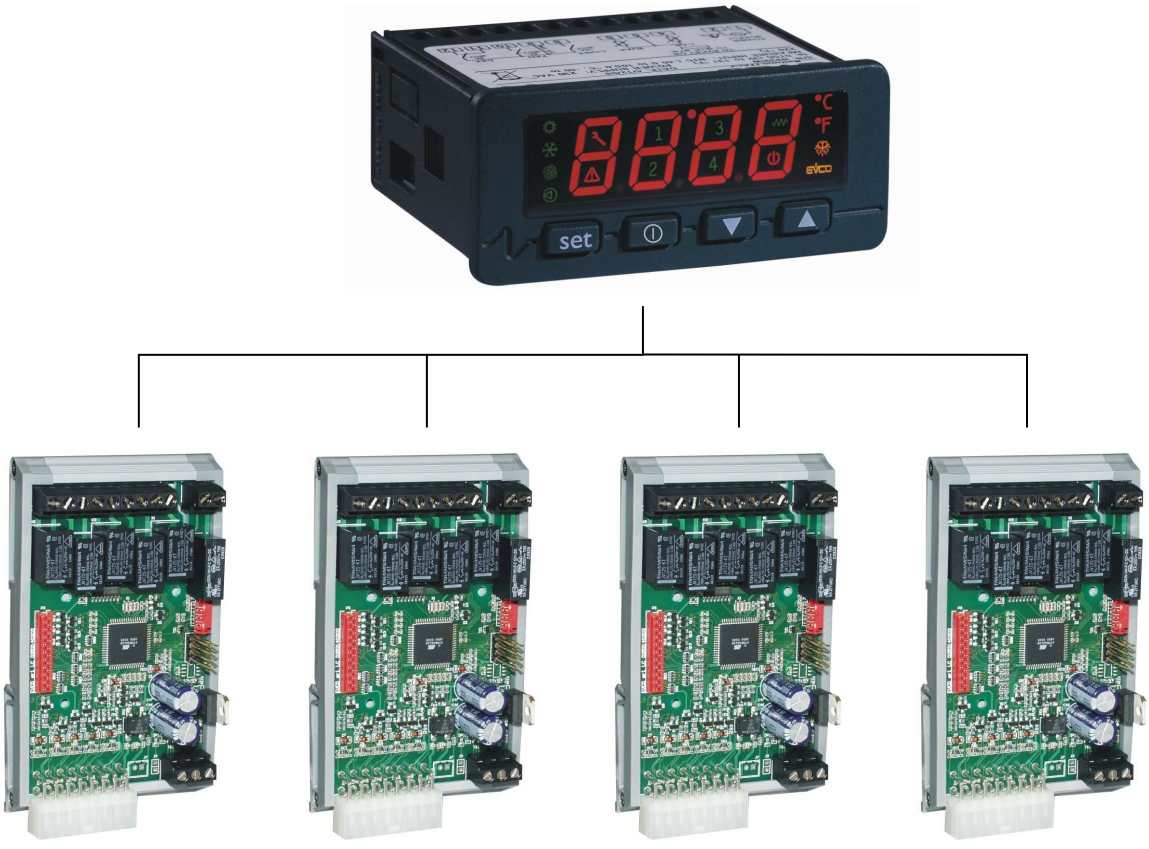
PROGRAMMABLE CONTROLLERS FOR
CHILLER AND HEAT PUMP
FOR NAVAL APPLICATIONS



APPLICATION MANUAL

CODE 144NAV0NUE16

Important

Read these instructions carefully before installation and use and follow all recommendations regarding installation and for the electric connection; keep these instructions for future reference.

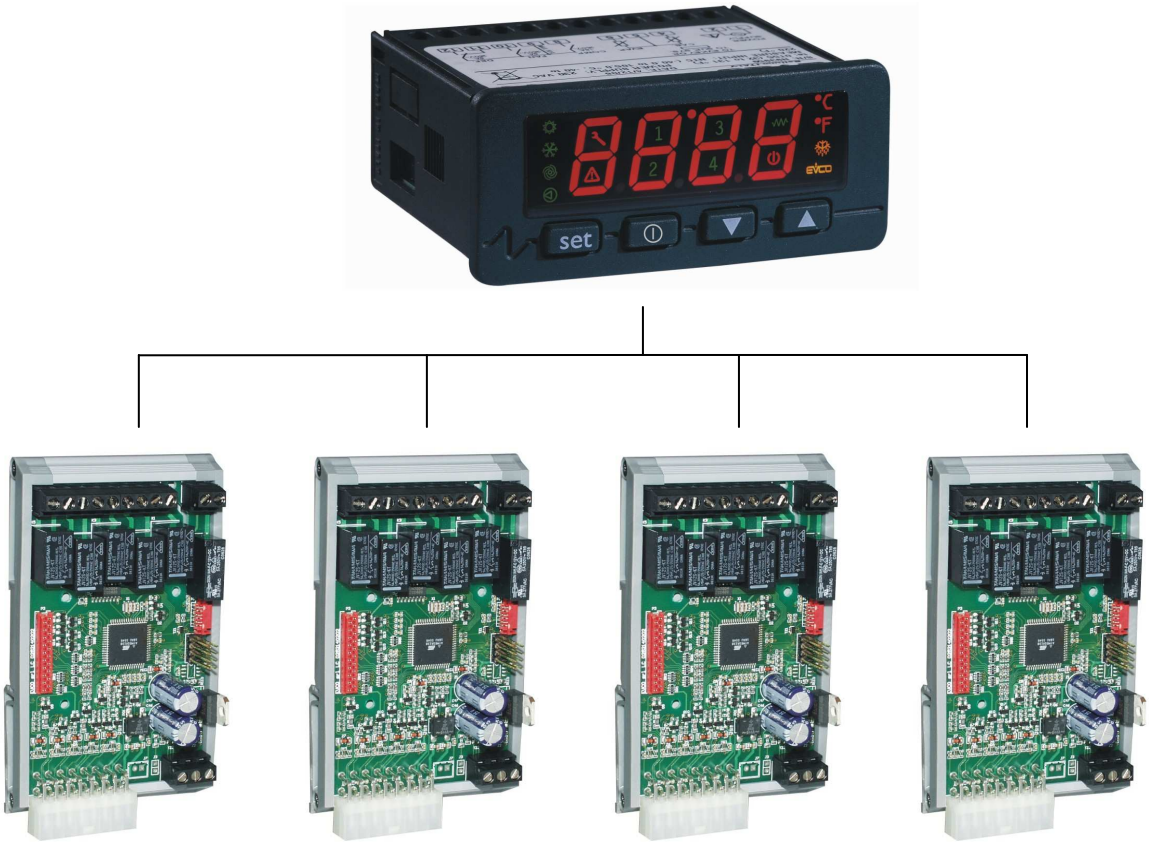
The instrument must be disposed of according to local Standards regarding the collection of electric and electronic appliances.

Summary

1 Generalities

1.1 Description

The software application is realised with UNI-PRO and can manage Chiller and air-water Heat Pump units for naval applications, with control of the two fresh water and salt water hydraulic circuits. These units manage one compressor each and up to a maximum of 4 can be used together, connected to a master control for the enabling of regulation.
The acquisition of all sizes necessary for regulation takes place at the level of the unit and the flow of information between the units and the master is guaranteed by the CAN network.



2 Applications

The following types of controllers can be managed:

2.1 Master (nano)

Master for chiller + single circuit water -water heat pump units.

Analogue Inputs		
AI 1 (NTC)	-	
AI 2 (NTC)	-	
AI 3 (NTC)	-	
AI 4 (NTC)	-	
Digital Inputs		
DI 1	-	
DI 2	Change-Over	Summer/Winter
DI 3	-	
DI 4	-	
DI 5	-	
Digital Outputs		
DO 1	-	
DO 2	-	
DO 3	Fresh water pump	
DO 4	General alarm	
DO 5	-	
DO 6	-	
Analogue outputs		
AO 1 (PWM)	-	-
AO 2 (0..10V)	-	
AO 3 (0..10V)	-	-

Total analogical inputs: 0
Total digital inputs: 1
Total analogical outputs: 0
Total digital outputs: 2

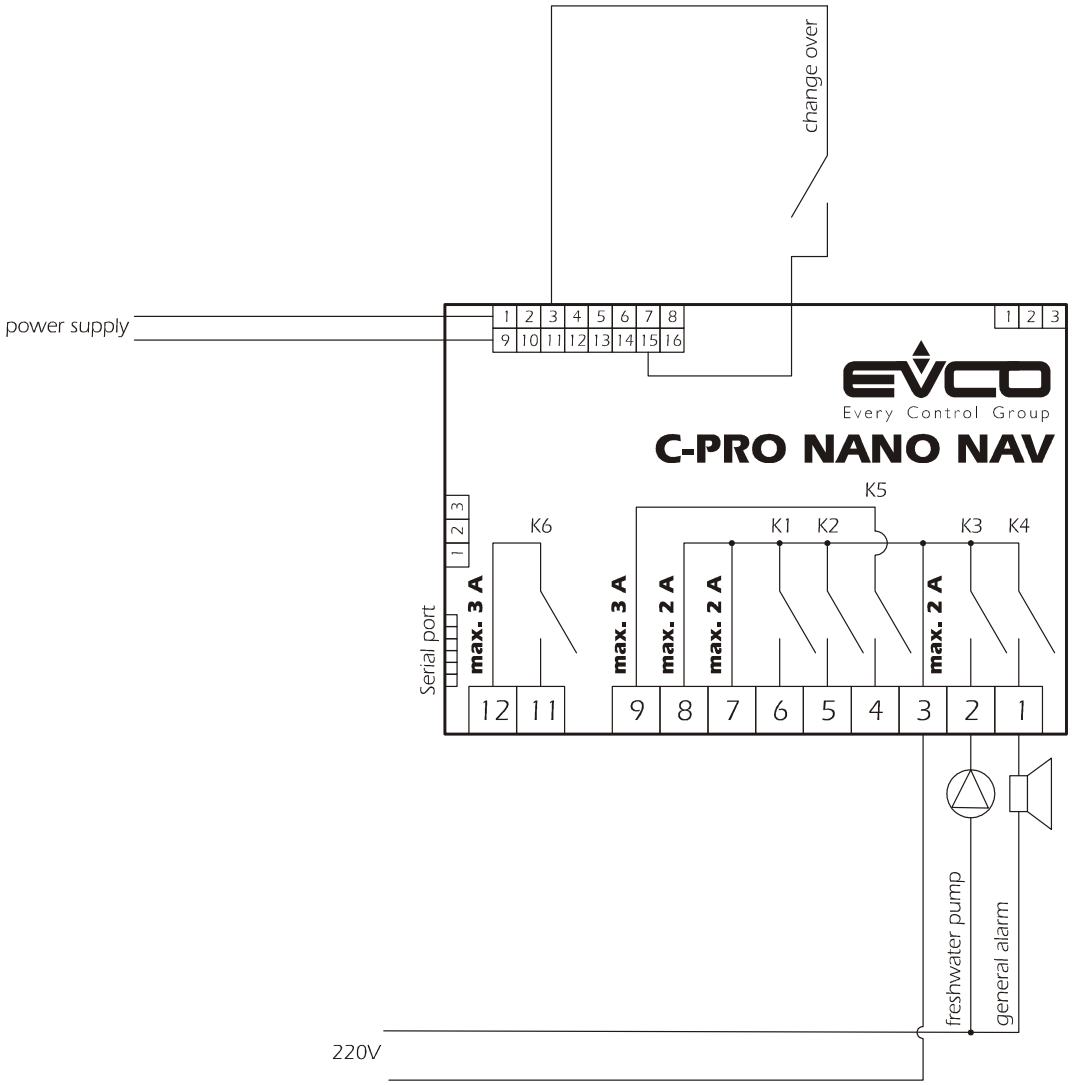
2.2 Slave unit (micro)

Chiller + single circuit water -water heat pump unit.

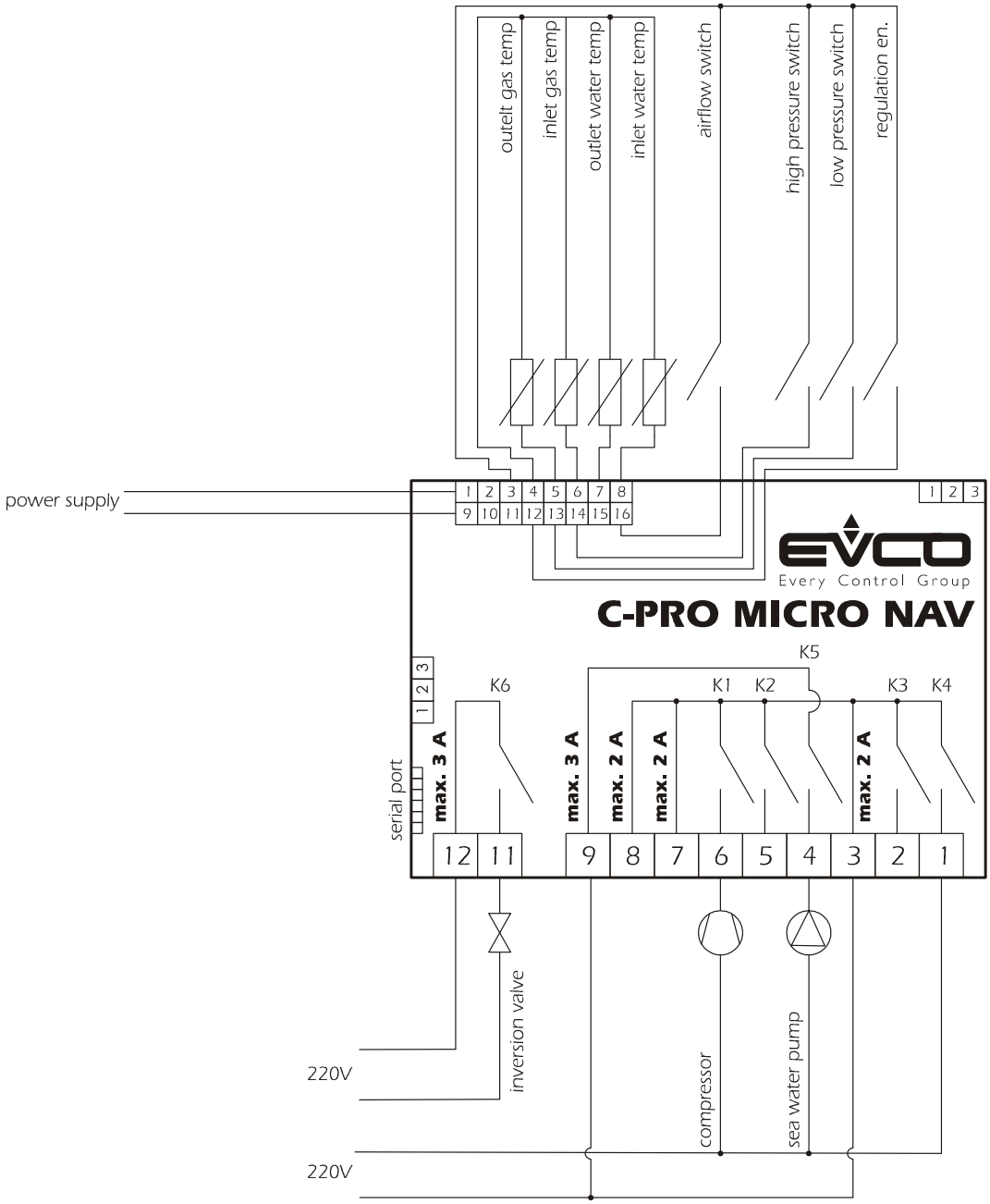
Analogue Inputs		
AI 1 (NTC)	Input fresh water temperature probe	°C
AI 2 (NTC)	Output fresh water temperature probe	°C
AI 3 (NTC)	Condenser input gas temperature probe	°C
AI 4 (NTC)	Evaporator output gas temperature probe	°C
Digital Inputs		
DI 1	Flow switch	
DI 2	-	
DI 3	High pressure switch	
DI 4	Low pressure switch	
DI 5	Enabling for regulation	
Digital Outputs		
DO 1	Compressor switch-on	
DO 2	-	
DO 3	-	
DO 4	-	
DO 5	Salt water pump	
DO 6	Circuit reverse valve	
Analogue outputs		
AO 1 (PWM)	-	
AO 2 (0..10V)	-	
AO 3 (0..10V)	-	

Total analogical inputs: 4
Total digital inputs: 4
Total analogical outputs: 0
Total digital outputs: 3

2.3 C-PRO NANO connection layout

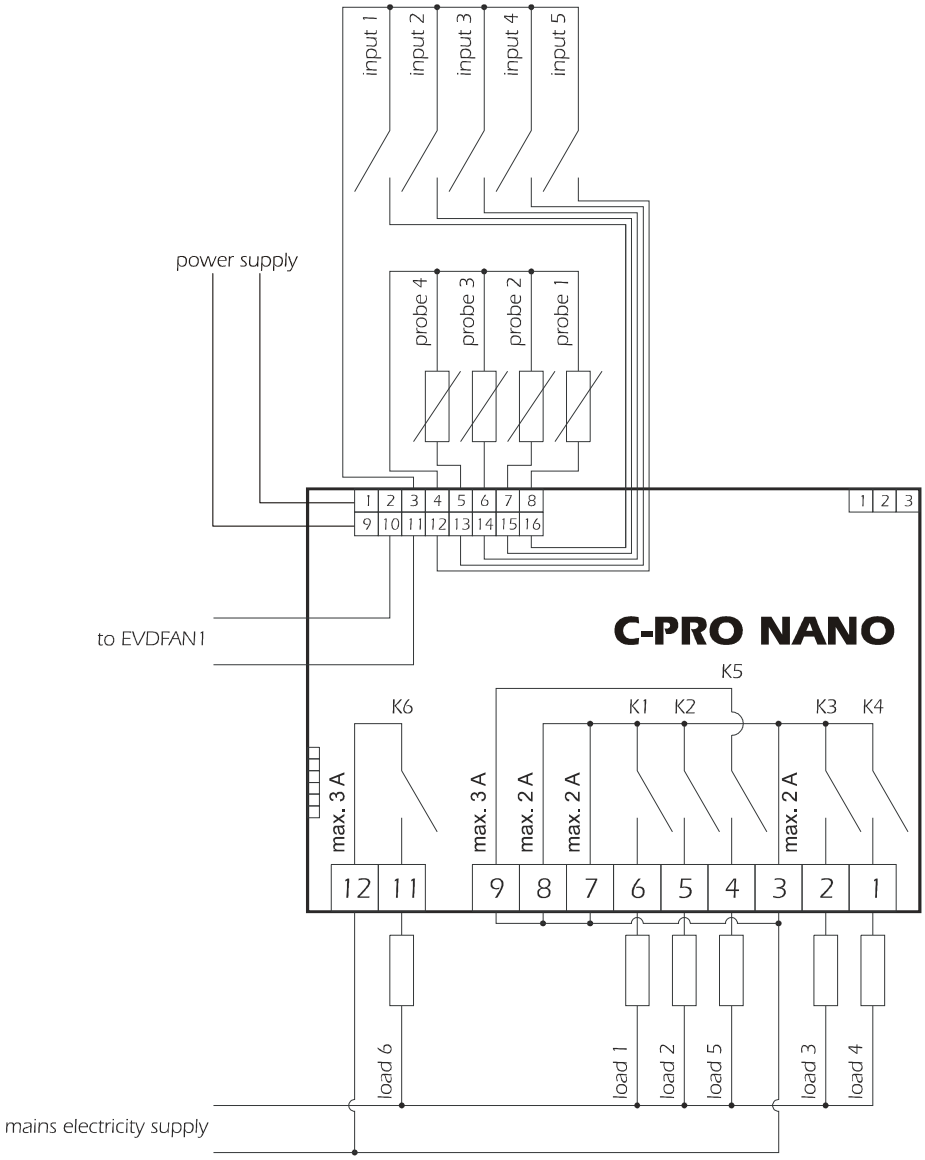


2.4 C-PRO MICRO connection layout



2.5 C-PRO NANO electric connections

Below find a representation of the connection layout of the C-PRO NANO controller with tables relative to the meaning of the inputs and outputs.



C-PRO NANO connections

Connector 1: Connection for the relay outputs		
Conn.	**Code**	**Description**
C1-1	DO4	Relay n.4 normally open contact
C1-2	DO3	Relay n.3 normally open contact
C1-3	COMMON1	Common relays n.1,2,3,4
C1-4	DO5	Relay n.5 normally open contact
C1-5	DO2	Relay n.2 normally open contact
C1-6	DO1	Relay n.1 normally open contact
C1-7	COMMON1	Common relays n.1,2,3,4
C1-8	COMMON1	Common relays n.1,2,3,4
C1-9	COMMON DO5	Common relay n.5
C1-10		Not used
C1-11	DO6	Relay n.6 normally open contact

Connector 2: Connection for the upload/download parameters key and/or output for RS485 module and/or download flash module of the controller		
Connector 3: Connector for analogue output		
Conn.	**Code**	**Description (Version V+I)**
C3-1	AO2	0-10Vdc
C3-2	GND	Common analogue output
C3-3	AO3	4-20mA
		Description (Version I+I)
C3-1	*AO2*	*4-20mA*
C3-2	*GND*	*Common analogue output*
C3-3	*AO3*	*4-20mA*
		Description (Version V+V)
C3-1	AO2	0-10Vdc
C3-2	GND	Common analogue output
C3-3	AO3	0-10Vdc

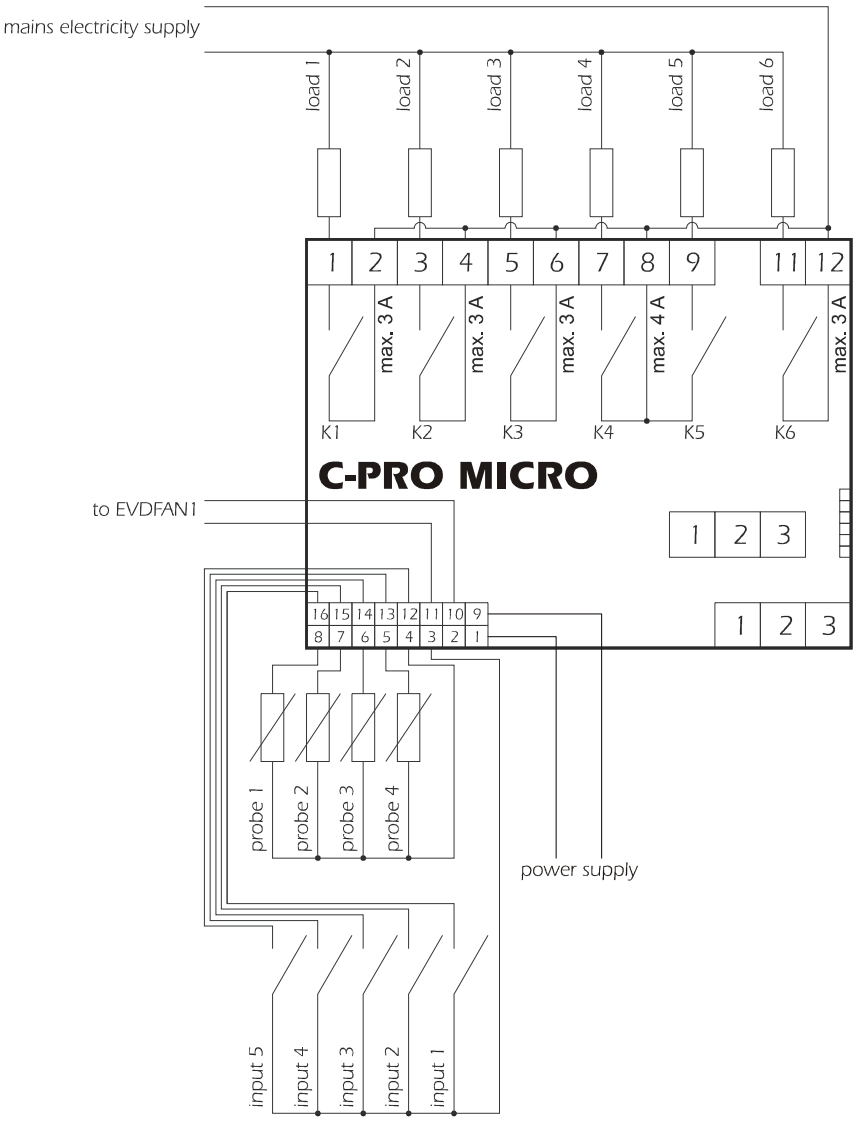
Connector 4: Connector for low voltage signals		
Conn.	**Code**	**Description**
C4-1	12Vac (Power)	Instrument power supply (12Vac/dc)
C4-2	5V	Raziometric power supply
C4-3	GND	Common analogue and digital inputs
C4-4	GND	Common analogue and digital inputs
C4-5	AI4	Analogue input n.4 (for NTC probes or for 0/4-20 mA transducers or 0-5V)
C4-6	AI3	Analogue input n.3 (for NTC probes or for 0/4-20 mA transducers or 0-5V)
C4-7	AI2	Analogue input n.2 (for NTC probes)
C4-8	AI1	Analogue input n.1 (for NTC probes)
C4-9	12Vac (Power)	Instrument power supply (12Vac/dc)
C4-10	12Vdc	Current transducers and phase cut module power supply (max. 50 mA, not protected against short circuit)
C4-11	AO1	Impulses output for phase cut module
C4-12	DI5	Digital input n.5
C4-13	DI4	Digital input n.4
C4-14	DI3	Digital input n.3
C4-15	DI2	Digital input n.2
C4-16	DI1	Digital input n.1

Connector 5: Connector for the remote keyboard and I/O expansion (IntraBus)		
Conn.	**Code**	**Description**
C5-1	VDC	Remote keyboard power supply (12Vdc max 50mA, not protected against short circuit) (Note: any expansion must be powered locally)
C5-2	GND	Common
C5-3	DATA	Serial live

Connector 5: Connector for the remote keyboard and I/O expansion (CAN)		
Conn.	**Code**	**Description**
C5-1	+	Connector for the connection of the CAN + serial
C5-2	GND	Earth reference connector
C5-3	-	Connector for the connection of the CAN - serial

2.6 C-PRO MICRO electric connections

Below find a representation of the connection layout of the C-PRO MICRO controller with tables relative to the meaning of the inputs and outputs.



C-PRO MICRO connections

Connector 1: Connection for the relay outputs		
Conn.	**Code**	**Description**
C1-1	DO1	Relay n.1 normally open contact
C1-2	COMMON DO1	Common relay n.1
C1-3	DO2	Relay n.2 normally open contact
C1-4	COMMON DO2	Common relay n.2
C1-5	DO3	Relay n.3 normally open contact
C1-6	COMMON DO3	Common relay n.3
C1-7	DO4	Relay n.4 normally open contact
C1-8	COMMON DO4, DO5	Common relay n.4,5
C1-9	DO5	Relay n.5 normally open contact
C1-11	DO6	Relay n.6 normally open contact
C1-12	COMMON DO6	Common relay n.6

Connector 2: Connection for the upload/download parameters key and/or output for RS485 module and/or download flash module of the controller

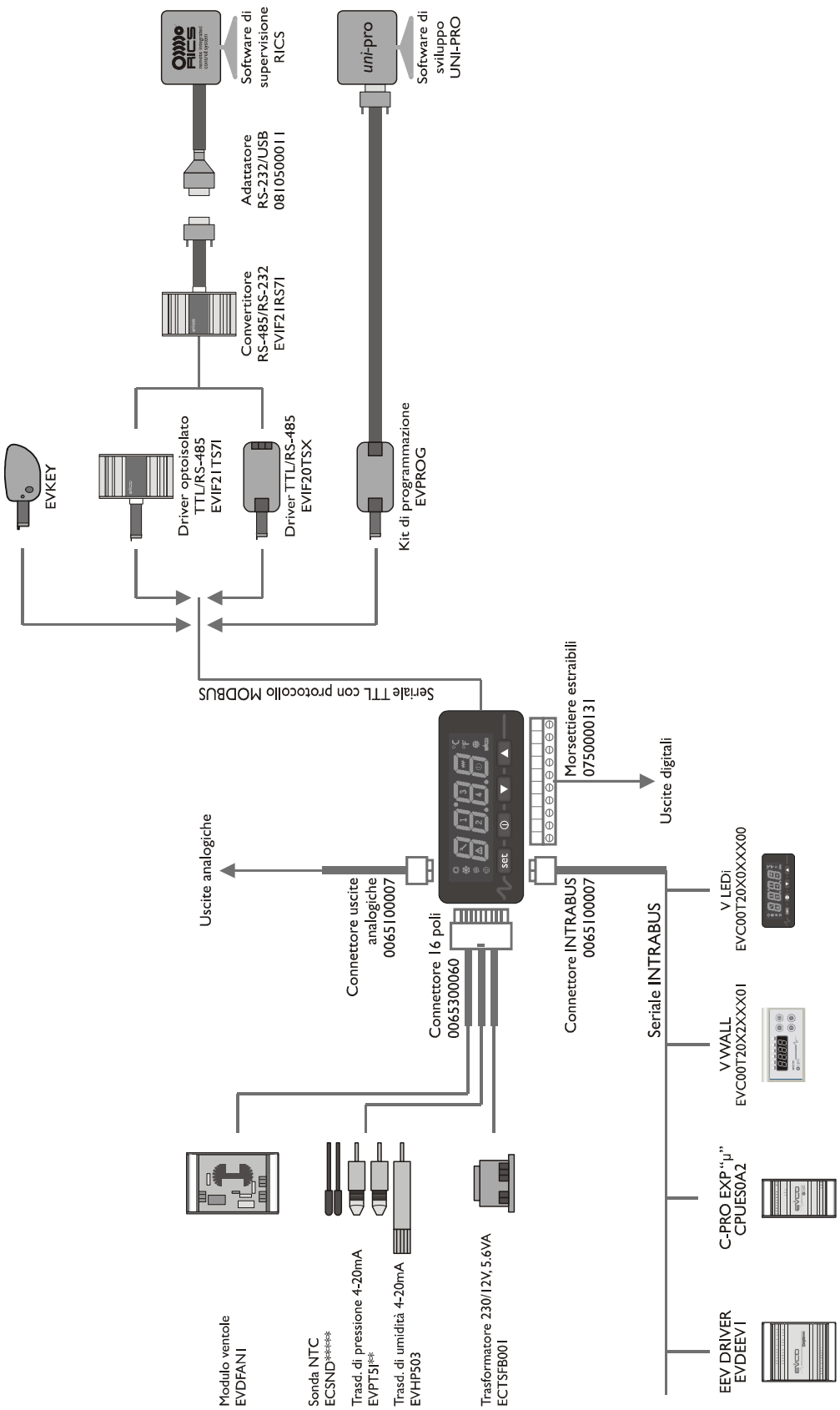
Connector 3: Connector for analogue output (optional, not available in the day versions)		
Conn.	**Code**	**Description (Version V+I)**
C3-1	AO2	0-10Vdc
C3-2	GND	Common analogue output
C3-3	AO3	4-20mA
		Description (Version I+I)
C3-1	*AO2*	*4-20mA*
C3-2	*GND*	*Common analogue output*
C3-3	*AO3*	*4-20mA*
		Description (Version V+V)
C3-1	AO2	0-10Vdc
C3-2	GND	Common analogue output
C3-3	AO3	0-10Vdc

Connector 4: Connector for low voltage signals		
Conn.	**Code**	**Description**
C4-1	12Vac (Power)	Instrument power supply (12Vac/dc)
C4-2	5V	Raziometric power supply
C4-3	GND	Common analogue and digital inputs
C4-4	GND	Common analogue and digital inputs
C4-5	AI4	Analogue input n.4 (for NTC probes or for 0/4-20 mA transducers or 0-5V)
C4-6	AI3	Analogue input n.3 (for NTC probes or for 0/4-20 mA transducers or 0-5V)
C4-7	AI2	Analogue input n.2 (for NTC probes)
C4-8	AI1	Analogue input n.1 (for NTC probes)
C4-9	12Vac (Power)	Instrument power supply (12Vac/dc) (max. 50 mA, not protected against short circuit)
C4-10	12Vdc	Current transducers and phase cut module power supply
C4-11	AO1	Impulses output for phase cut module
C4-12	DI5	Digital input n.5
C4-13	DI4	Digital input n.4
C4-14	DI3	Digital input n.3
C4-15	DI2	Digital input n.2
C4-16	DI1	Digital input n.1

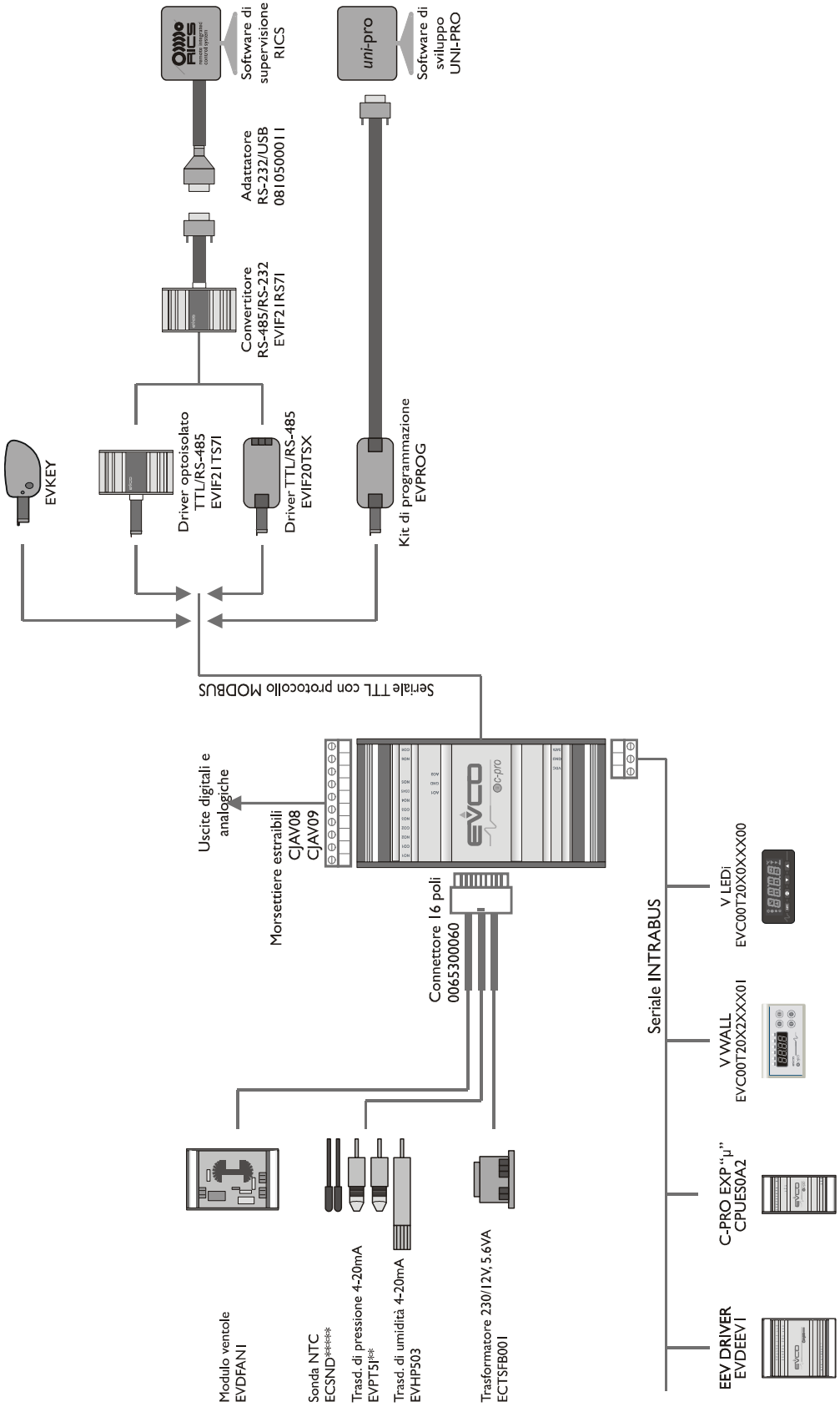
Connector 5: Connector for the remote keyboard and I/O expansion (IntraBus)		
Conn.	**Code**	**Description**
C5-1	VDC	Remote keyboard power supply (12Vdc max 50mA, not protected against short circuit) (Note: any expansion must be powered locally)
C5-2	GND	Common
C5-3	DATA	Serial live

Connector 5: Connector for the remote keyboard and I/O expansion (CAN)		
Conn.	**Code**	**Description**
C5-1	+	Connector for the connection of the CAN + serial
C5-2	GND	Earth reference connector
C5-3	-	Connector for the connection of the CAN - serial

2.7 Example for C-PRO NANO CHILL



2.8 Example for C-PRO MICRO CHILL



3 USER INTERFACE

3.1 Display and keyboard

The application is made up from two parts, 1 master and *n* slave (maximum 4). The slave units are blind (day version), therefore without display and without keys: the information can be displayed and parameters set directly by the master.
The master controller has a user interface with 4 displays with 7 segments and 16 icons. The controllers can also accept the EVCO Vgraph or Vtouch remote terminals that implement the CAN protocol (the necessary part of the application must be developed for this type of LCD graphics).
There are 4 keys on the keyboard for the navigation functions of the pages and display/modification of the values, with the following meaning:

- UP and DOWN: in editing mode, modifies the parameters; otherwise moves the display cursor.

- SET/ENTER: in editing mode confirms the value; otherwise sends the commands associated to the text where the cursor is found. If the ENTER key is held for about 2 seconds, it allows access to the main menu. If an alarm page is being displayed, by pressing for about 2 seconds, it allows the alarm to be reset. If an alarm page is being displayed, it scrolls all active alarms every time it is pressed.

- STAND-BY/ESC: in editing annulment of the value; otherwise request of the default page associated to the current page. If the ESC key is held for about 2 seconds, it allows to switch the machine on/off. If pressed in the main page, it allows access to the list of all active alarms.

The icons can have different meanings if displaying the information of an individual machine or the general information of the entire network of controllers:

- Sun icon: identifies the summer functioning mode (chiller). If stays off in heat pump functioning mode. The meaning can be exchanged with the winter icon via the *Icon* parameter:
    - MASTER: Slow flashing if no regulation necessity, otherwise on with fixed light.
    - UNIT: If there is no enabling of the regulation from input it flashes quickly. If there is enabling from input but there is no request from the master it flashes slowly. If it is regulating it is on with a fixed light

- Snow icon: identifies the winter functioning (heat pump) It stays off in chiller functioning mode. The meaning can be exchanged with the winter icon via the *Icon* parameter
    - MASTER: Slow flashing if no regulation necessity, otherwise on with fixed light.
    - UNIT: If there is no enabling of the regulation from input it flashes quickly. If there is enabling from input but there is no request from the master it flashes slowly. If it is regulating it is on with a fixed light

- Fan icon: identifies the status of the compressor.
    - UNIT: If on the compressor is functioning, if flashing fast timing is in progress for a successive switch-on or off, otherwise it remains off.

- Salt water pump icon: identifies the status of the selected unit pump.
    - UNIT: If on the pump is functioning, if flashing fast it signals that timing is active.

- Alarm icon: Identifies the presence or not of alarms.
  If on, alarms are present in at least one of the units, otherwise it remains off. Flashing signals the presence of a new alarm not yet displayed. The icon flashes if there are alarms when the machine is off.

- Icon 1: When displaying the master it indicates the status of the salt water pump and of the unit compressor: if timing is in progress, before switch-on of the salt water pump it flashes slowly. If compressor timing is in progress it flashes quickly, if the compressor is running it remains on. When displaying the alarms it shows whether the unit is in alarm. When displaying the slave it flashes to indicate that the information linked to the first network unit is being displayed.

- Icon 2: When displaying the master it indicates the status of the salt water pump and of the unit compressor: if timing is in progress, before switch-on of the salt water pump it flashes slowly. If compressor timing is in progress it flashes quickly, if the compressor is running it remains on. When displaying the alarms it shows whether the unit is in alarm. When displaying the slave it flashes to indicate that the information linked to the second network unit is being displayed.

- Icon 3: When displaying the master it indicates the status of the salt water pump and of the unit compressor: if timing is in progress, before switch-on of the salt water pump it flashes slowly. If compressor timing is in progress it flashes quickly, if the compressor is running it remains on. When displaying the alarms it shows whether the unit is in alarm. When displaying the slave it flashes to indicate that the information linked to the third network unit is being displayed.

- Icon 4: When displaying the master it indicates the status of the salt water pump and of the unit compressor: if timing is in progress, before switch-on of the salt water pump it flashes slowly. If compressor timing is in progress it flashes quickly, if the compressor is running it remains on. When displaying the alarms it shows whether the unit is in alarm. When displaying the slave it flashes to indicate that the information linked to the fourth network unit is being displayed.

- Stand-by icon: associated to the ESC key, it identifies the status of the machine:
  Off: machine on
  On: machine off

- °C/°F icon: indicates the unit of measurement of the temperature displayed by the probes

3.2 List of the pages

This paragraph presents the main pages and the menus found in the application.

Main page

The main screen is different according whether the status of the machine is of or on:

- if the machine is off, the **OFF** wording is shown
- if the machine is on, the average of the fresh water input temperature values of the units connected to the master is displayed. If all of the units are disconnected, "**----**" appears. If all of the units are broken, "**Err**" appears.

From this page, using the UP and DOWN keys, access is given to the display of the other units and a flashing numeric al LED will indicate which unit is being displayed.
Moreover, using the ESC key from this page, it is possible to access the pages relative to the alarms, the events log and the functioning status (all information not protected by password).

Alarms menu

By pressing the ENTER key from **Alar** the code is displayed of the first active alarm or the word *none* if there are no alarms (see paragraph relative to the alarms for further information).

Events Log Menu

By pressing the ENTER key from **HiSt** the code is displayed of the last event saved or the word *none* if there are no events (see paragraph relative to the events log for further information).

Status Menu

If **MASt** is selected, enter the display of some main states of the master:

SEAS: seasonal functioning mode (**COLd, HEAT**)
StAt: indicates the status in which the machine is operating (**OFF**, **On**)
rEq: number of enabling steps
nUM: number of units available

Unit Menu

By pressing the ENTER key on **Unit**, the number of the remote unit on which the information is to be displayed is shown.
After the ENTER key on the node of interest has been pressed, the following items will be present

tIn: fresh water input temperature.
tOut: fresh water output temperature.
COnd: condensation gas input temperature
EvAp: evaporation gas output temperature
dIFF: fresh water input and output temperature difference
EnAb: request for regulation consent (**CLOS, OPEn**)
FLou: status of the flow switch (**CLOS, OPEn**)
HP: status of the high pressure switch (**CLOS, OPEn**)
LP: status of the low pressure switch (**CLOS, OPEn**)
StAt: indicates the status in which the machine is operating

- **WAIt:** Initial status of the unit in stand-by for switch-on of the master
- **ALAr:** Unit in alarm
- **OFF:** Unit disable by digital input
- **Stby:** Unit not ready to regulate
- **rEq:** Unit ready to regulate but in stand-by for enabling from master

- **On:** Unit that is regulating

PUMP: status of the salt water pump (**OFF**, **tOn**, **On**)
COMp: status of the compressor (**OFF**, **tOn**, **On**, **tOFF**)

The flashing numerical LED, within this menu, will remain on indicating the node that is being monitored.

Remote unit configuration menu

By pressing the ESC+ENTER key for 3 seconds, enter a configuration menu protected by password, which allows to display and configure the CAN addresses of the nodes and the functioning hours of the compressor.

Adrr: indicates the CAN address of the node
HCMp: indicates the compressor hours of the unit
bAUd: indicates the node baud

The flashing numerical LED, within this menu, will remain on indicating the node that is being monitored.

Password

There are also three levels present protected by password. user, installer and administrator.
A password is associated to a level, which allows access to the various functionalities present in that determined menu. Once the correct password has been entered, the protected functionalities will be accessible.
Every level password can be modified only from the third level (administrator).
The range of values that can be set of the password is-999 / 9999.
After 4 minutes that no key is pressed, the password expires and must be set again.
Pressing the ENTER key for 3 seconds, requests the introduction of a password: by entering a password correctly there are two effects:

- release the correlated level
- access to information the lower levels

Menu

The structure of the menus is the following:

- User menu (Level 1)
  - Display and modification of regulation set points
- Installer menu (Level 2)
  - Display and modification o the regulation parameters and alarm
- Administrator menu (Level 3)
  - Modifying the password
  - Changing the unit of measurement
  - Modbus serial configuration parameters

Project and firmware versions

Press UP+DOWN at the same time for about 2 seconds and successively press ENTER on the **InFo** label.
The information regarding the versions of the project and of the control firmware is displayed in sequence, precisely:

Project Number <-> Project Version<-> Project Revision
Firmware Number <-> Firmware Version<-> Firmware Revision

use the UP and DOWN keys to scroll the information. Press ESC to return to the application pages.

4 List of parameters

Below find the list of all parameters managed by the application. A brief description, the range of acceptable values, unit of measurement, the default value proposed and the menu in which it is found is supplied for every parameter. The menus are structured following this logic:

- LEV1: user menu
- LEV2 : installer menu
- LEV3 : administrator menu

4.1 List of the configuration parameters

Code	Parameter description	Default	Min	Max	U. M.	Menu	Notes
USER PARAMETERS							
SETC	Sets the value of the summer set point (chiller)	11.0	9.0	15.0	°C	LEV1	Note 1
SETH	Sets the value of the winter set point (heat pump)	40.0	35.0	47.0	°C	LEV1	Note 1
RESt	Rests events log	0	0	1		LEV1	
INSTALLER PARAMETERS							
BndC	Sets the value of the regulation band for the calculation of the enabling steps (chiller)	5.0	1.0	10.0	°C	LEV2	Note 1
BndH	Sets the value of the regulation band for the calculation of the enabling steps (heat pump)	5.0	1.0	10.0	°C	LEV2	Note 1
tI	Integral time for the calculation of the enabling steps	0	0	999	sec	LEV2	
diFC	Sets the value of the summer differential (chiller)	3.0	1.0	5.0	°C	LEV2	Note 1
diFH	Sets the value of the winter differential (heat pump)	3.0	1.0	5.0	°C	LEV2	Note 1
dEL	Heat drop delta	5.0	3.0	7.0	°C	LEV2	Note 1
MInC	Output temperature operational limit (chiller)	6.0	5.0	8.0	°C	LEV2	Note 1
MInH	Output temperature operational limit (heat pump)	46.0	45.0	48.0	°C	LEV2	Note 1
tOn	Minimum time for which the compressor must remain on even if switch-off is requested	0	0	240	sec	LEV2	
tOFF	Minimum time for which the compressor must remain off even if switch-on is requested	120	0	999	sec	LEV2	
nCMP	Maximum number of start-ups every hour	10	5	15		LEV2	
tLP	Compressor switch-on low pressure alarm delay	0	0	999	sec	LEV2	
nLP	Number of interventions/hour for low pressure alarm so that the alarm becomes manual	3	0	9		LEV2	
t1	Flow alarm delay from the activation of the regulation	30	0	t2	sec	LEV2	
t2	Salt water pump alarm delay from the activation of the regulation	60	t1	999	sec	LEV2	
t3	Compressor command delay from the activation of the salt water pump	15	0	999	sec	LEV2	
t4	Fresh water pump switch-off delay during unit change over or switch-off.	30	0	999	sec	LEV2	
t5	Activation delay between different compressors	10	0	999	sec	LEV2	

tFLo	Flow alarm delay during normal functioning	1	0	240	sec	LEV2	
tCoM	Communication alarm delay	10	1	99	sec	LEV2	
SET1	Summer condensation high temperature alarm set point (chiller)	100.0	80.0	115.0	°C	LEV2	Note 1
diF1	Summer condensation high temperature alarm differential (chiller)	5.0	1.0	15.0	°C	LEV2	Note 1
SET2	Summer evaporation low temperature alarm set point (chiller)	0.0	-15.0	5.0	°C	LEV2	Note 1
diF2	Summer evaporation low temperature alarm differential (chiller)	5.0	1.0	15.0	°C	LEV2	Note 1
SET3	Winter evaporation low temperature alarm set point (heat pump)	-9.0	-15.0	0.0	°C	LEV2	Note 1
diF3	Winter evaporation low temperature alarm differential (heat pump)	5.0	1.0	15.0	°C	LEV2	Note 1
SET4	Winter condensation high temperature alarm set point (heat pump)	115.0	90.0	120.0	°C	LEV2	Note 1
diF4	Winter condensation high temperature alarm differential (heat pump)	5.0	1.0	15.0	°C	LEV2	Note 1
dAL1	Delta 1 : temperature difference AI1 – AI2 that signals alarm (summer chiller)	9.0	0.0	20.0	°C	LEV2	Note 1
EAL1	Enable Delta 1 : temperature value below which the probe AI1 must be found	20.0	0.0	50.0	°C	LEV2	Note 1
dAL2	Delta 2 : temperature difference AI1 – AI2 that signals alarm (summer chiller)	-2.0	-10.0	0.0	°C	LEV2	Note 1
dAL3	Delta 3 : temperature difference AI2 – AI1 that signals alarm (winter heat pump)	11.0	0.0	20.0	°C	LEV2	Note 1
EAL3	Enable Delta 3 : temperature value above which the probe AI1 must be found	35.0	0.0	50.0	°C	LEV2	Note 1
dAL4	Delta 4 : temperature difference AI2 – SETH that signals alarm (winter heat pump)	2.0	0.0	20.0	°C	LEV2	Note 1
tAL4	Delta 4 alarm by-pass time	30	0	999	sec	LEV2	
nDeL	Number of interventions/hour of the Delta alarms so that the alarm becomes manual	1	0	9		LEV2	
tDeL	Activation delay time of the Delta alarms from compressor switch-on	10	0	999	sec	LEV2	
dSF	Minimum difference |AI1 – AI2| from compressor start-up that signals the ASF Phases Sequence alarm	0.8	0.0	2.0	°C	LEV2	Note 1
tSF	Phases Sequence alarm activation delay time from compressor start-up	100	0	999	sec	LEV2	
ADMINISTRATOR PARAMETERS							
nUM	Sets the number of slave units connected to the master	2	0	4		LEV3	
UdM	Sets the temperature unit of measurement: 0: °Celsius 1: °Fahrenheit	0 (°C)	0	1		LEV3	
Addr	Board Modbus Address	1	1	247		LEV3	
bAud	Baud Rate of the boar communication (1=2400, 2=4800, 3=9600, 4=19200)	3	1	4		LEV3	
Equal	ModBus Parity (0=none, 1=Odd, 2=Even)	2	0	2		LEV3	
StoP	StopBit ModBus (0=1bit, 1=2bit)	0	0	1		LEV3	
PDI1	Sets the digital input logic used for the flow switch: 0: Normally open NO	NO	NO (0)	NC (1)		LEV3	NC = flow OK

	1: Normally closed NC						
PDI2	Sets the digital input logic used for the change over: 0: Normally open NO 1: Normally closed NC	NO	NO (0)	NC (1)		LEV3	
PDI3	Sets the digital input logic used for the high pressure switch: 0: Normally open NO 1: Normally closed NC	NC	NO (0)	NC (1)		LEV3	
PDI4	Sets the digital input logic used for the low pressure switch: 0: Normally open NO 1: Normally closed NC	NC	NO (0)	NC (1)		LEV3	
PDI5	Sets the digital input logic used for regulation consent: 0: Normally open NO 1: Normally closed NC	NO	NO (0)	NC (1)		LEV3	
Icon	Sets the direction of the Sun and Snow icons 0: Sun = Cooling (Chiller mode) Snow = Heating (Heat Pump mode) 1: Sun = Heating (Heat Pump mode) Snow = Cooling (Chiller mode)	0	0	1		LEV3	
PSd1	Modifies the password at User level	1	-999	9999		LEV3	
PSd2	Modifies the password at Installer level	2	-999	9999		LEV3	
PSd3	Modifies the password at Administrator level	3	-999	9999		LEV3	
CAn	CAN communication Baud Rate (1=20K, 2=50K, 3=125K, 4=500K)	1	1	4		LEV3	

Note 1: The limits refer to the unit of measurement °C. In the event of °F they are changed consequently. The defaults are modified manually.

Note 2: Up to 9999 hours the values are displayed with the decimal point i.e. with the resolution of the hour and then the resolution of tens of hours

5 CONFIGURATIONS

5.1 Setting number of the slaves

To set the number of the slaves that will be connected to the master, hold the ENTER key for about 2 seconds and then access the main menu. Enter the administrator menu and modify the **nUM** parameter.

5.2 Setting addresses of the slaves

Procedure for setting the slave addresses (they leave the factory with the same configuration and address equal to 1):

- Power master
- Connect only one slave unit at a time tot he master and power it
- Press ENTER+ESC for 3 seconds
- Select the node to be configured (it will always be node 1)
- Select “Addr” from the node menu
- Introduce the protection password
- Sets the address of the unit as the most available address (address 4 if there are 4 units and none yet configured, address 3 if there are 3 units and none yet configured, address 2 if there are 4 units and two units already configured)
- Repeat the operation for every slave unit excluding the first, which will maintain its own default address at 1.

5.3 Setting baudrates of the slaves

Procedure for setting the baudRate (they leave the factory with the same configuration and equal to 20K):

- Power master and slave and configure the addresses (see previous paragraph)
- Press ENTER+ESC for 3 seconds
- Select the node to be configured
- Select “bAud” from the node menu
- Introduce the protection password
- Set the unit baud (20K, 50K, 125K, 500K) and remove it from the CAN network
- Repeat the operation for every slave unit.
- Once the operation has ended for the slave units, enter the master administrator parameters and select the (**Can**) parameter to set the master baud
- Re-connect all units to the network

6 REGULATIONS

6.1 Machine status

Procedure doe switch-on/off of the unit using the relative **On/Off key:**

Switch-on - press the relative key for about 2 seconds: the machine goes to "ON" and displays the average temperature of the input fresh water of the connected units.

Switch-off - press the relative key for about 2 seconds: the machine goes to "OFF".

The machine On/Off key is the ESC key.
During the ON state, the consent input of every unit enables them for regulation.

The slave units cannot function without any master, therefore the switch-on/off of the master also causes the switch-on/off of the slaves. (The units connected will be switched-off in a delayed sequence in order to prevent the simultaneous closure of all compressors that are on at that time)

6.2 Controlling the functioning mode

The operational mode can assume the following values:

"SEAS" status	*Operational mode*	*Description*
Off=0=COLd	***Chiller***	***Summer functioning mode***
On=1=HEAt	***Heat Pump***	***Winter functioning mode***

To modify the unit functioning mode, act using the **Change over** command from digital input DI2 (coming from the manual selector switch of the master on the electric control board). The units do not have this digital input, the information regarding the functioning mode is communicated by the master via CAN.

Setting: With closed contact the unit is in "winter" functioning mode, with open contact it is in "summer" mode.

During winter functioning mode (Heat Pump) the DO6 cycle reverse valve is activated on the unit.

Warning - The variation of the operational mode can also take place with the machine on: in this case, the machine switches off respecting its timing and therefore changes over and switches back on again automatically.

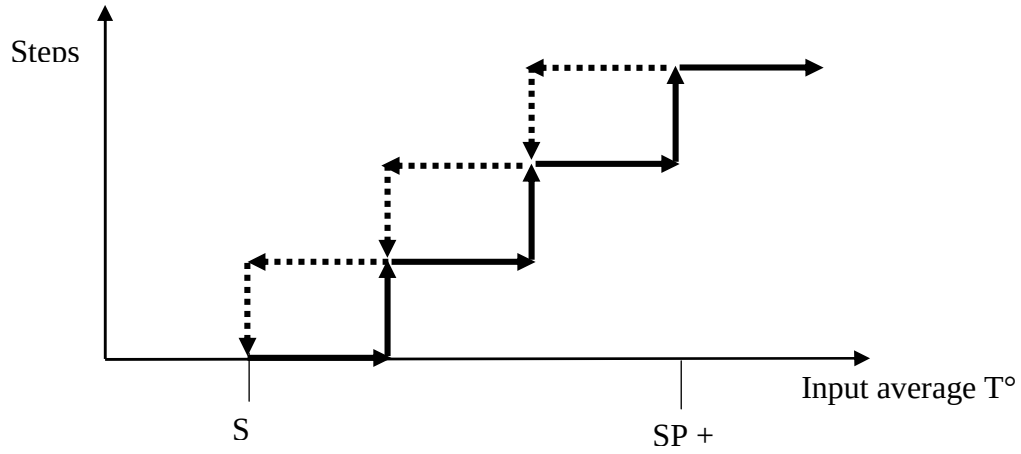
6.3 Set Point

The Set Point is set on the master and then sent to all slave units connected to the network.
This set point is updated systematically in the slaves and saved as parameter. In this way, also after any blackout or during network breakdown persistent data is guaranteed for regulation of the unit.
This set point is the same for the calculation of the steps (based on the average temperature of the input fresh water) and for the regulation of the compressor (based on the output fresh water) in the regulation of the SET compressor is "adjusted" thanks to the delta heat drop (dEL parameter) to balance the temperature difference of the input and output water.

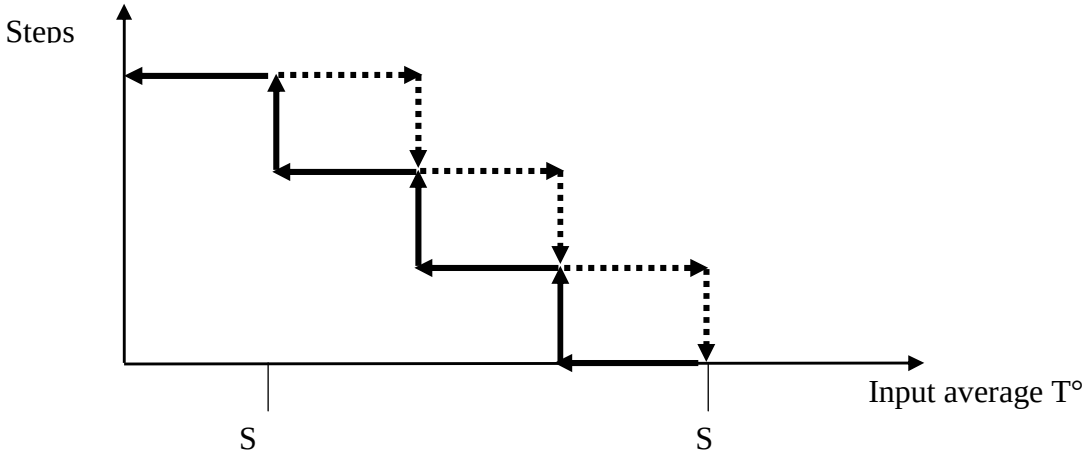
6.4 Calculating steps

The master acquires the fresh water input temperature of the slave units and calculate the enabling steps on the basis of the average input temperature and the **BAnd** regulation band.
The regulation band is divided into the same amount of steps as the slave units connected to the master, in this way the master decides how many chillers to activate.

In the case of summer functioning (chiller)



In the case of winter functioning (heat pump)

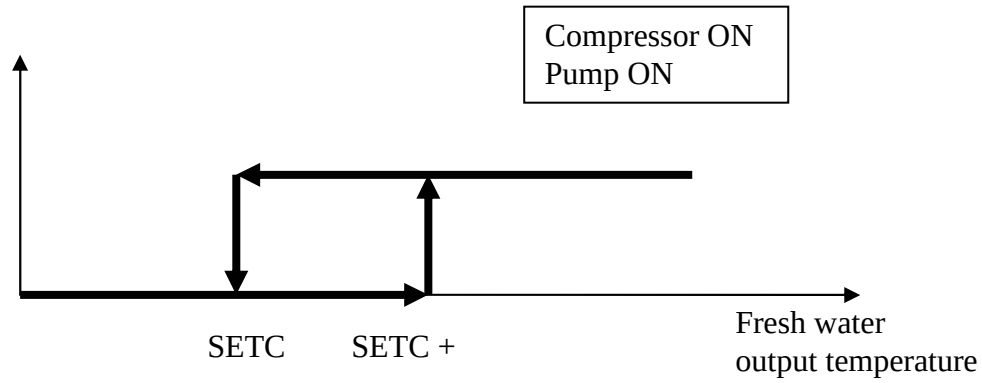


6.5 Enabling for regulation

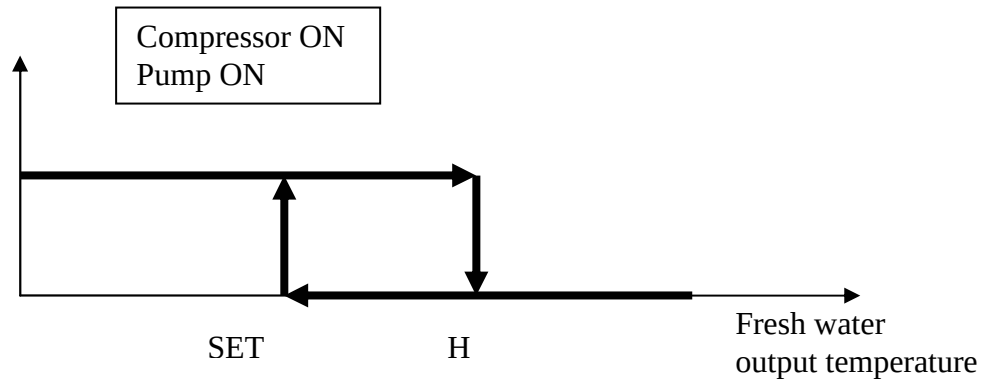
As well as deciding how many slave units to activate (enabling steps) the master also selects also which to enable for regulation from those in stand-by.
First selected are the units in conditions to regulate and whose fresh water output temperature is more offset from the set point. A control is also performed, meaning that a compressor that has exceeded the maximum number of start-up allowed every hour (nCMP parameter) cannot be enabled.

6.6 Regulation of the compressor

With consent from the master, the compressor switch-on command takes place on the basis of the AI2 output fresh water temperature.
The following figure shows the behaviour of the regulation in the case of summed functioning (chiller). On the basis of the output temperature value, the regulation request s the switch-on of the compressor. In this regulation, the band is moved totally above the set-point.



However, in winter functioning mode (heat pump), the band is moved totally below the set point.



6.6.1 Status of the compressors

The compressor has a functioning status associated visible via the relative LED or in the main menu status mask. The compressor assumes the following states:

- *On*: **"On"** appears on the status mask
- *Switch-on stand-by*: the compressor is in stand-by due to the switch-on protection times. **"tOn"** appears on the status mask
- *Off*: **"OFF"** appears on the status mask
- *Switch-off stand-by*: the compressor is in stand-by due to the switch-off protection times. **"tOFF"** appears on the status mask

6.6.2 Protection times

Below find a list of all times relative to management of the compressors
These times are used to protect the mechanical means from the various peaks to which they are subjected.

tOn = Compressors minimum switch-on time. Once activated, the compressor will remain on for this time before being able to be switched-off.

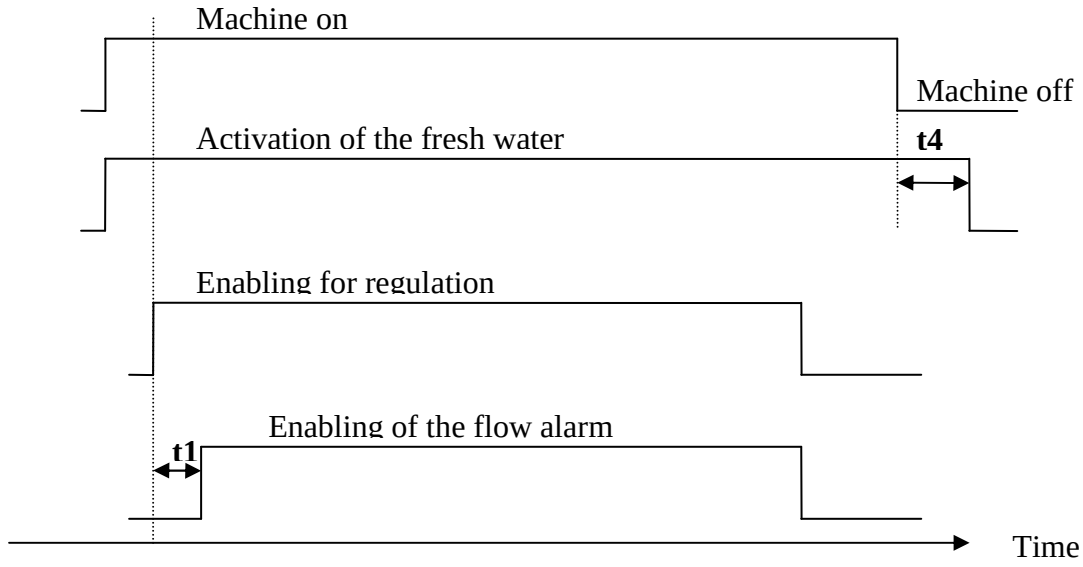
tOFF = Compressors minimum switch-off time. Minimum time that must pass from the last switch-off before the compressor can be switched-on again.

nCMP = Maximum number of compressor switch-ons in an hour. Establishes a maximum number of switch-ons during one hour: if this limit is reached, the regulator will wait for the conditions to be present before switching the compressor on again.

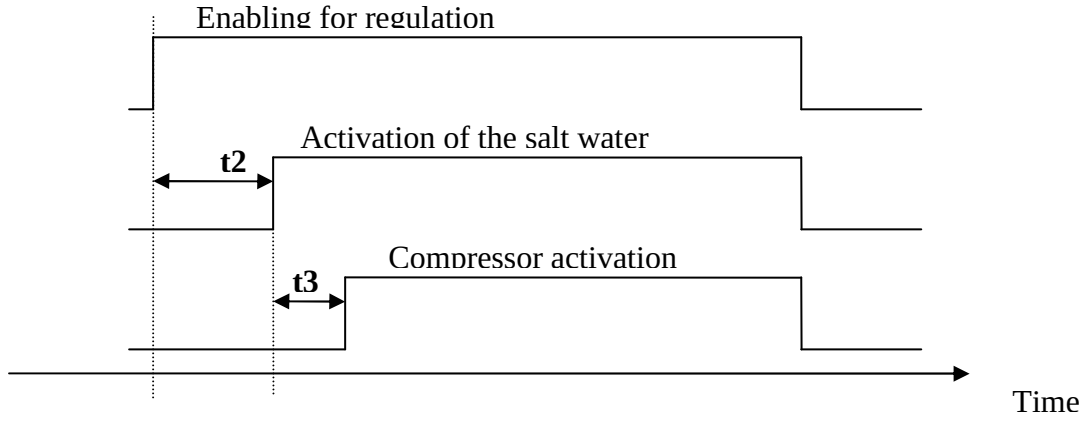
t5 =Activation delay between different compressors. Minimum time between the activation of the compressor of a unit after the last activation of a compressor of another unit.

6.7 Management of fresh water and salt water

The fresh water pump is switched-on when the machine is switched-on and remain on always during all functioning. Only for machine switch-off or for the change-over it is switched-off with a delay **t4**. The flow input determines the correct circulation of the fresh water in the circuit, stopping the machine the absence of flow is detected. From the enabling of the regulation a time of **t1** before checking the flow input.
The following diagram illustrates the switch-ob logic of the fresh water pump and the relative flow control:



From enabling to regulation, a time **t2** > **t1** must be waited before switching the slat water pump on. The compressor can only be switched on after time **t3** from the switch-on of the salt water pump. The following diagram illustrates the switch-on logic of the salt water pump and of the compressor:



During normal functioning, if the absence of flow is detected for a time **tFLO,** the alarm is activated that stops the pumps and the compressor.

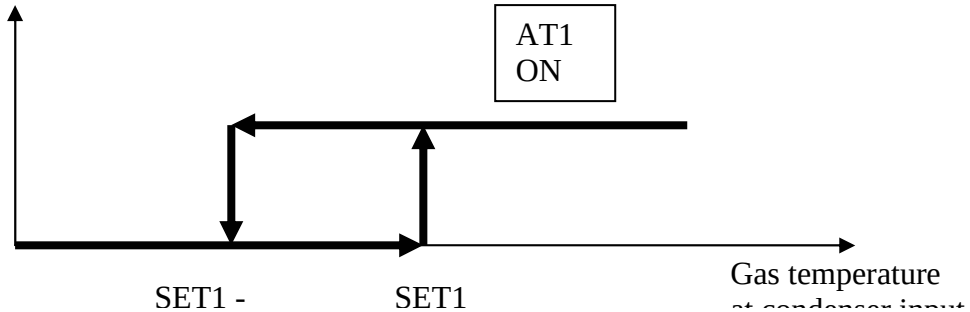
Compressor switch-off for example, because the local temperature regulation requests, switches the salt water pump off.

6.8 Condenser and evaporator alarms

The following controls check the temperature of the gas in the condensation and evaporation heat exchangers and detect the alarm conditions, which determine compressor block.
The alarms are active also with the compressor off.

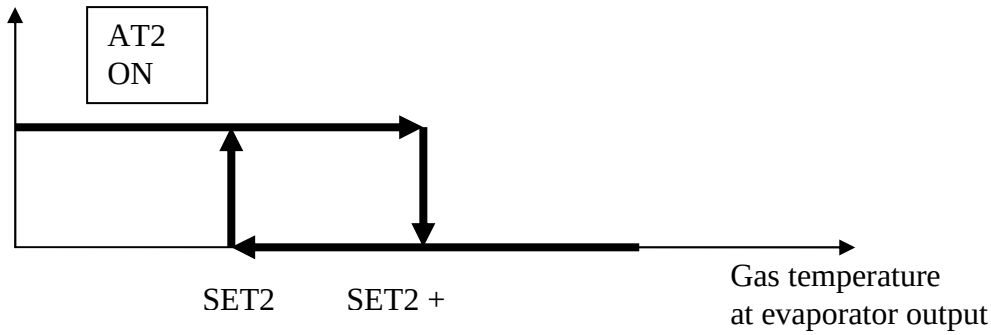
6.8.1 Summer condensation high temperature alarm

The following figure shows the behaviour on the condenser in the case of summed functioning (chiller). On the basis of the input gas temperature at the AI3 condenser, the alarm is activated above the set-point and deactivated after a differential below the set-point.



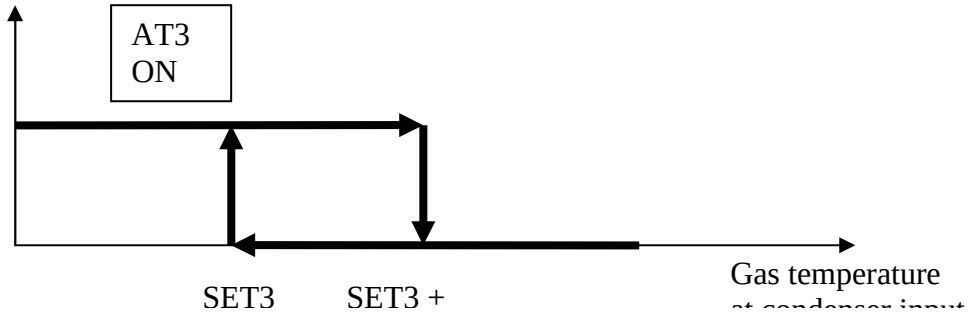
6.8.2 Summer evaporation low temperature alarm

The following figure shows the behaviour on the evaporator in the case of summed functioning (chiller). On the basis of the output gas temperature at the AI4 condenser, the alarm is activated below the set-point and deactivated after a differential over the set-point.



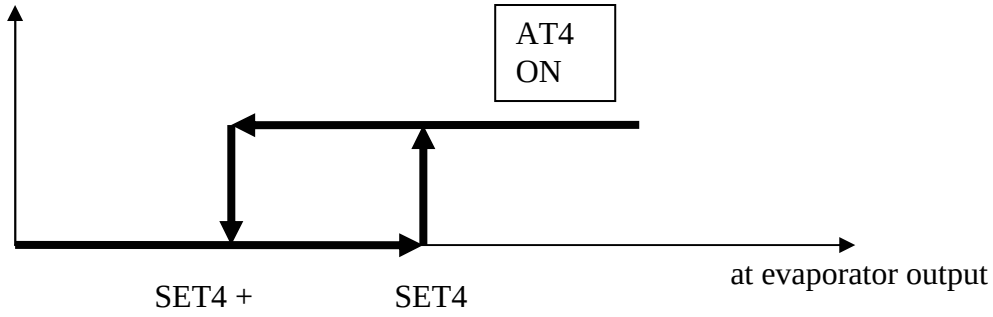
6.8.3 Winter condensation low temperature alarm

The following figure shows the behaviour on the condenser in the case of winter functioning (heat pump). On the basis of the input gas temperature at the AI3 condenser, the alarm is activated below the set-point and deactivated after a differential over the set-point.



6.8.4 Winter evaporation high temperature alarm

The following figure shows the behaviour on the evaporator in the case of winter functioning (heat pump). On the basis of the output gas temperature at the AI4 condenser, the alarm is activated over the set-point and deactivated after a differential below the set-point.



6.9 Pressure alarms

The program can control the refrigerant circuit pressure and signal the occurrence of high and low pressure alarms.

6.9.1 High pressure alarm

The alarm is diagnosed by the reading of the high pressure switch DI3 when the contact opens (normally closed).
This alarm has manual reset.
The alarm is always active also with the compressor off.

6.9.2 Low pressure alarm

The alarm is diagnosed by the reading of the low pressure switch DI4 when the contact closes (normally open).
This alarm is reset automatically for the first 3 (parameter) interventions in the hour, after it becomes manual.
The alarm is delayed for a period (parameter) from compressor switch-on.

6.10 DELTA alarms

These alarms allow to check the correct machine functioning, monitoring the respect of several temperature values with the compressor on. The alarm condition is delayed on start-up of the compressor by a time (tDEL parameter, default 10sec).

6.10.1 DELTA 1 alarm (summer functioning mode only)

The alarm is active in the following conditions:

- If the difference between the fresh water input temperature AI1 and the output temperature AI2 is greater than a value (dAL1 parameter)
- If the fresh water input temperature is lower than that set (EAL1 parameter)

The alarm deactivates if the difference drops back by a differential of 2 degrees.

6.10.2 DELTA 2 alarm (summer functioning mode only)

The alarm is active in the following conditions:

- If the difference between the fresh water input temperature AI1 and the output temperature AI2 is lower than a value (dAL2 parameter)

The alarm deactivates if the difference drops back by a differential of 2 degrees.

6.10.3 DELTA 3 alarm (winter functioning mode only)

The alarm is active in the following conditions:

- If the difference between the fresh water output temperature AI2 and the input temperature AI1 is greater than a value (dAL3 parameter)
- If the fresh water input temperature is higher than that a set (EAL3 parameter)

The alarm deactivates if the difference drops back by a differential of 2 degrees.

6.10.4 DELTA 4 alarm (winter functioning mode only)

The alarm is active in the following conditions:

- If the difference between the fresh water input temperature AI1 and that of the SETH set-point is greater than a value (dAL4 parameter)
- If this difference remains higher for a time (parameter tAL4)

The alarm deactivates if the difference drops back by a differential of 2 degrees.

6.11 Phase sequence alarm

To check the correct connection of the compressor motor phases, the fresh water temperature variation between input and output is measured after a time sufficient to appreciate offset (tSF parameter, default 100sec). The formula of the offset is:

$$|AI1 - AI2| < \Delta Tmin$$

where ΔTmin can be set via parameter dSF.
The alarm intervention (with manual restore) switches the compressor and the salt water pump off.

7 DIAGNOSTICS

The application can manage a series of alarm relative to compressors, fans, circuits and system functionality. On the basis of the various types of alarm a reset can be configured (if manual or automatic), any signal delay and the actions to be performed in the specific case.
The display alarm icon flashes when one or more alarms are active.
In order to display the various alarms, use ESC to display the "Alar" menu from the main page and then press ENTER. If ESC is pressed from an alarm page or 60seconds of timeout are waited, go back to the main application page.
To scroll the various active alarms, press the ENTER key again: the alarms are presented in priority order, as they are listed in the table of alarms in the following paragraph.

7.1 Manual and automatic alarms

There are two types of alarm, those with manual reset and those with automatic reset. Some of these can have automatic reset, but become manual if they occur a certain number of times in the hour.

7.1.1 Alarms with automatic reset

If there is an alarm with automatic reset:

- The alarm icon starts to flash

By pressing the ENTER key from the "Alar" menu, the code of the first active alarm is displayed.
Once the conditions for which the alarm has occurred reset the reset and the deletion of the alarm message has been are reset automatically without user intervention.
The consequences that derive from an active automatic alarm remain valid until to the causes that have tripped the alarm are reset.

7.1.2 Alarms with manual reset

If there is an alarm with manual reset:

- The alarm icon starts to flash

By pressing the ENTER key from the "Alar" menu, the code of the first active alarm is displayed.
Once the conditions for which the alarm has occurred have been restored, it is possible to rearm the alarm manually.
To reset manually:

- Position on the page of the alarm to be restored
- Hold the enter key down for about 2 seconds.

At this point, if there are no other alarms, the page indicating "none" will be presented, the alarm icon will switch-off and the machine will go back to normal functioning or the code relative to the successive active alarm will be displayed.
The consequences that derive from a manual alarm remain valid until the user deletes the alarm message.

7.2 Alarms Table

Below is a list of all alarms managed by the application. The order of presentation is the same as the order with which the alarms are displayed when active. The alarms code as the number of the unit where the alarm is occurring as the last number (in the table indicated by ***n***)

Code	Alarm description	Type	Consequence	Notes
COMn	Communication error with the unit n	Auto	Compressor OFF Salt water pump OFF Fresh water pump OFF*	Delayed Always active
ES1n	Fresh water input temp. probe broken or disconnected error	Manu	Compressor OFF Salt water pump OFF	Instant Always active
ES2n	Fresh water output temp. probe broken or disconnected error	Manu	Compressor OFF Salt water pump OFF Fresh water pump OFF*	Instant Always active
ES3n	Condenser gas input temp. probe broken or disconnected error	Manu	Compressor OFF Salt water pump OFF	Instant Always active
ES4n	Evaporator gas output temp. probe broken or disconnected error	Manu	Compressor OFF Salt water pump OFF	Instant Always active
AHPn	High pressure alarm	Manu	Compressor OFF Salt water pump OFF	Instant Always active
ALPn	Low pressure alarm	Auto/Manu	Compressor OFF Salt water pump OFF	Compressor start-up delay. Always active
AFLn	Flow switch alarm	Manu	Compressor OFF Salt water pump OFF Fresh water pump OFF*	Delayed at start-up Only with pump on
AT1n	Condenser high temperature alarm	Manu	Compressor OFF Salt water pump OFF	Instant In summer only
AT2n	Evaporator low temperature alarm	Manu	Compressor OFF Salt water pump OFF	Instant In summer only
AT3n	Condenser low temperature alarm	Manu	Compressor OFF Salt water pump OFF	Instant In winter only
AT4n	Evaporator high temperature alarm	Manu	Compressor OFF Salt water pump OFF	Instant In winter only

AL1n	DELTA 1 alarm	Auto /Manu	Compressor OFF Salt water pump OFF	Compressor start-up delay. In summer only
AL2n	DELTA 2 alarm	Auto /Manu	Compressor OFF Salt water pump OFF	Compressor start-up delay. In summer only
AL3n	DELTA 3 alarm	Auto /Manu	Compressor OFF Salt water pump OFF	Compressor start-up delay. In winter only
AL4n	DELTA 4 alarm	Auto /Manu	Compressor OFF Salt water pump OFF	Compressor start-up delay. In winter only
ASFn	Phase sequence alarm	Manu	Compressor OFF Salt water pump OFF	Instant Always active

Notes: Auto/Manu = Auto or Manual alarm (can be set by number interventions/hour)
* If all units are in error mode.

7.3 Alarm relay

The program has the possibility of managing alarm cumulative relay.

8 List of Modbus variables

To be realised on Customer request

Application manual C-PRO NANO AND MICRO NAV
Version 1.6 of September 2010
Code 144NAV0NUE16.

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