KOSTAL

Smart
connections.

Operating manual
INVEOR

LEGAL NOTICE

Exclusion of liability

All names of usage, trade names, product names or other designations given in this manual may also be legally protected even without special labelling (e.g. as a trademark). The KOSTAL company assumes no liability for their free usage.

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

General note on equal treatment

The KOSTAL company publishers are aware of the meaning of language with regard to the equality of women and men and always make an effort to reflect this in the documentation. The continuous rendition of gender-equitable formulations, however, conflicted with the easy readability of the text. For this reason, the masculine form has been used as a rule.
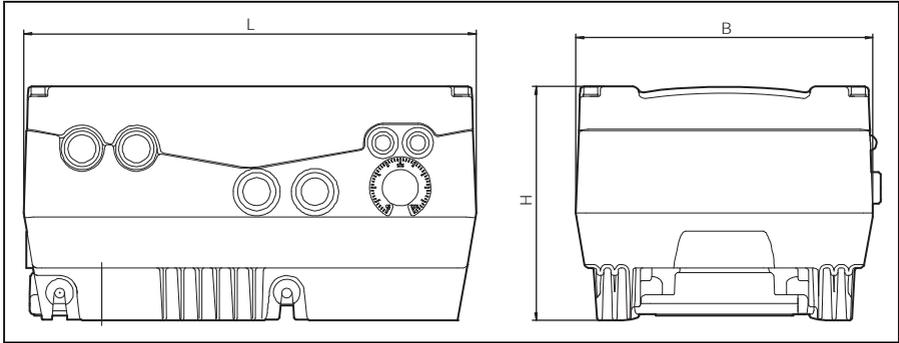
Table of contents

Overview of installation sizes

Dimensioned drawings

The drive controls are available in the following performance classes and under the specified installation size names.

Installation size INVEOR motor integrated	MA	MB	MC	MD
Recommended motor power [kW]	0.55 / 0.75 / 1.1 / 1.5	2.2 / 3.0 / 4.0	5.5 / 7.5	11.0 / 15.0 / 18.5 / 22.0
Dimensions [L x B x H] mm	233 x 153 x 120	270 x 189 x 133	307 x 223 x 181	414 x 294 x 238

Installation sizes

1 Important information

This chapter contains important information on the safe handling of the product and on the operating manual.

1.1 Notes on the documentation

The following notes are a directory for the overall documentation.

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

Provide this manual to the operator of the system so that it will be available when required.

1.1.1 Other applicable documents

This refers to all manuals that describe how to operate the drive control system, and any other manuals for equipment parts in use. Download the 3D files (.stp) for INVEOR and adapter plates under www.kostal.com/industrie.

A parameter description is available for download (www.kostal.com/industrie) for parameterising the drive control system. In the download, you will find al the information required for correct parameterising.

1.1.2 Storing the documentation

Store this manual and all other applicable documents safely so they will be available when required.

1.1.3 Symbols

⚠ DANGER

Note on safety: Non-observance will result in death or serious injury.

⚠ WARNING

Note on safety: Non-observance can lead to death or serious injury.

ATTENTION!

Non-observance can result in material being damaged and can affect the function of the drive control.

Supplemental information on operating the drive control.

● Action: This symbol indicates that you have to perform an action. The required actions are described step by step.
➢ This symbol indicates the result of an action.

1.2 Qualified staff

In the context of this operating manual and the notes relating to the product itself, qualified staff refers to electronic specialists that are familiar with the installation, assembly, start-up and operation of the drive control and with the dangers involved, and whose specialist training and knowledge of relevant standards and regulations provide them with the necessary abilities.

1.3 CE marking

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

– Directive on Electromagnetic Compatibility (Directive 2004/108/EC of the Council)
– Low Voltage Directive (Directive 2006/95/EC of the Council)

You will find the declaration of conformity for download on www.kostal.com/industrie.

1.4 Safety instructions

The following warnings, precautionary measures and comments are provided for your safety and serve to prevent damage to the drive control and the components connected to it. This chapter contains warnings and notes that are generally applicable when handling drive controls. They are separated into general information, transport & storage, start-up, operation, repair and dismantling & disposal.

Specific warnings and comments that apply to specific activities are placed at the start of the appropriate chapters and are repeated and enhanced at different critical points within these chapters.

Please read this information carefully, as it is provided for your personal safety and will also support a longer life for the drive control and the connected devices.

1.4.1 General information

⚠ **WARNING**

This drive control contains dangerous voltage and controls revolving mechanical parts that may be dangerous.

Disregarding warnings or non-compliance with the notes in this manual can result in death, serious injury or serious damage to property.

● Only appropriately trained persons may perform work on this drive control. These persons must be familiar with all safety instructions and all measures relating to installation, operation and maintenance that are contained in this manual. Proper and safe operation of the drive control requires proper transport, installation, operation and maintenance.

⚠ **WARNING**

Danger of fire or electric shock.

Improper use, changes and the use of spare parts and accessories not sold or recommended by the manufacturer of the drive control can cause fire, electric shock and injury.

● The cooling elements in the drive control and motor can reach temperatures above 70 °C. Ensure that there is sufficient distance from neighbouring components during installation. Allow sufficient cooling time before working on the drive control or the motor. If necessary, protection should be installed against accidental contact.

ATTENTION!

The drive control can only be operated safely if the required environmental conditions listed in the "Suitable environmental conditions" chapter are fulfilled.

ATTENTION!

This operating manual must be accessible near the device and available to all users.

ATTENTION!

Please read these safety instructions and warnings before installation and start-up; this also applies to all warning signs attached to the device. Make sure that the warning signs are legible and replace missing or damaged signs.

1.4.2 Transport & storage

ATTENTION!

Risk of damaging the drive control.

If the notes are not observed, the drive control could be damaged and destroyed during subsequent start-up.

● Proper and safe operation of the drive control requires proper storage, set-up and assembly as well as careful operation and maintenance.
The drive control must be protected from mechanical jolts and vibrations during transport and storage. Protection from impermissible temperatures (see technical data) must also be guaranteed.

1.4.3   Commissioning

⚠ WARNING

Danger of injury through electric shock.

Non-observance of warnings can result in serious injury or damage.

- Only hard-wired network connections are permitted. The device must be grounded (DIN EN 61140; VDE 0140-1).

- Frequency inverters of the INVEOR series can contain contact currents (leakage currents) > 3.5 mA. According to chapter 4.3.5.5.2 of DIN EN 61800-5-1, a reinforced protective ground wire (at least 10 mm^2 Cu or 16 mm^2 Al) must be used.

- If three-phase frequency inverters are in use, it is not permitted to use standard type A FI protection switches, or RCDs (residual current-operated protective devices) to protect from direct or indirect contact. According to DIN VDE 0160, section 5.5.2 and EN 50178, section 5.2.11.1, the FI protection switch must be universal current sensitive (RCD type B).

- The following terminals can lead to dangerous currents even when the motor is not running:
  - Supply terminals X1: L1, L2, L3
  - Motor connection terminals X2: U, V, W
  - Connecting terminals X6, X7: Relay contacts for relays 1 and 2

- If different voltages are in use (e.g. +24 V/230 V), crossing cable runs are never permitted. The operator must also ensure compliance with the applicable regulations (e.g. double or strengthened insulation acc. to DIN EN 61800-5-1).

- The drive control contains components susceptible to electrical discharge. These components can be destroyed through improper handling; therefore, precautionary measures against electrostatic charges must be taken when work is performed on these components.

1.4.4 Operation

⚠ **WARNING**

Danger of injury due to electric shocks or restarting motors.

Non-observance of warnings can result in serious injury or damage.

● Observe the following instructions during operation:
  – The drive control works with high voltages.
  – When electrical devices are operated, some parts of them are always subject to dangerous voltage.
  – Emergency off equipment according to DIN EN 60204-1; VDE 0113-1:2007-06 has to be functional in all operating modes of the control device. 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 all-pole disconnected from the drive control.
  – Certain parameter settings can result in the drive control restarting automatically after the supply voltage has failed.

ATTENTION!

Risk of damaging the drive control.

If the notes are not observed, the drive control could be damaged and destroyed during subsequent start-up.

● 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 control contains internal motor overload protection. See P0610 (level 3) and P0335. I^2T is ON by default. Motor overload protection can also be ensured via an external PTC.
  – The drive control may not be used as "Emergency-off equipment" (see DIN EN 60204-1; VDE 0113-1:2007-06).
  – Drive controls are maintenance-free if operated properly. If the air contains dust, the cooling fins of the motor and drive control have to be cleaned regularly.

1.4.5 Repairs

ATTENTION!

Risk of damaging the drive control.

If the notes are not observed, the drive control could be damaged and destroyed during subsequent start-up.

- Repairs of the drive control may only be performed by the KOSTAL Service department.

⚠ WARNING

Danger of injury through electric shock.

Non-observance of warnings can result in serious injury or damage.

- When the drive control is disconnected from the mains voltage, parts and connections of the device subject to current may not be touched immediately in case the condensers are still charged.

1.4.6 Disassembly & disposal

Screw and snap-on connections are easy to release and allow the drive control to be dismantled into its individual parts. These parts can be sorted for recycling. Please comply with local regulations during disposal.

Components with electronic parts may not be placed in normal household waste. They have to be collected separately with old electric and electronic equipment in accordance with applicable legislation.

1.5 Proper use

If the device is installed in a machine, inverters may not be started up (i.e. intended operation may not begin) until it has been determined that the machine complies with the regulations in EC Directive 2006/42/EC (machine directive); DIN EN 60204-1; VDE 0113-1:2007-06 must be observed.

Start-up (i.e. beginning intended operation) is only permitted if the EMV Directive (2004/108/EC) is complied with.

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

This drive control 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 can result in death, injury and damage. The warranty provided by KOSTAL will be invalidated in this case.

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

> Using drive units 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.

1.6 Responsibility

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

Section "Electrical equipment of machines" in DIN EN 60204-1; VDE 0113-1:2007-06, "Safety of machinery" describes the safety requirements for electric control units. These are provided for the safety of persons and machines, and in order to retain the functional capability of the machine or system; they have to be observed.

The function of an emergency-off feature does not have to result in the power supply for the drive being switched off. In order to prevent danger, it can be useful to keep individual drives in operation or initiate specific safety procedures. The performance of emergency-off measures is evaluated by

means of a risk assessment for the machine or system and its electrical equipment, and is determined with a selection of the circuit category according to DIN EN 13849 "Safety of machinery – Safety-related parts of control systems".

1.7   Contacts for information

Further information is available from:

Central service hotline

Tel: +49 2331 8040-4848
Monday to Friday: 7.00 to 17.00 (local time)

Fax: +49 2331 8040-4811

Email: INVEOR-service@kostal.com

Internet address

Customers can access technical and general information from the following address:

www.kostal.com/industrie

2 Overview of the drive control

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

2.1 Model description

Fig. 1:   Article description

Key		
1 Drive control series: **INVEOR**	6	Housing: **G0** – standard (black with inscription); **0** – standard (cooling element); **0** – standard (with potentiometer); **00** – standard screw connections
2 Installation location/installation size: **M** – integrated into a motor, installation size: **A**, B, C, D		
	7	Firmware version: **S00** – standard
3 Input voltage: **4** – 400 V	8	Versions: **000** – standard; **001** – specific
4 Recommended motor power: **0.55**; 0.75; 1.1; 1.5; 2.2; 3; 4; 5.5; 7.5; 11; 15; 18.5; 22 kW	9	Equipment generation: **1** – current version
5 Printes circuit board: **L00** – standard (without brake chopper); **A00** – standard (without TTL evaluation); **–** standard (without field bus)		

2.2 Scope of delivery

Compare your product to the scope of delivery described below.
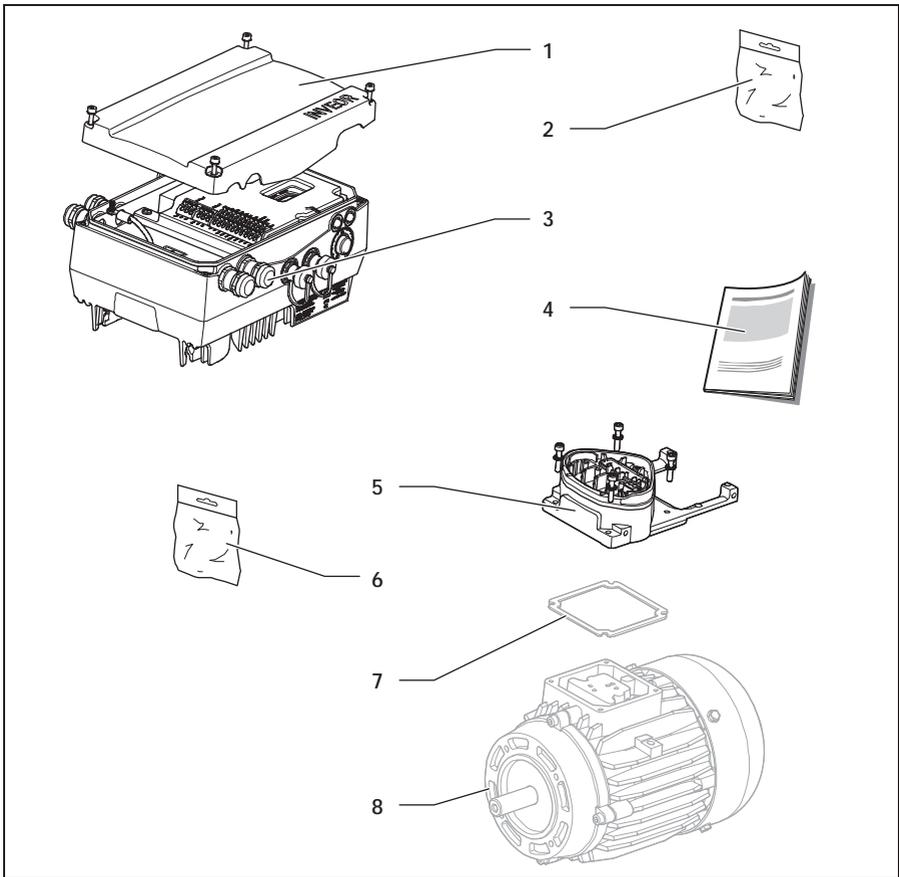
Fig. 2: Scope of delivery

Key	
Drive control article number	**Adapter plate article number**
1 Drive control (variant)	5 Adapter plate with connecting terminal
2 Poly bag with fastening bolts	6 Poly bag with connecting material for terminal block
3 Cable screw connections	
4 Operating manual	
	7 Seal (not part of the scope of delivery)
	8 Motor (not part of the scope of delivery)

2.3   Description of the INVEOR drive control

The INVEOR drive control is a device for speed control in three-phase a.c. motors.

The drive control can be integrated in the motor (with the standard adapter plate) or close to the motor (with the wall installation adapter plate).

The permitted ambient temperatures specified under Technical data refer to operation at nominal load. In many cases of application, higher temperatures may be permitted after a detailed technical analysis. These have to be approved by KOSTAL for each individual case.

3   Installation

3.1   Safety instructions during installation

⚠ **WARNING**

● Installation may be performed only be appropriately qualified employees who are trained in the set-up, installation, start-up and operation of the product. Work performed on the drive control by unqualified staff and non-observance of warnings can result in serious injury or damage.

● The device must be grounded in accordance with DIN EN 61140; VDE 0140, NEC and other relevant standards. Mains connections must be hardwired.

3.2   Installation requirements

3.2.1   Suitable ambient conditions

Altitude of the installation site:	up to 1,000 m above sea level / over 1,000 m with reduced performance (1% per 100 m) (max. 2,000 m)
Ambient temperature:	-25 °C to +50 °C (different ambient temperatures may be possible in individual cases)
Relative humidity:	≤ 96%, condensation not permitted
Resistance to vibration and shock:	acc. to FN 942 017 part 4; 5.3.3.3 Combined test 2; 5...200 Hz for sinusoidal oscillation
Electromagnetic compatibility:	Immune to interference acc. to DIN EN 61800-3
Cooling:	Surface cooling: installation sizes A to C: free convection; installation size C: optionally with integrated fan installation size D: with integrated fans

Tab. 1:   Ambient conditions

● Make certain that the housing type (protection type) 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 have to be sealed.

– Check that the cover of the drive control is closed and bolted down tightly.

Although the drive control can, in principle, be subsequently painted, the user must nevertheless check the material compatibility of the paint that is to be used. A failure to comply with this can eventually result in the loss of the protection class (particularly in respect of seals and fibre-optic elements). The standard colour is black (RAL 9005).
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 earthing!

3.2.2 Suitable installation location for the motor integrated drive control

● Ensure that the motor with a motor integrated drive control is only installed and operated if aligned as shown in the following image.
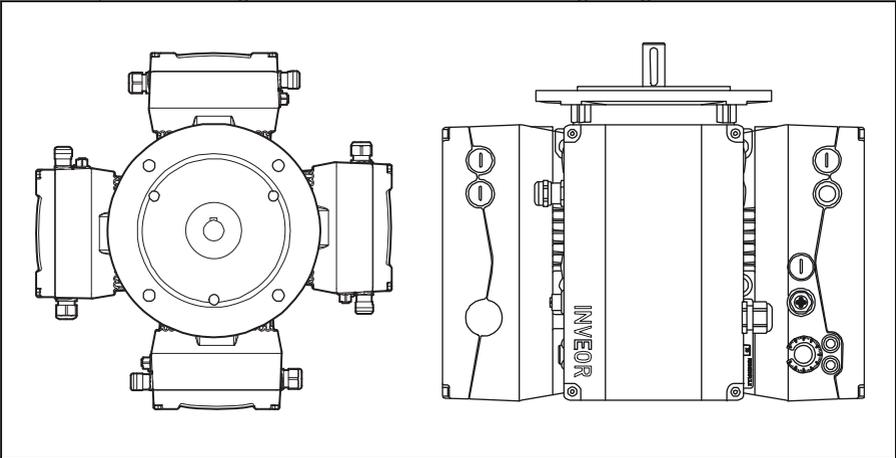
Fig. 3:   Motor installation location/permitted alignments

3.2.3 Basic connection versions
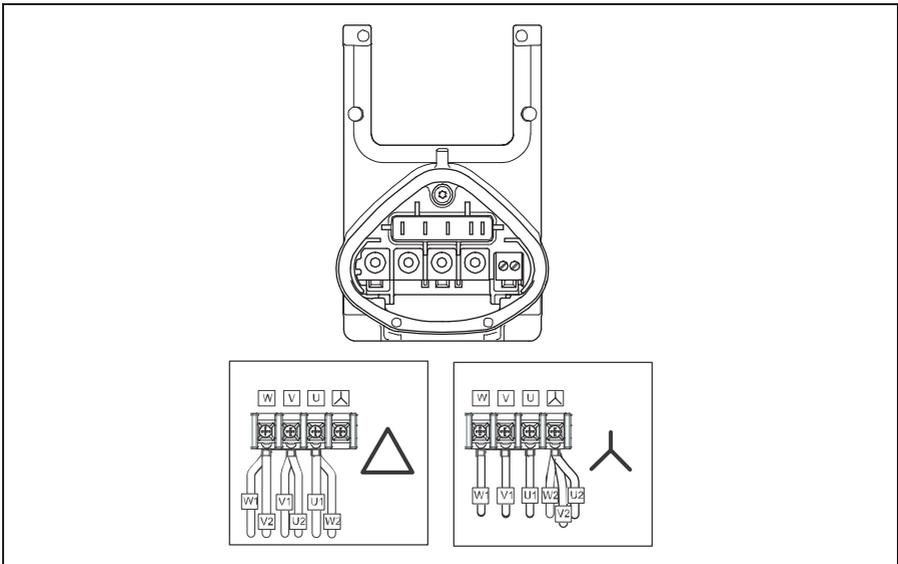
Fig. 4:   Star or triangle connection for drive controls integrated in the motor

ATTENTION!

Risk of damaging the drive control.

The correct phase sequence must be observed when the drive control is connected, as the motor could otherwise be overloaded.

● Ensure that the phase sequence is correct when connecting the motor.

The supplied assembly material can be used to connect core end sleeves and cable shoes. Fig. 4 shows the different connection options.

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

👉	If a PTC or Klixxon is used, the electric jumper fitted on the connection terminal for the PTC in the delivery state has to be removed.

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

3.2.4   Short circuit and ground protection

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

3.2.5   Wiring instructions

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

Terminals:	Plug terminal clamp with activation button (slot screwdriver, max. width 2.5 mm)
Connection cross-section: AWG 14	0.5 to 1.5 mm^2, single-wire, AWG 20 to
Connection cross-section: AWG 14	0.75 to 1.5 mm^2, fine-wired, AWG 18 to
Connection cross-section:	0.5 to 1.0 mm^2, fine-wired, (core end sleeves with and without plastic collar)
Length of stripped insulation:	9 to 10 mm

The terminals for the mains cable are located inside the drive control. The INVEOR also has the option of being equipped with terminals for connecting a brake resistor.
The configuration can 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)
Connection cross-section:	0.2 to 10 mm^2, rigid, 0.2 to 6 mm^2, flexible
Connection cross-section:	0.25 to 6 mm^2 (core end sleeves without plastic collar)
Connection cross-section:	0.25 to 4 mm^2 (core end sleeves with plastic collar)
Connection cross-section:	0.25 to 1.5 mm^2 for 2 conductors of the same cross-section (twin-core end sleeves with plastic collar)
Conductor cross-section:	AWG 24 to AWG 8
Length of stripped insulation:	15 mm

3.2.6   Preventing electromagnetic interferences

Screened lines should be used for control circuits where possible. The screening should be applied to the line end with special care without laying the leads across longer stretches without screening.

Screening for analogue target values should only be applied on one side of the drive control.
In principle, control lines should always be laid as far away from power-conducting lines; it may be necessary to use separate ducts. If lines do cross, they should do so at an angle of 90°.

Upstream circuit elements, such as protector switches and brake coils, or circuit elements that are operated via the outputs of the drive control have to be interference-suppressed. RC circuits are suitable as a.c. 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. Power supply for a mechanical brake may not be carried in the same cable.

Power connections between the drive control and the motor should always be screened or reinforced, and the screening has to have large-scale grounding at both ends. The use of EMV cable screw connections is recommended. These are not part of the scope of delivery.

Wiring suitable for EMV must be ensured.

3.3   Installing the drive control integrated in the motor

3.3.1   Mechanical installation

Proceed as follows when mechanically installing the drive control:

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 fastening screws of the connection housing and remove it. Make sure that the seal is not damaged.
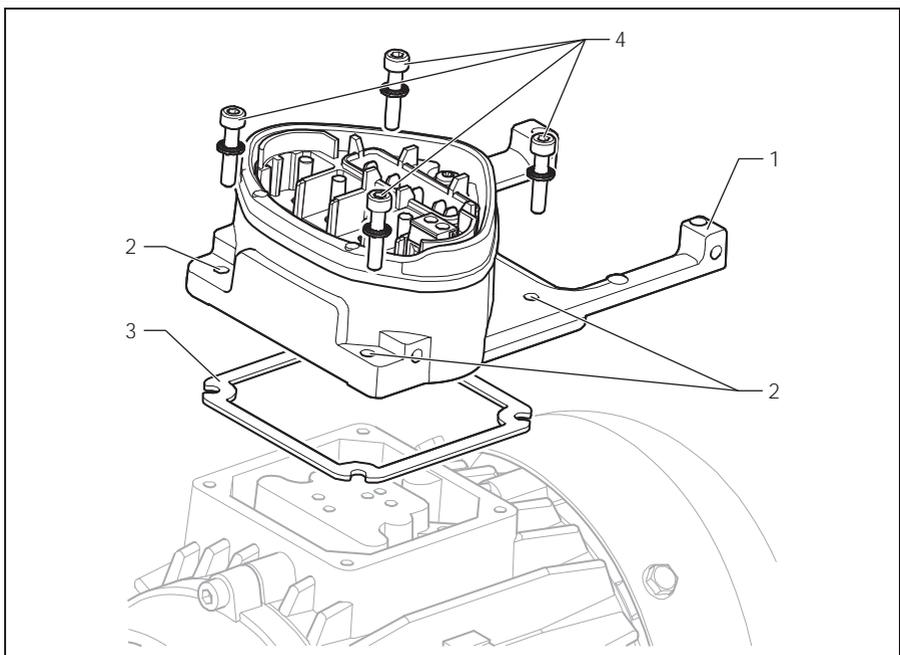
Fig. 5:   Assembly sequence: Connection box – adapter plate

☞ The standard adapter plate is an adapter plate whose underpart has not been refinished. There are no boreholes.

Individual tailored adapter plates for selected motors are available from KOSTAL.

5. Adjust the adapter plate (1) by creating the appropriate boreholes (2) for attachment to the motor.

☞ The contractor starting up the device is responsible for complying with the protection category when sealing the adapter plate on the motor.
In case of questions, please contact your usual KOSTAL contact person.

6. Place the seal (3).
7. Lead the motor connection line past the connection terminal and through the adapter plate; attach the adapter plate to the motor with the four fastening bolts (4) (torque: 2.0 Nm).

8. Attach the engine wires in the correct circuit, see also Fig. 4. (torque: 3,0 Nm).

> When installing the engine wires, ensure that all bolts on the terminal board are used with the nuts provided, even if the star point is not connected!
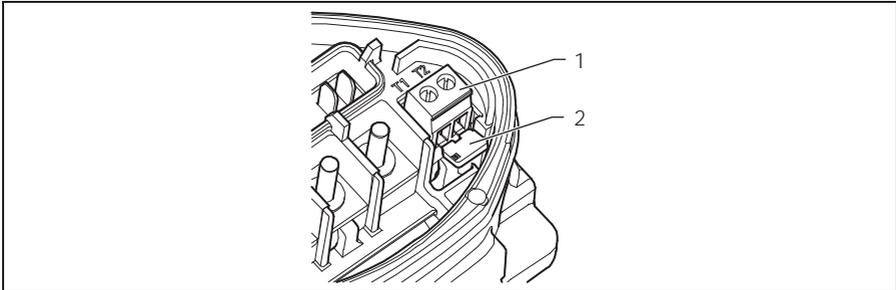
Fig. 6:   Electric jumper

9. If a motor PTC/Klixxon is available, wire the connection cables to terminals T1 and T2 (1) (torque: 0.6 Nm).

> Make sure during assembly that the connection cables are not trapped.

> If the motor has a temperature sensor, this has to be connected to terminals T1 and T2 (1); this requires that the electric jumper (2) fitted in the delivery state has to be removed.
> **If the electric jumper is installed, the temperature of the motor will not be monitored.**

10. Plug the drive control onto the adapter plate and fasten it evenly using the four lateral bolts (torque: 4.0 Nm).

3.3.2 Power connection
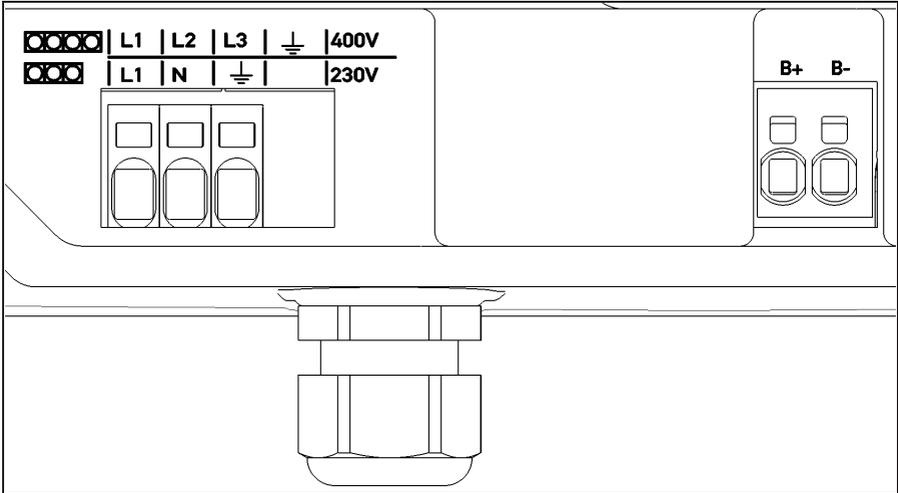
Fig. 7:   Power connection

- Unscrew the four bolts from the housing cover of the drive control and remove the cover.
- Guide the power cord through the cable connection and connect the phases to contacts L1, L2, L3 and the ground cable to the PE contact of the connection terminal. The cable provides strain relief, and the PE connection line has to be connected in a leading fashion (considerably longer).

☞   If a brake resistor is connected, screened and doubly insulated lines must be used.

Terminal no.	Designation	Configuration
1	L1	Mains phase 1
2	L2	Mains phase 2
3	L3	Mains phase 3
4	PE	Ground cable

Tab. 2:   Terminal configuration X1

3.3.3   Connections for brake resistor

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

Tab. 3:   Optional terminal configuration for brake chopper

3.3.4   Control connections
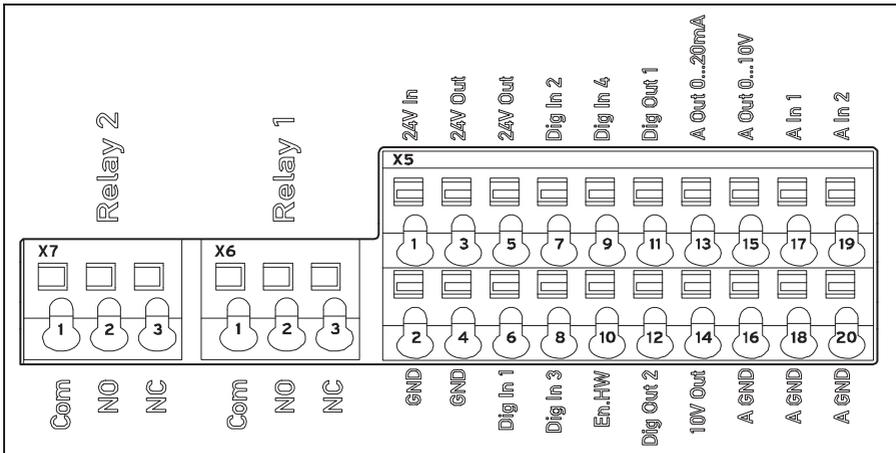
Fig. 8:   Control connections

ATTENTION

Danger of external signals being coupled in.

Use only screened control lines.

- Guide the required control lines into the housing through the cable screw connections.
- Connect the control lines according to the figure and/or table. Use screened control lines.
- Place the cover on the housing of the drive control and bolt it (torque: 2.0 Nm) tight.

Terminal no.	Designation	Configuration
1	24 V In	ext. power supply
2	GND (ground)	Mass
3	24 V Out	int. power supply
4	GND (ground)	Mass
5	24 V Out	int. power supply
6	Dig. In 1	Target value release (parameter 1,131)
7	Dig. In 2	Free (not allocated)
8	Dig. In 3	Free (not allocated)
9	Dig. In 4	Error reset (parameter 1,180)
10	En-HW (release)	Hardware release
11	Dig. Out 1	Fault message (parameter 4,150)
12	Dig. Out 2	Free (not allocated)
13	A. Out 0 ... 20 mA	Actual frequency (parameter 4,100)
14	10 V Out	for ext. voltage divider
15	A. Out 0 ... 10 V	Actual frequency (parameter 4,100)
16	A GND (ground 10 V)	Mass
17	A. In 1	Analogue input 1
18	A GND (ground 10 V)	Mass
19	A. In 2	Analogue input 2
20	A GND (ground 10 V)	Mass

Tab. 4:   Terminal configuration X5

Terminal no.	Designation	Configuration
1	COM	Centre contact relay 1
2	NO	Closing contact relay 1
3	NC	Opening contact relay 1

Tab. 5: Terminal configuration X6 (relay 1)

☞ In the factory setting, relay 1 is programmed as "relay error" (parameter 4.190).

Terminal no.	Designation	Configuration
1	COM	Centre contact relay 2
2	NO	Closing contact relay 2
3	NC	Opening contact relay 2

Tab. 6: Terminal configuration X7 (relay 2)

☞ In the factory setting,"no function" is allocated to relay 2 (parameter 4.210).

3.3.5   Terminal connection diagram
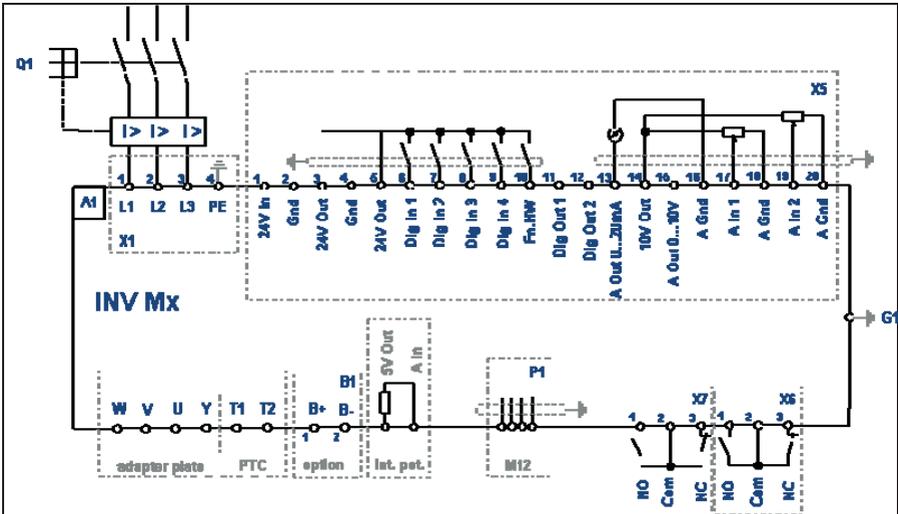
Fig. 9:   Connection diagram

The drive control is operational after the 400 V power supply has been switched on. Alternatively, the drive control can be started up by connecting an external 24 V power supply.
The settings required for this are described in the "System parameters" chapter. A detailed description of the functions of the drive control can be found in the parameter description (www.kostal.com/industrie).

3.4   Installing the wall-mounted drive control

3.4.1   Suitable installation location for wall mounting

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

  – The drive control has to be mounted on an even and fixed surface.

  – The drive control may only be mounted on non-flammable bases.

  – There must be a minimum of 20 cm clearance all around the drive control to ensure free convection.

The following figure shows the assembly dimensions and the free spaces required for installing the drive control.
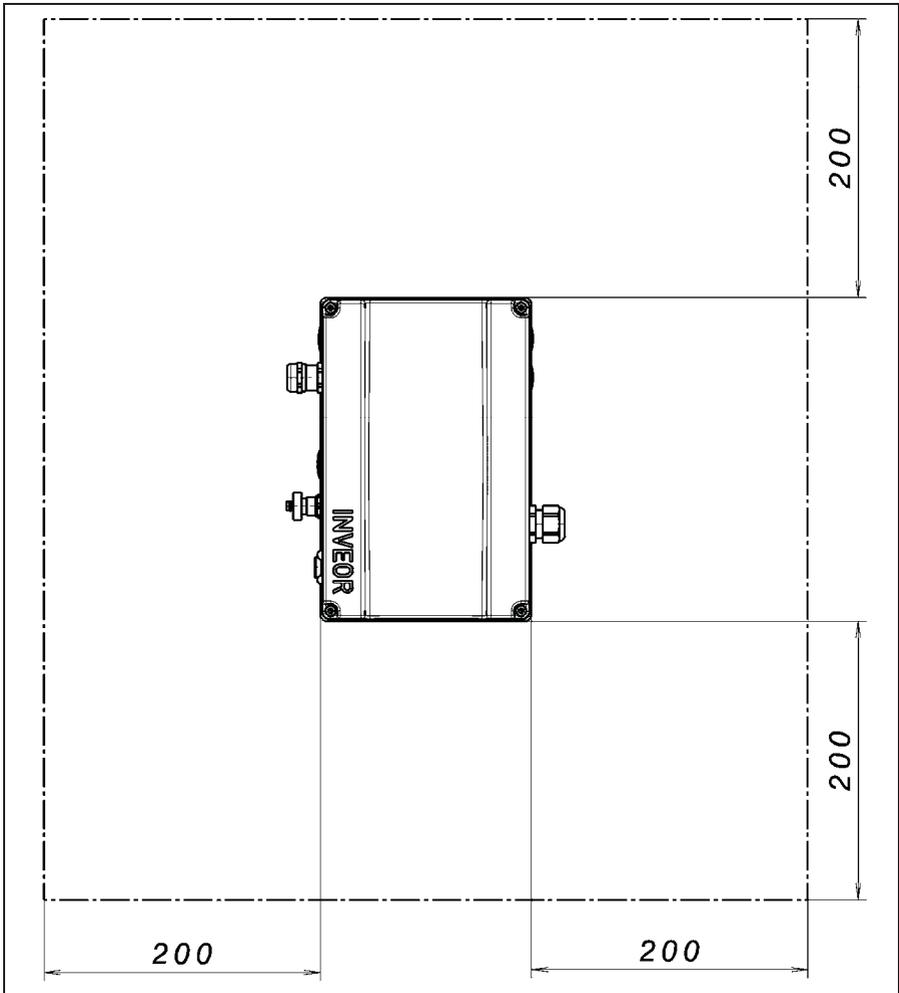
Fig. 10:   Minimum clearances

For the "wall mounting" version, the line length between the motor and INVEOR may not exceed 5 m. A screened cable with the required cross-section must be used. There must be a PE connection (underneath the wall mounting's terminal board)!

3.4.2 Mechanical installation

Fig. 11: Wiring on the motor connection box

● Open the motor connection box.

ATTENTION

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

● Use a suitable EMC screw connection to attach the screened cable to the motor connection box and ensure that the screening contact is in order (large surface).
● Connecting a PE connection in the motor connection box is mandatory.
● Close the motor connection box.
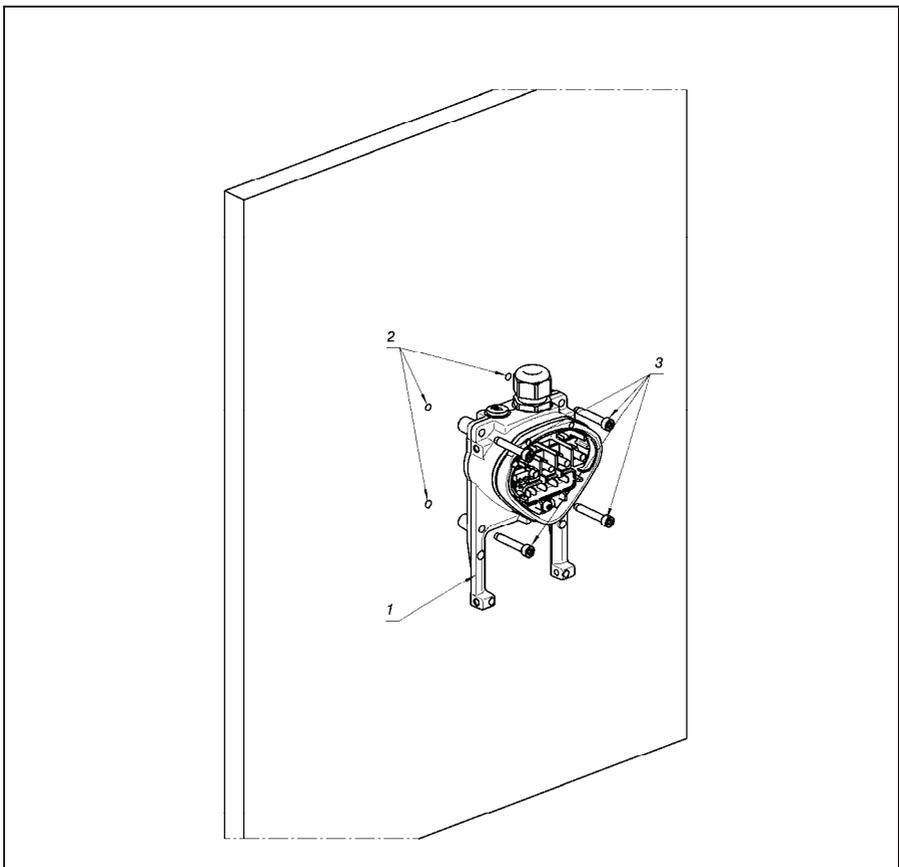
Fig. 12: Fastening the adapter plate to a wall

⚠ DANGER!

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

- Find a position that meets the required ambient conditions as described in the "Installation requirements" section.
- To achieve optimum self-convection of the drive control, ensure that the (EMC) screw connection is facing upwards when installing.
- Without any additional ventilation for the INVEOR (optional for BG C), it is only permitted to be installed vertically.
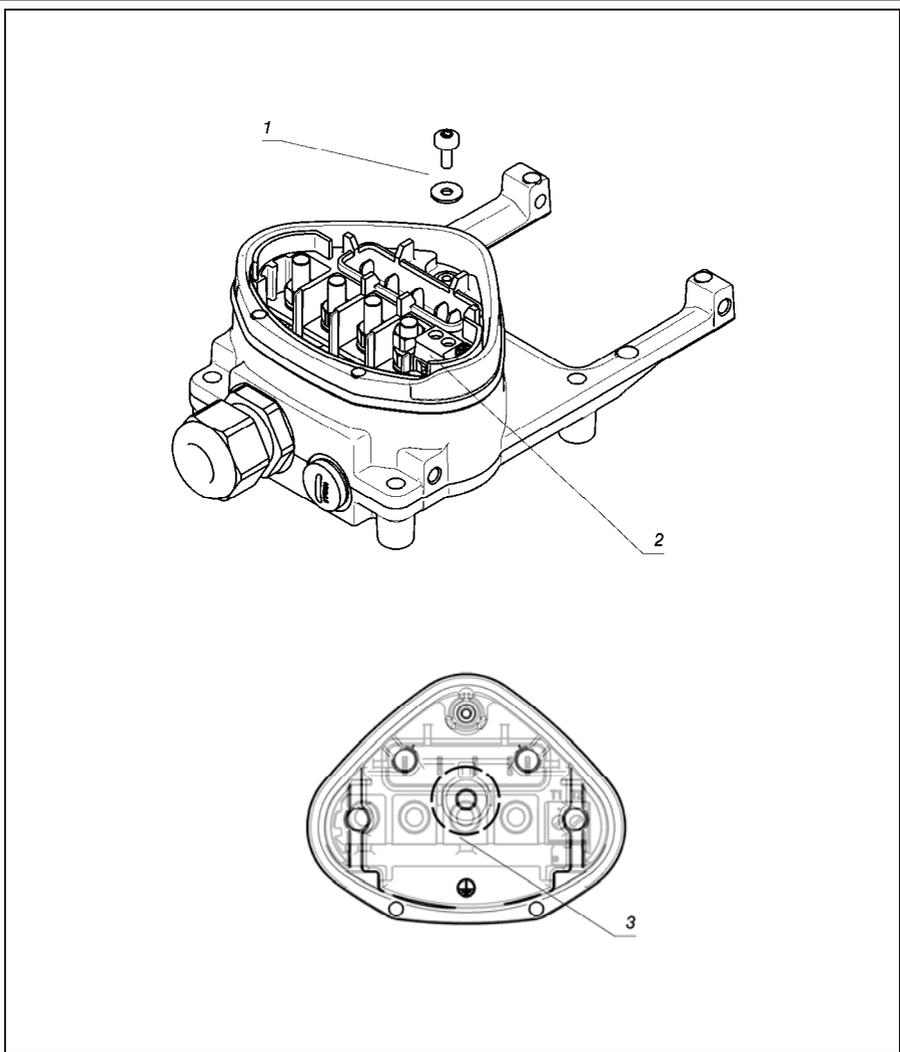
Fig. 13:   Wiring

1. Release the screw (1) to remove the contact plate from the adapter plate. The (M6) PE connection (3) is underneath this contact plate.
2. Guide the connection cable from the motor to the adapter plate through the integrated EMC screw connection.
3. This connection has to be made to the same ground potential of the motor. The cross-section of the equipotential bonding line must correspond to at least the cross-section of the power cord.
4. Reattach the contact plate using the screw (**1**).

5. Wire the motor cable to contacts U, V, W (and star point in some cases) in the connection terminal, as described in the "Basic connection versions" chapter. Use cable shoes (M5) to do this.

6. Before connecting an available motor PTC to the T1 and T2 terminals, remove the preassembled short-circuit bridge (2).
The motor PTC is potential-free after connecting the INVEOR, therefore it must be connected using a separate motor lead.
Replace the dummy screw with a suitable standard screw connection and guide both ends to T1 and T2.
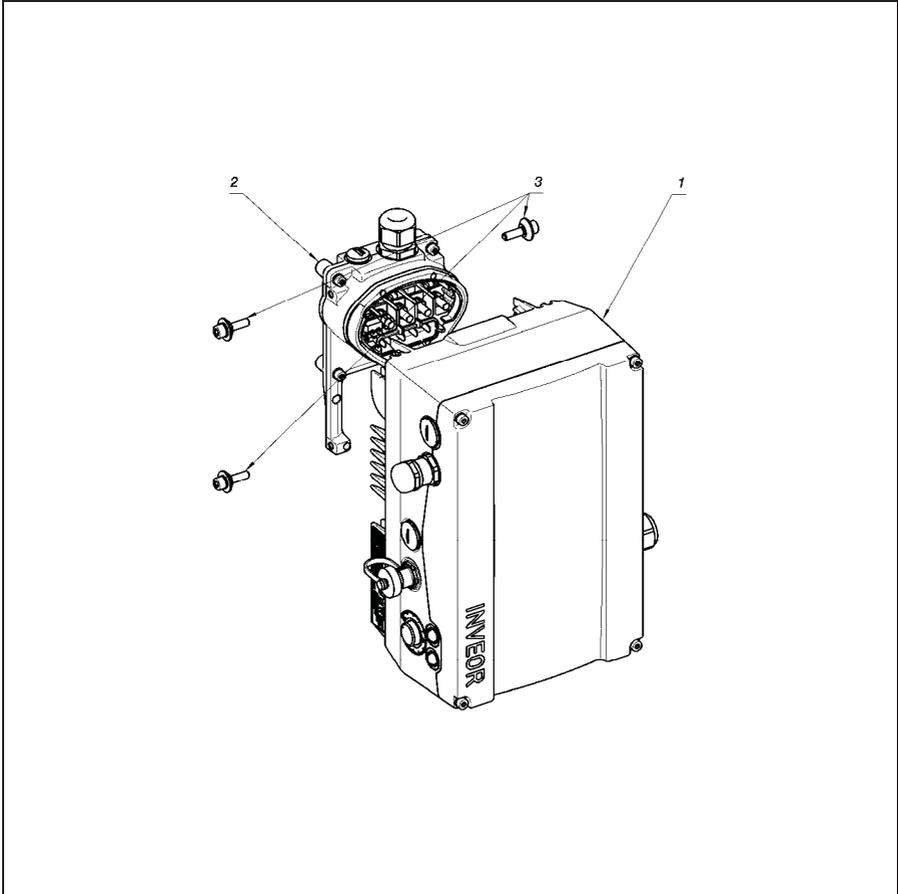
Fig. 14:   Attaching the drive control

7. Position the drive control (1) on the adapter plate (2) so that the collar of the adapter dips into the opening on the floor of the cooling element.

8. Fasten the control unit to the adapter plate with the help of the screws (3) provided (torque: 4.0 Nm).

3.4.3   Power connection

The power connections should be designed as described in section 3.3.2 ff. "Installing the drive control integrated in the motor".

3.4.4   Brake chopper

The brake connections should be designed as described in section 3.3.3 ff. "Installing the drive control integrated in the motor".

3.4.5   Control connections

The control connections should be designed as described in section 3.3.4 ff. "Installing the drive control integrated in the motor".

4 Commissioning

4.1 Safety instructions during commissioning

ATTENTION!

Danger of damage

If the notes are not observed, the drive control could be damaged and destroyed during subsequent start-up.

● Commissioning may only be performed by qualified staff. Safety precautions and warnings must always be observed.

⚠ **WARNING**

Danger of injury

Non-observance of warnings can result in serious injury or damage.

● Make certain 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 the drive control.

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

● The drive control must be grounded with the motor according to regulations. Non-compliance can result in serious injury.

4.2 Communication

The drive control can be commissioned in the following ways:

– Using the PC software

Fig. 15: PC software – start screen

– Using MMI

Fig. 16: Manual control unit MMI

4.3 Block diagram
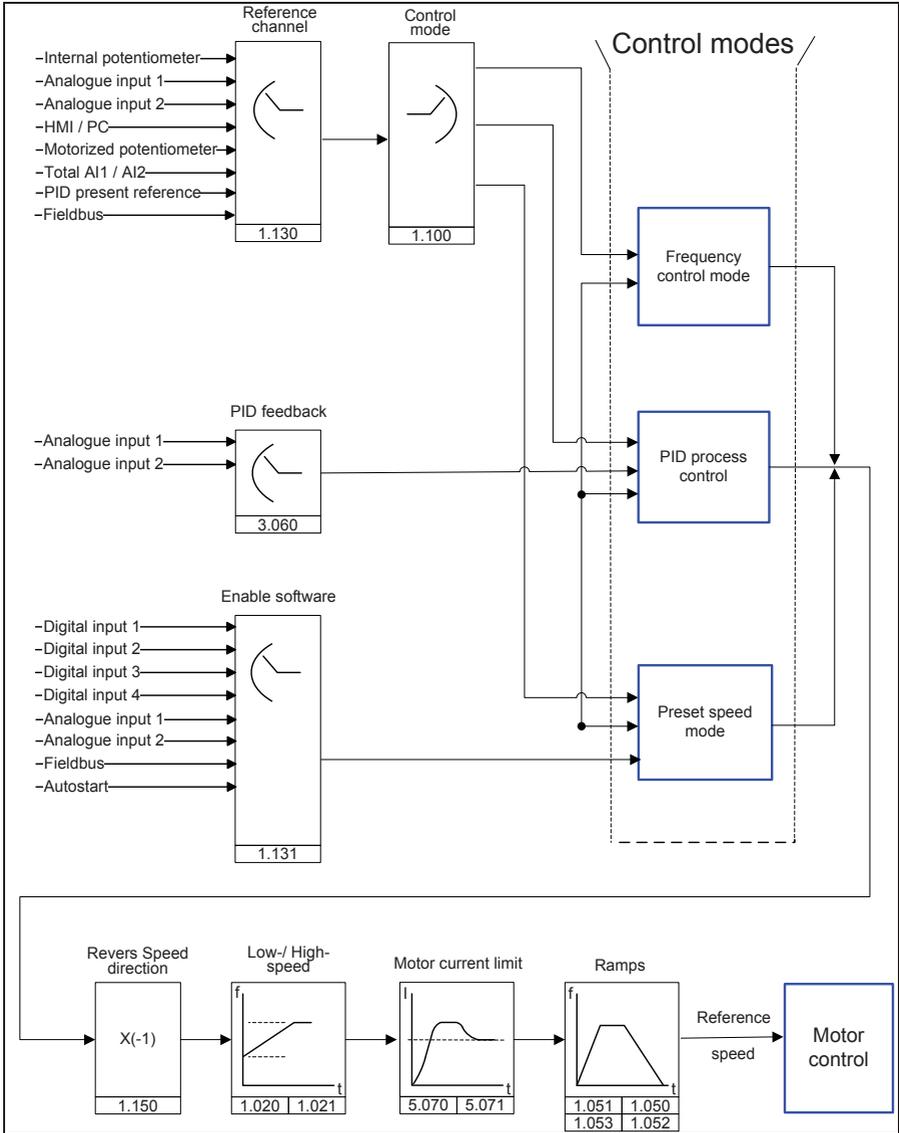
Fig. 17: General structure of target value generation

4.4 Start-up steps

 Parameterising is possible prior to installation. Parameterisation can be performed before the drive control is installed in the engine. The drive control has a 24 V low-voltage input for this purpose, which can supply the electric system without requiring mains power.

The start-up can be performed using a PC communication cable USB at plug M12 with integrated interface converter RS485/RS232 (article no. 10023950) or using the INVEOR manual control unit MMI with connection cable RJ11 at plug M12 (article no. 10004768).

Start-up using the PC:
- Install the INVEORpc software (you can obtain programming software from KOSTAL free of charge).
- Connect the PC to the M12 plug M1 with the optional connection cable.
- 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).
- Make the application settings (ramps, inputs, outputs, target values etc.).
- Optional: Define an access level (1 – MMI, 2 – user, 3 – manufacturer).

Please see also the quickstart guide in chapter 9.5.

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

1. Manual control unit: – the drive control is programmed using the manual control unit

2. User: – the basic parameters can be programmed into the drive control using the PC software

3. Manufacturer: – an extended selection of parameters can be programmed into the drive control using the PC software

5 Parameters

This chapter contains the following:
– An introduction to the parameters
– An overview of the most important start-up and operation parameters

5.1 Safety instructions for dealing with parameters

⚠ **WARNING**

Danger of injury due to restarting motors.

Non-observance can result in serious injury or damage.

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

☞ If parameters are changed while the device is in operation, it may take a few seconds until the effect becomes noticeable.

5.2 General information on parameters

5.2.1 Explanation of operating modes

The operating mode is the instance in which the reference is generated. In case of the frequency setting mode, this is a simple conversion of the raw input reference into a rotation speed reference; in the case of PID process control, the reference and feedback are compared and then a control to a specific process variable is performed.

Frequency setting mode:

The references from the "reference channel" (1,130) are rescaled into frequency reference. 0% is the "low speed" (1,020), 100% is the "high speed" (1,021).
The plus or minus sign of the reference is the decisive factor in rescaling.

PID process control:

The reference for the PID process control 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 from the active channel (selected by the "PID feedback").
Depending on the control difference, a rotation speed value is output to the control output with the help of the amplification factors for the propotional gain (3,050), integral gain (3,051) and derivative gain (3,052). In order to prevent the integral share from increasing limitlessly in case of uncontrollable control differences, this value is limited to a specific set value (corresponding to the "maximum frequency" (1,021)).

PID inverse:

The PID feedback can be inverted using the 3.061 parameter. The feedback is imported inversely, i.e. 0 V…10 V correspond internally to 100%…0%.
Please note that the reference must also be defined inversely.

An example:

A sensor with an analogue output signal of (0 V…10 V) is to operate as the source of the feedback channel (at AIx). At an output variable of 7 V (70%), this is to be regulated inversely. The internal feedback then corresponds to 100% − 70% = 30%. Accordingly, the specified reference is 30%.
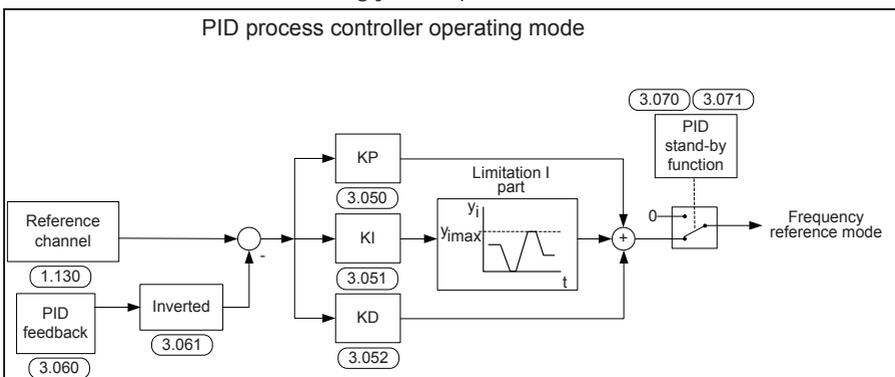
Fig. 18: PID process control

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 on a "minimum frequency" (1,020). As the inverter can reduce the rotation speed of the pump in normal operation when the process variable is reducing, but is never able to fall below the "minimum frequency" (1,020), this provides the opportunity of stopping the engine if it is running during a waiting time, the "PID stand-by time" (3,070) with the "minimum frequency" (1,020).

Once the reference diverges from the set % value, the "PID stand-by hysteresis" (3,071), the control (the motor) is started again.
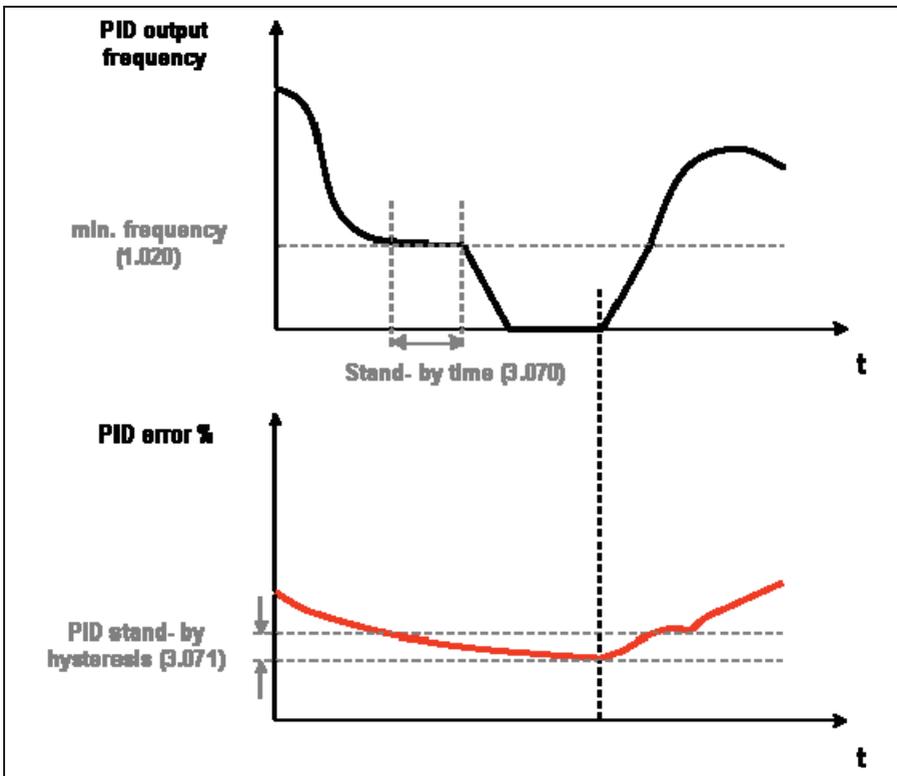
Fig. 19:   Stand-by function in PID process control

Preset speed:

In this operating mode, preset speed references are transferred to the motor control. There are 7 preset speeds (2,051 to 2,057) that are BCD coded and attached fixedly to digital inputs 1 to 3. These seven preset speeds can be released in three groups via the "preset speed mode" (2,050) parameter:
0 = preset speed 1, 1 = preset speed 1 to 3, 2 = preset speed 1 to 7.

DI 3	DI 2	DI 1	Selection	Parameters	Presetting
0	0	0	Min. frequency	1.020	0 Hz
0	0	1	preset speed 1	2.051	10 Hz
0	1	0	preset speed 2	2.052	20 Hz
0	1	1	preset speed 3	2.053	30 Hz
1	0	0	preset speed 4	2.054	35 Hz
1	0	1	preset speed 5	2.055	40 Hz
1	1	0	preset speed 6	2.056	45 Hz
1	1	1	preset speed 7	2.057	50 Hz

Tab. 7:   Logic table of fixed frequencies

5.2.2 Structure of the parameter tables

Fig. 20: Example for a parameter table

Key		
1 Parameter numbers	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 control off and on for transfer 1 = set hardware release again 2 = during operation	9	There are further parameters that relate to these parameters
5 Value range (from – to – factory setting)		

5.3   Application parameters

5.3.1   Basic parameters

1.020	Low speed		Unit: Hz	
Relationship to parameter: 1,150 3,070	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 400 def.: 0	own value (**to be entered!**)
	The low speed is the frequency provided by the drive control as soon as it released and no additional target value is pending. This frequency is not reached if a) acceleration is carried out while the drive is not moving. b) the frequency inverter is blocked. The frequency is then reduced to 0 Hz before it is blocked. c) the frequency inverter reverses (1,150). The revolving field is reversed at 0 Hz. d) the stand-by function (3,070) is active.			

1.021	High speed		Unit: Hz	
Relationship to parameter: 1,050 1,051	Parameter manual: p. xy	Transfer status: 2	min: 5 max.: 400 def.: 50	own value (**to be entered!**)
	The high speed is the frequency produced by the inverter in dependence on the reference.			

1.050	Deceleration 1:		Unit: s	
Relationship to parameter: 1,021 1,054	Parameter manual: p. xy	Transfer status: 2	min: 0,1 max.: 1000 def.: 5	own value (**to be entered!**)
	Deceleration 1 is the time that the inverter takes to brake to 0 Hz from the high speed (1,021). If the set deceleration time cannot be reached, the fastest possible deceleration time is implemented.			

1.051	Acceleration 1		Unit: s	
Relationship to parameter: 1,021 1,054	Parameter manual: p. xy	Transfer status: 2	min: 0,1 max.: 1000 def.: 5	own value (**to be entered!**)
	Acceleration 1 is the time that the inverter takes to speed up from 0 Hz to the high speed. The acceleration time can be increased through certain circumstances, e.g. if the drive control is overloaded.			

1.052	Deceleration 2		Unit: s	
Relationship to parameter: 1,021 1,054	Parameter manual: p. xy	Transfer status: 2	min: 0,1 max.: 1,000 def.: 10	own value (**to be entered!**)
	Deceleration 2 is the time that the inverter takes to brake to 0 Hz from the high speed (1,021). If the set deceleration time cannot be reached, the fastest possible deceleration time is implemented.			

1.053	Acceleration 2		Unit: s	
Relationship to parameter: 1,021 1,054	Parameter manual: p. xy	Transfer status: 2	min: 0,1 max.: 1,000 def.: 10	own value (**to be entered!**)
	Acceleration 2 is the time that the inverter takes to speed up from 0 Hz to the high speed. The acceleration time can be increased through certain circumstances, e.g. if the drive control is overloaded.			

1.054	Ramp selection		Unit: integer	
Relationship to parameter: 1,050 to 1,053	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 6 def.: 0	own value (**to be entered!**)
	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) 4 = digital input 3 (false = ramp pair 1 / true = ramp pair 2) 5 = digital input 4 (false = ramp pair 1 / true = ramp pair 2) 6 = INVEOR Soft-PLC			

1.100	Control 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: 0 max.: 4 def.: 0	own value (**to be entered!**)
	Selecting the operating mode. After SW release (1,131) and hardware release, the drive control runs as follows: 0 = frequency control mode, with the target value of the selected reference channel (1,130) 1 = PID process control, with the target value of the PID process control (3,050–3,071) 2 = preset speed mode, with the frequencies specified by parameters 2,051–2,057 3 = selection from INVEOR Soft-PLC			

1.130	Reference channel		Unit: integer	
Relationship to parameter: 3,062 to 3,069	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 10 def.: 0	own value (**to be entered!**)
	Determines the source from where the reference is to be read. 0 = internal potentiometer 1 = analogue input 1 2 = analogue input 2 3 = MMI/PC 4 = SAS 6 = motorizes potentiometer 7= total analogue inputs 1 and 2 8 = PID preset reference mode (3,062) 9 = fieldbus 10 = reference from 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.: 11 def.: 0	own value (**to be entered!**)
	⚠ WARNING The motor may start immediately, depending on the change made. Selection of the source for the control release. 0 = digital input 1 1 = digital input 2 2 = digital input 3 3 = digital input 4 4 = analogue input 1 (has to be selected in parameter 4.030) 5 = analogue input 2 (has to be selected in parameter 4.050) 6 = fieldbus 7 = SAS 8 = digital input 1 right / digital input 2 left 1,150 must be set to "0" 9 = autostart: 10 = INVEOR Soft-PLC 11 = preset frequency input (all inputs which are selected in parameter 2,050) The motor may start immediately if hardware is enabled (En.Hw. Fig. 8) and a reference have been provided. This cannot be prevented even with parameter 1,132.			

1.132	Start protect		Unit: integer	
Relationship to parameter: 1,131	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 1 def.: 1	own value (**to be entered!**)
	Selection of the behaviour in response to enable software (parameter 1,131). No effect if autostart was selected. 0 = immediate start when high signal is received at start input of control release 1 = start only in case of rising shoulder at start input of control release 2 = digital input 1 (function active at high signal) 3 = digital input 2 (function active at high signal) 4 = digital input 3 (function active at high signal) 5 = digital input 4 (function active at high signal)			

1.150	Rotation direction		Unit: integer	
Relationship to parameter: 1,131	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 7 def.: 0	own value (**to be entered!**)
	Selecting the rotational direction specification 0 = dependent on target value (depending on the plus or minus sign of the target value: positive: forward; negative: backwards) 1 = forwards only (rotational direction cannot be changed) 2 = backwards only (rotational direction cannot be changed) 3 = digital input 1 (0 V = forwards, 24 V = backwards) 4 = digital input 2 (0 V = forwards, 24 V = backwards) 5 = digital input 3 (0 V = forwards, 24 V = backwards) 6 = digital input 4 (0 V = forwards, 24 V = backwards) 7 = reference from INVEOR Soft-PLC			

1.180	Reset		Unit: integer	
Relationship to parameter: 1,181 1,182	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 4 def.: 4	own value (**to be entered!**)
	Selection of the source for error confirmation. Errors can only be confirmed once the error has been removed. Some errors can only be confirmed by switching the control off and then on again, see list of errors. Auto-confirmation via parameter 1,181. 0 = no manual confirmation possible 1 = rising shoulder at digital input 1 2 = rising shoulder at digital input 2 3 = rising shoulder at digital input 3 4 = rising shoulder at digital input 4			

1.181	Automatic reset		Unit: s	
Relationship to parameter: 1,180 1,182	Parameter manual: p. xy	Transfer status: 2	min: 0 max.:1,000,000 def.: 0	own value (**to be entered!**)
	Next to the reset function (1,180), an automatic reset can be selected. 0 = no automatic confirmation > 0 = time for automatic reset of error in seconds			

1.182	Quantity of automatic reset		Unit:	
Relationship to parameter: 1,180 1,181	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 500 def.: 5	own value (**to be entered!**)
	Next to the automatic reset (1,181), it is possible to limit the number of maximum automatic resets here. 0 = no restriction of automatic confirmations > 0 = number of maximum permitted automatic confirmations			

5.3.2   Preset speed mode

This mode has to be selected in parameter 1,100,
see also the section on selecting the operating mode

2.050	Preset speed mode		Unit: integer	
Relationship to parameter: 1,100 2,051 to 2,057	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 2 def.: 2	own value (**to be entered!**)
	Selection of the digital inputs used for the preset speeds 0 = Digital In 1 (preset speed 1) (2,051) 1 = Digital In 1, 2 (preset speeds 1 - 3) (2,051 to 2,053) 2 = Digital In 1, 2, 3 (preset speeds 1 - 7) (2,051 to 2,057)			

2,051 to 2,057	Preset speed		Unit: Hz	
Relationship to parameter: 1,020 1,021 1,100 1,150 2,050	Parameter manual: p. xy	Transfer status: 2	min: -400 max.: +400 def.: 0	own value (**to be entered!**)
	The frequencies that are to be put out at the digital inputs 1 - 3 specified in parameter 2,050 in dependence on the switching patterns. See chapter 5.2.1 on preset speeds.			

5.3.3 Motorized potentiometer

This mode must be selected in the parameter 1.130. This function can be used as a source of target values for the frequency setting mode as well as for the PID process controller.

2.150	MOP digital Input		unit: integer	
Relationship to Parameter: 1,130 4,030 4,050	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 7 def.: 3	Own value (to be entered!)
	Selection of the source for increasing and reducing the target value 0 = Digital In 1 + / Digital In 2 - 1 = Digital In 1 + / Digital In 3 - 2 = Digital In 1 + / Digital In 4 - 3 = Digital In 2 + / Digital 3 - 4 = Digital In 2 + / Digital In 4 - 5 = Digital In 3 + / Digital In 4 - 6 = Analogue In 1 + / Analogue In 2 - (must be selected in parameter 4,030 / 4,050) 7 = reference from customer PLC			

2.151	MOP step range		Unit: %	
Relationship to parameter: 1.020 1.021	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 100 def.: 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: 0.02 max.: 1000 def.: 0.04	Own value (**to be entered!**)
	Indicates the time in which the target value totals up for 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 has to be selected in parameter 1,100,
the target value source has to be selected in parameter 1,130,
see also chapter 5.2.1, "Explanation of operating modes – preset speed".

3.050	PID proportional gain		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			

3.051	PID integral gain		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			

3.052	PID derivative gain			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				

3.060	PID feedback			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 feedback for the PID process controller is imported: 0 = analogue input1 1 = analogue input2				

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 source of the feedback (parameter 3,060) is inverted 0 = disable 1 = enable				

3.062 to 3.068	PID preset reference			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 preset reference depending on the switching patterns are to be issued at the digital inputs 1 – 3 specified in parameter 3,069 (has to be selected in parameter 1,130).				

3.069	PID peset reference mode		Unit: integer	
Relationship to parameter: 1,100 3,062 to 3,068	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 2 def.: 0	own value (**to be entered!**)
	Selection of the digital inputs used for fixed frequencies 0 = Digital In 1 (PID preset reference 1) (3,062) 1 = Digital In 1, 2 (PID preset references 1 – 3) (3,062 to 3,064) 2 = Digital In 1, 2, 3 (PID preset references 1 – 7) (3,062 to 3,068)			

3.070	PID stand-by time		Unit: s	
Relationship to parameter: 1,020	Parameter manual: S. xy	Transfer status: 2	min: 0 max.: 10000 def.: 0	own value (**to be entered!**)
	If the drive control operates the set time with the low speed (parameter 1,020), the motor is stopped (0 Hz), see also Chapter 5.2.1, "PID process control" 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 max.: 50 def.: 0	own value (**to be entered!**)
	Condition for waking up the PID controller from stand-by. Once the control difference exceeds the set value in %, the control begins again, see also "Control mode (parameter 1,100) – PID controller".			

5.3.5 Analogue inputs

For analogue inputs 1 and 2 (AIx display AI1/AI2)

4.020/4.050	AIx reference type		Unit: integer	
Relationship to parameter:	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 1 def.: 1	own value (**to be entered!**)
	Function of analogue inputs 1/2: 1 = voltage input 2 = current input			

4.021/4.051	AIx minimum input		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 inputs as a percentage of the final area value. Example: 0…10 V or 0…20 mA = 0%…100% 2…10 V or 4…20 mA = 20%…100%			

4.022/4.052	AIx maximum input		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 inputs as a percentage of the final area value. Example: 0…10 V or 0…20 mA = 0%…100% 2…10 V or 4…20 mA = 20%…100%			

4.023/4.053	AIx 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 in percentage of the final area value of the analogue inputs.			

4.024/4.054	AIx filter time			Unit: s	
Relationship to parameter:	Parameter manual: p. xy	Transfer status: 2	min: max.: def.:	0.02 1.00 0	own value (**to be entered!**)
	Filter time of analogue inputs in seconds.				

4.030/4.060	AIx function			Unit: integer	
Relationship to parameter:	Parameter manual: p. xy	Transfer status: 2	min: max.: def.:	0 1 0	own value (**to be entered!**)
	Function of analogue inputs 1/2 0 = analogue input 1 = digital input				

4.033/4.063	AIx physical unit			Unit:	
Relationship to parameter: 4,034/4,064 4,035/4,065	Parameter manual: p. xy	Transfer status: 2	min: max.: def.:	0 10 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				

4.034/4.064	Alx physical minimum		Unit:	
Relationship to parameter:	Parameter manual:	Transfer status:	min:-10,000	own value (**to be entered!**)
			max.:+10,000	
4,033/4,063	p. xy	2	def.: 0	
4,035/4,065	Selection of the lower limit of a physical value to be displayed.			

4.035/4.065	Alx physical maximum		Unit:	
Relationship to parameter:	Parameter manual:	Transfer status:	min:-10,000	own value (**to be entered!**)
			max.:+10,000	
4,033/4,063	p. xy	2	def.: 100	
4,034/4,064	Selection of the upper limit of a physical value to be displayed.			

5.3.6   Digital inputs

4.110 to 4.113	DIx inverted		Unit: integer	
Relationship to parameter:	Parameter manual:	Transfer status:	min: 0	own value (**to be entered!**)
			max.: 1	
	p. xy	2	def.: 0	
	This parameter can be used to invert the digital input. 0 = disable 1 = enable			

5.3.7   Analogue output

4.100	AO1 function		Unit: integer	
Relationship to parameter: 4,101 4,102	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 40 def.: 0	own value (**to be entered!**)
	Selection of the process value that is output at the analogue output. The standardisation (4,101/4,102) has to be adapted, depending on the selected process value. 0 = not allocated / INVEOR Soft-PLC 1 = intermediate circuit voltage 2 = supply voltage 3 = motor voltage 4 = motor current 5 = frequency feedback 6 = speed measured externally by speed sensor (if available) 7 = current angle or position (if available) 8 = IGBT temperature 9 = internal temperature 10 = analogue input1 11 = analogue input2 12 = frequency reference 13 = motor power 14 = torque 15 = field bus			

4.101	AO1 minimum output		Unit:	
Relationship to parameter: 4,100	Parameter manual: p. xy	Transfer status: 2	min:-10,000,000 max.:+1,000,000 def.: 0	own value (**to be entered!**)
	Describes which area is to be resolved to the 0-10 V output voltage or the 0-20 mA output current.			

4.102	AO1 maximum output		Unit:	
Relationship to parameter: 4,100	Parameter manual: p. xy	Transfer status: 2	min: 0 max.:+1,000,000 def.: 0	own value (**to be entered!**)
	Describes which area is to be resolved to the 0-10 V output voltage or the 0-20 mA output current.			

5.3.8 Digital outputs

For digital outputs 1 and 2 (DOx display DO1/DO2)

4.150/4.170	DOx function		Unit: integer	
Relationship to parameter: 4,151/4,171 4,152/4,172	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 50 def.: 0	own value (**to be entered!**)
	Selection of the process value to which the output should switch. 0 = not allocated / INVEOR Soft-PLC 1= DC bus voltage 2= line voltage 3= motor voltage 4= motor current 5= frequency feedback 6= – 7= – 8= IGBT temperature 9= internal temperature 10= error (NO) 11= inverted error (NC) 12= final release levels 13= digital input1 14= digital input 2 15= digital input 3 16= digital input 4 17= ready for operation 18= ready 19= operation 20= ready for operation + ready 21= ready for operation + ready + operation 22= ready + operation 23 = motor power 24 = torque 25 = field bus 50 = motor current limit active			

4.151/4.171	DOx on		Unit:	
Relationship to parameter: 4,150/4,170	Parameter manual: p. xy	Transfer status: 2	min: 0 max.:1,000,000 def.: 0	own value (**to be entered!**)
	If the set process value exceeds the switch-on limit, the output is set to 1.			

4.152/4.172	DOx off		Unit:	
Relationship to parameter: 4,150/4,170	Parameter manual: p. xy	Transfer status: 2	min: 0 max.:1,000,000 def.: 0	own value (**to be entered!**)
	If the set process value exceeds the switch-on limit, the output is set to 1.			

5.3.9 Relay

For relays 1 and 2 (Rel.x – display Rel. 1/Rel. 2)

4.190/4.210	Rel.x function		Unit: integer	
Relationship to parameter: 4,191/4,211 4,192/4,212	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 500 def.: 0	own value (**to be entered!**)
	Selection of the process value to which the output should switch. 0= not allocated / INVEOR Soft-PLC 1= DC bus voltage 2= line voltage 3= motor voltage 4= motor current 5= frequency feedback 6= – 7= – 8= IGBT temperature 9= internal temperature 10= error (NO) 11= inverted error (NC) 12= final release levels 13= digital input1 14= digital input 2 15= digital input 3 16= digital input 4 17= ready for operation 18= ready 19= operation 20= ready for operation + ready 21= ready for operation + ready + operation 22= ready + operation 23 = motor power 24 = torque 25 = field bus 50 = motor current limit active			

4.191/4.211	Rel.x on			Unit:	
Relationship to parameter: 4,190/4,210	Parameter manual: p. xy	Transfer status: 2	min: 0	own value (**to be entered!**)	
			max.:1000000		
			def.: 0		
	If the set process value exceeds the switch-on limit, the output is set to 1.				

4.192/4.212	Rel.x off			Unit:	
Relationship to parameter: 4,190/4,210	Parameter manual: p. xy	Transfer status: 2	min: 0	own value (**to be entered!**)	
			max.:1000000		
			def.: 0		
	If the set process value exceeds the switch-on limit, the output is set to 1.				

4.193/4.213	Rel.x on delay			Unit:	
Relationship to parameter: 4,194/4,214	Parameter manual: p. xy	Transfer status: 2	min: 0	own value (**to be entered!**)	
			max.: 99		
			def.: 0		
	Specifies the length of the switch-on delay.				

4.194/4.214	Rel.x off delay			Unit:	
Relationship to parameter: 4,193/4,213	Parameter manual: p. xy	Transfer status: 2	min: 0	own value (**to be entered!**)	
			max.: 99		
			def.: 0		
	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 to 4,113	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 4 def.: 0	own value (**to be entered!**)
	Selection of the source from which an external error can be reported. 0 = not allocated / INVEOR Soft-PLC 1 = digital input 1 2 = digital input 2 3 = digital input 3 4 = digital input 4 If the selected digital input has a high signal, the inverter switches to error no. 23/24 external fault 1/2. Parameters 4,110 to 4,113 DIx inverse 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 surface has been reached.

This motor current limit is monitored at application level and thereby limits with relatively low dynamics. This has to be considered when selecting this function.

The maximum value is determined using the "motor current limit in %" parameter (5,070). This is given in percent and relates to the nominal motor current specified in the "motor current" type plate data (33,031).

The maximum current-time surface is calculated from the product of the "motor current limit in s" parameter (5,071) and the fixed over-current of 50% of the required motor current limit.

As soon as this current-time surface is exceeded, the motor current is restricted to the limit value by reducing the rotation speed. If the output current of the drive control exceeds the motor current (parameter 33,031) multiplied by the set limit in % (parameter 5,070) for the set time (parameter 5,071), the speed of the motor is reduced until the output current is below the set limit.

The dimming is performed by a PI controller that works in dependence on the current difference.
The entire function can be deactivated by setting the "motor current limit in %" parameter (5,070) to zero.

5.070	Motor current limit		Unit: %	
Relationship to parameter:	Parameter manual:	Transfer status:	min: 0	own value (**to be entered!**)
			max.: 250	
5,071 33,031	p. xy	2	def.: 0	
	0 = disable			

5.071	Motor current limit		Unit: s	
Relationship to parameter:	Parameter manual:	Transfer status:	min: 0	own value (**to be entered!**)
			max.: 100	
5,070 33,031	p. xy	2	def.: 1	

5.3.12 Stall detection

5.080	Stall detection		Unit: integer	
Relationship to parameter:	Parameter manual:	Transfer status:	min: 0	own value (**to be entered!**)
			max.: 1	
5,081	p. xy	2	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:	min: 0	Own value (**to be entered!**)
			max.: 50	
5,080	p. xy	2	def.: 2	
	Indicates the time after which a blockage is detected.			

5.4 Performance parameters

5.4.1 Motor data

33.001	Type of motor		Unit: Integer	
Relationship to parameter: 34,010	Parameter manual: S. xy	Transfer status: 1	min: 1 max.: 2 def.: 1	own value (**to be entered!**)
	Selecting the 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.			

33.031	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 power		Unit: W	
Relationship to parameter:	Parameter manual: p. xy	Transfer status: 1	min: 0 max.: 680 def.: 0	own value (**to be entered!**)
	A performance value [kW] P $_{M,N}$ has to be set here that corresponds to the motor power.			

33.034	Motor speed		Unit: rpm	
Relationship to parameter: 34,120	Parameter manual: p. xy	Transfer status: 1	min: 0 max.:10,000 def.: 0	own value (**to be entered!**)
	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: 40 max.: 100 def.: 0	own value (**to be entered!**)
	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 max.: 30 def.: 0,001	own value (**to be entered!**)
	The stator resistance can be optimised here, if the automatically determined value (motor identification) is insufficient.			

33.110	Motor voltage		Unit: V	
Relationship to parameter:	Parameter manual: p. xy	Transfer status: 1	min: 0 max.: 680 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 cosphi.			

33.200	Stator inductance		Unit: H	
Relationship to parameter:	Parameter manual: p. xy	Transfer status: 1	min: 0 max.: 100 def.: 0	Own value (**to be entered!**)
	For synchronous motors only. The stator inductivity 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.: 5000 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.			

5.4.2   I²T

33.010	I²T fact. motor		Unit: %	
Relationship to parameter:	Parameter manual:	Transfer status:	min: 0	own value (**to be entered!**)
			max.: 150	
33,031 33,011	p. xy	2	def.: 100	
	The percental current threshold (in relation to motor current 33,031) at the start of integration can be set here.			

33.011	I²T time		Unit: s	
Relationship to parameter:	Parameter manual:	Transfer status:	min: 0	own value (**to be entered!**)
			max.: 30	
33,010	p. xy	2	def.: 25	
	Time after which the drive control switches off with I²T.			

33.138	Holding current time		Unit: s	
Relationship to parameter:	Parameter manual:	Transfer status:	min: 0	own value (**to be entered!**)
			max.: 120	
33,010	p. xy	2	def.: 2	
	Only for asynchronous motors.			
	This is the time span during which the drive is held with continuous current after the brake ramp has been completed.			

5.4.3 Switching frequency

The internal switching frequency (clocking frequency) can be changed in order to control the power element. A high setting reduces noise in the motor but increases EMV emission and losses in the drive control.

34.030	Switching frequency		Unit: Hz	
Relationship to parameter:	Parameter manual: p. xy	Transfer status: 2	min: 1 max.: 4 def.: 2	own value (**to be entered!**)
	Selection of the switching frequency for the inverter 1 = 16 kHz 2 = 8 kHz 4 = 4 kHz			

5.4.4 Controller data

34.010	Control method		Unit: integer	
Relationship to parameter: 33,001 34,011	Parameter manual: p. xy	Transfer status: 2	min: 100 max.: 200 def.: 100	Own value (**to be entered!**)
	Selection of the type of control. 100 = open-loop asynchronous motor 101 = close-loop asynchronous motor 200 = open-loop synchronous motor 201 = close-loop synchronous motor			

34.011	Type of encoder		Unit: integer	
Relationship to parameter: 34,010 34,012 34,013	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 2 def.: 0	Own value (**to be entered!**)
	Selection of the type of sensor 0 = inactive 1 = TTL sensor 2 = HTL sensor ⚠ WARNING When selecting the HTL sensor, 24V is transmitted via the interface. If using a TTL sensor, this could result in damage to the sensor.			

34.012	Encoder line count		Unit: integer	
Relationship to parameter: 34,010 34,011 34,013	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 10000 def.: 1024	Own value (**to be entered!**)
	Selection of the line count of the sensor used.			

34.013	Encoder offset		Unit: °	
Relationship to parameter: 34,010 34,011 34,012	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 360 def.: 0	Own value (**to be entered!**)
	An encoder offset for the sensor can be set here.			

34.021	Flying restart		Unit:	
Relationship to parameter:	Parameter manual: p. xy	Transfer status: 1	min: 0 max.: 1 def.: 1	own value (**to be entered!**)
	This parameter is used to activate the capture function. 0 = disable 1 = enable			

34.090	Speed control K_p		Unit: mA/rad/s	
Relationship to parameter:	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 10,000 def.: 150	own value (**to be entered!**)
	The control boost of the speed control can be optimised here, if the automatically determined results (of the motor identification) are insufficient.			

34.091	Speed control 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!**)
	The reset time of the speed control can be optimised here, if the automatically determined results (of the motor identification) are insufficient.			

34.110	Slip trimmer		Unit:	
Relationship to parameter: 33,034	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 1.3 def.: 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..			

34.130	Voltage control reserve		Unit:	
Relationship to parameter:	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 2 def.: 0,95	own value (**to be entered!**)
	Only for asynchronous motors. This parameter can be used to adjust voltage output.			

5.4.5 Squared characteristic

34.120	Squared characteristic		Unit: integer	
Relationship to parameter: 34,121	Parameter manual: p. xy	Transfer status: 2	min: 0 max.: 1 def.: 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 compensation		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.			

5.4.6 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 inverter has reached its current limit or the maximum permissible EMK.			

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 can be adjusted which was impressed in the motor before starting the control. In % 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 can be set in which the start up current 34.226 is impressed.			

34.228 – 34.230	Startup 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 startup procedure to "Controlled", higher starting torques can be achieved. 0 = regulated, the inverter switches directly to the controller after the impression phase. 1 = controlled, after the impression 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

⚠ WARNING

Danger injury and danger of electric shock.

Non-observance of warnings can result in serious injury or damage.

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

- Damaged parts or components have to be replaced with parts from the appropriate list of spare parts.

- The frequency inverter has to be disconnected prior to opening, assembly or disassembly.

6.1 List of the LED flash codes for error recognition

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

The following table contains an overview.

Red LED	Green LED	State
○	☀	Ready for operation (activate En_HW for operation)
○	●	Operation
☀	●	Warning
●	○	Error
☀	☀	Identification of motor data
○	☀	Initialisation
☀	☀	Firmware update
☀	●	Bus error operation
☀	☀	Bus error ready for operation

Tab. 8:   LED flash codes

Key

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

6.2   List of errors and system errors

When an error occurs, the inverter is switched off; you can find the corresponding error numbers in the flash code table or the PC tool.

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

Error messages can be confirmed as follows:
– digital input (programmable)
– via the MMI (manual operating unit)
– auto confirmation (parameter 1,181, page 38)
– switching the device off and on
– via field bus (CANOpen, Profibus DP, EtherCAD)

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

No.	Error name	Description of fault	Possible cause/remedy
1	Undervoltage 24 V application	Supply voltage for the application is lower than 15 V	Overload of the 24 V supply
2	Overvoltage 24 V application	Supply voltage for the application is greater than 31 V	Internal 24 V supply is not OK or external supply is not OK
8	Communication application<>power	Internal communications between the application plate and the power-conducting plate is not OK	EMV interferences
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 in 1 (4–20 mA / 2–10 V)	Current or voltage are lower than the lower limit of analogue input 1 (this error monitoring is activated automatically by setting parameter 4,021 to 20	Cable brake, faulty external sensor
14	Cable break at analogue in 2 (4–20 mA / 2–10 V)	Current or voltage are lower than the lower limit of analogue input 2 (this error monitoring is activated automatically by setting parameter 4,021 to 20	Cable brake, faulty external sensor

No.	Error name	Description of fault	Possible cause/remedy
15	Stall detection	The drive shaft of the motor is stalled. 5.080	Remove the blockade
18	Excess frequency inverter temperature application	Inner temperature too high	Insufficient cooling, low motor speed and high torque, clocking frequency too high
21	Bus time-out	No answer from bus sharing unit or MMI/PC	Check bus wiring
22	Confirmation error	The number of maximum automatic confirmations (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
23	External fault 2	The parameterised fault input is active. 5.010	Correct the external fault
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 current has been exceeded	Feedback by motor in generating operation / mains voltage too high / faulty setting for rotation speed control
34	Undervoltage of intermediate circuit	The minimum intermediate circuit current has not been reached	Mains voltage too low
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		A 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, clocking frequency too high
39	Overcurrent	Maximum output current of the converter exceeded	
40	Excess frequency inverter temperature	Inside temperature too high	Insufficient cooling, low motor speed and high torque, clocking frequency too high

Error detection and troubleshooting

No.	Error name	Description of fault	Possible cause/remedy
42	I²T motor safety shut-off	The internal I2T motor protection (can be parameterised) has been triggered	Long-term overload
43	Ground leak	Ground leak during a motor phase	Insulation error
45	Motor connection disrupted	No motor current in spite of control through frequency inverter	No motor connected
46	Motor parameters	Plausibility check for motor parameters failed	Parameter set not OK
47	Drive control parameters	Plausibility check for drive control parameters failed	Parameter set not OK Please check the parameters 33.001 and 34.010
48	Type plate data	No motor data were entered.	Please enter the motor data according to the rating plate
49	Power-class restriction	Max overload of the drive control exceeded for more than 60 sec.	Check application / reduce load / dimension larger drive control

Tab. 9:   Error detection

7 Technical data

7.1 General data

This chapter contains the technical data.

Installation size	MA				MB			MC		MD			
Rated motor power [kW] (4-pol asynchr. motor)	0,55	0,75	1,1	1,5	2,2	3	4	5,5	7,5	11	15	18,5	22
Ambient temperature [°C]	-25 (non condensing) bis +50 (without derating) *												
Mains voltage [V]	3~ 200 -10% ... 480 +10%												
Mains frequency [Hz]	47 bis 63												
Network configurations	TN/TT												
Line current [A]	1,4	1,9	2,6	3,3	4,6	6,2	7,9	10,8	14,8	23,3	28,3	33,3	39,9
Nominalcurrent, eff. [I_N at 8kHz/400 V]	1,7	2,3	3,1	4,0	5,6	7,5	9,5	13,0	17,8	28,0	34,0	40,0	48,0
Min. brake resistance [Ω]	100				50			50		30			
Max. current, eff.	150% of the nominal current for 60 sec												130%
Switching frequency [kHz]	4, 8, 16, (factory setting 8)												
Rotating field frequency [Hz]	0 - 400												
Protective function	Undervoltage, Overvoltage, I²t restriction, short circuit, motor –inverter temperature, anti-tilt protection, stall protection												
Process control	PID controller, free configuration												
Dimensions [L x W x H] mm	233 x 153 x 120				270 x 189 x 133			307x223x181		414 x 294 x 238			
Weight including adapter plate [kg]	3,9				5,0			8,7		21,0			
Protection type [IPxy]	65												
EMC	approvals acc. to DIN EN 61800-3, class C2												

Tab. 10: Technical data (technical changes reserved)

* in terms of the UL 508C standard, please see chapter 9.4!

Designation	Function
Digital inputs 1–4	- Switching level low < 5 V / high > 15 V - Imax (at 24 V) = 3 mA - Rin = 8.6 kOhm
Analogue inputs 1, 2	- In +/- 10 V or 0–20 mA - In 2–10 V or 4–20 mA - Resolution 10 Bit - Rin = 10 kOhm
Digital outputs 1, 2	- Short-circuit proof - Imax = 20 mA
Relays 1, 2	1 changeover contact (NO/NC) maximum switching power *: - at ohmic load (cos φ = 1): 5 A at ~230 V or = 30 V - under 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
Analogue output 1 (current)	- Short-circuit proof - Iout = 0..20 mA - burden = 500 ohm
Analogue output 1 (voltage)	- Short-circuit proof - Uout = 0..10 V -Imax = 10 mA
Power supply 24 V	- Auxiliary voltage U = 24V 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. 11: Specification of interfaces

* in terms of the UL 508C standard, the maximum allowed is 2 A!

8 Optional accessories

This chapter contains brief descriptions of the following optional accessories

– Adapter plates
– Manual control unit MMI including connection cable RJ11 on plug M12
– Brake resistors

8.1 Adapter plates

8.1.1 Motor adapter plates

A standard motor adapter plate (with an integrated terminal board) is available for each INVEOR installation size. Download the 3D files (.stp) for INVEOR and adapter plates under www.kostal.com/industrie.

INVEOR installation size	A	B	C
Power [kW]	0.55 to 1.5	2.2 to 4	5.5 to 7.5
Designation	ADP MA MOT 0000 A00 000 1	ADP MB MOT 0000 A00 000 1	ADP MC MOT 0000 A00 000 1
Part no.	10023106	10026184	10025632

The customer needs to drill the four holes for mounting the standard adapter plate on the motor. Below are technical drawings reflecting the possible locations of the holes for each of the respective installation sizes.
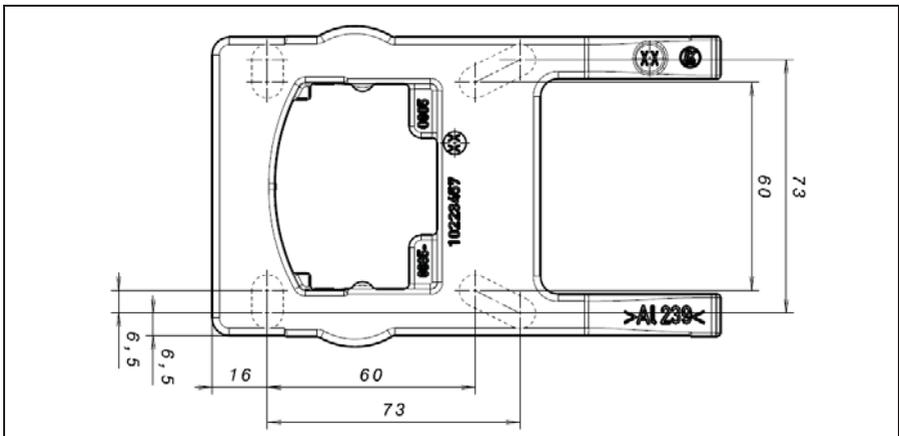
Fig. 21:   Hole pattern for BG A standard adapter plate
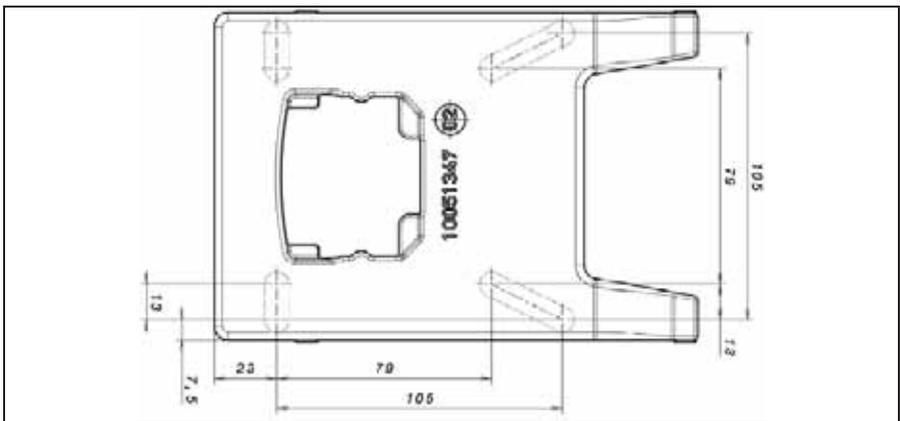
Fig. 22:   Hole pattern for BG B standard adapter plate
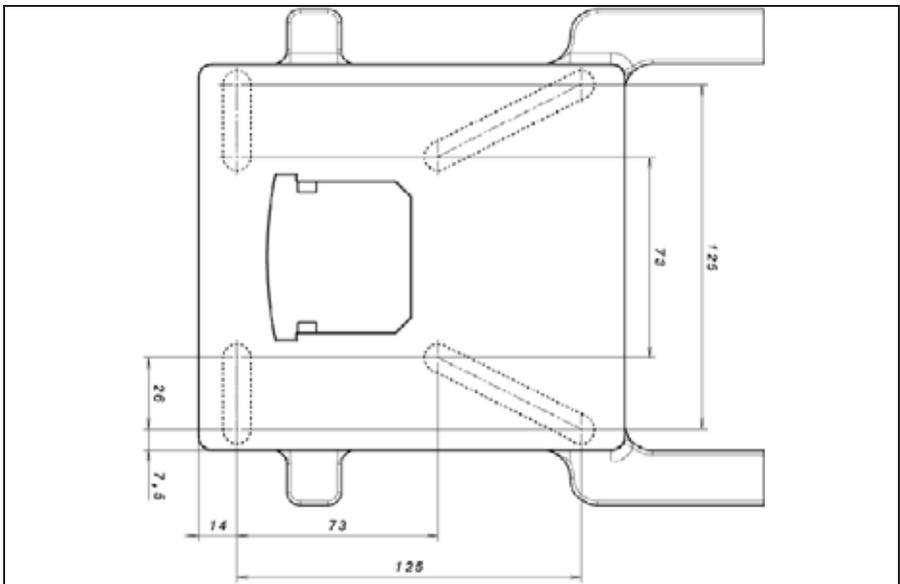
Fig. 23:   Hole pattern for BG C standard adapter plate

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

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

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

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

8.1.2 Motor adapter plates (specific)

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

8.1.3 Wall adapter plates (standard)

A standard wall adapter plate (with an integrated terminal board) is available for each INVEOR installation size. Download the 3D files for INVEOR and adapter plates under www.kostal.com/industrie. Four holes for mounting the adapter plate, as well as an EMC screw connection, are already present.

INVEOR installation size	A	B	C
Power [kW]	0.55 to 1.5	2.2 to 4	5.5 to 7.5
Designation	ADP MA WDM 0000 A00 000 1	ADP MB WDM 0000 A00 000 1	ADP MC WDM 0000 A00 000 1
Part no.	10023107	10026185	10025932
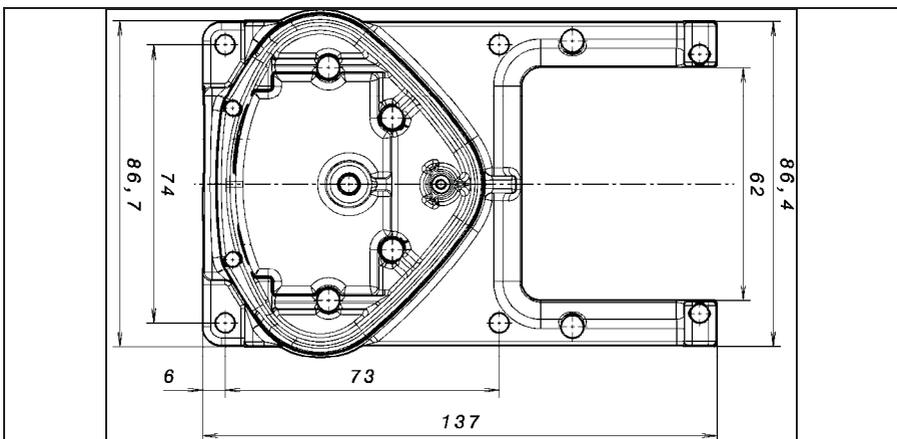
Fig. 24:   Hole pattern for BG A standard wall adapter plate
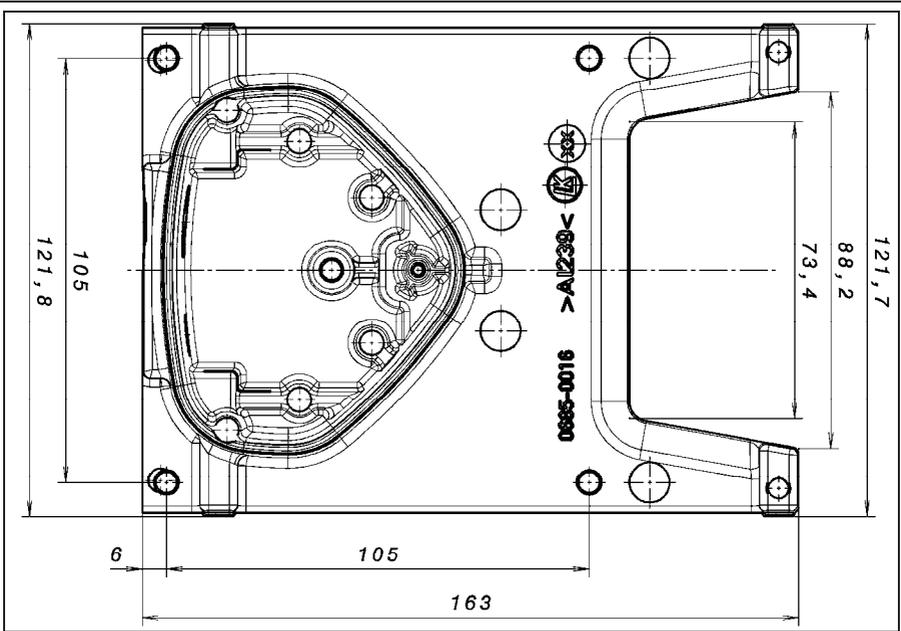
Fig. 25:   Hole pattern for BG B standard wall adapter plate
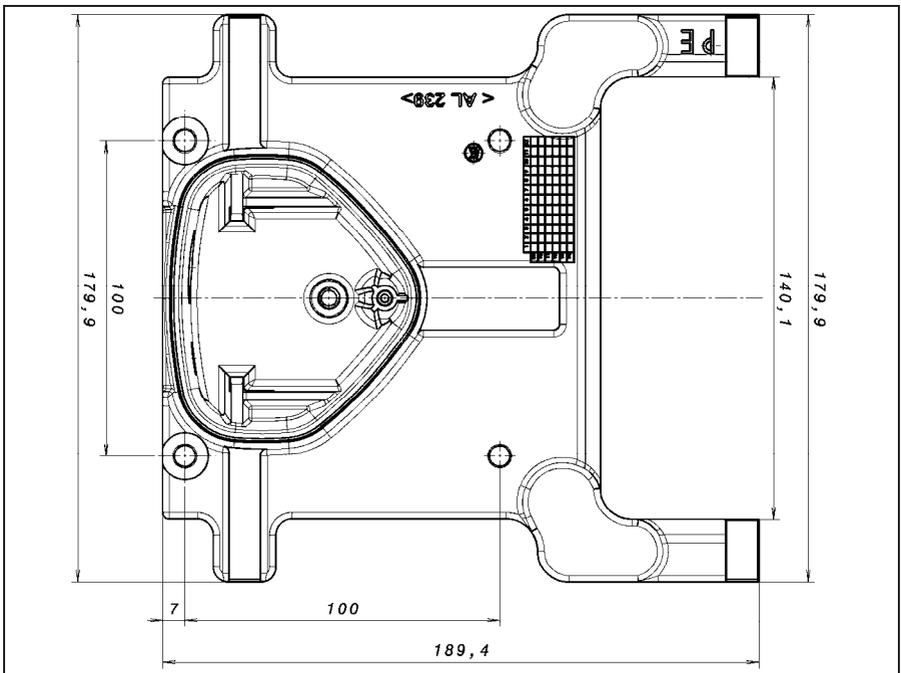
Fig. 26:   Hole pattern for BG C standard wall adapter plate

8.2 MMI manual control unit including a 3 m RJ11 connection cable on an M12 plug

The MMI manual control unit (part no. 10004768) is connected to the integrated M12 interface of the INVEOR. This operating unit allows the user to write (program) and/or to visualize all the parameters of the INVEOR. Up to 8 complete data records can be stored in an MMI and copied to other INVEOR. As an alternative to the free INVEORpc software, a complete commissioning is available, external signals are not necessary.

8.3 PC communication cable USB on M12 plug (converter RS485/RS232 integrated)

As an alternative to the MMI manual control unit, an INVEOR can also be put into operation using the PC communication cable (part no. 10023950) and the INVEORpc software. The INVEORpc software is available free of charge at the KOSTAL homepage under www.kostal.com/industrie.

9 Guidelines, Norms and Standards

This chapter contains information about electromagnetic compatibility (EMC), and guidelines, norms and standards.

9.1 EMV limit classes

Please note that EMV limit classes are only reached if the standard switching frequency (clocking 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 the device is mounted on the wall, the length of the screened motor cables (with large surfaces on both sides) (max. 3 m) may not exceed the permitted limits.

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

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

9.2 Classification acc. to IEC/EN 61800-3

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

Definition of the 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 surroundings with their own supply network that is separated from the public low-voltage supply by a transformer.

9.3   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)

– Product standards list

9.4   Required markings for UL

Required Markings

For installation on industrial machines in accordance with the Standard for Industrial Machinery NFPA79 only.

Maximum Ambient Temperature:

Electronic	Adapter	Ambient
INV MA 4 1.5	ADP MA WDM	35°C
INV MB 4 2.2	ADP MB WDM	45°C
INV MB 4 3.0	ADP MB WDM	40°C
INV MB 4 4.0	ADP MB WDM	35°C
INV MC 4 5.5	ADP MC WDM	40°C
INV MC 4 7.5	ADP MC WDM	35°C

Internal Overload Protection Operates within 60 seconds when reaching 150% of the Motor Full Load Current.

Suitable For Use On A Circuit Capable Of Delivering Not More Than 5kA rms Symmetrical Amperes, 400 Volts Maximum When Protected by Fuses.

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.

Instruction for operator and servicing instructions on how to mount and connect the products using the intended motor connection adapter.

Use 75°C copper wires only.

Connection of external motor overtemperature sensing is required.

9.5 Quickstart guide

9.5.1 Quickstart guide for asynchronous motors
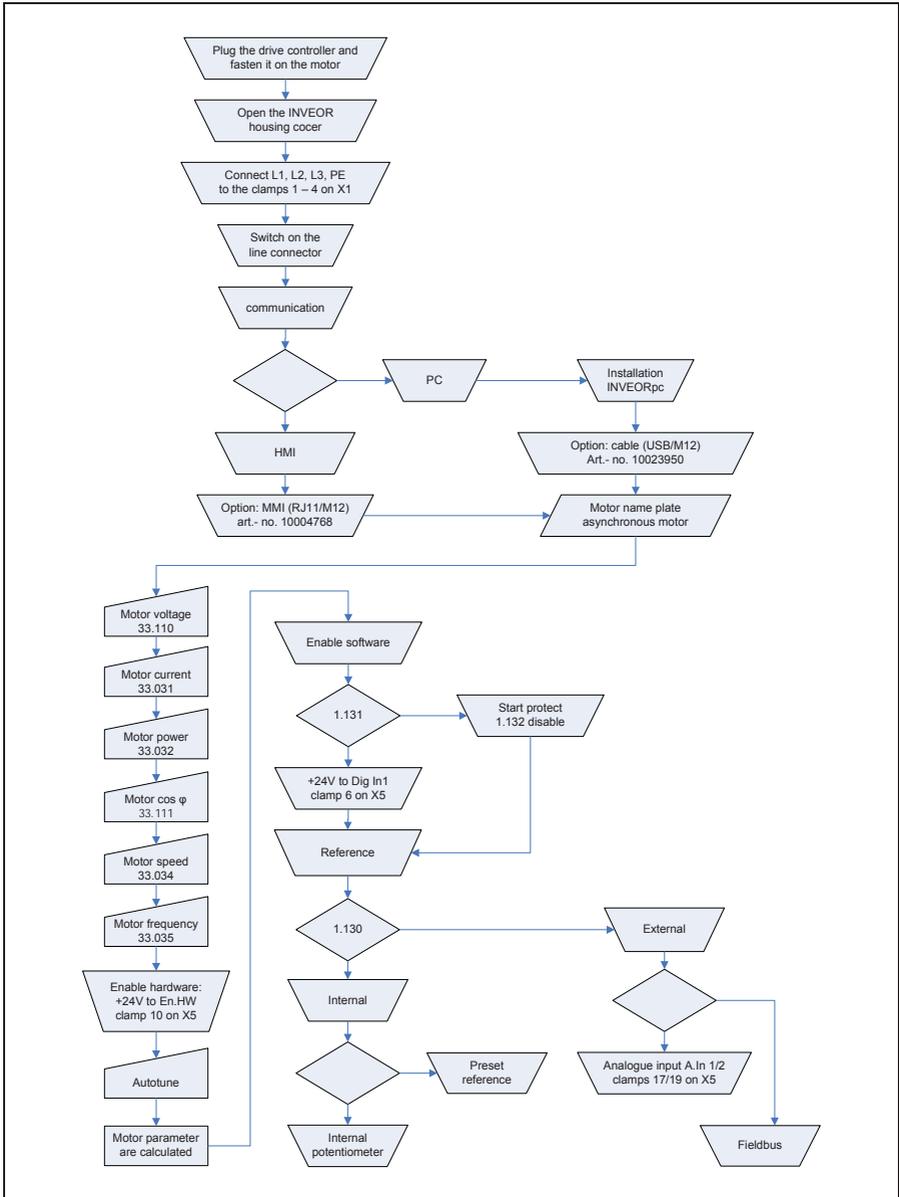
Fig. 27: Startup diagram for ASM

9.5.2   Quickstart guide for synchronous motors
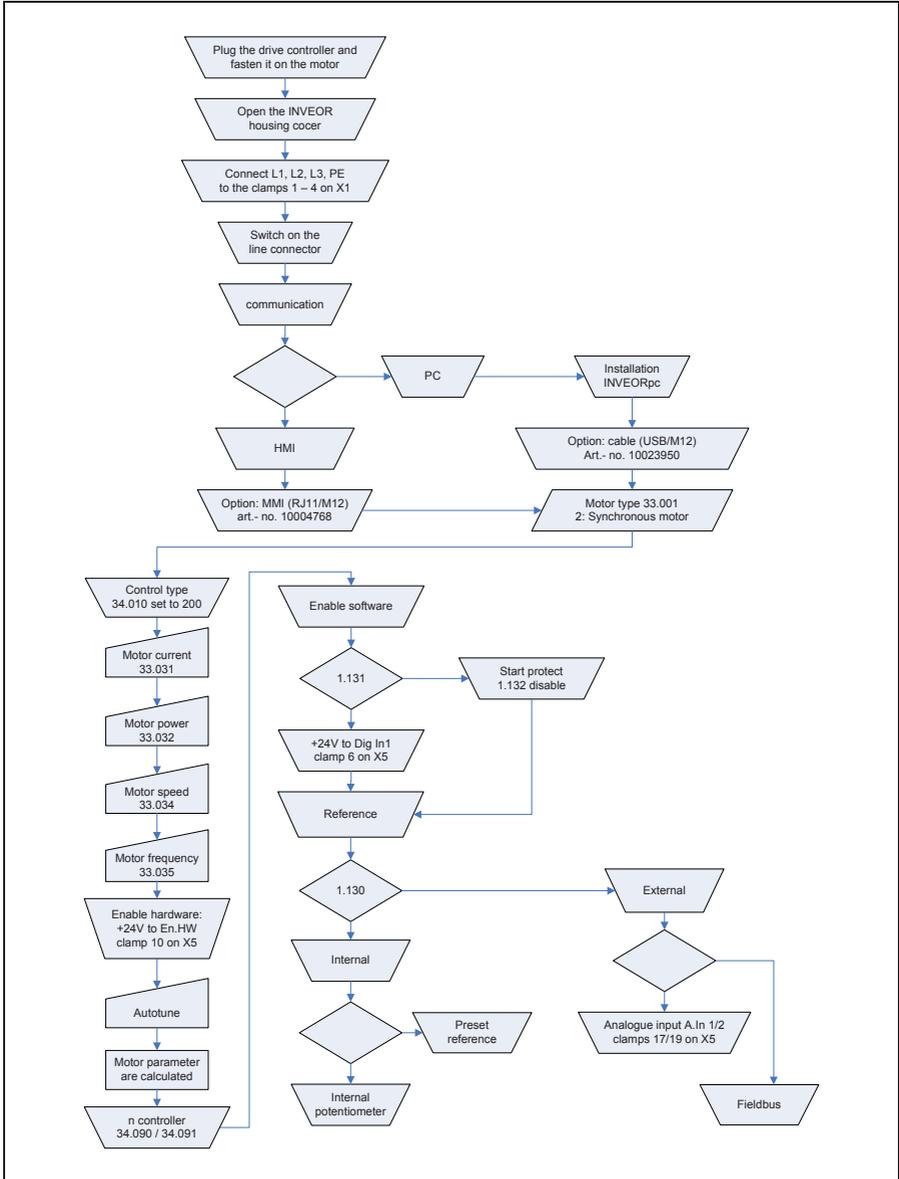
Fig. 28:   Startup diagram for SM

10 Stichwortverzeichnis

10205766

KOSTAL