c-pro 3 HPRU

Programmable controllers for managing variable capacity heat pumps

ENGLISH

USER MANUAL ver. 3.0

CODE 144CP3HPI304

Important

Important

Read this document carefully before installation and before using the device and take all the prescribed precautions. Keep this document with the device for future consultation.

The following symbols are used in this document:

- indicates a suggestion
- ⚠ indicates a warning.

The device must be disposed of according to local regulations governing the collection of electrical and electronic waste.

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1 GENERAL INFORMATION

1.1 Description

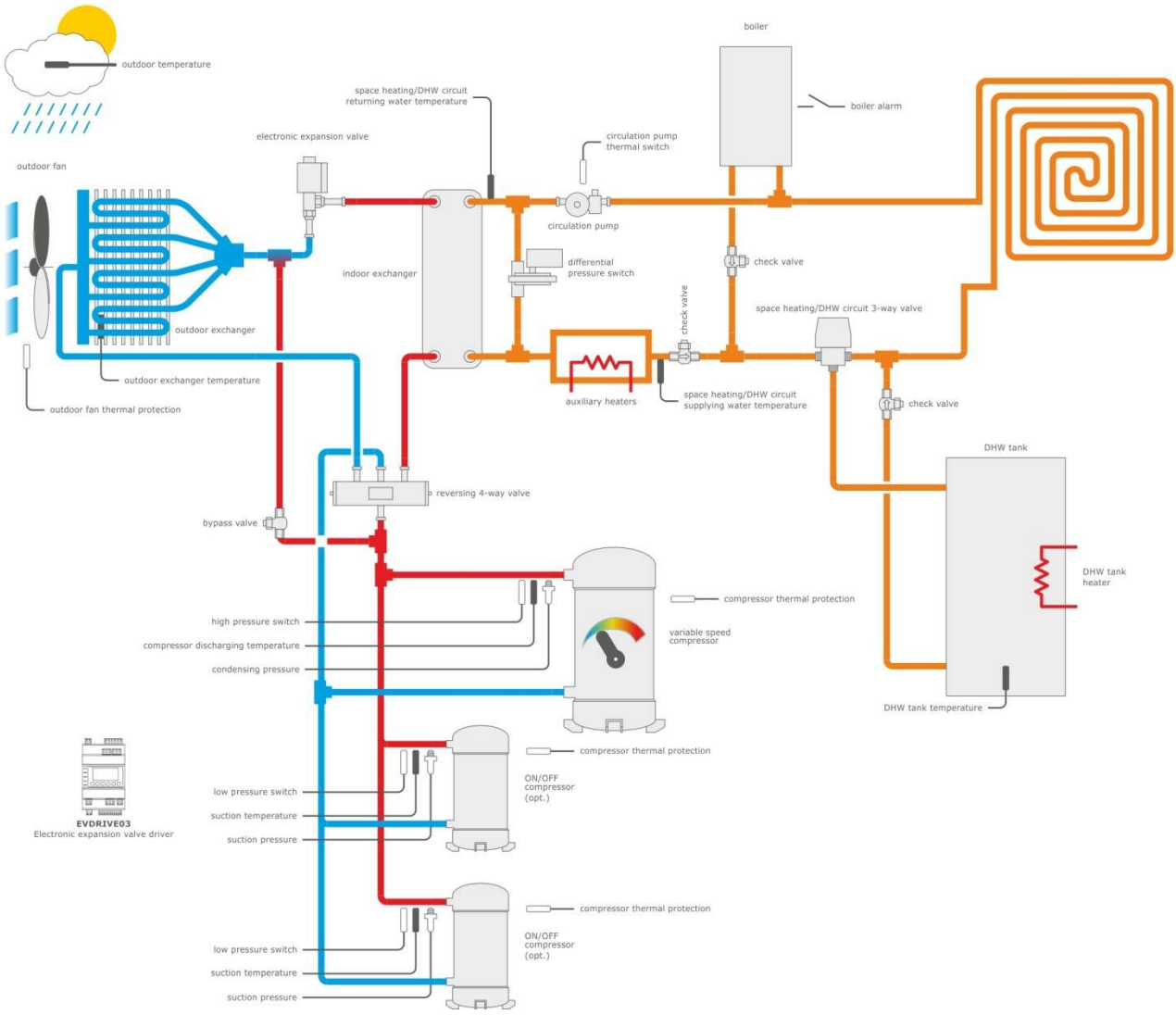
c-pro 3 *HPRU* is a line of programmable controllers for managing reversible heat pumps with variable capacity compressor and with electronic expansion valve.

The controllers can manage the most common plants of residential heat pumps and integrate management of the electronic expansion valve to maximise the system's efficiency.

The user interfaces can easily be integrated both into residential and business environments. You can put the EVCO plaques or plaques belonging to the "Living" and "Light" BTicino lines on the front.

The use of the communication ports makes it possible to connect the controllers to the Parameters Management set-up software system and to the CloudEvolution web-based plant monitoring and supervision system and to perform upload and download of the configuration parameters with a common USB device.

1.2 Principle Diagram

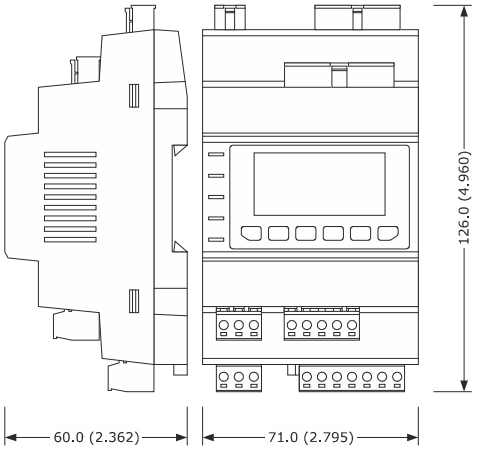


1.3 MEASUREMENTS AND INSTALLATION

1.3.1 Measurements

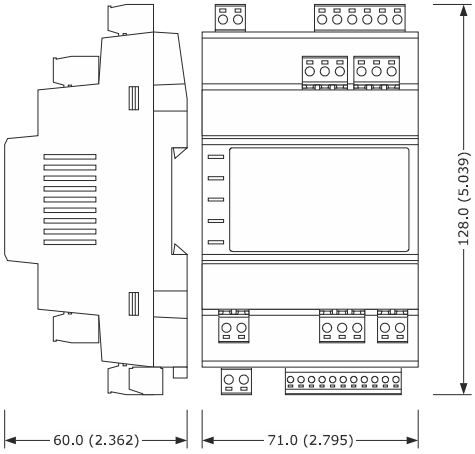
1.3.1.1 c-pro 3 micro+ HPRU module measurements

4 DIN modules; measurements are expressed in mm (inches).



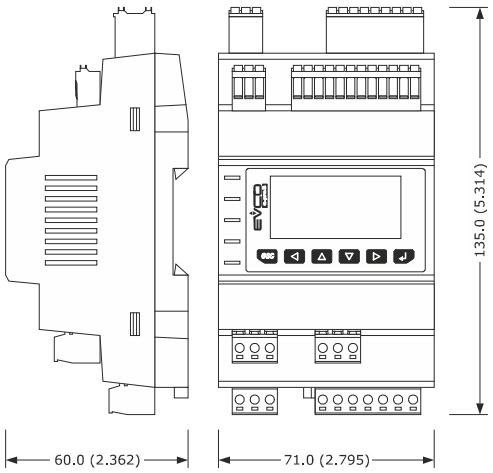
1.3.1.2 EVDRIVE03 module measurements

4 DIN modules; measurements are expressed in mm (inches).



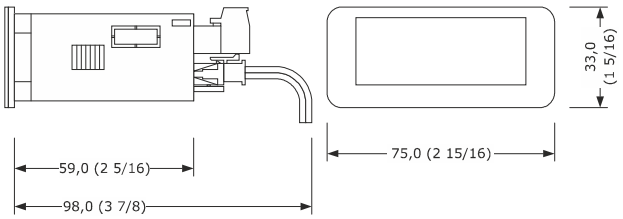
1.3.1.3 KiloEEV module measurements

4 DIN modules; measurements are expressed in mm (inches).



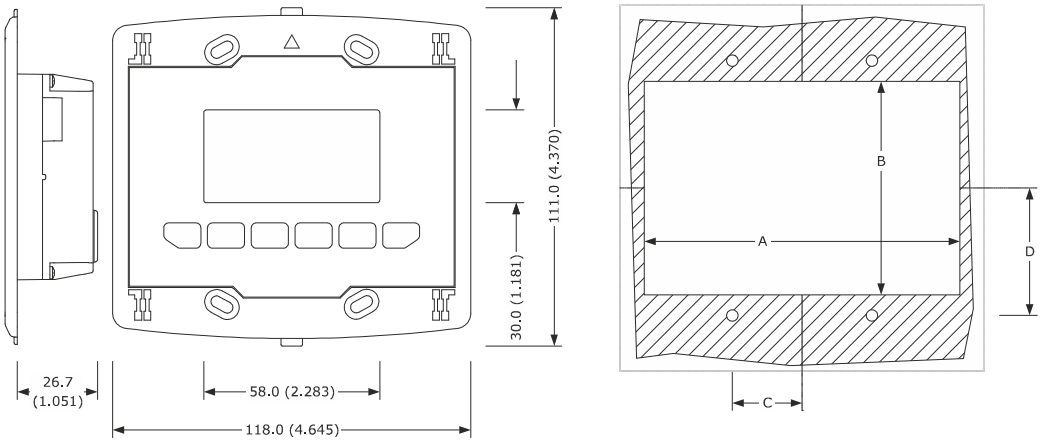
1.3.1.4 nano+ module measurements

Measurements are expressed in mm (inches).



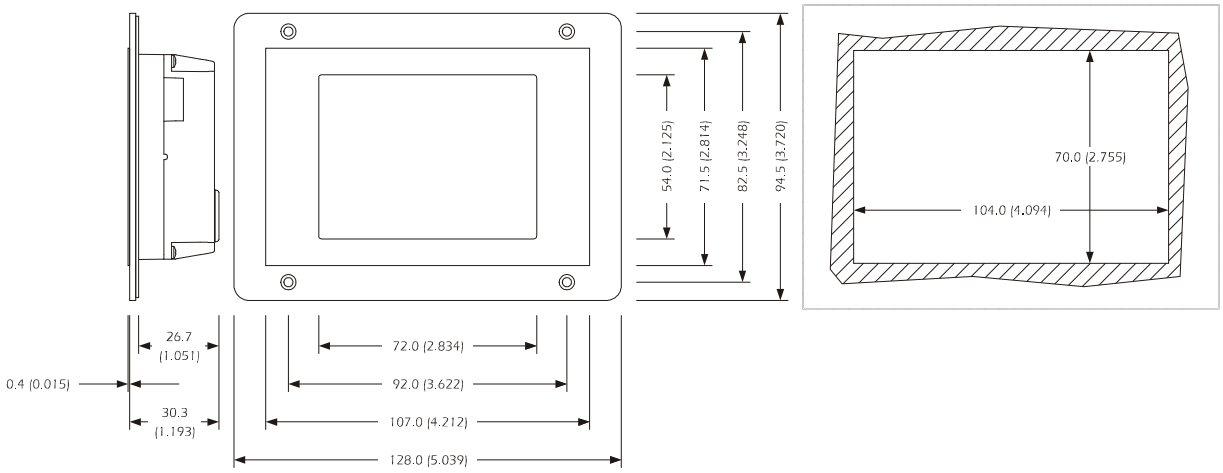
1.3.1.5 Vgraph user interface measurements

Measurements are expressed in mm (inches).



Measurements	Minimum	Typical	Maximum
A	104.0 (4.094)	104.0 (4.094)	104.8 (4.125)
B	70.0 (2.755)	70.0 (2.755)	70.8 (2.787)
C	22.0 (0.866)	23.0 (0.905)	24.0 (0.944)
D	40.8 (1.606)	41.8 (1.645)	42.8 (1.685)

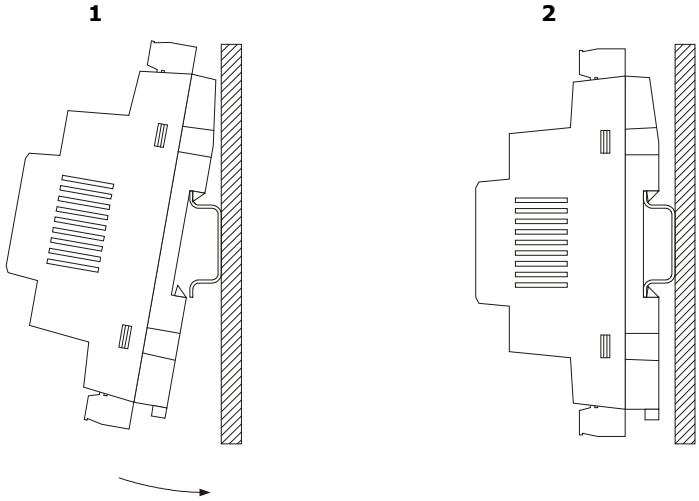
1.3.1.6 Vcolor user interface measurements



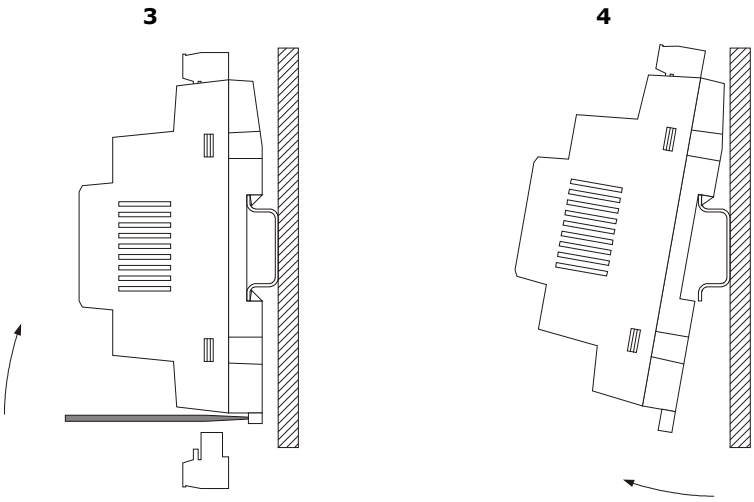
1.3.2 Installation

1.3.2.1 c-pro 3 micro+ control module, KiloEEV, and EVDRIVE03 Installation

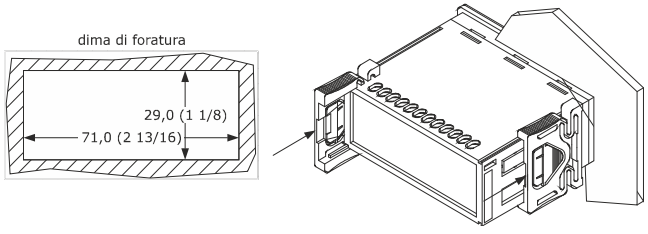
On a DIN rail 35.0 x 7.5mm (1.377 x 0.295 in) or 35.0 x 15.0mm (1.377 x 0.590 in).
The pictures below show how to install the devices.



To remove the devices, first remove any plug-in screw terminal blocks fitted in the lower part, then, using a screwdriver, loosen the DIN rail clip, as shown in the pictures below.



1.3.2.2 c-pro 3 nano+ control module installation

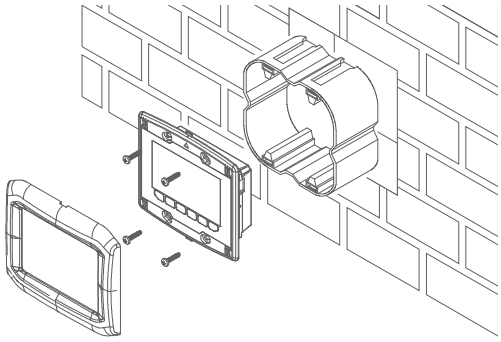


1.3.2.3 Vgraph and Vcolor user interface installation

Types of installation:

- panel-mounted
- built into the wall, in conventional box (type 506 E)
- wall-mounted, on Evco CPVW00 surface (to be ordered separately).

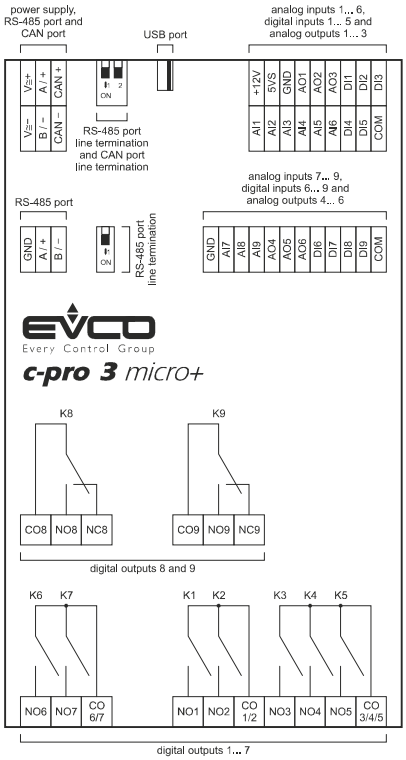
The following design illustrates panel mounting with four screws (provided).



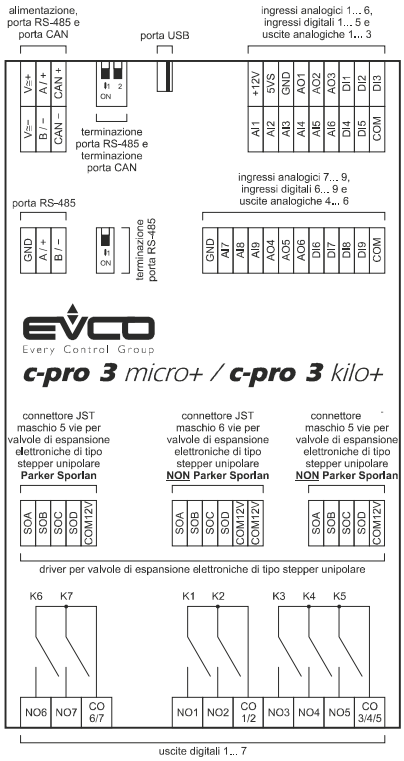
You can put EVCO CPVP* plaques on the front of the terminal (to be ordered separately, in plastic and available in two different colours, black and white).

2 Electrical connections

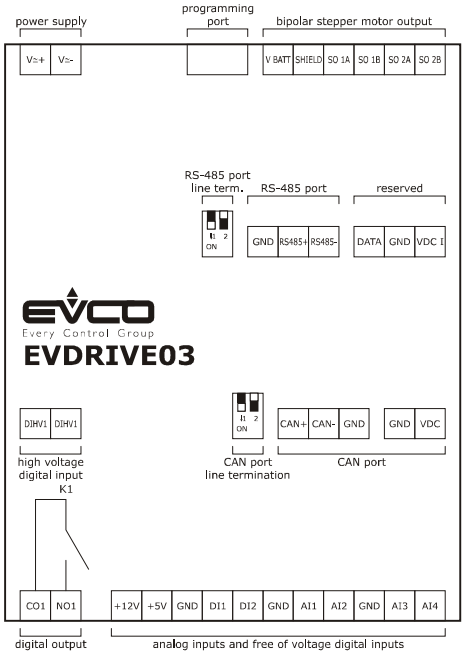
2.1 c-pro 3 micro+



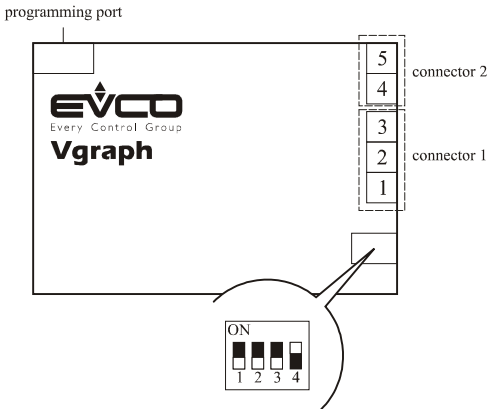
Models with driver for built-in unipolar stepper electronic expansion valves



2.2 EVDRIVE03



2.3 Vgraph



Flip micro switch 4 to the ON position to insert the termination of the CAN port; micro switches 1, 2, and 3 are unused. The tables below describe the connectors.

Connector 1: CAN port.

Terminal	Description
1	ground
2	+ signal
3	- signal

Connector 2: power supply (24 VAC or 20 ... 40 VDC not insulated or 12-24 VAC or 15 ... 40 VDC insulated, according to the model).

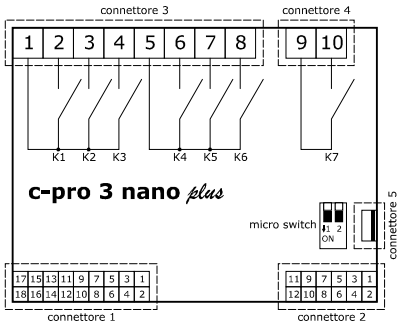
Terminal	Description
4	power supply
5	power supply

⚠ The maximum length of the connection cables of the power supply is 10 m (32.8 ft).

2.4 c-pro 3 nano+

2.4.1 Connectors

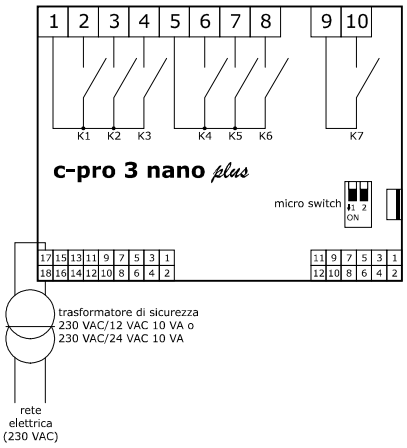
The picture below shows the c-pro 3 nano plus connectors.



The tables below describe the connectors.

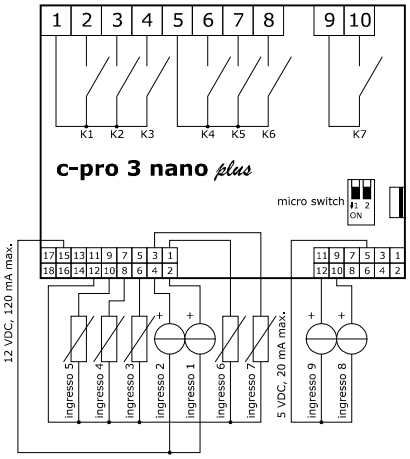
2.4.2 Connection to the power supply

The picture below shows the c-pro 3 nano plus connection to the power supply.



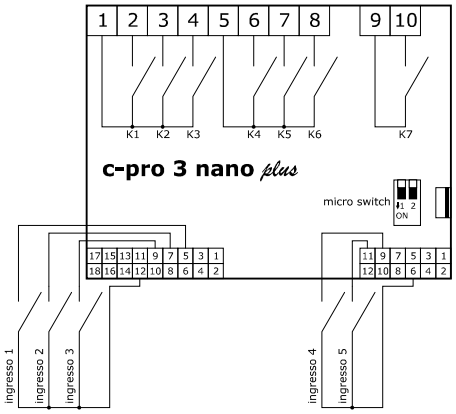
2.4.3 Analogue input connection

The picture below shows an example of c-pro 3 nano plus analogue input connection.



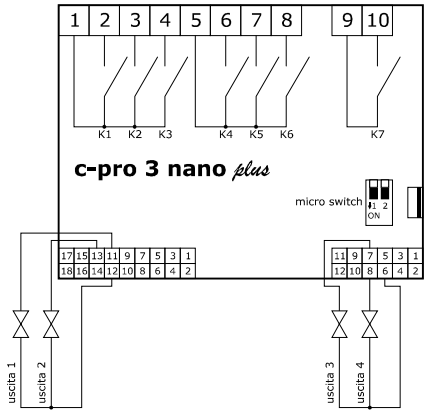
2.4.4 Digital input connection

The picture below shows the c-pro 3 nano plus digital input connection.



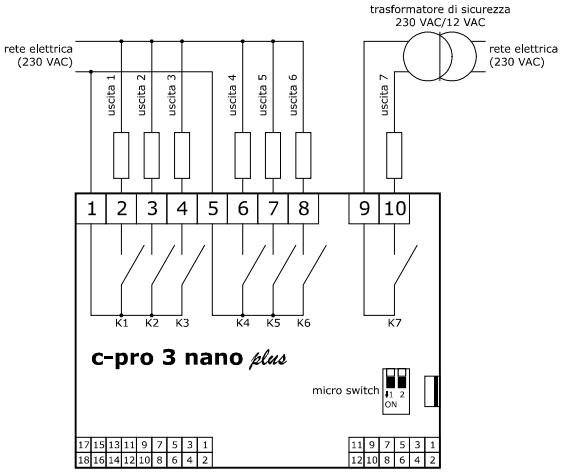
2.4.5 Analogue output connection

The picture below shows the c-pro 3 nano plus analogue output connection.



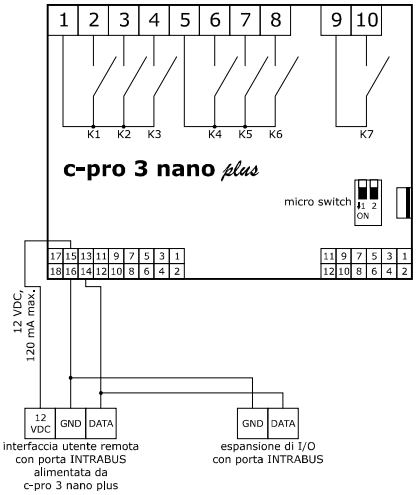
2.4.6 Digital output connection

The picture below shows an example of c-pro 3 nano plus digital output connection.



2.4.7 INTRABUS port connection

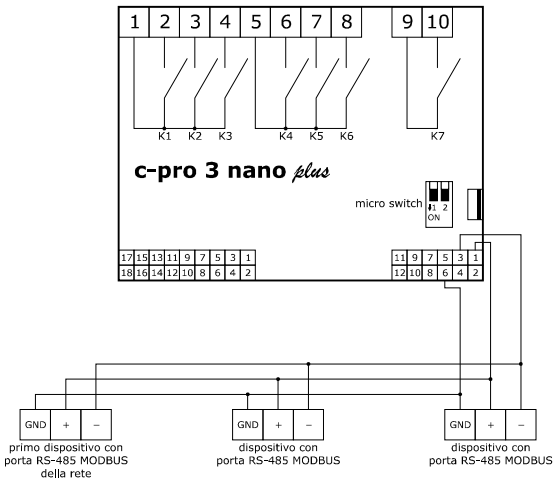
The picture below shows an example of c-pro 3 nano plus INTRABUS port connection.



The maximum configuration of the INTRABUS network permits 1 programmable controller and 1 remote user interface.

2.4.8 RS-485 MODBUS port connection

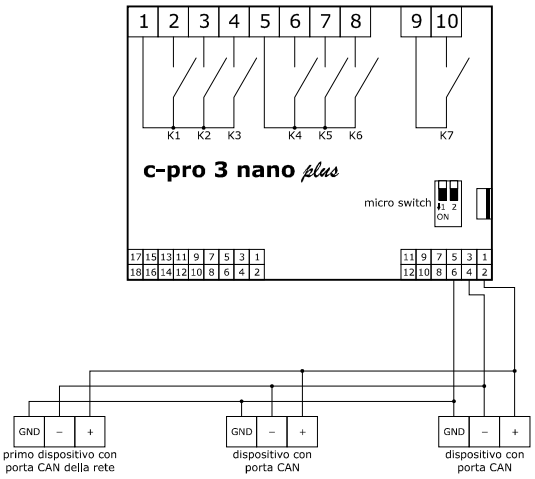
The picture below shows an example of c-pro 3 nano plus RS-485 MODBUS port connection.



In the example, the c-pro 3 nano plus is the last device on the network with an RS-485 MODBUS port.

2.4.9 CAN port connection

The picture below shows an example of c-pro 3 nano plus CAN port connection.

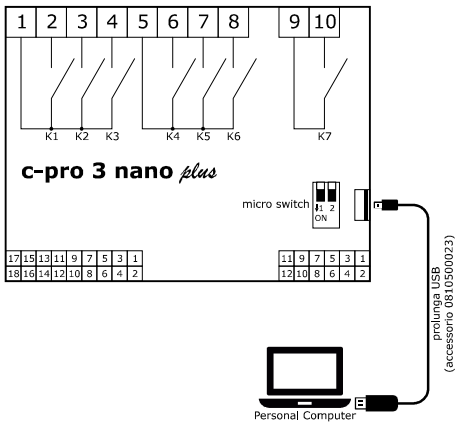


The maximum CAN network configuration includes:

- 1 programmable controller
- 1 driver for EEV (EVDRIVE03)
- 1 remote user interface

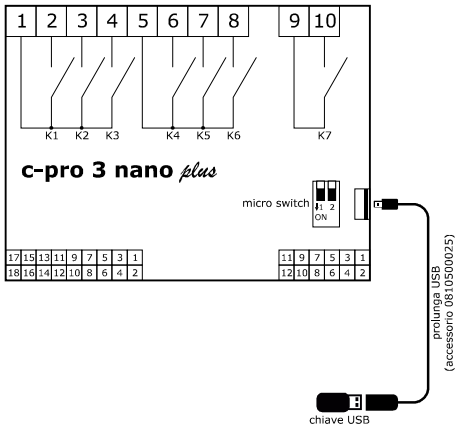
2.4.10 USB port connection to a personal computer

The picture below shows the c-pro 3 nano plus USB port connection to a personal computer.



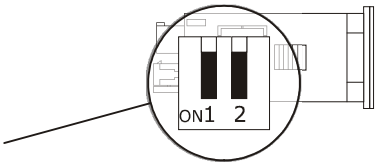
2.4.11 USB flash drive connection

The picture below shows a USB flash drive connection to the c-pro 3 nano plus.



2.4.12 Fitting the termination resistor for the RS-485 MODBUS and CAN networks

To reduce any reflections on the signal transmitted along the cables connecting the devices to a RS-485 MODBUS network and/or a CAN network it is necessary to fit a termination resistor to the first and last device in the network.
The picture below shows the left side of the devices.



To fit the RS-485 MODBUS network termination resistor, place micro-switch 1 in position ON. To fit the CAN network termination resistor, place micro-switch 2 in position ON.

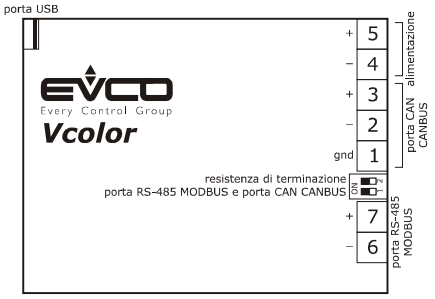
2.4.13

PRECAUTIONS FOR ELECTRICAL CONNECTION
- if using an electrical or pneumatic screwdriver, adjust the tightening torque
- if the device has been moved from a cold to a warm place, the humidity may have caused condensation to form inside. Wait about an hour before switching on the power
- make sure that the supply voltage, electrical frequency and power are within the set limits. See the section TECHNICAL SPECIFICATIONS
- disconnect the power supply before doing any type of maintenance
- do not use the device as safety device
- for repairs and for further information, contact the EVCO sales network.

2.5 Vcolor

2.5.1 Connectors

The picture below shows the connectors of the devices.



2.6 Table I/O settings without DHW

2.6.1 Micro+ versions with driver that is not built in

I/O	Description
	Analogue inputs
AI 1	Plant output temperature
AI 2	External temperature
AI 3	Source output temperature
AI 4	Plant input temperature
AI 5	Coil temperature
AI 6	*Not used*
AI 7	*Not used*
AI 8	*Not used*
AI 9	*Not used*
AI 10 (*EVDRIVE03*)	Condensation pressure
AI 11 (*EVDRIVE03*)	Compressor discharge temperature
AI 12 (*EVDRIVE03*)	Compressor intake temperature
AI 13 (*EVDRIVE03*)	Evaporation pressure
	Serial ports
RS 485	Modbus RTU Master + Slave protocol
CANbus	***Vgraph*** and *EVDRIVE03*
	Digital inputs
DI 1	Plant pump flow switch
DI 2	Boiler alarm
DI 3	Fan thermal switch
DI 4	Summer/Winter
DI 5	ON/OFF
DI 6	Source pump flow switch/thermal switch
DI 7	Plant pump thermal switch
DI 8	*Not used*

DI 9	*Not used*
DI 10 (*EVDRIVE03*)	High pressure
DI 11 (*EVDRIVE03*)	Low pressure
DI 12 (*EVDRIVE03*)	Compressor thermal switch
	Analogue outputs
AO 1	Fan
AO 2	Compressor
	Digital outputs
DO 1	Plant pump
DO 2	Fan
DO 3	Reversing valve
DO 4	Boiler (integration)
DO 5	Source pump
DO 6	Compressor 1
DO 7	*Not used*
DO 8	*Not used*
DO 9	*Not used*
DO 10 (*EVDRIVE03*)	Solenoid valve

2.6.2 Nano+ versions with driver that is not built in

I/O	**Description**
	Analogue inputs
AI 1	Plant output temperature
AI 2	External temperature
AI 3	Source output temperature
AI 4	Plant input temperature
AI 5	Coil temperature
AI 6	*Not used*
AI 7	*Not used*
AI 8	*Not used*
AI 9	*Not used*
AI 10 (*EVDRIVE03*)	Condensation pressure
AI 11 (*EVDRIVE03*)	Compressor discharge temperature
AI 12 (*EVDRIVE03*)	Compressor intake temperature
AI 13 (*EVDRIVE03*)	Evaporation pressure
	Serial ports
RS 485	Modbus RTU Master + Slave protocol
CANbus	***Vgraph*** and *EVDRIVE03*
	Digital inputs
DI 1	Source pump flow switch/thermal switch
DI 2	*Not used*
DI 3	Fan thermal switch
DI 4	Summer/Winter
DI 5	ON/OFF
DI 10 (*EVDRIVE03*)	High pressure

DI 11 (*EVDRIVE03*)	Low pressure
DI 12 (*EVDRIVE03*)	Compressor thermal switch
	Analogue outputs
AO 1	Fan
AO 2	Compressor
AO 3	*Not used*
AO 4	*Not used*
	Digital outputs
DO 1	Plant pump
DO 2	Fan
DO 3	Reversing valve
DO 4	Boiler (integration)
DO 5	Not used
DO 6	Compressor 1
DO 7	*Alarm*
DO 10 (*EVDRIVE03*)	Solenoid valve

2.6.3 KiloEEV versions with built-in driver

I/O	**Description**
	Analogue inputs
AI 1	Plant input temperature
AI 2	External temperature
AI 3	Coil temperature
AI 4	Plant output temperature
AI 5	Compressor discharge temperature
AI 6	*Not used*
AI 7	Condensation pressure
AI 8	Compressor intake temperature
AI 9	Evaporation pressure
	Serial ports
RS 485	Modbus RTU Master + Slave protocol
CANbus	***Vgraph*** and *EVDRIVE03*
	Digital inputs
DI 1	Plant pump flow switch
DI 2	Boiler alarm
DI 3	Fan thermal switch
DI 4	Summer/Winter
DI 5	ON/OFF
DI 6	Plant pump thermal switch
DI 7	High pressure alarm
DI 8	Low pressure alarm
DI 9	Compressor thermal switch
	Analogue outputs
AO 1	Fan
AO 2	Compressor

	Digital outputs
DO 1	Plant pump
DO 2	Fan
DO 3	Reversing valve
DO 4	Boiler
DO 5	Alarm
DO 6	Compressor 1
DO 7	Solenoid valve

2.7 Table I/O settings with DHW

2.7.1 Micro+ versions with driver that is not built in

I/O	**Description**
	Analogue inputs
AI 1	Plant output temperature
AI 2	External temperature
AI 3	Coil 1 temperature
AI 4	Plant input temperature
AI 5	*Not used*
AI 6	DHW temperature at the top
AI 7	DHW temperature at the bottom
AI 8	Solar panel output temperature
AI 9	Solar panel input temperature
AI 10 (*EVDRIVE03*)	Condensation pressure
AI 11 (*EVDRIVE03*)	Compressor discharge temperature
AI 12 (*EVDRIVE03*)	Compressor intake temperature
AI 13 (*EVDRIVE03*)	Evaporation pressure
	Serial ports
RS 485	Modbus RTU Master + Slave protocol
CANbus	***Vgraph*** and *EVDRIVE03*
	Digital inputs
DI 1	Flow switch
DI 2	Boiler alarm
DI 3	Fan thermal switch
DI 4	Summer/Winter
DI 5	ON/OFF
DI 6	Plant pump thermal switch
DI 7	DHW heater thermal switch
DI 8	Solar panel pump flow switch/thermal switch
DI 9	DHW mode
DI 10 (*EVDRIVE03*)	High pressure

DI 11 (*EVDRIVE03*)	Low pressure
DI 12 (*EVDRIVE03*)	Compressor thermal switch
	Analogue outputs
AO 1	Fan
AO 2	Compressor

	Digital outputs
DO 1	Plant pump
DO 2	Fan
DO 3	Reversing valve
DO 4	Boiler
DO 5	Alarm
DO 6	Compressor 1
DO 7	DHW valve
DO 8	DHW heater
DO 9	Solar panel pump
DO 10 (*EVDRIVE03*)	Solenoid valve

2.7.2 Nano+ versions with driver that is not built in

I/O	**Description**
	Analogue inputs
AI 1	Plant output temperature
AI 2	External temperature
AI 3	Coil 1 temperature
AI 4	Plant input temperature
AI 5	Plant pump thermal switch
AI 6	DHW temperature at the top
AI 7	DHW temperature at the bottom
AI 8	DHW mode
AI 9	*Not used*
AI 10 (*EVDRIVE03*)	Condensation pressure
AI 11 (*EVDRIVE03*)	Compressor discharge temperature
AI 12 (*EVDRIVE03*)	Compressor intake temperature
AI 13 (*EVDRIVE03*)	Evaporation pressure
	Serial ports
RS 485	Modbus RTU Master + Slave protocol
CANbus	***Vgraph*** and *EVDRIVE03*
	Digital inputs
DI 1	Source pump flow switch/thermal switch
DI 2	Boiler alarm
DI 3	Fan thermal switch
DI 4	Summer/Winter
DI 5	ON/OFF
DI 10 (*EVDRIVE03*)	High pressure
DI 11 (*EVDRIVE03*)	Low pressure

DI 12 (*EVDRIVE03*)	Compressor thermal switch
	Analogue outputs
AO 1	Fan
AO 2	Compressor
AO 3	*Not used*
AO 4	*Not used*

	Digital outputs
DO 1	Plant pump
DO 2	Fan
DO 3	Reversing valve
DO 4	Boiler
DO 5	DHW valve
DO 6	Compressor 1
DO 7	Alarm
DO 10 (*EVDRIVE03*)	Solenoid valve

2.7.3 KiloEEV versions with built-in driver

I/O	Description
	Analogue inputs
AI 1	Plant input temperature
AI 2	External temperature
AI 3	Coil temperature
AI 4	DHW temperature at the top
AI 5	Plant output temperature
AI 6	Compressor discharge temperature
AI 7	Condensation pressure
AI 8	Compressor intake temperature
AI 9	Evaporation pressure
	Serial ports
RS 485	Modbus RTU Master + Slave protocol
CANbus	***Vgraph*** and *EVDRIVE03*
	Digital inputs
DI 1	Plant pump flow switch
DI 2	Boiler alarm
DI 3	Fan thermal switch
DI 4	Summer/Winter
DI 5	ON/OFF
DI 6	Plant pump thermal switch
DI 7	High pressure alarm
DI 8	Low pressure alarm
DI 9	Compressor thermal switch
	Analogue outputs
AO 1	Fan

AO 2	Compressor
	Digital outputs
DO 1	Plant pump
DO 2	Fan
DO 3	Reversing valve
DO 4	Boiler
DO 5	Solenoid valve
DO 6	Compressor 1
DO 7	DHW valve

2.8 I/O Settings

The tables in the paragraph above define the default settings of the I/Os, but it is not the only option offered.
You define a set of possible admissible values and a set of parameters that the wizard parameters reset. You have the option to change the value. The admissible values are:

2.8.1 Micro+ versions with driver that is not built in

Analogue inputs (AI) (AI1, AI2, AI3, AI7, AI8 and AI9)	
Value	**Description**
0	Disabled
1	Plant IN temperature
2	Plant OUT temperature
3	Top DHW
4	Bottom DHW
5	External temperature
6	Coil 1 temperature
7	Coil 2 temperature
8	Source OUT temperature
9	Solar panel IN temperature
10	Solar panel OUT temperature
11	COMP discharge temperature
12	AUX1 probe (NTC)
13	AUX2 probe (NTC)
14	Condenser pressure (4-20mA)
15	Condenser Pressure (0-5V)
16	Evaporator pressure (4-20mA)
17	Evaporator Pressure (0-5V)
18	AUX1 probe (4-20mA)
19	AUX1 probe (0-5V)
20	AUX1 probe (0-10V)
21	AUX2 probe (4-20mA)
22	AUX2 probe (0-5V)
23	AUX2 probe (0-10V)
24	Plant pump flow switch NC
25	Plant pump flow switch NO
26	Plant pump thermal switch NC
27	Plant pump thermal switch NO
28	Plant pump flow switch+thermal switch NC
29	Plant pump flow switch+thermal switch NO
30	Boiler NC ALARM
31	Boiler NO ALARM
32	Heater thermal switch NC
33	Heater thermal switch NO
34	Boiler+heater thermal switch NC
35	Boiler+heater thermal switch NO
36	Fan thermal switch NC

37	Fan thermal switch NO
38	DHW heater thermal switch NC
39	DHW heater thermal switch NO
40	Solar panel pump flow switch+thermal switch NC
41	Solar panel pump flow switch+thermal switch NO
42	On-Off NC
43	On-Off NO
44	Summer-Winter NC
45	Summer-Winter NO
46	DHW mode NC
47	DHW mode NO
48	High Pressure NC ALARM
49	High Pressure NO ALARM
50	Low Pressure NC ALARM
51	Low Pressure NO ALARM
52	COMP1 thermal switch NC
53	COMP1 thermal switch NO
54	COMP2 thermal switch NC
55	COMP2 thermal switch NO
56	COMP3 thermal switch NC
57	COMP3 thermal switch NO
58	COMPRESSOR thermal switch NC
59	COMPRESSOR thermal switch NO
60	Source pump thermal switch NC
61	Source pump thermal switch NO
62	Auxiliary 1 NC
63	Auxiliary 1 NO
64	Auxiliary 2 NC
65	Auxiliary 2 NO

Analogue inputs (AI) (AI4, AI5 and AI6)	
Value	**Description**
0	Disabled
1	Plant IN temperature
2	Plant OUT temperature
3	Top DHW
4	Bottom DHW
5	Ext. temperature
6	Coil 1 Temperature
7	Coil 2 Temperature
8	Source OUT temperature
9	Solar panel IN temperature
10	Solar panel OUT temperature
11	COMP discharge temperature
12	AUX1 probe (NTC)
13	AUX2 probe (NTC)
14	Plant pump flow switch NC
15	Plant pump flow switch NO
16	Plant pump thermal switch NC
17	Plant pump thermal switch NO
18	Plant pump flow switch+thermal switch NC
19	Plant pump flow switch+thermal switch NO
20	Boiler NC ALARM
21	Boiler NO ALARM
22	Heater thermal switch NC
23	Heater thermal switch NO
24	Boiler+heater thermal switch NC
25	Boiler+heater thermal switch NO
26	Fan thermal switch NC
27	Fan thermal switch NO
28	DHW heater thermal switch NC
29	DHW heater thermal switch NO
30	Solar panel pump flow switch+thermal switch NC
31	Solar panel pump flow switch+thermal switch NO
32	On-Off NC
33	On-Off NO
34	Summer-Winter NC
35	Summer-Winter NO
36	DHW mode NC
37	DHW mode NO
38	High Pressure NC ALARM
39	High Pressure NO ALARM
40	Low Pressure NC ALARM
41	Low Pressure NO ALARM
42	COMP1 thermal switch NC

43	COMP1 thermal switch NO
44	COMP2 thermal switch NC
45	COMP2 thermal switch NO
46	COMP3 thermal switch NC
47	COMP3 thermal switch NO
48	COMPRESSOR thermal switch NC
49	COMPRESSOR thermal switch NO
50	Source pump thermal switch NC
51	Source pump thermal switch NO
52	Auxiliary 1 NC
53	Auxiliary 1 NO
54	Auxiliary 2 NC
55	Auxiliary 2 NO

Digital inputs (DI)	
Value	**Description**
0	Disabled
1	Plant pump flow switch NC
2	Plant pump flow switch NO
3	Plant pump thermal switch NC
4	Plant pump thermal switch NO
5	Plant pump flow switch+thermal switch NC
6	Plant pump flow switch+thermal switch NO
7	Boiler NC ALARM
8	Boiler NO ALARM
9	Heater thermal switch NC
10	Heater thermal switch NO
11	Boiler+heater thermal switch NC
12	Boiler+heater thermal switch NO
13	Fan thermal switch NC
14	Fan thermal switch NO
15	DHW heater thermal switch NC
16	DHW heater thermal switch NO
17	Solar panel pump flow switch+thermal switch NC
18	Solar panel pump flow switch+thermal switch NO
19	On-Off NC
20	On-Off NO
21	Summer-Winter NC
22	Summer-Winter NO
23	DHW mode NC
24	DHW mode NO
25	High Pressure NC ALARM
26	High Pressure NO ALARM
27	Low Pressure NC ALARM
28	Low Pressure NO ALARM

29	COMP1 thermal switch NC
30	COMP1 thermal switch NO
31	COMP2 thermal switch NC
32	COMP2 thermal switch NO
33	COMP3 thermal switch NC
34	COMP3 thermal switch NO
35	COMPRESSOR thermal switch NC
36	COMPRESSOR thermal switch NO
37	Source pump thermal switch NC
38	Source pump thermal switch NO
39	Auxiliary 1 NC
40	Auxiliary 1 NO
41	Auxiliary 2 NC
42	Auxiliary 2 NO

Analogue outputs (AO) (AO1 and AO2)	
Value	**Description**
0	Disabled
1	0-10V fan
2	0-10V compressor
3	PWM fan
4	FAN
5	Condensate tray anti-ice heater 0-10V
6	Auxiliary 1 0-10V
7	Auxiliary 2 0-10V

Analogue outputs (AO) (AO3 and AO4)	
Value	**Description**
0	Disabled
1	0-10V fan
2	0-10V compressor
3	4..20mA compressor
4	Condensate tray anti-ice heater 0-10V
5	Condensate tray anti-ice heater 4..20mA
6	Auxiliary 1 0-10V
7	Auxiliary 1 4..20mA
8	Auxiliary 2 0-10V
9	Auxiliary 2 4..20mA

Analogue outputs (AO) (AO5 and AO6)	
Value	**Description**
0	Disabled
1	0-10V fan
2	0-10V compressor
3	Condensate tray anti-ice heater 0-10V

4	Auxiliary 1 0-10V
5	Auxiliary 2 0-10V

Digital outputs (DO)	
Value	**Description**
0	Disabled
1	Plant pump
2	Enable fan
3	Source pump
4	Reversing valve NC
5	Reversing valve NO
6	Boiler
7	Heaters in integration mode
8	DHW heaters
9	Alarm NC
10	Alarm NO
11	Three-way DHW valve
12	Compressor 1 (enable)
13	Compressor 2
14	Compressor 3
15	PS Pump
16	Compressor Bypass NC
17	Compressor Bypass NO
18	Anti-freeze Heater
19	Condensate tray anti-ice heater
20	Auxiliary 1 NC
21	Auxiliary 1 NO
22	Auxiliary 2 NC
23	Auxiliary 2 NO

2.8.2 Nano+ versions with driver that is not built in

Analogue inputs (AI) (AI1, AI2, AI8 and AI9)	
Value	**Description**
0	Disabled
1	Plant IN temperature
2	Plant OUT temperature
3	Top DHW
4	Bottom DHW
5	External temperature
6	Coil 1 temperature
7	Coil 2 temperature
8	Source OUT temperature

9	Solar panel IN temperature
10	Solar panel OUT temperature
11	COMP discharge temperature
12	AUX1 probe (NTC)
13	AUX2 probe (NTC)
14	Condenser pressure (4-20mA)
15	Condenser Pressure (0-5V)
16	Evaporator pressure (4-20mA)
17	Evaporator Pressure (0-5V)
18	AUX1 probe (4-20mA)
19	AUX1 probe (0-5V)
20	AUX1 probe (0-10V)
21	AUX2 probe (4-20mA)
22	AUX2 probe (0-5V)
23	AUX2 probe (0-10V)
24	Plant pump flow switch NC
25	Plant pump flow switch NO
26	Plant pump thermal switch NC
27	Plant pump thermal switch NO
28	Plant pump flow switch+thermal switch NC
29	Plant pump flow switch+thermal switch NO
30	Boiler NC ALARM
31	Boiler NO ALARM
32	Heater thermal switch NC
33	Heater thermal switch NO
34	Boiler+heater thermal switch NC
35	Boiler+heater thermal switch NO
36	Fan thermal switch NC
37	Fan thermal switch NO
38	DHW heater thermal switch NC
39	DHW heater thermal switch NO
40	Solar panel pump flow switch+thermal switch NC
41	Solar panel pump flow switch+thermal switch NO
42	On-Off NC
43	On-Off NO
44	Summer-Winter NC
45	Summer-Winter NO
46	DHW mode NC
47	DHW mode NO
48	High Pressure NC ALARM
49	High Pressure NO ALARM
50	Low Pressure NC ALARM
51	Low Pressure NO ALARM
52	COMP1 thermal switch NC
53	COMP1 thermal switch NO

54	COMP2 thermal switch NC
55	COMP2 thermal switch NO
56	COMP3 thermal switch NC
57	COMP3 thermal switch NO
58	COMPRESSOR thermal switch NC
59	COMPRESSOR thermal switch NO
60	Source pump thermal switch NC
61	Source pump thermal switch NO
62	Auxiliary 1 NC
63	Auxiliary 1 NO
64	Auxiliary 2 NC
65	Auxiliary 2 NO

Analogue inputs (AI) (AI3, AI4, AI5, AI6 and AI7)	
Value	**Description**
0	Disabled
1	Plant IN temperature
2	Plant OUT temperature
3	Top DHW
4	Bottom DHW
5	Ext. temperature
6	Coil 1 Temperature
7	Coil 2 Temperature
8	Source OUT temperature
9	Solar panel IN temperature
10	Solar panel OUT temperature
11	COMP discharge temperature
12	AUX1 probe (NTC)
13	AUX2 probe (NTC)
14	Plant pump flow switch NC
15	Plant pump flow switch NO
16	Plant pump thermal switch NC
17	Plant pump thermal switch NO
18	Plant pump flow switch+thermal switch NC
19	Plant pump flow switch+thermal switch NO
20	Boiler NC ALARM
21	Boiler NO ALARM
22	Heater thermal switch NC
23	Heater thermal switch NO
24	Boiler+heater thermal switch NC
25	Boiler+heater thermal switch NO
26	Fan thermal switch NC
27	Fan thermal switch NO
28	DHW heater thermal switch NC
29	DHW heater thermal switch NO

30	Solar panel pump flow switch+thermal switch NC
31	Solar panel pump flow switch+thermal switch NO
32	On-Off NC
33	On-Off NO
34	Summer-Winter NC
35	Summer-Winter NO
36	DHW mode NC
37	DHW mode NO
38	High Pressure NC ALARM
39	High Pressure NO ALARM
40	Low Pressure NC ALARM
41	Low Pressure NO ALARM
42	COMP1 thermal switch NC
43	COMP1 thermal switch NO
44	COMP2 thermal switch NC
45	COMP2 thermal switch NO
46	COMP3 thermal switch NC
47	COMP3 thermal switch NO
48	COMPRESSOR thermal switch NC
49	COMPRESSOR thermal switch NO
50	Source pump thermal switch NC
51	Source pump thermal switch NO
52	Auxiliary 1 NC
53	Auxiliary 1 NO
54	Auxiliary 2 NC
55	Auxiliary 2 NO

Digital inputs (DI)	
Value	**Description**
0	Disabled
1	Plant pump flow switch NC
2	Plant pump flow switch NO
3	Plant pump thermal switch NC
4	Plant pump thermal switch NO
5	Plant pump flow switch+thermal switch NC
6	Plant pump flow switch+thermal switch NO
7	Boiler NC ALARM
8	Boiler NO ALARM
9	Heater thermal switch NC
10	Heater thermal switch NO
11	Boiler+heater thermal switch NC
12	Boiler+heater thermal switch NO
13	Fan thermal switch NC
14	Fan thermal switch NO
15	DHW heater thermal switch NC

16	DHW heater thermal switch NO
17	Solar panel pump flow switch+thermal switch NC
18	Solar panel pump flow switch+thermal switch NO
19	On-Off NC
20	On-Off NO
21	Summer-Winter NC
22	Summer-Winter NO
23	DHW mode NC
24	DHW mode NO
25	High Pressure NC ALARM
26	High Pressure NO ALARM
27	Low Pressure NC ALARM
28	Low Pressure NO ALARM
29	COMP1 thermal switch NC
30	COMP1 thermal switch NO
31	COMP2 thermal switch NC
32	COMP2 thermal switch NO
33	COMP3 thermal switch NC
34	COMP3 thermal switch NO
35	COMPRESSOR thermal switch NC
36	COMPRESSOR thermal switch NO
37	Source pump thermal switch NC
38	Source pump thermal switch NO
39	Auxiliary 1 NC
40	Auxiliary 1 NO
41	Auxiliary 2 NC
42	Auxiliary 2 NO

Analogue outputs (AO) (AO1 and AO2)	
Value	**Description**
0	Disabled
1	0-10V fan
2	0-10V compressor
3	PWM fan
4	FAN
5	Condensate tray anti-ice heater 0-10V
6	Auxiliary 1 0-10V
7	Auxiliary 2 0-10V

Analogue outputs (AO) (AO3 and AO4)	
Value	**Description**
0	Disabled
1	0-10V fan
2	0-10V compressor
3	4..20mA compressor

4	Condensate tray anti-ice heater 0-10V
5	Condensate tray anti-ice heater 4..20mA
6	Auxiliary 1 0-10V
7	Auxiliary 1 4..20mA
8	Auxiliary 2 0-10V
9	Auxiliary 2 4..20mA

Digital outputs (DO)	
Value	**Description**
0	Disabled
1	Plant pump
2	Enable fan
3	Source pump
4	Reversing valve NC
5	Reversing valve NO
6	Boiler
7	Integration heaters
8	DHW heaters
9	Alarm NC
10	Alarm NO
11	Three-way DHW valve
12	Compressor 1 (enable)
13	Compressor 2
14	Compressor 3
15	PS Pump
16	Compressor Bypass NC
17	Compressor Bypass NO
18	Anti-freeze Heater
19	Condensate tray anti-ice heater
20	Auxiliary 1 NC
21	Auxiliary 1 NO
22	Auxiliary 2 NC
23	Auxiliary 2 NO

2.8.3 KiloEEV versions with built-in driver

Analogue inputs (AI) (AI1, AI2, AI3, AI7, AI8 and AI9)	
Value	**Description**
0	Disabled
1	Plant IN temperature
2	Plant OUT temperature
3	Top DHW
4	Bottom DHW
5	External temperature
6	Coil 1 temperature
7	Coil 2 temperature

8	Source OUT temperature
9	Solar panel IN temperature
10	Solar panel OUT temperature
11	COMP discharge temperature
12	Compressor intake temperature
13	AUX1 probe (NTC)
14	AUX2 probe (NTC)
15	Condenser pressure (4-20mA)
16	Condenser Pressure (0-5V)
17	Evaporator pressure (4-20mA)
18	Evaporator Pressure (0-5V)
19	AUX1 probe (4-20mA)
20	AUX1 probe (0-5V)
21	AUX1 probe (0-10V)
22	AUX2 probe (4-20mA)
23	AUX2 probe (0-5V)
24	AUX2 probe (0-10V)
25	Plant pump flow switch NC
26	Plant pump flow switch NO
27	Plant pump thermal switch NC
28	Plant pump thermal switch NO
29	Plant pump flow switch+thermal switch NC
30	Plant pump flow switch+thermal switch NO
31	Boiler NC ALARM
32	Boiler NO ALARM
33	Heater thermal switch NC
34	Heater thermal switch NO
35	Boiler+heater thermal switch NC
36	Boiler+heater thermal switch NO
37	Fan thermal switch NC
38	Fan thermal switch NO
39	DHW heater thermal switch NC
40	DHW heater thermal switch NO
41	Solar panel pump flow switch+thermal switch NC
42	Solar panel pump flow switch+thermal switch NO
43	On-Off NC
44	On-Off NO
45	Summer-Winter NC
46	Summer-Winter NO
47	DHW mode NC
48	DHW mode NO
49	High Pressure NC ALARM
50	High Pressure NO ALARM
51	Low Pressure NC ALARM
52	Low Pressure NO ALARM

53	COMP1 thermal switch NC
54	COMP1 thermal switch NO
55	COMP2 thermal switch NC
56	COMP2 thermal switch NO
57	COMP3 thermal switch NC
58	COMP3 thermal switch NO
59	COMPRESSOR thermal switch NC
60	COMPRESSOR thermal switch NO
61	Source pump thermal switch NC
62	Source pump thermal switch NO
63	Auxiliary 1 NC
64	Auxiliary 1 NO
65	Auxiliary 2 NC
66	Auxiliary 2 NO

Analogue inputs (AI) (AI4, AI5 and AI6)	
Value	**Description**
0	Disabled
1	Plant IN temperature
2	Plant OUT temperature
3	Top DHW
4	Bottom DHW
5	Ext. temperature
6	Coil 1 Temperature
7	Coil 2 Temperature
8	Source OUT temperature
9	Solar panel IN temperature
10	Solar panel OUT temperature
11	COMP discharge temperature
12	Compressor intake temperature
13	AUX1 probe (NTC)
14	AUX2 probe (NTC)
15	Plant pump flow switch NC
16	Plant pump flow switch NO
17	Plant pump thermal switch NC
18	Plant pump thermal switch NO
19	Plant pump flow switch+thermal switch NC
20	Plant pump flow switch+thermal switch NO
21	Boiler NC ALARM
22	Boiler NO ALARM

23	Heater thermal switch NC
24	Heater thermal switch NO
25	Boiler+heater thermal switch NC
26	Boiler+heater thermal switch NO
27	Fan thermal switch NC
28	Fan thermal switch NO
29	DHW heater thermal switch NC
30	DHW heater thermal switch NO
31	Solar panel pump flow switch+thermal switch NC
32	Solar panel pump flow switch+thermal switch NO
33	On-Off NC
34	On-Off NO
35	Summer-Winter NC
36	Summer-Winter NO
37	DHW mode NC
38	DHW mode NO
39	High Pressure NC ALARM
40	High Pressure NO ALARM
41	Low Pressure NC ALARM
42	Low Pressure NO ALARM
43	COMP1 thermal switch NC
44	COMP1 thermal switch NO
45	COMP2 thermal switch NC
46	COMP2 thermal switch NO
47	COMP3 thermal switch NC
48	COMP3 thermal switch NO
49	COMPRESSOR thermal switch NC
50	COMPRESSOR thermal switch NO
51	Source pump thermal switch NC
52	Source pump thermal switch NO
53	Auxiliary 1 NC
54	Auxiliary 1 NO
55	Auxiliary 2 NC
56	Auxiliary 2 NO

Digital inputs (DI)	
Value	**Description**
0	Disabled
1	Plant pump flow switch NC
2	Plant pump flow switch NO
3	Plant pump thermal switch NC
4	Plant pump thermal switch NO
5	Plant pump flow switch+thermal switch NC
6	Plant pump flow switch+thermal switch NO
7	Boiler NC ALARM

8	Boiler NO ALARM
9	Heater thermal switch NC
10	Heater thermal switch NO
11	Boiler+heater thermal switch NC
12	Boiler+heater thermal switch NO
13	Fan thermal switch NC
14	Fan thermal switch NO
15	DHW heater thermal switch NC
16	DHW heater thermal switch NO
17	Solar panel pump flow switch+thermal switch NC
18	Solar panel pump flow switch+thermal switch NO
19	On-Off NC
20	On-Off NO
21	Summer-Winter NC
22	Summer-Winter NO
23	DHW mode NC
24	DHW mode NO
25	High Pressure NC ALARM
26	High Pressure NO ALARM
27	Low Pressure NC ALARM
28	Low Pressure NO ALARM
29	COMP1 thermal switch NC
30	COMP1 thermal switch NO
31	COMP2 thermal switch NC
32	COMP2 thermal switch NO
33	COMP3 thermal switch NC
34	COMP3 thermal switch NO
35	COMPRESSOR thermal switch NC
36	COMPRESSOR thermal switch NO
37	Source pump thermal switch NC
38	Source pump thermal switch NO
39	Auxiliary 1 NC
40	Auxiliary 1 NO
41	Auxiliary 2 NC
42	Auxiliary 2 NO

Analogue outputs (AO) (AO1 and AO2)	
Value	**Description**
0	Disabled
1	0-10V fan
2	0-10V compressor
3	PWM fan
4	FAN
5	Condensate tray anti-ice heater 0-10V
6	Auxiliary 1 0-10V

7	Auxiliary 2 0-10V

Analogue outputs (AO) (AO3 and AO4)	
Value	**Description**
0	Disabled
1	0-10V fan
2	0-10V compressor
3	4..20mA compressor
4	Condensate tray anti-ice heater 0-10V
5	Condensate tray anti-ice heater 4..20mA
6	Auxiliary 1 0-10V
7	Auxiliary 1 4..20mA
8	Auxiliary 2 0-10V
9	Auxiliary 2 4..20mA

Analogue outputs (AO) (AO5 and AO6)	
Value	**Description**
0	Disabled
1	0-10V fan
2	0-10V compressor
3	Condensate tray anti-ice heater 0-10V
4	Auxiliary 1 0-10V
5	Auxiliary 2 0-10V

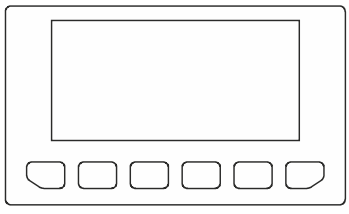
Digital outputs (DO)	
Value	**Description**
0	Disabled
1	Plant pump
2	Enable fan
3	Source pump
4	Reversing valve NC
5	Reversing valve NO
6	Boiler
7	Integration heaters
8	DHW heaters
9	Alarm NC
10	Alarm NO
11	Three-way DHW valve
12	Compressor 1 (enable)
13	Compressor 2
14	Compressor 3
15	PS Pump
16	Compressor Bypass NC

17	Compressor Bypass NO
18	Solenoid valve (NO)
19	Anti-freeze Heater
20	Condensate tray anti-ice heater
21	Auxiliary 1 NC
22	Auxiliary 1 NO
23	Auxiliary 2 NC
24	Auxiliary 2 NO

3 User interface

The user interface will be the LCD display of the ***c-pro 3*** *micro+ controller,* the LED display of the ***c-pro 3*** *nano+* controller, or the ***Vgraph*** user interface.

3.1 *C-pro 3 micro*+ controller user interface:

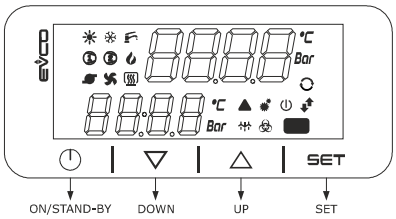


The table below describes each part of the keypad.

Key	Preset function
ESC	cancel, hereinafter also called the ESC key

◁	move left, hereinafter also called the LEFT key
△	increase, hereinafter also called the UP key
▽	decrease, hereinafter also called the DOWN key
▷	move right, hereinafter also called the RIGHT key
↵	confirm, hereinafter also called the ENTER key

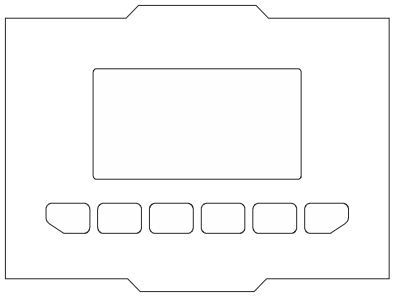
3.2 *C-pro 3 nano*+ controller user interface:



Key	Description
△ ▽	movement keys (hereinafter called the UP and/or DOWN keys)
SET	confirm key (hereinafter called the SET key)
⏻	On key, (hereinafter also called the ON/STANDBY key)

3.3 *Vgraph/Vcolor* user interface:

The terminal's main characteristics are the chance to communicate a remarkable amount of information to the user and how extremely easy it is to use; these characteristics derive from a graph viewer and a six-key membrane keyboard (with preset functions) and the CAN bus (to connect to the controllers).



The table below describes the main parts of the keypad.

Key	Description

ESC	cancel key (hereinafter called the ESC key)
◁	move left key (hereinafter called the LEFT key)
△	increase key (hereinafter called the UP key)
▽	decrease key (hereinafter called the DOWN key)
▷	move right key (hereinafter called the RIGHT key)
↵	confirm key (hereinafter called the ENTER key)

4 Menu and Submenu Structure

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

The menu is structured as follows:

4.1 Main menu

The main menu is divided up into four categories which are:

- Operating modes
- Parameters
- Input Output
- Alarms

4.1.1 Operating modes

The operating modes menu lists the modes of all the functions and loads:

- Compressors
- Exchangers (pumps and fans)
- Domestic hot water
- Defrost
- Solar panels
- Auxiliary heating
- Electronic valve

Each item gives all the operating modes for the chosen function.

4.1.2 Parameters

In the parameters menu you can access the different levels of management that go from level 0 up to level 3.

Level 0 is the user level and does not call for a password, while for levels one, two, and three you will need a password. The items in the menu are:

- User (level 0)
- Servicer (level 1)
- Installer (level 2)
- Manufacturer (level 3)

The submenus for these items are:

- Parameters Menu
  - User
  - Servicer
    - Operation section
    - Manual section
    - Calibration section
    - Input/output section
  - Installer
    - Regulations section
    - Exchangers (pumps and fans) section
    - Anti-Legionella section
    - Auxiliary heating section
    - Auxiliary outputs section
    - Safety devices section (alarms)
    - Miscellaneous section (other parameters)
  - Manufacturer
    - Compressors section
    - Regulations section
    - Defrost section
    - Exchangers (pumps and fans) section
    - Anti-Legionella section
    - Auxiliary heating section
    - Safety devices section (alarms)
    - Miscellaneous section (other parameters)

For the content of each of these submenus see the parameters list. Whether a certain parameter belongs in the Installer menu rather than the Manufacturer menu depends on the password level associated to that parameter.

4.1.3 Input Output

This menu contains the list of Inputs and Outputs divided up by type with a description and the mode.
Example:

I/O	Description	Logical mode	Physical mode
DO01	Plant pump	Active	Closed

4.1.4 Alarms

The alarms menu is divided up into two submenus:

- Alarms active
- Alarms history

In the active alarms submenu all the active alarms are given, while the alarms history menu lists the last alarms.

5 Operation

The ***c-pro 3*** HPRU control system can manage reversible heat pumps with the following characteristics:

- Heat source exchanger containing water or air
- Management of the DHW function
- Integrated management of the electronic thermostatic valve
- Management of a BLDC compressor
- Management of 1-3 ON-OFF compressors.
- Management of adaptive defrost

5.1 Management of the operating mode

There are various ways to turn on, off, and change the machine's operating mode based on the value of the relative setting parameters.

5.1.1 Turning on and off

The machine can be turned on and off:

- From the keyboard (by going into the relative menu or pressing the ESC key for two seconds)
- From the digital input
- From BMS (when there is no communication after a settable delay, the unit goes into "off-line" mode, however maintaining its previous operating mode).

While you can still can turn the machine on and off from the keyboard - an always available function - you can turn it on and off remotely from ID or BMS. You can only do one or the other.

5.1.2 Changing operating mode

The machine has three operating modes

- Cold
- Hot
- Only DHW, useful in spring and autumn.

They can be changed from the keyboard, ID, BMS (off-line after a settable time period and maintenance of the mode if there is no communication) or from external temperature probe. In this case, too, you can always change the operating mode from the keyboard, but the other modes will be mutually exclusive.

You can set an OFF time for the machine before the season actually changes.

5.2 Temperature regulation

c-pro 3 HPRU offers the option to manage one or two compressors and a resource for auxiliary heating (boiler or electric heater), this, too, ON-OFF or modulating. The auxiliary heating can be a sole source of heating or an integration to be turned on when the compressors are unable to meet the system's heating demand.

In any event, a working set point (differentiated for the Heating and Cooling functions), a Proportional Band (Lateral Band or Neutral Zone), and if necessary, an Integral Time (only for the modulating regulation) will be defined . An offset is also defined with respect to the set point (below the setpoint in cooling, above the setpoint in heating) to turn off the compressor to prevent "rebounds" in the case of regulation based on the output temperature.

5.2.1 ON-OFF Compressors

Activation of a single compressor or the two compressors is in function of the temperature read by the temperature regulation probe and can be in the Neutral Zone, in Lateral Band, or modulating. If a modulating compressor is used, regulation may be purely proportional or PI. If there is a first modulating compressor and a second ON-OFF compressor, the adjustment will be "sawtooth" for the modulating one and in lateral band for the ON-OFF one.

If you have a unit with two ON-OFF compressors, the rotation of the compressors must also be managed; see the paragraph on this topic.

5.2.1.1 ON-OFF Regulation in neutral zone

This type of regulation is used by default when the temperature regulation based on the temperature the heat pump puts out. A parameter will define the position of the neutral zone of regulation:

- Above or below the set point based on the active function
- Straddling the set point

To explain how it works, it is necessary to distinguish the turning on phase from the turning off phase.

When turning on:

- The compressor turns on when the regulation temperature goes out of the neutral zone:
  - ✓ Cooling: Regulation temperature > Set Point + Neutral Zone
  - ✓ Heating: Regulation temperature < Set Point - Neutral Zone
- The compressor stays off if the adjustment temperature stays within the neutral zone or if:
  - ✓ Cooling: Regulation temperature < Set Point
  - ✓ Heating: Regulation temperature > Set Point

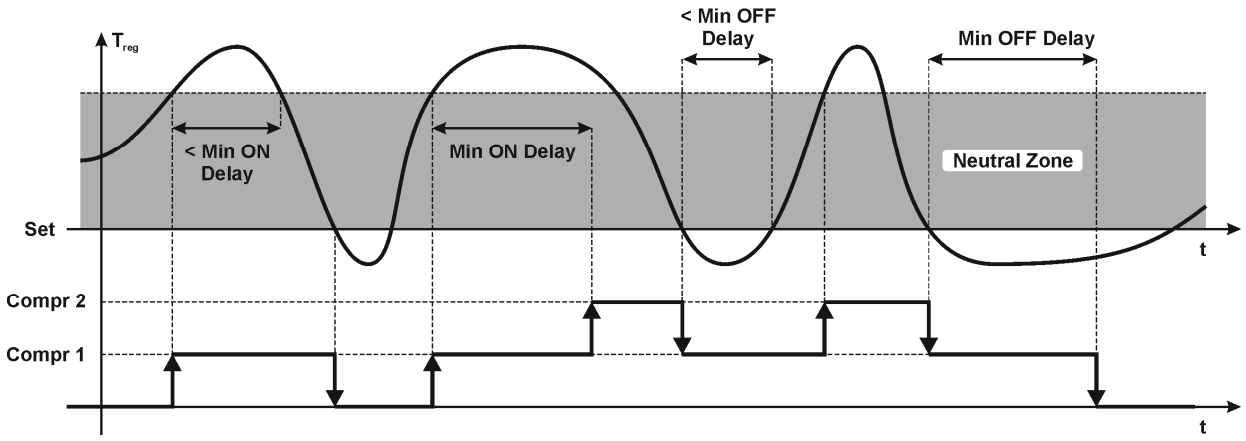
The second compressor is not turned on right after the first even if the temperature stays outside the neutral zone, but a delay defined by a parameter will be followed.

When turning off:

- The compressor turns off when the regulation temperature:
  - ✓ Cooling: Regulation temperature < Set Point
  - ✓ Heating: Regulation temperature > Set Point
- The compressor stays on if the regulation temperature stays within the neutral zone or if:
  - ✓ Cooling: Regulation temperature > Set Point + Neutral Zone
  - ✓ Heating: Regulation temperature < Set Point - Neutral Zone

The second compressor is not turned off right after the first even if the temperature stays outside the neutral zone, but a delay defined by a parameter will be followed (separate from the one when turning on).

The way the ON-OFF compressors react in the neutral zone can be effectively outlined for the cooling function with the following diagram:



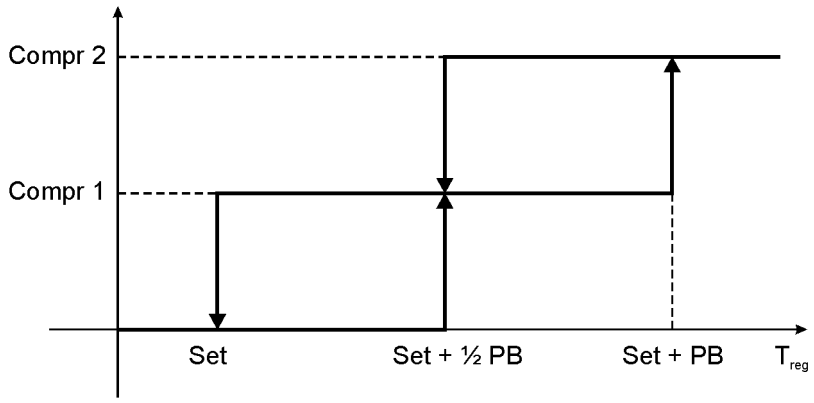
Code	Parameter description	Default	Min	Max	U.M.	Menu
SPC1	Cooling set-point	8.5 47.3	PC21	PC22	°C °F	UT
SPH1	Heating set-point	40.0 104.0	PC23	PC24	°C °F	UT
PC00	Temperature regulation probe. 0: supply temp. probe 1: return temp. probe	1	0	1		CO-C
PC14	Neutral Zone of regulation	5.0 9.0	PC15	PC16	°C °F	IS-R
PC17	Fitting/release time (neutral zone)	20	0	999	sec	IS-R
PC18	Type of neutral zone: 0: divided 1: whole	0	0	1		IS-R

5.2.1.2 ON-OFF Regulation in lateral band

This type of regulation is not affected by the mode of the compressor, but rather only depends on the regulation temperature. It is used by default when the temperature regulation is based on the temperature going into the heat pump.

- The compressor turns on if:
  - ✓ Cooling: Regulation temperature > Set Point + Lateral Band
  - ✓ Heating: Regulation temperature < Set Point - Lateral Band
- The compressor turns off if:
  - ✓ Cooling: Regulation temperature < Set Point
  - ✓ Heating: Regulation temperature > Set Point

If there are two compressors, the lateral band is divided into two parts (identical or according to the % of power specified) as per the diagram below (cooling function same-power compressors).



Code	Parameter description	Default	Min	Max	U.M.	Menu
SPC1	Cooling set-point	8.5 47.3	PC21	PC22	°C °F	UT
SPH1	Heating set-point	40.0 104.0	PC23	PC24	°C °F	UT

PC00	Temperature regulation probe. 0: supply temp. probe 1: return temp. probe	1	0	1		CO-C
PC12	Regulation band (lateral band)	2.5 4.5	0.1	20.0 36.0	°C °F	IS-R

5.2.2 Modulating regulation

With modulating regulation you have three options:

1) Single modulating compressor
2) Modulating compressor + 1 OnOff compressor
3) Modulating compressor + 2 OnOff compressors

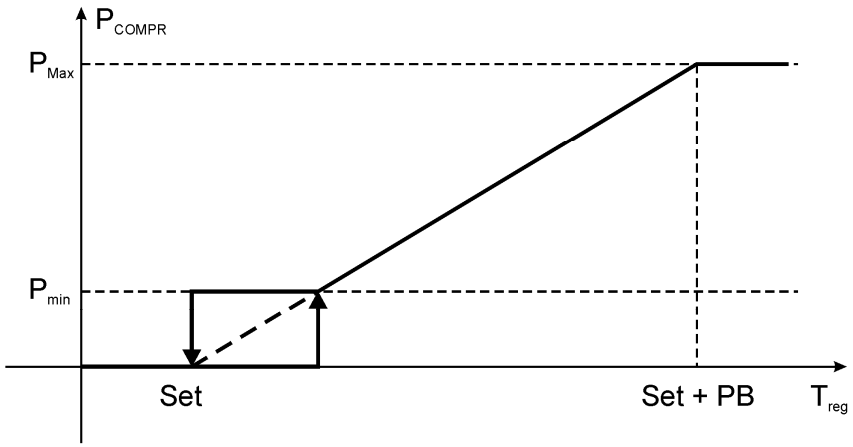
The characteristics of temperature regulation are listed below. For problems piloting the compressor with inverter see the paragraph on this topic.

5.2.2.1 Single compressor

In this case, the power of the compressor will take on the value in function of the output of the PI regulation algorithm. Based on the power value requested, if there is a single modulating compressor, three cases are distinguished:

- Minimum suppliable power < Power requested < Maximum suppliable power: The compressor will go to the requested power level
- Power requested > Maximum power suppliable: The compressor will go to the maximum power level
- Power requested < Minimum power suppliable. In this case, the reaction depends on the compressor's mode:
  - ✓ Compressor off: The compressor will stay off, turning on only when the requested power reaches the minimum suppliable level.
  - ✓ Compressor on: The compressor will stay on at the minimum suppliable level, turning off only when the requested power level gets to zero.

The figure illustrates modulation of a single compressor in the purely proportional case operating in cooling.



Code	Parameter description	Default	Min	Max	U.M.	Menu
SPC1	Cooling set-point	8.5 47.3	PC21	PC22	°C °F	UT
SPH1	Heating set-point	40.0 104.0	PC23	PC24	°C °F	UT
PC30	Modulating compressor proportional band	10.0 18.0	0.0	20.0 36.0	°C °F	IS-R

PC31	Modulating compressor integral PI time	0	0	999	sec	IS-R
PC32	Modulating compressor minimum speed (% PI output)	16.70	0.00	100.00	%	CO-R
PC33	Modulating compressor maximum speed (% PI output)	100.00	0.00	100.00	%	CO-R

If set, the relay for enabling the compressor will activate as soon as the value of the analogue output becomes greater than zero.

5.2.2.2 A modulating compressor and an ON-OFF compressor

In this case, the temperature regulator must know the ratio of the maximum suppliable power from the modulating compressor and that which may be supplied by the ON-OFF compressor so as to properly divide up the proportional band *($PB=PB_{MOD}+PB_{ON-OFF}$)*. For example, if the modulating compressor provides 60% of the power and the ON-OFF compressor 40%, the proportional band will be divided up so as to follow this power ratio: *$PB_{MOD}=60\% \times PB$, $PB_{ON-OFF}=40\% \times PB$*.

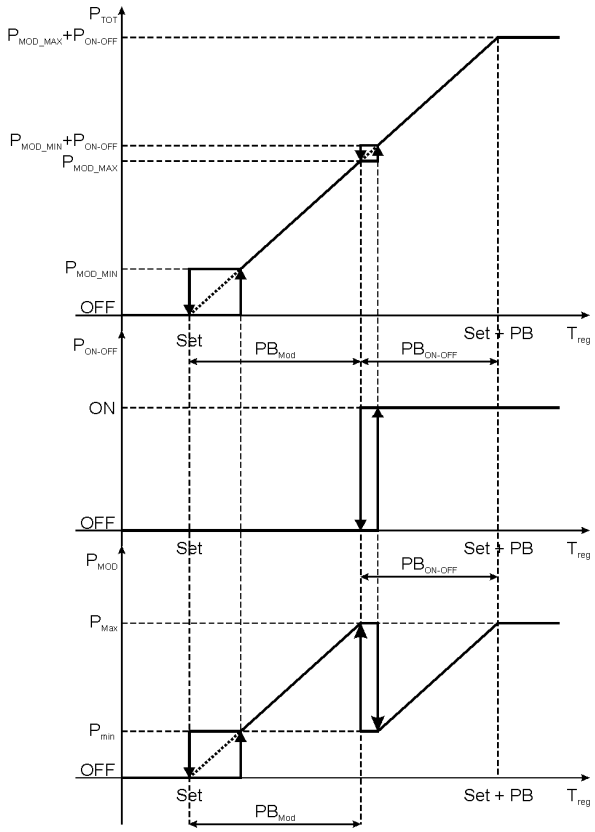
As the temperature detected by the temperature regulation probe increases, the power requested (**P_{REQ}**) from the compressors proportionately increases. The actions performed by the temperature regulator in function of the level of requested power reached are:

- **$P_{REQ} < P_{MOD-MIN}$** *(Minimum power suppliable by the modulating compressor)* → Both the modulating compressor and the ON-OFF one stay off.
- **$P_{REQ} = P_{MOD-MIN}$** → The modulating compressor is turned on at its minimum power
- **$P_{MOD-MIN} < P_{REQ} < P_{MOD-MAX}$** *(Maximum power suppliable by the modulating compressor)* → The power of the modulating compressor is adjusted to the requested power
- **$P_{REQ} = P_{MOD-MAX}$** → The modulating compressor is brought to its maximum power
- **$P_{MOD-MAX} < P_{REQ} < P_{MOD-MIN} + P_{ON-OFF}$** *(Power of the ON-OFF compressor)* → The modulating compressor stays at the maximum power and the ON-OFF compressor stays off
- **$P_{REQ} = P_{MOD-MIN} + P_{ON-OFF}$** → Before the modulating compressor is brought from the maximum to the minimum power taking into account safe timing, when the modulating compressor power has reached the minimum the ON-OFF compressor is activated.
- **$P_{MOD-MIN} + P_{ON-OFF} < P_{REQ} < P_{MOD-MAX} + P_{ON-OFF}$** → The ON-OFF compressor is on and the modulating compressor power is adjusted to the requested power
- **$P_{REQ} \geq P_{MOD-MAX} + P_{ON-OFF}$** → The ON-OFF compressor is on and the modulating compressor is active at maximum power.

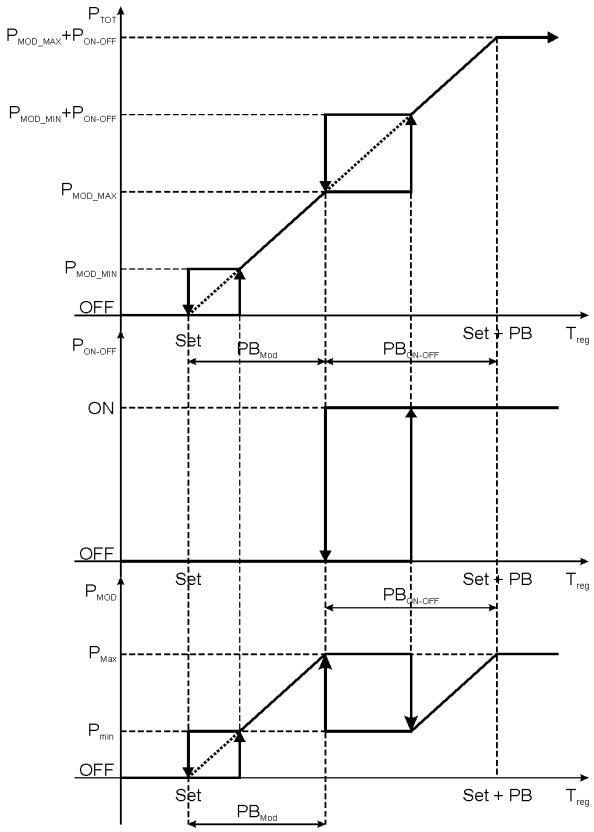
As the temperature detected by the temperature regulation probe decreases, the power requested proportionately decreases. The sequence described above is run in the opposite direction for the modulation parts; instead, the reaction is different in the following cases:

- **$P_{MOD-MIN} + P_{ON-OFF} > P_{REQ} > P_{MOD-MAX}$** → The ON-OFF compressor stays active and the modulating one stays at minimum power.
- **$P_{REQ} = P_{MOD-MAX}$** → First the ON-OFF compressor is turned off and then the modulating compressor is brought from the minimum to the maximum power, taking into account safe timing.
- **$P_{MOD-MIN} > P_{REQ} > 0$** → The modulating compressor is kept active at the minimum suppliable power.
- **$P_{REQ} = 0$** → Only when the requested power reaches zero is the modulating compressor turned off

The figures illustrate the case of a modulating compressor in tandem with an ON-OFF compressor, also in the purely proportional case in cooling:



Modulating compressor power > ON-OFF compressor power



Modulating compressor power < ON-OFF compressor power

Code	Parameter description	Default	Min	Max	U.M.	Menu
PC34	Percentage power supplied by the modulating compressor	100.00	0.00	100.00	%	CO-R
PC35	Percentage power expressed by the first OnOff compressor	0.00	0.00	100.00	%	CO-R
PC36	Percentage power expressed by the second OnOff compressor	0.00	0.00	100.00	%	CO-R

5.2.2.3 Modulating compressor with two ON-OFF compressors

Works like the previous case, but with a second ON-OFF compressor to be managed in the same way as the first. The modulating compressor will follow a "sawtooth" type of regulation while the two ON-OFF compressors will be activated "in steps".

5.3 DHW (Domestic hot water)

c-pro 3 HPRU can manage the Domestic Hot Water function; the heat pump will be equipped with a three-way valve to deviate the flow of the hot water from the system to the DHW tank. When there are simultaneous requests for temperature regulation from the system and the DHW tank, the controller will decide which request takes precedence and will set into action all necessary measures to satisfy this request.

During the reversal of the three-way valve, it might be necessary to stop the pump (if it is a ball valve) for which a pump stop period is set, parametrisable during reversals.

Having to "share" the compressor with the system during operation in DHW, the machine will always operate at maximum power (it turns on before any ON-OFF steps and then the modulating compressor is brought to 100% power as fast as possible) to make the cycle last as little as possible.
The auxiliary heating can be turned on to help reach the DHW setpoint.
The request for DHW is considered active when the temperature detected by the probe installed in the storage tank (upper part if there are two) drops below the DHW setpoint minus the regulation band (e.g., DHW setpoint = 50°C, DHW regulation band = 5°C → DHW request active if the probe in the top part of the DHW tank detects a temperature lower than 45°C). The regulation probe in the lower part of the DHW storage tank will help with the anti-Legionella function and for regulation of the solar panels.

5.3.1 Management of priorities

DHW production is always a priority over the temperature regulation request from the system. In any event, a maximum operation time limit is set for the DHW production unit to keep from straining the system too much. Even if there wasn't any request from the system at the time of activation of the DHW function, one may arise during operation in DHW (for which the maximum time will still be valid). Once the maximum time in DHW is up, after reversal of the three-way valve the pump will be activated for a set time (sniffing) so as to ensure proper reading of the temperature regulation probe.
Likewise, a maximum operation time in cooling/heating is set in cooling/heating before going back to producing DHW if there is a request. In this case, the probe is dedicated and installed in the storage tank, so it's easier to tell whether or not there is a DHW request.

5.3.2 Operation

During "Normal" operation in Heating/Cooling, that is, with request for temperature regulation coming from the system, the V3V is in resting mode.
When there is a DHW request, the controller performs this sequence:

- The compressor is turned off (only if the pump must be off and/or turning off is requested in the settings)
- After the *Minimal delay between turning off of the compressor and turning off of the pump* (PP05) the pump is turned off (only if PP06 > 0, otherwise the pump stays on)
- The three-way valve goes from resting state to operational state (the valve deviates the flow from the Heating/Cooling system to the DHW tank. This operation includes a reversal period (that depends on the type of valve established in parameter PP06) during which the pump must stay off. This period can be set at zero, in which case the pump is not turned off.

- Halfway through the reversal period, the reversing valve is reversed if cooling is active, otherwise, the reversing valve stays in the last position it was in. In any event, there is a compressor stop period (even if the pump is not to be turned off) for a change in operating mode (Parameter PC08) if the cooling function is active, halfway through which the actual reversal of the cycle reversing valve takes place.
- The pump is reactivated
- After the *Minimum delay between turning on the pump and turning on the compressor* (PP04), the compressor is reactivated. **If parameter PC07 is active** (Compressor safety periods bypass in the reversals) **the compressor's safety periods are not followed** (minimum compressor switch-off time – PC05 and minimum time between two switch-ons of the same compressor – PC06). In total, the compressor will stay off for whichever is the greater time between PC08 and (PP05+PP06+PP04). In the case that neither a reversal period for the three-way valve with pump off nor a minimum compressor switch-off period are to take place during reversal of the cycle reversing valve, the compressor will always stay on.

At the end of operation in DHW, to reach the programmed setpoint or because maximum time has elapsed, the controller carries out the opposite sequence:

- The compressor is turned off (only if PC08 ≠ 0 and/or PP06 ≠ 0)

- After the *Minimum delay between turning off of the compressor and turning off of the pump* (PP05) the pump is turned off (only if PP06 ≠ 0, otherwise the pump stays on)
- The three-way valve reverses from operational state to resting state (the valve deviates the flow from the DHW tank to the Heating/Cooling system. This operation includes a reversal period (which depends on the type of valve used established in parameter PP06) during which the pump must stay off. This period can be set at zero, in which case the pump is not turned off.
- Halfway through the reversal time, the reversing valve is reversed if there is activation of the cooling function, otherwise, the reversing valve stays in the last position it was in. In any event, there is a compressor stop period (even if PP06=0) for a change in operating mode (Parameter PC08) if there is activation of the cooling function, halfway through which the actual reversal of the cycle reversing valve takes place.
- The pump is reactivated

After the *Minimum delay between turning on the pump and turning on the compressor* (PP04), the compressor is reactivated. **If parameter PC07 is active** (Compressor safety periods bypass in the reversals) **the compressor's safety periods are not followed** (minimum compressor switch-off time – PC05 and minimum time between two switch-ons of the same compressor – PC06). In total, the compressor will stay off for whichever is the greater time between PC08 and (PP05+PP06+PP04). In the case that neither a reversal period for the three-way valve with pump off nor a minimum compressor switch-off period are to take place during reversal of the cycle reversing valve, the compressor will always stay on.

5.3.3 Using the auxiliary heating

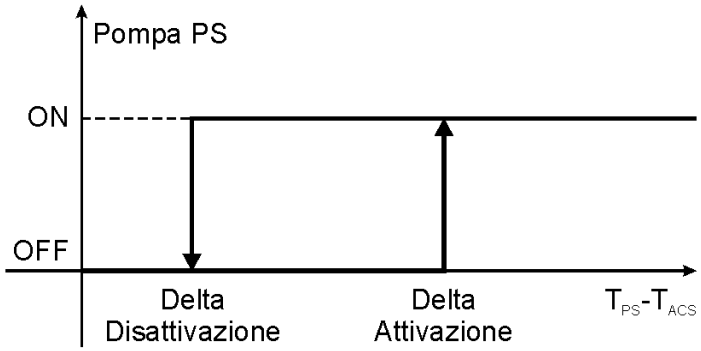
In all operating modes in DHW if the heat pump can't manage to bring the DHW tank's temperature to the setpoint within a time interval set in the parameters, you can have the available auxiliary heating steps intervene.

5.3.4 Management of a solar panel circuit

The solar panel circuit is comprised of a dedicated pump with relative flow switch and pump thermal switch and by a probe that detects the water temperature in the solar panel circuit.

The solar panel circuit pump can have a sniffing cycle which can be activated in the parameters with ON and OFF periods also set in the parameters if operation of the pump is necessary to correctly detect the temperature of the solar panel circuit.

The solar panel pump will be activated as soon as the temperature detected by the solar panel circuit probe goes over the temperature in the bottom of the DHW tank by a minimum Delta set in the parameters. The solar panel pump will be stopped when the temperature at the bottom of the DHW tank goes over the temperature of the solar panel circuit temperature minus a second Delta set in the parameters (the second Delta will be less than the first). This rule outlined in the figure below aims to optimally exploit the "free" solar panel resource.



Code	Parameter description	Default	Min	Max	U.M.	Menu

PP31	Solar panel regulation probe: 0 – Input 1 – Output	0	0	1		IS-P
PP32	Delta solar panel pump activation	5.0 9.0	0.0	20.0 36.0	°C °F	IS-P
PP33	Delta solar panel pump deactivation	3.0 5.5	0.0	20.0 36.0	°C °F	IS-P
PP34	Pump switch-on time during the Refresh Cycle	2	1	99	Min	IS-P
PP35	Pump delay prior to the refresh cycle	5	1	99	Min	IS-P

5.3.5 High Temperature

If there is a high temperature in the DHW tank (DHW Temperature top part) or high temperature of the water in the solar panel circuit, the solar panel pump is disabled.

Code	Parameter description	Default	Min	Max	U.M.	Menu
PP36	DHW high temperature set-point	70.0 158.0	0.0 32.0	90.0 194.0	°C °F	IS-P
PP37	DHW high temperature differential	10.0 18.0	0.0	20.0 36.0	°C °F	IS-P
PP38	Solar panel high temperature set-point	100.0 212.0	0.0 32.0	130.0 266.0	°C °F	IS-P
PP39	Solar panel high temperature differential	10.0 18.0	0.0	20.0 36.0	°C °F	IS-P

5.4 Anti-Legionella

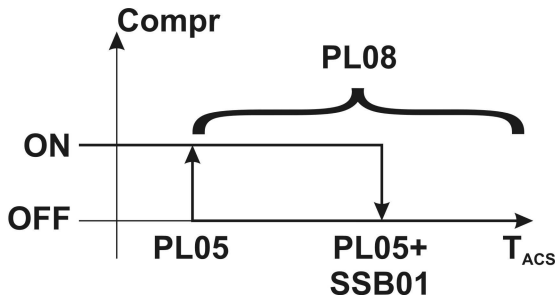
This is a high temperature treatment for disinfecting the DHW storage tank, which must be done periodically. If enabled, the anti-Legionella cycle is done at time intervals set by the *Anti-Legionella cycle interval* (PL02) which is expressed in days. The timer for the anti-Legionella cycle is always on when the unit is connected to a power source. You can set an anti-Legionella cycle at Power ON (PL03=1); in this case, as soon as the device is plugged into the power feed an anti-Legionella cycle is performed.

5.4.1 How it is done

Upon activation of the cycle, the unit goes into DHW function with a lateral band regulation with dedicated set point and band equal to that of DHW:

- Set point: *Anti-Legionella setpoint* (PL05)
- Band: *DHW Band* (SSB01)

During the anti-Legionella cycle if the water temperature in the DHW tank exceeds PL5+ SSB01, the compressor is turned off. If the temperature drops below PL05 the compressor is turned back on as illustrated in the figure below:



To consider the anti-Legionella cycle complete, the temperature must stay above PL05 for the *Anti-Legionella holding period* (PL08). Once the anti-Legionella cycle has been started, if the compressor alone can't reach the anti-Legionella setpoint, the auxiliary heating is turned on with the procedures and the delays outlined in the paragraph on this topic.
If the unit is unable to successfully complete the anti-Legionella cycle (T_{ACS} > PL05 for at least (PL08) it is still stopped once the *Maximum Anti-Legionella period* (PL04) has elapsed. In this case the Anti-Legionella alarm (AL11) is activated just as a warning. Once the anti-Legionella cycle has been started, if the unit turns off due to alarm or Power OFF, the mode is kept in the memory and when the unit is started back up the anti-Legionella cycle is relaunched. The PL08 period timer is set back to zero.

6 Heat source exchanger management

c-pro 3 HPRU manages an energy heat source exchanger in order to optimise exchange of energy with the environment. Exchangers can be one of two types:

1. Finned: in this case, the speed of the fans is regulated
2. With water: in this case the capacity of the source pump is regulated and the temperature of the water is monitored to keep it from freezing

The regulation of the speed of the fans or the capacity of the pump is meant to keep the condensation temperature and evaporation temperature within the set limits in the summer and winter cycles respectively.

The condensation/evaporation temperature may be detected by one or two temperature or pressure probes based on the machine's construction characteristics. You may not apply a sole probe if you use an EEV, which requires a pressure probe and a temperature probe, also in low pressure.

In addition to automatic regulation modulated by the probes, you can use fixed regulation for the speed/capacity of the exchanger, setting it in the parameters (PF01). The manufacturer sets the speed values with the PF61, PF62, PF63, and PF64 parameters.

6.1 Finned Coil Pack with Ventilation

Depending on the machine's settings, management of ventilation can be handled with:

- Analogue output (0-10 V or PWM)
- Digital output (relay)
- Both analogue and digital outputs

In this last case, the digital output will be managed as enablement of speed regulator operation (for some inverters it's necessary to provide this enablement to guarantee their proper function) and will be activated as soon as the value of the analogue output becomes greater than zero.

For all the functions that include operation of ventilation (Cooling, Heating, and Defrost) the following are established: a setpoint (condensation pressure in cooling (PF11) and defrost (PF51), evaporation pressure in heating (PF21)), a proportional band (PF12/PF52/PF22), and a minimum and maximum percentage in normal operating conditions for activation and regulation of the fan speed (PF16 and PF17 / PF58 and PF59 / PF31 and PF32).

For modulating regulation when the pressure

- of condensation around the top in cooling
- of evaporation around the bottom in heating

reaches the relative setpoint, the modulating ventilation is activated at minimum speed. In the event of PWM signal for the piloting of a phase cutting regulator, a start-up to 100% for a time period set in the parameters (PF27) will also occur.

The speed of the fans goes from minimum to maximum in function of the progress of the pressure:

- of condensation rising from setpoint to setpoint + PB (proportional band) in cooling
- of evaporation in falling from setpoint to setpoint - PB in heating

For the ON-OFF fans activation occurs when the pressure:

- of condensation exceeds setpoint + PB in cooling
- of evaporation falls below setpoint - PB in heating

and there is deactivation when the pressure:

- of condensation falls below the setpoint in cooling
- of evaporation rises above the setpoint in heating

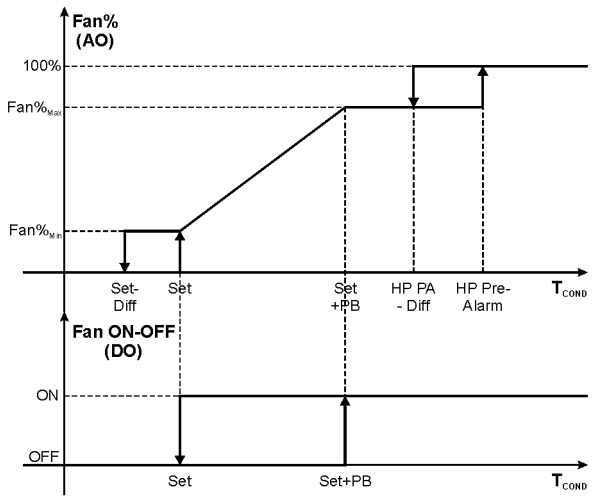
In the event of modulating regulation, if the high-pressure prealarm is enabled when the pressure

- of condensation around the top in cooling
- of evaporation around the bottom in heating

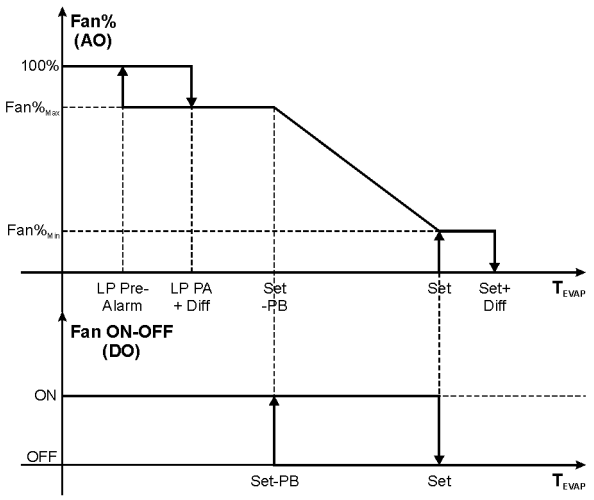
reaches the Prealarm setpoint (HP in cooling, LP in heating), the modulating ventilation is forced to 100% (parameters PF13, PF14, PF15, PF53, PF54, PF55, PF23, PF24, and PF25). This operation ends bringing the speed of the fans to maximum in normal operating state of the active function when the pressure (parameters PF18, PF19, PF56, PF57, PF33, and PF34):

- of condensation falls below the HP prealarm threshold minus the relative differential in cooling
- of evaporation rises above the LP prealarm threshold plus the relative differential in heating

This trend is outlined for the heating and cooling functions by figures 6.1 – 1 and 6.1 – 2 respectively.



Ventilation in Cooling



Ventilation in Heating

The function of the defrost fan slightly differs from that in cooling and will be described in the paragraph on this topic.

7 Heat sink exchanger management

c-pro 3 HPRU manages a heat sink exchanger with water (typically with plate heat exchangers but not necessarily) with ON-OFF pump
The pump can be managed continuously, by temperature regulation or with sniffing cycles.
Even the flow switch will be managed the same way.

8 Defrost management

Starting with integration of more simple functions, the means of defrost required for ***c-pro 3*** HPRU (PD10) are described below.

8.1 Button-press defrost

In this case, defrost is done by entering the User Menu and selecting "Start" under the item "Defrost".
start cycle".
The defrost cycle will end when the set output condition is reached or once the maximum time has elapsed. In this case, you must be able to choose to exit the cycle "normally" or because of the time elapsed; this function is available in the user menu.

8.2 Defrost Based on Temperature

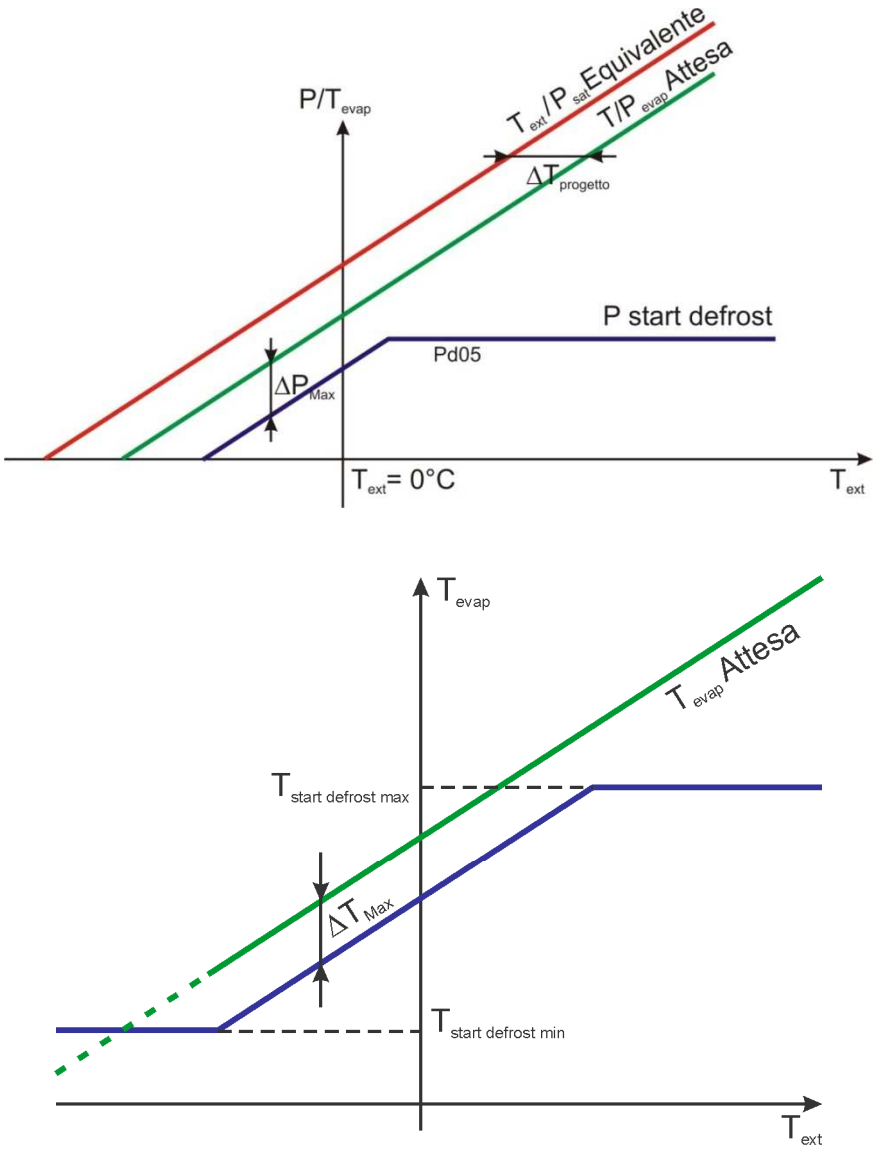
When the evaporation temperature drops below a value set in the parameters (PD02) the timer for the delay for defrost starts. At the end of this delay, the actual cycle begins with a subsequent dripping period.
The length of the delay may be compensated based on the temperature. The timer will be paused if the evaporation temperature goes back up above the setpoint at which the timer was started and the timer will be set back to zero if the evaporation temperature exceeds the setpoint of a differential set in the parameters.

8.3 Adaptive defrost

As the external temperature drops, the evaporation pressure decreases even with a clean coil. It therefore makes sense to consequently lower the defrost delay setpoint.
If the ***Dynamic compensation*** function is enabled through the PD10 parameter and there is an external temperature probe that is enabled and not in error, the defrost start setpoint is made dynamic.
Expected difference between the external temperature and the evaporation temperature must be set in the *External temperature – evaporation temperature* differential (PD11). This data will then be "updated" by the controller measuring the actual difference after each defrost successfully completed (not because of maximum time) once the *Settling period after defrosting* (PD13) has elapsed.
The differential measured will be averaged with the initial value of the parameter which will be updated as a consequence. You can always check (and change) the actual differential by going into the PD11 parameter (Manufacturer Menu).
Then in the *Dynamic defrost temperature delta* (PD12) the maximum difference between the expected (equivalent to Text – PD11) and the measured evaporation temperature must be stated, which can be accepted before starting the defrost delay.

In function of the expected differential between external temperature and evaporation temperature the expected evaporation temperature is calculated (Text – PD11), and as a consequence, the evaporation temperature that sets off the start of the delay before defrost (Text – PD11 – PD12).
The actual setpoint for defrost start will be the lesser of the value calculated as described above and the *Defrost start setpoint* (PD02). This value may be viewed in the machine mode menu and will in any event be limited by the PD19 parameter.

The trend of the actual defrost start setpoint is outlined in the figure below.

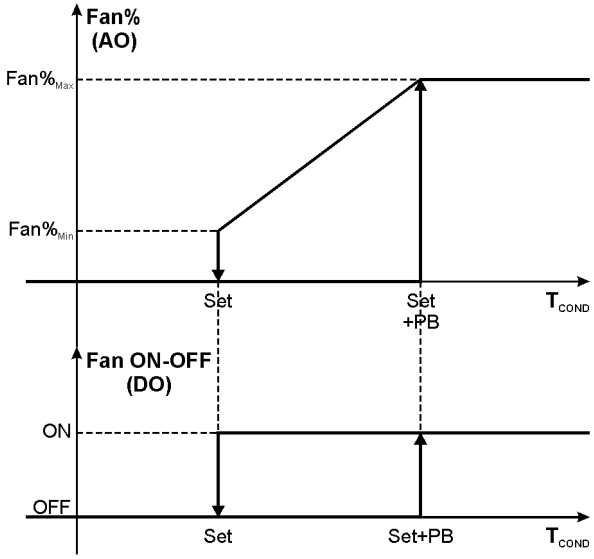


By setting the *Defrost compensation type* (PD10 – default value) to 4, both the time compensation and the dynamic compensation will be enabled, limiting the defrost cycle to that which is strictly necessary and maximising heat pump efficiency.

8.4 Ventilation in defrost

You can enable (in parameter PF03) ventilation during the defrost cycle with a designated parameter set (minimum and maximum speed, setpoint, and regulation band). The means of activation of the fan is reversed compared to the

normal regulation, or instead of starting at the minimum speed when the condensation temperature exceeds the relative setpoint, it starts at the maximum speed when the condensation temperature exceeds the setpoint + band and regulates "downhill".
This procedure makes it possible to get out of critical conditions where the defrost cycle is unable to conclude in a satisfactory manner with complete evacuation of ice from the coil. Indeed, ventilation sets off a prolonged defrost cycle without the condensation temperature becoming so high as to send the machine into alarm, increasing the amount of ice removed from the coil. The speed trend of the fans in defrost is represented in the figure below.



8.5 Holding period of the temperature at the end of defrost

To keep the defrost cycle from ending without it having been effective enough, a period of operation of the machine in defrost mode after reaching the condition of end of defrost (PD18) is set.

8.6 Condensate collecting anti-ice heater

There is management of a heater positioned inside the condensate tray to keep
ice from forming during defrost. When active, defrost and the external temperature is below a threshold set in the parameters, a heater must turn on.
The output to be activated may be:

- A dedicated digital output
- An analogue output with external relay
- That of the boiler (if one of the two items above has not been set)

Code	Parameter description	Default	Min	Max	U.M.	Menu
Pd30	Enable condensate tray heater tank in defrost	No (0)	No (0)	Yes (1)		CO-D
Pd31	Setpoint of condensate tray heater tank in defrost	3.0 37.4	-10.0 14.0	30.0 86.0	°C °F	IS-D
Pd32	Differential of condensate tray heater tank in defrost	5.0 9.0	0.0 0.0	20.0 36.0	°C °F	IS-D

9 Compressor Management

The compressors require some simple precautionary measures to guarantee their integrity, endurance, and proper operation. There will be differences between ON-OFF compressors and modulating fans and other common characteristics. The common characteristics are listed below.

9.1 Setting the Power Yielded by the Compressors

To be able to precisely modulate the power yield from the machine in relation to the power requested by the different circuits active, ***c-pro 3*** HPRU allows for definition of the individual fraction of power for each compressor. Based on the power requested, this piece of data, and the fact that the "next" compressor to be turned on or turned off is known, you will be able to activate/deactivate the resources to the right level.

Example: Case of a modulating compressor plus an ON-OFF compressor The fraction of power of the modulating compressor is set at 52% and the ON-OFF compressor at 48%. This piece of data will orient the temperature regulation algorithm bringing the modulating compressor to maximum power when the power requested reaches 52% of the total power. If the minimum power that may be supplied by the modulating compressor is 20%, the temperature regulation algorithm can calculate that this fraction equals 10.4% of the machine's total power. The modulating compressor will be brought to minimum power and the On-OFF compressor will be turned on when the power requested by the system reaches 58.4% of the total. Afterwards the modulating compressor's power will be increased proportionately to the requested power.

9.2 Safety periods

The following safety periods will be set (in the parameters) and valid for all compressors:

1. Minimum OFF period (PC05)
2. Minimum ON period (except in alarm states) (PC04)
3. Minimum period between two consecutive starts of the same compressor (PC06)
4. Minimum period between the start of different compressors (PC03)
5. Minimum period between the switch-off of different compressors (PC11).

9.3 Switch-on and Switch-off Sequence

When there is more than one compressor a sequence for switching on the compressors must be determined. There will be settings with a set sequence for switching on and off and others where the sequence varies. In the switch-on sequence the activation of the "next compressor" will depend on the fraction of total power that this compressor must provide. The possible scenarios are listed below; they will be known to ***c-pro 3*** HPRU based on the value of the setting parameters.

9.3.1 Fixed-sequence Settings

Settings where the switch-on and switch-off sequences is fixed are listed in Table 9.3.1 – 1 with relative explanation:

Configuration	Switch-on and switch-off rationale
A modulating compressor and an ON-OFF compressor	Under normal conditions the modulating compressor will always be turned on first and then the fixed one. When upon start-up the power requested by the system is greater than the level to which the modulating compressor is brought at the minimum power and the ON-OFF compressor is switched on, the latter is switched on first and the modulating compressor is switched on after the ON-OFF one and its power is modulated based on the system's request.
A modulating compressor and two ON-OFF compressors.	Under normal conditions the modulating compressor will always be switched on first and then the ON-OFF ones in sequence. When upon start-up the power requested by the system is greater than the level to which the modulating compressor is brought at the minimum power and the ON-OFF compressor is switched on, the latter is turned on first and the modulating compressor is switched on after the ON-OFF one and its power is modulated based on the system's request.

9.3.2 Variable sequence settings

Settings with two or three ON-OFF compressors: the compressors are turned on in steps (neutral zone or proportional band). Regardless of the number of active compressors, the "next" compressor to be switched on will be the one that - based on the number of operating hours and number of start-ups - has the least mechanical wear and tear among those that are off. Similarly, the "next" compressor to be switched off will be that with the greatest mechanical wear and tear among those on.

The compressors will be both activated and deactivated in increasing order based on wear and tear – The wear (w = wear) of the compressors is defined with a formula that puts it in relation to the number of hours of operation (h) and to the number of start-ups (s) with two coefficients (n,k) defined by the same number of parameters:

$$w = n_x h + k_x s$$

By choosing this type of sequence and setting one of the two parameters that express the coefficients to zero, only the number of hours of operation or just the number of start-ups may be taken into consideration. You won't be able to set both parameters to zero. The compressor off with the lowest wear and tear index will be turned on first; the compressor on with the highest wear-and-tear index will be turned off first.

Code	Parameter description	Default	Min	Max	U.M.	Menu
PC02	Compressor rotation: 0:FIFO 1:LIFO 2:FIFO+HS 3:LIFO+HS	3	0	3		CO-C
PC19	Compressor operating hours factor	1	0	255		IS-R
PC20	Compressor operation start-ups factor	1	0	255		IS-R

9.4 Modulating compressor management

The modulating compressors require several more measures than the ON-OFF ones. Every modulating compressor by every manufacturer has particular characteristics for each of which it will be necessary to define an ABL that has all of

these characteristics. Below are the required modes which are qualitatively equal for all compressors. These modes may then be tailored to the different models. SIAM BLDC compressors, whose characteristics are known, will be taken as an example.

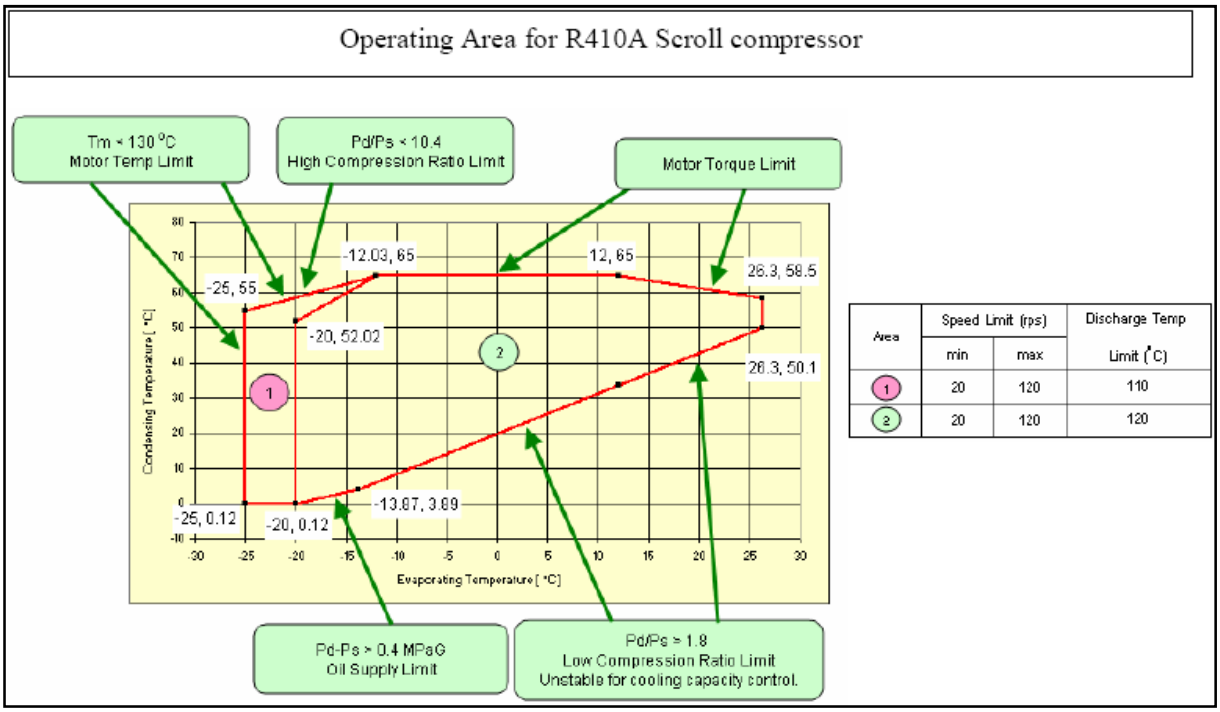
9.4.1 Switch-on and switch-off with the relative safety periods

The compressor turns on at a minimum speed that depends on the model defined in the parameters (PC32-39-40). Immediately afterwards the compressor goes to a higher rotation speed to guarantee the return of the oil and stabilisation of the working conditions (PC41-42). To get from the minimum rotation speed to the stabilisation speed, the compressor must use the maximum allowed acceleration which is limited in the parameters (PC47) in deceleration as well. The compressor will start at a minimum rotation speed (PC32), and will go to a stabilisation speed (PC41) in a set time interval (PC47).

Even while it is turning off, the compressor must first go to the minimum speed and then switch off in order to ensure balancing of the pressures in the circuit. For switch-off due to an alarm, the compressor must in any event not be switched off immediately, but must be brought to the minimum speed with a greater deceleration, seven RPS/sec (PC48).

9.4.2 Management of the envelope of the modulating compressor

In addition to the strategies of variation of the speed of the modulating compressor it is necessary to verify that the working point is inside the permitted area (Envelope) which is a function of the frequency of work. An envelope is set for each compressor and is managed by the application.

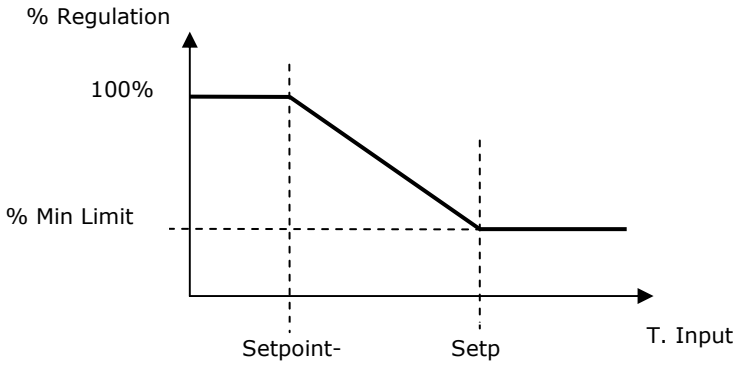


Area	Speed Limit (rps)		Discharge Temp
	min	max	Limit (°C)
1	20	120	110
2	20	120	120

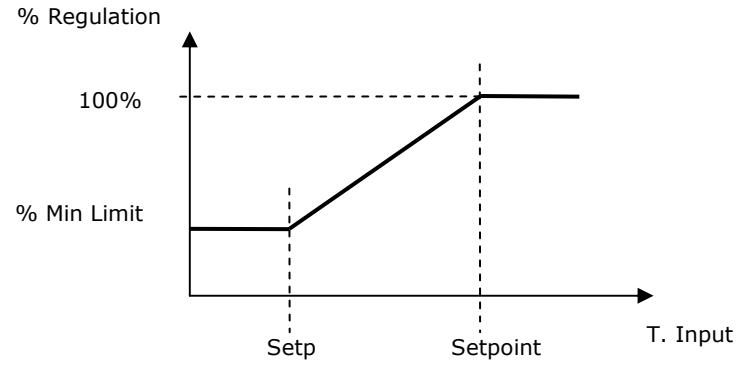
9.4.3 Slowing rotation speed

This is a strategy for reducing the load (compressor rotation speed) to deal with transients (with water that is too hot in the summer or too cold in the winter). The compressor's rotation speed is slowed proportionately so that the water temperature goes back into a manageable range. If the limitation parameter is set at 100%, regulation is disabled. If the parameter is set at a value below 100%, the request for regulation is blocked at this parameter if it is higher.

Operation in Cooling



Operation in Heating



Code	Parameter description	Default	Min	Max	U.M.	Menu
PC80	Limit value of the requested power (unloading) with use of the modulating compressor	100.0	0.0	100.0	%	CO-R
PC81	Power limitation setpoint (unloading) in cooling	25.0 29.0	SPC1	PA27	°C °F	CO-R
PC82	Power limitation setpoint (unloading) in heating	15.0 29.0	PA26	SPH1	°C °F	CO-R
PC83	Power limitation for unloading differential	5.0 9.0	0.0	20.0 36.0	°C °F	CO-R

9.4.4 Compressor oil return management

When the compressor's speed is low, the return of the oil to the compressor is no longer guaranteed. To prevent problems due to lack of lubrication, compressor operation at low speeds is allowed only for short periods of time.
The management strategy of this function is quite simple: when the rotation speed drops below
a level set in the parameters (light load) timing begins (also set in the parameters). Once
up, the compressor is forced to maximum speed for a period set in a third parameter.
This operation usually brings the water temperature to setpoint; in this case, the compressor is turned off
at the end of the procedure. If instead there is still a demand, the compressor goes to the speed requested by the temperature regulation, if necessary starting the timer again.

Code	Parameter description	Default	Min	Max	U.M.	Menu
PC85	Type of modulating compressor oil return management: 0=Disabled 1=Only with modulating 2=Modulating and OnOff	0	0	2		CO-R
PC86	Period of maintenance below the minimum threshold for oil return activation	5	0	999	Min	CO-R
PC87	Period of forcing modulating compressor to the maximum for oil return	60	0	999	Sec	CO-R
PC88	Minimum rotation threshold for oil return activation	40.0	PC32	100.0	%	CO-R

10 Management of the electronic expansion valve

Management of the electronic expansion valve with EVDRIVE03

Management of the electronic valve must be optimised and not be limited to a typical superheating check.
There are some conditions and rules which must take into account other variables of the system on the whole in addition to variables concerning superheating (evaporation temperature and pressure) in order to limit problems due to delays introduced by the temperature probe itself and its positioning. You must be able to enable these functions in the parameters so that a manufacturer may exclude them.

Management of the electronic expansion valve with *c-pro3 micro*+ with built-in driver

Management of the electronic valve must be optimised and not be limited to a typical superheating check.
There are some conditions and rules which must take into account other variables of the system on the whole in addition to variables concerning superheating (evaporation temperature and pressure) in order to limit problems due to delays introduced by the temperature probe itself and its positioning. You must be able to enable these functions in the parameters so that a manufacturer may exclude them.
The choice of type of valve is made with parameter PV90. The table below specifies how the electronic valve piloting parameters are set according to the selection.
The *Minimum regulation steps* are the steps (FullStep) to which to associate the position 0% (valve closed)
The *Maximum regulation steps* are the steps (FullStep) to which to associate the position 100% (valve completely open)

The *Overdrive steps* are steps (FullStep) of complete closure of synchronisation
The *StepRate* is the speed of the valve expressed in FullStep/second
The *Step Mode* is the method of valve piloting
The *Duty Cycle* is the duty cycle that you wish to set to keep the board from superheating and depends on the phase current which requires the valve to be able to be piloted (verify the setting for this parameter with EVCO if you use the generic valve)
By choosing PV90 = 0 users are free to enter the parameters (PV91-PV96) at their own discretion.

PV90	Valve name	Minimum regulation steps [FullStep]	Maximum regulation steps [FullStep]	Overdriving steps [FullStep]	Stepping rate [FullStep/s]	Maintenance voltage [V]	Supply voltage [V]	Step Mode	Duty Cycle [%]
0	Generic valve	PV91	PV92	PV93	PV94	0V	12V	PV95	PV96
1	Sanhua DPF	0	250	300	45	0V	12V	HalfStep	100
2	Danfoss ETS6	0	250	300	45	0V	12V	HalfStep	100
3	Sporlan SER-U	0	800	1250	100	0V	12V	HalfStep	100
4	Sporlan ESX	0	250	300	45	0V	12V	HalfStep	100

10.1 Enable EEV Operation

The controller knows when it's time to activate the unit (turn on a compressor) and consequently must enable the operation of the EVDRIVE 03 driver via CAN bus (in the event of external driver) or the valve functions (in the event of built-in driver).
Enablement of operation must come a few seconds before compressor start-up; the valve must be "prepared" open a percentage adequate to the compressor being turned on.

10.2 PID Parameter Sets

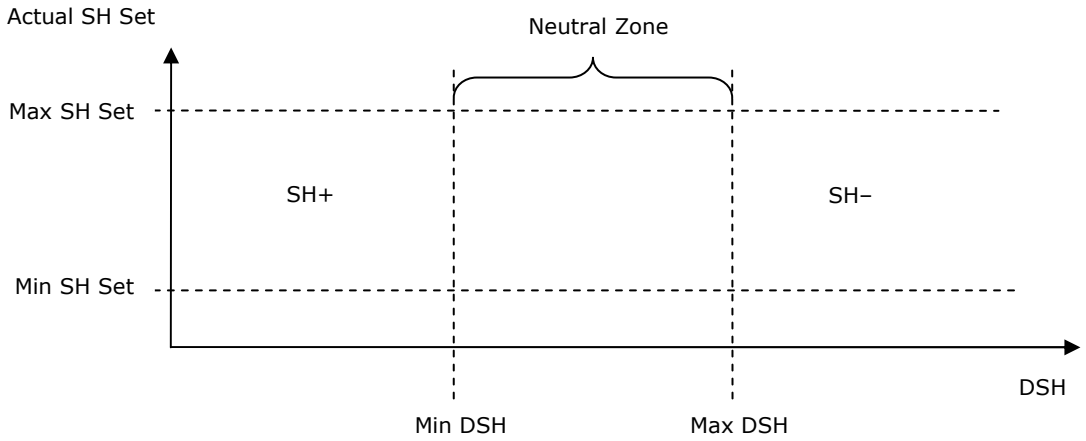
The controller has two sets of independent parameters to be used in the cooling (and defrost) and heating operating modes. The controller must be able to choose the best set of parameters based on the operating mode running.

10.3 Modulation of the SH Set (Neutral Zone)

In a properly functioning machine the difference between the compressor's discharge temperature and condensation/discharge superheating (DSH) temperature should be between 20 and 30K.

- If the DSH is too low it could get back to the compressor in liquid form – to prevent this, it helps to raise the SH set.
- If the differential is too high there is no risk of liquid return – given the "favourable" condition as far as safety of the compressor you can lower the SH set to increase the system's efficiency (reduction of the condensation pressure and increase of the evaporation pressure).

These variations will have a minimum and maximum and will be parametrisable; you use a neutral zone regulation on the DSH to increase or decrease the SH set. Each variation is conditioned to a period of time so as to allow the system to stabilise itself.



This way the risks of liquid return to the compressor are limited and system efficiency increases based on the machine's working conditions.

Code	Parameter description	Default	Min	Max	U.M.	Menu
PV60	Enable modulating SH (neutral zone)	Yes (1)	No (0)	Yes (1)		CO-V
PV61	Maximum SH set	15.0	3.0	25.0	K	CO-V
PV62	Minimum SH set	2.0	1.0	25.0	K	CO-V
PV63	Maximum DSH value	30.0	Pv64	50.0	K	CO-V
PV64	Minimum DSH value	20.0	0.0	Pv63	K	CO-V
PV65	Delay SH variation outside neutral zone	5	1	60	Min	CO-V
PV66	Negative SH variation of the SH above the zone	0.2	0.1	2.0	K	CO-V
PV67	Positive variation of the SH below the zone	1.0	0.1	2.0	K	CO-V

10.4 Pump down

The electronic valve can be disabled before turning off the compressor to perform the pump-down function when required. The compressor (at minimum speed if modulating) will be turned off when the evaporation pressure drops below a designated parameter. When it is restarted, the valve may be asked to open before the compressor starts so that the pressures can be rebalanced; in this case, the compressor will be re-enabled when the evaporation pressure rises above another designated parameter.

11 Management of the compressor's bypass valve

This function, useful only when an ON-OFF compressor is used, helps sustain the evaporation pressure in the winter cycle. The bypass valve will be activated if the evaporation temperature remains below a value set in the parameters for a period defined in another parameter without it involving the defrost. That is, the lowering of the evaporation temperature is completely justified by the drop in the external temperature (or by the water that circulates in the external exchanger) but causes the machine too many problems. In this case, the compressor's bypass valve may be activated. The activation will have a maximum ON period after which a minimum OFF period must follow before being able to reactivate the valve and a maximum number of consecutive activations following which the machine will be "let to go into alarm" without any other interventions. The valve can be activated even if the discharge temperature rises above a setpoint for a set period of time. In any event, activation is "intermittent" with a T ON and a T OFF.

12 Auxiliary Heating

c-pro 3 HPRU includes the option to activate alternative heating resources for the compressors in situations where this is necessary. In any event, this is in working conditions outside the scope of normality and are to be considered "exceptional".

The resources available will be set in the Manufacturer's I/O settings parameters:

- ***A boiler:*** this resource is added at the end of the heat pump on the supply pipe and may also be used for DHW production.
- ***An electric heater for the heating circuit:*** as an alternative to a boiler, or one can arrange for having this heater when there isn't a boiler or to be used only for the DHW tank.
- ***An electric heater for the DHW tank:*** as an alternative or in addition to the boiler

The temperature regulations that supervise the auxiliary heating will follow the same rationale as those for the compressors set in the setting parameters described under the paragraph on temperature regulation (in lateral band or in neutral zone if ON-OFF, PI if modulating), but for each of the resources listed they will have independent regulation bands.

The conditions and means by which the heating can be activated, in addition to the alarm conditions that will be highlighted in the designated paragraph, are described in the paragraphs below.

12.1Low External Temperature (air-water)

During the winter when the external temperature drops to particularly low values, it might no longer be cheap or sufficient to heat using the heat pump both for the heating circuit and for DHW. To manage this limiting condition there are two auxiliary heating levels defined in the parameter *Auxiliary heating due to low external temperature* which can take on the following values:

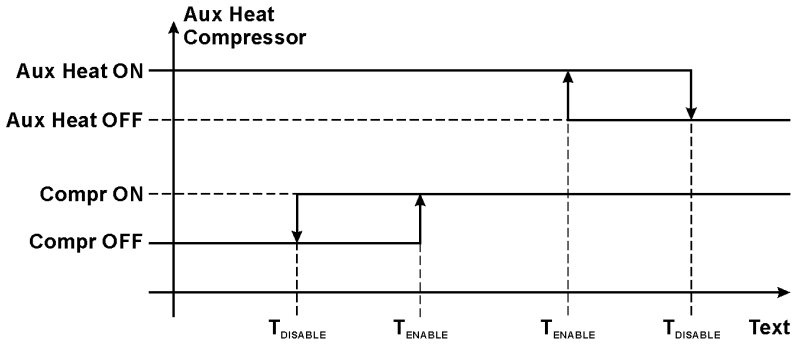
0 – Auxiliary heating due to low external temperature disabled

1 – Auxiliary heating enabled in Integration: When the Text drops below the *Auxiliary heating setpoint in integration* the auxiliary heating is activated. The auxiliary heating is deactivated when the Text rises above the setpoint + *Auxiliary heating in integration differential*

2 – Auxiliary heating enabled in Integration and Replacement: like in the previous case, plus if the Text drops even farther below the *Auxiliary heating setpoint in replacement,* the compressors are disabled. Therefore only the auxiliary heating stays on. The compressors are turned back on when the Text rises above the setpoint + *Auxiliary heating in replacement differential.*

3 – Auxiliary heating enabled in Replacement: When the Text drops below the *Auxiliary heating setpoint in replacement* the auxiliary heating is activated and the compressors are disabled. The auxiliary heating is deactivated and the compressors are turned back on when the Text rises above the setpoint + *Auxiliary heating in replacement differential*

In the two cases above, if the compressors are disabled due to low external temperature, they can be turned back on (optional parameter) if an alarm goes off that blocks auxiliary heating. Operation of the auxiliary heating due to limit of operation is illustrated in the figure below:



Code	Parameter description	Default	Min	Max	U.M.	Menu
Pr16	Auxiliary heating setpoint (outside air) in integration due to limit of operation	0.0 32.0	-30.0 -22.0	10.0 50.0	°C °F	CO-A
Pr17	Auxiliary heating in integration due to limit of operation differential	10.0 18.0	0.0 0.0	20.0 36.0	°C °F	CO-A
Pr18	Auxiliary heating setpoint (outside air) in replacement due to limit of operation	-10.0 14.0	-30.0 -22.0	10.0 50.0	°C °F	CO-A
Pr19	Auxiliary heating differential in replacement due to limit of operation	10.0 18.0	0.0 0.0	20.0 36.0	°C °F	CO-A
Pr20	Re-enable compressor for heater/boiler thermal switch 0 = Compressor disabled 1 = Compressor enabled	1	0	1		CO-A

In this condition of activation the auxiliary heating acts as an additional power step (integration) or as the sole energy source both for the system and for the DHW.
The replacement scenario is pretty simple; indeed the operation of the auxiliary heat source will be analogous to that of the compressors.
The scenario of integration is more delicate since the compressors are on. In this case, auxiliary heating will be activated, always maintaining the same work setpoint (which differs according to the function active), only when the power affected by the function constantly stays over 100% for a minimum period set in the parameters. The auxiliary heating source will follow its own temperature regulation independently from that of the compressor and will be deactivated (first) upon reaching the setpoint, still keeping the compressors at maximum power.

12.2 Setpoint Not Met

Another scenario when the auxiliary heating is activated is when it is impossible to reach the active setpoint (Heating, DHW, and anti-Legionella) within a "reasonable" time set in the parameters.
In this case, an "individual" delay will be set for the various functions involved. Timing of this delay will begin from the moment when the power requested exceeds 100% and will keep going until the power stays above this threshold. Timing stops if the power requested falls below 100% and is restored to its initial value if the power requested falls below 100% minus an offset defined in the parameters. If the timing reaches zero, the auxiliary heating is activated to help reach the setpoint in question. The auxiliary heating resource will follow its own temperature regulation independently from that of the compressor and will be deactivated (first) upon reaching the setpoint, still keeping the compressors at maximum power.

12.3Defrost

During defrost the temperature of the water in the system or the DHW tank drops. A dedicated set will be defined to request activation of auxiliary heating and keep the reference temperature from dropping substantially.
According to the active function, the auxiliary heating resources available will be activated.

13 Auxiliary Functions

c-pro 3 HPRU offers the option to activate auxiliary functions.

AUXILIARY OUTPUTS (IS-U)*							
PU01	Auxiliary 1 regulation type 0 = Cold 1 = Hot	0	0	1		IS-U	
PU02	Auxiliary 1 regulation setpoint	20.0	-50.0	302.0		IS-U	
PU03	Auxiliary regulation 1 differential	2.0	0.0	36.0		IS-U	
PU04	Auxiliary output 1 minimum value	0.0	0.0	100.0	%	IS-U	
PU05	Auxiliary output 1 maximum value	100.0	0.0	100.0	%	IS-U	
PU06	Auxiliary 1 analogue regulation type 0 = Minimum to unit ON 1 = Enablement step	1	0	1		IS-U	
PU21	Auxiliary 2 regulation type 0 = Cold 1 = Hot	0	0	1		IS-U	
PU22	Auxiliary 2 regulation setpoint	20.0	-50.0	302.0		IS-U	
PU23	Auxiliary 2 regulation differential	2.0	0.0	36.0		IS-U	
PU24	Auxiliary output 2 minimum value	0.0	0.0	100.0	%	IS-U	
PU25	Auxiliary output 2 maximum value	100.0	0.0	100.0	%	IS-U	
PU26	Auxiliary 2 analogue regulation type 0 = Minimum to unit ON 1 = Enablement step	1	0	1		IS-U	

14 Alarms

14.1 Antifreeze

function active (Heating, Cooling, or DHW) according to the parameters described below.

- System antifreeze alarm set
- Anti-freeze differential (like above)
- Anti-freeze alarm bypass time
- Automatic switch-on of unit for antifreeze function

The anti-freeze control is active even while the unit is off (controller powered and in anti-freeze standby operation).
Only for winter operation, there is a specific threshold with relative differential to activate the unit and signal the alarm.
If the anti-freeze alarm should continue for a *Period of pump operation with low temperature,* the pump is turned off until the next time the alarm is reset.
If there are integration heaters on the unit's heating coil and the DHW tank, they may be sent into operation together with the pump or as an alternative to starting the unit for anti-freeze depending on the value of the parameter Pr02.
If an anti-freeze condition comes up during production of DHW, two scenarios may occur:
The Domestic hot water enablement in antifreeze parameter (PH05) = 1: in this case the unit continues to operate in DHW
The Domestic hot water enablement in antifreeze parameter (PH05) = 0: in this case the unit goes back to the last operating mode.
In any event, the unit sets off the required actions (switches on auxiliary heating, etc.) and turns off if exiting the anti-freeze condition is not possible.

14.2Temperature Alarm Check

The temperature alarms are managed only when the machine is on based on the operating mode, monitoring the water temperature detected by the different probes and comparing them with the limits set in the designated parameters. The following parameters are valid for all the temperature alarms:

- *Consequence of a temperature alarm* (PA20) which defines the required action in the event that one of these alarms goes off:
  PA20 = 0 Disabled
  PA13 = 1 – The temperature alarm is just a warning
  PA13 = 2 – The temperature alarm causes locking of the unit with an always automatic rearm
  PA13 = 3 – The temperature alarm causes locking of the unit with automatic rearm; if the alarm condition continues for the *Maximum temperature alarm period* (PA21) the alarm changes to manual rearm.
- *Temperature alarm delay* (PA23) which is the minimum time for which the alarm condition must stay active before the alarm is reported and the foreseen actions are set in place.
- *Temperature alarm differential* (PA22) which sets the differential with respect to the set necessary to consider the alarm condition over, perform rearm of the alarm (always automatic), and restore full operation of the unit.
- *Temperature alarms bypass upon start-up* (PA24) which sets the period of inhibition of the temperature alarms when the unit is started (from OFF)

If an alarm condition forms and the condition stays active for the period PA18, its alarm code is reported (outlined in the following paragraphs).

14.2.1 High Temperature Alarm:

The *High temperature alarm* (AL02) is defined within the limits and the actions set in place (P20), as follows:

- Operation in Heating: The **supply** temperature must exceed the *High temperature alarm in heating* (PA25). When the alarm is activated the compressor and all the active auxiliary heating steps are turned off and the circulation pump is kept on.
- Operation in DHW: The **DHW and/or supply** temperature must exceed the *High temperature alarm in DHW* (PA29). When the alarm is activated the compressor and all the active auxiliary heating steps are turned off and the circulation pump is kept on.
- Operation in anti-Legionella: The **DHW and/or supply** temperature must exceed the *High temperature alarm in anti-Legionella* (PA31). When the alarm is activated the compressor and all the active auxiliary heating steps are turned off and the circulation pump is kept on.
- Operation in Cooling: The **return** temperature must exceed the *High temperature alarm in cooling* (PA27). When the alarm is activated both the compressor and the circulation pump are turned off. The circulation pump will be turned back on periodically for a refresh cycle. If the condition stays the same for the maximum temperature alarm period (PA21) and PA20 = 3, the compressor and circulation pump are turned off and the alarm changes to manual rearm.

14.2.2 Low Temperature Alarm:

The *Low temperature alarm* (AL01) is defined within the limits and the actions set in place (PA20), as follows:

- Operation in Heating: The **return** temperature must drop below the *Low temperature alarm in heating* (PA26). When the alarm is activated the auxiliary heating steps are activated in sequence. If the condition stays the same for the *Maximum temperature alarm period* (PA21) and PA20 = 3, all plants are switched off (the compressor, auxiliary heating, and circulation pump) and the alarm changes to manual rearm. TBI
- Operation in DHW and anti-Legionella: The **DHW and/or return** temperature must drop below the *Low temperature alarm in DHW* (PA30). When the alarm is activated the heating steps are activated in sequence. If the condition stays the same for the *Maximum temperature alarm period* (PA21) and PA20 = 3, all plants are switched off (the compressor, auxiliary heating, and circulation pump) and the alarm changes to manual rearm. TBI
- Operation in Cooling: The **supply** temperature must drop below the *High temperature alarm in cooling* (PA28). When the alarm is activated the compressor is turned off and the circulation pump is kept on.

14.2.3 Compressor Discharge Gas High Temperature Alarm

The controller also manages a "compressor discharge hot gas" temperature probe. If the temperature of the hot gas exceeds the Discharge high temperature alarm (PA85) for the Discharge high temperature delay (PA87), a *Compressor discharge high temperature alarm* (AL21) with automatic or manual rearm based on the setting of the *Compressor discharge high temperature rearm type* (PA88) is signalled. The alarm makes the compressor shut off.

14.3 Pressure Alarm Check

Depending on the operating mode, the pressure alarms are managed monitoring the status of the high and low pressure switches and the pressure detected by the high and low pressure transducers.

14.3.1 High Pressure Alarm from the Pressure Switch

If the high pressure switch digital input activates, the *pressure switch-activated high pressure alarm* (AL04) goes off, which immediately makes the compressor stop and has a manual rearm.

- In heating or DHW mode, if heating requests are underway, heating is activated and the circulation pump stays active with normal operation.

- In cooling mode, the circulation pump is turned off and ventilation is forced (or kept) to maximum, even if it was linked to compressor start-up (PF02=1).

14.3.2 Low Pressure Alarm from the Pressure Switch

If the low pressure switch digital input activates, the *low pressure from pressure switch alarm* (AL05) goes off, which immediately makes the compressor stop and has an automatic rearm. The alarm rearm changes to manual when the alarm has gone off the number of times set in parameter PA43.

- In heating or DHW mode, if heating requests are underway, heating is activated, the circulation pump stays on with normal operation, and ventilation is forced (or kept) to maximum, even if it was linked to compressor start-up (PF02=1).
- In cooling mode, the circulation pump stays on.

Here are some special cases:

- Low pressure switch digital input active with compressor off: if in this situation there is a request for compressor start-up, the circulation pump is turned on (if not already on) but the compressor is not allowed to turn on (flashing icon on the display). If the pressure switch re-arms within the *Low pressure alarm delay upon start-up* (PA42) the compressor is allowed to turn on, otherwise alarm AL05 is set off with the corresponding actions.
- Bypass upon start-up: when the compressor is turned on the low-pressure alarm is inhibited for the *Low pressure alarm bypass upon start-up* (PA47) during which activation of the low pressure switch does not make the alarm go off.

14.3.3 High Pressure Alarm from the Transducer

If the condensation pressure exceeds the *High-pressure alarm setpoint* (PA48) the *high-pressure alarm from transducer* (AL06) with management identical to that of the high-pressure alarm from pressure switch is set off. The alarm condition cancels itself (and the alarm becomes resettable) when the condensation pressure falls below the PA48 setpoint by the *High pressure alarm differential* (PA49).

14.3.4 Low Pressure Alarm from the Transducer

In general, the low pressure switch is calibrated for operation in heat pump at a lower value than that adequate to cooling mode. It was decided to activate the low-pressure alarm **only for the cooling mode** so as to have a calibration of the alarm that would also be adequate in this mode. In addition to in cooling mode, the low-pressure alarm from the transducer can also activate upon compressor start-up (during the bypass period upon compressor start-up) according to the value of the *Low-pressure alarm enablement during bypass* (PA44):

- PA44 = 0 – Alarm disabled during bypass
- PA44 = 1 – Alarm enabled during bypass only in Cooling mode
- PA44 = 2 – Alarm enabled during bypass only in Heating and DHW mode
- PA44 = 3 – Alarm always enabled during bypass

Based on these premises, if the evaporation pressure falls below the

- *Low-pressure alarm setpoint in cooling* (PA40) in Cooling mode
- *Low-pressure alarm setpoint during bypass* (P845) during the low-pressure alarm bypass upon compressor start-up

the *Low-pressure alarm from transducer* (AL07) with management identical to that of the low-pressure alarm from pressure switch is activated. Naturally, the low-pressure alarm during bypass upon compressor start-up is an exception that is enabled only during this phase (neither before compressor start-up nor during normal operation)
The alarm condition cancels itself and the alarm rearms (or becomes resettable) when the evaporation pressure:

- Exceeds the PA40 setpoint by the *Low pressure alarm differential in cooling* (PA41).
- Exceeds the PA45 setpoint by the *Low pressure alarm differential during bypass* (PA46).

Like with the low-pressure alarm from pressure switch, with the following integrations:
The alarm initially has automatic rearm, unless it exceeds a certain number of interventions within the hour (*PA16*); in this case it changes to manual rearm and can be reset if in the meantime the pressure rises above the minimum threshold of a certain differential value.

14.4Superheating Control Algorithm Alarm Check

These are alarms that are calculated only if the superheating control algorithm is enabled. They are automatically reset every time that superheating control is disabled.
A delay may be set for all these alarms: if the measure is beyond the threshold, first a warning is given. When the set delay has elapsed the alarm is activated.
A hysteresis may also be set; if you are in a warning state and the measure goes back within the threshold of a quantity equal to the hysteresis, the state of the measure automatically goes back to OK without setting off the alarm.

14.4.1 Low Superheating LoSH Alarm

If the superheating falls below the set threshold (PV02, PV12) for more than the permitted period (PV71) the low superheating alarm is activated. A hysteresis may be set (PV70).

14.4.2 High Superheating HiSH Alarm

If the superheating rises above the set threshold (PV03, Pv13) for more than the permitted period (PV73) the high superheating alarm is activated. A hysteresis may be set (PV72).

14.4.3 Low Operating Pressure LOP Alarm

If the evaporation temperature falls below the set threshold (PV04, PV14) for more than the permitted period (PV83) the LOP alarm is activated. A hysteresis may be set (PV82).
A correction algorithm is activated during the warning state which modifies the valve's aperture position.

14.4.4 Maximum Operating Pressure MOP Alarm

If the evaporation temperature rises above the set threshold (PV05, PV15) for more than the permitted period (PV77) the MOP alarm is activated. A hysteresis may be set (PV76).
A correction algorithm is activated during the warning state which modifies the superheating setpoint on which the superheating control then acts.
The parameters that govern this algorithm are:

- PV78: working band of the algorithm of regulation of the MOP
- PV79: filter applied to the measurement of the evaporation temperature
- PV80: maximum variation applicable to the superheating setpoint
- PV81: delay with which the MOP control algorithm is activated with respect to activation of superheating control.

14.4.5 Low Pressure LP Alarm

If the evaporation pressure falls below the set threshold (PV34) for more than the permitted period (PV75) the LOP alarm is activated. A hysteresis may be set (PV74).

14.5Diagnostics

There are two types of alarms: manual rearm and automatic rearm. For many alarms you can set the type of rearm most suitable to your needs in the parameters.

14.5.1 Manual Rearm Alarms

If an alarm with manual rearm goes off:

- The alarm icon starts blinking

Press the ENTER key (set) in the "Alarm" menu; the code of the first active alarm is shown.

Once the conditions that the alarm went off for run out, you can manually rearm the alarm. To perform this operation:

- go to the page of the alarm to be reset
- hold down the ENTER key (set) for about two seconds.

At this point, if there aren't other alarms, a page saying "none" will appear, the alarm icon will turn off, and the machine will go back to its normal operation. If instead there are other alarms, the code for the next active alarm will be shown.

The consequences that derive from an active manual alarm still stand until the user deletes the alarm message.

14.5.2 Automatic Rearm Alarms

If an alarm with automatic rearm goes off:

- The alarm icon starts blinking

Press the ENTER key (set) in the "Alarm" menu; the code of the first active alarm is shown.

Once the conditions for which the alarm went off have run out, the rearming and deletion of the alarm message occur automatically without the user having to intervene.

The consequences that derive from an active automatic alarm still stand until the causes that set off the alarm have been solved.

14.6Alarm Table

Code	Alarm description	Type	Result	Notes
AL01	Low temperature	W/A/ M	Only a warning or Compressor OFF (*1)	Settable delay
AL02	High temperature	W/A/ M	Only a warning or compressor OFF (*1)	Settable delay
AL03	Flow switch	A/M	Compressor OFF Pump OFF after PP09	Settable delay
AL04	High pressure from pressure switch	Manu	Compressor OFF (*2)	
AL05	Low pressure from pressure switch	A/M	Compressor and fan OFF (*2)	Settable start delay and speed
AL06	High pressure from transducer	Manu	Compressor OFF (*2)	
AL07	Low pressure from transducer	A/M	Compressor and fan OFF (*2)	Settable start delay and speed
AL08	Start-up failed due to low pressure	Auto	Compressor OFF	Settable delay
AL09	Antifreeze	Manu	Compressor OFF Pump OFF after PP10 (*3)	Settable delay
AL10	Solar panel flow switch	A/M	Pump OFF after PP09	Settable delay
AC21	Compressor1 thermal switch	A/M	Compressor OFF	Settable delay
AC22	Compressor2 thermal switch	A/M	Compressor OFF	Settable delay
AC23	Compressor3 thermal switch	A/M	Compressor OFF	Settable delay
AC24	Boiler thermal switch	A/M	Boiler OFF	Settable delay

AC25	Fan thermal switch	A/M	Fan OFF	Settable delay
AC26	Plant pump thermal switch	A/M	Pump OFF	Settable delay
AC27	Source pump thermal switch	A/M	Pump OFF	Settable delay
AC28	Solar panel pump thermal switch	A/M	Pump OFF	Settable delay
AC29	Heater thermal switch	A/M	Heater OFF	Settable delay
AC30	DHW heater thermal switch	A/M	DHW heater OFF	Settable delay
AL11	Compressor discharge gas high temperature	A/M	Compressor OFF	Settable delay
AL12	Anti-Legionella	A/M	Display	Settable delay
AL13	Limit of operation	A/M	Display	
AL14	Defrost	A/M	Display	
AC01	Compressor operating hours	Auto	Display	
AP01	Plant pump operating hours	Auto	Display	
AP02	Source pump operating hours	Auto	Display	
AP03	PS pump operating hours	Auto	Display	
AF01	Fan operating hours	Auto	Display	
ES01	Input temperature probe (plant)	Auto	Inhibits the functions that use it	Settable delay
ES02	External temperature probe	Auto	Inhibits the functions that use it	Settable delay
ES03	Output temperature probe (plant)	Auto	Inhibits the functions that use it	Settable delay
ES04	Output temperature probe (source)	Auto	Inhibits the functions that use it	Settable delay
ES05	Coil temperature probe 1	Auto	Inhibits the functions that use it	Settable delay
ES06	DHW temperature probe (at the top)	Auto	Inhibits the functions that use it	Settable delay
ES07	DHW temperature probe (at the bottom)	Auto	Inhibits the functions that use it	Settable delay
ES08	Solar panel output temperature probe	Auto	Inhibits the functions that use it	Settable delay
ES09	Solar panel input temperature probe	Auto	Inhibits the functions that use it	Settable delay
ES10	Condensation pressure transducer	Auto	Inhibits the functions that use it	Settable delay
ES11	Compressor discharge temperature probe	Auto	Inhibits the functions that use it	Settable delay
ES12	Intake temperature probe	Auto	Inhibits the functions that use it	Settable delay
ES13	Evaporation pressure transducer	Auto	Inhibits the functions that use it	Settable delay
ES14	Coil temperature 2 probe	Auto	Inhibits the functions that use it	Settable delay
ES15	Auxiliary probe 1	Auto	Inhibits the functions that use it	Settable delay
ES16	Auxiliary probe 2	Auto	Inhibits the functions	Settable delay

			that use it	
AL15	I/O settings alarm	Auto	Display	
AL16	Modulating compressor discharge temperature limit	Auto	Compressor OFF	
AL17	Envelope output alarm	A/M	Compressor OFF	Settable delay
AL19	RTC down/broken alarm	A/M	Display	
AL20	Inverter alarm	Auto	Compressor OFF	
AL21	EEV alarm: LoSH (low superheating)	Auto	Compressor OFF	Settable delay
AL22	EEV alarm: HiSH (high superheating)	Auto	Compressor OFF	Settable delay
AL23	EEV alarm: LOP (low operating pressure)	Auto	Compressor OFF	Settable delay
AL24	EEV alarm: MOP (maximum operating pressure)	Auto	Compressor OFF	Settable delay
AL25	EEV alarm: LP (low pressure)	Auto	Compressor OFF	Settable delay

(*) Upon start-up all the alarms are reset

(*[1]) The pump is commanded based on the mode (heat/cool) and the type of alarm (high/low temperature)

(*[1]) The pump is commanded based on the mode (heat/cool) and the type of alarm (high/low pressure)

(*[3]) As an alternative, the unit is turned on or the heaters are activated

W/A/M = Warning, Auto, or Manual alarm (settable in the parameters or due to number of interventions/hour)

14.7Alarm History

c-pro 3 HPRU has a history that keeps track of the last 100 "exceptional" events (for example, including manual operation and key-press defrost). Once 100 events are reached, the oldest ones are overwritten. In the case of events that do not indicate an alarm (key-press defrost, etc.), pre-alarms, and automatic rearm alarms, the date and time of the start and end of the alarm condition are recorded. In the case of manual rearm alarms, the date and time of the manual rearm are also recorded.

15 General List of Parameters

Code	Parameter description	Default	Min	Max	U.M.	Menu	Notes
USER MENU (UT)							
MOdE	Sets the operating mode: 0: CooL, (Cooling/Summer) 1: HEAt (Heating/Winter)	0	0	1		UT	
SPC1	Cooling set-point	8.5 47.3	PC21	PC22	°C °F	UT	
SPH1	Heating set-point	40.0 104.0	PC23	PC24	°C °F	UT	
SPB1	Domestic Hot Water (DHW) Setpoint	50.0 122.0	20.0 68.0	95.0 203.0	°C °F	UT	
SSB1	Sets the value of the domestic hot water setpoint differential	1.0 1.8	0.0 0.0	10.0 18.0	°C °F	UT	
PSd1	User Password	0	-999	9999		UT	
MAINTENANCE MENU (MA)							
OPERATION (MA-F)							

Code	Parameter description	Default	Min	Max	U.M.	Menu	Notes
PM00	Compressor operating hours limit	2000	0	100000	hours	MA-F	
PM30	Pump operating hours limit	2000	0	9999	hours x 10	MA-F	Expressed in ten-hour periods
PM40	Fan operating hours limit	2000	0	9999	hours x 10	MA-F	Expressed in ten-hour periods
FORCINGS (MA-F)							
PM01	Compressor1 operating hours	0	0	100000	hours	MA-F	
PM02	Compressor2 operating hours	0	0	100000	hours	MA-F	
PM03	Compressor3 operating hours	0	0	100000	hours	MA-F	
PM04	Compressor1 start-ups	0	0	10000000		MA-F	
PM05	Compressor2 start-ups	0	0	10000000		MA-F	
PM06	Compressor3 start-ups	0	0	10000000		MA-F	
PM31	Pump operating hours	0	0	100000	hours	MA-F	
PM32	Source pump operating hours	0	0	100000	hours	MA-F	
PM33	Solar panel pump operating hours	0	0	100000	hours	MA-F	
PM41	Fan operating hours	0	0	100000	hours	MA-F	
PM91	Year of last maintenance job	2011	2011	2060		MA-F	
PM92	Month of last maintenance job	1	1	12		MA-F	
PM93	Day of last maintenance job	1	1	31		MA-F	
MANUAL OPERATION (MA-M)							
PM11	Enable manual operation of compressor1 0: Auto – normal operation 1: Manu – manual operation	0	0	1		MA-M	
PM12	Enable manual operation of compressor2 0: Auto – normal operation 1: Manu – manual operation	0	0	1		MA-M	
PM13	Enable manual operation of compressor3 0: Auto – normal operation 1: Manu – manual operation	0	0	1		MA-M	
PM21	Forcing of start-up of compressor1 0: turn off compressor 1: turn on compressor	0	0	1		MA-M	
PM22	Forcing of start-up of compressor2 0: turn off compressor 1: turn on compressor	0	0	1		MA-M	
PM23	Forcing of start-up of compressor3 0: turns off compressor 1: turns on compressor	0	0	1		MA-M	

Code	Parameter description	Default	Min	Max	U.M.	Menu	Notes
PM51	Enable manual operation of the fan 0: Auto – normal operation 1: Manu – manual operation	0	0	1		MA-M	
PM52	Enable manual operation of the pump 0: Auto – normal operation 1: Manu – manual operation	0	0	1		MA-M	
PM53	Enable manual operation of the solar panel pump 0: Auto – normal operation 1: Manu – manual operation	0	0	1		MA-M	
PM54	Enable manual operation of the source pump 0: Auto – normal operation 1: Manu – manual operation	0	0	1		MA-M	
PM61	Forcing fan speed	0.0	0.0	100.0	%	MA-M	
PM62	Forcing pump start-up 0: turns off pump 1: turns on pump	0	0	1		MA-M	
PM63	Forcing solar panel pump start-up 0: turns off pump 1: turns on pump	0	0	1		MA-M	
PM64	Forcing source pump start-up 0: turns off pump 1: turns on pump	0	0	1		MA-M	
CALIBRATION (MA-CA)							
PM81	Return temperature probe calibration	0.0 0.0	-20.0 -36.0	20.0 36.0	°C °F	MA-CA	
PM82	External temperature probe calibration	0.0 0.0	-20.0 -36.0	20.0 36.0	°C °F	MA-CA	
PM83	Low pressure transducer calibration	0.0 0.0	-20.0 -290.0	20.0 290.0	Bar psi	MA-CA	
PM84	Supply temperature calibration probe	0.0 0.0	-20.0 -290.0	20.0 290.0	Bar psi	MA-CA	
PM85	High-pressure transducer calibration	0.0 0.0	-20.0 -36.0	20.0 36.0	°C °F	MA-CA	
PM86	Compressor discharge temperature probe calibration	0.0 0.0	-20.0 -36.0	20.0 36.0	°C °F	MA-CA	
PM87	Top part DHW temperature probe calibration	0.0 0.0	-20.0 -36.0	20.0 36.0	°C °F	MA-CA	
PM88	Lower part DHW temperature probe calibration	0.0 0.0	-20.0 -36.0	20.0 36.0	°C °F	MA-CA	
PM89	Coil1 temperature probe calibration	0.0 0.0	-20.0 -36.0	20.0 36.0	°C °F	MA-CA	

Code	Parameter description	Default	Min	Max	U.M.	Menu	Notes
PM90	Coil2 temperature probe calibration	0.0 0.0	-20.0 -36.0	20.0 36.0	°C °F	MA-CA	
PM91	Output temperature probe (source) calibration	0.0 0.0	-20.0 -36.0	20.0 36.0	°C °F	MA-CA	
PM92	Solar panel input temperature probe calibration	0.0 0.0	-20.0 -36.0	20.0 36.0	°C °F	MA-CA	
PM93	Solar panel output temperature probe calibration	0.0 0.0	-20.0 -36.0	20.0 36.0	°C °F	MA-CA	
PM94	Intake temperature probe calibration	0.0 0.0	-20.0 -36.0	20.0 36.0	°C °F	MA-CA	
PSd2	Password to Servicer	-1	-999	9999		MA-F	
INSTALLER MENU (IS)							
COMPRESSOR (IS-C)							
PC28	Maximum time in heating/cooling	10	1	999	Min	IS-C	
PC29	Maximum DHW time	30	1	999	Min	IS-C	
PC56	Maximum number of bypass valve activations	5	1	10		IS-C	
REGULATION (IS-R)							
PC00	Temperature regulation probe. 0: supply temp. probe 1: return temp. probe	1	0	1		CO-C	
PC02	Compressor rotation: 0:FIFO 1:LIFO 2:FIFO+HS 3:LIFO+HS	3	0	3		CO-C	
PC12	Regulation band (lateral band)	2.5 4.5	0.1	20.0 36.0	°C °F	IS-R	
PC14	Neutral Zone of regulation	5.0 9.0	PC15	PC16	°C °F	IS-R	
PC17	Fitting/release time (neutral zone)	20	0	999	sec	IS-R	
PC18	Type of neutral zone: 0: divided 1: whole	0	0	1		IS-R	
PC19	Compressor operating hours factor	1	0	255		IS-R	
PC20	Compressor operation start-ups factor	1	0	255		IS-R	
PC30	Modulating compressor proportional band	10.0 18.0	0.0	20.0 36.0	°C °F	IS-R	
PC31	Modulating compressor integral PI time	0	0	999	sec	IS-R	
PC62	Heating – cooling automatic changeover setpoint	20.0 68.0	PC63	40.0 104.0	°C °F	IS-R	
PC63	Cooling – heating automatic changeover setpoint	10.0 50.0	0.0 32.0	PC62	°C °F	IS-R	

Code	Parameter description	Default	Min	Max	U.M.	Menu	Notes
PC64	Dynamic set point maximum offset in Cooling	-5.0 -9.0	-10.0 -18.0	10.0 18.0	°C °F	IS-R	
PC65	External temperature for dynamic setpoint maximum offset in Cooling	25.0 77.0	10.0 50.0	PC66	°C °F	IS-R	
PC66	External temperature for dynamic setpoint offset cancellation in Cooling	35.0 95.0	PC65	50.0 122.0	°C °F	IS-R	
PC67	Dynamic set point maximum offset in Heating	-10.0 -18.0	-20.0 -36.0	20.0 36.0	°C °F	IS-R	
PC68	External temperature for dynamic set point maximum offset in Heating	5.0 41.0	-10.0 14.0	PC69	°C °F	IS-R	
PC69	External temperature for dynamic set point offset cancellation in Heating	15.0 59.0	PC68	25.0 77.0	°C °F	IS-R	
VENTILATION (IS-F)*							
PF01	Type of exchanger regulation: 0: Automatic 1: Speed 1 (par. PF61) 2: Speed 2 (par. PF62) 3: Speed 3 (par. PF63) 4: Speed 4 (par. PF64)	0 (Auto.)	0	4		IS-F	In V-Color the parameter is incorporated in the IS-R menu
DEFROST (IS-D)							
Pd10	Type of defrost 0: none 1: timed 2: temperature 3: dynamic 4: dynamic + timed	4	0	4		IS-D	
Pd21	External temperature for defrost time compensation offset cancellation	5.0	Pd22	20.0 68.0	°C °F	IS-D	
Pd22	External temperature for defrost time compensation maximum offset	-5.0	-30.0 -22.0	Pd21	°C °F	IS-D	
Pd23	Maximum defrost delay	3600	Pd05	9600		IS-D	
Pd31	Setpoint of condensate tray heater tank in defrost	3.0 37.4	-10.0 14.0	30.0 86.0	°C °F	IS-D	
Pd32	Condensate tray heater tank in defrost differential	5.0 9.0	0.0 0.0	20.0 36.0	°C °F	IS-D	

PUMP AND FLOW SWITCH (IS-P)							
PP07	Pump switch-off in defrost	No (0)	No (0)	Yes (1)		IS-P	By enabling pump switch-off in defrost, the antifreeze will be determined by the low pressure transducer,
PP11	Means of pump activation: 0 – Pump always active with unit ON 1 – Pump active only by request of temperature regulator 2 – Pump active by temperature regulator request with Refresh Cycle	2	0	2		IS-P	
PP12	Pump delay prior to the refresh cycle	5	1	99	Min	IS-P	
PP13	Pump switch-on time during the Refresh Cycle	2	1	99	Min	IS-P	
PP15	Number of days with pump off for anti-grip activation	3	0	30	Days	IS-P	If PP15=0 the function is not active
PP16	Pump switch-on time during the anti-grip	30	5	999	Sec	IS-P	
PP21	Means of source pump activation: 0 – Pump always active with unit ON 1 – Pump active only by request of temperature regulator 2 – Pump active by temperature regulator request with Refresh Cycle	2	0	2		IS-P	
PP31	Solar panel regulation probe: 0 – Input 1 – Output	0	0	1		IS-P	
PP32	Solar panel pump activation delta	5.0 9.0	PP33	20.0 36.0	°C °F	IS-P	
PP33	Solar panel pump deactivation delta	3.0 5.5	0.0	PP32	°C °F	IS-P	
PP34	Pump switch-on time during the Refresh Cycle	2	1	99	Min	IS-P	
PP35	Pump delay prior to the refresh cycle	5	1	99	Min	IS-P	
PP36	DHW high temperature set-point	70.0 158.0	0.0 32.0	90.0 194.0	°C °F	IS-P	

PP37	DHW high temperature differential	10.0 18.0	0.0	20.0 36.0	°C °F	IS-P	
PP38	Solar panel high temperature set-point	100.0 212.0	0.0 32.0	130.0 266.0	°C °F	IS-P	
PP39	Solar panel high temperature differential	10.0 18.0	0.0	20.0 36.0	°C °F	IS-P	
ANTILEGIONELLA (IS-L)							
PL01	Enable Anti-Legionella cycle: 0: disabled 1: enabled	1	0	1		IS-L	
PL02	Power ON interval to perform an anti-Legionella cycle	7	1	60	Days	IS-L	Power ON, not actual operation
PL03	Enable an anti-Legionella cycle at Power ON 0: disabled 1: enabled	1	0	1		IS-L	
PL04	Maximum duration of the anti-Legionella cycle	120	1	999	Min	IS-L	
PL05	Anti-Legionella set-point	70.0 158.0	SPB1	80.0 176.0	°C °F	IS-L	
AUXILIARY HEATING (IS-A)							
Pr06	Auxiliary heating setpoint in defrost	15.0 59.0	0.0 32.0	70.0 158.0	°C °F	IS-A	
Pr07	Auxiliary heating neutral zone in defrost	5.0 9.0	0.1 0.1	10.0 18.0	°C °F	IS-A	
Pr08	Auxiliary heating priority 0 = Disabled 1 = Heater then boiler in integration 2 = Heater then boiler in replacement 3 = Boiler then heater in integration 4 = Boiler then heater in replacement	0	1	4		IS-A	Only the enabled auxiliary heating steps are activated
Pr09	Delay in activation of first auxiliary heating step (heater or boiler)	60	0	600	sec	IS-A	
Pr10	Delay in activation of second auxiliary heating step (heater or boiler)	60	0	600	sec	IS-A	
Pr11	Delay in activation of third auxiliary heating step (heater or boiler)	60	0	600	sec	IS-A	
Pr12	Low system water temperature auxiliary heating setpoint	30.0 86.0	0.0 32.0	70.0 158.0	°C °F	IS-A	
Pr13	Low system water temperature auxiliary heating neutral zone	5.0 9.0	0.0 0.0	10.0 18.0	°C °F	IS-A	
Pr14	Low system water temperature auxiliary heating delay	60	1	600	Min	IS-A	

Pr22	DHW tank heater setpoint in defrost	30.0 86.0	10.0 50.0	70.0 158.0	°C °F	IS-A	
Pr23	DHW tank heater differential in defrost	10.0 18.0	0.0 0.0	20.0 36.0	°C °F	IS-A	
Pr24	DHW heater in integration to the heat pump activation delay	30	0	PC30	min	IS-A	
Pr25	Setpoint not reached-delay due to auxiliary heating	20	0	999	min	IS-A	
AUXILIARY OUTPUTS (IS-U)*							
PU01	Auxiliary 1 regulation type 0 = Cold 1 = Hot	0	0	1		IS-U	
PU02	Auxiliary 1 regulation setpoint	20.0	-50.0	302.0		IS-U	
PU03	Auxiliary 1 regulation differential	2.0	0.0	36.0		IS-U	
PU04	Auxiliary output 1 minimum value	0.0	0.0	100.0	%	IS-U	
PU05	Auxiliary output 1 maximum value	100.0	0.0	100.0	%	IS-U	
PU06	Auxiliary 1 analogue regulation type 0 = Minimum to unit ON 1 = Enablement step	1	0	1		IS-U	
PU21	Auxiliary 2 regulation type 0 = Cold 1 = Hot	0	0	1		IS-U	
PU22	Auxiliary 2 regulation setpoint	20.0	-50.0	302.0		IS-U	
PU23	Auxiliary 2 regulation differential	2.0	0.0	36.0		IS-U	
PU24	Auxiliary output 2 minimum value	0.0	0.0	100.0	%	IS-U	
PU25	Auxiliary output 2 maximum value	100.0	0.0	100.0	%	IS-U	
PU26	Auxiliary 2 analogue regulation type 0 = Minimum to unit ON 1 = Enablement step	1	0	1		IS-U	
ALARM (IS-S)							
PA01	Antifreeze setpoint for unit switch-on in Heating	5.0 41.0	PA03	10.0 50.0	°C °F	IS-S	
PA02	Anti-freeze differential	2.0 3.6	0.1 0.1	10.0 18.0	°C °F	IS-S	
PA03	Antifreeze alarm set	3.0 37.4	-30.0 -22.0	PA01	°C °F	IS-S	
PA04	Antifreeze alarm differential	2.0 3.6	0.1 0.2	10.0 18.0	°C °F	IS-S	
PA80	Enable compressor operating hours alarm	Yes (1)	No (0)	Yes (1)		IS-S	
PA81	Enable pump operating hours alarm	Yes (1)	No (0)	Yes (1)		IS-S	
PA82	Enable fan operating hours alarm	Yes (1)	No (0)	Yes (1)		IS-S	
PA83	Enable defrost finished alarm	No (0)	No (0)	Yes (1)		IS-S	
OTHER PARAMETERS (IS-V)							

PH01	Start of low pressure transducer scale	0.0 0.0	-1.0 -14.5	PH02	Bar psi	IS-V	
PH02	End of low pressure transducer scale	20.0 290.0	PH01	15.0 217.5	Bar psi	IS-V	
PH03	Start of high pressure transducer scale	0.0 0.0	-1.0 -14.5	PH04	Bar psi	IS-V	
PH04	End of high pressure transducer scale	50.0 725.0	PH03	60.0 870.0	Bar psi	IS-V	
PH05	Forcing of the system's three-way valve due to antifreeze alarm	Yes (1)	No (0)	Yes (1)		IS-V	
PH06	Sets the means of unit switch-off: 0 = From ESC key (⏻) 1 = From Digital Input 2 = From key and Digital Input 3 = From Supervisor 4 = From Key and from Supervisor	0	0	4		IS-V	
PH07	Sets the means of changeover: 0 = Disabled 1 = From Digital Input 2 = From external temperature probe 3 = From Supervisor	0	0	3		IS-V	Changeover from keyboard (User Menu/Mode) is always active but never has priority over the other means.
PH09	Language: 0 = English 1 = Italian	1	0	1		IS-V	
PH10	CAN baud rate 1= 20K 2= 50K 3= 125K 3= 500K	2	1	4		IS-V	
PH11	Modbus Address of the board	1	1	247		IS-V	
PH12	Baud Rate of the communication for the board (1=2400, 2=4800, 3=9600, 4=19200)	3	1	4		IS-V	
PH13	ModBus Parity (0=none, 1=Odd, 2=Even)	2	0	2		IS-V	
PH14	ModBus StopBit (0=1bit, 1=2bit)	0	0	1		IS-V	

PH15	Refreshes the factory default setting in the parameters	No (0)	No (0)	Yes (1)		IS-V	Wait for the 0 value to be read again at the end of the refresh
PH29	Enable dynamic Setpoint	No (0)	No (0)	Yes (1)		IS-V	
PSd3	Installer Password	-2	-999	9999		IS-V	
MANUFACTURER'S PARAMETERS (CO)							
SETTINGS PARAMETERS (CO-I)							
PG00	Machine type: 0= Standard 1= With Domestic Hot Water	0	0	1		CO-I	
PG01	Enable EVdrive: 0= Disabled 1= Enabled	1	0	1		CO-I	
PG02	Compressor type: 0= 1 OnOff compressor 1= 2 OnOff compressor 2= 3 OnOff compressor 3= 1 modulating compressor 4=1 modulating compressor + 1OnOff 5=1 modulating compressor + 2OnOff	3	0	5		CO-I	
PG03	Compressor model: 0= SANYO C-SDP205H02B 1= TOSHIBA DA422A3F-27M 2 = LG AR055VAD 3 = LG GJT240DAA.A11EMB 4 = LG GKT141DAA_EMB 5 = LG GPT425DAA A11EMB 6 = BOCK HGX34e/215-4 S 7 = BRISTOL V80J503MB2A	0	0	7		CO-I	
PG04	Enable inverter (not available in HPRU3 nano+): 0= Disabled 1= Enabled	0	0	1		CO-I	
COMPRESSOR PARAMETERS (CO-C)							
PC03	Switch-on time between 2 compressors	10	0	999	Sec	CO-C	
PC04	Minimum compressor switch-on time	20	0	999	Sec	CO-C	
PC05	Minimum compressor switch-off time	120	0	999	Sec	CO-C	
PC06	Minimum time between two consecutive switch-ons of the same compressor	360	0	999	Sec	CO-C	
PC07	Enable compressor safety periods bypass in the reversals	1	0	1		CO-C	

PC08	Minimum compressor switch-off time during the reversal of the cycle reversing valve for the DHW function (from cooling)	30	0	999	Sec	CO-C	
PC09	Minimum machine OFF period during operating mode change	5	0	999	Min	CO-C	
PC10	State of the compressor in probe error 0: OFF – turned off 1: ON – turned on	0	0	1		CO-C	
PC11	Switch-off time between 2 compressors	20	0	999	Min	CO-C	
PC54	Maximum activation time hot gas bypass	30	1	999	Sec	CO-C	
PC55	Maximum deactivation time hot gas bypass	30	1	999	Sec	CO-C	
PC70	Envelope check delay from compressor start-up	10	0	999	Sec	CO-C	
PC71	Period of forcing compressor outside envelope	30	0	999	Sec	CO-C	
REGULATION PARAMETERS (CO-R)							
PC15	Minimum value of the Neutral Zone of regulation	1.0 1.8	0.1	PC16	°C °F	CO-R	
PC16	Maximum value of the Neutral Zone of regulation	10.0 18.0	PC15	20.0 36.0	°C °F	CO-R	
PC21	Minimum set-point value cooling	5.0 41.0	0.0 32.0	PC22	°C °F	CO-R	
PC22	Maximum set-point value cooling	10.0 50.0	PC21	40.0 104.0	°C °F	CO-R	
PC23	Minimum set-point value heating	30.0 86.0	20.0 68.0	PC24	°C °F	CO-R	
PC24	Maximum set-point value heating	45.0 113.0	PC23	80.0 176.0	°C °F	CO-R	
PC32	Modulating compressor minimum speed (% PI output)	16.70	0.00	100.00	%	CO-R	
PC33	Modulating compressor maximum speed (% PI output)	100.00	0.00	100.00	%	CO-R	
PC34	Percentage power supplied by the modulating compressor	100.00	0.00	100.00	%	CO-R	
PC35	Percentage power expressed by the first OnOff compressor	0.00	0.00	100.00	%	CO-R	
PC36	Percentage power expressed by the second OnOff compressor	0.00	0.00	100.00	%	CO-R	
PC37	Modulating compressor percentage linearisation minimum value	0.00	0.00	100.00	%	CO-R	

PC38	Modulating compressor percentage linearisation maximum value	100.00	0.00	100.00	%	CO-R	
PC39	Modulating compressor minimum RPS linearisation value	0	0	200	RPS	CO-R	
PC40	Modulating compressor maximum RPS linearisation value	120	0	200	RPS	CO-R	
PC41	Modulating compressor initial stabilisation speed	55	20	120	RPS	CO-R	
PC42	Modulating compressor initial stabilisation period	180	0	999	Sec	CO-R	
PC43	Modulating compressor limitation from discharge temperature: maximum permitted temperature	105.0 221	50.0 122.0	130.0 266.0	°C °F	CO-R	
PC44	Modulating compressor limitation from discharge temperature: protection temperature	115.0 239.0	50.0 122.0	130.0 266.0	°C °F	CO-R	
PC45	Modulating compressor limitation from discharge temperature: locking temperature	120.0 248.0	50.0 122.0	130.0 266.0	°C °F	CO-R	
PC46	Modulating compressor limitation from discharge temperature: maximum RPS limitation	20	0	200		CO-R	
PC47	Modulating compressor RPS	2	0	200		CO-R	
PC48	Modulating compressor RPS in alarm	7	0	200		CO-R	
PC49	Enable modulating compressor output modulation control from RPS (par PC46/PC47)	Yes (1)	No (0)	Yes (1)		CO-R	
PC50	Type of bypass: 0= Disabled 1= Chiller mode 2= HP mode 3= Always	2	0	3		CO-R	
PC51	Pressure setpoint for by-pass (chiller)	5.0 72.5	0.1	15.0 217.5	Bar psi	CO-R	
PC52	Pressure setpoint for bypass (HP)	5.0 72.5	0.1	15.0 217.5	Bar psi	CO-R	
PC53	Low pressure differential for parcelling in cooling	2.0 29.0	0.1	5.0 72.5	Bar psi	CO-R	
PC80	Limit value of the power (unloading) required with use of the modulating compressor	100.0	0.0	100.0	%	CO-R	With PC80=100% operation is inhibited
PC81	Power limitation setpoint (unloading) in cooling	25.0 29.0	SPC1	PA27	°C °F	CO-R	

PC82	Power limitation setpoint (unloading) in heating	15.0 29.0	PA26	SPH1	°C °F	CO-R	
PC83	Power limitation for unloading differential	5.0 9.0	0.0	20.0 36.0	°C °F	CO-R	
PC85	Type of modulating compressor oil return management: 0=Disabled 1=Only with modulating 2=Modulating and OnOff	0	0	2		CO-R	
PC86	Period of maintenance below the minimum threshold for oil return activation	5	0	999	Min	CO-R	
PC87	Period of forcing modulating compressor to the maximum for oil return	60	0	999	Sec	CO-R	
PC88	Minimum rotation threshold for oil return activation	40.0	PC32	100.0	%	CO-R	
VENTILATION (CO-F)							
PF02	Enable the fans only if the compressor is on	No (0)	No (0)	Yes (1)		CO-F	
PF03	Enable ventilation during defrost	No (0)	No (0)	Yes (1)		CO-F	
PF04	Outside temperature setpoint for ventilation in dripping	5.0 41.0	0.0 32.0	20.0 68.0	°C °F	CO-F	
PF10	Forcing of fans if in alarm on the condensation probe	0.0	0.0	100.0	%	CO-F	
PF11	Ventilation setpoint in cooling	20.0 290.0	5.0 72.5	45.0 652.5	Bar psi	CO-F	
PF12	Ventilation band in cooling	12.0 174.0	0.1 1.5	15.0 217.5	Bar psi	CO-F	
PF13	Enable forcing to the maximum in cooling	Yes (1)	No (0)	Yes (1)		CO-F	
PF14	Forcing to the maximum setpoint in cooling	26.0 377.0	15.0 217.5	45.0 652.5	Bar psi	CO-F	
PF15	Forcing to the maximum differential in cooling	2.0 29.0	0.1 1.5	5.0 72.5	Bar psi	CO-F	
PF16	Linear ventilation regulation maximum lower limit in cooling	30.0	0	PF32	%	CO-F	
PF17	Ventilation regulation maximum upper limit in cooling	100.0	PF31	100.0	%	CO-F	
PF18	Enable regulation below the maximum minimum ventilation limit in cooling	Yes (1)	No (0)	Yes (1)		CO-F	
PF19	Switch-off differential below the maximum minimum ventilation limit in cooling	2.0 29.0	0.0 0.0	5.0 72.5	Bar psi	CO-F	

PF21	Ventilation setpoint in heating	9.0 130.5	0.5 7.3	15.0 217.5	Bar psi	CO-F	
PF22	Ventilation band in heating	2.0 29.0	0.1 1.5	15.0 217.5	Bar psi	CO-F	
PF23	Enable forcing to the maximum in heating	Yes (1)	No (0)	Yes (1)		CO-F	
PF24	Forcing to the maximum setpoint in heating	3.2 46.4	0.5 7.3	20.0 290.0	Bar psi	CO-F	
PF25	Forcing to the maximum in heating differential	0.5 7.3	0.1 1.5	5.0 72.5	Bar psi	CO-F	
PF26	Forcing of ventilation minimum value	0.0	0.0	100.0	%	CO-F	
PF27	Speed-up period upon fan switch-on	4	0	999	Sec	CO-F	
PF31	Linear ventilation regulation lower limit	30.0	0	PF32	%	CO-F	
PF32	Ventilation regulation upper limit	100.0	PF31	100.0	%	CO-F	
PF33	Enable regulation below the minimum ventilation limit	Yes (1)	No (0)	Yes (1)		CO-F	
PF34	Switch-off differential below the minimum ventilation limit	2.0 29.0	0.0 0.0	5.0 72.5	Bar psi	CO-F	
PF36	Enable condensation fan pre-start-up due to high external temperatures	No (0)	No (0)	Yes (1)		CO-F	
PF37	External temperature threshold for condensation fan pre-start-up	30.0 86.0	20.0 68.0	40.0 104.0	°C °F	CO-F	
PF38	Fan pre-start-up speed	50.0	0	100.0	%	CO-F	
PF39	Compressor delay from condensation fan pre-start-up	5	0	999	sec	CO-F	
PF51	Ventilation setpoint in defrost	20.0 290.0	5.0 72.5	45.0 652.5	Bar psi	CO-F	
PF52	Ventilation band in defrost	12.0 174.0	5.0 72.5	15.0 217.5	Bar psi	CO-F	
PF53	Enable forcing to the maximum in defrost	Yes (1)	No (0)	Yes (1)		CO-F	
PF54	Forcing to the maximum setpoint in defrost	26.0 377.0	15.0 217.5	45.0 652.5	Bar psi	CO-F	
PF55	Forcing to the maximum differential in defrost	2.0 29.0	0.1 1.5	5.0 72.5	Bar psi	CO-F	
PF56	Enable regulation below the maximum minimum ventilation limit in cooling	Yes (1)	No (0)	Yes (1)		CO-F	
PF57	Switch-off differential below the maximum minimum ventilation limit in cooling	2.0 29.0	0.0 0.0	5.0 72.5	Bar psi	CO-F	
PF58	Ventilation regulation maximum upper limit in defrost	100.0	PF59	100.0	%	CO-F	
PF59	Linear ventilation regulation maximum lower limit in defrost	30.0	0	PF58	%	CO-F	

PF60	Type of condensation: 0: fan (air) 1: modulating pump (water)	0	0	1		CO-F	
PF61	Speed 1 in fixed regulation	20.0	0.0	100.0	%	CO-F	With PF01 = 1
PF62	Speed 2 in fixed regulation	40.0	0.0	100.0	%	CO-F	With PF01 = 2
PF63	Speed 3 in fixed regulation	60.0	0.0	100.0	%	CO-F	With PF01 = 3
PF64	Speed 4 in fixed regulation	80.0	0.0	100.0	%	CO-F	With PF01 = 4
PF65	Forcing of ventilation period for high or low pressure ALARM	0	0	99	Min	CO-F	
DEFROST (CO-D)							
Pd01	Probe choice to begin defrost 1 – Evaporation temperature 2 – Coil temperature probe (middle) 3 – Coil temperature probe (bottom)	1	1	3		CO-D	
Pd02	Defrost start set-point	-5.0 23.0	Pd14	20.0 68.0	°C °F	CO-D	
Pd03	Probe choice for the end of defrost 1 – Evaporation temperature 2 – Condensation transducer 3 – Coil temperature probe (medium) 4 – Coil temperature probe (small)	1	1	4		CO-D	
Pd04	Temperature setpoint of end of defrost	15.0 59.0	0.0 32.0	30.0 86.0	°C °F	CO-D	
Pd05	Defrost delay	1200	60	Pd23	Sec	CO-D	
Pd06	Maximum defrost time	300	60	1200	Sec	CO-D	
Pd07	Compressor stop prior to defrost	30	0	600	Sec	CO-D	
Pd08	Drip duration	30	0	600	Sec	CO-D	
Pd11	Design delta between external temperature and evaporation temperature	5.0 9.0	0.0 0.0	50.0 90.0	°C °F	CO-D	
Pd12	Differential for dynamic defrost	10.0 50.0	0.0 0.0	50.0 90.0	Bar psi	CO-D	
Pd13	Settling period after defrost (self learning)	5	0	99	Min	CO-D	
Pd14	Forced defrost setpoint	-25.0 -13.0	-40.0 -40.0	Pd02	°C °F	CO-D	
Pd15	Forced defrost differential	5.0 9.0	0.0 0.0	30.0 54.0	°C °F	CO-D	
Pd16	Forced defrost delay	60	0	240	Sec	CO-D	
Pd17	Differential for defrost timer reset	10.0 18.0	0.0 0.0	30.0 54.0	°C °F	CO-D	

Pd18	Holding period for end of defrost	60	0	600	Sec	CO-D	
Pd19	Defrost start setpoint minimum limit	-40.0 -40.0	-40.0 -40.0	Pd02	°C °F	CO-D	
Pd30	Enable condensate tray heater tank in defrost	No (0)	No (0)	Yes (1)		CO-D	
PUMP AND FLOW SWITCH (CO-P)							
PP04	Minimum delay between pump switch-on and compressor switch-on	60	0	999	Sec	CO-P	
PP05	Minimum delay between compressor switch-off and pump switch-off	60	0	999	Sec	CO-P	
PP06	Pump switch-off period for three way valve reversal	60	0	999	Sec	CO-P	
PP09	Pump operation period with flow switch alarm active	30	0	999	Sec	CO-P	
PP10	Pump operation period with low temperature output water (antifreeze alarm)	15	0	999	Sec	CO-P	
ANTI-LEGIONELLA PARAMETERS (CO-L)							
PL08	Anti-Legionella holding period	5	1	999	Min	CO-L	
AUXILIARY HEATING PARAMETERS (CO-A)							
Pr04	Enable auxiliary heating for antifreeze in cooling	1	0	1		CO-A	After having spent compressors with delays PR09 – 11
Pr05	Enable auxiliary heating in defrost	1	0	1		CO-A	
Pr15	Auxiliary heating operation due to limit of operation 0 = Disabled 1 = Integration 2 = Integration then replacement 3 = Replacement	2	0	4		CO-A	Also DHW
Pr16	Auxiliary heating setpoint (outside air) in integration due to limit of operation	0.0 32.0	-30.0 -22.0	10.0 50.0	°C °F	CO-A	
Pr17	Auxiliary heating differential in integration due to limit of operation	10.0 18.0	0.0 0.0	20.0 36.0	°C °F	CO-A	
Pr18	Auxiliary heating setpoint (outside air) in replacement due to limit of operation	-10.0 14.0	-30.0 -22.0	10.0 50.0	°C °F	CO-A	
Pr19	Auxiliary heating differential in replacement due to limit of operation	10.0 18.0	0.0 0.0	20.0 36.0	°C °F	CO-A	
Pr20	Re-enable compressor for heater/boiler thermal switch 0 = Compressor disabled 1 = Compressor enabled	1	0	1		CO-A	

Pr28	Heater use for antifreeze: 0=No 1=Only DO heater 2=Only unit switch-on (Winter Mode) 3=Heater + Unit Switch-on	3	0	3		CO-A	
ALARM (CO-S)							
PA05	Antifreeze alarm delay	30	0	999	Sec	CO-S	
PA06	Antifreeze setpoint during defrost	3.0 43.5	PA07	15.0 217.5	Bar psi	CO-S	For activation of the pump if PP07=1
PA07	Antifreeze differential during defrost	1.0 14.5	0.1 1.5	4.0 58.0	Bar psi	CO-S	
PA08	Anti-freeze alarm setpoint during defrost	1.0 14.5	0.0 0.0	PA05	Bar psi	CO-S	
PA09	Antifreeze alarm differential during defrost	1.0 14.5	0.1 1.5	4.0 58.0	Bar psi	CO-S	
PA10	Flow alarm bypass upon pump activation	30	1	999	Sec	CO-S	
PA11	Flow alarm delay in normal operation	10	1	999	Sec	CO-S	
PA12	Number of interventions/hour flow alarm for manual rearm	5	0	10		CO-S	
PA19	Probe error warning delay period	10	0	240	Sec	CO-S	
PA20	Consequence of a temperature alarm: 0 = Disabled 1 = Only a warning 2 = Machine locking upon automatic rearm 3= Machine locking upon rearm, first automatic then manual	0	0	3	Sec	CO-S	
PA21	Maximum period in temperature alarm for manual rearm	5	0	99	Min	CO-S	
PA22	Temperature alarm turn-off differential	2.0 3.6	0.1 0.2	10.0 18.0	°C °F	CO-S	
PA23	Temperature alarm intervention delay	30	1	999	Sec	CO-S	
PA24	Temperature alarm bypass upon switch-on	15	0	999	Sec	CO-S	
PA25	High temperature alarm setpoint in heating	50.0 122.0	SPH1	70.0 158.0	°C °F	CO-S	
PA26	Low temperature alarm setpoint in heating	10.0 50.0	8.0 46.4	SPH1	°C °F	CO-S	
PA27	High temperature alarm setpoint in cooling	30.0 86.0	SPC1	35.0 95.0	°C °F	CO-S	
PA28	Low temperature alarm setpoint in cooling	6.0 42.8	PA01	SPC1	°C °F	CO-S	
PA29	High temperature alarm setpoint in DHW	60.0 140.0	SPB1	70.0 158.0	°C °F	CO-S	

PA30	Low temperature alarm setpoint in DHW	25.0 77.0	20.0 68.0	SPB1	°C °F	CO-S	
PA31	High temperature alarm setpoint in anti-Legionella	70.0 158.0	SPB1	95.0 203.0	°C °F	CO-S	
PA38	Enable RTC alarm	Yes (1)	No (0)	Yes (1)		CO-S	
PA39	RTC alarm type	Auto (0)	Auto (0)	Manu (1)		CO-S	
PA40	Low-pressure alarm setpoint in cooling	3.0 43.5	PA29	10.0 145.0	Bar psi	CO-S	
PA41	Low-pressure alarm differential in cooling	1.0 14.5	0.1 1.5	4.0 58.0	Bar psi	CO-S	
PA42	Low-pressure alarm bypass upon compressor switch-on	120	0	999	Sec	CO-S	
PA43	Number of low-pressure alarms hour for manual rearm	3	0	5		CO-S	
PA44	Enable low-pressure alarm during bypass 0 = Disabled 1 = Only Cooling 2 = Only Heating (including DHW) 3 = Both operating modes	2	0	3		CO-S	
PA45	Low-pressure alarm setpoint during bypass	1.0 14.5	0.1 1.5	PA24	Bar psi	CO-S	
PA46	Low pressure alarm differential during bypass	0.5 7.3	0.1 1.5	4.0 58.0	Bar psi	CO-S	
PA47	Low-pressure alarm delay upon compressor start-up	5	0	PA26	Sec	CO-S	
PA48	High-pressure alarm setpoint	42.0 609.0	16.0 232.0	45.0 652.5	Bar psi	CO-S	
PA49	High-pressure alarm differential	7.0 101.5	0.1 1.5	10.0 145.0	Bar psi	CO-S	
PA66	Solar panel pump thermal alarm activation delay	10	0	999	Sec	CO-S	
PA67	Solar panel pump thermal alarm rearm type 0: Automatic 1: Manual	Manual (1)	Auto-matic (0)	Manual (1)		CO-S	
PA68	Source pump thermal alarm activation delay	10	0	999	Sec	CO-S	
PA69	Source pump thermal alarm rearm type 0: Automatic 1: Manual	Manual (1)	Auto-matic (0)	Manual (1)		CO-S	
PA70	Compressor thermal alarm activation delay	10	0	999	Sec	CO-S	

PA71	Compressor thermal alarm rearm type 0: Automatic 1: Manual	Manual (1)	Auto-matic (0)	Manual (1)		CO-S	
PA72	Fan thermal alarm activation delay	10	0	999	Sec	CO-S	
PA73	Fan thermal alarm rearm type 0: Automatic 1: Manual	Manual (1)	Auto-matic (0)	Manual (1)		CO-S	
PA74	Pump thermal alarm activation delay	10	0	999	Sec	CO-S	
PA75	Pump thermal alarm rearm type 0: Automatic 1: Manual	Manual (1)	Auto-matic (0)	Manual (1)		CO-S	
PA76	Boiler thermal alarm activation delay	10	0	999	Sec	CO-S	
PA77	Boiler thermal alarm rearm type 0: Automatic 1: Manual	Manual (1)	Auto-matic (0)	Manual (1)		CO-S	
PA78	Heater thermal alarm activation delay	10	0	999	Sec	CO-S	
PA79	Heater thermal alarm rearm type 0: Automatic 1: Manual	Manual (1)	Auto-matic (0)	Manual (1)		CO-S	
PA85	Discharge gas high temperature alarm setpoint	90.0 194.0	70.0 158.0	140.0 284.0	°C °F	CO-S	
PA86	Discharge gas high-temperature alarm differential	20.0 36.0	10.0 18.0	30.0 54.0	°C °F	CO-S	
PA87	Discharge gas high temperature alarm activation delay	30	0	999	Sec	CO-S	
PA88	Discharge gas high temperature alarm rearm type 0: Automatic 1: Manual	Manual (1)	Auto-matic (0)	Manual (1)		CO-S	
OTHER PARAMETERS (CO-V)							
PH31	Type of coolant used (temperature-pressure conversion) 1: R22 2: R134a 3: R404A 4: R407C 5: R410A 6: R507	5 (R410A)	1	6		CO-V	

* For the interface on V-color see the Installer-Regulation (IS-R) menu

15.1 micro+ Parameters with External Driver

EVCM PARAMETERS (CO-V)							
PV01	SH set-point (1)	6.0	3.0	25.0	K	CO-V	
PV02	LoSH set-point (1)	2.0	1.0	3.0	K	CO-V	

PV03	HiSH set-point (1)	15.0	10.0	40.0	K	CO-V	
PV04	LOP set-point (1)	-40.0	-40.0	40.0	K	CO-V	
PV05	MOP set-point (1)	40.0	-40.0	40.0	K	CO-V	
PV06	PID – proportional band (1)	7.0	1.0	100.0	K	CO-V	
PV07	PID – integral time (1)	120	0	999	sec	CO-V	
PV08	PID – derivative time (1)	120	0	999	sec	CO-V	
PV09	Start-up delay (1)	5	1	255	sec	CO-V	
PV10	Start-up position (1)	50.00	0.00	100.00	%	CO-V	
PV11	SH set-point (2)	6.0 10.8	3.0 5.4	25.0 45.0	K R	CO-V	
PV12	LoSH set-point (2)	2.0 3.6	1.0 1.8	3.0 5.4	K R	CO-V	
PV13	HiSH set-point (2)	15.0 27.0	10.0 18.0	40.0 72.0	K R	CO-V	
PV14	LOP set-point (2)	-40.0 -72.0	-40.0 -72.0	40.0 72.0	K R	CO-V	
PV15	MOP set-point (2)	40.0 72.0	-40.0 -72.0	40.0 72.0	K R	CO-V	
PV16	PID – proportional band (2)	7.0 12.6	1.0 1.8	100.0 180.0	K R	CO-V	
PV17	PID – integral time (2)	120	0	999	sec	CO-V	
PV18	PID – derivative time (2)	120	0	999	sec	CO-V	
PV19	Start-up delay (2)	5	1	255	sec	CO-V	
PV20	Start-up position (2)	50.00	0.00	100.00	%	CO-V	
PV21	Stabilisation period	0	0	255	sec	CO-V	
PV22	Stabilisation position	100.00	0.00	100.00	%	CO-V	
PV23	Operating mode: 0= SH algo 1= Manual	0	0	1		CO-V	
PV24	Manual position	0.00	0.00	100.00	%	CO-V	
PV25	SH parameter setpoint: 0= set1 1= set2	0	0	1		CO-V	
PV26	Relay function: 0= Disabled 1= Enabled: any alarm 2= Enabled: probe error 3= LoSH alarm 4= MOP alarm 5= valve alarm 6= solenoid valve 7= solenoid valve + alarms 8= resynchro	6	0	8		CO-V	

PV27	Probe type 3: 0= NTC 1= PT1000	0	0	1		CO-V	
PV28	Probe type 4: 0= 4..20mA (0.5 – 8) 1= 4..20mA (0 – 30) 2= 0-5V (0 – 7) 3= 0-5V (0 – 25) 4= 0-5V (0 – 60) 5= scaling	0	0	1		CO-V	
PV29	Probe type 1 (Condenser pressure): 1= PTC 2= NTC 3= 0..20mA 4= 4..20mA 5= 0-5V 6= 0-10V 7= PT1000 8= NTC K2 9= NTC K3	5	1	9		CO-V	
PV30	Probe type 2 (Discharge T.): 1= PTC 2= NTC 3= 0..20mA 4= 4..20mA 5= 0-5V 6= 0-10V 7= PT1000 8= NTC K2 9= NTC K3	2	1	9		CO-V	
PV31	Ts offset	0.0	-10.0	10.0	K	CO-V	
PV32	Te offset	0.0	-10.0	10.0	K	CO-V	
PV34	Relay logic	N.O. (0)	N.O. (0)	N.C. (1)		CO-V	
PV35	DI1 Logic	N.O. (0)	N.O. (0)	N.C. (1)		CO-V	
PV36	DI2 Logic	N.O. (0)	N.O. (0)	N.C. (1)		CO-V	
PV37	DI3 Logic	N.O. (0)	N.O. (0)	N.C. (1)		CO-V	
PV60	Enable modulating SH (neutral zone)	Yes (1)	No (0)	Yes (1)		CO-V	
PV61	Maximum SH set	15.0	3.0	25.0	K	CO-V	
PV62	Minimum SH set	2.0	1.0	25.0	K	CO-V	
PV63	Maximum DSH value	30.0	Pv64	50.0	K	CO-V	
PV64	Minimum DSH value	20.0	0.0	Pv63	K	CO-V	
PV65	Delay SH variation outside neutral zone	5	1	60	Min	CO-V	
PV66	Negative variation of the SH above the zone	0.2	0.1	2.0	K	CO-V	

PV67	Positive variation of the SH below the zone	1.0	0.1	2.0	K	CO-V	
I/O SETT. (CO-O)							
HA01	Analogue Input 1 (see table AI values)	2	0	65		CO-O	
HA02	Analogue Input 2 (see table AI values)	5	0	65		CO-O	
HA03	Analogue Input 3 (see table AI values)	8	0	65		CO-O	
HA04	Analogue Input 4 (see table AI values)	1	0	55		CO-O	
HA05	Analogue Input 5 (see table AI values)	6	0	55		CO-O	
HA06	Analogue Input 6 (see table AI values)	3	0	55		CO-O	
HA07	Analogue Input 7 (see table AI values)	4	0	65		CO-O	
HA08	Analogue Input 8 (see table AI values)	10	0	65		CO-O	
HA09	Analogue Input 9 (see table AI values)	9	0	65		CO-O	
HB01	Digital Input 1 (see table DI values)	2	0	42		CO-O	
HB02	Digital Input 2 (see table DI values)	8	0	42		CO-O	
HB03	Digital Input 3 (see table DI values)	14	0	42		CO-O	
HB04	Digital Input 4 (see table DI values)	22	0	42		CO-O	
HB05	Digital Input 5 (see table DI values)	20	0	42		CO-O	
HB06	Digital Input 6 (see table DI values)	38	0	42		CO-O	
HB07	Digital Input 7 (see table DI values)	4	0	42		CO-O	
HB08	Digital Input 8 (see table DI values)	0	0	42		CO-O	
HB09	Digital Input 9 (see table DI values)	0	0	42		CO-O	
HC01	Analogue Output 1 (see table AO values)	1	0	7		CO-O	
HC02	Analogue Output 2 (see table AO values)	2	0	7		CO-O	
HC03	Analogue Output 3 (see table AO values)	0	0	9		CO-O	

HC04	Analogue Output 4 (see table AO values)	0	0	9		CO-O	
HC05	Analogue Output 5 (see table AO values)	0	0	5		CO-O	
HC06	Analogue Output 6 (see table AO values)	0	0	5		CO-O	
HCF1	PWM fan frequency	10	10	2000		CO-O	
HD01	Digital Output 1 (see table DO values)	1	0	23		CO-O	
HD02	Digital Output 2 (see table DO values)	2	0	23		CO-O	
HD03	Digital Output 3 (see table DO values)	5	0	23		CO-O	
HD04	Digital Output 4 (see table DO values)	6	0	23		CO-O	
HD05	Digital Output 5 (see table DO values)	3	0	23		CO-O	
HD06	Digital Output 6 (see table DO values)	12	0	23		CO-O	
HD07	Digital Output 7 (see table DO values)	0	0	23		CO-O	
HD08	Digital Output 8 (see table DO values)	0	0	23		CO-O	
HD09	Digital Output 9 (see table DO values)	0	0	23		CO-O	
PSd4	Manufacturer Password	-3	-999	9999		CO	

15.2 nano+ Parameters with External Driver

EVCM PARAMETERS (CO-V)							
PV01	SH set-point (1)	6.0	3.0	25.0	K	CO-V	
PV02	LoSH set-point (1)	2.0	1.0	3.0	K	CO-V	
PV03	HiSH set-point (1)	15.0	10.0	40.0	K	CO-V	
PV04	LOP set-point (1)	-40.0	-40.0	40.0	K	CO-V	
PV05	MOP set-point (1)	40.0	-40.0	40.0	K	CO-V	
PV06	PID – proportional band (1)	7.0	1.0	100.0	K	CO-V	
PV07	PID – integral time (1)	120	0	999	sec	CO-V	
PV08	PID – derivative time (1)	120	0	999	sec	CO-V	
PV09	Start-up delay (1)	5	1	255	sec	CO-V	
PV10	Start-up position (1)	50.00	0.00	100.00	%	CO-V	
PV11	SH set-point (2)	6.0 10.8	3.0 5.4	25.0 45.0	K R	CO-V	
PV12	LoSH set-point (2)	2.0 3.6	1.0 1.8	3.0 5.4	K R	CO-V	

PV13	HiSH set-point (2)	15.0 27.0	10.0 18.0	40.0 72.0	K R	CO-V	
PV14	LOP set-point (2)	-40.0 -72.0	-40.0 -72.0	40.0 72.0	K R	CO-V	
PV15	MOP set-point (2)	40.0 72.0	-40.0 -72.0	40.0 72.0	K R	CO-V	
PV16	PID – proportional band (2)	7.0 12.6	1.0 1.8	100.0 180.0	K R	CO-V	
PV17	PID – integral time (2)	120	0	999	sec	CO-V	
PV18	PID – derivative time (2)	120	0	999	sec	CO-V	
PV19	Start-up delay (2)	5	1	255	sec	CO-V	
PV20	Start-up position (2)	50.00	0.00	100.00	%	CO-V	
PV21	Stabilisation period	0	0	255	sec	CO-V	
PV22	Stabilisation position	100.00	0.00	100.00	%	CO-V	
PV23	Operating mode: 0= SH algo 1= Manual	0	0	1		CO-V	
PV24	Manual position	0.00	0.00	100.00	%	CO-V	
PV25	SH parameter setpoint: 0= set1 1= set2	0	0	1		CO-V	
PV26	Relay function: 0= Disabled 1= Enabled: any alarm 2= Enabled: probe error 3= LoSH alarm 4= MOP alarm 5= valve alarm 6= solenoid valve 7= solenoid valve + alarms 8= resynchro	6	0	8		CO-V	
PV27	Probe type 3: 0= NTC 1= PT1000	0	0	1		CO-V	
PV28	Probe type 4: 0= 4..20mA (0.5 – 8) 1= 4..20mA (0 – 30) 2= 0-5V (0 – 7) 3= 0-5V (0 – 25) 4= 0-5V (0 – 60) 5= scaling	0	0	1		CO-V	

PV29	Probe type 1 (Condenser pressure): 1= PTC 2= NTC 3= 0..20mA 4= 4..20mA 5= 0-5V 6= 0-10V 7= PT1000 8= NTC K2 9= NTC K3	5	1	9		CO-V	
PV30	Probe type 2 (Discharge T.): 1= PTC 2= NTC 3= 0..20mA 4= 4..20mA 5= 0-5V 6= 0-10V 7= PT1000 8= NTC K2 9= NTC K3	2	1	9		CO-V	
PV31	Ts offset	0.0	-10.0	10.0	K	CO-V	
PV32	Te offset	0.0	-10.0	10.0	K	CO-V	
PV34	Relay logic	N.O. (0)	N.O. (0)	N.C. (1)		CO-V	
PV35	DI1 Logic	N.O. (0)	N.O. (0)	N.C. (1)		CO-V	
PV36	DI2 Logic	N.O. (0)	N.O. (0)	N.C. (1)		CO-V	
PV37	DI3 Logic	N.O. (0)	N.O. (0)	N.C. (1)		CO-V	
PV60	Enable modulating SH (neutral zone)	Yes (1)	No (0)	Yes (1)		CO-V	
PV61	Maximum SH setpoint	15.0	3.0	25.0	K	CO-V	
PV62	Minimum SH setpoint	2.0	1.0	25.0	K	CO-V	
PV63	Maximum DSH value	30.0	Pv64	50.0	K	CO-V	
PV64	Minimum DSH value	20.0	0.0	Pv63	K	CO-V	
PV65	Delay SH variation outside neutral zone	5	1	60	Min	CO-V	
PV66	Negative variation of the SH above the zone	0.2	0.1	2.0	K	CO-V	
PV67	Positive variation of the SH below the zone	1.0	0.1	2.0	K	CO-V	
I/O SETT. (CO-O)							
HA01	Analogue Input 1 (see table AI values)	2	0	65		CO-O	
HA02	Analogue Input 2 (see table AI values)	5	0	65		CO-O	
HA03	Analogue Input 3 (see table AI values)	8	0	55		CO-O	

HA04	Analogue Input 4 (see table AI values)	1	0	55		CO-O	
HA05	Analogue Input 5 (see table AI values)	6	0	55		CO-O	
HA06	Analogue Input 6 (see table AI values)	0	0	55		CO-O	
HA07	Analogue Input 7 (see table AI values)	0	0	55		CO-O	
HA08	Analogue Input 8 (see table AI values)	0	0	65		CO-O	
HA09	Analogue Input 9 (see table AI values)	0	0	65		CO-O	
HB01	Digital Input 1 (see table DI values)	6	0	42		CO-O	
HB02	Digital Input 2 (see table DI values)	0	0	42		CO-O	
HB03	Digital Input 3 (see table DI values)	14	0	42		CO-O	
HB04	Digital Input 4 (see table DI values)	22	0	42		CO-O	
HB05	Digital Input 5 (see table DI values)	20	0	42		CO-O	
HC01	Analogue Output 1 (see table AO values)	1	0	7		CO-O	
HC02	Analogue Output 2 (see table AO values)	2	0	7		CO-O	
HC03	Analogue Output 3 (see table AO values)	0	0	9		CO-O	
HC04	Analogue Output 4 (see table AO values)	0	0	9		CO-O	
HCF1	PWM fan frequency	10	10	2000		CO-O	
HD01	Digital Output 1 (see table DO values)	1	0	23		CO-O	
HD02	Digital Output 2 (see table DO values)	2	0	23		CO-O	
HD03	Digital Output 3 (see table DO values)	5	0	23		CO-O	
HD04	Digital Output 4 (see table DO values)	6	0	23		CO-O	
HD05	Digital Output 5 (see table DO values)	0	0	23		CO-O	
HD06	Digital Output 6 (see table DO values)	12	0	23		CO-O	
HD07	Digital Output 7 (see table DO values)	10	0	23		CO-O	

PSd4	Manufacturer Password	-3	-999	9999		CO	

15.3 KiloEEV Parameters with Built-in Driver

EVCM PARAMETERS (CO-V)							
PV01	SH set-point (1)	6.0 10.8	3.0 5.4	25.0 45.0	K R	CO-V	
PV02	LoSH set-point (1)	2.0 3.6	1.0 1.8	3.0 5.4	K R	CO-V	
PV03	HiSH set-point (1)	15.0 27.0	10.0 18.0	40.0 72.0	K R	CO-V	
PV04	LOP set-point (1)	-40.0 -72.0	-40.0 -72.0	40.0 72.0	K R	CO-V	
PV05	MOP set-point (1)	40.0 72.0	-40.0 -72.0	40.0 72.0	K R	CO-V	
PV06	PID – proportional band (1)	7.0 12.6	1.0 1.8	100.0 180.0	K R	CO-V	
PV07	PID – integral time (1)	120	0	999	sec	CO-V	
PV08	PID – derivative time (1)	120	0	999	sec	CO-V	
PV09	Start-up delay (1)	5	1	255	sec	CO-V	
PV10	Start-up position (1)	50.00	0.00	100.00	%	CO-V	
PV11	SH set-point (2)	6.0 10.8	3.0 5.4	25.0 45.0	K R	CO-V	
PV12	LoSH set-point (2)	2.0 3.6	1.0 1.8	3.0 5.4	K R	CO-V	
PV13	HiSH set-point (2)	15.0 27.0	10.0 18.0	40.0 72.0	K R	CO-V	
PV14	LOP set-point (2)	-40.0 -72.0	-40.0 -72.0	40.0 72.0	K R	CO-V	
PV15	MOP set-point (2)	40.0 72.0	-40.0 -72.0	40.0 72.0	K R	CO-V	
PV16	PID – proportional band (2)	7.0 12.6	1.0 1.8	100.0 180.0	K R	CO-V	
PV17	PID – integral time (2)	120	0	999	sec	CO-V	
PV18	PID – derivative time (2)	120	0	999	sec	CO-V	
PV19	Start-up delay (2)	5	1	255	sec	CO-V	
PV20	Start-up position (2)	50.00	0.00	100.00	%	CO-V	
PV21	Stabilisation period	0	0	255	sec	CO-V	
PV22	Stabilisation position	100.00	0.00	100.00	%	CO-V	
PV23	Operating mode: 0= SH algo 1= Manual	0	0	1		CO-V	
PV24	Manual position	0.00	0.00	100.00	%	CO-V	

PV25	SH parameter setpoint: 0= set1 1= set2	0	0	1		CO-V	
PV26	Stand-by position:	0.00	0.00	100.00	%	CO-V	
PV27	Position in the event of an alarm	0.00	0.00	100.00	%	CO-V	
PV28	Filter on the SH value in the PID	10	1	255	100ms	CO-V	
PV29	Fast action level	100	1	100	%	CO-V	100 = disabled 1= maximum level
PV30	Fast action threshold	-1.0 -1.8	-10.0 -18.0	0.0	K R	CO-V	
PV31	Dead zone threshold	1.0 1.8	0.0	25.0 45.0	K R	CO-V	
PV32	Proportional constant area threshold (smart band)	3.0 5.4	0.0	25.0 45.0	K R	CO-V	
PV33	Interval between two resynchronisations	1	0	255	days	CO-V	0= disabled
PV34	Setpoint LowPressure	0.00	0.00	20.00 290.00	Bar psi	CO-V	
PV60	Enable modulating SH (neutral zone)	Yes (1)	No (0)	Yes (1)		CO-V	
PV61	Maximum SH setpoint	15.0	3.0	25.0	K	CO-V	
PV62	Minimum SH setpoint	2.0	1.0	25.0	K	CO-V	
PV63	Maximum DSH value	30.0	Pv64	50.0	K	CO-V	
PV64	Minimum DSH value	20.0	0.0	Pv63	K	CO-V	
PV65	Delay SH variation outside neutral zone	5	1	60	Min	CO-V	
PV66	Negative variation of the SH above the zone	0.2	0.1	2.0	K	CO-V	
PV67	Positive variation of the SH below the zone	1.0	0.1	2.0	K	CO-V	
PV71	LoSH alarm delay	3	0	255	min	COV	
PV72	HiSH alarm hysteresis	1.0 1.8	0.0	25.0 45.0	K R	CO-V	
PV73	HiSH alarm delay	3	0	255	min	COV	
PV74	LP alarm hysteresis	0.30 4.35	0.20 2.9	1.00 14.50	Bar Psi	CO-V	
PV75	LP alarm delay	3	0	255	min	COV	
PV76	MOP alarm hysteresis	1.0 1.8	0.0	25.0 45.0	K R	CO-V	
PV77	MOP alarm delay	3	0	255	min	CO-V	
PV78	Band for MOP correction algorithm	8.0 14.4	0.0	25.0 45.0	K R	CO-V	

PV79	Time constant for MOP correction	15	0	255	10s	CO-V	
PV80	Maximum DSH applicable from the correction	7.0 12.6	0.0	25.0 45.0	K R	CO-V	
PV81	Delay applied to the correction calculation from the start of the algorithm	10	0	255	min	CO-V	
PV82	LOP alarm hysteresis	1.0 1.8	0.0	25.0 45.0	K R	CO-V	
PV83	LOP alarm delay	3	0	255	min	CO-V	
PV90	Type of unipolar valve 0: generic valve (see parameters (PV91-PV96)) 1: Sanhua DPF 2: Danfoss ETS 3:Sporlan SER-U 4: Sporlan ESX	1	0	4		CO-V	
PV91	Minimum steps generic valve	0	0	4900	step	CO-V	
PV92	Maximum steps generic valve	1000	0	4900	step	CO-V	
PV93	Total closure steps generic valve	1500	0	4900	step	CO-V	
PV94	Step rate generic valve	100	25	1000	step/s	CO-V	
PV95	Piloting mode generic valve 0: Full step 2 Ph On 1: Full step 1 Ph On 2: Half step	2	0	2		CO-V	
PV96	Duty cycle generic valve	100	50	100	%	CO-V	Duty cycle on the motion of the valve during normal work positions to prevent superheating of the board.
I/O SETT. (CO-O)							
HA01	Analogue Input 1 (see table AI values)	2	0	66		CO-O	
HA02	Analogue Input 2 (see table AI values)	5	0	66		CO-O	
HA03	Analogue Input 3 (see table AI values)	8	0	66		CO-O	
HA04	Analogue Input 4 (see table AI values)	1	0	56		CO-O	

HA05	Analogue Input 5 (see table AI values)	6	0	56		CO-O	
HA06	Analogue Input 6 (see table AI values)	3	0	56		CO-O	
HA07	Analogue Input 7 (see table AI values)	4	0	66		CO-O	
HA08	Analogue Input 8 (see table AI values)	10	0	66		CO-O	
HA09	Analogue Input 9 (see table AI values)	9	0	66		CO-O	
HB01	Digital Input 1 (see table DI values)	2	0	42		CO-O	
HB02	Digital Input 2 (see table DI values)	8	0	42		CO-O	
HB03	Digital Input 3 (see table DI values)	14	0	42		CO-O	
HB04	Digital Input 4 (see table DI values)	22	0	42		CO-O	
HB05	Digital Input 5 (see table DI values)	20	0	42		CO-O	
HB06	Digital Input 6 (see table DI values)	38	0	42		CO-O	
HB07	Digital Input 7 (see table DI values)	4	0	42		CO-O	
HB08	Digital Input 8 (see table DI values)	0	0	42		CO-O	
HB09	Digital Input 9 (see table DI values)	0	0	42		CO-O	
HC01	Analogue Output 1 (see table AO values)	1	0	7		CO-O	
HC02	Analogue Output 2 (see table AO values)	2	0	7		CO-O	
HC03	Analogue Output 3 (see table AO values)	0	0	9		CO-O	
HC04	Analogue Output 4 (see table AO values)	0	0	9		CO-O	
HC05	Analogue Output 5 (see table AO values)	0	0	5		CO-O	
HC06	Analogue Output 6 (see table AO values)	0	0	5		CO-O	
HCF1	PWM fan frequency	10	10	2000		CO-O	
HD01	Digital Output 1 (see table DO values)	1	0	24		CO-O	
HD02	Digital Output 2 (see table DO values)	2	0	24		CO-O	

HD03	Digital Output 3 (see table DO values)	5	0	24		CO-O	
HD04	Digital Output 4 (see table DO values)	6	0	24		CO-O	
HD05	Digital Output 5 (see table DO values)	10	0	24		CO-O	
HD06	Digital Output 6 (see table DO values)	12	0	24		CO-O	
HD07	Digital Output 7 (see table DO values)	18	0	24		CO-O	
PSd4	Manufacturer Password	-3	-999	9999		CO	

Notes

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