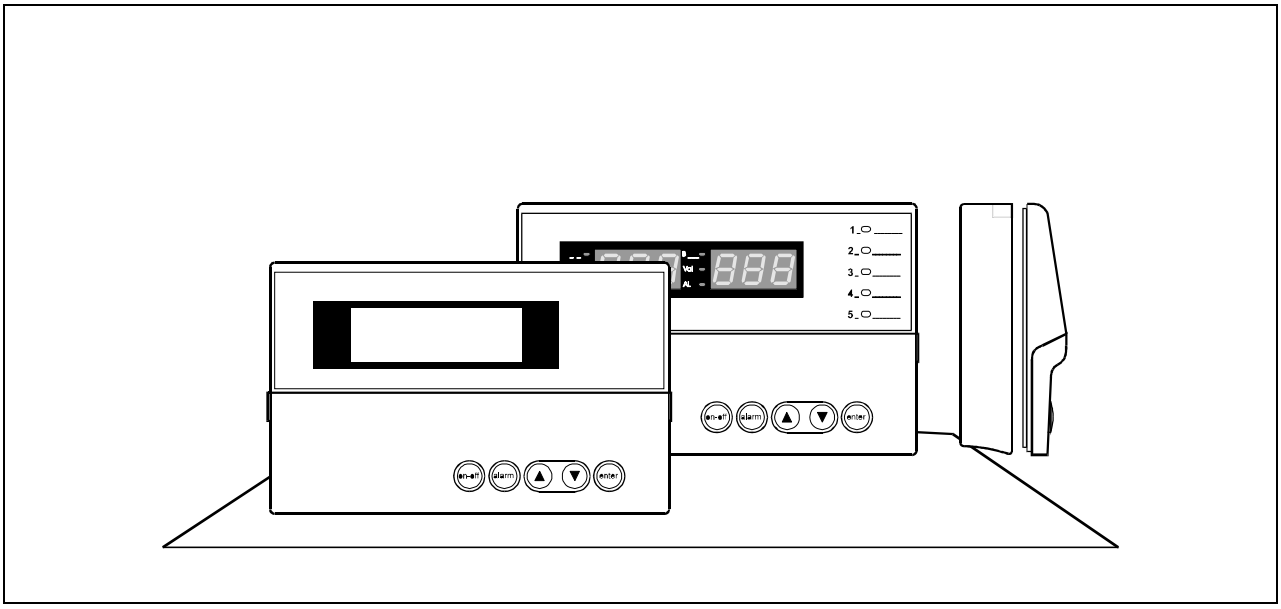
pLAN application software



Modular
Chiller-HP pLAN
for screw compressors,
1/4 compressors

Manual version: 2.812 – 20/03/02

Program code: **EPSTDEMSCA**

Version: **2.812**

CAREL
Technology & Evolution

We wish to save you time and money!
We can assure you that a thorough reading of this manual will guarantee correct installation and safe use of the product described.

IMPORTANT WARNINGS

BEFORE INSTALLING OR OPERATING ON THE DEVICE, CAREFULLY READ THE INSTRUCTIONS IN THIS MANUAL.

The instrument for which this software is dedicated has been designed to operate without risks for the established purposes, provided that:

- the conditions described in the installation and operating manual for the device in question are observed
- the installation of the software, operation and maintenance are performed according to the instructions provided in this manual, by qualified personnel.

Any different use or changes which have not been previously authorised by the manufacturer, are considered improper. Liability for injures or damage caused by improper use lies exclusively with the user.

INDEX

1. Applications and functions performed by system

1.1 Type of units controlled

1.1.1 AIR / WATER CHILLER

- Chiller only.
- Chiller + Heat pump
- Chiller + Freecooling

1.1.2 WATER / WATER CHILLER

- Chiller only
- Chiller + Heat pump with reversal on refrigerant circuit
- Chiller + Heat pump with reversal on water circuit

1.2 Type of control

Proportional or proportional + integral control on the evaporator inlet temperature probe.
Timed dead zone control on the evaporator outlet temperature probe

1.3 Type of compressors

Screw compressors with 4 capacity stages
Screw compressors with continuous capacity control

1.4 Maximum number of compressors

From 1 to 4 with max 4 capacity stages (1 compressor for each pCO)
From 1 to 4 with continuous capacity control (1 compressor for each pCO)

1.5 Compressor call rotation

Rotation of all compressors with FIFO logic in stepped capacity-control and continuous capacity control .

1.6 Condenser control

Temperature, pressure or ON/OFF condenser control can be selected.
The fans can be managed in stepped mode or alternatively using a proportional 0/10V signal

1.7 Type of defrosting

Global defrosting of all the pCO units connected to the network: Independent/Simultaneous/Separate.

1.8 Safety devices for each refrigerator circuit

High pressure (pressure switch/transducer)
Low pressure (pressure switch/transducer)
Oil differential pressure switch / Oil level
Compressor overload
Condenser fan overload
High compressor supply temperature
Differential pressure alarm
Antifreeze alarm

1.9 System safety devices

One serious alarm input (switches off the entire unit).
One evaporator/condenser flow switch input (switches off the entire unit).
One pump overload input (switches off the entire unit)
Remote ON/OFF input

1.10 Number of accessories

Supervisor with RS422/RS485 serial board
Alarm log with 32Kbyte clock card

2. Structure of the master/slave system

The system is made up of four pCO boards connected in a local network; the first of these acts as the network master, while the others are slaves.

2.1 Functions of the master

Temperature control
Calling of the compressors, maximum 4 screw compressors (start, stop, alarms, EXV)
Management of system alarms
Circuit alarm management
Logging of alarms
Communication with external supervisor

2.2 Functions of the slaves

Management of 1 screw compressor (start, stop, alarm, EXV)
Circuit alarm management
Logging of alarms
Communication with external supervisor

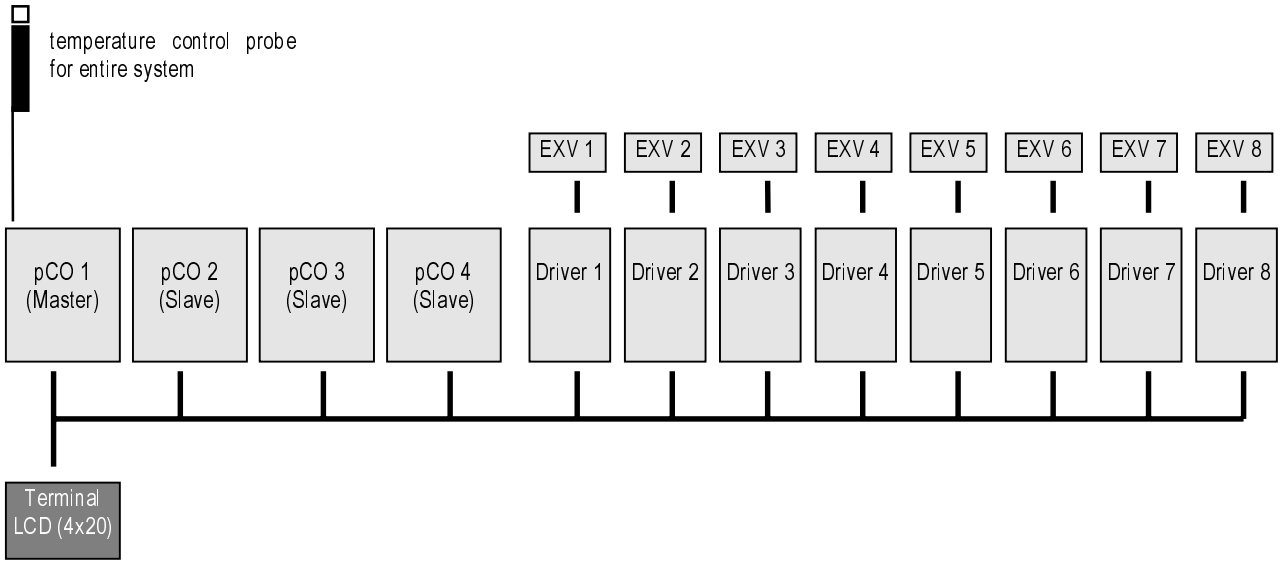
2.3 Electronic expansion valves

The Master and Slaves manage the configuration and control of maximum 2 EVD drivers (thus 2 EXV valves) each.

2.4 Control probe

The temperature control probe must be connected to the master pCO only.

2.5 Setting the system addresses



Each component in the system, whether a pCO board, Driver or Terminal, is identified by a specific address.
The address of the terminals is set using the dip-switches located in the rear of the terminals themselves.
The address of the pCO I/O boards is set using the dip-switches located on an address card (code PCOADR0000 - PCOCLKMEM0, respectively without – with clock option, purchased separately from the pCO board).
The dip-switches for setting the address of the EVD driver are on the rear of the front panel (removable) of the driver itself.

2.5.1 Specific unit addresses

The address of the pCO master must be 1
The addresses of the pCO slaves must be 2/3/4
The addresses of the master board drivers must be 5 / 6
The addresses of the slave board 1 drivers must be 7 / 8
The addresses of the slave board 2 drivers must be 9 / 10
The addresses of the slave board 3 drivers must be 11 / 12
The address of the shared terminal (unique for all boards) must be 16

3. PLAN network

All the devices connected to the pLAN network are identified by a specific address.
As terminals and pCO boards use the same type of address setting, terminals and pCO boards cannot have the same identifier.
In general, the addresses of the boards and terminals can be between 1 and 32.
For special applications, see the address settings shown in the paragraph "Setting the system addresses".

The address of the terminals is set using the dip-switches at the rear, while the pCO boards require the optional network card.

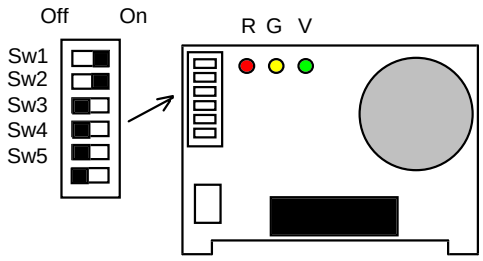
3.1 I/O board addresses

Optional network card (PCOADR0000 / PCOCLKMEM0)

There are two versions of the optional network card:
dip-switches and LEDs — Code: PCOADR0000
dip-switches, LEDs and clock-calendar — Code: PCOCLKMEM0

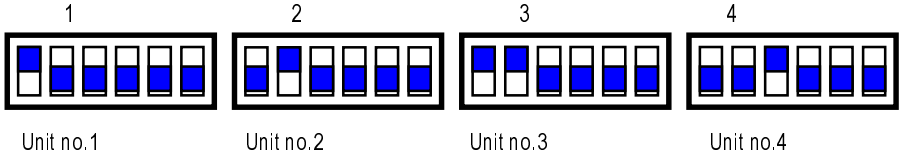
This card is required for the operation of the pCO boards in a local network.
Without this card, the unit cannot be controlled and there will be no exchange of information between the pCO boards installed

Adr	Sw1	Sw2	Sw3	Sw4
0	not allowed			
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	ON	ON	OFF	OFF
4	OFF	OFF	ON	OFF
....	....	....	....	....
15	OFF	ON	ON	ON
16	ON	ON	ON	ON



	Sw1		Sw2		Sw3		Sw4	
Status	OFF	ON	OFF	ON	OFF	ON	OFF	ON
P	0	1	0	2	0	4	0	8
Addr=P(Sw1)+P(Sw2)+P(Sw3)+P(Sw4)								

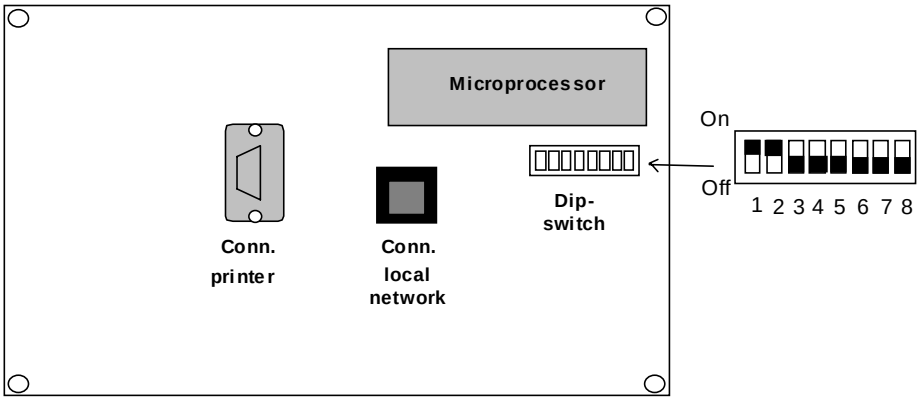
In the standard modular chiller application for screw compressors, EPSTDIMSCA, the addresses of the pCO units must be set as follows:



Unit no.1 Unit no.2 Unit no.3 Unit no.4

3.2 Terminal addresses

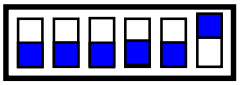
Terminal board, rear view



The address of the terminals is sets using the dip-switches at the rear.
The address can be set in the range from 13-32, using dip-switches 1-6.
The value of the address is derived as shown in the following table (also see the previous paragraph):

	Sw1		Sw2		Sw3		Sw4		Sw5		Sw5	
Status	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON
P	0	1	0	2	0	16	0	8	0	16	0	32
Addr=P(Sw1)+P(Sw2)+P(Sw3)+P(Sw4)+P(Sw5)+P(Sw6)												

Unit terminal No.: 1,2,3,4.

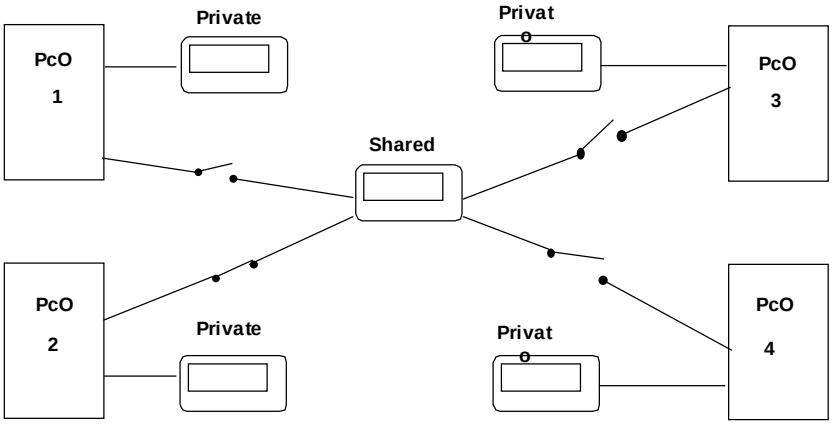


Terminal 16

The address of the shared terminal for the 4 pCO units must be 16.

3.3 Terminal management

- Each pCO board, connected to the network, can manage more than 1 terminal (max 3). The display on these occurs simultaneously and not independently, like having the keypad and display connected in parallel.
- Each terminal associated to a specific board, can be *private* or *shared*.
  Private a terminal is *private* if it only shows the output of one I/O board.
  Shared a terminal is *shared* if, automatically or using the keypad, it can be switched between the output of more than one board.
- Each pCO constantly updates the display of the private terminals; shared terminals, on the other hand, are updated only if the pCO in question currently has the control. The following diagram is valid from a logical point of view:



In this example the shared terminal is associated to 4 I/O boards yet, currently, only no. 2 can display data and receive the commands from the keypad.

- The switching between boards occurs in a cyclical sequence (1→2→3→4→1....), pressing the button (or combination of two buttons) which has been assigned this function
  The switching can also be handled automatically, upon direct request of the program. For example, an I/O board can request the control of the shared terminal to display alarms or, on the contrary, transfer possession to the following board at the end of a pre-set time (cyclical rotation)..

The number and the type of terminals is set during the initial configuration of the network. The relative data is saved in the EEPROM memory of each individual I/O board.

3.4 Terminal configuration procedure

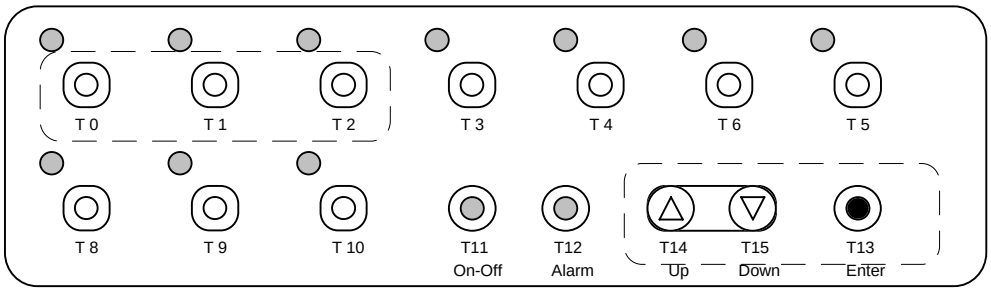
The pLAN network self-configuration procedure is performed by the software every time the default values are installed.
If the addresses of the boards and the terminal are set correctly, when first installing the EPROM, following the automatic default value installation procedure, the pLAN network will be configured with one shared terminal between the boards, with address = 16; this can accessed from the various units connected in the network.

If the addresses are not set correctly or the EPROM is replaced by another with the same version and date, and the terminal cannot access any of the units present, proceed as follows.
The following procedure must be performed when modifying the system pLAN configuration, for example when adding a private terminal for each board.

- To start the procedure, check that that the address of each pCO board and terminal is set correctly, as established during the design of the network.
  It should be remembered that the address set is received only when the device is reset.
  It is good practice to perform a global reset for the devices in the network in the event where, during configuration, more than one board has the same address.
- The configuration procedure must be run for each pCO board and must involve all the terminals in the network. The procedure can be started from any terminal, and this can also be temporarily connected for the purpose of performing the configuration operations, and then removed at the end of the procedure.
- The following operations must be performed:

3.4.1 Step 1: select the pCO board

- The procedure is activated by pressing buttons 0-1-2 together for at least 5 secs. (for compatibility, the buttons ▲ ▼ -Enter perform the same function):



- If the display is an LCD, the following screen is displayed:

```
Terminal Adr: nn
I/O Board Adr: 12
```

- The field "*Terminal Adr*" always represents the address of the terminal being operated on.
- The field "*I/O Board Adr*" initially shows the address of the pCO board currently connected to the terminal.
  If the terminal is not connected to any pCO board, the "—" is displayed.
  Use the arrow buttons to modify the setting and force connection to a different pCO board.
  The values displayed during the selection are the addresses of the pCO boards which are effectively connected to the network; if no pCO is active, the value "—" cannot be changed.
- Pressing the "Enter" button exits the first phase of the address setting procedure, and enters the actual terminal configuration screen.
- If the terminal remains inactive (no button is pressed) for more than 15 seconds, the configuration procedure is automatically ended.

3.4.2 Step 2: select associated terminals

For LCD displays, the screens displayed are:

```
   Terminal Config

    Press ENTER
    to continue
```

Enter

⇓

```
P:12 Adr   Priv/Shared
Trm1 02    Sh
Trm2 03    Pr
Trm3 None   -- Ok? No
```

- In this screen the "Enter" button moves the cursor from one field to the next, while the arrow buttons change the current value of the field. The text P:00 indicates the address of the selected board; in the above example, it indicates that the I/O board with address 12 has been selected.
- To exit the configuration procedure and save the values, select the field "Ok ? No" and using the cursor buttons, bring up the message "Yes", then press "Enter".
  To exit without saving, wait 30 secs without pressing any button.

3.4.3 Display terminal connection status

- If the terminal detects the inactivity of the pCO board being displayed, it switches off the display and then shows the message:

```
I/O Board xx fault
```

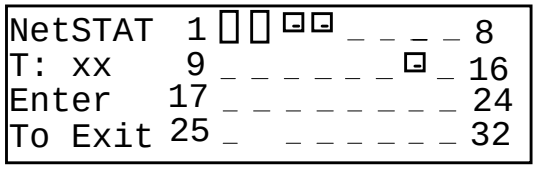
- If the terminal does not receive the network synchronisation message (token) for more than 10 seconds, it switches off the display and then shows the message:

```
NO LINK
```

In this situation, the green LED on the optional network card, installed on each pCO board, goes off.

3.4.4 Display network status: NetSTAT

The program includes a procedure, which can be activated only in the LCD version, for the real time display of the status and the type of currently connected peripherals.
This procedure is activated by pressing buttons 0-1-2 together (or alternatively Up-Down-Enter) for at least 10 seconds (after the first 5 seconds, the terminal configuration procedure is accessed). The following screen is displayed:

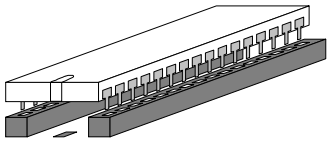


The number after the T indicates the address of the terminal that the procedure is being activated on, the symbols indicate the type of peripheral (terminal/pCO) and the corresponding address.
In the example, the network is made up of 2 pCO boards with addresses 1 and 2, and 3 terminals with addresses 3, 4, and 15.

4. Installing the EPROM

To install/replace the EPROM(s) that contain the program, for multi-board applications, the user must check that the EPROMs have the same reference date and software version, otherwise the system will not work correctly.

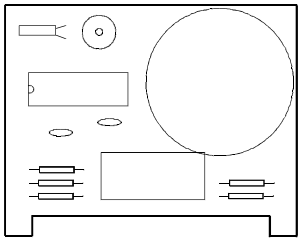
Before inserting/removing the EPROM, switch off the pCO board.
The EPROM must be inserted in the special socket **on the main board**, making sure that **the "notch" on the surface of the EPROM is in line with the "notch" on the socket**. To be perfectly sure, check that the enamelled side of the EPROM is in line with the enamelled side of the socket, or with the reference notch silk-screened onto the board.
When installing the EPROM, check that all the pins are correctly inserted.



When removing the EPROM, avoid touching the SMD components on the board in the space inside the socket.
The electronic components are almost always **damaged** when touching due to **electrostatic discharges** from the operator.

5. Connecting the optional cards

5.1 Clock card

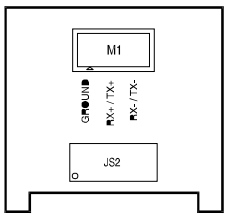


The Figure shows the real time clock card used to display the current date and time.

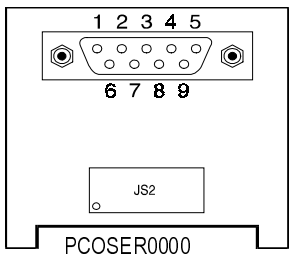
This card is required for the alarm log function.

When to the pCO is disconnected from the power supply, the rechargeable lithium battery ensures the operation of the clock, constantly updating the date and time values.

5.2 RS485 / RS422 serial card



PCOSER4850



PCOSER0000

The **PCOSER4850 and PCOSER0000** serial cards are used to interface to a RS485 or RS422 serial network for the transmission of data. The optional card is inserted in the special connector on the pCO board.
For multi-board applications, each pCO board must have its own serial interface card.

6. List of inputs/outputs

Various different types of unit can be managed, each associated to an ID number; to configure the inputs and outputs as required, identify the type of unit managed from those described below, and then enter the corresponding number in the dedicated setting screen.
For the connections of the pCO board inputs and outputs, refer to the specific operating manual, available upon request.

6.1 AIR/WATER units with maximum 4 screw compressors (up to 4 stages per comp.)

6.1.1 CHILLER ONLY (MACHINE TYPE "0")

Digital inputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)
2	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Pump thermal overload			
5	Low pressure switch 1	Low pressure switch 2	Low pressure switch 3	Low pressure switch 4
6	Oil Differential / Level	Oil Differential / Level	Oil Differential / Level	Oil Differential / Level
7	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)
8	Double Set Point			
9	Fan 1 thermal overload C 1	Fan 1 thermal overload C 2	Fan 1 thermal overload C 3	Fan 1 thermal overload C 4
10	Fan 2 thermal overload C 1	Fan 2 thermal overload C 2	Fan 2 thermal overload C 3	Fan 2 thermal overload C 4
11	High pressure switch C 1	High pressure switch C 2	High pressure switch C 3	High pressure switch C 4
12	Compressor 1 thermal overload	Compressor 2 thermal overload	Compressor 3 thermal overload	Compressor 4 thermal overload

Analogue inputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Evaporator Water Inlet Temperature			
2	Evaporator Water Outlet Temperature C 1	Evaporator Water Outlet Temperature C 2	Evaporator Water Outlet Temperature C 3	Evaporator Water Outlet Temperature C 4
3	Condensing temperature C 1	Condensing temperature C 2	Condensing temperature C 3	Condensing temperature C 4
4				
5	Voltage / Current / Outside set point	Voltage / Current	Voltage / Current	Voltage / Current
6	Outlet Temperature Comp.1	Outlet Temperature Comp.2	Outlet Temperature Comp.3	Outlet Temperature Comp.4
7	High pressure C 1	High pressure C 2	High pressure C 3	High pressure C 4
8	Low pressure C 1	Low pressure C 2	Low pressure C 3	Low pressure C 4

Digital outputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Pump			
2	Line Contactor Comp.1	Line Contactor Comp.2	Line Contactor Comp.3	Line Contactor Comp.4
3	Star Contactor Comp.1	Star Contactor Comp.2	Star Contactor Comp.3	Star Contactor Comp.4
4	Delta Contactor Comp.1	Delta Contactor Comp.2	Delta Contactor Comp.3	Delta Contactor Comp.4
5	Liquid solenoid C 1	Liquid solenoid C 2	Liquid solenoid C 3	Liquid solenoid C 4
6	Cap.Cont. Relay 1 Comp.1	Cap.Cont. Relay 1 Comp.2	Cap.Cont. Relay 1 Comp.3	Cap.Cont. Relay 1 Comp.4
7	Cap.Cont. Relay 2 Comp.1	Cap.Cont. Relay 2 Comp.2	Cap.Cont. Relay 2 Comp.3	Cap.Cont. Relay 2 Comp.4
8	Cap.Cont. Relay 3 Comp.1	Cap.Cont. Relay 3 Comp.2	Cap.Cont. Relay 3 Comp.3	Cap.Cont. Relay 3 Comp.4
9	Liquid Inj. / Econ. / Oil Cooler Comp.1	Liquid Inj. / Econ. / Oil Cooler Comp.2	Liquid Inj. / Econ. / Oil Cooler Comp.3	Liquid Inj. / Econ. / Oil Cooler Comp.4
10	Antifreeze heater C 1	Antifreeze heater C 2	Antifreeze heater C 3	Antifreeze heater C 4
11	General alarm	General alarm	General alarm	General alarm
12	Fan 1 C 1	Fan 1 C 2	Fan 1 C 3	Fan 1 C 4
13	Fan 2 C 1	Fan 2 C 2	Fan 2 C 3	Fan 2 C 4

Analogue outputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Speed Controller C 1	Speed Controller C 2	Speed Controller C 3	Speed Controller C 4
2				

6.1.2 CHILLER + HEAT PUMP (MACHINE TYPE "1")

Digital inputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)
2	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Pump thermal overload			
5	Low pressure switch 1	Low pressure switch 2	Low pressure switch 3	Low pressure switch 4
6	Oil Differential / Level	Oil Differential / Level	Oil Differential / Level	Oil Differential / Level
7	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)
8	Double Set Point			
9	Fan 1 thermal overload C 1	Fan 1 thermal overload C 2	Fan 1 thermal overload C 3	Fan 1 thermal overload C 4
10	Cooling / Heating			
11	High pressure switch C 1	High pressure switch C 2	High pressure switch C 3	High pressure switch C 4
12	Compressor 1 thermal overload	Compressor 2 thermal overload	Compressor 3 thermal overload	Compressor 4 thermal overload

Analogue inputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Evaporator Water Inlet Temperature			
2	Evaporator Water Outlet Temperature C 1	Evaporator Water Outlet Temperature C 2	Evaporator Water Outlet Temperature C 3	Evaporator Water Outlet Temperature C 4
3	Condensing temperature C 1	Condensing temperature C 2	Condensing temperature C 3	Condensing temperature C 4
4				
5	Voltage / Current / Outside set point	Voltage / Current	Voltage / Current	Voltage / Current
6	Outlet Temperature Comp.1	Outlet Temperature Comp.2	Outlet Temperature Comp.3	Outlet Temperature Comp.4
7	High pressure C 1	High pressure C 2	High pressure C 3	High pressure C 4
8	Low pressure C 1	Low pressure C 2	Low pressure C 3	Low pressure C 4

Digital outputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Pump			
2	Line Contactor Comp.1	Line Contactor Comp.2	Line Contactor Comp.3	Line Contactor Comp.4
3	Star Contactor Comp.1	Star Contactor Comp.2	Star Contactor Comp.3	Star Contactor Comp.4
4	Delta Contactor Comp.1	Delta Contactor Comp.2	Delta Contactor Comp.3	Delta Contactor Comp.4
5	Liquid solenoid C 1	Liquid solenoid C 2	Liquid solenoid C 3	Liquid solenoid C 4
6	Cap.Cont. Relay 1 Comp.1	Cap.Cont. Relay 1 Comp.2	Cap.Cont. Relay 1 Comp.3	Cap.Cont. Relay 1 Comp.4
7	Cap.Cont. Relay 2 Comp.1	Cap.Cont. Relay 2 Comp.2	Cap.Cont. Relay 2 Comp.3	Cap.Cont. Relay 2 Comp.4
8	Cap.Cont. Relay 3 Comp.1	Cap.Cont. Relay 3 Comp.2	Cap.Cont. Relay 3 Comp.3	Cap.Cont. Relay 3 Comp.4
9	Liquid Inj. / Econ. / Oil Cooler Comp.1	Liquid Inj. / Econ. / Oil Cooler Comp.2	Liquid Inj. / Econ. / Oil Cooler Comp.3	Liquid Inj. / Econ. / Oil Cooler Comp.4
10	Antifreeze heater C 1	Antifreeze heater C 2	Antifreeze heater C 3	Antifreeze heater C 4
11	General alarm	General alarm	General alarm	General alarm
12	4-way Valve Circuit 1	4-way Valve Circuit 2	4-way Valve Circuit 3	4-way Valve Circuit 4
13	Fan 1 Circuit 1	Fan 1 Circuit 2	Fan 1 Circuit 3	Fan 1 Circuit 4

Analogue outputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1				
2	Speed Controller C 1	Speed Controller C 2	Speed Controller C 3	Speed Controller C 4

6.1.3 CHILLER + FREECOOLING (MACHINE TYPE "2")

Digital inputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)
2	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Pump thermal overload			
5	Low pressure switch 1	Low pressure switch 2	Low pressure switch 3	Low pressure switch 4
6	Oil Differential / Level	Oil Differential / Level	Oil Differential / Level	Oil Differential / Level
7	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)
8	Double Set Point			
9	Fan 1 thermal overload C 1	Fan 1 thermal overload C 2	Fan 1 thermal overload C 3	Fan 1 thermal overload C 4
10	Fan 2 thermal overload C 1	Fan 2 thermal overload C 2	Fan 2 thermal overload C 3	Fan 2 thermal overload C 4
11	High pressure switch C 1	High pressure switch C 2	High pressure switch C 3	High pressure switch C 4
12	Compressor 1 thermal overload	Compressor 2 thermal overload	Compressor 3 thermal overload	Compressor 4 thermal overload

Analogue inputs

NO.	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Evaporator Water Inlet Temperature			
2	Evaporator Water Outlet Temperature C 1	Evaporator Water Outlet Temperature C 2	Evaporator Water Outlet Temperature C 3	Evaporator Water Outlet Temperature C 4
3	Outside Air Temperature			
4	Freecooling Water Inlet Temperature			
5	Voltage / Current / Outside set point	Voltage / Current	Voltage / Current	Voltage / Current
6	Outlet Temperature Comp.1	Outlet Temperature Comp.2	Outlet Temperature Comp.3	Outlet Temperature Comp.4
7	High pressure C 1	High pressure C 2	High pressure C 3	High pressure C 4
8	Low pressure C 1	Low pressure C 2	Low pressure C 3	Low pressure C 4

Digital outputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Pump			
2	Line Contactor Comp.1	Line Contactor Comp.2	Line Contactor Comp.3	Line Contactor Comp.4
3	Star Contactor Comp.1	Star Contactor Comp.2	Star Contactor Comp.3	Star Contactor Comp.4
4	Delta Contactor Comp.1	Delta Contactor Comp.2	Delta Contactor Comp.3	Delta Contactor Comp.4
5	Liquid solenoid C 1	Liquid solenoid C 2	Liquid solenoid C 3	Liquid solenoid C 4
6	Cap.Cont. Relay 1 Comp.1	Cap.Cont. Relay 1 Comp.2	Cap.Cont. Relay 1 Comp.3	Cap.Cont. Relay 1 Comp.4
7	Cap.Cont. Relay 2 Comp.1	Cap.Cont. Relay 2 Comp.2	Cap.Cont. Relay 2 Comp.3	Cap.Cont. Relay 2 Comp.4
8	Cap.Cont. Relay 3 Comp.1	Cap.Cont. Relay 3 Comp.2	Cap.Cont. Relay 3 Comp.3	Cap.Cont. Relay 3 Comp.4
9	Fan 2 C 1	Fan 2 C 2	Fan 2 C 3	Fan 2 C 4
10	Antifreeze heater C 1	Antifreeze heater C 2	Antifreeze heater C 3	Antifreeze heater C 4
11	General alarm	General alarm	General alarm	General alarm
12	Fan 1 C 1	Fan 1 C 2	Fan 1 C 3	Fan 1 C 4
13	Freecooling ON/OFF Valve			

Analogue outputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Speed Controller C 1	Speed Controller C 2	Speed Controller C 3	Speed Controller C 4
2	3-way Freecooling Valve			

6.2 WATER/WATER units with maximum 4 screw compressors (up to 4 stages per comp.)

6.2.1 CHILLER-ONLY (MACHINE TYPE "3")

Digital inputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)
2	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Evaporator pump thermal overload			
5	Low pressure switch 1	Low pressure switch 2	Low pressure switch 3	Low pressure switch 4
6	Oil Differential / Level	Oil Differential / Level	Oil Differential / Level	Oil Differential / Level
7	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)
8	Double Set Point			
9	Condenser flow switch (Can be enabled)	Condenser flow switch (Can be enabled)	Condenser flow switch (Can be enabled)	Condenser flow switch (Can be enabled)
10	Condenser pump thermal overload			
11	High pressure switch C 1	High pressure switch C 2	High pressure switch C 3	High pressure switch C 4
12	Compressor 1 thermal overload	Compressor 2 thermal overload	Compressor 3 thermal overload	Compressor 4 thermal overload

Analogue inputs

NO.	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Evaporator Water Inlet Temperature			
2	Evaporator Water Outlet Temperature C 1	Evaporator Water Outlet Temperature C 2	Evaporator Water Outlet Temperature C 3	Evaporator Water Outlet Temperature C 4
3	Condenser Water Inlet Temperature C 1			
4	Condenser Water Outlet Temperature C 1	Condenser Water Outlet Temperature C 2	Condenser Water Outlet Temperature C 2	Condenser Water Outlet Temperature C 2
5	Voltage / Current / Outside set point	Voltage / Current	Voltage / Current	Voltage / Current
6	Outlet Temperature Comp.1	Outlet Temperature Comp.2	Outlet Temperature Comp.3	Outlet Temperature Comp.4
7	High pressure C 1	High pressure C 2	High pressure C 3	High pressure C 4
8	Low pressure C 1	Low pressure C 2	Low pressure C 3	Low pressure C 4

Digital outputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Evaporator pump			
2	Line Contactor Comp.1	Line Contactor Comp.2	Line Contactor Comp.3	Line Contactor Comp.4
3	Star Contactor Comp.1	Star Contactor Comp.2	Star Contactor Comp.3	Star Contactor Comp.4
4	Delta Contactor Comp.1	Delta Contactor Comp.2	Delta Contactor Comp.3	Delta Contactor Comp.4
5	Liquid solenoid C 1	Liquid solenoid C 2	Liquid solenoid C 3	Liquid solenoid C 4
6	Cap.Cont. Relay 1 Comp.1	Cap.Cont. Relay 1 Comp.2	Cap.Cont. Relay 1 Comp.3	Cap.Cont. Relay 1 Comp.4
7	Cap.Cont. Relay 2 Comp.1	Cap.Cont. Relay 2 Comp.2	Cap.Cont. Relay 2 Comp.3	Cap.Cont. Relay 2 Comp.4
8	Cap.Cont. Relay 3 Comp.1	Cap.Cont. Relay 3 Comp.2	Cap.Cont. Relay 3 Comp.3	Cap.Cont. Relay 3 Comp.4
9	Liquid Inj. / Econ. / Oil Cooler Comp.1	Liquid Inj. / Econ. / Oil Cooler Comp.2	Liquid Inj. / Econ. / Oil Cooler Comp.3	Liquid Inj. / Econ. / Oil Cooler Comp.4
10	Antifreeze heater C 1	Antifreeze heater C 2	Antifreeze heater C 3	Antifreeze heater C 4
11	General alarm	General alarm	General alarm	General alarm
12	Condenser pump			
13				

Analogue outputs

NO.	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1				
2				

6.2.2 CHILLER + HEAT PUMP WITH REVERSAL ON REFRIGERANT CIRCUIT (MACHINE TYPE "4")

Digital inputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)
2	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)
3	Remote ON/OFF			
4	Evaporator pump thermal overload			
5	Low pressure switch 1	Low pressure switch 2	Low pressure switch 3	Low pressure switch 4
6	Oil differential 1/ Oil level 1	Oil differential 2/ Oil level 2	Oil differential 3/ Oil level 3	Oil differential 4/ Oil level 4
7	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)
8	Double Set Point			
9	Condenser flow switch (Can be enabled)	Condenser flow switch (Can be enabled)	Condenser flow switch (Can be enabled)	Condenser flow switch (Can be enabled)
10	Cooling / Heating			
11	High pressure switch 1	High pressure switch 2	High pressure switch 3	High pressure switch 4
12	Compressor 1 thermal overload	Compressor 2 thermal overload	Compressor 3 thermal overload	Compressor 4 thermal overload

Analogue inputs

NO.	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Evaporator Water Inlet Temperature			
2	Evaporator Water Outlet Temperature C 1	Evaporator Water Outlet Temperature C 2	Evaporator Water Outlet Temperature C 3	Evaporator Water Outlet Temperature C 4
3	Condenser Water Inlet Temperature C 1			
4	Condenser Water Outlet Temperature C 1	Condenser Water Outlet Temperature C 2	Condenser Water Outlet Temperature C 2	Condenser Water Outlet Temperature C 2
5	Voltage / Current / Outside set point	Voltage / Current	Voltage / Current	Voltage / Current
6	Outlet Temperature Comp.1	Outlet Temperature Comp.2	Outlet Temperature Comp.3	Outlet Temperature Comp.4
7	High pressure C 1	High pressure C 2	High pressure C 3	High pressure C 4
8	Low pressure C 1	Low pressure C 2	Low pressure C 3	Low pressure C 4

Digital outputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Evaporator pump			
2	Line Contactor Comp.1	Line Contactor Comp.2	Line Contactor Comp.3	Line Contactor Comp.4
3	Star Contactor Comp.1	Star Contactor Comp.2	Star Contactor Comp.3	Star Contactor Comp.4
4	Delta Contactor Comp.1	Delta Contactor Comp.2	Delta Contactor Comp.3	Delta Contactor Comp.4
5	Liquid solenoid C 1	Liquid solenoid C 2	Liquid solenoid C 3	Liquid solenoid C 4
6	Cap.Cont. Relay 1 Comp.1	Cap.Cont. Relay 1 Comp.2	Cap.Cont. Relay 1 Comp.3	Cap.Cont. Relay 1 Comp.4
7	Cap.Cont. Relay 2 Comp.1	Cap.Cont. Relay 2 Comp.2	Cap.Cont. Relay 2 Comp.3	Cap.Cont. Relay 2 Comp.4
8	Cap.Cont. Relay 3 Comp.1	Cap.Cont. Relay 3 Comp.2	Cap.Cont. Relay 3 Comp.3	Cap.Cont. Relay 3 Comp.4
9	Liquid Inj. / Econ. / Oil Cooler Comp.1	Liquid Inj. / Econ. / Oil Cooler Comp.2	Liquid Inj. / Econ. / Oil Cooler Comp.3	Liquid Inj. / Econ. / Oil Cooler Comp.4
10	Antifreeze heater C 1	Antifreeze heater C 2	Antifreeze heater C 3	Antifreeze heater C 4
11	General alarm	General alarm	General alarm	General alarm
12	Condenser pump			
13	4-way Valve Circuit 1	4-way Valve Circuit 2	4-way Valve Circuit 3	4-way Valve Circuit 4

Analogue outputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1				
2				

6.2.3 CHILLER + HEAT PUMP WITH REVERSAL ON WATER CIRCUIT (MACHINE TYPE "5")

Digital inputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)	Serious alarm (Can be enabled)
2	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)	Evaporator flow switch (Can be enabled)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Evaporator pump thermal overload			
5	Low pressure switch 1	Low pressure switch 2	Low pressure switch 3	Low pressure switch 4
6	Oil differential 1/ Oil level 1	Oil differential 2/ Oil level 2	Oil differential 3/ Oil level 3	Oil differential 4/ Oil level 4
7	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)	Phase Monitor (Can be enabled)
8	Double Set Point			
9	Condenser flow switch (Can be enabled)	Condenser flow switch (Can be enabled)	Condenser flow switch (Can be enabled)	Condenser flow switch (Can be enabled)
10	Cooling / Heating			
11	High pressure switch 1	High pressure switch 2	High pressure switch 3	High pressure switch 4
12	Compressor 1 thermal overload	Compressor 2 thermal overload	Compressor 3 thermal overload	Compressor 4 thermal overload

Analogue inputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Evaporator Water Inlet Temperature			
2	Evaporator Water Outlet Temperature C 1	Evaporator Water Outlet Temperature C 2	Evaporator Water Outlet Temperature C 3	Evaporator Water Outlet Temperature C 4
3	Condenser Water Inlet Temperature C 1			
4	Condenser Water Outlet Temperature C 1	Condenser Water Outlet Temperature C 2	Condenser Water Outlet Temperature C 2	Condenser Water Outlet Temperature C 2
5	Voltage / Current / Outside set point	Voltage / Current	Voltage / Current	Voltage / Current
6	Outlet Temperature Comp.1	Outlet Temperature Comp.2	Outlet Temperature Comp.3	Outlet Temperature Comp.4
7	High pressure C 1	High pressure C 2	High pressure C 3	High pressure C 4
8	Low pressure C 1	Low pressure C 2	Low pressure C 3	Low pressure C 4

Digital outputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1	Evaporator pump			
2	Line Contactor Comp.1	Line Contactor Comp.2	Line Contactor Comp.3	Line Contactor Comp.4
3	Star Contactor Comp.1	Star Contactor Comp.2	Star Contactor Comp.3	Star Contactor Comp.4
4	Delta Contactor Comp.1	Delta Contactor Comp.2	Delta Contactor Comp.3	Delta Contactor Comp.4
5	Liquid solenoid C 1	Liquid solenoid C 2	Liquid solenoid C 3	Liquid solenoid C 4
6	Cap.Cont. Relay 1 Comp.1	Cap.Cont. Relay 1 Comp.2	Cap.Cont. Relay 1 Comp.3	Cap.Cont. Relay 1 Comp.4
7	Cap.Cont. Relay 2 Comp.1	Cap.Cont. Relay 2 Comp.2	Cap.Cont. Relay 2 Comp.3	Cap.Cont. Relay 2 Comp.4
8	Cap.Cont. Relay 3 Comp.1	Cap.Cont. Relay 3 Comp.2	Cap.Cont. Relay 3 Comp.3	Cap.Cont. Relay 3 Comp.4
9	Liquid Inj. / Econ. / Oil Cooler Comp.1	Liquid Inj. / Econ. / Oil Cooler Comp.2	Liquid Inj. / Econ. / Oil Cooler Comp.3	Liquid Inj. / Econ. / Oil Cooler Comp.4
10	Antifreeze heater C 1	Antifreeze heater C 2	Antifreeze heater C 3	Antifreeze heater C 4
11	General alarm	General alarm	General alarm	General alarm
12	Condenser pump			
13	4-way Valve Circuit 1	4-way Valve Circuit 2	4-way Valve Circuit 3	4-way Valve Circuit 4

Analogue outputs

NO	UNIT 1(Master)	UNIT 2 (Slave no. 1)	UNIT 3 (Slave no. 2)	UNIT 4 (Slave no. 3)
1				
2				

7. Control

Two distinct temperature control modes are available:

- Control according to the water temperature measured by the probe located at the evaporator inlet
- Control according to the water temperature measured by the probe located at the evaporator outlet

The first type involves proportional control based on the absolute temperature measured by the probe; the second type involves dead zone control based on the time the temperature measured by the probe remains over specific thresholds.

The selection of the type of control in any case limited by the type of compressor managed.
If the compressor controlled features stepped capacity control, both types of control can be used, as desired.
If the compressor controlled features continuous capacity control, then only outlet temperature control is possible.

7.1 Inlet temperature control

Inputs used:

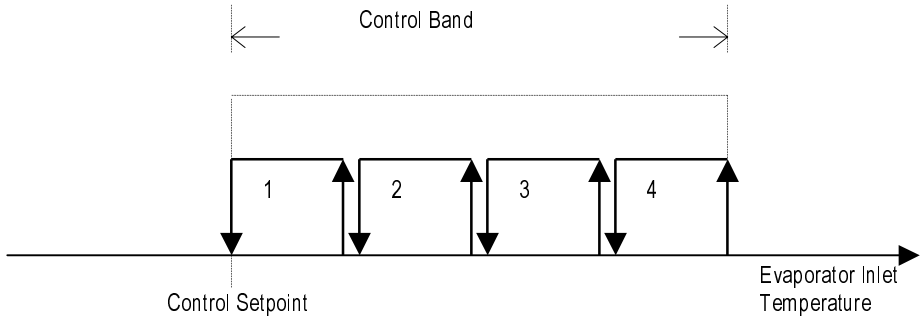
- Evaporator water inlet temperature

Parameters used:

- Type of unit
- Total number of compressors
- Type of compressor capacity control
- Number of capacity-control steps
- Control set point
- Proportional band for inlet control
- Type of control (proportional or proportional + integral)
- Integration time (if proportional + integral control enabled)
- Time between compressor start and first capacity stage
- Time between the first and the second capacity stage
- Time between the second and the third capacity stage
- Time between the third and fourth capacity stage

Outputs used:

- Liquid solenoid
- Compressor Line-Star-Delta windings
- All compressor capacity control relays



Temperature control according to the values measured by the temperature probe located at the evaporator inlet is proportional.

Depending on the total number of compressors configured and the number of capacity stages per compressor, the control band set will be divided into a series of steps of the same amplitude.
When the activation thresholds for the various steps are exceeded, a different compressor or capacity stage will be activated.

The following relationships are applied to determine the various activation thresholds.

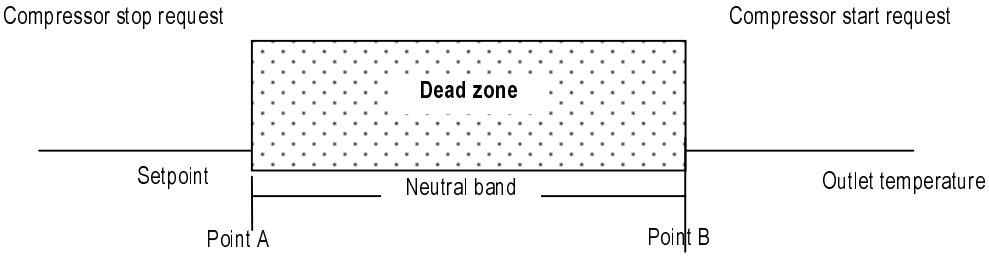
Number total of steps =	Total number of compressors * Number of capacity stages /compressor
Proportional step amplitude =	Proportional control band / Total number of control steps
Step activation threshold =	Control set point + (Proportional step amplitude * Progressive step no. [1,2.3...]

7.2 Outlet temperature control

Inputs used:
- Evaporator water outlet temperature

Parameters used:
- Type of unit
- Total number of compressors
- Type of compressor capacity control
- Number of capacity-control steps
- Control set point
- Control band for outlet control
- Compressor capacity stage activation delays
- Device activation delay
- Device stop delay
- Outlet temperature limit in cooling (stops all the compressors without waiting the deactivation time)
- Outlet temperature limit in heating (stops all the compressors without waiting the deactivation time)

Outputs used:
- Liquid solenoid
- Compressor Line-Star-Delta windings
- All compressor capacity control relays



A temperature dead zone is defined based on the set point and band values.
Temperature values between the set point and set point + band (A ≤ Temperature ≤ B) will not switch the compressors On/Off.
Temperature values higher than the set point + band (Temperature > Point B) will start the compressors
Temperature values lower than the set point (Temperature < Point A) will stop the compressors

For each operating mode, cooling or heating, there is a distinct threshold temperature below or above which the installed devices will be stopped, so as to avoid excessive cooling/heating by the unit.

7.3 Control of water/water chiller-only units

Inputs used:
- Evaporator water inlet temperature
- Evaporator water outlet temperature
- Condenser water inlet temperature
- Condenser water outlet temperature

Parameters used:
- Type of unit
- Total number of compressors
- Type of compressor capacity control
- Number of capacity-control steps
- Control set point
- Control band
- Type of control (inlet – outlet)
- Inlet control mode (proportional – proportional+intergral)
- Integration time (if proportional+integral control is enabled)
- Compressor capacity stage activation delays
- Device activation delay

Outputs used:
- Liquid solenoid
- Compressor Line-Star-Delta windings
- All compressor capacity control relays

7.3.1 Operating description:

The activation of the compressors is controlled by the water temperature measured by the probe located at the evaporator inlet/outlet. There are no condenser fans as the condenser is water-cooled.

7.4 Control of water/water chillers with heat pump and reversal on the refrigerant circuit

Inputs used:
- Evaporator water inlet temperature
- Evaporator water outlet temperature
- Condenser water inlet temperature
- Condenser water outlet temperature

Parameters used:
- Type of unit
- Total number of compressors
- Type of compressor capacity control
- Number of capacity-control steps
- Control set point
- Control band
- Type of control (inlet – outlet)
- Inlet control mode (proportional – proportional+intergral)
- Integration time (if proportional+integral control is enabled)
- Compressor capacity stage activation delays
- Device activation delay
- Refrigerant circuit reversing valve logic

Outputs used
- Liquid solenoid
- Compressor Line-Star-Delta windings
- All compressor capacity control relays
- Refrigerant circuit reversing valve

7.4.1 Operating description:

The activation of the compressors is controlled by the water temperature measured by the probe located at the evaporator inlet/outlet. There are no condenser fans as the condenser is water-cooled.
When the cycle is reversed, that is, when switching from cooling to heating or vice-versa, the functions of the evaporator and the condenser are exchanged.
In this way, the refrigerant circuit is reversed, and the compressors are still controlled by the evaporator inlet/outlet temperature.

7.5 Control of water/water chillers with heat pump and reversal on water circuit

Inputs used:
- Evaporator water inlet temperature
- Evaporator water outlet temperature
- Condenser water inlet temperature
- Condenser water outlet temperature

Parameters used:
- Type of unit
- Total number of compressors
- Type of compressor capacity control
- Number of capacity-control steps
- Control set point
- Control band
- Type of control (inlet – outlet)
- Inlet control mode (proportional – proportional+intergral)
- Integration time (if proportional+integral control is enabled)
- Compressor capacity stage activation delays
- Device activation delay
- Water circuit reversing valve logic

Outputs used
- Liquid solenoid
- Compressor Line-Star-Delta windings
- All compressor capacity control relays
- Water circuit reversing valve

7.5.1 Operating description:

The activation of the compressors is controlled by the water temperature measured by the probe located at the evaporator inlet/outlet. There are no condenser fans as the condenser is water-cooled.
When the cycle is reversed, that is, when switching from cooling to heating or vice-versa, the functions of the evaporator and the condenser are not exchanged.
In this way, the water circuit is reversed, and the compressors are controlled by the evaporator or condenser inlet/outlet temperature, depending on the mode selected.

8. Types of compressors controlled

8.1 Stepped capacity control

A maximum of four compressors can be managed, with maximum four capacity stages each.
Capacity control is effected using three relay outputs that, suitably controlled, short-circuit the refrigerant driven by the compressor, thus varying the flow-rate and consequently the capacity available to the circuit.

8.1.1 Stepped capacity control relay configuration

The activation sequence for the capacity-control relays is different for each compressor, and the software thus allows the possibility to configure the activation sequence according to the requirements of different compressor manufacturers.

For multi-board systems, considering the installation of the different compressors on the same machine, it is assumed that the compressors controlled by each pCO are perfectly balanced and thus the configuration of the capacity-control steps selected on the master board is also valid for the slave boards.

The following tables show some example configurations for the digital outputs dedicated to the various capacity-control steps.

The data shown is the effective status of the digital output.
Correspondence between the data shown in the table and the values set on the display:
Closed = ON
Open = OFF

Default configuration:

CAPACITY %	Relay 1	Relay 2	Relay 3
25%	CLOSED	OPEN	OPEN
50%	OPEN	OPEN	CLOSED
75%	OPEN	CLOSED	OPEN
100%	OPEN	OPEN	OPEN

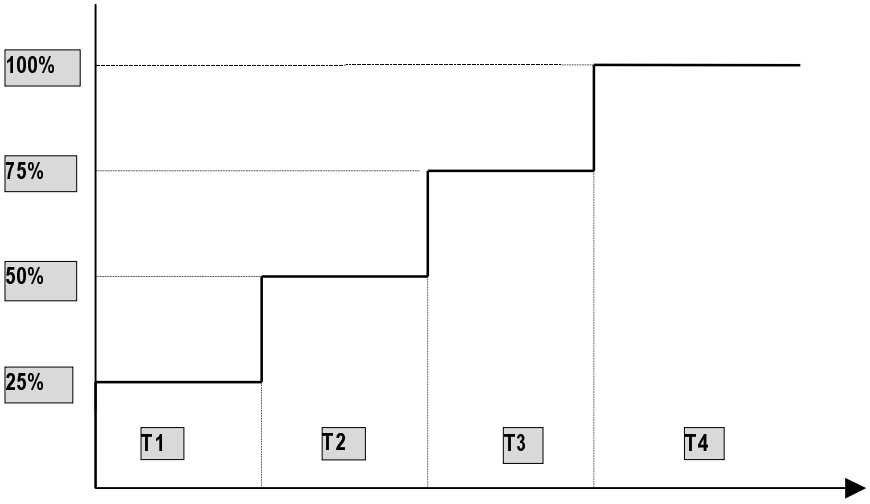
Example configuration:

CAPACITY %	Relay 1	Relay 2	Relay 3
25%	OPEN	CLOSED	CLOSED
50%	CLOSED	CLOSED	OPEN
75%	CLOSED	OPEN	CLOSED
100%	CLOSED	CLOSED	CLOSED

8.1.2 Stepped capacity control times

Stepped capacity control also allows a number of delays to be set for the activation of the various steps
These delays indicate the minimum compressor operating time at a specific stage, thus avoiding, when the machine is started with a request for maximum capacity, to switch directly from level 0 to the maximum level.

Time graph for 4-step capacity-control:



8.1.3 Specific management of the first capacity stage

The first capacity stage can be managed specifically so as to respond to the special needs of the compressor when working at low capacity.

In general, the control function uses the first capacity stage only during the start-up phase, and if the temperature falls below the control set point. For compressor control, it will use a reduced field of capacity modulation between the second and the maximum capacity stage.

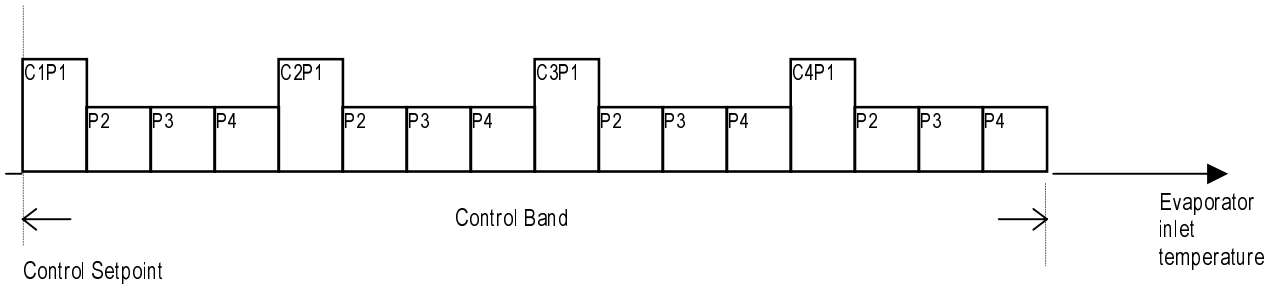
The type of management differs according to whether the compressor is starting or stopping, and in both cases avoids working at 25% capacity for too long:

- Start: once started, if the compressor does not receive a request to switch to the second capacity stage, the second stage is forced on by the software, following a time that can be set on the screen (T1).
- Stop: if a decrease in the capacity of the circuit is requested, this will remain between the maximum and the second capacity stage, and only if the temperature falls below the set point will the compressor be forced to operate at the first capacity stage for the set time (T1)

This specific operating mode can be enabled on the screen.
If it not enabled, the first capacity stage is treated just like the other stages, and the compressor will be able to operate at this capacity for an indefinite time.

8.2 Stepped capacity control with inlet control

Operating description of stepped capacity control for 4 compressors with four capacity stages each:



All the compressors and the corresponding capacity stages are positioned proportionally across the band, and increasing temperature values will lead to the activation of the successive stage, following the set delay times.

The compressor starts at the first capacity stage.
If specific management of the first capacity stage is enabled, the compressor will behave as described in the corresponding section.

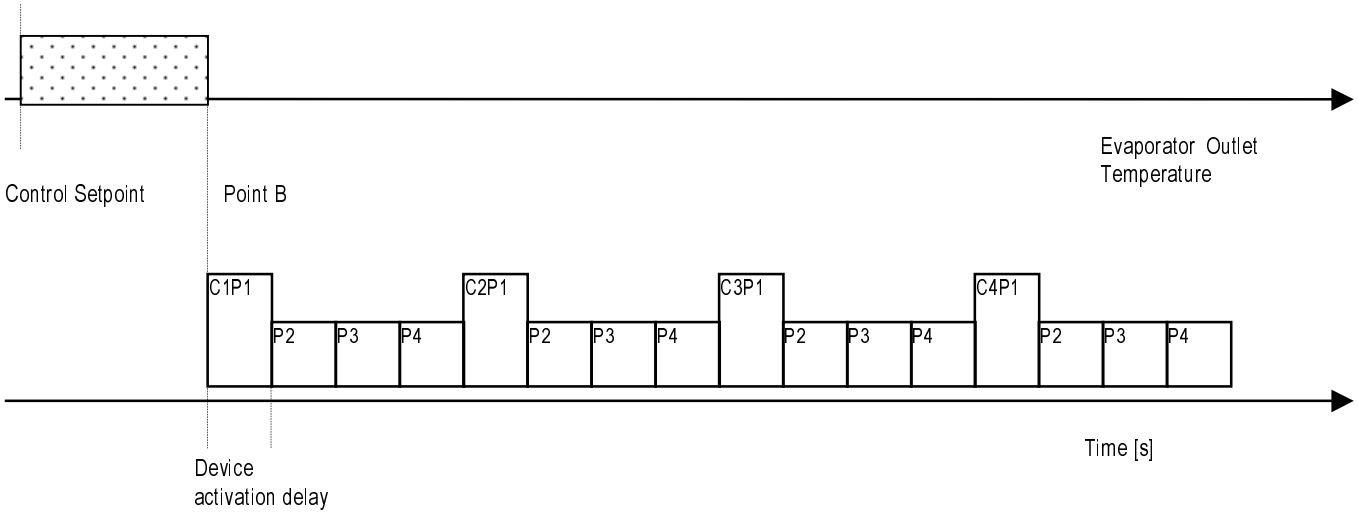
In any case, the delay times for the capacity-control steps will be applied as described.

8.3 Stepped capacity control with outlet control

Operating description of stepped capacity control for 4 compressors with four capacity stages each:

8.3.1 Compressor activation

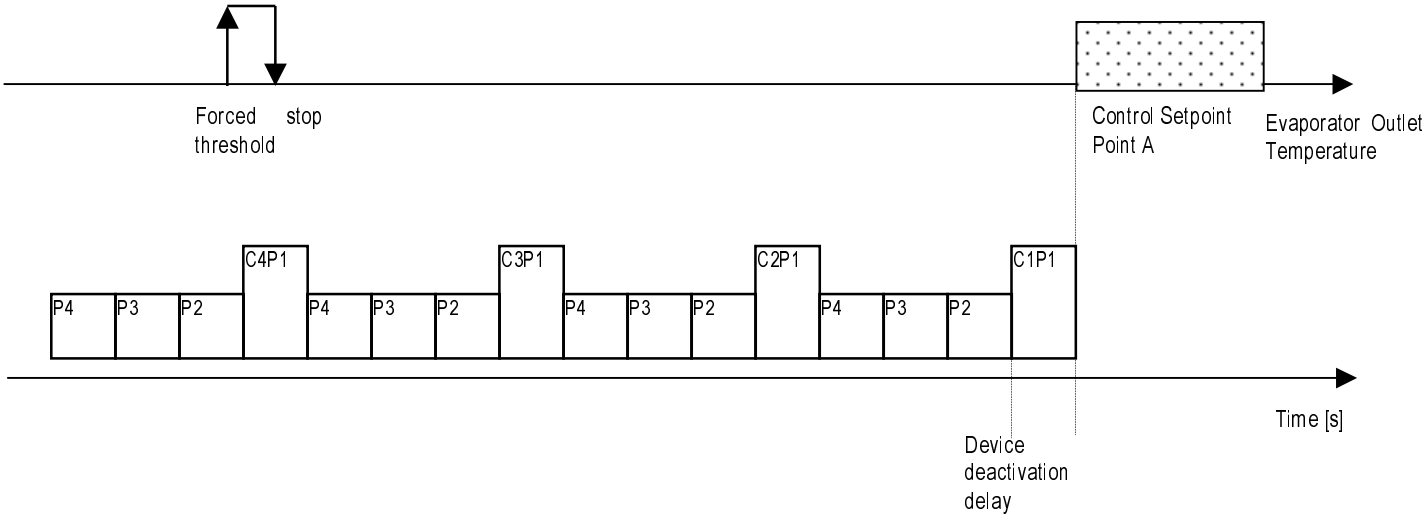
If the water temperature measured by the probe located at the evaporator outlet rises above the threshold represented by the Control set point + Control band (Point B), then the active capacity-control step will be increased, according to the set "device activation delay".



The activation delay of the different devices is the same for both compressors and capacity-control steps.
The capacity-control step activation delays are only considered when the delay in the activation of the steps is less than the lowest delay set. In this way, the speed of increase of compressor capacity is reduced, as excessive difference between the times may lead to the following compressor being started when the previous is not yet at full capacity.

8.3.2 Compressor deactivation

If the water temperature measured by the probe located at the evaporator outlet falls below the Control set point (Point A), then the capacity-control step will be decreased, according the set "device stop delay".

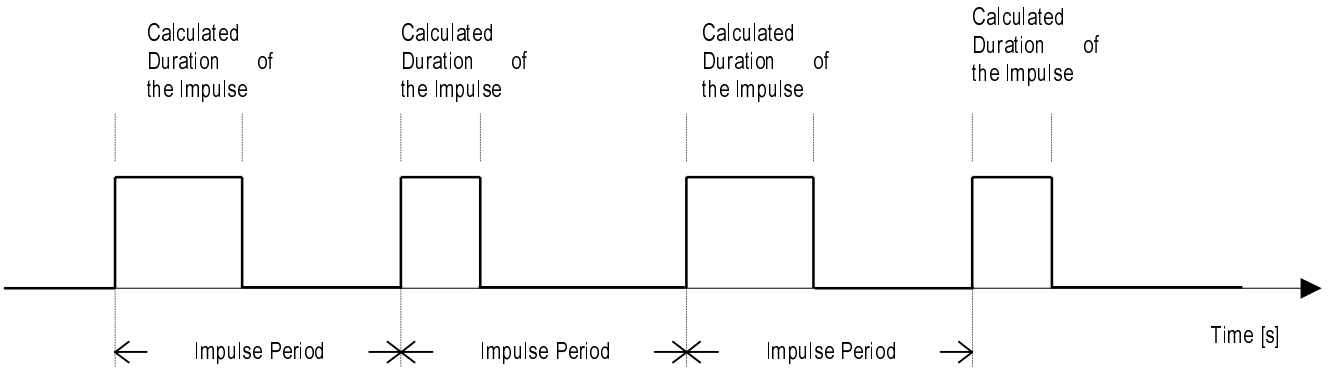


If the temperature falls below the forced stop threshold, the compressors are stopped irrespective of the set delays, to avoid the activation of the antifreeze alarm.

8.4 Continuous capacity control

A maximum of four compressors can be managed, with continuous capacity control.
Capacity control is effected using two relay outputs that, suitably controlled, increase or decrease the compressor capacity by varying the capacity of the compression chamber.

Compressor capacity is controlled by sending impulses to the capacity-control relay outputs so as to charge or discharge the compressor.
These impulses have a constant frequency, which can be set, and a variable duration between two minimum and maximum limits, which can also be set.
As the absolute position of the compressor capacity-control valve is not acquired, and thus it is not possible to directly check the percentage of capacity delivered to the circuit, when reaching a set time threshold, the compressor is considered completely charged/discharged and the capacity-control impulses are thus stopped.



8.4.1 Continuous capacity-control relay configuration

The activation sequence for the capacity-control relays is different for each compressor, and the software thus allows the possibility to configure the activation sequence according to the requirements of different compressor manufacturers.

For multi-board systems, considering the installation of the different compressors on the same machine, it is assumed that the compressors controlled by each pCO are perfectly balanced and thus the configuration of the capacity-control steps selected on the master board is also valid for the slave boards.

The following tables show some example configurations for the digital outputs dedicated to the various capacity-control steps.

The data shown is the effective status of the digital output.
Correspondence between the data shown in the table and the values set on the display:
Closed = ON
Open = OFF

Default configuration:

Compressor Behaviour	Relay 1	Relay 2
8.4.2 Decrease Capacity	CLOSED	CLOSED
Stand-by Capacity	OPEN	CLOSED
Increase Capacity	OPEN	OPEN

The stand-by capacity configuration refers to the status of the outputs when no variation in capacity is requested, either because the maximum/minimum compressor capacity has been reached, or because the water temperature measured by the probe located at the evaporator outlet is within the dead zone.
When charging/discharging the compressor, the digital outputs on the pCO board are controlled alternately according to the stand-by and the charge/discharge configuration, thus causing the pulsing of the specific relay.

8.5 Continuous capacity control with outlet control

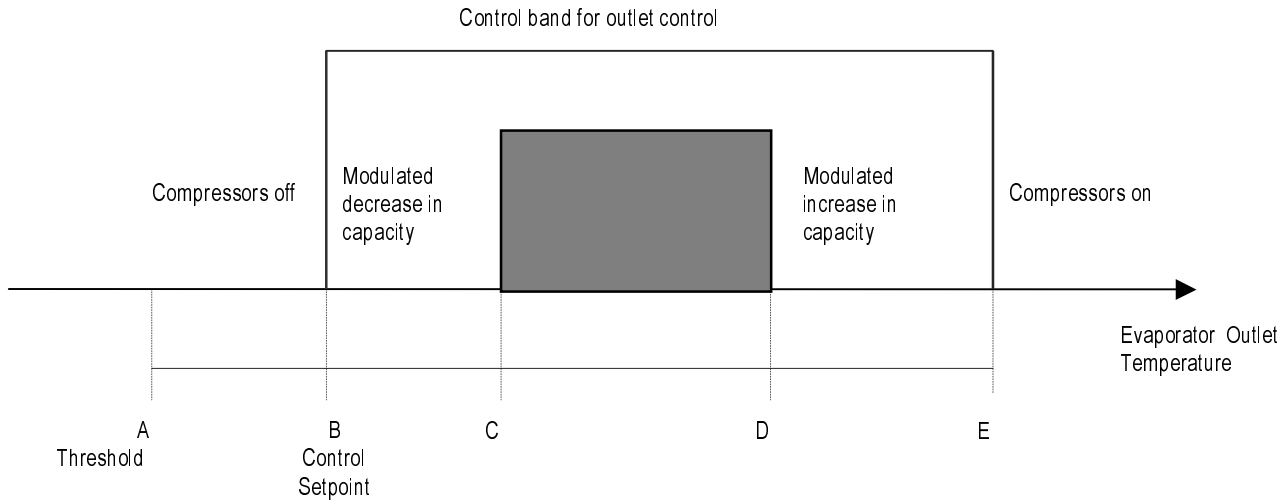
Temperature control with continuous compressor capacity management can be activated only if outlet control according to the temperature measured by the probe located at the evaporator outlet is selected.
In this regard, further specific configuration parameters have been introduced for the type of compressor, in addition to those previously mentioned in the description of the type of control.

Parameters used:

- Dead zone for continuous capacity control
- Impulse period
- Minimum charge impulse duration
- Maximum charge impulse duration
- Minimum discharge impulse duration
- Maximum discharge impulse duration
- Forced discharge period at compressor start
- Enable force capacity-control relay when compressor off

Outputs used:

- Compressor capacity-control relay 1
- Compressor capacity-control relay 2



8.5.1 Continuous capacity control according to points on the graph

Based on the set point, control band with outlet control and continuous capacity control dead zone values, points C,D,E are identified.
The values set for the parameters "Dead zone for continuous capacity control" and "Control band for outlet control" are verified. If point D is higher than point E, then the red LED under the alarm button will flash.

If the water temperature measured by the probe located at the evaporator outlet is higher than point E

Point E = Control Set Point + Outlet Control Band

Then there will be a request for the compressor to start and an increase in capacity according to charge impulses of the maximum duration until reaching the maximum compressor charge time.

If the water temperature measured by the probe located at the evaporator outlet is lower than point B

Point B = Control Set Point

Then the compressors will be discharged according to impulses of the maximum duration, until reaching the maximum compressor discharge time or the compressor stops.

If the water temperature measured by the probe located at the evaporator outlet is between points D-E/B-C

Point D = Control Set Point +(Outlet Control Band – Continuous Capacity Control Dead Zone)
Point C = Point D – Continuous Capacity Control Dead Zone

Then the compressor capacity will be increased/decreased with impulses of variable duration depending on the values calculated between the minimum and maximum set limits, for an indefinite time.

8.5.2 Compressor activation (temperature greater than point E)

The compressors are started sequentially with a frequency dictated by the time required to reach the maximum set capacity.
As there is no absolute measurement of the effective capacity, when the compressor is started it performs a forced discharge cycle for a set time (capacity-control relays energised continuously according to the capacity discharge configuration)
Subsequently the compressor capacity will be increased, with impulses of the maximum duration.

8.5.3 Increase in compressor capacity

Once the maximum time limit for reaching maximum capacity has elapsed, capacity will be controlled according to a forced charge cycle for a time equal to 20% of the set threshold, and then the compressor capacity-control relays will switch to the stand-by capacity configuration.
If the temperature remains in the activation zone (above point E), a charge cycle will forced every ten minutes lasting 20% of the time required to reach the maximum set capacity.
In multi-compressor units the periodical forced charge cycle will be performed by all the compressors that have reached the maximum capacity.

8.5.4 Modulating increase in capacity (temperature between points D-E)

In this temperature band the compressor capacity is modulated, by sending charge impulses to the capacity-control relays of variable duration (calculated between the minimum and maximum set values, depending on the temperature measured).
For multi-compressor units, the modulating increase in capacity is simultaneous for all the compressors that are on.

8.5.5 Compressor operation in the dead zone (temperature between points C-D)

If the temperature is within the dead zone, the capacity-control relays for all the compressors switch to stand-by capacity configuration, thus maintaining the level of capacity previously reached.

8.5.6 Modulating decrease in capacity (temperature between points C-B)

In this temperature band the compressor capacity is modulated, by sending discharge impulses to the capacity-control relays of variable duration (calculated between the minimum and maximum set values, depending on the temperature measured).
For multi-compressor units, the modulating decrease in capacity is simultaneous for all the compressors that are on.

8.5.7 Compressor deactivation (temperature less than point B)

The compressors are first discharged by sending discharge impulses of the maximum duration to the capacity-control relays.
The compressors are then stopped by decreasing the number of devices required at a frequency equal to the time taken to reach the minimum set capacity.
If FIFO rotation is enabled, the compressor that started first will be the first to be discharged and then stopped; vice-versa, with rotation disabled, the compressor that started last will be the first to be discharged and then stopped.

9. Compressor rotation

The compressor calls are rotated so as to balance the number of operating hours and starts between the devices. Rotation follows FIFO logic: the first compressor that starts will be the first to stop. Initially there may be large differences between on the operating hours of the various compressors, however in normal operating conditions the number of hours will tend to balance out.
Rotation is only applied between the compressors and not between the capacity-control steps, and in any case this type of rotation only works for stepped capacity-control.

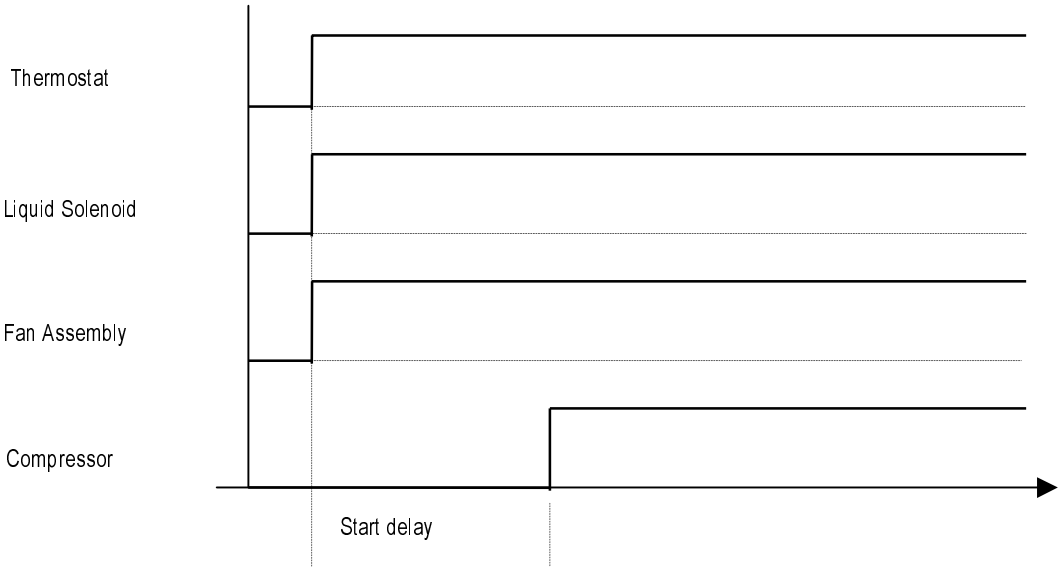
Management without rotation:
- Start: C1,C2,C3,C4.
- Stop: C4,C3,C2,C1.

Management with FIFO rotation (the first compressor that starts will be the first to stop):
- Start: C1,C2,C3,C4.
- Stop: C1,C2,C3,C4.

10. Start-up of an individual compressor

10.1.1 Operating description

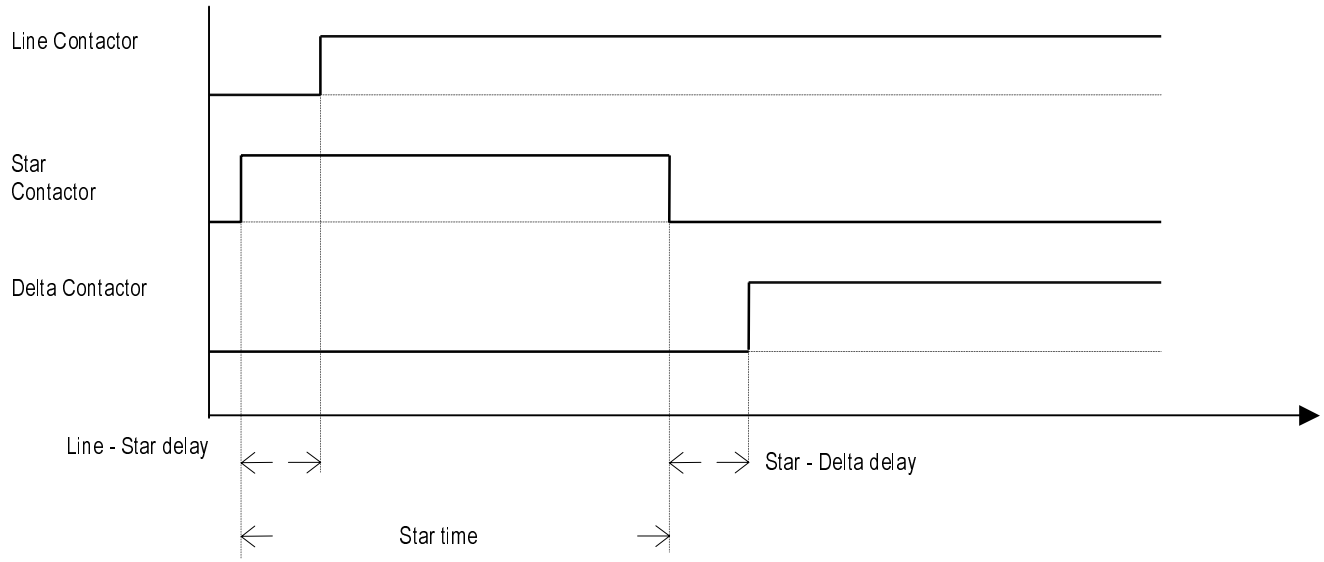
The start-up phases are described in the following graph



10.2 Compressor motor starting

10.2.1 Star - Delta starting

The starting of the motor is described in the following diagram



10.2.2 Part-Winding starting

For part-winding compressor starting, the star and star-line times must be reset, and the star-delta time set to the desired part-winding time.
The outputs used are the line and delta relays, respectively part-winding relay A and B.

Example:

Star–line time	0/100 s	
Star time	0/100 s	
Star-delta time	100/100 s	for a part-winding time of 1 s

10.3 Compressor start limits

Two types of limits have been applied to starting of the compressors, and both ensure the compressor starts directly from the delta contactor, bypassing the star contactor. Enabling is the same for both of the following cases:

1. When set high and low pressure values are exceeded.
2. When the equalised pressure threshold is exceeded (this pressure is the average between the low and the high pressure value measured by the transducers).

11. Forced capacity control

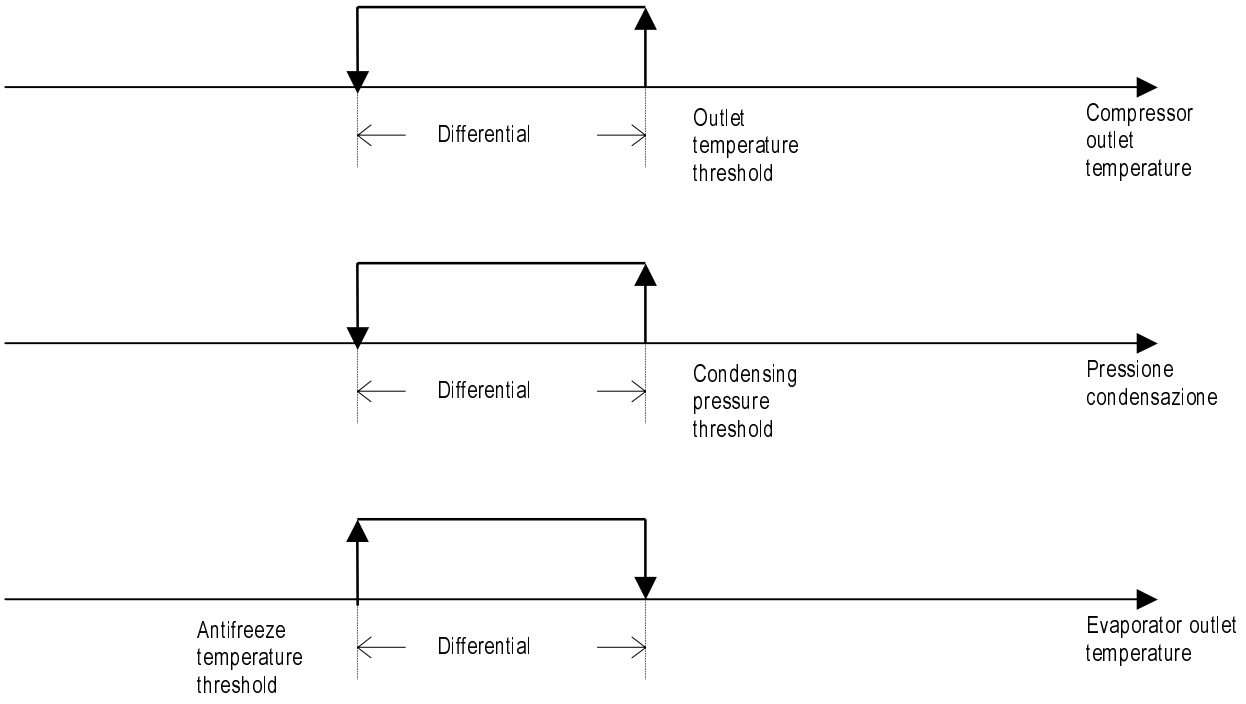
Inputs used
- Evaporator water outlet temperature
- Compressor outlet temperature
- Condensing pressure

Parameters used
- High outlet temperature prevention threshold
- High outlet temperature prevention differential
- High pressure prevention threshold
- High pressure prevention differential
- Antifreeze temperature prevention threshold
- Antifreeze temperature prevention differential
- Select force compressor to minimum/maximum capacity

Outputs used
- All compressor capacity control relays

11.1.1 Operating description

The forced compressor capacity control function prevents the unit from operating in anomalous pressure, chilled water temperature or condensing temperature conditions, by avoiding the activation of the specific alarms.
The compressor operating mode when forced capacity control is activated can be selected; depending on the mode selected, the compressor can operate at the minimum/maximum capacity when:
- The high outlet temperature threshold has been exceeded
- The high pressure threshold has been exceeded
- The antifreeze temperature threshold has been exceeded.



11.1.2 Compressors with stepped capacity control

In the case of compressors with stepped capacity control, forced capacity control operates the compressor at the minimum or maximum capacity, according to the mode selected.

11.1.3 Compressors with continuous capacity control

In the case of compressors with continuous capacity control, forced capacity control operates the compressor in continuous discharge or charge mode, according to the mode selected.

12. Solenoid valve management

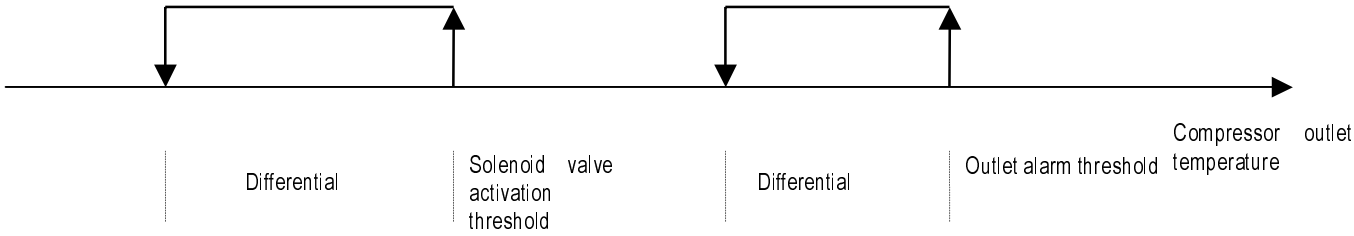
Inputs used:
- Compressor outlet temperature

Parameters used:
- Solenoid valve activation threshold
- Solenoid valve differential

Outputs used:
- Economizer, oil-cooler, liquid-injection solenoid valve

12.1.1 Operating description

A digital output is used to control an economizer, oil-cooler, liquid-injection solenoid valve. The valve is activated based on the compressor outlet temperature read by the probe, according to the following graph



13. Pump-down

Inputs used
- Low pressure switch

Parameters used
- Enable pump-down
- Maximum pump-down duration

Outputs used
- Liquid solenoid
- Compressor Line-Star-Delta windings
- All compressor capacity control relays

13.1.1 Operating description

If enabled, the pump-down function works when the compressor is stopped by the thermostat.
Its duration can be set and may end after a maximum time or alternatively due to the activation of the high pressure switch.
In the event where an alarm is activated to switch off the machine or just the compressor, the pump-down function ends immediately.

The activation of the pump-down function forces the compressor capacity-control operation.
For compressors with stepped capacity control, the compressor is operates at minimum/maximum capacity.
For compressors with modulating capacity-control, a continuous compressor discharge/charge is forced.

14. Condenser control

Condenser control can be performed in the following ways:
- ON/OFF linked to the operation of the compressor (without the pressure transducers)
- ON/OFF or modulating linked to the reading of the pressure transducer (if the high pressure transducers have been enabled)
- ON/OFF or modulating linked to the reading of the coil temperature probes (if the coil temperature probes have been enabled)

Inputs used:
- high pressure probe B7
- coil temperature probe B3

Outputs used:
- Fan 1
- Fan 2
- Fan speed control AOUT1

Parameters used:
- Select condenser control: none/pressure/temperature
- Condenser control set point
- Condenser control band
- Number of fans.
- Enable prevent function
- Prevent threshold
- Prevent differential
- Output voltage corresponding to minimum inverter speed
- Output voltage corresponding to maximum inverter speed
- Inverter speed-up time

14.1 ON/OFF condenser control linked to compressor operation:

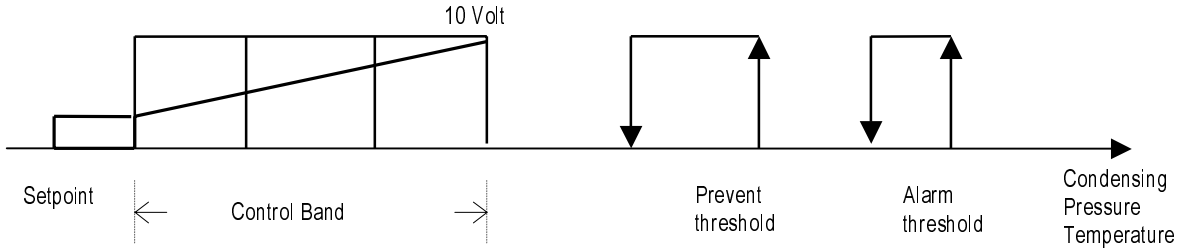
With this type of condenser control, the operation of the fans is subordinate only to the operation of the compressors:
Compressor off = fan off
Compressor on = fan on

14.2 ON/OFF condenser control linked to the pressure or temperature sensor:

The operation of the fans is subordinate to the operation of the compressors and to the value read by the pressure or temperature sensors, according to a set point and a band. When the pressure/temperature is less than or equal to the set point, all the fans are off; when the pressure/temperature rises to the set-point + band, all the fans are started.

14.3 Modulating condenser control linked to the pressure or temperature sensor:

With this type of condenser control, the fans are controlled using an 0/10V analogue output proportional to the request of the pressure/temperature sensor. If the lower limit of the ramp is greater than 0V, the line will not be proportional but rather, as seen in the first section of the graph, one step below the setpoint-diff.



14.4 Prevent function:

This function can be selected on entering the manufacturer password, and is used to avoid the circuits being shut-down due to high pressure.
With the compressor on, when this threshold is reached the compressor is forced to capacity-control operation, until the pressure falls below the set point minus a differential value (which can be set).
With the compressor off, when this threshold is reached the fans are forced on, until the pressure falls below the set point minus a differential value (which can be set).

15. Defrost control for Water/Air machines

Inputs used:
- coil temperature B3 (can be used as a pressure switch)
- high pressure B7
- defrost pressure switch 1

Parameters used:
- Inputs used for defrosting
- Type of global defrosting (simultaneous / separate / independent)
- Type of start and end defrost (compressor behaviour)
- Start defrost set point
- End defrost set point
- Defrost delay time
- Maximum defrost time
- Type of compressor operation during the cycle reversal phase
- Dripping time

Outputs used:
- Compressor 1
- Reverse cycle solenoid electrovalve 1
- Fan.

15.1 Types of defrost:

15.1.1 Simultaneous

Only one circuit needs to enter in the defrost cycle for all the circuits to be forced to defrost; the circuits which do not require defrost (temperature greater than the end defrost set point) stop and go to stand-by; as soon as all the circuits end their defrost cycle the compressors can start again in heat pump operation.

15.1.2 Separate

The first pCO unit that requests defrost starts defrosting, while the other units, even if they require defrost, go to stand-by (continue to operate in heat pump mode) until the first ends its defrost; all the units complete their own defrost cycle in this sequence.

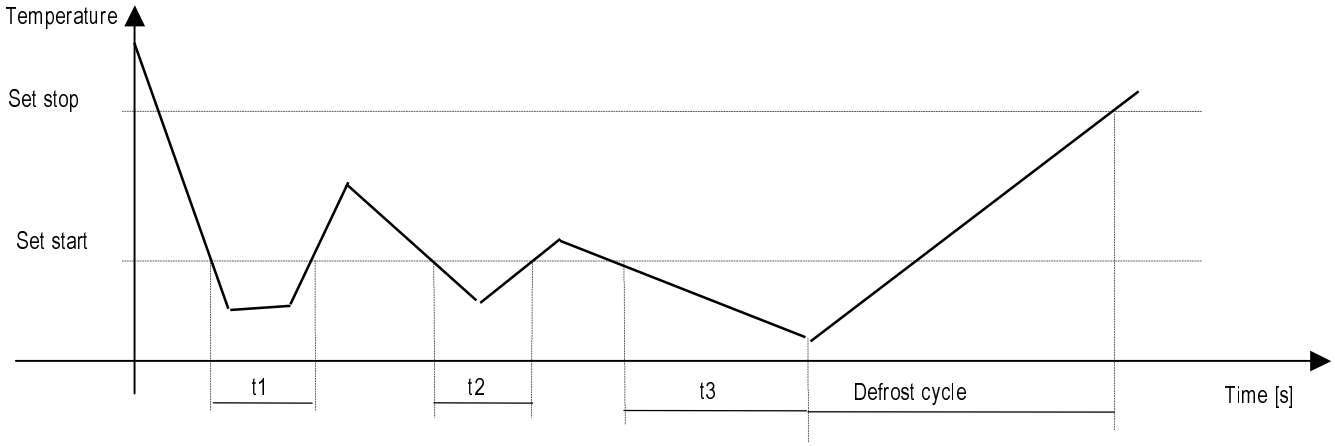
15.1.3 Independent

The various units can start defrost in a random fashion, independently from the others. In this way a series of machines can start defrosting at the same time.

15.2 Type of end and start defrost:

Defrosting can be managed either by the coil temperature probe B3 or alternatively by the high pressure probe B7; the user can choose, on the screen, one of the two probes.
The compressor can have four different start/end defrost actions. This offers the possibility, if necessary, to protect the compressor from rapid reversals of cycle. The other compressor times are not considered in these starts and stops.
- *None:* The compressor is on when the cycle is reversed at the start/end of the defrost.
- *Start defrost*: The compressor is stopped, before the cycle is reversed, only at the start of the defrost
- *End defrost*: The compressor is stopped , before the cycle is reversed, only at the end of the defrost.
- *Start/end defrost*: The compressor is stopped, before the cycle is reversed, both at the start and end of the defrost.

15.3 Circuit defrosting with time/temperature control



If the temperature/pressure of a coil remains below the start defrost set point for a cumulative time equal to the defrost delay time, the circuit in question will start a defrost cycle:

- the system is taken to maximum refrigeration capacity
- the refrigerant circuit is reversed using 4-way valve
- the fan in question is switched off (if the pressure probes are present)

The circuit exits the defrost cycle due to the temperature/pressure (if the coil temperature exceeds the end defrost set point) or after a maximum time, if the defrost cycle exceeds the maximum set threshold time.

15.4 Circuit defrosting with time/pressure switch control:

The control is exactly the same, the only difference is the fact the temperature/pressure is no longer counted, but rather the status of the pressure-switches.

15.5 Fan operation during defrost:

During the defrost cycle, the fans are normally off, and are activated only in the case where the pressure probes have been installed and the pressure exceeds the prevent threshold, to prevent the high pressure alarm being activated.

16. Freecooling control

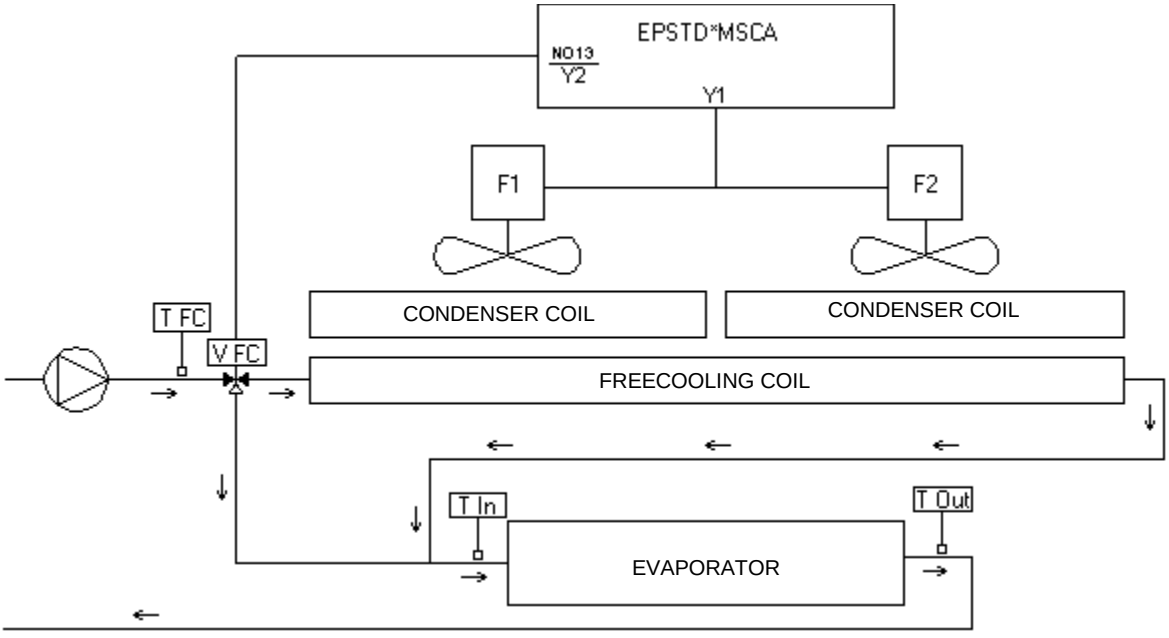
Inputs used
- Evaporator water inlet temperature
- Evaporator water outlet temperature
- Freecooling coil water inlet temperature
- Outside air temperature

Parameters used
- Type of unit
- Number of units
- Type of condenser control
- Number fans
- Type of freecooling valve
- Control set point
- Freecooling delta
- Freecooling differential
- Maximum freecooling valve opening threshold
- Minimum condenser fan speed control threshold

Outputs used
- Condenser fans
- Condenser fan speed control
- ON/OFF Freecooling valve
- 3 way Freecooling valve

16.1.1 Operating description

Freecooling control exploits the temperature of the outside air to assist in the cooling of the utility water.
This function uses a heat exchanger, through which a special valve deviates a certain quantity of return water from the system.
The favourable outside air temperature conditions thus cool the water prior to its return, and the activation of the cooling devices is therefore delayed.
Freecooling is envisaged for air/water units in internal freecooling mode, that is, with the freecooling coil housed inside the machine near the condenser coil/coils, with which it shares the control of the condenser fan/fans.



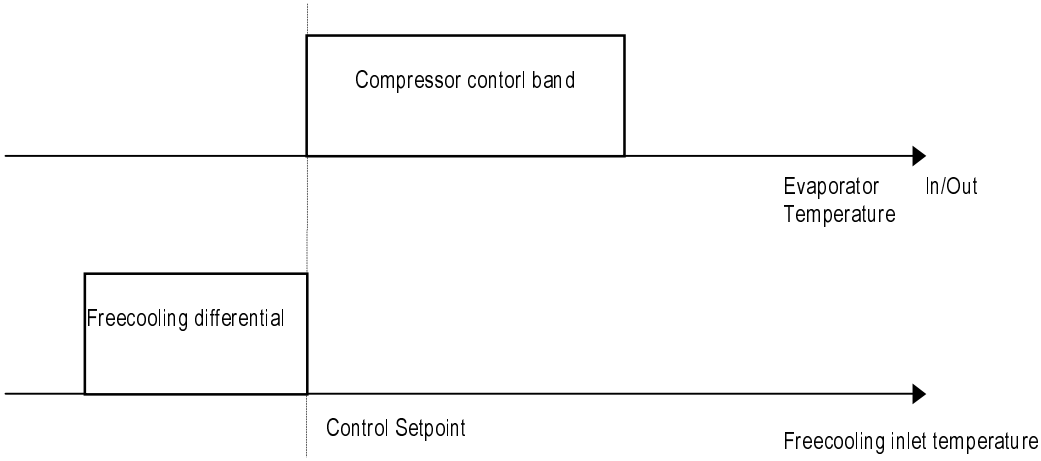
16.2 Activation of the freecooling function

The freecooling function is based on a mathematical equation that compares the temperature measured by the outside temperature probe, the temperature measured by the temperature probe located al the freecooling inlet, and the set freecooling delta.

Outside temp. ≤ Freecooling IN temp. – Freecooling delta

If this condition is true, the freecooling function will be enabled, by activating/deactivating the dedicated devices.

16.3 Freecooling thermostat



The freecooling function uses the control set point, the freecooling differential and the compressor control band values to identify the zones shown in the graph.
The set point includes any compensation and/or remote set points enabled.

In the freecooling band, identified by temperature values between (Control set point – Freecooling differential) and the control set point, the activation thresholds are calculated for the dedicated devices, such as valves, fans or speed controllers, depending on the mode selected.

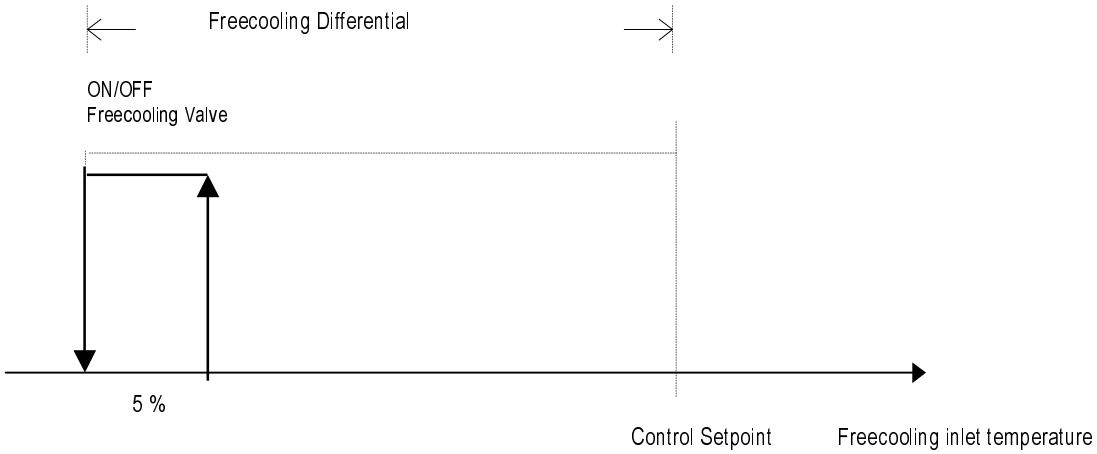
When freecooling is active, the condenser fans will be controlled based on the temperature measured by the freecooling coil inlet probe.

If, following an increase in load, the compressors start, the fans will be controlled by the condenser control function.
The freecooling valve will in any case be controlled, and will be completely open as the temperature measured by the freecooling coil inlet probe (in series with the evaporator inlet/outlet probe for the control of the compressors) is higher than the control set point.
The freecooling valve will be closed if and only if the freecooling conditions are no longer true (Outside temp. ≥ Freecooling temp. – Freecooling delta) or the system return water temperature is less than the activation step of the valve.

The reading of the water temperature probe located at the evaporator outlet is controlled for safety reasons.
Based on the set thresholds, an antifreeze pre-alarm is managed, which activates any post-heaters and switches off all the freecooling devices, along with an antifreeze alarm that shuts down the entire unit.
Other system safety devices, such as: serious alarm from digital input, pump thermal overload, broken control probe, broken antifreeze control probe, evaporator flow switch alarm and the phase monitor alarm, cause the complete shut-down of the unit, and thus the freecooling function.

With temperature control based on the reading of the temperature probe located at the evaporator outlet, a parameter called "Setpoint offset" can be applied, using which the freecooling setpoint is shifted from the compressor control setpoint in order to the account for the rated cooling capacity of the freecooling coil, installed in series with the evaporator.

16.4 ON/OFF freecooling valve

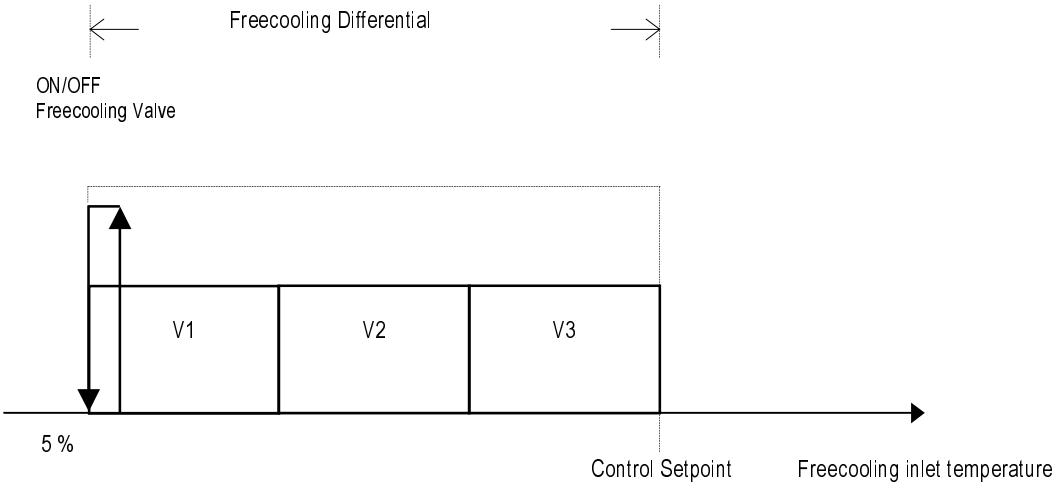


If the temperature conditions allow freecooling control, the ON/OFF freecooling valve will be activated as soon as to the temperature exceeds the activation threshold for the step in question by a temperature value equal to:

Control Set Point – Freecooling differential + 5.0 % Freecooling differential

The amplitude of the step is fixed at 5% of the Freecooling differential.

16.5 ON/OFF freecooling valve with stepped condenser control



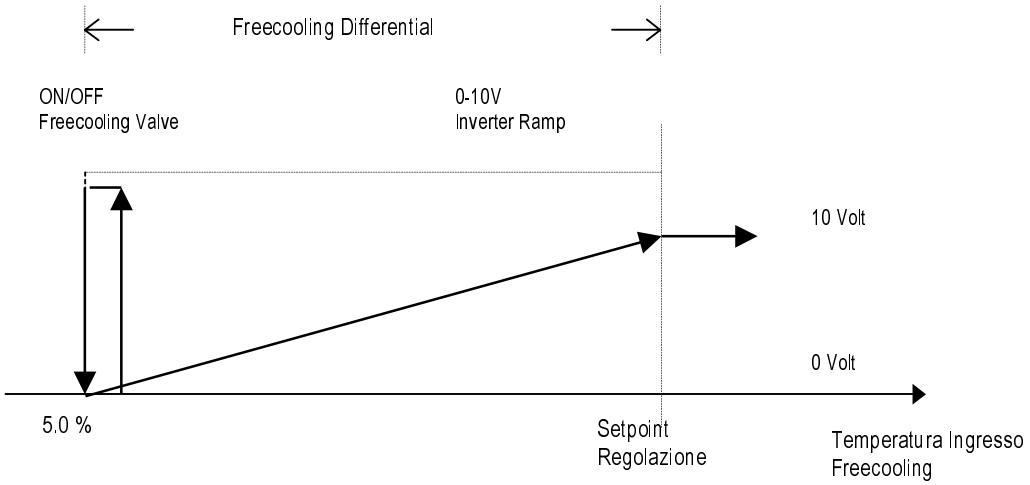
Example of freecooling control with ON/OFF valve and three condenser control steps.

The activation step of the ON/OFF valve will in any case be positioned in the first part of the control differential, and its amplitude will be 5% of the differential.
The activation steps of the condenser fans will be positioned proportionally inside the freecooling differential.
To calculate the amplitude of each step, use the following equation:

$$\text{Step amplitude} = \frac{\text{Freecooling differential}}{\text{(No. Master Fans X Number Boards)}}$$

It is assumed that all the circuits controlled by the different pCO boards making up the system are equivalent and the same number of devices are controlled.

16.6 ON/OFF freecooling valve with condenser inverter

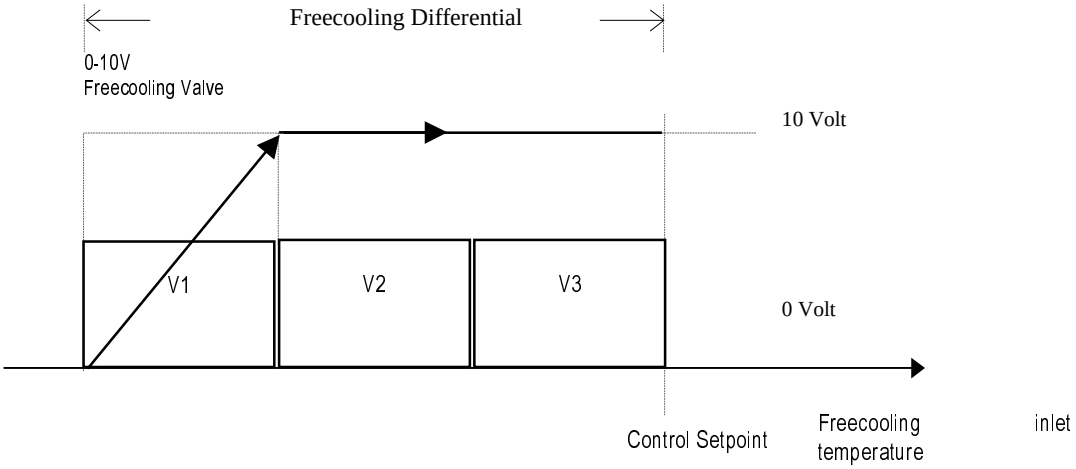


The activation step of the ON/OFF valve will in any case be positioned in the first part of the control differential, and its amplitude will be 5% of the differential.
The proportional ramp for the control of the condenser inverter analogue output will be calculated across the entire control differential; the 0-10 Volt value may be limited at the lower end based on the minimum output voltage value set on the screen.
All the proportional outputs relating to the different units making up the system are controlled in parallel.

16.7 0-10 Volt freecooling valve

The proportional control of the freecooling valve depends on whether stepped condenser control or a condenser inverter is used. Below are the control diagrams for both situations.

16.8 0-10 Volt freecooling valve with stepped condenser control

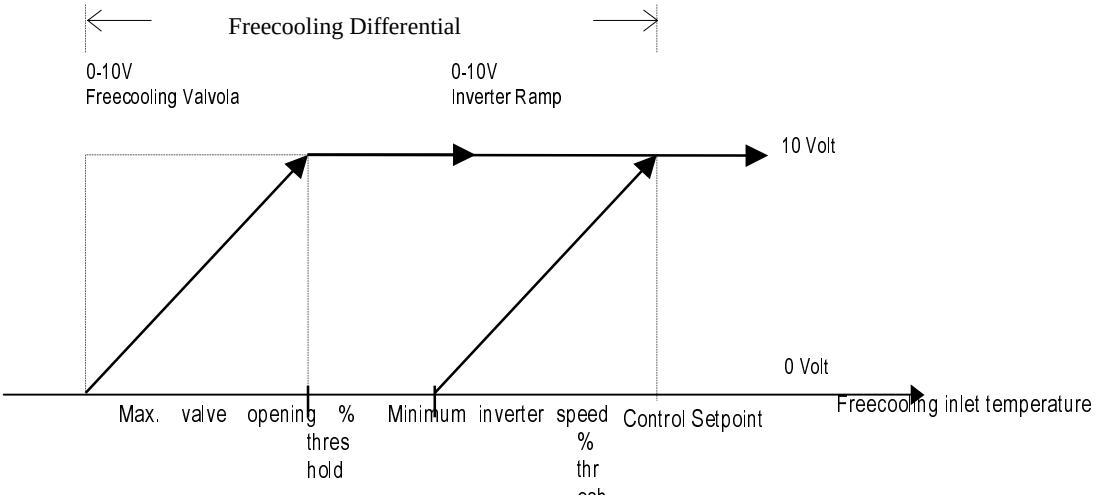


The freecooling valve proportional control ramp is calculated inside the first condenser fan activation step, in this way, when the first fan is started, the valve will be completely open, and thus there will be maximum water flow through the freecooling coil.
The activation steps of the condenser fans will be positioned proportionally inside the freecooling differential.
To calculate the amplitude of each step, use the following equation:

$$\text{Step amplitude} = \frac{\text{Freecooling differential}}{\text{(No. Master Fans X Number Boards)}}$$

It is assumed that all the circuits controlled by the different pCO boards making up the system are equivalent and the same number of devices are controlled.

16.9 0-10 Volt freecooling valve with condenser inverter



The freecooling valve proportional control ramp is calculated inside the area determined by the following thresholds:
Control set point – Freecooling differential
Control set point – Freecooling differential + Maximum valve opening % threshold

The condenser inverter proportional control ramp is calculated inside the area determined by the following thresholds:
Control set point – Freecooling differential + Minimum inverter speed % threshold
Control set point

The start/end points of the two control ramps can be modified as desired, by varying the threshold values (see graph), expressed as percentages of the set Freecooling differential.
For the Freecooling valve, the settings range from 25 to 100% of the differential.
For the condenser inverter, the settings range from 0 to 75% of the differential.

Example

Control set point:	12ºC
Freecooling differential:	4ºC
Freecooling valve % threshold:	40%
Condenser inverter % threshold:	80%
Freecooling valve proportional control area =	8 - 9.6°C
Control set point – Freecooling differential =	8ºC
Maximum valve opening % threshold =	1.6ºC
Condenser inverter proportional control area =	11.2 - 8°C
Control set point – Freecooling differential =	8ºC
Control set point – Freecooling differential + Minimum inverter speed % threshold =	11.2ºC

17. Alarms

The alarms are divided into three categories
Signal-only alarms (signal on the display and buzzer, signal on the display, buzzer, and alarm relay)
Circuit alarms (deactivate only the corresponding circuit, signal on the display, buzzer, alarm relay)
Serious alarms (deactivate the entire system, signal on the display, buzzer, alarm relay)

17.1 Serious alarms

- No water flow alarm
- Evaporator antifreeze alarm with manual reset
- Serious alarm from digital input
- Phase monitor alarm
- Pump thermal overload

17.2 Circuit alarms

- High pressure/pressure switch alarm
- Low pressure alarm
- Compressor thermal overload alarm
- Oil differential alarm
- Fan thermal overload alarm
- Unit disconnected from network alarm
- Pressure differential alarm

17.3 Signal-only alarms

- Unit maintenance alarm
- Compressor maintenance alarm
- Clock board fault or disconnected alarm

17.4 Pressure differential alarm management

Inputs used
- Low pressure transducer
- High pressure transducer

Parameters used
- Enable alarm
- Pressure differential set point
- Alarm activation delay

Outputs used
- General alarm relay
- All the outputs relating to the compressors

17.4.1 Operating description

The alarm is based on the differential between the readings of the high and low pressure probes. If this falls below the set differential, the alarm is signalled and the compressor is stopped, according to the set delay.

17.5 Antifreeze control

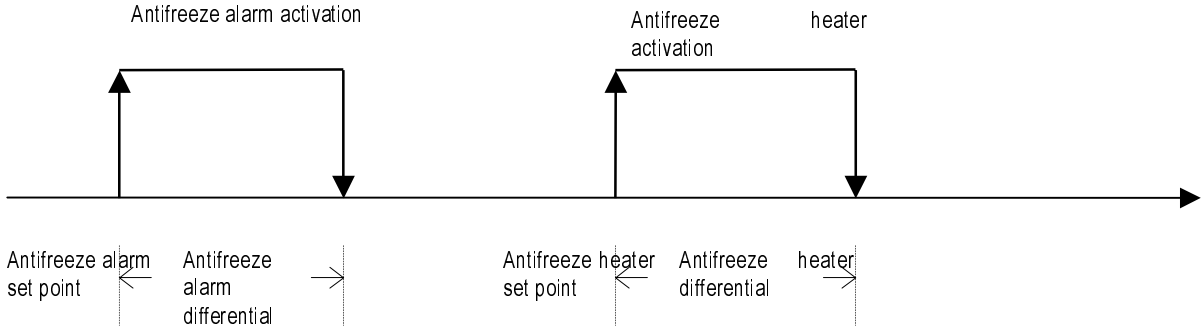
Inputs used:
- Evaporator water outlet temperature
- Condenser water outlet temperature

Parameters used:
- Enable evaporator outlet probe
- Enable condenser outlet probe
- Antifreeze heater set point
- Antifreeze heater differential
- Antifreeze alarm set point
- Antifreeze alarm differential
- Force main pump due to antifreeze alarm

Outputs used:
- Antifreeze heater
- General alarm relay
- All the outputs relating to the compressors
- Main pump

17.5.1 Operating description

Each pCO unit can manage the antifreeze function as long as the evaporator/condenser water outlet temperature probe is connected and enabled, according to the type of unit controlled.



The antifreeze function is always active, even when the machine is off, in both cooling and heating operation.
For type 5 machines with reversal on the water circuit, the antifreeze function controls the water outlet temperature of either the evaporator or the condenser, depending on the operating mode (cooling-heating).

In multi-board systems, an active antifreeze alarm on any of the units causes the total shut-down of the machine.

A special control parameter can be used to select whether or not to run the main pump in the event of an antifreeze alarm.

17.6 Table of pCO alarms

Code	Alarm description	Comp. OFF	Fans OFF	Pump OFF	System OFF	Reset	Delay	Signal
011	Serious alarm	*	*	*	*	Manual		Mst/Slv
012	Phase Monitor alarm	*	*	*	*	Manual		Mst/Slv
018	Evaporator pump thermal overload	*	*	*	*	Manual		Mst
019	Condenser pump thermal overload	*	*	*	*	Manual		Mst
013	Evaporator flow switch	*	*	*	*	Manual	Can be set	Mst/Slv
014	Condenser flow switch	*	*	*	*	Manual	Can be set	Mst/Slv
031	Antifreeze alarm	*	*		*	Manual		Mst/Slv
001	Unit 1 Offline	*	*	*	*	Automatic	50 / 30 s	Slv
002	Unit 2 Offline	*	*	*	*	Automatic	50 / 30 s	Mst
003	Unit 3 Offline	*	*	*	*	Automatic	50 / 30 s	Mst
004	Unit 4 Offline	*	*	*	*	Automatic	50 / 30 s	Mst
020	Compressor thermal overload	*				Manual		Mst/Slv
015	Oil differential pressure switch	*	*			Manual	Can be set	Mst/Slv
032	Low differential pressure	*				Manual	Can be set	Mst/Slv
017	Low pressure switch	*	*			Manual	Can be set	Mst/Slv
016	High pressure switch	*	*			Manual		Mst/Slv
034	Low pressure, transducer	*				Manual		Mst/Slv
033	High pressure, transducer	*	*			Manual		Mst/Slv
021	Fan 1 thermal overload		*			Manual		Mst/Slv
022	Fan 2 thermal overload		*			Manual		Mst/Slv
036	High voltage					Manual		Mst/Slv
037	High current					Manual		Mst/Slv
051	Evap. Pump Maintenance					Manual		Mst
052	Cond. Pump Maintenance					Manual		Mst
053	Compressor maintenance					Manual		Mst/Slv
060	Probe fault B1	*	*	*	*	Automatic	10 s	Mst
061	Probe fault B2	*	*	*	*	Automatic	10 s	Mst/Slv
062	Probe fault B3					Automatic	10 s	Mst/Slv
063	Probe fault B4					Automatic	10 s	Mst/Slv
064	Probe fault B5					Automatic	10 s	Mst/Slv
065	Probe fault B6					Automatic	10 s	Mst/Slv
066	Probe fault B7					Automatic	10 s	Mst/Slv
067	Probe fault B8					Automatic	10 s	Mst/Slv
041	32kB clock card fault					Manual		Mst/Slv

17.7 Driver alarms

The alarms deriving from the driver boards also identify the driver that generated the alarm (in the example: "D:3")

Example :

M_Drv1_Alarm107

```
AL:107       D:1 U:

  Super heat alarm
```

When an alarm screen relating to one of the driver boards appears, in the upper left the message "Driver" appears; in addition, on the right, "D:" indicates the driver while, "U:" indicates the pCO board connected to the driver indicated.
In the example, the alarm is from driver no. 3, which is connected via pLAN to pCO board no. 3. This numbering also refers to the connection layout described earlier on, and summarised below.

17.8 Driver board alarms

- Probe error (malfunctioning or breakage of the temperature and/or pressure probe)
- Stepper motor error (defective valve motor connections)
- eEPROM error (malfunctioning of eEPROM during read or write)
- Battery error (battery malfunction)
- High pressure on EXV driver (the operating pressure has exceeded the max. threshold - MOP)
- Low pressure on EXV driver (the operating pressure has exceeded the min. threshold - LOP)
- Super-heat alarm (superheating alarm)
- Valve not closed during shut-down (valve not completely closed after the previous blackout)
- Wait reopening of valve (warning! wait until the valve is completely closed for correct re-start)
- Wait battery recharge (warning! wait for the battery to recharge)
- Wait eEPROM reboot (warning! wait for the eEPROM to reboot)

The compressor(s) in the circuit can be stopped when the corresponding driver shows the "battery error" and/or "low pressure on EXV driver" (LOP mode) alarm.
A delay can also be entered for the latter alarm, set as default to 0 seconds.

Manuf_Drv_110

```
Manufacturer D:1 U:
Switch off compress.
if battery error   N
Delay        ----sec
```

Manuf_Drv_120

```
Manufacturer D:1 U:
Switch off compress.
if low pressure    N
Delay        ----sec
```

18. Alarm log

The alarm log function saves all the alarm events from a specific pCO board. To enable this function, an optional card must be installed to set the serial address, including the clock option and 32kB memory (see the paragraph on the installation of the optional cards) and then enable the function on the corresponding screen.

Each alarm is associated to an ID code that is shown on the alarm screens; this code is saved and displayed when the log is accessed.

The log is a circular list of data made up of a maximum of 250 events (maximum number of alarms saved = 250), and once the maximum limit has been reached, the least recent data is overwritten.

Each alarm code saved is accompanied by the day-month-year-hour-minute of the event, the water inlet temperature, water outlet temperature, high pressure and low pressure measured at that moment, so as to provide a more or less detailed idea of the unit operating conditions.

A procedure is available for completely and unconditionally deleting all the data saved in the log, and is protected by the maintenance password. The procedure may take a few minutes.
It is good practice to delete the alarm log when installing a new optional 32kB card or when first starting the unit.

Each unit has its own alarm log, and so for multi-board applications each pCO must feature an optional 32kB clock card.
To ensure the uniformity of the data, the date and time of the alarm event in any case refer to the master board, irrespective of the address of the slave.

Below is a list of the alarm codes and corresponding descriptions for the alarms managed by the software:

AL:001 Unit no.1 Offline
AL:002 Unit no.2 Offline
AL:003 Unit no.3 Offline
AL:004 Unit no.4 Offline
AL:011 Serious alarm from digital input
AL:012 Alarm monitor phase
AL:013 Evaporator flow switch alarm
AL:014 Condenser flow switch alarm
AL:015 Oil level alarm
AL:016 High pressure alarm (pressure switch)
AL:017 Low pressure alarm (pressure switch)
AL:018 Evaporator pump thermal overload
AL:019 Condenser pump thermal overload
AL:020 Compressor thermal overload
AL:021 Condenser fan 1 thermal overload
AL:022 Condenser fan 2 thermal overload
AL:031 Antifreeze alarm
AL:032 Low differential pressure alarm
AL:033 High pressure alarm (transducer)
AL:034 Low pressure alarm (transducer)
AL:035 High outlet temperature alarm
AL:036 High voltage alarm
AL:037 High current alarm
AL:041 32kB clock card broken or not connected
AL:051 Evaporator pump maintenance
AL:052 Condenser pump maintenance
AL:053 Compressor maintenance
AL:060 Probe B1 broken or not connected
AL:061 Probe B2 broken or not connected
AL:062 Probe B3 broken or not connected
AL:063 Probe B4 broken or not connected
AL:064 Probe B5 broken or not connected
AL:065 Probe B6 broken or not connected
AL:066 Probe B7 broken or not connected
AL:067 Probe B8 broken or not connected
AL:101 Probe error
AL:102 Stepper motor error
AL:103 EEPROM error
AL:104 Battery error
AL:105 High pressure
AL:106 Low pressure
AL:107 Super-heat alarm
AL:108 Valve not closed during shut-down
AL:109 Wait valve re-opening
AL:110 Wait battery recharge
AL:111 Wait EEPROM reboot
AL:201 Probe error
AL:202 Stepper motor error
AL:203 EEPROM error
AL:204 Battery error
AL:205 High pressure
AL:206 Low pressure
AL:207 Super-heat alarm
AL:208 Valve not closed during shut-down
AL:209 Wait valve re-opening
AL:210 Wait battery recharge
AL:211 Wait EEPROM reboot

19. First start-up

Only one program EPROM is featured, valid for the master and slave boards, which recognises the correct operating mode based on the address of the pCO board where installed.
When a new EPROM is installed on the pCO board, **the default values must be installed**.
An automatic default installation procedure is available, which operates based on the difference between the date and version of the software saved.
If Alco drivers are used for the electronic expansion valves, during the default installation procedure these must be powered and connected to the pLAN network, otherwise they will not be initialised.

19.1 Installing the default values

19.1.1 pCO board

This procedure unconditionally deletes the pCO board memory and installs the values set by Carel for the initial operation of the machine.
Any previous setting will be irreversibly lost.

WARNING! This operation should also be repeated if the EPROM or pCO board are replaced, or in the case of any other modifications to the system hardware that may compromise the software.

M_Pw_Manuf

```
╔═══════════════════╗
║Insert          U: ║
║manufacturer       ║
║password           ║
║              0000 ║
╚═══════════════════╝
```

Press the buttons MENU and PROG together

After having entered the correct password, the following screen is displayed:
M_Manuf245

```
╔═══════════════════╗
║Erase memory    U: ║
║Install global     ║
║default values    N║
║                   ║
╚═══════════════════╝
```

Move to the Y/N field by pressing ENTER, and using the arrow buttons change N to Y, when the message "Please wait.." disappears, the default values have been installed.
At this point switch the pCO board off and on again. This resets all the counters on the board and renders the set data effective.

If using the 32kB clock card for logging the alarms, the alarm log should also be deleted, as it may contain meaningless data, especially if the board is new. The procedure must be performed separately in the password-protected maintenance branch, and only if the clock card is enabled.

19.1.2 EXV driver

A function is available for initialising the individual drivers, and can be used when needing to replace one of these devices, thus avoiding the need to completely re-initialise the machine and hence saving time.

To initialises an individual driver, access the manufacturer screens dedicated to the drivers, and then access the configuration parameters for the driver in question.

Manuf_Drv_280

```
╔═══════════════════╗
║Manufacturer D:1 U:║
║Install default    ║
║values            N║
║                   ║
╚═══════════════════╝
```

On the screen
Select Y, and when the message "Please wait ..." disappears the driver has been initialised.
At the end of the operation, turn the driver off and on again to render the new settings effective.
Following this the control parameters for the driver can be configured as desired.

19.2 Switching the machine On/Off

There are two ways to switch the machine On/Off:

1. System On/Off
2. Circuit On/Off

The machine status can be controlled from the keypad, digital input (this can be enabled) or supervisor (this can also can be enabled).

Switching the machine On/Off from the keypad using the ON/OFF button has absolute priority, and when the button is pressed the green LED indicating the status will turn on or off accordingly.
Only if the machine has been switched on from the keypad can it be controlled by the supervisor and/or the digital input, and the switching off of the machine from the supervisor and/or digital input will be signalled by the flashing of the green ON/OFF LED and a special message on the main menu screen.

19.2.1 System On/Off

The command is given on the master board: if switched on, it will also switch on all the slaves in the system, and vice-versa if switched off.

19.2.2 Circuit On/Off

The command is given by the slave boards: only if the master board is on can the individual slave boards be switched on/off by the supervisor/digital input.

20. User Interface

20.1 Table of Parameters

No.	Description	Master/Slave	Default	Limits
	Manufacturer parameters			
1	Type of unit (see table of inputs/outputs)	Mst/slv	0	0 – 5
2	Enable probe B1	Mst/slv	S	Y/N
3	Enable probe B2	Mst/slv	N	Y/N
4	Enable probe B3	Mst/slv	N	Y/N
5	Enable probe B4	Mst/slv	N	Y/N
6	Enable probe B5	Mst/slv	N	Y/N
7	Enable probe B6	Mst/slv	N	Y/N
8	Enable probe B7	Mst/slv	N	Y/N
9	Enable probe B8	Mst/slv	N	Y/N
11	Select type of probe no. 5	Mst	NONE	NONE/OUTSIDE SET POINT/VOLTAGE/CURRENT
12	Select type of outlet temp. probe	Mst/slv	0 / 1 V	0/1 V - 4/20 mA
13	Minimum limit for probe no. 5	Mst/slv	0.0	-999.9 - 999.9
14	Maximum limit for probe no. 5	Mst/slv	0.0	-999.9 - 999.9
15	Start scale for outlet temperature probes	Mst/slv	-30.0°C	-999.9 - 999.9°C
16	End scale for outlet temperature probes	Mst/slv	150.0°C	0 - 999.9°C
17	Start scale for high pressure probes (4mA)	Mst/slv	0.0 bars	0 - 999.9 bars
18	End scale for high pressure probes (20mA)	Mst/slv	30.0 bars	0 - 999.9 bars
19	Start scale for low pressure probes (4mA)	Mst/slv	-0.5 bars	-99.9 - 99.9 bars
20	End scale for low pressure probes (20mA)	Mst/slv	7.0 bars	-99.9 - 99.9 bars
21	Enable Double Set Point	Mst	N	Y/N
22	Number of drivers present	Mst/slv	0	0 - 2
23	Total number of compressors	Mst	1	1 - 4
24	Enable compressor rotation (FIFO logic)	Mst	S	Y/N
25	Type of capacity control	Mst/Slv	STEP	STEP / MODULATING
26	Number of capacity stages per compressor	Mst	4	1 - 4
27	Time between Line and Star	Mst/slv	100 s/100	0 - 999 s/100
28	Star time	Mst/slv	500 s/100	0 - 999 s/100
29	Time between Star and Delta	Mst/slv	100 s/100	0 - 999 s/100
30	Enable compressor limits at start	Mst/slv	N	Y/N
31	Low pressure limit at start	Mst/slv	6.0 bars	0 - 99.9 bars
32	High pressure limit at start	Mst/slv	18.0 bars	0 - 99.9 bars
33	Threshold for equalised pressure	Mst/slv	13.0 bars	0 - 99.9 bars
34	Minimum compressor on time	Mst/slv	60 s	0 - 9999 s
35	Minimum compressor off time	Mst/slv	360 s	0 - 9999 s
36	Time between starts of different compressors	Mst/slv	10 s	0 - 9999 s
37	Time between two starts of the same compressor	Mst/slv	450 s	0 - 9999 s
38	Capacity-control relay configuration for the first capacity stage	Mst	ON/OFF/OFF	ON/OFF
39	Capacity-control relay configuration for the second capacity stage	Mst	OFF/OFF/ON	ON/OFF
40	Capacity-control relay configuration for the third capacity stage	Mst	OFF/ON/OFF	ON/OFF
41	Capacity-control relay configuration for the fourth capacity stage	Mst	OFF/OFF/OFF	ON/OFF
42	Enable special management of first capacity stage	Mst/slv	N	Y/N
43	Time between the opening of the liquid solenoid and compressor start	Mst/slv	10 s	0 - 9999 s
44	Time between the first capacity stage and the second	Mst/slv	25 s	0 - 9999 s
45	Time between second capacity stage and the third	Mst/slv	300 s	0 - 9999 s
46	Time between the third capacity stage and the fourth	Mst/slv	300 s	0 - 9999 s
47	Stand-by configurat. of the capacity-control relays for continuous capacity control	Mst	OFF/ON	ON/OFF
48	Discharge config. of the capacity-control relays for continuous capacity control	Mst	ON/ON	ON/OFF
49	Charge configurat. of the capacity-control relays for continuous capacity control	Mst	OFF/OFF	ON/OFF
50	Capacity control impulse period	Mst/slv	6 s	0 - 99 s
51	Minimum duration of the discharge impulse	Mst/slv	1.5 s	0.0 - 99.9 s
52	Maximum duration of the discharge impulse	Mst/slv	3.0 s	0.0 - 99.9 s
53	Minimum duration of the charge impulse	Mst/slv	1.5 s	0.0 - 99.9 s
54	Maximum duration of the charge impulse	Mst/slv	3.0 s	0.0 - 99.9 s
55	Forced discharge time at compressor start	Mst/slv	30 s	0 - 999 s
56	Enable forced solenoid discharge when compressor off	Mst/slv	N	Y/N
57	Enable pump-down	Mst/slv	N	Y/N
58	Maximum pump-down time	Mst/slv	50 s	0 - 999 s
59	Forced compressor capacity control configuration	Mst/slv	MINIMUM CAPACITY	MINIMUM / MAXIMUM CAPACITY

No.	Description	Master/Slave	Default	Limits
60	Select high condensing temper./pressure prevention for forced capacity control	Mst/slv	PRESSURE	PRESSURE / TEMPERATURE
61	Enable forced capacity control for high condensing pressure	Mst/slv	N	Y/N
62	High pressure threshold for forced capacity control	Mst/slv	20.0 bars	0.0 - 99.9
63	High pressure differential for forced capacity control	Mst/slv	2.0 bars	0.0 - 99.9
64	Enable forced capacity control for high outlet temperature	Mst/slv	S	Y/N
65	High outlet temperature threshold for forced capacity control	Mst/slv	90.0°C	0.0 - 999.9°C
66	High outlet temperature differential for forced capacity control	Mst/slv	5.0°C	0.0 - 99.9°C
67	Antifreeze temperature threshold for forced capacity control	Mst/slv	6.0°C	-99.9 - 99.9°C
68	Antifreeze temperature differential for forced capacity control	Mst/slv	1.0°C	0.0 - 99.9°C
69	Enable condenser control	Mst/slv	N	N / PRESSURE / TEMPERATURE
70	Type of condenser control	Mst/slv	INVERTER	STEPS / INVERTER
71	Number of condenser fans	Mst/slv	1	1 - 2
72	Condenser control set point	Mst/slv	14.0 bars	0.0 - 999.9 bars
73	Condenser control differential	Mst/slv	2.0 bars	0.0 - 999.9 bars
74	Voltage at maximum inverter speed	Mst/slv	10.0 V	0.0 - 10.0 V
75	Voltage at minimum inverter speed	Mst/slv	3.0 V	0.0 - 10.0 V
76	Inverter speed-up time	Mst/slv	10 s	0 - 99 s
77	Enable the evaporator flow switch alarm	Mst/slv	N	Y/N
78	Enable the condenser flow switch alarm	Mst/slv	N	Y/N
79	Evaporator flow switch alarm delay at start	Mst	15 s	0 - 99 s
80	Evaporator flow switch alarm delay when stable	Mst	3 s	0 - 99 s
81	Condenser flow switch alarm delay at start	Mst	15 s	0 - 99 s
82	Condenser flow switch alarm delay when stable	Mst	3 s	0 - 99 s
83	High outlet temperature alarm set point	Mst/slv	120.0°C	0.0 - 999.9°C
84	High outlet temperature alarm differential	Mst/slv	5.0°C	0.0 - 99.9°C
85	High pressure alarm set point	Mst/slv	21.0 bars	0.0 - 99.9 bars
86	High pressure alarm differential	Mst/slv	2.0 bars	0.0 - 99.9 bars
87	Low pressure alarm set point	Mst/slv	1.0 bars	-99.9 - 99.9 bars
88	Low pressure alarm differential	Mst/slv	0.5 bars	-99.9 - 99.9 bars
89	Enable low pressure differential alarm	Mst/slv	N	Y/N
90	Low pressure differential alarm set point	Mst/slv	6.0 bars	0.0 - 99.9 bars
91	Low pressure differential alarm differential	Mst/slv	2.0 bars	0.0 - 99.9 bars
92	Low pressure alarm delay at start	Mst/slv	40 s	0 - 999 s
93	Low pressure alarm delay when stable	Mst/slv	0 s	0 - 999 s
94	Oil differential alarm delay at start	Mst/slv	120 s	0 - 999 s
95	Oil differential alarm delay when stable	Mst/slv	10 s	0 - 999 s
96	High voltage alarm set point	Mst/slv	440.0 V	0.0 - 999.9 V
97	High voltage alarm differential	Mst/slv	5.0 V	0.0 - 99.9 V
98	High current alarm set point	Mst/slv	90.0 A	0.0 - 999.9 V
99	High current alarm differential	Mst/slv	5.0 A	0.0 - 99.9 V
100	Antifreeze alarm set point	Mst/slv	3.0°C	-99.9 - 99.9°C
101	Antifreeze alarm differential	Mst/slv	1.0°C	-99.9 - 99.9°C
102	Select pump control mode for antifreeze alarm	Mst/slv	PUMP ON	PUMP ON / OFF
103	Solenoid valve activation threshold (Economizer/oil-cooler/liquid-injection)	Mst/slv	80.0°C	0.0 - 999.9°C
104	Solenoid valve activation differential	Mst/slv	10.0°C	0.0 - 99.9°C
105	Antifreeze heater activation set point	Mst/slv	5.0°C	-99.9 - 99.9°C
106	Antifreeze heater differential	Mst/slv	1.0°C	-99.9 - 99.9°C
107	Reverse cycle valve logic	Mst/slv	N.O.	N.C. / N.O.
108	Type of freecooling valve (ON/OFF; modulating 0/10V)	Mst	0/10V	ON/OFF – 0/10V
109	Defrost probe configuration	Mst/slv	TEMPERATURE	PRESSURE SWITCHES TEMPERATURE PRESSURE
110	Global defrost configuration	Mst/slv	SIMULTANEOUS	INDEPENDENT SIMULTANEOUS SEPARATE
111	Enable 32kB clock card for alarm log function	Mst/slv	N	Y/N
112	Supervisor system communication speed	Mst/slv	19200 bps	1200/2400/4800/9600/19200 bps
113	Serial communication ID	Mst/slv	1	1 - 200
114	Reset all parameters and install default values	Mst/slv	N	Y/N
115	Set new manufacturer password	Mst/slv	1234	0 - 9999
	User parameters			
116	Cooling set point upper limit	Mst	17.0°C	-99.9 - 99.9°C
117	Cooling set point lower limit	Mst	7.0°C	-99.9 - 99.9°C
118	Heating set point upper limit	Mst	50.0°C	-99.9 - 99.9°C
119	Heating set point lower limit	Mst	40.0°C	-99.9 - 99.9°C

No.	Description	Master/Slave	Default	Limits
120	Type of control	Mst	INLET	INPUT / OUTLET
121	Type of inlet control, select probe for control: water inlet (P/PI) water outlet (dead zone)	Mst	PROPORTIONAL	PROPORTIONAL / PROPORTIONAL + INTEGRAL
122	Integration time (for PI inlet control)	Mst	600 s	0 - 999 s
123	Cooling threshold for forcing OFF steps with outlet control (chiller operation, avoid antifreeze alarm)	Mst	10.0°C	-99.9 - 99.9°C
124	Heating threshold for forcing OFF steps with outlet control (heat pump operation)	Mst	47.0°C	-99.9 - 99.9°C
125	Temperature control band	Mst	3.0°C	0.0 - 99.9°C
126	Dead zone for continuous capacity control	Mst/slv	1.0°C	0.0 - 99.9°C
127	Minimum time between pump/fan start and compressor start	Mst	5 s	0 - 999 s
128	Pump/fan off delay	Mst	5 s	0 - 999 s
129	Enable ON/OFF from digital input	Mst/slv	N	Y/N
130	Enable ON/OFF from supervisor	Mst/slv	N	Y/N
131	Enable cooling/heating from digital input	Mst	N	Y/N
132	Enable cooling/heating from supervisor	Mst	N	Y/N
133	Offset Setpoint Freecooling regulation	Mst	5.0°C	0.0 - 99.9°C
134	Temperature difference for freecooling activation	Mst	2.0°C	0.0 - 99.9°C
135	Temperature differential for fan control in Freecooling	Mst	3.0°C	2.0 - 99.9°C
136	Maximum Freecooling valve opening threshold	Mst/slv	50%	25 - 100%
137	Minimum inverter speed threshold in freecooling	Mst/slv	50%	0 - 75%
138	Start defrost threshold	Mst/slv	2.0°C	-99/99
139	End defrost threshold	Mst/slv	12.0°C	-99/99
140	Dripping time	Mst/slv	10 s	0 - 999 s
141	Minimum time between defrosts	Mst/slv	1800 s	0 - 30000 s
142	Maximum defrost time	Mst/slv	300 s	0 - 30000 s
143	Configure compressor operation when reversing cycle	Mst/slv	COMP ON	COMP ON / COMP OFF START / COMP OFF END / COMP OFF START-END
144	Set new user password	Mst/slv	1234	0 - 9999
	Maintenance parameters			
145	Evaporator pump operating hour threshold	Mst	10000	0 - 999999
146	Condenser pump operating hour threshold	Mst	10000	0 - 999999
147	Compressor operating hour threshold	Mst/slv	10000	0 - 999999
148	Enable software filter for protection against electromagnetic disturbance	Mst/slv	N	Y/N
149	Filter delay on analogue inputs	Mst/slv	5 s	0 - 9 s
150	Filter delay on digital inputs	Mst/slv	1 s	0 - 9 s
151	Probe calibration B1	Mst/slv	0.0	-9.9 - 9.9
152	Probe calibration B2	Mst/slv	0.0	-9.9 - 9.9
153	Probe calibration B3	Mst/slv	0.0	-9.9 - 9.9
154	Probe calibration B4	Mst/slv	0.0	-9.9 - 9.9
155	Probe calibration B5	Mst/slv	0.0	-9.9 - 9.9
156	Probe calibration B6	Mst/slv	0.0	-9.9 - 9.9
157	Probe calibration B7	Mst/slv	0.0	-9.9 - 9.9
158	Probe calibration B8	Mst/slv	0.0	-9.9 - 9.9
159	Enable compressor no.1	Mst	S	Y/N
160	Enable compressor no.2	Mst	S	Y/N
161	Enable compressor no.3	Mst	S	Y/N
162	Enable compressor no.4	Mst	S	Y/N
163	Delete entire alarm log memory		N	Y/N
164	Set new maintenance password	Mst/slv	1234	0 - 9999
	Set point parameters			
165	Cooling set point	Mst	12.0°C	Set point minimum/maximum limit
166	Heating set point	Mst	45.0°C	Set point minimum/maximum limit
167	Double cooling set point	Mst	12.0°C	Set point minimum/maximum limit
168	Double heating set point	Mst	45.0°C	Set point minimum/maximum limit
	Clock parameters			
169	Control hours	Mst/slv		0 - 23
170	Control minutes	Mst/slv		0 - 59
171	Control day	Mst/slv		0 - 31
172	Control month	Mst/slv		0 - 12
173	Control year	Mst/slv		0 - 99

21. Driver software configuration

21.1 Configuration branches

The software features numerous configuration / display branches, divided as follows (the column on the left describes the headings of the screens in the branch, while the column on the right briefly describes the function of the branch):

- EXV Manufacturer → configuration Driver 1 (manufacturer parameters)
- EXV Carel → configuration Driver 1 (CAREL parameters)
- EXV Maintenance → configuration Driver 1 (maintenance parameters)

21.2 User interface (Driver)

21.2.1 Password screens

The following are the password screens for accessing the configuration branches.

Manuf_PW_Drv

```
EXV driver       U:
Insert manufacturer
password
               0000
```

Once having entered the password, the software skips to the “manufacturer” configuration branch for driver 1.
Once inside the branch, pressing the MENU button returns to this screen.

Once having entered the password, the software skips to the “manufacturer” configuration branch for driver 2.
Once inside the branch, pressing the MENU button returns to this screen.

Carel_PW_Drv

```
CAREL EXV Driver U:
reserved parameters
Insert password
               0000
```

Once having entered the password, the software skips to the “CAREL” configuration branch for driver 1.
Once inside the branch, pressing the MENU button returns to this screen.

Once having entered the password, the software skips to the “CAREL” configuration branch for driver 2.
Once inside the branch, pressing the MENU button returns to this screen.

21.3 Manufacturer parameters

No.	Parameter	Meaning
1	Type of control	no (off) → no control (the valve is kept closed) self-adapting → automatic control from User config. → manual control (the PID parameters are set by the user) forced opening → forces the complete opening of the valve
2	Stages present	Number of steps present in the circuit = no. compressors*(1+no. capacity stages per comp.)
3	Type of gas	Type of gas used in the circuit
4	Type of valve	Type of valve used (EX6, EX7, EX8)
5	Comp. cool capacity	Cooling capacity of the compressor (in kW)
6	Enable probe error	Enables driver alarm relay signal in the event of a fault with the driver probe
7	Enable stepper motor error	Enables driver alarm relay signal in the event of poor connection of the stepper motor
8	Enable EEPROM error	Enables driver alarm relay signal in the event of eEPROM damage
9	Enable battery error	Enables driver alarm relay signal in the event of a battery malfunction
10	Enable high press. error	Enables driver alarm relay signal in the event of high pressure (greater than MOP)
11	Enable low press. error	Enables driver alarm relay signal in the event of low pressure (less than LOP)
12	Enable low superheat alarm	Enables driver alarm relay signal in the event of a low superheating value (less than parameter 26)
13	Enable valve not closed alarm	Enables driver alarm relay signal in the event where the valve was not completely closed during the previous power failure
14	Superheat set point	Superheating set point (required superheating temperature)
15	Min. operating pressure	Low operating pressure threshold (below which the "low pressure alarm is signalled") (LOP, Lowest Operating Pressure))
16	Max. operating pressure	High operating pressure threshold (above which the "high pressure alarm" is signalled) (MOP, Maximum Operating Pressure)
17	Prop. factor	Proportional factor (P)
18	Integ. factor	Integration factor (I)
19	Deriv. factor	Derivation factor (D)
20	Adjust pos.	Reserved
21	Max valve steps	Max number of valve steps
22	Press. probe config. 0/4mA - 20mA	Pressure probe calibration: number of barg read at 4mA and at 20mA
23	Evaporator outlet press.	Set point for the evaporator outlet pressure
24	Superheat hysteresis after high pressure alarm	Superheating hysteresis after the high pressure alarm
25	Superheat hysteresis after low pressure alarm	Superheating hysteresis after the low pressure alarm
26	Close valve at min. pos. when superheat less than	Superheating threshold below which the valve is closed at the minimum position (position minimum means the value set for parameter 37) and the "low superheat" alarm is signalled (if enabled).
27	Valve control	Additional information on the valve control (only used when parameter 1 is set to "forced opening"). Valve OFF .....: the valve is kept closed Manual position..: in "forced opening" mode opens the valve completely
28	Type of compressor status input	Used to select the input for defining the status of the compressors: pLAN → provides the exact status of the compressors (number of compressors on and number of capacity-control steps active); this information allows the pre-positioning of the valve. DIGITAL INPUT → provides the status of the compressors simply as 0="all off" and 1="at least one on". This information **does not** allow pre-positioning. When the input is 0, the valve is kept closed, while if it is 1 the valve is opened and subsequently, based on the pressure and superheating value, the driver starts operating.
29	Press. probe	Type of pressure probe: 4-20mA or 0-20mA
30	Type of temp probe.	Type of temperature probe: NTC 103-AT (CAREL) or alternatively NTC 103-ETB
31	pLAN present	Informs the driver of the presence or otherwise of the pLAN network. If the pLAN is not present, the driver does not manage the pLAN alarm, and in addition signals the following alarms for 10 seconds only: • wait valve restart • wait battery recharge • wait eEPROM reboot
32	Battery present	Informs the software of the presence or otherwise of the battery If the battery is not present, the driver does not manage the corresponding alarms, tests, etc.

21.4 CAREL parameters

No.	Parameter	Meaning
33	No. of samples used to calculate of the average of the inputs	minimum number of samples used to calculate the average of the driver analogue inputs (pressure, temperature, ...). A high sampling number increases the precision of the control and thus makes it more stable, but at the same time makes it slower to respond to variations in system conditions.
34	Syst.stab.up.limit	upper limit of the system stability index
35	Syst.stab.low.limit	lower limit of the system stability index
36	Average pos. err. time	average positioning error time
37	No. of steps below which the valve is considered closed	Number of steps below which the valve is considered closed
38	Stepper motor - frequency	Operating frequency of the valve motor
39	Stepper motor- max. current	Max. operating current of the valve motor Two values can be selected: 0.75A and 1.5A
40	Calculated valve position	Calculated position of the valve (expressed in steps): this does not indicate the actual position of the valve, but rather the required position (that it will reach within a certain time).
41	Sampling time	Sampling time: the driver inputs are digitally filtered. This parameter is used to set the sampling time for the digital filters.
42	System stability	System stability index
43	Reserved (INT37)	Currently reserved. LEAVE THE DEFAULT VALUE. Used to modify the max. operating current of the valve motor. The default value is 1000. Each unit represents a current value equal to the "max. valve motor current"/1000. E.g.: if set to 2000, and the max. current is 1.5A, the max. current used by the control will be: 1.5/1000 * 2000 = 3A
44	Test (INT44)	Reserved. LEAVE THE DEFAULT VALUE.

21.5 Maintenance parameters

No.	Parameter	Meaning
45	Battery status	Displays the status of the battery: • battery disconnected (internal resistance of 255 Ohm) • high internal resistance (>15 Ohm) when the battery is not sufficiently charged to close the valve in the event of a power failure • not rechargeable (when the battery can no longer be recharged) • discharged (but rechargeable) • battery charged and operating correctly
46	Enable alarm if the valve remains open after shut-down	enables the "valve open" alarm in the event of a power failure
47	Restart after shut-down/black-out	After a power failure the driver can start controlling again • in any case • only if the battery is charged (If the battery is discharged or faulty the valve is kept closed and the system will not restart until the battery is replaced or recharged)
48	Battery resistance	internal resistance of the battery (Ohm)
49	Time since last battery test	time elapsed since the last battery status test The test is performed every 255 hours and involves a 10% discharge of the capacity of the battery. Other tests are also performed, however as these are not evident to the user, they are not described here
50	Time since the last battery use	time elapsed since the last time the battery was used to close the valve after a power failure
51	Capacity	request (percentage) sent to the driver The driver calculates the percentage of the request as follows: n. stages required / stages present * 100 (see Chap. "Request management" for further information)
52	Valve position	actual position of the valve (in steps)
53	Intake temperature	gas intake temperature
54	Intake pressure	gas intake pressure
55	Evaporator temperature	evaporator temperature (equal to the gas saturation temperature : calculated according to the type and pressure of the gas)
56	Evaporator superheating	calculated evaporator superheating value

22. Driver control

The control algorithm offers the following functions:

- *superheating control (super-heat mode)*, in normal system operating conditions the superheating value remains fixed and equal to the set point;
- *intake pressure control (pressure mode)*, in overload or under-load conditions. These conditions arise when the pressure exceeds the set MOP (Maximum Operating Pressure) or LOP (Lowest Operating Pressure) limits. In these conditions, the driver attempts to return the pressure within the MOP and LOP limits.

Superheating is still controlled in these circumstances.

- *Diagnostics, alarms*. The driver can recognise various alarm situations (see the corresponding paragraph).

The control algorithm allows the pCO board that manages the circuit to communicate the capacity-control status of the compressors to the driver whenever this is varied. In this way, the driver knows the active cooling capacity and can thus pre-position the valve to the position that *nominally* corresponds to this capacity (according to the typical curve of the valve itself). As a result, the algorithm is able to react quickly to rapid variations (=activation of compressor capacity stages) in the cooling capacity. Once pre-positioned, the valve is controlled automatically according to the measurements made by the control probes.

For more details please refer to the following paragraphs. All the parameters quoted below are described in the table on driver parameters.

22.1 Request management - “Capacity” parameter

“Capacity” is the parameter that the pCO board which manages the circuit uses to communicate the number of active compressor stages to the driver whenever these are varied. This information is sent in the form of a percentage:

Capacity = number of active stages / “stages present” * 100

“Stages present” is the total number of stages present in the refrigerant circuit, and is a driver configuration parameter.

NB: if the “Capacity” is equal to zero, the valve is closed.

The control of the valve is affected by the “Capacity” value only in the initial pre-positioning phase. Subsequently, the valve is opened/closed according to the superheating or pressure values measured.

22.2 Control algorithm

After pre-positioning, the aim of the control algorithm is to ensure the most constant superheating value possible. The required value is set using the “super-heat set point” parameter.

Error correction is performed using a PID algorithm (proportional + integral + differential).
The values of the three parameters (“P”, “I”, “D”) can be set manually by the user (parameter “Type of control” = manual; in this case the control function will maintain the set PID values) or alternatively adjusted in real time by the software (parameter “Type of control” = “self-adapting”; in this case, control is automatic).

As well as the superheating value, there is another fundamental parameter for the control function: the gas pressure.
There are two parameters (“Min operating pressure” and “Max operating pressure”) that identify the range of operating pressures within which control is performed, returning the superheating to the set point value (**Super-heat mode**).

Outside of the range of values identified by the “Min operating pressure” and “Max operating pressure”, the operating conditions are considered critical, and the priority of the control moves from superheating to pressure. In other words, the main controlled value becomes the pressure (**Pressure mode**), and the valve is managed so as to return the pressure within the operating range. During this phase, the superheating value is still evaluated, to avoid this reaching critical values for the system.
“Superheating hysteresis after high pressure alarm” is the parameter that allows the setting of the safety range to be satisfied in order to cancel the high or low pressure alarm and return to “normal” control. In other words:

- in the case of the high pressure alarm, the alarm returns when the superheating value falls below the “Super-heat set point”-“Super-heat hysteresis after high pressure alarm”.
- in the case of the low pressure alarm, the alarm returns when the superheating value rises above the “Super-heat set point” + “ Super-heat hysteresis after low pressure alarm”.

Other significant parameters used during control are:

- “Close valve at min. pos. when super-heat less than”: allows the setting of a minimum threshold below which the valve is closed in the minimum position (see parameter: “No. steps below which the valve is considered closed”).
- “System stability: provides an index of the system stability. The values which represent system stability are “Sys.stab.up.limit.” and “Sys.stab.low.limit”. Values outside of this range mean that the control has not yet reached a point of equilibrium.
- “Valve pos.”, “evaporator super-heat”, “evaporator temperature” and ”intake pressure”: these are display-only parameters that respectively provide information on the position of the valve (expressed in steps), the superheating value, the evaporation temperature and the intake pressure. All these values are shown on a screen (one for each driver) at the end of the I/O branch.

22.3 Valve pre-positioning

The EXV control algorithm of the is based on the pre-positioning of the valve according to the number of active compressor stages.
The pre-positioning function considers the total capacity for the circuit controlled by the electronic expansion valve, the total number of capacity-control steps used to modulate it, and the number of active capacity-control steps.

The total number of steps set during the configuration of the expansion electronic valve control driver is determined by the following ratio:

Number of valve capacity stages = Number of compressors in circuit * Number compressor capacity stages

Example: A chiller with 2 circuits, 2 compressors with 4 capacity stages each.
2 pCO boards and 2 drivers are used (1 driver for each pCO board).
The master must be configured for 2 compressors
The slave must be configured for 1 compressor
4 capacity stages must be configured per compressor.

pCO: Compressor configuration

M_Manuf45

```
Unit configuration
N. local drivers  0
N. compressors    0
Comp. rotation    N
```

Driver : Configuration driver 1

Manuf_Drv_10

```
Manufacturer D:1 U:
Regulation mode
REGULATION OFF
Present stages   000
```

22.3.1 Compressors with continuous capacity control

- For compressors with continuous capacity control, as the number of capacity stages is not defined, the maximum setting is equal to 100.

22.4 Special “Ignore” function

Maint_Drv_50

```
WARNING  !!  D:1 U:
System's waiting for
VALVE OPEN RESTART
Go ahead? N
```

There are three alarm conditions that prevent the driver from performing normal control:

- valve re-opening → during the last power failure the valve was not closed completely
- battery recharge → the battery does not work correctly or is discharged or not connected
- EEPROM reboot → EEPROM malfunction

The “Ignore” function allows these alarms to be ignored, so as to allow the valve to be controlled by the driver (which would otherwise keep it closed) until the alarm ends.

WARNING! cancelling the alarms means ignoring them; it is thus recommended to carefully check that the system will not be damaged, malfunction or become unreliable (e.g.: if “battery recharge” is signalled, it probably means that the battery is not charged or alternatively is not connected, etc. This, in the event of a power failure, will not allow the valve to close. The valve would thus stay open even when the system restarts).

If none of the three above alarms are present, the screen is as follows:

Maint_Drv_50

```
Maintenance  D:1 U:

NO WARNINGS
          N
```

22.5 Operation of the valves in "Chiller" and "Heat pump" mode

The "heat pump" mode features a different hardware configuration according to the type of valve used. As the EX-7 and EX-8 valves are one-way for the flow of the gas in chiller + heat pump units, two valves are required for each circuit (and consequently 2 drivers).
The two valves are controlled separately, according to the operating mode (cooling or heating).
They are never used at the same time:

- in chiller mode valve 1 operates while valve 2 is kept closed
- in heat pump mode valve 2 operates while valve 1 is kept closed.

This problem does not exist for the EX-6 valve, which allows bi-directional refrigerant gas flow.

23. Supervisor

The unit can be interfaced to a local or remote supervisor/telemaintenance system.
The accessories available for the pCO board include an optional RS422 or RS485 serial interface card, supplied separately from the pCO board.
If the serial communication values, such as the serial address and communication speed, are set correctly, the following parameters will be sent by the unit.

23.1.1 Key

A Analogue variable
D Digital variable
I Integer variable

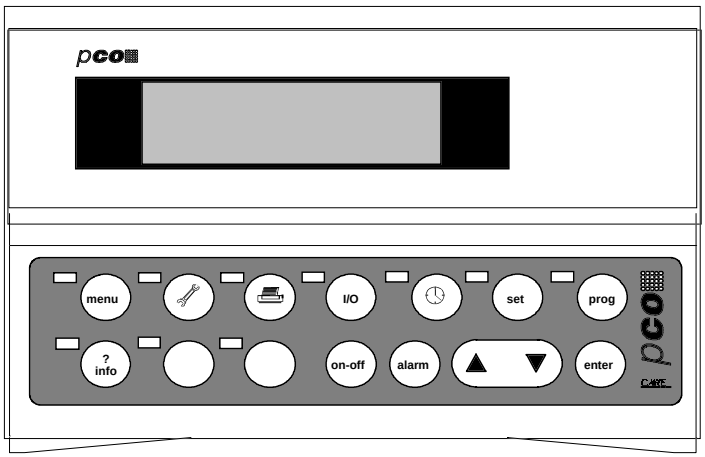
IN Input variable pCO ← Supervisor
OUT Output variable pCO → Supervisor
IN/OUT Input/output variable pCO←→ Supervisor

Type	Direction	Address	Description
A	OUT	1	Value of analogue input 1
A	OUT	2	Value of analogue input 2
A	OUT	3	Value of analogue input 3
A	OUT	4	Value of analogue input 4
A	OUT	5	Value of analogue input 5
A	OUT	6	Value of analogue input 6
A	OUT	7	Value of analogue input 7
A	OUT	8	Value of analogue input 8
A	OUT	9	Value of analogue output 1
A	OUT	10	Value of analogue output 2
A	IN / OUT	11	Cooling set point temperature
A	IN / OUT	12	Heating set point temperature
A	IN / OUT	13	Condenser control set point
A	IN / OUT	14	Temperature control band
I	OUT	1	Unit status
I	OUT	2	Unit pLAN address
I	IN / OUT	3	Type of fan management
I	IN / OUT	4	Type of unit configuration
I	IN / OUT	5	Number of compressors
I	IN / OUT	6	Number of fans
D	OUT	1	Unit status
D	OUT	2	Status of digital output 1
D	OUT	3	Status of digital output 2
D	OUT	4	Status of digital output 3
D	OUT	5	Status of digital output 4
D	OUT	6	Status of digital output 5
D	OUT	7	Status of digital output 6
D	OUT	8	Status of digital output 7
D	OUT	9	Status of digital output 8
D	OUT	10	Status of digital output 9
D	OUT	11	Status of digital output 10
D	OUT	12	Status of digital output 11
D	OUT	13	Status of digital output 12
D	OUT	14	Status of digital output 13
D	IN / OUT	15	Enable evaporator flow switch alarm
D	IN / OUT	16	Enable probe 1
D	IN / OUT	17	Enable probe 2
D	IN / OUT	18	Enable probe 3
D	IN / OUT	19	Enable probe 4
D	IN / OUT	20	Enable probe 5

Type	Direction	Address	Description
D	IN / OUT	21	Enable probe 6
D	IN / OUT	22	Enable probe 7
D	IN / OUT	23	Enable probe 8
D	IN / OUT	24	ON/OFF from supervisor
D	IN / OUT	25	Enable limits at start
D	IN / OUT	26	Type of compressor capacity control
D	OUT	27	Select Cooling/Heating from digital input
D	OUT	28	
D	OUT	29	Cooling/Heating operation
D	OUT	30	Select condenser inverter
D	OUT	45	
D	OUT	46	Antifreeze alarm
D	OUT	47	Compressor thermal overload alarm
D	OUT	48	Evaporator flow switch alarm
D	OUT	49	Condenser flow switch alarm
D	OUT	50	High pressure alarm from pressure switch
D	OUT	51	Oil level alarm
D	OUT	52	Low pressure alarm from pressure switch
D	OUT	53	High pressure alarm from transducer
D	OUT	54	Serious alarm from digital input
D	OUT	55	Fan 1 thermal overload alarm
D	OUT	56	Fan 2 thermal overload alarm
D	OUT	57	Pump thermal overload alarm evaporator
D	OUT	58	Board 1 Offline alarm
D	OUT	59	Slave 1 Offline alarm
D	OUT	60	Slave 2 Offline alarm
D	OUT	61	Slave 3 Offline alarm
D	OUT	62	Probe 1 broken or not connected alarm
D	OUT	63	Probe 2 broken or not connected alarm
D	OUT	64	Probe 3 broken or not connected alarm
D	OUT	65	Probe 4 broken or not connected alarm
D	OUT	66	Probe 5 broken or not connected alarm
D	OUT	67	Probe 6 broken or not connected alarm
D	OUT	68	Probe 7 broken or not connected alarm
D	OUT	69	Probe 8 broken or not connected alarm
D	OUT	70	Condenser pump operating hours alarm
D	OUT	71	Compressor operating hours alarm
D	OUT	72	Condenser pump thermal overload alarm
D	OUT	73	Clock alarm
D	OUT	74	Phase monitor alarm
D	OUT	75	Low pressure alarm from transducer
D	OUT	76	High voltage alarm
D	OUT	77	High current alarm
D	OUT	78	Evaporator pump operating hours alarm
D	OUT	79	Value entry error
D	OUT	80	High outlet temperature alarm
D	OUT	81	Pressure differential alarm
D	OUT	82	Driver probe alarm
D	OUT	83	Valve stepper motor error alarm
D	OUT	84	Driver EEPROM error alarm
D	OUT	85	Battery error alarm
D	OUT	86	Driver high pressure alarm
D	OUT	87	Driver low pressure alarm
D	OUT	88	High superheat alarm
D	OUT	89	Valve not closed after blackout alarm
D	OUT	90	Valve open at unit restart alarm
D	OUT	91	Wait battery recharge
D	OUT	92	Wait EEPROM error reset

24. Keypad

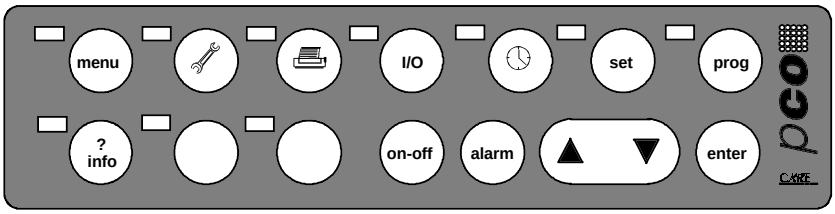
The figure below shows the *terminal* with the control board front door open.
The *terminal*, always managed by microprocessor, is fitted with a 4 row x 20 column LCD display, keypad and LEDs, to allow the programming of the control parameters (setpoint, differential band, alarm thresholds) and basic operation by the user. The *terminal* does not have to be connected to the *main board* for the normal operation of the control.



The terminal is used for the initial programming of the parameters, and the display of the operating data, specifically:

- the initial programming of the machine, with password protection to ensure security
- the possibility to modify fundamental run-time operating parameters
- the display of the active alarms and their audible signal by 'buzzer'.
- the display of all the values measured

The pCO keypad features 15 buttons, which together with the liquid crystal display represent the system user interface.



The keypad can be used to directly access the main parameters or sets of parameters, divided as follows:

ON / OFF button 

Starts and stops the controlled devices.

ALARM button 

Opens the first screen of active alarms and silences the alarm buzzer.
If an alarm screen is displayed, pressing this button again resets the alarm and displays the first screen.
If there are no active alarms, it opens the NO ACTIVE ALARMS screen.
The list of active alarm screens can be displayed by pressing the arrow buttons.

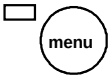
UP/DOWN buttons 

When the cursor in the HOME position (position 0,0 on the display) the buttons are used to scroll the screens in a group.
The last screen scrolls on to the first, and vice-versa.
If the cursor is positioned in a numeric field, the buttons vary the value of the selected parameter.
If the cursor is positioned in a selection field, the available options are displayed (e.g. YES / NO).

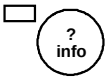
ENTER button 

In the screens used to set the values, pressing the button once moves the cursor to the first active setting field.

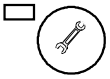
Pressing it again confirms the set value and moves the cursor to the next field. From the last field it returns the cursor to the HOME position.

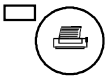
MENU button 

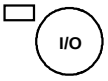
Goes to the screen M_MAINMASK

INFO button 

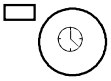
Switches the control of the terminal from one pCO board to another pCO board.

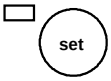
MAINT button 
Goes to screen M_MAINT5

PRINT button 
NOT FEATURED

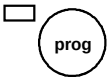
I/O button 

Goes to screen M_INOUT5

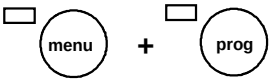
CLOCK button 
Goes to screen m_CLOCK5 / m_CLOCK10 if the clock card is enabled

SET button 

Goes to screen M_SETPOINT5

PROG button 

The password is required. If entered correctly goes to screen M_USER5

MENU+PROG buttons 

The buttons must be pressed and released at the same time. The password is required. If entered correctly, goes to screen M_MANUF5

24.1 LEDs

Next to each button is a green LED that lights up when the corresponding button is pressed, and indicates which group of screens the user is currently in.

When entering the machine configuration screens by pressing the MENU+PROG buttons, the LEDs on the MENU and PROG buttons light up.

A further three LEDs are located under the rubber buttons, and indicate respectively:

1. ON / OFF button Green LED
   The following conditions are possible
   Off Unit switched off from the keypad
   On Unit on and operating
   Flashing Unit switched on from the local keypad but off due to an alarm/remote control/shut-down of the master.

2. ALARM button Red LED
   Indicates the presence of an alarm situation.
   If flashing, signals the incorrect entry of the temperature control parameters for compressors with continuous capacity control.

3. ENTER button Yellow LED
   Indicates that the instrument is correctly powered.

25. List of screens

M_Initing

```
--  WAIT  PLEASE  --
-- READING INPUTS --
```

25.1 Menu Button

M_MainMask

```
00 00        00 00 00
In water E.    00.0°C
Out water E.   00.0°C
U:00 ON
```

25.2 Maintenance Button

M_Maint5

```
Hour counter      U:

Pump evap.     000000
Pump cond.     000000
```

M_Maint10

```
Hour counter      U:

Compressor     000000
```

M_Maint15

```
Alarms history
AL000 00:00 00/00/00
T.In 00.0 T.Out 00.0
HP   00.0 LP    00.0
```

Maint_PW_Drv

```
EXV driver        U:
Insert maintenance
password
                0000
```

M_Pw_Maint

```
Insert            U:
maintenance password

                0000
```

M_Maint20

```
Evaporator pump   U:
hour counter
Threshold    000x1000
Req.reset    N 000000
```

M_Maint23

```
Condensator pump U:
hour counter
Threshold    000x1000
Req.reset    N 000000
```

M_Maint25

```
Compressor        U:
hour counter
Threshold    000x1000
Req.reset    N 000000
```

M_Maint45

```
Filters config.   U:
Enable             N
Anal.delay time    0s
Dig.delay time     0s
```

M_Maint50

```
Inputs probes     U:
offset
B1: 0.0     B2: 0.0
B3: 0.0     B4: 0.0
```

M_Maint55

```
Inputs probes     U:
offset
B5: 0.0     B6: 0.0
B7: 0.0     B8: 0.0
```

M_Maint60

```
Compressors enable

C1:N C2:N C3:N C4:N
```

M_Maint65

```
Erase alarms
history memory     N
```

M_Maint100

```
Insert another    U:
maintenance
password
                0000
```

25.2.1 Drivers

Drivers_Menu

```
Drivers config.   U:

Driver 1            ->
Driver 2            ->
```

Drivers_Waiting

```
Maintenance
Driver 1 Unit

ENTER to continue
```

Maint_Drv_10

```
Maintenance  D:1 U:
Time after last
battery test     000h
battery use      000h
```

Maint_Drv_20

```
Maintenance  D:1 U:
Batt.resistance 000
Capacity         000%
Valve position   0000
```

Maint_Drv_30

```
Maintenance  D:1 U:
Suction
Temperature    00.0°C
Pressure      00.0bar
```

Maint_Drv_40

```
Maintenance  D:1 U:
Calculated evaporat.
Temperature    00.0°C
Super-heat     00.0°C
```

Maint_Drv_50

```
Maintenance  D:1 U:

NO WARNINGS
           N
```

Maint_Drv_60

```
Insert another    U:
drivers maintenance
password
                0000
```

Print Button

M_Printer5

```
Printer not
 available
```

25.4 I/O Button

M_InOut5

```
     CAREL srl
 Brugine (PD) Italy
CODE: EPSTDEMSCA
Ver. 2.712  06/12/01
```

InOut_Drv

```
Firmware version U:
             H.W S.W
Driver 1     000 000
Driver 2     000 000
```

M_InOut10

```
Digital inputs   U:
CCCCCCCCCCCC
Digital outputs
OOOOOOOOOOOO
```

M_InOut15

```
Analog inputs    U:

B1:           ----■C
B2:           ----■C
```

M_InOut20

```
Analog inputs    U:

B3:           ----■C
B4:           ----■C
```

M_InOut25

```
Analog inputs    U:

B5:          0----■C
B6:          0----■C
```

M_InOut30

```
Analog inputs    U:

B7:          00.0bar
B8:          00.0bar
```

M_InOut35

```
Analog outputs   U:

Y0:            00.0V
Y1:            00.0V
```

M_InOut60

```
Drv1 Valve Pos. 0000
Super-heat    00.0■C
Suct.temp.    00.0■C
Suct.press.  00.0bar
```

M_InOut65

```
Drv2 Valve Pos. 0000
Super-heat    00.0■C
Suct.temp.    00.0■C
Suct.press.  00.0bar
```

M_InOut70

```
Drv1 battery state
DISCONNECTED
Drv2 battery state
DISCONNECTED
```

25.5 Clock Button

M_Clock5

```
    Clock not
    installed
```

M_Clock10

```
Clock config.    U:

Time           00:00
Date        00/00/00
```

Set Button

M_Setpoint5

```
Actual setpoint

              00.0■C
```

M_Setpoint10

```
Summer
setpoint      00.0■C
Winter
setpoint      ----■C
```

M_Setpoint15

```
Summer double
setpoint      00.0■C
Winter double
setpoint      ----■C
```

Prog Button

M_Pw_User

```
Insert            U:
user password

                0000
```

M_User5

```
Summer temperature
setpoint limits
Low           00.0°C
High          00.0°C
```

M_User15

```
Winter temperature
setpoint limits
Low           00.0°C
High          00.0°C
```

M_User17

```
Regulat. temperature

Type            INLET
```

M_User20

```
Inlet regulation

Type             PROP
Integration t. 0000s
```

M_User23

```
Outlet regulation
force off
Summer        00.0°C
Winter        00.0°C
```

M_User25

```
Temperature band
              00.0°C
```

M_User27

```
Modulation band

Neutral zone  00.0°C
```

M_User30

```
Time between main
pump/fan and comp.
start
                000s
```

M_User35

```
Delay on switching
the main pump off

                000s
```

M_User40

```
Digital input remote
on / off          N
Supervisory remote
on / off          N
```

M_User42

```
Digital input remote
Summer / Winter   N
Supervisory remote
Summer / Winter   N
```

M_User45

```
Freecool. parameters
Setp. Offset  00.0°C
Delta         00.0°C
Diff.         00.0°C
```

M_User46

```
Freecooling max.vlv
open threshold  000%
Freecooling min.inv.
start threshold 000%
```

M_User50

```
Defrost parameters

Start        00.0---
Stop         00.0---
```

M_User55

```
Defrost parameters
Drip time       000s
Delay time    00000s
Maximum time  00000s
```

M_User58

```
Config.reverse cycle
mode in defrost

NO OFF COMP
```

M_User60

```
Insert another   U:
user password

                0000
```

Menu+Prog Button

M_Pw_Manuf

```
Insert            U:
manufacturer
password
                0000
```

M_Manuf5

```
Unit config.: 00 U:
WATER/AIR
CHILLER
```

M_Manuf10

```
Probes enable     U:
B1: N  B2: N  B3: N
B4: N  B5: N  B6: N
B7: N  B8: N
```

M_Manuf15

```
Probe 5 type config.
NONE
Discharge probe type
      0/1V
```

M_Manuf20

```
Multiple analog.in 5
None
Minimum       000.0
Maximum       000.0
```

M_Manuf30

```
Discharge temp.
probe limits
 0Volt        000.0°C
 1Volt        000.0°C
```

M_Manuf35

```
High pressure probe
configuration
 4mA          00.0bar
20mA          00.0bar
```

M_Manuf40

```
Low  pressure probe
configuration
 4mA          00.0bar
20mA          00.0bar
```

M_Manuf43

```
Enable double
setpoint          N
```

M_Manuf45

```
Unit configuration
N. local drivers  0
N. compressors    0
Comp. rotation    N
```

M_Manuf50

```
Compressor config
Type of unloads STEP
Stages per
compressor        0
```

M_Manuf55

```
Compressor config.
T.Star/Line 000s/100
T.Star      000s/100
T.Star/Delta000s/100
```

M_Manuf60

```
Enable start
restrictions      N
```

M_Manuf63

```
Start restriction
Low press.   00.0bar
High press.  00.0bar
Equal.press. 00.0bar
```

M_Manuf65

```
Minimum compressors
power-on time  0000s
Minimum compressors
power-off time 0000s
```

M_Manuf70

```
Min time betw. diff.
comp. starts   0000s
Min time betw. same
comp. starts   0000s
```

M_Manuf75

```
Stage 1
Logic relay 1    N
Logic relay 2    N
Logic relay 3    N
```

M_Manuf80

```
Stage 2
Logic relay 1    N
Logic relay 2    N
Logic relay 3    N
```

M_Manuf85

```
Stage 3
Logic relay 1    N
Logic relay 2    N
Logic relay 3    N
```

M_Manuf90

```
Stage 4
Logic relay 1    N
Logic relay 2    N
Logic relay 3    N
```

M_Manuf93

```
Enable particular
management of
stage 1           N
```

M_Manuf95

```
Time SOL/S1    0000s
Time S1/S2     0000s
Time S2/S3     0000s
Time S3/S4     0000s
```

M_Manuf97

```
Standby config.

Relay 6          N
Relay 7          N
```

M_Manuf98

```
Decrement config.

Relay 6          N
Relay 7          N
```

m_manuf99

```
Increment config.

Relay 6          N
Relay 7          N
```

M_Manuf100

```
Modulation config.
Pulse period     00s
Min pulse D.   00.0s
Max pulse D.   00.0s
```

M_Manuf105

```
Modulation config.

Min pulse I.   00.0s
Max pulse I.   00.0s
```

M_Manuf110

```
Modulation config.

Time force decr. for
start compress. 000s
```

M_Manuf115

```
Enable force
solenoid ON with
compressor OFF    N
```

M_Manuf120

```
Pump down config.

Enable            N
Maximum time    000s
```

M_Manuf123

```
Compressor
Safety unloader step
configuration
MINIMUM POWER
```

M_Manuf125

```
Prevent high cond.
PRESSURE          N
Setpoint     00.0bar
Diff.        00.0bar
```

M_Manuf130

```
Discharge temp.
prevent           N
Setpoint     000.0■C
Diff.         00.0■C
```

M_Manuf135

```
Freeze prevent

Setpoint      00.0■C
Diff.         00.0■C
```

M_Manuf140

```
Condensation
Enable         NONE
Type           INV.
Number Fans    0
```

M_Manuf150

```
Condensation

Setpoint     00.0---
Diff.        00.0---
```

M_Manuf155

```
Inverter
Max.speed      00.0V
Min.speed      00.0V
Speed up time    00s
```

M_Manuf160

```
Enable of
seriuos alarm     N
Enable phase
alarm             N
```

M_Manuf165

```
Enable evaporator
flow alarm        N
Enable condensator
flow alarm        N
```

M_Manuf170

```
Evaporat. flow alarm
delays
Startup delay    00s
Run delay        00s
```

M_Manuf175

```
Condens. flow alarm
delays
Startup delay    00s
Run delay        00s
```

M_Manuf178

```
Discharge temp.
alarm
Setpoint     000.0■C
Diff.         00.0■C
```

M_Manuf180

```
Transducers high
pressure alarm
Setpoint     00.0bar
Diff.        00.0bar
```

M_Manuf185

```
Transducer low
pressure alarm
Setpoint     00.0bar
Diff.        00.0bar
```

M_Manuf187

```
Low differential
pressure alarm  N
Setpoint     00.0bar
Startup delay   000s
```

M_Manuf190

```
Low pressure alarm
delays
Startup delay   000s
Run delay       000s
```

M_Manuf195

```
Oil level alarm
delays
Startup delay   000s
Run delay       000s
```

M_Manuf200

```
High voltage alarm

Setpoint      000.0V
Diff.          00.0V
```

M_Manuf205

```
High current alarm

Setpoint      000.0A
Diff.          00.0A
```

M_Manuf210

```
Antifreeze alarm

Setpoint      00.0■C
Diff.         00.0■C
```

M_Manuf211

```
Antifreeze alarm

If antifreeze alarm
MAIN PUMP OFF
```

M_Manuf215

```
Electrovalve
management
Setpoint     000.0■C
Diff.         00.0■C
```

M_Manuf220

```
Antifreeze heater

Setpoint      00.0■C
Diff.         00.0■C
```

M_Manuf230

```
Logic of valves

Reversing (4way)N.C.
Freecooling   ON/OFF
```

M_Manuf235

```
Defrost config.

Probe   PRESSOSTATS
Global  SIMULTANEOUS
```

M_Manuf240

```
Clock board 32k
Enable            N
```

M_Manuf242

```
Supervisor System
Comunication speed:
1200 (RS485/RS422)
Identificat. No.:000
```

Manuf_PW_Drv

```
EXV driver       U:
Insert manufacturer
password
               0000
```

M_Manuf245

```
Erase memory     U:
Install global
default values    N
```

M_Manuf250

```
Insert another   U:
manufacturer
password
               0000
```

25.9 Drivers

Drivers_Menu

```
Drivers config.  U:

Driver 1          ->
Driver 2          ->
```

Drivers_Waiting

```
Maintenance
Driver 1 Unit

ENTER to continue
```

Carel_PW_Drv

```
CAREL EXV Driver U:
reserved parameters
Insert password
               0000
```

Manuf_Drv_10

```
Manufacturer D:1 U:
Regulation mode
REGULATION OFF
Present stages   000
```

Manuf_Drv_20

```
Manufacturer D:1 U:
Gas type       -----
Used valve type
EX-7 OR LOWER CAP.
```

Manuf_Drv_30

```
Manufacturer D:1 U:
Comp.capacity 0000KW
Super-heat
Setpoint      00.0°C
```

Manuf_Drv_40

```
Manufacturer D:1 U:
Valve opening when
screw compressor
switches ON     000%
```

Manuf_Drv_50

```
Manufacturer D:1 U:
En.probe error     N
En.step motor fail N
En.Eeprom error    N
```

Manuf_Drv_60

```
Manufacturer D:1 U:
En.battery error   N
En.high pressure   N
En.low pressure    N
```

Manuf_Drv_70

```
Manufacturer D:1 U:

En.low super-heat  N
En.valve not close N
```

Manuf_Drv_80

```
Manufacturer D:1 U:
Alarms delays
High pressure  0000s
Super-heat     0000s
```

Manuf_Drv_90

```
Manufacturer D:1 U:
Switch off compress.
if probe error
Delay          ----sec
```

Manuf_Drv_100

```
Manufacturer D:1 U:
Switch off compress.
if eeprom error
Delay          ----sec
```

Manuf_Drv_110

```
Manufacturer D:1 U:
Switch off compress.
if battery error   N
Delay          ----sec
```

Manuf_Drv_120

```
Manufacturer D:1 U:
Switch off compress.
if low pressure    N
Delay          ----sec
```

Manuf_Drv_130

```
Manufacturer D:1 U:
Enable alarm when
valve is open after
power failure      N
```

Manuf_Drv_140

```
Manufacturer D:1 U:
Operating pressure
Min. set     00.0bar
Max. set     00.0bar
```

Manuf_Drv_150

```
Manufacturer D:1 U:
Propor. factor  00.0
Integr. factor  00.0
Differ. factor  00.0
```

Manuf_Drv_160

```
Manufacturer D:1 U:

Max valve steps 0000
Max pos.adjust 00000
```

Manuf_Drv_170

```
Manufacturer D:1 U:
Pressure probe conf.
4mA          00.0bar
20mA         00.0bar
```

Manuf_Dvr_180

```
Manufacturer D:1 U:

Evaporator output
press. set   00.0bar
```

Manuf_Drv_190

```
Manufacturer D:1 U:
Superheat hysteresis
after max pressure
alarm         00.0°C
```

Manuf_Drv_200

```
Manufacturer D:1 U:
Superheat hysteresis
after low pressure
alarm         00.0°C
```

Manuf_Drv_210

```
Manufacturer D:1 U:
Valve closing to min
position when super-
heat below    00.0°C
```

Manuf_Drv_220

```
Manufacturer D:1 U:

Valve regulation
VALVE OFF
```

Manuf_Drv_230

```
Manufacturer D:1 U:
Compressor status
input type
pLAN
```

Manuf_Drv_240

```
Manufacturer D:1 U:
In case of pLAN
failure
USE 0-1V COMP.STATUS
```

Manuf_Drv_250

```
Manufacturer D:1 U:
Restart after power
failure
ALWAYS
```

Manuf_Drv_260

```
Manufacturer D:1 U:
Press. probe  4-20mA
Temp. probe 1 type
NTC 103-AT (CAREL)
```

Manuf_Drv_270

```
Manufacturer D:1 U:

pLAN existence     N
Battery existence  N
```

Manuf_Drv_280

```
Manufacturer D:1 U:
Install default
values             N
```

Manuf_Drv_290

```
Insert another   U:
drivers manufacturer
password
               0000
```

Carel_Drv_10

```
CAREL        D:1 U:
No. of samples for
calculating analog
inputs average  0000
```

Carel_Drv_20

```
CAREL        D:1 U:
Av.time pos.err. 000
Sys.stab.up lim.  00
Sys.stab.low lim. 00
```

Carel_Drv_30

```
CAREL        D:1 U:
Steps Nr.below which
valve is considered
closed          0000
```

Carel_Drv_40

```
CAREL        D:1 U:
Stepper motor
Max.current    0.75A
Frequency     0000Hz
```

Carel_Drv_50

```
CAREL        D:1 U:

Calculated valve
position        0000
```

Carel_Drv_60

```
CAREL        D:1 U:

Sampling time 0000ms
System stability  00
```

Carel_Drv_70

```
CAREL        D:1 U:

INT37-reserved 00000
INT44-test     00000
```

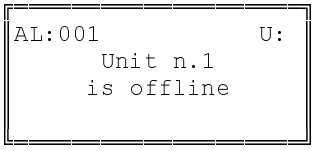
Carel_Drv_80

```
Insert another   U:
drivers CAREL
password
               0000
```

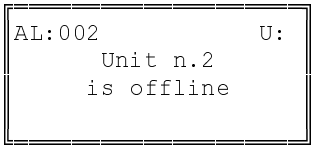
25.10 Alarm Button

M_Alarm0

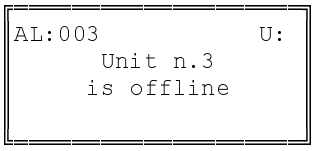
M_Alarm10



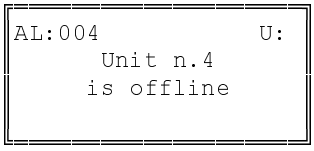
M_Alarm20



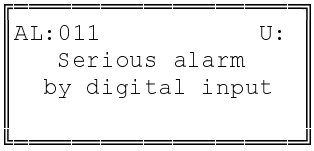
M_Alarm30



M_Alarm40

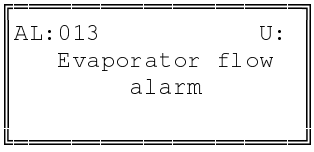


M_Alarm50

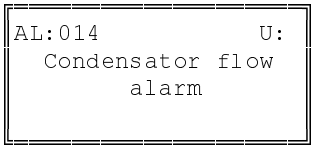


M_Alarm60

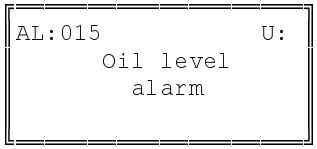
M_Alarm70



M_Alarm80



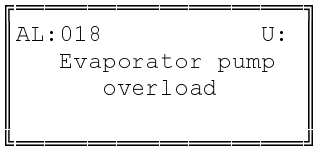
M_Alarm90



M_Alarm100

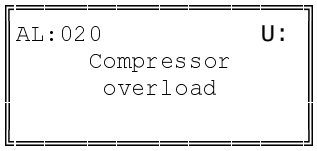
M_Alarm110

M_Alarm120

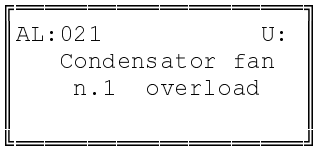


M_Alarm130

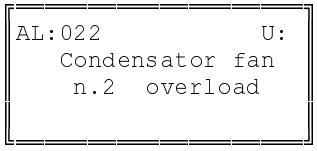
M_Alarm140



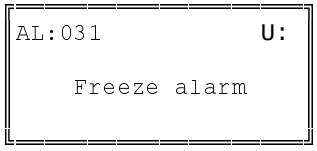
M_Alarm150



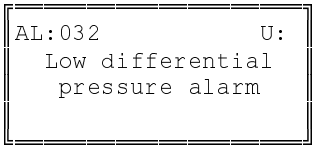
M_Alarm160



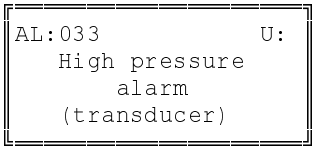
M_Alarm170



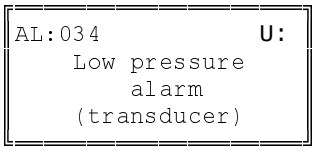
M_Alarm180



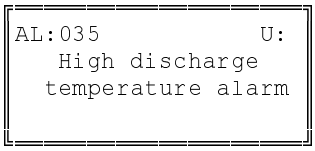
M_Alarm190



M_Alarm200



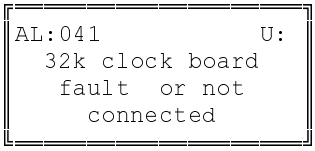
M_Alarm210



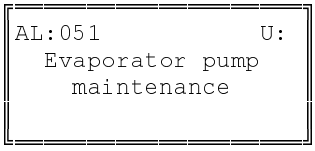
M_Alarm220

M_Alarm230

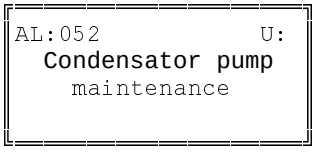
M_Alarm240



M_Alarm250



M_Alarm260



25.11 Driver

M_Alarm270

```
AL:053          U:
     Compressor
     maintenance
```

M_Alarm280

```
AL:060          U:
   B1 probe fault
  or not connected
```

M_Alarm290

```
AL:061          U:
   B2 probe fault
  or not connected
```

M_Alarm300

```
AL:062          U:
   B3 probe fault
  or not connected
```

M_Alarm310

```
AL:063          U:
   B4 probe fault
  or not connected
```

M_Alarm320

```
AL:064          U:
   B5 probe fault
  or not connected
```

M_Alarm330

```
AL:065          U:
   B6 probe fault
  or not connected
```

M_Alarm340

```
AL:066          U:
   B7 probe fault
  or not connected
```

M_Alarm350

```
AL:067          U:
   B8 probe fault
  or not connected
```

M_Drv1_Alarm101

```
AL:101       D:1 U:

    Probe error
```

M_Drv1_Alarm102

```
AL:102       D:1 U:

  Step motor error
```

M_Drv1_Alarm103

```
AL:103       D:1 U:

    Eeprom error
```

M_Drv1_Alarm104

```
AL:104       D:1 U:

   Battery error
```

M_Drv1_Alarm105

```
AL:105       D:1 U:

   High pressure
```

M_Drv1_Alarm106

```
AL:106       D:1 U:

    Low pressure
```

M_Drv1_Alarm107

```
AL:107       D:1 U:

  Super heat alarm
```

M_Drv1_Alarm108

```
AL:108       D:1 U:
  Valve not closed
  during power OFF
```

M_Drv1_Alarm109

```
AL:109       D:1 U:
  Waiting for valve
    open restart
```

M_Drv1_Alarm110

```
AL:110       D:1 U:
Waiting for battery
  charged restart
```

M_Drv1_Alarm111

```
AL:111       D:1 U:
 Waiting for eeprom
   error restart
```

M_Drv2_Alarm201

```
AL:201       D:2 U:

    Probe error
```

M_Drv2_Alarm202

```
AL:202       D:2 U:

  Step motor error
```

M_Drv2_Alarm203

```
AL:203       D:2 U:

    Eeprom error
```

M_Drv2_Alarm204

```
AL:204       D:2 U:

   Battery error
```

M_Drv2_Alarm205

```
AL:205       D:2 U:

   High pressure
```

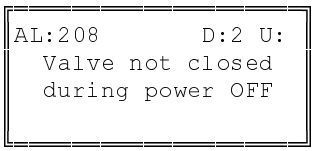
M_Drv2_Alarm206

```
AL:206       D:2 U:

    Low pressure
```

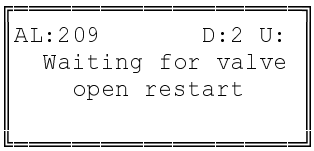
M_Drv2_Alarm207

```
AL:207       D:2 U:

  Super heat alarm
```

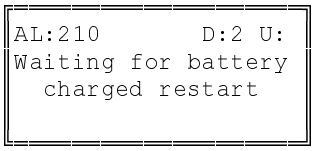
M_Drv2_Alarm208



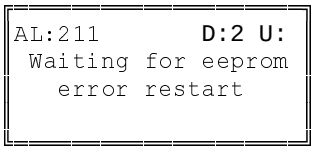
M_Drv2_Alarm209



M_Drv2_Alarm210



M_Drv2_Alarm211



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Technology & Evolution

CAREL S.p.A.
Via dell'Industria, 11 - 35020 Brugine - Padova (Italy)
Tel. (+39) 049.9716611 Fax (+39) 049.9716600
http://www.carel.com - e-mail: carel@carel.com

Agency:

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