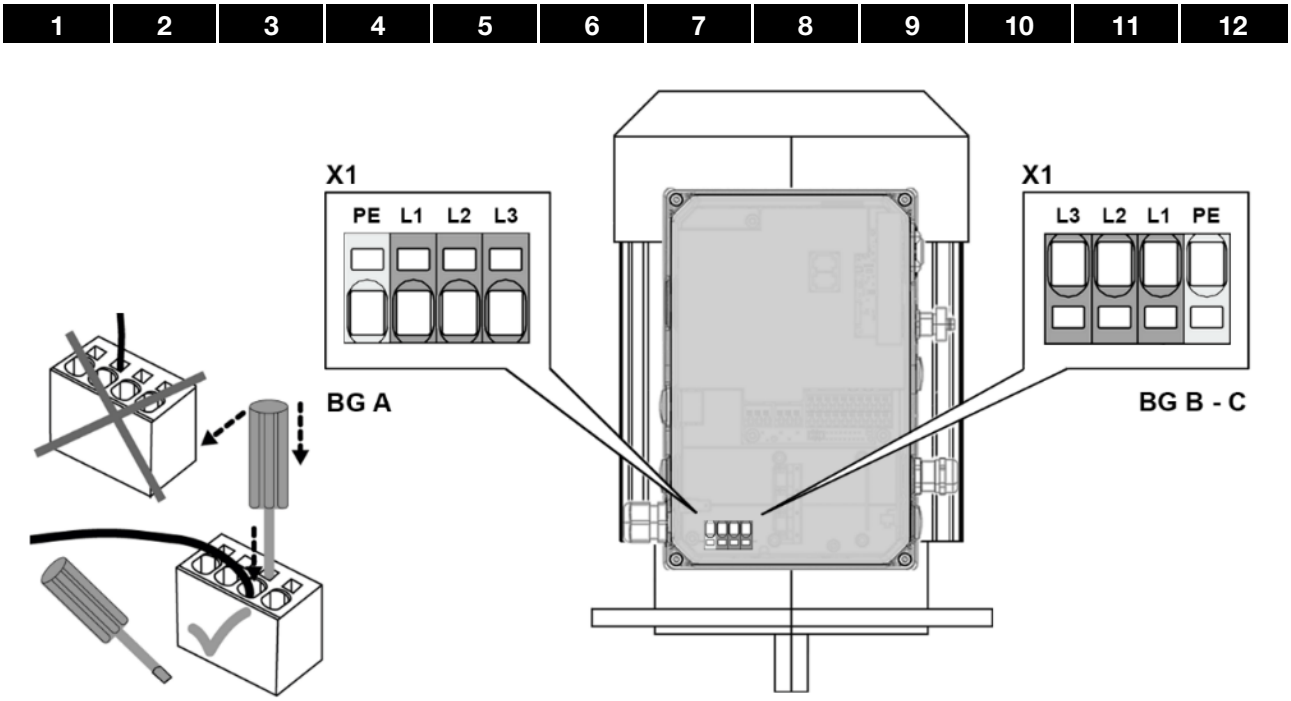
Risk of death due to electrical shock!

Death or serious injury!

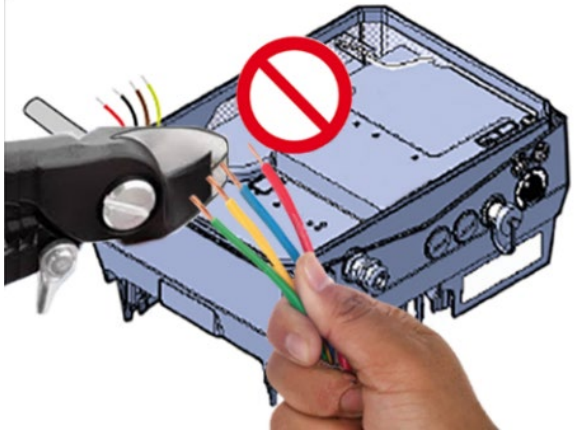
De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted.

Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down.

1. Unscrew the four screws (1) from the drive controller's housing cover (2) and then take it off.
2. Guide mains connection cable through cable screw connection (3) into housing of drive controller.



Caution!
Do not strip insulation off wires inside the drive controller



3. Connect the cables with the terminals as follows:

Size	400 V connection			
A	PE	L1	L2	L3
B-C	L3	L2	L1	PE

Terminal no.	Designation	Assignment
1	L1	Mains phase 1
2	L2	Mains phase 2
3	L3	Mains phase 3
4	PE	Protective conductor

Tab. 2: 3 x 400 V AC terminal assignment X1

Terminal no.	Designation	Assignment
1	L1	DC mains (+)
2	L2	Not assigned
3	L3	DC mains (-)
4	PE	Protective conductor

Tab. 3: DC feed 565 V terminal assignment X1

1	2	3	4	5	6	7	8	9	10	11	12

Power connection for size D

IMPORTANT INFORMATION

When connecting a brake resistor to an optional brake chopper, cables with shielding and double insulation must be used!

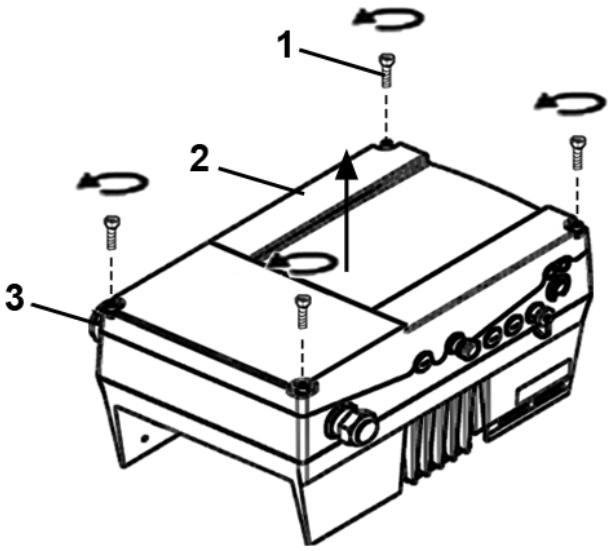
DANGER!

Risk of death due to electrical shock!

Death or serious injury!

De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted.

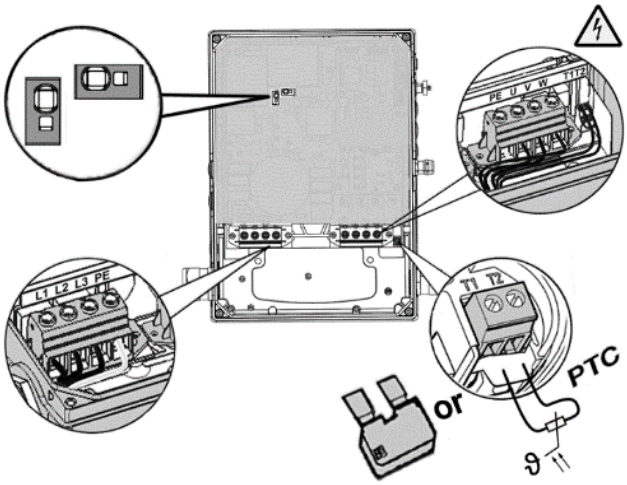
Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down.



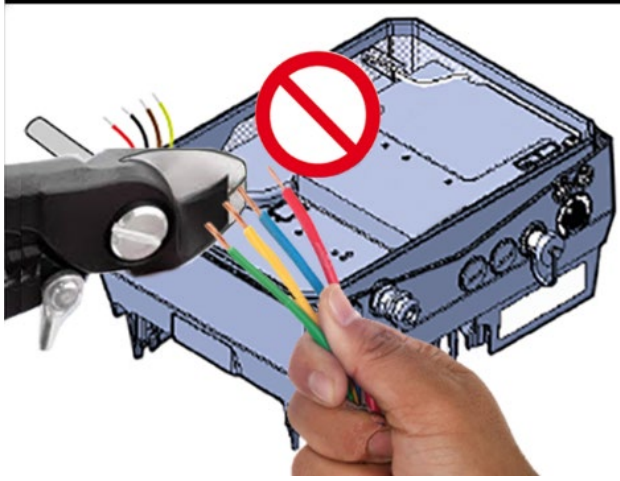
1. Unscrew the four screws (1) from the drive controller's housing cover (2) and then take it off.
2. Guide mains connection cable through cable screw connection (3) into housing of drive controller.

IMPORTANT INFORMATION

The cable screw connection provides strain relief, and the PE connection cable must be connected in a leading fashion (considerably longer).



Caution!
Do not strip insulation off wires inside the drive controller



3. Connect the cables with the terminals as follows:

400 V connection			
L1	L2	L3	PE
L3	L2	L1	PE

Terminal no.	Designation	Assignment
1	L1	Mains phase 1
2	L2	Mains phase 2
3	L3	Mains phase 3
4	PE	Protective conductor

Tab. 4: 3 x 400 V AC terminal assignment X1

The protective conductor must be connected to the "PE" contacts.

1	2	3	4	5	6	7	8	9	10	11	12

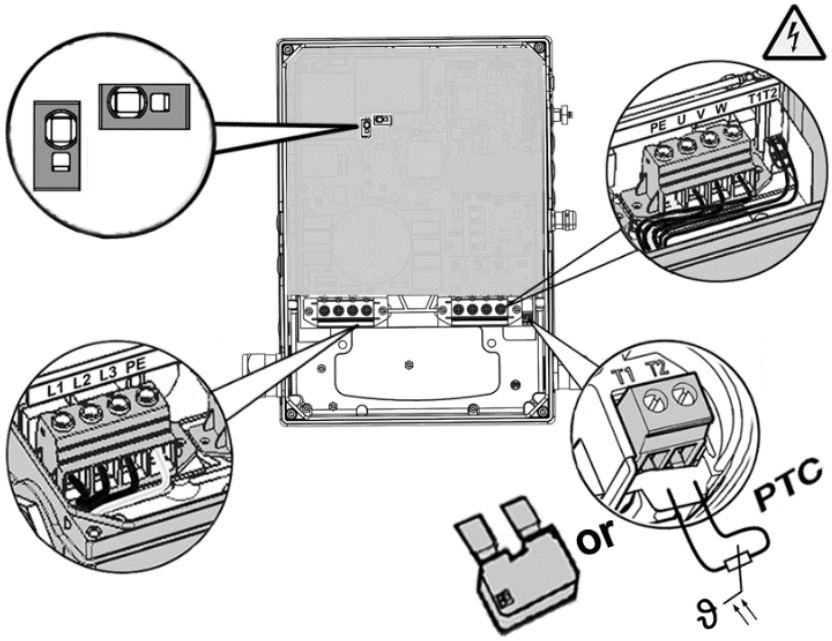


Fig. 16: Size D

Terminal no.	Designation	Assignment
1	L1	DC mains (+)
2	L2	Not assigned
3	L3	DC mains (-)
4	PE	Protective conductor

Tab. 5: DC feed 565 V terminal assignment X1

Terminal no.	Designation	Assignment
1	PE	Protective conductor
2	U	Motor phase 1
3	V	Motor phase 2
4	W	Motor phase 3

Tab. 6: Motor connection assignment X4

3.4.3 Connections for brake resistor

Terminal no.	Designation	Assignment
1	B+	Connection for brake resistor (+)
2	B -	Connection for brake resistor (-)

Tab. 7: Optional terminal assignment for brake chopper

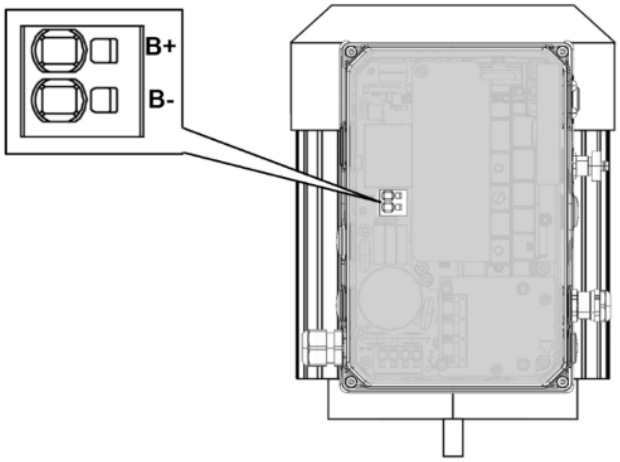


Fig. 17: Sizes A - C

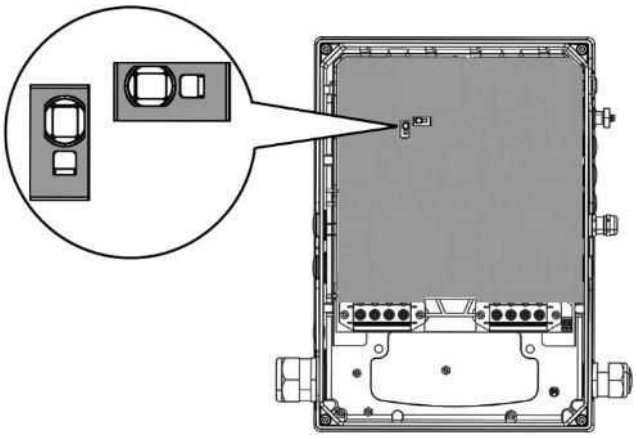
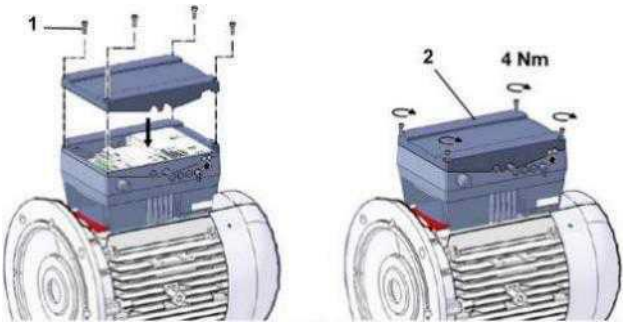


Fig. 18: Size D

1	2	3	4	5	6	7	8	9	10	11	12



4. Place the housing cover (2) on the drive controller and screw down with the four screws (1). (Torque 4 Nm)

Size.	Torque
A - C	2 Nm (4 x M4 x 28)
D	4 Nm (4 x M6 x 28)

3.4.4 Connection using Harting plug

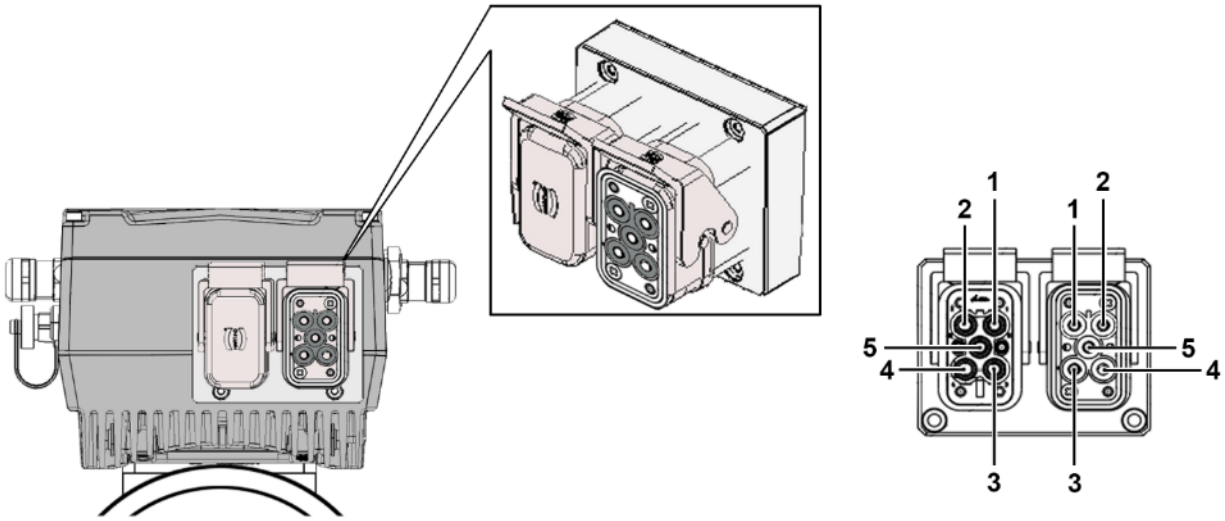


Fig. 19: Harting plug

Pin male connector	Pin female connector	Assignment
1	1	L1
2	2	L2
3	3	L3
4	4	-
5	5	PE

1	2	3	4	5	6	7	8	9	10	11	12

3.4.5 PHOENIX Quickon connection

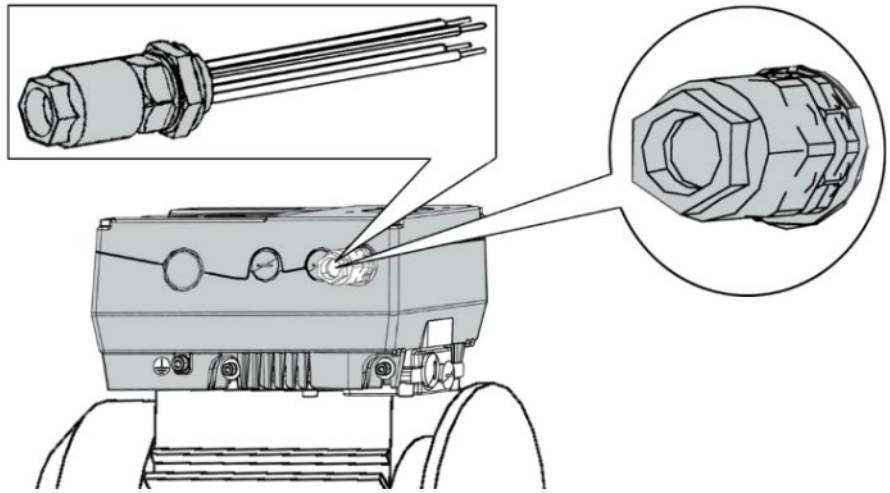


Fig. 20: PHOENIX Quickon

Pin	Colour	Assignment
1	Sw / BK	L1
2	br / BN	L2
3	gr / GY	L3
4	ge / YE	PE

3.4.6 Connection via main switch

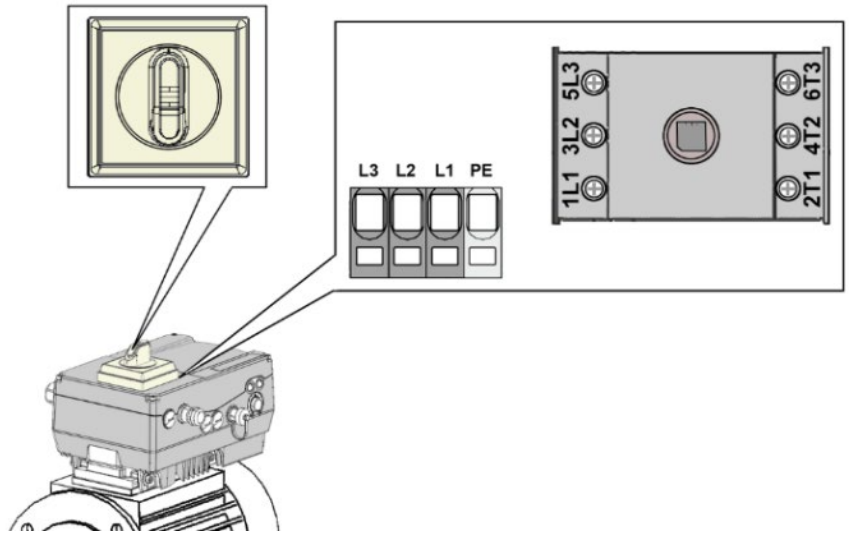
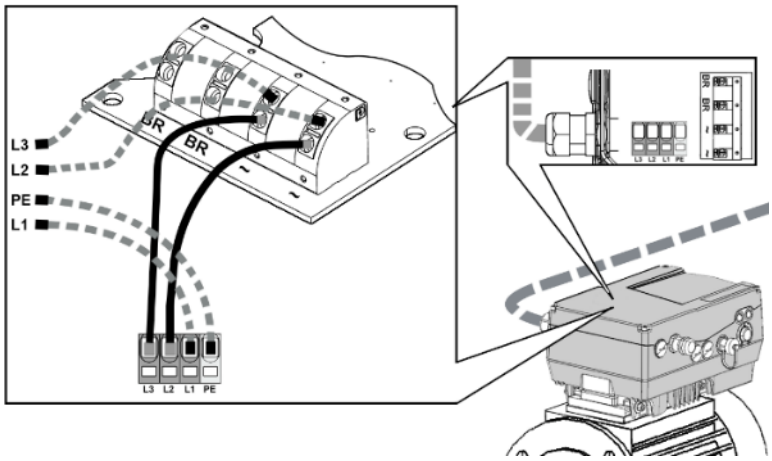


Fig. 21: Main switch

Pin	Assignment
1L1	L1
3L2	L2
5L3	L3
PE	PE

1	2	3	4	5	6	7	8	9	10	11	12

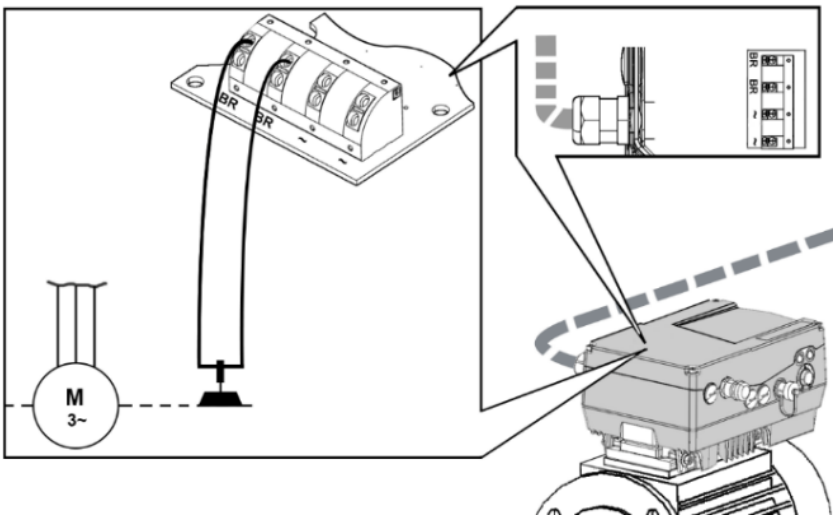
3.4.7 Mains supply connection variant with brake module, size A



IMPORTANT INFORMATION

The brake module's mains supply is wired ex-factory with sizes B - D!

3.4.8 Connection of mechanical brake to brake module



DAMAGE TO PROPERTY POSSIBLE

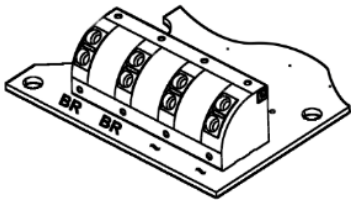
Make sure that the supply voltage of the brake matches the mains voltage used!

When the supply is 400 V AC, a brake with 180 V DC must **always** be used!

Technical data for brake module

Property	Value
Type	Half-wave rectifier
Output voltage	Vgrid * 0.445 Example: Grid at 230 V~ ≈ 102 V DC Grid at 400 V~ ≈ 180 V DC
Switching the brake voltage	At DC end
Maximum DC output current	0.9 A
Current limitation	none
Voltage limit	none
Short-circuit proof	Yes, via PCB fuses, module must be replaced
Response time	< 10 ms
Switching frequency	< 5 Hz

1	2	3	4	5	6	7	8	9	10	11	12



Connection data for brake module	min.	max.
Conductor cross-section, rigid	0.2 mm²	2.5 mm²
Conductor cross-section, flexible	0.2 mm²	2.5 mm²
Conductor cross-section, flexible with core end sleeve without plastic sleeve	0.5 mm²	2.5 mm²
Conductor cross-section, flexible with core end sleeve with plastic sleeve	0.5 mm²	1 mm²
Conductor cross-section AWG	24	14
2 conductors of the same cross-section, rigid	0.2 mm²	2.5 mm²
2 conductors of the same cross-section, flexible	0.2 mm²	2.5 mm²
2 conductors of the same cross-section, flexible with AEH without plastic sleeve	0.5 mm²	2.5 mm²
2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve	0.5 mm²	1 mm²

3.4.9 Connection diagram (IO module option)

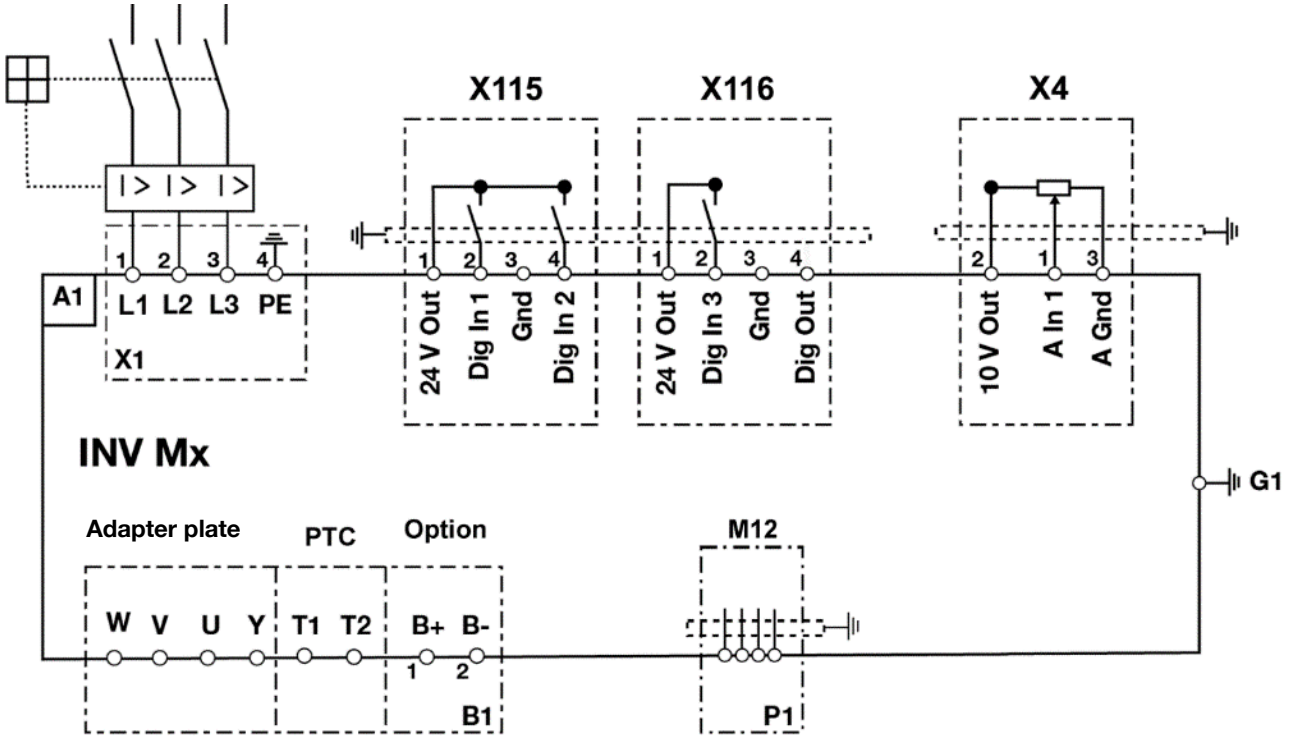


Fig. 22: Connection diagram (IO module option)

Characters	Explanation
A1	Drive controller type: INV Mx IV01 (3 x 400 V AC)
B1	Connection for external brake resistor (option)
G1	M6 grounding screw (connection for residual currents > 3.5 mA)
P1	RS485 programming interface (M12 plug)
X4	Internal potentiometer / analogue input 1
Q1	Motor protection switch or load break switch (optional)
X1	Mains terminals
X15 – X16	Digital inputs and outputs

The drive controller is ready once a 3 x 400 V AC mains supply has been activated (on terminals L1 to L3) or a 565 V DC mains supply has been activated (on terminals L1 and L3).

1	2	3	4	5	6	7	8	9	10	11	12

3.4.10 Basic fieldbus integrated on MP Modular

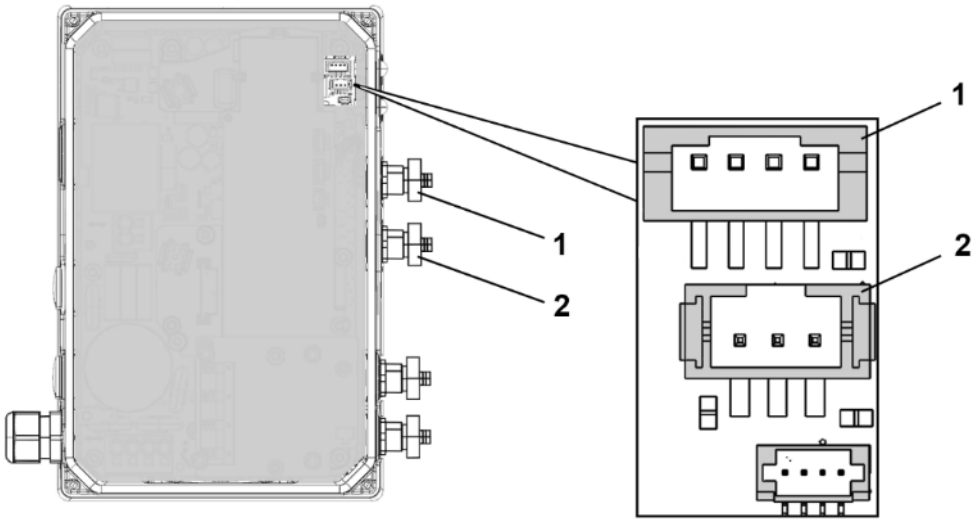


Fig. 23: Basic fieldbus integrated on MP Modular

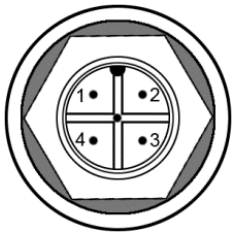
Pin assignment of interfaces for M12 socket for Modbus				
JST RS485				
Socket		Pin no.	Signal	Article no.
lt.		1	n. c.	10118216
1		2	RS 485 - A	
		3	GND	
		4	RS 485 - B	
		Housing	Shielding	

Fig. 24: Round plug connector, 4-pin, M12, A-coded for Modbus fieldbus

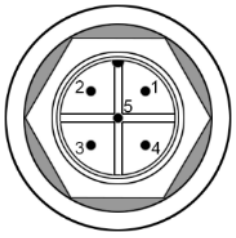
Pin assignment of interfaces for M12 plug for CANopen				
JST CANopen				
Plug		Pin no.	Signal	Article no.
lt.		1	Not assigned	10118224
2		2	Not assigned	
		3	CAN_GND	
		4	CAN_H	
		5	CAN_L	
		Housing	Shielding	

Fig. 25: Round plug connector, 5-pin, M12, A-coded for CANopen fieldbus

1	2	3	4	5	6	7	8	9	10	11	12

3.4.11 IO module / assignment of plugs (option)

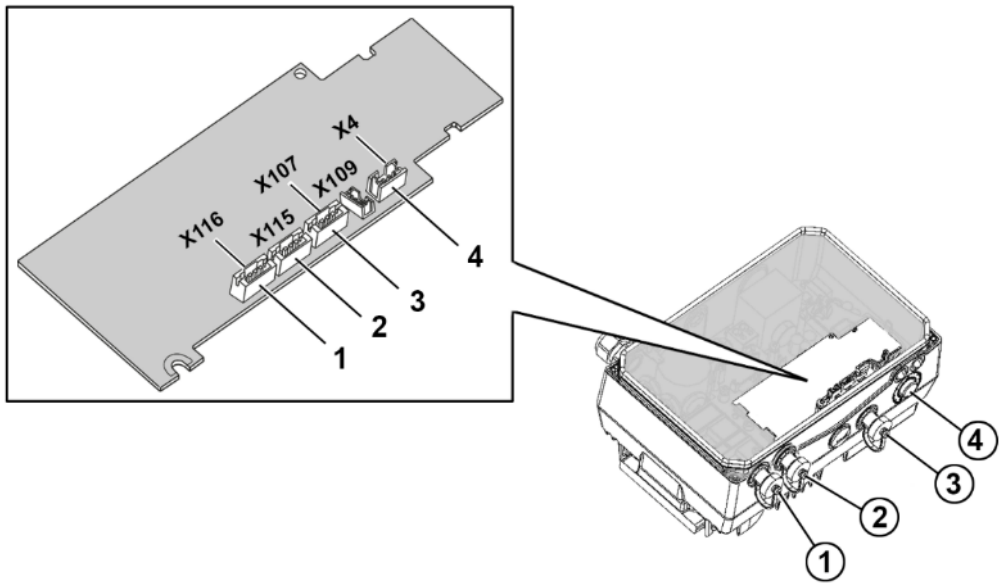


Fig. 26: IO module / assignment of plugs (option)

Pin assignment of interfaces for M12 socket for JST I/O 2				
Socket		Pin no.	Signal	Article no.
lt. 1 (X116)		1	24 V Out/In*	10118216
		2	Dig In 3	
		3	GND	
		4	Dig Out 1	

Fig. 27: Round plug connector, 4-pin, M12, A-coded for IO plug 2

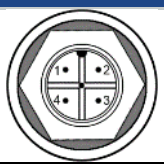
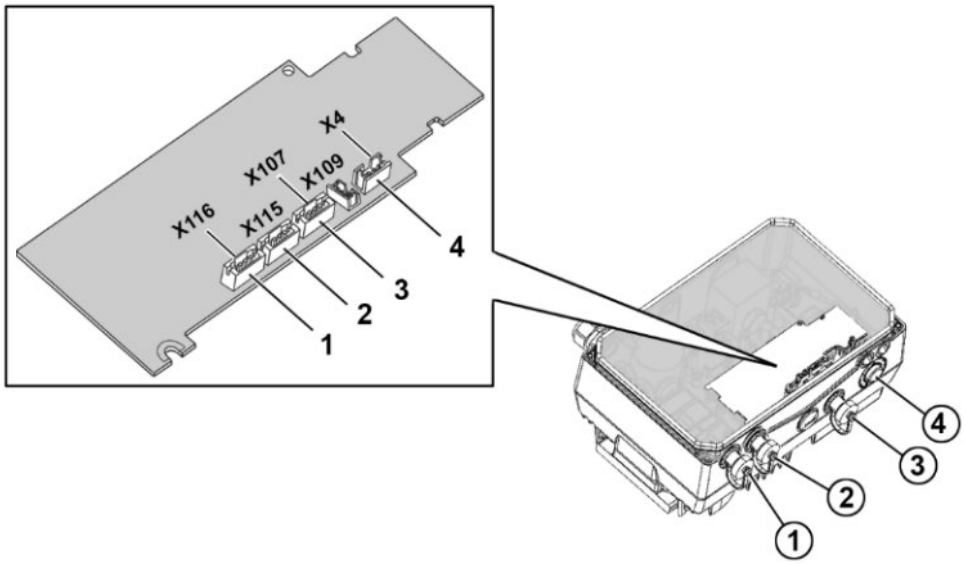
Pin assignment of interfaces for M12 socket for JST I/O 1				
Socket		Pin no.	Signal	Article no.
lt. 2 (X115)		1	24 V Out/In*	10118216
		2	Dig In 1	
		3	GND	
		4	Dig In 2	

Fig. 28: Round plug connector, 4-pin, M12, A-coded for IO plug 1

* With an external 24 V supply, ensure that the internal electrical supply of the inverter is decoupled from the external one (e.g. with a diode).

1	2	3	4	5	6	7	8	9	10	11	12



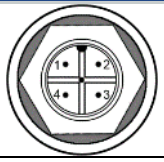
Pin assignment of interfaces for M12 socket for JST RS485 24 V MMI plug				
Socket		Pin no.	Signal	Article no.
lt.		1	24 V Out/In*	10118216
3 (X107)		2	RS485 - A	
		3	GND	
		4	RS485 - B	

Fig. 29: Round plug connector, 4-pin, M12, A-coded for MMI plug

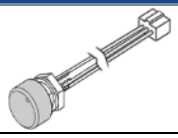
Pin assignment of interface for JST potentiometer		
lt.	JST potentiometer	
4 (X4)		Signal
		Analogue In 1 0 V – 10 V
		10 V
		GND

Fig. 30: Internal potentiometer

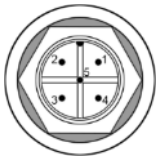
Pin assignment of interfaces for M12 plug for analogue input				
Plug		Pin no.	Signal	Article no.
lt.		**1**	Not assigned	10118224
(X4)		**2**	Not assigned	
		3	GND	
		4	10 V	
		5	Analogue In 1 0 V – 10 V	
		Housing	**Shielding**	

Fig. 31: Round plug connector, 5-pin, M12, A-coded for analogue input

* With an external 24 V supply, ensure that the internal electrical supply of the inverter is decoupled from the external one (e.g. with a diode).

3.5 Installation of main switch, size D (optional)

IMPORTANT INFORMATION

The main switch may only be installed by a trained and qualified electrician.

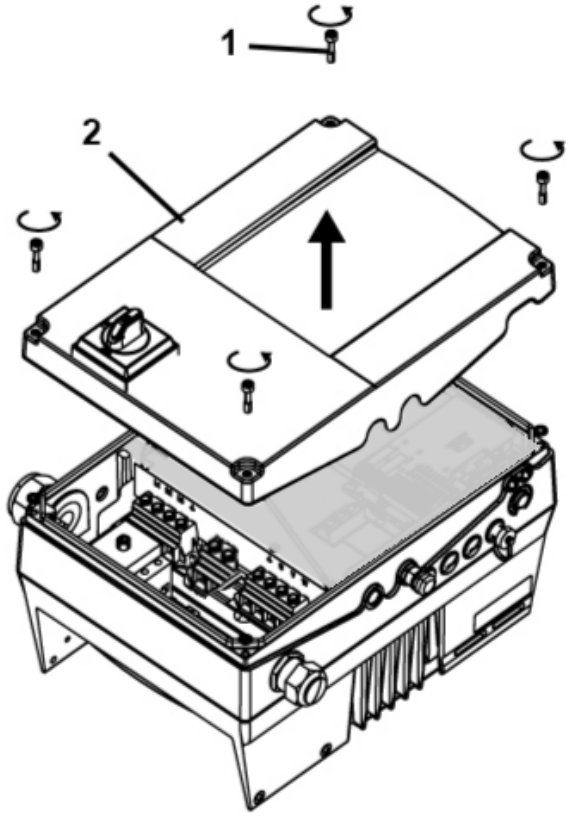
DANGER!

Risk of death due to electrical shock!

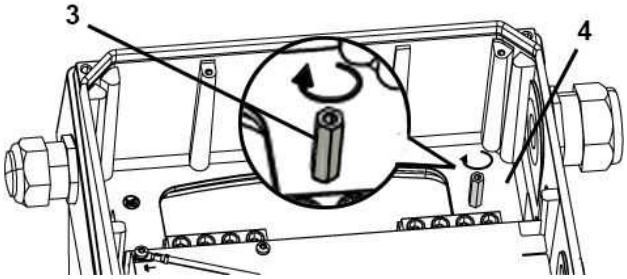
Death or serious injury!

De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted.

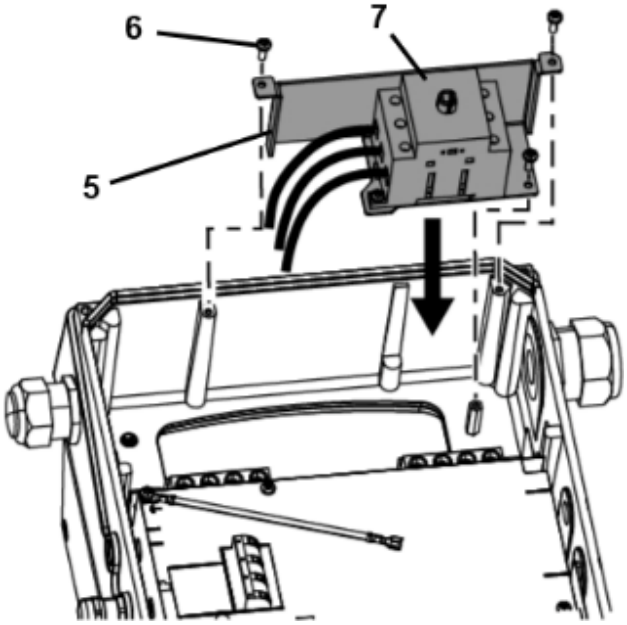
Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down.



1. Unscrew the four screws (1) from the drive controller's housing cover (2) and then take it off.

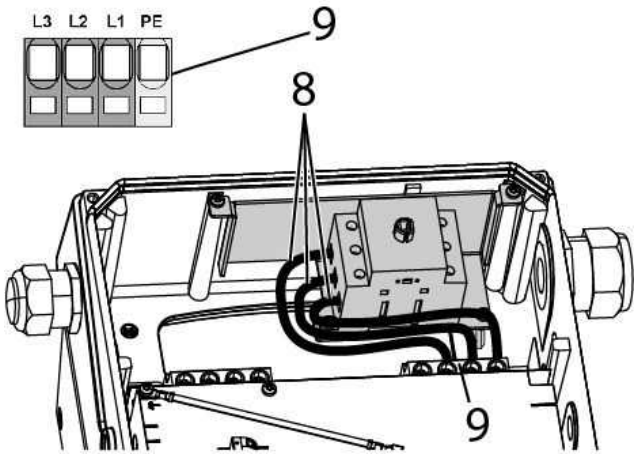


2. Screw bolt (3) into base (4) of INVEOR MP Modular (torque 2 Nm).



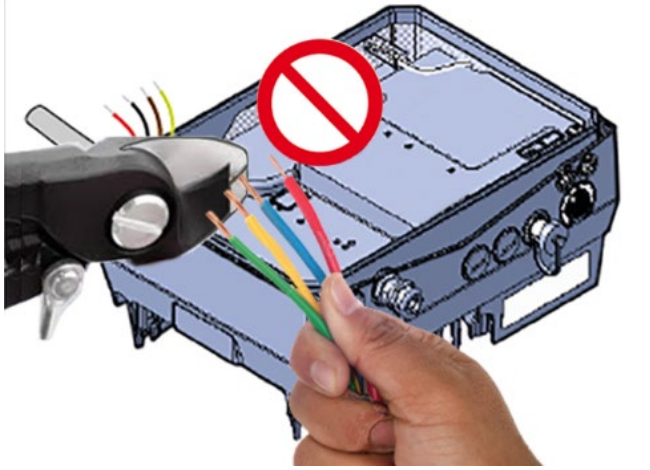
3. Insert the unit, comprising retaining plate (5) and main switch (7), into the INVEOR MP Modular housing.
4. Use the three screws (6) to screw unit and housing together (torque 2 Nm).

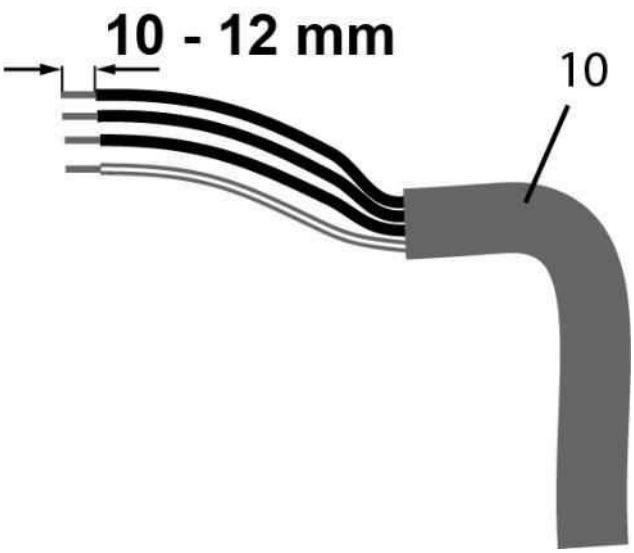
1	2	3	4	5	6	7	8	9	10	11	12



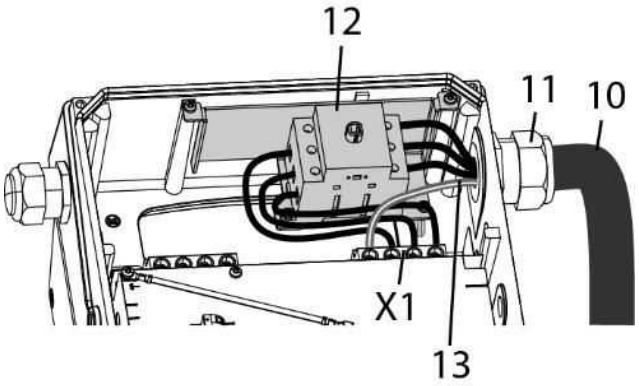
5. Connect cables (8) to mains terminal [X1] (9)
   (torque of mains terminal screws 2 Nm)

Caution!
Do not strip insulation off wires inside the drive controller





6. Strip 10 - 12 mm of insulation off individual cables of mains cable feed (10).



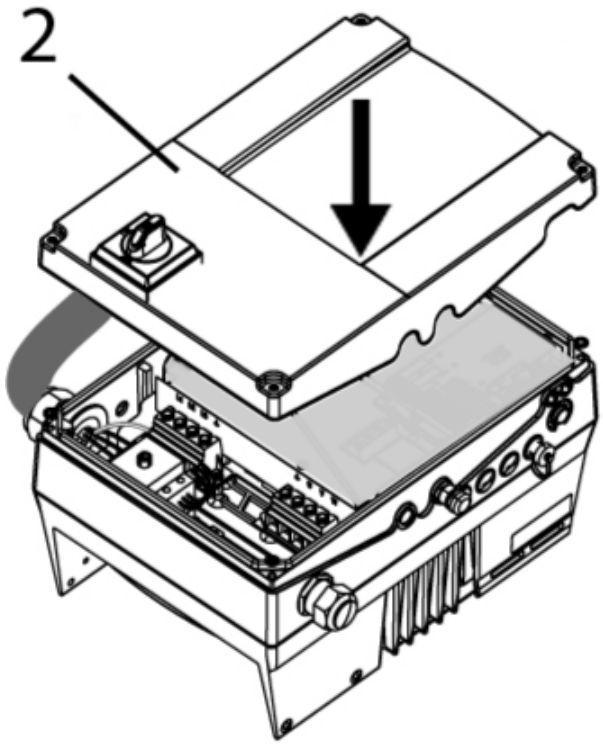
7. Guide mains cable feed (10) through cable gland (11) and into housing of INVEOR MP Modular.
8. Connect individual cables to terminals of main switch (12).
   (Torque of main switch screws 2 Nm).
9. Connect PE cable (13) of mains feed (10) to “PE” of mains terminal [X1] (9).
   (Torque of mains terminal screw “PE” 2 Nm).

DANGER!

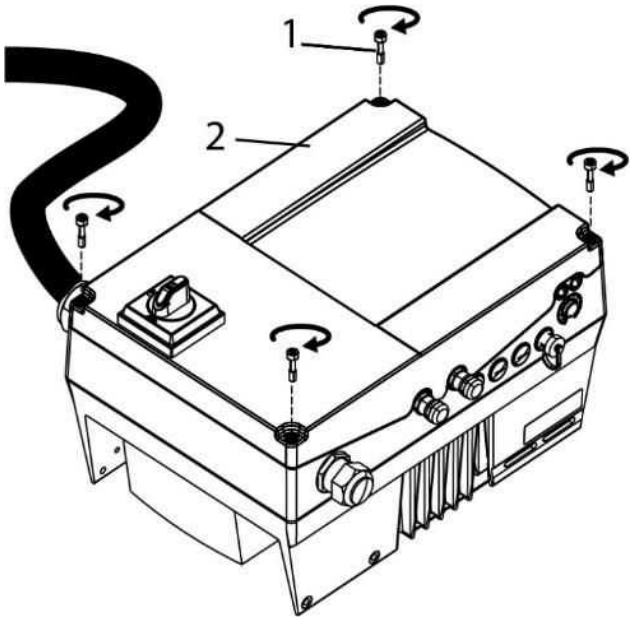
Risk of death due to electrical shock!

Death or serious injury!

De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted..



10. Carefully place housing cover (2) onto housing of INVEOR MP Modular.



11. Insert the four screws (1) into the cover (2) and screw both components together.
(Torque of screws (1) 4 Nm)

3.6 Installing the wall-mounted drive controller

3.6.1 Suitable installation location for wall mounting

Ensure that the installation location for an INVEOR wall mounting meets the following conditions:

- The drive controller has to be mounted on an even and fixed surface.
- The drive controller may only be mounted on non-flammable bases.
- There must be clearance of 200 mm around the drive controller to ensure free convection.

The following figure shows the assembly dimensions and the free spaces required for installing the drive controller.

For the "wall mounting" version, the line length between the motor and INVEOR may not exceed 5 m (for exception, see Chapter 10.1 EMC limit classes). Only use a shielded cable with the required cross-section.
There must be a PE connection (underneath the wall mounting's terminal board)!

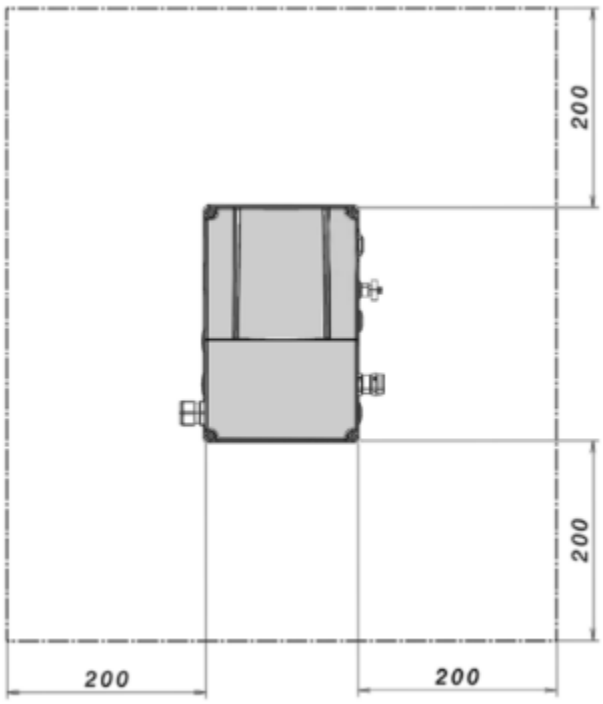


Fig. 32: Minimum clearances

3.6.2 Mechanical installation of sizes A - C

1. Open the motor connection box.

IMPORTANT INFORMATION

Depending on the required motor voltage, the star or delta connection must be made in the motor connection box!

2. Use a suitable EMC screw connection to attach the shielded cable to the motor connection box! Ensure that the shielding contact is in order (large surface)!
3. Connect the prescribed PE connection in the motor connection box!
4. Close the motor connection box.

Fig. 33: Wiring on the motor connection box

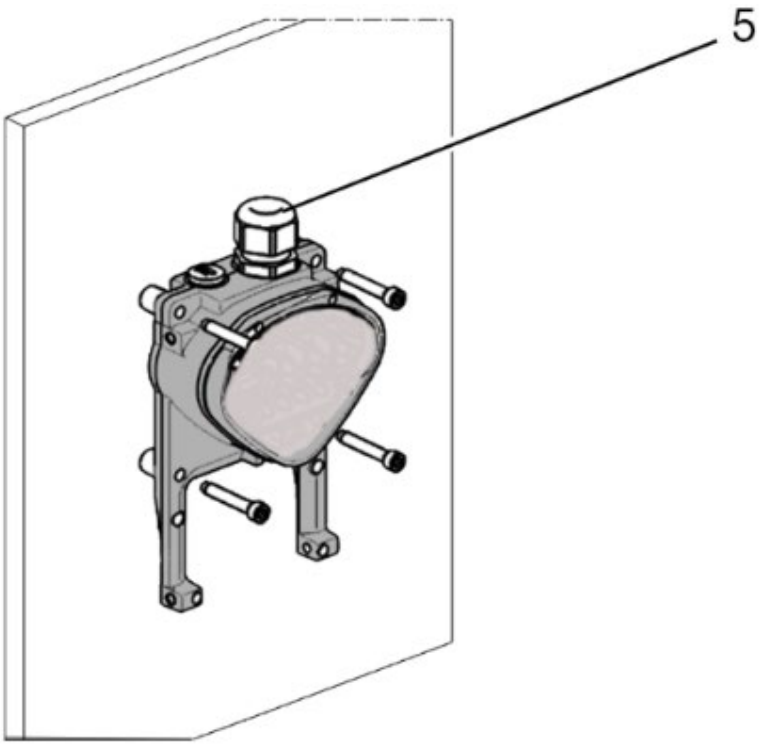


Fig. 34: Fastening the adapter plate to the wall

IMPORTANT INFORMATION

The drive controller may not be installed without an adapter plate!

- Find a position that meets the required ambient conditions described in the "**Installation requirements**" section.
- To achieve optimum self-convection of the drive controller, ensure that the (EMC) screw connection (5) is facing upwards during installation.
- If there is no additional ventilation for the INVEOR MP Modular, only vertical installation is permitted.

Wiring of wall adapter plate, size A

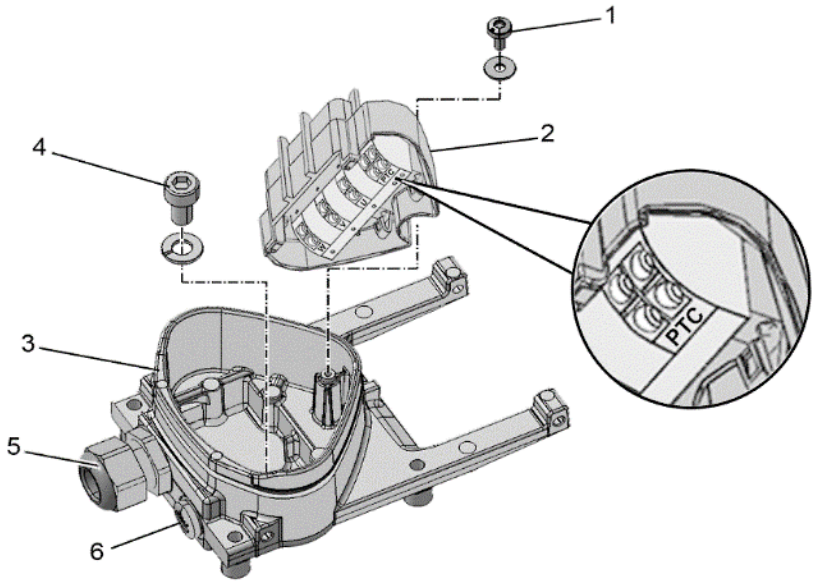


Fig. 35: Wiring of wall adapter plate, size A

1. Release the screw (1) to remove the contact plate (2) from the adapter plate (3).
   The (M6 x 12) PE connection (4) is underneath the contact plate.
2. Guide the connection cable from the motor to the adapter plate (3) through the integrated EMC screw connection (5).
3. This PE connection (torque: 4.0 Nm) must be made to the same ground potential as the motor.
   The cross-section of the equipotential bonding line must correspond to at least the cross-section of the power cable.

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.

The drive controller must be grounded with the motor according to relevant regulations.

The PE connection between the motor and drive controller should be established using the hexagon socket screw (4) and the spring ring included in the scope of supply for the adapter plate (3).

4. Wire the motor cable to contacts U, V, W (and the star point in some cases) in the connection terminal, as described in the "**Basic connection versions**" chapter.
5. If there is a motor PTC present, connect to the corresponding terminals of contact plate (2).
   Replace the dummy screw connection (6) with a suitable standard screw connection and guide the connecting cable to the motor PTC into the adapter plate (3).

IMPORTANT INFORMATION

Only motor PTCs corresponding to DIN 44081/44082 may be connected!

If the motor is **not** fitted with a temperature sensor, you must use the bridges contained in the scope of delivery of the drive controller on the terminal PTC.

6. Refit the contact plate (2) in the adapter plate (3).
7. Fasten the contact plate (2) using the screw (1) (torque: 1.2 Nm).

INFORMATION

After fastening the contact plate (2), ensure that it is mounted floating.

1	2	3	4	5	6	7	8	9	10	11	12

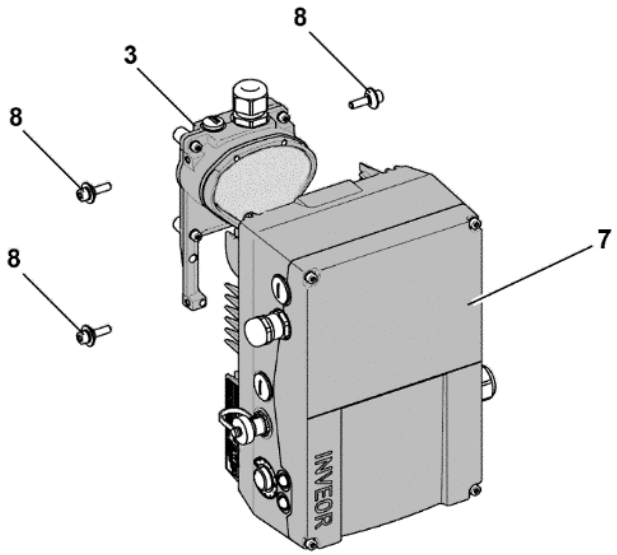


Fig. 36: Attaching the drive controller

8. Position the drive controller (7) on the adapter plate (3) so that the collar of the adapter dips into the opening on the floor of the cooling element.

9. Fasten the drive controller (7) to the adapter plate (3) with the help of the screws (8) provided (torque: 4.0 Nm)

Wiring of wall adapter plate, sizes B - C

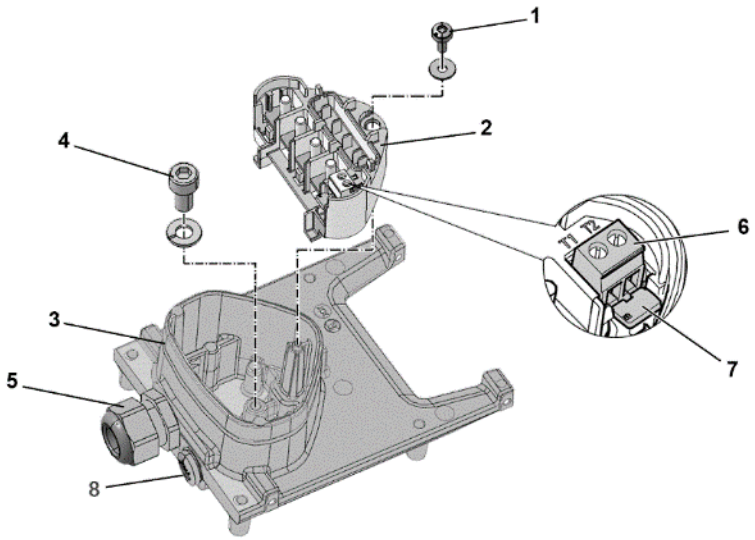


Fig. 37: Wiring of wall adapter plate, sizes B - C

1. Release the screw (1) to remove the contact plate (2) from the adapter plate (3).
   The (M6 x 12) PE connection (4) is underneath the contact plate.
2. Guide the connection cable from the motor to the adapter plate (3) through the integrated EMC screw connection (5).
3. This PE connection (torque: 4.0 Nm) must be made to the same ground potential as the motor.
   The cross-section of the equipotential bonding line must correspond to at least the cross-section of the power cable.

DANGER!

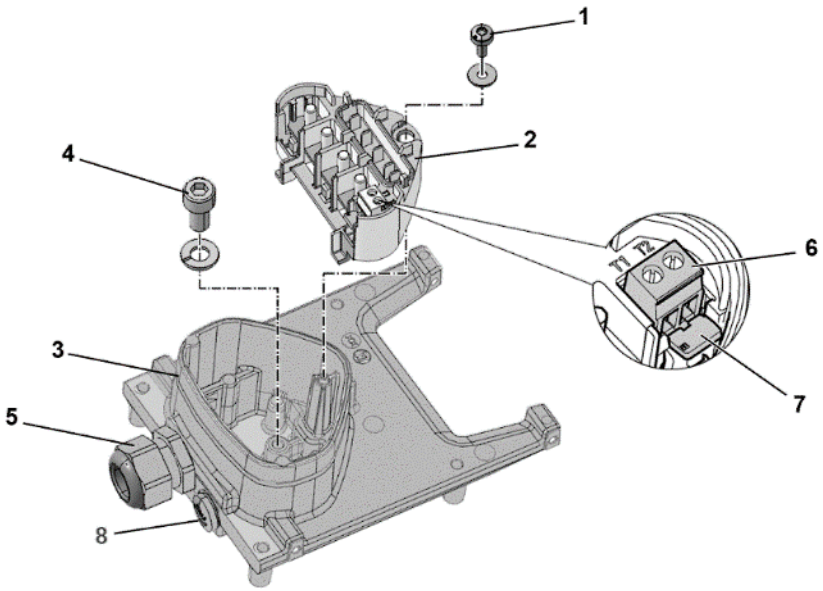
Risk of death due to electrical shock!

Death or serious injury!

The drive controller must be grounded with the motor according to relevant regulations.

The PE connection between the motor and drive controller should be established using the hexagon socket screw (4) and the spring ring included in the scope of supply for the adapter plate (3).

1	2	3	4	5	6	7	8	9	10	11	12



4. Wire the motor cable to contacts U, V, W (and the star point in some cases) in the connection terminal, as described in the "**Basic connection versions**" chapter. Use cable shoes (M5) to do this.
5. Before connecting an existing motor PTC to the T1 and T2 terminals (6), remove the pre-assembled short-circuit bridge (7).

   Replace the dummy screw (8) with a suitable standard screw connection and guide both ends to T1 and T2 (6).

IMPORTANT INFORMATION

If the motor is fitted with a temperature sensor, this is connected to the T1 and T2 terminals (6). Remove the bridging contact (7) inserted for delivery for this purpose.
When the bridge is in place, the temperature of the motor is not monitored!
Only motor PTCs corresponding to DIN 44081/44082 may be connected!

6. Refit the contact plate (2) in the adapter plate (3).
7. Fasten the contact plate (2) using the screw (1) (torque: 1.2 Nm).

INFORMATION

After fastening the contact plate (2), ensure that it is mounted floating.

1	2	3	4	5	6	7	8	9	10	11	12

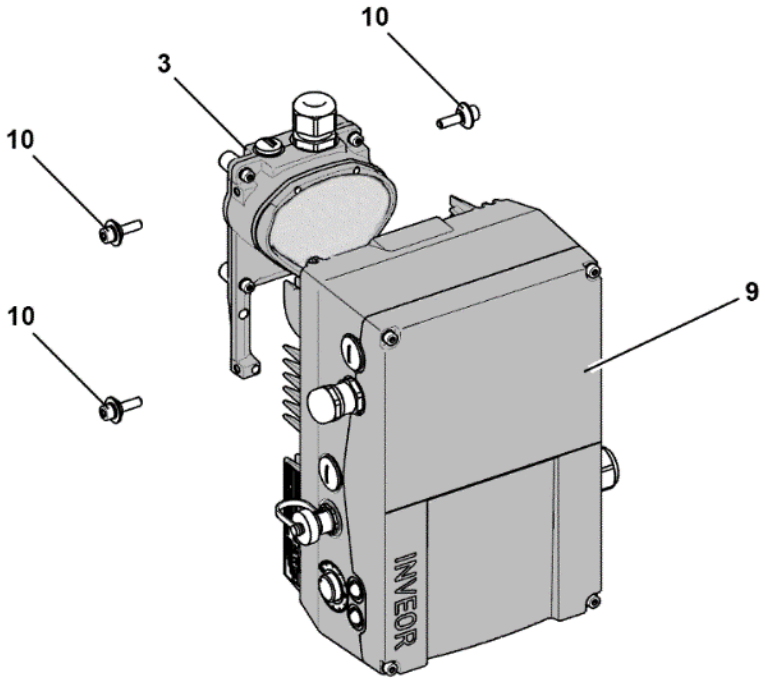


Fig. 38: Attaching the drive controller

8. Position the drive controller (9) on the adapter plate (3) so that the collar of the adapter dips into the opening on the floor of the cooling element.
9.
10. Fasten the drive controller (9) to the adapter plate (3) with the help of the screws (10) provided (torque: 4.0 Nm).

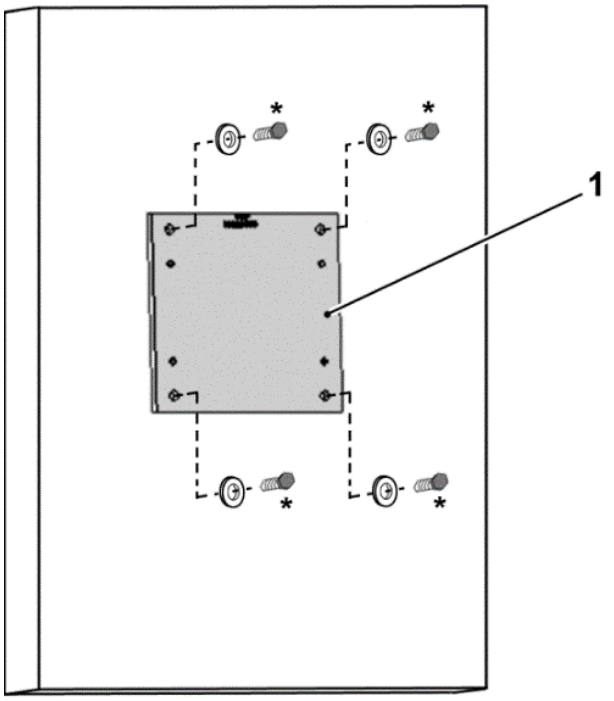
3.6.3 Mechanical installation of size D

1. Open the motor connection box.

> **IMPORTANT INFORMATION**
> Depending on the required motor voltage, the star or delta connection must be made in the motor connection box!

2. Use a suitable EMC screw connection to attach the shielded cable to the motor connection box! Ensure that the shielding contact is in order (large surface)!
3. Connect the prescribed PE connection in the motor connection box!
4. Close the motor connection box.

1	2	3	4	5	6	7	8	9	10	11	12



IMPORTANT INFORMATION

The drive controller may not be installed without an adapter plate (1)!

Find a position that meets the required ambient conditions described in the 3.3 "Installation requirements" section.

5. Mount the adapter plate (1) on the wall with four screws*.

*** The screws are not part of the scope of delivery.**

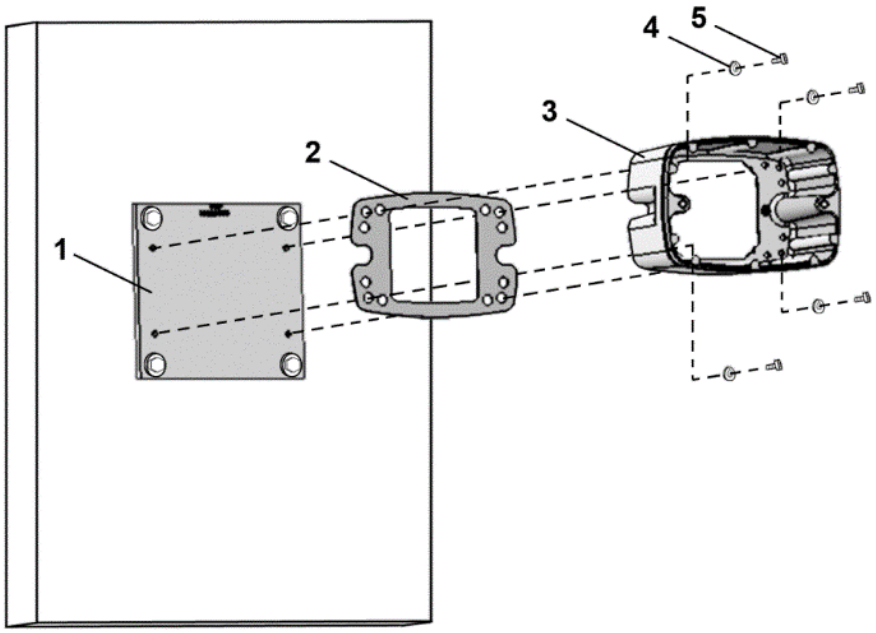


Fig. 39: Fastening the size D cup to the adapter plate

6. Mount seal (2), along with cup (3), to the adapter plate (1).
   Use the retaining bolts (5) and spring elements (4) provided (torque 8.5 Nm).

IMPORTANT INFORMATION

Please ensure that the seal (2) sits perfectly!

1	2	3	4	5	6	7	8	9	10	11	12

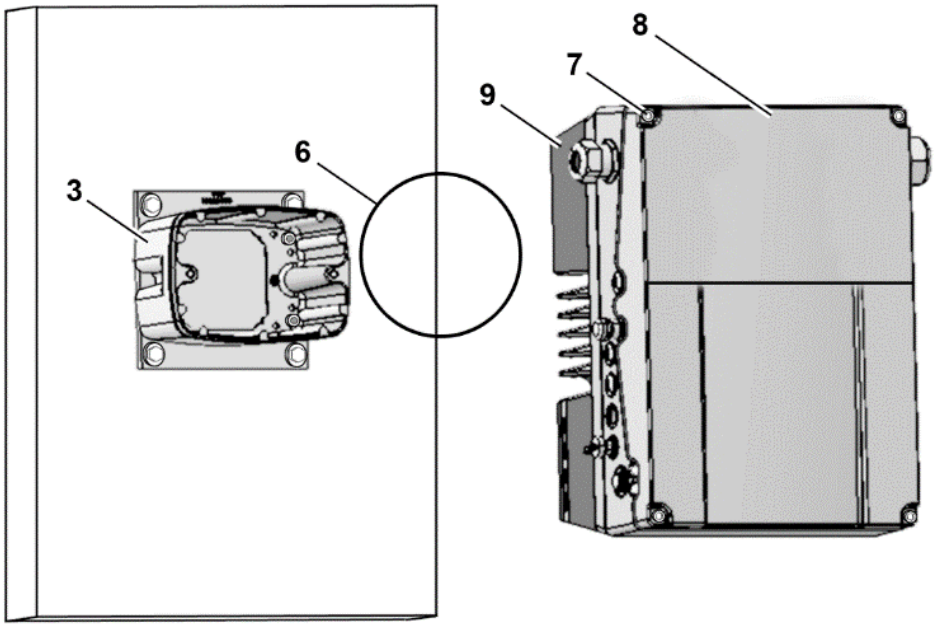


Fig. 40: Inserting O-ring seal size D

7. Insert the O-ring seal (6) in the groove of the cup (3).

IMPORTANT INFORMATION
Please ensure that the O-ring seal (6) is seated correctly.

8. Unscrew the four screws (7) from the cover (8) of the drive controller (9).
9. Take off the cover (8).

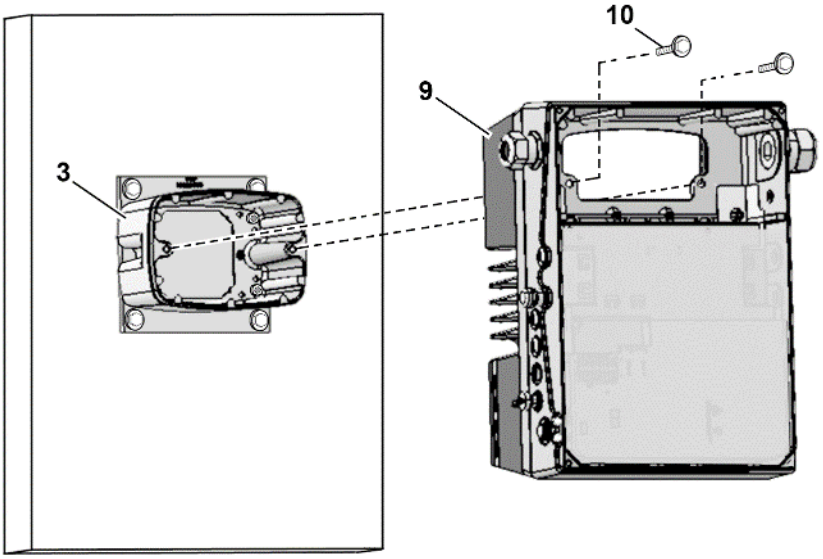


Fig. 41: Fastening drive controller to size D cup

10. Carefully place the drive controller (9) onto the cup (3)
11. Screw down both parts uniformly with the two M8 screws (10)
(torque: max. 25 Nm).

1	2	3	4	5	6	7	8	9	10	11	12

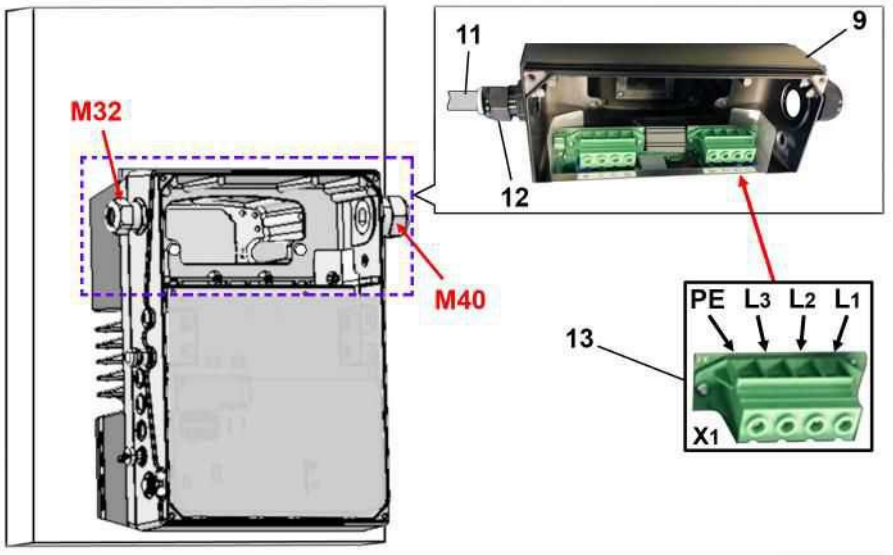


Fig. 42: Mains connection size D

12. Guide mains connection cable (11) through cable screw connection (12) [M32] into drive controller (9).

IMPORTANT INFORMATION

The cable screw connection provides strain relief, and the PE connection cable must be connected in a leading fashion (considerably longer).

13. Connect the cables with the terminals [X1] (13) as follows:

400 V connection			
L1	L2	L3	PE

The protective conductor must be connected to the "PE" contact.

Terminal no.	Designation	Assignment
1	L1	Mains phase 1
2	L2	Mains phase 2
3	L3	Mains phase 3
4	PE	Protective conductor

Tab. 7: 3~ 400 V terminal assignment X1

Terminal no.	Designation	Assignment
1	L1	DC mains (+)
2	L2	Not assigned
3	L3	DC mains (-)
4	PE	Protective conductor

Tab. 8: DC feed 565 V terminal assignment X1

1	2	3	4	5	6	7	8	9	10	11	12

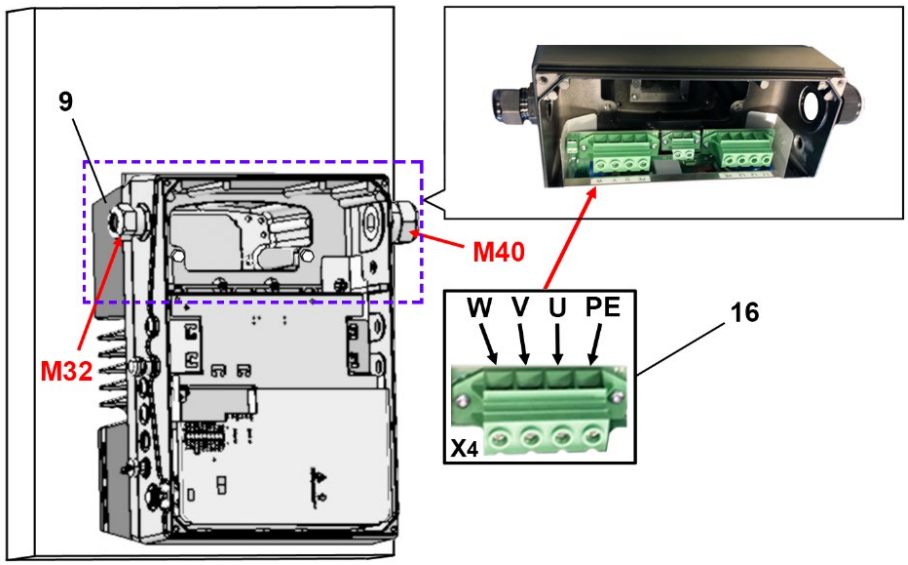


Fig. 43: Motor connection size D

14. Feed the motor connection cable through the cable gland (M32) or (M40) into the drive controller (9).

IMPORTANT INFORMATION

The cable screw connection provides strain relief, and the PE connection cable must be connected in a leading fashion (considerably longer).

15. Connect the cables with the terminals [X4] (16) as follows:

Terminal no.	Designation	Assignment
1	PE	Protective conductor
2	U	Motor phase 1
3	V	Motor phase 2
4	W	Motor phase 3

Tab. 9: Motor connection assignment X4

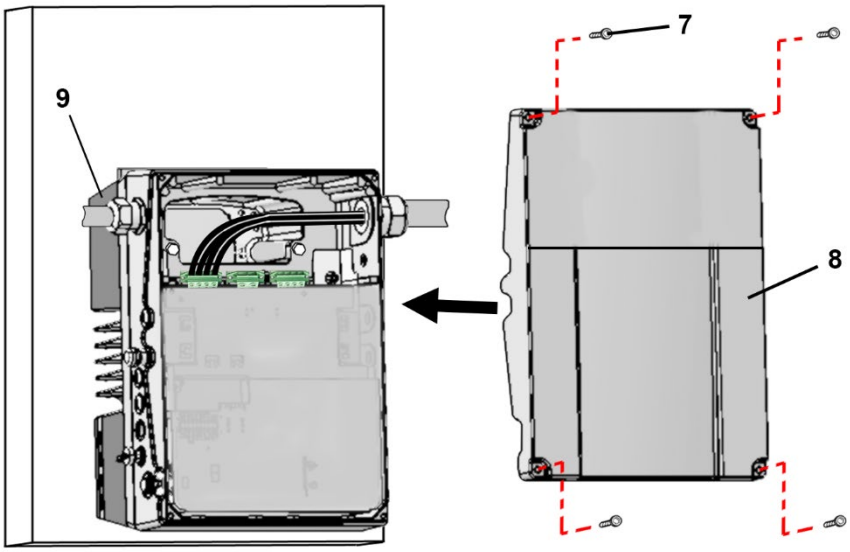


Fig. 44: Closing housing size D

16. Place cover (8) on housing of drive controller (9).
17. Screw down both parts with the four screws (7) (torque 4 Nm).

4. Commissioning

4.1 Safety instructions for commissioning

DAMAGE TO PROPERTY POSSIBLE

If the information is not observed, the drive controller could be damaged and destroyed during subsequent commissioning.
Commissioning may only be performed by qualified staff. Safety precautions and warnings must always be observed.

Risk of death due to electrical shock!

Death or serious injury!

Be sure that the power supply provides the correct voltage and is designed for the required current.

Use suitable circuit breakers with the prescribed nominal current between the mains and drive controller.

Use suitable fuses with appropriate current values between the mains and drive controller (see technical data).

The drive controller must be grounded with the motor according to relevant regulations. Non-compliance may result in serious injury.

IMPORTANT INFORMATION

The use of a mains choke or operation on the transformer may impact the control!
This impact may result in the "overcurrent" or "DC link overvoltage" error messages!

4.2 Communication

The drive controller can be commissioned in the following ways:

- using the INVERTERpc PC software

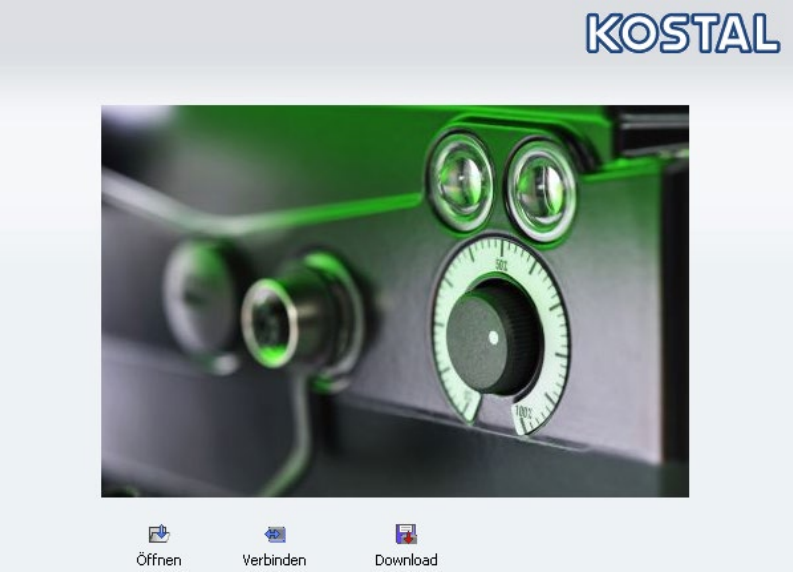


Fig. 45: PC software – start screen

1	2	3	4	5	6	7	8	9	10	11	12

- using the INVEOR MMI handheld controller*

Fig. 46: MMI handheld controller

- using the MMI* in the cover (MMI option)

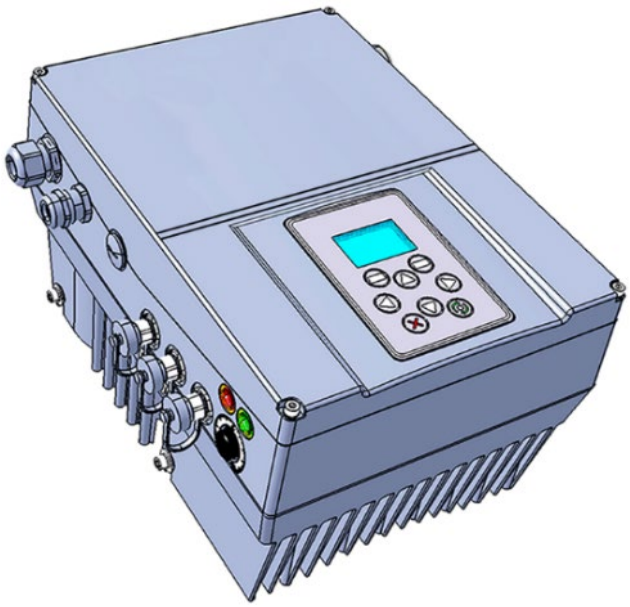


Fig. 47: MMI option

*** Man-machine interface**

1	2	3	4	5	6	7	8	9	10	11	12

- using Bluetooth (option)

ANDROID APP ON Google play

Available on the App Store

Fig. 48: INVERTERapp

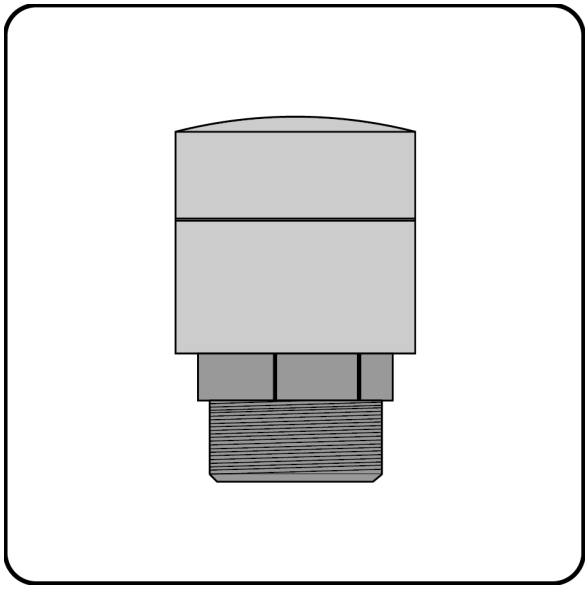


Fig. 49: Bluetooth module M16 (permanently fitted ex factory)

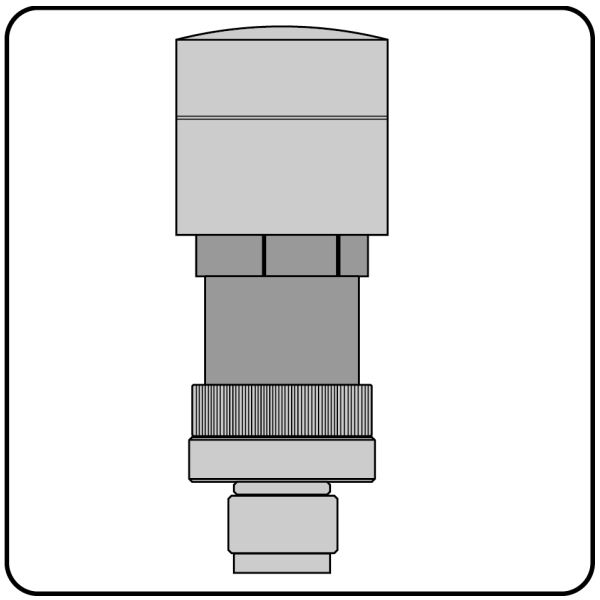


Fig. 50: Bluetooth stick M12 (optional accessories)

NOTE

If using the Bluetooth stick, the password is fixed as 000000.

4.3 Block diagram

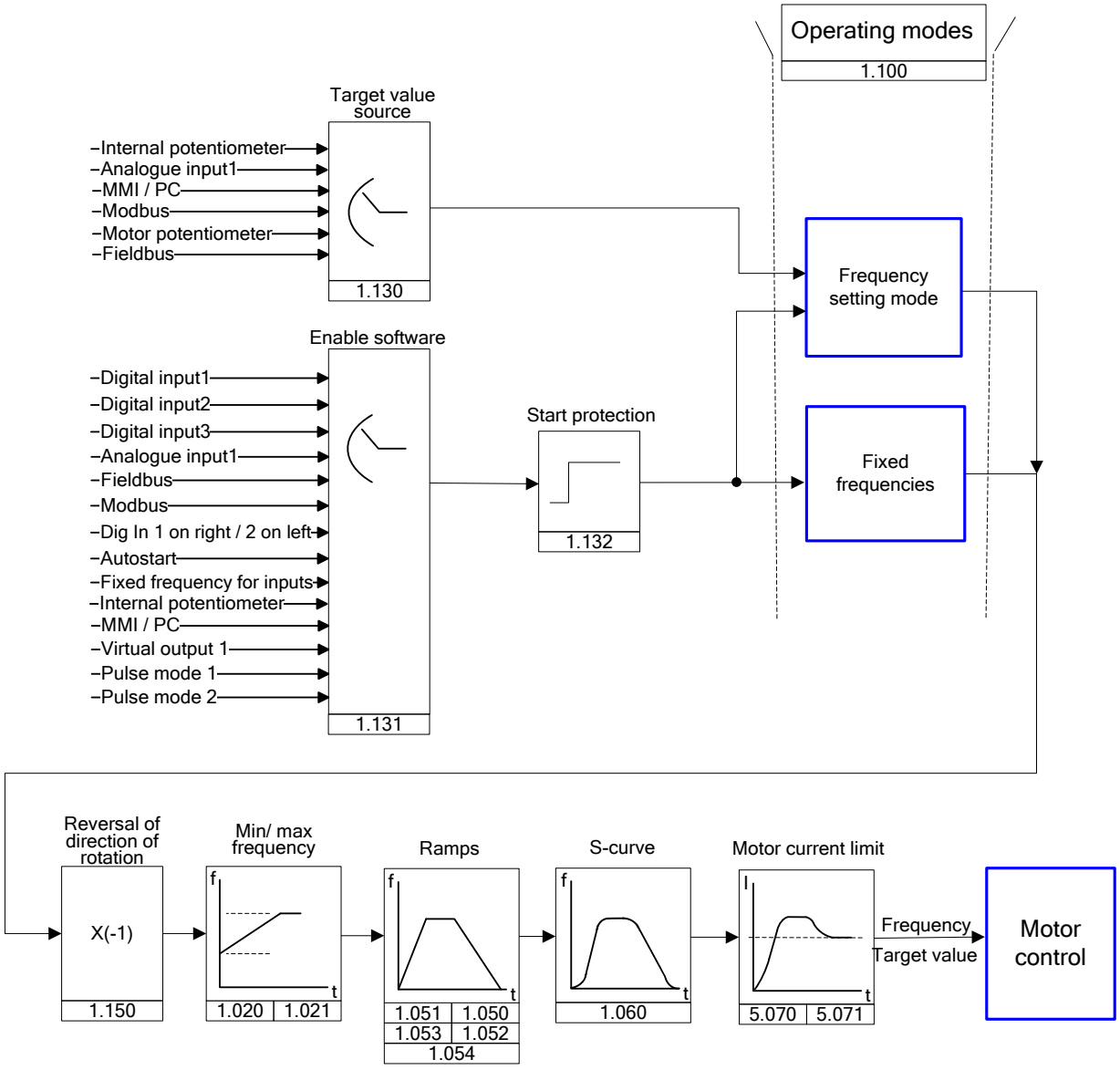


Fig. 51: General structure of target value generation

4.4 Commissioning steps

INFORMATION

Parameterisation is possible prior to device installation!

Parameterisation can be performed before the drive controller is installed in the motor.

The drive control has a 24 V low-voltage input for this purpose, which can supply the electric system without requiring mains power.

The commissioning can be performed using a PC communication cable USB at M12 plug with integrated interface converter RS485/RS232 (part no. 10023950) or using the INVEOR handheld controller MMI with connection cable RJ9 at M12 plug (part no. 10004768).

4.4.1 Commissioning using the PC:

IMPORTANT INFORMATION

For functions with software version 1.50, you need the KOSTAL INVERTERpc software version >3.60!
(see https://www.kostal-drives-technology.com/download)

1. Install the INVERTERpc software (you can obtain programming software from KOSTAL free of charge. Operating system required: Windows 7 or later [32 / 64 bit]).
   We recommend undertaking the installation process as an administrator.
2. Connect the PC to the M12 plug M1 with the optional connection cable.
3. Load or determine the motor data record (parameters 33.031 to 33.050); it may be necessary to optimise the speed control (parameters 34.090 to 34.091).
4. Perform the application settings (ramps, inputs, outputs, target values etc.).
5. Optional: Define an access level (1 – MMI, 2 – user, 3 – manufacturer).

See Fig. in chapter 11

Quickstart guide

In order to ensure an ideal operating structure for the PC software, the parameters are classified into different access levels.

The following levels exist:

1. handheld controller: – the drive controller is programmed using the handheld controller.
2. user: – the basic parameters can be programmed into the drive controller using the PC software.
3. Manufacturer: - an extended selection of parameters can be programmed into the drive controller using the PC software.

4.4.2 Commissioning using PC, combined with MMI option

IMPORTANT INFORMATION

For functions with software version 1.50, you need the KOSTAL INVERTERpc software version >3.60!
(see https://www.kostal-drives-technology.com/download)

1. Install the INVERTERpc software (you can obtain programming software from KOSTAL free of charge. Operating system required: Windows 7 or later [32 / 64 bit]).
   We recommend undertaking the installation process as an administrator.
2. Connect the PC to the M12 plug M1 with the optional connection cable.

IMPORTANT INFORMATION

After the power on the drive controller has been switched on, the diagnosis interface (M12 PC/MMI) is initially inactive.

To activate this interface, the "MMI option" has to be put into standby mode.

To do this, simultaneously press buttons (1) and (2) for approx. 1.5 sec.

"Standby" appears in the MMI display and internal communication is interrupted for 25 sec.

If communication for the INVERTERpc tool is established within 25 sec., the "MMI option" remains in standby mode.

Data can now be exchanged with the PC and/or an external MMI.
If communication is aborted or cannot be established within 25 sec., the "MMI option" switches from standby mode to normal mode.

Turning the display 180°

Depending on how the INVEOR is installed within the system, the display may have to be turned 180°.

You can turn the display 180° using parameter 5.200

by setting the parameter value to "1"

Alternatively, the display can also be turned 180° in "normal mode".

To do this, simultaneously press buttons (3) and (4) for approx. 1.5 sec.
The display and functional button assignment are turned 180°.

INFORMATION

The display is only turned 180 ° once the "Disconnect" button has been pressed in the "INVERTERpc tool".

5. Parameter

This chapter contains the following:

- an introduction to the parameters
- an overview of the most important commissioning and operation parameters

5.1 Safety instructions for working with parameters

DANGER!

Risk of death due to restarting motors!

Death or serious injury!

Non-observance may result in death, serious injury or damage.

Certain parameter settings and changing parameter settings during operation may result in the INVEOR drive controller restarting automatically after the supply voltage has failed, or in undesirable changes in the operating behaviour.

INFORMATION

If parameters are changed while the device is in operation, it may take a few seconds for the effect to become noticeable.

5.2 General information on parameters

5.2.1 Explanation of operating modes

The operating mode is the instance in which the target value is generated. In the case of frequency setting mode, this is a simple conversion of the raw input target value into a rotation speed target value.

Frequency setting mode:

The target values from the "target value source" (1.130) are rescaled into target frequency values.

0 % is the "minimum frequency" (1.020).

100 % is the "maximum frequency" (1.021).

The target value's plus or minus sign is the decisive factor in rescaling.

Fixed frequency

This operating mode controls the drive controller with up to 7 fixed target values.

These are selected under parameter 2.050, where you can select how many fixed frequencies are to be used.

Parameter	Name	Selection options	Function	Number of digital inputs needed
2.050	Fixed frequency/mode	0	1 fixed frequency	1
		1	3 fixed frequencies	2
		2	7 fixed frequencies	3

1	2	3	4	5	6	7	8	9	10	11	12

Depending on the number of fixed frequencies required, up to 3 digital inputs are permanently assigned in the table.

Parameter	Name	Presetting	DI 3	DI2	DI1
1.020	Min. frequency	0 Hz	0	0	0
2.051 to 2.057	Fixed frequency 1	10 Hz	0	0	1
2.051 to 2.057	Fixed frequency 2	20 Hz	0	1	0
2.051 to 2.057	Fixed frequency 3	30 Hz	0	1	1
2.051 to 2.057	Fixed frequency 4	35 Hz	1	0	0
2.051 to 2.057	Fixed frequency 5	40 Hz	1	0	1
2.051 to 2.057	Fixed frequency 6	45 Hz	1	1	0
2.051 to 2.057	Fixed frequency 7	50 Hz	1	1	1

Tab. 10: Logic table for fixed frequencies

5.2.2 Motor identification

Various parameters are required for regulated operation of the motor.
For the majority of the parameters, please refer to the motor's type plate. Depending on the selected drive type, additional parameters may be required. These are automatically determined in the associated motor identification.

IMPORTANT INFORMATION

For the procedure for commissioning a drive, including automatic motor identification, please refer to chapter 11 "
Quickstart guide".

INFORMATION

After a motor is successfully commissioned, the determined data sets can be transferred to additional INVEOR converters with the same motor without repeated motor identification.

5.2.3 Drive type

IMPORTANT INFORMATION

Please note that a new motor identification must be carried out each time the drive type is changed!

The drive type determines the control process used. This has broad consequences on parameters and performance.

The control process is adapted accordingly to the following three motor types:

a) Asynchronous motor (ASM)

b) Synchronous motor with permanent magnets (PMSM)

c) Synchronous motor without permanent magnets (SynRM) also referred to as (synchronous) reluctance motors

Reluctance motors with permanent magnet support (PMaSynRM) are a special case and are dealt with separately in the following section "PMaSynRM".

The following table provides an overview of the characteristics of the drive types and the associated motor identification.

Drive type	Required motor type	Operating characteristics	Motor identification
10: V/f	Asynchronous motor	Controlled, encoderless, speed setting range 1:25	Not required
20: ASM open-loop	Asynchronous motor	Regulated, encoderless speed setting range 1:100	Stationary, < 10 sec
40: ASM efficiency	Asynchronous motor	Regulated, encoderless, down to zero speed, highest efficiency	Rotating, < 1 min (stationary possible, rotating recommended)
100: PMSM Standard	Synchronous motor with permanent magnets	Regulated, encoderless, down to zero speed	Rotating, < 1 min (stationary possible, rotating recommended)
110: PMSM Efficiency	Synchronous motor with permanent magnets	Regulated, encoderless overload capable, down to zero speed, highest efficiency	Rotating, < 5 min (stationary possible, rotating recommended)
120 PMSM Isotropy	Synchronous motor with surface magnets/ servomotors without Ld/Lq difference	Regulated, encoderless overload capable, down to zero speed, highest efficiency from medium speeds onward	Rotating, < 10 min (stationary possible, rotating recommended)
210: SynRM efficiency	Synchronous motor without permanent magnets	Regulated, encoderless overload capable, down to zero speed, highest efficiency	Stationary, < 5 min

Continues on next page

1	2	3	4	5	6	7	8	9	10	11	12

Continuation

COMMENT:

If you are unsure which motor type is present, the following test procedure will help you to differentiate between them:

The rated frequency and rated speed are indicated on the motor's type plate.

Calculate $\frac{60\ x\ rated\ frequency}{rated\ speed}$

The result is not a whole number but has decimal places

a) This statement is correct: Then it is an asynchronous motor (ASM)

b) This statement is incorrect: Then it is a synchronous motor and it needs to be ascertained whether it contains permanent magnets.

To do this, bridge the motor terminals and then turn the motor shaft by hand.
Is a speed-proportionate resistance torque felt?

b1) Yes: Then it is a synchronous motor **with** permanent magnets (PMSM)

b2) No: Then it is a synchronous motor **without** permanent magnets (SynRM)

DANGER!

Danger to life due to rotating or moving mechanical parts!

Death or serious injury!

Before starting work, block off the entire danger zone of the machine in such a way that uninvolved persons cannot come to harm!

IMPORTANT INFORMATION

In the detailed motor identification for the drive types "110: PMSM efficiency" and "200: SynRM efficiency", current pulses are applied to the motor up to the set "Motor current limit fixed" (5.069).

This will result in corresponding torques for a few milliseconds.

The resulting jolting movements of the motor shaft and the noises produced are normal!

1	2	3	4	5	6	7	8	9	10	11	12

PMaSynRM – Reluctance motors with permanent magnet support

Despite its largely reluctance-based torque generation, the PMaSynRM counts as a PMSM in the context of drive types, simply because it contains permanent magnets. Because of its strongly non-linear magnetic properties, it is essential to identify and operate it with drive type "110: PMSM efficiency".

DAMAGE TO PROPERTY POSSIBLE

This type of motor usually carries a particularly high risk of demagnetisation.

It is therefore essential to find out which short-term maximum current value is permissible **before identification** (data sheet; if necessary, contact the motor manufacturer)!

Then enter this value in amperes (r.m.s value) in parameter 61.210 "Overcurrent shut-off".

Then restart the INVEOR via a voltage reset.

For safety reasons, the motor identification aborts with error 46 "Motor parameters invalid" if parameter 61.210 "Overcurrent shut-off" has not been entered.

Next, please enter parameter 5.069 "Motor current limit fixed" (set current limitation as a multiple of the rated motor current 33.031) with some tolerance distance below this overcurrent shut-off.

INFORMATION

Up to firmware version < 1.40, the information given under 1) and 2) must be observed!

1) For the quality of the motor identification's measurement data, it can be advantageous with this motor type to block the motor shaft for the second part of the motor identification (certain specimens do not realign themselves exactly after the measurement pulses, which impairs the identification data to the point of making it unusable).

2) After the first part of the motor identification, there is a corresponding pause and a request to block.

   If blocking is not readily possible, motor identification can be carried out without blocking on a trial basis (OK for some instances). Afterwards, however, the operating characteristics should be checked critically and, if there is an error, the motor identification should be carried out again with blocking.

5.2.4 Multiple-pump control

Application

The multiple-pump control function is intended for applications where several pumps, fans or compressors control a common process. With this solution, all process control is stored in the INVEOR drive controllers. A total of up to 6 INVEOR drive controllers can be connected together.

In such cases, the parameters for one pump are set as master and this pump assumes control of the process.

To increase system redundancy, the parameters for another pump can be set as auxiliary master. Should the master fail, this would then assume control and monitoring of the system.

The remaining INVEOR drive controllers can be set as slaves.

Functionality

The process control needed for this functionality is provided via the integrated PID process controller of the master active at that time.

The process controller itself requires an actual value signal sent via a sensor connected to the process.

If an auxiliary master has been activated, this also needs a sensor signal. Here there are options to either use a sensor with a voltage output, which can then be connected in parallel to the analogue inputs of the master and auxiliary master or two separate sensors can be used for the two masters.

The target speed value calculated by the process controller is stipulated for all active pumps in parallel.

Should one pump not reach the target value, a second pump automatically activates.

If this also fails to reach the target value, more pumps are successively activated as required.

Vice versa, if too high a process value is reached, the speed of the active pumps is reduced to a minimum frequency and successive pumps are shut down if necessary.

The CANopen fieldbus is needed for communication.

There are no fixed assignments for the base load pump or auxiliary pumps. Each pump can act as a base load or auxiliary pump depending on operating hours.

Auxiliary master

In order to ensure continued operation in the event of a defective master, one of the pumps can be activated as auxiliary master.

To do this, the multiple-pump mode parameter 8.010 must be set to a value of 1 and the fieldbus address to 2.

For as long as the master is fully functional, the auxiliary master behaves like a slave drive.

But should the master fail (application electronics or fieldbus connection defective), the auxiliary master assumes control.

For this to happen, the auxiliary master also has to receive a sensor signal. There are options to either use a sensor with a voltage output, which can then be connected in parallel to the analogue inputs of the master and auxiliary master or two separate sensors can be used for the two masters.

Emergency operation if there is master and auxiliary master failure

If there is a master and auxiliary master failure, the emergency mode can be activated. This emergency mode can be used with or without an auxiliary master. In emergency mode, all available slave drives run with the frequency parametrised under fixed frequency 1 (2.051).

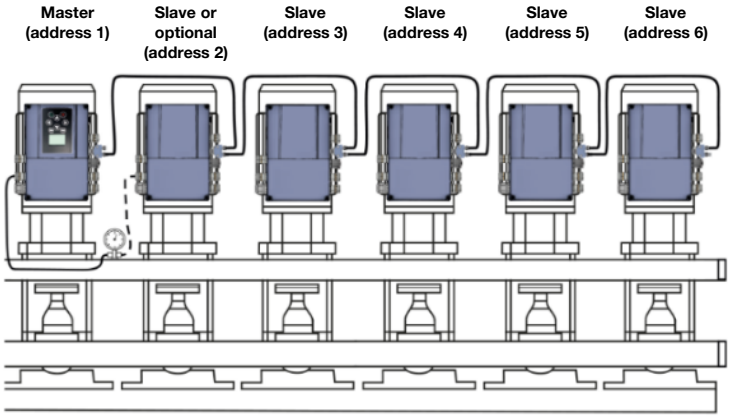
Automatic pump changes

To ensure even wear on the pumps, the "Pump change time 8.050" parameter can be set to a value in hours.

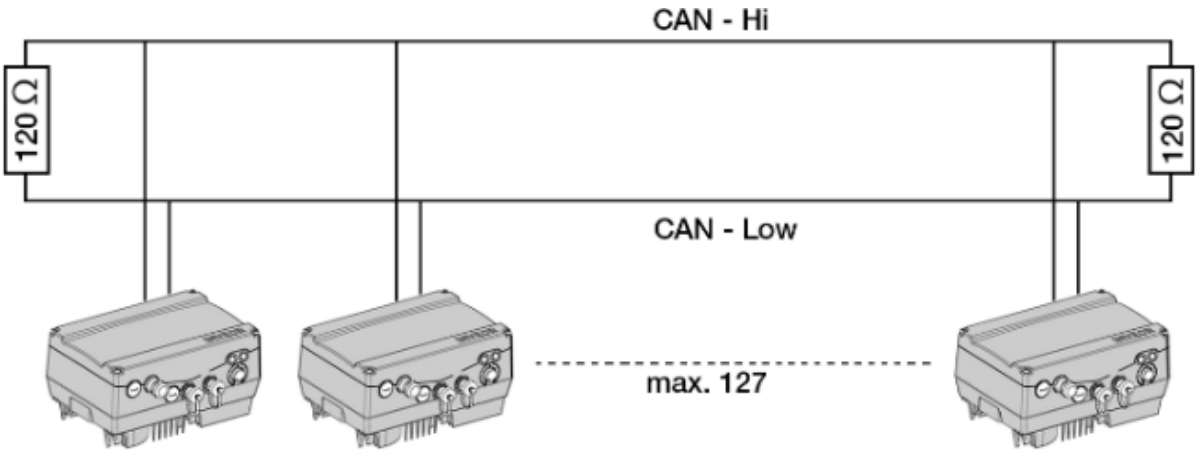
Once this time has lapsed, the system always changes over to the pump with the lowest operating hours.

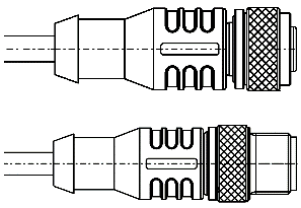
1	2	3	4	5	6	7	8	9	10	11	12

Communication via CANopen fieldbus (example)



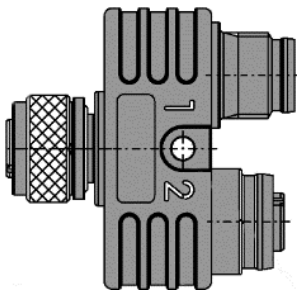
General setup and connection





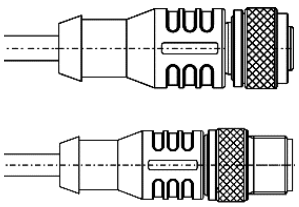
M12 connecting cable (2 m)

(Article no.:10138812)



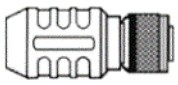
M12 Y-splitter

(Article no.:10138799)



M12 connecting cable (5 m)

(Article no.:10138813)



M12 terminating resistor

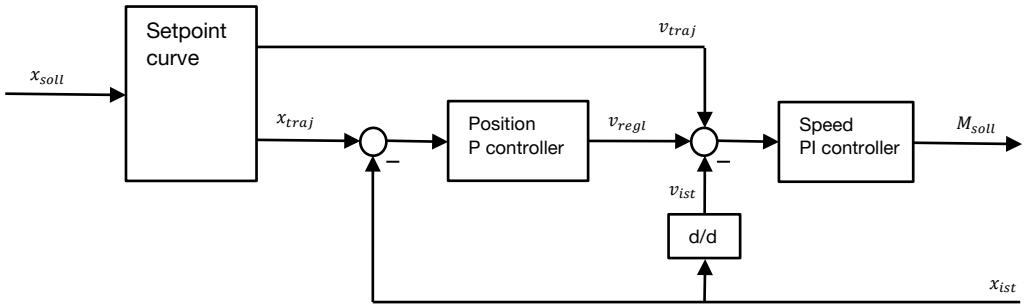
(Article no.:10138793)

5.2.5 Positioning

WICHTIGE INFORMATION

The operating mode is only available in connection with drive types ≥ 100 PMSM or SynRM

The structure of the position control consists of a cascaded controller structure with setpoint curve.



The position target values $X_{setpoint}$ can be specified via bus (Profinet, Ethercat, Modbus, CAN, etc.), while physical loads may counteract the target torque $M_{setpoint}$ in addition to inertia.

The special design of the controller structure enables the guidance and disturbance behaviour to be set independently. It is therefore possible to react differently to target value changes than to changes in the load.

Guidance behaviour setting

The mostly abrupt changes of $X_{setpoint}$ are transformed by the setpoint curve into a smooth progression X_{traj}, whose rise and curvature adhere to the following limits:

Limitation		as per parameter	Number
Max. speed	dx/dt	Target frequency value	-
Max. acceleration	d^2x/dt^2	Run up time 1	1.051
Max. delay	d^2x/dt^2	Deceleration time 1	1.050
Max. jolt	d^3x/dt^3	S-curve	1.060

Within these limits, X_{traj} is always the shortest possible (time-optimal) course to the target $X_{setpoint}$.
These parameters determine the guidance behaviour of the positioning, i.e. the response to a target value change.

1	2	3	4	5	6	7	8	9	10	11	12

Interference behaviour tuning/setting

An additional P controller is now superimposed on the PI speed controller in positioning mode from the frequency setting mode. The I component of the speed controller also ensures that no stationary position control deviation remains under load.

The disturbance behaviour of the position control is thus determined by the following parameters:

Parameter name	Number	Affects
Pos. control boost	9.100	P component of the position controller
Speed controller Kp	34.090	P component of the speed controller
Speed controller Tn	34.091	I component of the speed controller

A stability requirement of cascaded control structures is for a subordinate control loop to be at least 2 to 4 times faster than the next one out. In position control, the bandwidth of the position controller (= P- Pos. control boost.) should therefore be correspondingly lower than the bandwidth of the speed controller (= speed controller Kp / rotor inertia * number of pool pairs).

Empirical parameter tuning should be done from the inside out:

1. Change in frequency setting mode (parameter 1.100)
2. Set fast run up time/deceleration time (e.g. 0.1 s) and S-curve (0.001 s)
3. Deactivate I component of speed controller (speed controller Tn >> 1 s)
4. Observe guide step response while slowly increasing speed controller Kp until undesired effects occur (oscillation, scratching, other individual criteria)
5. Starting from this, halve speed controller Kp and save.
6. Slowly lower the speed controller Tn until unwanted effects occur (multiple overshoots)
7. Starting from this, double speed controller Tn (increase further if necessary, multiple overshoots must be omitted) and save.
8. Change to positioning mode (parameter 1.100)
9. Observe guidance step response and thereby slowly increase or lower Pos. control boost (9.100) until the (subjectively) desired controller hardness is achieved. There should be no overshooting.

1	2	3	4	5	6	7	8	9	10	11	12

5.2.6 Structure of the parameter tables

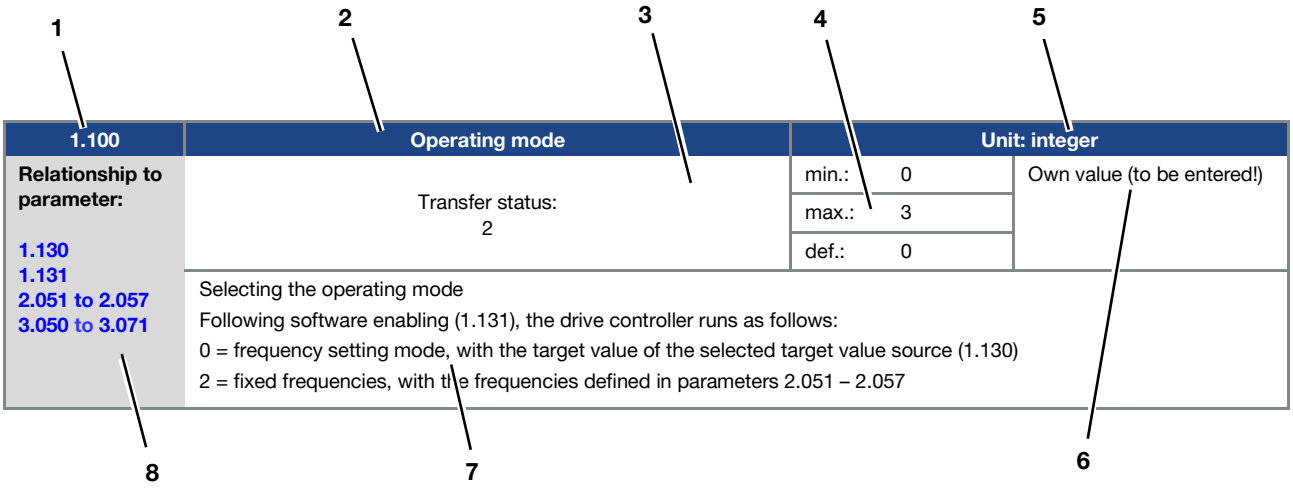


Fig. 52 Example of a parameter table

Key			
1	Parameter number	5	Unit
2	Parameter name	6	Field for entering an own value
3	Transfer status 0 = switch drive controller off and on for transfer 1 = at speed of 0 2 = during operation	7	Explanation of the parameter
4	Value range (from – to – factory setting)	8	Other parameters related to this parameter.

5.3 Application parameters

5.3.1 Basic parameter

1.020	Minimum frequency	Unit: Hz	
Relationship to parameter: 1.150 3.070 5.085	Transfer status: 2	min.: 0 max.: 599 def.: 0	Own value (to be entered!)
The minimum frequency is the frequency which is supplied by the drive controller as soon as it is enabled and there is no additional target value. The frequency falls below this level if: a) the drive accelerates from stationary b) the frequency converter is blocked. The frequency then falls to 0 Hz before it is blocked. c) the frequency converter reverses (1.150). The field of rotation reverses at 0 Hz. d) the standby function (3.070) is active. d) the current limit is reached f) when the torque limit is reached			

1.021	Maximum frequency	Unit: Hz	
Relationship to parameter: 1.050 1.051	Transfer status: 2	min.: 5 max.: 599 def.: 50	Own value (to be entered!)
The maximum frequency is the highest frequency produced by the inverter depending on the target value.			

1.050	Deceleration time 1	Unit: s	
Relationship to parameter: 1.021 1.054	Transfer status: 2	min.: 0.001 max.: 1000 def.: 5	Own value (to be entered!)
Deceleration time 1 is the time that the drive controller needs to brake to 0 Hz from the max. frequency (1.021). If the set deceleration time cannot be reached, the fastest possible deceleration time is implemented.			

1.051	Run up time 1	Unit: s	
Relationship to parameter: 1.021 1.050 1.054	Transfer status: 2	min.: 0.001 max.: 1000 def.: 5	Own value (to be entered!)
Run up time 1 is the time that the drive controller needs to accelerate from 0 Hz to the max. frequency. The run up time can be increased as a result of certain circumstances, e.g. if the drive controller is overloaded.			

1.052	Deceleration time 2	Unit: s	
Relationship to parameter: 1.021 1.050 1.054	Transfer status: 2	min.: 0.001 max.: 1000 def.: 10	Own value (to be entered!)
Deceleration time 2 is the time that the drive controller needs to brake to 0 Hz from the max. frequency (1.021). If the set deceleration time cannot be reached, the fastest possible deceleration time is implemented.			

1	2	3	4	5	6	7	8	9	10	11	12

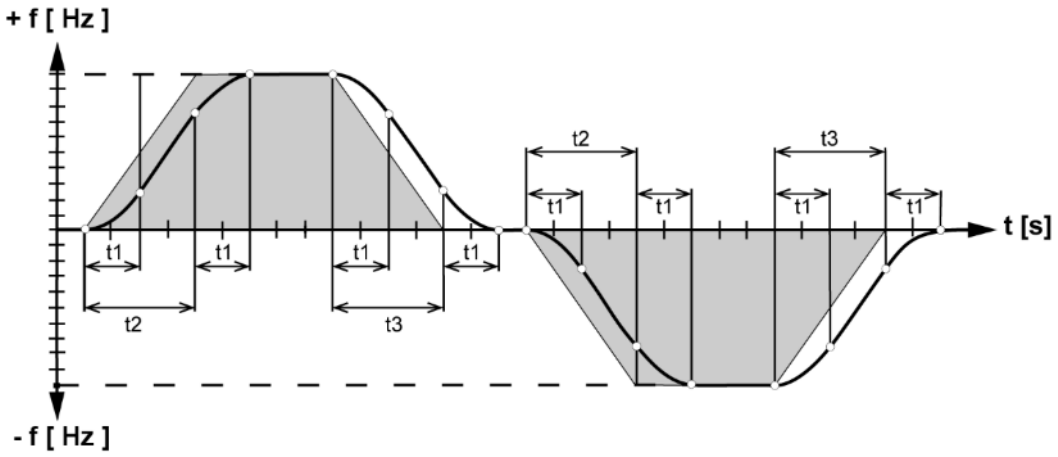
1.053	Run up time 2	Unit: s		
Relationship to parameter: 1.021 1.050 1.054	Transfer status: 2	min.:	0.001	Own value (to be entered!)
		max.:	1000	
		def.:	10	
	Run up time 2 is the time that the drive controller needs to accelerate from 0 Hz to the max. frequency. The acceleration time can be increased as a result of certain circumstances, e.g. if the drive controller is overloaded.			

1.054	Ramp selection	Unit: integer		
Relationship to parameter: 1.050 - 1.053	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	9	
		def.:	0	
	Selection of used ramp pair 0 = deceleration time 1 (1.050) / acceleration 1 (1.051) 1 = deceleration time 2 (1.052) / acceleration 2 (1.053) 2 = digital input 1 (false = ramp pair 1 / true = ramp pair 2) 3 = digital input 2 (false = ramp pair 1 / true = ramp pair 2) 4 = digital input 3 (false = ramp pair 1 / true = ramp pair 2) 7 = analogue input 1 (must be selected in parameter 4.030) 9 = virtual output (4.230)			

1.060	S-curve	Unit: s		
Relationship to parameter: 1.050 1.051	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	0.001	

Given the application, it is good if the drive starts and stops smoothly.
This can be achieved by smoothing the acceleration and delay time.

t1 S-curve time (1.060)
t2 Run up time (1.051)
t3 Deceleration time (1.050)



1	2	3	4	5	6	7	8	9	10	11	12

1.088	Rapid stop	Unit: s		
Relationship to parameter:	Transfer status: 2	min.:	0.1	Own value (to be entered!)
		max.:	1000	
		def.:	10	
	Only for variant with functional safety The rapid stop parameter prescribes the time that the inverter requires to brake to 0 Hz from the max. speed (1.021). If the set rapid stop time cannot be achieved, the fastest possible deceleration time is implemented.			

1.100	Operating mode	Unit: integer		
Relationship to parameter: **1.130** **1.131** **2.051 to 2.057** **3.050 to 3.071**	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	3	
		def.:	0	
	Selecting the operating mode Following software enabling (1.131) and hardware enabling, the drive controller runs as follows: 0 = frequency setting mode, with the target value of the selected target value source (1.130) 1 = PID process controller, with the target value of the PID process controller (3.050 – 3.071), 2 = fixed frequencies, with the frequencies defined in parameters 2.051 – 2.057 3 = selection via INVEOR soft PLC 4 = multiple-pump control (parameters 8.010 - 8.050) 5 = positioning (parameters 9.010 – 9.100) [only with drive type ≥ 100 PMSM or SynRM]			

1.130	Target value source	Unit: integer		
Relationship to parameter: **3.062 to 3.069**	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	10	
		def.:	0	
	Determines the source from which the target value is to be read. 0 = internal potentiometer 1 = analogue input 1 3 = MMI/PC 4 = Modbus 9 = fieldbus 10 = INVEOR soft PLC			

1	2	3	4	5	6	7	8	9	10	11	12

1.131	Enable software	Unit: integer		
Relationship to parameter: 1.132 1.150 2.050 4.030 4.030	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	16	
		def.:	0	

⚠ DANGER!

The motor may start immediately, depending on the change made.

Selection of the source for the control release.

0 = digital input 1
1 = digital input 2
2 = digital input 3
4 = analogue input 1 (must be selected in parameter 4.030)
6 = field bus
7 = Modbus
8 = digital input 1 on right / digital input 2 on left
1.150 must be set to "0"
9 = autostart
The motor may start immediately if a target value is present!
This cannot be prevented even with parameter 1.132.
11 = fixed frequency inputs
(all inputs which were selected in parameter 2.050)
12 = internal potentiometer
14 = MMI/PC
15 = virtual output (4.230)
17 = edge for Dig In 1 start / Dig In 2 stop
18 = edge for Dig In 1 start on right /
edge for Dig In 2 start on left /
Dig In 3 stop
(1.150 must be set to “0”)

1.132	Start-up protection	Unit: integer		
Relationship to parameter: 1.131	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	8	
		def.:	1	

Selection of behaviour in response to enabling software (parameter 1.131).

No effect if autostart was selected.

0 = immediate start with high signal at input of control enable
1 = start only with rising edge at input of control enable
2 = digital input 1 (function active with high signal)
3 = digital input 2 (function active with high signal)
4 = digital input 3 (function active with high signal)
7 = analogue input 1 (must be selected in parameter 4.030)

1.133	Free shutdown	Unit: integer		
Relationship to parameter:	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	3	
		def.:	0	

As well as enabling the software, the parameter can be used to parameterise another input for the free shutdown. When the input is switched off, the output stages are shut down and the motor spins. The function runs regardless of software enabling.

0 = no free shutdown
1 = digital input 1
2 = digital input 2
3 = digital input 3

1	2	3	4	5	6	7	8	9	10	11	12

1.150	Rotation direction	Unit: integer		
Relationship to parameter: 1.131 4.030 4.030	Transfer status: 2	min.: 0 max.: 16 def.: 0	Own value (to be entered!)	
	Selection of direction of rotation specification 0 = dependent on target value (depending on the plus or minus sign of the target value: positive: forwards; negative: backwards) 1 = forwards only (no change in direction of rotation possible) 2 = backwards only (no change in direction of rotation possible) 3 = digital input 1 (0 V = forwards, 24 V = backwards) 4 = digital input 2 (0 V = forwards, 24 V = backwards) 5 = digital input 3 (0 V = forwards, 24 V = backwards) 8 = analogue input 1 (must be selected in parameter 4.030) 13 = virtual output (4.230)			

1.180	Acknowledge function	Unit: integer		
Relationship to parameter: 1.181 1.182	Transfer status: 2	min.: 0 max.: 7 def.: 4	Own value (to be entered!)	
	Selection of the source for error acknowledgement. Errors can only be acknowledged once the error is no longer present. Auto acknowledgement via parameter 1.181. 0 = manual acknowledgement not possible 1 = rising flank at digital input 1 2 = rising flank at digital input 2 3 = rising flank at digital input 3 5 = foil keypad (Ackn key) 6 = analogue input 1 (must be selected in parameter 4.030)			

1.181	Automatic acknowledge function	Unit: s		
Relationship to parameter: 1.180 1.182	Transfer status: 2	min.: 0 max.: 1000 def.: 0	Own value (to be entered!)	
	In addition to the acknowledge function (1.180), an automatic fault acknowledgement can be selected. 0 = no automatic acknowledgement > 0 = time for automatic resetting of error in seconds			

1	2	3	4	5	6	7	8	9	10	11	12

1.182	Number of automatic acknowledgements	Unit:		
Relationship to parameter: 1.180 1.181	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	500	
		def.:	5	
	In addition to the automatic acknowledge function (1.181), it is possible to limit the maximum number of automatic acknowledgements here. 0 = no restriction on automatic acknowledgements > 0 = maximum number of automatic acknowledgements			

INFORMATION

INFORMATION

The internal counter for automatic acknowledgements already undertaken is reset if the motor is operated for the "maximum number of acknowledgements x auto acknowledgement time" period without any errors occurring (motor current > 0.2 A).

Example of resetting the auto acknowledgement counter

max. number of acknowledgements = 8
auto acknowledgement time = 20 sec. } 8 x 20 sec. = 160 sec.

After 160 sec. of motor operation without errors, the internal counter for "auto acknowledgements" undertaken is reset to "0".

In this example, 8 "auto acknowledgements" were accepted.

If an error occurs within the 160 sec., "error 22" is triggered on the 9th acknowledgement attempt.

This error has to be acknowledged manually by switching off the mains.

5.3.2 Fixed frequency

This mode has to be selected in parameter 1.100, see also the section on selecting the operating mode.

2.050	Fixed frequency mode	Unit: integer		
Relationship to parameter: 1.100 2.051 to 2.057	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	4	
		def.:	2	
	Selection of the digital inputs used for fixed frequencies 0 = Digital In 1 (Fixed frequency 1) (2.051) 1 = Digital In 1, 2 (Fixed frequencies 1 - 3) (2.051 to 2.053) 2 = Digital In 1, 2, 3 (Fixed frequencies 1 - 7) (2.051 to 2.057)			

2.051 to 2.057	Fixed frequency	Unit: Hz		
Relationship to parameter: 1.020 1.021 1.100 1.150 2.050	Transfer status: 2	min.:	- 599	Own value (to be entered!)
		max.:	+ 599	
		def.:		
	The frequencies that are to be output at the digital inputs 1 - 3 specified in parameter 2.050 depending on the switching patterns. See chapter 5.2.1 Explanation of operating modes / fixed frequency.			

5.3.3 Analogue inputs

For analogue input 1

4.023	Ai1 dead time	Unit: %	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 100 def.: 0	Own value (to be entered!)
	Dead time as percentage of the range of the analogue inputs.		

4.024	Ai1 filter time	Unit: s	
Relationship to parameter:	Transfer status: 2	min.: 0.02 max.: 1.00 def.: 0	Own value (to be entered!)
	Filter time of analogue inputs in seconds.		

4.030	Ai1 function	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	Function of analogue inputs 1/2 0 = analogue input 1 = digital input		

4.033	Ai1 physical unit	Unit: integer	
Relationship to parameter: 4.034 4.035	Transfer status: 2	min.: 0 max.: 15 def.: 0	Own value (to be entered!)
	Selection of different physical values to be displayed. 0 = % 1 = bar 2 = mbar 3 = psi 4 = Pa 5 = m^3/h 6 = l/min 7 = ° C 8 = ° F 9 = m 10 = mm		

1	2	3	4	5	6	7	8	9	10	11	12

4.034	Ai1 physical minimum	Unit:	
Relationship to parameter: 4.033 4.035	Transfer status: 2	min.: - 10000 max.: + 10000 def.: 0	Own value (to be entered!)
	Selection of the lower limit of a physical value to be displayed.		

4.035 / 4.065	Ai1 physical maximum	Unit:	
Relationship to parameter: 4.033 4.034	Transfer status: 2	min.: - 10000 max.:+ 10000 def.: 100	Own value (to be entered!)
	Selection of the upper limit of a physical value to be displayed.		

4.037	Ai1 inverted	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	The signal of the analogue input can be inverted here. 0 = disable (example: 0 V = 0 % 10 V = 100 %) 1 = enable (example: 0 V = 100 % 10 V = 0 %)		

5.3.4 Digital inputs

4.110 to 4.112	DIx inverted	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	This parameter can be used to invert the digital input. 0 = disable 1 = enable		

1	2	3	4	5	6	7	8	9	10	11	12

5.3.5 Digital outputs

For digital outputs 1 (Dox display DO1)

4.150 / 4.170	Dox function	Unit: integer	
Relationship to parameter: 4.151 / 4.171 4.152 / 4.172	Transfer status: 2	min.: 0 max.: 51 def.: 0	Own value (to be entered!)
	Selection of the process variable to which the output should switch. 0 = Not used 1 = Intermediate circuit voltage 2 = Supply voltage 3 = Motor voltage 4 = Motor current 5 = Actual frequency value 6 = - 7 = - 8 = IGBT temperature 9 = Inner temperature 10 = Error (NO) 11 = Error inverted (NC) 13 = Digital input 1 14 = Digital input 2 15 = Digital input 3 17 = Ready for operation (mains supply on, no HW enable, motor stationary) 18 = Ready (mains supply on, HW enable set, motor stationary) 19 = Operation (mains supply on, HW enable set, motor running) 20 = Ready for operation + Ready 21 = Ready for operation + Ready + Operation 22 = Ready + Operation 23 = Motor rating 24 = Torque 25 = Fieldbus 26 = Analogue input 1 32 = Target frequency value after ramp 33 = Target frequency value 34 = Actual speed value 35 = Actual frequency value sum 36 = Torque sum 37 = Target frequency value after ramp sum 38 = Target frequency value sum 39 = Actual speed value sum 40 = Virtual output 50 = Motor current limit enabled		

4.151 / 4.171	Dox on	Unit:	
Relationship to parameter: 4.150 / 4.170	Transfer status: 2	min.: - 32767 max.: 32767 def.: 0	Own value (to be entered!)
	If the set process variable exceeds the switch-on limit, the output is set to 1.		

1	2	3	4	5	6	7	8	9	10	11	12

4.152 / 4.172	Dox off	Unit:	
Relationship to parameter: 4.150 / 4.170	Transfer status: 2	min.: - 32767 max.: 32767 def.: 0	Own value (to be entered!)
	If the set process variable exceeds the switch-off limit, the output is again set to 0.		

5.3.6 Virtual output

The virtual output can be parameterised like a relay and is available as an option with the following parameters:
1.131 Software enable / 1.150 Direction of rotation / 1.054 Ramp selection /
5.090 Parameter set change / 5.010 + 5.011 External error 1 + 2

4.230	VO function	Unit: integer	
Relationship to parameter: 1.054 1.131 1.150 4.231 4.232 5.010 / 5.011 5.090	Transfer status: 2	min.: 0 max.: 51 def.: 0	Own value (to be entered!)
	Selection of the process variable to which the output should switch. 0 = Not used 1 = Intermediate circuit voltage 2 = Supply voltage 3 = Motor voltage 4 = Motor current 5 = Actual frequency value 6 = - 7 = - 8 = IGBT temperature 9 = Inner temperature 10 = Error (NO) 11 = Error inverted (NC) 13 = Digital input 1 14 = Digital input 2 15 = Digital input 3 17 = Ready for operation (mains supply on, no HW enable, motor stationary) 18 = Ready (mains supply on, HW enable set, motor stationary) 19 = Operation (mains supply on, HW enable set, motor running) 20 = Ready for operation + Ready 21 = Ready for operation + Ready + Operation 22 = Ready + Operation 23 = Motor rating 24 = Torque 25 = Fieldbus 26 = Analogue input 1 32 = Target frequency value after ramp 33 = Target frequency value 34 = Actual speed value 35 = Actual frequency value sum 36 = Torque sum 37 = Target frequency value after ramp sum 38 = Target frequency value sum 39 = Actual speed value sum 50 = Motor current limit enabled 51 = Nominal-actual comparison (para. 6.070 – 6.071)		

1	2	3	4	5	6	7	8	9	10	11	12

4.231	VO-On	Unit:	
Relationship to parameter: 4.230	Transfer status: 2	min.: - 32767 max.: 32767 def.: 0	Own value (to be entered!)
	If the set process variable exceeds the switch-on limit, the output is set to 1.		

4.232	VO-Off	Unit:	
Relationship to parameter: 4.230	Transfer status: 2	min.: - 32767 max.: 32767 def.: 0	Own value (to be entered!)
	If the set process variable exceeds the switch-off limit, the output is again set to 0.		

4.233	VO-On delay	Unit: s	
Relationship to parameter: 4.234	Transfer status: 2	min.: 0 max.: 10000 def.: 0	Own value (to be entered!)
	Specifies the length of the switch-on delay.		

4.234	VO-Off delay	Unit:	
Relationship to parameter: 4.233	Transfer status: 2	min.: 0 max.: 10000 def.: 0	Own value (to be entered!)
	Specifies the length of the switch-off delay.		

4.235	VO inverted	Unit: integer	
Relationship to parameter: 4.230	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	This parameter can be used to invert the virtual output. 0 = disable 1 = enable		

5.3.7 External error

5.010 / 5.011	External error 1/2	Unit: integer	
Relationship to parameter: 4.110 / 4.113 4.230	Transfer status: 2	min.: 0 max.: 7 def.: 0	Own value (to be entered!)
	Selection of source via which an external error can be reported. 0 = Not used 1 = Digital input 1 2 = Digital input 2 3 = Digital input 3 5 = Virtual output (parameter 4.230) 6 = Analogue input 1 (must be selected in parameter 4.030) If there is a high signal at the selected digital input, the drive controller with error no. 23 / 24, switches external error ½. Parameters 4.110 to 4.113 Dix inverse can be used to invert the logic of the digital input.		

5.3.8 Motor current limit

The maximum permissible motor current can be set via parameter "Motor current limit fixed" (5.069) as a percentage of the rated motor current as per parameter "Motor current" (33.031).

In addition, the motor current can be limited to a parametrised maximum value after reaching a parametrised current-time zone.

The motor current limit operating over the current-time zone is monitored at application level and therefore limits with a relatively low dynamic.
This has to be taken into consideration when selecting this function.

The maximum value is determined using the “motor current limit as %” parameter (5.070).
This is stated as a percentage and relates to the nominal motor current specified in the “motor current” type plate data (33.031).

The maximum current-time zone is calculated from the product of the “motor current limit in s” parameter (5.071) and the fixed overcurrent of 50% of the required motor current limit.

As soon as this current-time zone is exceeded, the motor current is restricted to the limit value by reducing the speed. If the output current of the drive controller exceeds the motor current (parameter 33.031) multiplied by the set limit as % (parameter 5.070) for the set time (parameter 5.071), the output current of the drive controller is limited permanently to the parametrised value.

The entire function can be deactivated by setting the “motor current limit as %” parameter (5.070) to zero.

5.069	Motor current limit fixed	Unit: %		
Relationship to parameter: 33.031	Transfer status: 2	min.:	500	Own value (to be entered!)
		max.:	500	
		def.:	200	
	(see description above)			

5.070	Motor current limit as %	Unit: %		
Relationship to parameter: 5.071 33.031	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	250	
		def.:	0	
	0 = disable **(see description above)**			

5.071	Motor current limit s	Unit: s		
Relationship to parameter: 5.070 33.031	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	100	
		def.:	1	
	(see description above)			

5.3.9 Gearbox factor

5.075	Gearbox factor	Unit:	
Relationship to parameter: 33.034	Transfer status: 2	min.: 0	Own value (to be entered!)
		max.: 1000	
		def.: 1	
	A gearbox factor can be set here. The mechanical speed display can be adjusted using the gearbox factor.		

5.3.10 Blocking detection

5.080	Blocking detection	Unit: integer	
Relationship to parameter: 5.081	Transfer status: 2	min.: 0	Own value (to be entered!)
		max.: 1	
		def.: 0	
	This parameter can be used to activate blocking detection. 0 = disable 1 = enable This function only works reliably if the motor data has been entered correctly and the slip compensation has not been deactivated.		

5.081	Blocking time	Unit: s	
Relationship to parameter: 5.080	Transfer status: 2	min.: 0	Own value (to be entered!)
		max.: 50	
		def.: 2	
	Indicates the time after which a blockage is detected.		

5.3.11 Additional functions

5.082	Start-up error active	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0	Own value (to be entered!)
		max.: 1	
		def.: 1	
	Start-up error is defined as follows: Actual value does not reach 10 % of the rated motor frequency after 30 seconds (if target frequency < 10 %, the error is not generated). If the acceleration time is parametrised as > 60 seconds, half the acceleration time is used in place of the 30 seconds. 0 = Function disabled 1 = Function enabled		

5.085	F. min monitoring	Unit: s	
Relationship to parameter: 1.020	Transfer status: 2	min.: 0	Own value (to be entered!)
		max.: 10000	
		def.: 0	
	The delay for monitoring the minimum frequency can be set here. If the minimum frequency for the set time is not reached, error 28 is generated. 0s = function disabled >0s = function enabled The time must be long enough for the motor to be able to reliably start.		

Continues on next page

Continuation

5.086	F. max monitoring	Unit: s		
Relationship to parameter: 1.021	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	10000	
		def.:	0	
	The delay for monitoring the maximum frequency can be set here. If the maximum frequency for the set time is exceeded, error 28 is generated. 0s = function disabled >0s = function enabled			

5.090	Parameter set change	Unit: integer		
Relationship to parameter: 4.030	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	12	
		def.:	0	
	Selection of the active data set. 0 = Not used 1 = Data record 1 active 2 = Data record 2 active 3 = Digital input 1 4 = Digital input 2 5 = Digital input 3 6 = Digital input 4 7 = INVEOR soft PLC 8 = Virtual output (parameter 4.230) 9 = Analogue input 1 (must be selected in parameter 4.030) 10 = Analogue input 2 (must be selected in parameter 4.060) 11 = Foil keypad key I for data set 1, key II for data set 2 12 = Foil keypad key I for data set 1, key II for data set 2 storing			
	The 2nd data record is only displayed in the PC software if this parameter is <> 0. The values of the data set currently selected are always displayed in the MMI.			

5.3.12 MMI parameter

5.200	Turning MMI* display	Unit: integer		
Relationship to parameter:	Transfer status: 2	min.:	0	Own value (to be entered!)
		max.:	1	
		def.:	0	
	Only for MMI in cover. Here the user can define whether the screen / key assignment is turned 180°. 0 = Function disabled 1 = Function enabled			

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Continuation

5.201	Save MMI* display	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 1	Own value (to be entered!)
		max.: 5	
		def.: 1	
	The status screen displayed in the MMI * can be selected here. 1 = status 01: Target / actual frequency / motor current 2 = status 02: Speed / motor current / process value 1 3 = status 03: Speed / motor current / process value 2 4 = status 04: Speed / PID target value / PID actual value 5 = status 05: Customer PLC output variable 1 / 2 / 3		

5.202	MMI* password	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0	Own value (to be entered!)
		max.: 9999	
		def.: 0	
	A password can be allocated here, which is requested when expert mode is selected in the MMI * or the app is queried. 0: Password request deactivated The password can be individually set in both data sets.		

5.210	MMI* option language	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0	Own value (to be entered!)
		max.: 1	
		def.: 0	
	This parameter can be used to select the language which the MMI * option displays. 0 = local language (factory setting is German) 1 = English This setting does not affect the language choice for the MMI handheld controller.		

*** Man-machine interface**

5.3.13 Fieldbus

6.010	Ethernet fieldbus	Unit: integer	
Relationship to parameter:	Transfer status: 0	min.: 0 max.: 2 def.: 0	Own value (to be entered!)

This parameter can be used to select the Ethernet fieldbus cycle:
0 = Profinet
1 = Sercos III
2 = EtherCat
3 = Ethernet/IP

IMPORTANT INFORMATION

May result in destruction of the device.

The INVEOR **must** be de-energised once after the parameter has been changed!
Once the voltage is activated, the selected fieldbus cycle is loaded, this process may take one to two minutes.
The INVEOR **must not be switched off** during this time!
Once successfully loaded, the INVEOR restarts!

6.040	CAN active	Unit: integer	
Relationship to parameter:	Transfer status: 0	min.: 0 max.: 6 def.: 0	Own value (to be entered!)

The parameter can be used to switch the bus interface on the powerstack PCB from Modbus RTU / service interface to Can Open
0=CAN inactive
1=CAN active
2 = J1939 DC/AC Accessory Inverter 1
3 = J1939 DC/AC Accessory Inverter 2
4 = J1939 DC/AC Accessory Inverter 3
5 = J1939 DC/AC Accessory Inverter 4
6 = J1939 DC/AC Accessory Inverter 5

Important information:
When CAN active is selected, the PC software can no longer be accessed via the MMI / PC interface on the power stack PCB. The MMI / PC interface on the IO module must be used.

Communication with the INVERTERpc PC software if the CAN parameter is active.
During the first 5 seconds after the supply voltage is switched on, the INVERTERpc PC software can still access the MMI / PC interface.

6.060	Fieldbus address	Unit: integer	
Relationship to parameter:	Transfer status: 0	min.: 0 max.: 127 def.: 0	Own value (to be entered!)

For this address to be used, the address coding switches in the device must be set to 00.
A change to the fieldbus address is only undertaken once INVEOR is restarted

1	2	3	4	5	6	7	8	9	10	11	12

6.061	Fieldbus baud rate		Unit: integer	
Relationship to parameter:	Transfer status: 2		min.: 1 0 max.: 8 def.: 2	Own value (to be entered!)
	Only for CanOpen:	0 = 1 Mbit, 2 = 500 kBit, 3 = 250 kBit, 4 = 125 kBit, 6 = 50 kBit, 7 = 20 kBit, 8 = 10 kBit		

6.062	Bus time-out	Unit in s	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 100 def.: 5	Own value (to be entered!)
	Bus timeout, if no fieldbus telegram is received after the set time has expired, the INVEOR shuts down with the "Bus timeout" error. The function is only activated once a telegram has been successfully received. 0 = Monitoring disabled		

IMPORTANT INFORMATION

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

6.067	IP-address	Unit:	
Relationship to parameter:	Transfer status: 0	min.: 0.0.0.0 max.: 255.255.255.255 def.: 192.168.0.31	Own value (to be entered!)
	The IP address of the Ethernet-based fieldbus can be entered into this parameter if the default address set at the factory is to be changed. If the IP address is set automatically by the fieldbus master, the parameter can be set to 0.0.0.0 or another value.		

5.3.14 MQTT

6.150	MQTT active	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	The MQTT protocol can be activated via the parameter. The MQTT protocol is available via the Profinet and Ethernet IP fieldbus options. 0 = MQTT inactive 1 = MQTT active		

6.151	MQTT Broker adr.	Unit:	
Relationship to parameter:	Transfer status: 0	min.: 0.0.0.0 max.: 255.255.255.255 def.: 192.168.0.2	Own value (to be entered!)
	The IP address of the broker can be entered in this parameter.		

6.152	MQTT Broker Port	Unit: integer	
Relationship to parameter:	Transfer status: 0	min.: 0 max.: 99999 def.: 1883	Own value (to be entered!)
	The port number of the broker can be entered in this parameter.		

6.153	MQTT Sample Rate	Unit: s	
Relationship to parameter:	Transfer status: 2	min.: 0,1 max.: 60 def.: 0,1	Own value (to be entered!)
	This parameter can be used to set the cycle time with which the data is transmitted via MQTT.		

6.160 / 6.161 / 6.162 / 6.163 / 6.164	MQTT Out x	Unit: int	
Relationship to parameter: **6.150 / 6.151 / 6.152 / 6.153**	Transfer status: 2	min.: 0 max.: 69 def.: 6 / 38 / 3 / 8 / 15	Own value (to be entered!)

Two topicals are sent via MQTT.

Topic 1: fixed data package

Topic 2: individually configurable data package

Topic	Message ID	Data 1	Data 2	Data 3	Data 4	Data 5
fix1	A or B Data package with the same time stamp are labelled with the same message ID	Time on grid	Motor current	Shaft speed	Torque	Power stage starts
dyn1	A or B Data package with the same time stamp are labelled with the same message ID	MQTT Out 1 Default: Mains voltage	MQTT Out 2 Default: Operating time	MQTT Out 3 Default: IGBT temperature	MQTT Out 4 Default: Indor temperature	MQTT Out 5 Default: Digital inputs (bit-coded)

Selection of the process variable that should be sent via the topic “dyn1”.

1 = Motor voltage
2 = Motor current
3 = IGBT temperature
4 = Intermediate circuit voltage
5 = Target frequency value
6 = Supply voltage
8 = Inner temperature
11 = Error word 1
13 = Error word 2
15 = Digital inputs bit-coded

Continues on next page

1	2	3	4	5	6	7	8	9	10	11	12

Continuation

6.160 / 6.161 / 6.162 / 6.163 / 6.164	MQTT Out x	Unit: int	
Relationship to parameter: **6.150 / 6.151 / 6.152 / 6.153**	Transfer status: 2	min.: 0 max.: 69 def.: 6 / 38 / 3 / 8 / 15	Own value (to be entered!)
	Selection of the process variable that should be sent via the topic “dyn1”. 16 = Analogue input 1 17 = Analogue input 2 18 = Target frequency value after ramp 20 = PID actual value 21 = PID target value 22 = Analogue output 1 23 = DC-link power 24 = Analogue input 3 25 = Analogue input 4 26 = Analogue output 2 30 = Mechanical speed 31 = Torque 32 = Motor rating 33 = Customised PLC output variable 1 (digital 32-bit) 35 = Customised PLC output variable 2 36 = Customised PLC output variable 3 37 = Customised PLC output variable 4 38 = Operating time 39 = Power on Zyklen 40 = Electrical energy 41 = Status of the outputs 47 = Current position 61 = Vibration X- axis RMS 62 = Vibration Y- axis RMS 63 = Vibration Z- axis RMS		

5.3.15 Bluetooth

6.200	Bluetooth name	Unit: Text	
Relationship to parameter: 4.150 / 4.170 4.230	Transfer status: 2	min.: 3 characters max.: 10 characters def.: INV-xxx-xx	Own value (to be entered!)
	Bluetooth module (fitted permanently ex factory) The PC software (Tools Bluetooth device name) can be used to specify an individual name for the permanent Bluetooth module.		
	Bluetooth stick If using the Bluetooth stick, the name “INV stick” is fixed.		

Continues on next page

*** Man-machine interface**

Continuation

6.201	Bluetooth password	Unit integer		
Relationship to parameter:	Transfer status: 0	min.:	0	Own value (to be entered!)
		max.:	999999	
		def.:	000000	
	The Bluetooth standard 4.2 low energy is used for communication. A 6-digit password is absolutely essential for this. **Bluetooth module** (fitted permanently ex factory) A password can be allocated here, which is requested when establishing a connection between the KOSTAL INVERTERapp and the permanently fitted Bluetooth module. If a password with fewer than 6 digits is entered, leading zeros are added. 0 = 000000 1 = 000001			
	Bluetooth stick If using the Bluetooth stick, the password is fixed as 000000.			

6.202	Bluetoothtransmission power	Unit integer		
Relationship to parameter:	Transfer status: 0	min.:	0	Own value (to be entered!)
		max.:	7	
		def.:	0	
	Bluetooth module (fitted permanently ex factory) The transmission power of the Bluetooth module permanently fitted ex factory can be reduced here. 0: 4 dB 1: 0 dB 2: -4 dB 3: -8 dB 4: -12 dB 5: -16 dB 6: -20 dB 7: -30 dB			
	Bluetooth stick If using the Bluetooth stick, the maximum transmission power is fixed.			

5.3.16 Torque control / limit

7.010	Torque target value source	Unit: integer	
Relationship to parameter:	Transfer status: 2	min.: 0	Own value (to be entered!)
		max.: 7	
		def.: 0	
	Determines the source from which the torque limit / target value is to be read. 0 = disable, 1 = internal potentiometer 2 = analogue input 1 3 = analogue input 2 4 = Modbus 5 = fixed target value (7.040) 6 = fieldbus (Modbus: 16 bit "1.056" / 32 bit "2.113" / other fieldbuses via "Process data In x" parameter e.g. 6.110) 7 = INVEOR soft PLC		

1	2	3	4	5	6	7	8	9	10	11	12

7.030	Min. torque limit	Unit: Nm	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1000 def.: 0	Own value (to be entered!)
	This parameter can be used to specify the minimum target value. If a smaller target value is to be specified, work with the min. target value.		

7.031	Max. torque limit	Unit: Nm	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1000 def.: 100	Own value (to be entered!)
	This parameter can be used to specify the maximum target value. If a larger target value is to be specified, work with the max. target value. If a target value is specified via an analogue input, the analogue signal's adjustment range is split between the min. and max. limit.		

7.040	Fixed target value for torque	Unit: Nm	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1000 def.: 50	Own value (to be entered!)
	A fixed target value can be specified here. To do this, selection "5 = fixed target value" must be made for parameter 7.010.		

7.050	Torque delay	Unit: s	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 1000 def.: 0	Own value (to be entered!)
	If 0 s is entered, the torque is immediately restricted to the set value. If > 0 s is entered, the torque is only reduced once the set torque is exceeded and a torque time period has lapsed. The torque time period results from the set time and 150 % of the set torque limit. **Example:** Torque limit = 10 Nm Torque delay = 30 sec. **Scenario 1** Current torque = 12.5 Nm After 60 sec., the INVEOR restricts the torque to 10 Nm **Scenario 2** Current torque = 15 Nm After 30 sec., the INVEOR restricts the torque to 10 Nm **Scenario 3** Current torque = 20 Nm After 15 sec., the INVEOR restricts the torque to 10 Nm		

5.3.17 Multiple-pump control parameter

(see also chapter 5.2.4 Multiple-pump control)

IMPORTANT INFORMATION

All devices connected in the grid must be assigned a clear fieldbus address.

- Address 1 = master
- Address 2 = auxiliary master or slave (selection under parameter 8.016)
- Address 3 - 6 = all other slaves

Fieldbus baud rate (parameter 6.061)

- Setting 3 = 250 kBaud

8.010	Multiple-pump mode	Unit integer	
Relationship to parameter:	Transfer status: 2	min.: 0 max.: 2 def.: 0	Own value (to be entered!)
	This parameter can be used to activate or deactivate the auxiliary master. 0 = no auxiliary master, no emergency mode slaves 1 = with auxiliary master, with emergency mode slaves 2 = without auxiliary master with emergency operation slaves (emergency frequency = 2.051 fixed frequency 1) 3 = with auxiliary master with emergency operation slaves (emergency frequency = 2.051 fixed frequency 1)		

8.020	Number of pumps	Unit integer	
Relationship to parameter:	Transfer status: 2	min.: 1 max.: 6 def.: 1 hrs	Own value (to be entered!)
	The total number of devices located in the network must be stated under this parameter		

8.040	Start frequency of auxiliary pump	Unit: Hz	
Relationship to parameter:	Transfer status: 2	min.: 5 Hz max.: 599 Hz def.: 40 Hz	Own value (to be entered!)
	This parameter specifies the frequency as of which the next pump is to be activated if the active pumps are not able to control the process. Furthermore, once this frequency has been exceeded, the pump settling time (parameter 8.042) also has to lapse for the next pump to be activated. It is always the pump with the lowest operating hours which is activated.		

8.041	Stop frequency of auxiliary pump	Unit: Hz	
Relationship to parameter:	Transfer status: 2	min.: 5 Hz max.: 599 Hz def.: 25 Hz	Own value (to be entered!)
	This parameter specifies the frequency as of which a pump is to be deactivated if too many pumps have been activated to control the process. Furthermore, once the frequency falls below the stated frequency, the pump settling time (parameter 8.013) also has to lapse for a pump to be deactivated. It is always the pump with the lowest operating hours which is activated.		

8.042	Settling time	Unit: s	
Relationship to parameter:	Transfer status: 2	min.: 0.1 s max.: 9999999 s def.: 5 s	Own value (to be entered!)
	To be able to optimise the transition when activating or deactivating pumps, this parameter can be used to set parameters for a time delay. This time is started when the frequency exceeds the start frequency or falls below the stop frequency. A pump is only activated or deactivated after this time.		

8.050	Pump change time	Unit: h	
Relationship to parameter:	Transfer status: 2	min.: 0.1 hrs max.: 2400 hrs def.: 5 hrs	Own value (to be entered!)
	To ensure even wear on all pumps, a time can be set here in hours. Once this time has lapsed, the next pump is automatically enabled as the main pump. A switch is always made to the pump with the lowest operating hours.		

8.060	Pump operating hours correction	Unit: h	
Relationship to parameter:	Transfer status: 2	min.: -9999999 hrs max.: 9999999 hrs def.: 0 hrs	Own value (to be entered!)
	The inverter's operating hours may differ from the pump's operating hours. This is the case when replacing the pump or the inverter. To adjust the actual hours of the pump, the difference between the converter operating hours and the pump operating hours can be specified in parameter 8.060. Example: • Converter fails after 68000 hours ⇨ Pump operating hours = 68000 h ⇨ Operating hours of defective converter = 68000 h • Operating hours of new converter before replacement = 0 h • Value to be entered in parameter 8.060 = Pump operating hours - New converter operating hours ⇨ Parameter 8.060 = 68000 h – 0 = 68000 h		

1	2	3	4	5	6	7	8	9	10	11	12

5.3.18 Positioning

(see also chapter 0 Positioning)

Target position values that are approached or held in this mode can be transferred via bus (Profinet, Ethercat, Modbus, CAN, SPF, etc.) or via analogue input.

The start-up is as quick as possible while adhering to the set limits:

1. Max. speed as per target frequency value
2. Max. acceleration as per run up time 1 (parameter 1.051)
3. Max. delay as per deceleration time 1 (parameter 1.050)
4. Max. jolt as per S-curve (parameter 1.060)

9.010	Position mode	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	**U/f**	**ASM**	**PMSM**	**SynRM**
				x	x
	0 = Profile position mode 1 = Interpolated position mode In the profile position mode, the target position values can be specified in any time intervals. After the transfer, the motor moves as quickly as possible (while keeping within the limits) to the target value, stops there and holds the target position. The braking process is initiated in good time before the target value is reached so that overshooting does not occur. In interpolated position mode, the target position values must be specified in fixed time intervals. It also moves as quickly as possible (while keeping within the limits) to the target value but does not stop there. Instead, it continues evenly to the following target value. In this way, position trajectories can be run.				

9.015	Position target value	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 4			
		def.: 3			
	Drive type	**U/f**	**ASM**	**PMSM**	**SynRM**
				x	x
	0 = Potentiometer 1 = Analogue In 1 2 = Analogue In 2 3 = Fieldbus 4 = Customer PLC 5 = analogue input 3				

1	2	3	4	5	6	7	8	9	10	11	12

9.020	STW position	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	**U/f**	**ASM**	**PMSM**	**SynRM**
				x	x
	Selecting the maximum speed during positioning. 0 = max.speed corresponds to maximum frequency parameter (parameter 1.021) 1 = max. speed is specified via the target frequency value				

9.050	Pos. value unit	Unit: integer			
Relationship to parameter:	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 10			
		def.: 0			
	Drive type	**U/f**	**ASM**	**PMSM**	**SynRM**
				x	x
	Currently not implemented.				

9.051	Pos.value offset	Unit: integer			
Relationship to parameter:	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 1000000			
		def.: 0			
	Drive type	**U/f**	**ASM**	**PMSM**	**SynRM**
				x	x
	If necessary, the current position can be adjusted with an offset.				

9.052	Pos. value factor	Unit: -			
Relationship to parameter:	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 1000000			
		def.: 1			
	Drive type	**U/f**	**ASM**	**PMSM**	**SynRM**
				x	x
	If necessary, the current position can be adjusted with a factor.				

9.100	Pos. control boost	Unit: 1/s			
Relationship to parameter:	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 10000			
		def.: 10			
	Drive type	**U/f**	**ASM**	**PMSM**	**SynRM**
				x	x
	P amplification of the position controller				

5.4 Performance parameters

5.4.1 Drive type

33.010	Drive type	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0		Own value (to be entered!)	
		max.: 299			
		def.: 20			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	This can be used to select the motor type and type of control. 10 = V/f 20 = ASM open-loop (motor identification needed) 40 = ASM efficiency mode* (motor identification needed) 100 = PMSM standard mode (motor identification needed) 110 = PMSM efficiency mode* (motor identification needed) 120 = PMSM Isotropy (see 5.2.3 Drive type [from firmware 1.50] 210 = SynRM efficiency mode* (motor identification needed) * Loss-optimised operation with maximum load capacity, also suitable for special motors				

5.4.2 Motor data

33.020	R optimisation	Unit: %			
Relationship to parameter:	Transfer status: 1	min: 0		Own value (to be entered!)	
		max: 200			
		def.: 100			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	If necessary, this parameter can be used to optimise the start-up behaviour.				

33.031	Motor current	Unit: A			
Relationship to parameter: **5.070**	Transfer status: 1	min.: 0		Own value (to be entered!)	
		max.: 150			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	This is used to set the nominal motor current $I_{M,N}$ for either the star or delta connection.				

1	2	3	4	5	6	7	8	9	10	11	12

33.032	Motor rating	Unit: W			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 55000			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	A performance value $P_{M,N}$ has to be set here that corresponds to the nominal motor rating. If no power value is specified, it can be calculated from the motor torque $M_{M,N}$ and the motor speed $n_{M,N}$ as follows: $P_{M,N} = M_{M,N} * n_{M,N} / 9.55$				

33.034	Motor speed	Unit: rpm			
Relationship to parameter: **34.120** **5.075**	Transfer status: 1	min: 0			Own value (to be entered!)
		max: 10000			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	The value from the motor's type plate data has to be entered here for the nominal motor rotation speed $n_{M,N}$.				

33.035	Motor frequency	Unit: Hz			
Relationship to parameter:	Transfer status: 1	min.: 10			Own value (to be entered!)
		max.: 599			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	This is where the nominal motor frequency $f_{M,N}$ is set.				

33.050	Stator resistance	Unit: Ohm			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 100			
		def.: 0.001			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	The automatically calculated value (of motor identification) for stator resistance can be adjusted here.				

33.105	Leakage inductance	Unit: H			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	The automatically calculated value (of motor identification) for leakage inductance can be adjusted here.				

33.110	Motor voltage	Unit: V			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1500			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	This is used to set the nominal motor voltage $U_{M,N}$ for either the star or delta connection.				

33.111	Motor cos phi	Unit:			
Relationship to parameter:	Transfer status: 1	min.: 0.5			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		x
	The value from the motor's type plate data has to be entered here for the power factor cos phi.				

33.112	Boost v/f	Unit: V			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 200			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x			
	The torque can be increased here at low frequencies. This parameter determines the output voltage at 0 Hz for increasing the available torque at low speeds. **Note:** If the breakaway torque isn't sufficient, we would recommend setting parameter 33.010 drive type to 20: ASM open-loop.				

33.201	Nominal flux	Unit: mVs			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 10000			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
				x	
	The automatically determined value (of motor identification) for the nominal flux can be adjusted here.				

1	2	3	4	5	6	7	8	9	10	11	12

33.248	d inductance	Unit: H			
Relationship to parameter:	Transfer status: 1	min.: 0		Own value (to be entered!)	
		max.: 1			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
				x	
	The automatically calculated value (of motor identification) for series inductance can be adjusted here.				

33.249	q inductance	Unit: H			
Relationship to parameter:	Transfer status: 1	min.: 0		Own value (to be entered!)	
		max.: 1			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
				x	
	The automatically calculated value (of motor identification) for shunt inductance can be adjusted here.				

5.4.3 I^2t

IMPORTANT INFORMATION

The I^2T function also takes into account the heating of the motor below the I^2T limit. As a result, the I^2T counter counts up to 86 % during continuous operation at the set I^2T limit (e.g. nominal point), as the motor can already reach its nominal temperature here.

33.015	I^2T function	Unit:			
Relationship to parameter: 33.031 33.012 – 33.014	Transfer status: 2	min.: 0		Own value (to be entered!)	
		max.: 1			
		def.: 1			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	The I^2T protective function can be activated here. 0 = I^2T function disabled 1 = I^2T function enabled				

1	2	3	4	5	6	7	8	9	10	11	12

33.012 to 33.014	I^2T limit 1 to 3	Unit: %			
Relationship to parameter: 33.031 33.015	Transfer status: 2	min.: 10		Own value (to be entered!)	
		max.: 500			
		def.: 100			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x

The percentage current threshold (in relation to motor current 33.031) at the start of integration can be set here for various frequency ranges.

Parameter	Frequency range as % of rated frequency	Default value as % of rated current
33.012	0 – 50%	100 %
33.013	50 – 100%	100 %
33.014	> 100 %	100 %

We recommend using winding protection contacts in heat-sensitive applications!

33.011	I^2T time	Unit: s			
Relationship to parameter:	Transfer status: 2	min.: 0		Own value (to be entered!)	
		max.: 1200			
		def.: 30			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	Time for calculating the I^2t time period.				

33.016	Motor phases monitoring	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0		Own value (to be entered!)	
		max.: 1			
		def.: 1			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	The "Motor connection interrupted" error monitoring (error -45) can be disabled with this parameter. 0 = Monitoring disabled 1 = Monitoring enabled				

5.4.4 Switching frequency

The internal switching frequency can be changed in order to control the power element.
A high setting reduces noise in the motor but results in increased EMC emissions and losses in the drive controller.

34.030	Switching frequency	Unit: Hz			
Relationship to parameter: 33.010	Transfer status: 2	min.: 0 max.: 6 def.: 1			Own value (to be entered!)
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	Selection of the switching frequency for the drive controller: 0 = 2 kHz 1 = 4 kHz 2 = 6 kHz 3 = 8 kHz 4 = 12 kHz 5 = 16 kHz 6 = auto* * The drive starts with the maximum switching frequency set in parameter 34.032. Depending on the interior or IGBT temperature, the switching frequency is reduced step by step, up to a maximum of the parametrised 34.031 minimum switching frequency. As soon as the temperature drops again, the switching frequency is gradually increased again.				

34.031	Auto sw.f. min	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0 max.: 5 def.: 0			Own value (to be entered!)
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	0 = 2 kHz 1 = 4 kHz 2 = 6 kHz 3 = 8 kHz 4 = 12 kHz 5 = 16 kHz				

34.032	Auto sw.f. max	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0 max.: 5 def.: 5			Own value (to be entered!)
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	0 = 2 kHz 1 = 4 kHz 2 = 6 kHz 3 = 8 kHz 4 = 12 kHz 5 = 16 kHz				

5.4.5 Controller data

34.015	Ramp corr. active	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 1			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	0 = the ramp correction can be disabled to increase dynamism. With slow ramps, this may lead to an unintended dead time. 1 = the ramp generator takes account of the actual frequency. An impermissibly large deviation between target and actual value is suppressed.				

34.020	Flying restart	Unit:			
Relationship to parameter: 34.021	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 1			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	The flying restart can be used to switch the drive controller to a rotating motor. 0 = disable 1 = enable				

34.021	Catch time	Unit: ms			
Relationship to parameter:	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 10000			
		def.: 100			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		x
	For asynchronous motors: The catch time can be optimised here, if the automatically determined results (of the motor identification) are insufficient.				

34.060 - 61	Current regulator for trimmer for d and q direction	Unit: %			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1000 %			
		def.: 100 %			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	Here, the control boost of the current controller can be optimised in longitudinal (d) and transverse (q) direction, if the automatically determined results (of the motor identification) should not be sufficient. **Only for asynchronous motors:** For high speed applications (maximum frequency (parameter 1.020): Switching frequency (parameter 34.030) in the range 1:10 or higher), the current controllers for trimmers should be increased.				

1	2	3	4	5	6	7	8	9	10	11	12

34.090	Speed controller K_p	Unit: mNm / rad / s			
Relationship to parameter:	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 10000			
		def.: 150			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	The control boost of the speed controller can be optimised here, if the automatically determined results (of the motor identification) are insufficient.				

34.091	Speed controller T_n	Unit: s			
Relationship to parameter:	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 10			
		def.: 4			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	For asynchronous motors: The reset time of the speed controller can be optimised here, if the automatically determined results (of the motor identification) are insufficient. For synchronous motors: The reset time of the speed controller must be optimised here, the recommendation being a value between 0.1 s and 0.5 s.				

34.092	Actual speed filter	Unit: s			
Relationship to parameter: **34.090**	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 100			
		def.: 0.005			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	The time constant of the speed filter can be set here. For an optimal setting, the speed filter should be 2 to 4 times faster than the speed controller's cut-off frequency, which results from speed controller Kp / rotor inertia * number of pole pairs.				

34.110	Slip trimmer	Unit:			
Relationship to parameter: 5.080 33.034	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 1.5			
		def.: 1			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	This parameter can be used to optimise or deactivate slippage compensation. 0 = disable (performance as on the grid) 1 = compensation for slippage. Example: 4 pole asynchronous motor at 1410 rpm, target frequency 50 Hz Motor idling 0 = approx. 1500 rpm 1 = 1500 rpm Motor at nominal point 0 = 1410 rpm 1 = 1500 rpm 50 Hz is always displayed as the actual frequency. Deactivating slip compensation may result in blocking detection no longer working reliably.				

1	2	3	4	5	6	7	8	9	10	11	12

34.122	max. flux reduction	Unit: %			
Relationship to parameter: 34.090 34.091	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 75			
		def.: 25			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	Determines the maximum by which the flux may be reduced depending on load. Is stated relative to the nominal flux calculated from type plate data. Only for drive type 40: ASM efficiency. This parameter influences the speed controller settings determined during self-commissioning. If the parameter is changed after commissioning, the speed controller may have to be adjusted manually. The following applies: the further the flux may be reduced, the slower the speed controller should be.				

34.130	Voltage utilization	Unit:			
Relationship to parameter:	Transfer status: 2	min.: 0 %			Own value (to be entered!)
		max.: 300 %			
		def.: 97.4 %			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	This parameter can be used to adjust voltage output. It tells the field weakening logic which part of the supply voltage is to be used for torque generation. The remaining part enables the compensation of control deviations.				

34.132	Overmodulation	Unit:			
Relationship to parameter:	Transfer status: 2	min.: 0 %			Own value (to be entered!)
		max.: 10 %			
		def.: 4 %			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	This parameter can be used to increase the voltage output (motor voltage) in the nominal point / field weakening range using overmodulation in order to reduce the motor current (motor heating). Detail Explanation: The percentage value indicates the increase in the voltage fundamental, whereby voltage harmonics arise. In the 0 %-4.9 % range, the corners of the possible voltage hexagon are increasingly driven into, above 5 %-10 % the hexagon corners are increasingly lingered on until block operation is reached at 10 %. The voltage harmonics increase progressively over the gain in fundamental wave, so that the last percentage points in particular are no longer worthwhile. As a rough guide, the optimum efficiency for asynchronous motors is in the 4-5 % range and for synchronous motors in the 7-8 % range, with the latter overmodulation values being able to cause audible noises, particularly in the case of synchronous servomotors.				

34.138	Holding current time	Unit: s			
Relationship to parameter: 33.010	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 3600			
		def.: 2			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	This is the time during which the drive is held at continuous current after the brake ramp has been completed.				

34.193	Start freq.	Unit: %			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 100			
		def.: 0.5			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	Target frequency as % of the nominal frequency from which the control starts. If a lower target frequency is specified during operation, the motor is stopped.				
	INFORMATION For drive type 10: V/f, values < 4 % are ignored. For drive type 20: ASM open-loop, values < 1 % are ignored.				

34.226	Starting current	Unit: %			
Relationship to parameter: 34.227	Transfer status: 2	min.: 5			Own value (to be entered!)
		max.: 1000			
		def.: 25			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	Only during start-up procedure: controlled. Here the current which was stamped in the motor before starting the control can be adjusted. Value as % of nominal motor current.				

34.228 – 34.230	Start-up procedure	Unit: integer			
Relationship to parameter:	Transfer status: 1	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	0 = regulated, the drive controller is run with regulation over the entire speed range. 1 = controlled, after the stamping phase the rotation field is increased by the control with start ramp 34.229 up to start-up frequency 34.230, then switched to the controller.				

34.233	Brake current	Unit: %			
Relationship to parameter:	Transfer status: 1	min.: - 400			Own value (to be entered!)
		max.: + 400			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x	x	x
	Faster braking even without chopper due to loss generation by means of reactive current in the motor. The percentage value refers to the motor current (rated current). Positive values use the standard current injection, which produces the fastest and smoothest possible braking processes during usual operation. Negative values may produce better braking properties in applications with particularly high speed (field weakening), which may have to be assessed by the user.				

1	2	3	4	5	6	7	8	9	10	11	12

34.246	Injection RANGE	Unit: s			
Relationship to parameter:	Transfer status: 1	min.: 0		Own value (to be entered!)	
		max.: 1			
		def.: 0.02			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x

34.249	Field weakening filter	Unit: s			
Relationship to parameter:	Transfer status: 1	min.: 0		Own value (to be entered!)	
		max.: 100			
		def.: 0.01			
	Drive type	**U/f**	**ASM**	**PMSM**	**SynRM**
			x	x	
	Filter time constant for applying the field weakening current. Larger values smoothen the field weakening and also the overmodulation, but can lead to delays in fast speed transients				

36.020	Deact grid monitoring	Unit: integer			
Relationship to parameter:	Transfer status: 2	min.: 0		Own value (to be entered!)	
		max.: 1			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
		x	x	x	x
	Grid monitoring can be deactivated here. 0: deactivated 1: activated				

1	2	3	4	5	6	7	8	9	10	11	12

5.4.6 Quadratic characteristic curve

34.120	Quadratic characteristic curve	Unit: integer			
Relationship to parameter: 34.121	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 1			
		def.: 0			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	A flux reduction logic can be activated here, which is suitable for loads with a quadratic torque-speed characteristic. 0 = disable 1 = enable				

34.121	Flux adjustment	Unit: %			
Relationship to parameter: 34.120	Transfer status: 2	min.: 0			Own value (to be entered!)
		max.: 100			
		def.: 50			
	Drive type	**V/f**	**ASM**	**PMSM**	**SynRM**
			x		
	The percentage by which the flux for small speeds is to be reduced can be set here. An overvoltage shutdown can occur if there are any major changes in operation.				

5.5 Activation of brake module

DANGER!

Risk of death due to moving mechanical parts!

Death or serious injury!

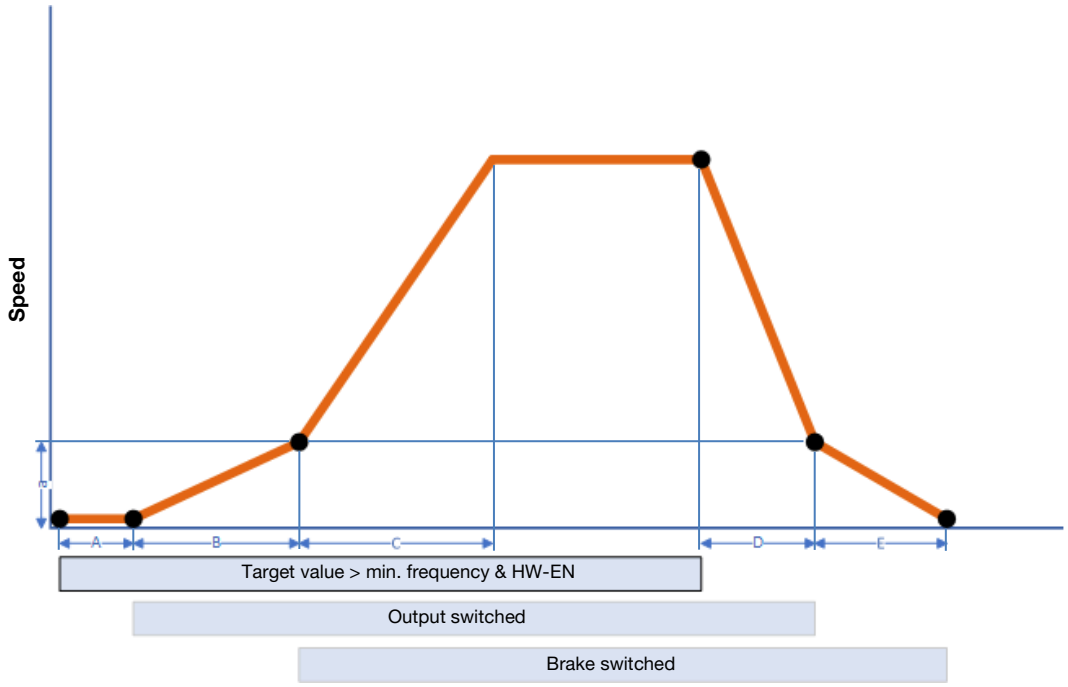
- If the brake control is to function smoothly, the various delay times from the following parameter tables need to be correctly determined and entered.
- Even slight deviations in the parameter details will mean that the brake is activated incorrectly.
- Incorrect settings in the closing and opening times may result in the brake activating incorrectly!
- If the closing time is set to be too short, the controller block is set and the drive has no torque before the brake is fully closed.
- Once the parameters have been entered, always check that the brake is being activated correctly!

IMPORTANT INFORMATION

- Do not set the lower speed threshold for closing the brake too high to prevent disproportionate wear on the brake!
- The brake module is **not** designed and approved for safety-critical applications.
- Following errors involving short circuits or ground leaks, brake modules are no longer operable. Replace the brake module with a new one.
- If operating with direct current, a brake module is **not** permitted.
- The output voltage is not smoothed, the brakes need to be designed for this.

1	2	3	4	5	6	7	8	9	10	11	12

Activation of brake module



A: Magnetisation
B: Br. opening time
C: Run up time
D: Deceleration time
E: Br. closing time
a: Brake frequency

During automatic operation of the brake module, automatic mode passes through several steps.

These are detailed below:

Initial position:

To start, the brake module is in its initial position (output not switched).
When the software enable is set, if the target value is greater than the set "Br. min. frequency", the converter's output stage is activated.

If the target value is less than the "Br. min. frequency", the brake module remains in its initial position.

Magnetisation (A):

To start, the motor is pre-magnetised for a time (A) calculated by the system in order to build up torque.

Br. opening time (B):

Every electromechanical brake has a switching delay; from the time when the output is switched to when the brake is fully opened (br. opening time). During this time, the output frequency is restricted to the "Br. min. frequency".

Operation:

After the "Br. opening time", the device goes into normal operation, with the specified target value and ramp time (C).

Motor braking:

If the target value falls below "Br. min. frequency" or if the software enable is withdrawn, the motor decelerates the system in the set deceleration time (D) to "Br. min. frequency".

If the set ramp time cannot be observed, the mechanical brake helps to decelerate the system to a stop.

Br. closing time (E):

For the duration of the br. closing time (E), the motor continues to be energised to maintain torque.
Then the output stage is deactivated.

If a device error is detected or the hardware enable is withdrawn in "Brake control auto" mode, the mechanical brake closes immediately.

1	2	3	4	5	6	7	8	9	10	11	12

System-specific settings

For load applications performed vertically with a controlled motor operation (crane or lifting applications), a value of 10 (vertical drive/lifting application) should be set in parameter 37.020.
During the start-up phase, this setting activates a servo control during which the holding torque is always built up first in a positive target value direction. To ensure a jolt-free start, this direction must always be against gravity. In V/f mode, deactivate the servo control using the value 20.

During horizontal movement (conveyor belt or linear conveyance of load) a value of 20 should be set in parameter 37.020. In such cases, servo control is always undertaken in a direction of motion dependent on the current target value. A holding torque is also built up.

With rotating machines, "0" should be entered for the br. closing and br. opening time. No holding torque is then built up and the machine can start and stop freely.

37.010	Manual brake activation	Unit: integer		
Relationship to parameter:	Transfer status: 1	min.: 0 max.: 30 def.: 0	Own value (to be entered!)	
	Selection of an input for manually activating the brake module 0 = disable 1 = digital input 1 2 = digital input 2 3 = digital input 3 4 = digital input 4 5 = analogue input 1 6 = analogue input 2 7 = fieldbus (via bit 8 in process variable 0x9c Dig Outs) 8 = customer PLC 9 = virtual output 20 = digital input 1 + HW enable / STO 21 = digital input 2 + HW enable / STO 22 = digital input 3 + HW enable / STO 23 = digital input 4 + HW enable / STO 24 = analogue input 1 + HW enable / STO 25 = analogue input 2 + HW enable / STO 26 = fieldbus (via bit 8 in process variable 0x9c Dig Outs) + HW enable / STO 27 = customer PLC + HW enable / STO 28 = virtual output + HW enable / STO			

37.020	Auto brake activation	Unit: integer		
Relationship to parameter:	Transfer status: 1	min.: 0 max.: 20 def.: 0	Own value (to be entered!)	
	Activation of automatic activation of brake module based on parameters 37.030 – 37.060 0 = disable 10 = vertical drive/lifting application 20 = horizontal drive			

37.030	Br. min. frequency	Unit: Hz		
Relationship to parameter:	Transfer status: 1	min.: 0 max.: 499 def.: 2	Own value (to be entered!)	
	Servo control variable for the controller when starting and stopping as well as speed at which the brake opens and closes.			

1	2	3	4	5	6	7	8	9	10	11	12

37.040	Br. opening time		Unit: s	
Relationship to parameter:	Transfer status: 1	min.:	0	Own value (to be entered!)
		max.:	10	
		def.:	0.2	
	Opening time of brake. (see data sheet from brake manufacturer)			

37.050	Br. closing time		Unit: s	
Relationship to parameter:	Transfer status: 1	min.:	0	Own value (to be entered!)
		max.:	10	
		def.:	0.2	
	Closing time of brake. (see data sheet from brake manufacturer)			

37.060	Brake activation invert		Unit: integer	
Relationship to parameter:	Transfer status: 1	min.:	0	Own value (to be entered!)
		max.:	1	
		def.:	0	
	DANGER! **Changing the parameter switches the brake module's output!** **This may result in venting of the brake!**			
	Inversion of activation signal for brake module 0 = disable 1 = enable			

6. Error detection and troubleshooting

This chapter contains the following:

- a list of the LED flash codes for error recognition
- a description of error recognition using PC tools
- a list of errors and system errors
- notes on error detection with the MMI

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted.

If damaged parts or components need replacing, only ever replace with original parts.

Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down.

6.1 List of the LED flash codes for error recognition

When an error occurs, the LEDs on the drive controller display a flashing code that allows the errors to be diagnosed.

The following table contains an overview:

Red LED	Green LED	State
☀	☀	Bootloader active (both LEDs briefly flash twice. The process is repeated after a short pause)
○	☀	Ready for operation (activate En_HW for operation)
○	●	Operation / ready
☀	●	Warning
●	○	Error
●	●	Identification of motor data
○	☀	Initialisation
☀	☀	Firmware update
☀	●	Bus error operation
☀	☀	Bus error ready for operation

Tab. 11: LED flash codes

Key			
○	LED off	●	LED on
☀	LED flashing	☀	LED flashing quickly

6.2 List of errors and system errors

The driver controller shuts down if an error occurs. Consult the flash code table / PC tool for the corresponding error numbers.

IMPORTANT INFORMATION

Error messages can only be acknowledged once the error has been remedied.

Error messages can be acknowledged as follows:

- digital input (can be programmed)
- using MMI (handheld controller)
- auto acknowledge function (parameter 1.181)
- switch device off and on again

using fieldbus (CANOpen, Modbus RTU)

Errors must always be rectified before acknowledgement, otherwise the drive controller may be damaged.

The following section contains a list of possible error messages. Please contact the KOSTAL service department if you encounter errors that are not listed here.

No.	Error name	Description of error	Possible causes/remedy
1	Undervoltage 24 V application	Supply voltage for the application is less than 15 V	24 V supply overload
2	Overvoltage 24 V application	Supply voltage for the application is greater than 31 V	Internal 24 V supply is not OK or external supply is not OK
9	Warning: Multi-pump error	A fault has occurred in the multi-pump system: One participant has a fault The CANopen connection is disturbed/interrupted	Check that all participants are available and the status LED is green. Check CANopen connection
10	Parameter distributor	The internal distribution of parameters during initialisation failed	Parameter set is incomplete
11	Time-out power	The power stack does not respond	Operation with 24 V without mains feed-in
13	Cable break at analogue in1 (2–10 V)	Current or voltage is less than the lower limit of analogue input 1 (monitoring for this error is activated automatically by setting parameter 4.021 to 20 %).	Cable break, faulty external sensor
15	Blocking detection	The drive shaft of the motor is stalled. 5.080	Remove the blockage
17	Start-up error	Motor not starting up or starting up incorrectly. 5.082	Check motor connections/check motor and controller parameters; if necessary, disable error (5.082).
19	Firmware update error	A firmware update could not be completed.	Connection aborted during a FW update. Repeat the FW update The INVEOR is supplied externally with 24 V. Note: During a firmware update, 24 V must not be connected externally.
21	Bus timeout	Bus communication aborted, no telegrams were received during the bus timeout time (6.062).	Check external wiring. Check fieldbus communication. Increase bus timeout time.
22	Acknowledgement error	The number of maximum automatic acknowledgements (1.182) was exceeded	Check error history and remedy error
23	External error 1	The parameterised fault input is active. 5.010	Correct the external error
24	External error 2	The parameterised fault input is active. 5.011	Correct the external error
25	Motor detection	Motor identification error	Check INVEOR/motor and PC / MMI / INVEOR connections / restart motor identification
27	Bus add. invalid	Can Open fieldbus address invalid	The node ID must be > 0 and < 127
28	Limit frequency exceeded / not met	The parameterised minimum / maximum frequency has not been met / has been exceeded.	The parameterised time 5.085 or 5.086 is too short / Motor blocked / Brake not opened / Motor overloaded

No.	Error name	Description of error	Possible causes/remedy
32	Trip IGBT **	Protection of the IGBT module against overcurrent has been triggered	Short circuit in the motor or motor feed line / controller settings
33	Overvoltage of intermediate circuit **	The maximum intermediate circuit voltage has been exceeded	Feedback by motor in generator mode / supply voltage too high / incorrect setting of speed controller / brake resistor not connected or defective / ramp times too short / operation on transformer / operation with mains choke
34	Undervoltage of intermediate circuit	The minimum intermediate circuit voltage has not been reached	Supply voltage too low, grid connection defective / check wiring
35	Excess motor temperature	Motor PTC has been triggered	Overload of the motor (e.g. high torque at low motor speed) / ambient temperature too high
36	Power failure	The supply voltage has dropped briefly	Grid fluctuation / grid voltage interrupted
38	Excess IGBT module temperature	Excess IGBT module temperature	Insufficient cooling, low motor speed and high torque, switching frequency too high
39	Overcurrent **	Maximum output current of drive controller exceeded	Motor stalled / check motor connection / incorrect speed controller setting / check motor parameters / ramp times too short / brake not open
40	Excess frequency converter temperature	Inner temperature too high	Insufficient cooling / low motor speed and high torque / switching frequency too high permanent overload / reduce ambient temperature / check fan
42	I^2t motor protection shut-off	The internal I^2t motor protection (can be parametrised) has been triggered	Permanent overload
43	Ground leak **	Ground leak during a motor phase	Insulation fault
45	Motor connection disrupted	No motor current in spite of control through frequency converter	No motor connected or not completely connected. Check phases or motor connections and connect correctly when necessary. *
46	Motor parameters	Plausibility check for motor parameters failed	Parameter set not OK
47	Drive controller parameters	Plausibility check for drive controller parameters failed	Parameter set not OK, motor type 33.001 and control method 34.010 not plausible.
48	Type plate data	No motor data entered	Please enter the motor data according to the type plate
49	Power class restriction	Max. overload of the drive controller exceeded for more than 60 sec.	Check application / reduce load / use larger drive controller.

1	2	3	4	5	6	7	8	9	10	11	12

No.	Error name	Description of error	Possible causes/remedy
53	Motor tipped	Only for synchronous motors, field orientation lost	Load too high. Optimise controller parameters.
56	Grid overvoltage	The mains input voltage is above 528V AC	Check mains supply
57	Warning: Switching frequency reduction active	The switching frequency was reduced due to the ambient temperature	cooling not sufficient / low speed and high torque/ permanent overload / reduce ambient temperature / check fan
58	IGBT module overheating	The IGBT module overheating at high starting current and high clocking frequency	Reduce clocking frequency Reduce load in the lower speed range

Tab. 12: Error detection

* In exceptional cases, the error may be displayed erroneously when idling (very low motor current) synchronous motors.
Set parameter 33.016 accordingly when the phases or motor connections are connected correctly.

** Should the error occur again, depending on frequency, it can only be acknowledged after the following times:

1 -3	acknowledgements permitted =	1	s waiting time
4 -5	acknowledgements permitted =	5	s waiting time
> 5	acknowledgements permitted =	30	s waiting time

The number of acknowledgements is deleted after 120 s without any errors!

7. Disassembly and disposal

This chapter contains the following:

- a description of how to disassemble the drive controller
- information on correct disposal

7.1 Drive controller disassembly

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

De-energise the drive controller, wait until the motor has come to a standstill, determine that it is voltage-free and secure it against being restarted.

Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down.

1. Open drive controller cover.
2. Release cables at terminals.
3. Remove all cables.
4. Remove connection screws for drive controller / adapter plate.
5. Remove drive controller.

7.2 Information on correct disposal

Dispose of drive controller, packaging and replaced parts in accordance with the regulations of the country in which the drive controller has been installed.
The drive controller may not be disposed of with household waste.

8. Technical data

8.1 General data

8.1.1 General technical data for 400V devices

Sizes A - B

	Size	A					B			
Electrical data	Recommended motor rating [1] [kW]	0.55	0.75	1.1	1.5	2.2 LD [7]	2.2	3.0	4.0	5.5 LD [7]
	Supply voltage	3 x 200 V AC -10 %...480 V AC +10 % 280 V DC -10 %...680 V DC +10 % [2]								
	Grid frequency	50/60Hz ± 6%								
	Network configurations	TN / TT								
	Line current [A]	1.4	1.9	2.6	3.3	3.9	4.6	6.2	7.9	9.3
	Rated current output eff. [IN at 4 kHz]	1.7	2.3	3.1	4.0	4.8	5.6	7.5	9.5	11.0
	Min. brake resistance [Ω]	100					50			
	Overload for 60 sec. in %	150				110	150			110
	Overload for 3 sec. in %	200				150	200			150
	Switching frequency	Auto regardless of temperature, 2 kHz, 4 kHz, 6 kHz, 8 kHz, 12 kHz, 16 kHz, (factory setting 4 kHz)								
	Output frequency	0 Hz - 599 Hz								
	Rated apparent output power [kVA]	1.06	1.43	1.93	2.49	2.99	3.49	4.68	5.92	6.86
	Mains cycles of operation	Unlimited [3]								
	DIN EN 61800-5 touch current	< 3.5 mA [4]								
Functions	Protective function	Overvoltage and undervoltage, I^2t restriction, short-circuit, ground leak, motor and drive controller temperature, stall prevention, blocking detection, PID dry run, functional safety (SIL 2/PIe)								
	Software functions	Torque control [6], multiple pumps, process control (PID controller), fixed frequencies, data record changeover, flying restart, motor current limit								
	Soft PLC	IEC61131-3, FBD, ST, AWL								
Mechanical data	Housing	Two-part aluminium die-cast casing								
	Dimensions [L x W x H] mm	233 x 153 x 120					270 x 189 x 140			
	Weight including adapter plate	3.9 kg					5.0 kg			
	Protection class [IPxy]	IP 65								
	Cooling	Passive cooling								
Environmental conditions	Climate class	3K3 (50 °C)				3K3 (40 °C)	3K3 (50 °C)			3K3 (40 °C)
	Ambient temperature	- 40 °C (non-condensing) to + 50 °C (without derating)				to + 40 °C	- 40 °C (non-condensing) to + 50 °C (without derating)			to + 40 °C
	Storage temperature	- 40 °C…+ 85 °C								
	Altitude of the installation location	up to 1000 m above sea level/over 1000 m with reduced performance (1% per 100 m) / above 2000 m see chapter 8.2.2								
	Relative air humidity	≤ 96 %, condensation not permitted								
	Vibration resistance (DIN EN 60721-3-3) [5]	3M7 (3g)								
	EMC (DIN-EN-61800-3)	C2								
	Energy efficiency class (EN 61800-9-2)	IE2								
	Certificates and conformity	RoHS 2011/65/EU				CE		c UL us LISTED		

Technical data for INVEOR MP Modular 400 V devices
(subject to technical changes)

[1] Recommended motor rating (4-pole asynchronous IE3 motor) is specified based on the 400 V AC supply voltage.

[2] In compliance with the overvoltage category.

[3] < 3 s may result in power failure/intermediate circuit undervoltage errors.

[4] With 1LA7 asynchronous motor, motor-mounted.

[5] Installation- and application-related resonance frequencies may cause damage to devices

[6] Only for synchronous and reluctance motors

[7] Low-duty devices with reduced output currents

1	2	3	4	5	6	7	8	9	10	11	12

Sizes C - D

	Size	C			D				
Electrical data	Recommended motor rating [1] [kW]	5.5	7.5	11 LD [7]	11	15	18.5	22	30 LD [7]
	Supply voltage	3 x 200 V AC -10 %...480 V AC +10 % 280 V DC -10 %...680 V DC +10 % [2]							
	Grid frequency	50/60Hz ± 6%							
	Network configurations	TN / TT							
	Line current [A]	10.8	13.8	18.3	23.2	28.2	33.2	38.2	49.8
	Rated current output eff. [IN at 4 kHz]	13	16.5	22	28	34	40	46	60
	Min. brake resistance [Ω]	50			30				
	Overload for 60 sec. in %	150		110	150				110
	Overload for 3 sec. in %	200		150	200				150
	Switching frequency	Auto regardless of temperature, 2 kHz, 4 kHz, 6 kHz, 8 kHz, 12 kHz, 16 kHz, (factory setting 4 kHz)							
	Output frequency	0 Hz - 599 Hz							
	Rated apparent output power [kVA]	8.11	10.29	13.72	17.46	21.2	24.94	28.68	37.41
	Mains cycles of operation / restart	Unlimited [3]			> 2 min.				
	DIN EN 61800-5 touch current	< 3.5 mA [4]							
Functions	Protective function	Overvoltage and undervoltage, I^2t restriction, short-circuit, ground leak, motor and drive controller temperature, stall prevention, blocking detection, PID dry run, functional safety (SIL 2/PIe)							
	Software functions	Torque control [6], multiple pumps, process control (PID controller), fixed frequencies, data record changeover, flying restart, motor current limit							
	Soft PLC	IEC61131-3, FBD, ST, AWL							
Mechanical data	Housing	Two-part aluminium die-cast casing							
	Dimensions [L x W x H] mm	307 x 223 x 181			414 x 294 x 232				
	Weight including adapter plate [kg]	8.7 kg			21.0 kg				
	Protection class [IPxy]	IP 65			IP55				
	Cooling	Passive cooling			Active cooling				
Environmental conditions	Climate class (DIN EN 60721-3-3)	3K3 (50 °C)		3K3 (40 °C)	3K3 (50 °C)				3K3 (40 °C)
	Ambient temperature	- 40 °C to + 50 °C > 50 °C (with derating)		up to + 40 °C	- 40 °C to + 50 °C > 50 °C (with derating)				up to + 40 °C
	Storage temperature	- 40 °C…+ 85 °C							
	Altitude of the installation location	up to 1000 m above sea level/over 1000 m with reduced performance (1% per 100 m) / above 2000 m see chapter 8.2.2							
	Relative air humidity	≤ 96 %, condensation not permitted							
	Vibration resistance (DIN EN 60721-3-3) [5]	3M7 (3g)							
	EMC (DIN-EN-61800-3)	C2							
	Energy efficiency class (EN 61800-9-2)	IE2							
	Certificates and conformity	RoHS 2011/65/EU			CE			cULus LISTED	

Technical data for INVEOR MP Modular 400 V devices
(subject to technical changes)

[1] Recommended motor rating (4-pole asynchronous IE3 motor) is specified based on the 400 V AC supply voltage.

[2] In compliance with the overvoltage category.

[3] < 3 s may result in power failure/intermediate circuit undervoltage errors.

[4] With 1LA7 asynchronous motor, motor-mounted.

[5] Installation- and application-related resonance frequencies may cause damage to devices

[6] Only for synchronous and reluctance motors

[7] Low-duty devices with reduced output currents

1	2	3	4	5	6	7	8	9	10	11	12

8.1.2 Specification of interfaces

Designation	Function
Digital inputs 1 – 3	- Switching level low < 2 V / high > 18 V - Imax (at 24 V) = 3 mA - Rin = 8.6 kOhm
Analogue input 1	- 0 – 10 V - 10-bit resolution - Tolerance +/- 2 % - - Rin = 10 kOhm
Digital output 1	- Short-circuit proof - Imax = 20 mA
Power supply 24 V	- Auxiliary voltage U = 24 V DC - SELV - Short-circuit proof - Imax = 100 mA
Power supply 10 V	- Auxiliary voltage U = 10 V DC - Short-circuit proof - Imax = 30 mA

Tab. 13: Specification of interfaces

1	2	3	4	5	6	7	8	9	10	11	12

8.1.3 Table of power loss

INVEOR MP Modular Variant	Supply voltage [V]	Nominal current [A]	Measurement (90; 100)	Measurement (50; 100)	Measurement (10; 100)	Measurement (90; 50)	Measurement (50; 50)	Measurement (10; 50)	Measurement (50; 25)	Measurement (10; 25)	Standby losses	IE class
			Absolute power loss [W] [1) 2)]									
			Relative losses [%] [1) 2) 3)]									
Size A 0.55 kW	400	1.7	24	24	27	22	20	25	24	25	5	IE2
			2.3	2.2	2.5	2	1.9	2.4	2.2	2.3		
Size A 0.75 kW	400	2.3	29	28	32	23	21	28	25	27	5	IE2
			2	1.9	2.2	1.6	1.5	2	1.7	1.9		
Size A 1.1 kW	400	3.1	35	30	38	27	26	31	26	28	5	IE2
			1.8	1.6	2	1.4	1.3	1.6	1.4	1.4		
Size A 1.5 kW	400	4.0	45	39	46	31	27	36	25	31	5	IE2
			1.8	1.6	1.8	1.3	1.1	1.4	1	1.2		
Size A 2.2 kW LD	400	4.8	56	51	54	39	36	40	35	33	5	IE2
			1.9	1.7	1.8	1.3	1.2	1.3	1.2	1.1		
Size B 2.2 kW	400	5.6	61	60	65	46	38	48	37	42	7	IE2
			1.7	1.7	1.9	1.3	1.1	1.4	1	1.2		
Size B 3.0 kW	400	7.5	83	62	80	54	38	58	28	51	7	IE2
			1.8	1.3	1.7	1.2	0.8	1.3	0.6	1.1		
Size B 4.0 kW	400	9.5	107	80	98	66	51	70	31	58	7	IE2
			1.8	1.4	1.7	1.1	0.9	1.2	0.5	1		
Size B 5.5 kW LD	400	11.0	137	117	122	71	67	70	50	56	7	IE2
			2	1.7	1.8	1	1	1	0.7	0.8		
Size C 5.5 kW	400	13.0	149	114	125	69	52	76	44	70	7	IE2
			1.8	1.4	1.5	0.9	0.6	0.9	0.5	0.9		
Size C 7.5 kW	400	16.5	203	157	166	98	75	95	58	78	7	IE2
			2	1.5	1.6	0.9	0.7	0.9	0.6	0.8		
Size C 11.0 kW LD	400	22.0	323	226	244	151	123	133	80	99	7	IE2
			2.4	1.6	1.8	1.1	0.9	1	0.6	0.7		
Size D 11.0 kW	400	28.0	249	222	245	148	133	140	101	109	18	IE2
			1.4	1.3	1.4	0.8	0.8	0.8	0.6	0.6		
Size D 15.0 kW	400	34.0	314	279	298	181	163	173	122	134	18	IE2
			1.5	1.3	1.4	0.9	0.8	0.8	0.6	0.6		
Size D 18.5 kW	400	40.0	381	333	347	211	189	202	140	152	18	IE2
			1.5	1.3	1.4	0.8	0.8	0.8	0.6	0.6		
Size D 22.0 kW	400	46.0	485	398	392	247	189	276	197	194	18	IE2
			1.7	1.4	1.4	0.9	0.7	1	0.7	0.7		
Size D 30.0 kW LD	400	60.0	710	579	581	360	284	317	125	243	18	IE2
			1.9	1.5	1.6	1	0.8	0.8	0.3	0.6		

1) Loss values at 4 kHz switching frequency
2) Loss values include 10% mark-up as per guideline
3) Relative losses in relation to the device's rated apparent output power

8.2 Derating of output power

Drive controllers of the INVEOR series have two integrated PTC resistors as standard which monitor both the heat sink temperature and the inner temperature. As soon as a permissible IGBT temperature of 95°C or a permissible inner temperature of 85°C is exceeded, the drive controller shuts down.

INVEOR MP Modular type drive controllers are designed for an overload of 150 % for 60 sec. and 200 % for 3 sec. (every 10 min.).

Reductions in the ability to handle overload and/or its duration should be taken into account in the following circumstances:

- A clocking frequency permanently set too high >4 kHz (load-dependent).
- A permanently increased heat sink temperature, caused by a blocked air flow or a thermal blockage (dirty cooling ribs).
- Depending on the type of assembly, permanently excessive ambient temperature.

The respective max. output values can be determined from the following characteristic curves.

8.2.1 Derating due to increased ambient temperature

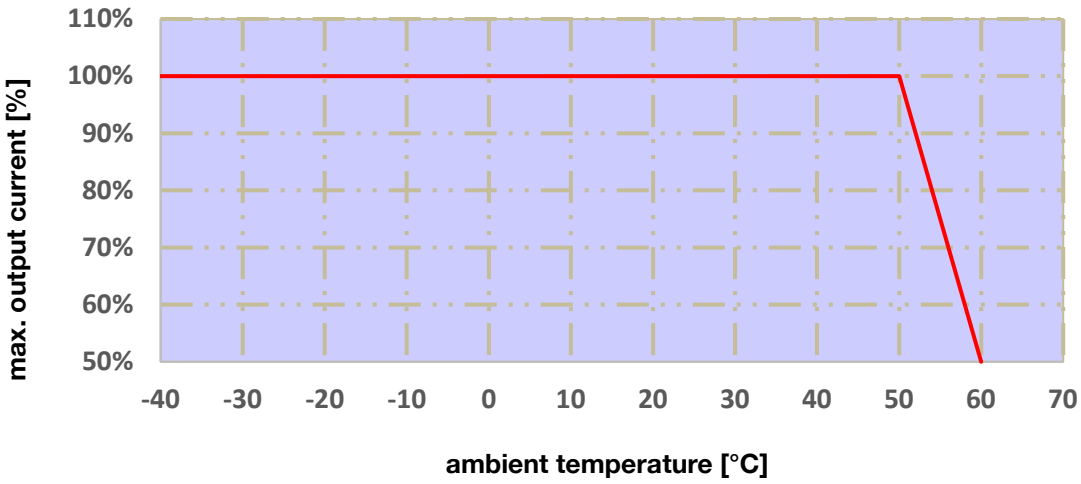


Fig. 53: Derating for motor-mounted drive controller

1	2	3	4	5	6	7	8	9	10	11	12

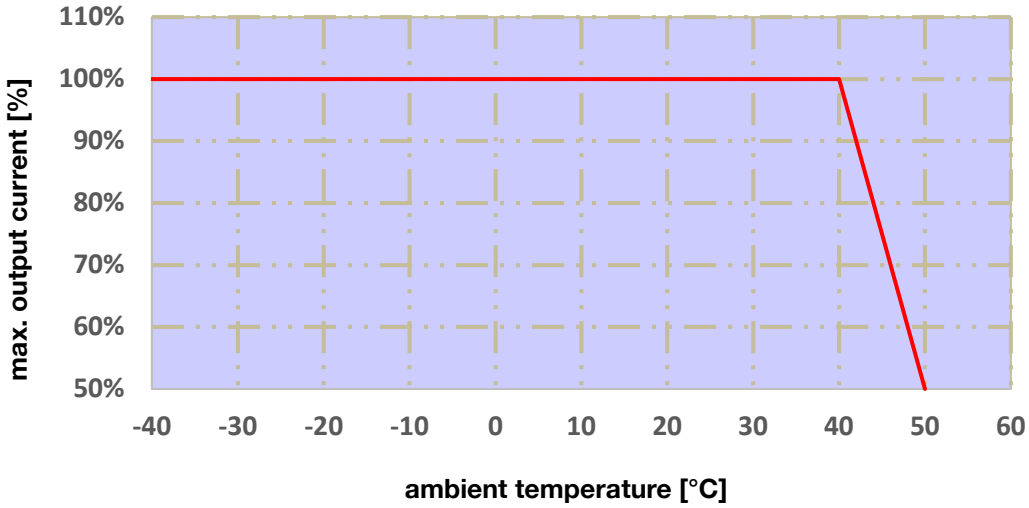


Fig. 54: Derating for wall-mounted drive controller

8.2.2 Derating due to installation altitude

The following applies to all INVEOR drive controllers:

- No reduction in performance is needed in S1 mode up to 1000m above sea level.
- A reduction in performance of 1% every 100 m is needed from 1000m ≤ 2000m. Overvoltage category 3 is observed!
- Overvoltage category 2 should be observed from 2000 m ≤ 4000 m because of the lower air pressure!

In order to observe the overvoltage category:

- use external overvoltage protection in the INVEOR's mains cable.
- reduce the input voltage.

Please contact the KOSTAL Service department.

The respective max. output values can be determined from the following characteristic curves.

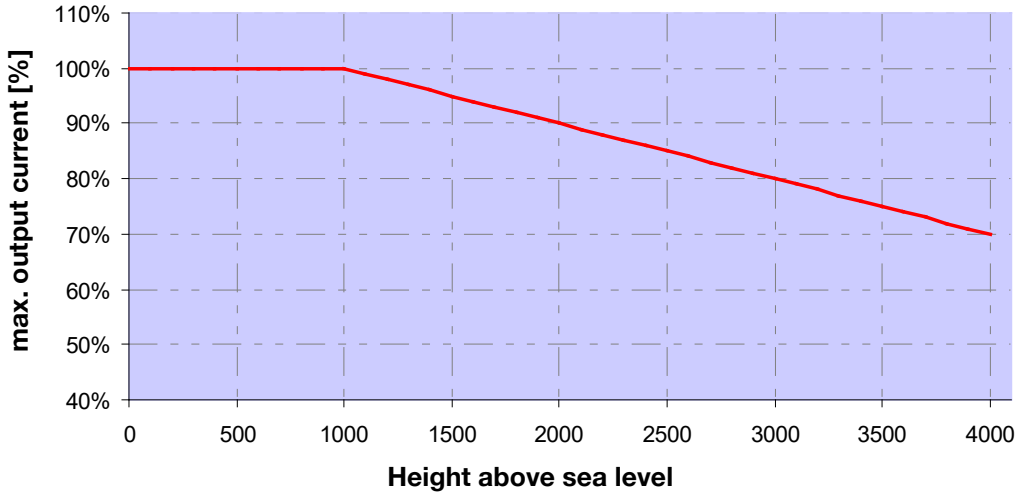


Fig. 55: Derating of maximum output current as a result of installation altitude

1	2	3	4	5	6	7	8	9	10	11	12

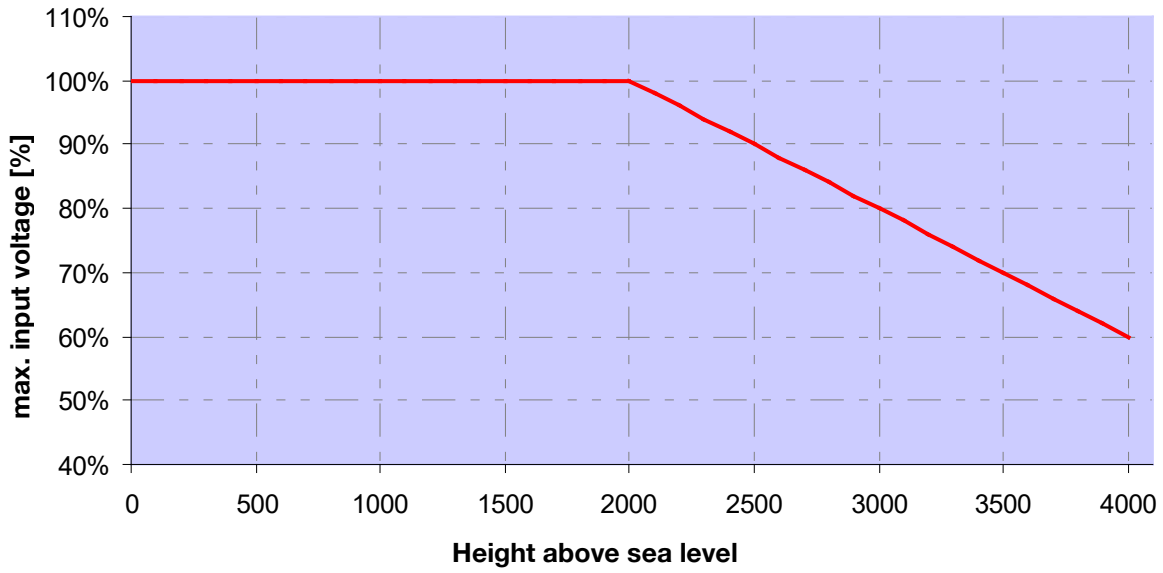


Fig. 56: Derating of maximum input voltage as a result of installation altitude

8.2.3 Derating due to switching frequency

The following diagram shows the output current, depending on switching frequency. To limit the thermal losses in the drive controller, the output current must be reduced.

Note: The switching frequency is not reduced automatically!

The max. output values can be determined from the following characteristic curve.

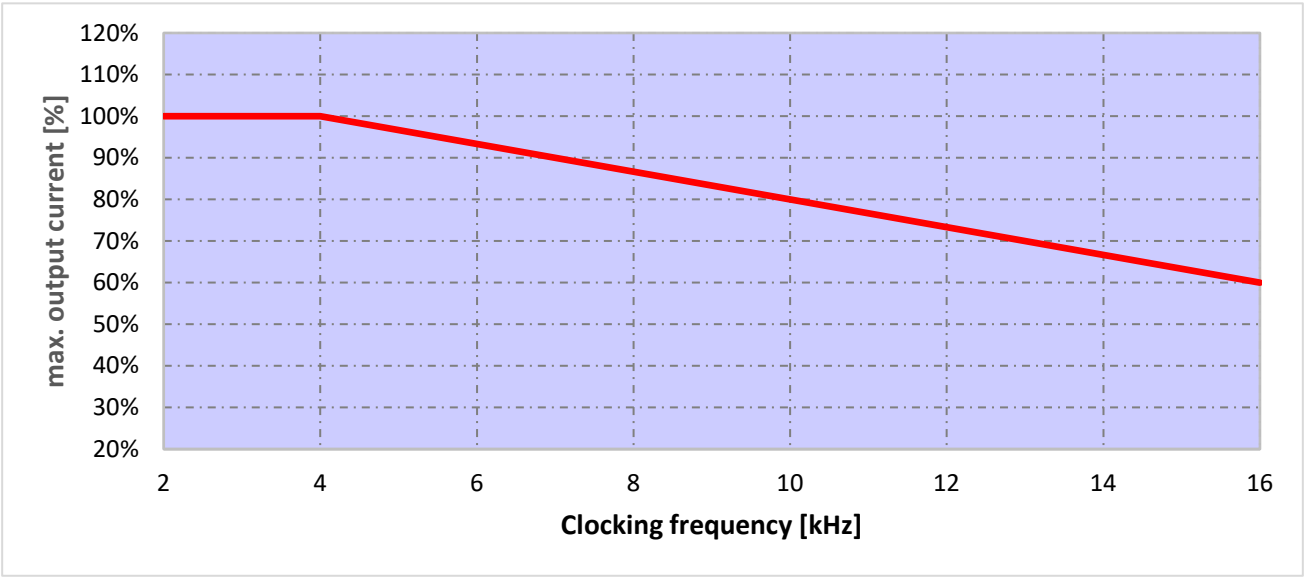


Fig. 57: Derating of maximum output current as a result of switching frequency

9. Optional accessories

This chapter contains brief descriptions of the following optional accessories

- Adapter plates
- MMI handheld controller including connection cable RJ9 on M12 plug
- Brake resistors

9.1 Adapter plates

9.1.1 Motor adapter plates

A standard motor adapter plate (with an integrated terminal board for size A up to C) is available for each INVEOR size. Download the 3D files (.stp) for INVEOR and adapter plates from
https://www.kostal-drives-technology.com/download

INVEOR size	A	B	C	D
Power [kW]	**0.55 to 2.2**	**2.2 to 5.5**	**5.5 - 11**	**11 - 30**
Designation	ADP MA MOT 0000 A00 000 1	ADP MB MOT 0000 A00 000 1	ADP MC MOT 0000 A00 000 1	ADP MD MOT 0000 A00 000 1
Part no.	10506789	10026184	10025632	10098202

The customer needs to drill the four holes for mounting the standard adapter plate on the motor. Below are technical drawings showing the possible locations of the holes for each of the respective sizes.

INFORMATION

The following applies to size D drive controllers:

An additional support is not necessarily needed in industrial use.

In the event of more stringent vibration requirements, it may be necessary for an additional support to be provided on the B side of the motor.

For help with project planning, please contact the KOSTAL Sales department.

INFORMATION

The system integrator is responsible for whether the connection between the motor and adapter plate satisfies the mechanical requirements of the application.

Because the motor does not form part of the scope of supply of the drive controller, the system integrator must ensure the following when assembling the drive controller on the motor.

- Actual dimensions of the attachment interface
- Blind hole depth, diameter and thread type of attachment points

IMPORTANT INFORMATION

KOSTAL Industrie Elektrik GmbH & Co KG assumes no liability for the connection between the motor and INVEOR**!**

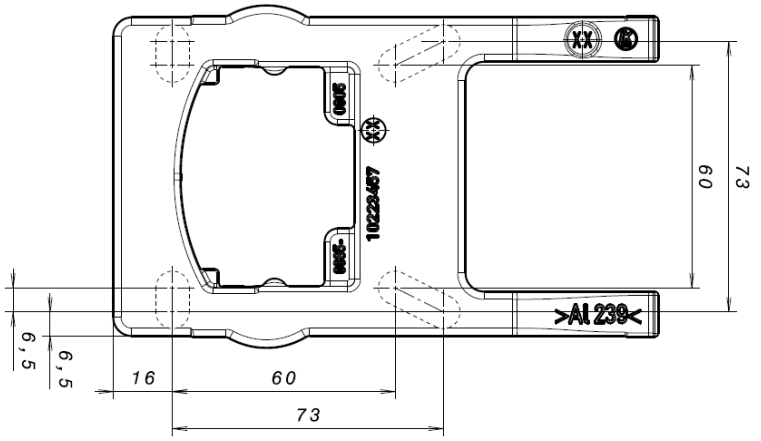


Fig. 58: Hole pattern for size A standard adapter plate

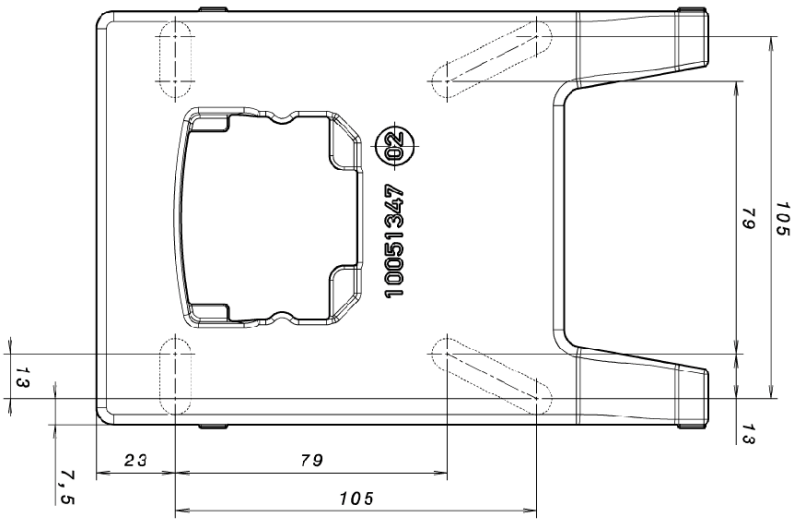


Fig. 59: Hole pattern for size B standard adapter plate

When using cylindrical head screws (cf. DIN 912 / DIN 6912) or flat head screws (cf. DIN EN ISO 7380), the hole pattern must be drilled on the INVEOR mounting frame in compliance with the applicable drawing.
The drill-hole centres should be on the respective centre lines of the slots illustrated.

If the mounting frame is to be attached to a connection box that has no square hole pattern, then the drawing's diagonal centre lines are decisive.

If the mounting holes are outside the positions indicated, countersunk screws must be used to avoid fouling the attachment of the INVEOR MP Modular.

If the existing flat seals are in a good condition, they should be reused.

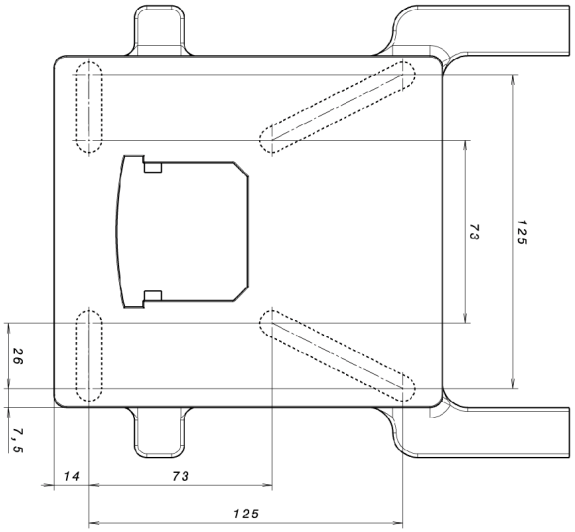


Fig. 60: Hole pattern for size C standard adapter plate

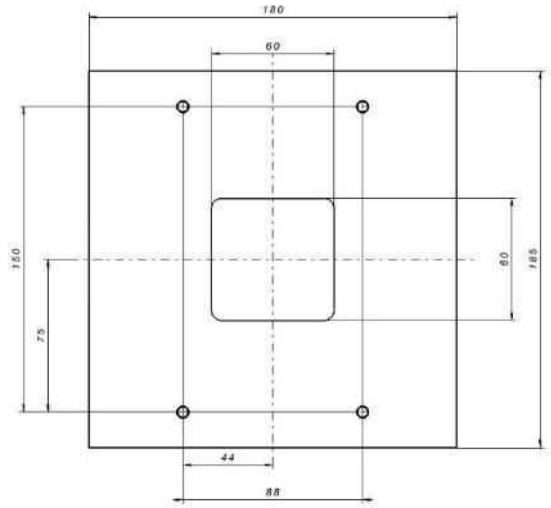


Fig. 61: Hole pattern for size D standard adapter plate

When using cylindrical head screws (cf. DIN 912 / DIN 6912) or flat head screws (cf. DIN EN ISO 7380), the hole pattern must be drilled on the INVEOR mounting frame in compliance with the applicable drawing.
The drill-hole centres should be on the respective centre lines of the slots illustrated.

If the mounting frame is to be attached to a connection box that has no square hole pattern, then the drawing's diagonal centre lines are decisive.

If the mounting holes are outside the positions indicated, countersunk screws must be used to avoid fouling the attachment of the INVEOR MP Modular.

If the existing flat seals are in a good condition, they should be reused.

9.1.2 Motor adapter plates (specific)

In addition to the standard motor adapter plates (with integrated terminal boards for sizes A to C), there are also specific versions available for various motor suppliers (on request).

INFORMATION

The system integrator is responsible for whether the connection between the motor and adapter plate satisfies the mechanical requirements of the application.

Because the motor does not form part of the scope of supply of the drive controller, the system integrator must ensure the following when assembling the drive controller on the motor.

- Actual dimensions of the attachment interface
- Blind hole depth, diameter and thread type of attachment points

9.1.3 Wall adapter plates (standard)

A standard wall adapter plate (with an integrated terminal board for sizes A to C) is available for each INVEOR size. Download the 3D files for INVEOR and adapter plates from https://www.kostal-drives-technology.com/download.

Four holes for mounting the adapter plate, as well as an EMC cable gland, are already featured.

INVEOR size	A	B	C	D
Power [kW]	**0.55 to 2.2**	**2.2 to 5.5**	**5.5 - 11**	**11 - 30**
Designation	ADP MA WDM 0000 A00 000 1	ADP MB WDM 0000 A00 000 1	ADP MC WDM 0000 A00 000 1	ADP MD WDM 0000 A00 000 1
Article number	10506806	10026185	10025932	10098170

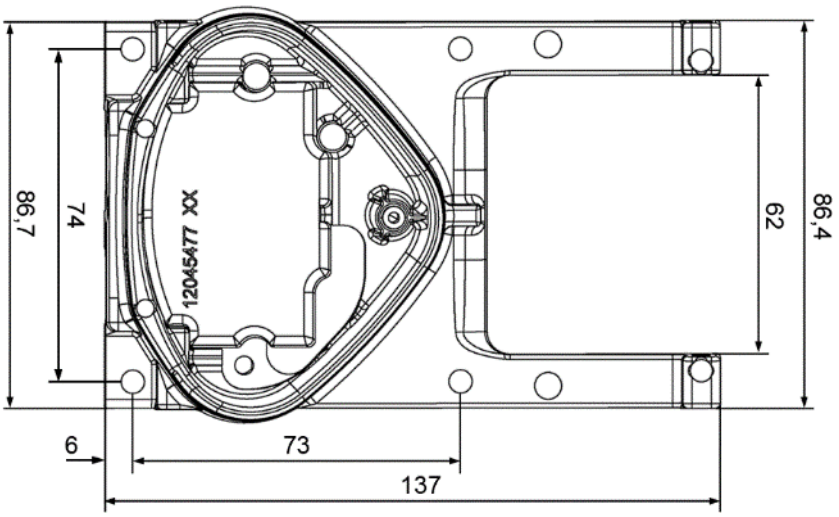


Fig. 62: Hole pattern for size A standard wall adapter plate

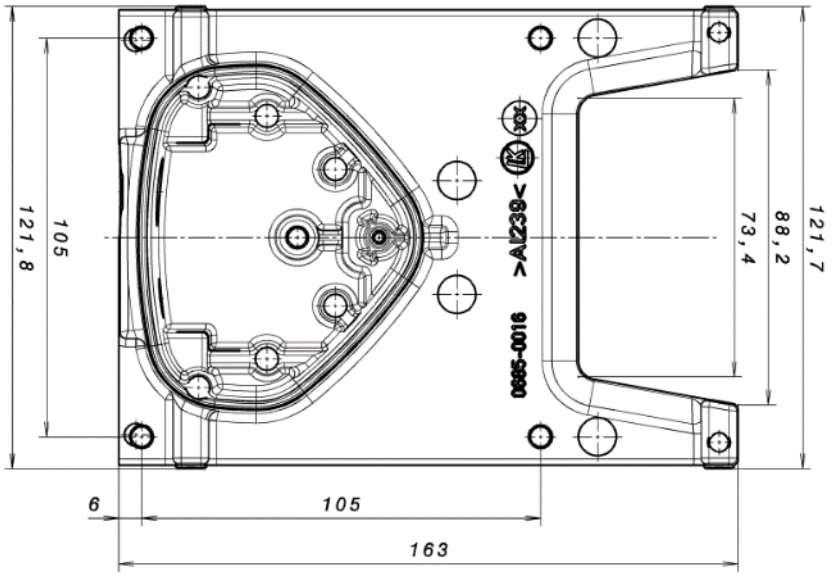


Fig. 63: Hole pattern for size B standard wall adapter plate

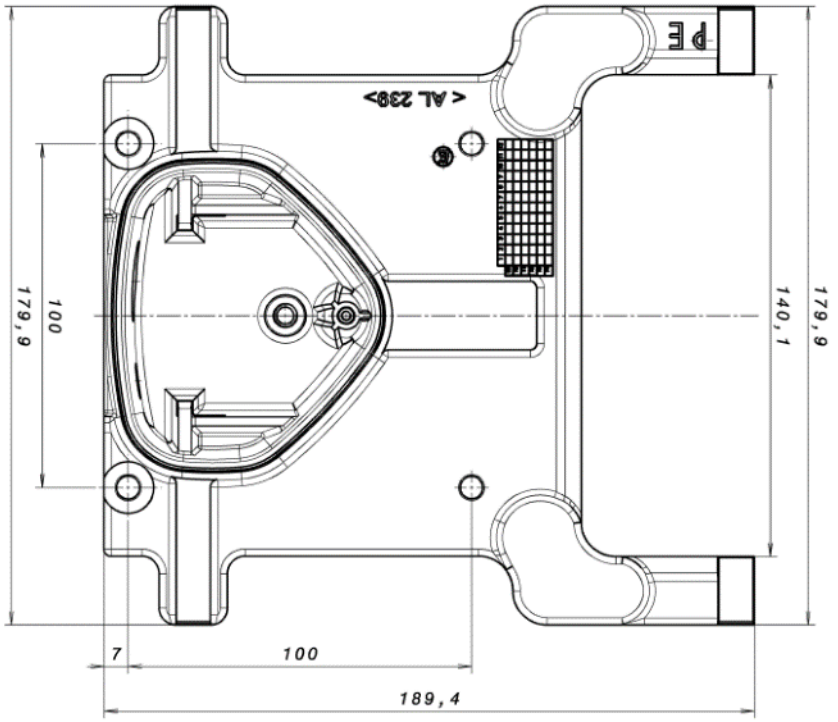


Fig. 64: Hole pattern for size C standard wall adapter plate

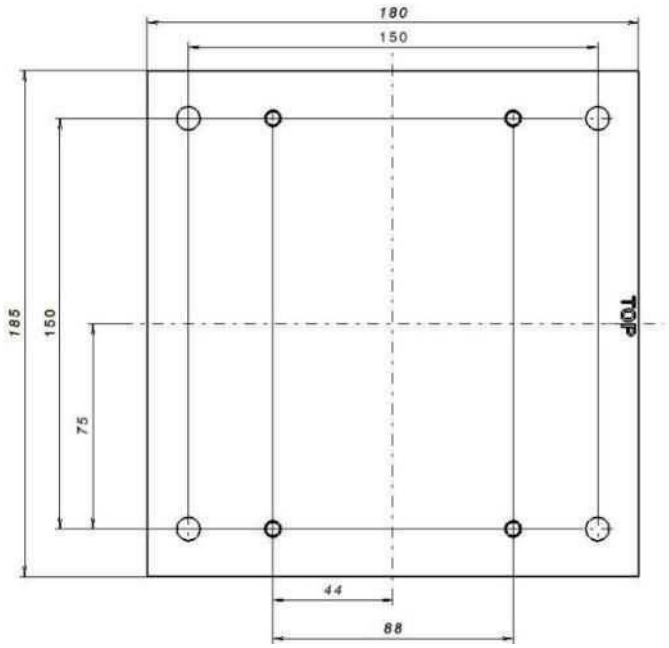


Fig. 65: Hole pattern for size D standard wall adapter plate

9.2 Foil keypad

As an option, the devices of the INVEOR family are also available as a variant with an integrated foil keypad. This keypad can be used to operate the drive controller locally.

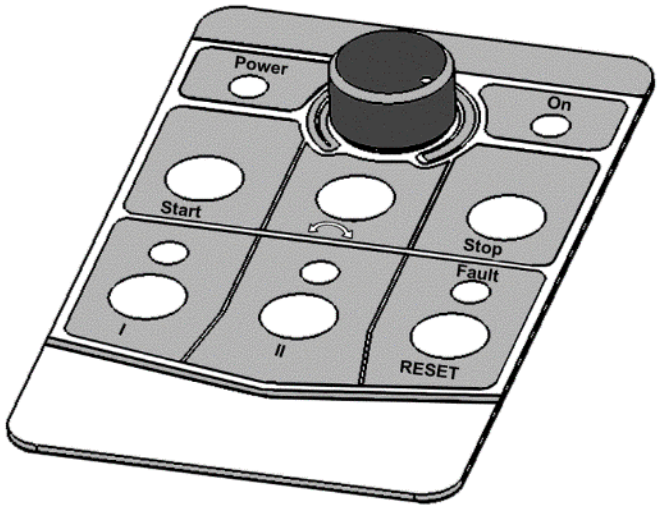


Fig. 66: Standard foil keypad

The following functionalities can be realised using the integrated foil keypad:

- **Target value specification:** A target value (parameter 1.130) can be specified using the potentiometer integrated in the foil keypad (select internal potentiometer).
- **Target value approval:** The start and stop keys integrated in the foil keypad (select foil keypad) can be used to approve the drive software (parameter 1.131).

1	2	3	4	5	6	7	8	9	10	11	12

- **Direction of rotation V1:** The direction of rotation (parameter 1.150) can be changed using the key integrated in the foil keypad (select foil keypad, direction of rotation key).
  The direction of rotation can only be changed when the motor is running.

  Direction of rotation V2: The direction of rotation (parameter 1.150) can be changed using keys I and II integrated in the foil keypad (select foil keypad, key I clockwise/key II anti-clockwise via stop).
  The direction of rotation can only be changed when the motor is stationary.
  The integrated LEDs indicate the current direction of rotation.

  Direction of rotation V3: The direction of rotation (parameter 1.150) can be changed using keys I and II integrated in the foil keypad (select foil keypad, key I clockwise/key II anti-clockwise always). The direction of rotation can be changed when the motor is running and stationary. The integrated LEDs indicate the current direction of rotation.

- **Acknowledge function:** An error can be acknowledged (parameter 1.180) using the reset key integrated in the foil keypad (select foil keypad).

- **Motor potentiometer:** A motor potentiometer (parameter 2.150) can be realised using the configurable keys I and II integrated in the foil keypad (MOP digit.inp.). This function can be used to increase or decrease the target value.
  The integrated LEDs indicate when the minimum/maximum target value is reached.

  To activate this function, the target value specification (parameter 1.130) must be set to motor potentiometer!

- **Fixed frequency:** Two fixed frequencies (parameter 2.050) can be realised using the configurable keys I and II integrated in the foil keypad (MOP digit.inp.). This function can be used to increase or decrease the target value.
  The integrated LEDs indicate the target value currently selected.

The LEDs integrated in the foil keypad provide a general indication of the drive controllers.

Power LED:	Lights up as soon as there is a voltage supply.
On LED:	Lights up during operation.
Fault LED:	Lights up when there is an error. Flashes as soon as an error can be acknowledged.

9.3 MMI handheld controller including a 3 m RJ9 connection cable with M12 plug

IMPORTANT INFORMATION

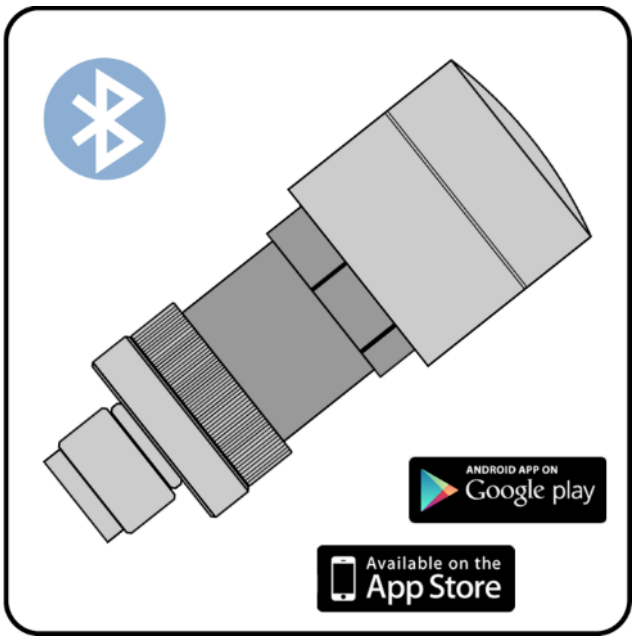
The MMI handheld controller (part. no. 10004768) may only ever be used with an INVEOR!

The MMI handheld controller is connected to the integrated INVEOR M12 interface. This operating unit allows the user to write (program) and/or to visualise all the parameters of the INVEOR.
Up to 8 complete data sets can be stored in an MMI and copied to other INVEORs.
Complete commissioning is possible as an alternative to the free INVERTERpc software.
External signals are not needed.

9.4 PC communication cable USB on M12/RS485 plug (converter integrated)

As an alternative to the MMI handheld controller, an INVEOR can also be put into operation using the PC communication cable (art no. 10023950) and the INVERTERpc software.
The INVERTERpc software is available free of charge from the KOSTAL homepage at https://www.kostal-drives-technology.com/download .

9.5 Bluetooth stick M12



You can start up your INVEOR MP Modular using the Bluetooth stick and a mobile end device.

To establish communication, you can download our free KOSTAL INVERTERapp onto your mobile end device from the Google Play Store (ANDROID) or App Store (Apple IOS).

NOTE
If using the Bluetooth stick, the password is fixed as 000000.

10. Approvals, standards and guidelines

This chapter contains information about electromagnetic compatibility (EMC), and applicable guidelines, norms and standards.
For binding information about the relevant drive controller approvals, please refer to the relevant type plate!

10.1 EMC limit classes

Please note that EMC limit classes are only reached if the standard switching frequency of 4 kHz is complied with. Depending on the installation material used and/or extreme ambient conditions, it might be necessary to use additional sheath wave filters (ferrite rings). If mounting on a wall, the shielded motor cable must not exceed a maximum length of 3 m!

Wiring suitable for EMC also requires that EMC screw connections be used on both sides (drive controller and motor).

IMPORTANT INFORMATION

- In a residential environment, this product can cause high-frequency disturbances that may require interference suppression measures.
- Wiring suitable for EMC also requires that EMC screw connections be used on both sides (drive controller and motor).
- If unshielded cables are used, certain EMC requirements may not be met in all circumstances, and additional EMC measures will therefore be required.

10.2 Classification acc. to IEC/EN 61800-3

The generic standard defines test procedures and severity levels for every environment in the drive controller category; these have to be complied with.

Definition of environment

First environment (residential, commercial and industrial area):

All “areas” that are directly supplied by a public low-voltage connection, such as:

- residential area, e.g. houses, apartments etc.
- retail area, e.g. shops, supermarkets
- public institutions, e.g. theatres, stations
- outside areas, e.g. petrol stations and parking areas
- light industry, e.g. workshops, laboratories, small businesses

Second environment (industry):

Industrial environments with their own supply network that is separated from the public low-voltage supply by a transformer.

10.3 Harmonics currents and grid impedance for devices > 16 A and ≤ 75 A

Extract from EN 61000-3-12, applies to devices with a rated current > 16 A and ≤ 75 A, which are intended for connection to public low-voltage grids.

This device complies with IEC 61000-3-12 provided that the short-circuit power S_{SC} at the point where the customer's system connects with the public grid is greater than or equal to $R_{SCE} \times S_{equ}$. If found to be necessary after contacting the distributor grid operator, the installer or operator of the device is responsible for ensuring that the device is only connected at a point with a short-circuit power S_{SC} greater than or equal to $R_{SCE} \times S_{equ}$.	
S_{SC}	Grid's short-circuit power at point where customer's system connects with the public grid.
S_{equ}	Rated apparent power for three-phase devices: $S_{equ} = \sqrt{3} \times U_l \times I_{equ}$ (Ul = external wire voltage, see technical data → supply voltage) (Iequ = rated current of device, see technical data → line current)
R_{SCE}	Short-circuit power relation For these devices: $R_{SCE} \geq 350$

10.4 Standards and guidelines

The following specifically apply:

- Directive 2014/53/EU - Radio Equipment Directive (OJ L 153 from 22.05.2014, p. 62) *
- Directive 2011/65/EU - RoHS Directive (OJ L 174 from 01.07.2011, p. 88)

* The basic requirements of the Low Voltage Directive and EMC Directive are also met here.

10.5 UL approval

10.5.1 UL Specification (English version)

Maximum Ambient Temperature:

Electronic	Adapter	Ambient	Suffix
INV MP(M) A IV01 PW03	ADP MA WDM	50°C	-
INV MP(M) A IV01 PW04	ADP MA WDM	50°C	-
INV MP(M) A IV01 PW05	ADP MA WDM	50°C	-
INV MP(M) A IV01 PW06	ADP MA WDM	45°C	-
INV MP(M) A IV01 PW46	ADP MA WDM	40°C	-
INV MP(M) B IV01 PW07	ADP MB WDM	50°C	GH4x, GH5x
INV MP(M) B IV01 PW08	ADP MB WDM	50°C	GH4x, GH5x
INV MP(M) B IV01 PW09	ADP MB WDM	45°C	GH4x, GH5x
INV MP(M) B IV01 PW49	ADP MB WDM	40°C	GH4x, GH5x
INV MP(M) B IV01 PW07	ADP MB WDM	45°C	Not GH4x, GH5x
INV MP(M) B IV01 PW08	ADP MB WDM	45°C	Not GH4x, GH5x
INV MP(M) B IV01 PW09	ADP MB WDM	35°C	Not GH4x, GH5x
INV MP(M) B IV01 PW49	ADP MB WDM	30°C	Not GH4x, GH5x
INV MP(M) C IV01 PW10	ADP MC WDM	40°C	-
INV MP(M) C IV01 PW11	ADP MC WDM	40°C	-
INV MP(M) C IV01 PW51	ADP MC WDM	40°C	-
INV MP(M) D IV01 PW12	ADP MD WDM	50°C	-
INV MP(M) D IV01 PW13	ADP MD WDM	50°C	-
INV MP(M) D IV01 PW14	ADP MD WDM	50°C	-
INV MP(M) D IV01 PW15	ADP MD WDM	50°C	-
INV MP(M) D IV01 PW55	ADP MD WDM	35°C	-

Required markings

To maintain the environmental integrity of the enclosure openings shall be closed by field-installed industrial conduit hubs or closure plates at least suitable for enclosure type 1.

Short circuit current rating (SCCR)

“Suitable For Use On A Circuit Capable Of Delivering Not More Than 5000 rms Symmetrical Amperes, 480 Volts Maximum When Protected by Class RK5 Class Fuses rated ___A:

INV MP A = max. 400 % motor current and not more than 15 A

INV MP B = max. 400 % motor current and not more than 35 A

INV MP C = max. 400 % motor current and not more than 35 A

INV MP D = max. 400 % motor current and not more than 100 A

CAUTION: Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Manufacturer Instructions, National Electrical Code and any additional local codes.

CAUTION: Use 75° C copper wires only.

CAUTION:"Motor overtemperature sensing is not provided by the drive”.

The Type of branch circuit protection devices used for BREAKDOWN OF COMPONENT TEST is Nonrenewable Cartridge Fuse, Class _RK5.

As RK5 is the worst Case Type, any other Type can be used.

1	2	3	4	5	6	7	8	9	10	11	12

10.5.2 Homologation CL (Version en française)

Température ambiante maximale:

Électronique	Adaptateur	Ambiante	Suffixe
INV MP(M) A IV01 PW03	ADP MA WDM	50°C	-
INV MP(M) A IV01 PW04	ADP MA WDM	50°C	-
INV MP(M) A IV01 PW05	ADP MA WDM	50°C	-
INV MP(M) A IV01 PW06	ADP MA WDM	45°C	-
INV MP(M) A IV01 PW46	ADP MA WDM	40°C	-
INV MP(M) B IV01 PW07	ADP MB WDM	50°C	GH4x, GH5x
INV MP(M) B IV01 PW08	ADP MB WDM	50°C	GH4x, GH5x
INV MP(M) B IV01 PW09	ADP MB WDM	45°C	GH4x, GH5x
INV MP(M) B IV01 PW49	ADP MB WDM	40°C	GH4x, GH5x
INV MP(M) B IV01 PW07	ADP MB WDM	45°C	Not GH4x, GH5x
INV MP(M) B IV01 PW08	ADP MB WDM	45°C	Not GH4x, GH5x
INV MP(M) B IV01 PW09	ADP MB WDM	35°C	Not GH4x, GH5x
INV MP(M) B IV01 PW49	ADP MB WDM	30°C	Not GH4x, GH5x
INV MP(M) C IV01 PW10	ADP MC WDM	40°C	-
INV MP(M) C IV01 PW11	ADP MC WDM	40°C	-
INV MP(M) C IV01 PW51	ADP MC WDM	40°C	-
INV MP(M) D IV01 PW12	ADP MD WDM	50°C	-
INV MP(M) D IV01 PW13	ADP MD WDM	50°C	-
INV MP(M) D IV01 PW14	ADP MD WDM	50°C	-
INV MP(M) D IV01 PW15	ADP MD WDM	50°C	-
INV MP(M) D IV01 PW55	ADP MD WDM	35°C	-

Marquages requis

Afin de préserver l'intégrité environnementale du boîtier, les ouvertures doivent être fermées par des raccords de conduits industriels installés sur le terrain ou des plaques d'obturation compatibles au minimum avec un boîtier de type 1.

Courant nominal de court-circuit (SCCR – Short circuit current rating)

Convient pour une utilisation sur un circuit d'une puissance maximale de 5 000 ampères symétriques efficaces, max. 480 volts avec une protection par fusibles de classe RK5 de
catégorie ___A :

INV MP A = courant du moteur max. 400 % et n'excédant pas 15 A

INV MP B = courant du moteur max. 400 % et n'excédant pas 35 A

INV MP C = courant du moteur max. 400 % et n'excédant pas 35 A

INV MP D = courant du moteur max. 400 % et n'excédant pas 100 A

ATTENTION : La protection contre les courts-circuits à semi-conducteurs n'assure pas la protection du circuit de dérivation. Le circuit de dérivation doit être protégé conformément aux instructions du fabricant, au code national électrique américain (NEC) et aux codes d'électricité locaux en vigueur.

ATTENTION : Utiliser uniquement des câbles en cuivre 75 °C.

ATTENTION :« L'entraînement ne détecte pas la surtempérature du moteur ».

Le type de dispositifs de protection des circuits de dérivation utilisé pour l'ESSAI DE PANNE DES COMPOSANTS est une cartouche fusible à usage unique de classe _RK5.

La classe RK5 est la plus basse. Toutes les autres classes peuvent être utilisées.

10.6 Waste disposal

IMPORTANT INFORMATION

The products of KOSTAL Industrie Elektrik GmbH & Co KG consist of high-quality components and valuable materials. Therefore, have faulty or defective devices checked for the possibility of repair and reuse.

If repair or reuse is not possible, observe the following disposal instructions.

The symbol of the crossed-out waste bin on an electrical or electronic device indicates that the electrical or electronic device may not be disposed of with unsorted municipal waste (household waste), but must be sent to a separate collection.

You are obliged to take this device and its accessories to a WEEE* registered collection point.

WEEE-Reg.-Nr.: DE72377491* **KOSTAL Industrie Elektrik GmbH & Co KG**

*** Waste of Electrical and Electronic Equipment**

11. Quickstart guide

11.1 Quick-start guide for asynchronous motors

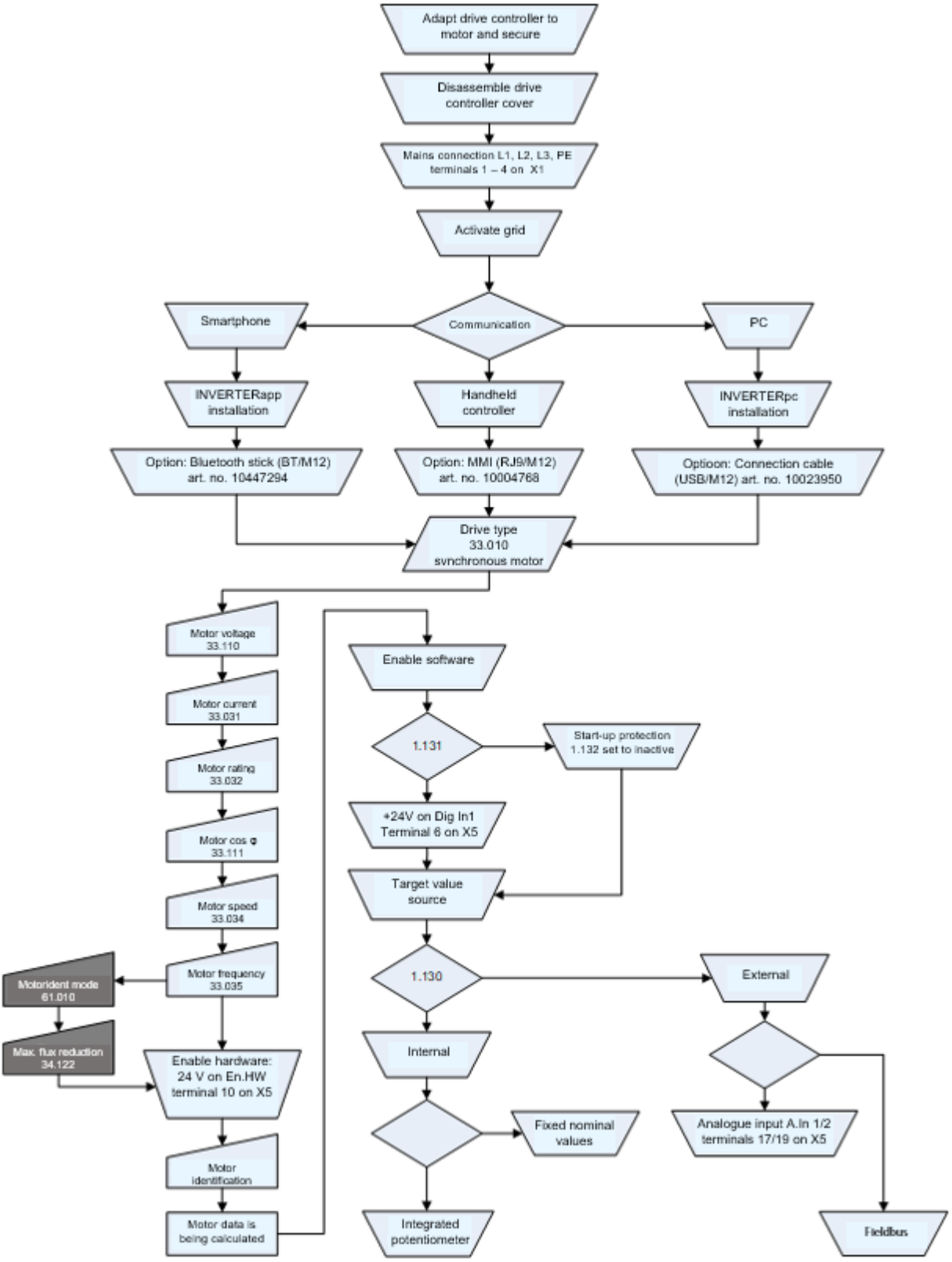


Fig. 67: Block diagram for quick start ASM

11.2 Quickstart guide for synchronous motors

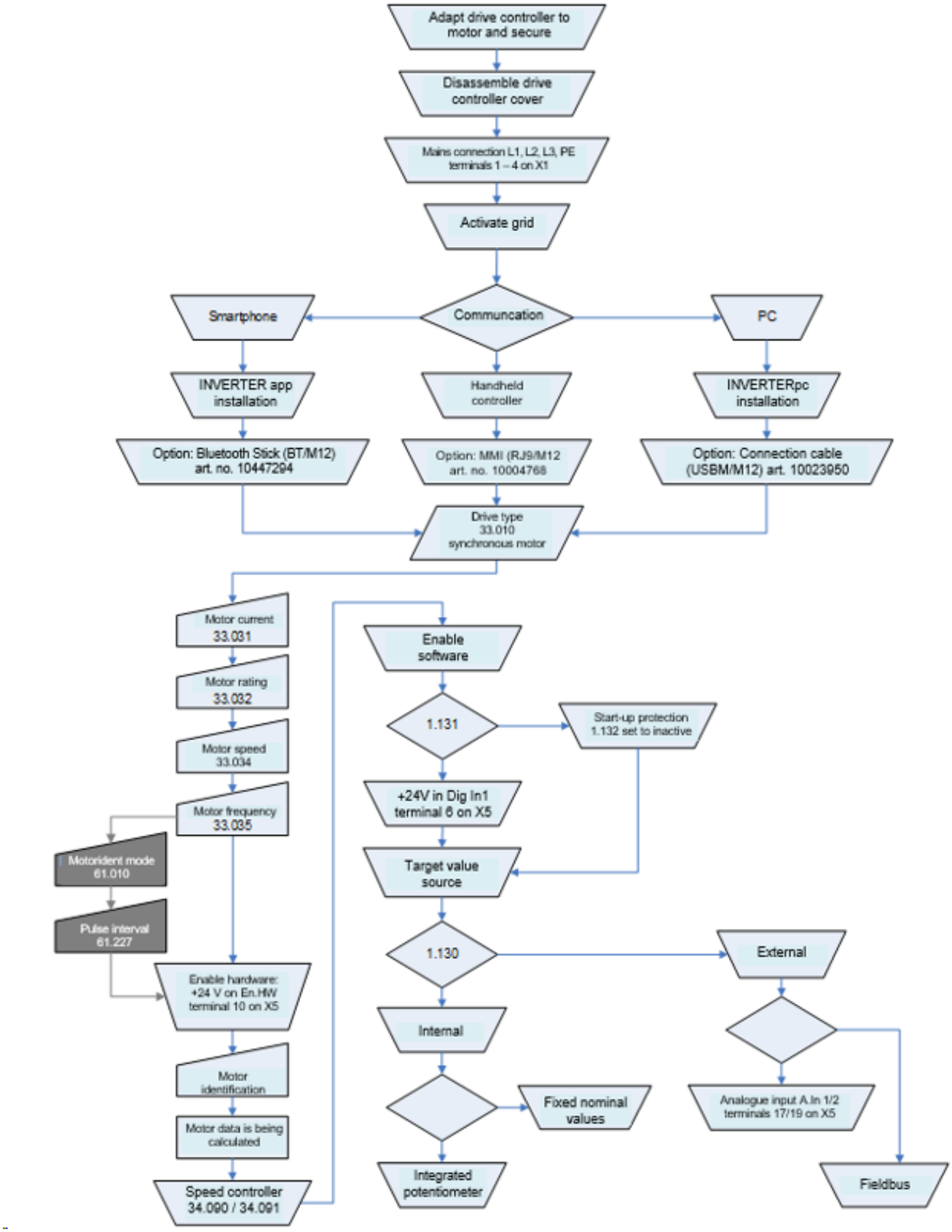


Fig. 68: Block diagram for PMSM and SynRN quick commissioning

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