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KEY

In this document, the following symbols have been used:

General danger. Failure to observe the warnings alongside this symbol can cause damage or physical injury.

Risk of electric shock. Failure to observe the warnings alongside this symbol can cause serious hazards with risk to personal safety.

Notes

WARNINGS

Carefully read this manual before performing any operations
Keep this manual in a safe place for future consultation.

Electrical and hydraulic connections must be made by qualified personnel in possession of the technical requirements as specified by current safety standards in the country of product installation.

The term “qualified personnel” refers to all persons specially trained, instructed and with the relative experience and knowledge of relative standards, prescriptions and provisions for accident prevention and working conditions, and are therefore authorised by the system safety supervisor to perform all necessary tasks, and are aware of and able to avoid any hazards. (Definition of technical personnel according to IEC 364).

The products dealt with in this discussion fall within the type of professional equipment and belong to insulation class 1.

It will be the task of the installer to ensure that the electrical power installation is equipped with an efficient earthing system in accordance with current standards.

To improve immunity against possible noise radiated to other equipment, separate routing of electrical power cables of the inverter is recommended.

Failure to observe these warning may lead to hazardous situations with risks to persons or objects, rendering the product guarantee null and void.

LIABILITY

The manufacturer denies all liability for malfunctions in the event of incorrect product installation, tampering, modifications, improper use or application not compatible with dataplate specifications.
The manufacturer shall also not be liable for any inaccuracies in this manual, when due to printing or transcription errors.
The manufacturer reserves the right to apply modifications to the product when deemed necessary or appropriate, without impairing the essential characteristics.
Liability of the manufacturer remains exclusively with the product itself, excluding costs or further damages due to malfunctions of installations.

1. GENERAL INFORMATION

Inverter for three-phase pump designed for the pressurisation of hydraulic systems and also optionally for flow measurement .
The inverter maintains the pressure value in a hydraulic circuit constant by varying the rpm of the electric pump; the inverter is switched on and off by sesnors according to hydraulic requirements.
There are a wide range of operating modes and optional accessories. By means of the various possible settings and availability of configurable inputs and outputs, operation of the inverter can be adapted to meet the requirements of all systems. 6 SIGNIFICATO DEI SINGOLI PARAMETRI specifies the various settable values: pressure, protection cut-out trip, frequency of rotation, etc.
In this manual the pump will also be referred to in the abbreviated form "inverter", when dealing with common characteristics.

1.1 Applications

Possible applications include:

- homes
- apartment blocks
- camp sites
- swimming pools
- farms
- irrigation for greenhouses, gardens, agriculture
- re-use of rainwater
- industrial systems

1.2 Technical specifications

Table 1 shows the technical specifications of the products in the range referred to in this manual.

Technical specifications				
		MCE-22/P	MCE-15/P	MCE-11/P
Inverter power supply	Voltage [VAC] (Tol +10/-20%)	220-240	220-240	220-240
	Phases	1	1	1
	Frequency [Hz]	50/60	50/60	50/60
	Current [A]	22,0	18,7	12,0
	Leakage current to earth [ma]	<2,5	<2,5	<2,5
Inverter output	Voltage [VAC]	0 - V alim.	0 - V alim.	0 - V alim.
	Phases	3	3	3
	Frequency [Hz]	0-200	0-200	0-200
	Maximum current[A rms]	10,5	8,0	6,5
	Minimum pump current [A rms]	1	1	1
	Max. power output [kVA] (400 Vrms)	2,8	2,0	1,5
	Mechanical power P2	3 CV / 2,2 kW	2 CV / 1,5 kW	1,5 CV / 1,1 kW
Mechanical specifications	Unit weight [kg] (excluding packaging)	6,3		
	Maximum dimensions [mm](WxHxD)	173x280x180		
Installation	Work position	Any		
	IP protection rating	55		
	Max. ambient temperature [°C]	40		
	Max. section of lead accepted by input and output terminals [mm²]	4		
	Min. diameter of cable accepted by input and output cable glands [mm]	6		
	Max. diameter of cable accepted by input and output cable glands [mm]	12		
Control and operating hydraulic specifications	Pressure regulation range [bar]	1 – 95% full scale without press.		
	Options	Flow sensor		
Sensors	Type of pressure sensors	Ratiometric (0-5V) / 4:20 mA		
	Pressure sensor full scale [bar]	16 / 25 / 40		
	Type of flow sensor supported	5 pulses [Vpp]		
Functions and safety devices	Connectivity	• Serial interface • Multi inverter connection		
	Safety devices	• Dry running • Current sensitivity on output phases • Temperature overload on internal electronics • Abnormal power supply voltages • Direct shorting between output phases • Fault on pressure sensor		

Technical specifications					
		MCE-55/P	MCE-30/P	MCE-150/P	MCE-110/P
	Voltage [VAC] (Tol +10/-20%)	380-480	380-480	380-480	380-480

Inverter power supply	Phases	3	3	3	3
	Frequency [Hz]	50/60	50/60	50/60	50/60
	Current (380V- 480V) [A]	17,0-13,0	11,5-9,0	42,0-33,5	32,5-26,0
	Leakage current to earth [ma]	<3	<3	<7,5	<7,5
Inverter output	Voltage [VAC]	0 - V alim.	0 - V alim.	0 - V alim.	0 - V alim.
	Phases	3	3	3	3
	Frequency [Hz]	0-200	0-200	0-200	0-200
	Maximum current [A rms]	13,5	7,5	32,0	24,0
	Minimum current [A rms]	2	2	2	2
	Max. power output [kW]	7,0	4,0	19,0	14,0
	Mechanical power P2	7,5 CV / 5,5 kW	4,0 CV / 3 kW	20 CV / 15 kW	15 CV / 11 kW
Mechanical specifications	Unit weight [kg] (excluding packaging)	7,6		16	
	Maximum dimensions [mm](WxHxD)	267x196x352		265x390x228	
Installation	Work position	Any			
	IP protection rating	55			
	Max. ambient temperature [°C]	40			
	Max. section of lead accepted by input and output terminals [mm²]	4		16	
	Min. diameter of cable accepted by input and output cable glands [mm]	11		18	
	Max. diameter of cable accepted by input and output cable glands [mm]	17		25	
Control and operating hydraulic specifications	Pressure regulation range [bar]	1 – 95% full scale without press.			
	Options	Flow sensor			
Sensors	Type of pressure sensors	Ratiometric (0-5V) / 4:20 mA			
	Pressure sensor full scale [bar]	16 / 25 / 40			
	Type of flow sensor supported	5 pulses [Vpp]			
Functions and safety devices	Connectivity	• Serial interface • Multi inverter connection			
	Safety devices	• Dry running • Current sensitivity on output phases • Temperature overload on internal electronics • Abnormal power supply voltages • Direct shorting between output phases • Fault on pressure sensor			

Table 1: Technical specifications

1.2.1 Ambient temperature

The inverter can still run at ambient temperatures above those specified in Table 1 but the current delivery must be reduced, as specified in Figure 1.

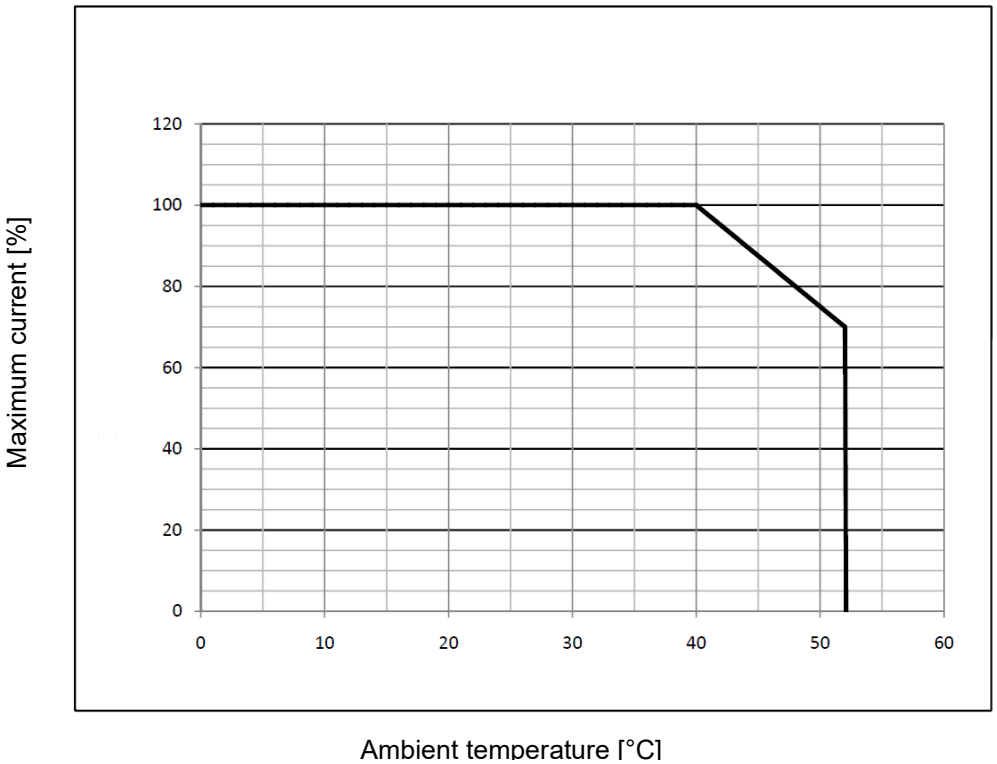


Figure 1: Current reduction curve according to ambient temperature

2. INSTALLATION

Carefully follow all recommendations in this chapter to achieve correct electrical, hydraulic and mechanical installations. On correct completion of installation, power up the system and proceed with settings as described in chapter 5 POWER-UP AND START-UP.

The inverter is cooled by the motor cooling air, therefore it is necessary to make sure that the motor's cooling system is in good working condition.

Before performing any installation disconnect the power supply to the motor and the inverter.

2.1 Fixing the unit

The inverter must be securely anchored to the motor by means of the special fixing kit. The fixing kit must be selected according to the size of the motor to be used.
The inverter can be mechanically fixed to the motor in 2 ways:

1. fixing with tie rods
2. fixing with screws

2.1.1 Fixing with tie rods

Special shaped tie rods are supplied for this fixing system; the tie rods feature a male-female connection on one side and a hook with a nut on the other. The kit also includes a dowel to center the inverter, which must be screwed into the central hole of the cooling fin using thread locking adhesive. The tie rods must be uniformly distributed around the circumference of the motor. The male-female connection side of the tie rod must be inserted in the special holes on the inverter's cooling fin, while the other side hooks onto the motor. The nuts of the tie rods must be tightened until the inverter and the motor are tightly fixed together and centered.

2.1.2 Fixing with screws

The kit for this fixing system includes a fan cover, “L” shaped brackets to fix the inverter to the motor and some screws. To install the inverter remove the motor’s original fan cover and fix the “L” shaped brackets to the stud bolts on the motor casing (position the "L” shaped brackets so that the hole to fix the inverter to the fan cover is in line with the centre of the motor); then fix the fan cover supplied to the inverter cooling fin using the screws and thread locking adhesive. Now fit the fan cover-inverter assembly on the motor and insert the special anchoring screws between the brackets mounted on the motor and the fan cover.

2.2 Connections

All electrical terminals are accessible by removing the 4 screws in the corners of the plastic cover.

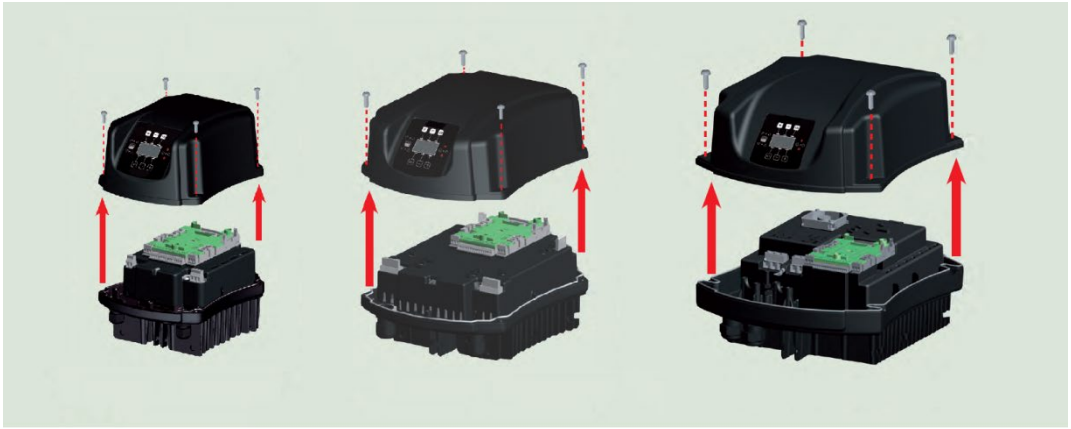


Figure 2: Removing the cover to access the connections

Before performing any installation or maintenance operation, disconnect the inverter from the electrical mains and wait for at least 15 minutes before touching internal parts.

Ensure that the voltage and frequency values on the inverter data plate correspond to those of the power mains.

2.2.1 Electrical connections

To improve the immunity to any noise radiated towards other equipment we recommend using separate ducts for the inverter supply cables.
It is recommended to carry out installation as indicated in the manual, in compliance with the laws, directives and standards in force in the place of use and depending on the application.
The product contains an inverter inside which there are continuous voltages and currents with high-frequency components (see table 1a).

Type of possible fault currents to earth				
	Alternating	Unipolar pulsed	Direct	With high-frequency components
Inverter with single-phase power supply	✓	✓		✓
Inverter with three-phase power supply	✓	✓	✓	✓

Table 2a: Type of possible fault currents to earth

If a differential switch is used with an inverter with three-phase power supply, in compatibility with the above indications and with the requirements of system protection, it is advised to use a switch that is protected against sudden tripping.

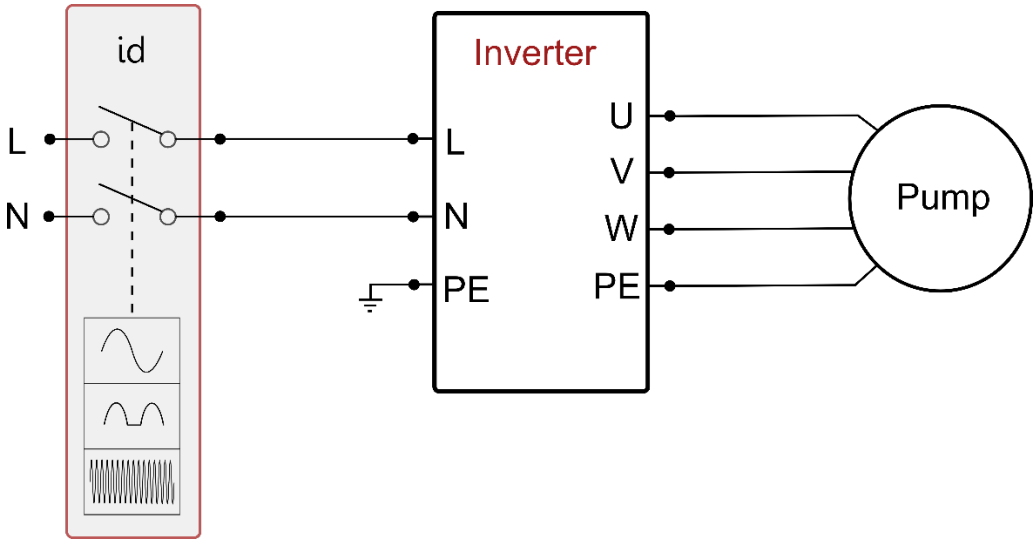


Figure 3a: Example of installation with single-phase power supply

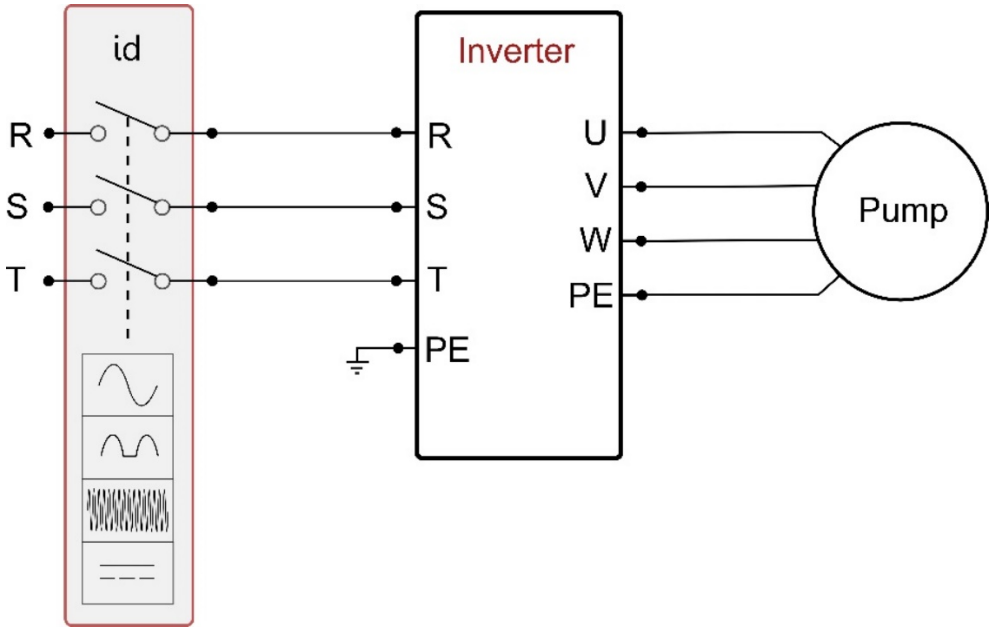


Figure 4b: Example of installation with three-phase power supply

The appliance must be connected to a main switch that cuts off all the power supply poles. When the switch is in off position, the distance separating each contact must respect the indications in table 1b.

Minimum distance between the contacts of the power switch		
Power supply [V]	>127 and ≤240	>240 and ≤480
Minimum distance [mm]	>3	>6

Table 3b: Minimum distance between the contacts of the power switch

Current absorption and thermal magnetic circuit breaker sizing for maximum power								
	MCE-22/P		**MCE-15/P**		**MCE-11/P**			
Supply voltage [V]	230 V		230 V		230 V			
Max. motor current absorption [A]	10,5		8,0		6,5			
Max. inverter current absorption [A]	22,0		18,7		12,0			
Rated current of thermal magnetic circuit breaker [A]	25		20		16			
	MCE-55/P		**MCE-30/P**		**MCE-150/P**		**MCE-110/P**	
Supply voltage [3 x V]	380	480	380	480	380	480	380	480
Max. motor current absorption [A]	13,5	10,7	13,5	10,7	32,0	25,3	32,0	25,3
Max. inverter current absorption [A	17,0	13,0	17,0	13,0	42,0	33,5	42,0	33,5
Rated current of thermal magnetic circuit breaker [A]	20	16	20	16	50	40	50	40

Table 4c: Current absorption and thermal magnetic circuit breaker sizing for maximum power

CAUTION: The line voltage may change when the electrical pump is started up by the inverter.
The voltage may be subject to variations according to other devices connected, and the quality of the line.

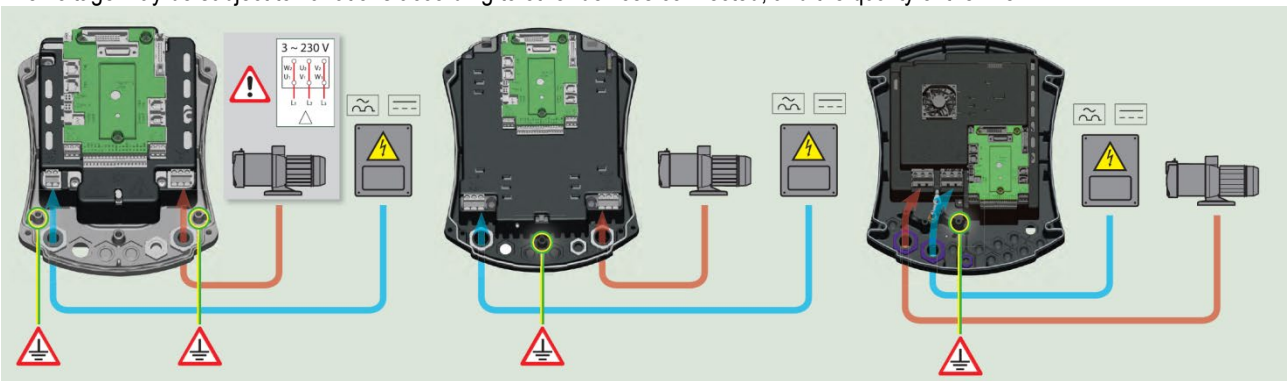


Figure 5: Electrical connections

2.2.1.1 Connection to the power line MCE-22/P – MCE-15/P – MCE-11/P

The inverter must be connected to the single-phase power line by means of a 3-core cable (phase neutral + earth). The relative line specifications must correspond to those shown in Table 1.
The input terminals are those marked with the text LN and an arrow pointing towards the terminals; see
Figure 3.
The section, type and laying of cables for inverter power supply and electric pump connections must be selected in compliance with current standards. Table 2 provides indications on the cable section to be used. The table refers to cables in PVC with 3-core cable (phase neutral + earth)with the minimum recommended section based on the current and length of cable.
The current supply to the inverter can generally by estimated (with a relative safety margin) at 2.5 times the current absorbed by the three-phase pump. For example, if the pump connected to the inverter absorbs 10A per phase, the inverter power supply cables should be sized for 25A.
Although the inverter is already equipped with internal safety devices, the installation of a suitably sized thermal magnetic circuit breaker is recommended.
If using all the power available, in order to calculate the current to use when selecting the cables and the thermal magnetic cut-out, refer to the Table 1c which specifies the type of thermal magnetic cut-out to be used according to current values.

Power supply cable section in mm²															
	10 m	20 m	30 m	40 m	50 m	60 m	70 m	80 m	90 m	100 m	120 m	140 m	160 m	180 m	200 m
4 A	1,5	1,5	1,5	1,5	2,5	2,5	2,5	2,5	4	4	4	6	6	6	10
8 A	1,5	1,5	2,5	2,5	4	4	6	6	6	10	10	10	10	16	16
12 A	1,5	2,5	4	4	6	6	10	10	10	10	16	16	16		
16 A	2,5	2,5	4	6	10	10	10	10	16	16	16				
20 A	4	4	6	10	10	10	16	16	16	16					
24 A	4	4	6	10	10	16	16	16							
28 A	6	6	10	10	16	16	16								
Data concerning 3-core PVC cables (phase neutral+earth)															

Table 5: Single phase line power cable section

2.2.1.2 Connection to the power line MCE-150/P – MCE-110/P – MCE-55/P – MCE-30/P

The inverter must be connected to the 3-phase power line by means of a 4-core cable (3 phases+earth) The relative line specifications must correspond to those shown in Table 1.
The input terminals are those marked with the text RST and an arrow pointing towards the terminals; see
Figure 3. The section, type and laying of cables for inverter power supply and electric pump connections must be selected in compliance with current standards. Table 4 provides indications on the cable section to be used. The table refers to cables in PVC with 4 wires (3 phases+earth) with the minimum recommended section based on the current and length of cable.
The current supply to the inverter can normally be calculated (taking a safety margin into account) as 1/8 of the current absorbed by the pump.
Although the inverter is already equipped with internal safety devices, the installation of a suitably sized thermal magnetic circuit breaker is recommended.
If the entire power range available is used, for specific information on the current to be used when choosing cables and the thermal magnetic circuit breaker, refer to Table 4.
Table 1c also indicates the sizes of thermal magnetic circuit breakers to be used, according to the current absorption.

2.2.1.3 Electrical connections to the pump

The connection between the inverter and the electropump must be made with a 4-core cable (3 phases + earth). The characteristics of the connected electropump must be able to satisfy the indications in Table 1.
The output terminals are those marked with the text UVW and an arrow pointing away from the terminals; see Figure 3.
The section, type and laying of the cables for connection to the electropump must be chosen according to the regulations in force. Table 4 supplies an indication on the section of the cable to be used. The table refers to 4-core PVC cables (3 phases + earth) and gives the recommended minimum section with relation to the current and the length of the cable.
The electropump current is generally specified on the motor data plate.
The rated voltage of the electric pump must be the same as the supply voltage of the inverter.
The rated frequency of the electric pump can be set via the display according to the specifications on the manufacturer's dataplate.
For example, the inverter can also be powered at 50 [Hz] with control of an electric pump at 60 [Hz] - nominal (provided that the pump is declared as compatible for this frequency).
For special applications, pumps are also available with frequency up to 200 [Hz].
The utility connected to the inverter must not absorb current in excess of the maximum values specified in Table 1.
Check the dataplates and type of motor connection (star or delta) used to ensure compliance with the above conditions.

2.2.1.4 Electrical connections to the electric pump MCE-22/P – MCE-15/P – MCE-11/P

Models MCE 22/P – MCE 15/P – MCE 11/P require motor configuration for a three-phase voltage of 230V. This is normally obtained by a delta configuration of the motor. See Figure 4.

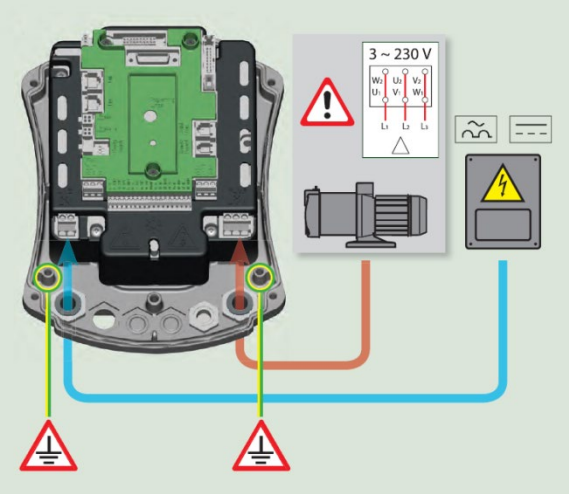


Figure 6: Pump connection MCE 22/P – MCE 15/P – MCE 11/P

Incorrect connection of the earthing line, to a terminal other than the earth terminal can cause irremediable damage to the equipment.

Incorrect connection of the power line on the output load terminals can cause irremediable damage to the equipment.

Cable section in mm²															
	10 m	20 m	30 m	40 m	50 m	60 m	70 m	80 m	90 m	100 m	120 m	140 m	160 m	180 m	200 m
4 A	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	2,5	2,5	2,5	2,5	4	4	4
8 A	1,5	1,5	1,5	1,5	2,5	2,5	2,5	4	4	4	6	6	6	10	10
12 A	1,5	1,5	2,5	2,5	4	4	4	6	6	6	10	10	10	10	16
16 A	2,5	2,5	2,5	4	4	6	6	6	10	10	10	10	16	16	16
20 A	2,5	2,5	4	4	6	6	10	10	10	10	16	16	16	16	16
24 A	4	4	4	6	6	10	10	10	10	16	16	16	16	16	16
28 A	6	6	6	6	10	10	10	10	16	16	16	16	16	16	16
32 A	6	6	6	6	10	10	10	16	16	16	16	16	16	16	16
36 A	10	10	10	10	10	10	16	16	16	16	16	16	16	16	16
40 A	10	10	10	10	10	16	16	16	16	16	16	16	16	16	16
44 A	10	10	10	10	10	16	16	16	16	16	16	16	16	16	16
48 A	10	10	10	10	16	16	16	16	16	16	16	16	16	16	16
52 A	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
56 A	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
60 A	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Table applicable to cables in PVC with 4 wires (3 phases + earth)															

Table 6: Section of 4-wire cable (3 phases + earth)

As regards the section of the earthing cable, refer to current standards.

2.2.2 Hydraulic connections

The inverter is connected to the hydraulic section by means of pressure and flow sensors. The pressure sensor is always required, while the flow sensor is optional if operating in stand alone mode, and is compulsory when creating multi inverter systems.
Both are mounted on pump delivery and connected by means of the relative cables to the respective inputs on the inverter board.
Always fit a check valve on pump suction and an expansion vessel on pump delivery.
In all circuits subject to the risk of water hammer (for example irrigation systems with flow rate interrupted suddenly by solenoid valves), fit a further check valve downline of the pump and mount the sensors and expansion vessel between the pump and valve.

The hydraulic connection between the pump and sensors must not have branched sections.
Pipelines must be sized according to the type of electric pump installed.
Excessively deformable systems may generate oscillations; if this occurs, the user may solve the problem by adjusting control parameters “GP” and “GI” (see sections 6.6.4 and 6.6.5)

The inverter makes the system work at constant pressure. This setting is best exploited if the hydraulic system downline of the system is suitably sized. Systems with excessively small pipelines can cause pressure drops for which the equipment is unable to compensate; the result is constant pressure on the sensors but not on the utility.

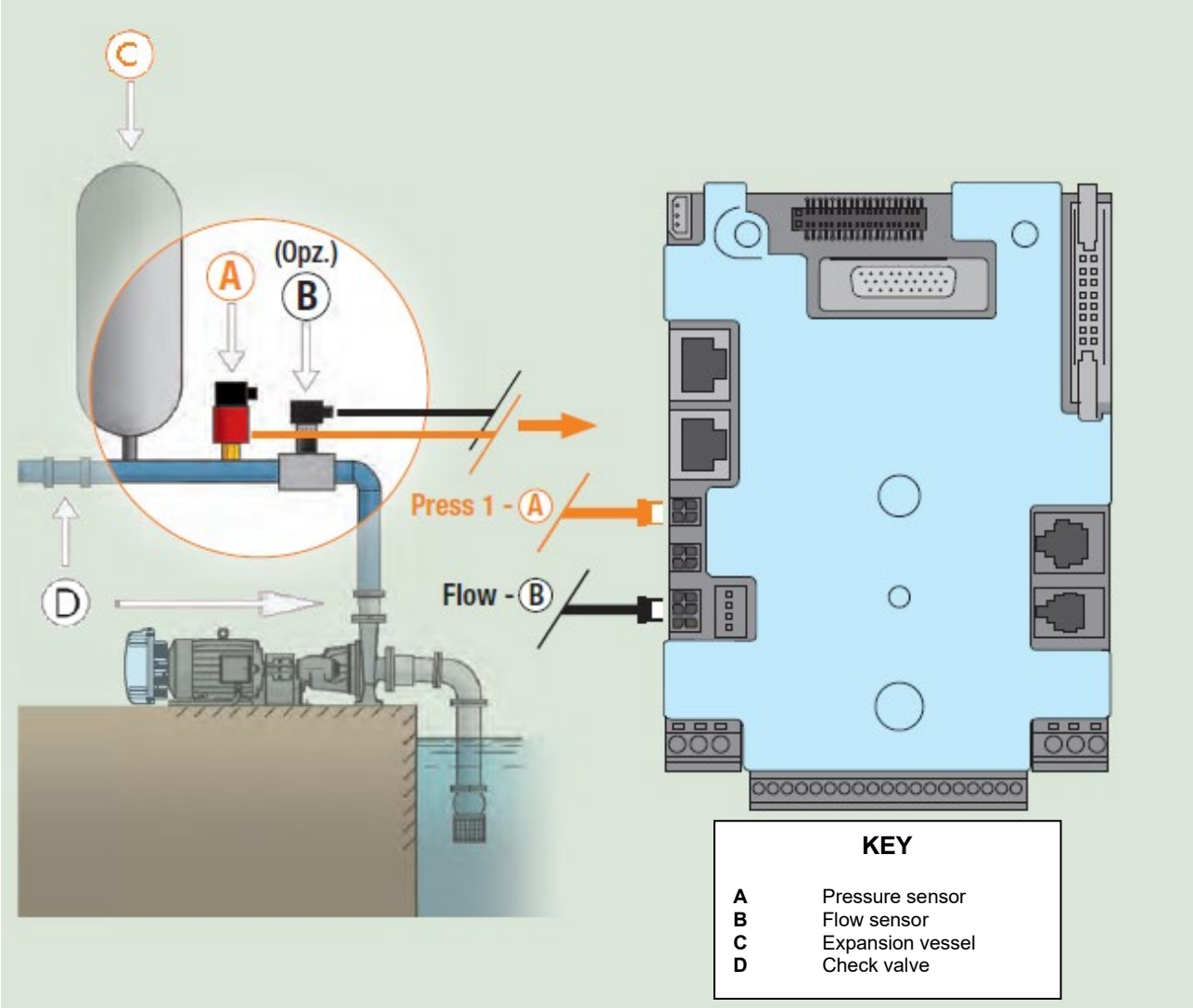


Figure 7: Hydraulic installation

Risk of foreign bodies in pipelines: the presence of dirt in the fluid may obstruct transfer channels, block the flow or pressure sensor and impair correct system operation. Take care to install the sensors so that they are not subject to the build-up of excessive sediment or air bubbles that may impair operation. If the size of the pipeline enables transit of foreign bodies, a special filter may need to be installed.

2.2.3 Connection of sensors

The ends for connecting the sensors are in the centre and are accessible by removing the screw of the connections cover, see Figure 2. The sensors must be connected to the relative inputs marked "Press" and "Flow"; see Figure 6.

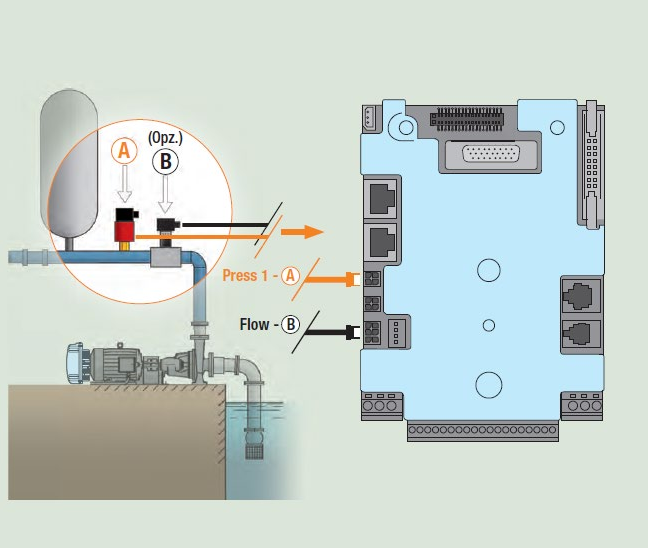


Figure 8: Sensor connections

2.2.3.1 Connecting the pressure sensor

The inverter accepts two types of pressure sensor:

1. Ratiometric 0 – 5V (Voltage sensor to be connected to connector press1)
2. In current 4 - 20 mA (Current sensor to be connected to connector J5)

The pressure sensor is supplied with its own cable, and the cable and connection on the board varies according to the type of sensor used. Both types of sensor can be supplied

2.2.3.1.1 Connecting a ratiometric sensor

One end of the cable must be connected to the sensor and the other end to the relative inverter pressure sensor input, marked "Press 1"; see Figure 6.
The cable has two different terminals with compulsory direction of insertion: connector for industrial applications (DIN 43650) on the sensor side and 4-pole connector on the inverter side.

On multiple systems, the ratiometric pressure sensor (0-5V) can be connected to any inverter in the chain.

The use of ratiometric pressure sensors (0-5V) is strongly recommended to facilitate wiring. When using ratiometric pressure sensors, there is no need for wiring to transfer pressure information readings between the various inverters. The interconnection link cable deals with this operation.

On systems with multiple pressure sensors, only ratiometric pressure sensors (0-5V) can be used (0-5V).

2.2.3.1.2 Connecting a 4 - 20 mA current sensor

Single inverter connection:

The selected 4-20mA current sensor has 2 wires, one brown (IN +) to connect to terminal 11 of J5 (V+), and one green (OUT -) to connect to terminal 7 of J5 (A1C+). A jumper should also be wired in between terminal 9 and 10 of J5. The connections are shown in Figure 7 and summarised in Table 5.

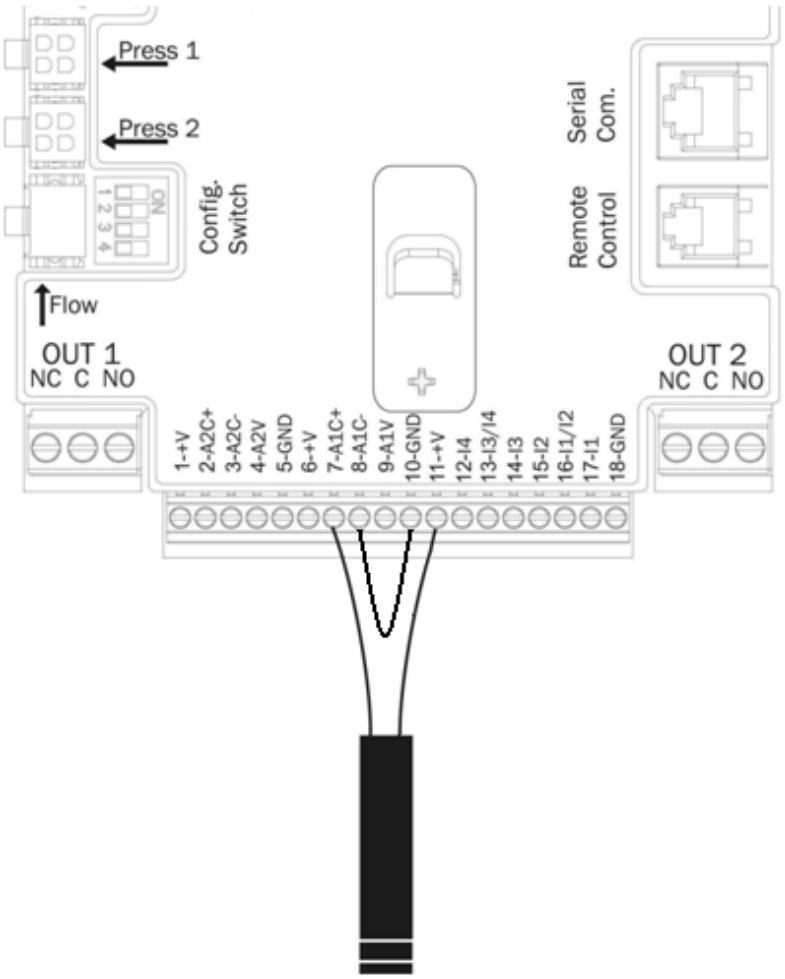


Figure 9: Connecting the 4 - 20 mA pressure sensor

4 – 20mA sensor connections Single inverter system	
Terminal	Cable to connect
7	Green (OUT -)
8 -10	Jumper
11	Brown (IN +)

Table 7: Connecting the 4 - 20 mA pressure sensor

To enable use, the current pressure sensor must be configured via software, parameter PR in the installer menu; refer to paragraph 6.5.7.

Multiple inverter connection:

Multiple inverter systems can be set up with a single 4-20mA current pressure sensor, but the sensor must be wired on all inverters.
To connect the inverters, a shielded cable must be used (sheath + 2 wires).
Proceed as follows:

- Connect all earthing terminals of the inverters.
- Connect terminal 18 of J5 (GND) of all inverters in the chain (use the sheath of the shielded cable).
- Connect terminal 1 of J5 (GND) of all inverters in the chain (use the sheath of the shielded cable).
- Connect the pressure sensor to the first inverter in the chain.
    - brown wire (IN +) on terminal 11 of J5
    - green wire (OUT +) on terminal 7 of J5

- Attach connector 8 of J5 on the 1st inverter to connector 7 of J5 on the 2nd inverter. Repeat the operation for all inverters in the chain (use the shielded cable).
- Wire in a jumper between connector 8 and 10 of J5 on the last inverter to close the chain.

Figure 8 provides the wiring diagram for this procedure.

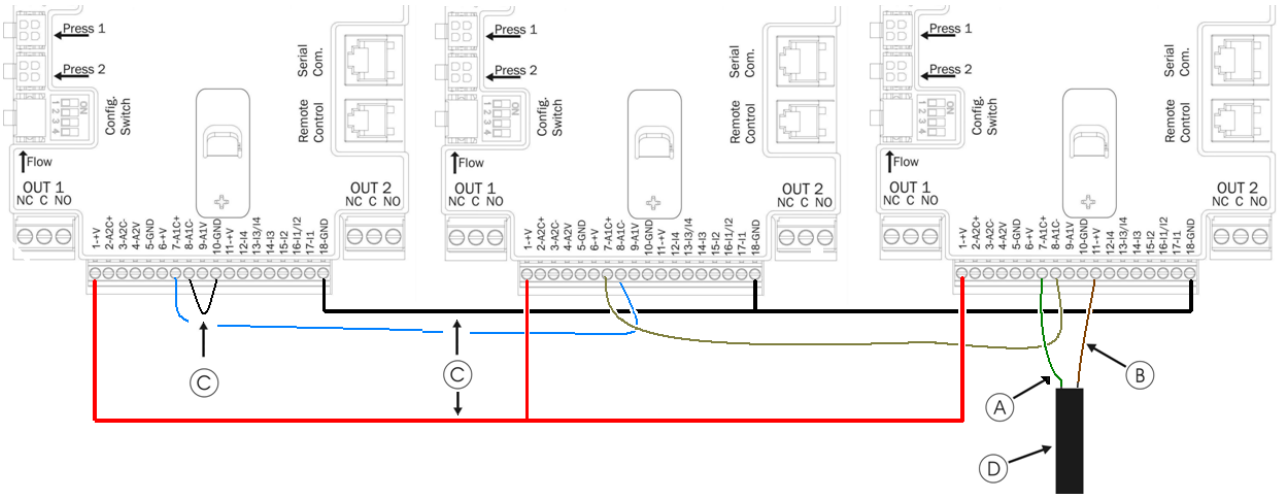


Figure 10: Connection of 4 - 20 mA pressure sensor on a multiple inverter system

KEY
the colours refer to the 4-20mA sensor supplied as an accessory

A	Green (OUT -)
B	Brown (IN +)
C	Jumpers
D	Cable from sensor

Caution: always use shielded cable to connect the sensors.

To enable use, the current pressure sensor must be configured via software, parameter **PR** in the installer menu; refer to paragraph 6.5.7. Otherwise the unit may not run, with error BP1 (pressure sensor not connected).

2.2.3.2 Connecting the flow sensor

The flow sensor is supplied with its own cable. One end of the cable must be connected to the sensor and the other end to the relative inverter flow sensor input, marked "Flow 1"; see Figure 6.
The cable has two different terminals with compulsory direction of insertion: connector for industrial applications (DIN 43650) on the sensor side and 6-pole connector on the inverter side.

The body of the flow sensor and ratiometric pressure sensor (0-5V) have the same type of DIN 43650 connector, and therefore take care to ensure that the correct sensor is connected to the correct cable.

2.2.4 Utility input and output electrical connections

The inverters are equipped with 4 inputs and 2 outputs to enable a number of solutions for interface with more complex installations. Figure 9 and Figure 10 show examples of two possible configurations of the inputs and outputs.
For the installer it is sufficient to wire the required input and output contacts and then configure the functions as necessary (see sections 6.6.13 and 6.6.14).

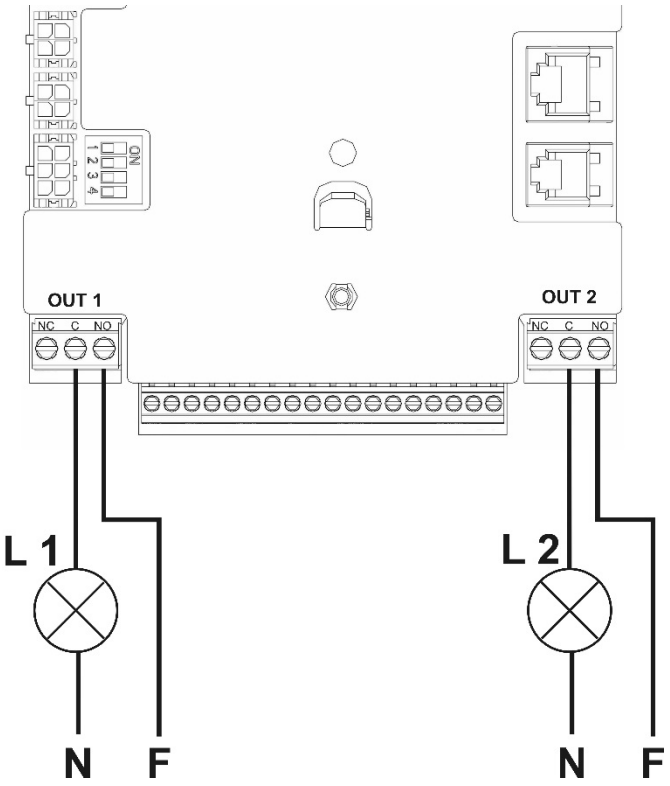
The +19 [Vdc] power supplies to pins 11 and 18 and J5 (18-pole terminal board) can deliver a maximum of 50 [mA].

2.2.4.1 OUT 1 and OUT 2 output contacts:

The connections of the outputs listed below refer to the two 3-pole terminal boards J3 and J4 marked OUT1 and OUT 2, with a text below indicating the type of terminal contact.

Output contact specifications	
Type of contact	NO, NC, COM
Max. admissible voltage [V]	250
Max. admissible current [A]	5 -> resistive load 2,5 -> inductive load
Max. admissible cable section [mm²]	3,80

Table 8: Output contact specifications



With reference to the example in Figure 9 and using the default settings (O1 = 2: contact NO; O2 = 2; contact NO) the following is obtained:

- *L1 lights up when the pump is blocked (e.g. "BL": water failure block).*
- *L2 lights up when the pump is running ("GO").*

Figure 11: Example of output connections

2.2.4.2 Input contacts (photocoupled)

The connections of the inputs listed below refer to the 18-pole terminal board J5, with numbering starting from pin 1 from the left. The base of the terminal board also bears the text of the corresponding inputs.

- I 1: Pins 16 and 17

- I 2: Pins 15 and 16
- I 3: Pins 13 and 14
- I 4: Pins 12 and 13

The inputs can be activated in DC or AC (50-60 Hz). The following table shows the electrical specifications of the inputs: Table 7.

Input specifications		
	DC inputs [V]	AC inputs 50-60 Hz [Vrms]
Minimum activation voltage [V]	8	6
Maximum deactivation voltage [V]	2	1,5
Maximum admissible voltage [V]	36	36
Current absorption at 12V [mA]	3,3	3,3
Max. admissible cable section [mm²]	2,13	
N.B. Inputs can be controlled with both polarities (positive or negative with respective return to earth)		

Table 9: Input specifications

In Figure 10 and Table 8 show the input connections.

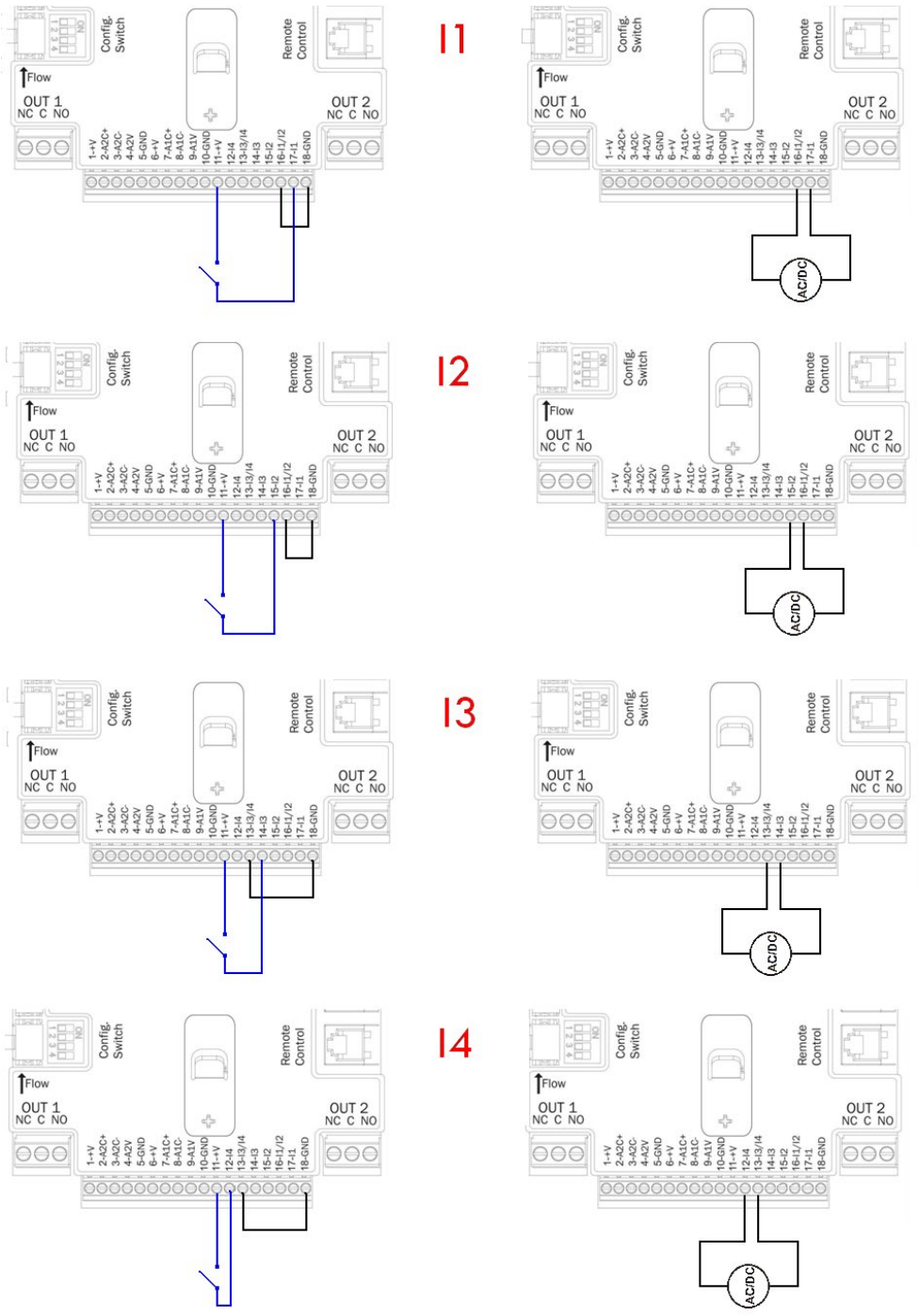


Figure 12: Example of input connections

Input wiring (J5)			
	input connected to voltage-free contact		input connected to voltage signal
Voltage-free	contact input between pins	Jumper	Signal connection pin
I1	11 - 17	16 -18	16-17
I2	11 - 15	16 -18	15-16
I3	11 - 14	13 -18	13-14
I4	11 - 12	13 - 8	12-13

Table 10: Input connection

With reference to the example in Figure 10 and using the factory settings of the inputs (I1 = 1; I2 = 3; I3 = 5; I4=10) the following is obtained:

- *When the switch is closed on I1 the pump blocks and error code "F1" is displayed (e.g. I1 connected to a float; see para. 6.6.13.2 External float function settings).*
- *When the switch is closed on I2 the control pressure becomes "P2" (see para. 6.6.13.3* Auxiliary pressure input function settings*).*
- *When the switch is closed on I3 the pump blocks and error code "F3" is displayed (see para. 6.6.13.4* Settings for system enable and fault reset).
- *When the switch is closed on I4 after time T1 the pump blocks and error code F4 is displayed.(see para. 6.6.13.5 Setting low pressure detection).*

The example in Figure 10, refers to a connection with voltage-free contact, using the internal voltage to control the inputs (obviously using only useful inputs).
If a voltage rather than a contact is available, this can still be used to control the inputs: in this case terminals +V and GND are not used and the voltage source (complying with the specifications of Table 7) is connected to the required input. If an external voltage is used to control the inputs, all the circuitry must be protected by double insulation.

CAUTION: the pairs of inputs I1/I2 and I3/I4 have a pole in common for each pair.

3. KEYBOARD AND DISPLAY

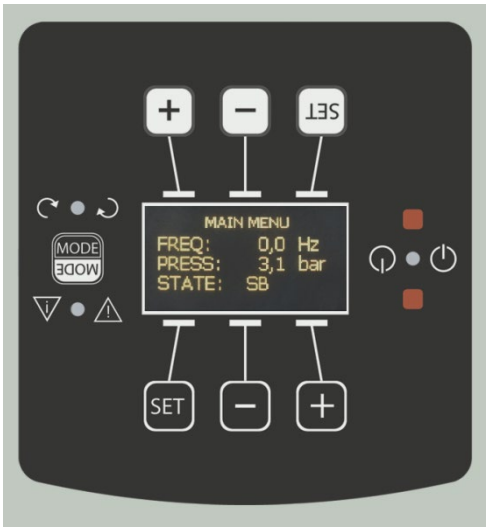


Figure 13: User interface layout

The machine interface comprises a yellow Oled display (64 X 128) with black background and 4 buttons named "MODE", "SET", "+",and "-"; see Figure 11.
When any of the keys "SET", "+", or "-" are pressed over the display, the image shown is rotated to facilitate reading from any angle.
The display shows the inverter values and statuses, and indicates the functions of the various parameters.
The button functions are summarised in Table 9.

MODE	The MODE button enables the user to move to the next items in the same menu. When pressed for at least 1 sec it enables the user to skip to the previous menu item.
SET	The SET button enables the user to exit the current menu.
−	This decreases the current parameter (if modifiable).
+	This increases the current parameter (if modifiable).

Table 11: Button functions

When pressed for a longer interval, buttons +/- enable automatic increase/decrease of the selected parameter. If button +/- is pressed for more than 3 seconds, the automatic increase/decrease speed is increased.

When the button + or – is pressed, the selected value is modified and saved immediately on the permanent memory (EEprom). Unit shutdown in this phase, even if inadvertent, does not cause loss of the set parameter.
The SET button is only used to exit the current menu and is not used to save any changes. Only in some special cases described in 6 some values are implemented by pressing "SET" or "MODE"

3.1 Menus

The complete structure of all menus and relative items is shown in Table 11.

3.2 Access to menus

There are two ways to access the various menus from the main menu:

1) Direct access with button combinations
2) Access by name via drop-down menus

3.2.1 Direct access with button combinations

The menu is accessed directly by pressing the relative combination of buttons simultaneously (for example MODE SET to enter the Setpoint menu) and the MODE button can be used to scroll through the various items.
Table 10 shows the menus accessible via button combinations.

MENU NAME	DIRECT ACCESS BUTTONS	PRESS-AND-HOLD TIME
User		On release of button
Monitor		2 Sec
Setpoint		2 Sec
Manual		5 Sec
Installer		5 Sec
Technical assistance		5 Sec
Restore default settings		2 Sec on power-up of unit
Reset		2 Sec

Table 12: Access to menus

Quick-view menu (visible)			*Full Menu (direct or password access)*			
Main menu	**User menu** *mode*	**Monitor menu** *set-minus*	**Setpoint menu** *mode-set*	**Manual menu** *set-plus-minus*	**Installer menu** *mode-set-minus*	**Tech. Assist. menu** *mode-set-plus*
MAIN (Main page)	**FR** Minimum of rotation	**VF** Flow display	**SP** Setpoint pressure	**FP** Minimum Frequency mode	**RC** Current frequency	**TB** Block time due to water failure
Menu selection	**VP** Pressure	**TE** Dissipator temperature	**P1** Aux. 1 pressure	**VP** Pressure	**RT** Direction of rotation	**T1** Shutdown time after low pressure
	C1 Pump phase current	**BT** Card temperature	**P2** Aux. 2 pressure	**C1** Pump phase current	**FN** Rated frequency	**T2** Delay on shutdown
	PO Power delivered to the pump	**FF** Fault & Warning Log	**P3** Aux. 3 pressure	**PO** Power delivered to the pump	**OD** Type of system	**GP** Integral gain
	SM System monitor	**CT** Contrast	**P4** Aux. 4 pressure	**RT** Direction of rotation	**RP** Restart Pressure decr.	**GI** Integral gain
	VE HW and SW information	**LA** Language		**VF** Flow display	**AD** Address	**FS** Maximum frequency
		HO Operating hours			**PR** Pressure sensor	**FL** Minimum frequency
					MS Measurement system	**NA** Active inverters
					FI **Flow sensor**	**NC** Max. simultaneous inverters
					FD Pipe diameter	**IC** Inverter config
					FK K-factor	**ET** Max. exchange time
					FZ Zero flow frequency	**CF** Carrier
					FT Min. flow threshold	**AC** Acceleration
					SO **Dry running factor Min. threshold**	**AE** Antiblocking
					MP Min. dry running pressure	**I1** Input 2 function
						I2 Input 2 function
						I3 Input 2 function
						I4 Input 2 function
						O1 Output 2 function
						O2 Output 2 function
						RF fault & warning reset
						PW Setting Password

Key	
Identification colours	Modification of multi inverter unit parameters
	Series of sensitive parameters. These parameters must be aligned to enable start-up of the multi-inverter system. Modification of one of these parameters on any inverter will automatically align all other inverters without the need for any command.
	Parameters that enable facilitated alignment from a single inverter, transferring data to all others. It is admissible that these differ between inverters.
	Series of parameters that can be aligned in broadcast mode by one inverter only.
	Setting parameters significant on a local level only
	Read-only parameters

Table 13: Menu structure

3.2.2 Access by name via drop-down menus

The menus are selected via their specific name. The user accesses menu selection via the main menu, by pressing button + or –.
The menu selection pages contains all the names of menus accessible, one of which is highlighted with a bar (see Figure 12). The buttons + and - can be used to move the highlighter bar to the menu required, which is then entered by pressing SET.

Figure 14: Drop-down menu selection

The menus available are MAIN, USER, and MONITOR; after access to these, a fourth FULL MENU is displayed, to enable full display of the menus selected. On selection of EXTENDED MENU a pop-up window is displayed, requesting entry of a PASSWORD. The PASSWORD is the same as the key combination used for direct access and enables the user to expand display of the menus from the password-protected menu to all those with lower priority.
The menu order is: User, Monitor, Setpoint, Manual, Installer, Technical Assistance.
On entry of a password, the unlocked menus remain available for 15 minutes or until disabled manually by means of the menu command “Hide advanced menus” which appears on selection of menus after entry of the password.
Figure 13 shows the functional scheme for menu selection.
The centre of the page shows the menus; the user can access these from the right using the button combinations, or from the left by means of the drop-down menu selection system.

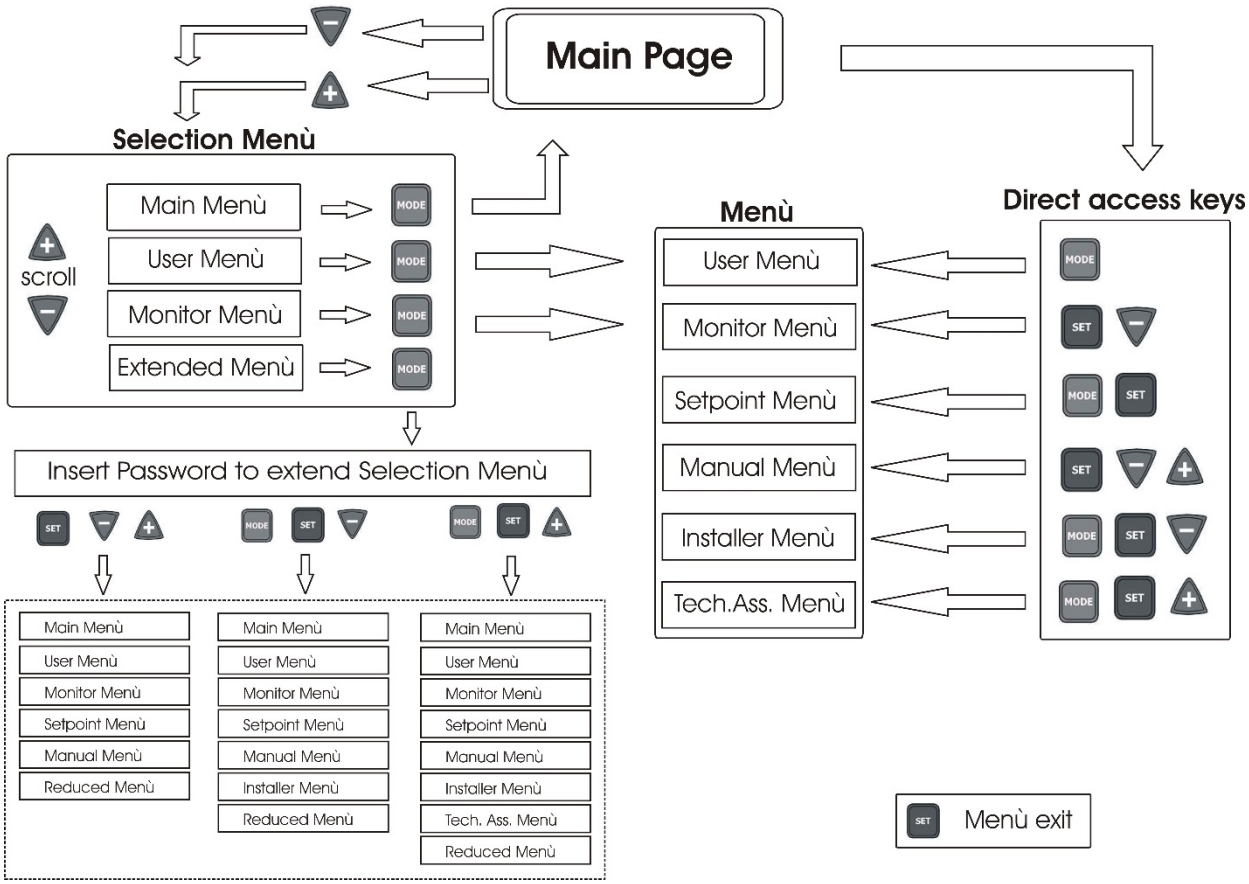


Figure 15: Optional menu access scheme

3.3 Structure of menu pages

On power-up, a number of presentation pages are displayed, with the name of the product and logo, then moving on to the main menu.
The name of each menu is always displayed at the top of the screen.

The main menu always displays the following items:
Status: operating status (e.g. standby, go, Fault, input functions)
Frequency: value in [Hz]
Pressure: value in [bar] or [psi] depending on the set unit of measurement.
If an event occurs, the following may be displayed:
Fault messages
Warning messages
Messages on functions associated with inputs
Special icons
The error or status conditions visible in the main menu are listed in Table 12.

Error and status conditions	
Identifier	**Description**
GO	Electric pump ON
SB	Electric pump OFF
BL	Block due to water failure
LP	Block due to low power supply voltage
HP	Block due to high internal power supply voltage
EC	Block due to incorrect setting of rated current
OC	Block due to current overload on electric pump motor
OF	Block due to current overload on final stages of output
SC	Block due to short circuit on output phases
OT	Block due to overheating of final power stages
OB	Block due to overheating of printed circuit
BP	Block due to fault on pressure sensor
NC	Pump not connected
F1	Float function status/alarm
F3	System disable function status/alarm
F4	Low pressure signal function status/alarm
P1	Operating status with auxiliary 1 pressure
P2	Operating status with auxiliary 2 pressure
P3	Operating status with auxiliary 3 pressure
P4	Operating status with auxiliary 4 pressure
Com. icon with number	Operating status in multi inverter communication with specified address
Com. icon with E	Error status in communication of multi inverter system
E0...E16	Internal error 0...16
EE	Writing and reading on EEprom of factory settings
WARN. Low voltage	Warning due to power supply voltage failure

Table 14: Error status messages on main page

The other menu pages vary according to the associated functions, and are described below according to the type of specification or setting. After entering any one of the menus, the lower section of the page always shows a summary of the main operating parameters (operating status or possible fault status, applied frequency and pressure).
This enables a constant overview of the main machine parameters.

Figure 16: Menu parameter display

Status bar indications at the bottom of each page	
Identifier	**Description**
GO	Electric pump ON
SB	Electric pump OFF
FAULT	Presence of error that prevents control of the electric pump

Table 15: Status bar indications

The following can be shown on parameter display pages: numerical values and unit of measurement of current item, values of other parameters related to setting of current item, graphic bar, lists; see Figure 14.

3.4 Parameter setting block via Password

The inverter is equipped with a password protection system. If a password is set, the inverter parameters will be accessible and readable, but no modifications are admitted.

The password management system is located in the menu “technical assistance” and is managed by means of parameter PW, see paragrap 6.6.16.

4. MULTI INVERTER SYSTEM

4.1 Introduction to multi inverter systems

A multi inverter system comprises a pump set made up of a series of pumps with delivery outlets all conveying to a single manifold. Each pump of the set is connected to its own inverter and the various inverters communicate via a special connection (Link).
The maximum number of pump-inverter elements possible in a group is 8.
A multi inverter system is mainly used to:

- Increase the hydraulic performance with respect to a single inverter
- Ensure operation continuity in the event of a fault on a pump or inverter
- Partition maximum power

4.2 Setting up a multi inverter system

The pumps, motors and inverters in the system must be identical versions. The hydraulic system must be as symmetric as possible in order to achieve a hydraulic load evenly distributed on all the pumps.
The pumps must all be connected to a single delivery manifold and the flow sensor must be placed on the outlet of the latter to read the flow to the entire pump set. In the case of using multiple flow sensors, these must be installed on the delivery of each pump.
The pressure sensor must be connected to the outlet manifold. If more than one pressure sensor is used, these must also be installed on the manifold or in any event on a pipeline that is connected to it.

If several pressure sensors are used, ensure that there are no check valves on the pipeline between one sensor and another; otherwise different pressures may be read, leading to incorrect average readings and incorrect adjustments.

To ensure correct operation of the pressure set, the following must be identical for each inverter-pump pair:

- type of pump and motor
- hydraulic connections
- rated frequency
- minimum frequency
- maximum frequency
- the shutdown frequency without flow sensor

4.2.1 Communication cable (Link)

The inverters communicate with one another and propagate the flow and pressure signals (only if a ratiometric pressure sensor is used) via the specific connection cable.
The cable can be connected to any one of the two connectors marked “Link”, see Figure 15.

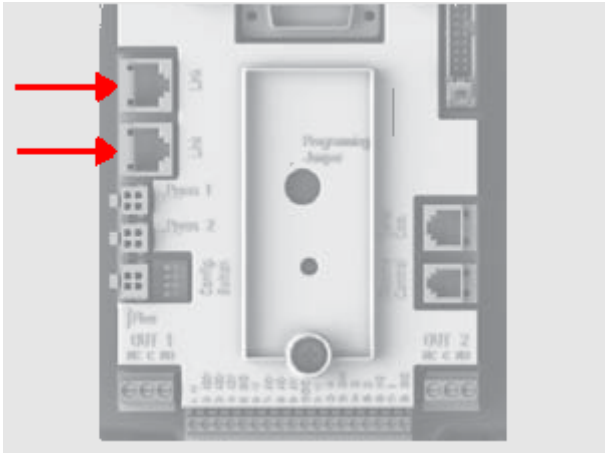


Figure 17: Link connection

WARNING: only use cables supplied with the inverter or which are considered as inverter accessories (it is not a standard cable available on the market).

4.2.2 Sensors

To enable operation, a pressure set requires at least one pressure sensor and optionally one or more flow sensors.
The pressure sensors are ratiometric 0-5V versions, and in this case one can be connected per inverter, or 4-20mA current sensors, in which case only one can be connected.

The flow sensors are always optional and from 0 to 1 can be connected per inverter.

4.2.2.1 Flow sensors

The flow sensor must be inserted on the delivery manifold on which all pumps are connected, and the electrical connection can be made on any of the inverters.
The flow sensors can be connected in two ways:

- one sensor only
- the same number of sensors as inverters

The setting is entered on parameter FI.
Multiple sensors are useful when a specific flow rate is required on each pump, and enhance protection against dry running operation. To use multiple flow sensors, parameter FI must be set to multiple sensors and each flow sensor must be connected to the inverter that controls the pump delivery where the sensor is located.

4.2.2.2 Sets with one pressure sensor only

Pressure sets can also be set up without a flow sensor. In this case the pump shutdown frequency **FZ** must be set as described in 6.5.9.1.

The dry running protection continues to function without the use of a flow sensor.

4.2.2.3 Pressure sensors

The pressure sensor/s must be inserted on the delivery manifold. There must be more than one pressure sensor if ratiometric (0-5V), and only one if current (4-20mA). In the case of multiple sensors, the pressure reading will be the average of all those fitted. To use multiple ratiometric pressure sensors (0-5V) simple insert the connectors in the relative inputs, without the need for setting any parameters. The number of ratiometric pressure sensors (0-5V) installed can vary as required, from one to the maximum number of inverters present. In the case of 4-20mA pressure sensors, only one may be installed; refer to paragraph 2.2.3.1.

4.2.3 Connection and setting of the optical coupling inputs

The inputs of the inverter are photocoupled (see para. 2.2.4 and 6.6.13); this means that galvanic separation of the inputs from the inverter is guaranteed, to enable the functions for the float, auxiliary pressure, system disable, and low pressure on intake. The functions are indicated respectively by the messages F1, Paux, F3, F4. If activated, the Paux function boosts the pressure in the system to the set pressure, see par. 6.6.13.3. The functions F1, F3, F4 stop the pump for 3 different reasons, see par. 6.6.13.2, 6.6.13.4, 6.6.13.5.
When using a multiple inverter system, the inputs must be used with the following settings:

- the contacts that perform the auxiliary pressures must be connected in parallel on all the inverters so that the same signal arrives on all the inverters.
- the contacts that perform the functions F1, F3, F4 may be connected either with independent contacts for each inverter, or with only one contact connected in parallel on all the inverters (the function is activated only on the inverter at which the command arrives).

The parameters for setting the inputs I1, I2, I3, I4 are part of the sensitive parameters, so setting one of these on any inverter means that they are automatically aligned on all the inverters. As the setting of the inputs not only selects the function, but also the type of polarity of the contact, the function associated with the same type of contact will perforce be found on all the inverters. For the above reason, when using independent contacts for each inverter (as is possible for the functions F1, F3, F4), these must all have the same logic for the various inputs with the same name; that is, for the same input, either normally open contacts are used for all the inverters or normally closed ones.

4.3 Multi inverter operating parameters

The parameters displayed on the menu, in a multi-inverter configuration, can be classed as follows:

- Read-only parameters
- Local parameters
- Multi inverter system configuration parameters *in turn divided as*
  - Sensitive parameters
  - Parameters with optional alignment

4.3.1 Parameters related to multi inverter systems

4.3.1.1 Local parameters

These are parameters that can differ from one inverter to another and in some cases actually need to be different. For these parameters, automatic alignment of inverter configuration is not admitted. In the case of manual assignment of addresses, these must all be different.
List of local parameters for inverters:

- ❖ CT Contrast
- ❖ FP Test frequency in manual mode
- ❖ RT Direction of rotation
- ❖ AD Address
- ❖ IC Reserve configuration
- ❖ RF Fault and warning reset

4.3.1.2 Sensitive parameters

These are parameters that must be aligned on the entire series for control purposes.
List of sensitive parameters:

- SP Setpoint pressure
- P1 Input 1 auxiliary pressure
- P2 Input 2 auxiliary pressure
- P3 Input 3 auxiliary pressure
- P4 Input 4 auxiliary pressure
- FN Nominal frequency
- RP Pressure drop for restart

- FI Flow sensor
- FK K factor
- FD Pipe diameter
- FZ Zero flow frequency
- FT Min. flow threshold
- MP Minimum pressure pump stop due to water failure
- ET Exchange time
- AC Acceleration
- NA Number of active inverters
- NC Number of simultaneous inverters
- CF Carrier frequency
- TB Dry run time
- T1 Shutdown time after low pressure signal
- T2 Shutdown time
- GI Integral gain
- GP Proportional gain
- FL Minimum Frequency
- I1 Input 1 setting
- I2 Input 2 setting
- I3 Input 3 setting
- I4 Input 4 setting
- OD Type of system
- PR Pressure sensor
- PW Password Settings

4.3.1.2.1 Automatic alignment of sensitive parameters

When a multi inverter system is detected, the unit checks for consistency of the set parameters. If the sensitive parameters are not aligned on all inverters, the display of each inverter shows a message requesting whether to transfer the configuration of the specific inverter to the entire system. On acceptance, the sensitive parameters on the inverter where confirmation is given are distributed to all other inverters in the series.
If there are configurations incompatible with the system, the configuration cannot be aligned from these inverters.
During normal operation, modification of a sensitive parameter on an inverter will cause automatic alignment of the parameter on all other inverters without any request for confirmation.

Automatic alignment of sensitive parameters has no effect on all other types of parameter.

In the particular case of inserting an inverter with default settings in the series (in the case of an inverter which replaces an existing model or an inverter with restored factory settings), if the configurations applied, with the exception of factory settings, are consistent, the inverter with the factory settings will automatically take on the sensitive parameters of the series.

4.3.1.3 Parameters with optional alignment

These are the parameters that are admissible even if not aligned with other inverters. Each time these parameters are modified, when SET or MODE is pressed, the request is displayed whether to modify the entire communicating inverter series. In this way if the series has all the same settings, the same data does not need to be set on all inverters.
List of parameters with optional alignment:

- LA Language
- RC Rated current
- MS Measurement system
- FS Maximum frequency
- SO Min. dry-running factor threshold
- AE Anti-blocking
- O1 Output 1 function
- O2 Output 2 function

4.4 Initial start-up of multiple inverter system

Make electrical and hydraulic connections of the entire system as described in para 2.2 and para 4.2.
Switch on one inverter at a time and configure the parameters as described in chapter 5 taking care that when turning on one inverter, all others are switched off.
After configuring all inverters individually, all can be switched on simultaneously.

4.5 Multi-inverter settings

When a multi inverter system is switched on, the addresses are assigned automatically and, by means of an algorithm, an inverter is nominated as the settings leader. The leader decides on the frequency and order of start-up of each inverter in the series.
The settings mode is sequential (inverters start one at a time). When start-up conditions are enabled, the first inverter starts, and when this reaches maximum frequency, the next one starts, and so on. The order of start-up is not necessarily ascending according to the machine address, but depends on the hours of operation; see ET: Tempo di scambio par. 6.6.9.
When the minimum frequency FL is used, and there is only one inverter operative pressure surges may occur. Depending on the case, pressure surges may be inevitable and may occur at the minimum frequency when this value, in relation to the hydraulic load, causes a pressure level greater than the required value. On multi inverter systems, this problem remains limited to the first pump that is started up, as on the subsequent pumps the situation is as follows: when the previous pump reaches the maximum frequency, the next one starts up at the minimum frequency to then reach the maximum frequency. When the frequency of the pump at maximum is reduced (obviously through to the minimum frequency limit) the pump activation overlaps, which while observing minimum frequency rates, does not cause pressure surges.

4.5.1 Assigning the start-up order

Each time the system is activated, each inverter is associated a starting order. This setting establishes the order of inverter start-up.
The starting order is modified during use according to requirements, by the two following algorithms:

- Reaching of maximum operating time
- Reaching of maximum inactivity time

4.5.1.1 Maximum operating time

According to parameter ET (maximum operating time), each inverter has an hour counter, and the starting order is updated on the basis of these values according to the following algorithm:

- if at least half of the value ET is exceeded, priority is changed on the first shutdown of the inverter (switch to standby).
- if the value ET is reached without stopping, the inverter stops unconditionally and this sets to the minimum restart priority (switch during operation).

If parameter ET (maximum working time) is set to 0, exchange occurs on each restart.

See ET: Tempo di scambio par 6.6.9.

4.5.1.2 Reaching of maximum inactivity time

The multi inverter system has an anti-stagnant algorithm that is aimed at maintaining pump efficiency and integrity of the pumped liquid. It acts by enabling rotation of the pump starting order to ensure a delivery to all pumps of at least one minute of flow every 23 hours. This is implemented regardless of the inverter configuration (enabled or reserve). Priority switch envisages that the inverter stationary for 23 hours is set to maximum priority in the starting order. This means that it is the first to be started up as soon as flow delivery is required. The inverters configured as reserve have priority over the others. The algorithm terminates action when the inverter has delivered at least one minute of flow.

After the anti-stagnant interval, if the inverter is configured as reserve, it is set to minimum priority to avoid premature wear.

4.5.2 Reserves and number of inverters involved in pumping

The multi inverter system reads how many elements are connected in communicating mode and calls this number N.
Then, on the basis of parameters NA and NC it decides how many and which inverters must work at a given time. NA represents the number of inverters involved in pumping NC represents the maximum number of
inverters that can run simultaneously.
In a series, if there are NA active inverters and NC simultaneous inverters, when NC is less than NA, this means that a maximum of NC inverters will start up simultaneously, and these will switch between NA elements. If an inverter is configured with reserve priority, it will set as last in the starting order, therefore for example, if there are 3 inverters and one of these is configured as reserve, the reserve unit will start in third place; otherwise if set to NA=2 the reserve will not start up unless one of the two active units sets to fault status.
See also the explanation of parameters
NA: Inverter attivi par. 6.6.8.1;
NC: Inverter contemporanei par. 6.6.8.2;
IC: Configurazione della riserva 6.6.8.3.

5. POWER-UP AND START-UP

5.1 Initial power-up operations

On correct completion of installation of the hydraulic and electrical system (see chapter 2 INSTALLAZIONE) and after reading the entire manual, the inverter can be powered up. Only in the case of initial power-up, after the initial presentation, the display shows the error condition "EC" with the message informing the user to set the parameters required for control of the electric pump; the inverter does not start up. To unlock the unit, simply set the rated current value [A] of the electric pump used. Before start-up, if the system pump requires special settings, other than the default versions (see par. 8.2) first make the modifications required and then set the rated current value, to ensure start-up with the correct settings. The parameters can be set at any time, but it is recommended to follow this procedure when the application is in operating conditions that may impair integrity of the system components, such as in the case of pumps with a minimum frequency limit or do not tolerate certain dry running times etc.
The following steps apply both in the case of systems with a single inverter and multi-inverter systems. In the case of multi inverter systems, the relative connections of sensors and communication cables must be made, after which one inverter at a time must be activated, performing the initial power-procedure for each. Once all inverters are configured, all multi-inverter system elements can be powered up.

5.1.1 Rated current settings

From the page displaying the message EC, or more in general from the main menu, access the Installer menu by pressing and holding the buttons “MODE” & “SET” & “- ” simultaneously until “RC” appears on display. In these conditions, buttons + and – enable respectively increase and decrease of the parameter value. Set the current as specified in the manual or on the electric pump dataplate (for example 8.0 A).
After setting the RC value and enabling it by pressing SET or MODE, if all elements have been installed correctly, the inverter starts up the pump (unless error, blocking or protection conditions do not occur).

CAUTION: THE INVERTER STARTS UP THE PUMP AS SOON AS THE *RC* PARAMETER HAS BEEN SET.

5.1.2 Rated frequency settings

From the installer menu (if the RC value has just been entered, this is the same page; otherwise access as described in the above section 5.1.1) press MODE and scroll through the menus to FN. Set the frequency using buttons + and - as specified in the manual or on the electric pump dataplate (for example 50 [Hz]).

Incorrect settings of the parameters RC and FN, or improper connections can generate the errors "OC", "OF" and in the case of operation without the flow sensor, may generate the false errors "BL". Incorrect settings of the parameters RC and FN can also cause failure of the current sensitivity protection device, leading to loads exceeding the safety threshold of the motor, with consequent damage to the latter.

Incorrect configuration of the electric motor with star or delta connection may cause damage to the motor.

Incorrect configuration of the operating frequency of the electric pump can cause damage to the latter.

5.1.3 Setting the direction of rotation

Once the pump has started up, the user must ensure that the direction of rotation is correct (the direction is usually indicated by an arrow on the pump casing). To start up the motor and check the direction of rotation, simply switch on a utility.
From the same menu as RC (MODE SET – "Installer menu") press MODE and scroll through the menus to RT. In these conditions, buttons + and – enable the user to invert the direction of motor rotation. The function is also enabled when the motor is running.
If it is not possible to see the direction of motor rotation, proceed as follows:

Method to check rotation frequency

- Access parameter RT as described above.
- Turn on a utility and observe the frequency that is shown on the status bar at the bottom of the utility control page, to ensure that the operating frequency is less than the rated frequency of the pump FN.
- Without changing collection, modify parameter RT by means of buttons + or – and check frequency FR again.
- The correct RT parameter is that which requires, compared to collection, a lower frequency FR.

5.1.4 Setting the setpoint pressure

From the main menu, press and hold MODE and SET simultaneously until “SP” appears on display. In these conditions, buttons “+” and “–“ enable respectively increase and decrease of the required pressure value.
The regulation range depends on the sensor used.
Press SET to return to the main page.

5.1.5 System with flow sensor

From the installer menu (the same used to set RC, RT and FN) scroll through the parameters using MODE to reach FI.
To work with the flow sensor set FI to 1. Use MODE to scroll through to the next parameter FD (pipeline diameter) and set the diameter in inches of the pipe mounting the flow sensor.
Press SET to return to the main page.

5.1.6 System without flow sensor

From the installer menu (the same used to set RC RT and FN) scroll through the parameters using MODE to display FI. To work without the flow sensor, set FI to 0 (default value).

Without the flow sensor, there are two flow reading modes, both settable on parameter FZ in the installer menu.

- Automatic (self-learning): the system automatically identifies the flow and automatically adjusts settings accordingly. To set this operating mode, set FZ to 0.
- Minimum frequency mode: in this mode the shutdown frequency is set at zero flow. To use this mode, move to parameter FZ, close delivery gradually (to avoid generating overpressure) and read the frequency value at which the inverter is stabilised. Set FZ at this value + 2.
  Example: if the inverter stabilises at 35Hz, set FZ at 37.

An excessively low value of FZ can cause irreparable damage to the pumps, because in this case the inverter would never stop the pumps.

An excessively high value of FZ can cause pump shutdown even when there is flow present.

Modifications to the pressure set point thus also requires adjustment of the FZ value.

On multiple inverter systems without the flow sensor, the only admissible method of setting the FZ value is in minimum frequency mode.

The auxiliary set points are disabled if the flow sensor is not used (FI=0) and when FZ is used in minimum frequency mode (FZ ≠ 0).

5.1.7 Setting other parameters

After the initial start-up procedure, the other pre-set parameters can be modified as required, by accessing the relative menus and following the instructions for the specific parameters (see chapter 6). The most common parameters are: restart pressure, regulation gain values GI and GP, minimum frequency FL, water failure time TB, etc.

5.2 Troubleshooting on initial installation

Fault	Possible causes	Remedy
The display shows EC	Pump current (RC) not set	Set parameter RC (see section 6.5.1).
The display shows BL	1) No water. 2) Pump not primed. 3) Flow sensor disconnected. 4) Entry of setpoint too high for pump. 5) Inverted direction of rotation. 6) Incorrect setting of pump current RC(*). 7) Maximum frequency too low (*). 8) SO parameter not set correctly 9) MP minimum pressure parameter not set correctly	1-2) Prime the pump ad ensure that there is no air in the pipelines. Check that intake or any filters are not obstructed Check that the pipeline from the pump to the inverter is not damaged or leaking. 3) Check the connections to the flow sensor. 4) Lower the setpoint or use a pump suited to system requirements. 5) Check the direction of rotation (see 6.5.2). 6) Set a correct value for pump current RC(*) (see 6.5.1). 7) If possible, increase FS or lower RC(*) (see 6.6.6). 8) set SO value correctly (see para. 6.5.14) 9) set MP value correctly (see para. 6.5.15
The display shows BPx	1) Pressure sensor disconnected. 2) Pressure sensor faulty.	1) Check the pressure sensor cable connection. BP1 refers to the sensor connected to Press 1, BP2 to press2, BP3 to current sensor connected to J5 2) Replace the pressure sensor.
The display shows OF	1) Excessive absorption. 2) Pump blocked. 3) Pump absorbs high current on start-up.	1) Check type of connection; star or delta. Check that the motor does not absorb current over the max. admissible value for inverter. Check that the motor has all phases connected. 2) Check that the impeller or motor is not blocked or obstructed by foreign bodies. Check motor phase connections 3) Reduce the acceleration parameter AC (see 6.6.11).
The display shows OC	1) Incorrect pump current setting (RC). 2) Excessive absorption. 3) Pump blocked. 4) Inverted direction of rotation.	1) Set RC with the current according to the type of connection (star or delta) as stated on the motor dataplate (see 6.5.1) 2) Check that the motor has all phases connected. 3) Check that the impeller or motor is not blocked or obstructed by foreign bodies. 4) Check the direction of rotation (see 6.5.2).
The display shows LP	1) Low power supply voltage 2) Excessive voltage drop on line	1) Ensure presence of correct line voltage. 2) Check the power cable section (see section 2.2.1).
Regulation pressure greater than SP	FL setting too high	Reduce minimum operating frequency FL (if electric pump enables this)
The display shows SC	Short circuit between phases	Ensure that the motor is in the correct condition and check connections to the latter
The pump never stops	1) Minimum flow threshold FT setting too low. 2) Setting a minimum frequency of power off FZ too low (*). 2) Short observation time(*). 3) Unstable pressure regulation(*). 4) Incompatible use (*).	1) Set a higher FT threshold 2) Set a higher FZ threshold 3) Wait for the self-learning process (*) or run quick learning mode (see para 6.5.9.1.1) 3) Correct GI and GP(*) (see 6.6.4 and 6.6.5) 4) Ensure that the system meets the operating requirements without the flow sensor (*) (see section 6.5.9.1). Attempt to reset by pressing MODE SET + - to recalculate conditions without the flow sensor.
The pump stops even when not required	1)Short observation time(*). 2) Minimum frequency FL setting too high (*). 3) Excessively high setting of minimum shutdown frequency FZ (*).	1) Wait for the self-learning process (*) or run quick learning mode (see para 6.5.9.1.1). 2) If possible set a lower FL value(*). 3) Enter a lower threshold for FZ.
The multi inverter system does not start	One or more inverters have an incorrect RC current setting.	Check the RC current setting on each inverter.
The display shows: Press + to align this config	One or more inverters have sensitive parameters not aligned	Press + on the inverter that has the most recent and correct configuration of parameters.
In a multiple inverter system the parametres are not propagatable	1) Different passwords 2) Presence of non-propagatable configurations	1) access each inverter individually and enter the same password on all, or remove the password. See para. 6.6.16 2) modify the configuration so that it is propagatable; it is not admitted to propagate configurations with FI=0 or FZ=0. See paragraph 4.2.2.2
(*) The asterisk refers to cases of systems without the flow sensor		

Table 16: Troubleshooting

6. KEY TO INDIVIDUAL PARAMETERS

6.1 User menu

The USER MENU is accessed by pressing MODE (or via the selection menu by pressing + or -). Within this menu, again by pressing MODE, the following values are displayed consecutively.

6.1.1 FR: Display of rotation frequency

Current rotation frequency with electric pump is controlled, in [Hz].

6.1.2 VP: Display of pressure

System pressure measured in [bar] or [psi] depending on measurement system used.

6.1.3 C1: Display of phase current

Phase current of electric pump in [A]
A round flashing symbol may appear under the phase current C1symbol. This signals that the pre-alarm threshold of maximum current allowed has been exceeded. If the symbol flashes at regular intervals it means that the motor overcurrent protection is being activated and that it will probably be triggered. In this case it is necessary to check the correct setting of the maximum current of the RC pump, see paragraph 6.5.1 and the electric pump connections.

6.1.4 PO: Display of the power delivered

Power delivered to the electric pump in [kW].
A round flashing symbol may appear under the measured power PO symbol. This signals that the pre-alarm threshold of maximum power allowed has been exceeded.

6.1.5 SM: System monitor

Displays the system status in the case of a multi-inverter installation. If there is no communication, an icon is displayed, showing communication absent or interrupted. If there are several interconnected inverters, an icon is shown for each. The icon bears the symbol of a pump with pump status indications below.
Depending on operating status, the item in Table 15 is displayed.

System display		
Status	**Icon**	**Status information below icon**
Inverter in run	Symbol of pump running	Frequency implemented on 3 digits
Inverter in standby	Symbol of static pump	SB
Inverter in fault	Symbol of static pump	F

Table 17: Display of SM system monitor

If the inverter is configured as reserve, the upper section of the icon representing the motor is displayed in colour, while the display remains the same as in Table 15 with the exception that if the motor is stationary F is displayed instead of Sb.

If one or more inverters have RC without a setting, the letter A appears in place of the status information (below all icons of the inverters present), and system start-up is disabled.

To reserve more space for the system display, the name of the parameter SM is not shown, but simply the text "system" below the menu name.

6.1.6 VE: Display of version

Hardware and software version of the equipment.

For firmware versions 26.1.0 and later, the following also applies:
On this page after the prefix S: the last 5 figures of the single serial number attributed for connectivity are showed. The whole serial number can be viewed by pressing the "+" key.

6.2 Monitor menu

The MONITOR MENU is accessed from the main menu by pressing and holding the buttons "SET" and "-" (minus) simultaneously for 2 seconds, or via the selection menu using buttons + or -.
Within this menu, by pressing MODE, the following values are displayed consecutively.

6.2.1 VF: Flow display

This displays the instant flow in [litres/min] or [gal/min] depending on the set unit of measurement. If the mode without flow sensor is selected, an adimensional flow is displayed.

6.2.2 TE: Display of final power stage temperature

6.2.3 BT: Display of electronic board temperature

6.2.4 FF: Display of fault log

Chronological display of faults occurring during system operation.
Tow numbers x/y are displayed below the symbol FF, which indicate respectively "x" for the fault displayed and "y" for the total number of faults present; an indication of the type of fault is displayed to the right.
Buttons + and – can be used to scroll through the list of faults: press – to move back through the log through to the oldest fault present, or + to scroll forward to the most recent.

The faults are shown in chronological order, starting from the oldest x=1 to the most recent x=y. The maximum number of faults displayable is 64; after which the system overwrites the oldest versions in order.
This menu item displays the fault list but does not enable reset. The list can only be cleared by means of the specific command in the item RF of the TECHNICAL ASSISTANCE MENU.
Neither a manual reset or shutdown of the unit, or restored default settings will clear the fault log; only the above procedure will enable this.

6.2.5 CT: Display contrast

This adjusts the display contrast.

6.2.6 LA: Language

Display in one of the following languages:

- Italian
- English
- French
- German

- Spanish
- Dutch
- Swedish
- Turkish
- Slovakian
- Romanian

6.2.7 HO: Operating hours

Indicates, on two lines, the hours of inverter activation and pump operating hours.

6.3 Setpoint menu

From the main menu, press and hold MODE and SET simultaneously until "SP" appears on display (or use the buttons + or – in the selection menu).
Buttons + and – enable respectively to increase and decrease the system pressurisation value.
To exit the current menu and return to the main menu, press SET.

This menu enables the user to set the system operating pressure.
The pressure range depends on the sensor used (see PR: Pressure sensor section 6.5.7) and varies as shown in Table 16. System pressure can be displayed in [bar] or [psi] depending on measurement system used.

Regulation pressure values		
Type of sensor used	Regulation pressure [bar]	Regulation pressure [psi]
16 bar	1,0 - 15,2	14 - 220
25 bar	1,0 - 23,7	14 - 344
40 bar	1,0 - 38,0	14 - 551

Table 18: Maximum regulation pressure values

6.3.1 SP: Setting the setpoint pressure

Pressure to apply to the system if the auxiliary pressure regulation functions are not active.

6.3.2 Auxiliary pressure settings

The inverter can vary the set point pressure according to the status of the inputs; up to 4 auxiliary pressure values can be set for a total of 5 different set points. For the electrical connections, refer to paragraph 2.2.4.2, and for software settings, refer to paragraph 6.6.13.3.

If you are active at the same time more pressure auxiliary functions associated with multiple inputs, the inverter will realize the lower pressure of all those activated.

The auxiliary set points are disabled if the flow sensor is not used (FI=0) and when FZ is used in minimum frequency mode (FZ ≠ 0).

6.3.2.1 P1: Auxiliary pressure 1 setting

Pressure to apply to the system if the auxiliary pressure function is activated on input 1.

6.3.2.2 P2: Auxiliary pressure 2 setting

Pressure to apply to the system if the auxiliary pressure function is activated on input 2.

6.3.2.3 P3: Auxiliary pressure 3 setting

Pressure to apply to the system if the auxiliary pressure function is activated on input 3.

6.3.2.4 P4: Auxiliary pressure 4 setting

Pressure to apply to the system if the auxiliary pressure function is activated on input 4.

The pump restart pressure depends both on the set pressure (SP, P1, P2, P3, P4) and RP.
RP expresses the reduction in pressure, with respect to "SP" (or an auxiliary pressure if activated), which generates pump start-up.

Example: SP = 3,0 [bar]; RP = 0,5 [bar]; no auxiliary pressure function active:
During normal operation, the system pressure is set at 3.0 [bar].
The electric pump is restarted when the pressure falls below 2.5 [bar].

Entry of an excessively high pressure setting (SP, P1, P2, P3, P4) with respect to the pump output specifications, may cause false errors of water failure (BL); in this case lower the pressure setting or use a pump suited to system requirements.

6.4 Manual menu

From the main menu, press and hold “SET" & “+” & “-“ simultaneously until “FP” appears on display (or use the buttons + or – in the selection menu).
This menu enables the display and modification of various configuration parameters. The MODE button enables the user to scroll through the menu pages, while buttons + and – enable respectively to increase and decrease the value of the parameter concerned.
To exit the current menu and return to the main menu, press SET.

In manual mode, regardless of the parameter on display, the following commands are enabled:

Temporary start-up of electric pump
When the buttons MODE and - are pressed simultaneously, the pump is started up at the frequency FP and this operating status remains while the buttons are pressed.
When the pump ON or pump OFF command is activated, the relative notification is shown on display.
Pump start-up
When the buttons MODE and + are pressed simultaneously for 2 seconds, the pump is started up at the frequency FP. This operating status remains until SET is pressed. When SET is pressed again, the user exits the manual mode menu.
When the pump ON or pump OFF command is activated, the relative notification is shown on display.
Inversion of direction of rotation
When the buttons SET and - are pressed simultaneously for 2 seconds, the pump changes direction of rotation. The function is also enabled when the motor is running.

6.4.1 FP: Test frequency setting

This displays the test frequency in [Hz] and enables modification by means of the buttons “+” and “-“.
The default value is FN – 20% and can be set between 0 and FN.

6.4.2 VP: Display of pressure

System pressure measured in [bar] or [psi] depending on measurement system selected.

6.4.3 C1: Display of phase current

Phase current of electric pump in [A]
A round flashing symbol may appear under the phase current C1 symbol. This signals that the pre-alarm threshold of maximum current allowed has been exceeded. If the symbol flashes at regular intervals it means that the motor overcurrent protection is being activated and that it will probably be triggered. In this case it is necessary to check the correct setting of the maximum current of the RC pump, see paragraph 6.5.1 and the electric pump connections.

6.4.4 PO: Display of the power delivered

Power delivered to the electric pump in [kW].
A round flashing symbol may appear under the measured power PO symbol. This signals that the pre-alarm threshold of maximum power allowed has been exceeded.

6.4.5 RT: Setting the direction of rotation

If the direction of pump rotation is incorrect, it can be inverted by changing this parameter. In this menu item, use buttons + and – to activate and display the two possible states “0” or “1”. The phase sequence is shown in the comment line on display. The function is also enabled when the motor is running.
If it is not possible to see the direction of motor rotation after entering manual mode, proceed as follows:

- Start up the pump at frequency FP (pressing MODE and + or MODE + -)
- Turn on a utility and check the pressure
- Without changing collection, modify parameter RT and the pressure again.
- The correct RT parameter is that which generates a higher pressure.

6.4.6 VF: Flow display

If the flow sensor is selected, this enables display of the flow in the selected unit of measurement. The unit of measurement can be [l/min] or [gal/min] see section 6.5.8. In the case of operation without the flow sensor, “--“ is displayed.

6.5 Installer menu

From the main menu, press and hold “MODE” & “SET” & “-“ simultaneously until “RC” appears on display (or use the buttons + or – in the selection menu). This menu enables the display and modification of various configuration parameters. The MODE button enables the user to scroll through the menu pages, while buttons + and – enable respectively to increase and decrease the value of the parameter concerned. To exit the current menu and return to the main menu, press SET.

6.5.1 RC: Electric pump rated current setting

Rated current absorbed by a pump phase in Amperes (A). For models with single-phase power supply, the current absorbed by the motor must be set, if powered, by a three phase 230V circuit. For models with three-phase 400V power supply, the current absorbed by the motor must be set, if powered, by a three phase 400V circuit.
If the parameter entered is lower than the correct value, the error “OC" is displayed during operation as soon as the set current exceeds the current set value for a set time interval.
If the parameter entered is higher than the correct value, the current sensitivity protection will trip inadvertently over the motor safety threshold.

On initial start-up and when default settings are restored, RC is set to 0.0[A] and the correct value must be entered; otherwise the unit will not start and the error message EC is displayed.

6.5.2 RT: Setting the direction of rotation

If the direction of pump rotation is incorrect, it can be inverted by changing this parameter. In this menu item, use buttons + and – to activate and display the two possible states “0” or “1”. The phase sequence is shown in the comment line on display. The function is also enabled when the motor is running.
If it is not possible to see the direction of motor rotation, proceed as follows:

- Turn on a utility and check the frequency.
- Without changing collection, modify parameter RT and check the FR frequency again.
- The correct RT parameter is that which requires, compared to collection, a lower frequency FR.

CAUTION: on some electric pumps, it may occur that there is little difference in frequency in the two cases, and it is therefore difficult to understand which is the correct direction of rotation. In these cases, repeat the test described above, but rather than checking frequency, attempt to check the phase current absorption (parameter C1 in the user menu). The correct RT parameter is that which requires, compared to collection, a lower phase current C1.

6.5.3 FN: Rated frequency settings

This parameter defines the rated frequency of the electric pump, and can be set from a minimum of 50 [Hz] and maximum of 200 [Hz]. Press “+” or “-” to selected the required frequency starting from 50 [Hz].
The values 50 and 60 [Hz] have priority over other selections as they are the most common: on entry of any frequency value, when the value 50 or 60 [Hz] is reached, the increment or decrement stops; to modify the frequency from one of these two values, release each button and then press "+" or "-" for at least 3 seconds.

On initial start-up and when default settings are restored, FN is set at 50 [Hz] and the correct value must be entered, as stated on the pump.

Each modification to FN is interpreted as a system change, and therefore the parameters FS, FL and FP are adjusted automatically according to the set FN. On each variation to FN re-check FS, FL, FP to ensure settings are as required.

6.5.4 OD: Type of system

Set with two possible values (1 and 2) according to a rigid or flexible system.
The inverter leaves the factory set to mode 1, suited to most systems. In the event of pressure variations that cannot be stabilised by adjusting parameters GI and GP, switch to mode 2.

IMPORTANT: In the two configurations, the values of adjustment parameters **GP** and **GI** also change. Furthermore, the values of GP and GI set in mode 1 are stored in a different memory from the GP and GI values set in mode 2. Therefore, for example, the value of GP in mode 1, when switching to mode 2, is replaced by the GP value of mode 2, but is stored and restored on return to mode 1. The same value seen on display has a different meaning in each of the modes, as the check algorithm is different.

6.5.5 RP: Setting the pressure drop for restart

This shows the drop in pressure, with respect to the value SP which causes pump restart.
For example, if the setpoint pressure is 3.0 [bar] and RP is 0.5 [bar] the pump is restarted at 2.5 [bar].
RP is normally set from a minimum of 0.1 to maximum 5 [bar]. In special conditions (for example in the case of a setpoint lower than RP) this can be limited automatically.

To facilitate the work of the user, the RP setting page, highlighted below the symbol RP, shows the effective restart pressure; see Figure 16.

Figure 18: Setting the restart pressure

6.5.6 AD: Address configuration

This is only applicable on multi-inverter systems. It sets the communication address to be assigned to the inverter. The possible values are: automatic (default), or manually assigned address.
The manually assigned addresses can have values from 1 to 8. Configuration of the addresses must be uniform for all inverters in the series: either all automatic or all manual. Identical addresses are not admitted.
If the address assignment modes are mixed (some manual and some automatic), and also if an address is duplicated, the relative error is shown. The error is indicated with a flashing “E” in place of the unit address.
If selected assignment is automatic, each time the system is turned on, the addresses are assigned automatically and may be different from the previous time; this has no effect on correct operation.

6.5.7 PR: Pressure sensor

Setting of the type of pressure sensor used. This parameter enables selection of a ratiometric or current type pressure sensor. For each type of sensor, different full scales can be selected. When a ratiometric sensor is selected (default) the input Press 1 must be used for connection. When a 4-20mA current sensor is used, the relative screw terminals on the input terminal board must be used. (See Collegamento del sensore di pressione par 2.2.3.1)

Pressure sensor settings				
PR value	Type of sensor	Information	Full scale [bar]	Full scale [psi]
0	6.6 Ratiometric (0-5V)	501 R 16 bar	16	232
1	6.7 Ratiometric (0-5V)	501 R 25 bar	25	363
2	6.8 Ratiometric (0-5V)	501 R 40 bar	40	580
3	4-20 mA	4/20 mA 16 bar	16	232
4	4-20 mA	4/20 mA 25 bar	25	363
5	4-20 mA	4/20 mA 40 bar	40	580

Table 19: Pressure sensor settings

The setting of the pressure sensor does not depend on the pressure to be obtained, but on the sensor to be fitted on the system.

6.5.8 MS: Measurement system

Sets the system of units of measurement between international and Anglo-American. The values displayed are shown in Table 18.

Units of measurement displayed		
Value	International unit of measurement	Anglo-American unit of measurement
Restart	bar	
Temperature	°C	°F
Flow	l / min	gal / min

Table 20: Unit of measurement system

6.5.9 FI: Flow sensor setting

This enables setting of operation as described in Table 19.

Flow sensor setting		
Value	Type of use	Notes
0	without flow sensor	default
1	single specific flow sensor (F3.00)	
2	multiple specific flow sensor (F3.00)	
3	manual setting for a general single pulse flow sensor	
4	manual setting for a general multiple pulse flow sensor	

Table 21: Flow sensor settings

In the case of multi inverter operation, use of multiple sensors can be specified.

6.5.9.1 Operation without flow sensor

When the setting without flow sensor is selected, the FK and FD settings are automatically disabled as these parameters are not necessary. The parameter disabled message is indicated by an icon showing a padlock.

It is possible to choose between 2 different operating modes without flow sensor by means of the parameter FZ (see par. 6.5.12):

Minimum frequency mode: this mode allows you to set the frequency (FZ) below which it is considered that there is zero flow. In this mode the electropump stops when its rotating frequency falls below FZ for a time of T2 (see par. 6.6.3).

IMPORTANT: An incorrect setting of FZ causes:

1. If FZ is too high, the electropump could cut out even in the presence of flow and then start again as soon as the pressure falls below the restarting pressure (see 6.5.5). So there could be repeated episodes of switching on and off, even quite close together.
2. If FZ is too low, the electropump might never stop even in the absence of flow, or with very low flows. This situation could lead to damage of the electropump due to overheating.

Since the zero flow frequency FZ may vary as the Setpoint varies, it is important that:.

1. Whenever the Setpoint is changed you check that the set value of FZ is adequate for the new Setpoint.

The auxiliary set points are disabled if the flow sensor is not used (FI=0) and when FZ is used in minimum frequency mode (FZ ≠ 0).

CAUTION: the minimum frequency mode is the only operating mode without flow sensor admitted for multiple inverter systems.

Self-adaptive mode: this mode consists of a particular and efficient self-adaptive algorithm which allows operation in nearly all cases without any problem. The algorithm acquires information and updates the relative parameters during operation. To ensure optimal operation, there should not be any substantial periodic variations on the hydraulic system, which cause significant differences between values (such as solenoid valves that exchange hydraulic sectors with very different characteristics), as the algorithm adapts only to one of these and cannot provide the expected results as soon as switching is performed. On the other hand, if the system remains with similar characteristics (elasticity length and minimum required flow rate) there are no problems.
On each restart or reset of the unit, the self-learnt values are reset, and therefore a specific time interval is required to self-adapt.
The algorithm used, measures the various sensitive parameters and analyses the unit status to detect the presence and entity of the flow. For this reason, and to avoid false errors, correct parameter settings are fundamental, and in particular:

- Ensure that there are no system oscillations during regulation (if this occurs, adjust parameters GP and GI section 6.6.4 and 6.6.5)
- Enter the correct rated current setting RC
- Set an adequate minimum flow FT
- Set the correct minimum frequency FL
- Set the correct direction of rotation

WARNING: the self-adaptive mode is not allowed on multi-inverter systems.

IMPORTANT: In both operating modes the system is able to detect the lack of water by measuring the current absorbed by the pump and comparing it with the parameter RC (see 6.5.1). If the maximum operating frequency FS is set with a value that does not enable absorption of a value close to the current under full load of the pump, false water failure errors (BL) may occur. In this case, remedy the situation as follows: turn on the utilities to reach the frequency FS and at this value, check pump absorption (easily seen on phase current parameter C1 in the User menu), then set the current value reading on RC.

6.5.9.1.1 Fast self-learning method for auto-adaptive mode

The self-learning algorithm is adaptable to various systems automatically on acquisition of information on the type of system.
The system set-up process can be shortened by using the quick learning the procedure:

1) Turn on the unit or, if already powered, press MODE SET + - simultaneously for 2 seconds to generate a reset.
2) Enter the Installer menu (MODE SET -) set FI to 0 (no flow sensor) then in the same menu go to item FT.
3) Turn on a utility and run the pump.
4) Slowly turn off the utility to reach minimum flow (utility closed) and when this value stabilises, note the corresponding frequency.
5) Wait 1-2 minutes for the simulated flow reading; this is confirmed by shutdown of the motor.
6) Turn on a utility to achieve a frequency that is 2 – 5 [Hz] greater than the previous frequency reading, and then wait 1-2 minutes for another shutdown.

IMPORTANT: the method is only effective if, while gradually closing the utility in point 4) the frequency remains at a fixed value through to reading of the flow VF. It should not be considered a valid procedure if, after closure, frequency reaches 0

[Hz]; in this case the operations from point 3 must be repeated; otherwise leave the unit to self-learn for the time interval specified above.

6.5.9.2 Operation with specific pre-defined flow sensor

This applies both to single and multiple sensors.
Use of the flow sensor enables effective measurement of the flow and the possibility of operation in special applications.
On selection of one of the pre-defined sensors available, the diameter of the pipeline must be entered in inches in the page FD to ensure correct flow readings (see section 6.5.10).
On selection of a pre-defined sensor, the setting of KF is disabled automatically. The parameter disabled message is displayed by means of an icon with a padlock.

6.5.9.3 Operation with general flow sensor

This applies both to single and multiple sensors.
Use of the flow sensor enables effective measurement of the flow and the possibility of operation in special applications.
This setting enables use of a general pulse type flow sensor by setting the relative K-factor, i.e. the factor of pulse/litre conversion, depending on the sensor and pipeline on which it is installed. This operating mode can also be useful in the case of using a pre-defined sensor fitted on a pipe with a diameter not present in those available on the FD page. The k-factor can also be used when fitting a pre-defined sensor, when the user requires a precise calibration of the flow sensor; obviously a precise flow measurement device must be available. The setting of k-factor is made in the page FK (see section 6.5.11).
On selection of a general sensor, the setting of FD is disabled automatically. The parameter disabled message is displayed by means of an icon with a padlock.

6.5.10 FD: Pipeline diameter setting

Diameter in inches of the pipeline on which the flow sensor is installed. This can only be set if a pre-defined flow sensor has been selected.
If FI has been set for manual entry of the flow sensor, or if operation without flow sensor has been selected, the parameter FD is disabled. The parameter disabled message is displayed by means of an icon with a padlock.
The setting range is between ½ " and 24".
The pipelines and flanges on which the flow sensor is fitted can be, according to diameter, of different types and in different materials; the transit sections may therefore differ slightly. As calculations of the flow take into account average conversion values to enable operation with all types of pipeline, this may cause a marginal error in reading the flow rate. The value read may differ by a small percentage, but if the user requires a more precise reading, the following procedure is possible: insert a test flow reading device on the pipeline, set FI for manual setting, modify the k-factor until the inverter shows the same reading as the test instrument; see section 6.5.11. The same considerations apply when using a pipeline with non-standard section; therefore: either enter the section closest to the effective value and accept the error margin, or change the setting of k-factor, if required with reference to Table 20.

Incorrect settings of FD causes false flow reading with possible risk of shutdown.

An incorrect selection of the diameter of pipeline where the flow sensor is to be connected may lead to flow reading errors and system malfunctions.

Example: if a flow sensor is connected to a section of DN 100 pipeline, the minimum flow that the F3.00 sensor can read is 70.7 l/min. Below this flow rate, the inverter shuts down the pumps even in the case of a high flow rate, for example of 50l/min.

6.5.11 FK: Pulse/litre conversion factor settings

This expresses the number of pulses related to transit of one litre of fluid; it is based on the sensor used and section of the pipeline on which it is installed.
If a flow sensor is fitted with a pulse type output, FK must be set according to the instructions of the sensor manufacturer.
If FI has been set for a specific sensor from the pre-defined series, or operation without flow sensor has been selected, the parameter is disabled. The parameter disabled message is displayed by means of an icon with a padlock.
The setting range is between 0.01 and 320.00 pulses/litre. The parameter is applied by pressing SET or MODE. The flow values found, but setting the pipeline diameter FD may differ slightly from the effective flow measured due to the average conversion factor

used in calculations, as explained in section 6.5.10, and KF may also be used with one of the pre-defined sensors, both to operate with non-standard pipeline diameters or to perform a calibration procedure.

Table 20 specifies the k-factor used by the inverter according to the pipeline diameter when using sensor F3.00.

Table of correspondence of diameters and k-factors for flow sensor F3.00				
Pipe diameter [inch]	Internal DN pipe diameter [mm]	K-factor	Minimum flow l/min	Maximum flow l/min
1/2	15	225.0	1.6	85
3/4	20	142.0	2.8	151
1	25	90.0	4.4	236
1 1/4	32	60.7	7.2	386
1 1/2	40	42.5	11.3	603
2	50	24.4	17.7	942
2 1/2	65	15.8	29.8	1592
3	80	11.0	45.2	2412
3 1/2	90	8.0	57.2	3052
4	100	6.1	70.7	3768
5	125	4.0	110.4	5888
6	150	2.60	159.0	8478
8	200	1.45	282.6	15072
10	250	0.89	441.6	23550
12	300	0.60	635.9	33912
14	350	0.43	865.5	46158
16	400	0.32	1130.4	60288
18	450	0.25	1430.7	76302
20	500	0.20	1766.3	94200
24	600	0.14	2543.4	135648

Table 22: Diameter of pipelines, FK conversion factor, minimum and maximum admissible flow

CAUTION: always refer to the manufacturer's installation notes and compatibility of electric parameters of the flow sensor and those of the inverter, as well as exact correspondence of connections. Incorrect settings will cause false flow readings with possible undesired shutdown or continuous operation without stops.

6.5.12 FZ: Setting zero flow frequency

It expresses the frequency below which it may be considered that there is zero flow in the system.
It can be set only if FI has been set to operate without a flow sensor. If FI has been set to operate with a flow sensor, the parameter FZ is blocked. The parameter disabled message is indicated by an icon showing a padlock.

If FZ = 0 Hz is set the inverter will use the self-adaptive operating mode, instead if FZ ≠ 0 Hz is set then the inverter will use the minimum frequency operating mode (see par. 6.5.9.1).

6.5.13 FT: Shutdown threshold setting

This sets a minimum flow threshold, below which, if there is pressure, the inverter stops the electric pump.
This parameter is used in both operation with and without flow sensor, but the two parameters are different; therefore even when the setting of FI is changed, the FT value remains consistent with the type of operating mode without overwriting the two values. In operation with the flow sensor, the FT parameter is in litres/minute or gal/min, while without the flow sensor the value is adimensional. In the same page, as well as the flow shutdown setting FT, the measured flow rate is displayed, to facilitate user operations. This appears in a highlighted box below the name of the FT parameter, and bears the text "fl". In operating mode without flow sensor, the minimum flow "fl" displayed in the box is not immediately available, and may take a few minutes of operation for the figure to be calculated.

CAUTION: if an excessively high FT value is set, undesired shutdown may occur; if the value is too low operation may be continuous without stops.

6.5.14 SO: Dry running factor

This sets the minimum dry running factor threshold below which the lack of water is detected. The dry running factor is a non-dimensional parameter obtained by combining absorbed current and the pump power factor. Thanks to this parameter it is possible to correctly establish when there is air in the impeller of a pump or if the suction flow is interrupted.
This parameter is used on all multi inverter systems and on all systems without flow sensor. If the pump functions only with one inverter and flow sensor SO is blocked and disabled.

To help the user with the setting, the page shows the dry running factor measured in real time (in addition to the SO minimum dry running factor to be set). The value measured is shown in a box below the name of the SO parameter and is called "SOm".

In the multi inverter configuration, SO is a parameter which can be propagated between inverters but it is not a sensitive parameter, i.e. it does not necessarily have to be the same for all inverters. When a change in SO is measured the user is asked whether the value should be propagated to all the inverters.

6.5.15 MP: Minimum pressure pump stop due to water failure

This sets the minimum pressure pump stop due to water failure. If the system pressure reaches a pressure below MP the lack of water is signalled.
This parameter is set on all systems without flow sensor. If the pump functions with flow sensor MP is blocked and disabled.
The MP default value is 0.0 bar and can be set up to 5.0 bar.
If MP=0 (default), the dry running is detected by the flow or the dry running factor SO algorithm;
if MP is not equal to 0, the lack of water is detected when the pressure is below the MP value.
The lack of water alarm is detected only when the pressure goes below the MP value for the amount of time set for the TB value, see par. 6.6.1.
In the multi inverter configuration, MP is a sensitive parameter therefore it must always be the same along the chain of inverters in communication and when the value is changed it is automatically propagated to all the inverters.

6.6 Technical Assistance Menu

From the main menu, press and hold "MODE" & "SET" & "+" simultaneously until "TB" appears on display (or use the buttons + or – in the selection menu). This menu enables the display and modification of various configuration parameters. The MODE button enables the user to scroll through the menu pages, while buttons + and – enable respectively to increase and decrease the value of the parameter concerned. To exit the current menu and return to the main menu, press SET.

6.6.1 TB: Water failure block time

Entry of a water failure block delay time enables selection of the time (in seconds) taken by the inverter to notify of low water levels on the electric pump.
Modifications to this parameter may be useful if a known delay exists between the moment in which the pump is activated and the actual moment of supply. One example is that of a system where the electric pump intake line is particularly long and is subject to small leaks. In this case it may occur that the pipeline empties, and even if the water supply is regular, the electric pump takes some time to reload, deliver flow and pressurise the system.

6.6.2 T1: Shutdown time after low pressure signal

This sets the inverter shutdown time starting from reception of the low pressure signal (see Impostazione della rilevazione di bassa pressione par 6.6.13.5). The low pressure signal may be received on any of the 4 inputs, by suitably configuring the input (Setup degli ingressi digitali ausiliari IN1, IN2, IN3, IN4 par 6.6.13).
T1 can be set between 0 and 12 s. The default setting is 2 s.

6.6.3 T2: Shutdown delay

This sets the delay after which the inverter shuts down after shutdown conditions have been reached: system pressure and flow at minimum values.
T2 can be set between 5 and 120 s. The default setting is 10 s.

6.6.4 GP: Proportional gain coefficient

The proportional gain should generally be increased for elastic systems (wide and PVC pipelines) and reduced in the case of rigid systems (narrow and steel pipelines).
To maintain constant system pressure, the inverter performs a PI check on the measured pressure error. On the basis of this error, the inverter calculates the power to supply to the electric pump. The behaviour of this check depends on the set parameters GP and GI. To meet the different requirements of the various types of hydraulic systems where the system may operate, the inverter enables the selection of parameters that are different from the default settings. **On virtually all systems, the factory setting of parameters GP and GI are optimal.** However, in the event of problems with regulation, these settings may be modified as required.

6.6.5 GI: Integral gain coefficient

In the event of significant pressure drops on sudden increases in flow, or a slow system response, increase the value of GI. Otherwise, in the event of pressure oscillations around the setpoint, reduce the value of GI.

A typical example in which the value of GI should be reduced is that in which the inverter is located far from the electric pump. This distance causes hydraulic elasticity which influences control of PI and therefore pressure regulation.

IMPORTANT: To obtain satisfactory pressure settings, both values GP and GI should be adjusted.

6.6.6 FS: Maximum rotation frequency

This sets the maximum pump rotation frequency.
This sets a maximum rpm limit and can be set between FN and FN - 20%.
FS, in any conditions of regulation, ensures that the electric pump is never controlled at a frequency higher than the set value.
FS can be automatically reconfigured following modifications to FN, when the above ratio is not verified (e.g. if the value of FS is less than FN - 20%, FS will be reset to FN - 20%).

6.6.7 FL: Minimum rotation frequency

FL is used to set the minimum pump rotation frequency. The minimum admissible value is 0 [Hz], and the maximum is 80% of FN; for example, if FN = 50 [Hz], FL can be set between 0 and 40[Hz].
FL can be automatically reconfigured following modifications to FN, when the above ratio is not verified (e.g. if the value of FL is greater than 80% of the set FN value, FL will be reset to 80% of FN).

Set a minimum frequency according to the pump manufacturer's specifications.

The inverter will not control the pump at a frequency below FL; this means that if the pump, at the frequency FL, generates a pressure above the set point, there will be a pressure overload in the system.

6.6.8 Setting the number of inverters and reserves

6.6.8.1 NA: Active inverters

This sets the maximum number of inverters involved in pumping.
It can be set with a value between 1 and the number of inverters present (max. 8). The default value for NA is N, i.e. the number of inverters in the series; this means that if inverters are removed or inserted in the series, NA always has the same number as that of the inverters, as read automatically. If a value other than N is entered, the system sets to the maximum number of inverters that can be involved in pumping.
This parameter is used when there is a limited number of pumps to be kept in operation, and if one or more inverters are to be kept as reserves (see IC: Configurazione della riserva section 6.6.8.3 and the following examples).
In the same menu page, the user can view (without the option of modification) a further two system parameters related to this value, i.e. N, the number of inverters detected automatically by the system, and NC, the maximum number of simultaneous inverters.

6.6.8.2 NC: Simultaneous inverters

This sets the maximum number of inverters that can operate simultaneously.
It can be set with a value from 1 to NA. By default NC is set with the value NA; this means that whatever increase applied to NA, NC is always set with the value of NA. If a different value from NA is set, the system sets to the set maximum number of simultaneous inverters. This parameter is used when there is a limited number of pumps to be kept in operation (see IC: Configurazione della riserva section 6.6.8.3 and the following examples).
In the same menu page, the user can view (without the option of modification) a further two system parameters related to this value, i.e. N, the number of inverters detected automatically by the system, and NA, the number of active inverters.

6.6.8.3 IC: Reserve configuration

This configures the inverter as automatic or reserve. If set to auto (default) the inverter participates in the normal pumping process; if configured as reserve, it is assigned with minimum start-up priority, i.e. this inverter will be the last to start up. If the number of active inverters setting is lower of one unit than the number of inverters present and one element is set as reserve, this means that in normal operating conditions the reserve inverter does not participate in normal pumping operations; otherwise if there is a fault on one of the active inverters, (power supply failure, safety device trip etc.) the reserve inverter is started up.
The reserve configuration status can be checked as follows: in the SM page, the upper section of the icon is coloured; in the AD and main pages, the communication icon representing the inverter address is displayed with the number on a coloured background. There may be more than one inverter configured as reserve in a pumping system.
Inverters configured as reserve, even though not part of the normal pumping process, are still kept efficient by means of the anti-stagnant algorithm. The anti-stagnant algorithm envisages, once every 23 hours, the exchange of start-up priority, to ensure that each inverter accumulates at least one minute of continuous flow. This algorithm aims at avoiding deterioration of the water in the impeller and to maintain efficiency of moving parts; it is useful for all inverters and in particular for the inverters configured as reserve, which do not operate in normal conditions.

6.6.8.3.1 Examples of configuration for multi-inverter systems

Example 1:
A pump set comprising 2 inverters (N=2 detected automatically) of which 1 is set as active (NA=1), one simultaneous (NC=1 or NC=NA provided that NA=1) and one as reserve (IC=reserve on one of the two inverters).
The effect is as follows: the inverter not configured as reserve starts up and runs alone (even if it cannot withstand the hydraulic load and the pressure is too low). In the event of a fault, the reserve inverter is started up.

Example 2:
A pump set comprising 2 inverters (N=2 detected automatically) of which all inverters are active and simultaneous (default setting NA=N and NC=NA) and one as reserve (IC=reserve on one of the two inverters).
The effect is as follows: the inverter not configured as reserve always starts up first; if the pressure reached is too low, the second inverter, configured as reserve, also starts up. In this way, the use of one inverter in particular is preserved (the inverter configured as reserve), but is always available as a support when necessary in the event of increased hydraulic loads.

Example 3:
A pump set comprising 6 inverters (N=6 detected automatically) of which 4 are set as active (NA=4), 3 simultaneous (NC=3) and 2 as reserve (IC=reserve on two inverters).
The effect is as follows: a maximum of 3 inverters start up simultaneously. Operation of the 3 inverters enabled for simultaneous mode is implemented in rotation between the 4 inverters to remain within the maximum operating time of each ET. In the event of a fault on one of the active inverters, no reserve unit is started up as no more than three inverters can be started up at a time (NC=3) and there are still three active inverters present. The first reserve unit intervenes only when one of the remaining three has a fault; the second reserve is started up when another of the three (including the first reserve) has a fault.

6.6.9 ET: Exchange time

This sets the maximum continuous operating time of an inverter within a group. It is only applicable on pump sets with interconnected inverters (link). The time can be set to between 10 s and 9 hours, or to 0; the factory setting is 2 hours.
When the time ET of an inverter has elapsed, the system starting order is re-assigned so that the “expired” inverter is set to minimum priority. This strategy aims at reducing use of the inverter that has already been in operation, and to balance operating times of the

various units in the group. Despite assignment as the last unit in the starting order, if the hydraulic load requires intervention of this specific inverter, it is started up to guarantee adequate system pressure.
The starting priority is re-assigned in two conditions, according to the time ET:

1) Exchange during pumping process: when the pump is active continuously through to exceeding the maximum absolute pumping time.
2) Exchange on standby: when the pump is on standby but 50% of the time ET has been exceeded.

If ET is set to 0, exchange occurs on standby. Each time a pump in the group stops, a different pump will be activated on restart.

If the parameter ET (maximum working time) is set to 0, exchange occurs on each restart, regardless of the effective working time of the pump.

6.6.10 CF: Carrier frequency

This sets the carrier frequency of the inverter modulation. The value set as default, is the correct value in most cases, and therefore modifications are not recommended unless fully aware of the changes made.

6.6.11 AC: Acceleration

This sets the speed of variation with which the inverter varies frequency. This acts both on the start-up phase and during control. In general, the pre-set value is optimal, but in the event of problems during start-up or HP errors, it can be modified or reduced as required. Each time this parameter is modified, it is advisable to check that system control is still efficient. In the event of problems of oscillation, lower the GI and GP gain values; see paragraphs 6.9.4 and 6.6.5. A reduction to AC will slow down the inverter.

6.6.12 AE: Enabling the anti-blocking function

This function serves to avoid mechanical blockages in the event of prolonged disuses; it acts by periodically activating the pump in rotation.
When this function is enabled, every 23 hours the pump complete an unblocking cycle lasting 1 minute.

6.6.13 Setup of auxiliary digital inputs IN1, IN2, IN3, IN4

This section shows the functions and possible configurations of the inputs by means of parameters I1, I2, I3, I4. For electrical connections, see section 2.2.4.2.
The inputs are all the same and all functions can be associated with each. The parameter IN1..IN4 enables the user to associate the required function with the input of the same name.
Each function associated with the inputs is explained in more detail further in this section.
Table 22 summarises the functions and various configurations.

The default settings are those in Table 21.

Default settings of inputs IN1, IN2, IN3, IN4	
Input	**Value**
1	1 (float NO)
2	3 (P aux NO)
3	5 (enable NO)
4	10 (low pressure NO)

Table 23: Default settings of inputs

Summary of possible configurations of digital inputs IN1, IN2, IN3, IN4 and relative operation		
Value	**Function associated with general input i**	**Display of active function associated with input**
0	Input functions disabled	
1	Water failure from external float (NO)	F1
2	Water failure from external float (NC)	F1
3	Auxiliary setpoint Pi (NO) related to input used	F2
4	Auxiliary setpoint Pi (NC) related to input used	F2
5	General enable of the inverter from external signal (NO)	F3
6	General enable of the inverter from external signal (NC)	F3
7	General enable of the inverter from external signal (NO) + Reset of resettable blocks	F3
8	General enable of the inverter from external signal (NC) + Reset of resettable blocks	F3
9	Reset of resettable blocks NO	
10	Low pressure signal input NO, automatic and manual reset	F4
11	Low pressure signal input NC, automatic and manual reset	F4
12	NO low pressure input, manual reset only	F4
13	NC low pressure input, manual reset only	F4
14*	General enabling of the inverter by an external signal (NO) without error message	F3
15*	General enabling of the inverter by an external signal (NC) without error message	F3
* Function available for firmware V 26.1.0 and later versions		

Table 24: Input configuration

6.6.13.1 Disabling functions associated with input

If an input is configured at 0, each function associated with this input will be disabled, regardless of the signal on the terminals of the input itself.

6.6.13.2 Setting the external float function

The external float can be connected to any input, for all electrical connections, refer to paragraph 2.2.4.2. The float function is implemented by setting the parameter INx associated with the input where the float is connected, with one of the values of Table 23.

Activation of the external float function generates a system block. The function is envisaged to connect the input to a signal from a float that indicates a water supply failure.
When this function is enabled, the symbol F1 is shown on the STATUS line of the main page.

The input must be activated for at least one second for the system to block and indicate the error F1.
When in the F1 error condition, the input must be deactivated for at least 30 seconds before the system unblocks. The function behaviour is summarised in Table 23.
When several float functions are configured at the same time on different inputs, the system indicates F1 when at least one function is activated and clears the alarm when none are activated.

Response of external float function according to setting of INx and input				
Parameter value INx	**Input configuration**	**Input status**	**Operation**	**Display**
1	Active with high signal on input (NO)	Absent	Normal	None
		Present	System block due to lack of water from external float	F1
2	Active with low signal on input (NO)	Absent	System block due to lack of water from external float	F1
		Present	Normal	None

Table 25: External float function

6.6.13.3 Setting the auxiliary pressure input function

The auxiliary set points are disabled if the flow sensor is not used (FI=0) and when FZ is used in minimum frequency mode (FZ ≠ 0).

The signal that enables an auxiliary set point can be supplied on any one of the 4 inputs, (for electrical connections, refer to paragraph 2.2.4.2). The auxiliary set point function is obtained by setting parameter INx, associated with the input on which the connection is made, in accordance with Table 24.

The auxiliary pressure function modifies the system setpoint from pressure SP (see section 6.3) to pressure Pi . For electrical connections, see paragraph 2.2.4.2) where i represents the input used. In this way, as well as SP there are four additional pressures available: P1, P2, P3, and P4.
When this function is enabled, the symbol Pi is shown on the STATUS line of the main page.
The input must be active for at least 1 second for the system to operate with the auxiliary setpoint.
When operating with the auxiliary setpoint, the input must not be active for at least 1 second to return to operation with setpoint SP.
The function behaviour is summarised in Table 24.
If several auxiliary pressure values are configured at the same time on different inputs, the system indicates Pi when at least one function is activated. For simultaneous activations, the pressure reached will be the lowest from those with the input active. The alarm is cleared when no input is activated.

Response of auxiliary pressure function according to setting of INx and input				
Parameter value INx	**Input configuration**	**Input status**	**Operation**	**Display**
3	Active with high signal on input (NO)	Absent	Auxiliary set point of same name not active	None
		Present	Auxiliary set point of same name active	Px
4	Active with low signal on input (NO)	Absent	Auxiliary set point of same name active	Px
		Present	Auxiliary set point of same name not active	None

Table 26: Auxiliary setpoints

6.6.13.4 Setting the system enable and fault reset

The signal that enables the system can be supplied from any input (for electrical connections, refer to paragraph 2.2.4.2) The system enable function is obtained by setting the parameter INx, associated with the input where the enable signal is connected, to one of the values in Table 24.
When this function is active, the system is totally disabled, and F3 is displayed n the STATUS line of the main page.
When several system disable functions are configured at the same time on different inputs, the system indicates F3 when at least one function is activated and clears the alarm when none are activated.
The input must be active for at least 1 second for the system to implement the disable function.
When the system is disabled, the input must not be active for at least 1 second for the function to be deactivated (system re-enable).
The function behaviour is summarised in Table 25.
If several disable functions are configured at the same time on different inputs, the system indicates F3 when at least one function is activated. The alarm is cleared when no input is activated.

Response of system enable and fault reset function according to setting of INx and input				
Parameter value INx	**Input configuration**	**Input status**	**Operation**	**Display**
5	Active with high signal on input (NO)	Absent	Inverter Enabled	None
		Present	Inverter Disabled	F3
6	Active with low signal on input (NO)	Absent	Inverter Disabled	F3
		Present	Inverter Enabled	None

7	Active with high signal on input (NO)	Absent	Inverter Enabled	None
		Present	Inverter disabled + block reset	F3
8	Active with low signal on input (NO)	Absent	Inverter disabled + block reset	F3
		Present	Inverter Enabled	
9	Active with high signal on input (NO)	Absent	Inverter Enabled	None
		Present	Block reset	None
14*	Active with high signal on input (NO)	Absent	Inverter Enabled	None
		Present	Inverter Disabled no error message	F3
15*	Active with low signal on input (NC)	Absent	Inverter Disabled no error message	F3
		Present	Inverter Enabled	None
* Function available for firmware V 26.1.0 and later versions				

Table 27: System enable and fault reset

6.6.13.5 Setting low pressure detection (KIWA)

The minimum pressure switch that detects low pressure can be connected to any input (for electrical connections, refer to paragraph 2.2.4.2) The low pressure detection function is obtained by setting the parameter INx, associated with the input where the enable signal is connected, to one of the values in Table 26.

Activation of the low pressure detection function generate a system block after time T1 (see T1: Tempo di spegnimento dopo il segnale bassa pressione par. 6.6.2). This function is envisaged to connect the input to a signal from a pressure switch that indicates excessively low pressure on pump intake.
When this function is enabled, the symbol F4 is shown on the STATUS line of the main page.

When in the F4 error condition, the input must be deactivated for at least 2 seconds before the system unblocks. The function behaviour is summarised in Table 26.
When several low pressure detection functions are configured at the same time on different inputs, the system indicates F4 when at least one function is activated and clears the alarm when none are activated.

Response of system enable and fault reset function according to setting of INx and input				
Parameter value INx	**Input configuration**	**Input status**	**Operation**	**Display**
10	Active with high signal on input (NO)	Absent	Normal	None
		Present	System block due to low pressure on intake; automatic + manual reset	F4
11	Active with low signal on input (NO)	Absent	System block due to low pressure on intake; automatic + manual reset	F4
		Present	Normal	None
12	Active with high signal on input (NO)	Absent	Normal	None
		Present	System block due to low pressure on intake. Manual reset	F4
13	Active with low signal on input (NO)	Absent	System block due to low pressure on intake. Manual reset	F4
		Present	Normal	None

Table 28: Low pressure signal detection (KIWA)

6.6.14 Setup of outputs OUT1, OUT2

This section illustrates the functions and possible configurations of the outputs OUT1 and OUT2 via parameters O1 and O2.
For electrical connections, see section 2.2.4.
The default settings are those in Table 27.

Default output settings	
Output	**Value**
OUT 1	2 (fault NO closes)
OUT 2	2 (Pump running NO closes)

Table 29: Default output settings

6.6.14.1 O1: Output 1 function setting

Output 1 notifies of an active alarm (i.e. that there is a system block). The output enables use of a normally closed or normally open voltage-free contact.
Parameter O1 is associated with the values and functions specified in Table 28.

6.6.14.2 O2: Output 2 function setting

Output 2 notifies of electric pump running status (pump on/off). The output enables use of a normally closed or normally open voltage-free contact.
Parameter O2 is associated with the values and functions specified in Table 28.

Configuration of functions associated with outputs				
Output configuration	OUT1		OUT2	
	Activation conditions	Output contact status	Activation conditions	Output contact status
0	No function associated	NO contact always open, NC contact always closed	No function associated	NO contact always open, NC contact always closed
1	No function associated	NO contact always closed, NC contact always open	No function associated	NO contact always closed, NC contact always open
2	Presence of blocking errors	In event of blocking errors NO contact closes and NC contact opens	Activation of output in event of blocking errors	When the pump is running, the NO contact closes and the NC contact opens
3	Presence of blocking errors	In event of blocking errors NO contact opens and NC contact closes	Activation of output in event of blocking errors	When the pump is running, the NO contact opens and the NC contact closes

Table 30: Output configuration

6.6.15 RF: Fault and warning log reset

To clear the fault and warning log, press and hold the buttons + and – simultaneously for at least 2 seconds. The number of faults present in the log (max. 64) are summarised below the RF symbol.
The log can be viewed from the MONITOR menu on the FF page.

6.6.16 PW: Password settings

The inverter is equipped with a password protection system. If a password is set, the inverter parameters will be accessible and readable, but no modifications are admitted.

When the password (PW) is "0" all parameters are unlocked and can be modified.

When a password is used (PW value other than 0) all modifications are blocked and "XXXX" is displayed on the PW page.

If a password is set, user navigation is admitted in all pages, but on any attempt to make modifications to a parameter, a pop-up window is displayed, requesting entry of the password. The pop-up window enables the user to exit the window or enter the password for access.
When the correct password is entered, the parameters remain unlocked and modifiable for 10'.

To cancel the password timer, enter the PW page and press + and - at the same time for 2 seconds.
On entry of the correct password, an opened padlock symbol appears, while on entry of the incorrect password will display a flashing padlock symbol.
If the incorrect password is entered 10 times consecutively, the same padlock error symbol appears with inverted colours, to indicate that no password will now be accepted until the unit is switched off and on again. After the factory settings are restored, the password is reset to "0".
Any change to the password is applied when Mode or Set is pressed, and any subsequent change to a parameter requires entry of the new password (e.g. the installer makes all settings with the default PW value = 0, and the last thing he/she does is to set the PW so that the machine is totally safe without any further actions).

If a password is lost, there are two options to modify the inverter parameters:

- Note down the value of all parameters, reset the inverter to factory settings; see paragraph 7.3. The reset operation deletes all inverter parameters, including the password.
- Note down the number on the password page, send an email with this number to the local service centre, and a new password will be sent within a few days to unlock the inverter.

6.6.16.1 **Multiple inverter system password**

The parameter PW is one of the sensitive parameters, and therefore must be identical for all inverters to ensure inverter operation. If there is already a chain with aligned PW, and inverter is added with PW=0, a request is displayed to align the parameters. In these conditions, the inverter with PW=0 can implement the configuration including the Password, but cannot propagate this configuration.

In the case of unaligned sensitive parameters, the key parameter with relative value is displayed in the parameter alignment page to aid the user in checking whether a configuration can be propagated.
The key represents a password code. Depending on the key correspondence, the user can check whether the inverters in a chain can be aligned.

Key equal to - -

- the inverter can receive the configuration from all
- the inverter can propagate its configuration to inverters with key equal to - -
- the inverter cannot propagate its configuration to inverters with keys other than - -

Key greater than or equal to 0

- the inverter can only receive the configuration from inverters with the same key.
- the inverter cannot propagate its configuration to inverters with the same key or with keys = --
- the inverter cannot propagate its configuration to inverters with different keys.

When the PW is entered to unlock an inverter in a group, all inverters are unlocked.
When the PW is modified on one inverter in a group, the modification is applied to all inverters.
When password protection is applied to one inverter in a group (+ and – in the PW page when PW≠0), protection is applied to all inverters (the password is required to apply any modifications)

7. PROTECTION SYSTEMS

The inverter is equipped with protection systems designed to preserve the pump, motor, power line and the inverter itself. When one or more protections trip, the one with the highest priority is shown on display. Depending on the type of error, the electric pump may shut down, but when normal conditions are restored, the error state may clear automatically, immediately or after a set time interval following automatic reset.
In the case of a block due to water supply failure (BL), block due to pump motor current overload (OC), block due to final output stage current overload (OF), block due to direct short circuit between the phases on the output terminal (SC), the user can attempt to manually reset the error condition by pressing and releasing buttons + and - simultaneously. If the error condition persists, the cause of the fault must be located and eliminated.

Alarm in fault log	
Display message	**Description**
PD	Irregular shutdown
FA	Problems with cooling system

Table 31: Alarms

Block conditions	
Display message	**Description**
BL	Block due to water failure
BPx	Block due to reading error of the pressure sensor named
LP	Block due to low power supply voltage
HP	Block due to high internal power supply voltage
OT	Block due to overheating of final power stages
OB	Block due to overheating of printed circuit
OC	Block due to current overload on electric pump motor
OF	Block due to current overload on final stages of output
SC	Block due to direct short circuit between the phases on the output terminal
EC	Block due to lack of rated current setting (RC)
Ei	Block due to "i" internal error
Vi	Block due to "I" internal voltage outside tolerance

Table 32: Block information

7.1 Description of blocks

7.1.1 "BL" Block due to water failure

In flow conditions below minimum value, with pressure lower than the set regulation value, a water failure signal is emitted and the system shuts down the pump. The delay interval without pressure and flow can be set in the parameter TB of the TECHNICAL ASSISTANCE menu.
If the user inadvertently enters a pressure setpoint higher than the pressure that the electric pump can supply on closure, the system indicates "block due to water failure" (BL) even if this is not precisely the problem. In this case, lower the regulation pressure to a reasonable value, which does not normally exceed 2/3 of the head of the electrical pump installed.
The parameters SO: Dry running factor 6.5.14 and Minimum pressure pump stop due to water failure 6.5.15 enable the user to enter the dry running protection activation thresholds.

If the parameters: SP, RC, SO and MP are not set correctly, the water failure protection will not function correctly.

7.1.2 "BPx" Block due to fault on pressure sensor

If the inverter detects a fault on the pressure sensor, the pump remains blocked and the error signal "BPx" is displayed. This status starts as soon as the problem is detected and is reset automatically when the correct conditions are restored.

BP1 indicates an error on the sensor connected to press1, BP2 indicates an error on the sensor connected to press2,
BP3 indicates an error on the sensor connected to terminal board J5

7.1.3 "LP" Block due to low power supply voltage

Activated when the line voltage on the power supply terminal falls below the minimum admissible voltage of 295VAC. Reset is only automatic when the voltage on the terminal exceeds 348VAC as per standard.

7.1.4 "HP" Block due to high internal power supply voltage

Activated when the internal power supply values are outside the specified range. Reset is only automatic when the voltage returns to within the admissible values. This may be due to voltage surges or excessively brusque shutdown of the pump.

7.1.5 "SC" Block due to direct short circuit between the phases on the output terminal

The inverter is equipped with a protection against direct short circuits, which may occur between the phases U, V, and W of the output terminal "PUMP". When this block signal is sent, the user can attempt reset by pressing buttons + and – simultaneously **which in any event does not have any effect until 10 seconds has passed since the moment of the short circuit.**

7.2 Manual reset of error conditions

In error status, the user can reset the fault by overriding a new attempt by pressing and releasing buttons + and -.

7.3 Auto-reset of error conditions

In the cases of some malfunctions and block conditions, the system makes a number of attempts at automatic reset of the electric pump.
The auto-reset system regards in particular:

- "BL" Block due to water failure
- "LP" Block due to low power supply voltage
- "HP" Block due to internal high voltage
- "OT" Block due to overheating of final power stages
- "OB" Block due to overheating of printed circuit
- "OC" Block due to current overload on electric pump motor
- "OF" Block due to current overload on final stages of output
- "BP" Block due to fault on pressure sensor

If, for example, the pump is blocked due to water supply failure, the inverter automatically starts a test procedure to verify that the unit is effectively without water permanently. During the sequence of operations, if a reset attempt succeeds (for example water has returned), the procedure is interrupted and normal operation is resumed.
Table 31 shows the sequence of operations performed by the inverter for the different types of block.

Automatic reset of error conditions		
Display message	**Description**	**Automatic reset sequence**
BL	Block due to water failure	- One attempt every 10 minutes for a total of 6 attempts - One attempt every hour for a total of 24 attempts - One attempt every 24 hours for a total of 30 attempts
LP	Block due to low line voltage	- Reset when specified voltage is restored
HP	Block due to high internal power supply voltage	- Reset when voltage returns to a specified value
OT	Block due to overheating of final power stages (TE > 100°C)	- Reset when temperature of final power stages falls below 85°C
OB	Block due to overheating of printed circuit (BT> 120°C)	- Reset when temperature of printed circuit falls below 100°C
OC	Block due to current overload on electric pump motor	- An attempt every 10 minutes for a total of 6 attempts - An attempt every hour for a total of 24 attempts - An attempt every 24 hours for a total of 30 attempts
OF	Block due to current overload on final stages of output	- An attempt every 10 minutes for a total of 6 attempts - An attempt every hour for a total of 24 attempts - - An attempt every 24 hours for a total of 30 attempts

Table 33: Auto-reset of blocks

8. RESET AND DEFAULT SETTINGS

8.1 General system reset

To reset PMW press and hold the 4 buttons simultaneously for 2 Sec. This operation does not delete settings memorised by the user.

8.2 Default settings

The inverter leaves the factory with a series of pre-set parameters, which can be modified according to user requirements. Each modification to settings is automatically saved in the memory, while the user, when required, can always restore the default conditions (see Ripristino delle impostazioni di fabbrica par. 8.3).

8.3 Restoring default settings

To restore the default settings, switch off the inverter, wait for complete shutdown of the fans and display, then press and hold buttons “SET” and “+” and power up the unit; only release the two buttons when the text "EE" is displayed.
In this case the default settings are restored (writing and reading on EEPROM of the default settings saved permanently on the FLASH memory).
After setting all parameters, the inverter resumes normal operation.

After restoring default settings, all system parameters should be reconfigured (current, gain, minimum frequency, setpoint pressure etc.) as per the initial installation procedure.

Default settings					
		MCE-22/P MCE-15/P MCE-11/P	MCE-55/P MCE-30/P	MCE-150/P MCE-110/P	Installation note
Identifier	**Description**	**Value**			
LA	Language	ITA	ITA	ITA	
SP	Setpoint pressure [bar]	3,0	3,0	3,0	
P1	Setpoint P1 [bar]	2,0	2,0	2,0	
P2	Setpoint P2 [bar]	2,5	2,5	2,5	
P3	Setpoint P3 [bar]	3,5	3,5	3,5	
P4	Setpoint P4 [bar]	4,0	4,0	4,0	
FP	Test frequency in manual mode	40,0	40,0	40,0	
RC	Rated current of electric pump [A]	0,0	0,0	0,0	
RT	Direction of rotation	0 (UVW)	0 (UVW)	0 (UVW)	
FN	Rated frequency [Hz]	50,0	50,0	50,0	
OD	Type of system	1 (Rigid)	1 (Rigid)	1 (Rigid)	
RP	Pressure drop for restart [bar]	0,5	0,5	0,5	
AD	Address	0 (Auto)	0 (Auto)	0 (Auto)	
PR	Pressure sensor	1 (501 R 25 bar)	1 (501 R 25 bar)	1 (501 R 25 bar)	
MS	Measurement system	0 (International)	0 (International)	0 (International)	
FI	Flow sensor	0 (Absent)	0 (Absent)	0 (Absent)	
FD	Pipeline diameter [inch]	2	2	2	
FK	K-factor [pulse/l]	24,40	24,40	24,40	
FZ	Setting zero flow frequency	0	0	0	
FT	Minimum shutdown flow [l/min]*	50	50	50	
SO	Dry running factor	22	22	22	
MP	Minimum pressure pump stop [bar]	0,0	0,0	0,0	
TB	Delay for water failure block [s]	10	10	10	
T1	Shutdown delay [s]	2	2	2	
T2	Shutdown delay [s]	10	10	10	
GP	Proportional gain coefficient	0,5	0,5	0,5	
GI	Integral gain coefficient	1,2	1,2	1,2	
FS	Maximum rotation frequency [Hz]	50,0	50,0	50,0	
FL	Minimum rotation frequency [Hz]	0,0	0,0	0,0	
NA	Active inverters	N	N	N	
NC	Simultaneous inverters	NA	NA	NA	
IC	Reserve configuration	1 (Auto)	1 (Auto)	1 (Auto)	
ET	Exchange time [h]	2	2	2	
CF	Carrier [kHz]	20	10	5	
AC	Acceleration	5	4	2	
AE	Anti-blocking function	1(enabled)	1(enabled)	1(enabled)	
I1	Function I1	1 (float)	1 (float)	1 (float)	
I2	Function I2	3 (P Aux)	3 (P Aux)	3 (P Aux)	
I3	Function I3	5 (Disable)	5 (Disable)	5 (Disable)	
I4	Function I4	10 (Low press)	10 (Low press)	10 (Low press)	
O1	Output 1 function	2	2	2	
O2	Output 2 function	2	2	2	
PW	Password settings	0	0	0	
*in case of FI=0 (sensor absent), the value indicated by FT is non-dimensional					

Table 34: Default settings