

ELECTRIC PUMPS UNITS FOR
WATER LIFTING AND
PRESSURISATION

USE AND MAINTENANCE MANUAL

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Declaration of conformity

of type A (according to Directive 2006/42/EC attachment II)

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DECLARES

that the "Booster set" pressurisation units are compliant with the prescriptions of Directives:

- 2006/42/EC and subsequent amendments (Machinery Directive)
- 2014/35/UE and subsequent amendments (Low Voltage Directive)
- 2014/30/UE and subsequent amendments (Electro-magnetic Compatibility Directive)

Veronella (Vr), 03 March 2016

The Legal Representative



Gianluigi Pedrollo

1. General information

1.1. Symbols



Symbol indicating the instructions of the manual relating to safety. The non-compliance with these instructions exposes to health risks.



Symbol indicating the instructions of the manual relating to electrical safety. The non-compliance with these instructions exposes to electrical risks.

ATTENTION

Wording indicating the main warnings for correct system installation, functioning and management. However, for a correct use of the system for its entire life-span, all instructions and indications supplied in this manual must be complied with.

1.2. Generality

Check that the material received corresponds to that in the transport document and that it is not damaged.



To work safely and obtain the best results, before starting the system remember to read all the instructions contained in this manual and in the attached documentation.

The manual and the attached documentation constitute integrating part of the system and must be kept with care and be consulted by those in charge of use and maintenance of the system.

No part of this documentation can be reproduced without the written authorisation by the manufacturer.

Given the quick technical progress, the not strictly standard production and the company continuous improvement policy, the units may be subject to amendments by the manufacturer without prior notice.

The non compliance with all indications supplied in this manual, an improper use of or unauthorised amendments made to the system void any form of responsibility by the manufacturer for eventual damages to persons, animals or things.

1.3. Identification of the units

Every unit is provided with an identification plate similar to that shown in fig. 1, on which the following is reported:

- Trademark, denomination and manufacturer address
- Unit type
- Month/year of manufacture
- Serial (N./Ref.)
- Total power
- Pressure switches calibration

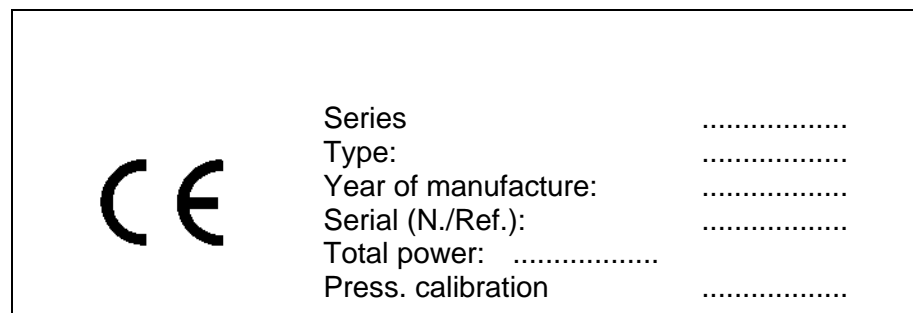


fig. 1

2. Systems description

The pressurisation unit is composed by:

- identical motor-driven pumps connected in parallel, single-phase or three-phase, with horizontal or vertical axis, with sequential start-up with cyclical inversion, in variable number from 1 to 3 and chosen according to the requested features
- steel full port intake and flow collectors, threaded (or flanged) and galvanised
- steel, galvanised unit base and support for electric board
- one check valve for each pump, assembled at intake
- ball valves with inlet for each pump one assembled at intake and one at flow
- a coupling stub pipe for each pump assembled at intake and provided with threaded hole for the connection of eventual air feeder
- rubber anti-vibrating supports with metal core
- manometer with radial connection
- electric board in IP 55 plastic box

-
- pre-calibrated pressure switches (one per pump) assembled on the flow collector and directly connected to the electric board
 - heat protection electric cables of fire-retardant type, connected to the equipment and to the board
 - UPON REQUEST: can be supplied separately membrane tanks (20, 24 litres)

ATTENTION

For a correct use, at least one autoclave reservoir must be installed in the system.

ATTENTION

ALL UNITS:

- ARE BUILT IN COMPACT EXECUTION TO ENABLE THEIR USE IN REDUCED SPACES ALSO
- ARE REALISED USING HIGH QUALITY COMPONENTS
- ARE COMPLETELY ASSEMBLED AND TESTED IN FACTORY
- TO FUNCTION THEY MUST FIRSTLY BE CONNECTED TO THE HYDRAULIC SYSTEM AND TO THE POWER SUPPLY LINE.

2.1. Functioning principle

In static position with system pressurised, the contacts of the pressure switches result open and the system in stand-by. Upon decreasing of the pressure due to water request, pressure switch number one closes the contact and starts the first motor-driven pump. If the performances supplied by the same are sufficient for maintaining an adequate pressure, the motor-driven pump works until no water flow request and stops. If, on the contrary, other utilities are used and the pressure decreases further, the second pressure switch closes the contact and starts the second motor-driven pump and so on for other eventually available units. Upon stabilising of the pressure, the contacts of the pressure switches open and the motor-driven pumps stop with reverse order to start-up. The electric board changes the starting order of the motor-driven pumps at the beginning of every new cycle, so as to obtain a balanced share of the work times. The protection of the motor-driven pumps against the disconnection and the dry start, is assured by a float on the intake tank, to be connected by the user to the contacts envisioned on the electric board.

2.2. Use and counterindications

The units in standard execution are designed and built for the pressurised maintenance of the water systems using clear water from collection tank.

ATTENTION

The standard execution units are not suitable for:



- the dry running
- the pumping of liquids different from clear, clean, chemically and mechanically non aggressive water
- the pumping of liquids with temperature above 40°C
- the pumping of flammable liquids
- the functioning in places classified at risk of explosion
- the functioning in places without ventilation, in that they do not guarantee the ventilation of the motors and facilitate the forming of condensation
- the functioning with too frequent start-ups and switch-offs (approximately from 5 to 30 start-ups every hour, at regular intervals, per individual pump. The greater the power of the pumps, the lower the number of start-ups admitted). For further information please contact the manufacturer.
- the functioning at altimetric level, approximately above 1000 m (can vary depending on the type of motors used). For further information please contact the manufacturer.
- the functioning with ambient temperatures above 40°C

2.3. Use limits

- working pressure depending on the type of pump (see booklet) and use limits of the membrane reservoirs
- minimum intake pressure depending on the NPSH value requested by the pump and load losses (with safety margin of 0.5/1.0 metres)
- the maximum pressure at intake summed to the maximum pressure of the pump must be lower than the working pressure

3. Safety regulations

The "Booster set" units, if correctly installed, function in automatic mode and do not therefore present particular or significant risks linked to their normal use.



The handling, installation, maintenance, eventual repair and dismissal of the units described in this manual must be carried out by qualified staff that has read and understood the content of this manual and the eventual attached documentation. The running of the units can also be carried out by unqualified staff.



Remove voltage by disconnecting from the electric power supply before carrying out any maintenance or repair operations on the units. Place the protection switches upstream of the system in position off or remove the plug from the power supply socket.



In case of fire in the electric equipment, do not use water to put it out.



The units use motor-driven pumps with mechanical parts in motion fully protected against accidental contacts, by means of suitable sumps. Every responsibility is declined in case of damages to persons, animals or things caused by the removal of or tampering with said devices.



The pressurisation unit is an automatic system, therefore the pumps can start without warning. It is therefore necessary to pay maximum attention before any intervention.

4. Information on overhead noise

For information on the power and acoustic pressure level, refer to that reported on the instruction booklet of the pumps.

5. Installation

Do not disperse the packaging materials in the environment, but keep to the regulations in force on the disposal of waste.

5.1. Handling

The units are delivered in cardboard packages on appropriate pallets and can therefore be transported by means of lifting trolley or pallet truck.



It is necessary to verify that the maximum capacity of the hoisting mean is compatible with the weight of the unit.

In case of handling from above (crane, bridge crane, forklift) it is necessary to hook the unit by passing suitable belts from underneath the pumps, in front and behind the fixing points on the base, in order to avoid the possibility of capsizing. Proceed cautiously to avoid accidental impacts.

5.2. Assembly and dismantling

The units are delivered fully assembled and do not therefore require any assembly operation, if not for additional requested accessories.

Verify that the positioning is on a flat and regular surface, act at supporting the weight of the unit and sufficiently spacious to allow the carrying out of use and maintenance operations in safe conditions.

For every dismantling intervention that should be necessary, pre-emptively proceed to the hydraulic and electrical insulation of the components to be dismantled.

ATTENTION

Remember that for every dismantling and assembly operation it is a good rule to check and, if necessary, replace, the gaskets and to fasten the flanges proceeding progressively for nuts diametrically opposite.

5.3. Hydraulic connections

The installation of the units described in this manual must be carried out by qualified staff that has read and understood the content of this manual and the eventual attached documentation.

In carrying out the hydraulic connections verify that:

- the sections of the intake and flow piping are equal or greater than those of the collectors or stub pipe or, however, such to avoid a too high speed of the flow (it is preferable to remain below 2 m/sec.).
- the intake and flow piping is perfectly aligned with the collectors of the inserted unit
- the intake piping has the lowest possible number of bends and section variations and is as short as possible

ATTENTION

We recommend overlapping anti-vibrating elastic joints to eliminate any misalignment and to reduce the propagation of the vibrations.

ATTENTION

We recommend installing a float switch (the electric board is already prepared for the connection) to prevent dry running.

ATTENTION

In case of water withdrawal from well or, however, above water level, we recommend mounting a bottom valve with filter on to the intake piping.

In case of withdrawal from reservoir or collection tank, this must be dimensioned according to the maximum water request point and to the supply possibility of the water system.

5.4. Electrical connections



The electric connections must be carried out by qualified staff, following the electric layouts and applying the state-of-the-art rules.



Verify that the electric power supply system is provided with an efficient earthing system. The yellow-green earth conductors must be connected to the electric boards before the other conductors whereas, during the disconnection phase, they must be the last to be removed.

ATTENTION

Verify the correspondence between voltage and frequency of the electric power supply network and the plate data of the motor-driven pumps.

6. Start-up, running, checks

6.1. Start-up

Before starting the unit, verify that the motor shafts of the motor-driven pumps rotate freely.

ATTENTION

In case of three-phase motor-driven pumps, verify that the rotation direction corresponds to that indicated by the arrows placed on the pump bodies or on the fan covers; on the contrary, invert the connections of two phases of the electric power supply cable.

Perform the full priming of the pumps by carrying out the following operations:

1. Loosen the cap on the intake collector.
2. Open all collectors motor-driven pumps connection valves.
3. Completely fill with water.
4. Close the cap.
5. Open the motor-driven pumps priming caps and carry out similar operation.
6. Close the caps and the flow valves.
7. Start the pumps from the electric board with manual control.
8. Slowly open the flow valves so as to eliminate the trapped air bubbles (if necessary, stop the pumps and repeat the priming operation, to fill the spaces left empty by the air).
9. Eventually repeat the manual start-up operations a few times for a short time to allow the bleeding of the trapped air.
10. Completely open the flow valves and switch to automatic functioning of the pumps, by acting on the selector switches on the electric board.

6.2. Electric board controls

1 Voltage presence warning light

2 Level alarm warning light

3,4 Motors on warning lights

5,6 Motors in protection warning lights

7,8 Switches and automatic position warning lights

9, 10 Stop buttons

11,12 Manual functioning buttons

ATTENTION

All information regarding the electric board, descriptions, regulations, procedures and indications are reported in the specific use and maintenance booklet provided.

6.3. Regulations and calibrations

The units are calibrated and tested before delivery. Should adjustments to regulations of the electric boards or pressure switches be necessary, the same must be carried out by qualified staff. Pressure switches calibration procedure: remove the lid to access the regulating nuts - act on calibration nut "P" to regulate the connection pressure also called minimum pressure (a clockwise rotation increases the value, vice-versa, an anti-clockwise rotation decreases the value) - act on nut " ΔP " to regulate the pressure differential (a clockwise rotation increases the calibration differential and, consequently, fixed the connection pressure, also the stop pressure value also called disconnection or maximum pressure).

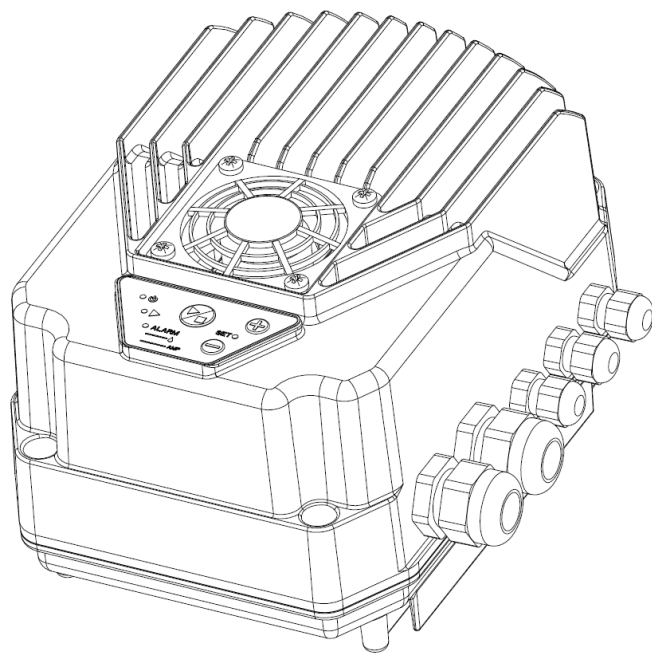
6.4. Maintenance

The pressurisation units do not require *routine* maintenance, whereas the eventual interventions of *extraordinary* maintenance, that should be necessary in case of fault, must only be carried out by experienced staff.

7. Out of service

In case of placing a unit out of service, ensure to hydraulically and electrically insulate the same before proceeding to the dismantling.

Do not disperse materials forming part of the system in the environment; keep to the local legal dispositions with regard to disposal, recovery, re-use, recycling of the materials.



EPIC

Installation, use and maintenance manual

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1. EPIC presentation

EPIC is a control and protection device for pumping systems based on the power supply frequency variation of the pump.

EPIC guarantees:

- Energy and cost saving.
- Simplified installation and lower costs of the system.
- Extended durability of the system.
- Increased reliability.

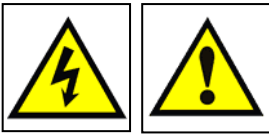
EPIC guarantees pump operation to maintain the pressure constant according to the use conditions variations. This way, the pump, or pump system, is activated only when required, for the time required; as a result, energy waste is avoided and its durability is longer.

At the same time, EPIC can:

- Protect the motor against overload and dry operation and provide a relative alarm indication.
- Activate soft start and soft stop to extend system durability and reduce consumption peaks.
- Connect to another EPIC device for combined operation (COMBO).

2. Safety warnings

The manufacturer recommends reading the instruction manuals of his products carefully before their installation and use.



Any operation must be performed by qualified personnel.

Failure to comply with the recommendations provided in this manual, and in general, with the universal safety standards, may cause severe electric shocks or death.

The device must be connected to the mains via a switch/cut-out switch in order to guarantee disconnection from the power supply (even visual), before acting on the EPIC and on any connected load.

Disconnect the EPIC from the power supply before acting on the device and connected loads.

Never remove the cable gland plate or cover, before having disconnected EPIC from the power supply and waited for at least 5 minutes.

The EPIC system and pump must be accurately earthed before commissioning.

During the period in which EPIC is powered by the mains,

regardless of whether it is activating the load or is in standby mode (digital deactivation of the load), the motor output terminals remain live compared to the earth. This way, the opera-

tor is exposed to risks, as by seeing the load stopped, he/she may operate on the device.

We recommend tightening the 4 cover screws with relative washers before powering the device. Otherwise, the cover earth connection may fail causing electric shock or death.

Avoid impacts to the product or extreme climatic conditions during transport.

Make sure the product comes fully equipped with its accessories. In the event components are missing, immediately contact the supplier.

Damage to the product due to transport, installation, or improper use is not covered by the warranty of the manufacturer. Tampering with or disassembling any component will automatically make the warranty void and null.

The manufacturer declines any liability for damage to persons or objects due to improper use of his products.

3. Installation

EPIC can be mounted directly on the motor, replacing the terminal box. Refer to the manufacturer for compatibility and motor-EPIC coupling mode.

The device consists of two essential components.

- Coupling base
- Heat sink with electronic board

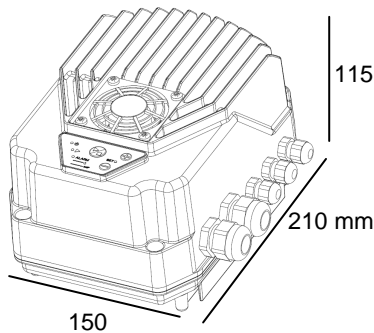
The heat sink part can be rotated by 180° to meet the application with vertical axes pumps.

4. Technical characteristics

Vin +/- 15%	Max Vout	Max I line	Max I out	P2 typical	Weig ht
[VAC]	[VAC]	[A]	[A]	[KW]	[kg]
1 x 230	3 x 230	11	7.5	1.5	2.5

- P.F. line side: 1 (in compliance with EN61000-3-2).
- Power supply frequency: 48 - 62 Hz .
- Max. operating temperature at nominal load: 40°C (104 °F).
- Maximum humidity relative to the installation environment: 50% at 40°C without condensation.
- Max. altitude at nominal load: 1000 m.
- Protection rate: IP55 (NEMA 4).
- Connectivity: RS 485 serial port for COMBO operation.

- PWM configurable: 2.5, 8 kHz.



- **AN2:** analogue input 0-10 V
- **+10V:** power supply 10 VDC
- **0V:** reference 0V

To switch to the external frequency operation mode via analogue input AN2, connect the pressure sensor upon device activation.

The device will power the motor, which has variable frequency and is proportional to the AN2 analogue input signal.

Digital inputs IN1 and IN2 for motor start/stop:

- **IN1, 0V :** digital input 1
- **IN2, 0V :** digital input 2

Digital inputs 1 and 2 are non-voltage potential free contacts, which allow you to control the motor start/stop.

Both inputs are Normally Closed. Open one of the two contacts to stop the motor (e.g. floater).

Alarm output:

- **N.O. , COM :** the contact is closed in the presence of an alarm or power failure.
- **N.C. , COM:** the contact is open in the presence of an alarm.

Attention: Max. 250 VAC, 2A

RS485 serial for COMBO operation:

S+ , S-

Thanks to the RS485 serial connection, two devices can communicate with each other to allow the COMBO operation in a pressure unit.

We recommend using bipolar cables with minimum 0.35 mm section².

Fan power supply (12 VDC):

- **VENT: + , -**

Attention: the fan start and stop depend on the temperature of the device.

Attention: Failure to comply with the polarities may damage the fan.



5. Electrical connections

Disconnect the EPIC from the power supply before acting on the device and connected loads. Read the chapter relative to electrical safety carefully.

Line power supply:

L1, L2, P.E.

Attention: we recommend using pre-insulated female faston terminals 6.3 x 0.8

Motor output:

- **U, V, W, (P.E.)**

Attention: we recommend using pre-insulated female faston terminals 6.3 x 0.8

Attention: follow the phase sequence to guarantee correct rotation direction of the motor.

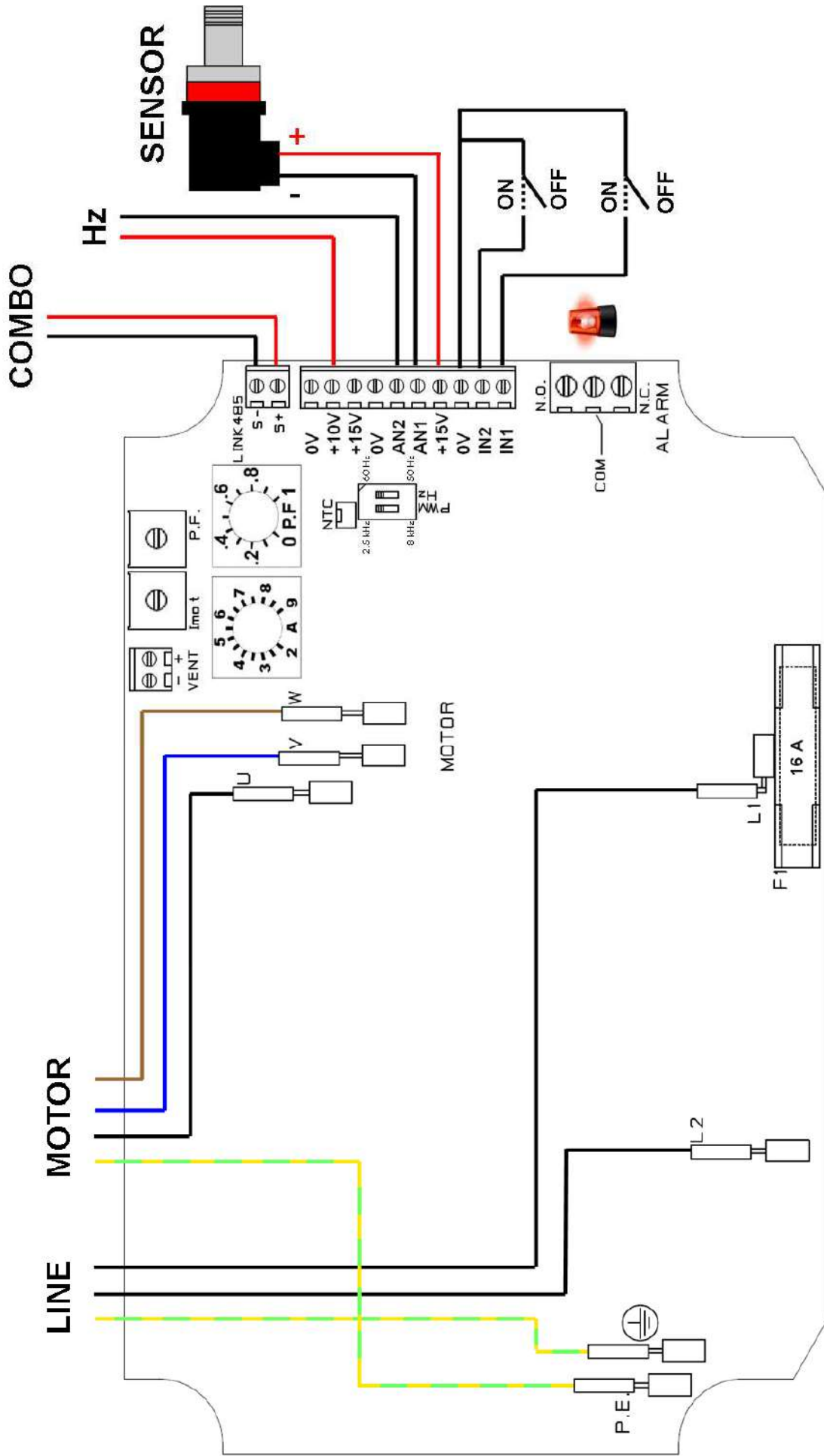
Pressure sensor input:

- **AN1:** analogue input 4-20 mA
- **+15V:** sensor power supply 15 VDC

Attention: if the pressure sensor has only two wires, it is not necessary to connect the signal earth.

Attention: connect the shield of the shielded cable directly to the device earth.

External frequency signal input:



6. Mains protection and electromagnetic compatibility

The device is equipped with a 16 A delayed fuse (6.3 x 32 mm), as per standard.

The mains protection devices required upstream the device depend on the type of installation and local standards. We recommend using a circuit breaker protection with characteristic curve of type C and differential switch of type A.

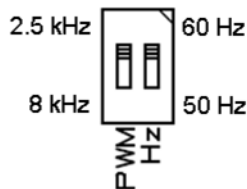
Comply with the following provisions to guarantee electromagnetic compatibility (EMC) of the system:

- always connect the device to earth.
- if required, use shielded signal cables earthing the shield to one end only.
- install signal cables, motor cables and power supply separately.
- use motor cables as short as possible (< 1 m).

We recommend installing an additional inlet filter for particularly sensitive installation environments. (Available upon request).

7. Settings

PWM regulation and nominal Hz of the motor via dip-switch.



The dip-switch allows you to vary:

- Modulation frequency (PWM):
 - 8 kHz : suitable for device application on board the motor.
 - 2.5 kHz: suitable for wall-mounted application of the device and motor cables longer than 10 m.

Nominal frequency of the applied motor (50 Hz or 60 Hz). Attention: the 50 Hz setting with 60 Hz nominal frequency motor may reduce the provided performance. The 60 Hz setting with 50 Hz nominal frequency motor may produce motor overload and trigger an overload alarm.

Regulation of the maximum motor current threshold and P.F. (power factor or $\cos\phi$) threshold of dry operation.

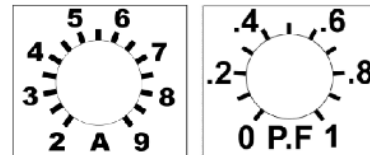
The Imot trimmers and P.F. allow you to adjust the two alarm thresholds:

- **maximum motor current threshold:** when this value is exceeded, the device stops the load and triggers an over-current alarm. We recommend setting a maximum motor current threshold equal to the nominal current of the motor increased by 10%.
- **P.F. threshold of dry operation:** under this value, the device stops the load and triggers the dry operation alarm.

After 5 minutes from the stop, the device will attempt an automatic restart. In the event the attempt triggers an additional dry operation alarm, the pump stops for another 10 minutes before another attempt is carried out. Similarly, the attempts will be repeated automatically after 20, 40, 80 minutes. In the event all 5 attempts fail to restore the alarm, the device will stop the pump definitely. Therefore, to restore the operation, you must deactivate and activate the device manually.

To adjust the trimmer position correctly, we recommend referring to the indication below.

Generally, the P.F. value of the dry operation may vary be-

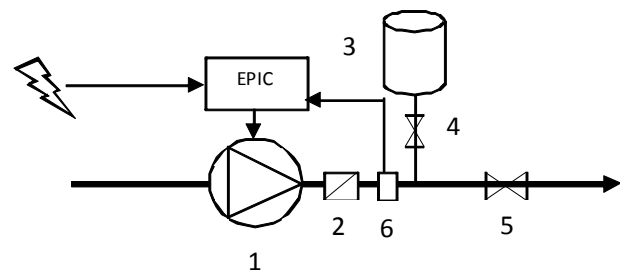


tween 60% and 70% compared to the nominal P.F. value of the pump.

8. Installation for constant pressure operation

The EPIC can manage the rotation speed of the pump in order to maintain pressure constant in a point of the system according to the water request variation of the utility.

The basic diagram of a pumping line that performs this operation is the following:



1. pump
2. check valve
3. expansion tank

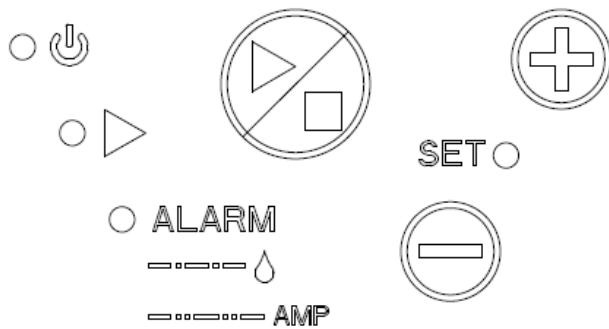
- 4. valve
- 5. valve
- 6. pressure sensor

The expansion tank, in water systems equipped with EPIC, compensates leaks (or minimum water consumption) and maintains the pressure when the pump is stopped, preventing excessively frequent start/stop cycles. It is essential to choose the correct volume and pre-charge pressure of the expansion tank. Excessively low volumes do not allow effective compensation of minimum water consumptions or leaks when the pump is stopped. On the other hand, excessively high volumes complicate the control of the pressure made by EPIC, besides involving an economic and space waste.

Place an expansion tank with a volume equal to 10% of the maximum flow rate required, considered in litres/minute. E.g.: if the maximum flow rate required is 60 litres/min, use a 6-litre expansion tank.

The pre-charge pressure of the expansion tank must be equal to 80% of the operating pressure. E.g.: if the pressure set in EPIC, to which the system must be kept independently from water consumption, is 4 bar, the pre-charge pressure of the expansion tank must be about 3.2 bar.

9. Use and programming



The red STANDBY LED switches on when the device is powered.

Then, the green SET LED starts blinking to indicate that the device is ready to start in a constant pressure control mode.

STARTING THE PUMP Press PLAY to start the pump. The green PLAY LED blinks with variable frequency: the closer the measured pressure is to the set pressure and the higher the frequency.

STOPPING THE PUMP
Press STOP to stop the pump. The green PLAY LED switches off.

MODIFICATION OF THE PRESSURE
Have a pressure gauge placed close to the pressure sensor. Open a tap with low flow to help the setting.

To modify the pressure:

- Start the pump.
- If the SET LED blinks, hold key + down until the SET LED remains on.
- Then press keys + or - to modify the pressure value.

MANUAL START UP OF THE PUMP WITH FIXED FREQUENCY

If the pressure sensor is disconnected or failed, the corresponding alarm is triggered (see alarm list). The pump can be started manually with fixed speed by holding the PLAY key down for at least 5 seconds.

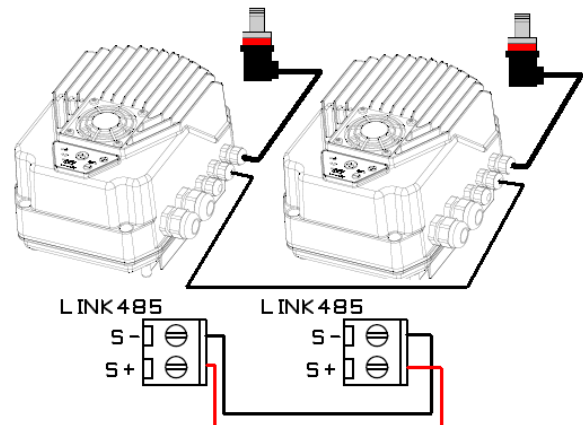
The pump starts at a minimum frequency of 20 Hz. Press keys + or - to vary the frequency. If the SET LED is off, hold key + or - down until the SET LED switches on.

EXTERNAL FREQUENCY OPERATION The pump frequency (speed) can be varied with analogue input AN2 (0-10VDC).

Make sure the pressure sensor is not connected to analogue input AN1.

10. COMBO operating mode

To allow two EPIC devices to communicate with each other within a unit, connect the RS485 serial ports with a bipolar cable with minimum 0.35 mm² section.



Every EPIC must be equipped with its pressure sensor in COMBO operating mode.

We recommend equipping every device with independent circuit breaker and residual current protection in order to guarantee the operation of the unit in the event one unit fails.

We recommend following the procedure below upon the first start up:

1. Connect the two devices via serial with power supply disconnected.
2. Power one of the two devices.
3. Wait at least 30 seconds and then power the second device.

The device that has been switched on first is the MASTER device of the unit (as indicated by the blinking SET LED), while the second device is called SLAVE.

To start/stop the unit in COMBO mode, press PLAY or STOP from the MASTER device (blinking SET LED).

Pressure must be adjusted always from the MASTER device.

In the event one of the two units fails or triggers an alarm, the other unit restarts operation after 1 minute from the stop, guaranteeing continuity of service.

The device can alternate the operation of the pumps to maintain the same operation hours and, therefore, their wear, facilitating programmed maintenance operations.

11. Alarms and warnings



- LED Off: No power supply
- LED On: Correct power supply (1 x 230 VAC +/- 15%)
- Blinking Red LED: under-voltage
- Blinking Red and Yellow LEDs: over-voltage



- LED On: motor on.
 - Pressure control: pump operation at the required pressure.
 - Fixed frequency / external frequency: pump operation at fixed frequency.
- Blinking LED: Pressure control pump with measured pressure different from the required pressure. The blinking frequency of the LED increases when the required pressure is about to be reached.

SET

- Blinking LED: EPIC in constant pressure regulation mode and regulation buttons deactivated.

The SET LED switches on and regulation is activated by holding key + down for three seconds.

- LED off: EPIC in manual mode at fixed frequency or external frequency

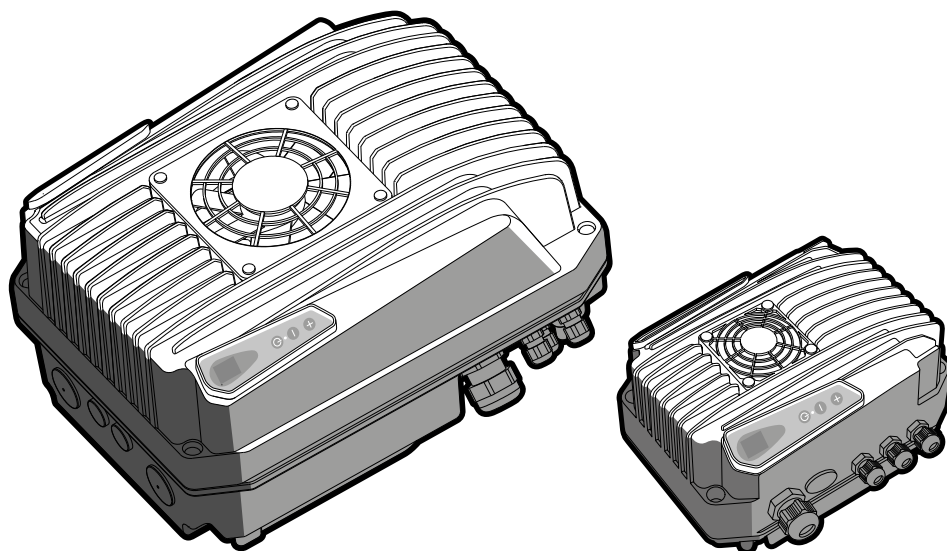
In COMBO operating mode, the SET LED is off in the SLAVE device.

- LED On: regulation activated.

ALARM

The ALARM LED indicates an alarm based on a variable number of blinks followed by a three-second pause.

- 1 Blink: no water; automatic restore attempt after 5-10-20-40-80 minutes followed by definitive alarm (restart is possible only after deactivation).
- 2 Blinks: maximum motor current (consumed current higher than the set threshold).
- 3 Blinks: sensor alarm (no connected and efficient sensor, incorrect connection or output current lower than 2 mA).
- 4 Blinks: thermal alarm (NTC heat sink temperature higher than 70 °C).
- 5 Blinks: maximum inverter current alarm (restart is possible only after deactivation).
- 6 Blinks: master conflict alarm during COMBO operation (switch one of the inverters with triggered alarm off).
- 7 Blinks: no Master. Wait until the Slave becomes Master (it may require up to one minute)
- 8 Blinks: No control communication - power side (this alarm is normally triggered upon activation for a few seconds)
- Fast blinks without intermediate pauses: Digital inputs open.



EPIC-A

Installation, use and maintenance manual

V 8.2
07/07/2023

The information contained in this document may be changed without notice

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1. Introduction

1.1. Purpose of the manual

The purpose of this manual is to provide users with detailed information on the installation, operation, and maintenance of the product, with special regard to safety regulations.

**WARNING**

Read the manual carefully before installing and using the product.

**WARNING**

Failure to follow the instructions may result in damage to the product, the system in which it is installed and, in the worst cases, damage to property or persons with even fatal consequences.

**NOTE**

Store the manual in a protected and easily accessible place next to the installation location for possible consultation. A digital copy of this manual can be downloaded from the manufacturer's website or via the QR code shown on the product itself.

**WARNING**

At the time of installation and periodically, at least once a year, it is recommended to check the availability of firmware updates for the device using the appropriate control App. Updates may include additional features, enhancements to existing features, and bug fixes to improve system efficiency and reliability.

1.2. Product overview

EPIC-A is a device for the control and protection of pumping systems based on the variation of the pump power supply frequency. It can be applied to both new and old systems ensuring:

- energy and economic savings
- simplified installation and lower system costs
- extended life of the system
- improved reliability

EPIC-A, when connected to any pump on the market, it manages its operation in order to keep a certain physical quantity constant (pressure, differential pressure, flow rate, temperature, etc.) as the conditions of use change. In this manner, the pump, or the pump system, is operated only when, and to the extent that, it is needed, thus avoiding unnecessary energy waste and extending its life. At the same time the device can:

- protect the motor from overloads and dry runs
- implement soft starts and soft stops to increase system life and reduce absorption peaks
- provide an indication of the current consumption and the supply voltage

- record the operating hours and, based on these, the errors and faults reported by the system
- connect to other devices to obtain combined operation

Appropriate output filters, available upon request, allow reducing the dangerous overvoltages that are generated in very long cables and, therefore, make the device ideal also for controlling submerged pumps.

2. Safety

2.1. Symbols

**TIP**

This symbol indicates a TIP or recommendation.

**NOTE**

This symbol indicates a NOTE or an indication or concept to be emphasised.

**CAUTION**

This symbol indicates CAUTION, thus an indication which failure to respect can lead to minor or moderate damage.

**WARNING**

This symbol indicates a WARNING, thus an indication which, in the event of non-compliance, may lead to serious, even fatal damage to persons or things.

**DANGER**

This symbol indicates an ELECTRICAL HAZARD, which if not avoided will result in death or electrocution.

2.2. Qualified personnel

**WARNING**

The installation, use and maintenance of the product are strictly for qualified personnel who have undergone appropriate training. Any use by unqualified personnel must be carried out under the approval, responsibility, and close monitoring of the latter.

**WARNING**

Failure to follow the instructions may result in damage to the product, the system in which it is installed and, in the worst cases, damage to property or persons with even fatal consequences.

**WARNING**

Failure to comply with the instructions may lead to loss of warranty.

**WARNING**

Keep out of the reach of children.

2.3. Safety warnings

**WARNING**

During installation and use of the product, comply with the general safety regulations, working in a clean, dry environment, free of hazardous substances and using the appropriate accident prevention tools (gloves, helmet, goggles, shoes, and whatever else is necessary).

**WARNING**

The product is suitable for installation in industrial environments. In case of installation in a residential environment, it is recommended to adopt all the safety precautions required by local regulations.

**WARNING**

The unsuitable use of the product, non-original spare parts or tampering with the hardware and/or firmware of the product may lead to serious damage to property or persons in addition to the loss of warranty. The manufacturer waives all liability due to the improper use of its products.

**WARNING**

Before commissioning the product, ensure that the installation is safe and in accordance with local regulations.

**WARNING**

Comply with the provisions to meet EMC requirements.

**WARNING**

Use cables of the appropriate type and cross-section according to the electrical characteristics of the load, the ambient temperature and local regulations.

**WARNING**

Any insulation tests may only be performed in accordance with the manufacturer's instructions. Failure to do so may result in damage to the unit.

**CAUTION**

Electronic boards and components may be damaged by electrostatic discharge. We therefore, recommend to don't touch the components.

**CAUTION**

Take care during installation and electrical connection that no foreign bodies enter into the device.

**DANGER**

During the entire period in which the device is powered, regardless of whether it is operated or remains in stand-by (digital shutdown), high voltage is present inside the device and at the input and output terminals.

**DANGER**

The device, previously in stand-by condition, may suddenly start up following the reset of an alarm or changed system conditions. This may result in serious mechanical and electrical danger to the operator who, upon seeing the device stopped, may have intervened on it, on the load or on the system in which it is installed.

**DANGER**

Disconnect the device from the power supply, check that the load is completely stopped and wait at least 5 minutes before intervening on it or on the load applied to it.

**DANGER**

If the motor is of the permanent magnet type, the device may be energized by the passive rotation of the motor. In this case, both the power supply and the load should be disconnected before working on the device itself.

**DANGER**

Ensure that the device is fully closed and all fixing screws are properly tightened before supplying power. Do not remove the protective parts for any reason while the device is powered on.

**DANGER**

It is recommended to install the appropriate protection devices upstream of the device, such as a circuit breakers, fuses and a residual current device (RCD).

**DANGER**

Make sure that the device and the loads connected to it are properly grounded with the appropriate connection terminals before commissioning.

Ensure that the grounding system is compliant and refer to local regulations for grounding devices.

Each load must be fitted with its own earthing cable, the length of which must be as short as possible. Do not make interconnected grounding connections.

Leakage currents may exceed 3.5 mA. It is recommended to use the reinforced ground connection if necessary.

**CAUTION**

During operation, some surfaces may reach high temperatures that may cause burns upon contact with skin. Be very careful when touching the device!

Avoid contact with flammable products.

**WARNING**

Do not place any interrupting or switching devices between the inverter and the load. Interruption or switching during motor operation may cause serious damage to the device.

**WARNING**

Do not perform insulation tests on the load or power cable without first disconnecting them from the device.

2.4. Acoustic emission

The device has an acoustic emission:

<65 dB at a distance of 1 meter with cooling fans at maximum speed.

2.5. Certifications

The product has the following certifications:

- CE

3. Maintenance

3.1. Maintenance

**WARNING**

Before carrying out any work on the device, carefully read the chapter [Safety \[6\]](#) in the manual.

**WARNING**

Failure to follow the instructions may result in damage to the product, the system in which it is installed and, in the worst cases, damage to property or persons with even fatal consequences.

**WARNING**

Failure to comply with the instructions may lead to loss of warranty.

The device requires the following maintenance:

Intervention	Interval
Check that the unit is properly cooled, that the fans are functioning and that the cooling surfaces are clean	Every 6 months, or following a temperature alarm

Intervention	Interval
Check for alarms	Every 12 months
Check the correct tightening of the power terminals	Every 12 months
Verify the maintenance of the protection rating (ingress of dust or water) by checking the tightening of the screws in the mechanical closing parts, the gaskets, and the cable glands.	Every 12 months

3.2. Warranty

Pentax guarantees that the products accompanied by this warranty are free from material or workmanship defects. The Company has the right to inspect any product returned under warranty, and confirm that the product contains a material or workmanship defect. The Company has the exclusive right to decide whether to repair or replace defective equipment, parts or components. To qualify for the warranty coverage, the buyer must return the product to the place of purchase. Subject to the terms and conditions listed below, the Company agrees to repair or replace any part of this product that has material or workmanship defects. The Company will evaluate products under warranty for 24 months from the date of installation (only in case of product registration) but no longer than 36 months from the date of invoice. IN NO EVENT shall the Company be liable for any other costs incurred by the customer in removing and/or fastening any product, part or component thereof. The Company reserves the right to change or improve its products or any part thereof, without being obliged to provide such a change or improvement for products previously sold. THIS WARRANTY DOES NOT APPLY to products damaged by natural events, including lightning, normal wear and tear, normal maintenance services, or any other condition beyond the control of the Company. THIS WARRANTY WILL BE VOIDED if any of the following conditions occurs:

- The product is used for purposes other than those for which it was designed and manufactured.
- The product has not been installed in accordance with applicable codes and rulings.
- The product has not been installed by qualified personnel.
- The item has been damaged due to negligence, abuse, misapplication, tampering, alteration, improper installation, operation, maintenance and storage.

If the customer wishes to make a warranty claim, it is necessary:

- Fill in the warranty claim
- Wait for the result from the Pentax technical support service. The outcome may envisage the following:
 - Absence of warranty based on the information received. A quotation for repair or spare parts may be made upon request.
 - Warranty advanced based on information received. Pentax will decide if the product is to be replaced under warranty. However, Pentax reserves the right to inspect the product.
 - Need to receive the product by the manufacturer in order to establish the potential warranty. Following the analysis of the returned product, Pentax will establish the unquestionable existence or absence of the warranty conditions by providing a detailed report on the damage found and its origins. If the warranty is applicable, Pentax will repair the device. Pentax is willing to refurbish the product upon offer. In the absence of a warranty, Pentax will make an offer to repair and/or refurbish the device. After 60 days from the offer, if no response is received from the buyer, Pentax will scrap the product upon notice. Pentax does not cover any warranties provided by the buyer to third parties, without its prior authorization.

3.3. Product registration

The warranty is offered through the distribution chain. It is therefore necessary to specify the official distributor or importer from which the product was purchased. Alternatively, the distributor can register the product in the customer's name.

3.4. Spare parts

The manufacturer provides spare parts for the device. Contact your dealer for more information.

**WARNING**

It is recommended to use only original spare parts.

**WARNING**

Failure to follow the instructions may result in damage to the product, the system in which it is installed and, in the worst cases, damage to property or persons with even fatal consequences.

**WARNING**

Failure to comply with the instructions may lead to loss of warranty.

3.5. Disassembly and repair

If it is necessary to disassemble and repair the device, it is recommended that the safety instructions be strictly observed.

**WARNING**

The installation, use and maintenance of the product are strictly for qualified personnel who have undergone appropriate training. Any use by unqualified personnel must be carried out under the approval, responsibility, and close monitoring of the latter.

**WARNING**

Failure to follow the instructions may result in damage to the product, the system in which it is installed and, in the worst cases, damage to property or persons with even fatal consequences.

**WARNING**

Failure to comply with the instructions may lead to loss of warranty.

3.6. Disposal



Devices marked with this symbol cannot be disposed of in household waste but must be disposed of at appropriate waste drop-off centres. It is recommended to contact the Waste Electrical and Electronic Equipment drop-off centres (WEEE) in the area. If not disposed of properly, the product may have potential harmful effects on the environment and on human health due to certain substances present within. Illegal or incorrect disposal of the product is subject to severe administrative and/or criminal penalties.

4. Transport and storage

4.1. Transport

Avoid subjecting the product to severe shocks or extreme weather conditions during transport. The packaging must remain dry and at a temperature between -20°C (-4°F) and +70°C (+158°F). Do not stack packages without first checking feasibility with the manufacturer.

**TIP**

It is advisable to always indicate FRAGILE on the packaging

4.2. Inspection on delivery

Upon receipt of the product, check:

- the integrity of the packaging
- the integrity of the content
- the presence of all components

In case of problems, notify the forwarder immediately.



WARNING

The manufacturer declines all responsibility for damage to the product due to transport

4.3. Handling

The product must be handled by hand or using suitable lifting equipment in relation to its weight and the regulations in force.

If necessary, use dedicated handling equipment (cranes, ropes, trolleys), using the lifting points provided in the product.

During handling it is recommended to:

- Handle with care
- keep away from suspended loads
- always wear accident prevention equipment
- be careful not to damage electrical cables

Do not handle the product using electrical cables as lifting gear.



WARNING

Failure to follow the instructions may result in damage to the product, the system in which it is installed and, in the worst cases, damage to property or persons with even fatal consequences.

4.4. Storage

The product must be stored in its packaging in a dry place, without sudden changes in humidity and temperature and protected from mechanical (weights, vibrations), thermal and chemical agents.

The temperature of the storage environment must be between -20°C (-4°F) and 70°C (+158°F) with a maximum relative humidity of 85% (non-condensing).

If the product remains in stock for more than 24 months from the manufacturing date shown on the packaging, it is necessary to check the mechanical integrity of its parts and supply power to it at least once every 12 months.

If the product is put back into storage after it has been used, it is advisable to contact the manufacturer for further information on storage.

5. Technical features

5.1. Power factor corrector

Devices with single-phase power supply are equipped with an electronic circuit (PFC) which corrects the power factor on the power supply side until it is close to unity.

This content minimizes the input current (up to 30% less than single-phase devices not equipped with PFC) and the heating of the power cables to the benefit of system efficiency.

5.2. Advanced motor controls

Depending on the model, the device is able to control both submersible and surface motors, both single-phase and three-phase of various types.

Motor type	Description	How to recognize it
Three-phase asynchronous	Three-phase asynchronous induction motor. It represents the most common type of three-phase motor.	The motor cable has 3 wires and any control panel does not contain capacitors or starting relays. The motor can be operated via a protection panel or inverter.
Permanent magnet three-phase	Permanent magnet three-phase synchronous motor.	The motor cable has 3 wires and requires inverter control for operation.
Single-phase 2-wire PSC	The PSC (Permanent Split Capacitor) 2-wire single-phase motor is equipped with an integrated capacitor which remains permanently inserted during operation. This motor can only be controlled by devices that are single-phase powered and have PFC.	The motor cable has 2 wires and the motor manufacturer uses PSC technology (check motor make and model).
Single-phase 2-wire split-phase	The single-phase 2-wire split-phase motor is equipped with an internal circuit which interrupts the voltage to the starter winding as soon as the motor has started This engine can only be controlled by: • EPIC-A 109	The motor cable has 2 wires and the motor manufacturer uses split phase technology (check motor make and model).
Single-phase 3-wire PSC	The PSC (Permanent Split Capacitor) 3-wire single-phase motor requires a control panel to operate, inside which there is a capacitor which remains permanently inserted during operation. This motor can only be controlled by devices that are single-phase powered and have PFC.	The motor cable has 3 wires and the control box contains only one capacitor inside.
Single-phase 3-wire CSCR	The CSCR (Capacitor Start / Capacitor Run) 3-wire single-phase motor requires a control panel to operate, which contains a start capacitor which is disconnected by a special relay as soon as the motor has started and by a run capacitor which remains inserted during operation. This motor can only be controlled by devices that are single-phase powered and have PFC.	The motor cable has 3 wires and the control box contains two capacitors and a starter relay inside.
Single-phase 3-wire CSIR	The CSIR (Capacitor Start / Induction Run) 3-wire single-phase motor requires a control panel to function, inside which there is a starting capacitor which is disconnected by a special relay as soon as the motor has started This motor can only be controlled by devices that are single-phase powered and have PFC.	The motor cable has 3 wires and the control box contains a capacitor and a starter relay inside.



WARNING

Before installing the device, it is necessary to know exactly the type of motor, its plate data and the characteristics of the system including the length and section of the motor cable.

The incorrect setting of the type of motor and its electrical parameters can cause damage to the device and the motor itself.

If you are not sure of the type of motor or its plate data, it is advisable not to continue with the installation.

5.3. Name

EPIC-A 306

- **EPIC-A**:Product name
- **3**: Nominal AC supply voltage (**1** =1x230 VAC, **2** = 3x230 VAC, **3** = 3x400 VAC)
- **06** Rated output current

5.4. Technical Data

Electrical specifications by model:

Model	Vin +/- 15% [VAC]	Max V out [VAC]	Max I in [A]	Max I out [A]	Typical motor P2 [kW]	η _{max} [%]	Size
EPIC-A 103	1 x 230	3 x 250	4,5	6 A (1~) 3 A (3~)	0,37 0,55	94,5	1

EPIC-A

Model	Vin +/- 15% [VAC]	Max V out [VAC]	Max I in [A]	Max I out [A]	Typical motor P2 [kW]	η_{max} [%]	Size
EPIC-A 105	1 x 230	3 x 250	7,5	10 A (1~) 5 A (3~)	0,75 1,1	94	1
EPIC-A 107	1 x 230	3 x 250	11	12 A (1~) 7,5 A (3~)	1,1 1,5	94	1
EPIC-A 109	1 x 230	3 x 250	14,5	13,5 A (1~) 9,5 A (3~)	1,5 2,2	94	2
EPIC-A 112	1 x 230	3 x 250	19,5	13,5 A (1~) 12,5 A (3~)	1,5 3	94	2
EPIC-A 118	1 x 230	3 x 250	32	17,5 A (1~) 18,5 A (3~)	2,2 4	94	2
EPIC-A 204	3 x 230	3 x Vin	3,7	4	0,75	96	1
EPIC-A 206	3 x 230	3 x Vin	5,4	6	1,1	96	1
EPIC-A 209	3 x 230	3 x Vin	8	9	2,2	96	1
EPIC-A 214	3 x 230	3 x Vin	13,5	14	3	97	2
EPIC-A 218	3 x 230	3 x Vin	17,5	18	4	97	2
EPIC-A 225	3 x 230	3 x Vin	24	25	5,5	97	2
EPIC-A 230	3 x 230	3 x Vin	29	30	7,5	97	2
EPIC-A 238	3 x 230	3 x Vin	42	38	9,2	97	2
EPIC-A 244	3 x 230	3 x Vin	42	44	11	97	2
EPIC-A 304	3 x 380 - 460	3 x Vin	3,7	4	1,1	96	1
EPIC-A 306	3 x 380 - 460	3 x Vin	5,4	6	2,2	96	1
EPIC-A 309	3 x 380 - 460	3 x Vin	8	9	4	96	1
EPIC-A 314	3 x 380 - 460	3 x Vin	13,5	14	5,5	97	2
EPIC-A 318	3 x 380 - 460	3 x Vin	17,5	18	7,5	97	2
EPIC-A 325	3 x 380 - 460	3 x Vin	24	25	11	97	2
EPIC-A 330	3 x 380 - 460	3 x Vin	29	30	15	97	2
EPIC-A 338	3 x 380 - 460	3 x Vin	36	38	18,5	97	2
EPIC-A 344	3 x 380 - 460	3 x Vin	42	44	22	97	2

General electrical specifications:

Power supply frequency	50 - 60 Hz (+/- 2%)
Voltage unbalance between the power supply phases	+/- 2%
Maximum output frequency	300 Hz
EMC compliance	EN61800-3 C1 for single-phase models, C2 for three-phase models
Energy efficiency class (according to EN61800-9-2)	IE2

Environmental specifications:

Relative humidity of the operating environment	5 - 95 % non-condensing
Workplace temperature	from -10 °C (14 °F) to 60 °C (140 °F)
Maximum workplace temperature at nominal load	40 °C (104 °F)
Power derating beyond maximum temperature	-2.5% every °C (-1.4% every °F)
Maximum altitude at nominal load	1000 m (3280 ft)
Power derating beyond maximum altitude	- 1% every 100 m (328 ft)

Mechanical specifications:

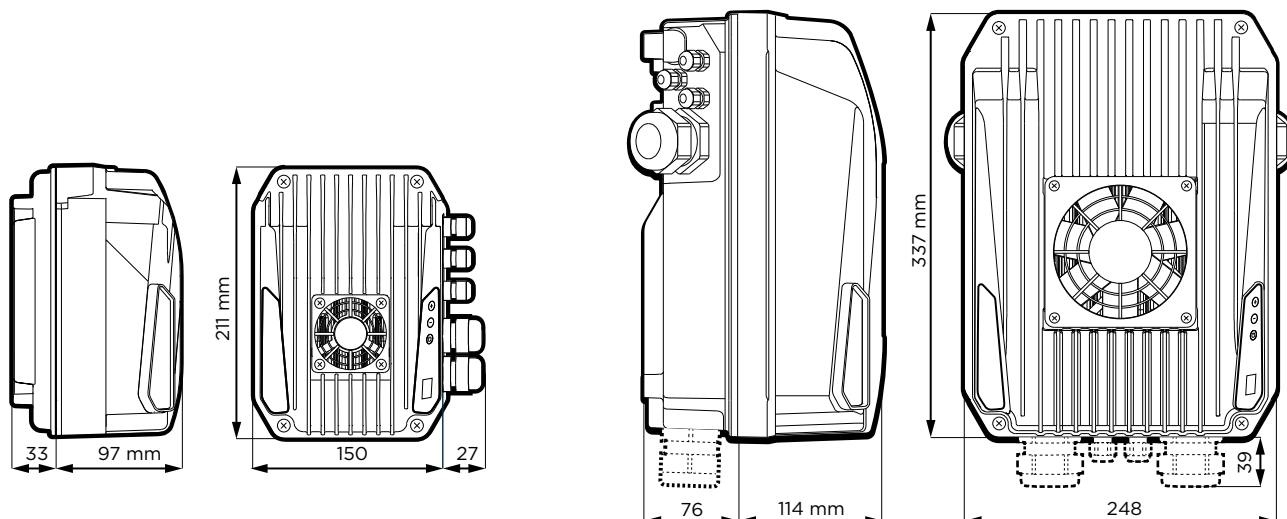
Protection rating	IP66 (NEMA 4X)
Resistance to vibrations	EN60068-2-6:2008, EN60068-2-27:2009, EN60068-2-64:2008,



WARNING

Protect the device from direct exposure to weather and sunlight.

5.5. Dimensions and weight



Size	Maximum weight [kg]
1	2,5 kg (5,5 lb)
2	10 kg (22 lb)

5.6. Cables entry

Cable gland	Tightening torque [Nm]	Cable diameter [mm]	Size		
			1	2	2
					EPIC-A 109 , 112 , 118 , 238 , 244
M12	1,5	3,5-7	3	6	6
M16	3	5-10	-	2	2
M20	6	7-13	2	-	-
M25	8	10-17	-	2	-
M40	13	19 -28	-	-	2

6. Mechanical installation



WARNING

Read the safety chapter carefully before continuing.

6.1. Installation environment



WARNING

The environmental specifications stated in the technical data of the product must be strictly complied with.



WARNING

Do not install the device in environments at a risk of explosion, flooding, or in the presence of flammable fluids or solids. Ensure sufficient ventilation in the room.

Refer to local regulations when selecting the appropriate installation location.

**WARNING**

The degree of protection of the device is only ensured if, at the end of the installation, the cover screws and the cable glands have been properly tightened. Close the holes of unused cable glands with the appropriate plugs.

Protect the device from direct exposure to weather and sunlight.

Do not leave the device installed without cover or with the cable glands open, even if not connected to the power supply. The infiltration of dust, water or humidity may irreparably damage the device.

**WARNING**

To ensure uninterrupted operation, the device can gradually and automatically reduce performance before shutting down following over-temperature. However, prolonged operation above the rated temperature leads to a reduction in the life of the device.

6.2. Cooling

The device is cooled primarily by forced air circulation through the heat sink element.

In addition to the heat sink, the device also uses the remaining surfaces to cool itself. It is therefore necessary to ensure sufficient space around the device during installation.

In particular, the distance between the suction and discharge side of the heat sink and the other surfaces must be at least:

- 150 mm (5,9") for current intensity up to 18 A
- 200 mm (7,9") for current intensity up to 30 A
- 250 mm (9,8") for current intensity up to 44 A

On the other sides, maintain a minimum distance of 100 mm (3,9") to ensure cooling and to make installation and maintenance operations easier.



During operation, the surfaces of the device can become hot enough to cause burns. Do not touch them.

In the case of installation inside electric cabinet, it is necessary to guarantee the appropriate air flow for the heat dissipation of all the components. The heat released by the device may be calculated from its conversion efficiency.

**WARNING**

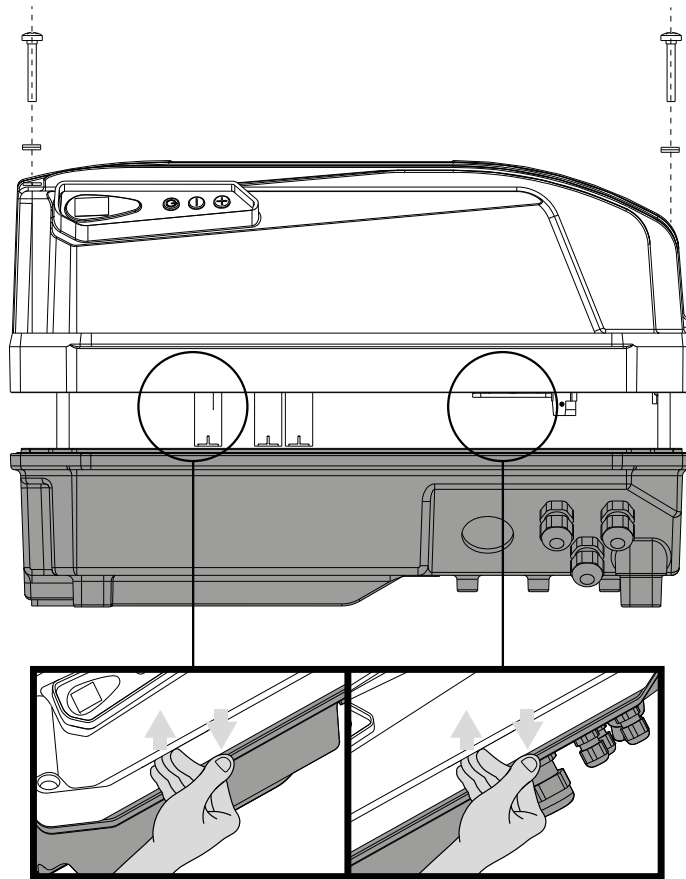
Do not place any heat-generating elements (outlet filters) on the suction side of the device to prevent dangerous overheating.

6.3. Mechanical assembly of size 2 devices

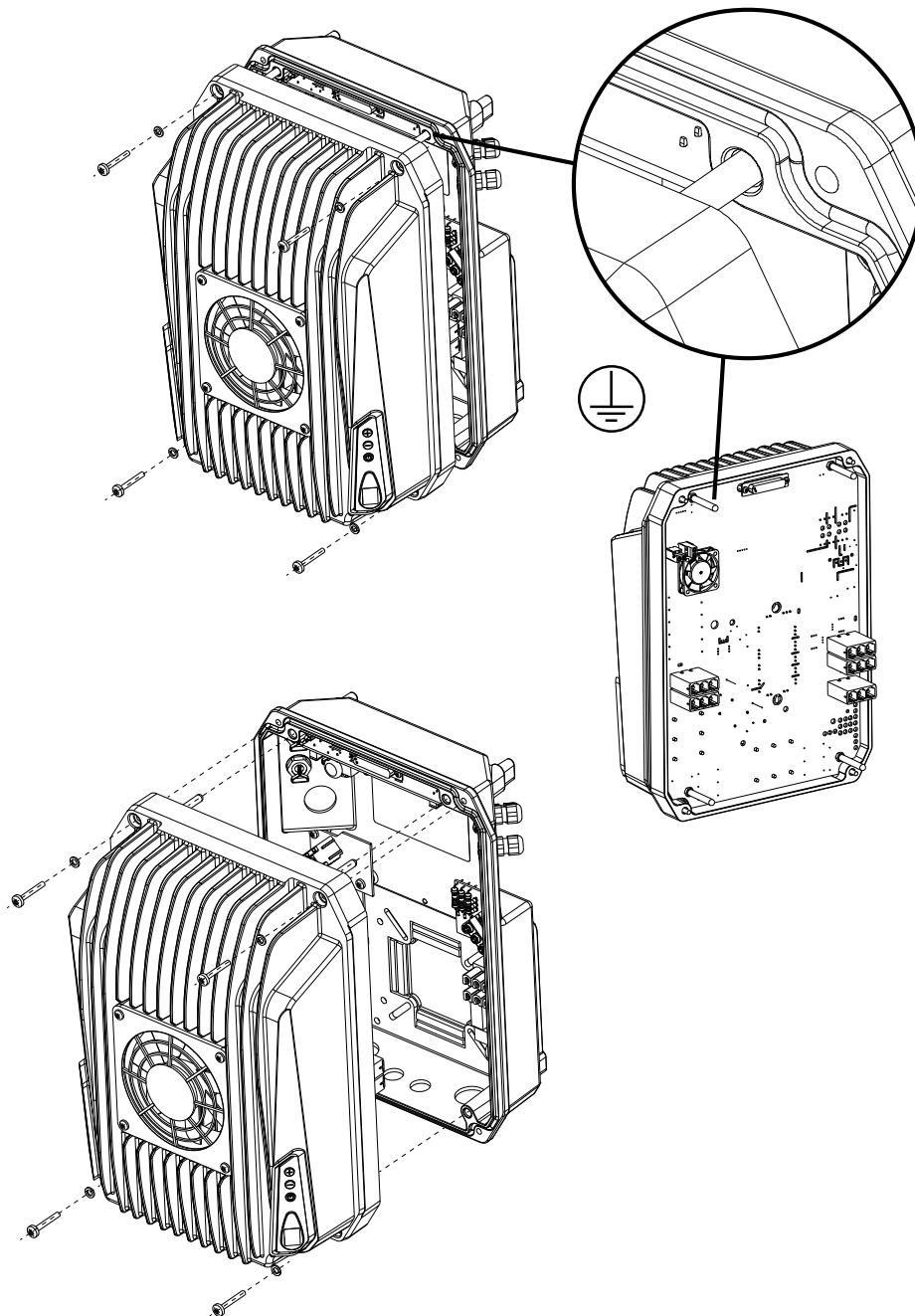
The size 2 devices are equipped with a quick connection system that allows carrying out both power and signal electrical connections on the fixed part, called "base", while the mobile part, called "power", is applied later.

This allows working smoothly during electrical connections without running the risk of damaging the power part. It also facilitates quick power replacement in case of failure without the need to remove connections.

To open the device, please follow the instructions shown in the figure and proceed with caution.



In size 2 devices, the ground connection between the base and the power is made by means of four metal pins on the power side that engage into four special holes on the base with spring contacts. At the same time, these metal pins serve as a guide for a correct coupling between the base and the heat sink.

**DANGER**

Be careful not to damage or remove the four metal pins, as this will not only compromise the mechanical coupling between the base and the power, but also the ground connection.

6.4. Assembly on-board the motor

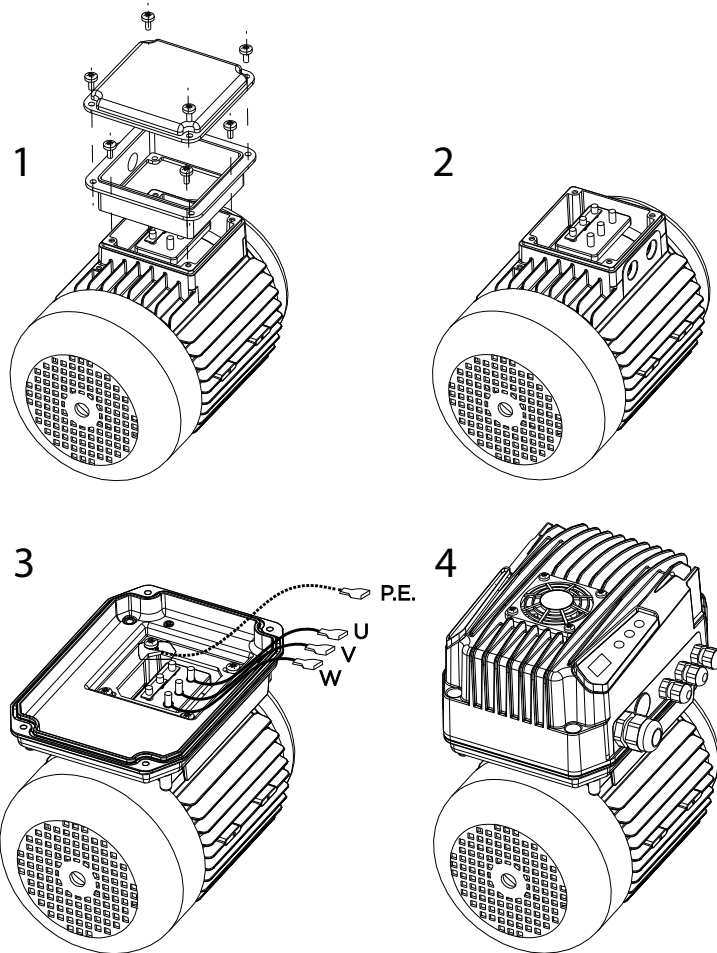
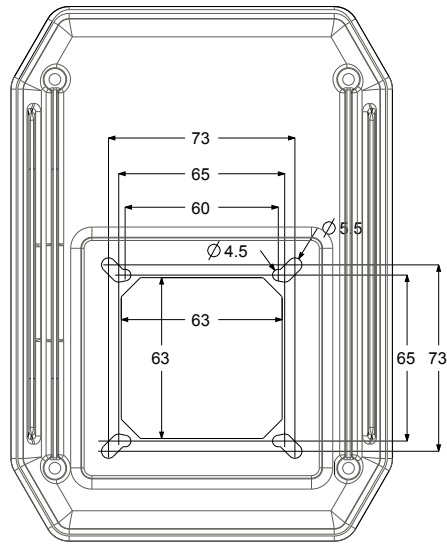
The device may be installed in place of the motor terminal box cover both horizontally and vertically. It is necessary to check with the motor manufacturer whether the base of the device can be fastened to the motor casing.

The seal on the base of the device provides protection against the ingress of water and dust. Drill the seal only in the area where the four holes for fastening to the motor casing are. It is possible to use the same screws and washers with which the terminal box cover was fastened to the motor casing. Please refer to the following instructions when fastening the device to the motor.

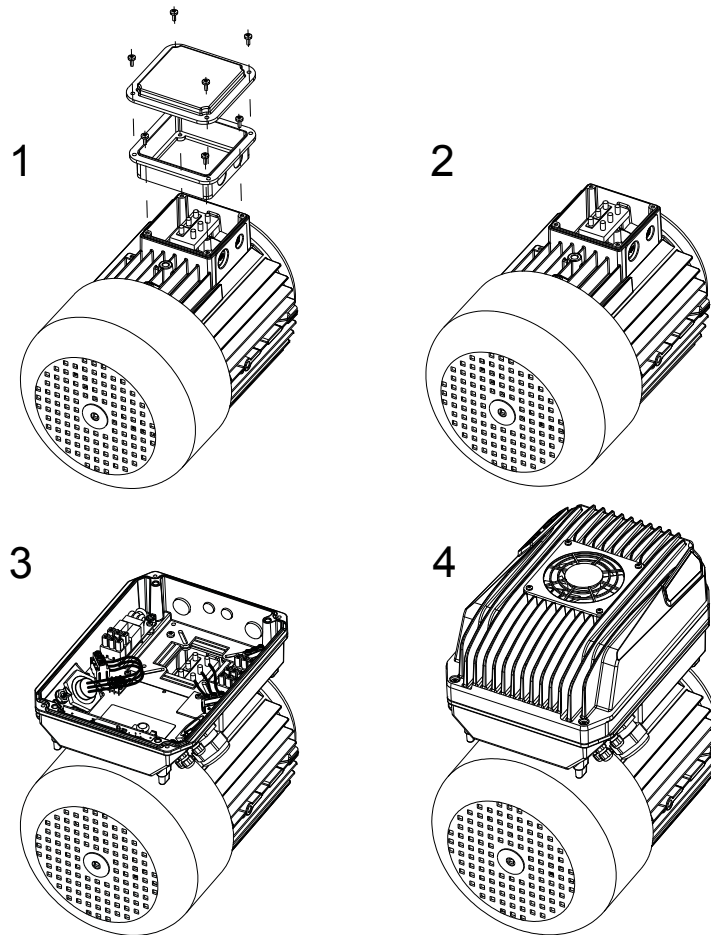
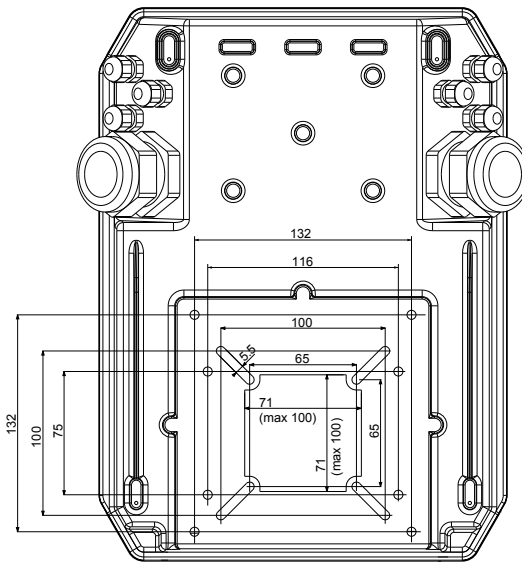
**DANGER**

At the end of the installation, check the ground continuity between the base of the device and the motor casing.

On-board motor installation for size 1 devices



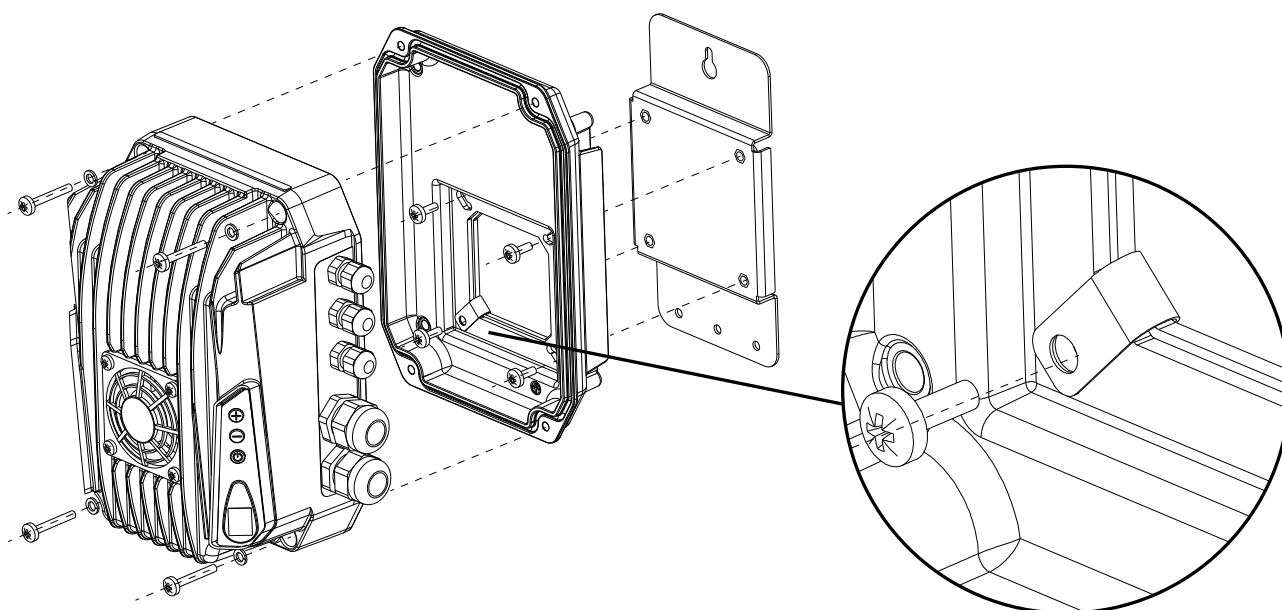
On-board motor installation for size 2 devices



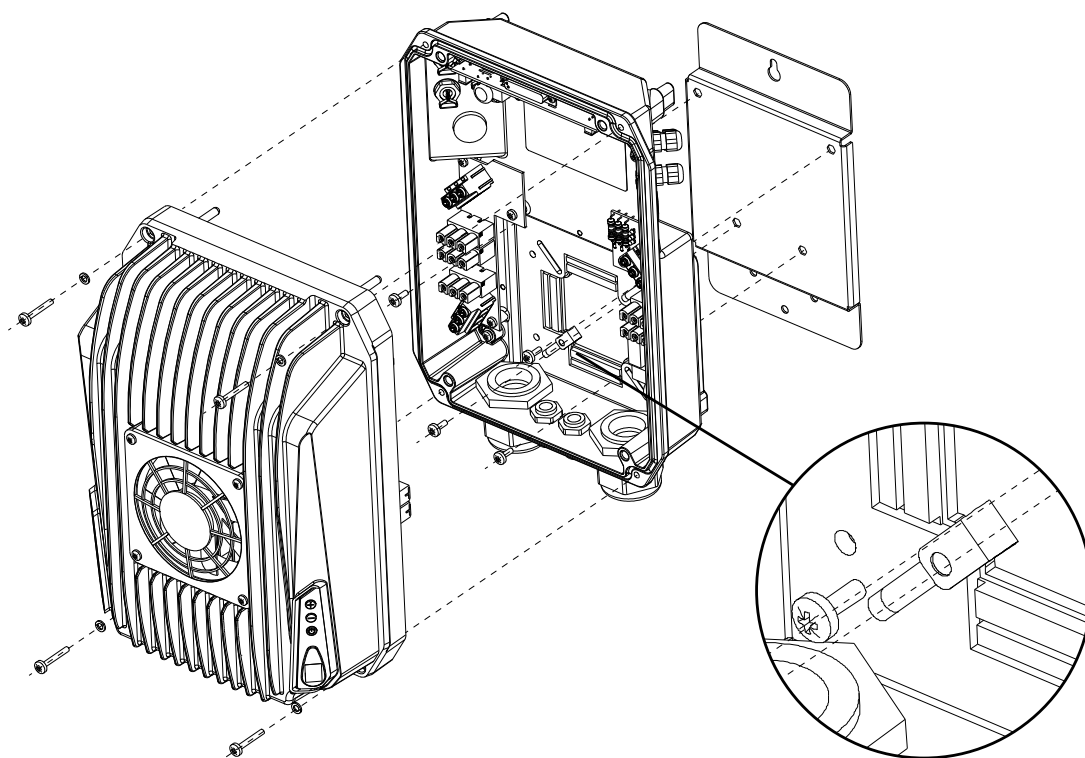
6.5. Wall installation

Wall installation is carried out by means of the special metal bracket available on request.

Wall installation for size 1 devices



Wall installation for size 2 devices



DANGER

The ground continuity between the base of the device and the bracket is ensured by the special component shown in the figure. Install this component and verify the ground continuity between the bracket and the base of the device at the end of the installation.

Alternatively, it is possible to drill the aluminum base in the area where the four special fixing holes are. The fixing screws must be equipped with O-rings to guarantee the protection rating.

7. Electrical installation



WARNING

Read the safety chapter carefully before continuing.

7.1. Grounding



DANGER

Make sure that the device and the loads connected to it are properly grounded with the appropriate connection terminals before commissioning.

Ensure that the grounding system is compliant and refer to local regulations for grounding devices.

Each load must be fitted with its own earthing cable, the length of which must be as short as possible. Do not make interconnected grounding connections.

Leakage currents may exceed 3.5 mA. It is recommended to use the reinforced ground connection if necessary.

Use the following minimum cross-sections for ground cables:

- cross-section equal to the mains power cable cross-section up to 16 mm². (6 AWG)
- 16 mm² (6 AWG) for mains power cable cross-section between 16 mm² (6 AWG) and 35 mm² (1 AWG).
- cross-section equal to half the cross-section of the power supply cable when the latter is greater than 35 mm² (1 AWG).

7.2. Protection devices



DANGER

It is recommended to install the appropriate protection devices upstream of the device, such as circuit breakers, fuses and a residual current device (RCD).

Fuses and switches.

The control device can protect the motor from overloads by digitally controlling the absorbed current against the set rated current.

It is therefore not necessary to install any overload protection device between the inverter and the motor.




Instead, it is necessary to install overcurrent and short-circuit protection devices, such as fuses and circuit breakers, upstream of the device. These trigger in the event of failure of a component inside the device.

Supply voltage	Model	Recommended fuse gC	Recommended circuit breaker ABB MCB S200
1 x 230 VAC	EPIC-A 103	10	S201-C10
1 x 230 VAC	EPIC-A 105	10	S201-C10
1 x 230 VAC	EPIC-A 107	16	S201-C16
1 x 230 VAC	EPIC-A 109	20	S201-C20
1 x 230 VAC	EPIC-A 112	25	S201-C25
1 x 230 VAC	EPIC-A 118	40	S201-C40
3 x 230 VAC	EPIC-A 204	10	S203-C10
3 x 230 VAC	EPIC-A 206	10	S203-C10
3 x 230 VAC	EPIC-A 209	16	S203-C16
3 x 230 VAC	EPIC-A 214	20	S203-C20
3 x 230 VAC	EPIC-A 218	25	S203-C25
3 x 230 VAC	EPIC-A 225	30	S203-C32
3 x 230 VAC	EPIC-A 230	35	S203-C40
3 x 230 VAC	EPIC-A 238	50	S203-C50
3 x 230 VAC	EPIC-A 244	63	S203-C63
3 x 380 - 460 VAC	EPIC-A 304	10	S203-C10
3 x 380 - 460 VAC	EPIC-A 306	10	S203-C10

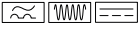
Supply voltage	Model	Recommended fuse gC	Recommended circuit breaker ABB MCB S200
3 x 380 - 460 VAC	EPIC-A 309	16	S203-C16
3 x 380 - 460 VAC	EPIC-A 314	20	S203-C20
3 x 380 - 460 VAC	EPIC-A 318	25	S203-C25
3 x 380 - 460 VAC	EPIC-A 325	30	S203-C32
3 x 380 - 460 VAC	EPIC-A 330	35	S203-C40
3 x 380 - 460 VAC	EPIC-A 338	50	S203-C50
3 x 380 - 460 VAC	EPIC-A 344	63	S203-C63

Residual Current Devices (RCD)

For inverter devices with single-phase power supply, use AC-sensitive RCD devices of both sine and pulse types. The devices listed are, in order of priority:

- type F, marked with the symbols  capable of detecting high-frequency currents up to 1 kHz.
- type A-APR, marked with the symbols  characterized by a slight intervention delay.
- type A, marked with the symbols 

For inverter devices with three-phase power supply, use RCD devices that are sensitive to both alternating and direct current. The following are suitable devices:

- Type B, marked with the symbols 

7.3. Connecting cables



WARNING

The connecting cables must comply with local regulations, feature the appropriate cross-section, and meet the requirements for voltage, current, and temperature.

7.3.1. Power cables

Model	Maximum cross-section of the input cable with ground	Maximum cross-section of the output cable with ground	Cable tightening torque [Nm]	Ground cable tightening torque [Nm]
EPIC-A 103	3 x 2,5 mm ²	4 x 2,5 mm ²	-	-
EPIC-A 105	3 x 2,5 mm ²	4 x 2,5 mm ²	-	-
EPIC-A 107	3 x 2,5 mm ²	4 x 2,5 mm ²	-	-
EPIC-A 109	3 x 16 mm ²	4 x 16 mm ²	1,5	3
EPIC-A 112	3 x 16 mm ²	4 x 16 mm ²	1,5	3
EPIC-A 118	3 x 16 mm ²	4 x 16 mm ²	1,5	3
EPIC-A 204	4 x 2,5 mm ²	4 x 2,5 mm ²	-	-
EPIC-A 206	4 x 2,5 mm ²	4 x 2,5 mm ²	-	-
EPIC-A 209	4 x 2,5 mm ²	4 x 2,5 mm ²	-	-
EPIC-A 214	4 x 6 mm ²	4 x 6 mm ²	1	3
EPIC-A 218	4 x 6 mm ²	4 x 6 mm ²	1	3
EPIC-A 225	4 x 6 mm ²	4 x 6 mm ²	1,5	3
EPIC-A 230	4 x 6 mm ²	4 x 6 mm ²	1,5	3
EPIC-A 238	4 x 16 mm ²	4 x 16 mm ²	1,5	3
EPIC-A 244	4 x 16 mm ²	4 x 16 mm ²	1,5	3
EPIC-A 304	4 x 2,5 mm ²	4 x 2,5 mm ²	-	-
EPIC-A 306	4 x 2,5 mm ²	4 x 2,5 mm ²	-	-
EPIC-A 309	4 x 2,5 mm ²	4 x 2,5 mm ²	-	-
EPIC-A 314	4 x 6 mm ²	4 x 6 mm ²	1	3
EPIC-A 318	4 x 6 mm ²	4 x 6 mm ²	1	3
EPIC-A 325	4 x 6 mm ²	4 x 6 mm ²	1,5	3
EPIC-A 330	4 x 6 mm ²	4 x 6 mm ²	1,5	3
EPIC-A 338	4 x 16 mm ²	4 x 16 mm ²	1,5	3

Model	Maximum cross-section of the input cable with ground	Maximum cross-section of the output cable with ground	Cable tightening torque [Nm]	Ground cable tightening torque [Nm]
EPIC-A 344	4 x 16 mm ²	4 x 16 mm ²	1,5	3



WARNING

Use unshielded cables for input cables and shielded cables for output cables.



WARNING

Always use cables with appropriate cable lugs, which may be supplied with the product.



WARNING

For motor cable lengths greater than 5 meters, the use of special output filters, available on request, is recommended.

7.3.2. Control cables

Model	Maximum cross-section of the control cables	Tightening torque [Nm]
Control terminals of all models	1 mm ² (16 AWG)	0,5 Nm (0,37 ftlbs)



WARNING

Use shielded cable for control cables.



WARNING

Always use cables with appropriate cable lugs, which may be supplied with the product.

7.4. Electromagnetic Compatibility (EMC)

The device meets the requirements of electromagnetic compatibility according to the EN61800-3 standard. However, to ensure the electromagnetic compatibility of the system in which it is installed, it is necessary:

- use ground connection cables that are as short as possible.
- use motor cables that are as short as possible and shielded, with the shield connected at both ends.
- use shielded signal cables with the shield connected at one end only.



WARNING

Install signal, motor, and power cables separately from each other at a distance of at least 30 cm (1,18"). If the signal cables meet the power cables, cross them perpendicularly.

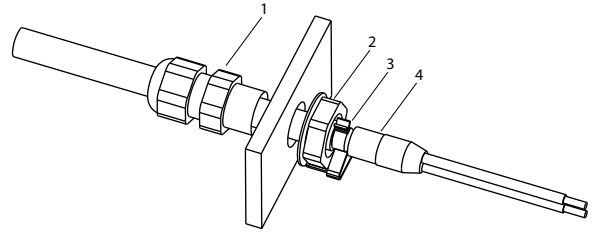
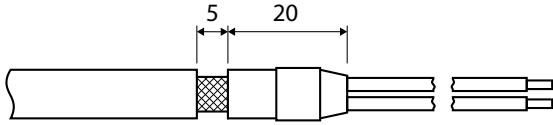


WARNING

It is possible to remove the connection of the filter capacitors Cy to the ground by removing the screws marked with the EMC symbol. In this way, the ground leakage currents caused by the filter are reduced, but the intrinsic EMC compatibility of the device is no longer valid and must therefore be guaranteed externally in another way.

EMC clip for cable glands

To ensure correct grounding of the shield when using shielded cables, it is recommended to use the appropriate EMC clips as shown below.

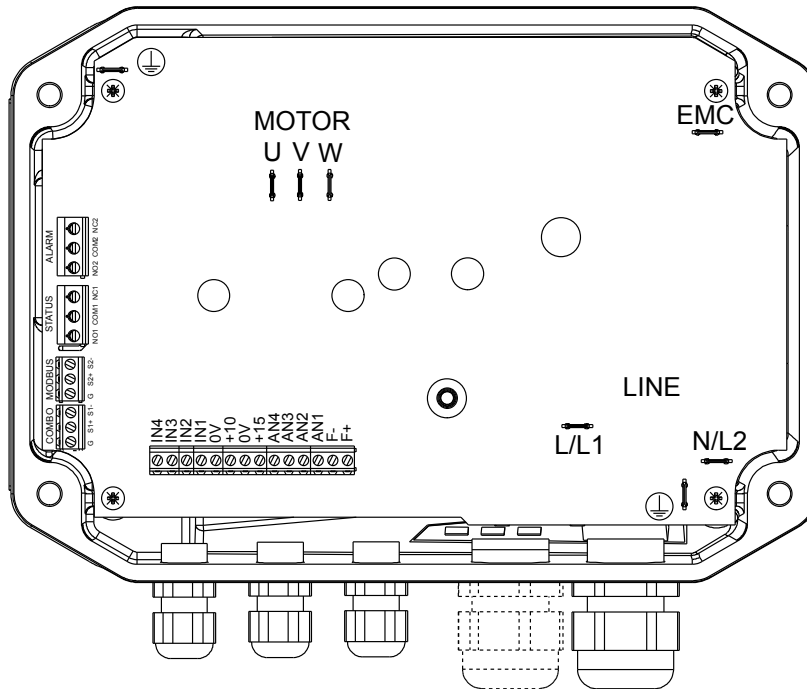


1: Cable gland; 2: Lock nut; 3: EMC clip; 4: Shielded cable

7.5. Electrical connections

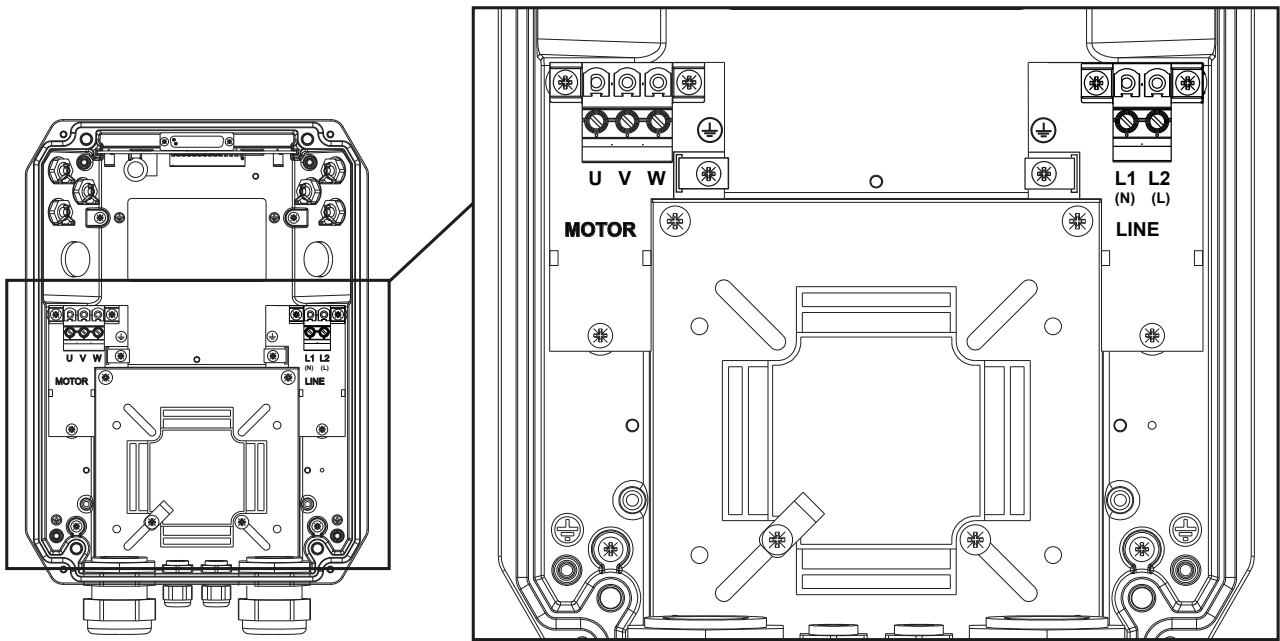
7.5.1. Power connections

EPIC-A 103 , 105 , 107



		A [mm]	Pre-insulated cable lug	Stripping diagram
Power Supply LINE	L1/L	70	6.3 x 0.8 mm female Faston	
	L2/N	70	6.3 x 0.8 mm female Faston	
	P.E. ⊕	70	6.3 x 0.8 mm female Faston	
Motor MOTOR	U	120 (200)	6.3 x 0.8 mm female Faston	Wall installation
	V	120 (200)	6.3 x 0.8 mm female Faston	
	W	120 (200)	6.3 x 0.8 mm female Faston	
	P.E. ⊕	180 (200)	6.3 x 0.8 mm female Faston	Installation on board the engine

EPIC-A 109 , 112 , 118



		A [mm]	Pre-insulated cable lug	Stripping diagram
Power Supply LINE	L1/L	180	Tip	
	L2/N	180	Tip	
	P.E. ⊕	180	Fork for M4 screw	
Motor MOTOR	U	180	Tip	
	V	180	Tip	
	W	180	Tip	
	P.E. ⊕	180	Fork for M4 screw	

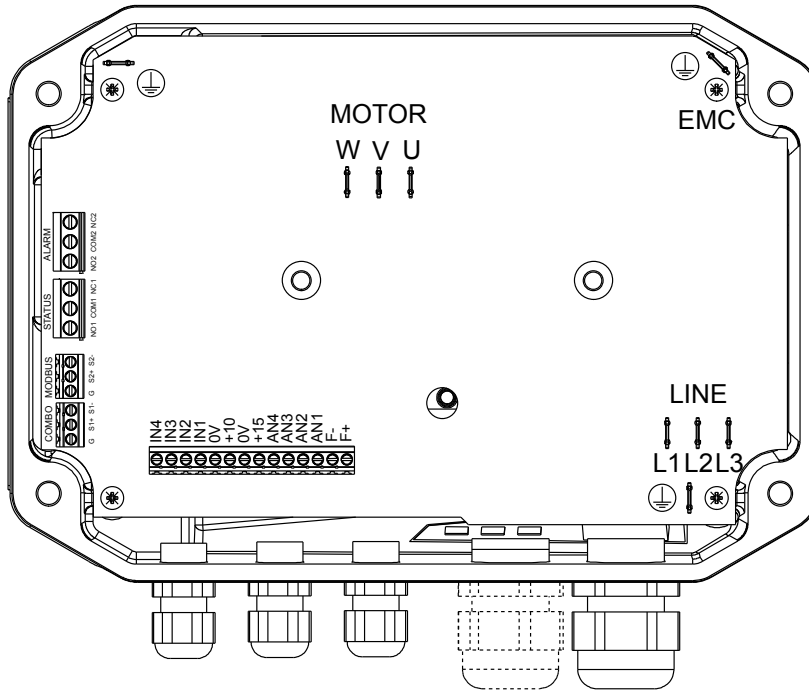
MOTOR TYPE	MOTOR TERMINALS		
3 phase	U	V	W
1 phase, 3 wire	MAIN (RUN)	COM	AUX (START)
1 phase, 3 wire USA	BLACK	YELLOW	RED
1 phase, 3 wire AUSTRALIA	BLUE	RED	WHITE
1 phase, 3 wire EUROPE	BLUE / GREY	BROWN	BLACK
1 phase, 3 wire PSC	BLUE / GREY	BLACK	BROWN
1 phase, 2 wire	BLACK	BLACK	-



WARNING

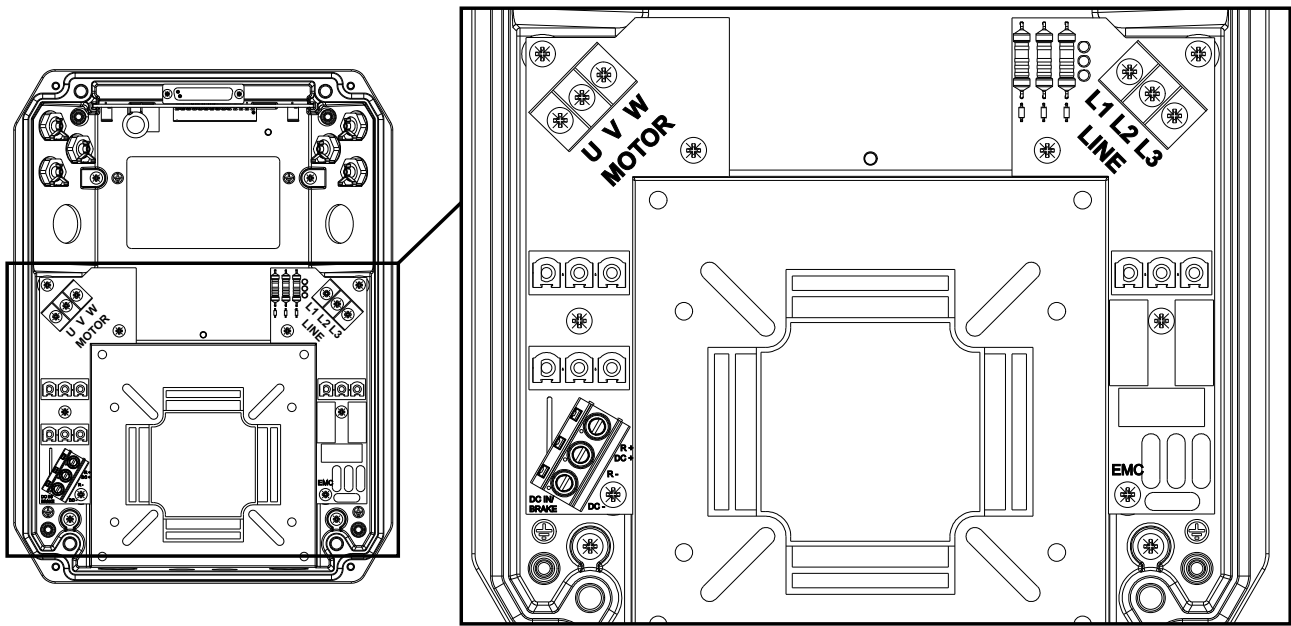
Pay close attention to the correct connection of the motor cables based on the type of motor to be controlled. Incorrect connection can cause damage to the motor.

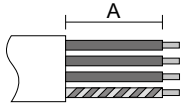
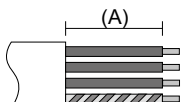
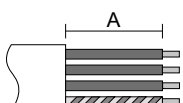
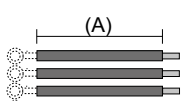
EPIC-A 204, 206, 209, 304, 306, 309



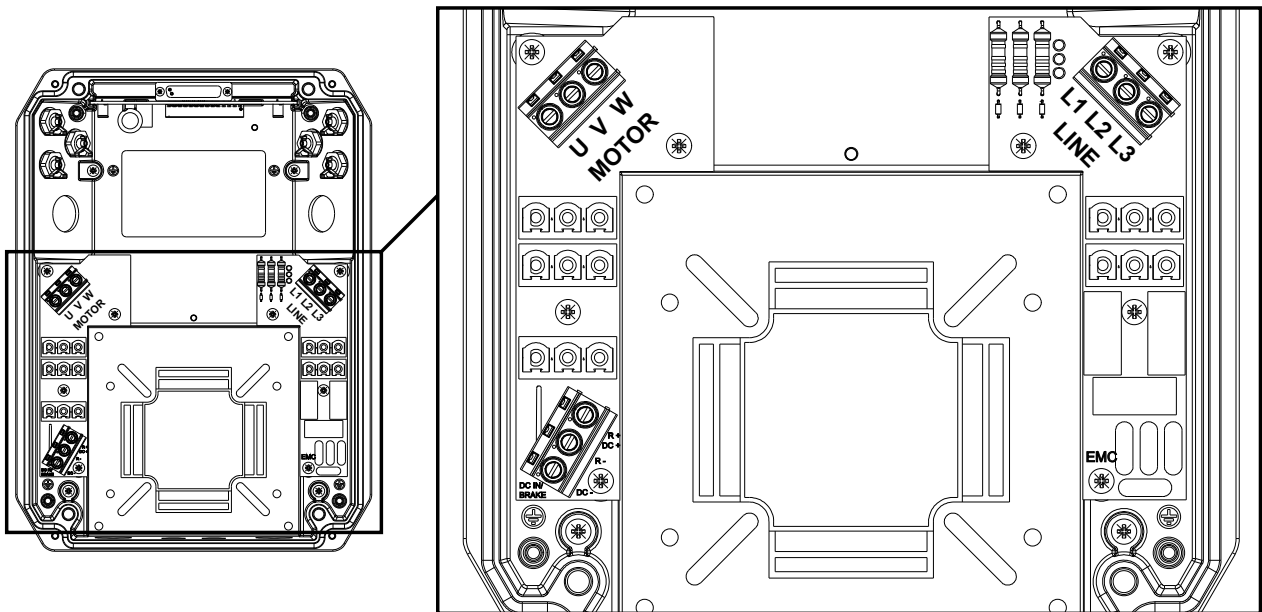
		A [mm]	Pre-insulated cable lug	Stripping diagram
Power Supply LINE	L1	70	6.3 x 0.8 mm female Faston	
	L2	70	6.3 x 0.8 mm female Faston	
	L3	70	6.3 x 0.8 mm female Faston	
	P.E. ⊕	70	6.3 x 0.8 mm female Faston	
Motor MOTOR	U	120 (200)	6.3 x 0.8 mm female Faston	Wall installation
	V	120 (200)	6.3 x 0.8 mm female Faston	
	W	120 (200)	6.3 x 0.8 mm female Faston	
	P.E. ⊕	180 (200)	6.3 x 0.8 mm female Faston	Installation on board the engine

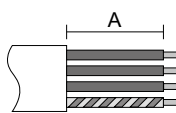
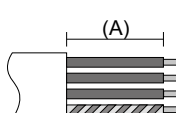
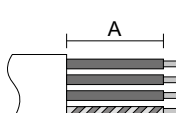
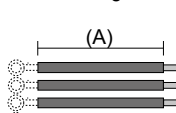
EPIC-A 214 , 218 , 314 , 318



		A [mm]	Pre-insulated cable lug	Stripping diagram
Power Supply LINE	L1	180 (120)	Fork for M4 screw	Wall installation (through lower cable glands) 
	L2	180 (120)	Fork for M4 screw	
	L3	180 (120)	Fork for M4 screw	
	P.E. ⊕	180 (120)	Eyelet for M4 screw	Installation on motor (through lateral cable glands) 
Motor MOTOR	U	180 (180)	Fork for M4 screw	Wall installation 
	V	180 (180)	Fork for M4 screw	
	W	180 (180)	Fork for M4 screw	
	P.E. ⊕	180 (180)	Eyelet for M4 screw	Installation on board the engine 

EPIC-A 225 , 230 , 238 , 244 , 325 , 330 , 338 , 344



		A [mm]	Pre-insulated cable lug	Stripping diagram
Power Supply LINE	L1	180 (120)	Tip	Wall installation (through lower cable glands) 
	L2	180 (120)	Tip	
	L3	180 (120)	Tip	
	P.E. ⊕	180 (120)	Eyelet for M4 screw	Installation on motor (through lateral cable glands) 
Motor MOTOR	U	180 (180)	Tip	Wall installation 
	V	180 (180)	Tip	
	W	180 (180)	Tip	
	P.E. ⊕	180 (180)	Eyelet for M4 screw	Installation on board the engine 

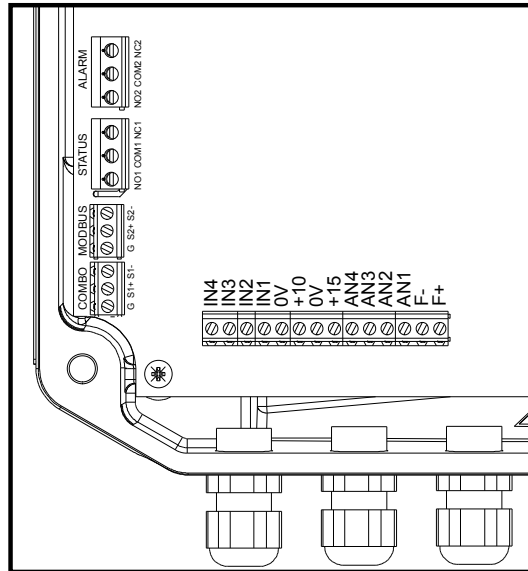


DANGER

In size 2 devices, the DL1, DL2, DL3 LEDs next to the power supply terminal block indicate the presence of voltage in the input phases. Do not touch the device and its components for any reason if one or more LEDs are on.

7.5.2. Control connections

Control connections for size 1 devices



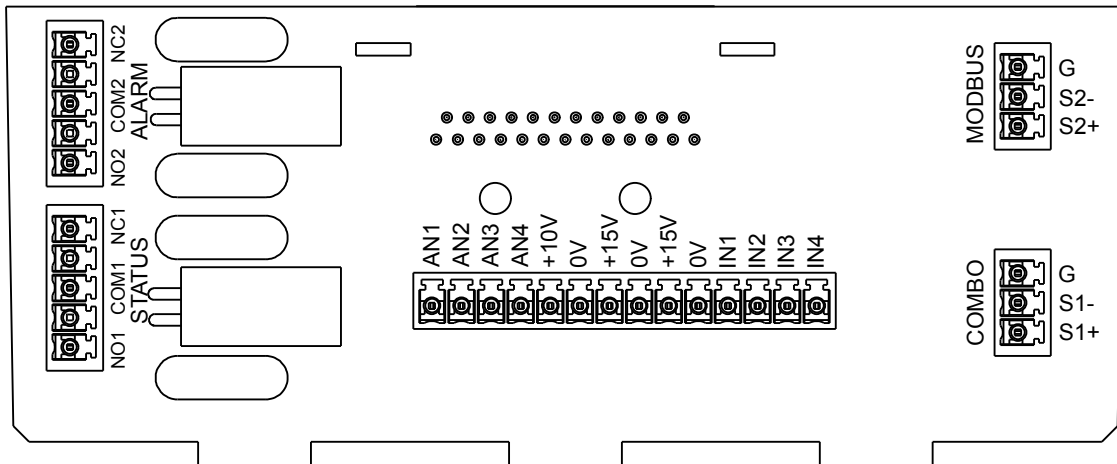
DANGER

The access of the signal (control) cables in the size 1 devices is allowed only through the three M12 cable glands as they are positioned in the SELV isolated area of the device delimited by the dotted line shown on the printed circuit.

The access of the signal cables through the two M20 cable glands, positioned in the non-insulated POWER area, exposes them to the risk of contact with live parts, compromising the user's safety and causing possible damage to the device.

If it is therefore necessary to access the signal cables through one of the M20 cable glands, it is the installer's responsibility to ensure reinforced insulation (double insulation) of the signal cables at least up to the dotted SELV insulated area.

Control connections for size 2 devices



Type		Description	Functionality	Comments
Analog inputs	AN1	4-20 mA	Sensor 1	-
	AN2	4-20 mA	Sensor 2	-
	AN3	0-10 V	External set value	
	AN4	0-10 V	External frequency	
Power Supply	+15V	15 VDC, max 100 mA	Power supply for 4-20 mA analog inputs	Do not use as a power supply for the digital inputs!

Type		Description	Functionality	Comments
Power Supply	+10V	10 VDC, max 3 mA	Power supply for 0-10 V analog inputs	Do not use as a power supply for the digital inputs!
Signal GND	0V	Insulated	Signal GND for analog and digital inputs	-
Digital inputs	IN1	Active low	Motor start and stop	Programmable as Normally Open or Normally Closed.
	IN2	Active low	Motor start and stop Switching of set value 1 and 2 Switching of work frequency 1 and 2	Programmable as Normally Open or Normally Closed.
	IN3	Active low	Motor start and stop Switching of sensors 1 and 2	Programmable as Normally Open or Normally Closed.
	IN4	Active low	Alarms reset Motor start and stop Switch between main and auxiliary control modes	Programmable as Normally Open or Normally Closed.
Relay outputs	NO1	Normally Open	STATUS relay NO1, COM1: closed contact with motor running. NC1, COM1: closed contact with motor stopped.	Potential-free contacts
	COM1	Common		Max 250 VAC, 2 A
	NC1	Normally Closed		Max 30 VDC, 2 A
Relay outputs	NO2	Normally Open	ALARM relay NO2, COM2: closed contact without alarm. NC2, COM2: closed contact with alarm or without power supply.	Potential-free contacts
	COM2	Common		Max 250 VAC, 2 A
	NC2	Normally Closed		Max 30 VDC, 2 A
RS485 serial port	S1+	Positive	Communication	-
	S1-	Negative	COMBO	-
	G	Serial GND		The serial GND is isolated from the signal GND
RS485 serial port	S2+	Positive	Communication	-
	S2-	Negative	MODBUS RTU BACnet (if available)	-
	G	Serial GND		The serial GND is isolated from the signal GND

7.6. Output filter board (accessory for size 2 devices)

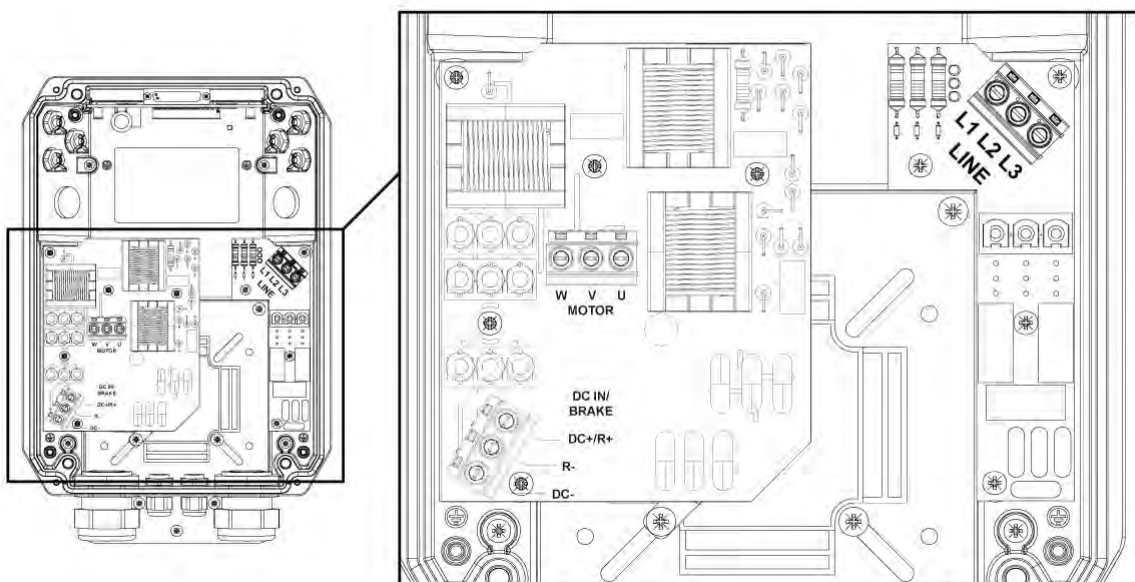
In the presence of motor cables longer than 5 meters, to reduce the dangerous overvoltages generated in the motor windings and improve the EMC performance of the system, it is possible to install the special filter board on board the inverter as an alternative to using filters external.

To install the filter card, simply remove the motor output card from the base and apply the filter card using the appropriate screws.



WARNING

When using the filter tab, it is recommended to set the parameter PWM at 2.5 kHz and keep the length of the motor cable within 150 m.



8. Commissioning

8.1. Preliminary checks

Before supplying power to the device, carry out the following electrical and mechanical checks:

- Check that the device complies with the motor control according to its data plate.
- Verify proper grounding of the device, of the load, and of the entire system.
- Check the correct connection of the power supply cable and the motor cable, paying particular attention to any connection reversal.
- Check the correct connection of the power and signal cables, paying particular attention to any polarity.
- Check that the connection terminals of the power and signal cables are correctly tightened.
- Check the implementation of electromagnetic compatibility (EMC) regulations and the correct connection of cable shields.
- Check that the protective devices are present and correctly installed.
- Check that the mechanical installation is correct, sturdy and complies with environmental and cooling requirements.
- Check that the seals are intact and correctly positioned in their seats.
- Check that the cable glands and screws are properly tightened.
- Check that the device is completely closed and that live parts are not accessible.

8.2. Powering



DANGER

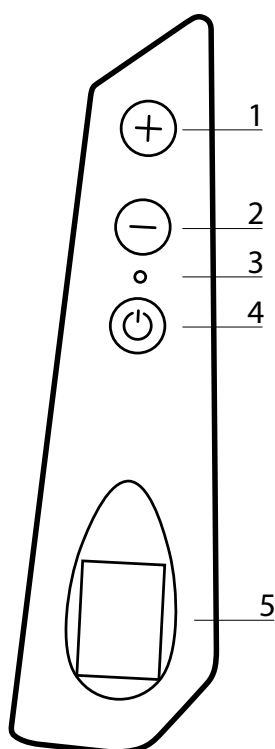
Before supplying power to the device, make sure you have read, understood and implemented all the safety, mechanical, and electrical installation instructions.

At the end, it shall be possible to:

- power up the device.
- verify the correct switching on and the absence of alarm messages.
- perform programming.
- start the motor.

9. Use and programming

9.1. Keyboard and display



WARNING

Protect the keyboard and display from shocks. Press with fingers only on the keys and never on the display. Excessive pressure on the display and surrounding area can lead to damage.

1. +: parameter scrolling / parameter editing
Use the + key to increase the set value or frequency. In order to allow the set value to be edited, it is necessary to hold down the + or - button for more than 5 seconds until the set value to be edited starts flashing. To confirm the set value, simply wait 5 seconds or press the START/STOP button.
2. -: parameter scrolling / parameter editing
Use the - key to decrease the set value or frequency. In order to allow the set value to be edited, it is necessary to hold down the + or - button for more than 5 seconds until the set value to be edited starts flashing. To confirm the set value, simply wait 5 seconds or press the START/STOP button.
3. Signaling LEDs:
 - RED on: the device is powered with the correct supply voltage and is in stand-by.
 - GREEN: motor running.
 - YELLOW flashing: alarm condition.
4. START / STOP: motor start / stop
5. DISPLAY

Keep the START / STOP key pressed down for at least 5 seconds to activate the START/STOP key lock function through which it is only possible to scroll and view the operating parameters, using the + and - keys; this does not allow starting or stopping the motor. Press the START/STOP button again for at least 5 seconds to deactivate the lock.

Keep the + and - keys pressed for at least 5 seconds to reverse the display.

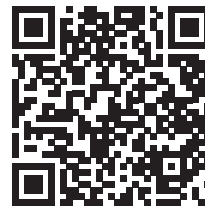
9.2. Control via App

The device can be controlled using a smartphone or tablet equipped with Bluetooth BTLE connectivity and with the App Pentax IPFC installed. The App is available for Android and iOS and may be downloaded, free of charge, from the respective online stores.

Android



iOS



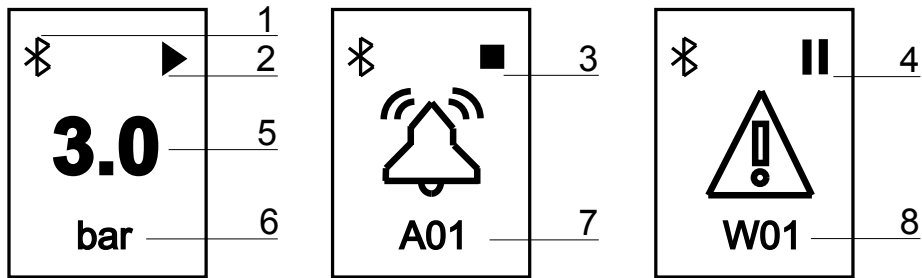
Through the application it is possible to:

- Monitor multiple operating parameters simultaneously.
- Obtain energy consumption statistics and check alarm history.
- Run reports with the possibility of adding notes, images and send them by e-mail or store them in the digital archive.
- Create schedules, save them in the archive, copy them to other devices, and share them among multiple users
- Control a device remotely, via Wi-Fi or GSM, using a smartphone placed nearby as a modem.
- Access manuals and additional technical documentation.
- Receive online help on parameters and alarms.

9.3. Initial display

When the device is switched on, the control firmware version (LCD = X.XX), the power firmware version (INV = X.XX) and the hardware version (HW = X.XX) are communicated to the user.

Next, the initial view opens.



1: Bluetooth on. Flashing during communication; 2: Motor running; 3: Motor stopped; 4: Stand-by; 5: Value read; 6: Units of measurement; 7: Alarm; 8: Warning

Parameter	Description
XX.X [bar]	Measured pressure value.
XXX.X [Hz]	Frequency with which the inverter is powering the motor.
XXX [VAC]	Inverter power supply voltage. This appears only while the motor is in the OFF state. In the ON state, the current absorbed by the motor is displayed instead of the supply voltage.
XX.X [A]	Current absorbed by the motor.
X.XX [cos ϕ]	Cosine of the ϕ phase displacement angle between voltage and current. It is also called the motor power factor.
XX.X [kW]	Estimate of the active electrical power absorbed by the motor.
X [INV]	Device address when COMBO functionality is enabled.
AXX	Alarm XX.
WXX	Warning XX.

The App allows monitoring other parameters and consult the alarm log.

9.4. FOC motor control

9.4.1. Introduction

The benefits provided by the FOC (Field Oriented Control) motor control implemented in the "FOC-ready" inverters over a traditional control are as follows:

- Ideal control of the current at each operating point.
- Quick and accurate speed adjustment.
- Lower energy consumption.
- Reduction of torque fluctuations (vibrations) for smoother and more regular operation throughout the frequency range and less system noise.
- Less mechanical stress on the motor, pump and hydraulic system.

The FOC control of "FOC-ready" devices can be used with:

- Three-phase asynchronous motors
- Permanent magnet three-phase synchronous motors

The control is "sensorless" and therefore does not require the use of any sensor.

9.4.2. FOC control calibration

To enable the device to perform the FOC check it is necessary:

1. Carry out all system wiring. Connect the load (pump) to the inverter using a cable of suitable length, and any dV / dt or sine filter.
2. Power up the system and follow the initial set-up procedure specifying:
 - a. Motor type: three-phase asynchronous or permanent magnet synchronous motor.
 - b. Rated voltage of the motor according to its data plate.
 - c. Rated frequency of the motor according to its data plate.
 - d. Rated current of the motor increased by 5% compared to the value on the data plate.
3. Carry out the Auto tuning process to allow the inverter to learn the electrical information of the load connected to it (motor, cable and filter - if any). The calibration process can take up to 1 minute.
4. Wait for the calibration process to be completed successfully.



NOTE

The calibration process can take up to 1 minute. Wait until it is completed.



NOTE

The calibration process must be performed in the final electrical configuration of the system, that is after the motor, the cable and any filter have been fitted.

If a change is made to the motor, cable or filter once they have been fitted, the calibration process must be repeated.



CAUTION

Incorrect setting of motor voltage, frequency and rated current leads to incorrect results in the calibration process and consequently to motor malfunction.



WARNING

Setting the rated current of the motor too high compared to the value on the data plate can seriously damage both the motor and the inverter. Setting the rated current of the motor too high compared to the value on the data plate can seriously damage both the motor and the inverter.



WARNING

During calibration the motor coils are heated by the test current. If the motor is self-ventilated, the absence of motor rotation does not allow the heat to be dispersed by force. The motor should therefore be allowed to cool between one calibration and the next.



DANGER

During the calibration process, the motor remains stationary but is powered for the entire calibration period. Disconnect the device from the power supply before any intervention on the equipment and on the loads connected to it.

If the calibration process is not successful, check that:

- The connections between the inverter and the load (including any interposed motor filters).
- The set rated voltage, frequency and current values.



NOTE

The motor cannot be started until the calibration process has been completed.



NOTE

If the calibration process cannot be completed, it is possible to manually enter the parameters or stator resistance (Rs) and stator inductance (Ls) in the motor parameters menu (default password 002). These data can be provided by the motor manufacturer or obtained through measurements. If you do not have these data and the self-calibration process is not successful, contact the technical support service.

9.4.3. Adjusting the FOC control

The FOC control algorithm checks current (torque) and speed with defined response dynamics.

The FOC dynamics is set by default to a value sufficient to guarantee accurate and oscillation-free control in most applications.

In some cases, however, it may be necessary to increase (in case of frequency oscillations) or to lower (in case of overcurrent or igbt trip alarms) the "FOC dynamic" setting in the motor parameters menu (default password 002) according to the following table:

Configuration	FOC dynamics
Motor cables shorter than 100 m and no filter between inverter and motor.	200
Motor cables shorter than 100 m and a dV/dt filter between the inverter and the motor.	150
Motor cables longer than 100 m and a dV/dt filter between the inverter and the motor.	100
Presence of a sine filter between the inverter and the motor.	50 or 40 or less



WARNING

The incorrect configuration of the FOC dynamics may cause:

- Speed oscillations if the FOC dynamics is too slow.
- Overcurrent or igbt trip alarms if the FOC dynamics is too fast.

Intervene promptly by appropriately adjusting the "FOC Dynamics" parameter if the conditions listed above are present. Failure to act may lead to damages to the inverter, the motor and the system.

9.5. Menu

Access to the menus is password-protected at two levels:

- **Installer level:** Allows editing the parameters related to pump operation in the hydraulic system on which it is installed. **Password 1, default 001.**
- **Advanced level:** Allows editing the parameters that so critical that they may compromise the life of the device, the pump, and the system if they are set incorrectly. **Password 2, default 002.**

Within each menu, it is possible to change the relative access password.



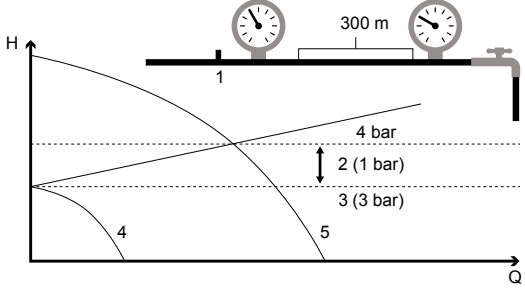
NOTE

When an incorrect password is entered to access both the installer and advanced level, the parameters can only be displayed but not edited.

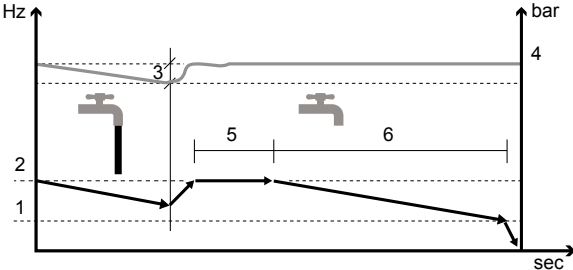
In case of loss of the password, contact the technical support service to obtain the universal password.

Menu	Description	Level	Default password
Control parameters	Menu of parameters for controlling the pump in the hydraulic system in which it is installed.	Installer	001
Motor parameters	Menu of parameters for motor control	Advanced	002
IN/OUT parameters	Menu of parameters for analog and digital inputs and outputs	Installer	001
Connectivity parameters	Menu of parameters for connectivity and external communication.	Installer	001

9.6. Control parameters

Parameter	Default	Description	1	2	3	4	5
Control mode 1. Constant value 2. Fix speed 3. Constant value 2 set 4. Fix speed 2 values 5. External speed	Constant value	The following control modes can be selected: 1. Constant value: the device varies the speed of the pump in such a way as to keep the set value constant regardless of water consumption. 2. Fix speed: the device powers the pump at the set frequency. 3. Constant value 2 set: two desired values can be selected by opening or closing digital input 2. 4. Fix speed 2 values: two desired frequency values can be selected by opening or closing digital input 2. 5. External speed: it is possible to control the motor frequency through an analog signal connected to analog input 4.	x	x	x	x	x
Control mode aux XXXXXXXX	Constant value	Operate on digital input 4 to switch from the main control mode to the auxiliary control mode and vice versa.	x	x	x	x	x
Max alarm value p = XX.X [bar]	10 bar	Value that can be reached in the system beyond which, even in constant frequency operating mode, the pump is stopped and an alarm signal is emitted. The pump is restarted only after the measured value has dropped below the maximum alarm value for more than 5 seconds.	x	x	x	x	x
Min alarm value p = XX.X [bar]	0	Minimum value that can be reached in the system below which, even in constant frequency operating mode, the pump is stopped and an alarm signal is emitted. The pump is restarted only after the measured value has risen above the minimum alarm value for more than 5 seconds.	x	x	x	x	x
Pipe fill ramp XXX [s]	= Ramp up time	Ramp time to follow after a start if the measured value is lower than the minimum alarm value. The piping filling ramp expires after the set time or if the measured value reaches the set value. In COMBO mode, only one unit is enabled to operate as long as the filling ramp is active.	x		x		
External set enabling ON/OFF	OFF	Enabling the setting of the set value via analog input 3.	x		x		
Set value p = XXX.X [bar]	3 bar	Value that you want to keep constant.	x				
Compensation p = XXX.X [bar]	0	Compensation at the maximum frequency. The sign can be reversed via the green key.  <p>1: sensor; 2: Compensation ; 3: Set value ; 4: Min motor frequency; 5: Max motor frequency</p> <p>In the case of a group of pumps in COMBO mode, the compensation must be referred to each pump.</p>	x				
Set value 2 p = XXX.X [bar]	3 bar	Value that you want to keep constant.			x		

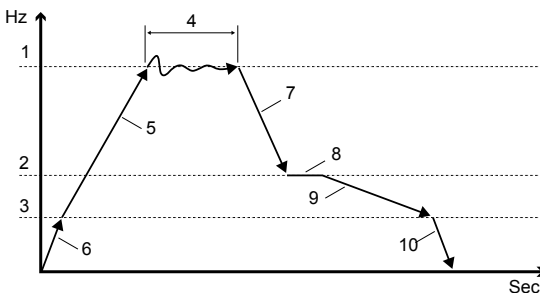

EPIC-A


Parameter	Default	Description	1	2	3	4	5
Compensation set 2 p = XX.X [bar]	0	Compensation at the maximum frequency. The sign can be reversed via the green key.			x		
Value set update t = XX [s]	5 s	Time interval for updating the set value according to the compensation.	x		x		
Operating frequency f = XXX [Hz]	= Max motor frequency	Frequency used by the device to power the motor.		x		x	
Operating frequency 2 f = XXX [Hz]	= Max motor frequency	Frequency used by the device to power the motor.				x	
Frequency min control fmin = XXX [Hz]	= Max motor frequency	Minimum frequency below which the pump must try to stop following the control ramp (Control ramp).	x		x		
Stop delay t = XX [s]	5 s	Delay during which an attempt is made to stop the pump below the minimum control frequency (Frequency min control).	x		x		
Control ramp t = XX [s]	30 s	Time in which the device decreases the motor power frequency from the minimum control frequency (Frequency min control) to the minimum motor frequency (Min motor frequency). If during this time the measured value falls below Set value - Delta control, the device restarts the motor. If not, the device will stop the motor completely following the control ramp (Control ramp).	x		x		
Delta start p = XXX.X [bar]	0.3 bar (6 psi)	This parameter communicates by how much the measured value must fall from the set value for the previously stopped pump to be restarted.	x		x		
Delta control p = XXX.X [bar]	0.1 bar (2 psi)	This parameter communicates by how much the measured value must fall in relation to the set value so that the pump, during shutdown in control ramp, is restarted.  <p>1: Min motor frequency; 2: Frequency min control; 3: Delta control; 4: Set value ; 5: Stop delay; 6: Control ramp</p>	x		x		
Delta stop p = XX.X [bar]	0.5 bar (8 psi)	This parameter represents the increment of the measured value with respect to the set value that must be exceeded so that a forced shutdown of the pump according to the stop ramp can occur.	x		x		
Ki XXX	50	Integral coefficient used in constant value adjustment.	x		x		
Kp XXX	5	Proportional coefficient used in constant value adjustment.	x		x		
COMBO ON/OFF	OFF	Enable the function COMBO for the combined operation of several pumps in parallel. Read the dedicated chapter.	x		x		
Address COMBO XX	01	Device address when in COMBO mode: • 0: master • 01 to 07: slave	x		x		
Alternance ON/OFF	ON	Enabling the alternation between units in COMBO and D.O.L. The order of priority of operation is alternated based on the previous start-up of each pump in order to obtain an almost uniform wear of the pumps.	x		x		
Alternance period t = XX [h]	0	Maximum difference in operating hours between multiple devices in the unit. 0 means 5 minutes.	x		x		

Parameter	Default	Description	1	2	3	4	5
COMBO synchrony ON/OFF	OFF	Through this parameter it is possible to activate the synchronous operation of the pumps in COMBO. Read the dedicated chapter. However, it is necessary to lower parameter Frequency min control accordingly.	x		x		
Start delay AUX t = XX [s]	00	Time delay with which the pumps in a group start up after the variable speed pump has reached the maximum motor frequency and the measured value has fallen below the difference Set value - Delta control.	x		x		
PI control Direct/Reverse	Direct	PI control mode: <ul style="list-style-type: none"> • Direct: as the pump speed increases, the measured value increases. • Reverse: as the pump speed increases, the measured value decreases. 	x		x		
Periodic autorun t = XX [h]	00	Periodic pump start-up after X hours of inactivity. The value 0 disables the function.	x	x	x	x	x
Dry run cosphi cosphi = X.XX		Cosphi value that is measured when the pump is running dry. Below this value the device stops the pump and generates a water shortage alarm. If the motor is of the synchronous type with permanent magnets, this parameter represents the percentage with respect to the rated current set below which the device stops the motor and generates the no-water alarm.	x	x	x	x	x
Restarts delay t = XX [min]	10 min	Time base that establishes the delay of attempts to restart the pump following a no-water alarm. With each attempt, the delay time is doubled. The maximum number of attempts is 5.	x	x	x	x	x
Change password1 Press ENT		By pressing the ENT key it is possible to change the installer level password (level 1) (default 001).	x	x	x	x	x

9.7. Motor parameters

Parameter	Default	Description
Motor type XXXXXXXX	Threephase asynchronous	Type of motor connected and control used: <ul style="list-style-type: none"> • Threephase asynchronous: control for three-phase asynchronous motors. • Synchronous PM: control for permanent magnet synchronous motors. • Singlephase PSC: control for single-phase 2-wire PSC motors. • Singlephase 3 wire PSC : control for single-phase 3-wire PSC motors. • Singlephase 3 wire CSCR : control for single-phase 3-wire CSCR motors. • Singlephase 3 wire CSIR : control for single-phase 3-wire CSIR motors. • Scalar: V / f scalar control.
Rated motor voltage V = XXX [V]		Rated voltage of the motor according to its data plate. The average voltage drop across the inverter is 20 to 30V RMS depending on the load conditions.
Voltage boost V = XX.X [%]		Motor starting voltage increase to favor the starting torque. Contact the motor manufacturer for more information.
Rated motor current I = XX.X [A]		Motor rated current according to its data plate increased by 5%. The voltage drop across the inverter may result in a current absorption greater than the motor rated current indicated on the data plate. It is necessary to check with the motor manufacturer that this overcurrent can be tolerated.
Rated motor current start/aux I = XX.X [A]		Rated motor current of the start/aux winding. Contact the motor manufacturer for more information. The device suggests as default a rescaled value based on the parameters Rated motor current And Motor type. In case of Singlephase 3 wire CSCR the set value will be equal to 25% of Rated motor current. In case of Singlephase 3 wire PSC the set value will be equal to 40% of Rated motor current. This parameter is present only if Motor type = Singlephase 3 wire PSC or Singlephase 3 wire CSCR.
Rated motor frequency f = XXX [Hz]	50 Hz (60 Hz)	Rated frequency of the motor according to its data plate.
Max motor frequency f = XXX [Hz]	50 Hz (60 Hz)	Maximum frequency intended to power the motor. Reducing the maximum motor frequency reduces the maximum current consumption.

Parameter	Default	Description
Min motor frequency f = XXX [Hz]	30 Hz (35 Hz)	Minimum motor frequency. When using submersible pumps with Kingsbury type thrust system, it is recommended not to go below 1750 rpm so as not to compromise the thrust system.
Ramp up time t = XX [sec]	3 s	Motor start ramp from minimum frequency (Min motor frequency) to maximum frequency (Max motor frequency). Slower ramps cause less strain on the motor and pump and therefore promote longer life. On the other hand, response times are longer. Excessively fast start-up ramps may lead to an overload in the inverter.
Ramp down t = XX [sec]	3 s	Motor stop ramp from maximum frequency (Max motor frequency) to minimum frequency (Min motor frequency). Slower ramps cause less strain on the motor and pump and therefore promote longer life. On the other hand, response times are longer. Excessively fast stop ramps may lead to an overvoltage in the inverter due to the regenerative effect.
Ramp freq. min motor t = XX [sec]	1 s	Time in which the motor reaches the minimum frequency from standstill (Min motor frequency) and vice versa.  <p>1: Max motor frequency; 2: Frequency min control; 3: Min motor frequency; 4: PI control; 5: Ramp up time; 6: Ramp freq. min motor ; 7: Ramp down; 8: Stop delay; 9: Control ramp; 10: Ramp freq. min motor</p>
Output filter	None	Type of output filter possibly installed between the inverter and the motor: <ul style="list-style-type: none"> • None : no filter installed • dV/dt : dV/dt filter • Sin : sine filter
PWM f = XX [kHz]		Inverter modulation frequency. It is possible to choose between 2.5, 4, 6, 8, 10 kHz depending on the inverter model. Higher values correspond to a more faithful reconstruction of the sine wave. When using very long motor cables (>20 m), the appropriate output filters, available upon request, should be interposed between the inverter and the motor and the correct value of the PWM parameter according to the type of filter and the length of the cable should be set. This reduces the probability of voltage peaks at the motor input while safeguarding the winding insulation. Lower values reduce the heating of the inverter.
Voltage boost START/AUX V = XX.X [%]		Voltage supplied to the start/aux winding. The device suggests as default a rescaled value based on the parameter Motor type. In case of Singlephase 3 wire CSCR the set value will be equal to 35%. In case of Singlephase 3 wire PSC the set value will be equal to 50%. This parameter is present only if Motor type = Singlephase 3 wire PSC or Singlephase 3 wire CSCR.
V/f linear quadratic XXX %	80%	This parameter allows changing the V/f characteristic with which the device supplies the motor. The linear characteristic corresponds to a constant torque characteristic with varying revolutions. The quadratic characteristic corresponds to a variable torque characteristic and is generally suitable for use with centrifugal pumps. The torque characteristic must be chosen ensuring smooth operation, reduced energy consumption and lower heating and motor noise. With single-phase motors, we recommend setting linear V/f (0%).
Rotation sense ---> / <---	--->	Running direction of the motor. Should the motor run in the wrong direction, it is possible to reverse the running direction without having to change the phase sequence in the connection. <div style="border: 1px solid black; padding: 5px; background-color: #f0f0f0;">  <p>CAUTION If there is more than one pump in a COMBO unit, it is best to use the same phase sequence when connecting the motors and to set the same running direction.</p> </div>

Parameter	Default	Description
Motor tuning ENT to access		<p>If the device is "FOC-ready", motor calibration must be carried out before commissioning.</p> <div style="border: 1px solid black; padding: 5px; background-color: #f0f0f0;">  <p>WARNING Carefully read the chapter dedicated to the FOC motor control.</p> </div>
Motor resistance Rs=XXX.XX [Ohm]		Manual setting of the stator resistance.
Motor inductance Ls=XXX.XX [mH]		Manual setting of the stator inductance.
FOC dynamics XXX	200	Setting of the control dynamic of the FOC algorithm.
FOC speed XXX	5	Setting of the control speed of the FOC algorithm.
Autorestart ON/OFF	OFF	By selecting ON, when the mains power is restored after a power failure, the device will return to the same state it was in before the power failure: this means that if the pump was working, it will start working again
Change password2 Press ENT		By pressing the ENT key it is possible to change the advanced level password (level 2) (default 002).

9.8. IN / OUT parameters

Parameter	Default	Description
Unit XXXXX	bar	Units of measurement [bar,%, ft, in, cm, m, K, F, C, gpm, l / min, m3 / h, atm, psi].
Full scale sensor p = XXX.X [bar]	16 bar (250 psi)	Full scale of the sensor.
Min value sensor p = XXX.X [bar]	0	Minimum sensor value.
Offset input1 XX.X [%]	20%	Zero correction for analog input 1 (4-20 mA). (20 mA x 20% = 4 mA).
Offset input2 XX.X [%]	20%	Zero correction for analog input 2 (4-20 mA). (20 mA x 20% = 4 mA).
Offset input3 XX.X [%]	0%	Zero correction for analog input 3. 0-10 V : 10V x 0% = 0 V
Offset input4 XX.X [%]	0%	Zero correction for analog input 4. 0-10 V : 10V x 0% = 0 V
AN1, AN2 function XXXXXXXX	Independent	<p>Operating logic of analog inputs AN1, AN2:</p> <ul style="list-style-type: none"> • Independent. The active sensor is relative to analog input 1, while the sensor connected to analog input 2 serves as an auxiliary in case of failure of the sensor or of analog input 1. • Selectable. The active sensor may be selected via digital input 3. • Difference 1-2. The digital difference in absolute value is performed between the measurements of analog input 1 and analog input 2. • Higher value. The maximum value between the measurements of the two sensors is considered. • Lower value. The minimum value between the measurements of the two sensors is considered.
Digital input1 N.O./N.C.	N.O.	<p>If N.O.(Normally Open) is selected, the device will continue to operate the motor if digital input 1 is open. Conversely, it will stop the motor if digital input 1 is closed.</p> <p>If N.C. (Normally Closed) is selected, the device will continue to operate the motor if digital input 1 is closed. Conversely, it will stop the motor if digital input 1 is open.</p>
Digital input2 N.O./N.C.	N.O.	<p>If N.O.(Normally Open) is selected, the device will continue to operate the motor if digital input 2 is open. Conversely, it will stop the motor if digital input 2 is closed.</p> <p>If N.C. (Normally Closed) is selected, the device will continue to operate the motor if digital input 2 is closed. Conversely, it will stop the motor if digital input 2 is open.</p> <p>Digital input 2 is also used to select set value 1 or set value 2 in the control mode Constant value 2 set or to select working frequency 1 or 2 in the control mode Fix speed 2 values.</p>

Parameter	Default	Description
Digital input3 N.O./N.C.	N.O.	If N.O.(Normally Open) is selected, the device will continue to operate the motor if digital input 3 is open. Conversely, it will stop the motor if digital input 3 is closed. If N.C. (Normally Closed) is selected, the device will continue to operate the motor if digital input 3 is closed. Conversely, it will stop the motor if digital input 3 is open. Digital input 3 is also used to select sensor 1 or sensor 2 when the parameter AN1, AN2 function is set to Selectable.
Digital input4 N.O./N.C.	N.O.	If N.O.(Normally Open) is selected, the device will continue to operate the motor if digital input 4 is open. Conversely, it will stop the motor if digital input 4 is closed. If N.C.(Normally Closed) is selected, the device will continue to operate the motor if digital input 4 is closed. Conversely, it will stop the motor if digital input 4 is open. Digital input 4 is also used to select the main or auxiliary control mode in case they are different. Digital input 4 also serves as alarm reset.
Man reset In Dig1	OFF	Enabling or disabling the manual reset of the digital input.
Man reset In Dig2	OFF	Enabling or disabling the manual reset of the digital input.
Man reset In Dig3	OFF	Enabling or disabling the manual reset of the digital input.
Man reset In Dig4	OFF	Enabling or disabling the manual reset of the digital input.
Dig. input 2/3 delay t = XX [s]	1	Delay of digital inputs 2 and 3. Digital inputs 1 and 4 have a fixed delay of 1 second.
Change password1 Press ENT		By pressing the ENT key it is possible to change the installer level password (level 1) (default 001).

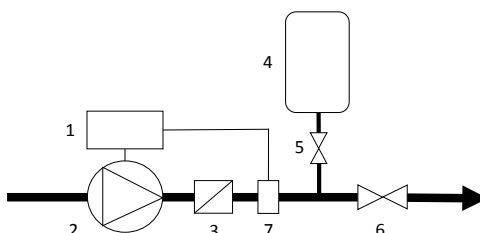
9.9. Connectivity parameters

Parameter	Default	Description
Address RS-485 XXX	1	Address from 1 to 247
Baudrate XXXXX	9600	Baudrate from 1200 bps to 57600 bps
Data format XXXXX	N81	Data format: N81, N82, E81, O81
EEPROM write ON/OFF	OFF	Setting the writing mode of the parameters transmitted via: ON: the datum is saved in EEPROM OFF: the datum is not saved in EEPROM
Change password1 Press ENT		By pressing the ENT key it is possible to change the installer level password (level 1) (default 001).

10. Constant pressure operation

10.1. Introduction

The EPIC-A can manage the running speed of the pump in such a way as to keep the pressure constant as the water demand changes. A pressure sensor placed as close as possible to the pump is used for this purpose.



1: Inverter; 2: Pump; 3: Check valve; 4: Pressure vessel; 5: Gate valve; 6: Gate valve; 7: Pressure sensor

10.2. The pressure vessel

In water systems equipped with inverters, the function of the pressure vessel is to compensate for losses (or minimum water consumption) and maintain pressure when the pump is stopped, thus avoiding excessively frequent start/stop cycles. It is of fundamental importance to correctly choose the volume and the pre-charge pressure of the pressure vessel. Too small volumes do not allow effectively compensating the minimum water consumption or the losses when the pump is stopped, while too high volumes make it difficult for the inverter to control the pressure. It is generally sufficient to place a pressure vessel with a volume of about 10% of the maximum flow rate required, considered in liters/minute.

Example

If the maximum flow rate required is 60 l/min, it is sufficient to use a 6 liter pressure vessel.

If the maximum flow rate required is 60 GPM, it is sufficient to use a 6 gallons pressure vessel.



NOTE

If the expansion vessel already exists and has dimensions greater than those recommended, it may be necessary to adjust the parameters K_i and K_p in the menu Control parameters to ensure optimal control.

The pre-charge pressure of the pressure vessel must be approx. 80% of the operating pressure.

Example

If the set pressure in the inverter is 4 bar, the pre-charge pressure of the pressure vessel should be approx. 3.2 bar.

If the set pressure in the inverter is 60 psi, the pre-charge pressure of the pressure vessel should be approx. 48 psi



NOTE

The pre-charge pressure must be adjusted with the system completely unloaded.

10.3. Electrical connections

The device may be connected to linear pressure sensors with 4 - 20 mA output. The supply voltage range of the sensor must be such as to include the 15 V DC voltage with which the device feeds the analog inputs.

The pressure sensor is connected via the terminals of the analogue input 1, i.e:

- AN1: 4-20 mA signal (-)
- +15V: 15 VDC power supply (+)

The device supports the installation of a second pressure sensor for:

- Operating at constant differential pressure (read the dedicated chapter).
- Automatic replacement of the main pressure sensor in case of failure.
- Exchange of active pressure sensor via digital input.

The secondary pressure sensor is connected via the terminals of the analogue input 2, i.e:

- AN2: 4-20 mA signal (-)
- +15V: 15 VDC power supply (+)



NOTE

In case there is a failure of the analog input AN1 and the parameter AN1, AN2 function is set to value Independent, it is possible to connect the pressure sensor to the analog input AN2 to restore the functioning of the system.

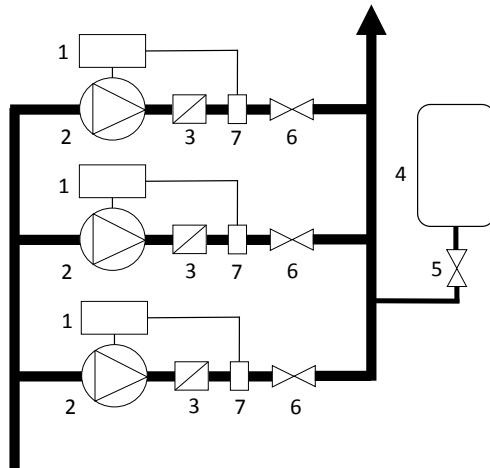
11. Splitting the pumping system

11.1. Introduction.

When the variation in water demand is considerable, it is a good idea to split the pumping unit into several units to ensure greater efficiency and reliability.

A splitting method (called COMBO mode) consists in using several pumps in parallel (up to 8) each controlled by an inverter.

In this case, the efficiency and reliability of the pumping unit is maximized, ensuring soft starts and stops and complete protection of the pumps. The alternation of operation also allows to even out the wear of the pumps and, in case of failure of a pump or an inverter, the remaining units of the group can continue their operation.



1: Inverter; 2: Pump; 3: Check valve; 4: Pressure vessel; 5: Gate valve; 6: Gate valve; 7: Pressure sensor

11.2. Variable speed pumping unit with two or more pumps in COMBO mode.

The unit consists of two or more pumps (up to 8) each controlled by an inverter, and each equipped with its own pressure sensor. The inverters are connected to each other via RS485 serial port.

One inverter is configured as master (address 00) whereas the others are configured as slaves (addresses 01 to 07).



NOTE

Each inverter must be equipped with its own pressure sensor.

11.2.1. Cascade operating principle.

Cascade operation is the default operation in COMBO mode.

When water is required, a pump is started at variable speed according to the demand.

As the demand increases and the maximum frequency is reached, a second pump is started.

An additional water demand, leads to an increase in the pump frequency until, having reached its maximum frequency, a third pump is started and so on.

In case of reduced demand, the last pump started decreases its frequency until it switches off.

11.2.2. Synchronous operating principle.

If parameter COMBO synchrony is set to ON, synchronous operation is achieved. This operating mode provides additional energy savings over cascade operation.

When water is required, a pump is started at variable speed according to the demand.

When the demand increases and the maximum frequency is reached, a second pump is started and the two pumps run at the same speed to satisfy the water demand.

A further request leads to an increase in the frequency of the two pumps until, having reached their maximum frequency, a third pump is started and so on.

In case of reduced demand, all the pumps of the unit reduce their frequency and, once reached the minimum frequency, the pump that was started last switches off.



NOTE

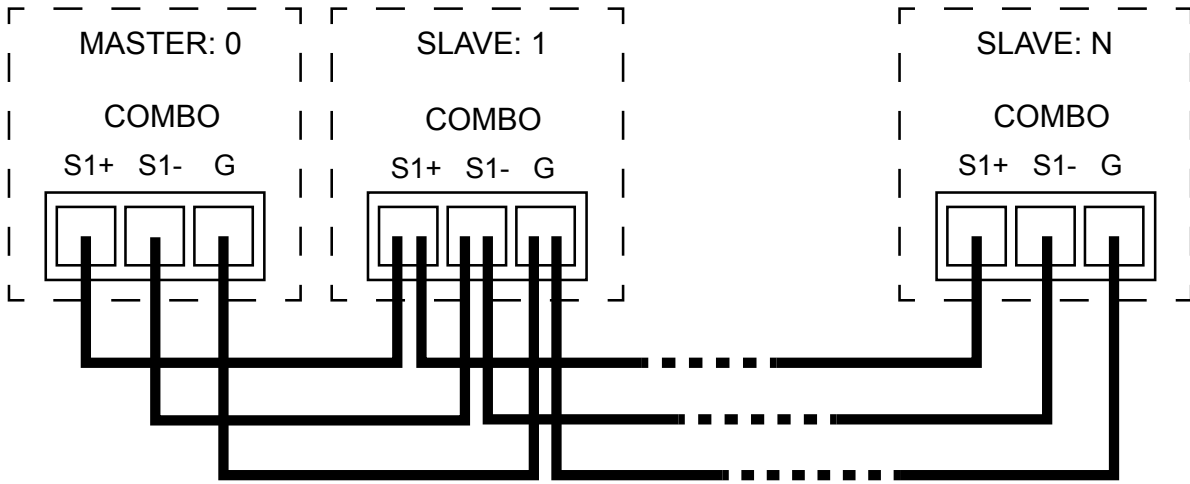
To ensure correct synchronous operation, parameter Frequency min control must be set appropriately, i.e. two or three Hz above the working frequency at zero flow.



NOTE

If parameter Alternance is set to ON , the start priority of the pumps in COMBO mode is established according to the operating hours, and parameter Alternance period establishes the number of hours of continuous operation after which the pumps in the unit are forced to alternate.

11.2.3. Electrical connections.



WARNING

Respect the polarity of the connections.

11.2.4. Programming the master unit.

Menu	Parameter	Value
Control parameters	COMBO	ON to activate.
Control parameters	Address COMBO	00
Control parameters	Alternance	ON to activate / OFF to deactivate.
Control parameters	Alternance period	Establishes the number of hours of continuous operation after which the pumps in the unit are forced to alternate. The value 0 means 5 minutes.
Control parameters	COMBO synchrony	ON to activate / OFF to deactivate.
Control parameters	Start delay AUX	We recommend setting 0 s.

11.2.5. Programming of slave units.

Menu	Parameter	Value
Control parameters	COMBO	ON to activate.
Control parameters	Address COMBO	from 01 to 07.
Control parameters	Alternance	ON to activate / OFF to deactivate. It is possible to determine which devices are included in the alternation and which are not. Devices excluded from the alternation will receive a starting priority based on their address.



NOTE

To start or stop a unit in COMBO mode, simply press the START or STOP button on the master unit only.



NOTE

To change the operating parameters of a COMBO unit, operate on the unit's master. When the Master Menu is exited, the remote programming of the connected slave units is required. In this manner, all parameters set in the master are also copied to the slaves with the exception of parameter Address COMBO.

**CAUTION**

When the master menu is accessed, the communication with the slave units is interrupted and the A13 No communication alarm is produced. Communication is automatically re-established by exiting the Master Menu.

**WARNING**

In case of pumps in COMBO mode, it is recommended to make the connections to the motor respecting the same phase sequence. In this manner, it will be ensured that by copying parameter Rotation sense from the master unit to the slave units, all the pumps in the unit will maintain the correct running direction.

11.2.6. Automatic master replacement

In COMBO mode, if a slave or the pump connected to it should fail or enter an alarm state, the unit will continue to operate with the remaining units.

In case the master or the pump connected to it should break down or enter an alarm state, the unit will stop for about 30 seconds generating the A13 No communication alarm in the slaves. After the waiting time has elapsed, the slave with address 1 will become the master, thus allowing the unit to resume operation.

If the master reappears in the unit, the latter will stop again for about 30 seconds, generating the A12 Address error alarm in the master and in the slave 1.

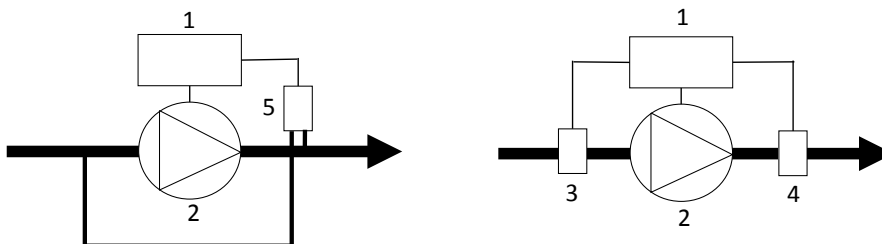
After the waiting time has elapsed, the master will assume address 0 and the slave address 1, thus allowing the unit to resume operation.

**CAUTION**

In order to enable automatic master changeover, parameter Autorestart must be set to ON. Do not touch the keypad of the devices during the master replacement process, otherwise the master change process will be interrupted.

12. Operation at constant differential pressure**12.1. Introduction**

The inverter may manage the running speed of the pump in such a way as to maintain a constant differential pressure between the delivery and the suction of the pump in circulation systems. For this purpose, a differential pressure sensor is used or, alternatively, it is possible to use two identical pressure sensors placed one in the suction and the other in the delivery section of the pump. The absolute difference of the read values is performed by the device itself.



1: Inverter; 2: Pump; 3: Pressure sensor; 4: Pressure sensor; 5: Differential pressure sensor

**NOTE**

If the suction pressure is expected to drop below atmospheric pressure during operation, absolute rather than relative pressure sensors must be used.

12.2. Electrical connections

The device may be connected to linear pressure sensors with 4 - 20 mA output. The supply voltage range of the sensor must be such as to include the 15 V DC voltage with which the device feeds the analog inputs.

If a differential pressure sensor is used, it is necessary to connect the sensor to the analog input 1, i.e.:

- AN1: 4-20 mA signal (-)
- +15V: 15 VDC power supply (+)

If two pressure sensors are used, one sensor must be connected to analog input 1 while the other sensor must be connected to analog input 2, i.e.:

- Sensor 1:
 - AN1: 4-20 mA signal (-)
 - +15V: 15 VDC power supply (+)
- Sensor 2:
 - AN2 4-20 mA signal (-)
 - +15V: 15 VDC power supply (+)

In circulation systems, the start and stop of the pump is generally controlled by an external contact which can therefore be connected to digital input 1 (IN1, 0V) and configured accordingly.

12.3. Programming




Menu	Parameter	Value
IN/OUT parameters	Full scale sensor	Sensor full scale value range.
IN/OUT parameters	Min value sensor	Minimum sensor value.
IN/OUT parameters	AN1, AN2 function	Independent when a differential pressure sensor is used. Difference 1-2 when two pressure sensors are used.
IN/OUT parameters	Digital input 1	N.O. when the pump is stopped by closing the contact of digital input 1 N.C. when the pump is stopped by opening the contact of digital input 1
Control parameters	Control mode	Constant value
Control parameters	Set value	Differential pressure value that you may want to keep constant.
Control parameters	Compensation	<p>This parameter is set other than 0 if you intend to operate a proportional differential pressure control. Additional energy savings may be achieved through this type of control.</p> <p>The pressure difference that you want to keep constant at Max motor frequency is given by the sum of parameters Set value + Compensation.</p> <p>The pressure difference that you want to keep constant at Min motor frequency corresponds to Set value .</p> <p>The pressure set then varies proportionally between Min motor frequency and Max motor frequency.</p> <p>1: Compensation; 2: System curve; 3: Proportional differential pressure; 4: Constant differential pressure</p>
Control parameters	Frequency min control	Same as Min motor frequency
Control parameters	Stop delay	99 s
Control parameters	Start delay AUX	In twin circulation systems (two pumps), each controlled by an inverter in COMBO mode, this parameter should be set to 99 s in order to activate only one pump at a time while ensuring the alternation of the same.



13. Alarms




WARNING

Immediate remedies must be implemented in case of alarms to safeguard the integrity of the device itself and of the system in which it is installed.

Alarm	Description	Possible solutions
LINE<->MOT INV.	Reverse the connection of the power cable and motor cable.	<ul style="list-style-type: none"> Correct the connection of the power and motor cables.
A01 Overcurrent motor	<p>The current absorbed by the motor exceeds the value set in the parameter Rated motor current.</p> <p>Reset mode:</p> <ul style="list-style-type: none"> Automatic reset after 10 seconds for up to 7 attempts, after which you must wait for 60 minutes. Disconnecting the power supply. 	<ul style="list-style-type: none"> Verify that the value set for the parameter Rated motor current corresponds at least to the rated current of the motor according to its rating plate data. <div style="border: 1px solid black; padding: 5px; margin: 5px 0;">  <p>NOTE</p> <p>The voltage drop across the inverter (variable between 20 and 40 VAC) causes the motor to be powered at a slightly lower voltage than the one stated on the data plate. The current absorbed by the motor could therefore be slightly higher than the rated current indicated in data plate and, to obtain maximum performance, it is necessary to increase the parameter Rated motor current between 5% and 10%.</p> </div> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;">  <p>WARNING</p> <p>Check with the motor manufacturer the tolerability to withstand a current greater than its rated current.</p> </div> <ul style="list-style-type: none"> Check that all the motor phases are correctly connected and that the connection is suitably configured in Star or Delta. Check that motor parameters are correctly set. In devices with FOC control, perform a new motor calibration. In the presence of output filters (dV / dt or sinusoidal), check that they are correctly connected and, in devices with FOC control, check that you have correctly set the parameters PWM and FOC dynamics in relation to the length of the motor cable and the type of filter used. Check that the pump is turning in the correct direction. Make sure that the motor is free to rotate and check for any mechanical issues. Adjust parameter Voltage boost
A02 Sensor fault	<p>The current value read by the analog input is less than 4 mA.</p> <p>Reset mode:</p> <ul style="list-style-type: none"> Alarm reset by STOP key. Disconnecting the power supply 	<ul style="list-style-type: none"> Check that the connections on the device side and on the sensor side are correct. Check that the sensor is fed the correct power. Check that the sensor is working properly. If only one sensor is connected to analog input 1, try to connect it to analog input 2.
A03 Over temperature inverter	<p>The temperature reached by the device is higher than the maximum allowed value.</p> <p>Reset mode:</p> <ul style="list-style-type: none"> Automatic reset 	<ul style="list-style-type: none"> Check that the ambient temperature is within the allowed limits. Make sure the device is protected from direct exposure to sunlight or heat sources. Check that both the external and internal cooling fans (if present) are working properly. Check that the dissipation channels are clean. Check that the device is cooled as indicated in the dedicated chapter. Reduce parameter PWM as much as possible. <div style="border: 1px solid black; padding: 5px; margin: 5px 0;">  <p>NOTE</p> <p>To ensure uninterrupted operation, the inverter automatically reduces the maximum frequency (i.e. power) when the internal temperature reaches a certain threshold. If such frequency reduction is not sufficient to keep the temperature above the maximum permitted value, the inverter will stop the motor and trigger the alarm A03 Over temperature inverter.</p> </div>

Alarm	Description	Possible solutions
A04 Dry run cosphi	<p>The warning W26 No water appeared 5 consecutive times following the automatic reset attempts.</p> <p>Reset mode:</p> <ul style="list-style-type: none"> • Alarm reset by STOP key. • Disconnecting the power supply 	<div style="border: 1px solid black; padding: 5px;">  <p>WARNING</p> <p>When the warning W26 No water appears, the device will automatically restart the load after a time equal to the value set in the parameter Restarts delay multiplied by the number of attempts made. At the end of the fifth attempt, the device will definitively stop the load producing the alarm A04 Dry run cosphi. The alarm must be reset manually.</p> </div>
A05 Under voltage	<ul style="list-style-type: none"> • Supply voltage below the minimum allowed value. • Insufficient input power to power the device. <p>Reset mode:</p> <ul style="list-style-type: none"> • Automatic reset if parameter Autorestart = ON 	<ul style="list-style-type: none"> • Check the value of the power supply voltage both under no load and load conditions. • Verify that the source has enough power to power the load.
A06 Over voltage	<p>The power supply voltage or the voltage inside the device exceeds the maximum allowed value.</p> <p>Reset mode:</p> <ul style="list-style-type: none"> • Automatic reset if parameter Autorestart = ON 	<ul style="list-style-type: none"> • Check the value of the power supply voltage both under no load and load conditions. • Check for regeneration from the load. • Increase parameter Ramp down • Increase parameter Ramp freq. min motor • In the case of a permanent magnet motor, check that the load is not subjected to passive movement.
A07 Max value alarm	<p>The value read by the analog input is higher than the value set for the parameter Max alarm value.</p> <p>Reset mode:</p> <ul style="list-style-type: none"> • Automatic reset 	<ul style="list-style-type: none"> • Check the value set for the parameter. • Check the hydraulic causes that lead to the alarm condition. • Check that the sensor is working properly.
A08 Locked rotor	<p>The automatic frequency limitation created by the inverter following an excessive absorption by the motor (beyond the value set in the parameter Rated motor current) causes a reduction of the frequency below the average value between Min motor frequency and Max motor frequency.</p> <p>Reset mode:</p> <ul style="list-style-type: none"> • Alarm reset by STOP key. • Disconnecting the power supply 	<ul style="list-style-type: none"> • Check the possible solutions for the alarm A01 Overcurrent motor
A09 Overload inverter	<p>The current absorbed by the load exceeds the rated current of the device.</p> <p>Reset mode:</p> <ul style="list-style-type: none"> • Alarm reset by STOP key. • Disconnecting the power supply 	<ul style="list-style-type: none"> • Check that the rated current of the motor is lower than the rated current of the device. • Make sure that the motor is free to rotate and check for any mechanical issues. • Increase the value of the parameter Ramp up time. • Increase the value of the parameter Ramp freq. min motor. • Adjust parameter Voltage boost • Check the value of the power supply voltage both under no load and load conditions. <div style="border: 1px solid black; padding: 5px;">  <p>CAUTION</p> <p>The device can supply power to the load for 10 minutes at a current consumption of 101 % of the rated current of the device, and for 1 minute at a current consumption of 110 % of the rated current of the device.</p> </div>
A10 IGBT trip alarm	<p>The current absorbed by the load instantaneously exceeds the maximum current protection of the device's power module.</p> <p>Reset mode:</p> <ul style="list-style-type: none"> • Automatic reset after 10 seconds for up to 3 attempts, after which you must wait for 60 minutes. • Disconnecting the power supply 	<ul style="list-style-type: none"> • Check the possible solutions for alarms A01 Overcurrent motor and A09 Overload inverter. • Check for short circuits between the output phases and the ground insulation. • Check that the system is properly grounded. • Check for electrical noise from other devices connected to the system.

Alarm	Description	Possible solutions
A11 No load	The current absorbed by the load is too low in relation to the parameter Rated motor current. Reset mode: <ul style="list-style-type: none"> Alarm reset by STOP key. Disconnecting the power supply 	<ul style="list-style-type: none"> Check the possible solutions for the alarm A01 Overcurrent motor
A12 Address error	In COMBO mode, multiple devices in the group have the same address. Reset mode: <ul style="list-style-type: none"> Automatic reset 	<ul style="list-style-type: none"> Restore the correct value of parameter Address COMBO in all the devices in the group. Verify which situation triggers the alarm. If the alarm is triggered after a master replacement, check that the parameter Autorestart is activated. Check the electrical connection between the slave unit and the master, and the presence of possible disturbances.
A13 No communication	In COMBO mode, the communication between the slave unit and the master has been interrupted. Reset mode: <ul style="list-style-type: none"> Automatic reset 	<ul style="list-style-type: none"> Check the electrical connection between the slave unit and the master, and the presence of possible disturbances. Exit the master programming menu. Attempt a manual reset of the alarm. <div style="border: 1px solid black; padding: 5px; margin-top: 10px;">  <p>CAUTION Keep signal cables separate and never parallel to power cables. If it is necessary to cross them, make sure that they cross perpendicularly.</p> </div>
A14 Min value alarm	The value read by the analog input is lower than the value set for the parameter Min alarm value. Reset mode: <ul style="list-style-type: none"> Automatic reset 	<ul style="list-style-type: none"> Check the value set for the parameter. Check the hydraulic causes that lead to the alarm condition. Check that the sensor is working properly.
A15 Keyboard fault	One of the keys of the keyboard was held down for more than 30 seconds. Reset mode: <ul style="list-style-type: none"> Alarm reset by STOP key. Disconnecting the power supply 	<ul style="list-style-type: none"> Check that the keys are mechanically free.
A16 CPU alarm	Communication error between the control part and the power part or error in the CPU. Reset mode: <ul style="list-style-type: none"> Automatic reset 	<ul style="list-style-type: none"> Check the value of the power supply voltage both under no load and load conditions. Check for electrical noise from other devices connected to the system. Check the integrity of the communication cable between the control board and the power board.
A17 Brake alarm	In devices equipped with brakes, it indicates the achievement of the maximum energy that the braking resistor can withstand. Reset mode: <ul style="list-style-type: none"> Automatic reset if parameter Autorestart = ON 	<ul style="list-style-type: none"> Check the possible solutions for the alarm A06 Over voltage .
A19 Out of step	With parameter Motor type set to Synchronous PM, the loss of motor control occurs. Reset mode: <ul style="list-style-type: none"> Automatic reset with a 3-minute delay. 	<ul style="list-style-type: none"> Check the possible solutions for the alarm A01 Overcurrent motor
A20 Input phase loss	Absence of a power supply phase. Reset mode: <ul style="list-style-type: none"> Automatic reset if parameter Autorestart = ON 	<ul style="list-style-type: none"> Check that all three power phases are present. Check the balance of the power supply phases.
A22 ALL. TEMP. MOT.	The temperature measured by the PT100 or PT1000 probe has reached the value set in the parameter PT alarm and the device stops the engine. Reset mode: <ul style="list-style-type: none"> Automatic reset when the temperature falls below the parameter PT restart. 	<ul style="list-style-type: none"> Check that the motor is cooled correctly. Check the value set for the parameter PT alarm.

14. Warnings

Warning	Description	Possible solutions
W01 Digital input active 1	Digital input 1 has been activated.	<ul style="list-style-type: none"> • Check the configuration and connections to digital input 1.
W02 Digital input active 2	Digital input 2 has been activated.	<ul style="list-style-type: none"> • Check the configuration and connections to digital input 2.
W03 Digital input active 3	Digital input 3 has been activated.	<ul style="list-style-type: none"> • Check the configuration and connections to digital input 3.
W04 Digital input active 4	Digital input 4 has been activated.	<ul style="list-style-type: none"> • Check the configuration and connections to digital input 4.
W20 Temp. derate	The inverter is limiting the maximum motor frequency to keep the inverter temperature below the maximum limit.	<ul style="list-style-type: none"> • Check the possible solutions for the alarm A03 Over temperature inverter.
W21 Overload 15V	15V power supply overload.	<ul style="list-style-type: none"> • Check the absorption of the loads and any short circuits connected to the 15V power supply
W22 EEPROM COM.	No communication with EEPROM	<ul style="list-style-type: none"> • Contact the technical support service.
W23 EEPROM fault	Failure in EEPROM	<ul style="list-style-type: none"> • Contact the technical support service
W25 Alarm slave X	In control mode COMBO, the master has detected an alarm in the X slave.	<ul style="list-style-type: none"> • Check the status of the XX slave unit indicated by the master.
W26 No water	The power factor (cosphi) of the motor read by the device is permanently below the value set in the parameter Dry run cosphi.	<ul style="list-style-type: none"> • Check that the pump is properly primed. • Check that the pump is turning in the correct direction. • Check that the parameter Dry run cosphi is set correctly.
W27 START/STOP block	The START/STOP buttons have been locked.	<ul style="list-style-type: none"> • Press the START or STOP button for at least 5 seconds to release the lock.
W29 FREQ. RESTARTS	<p>The engine has been restarted periodically too many times.</p> <p>This warning does not involve stopping the engine, but simply serves as an indication for checking the system.</p>	<ul style="list-style-type: none"> • Check that there are no leaks in the system. • Check the correct volume and pre-charge pressure of the expansion tank. • Check the correct setting of the parameters Delta start , Delta control , Delta stop , Control ramp



NOTE

With three-phase asynchronous motors, the correct value to which parameter Dry run cosphi is to be set depends on:

- The type of motor (construction and winding data). Generally, three-phase surface motors have a higher rated cosphi than submersible motors having the same power rating.
- The type of pump (hydraulic performance and power consumption curve).
- The power supply characteristics (voltage and frequency).

In general, the parameter Dry run cosphi may be set to 60% of the nominal cosphi shown on the pump's data plate.

Parameter Dry run cosphi must also be determined empirically at the end of the installation. In the presence of centrifugal pumps with three-phase asynchronous motor, a simple method consists in starting the pump at the rated frequency and, paying attention to the sustainability of the system, completely closing the delivery and then reading the measured cosphi value on the display (or on the App). Parameter Dry run cosphi must therefore be set to 10% less than the cosphi value read under closed flow condition.



CAUTION

The electronic water shortage protection based on parameter Dry run cosphi works correctly only with centrifugal pumps equipped with three-phase asynchronous motors.

In the presence of permanent magnet motors it is not possible to base the water shortage protection on the cosphi reading; it must be based on the absorbed power, instead.

When the parameter Motor type is set to Synchronous PM, the parameter Dry run cosphi assumes the meaning of percentage of Rated motor current

In the presence of other types of pumps and motors, it is advisable to contact the technical support service.

**WARNING**

If parameter Dry run cosphi is set too low, the electronic water shortage protection may no longer be effective.

Typically, it is recommended not to go below the value of 0.5 with centrifugal surface pumps and 0.4 with centrifugal submersible pumps equipped with asynchronous three-phase motor.

Setting parameter Dry run cosphi to 0 completely excludes the water shortage protection.

15. EC Declaration of Conformity

PENTAX S.p.A.

Viale dell'Industria, 1

37040 Veronella (VR) - Italy

declares under its own responsibility that the product complies with the following directives:

- 2014/53 / EU Radio Equipment Directive (RED)
- 2011/65 / EU - RoHS Directive

and that the following harmonized standards and technical specifications have been applied:

- EN 61000-6-4:2007 + A1:2011
- EN 61000-6-3:2007 + A1:2011
(EPIC-A 203 , EPIC-A 205 , EPIC-A 207)
- EN 61000-6-1:2007 + A1:2011
(EPIC-A 203 , EPIC-A 205 , EPIC-A 207)
- EN 61000-3-2:2011
- EN 61000-3-3:2000
- EN 61000-6-2:2005 + AC:2005
- EN 61800-3:2004 + A1:2012
- EN 62233:2008
- EN 62311:2008
- ETSI EN 301 489-17 V3.1.1:2017
- ETSI EN 301 489-3 V1.1.1:2017
- ETSI EN 301 489-1 V2.1.1:2017
- ETSI EN 300 328 V2.1.1:2016-11
- EN 60529:1991 + A1:2000 + A2:2013
- EN 60335-1:2012 + AC:2014 + A11:2014 + A13:2017
- EN 50581:2012

16. UK Declaration of Conformity

PENTAX S.p.A.

Viale dell'Industria, 1

37040 Veronella (VR) - Italy

declares, under its own responsibility, that the product complies with the following directives:

- UK SI 2017 No. 1206 Radio Equipment Regulations 2017
- UK SI 2012 No. 3032. Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (RoHS2)

and that the following harmonised standards and technical specifications have been applied:

- BS EN 61000-6-4:2007 + A1:2011
- BS EN 61000-6-3:2007 + A1:2011
(EPIC-A 103 , 105 , 107)
- BS EN 61000-6-1:2007 + A1:2011
(EPIC-A 103 , 105 , 107)
- BS EN 61000-3-2:2011
- BS EN 61000-3-3:2000
- BS EN 61000-6-2:2005 + AC:2005
- BS EN 61800-3:2004 + A1:2012
- BS EN 62233:2008
- BS EN 62311:2008
- ETSI EN 301 489-17 V3.1.1:2017
- ETSI EN 301 489-3 V1.1.1:2017
- ETSI EN 301 489-1 V2.1.1:2017
- ETSI EN 300 328 V2.1.1:2016-11
- BS EN 60529:1991 + A1:2000 + A2:2013
- BS EN 60335-1:2012 + AC:2014 + A11:2014 + A13:2017
- BS EN 50581:2012

Operating manual

IPFC



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1. IPFC Introduction

IPFC is a variable frequency drive designed to control and protect pumping systems by varying the output frequency to the pump.

IPFC can be applied to both new and existing pumping systems, and provides:

- energy and cost savings
- simplified installation and an overall lower pumping system cost
- longer life of the pumping system and relevant components
- improved reliability

IPFC, when connected to any pump, manages the system operation to maintain a certain constant physical quantity (pressure, differential pressure, flow, temperature, etc.) regardless of the conditions of use. The pump is operated only when needed thus avoiding unnecessary energy consumption.



IPFC at the same time is able to:

- protect the motor from overload and dry running
- implement soft start and soft stop to increase the system life and reduce current peaks
- provide an indication of current consumption, voltage, and power
- maintain a record of run time and display any errors and/or failures reported by the system
- control up to two additional pumps at a constant speed (Direct On Line)
- connect to other IPFC units for combined operation

Through the use of inductive filters (optional) IPFC eliminates dangerous surges that are induced in long cables, making IPFC suitable for control of submersible pumps.

2. Safety Instructions

The manufacturer strongly suggests carefully reading this operation manual before using and installing its products. Any operation (installation, maintenance and repair) must be carried out by trained, skilled, and qualified personnel. Failure to observe and follow the instructions in this manual may result in dangerous and potentially lethal electric shock. Pay attention to all standard safety and accident prevention regulations.

	<p>The device must be connected to main power supply via a switch to ensure the complete disconnection from the network before any operation on the IPFC itself (including visual inspection) and/or on the connected load.</p>
	<p>Disconnect IPFC from the main power supply before commencing any work.</p> <p>Do not remove, for any reason, the cover and the cable plate without having first disconnected the device from the main power supply and having waited at least 5 minutes.</p> <p>IPFC and pumping system must be grounded properly before operation. For the entire period IPFC is powered, high voltage is present on the output terminals of the inverter whether or not the pump is running.</p> <p>Tightening all screws on the cover with washers is recommended before powering the device. Otherwise, there may be a failure to connect the cover to ground, creating the risk of electric shock or even death.</p>

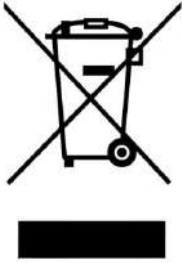
Avoid any shock or significant impact during transport.

Check the IPFC immediately upon delivery and check for damage and/or missing parts. If either occurs, immediately notify the supplier.

Damages due to transport, incorrect installation, or improper use of the device will null and void the warranty.

Tampering or disassembly of any component will automatically void the warranty.

The manufacturer cannot be held responsible for any damages to people and/or property due to improper use of its products.



Devices marked with this symbol cannot be disposed of in household waste but must be disposed of at appropriate waste drop-off centres. It is recommended to contact the Waste Electrical and Electronic Equipment drop-off centres (WEEE) in the area. If not disposed of properly, the product can have potential harmful effects on the environment and on human health due to certain substances present within. Illegal or incorrect disposal of the product is subject to serious administrative and/or criminal penalties.

3. Technical Characteristics

Model	Vin +/- 15% [V]	Max V out [V]	Max I in [A]	Max I out [A]	P2 motor power* [kW]	Size
IPFC 109	1 x 230	1 x Vin	15	9	1,1	1
		3 x Vin		7	1,5	1
IPFC 114	1 x 230	1 x Vin	20	9	1,1	1
		3 x Vin		11	3	1
IPFC 306	3 x 380 - 460	3 x Vin	10	6	2,2	1
IPFC 309	3 x 380 - 460	3 x Vin	13,5	9	4	1
IPFC 314	3 x 380 - 460	3 x Vin	16	14	5,5	2
IPFC 318	3 x 380 - 460	3 x Vin	21	18	7,5	2
IPFC 325	3 x 380 - 460	3 x Vin	31	25	11	2
IPFC 330	3 x 380 - 460	3 x Vin	35	30	15	2
IPFC 338	3 x 380 - 460	3 x Vin	42	38	18,5	3
IPFC 348	3 x 380 - 460	3 x Vin	52	48	22	3
IPFC 365	3 x 380 - 460	3 x Vin	68	65	30	3
IPFC 375	3 x 380 - 460	3 x Vin	78	75	37	3
IPFC 385	3 x 380 - 460	3 x Vin	88	85	45	3

- Power frequency: 50 - 60 Hz (+/- 2%)
- Max. ambient temperature at nominal current: 40°C (104 °F)
- Max. altitude at nominal current: 1000 m
- Grade of protection: IP55 (SIZE 1,2) , IP54 (SIZE 3) *
- RS485 serial communication

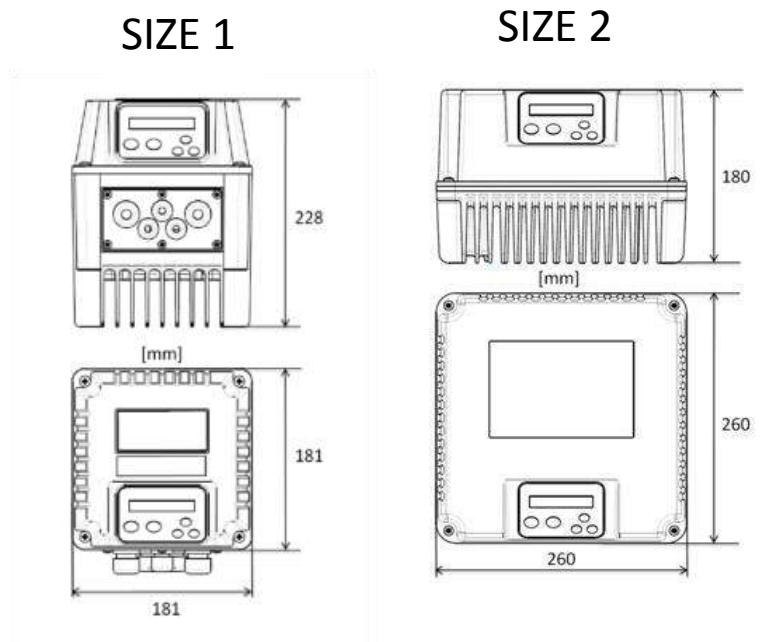
* auxiliary cooling fan of the IPFC, used in wall mounted applications, has a protection rating of IP54.

IPFC is able to power the motor with a higher current for a short period of time according to the linear relation: 101% of the nominal current for 10min., 110% nominal current for 1 min.

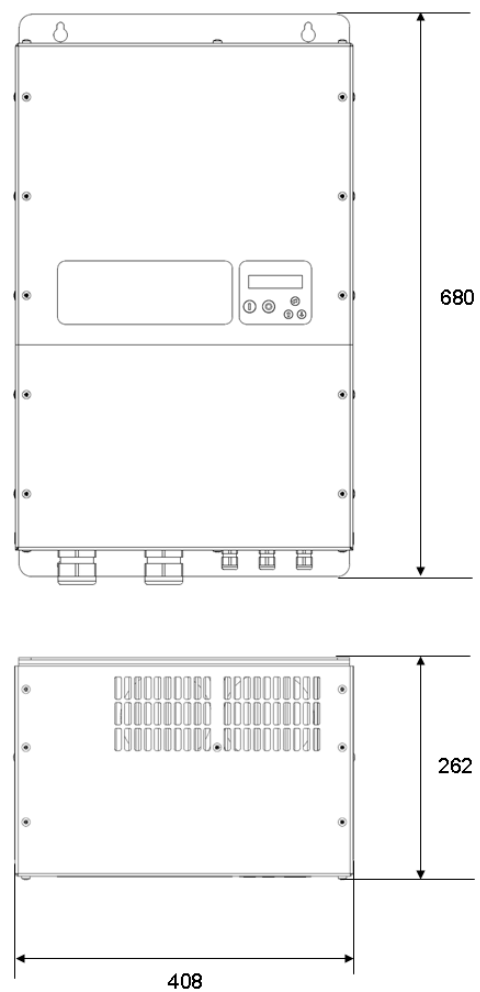
3.1 Weight and dimensions

Model	Weight *	Size
	[Kg]	
IPFC 109	4	1
IPFC 114	4,3	1
IPFC 306	4,4	1
IPFC 309	4,4	1
IPFC 314	7	2
IPFC 318	7	2
IPFC 325	7	2
IPFC 330	7,2	2
IPFC 338	33	3
IPFC 348	33	3
IPFC 365	34	3
IPFC 375	34	3
IPFC 385	34	3

* Weight without packing.

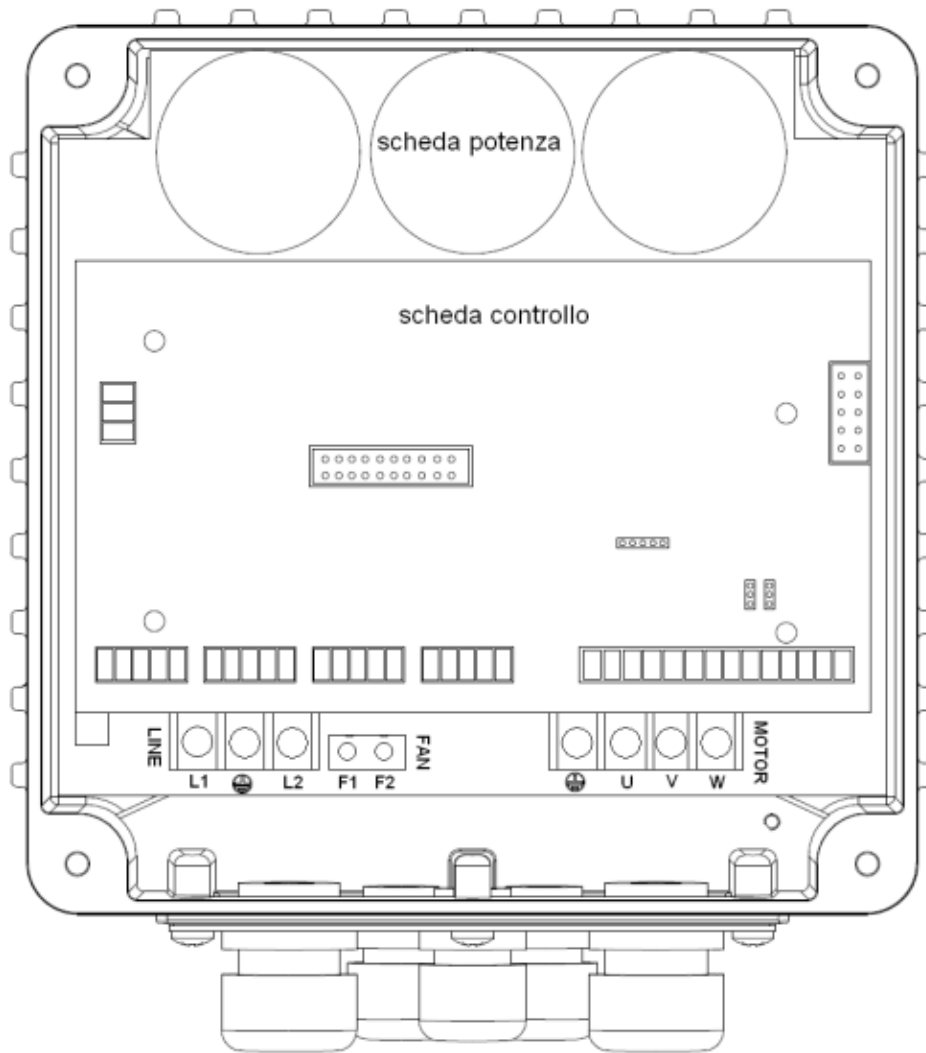


SIZE 3



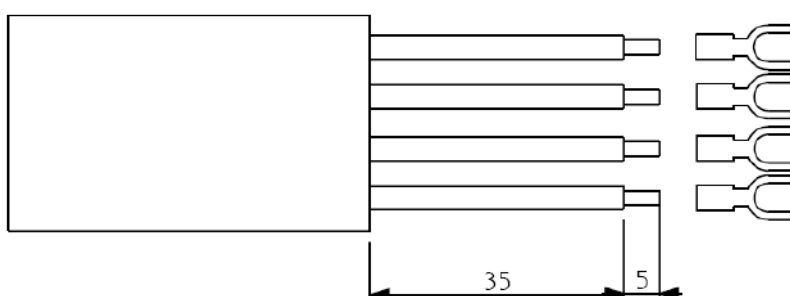
4. Electric wiring

Power board IPFC 109,114

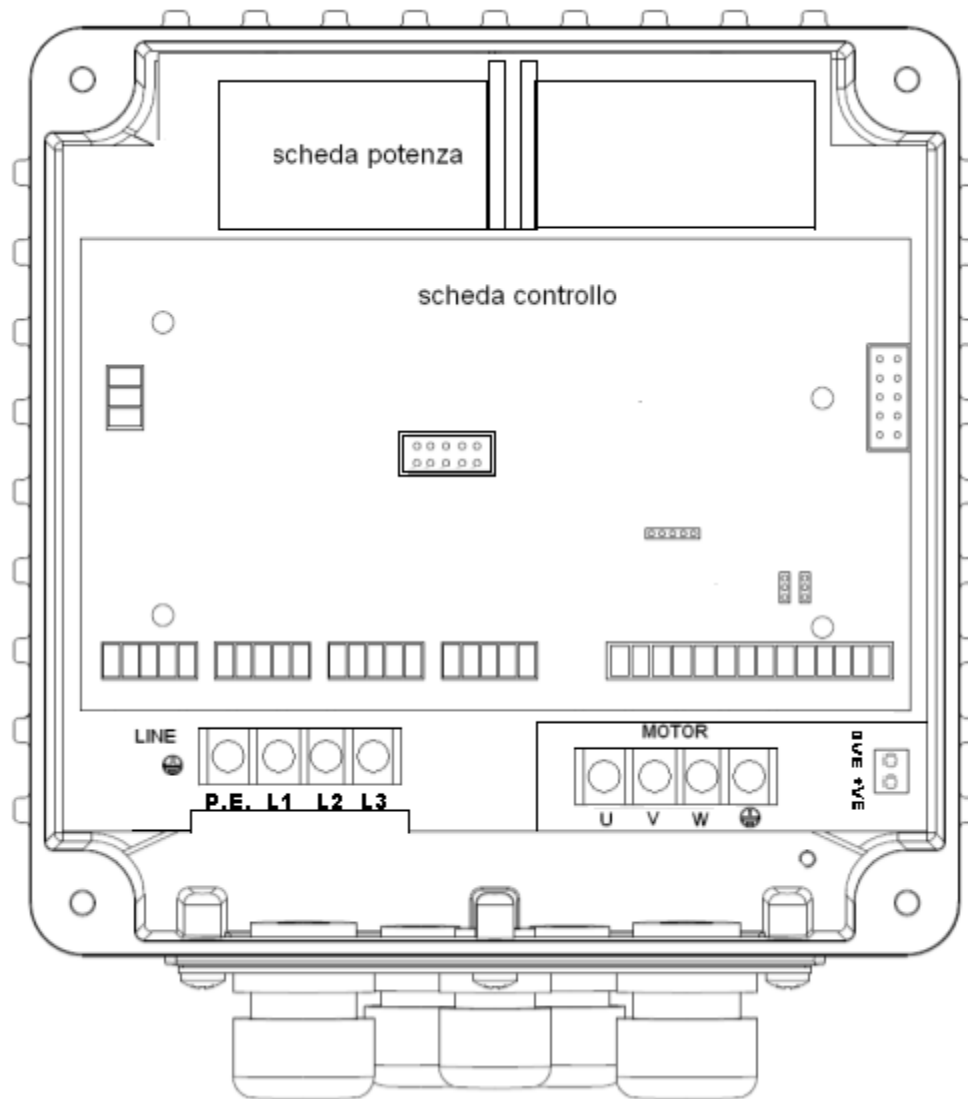


<p>Power supply: LINE: L1, L2,GND It is recommended to use cable lugs</p>	<p>Output: 3 ph motor: GND,U,V,W, 1 ph motor: earth, U (running), V (common) It is recommended to use cable lugs.</p>	<p>230 V AC auxiliary fans (wall mounting kit) FAN: F1, F2</p>
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Recommended line and motor cables stripping

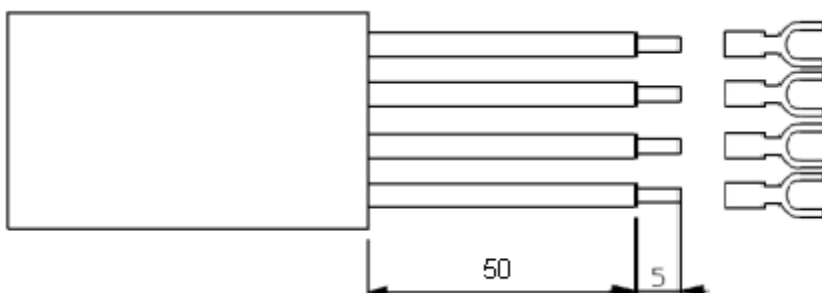


Power board IPFC 306,309

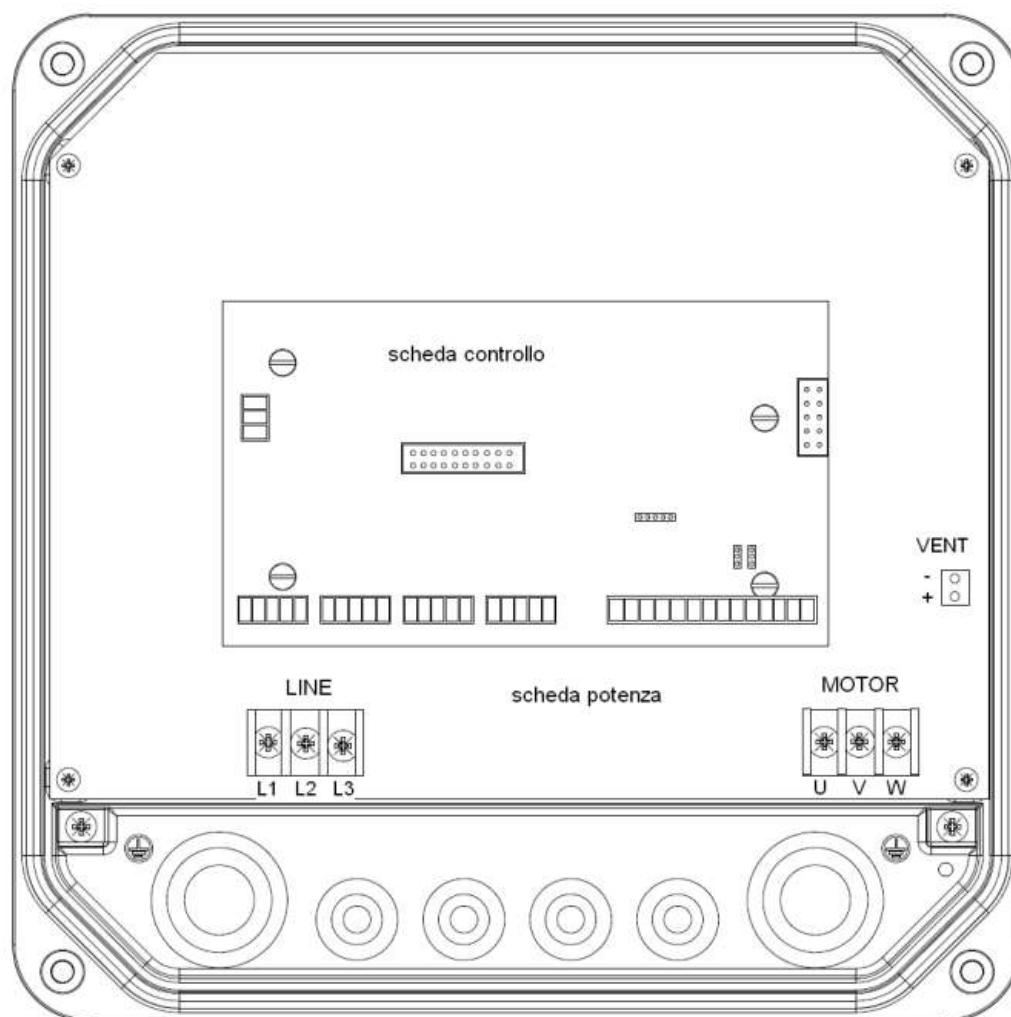


<p>Power supply: LINE: GND , L1, L2, L3, It is recommended to use cable lugs.</p>	<p>Motor output: MOTOR: U, V, W, GND It is recommended to use cable lugs.</p>	<p>12 V dc auxiliary fan (wall mounting kit) : 0VE, + VE WARNING: respect the polarity.</p>
--------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------

Cable stripping recommended for line input and output to the motor.

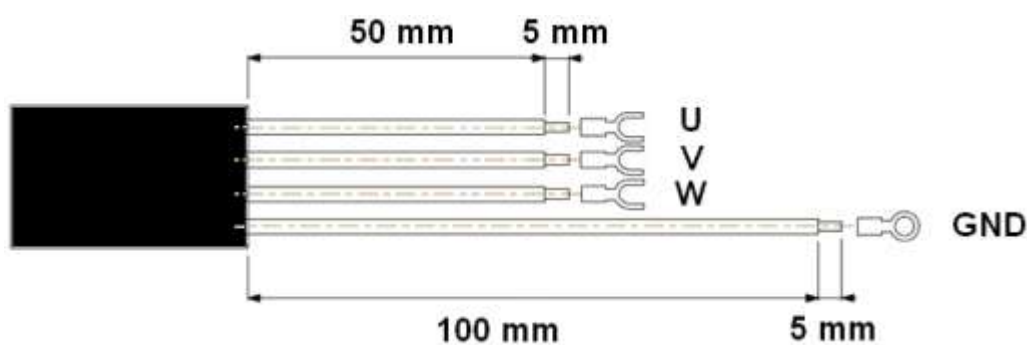


Power board IPFC 314,318,325,330

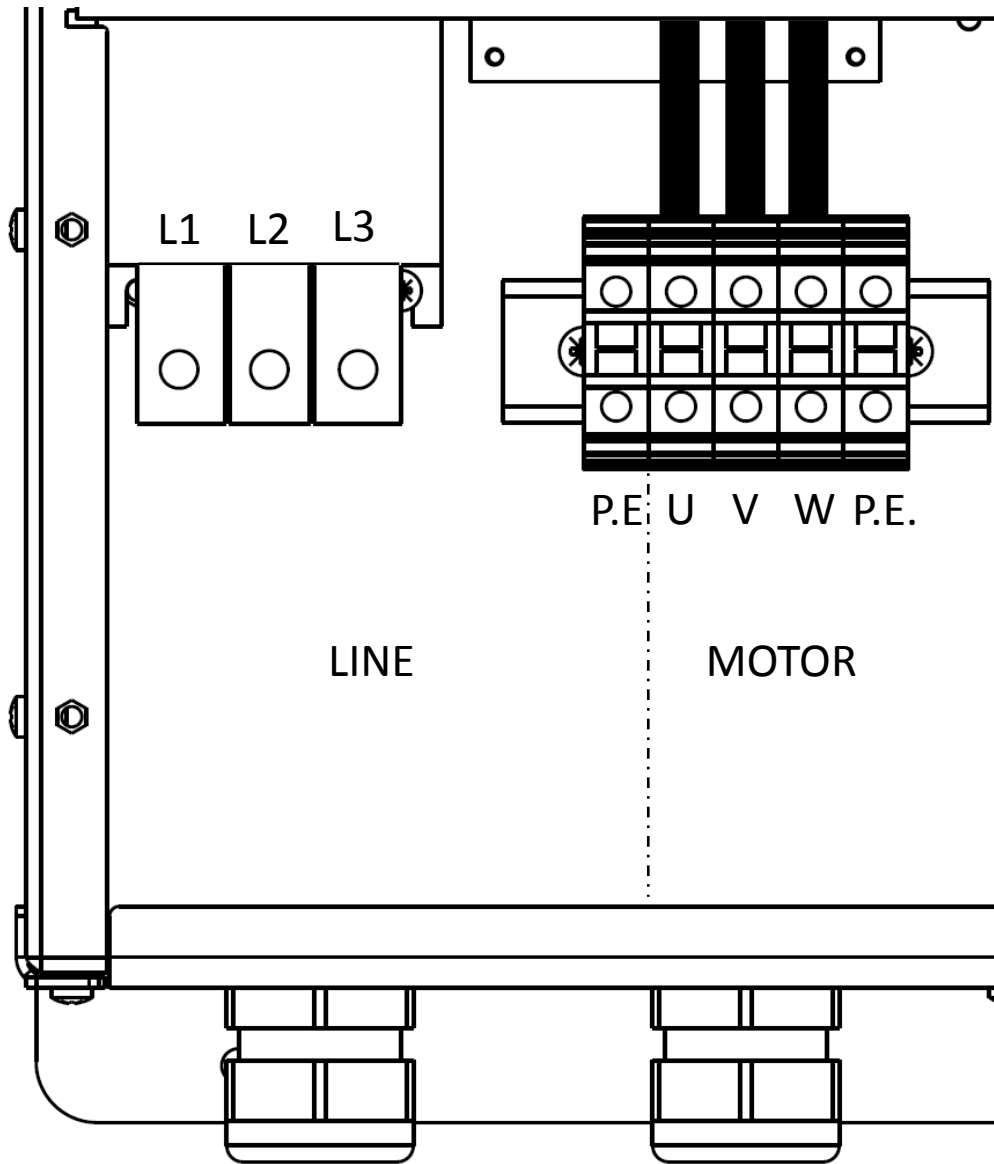


<p>Power supply: LINE: L1, L2, L3, GND It is recommended to use cable lugs.</p>	<p>Motor output: MOTOR: U, V, W, GND It is recommended to use cable lugs.</p>	<p>12 V dc auxiliary fans (wall mounting kit) VENT: +, - WARNING: respect the polarity.</p>
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Cable stripping recommended for line input and output to the motor.

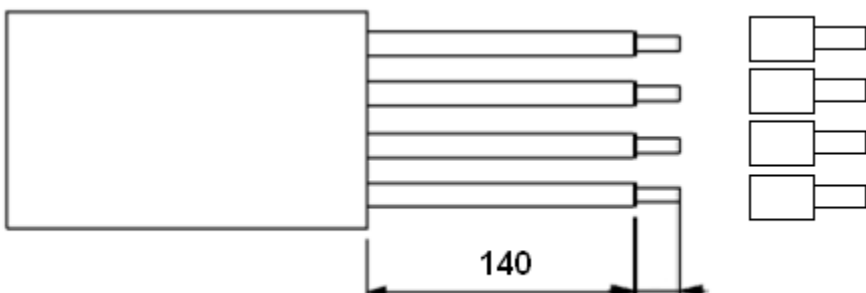


Power board IPFC 338,348,365,375,385

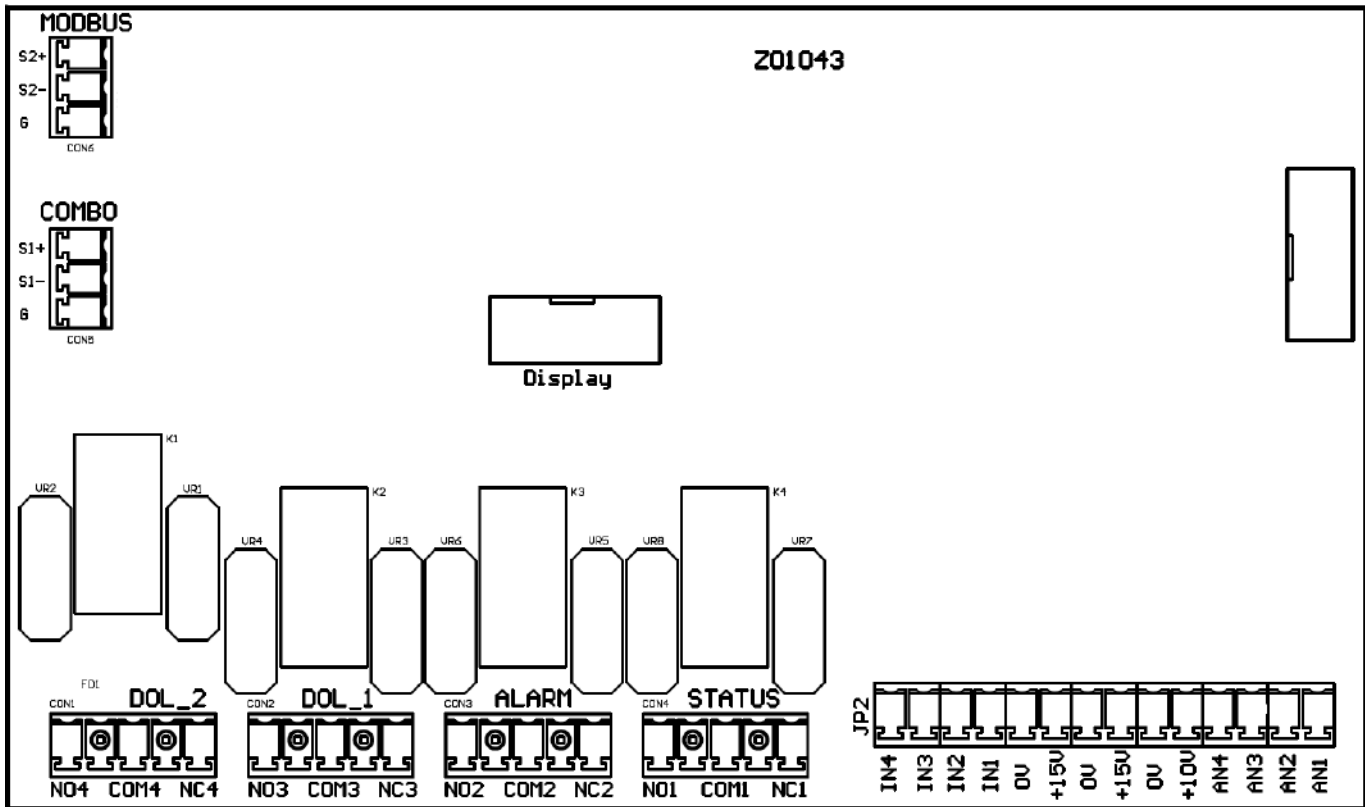


<p>Power supply:</p> <p>LINE: L1, L2, L3, P.E.</p> <p>It is recommended to use cable lugs.</p>	<p>Motor output:</p> <p>MOTOR: U, V, W, P.E.</p> <p>It is recommended to use cable lugs.</p>
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Cable stripping recommended for line input and output to the motor.



Control board



<p>Analog inputs (10 or 15 Vdc):</p> <ol style="list-style-type: none"> 1. AN1: 4-20 mA: sensor 1 2. AN2: 4-20 mA: sensor 2 3. AN3: 4-20 mA / 0 - 10 Vdc (settable by jumper C.C.): external set 4. AN4: 4-20 mA / 0 - 10 Vdc (settable by C.C.): trimmer for frequency regulation / external set 2 	<p>Digital outputs:</p> <ul style="list-style-type: none"> • motor run signal: NO1, COM1: closed contact with motor running. NC1, COM1: closed contact with motor stopped. • alarm signal NO2, COM2: closed contact without alarm. NC2, COM2: closed contact with alarm or no power supply. • DOL1 pump relay: NO3, COM3: closed contact with DOL1 running. NC3, COM3: opened contact with DOL1 running. • DOL2 pump relay: NO4, COM4: closed contact with DOL2 running. NC4, COM4: opened contact with DOL2 running. <p>Relays are no voltage contacts. Max. voltage to the contacts is 250 V with max current of 5 A.</p>	<p>RS485 for COMBO:</p> <ul style="list-style-type: none"> • S1+ • S1- • G <p>It is recommended to respect the polarity linking more IPFCs in series.</p>
<p>Digital inputs:</p> <ul style="list-style-type: none"> • IN1 : motor start & stop • IN2: value set 1 & 2 switching • IN3: sensor 1 & 2 switching • IN4 : motor start & stop + alarms reset • 0V <p>We recommend using only no voltage contacts. Opening or closing the digital contacts (depending on software configuration set (see IN/OUT. parameters) you can start or stop the motor.</p>		<p>RS485 for MODBUS:</p> <ul style="list-style-type: none"> • S2+ • S2- • G <p>It is recommended to respect the polarity.</p>

4.1 Protections

The protections required upstream each IPFCs depends on the type of installation, and local regulations. We recommend to use overload protection with the characteristic curve of type C and type B circuit breaker, sensitive to both AC and DC current.

4.2 Electromagnetic compliance

To ensure electromagnetic compatibility (EMC) of the system, it is necessary to apply the following measures:

- Always connect the device to ground
- Use shielded signal cables by placing the screen at one end.
- Use motor cable as short as possible (<1 m / <3 ft). For longer lengths, it is recommended to use shielded cables connecting the screen at both ends.
- Separate signal, motor, and power supply cables.

Note: To enable the restoration of the display screen when there are electromagnetic interference, IPFC periodically provides some fast "refresh" of the display.

4.3 Installation with long motor cables

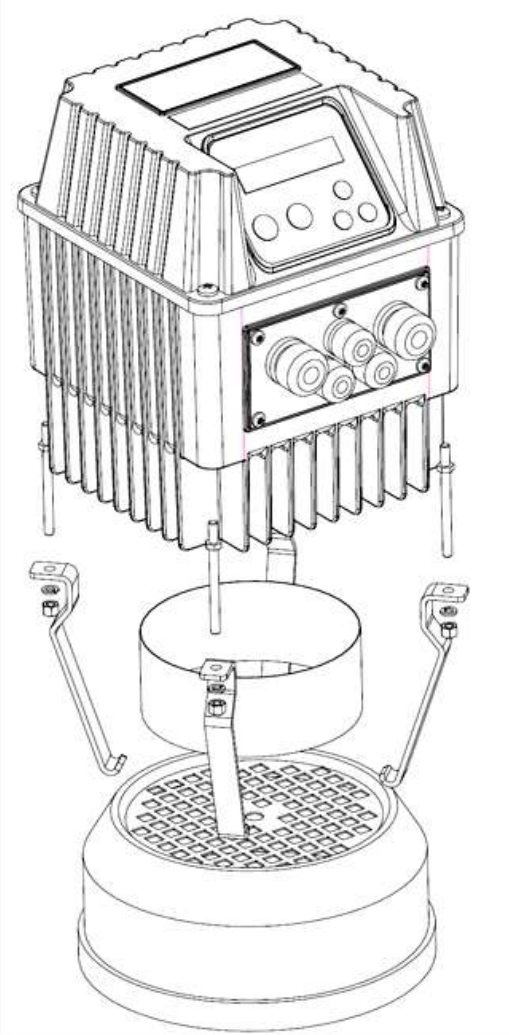
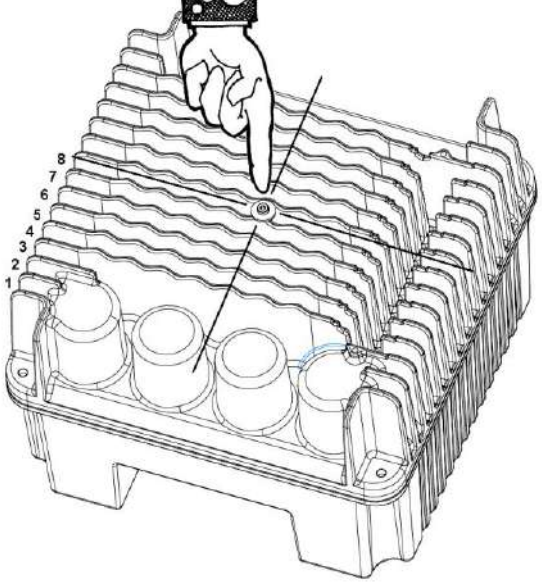
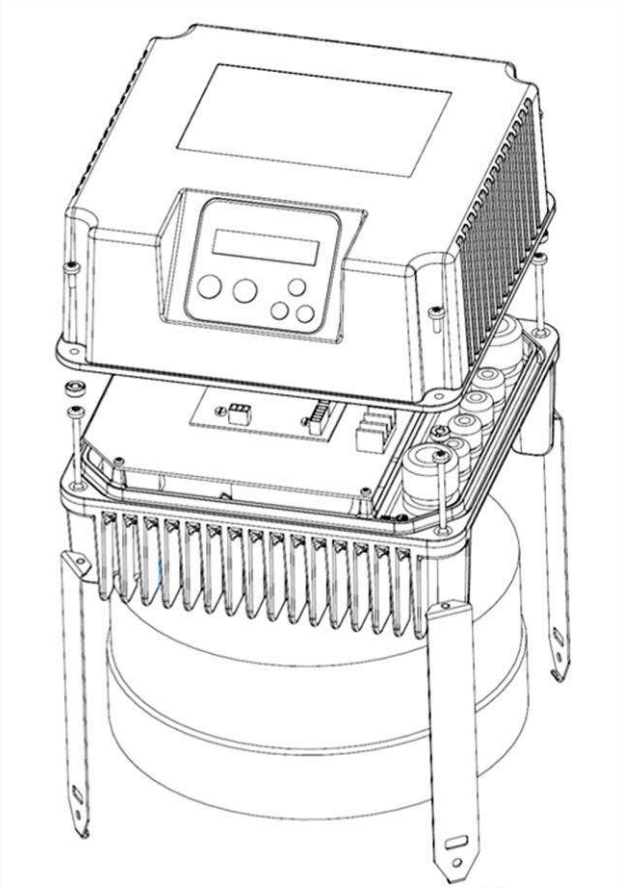
<p>With long motor cables it's recommended to decrease the commutation frequency from 10 kHz (default) to 2.5 kHz (advanced parameters). This reduces the probability of voltage spikes in the motor windings which may damage the insulation.</p>	<div data-bbox="954 954 1401 1361" data-label="Figure"> </div> <p>To prevent dangerous overheating of dv/dt and sinusoidal filters it is recommended to set the correct PWM value in relation to the cable length.</p>
<p>For motor cable lengths up to 50 meters it's recommended to place between IPFC and motor a dv/dt reactance, available on request.</p> <div data-bbox="384 1686 600 1944" data-label="Image"> </div>	<p>For motor cable lengths greater than 50 meters it's recommended to place between IPFC and motor a sinusoidal filter, available on request.</p> <div data-bbox="1046 1686 1294 1966" data-label="Image"> </div>

5. IPFC installation

IPFC can be installed directly on the fan cover **of the motor** or mounted on the **wall**.

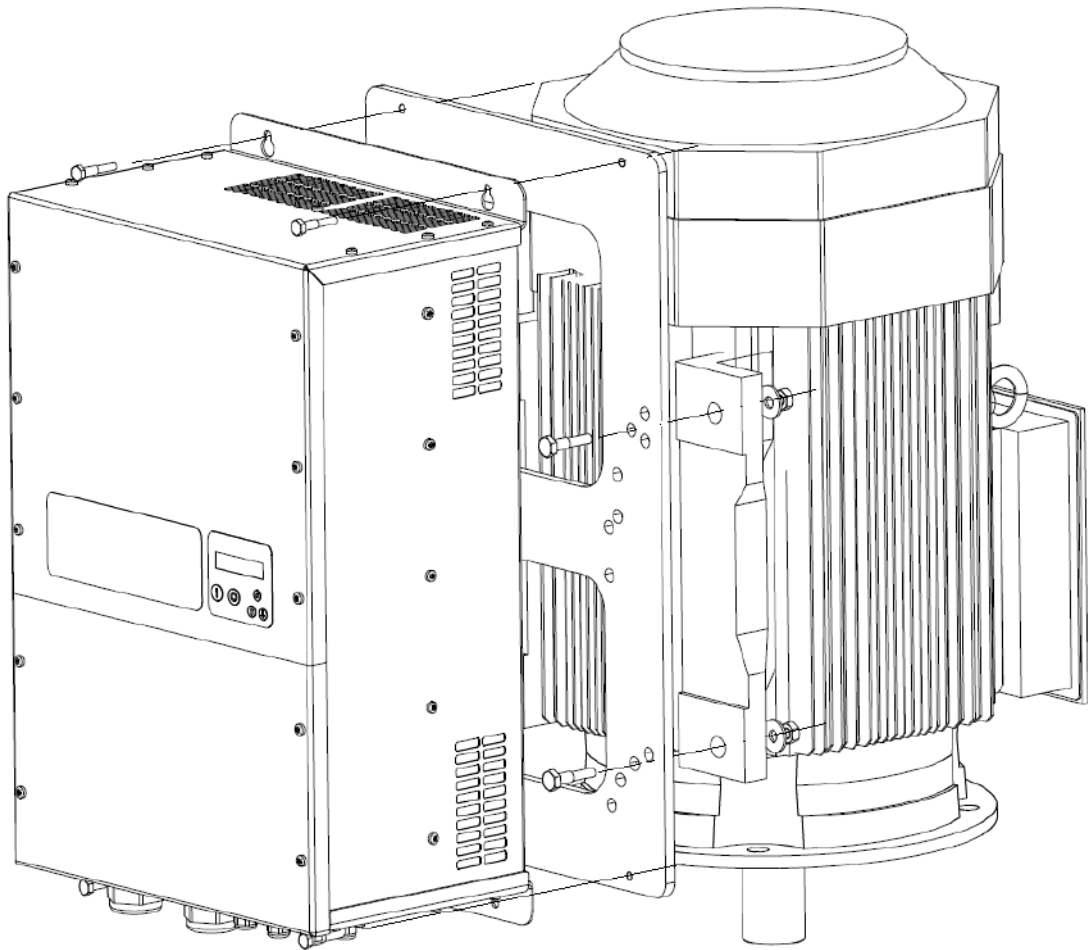
Motor mounting kit

In this application IPFC is cooled by the motor fan. Motor kit (available upon request) allows a solid coupling of the two units and it is composed of:

IPFC SIZE 1	IPFC SIZE 2
<ul style="list-style-type: none"> • n.°4 rods • n.°4 M5 nuts • n.° 4 hooks • n.° 1 cooling ring 	<ul style="list-style-type: none"> • n.° 4 M5 screws. • n.° 4 clamps • n.° 4 clips to add if necessary • n.°1 centre pin
 <p>The diagram shows the IPFC Size 1 unit with four vertical rods extending from its base. Below the unit is a circular cooling ring with a grid pattern. Four hooks are shown, each designed to grip one of the rods and the cooling ring to secure them together.</p>	  <p>The top diagram shows a hand pointing to a hole on the top surface of the IPFC Size 2 unit, with a line indicating the location of a screw. The bottom diagram shows the IPFC Size 2 unit with four clamps and four clips attached to its sides, and a central pin inserted into the bottom.</p>
<p>Use the cooling ring for best cooling of IPFC during operation. Warning: when using the cooling ring, the cooling air of the motor is slightly warmer than without the IPFC; if the resulting motor temperature exceeds the indicated maximum allowable value, remove the cooling ring, leaving the IPFC to be cooled by itself.</p>	

IPFC SIZE 3

- n.º 1 motor feet adaptor for MEC160,180,200,225
- n.º 4 M8 bolts,
- n.º 4 M10 bolts, nuts and washer

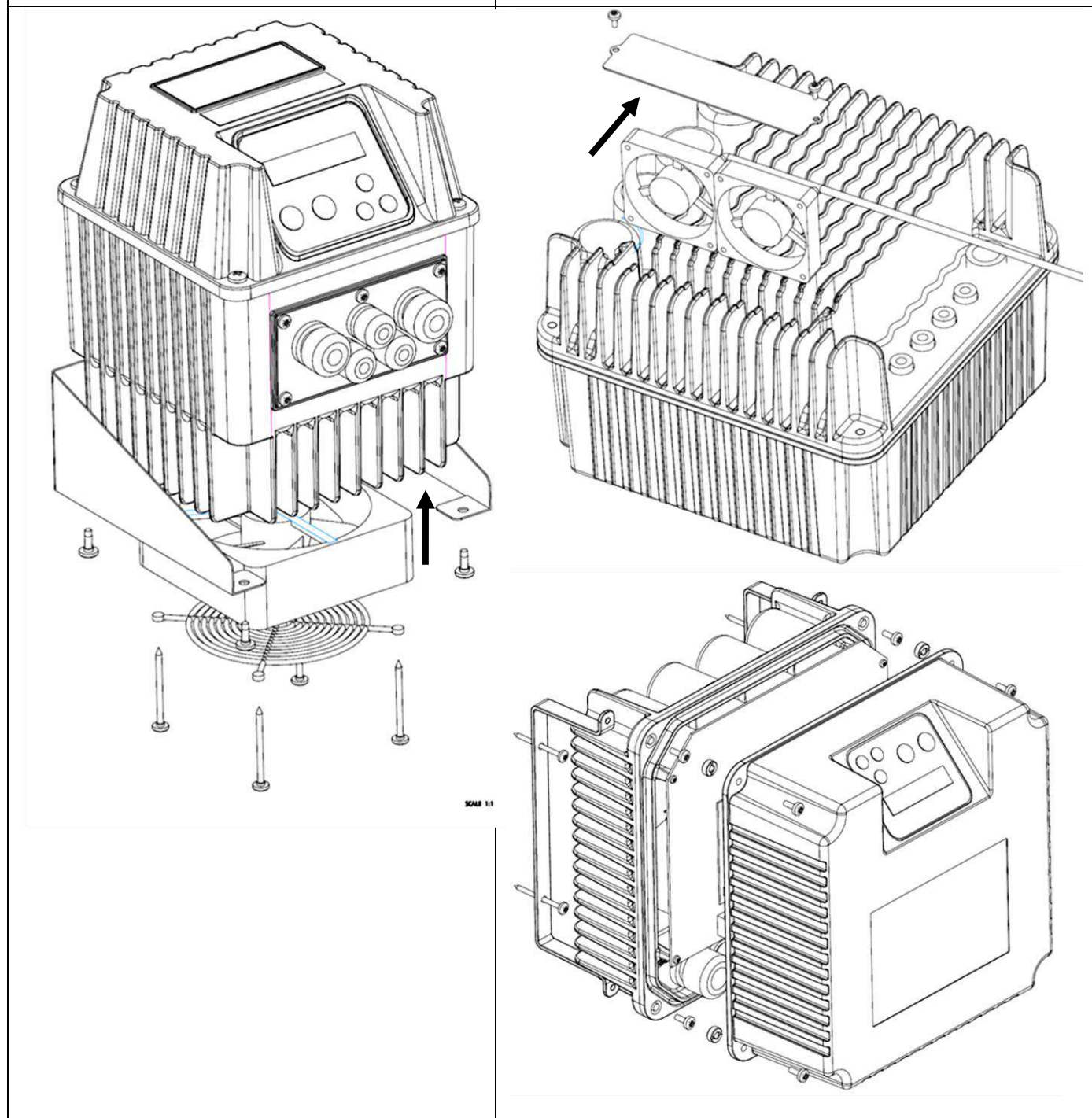


Wall mounting kit

In this application IPFC is cooled independently by its auxiliary cooling fan integrated in the radiator.

Wall-mounted kit is composed of:

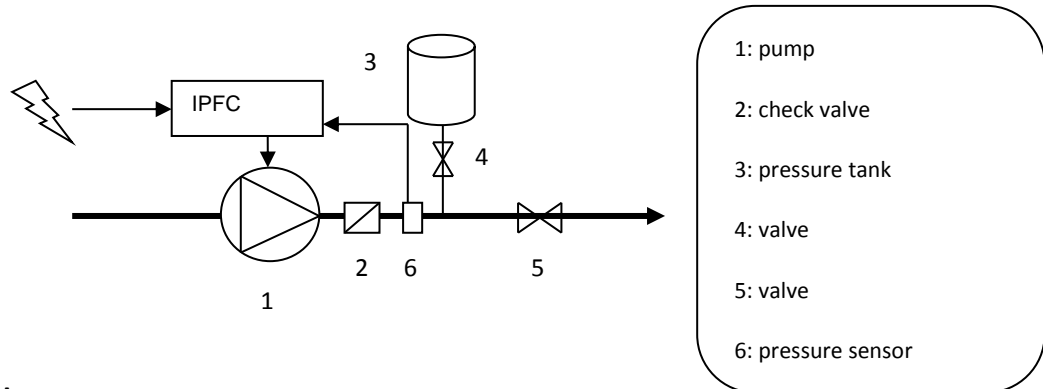
IPFC SIZE 1	IPFC SIZE 2
<ul style="list-style-type: none">• n.° 1 auxiliary fan 230V AC (IPFC 109,114) or 12 VDC (IPFC 306,309)• n.° 4 screws to fix cooling fan• n.° 1 protection grill• n.° 1 metal bracket in AISI 304• n.° 4 screws to fix IPFC to wall bracket	<ul style="list-style-type: none">• n.° 2 12 V DC fans.• n.° 1 fans cover.• n.° 2 fans cover fixing screws• n.° 2 wall fixing brackets• n.° 4 M5 screws for IPFC fixing to the brackets• n.°1 holes reference sheet



Make sure the manufacturer that the electric motor is suited for operation in the inverter
Make sure to properly attach the grid of the auxiliary cooling fan.
Make sure to remove the auxiliary cooling fan if IPFC is coupled to a motor. Failure to do so creates a high risk of overheating the motor and IPFC unit.

5.1 IPFC Installation for constant pressure control

IPFC controls the pump speed to maintain constant pressure at a set point independent of the water demand in the system. A basic schematic is shown below:



5.1.1 Pressure tank

Installation of a pressure tank in the hydraulic system is recommended to compensate leakage of water in the system (or during minimum water demand) and to avoid continuous start/stop cycling of the pump (check the appendix for more information). Selecting the proper volume and pre-charge pressure of the tank is very important; smaller tank volumes will not compensate adequately for minimum water usage or leakage, while larger volumes make it more difficult for IPFC to control the pressure evenly.

Recommended tank volume is equal to the 10% of the maximum water flow of the system (expressed in volume unit/min)

Example: if the max water flow is 50 liters/min, the pressure tank should have a capacity of 5 liters

If the max water flow is 20 gpm, the pressure tank should have a capacity of 2 gallons

Pre-charge pressure of the pressure tank should be at least 80% than the set-pressure of the system.

Example: if the set-pressure of the system is 4 bar, the pre-charge pressure of the tank should be 3.2 bar

If the set-pressure of the system is 60 psi, the pre-charge pressure of the tank should be 48 psi

5.1.2 Pressure sensor

IPFC requires a pressure sensor with a linear output signal within the range 4 – 20 mA. The pressure transducer can be powered by any range of DC Voltage which includes the value 15 V dc.

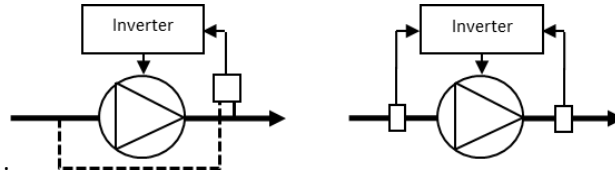
IPFC accepts the signal of a second pressure sensor in order to:

- realize constant differential pressure (AN1 – AN2).
- substitute first pressure sensor when it fails
- switch pressure sensor by closing digital input IN2

SENSOR 1	<ul style="list-style-type: none"> • AN1: 4-20 mA (-) signal • +15V: 15 Vdc (+) power supply
SENSOR 2	<ul style="list-style-type: none"> • AN2: 4-20 mA (-) signal • +15V: 15 Vdc (+) power supply

5.2 IPFC installation for differential constant pressure applications

IPFC can manage the pump speed in order to keep constant the pressure difference between the discharge and suction side of the pump in circulation systems. To do this, it is usually installed a differential pressure sensor. Alternatively, it is possible to use two identical pressure sensors: one in suction side and one in discharge side of the pump. The difference of values is performed by the IPFC itself.



N.B. If during the operation it is expected that the pressure in the suction side falls below the atmospheric pressure, it is necessary to use absolute pressure sensors and not relative ones.

5.2.1 Sensors wiring

The IPFC can be connected to linear pressure sensors with 4 - 20 mA output. The supply voltage range of the sensors must include the 15 VDC with which the IPFC feeds the analog inputs.

If you are using a differential pressure sensor it is necessary to connect the sensor to the analog input 1:

DIFFERENTIAL SENSOR	<ul style="list-style-type: none"> • AN1: 4-20 mA (-) signal • +15V: 15 Vdc (+) supply
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In case two pressure sensors are used, the pressure sensor in the discharge side must be connected to the analog input 1 while the pressure sensor in the suction side must be connected to the analog input 2:

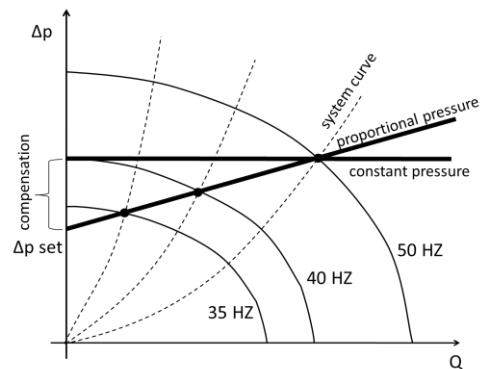
SENSOR 1 (discharge)	<ul style="list-style-type: none"> • AN1: 4-20 mA (-) signal • +15V: 15 Vdc (+) supply
SENSOR 2 (suction)	<ul style="list-style-type: none"> • AN2: 4-20 mA (-) signal • +15V: 15 Vdc (+) supply

In the IN/OUT parameters menu it is therefore necessary to set the logic AN1, AN2 as "difference".

5.2.2 Programming

In circulation systems pump starting and stopping is usually controlled by an external contact that can be connected to the digital input 1 (IN1, 0V) and configured as N.O or N.C in the IN/OUT parameters menu. It is then recommended to set the following parameters:

Control parameter	Recommended value
Freq. min control	Same as minimum motor frequency
Delta control	0 bar
Delta start	0 bar
Stop delay	99 sec
IN/OUT parameter	Recommended value
Function AN1,AN2	Difference 1-2



Constant differential pressure

The "set value" corresponds to the differential pressure to be kept constant.

Set the "set value" equal to the pressure difference measured between the discharge and the suction side of the pump at maximum load (all utilities opened) and at maximum frequency (50 Hz).

Proportional differential pressure

In case it is needed to use a control logic based on proportional differential pressure (in order to achieve a further energy saving), it is necessary to set the "set value" equal to the pressure difference between the discharge and suction side of the pump at minimum frequency (20 Hz) and "compensation" in order to reach the maximum set value at maximum frequency (50 Hz) and maximum load (all utilities opened).

6. IPFC Use and Programming

IPFC software is extremely simple to use, but allows a wide variety of parameters to be set for ideal system calibration. Setting Parameters are organized in 2 levels:

1: Installer level (MENU' CONTROL PARAMETERS, MENU' IN/OUT PARAMETERS, MENU' CONNECTIVITY PARAM.)

A password is required for this level; these parameters are adjustable by trained professionals

Default password: **001**

From the menu a different password can be set up.

2. Advanced level (MENU' MOTOR PARAMETERS)

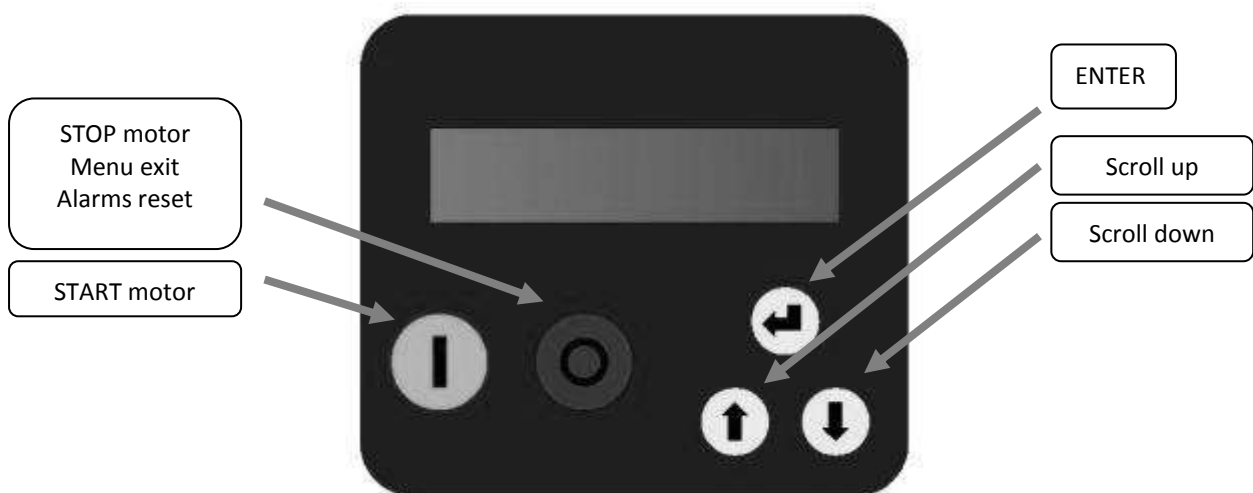
A second and different password is required; improper setting of these advanced parameters could compromise the integrity and the life of IPFC and pump;

Default password **002**

It is possible to set up a different password.

Installer and Advanced levels can be entered only with the correct password; otherwise, it is impossible to set up and/or modify any parameters (they can be only displayed).

6.1 IPFC display



Screen is a back-lit LCD displaying 2 rows of 16 digits each. Alarms are indicated by an audible signal.

6.2 Initial configuration

When IPFC is switched on for the first time, the initial setting menu is displayed for the initial setting of parameters to configure pump characteristics, pressure sensor range, and system characteristics.

If the initial setting procedure is not completed properly, it is impossible to run the pump. Initial setting procedure can be repeated if necessary.

The initial setting procedure can be repeated (by using the 2nd level password) to reconfigure IPFC or if IPFC is installed in a different system.

A brief description of parameters and their allowable ranges are listed below:

Parameter	Default	Description
Language XXXXXX	XXXX	End user communication language
Unit XXXXX	bar	Unit
Motor type XXXXXX	three-phase	Type of motor connected: <ul style="list-style-type: none"> • single phase (IPFC 109, 114) • asynchronous three-phase • synchronous PM (permanent magnets)
Rated motor Amp. I = XX.X [A]	XX	Rated current of the motor per it's nameplate indication increased by 10%. The voltage drop caused by the inverter leads to higher input current than nominal. Make sure motor is capable of accepting increased current.
Rated motor freq f = XXX [Hz]	50	Rated frequency of the motor per its nameplate.
Control mode: Constant value [bar]		
F. scale sensor p = XX.X [bar]	16	Sensor full scale.
Sensor test Press ENT		If the transducer is not connected or connected improperly, the signal SENSOR OFF is activated when pressing ENTER.
Max alarm value p = XX.X [bar]	10	Maximum pressure allowed in the system. If the pressure goes over this value, an alarm occurs and the pump is stopped. Pump is automatically restarted if the pressure goes below the maximum value for a period of at least 5 seconds.
Set value p = XX.X [bar]	3	The pressure value to be kept constant.
MOTOR TUNING press ENT		If the device is "FOC-ready", motor calibration must be carried out before commissioning. Carefully read the pertinent chapter.
Motor test START/STOP		Press START/STOP to run a test at rated frequency Warning: make sure to run the system without damaging pump and system
Rotation sense ---> / <---	--->	If, during the test, the motor runs in reverse, it is possible to change the wiring sequence via software without physically changing wires at the terminals.
COMBO ON/OFF	OFF	Activation or deactivation of COMBO operation.
Autorestart ON/OFF	OFF	If ON is selected, after a lack of voltage, IPFC returns to its normal status; if IPFC was powering the pump before the voltage drop, it resumes powering the pump automatically. <u>Warning</u> , review the advice in chapter 1

<p>INITIAL SETUP COMPLETED</p>		<p>Once the Setting procedure is completed you will get this indication on the display; setting parameters are recorded by IPFC; these parameters can be set up individually in the parameters menu.</p>
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6.2.1 FOC motor control

Introduction

FOC (Field Oriented Control) motor control implemented in FOC-ready inverters provides the following advantages compared to traditional control:

- Optimal control of the current at each work point.
- Quick and precise speed adjustment.
- Lower energy consumption.
- Reduction of torque oscillations (vibrations) for smoother and more regular operation throughout the frequency range and lower system noise.
- Lower mechanical stress on the motor, pump and hydraulic system.

FOC control of FOC-ready devices can be used with:


- Asynchronous three-phase motors
- Permanent magnet three-phase synchronous motors


The control is sensorless, i.e. not requiring the use of any sensors.

Calibration of the FOC control

To enable the device to perform FOC control, it is necessary to:


1. Perform all system wiring. Connect the load (pump) to the inverter with a cable of appropriate length and possible presence of a dV/dt or sinusoidal filter.
2. Power the system and follow the initial configuration procedure by specifying:
 - a) Motor type: three-phase asynchronous or permanent magnet synchronous.
 - b) Rated voltage of the motor.
 - c) Rated frequency of the motor.
 - d) Rated current of the motor increased by 5%.
3. Perform the Auto tuning process to allow the inverter to learn the electrical information of the load connected to it (motor, cable and any filter). The calibration process can take up to one minute.
4. Wait for the calibration process to complete successfully.

	<p>During the calibration process the motor remains stationary but is powered for the entire calibration period. Disconnect the device from the power supply before any intervention on the equipment and on the loads connected to it. Carefully follow the safety instructions in the installation and operating manual of the device.</p>
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	<p>The calibration process can take up to one minute. Wait until it has completed.</p> <p>The calibration process must be performed during the final electrical configuration of the system, i.e. with the motor, the cable and any filter applied.</p> <p>If there is any variation of the motor, cable or filter applied, it is necessary to repeat the calibration process by accessing the motor parameters menu (default password 002).</p> <p>An incorrect configuration of the motor's rated voltage, frequency or current will lead to erroneous results in the calibration process and therefore to a malfunctioning of the motor.</p> <p>Setting the rated motor current higher than the tag value can seriously damage both the motor and the inverter.</p> <p>During calibration the motor coils are heated by the test current. If the motor is self-ventilated the absence of motor rotation does not allow the heat to be dispersed by force.</p> <p>It is therefore recommended to allow the motor to cool between one calibration and the next.</p>
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If the calibration process is not successful, it is necessary to check:

- The connections between the inverter and the load (including any motor filters in between).
- The rated voltage, frequency and current values set.

	<p>The motor cannot be started until the calibration process has been completed.</p> <p>If the calibration process cannot be completed, it is possible to manually enter the parameters or stator resistance (Rs) and stator inductance (Ls) in the motor parameters menu (default password 002).</p> <p>These data can be provided by the motor manufacturer or obtained through measurements.</p> <p>If you do not have these data and the self calibration process is not successful, it is recommended to contact technical assistance.</p>
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Adjustment of the FOC control

The FOC control algorithm checks current (torque) and speed with defined response dynamics.

The FOC dynamic is set by default to a value sufficient to guarantee precise and oscillation-free control in most applications.

In some cases, however, it may be necessary to increase (if there are frequency oscillations) or to lower (in the event of overcurrent or igbt trip alarms) the "FOC dynamic" setting in the motor parameters menu (default password 002) according to the following table :

CONFIGURATION	FOC DYNAMIC
Motor cables shorter than 100 m and no filter between inverter and motor.	200
Motor cables shorter than 100 m and a dV/dt filter between the inverter and the motor.	150
Motor cables longer than 100 m and a dV/dt filter between the inverter and the motor.	100
Presence of a sinusoidal filter between the inverter and the motor.	50

	<p>The incorrect setting of the FOC dynamic can cause:</p> <ul style="list-style-type: none"> • Speed oscillations if the FOC dynamic is too slow. • Overcurrent or igbt trip alarms if the FOC dynamic is too fast. <p>It is recommended to intervene promptly by appropriately adjusting the "FOC Dynamic" parameter if the conditions listed above are present.</p> <p>Lack of intervention could lead to damage to the inverter, the motor and the system.</p>
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6.3 Initial view

When first powering the IPFC, the display shows : release of display software (LCD = X.XX) and the release of inverter software (INV = X.XX) as shown below:

The following End User messages are displayed by pushing the scroll buttons:

<p>Inv: ON/OFF Mot: ON/OFF p = XX.X [bar]</p>	<p><i>p is the pressure value read by the pressure transducer. By pressing ENTER the pressure set value is displayed <XXX.X></i></p>
<p>Inv: ON/OFF Mot: ON/OFF f = XXX [Hz]</p>	<p>f value is the supply frequency to the motor; On fix frequency control mode, by pressing ENTER you can change the f value manually (word "set" is displayed) , press ENTER again to exit parameter setting (word "set" disappeared).</p>
<p>Inv: ON/OFF Mot: ON/OFF V_in = X.XX [V] I= XX.X</p>	<p>V_in is the line voltage. This value is displayed only if motor is OFF; if motor is ON, A value equal to the absorbed motor current.</p>
<p>Inv: ON/OFF Mot: ON/OFF cosphi = XXX</p>	<p>cosphi index means the angle phi between the voltage and current absorbed by the motor</p>
<p>Inv: ON/OFF Mot: ON/OFF P = XXXXX [W]</p>	<p>P is the power in Watts supplied to the pump.</p>
<p>Inv: ON/OFF Mot: ON/OFF STATUS: NORMAL</p> <hr/> <p>Inverter Life xxxxx h : xx m</p> <hr/> <p>Motor Life xxxxx h : xx m</p> <hr/> <p>%f 25 50 75 100 %h XX XX XX XX</p> <hr/> <p>XXXXXXXXXXXXXXXXXXXX XXXXXXXX h : XX m</p>	<p>NORMAL status means no alarms. If an alarm occurs, a message blinks on the display and an audible signal is activated. Pressing ENTER accesses: IPFC lifetime, PUMP lifetime, consumption statistic, alarm list. To return to previous views, press ENTER.</p>
<p>Menù ENT to access</p>	

First row gives the IPFC status:

- **Inv: ON XXX.X Hz** IPFC is powered and is powering the motor showing its frequency.
- **Inv: ON Mot: OFF** IPFC is powered but motor is not running (i.e. motor/pump was stopped due to minimum frequency being reached)
- **Inv: OFF Mot: OFF** IPFC is not powered

If COMBO function is activated, the IPFC address is placed close to indication "Inv".

6.4 Menu view

Pressing ENTER when you are in [MENU' / ENT to access] in initial display, will display the following MENUS:

MENU' Control. param.	Installer password required to enter level 1 (default 001)
MENU' Motor param.	Advanced password required to enter level 2 (default 002)
MENU' IN/OUT. param.	Installer password required to enter level 1 (default 001)
MENU' Connect. param.	Installer password required to enter level 1 (default 001)
MENU' Change init.set.	Advanced password required to enter level 2 (default 002)

To exit the Menu level and return to initial display, press STOP button.

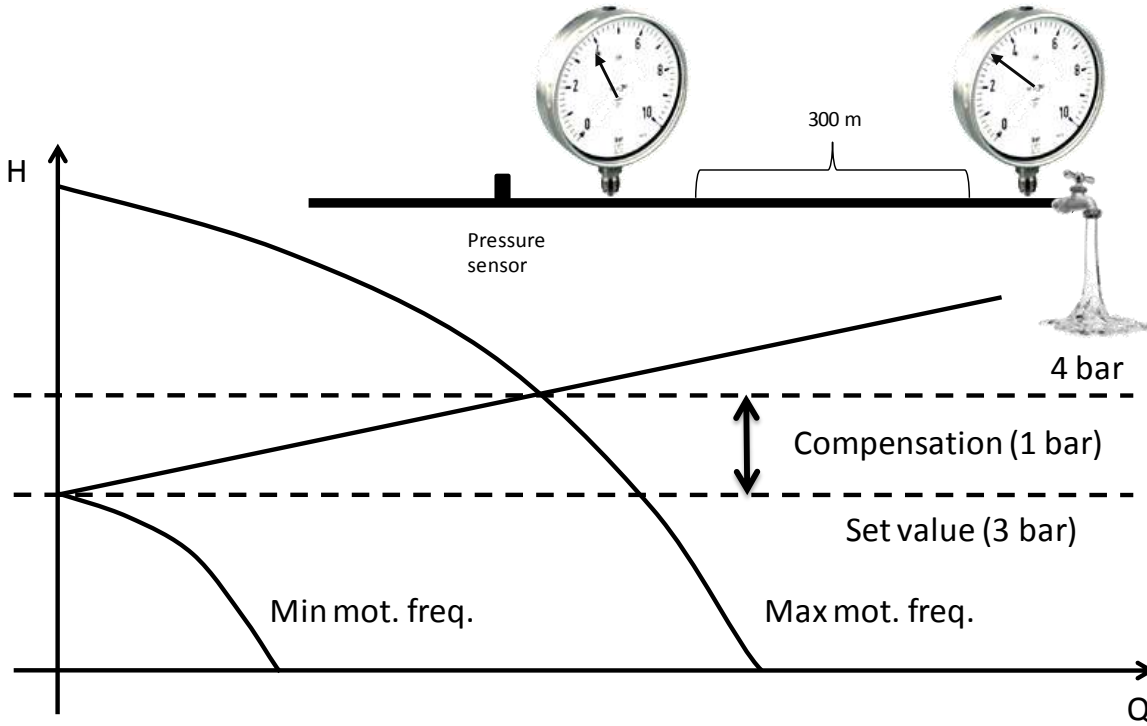
6.5 Control parameters

Parameter	Default	Description	Constant value	Fix speed	Const.value 2 set	Fix speed 2 val.	External speed
<div style="border: 1px solid black; padding: 5px;"> <p>Control mode</p> <ul style="list-style-type: none"> • Constant value • Fix speed • Const.value 2set • Fix speed 2 val. • External speed </div>	Constant value	<p>Mode of control:</p> <ul style="list-style-type: none"> • Constant value: IPFC changes the pump speed to keep the set value constant regardless water demand. • Fix speed: IPFC feeds the pump at set frequency, so the pump speed is kept constant. • Const. value 2 set: the two values are selected by opening or closing the digital input IN2. • Fix speed 2 val: the two values are selected by opening or closing the digital input IN2. • External speed: control motor frequency by using analogical input AN4. 					
<div style="border: 1px solid black; padding: 5px;"> <p>Max alarm value</p> <p>XXX.X [bar]</p> </div>	10	<p>Maximum value allowed in the system. If the readen value goes over this value, an alarm occurs and the pump is stopped. Pump is automatically restarted if the readen value goes below the maximum value for a period of at least 5 seconds.</p>	✓	✓	✓	✓	✓

Parameter	Default	Description	Constant value	Fix speed	Const. value 2 set	Fix speed 2 val.	External speed
Min alarm value XXX.X [bar]	0	Minimum value allowed in the system. If the readen value goes lower than this value, an alarm occurs and the pump is stopped. Pump is automatically restarted if the readen value goes higher than the minimum value for a period of at least 5 seconds.	✓	✓	✓	✓	✓
Ext.set enabling ON/OFF	OFF	Enabling of set value changing by analog input AN3.	✓		✓		
Set value XXX.X [bar]	3	Set value to be kept constant.	✓				
Compensation XXX.X [bar]	0	Value compensation at the maximum frequency for each pump. Acting on the green button you can reverse the sign.	✓				
Set value 2 XXX.X [bar]	3	Set value to be kept constant.			✓		
Compensation 2 XXX.X [bar]	0	Value compensation at the maximum frequency for each pump. Acting on the green button you can reverse the sign.			✓		
Set value update XX [s]	5	Time to update set value for compensation.	✓		✓		

Parameter	Default	Description	Constant value	Fix speed	Const.value 2 set	Fix speed 2 val.	External speed
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To ensure proper operation of pressure control is recommended to place the sensor near the pump.
 To compensate the pressure loss in the pipes (proportional to flow) it is possible to vary the pressure set in a linear relation with respect to frequency.



It can perform the following test to verify the correct value of compensation:

1. install a pressure gauge away from the pressure sensor
2. open completely the valve
3. check the pressure gauge

--> Set the value of *compensation*. equal to the difference of the values from the two gauges.

When using a group of pumps, the pressure compensation to be applied to each pump is equal to the total pressure compensation (when all the pumps are running at full speed) divided by the number of pumps in the group.

Operating freq. XXX [Hz]	50	Frequency value to feed the pump.		✓			
Operating freq. 2 XXX [Hz]	50	Frequency value to feed the pump.				✓	
Freq.min.control XXX [Hz]	50	Minimum frequency below which the pump tries to stop.	✓		✓		✓
Stop delay XX [s]	5	Delay for which the pump tries to stop below freq.min.control.	✓		✓		✓
Control ramp XXX.X [s]	20	Ramp time from freq.min.control to min.motor freq. If, during this time, the read value goes below the (set value - delta control), IPFC powers the motor again; otherwise, IPFC will stop the pump.	✓		✓		✓

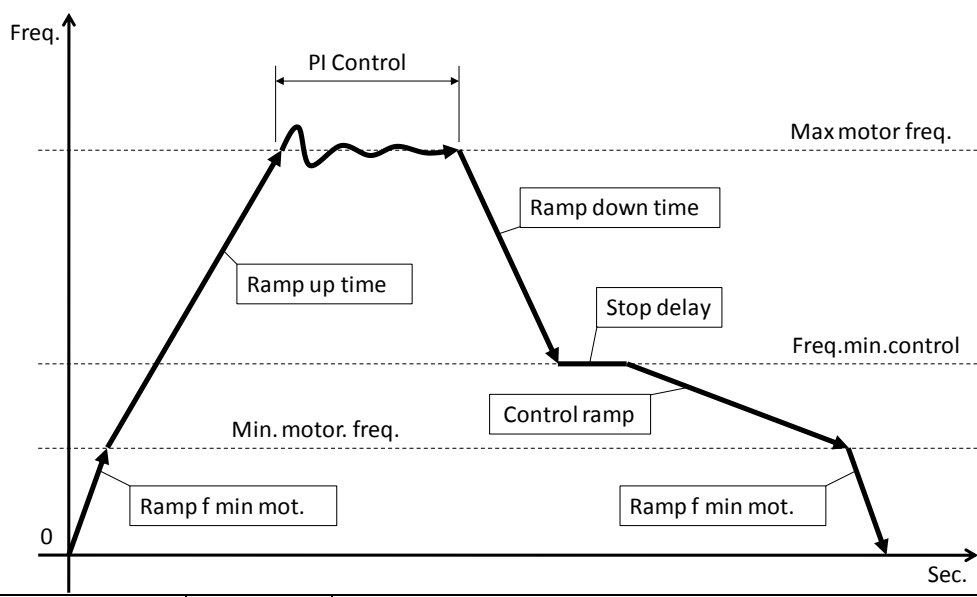
Parameter	Default	Description	Constant value	Fix speed	Const. value 2 set	Fix speed 2 val.	External speed
Delta control XXX.X [bar]	0.1	Value drop below the set value required to restart the pump during control ramp.	✓		✓		
Delta start XXX.X [bar]	0.5	Value drop below the set value required to start the pump from stop condition.	✓		✓		
Delta stop XXX.X [bar]	0.5	Value increase respect to set value which must be passed so that there is a forced shutdown of the pump.	✓		✓		
Ki		Kp and Ki parameters allow the dynamic control of system by IPFC; set values (Ki=50, Kp=005) are usually enough to get a valid dynamic control.	✓		✓		
Kp							
Pump DOL 1 ON/OFF	OFF	Function to activate (ON) the first auxiliary pump DOL 1 (Direct On Line pump).	✓		✓		
Pump DOL 2 ON/OFF	OFF	Function to activate (ON) the second auxiliary pump DOL 2 (Direct On Line pump).	✓		✓		
COMBO ON/OFF	OFF	Enabling or disabling COMBO operation as described in COMBO chapter.	✓		✓		

Parameter	Default	Description	Constant value	Fix speed	Const.value 2 set	Fix speed 2 val.	External speed
Address XX	00	IPFC address: <ul style="list-style-type: none"> • 00 master • 01 to 07 slaves 	✓		✓		
Alternance ON/OFF	OFF	Function to allow alternating between the IPFCs connected in COMBO (or pumps connected in DOL) in order to allow equal use of each pump in the group; master will reorganize the starting priority of the pumps by checking the life of each of them.	✓		✓		
Alternance period XX [h]	0	Maximum difference in terms of hours between IPFCs in the group. 0 stays for 5 minutes.	✓		✓		
COMBO synchrony ON/OFF	OFF	With this parameter it is possible to activate the synchronous operation (same speed) of the pumps in COMBO. It is however necessary to appropriately lower the parameter "f. min. control".	✓		✓		
Start delay AUX t = XX [s]	0	Delay time with which the slaves start after the variable speed pump has reached the maximum frequency and the pressure value has fallen below set value – delta control	✓		✓		
PI control Direct/Reverse	Direct	Direct: increasing motor speed also misured value increases Reverse: increasing motor speed, misured value decreases.	✓		✓		
Periodic autorun t = XX [h]	0	Pump periodic autorun after XX hours of inactivity. Value 0 makes function disabled. <u>Warning</u> , review the advice in chapter 1.	✓	✓	✓	✓	✓
Dry run cosphi X.XX	0.65	Cosphi value below which the unit stops the motor and give "no water" alarm.	✓	✓	✓	✓	✓
Restarts delay XX [min]	10	Restart delay after a dry running alarm. At each tentative (max 5) restart delay will be doubled.	✓	✓	✓	✓	✓

6.6 Motor parameters

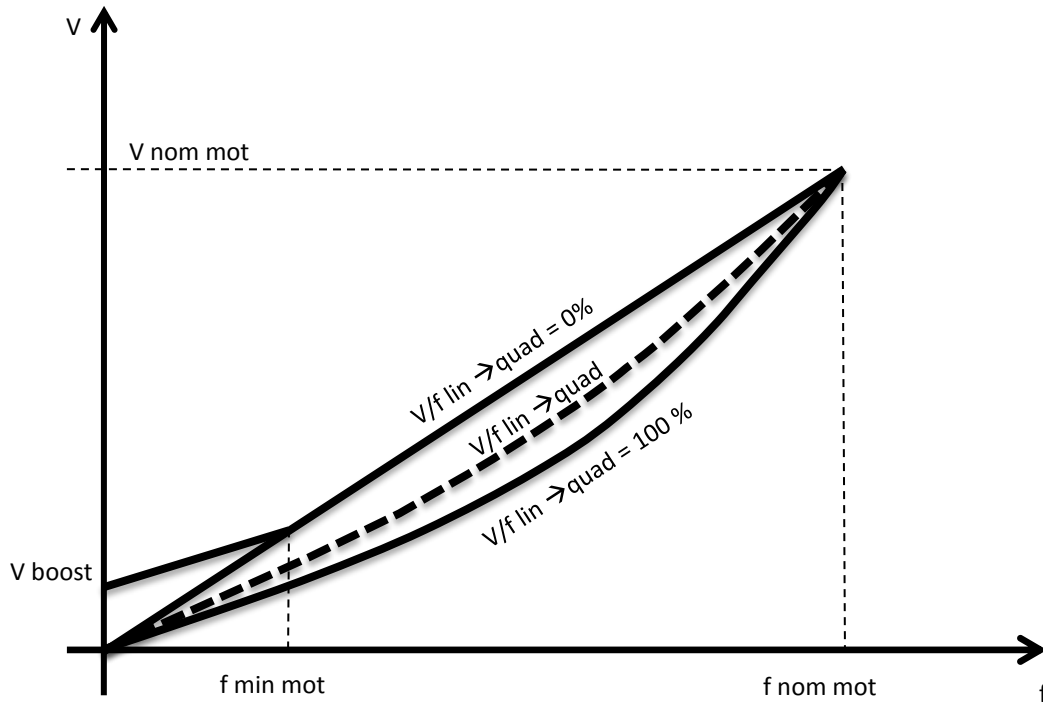
Parameters	Default	Description
Rated motor Volt. XXX [V]	XXX	Motor rated voltage (as shown on motor nameplate).

Voltage boost XX.X [%]	0%	Voltage increase during the motor start up. Warning: An excessive value can seriously damage the motor. Contact the motor manufacturer for further information.
Rated motor Amp. XX.X [A]	XX	Rated motor current as per its nameplate indication increased by 5%.
Rated motor freq XXX [Hz]	50	Rated motor frequency as per its nameplate.
Max motor freq. XXX [Hz]	50	Maximum motor frequency. Note: by reducing the maximum motor frequency, maximum current will be reduced as well.
Min motor freq. XXX [Hz]	20	Minimum motor frequency.
Ramp up time XXX.X [sec]	4	Ramp-up time to reach the speed required to achieve the set pressure (or frequency value). Longer times delay the system reaching the preset value but better protect system components. Excessively long ramp-up times can create difficulties in IPFC setup, and can also cause false overload alarms.
Ramp down time XXX.X [sec]	4	Ramp-down time to reach zero speed. Longer times keep the system pressurized, while protecting the system components. Excessively long ramp-down times can create difficulties in IPFC setup. Excessively short ramp-down times can cause false overload alarms.
Ramp f min mot. XXX.X [sec]	1.5	Time to reach the minimum motor frequency and vice versa.



PWM XX.X [kHz]	8	Carrier frequency (switching frequency). It is possible to choose PWM in the range of 2.5 ,4, 6, 8, 10 kHz . Higher values give a more sinusoidal wave with fewer losses for the motor but higher losses for the inverter (increased inverter heating). If long cables are used (>20 m / >76 ft) (submersible pump) it is recommended to install an inductive filter between IPFC and the motor (available upon request) and to set the value of PWM to 2.5 kHz. This reduces the risk of voltage spikes, which can damage motor and cable insulation.
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V/f lin. --> quad. XXX [%]	85 %	V / f characteristic with which IPFC feeds the engine. The linear characteristic corresponds to constant torque with variable speed. The quadratic characteristic is normally used with centrifugal pumps. The selection of torque characteristic should be done ensuring a smooth operation, a reduction of energy consumption and a lower level of heat and acoustic noise.
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Rotation sense ---> / <---	--->	If, during the test, the motor runs in reverse, it is possible to change the wiring sequence via software without physically changing wires at the terminals.
MOTOR TUNING press ENT		If the device is "FOC-ready", motor calibration must be carried out before commissioning. Carefully read the pertinent chapter.
Mot. resistance Rs=XXX.XX [Ohm]		Manual setting of the stator resistance.
Mot. inductance Ls=XXX.XX [mH]		Manual setting of the stator inductance.
FOC dynamic XXX		Setting of the control dynamic of the FOC algorithm.
Autorestart ON/OFF	OFF	If ON is selected, after a lack of voltage, IPFC returns to its normal status; if IPFC was powering the pump before the voltage drop, it resumes powering the pump automatically. <u>Warning</u> , review the advice in chapter 1.

6.7 IN/OUT parameters

Parameter	Default	Description
Unit XXXXX	bar	Unit [bar,%,ft,in,cm,m,K,F,C,gpm,l/min,m3/h,atm,psi]
F. scale sensor XXX.X	16	Sensor full scale.
Min.value sensor XXX.X	0	Sensor minimum value.
Offset input 1 [%]	20%	Zero correction for analog input 1 (4-20 mA) (20 mA x 20% = 4 mA).
Offset input 2 [%]	20%	Zero correction for analog input 2 (4-20 mA) (20 mA x 20% = 4 mA).
Offset input 3 [%]	0%	Zero correction for analog input 3 (0-10V) (10V x 00% = 0 V).
Offset input 4 [%]	0%	Zero correction for analog input 4 (0-10V) (10V x 00% = 0 V).
AN1,AN2 function XXXXXX	Independent	Function logic for analog input AN1,AN2 (independent, lower value, higher value, difference 1-2).
Digital input 1 N.O. / N.C.	N.O.	By selecting N.O. (normally open) IPFC runs the motor if the digital input 1 is open; motor will be stopped if the digital input 1 is closed. By selecting N.C. (normally closed) IPFC runs the motor if the digital input 1 is closed; motor will be stopped if the digital input 1 is opened.
Digital input 2 N.O. / N.C.	N.O.	By selecting N.O. (normally open) IPFC runs the motor if the digital input 2 is open; motor will be stopped if the digital input 2 is closed. By selecting N.C. (normally closed) IPFC runs the motor if the digital input 2 is closed; motor will be stopped if the digital input 2 is opened.
Digital input 3 N.O. / N.C.	N.O.	By selecting N.O. (normally open) IPFC runs the motor if the digital input 3 is open; motor will be stopped if the digital input 3 is closed. By selecting N.C. (normally closed) IPFC runs the motor if the digital input 3 is closed; motor will be stopped if the digital input 3 is opened.
Digital input 4 N.O. / N.C.	N.O.	By selecting N.O. (normally open) IPFC runs the motor if the digital input 4 is open; motor will be stopped if the digital input 4 is closed. By selecting N.C. (normally closed) IPFC runs the motor if the digital input 4 is closed; motor will be stopped if the digital input 4 is opened.

Parameter	Default	Description
Dig.In.2/3 delay [s]	3	Digital input IN2 & IN3 delay. Digital input IN1 has 1 second fix delay.

6.8 Connectivity parameters

Parameters	Default	Description
MODBUS address XXX	1	MODBUS address from 1 to 247
MODBUS baudrate XXXXX [bps]	9600	MODBUS baudrate from 1200 bps to 57600 bps
MODBUS data format XXXXX	RTU N81	MODBUS data format: RTU N81, RTU N82, RTU E81, ETU O81

7. Protections and alarms

Anytime a protection occurs a blinking message is displayed together with an audible alarm; on STATUS in the initial view, the protection is displayed; by pressing the STOP button. Only from this position (STATUS) in the initial view is it possible to try to reset the alarm; if IPFC does not reset the alarm it is displayed again together an audible sound.

ALARM MESSAGE	ALARM DESCRIPTION	POSSIBLE SOLUTIONS
OVERCURRENT MOT.	Motor overload: input current of the motor is higher than the rated motor current setting parameter. Motor voltage drop caused by the inverter causes the motor input current to be higher than rated. Contact motor manufacturer to check if motor is capable of accepting this current.	<ul style="list-style-type: none"> • Make sure that the motor current setting parameter is higher than rated. • Check other possible causes of over current
UNDER VOLTAGE	Supply voltage too low	Check possible causes of undervoltage
OVER VOLTAGE	Supply voltage too high	Check possible causes of overvoltage
OVER TEMP. INV.	Inverter over temperature	<ul style="list-style-type: none"> • Make sure than ambient temperature is less than 40 °C (104 °F). • Check if auxiliary cooling fan is working properly and if mounting space is adequate for proper cooling. • Reduce the PWM value (<i>Advance Parameter Menu</i>)
NO LOAD	No load	<ul style="list-style-type: none"> • Check if load is properly connected to the IPFC terminals

<p style="text-align: center;">NO WATER (DRY RUN COSPHI)</p>	<p>Motor cosphi is lower than the set value of dry running cosphi</p>	<ul style="list-style-type: none"> • Check if the pump is primed • Check the set value of dry running cosphi. Dry running cosphi is approximately 60% of the rated cosphi (at rated frequency) listed on the motor plate. <p>If pump's cosphi is lower than the set dry-running cosphi for at least 2 seconds, IPFC stops the pump. IPFC tries to run the pump every 10, 20, 40, 80, 160 minutes and then the pump is stopped.</p> <p><u>WARNING</u>: if dry running protection occurs, IPFC will try to start the pump automatically. Be sure to cut power supply to IPFC before performing any maintenance.</p>
<p style="text-align: center;">SENSOR FAULT</p>	<p>Sensor error</p>	<ul style="list-style-type: none"> • Check the transducer • Check the wiring of transducer
<p style="text-align: center;">MAX. VALUE ALARM</p>	<p>Measured value has reached the maximum value accepted by the system.</p>	<ul style="list-style-type: none"> • Check possible causes of reaching max value • Check the max alarm value setting
<p style="text-align: center;">MIN. VALUE ALARM</p>	<p>Measured value has reached the lowest value accepted by the system.</p>	<ul style="list-style-type: none"> • Check possible causes reaching min value (i.e. broken pipe, open pressure relief valve, etc.) • Check the min alarm value setting.
<p style="text-align: center;">IGBT TRIP ALARM</p>	<p>The current drawn by the load exceeds the capacity of IPFC. IPFC is still able to continue to power the load for 10 minutes with an output current of 101% of nominal and for 1 minute with an output current of 110% of nominal</p>	<ul style="list-style-type: none"> • Increase the ramp-up time • Make sure that the load current is at least 10% below the IPFC nominal current • Check the voltage drop along the supply cable to the motor
<p style="text-align: center;">NO COMMUNICATION</p>	<p>Communication between Master and slave(s) has been interrupted</p>	<ul style="list-style-type: none"> • Check the wiring connections • Make sure the Master is not in the Menu level; if so, exit from the level. • In the STATUS of the slave (where the alarm is displayed) try to reset the alarm by pushing STOP button.
<p style="text-align: center;">ADDRESS ERROR</p>	<p>Same address as other IPFCs in the group</p>	<ul style="list-style-type: none"> • The address of each IPFC needs to be different
<p style="text-align: center;">KEYBOARD FAULT</p>	<p>A Button on the keyboard has been pressed for more than 150 seconds</p>	<ul style="list-style-type: none"> • Make sure buttons are not depressed • Call service assistance
<p style="text-align: center;">ACTIVE DIG.IN.X</p>	<p>Digital input X opened /closed</p>	<ul style="list-style-type: none"> • Check the input digital configuration (IN/OUT Parameters menu)
<p style="text-align: center;">ALARM SLAVE XX</p>	<p>slave XX error detected by master</p>	<ul style="list-style-type: none"> • check the status of the slave



If pumps cosphi is lower than the dry-running cosphi for at least 2 seconds, IPFC will stop the pump. IPFC will try to run the pump every 10, 20, 40, 80, 160 minutes and then the pump is stopped.

ATTENTION: if dry-running protection occurs, IPFC will try to start the pump automatically.

Be sure to cut power supply before attempting maintenance

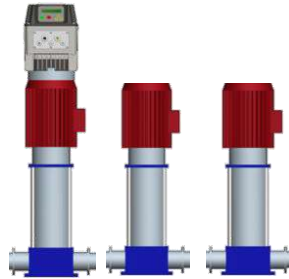
IPFC will stop the pump if the input motor current is higher than the set motor current for an extended time. By pressing the START button it is possible to run the pump again.

IPFC will stop the pump if the input voltage is higher than the set voltage for an extended time. By pressing the START button it is possible to run the pump again. IPFC will stop the pump if the input voltage is lower than the set voltage for an extended time. By pressing the START button it is possible to run the pump again.

8. Auxiliary pumps during constant pressure control

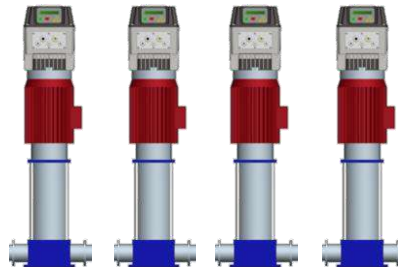
When the water needs vary considerably, it is advisable to share the water request between several pumps ensuring better efficiency and reliability.

A first method consists of a single pump driven directly by IPFC and another 1 or 2 pumps directly connected to the mains DOL (Direct On Line); DOL pumps are controlled by IPFC and connected to the mains through 1 or 2 contactors.

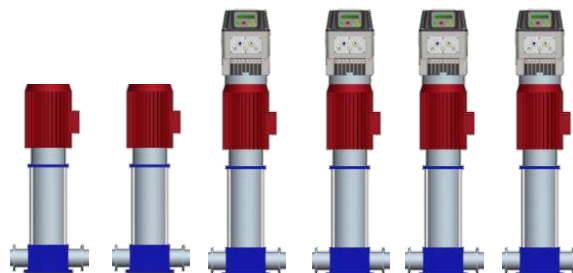


In this method, DOL pumps are not started and stopped smoothly with the corresponding increase in energy consumption and mechanical wear (startup current). Also note that DOL pumps are not protected by IPFC.

A second method of sharing water demand (named COMBO mode) consists of using additional pumps in parallel (up to 8), with each one driven by a IPFC.




In this method, energy consumption and reliability of the pumping system is maximized: IPFC monitors and protects each pump. It is possible to assemble a booster system composed of pumps connected in COMBO mode and another 1 or 2 DOL pumps to cover additional water demand (managed only by master).

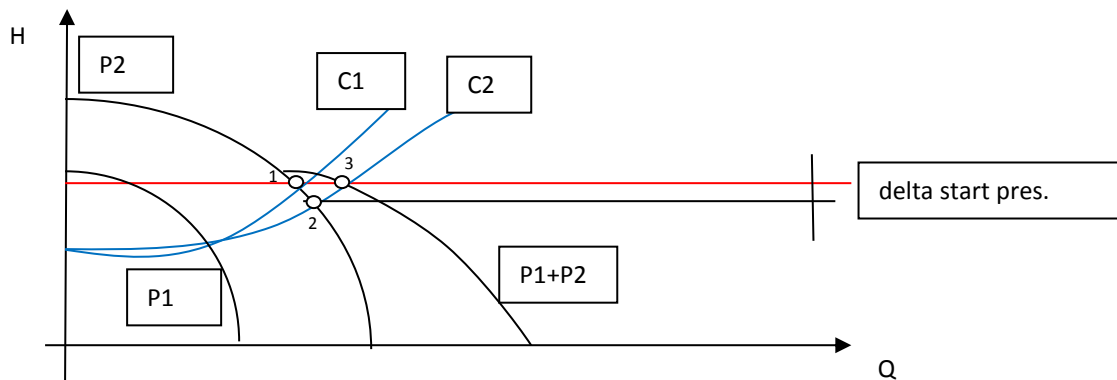


8.1 DOL pumps

Each DOL pump is switched on by a contactor controlled by the digital output DOL1 and DOL2 present in the IPFC.

	<p>IPFC relays driving the DOL pumps are relays with no voltage contacts. Max voltage to the contacts is 250 V, max current 5 A.</p>
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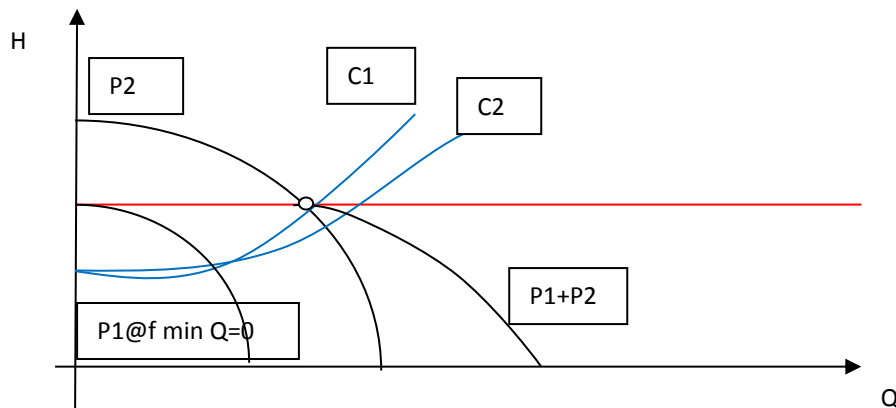
Two pumps are connected in parallel, with one pump (pump 1, P1) run by the inverter, while the second pump (pump 2, P2) is directly connected to the main power ("Direct On Line" connection). Start/Run of the second pump is controlled by the relay DOL1 (allowing a third pump to be controlled by the relay DOL2).




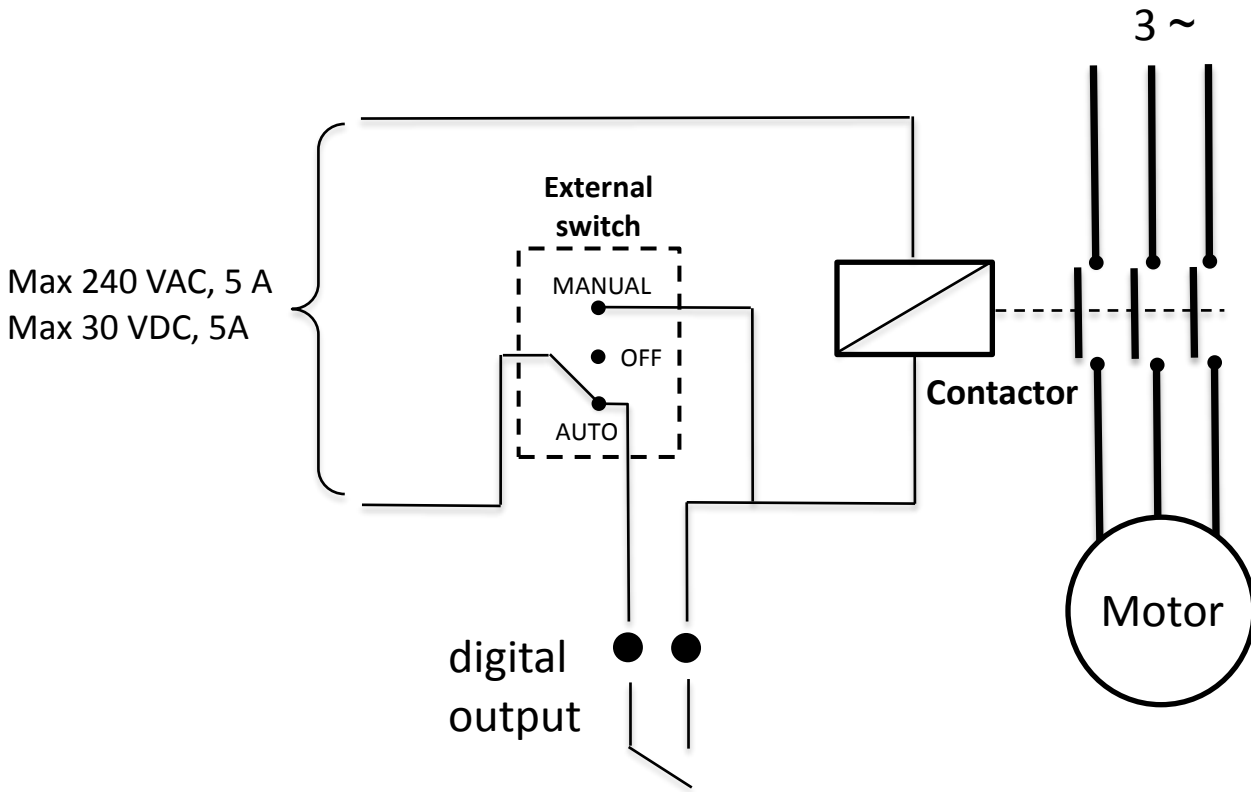
If pump 1 (P1) is already running to maintain the desired set pressure (red line), an additional water request changes the system curve from C1 to C2; since pump 1 (P1) is running at maximum speed, it is not possible to maintain the set pressure by increasing the speed, so the system pressure will drop till reaching the new working point 2.

If pressure at the point 2 is (set value – delta control), IPFC will run the DOL by relay DOL1. The DOL pump will run at its nominal speed while the pump 1 will drop its speed equal to the P1 pattern to maintain set pressure.

If water demands decrease, returning to the system curve C1, pump 1 will reduce the pump speed to maintain constant pressure in the system. When pump 1 reaches a frequency equivalent to the minimum frequency, while still maintaining set pressure, the DOL pump will be switched off and pump 1 will increase the speed to maintain the p_{set} in the system.



	<p>If two pumps are connected in parallel, the first driven by IPFC and the second with a DOL connection, it is necessary to make sure that the value "delta control" will be sufficiently high to ensure the first pump, once the DOL pump is switched on, will reach a frequency higher than its minimum frequency value.</p> <p>By proper setting of the minimum frequency, excessive pump ON/OFF cycling is avoided, thus preventing damage to the DOL pump.</p>
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8.2 COMBO function

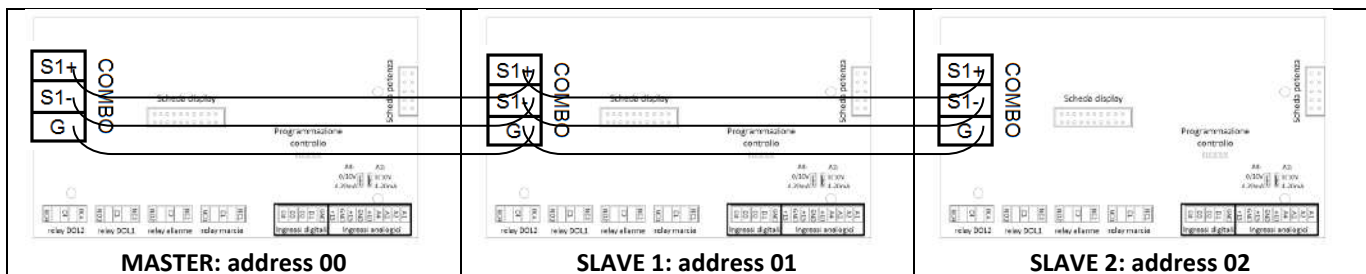
In the “Control parameters” menu it is possible to enable the COMBO function that allows serial communication between up to 8 IPFCs, each one connected to a pump. The operating principle (switch on/off) of pumps is similar to as stated in chapter 8.1.

To achieve the COMBO function in a system consisting of several interconnected IPFCs, use a pressure sensor connected to each IPFC. The value of the *set pressure* is communicated to the slaves via the serial port.

As a further help, you can connect another two DOL pumps to the IPFC Master to cover additional water demand; they will be operated only when all the COMBO pumps are already in operation.

RS485 serial connection

IPFC's communication is made through a private protocol using the RS485 port. Each IPFC must be connected to each other by using a tripolar cable (0,5 mm²) wired on S+,S-,G pins on control board.



Master setup

1. Supply power to the IPFC master.
2. If not yet completed, perform the initial configuration as described on chapter 6.2
3. Initial view is shown:

Inv: ON/OFF Mot: ON/OFF

p_mis=XX.X [bar]

4. Scroll until:

Menù

ENT to access

5. Press ENT

MENU'

Control. param.

6. Press ENT
7. Insert password (default 001).

8. Scroll until:

Combo

ON/OFF

9. Set ON
10. Set:

Address XX	00	IPFC's address in parallel operation. • 00 : IPFC master
Alternance ON/OFF	OFF	Function to allow alternating between the IPFCs connected in parallel in order to allow equal use of each pump in the group; in this way Master will reorganize the starting priority of the pumps by checking the life of each of them.
Start delay AUX t = XX [s]	0	Delay time with which the slaves start after the variable speed pump has reached the maximum frequency and the pressure value has fallen below set value – delta control

11. Press STOP (red button)
12. Press STOP again

Slave setup

Follow Master setup until point 11.

In case of failure of master in a Combo system, will be replaced by slave. As a consequence, all parameters must be setup independently on each inverter, master mode.

1. Set:

Address XX	IPFC's address in parallel operation. <ul style="list-style-type: none">• 01 --> 07: IPFC slaves
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2. Press STOP (red button).
3. In the *Motor parameters* verify that *Autorestart* is set *ON*.
4. Press STOP (red button).
5. Press STOP again.

Whenever the user accesses the Menu screen of the IPFC master, the communication between IPFCs is automatically interrupted.

In case of alarm or failure of a pump in a Combo system, this pump's operation will be replaced (temporary or permanently) by another pump.

In case of failure of master in a Combo system, it will be replaced by the next slave after about 1 minute. In order to enable master replacement Autorestart must be set ON in each slaves.

9. Trouble-shooting chart

<p>LCD does not switch on after powering the IPFC</p>	<ul style="list-style-type: none"> • Check the connecting flat cable between the LCD board (attached to the cover) and the control board • Check the fuses • Check that the power cables are properly connected.
<p>Power line of IPFC is interrupted by the differential protection contactor</p>	<ul style="list-style-type: none"> • Check the leakage current to ground of EMC filter • Following a rapid off/on the power supply, the differential contactor can interrupt the power. After turning off the IPFC it is recommended to wait at least 1 minute before restarting.
<p>When performing sensor test operation, SENSOR OFF alarm occurs</p>	<ul style="list-style-type: none"> • Check that the sensor cable is properly connected to the sensor device and to the IPFC. • Make sure that the sensor and its cable are not damaged. • Check that the operating range of sensor is of 4 -20 mA type and the value of 15 V is within the voltage feed range of the sensor.
<p>Frequency and pressure oscillation on constant pressure control mode</p>	<ul style="list-style-type: none"> • Check if the water tank and its air pressure are correctly set. It may be necessary to increase the tank volume or reduce the pre-charge pressure. • Check the ki & kp parameters (Control parameters menu). At first, it is suggestable to increase the Ki value. If it not enough reduce of one unit the Kp value.
<p>DOL pump stops and starts continuously</p>	<ul style="list-style-type: none"> • Increase <i>delta control</i>. • Check to see if the water tank and it's air pressure are correctly set. It may be necessary to increase the tank volume or reduce the pre-charge pressure.
<p>Measured pressure drops too much before IPFC starts the pump.</p>	<ul style="list-style-type: none"> • Decrease the delta start value (Control Parameters menu) . • Check to see if the water tank and it's air pressure are correctly set. It may be necessary to increase the tank volume or reduce the pre-charge pressure. • Modify the value of ki & kp parameters (Control Parameters menu). At first, it is suggestable to reduce the Ki value. If it is not enough increase of one unit the Kp value.

10. Technical Assistance

For more technical information contact the authorized reseller providing the following information. The solution to the problem will be found faster and easier if full information is provided.

Model/Serial Code	LCD version (shown when IPFC is power supplied) LCD = _._	INV version (shown when IPFC is power supplied) INV = _._
Line Voltage: ___ [V]	Line Frequency: <input type="checkbox"/> 50 Hz <input type="checkbox"/> 60 Hz	
description of problem:		
installation type: <input type="checkbox"/> wall mounted <input type="checkbox"/> on motor fan cover		
motor type: <input type="checkbox"/> single phase <input type="checkbox"/> three phase <input type="checkbox"/> submersible <input type="checkbox"/> surface		
if submersible: cable length [m]: _____		if submersible: cable section [mm ²]: _____
P2 motor [kW]: _____	rated motor Volt [V]: _____	rated motor Amp [A]: _____
rated motor Hz: _____		
if single phase: capacitor _____ [UF]	if single phase: starting Amp I _{st} = _____ [A]	pump performances Q = _____ [l/min] H = _____ [m]
tank volume: _____ [liters]	precharge pressure: _____ [bar]	
number of DOL pumps: _____	number of COMBO pumps: _____	
medium ambient temperature: _____ [°C]	pressure sensor 4 mA = _____ [bar] 20 mA = _____ [bar]	
digital inputs used:	digital outputs used:	
electric and hydraulic scheme of the system (more detailed as possible)		
set parameters: please fill the instal. param. and adv. param columns in the software scheme.		

DECLARATION OF CONFORMITY

In according with:

Machine Directive 2006/42/EC

EMC Directive 2014/30/EU

Low Voltage Directive 2014/35/EU

R&TTE Directive 2014/53/EU

IPFC is an electronic device to be connected to other electrical equipment with which it is to form individual units. It must, therefore, that the putting into service of this unit (with all its subsidiary equipments) to be performed by qualified personnel.

The product conforms to the following regulations:

EN 55011 Class A

EN 61000

EN 60146

EN 50178

EN 60204-1

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