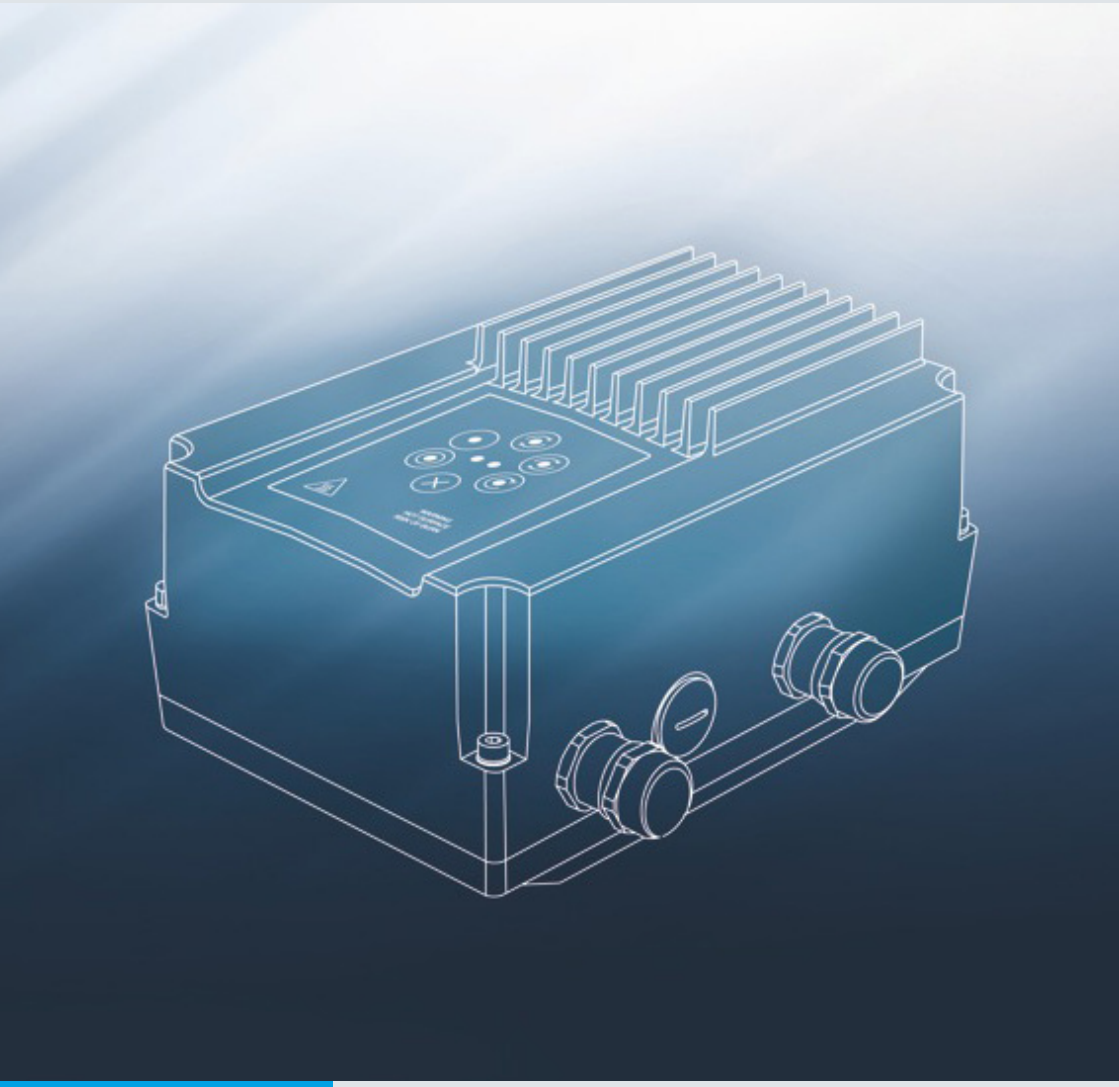
KOSTAL



Smart connections.

Operating manual

INVEOR Drive Controller α

Legal notice

KOSTAL Industrie Elektrik GmbH
An der Bellmerei 10
58513 Lüdenscheid
Germany

Exclusion of liability

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

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

General note on gender equality

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

KOSTAL

Contents

1. General information

Thank you for choosing an INVEOR α drive controller from KOSTAL Industrie Elektrik GmbH!
Our INVEOR α drive controller platform 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
Website
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 α.
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 α from KOSTAL Industrie Elektrik GmbH.
Provide the operator of the system with this manual so it is available when needed.

1.1.1 Other applicable documents

This refers to all manuals that describe how to operate the drive controller system and any other manuals for the equipment used. Download the 3D files (.stp) for INVEOR and adapter plates from www.kostal-industrie-elektrik.com.
A description of parameters is available for download (https://www.kostal-industrie-elektrik.com/en-gb/downloads/download-drives) for parametrising the drive controller system. In the download, you will find all the information required for correct parameterisation.

1.1.2 Storing the documentation

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

1.2 Notes in this manual

1.2.1 Warnings

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

Each warning consists of the following elements:

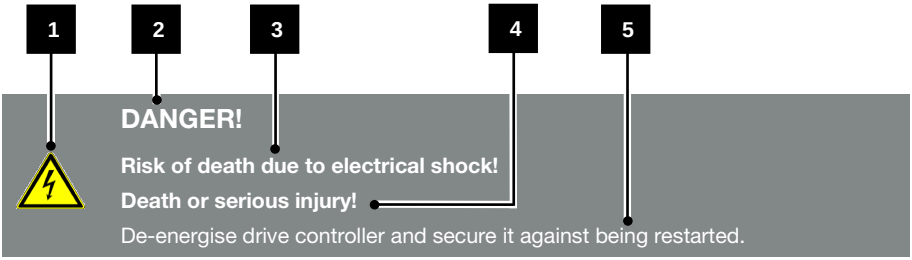


Fig.: 1 Structure of warnings

1 Warning symbol

2 Signal word

3 Type of danger and its source

4 Possible consequence(s) of failure to comply

5 Corrective actions

1.2.2 Warning symbols used

Symbol	Meaning
	Danger
	Danger due to electrical shock and discharge
	Danger due to burns
	Danger due to electromagnetic fields

1.2.3 Signal words

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

DANGER

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

WARNING

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

CAUTION

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

1.2.4 Information notes

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

IMPORTANT INFORMATION

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

Fig.: 2 Example of an information note

Symbols within the information notes

Symbol	Meaning
	Important information
	Damage to property possible

Fig.: 3 Symbols within the information notes

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.: 4 Symbols and icons used

Abbreviations used

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

1.4 Labels on the drive controller

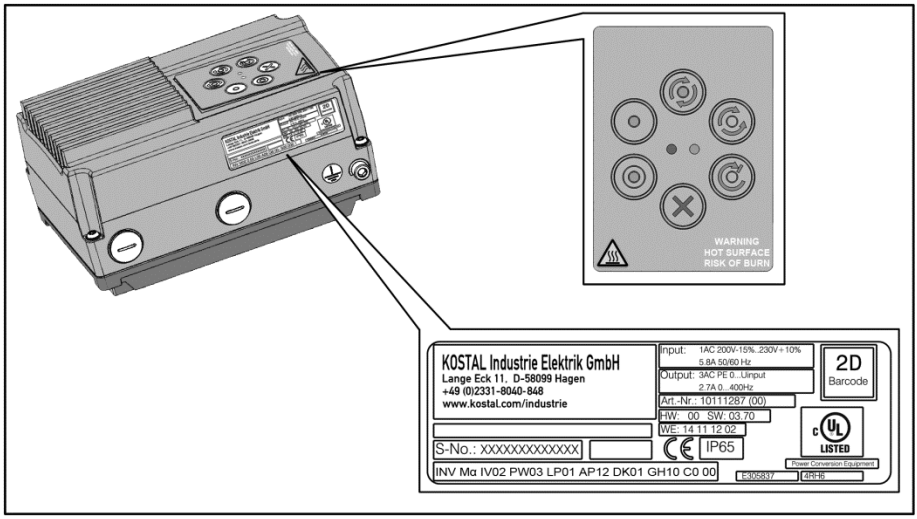


Fig.: 5 Labels on the drive controller

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 burns	WARNING HOT SURFACE RISK OF BURN
	Danger due to electrical shock and discharge. Wait two minutes (discharge time of the capacitors) after shut-down	
	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 0113-1:2007-06 must be observed.

Commissioning (i.e. beginning intended operation) is only permitted if the EMC Directive (2004/108/EC) is complied with.

The harmonised standards of DIN EN 50178; VDE 0160:1998-04 must be applied for this drive controller along with DIN EN 60439-1; VDE 0660-500:2005-01.

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.

External mechanical loads such as stepping on the housing are not permitted!

IMPORTANT INFORMATION

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 0113-1:2007-06, “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 have to 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

With the CE marking, we, as the manufacturer of the device, confirm that the drive controller meets the basic requirements of the following guidelines:

- Directive on Electromagnetic Compatibility (Directive 2004/108/EC of the Council EN 61800-3:2004).
- Low Voltage Directive (Directive 2006/95/EC of the Council EN 61800-5-1:2003).

You can download the Declaration of Conformity from https://www.kostal-industrie-elektrik.com/en-gb/downloads/download-drives.

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 generally applicable when handling drive controls. They are split into general information, transport & storage and dismantling & 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 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.

Keep the operating manual close to the drive controller so it is easily accessible to all users.

IMPORTANT INFORMATION

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 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.

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

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

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.

IMPORTANT INFORMATION

Do not place flammable parts (e.g. cable ducts) directly or indirectly on the drive controller.

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!

Transport the drive controller properly in its original packaging.

Always store the drive controller properly.

Only allow qualified staff to undertake installation and assembly.

1.9.3 Long-term storage of devices

IMPORTANT INFORMATION

If drive controllers have been in storage for more than 2 years, the following regeneration process is required before installation / use under the nominal conditions:

- The drive controller must be connected to supply voltage (+/- 3 %) for 30 minutes without the device being loaded. This applies to the motor connection as well as possible consumers and connections to the application.
- Perform this process once before commissioning.

In all cases, observe the general requirements for storing drive controllers!

1.9.4 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.

- Supply terminals X1: L
- Motor connection terminals X411: T1, T2, U, V, W
- Connecting terminals X6: Relay contacts

IMPORTANT INFORMATION

- Only use mains connections with hardwiring.
- Ground the drive controller in accordance with DIN EN 61140; VDE 0140-1.
- The INVEOR α 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 on the outside of the device. A suitable M6 x 8 screw (torque M_A = 4.0 Nm) is provided by INVEOR.
- If 1~INVEOR devices are used, it is permitted to use standard type A FI protection switches or RCDs (residual current-operated protective devices) in accordance with DIN VDE 0160 and EN 50178 to protect against direct or indirect contact.

If 3~ INVEOR devices are used, it is not permitted to use standard type A FI protection switches or RCDs (residual current-operated protective devices) to protect 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)!

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.

1.9.5 Instructions concerning operation

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 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.
- A pause of at least 1 to 2 mins must be observed between consecutive mains activations for devices with a single-phase feed.
- 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).

1.9.6 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 contains dust, the cooling fins of the motor and drive controller have to be cleaned regularly.

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 part

The power part of an INVEOR α 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 part alone,
- to avoid excessively high voltages, all the INVEOR α's connection cables must be disconnected before testing,
- a 500 V DC insulation tester should be used.

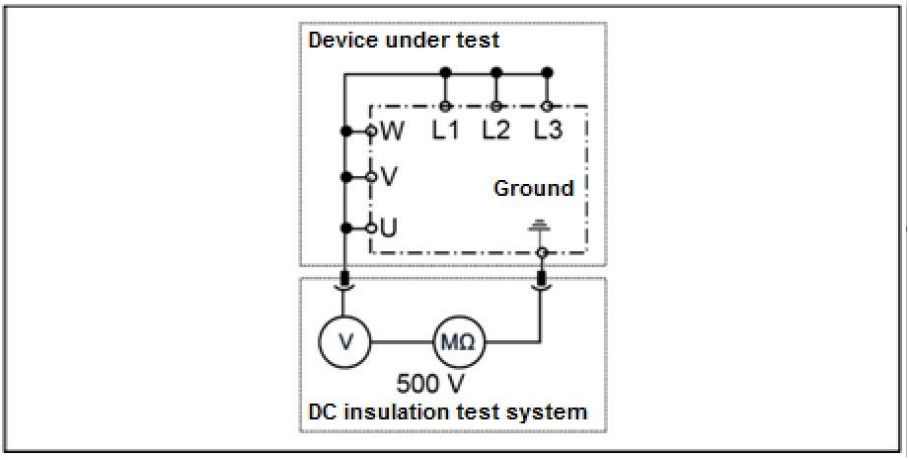


Fig.: 6 Insulation test on the power board

Pressure test on an INVEOR α

IMPORTANT INFORMATION

A pressure test is not permitted on a standard INVEOR.

1.9.7 Repairs

DAMAGE TO PROPERTY POSSIBLE

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.

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.

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

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

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

2. Overview of the drive controller

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

2.1 Model description

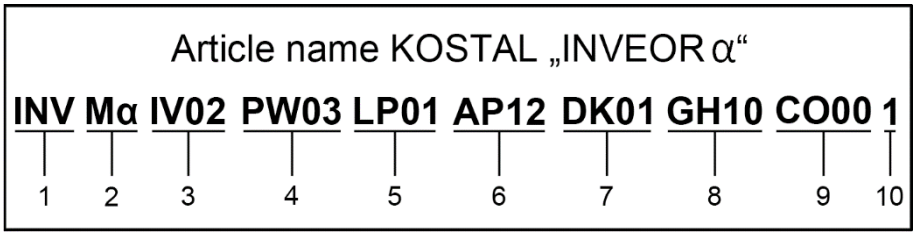


Fig.: 7 Item description

Key			
1	Drive controller series: INVEOR	**6**	Application printed circuit board: AP12 - standard AP13 - CANopen
2	Installation location/size: M-motor-integrated, size: α	**7**	Operation: DK01 – Standard (without operating film) DK04 - with operating film
3	Input voltage: IV02 – 230 V	**8**	Housing: GH10 – standard cooling elements (painted black)
4	Recommended motor rating: PW01 (0.25 kW); PW02 (0.37 kW); PW03 (0.55 kW); PW04 (0.75 kW)	**9**	Firmware version: CO00 - standard CO01 - Specific
5	Power printed circuit board: LP01 - standard LP07 - IT network	**10**	Equipment generation: 1 - current version

2.2 Scope of delivery

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

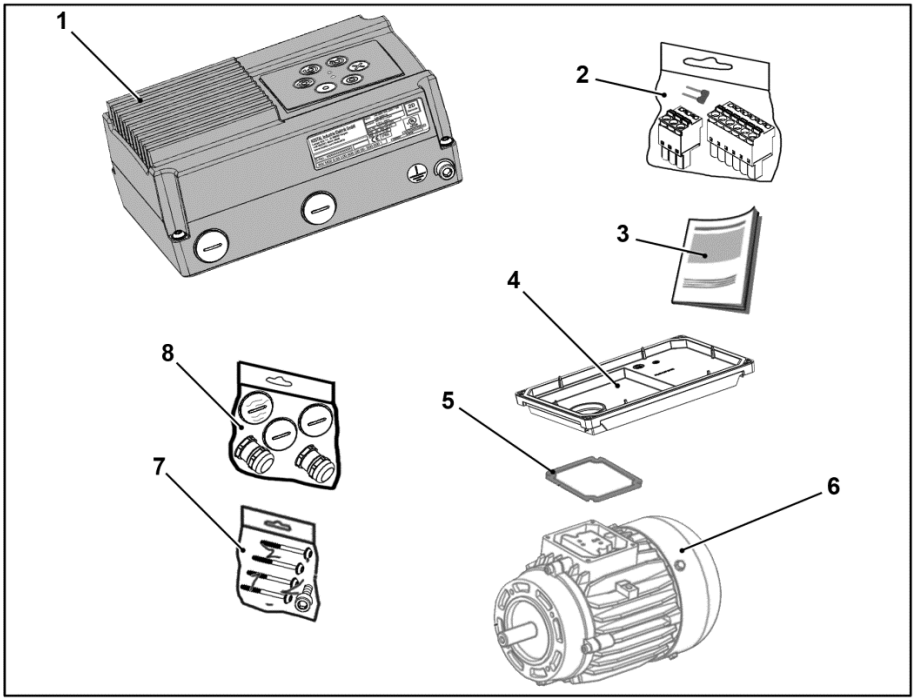


Fig.: 8 Scope of delivery

Key			
1	INVEOR α drive controller (variant)	**5**	Seal (not part of the scope of delivery)
2	Poly bag containing plug terminals (grid and motor terminal) and PTC bridge	**6**	Motor (not part of the scope of delivery)
3	Operating manual	**7**	Poly bag containing fastening bolts Cooling elements and M6 ground screw
4	Adapter plate (not part of the scope of delivery)	**8**	Poly bag containing 2 x M16 cable screw connections, 2 x M16 plugs and 1 x M16 transparent plugs

2.3 Description of INVEOR α drive controller

The INVEOR α drive controller is a device for speed control in 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 installation 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 drive controller 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.

Mains connections must be hardwired.

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.

3.2 Recommended preliminary fuses / line protection

INVEOR Alpha	Size α 1 x 230 V AC
Nominal motor rating	up to 0.75 kW
Mains current	7.3 A
Mains current 150% (overload 60 s)	10.95 A
Line circuit breaker - recommendation	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.

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:	-10 °C to +40 °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 60068-2-6 severity 2 (max. 50 m/s^2; 5…200 Hz) DIN EN 60068-2-27 (300 m/s^2)
Electromagnetic compatibility:	Immune to interference acc. to DIN EN 61800-3
Cooling:	Surface cooling

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 whether the drive controller's cooling elements have been closed and screwed down to the adapter plate with the following torque, size α (4 x T20 4 x 35) 1.2 Nm.

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 standard colour is black RAL 9005 (black).

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

Ensure that the motor with a motor-integrated drive controller is only installed and operated if aligned as shown in the following diagram.

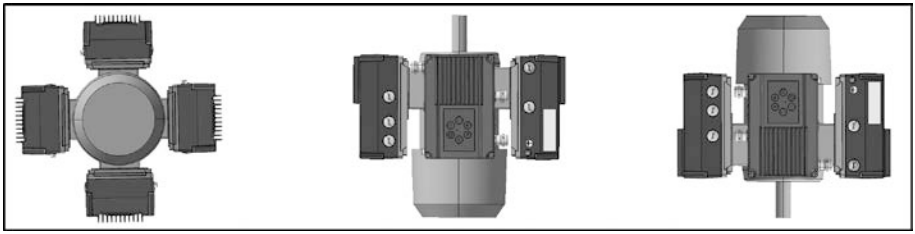


Fig.: 9 Motor installation location/permitted alignments

IMPORTANT INFORMATION

During assembly, no condensate may enter the drive controller from the motor

3.3.3 Basic connection versions

Triangle connection variant

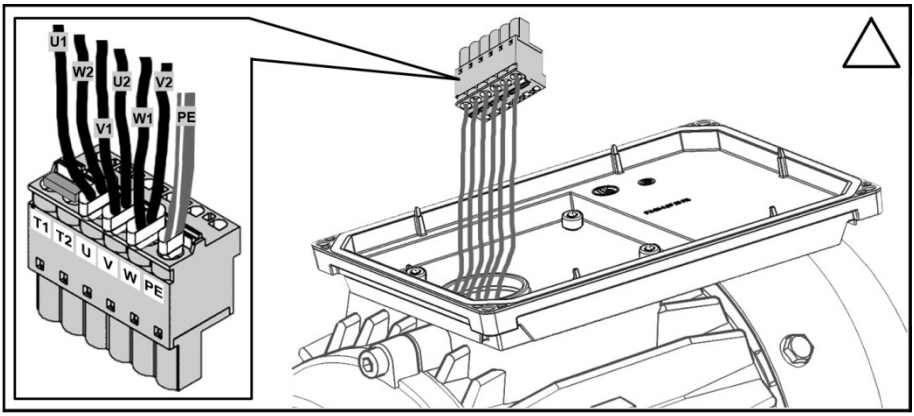


Fig.: 10 Triangle connection with motor-integrated drive controller

Triangle connection terminal assignment	
U	W2, U1
V	U2, V1
W	V2, W1
PE	PE
T1, T2	Connect bridge (see scope of delivery)

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

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

Star connection variant

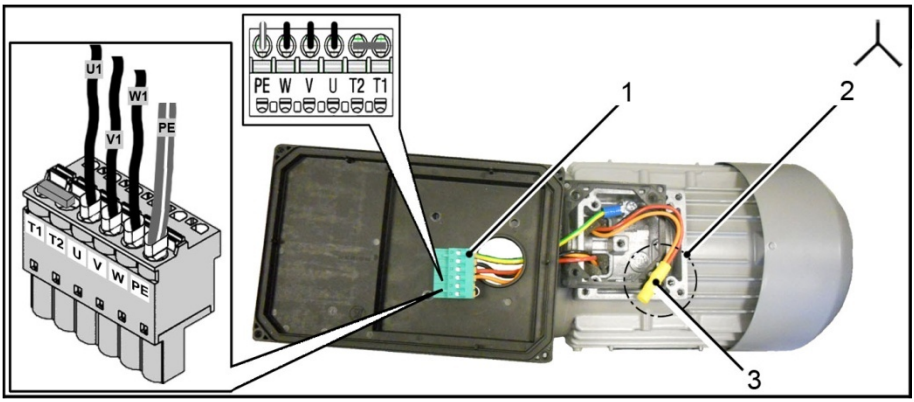


Fig.: 11 Star connection with motor-integrated drive controller

1 Motor connector
2 Star point
3 Butt connector

Star connection terminal assignment	
U	U1
V	V1
W	W1
PE	PE
T1, T2	Connect bridge (see scope of delivery)

Star formation
W2, U2, V2

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

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

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 and 6 show the different connection options.

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

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

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

IMPORTANT INFORMATION

If a thermal resistor (PTC or Klixon) is not used, the T1 and T2 bridging contacts supplied must be connected (as described in chapter 3.3.1).

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.

3.3.4 Short circuit and ground protection

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

3.3.5 Wiring instructions

The control connections of the application card are located inside the drive control.
The configuration may vary depending on the version.

Control terminals (size α)

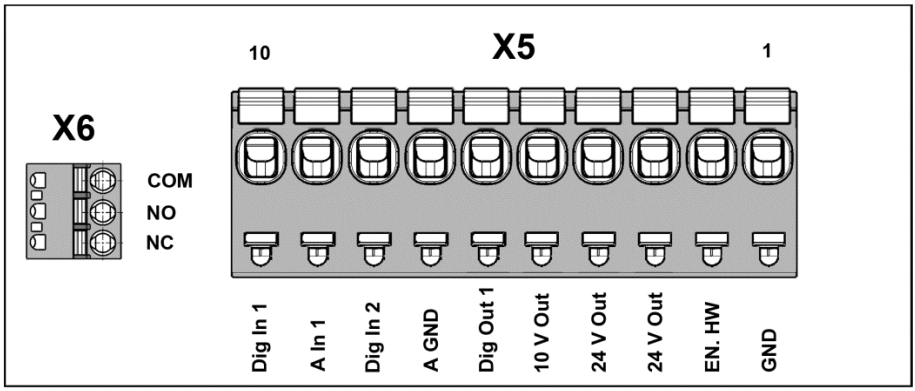


Fig.: 12 Control terminals (size α)

Size α		
X5 – X6	Terminals:	Plug terminal clamp with activation button (slot screwdriver, max. width 2.5 mm)
	[X5] Connection cross-section:	0.14 to 1.5 mm², fine-wired, AWG 30 to AWG 16
	[X6] Connection cross-section:	0.2 to 2.5 mm², fine-wired, AWG 30 to AWG 12
	Connection cross-section:	0.5 to 1.0 mm², fine-wired (core end sleeves with and without plastic collars)
	Length of stripped insulation:	9 to 10 mm

For technical data on power connections, see page 35

Power connections (size α)

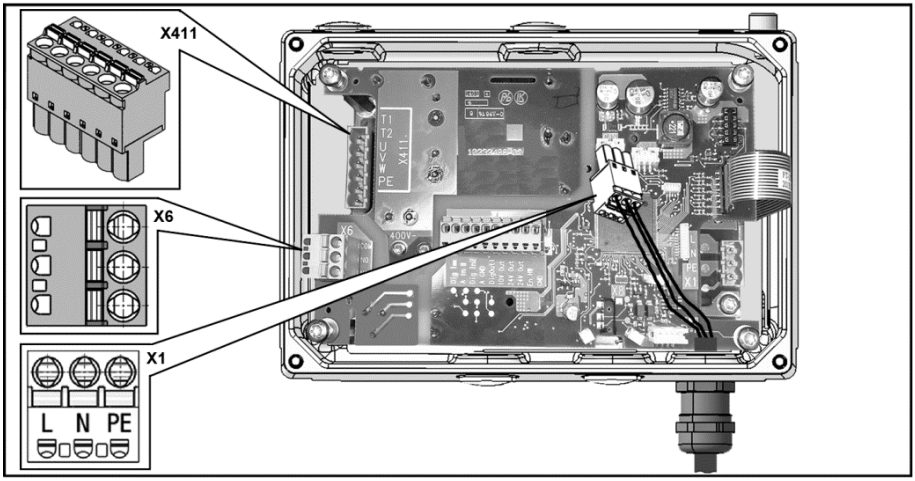


Fig.: 13 Power connections (size α)

Size α		
X1 mains +X6 relay + X411 motor / PTC	The terminals for the mains cable are located inside the drive controller. The configuration may vary depending on the version.	
	Core end sleeves with plastic collars and lugs are recommended.	
	Terminals:	Spring force connection (slot screwdriver, max. width 2.5 mm)
	Conductor cross-section, flexible:	min. 0.2 mm² max. 2.5 mm²
	Conductor cross-section, flexible with core end sleeve without and with plastic sleeve:	min. 0.25 mm² max. 2.5 mm²
	2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve:	min. 0.25 mm² max. 1.25 mm²
	Conductor cross-section AWG:	min. 30 max. 12
	Length of stripped insulation:	10 mm
	Mounting temperature:	-5°C to +100°C

3.3.6 Preventing electromagnetic interferences

Where possible use shielded lines for control circuits.
The shielding should be applied to the line end with special care and without laying the leads across longer stretches without shielding.

Ensure that no parasitic currents (compensating currents etc.) can flow via the analogue 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.

Upstream circuit 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 size α

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. Be careful not to damage the seal.

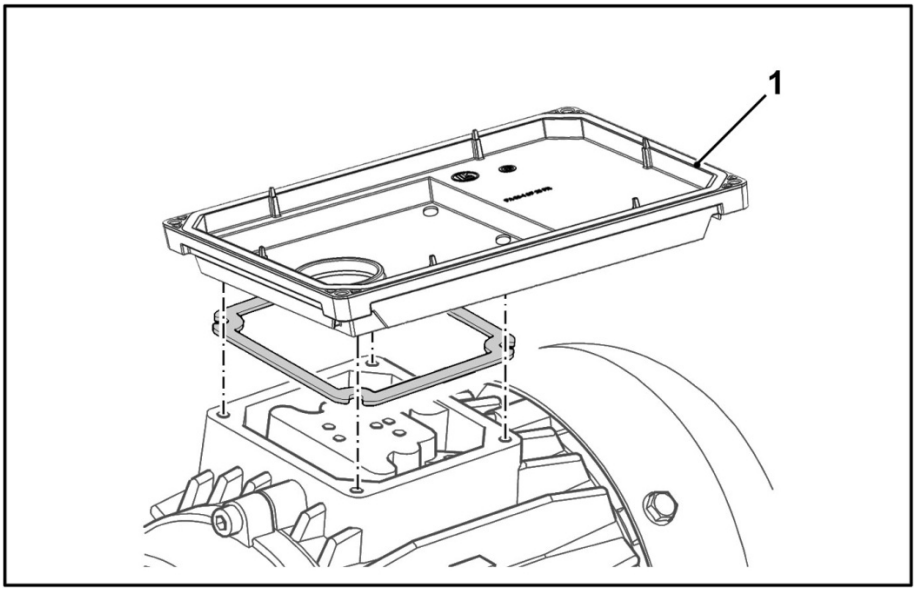


Fig.: 14 Assembly sequence: Connection box – adapter plate (size α)

INFORMATION

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

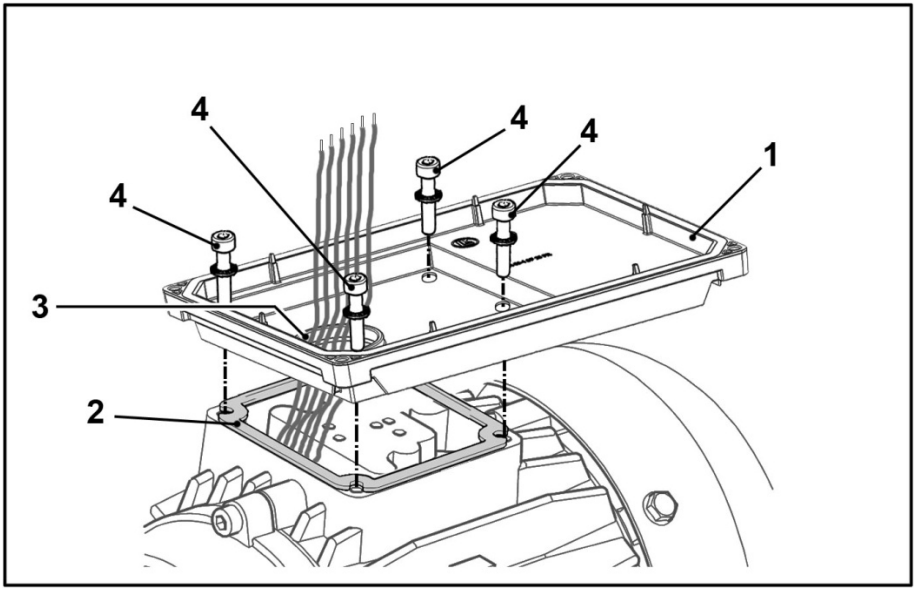
You can order individually modified adapter plates from KOSTAL for selected motors.

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

INFORMATION

The commissioning technician is responsible for protection class compliance when sealing the adapter plate on the motor.

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



6. Fit the seal (2).
7. Lead the motor connection lines through the opening (3) in the adapter plate (1).

INFORMATION

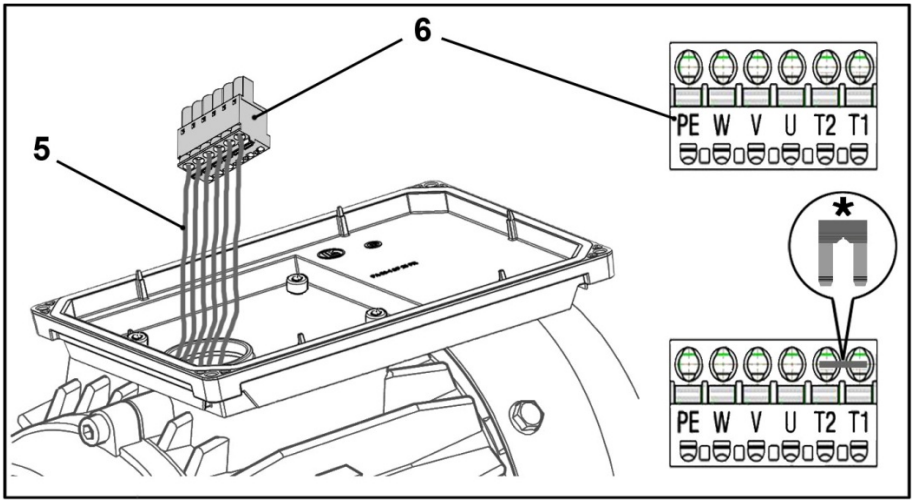
If the motor connection lines are too short, extend them as required with the cable set extension (option) article no.: 10118226

8. Screw the adapter plate on to the motor with the four retaining bolts (4) and four spring elements.

IMPORTANT INFORMATION

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

9. Attach the motor lines (5) in the correct circuit to plug of motor plugs (6).



10. If present, wire the connection cable of the motor PTC/Klixon to the T1 and T2 terminals.

* If the motor used does not have a motor PTC, you must connect the bridge included in the scope of delivery.

If the bridge is not connected, the red status LED lights up and the motor does not start.

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

The motor PTC is potential-free once the INVEOR is connected, therefore it must be connected using a separate motor lead.

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

3.4.2 Power connection

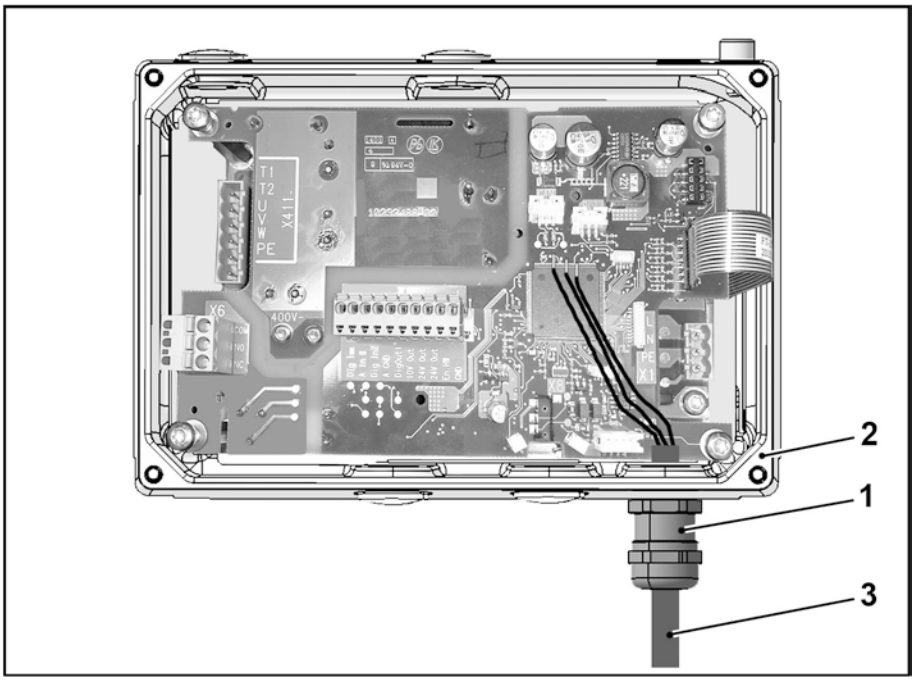
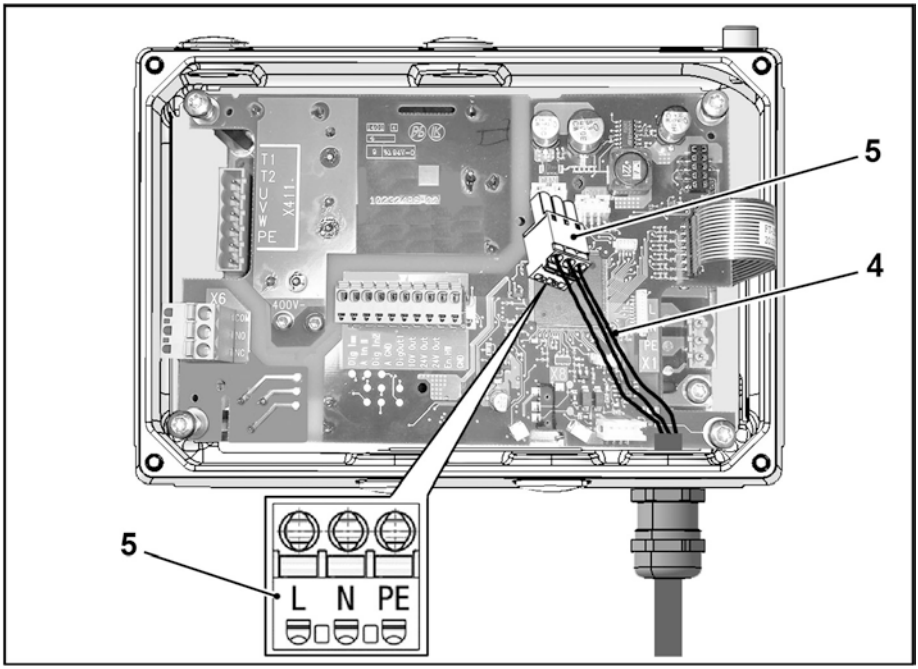


Fig.: 15 Mains connection cable connection

1. Screw cable screw connection (1) into cooling elements (2) (M_A = 3 Nm).
2. Guide mains connection cable (3) through cable screw connection (1) into cooling elements (2).

   Fix mains connection cable (3) by tightening (M_A = 3 Nm) rear section of cable screw connection (1).



3. Connect mains cables (4) to mains plug (5) as follows:

230 V connection		
L	N	PE

Terminal no.	Designation	Assignment
1	L	Mains phase
2	N	Neutral wire
3	PE	Protective conductor

4. Plug mains plug (5) onto mains connection socket X1.

3.4.3 Control connections of application board

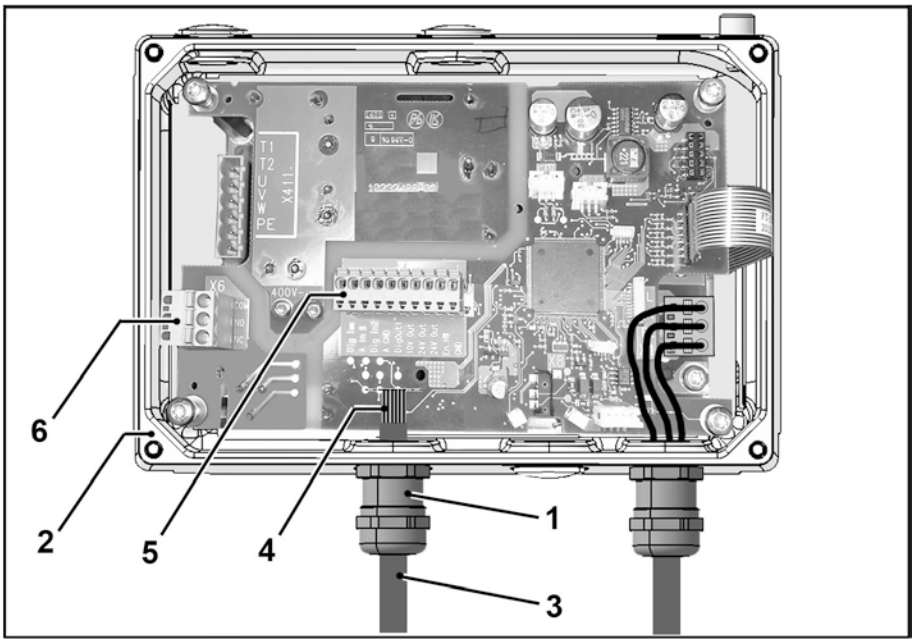
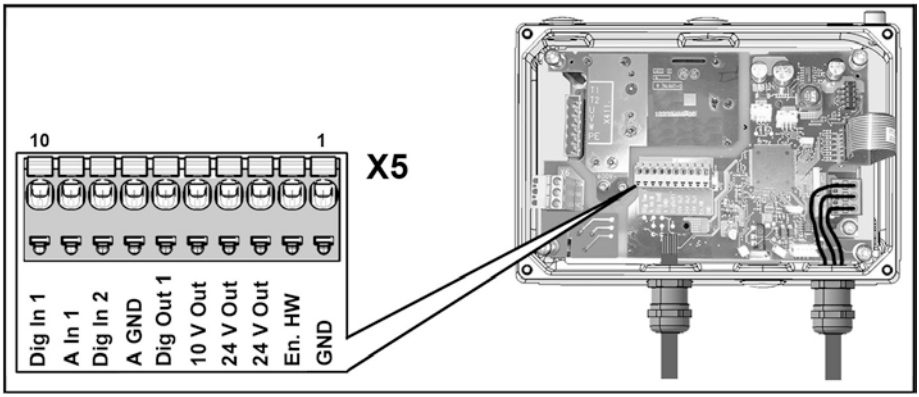


Fig.: 16 Control connections of application board

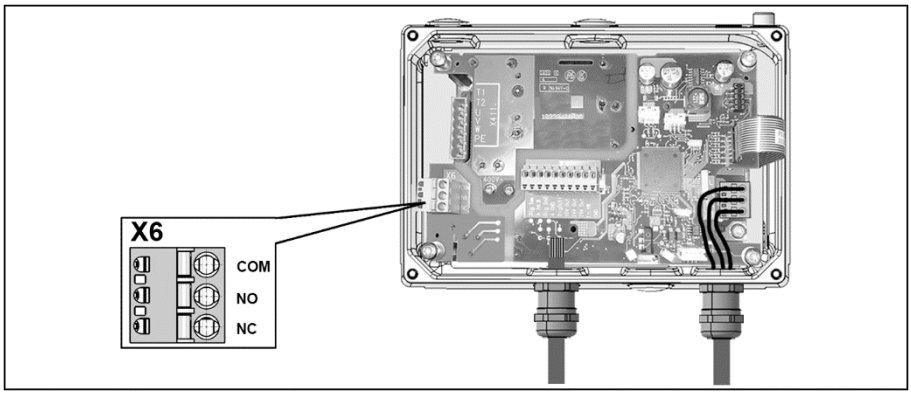
1. Screw cable screw connection (1) into cooling elements (2) (M_A = 3 Nm).
2. Guide control line (3) through cable screw connection (1) into cooling elements (2).
   Fix control line (3) by tightening (M_A = 3 Nm) rear section of cable screw connection (1).
3. Connect control lines (4) to control connection terminals X5 (5) and X6 (6) respectively.



Control connection X5		
Terminal no.	**Designation**	**Assignment**
1	GND (ground)	Ground
2	En HW (enable)	Enable hardware
3	24 V Out	Int. power supply
4	24 V Out	Int. power supply
5	10 V Out	For ext. voltage divider
6	Dig. Out1	Fault message (parameter 4.150)
7	A GND (ground 10 V)	Ground
8	Dig. In 2	Free (not assigned)
9	A. In 1	Free (not assigned)
10	Dig. In 1	Target value enable (parameter 1.131)

IMPORTANT INFORMATION

If a control line is not attached, a bridge must be connected between "24 V Out" and "En. HW". When the bridge is connected, the drive controller's output stage is always enabled.



Relay X6	
Designation	**Assignment**
COM	Centre contact relay
NO	Normally open contact relay
NC	Normally closed contact

For technical data on power connections, see page 35

3.4.4 Placing cooling elements on adapter plate

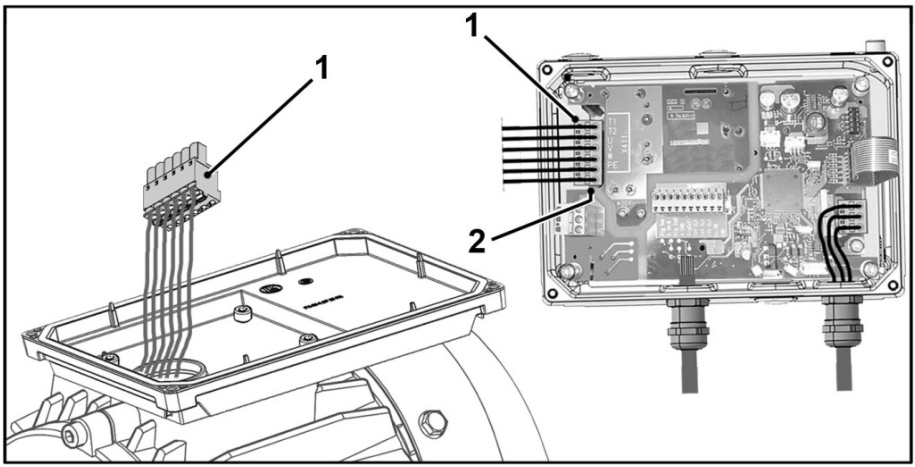
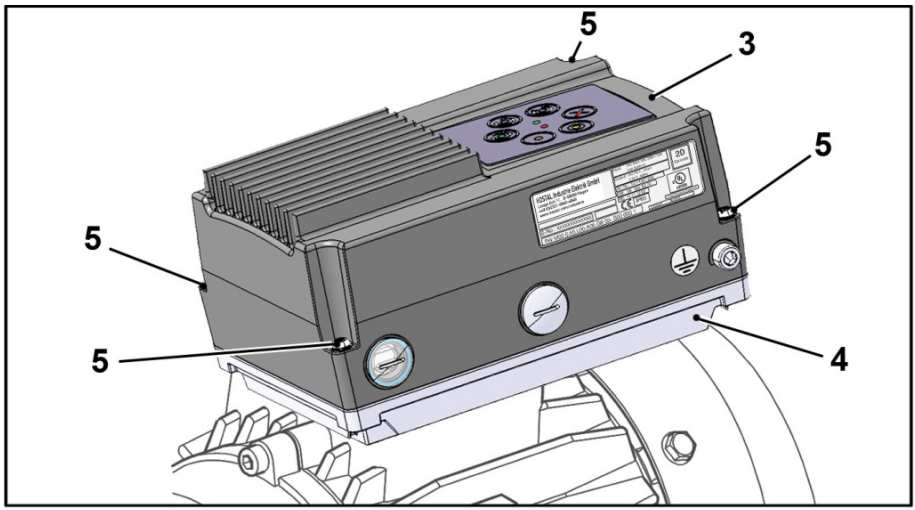


Fig.: 17 Placing cooling elements on adapter plate

1. Plug motor plug (1) onto motor terminal X411 (2).



2. Carefully attach cooling elements (3) on adapter plate (4).

DAMAGE TO PROPERTY POSSIBLE

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

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

3. Screw down cooling elements (3) to adapter plate (4) using four retaining bolts (5) (M_A = 1.2 Nm).

3.4.5 Connection diagram

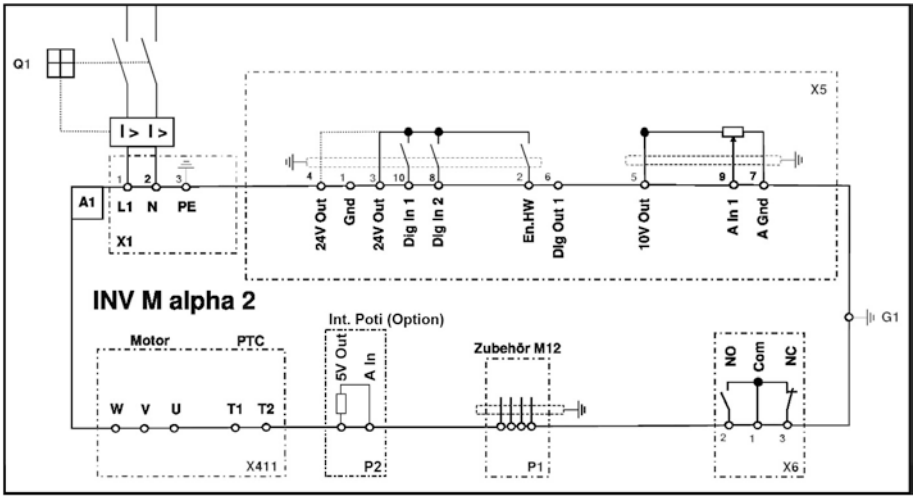


Fig.: 18 Connection diagram

Characters	Explanation
A1	Drive controller type: INVEOR M α 2 (1~ 230 V)
G1	M6 grounding screw (connection for residual currents > 3.5 mA)
P1	RS485 internal programming interface (M12 plug) (optional)
P2	Internal potentiometer (optional)
Q1	Motor protection switch or load break switch (optional)
X1	Mains terminals
X411	Motor and PTC terminals
X5 – X6	Digital/analogue inputs and outputs

The drive controller is ready once a 230 V AC mains supply has been activated (on terminals L and N) or a 325 V DC mains supply has been activated (on terminals L and N).

3.5 Installing the wall-mounted drive controller

3.5.1 Suitable installation location for wall mounting

Ensure that the installation location for an INVEOR α 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.

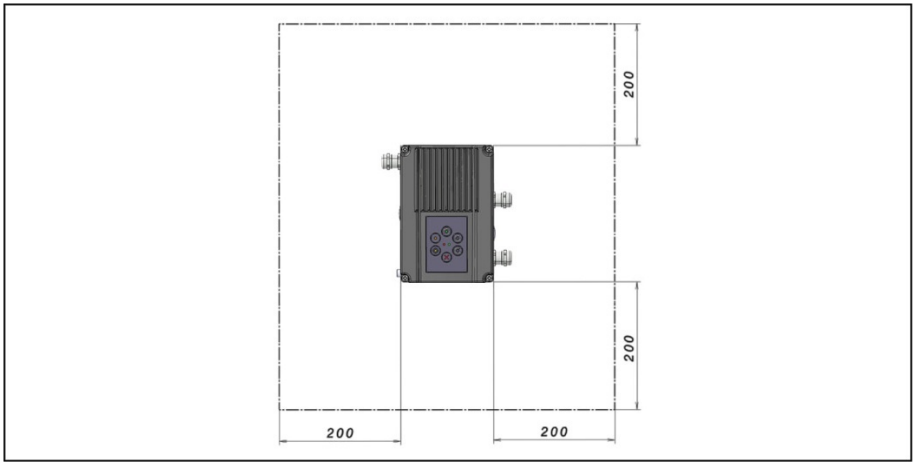


Fig.: 19 Installing the wall-mounted drive controller

For the "wall mounting" version, the line length between the motor and INVEOR αmay not exceed 5 m. Only use a shielded cable with the required cross-section.

3.5.2 Mechanical installation

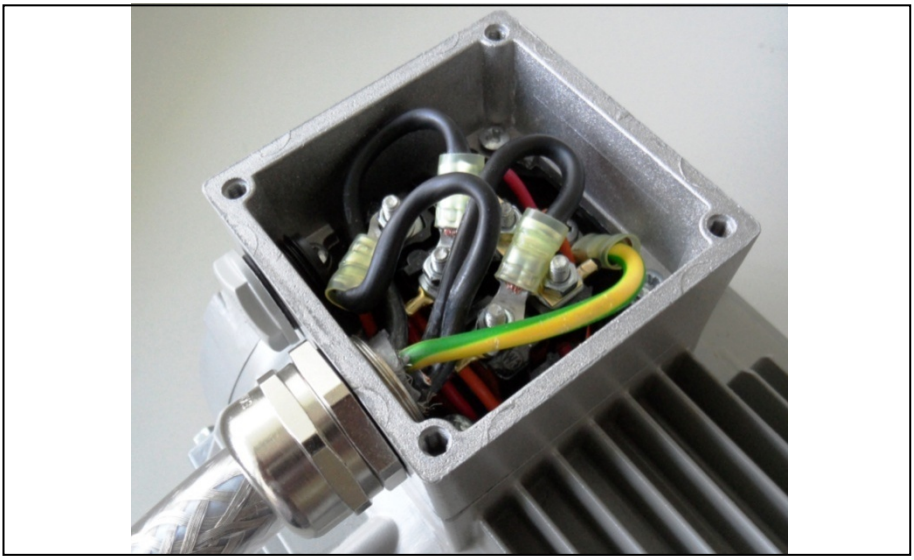


Fig.: 20 Wiring on the motor connection box

1. Open the motor connection box.

IMPORTANT INFORMATION

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

2. Use a suitable EMC screw connection to attach the shielded motor 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.

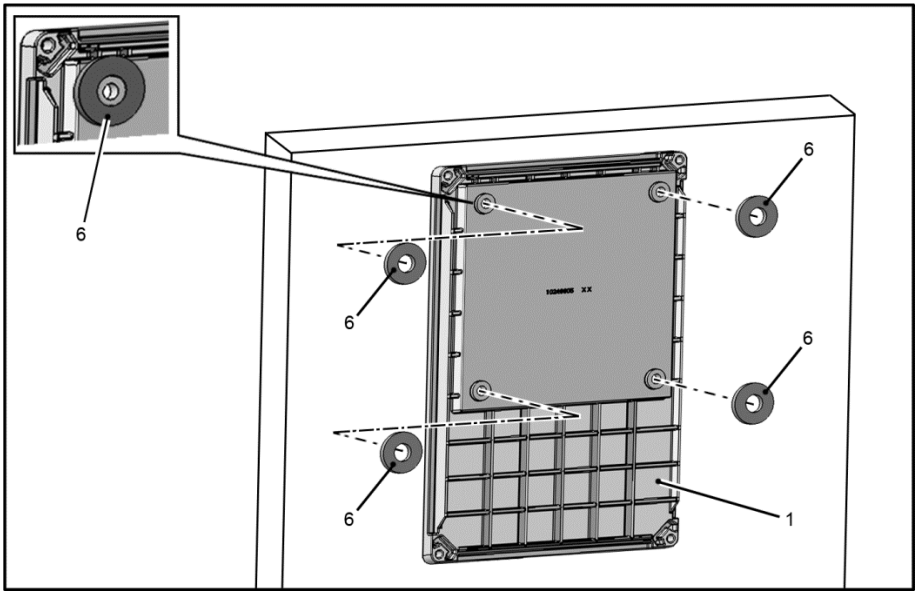


Fig.: 21 Placing flat seals on rear of adapter plate

IMPORTANT INFORMATION

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

5. Find a position that meets the required ambient conditions (see 3.3 "Installation requirements" section).
6. Carefully place flat seals (6) on the rear of adapter plate (1).

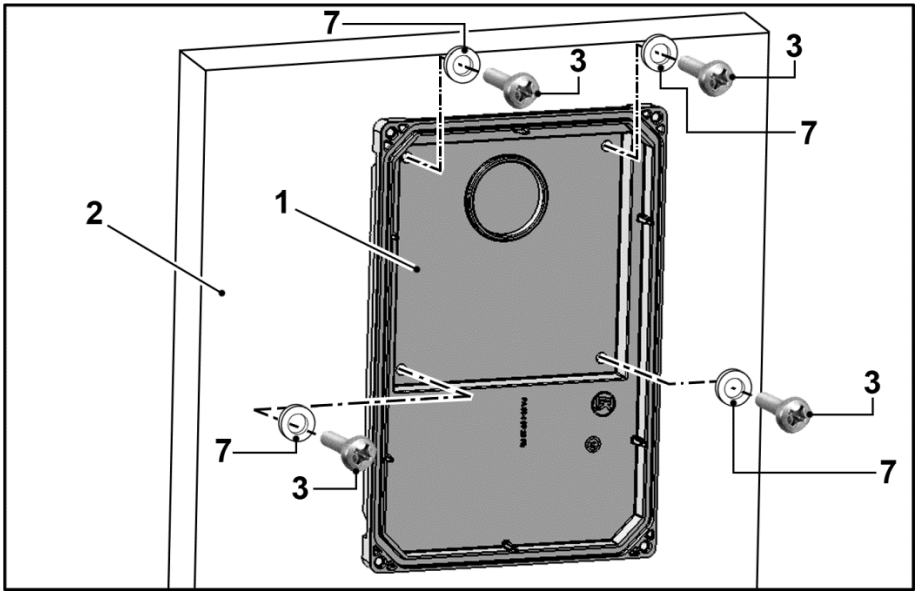


Fig.: 22 Fastening the adapter plate to the wall

IMPORTANT INFORMATION

The adapter plate must not be fitted overhead!

7. Secure adapter plate (1) to your chosen base (2).
8. Depending on the base, use appropriate retaining bolts* (3) and plain washers** (7) for securing.

IMPORTANT INFORMATION

Screw drive controller down to base with no clearance.

Ensure that the seals are in full contact with the base.

* Not part of the scope of delivery

** Not part of the scope of delivery

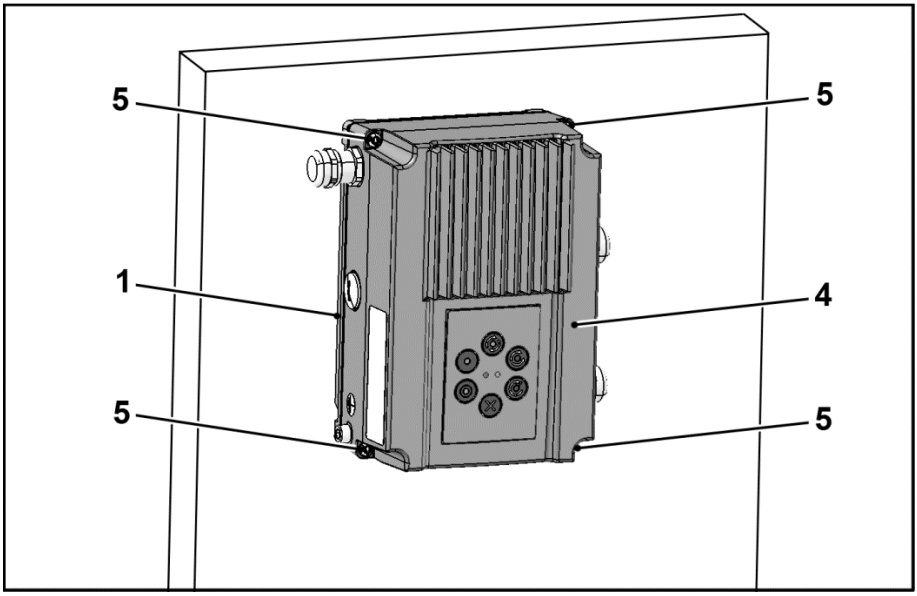


Fig.: 23 Attaching drive controller (wall mounting)

9. Place drive controller (4) on adapter plate (1).
10. Screw down cooling elements (4) to the adapter plate (1) with the help of the screws (5) provided (torque: M_A = 1.2 Nm).

3.5.3 Power connection

The power connections should be designed as described in section 3.3 ff. "Installing the drive controller integrated in the motor".

3.5.4 Control connections

The control connections should be designed as described in section 3.3 ff. "Installing the drive controller integrated in the motor".

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.

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.

DANGER!

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.

4.2 Communication

The drive controller can be commissioned in the following ways:

- using the INVEORpc PC software

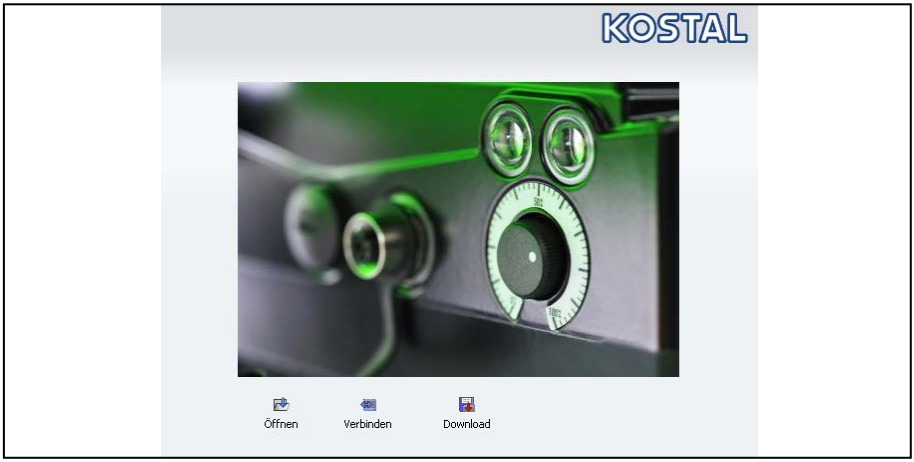


Fig.: 24 PC software – start screen

- using the INVEOR MMI handheld controller*

Fig.: 25 MMI handheld controller

* Man-Machine Interface

4.3 Block diagram

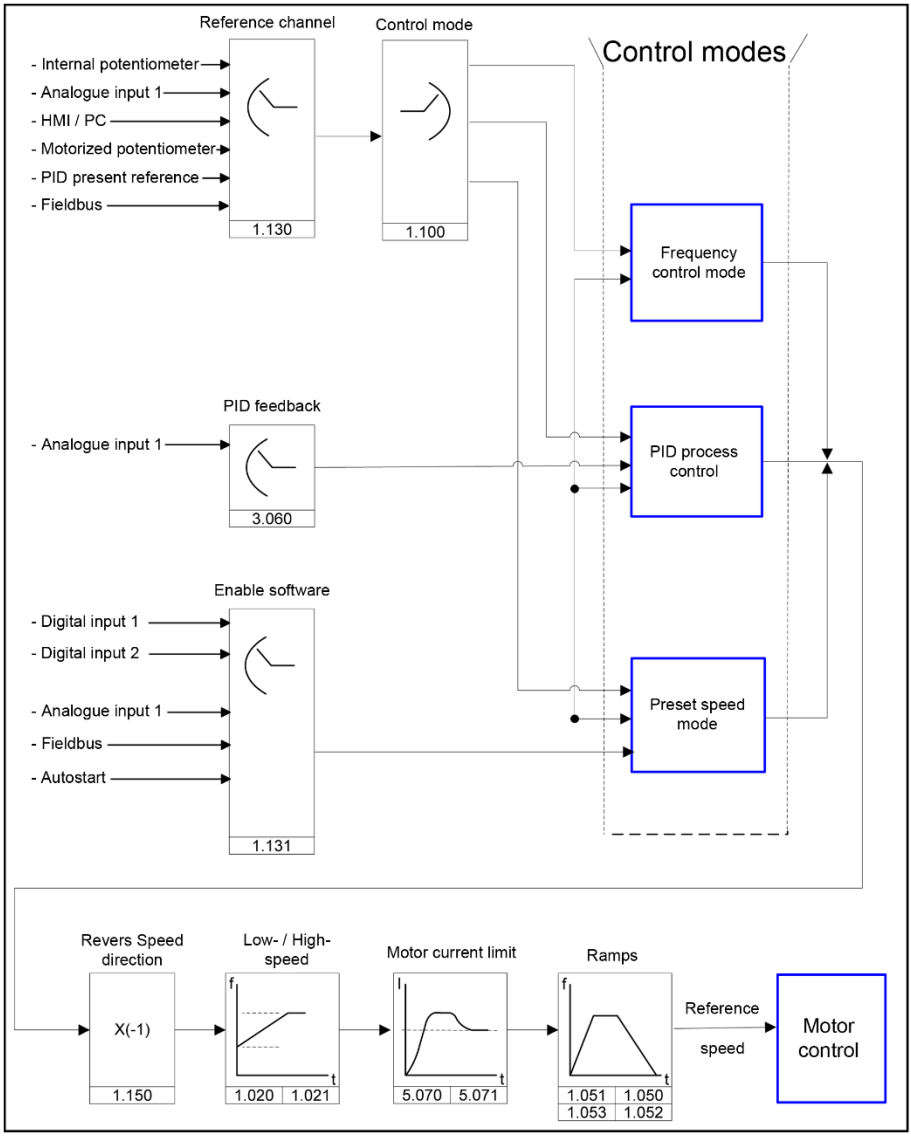


Fig.: 26 General structure of target value generation

4.4 Commissioning steps

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).

As an option, an INVEOR α adapter cable (jack plug on M12) must be used (article no.:10118219)

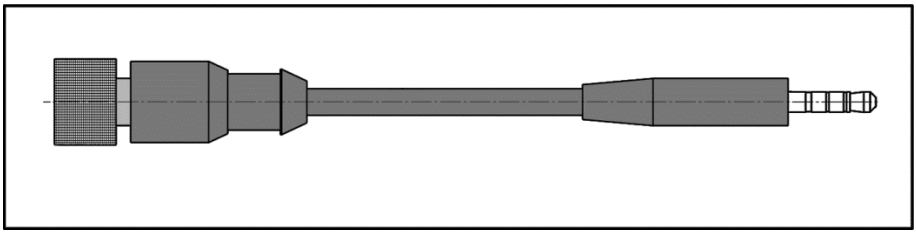


Fig.: 27 INVEOR α adapter cable

The above commissioning options (PC communication cable/handheld controller MMI) may only be used in conjunction with the option (jack plug on M12) (art. no. 10118219).

Commissioning can also be carried out using MMI M12 plugs (line set MMI 4-pin) (art. no. 10118216) (optional).

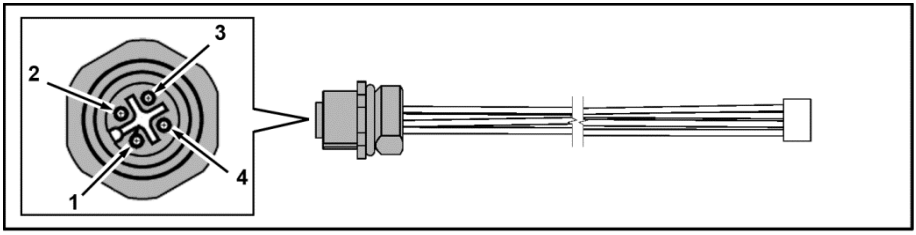


Fig.: 28 MMI M12 plug (JST plug)

M12 plug assignment	Signal
1	24 V
2	RS485 - A

M12 plug assignment	Signal
3	GND
4	RS485 - B

* Man-Machine Interface

4.4.1 Commissioning using the PC:

1. Please install the INVEORpc software. The programming software is available free of charge from the KOSTAL website. Operating system required: Windows XP or Windows 7 [32 / 64 bit]). We recommend undertaking the installation process as an administrator.
2. Unscrew the transparent screw connection.

DAMAGE TO PROPERTY POSSIBLE

The drive controller may be damaged if the notices are not observed!

- When connecting to the jack plug, do not move the INVEOR α adapter cable in the directions indicated by the arrows.
- Only connect the INVEOR α adapter cable to the jack plug in a straight line.

3. Use the optional PC connection cable (art. no. 10023950) to connect the PC to the M12 plug M1 (adapter plug option, art. no. 10118219).
4. Load or determine the motor data record (parameters 33.030 to 33.050); it may be necessary to optimise the speed control (parameters 34.100 to 34.101).
5. Perform the application settings (ramps, inputs, outputs, target values etc.).
6. Optional: Define an access level (1 – MMI, 2 – user, 3 – manufacturer).

DAMAGE TO PROPERTY POSSIBLE

The drive controller may be damaged if the notices are not observed!

- When pulling off the jack plug, do not move the INVEOR α adapter cable in the directions indicated by the arrows.
- Only pull the INVEOR α adapter cable off the jack plug in a straight line.

7. Pull the INVEOR α adapter cable off the jack plug in a straight line.
8. Screw the transparent screw connection back in.

See Fig. of block diagram in chapter Schnellinbetriebnahme 11

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

The following levels exist:

- handheld controller: The drive controller is programmed using the handheld controller.
- user: The basic parameters can be programmed into the drive controller using the PC software.
- Manufacturer: An extended selection of parameters can be programmed into the drive controller using the PC software.

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 α 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. In the case of PID process control, the target value and actual value are compared and the system then regulates to a specific process variable.

Frequency setting mode:

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

PID process control:

The target value for the PID process controller is read in percentage steps as in the “frequency setting mode”. 100 % corresponds to the working range of the connected sensor, which is read in via the actual value input (selected by the “PID actual value”).

Depending on the control difference, a rotation speed value is output to the control output with the help of the amplification factors for the proportional gain (3.050),
integral gain (3.051) and derivative gain (3.052).

In order to prevent the integral share from increasing infinitely in the case of uncontrollable control differences, this value is limited to a specific set value (corresponding to the "maximum frequency" (1.021)).

PID inverted:

The PID actual value can be inverted using parameter 3.061. The actual value is imported inversely, i.e. 0 V…10 V correspond internally to 100%…0%.

Please note that the target value must also be defined inversely.

An example:

A sensor with an analogue output signal (0 V…10 V) is to operate as the source of the actual value (at AIx). At an output variable of 7 V (70 %), this is to be regulated inversely. The internal actual value then corresponds to 100 % – 70 % = 30 %.

In other words, the target value to be specified is 30 %.

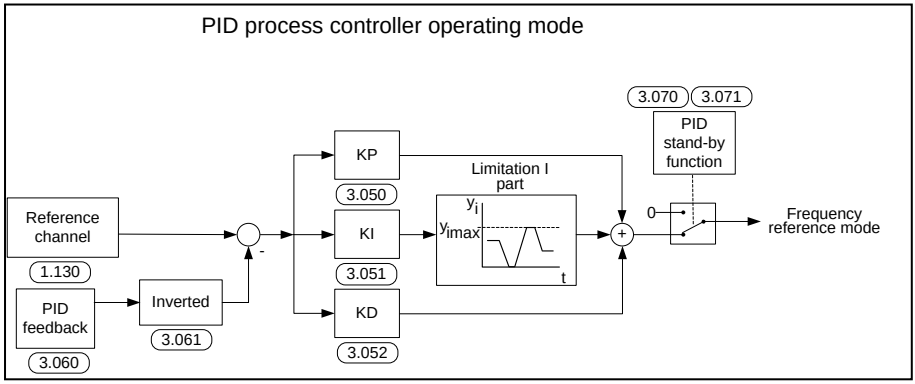


Fig.: 29 PID process control

Stand-by function in PID process control

This function can provide energy savings in applications such as booster stations where PID process control is used to control to a specific process value and the pump has to run at a "minimum frequency" (1.020). As the drive controller can reduce the rotation speed of the pump in normal operation when the process variable is reducing, but it can never fall below the “minimum frequency” (1.020), this provides an opportunity for stopping the motor if it is running during a waiting time, the “PID stand-by time” (3.070) with the “minimum frequency” (1.020).

Once the actual value deviates from the target value by the set % value, the “PID stand-by hysteresis” (3.071), the control (the motor) is started again.

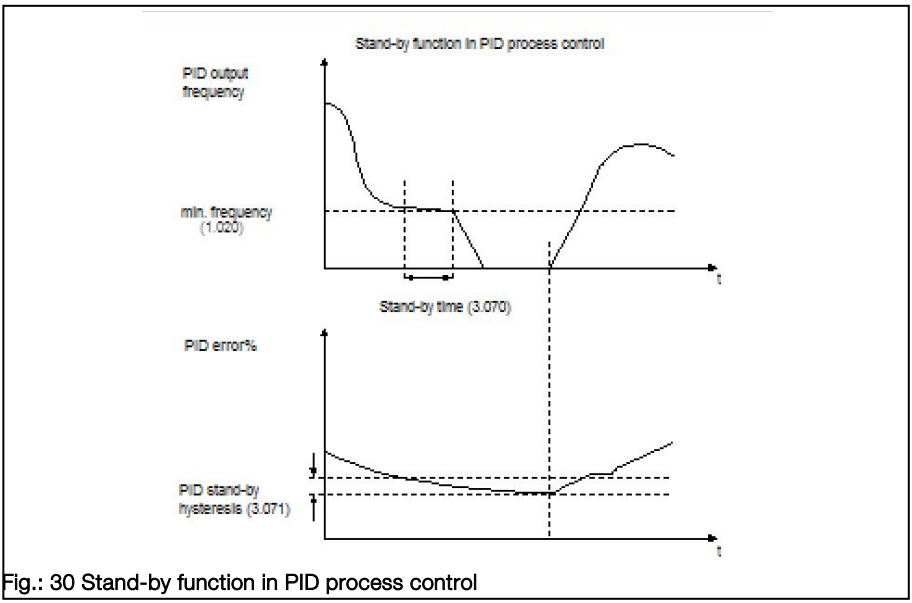


Fig.: 30 Stand-by function in PID process control

Fixed frequency

This operating mode controls the drive controller with up to 3 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 fixed frequencies	-
	Foil keypad (option)	3	2 fixed frequencies	-
	Foil keypad (option)	4		

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

Parameter	Name	Presetting	DI2	DI1
1.020	Min. frequency	0 Hz	0	0
2.051	Fixed frequency 1	10 Hz	0	1
2.052	Fixed frequency 2	20 Hz	1	0
2.053	Fixed frequency 3	30 Hz	1	1

Tab. 2: Logic table for fixed frequencies

5.2.2 Structure of the parameter tables

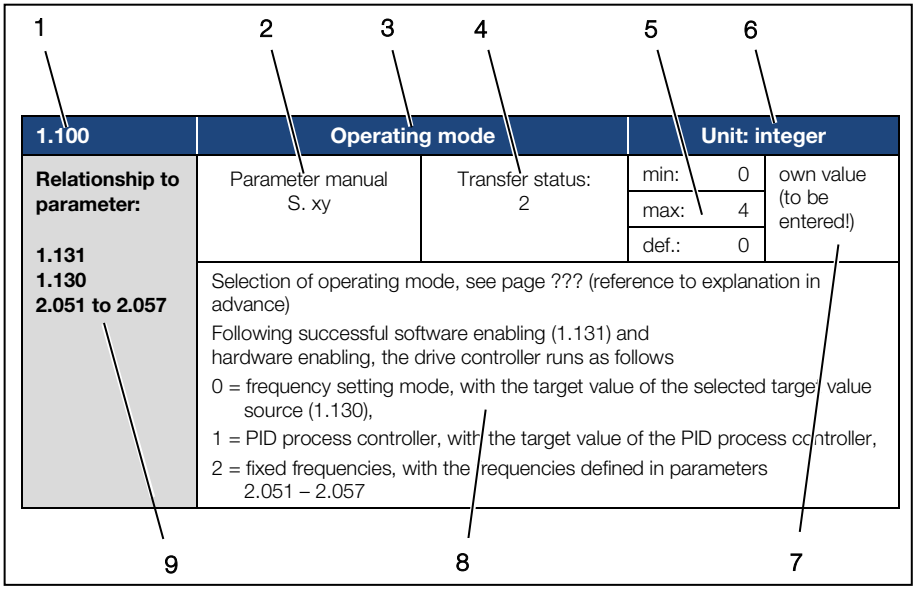


Fig.: 31 Example of a parameter table

Key			
1	Parameter number	6	Unit
2	Description in the parameter manual on page …..	7	Field for entering an own value
3	Parameter name	8	Explanation of the parameter
4	Transfer status 0 = switch drive controller off and on for transfer 1 = at speed of 0 2 = during operation	9	Other parameters related to this parameter.
5	Value range (from – to factory setting)		

5.3 Application parameters

5.3.1 Basic parameter

1.020	Minimum frequency		Unit: Hz	
Relationship to parameter: 1.150 3.070 3.080	Parameter manual: S.xy	Transfer status: 2	min.: 0 max.: 400 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.			

1.021	Maximum frequency		Unit: Hz	
Relationship to parameter: 1.050 1.051	Parameter manual: S.xy	Transfer status: 2	min.: 0 max.: 400 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	Parameter manual: S.xy	Transfer status: 2	min.: 0.1 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 1.054	Parameter manual: S.xy	Transfer status: 2	min.:	0.1	Own value (to be entered!)
			max.:	1000	
			def.:	5	
	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 1.054	Parameter manual: S.xy	Transfer status: 2	min.:	0.1	Own value (to be entered!)
			max.:	1000	
			def.:	10	
	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.				

1.053	Run up time 2				Unit: s
Relationship to parameter: 1.021 1.054	Parameter manual: S.xy	Transfer status: 2	min.:	0.1	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	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	9	
			def.:	0	
	Selection of used ramp pair 0 = deceleration 1 (1.050) / acceleration 1 (1.051) 1 = deceleration 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) 6 = customer PLC 7 = analogue input 1 (must be selected in parameter 4.030) (V 03.70 and higher) 9 = virtual output (4.230) (V 03.70 and higher)				

1.088	Rapid stop		Unit: s		
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.:	0.1	Own value (to be entered!)
			max.:	1000	
			def.:	10	
	Only for the 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**	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 3 0	Own value (to be entered!)
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					

1.130	Target value source		Unit: integer		
Relationship to parameter: **3.062 to 3.069**	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 10 0	Own value (to be entered!)
Determines the source from which the target value is to be read. 0 = internal potentiometer 1 = analogue input 1 3 = MMI/PC 4 = SAS / Modbus (V 03.80 and higher) 6 = motor potentiometer 8 = PID fixed target values (3.062 to 3.069) 9 = field bus 10 = INVEOR soft PLC					

1.131	Enable software		Unit: integer	
Relationship to parameter: 1.132 1.150 2.050 4.030 4.050	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 16 def.: 0	Own value (to be entered!)

⚠ 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

4 = analogue input 1 (must be selected in parameter 4.030)

6 = field bus

7 = SAS / Modbus (V 03.80 and higher)

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 hardware is enabled and a target value has been provided.
This cannot be prevented even with parameter 1.132.

10 = INVEOR soft PLC

11 = fixed frequency inputs (all inputs which were selected in parameter 2.050)

12 = internal potentiometer

13 = foil keypad (Start & Stop keys)

14 = MMI/PC

15 = virtual output (4.230) (V 03.70 and higher)

16 = foil keypad storing (V 03.70 and higher)

1.132	Start protection		Unit: integer		
Relationship to parameter: 1.131	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 8 1	Own value (to be entered!)
	Selection of behaviour in response to enabling software (parameter 1.131). No effect if autostart was selected. 0 = immediate start with high signal at start input of control enable 1 = start only with rising flank at start input of control enable 2 = digital input 1 (function active with high signal) 3 = digital input 2 (function active with high signal) 6 = INVEOR soft PLC 7 = analogue input 1 (must be selected in parameter 4.030) (V 03.70 and higher)				

1.150	Rotation direction		Unit: integer		
Relationship to parameter: 1.131 4.030 4.050	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 16 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) 7 = INVEOR soft PLC 8 = analogue input 1 (must be selected in parameter 4.030) 10 = foil keypad key for reversing direction of rotation (only when motor is running) 11 = foil keypad key 1 forwards / 2 backwards (reversal always possible) 12 = foil keypad key 1 forwards / 2 backwards (reversal only possible when motor stationary) 13 = virtual output (4.230) (V 03.70 and higher) 14 = foil keypad key for reversing direction of rotation (only in operational status) storing (V 03.70 and higher) 15 = foil keypad key I + key II storing (V 03.70 and higher) 16 = foil keypad key I + II (only if motor is stationary) storing (V 03.70 and higher)				

1.180	Acknowledge function		Unit: integer	
Relationship to parameter: 1.181 1.182	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 6 def.: 4	Own value (to be entered!)
	Selection of the source for error confirmation. Errors can only be acknowledged once the error is no longer present. Certain errors can only be acknowledged by switching the controller off and on, see list of errors. 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 5 = foil keypad (Ackn key) 6 = analogue input 1 (must be selected in parameter 4.030) (V 03.70 and higher)			

1.181	Automatic acknowledgement function		Unit: s	
Relationship to parameter: 1.180 1.182	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 1000000 def.: 0	Own value (to be entered!)
	In addition to the acknowledgement function (1.180), an automatic fault acknowledgement can be selected. 0 = no automatic acknowledgement > 0 = time for automatic resetting of error in seconds			

1.182	Number of automatic acknowledgements		Unit:		
Relationship to parameter: 1.180 1.181	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 500 5	Own value (to be entered!)
	In addition to the automatic acknowledgement 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 permitted				

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	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 4 2	Own value (to be entered!)
	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) 3 = foil keypad (key 1 = fixed frequency 1 / key 2 = fixed frequency 2) 4 = fixed frequency (key I = fixed frequency 1 / key II = fixed frequency 2) storing (V 03.70 and higher)				

2.051 to 2.057	Fixed frequency		Unit: Hz		
Relationship to parameter: 1.020 1.021 1.100 1.150 2.050	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	- 400 + 400 0	Own value (to be entered!)
	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 Motor potentiometer

This mode must be selected in parameter 1.130.
The function can be used as a target value source for frequency mode and for the PID process controller.

The motor potentiometer can be used to gradually increase / decrease the target value (PID/frequency). Use parameters 2.150 to 2.154 for this purpose.

2.150	MOP digital Input		Unit: integer		
Relationship to parameter: 1.130 4.030 4.050	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 8 3	Own value (to be entered!)
	Selection of the source for increasing and reducing the target value 0 = digital input 1 + / digital input 2 - 7 = INVEOR soft PLC 8 = foil keypad (key 1 - / key 2 +)				

2.151	MOP step range		Unit: %		
Relationship to parameter: 1.020 1.021	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 100 1	Own value (to be entered!)
	Increments at which the target value changes per keystroke.				

2.152	MOP step time		Unit: s		
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0.02 1000 0.04	Own value (to be entered!)
	Indicates the time during which the target value is totalled with a permanent signal.				

2.153	MOP response time		Unit: s	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 0.02 max.: 1000 def.: 0.3	Own value (to be entered!)
	Indicates the time for which the signal is considered permanent.			

2.154	MOP reference memory		Unit: integer	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	Defines whether the target value of the motor potentiometer is retained even after power outage. 0 = disable 1 = enable			

5.3.4 PID process controller

This mode must be selected in parameter 1.100,
the target value source must be selected in parameter 1.130,
see also chapter 5.2.1 Explanation of operating modes / fixed frequency.

3.050	PID-P amplification factor		Unit:	
Relationship to parameter: **1.100** **1.130**	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 100 def.: 1	Own value (to be entered!)
	Proportional share of PID controller amplification factor			

3.051	PID-P amplification factor		Unit: 1/s	
Relationship to parameter: **1.100** **1.130**	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 100 def.: 1	Own value (to be entered!)
	Integral share of PID controller amplification factor			

3.052	PID-P amplification factor		Unit: s	
Relationship to parameter: 1.100 1.130	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 100 def.: 0	Own value (to be entered!)
	Differential share of PID controller amplification factor			

3.060	PID actual value		Unit: integer	
Relationship to parameter: 1.100 1.130 3.061	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 3 def.: 0	Own value (to be entered!)
	Selection of the input source from which the actual value for the PID process controller is imported: 0 = analogue input 1 2 = INVEOR soft PLC 3 = field bus (fixed customer-specific input variable 2) (V 03.72 and higher)			

3.061	PID inverted		Unit: integer	
Relationship to parameter: 3.060	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	The actual value source (parameter 3.060) is inverted 0 = disable 1 = enable			

3.062 to 3.068	PID fixed target values		Unit: %	
Relationship to parameter: 1.130 3.069	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 100 def.: 0	Own value (to be entered!)
	The PID fixed target values which are to be issued depending on the switching patterns at the digital inputs 1 – 3 specified in parameter 3.069 (has to be selected in parameter 1.130).			

3.069	PID fixed target mode		Unit: integer		
Relationship to parameter: 1.100 3.062 to 3.068	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	2	
			def.:	0	
	Selection of the digital inputs used for fixed frequencies				
	0 = Digital In 1 1 = Digital In 1, 2	(PID fixed target value 1) (3.064) (PID fixed target values 1 – 3) (3.062 to 3.064)			

3.070	PID standby time		Unit: s		
Relationship to parameter: 1.020	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	10000	
			def.:	0	
	If the drive controller runs for the set time at its minimum frequency (parameter 1.020), the motor is stopped (0 Hz), see also Chapter 5.2.1 Explanation of operating modes / fixed frequency. 0 = disable > 0 = waiting time until stand-by function is enabled				

3.071	PID stand-by hysteresis		Unit: %		
Relationship to parameter: 3.060	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	50	
			def.:	0	
	Condition for waking up the PID controller from stand-by. Once the control difference exceeds the set value as %, the control begins again, see also PID controller operating modes.				

3.072	PID dry run time				
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	32767	
			def.:	0	
	(V 03.70 and higher) After this set time, if the PID actual value has not reached at least 5 % and the controller is running at the max. limit, the INVEOR switches off with error no. 16 PID dry run.				

3.073	PID nominal value min				
Relationship to parameter: 3.074	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	100	
			def.:	0	
	(V 03.70 and higher) The PID nominal value can be limited using 2 parameters. Example: 0 -10 V nominal value potentiometer Read Min PID nominal value = 20 % Read Max PID nominal value = 80 % (3.074) Nominal value at < 2 V = 20 % Nominal value at 2 V – 8 V = 20 % - 80 % Nominal value at > 8 V = 80 %				

3.074	PID nominal value max.		Unit: %	
Relationship to parameter: **3.073**	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 100 def.: 100	Own value (to be entered!)
	(V 03.70 and higher) The PID nominal value can be limited using 2 parameters. Example: 0 -10 V nominal value potentiometer Read Min PID nominal value = 20 % Read Max PID nominal value = 80 % (3.073) Nominal value at < 2 V = 0 % Nominal value at 2 V – 8 V = 20 % - 80 % Nominal value at > 8 V = 80 %			

3.080	PID minimum frequency 2		Unit: Hz	
Relationship to parameter: **1.020**	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 400 def.: 0	Own value (to be entered!)
	(V 03.80 and higher) The minimum frequency is calculated depending on the PID target value Example: 1.020 minimum frequency = 10 Hz 3.080 PID minimum frequency 2 = 20 Hz Minimum frequency when PID target value is 0 % = 10 Hz Minimum frequency when PID target value is 50 % = 15 Hz Minimum frequency when PID target value is 100 % = 20 Hz			

5.3.5 Analogue input

For analogue input 1

4.020	AI1 input type		Unit: integer	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 1 max.: 2 def.: 1	Own value (to be entered!)
	Function of analogue input 1. 1 = voltage input 2 = current input			

4.021	AI1 standard. Low		Unit: %	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 100 def.: 0	Own value (to be entered!)
	Specifies the minimum value of the analogue input as a percentage of the range Example: 0…10 V and/or 0…20 mA = 0 %...100 % 2…10 V and/or 4…20 mA = 20 %...100 %			

4.022	AI1 standard. High		Unit: %	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 100 def.: 100	Own value (to be entered!)
	Specifies the maximum value of the analogue input as a percentage of the range. Example: 0…10 V and/or 0…20 mA = 0 %...100 % 2…10 V and/or 4…20 mA = 20 %...100 %			

4.023	AI1 dead time		Unit: %	
Relationship to parameter:	Parameter manual: P. xy	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:	Parameter manual: P. xy	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:	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	Function of analogue input 1 0 = analogue input 1 = digital input			

4.033	AI1 physical unit		Unit:	
Relationship to parameter: 4.034 4.035	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 10 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			

4.034	AI1 physical minimum		Unit:	
Relationship to parameter: 4.033 4.035	Parameter manual: P. xy	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	AI1 physical maximum		Unit:	
Relationship to parameter: 4.033 4.034	Parameter manual: P. xy	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.			

4.036 / 4.066	AI1 wire break time		Unit:	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 32767 def.: 0.5	Own value (to be entered!)
	(V 03.70 and higher) Once the mains is activated, wire break detection is only activated after this set time			

4.037 / 4.067	AIx inversely		Unit: integer	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	(V 03.80 and higher) 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 %)			

5.3.6 Digital inputs

4.110 to 4.111	DIx inverted		Unit: integer	
Relationship to parameter:	Parameter manual: P. xy	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			

5.3.7 Digital output

For digital input 1

4.150	DO1 function		Unit: integer	
Relationship to parameter: 4.151 4.152	Parameter manual: P. xy	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 assigned / INVEOR soft PLC
1	=	Intermediate circuit voltage
2	=	Grid voltage
3	=	Motor voltage
4	=	Motor current
5	=	Actual frequency value
8	=	IGBT temperature
9	=	Inner temperature
10	=	Error (NO)
11	=	Error inverted (NC)
12	=	Limit steps enable
13	=	Digital input 1
14	=	Digital input 2
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	=	Field bus
26	=	Analogue input 1 (V 3.60 and higher)
28	=	PID target value (V 3.60 and higher)
29	=	PID actual value (V 3.60 and higher)

Table continues on next page

4.150	DO1 function		Unit: integer	
Relationship to parameter: 4.151 4.152	Parameter manual: P. xy	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. **Continuation of table** 30 = STO channel 1 (V 03.70 and higher) 31 = STO channel 2 (V 03.70 and higher) 32 = Target frequency value after ramp (V 03.70 and higher) 33 = Target frequency value (V 03.70 and higher) 34 = Actual speed value (V 03.70 and higher) 35 = Actual frequency value sum (V 03.70 and higher) 36 = Torque sum (V 03.70 and higher) 37 = Target frequency value after ramp sum (V 03.70 and higher) 38 = Target frequency value sum (V 03.70 and higher) 39 = Actual speed value sum (V 03.70 and higher) 50 = Motor current limit enabled (V 03.70 and higher) 51 = Nominal-actual comparison (para. 6.070 – 6.071) (V 03.70 and higher)			

4.151	DO1 on		Unit:	
Relationship to parameter: 4.150	Parameter manual: P. xy	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.				

4.152	DO1 off		Unit:	
Relationship to parameter: 4.150	Parameter manual: P. xy	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.				

5.3.8 Relay

For relay 1

4.190	Rel.1 function		Unit: integer	
Relationship to parameter: 4.191 4.192	Parameter manual: P. xy	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 assigned / INVEOR soft PLC
1	=	Intermediate circuit voltage
2	=	Grid voltage
3	=	Motor voltage
4	=	Motor current
5	=	Actual frequency value
8	=	IGBT temperature
9	=	Inner temperature
10	=	Error (NO)
11	=	Error inverted (NC)
12	=	Limit steps enable
13	=	Digital input 1
14	=	Digital input 2
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	=	Field bus
26	=	Analogue input 1 (V 3.60 and higher)
28	=	PID target value (V 3.60 and higher)
29	=	PID actual value (V 3.60 and higher)

Table continues on next page

4.190	DO1 function		Unit: integer	
Relationship to parameter: 4.151 4.152	Parameter manual: P. xy	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. **Continuation of table** 30 = STO channel 1 (V 03.70 and higher) 31 = STO channel 2 (V 03.70 and higher) 32 = Target frequency value after ramp (V 03.70 and higher) 33 = Target frequency value (V 03.70 and higher) 34 = Actual speed value (V 03.70 and higher) 35 = Actual frequency value sum (V 03.70 and higher) 36 = Torque sum (V 03.70 and higher) 37 = Target frequency value after ramp sum (V 03.70 and higher) 38 = Target frequency value sum (V 03.70 and higher) 39 = Actual speed value sum (V 03.70 and higher) 50 = Motor current limit enabled (V 03.70 and higher) 51 = Nominal-actual comparison (para. 6.070 – 6.071) (V 03.70 and higher)				

4.191	Relay 1 on		Unit:	
Relationship to parameter: 4.190	Parameter manual: P. xy	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.				

4.192	Relay 1 off		Unit:	
Relationship to parameter:	Parameter manual:	Transfer status: 2	min: - 32767	Own value (to be entered!)
			max: 32767	
4.190	P. xy		def.: 0	
	If the set process variable exceeds the switch-off limit, the output is again set to 0.			

4.193	Relay1 on delay		Unit: s	
Relationship to parameter:	Parameter manual:	Transfer status: 2	min.: 0	Own value (to be entered!)
			max.: 10000	
4.194	P. xy		def.: 0	
	Specifies the length of the switch-on delay.			

4.194	Relay1 off delay		Unit:	
Relationship to parameter:	Parameter manual:	Transfer status: 2	min.: 0	Own value (to be entered!)
			max.: 10000	
4.193 / 4.213	P. xy		def.: 0	
	Specifies the length of the switch-off delay.			

5.3.9 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 5.010 / 5.011 5.090	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 51 def.: 0	Own value (to be entered!)

(V 03.70 and higher)

Selection of the process variable to which the output should switch.

0	=	Not assigned / INVEOR soft PLC
1	=	Intermediate circuit voltage
2	=	Grid 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)
12	=	Limit steps enable
13	=	Digital input 1
14	=	Digital input 2
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 (V 03.84 and higher)

Table continues on next page

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	Parameter manual: P. xy	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. **Continuation of table** 26 = Analogue input 1 (V 3.60 and higher) 28 = PID target value (V 3.60 and higher) 29 = PID actual value (V 3.60 and higher) 30 = STO channel 1 31 = STO channel 2 32 = Nominal frequency value after ramp 33 = Nominal frequency value 34 = Actual speed value 35 = Actual frequency value sum 36 = Torque sum 37 = Nominal frequency value after ramp sum 38 = Nominal frequency value sum 39 = Actual speed value sum 50 = Motor current limit enabled 51 = Nominal-actual comparison (para. 6.070 – 6.071)			

4.231	VO-On		Unit:	
Relationship to parameter: **4.230**	Parameter manual: P. xy	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**	Parameter manual: P. xy	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	Parameter manual: P. xy	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	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 10000 def.: 0	Own value (to be entered!)
	Specifies the length of the switch-off delay.			

5.3.10 External fault

5.010 / 5.011	External fault 1/2		Unit: integer	
Relationship to parameter: 4.110 / 4.111 4.230	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 6 def.: 0	Own value (to be entered!)
	Selection of source via which an external fault can be reported. 0 = Not assigned / INVEOR soft PLC 1 = Digital input 1 2 = Digital input 2 5 = Virtual output (parameter 4.230) (V 03.70 and higher) 6 = Analogue input 1 (must be selected in parameter 4.030) (V 03.70 and higher)			
	If there is a high signal at the selected digital input, the drive controller switches with fault no. 23 / 24 of external fault ½. Parameters 4.110 to 4.113 Dix inverted can be used to invert the logic of the digital input.			

5.3.11 Motor current limit

This function limits the motor current to a parameterised maximum value after a parameterised current-time zone has been reached.

This motor current limit is monitored at application level and thereby limits with relatively low dynamics. 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 parameterised value.

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

5.070	Motor current limit as %		Unit: %		
Relationship to parameter: 5.071 33.031	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	250	
			def.:	0	
	0 = disable **See description 5.3.1**				

5.071	Motor current limit S		Unit: s		
Relationship to parameter: 5.070 33.031	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	100	
			def.:	1	
	See description 5.3.1				

5.075	5.4 Gearbox factor		Unit:	
Relationship to parameter:	Parameter manual:	Transfer status: 2	min.: 0	Own value (to be entered!)
			max.: 1000	
33.034	P. xy		def.: 1	
	A gearbox factor can be set here. The mechanical speed display can be adjusted using the gearbox factor.			

5.4.1 Blocking detection

5.080	Blocking detection		Unit: integer	
Relationship to parameter:	Parameter manual:	Transfer status: 2	min.: 0	Own value (to be entered!)
			max.: 1	
5.081	P. xy		def.: 0	
	This parameter can be used to activate stall detection. 0 = disable 1 = enable			

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

5.082	Start-up error active		Unit: integer		
Relationship to parameter: 4.233	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	1	
			def.:	1	
	(V 03.70 and higher) Start-up error is defined as follows: Actual value does not reach 10 % of the rated motor frequency after 30 seconds (if nominal frequency < 10 %, the error is not generated). If the acceleration time is parameterised as > 60 seconds, half the acceleration time is used in place of the 30 seconds. 0 = Function disabled 1 = Function enabled				

5.083	Deactivation error log 11		Unit: integer		
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	10	
			def.:	0	
	(V 03.80 and higher) If supplied with external 24 V, the logging of error no. 11 "Time out power" can be suppressed here. The error counter is not affected. 0 = Function disabled 1 = Function enabled				

5.090	Parameter set change		Unit: integer		
Relationship to parameter: 4.030 4.230	Parameter manual: P. xy	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 set 1 active
2	=	Data set 2 active
3	=	Digital input 1
4	=	Digital input 2
7	=	INVEOR soft PLC
8	=	Virtual output (parameter 4.230) (V 03.70 and higher)
9	=	Analogue input 1 (V 03.70 and higher)
11	=	Foil keypad key I for data set 1, key II for data set 2 (V 03.70 and higher)
12	=	Foil keypad key I for data set 1, key II for data set 2 storing (V 03.70 and higher)

The 2nd data set 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.

5.200	Turning MMI display		Unit: integer		
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	1	
			def.:	0	

(V 03.80 and higher)
Only for MMI in cover.
Here the user can define whether the screen / key assignment is turned 180°.
0 = Function disabled
1 = Function enabled

5.201	Save MMI display		Unit: integer	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 1 max.: 5 def.: 1	Own value (to be entered!)
	(V 03.80 and higher) 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:	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 9999 def.: 0	Own value (to be entered!)
	(V 03.88 and higher) A password can be allocated here, which is requested when expert mode is selected in the MMI. 0: Password request deactivated The password can be individually set in both data sets.			

5.4.2 Field bus

6.060	Fieldbus address		Unit: integer	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 0	min.: 0 max.: 127 def.: 0	Own value (to be entered!)
	The fieldbus address can be set here. A change to the fieldbus address is only undertaken once INVEOR is restarted			

6.061	Set field bus baud rate		Unit: integer		
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	8	
			def.:	2	
	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	Set bus time-out		Unit: s		
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	100	
			def.:	5	
	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.

6.070 / 6.071	Target / nominal value deviation		Unit: %	
Relationship to parameter: 4.150 4.190 4.230	Parameter manual: P. xy	Transfer status: 2	min.: 0 % / 0 sec. max.: 100 % / 32767 sec. def.: 0 % / 0 sec.	Own value (to be entered!)
	A target / actual value comparison can be undertaken with this function. The result is output via the field bus status word or a digital output. Parameter 6.070 can be used to define the tolerance range of the target value. Parameter 6.071 can be used to set the time for which the actual value has to be outside the tolerance range before the output is reset. Example: Operating mode = PID control PID target value = 50 % 6.070 = 10 % 6.071 = 1 sec. As soon as the actual value is between 40 % and 60 %, the output is set. If the actual value is outside 40 % to 60 % for 1 sec., the output is reset.			

5.5 Performance parameters

5.5.1 Motor data

33.001	Type of motor		Unit: integer	
Relationship to parameter: 33.010	Parameter manual: P. xy	Transfer status: 1	min.: 1 max.: 2 def.: 1	Own value (to be entered!)
	Selection of type of motor. 1 = asynchronous motor 2 = synchronous motor The parameters are shown depending on the type of motor selected. The type of control (parameter 34.010) must also be selected.			

33.015	R optimisation		Unit: %	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 1	min.: 0 max.: 200 def.: 100	Own value (to be entered!)
	If necessary, this parameter can be used to optimise the start-up behaviour.			

33.016	Motor phases monitoring		Unit: integer	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 1	min.: 0 max.: 1 def.: 1	Own value (to be entered!)
	(V 03.72 and higher) The "Motor connection interrupted" error monitoring (error -45) can be disabled with this parameter. 0 = Monitoring disabled 1 = Monitoring enabled			

33.031	Motor current		Unit: A	
Relationship to parameter: 5.070	Parameter manual: P. xy	Transfer status: 1	min.: 0 max.: 150 def.: 0	Own value (to be entered!)
	This is used to set the nominal motor current $I_{M,N}$ for either the star or triangle connection.			

33.032	Motor rating		Unit: W	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 1	min.: 0 max.: 55000 def.: 0	Own value (to be entered!)
	A performance value [W] $P_{M,N}$ has to be set here that corresponds to the nominal motor rating.			

33.034	Motor speed		Unit: rpm		
Relationship to parameter: 34.120 5.075	Parameter manual: P. xy	Transfer status: 1	min:	0	Own value (to be entered!)
			max:	10000	
			def.:	0	
	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:	Parameter manual: P. xy	Transfer status: 1	min.:	10	Own value (to be entered!)
			max.:	400	
			def.:	0	
	This is where the nominal motor frequency $f_{M,N}$ is set.				

33.050	Stator resistance		Unit: Ohm		
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 1	min.:	0	Own value (to be entered!)
			max.:	100	
			def.:	0.001	
	The stator resistance can be optimised here, if the automatically determined value (motor identification) is insufficient.				

33.105	Leakage inductance		Unit: H		
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 1	min.:	0	Own value (to be entered!)
			max.:	1	
			def.:	0	
	Only for asynchronous motors. Here the leakage inductance can be optimised if the automatically calculated value (of motor identification) isn't sufficient.				

33.110	Motor voltage		Unit: V	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 1	min.: 0 max.: 1500 def.: 0	Own value (to be entered!)
	Only for asynchronous motors. This is used to set the nominal motor voltage $U_{M,N}$ for either the star or triangle connection.			

33.111	Motor cos phi		Unit: 1	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 1	min.: 0.5 max.: 1 def.: 0	Own value (to be entered!)
	Only for asynchronous motors. The value from the motor's type plate data has to be entered here for the power factor cos phi.			

33.200	Stator inductance		Unit: H	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 1	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	For synchronous motors only. The stator inductance can be optimised here if the automatically determined value (motor identification) is insufficient.			

33.201	Nominal flux		Unit: mVs	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 1	min.: 0 max.: 10000 def.: 0	Own value (to be entered!)
	For synchronous motors only. The nominal flux can be optimised here if the automatically determined value (motor identification) is insufficient.			

5.5.2 I²T

33.010	I²T fact. motor		Unit: %		
Relationship to parameter: 33.031 33.011	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 1000 100	Own value (to be entered!)
	The percentage current threshold (in relation to motor current 33.031) at the start of integration can be set here. 0 % = disable We recommend using winding protection contacts in heat-sensitive applications!				

33.011	I²T time		Unit: s		
Relationship to parameter: 33.010	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 1200 30	Own value (to be entered!)
	Time after which the drive controller switches off with I²T.				

33.138	Holding current time		Unit: s		
Relationship to parameter: 33.010	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 3600 2	Own value (to be entered!)
	Only for asynchronous motors. This is the time during which the drive is held at continuous current after the brake ramp has been completed.				

5.5.3 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:	Parameter manual:	Transfer status: 2	min.:	1	Own value (to be entered!)
			max.:	4	
33.010	P. xy		def.:	2	
	Selection of the switching frequency for the drive controller: 1 = 16 kHz 2 = 8 kHz 4 = 4 kHz				

5.5.4 Controller data

34.010	Control method		Unit: integer		
Relationship to parameter:	Parameter manual:	Transfer status: 2	min.:	100	Own value (to be entered!)
			max.:	201	
33.001 34.011	P. xy		def.:	100	
	Selection of the control method: 100 = open-loop asynchronous motor 200 = open-loop synchronous motor				

34.020	Flying restart		Unit:		
Relationship to parameter:	Parameter manual:	Transfer status: 2	min.:	0	Own value (to be entered!)
			max.:	1	
34.021	P. xy		def.:	1	
	This parameter can be used to activate the flying restart. 0 = disable 1 = enable				

34.021	Catch time		Unit: ms	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 10 000 def.: 100	Own value (to be entered!)
	The catch time can be optimised here, if the automatically determined results (of the motor identification) are insufficient.			

34.090	Speed controller K_p		Unit: mA / rad / s	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 10000 def.: 150	Own value (to be entered!)
	For asynchronous motors: The control boost of the speed controller can be optimised here, if the automatically determined results (of the motor identification) are insufficient. For synchronous motors: The control boost of the speed controller can be set here.			

34.091	Speed controller T_n		Unit: s	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 10 def.: 4	Own value (to be entered!)
	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, we would recommend a value between 0.1 s and 0.5 s.			

34.110	Slip trimmer		Unit:		
Relationship to parameter: 33.034	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 1.5 1	Own value (to be entered!)
	Only for asynchronous motors. 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.				

34.130	Voltage control reserve		Unit:		
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 2 0.95	Own value (to be entered!)
	Only for asynchronous motors. This parameter can be used to adjust voltage output.				

5.5.5 Quadratic characteristic curve

34.120	Quadratic characteristic curve		Unit: integer		
Relationship to parameter: 34.121	Parameter manual: P. xy	Transfer status: 2	min.: max.: def.:	0 1 0	Own value (to be entered!)
	Only for asynchronous motors. The quadratic characteristic curve function can be activated here. 0 = disable 1 = enable				

34.121	Flux adjustment		Unit: %	
Relationship to parameter: 34.120	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 100 def.: 50	Own value (to be entered!)
	Only for asynchronous motors. The percentage by which the flux is to be reduced can be set here. An overvoltage shutdown can occur if there are any major changes in operation.			

5.5.6 Synchronous motor controller data

34.225	Field weakening		Unit: integer	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	For synchronous motors only. 0 = disable, the motor cannot be run in the field weakening. 1 = enable, the motor can be placed in the field weakening until the drive controller has reached its current limit or the maximum permissible electromotive force.			

34.226	Starting current		Unit: %	
Relationship to parameter: 34.227	Parameter manual: P. xy	Transfer status: 2	min.: 5 max.: 1000 def.: 25	Own value (to be entered!)
	For synchronous motors only. Here the current which was stamped in the motor before starting the control can be adjusted. Value as % of nominal motor current.			

34.227	Init time		Unit: s	
Relationship to parameter: 34.226	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 100 def.: 0.25	Own value (to be entered!)
	For synchronous motors only. Here the time during which the start up current 34.226 is stamped can be set.			

34.228 – 34.230	Start-up procedure		Unit: integer	
Relationship to parameter:	Parameter manual: P. xy	Transfer status: 2	min.: 0 max.: 1 def.: 0	Own value (to be entered!)
	For synchronous motors only. By changing the start-up procedure to “Controlled”, higher starting torques can be achieved. 0 = regulated, the drive controller directly to the control after the stamping phase. 1 = controlled, after the stamping phase the rotation field is increased by the control with start ramp 34.229 up to start frequency 34.230, then switched to the controller.			

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 drive controller 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
☀	○	Boot loader active (flashing in turn)
○	☀	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. 3: 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-Quittierfunktion (Parameter 1.181)
- Switch device off and on via fieldbus (CANOpen, Profibus DP, EtherCAT)

IMPORTANT INFORMATION

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 not OK or external supply not OK.
6	Customer PLC version error	The version of the customer PLC doesn't match the device firmware	Check the version numbers of the customer PLC and device firmware
8	Communication application<>power	Internal communication between the application plate and the power-conducting plate is not OK	EMC interference

No.	Error name	Description of error	Possible causes/remedy
10	Parameter distributor	The internal distribution of parameters during initialisation failed	Parameter set is incomplete
11	Time-out power	The power part does not respond	Operation with 24 V without mains feed-in
13	Cable break at analogue in1 (4–20 mA / 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
16	PID dry run	No PID actual value despite maximum speed	PID actual value sensor defective. Extend dry run time (parameter 3.072)
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).
18	Excess temperature for frequency converter application	Inner temperature too high	Insufficient cooling, low motor speed and high torque, switching frequency too high.
21	Bus time-out	No response from bus sharing unit or MMI/PC	Check bus wiring
22	Acknowledgement error	The number of maximum automatic acknowledgements (1.182) was exceeded	Check error history and remedy error
23	External fault 1	The parameterised fault input is active. 5.010	Correct the external fault
24	External fault 2	The parameterised fault input is active. 5.011	Correct the external fault
25	Motor detection	Motor identification error	Check INVEOR/motor and PC / MMI / INVEOR connections / restart motor identification

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 / mains voltage too high / faulty setting for rotation speed controller / brake resistor not connected or defective / ramp times too short
34	Undervoltage of intermediate circuit	The minimum intermediate circuit voltage has not been reached	Mains voltage too low, mains 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	Interruption to grid voltage present	A mains phase is missing / mains voltage has been disrupted
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 parameterised) has been triggered	Permanent overload

No.	Error name	Description of error	Possible causes/remedy
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
53	Motor tipped	Only for synchronous motors, field orientation lost	Load too high. Optimise controller parameters.

Tab. 4: 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

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

.

DANGER!

Risk of death due to electrical shock!

Death or serious injury!

De-energise drive controller 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.

1. Release four retaining bolts of cooling elements.
2. Carefully lift cooling elements off adapter plate.
3. Remove all cables.
4. Remove the drive controller.
5. Release the adapter plate's retaining bolts.
6. Remove the adapter plate.

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 230 V devices

	Size	M α			
Electrical data	Recommended motor rating [1] [kW]	0.25 kW	0.37 kW	0.55 kW	0.75 kW
	Supply voltage [2]	1 x 100 VAC -15 %...230 VAC +10 % 140 VDC -15 %...320 VDC +10 %			
	Grid frequency	50/60 Hz ± 6 %			
	Mains configurations	TN / TT / IT (option)			
	Mains current [A]	4.5	4.5	5.8	7.3
	Rated output current eff.[IN at 8 kHz]	1.4 [A]	2.2 [A]	2.7 [A]	3.3 [A]
	Min. brake resistance [Ω]	-			
	Overload for 60 sec.	150 %			
	Switching frequency	4 kHz, 8 kHz, 16 kHz, (factory setting 8 kHz)			
	Output frequency	0 Hz – 400 Hz			
	Mains cycles of operation / restart	Every 2 min.			
	DIN EN 61800-5 touch current	< 10 mA [3]			
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 protection			
	Software functions	Process control (PID controller), fixed frequencies, data record changeover, flying restart, motor current limit			
	Soft PLC	IEC61131-3, FBD, ST, AWL			
Mechanical data	Housing	Plastic adapter plate / aluminium die-cast casing			
	Dimensions [L x W x H] mm	187 x 126 x 70		187 x 126 x 80	
	Weight including adapter plate	1.5 kg			
	Protection class [IPxy]	IP 65			
	Cooling	Passive cooling			
Environmental conditions	Ambient temperature	-10 °C (non-condensing) to +40 °C (50 °C with derating) [4]			
	Storage temperature	-25 °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 60068-2-6)	50 m/s²; 5…200 Hz [5]			
	Shock resistance (DIN EN 60068-2-27)	300 m/s²			
	EMC (DIN-EN-61800-3)	C2			

Tab. 5: Technical data for 230 V devices (subject to technical changes)

Technical data for INVEOR M 230 V devices (subject to technical changes)

[1] Recommended motor rating (4-pole asynchr. motor) is given based on the 230 VAC supply voltage.

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

[3] Combined vibration test, part 4, severity 2 in accordance with FN942017

Subject to technical change.

8.1.2 Specification of interfaces

Designation	Function
Digital inputs 1 – 2	- Switching level low < 5 V / high > 15 V - Imax (at 24 V) = 3 mA - Rin = 8.6 kOhm
Hardware approval for input	- Switching level low < 3 V / high > 18 V - Imax (at 24 V) = 8 mA
Analogue inputs 1	- In +/- 10 V or 0 - 20 mA - In 2 - 10 V or 4 - 20 mA - 10-bit resolution - Tolerance +/- 2 % Voltage input: - Rin = 10 kOhm Current input: - Working resistance = 500 Ohm
Digital outputs 1	- Short-circuit proof - Imax = 20 mA
Relay 1	1 changeover contact (NO/NC) Maximum switching power * - at ohmic load (cos φ = 1): 5 A at ~ 230 V or = 30 V - at inductive load (cos φ = 0.4 and L/R = 7 ms): 2 A at ~ 230 V or = 30 V Maximum reaction time: 7 ms ± 0.5 ms Electric life: 100 000 switching cycles
Power supply 24 V	- Auxiliary voltage U = 24 V DC - Short-circuit proof - Imax = 100 mA - external feeding of 24 V possible
Power supply 10 V	- Auxiliary voltage U = 10 V DC - Short-circuit proof - Imax = 30 mA

Tab. 6: Specification of interfaces

***** in accordance with UL-61800-5-1 the maximum allowed is 2 A!

8.2 Derating of output power

Drive controllers of the INVEOR α 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.

The INVEOR α is designed for an overload of 150 % for 60 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 switching frequency permanently set too high >8 kHz (load-dependent).
- A permanently increased heat sink temperature, caused by 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

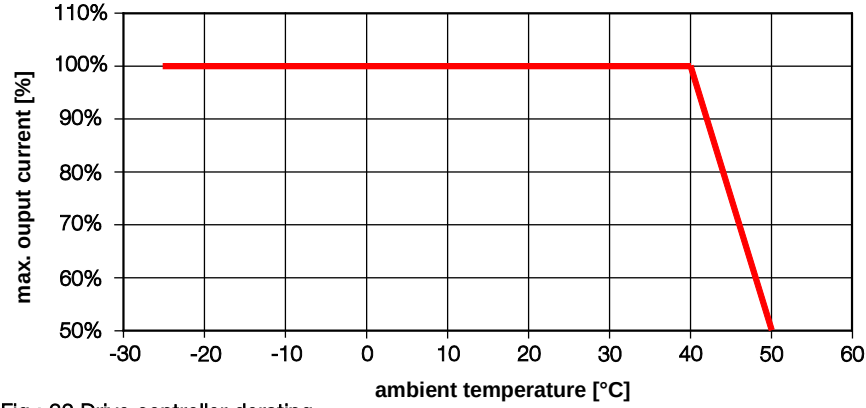


Fig.: 32 Drive controller derating

8.2.2 Derating due to installation altitude

The following applies to all INVEOR α 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 α'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.

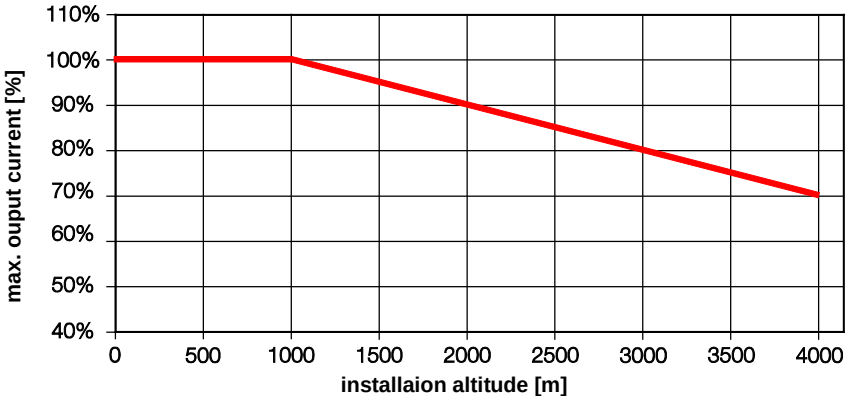


Fig.: 33 Derating of maximum output current as a result of installation altitude

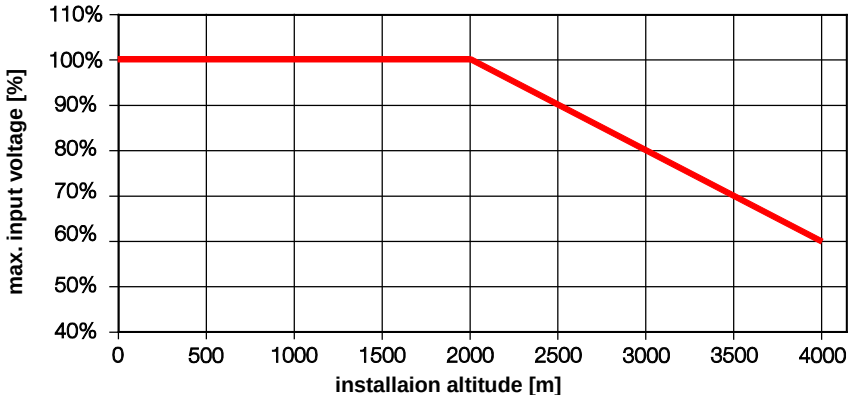


Fig.: 34 Derating of maximum input voltage as a result of installation altitude

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.

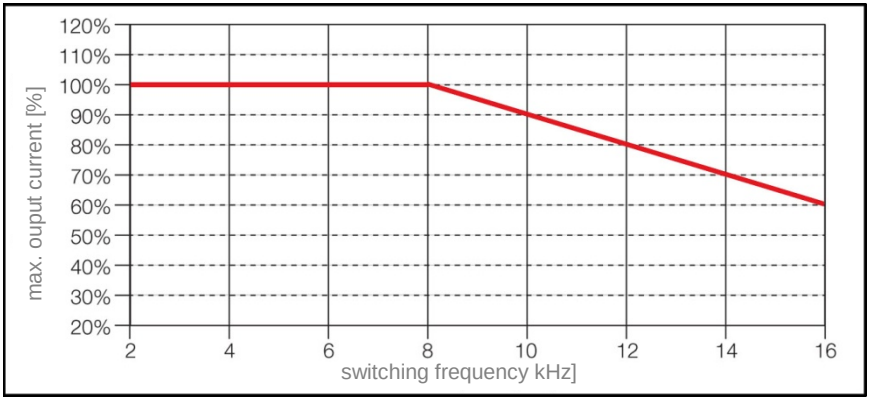


Fig.: 35 Derating of maximum output current as a result of switching frequency

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 is available for each INVEOR α size.
Download the 3D files (.stp) for INVEOR and adapter plates from
https://www.kostal-industrie-elektrik.com/en-gb/downloads/download-drives.

INVEOR size	M α
Output	**0.25 kW to 0.75 kW**
Designation	ADP Mα MOT 0000 A-000 1
Art. no.	10117052

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 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 assumes no liability for the connection between the motor and INVEOR!

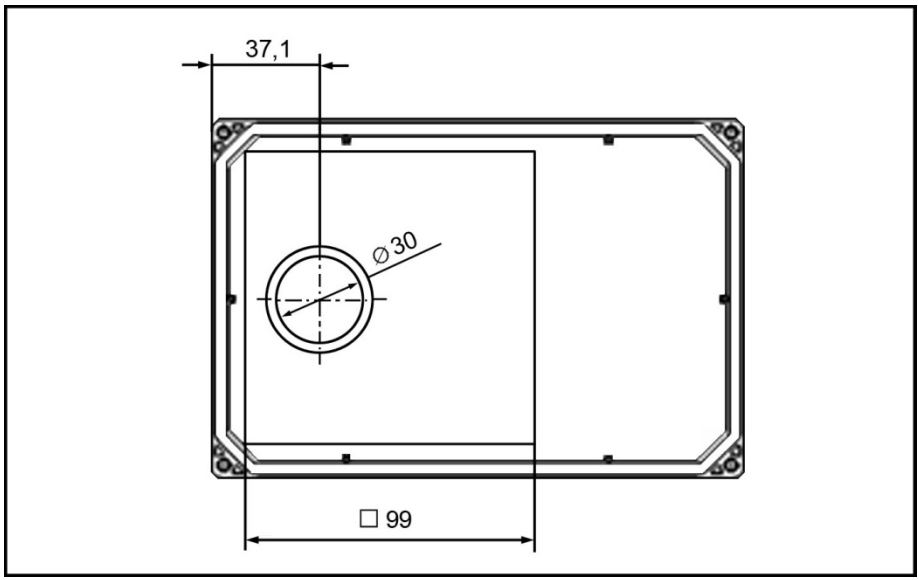


Fig.: 36 Hole pattern for size α standard adapter plate

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.

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, 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 is available for each INVEOR α size.
Download the 3D files for INVEOR and adapter plates from
https://www.kostal-industrie-elektrik.com/en-gb/downloads/download-drives.

Four holes for mounting the adapter plate are present.

INVEOR size	M α
Output	**0.25 kW to 0.75 kW**
Designation	ADP Mα WDM 0000 A-000 1
Art. no.	10117051

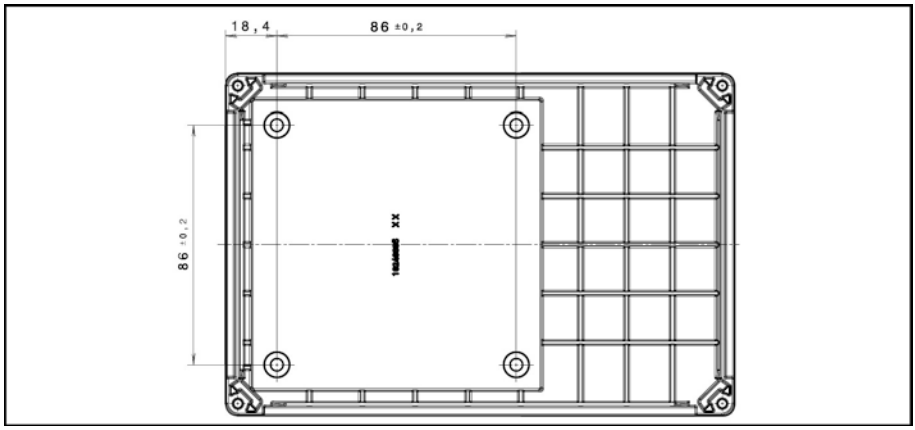


Fig.: 37 Hole pattern for size α standard wall adapter plate

9.2 Foil keypad

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

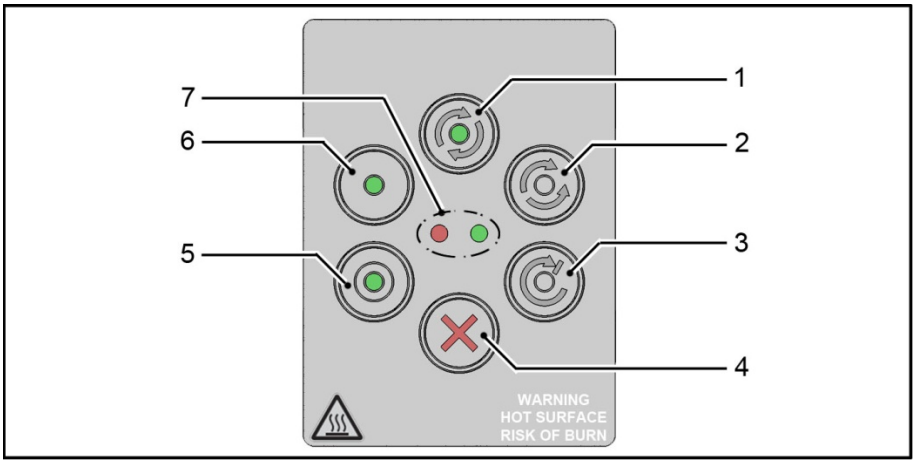
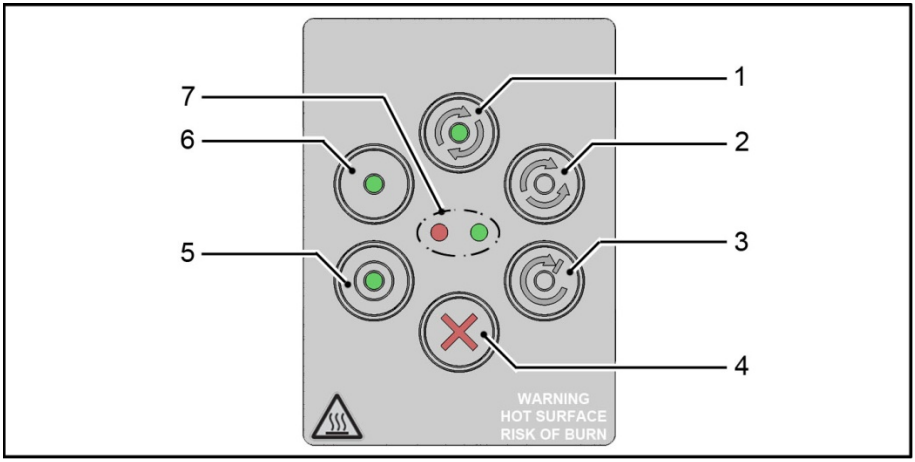


Fig.: 38 Standard foil keypad

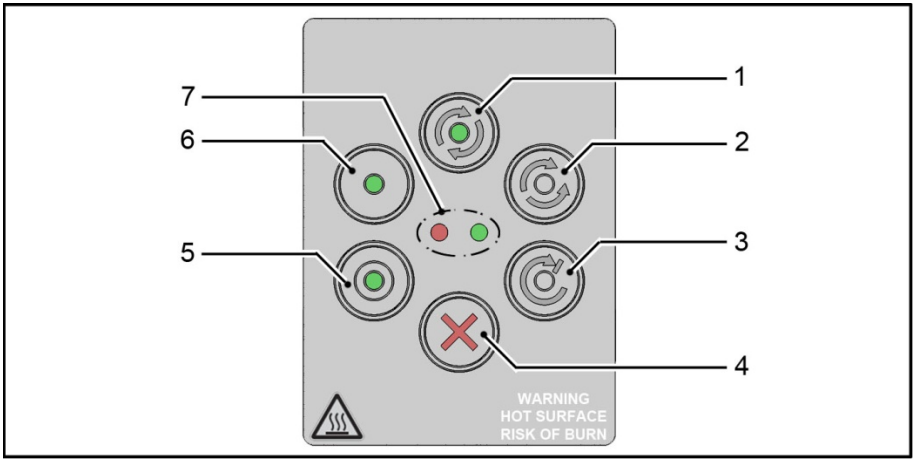
Key	
It.	
1	Start
2	Reversal of direction of rotation
3	Stop
4	Reset
5	Function key 2
6	Function key 1
7	Status LED 1 and 2



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

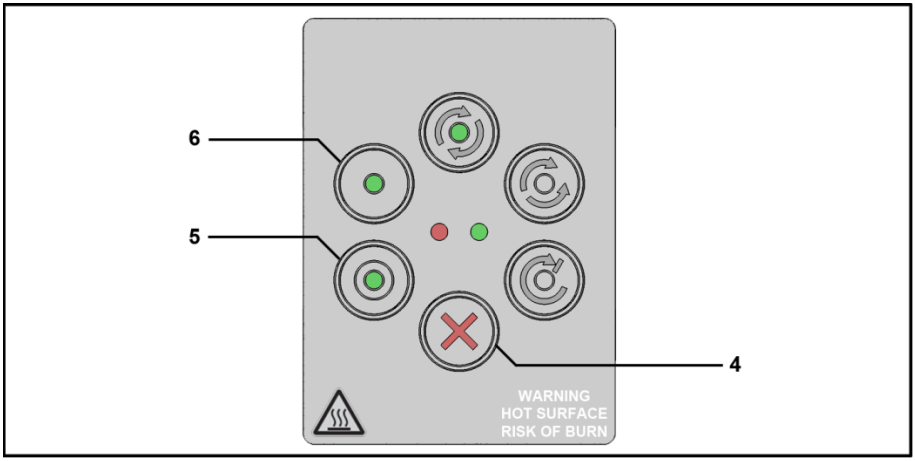
- **Motor potentiometer:** A motor potentiometer (parameter 2.150) can be realised using the configurable function keys (5) and (6) (MOP digit. input) integrated in the foil keypad.
  This function can be used to increase or decrease the target value. The integrated (LEDs) indicate when the minimum/maximum target value is reached.

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

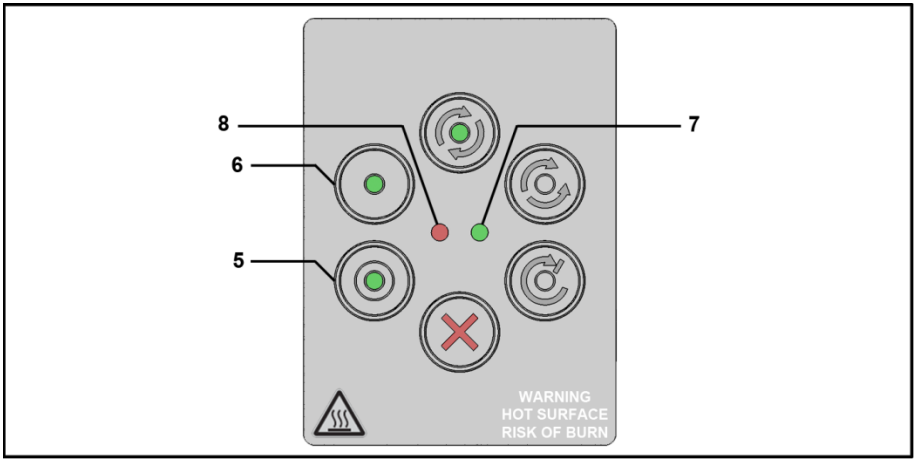


- **Target value approval:** The start (1) and stop (3) keys integrated in the foil keypad (select foil keypad) can be used to approve the drive software (parameter 1.131).
- **Direction of rotation V1:** The direction of rotation (parameter 1.150) can be changed using the key (2) integrated in the foil 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 (6) and (5) 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 (6) and (5) 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.
- **Acknowledgement function:** An error can be acknowledged (parameter 1.180) using the reset key (4) integrated in the foil keypad (select foil keypad).



- **Fixed frequency:** Two fixed frequencies (parameter 2.050) can be realised using the configurable keys (6) and (5) integrated in the foil keypad (MOP digit. input).
  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.

Green status LED (7):
Red status LED (8):

} For the functions of the status LEDs, please refer to the overview in chapter 6.1.

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

Fig.: 39 MMI handheld controller

IMPORTANT INFORMATION

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

The MMI handheld controller is connected to the integrated jack plug of the INVEOR α.
The "INVEOR α adapter cable" (art. no. 10118219) is needed for this. As an alternative to using the "INVEOR α adapter cable", the MMI can be connected via the M12 socket (art. no. 10118216) (JST plug). This operating unit allows the user to write (program) and/or to visualise all the parameters of the INVEOR α. Up to 8 complete data sets can be stored in an MMI and copied to other INVEOR αs. Complete commissioning is possible as an alternative to the free INVEORpc software. External signals are not needed.

* Man-Machine Interface

9.3.1 MMI/connecting cable PIN assignment

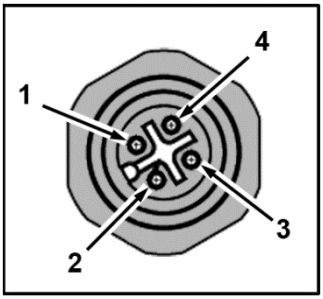


Fig. 1: M12
plug PIN assignment

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

M12 plug assignment	Signal
1	24 V
2	RS485 - A
3	GND
4	RS485 - B

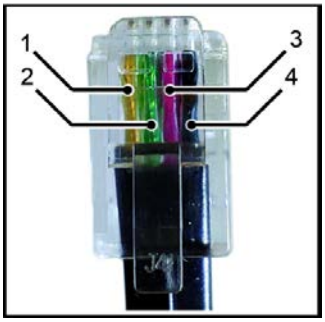


Fig. 2: RJ9 plug connector

Description: RJ9 plug connector

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

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

Fig.: 40 PC communication cable USB on M12 plug

As an alternative to using the MMI handheld controller, an INVEOR α can also be put into operation using the PC communication cable (art. no. 10023950) and the INVEORpc software. The "INVEOR α adapter cable" (art. no. 10118219) is also needed for this. As an alternative to using the "INVEOR α adapter cable", the PC communication cable can be connected via the M12 socket (art. no. 10118216) (JST plug).

The INVEORpc software is available free of charge from the KOSTAL homepage at https://www.kostal-industrie-elektrik.com/en-gb/downloads/download-drives.

9.5 INVEOR α adapter cable

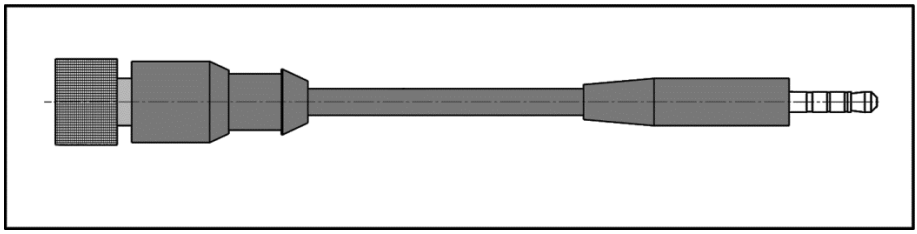


Fig.: 41 INVEOR α adapter cable

The "INVEOR α adapter cable" is needed to connect the MMI handheld controller or PC communication cable with the INVEOR α.

IMPORTANT INFORMATION

The "INVEOR α adapter cable"
(art. no. 10118219) may only ever be used with an INVEOR α.

9.6 Internal potentiometer

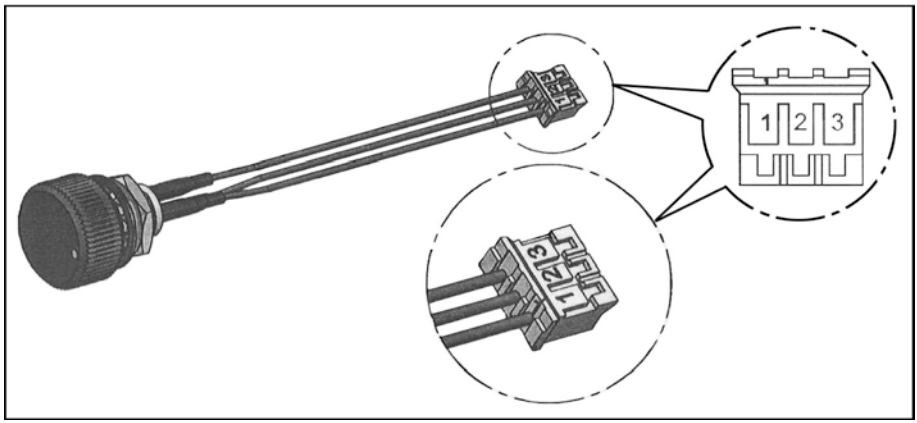


Fig.: 42 Internal potentiometer

The internal potentiometer (art. no. 10118232) is used to specify the nominal speed in an infinitely variable manner.

9.7 MMI M12 plug (JST plug)

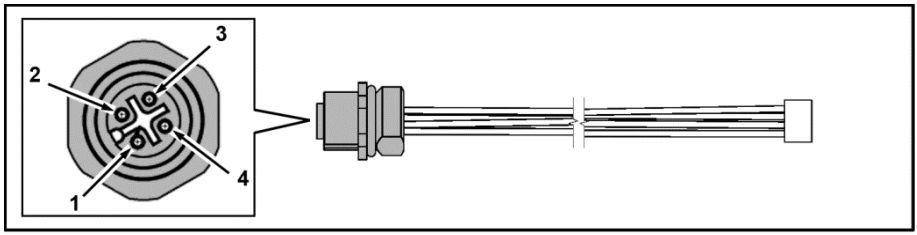


Fig.: 43 MMI M12 plug (JST plug)

Round plug connector (socket) 4-pin M12 A-coded.

The MMI M12 connection cable (art. no.: 10118216) is only intended for fitting in the cooling elements.

The MMI M12 connection cable can be used to permanently connect the drive controller with the MMI or PC.

IMPORTANT INFORMATION

Note that the MMI/PC interface is not intended for connecting several control devices!

M12 plug assignment	Signal
1	24 V
2	RS485 - A

M12 plug assignment	Signal
3	GND
4	RS485 - B

IMPORTANT INFORMATION

The "MMI plug" (art. no. 10118216) may only ever be used with an INVEOR α.

9.8 CANopen connection cable

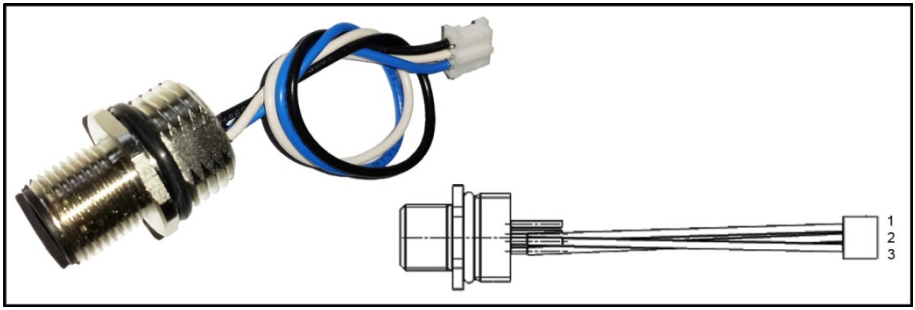


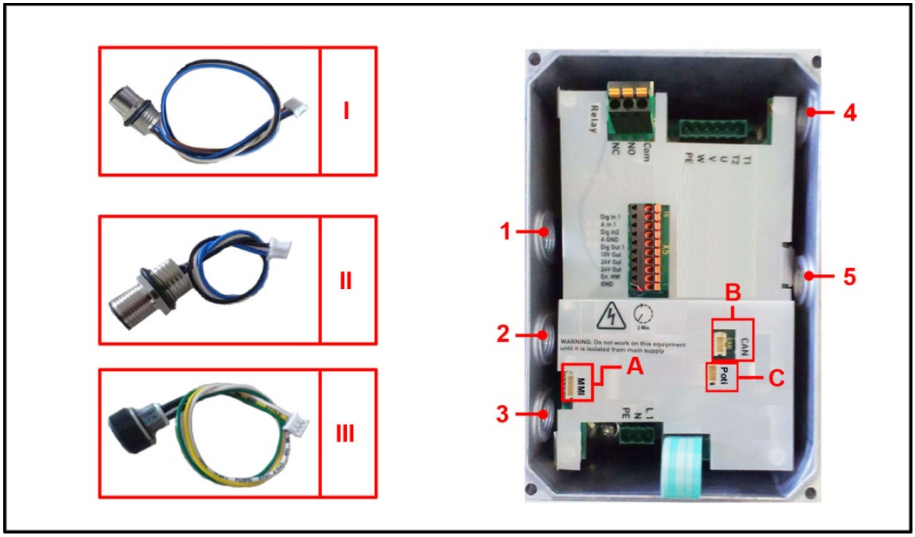
Fig.: 44 CANopen connection cable

The CANopen connection cable (art. no.: 10118224) is only intended for fitting in the cooling elements.

The drive controller can be connected to a CANopen bus system via the connection.

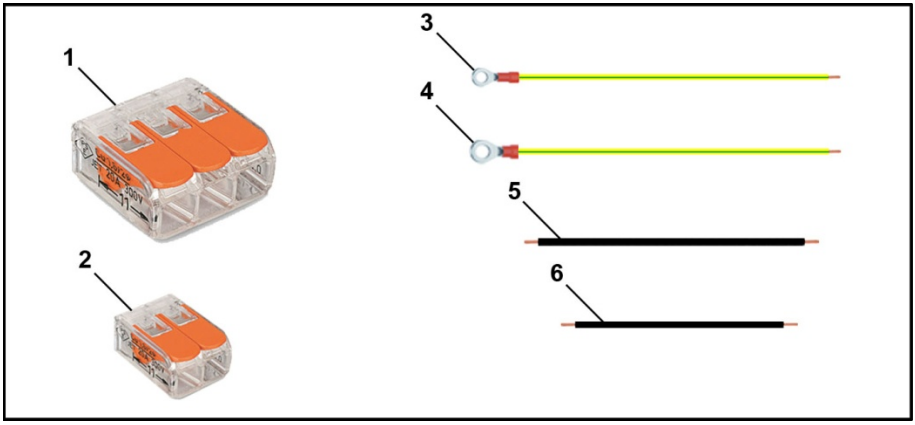
CANopen connection cable pin assignment			
JST plug pin assignment	**Line colour**	**Signal**	**M12 plug assignment**
1	black	CAN_L	5
2	white	Can_H	4
3	blue	GND	3
			1
			2

9.9 Connection and screw-in information for "Optional accessories"



Connection and screw-in information for "Optional accessories"			
Optional accessories		**Possible screw-in position**	**connection position on I/O board**
MMI M12 (art. no.: 10118216)	I	1, 4, 5	A
CANopen (art. no.: 10118224)	II	1, 4, 5	B
Potentiometer (art. no.: 10118232)	III	1, 4, 5	C
All optional screw connections can also be fitted in position 2, but the status LEDs are then no longer visible.			

9.10 Cable set extension



It.	Quantity	Name
1	4	3-pin connection terminal
2	2	2-pin connection terminal
3	1	Ground; 1.0 mm² approx. 200 mm with crimped M4 cable shoe
4	1	Ground; 1.0 mm² approx. 200 mm with crimped M5 cable shoe
5	3	Phases 1.0 mm² approx. 150 mm
6	2	PTC 0.25 mm² approx. 100 mm

Fig.: 45 Cable set extension

The cable set extension (art. no. 10118226) for the motor connection to the INVEOR α is used to extend the motor cable.

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 8 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 exceeda maximum length of 3m!

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

INFORMATION

In a residential environment, this product can cause high-frequency disturbances that may require interference suppression measures.

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 Standards and guidelines

The following specifically apply:

- Directive on Electromagnetic Compatibility
  (Directive 2004/108/EC of the Council EN 61800-3:2004)
- Low Voltage Directive
  (Directive 2006/95/EC of the Council EN 61800-5-1:2003)

10.4 UL approval

10.4.1 UL Specification (English version)

Maximum Ambient Temperature:

Electronic	Adapter	Ambient
INV Mα 2 0.25	ADP Mα WDM *	50 °C [122 °F]
INV Mα 2 0.37	ADP Mα WDM *	45 °C [113 °F]
INV Mα 2 0.55	ADP Mα WDM *	40 °C [104 °F]
INV Mα 2 0.75	ADP Mα WDM *	35 °C [95 °F]

* WDM = Wall mounting

Required Markings

Enclosure intended for use with field-installed conduit hubs, fittings or closure plates UL approved in accordance to UL514B and CSA certified in accordance to C22.2 No. 18, environmental Type 1 or higher.

Suitable for use on a circuit capable of delivering not more than 5 kA rms symmetrical amperes, 240 V maximum and when protected by RK5 class fuses rated 15 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.

All wiring terminals marked to indicate proper connections for the power supply, load and control circuitry.

For instructions for operator and servicing instructions on how to mount and connect the products using the intended motor connection adapter, please see chapter 3.3 and 9.1 in the operating manual.

CAUTION: Use 75° C [167° F] wires only.

CAUTION: Use copper conductors only.

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

Internal overload protection activates within 60 seconds of reaching 150 % of the motor full load current.

For used in Canada: TRANSIENT SURGE SUPPRESSION SHALL BE INSTALLED ON THE LINE SIDE OF THIS EQUIPMENT AND SHALL BE RATED TO 240 V (PHASE TO GROUND), SUITABLE FOR OVERVOLTAGE CATEGORY III, AND SHALL PROVIDE PROTECTION FOR A RATED IMPULSE WITHSTAND VOLTAGE PEAK OF 2.5 kV

10.4.2 Homologation CL (Version en française)

Température ambiante maximale:

Électronic	Adaptateur	Ambiante
INV Mα 2 0.25	ADP Mα WDM *	50 °C [122 °F]
INV Mα 2 0.37	ADP Mα WDM *	45 °C [113 °F]
INV Mα 2 0.55	ADP Mα WDM *	40 °C [104 °F]
INV Mα 2 0.75	ADP Mα WDM *	35 °C [95 °F]

***** WDM = Montage mural

Mentions requises

Boîtier prévu pour une utilisation avec entrées de conduit filetées installées sur le terrain, raccords ou plaques d'obturation approuvées UL conformément à UL61800-5-1 et certifiées CSA 22.2 conformément à C22.2 No. 18, étiquetage environnemental de type 1 ou plus.

suite

Convient pour une utilisation sur un circuit capable de délivrer pas plus de 5 kA ampères symétriques rms, 240 V maximum, et protégé par des fusibles de classe RK5 d'une valeur nominale de 15 A.

La protection intégrée contre les courts-circuits à semi-conducteur n'assure pas la protection du circuit de dérivation. Le circuit de dérivation doit être protégé conformément aux instructions du fabricant, au code national d'électricité et à tout autre code local additionnel.

Toutes les bornes de câblage avec repères pour les connexions correctes pour l'alimentation électrique, la charge et les circuits de commande.

Pour les instructions destinées à l'opérateur et les instructions de service relatives au montage et à la connexion des produits à l'aide de l'adaptateur de connexion du moteur prévu à cet effet, voir les chapitres 3.3 et 9.1 contenus dans le Manuel d'utilisation.

Utiliser uniquement des câbles en cuivre 75 °C [167 °F].

Aucune détection de surtempérature du moteur n'est fournie par l'entraînement.

La protection interne contre les surcharges se met en marche en l'espace de 60 secondes une fois 150 % du courant nominal du moteur atteints.

Pour une utilisation au Canada : LA SUPPRESSION DE TENSION TRANSITOIRE DOIT ÊTRE INSTALLÉE CÔTÉ LIGNE DE CET ÉQUIPEMENT ET AVOIR UNE VALEUR NOMINALE DE 240 V (PHASE-TERRE), EN COMPATIBILITÉ AVEC LA CATÉGORIE DE SURTENSION III, ET DOIT OFFRIR UNE PROTECTION CONTRE UN PIC DE TENSION ASSIGNÉE DE TENUE AUX CHOCS DE 2,5 kV

11. Quickstart guide

11.1 Quickstart guide for asynchronous motors

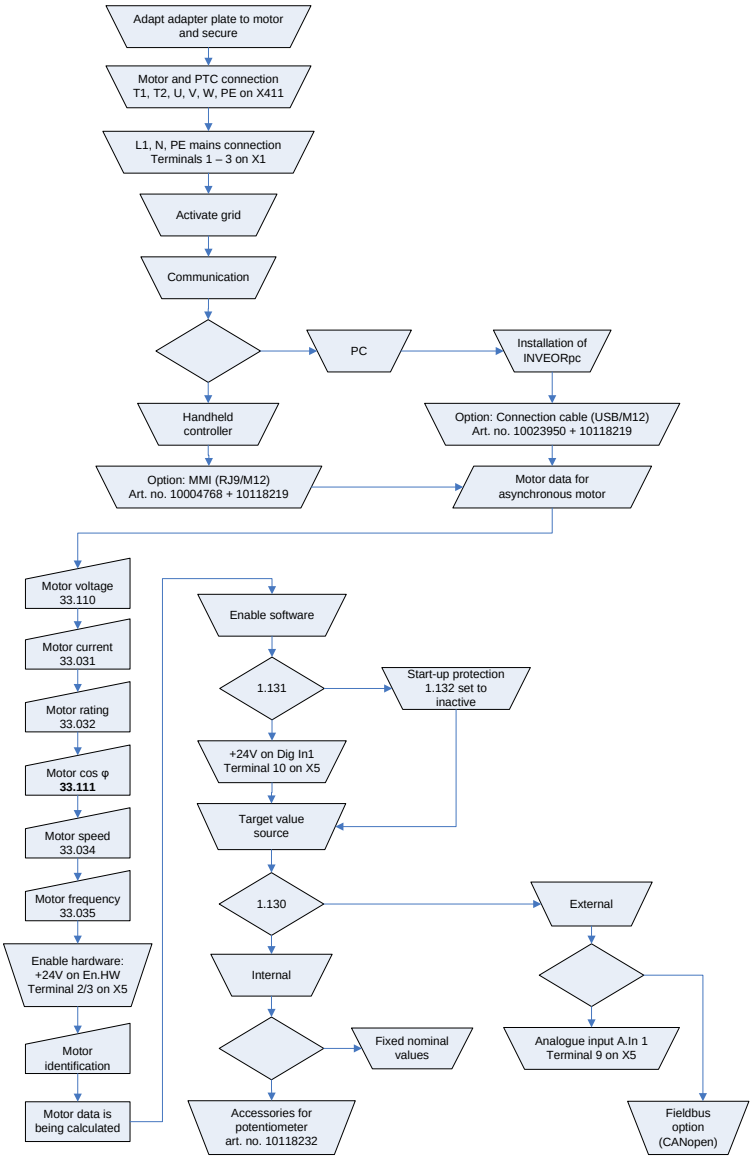


Fig.: 46 Block diagram for quick start for ASM

11.2 Quickstart guide for synchronous motors

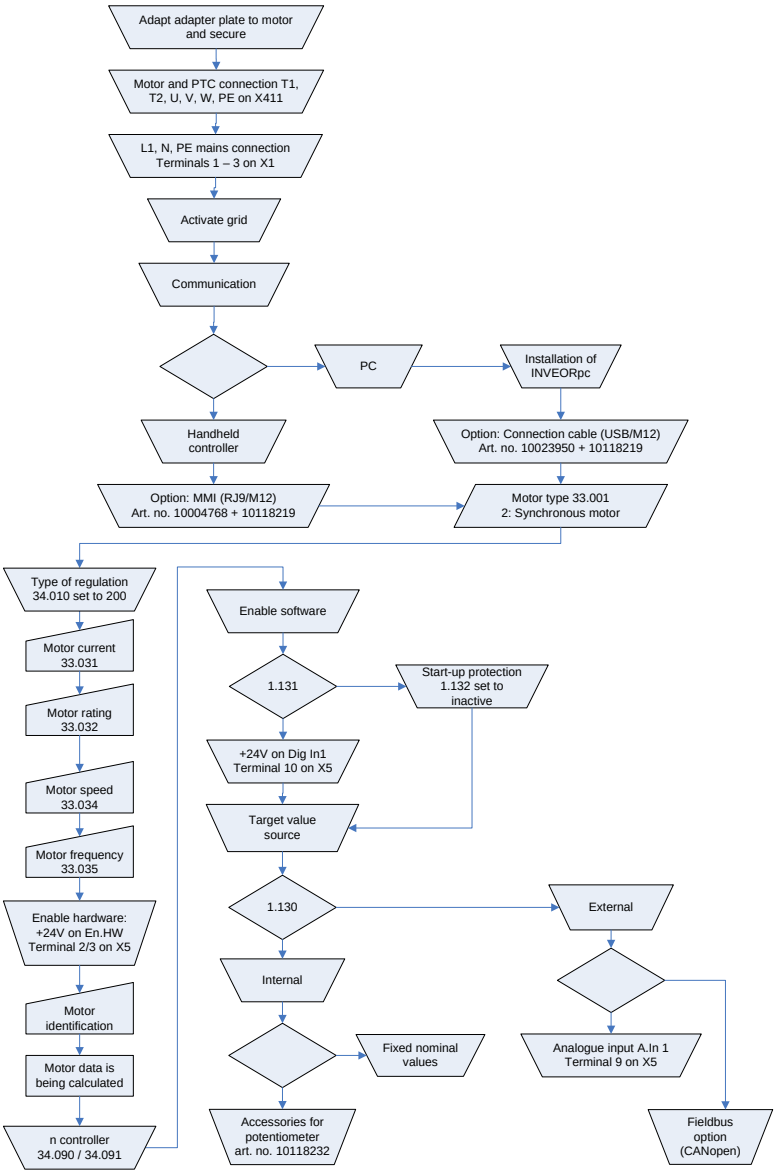


Fig.: 47 Block diagram for quick start for SM

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