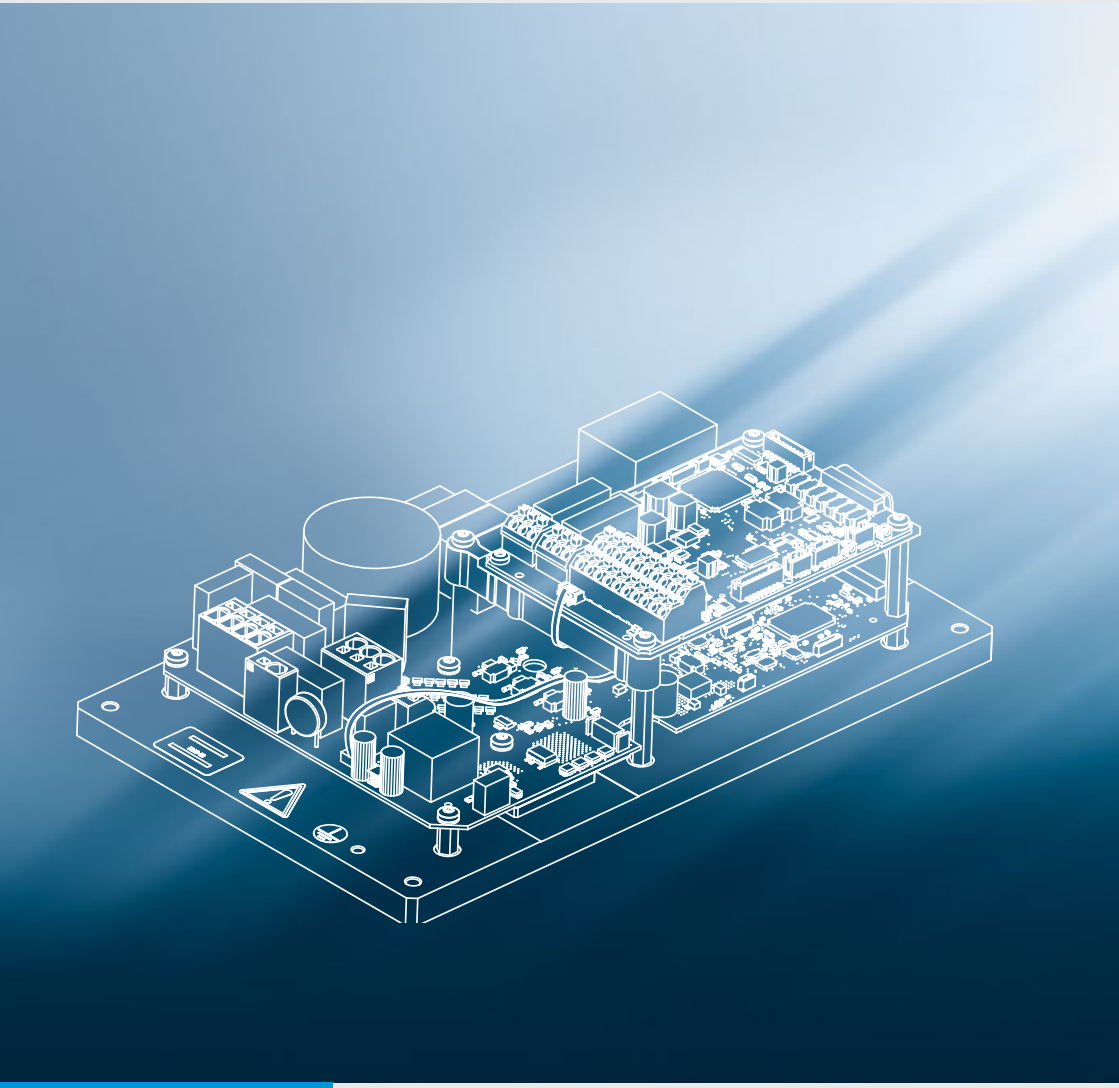
INDUSTRIE ELEKTRIK

KOSTAL



Smart connections.

# Operating manual

## INVEOR P Drive Controller

# Legal notice

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

## Exclusion of liability

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

## General note on gender equality

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

# 1. General information

Thank you for choosing an INVEOR P drive controller (Cold Plate) from KOSTAL Industrie Elektrik GmbH! Our INVEOR line of drive controllers is designed to be universally usable with all common motor types.

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

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

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

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

E-mail: INVEOR-service@kostal.com

Website

www.kostal-industrie-elektrik.com

## 1.1 Information about documentation

The following information explains how to navigate through the documentation.

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

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

This manual is an integral part of the product and applies exclusively to the INVEOR P from KOSTAL Industrie Elektrik GmbH.

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

### 1.1.1 Other applicable documents

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

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

### 1.1.2 Storing the documentation

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

## 1.2 Notes in this manual

### 1.2.1 Warnings

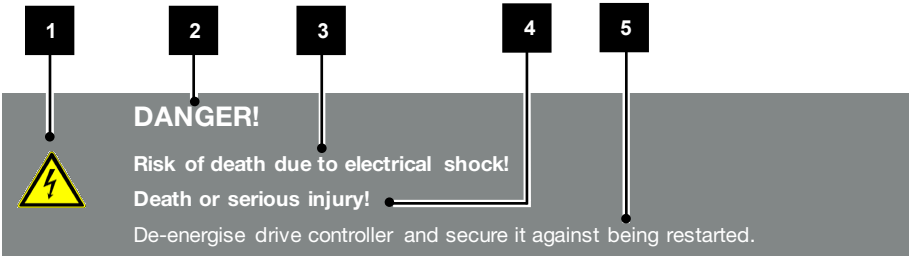



Fig.: 1 Structure of the warnings

| | |
|---|---|
| 1 | Warning symbol |
| 2 | Signal word |
| 3 | Type of danger and its source |
| 4 | Possible consequence(s) of failure to comply |
| 5 | Corrective actions |

### 1.2.2 Warning symbols used

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

### 1.2.3 Signal words

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

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

**WARNING**

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

**CAUTION**

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

### 1.2.4 Information notes

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

**IMPORTANT INFORMATION**

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

Fig.: 2 Example of an information note

### Symbols within the information notes

| Symbol | Meaning |
|---|---|
|  | Important information |
|  | Damage to property possible |

### Other notes

| Symbol | Meaning |
|---|---|
|  | INFORMATION |
|  | Enlarged view |

## 1.3 Symbols used in this manual

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

Fig.: 3 Symbols and icons used

### Abbreviations used

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

## 1.4 Labels on the drive controller

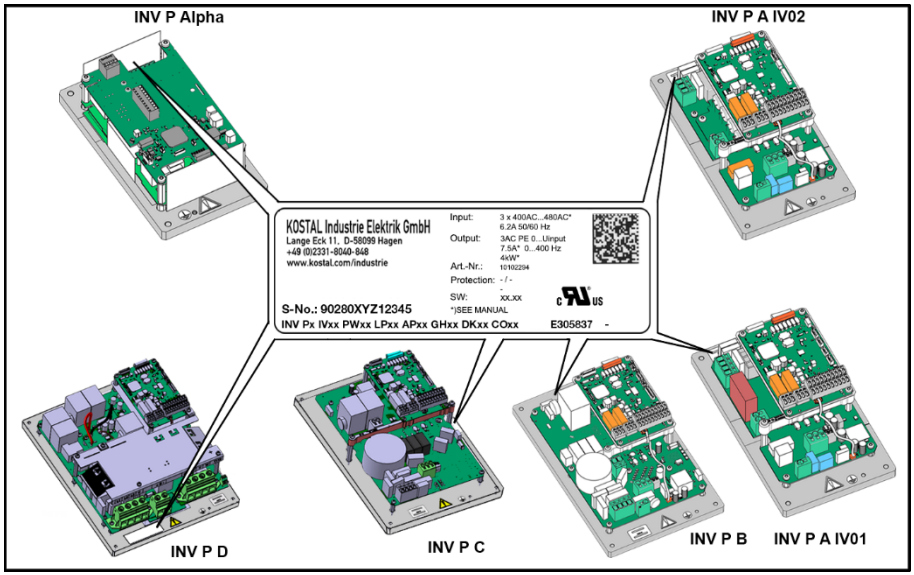



Fig.: 4 Type plate on the drive controller

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

| Symbol | Meaning |
|---|---|
|  | Danger due to electrical shock and discharge |
|   | Danger due to electrical shock and discharge.<br>Wait two minutes (discharge time of the capacitors) after shut-down |
|  | Additional earth connection |
|  | Observe and read operating manual |

## 1.5 Qualified staff

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

## 1.6 Proper use

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

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

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

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

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

**IMPORTANT INFORMATION**

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

## 1.7 Responsibility

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

The “Electrical equipment of machines” section in DIN EN 60204-1; VDE 0113-1:2007-06, “Safety of machinery” describes the safety requirements for electrical control units. These are provided for the safety of people and machines and must be observed in order to retain the functional capability of the machine or system.

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

## 1.8 EU Declaration of Conformity

**KOSTAL Industrie Elektrik GmbH** hereby declares that the drive controller described in this document complies with the basic requirements and other relevant conditions of the directives listed below.

- Directive 2014/30/EU
  on the approximation of the laws of the Member States relating to electromagnetic compatibility (EMC)
- Directive 2014/35/EU
  on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits – for short: Low Voltage Directive)
- Directive 2011/65/EU
  (to limit the use of certain hazardous substances in electrical and electronic equipment – in short: RoHS)

The declaration of conformity for the M product family of the INVEOR serves as an example. This can be found at:

https://www.kostal-industrie-elektrik.com/downloads

**IMPORTANT INFORMATION**

INVEOR P is a component solely intended for installation in the final application during the distributor's installation.

Electrical safety is heavily dependent on the precautionary measures taken by the distributor during installation in the final application.

**IMPORTANT INFORMATION**

CE marking is the sole responsibility of the distributor.

Note the project planning information (chapter 1.9) for details.

## 1.9 Project planning information for housing design

The following information should help you produce the housing design.

**IMPORTANT INFORMATION**

Compliance with all project planning information is the sole responsibility of the system integrator!

**IMPORTANT INFORMATION**

**Contact surface to the cooler**

The drive controller can either be cooled by a sufficiently large installation plate or an additional cooler.

Evenness required of contact surface = 0.05 mm

Maximum roughness of contact surface = RZ 6

**IMPORTANT INFORMATION**

**Applying the thermal conductivity paste**

Coat the surfaces between the installation plate (Cold Plate) and cooler with thermal conductivity paste (layer thickness 30 – 70 µ).

Article no. of thermal conductivity paste 10139778

**IMPORTANT INFORMATION**

**"IGBT temperature" shutdown threshold**

IGBT module at transition to cooling element.

If the cooling element is not adequately dimensioned or if heat transfer between the INVEOR installation plate and cooling element provided by the customer is not properly implemented (thermal conductivity paste not used or poorly applied, foreign bodies on cooling surface), the drive controller shuts down at 95 °C (measured in the power module) with the error message "IGBT temperature".

**IMPORTANT INFORMATION**

**"Interior temperature" shutdown threshold**

Temperature in device interior

If the temperature in the device interior is too high because the removal of lost heat via the housing has been inadequately dimensioned, the drive controller shuts down at an interior temperature of 85 °C. The "Interior temperature" error message is displayed.

**IMPORTANT INFORMATION**

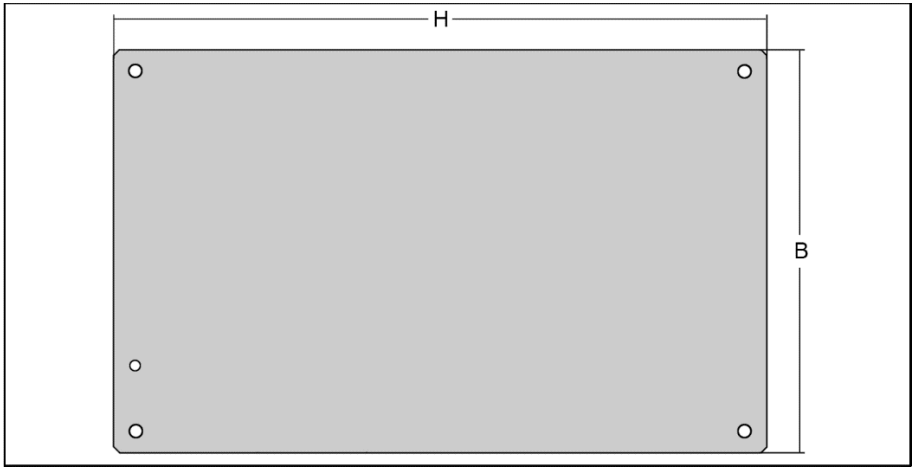
**"Interior temperature" shutdown threshold**

**Testing the heat transfer**

The heat transfer and installation on the customer's cooling element must be verified during the prototype phase by a customer test.

### Active cooling plate dimensions

| Size | Output | Active cooling surfaces | |
|---|---|---|---|
| | [kW] | B [mm] | H [mm] |
| Alpha | 0.75 | 120 | 210 |
| A | 1.5 | 150 | 261.5 |
| B | 4.0 | 185 | 300 |
| C | 7.5 | 220 | 330 |
| D | 22 | 270 | 343 |



### Max. thermal resistance of customer's cooler

- Rated output of size

| Size | Performance categories | Rth [K/W] | For ambient temp. |
|---|---|---|---|
| Alpha, 1 x 230 VAC | PW04 → 0.75 kW | 0.688 | 50 °C |
| A, 1 x 230 VAC | PW05 → 1.10 kW | 0.186 | 50 °C |
| A, 3 x 400 VAC | PW06 → 1.50 kW | 0.431 | 50 °C |
| B, 3 x 400 VAC | PW07 → 4.00 kW | 0.280 | 50 °C |
| C, 3 x 400 VAC | PW11 → 7.50 kW | 0.117 | 50 °C |
| D, 3 x 400 VAC | PW13 → 15.00 kW | 0.087 | 40 °C |
| D, 3 x 400 VAC | PW15 → 22.00 kW | 0.037 | 40 °C |

**IMPORTANT INFORMATION**

Active cooling of size D is recommended to reduce the size of the cooling element.

**DANGER!**

**Risk of death due to electrical shock!**
**Death or serious injury!**

Spacing and insulation

The power-conducting plate and parts of the application PCB have a potential of up to 400 V to PE (housing).

Spacing of 10 mm should therefore be planned between the metallic housing and printed circuit boards and between components on the printed circuit boards and the 20-pin ribbon cable.

Use an insulating film with a voltage resistance of at least 600 V at points where this spacing isn't provided.

## WARNING!

**Risk of death due to electrical shock!**
**Death or serious injury!**

**Degree of contamination**

The INVEOR P drive controller may only be installed in housings complying with at least degree of contamination 2.

This is usually ensured by the IP55 housing (or larger).

Customers must create equivalent or better conditions (degree of contamination 1) in their housings.

**Key for degree of contamination 1**

Only dry, non-conductive contamination is present if any, e.g. in clean, dry rooms or rooms with air conditioning.

**Key for degree of contamination 2**

Only non-conductive contamination is present. Temporary conductivity caused by condensation must be expected occasionally, e.g. in laboratories, precision mechanics workshops, test fields, sales showrooms.

## DANGER!

**Risk of death due to electrical shock!**
**Death or serious injury!**

**Live parts**

Attach a warning notice in accordance with IEC 60417-5036 (2002-10) to the last housing part removed (with tool) before accessing live parts.

## DANGER!

**Risk of death due to electrical shock!**

**Death or serious injury!**

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


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

**Fitting the warning notice is the sole responsibility of the system integrator!**

## WARNING!

**Fire hazard due to short-circuit current!**

**Serious burns!**

In sizes C and D, the brake chopper – IGBT is smaller than the rest of the output stage.

Because the preliminary fuses are designed for the nominal values of the output stage, it is very possible that the fuse will not trip directly and the brake chopper's short-circuit current will exist for a long time.

Fires may result.

The INVEOR standard housing is not critical in this regard.

### 1.9.1 Project planning information for housing design for STO variant

**IMPORTANT INFORMATION**

The INVEOR P with functional safety is just one component in the final application. As a result, the STO function of the INVEOR P must be approved separately in the final application.
The design of the housing design must satisfy the following conditions.

**Protection from pollution**

**IMPORTANT INFORMATION**

With open housing, pollution degree 2 must be observed in order to ensure the safety function.

**Elimination of errors**

**IMPORTANT INFORMATION**

The STO connection line must be shielded in order that the elimination of errors with regard to external voltage coupling may be applied. EMC screw connections must be used for the cable inlet into the housing.

**Elimination of errors with regard to short circuit**

**IMPORTANT INFORMATION**

With reference to the STO connection line, the "elimination of errors with regard to short circuit" is achieved in accordance with DIN EN 13849-2 in that a separate, shielded cable is used for each channel. Shielding is to be applied at both ends. The EMC screw connections provided must be used for this purpose.

**IMPORTANT INFORMATION**

If only one shielded cable is used for both STO channels, a safety switching device must be used to detect possible crossovers between the channels to qualify for observation of the "elimination of errors short circuit" in accordance with DIN EN 13849-2.

### Visual inspection

**IMPORTANT INFORMATION**
All cables are to be inspected for correct wiring prior to commissioning.

### Loss of the safety function

**IMPORTANT INFORMATION**
Permanent 24 V voltage to the STO inputs results in the loss of the safety function.

### EMC approval

**IMPORTANT INFORMATION**
EMC approval has been carried out for the entire INVEOR system.
In exceptional cases, individual tests may have to be repeated. When undertaking the individual test, take account of the more stringent requirements for “functional safety”.

### Approval

**IMPORTANT INFORMATION**
The entire system must be approved by a named body.
The INVEOR system itself has been certified by TÜV Rheinland.

## 1.10 Safety instructions

The following warnings, precautionary measures and information are provided for your safety and serve to prevent damage to the drive controller and the components connected to it. This chapter contains warnings and information that are generally applicable when handling drive controls. They are split into general information, transport & storage and dismantling & disposal.

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

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

### 1.10.1 General information

**IMPORTANT INFORMATION**

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

They contain important information on the installation and operation of the drive controller. In particular, note the information in the "Important information" chapter. KOSTAL Industrie Elektrik GmbH assumes no liability for damages arising from the non-observance of this operating manual.

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

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

**IMPORTANT INFORMATION**

The drive controller can only be operated safely if the required environmental conditions listed in the “Suitable environmental conditions” chapter are met.

**DANGER!**

**Risk of death due to electrical shock!**

**Death or serious injury!**

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

**DANGER!**

**Risk of death due to revolving mechanical parts!**

**Death or serious injury!**

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

**DANGER!**

**Risk of death due to fire or electrical shock!**

**Death or serious injury!**

Always use the drive controller as intended.

Do not modify the drive controller.

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

During assembly, ensure a sufficient distance from neighbouring parts.

**CAUTION!**

**Risk of burns from hot surfaces!**

**Serious burns to the skin from hot surfaces!**

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

Allow the neighbouring parts to cool sufficiently.

If necessary, install protection against accidental contact.

## 1.10.2 Transport & storage

**Damage to property possible**

Risk of damage to drive controller!

Risk of damage to drive controller from improper transport, storage, installation and assembly!

Transport the drive controller properly in its original packaging on a pallet.

Always store the drive controller properly.

Only allow qualified staff to undertake installation and assembly.

## 1.10.3 Long –term storage

**IMPORTANT INFORMATION**

If devices with a single-phase feed-in have been in storage for more than 2 years, the following regeneration process is required before installation / use under the nominal conditions:

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

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

## 1.10.4 Information about commissioning

**DANGER!**

**Risk of death due to electrical shock!**
**Death or serious injury!**

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

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

| | | |
|---|---|---|
| **Supply terminals** | **X1** | **(INV. Alpha-A):L. N** |
| | **X1** | **(INV. A-D): L1, L2, L3** |
| **Motor connection terminals** | **X411** | **(INV. Alpha): U, V, W** |
| | **X4** | **(INV. A-D): U, V, W** |
| **Relay connection terminals** | **X6, X7** | |
| **PTC terminals** | **T1 / T2** | |

**IMPORTANT INFORMATION**

- Only use mains connections with hardwiring.
- Ground the drive controller in accordance with DIN EN 61140.
- The INVEOR P may have touch currents of > 3.5 mA.
  In accordance with DIN EN 61800-5-1, an extra protective grounding conductor of the same cross-section as the original protective grounding conductor should therefore be fitted. A second protective grounding conductor can be connected under the mains supply (position marked with a ground symbol) on the outside of the device. A suitable M6x15 screw (4.0 Nm torque) is provided with the adapter plate.
- If three-phase frequency inverters are used, it is not permitted to use standard type A FI protection switches, or RCDs (residual current-operated protective devices) to protect against direct or indirect contact. According to DIN VDE 0160 and EN 50178, the FI protection switch must be universal current sensitive (RCD type B)

**IMPORTANT INFORMATION**

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

### 1.10.5 Instructions concerning operation

**DANGER!**

**Risk of death due to electrical shock!**
**Death or serious injury!**
De-energise drive controller and secure it against being restarted.

**DANGER!**

**Risk of death due to revolving mechanical parts!**
**Death or serious injury!**
De-energise drive controller and secure it against being restarted.

**IMPORTANT INFORMATION**

Observe the following instructions during operation:

- The drive controller runs at high voltages.
- When electrical devices are operated, some of their parts are always subject to dangerous voltage.
- Emergency stop equipment according to DIN EN 60204-1; VDE 0113-1:2007-06 must function in all the control device's operating modes. Resetting the emergency stop equipment may not result in uncontrolled or undefined restarting.
- In order to ensure safe disconnection from the mains, the mains cable has to be fully disconnected from the drive controller in a synchronous manner.
- A pause of at least 1 to 2 mins must be observed between consecutive mains activations for devices with a single-phase feed and for size D (11 to 22 kW).
- A pause of at least 3 sec. must be observed between consecutive grid connections for devices with three-phase feed-in in sizes A - C (0.55 to 7.5 kW).
- Certain parameter settings may result in the drive controller restarting automatically after the supply voltage has failed.

**Damage to property possible**

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

Observe the following instructions during operation:

- The motor parameters, especially the I2T settings, have to be configured properly to provide proper motor overload protection.
- The drive controller has internal motor overload protection. See parameters 33.010 and 33.011.
  I2T is ON by default. Motor overload protection can also be ensured via an external PTC.
- The drive controller may not be used as “Emergency stop equipment” (see DIN EN 60204-1; VDE 01131:2007-06).

## 1.10.6 Maintenance and inspection

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

**Measurement of insulation resistance on control part**

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

## 1.10.7 Repairs

**Damage to property possible**

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

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

**CAUTION!**

**Risk of burns from hot surfaces!**

**Serious burns to the skin from hot surfaces!**

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

**DANGER!**

**Risk of death due to electrical shock!**

**Death or serious injury!**

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


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

# 2. Overview of the drive controller

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

## 2.1 Model description size Alpha, size A - D

| | Drive controller type, size |
|---|---|
| INV P α | Inverter Plate, size Alpha |
| INV P A | Inverter Plate, size A |
| INV P B | Inverter Plate, size B |
| INV P C | Inverter Plate, size C |
| INV P D | Inverter Plate, size D |

| | Grid voltage | | α | A | B | C | D |
|---|---|---|---|---|---|---|---|
| IV01 | 400 V | | | x | x | x | x |
| IV02 | 230 V | | x | x | | | |

| | Recommended motor rating | α | A | B | C | D |
|---|---|---|---|---|---|---|---|
| PW04 | 0.75 kW | x | | | | |
| PW05 | 1.10 kW | | x | | | |
| PW06 | 1.50 kW | | x | | | |
| PW09 | 4.00 kW | | | x | | |
| PW11 | 7.50 kW | | | | x | |
| PW13 | 15.00 kW | | | | | x |
| PW15 | 22.00 kW | | | | | x |

| | Power-conducting plate | α | A | B | C | D |
|---|---|---|---|---|---|---|
| LP01 | without brake chopper | x | x | x | x | |
| LP02 | with brake chopper | | x | x | | |
| LP03 | without brake chopper | | | | | x |
| LP04 | with brake chopper | | | | x | x |

| | Application PCB | α | A | B | C | D |
|---|---|---|---|---|---|---|
| AP01 | Standard | | x | x | x | x |
| AP03 | Basic | | x | x | x | |
| AP05 | Standard + CANopen | | x | x | x | x |
| AP06 | Standard + EtherCAT | | x | x | x | x |
| AP09 | Standard + PROFINET | | x | x | x | x |
| AP12 | Standard | x | | | | |
| AP13 | Standard + CANopen | x | | | | |
| AP14 | Standard + Sercos III | | x | x | x | x |
| AP16 | Standard + PROFIBUS COMX (as of SW3.8x) | | x | x | x | x |

| | Housing type | α | A | B | C | D |
|---|---|---|---|---|---|---|
| GH03 | Sandwich | x | x | x | x | x |

| | Cover type | α | A | B | C | D |
|---|---|---|---|---|---|---|
| DK03 | without cover | x | x | x | x | x |

| | Model | α | A | B | C | D |
|---|---|---|---|---|---|---|
| CO00 | KOSTAL - standard | x | x | x | x | x |

| INV Px | IVxx | PWxx | LPxx | APxx | GHxx | DKxx | COxx |
|---|---|---|---|---|---|---|---|

## 2.2 Scope of delivery

Once you have received the product, please ensure that the delivery is complete.

### 2.2.1 Scope of delivery for INVEOR P size Alpha

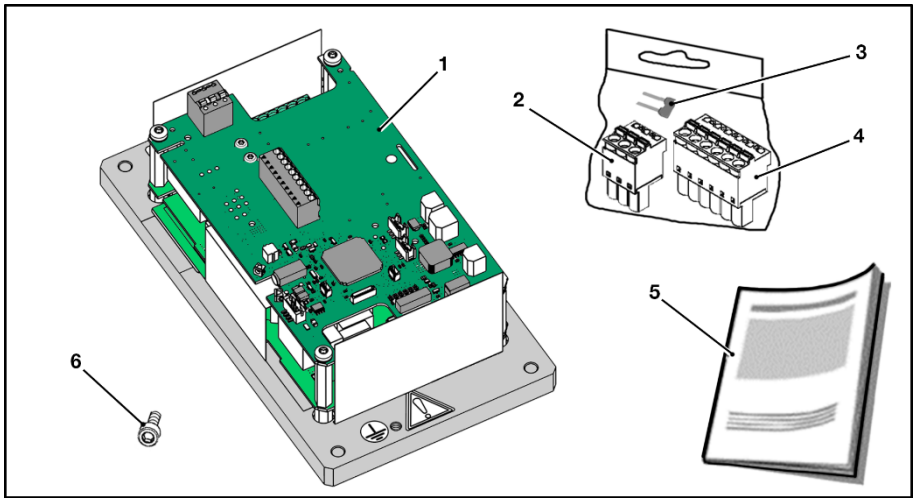



Fig.: 5 Scope of delivery for INVEOR P size Alpha

| Key | | | |
|---|---|---|---|
| **Drive controller article number** | | **Adapter plate article number** | |
| **1** | INVEOR P drive controller size Alpha | **4** | Motor terminal |
| **2** | Mains terminal | **5** | Operating manual |
| **3** | Bridge | **6** | M5 x 12 PE screw |

### 2.2.2 Scope of delivery for INVEOR P size A - D

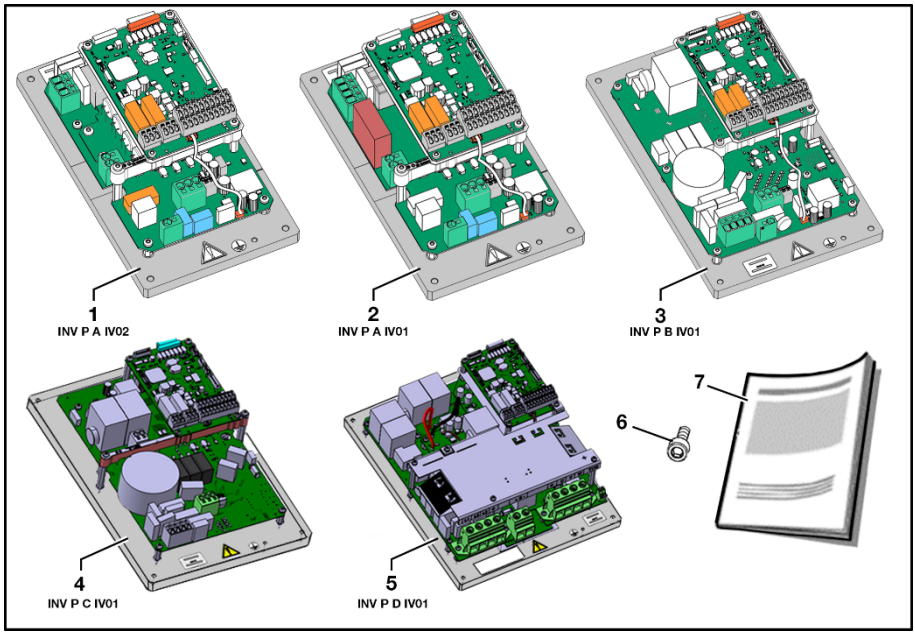



Fig.: 6 Scope of delivery for INV P size A - D

| Key | | | |
|---|---|---|---|
| **Drive controller article number** | | **Adapter plate article number** | |
| **1** | INVEOR P drive controller size A IV02<br>**or** | **5** | INVEOR P drive controller size D IV01 |
| **2** | INVEOR P drive controller size A IV01<br>**or** | **6** | M5 x 12 PE screw |
| **3** | INVEOR P drive controller size B IV01<br>**or** | **7** | Operating manual |
| **4** | INVEOR P drive controller size C IV01<br>**or** | | |

## 2.3 Description of INVEOR P drive controller

The INVEOR P drive controller is a device for speed control in three-phase AC motors.

The permitted ambient temperatures specified in the technical data refer to operation at nominal load.

# 3. Installation

## 3.1 Safety instructions for installation

**DANGER**

**Risk of death due to revolving mechanical parts!**

**Death or serious injury!**

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

Only allow appropriately qualified staff to install the drive controller.

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

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

Mains connections must be hardwired.

**CAUTION**

**Risk of burns from hot surfaces!**

**Serious burns to the skin from hot surfaces!**

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

## 3.2 Recommended preliminary fuses / line protection

| INVEOR P | Size Alpha 1 x 230 V AC | Size A 1 x 230 V AC | Size A 3 x 400 V AC | Size B 3 x 400 V AC | Size C 3 x 400 V AC | Size D 3 x 400 V AC | Size D 3 x 400 V AC |
|---|---|---|---|---|---|---|---|
| Nominal motor rating | up to 0.75 kW | up to 1.1 kW | up to 1.5 kW | up to 4.0 kW | up to 7.5 kW | up to 15 kW | up to 22 kW |
| Mains current | 7.3 A | 9.2 A | 3.3 A | 7.9 A | 14.8 A | 28.2 A | 39.9 A |
| Mains current 150% (overload 60 s) | 10.95 A | 13.8 A | 4.95 A | 11.85 A | 22.2 A | 42.3 A | 51.87 A |
| Line circuit breaker – recommen-dation | C 16 | C 16 | C 10 | C 16 | C 25 | C 50 | C 63 |
| | Characteristics C = line circuit breaker tripping between 6 – 10 times In | | | | | | |
|  | The cross-section of the supply line must be designed according to the transfer category and maximum permitted current. The contractor commissioning the device must ensure protection for the power line. | | | | | | |

## 3.3 Installation requirements for INVEOR P size Alpha

### 3.3.1 Suitable ambient conditions (see chapter 1.9)

| Conditions | Values |
|---|---|
| Altitude of the installation location: | up to 1000 m AMSL |
| Ambient temperature:<br>Size Alpha, A, B, C | - 25 °C to + 50 °C |
| Ambient temperature:<br>Size D | - 25 °C to + 40 °C |
| Relative air humidity | ≤ 96 %, condensation not permitted. |
| Cooling: | Surface cooling, realised in the customer application. |

Tab. 1: Ambient conditions

Ensure that the housing type (protection type) is suitable for the operating environment.

Ensure that the surfaces between the installation plate (Cold Plate) and cooler are coated with thermal conductivity paste (layer thickness 30 – 70 µ).

**Damage to property possible**

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

- Disassembling the circuit boards renders the warranty void!
- Mounting points and sealing surfaces must be kept free of paint for purposes of EMC and grounding!

### 3.3.2 Basic connection versions/power connections (INVEOR P size Alpha)

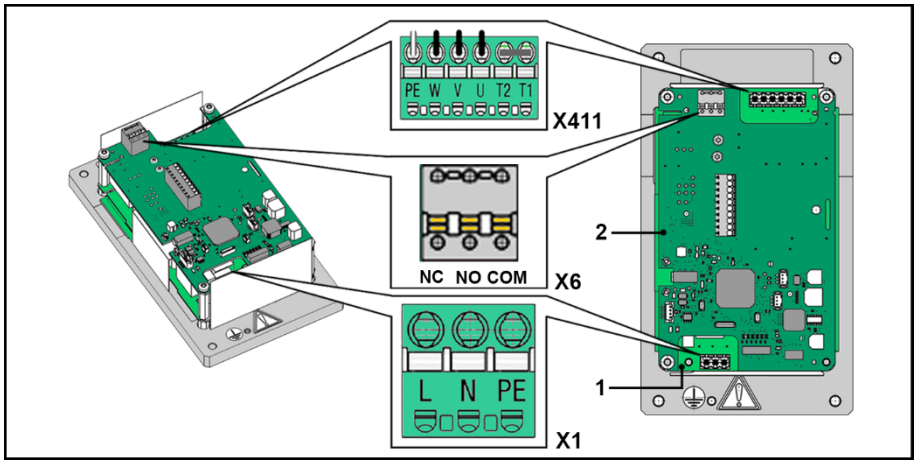



Fig.: 7 Basic connection version (INVEOR P size Alpha)

| Terminal assignment X411 (motor) | |
|---|---|
| **U** | U1 |
| **V** | V1 |
| **W** | W1 |
| **PE** | PE |
| **T1, T2** | Connect bridge (see scope of delivery) |

| Terminal assignment X1 (mains connection) | |
|---|---|
| L | Mains phase |
| N | Neutral wire |
| PE | Earth connection point |

**DANGER**

**Risk of death due to electrical shock!**
**Death or serious injury!**

De-energise drive controller and secure it against being restarted

| | Size Alpha | |
|---|---|---|
| X1 mains +X6 relay + X411 motor / PTC | The terminals for the mains cable are located on the IPM printed circuit board (1) and/or on the application board (2). The configuration may vary depending on the version. | |
| | Core end sleeves with plastic collars and lugs are recommended. | |
| | Terminals: | Spring force connection (slot screwdriver, max. width 2.5 mm) |
| | Conductor cross-section, flexible: | min. 0.2 mm²<br>max. 2.5 mm² |
| | Conductor cross-section, flexible with core end sleeve without and with plastic sleeve: | min. 0.25 mm²<br>max. 2.5 mm² |
| | 2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve: | min. 0.25 mm²<br>max. 1.25 mm² |
| | Conductor cross-section AWG: | min. 30<br>max. 12 |
| | Length of stripped insulation: | 10 mm |

**Damage to property possible**

Risk of damage to the drive controller.
Correct phase assignment must be observed when connecting the drive controller, otherwise the motor may be overloaded.

**IMPORTANT INFORMATION**

If a thermal resistor (PTC or Klixon) is not used, the bridging contact inserted for delivery must be connected.

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

### 3.3.3 Basic connection versions/power connections (INVEOR P size A 1 IV02 [1 x 230 V AC])

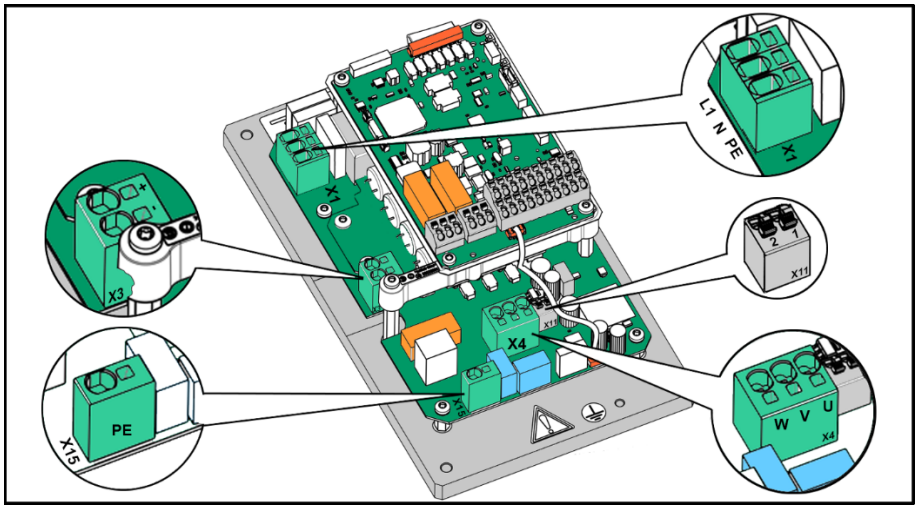



Fig.: 8 Basic connection versions (INVEOR P size A IV02)

| Terminal assignment X1 (mains connection) | |
|---|---|
| **L1** | Mains phase |
| **N** | Neutral wire |
| **PE** | Earth connection point |
| **Terminal assignment X3 (optional)** | |
| Connection for external brake resistor (+) | |
| Connection for external brake resistor (-) | |
| **Terminal assignment X4** | |
| **U** | Motor phase U |
| **V** | Motor phase V |
| **W** | Motor phase W |
| **Terminal assignment X11 (option)** | |
| **1** | Motor temperature (-) |
| **2** | Motor temperature (+) |
| **Terminal assignment X15** | |
| **PE** | Earth connection point |

**DANGER**

**Risk of death due to electrical shock!**
**Death or serious injury!**
De-energise drive controller and secure it against being restarted

| X1 mains + B - brake resistor | Size A | |
|---|---|---|
| | The terminals for the mains cable (X1) are located on the IPM printed circuit board. The INVEOR P also has the option of being equipped with terminals (X3) for connecting a brake resistor. The configuration may vary depending on the version. | |
| | Core end sleeves with plastic collars and lugs are recommended. | |
| | Terminals: | Spring force connection (slot screwdriver, max. width 2.5 mm) |
| | Conductor cross-section, rigid | min. 0.2 mm²<br>max. 10 mm² |
| | Conductor cross-section, flexible | min. 0.2 mm²<br>max. 6 mm² |
| | Conductor cross-section, flexible with core end sleeve without plastic sleeve | min. 0.25 mm²<br>max. 6 mm² |
| | Conductor cross-section, flexible with core end sleeve with plastic sleeve | min. 0.25 mm²<br>max. 4 mm² |
| | 2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve | min. 0.25 mm²<br>max. 1.5 mm² |
| | AWG/kcmil conductor cross-section according to UL/CUL | min. 24<br>max. 8 |
| | Length of stripped insulation: | 15 mm |

**IMPORTANT INFORMATION**

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

**Damage to property possible**

Risk of damage to the drive controller.

Correct phase assignment must be observed when connecting the drive controller, otherwise the motor may be overloaded.

**IMPORTANT INFORMATION**

If a thermal resistor (PTC or Klixon) is not used, the bridging contact inserted for delivery must be connected.

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

### 3.3.4 Basic connection versions/power connections (INVEOR P size A IV01 [3 x 400 V AC])

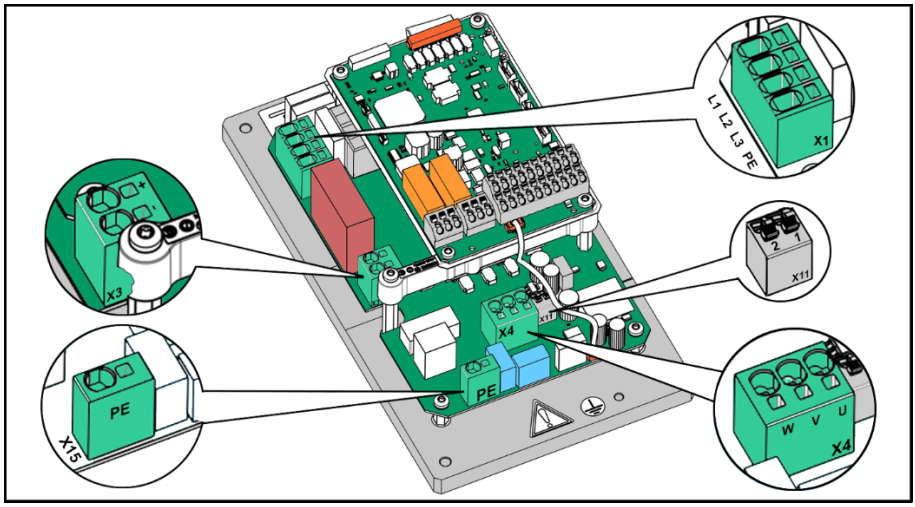



Fig.: 9 Basic connection versions (INVEOR P size A IV01)

| Terminal assignment X1 (mains connection) | |
|---|---|
| **L1** | Mains phase L1 |
| **L2** | Mains phase L2 |
| **L3** | Mains phase L3 |
| **PE** | Earth connection point |
| **Terminal assignment X3 (optional)** | |
| Connection for external brake resistor (+) | |
| Connection for external brake resistor (-) | |
| **Terminal assignment X4** | |
| **U** | Motor phase U |
| **V** | Motor phase V |
| **W** | Motor phase W |
| **Terminal assignment X11 (option)** | |
| **1** | Motor temperature (-) |
| **2** | Motor temperature (+) |
| **Terminal assignment X15** | |
| **PE** | Earth connection point |

**DANGER**

**Risk of death due to electrical shock!**
**Death or serious injury!**
De-energise drive controller and secure it against being restarted

| X1 mains + B - brake resistor | Size A | |
|---|---|---|
| | The terminals for the mains cable (X1) are located on the IPM printed circuit board. The INVEOR P also has the option of being equipped with terminals (X3) for connecting a brake resistor. The configuration may vary depending on the version. | |
| | Core end sleeves with plastic collars and lugs are recommended. | |
| | Terminals: | Spring force connection (slot screwdriver, max. width 2.5 mm) |
| | Conductor cross-section, rigid | min. 0.2 mm²<br>max. 10 mm² |
| | Conductor cross-section, flexible | min. 0.2 mm²<br>max. 6 mm² |
| | Conductor cross-section, flexible with core end sleeve without plastic sleeve | min. 0.25 mm²<br>max. 6 mm² |
| | Conductor cross-section, flexible with core end sleeve with plastic sleeve | min. 0.25 mm²<br>max. 4 mm² |
| | 2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve | min. 0.25 mm²<br>max. 1.5 mm² |
| | AWG/kcmil conductor cross-section according to UL/CUL | min. 24<br>max. 8 |
| | Length of stripped insulation: | 15 mm |

**IMPORTANT INFORMATION**

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

**Damage to property possible**

Risk of damage to the drive controller.

Correct phase assignment must be observed when connecting the drive controller, otherwise the motor may be overloaded.

**IMPORTANT INFORMATION**

If a thermal resistor (PTC or Klixon) is not used, the bridging contact inserted for delivery must be connected.

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

### 3.3.5 Basic connection versions (INVEOR P size B IV01 [3 x 400 V AC])

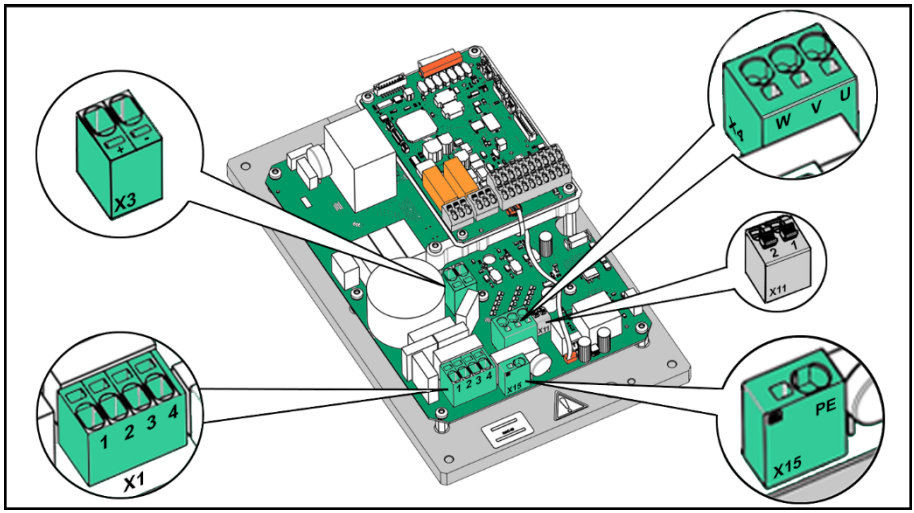



Fig.: 10 Basic connection versions (INVEOR P size B IV01)

| Terminal assignment X1 (mains connection) | |
|---|---|
| **L1** | Mains phase L1 |
| **L2** | Mains phase L2 |
| **L3** | Mains phase L3 |
| **PE** | Earth connection point |
| **Terminal assignment X3 (optional)** | |
| Connection for external brake resistor (+) | |
| Connection for external brake resistor (-) | |
| **Terminal assignment X4** | |
| **U** | Motor phase U |
| **V** | Motor phase V |
| **W** | Motor phase W |
| **Terminal assignment X11 (option)** | |
| **1** | Motor temperature (-) |
| **2** | Motor temperature (+) |
| **Terminal assignment X15** | |
| **PE** | Earth connection point |

**DANGER**

**Risk of death due to electrical shock!**
**Death or serious injury!**
De-energise drive controller and secure it against being restarted

| X1 mains + B - brake resistor | Size B | |
|---|---|---|
| | The terminals for the mains cable (X1) are located on the IPM printed circuit board. The INVEOR P also has the option of being equipped with terminals (X3) for connecting a brake resistor. The configuration may vary depending on the version. | |
| | Core end sleeves with plastic collars and lugs are recommended. | |
| | Terminals: | Spring force connection (slot screwdriver, max. width 2.5 mm) |
| | Conductor cross-section, rigid | min. 0.2 mm²<br>max. 10 mm² |
| | Conductor cross-section, flexible | min. 0.2 mm²<br>max. 6 mm² |
| | Conductor cross-section, flexible with core end sleeve without plastic sleeve | min. 0.25 mm²<br>max. 6 mm² |
| | Conductor cross-section, flexible with core end sleeve with plastic sleeve | min. 0.25 mm²<br>max. 4 mm² |
| | 2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve | min. 0.25 mm²<br>max. 1.5 mm² |
| | AWG/kcmil conductor cross-section according to UL/CUL | min. 24<br>max. 8 |
| | Length of stripped insulation: | 15 mm |

**IMPORTANT INFORMATION**

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

**Damage to property possible**

Risk of damage to the drive controller.

Correct phase assignment must be observed when connecting the drive controller, otherwise the motor may be overloaded.

**IMPORTANT INFORMATION**

If a thermal resistor (PTC or Klixon) is not used, the bridging contact inserted for delivery must be connected.

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

### 3.3.6 Basic connection versions (INVEOR P size C IV01 [3 x 400 V AC])

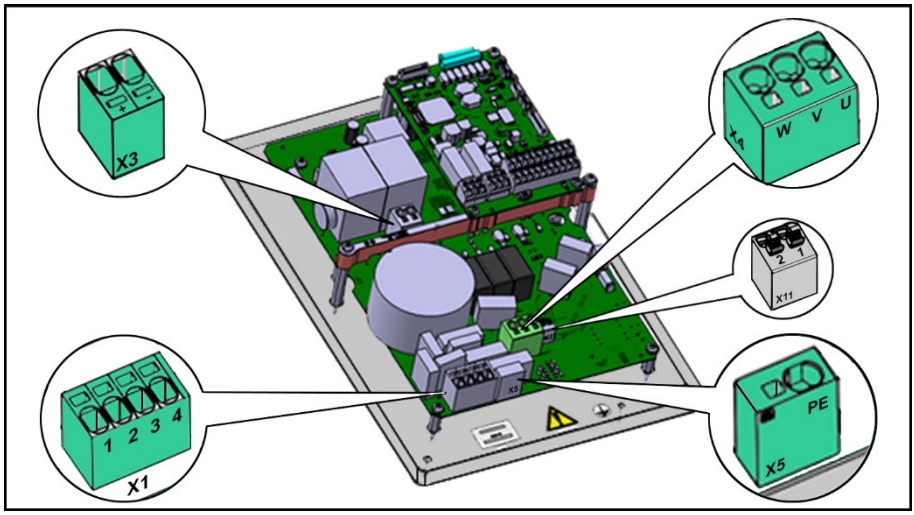



Fig.: 11 Basic connection versions (INVEOR P size C IV01)

| Terminal assignment X1 (mains connection) | |
|---|---|
| **L1** | Mains phase L1 |
| **L2** | Mains phase L2 |
| **L3** | Mains phase L3 |
| **PE** | Earth connection point |
| **Terminal assignment X3 (optional)** | |
| Connection for external brake resistor (+) | |
| Connection for external brake resistor (-) | |
| **Terminal assignment X4** | |
| **U** | Motor phase U |
| **V** | Motor phase V |
| **W** | Motor phase W |
| **Terminal assignment X11 (option)** | |
| **1** | Motor temperature (-) |
| **2** | Motor temperature (+) |
| **Terminal assignment X5** | |
| **PE** | Earth connection point |

**DANGER**

**Risk of death due to electrical shock!**
**Death or serious injury!**
De-energise drive controller and secure it against being restarted

| X1 mains + B - brake resistor | Size C | |
|---|---|---|
| | The terminals for the mains cable (X1) are located on the IPM printed circuit board. The INVEOR P also has the option of being equipped with terminals (X3) for connecting a brake resistor. The configuration may vary depending on the version. | |
| | Core end sleeves with plastic collars and lugs are recommended. | |
| | Terminals: | Spring force connection (slot screwdriver, max. width 2.5 mm) |
| | Conductor cross-section, rigid | min. 0.2 mm²<br>max. 10 mm² |
| | Conductor cross-section, flexible | min. 0.2 mm²<br>max. 6 mm² |
| | Conductor cross-section, flexible with core end sleeve without plastic sleeve | min. 0.25 mm²<br>max. 6 mm² |
| | Conductor cross-section, flexible with core end sleeve with plastic sleeve | min. 0.25 mm²<br>max. 4 mm² |
| | 2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve | min. 0.25 mm²<br>max. 1.5 mm² |
| | AWG/kcmil conductor cross-section according to UL/CUL | min. 24<br>max. 8 |
| | Length of stripped insulation: | 15 mm |

**IMPORTANT INFORMATION**

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

**Damage to property possible**

Risk of damage to the drive controller.

Correct phase assignment must be observed when connecting the drive controller, otherwise the motor may be overloaded.

**IMPORTANT INFORMATION**

If a thermal resistor (PTC or Klixon) is not used, the bridging contact inserted for delivery must be connected.

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

### 3.3.7 Basic connection versions (INVEOR P size D IV01 [3 x 400 V AC])

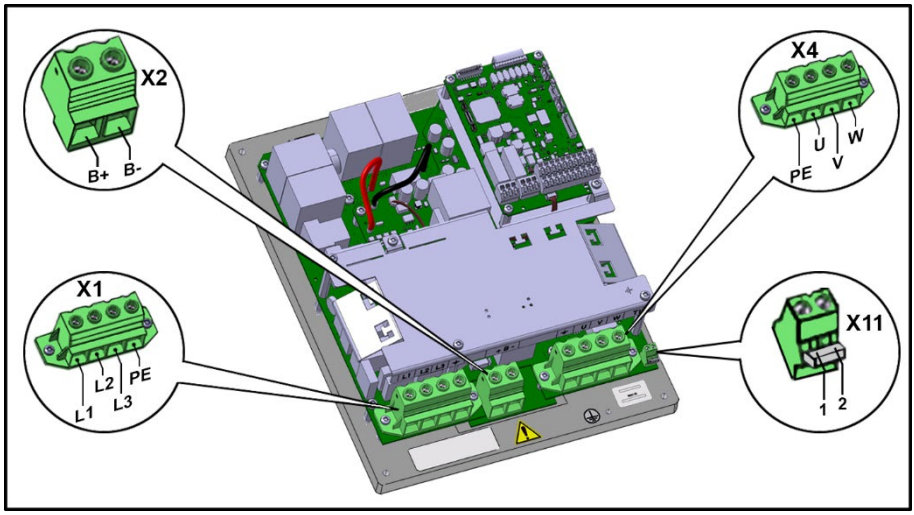



Fig.: 12 Basic connection versions (INVEOR P size D IV01)

| Terminal assignment X1 (mains connection) | |
|---|---|
| L1 | Mains phase L1 |
| L2 | Mains phase L2 |
| L3 | Mains phase L3 |
| PE | Earth connection point |
| **Terminal assignment X2 (optional)** | |
| Connection for external brake resistor (+) | |
| Connection for external brake resistor (-) | |
| **Terminal assignment X4** | |
| PE | Earth connection point |
| U | Motor phase U |
| V | Motor phase V |
| W | Motor phase W |
| **Terminal assignment X11** | |
| **1** | Motor temperature (-) |
| **2** | Motor temperature (+) |

**DANGER**

**Risk of death due to electrical shock!**

**Death or serious injury!**

De-energise drive controller and secure it against being restarted

| | Size D | |
|---|---|---|
| X1 mains + B - brake resistor | The terminals for the mains cable (X1) are located on the IPM printed circuit board. The INVEOR P also has the option of being equipped with terminals (X2) for connecting a brake resistor. The configuration may vary depending on the version. | |
| | Core end sleeves with plastic collars and lugs are recommended. | |
| | Torque min. 2.5 Nm / max. 4.5 Nm | |
| | Conductor cross-section: | rigid min. 0.5 $mm^2$ / rigid max. 35 $mm^2$ |
| | Conductor cross-section, flexible: | min. 0.5 $mm^2$ /max. 25 $mm^2$ |
| | Conductor cross-section, flexible with core end sleeve without plastic collar | min. 1 $mm^2$<br>max. 25 $mm^2$ |
| | Conductor cross-section, flexible with core end sleeve with plastic collar | min. 1.5 $mm^2$<br>max. 25 $mm^2$ |
| | AWG/kcmil conductor cross-section according to UL/CUL | min. 20<br>max. 2 |
| | 2 conductors of the same cross-section, rigid | min. 0.5 $mm^2$<br>max. 6 $mm^2$ |
| | 2 conductors of the same cross-section, flexible | min. 0.5 $mm^2$<br>max. 6 $mm^2$ |
| | 2 conductors of the same cross-section, flexible with AEH without plastic sleeve | min. 0.5 $mm^2$<br>max. 4 $mm^2$ |
| | 2 conductors of the same cross-section, flexible with TWIN-AEH with plastic sleeve | min. 0.5 $mm^2$<br>max. 6 $mm^2$ |
| | AWG according to UL/CUL | min. 20<br>max. 2 |

**IMPORTANT INFORMATION**

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

**Damage to property possible**

Risk of damage to the drive controller.
Correct phase assignment must be observed when connecting the drive controller, otherwise the motor may be overloaded.

**IMPORTANT INFORMATION**

If a thermal resistor (PTC or Klixon) is not used, the bridging contact inserted for delivery must be connected.

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

### 3.3.8 Short circuit and ground protection

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

### 3.3.9 Requirements of the brake resistors to use

For safe operation of the "brake chopper" option, inherently safe brake resistors must be used.

Inherently safe, wire-based resistors:

The inherently safe brake resistor prevents the following in the event of long-lasting overload, such as a short circuit of the brake IGBT (brake chopper):

- Short circuit
- Short circuit to earth / earth fault
- Fire
- Explosion
- Melting of aluminium housing of resistor

## 3.4 Wiring instructions

### 3.4.1 Wiring instructions for control terminals INVEOR P size Alpha

The control connections are located on the application board.

The configuration may vary depending on the version.

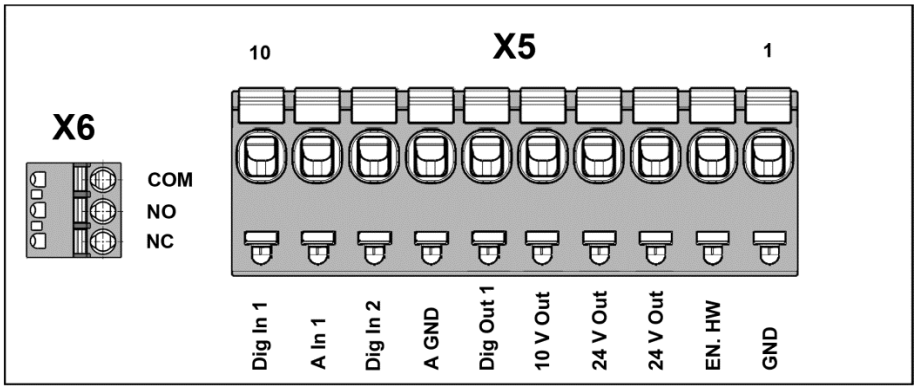



Fig.: 13 Control terminals (size Alpha)

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

For technical data on power connections, see chapter 3.3.2.

### 3.4.2 Wiring instructions for control terminals INVEOR P size A-D

The control connections are located on the application board.

The configuration may vary depending on the version.

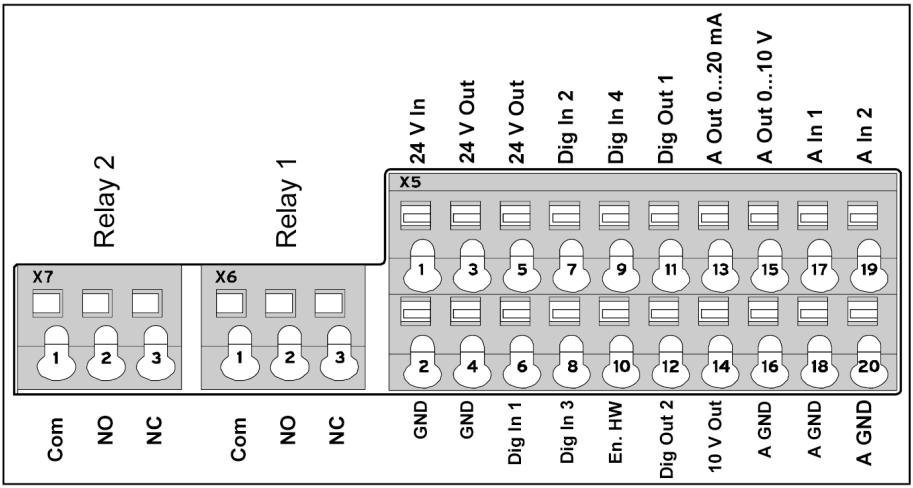



Fig.: 14 Wiring instructions for control terminals INVEOR P size A-D

| | Sizes A - D | |
|---|---|---|
| X5 – X7 | Terminals: | Plug terminal clamp with activation button (slot screwdriver, max. width 2.5 mm) |
| | Connection cross-section: | 0.5 to 1.5 $mm^2$, single-wire, AWG 20 to AWG 14 |
| | Connection cross-section: | 0.75 to 1.5 $mm^2$, fine-wired, AWG 18 to AWG 14 |
| | Connection cross-section: | 0.5 to 1.0 $mm^2$, fine-wired (core end sleeves with and without plastic collars) |
| | Length of stripped insulation: | 9 to 10 mm |

### 3.4.3 Preventing electromagnetic interferences

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

Ensure that no parasitic currents (compensating currents etc.) can flow via the analogue cable's shielding.
Route the control lines as far away as possible from the power lines. Under certain circumstances, separate power ducts should be used.
If lines do cross, an angle of 90° should be observed.

Upstream circuit elements, such as protector switches and brake coils, or circuit elements that are operated via the outputs of the drive controller have to be interference-suppressed. RC circuits are suitable as AC voltage protector switches, while free-wheeling diodes or varistors are usually used as DC voltage protector switches. These interference suppression devices are attached directly to the protector switch coils.

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

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

Wiring suitable for EMC must be ensured.

## 3.5 Installing the INVEOR P

### 3.5.1 Mechanical installation

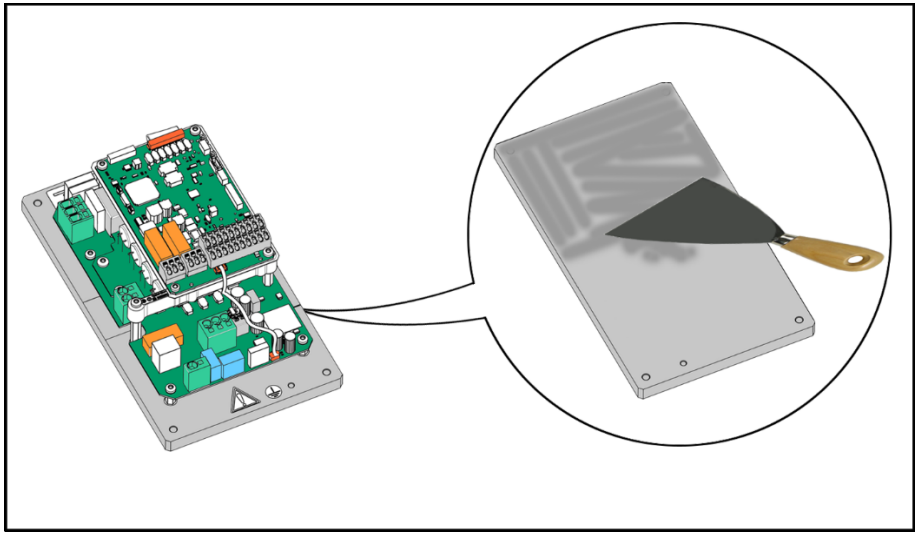


Fig.: 15 Applying thermal conductivity paste

Please proceed as follows to mechanically install the INVEOR P:

1. Clean the surface of the thermal sink on which the INVEOR P is to be fitted.
2. Use a spatula to apply the thermal conductivity paste (layer thickness 30 – 70 µ) on the underside of the INVEOR P.
3. Place the INVEOR P in the desired position.
4. Tightly connect the INVEOR P with the thermal sink.

**IMPORTANT INFORMATION**

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

### 3.5.2 Wiring diagram for INVEOR P size Alpha

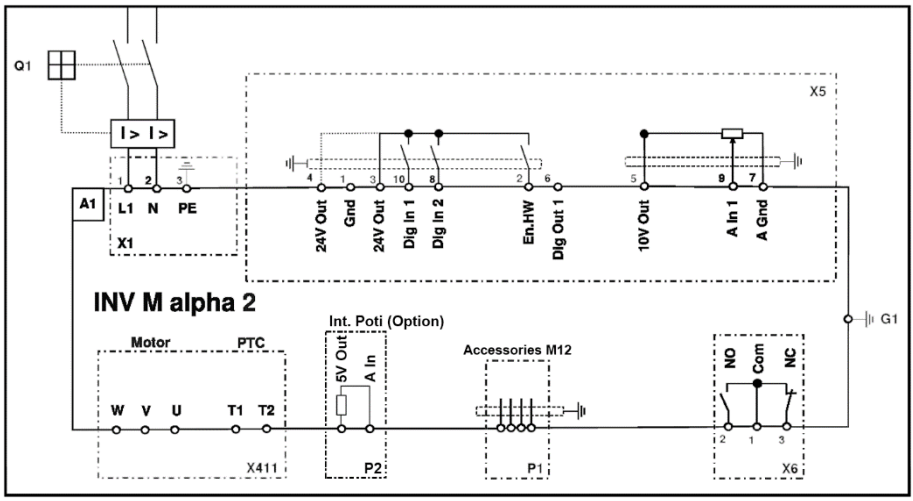


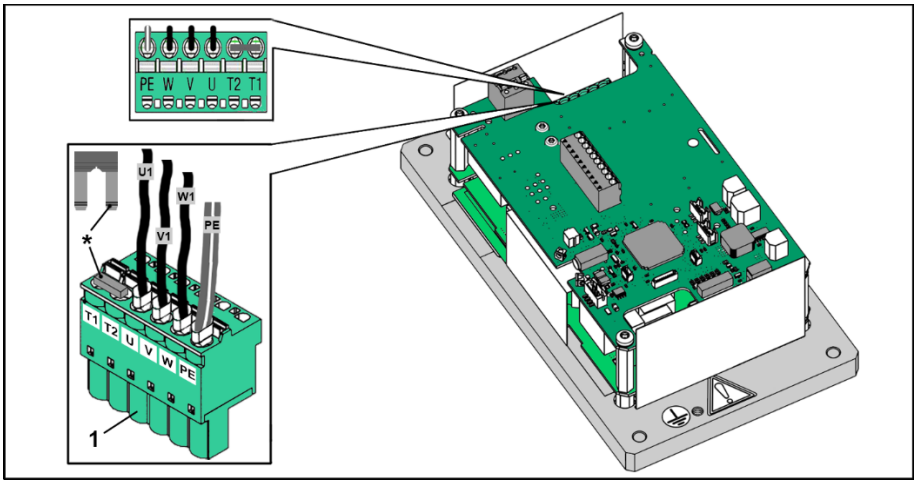

Fig.: 16 Wiring diagram for size Alpha

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

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

### 3.5.3 Electrical installation for INVEOR P size Alpha

**IMPORTANT INFORMATION**
Compliance with the type of protection is the sole responsibility of the system integrator.
If you have any questions, please ask your KOSTAL contact.

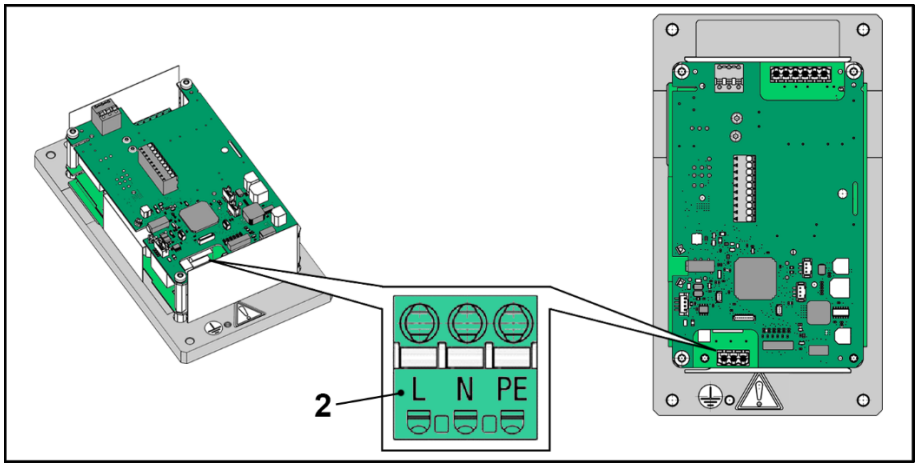



(also see 3.5.2 Wiring diagram INVEOR P size Alpha)

1. Attach the motor lines in the correct circuit to the motor plug (1).
2. If present, wire the connection cable of the motor PTC/Klixon to the T1 and T2 terminals.
   * If the motor used does not have a motor PTC, you must connect the bridge included in the scope of delivery.

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

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




(also see 3.5.2 Wiring diagram INVEOR P size Alpha)

**DANGER**

**Risk of death due to electrical shock!**

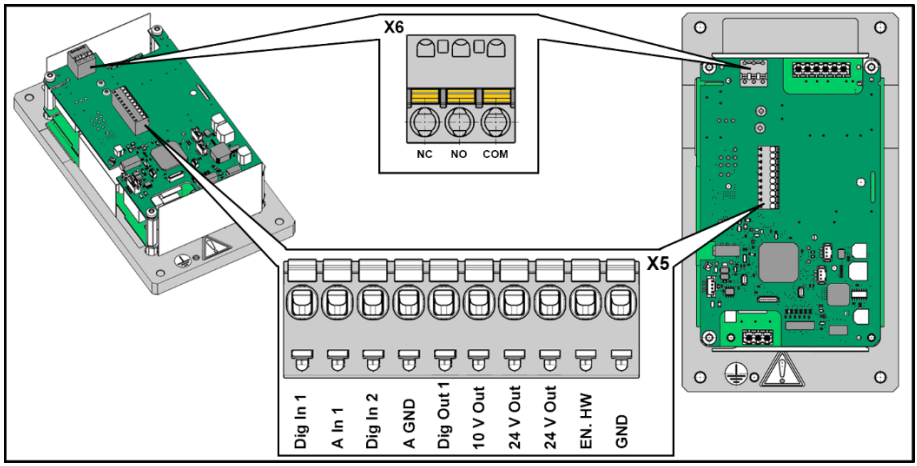
**Death or serious injury!**

De-energise mains cable and secure it against being restarted.

3. Connect mains cables to mains plug (2) as follows:

| 230 V connection | | |
|---|---|---|
| L | N | PE |

| Terminal no. | Designation | Assignment |
|---|---|---|
| 1 | L | Mains phase |
| 2 | N | Neutral wire |
| 3 | PE | Earth connection point |



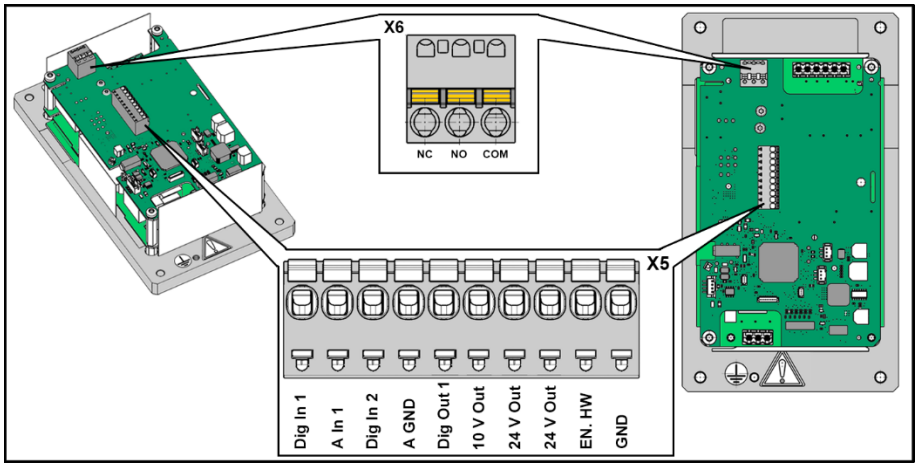

(also see 3.5.2 Wiring diagram INVEOR P size Alpha)

4. Connect control connections of application board as follows:

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

**IMPORTANT INFORMATION**

If a control line is not attached, a bridge must be connected between "24 V Out" and "En. HW".




(also see 3.5.2 Wiring diagram INVEOR P size Alpha)

| Relay X6<br>Designation | Assignment |
|---|---|
| COM | Centre contact relay |
| NO | Normally open contact relay |
| NC | Normally closed contact |

For technical data on power connections, see chapter 3.3.2.

### 3.5.4 Electrical installation for INVEOR P size A-B

**IMPORTANT INFORMATION**

Compliance with the type of protection is the sole responsibility of the system integrator. If you have any questions, please ask your KOSTAL contact.

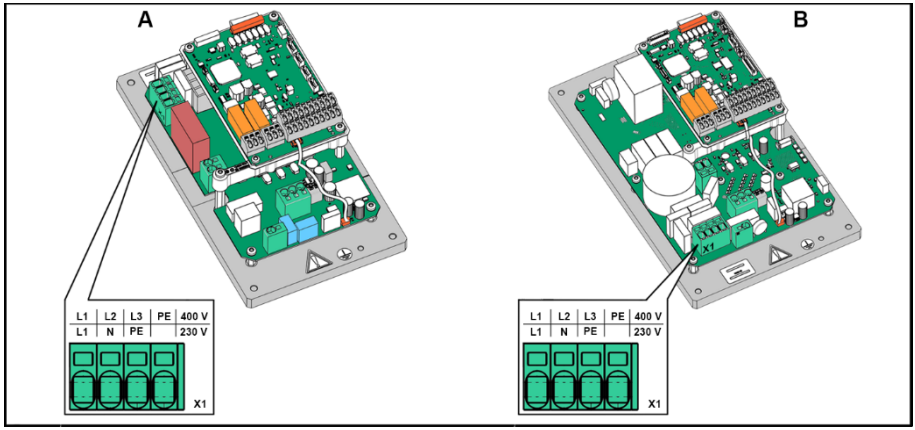



Fig.: 17 Electrical installation for INVEOR P size A-B

**DANGER**

**Risk of death due to electrical shock!**

**Death or serious injury!**

De-energise mains cable and secure it against being restarted.

1. Connect mains cables to mains terminal as follows:

| 230 V connection | | | |
|---|---|---|---|
| L1 | N | PE | |
| **400 V connection** | | | |
| L1 | L2 | L3 | PE |

Continues on next page

Continuation

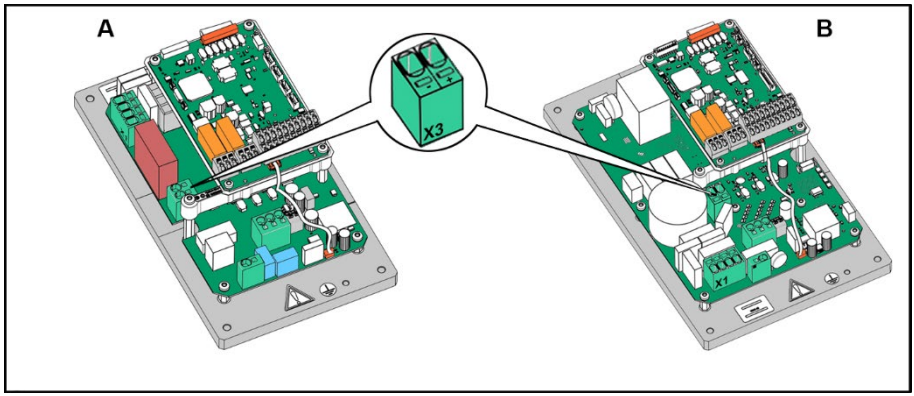



Fig.: 18 Wiring for brake chopper connection cable

**IMPORTANT INFORMATION**

When connecting a brake resistor to an optional brake chopper (X3), cables with shielding and double insulation must be used!

2. Connect the cables of the brake resistor to the terminal (X3) as follows:

| Connections for brake resistor (X3) (option) | |
|---|---|
| B+ | Connection for brake resistor (+) |
| B - | Connection for brake resistor (-) |

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Continuation

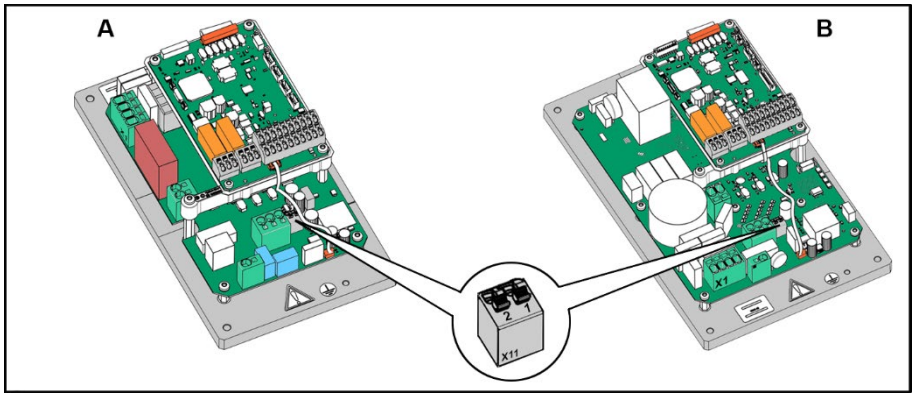


Fig.: 19 Wiring for motor PTC/Klixon connection cable

3. If present, wire the connection cable of the motor PTC/Klixon to the terminal (X11) as follows.

| Connections for motor PTC / Klixon (X11) | |
|---|---|
| 1 | (+) |
| 2 | (-) |

**IMPORTANT INFORMATION**

If the motor is fitted with a temperature sensor, this is connected to the terminals (1) and (2). Remove the bridging contact inserted for delivery for this purpose.
When the bridge is in place, the temperature of the motor is not monitored!
Only motor PTCs corresponding to DIN 44081/44082 may be connected!

### 3.5.5 Electrical installation for INVEOR P size C-D

**IMPORTANT INFORMATION**
Compliance with the type of protection is the sole responsibility of the system integrator.
If you have any questions, please ask your KOSTAL contact.

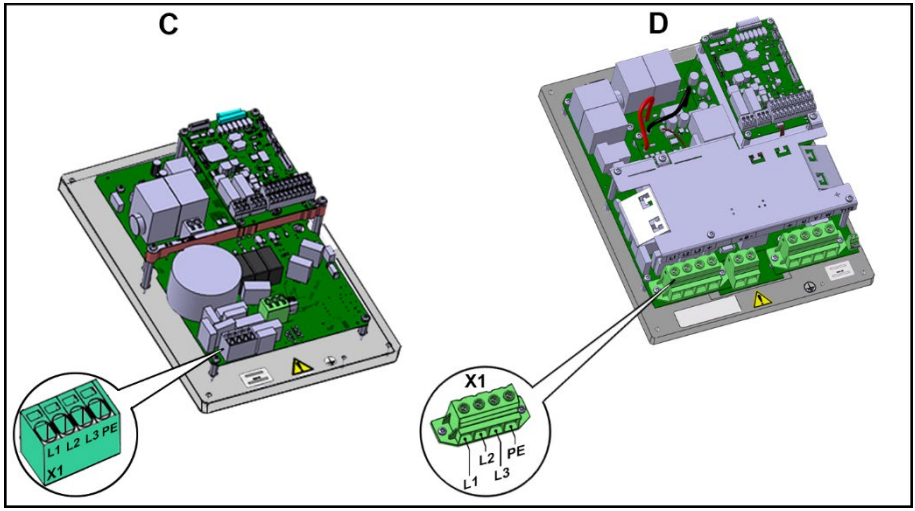


Fig.: 20 Electrical installation for INVEOR P size C-D

**DANGER**
**Risk of death due to electrical shock!**
**Death or serious injury!**
De-energise mains cable and secure it against being restarted.

1. Connect mains cables to mains terminal (X1) as follows:

| 400 V connection | | | |
|---|---|---|---|
| L1 | L2 | L3 | PE |

Continues on next page

Continuation

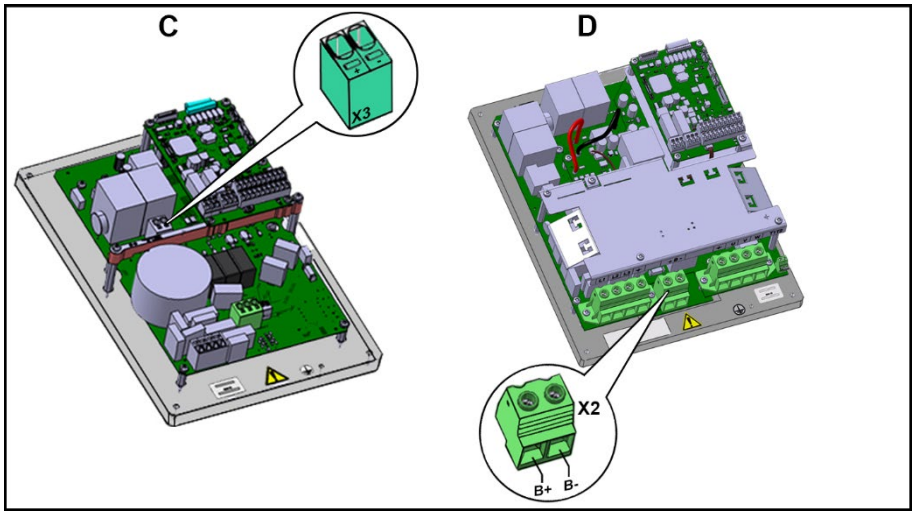


Fig.: 21 Wiring for brake chopper connection cable

**IMPORTANT INFORMATION**

When connecting a brake resistor to an optional brake chopper (X2/X3), cables with shielding and double insulation must be used!

2. Connect the cables of the brake resistor to the terminal (X2/X3) as follows:

| Connections for brake resistor (X2/X3) (option) | |
|---|---|
| B+ | Connection for brake resistor (+) |
| B - | Connection for brake resistor (-) |

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Continuation

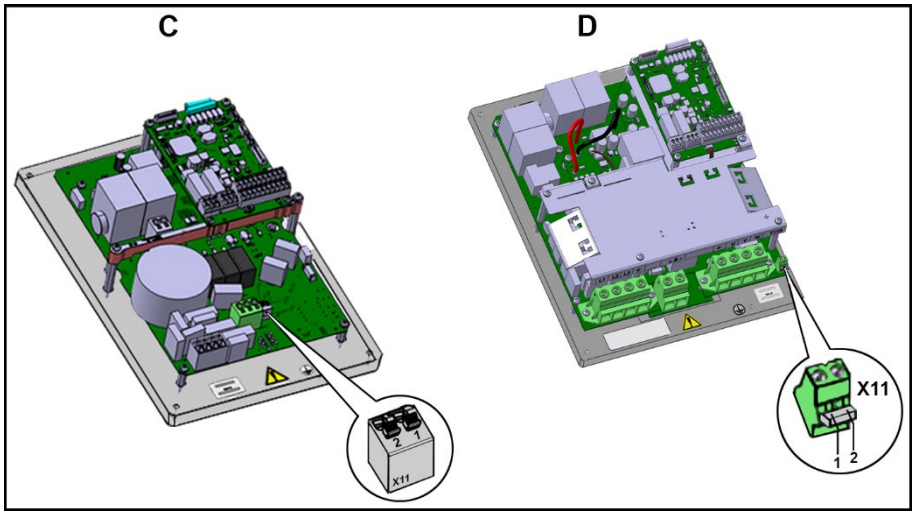



Fig.: 22 Wiring for brake chopper connection cable

3. If present, wire the connection cable of the motor PTC/Klixon to the terminal (X11) as follows.

| Connections for motor PTC / Klixon (X11) | |
|---|---|
| 1 | (+) |
| 2 | (-) |

**IMPORTANT INFORMATION**

If the motor is fitted with a temperature sensor, this is connected to the terminals (1) and (2). Remove the bridging contact inserted for delivery for this purpose.
When the bridge is in place, the temperature of the motor is not monitored!
Only motor PTCs corresponding to DIN 44081/44082 may be connected!

### 3.5.6 Connection diagram for INVEOR P size A-D

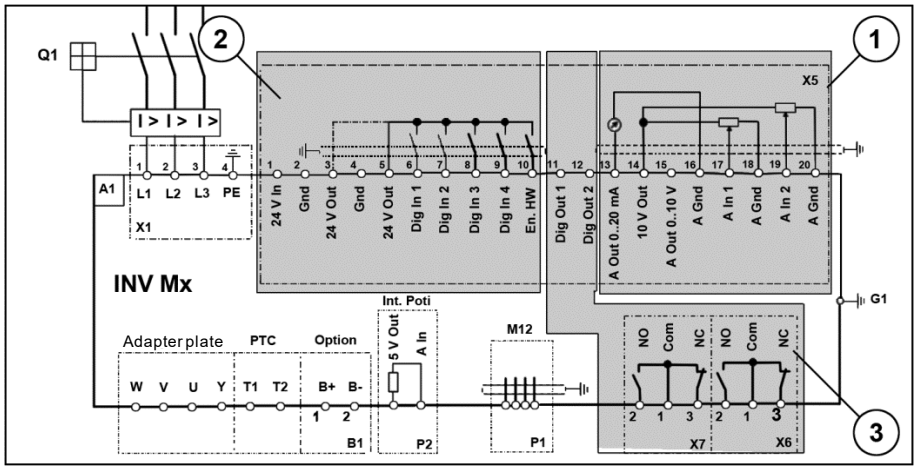
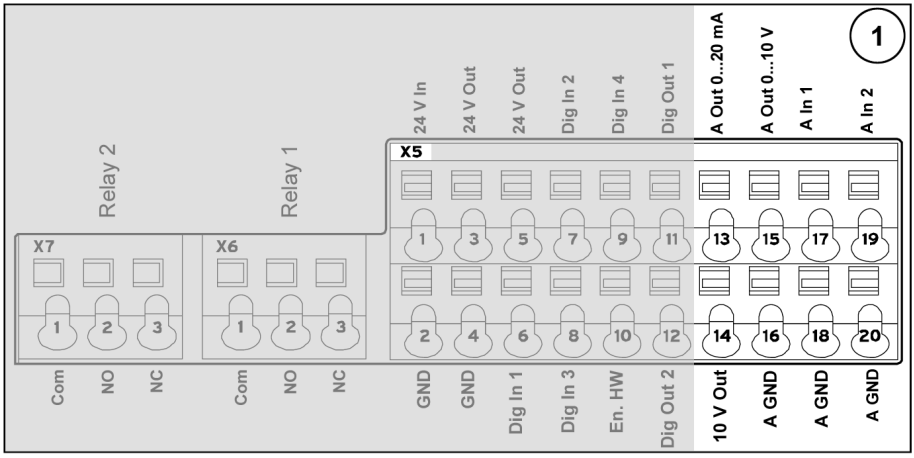



Fig.: 23 Control connections for size A-D

| Characters | Explanation |
|---|---|
| A1 | Drive controller type: INVEOR Mx 4 (3 AC 400 V) |
| B1 | Connection for external brake resistor (option) |
| G1 | M6 grounding screw (connection for residual currents > 3.5 mA) |
| P1 | RS485 programming interface (M12 plug) |
| P2 | Internal potentiometer |
| Q1 | Motor protection switch or load break switch (optional) |
| X1 | Mains terminals |
| X5 – X7 | Digital/analogue inputs and outputs |

The drive controller is ready once a 400 V AC mains supply has been activated (on terminals L1 to L3) or a 565 V DC mains supply has been activated (on terminals L1 and L3).
The drive controller can also be started up by connecting an external 24 V voltage .



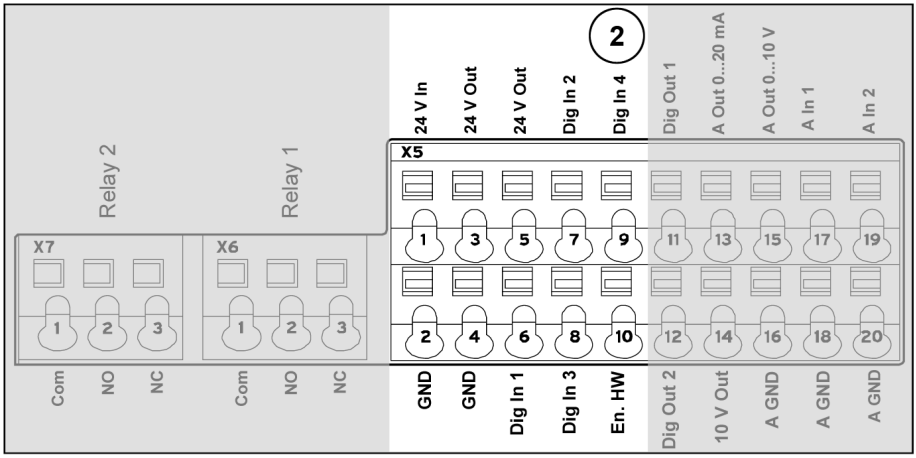

(also see 3.5.6 Wiring diagram INVEOR P for size A-D)

**IMPORTANT INFORMATION**
Danger of external signals being coupled in.
Use only shielded control line!

4. Connect the control cables according to the figure and/or table. Use shielded control cables.

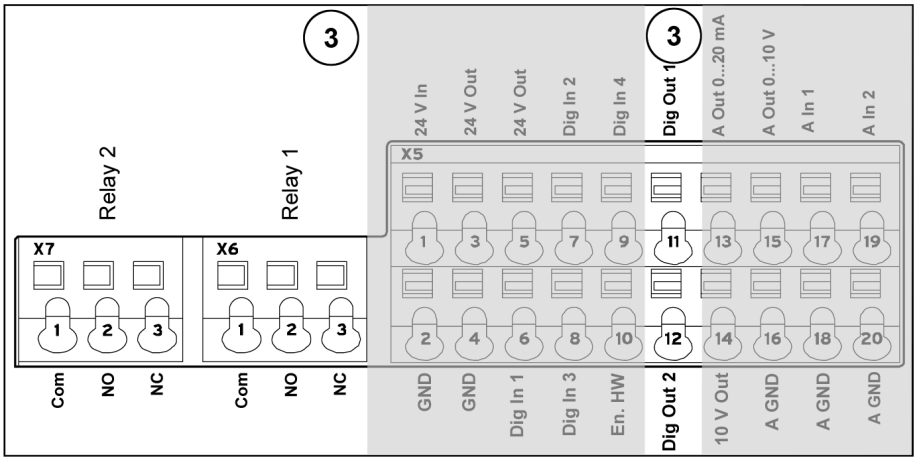
| Terminal no. | Designation | Assignment |
|---|---|---|
| 13 | A. Out 0 … 20 mA | Actual frequency (parameter 4.100) |
| 14 | 10 V Out | For ext. voltage divider |
| 15 | A. Out 0 … 10 V | Actual frequency (parameter 4.100) |
| 16 | A GND (ground 10 V) | Ground |
| 17 | A. In 1 | PID actual value (parameter 3.060) |
| 18 | A GND (Ground 10 V) | Ground |
| 19 | A. In 2 | Free (not assigned) |
| 20 | A GND (ground 10 V) | Ground |

Tab. 2




(also see 3.5.6 Wiring diagram INVEOR P for size A-D)

| Terminal no. | Designation | Assignment |
|---|---|---|
| 1 | 24 V In | Ext. power supply |
| 2 | GND (ground) | Ground |
| 3 | 24 V Out | Int. power supply |
| 4 | GND (ground) | Ground |
| 5 | 24 V Out | Int. power supply |
| 6 | Dig. In 1 | Target value enable (parameter 1.131) |
| 7 | Dig. In 2 | Free (not assigned) |
| 8 | Dig. In 3 | Free (not assigned) |
| 9 | Dig. In 4 | Error reset (parameter 1.180) |
| 10 | En HW (enable) | Enable hardware |




(also see 3.5.6 Wiring diagram INVEOR P for size A-D)

| Terminal no. | Designation | Assignment |
|---|---|---|
| 11 | Dig. Out 1 | Fault message (parameter 4.150) |
| 12 | Dig. Out 2 | Free (not assigned) |

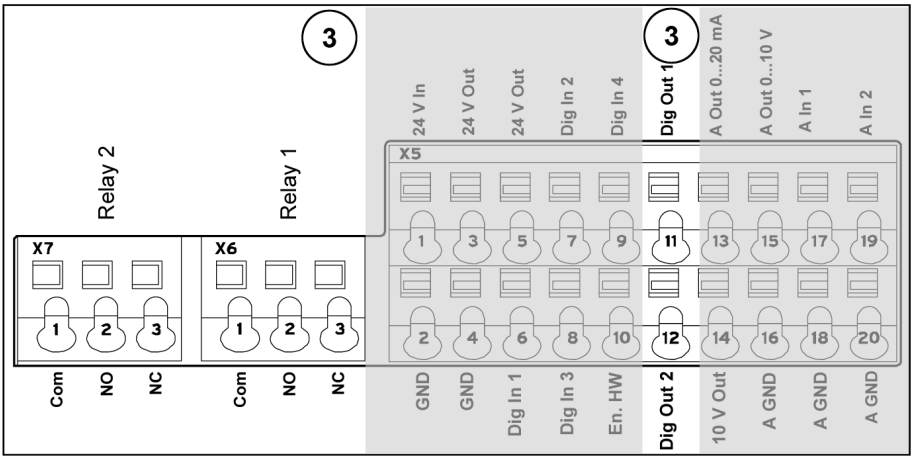
### X6 relay 1

| Terminal no. | Designation | Assignment |
|---|---|---|
| 1 | COM | Centre contact relay 1 |
| 2 | NO | Normally open relay 1 |
| 3 | NC | Normally closed relay 1 |

Tab. 3

**IMPORTANT INFORMATION**

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




(also see 3.5.6 Wiring diagram INVEOR P for size A-D)

### X7 relay

| Terminal no. | Designation | Assignment |
|---|---|---|
| 1 | COM | Centre contact relay 2 |
| 2 | NO | Normally open relay 2 |
| 3 | NC | Normally closed relay 2 |

Tab. 4

**INFORMATION**
In the factory setting, “no function” is assigned to relay 2 (parameter 4.210).

### Control connections of the basic application board

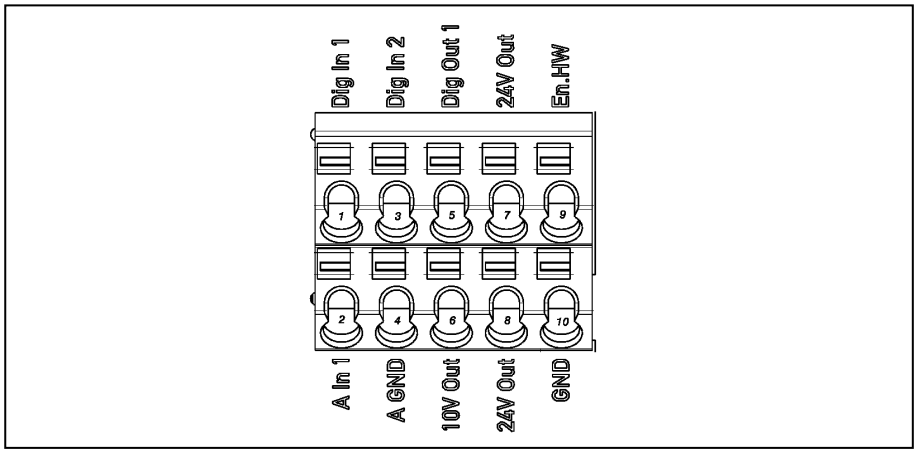



Fig.: 24 Control connections of the basic application board (configuration feature AP03)

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

# 4. Commissioning



## 4.1 Commissioning of INVEOR P size Alpha

You will find the "Commissioning" chapter for the INVEOR P (size Alpha) in the detailed operating manual for the INVEOR Alpha.

Please download the complete operating manual for the INVEOR **Alpha** from the download area of our website under the following link:

https://www.kostal-industrie-elektrik.com/downloads

## 4.2 Commissioning INVEOR P size A-D

You will find the "Commissioning" chapter for the INVEOR P (size A-D) in the detailed operating manual for the INVEOR.

Please download the complete operating manual for the INVEOR from the download area of our website under the following link:

https://www.kostal-industrie-elektrik.com/downloads

# 5. Parameter



## 5.1 Parameters for INVEOR P size Alpha

You will find the "Parameters" chapter for the INVEOR P (size **Alpha**) in the detailed operating manual for the INVEOR **Alpha**.

Please download the complete operating manual for the INVEOR **Alpha** from the download area of our website under the following link:

https://www.kostal-industrie-elektrik.com/downloads

## 5.2 Parameters for INVEOR P size A-D

You will find the "Parameters" chapter for the INVEOR P (size A-D) in the detailed operating manual for the INVEOR.

Please download the complete operating manual for the INVEOR from the download area of our website under the following link:

https://www.kostal-industrie-elektrik.com/downloads

# 6. Error detection and troubleshooting



## 6.1 Error detection and troubleshooting for INVEOR P size Alpha

You will find the "Error detection and troubleshooting" chapter for the INVEOR P (size Alpha) in the detailed operating manual for the INVEOR Alpha.

Please download the complete operating manual for the INVEOR **Alpha** from the download area of our website under the following link:

https://www.kostal-industrie-elektrik.com/downloads

## 6.2 Error detection and troubleshooting for INVEOR P size A-D

You will find the "Error detection and troubleshooting" chapter for the INVEOR P (size A-D) in the detailed operating manual for the INVEOR.

Please download the complete operating manual for the INVEOR from the download area of our website under the following link:

https://www.kostal-industrie-elektrik.com/downloads

# 7. Disassembly and disposal



This chapter contains the following:

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

## 7.1 Drive controller disassembly


**DANGER!**

**Risk of death due to electrical shock!**
**Death or serious injury!**
De-energise drive controller and secure it against being restarted.

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

**DANGER!**

**Risk of death due to electrical shock!**
**Death or serious injury!**
De-energise drive controller and secure it against being switched back on before removing housing parts which provide protection against contact with live parts.

## 7.2 Information on correct disposal

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

+

# 8. Technical data

# 8.1 General data

## 8.1.1 General technical data for 230 V/400 V devices

| Size | 230 V | | 400 V | | | | |
|---|---|---|---|---|---|---|---|
| | Pα | PA (1 AC) | PA (3 AC) | PB (3 AC) | PC (3 AC) | PD (3 AC) | PD (3 AC) |
| Recommended motor rating (4-pole asynchr. motor) | 0.75 | 1.1 | 1.5 | 4.0 | 7.5 | 15.0 | 22.0 |
| Ambient temperature [ °C] | - 10 °C (non condensing) to + 40 °C (50 °C with derating)[1] | | - 25 °C (non condensing) to + 50 °C (without derating) | | | - 25 °C (non condensing) to + 40 °C (without derating) | |
| Mains voltage [V] | 1 x 100 VAC – 15 % …230 VAC + 10 % | | 3 x 200 VAC – 10 %…480 VAC + 10 % | | | | |
| Mains frequency [Hz] | 50 Hz / 60 Hz ± 6 % | | | | | | |
| Mains configurations | TN / TT / IT (options) | | TN / TT | | | | |
| Mains current [A] | 7.3 | 9.2 | 3.3 | 7.9 | 14.8 | 28.2 | 39.8 |
| Nominal current output eff. [$I_N$ at 8 kHz / 230 V] | 3.3 | 5.2 | - | - | - | - | - |
| Nominal current output eff. [$I_N$ at 8 kHz / 400 V] | - | | 4.0 | 9.5 | 17.8 | 34.0 | 48.0 |
| Min. brake resistance [Ω] | - | 50 | 100 | 50 | 50 | 30 | |
| Maximum overload | 150 % of nominal current for 60 sec | | | | | | 130 % of nominal current for 60 sec |
| Switching frequency | 4 kHz, 8 kHz, 16 kHz, (factory setting 8 kHz) | | | | | | |
| Rotating field frequency | 0 Hz – 400 Hz | | | | | | |
| Protective functions | Overvoltage and undervoltage, $I^2t$ restriction, short circuit, motor- drive controller temperature, anti-tilt protection, stall protection | | | | | | |
| Process control | Freely configurable PID controller | | | | | | |
| Dimensions [L x W x H] mm | 210x120x71 | 261.5x150x82.9 | 261.5x150x82.9 | 300x185x83.3 | 330x220x91 | 343x270x113 | |
| Weight including cooling plate [kg] | 1.6 | 2.2 | 2.2 | 2.9 | 4.2 | 6.5 | |
| Protection type [IPxy] | IP 00 (type of protection is determined by the final application)I | | | | | | |
| EMC | prepared for satisfying DIN EN 61800-3, class C2 | prepared for satisfying DIN EN 61800-3, class C1 | prepared for satisfying DIN EN 61800-3, class C2 | | | | |
| Certificates and conformity | | | | | | | |

Tab. 5: Technical data for 230 V and 400 V INVEOR P devices (subject to technical changes)

[*] The recommended motor rating is stated for single-phase and three-phase devices based on a grid voltage of 230 VAC and 400 VAC.

Subject to technical change.

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

Tab. 6: Specification of interfaces (size Alpha)

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

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

Tab. 7: Specification of interfaces (size A-D)

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

# 9. Optional accessories

This chapter contains brief descriptions of the following optional accessories:

- MMI handheld controller
- MMI/connecting cable PIN assignment
- PC communication cable USB on M12 plug
- INVEOR P Alpha adapter cable
- Internal potentiometer
- MMI M12 plug (JST plug)
- CANopen connection cable
- Profibus connection cable
- Thermal conductivity paste

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

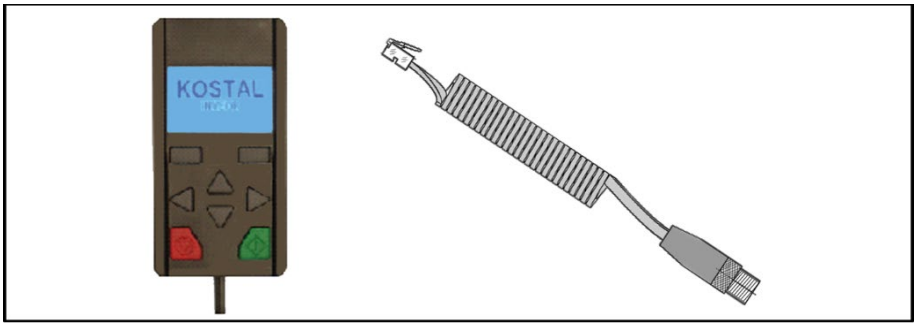



Fig.: 25 MMI handheld controller

**IMPORTANT INFORMATION**

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

The MMI handheld controller is connected to the M12 interface (option) of the INVEOR P. With the INVEOR P size Alpha, the MMI handheld controller can also be connected to the internal jack plug. The INVEOR Alpha adapter cable
(art. no. 10118219) is needed for this.

Fig.: 26 INVEOR P Alpha adapter cable

The MMI handheld controller allows the user to write (program) and/or to visualise all the parameters of the INVEOR P. Complete commissioning is possible as an alternative to the free INVEORpc software. External signals are not needed.

## 9.2 MMI*/connecting cable PIN assignment

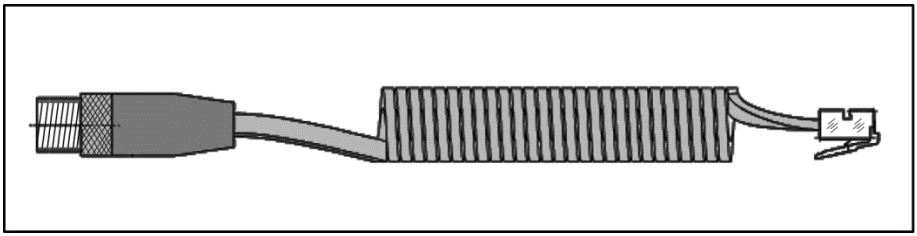


Fig.: 27 MMI connecting cable, can be ordered along with handheld controller, order number 10004768

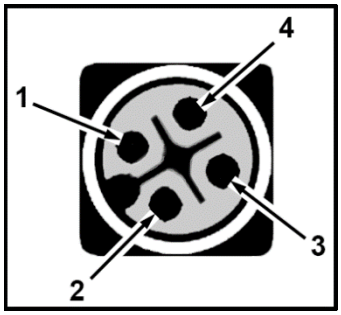



Fig.: 28 M12 plug PIN assignment

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

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

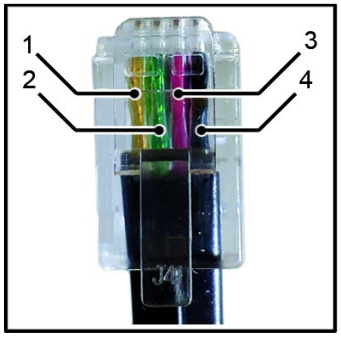



Fig.: 29 RJ9 plug connector

Description: RJ9 plug connector

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

* Man-machine interface

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

Fig.: 30 PC communication cable USB on M12 plug

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

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

## 9.4 Adapter cable for INVEOR P size Alpha

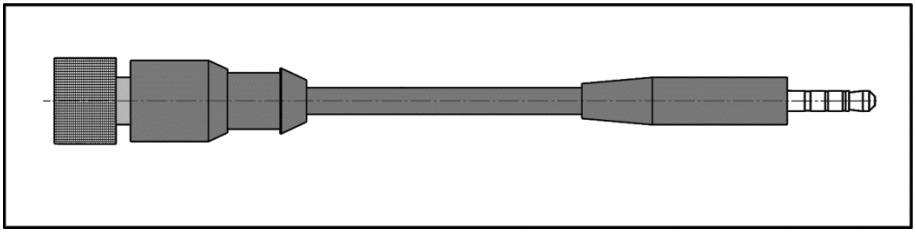


Fig.: 31 INVEOR Alpha adapter cable

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

**IMPORTANT INFORMATION**

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

## 9.5 Internal potentiometer

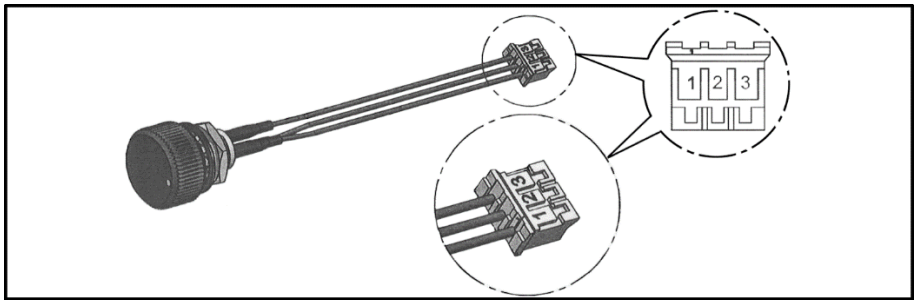



Fig.: 32 Internal potentiometer

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

## 9.6 MMI M12 plug (JST plug)

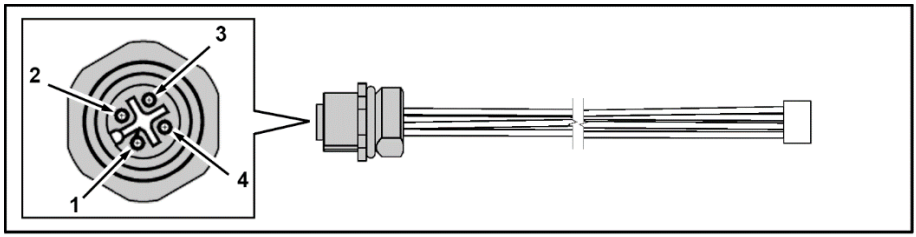



Fig.: 33 MMI M12 plug (JST plug)

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

The MMI M12 connection cable (art. no.: 10118216) can be used to permanently connect the drive controller with the MMI or PC.

**IMPORTANT INFORMATION**

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

| M12 plug assignment | Signal |
|---|---|
| 1 | 24 V |
| 2 | RS485 - A |

| M12 plug assignment | Signal |
|---|---|
| 3 | GND |
| 4 | RS485 - B |

## 9.7 CANopen connection cable

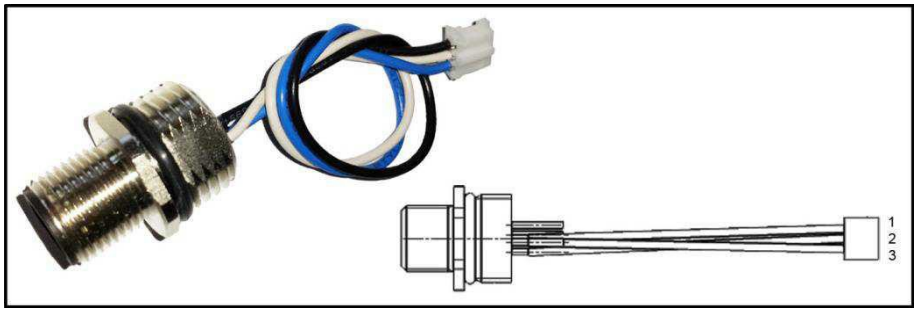



Fig.: 34 CANopen connection cable

The connection cable (art. no.: 10118224) can be used to connect the drive controller to a CANopen bus system.

| CANopen connection cable pin assignment | | | |
|---|---|---|---|
| JST plug pin assignment | Line colour | Signal | M12 plug assignment |
| 1 | black | CAN_L | 5 |
| 2 | white | CAN_H | 4 |
| 3 | blue | GND | 3 |
| | | Not used | 1 |
| | | Not used | 2 |

## 9.8 PROFIBUS connection cable

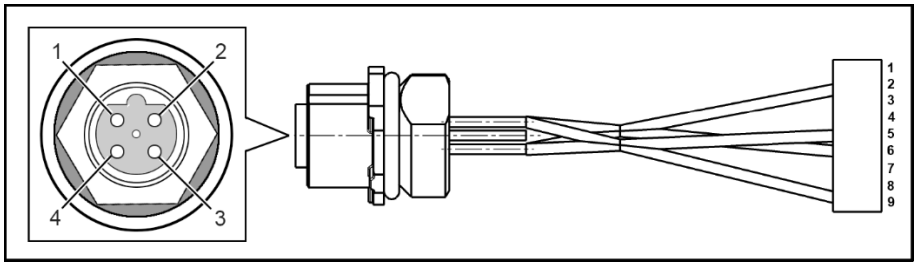



Fig.: 35 PROFIBUS connection cable

The connection cable (art. no.: 10056418) can be used to connect the drive controller to a PROFIBUS bus system.

| PROFIBUS connection cable pin assignment | | | |
|---|---|---|---|
| JST plug pin assignment | Line colour | Signal | M12 plug assignment |
| 1 | | | |
| 2 | brown | VP | 1 |
| 3 | | | |
| 4 | | | |
| 5 | red | RXD / TXD-P | 4 |
| 6 | green | RXD / TXD-N | 2 |
| 7 | | | |
| 8 | | | 3 |
| 9 | blue | DGND | |
| | | | 5 |

## 9.9 Ethercat/PROFINET/Sercos III connection cable

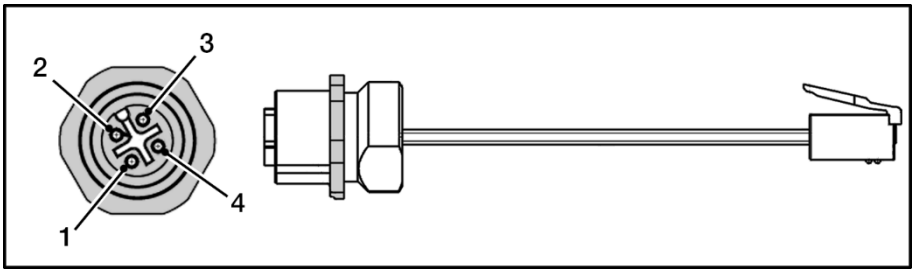



Fig.: 36 EtherCAT/PROFINET/Sercos III connection cable

The connection cable (art. no.: 10085888) can be used to connect the drive controller to an EtherCAT/PROFINET/Sercos III bus system.

| Pin assignment for EtherCAT/PROFINET/Sercos III | | |
|---|---|---|
| **Pin assignment RJ 45 plug** | **Signal** | **Assignment for M12 plug** |
| 1 | Tx + | 1 |
| 2 | Tx - | 3 |
| 3 | Rx + | 2 |
| 4 | | |
| 5 | | |
| 6 | Rx - | 4 |
| 7 | | |
| 8 | | |

## 9.10 Thermal conductivity paste

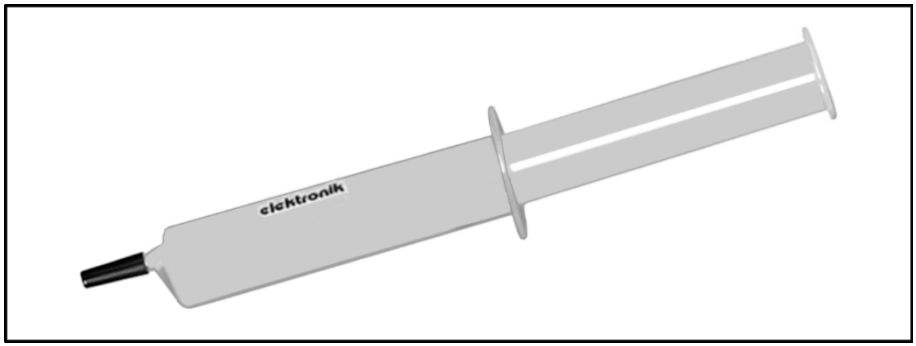



Fig.: 37 Thermal conductivity paste spraying device

The thermal conductivity paste (art. no: 10139778) improves heat transfer between the cooling plate and thermal sink.

For the correct way to apply this paste, please consult chapter 3.5.1 Mechanical installation.

# 10. Approvals, standards and guidelines

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

Because the INVEOR P device is based on the housed INVEOR M device, the INVEOR P is provided with all filter measures.
The system integrator therefore only has to remeasure the integrated electronics together with his or her specific housing with regard to the EMC stated in DIN EN 61800-3:2004/A1:2012.

Requirements of a housing with proper EMC:

- closed, earthed metallic surface
- EMC screw connections

For binding information about the relevant drive controller approvals, please refer to the type plate for the entire device!

## 10.1 EMC limit classes

Please note that EMC limit classes are only reached if the standard switching frequency of 8 kHz is complied with.
Depending on the installation material used and/or extreme ambient conditions, it might be necessary to use additional sheath wave filters (ferrite rings). If mounting on a wall, the shielded motor cable must not exceed a maximum length of 3 m!

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

**IMPORTANT INFORMATION**

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

## 10.2 Classification acc. to IEC/EN 61800-3

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

### Definition of environment

First environment (residential, commercial and industrial area):

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

residential area, e.g. houses, apartments etc.

retail area, e.g. shops, supermarkets

public institutions, e.g. theatres, stations

outside areas, e.g. petrol stations and parking areas

light industry, e.g. workshops, laboratories, small businesses

Second environment (industry):

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

## 10.3 Standards and guidelines

The following specifically apply:

Directive on Electromagnetic Compatibility
(Directive 2014/30/EU Standard: EN 61800-3 2004/A1:2012).

Low Voltage Directive
(Directive 2014/35/EU Standard EN 61800-5-1:2007)

RoHS Directive
Directive 2011/65/EU Standard EN 50581 :2012

## 10.4 UL approval

### 10.4.1 UL Specification (English version)

#### CONDITIONS OF ACCEPTABILITY:

Use - For use only in complete equipment where the acceptability of the combination is determined by Underwriters Laboratories Inc.

1. INV P Alpha:
   These cold-plate drives are designed for installation on an external heatsink in the end-use. Unless operated other than as specified in item 2 of the Conditions of Acceptability below, temperature test shall be repeated in the end-use.

   INV PA 2 / INV PA 4 / INV PB 4 / INV PC 4 / INV PD 4:
   These drives are incomplete in construction and have to be attached to an external heatsink in the end-use. Unless operated with the heatsink as noted in item 2 of the conditions of acceptability below, temperature test shall be conducted in the end-use.

2. INV P Alpha:
   Temperature test on these drives was conducted without any external heatsink (only with cold-plate being integral part of the drive) at rated load and maximum surrounding air temperature of 50 °C.

   Temperature test was conducted at rated load and maximum surrounding air temperature with drive installed on aluminum heatsink, overall dimensions, shape and number of ribs as outlined below:

   INV P Alpha / INV PA 2 / INV PA 4 / INV PB 4 / INV PC 4:
   Temperature test was conducted with drive installed on aluminum heatsink, overall dimensions and ribs shape as outlined below:

| Drive series | Overall heatsink dimensions (W x H x L) in millimeters | Illustration | Max. surrounding air temperature |
|---|---|---|---|
| INV **P** Alpha | 120 x 27 x 210 | ILL. 1 | 60 °C |
| INV **PA** 2* | 150 x 27 x 210 | ILL. 1 | 50 °C |
| INV **PA** 4** | 150 x 27 x 210 | ILL. 1 | 65 °C |
| INV **PB** 4** | 200 x 40 x 250 | ILL. 2 | 60 °C |
| INV **PC** 4** | 216 x 83 x 300 | ILL. 3 | 65 °C |

*2 = IV 02 **4 = IV 01

INV PD 4:
Temperature test was not conducted on models INV PD 4. Suitability of drive - heatsink combination shall be determined by subjecting to temperature test in the end-use.

3. INV PA 2 / INV PA 4 / INV PB 4 / INV PC 4 / INV PD 4:
Suitability of grounding for the combination of drive and heatsink needs to be verified in accordance with the end-use standard.

### Required Markings

Mechanical considerations: mounting drawing; handling and mounting instructions **see chapter 3.4 in the operating manual**.

Marking for proper connection; range of values or a nominal value of tightening torque in pound-inches to be applied to the clamping screws of all terminal connectors for field wiring **see chapter 3.4 in the operating manual**.

**CAUTION:** "Use 75 °C wires only"

**CAUTION:** "Use Copper Conductors Only"

**CAUTION:** "Suitable For Use On A Circuit Capable Of Delivering Not More Than 5000 A rms Symmetrical Amperes, 240 Volts Maximum" and "When Protected by RK5 Class Fuses rated 15 A"

Indication of motor overload protection level in percent of full-load current. **Internal Overload Protection Operates within 60 seconds when reaching 150 % of the Motor Full Load Current**.

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

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

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

**CAUTION:** "For use in Pollution Degree 2 Environment only".

INV PA 2:

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

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

**CAUTION:** "Suitable For Use On A Circuit Capable Of Delivering Not More Than 5 kA rms Symmetrical Amperes, 240 Volts Maximum when Protected by Fuses”.

All wiring terminals marked to indicate proper connections for the power supply, load and control circuitry **see chapter 3.4 in the operating manual**.

**CAUTION:** Use 75 °C copper wires only.

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

**CAUTION:** "For use in Pollution Degree 2 only."

## Illustrations

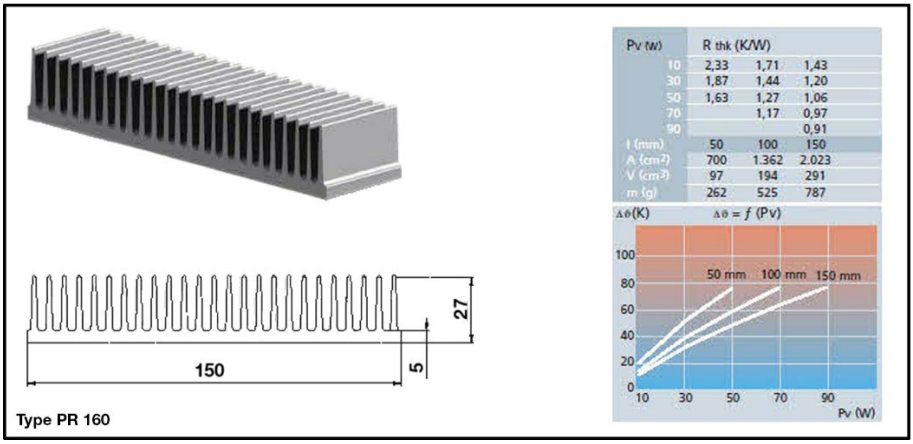



Fig.: 38 ILL. 1

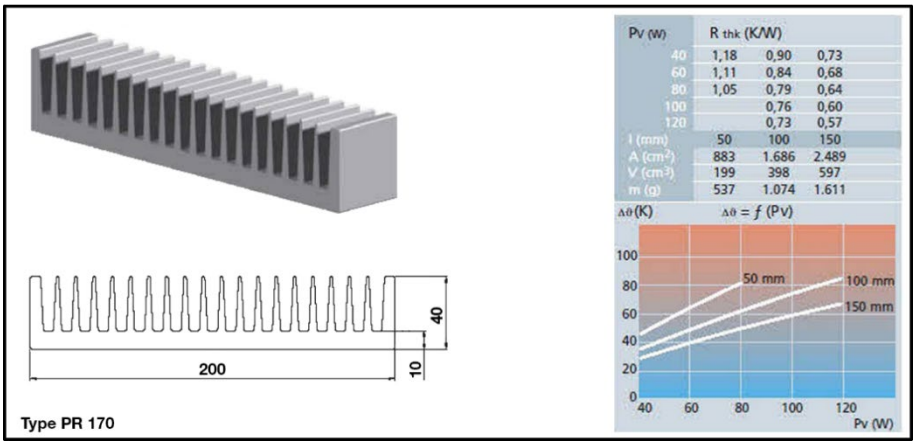



Fig.: 39 ILL. 2

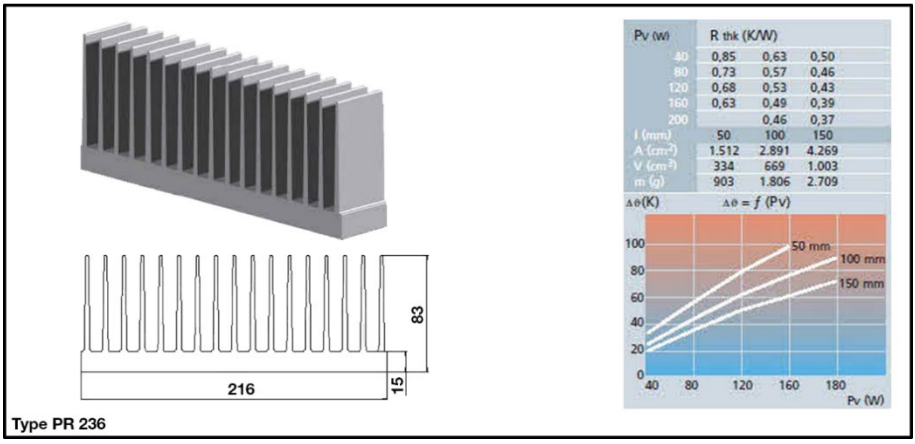



Fig.: 40 ILL. 3

## 10.4.2 Homologation CL (Version en française)

### CONDITIONS D'ACCEPTABILITÉ :

Usage : usage uniquement réservé aux équipements complets dont l'acceptabilité de la combinaison est déterminée par la société Underwriters Laboratories Inc.

1. INV P Alpha :
   Ces commandes à plaques de refroidissement sont destinées à être installées sur un dissipateur thermique externe
   en utilisation finale. Sauf en cas d'exploitation autre que celle indiquée à l'élément 2 des conditions d'acceptabilité ci-dessous, le test de température doit être répété en utilisation finale.

   INV PA 2 / INV PA 4 / INV PB 4 / INV PC 4 / INV PD 4 :
   Ces commandes ne sont pas complètement finies et doivent être fixées à un dissipateur thermique externe en utilisation finale. Sauf en cas d'exploitation avec le dissipateur thermique comme cela est précisé à l'élément 2 des conditions d'acceptabilité ci-dessous, le test de température doit être effectué en utilisation finale.
2. INV P Alpha :
   Le test de température sur ces commandes a été effectué sans dissipateur thermique externe (uniquement avec une plaque de refroidissement faisant partie intégrante de la commande) à la charge nominale et à une température ambiante maximale de 50 °C.

   Le test de température a été effectué à charge nominale et à la température ambiante maximale alors que la commande était installée sur un dissipateur thermique en aluminium. Les dimensions générales, la forme et le nombre de nervures correspondaient à ceux indiqués ci-dessous :

   **INV P Alpha / INV PA 2 / INV PA 4 / INV PB 4 / INV PC 4:**

   Le test de température a été effectué alors que la commande était installée sur un dissipateur thermique en aluminium. Les dimensions générales et la forme des nervures correspondaient à celles indiquées ci-dessous :

| Série de commandes | Dimensions générales du dissipateur thermique (largeur x hauteur x longueur) en millimètres | Illustration | Température maxi. de l'air ambiant |
|---|---|---|---|
| INV **P** Alpha | 120 x 27 x 210 | ILL. 1 | 60 °C |
| INV **PA** 2 | 150 x 27 x 210 | ILL. 1 | 50 °C |
| INV **PA** 4 | 150 x 27 x 210 | ILL. 1 | 65 °C |
| INV **PB** 4 | 200 x 40 x 250 | ILL. 2 | 60 °C |
| INV **PC** 4 | 216 x 83 x 300 | ILL. 3 | 65 °C |

2 = IV 02 4 = IV 01

INV PD 4 :
Le test de température n'a pas été effectué sur les modèles INV PD 4. L'adéquation de l'association commande - dissipateur thermique sera déterminée par la réalisation du test de température en utilisation finale.

3. INV PA 2 / INV PA 4 / INV PB 4 / INV PC 4 / INV PD 4:
Suitability of grounding for the combination of drive and heatsink needs to be verified in accordance with the end-use standard.

## Mentions obligatoires

Considérations mécaniques : plan de montage ; instructions de manipulation et montage, **voir chapitre 3.4 du manuel d'exploitation**.
Mention relative au bon raccordement ; plage de valeurs ou valeur nominale du couple de serrage en livres-pouces à appliquer aux vis de serrage de tous les connecteurs de borne pour le câblage de champ, **voir chapitre 3.4 du manuel d'exploitation**.

**AVERTISSEMENT :** « Utiliser uniquement des câbles de 75 °C »

**AVERTISSEMENT :** « Utiliser uniquement des conducteurs en cuivre »

**AVERTISSEMENT :** « Convient à une utilisation sur un circuit capable de fournir un courant maximal de 5 000 ampères symétriques (A rms) et une tension maximale de 240 volts » et « en cas de protection par des fusibles de 15 A de classe RK5 »

Indication du niveau de protection contre la surcharge du moteur en pourcentage du courant nominal. **La protection interne contre les surcharges se déclenche dans un délai de 60 secondes lorsque la surcharge atteint 150 % du courant nominal du moteur**.

**AVERTISSEMENT :** « La commande ne détecte pas la surchauffe du moteur ».

**AVERTISSEMENT :** « Le système de protection intégrale contre les courts-circuits des relais statiques ne protège pas les circuits de dérivation. La protection des circuits de dérivation doit être assurée conformément aux instructions du fabricant, au Code national de l'électricité et à tous les autres codes locaux. »

**AVERTISSEMENT :** Pour utilisation au Canada : « L'ÉCRÊTAGE DE TENSION TRANSITOIRE DOIT ÊTRE INSTALLÉ DU CÔTÉ LIGNE DE CET ÉQUIPEMENT ET DOÎT ÊTRE CONÇU POUR 240 V (PHASE - TERRE), ÊTRE CONFORME À LA CATÉGORIE DE SURTENSION III ET FOURNIR UNE PROTECTION CONTRE UNE TENSION ASSIGNÉE DE TENUE AUX CHOCS DE 2,5 kV ».

**AVERTISSEMENT :** « Uniquement pour utilisation dans un environnement de degré de pollution 2 ».

INV PA 2 :

« La protection interne contre les surcharges se déclenche dans un délai de 60 secondes lorsque la surcharge atteint 150 % du courant nominal du moteur ».

**AVERTISSEMENT :** « Le système de protection intégrale contre les courts-circuits des relais statiques ne protège pas les circuits de dérivation. La protection des circuits de dérivation doit être assurée conformément au Code national de l'électricité et à tous les autres codes locaux. »

**AVERTISSEMENT :** « Convient à une utilisation sur un circuit capable de fournir un courant maximal de 5 000 ampères symétriques (kA rms) et une tension maximale de 240 volts en cas de protection par des fusibles ».

Toutes les bornes marquées pour indiquer les raccordements adéquats pour le circuit de commande, de charge et d'alimentation électrique, **voir chapitre 3.4 du manuel d'exploitation**.
**AVERTISSEMENT :** Utiliser uniquement des câbles en cuivre de 75 °C.

**AVERTISSEMENT :** « La commande ne détecte pas la surchauffe du moteur ».

**AVERTISSEMENT :** « Uniquement pour utilisation dans un environnement de degré de pollution 2 ».

### Illustrations

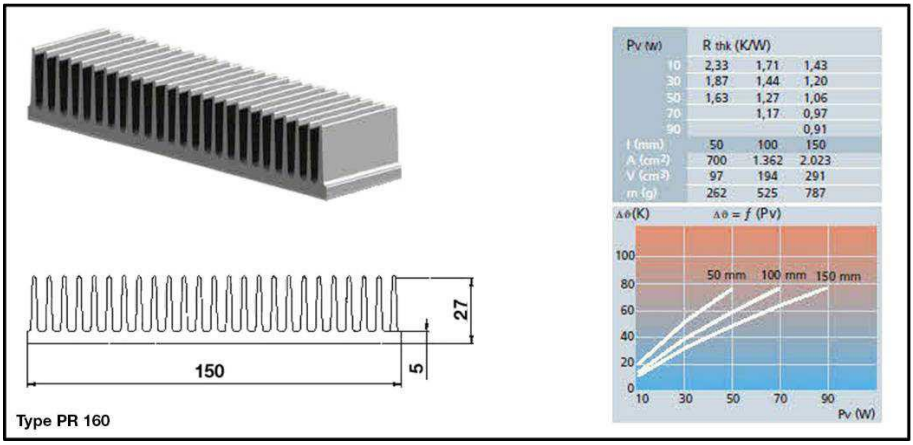



Fig. : 38 ILL. 1

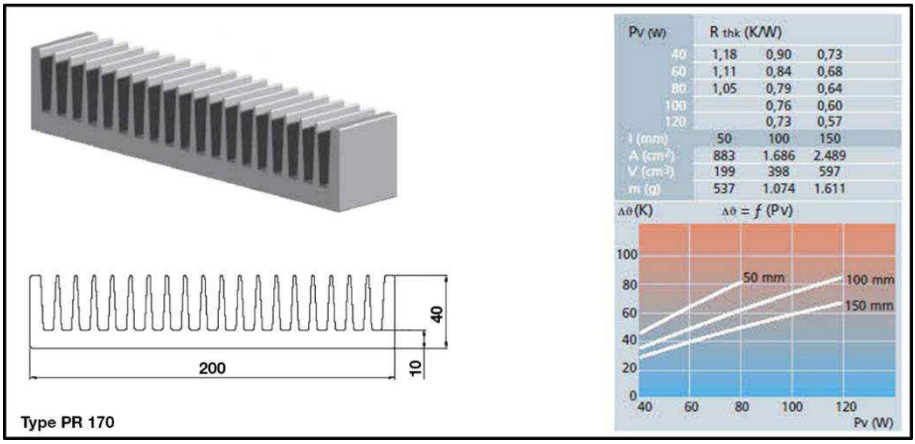



Fig. : 39 FIG. 2

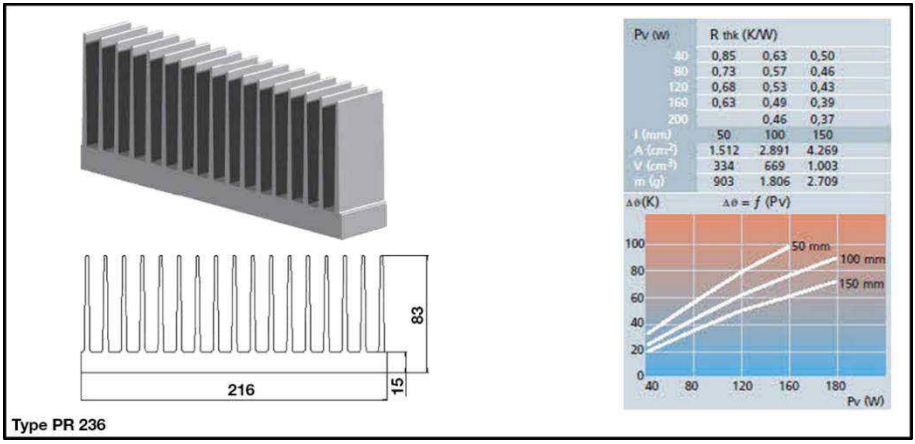



Fig.: 40

# 11. Index

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## U

KOSTAL Industrie Elektrik GmbH
Lange Eck 11
58099 Hagen
Deutschland

Service-Hotline: +49 2331 8040-848
Telefon: +49 2331 8040-800
Telefax: +49 2331 8040-602

**www.kostal-industrie-elektrik.com**

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