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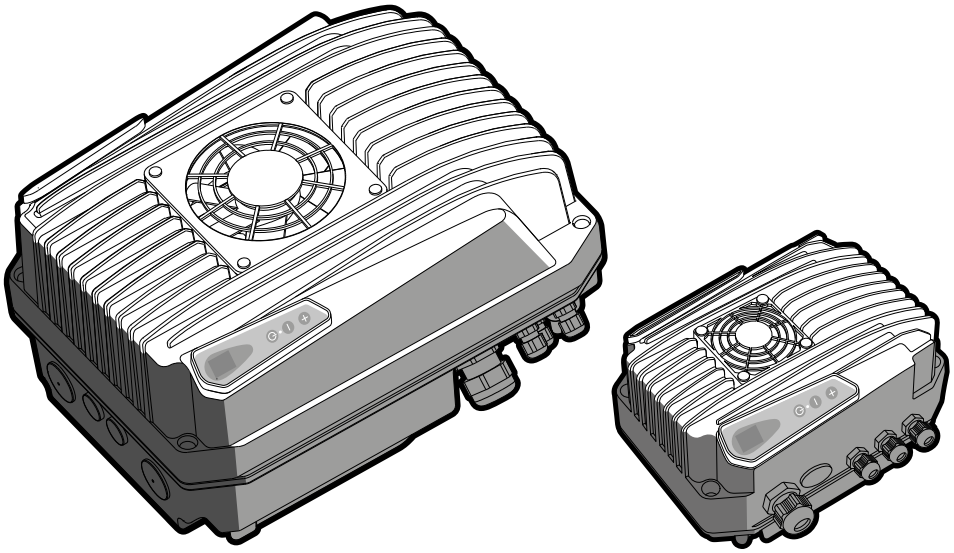
varisco®
solid pumping solutions



PSDrive

Installation, operation and maintenance manual

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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, paying particular attention 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
Keep the manual in a protected place near the installation and easily accessible for consultation. A digital copy of this manual may be downloaded from the manufacturer's website or by scanning the QR code on the product itself.

1.2. Product presentation

PSDrive is a device for the control and protection of pumping systems based on the variation of the pump supply frequency. It may be applied to both new and old systems, thus ensuring:

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

PSDrive, 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 as much as it is needed, thus avoiding unnecessary energy waste and extending its life. At the same time the device is able to:

- protect the motor from overloads and dry running
- 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 realize combined operation

Appropriate output filters, available upon request, allow for reducing the dangerous overvoltages that are generated in very long cables and, therefore, make the device optimal also when 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 15 minutes before working on it or on the load applied to it.

DANGER
If the motor is of permanent magnet type, the device may be energised by the passive rotation of the motor. In this case, it is recommended to disconnect both the power supply and the load 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 device 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 a noise emission:

< 65 dB at a distance of 1 meter with the 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, read the chapter carefully *Safety [6]* reported 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 12 months or in the presence of a temperature alarm
Check for alarms	Every 12 months
Check the correct tightening of the power terminals	Every 12 months
Verification of the maintenance of the degree of protection (ingress of dust or water) by checking the tightening of the screws in the mechanical closing parts, checking the gaskets, checking the cable glands.	Every 6 months

3.2. Warranty

The warranty conditions may be found in the sales documents. Contact your dealer for more information.

3.3. 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.

3.4. 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.

3.5. 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

Check upon receipt of the product:

- 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. 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]	Maximum efficiency [%]	Size
PSDrive 11	3 x 380 - 460	3 x Vin	3,7	4	1,1	96	1
PSDrive 22	3 x 380 - 460	3 x Vin	5,4	6	2,2	96	1
PSDrive 40	3 x 380 - 460	3 x Vin	8	9	4	96	1
PSDrive 55	3 x 380 - 460	3 x Vin	13,5	14	5,5	97	2
PSDrive 75	3 x 380 - 460	3 x Vin	17,5	18	7,5	97	2
PSDrive 110	3 x 380 - 460	3 x Vin	24	25	11	97	2
PSDrive 150	3 x 380 - 460	3 x Vin	29	30	15	97	2
PSDrive 185	3 x 380 - 460	3 x Vin	36	38	18,5	97	2
PSDrive 220	3 x 380 - 460	3 x Vin	42	44	22	97	2

General electrical specifications:

Power supppy 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

Ambient specifications:

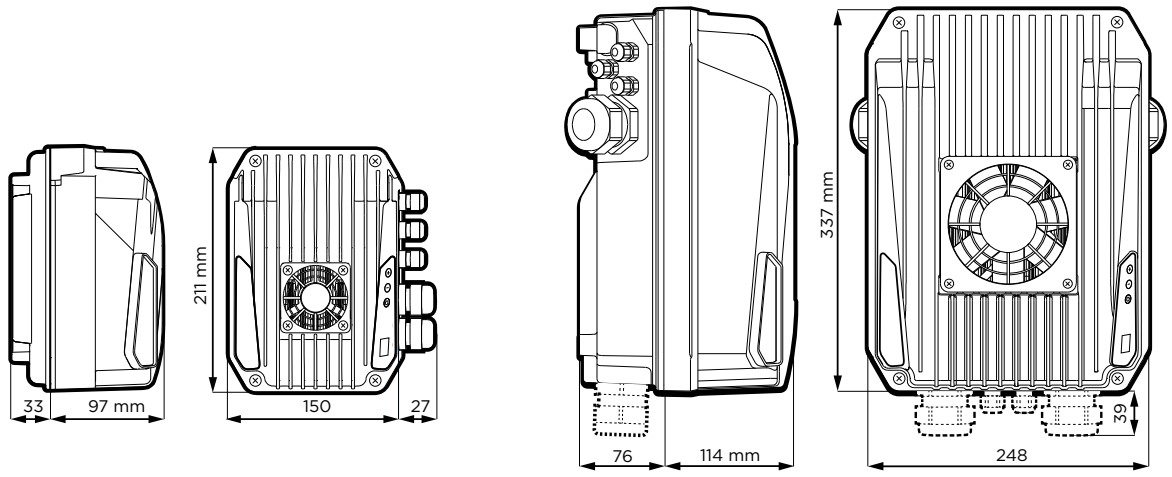
Relative humidity of the operating environment	5 - 95% non-condensing
Working environment temperature	10°C (14°F) to 60°C (140°C)
Maximum ambient working temperature at nominal load	40°C (104 °F)
Power derating above maximum temperature	-2.5% each °C (-1.4% each °F)
Maximum altitude at nominal load	1000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

Mechanical Specifications:

Degree of protection	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 sunlight and weather.

5.2. Dimensions and weight



Size	Maximum weight [kg]
1	2,5
2	10

5.3. Cable entry

Cable gland	Tightening torque [Nm]	Cable diameter [mm]	Size 1	Size 2	PSDrive 185 , PSDrive 220
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 adhered to.

WARNING
Do not install the device in environments with risk of explosion, flooding, or 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 continuity of operation, the device is able to gradually and automatically reduce performance before shutting down due to 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 suction and discharge side of the heat sink must have at least the following distances from other surfaces:

- 150 mm for current ratings up to 18 A
- 200 mm for current ratings up to 30 A
- 250 mm for current ratings up to 44 A

On the other sides, it is recommended to maintain a minimum distance of 100 mm to allow for cooling and to make installation and maintenance operations easier.

	During operation, the surfaces of the device may become so hot that burns may occur. It is advisable not to touch.

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.

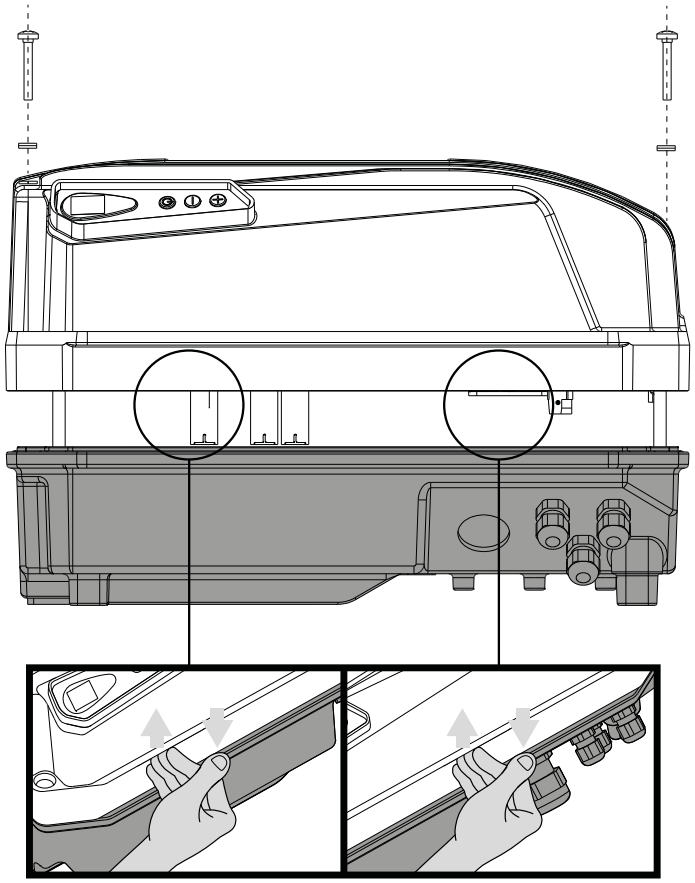
WARNING
Do not place any heat-generating elements (outlet filters) on the suction side of the device. Otherwise, dangerous overheating may occur.

6.3. Mechanical assembly of size 2 devices

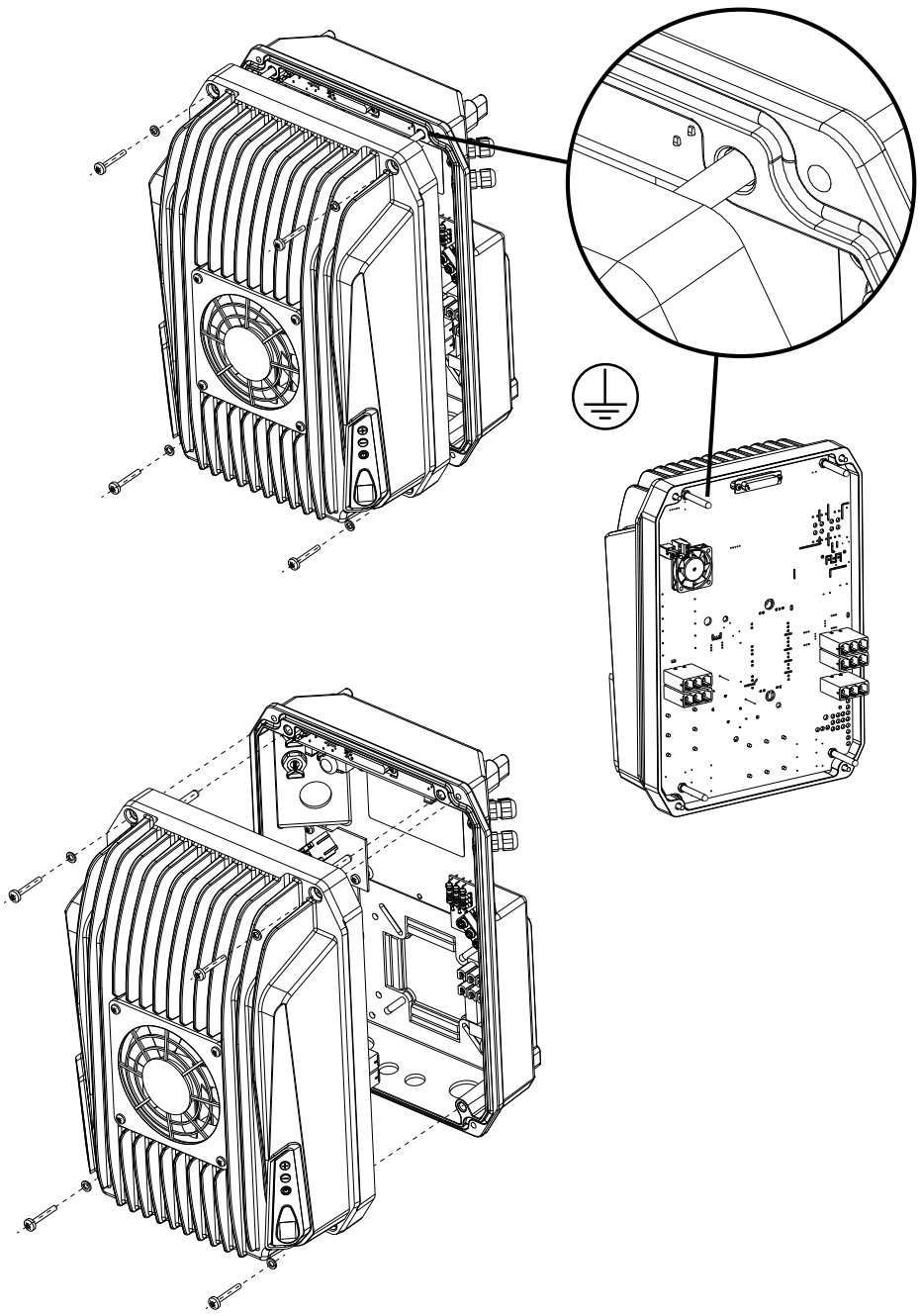
The size 2 devices are equipped with a quick connection system that allows to make both power and signal electrical connections on the fixed part, called "base", while the mobile part, called "power", is applied later.

This allows to work easily 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 earth 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.

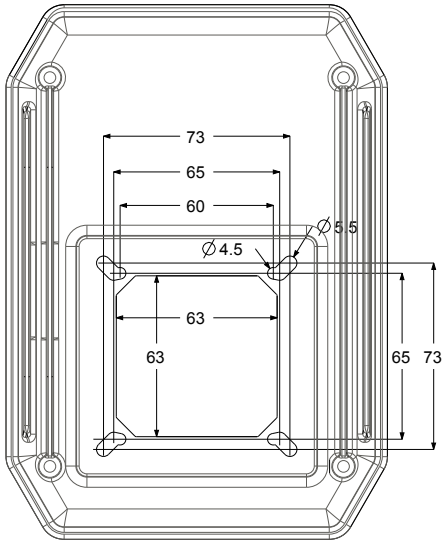
6.4. Motor on-board mounting

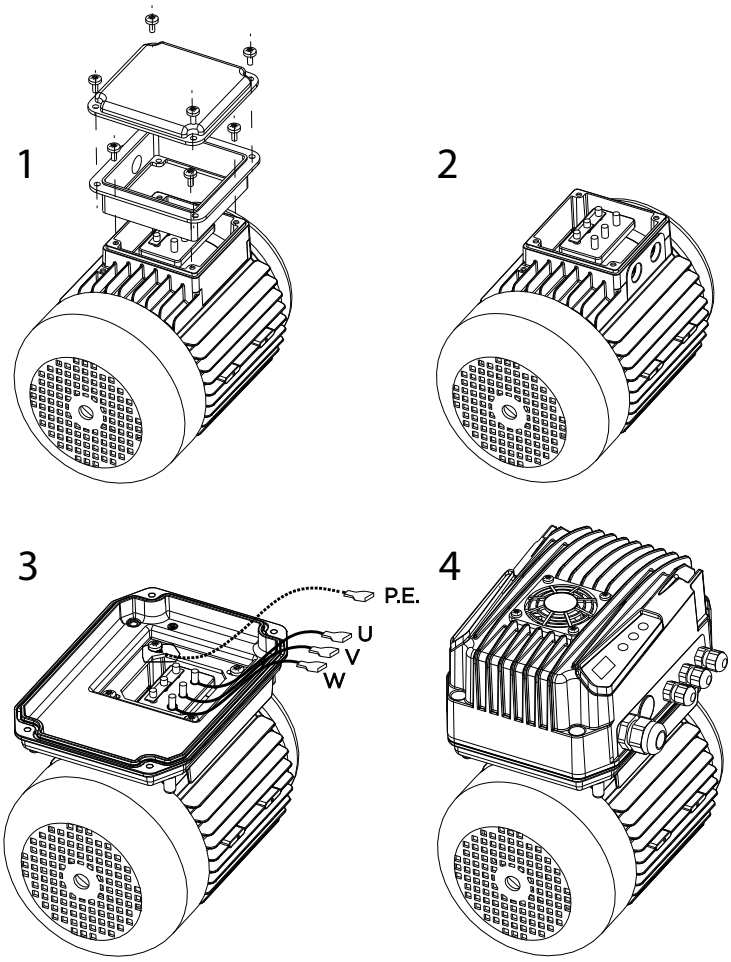
The device may be installed in place of the motor terminal cover in both horizontal and vertical positions. It is necessary to check the compatibility of fixing the base of the device to the motor case with the motor manufacturer.

The seal on the base of the device provides protection against the access of water and dust. It is recommended to drill the gasket only at the level of the four fixing holes to the motor case. It is possible to use the same screws and washers with which the terminal cover was fastened to the motor case. Please refer to the following instructions when attaching the device to the motor.

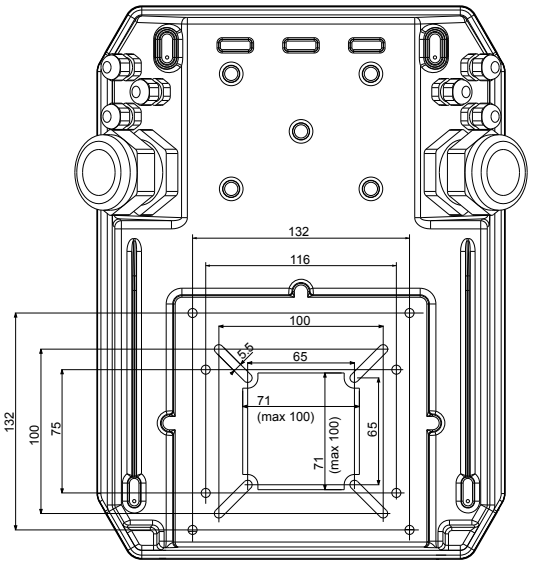
DANGER
At the end of the installation, check for ground continuity between the base of the device and the motor casing.

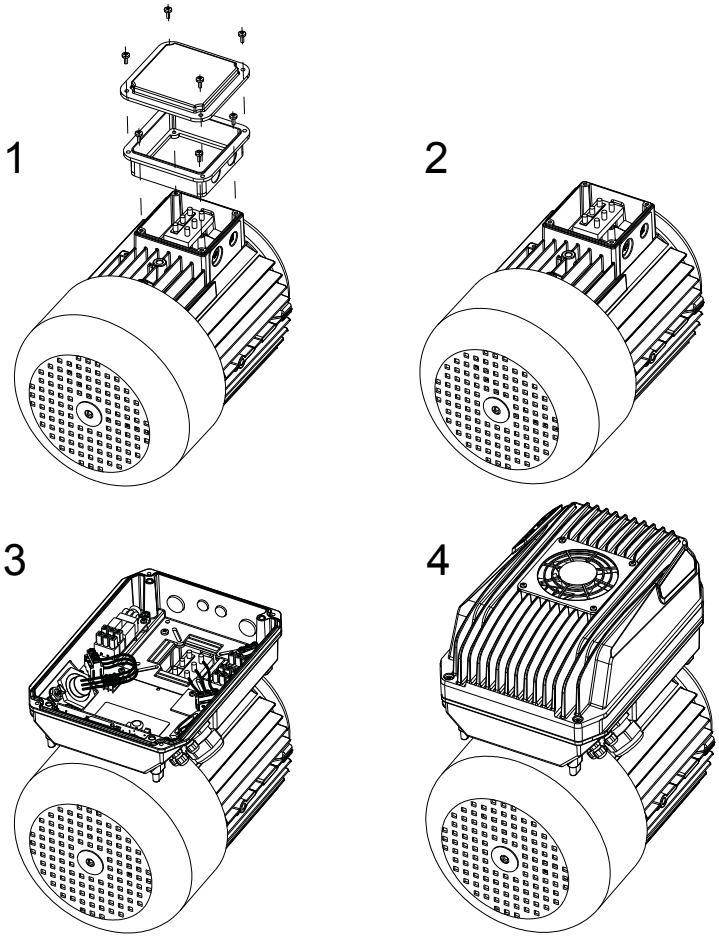
On-board mounting for size 1 devices





On-board mounting for size 2 devices

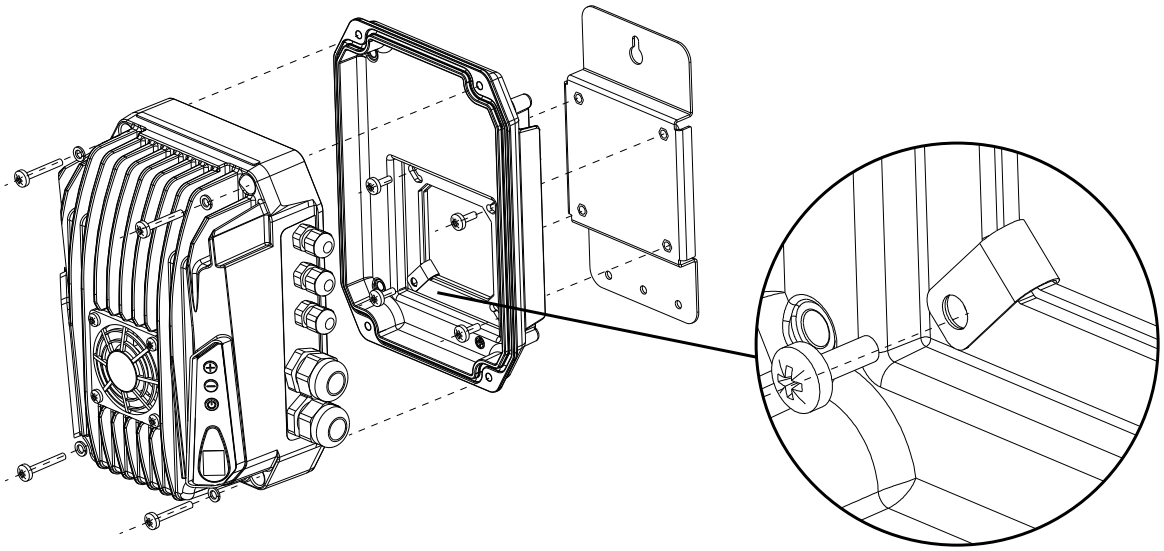




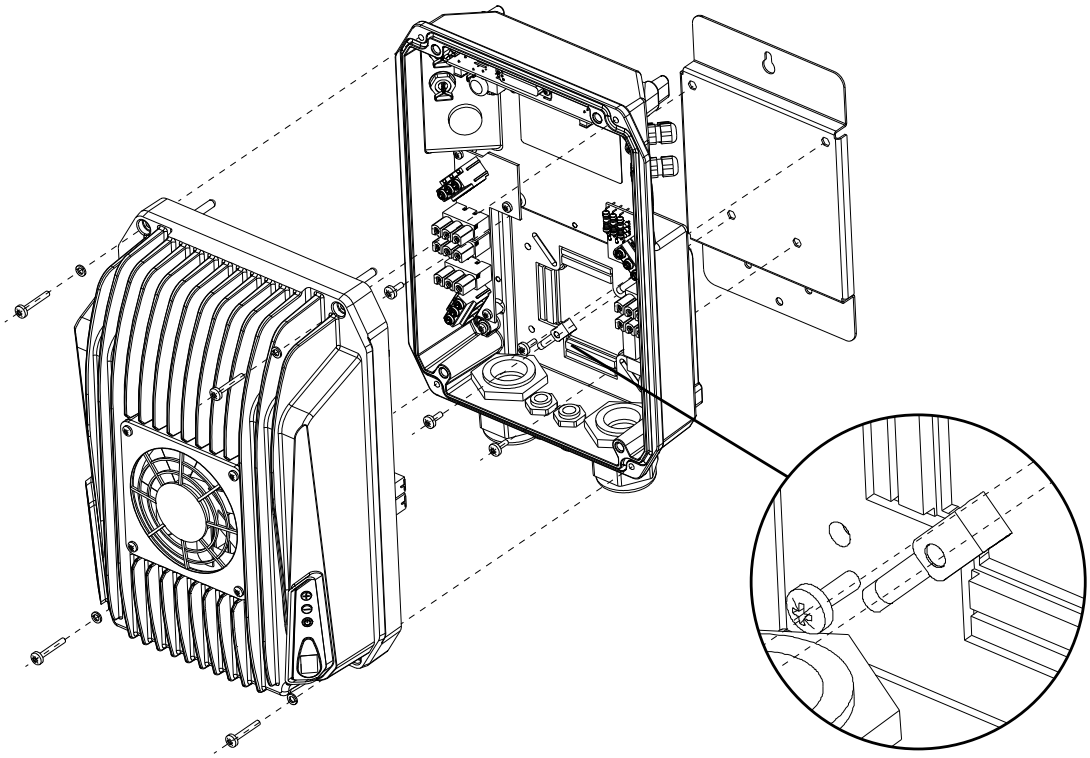
6.5. Wall mounting

The device is mounted to the wall by means of a special metal bracket available upon request.

Wall mounting for size 1 devices



Wall mounting 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. It is recommended to install this component and to 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 using a drill in correspondence with the four special fixing holes.

The fixing screws must be equipped with O-rings to guarantee the degree of protection.

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 section up 16 mm^2. (6 AWG)
- 16 mm2 (6 AWG) cross-section for mains power cable cross-section between 16 mm^2 (6 AWG) and 35 mm^2 (1 AWG).
- cross-section equal to half the cross-section of the power supply cable for a cable cross-section greater than 35 mm^2 (1 AWG).

7.2. Protective devices

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).

Fuses and circuit breakers

The control device is able to protect the motor from overload by means of digital control of the absorbed current with reference to the set nominal current.

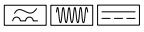
It is therefore, not necessary to install any other overload protection device between the inverter and the motor.

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

Supply voltage	Model	Recommended fuse gC	Recommended circuit breaker ABB MCB S200
3 x 380 - 460 VAC	PSDrive 11	10	S203-C10
3 x 380 - 460 VAC	PSDrive 22	10	S203-C10
3 x 380 - 460 VAC	PSDrive 40	16	S203-C16
3 x 380 - 460 VAC	PSDrive 55	20	S203-C20
3 x 380 - 460 VAC	PSDrive 75	25	S203-C25
3 x 380 - 460 VAC	PSDrive 110	30	S203-C32
3 x 380 - 460 VAC	PSDrive 150	35	S203-C40
3 x 380 - 460 VAC	PSDrive 185	50	S203-C50
3 x 380 - 460 VAC	PSDrive 220	63	S203-C63

Residual Current Devices (RCD)

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

- Type B, marked with the symbols 

7.3. Connecting cables

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

7.3.1. Power cables

Model	Maximum section of the input cable with earth	Maximum section of the output cable with earth	Cable tightening torque [Nm]	Ground cable tightening torque
PSDrive 11	4 x 2,5 mm^2	4 x 2,5 mm^2	-	-
PSDrive 22	4 x 2,5 mm^2	4 x 2,5 mm^2	-	-
PSDrive 40	4 x 2,5 mm^2	4 x 2,5 mm^2	-	-
PSDrive 55	4 x 6 mm^2	4 x 6 mm^2	1	3
PSDrive 75	4 x 6 mm^2	4 x 6 mm^2	1	3
PSDrive 110	4 x 6 mm^2	4 x 6 mm^2	1,5	3
PSDrive 150	4 x 6 mm^2	4 x 6 mm^2	1,5	3
PSDrive 185	4 x 16 mm^2	4 x 16 mm^2	1,5	3
PSDrive 220	4 x 16 mm^2	4 x 16 mm^2	1,5	3

WARNING
Use unshielded cable for input cables and shielded cable 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 control cables	Tightening torque [Nm]
Control terminals of all models	1 mm^2	0,5

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 for electromagnetic compatibility according to EN61800-3.

However, to ensure the electromagnetic compatibility of the system in which it is installed, the following is necessary:

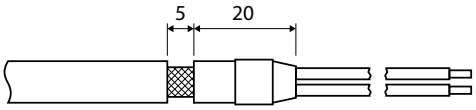
- Use ground cables that are as short as possible.
- use motor cables that are as short as possible and shielded with the shield connected at both ends.
- use shielded signal cables with the shield connected at one end only.

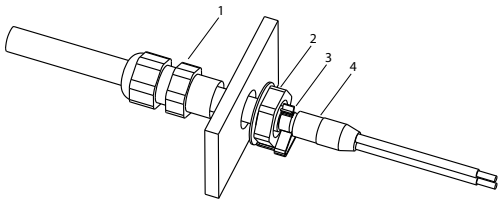
WARNING
Install signal, motor, and power cables separately from each other at a distance of at least 30 cm. If the interconnected signal cables are to meet the speaker cables, cross them at right angles.

WARNING
The connection of the Cy filter capacitors to ground may be removed by removing the screws marked with the EMC symbol. In this manner the leakage currents to ground due to the filter are reduced, but the intrinsic EMC compatibility of the device is not guaranteed and must therefore, be guaranteed externally in another way.

EMC clips for cable glands

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



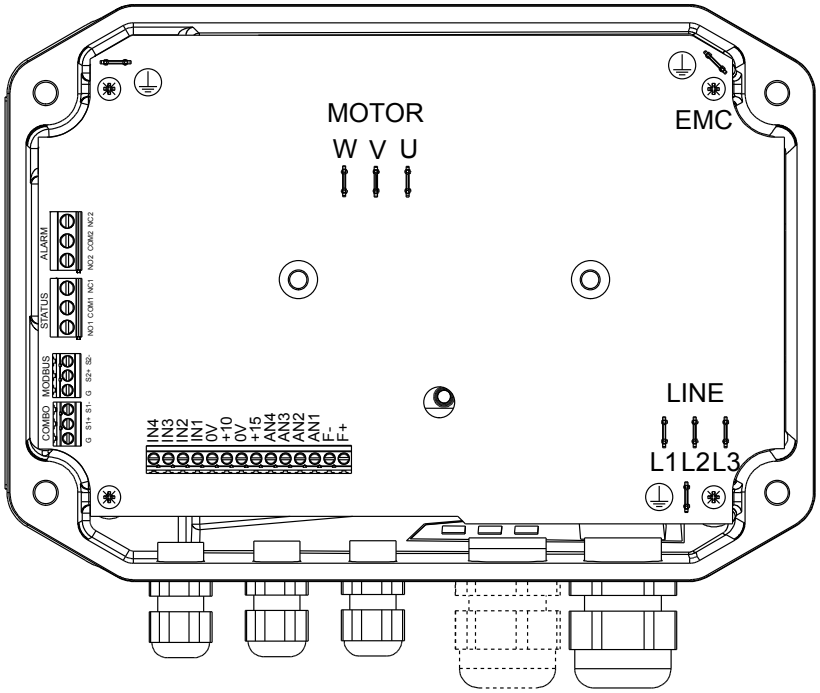


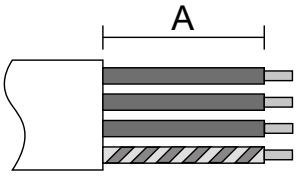
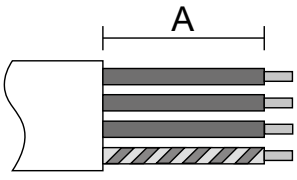
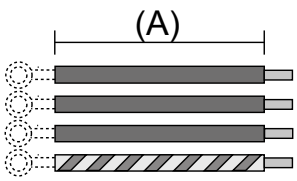
1: Cable gland; 2: Lock nut; 3: EMC clips; 4: Shielded cable

7.5. Electrical connections

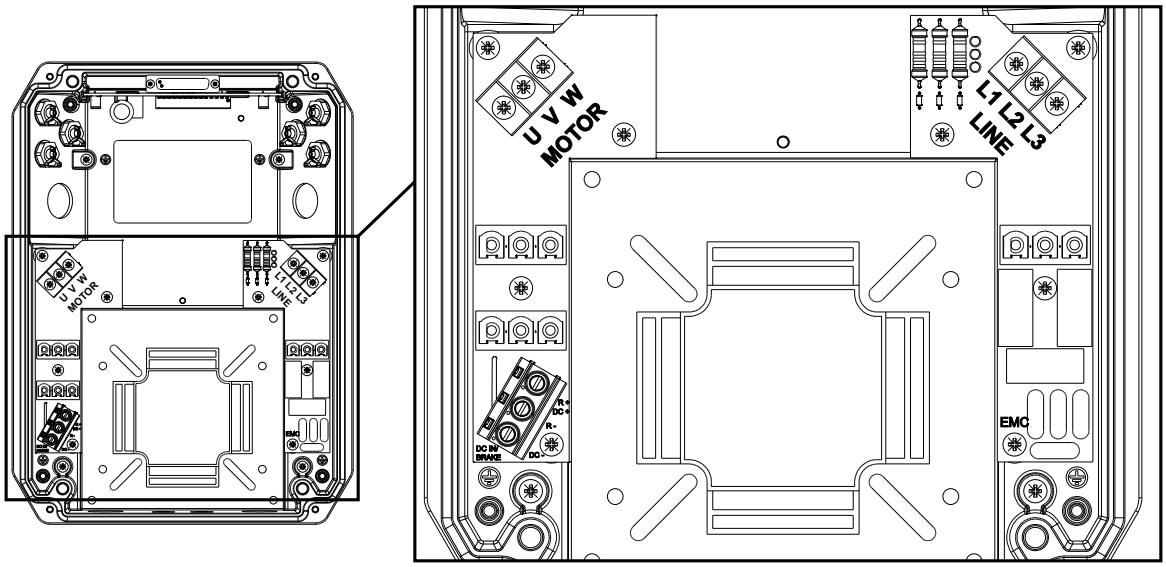
7.5.1. Power connections

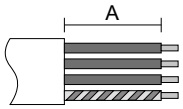
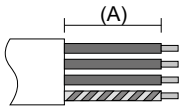
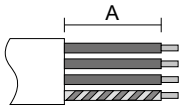
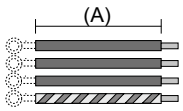
PSDrive 11 , PSDrive 22 , PSDrive 40



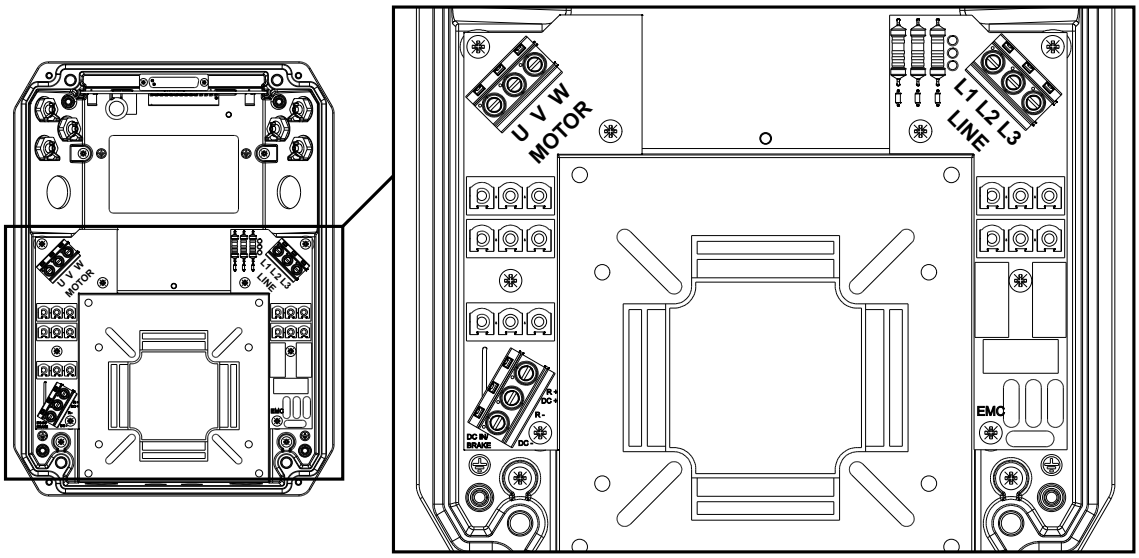
		A [mm]	Pre-insulated cable lug	Stripping scheme
Power supply **LINE**	**L1**	70	Female faston 6.3 x 0.8 mm	
	L2	70	Female faston 6.3 x 0.8 mm	
	L3	70	Female faston 6.3 x 0.8 mm	
	P.E. ⏚	70	Female faston 6.3 x 0.8 mm	
Motor **MOTOR**	**U**	120 (200)	Female faston 6.3 x 0.8 mm	Wall installation 
	V	120 (200)	Female faston 6.3 x 0.8 mm	
	W	120 (200)	Female faston 6.3 x 0.8 mm	
	P.E. ⏚	180 (200)	Female faston 6.3 x 0.8 mm	Installation on motor 

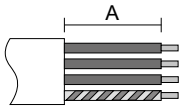
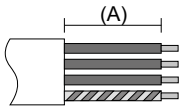
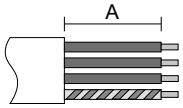
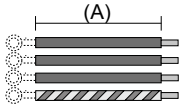
,PSDrive 55 , PSDrive 75



		A [mm]	Pre-insulated cable lug	Stripping scheme
Power supply **LINE**	**L1**	180 (120)	Fork for M4 screw	Wall installation (through lower cable glands)  Motor installation (through side cable glands) 
	L2	180 (120)	Fork for M4 screw	
	L3	180 (120)	Fork for M4 screw	
	P.E. ⏚	180 (120)	Eyelet for M4 screw	
Motor **MOTOR**	**U**	180 (180)	Fork for M4 screw	Wall installation  Installation on motor 
	V	180 (180)	Fork for M4 screw	
	W	180 (180)	Fork for M4 screw	
	P.E. ⏚	180 (180)	Eyelet for M4 screw	

, , , ,PSDrive 110 , PSDrive 150 , PSDrive 185 , PSDrive 220

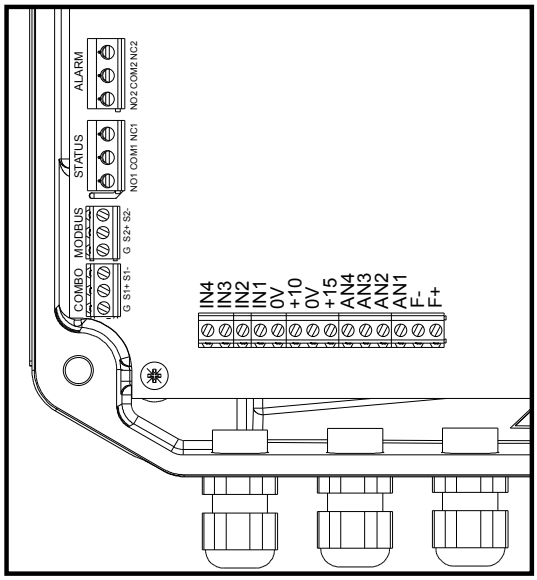


		A [mm]	Pre-insulated cable lug	Stripping scheme
Power supply **LINE**	**L1**	180 (120)	Tip	Wall installation (through lower cable glands)  Motor installation (through side cable glands) 
	L2	180 (120)	Tip	
	L3	180 (120)	Tip	
	P.E. ⏚	180 (120)	Eyelet for M4 screw	
Motor **MOTOR**	**U**	180 (180)	Tip	Wall installation  Installation on motor 
	V	180 (180)	Tip	
	W	180 (180)	Tip	
	P.E. ⏚	180 (180)	Eyelet for M4 screw	

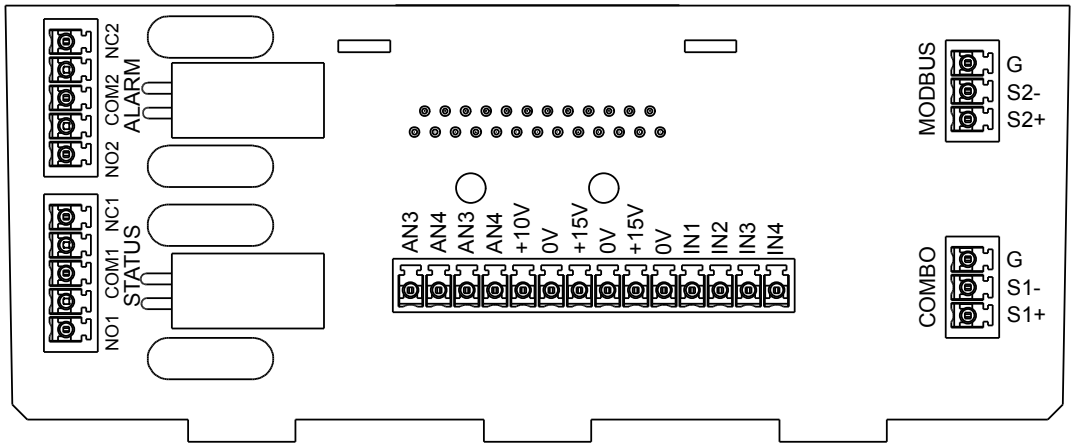
DANGER
In size 2 devices, the LEDs DL1, DL2, DL3 next to the power supply terminal block indicate the presence of voltage in the input phases. Do not touch the device and its components for any reason if one or more LEDs are lit.

7.5.2. Control connections

Control connections for size 1 devices



Control connections for size 2 devices



Type		Features	Features	Comments
Analog inputs	AN1	4-20 mA	Sensor 1	-
	AN2	4-20 mA	Sensor 2	-
	AN3	0-10 V	External set value	

Type		Features	Features	Comments
	AN4	0-10 V	External frequency External set value 2	
Power supply	+15 V	15 VDC, max 100 mA	Power supply for 4-20 mA analog inputs	Do not use as power supply to the digital inputs!
Power supply	+10 V	10 VDC, max 3 mA	Power supply for analogue inputs 0-10 V	Do not use as power supply to the digital inputs!
Signal GND	0V	Isolated	Signal GND for analog and digital inputs	-
Digital inputs	IN1	Active low	Starting and stopping the motor	Programmable as Normally Open or Normally Closed.
	IN2	Active low	Starting and stopping the motor Exchange value set 1 and 2	Programmable as Normally Open or Normally Closed.
	IN3	Active low	Starting and stopping the motor Exchange of sensors 1 and 2	Programmable as Normally Open or Normally Closed.
	IN4	Active low	Reset alarms Starting and stopping the motor Main and auxiliary control mode switch	Programmable as Normally Open or Normally Closed.
Relay outputs	NO1	Normally Open	STATUS Relay NO1, COM1: contact closed when the motor is running. NC1,COM1: contact closed with motor stopped.	Potential-free contacts Max 250 VAC, 2 A Max 30 VDC, 2 A
	COM1	Common		
	NC1	Normally Closed		
Relay outputs	NO2	Normally Open	ALARM relay NO2,COM2: contact closed without alarm. NC2,COM2: contact closed with alarm or without power supply.	Potential-free contacts Max 250 VAC, 2 A Max 30 VDC, 2 A
	COM2	Common		
	NC2	Normally Closed		
Serial RS485	S1+	Positive	Communication COMBO	-
	S1-	Negative		-
	G	Serial GND		Serial GND is isolated from signal GND
Serial RS485	S2+	Positive	Communication MODBUS RTU	-
	S2-	Negative		-
	G	Serial GND		Serial GND is isolated from signal GND

8. Commissioning

8.1. Preliminary checks

Before supplying power to the device, it is recommended to perform the following electrical and mechanical checks:

- Check that the device complies with the motor control according to its plate data.
- Verify proper grounding of the device, the load, and the entire system.

- Check the correct connection of the power supply cable and the motor cable, paying particular attention to any inversion of the connection.
- 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.
- Verify that the mechanical installation is correct, robust and complies with environmental and cooling requirements.
- Check that the gaskets 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

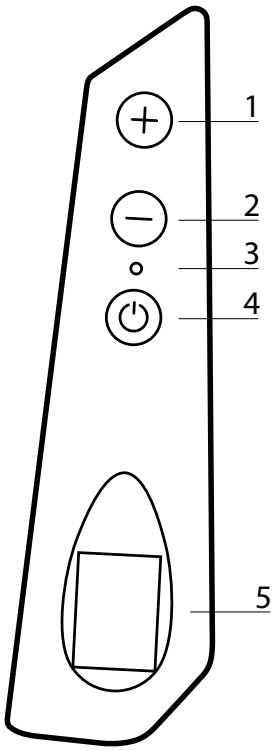
DANGER
Before supplying power to the device, make sure you have read, understood and implemented all the safety, mechanical, and electrical installation instructions.

Finally, the following is possible:

- Supply voltage to the device.
- Verify the correct switching on and the absence of alarm messages.
- Perform programming.
- Start the motor.

9. Operation and programming

9.1. Keyboard and display



1. + : scroll parameters / change parameters
   Use the + key to increase the set value or frequency. In order to allow the set value to be changed, it is necessary to hold down the + or - button for more than 5 seconds until the set value to be changed starts flashing. To confirm the set value, simply wait 5 seconds or press the START/STOP button.
2. - : Scrolling parameters/changing parameters
   The - key may be used to decrease the set value or frequency. In order to allow the set value to be changed, it is necessary to hold down the + or - button for more than 5 seconds until the set value to be changed starts flashing. To confirm the set value, simply wait 5 seconds or press the START/STOP button.
3. Signalling LEDs:
   - RED on: the device is powered with the correct supply voltage and is in stand-by condition.
   - GREEN: motor running.
   - Flashing YELLOW: Alarm condition.
4. START / STOP: Motor start / stop
5. DISPLAY

Keeping the START / STOP key pressed down for at least 5 seconds activates the START/STOP key lock function through which it is only possible to scroll and view the operating parameters, using the + and - keys, but not to start or stop the motor. Pressing the START/STOP button again for at least 5 seconds deactivates the lock.

Keeping the + and - keys pressed for at least 5 seconds will reverse the display.

9.2. Control via App

It is possible to control the device using a smartphone or tablet equipped with Bluetooth BTLE connectivity and with the App Varisco PSDrive installed. The App is available for Android and iOS and may be downloaded, free of charge, through the respective online stores.

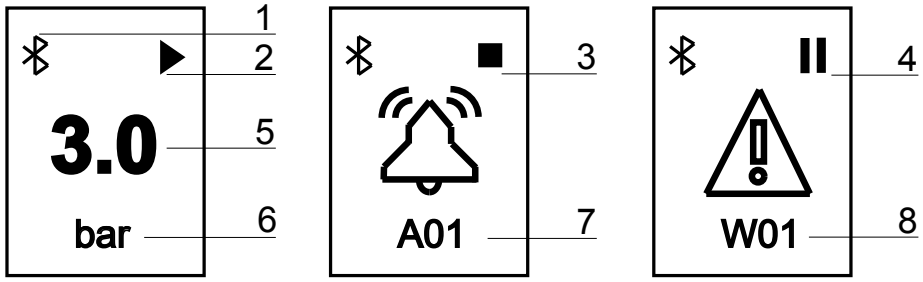
Through the application it is possible to:

- Monitor multiple operating parameters simultaneously.
- Get energy consumption statistics and check alarm history.
- Run reports with the ability to add 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 turned on, the user is notified of the control firmware version (LCD = X.XX), the power firmware version (INV = X.XX) and the hardware version (HW = X.XX)

Then 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: Notice

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

Using the App it is possible to monitor other parameters and consult the alarm history.

9.4. FOC motor control

9.4.1. 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 may 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.

9.4.2. 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.

NOTE
The calibration process can take up to one minute. Wait until it has completed.

NOTE
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.

If a change is made to the motor, cable or filter applied, the calibration process must be repeated.

CAUTION
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.

WARNING
Setting the motor rated current too high compared to the plate data may seriously damage both the motor and the inverter. Setting an excessive nominal current, compared to the plate, may 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. It is therefore recommended to allow the motor 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, 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.

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, it is recommended to contact technical assistance.

9.4.3. 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 or 40 or less

WARNING
The incorrect setting of the FOC dynamic may cause:

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

It is recommended to intervene promptly by appropriately adjusting the "FOC Dynamic" parameter if the conditions listed above are present. Lack of intervention could lead to damage to the inverter, the motor and the system.

9.5. Menu

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

- **Installer level**: Allows the modification of parameters related to the operation of the pump in the hydraulic system on which it is installed. **Password 1, default 001.**
- **Advanced level**. It allows for the modification of parameters so critical that, in case of the wrong setting, they may compromise the life of the device, the pump, and the system. **Password 2, default 002.**

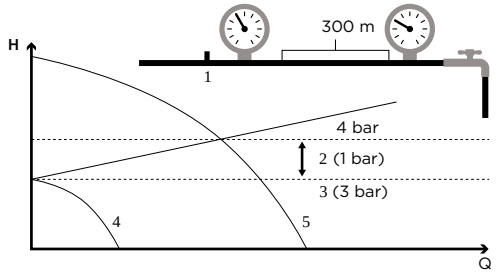
Within each menu, it is possible to change the relative access password.

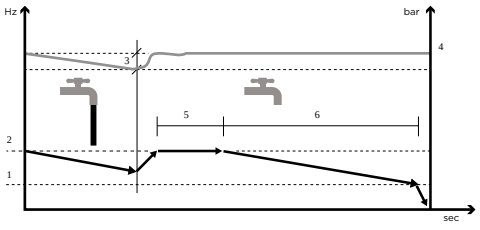
NOTE
Access to the installer or advanced level by means of an incorrect password entails only the possibility of displaying the parameters set without any possibility of modification.

In case of loss of the password, it is advisable to contact technical support to obtain the universal password.

Menu	Description	Level	Default password
Control. param.	Menu of parameters relating to the control of the pump in the hydraulic system in which it is installed.	Installer	001
Motor parameters	Motor control parameters menu	Advanced	002
IN/OUT paramet.	Parameter menu for analogue and digital inputs and outputs	Installer	001
Connect. param.	Parameters menu for connectivity and external communication.	Installer	001

9.6. Control parameters

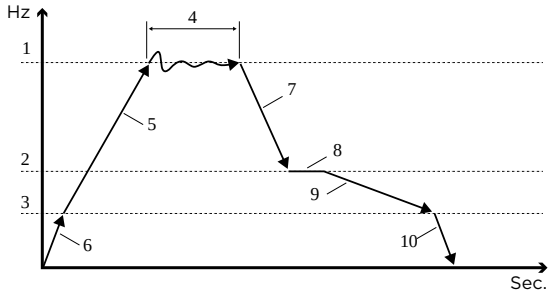
Parameter	Default	Description	1	2	3	4	5
Control mode 1. Constant value 2. Fix speed 3. Const.value 2set 4. Fix speed 2 val. 5. External speed	Constant value	It is possible to choose between the following control modes: 1. Constant value:The device varies the pump speed so as to keep the set value constant regardless of water consumption. 2. Fix speed:The device powers the pump at the set frequency. 3. Const.value 2set: Two desired values may be selected by opening or closing digital input 2. 4. Fix speed 2 val.: Two desired frequency values may 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
AUX control mode XXXXXXXX	Constant value	By acting on digital input 4, it is possible 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	Reachable value in the system beyond which, even in constant frequency operation mode, the pump stops and an alarm signal is emitted. The pump is only restarted after the measured value has fallen below the maximum alarm value for longer than 5 seconds.	x	x	x	x	x
Min alarm value p = XX.X [bar]	0	Minimum value that may be reached in the system below which, even in constant frequency operation mode, the pump stops and an alarm signal is emitted. The pump is only restarted 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 below the minimum alarm value. The pipe 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 run as long as the fill ramp is active.	x		x		
Ext.set enabling ON/OFF	OFF	Enabling of set value setting via analog input 3.	x		x		
Set value p = XXX.X [bar]	3	Value you want to keep constant.	x				
Compensation p = XXX.X [bar]	0	Compensation at maximum frequency. By pressing the green button it is possible to invert the sign.  1: sensor; 2: Compensation ; 3: Set value ; 4: Min motor freq.; 5: Max motor freq. In case of a pump group in COMBO mode, the compensation must be referred to each pump.	x				
Set value 2 p = XXX.X [bar]	3	Intended value to keep constant.			x		

Parameter	Default	Description	1	2	3	4	5
Compensat. set 2 p = XX.X [bar]	0	Compensation at maximum frequency. By pressing the green button it is possible to invert the sign.			x		
Value set update t = XX [s]	5	Time interval for updating the set value as a function of compensation.	x		x		
Operating freq. f = XXX [Hz]	= Max motor freq.	Frequency at which the device powers the motor.		x		x	
Operating freq.2 f = XXX [Hz]	= Max motor freq.	Frequency at which the device powers the motor.				x	
Freq.min.control fmin = XXX [Hz]	50	Minimum frequency below that the pump must try to stop following the control ramp (Control ramp).	x		x		
Stop delay t = XX [s]	5	Delay with which the pump is attempted to be stopped below the minimum control frequency (Freq.min.control).	x		x		
Control ramp t = XX [s]	40	Time in which the device decreases the motor power frequency from the minimum control frequency (Freq.min.control) to the minimum motor frequency (Min motor freq.). If during this time the measured value falls below Set value - Delta control, the device restarts the motor. Otherwise the device will stop the motor completely following the control ramp (Control ramp).	x		x		
Delta start p = XXX.X [bar]	0.5	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	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.  1: Min motor freq.; 2: Freq.min.control ; 3: Delta control; 4: Set value ; 5: Stop delay; 6: Control ramp	x		x		
Delta stop p = XX.X [bar]	0.5	This parameter represents the increment of the measured value with respect to the set value that must be exceeded in order for there to be a forced shutdown of the pump according to the stop ramp.	x		x		
Ki XXX		Integral coefficient used in constant value control.	x		x		
Ki XXX		Proportional coefficient used in constant value control.	x		x		
COMBO ON/OFF	OFF	Enabling of the COMBO function for the combined operation of several pumps in parallel. Read the dedicated chapter.	x		x		

Parameter	Default	Description	1	2	3	4	5
Address XX	01	Device address when in COMBO mode: • 0 : master • 01 to 07: slave	x		x		
Alternance ON/OFF	ON	Enabling of 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		
Altern. period t = XX [h]	0	Maximum difference in operating hours between multiple devices in the group. 0 means 5 minutes.	x		x		
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 the parameter Freq.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: • 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. A value of 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 produces a water shortage alarm. If the motor is of 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 lack of water alarm.	x	x	x	x	x
Restarts delay t = XX [min]	10	Time base that establishes the delay of attempts to restart the pump following a water shortage 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		The ENT key may be used 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 asyn.	Type of motor connected and control used: • Threephase asyn. : Control for three-phase asynchronous motors. • Synchronous PM : Control for permanent magnet synchronous motors.
Rated motor Volt V = XXX [V]		Nominal voltage of the motor according to its plate data. The average voltage drop across the inverter is between 20 and 30 V RMS depending on the load conditions.
Voltage boost V = XX.X [%]		Increased voltage at motor start-up to increase starting torque. Contact the motor manufacturer for more information.

Parameter	Default	Description
Rated motor Amp. I = XX.X [A]		Rated motor current according to its plate data increased by 5%. The voltage drop across the inverter may result in a current draw greater than the nominal motor current shown on the plate data. It is necessary to ensure, with the motor manufacturer, that such overcurrent can be tolerated.
Rated motor freq f = XXX [Hz]	50	Rated frequency of the motor.
Max motor freq. f = XXX [Hz]	50	Maximum frequency intended to power the motor. Reducing the maximum motor frequency reduces the maximum current consumption.
Min motor freq. f = XXX [Hz]	30	Minimum motor frequency. When using submersible pumps with Kingsbury type thrust system, it is recommended not to go below 30 Hz in order not to compromise the thrust system.
Ramp up time t = XX [sec]		Motor start ramp from minimum frequency (Min motor freq.) to maximum frequency (Max motor freq.). Slower ramps result in less strain on the motor and pump and therefore contribute to 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 time t = XX [sec]		Motor stop ramp from maximum frequency (Max motor freq.) to minimum frequency (Min motor freq.). Slower ramps result in less strain on the motor and pump and therefore contribute to longer life. On the other hand, response times are longer. Excessively fast stop ramps may generate overvoltage in the inverter due to the regenerative effect.
Ramp f min mot. t = XX [sec]		Time in which the motor reaches the minimum frequency from standstill (Min motor freq.) and vice versa.  1: Max motor freq.; 2: Freq.min.control ; 3: Min motor freq.; 4: PI control; 5: Ramp up time; 6: Ramp f min mot. ; 7: Ramp down time; 8: Stop delay; 9: Control ramp; 10: Ramp f min mot.
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), it is recommended to interpose between the inverter and the motor the appropriate output filters, available upon request, and to set the correct value of the PWM parameter according to the type of filter and the length of the cable. This reduces the probability of voltage peaks at the motor input while safeguarding the winding insulation. Lower values reduce the heating of the inverter.
V/f lin.-> quad. XXX %	80%	This parameter allows you to change 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 selection of the torque characteristic must be made ensuring smooth operation, reduced energy consumption and lower heating and motor noise. With single-phase motors, we recommend setting V/f linear (0%).

Parameter	Default	Description
Rotation sense ---> / <---	--->	Direction of motor rotation. If the motor should rotate in the wrong direction, it is possible to reverse the direction of rotation without having to change the phase sequence in the connection. **CAUTION** If there is more than one pump in a COMBO unit, it is recommended to use the same phase sequence when connecting the motors and to set the same direction of rotation.
Motor tuning ENT to access		If the device is "FOC-ready", motor calibration must be carried out before commissioning. **WARNING** Read the FOC motor control chapter carefully.
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 the control speed of the FOC algorithm.
Autorestart ON/OFF	OFF	Selecting ON, when the mains power returns 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		The ENT key may be used to change the advanced 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].
F.scale sensor p = XXX.X [bar]	16	Sensor full scale.
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 [%]	20% 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

Parameter	Default	Description
AN1AN2 function XXXXXXXX	Inde-pend-ent	Operating logic of the analogue inputs AN1,AN2: • Independent. The active sensor is relative to analog input 1 while the sensor connected to analog input 2 acts as an auxiliary in case of failure of the sensor or 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 the analog input 1 and the 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.	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. Selecting N.C. (Normally Closed) will continue to operate the motor if digital input 1 is closed. Conversely, it will stop the motor if digital input 1 is open.
Digital input2 N.O./N.C.	N.O.	If N.O. (Normally Open) is selected, the device will continue to drive the motor if digital input 2 is open. Conversely, it will stop the motor if digital input 2 is closed. Selecting N.C. (Normally Closed) will continue to drive the motor if digital input 2 is closed. Conversely, it will stop the motor if digital input 2 is open. Digital input 2 is also used to select set value 1 or set value 2 in the control mode Const.value 2set or to select working frequency 1 or 2 in the control mode Fix speed 2 val..
Digital input3 N.O./N.C.	N.O.	If N.O. (Normally Open) is selected, the device will continue to drive the motor if digital input 3 is open. Conversely, it will stop the motor if digital input 3 is closed. Selecting N.C. (Normally Closed) 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 AN1AN2 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 drive the motor if digital input 4 is open. Conversely, it will stop the motor if digital input 4 is closed. Selecting N.C.(Normally Closed) 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 acts as an alarm reset.
Man reset In Dig1	OFF	Enabling or disabling of the manual reset of the digital input.
Man reset In Dig2	OFF	Enabling or disabling of the manual reset of the digital input.
Dig.In.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 PASS-WORD1 Press ENT		The ENT key may be used to change the installer level password (level 1) (default 001).

9.9. Connectivity parameters

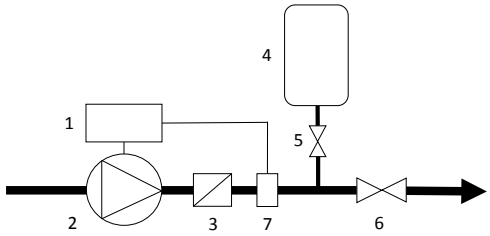
Parameter	Default	Description
MODBUS address XXX	1	MODBUS address 1 to 247
MODBUS baudrate XXXXX	9600	MODBUS baud rate 1200 bps to 57600 bps
MB data format XXXXX	RTU N81	MODBUS data format: RTU N81, RTU N82, RTU E81, ETU O81

Parameter	Default	Description
EEPROM writing ON/OFF	OFF	Setting the writing mode of the parameters transmitted via MODBUS: ON : The data is saved in EEPROM OFF : The data is not saved in EEPROM
Change PASS-WORD1 Press ENT		The ENT key may be used to change the installer level password (level 1) (default 001).

10. Constant pressure operation

10.1. Introduction

The PSDrive can manage the rotation 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 tank; 5: Valve; 6: Valve; 7: 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.

10.2. The pressure tank

In water systems equipped with inverters, the pressure tank has the sole function of compensating for losses (or minimum water consumption) and maintaining 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 tank. Too small volumes do not allow to effectively compensate the minimum water consumption or the losses when the pump is stopped, while too high volumes cause difficulties in the pressure control operated by the inverter.

It is generally sufficient to place a pressure tank with a volume of about 10% of the maximum flow rate required, considered in litres/minute.

Example

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

The pre-charge pressure of the pressure tank 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 tank should be approx. 3.2 bar.

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 supplies 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:

- Operation 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 connection of the secondary pressure sensor is made via the terminals of the analogue input 2 or:

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

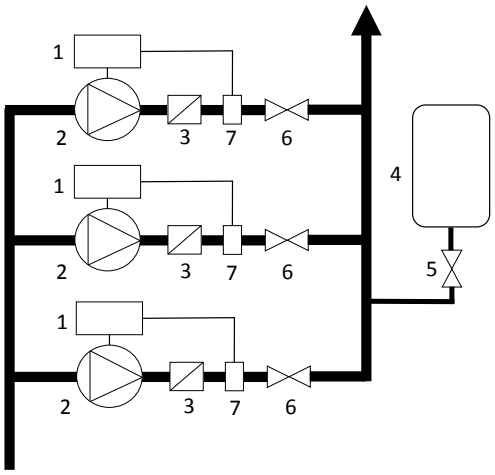
11. Fractioning of the pumping system

11.1. Introduction.

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

A fractioning 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 maximised, ensuring soft starts and stops and complete protection of the pumps. The alternation of operation also allows to uniform 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 tank; 5: Valve; 6: Valve; 7: Pressure sensor

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

The group 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 line.

One inverter is configured as master (address 00) while the other inverters are configured as slaves (addresses 01 to 07).

NOTE
Each inverter must be equipped with its own pressure sensor.

11.2.1. Principle of cascade operation.

Cascade operation is the default operation in COMBO mode.

When there is a water demand, 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 the parameter COMBO synchrony is set to ON , synchronous operation is realized. This mode of operation provides additional energy savings over cascade operation.

When there is water demand, 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.

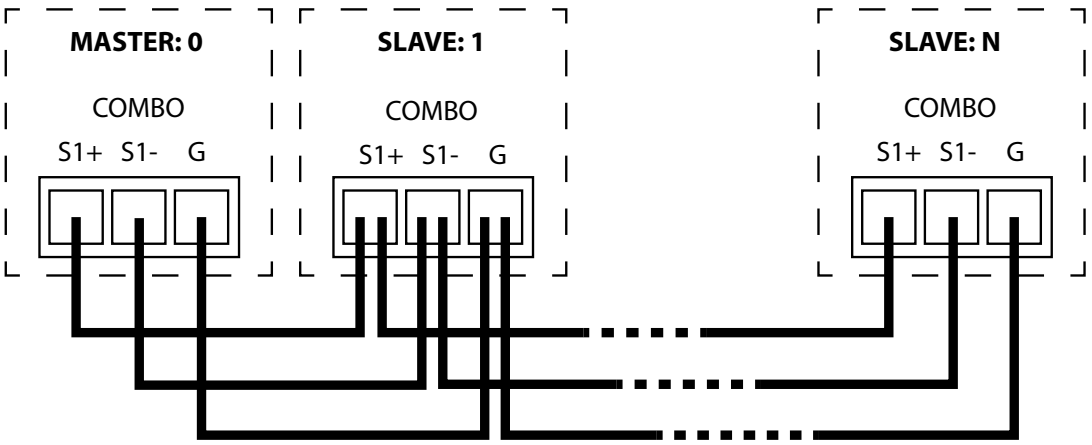
A further request leads to an increase in the frequency of the two pumps until, having reached their maximum frequency, a third pump is started and so on.

In case of reduction of the demand, all the pumps of the group reduce their frequency and, once reached the minimum frequency, the last started pump turns off.

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

NOTE
If the parameter Alternance is set to ON , the start priority of the pumps in COMBO is determined according to the operating hours and the parameter Altern. period later determines how many hours of continuous operation the pumps in the unit are forcibly switched over.

11.2.3. Electrical connections.



WARNING
Comply with the polarity of the connections.

11.2.4. Programming the master unit.

Menu	Parameter	Value
Control. param.	COMBO	ON to activate.
Control. param.	Address	00
Control. param.	Alternance	ON to activate / OFF to deactivate.
Control. param.	Altern. period	Determines after how many hours of continuous operation the pumps in the unit are forcibly switched. The value 0 means 5 minutes.
Control. param.	COMBO synchrony	ON to activate / OFF to deactivate.
Control. param.	Start delay AUX	We recommend setting 0 s.

11.2.5. Programming of slave units.

Menu	Parameter	Value
Control. param.	COMBO	ON to activate.
Control. param.	Address	01 to 07.
Control. param.	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 boot priority based on their address.

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

NOTE
To make changes to the operating parameters of a COMBO unit, it is recommended to act on the unit master.

Exiting the Master Menu, the remote programming of the connected slave units is requested. In this manner, all parameters set in the master are also copied to the slaves with the exception of the parameter Address.

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 certain that by copying the parameter Rotation sense from the master unit to the slave units, all the pumps in the group will maintain the correct direction of rotation.

11.2.6. Automatic master replacement

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

In case the master or the pump connected to it should break down or go into alarm, the group will stop for about 30 seconds producing the A13 NO COMMUNICATION alarm in the slaves. After the waiting time has elapsed, the slave with address 1 will become master, thus allowing the group to resume operation.

If the master should reappear in the group, the group will stop again for about 30 seconds, producing 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 group to resume operation.

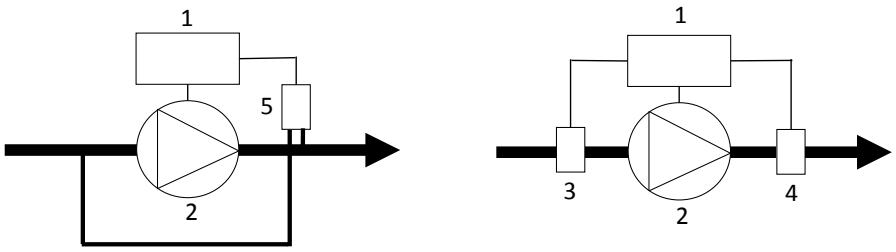
CAUTION
In order to enable automatic master changeover, the parameter Autorestart must be set to ON.

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 speed of rotation 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 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 supplies 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 (+)

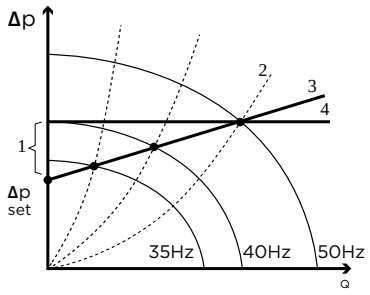
If two pressure sensors are used, one sensor must be connected to analog input 1 while the other sensor must be connected to analog input 2, i.e.:

- 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 paramet.	F.scale sensor	Sensor full scale value range.
IN/OUT paramet.	Min.value sensor	Minimum sensor value.
IN/OUT paramet.	AN1AN2 function	Independent If a differential pressure sensor is used. Difference 1-2 If two pressure sensors are used.
IN/OUT paramet.	Digital input 1	N.O. If you want to stop the pump by closing the contact of digital input 1 N.C. If you want to stop the pump by opening the contact of digital input 1
Control. param.	Control mode	Constant value
Control. param.	Set value	Differential pressure value that you want to keep constant.
Control. param.	Compensation	This parameter is set different from 0 if you intend to operate a proportional differential pressure control. Additional energy savings may be achieved through this type of control. The pressure difference that you want to keep constant at Max motor freq. is given by the sum of the parameters Set value + Compensation. The pressure difference that you want to keep constant at Min motor freq. corresponds to Set value . The pressure set then varies proportionally between Min motor freq. and Max motor freq..  1: Compensation; 2: System curve; 3: Proportional differential pressure; 4: Constant differential pressure
Control. param.	Freq.min.control	Same as Min motor freq.
Control. param.	Stop delay	99 s
Control. param.	Start delay AUX	In twin circulation systems (two pumps), each controlled by an inverter in COMBO mode, it is recommended to set this parameter to 99 s in order to activate only one pump at a time while ensuring the alternation of the same.

13. Alarms

WARNING
In the presence alarms it is necessary to take immediate action to safeguard the integrity of the device itself and the system in which it is installed.

Alarm	Description	Possible solutions
LINE<->MOT INV.	Reverse the connection of the power cable and motor cable.	• Correct the connection of the power and motor cables.
A01 OVERCURRENT MOT.	The current drawn by the motor exceeds the value set in the parameter Rated motor Amp.. Recovery mode: • Automatic reset after 10 seconds for up to 7 attempts, after which you must wait 60 minutes. • Removing the power supply.	• Check that the value set for the parameter Rated motor Amp. corresponds at least to the nominal current of the motor according to its plate data. **NOTE** The voltage drop across the inverter (varying between 20 and 40 VAC) causes the motor to be powered at a slightly lower voltage than its plate data. The current absorbed by the motor could therefore be slightly higher than the nominal current shown on its plate data and, to obtain maximum performance, it is necessary to increase the parameter Rated motor Amp. between 5% and 10%. **WARNING** Check the tolerability of carrying a current higher than its nominal current with the motor manufacturer. • Check that all motor phases are correctly connected and that the connection is properly configured in Star or Delta. • Check that the motor parameters are set correctly. • On 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 the parameters PWM and FOC dynamics have been set correctly in relation to the length of the motor cable and the type of filter used. • Check that the direction of rotation of the pump is correct. • Make sure the motor is free to rotate and check for mechanical causes . • Adjust parameter Voltage boost
A02 SENSOR FAULT	The current value read from the analog input is less than 4 mA. Recovery mode: • Alarm reset by STOP key. • Removing the power supply	• Check that the connections on the device side and the sensor side are correct. • Check that the sensor is receiving the correct power supply. • Check that the sensor is working properly. • In case of use of only one sensor connected to analog input 1, try to connect it to analog input 2.

Alarm	Description	Possible solutions
A03 OVER TEMP. INV.	The temperature reached by the device is higher than the maximum allowed value. Recovery mode: • Automatic reset	• Check that the ambient temperature is within the permissible limits. • Make sure the device is protected from direct exposure to sunlight or heat sources. • Check the correct functioning of both external and internal cooling fans (if present). • Check that the dissipation channels are clean. • Check that the device is cooled as prescribed in the dedicated chapter. • Reduce the parameter PWMas much as possible. **NOTE** To ensure continuity of operation, the inverter automatically reduces the maximum frequency (i.e. power) when the internal temperature reaches a certain threshold. If such reduction in frequency is not sufficient to keep the temperature above the maximum permitted value, the inverter will stop the motor and produce the alarm A03 OVER TEMP. INV..
A04 DRY RUN COSPHI	The warning W26 NO WATER is triggered 5 consecutive times following automatic reset attempts. Recovery mode: • Alarm reset by STOP key. • Removing the power supply	**WARNING** When the warning W26 NO WATER is triggered, 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. Resetting the alarm must be done manually.
A05 UNDER VOLTAGE	• Supply voltage below the minimum permitted value. • Insufficient input power to power the device. Recovery mode: • Automatic reset if parameter Autorestart = ON	• Check the value of the supply voltage both at no-load and at load. • Check that the source has sufficient power to supply the load.
A06 OVER VOLTAGE	The supply voltage or the voltage inside the device is beyond the maximum allowed value. Recovery mode: • Automatic reset if parameter Autorestart = ON	• Check the value of the supply voltage both at no-load and at load. • Check for regeneration from the load. • Increase parameter Ramp down time • Increase parameter Ramp f min mot. • In the case of a permanent magnet motor, check that the load is not placed in passive motion.
A07 MAX. VALUE ALARM	The value read by the analog input is higher than the value set for the parameter Max alarm value. Recovery mode: • Automatic reset	• Check the value set for the parameter. • Check the hydraulic causes that lead to the alarm condition. • Check that the sensor is working properly.

Alarm	Description	Possible solutions
A08 LOCKED ROTOR	The automatic frequency limitation created by the inverter following an excessive absorption of the motor (beyond the value set in the parameter Rated motor Amp.) causes a reduction of the frequency below the average value between Min motor freq. and Max motor freq.. Recovery mode: • Alarm reset by STOP key. • Removing the power supply	• Check possible solutions for the alarm A01 OVERCURRENT MOT.
A09 OVERLOAD INV.	The current drawn by the load exceeds the rated current of the device. Recovery mode: • Alarm reset by STOP key. • Removing the power supply	• Check that the rated motor current is lower than the rated device current. • Make sure the motor is free to rotate and check for mechanical causes . • Increase the value of the parameter Ramp up time. • Increase the value of the parameter Ramp f min mot.. • Adjust parameter Voltage boost • Check the value of the supply voltage both at no-load and at load. **CAUTION** The device is capable of continuing to 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.
A10 IGBT TRIP ALARM	The current drawn by the load instantaneously exceeds the maximum current protection of the device's power module. Recovery mode: • Automatic reset after 10 seconds for a maximum of 3 attempts, after which it is necessary to wait 60 minutes. • Removing the power supply	• Check possible solutions for alarms A01 OVERCURRENT MOT. and A09 OVERLOAD INV.. • Check for shorts 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.
A11 NO LOAD	The current drawn by the load is too low in relation to the parameter Rated motor Amp.. Recovery mode: • Alarm reset by STOP key. • Removing the power supply	• Check possible solutions for the alarm A01 OVERCURRENT MOT.
A12 ADDRESS ERROR	In COMBO mode, multiple devices in the group have the same address. Recovery mode: • Automatic reset	• Restore the correct value of the parameter Address in all devices in the group. • Check in which situation the alarm appears. • If the alarm appears after a master change, check that the parameter Autorestart is activated. • Check the electrical connection between the slave unit and the master, and the presence of possible disturbances.

Alarm	Description	Possible solutions
A13 NO COMMUNICATION	In COMBO mode, communication of the slave unit with the master has been interrupted. Recovery mode: • Automatic reset	• 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. **CAUTION** Keep signal cables separate and never parallel to power cables. If it is necessary to cross them, make sure that they cross at right angles.
A14 MIN. VALUE ALARM	The value read by the analog input is lower than the value set for the parameter Min alarm value. Recovery mode: • Automatic reset	• 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	A keyboard button has been pressed for more than 30 seconds. Recovery mode: • Alarm reset by STOP key. • Removing the power supply	• Check that the keyboard buttons are mechanically free.
A16 CPU ALARM	Communication error between the control part and the power part or error on the CPU. Recovery mode: • Automatic reset	• Check the value of the supply voltage both at no-load and at load. • 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 brake, it indicates the achievement of the maximum energy bearable by the braking resistance. Recovery mode: • Automatic reset if parameter Autorestart = ON	• Check possible solutions for the alarm A06 OVER VOLTAGE .
A19 OUT OF STEP	With parameter Motor type set to Synchronous PM, loss of motor control. Recovery mode: • Automatic reset with 3-minute delay.	• Check possible solutions for the alarm A01 OVERCURRENT MOT.
A20 INPUT PHASE LOSS	Absence of a power supply phase. Recovery mode: • Automatic reset if parameter Autorestart = ON	• Check that all three power phases are present. • Check the balance of the power supply phases.

14. Warnings

Alert	Description	Possible solutions
W01 ACTIVE DIG.IN. 1	Digital input 1 has been activated.	• Check the configuration and connections to digital input 1.

Alert	Description	Possible solutions
W02 ACTIVE DIG.IN. 2	Digital input 2 has been activated.	• Check the configuration and connections to digital input 2.
W03 ACTIVE DIG.IN. 3	Digital input 3 has been activated.	• Check the configuration and connections to digital input 3.
W04 ACTIVE DIG.IN. 4	Digital input 4 has been activated.	• 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.	• Check possible solutions for the alarm A03 OVER TEMP. INV..
W21 OVERLOAD 15V	Power supply overload 15V.	• Check the absorption of the loads and any short circuits connected to the 15V power supply
W22 EEPROM COM.	Lack of communication with EEPROM	• Contact technical support.
W23 EEPROM FAULT	Failure of EEPROM	• Contact technical support
W25 ALARM SLAVE X	In control mode COMBO, the master has detected an alarm in the X slave.	• 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 stably below the value set in the parameter Dry run cosphi.	• Check that the pump is properly primed. • Check that the direction of rotation of the pump is correct. • Check that the parameter Dry run cosphi is set correctly.
W27 BLOCK START/ STOP	The START/STOP buttons have been locked.	• Press the START or STOP button for at least 5 seconds to remove the lock.

NOTE

With threephase asynchronous motors, the correct value to set for the parameter Dry run cosphi depends on:

- Type of motor (construction and winding data). Generally, three-phase surface motors have a higher rated cosphi than submersible motors of the same power rating.
- Pump type (hydraulic performance and power consumption curve).
- 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 plate data.

The 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). The parameter Dry run cosphi must therefore be set to 10% less than the cosphi value read in the closed flow condition.

CAUTION
The electronic water shortage protection based on the 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 but it is necessary to base it on the absorbed power.

When the parameter Motor type is set to Synchronous PM, the parameter Dry run cosphi takes on the meaning of a percentage of the absorbed power.

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

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

15. EC Declaration of Conformity

The manufacturer hereby:

Varisco S.r.l.

Via Prima Strada, 37, 35129, Padova, Italy

declares, under its own responsibility, that the product:

PSDrive

complies with the following directives:

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

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

- EN 61000-6-4:2007 + A1:2011
- 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

Padova

23/01/2021

Daniele Lucchini

Legal Representative