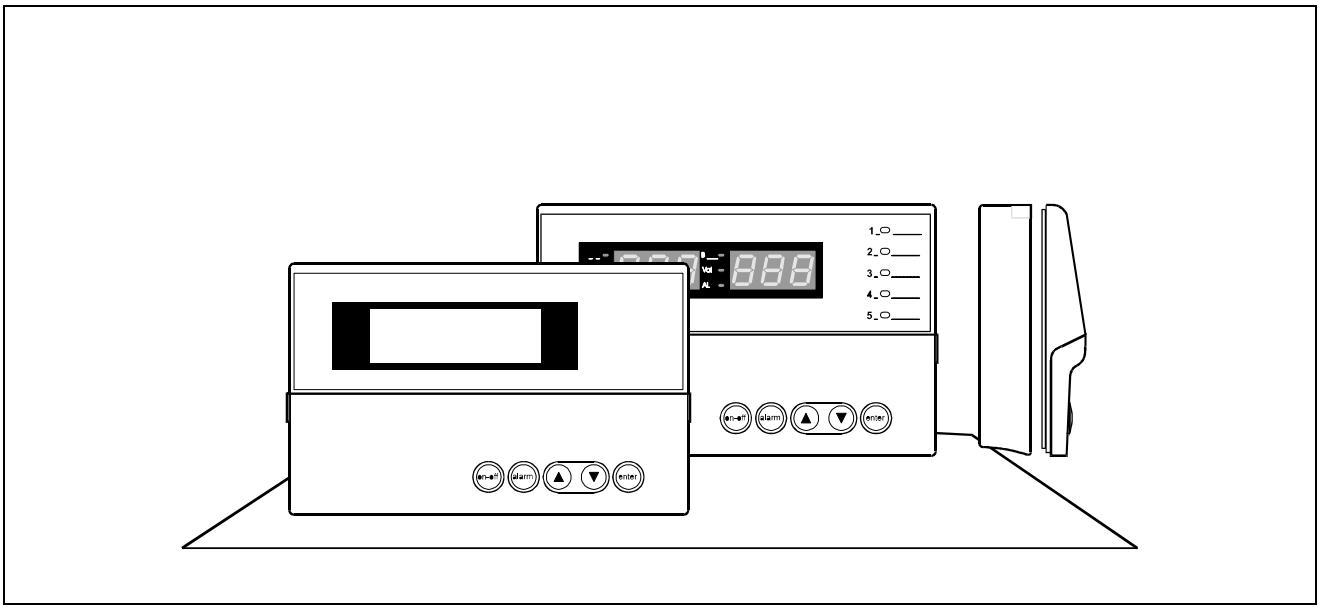


Modular Standard HP Chiller
pCO pLAN
screw compressor
1 4 compressors

manual version: 1.0 – 07/10/2003

Program code: EPSTDEMSDA
Version: starting from 1.5 version

CAREL
Technology & Evolution

LEGGI E CONSERVA QUESTE ISTRUZIONI

READ AND SAVE THESE INSTRUCTIONS

Do we want you to save you time and money?
We can assure you that reading this manual to the full will ensure correct installation and safe use of the product described here.

IMPORTANT WARNINGS

BEFORE INSTALLING OR CARRYING OUT ANY JOBS ON THE APPLIANCE, CAREFULLY READ AND FOLLOW THE INSTRUCTIONS IN THIS MANUAL.

The appliance to which this software is dedicated was built to operate without risks for the intended purposes, providing:

- all the conditions prescribed and contained in the installation and use manual of the application in question are observed.
- software installation, programming, operational control and maintenance must be carried out by qualified personnel according to the instructions in this manual;

All uses other than this use and the making of modifications, not expressly authorised by the manufacturer, are considered improper.

INDEX

1. Applications and functions performed by the system

1.1 Type of control unit

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 gas reversing
- Chiller + Heat pump with water reversing

1.2 Type of control

Proportional or proportional + integral control on the evaporator water inlet temperature probe.
Time control of the neutral zone on the evaporator water outlet temperature probe.

1.3 Types of compressors

Screw compressors with 4 capacity control steps
Screw compressors with continuous duty capacity control.

1.4 Maximum number of compressors

From 1 to 4 with a maximum of 4 capacity control steps (1 compressor for every pCO)
From 1 to 4 with continuous duty capacity control. (1 compressor for every pCO)

1.5 Compressor duty call rotation

Rotation of all compressors to FIFO logic for stepped and continuous duty capacity control.

1.6 Condensation

Condensation can be performed according to temperature, pressure or ON/OFF
Fan management in stepped mode or with 0/10 Volt proportional signal

1.7 Type of defrosting

Overall defrosting of all pCO units connected to network: Independent/Simultaneous/Separate

1.8 Safety devices for all refrigerating circuits

High pressure (pressure switch/transducer)
Low pressure (pressure switch/transducer)
Oil/Oil Level differential pressure switch
Compressor thermal cutout
Thermal cutout for condensation fan
High delivery temperature to compressor
Pressure differential alarm
Antifreeze alarm

1.9 System Safety devices

Serious alarm input (shuts down entire unit)
Flow-switch input for evaporator/condenser (shuts down entire unit)
Pump thermal cutout input (shuts down entire unit)
Remote ON/OFF input.

1.10 Number of accessories

Supervision with serial board RS422/RS485
Alarm log with 32 Kbyte clock board

2. Master/slave system architecture

The system consists of four pCO boards connected on the local network: the first board operates as the master and the others as slaves.

2.1 The master's function

Temperature control
Compressor duty call with a maximum of 4 screw compressors (start, power-down, alarms system, EXV)
System alarms management
Circuit alarms management
Alarms logging
Communication with outside supervisor

2.2 The slave's function

Management of 1 screw compressor (start, power-down, alarms system, EXV)
Circuit alarms management
Alarms logging
Communication with outside supervisor

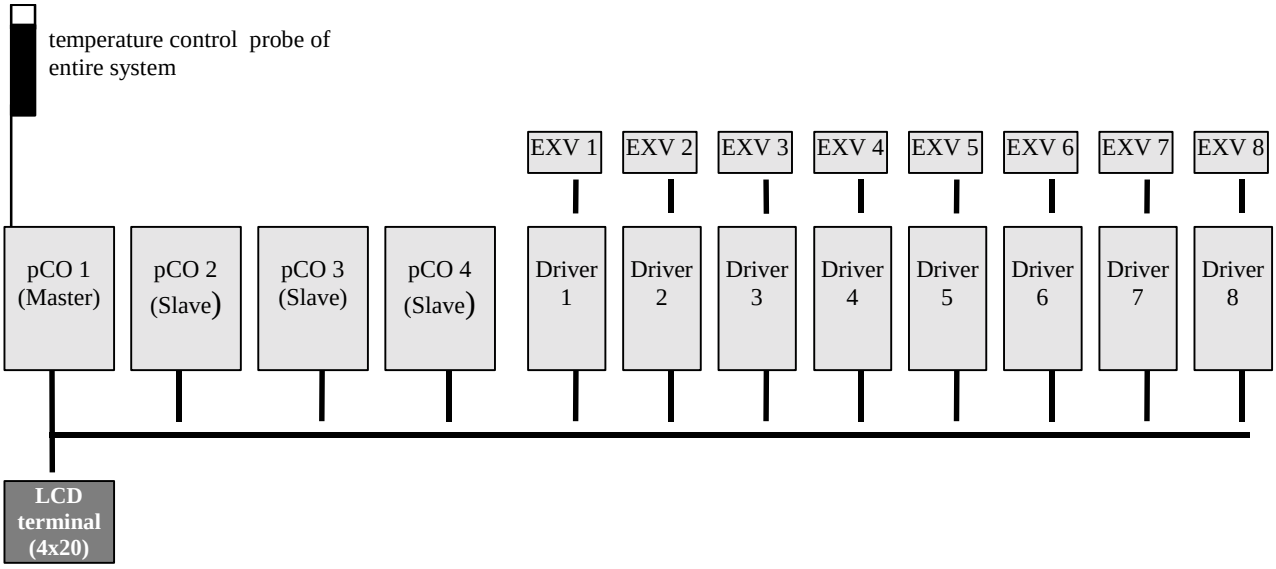
2.3 Electronic expansion valves

The master and slave manage the configuration and control of a maximum of 2 EVD drivers (therefore 2 EXV valves) each.

2.4 Control probe

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

2.5 Addressing the system



Each component of the system, whether pCO board, Driver or Terminal, is identified by a specific address.
The addresses of terminals are selected with the dip-switches located at the rear of the terminals.
The address of the pCO I/O boards is selected with the dip-switches on the addressing board (codes PCOADR0000 - PCOCLKMEM0 respectively, with/without the clock option - to be bought separately from the pCO board).
The address of the EDV drivers is selected with the dip-switches located at the rear of the front panel (removable) of the driver.

2.5.1 Specific addresses of units

The master pCO must have address 1
The pCO slaves must have address 2/3/4
The master board drivers must have addresses 5/6
The slave board 1 drivers must have addresses 7/8
The slave board 2 drivers must have address 9/10
The slave board 3 drivers must have address 11/12
The shared terminal (one only for all boards) must have address 16.

3. pLAN network

All devices connected to the pLAN network are identified by a specific address.
As terminals and pCO boards use the same type of addressing, there cannot be any terminals and pCO boards with the same identifier.
In general, board and terminal addresses may have values in the range 1 to 32.
For this particular application, the addressing indicated in paragraph "System addressing" applies.
Terminal addresses are set with the dip-switches at the rear, whereas, for the pCO boards, the optional network board is required.

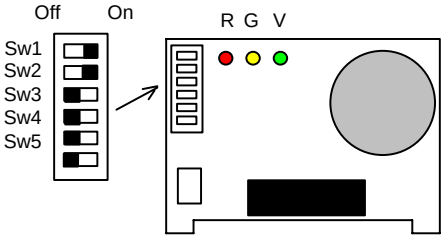
3.1 I/O boards address

Optional network board (PCOADR0000 / PCOCLKMEM0)
The optional network board is available in two versions:
dip-switch and LED Code: PCOADR0000
dip-switch LED and calendar clock Code.: PCOCLKMEM0

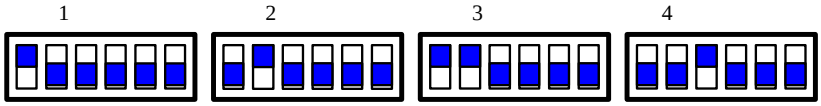
This board is essential for operation of pCO boards on the local network.
In the absence of this board, the controlled unit will be unable to control, and there will not be any information exchange between the installed pCO boards.

Adr	Sw1	Sw2	Sw3	Sw4
0	not permitted			
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)								



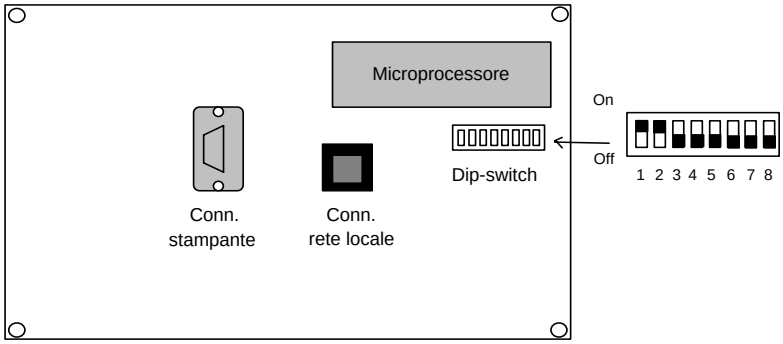
In the modular chiller standard application for screw compressor EPSTDIMSCA, the addresses for the pCO units must be set as shown below:



Unit No.1 Unit No.2 Unit No..3 Unit No.4

3.2 Address of terminals

Rear view of terminal board



Microprocessore = *Microprocessor*
Conn. Stampante = *Connection to printer*
Conn. Rete locale = *Local connection*
Dip-switch = *Dip-switch*

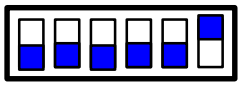
The address of the terminal is set with the set of dip-switches on the rear.
The address can be set in the range 13-32 using dip-switches 1-6.

The value of the address can be obtained with the following table (also see 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)												

The terminal for the4 pCO boards must have address 16.

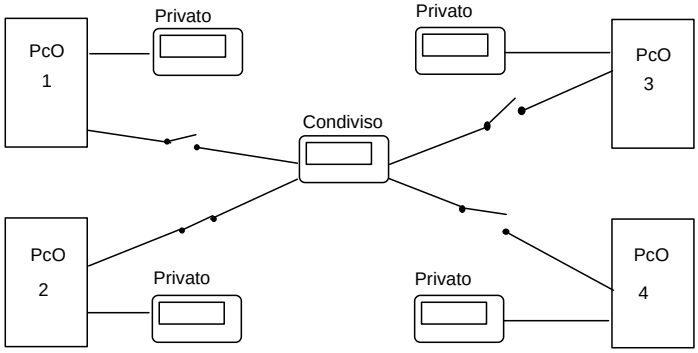
Terminal of units
No.: 1,2,3,4.



Terminal 16

3.3 Terminal management.

- Each pCO board connected to the network is able to manage several terminals (max 3) They are displayed simultaneously - like having keyboards and displays connected in parallel.
- Every terminal associated with a given board, can be either *private* or *shared.*
  Private a terminal that exclusively displays the output of a single I/O board.
  Shared a terminal that can be switched to display the output of several boards, either automatically or via the keyboard.
- Every pCO constantly updates the display of the private terminals. Any shared terminals will be updated only if the pCO in question has a control. The following diagram applies in terms of logic:



Privato = *Private*
Condiviso = *Shared*

In this example, the shared terminal is associated with 4 pCO boards. Currently, only board 2 can display data and receive commands from the keyboard.

- Switching between boards is cyclic (1→2→3→4→1....), by pressing the key (or combination of keys) to which this function is assigned. Switching can also be automatic if the program requests this directly. For example, a pCO board may request control of a shared terminal in order to display alarms, or, on the contrary, to hand over to the next board when a preset time elapses (cyclic rotation).

The number and types of terminals is established during initial configuration of the network. The relevant data are stored in the EEPROM memory of each I/O board.

3.4 Terminal configuration procedure

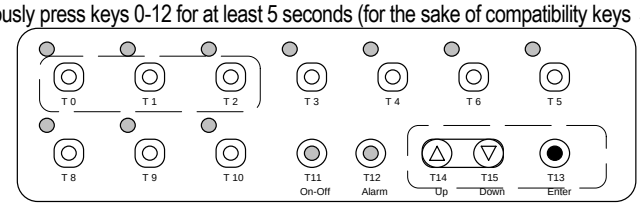
There is an automatic configuration procedure of the pLAN network. It is performed whenever the default values are installed.
If the board and terminal addresses are correctly set when the EEPROM is first installed (following the procedure for automatic installation of default values), the pLAN network will be configured with a single terminal, with address 16, shared by the boards. From this terminal access will be possible to the different units connected on the network.

If the addresses are incorrect or if the EPROM is replaced with one of the same version and date, and if none of the present units can be accessed from the terminal, proceed as described below.
The following procedure must be carried out if you wish to change the system's pLAN configuration, maybe to add a private terminal to each board.

- Before you begin the procedure, we advise you to make sure that each pCO board and terminal were correctly addressed as specified during the network design stage.
  Important: remember that the set address will be received only if the device is reset. It is good practice to globally reset the on-network devices, if several addresses are seen to overlap during configuration (several boards with the same address).
- The configuration procedure must be activated for every pCO board and must involve all the network's terminals. This procedure can be activated from any terminal. The terminal could also have been temporarily connected for configuration operations only and removed on completion.
- These are the operations to carry out:

3.4.1 Step 1: pCO board selection

- To activate the procedure, simultaneously press keys 0-12 for at least 5 seconds (for the sake of compatibility keys ▲ ▼ - Enter perform the same function.



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

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

- The field "*Terminal Adr*" is fixed, and refers to the address of the terminal you are working 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 communicating with any pCO board, characters "----" are shown.
  You can use the arrow keys to change this setting in order to force connection to a different pCO board.
  The values shown during selection indicate the addresses of the pCO boards connected to the network. If no pCO board is active, value "---" cannot be changed.
- If you press the "Enter" key, you leave the first stage of the address selection procedure and change over to the terminal configuration screen.
- If the terminal is inactive (no key pressed) for more than 15 seconds, the configuration procedure is automatically exited.

3.4.2 Step 2: selection of associated terminals

The following screens are shown on LCD displays:

```
 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" key moves the cursor from field to field, whereas the arrow keys change the current value of the field. P:00 indicates the address of the selected board - in this case, it indicates that pCO board of address 12 has been selected.
- To exit the configuration procedure and store the set data, select field "Ok?" "No", setting "Yes" with the arrow keys, confirming the data with "Enter". To exit without saving, wait for 30 seconds without pressing any key.

3.4.3 Display of terminal connection status

- If the terminal shows the inactivity status of the pCO board whose output is being viewed, the display is completely cancelled and the following message appears:

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

- If the terminal does not receive the network (token) synchronisation message for more than 10 seconds , the display is completely cancelled and the following message appears:

```
            NO LINK
```

In this situation, the green LED on the network optional board (installed on each pCO board) is also OFF:

3.4.4 Network status display: NetSTAT

There is a procedure in the program (can be activated in the LCD version only), for real-time display of the status and type of peripheral units currently connected. To activate this procedure, simultaneously press keys 0-1-2 (or Up-Down-Enter) for at least 10 s (when the 5 seconds are up, you obviously enter the terminals configuration procedure). The following screen is shown:

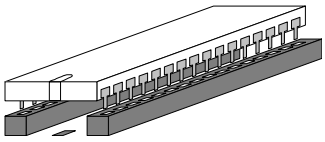
```
NetSTAT  1 □□⊡⊡_ _ _ 8
T: xx    9 _ _ _ _ _⊡_ 16
Enter   17 _ _ _ _ _ _ _ 24
To Exit 25 _  _ _ _ _ _ 32
```

The number after the T indicates the terminal from which the procedure was activated. The symbols indicate the type of peripheral unit (pCO terminal) and the respective address.
The example shows that the network consists of 2 pCO boards with address 1,2 and of 3 terminals with address 3,4, and 15.

4. Installing the EPROMs

To install/replace the EPROM/s containing the program, in multi-board applications, the user must make sure that s/he has EPROM/S with the same date and software version reference, otherwise the system will not work.

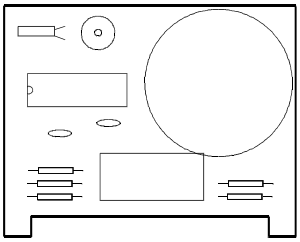
Before fitting/removing the EPROM, cut power to the pCO board.
The EPROM must be fitted on the appropriate base on the basic board making sure that the "mark" on the EPROM surface is pointing in the direction of the "mark" on the base. To make absolutely sure, check if the enamelled side of the EPROM coincides with the enamelled side of the base or with the screen-printed reference mark on the board.
When installing the EPROM, check if all the feet are correctly fitted in their seats.



When removing the EPROM, take care not to touch the SMD parts fitted in the space inside the base of the board. Any electrical damage to electrical components almost always occurs due to electrical discharges provoked by the operator.

5. Connecting optional boards

5.1 Clock board

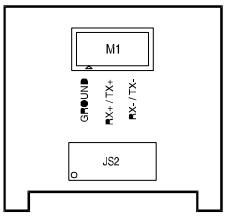


The above figure shows the real-time clock board enabling viewing of current date and time.

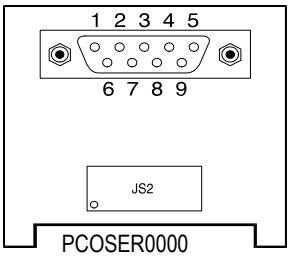
If you wish to use the alarms log function, this board is essential.

In case of a power cut to the pCO, the rechargeable lithium battery keeps the clock functions in action, constantly updating the date and time values.

5.2 Serial board RS485 / RS422



PCOSER4850



Serial boards PCOSER4850 and PCOSER0000 enable interfacing to an RS485 of RS422 serial network for data transmission.
To connect to the pCO board, position the optional board in the relevant connector.
In multi-board applications, each pCO board must be equipped with a dedicated serial interfacing board.

6. List of inputs/outputs

Different types of units can be managed, each associated with an identifier number. To configure the required inputs and outputs, identify the type of managed unit from among the suggested units, and type in the associated number on the dedicated setting screen.
For instructions on connecting the inputs and outputs of the pCO board, see the specific use manual, available on request.

6.1 AIR/WATER UNIT with max. 4 screw compressors (up to 4 capacity stages per compressor)

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 (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)
2	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Pump Thermal cutout			
5	Low Pressure Pressure-switch 1	Low Pressure Pressure-switch 2	Low Pressure Pressure-switch 3	Low Pressure Pressure-switch 4
6	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level
7	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)
8	Double Set-point			
9	Fan 1 C 1 thermal cutout	Fan 1 C 2 thermal cutout	Fan 1 C 3 thermal cutout	Fan 1 C 4 thermal cutout
10	Fan 2 C 1 thermal cutout	Fan 2 C 2 thermal cutout	Fan 2 C 3 thermal cutout	Fan 2 C 4 thermal cutout
11	High pressure pressure-switch C 1	High pressure Pressure-switch C 2	High pressure Pressure-switch C 3	High pressure Pressure-switch C 4
12	Comp. 1 thermal cutout	Comp. 2 thermal cutout	Comp. 3 thermal cutout	Comp. 4 thermal cutout

Analogue Inputs

No.	UNIT 1 (Master)	UNIT 2 (Slave No.1)	UNIT 3 (Slave No.2)	UNIT 4 (Slave No.3)
1	Water temperature at Evaporator Inlet			
2	Water temperature at Evaporator C1 Outlet	Water temperature at Evaporator C2 Outlet	Water temperature at Evaporator C3 Outlet	Water temperature at Evaporator C4 Outlet
3	C 1 Condenser temperature	C 2 Condenser temperature	C 3 Condenser temperature	C 4 Condenser temperature
4				
5	Voltage / Current / External Set-point	Voltage / Current	Voltage / Current	Voltage / Current
6	Cmp. 1 Delivery Temperature	Cmp. 2 Delivery Temperature	Cmp. 3 Delivery Temperature	Cmp. 4 Delivery Temperature
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	Circulation Pump			
2	Cmp. 1 Line Contactor	Cmp. 2 Line Contactor	Cmp. 3 Line Contactor	Cmp.4 Line Contactor
3	Cmp.1 Star Contactor	Cmp.2 Star Contactor	Cmp.3 Star Contactor	Cmp.4 Star Contactor
4	Cmp. 1 Delta Contactor	Cmp. 2 Delta Contactor	Cmp.3 Delta Contactor	Cmp.4 Delta Contactor
5	Liquid solenoid C 1	Liquid solenoid C 2	Liquid solenoid C 3	Liquid solenoid C 4
6	Cmp.1 Capacity Control Relay 1	Cmp.2 Capacity Control Relay 1	Cmp.3 Capacity Control Relay 1	Cmp.4 Capacity Control Relay 1
7	Cmp.1 Capacity Control Relay 2	Cmp.2 Capacity Control Relay 2	Cmp.3 Capacity Control Relay 2	Cmp.4 Capacity Control Relay 2
8	Cmp.1 Capacity Control Relay 3	Cmp.2 Capacity Control Relay 3	Cmp.3 Capacity Control Relay 3	Cmp.4 Capacity Control Relay 3
9	Liquid inj./Econ/Oil Cooler Cmp.1	Liquid inj./Econ/Oil Cooler Cmp.2	Liquid inj./Econ/Oil Cooler Cmp.3	Liquid inj./Econ/Oil Cooler Cmp.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 regulator C 1	Speed regulator C 2	Speed regulator C 3	Speed regulator C 4
2				

6.1.2 CHILLER UNIT + 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 (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)
2	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Pump Thermal cutout			
5	Low Pressure Pressure-switch 1	Low Pressure Pressure-switch 2	Low Pressure Pressure-switch 3	Low Pressure Pressure-switch 4
6	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level
7	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)
8	Double Set-point			
9	Fan 1 C 1 thermal cutout	Fan 1 C 2 thermal cutout	Fan 1 C 3 thermal cutout	Fan 1 C 4 thermal cutout
10	Summer / Winter			
11	High pressure pressure-switch C 1	High pressure Pressure-switch C 2	High pressure Pressure-switch C 3	High pressure Pressure-switch C 4
12	Comp. 1 thermal cutout	Comp. 2 thermal cutout	Comp. 3 thermal cutout	Comp. 4 thermal cutout

Analogue Inputs

No.	UNIT 1 (Master)	UNIT 2 (Slave No.1)	UNIT 3 (Slave No.2)	UNIT 4 (Slave No.3)
1	Water temperature at Evaporator Inlet			
2	Water temperature at Evaporator C1 Outlet	Water temperature at Evaporator C2 Outlet	Water temperature at Evaporator C3 Outlet	Water temperature at Evaporator C4 Outlet
3	C 1 Condenser temperature	C 2 Condenser temperature	C 3 Condenser temperature	C 4 Condenser temperature
4				
5	Voltage / Current / External Set-point	Voltage / Current	Voltage / Current	Voltage / Current
6	Cmp. 1 Delivery Temperature	Cmp. 2 Delivery Temperature	Cmp. 3 Delivery Temperature	Cmp. 4 Delivery Temperature
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	Circulation Pump			
2	Cmp. 1 Line Contactor	Cmp. 2 Line Contactor	Cmp. 3 Line Contactor	Cmp.4 Line Contactor
3	Cmp.1 Star Contactor	Cmp.2 Star Contactor	Cmp.3 Star Contactor	Cmp.4 Star Contactor
4	Cmp. 1 Delta Contactor	Cmp. 2 Delta Contactor	Cmp.3 Delta Contactor	Cmp.4 Delta Contactor
5	Liquid solenoid C 1	Liquid solenoid C 2	Liquid solenoid C 3	Liquid solenoid C 4
6	Cmp.1 Capacity Control Relay 1	Cmp.2 Capacity Control Relay 1	Cmp.3 Capacity Control Relay 1	Cmp.4 Capacity Control Relay 1
7	Cmp.1 Capacity Control Relay 2	Cmp.2 Capacity Control Relay 2	Cmp.3 Capacity Control Relay 2	Cmp.4 Capacity Control Relay 2
8	Cmp.1 Capacity Control Relay 3	Cmp.2 Capacity Control Relay 3	Cmp.3 Capacity Control Relay 3	Cmp.4 Capacity Control Relay 3
9	Liquid inj./Econ/Oil Cooler Cmp.1	Liquid inj./Econ/Oil Cooler Cmp.2	Liquid inj./Econ/Oil Cooler Cmp.3	Liquid inj./Econ/Oil Cooler Cmp.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-wayValve Circuit 1	4-wayValve Circuit 2	4-wayValve Circuit 3	4-wayValve Circuit 4
13	Circuit 1 Fan 1	Circuit 1 Fan 2	Circuit 1 Fan 3	Circuit 1 Fan 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 regulator C 1	Speed regulator C 2	Speed regulator C 3	Speed regulator 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 (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)
2	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Pump Thermal cutout			
5	Low Pressure Pressure-switch 1	Low Pressure Pressure-switch 2	Low Pressure Pressure-switch 3	Low Pressure Pressure-switch 4
6	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level
7	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)
8	Double Set-point			
9	Fan 1 C 1 thermal cutout	Fan 1 C 2 thermal cutout	Fan 1 C 3 thermal cutout	Fan 1 C 4 thermal cutout
10	Fan 2 C 1 thermal cutout	Fan 2 C 2 thermal cutout	Fan 2 C 3 thermal cutout	Fan 2 C 4 thermal cutout
11	High pressure pressure-switch C 1	High pressure Pressure-switch C 2	High pressure Pressure-switch C 3	High pressure Pressure-switch C 4
12	Comp. 1 thermal cutout	Comp. 2 thermal cutout	Comp. 3 thermal cutout	Comp. 4 thermal cutout

Analogue Inputs

No.	UNIT 1 (Master)	UNIT 2 (Slave No.1)	UNIT 3 (Slave No.2)	UNIT 4 (Slave No.3)
1	Water temperature at Evaporator Inlet			
2	Water temperature at Evaporator C1 Outlet	Water temperature at Evaporator C2 Outlet	Water temperature at Evaporator C3 Outlet	Water temperature at Evaporator C4 Outlet
3	Outside Air Temperature			
4	Water Temperature at Freecooling Inlet			
5	Voltage / Current / External Set-point	Voltage / Current	Voltage / Current	Voltage / Current
6	Cmp. 1 Delivery Temperature	Cmp. 2 Delivery Temperature	Cmp. 3 Delivery Temperature	Cmp. 4 Delivery Temperature
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	Circulation Pump			
2	Cmp. 1 Line Contactor	Cmp. 2 Line Contactor	Cmp. 3 Line Contactor	Cmp.4 Line Contactor
3	Cmp.1 Star Contactor	Cmp.2 Star Contactor	Cmp.3 Star Contactor	Cmp.4 Star Contactor
4	Cmp. 1 Delta Contactor	Cmp. 2 Delta Contactor	Cmp.3 Delta Contactor	Cmp.4 Delta Contactor
5	Liquid solenoid C 1	Liquid solenoid C 2	Liquid solenoid C 3	Liquid solenoid C 4
6	Cmp.1 Capacity Control Relay 1	Cmp.2 Capacity Control Relay 1	Cmp.3 Capacity Control Relay 1	Cmp.4 Capacity Control Relay 1
7	Cmp.1 Capacity Control Relay 2	Cmp.2 Capacity Control Relay 2	Cmp.3 Capacity Control Relay 2	Cmp.4 Capacity Control Relay 2
8	Cmp.1 Capacity Control Relay 3	Cmp.2 Capacity Control Relay 3	Cmp.3 Capacity Control Relay 3	Cmp.4 Capacity Control Relay 3
9	2 C 1 thermal cutout	2 C 2 thermal cutout	2 C 3 thermal cutout	2 C 4 thermal cutout
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	1 C 1 thermal cutout	1 C 2 thermal cutout	1 C 3 thermal cutout	1 C 4 thermal cutout
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 regulator C 1	Speed regulator C 2	Speed regulator C 3	Speed regulator C 4
2	3-way Freecooling Valve			

6.2 AIR/WATER unit with max. 4 screw compressors (up to 4 capacity stages per compressor)

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 (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)
2	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Evaporator Pump thermal Cutout			
5	Low Pressure Pressure-switch 1	Low Pressure Pressure-switch 2	Low Pressure Pressure-switch 3	Low Pressure Pressure-switch 4
6	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level
7	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)
8	Double Set-point			
9	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)
10	Condenser Pump thermal Cutout			
11	High pressure pressure-switch C 1	High pressure Pressure-switch C 2	High pressure Pressure-switch C 3	High pressure Pressure-switch C 4
12	Comp. 1 thermal cutout	Comp. 2 thermal cutout	Comp. 3 thermal cutout	Comp. 4 thermal cutout

Analogue Inputs

No.	UNIT 1 (Master)	UNIT 2 (Slave No.1)	UNIT 3 (Slave No.2)	UNIT 4 (Slave No.3)
1	Water temperature at Evaporator Inlet			
2	Water temperature at Evaporator C1 Outlet	Water temperature at Evaporator C2 Outlet	Water temperature at Evaporator C3 Outlet	Water temperature at Evaporator C4 Outlet
3	Water Temperature at Condenser C1 Inlet			
4	Water temperature at Condenser C1 Outlet	Water temperature at Condenser C2 Outlet	Water temperature at Condenser C2 Outlet	Water temperature at Condenser C2 Outlet
5	Voltage / Current / External Set-point	Voltage / Current	Voltage / Current	Voltage / Current
6	Cmp. 1 Delivery Temperature	Cmp. 2 Delivery Temperature	Cmp. 3 Delivery Temperature	Cmp. 4 Delivery Temperature
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	Cmp. 1 Line Contactor	Cmp. 2 Line Contactor	Cmp. 3 Line Contactor	Cmp.4 Line Contactor
3	Cmp.1 Star Contactor	Cmp.2 Star Contactor	Cmp.3 Star Contactor	Cmp.4 Star Contactor
4	Cmp. 1 Delta Contactor	Cmp. 2 Delta Contactor	Cmp.3 Delta Contactor	Cmp.4 Delta Contactor
5	Liquid solenoid C 1	Liquid solenoid C 2	Liquid solenoid C 3	Liquid solenoid C 4
6	Cmp.1 Capacity Control Relay 1	Cmp.2 Capacity Control Relay 1	Cmp.3 Capacity Control Relay 1	Cmp.4 Capacity Control Relay 1
7	Cmp.1 Capacity Control Relay 2	Cmp.2 Capacity Control Relay 2	Cmp.3 Capacity Control Relay 2	Cmp.4 Capacity Control Relay 2
8	Cmp.1 Capacity Control Relay 3	Cmp.2 Capacity Control Relay 3	Cmp.3 Capacity Control Relay 3	Cmp.4 Capacity Control Relay 3
9	Liquid inj./Econ/Oil Cooler Cmp.1	Liquid inj./Econ/Oil Cooler Cmp.2	Liquid inj./Econ/Oil Cooler Cmp.3	Liquid inj./Econ/Oil Cooler Cmp.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 UNIT + HEAT PUMP WITH GAS REVERSING (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 (Enablable)	Serious alarm (Enablable)	Serious alarm (Enablable)	Serious alarm (Enablable)
2	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)
3	Remote ON/OFF			
4	Evaporator Pump thermal Cutout			
5	Low Pressure Pressure-switch 1	Low Pressure Pressure-switch 2	Low Pressure Pressure-switch 3	Low Pressure 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 (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)
8	Double Set-point			
9	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)
10	Summer / Winter			
11	High pressure 1 pressure-switch	High pressure 2 pressure-switch	High pressure 3 pressure-switch	High pressure 4 pressure-switch
12	Comp. 1 thermal cutout	Comp. 2 thermal cutout	Comp. 3 thermal cutout	Comp. 4 thermal cutout

Analogue Inputs

No.	UNIT 1 (Master)	UNIT 2 (Slave No.1)	UNIT 3 (Slave No.2)	UNIT 4 (Slave No.3)
1	Water temperature at Evaporator Inlet			
2	Water temperature at Evaporator C1 Outlet	Water temperature at Evaporator C2 Outlet	Water temperature at Evaporator C3 Outlet	Water temperature at Evaporator C4 Outlet
3	Water Temperature at Condenser C1 Inlet			
4	Water temperature at Condenser C1 Outlet	Water temperature at Condenser C2 Outlet	Water temperature at Condenser C2 Outlet	Water temperature at Condenser C2 Outlet
5	Voltage / Current / External Set-point	Voltage / Current	Voltage / Current	Voltage / Current
6	Cmp. 1 Delivery Temperature	Cmp. 2 Delivery Temperature	Cmp. 3 Delivery Temperature	Cmp. 4 Delivery Temperature
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	Cmp. 1 Line Contactor	Cmp. 2 Line Contactor	Cmp. 3 Line Contactor	Cmp.4 Line Contactor
3	Cmp.1 Star Contactor	Cmp.2 Star Contactor	Cmp.3 Star Contactor	Cmp.4 Star Contactor
4	Cmp. 1 Delta Contactor	Cmp. 2 Delta Contactor	Cmp.3 Delta Contactor	Cmp.4 Delta Contactor
5	Liquid solenoid C 1	Liquid solenoid C 2	Liquid solenoid C 3	Liquid solenoid C 4
6	Cmp.1 Capacity Control Relay 1	Cmp.2 Capacity Control Relay 1	Cmp.3 Capacity Control Relay 1	Cmp.4 Capacity Control Relay 1
7	Cmp.1 Capacity Control Relay 2	Cmp.2 Capacity Control Relay 2	Cmp.3 Capacity Control Relay 2	Cmp.4 Capacity Control Relay 2
8	Cmp.1 Capacity Control Relay 3	Cmp.2 Capacity Control Relay 3	Cmp.3 Capacity Control Relay 3	Cmp.4 Capacity Control Relay 3
9	Liquid inj./Econ/Oil Cooler Cmp.1	Liquid inj./Econ/Oil Cooler Cmp.2	Liquid inj./Econ/Oil Cooler Cmp.3	Liquid inj./Econ/Oil Cooler Cmp.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-wayValve Circuit 1	4-wayValve Circuit 2	4-wayValve Circuit 3	4-wayValve 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 UNIT + HEAT PUMP WITH WATER REVERSING (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 (Enablable)	Serious alarm (Enablable)	Serious alarm (Enablable)	Serious alarm (Enablable)
2	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Evaporator Pump thermal Cutout			
5	Low Pressure Pressure-switch 1	Low Pressure Pressure-switch 2	Low Pressure Pressure-switch 3	Low Pressure 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 (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)
8	Double Set-point			
9	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)
10	Summer / Winter			
11	High pressure 1 pressure-switch	High pressure 2 pressure-switch	High pressure 3 pressure-switch	High pressure 4 pressure-switch
12	Comp. 1 thermal cutout	Comp. 2 thermal cutout	Comp. 3 thermal cutout	Comp. 4 thermal cutout

Analogue Inputs

No.	UNIT 1 (Master)	UNIT 2 (Slave No.1)	UNIT 3 (Slave No.2)	UNIT 4 (Slave No.3)
1	Water temperature at Evaporator Inlet			
2	Water temperature at Evaporator C1 Outlet	Water temperature at Evaporator C2 Outlet	Water temperature at Evaporator C3 Outlet	Water temperature at Evaporator C4 Outlet
3	Water Temperature at Condenser C1 Inlet			
4	Water temperature at Condenser C1 Outlet	Water temperature at Condenser C2 Outlet	Water temperature at Condenser C2 Outlet	Water temperature at Condenser C2 Outlet
5	Voltage / Current / External Set-point	Voltage / Current	Voltage / Current	Voltage / Current
6	Cmp. 1 Delivery Temperature	Cmp. 2 Delivery Temperature	Cmp. 3 Delivery Temperature	Cmp. 4 Delivery Temperature
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	Cmp. 1 Line Contactor	Cmp. 2 Line Contactor	Cmp. 3 Line Contactor	Cmp.4 Line Contactor
3	Cmp.1 Star Contactor	Cmp.2 Star Contactor	Cmp.3 Star Contactor	Cmp.4 Star Contactor
4	Cmp. 1 Delta Contactor	Cmp. 2 Delta Contactor	Cmp.3 Delta Contactor	Cmp.4 Delta Contactor
5	Liquid solenoid C 1	Liquid solenoid C 2	Liquid solenoid C 3	Liquid solenoid C 4
6	Cmp.1 Capacity Control Relay 1	Cmp.2 Capacity Control Relay 1	Cmp.3 Capacity Control Relay 1	Cmp.4 Capacity Control Relay 1
7	Cmp.1 Capacity Control Relay 2	Cmp.2 Capacity Control Relay 2	Cmp.3 Capacity Control Relay 2	Cmp.4 Capacity Control Relay 2
8	Cmp.1 Capacity Control Relay 3	Cmp.2 Capacity Control Relay 3	Cmp.3 Capacity Control Relay 3	Cmp.4 Capacity Control Relay 3
9	Liquid inj./Econ/Oil Cooler Cmp.1	Liquid inj./Econ/Oil Cooler Cmp.2	Liquid inj./Econ/Oil Cooler Cmp.3	Liquid inj./Econ/Oil Cooler Cmp.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-wayValve Circuit 1	4-wayValve Circuit 2	4-wayValve Circuit 3	4-wayValve 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

There are two different modes for controlling the control thermostat:

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

In the first case, control is proportional based on the absolute value of the temperature measured by the probe; in the second case, neutral zone control is used, and is based on the period when of the temperature measured by the probe is maintained, beyond certain thresholds.
However, the choice of the control type depends on the type of compressor managed.
If the controlled compressor is of the stepped capacity control type, in that case, both types of control can be used indifferently.
If the controlled compressor is of the continuous capacity control type, in that case, control based on outlet temperature only can be used.

7.1 Inlet temperature control

Inputs used:

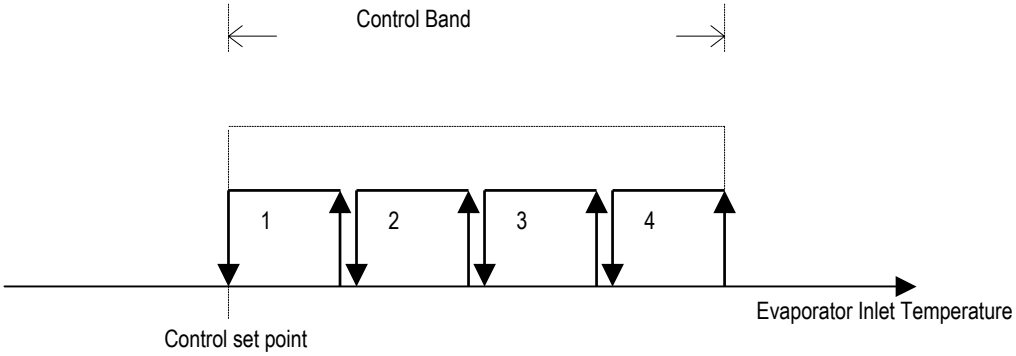
- Water temperature at evaporator inlet

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 control at inlet.
- Type of control (proportional or proportional + integral)
- Integration time (if the proportional + integral control is enabled)
- Time between start-up and first capacity control
- Time between first and second capacity control
- Time between second and third capacity control
- Time between third and fourth capacity control

Outputs used :

- Liquid Solenoid
- Windings for compressor Line - Delta - Star
- All compressor capacity control relays



The thermostatic control according to the values measured by the temperature probe at evaporator inlet, is based on proportional control.
According to the total number of configured compressors and capacity control steps per compressor, the set control band will be subdivided into a certain number of steps of equal amplitude.

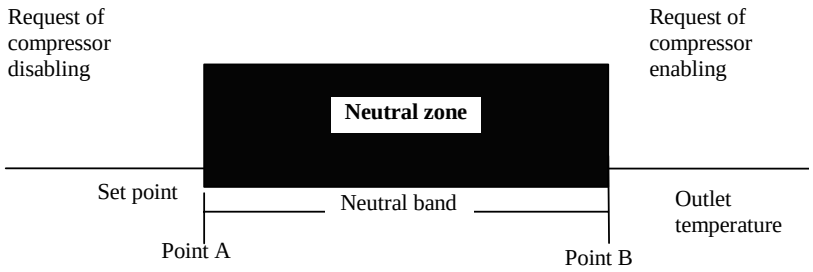
When the activation thresholds of the individual steps is exceeded, a different compressor or capacity control step will be activated.
To determine the different activation thresholds, the following relations must be applied:
Total number of control steps : Total number of compressors * Number of capacity control/compressor steps
Step proportional amplitude = Proportional control band / Total number of control steps
Step activation thresholds = Control set-point + (Step proportional amplitude * Step sequential number [1,2,3…]

7.2 Outlet temperature control

Inputs used:
- Water temperature at evaporator outlet

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 control at outlet
- Delayed starting of compressor capacity control stages
- Devices activation delay
- Devices disablement delay
- Summer limit of temperature at outlet (powers down all compressors without observing the disabling time)
- Winter limit of temperature at outlet (powers down all compressors without observing the disabling time)

Outputs used:
- Liquid Solenoid
- Windings for compressor Line - Delta - Star
- All compressor capacity control relays



A neutral temperature zone is identified, based on the set set-point and band values.
Temperature values between set-point and set-point + band (A ≤ Temperature ≤ B) will not cause enabling or disabling of the compressors.
Temperature values exceeding set-point and set-point + band (Temperature > point B) will not cause enabling of the compressors.
Temperature values below set-point and set-point + band (Temperature< point A) will not cause disabling of the compressors.

A temperature threshold, subdivided into summer and winter operation is also specified: the installed devices are unconditionally disabled above/below this threshold, in order to prevent the units producing too much cold/heat.

7.3 Control of water /water chiller only units

Inputs used:
- Water temperature at evaporator inlet
- Water temperature at evaporator outlet
- Water temperature at condenser inlet
- Water temperature at condenser outlet

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)
- Type of control at inlet (proportional - proportional + integral)
- Integration time (if the proportional + integral control is enabled)
- Delayed starting of compressor capacity control stages
- Devices activation delay

Outputs used:
- Liquid Solenoid
- Windings for compressor Line - Delta - Star
- All compressor capacity control relays

7.3.1 Description of operation :

Activation of compressors is controlled by the water temperature measured by the probe located at evaporator inlet/outlet. No condensation fans are supplied because the condenser is water-cooled.

7.4 Control of water/water chiller unit with gas reversing heat pump

Inputs used:
- Water temperature at evaporator inlet
- Water temperature at evaporator outlet
- Water temperature at condenser inlet
- Water temperature at condenser outlet

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 at inlet (proportional - proportional + integral)
- Integration time (if the proportional + integral control is enabled)
- Delayed starting of compressor capacity control stages
- Devices activation delay
- Refrigerating circuit reversing valve logic

Outputs used:
- Liquid Solenoid
- Windings for compressor Line - Delta - Star
- All compressor capacity control relays
- Refrigerating circuit reversing valve

7.4.1 Description of operation :

Activation of compressors is controlled by the water temperature measured by the probe located at evaporator inlet/outlet. No condensation fans are supplied because the condenser is water-cooled.
During the reversing of the refrigerator cycle, i.e. at changeover from refrigeration to heating and vice-versa, the evaporator and condenser functions are exchanged.
In this mode, the refrigerating circuit is reversed, but the compressors are always controlled by the temperature at evaporator inlet/outlet.

7.5 Control of water/water chiller unit with water reversing heat pump

Inputs used:
- Water temperature at evaporator inlet
- Water temperature at evaporator outlet
- Water temperature at condenser inlet
- Water temperature at condenser outlet

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)
- Type of control at inlet (proportional - proportional + integral)
- Integration time (if the proportional + integral control is enabled)
- Delayed starting of compressor capacity control stages
- Devices activation delay
- Water circuit reversing valve logic

Outputs used
- Liquid Solenoid
- Windings for compressor Line - Delta - Star
- All compressor capacity control relays
- Water circuit reversing valve

7.5.1 Description of operation :

Activation of compressors is controlled by the water temperature measured by the probe located at evaporator inlet/outlet. No condensation fans are supplied because the condenser is water-cooled.
During the reversing of the refrigerator cycle, i.e. at changeover from refrigeration to heating and vice-versa, the evaporator and condenser functions are not exchanged.
In this mode, the water circuit is reversed, and the compressors are controlled by the temperature at evaporator or condenser inlet/outlet according to the selected mode.

8. Types of controlled compressors

8.1 Stepped capacity control

A maximum number of four compressors are managed, with a maximum of four capacity control steps each. Capacity control is achieved by three relay outputs which, when suitably commanded, short-circuit the refrigerant thrust by the compressor, varying its capacity and, therefore, the power input into the circuit.

8.1.1 Configuration of stepped capacity control relays

The enabling sequence of the capacity control relays differs for each compressor. Therefore, the software has a facility for configuring the enabling sequence according to the needs of different compressor manufacturers.

For multi-card systems: as several compressors are housed on the same machine, it is considered that the compressors controlled by each pCO are perfectly equal and, therefore, the capacity control configuration selected on board the master card also applies to the slave cards.

The following table shows examples of the configuration of the dedicated digital outputs for the different power stages entered.
The effective status of the digital output is indicated.
The relation between the data in the table and the values set on the display.
Closed = ON
Open = OFF

Default configuration :

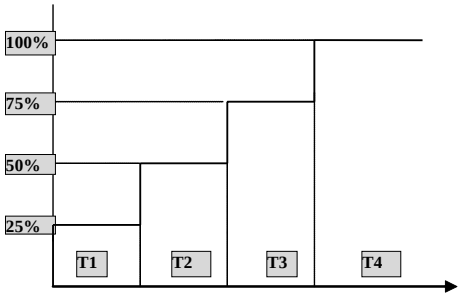
% LOAD	Relay 1	Relay 2	Relay 3
25%	CLOSED	OPEN	OPEN
50%	OPEN	OPEN	CLOSED
75%	OPEN	CLOSED	OPEN
100%	OPEN	OPEN	OPEN

Configuration example :

% LOAD	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

Delays are specified for capacity control management. These delays can be set when the capacity controls are enabled. Such delays indicate the minimum operating time of a compressor at a given power stage. If the machine is enabled at maximum level request, these delays prevent a changeover from power level 0 to maximum level.
Graph of times for capacity control in 4 steps:



8.1.3 Special management of capacity control first stage

A facility is provided for enabling special management of the first stage of capacity control, managing the compressor's special requirements when it is operating at low power.

In general, the control entails the use of the first capacity control stage only at power-up and if temperature falls below the control set-point. When controlling the compressor, this type of control uses a reduced power modulation range, between the second and maximum power stages.

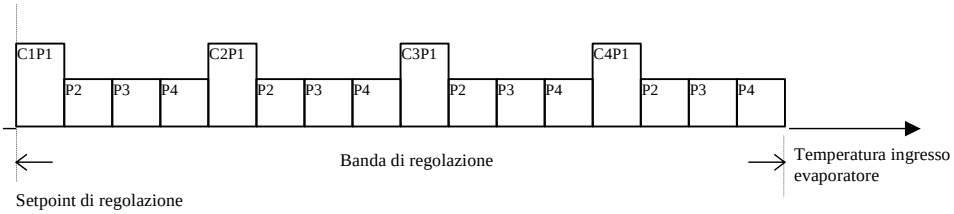
Management varies according to whether the compressor is in its starting or disabling stage. In both cases, you are recommended not work at 25% power for too long.

- Starting: after being started, if the compressor does not receive any thermostatic request for changeover to the second capacity control stage, the changeover is forced by the software after a time which can be set on the screen (T1).

Power-down: if a reduction in the power of the circuit is requested, power is controlled between the maximum and second capacity control stage. Only if temperature drops below set-point value, the compressor is forced to operate according to the first capacity control stage for the set time (T1).

This special operating mode is enabled from the screen. If the first capacity control step is not enabled, it is treated as just any step. The compressor can operate at this power level for an infinite time.

8.2 Stepped capacity control with control at inlet



A description of stepped capacity control of 4 compressors with four capacity control steps each:

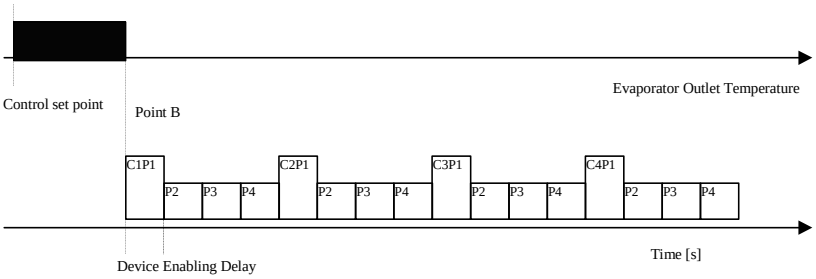
All compressors and the relevant capacity control steps will be proportionally positioned in the band. Increasing temperature values will cause the control steps to be subsequently input. Each step will be input according to the set delay times. The compressors will be started at the first entered capacity control stage. If special management of the first capacity control stage was selected, control will be effected according to the description in the dedicated section. In any event, the times for the capacity controls will be applied as described.

8.3 Stepped capacity control with control at outlet

A description of stepped capacity control of 4 compressors with four capacity control steps each:

8.3.1 Activation of compressors

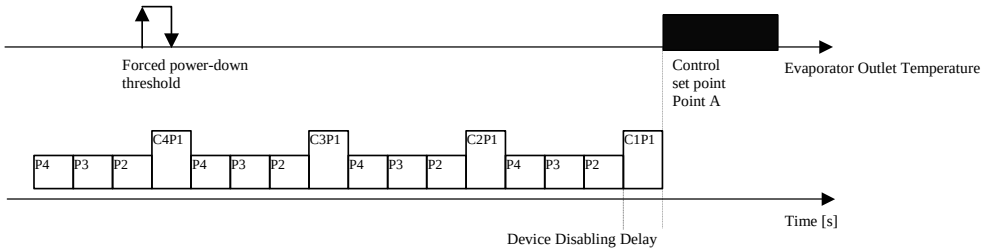
if the water temperature measured by the probe located at the evaporator outlet exceeds the threshold of Control Set-point + Control Band (Point B), the number of power stages will be increased - the power stages were input according to the set parameter known as "delay between power-up of different devices".



The activation delay of the different devices is the same, without distinction of compressors and capacity control steps. The activation delay times for the capacity controls are considered only if the step activation delay is shorter than the set delays. In this way, the power increase speed of the compressor is reduced. If the difference between the times is too high, if there is a powered up, but not fully loaded compressor, the next compressor could be started.

8.3.2 Power-down of compressors

If the water temperature measured by the probe located at the evaporator outlet is below the Control Set-point (Point A), the number of power stages will be reduced - power stages were input according to the set parameter known as "delay between power-downs of different devices".

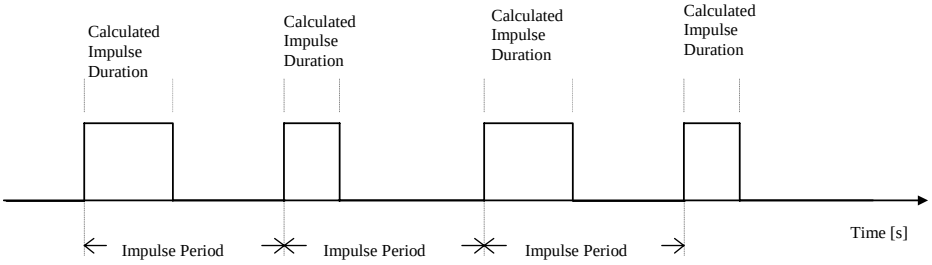


If temperature falls below the set forced power-down threshold, the compressors are powered down irrespective of the set delays, in order to prevent tripping the antifreeze alarm.

8.4 Continuous capacity control

A maximum number of four compressors are managed, with continuous capacity control.
The compressor's capacity is controlled by two relay outputs, which, when suitably controlled, enable compressor power to be increased or reduced, varying the capacity of the compression chamber.

Compressor power is controlled by sending impulses to the outputs of the capacity control relays. These impulses command the compressor to be charged or discharged. These impulses are at a constant frequency, settable, and of variable duration between two minimum and maximum limits, also settable. As there is no acquisition regarding the absolute position of the compressor 's capacity control valve, and, consequently, as no direct verification is possible of the power percentage input in the circuit, a time based control is run. With this control, when a set time threshold is reached, the compressor is considered fully charged/discharged and thus control of the capacity control impulses is suspended.



8.4.1 Configuration of continuous capacity control relays

The control method of the capacity control relays differs for each compressor. Therefore, the software has a facility for configuring the enabling sequence according to the needs of different compressor manufacturers.

For multi-card systems: as several compressors are housed on the same machine, it is considered that the compressors controlled by each pCO are perfectly equal and, therefore, the capacity control configuration selected on board the master card also applies to the slave cards.

The following table shows examples of the configuration of the dedicated digital outputs for the different power stages entered.

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

Default configuration :

Compressor behaviour	Relay 1	Relay 2
Power reduction	CLOSED	CLOSED
Power stand-by	OPEN	CLOSED
Power increase	OPEN	OPEN

The power stand-by configuration is taken on by the outputs when no variation of input power is requested, or if the maximum/minimum compressor power is reached, or because the water temperature measured by the probe located at evaporator outlet is inside the neutral control zone. For compressor charging /discharging, the digital outputs of the pCO card are commanded alternately according to the stand-by and charge/discharge configuration, causing the dedicated relay to pulse.

8.5 Continuous capacity control with control at outlet

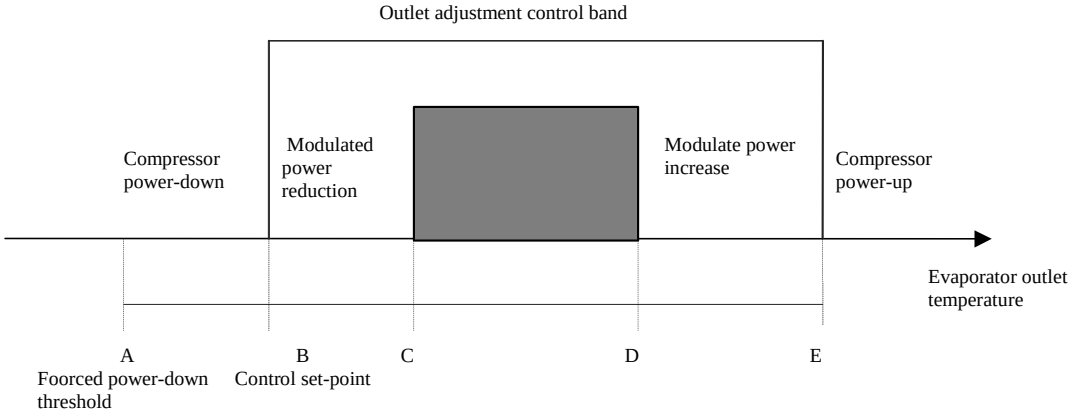
Temperature control with compressors on continuous capacity control can occur only if control at outlet is selected, according to the temperature values measured by the probe located at evaporator outlet.
To that end, further configuration parameters are input. They are specific for the particular type of compressor, and are added to those previously mentioned in the description of the special type of control.

Parameters used :

- Neutral zone for continuous capacity control
- Impulse period
- Charging impulse minimum duration
- Charging impulse maximum duration
- Discharging impulse minimum duration
- Discharging impulse maximum duration
- Forced discharge period at compressor power-up
- Capacity control relay forcing enabled when compressor is OFF:

Outputs used :

- Compressor capacity control Relay 1
- Compressor capacity control Relay 2



8.5.1 Control of continuous capacity control according to points in the graph

According to the set-point values, the control band with control at output and the neutral zone of compressors on continuous capacity control, points C, D and E are identified.
Temperature is provided for the values set for parameters "Neutral zone for continuous capacity control" and "Control band for control at outlet" If point D is beyond point E, the red LED under the alarm key flashes.

If the water temperature measured by the probe located at evaporator outlet exceeds point E
Point E = Control Set-point + Control Band with Control at Outlet

In this case, there is a request for the compressors to be powered up and for power to be increased according to the maximum duration charging impulses until compressor maximum charging time is reached.

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

Point B = Control Set-point

In this case, there is a request for the compressors to be discharged according to the maximum duration impulses until compressor maximum discharging time is reached and until possible power-down.

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

Point D = Control Set-point + (Control Band with Control at Outlet – Neutral Zone for Continuous Capacity control Compressors)
Point C = Point D - Neutral Zone for Continuous Capacity Control Compressors

Then the power of the compressor will be increased/reduced by impulses of variable duration according to the values calculated within the minimum and maximum limits set for an infinite time.

8.5.2 Power-up of compressors (temperature above point E)

The compressors are powered up in sequence at a rate calculated by the set time required to reach maximum power.
As there is no absolute reference concerning the value of input power, as soon as it is started, the compressor performs a forced discharge cycle for a set time (capacity control relays energised continuously according to the power discharge configuration).
Subsequently, the compressor power will be increased by maximum duration impulses.

8.5.3 Increase of compressor power

When the maximum time limit for reaching maximum power is reached, a forced charging cycle is commanded for a time of 20% of the set threshold, then the compressor capacity control relays change to the power stand-by configuration.
If the temperature remains in the power-up zone (beyond point E), every ten minutes a forced charging cycle is commanded with a duration of 20% of the time required to reach the maximum set power.
In the case of multi-compressor units, the periodic forced charging cycle will be carried out by all powered-up compressors which have reached maximum power.

8.5.4 Modulated increase of power (temperature in range between points D-E)

The compressor's power is modulated in this temperature range, by applying charging impulses of variable duration to the capacity control relays (duration is calculated between the minimum and maximum values set according to the measured temperature values).
For multi-compressor units, modulated increase of power will occur simultaneously for all powered-up compressors.

8.5.5 Operation of compressor in neutral zone (temperature in range between points C-D)

If the temperature value locates inside the neutral zone, the capacity control relays of all powered-up compressors change to the power stand-by configuration, thus maintaining the power level that had been reached.

8.5.6 Modulated reduction of power (temperature in range between points C-B)

The compressor's power is modulated in this temperature range, by applying discharging impulses of variable duration to the capacity control relays (duration is calculated between the minimum and maximum values set according to the measured temperature values).
For multi-compressor units, modulated reduction of power will occur simultaneously for all powered-up compressors.

8.5.7 Power-down of compressors (temperature below point B)

The compressors are first of all discharged by applying maximum duration discharging impulses to the capacity control relays.
The compressors are then powered down, by reducing the number of requested devices, at a rate equal to the time required to reach minimum set power.
FIFO Rotation is applied, whereby the first powered-up compressor is discharged and then powered-down. Instead, if rotation is disabled, the last powered-up compressors is discharged and then powered down.

9. Compressor rotation

Compressor calls are rotated in order to equal the number of duty hours and power-ups among the devices. Rotation follows the FIFO logic: the first compressor to be powered up is the first to be powered down. At the initial stage, there may be considerable differences in the on-duty hours of the compressors, however, the hours are very similar to each other in steady state.
Rotation occurs only among compressors and not among capacity controls, and, in any case, this type of rotation operates only if the compressors have stepped capacity control.

Rotation-free management

- Power-up: C1,C2,C3,C4.
- Power-down: C4,C3,C2,C1.

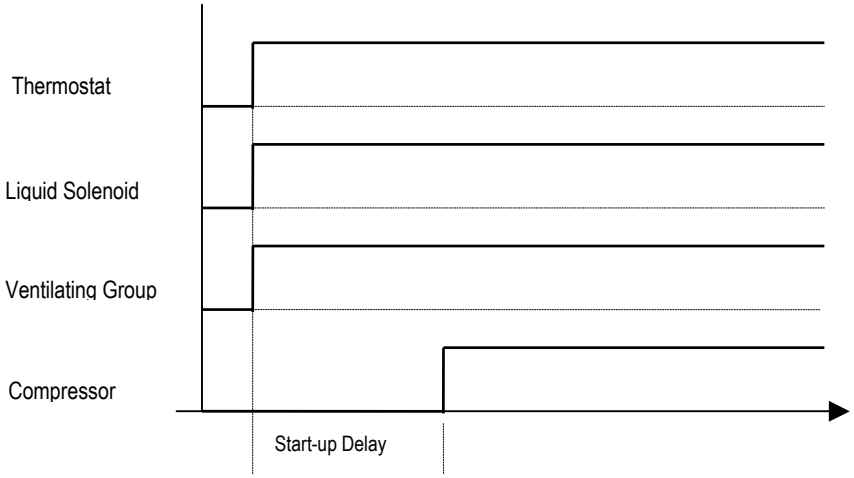
FIFO rotation management (the first compressor to be powered up is the first to be powered down):

- Power-up: C1,C2,C3,C4.
- Power-down: C1,C2,C3,C4.

10. Starting a single compressor

10.1 Description of operation

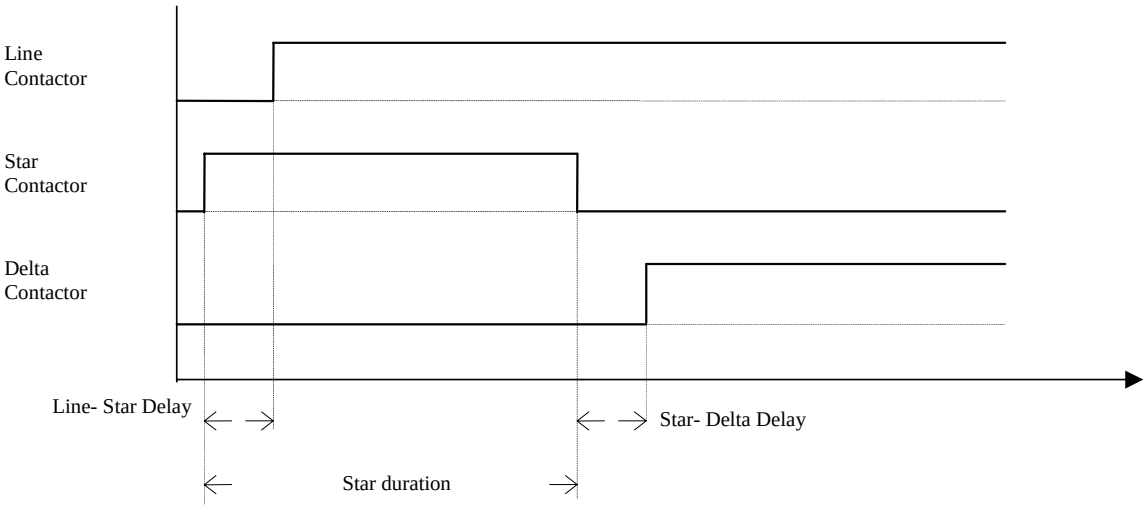
The start-up stages are described in the following graph



10.2 Starting the compressor motor

10.2.1 Delta / Star starting

Starting the motor is described in the following diagram



10.2.2 Starting with Part - Winding

To start the compressor with part-winding, you must reset the star and delta-star times, setting the desired part-winding time as the delta-star time.
The outputs used are those of the line and delta relays, used respectively as part-winding relays A and B.

Example:
Star-line time 0 / 100 s
Star Time 0 / 100 s
Delta-star time 100 / 100 s for a part-winding time of 1 s.

10.3 Compressor start restrictions

There are two start restricting methods. Both start the compressor directly with the delta contactor, by-passing the star contactor. There is a single enablement for both cases:

1. Set high and low pressure thresholds exceeded
2. Set equalised pressure threshold exceeded (equalised pressure is the average pressure between high and low pressure measured by the transducers).

11. Forced capacity control

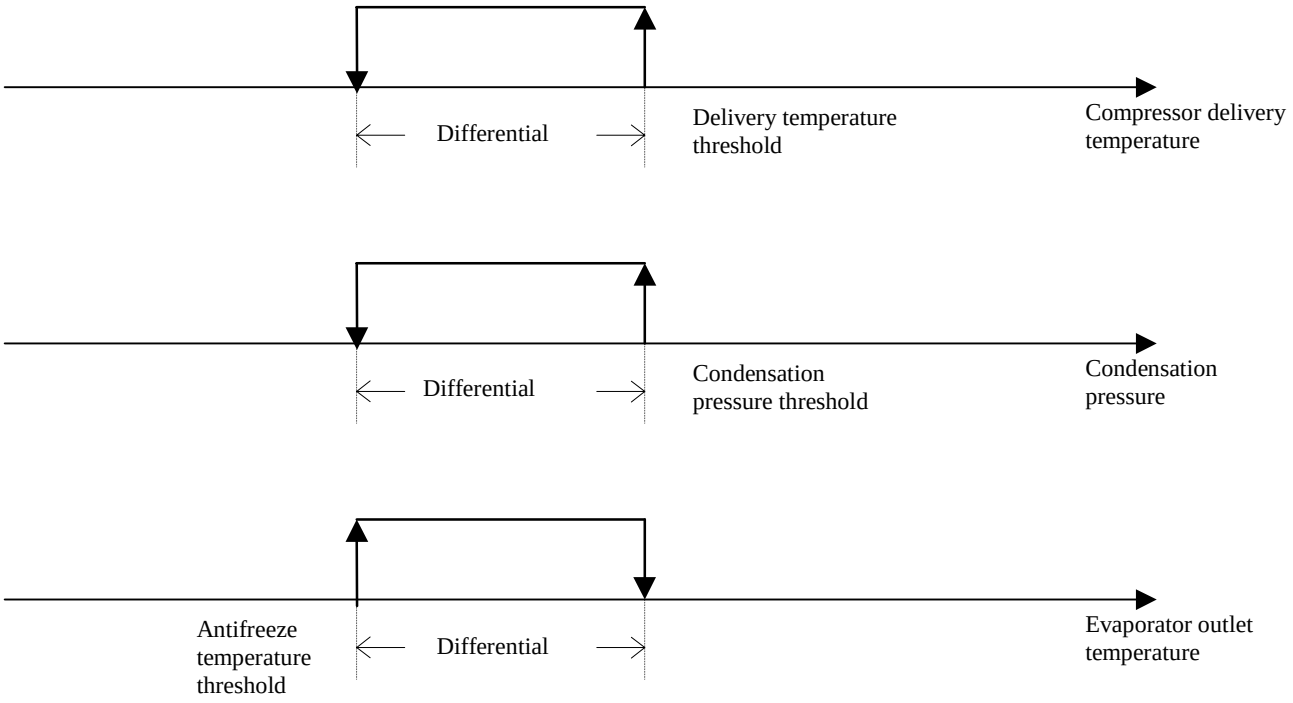
Inputs used
- Water temperature at evaporator outlet
- Compressor delivery temperature
- Condensation pressure

Parameters used
- High delivery temperature prevention threshold
- High delivery temperature prevention differential
- High pressure prevention threshold
- High pressure prevention differential
- Antifreeze temperature prevention threshold
- Antifreeze temperature prevention differential
- Forced selection of compressor at minimum/maximum power

Outputs used
- All compressor capacity control relays

11.1.1 Description of operation

The compressor forced capacity control function prevents the unit from operating in abnormal conditions of pressure, refrigerated water temperature or condensation temperature, thus preventing any intervention by specific alarms.
A parameter is provided for selecting the compressor operating mode if forced capacity control is enabled. The compressor can be taken to minimum/maximum power according to the selection when:
- High delivery temperature threshold exceeded
- High pressure threshold exceeded
- Antifreeze temperature threshold exceeded



11.1.2 Compressors with stepped capacity control

For compressors with stepped capacity control, forced capacity control means that the compressor has to operate at minimum or maximum power according to selection.

11.1.3 Compressors with continuous capacity control.

For compressors with continuous capacity control, forced capacity control means that the compressor has to operate in continuous charging or discharging mode according to selection.

12. Solenoid-valve management.

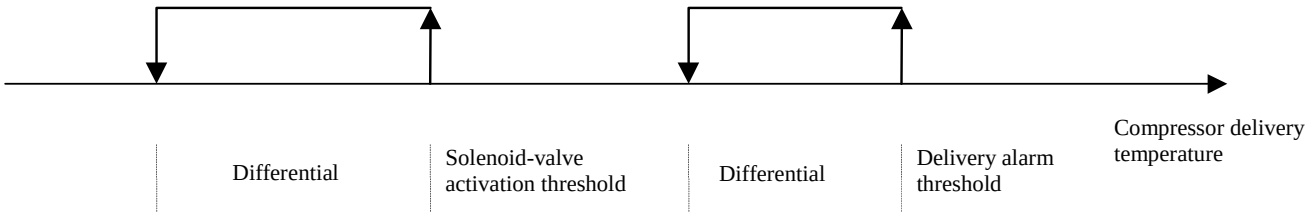
Inputs used:
- Compressor delivery temperature

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

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

12.1.1 Description of operation

A digital output is provided for controlling an economizer solenoid-valve, oil-cooler and liquid injection. Activation is based on the delivery temperature values of the compressor read by the probe according to the following graph



13. Pumpdown

Inputs used
- Low Pressure Pressure-switch

Parameters used
- Enable pumpdown
- Pumpdown maximum duration

Outputs used
- Liquid Solenoid
- Windings for compressor Line - Delta - Star
- All compressor capacity control relays

13.1.1 Description of operation

If enabled, pump-down occurs by the thermostat disabling the compressor.
Pump-down duration can be set and can cease due to maximum time or due to the tripping of the high pressure pressure switch.
If any alarm powers down the machine or even just the compressor, the pump-down finishes immediately.

When the pump-down function operates, this forces the compressor to forced capacity control.
For compressors with stepped capacity control, operation at minimum/maximum power is forced.
For compressors with modulating capacity control, continuous discharging/charging of the compressor is forced.

14. Condensation control

Condensation can be performed in the following modes:

- ON/OFF linked to compressor operation (without pressure transducers)
- ON/OFF or modulating linked to reading by the pressure transducer (if the high pressure transducers were enabled)
- ON/OFF or modulating linked to reading by the battery temperature probes (if the battery temperature probes were enabled)

Inputs used:

- high pressure probe B7
- battery temperature probe B3

Outputs used :

- Fan 1
- Fan 2
- Speed control for fans AOUT 1

Parameters used :

- Selection of condensation control None /pressure/temperature
- Condensation set point
- Condensation band
- Number of fans
- Enable prevent function
- Prevent threshold
- Prevent differential
- Output voltage for inverter minimum speed
- Output voltage for inverter maximum speed
- Inverter speed-up time

14.1 ON/OFF Condensation linked to operation of compressor:

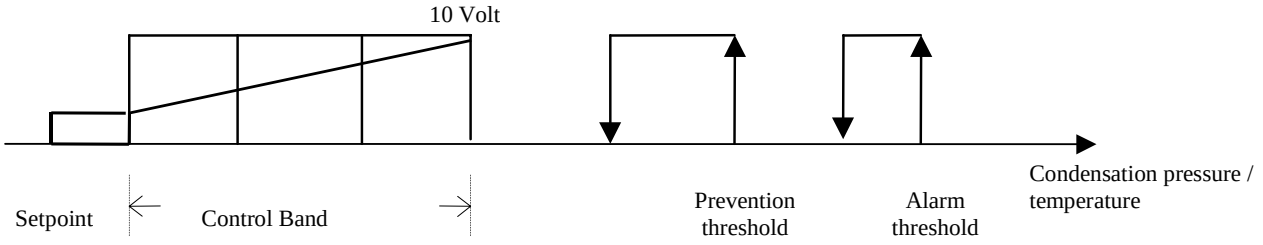
Fan operation will solely depend on compressor operation:
Compressor OFF = fan OFF
Compressor ON = fan ON

14.2 ON/OFF Condensation linked to pressure or temperature sensor :

Fan operation depends on compressor operation and on the value read by the pressure or temperature sensors according to a set point or to a band. When the pressure/temperature is lower than or equal to the set point, all fans are OFF, but when the pressure/temperature rises to set point + band, all fans are ON.

14.3 Modulating condensation linked to pressure or temperature sensor :

With this type of condensation, the fans will be controlled through a 0/10 V analogue output, in proportion to demand by the pressure/temperature sensors. If the lower limit of the ramp is greater than 0 V, there will not be a proportional straight line, but, as in the first section of the graph, it will be below the set point-diff. by one step.



14.4 Prevent function:

This function can be selected under the constructor password, and is used to prevent circuits shutting down due to high pressure.
With the compressor ON, when this threshold is reached, the compressor is capacity-control forced until pressure returns to below the set point - of a settable differential.
With the compressor OFF, when this threshold is reached, the fans are capacity-control forced until pressure returns to below the set point - a settable differential.

15. Defrosting control for water/air machines

Inputs used:
- battery B3 temperature (can be used as a pressure switch)
- high pressure B7
- Input for defrosting pressure switch 1

Parameters used :
- Inputs used for defrosting
- Type of defrosting (simultaneous / separate/independent)
- Type of defrosting start and finish (compressor behaviour)
- defrosting start set point
- defrosting stop set point
- Defrosting delay time
- Maximum defrosting time
- Type of compressor operation during the refrigerating cycle reversing stage.
- Drip-off time

Outputs used :
- Compressor 1
- Cycle reversing solenoid-valve 1
- Fan.

15.1 Types of defrosting

15.1.1 Simultaneous

Only one circuit has to request entering the defrosting cycle for all circuits to forcibly enter defrosting. Circuits which do not need to defrost (temperature above defrosting stop set-point) stop and wait. As soon as all circuits finish defrosting, the compressors may restart on heat pump operation.

15.1.2 Separate

The first pCO unit requesting defrosting begins to defrost, the other units - even if they request defrosting - wait (the heat pump continues to operate) until the first one finishes defrosting. All the units sequentially complete their defrosting cycle.

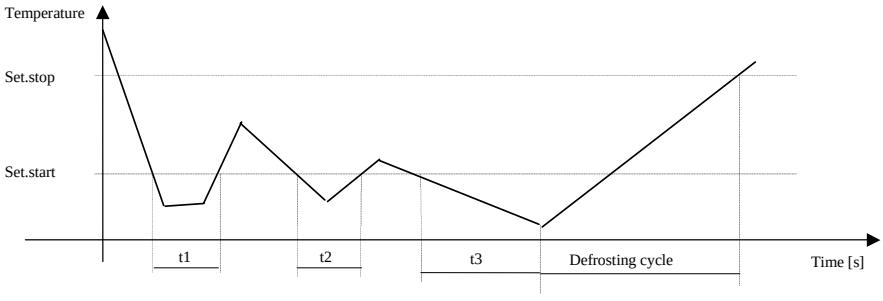
15.1.3 Independent

The units can start defrosting at random, independently of each other. In this way, there may be several machine starting to defrost simultaneously.

15.2 Type of defrosting start and end :

Defrosting management can be controlled either by battery B3 temperature probe, or by the B7 high pressure probe. The user can select one of the two probes from the screen. The compressor can have four different types of behaviour in connection with start/end of defrosting. This makes it possible to protect the compressor against sudden cycle reversing, if necessary. Times are not considered in these compressor power-downs and power-ups.
- *None:* The refrigerating cycle is reversed at inlet/outlet to/from the defrosting cycle occurs with the compressor ON.
- Start of defrosting: The compressor is powered down by the reversal of the refrigerating cycle only at the inlet of the defrosting cycle.
- End of Defrosting: The compressor is powered down by the reversal of the refrigerating cycle only at the outlet from the defrosting cycle.
- Start/end of defrosting: The compressor is powered down by the reversal of the refrigerating cycle both at the inlet and outlet to/from the defrosting cycle.

15.3 Defrosting a circuit with time/temperature control



If the battery temperature/pressure remains below the defrosting start set-point for a cumulative time equal to defrosting delay time, the circuit in question enters a defrosting cycle.
- the system's refrigerating capacity reaches maximum value
- the refrigerating circuit is reversed with the 4-way valve
- the fan in question goes OFF (if pressure probes are present)

The circuit leaves the defrosting cycle due to temperature/pressure (if battery temperature exceeds the defrosting stop set point) or due to maximum time if the defrosting cycle exceeds the set maximum time threshold.

15.4 Defrosting a circuit with time/pressure switches control

control is exactly the same, with the difference that the status of the pressure switches is counted rather than temperature/pressure.

15.5 Operation of fans during the defrosting stage

The fans are usually OFF during the defrosting cycle. They are activated only if the pressure probes were enabled and pressure exceeds the prevent threshold - in this way the unit is prevented from going into high pressure alarm status.

16. Free Cooling Control

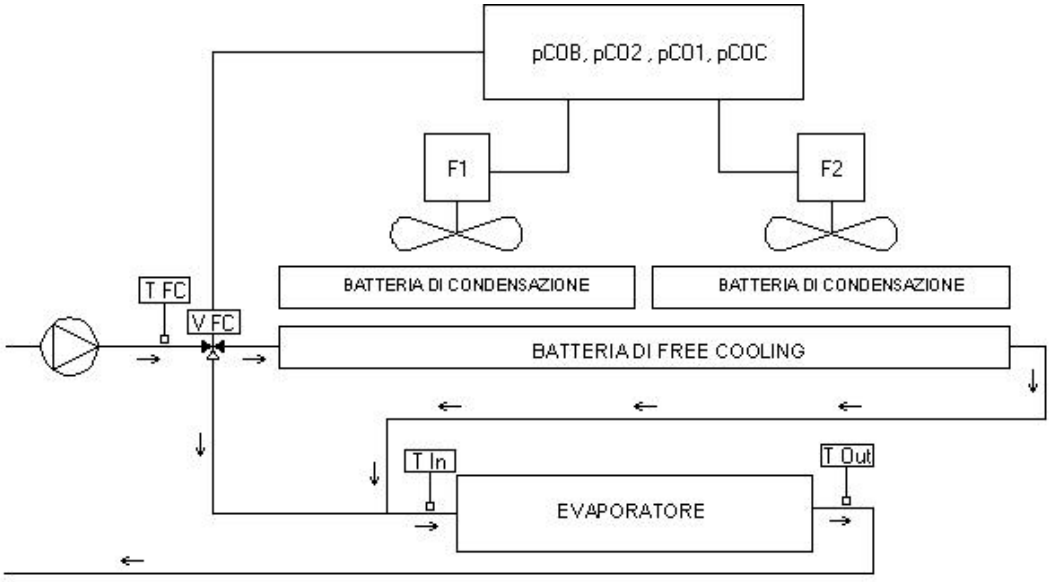
Inputs used
- Water temperature at evaporator outlet
- Water temperature at inlet of Free Cooling battery
- Outside air temperature

Parameters used
- Type of unit
- Number of units
- Type of condensation
- Number of fans
- Free Cooling valve type
- Free Cooling type control
- Integration time
- Control set point
- Control set point offset
- Minimum Free Cooling Delta
- Maximum Free Cooling Delta
- Free Cooling Control differential
- Maximum threshold for Free Cooling valve opening
- Minimum threshold for condensation speed controller
- Free Cooling antifreeze threshold
- Compressor activation delay

Outputs used
- Condensation fans
- Condensation fans speed controller
- Free Cooling ON/OFF valve
- Free Cooling 3-way valve

16.1.1 Description of operation

Free Cooling control makes it possible to exploit the temperature conditions of external air to facilitate cooling use water.
To this end, a heat exchanger is supplied. If necessary, a certain quantity of water is returned to this exchanger by the system, deviated via an appropriately commanded valve.
The favourable conditions of outside air cause the water to cool beforehand, and, therefore activation of the cooling devices is delayed. Free Cooling is available in the air/water unit in the internal Free Cooling mode only. i.e. with the Free Cooling battery housed inside the machine near the condensation battery/ies, with which its shares control of the condensation fan/s.



BATTERIA DI CONDENSAZIONE	=	*CONDENSATION BATTERY*
BATTERIA DI FREE COOLING	=	*FREE COOLING BATTERY*
EVAPORATORE	=	*EVAPORATOR*

16.2 Free Cooling activation condition

The entire Free Cooling procedure is based on a relationship between the temperature value measured by the external temperature probe, and the temperature value measured by the temperature probe located at the input of the Free Cooling heat exchanger and the set Free Cooling delta.

External T. ≤ Free Cooling Input T. – Free Cooling Delta

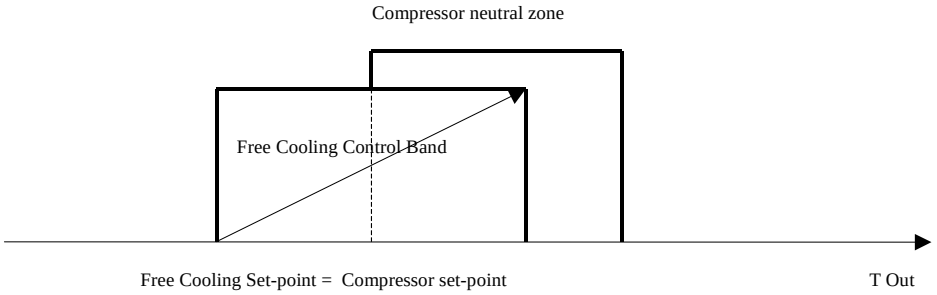
If this condition occurs, the control manages Free Cooling, enabling /disabling the dedicated devices.

16.3 Free Cooling Thermostat

Free Cooling control exploits the calculated control set point values (taking into account any compensation) and the set Free Cooling control differential.
The control is based on the water temperature measured by the probe located at the evaporator outlet, considering the effective supply of cold of the Free Cooling exchanger according to the different external temperature conditions.
Two different control modes can be selected: proportional, proportional + integral - the integration constant must be set in the latter case.

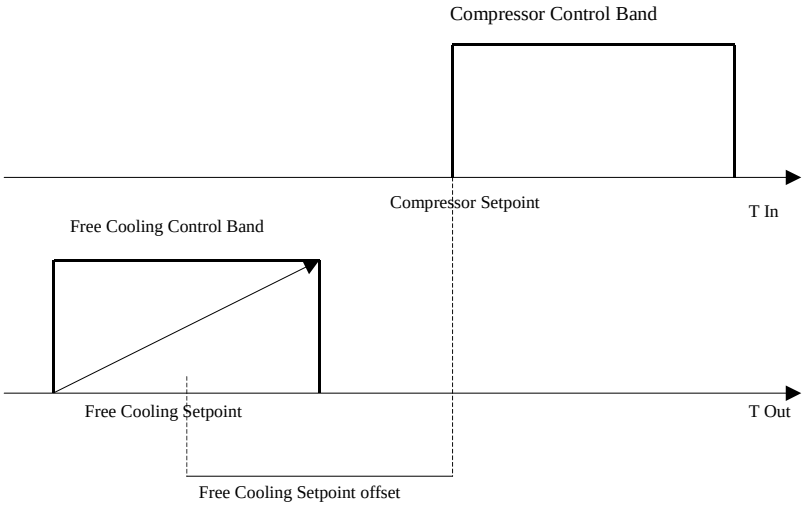
The set point for thermostatic control of Free Cooling will be determined according to the nominal value of the temperature of the water you wish the unit to produce.
According to the type of control adopted for compressor control (input - output), and as the temperature references are different, two distinct control graphs must be identified.
In machines controlled output with a neutral zone, the Free Cooling control set point will correspond to the control set point of the compressors.

Free Cooling Set point = Compressors setpoint



The proportional control band will be equally distributed at the sides of the set point.
In machines controlled at output with a lateral proportional band, the Free Cooling control set point takes into account an offset with respect to the control set point of the compressors to compensate for the presence of the evaporating battery.

Free Cooling Set point = Compressors Set-point - Offset



The proportional control band will be equally distributed at the sides of the set point.
In the Free Cooling control band, the activation thresholds for dedicated devices (e.g. valves and fans or speed variators) will be calculated in different ways according to the type of selection.
As the fans and/or speed variators are shared by Free Cooling control and condensation control, if one or more compressors in a given refrigerating circuit is/are enabled, priority will be given to condensation control to protect the circuit itself.
The Free Cooling valve will, in any event, be maintained fully open to provide as high as possible a thermal yield even at minimum ventilating capacity.
To optimise Free Cooling performance during the machine start transients and in steady state operating situations, a by-pass time is applied for thermostatic control of the compressors.
The purpose of this time is to delay the activation of the compressors in order to give Free Cooling sufficient time to reach the steady state conditions and take the machine's yield to nominal value. Only after this time has elapsed, and with the main thermostat dissatisfied, the compressors are commanded to operate. If time is set to 0, the function will be disabled.

While the unit is operating, the same parameter is used by Free Cooling control to reassess the machine's working conditions according to the value measured by the external temperature probe.
A further temperature delta should be set. This identifies a second threshold below which the yield of the Free Cooling battery is so high that it can fully satisfy the system's thermal load solely through combined operation of valve and fans.

If the compressors are ON, the external temperature falls below "maximum delta" set according to the following relation:

External T. $\leq$ Free Cooling Input T. – Free Cooling "Maximum Delta"

and this condition continues for a continuous time period equal to the set by-pass time for the compressors. When this time has elapsed, the compressors will be commanded to OFF followed by a changeover to pure Free Cooling operation to satisfy load requirements with minimum use of energy.
When the by-pass time for thermostatic control of the compressors has again elapsed, the requests will be re-assessed.

An antifreeze threshold is specified . It is based on the temperature value of external air to protect the heat exchanger when operating in a cold environment. If the temperature of external air is lower than the set threshold, the valve controlling water flow inside the Free Cooling exchanger will be commanded to open, and the main circulation pump will be enabled (if OFF). This pump moves the fluid and prevents the interior of the exchanger from freezing.

If the valve is a 0-10V type, the degree of opening will depend on the unit's operating status.

- with the machine OFF, opening to 100% of capacity will be commanded
- with the machine ON, opening to 10% of capacity will be commanded

If the valve is of the ON/OFF type, it will always open to maximum value irrespective of the unit's operating mode.
The entire procedure will finish as soon as the external air temperature reaches a fixed hysteresis of 1.0°C with respect to the set threshold.

16.4 Free Cooling disabling conditions

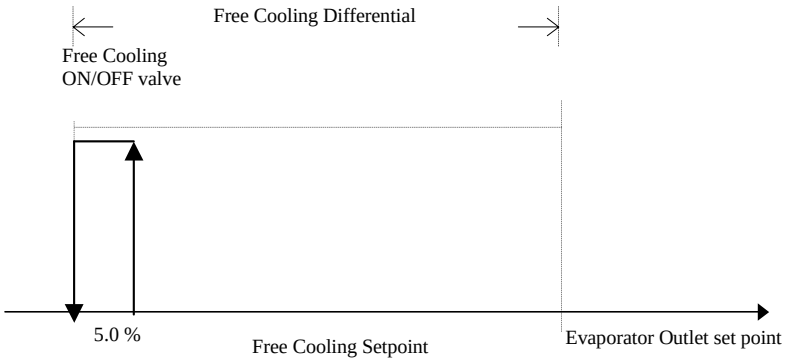
There are two main causes of the closure of the Free Cooling valve: the first depends on the external temperature conditions, and the second on thermostatic demand.
The Free Cooling valve will close if the Free Cooling conditions stop.

External T. ≤ Free Cooling Input T. – (Free Cooling Delta) + 1.5°C

The Free Cooling valve will close if the Free Cooling thermostat is satisfied.
For system safety, the reading of the water temperature probe a the evaporator outlet is checked.
According to the set thresholds, the following will be processed: an antifreeze pre-alarm, which will enable any post-heating heaters and totally disable the Free Cooling devices; and an antifreeze alarm which will totally disable the unit.
Other system safety devices : serious alarm from digital input, circulation pump thermal cutout, failed control probe, failed antifreeze control probe, evaporator flow-switch alarm, phase monitor alarm. These safety device will totally disabled the unit, and, therefore, stop the Free Cooling control.

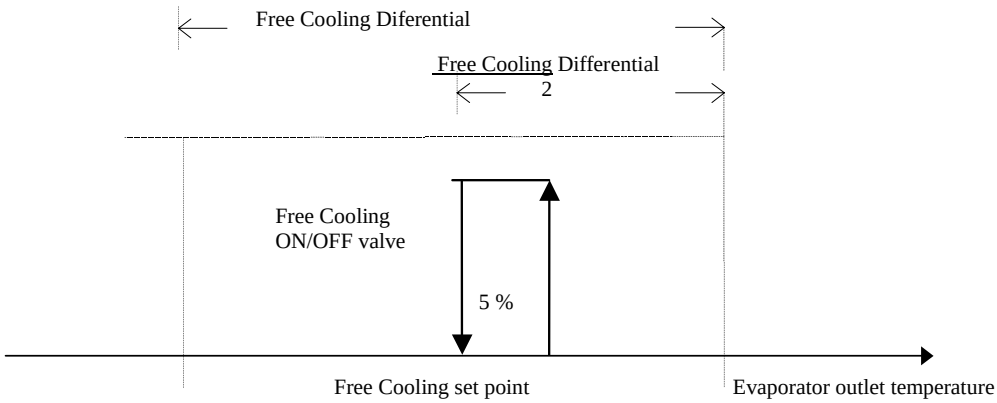
16.5 Free Cooling ON/OFF valve

Proportional control



If temperature conditions favour Free Cooling control, the Free Cooling ON/OFF valve will be activated as soon as temperature exceeds the activation threshold of the individual step, identified by a temperature value of:
Control Set point - Free Cooling Differential +5.0% Free Cooling Differential
The step amplitude is fixed at 5.0% of the set Free Cooling control differential.

Proportional + integral control



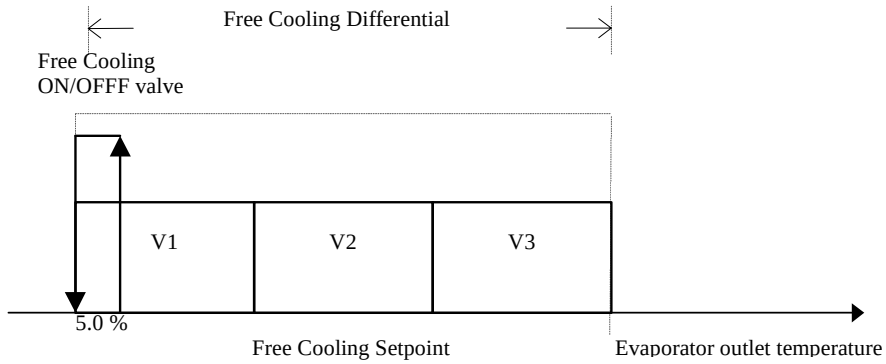
If temperature conditions favour Free Cooling control, the Free Cooling ON/OFF valve will be activated as soon as temperature exceeds the activation threshold of the individual step, identified by a temperature value of:

Control Set point + 5.0% Free Cooling Differential

The step amplitude is fixed at 5.0% of the Free Cooling control differential.

16.6 Free Cooling ON/OFF valve with stepped condensation

Proportional control

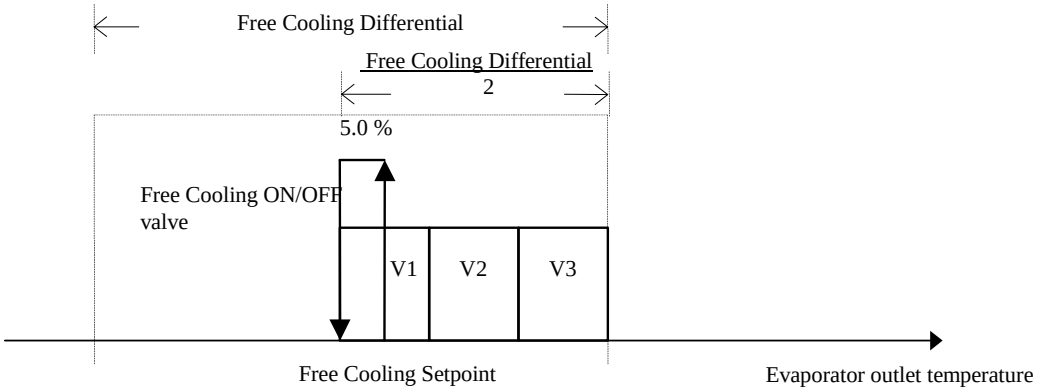


Here is an example of Free Cooling control with ON/OFF valve and three condensation steps.
The ON/OFF valve activation step will, in any case, be positioned in the first part of the control differential and will have an amplitude of 5.0% of the said differential. The activation steps of the condensation fans will be positioned proportionally inside the Free Cooling control differential. To calculate the amplitude of each step, use the following relation:

$$\text{Step amplitude} = \frac{\text{Free Cooling Differential}}{\text{(Number of Master fans X number of cards)}}$$

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

Proportional + integral control



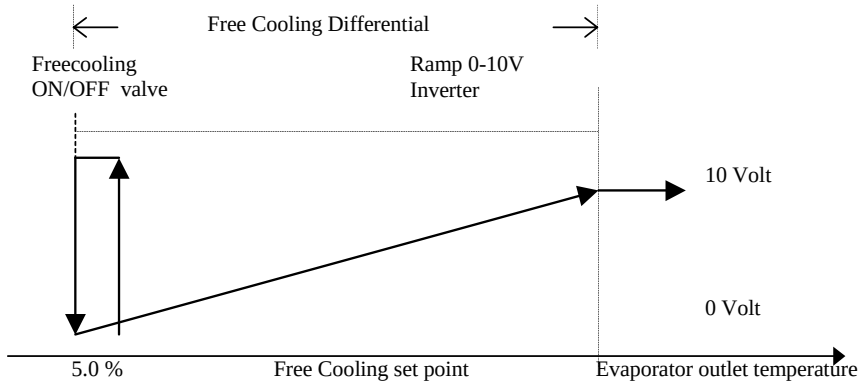
Here is an example of Free Cooling control with ON/OFF valve and three condensation steps.
The devices, whether they are valve or fans, will be activated in the second half of the control differential through the effect of the integrating control. Their activation will be tied to the set integrating constant: the slower it is, the greater the value attributed to the specific parameter.
The amplitude of the valve control step will be 5.50% of the said control differential.
The amplitude of the fan control steps will be calculated according to the following relation:

$$\text{Step amplitude} = \frac{\text{Free Cooling Differential}}{\text{(Number of Master fans X number of cards)}}$$

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

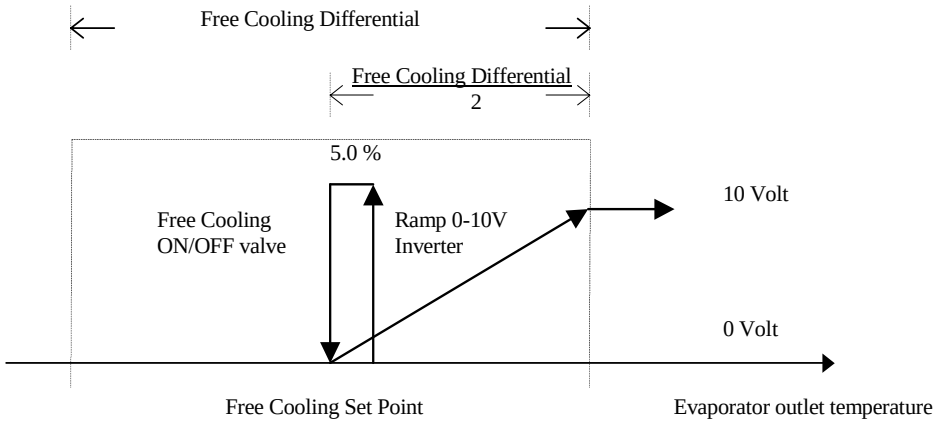
16.7 Free Cooling ON/OFF valve with inverter controlled condensation

Proportional control



The ON/OFF valve activation step will, in any case, be positioned in the first part of the control differential and will have an amplitude of 5.0% of the said differential. The proportional ramp for piloting the analogue control output of the condensation inverter will be calculated on the entire control differential. If necessary, Value 0-10 Volt can be further limited downward according to the minimum output voltage value set on the screen. All proportional outputs relating to the different units of the system will be piloted in parallel

Proportional + integral control

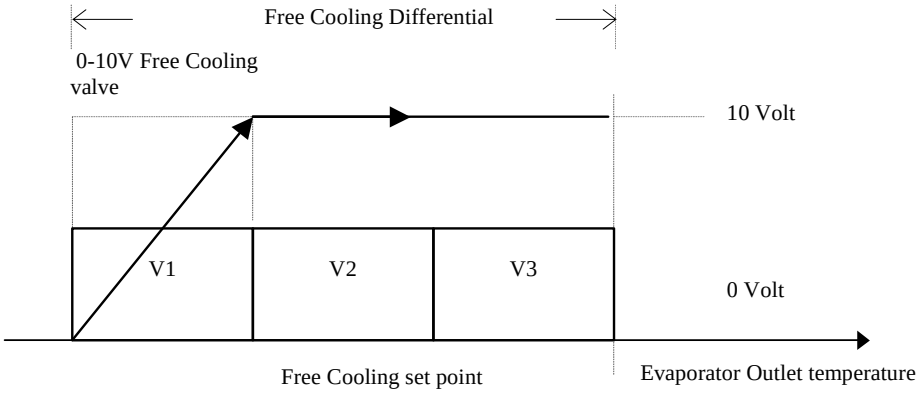


The devices, whether they are valve or fans, will be activated in the second half of the control differential through the effect of the integrating control. Their activation will be tied to the set integrating constant: the slower it is, the greater the value attributed to the specific parameter.
The amplitude of the valve control step will be 5.50% of the said control differential.
All proportional outputs relating to the different units of the system will be piloted in parallel

16.8 0-10 Volt Free Cooling ON/OFF valve

The Free Cooling valve is proportionally commanded in a different way depending on whether condensation control is in steps or by inverter.
The control diagrams of the two different situations are shown below.
0-10 Volt Free Cooling ON/OFF valve with stepped condensation

Proportional control

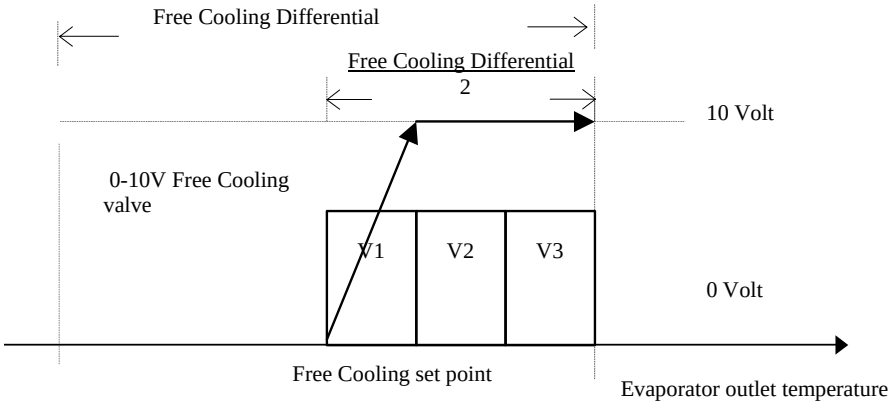


The proportional control ramp of the Free Cooling valve will be calculated inside the first activation step of the condensation fans. In this way, when the first fan is enabled, the valve will be completely open, and, therefore, water flow in the Free Cooling exchanger will be at maximum level.
The activation steps of the condensation fans will be positioned proportionally inside the Free Cooling control differential.
To calculate the amplitude of each step, use the following relation:

$$\text{Step amplitude} = \frac{\text{Free Cooling Differential}}{\text{(Number of Master fans X number of cards)}}$$

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

Proportional + integral control



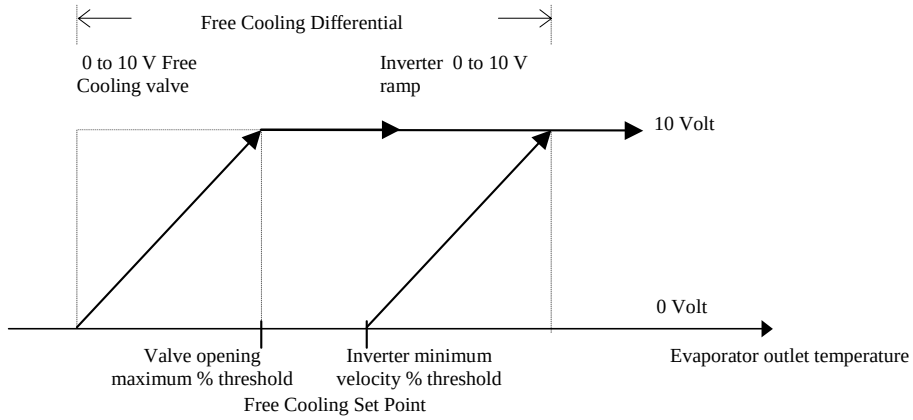
The devices, whether they are valve or fans, will be activated in the second half of the control differential through the effect of the integrating control. Their activation will be tied to the set integrating constant: the slower it is, the greater the value attributed to the specific parameter.
The proportional control ramp of the Free Cooling valve will be calculated inside the first activation step of the fans. In this way, when the first fan is enabled, the valve will be completely open, and, therefore, water flow in the Free Cooling battery (exchanger) will be at maximum level.
The activation steps of the fans will be positioned proportionally inside the Free Cooling control differential.
To calculate the amplitude of each step, use the following relation:

$$\text{Step amplitude} = \frac{\text{Free Cooling Differential}}{\text{(Number of Master fans X number of cards)}}$$

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

16.9 0-10 Volt Free Cooling valve with inverter controlled condensation

Proportional control



The control proportional ramp of the Free Cooling valve will be calculated inside the area determined by the thresholds:
Control Set point -Free Cooling Differential/2
Control Set point -Free Cooling Differential/2 + valve maximum opening % Threshold

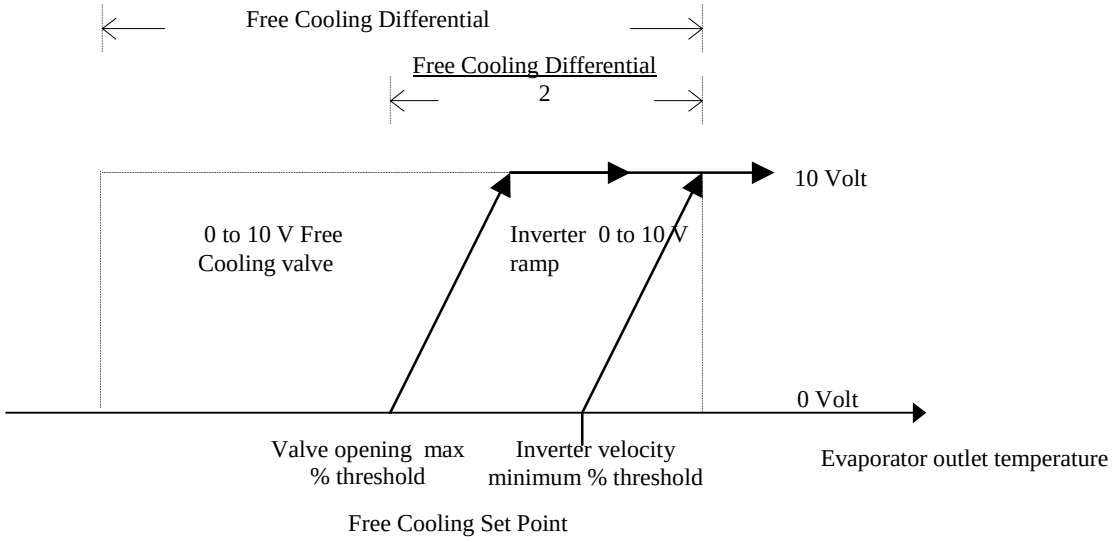
The control proportional ramp of the condensation inverter will be calculated inside the area determined by the thresholds:
Control Set point -Free Cooling Differential/2 + inverter speed minimum % Threshold
Control Set point + Free Cooling Differential/2

The start/end points of the two control ramps can be modified at the user's discretion by varying the value of the thresholds (see graph) as a percentage of the value of the set Free Cooling differential.
For the Free Cooling valve, the setting field ranges from 25 to 100% of the differential.
For the condensation inverter, the setting field ranges from 0 to 75% of the differential.

Example

Control set point	12.0°C
Free Cooling Differential	4.0°C
Free Cooling valve % threshold	40%
Condensation inverter % threshold:	80%
Proportional area for control of Free Cooling valve =	10.0 ÷ 11.6 °C
Control Set point - Free Cooling Differential/2 =	10.0°C
Maximum % threshold for valve opening =	1.6°C
Proportional area for control of condensation inverter =	13.2 ÷ 16.0 °C
Control Set point - Free Cooling Differential/2 =	10.0°C
Control Set point - Free Cooling Differential/2 + inverter speed minimum % Threshold =	13.2°C

Proportional + integral control



The devices, whether they are valve or fans, will be activated in the second half of the control differential through the effect of the integrating control.
This activation will be constrained by the set integrative constant. The greater the value assigned to the integration time, the slower the system's response.

17. Alarms

Alarms are divided into three categories:

- Warning-only alarms (only warning on display and buzzer, warning on display, buzzer, alarm relay)
- Circuit alarms (only disable relevant circuit, warning on display, buzzer, alarm relay)
- Serious alarms (disable whole system, warning on display, buzzer, alarm relay)

17.1 Serious alarms

- "No water flow" alarm
- Alarm: evaporator antifreeze with manual reset
- Serious alarm from digital input
- Phase monitor alarm
- Pump thermal cutout

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 Warning only alarms

- Unit maintenance alarm
- Compressor maintenance alarm
- Clock card faulty or disconnected alarm

17.4 Master unit alarm relay management

You may, at your discretion, decide whether or not to activate the master unit alarm relay when an alarm is received from the slave unit. This function is present in the following screen of the master unit user branch (board of auditors<d with address 1):

```
M_User59
+--------------------+
¦Alarms signalled
¦from slave board¦
¦                  ¦
¦MASTER-SLAVE      ¦
+--------------------+
```

If the parameter is configured as "MASTER-SLAVE", the master alarm relay is activated even if an alarm is received from the slaves, whereas, if you select "SLAVE ONLY", the relay is activated only if a master board alarm is present.

17.5 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 relays
- All compressor outputs

17.5.1 Description of operation

The alarm is based on the differential between high and low pressure probe readings If this differential drops below the set differential value, the alarm is signalled and the compressor is powered down, according to the set delay.

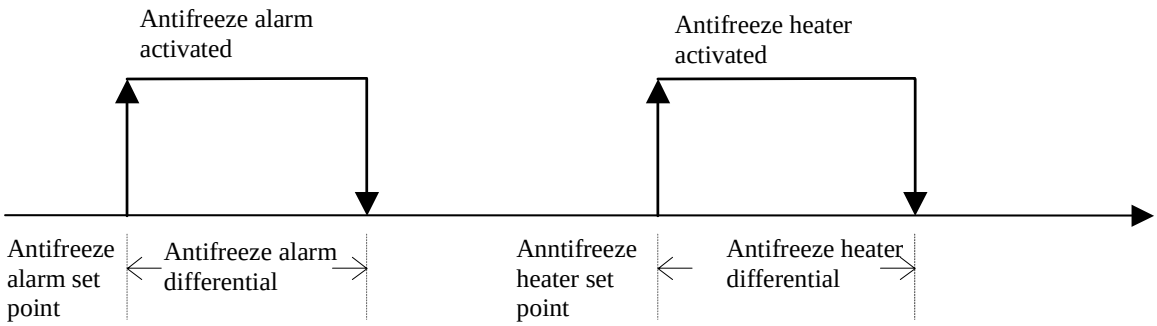
17.6 Antifreeze control

Inputs used:
- Water temperature at evaporator outlet
- Water temperature at condenser outlet

Parameters Used :
- Enable evaporator outlet probe
- Enable condenser outlet probe
- Antifreeze heater set point
- Antifreeze heater differential
- Antifreeze alarm set point
- Antifreeze alarm set point
- Forcing of main pump due to antifreeze alarm

Outputs used :
- Antifreeze heater
- General alarm relays
- All compressor outputs
- Main circulation pump

17.6.1 Description of operation



Every pCO unit is able to manage antifreeze control providing the water temperature probe at evaporator/condenser outlet is connected and enabled according to the type of unit being controlled.
Antifreeze control is always enabled, even if the machine is OFF, both in summer and winter operating modes. For type 5 machines with reversing of the water circuit, the antifreeze control always controls water temperature at evaporator outlet, shifting control to the evaporator or condenser according to the operating mode (summer-winter). The antifreeze alarms is a system alarm in multi-card systems. If present on any unit, it will totally shut down the machine. A control parameter is provided, which enables you to select whether to keep the main circulation pump ON or OFF in the event of an antifreeze alarm.

17.7 pCO alarms table

Code	Alarm description	OFF Compressors	OFF Fans	OFF Pump	OFF System	Reset	Delay	Separation
011	Serious Alarm	*	*	*	*	Manual		Mst/Slv
012	Phase Monitor Alarm	*	*	*	*	Manual		Mst/Slv
018	Evaporator Pump thermal Cutout	*	*	*	*	Manual		Mst
019	Condenser Pump thermal Cutout	*	*	*	*	Manual		Mst
013	Evaporator Flow-switch	*	*	*	*	Manual	Settable	Mst/Slv
014	Condenser Flow-switch	*	*	*	*	Manual	Settable	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 cutout	*				Manual		Mst/Slv
015	Oil Differential Pressure Switch	*	*			Manual	Settable	Mst/Slv
032	Low Pressure Differential	*				Manual	Settable	Mst/Slv
017	Low Pressure 2 Pressure-switch	*	*			Manual	Settable	Mst/Slv
016	High Pressure Pressure-switch	*	*			Manual		Mst/Slv
034	Low Transducer Pressure	*				Manual		Mst/Slv
033	High Transducer Pressure	*	*			Manual		Mst/Slv
021	Fan 1 Thermal cutout		*			Manual		Mst/Slv
022	Fan 2 Thermal cutout		*			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	B1 Probe Failed	*	*	*	*	Automatic	10 s	Mst
061	B2 Probe Failed	*	*	*	*	Automatic	10 s	Mst/Slv
062	B3 Probe Failed					Automatic	10 s	Mst/Slv
063	B4 Probe Failed					Automatic	10 s	Mst/Slv
064	B5 Probe Failed					Automatic	10 s	Mst/Slv
065	B6 Probe Failed					Automatic	10 s	Mst/Slv
066	B7 Probe Failed					Automatic	10 s	Mst/Slv
067	B8 Probe Failed					Automatic	10 s	Mst/Slv
041	32KB Clock Card Failed					Manual		Mst/Slv

17.8 Driver card alarms

Code	Alarm description	OFF Compressors	OFF Fans	OFF Pump	OFF System	Reset	Delay	Separation
101	Diver 1 probe error	*				Manual		Mst
102	Driver 1 stepped motor error	*				Manual		Mst/Slv
103	Driver 1 stepped motor error	*				Manual		Mst/Slv
104	Diver 1 battery error	*				Manual		Mst/Slv
105	High pressure on driver 1					Manual		Mst/Slv
1'6	Low pressure on driver 1					Manual		Mst/Slv
107	Low super-heat driver 1	*				Manual		Mst/Slv
108	Valve not shut while driver 1 being disabled	*				Manual		Mst/Slv
109	Driver 1 high intake temperature					Manual		Mst/Slv
110	Standby due to EEPROM /battery recharge / or open valve error, driver 1	*				Manual		Mst/Slv
111	LAN disconnected, driver 1	*				Manual		Mst/Slv
201	Diver 2 probe error	*				Manual		Mst
202	Driver 2 stepped motor error	*				Manual		Mst/Slv
203	Driver 2 stepped motor error	*				Manual		Mst/Slv
204	Diver 2 battery error	*				Manual		Mst/Slv
205	High pressure on driver 2					Manual		Mst/Slv
206	Low pressure on driver 2					Manual		Mst/Slv
207	Low super-heat driver 2	*				Manual		Mst/Slv
208	Valve not shut while driver 2 being disabled	*				Manual or		Mst/Slv
209	Driver 2 high intake temperature					Manual		Mst/Slv
210	Standby due to EEPROM /battery recharge / or open valve error, driver 2	*				Manual		Mst/Slv
211	LAN disconnected, driver 2	*				Manual		Mst/Slv

18. Alarm log

The alarms log function entails the storage of all alarm events occurring on a given pCO board. to this end, an optional serial addressing board must be installed, with an option providing a clock and a 32 KB memory (see the optional boards installation paragraph) enabling from-screen control for the board.

Each alarm is associated with an identifier code displayed on the alarm screens. This code will be saved and displayed during log questioning.

A circular data list consisting of a maximum of 250 elements is provided (250 = maximum number of storable alarms). When the maximum limit is reached, the oldest data-item will be overwritten.

Each stored alarm code will be accompanied by storage of the following: day-month-year of operation, inlet water temperature, outlet water temperature, high pressure, and low pressure. These values are measured at that moment, and are used to obtain a more or less indicative picture of the unit's operating conditions.

A procedure for total deletion of the log memory is available. This procedure is password protected and is used for unconditional deletion of stored data. The procedure may take a few minutes.
It is good practice to delete the alarms log memory when installing a new optional 32 KB board or when starting the unit for the first time.

Each unit has its own alarm log procedure. Therefore, in multi-board applications, every pCO board must be equipped with a 32KB optional board with clock.
For the sake of uniformity of the stored data (alarm operation date and time), the data referring to the master board will be used, irrespective of the slave address.

The following is a list of code-alarm description matches for all 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 Alarm serious from digital input
AL:012 Alarm phase monitor
AL:013 Alarm evaporator flowswitch
AL:014 Alarm Condenser flowswitch
AL:015 Alarm Oil level
AL:016 Alarm high pressure (pressure switch)
AL:017 Alarm low pressure (pressure switch)
AL:018 Thermal cut-out evaporator pump
AL:019 Thermal cut-out condenser pump
AL:020 Thermal cut-out compressor
AL:021 Thermal cut-out condensation fan 1
AL:022 Thermal cut-out condensation fan 2
AL:031 Alarm antifreeze
AL:032 Alarm low pressure differential pressure values
AL:033 Alarm high pressure (transducer)
AL:034 Alarm low pressure (transducer)
AL:035 Alarm high delivery pressure
AL:036 Alarm high voltage
AL:037 Alarm high current
AL:041 32KB clock board failed or not connected
AL:051 Maintenance condenser pump
AL:052 Maintenance condenser pump
AL:053 Maintenance compressor
AL:060 Probe B1 Failed or not connected
AL:061 Probe B2 Failed or not connected
AL:062 Probe B3 Failed or not connected
AL:063 Probe B4 Failed or not connected
AL:064 Probe B5 Failed or not connected
AL:065 Probe B6 Failed or not connected
AL:066 Probe B7 Failed or not connected
AL:067 Probe B8 Failed or not connected
AL:101 Error Probe driver 1
AL:102 Error EEPROM driver 1
AL:103 Error stepped motor driver 1
AL:104 Error battery driver 1
AL:105 Alta pressure (MOP) driver 1
AL:106 Low pressure (LOP) driver 1
AL:107 Alarm low super-heat driver 1
AL:108 Valve not closed at power-down driver 1
AL:109 Alta intake temperature driver 1
AL:110 Awaiting EEPROM error/ battery charged or valve open driver 1
AL:111 Lan disconnected driver 1
AL:201 Error probe driver 2
AL:202 Error EEPROM driver 2
AL:203 Error stepped motor driver 2
AL:204 Error battery driver 2
AL:205 High pressure (MOP) driver 2
AL:206 Low pressure (LOP) driver 2
AL:207 Alarm low super-heat driver 2
AL:208 Valve not closed at power-down driver 2
AL:209 Intake high temperature driver 2
AL:210 Await EEPROM error/ battery charged or valve open driver 2
AL:211 Lan disconnected driver 2

19. First start-up

A single program EPROM is provide. It is valid for master and slave boards and recognises correct operating mode according to the address of the pCO board where it is installed. When inserting a new EPROM on the pCO board the default values must be installed. There is an automatic installation procedure for the default values. It is based on the difference between the stored date and version values of the software. If using Carel drivers for the electronic expansion valve: during the installation of the default values, the drivers must be powered and connected to the pLAN network, otherwise they will not be initialised.

19.1 Installation of default values

19.1.1 pCO board

This procedure entails unconditional deletion of the pCO board memory and the installation of Carel's values for initial operation of the machine. Any previous setting will be irretrievably lost.

ATTENTION!: This operation should be repeated also if replacing the EPROM or the pCO board, or for any other modification to the hardware system which may compromise the software.

Before carrying out this operation, make sure that any drivers connected to the network are powered, otherwise they will not be initialised at this stage and could, therefore, operate incorrectly. Press the MENU and PROG keys simultaneously.

```
M_Pw_Manuf
+--------------------+
¦Type in U password: ¦
¦constructor         ¦
¦                    ¦
¦               0000 ¦
+--------------------+
```

After you have inserted the correct password, you enter the following screen:

```
M_Manuf245
+--------------------+
¦Delete U memory:    ¦
¦Install global      ¦
¦default values     N¦
¦                    ¦
+--------------------+
```

Move around the Y/N field, pressing ENTER and select Y - the installation will be completed when the words "Please wait…" disappear. We advise you to switch off and then switch on the pCO board. In this way, all internal containers of the board will be reset, and the set data will become effective. If using the 32KB clock board for logging the alarms, we advise you to delete the alarm log memory; non-significant data could be contained in it, especially if the board is new. The procedure must be carried out separately from the maintenance branch protected by password, only if the clock board is enabled.

19.1.2 EXV Driver

Before initialling the drivers: access the set of constructor screens dedicated to the drivers and access the configuration parameters of the driver you require.

When you reach the screen

Each pCO card manages a maximum of two drivers. As they all have the same configuration, this section illustrates only one.

- when you have selected the pCO unit to be configured, simultaneously press the "menu" and "prog" keys (as seen before), and type in the password - you have now reached the constructor loop.
- Scroll through the screens with the "down arrow" key, until you reach the first configuration screen for driver:

```
m_manuf_45
+--------------------+
¦Unit settings       ¦
¦No.local drivers  2 ¦
¦No.compressors    1 ¦
¦                    ¦
+--------------------+
```

This screen is used to set the number of drivers connected to the pCO board you are configuring.

- Scroll through the screens with the "down arrow" key, until you reach the driver configuration screens :

To access the configuration branch, type in password :

```
manuf_pw_drv
+--------------------+
¦Insert             ¦
¦password EXV driver ¦
¦constructor         ¦
¦               0000 ¦
+--------------------+
```

When you have typed in the password, you enter the "constructor" configuration branch:

```
m_Manuf_Drv1_1
+--------------------+
|Parameters   D:1 U:1|
|Valve type          |
|CUSTOM              |
|Battery presence   N|
+--------------------+
```

The type of valve and battery presence are set on this first screen. These are the possible valves:

- Alco (EX5, EX6, EX7, EX8)
- Sporlan (SEI 0.5, SEI 1, SEI 2, SEI 3.5, SEI 6, SEI 8,5, SEH 100, SEH 175, SEH 250)
- Danfoss (ETS50, ETS100)
- Carel EVD200
- Custom Valve

```
m_Manuf_Drv1_2
+-------------------+
|Parameters    D:1 U:1|
|                     |
|Percentage ratio     |
|cir./EEV        000%|
+-------------------+
```

This indicates the ratio, as a percentage, between the maximum refrigerating capacity of the circuit controlled by the EVDriver and the capacity obtainable through maximum opening of the expansion valve, *under the same operating conditions.* Operating conditions are all the system variables which influence the refrigerating yield of both the system and the valve (condensation temperature, subcooling, superheating, loss of load,….)

```
m_Manuf_D1_Ch1
+-------------------+
|Parameters-CH D:1 U:1|
|                     |
|Sheat set.    00.0°C|
|SH Dead band   0.0°C|
+-------------------+
```

Set point for superheating control. We advise you not to use values below 3°C
Superheating control dead band. Control is not enabled for temperatures in the range *Sheat Set – SH Dead band and Sheat Set + SH Dead band* For example, a dead band value of 1°C, with a set point of 5°C, means that superheating can vary from 4°C and 6°C without the control attempting to change it. The algorithm resumes controlling outside that range. We advise you not to use values of over 2°C
Attention: Suffix -CH means that these parameters are used for chiller operation. These parameters must be configured also for heat pump and defrosting operation.

```
m_Manuf_D1_Ch2
+-------------------+
|Parameters-CH D:1 U:1|
|Prop. gain     00.0 |
|Int.Time       000 s|
|Deriv.Time     000 s|
+-------------------+
```

Constants used for PID control of the EVDriver. The respectively represent the following:

- Proportional gain
- Integrating time constant
- Derivative time constant

Skip the next screens until you reach this screen:

```
m_Manuf_Drv_7
+-------------------+
|Parameters COMM  U:1|
|Evap.Pressure Probe |
|Min.threshd. 00.0bar|
|Max.threshd. 00.0bar|
+-------------------+
```

This screen shows the minimum and maximum values of the refrigerant pressure probe range at the outlet of the evaporator connected to the driver.
If the default values do not match those of the pressure probe being used, change them, by setting the values provided by the probe manufacturer.
The minimum configuration of the driver has been completed.

19.2 Power-up and power-down of machine

There two power-up and power-down modes for the machine:

1. Power-up and power-down of System
2. Power-up and power-down of Circuit

Machine status can be controlled from the keyboard, from digital input (enablable), of from the supervisor (enablable). The power-up/power down operation with the ON/OFF key on the keyboard has absolute priority. When this key is pressed, the green LED (ON or OFF) near the key will indicate the current status. The machine can be powered up or down from the supervisor and/or the digital input, only if it was powered up from the keyboard. Any power-down from the supervisor or digital input will be signalled by the flashing of the green LED on the ON/OFF key and by a special wording on the main menu screen.

19.2.1 Power-up and power-down of System

Control is by the master board : if the board is powered up, it will power up also all the system's slaves, and vice-versa if OFF.

19.2.2 Power-up and power-down of Circuit

Control is by the slave board : the individual slave boards can be powered up or down from the supervisor/digital input, only if the master card is ON.

20. User Interface

20.1 Parameters Table

N.	Description	Master/Slave	Default	Limits
	Constructor parameters :			
1	Unit type configuration (see inputs/outputs table)	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	Probe type selection: No.5	Mst	NONE	NONE/EXTENAL SETPOINT/VOLTAGE/CURRENT
12	Delivery temperature probe type selection: No.5	Mst/Slv	0/1 V	0/1 V - 420 mA
13	Minimum limit of probe No.5	Mst/Slv	0.0	-999.9÷999.9
14	Maximum limit of probe No.5	Mst/Slv	0.0	-999.9÷999.9
15	Scale begins: delivery temperature probes	Mst/Slv	-30.0°C	-999.9-999.9 °C
16	Scale ends: delivery temperature probes	Mst/Slv	150.0°C	0-999.9°C
17	Scale begins: high temperature probes (4mA)	Mst/Slv	0.0 bar	0-999.9 bar
18	Scale ends: high pressure probes (20mA)	Mst/Slv	30.0 bar	0-999.9 bar
19	Scale begins: low temperature probes (4mA)	Mst/Slv	-0.5 bar	-99.9-99.9 bar
20	Scale ends: low pressure probes (20mA)	Mst/Slv	7.0 bar	-99.9-99.9 bar
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 starting restrictions	Mst/Slv	N.	Y/N
31	Low pressure limit at start	Mst/Slv	6.0 bar	0-99.9 bar
32	High pressure limit at start	Mst/Slv	18.0 bar	0-99.9 bar
33	Equalised pressure threshold	Mst/Slv	13.0 bar	0-99.9 bar
34	Compressor minimum ON time	Mst/Slv	60 s	0-9999 s
35	Compressor minimum 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 same compressor	Mst/Slv	450 s	0-9999 s
38	Configuration of capacity control relays for first capacity control	Mst	ON/OFF/OFF Remote ON/OFF	ON/OFF
39	Configuration of capacity control relays for second capacity control	Mst	ON/OFF/ON	ON/OFF
40	Configuration of capacity control relays for third capacity control	Mst	OFF/ON/OFF	ON/OFF
41	Configuration of capacity control relays for fourth capacity control	Mst	OFF/OFF/OFF	ON/OFF
42	Enable special management at first capacity control	Mst/Slv	N.	Y/N
43	Time between opening of liquid solenoid and compressor	Mst/Slv	10 s	0-9999 s
44	Time between first and second capacity controls	Mst/Slv	25 s	0-9999 s
45	Time between second and third capacity controls	Mst/Slv	300 s	0-9999 s
46	Time between third and fourth capacity controls	Mst/Slv	300 s	0-9999 s
47	Stand-by configuration of capacity control relays for continuous capacity control	Mst	OFF/ON	ON/OFF
48	Discharging configuration of capacity control relays for continuous capacity control	Mst	ON/ON	ON/OFF
49	Charging configuration of 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	Discharging impulse minimum duration	Mst/Slv	1.5 s	0.0-99.9 s
52	Discharging impulse maximum duration	Mst/Slv	3.0 s	0.0-99.9 s
53	Charging impulse minimum duration	Mst/Slv	1.5 s	0.0-99.9 s
54	Charging impulse maximum duration	Mst/Slv	3.0 s	0.0-99.9 s
55	Forced discharging time at compressor start	Mst/Slv	30 s	0-999 s
56	Enable forcing when solenoids discharged with compressor OFF	Mst/Slv	N.	Y/N
57	Enable pump - down	Mst/Slv	N.	Y/N
58	Minimum pump - down time	Mst/Slv	50 s	0-999 s
59	Configuration of compressor forced capacity control stage	Mst/Slv	MINIMUM POWER	MINIMUM / MAXIMUM POWER
60	Select high condensation prevention control for compressor forced capacity control	Mst/Slv	PRESSURE	PRESSURE / TEMPERATURE
61	Enable compressor forced capacity control for high condensation	Mst/Slv	N.	Y/N
62	High pressure threshold for forced capacity control	Mst/Slv	20.0 bar	0.0÷99.9
63	High pressure differential for forced capacity control	Mst/Slv	2.0 bar	0.0÷99.9
64	Enable compressor forced capacity control for high delivery temperature	Mst/Slv	S	Y/N
65	High delivery temperature threshold for forced capacity control	Mst/Slv	90.0°C	0.0-999.9 °C
66	High delivery 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

N.	Description	Master/Slave	Default	Limits
68	Antifreeze temperature differential for forced capacity control	Mst/Slv	1.0°C	0.0-99.9 °C
69	Enable condensation	Mst/Slv	NONE	NONE /PRESSURE/TEMPERATURE
70	Type of condensation devices	Mst/Slv	INVERTER	STEPS/INVERTER
71	Number of condensation fans	Mst/Slv	1	1÷2
72	Condensation set point	Mst/Slv	14.0 bar	0.0-999.9 bar
73	Condensation differential	Mst/Slv	2.0 bar	0.0-999.9 bar
74	Volts at maximum inverter speed	Mst/Slv	10.0 V	0.0 - 10.0 V
75	Volts 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 evaporator flow-switch alarm	Mst/Slv	N.	Y/N
78	Enable condenser flow-switch alarm	Mst/Slv	N.	Y/N
79	Delayed start due to evaporator flow-switch alarm	Mst	15 s	0-99 s
80	Delayed steady state operation due to evaporator flow-switch alarm	Mst	3 s	0-99 s
81	Delayed start due to condenser flow-switch alarm	Mst	15 s	0-99 s
82	Delayed start due to condenser flow-switch alarm	Mst	3 s	0-99 s
83	High delivery temperature alarm set-point	Mst/Slv	120.0°C	0.0-999.9 °C
84	High delivery temperature alarm differential	Mst/Slv	5.0°C	0.0-99.9 °C
85	High pressure alarm set-point	Mst/Slv	21.0 bar	0.0-99.9 bar
86	High pressure alarm differential	Mst/Slv	2.0 bar	0.0-99.9 bar
87	Low pressure alarm set-point	Mst/Slv	1.0 bar	-99.9-99.9 bar
88	Low pressure alarm differential	Mst/Slv	0.5 bar	-99.9-99.9 bar
89	Enable low pressure differential alarm	Mst/Slv	N.	Y/N
90	Low pressure differential alarm set-point	Mst/Slv	6.0 bar	0.0-99.9 bar
91	Low pressure differential alarm differential	Mst/Slv	2.0 bar	0.0-99.9 bar
92	Delayed start due to low pressure alarm	Mst/Slv	40 s	0-999 s
93	Delayed steady state operation due to low pressure alarm	Mst/Slv	0 s	0-999 s
94	Delayed start due to oil differential alarm	Mst/Slv	120 s	0-999 s
95	Delayed steady state operation due to oil differential alarm	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 set point	Mst/Slv	1.0°C	-99.9-99.9 °C
102	Selection of circulation pump control mode if antifreeze alarm activated	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 setpoint	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	Cycle reversing valve logic	Mst/Slv	N.O.	N.C / N.O.
108	Freecooling valve type (ON/OFF; modulating 0/10 V)	Mst	0/10V	ON-OFF - 0/10V
109	Defrosting probes configuration	Mst/Slv	TEMPERATURE	PRESSURE SWITCHES TEMPERATURE PRESSURE
110	Overall defrosting configuration	Mst/Slv	SIMULTANEOUS	INDEPENDENT SIMULTANEOUS SEPARATE
111	Enable 32KB clock board for alarms 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 identifier	Mst/Slv	1	1÷200
114	Reset all parameters and install default values	Mst/Slv	N.	Y/N
115	Select other constructor password	Mst/Slv	1234	0÷9999
	User parameters			
116	Summer set point upper limit	Mst	17.0°C	-99.9-99.9 °C
117	Summer set point lower limit	Mst	7.0°C	-99.9-99.9 °C
118	Winter set point upper limit	Mst	50.0°C	-99.9-99.9 °C
119	Winter set point lower limit	Mst	40.0°C	-99.9-99.9 °C
120	Type of control	Mst	OUTLET	INLET /OUTLET
121	Type of inlet control to select control probe : water inlet (P/P) water outlet (neutral zone)	Mst	PROPORTIONAL	PROPORTIONAL / PROPORTIONAL + INTEGRAL
122	Integration time (PI control at inlet case)	Mst	600 s	0-999 s
123	Summer threshold for forced power-down inOFF steps with control at outlet. (chiller operation, prevents antifreeze alarm)	Mst	10.0°C	-99.9-99.9 °C
124	Winter threshold for forced power-down in OFF steps control at outlet (Heat pump operation)	Mst	40.0°C	-99.9-99.9 °C
125	Temperature control band	Mst	30.0°C	0.0-99.9 °C
126	Neutral zone for control of continuous capacity control	Mst/Slv	1.0°C	0.0-99.9 °C
127	Minimum time between activation of pump/fan and activation of compressors	Mst	5 s	0-999 s
128	Delayed power down of pump/fan	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 summer / winter from digital input	Mst	N.	Y/N
132	Enable summer / winter from supervisor	Mst	N.	Y/N

N.	Description	Master/Slave	Default	Limits
133	Frecooling Control setpoint offset	Mst	5.0°C	0.0-99.9 °C
134	Temperature delta for activating freecooling	Mst	2.0°C	0.0-99.9 °C
135	Temperature differential for controlling fans in freecooling mode	Mst	3.0°C	2-99.9 °C
136	Maximum threshold to open freecooling valve	Mst/Slv	50 %	25÷100%
137	Minimum threshold for Freecooling inverter speed	Mst/Slv	50%	0÷75%
138	Start of defrosting threshold	Mst/Slv	2.0°C	-99/99
139	End of defrosting threshold	Mst/Slv	12.0°C	-99/99
140	Drip-off time	Mst/Slv	10 s	0-999 s
141	Minimum time between defrosting operations	Mst/Slv	1800 s	0-30000 s
142	Maximum defrosting time	Mst/Slv	300 s	0-30000 s
143	Configure compressor operation for cycle reversing	Mst/Slv	CMP ON	CMP ON / CMP OFF START / CMP OFF STOP / CMP OFF START-STOP
144	Display slave board alarm	Mst	Master-Slave	Master-Slave/Slave
145	Select other user password	Mst/Slv	1234	0÷9999
	Maintenance parameters			
146	Duty hours threshold for evaporator pump	Mst	10000	0÷999999
147	Duty hours threshold for condenser pump	Mst	10000	0÷999999
148	Duty hours threshold for compressor	Mst/Slv	10000	0÷999999
149	Enable software filter to protect against electromagnetic noise	Mst/Slv	N.	Y/N
150	Delay filters on analogue inputs	Mst/Slv	5 s	0-9 s
151	Delay filters on digital inputs	Mst/Slv	1 s	0-9 s
152	Setting probe B1	Mst/Slv	0.0	-9.9÷9.9
153	Setting probe B2	Mst/Slv	0.0	-9.9÷9.9
154	Setting probe B3	Mst/Slv	0.0	-9.9÷9.9
155	Setting probe B4	Mst/Slv	0.0	-9.9÷9.9
156	Setting probe B5	Mst/Slv	0.0	-9.9÷9.9
157	Setting probe B6	Mst/Slv	0.0	-9.9÷9.9
158	Setting probe B7	Mst/Slv	0.0	-9.9÷9.9
159	Setting probe B8	Mst/Slv	0.0	-9.9÷9.9
160	Enable compressor No.1	Mst	S	Y/N
161	Enable compressor No.2	Mst	S	Y/N
162	Enable compressor No.3	Mst	S	Y/N
163	Enable compressor 4	Mst	S	Y/N
164	Total deletion of alarm log memory		N.	Y/N
165	Select other maintenance password	Mst/Slv	1234	0÷9999
	Set-point parameters			
166	Summer control set-point	Mst	12.0°C	Minimum / maximum set limits
167	Winter control set-point	Mst	45.0°C	Minimum / maximum set limits
168	Summer double set-point	Mst	12.0°C	Minimum / maximum set limits
169	Winter double set point	Mst	45.0°C	Minimum / maximum set limits
	Clock parameters :			
170	Hour setting	Mst/Slv		0÷23
171	Minute setting	Mst/Slv		0÷59
172	Day setting	Mst/Slv		0÷31
173	Month setting	Mst/Slv		0÷12
174	Year setting	Mst/Slv		0÷99

21. Driver configuration parameters

21.1 Constructor parameters

N.	Parameter	Meaning
1	Type of valve	Type of electronic valve connected to EVDriver • Alco (EX5, EX6, EX7, EX8) • Sporlan (SEI 0.5, SEI 1, SEI 2, SEI 3.5, SEI 6, SEI 8,5, SEH 100, SEH 175, SEH 250) • Danfoss (ETS50, ETS100) • Carel EVD200 • Custom Valve
2	Battery presence	Informs the driver whether or not battery is present If the battery is not present, the driver no longer manages the relevant alarms and tests.
3	Percentage ratio Circ./EEV	Ratio, as a percentage, between the maximum refrigerating capacity of the circuit controlled by the EVDriver and the capacity obtainable through maximum opening of the expansion valve, *under the same operating conditions.* Operating conditions are all the system variables which influence the refrigerating yield of both the system and the valve (condensation temperature, subcooling, superheating, loss of load,….)
4	Sheat set	Superheat set-point (required superheating temperature)
5	SH Dead zone	Superheating control dead band. Control is not enabled for temperatures in the range *Sheat Set – SH Dead band and Sheat Set + SH Dead band* For example, a dead band value of 1°C, with a set point of 5°C, means that superheating can vary from 4°C and 6°C without the control attempting to change it. The algorithm resumes controlling outside that range. We advise you not to use values of over 2°C
6	Prop. Gain	Proportional constant used for PID control of EVDriver. Also defines the gain of all active protective devices of EVDriver (LOW Sheat protection, LOP protection, MOP protection, HiTcond protection).
7	Int. time	Integrative constant used for PID control of EVDriver.
8	Deriv. time	Derivative constant used for PID control of EVDriver.
9	Low SH protection	Low superheating threshold This parameter defines the intervention threshold of the low superheating protective device: below this value, an integral *additional* control with settable constant begins (see the next parameter)
10	Low superheat threshold integral time	Integration constant for low superheat protection. N.B.: If the parameter is on zero, the function is completely disabled.
11	LP threshold	Intake low pressure threshold in saturated C°. This parameter defines the intervention threshold of the low pressure protective device: below this value, an integral control with settable constant begins (see the next parameter) to maintain temperature above the set value. This threshold also determines the start of the timer for the INTAKE LOW PRESSURE alarm
12	Integral time LOP	Integration constant for low pressure protection. N.B.: If the parameter is on zero, the function is completely disabled.
13	MOP threshold	Intake high pressure threshold (Maximum Operating Pressure) in saturated C°. This parameter defines the intervention threshold of the high pressure protective device: below this value, an integral control with settable constant begins (see the next parameter) to take back and maintain intake saturated temperature under the set value. This threshold also determines the start of the timer for the INTAKE HIGH PRESSURE alarm
14	Integral time MOP	Integration constant for high pressure protection. N.B.: If the parameter is on zero, the function is completely disabled.
15	Delayed MOP alarm at start	Time out after start of unit due to intervention of the (MOP) high pressure protective device. This allows correct starting with evaporation pressure above the threshold value assigned to MOP.
16	High Tcond threshold	High condensation pressure threshold in saturated C°. This parameter defines the intervention threshold of the condensation high pressure protective device: below this value, an integral control with settable constant begins (see the next parameter) to take back and maintain condensation saturated temperature under the set value.
17	High Tcond threshold integral time	Integration constant for condensation high pressure protection. N.B.: If the parameter is on zero, the function is completely disabled.
18	High intake temperature threshold	Maximum permitted temperature for gas exiting the evaporator. The controlled value is therefore that measured by the temperature probe and read by the EVDriver. This parameter limits the action of the MOP protective device (see parameter 13) so that, when this value is reached, the corrective action of the protective device is completely disabled until refrigerant temperature returns to below set value.
19	Refrigerant	Type of gas used in the circuit
20	Custom Valve Config: Minimum steps	Minimum number of steps for controlling the electronic valve. This parameter is used only if the valve connected to the EVDriver is a custom valve.
21	Custom Valve Config: Maximum steps	Maximum number of steps for controlling the electronic valve. This parameter is used only if the valve connected to the EVDriver is a custom valve.
22	Custom Valve Config: Closing steps	Number of steps set for the valve in the event of closing (due to power-down of unit or error) This parameter is used only if the valve connected to the EVDriver is a custom valve.
23	Custom Valve Config: Return steps	Number of return (re-opening) steps following complete closure of the valve. This value is useful for decompressing any closure spring inside the valve or for avoiding circuit sealing and thus enabling equalisation of the refrigerant circuit (single-phase compressor). This parameter is used only if the valve connected to the EVDriver is a custom valve.
24	Custom Valve Config: ExtraSteps opening	Enabling of the steps recovery procedure at opening. This parameter is used only if the valve connected to the EVDriver is a custom valve.
25	Custom Valve Config: Closing ExtraSteps	Enabling of the steps recovery procedure at closing. This parameter is used only if the valve connected to the EVDriver is a custom valve.
26	Custom Valve Config: Movement current	Current for feeding the motor phase of the electronic valve. This parameter is used only if the valve connected to the EVDriver is a custom valve.
27	Custom Valve Config: Stopping current	Stopped motor phase current of electronic valve. This parameter is used only if the valve connected to the EVDriver is a custom valve.
28	Custom Valve Config: Frequency	Positioning steps execution frequency of expansion valve. This parameter is used only if the valve connected to the EVDriver is a custom valve.
29	Custom Valve Config: Duty cycle	Maximum movement time percentage allowed for valve. This parameter is used only if the valve connected to the EVDriver is a custom valve.
30	Evaporation pressure probe minimum threshold	This screen shows the minimum range value of the refrigerant pressure probe at the outlet of the evaporator connected to the driver.
31	Evaporation pressure probe maximum threshold	This screen shows the maximum range value of the refrigerant pressure probe at the outlet of the evaporator connected to the driver.
32	Delay low super heat low alarm	Delay low superheat alarm When the threshold has been exceeded, the set time must elapse before the alarm is tripped.

N.	Parameter	Meaning
33	Delay high temperature intake alarm	Delay high intake temperature alarm When the threshold has been exceeded, the set time must elapse before the alarm is tripped.
34	Delay LOP alarm	Delay low pressure alarm When the threshold has been exceeded, the set time must elapse before the alarm is tripped.
35	Delay MOP alarm	Delay high pressure alarm When the threshold has been exceeded, the set time must elapse before the alarm is tripped.

21.1.1 Maintenance Parameters

.N.	Parameter	Meaning
36	EEV position	Type of control of EVDriver (automatic/manual)
37	Opening steps	Number of valve opening steps, with manual control

21.1.2 I/O parameters

.N.	Parameter	Meaning
38	Valve position	Indicates the number of opening steps the valve must reach.
39	SuperHeat	Current super-heat value
40	Evap. time	Evaporation saturated temperature (calculated on evaporation pressure)
41	Intake time	Superheat temperature probe reading
42	Evap. Press.	Evaporation pressure probe reading
43	Cond press.	Condensation pressure value (if probe configured)
44	Cond. time	Condensation temperature value (if condensation pressure probe configured)
45	Battery status	Battery status : 0 → disconnected 1 → high internal resistance 2 → time charging period 3 → discharged 4 → good 5 → operating 6 → Incomplete charging
46	Battery resistance	Battery resistance value
47	Battery voltage	Battery voltage.
48	Battery capacity	Battery residual capacity (as a percentage value)

21.1.3 Special function "Ignore"

```
+--------------------+
|Status:driver 1  U:1|
|                    |
|Valve not closed    |
|Ignore? N           |
+--------------------+
```

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

- an open valve → during the last blackout, the valve was not shut completely
- battery charge → the battery is not operating correctly or it is discharged or disconnected
- EEPROM restart → malfunctioning EEPROM

When one of these conditions is active, the following alarm appears:

```
+--------------------+
|AL:110              |
|D1:Wait for error   |
|eeprom/batt.chrg.or |
|open valve          |
+--------------------+
```

With the "Ignore" function, these alarms can be ignored to enable the driver to control the valve (otherwise the driver would keep the valve shut). ATTENTION! cancelling the alarms means ignoring them, and, therefore, we advise you to carefully check that the system is not damaged, is not malfunctioning or does not become unreliable (e.g.: if "recharge battery" is signalled, this probably means that the battery is not charged or not connected, etc. In the event of a blackout, this may not allow the valve to close. The valve would therefore stay shut even when the system restarts.
If none of the three above alarms is present, the screen changes over to the next screen:

```
+--------------------+
Driver 1 status
¦                    ¦
No fault
¦                    ¦
+--------------------+
```

21.2 Driver control

The control algorithm offers the following functions:

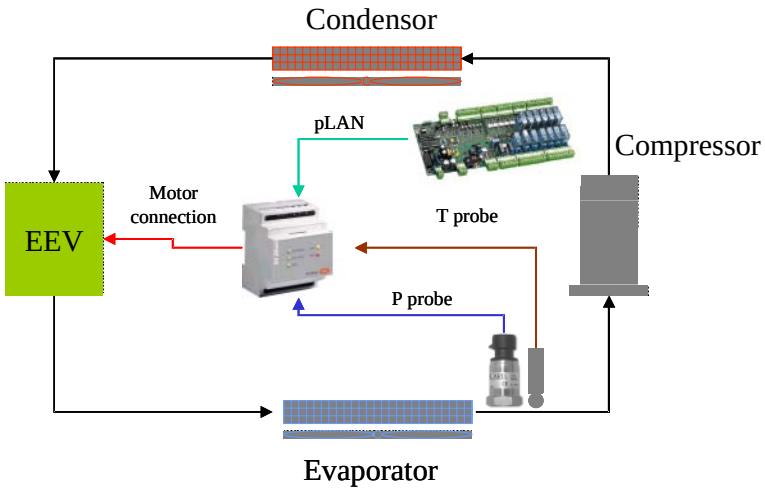
- *superheating control (super-heat mode)*: under normal system operating conditions, superheating is maintained fixed and equal to the set-point value.
- intake *pressure control* (*Pressure mode),* under overloaded or underloaded conditions. These conditions are measured when pressure exceeds the set limits for MOP (Maximum Operating Pressure) or LOP (Lowest Operating Pressure). Under these conditions, the driver tires to return pressure within MOP and LOP limits.
- *Diagnostics, alarms*. The driver is able to recognise the different alarm situations (see relevant paragraph).

The control algorithm ensures that pCO board managing the circuit communicates to the driver the capacity control status of the compressors whenever they are varied. In this way, the driver is able to recognise the active refrigerating power and can therefore position the valve in the position which *nominally* corresponds to this power (according to a characteristic curve of the valve). In this way, the algorithm is able to promptly react to sudden variations (enabling of compressor capacity controls) of capacity. When it has been positioned, the valve is automatically controlled according to the measures taken by the control probes.

By improving and stabilising the flow of refrigerant to the evaporator, we increases the system's overall performance, while guaranteeing safety (low pressure pressure switch less frequently tripped, fewer returns of liquid refrigerant to the compressor,…). Furthermore, if the EEV is correctly sized, use of condensation pressure (or evaporation pressure,) either floating or at low set point, considerably increases the system's efficiency, while ensuring lower energy consumption and greater refrigerating yield.

It is versatile, because the electronic expansion valve makes it possible to serve refrigerating units with a lower refrigerating capacity and in operating conditions which may differ considerably from each other.

Using an expansion valve entails the installation not only of the EVDriver and the expansion valve itself, but also of a temperature sensor and a pressure transducer, both located on the refrigerating side at the end of the evaporator (on the compressor's intake pipe). Consult the following diagram for a better understanding of the system's typical lay-out.



The basic principle of the new control algorithm is inspired by system stability combined, whenever possible, with rapid attainment of super-heating steady-state.
In this light, these are the priorities to be considered for optimal control of the refrigerating system: obtaining a high, constant refrigerating yield rather than very low, stable superheating.
The heart of the control is a PID control with settable coefficients for superheating.

These are the additional controls:

LOW	(Low superheating with integral time and adjustable threshold)
LOP	(Low evaporation pressure, operating in transients only, with integral time and adjustable threshold)
MOP	(High evaporation pressure with integral time and adjustable threshold)
HiT cond	(High condensation pressure, enablable only with the condensation pressure probe read by pCO, with integral time and adjustable threshold)

21.3 Operation of valves in "Chiller" and "Heat pump" modes

In the "heat pump" mode, as the valves are one-way, a specific hardware configuration is necessary.
In fact, for this type of unit, two valves per circuit are necessary for gas flow (therefore 2 drivers too)
The two valves are commanded alternately depending on summer or winter operation, but are never used simultaneously. These are the possible combinations:

- 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.
- in defrosting mode, valve 1 operates while valve 2 is kept closed.

22. Supervisor

The unit can be interfaced to a local or remote supervision/remote-assistance system.
pCO card accessories include an optional card for serial communication through interface RS422 or RS485, supplied separately from the pCO card.
If the serial communication values (serial address and communication speed) are correctly set, the parameters transmitted by the unit will be as shown on the following table.

22.1.1 Key

A Analogue variables
D Digital variables
I Entire variable

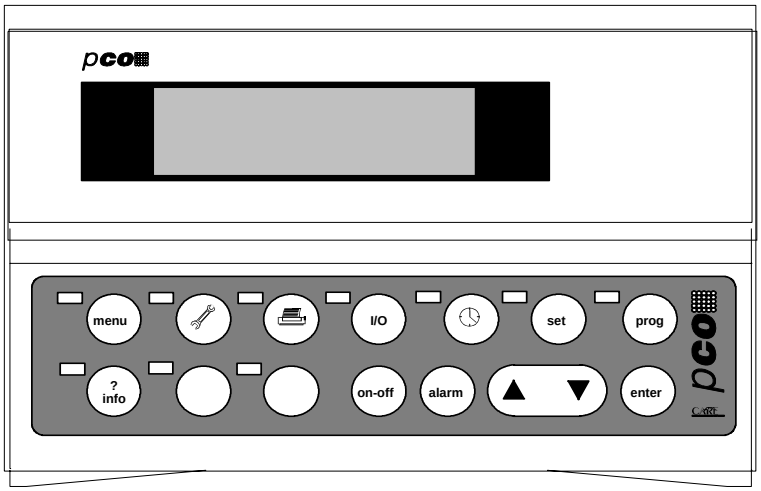
IN Input variables pCO ← Supervisor
OUT Output variable pCO → Supervisor
IN/OUT Input/output variable pCO ← →Supervisor

Type	Direction	Address	Description
A	OUT	1	Analogue input 1 value
A	OUT	2	Analogue input 2 value
A	OUT	3	Analogue input 3 value
A	OUT	4	Analogue input 4 value
A	OUT	5	Analogue input 5 value
A	OUT	6	Analogue input 6 value
A	OUT	7	Analogue input 7 value
A	OUT	8	Analogue input 8 value
A	OUT	9	Analogue output 1 value
A	OUT	10	Analogue output 2 value
A	IN/OUT	11	Summer temperature set-point
A	IN/OUT	12	Winter temperature set-point
A	IN/OUT	13	Condensation set-point
A	IN/OUT	14	Temperature control band
I	OUT	1	Status of unit
I	OUT	2	pLAN address of unit
I	IN/OUT	3	Type of fan management
I	IN/OUT	4	Unit configuration type
I	IN/OUT	5	Number of compressors
I	IN/OUT	6	Number of fans
D	OUT	1	Status of unit
D	OUT	2	Digital output 1 value
D	OUT	3	Digital output 2 value
D	OUT	4	Digital output 3 value
D	OUT	5	Digital output 4 value
D	OUT	6	Digital output 5 value
D	OUT	7	Digital output 6 value
D	OUT	8	Digital output 7 value
D	OUT	9	Digital output 8 value
D	OUT	10	Digital output 9 value
D	OUT	11	Digital output 10 value
D	OUT	12	Digital output 11 value
D	OUT	13	Digital output 12 value
D	OUT	14	Digital output 13 value
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
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 starting restrictions
D	IN/OUT	26	Type of compressor capacity control
D	OUT	27	Summer/Winter selection from digital input
D	OUT	28	
D	OUT	29	Summer/Winter operation
D	OUT	30	Selection of condensation with 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

Type	Direction	Address	Description
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 cutout alarm
D	OUT	56	Fan 2 thermal cutout alarm
D	OUT	57	Evaporator pump thermal cutout alarm
D	OUT	58	Card 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	Alarm: Probe 1 failed or not connected
D	OUT	63	Alarm: Probe 2 failed or not connected
D	OUT	64	Alarm: Probe 3 failed or not connected
D	OUT	65	Alarm: Probe 4 failed or not connected
D	OUT	66	Alarm: Probe 5 failed or not connected
D	OUT	67	Alarm: Probe 6 failed or not connected
D	OUT	68	Alarm: Probe 7 failed or not connected
D	OUT	69	Alarm: Probe 8 failed or not connected
D	OUT	70	Condenser pump duty hours alarm
D	OUT	71	Compressor duty hours alarm
D	OUT	72	Condenser pump thermal cutout 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 duty hours alarm
D	OUT	79	Values inputting error
D	OUT	80	High delivery temperature alarm
D	OUT	81	Pressure differential alarm
D	OUT	82	Diver 1 probe alarm
D	OUT	83	Alarm: driver 1 EEPROM error
D	OUT	84	Alarm: driver 1 stepped motor valve error
D	OUT	85	Alarm: driver 1 battery error
D	OUT	86	Driver 1 high pressure alarm (MOP)
D	OUT	87	Driver 1 low pressure alarm (LOP)
D	OUT	88	Driver 1 low superheat alarm
D	OUT	89	Alarm - valve not shut after driver 1 black-out
D	OUT	90	Driver 1 high intake temperature alarm
D	OUT	91	Diver 2 probe alarm
D	OUT	92	Alarm: driver 2 EEPROM error
D	OUT	93	Alarm: driver 2 stepped motor valve error
D	OUT	94	Alarm: driver 2 battery error
D	OUT	95	Driver 2 high pressure alarm (MOP)
D	OUT	96	Driver 2 low pressure alarm (LOP)
D	OUT	97	Driver 2 low superheat alarm
D	OUT	98	Alarm - valve not shut after driver 2 black-out
D	OUT	99	Driver 2 high intake temperature alarm
D	OUT	100	Standby due to EEPROM /battery recharge / or open valve error, driver 1
D	OUT	101	Standby due to EEPROM /battery recharge / or open valve error, driver 2

23. Keyboard

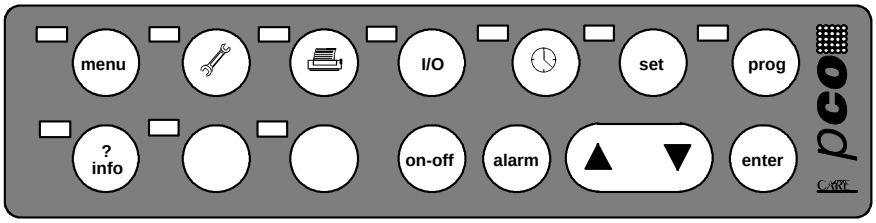
The figure shown below is the *terminal* with the front door of the control board open.
The *terminal* is always managed by the microprocessor and has an LCD display (4 lines x 20 columns), a keyboard and a LED, for user programming of control parameters (set-point, differential band, alarm thresholds) and for essential operations by the user. The *terminal* need not be connected to the *basic board* for normal controller operation.



The terminal is used for initial programming of parameters and for displaying work data. The following functions are possible:

- initial programming of machine with password to ensure secrecy
- facility for changing fundamental operation parameters in run-time.
- on-display viewing and buzzing of detected alarms.
- display of all measured quantities

The pcO keyboard has a 15-key keyboard. With the LC Display, it is the interface between operator and system.



From the keyboard, you can directly access the main parameters or parameter loops. broken down as follows:

ON/OFF key 

Enables and disables the controlled devices.

ALARM key 

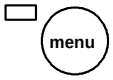
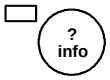
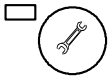
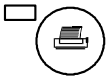
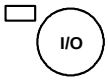
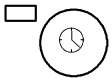
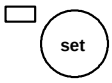
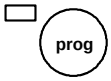
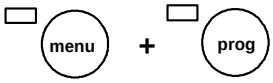
Takes you to the first active alarm screen and switches off the alarm buzzer.
If an alarm screen is shown, further key pressure will reset the alarm and display the first screen.
If there are no active alarms, you are sent to the NO ACTIVE ALARM screen. The list of active alarm screens can be viewed by pressing the arrow keys.

UP/DOWN keys 

When the cursor is located on HOME (cursor in 0.0 position of display) the keys have the function of scrolling through the screens of a group.
You can access the first from the last and vice-versa
If the cursor is located on a numeric field, the values of the selected parameter will vary.
If the cursor is located on a selection field, the available options are displayed (e.g. YES/NO)..

ENTER key: 

If you press the key for the first time in the values setting screens,
the cursor will move onto the first active setting field.
With the next key pressures, confirm the set value and move the cursor to the next field.
You then return from the last field to the HOME position.

MENU key		Go to the M_MAINMASK screen
INFO key		Changes terminal control from a pCO board to another pCO board.
MAINT key		Go to the M_MAINTS screen
PRINT key:		NOT SPECIFIED
I/O key		Go to the M_INOUTS screen
TIME key		Go to screen m_CLOCK5 / m_CLOCK10 if the clock board is enabled.
SET key		Go to the M_SET-POINTS screen
PROG key you move on to screen		You are prompted to supply the password If you have typed the password in correctly , M_USERS
MENU+PROG keys		The keys must be pressed and released simultaneously. You are prompted to supply the password If you have typed the password in correctly , you move on to screen M_MANUF5

23.1 LEDs

A green LED is located at the side of each key. It lights up when the associated key is pressed and indicates in which screen-group the user is.

When you enter the machine configuration screen-group, press keys MENU+PROG and the LEDs of keys MENU and PROG will light up.

Another three LEDs are located under the rubber keys, indicating the following:

1. ON/OFF key Green LED:
   The following operating conditions can occur OFF UNIT switched off from keyboard ON Unit ON and operating. Flashing Unit switched ON from local keyboard but switched OFF due to alarm/remote control/master power-down

2. ALARM key Red LED
   Indicates the presence of an alarm situation.
   If the LED flashes, this means there was an incorrect input of the thermostatic control parameters for compressors with continuous duty capacity control.

3. ENTER key: LED the instrument is correctly powered

24. Screen list

```
M_Initing
+--------------------+
|                    |
|--  WAIT  PLEASE  --|
|-- READING INPUTS --|
|                    |
+--------------------+
```

24.1 Menu key

```
M_MainMask
+--------------------+
|00 00       00 00 00|
|In water E.   00.0ßC|
|Out water E.  00.0ßC|
|U:00 ON             |
+--------------------+
```

24.2 Maintenance key

```
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|
+--------------------+

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
+--------------------+
|Compressor enable   |
|                    |
|C1:N C2:N C3:N C4:N |
|                    |
+--------------------+

M_Maint65
+--------------------+
|Erase alarms        |
|history memory    N |
|                    |
|                    |
+--------------------+

m_manual_drv1
+--------------------+
|Manual mng.  D:1 U: |
|EEV position    N   |
|Steps opening   0000|
|Position        0000|
+--------------------+

m_manual_drv2
+--------------------+
|Manual mng.  D:2 U: |
|EEV position    N   |
|Steps opening   0000|
|Position        0000|
+--------------------+

m_gohead_drv1
+--------------------+
|Driver 1 status  U: |
|                    |
|NO WARNINGS         |
|          N         |
+--------------------+

m_gohead_drv2
+--------------------+
|Driver 2 status  U: |
|                    |
|NO WARNINGS         |
|          N         |
+--------------------+

M_Maint100
+--------------------+
|Insert another   U: |
|maintenance         |
|password            |
|               0000 |
+--------------------+
```

24.3 Printer key

```
M_Printer5
+--------------------+
|                    |
|    Printer         |
|    not available   |
|                    |
+--------------------+
```

24.4 I/O key

```
M_InOut5
+--------------------+
|    CAREL S.p.A.    |
| Brugine (PD) Italy |
|CODE: EPSTDEMSDA    |
|Ver. 1.7    24/11/03|
+--------------------+

M_InOut10
+--------------------+
|Digital inputs   U: |
|CCCCCCCCCCCC        |
|Digital outputs     |
|OOOOOOOOOOOO        |
+--------------------+

M_InOut15
+--------------------+
|Analog inputs    U: |
|                    |
|B1:           ----ßC|
|B2:           ----ßC|
+--------------------+

M_InOut20
+--------------------+
|Analog inputs    U: |
|                    |
|B3:           ----ßC|
|B4:           ----ßC|
+--------------------+

M_InOut25
+--------------------+
|Analog inputs    U: |
|                    |
|B5:          0----ßC|
|B6:          0----ßC|
+--------------------+

M_InOut30
+--------------------+
|Analog inputs    U: |
|                    |
|B7:          00.0bar|
|B8:          00.0bar|
+--------------------+

M_InOut35
+--------------------+
|Analog outputs   U: |
|                    |
|Y0:            00.0V|
|Y1:            00.0V|
+--------------------+
```

m_inout_drv1

```
+--------------------+
|Driver 1         U: |
|EEV              AUTO|
|Valve position   0000|
|Power request    000%|
+--------------------+
```

m_inout_drv2

```
+--------------------+
|Driver 1         U: |
|SuperHeat     00.0ßC|
|Evap.Temp.    00.0ßC|
|Suct.Temp.    00.0ßC|
+--------------------+
```

m_inout_drv3

```
+--------------------+
|Driver 1         U: |
|                    |
|Evap.Press.   00.0bar|
|Evap.Temp.    00.0ßC |
+--------------------+
```

m_inout_drv4

```
+--------------------+
|Driver 1         U: |
|                    |
|Cond.Press.   00.0bar|
|Cond.Temp.    00.0ßC |
+--------------------+
```

m_inout_drv5

```
+--------------------+
|D1 battery state U: |
|DISCONNECTED        |
|R 00.0ohm           |
|V 00.0V     Cap 000%|
+--------------------+
```

m_inout_drv6

```
+--------------------+
|Driver 2         U: |
|EEV              AUTO|
|Valve position   0000|
|Power request    000%|
+--------------------+
```

m_inout_drv7

```
+--------------------+
|Driver 2         U: |
|SuperHeat     00.0ßC|
|Evap.Temp.    00.0ßC|
|Suct.Temp.    00.0ßC|
+--------------------+
```

m_inout_drv8

```
+--------------------+
|Driver 2         U: |
|                    |
|Evap.Press.   00.0bar|
|Evap.Temp.    00.0ßC |
+--------------------+
```

m_inout_drv9

```
+--------------------+
|Driver 2         U: |
|                    |
|Cond.Press.   00.0bar|
|Cond.Temp.    00.0ßC |
+--------------------+
```

m_inout_drv10

```
+--------------------+
|D2 battery state U: |
|DISCONNECTED        |
|R 00.0ohm           |
|V 00.0V     Cap 000%|
+--------------------+
```

m_inout_drv11

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

24.5 Clock key

M_Clock5

```
+--------------------+
|                    |
|     Clock not      |
|     installed      |
|                    |
+--------------------+
```

M_Clock10

```
+--------------------+
|Clock config.    U: |
|                    |
|Time           00:00|
|Date        00/00/00|
+--------------------+
```

24.6 Set key

M_Setpoint5

```
+--------------------+
|Actual setpoint     |
|                    |
|              00.0ßC|
|                    |
+--------------------+
```

M_Setpoint10

```
+--------------------+
|Summer              |
|setpoint      00.0ßC|
|Winter              |
|setpoint      ----ßC|
+--------------------+
```

M_Setpoint15

```
+--------------------+
|Summer double       |
|setpoint      00.0ßC|
|Winter double       |
|setpoint      ----ßC|
+--------------------+
```

24.7 Prog key

M_User5

```
+--------------------+
|Summer temperature  |
|setpoint limits     |
|Low           00.0ßC|
|High          00.0ßC|
+--------------------+
```

M_User15

```
+--------------------+
|Winter temperature  |
|setpoint limits     |
|Low           00.0ßC|
|High          00.0ßC|
+--------------------+
```

M_User17

```
+--------------------+
|Regulat.temperature |
|                    |
|Type          INLET |
|                    |
+--------------------+
```

M_User20

```
+--------------------+
|Inlet regulation    |
|                    |
|Type            PROP|
|Integration t. 0000s|
+--------------------+
```

M_User23

```
+--------------------+
|Outlet regulation   |
|force off           |
|Summer        00.0ßC|
|Winter        00.0ßC|
+--------------------+
```

M_User25

```
+--------------------+
|Temperature band    |
|              00.0ßC|
|                    |
|                    |
+--------------------+
```

M_User27

```
+--------------------+
|Modulation band     |
|                    |
|Neutral zone  00.0ßC|
|                    |
+--------------------+
```

M_User30

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

M_User35

```
+--------------------+
|Delay on switching  |
|the main pump off   |
|                    |
|                000s|
+--------------------+
```

M_User40

```
+--------------------+
|Dig input remote    |
|on / off          N |
|Supervisory remote  |
|on / off          N |
+--------------------+
```

M_User42

```
+--------------------+
|Dig input remote    |
|Summer / Winter   N |
|Supervisory remote  |
|Summer / Winter   N |
+--------------------+
```

M_User45

```
+--------------------+
|Freecool.parameters |
|Setp.offset   00.0C |
|Delta         00.0ßC|
|Diff.         00.0ßC|
+--------------------+
```

M_User46

```
+--------------------+
|Freecool.max.vlv    |
|open threshold  000%|
|Freecool.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|
|Max time      00000s|
+--------------------+
```

M_User58
```
+--------------------+
|Config.reverse cycle|
|mode in defrost     |
|                    |
|NO OFF COMP         |
+--------------------+
```

M_User59
```
+--------------------+
|Slave boards        |
|alarms display      |
|                    |
|MASTER - SLAVE      |
+--------------------+
```

M_User60
```
+--------------------+
|Insert another   U: |
|user                |
|Password            |
|               0000 |
+--------------------+
```

24.8 Menu+Prog key

M_Pw_Manuf
```
+--------------------+
|Insert           U: |
|manufacturer        |
|password            |
|               0000 |
+--------------------+
```

M_Pw_User
```
+--------------------+
|Insert           U: |
|user                |
|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|
|                    |
|Min          000.0  |
|Max          000.0  |
+--------------------+
```

M_Manuf30
```
+--------------------+
|Discharge temp.     |
|probe limits        |
| 0Volt       000.0ßC|
| 1Volt       000.0ßC|
+--------------------+
```

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 config         |
|N.local drivers   0 |
|N.comp            0 |
|Comp.rotation     N |
+--------------------+
```

M_Manuf50
```
+--------------------+
|Comp config         |
|Type of unloads STEP|
|Stages per          |
|comp             0  |
+--------------------+
```

M_Manuf55
```
+--------------------+
|Comp 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 comp        |
|power-on time  0000s|
|Minimum comp        |
|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	000.0ßC
Diff.	00.0ßC

M_Manuf135

Freeze prevent	
Setpoint	00.0ßC
Diff.	00.0ßC

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	000.0ßC
Diff.	00.0ßC

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	00.0ßC
Diff.	00.0ßC

M_Manuf211

Antifreeze alarm	
If antifreeze alarm	MAIN PUMP OFF

M_Manuf215

Electrovalve management	
Setpoint	000.0ßC
Diff.	00.0ßC

M_Manuf220

Antifreeze heater	
Setpoint	00.0ßC
Diff.	00.0ßC

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
+--------------------+
|Insert EXV       U: |
|driver manufacturer |
|password            |
|               0000 |
+--------------------+

M_Manuf245
+--------------------+
|Erase memory     U: |
|Install global      |
|default values     N|
|                    |
+--------------------+

M_Manuf250
+--------------------+
|Insert another   U: |
|manufacturer        |
|password            |
|               0000 |
+--------------------+
```

24.9 Driver

```
m_manuf_drv1_1
+--------------------+
|Manuf.       D:1 U: |
|Valve type          |
|ALCO EX5-EX6        |
|Battery presence   N|
+--------------------+

m_manuf_drv1_2
+--------------------+
|Manuf.       D:1 U: |
|                    |
|Circuit/EEV Ratio   |
|                000%|
+--------------------+

m_manuf_drv2_1
+--------------------+
|Manuf.       D:2 U: |
|Valve type          |
|ALCO EX5-EX6        |
|Battery presence   N|
+--------------------+

m_manuf_drv2_2
+--------------------+
|Manuf.       D:2 U: |
|                    |
|Circuit/EEV Ratio   |
|                000%|
+--------------------+

m_manuf_d1_ch1
+--------------------+
|Manuf. CH    D:1 U: |
|                    |
|SHeat setp.   00.0ßC|
|Dead zone      0.0ßC|
+--------------------+

m_manuf_d1_df1
+--------------------+
|Manuf. DF    D:1 U: |
|                    |
|SHeat setp.   00.0ßC|
|Dead zone      0.0ßC|
+--------------------+

m_manuf_d2_hp1
+--------------------+
|Manuf. HP    D:2 U: |
|                    |
|SHeat setp.   00.0ßC|
|Dead zone      0.0ßC|
+--------------------+

m_manuf_d1_ch2
+--------------------+
|Manuf. CH    D:1 U: |
|Prop. factor   00.0 |
|Int.  factor   000 s|
|Diff. factor   00.0s|
+--------------------+

m_manuf_d1_df2
+--------------------+
|Manuf. DF    D:1 U: |
|Prop. factor   00.0 |
|Int.  factor   000 s|
|Diff. factor   00.0s|
+--------------------+

m_manuf_d2_hp2
+--------------------+
|Manuf. HP    D:2 U: |
|Prop. factor   00.0 |
|Int.  factor   000 s|
|Diff. factor   00.0s|
+--------------------+

m_manuf_d1_ch3
+--------------------+
|Manuf. CH    D:1 U: |
|Low SHeat protection|
|Low limit     00.0ßC|
|Integral time 00.0 s|
+--------------------+

m_manuf_d1_df3
+--------------------+
|Manuf. DF    D:1 U: |
|Low SHeat protection|
|Low limit     00.0ßC|
|Integral time 00.0 s|
+--------------------+

m_manuf_d2_hp3
+--------------------+
|Manuf. HP    D:2 U: |
|Low SHeat protection|
|Low limit     00.0ßC|
|Integral time 00.0 s|
+--------------------+

m_manuf_drv_ch1
+--------------------+
|Manuf. COMM-CH   U: |
|LOP protection      |
|LOP limit     00.0ßC|
|Integral time 00.0 s|
+--------------------+

m_manuf_drv_hp1
+--------------------+
|Manuf. COMM-HP   U: |
|LOP protection      |
|LOP limit     00.0ßC|
|Integral time 00.0 s|
+--------------------+

m_manuf_drv_df1
+--------------------+
|Manuf. COMM-DF   U: |
|LOP protection      |
|LOP limit     00.0ßC|
|Integral time 00.0 s|
+--------------------+

m_manuf_drv_ch2
+--------------------+
|Manuf. COMM-CH   U: |
|MOP limit     00.0ßC|
|Integral time 00.0 s|
|Start-up delay 000 s|
+--------------------+

m_manuf_drv_hp2
+--------------------+
|Manuf. COMM-HP   U: |
|MOP limit     00.0ßC|
|Integral time 00.0 s|
|Start-up delay 000 s|
+--------------------+

m_manuf_drv_df2
+--------------------+
|Manuf. COMM-DF   U: |
|MOP limit     00.0ßC|
|Integral time 00.0 s|
|Start-up delay 000 s|
+--------------------+

m_manuf_drv_ch3
+--------------------+
|Manuf. COMM-CH   U: |
|Hi TCond.protection |
|HiTcond limit 00.0ßC|
|Integral time 00.0 s|
+--------------------+

m_manuf_drv_hp3
+--------------------+
|Manuf. COMM-HP   U: |
|Hi TCond.protection |
|HiTcond limit 00.0ßC|
|Integral time 00.0 s|
+--------------------+

m_manuf_drv_df3
+--------------------+
|Manuf. COMM-DF   U: |
|Hi TCond.protection |
|HiTcond limit 00.0ßC|
|Integral time 00.0 s|
+--------------------+

m_manuf_drv_ch4
+--------------------+
|Manuf. COMM-CH   U: |
|                    |
|Suction temp.       |
|high limit   000.0ßC|
+--------------------+

m_manuf_drv_hp4
+--------------------+
|Manuf. COMM-HP   U: |
|                    |
|Suction temp.       |
|high limit   000.0ßC|
+--------------------+
```

```
m_manuf_drv_df4
+--------------------+
|Manuf. COMM-DF   U: |
|                    |
|Suction temp.       |
|high limit   000.0ßC|
+--------------------+

m_manuf_drv_1
+--------------------+
|Manuf.  COMM     U: |
|                    |
|Refrigerant         |
|                    |
+--------------------+

m_manuf_drv_2
+--------------------+
|Manuf.  COMM     U: |
|Custom valve config.|
|Minimum steps   0000|
|Maximum steps   0000|
+--------------------+

m_manuf_drv_3
+--------------------+
|Manuf.  COMM     U: |
|Custom valve config.|
|Closing steps   0000|
|Back steps      0000|
+--------------------+

m_manuf_drv_4
+--------------------+
|Manuf.  COMM     U: |
|Custom valve config.|
|Opening EXTRAs     N|
|Closing EXTRAs     N|
+--------------------+

m_manuf_drv_5
+--------------------+
|Manuf.  COMM     U: |
|Custom valve config.|
|Phase current 0000mA|
|Still current 0000mA|
+--------------------+

m_manuf_drv_6
+--------------------+
|Manuf.  COMM     U: |
|Custom valve config.|
|Step rate      000Hz|
|Duty-cycle     000 %|
+--------------------+

m_manuf_drv_7
+--------------------+
|Manuf.  COMM     U: |
|Evap.pressure probe |
|Min value    00.0bar|
|Max value   000.0bar|
+--------------------+

m_manuf_drv_8
+--------------------+
|Manuf.  COMM     U: |
|Alarms delay        |
|Low SHeat      0000s|
|High TSuct     0000s|
+--------------------+

m_manuf_drv_9
+--------------------+
|Manuf.  COMM     U: |
|Alarms delay        |
|LOP            0000s|
|MOP            0000s|
+--------------------+
```

```
m_new_psw_drv
+--------------------+
|Insert new EXV   U: |
|driver manufacturer |
|password            |
|               0000 |
+--------------------+
```

24.10 Alarm key

```
M_Alarm0
+--------------------+
|                    |
|     No  alarms     |
|      detected      |
|                    |
+--------------------+

M_Alarm10
+--------------------+
|AL:001           U: |
|      Unit n.1      |
|     is offline     |
|                    |
+--------------------+

M_Alarm20
+--------------------+
|AL:002           U: |
|      Unit n.2      |
|     is offline     |
|                    |
+--------------------+

M_Alarm30
+--------------------+
|AL:003           U: |
|      Unit n.3      |
|     is offline     |
|                    |
+--------------------+

M_Alarm40
+--------------------+
|AL:004           U: |
|      Unit n.4      |
|     is offline     |
|                    |
+--------------------+

M_Alarm50
+--------------------+
|AL:011           U: |
|   Serious alarm    |
|  by digital input  |
|                    |
+--------------------+

M_Alarm60
+--------------------+
|AL:012           U: |
|   Phase monitor    |
|       alarm        |
|                    |
+--------------------+

M_Alarm70
+--------------------+
|AL:013           U: |
|   Evaporator flow  |
|        alarm       |
|                    |
+--------------------+

M_Alarm80
+--------------------+
|AL:014           U: |
|  Condensator flow  |
|        alarm       |
|                    |
+--------------------+
```

```
M_Alarm90
+--------------------+
|AL:015           U: |
|      Oil level     |
|        alarm       |
|                    |
+--------------------+

M_Alarm100
+--------------------+
|AL:016           U: |
|    High pressure   |
|        alarm       |
|    (pressostat)    |
+--------------------+

M_Alarm110
+--------------------+
|AL:017           U: |
|    Low pressure    |
|        alarm       |
|    (pressostat)    |
+--------------------+

M_Alarm120
+--------------------+
|AL:018           U: |
|   Evaporator pump  |
|      overload      |
|                    |
+--------------------+

M_Alarm130
+--------------------+
|AL:019           U: |
|  Condensator pump  |
|      overload      |
|                    |
+--------------------+

M_Alarm140
+--------------------+
|AL:020           U: |
|     Compressor     |
|      overload      |
|                    |
+--------------------+

M_Alarm150
+--------------------+
|AL:021           U: |
|   Condensator fan  |
|    n.1  overload   |
|                    |
+--------------------+

M_Alarm160
+--------------------+
|AL:022           U: |
|   Condensator fan  |
|    n.2  overload   |
|                    |
+--------------------+

M_Alarm170
+--------------------+
|AL:031           U: |
|                    |
|    Freeze alarm    |
|                    |
+--------------------+

M_Alarm180
+--------------------+
|AL:032           U: |
|  Low differential  |
|   pressure alarm   |
|                    |
+--------------------+
```

M_Alarm190

```
+--------------------+
|AL:033          U: |
|   High pressure    |
|       alarm        |
|   (transducer)     |
+--------------------+
```

M_Alarm200

```
+--------------------+
|AL:034          U: |
|    Low pressure    |
|        alarm       |
|    (transducer)    |
+--------------------+
```

M_Alarm210

```
+--------------------+
|AL:035          U: |
|   High discharge   |
|  temperature alarm |
|                    |
+--------------------+
```

M_Alarm220

```
+--------------------+
|AL:036          U: |
|    High voltage    |
|       alarm        |
|                    |
+--------------------+
```

M_Alarm230

```
+--------------------+
|AL:037          U: |
|    High current    |
|       alarm        |
|                    |
+--------------------+
```

M_Alarm240

```
+--------------------+
|AL:041          U: |
|  32k clock board   |
|   fault  or not    |
|     connected      |
+--------------------+
```

M_Alarm250

```
+--------------------+
|AL:051          U: |
|  Evaporator pump   |
|    maintenance     |
|                    |
+--------------------+
```

M_Alarm260

```
+--------------------+
|AL:052          U: |
|  Condensator pump  |
|    maintenance     |
|                    |
+--------------------+
```

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  |
|                    |
+--------------------+
```

24.11 Driver

al_42

```
+--------------------+
|AL:101          U: |
|      Driver1       |
|    Probe error     |
|                    |
+--------------------+
```

al_43

```
+--------------------+
|AL:102          U: |
|      Driver1       |
|    Eeprom error    |
|                    |
+--------------------+
```

al_44

```
+--------------------+
|AL:103          U: |
|       Driver1      |
|  Step motor error  |
|                    |
+--------------------+
```

al_45

```
+--------------------+
|AL:104          U: |
|      Driver1       |
|   Battery error    |
|                    |
+--------------------+
```

al_46

```
+--------------------+
|AL:105          U: |
|      Driver1       |
|  High evaporating  |
|   pressure (MOP)   |
+--------------------+
```

al_47

```
+--------------------+
|AL:106          U: |
|      Driver1       |
|   Low evaporating  |
|   pressure (LOP)   |
+--------------------+
```

al_48

```
+--------------------+
|AL:107          U: |
|      Driver1       |
|   Low Superheat    |
|                    |
+--------------------+
```

al_49

```
+--------------------+
|AL:108          U: |
|       Driver1      |
|  Valve not closed  |
|  during power OFF  |
+--------------------+
```

al_50

```
+--------------------+
|AL:109          U: |
|      Driver1       |
|    High suction    |
|     temperature    |
+--------------------+
```

al_60

```
+--------------------+
|AL:110          U: |
|Driver1:Waiting for |
|Eeprom/batt.charged |
|or open valve error |
+--------------------+
```

al_62

```
+--------------------+
|AL:111          U: |
|    Driver 1        |
|  Lan disconnected  |
|                    |
+--------------------+
```

al_51

```
+--------------------+
|AL:201          U: |
|      Driver2       |
|    Probe error     |
|                    |
+--------------------+
```

al_52

```
+--------------------+
|AL:202          U: |
|      Driver2       |
|    Eeprom error    |
|                    |
+--------------------+
```

```
al_53
+--------------------+
|AL:203          U: |
|       Driver2      |
|  Step motor error  |
|                    |
+--------------------+

al_54
+--------------------+
|AL:204          U: |
|      Driver2       |
|   Battery error    |
|                    |
+--------------------+

al_55
+--------------------+
|AL:205          U: |
|      Driver2       |
|  High evaporating  |
|   pressure (LOP)   |
+--------------------+

al_56
+--------------------+
|AL:206          U: |
|      Driver2       |
|   Low evaporating  |
|   pressure (LOP)   |
+--------------------+

al_57
+--------------------+
|AL:207          U: |
|      Driver2       |
|   Low Superheat    |
|                    |
+--------------------+

al_58
+--------------------+
|AL:208          U: |
|      Driver2       |
|  Valve not closed  |
|  during power OFF  |
+--------------------+

al_59
+--------------------+
|AL:209          U: |
|       Driver2      |
|    High suction    |
|     temperature    |
+--------------------+

al_61
+--------------------+
|AL:210          U: |
|Driver2:Waiting for |
|Eeprom/batt.charged |
|or open valve error |
+--------------------+

al_63
+--------------------+
|AL:211          U: |
|    Driver 2        |
|  Lan disconnected  |
|                    |
+--------------------+
```

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Technology & Evolution

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