Application program for pCO¹ pCO² pCO³ pCOC

Modular Standard Chiller HP 1/4 screw compressors with Carel driver

Manual version 1.1 – 26 / 09 / 2005

Program code: FLSTDmMSDE

LEGGI E CONSERVA QUESTE ISTRUZIONI

READ AND SAVE THESE INSTRUCTIONS

CAREL

Technology & Evolution

LEGGI E CONSERVA QUESTE ISTRUZIONI

READ AND SAVE THESE INSTRUCTIONS

We wish to save you time and money!

We can assure you that the thorough reading of this manual will guarantee correct installation and safe use of the product described.

IMPORTANT WARNINGS

BEFORE INSTALLING OR HANDLING THE APPLIANCE, PLEASE CAREFULLY READ AND FOLLOW THE INSTRUCTIONS CONTAINED IN THIS MANUAL.

The appliance this software is intended for has been expressly designed to ensure safe operation, provided that:
the software is installed, programmed, used and maintained by qualified personnel in full accordance with the instructions contained in this manual and by qualified personnel;
all conditions specified and contained in the appliance installation and user manual are met.

Any other use and modification to the appliance not expressly authorised by the manufacturer shall be considered improper.
Liability for injuries or damage caused by improper use lies exclusively with the user.

INDEX

1. Applications and functions performed by the software

Type of units controlled

AIR / WATER CHILLERS

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

WATER / WATER CHILLERS

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

Type of control

Proportional or proportional + integral control on the evaporator water inlet temperature probe.
Dead zone control by time on the evaporator water outlet temperature probe.

Type of compressors

Screw compressors with 4 load steps
Screw compressors with continuous capacity control

Maximum number of compressors

From 1 to 4 with maximum 4 load steps (1 compressor for each pCO*)
From 1 to 4 with continuous capacity control (1 compressor for each pCO*)

Compressor rotation

Rotation of all the compressors with FIFO logic for stepped capacity control and continuous capacity control.

Condensing pressure/temperature control

The condenser can be controlled by temperature, pressure or in ON/OFF mode
Fan management by steps or with 0/10 volt proportional signal

Type of defrost

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

Safety devices in each refrigerant circuit

High pressure (pressure switch/transducer)
Low pressure (pressure switch/transducer)
Oil differential pressure switch / Oil level
Compressor thermal cutout
Condenser fan thermal cutout
High compressor discharge temperature
Differential pressure alarm
Antifreeze alarm
Low superheat alarm (only with EVD driver enabled)

System safety devices

Serious alarm input (stops the entire unit)
Evaporator/condenser flow switch input (stops the entire unit)
Pump thermal cutout input (stops the entire unit)
Remote ON/OFF input
Check electronic expansion valve driver operating status (only with EVD driver enabled)

Other functions

Alarm logging
Management of the Built-In terminal (pCO^2 only)
Management of ratiometric probes for pressure control (pCO^1 only)
EVD driver for controlling the EXV valve.
Multi-language management.

Accessories

Supervision with RS485 serial board (CAREL or MODBUS protocol)
Supervision with LON serial board

Compatible hardware

pCO^1 Medium
pCO^2 Medium
pCO^3 Medium
pCOC

2. User terminal

2.1 Type and operation

Three different types of user terminal can be connected:

1. PGD0/semigraphic/6 buttons/4 rows - 20 columns/connection via telephone cable
2. LCD/15 buttons/4 rows - 20 columns/connection via telephone cable
3. Built-in display/6 buttons/4 rows - 20 columns (only on pCO^2 board)

The user terminal, whichever is used, can perform all the operations allowed by the application program installed
The user terminal displays the operating conditions of the unit.
The terminal can be used to modify all the unit operating parameters, in real time.
The user terminal is not required for the correct operation of the unit.

2.2 LEDs

2.2.1 PGD0 terminal with 6 buttons

LED	Colour	Description
[ ] button (Alarm)	Red	On – One or more alarm conditions have occurred
PRG button	Yellow	On – Unit on Flashing – Unit off from supervisor or digital input

All the LEDs not described and located underneath the remaining 4 buttons indicate that the instrument is powered.
Together with the backlighting of the display, these will be switched off if no button is pressed on the keypad for 5 minutes.

2.2.2 LCD terminal with 15 buttons

Each button has a green LED indicating the specific group of parameters selected during the operations to display/modify the operating parameters.
The silicone rubber buttons have three different coloured LEDs, whose meaning is specified in the following table:

LED	Colour	Description
[On/Off] button	Green	On – Unit on Flashing – Unit off from supervisor or digital input
[Alarm] button	Red	On – One or more alarm conditions have occurred
[Enter] button	Yellow	On – Instrument correctly powered

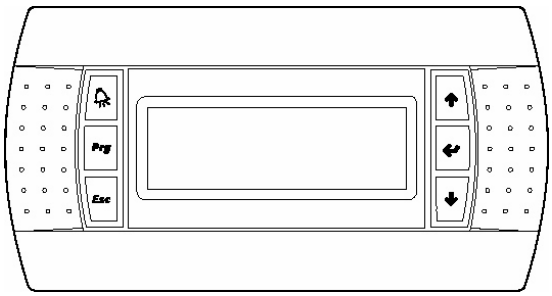
2.2.3 Built-In terminal with 6 buttons

Given the number of buttons and LEDs available, these have general meanings, as described below:

LED	Colour	Description
[ ] button (Alarm)	Red	On – One or more alarm conditions have occurred
[↵] button (Enter)	Yellow	On – Unit on Flashing – Unit off from supervisor or digital input
[Prg] button	Green	On – Displaying/modifying the operating parameters
[Esc] button	Green	On – Main menu parameters displayed

2.3 Use of the buttons

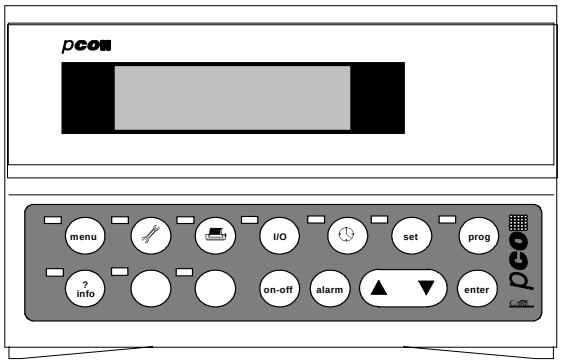
2.3.1 PGD0 terminal with 6 buttons



ALARM	UP
PRG	ENTER
ESC	DOWN

Button	Description
ALARM	displays the alarms, mutes the buzzer and deletes the active alarms
UP ARROW	if the cursor is in the home position (top left corner), scrolls up the screens in the same group; if the cursor is in a setting field, increases the value
DOWN ARROW	if the cursor is in the home position (top left corner), scrolls down the screens in the same group; if the cursor is in a setting field, decreases the value
ENTER	used to move the cursor from the home position (top left corner) to the setting fields, in the setting fields confirms the set value and moves to the next parameter
PRG	accesses the menu for selecting the group of parameters to be displayed/modified (access to the parameters is confirmed by pressing the [Enter] button)
PRG + ENTER	in pLAN applications with more than one board connected in the network and a shared user terminal, switches the user terminal between the different units to display/modify the parameters
ESC + ENTER	pressed at the same time for 20 seconds access the screen for switching the unit On/Off

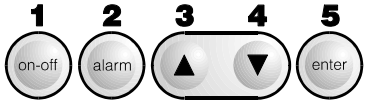
2.3.2 LCD terminal with15 buttons



Button		Description
	MENU	From any point of the user interface (with the exception of the manufacturer group of parameters) returns to the Main menu screen (M0) displaying the unit status, readings of the control probes and operating mode. In the group of manufacturer parameters, organised into nested sub-groups, returns to screen for selecting the parameters.
	SERVICE	Goes to the first screen of Maintenance parameters (A0) The Maintenance parameters are used to check the operating status of devices and the probes, calibrate the readings and run manual operations
	PRINTER	Temporary display of the pLAN address of the current board
	INPUTS AND OUTPUTS	Goes to the first screen of I/O parameters (I0) The I/O parameters display the status of the inputs and the outputs on the board
	CLOCK	Goes to the first screen of Clock parameters (K0) The Clock parameters are used to display/set the operating parameters for the clock board and activate the time bands

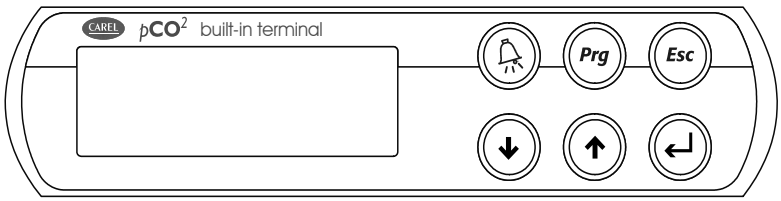
Button		Description
	SET POINT	Goes to the first screen of Set point parameters (S0). The Set point parameters are used to display/modify the unit working set point within the limits defined in the configuration
	PROGRAM	Goes to the screen for entering the user password (P0) The user parameters are used to modify the unit operating mode
	MENU+PROG	Goes to the screen for entering the manufacturer password (Z0) The manufacturer parameters are used to configure the unit in terms of the number and type of devices connected, enable specific accessories or special functions
	INFO	In pLAN applications with more than one board connected in the network and a shared user terminal, switches the user terminal between the different units to display/modify the parameters
	RED	With the unit off, if the chiller+heat pump configuration is featured, enables heating operation
	BLUE	With the unit off, if the chiller+heat pump configuration is featured, enables cooling operation

Silicone rubber buttons



Button		Description
1	ON/OFF	switches the unit on/off
2	ALARM	displays the alarms, mutes the buzzer and deletes the active alarms
3	UP ARROW	if the cursor is in the home position (top left corner), scrolls up the screens in the same group; if the cursor is in a setting field, increases the value
4	DOWN ARROW	if the cursor is in the home position (top left corner), scrolls down the screens in the same group; if the cursor is in a setting field, decreases the value
5	ENTER	used to move the cursor from the home position (top left corner) to the setting fields, in the setting fields confirms the set value and moves to the next parameter

2.3.3 Built-In terminal with 6 buttons



ALARM	PRG	ESC
UP	DOWN	ENTER

Button	Description
ALARM	displays the alarms, mutes the buzzer and deletes the active alarms
UP ARROW	if the cursor is in the home position (top left corner), scrolls up the screens in the same group; if the cursor is in a setting field, increases the value
DOWN ARROW	if the cursor is in the home position (top left corner), scrolls down the screens in the same group; if the cursor is in a setting field, decreases the value
ENTER	used to move the cursor from the home position (top left corner) to the setting fields, in the setting fields confirms the set value and moves to the next parameter
PRG	accesses the menu for selecting the group of parameters to be displayed/modified (access to the parameters is confirmed by pressing the [Enter] button)
PRG + ENTER	temporary display of the board pLAN serial address
ESC + ENTER	pressed at the same time for 20 seconds access the screen for switching the unit On/Off

3. pLAN management between boards

The pLAN network identifies a physical connection between the boards (pCO¹, pCO², pCO³ and pCOC) and the external terminals.
pLAN=**p**CO **L**ocal **A**rea **N**etwork. The purpose of the pLAN network connection between the boards is to exchange variables, according to the logic decided by the program, so as the units can operate together.
The variables exchanged between the boards are established by the program, as is the direction of exchange, and therefore there are no user settings; the only operation required by the user involves the electrical connections.

3.1 How to assign the pLAN addresses

The pLAN addresses are set with binary logic, changing the position of a group of dipswitches located on the rear of the external terminals, on the pCO² board (see the figure below) and inside the electronic valve drivers; in the pCO¹ and pCO3 the address is numerical and is assigned using an external terminal.
The addresses must be set with all the devices off, except in the case of the pCO¹, which uses the external terminal

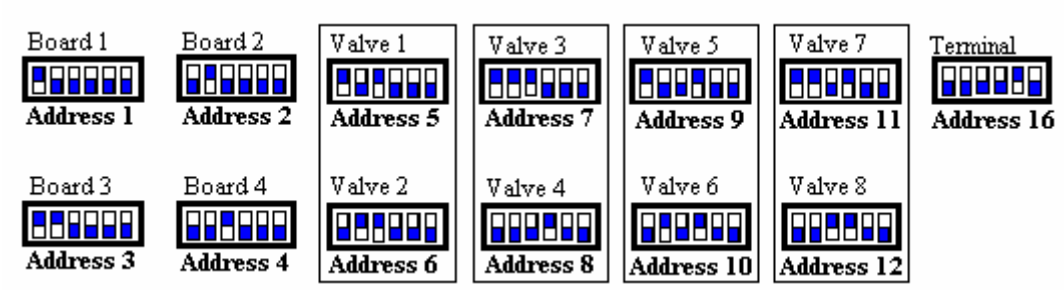
3.1.1 Setting the address on the pCO¹ and pCO³

Operations required to set the pLAN address on the pCO¹ and pCO³ boards.

1. Power down the pCO¹ board and connect an external terminal to the pLAN "0" address.
2. Power up the pCO¹ board, by holding down the Alarm + Up keys until a screen appears
3. When the screen is shown, run the indicated operations, i.e. enter the number (1,2,3…) of the pLAn address with the Up and Down buttons and then confirm by pressing Enter.
4. Power down the pCO¹/pCO³ board.
5. If necessary, assign the correct pLAN address to the external terminal according to the specific system configuration.
6. Power up the pCO¹/pCO³ board.

3.1.2 Setting the address on the pCO², external terminals and valve drivers

The following are the addresses that can be set on the pCO² boards, external terminals and electronic expansion valve drivers.



The Menu main screen indicated on the terminals shows the address of the connected board in the bottom left-hand corner.
The terminal with address 32 can be shared between the boards, in addition or in alternative to other private terminals for the various boards.
Pressing the info button switches between boards.
In all the other screens in the program, to display the address of the board that is currently connected, press the printer button or Enter+Prg, depending on the terminal used.

4. Installing the default values

After having checked the connections between the various boards and terminals, power up the pCO* board/boards.
On power-up, the software automatically installs the default values chosen by Carel for all the chiller and driver configuration parameters.
This section explains how to restore the default values and to return to the starting conditions. When starting for the first time, this operation is not required.
The following procedure is used to restore all the configuration parameters to the default values selected by Carel.

CAUTION! this procedure irreversibly deletes any programming performed by the user.

As resetting the default values is an operation that involves each pCO* board, when more than one board is present, the procedure must be repeated for the all the boards. The procedure is identical for all the boards.
Proceed as follows:

- press the "menu" and "prog" buttons on the LCD terminal at the same time (when pressed, the LEDs corresponding to the "menu" and "prog" buttons will come on;
- enter the password using the "arrow" buttons and press enter: this enters the "manufacturer" configuration branch:

```
+--------------------+
|Insert            Z0|
|manufacturer         |
|password             |
|               0000 |
+--------------------+
```

- press the arrow button once to enter default installation screen:

```
+--------------------+
|Erase memory      V0|
|Install global       |
|default values     N|
|Please wait…         |
+--------------------+
```

- press the "enter" button so as to position the cursor over the letter "N", and using the arrow buttons change this to "Y"; the message "please wait..." will appear; after a few seconds this disappears: at this stage, the default values have been installed completely

5. Selecting the language

When the unit is powered up, a screen is displayed for selecting the language to be used (Italian/English - French/German).
This screen is displayed for 30 seconds, after which the program automatically opens the main menu (M0 screen)
The function can be disabled. To do this, proceed as follows:

1. Press the PROGRAM button and access screen P0
2. Enter the correct password.
3. Go to screen "Pc", pressing the down arrow repeatedly
4. Choose "N" for the item "Display language screen at start-up".

In any case, language in use can be changed at any time. To do this, go to the first screen under the "I/O" branch (ref.10).

6. Selecting the unit of measure

The unit can be configured for operation with different units of measure for the temperature and pressure, depending on the target market. The options are metric (°C / Bar) or imperial (°F / Psi).
To change the setting, proceed as follows:

1. press the PROGRAM button and access screen P0;
2. enter the correct password;
3. go to screen "Pm", pressing the down arrow repeatedly;
4. choose "METRIC" or "IMPERIAL" for the item "Type of unit of measure".

After the selection has been made, all the parameters are converted into the new unit of measure.

7. List of inputs/outputs

Following is a list of the inputs and outputs for each the type of unit; each unit type has been given a number. This number is the main parameter of the program, as it identifies the configuration of the inputs and outputs. Select the associated number in the program configuration screens corresponding to the desired list of inputs and outputs.

AIR/WATER UNITS WITH MAX:4 SCREW COMPRESSORS (UP TO 4 STEPS PER COMP.)

7.1 Chiller-only units - unit type "0"

7.1.1 Digital inputs

	Chiller-only units - UNIT TYPE "0"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)
2	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Pump thermal cutout		Pump thermal cutout		Pump thermal cutout	
5	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch
6	Oil differential / Level	Oil differential / Level	Oil differential / Level	Oil differential / Level	Oil differential / Level	Oil differential / Level
7	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)
8	Double set point		Double set point		Double set point	
9	Fan 1 thermal cutout	Fan 1 thermal cutout	Fan 1 thermal cutout	Fan 1 thermal cutout	Fan 1 thermal cutout	Fan 1 thermal cutout
10	Fan 2 thermal cutout	Fan 2 thermal cutout	Fan 2 thermal cutout	Fan 2 thermal cutout	Fan 2 thermal cutout	Fan 2 thermal cutout
11	High pressure switch	High pressure switch	High pressure switch	High pressure switch	High pressure switch	High pressure switch
12	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout

7.1.2 Analogue inputs

	Chiller-only units - UNIT TYPE "0"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Evaporator water inlet temperature		High pressure	High pressure	Evaporator water inlet temperature	
2	Evaporator water outlet temperature	Evaporator water outlet temperature	Low pressure	Low pressure	Evaporator water outlet temperature	Evaporator water outlet temperature
3	Outlet temperature	Outlet temperature	Outlet temperature	Outlet temperature	Condenser temperature	Condenser temperature
4			Voltage / current / outside set point	Voltage / current		
5	Condenser temperature	Condenser temperature	Evaporator water inlet temperature		Voltage / current / outside set point	Voltage / current
6	Voltage / current / outside set point	Voltage / current	Evaporator water outlet temperature	Evaporator water outlet temperature	Outlet temperature	Outlet temperature
7	High pressure	High pressure	Condenser temperature	Condenser temperature	High pressure	High pressure
8	Low pressure	Low pressure			Low pressure	Low pressure

7.1.3 DIGITAL OUTPUTS

	Chiller-only units - UNIT TYPE "0"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Pump		Pump		Pump	
2	Line contactor	Line contactor	Line contactor	Line contactor	Line contactor	Line contactor
3	Star contactor	Star contactor	Star contactor	Star contactor	Star contactor	Star contactor
4	Delta contactor	Delta contactor	Delta contactor	Delta contactor	Delta contactor	Delta contactor
5	Liquid solenoid	Liquid solenoid	Liquid solenoid	Liquid solenoid	Liquid solenoid	Liquid solenoid
6	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1
7	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2
8	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3
9	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler
10	Antifreeze heater	Antifreeze heater	Antifreeze heater C 1	Antifreeze heater	Antifreeze heater	Antifreeze heater
11	General alarm	General alarm	General alarm	General alarm	General alarm	General alarm
12	Fan 1	Fan 1	Fan 1	Fan 1	Fan 1	Fan 1
13	Fan 2	Fan 2	Fan 2	Fan 2	Fan 2	Fan 2

7.1.4 Analogue outputs

	Chiller-only units - UNIT TYPE "0"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Speed controller	Speed controller	Speed controller	Speed controller	Speed controller	Speed controller
2						

7.2 Chiller + heat pump units- unit type "1"

7.2.1 Digital inputs

	Chiller + heat pump units - UNIT TYPE "1"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)
2	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Pump thermal cutout		Pump thermal cutout		Pump thermal cutout	
5	Low pressure switch 1	Low pressure switch 2	Low pressure switch 1	Low pressure switch 2	Low pressure switch 1	Low pressure switch 2
6	Oil differential / Level	Oil differential / Level	Oil differential / Level	Oil differential / Level	Oil differential / Level	Oil differential / Level
7	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)
8	Double set point		Double set point		Double set point	
9	Fan 1 thermal cutout	Fan 1 thermal cutout	Fan 1 thermal cutout	Fan 1 thermal cutout	Fan 1 thermal cutout	Fan 1 thermal cutout
10	Cooling / heating		Cooling / heating		Cooling / heating	
11	High pressure switch	High pressure switch	High pressure switch	High pressure switch	High pressure switch	High pressure switch
12	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout

7.2.2 Analogue inputs

	Chiller + heat pump units - UNIT TYPE "1"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Evaporator water inlet temperature		High pressure	High pressure	Evaporator water inlet temperature	
2	Evaporator water outlet temperature	Evaporator water outlet temperature	Low pressure	Low pressure	Evaporator water outlet temperature	Evaporator water outlet temperature
3	Outlet temperature	Outlet temperature	Outlet temperature	Outlet temperature	Condenser temperature	Condenser temperature
4			Voltage / current / outside set point	Voltage / current		
5	Condenser temperature	Condenser temperature	Evaporator water inlet temperature		Voltage / current / outside set point	Voltage / current
6	Voltage / current / outside set point	Voltage / current	Evaporator water outlet temperature	Evaporator water outlet temperature	Outlet temperature	Outlet temperature
7	High pressure	High pressure	Condenser temperature	Condenser temperature	High pressure	High pressure
8	Low pressure	Low pressure			Low pressure	Low pressure

7.2.3 Digital outputs

	Chiller + heat pump units - UNIT TYPE "1"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Pump		Pump		Pump	
2	Line contactor	Line contactor	Line contactor	Line contactor	Line contactor	Line contactor
3	Star contactor	Star contactor	Star contactor	Star contactor	Star contactor	Star contactor
4	Delta contactor	Delta contactor	Delta contactor	Delta contactor	Delta contactor	Delta contactor
5	Liquid solenoid	Liquid solenoid	Liquid solenoid	Liquid solenoid	Liquid solenoid	Liquid solenoid
6	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1
7	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2
8	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3
9	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler
10	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater
11	General alarm	General alarm	General alarm	General alarm	General alarm	General alarm
12	4-way valve	4-way valve	4-way valve	4-way valve	4-way valve	4-way valve
13	Fan 1	Fan 1	Fan 1	Fan 1	Fan 1	Fan 1

7.2.4 Analogue outputs

	Chiller + heat pump units - UNIT TYPE "1""					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1						
2	Speed controller	Speed controller	Speed controller	Speed controller	Speed controller	Speed controller

7.3 Chiller units with freecooling – unit type "2"

7.3.1 Digital inputs

	Chiller units with freecooling - UNIT TYPE "2"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)
2	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Pump thermal cutout		Pump thermal cutout		Pump thermal cutout	
5	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch
6	Oil differential / Level	Oil differential / Level	Oil differential / Level	Oil differential / Level	Oil differential / Level	Oil differential / Level
7	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)
8	Double set point		Double set point		Double set point	
9	Fan 1 thermal cutout	Fan 1 thermal cutout	Fan 1 thermal cutout	Fan 1 thermal cutout	Fan 1 thermal cutout	Fan 1 thermal cutout
10	Fan 2 thermal cutout	Fan 2 thermal cutout	Fan 2 thermal cutout	Fan 2 thermal cutout	Fan 2 thermal cutout	Fan 2 thermal cutout
11	High pressure switch	High pressure switch	High pressure switch	High pressure switch	High pressure switch	High pressure switch
12	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout

7.3.2 Analogue inputs

	Chiller units with freecooling - UNIT TYPE "2"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Evaporator water inlet temperature		High pressure	High pressure	Evaporator water inlet temperature	
2	Evaporator water outlet temperature	Evaporator water outlet temperature	Low pressure	Low pressure	Evaporator water outlet temperature	Evaporator water outlet temperature
3	Outlet temperature	Outlet temperature	Outlet temperature	Outlet temperature	Outside air temperature	
4	Freecooling water inlet temperature		Voltage / current / outside set point	Voltage / current	Freecooling water inlet temperature	
5	Outside air temperature		Evaporator water inlet temperature		Voltage / current / outside set point	Voltage / current
6	Voltage / current / outside set point	Voltage / current	Evaporator water outlet temperature	Evaporator water outlet temperature	Outlet temperature	Outlet temperature
7	High pressure	High pressure	Outside air temperature		High pressure	High pressure
8	Low pressure	Low pressure	Freecooling water inlet temperature		Low pressure	Low pressure

7.3.3 Digital outputs

	Chiller units with freecooling - UNIT TYPE "2"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Pump		Pump		Pump	
2	Line contactor	Line contactor	Line contactor	Line contactor	Line contactor	Line contactor
3	Star contactor	Star contactor	Star contactor	Star contactor	Star contactor	Star contactor
4	Delta contactor	Delta contactor	Delta contactor	Delta contactor	Delta contactor	Delta contactor
5	Liquid solenoid	Liquid solenoid C 2	Liquid solenoid	Liquid solenoid C 2	Liquid solenoid	Liquid solenoid C 2
6	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1
7	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2
8	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3
9	Fan 2	Fan 2	Fan 2	Fan 2	Fan 2	Fan 2
10	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater
11	General alarm	General alarm	General alarm	General alarm	General alarm	General alarm
12	Fan 1	Fan 1	Fan 1	Fan 1	Fan 1	Fan 1
13	ON/OFF freecooling valve		ON/OFF freecooling valve		ON/OFF freecooling valve	

7.3.4 Analogue outputs

	Chiller units with freecooling - UNIT TYPE "2"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Speed controller	Speed controller	Speed controller	Speed controller	Speed controller	Speed controller
2	3-way freecooling valve		3-way freecooling valve		3-way freecooling valve	

WATER/WATER UNITS WITH MAX. 4 SCREW COMPRESSORS (UP TO 4 STEPS PER COMP.)

7.4 Chiller-only units – unit type "3"

7.4.1 Digital inputs

	Chiller-only units - UNIT TYPE "3"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)
2	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Evaporator pump thermal cutout		Evaporator pump thermal cutout		Evaporator pump thermal cutout	
5	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch
6	Oil differential / Level	Oil differential / Level	Oil differential / Level	Oil differential / Level	Oil differential / Level	Oil differential / Level
7	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)
8	Double set point		Double set point		Double set point	
9	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)
10	Condenser pump thermal cutout		Condenser pump thermal cutout		Condenser pump thermal cutout	
11	High pressure switch	High pressure switch	High pressure switch	High pressure switch	High pressure switch	High pressure switch
12	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout

7.4.2 Analogue inputs

	Chiller-only units - UNIT TYPE "3"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Evaporator water inlet temperature		High pressure	High pressure	Evaporator water inlet temperature	
2	Evaporator water outlet temperature	Evaporator water outlet temperature	Low pressure	Low pressure	Evaporator water outlet temperature	Evaporator water outlet temperature
3	Outlet temperature	Outlet temperature	Outlet temperature	Outlet temperature	Condenser water inlet temperature	
4	Condenser water outlet temperature	Condenser water outlet temperature	Voltage / current / outside set point	Voltage / current	Condenser water outlet temperature	Condenser water outlet temperature
5	Condenser water inlet temperature		Evaporator water inlet temperature		Voltage / current / outside set point	Voltage / current
6	Voltage / current / outside set point	Voltage / current	Evaporator water outlet temperature	Evaporator water outlet temperature	Outlet temperature	Outlet temperature
7	High pressure	High pressure	Condenser water inlet temperature		High pressure	High pressure
8	Low pressure	Low pressure	Condenser water outlet temperature	Condenser water outlet temperature	Low pressure	Low pressure

7.4.3 Digital outputs

	Chiller-only units - UNIT TYPE "3"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Evaporator pump		Evaporator pump		Evaporator pump	
2	Line contactor	Line contactor	Line contactor	Line contactor	Line contactor	Line contactor
3	Star contactor	Star contactor	Star contactor	Star contactor	Star contactor	Star contactor
4	Delta contactor	Delta contactor	Delta contactor	Delta contactor	Delta contactor	Delta contactor
5	Liquid solenoid	Liquid solenoid C 2	Liquid solenoid	Liquid solenoid C 2	Liquid solenoid	Liquid solenoid C 2
6	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1
7	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2
8	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3
9	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler
10	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater
11	General alarm	General alarm	General alarm	General alarm	General alarm	General alarm
12	Condenser pump		Condenser pump		Condenser pump	
13						

7.4.4 Analogue outputs

	Chiller-only units - UNIT TYPE "3"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1						
2						

7.5 Chiller + heat pump units with reversal on gas circuit – unit type "4"

7.5.1 Digital inputs

	Chiller + heat pump units with reversal on gas circuit - UNIT TYPE "4"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)
2	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)
3	Remote ON/OFF		Remote ON/OFF		Remote ON/OFF	
4	Evaporator pump thermal cutout		Evaporator pump thermal cutout		Evaporator pump thermal cutout	
5	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch
6	Oil differential 1/ oil level	Oil differential 2/ oil level	Oil differential 1/ oil level	Oil differential 2/ oil level	Oil differential 1/ oil level	Oil differential 2/ oil level
7	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)
8	Double set point		Double set point		Double set point	
9	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)
10	Cooling / heating		Cooling / heating		Cooling / heating	
11	High pressure switch	High pressure switch	High pressure switch	High pressure switch	High pressure switch	High pressure switch
12	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout

7.5.2 Analogue inputs

	Chiller + heat pump units with reversal on gas circuit - UNIT TYPE "4"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Evaporator water inlet temperature		High pressure	High pressure	Evaporator water inlet temperature	
2	Evaporator water outlet temperature	Evaporator water outlet temperature	Low pressure	Low pressure	Evaporator water outlet temperature	Evaporator water outlet temperature
3	Outlet temperature	Outlet temperature	Outlet temperature	Outlet temperature	Condenser water inlet temperature	
4	Condenser water outlet temperature	Condenser water outlet temperature	Voltage / current / outside set point	Voltage / current	Condenser water outlet temperature	Condenser water outlet temperature
5	Condenser water inlet temperature		Evaporator water inlet temperature		Voltage / current / outside set point	Voltage / current
6	Voltage / current / outside set point	Voltage / current	Evaporator water outlet temperature	Evaporator water outlet temperature	Outlet temperature	Outlet temperature
7	High pressure	High pressure	Condenser water inlet temperature		High pressure	High pressure
8	Low pressure	Low pressure	Condenser water outlet temperature	Condenser water outlet temperature	Low pressure	Low pressure

7.5.3 Digital outputs

	Chiller + heat pump units with reversal on gas circuit - UNIT TYPE "4"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Evaporator pump		Evaporator pump		Evaporator pump	
2	Line contactor	Line contactor	Line contactor	Line contactor	Line contactor	Line contactor
3	Star contactor	Star contactor	Star contactor	Star contactor	Star contactor	Star contactor
4	Delta contactor	Delta contactor	Delta contactor	Delta contactor	Delta contactor	Delta contactor
5	Liquid solenoid	Liquid solenoid	Liquid solenoid	Liquid solenoid	Liquid solenoid	Liquid solenoid
6	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1
7	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2
8	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3
9	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler
10	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater
11	General alarm	General alarm	General alarm	General alarm	General alarm	General alarm
12	Condenser pump		Condenser pump		Condenser pump	
13	4-way valve	4-way valve	4-way valve	4-way valve	4-way valve	4-way valve

7.5.4 Analogue outputs

	Chiller + heat pump units with reversal on gas circuit - UNIT TYPE "4"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1						
2						

7.6 Chiller + heat pump units with reversal on water circuit – unit type "5"

7.6.1 Digital inputs

	Chiller + heat pump units with reversal on water circuit - UNIT TYPE "5"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)	Serious alarm (can be enabled)
2	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)	Evaporator flow switch (can be enabled)
3	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF	Remote ON/OFF
4	Evaporator pump thermal cutout		Evaporator pump thermal cutout		Evaporator pump thermal cutout	
5	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch	Low pressure switch
6	Oil differential 1/ oil level	Oil differential 2/ oil level	Oil differential 1/ oil level	Oil differential 2/ oil level	Oil differential 1/ oil level	Oil differential 2/ oil level
7	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)	Phase monitor (can be enabled)
8	Double set point		Double set point		Double set point	
9	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)	Condenser flow switch (can be enabled)
10	Cooling / heating		Cooling / heating		Cooling / heating	
11	High pressure switch	High pressure switch	High pressure switch	High pressure switch	High pressure switch	High pressure switch
12	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout	Compressor thermal cutout

7.6.2 Analogue inputs

	Chiller + heat pump units with reversal on water circuit - UNIT TYPE "5"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Evaporator water inlet temperature		High pressure	High pressure	Evaporator water inlet temperature	
2	Evaporator water outlet temperature	Evaporator water outlet temperature	Low pressure	Low pressure	Evaporator water outlet temperature	Evaporator water outlet temperature
3	Outlet temperature	Outlet temperature	Outlet temperature	Outlet temperature	Condenser water inlet temperature	
4	Condenser water outlet temperature	Condenser water outlet temperature	Voltage / current / outside set point	Voltage / current	Condenser water outlet temperature	Condenser water outlet temperature
5	Condenser water inlet temperature		Evaporator water inlet temperature		Voltage / current / outside set point	Voltage / current
6	Voltage / current / outside set point	Voltage / current	Evaporator water outlet temperature	Evaporator water outlet temperature	Outlet temperature	Outlet temperature
7	High pressure	High pressure	Condenser water inlet temperature		High pressure	High pressure
8	Low pressure	Low pressure	Condenser water outlet temperature	Condenser water outlet temperature	Low pressure	Low pressure

7.6.3 Digital outputs

	Chiller + heat pump units with reversal on water circuit - UNIT TYPE "5"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1	Evaporator pump		Evaporator pump		Evaporator pump	
2	Line contactor	Line contactor	Line contactor	Line contactor	Line contactor	Line contactor
3	Star contactor	Star contactor	Star contactor	Star contactor	Star contactor	Star contactor
4	Delta contactor	Delta contactor	Delta contactor	Delta contactor	Delta contactor	Delta contactor
5	Liquid solenoid	Liquid solenoid	Liquid solenoid	Liquid solenoid	Liquid solenoid	Liquid solenoid
6	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1	Unloader relay 1
7	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2	Unloader relay 2
8	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3	Unloader relay 3
9	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler	Liquid Inj. / Econ. / Oil Cooler
10	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater	Antifreeze heater
11	General alarm	General alarm	General alarm	General alarm	General alarm	General alarm
12	Condenser pump		Condenser pump		Condenser pump	
13	4-way valve	4-way valve	4-way valve	4-way valve	4-way valve	4-way valve

7.6.4 Analogue outputs

	Chiller + heat pump units with reversal on water circuit - UNIT TYPE "5"					
No.	pCO2 / pCO3 MEDIUM		pCO1 MEDIUM		pCOC MEDIUM	
	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)	Master (address 1)	Slaves (addresses 2/3/4)
1						
2						

8. List of parameters

The following table lists the parameters in the program, with the following information: code of the screen (the codes are shown in the top right of the screen) to assist the identification of the parameter (screen), default value, minimum and maximum limits for the settings (range), unit of measure, and a free column for writing the desired value.
To find the required on the terminal display, proceed as follows:

- Identify the parameter in the table below and the corresponding screen code
- Using the list of screens (following paragraph) and the screen code, scroll to the screen on the terminal

DESCRIPTION OF THE PARAMETER	MASK/ SCREEN	MASTER SLAVE	DEFAULT VALUE	USER VALUE	RANGE	UNIT OF MEASURE
						
Enter password	A3	M/S	1234		0 to 9999	
Evaporator pump operating hour threshold	A4	M	10		0 to 999	hours x 1000
Reset evaporator pump operating hours	A4	M	N		N / Y	
Condenser pump operating hour threshold	A5	M	10		0 to 999	hours x 1000
Reset condenser pump operating hours	A5	M	N		N / Y	
Compressor operating hour threshold	A6	M	10		0 to 999	hours x 1000
Reset compressor operating hours	A6	M	N		N / Y	
Calibration of probe B1	A7	M/S	0		-9.9 to 9.9	
Calibration of probe B2	A7	M/S	0		-9.9 to 9.9	
Calibration of probe B3	A7	M/S	0		-9.9 to 9.9	
Calibration of probe B4	A7	M/S	0		-9.9 to 9.9	
Calibration of probe B5	A8	M/S	0		-9.9 to 9.9	
Calibration of probe B6	A8	M/S	0		-9.9 to 9.9	
Calibration of probe B7	A8	M/S	0		-9.9 to 9.9	
Calibration of probe B8	A8	M/S	0		-9.9 to 9.9	
Enable compressor 1	A9	M	S		N / Y	
Enable compressor 2	A9	M	S		N / Y	
Enable compressor 3	A9	M	S		N / Y	
Enable compressor 4	A9	M	S		N / Y	
Delete alarm log	Aa	M/S	N		N / Y	
Valve control mode for Driver 1	Ab	M/S	Automatic		Aut/Man	
Number of valve manual opening steps Driver 1	Ab	M/S	0		0 to 9999	Steps
Valve control mode for Driver 2	Ac	M/S	Automatic		Aut/Man	
Number of valve manual opening steps Driver 2	Ac	M/S	0		0 to 9999	Steps
Release Driver 1 manually when starting	Ad	M/S	No		No/Yes	
Release Driver 2 manually when starting	Ae	M/S	No		No/Yes	
Enter new Maintenance password	Af	M/S	1234		0 to 9999	
						
Hour setting	K1	M/S	current hour		0 to 23	Hours
Minute setting	K1	M/S	current minutes		0 to 59	minutes
Day setting	K1	M/S	current day		1 to 31	
Month setting	K1	M/S	current month		1 to 12	
Year setting	K1	M/S	current year		0 to 99	
Enter clock password	K2	M	1234			
Enable on-off time bands	K3	M	N		N / S	
Start and end hours and minutes for time bands F1-1 and F1-2	K4	M	0		0-23 0-59	Hours Minutes
Start and end hours and minutes for time band F2	K5	M	0		0-23 0-59	Hours Minutes
Select time bands (F1-F2-F3-F4) for each day	K6	M	F1		F1-F2-F3-F4	
Enter new Clock password	K7	M	1234		0 to 9999	
						
Cooling set point	S1	M/S	12.0		see P1	°C
Heating set point	S1	M	45.0		see P2	°C
Second cooling set point	S2	M	12.0		see P1	°C
Second heating set point	S2	M/S	45.0		see P2	°C

DESCRIPTION OF THE PARAMETER	MASK/ SCREEN	MASTER SLAVE	DEFAULT VALUE	USER VALUE	RANGE	UNIT OF MEASURE
	prog					
Enter User password	P0	M/S	1234		0 to 9999	
Minimum limits for the cooling set point	P1	M/S	7.0		-99.9 / 99.9	°C
Maximum limits for the cooling set point	P1	M	17.0		-99.9 / 99.9	°C
Minimum limits for the heating set point	P2	M	40.0		-99.9 / 99.9	°C
Maximum limits for the heating set point	P2	M	50.0		-99.9 / 99.9	°C
Select control probe	P3	M	Inlet		Inlet / Outlet	
Type of control with evaporator inlet probe	P4	M	Prop.		Prop / Prop.+Int.	
Integral time	P4	M	600		0 to 9999	seconds
Outlet control – forced cooling shutdown	P5	M	5.0		-99.9 ÷ 99.9	°C
Outlet control – forced heating shutdown	P5	M	47.0		-99.9 ÷ 99.9	°C
Control band	P6	M	3.0		0 to 99.9	°C
Dead zone with modulating capacity control	P7	M/S	1.0		0 to 99.9	°C
Delay on power-up between pump-compressors	P8	M	5		0 to 999	seconds
Main pump stop delay	P9	M	5		0 to 999	seconds
Enable remote on / off	Pa	M/S	N		N / Y	
Type of remote on / off from master	Pa	M	Unit On/Off		Unit On/Off Circuit on/Off	
Enable on / off from the supervisor	Pl	M/S	N		N / Y	
Alarm relay logic	Pl	M/S	N.O.		N.O. / N.C.	
Enable cooling / heating selection from digital input	Pb	M	N		N / Y	
Enable cooling / heating selection from the supervisor	Pb	M	N		N / Y	
Enable language screen at power up	Pc	M/S	S		N / Y	
Type of freecooling control	Pd	M/S	Prop.		Prop / Prop.+Int.	
Integral time for freecooling management	Pd	M/S	150		0 to 9999	seconds
Freecooling offset on set point	Pd	M/S	5.0		0 to 99.9	°C
Minimum freecooling delta	Pe	M/S	2.0		0 to 99.9	°C
Maximum freecooling delta	Pe	M/S	10.0		0 to 99.9	°C
Freecooling differential	Pe	M/S	4.0		2.0 to 99.9	°C
Compressor delay in freecooling	Pe	M/S	5		0 to 500	minutes
Minimum threshold for opening freecooling valve	Pf	M/S	50		0 to 100	%
Maximum threshold for opening freecooling valve	Pf	M/S	50		0 to 100	%
Start defrost	Pg	M/S	2.0		-99.9 / 99.9	°C / bar
End defrost	Pg	M/S	12.0		-99.9 / 99.9	°C / bar
Dripping time	Ph	M/S	10		5 to 999	seconds
Defrost start delay	Ph	M/S	1800		0 to 32000	seconds
Maximum defrost time	Ph	M/S	300		0 to 32000	seconds
Reverse cycle configuration	Pi	M/S	Comp. always on		Comp. always on Comp. off start def. Comp. off end def. Comp. off start/end	
Board identification number for supervisory network	Pj	M/S	1		0 to 200	
Board communication speed for supervisory network	Pj	M/S	19200		1200 to 19200	bps
Select serial communication network	Pj	M/S	Carel		Carel / Modbus	
Select type of unit of measure	Pm	M	METRIC		METRIC / IMPERIAL	
Enter new User password	Pk	M/S	1234		0 to 9999	
menu + prog						
Enter Manufacturer password	Z0	M/S	1234		0 to 9999	
CONFIGURATION →						
Unit configuration	C1	M/S	0		0 to 5	
Enable probe B1	C2	M/S	Y (if pCO2-pCO3) N (if pCO1) Y (if pCOC)		N / Y	
Enable probe B2	C2	M/S	N		N / Y	
Enable probe B3	C2	M/S	N		N / Y	
Enable probe B4	C2	M/S	N		N / Y	
Enable probe B5	C2	M/S	N (if pCO2-pCO3) Y (if pCO1) N (if pCOC)		N / Y	
Enable probe B6	C2	M/S	N		N / Y	
Enable probe B7	C2	M/S	N		N / Y	
Enable probe B8	C2	M/S	N		N / Y	
General probe configuration (B4 on pCO1, B5su pCOC, B6 on pCO^2)	C3	M/S	No		No Outside set point Voltage Current	

Type of general probe	C3	M/S	0-1V (Set point and voltage) 4-20mA (current)		0 to 1 V 0 to 10 V 4-20mA	
Lower limit for general probe	C4	M/S	0 (voltage and current), -5.0 (outside set point)		-999.9 to 999.9	°C / V / A
Upper limit for general probe	C4	M/S	630 (voltage) 400 (current), 5.0 (outside set point)		-999.9 to 999.9	°C / V / A
Type of probes on analogue inputs 1 and 2 (pCO1 only)	C5	M/S	4-20mA		4-20mA / 0-5V	
Type of outlet temperature probe	C6	M/S	NTC		NTC / 4-20mA	
Lower limit for outlet probe	C6	M/S	-30.0		-999.9 to 999.9	°C
Upper limit for outlet probe	C6	M/S	150.0		0.0 to 999.9	°C
Lower limit for high pressure probe	C7	M/S	00.0		-99.9 to 99.9	bar
Upper limit for high pressure probe	C7	M/S	30.0		-99.9 to 99.9	bar
Lower limit for low pressure probe	C8	M/S	-0.5		-99.9 to 99.9	bar
Upper limit for low pressure probe	C8	M/S	7.0		-99.9 to 99.9	bar
Enable double set point	C9	M	Disabled		Disabled / Enabled	
Number of drivers	Ca	M/S	0		0 to 2	
Number of compressors	Ca	M/S	1		1 to 4	
Compressor rotation	Ca	M	S		N / Y	
Type of load steps	Cb	M/S	Steps		Steps / Mod.	
Number of steps per compressor	Cb	M/S	4		1 to 4	
Enable restrictions at power-up	Cc	M/S	N		N / Y	
Step 1 – Relay 1 logic	Cd	M/S	On		Off / On	
Step 1 – Relay 2 logic	Cd	M/S	Off		Off / On	
Step 1 – Relay 3 logic	Cd	M/S	Off		Off / On	
Step 2 – Relay 1 logic	Ce	M/S	Off		Off / On	
Step 2 – Relay 2 logic	Ce	M/S	Off		Off / On	
Step 2 – Relay 3 logic	Ce	M/S	On		Off / On	
Step 3 – Relay 1 logic	Cf	M/S	Off		Off / On	
Step 3 – Relay 2 logic	Cf	M/S	On		Off / On	
Step 3 – Relay 3 logic	Cf	M/S	Off		Off / On	
Step 4 – Relay 1 logic	Cg	M/S	Off		Off / On	
Step 4 – Relay 2 logic	Cg	M/S	Off		Off / On	
Step 4 – Relay 3 logic	Cg	M/S	Off		Off / On	
Enable special management for step 1	Ch	M/S	N		N / Y	
Standby configuration relay 6	Ci	M/S	Off		Off / On	
Standby configuration relay 7	Ci	M/S	On		Off / On	
Decrease configuration relay 6	Cj	M/S	On		Off / On	
Decrease configuration relay 7	Cj	M/S	On		Off / On	
Increase configuration relay 6	Ck	M/S	Off		Off / On	
Increase configuration relay 7	Ck	M/S	Off		Off / On	
Impulse period for modulating configuration	Cl	M/S	6		0 to 99	seconds
Minimum decrease impulse	Cl	M/S	1.5		0 to 99.9	seconds
Maximum decrease impulse	Cl	M/S	3.0		0 to 99.9	seconds
Derivation time for modulating configuration	Cm	M/S	3			seconds
Minimum decrease impulse	Cm	M/S	1.5		0 to 99.9	seconds
Maximum decrease impulse	Cm	M/S	3.0		0 to 99.9	seconds
Force decrease time at compressor start	Cn	M/S	20		0 to 999	seconds
Enable force compressor solenoid off	Co	M/S	N		N / Y	
Enable pumpdown	Cp	M/S	N		N / Y	
Maximum pumpdown time	Cp	M/S	50		0 to 999	seconds
Conf. step compressor for safety capacity	Cq	M/S	Max. capacity		Max. capacity / Min. capacity	
Enable condenser control	Cr	M/S	No		No / Yes	
Type of condenser control	Cr	M/S	Inverter		Inverter / Steps	
Number of fans per condenser	Cr	M/S	1		1 to 2	
Enable clock card	Cs	M/S	Disabled		Disabled / Enabled	
PARAMETERS →						
Restrictions at start-up – low pressure	G0	M/S				
Restrictions at start-up – high pressure	G0	M/S				
Restrictions at start-up – balancing pressure	G0	M/S				
Enable high condensing press./temp. prevention	G1	M/S	N		N / Y	
Type of condenser prevention	G1	M/S	Pressure		Press / Temp	
Condenser high press./temp. prevention set point	G1	M/S	20.0		0 to 99.9	bar / °C
Condenser high press./temp. prevention differential	G1	M/S	2.0		0 to 99.9	bar / °C
Enable outlet prevention	G2	M/S	N		N / Y	
Outlet prevention set point	G2	M/S	90.0		0 to 999.9	°C
Outlet prevention differential	G2	M/S	5.0		0 to 99.9	°C
Antifreeze prevention set point	G3	M/S	6.0		-99.9 to 99.9	°C
Antifreeze prevention differential	G3	M/S	1.0		0 to 99.9	°C
Condensing press./temp. set point	G4	M/S	14.0		-999.9 to 999.9	bar / °C
Condensing press./temp. differential	G4	M/S	2.0		-999.9 to 999.9	bar / °C

Maximum inverter speed	G5	M/S	10.0		0.0 to 10.0	V
Minimum inverter speed	G5	M/S	3.0		0.0 to 10.0	V
Maximum speed time	G5	M/S	10		0 to 99	seconds
Enable serious alarm	G6	M/S	N		N / Y	
Enable Phase Monitor alarm	G6	M/S	N		N / Y	
Enable evaporator flow switch alarm	G7	M/S	N		N / Y	
Enable condenser flow switch alarm	G7	M/S	N		N / Y	
Outlet temperature probe alarm set point	G8	M/S	120.0		0 to 999.9	°C
Outlet temperature probe alarm differential	G8	M/S	5.0		0 to 99.9	°C
High pressure probe alarm set point	G9	M/S	21.0		0 to 99.9	bar
High pressure probe alarm differential	G9	M/S	2.0		0 to 99.9	bar
Low pressure probe alarm set point	Ga	M/S	1.0		-99.9 to 99.9	bar
Low pressure probe alarm differential	Ga	M/S	0.5		-99.9 to 99.9	bar
Difference between high and low pressure alarm set point	Gb	M/S	6.0		0 to 99.9	bar
Diff. pressure alarm delay at start-up	Gb	M/S	20		0 to 999	seconds
High voltage alarm set point	Gc	M/S	440.0		0 to 999.9	V
High voltage alarm differential	Gc	M/S	5.0		0 to 99.9	V
High current alarm set point	Gd	M/S	200.0		0 to 999.9	A
High current alarm percentage differential	Gd	M/S	10.0		0 to 99.9	%
Antifreeze set point	Ge	M/S	3.0		0 to 999.9	°C
Antifreeze differential	Ge	M/S	1.0		0 to 99.9	°C
Pump status in the event of antifreeze alarm	Gf	M	Pump on		Pump on / Pump off	
Pump status in the event of evaporator or condenser flow switch alarm	Gk	M	Pumps off		Pumps on / Pumps off	
Solenoid valve management set point	Gg	M/S	80.0		0 to 999.9	°C
Solenoid valve management differential	Gg	M/S	10.0		0 to 99.9	°C
Antifreeze heater set point	Gh	M/S	5.0		0 to 99.9	°C
Antifreeze heater differential	Gh	M/S	1.0		0 to 99.9	°C
Reversing valve logic	Gi	M/S	N.O.		N.O. / N.C.	
Type of freecooling control	Gi	M/S	0/10V		On-off / 0-10V	
Antifreeze temperature	Gi	M/S	-2.0		-99.9 to 99.9	°C
Defrost probe configuration	Cj	M/S	Pressure switches		Temperature Pressure Pressure switches	
Type of global defrost	Cj	M/S	Simultaneous		Simultaneous Separate Independent	
CAREL EXV DRIVERS →						
Type of valve driver 1	F0	M/S	Custom		0 to 11 (see page 8)	
Enable battery 1	F0	M/S	N		N / Y	
Percentage ratio between cooling capacity and Driver 1 capacity	F1	M/S	60		0 to 100	%
Type of valve driver 2	F2	M/S	Custom		0 to 11 (see page 8)	
Enable battery 2	F2	M/S	N		N / Y	
Percentage ratio between cooling capacity and Driver 2 capacity	F3	M/S	60		0 to 100	%
Driver 1 superheat set point in chiller operation	F4	M/S	6.0		2.0 to 50.0	°C
Driver 1 dead band in chiller operation	F4	M/S	0		0 to 9.9	°C
Driver 1 superheat set point in defrost operation	F5	M/S	6.0		2.0 to 50.0	°C
Driver 1 dead band in defrost operation	F5	M/S	0		0 to 9.9	°C
Driver 2 superheat set point in heat pump operation	F6	M/S	6.0		2.0 to 50.0	°C
Driver 2 dead band in heat pump operation	F6	M/S	0		0 to 9.9	°C
Driver 1 proportional gain in chiller operation	F7	M/S	2.5		0.0 to 99.9	
Driver 1 integral time in chiller operation	F7	M/S	25		0 to 999	seconds
Driver 1 derivative time in chiller operation	F7	M/S	2.0		0.0 to 99.9	seconds
Driver 1 proportional gain in defrost operation	F8	M/S	2.5		0.0 to 99.9	
Driver 1 integral time in defrost operation	F8	M/S	25		0 to 999	seconds
Driver 1 derivative time in defrost operation	F8	M/S	2.0		0.0 to 99.9	seconds
Driver 2 proportional gain in heat pump operation	F9	M/S	2.5		0.0 to 99.9	
Driver 2 integral time in heat pump operation	F9	M/S	25		0 to 999	seconds
Driver 2 derivative time in heat pump operation	F9	M/S	2.0		0.0 to 99.9	seconds
Driver 1 threshold for low superheat protection in chiller operation	Fa	M/S	4.0		-4.0 to 10.0	°C
Driver 1 int. time for low superheat protection in chiller operation	Fa	M/S	1.0		0 to 25.5	seconds
Driver 1 threshold for low superheat protection in defrost operation	Fb	M/S	4.0		-4.0 to 10.0	°C
Driver 1 int. time for low superheat protection in defrost operation	Fb	M/S	1.0		0 to 25.5	Seconds
Driver 2 threshold for low superheat protection in heat pump operation	Fc	M/S	4.0		-4.0 to 10.0	°C
Driver 2 int. time for low superheat protection in heat pump operation	Fc	M/S	1.0		0 to 25.5	seconds
LOP protection threshold in chiller operation	Fd	M/S	-40.0		-70.0 to 50.0	°C
LOP protection integral time in chiller operation	Fd	M/S	4.0		0 to 25.5	seconds
LOP protection threshold in heat pump operation	Fe	M/S	-40.0		-70.0 to 50.0	°C
LOP protection integral time in heat pump operation	Fe	M/S	4.0		0 to 25.5	seconds
LOP protection threshold in defrost operation	Ff	M/S	-40.0		-70.0 to 50.0	°C
LOP protection integral time in defrost operation	Ff	M/S	4.0		0 to 25.5	seconds
MOP protection delay at start-up in chiller operation	Fg	M/S	30		0 to 500	seconds
MOP protection threshold in chiller operation	Fg	M/S	40.0		-50.0 to 99.9	°C
MOP protection integral time in chiller operation	Fg	M/S	4.0		0 to 25.5	seconds
MOP protection delay at start-up in heat pump operation	Fh	M/S	30		0 to 500	seconds
MOP protection threshold in heat pump operation	Fh	M/S	40.0		-50.0 to 99.9	°C

MOP protection integral time in heat pump operation	Fh	M/S	4.0		0 to 25.5	seconds
MOP protection delay at start-up in chiller operation	Fi	M/S	30		0 to 500	seconds
MOP protection threshold in chiller operation	Fi	M/S	40.0		-50.0 to 99.9	°C
MOP protection integral time in chiller operation	Fi	M/S	4.0		0 to 25.5	seconds
High condenser temp. protection threshold in chiller operation	Fj	M/S	75.0		0 to 99.9	°C
Integral time for high condenser temp. threshold in chiller operation	Fj	M/S	4.0		0 to 25.5	seconds
High condenser temp. protection threshold in heat pump operation	Fk	M/S	75.0		0 to 99.9	°C
Integral time for high condenser temp. threshold in heat pump operation	Fk	M/S	4.0		0 to 25.5	seconds
High condenser temp. protection threshold in defrost operation	Fl	M/S	75.0		0 to 99.9	°C
Integral time for high condenser temp. threshold in defrost operation	Fl	M/S	4.0		0 to 25.5	seconds
High suction temperature threshold in chiller operation	Fm	M/S	30.0		0 to 100.0	°C
High suction temperature threshold in heat pump operation	Fn	M/S	30.0		0 to 100.0	°C
High suction temperature threshold in defrost operation	Fo	M/S	30.0		0 to 100.0	°C
Type of refrigerant	Fp	M/S	R407c		R22 / R134a / R404a R407c / R410a / R507c R290 / R600 / R600a R717R / 744	
Custom Valve: minimum steps	Fq	M/S	0		0 to 8100	
Custom Valve: maximum steps	Fq	M/S	1600		0 to 8100	
Custom Valve: closing steps	Fr	M/S	3600		0 to 8100	
Custom Valve: return steps	Fr	M/S	0		0 to 8100	
Custom Valve: enable extra step in opening	Fs	M/S	N		N / Y	
Custom Valve: enable extra step in closing	Fs	M/S	N		N / Y	
Custom Valve: running current	Ft	M/S	250		0 to 1000	mA
Custom Valve: still current	Ft	M/S	100		0 to 1000	mA
Custom Valve: frequency	Fu	M/S	100		32÷330	Hertz
Custom Valve: duty cycle	Fu	M/S	50		0 to 100	%
Minimum evaporation pressure probe value	Fv	M/S	-0.5		-9.9÷10.0	Bar
Maximum evaporation pressure probe value	Fv	M/S	7.0		3.5÷200.0	Bar
Low superheat alarm delay	Fw	M/S	0		0 to 3600	seconds
High suction temperature alarm delay	Fw	M/S	0		0 to 3600	seconds
LOP alarm delay	Fx	M/S	0		0 to 3600	seconds
MOP alarm delay	Fx	M/S	0		0 to 3600	seconds
Capacity required from driver with step 1 active (stepped capacity control) or with continuous capacity control	Fy	M/S	33		0 to 100	%
Capacity required from driver with step 2 active	Fy	M/S	55		0 to 100	%
Capacity required from driver with step 3 active	Fz	M/S	77		0 to 100	%
Capacity required from driver with step 4 active	Fz	M/S	100		0 to 100	%
TIMES →						
Evaporator flow switch alarm delay at start-up	T0	M/S	15		0 to 99	seconds
Evaporator flow switch alarm delay in steady operation	T0	M/S	3		0 to 99	seconds
Condenser flow switch alarm delay at start-up	T1	M/S	15		0 to 99	seconds
Condenser flow switch alarm delay in steady operation	T1	M/S	3		0 to 99	seconds
Low pressure alarm delay at start-up	T2	M/S	40		0 to 99	seconds
Low pressure alarm delay in steady operation	T2	M/S	0		0 to 99	seconds
Oil differential alarm delay at start-up	T3	M/S	120		0 to 999	seconds
Oil differential alarm delay in steady operation	T3	M/S	10		0 to 999	seconds
High current alarm activation delay from compressor start	T9	M/S	10		0 to 9999	seconds
High current alarm delay from threshold exceeded	T9	M/S	300		0 to 9999	seconds
Time between star / line	T4	M/S	2		0 to 999	seconds/100
Star time	T4	M/S	200		0 to 999	seconds/100
Star / delta time	T4	M/S	1		0 to 999	seconds/100
Minimum compressor on time / Time to reach minimum capacity	T5	M/S	60		0 to 9999	seconds
Minimum compressor off time	T5	M/S	360		0 to 9999	seconds
Time between starts of different compressors / Time to reach maximum capacity	T6	M/S	10		0 to 9999	seconds
Time between starts of same compressor	T6	M/S	450		0 to 9999	seconds
Time between solenoid/load step 1	T7	M/S	10		0 to 9999	seconds
Time between load step 1 and load step 2	T7	M/S	25		0 to 9999	seconds
Time between load step 2 and load step 3	T7	M/S	300		0 to 9999	seconds
Time between load step 3 and load step 4	T7	M/S	300		0 to 9999	seconds
Time taken to reach arrive in steady operation after which the time between load steps is defined by the parameter below. If set to 0 the function is disabled.	T8	M	0		0 to 999	minutes
Time between load steps	T8	M	0		0 to 9999	seconds
INITIALISATION →						
Delete memory and install default values	V0	M/S	N		N / Y	
Set new Manufacturer password	V1	M/S	1234		0 to 9999	

9. Screens

The screens are sub-divided into 5 categories:

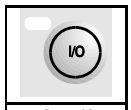
- **USER** screens, not password-protected: these are located in all the branches, except for "**prog**" and "**menu+prog**", and show the values read by the probes, the status of the alarms, the operating hours of the devices, the time and date; they are also used to set the temperature and humidity set point and the clock. These screens are indicated by the "⓿" symbol in the following table of parameters.
- **USER** screens, password-protected (1234, modifiable): these are accessed by pressing the "**prog**" button, and are used to set the main functions (times, set points, differentials) for the devices connected; the screens that relate to functions that are not available are not displayed. These screens are indicated by the "❶" symbol in the following table of parameters.
- **MAINTENANCE** screens, password-protected (1234, modifiable): these are accessed by pressing the "**maintenance**" button, and are used for performing the periodical checks on the devices, calibrating the probes, modifying the operating hours and manually activating the devices. These screens are indicated by the "❷" symbol in the following table of parameters.
- **MANUFACTURER** screens, password-protected (1234, modifiable): these are accessed by pressing the "**menu+prog**" buttons and are used to configure the air-conditioning unit, enable the main functions and select the devices connected. These screens are indicated by the "❸" symbol in the following table of parameters.

9.1 List of the screens

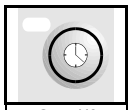
The following list shows the screens available on the display. The columns in the table represent the loop of screens, with the first screen (A0, B0…) being the one that is displayed when pressing the corresponding button, after which the arrow buttons can be used to scroll the other screens. The codes (Ax, Bx, Cx…) are displayed in the top right corner of the screens, making them easy to identify. The meaning of the symbols ⓿, ❶… is explained in the previous paragraph. The annotation PSW indicates screens that are protected by password.

⓿ M0

⓿ A0
⓿ A1
⓿ A2
⓿ A3
PSW A4
❷ A7
❷ A8
❷ A9
❷ Aa
❷ Ab
❷ Ac
❷ Ad
❷ Ae
❷ Af



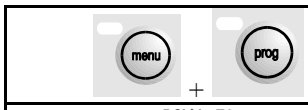
⓿ I0
⓿ I1
⓿ I2
⓿ I3
⓿ I4
⓿ I5
⓿ I6
⓿ I7
⓿ I8
⓿ I9
⓿ Ia
⓿ Ib
⓿ Ic
⓿ Id
⓿ Ie
⓿ If
⓿ Ig
⓿ Ih
⓿ Ii
⓿ Ij
⓿ Ik



⓿ K0
⓿ K1

⓿ S0
⓿ S1
⓿ S2

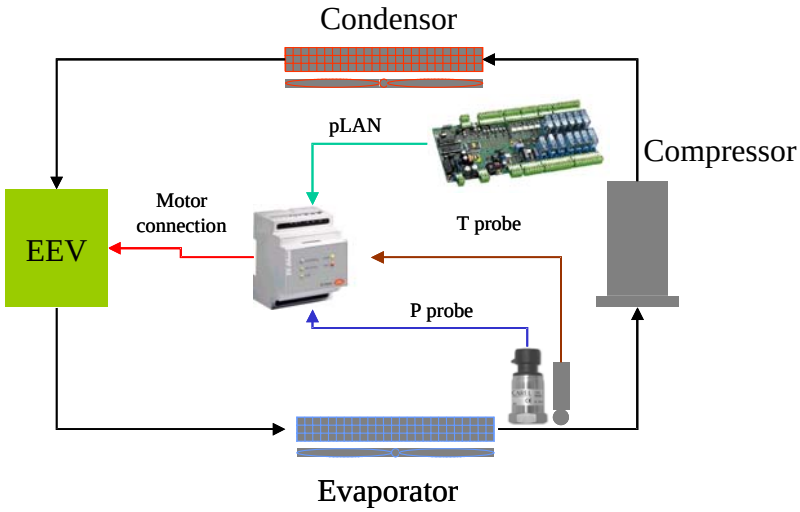
PSW P0
① P1
① P2
① P3
① P4
① P5
① P6
① P7
① P8
① P9
① Pl
① Pa
① Pb
① Pc
① Pd
① Pe
① Pf
① Pg
① Ph
① Pi
① Pj
① Pm
① Pk



	PSW Z0	
CONFIGURATION	→	③ C1
		③ C2
		③ C3
		③ C4
		.....
		③ Cr
		③ Cs
PARAMETERS	→	③ G0
		③ G1
		③ G2
		③ G3
		.....
		③ Gf
		③ Gk
		③ Gg
		③ Gh
		③ Gi
		③ Gj
CAREL EXV DRIVER	→	③ F0
		③ F1
		③ F2
		③ F3
		.....
		③ Fw
		③ Fx
		③ Fy
		③ Fz
TIMES	→	③ T0
		③ T1
		③ T2
		③ T3
		③ T9
		③ T4
		③ T5
		③ T6
		③ T7
		③ T8
INITIALISATION	→	③ V0
		③ V1

10. Electronic expansion valve

The EVDriver module for the control of electronic expansion valves (EEV) in pLAN networks allows superheating control on the suction side for a more efficient and versatile operation of the refrigerating unit.
Efficient because the optimisation and stabilisation of the flow of refrigerant to the evaporator increases the overall performance of the installation, at the same time guaranteeing the safety (less activations of the low pressure switch, less return of liquid refrigerant to the compressor,…). In addition, if the EEV is correctly sized, the use of floating condensing (and evaporation) pressure or a low set point significantly increases the efficiency of the installation, guaranteeing lower energy consumption, with higher refrigerating performance. Versatile because the electronic expansion valve allows the use of refrigeration units with different refrigerant capacities and operating in different conditions.
The use of an expansion valve requires the installation not only of the EVDriver and the expansion valve, but also of a temperature sensor and a pressure transducer, both fitted at the end of the evaporator on the refrigerant side (on the compressor intake pipe). See the diagram to better understand the typical layout of the installation. The priorities to be considered for the optimum control of the refrigeration system involve achieving a high and constant refrigerating efficiency, as well as low and stable superheating values. The heart of the control system is a PID control algorithm, with settable superheat coefficients.



The following values can also be set:

LOW (Low superheat with programmable integral time and threshold)

LOP (Low evaporation pressure, operating only in transients, with programmable integral time and threshold)

MOP (High evaporation pressure, with programmable integral time and threshold)

HiTcond (High condensing pressure, activated with condensing pressure probe read by the pCO, with programmable integral time and threshold)

The table of parameters lists the control parameters with the thresholds and default values. The table below explains the meaning of the TYPE OF VALVE parameter (see screens F1 – F2):

PARAMETER VALUE	CORRESPONDING TYPE OF VALVE
0	Alco EX5
1	Alco EX6
2	Alco EX7
3	Alco EX8
4	Sporlan SEI 0.5 - 11
5	Sporlan SEI 25
6	Sporlan SEI 50 – SHE 250
7	Danfoss ETS 50
8	Danfoss ETS 100
9	Carel E2V**P
10	Carel E2V**A
11	Custom (altro tipo di valvola)

10.1 DRIVER PARAMETERS

This section explains the fundamental parameters for setting up the driver. The description of the parameters includes the screen code, in brackets (see Chap. "LIST OF PARAMETERS") to assist the identification of the parameter.
Each pCO* board can manage a maximum of two drivers. As the configuration is identical for both, this section will only describe the configuration of the first driver.

10.1.1 Type of valve and use of the battery (F0)

The first screen is used to set the type of valve and whether the battery is sued. The following valves are possible:

- 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 E2V
- Custom Valve (when the valve used is not described above).

10.1.2 Percentage ratio circ./EEV (F1)

This indicates the ratio, expressed as a percentage, between the maximum cooling capacity of the circuit controlled by the EVDriver and the capacity attainable with the maximum opening of the expansion valve, *in the same normal operating conditions*. Normal operating conditions refer to all the installation variables that affect the refrigerating performance and the installation of the valve (condensing subcooling temperature, superheating, pressure drop,...).

10.1.3 Superheat set point in CH/HP/DF mode (F4/F5/F6)

Set point for superheat control. Values lower than 3°C are recommended. Dead band for superheat control. For temperatures between *Sheat Set – SH Dead band and Sheat Set + SH Dead band* the control is not active. For example, a dead band value of 1°C, with a set point of 5°C, means that the superheat is free to change between 4°C and 6°C without the controller attempting to modify it. Outside of this interval, the algorithm starts controlling again. Values above 2°C are recommended.
Important: The suffix -CH indicates that these parameters are used in chiller operation. The parameters must also be configured for heat pump and defrost operation.

10.1.4 PID parameters in CH/HP/DF operation (F7/F8/F9)

Constants used in the PID control of the EVDriver. These represent respectively:

- Proportional gain
- Integral time constant
- Derivative time constant

In this case too the configuration must be completed for all three types of operation.

10.1.5 Low superheat threshold in CH/HP/DF operation (Fa/Fb/Fc)

Low superheat threshold and corresponding integral constant for the activation of the low superheat protection. If the integral constant is set to zero the protection function is disabled.
In this case too the configuration must be completed for all three types of operation.

10.1.6 LOP threshold in CH/HP/DF operation (Fd/Fe/Ff)

Low suction pressure threshold and corresponding integral constant for the activation of the LOP protection. This protection function tends to open the electronic valve. If the integral constant is set to zero the protection function is disabled. In this case too the configuration must be completed for all three types of operation.

10.1.7 MOP threshold in CH/HP/DF operation (Fg/Fh/Fi)

High suction pressure threshold and corresponding integral constant for the activation of the MOP protection. This protection function tends to close the electronic valves. If the integral constant is set to zero the protection function is disabled. In this case too the configuration must be completed for all three types of operation

10.1.8 High condensing temperature threshold in CH/HP/DF operation (Fj/Fk/Fl)

High condensing temperature threshold and corresponding integral constant for the activation of the protection function. This protection function tends to close the electronic valves. If the integral constant is set to zero the protection function is disabled. In this case too the configuration must be completed for all three types of operation

10.1.9 Refrigerant (Fp)

Type of refrigerant used in the unit.

10.1.10 Configuration of the evaporation pressure probe (Fv)

This screen is used to set the minimum and maximum values for the range of the refrigerant pressure probe installed at the outlet of the evaporator connected to the driver.

10.2 Special "go ahead" function

```
+--------------------+
|Driver 1 status   Ad|
|                    |
|VALVE OPEN RESTART  |
|Go ahead? N         |
+--------------------+
```

There are three alarm conditions that prevent the driver from performing the normal control functions (one of these is displayed above):

- open valve → during the last blackout the valve was not closed completely
- recharge battery → the battery is not working correctly or alternatively is discharged or not connected
- reboot EEPROM → EEPROM malfunction

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

```
+--------------------+
|                AL86|
|Driver1:Waiting for |
|Eeprom/batt.charged |
|or open valve error |
+--------------------+
```

By using the "go ahead" function, these alarms can be ignored so as to allow the valve to be controlled by the driver (which otherwise would continue to keep it closed).

WARNING! deleting the alarms means ignoring them, and consequently it is recommended to carefully check that the system is not damaged or malfunctioning or becomes unreliable (e.g.: if "recharge battery" is signalled, it probably means that the battery is not charged or is not connected, etc. Consequently, in the event of a blackout, it may not be able to close the valve. The valve would thus remain open when the installation starts again). If none of the three alarms described above is present, the following screen is displayed:

```
+--------------------+
|Driver 1 status   Ad|
|                    |
|NO WARNINGS         |
|                    |
+--------------------+
```

11. Unit On/Off

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

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

The unit status can be controlled from the keypad, digital input (can be enabled), supervisor (can be enabled)
The On/Off operation from the keypad using the ON/OFF button has absolute priority, when the button is pressed the corresponding green LED will go off/come on to indicate the status.
Only if already on from the keypad can the unit be switched on/off from the supervisor and/or digital input; the unit off from supervisor and/or digital input is signalled by the flashing of the green LED corresponding to the ON/OFF button, and a special message on the main menu screen.

11.1.1 System On/Off

The function is performed by the master board: if switched on, it will also switch on all the slaves in the system, vice-versa for switching off.

11.1.2 Circuit On/Off

The function is performed by each slave board: only if the master board is on can the individual slave boards be switched on/off from the supervisor/digital input.

12. Control

Two separate types of temperature control are available:

- control depending on the water temperature values measured by the probe installed at the evaporator inlet;
- control depending on the water temperature values measured by the probe installed at the evaporator outlet.

In the first case, the control is proportional and based on the absolute temperature value measured by the probe; in the second case, control features a dead band based on the time the temperature measured by the probe remains over certain thresholds. The type of control in any case depends on the type of compressor managed:

- if the compressor features stepped capacity control (load steps) then either type of control can be used;
- if the compressor features continuous capacity control, then only outlet temperature control will be available.

12.1 Control set point

Inputs used:

- Digital input to enable second set point
- Analogue input for remote set point variation
- Supervisor serial network

Parameters used:

- Control set point
- Enable second set point from digital input
- Enable remote set point from analogue input
- Limits for calculating remote set point from analogue input
- Display set point used by the control

12.1.1 Description of operation

The temperature control, irrespective of the type, is based on the setting of two fundamental parameters: the set point and control band.
The control set point can be changed according to the operating requirements of the unit.
There are four different ways to change the control set point:

1. From the screen: accessing the special screen, the user can set the value of the parameter directly.
2. From the supervisor: if a supervisory system is connected, the cooling or heating set point can be modified by accessing the dedicated addresses.
3. From digital input: enabling the management of the secondary set point, the set point defined on the dedicated screen will be replaced by the corresponding user parameter, depending on the status of the digital input.
4. From analogue input: enabling the remote set point from analogue input (0-1V) will activate the control set point compensation, with a proportional value between the two limits for the conversion of the input signal.

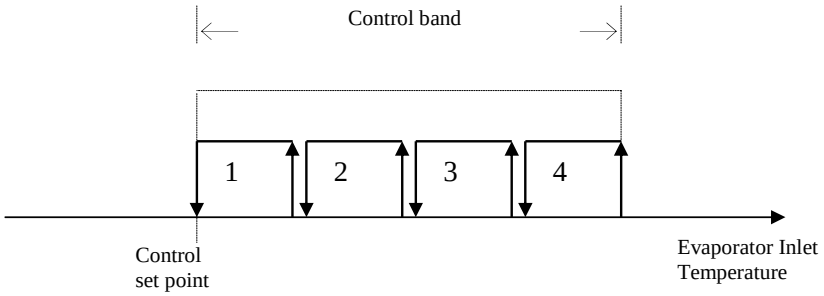
All the conditions may exist together, condition "1" is always active, while the others can be enabled or disabled separately.

12.2 Inlet temperature control

Inputs used:
- Evaporator water inlet temperature

Parameters used:
- Type of unit
- Total number of compressors
- Type of compressor capacity control
- Number of load steps
- Control set point
- Proportional band inlet control.
- Type of control (proportional or proportional + integral)
- Integral time (if proportional + integral control is enabled)
- Time between start and first load step
- Time between the first and second load step
- Time between the second and third load step
- Time between the third and fourth load step

Outputs used:
- Liquid solenoid
- Line - star - delta windings
- All compressor unloader relays



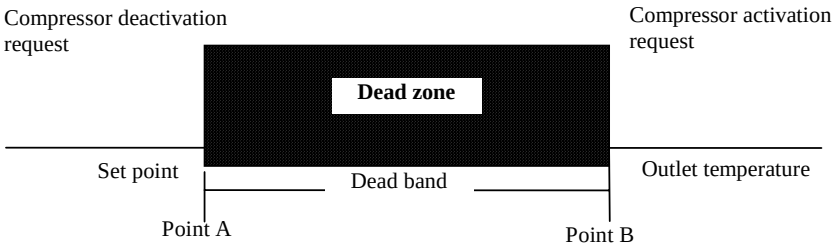
The temperature control depends on the values measured by the temperature probe located at the evaporator inlet, and follows proportional logic.
Depending on the total number of compressors configured and the number of load steps per compressor, the control band set will be divided into a number of steps of the same amplitude. When the various thresholds are exceeded, a compressor or load step will be activated.
The following relationships are applied to determine of the activation thresholds:
Total number of control steps = Number of compressors + (Number of compressors * Number load steps/compressor).
Proportional step amplitude = Proportional control band / Total number of control steps
Step activation threshold = Control set point + (Proportional step amplitude * Progressive step [1,2,3,…]).

12.3 Outlet temperature control

Inputs used:
- Evaporator water outlet temperature

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

Outputs used:
- Liquid solenoid
- Line - star -delta compressor windings
- All compressor unloader relays



A temperature dead band is identified based on the set point and band.
- Temperature values between the set point and set point + band (A $\leq$ Temperature $\leq$ B) will not switch any compressors On/Off.
- Temperature values above set point + band (Temperature > Point B) will activate the compressors
- Temperature values below the set point (Temperature < Point A) will deactivate the compressors

A temperature threshold is envisaged, for both cooling operation and heating operation, below/above which the devices installed will in any case be stopped, in order to avoid excessive cooling/heating output produced by the unit.
With capacity-control compressors, the activation and deactivation occur further outside of point A and B. See the chapter *Continuous capacity control with outlet control.*

12.4 Control of water/water chiller-only units

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

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

Outputs used:
- Liquid solenoid
- Line - star -delta compressor windings
- All compressor unloader relays

12.4.1 Description of operation:

The activation of the compressors depends on the water temperature measured by the evaporator inlet/outlet probe. There are no condenser fans because the condenser is water-cooled.

12.5 Control of water/water chiller units with heat pump and reversal on gas circuit

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

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

Outputs used
- Liquid solenoid
- Line - star -delta compressor windings
- All compressor unloader relays
- Refrigerant circuit reversing valve

12.5.1 Description of operation:

The activation of the compressors depends on the water temperature measured by the evaporator inlet/outlet probe. There are no condenser fans because the condenser is water-cooled.
When the refrigeration cycle is reversed, that is, switching from cooling to heating or vice-versa, the functions of the evaporator and the condenser are exchanged. The refrigerant circuit is reversed, and the compressors are always controlled according to the evaporator inlet/outlet temperature.

12.6 Control of water/water chiller units with heat pump and reversal on water circuit

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

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

Outputs used
- Liquid solenoid
- Line - star -delta compressor windings
- All compressor unloader relays
- Water circuit reversing valve

12.6.1 Description of operation:

The activation of the compressors depends on the water temperature measured by the evaporator inlet/outlet probe. There are no condenser fans because the condenser is water-cooled.
When the refrigeration cycle is reversed, that is, switching from cooling to heating or vice-versa, the functions of the evaporator and the condenser are not exchanged. The water circuit is reversed, and the compressors are always controlled according to the evaporator or condenser inlet/outlet temperature, depending on the mode selected.

13. Types of compressor controlled

13.1 Stepped capacity control

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

13.1.1 Unloader relay configuration

The activation sequence for the unloader relays is different for each compressor, and the software thus allows the possibility to configure the activation sequence according to the requirements of different compressor manufacturers.
For multi-board systems, considering the installation of the different compressors on the same unit, it is assumed that the compressors controlled by each pCO are perfectly balanced and thus the configuration of the load steps selected on the master board is also valid for the slave boards.
The following tables show some example configurations for the digital outputs dedicated to the various load steps.
The data shown is the effective status of the digital output.
Correspondence between the data shown in the table and the values set on the display:
Closed = ON Open = OFF

Default configuration:

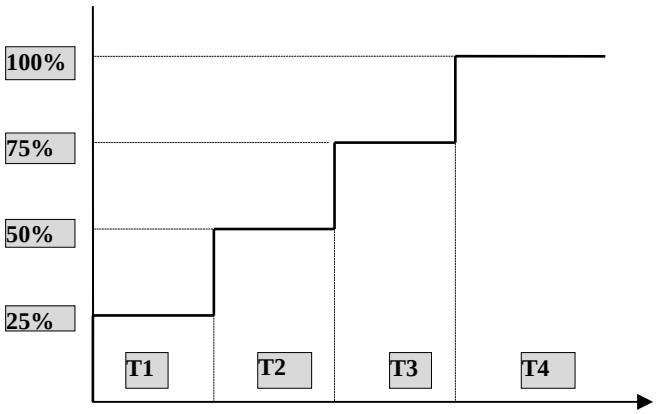
LOAD %	Relay 1	Relay 2	Relay 3
25%	CLOSED	OPEN	OPEN
50%	OPEN	OPEN	CLOSED
75%	OPEN	CLOSED	OPEN
100%	OPEN	OPEN	OPEN

Example configuration:

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

13.1.2 Stepped capacity control times

Stepped capacity control also allows a number of delays to be set for the activation of the various load steps
These delays indicate the minimum compressor ON time at a specific step, thus avoiding, when the unit is started with a request for maximum capacity, to switch directly from level 0 to the maximum level.
Time graph for 4-step capacity-control:



13.1.3 Special management of the first load step

The first capacity step can be managed specifically so as to respond to the special needs of the compressor when working at low capacity.
In general, this involves using the first capacity step only during the start-up phase, and if the temperature falls below the control set point. The compressor then uses a reduced capacity modulation field between the second step and maximum capacity.

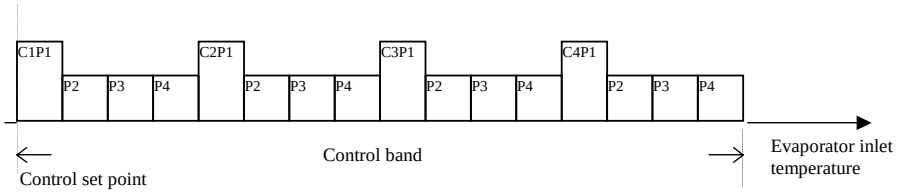
The type of management differs according to whether the compressor is starting or stopping, and in both cases avoids working at 25% capacity for too long:

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

This special operating mode can be enabled from the screen. If it is not enabled, the first load step is treated like the other steps, and the compressor will be able to operate at this load for an infinite time.

13.2 Stepped capacity control with inlet control

Description of operation of stepped capacity control for 4 compressors with four load steps each:



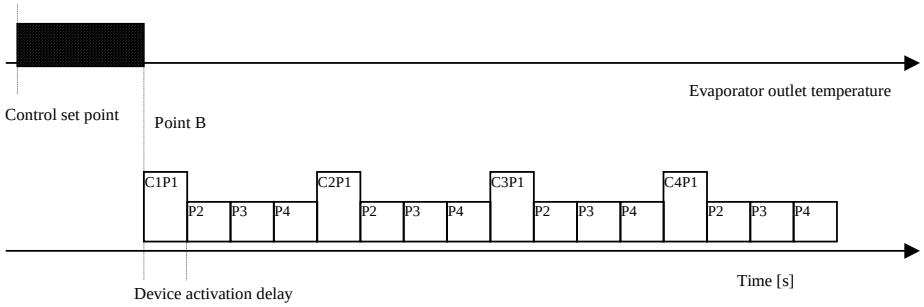
All the compressors and the corresponding load steps are positioned proportionally across the band. Increasing temperature values will lead to the activation of the successive step, following the set delay times relating. The compressor starts with the first load step activated. If special management of the first load step is enabled, the compressor will behave as described in the corresponding section. In any case, the delay times for the load steps will be applied as described.

13.3 Stepped capacity control with outlet control

Description of operation of stepped capacity control for 4 compressors with four load steps each:

13.3.1 Compressor activation

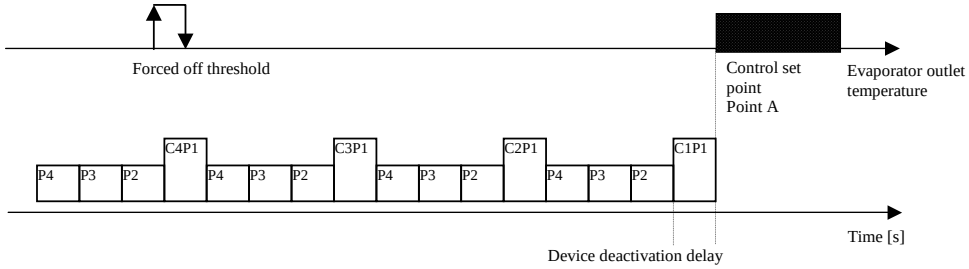
If the water temperature measured by the probe located at the evaporator outlet exceeds the threshold of the Control set point + Control band (Point b), then the number of active load steps will be increased, according to the parameter "device activation delay".



In this configuration the time between the activation of the steps will be equal to the set time between the starts of different compressors, while in the event of capacity-control, the delay time between load steps set will still be applied, and therefore the higher of the two times will prevail.

13.3.2 Compressor deactivation

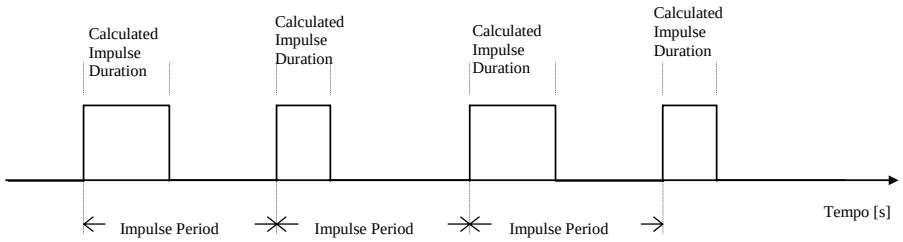
If the water temperature measured by the probe located at the evaporator outlet falls below the Control set point (Point A), then the number of load steps will be decreased, according to the parameter "device deactivation delay".



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

13.4 Continuous capacity control

A maximum of four compressors can be managed, with continuous capacity control. Capacity control is performed using two relay outputs that, suitably controlled, increase or decrease the compressor capacity by varying the capacity of the compression chamber. Compressor capacity is controlled by sending impulses to the unloader relay outputs so as to load or unload the compressor. These impulses have a constant frequency, which can be set, and a variable duration between two minimum and maximum limits, which can also be set. As the absolute position of the compressor capacity-control valve is not acquired, and thus it is not possible to directly check the percentage of capacity delivered to the circuit, when reaching a set time threshold, the compressor is considered completely loaded/unloaded and the capacity-control impulses are thus stopped.



13.4.1 Relay configuration for continuous capacity control

The activation sequence for the unloader relays is different for each compressor, and the software thus allows the possibility to configure the activation sequence according to the requirements of different compressor manufacturers.
For multi-board systems, considering the installation of the different compressors on the same unit, it is assumed that the compressors controlled by each pCO are perfectly balanced and thus the configuration of the load steps selected on the master board is also valid for the slave boards. The following tables show some example configurations for the digital outputs dedicated to the various load steps.
The data shown is the effective status of the digital output.
Correspondence between the data shown in the table and the values set on the display:
Closed = ON
Open = OFF

Default configuration:

Compressor behaviour	Relay 1	Relay 2
Decrease capacity	CLOSED	CLOSED
Maintain capacity	OPEN	CLOSED
Increase capacity	OPEN	OPEN

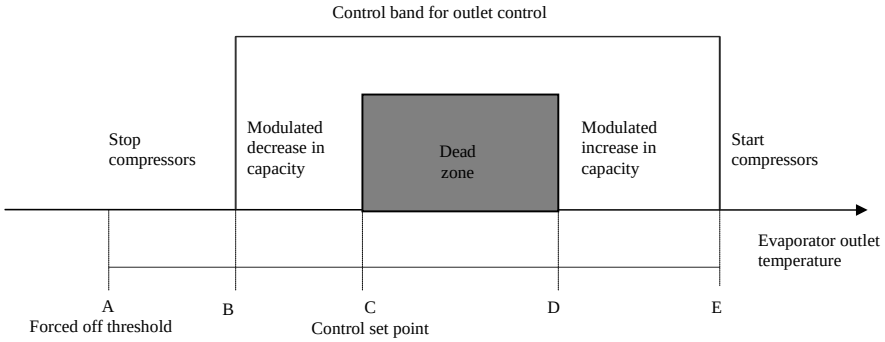
The maintain capacity configuration refers to the status of the outputs when no variation in capacity is requested, either because the maximum/minimum compressor capacity has been reached, or because the water temperature measured by the probe located at the evaporator outlet is within the dead zone.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

13.5 Continuous capacity control with outlet control

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

Parameters used:
- Dead zone for continuous capacity control
- Impulse period
- Minimum load impulse duration
- Maximum load impulse duration
- Minimum unload impulse duration
- Maximum unload impulse duration
- Forced unload period at compressor start
- Enable force unloader relay when compressor off

Outputs used:
- Compressor unloader relay 1
- Compressor unloader relay 2



13.5.1 Continuous capacity control according to points on the graph

Based on the set point, control band with outlet control and continuous capacity control dead zone values, points C, D, E are identified.
If the water temperature measured by the probe located at the evaporator outlet is higher than point E

Point E = Control set point + Control band/2 + Dead zone /2

Then there will be a request for the compressor to start and an increase in capacity according to charge impulses of the maximum duration until reaching the maximum compressor load time. If the water temperature measured by the probe located at the evaporator outlet is lower than point B

Point B = Control set point + Dead zone /2 - Control band/2

Then the compressors will be unloaded according to impulses of the maximum duration, until reaching the maximum compressor unload time or the compressor stops. If the water temperature measured by the probe located at the evaporator outlet is between points D-E/B-C

Point D = Control set point + Dead zone
Point C = Control set point

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

13.5.2 Compressor activation (temperature higher than point E)

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

13.5.3 Increase in compressor capacity

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

13.5.4 Modulated increase in capacity (temperature between points D-E)

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

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

If the temperature is inside dead zone, the unloader relays on all the active compressors take the maintain capacity configuration, thus maintaining the previous capacity reached.

13.5.6 Modulated decrease in capacity (temperature between points C-B)

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

13.5.7 Compressor deactivation (temperature below point b)

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

14. Compressor rotation

The compressor calls are rotated so as to balance the number of operating hours and starts between the devices. The rotation function follows FIFO logic: the first compressor to start will be the first to stop. At the beginning, there may be large differences between the operating hours of the various compressors, however over time these tend to balance out. Rotation is only performed between the compressors and not between the load steps, and in any case this type of rotation only works on compressors with load steps.
Management without rotation:

- Start: C1,C2,C3,C4.
- Stop: C4,C3,C2,C1.

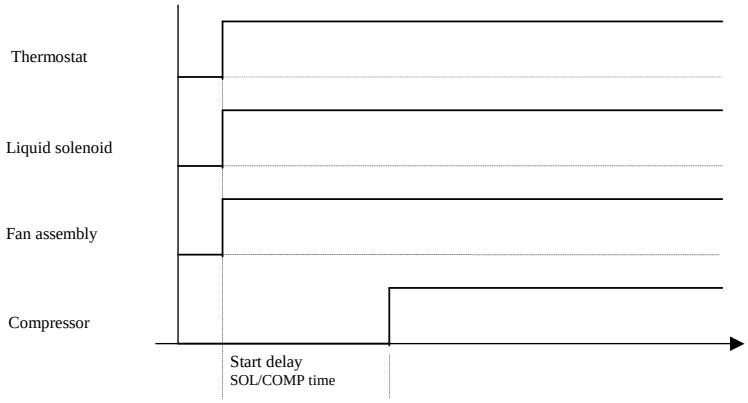
Management with FIFO rotation (the first compressor to start will be the first to stop):

- Start: C1,C2,C3,C4.
- Stop: C1,C2,C3,C4.

15. Starting an individual compressor

15.1.1 Description of operation

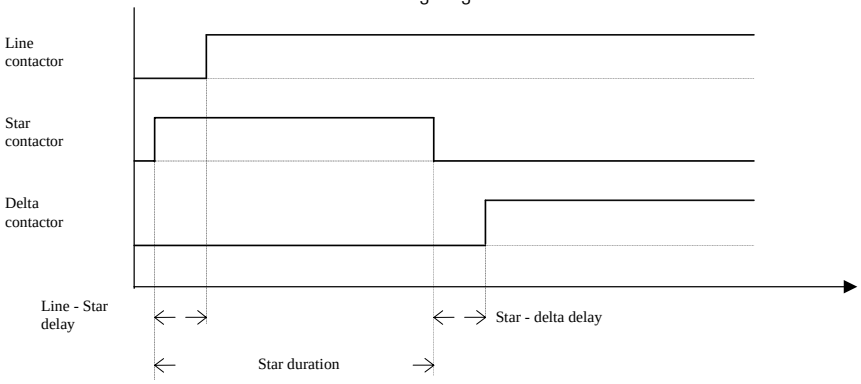
The start cycle is shown in the following graph



15.2 Starting the compressor motor

15.2.1 Star-delta

The motor is started as described in the following diagram



15.2.2 Starting with part-winding

To start the compressor with part-winding, the star and star-delta times must be reset, setting the required part-winding for the star-delta time. The line and delta relay outputs will be used, as part-winding relay A and B respectively. Example:

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

15.3 Restrictions when starting the compressor

There are two types of restrictions available when starting the compressor, and both make the compressor start directly using the delta contactor, bypassing the star contactor. These are both enabled in the same way:

1. When exceeding the set high and low pressure thresholds
2. When exceeding the set balanced pressure threshold (balanced pressure is the average between the low and high pressure measured by the transducers).

16. Forced capacity control

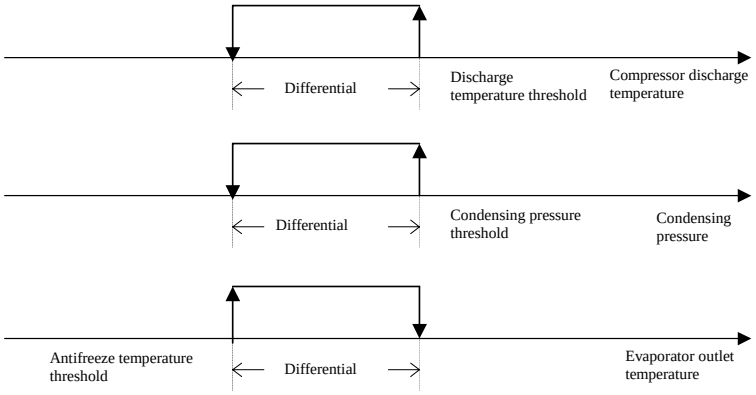
Inputs used
- Evaporator water outlet temperature
- Compressor discharge temperature
- Condensing pressure
- Current

Parameters used
- High discharge temperature prevention threshold
- high discharge temperature prevention differential
- High pressure prevention threshold
- High pressure prevention differential
- Antifreeze temperature prevention threshold
- Antifreeze temperature prevention differential
- Select force compressor to the minimum/maximum capacity
- High current alarm threshold
- High current alarm percentage differential
- Delay time to signal the high current alarm
- Delay time to prevent high current from compressor start

Outputs used
- All compressor unloader relays

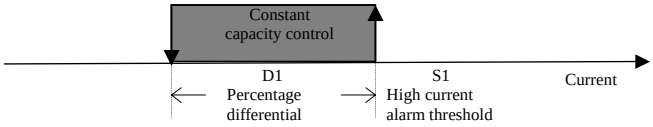
16.1.1 Description of the condensing pressure-antifreeze-discharge temperature prevent function

The forced compressor capacity control function prevents the unit from operating in abnormal pressure, chilled water temperature or condensing temperature conditions, thus avoiding the specific alarms. A parameter is available for selecting the compressor operating mode if forced capacity control is activated; the compressor can be operated at minimum/maximum capacity when:
- The high discharge temperature threshold is exceeded
- The high pressure threshold is exceeded
- The antifreeze temperature threshold is exceeded.



16.1.2 Description of the high current prevent function

If the probe for measuring the current input is enabled and correctly configured, forced capacity control is active for the high current condition.



The high current is controlled on a settable alarm threshold and differential. After a delay time from when compressor starts, is the current measured exceeds the set alarm threshold, a preventive action starts, which involves gradually decreasing the capacity of the compressor. The frequency of capacity reduction is equal to 1/3 of the set time T1 (delay time for signalling the high current alarm); in the case of compressors with stepped capacity control, the number of steps on will gradually be reduced, in the case of compressors with continuous capacity control, the unload will be managed with impulses lasting equal the minimum set time. There is a settable differential to return from the forced capacity control condition, expressed as a percentage of the alarm differential. The return of the current to values below the alarm threshold and in any case within the set differential will not cause any variation to the capacity of the compressor.
The activation of a further forced capacity-control function due to pressure or temperature will be managed by assigning higher priority to the function that involves a greater decrease in compressor capacity. The duration of the current measured above the alarm threshold for a continuous time that exceeds the set time, will involve the activation of the corresponding high current alarm, with the immediate shutdown of the compressor and the need for manual reset by the user.

16.1.3 Compressors with stepped capacity control

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

16.1.4 Compressors with continuous capacity control

In the case of compressors with continuous capacity control, the forced capacity control operates the compressor in continuous unload or continuous load mode, according to the setting made.

17. Solenoid valve management

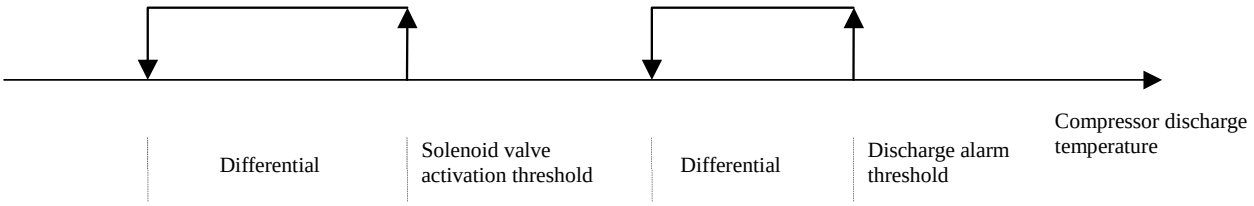
Inputs used:
- Compressor discharge temperature

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

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

17.1.1 Description of operation

A digital output is available for managing an economizer, oil-cooler or liquid-injection solenoid valve. Activation depends on the compressor discharge temperature read by the probe, as shown in the following graph:



18. Pump-down

Inputs used
- Low pressure switch

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

Outputs used
- Liquid solenoid
- Line - star -delta compressor windings
- All compressor unloader relays

18.1.1 Description of operation

If enabled, the pump-down function is activated when the compressor is stopped by the temperature controller.
The duration of the function can be set, and ends after a maximum time or if the low pressure switch is activated.
When an alarm that stops either the unit or the compressor is activated, the pump-down function ends immediately.
The activation of the pump-down function operates the compressor in forced capacity control mode:
- for compressors with stepped capacity control, the compressor operates at the minimum/maximum capacity.
- for compressors with modulating capacity-control, the compressor operates in continuous unload/load.

19. Condenser control

The condenser fans can be controlled as follows:
- in ON/OFF mode depending on the operation of the compressor (without the pressure transducers)
- in ON/OFF or modulating mode, depending on the reading of the pressure transducer (if the high pressure transducers have been enabled)
- in ON/OFF or modulating mode, depending on the coil temperature probes (if the coil temperature probes have been enabled)

Inputs used:
- Condensing pressure probe
- Condenser coil temperature probe

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

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

19.1 On/off condenser control linked to compressor operation

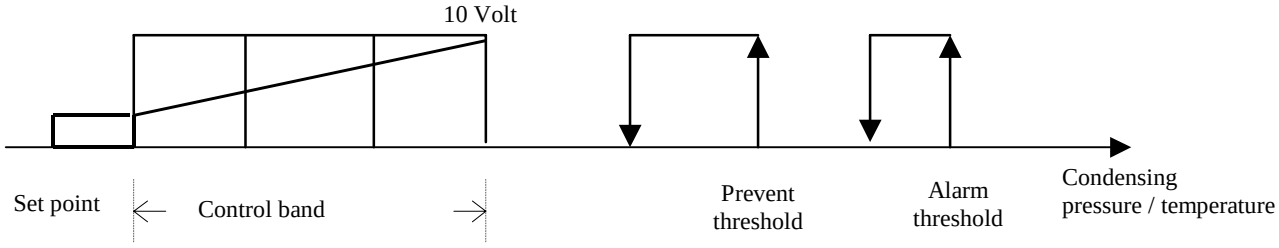
The operation of the fans depends exclusively on the operation of the compressors:
Compressor off = fan off
Compressor on = fan on

19.2 On/off condenser control linked to the pressure or temperature sensor

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

19.3 Modulating condenser control linked to the pressure or temperature sensor

In this mode, the fans are controlled using a 0/10V analogue output proportional to the reading of the pressure/temperature sensors. If the lower limit of the ramp is greater than 0V, the line will not be proportional but rather, as seen in the first section of the graph, one step below the set point - the differential.



19.4 Prevent function

This function can be enabled in the manufacturer branch, and prevents the circuits from being shutdown due to a high pressure alarm. When the compressors are on, once reaching the set threshold, the capacity of the compressor is controlled until the pressure returns below the set point by a set differential. When the compressors are off, once having reached the set threshold, the fans are started at maximum speed until the pressure returns below the set point by a set differential.

20. Defrost control for Water/Air units

Inputs used:
- Coil temperature B3 (can be used as a pressure switch)
- High pressure B7
- Defrost pressure switch 1 input

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

Outputs used:
- Compressor 1
- Reversing valve 1
- Fan

20.1 Types of defrost

20.1.1 Simultaneous

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

20.1.2 Separate

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

20.1.3 Independent

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

20.2 Type of end and start defrost

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

20.3 Defrosting a circuit with time/temperature control

If the temperature/pressure measured at a coil remains below the start defrost set point for a cumulative time equal to the defrost delay time, the circuit in question will start a defrost cycle:
- the system operates at maximum cooling capacity
- the refrigerant circuit is reversed using 4-way valve
- the fan in question is switched off (if the pressure probes are present)

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

20.4 Defrosting a circuit with time/pressure switch control

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

20.5 Fan operation during defrost

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

21. Freecooling control

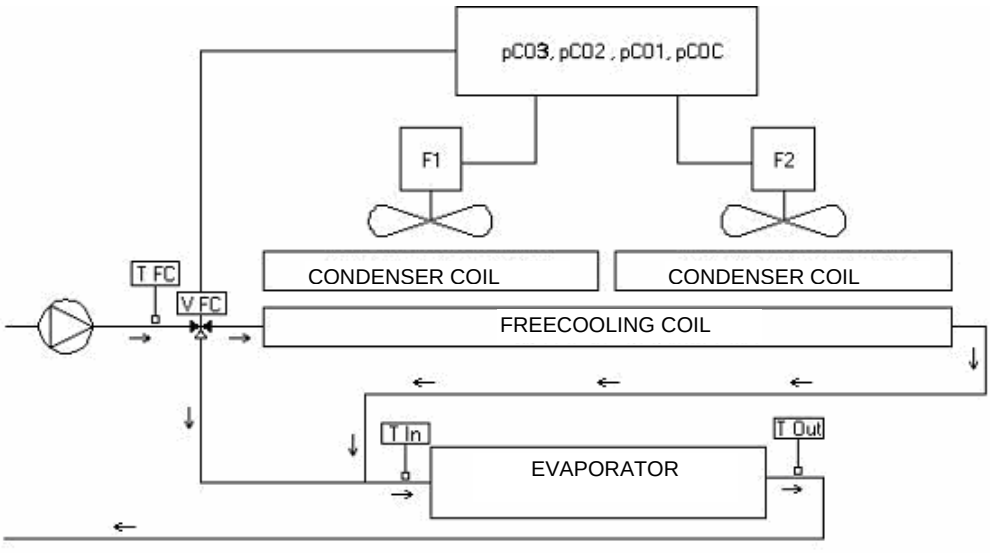
Inputs used
- Evaporator water outlet temperature
- Freecooling coil water inlet temperature
- Outside air temperature

Parameters used
- Type of unit
- Number of units
- Type of condenser control
- Number of fans
- Type of freecooling valve
- Type of freecooling control
- Integral time
- Control set point
- Control set point offset
- Minimum freecooling delta
- Maximum freecooling delta
- Freecooling control differential
- Maximum freecooling valve opening threshold
- Minimum condenser fan speed control threshold
- Freecooling antifreeze threshold
- Compressors activation delay

Outputs used
- Condenser fans
- Condenser fan speed control
- On/Off freecooling valve
- 3-way freecooling valve

21.1.1 Description of operation

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



21.2 Activation of the freecooling function

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

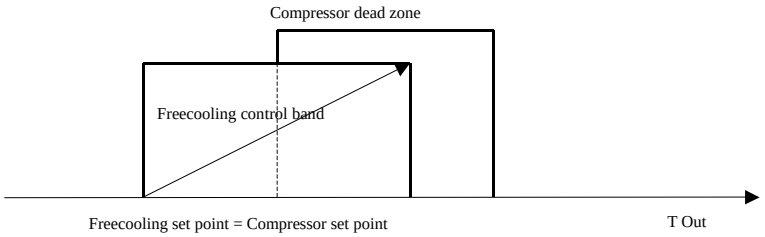
Outside temp. < Freecooling IN temp. – Min. freecooling delta

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

21.3 Freecooling thermostat

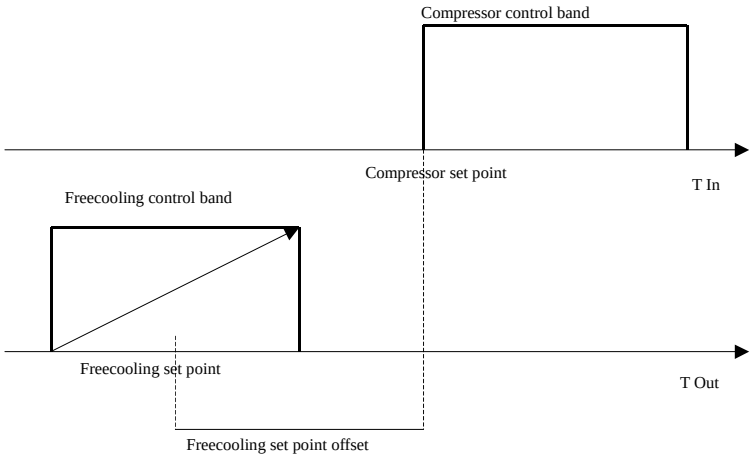
The freecooling function uses the control set point calculated (considering any compensation) and the freecooling control differential set. Control is based on the water temperature measured by the probe located at the evaporator outlet, considering the effective cooling contribution of the freecooling exchanger in the different outside temperature conditions.
Two different control modes can be selected: proportional, proportional + integral, in the latter case the integral constant will need to be set.
The set point for freecooling control will be determined based on the water temperature that needs to be produced by the unit. Depending on the type of control adopted for the compressors (inlet – outlet), as the temperature references are different, two distinct control graphs will be identified. In units with outlet control and dead zone, the freecooling control set point will correspond to the compressor control set point.

Freecooling set point = Compressor set point



The proportional control band will be equally distributed on both sides of the set point. The proportional band will be equally distributed on both sides of the set point.
In units with inlet control and proportional band, the freecooling control set point will use an offset from the compressor control set point to compensate for the presence of the evaporator coil.

Freecooling set point = Compressor set point – Offset



The proportional band will be equally distributed both sides of the set point. In the freecooling control band, the activation thresholds are calculated for the dedicated devices, such as valves, fans or speed controllers, depending on the mode selected.
As the fans and/or speed controllers are shared between freecooling and the condenser, if one or more compressors belonging to a certain refrigerant circuit are started, priority will be given to condenser control so as to safeguard the circuit.
The freecooling valve will in any case be kept completely open to maximise thermal performance, even with minimum ventilating capacity.
So as to optimise the efficiency of the freecooling function during the transients when the unit starts and in stable operation, a bypass time is envisaged for the thermostatic control of the compressors.
This time has the task of delaying the start of the compressors so as to allow the freecooling function to reach stable conditions and the bring the efficiency of the unit to the rated value; only after this time, with main thermostat not yet satisfied, will the compressors be started. When the time set is equal to 0, the function will be disabled. During the operation of the unit, the same parameter is used by the freecooling function to re-evaluate the operating conditions of the unit according to the value measured by the outside temperature probe. A further temperature delta can be set, which identifies a second threshold; below this value the efficiency of the freecooling coil is considered high enough as to be able to completely satisfy the thermal load of the installation by combined operation of the valve and fans only.

If the compressors are on, the outside temperature falls below the "maximum delta" set, according to the relationship:

Outside T. $\leq$ Freecooling Inlet T.– "Maximum delta" in freecooling

and the condition remains for a continuous time equal to the compressor bypass time set, the compressors will be stopped and operation will switch to freecooling only so as to satisfy the requirements of the load with the lowest possible energy expense. Once the bypass time elapses, the temperature control of the compressors will re-evaluate the requirements.
An antifreeze threshold is also envisaged, based on the value of the outside air temperature, so as to protect the exchanger during operation in cold environments. If the temperature of the outside air is less than the threshold, the valve that controls the flow of water inside the freecooling exchanger will be opened and the main circulating pump started (if off) to pump the fluid and prevent frost forming in the exchanger.
In the case of a 0 to 10V valve, the percentage of opening will depend on the unit operating status:

- with the unit off the valve will open to 100% of capacity
- with the unit on the valve will open to 10% of capacity

In the case of an on/off valve, the valve will always open to the maximum value, irrespective of the unit operating mode.
All the procedures will end as soon as the outside air temperature exceeds a fixed hysteresis of 1.0°C above the set threshold.

21.4 Deactivation of the freecooling function

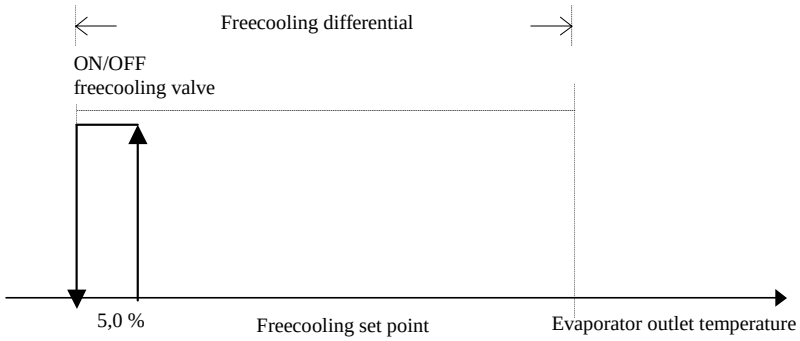
There are two main reasons for the freecooling valve to close, the first depending on the outside temperature, and the second depending on the desired control temperature. The freecooling valve will be closed if the freecooling conditions are no longer present

Outside T. $\geq$ (Freecooling T. – (Freecooling delta) + 1.5°C

The freecooling valve will be closed if the freecooling thermostat is satisfied. The reading of the water temperature probe located at the evaporator outlet is controlled for safety reasons. Based on the set thresholds, an antifreeze pre-alarm is managed, which will activate any post-heaters and deactivate the freecooling devices, as well as an antifreeze alarm that shuts down the entire unit. Other system safety devices, such as: serious alarm from digital input, pump thermal cutout, broken control probe, broken antifreeze control probe, evaporator flow switch alarm and the phase monitor alarm, will cause the complete shutdown of the unit, and consequently stop the freecooling function.

21.5 On/Off freecooling valve

21.5.1 Proportional control

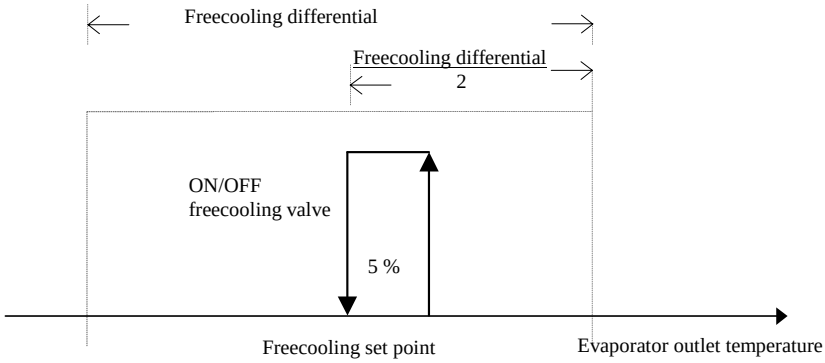


If the temperature conditions allow freecooling control, the ON/OFF freecooling valve will be activated as soon as the temperature exceeds the activation threshold for the step in question by a temperature value equal to:

Control set point – Freecooling differential + 5.0 % Freecooling differential

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

21.5.2 Proportional + integral control



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

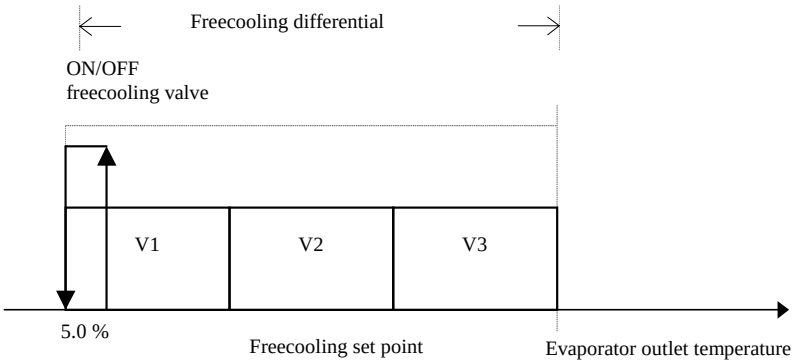
Control Set point + 5.0 % Freecooling differential

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

21.6 On/Off freecooling valve with condenser control by steps

21.6.1 Proportional control

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



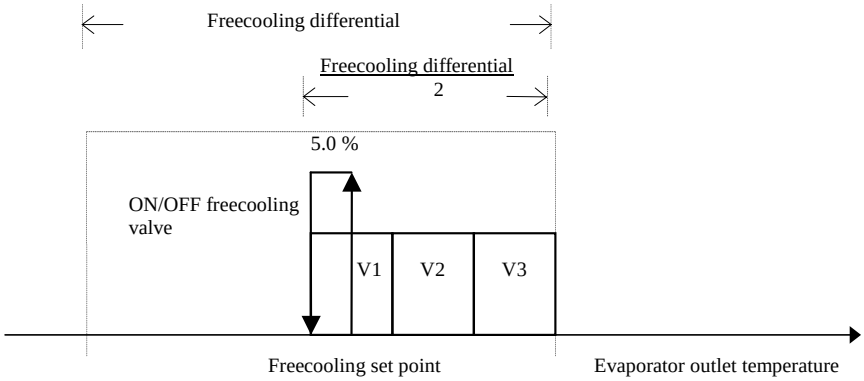
The activation step of the ON/OFF valve will in any case be positioned in the first part of the control differential, and its amplitude will be 5% of the differential. The activation steps of the condenser fans will be positioned proportionally inside the freecooling differential.
To calculate the amplitude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

$$\text{Step amplitude} = \frac{\text{Freecooling differential}}{\text{(No. master fans x Number of boards)}}$$

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

21.6.2 Proportional + integral control

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



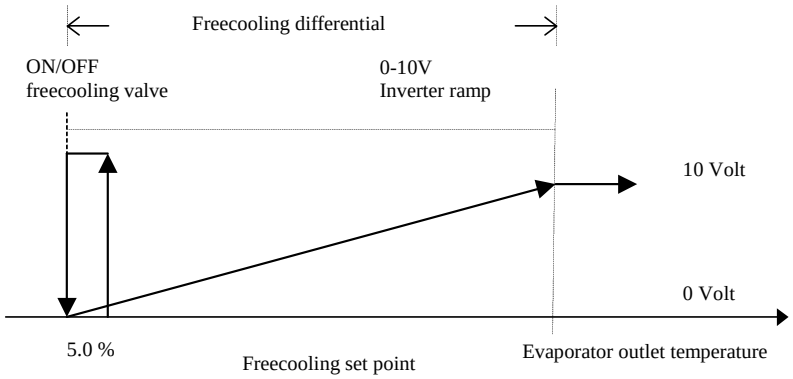
The devices, either valves or fans, will be activated in the second half of the control differential, due to the integral control. The activation of the devices will be bound by the integral constant, and will be slower as the value attributed to the specific parameter increases.
The amplitude of the valve control step will be equal to 5.0% of the control differential.
The amplitude of the fan control steps will be calculated as follows:

$$\text{Step amplitude} = \frac{\text{Freecooling differential}}{\text{(No. master fans x Number of boards)}}$$

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

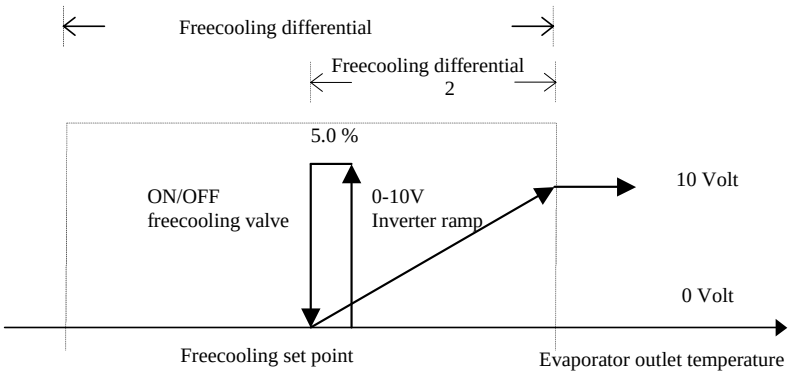
21.7 On/Off freecooling valve with condenser control by inverter

21.7.1 Proportional control



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

21.7.2 Proportional + integral control



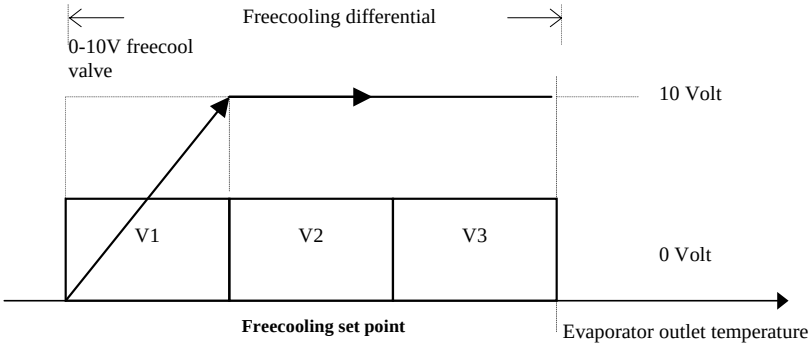
The devices, either valves or fans, will be activated in the second half of the control differential, due to the integral control. The activation of the devices will be bound by the integral constant, and will be slower as the value attributed to the specific parameter increases. The amplitude of the valve control step will be equal to 5.0% of the control differential. All the proportional outputs relating to the different units making up the system are controlled in parallel.

21.8 0 to 10 Volt freecooling valve

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

21.9 0 to 10 Volt freecooling valve with condenser control by steps

21.9.1 Proportional control

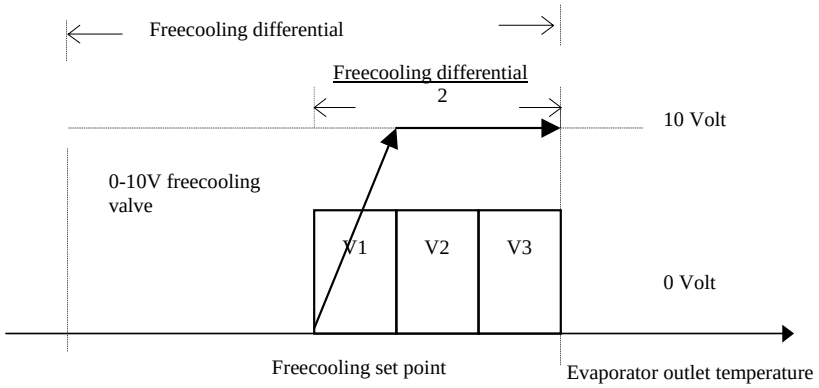


The freecooling valve proportional control ramp is calculated inside the first condenser fan activation step, in this way, when the first fan is started, the valve will be completely open, and thus there will be maximum water flow through the freecooling coil. The activation steps of the condenser fans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

$$\text{Step amplitude} = \frac{\text{Freecooling differential}}{\text{(No. master fans x Number of boards)}}$$

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

21.9.2 Proportional + integral control



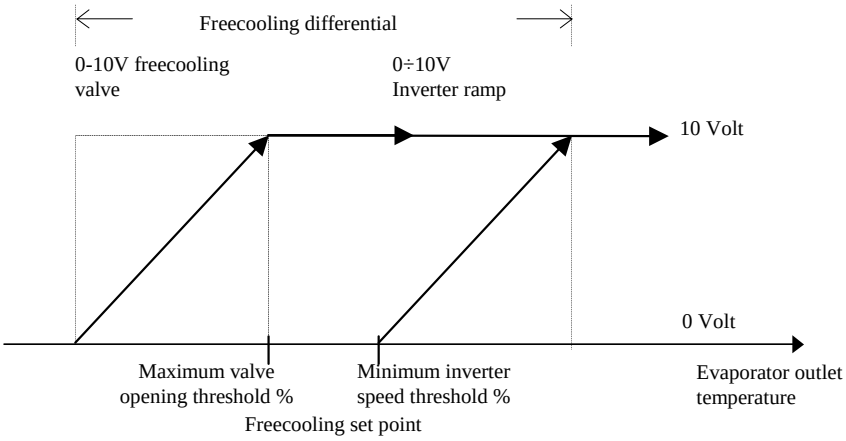
The devices, either valves or fans, will be activated in the second half of the control differential, due to the integral control. The activation of the devices will be bound by the integral constant set, and will be slower as the value attributed to the specific parameter increases. The freecooling valve proportional control ramp will be calculated inside the first fan activation step; in this way, when the first fan is started, the valve will be completely open, and thus there will be maximum water flow through the freecooling coil. The activation steps of the fans will be positioned proportionally inside the freecooling differential.
To calculate the amplitude of each step, use the following equation:

$$\text{Step amplitude} = \frac{\text{Freecooling differential}}{\text{(No. master fans x Number of boards)}}$$

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

21.10 0 to 10 Volt freecooling valve with condenser control by inverter

21.10.1 Proportional control



The proportional freecooling valve control ramp will be calculated inside the area determined by the following thresholds:
Control set point – Freecooling differential / 2
Control set point – Freecooling differential / 2 + Maximum valve opening threshold %

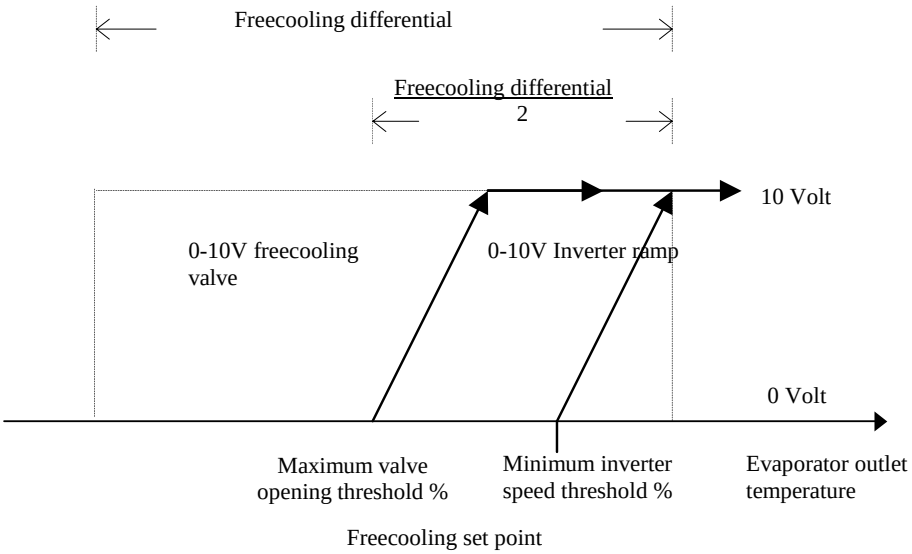
The proportional condenser inverter ramp will be calculated inside the area determined by the following thresholds:
Control set point –Freecooling differential / 2 + Minimum inverter speed threshold %
Control set point + Freecooling differential / 2

The start/end points of the two control ramps can be modified as desired by the user, by setting the value of the thresholds (see the graph) expressed as a percentage of the freecooling differential.
For the freecooling valve, the field of setting ranges from 25 to 100% of the differential.
For the condenser inverter, the field of setting ranges from 0 to 75% of the differential.

Example

Control set point =	12.0 °C
Freecooling differential =	4.0 °C
Freecooling valve threshold % =	40%
Condenser inverter threshold % =	80%
Freecooling valve control proportional area =	10.0 to 11.6°C
Control set point – Freecooling differential / 2 =	10.0°C
Maximum valve opening threshold % =	1.6°C
Condenser inverter control proportional area =	13.2 to.0°C
Control set point – Freecooling differential / 2 =	10.0°C
Control set point –Freecooling differential / 2 + Minimum inverter speed threshold % =	13.2°C

21.10.2 Proportional + integral control



The devices, either valves or fans, will be activated in the second half of the control differential, due to the integral control. The activation of the devices will be bound by the integral constant, and will be slower as the value attributed to the specific parameter increases.

22. Alarms

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

22.1 Serious alarms

- No water flow alarm
- Serious alarm from digital input
- Phase monitor alarm
- Pump thermal cutout

22.2 Circuit alarms

- High pressure alarm (pressure switch)
- Low pressure alarm
- Compressor thermal cutout alarm
- Oil differential alarm
- Fan thermal cutout alarm
- Unit disconnected from network alarm
- Differential pressure alarm
- Evaporator antifreeze alarm
- High current alarm

22.3 Signal-only alarms

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

22.4 Differential pressure management alarm

Inputs used
- Low pressure transducer
- High pressure transducer

Parameters used
- Enable alarm
- Differential pressure set point
- Alarm activation delay

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

22.4.1 Description of operation

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

22.5 Antifreeze control

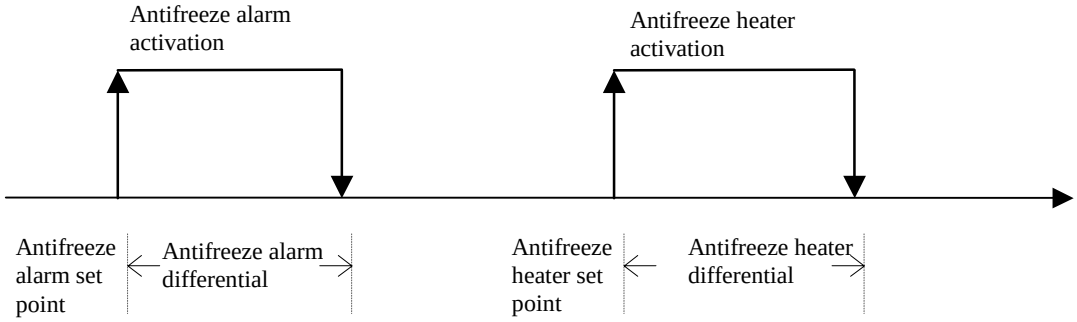
Inputs used:
- Evaporator water outlet temperature
- Condenser water outlet temperature

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

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

22.5.1 Description of operation

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



Antifreeze control is always active, even when the unit is off, in cooling and heating operation. For type 5 units with reversal on the water circuit, the antifreeze function always checks the evaporator water outlet temperature, using either the evaporator or the condenser according to the operating mode (cooling-heating).
The antifreeze alarm is a circuit alarm, in multi-board systems, and will cause the total shutdown of the unit when all the circuits are in antifreeze mode. A control parameter can be set to decide whether to leave the main pump on the event of antifreeze alarms. This will have effect only when all the circuits are in antifreeze status, otherwise the pump will remain on. In units with the freecooling coil, in the event of antifreeze alarms the 4-way valve will be closed.

22.6 Table of pCO alarms

Code	Alarm description	Compressors OFF	Fans OFF	Pump OFF	System OFF	Reset	Delay	Signal
011	Serious alarm	*	*	*	*	Manual		Mst/Slv
012	Phase monitor alarm	*	*	*	*	Manual		Mst/Slv
018	Evaporator pump thermal 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 differential pressure	*				Manual	Settable	Mst/Slv
017	Low pressure switch	*	*			Manual	Settable	Mst/Slv
016	High pressure switch	*				Manual		Mst/Slv
034	Low pressure transducer	*	*			Manual		Mst/Slv
033	High pressure transducer	*				Manual		Mst/Slv
021	Fan 1 thermal cutout		*			Manual		Mst/Slv
022	Fan 2 thermal cutout		*			Manual		Mst/Slv
035	High outlet temperature	*				Manual		Mst/Slv
036	High Voltage					Manual		Mst/Slv
037	High current	*				Manual		Mst/Slv
051	Evap. pump maintenance					Manual		Mst
052	Cond. pump maintenance					Manual		Mst
053	Compressor maintenance					Manual		Mst/Slv
060	Probe B1 fault	*	*	*	*	Automatic	10 s	Mst
061	Probe B2 fault	*	*	*	*	Automatic	10 s	Mst/Slv
062	Probe B3 fault					Automatic	10 s	Mst/Slv
063	Probe B4 fault					Automatic	10 s	Mst/Slv
064	Probe B5 fault					Automatic	10 s	Mst/Slv
065	Probe B6 fault					Automatic	10 s	Mst/Slv
066	Probe B7 fault					Automatic	10 s	Mst/Slv
067	Probe B8 fault					Automatic	10 s	Mst/Slv
041	32KB clock board fault					Manual		Mst/Slv

22.7 Driver board alarms

Code	Alarm description	Compressors OFF	Fans OFF	Pump OFF	System OFF	Reset	Delay	Signal
101	Probe error driver 1	*				Manual		Mst
102	EEPROM error driver 1	*				Manual		Mst/Slv
103	Stepper motor error driver 1	*				Manual		Mst/Slv
104	Battery error driver 1	*				Manual		Mst/Slv
105	High pressure on driver 1					Manual		Mst/Slv
106	Low pressure on driver 1					Manual		Mst/Slv
107	Low superheat driver 1	*				Manual		Mst/Slv
108	Valve not closed during shutdown driver 1	*				Manual		Mst/Slv
109	High suction temperature driver 1					Manual		Mst/Slv
110	Standby due to EEPROM/battery charge error or valve open driver 1	*				Manual		Mst/Slv
111	LAN disconnected driver 1	*				Manual		Mst/Slv
201	Probe error driver 2	*				Manual		Mst/Slv
202	EEPROM error driver 2	*				Manual		Mst/Slv
203	Stepper motor error driver 2	*				Manual		Mst/Slv
204	Battery error driver 2	*				Manual		Mst/Slv
205	High pressure on driver 2					Manual		Mst/Slv
206	Low pressure on driver 2					Manual		Mst/Slv
207	Low superheat driver 2	*				Manual		Mst/Slv
208	Valve not closed during shutdown driver 2	*				Manual or		Mst/Slv
209	High suction temperature driver 2					Manual		Mst/Slv
210	Standby due to EEPROM/battery charge error or valve open driver 2	*				Manual		Mst/Slv
211	LAN disconnected driver 2	*				Manual		Mst/Slv

23. Alarm log

The alarm log is used to save the operating status of the standard chiller when the alarms are generated. Each record saved to the memory represents an event that can be displayed. The log is useful in troubleshooting any faults as it represents a "snapshot" of the installation at the moment the alarm was generated, and may suggest the possible causes and solutions of the faults. The program features two types of log, the BASIC log and the ADVANCED log.

23.1 Basic log

Thanks to the significant buffer memory space, the pCO* boards can save the events in the BASIC log that is always present on the various boards. If the clock board (optional on pCO[1],pCO[XS] and pCO[C], built-in on pCO[2]) is not fitted, the BASIC log only displays the alarm code. A maximum number of 100 events can be saved; on reaching the one hundredth alarm, that is, the last space available in the memory, the next alarm overwrites the oldest alarm (00), which is thus deleted, and so on for the following events. The events saved cannot be deleted by the user. The BASIC log screen is accessible by pressing the MAINTENANCE button, and has the following layout:

```
+--------------------+
| Alarms history   A2|
|AL000 00:00 00/00/00|
|TIn 000.0 TOut 000.0|
|HP  000.0 LP   000.0|
+--------------------+
```

The following data are saved for each alarm, corresponding to the status of the standard chiller at the moment when the alarm occurred:

- alarm code
- time
- date
- chronological number of the event (0...99)

The chronological number of the event indicates the "age" of the event in the list of 100 events available. The alarm number 00 is the first event after the BASIC log was enabled, and therefore the oldest.
If the cursor is moved to the chronological number, the "history" of the alarms can be scrolled using the arrow buttons, from 0 to 99.
For example, from position 00 pressing the down arrow has no effect.
If 15 alarms have been saved and the log is in position 014, pressing the up arrow has no effect.

23.2 Advanced log

The events are saved to the 1MB or 2MB memory expansion, permanently connected to the board. The advantages and characteristics are listed below:

- Log by event: a typical log by event is the alarm log. If an alarm is activated, the alarm can be saved together with other significant values (temperature, pressure, set point, etc.).
- Log by time: a typical log by time is the log of temperature/pressure values. The temperature and pressure values are saved at regular intervals.
- Log of the logs: this saves the last alarms/temperature/pressure values recorded before a serious alarm. Unlike the data saved by the event and time logs, these data are not overwritten when the memory is full.
- Possibility to choose the values to be saved and the saving method at any time. The "WinLOAD" program can be used to define the values to be saved and the saving method, using a practical "Wizard". WinLOAD does not need the application software "files", as it can directly request the information required from the application software installed on the pCO[1] – pCO[2].
- 1MB dedicated flash memory. The system saves the data to the 1MB flash memory on the memory expansion (code PCO200MEM0). As an example, 1MB of memory can contain 5000 alarm events with 5 values for each alarm, and save 2 values, for example temperature and pressure, every 5 minutes for 6 months.
- Possibility to define up to 7 different log configurations. Typically each check will have configured a log of alarms, a log of the values of control (temperature/humidity/pressure) and some "log of the logs".
- Lookup the data saved from the LCD terminal (external or built-in) or from a connected PC.
- "Black box" operation. The memory expansion that contains the logs can be removed from the pCO[2] of the controlled unit and inserted in another pCO[2] to lookup the data saved. This pCO[2] does not need to run the same software as the original.
- Reliability of the data saved. The data are saved to FLASH memory that does not require batteries that may discharge. If following a software update the previously saved data are incompatible with the new software, all the data will be deleted (following confirmation).

23.3 List of alarm log codes

AL:001 Unit no. 1 Offline
AL:002 Unit no. 2 Offline
AL:003 Unit no. 3 Offline
AL:004 Unit no. 4 Offline
AL:011 Serious alarm from digital input
AL:012 Phase monitor alarm
AL:013 Evaporator flow switch alarm
AL:014 Condenser flow switch alarm
AL:015 Oil level alarm
AL:016 High pressure alarm (pressure switch)
AL:017 Low pressure alarm (pressure switch)
AL:018 Evaporator pump thermal cutout

AL:019 Condenser pump thermal cutout
AL:020 Compressor thermal cutout
AL:021 Condenser fan thermal cutout 1
AL:022 Condenser fan thermal cutout 2
AL:031 Antifreeze alarm
AL:032 Low pressure differential alarm
AL:033 High pressure alarm (transducer)
AL:034 Low pressure alarm (transducer)
AL:035 High outlet temperature alarm
AL:036 High voltage alarm
AL:037 High current alarm
AL:041 Clock board broken or not connected
AL:051 Evaporator pump maintenance
AL:052 Condenser pump maintenance
AL:053 Compressor maintenance
AL:060 Probe B1 broken or disconnected
AL:061 Probe B2 broken or disconnected
AL:062 Probe B3 broken or disconnected
AL:063 Probe B4 broken or disconnected
AL:064 Probe B5 broken or disconnected
AL:065 Probe B6 broken or disconnected
AL:066 Probe B7 broken or disconnected
AL:067 Probe B8 broken or disconnected
AL:101 Probe error driver 1
AL:102 EEPROM error driver 1
AL:103 Step motor error driver 1
AL:104 Battery error driver 1
AL:105 High pressure (MOP) driver 1
AL:106 Low pressure (LOP) driver 1
AL:107 Low superheat alarm driver 1
AL:108 Valve not closed during shutdown driver 1
AL:109 High suction temperature driver 1
AL:110 Standby for EEPROM error / battery recharge or valve open driver 1
AL:111 LAN disconnected driver 1
AL:201 Probe error driver 2
AL:202 EEPROM error driver 2
AL:203 Step motor error driver 2
AL:204 Battery error driver 2
AL:205 High pressure (MOP) driver 2
AL:206 Low pressure (LOP) driver 2
AL:207 Low superheat alarm driver 2
AL:208 Valve not closed during shutdown driver 2
AL:209 High suction temperature driver 2
AL:210 Standby for EEPROM error / battery recharge or valve open driver 2
AL:211 LAN disconnected driver 2

23.4 Short summary of the alarms deriving from the driver

- probe error (malfunction or breakage of the temperature and/or pressure probe);
- stepper motor error (fault in motor valve connections);
- EEPROM error (EEPROM malfunction in read or write);
- battery error (battery malfunction);
- high pressure at EXV driver (the operating pressure has exceeded the max. threshold, MOP);
- low pressure at EXV driver (the operating pressure has exceeded the min. threshold, LOP);
- low superheat alarm (superheat alarm);
- valve not closed during shutdown (valve not completely closed after the last blackout);
- high suction temperature alarm (the operating temperature has exceeded the max. threshold);
- standby due to EEPROM/battery charge error or valve open (the system is blocked due to a problem during the start-up of the driver, see the special "go ahead" function);
- LAN disconnected (malfunction or fault in the 485 communication between the pCO* and driver).

24. Supervisor

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

24.1.1 Key

A Analogue variable
D Digital variable
I Integer variable

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

Type	Direction	Address	Description
A	OUT	1	Value of analogue input 1
A	OUT	2	Value of analogue input 2
A	OUT	3	Value of analogue input 3
A	OUT	4	Value of analogue input 4
A	OUT	5	Value of analogue input 5
A	OUT	6	Value of analogue input 6
A	OUT	7	Value of analogue input 7
A	OUT	8	Value of analogue input 8
A	OUT	9	Value of analogue output 1
A	OUT	10	Value of analogue output 2
A	IN / OUT	11	Cooling temperature set point
A	IN / OUT	12	Heating temperature set point
A	IN / OUT	13	Condensing pressure/temperature set point
A	IN / OUT	14	Temperature control band
A	IN / OUT	15	Double cooling temperature set point
A	IN / OUT	16	Double heating temperature set point
I	OUT	2	pLAN address of the unit
I	IN / OUT	3	Type of fan management
I	IN / OUT	4	Type of unit configuration
I	IN / OUT	5	Number of compressors
I	IN / OUT	6	Number of fans
I	IN / OUT	50	Minimum compressor on time / Time to reach minimum capacity
I	IN / OUT	51	Minimum compressor off time
I	IN / OUT	52	Time between starts of different compressors / Time to reach maximum capacity
I	IN / OUT	53	Time between starts of same compressor
D	OUT	1	Unit status
D	OUT	2	Status of digital output 1
D	OUT	3	Status of digital output 2
D	OUT	4	Status of digital output 3
D	OUT	5	Status of digital output 4
D	OUT	6	Status of digital output 5
D	OUT	7	Status of digital output 6
D	OUT	8	Status of digital output 7
D	OUT	9	Status of digital output 8
D	OUT	10	Status of digital output 9
D	OUT	11	Status of digital output 10
D	OUT	12	Status of digital output 11
D	OUT	13	Status of digital output 12
D	OUT	14	Status of digital output 13
D	IN / OUT	15	Enable evaporator flow switch alarm
D	IN / OUT	16	Enable probe 1
D	IN / OUT	17	Enable probe 2
D	IN / OUT	18	Enable probe 3
D	IN / OUT	19	Enable probe 4
D	IN / OUT	20	Enable probe 5
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 restrictions at start-up
D	IN / OUT	26	Type of compressor capacity control
D	OUT	27	Select Cooling/Heating from digital input
D	OUT	28	Heat pump enabled
D	OUT	29	Cooling/Heating operation
D	OUT	30	Select condenser with inverter

Type	Direction	Address	Description
D	IN / OUT	31	Select cooling / heating
D	IN / OUT	32	Reset alarms
D	OUT	45	General alarm
D	OUT	46	Antifreeze alarm
D	OUT	47	Compressor thermal cutout alarm
D	OUT	48	Evaporator flow switch alarm
D	OUT	49	Condenser flow switch alarm
D	OUT	50	High pressure alarm from pressure switch
D	OUT	51	Oil level alarm
D	OUT	52	Low pressure alarm from pressure switch
D	OUT	53	High pressure alarm from transducer
D	OUT	54	Serious alarm from digital input
D	OUT	55	Fan 1 thermal cutout alarm
D	OUT	56	Fan 2 thermal cutout alarm
D	OUT	57	Evaporator pump thermal cutout alarm
D	OUT	58	Board 1 offline alarm
D	OUT	59	Slave 1 offline alarm
D	OUT	60	Slave2 offline alarm
D	OUT	61	Slave 3 offline alarm
D	OUT	62	Probe 1 broken or disconnected alarm
D	OUT	63	Probe 2 broken or disconnected alarm
D	OUT	64	Probe 3 broken or disconnected alarm
D	OUT	65	Probe 4 broken or disconnected alarm
D	OUT	66	Probe 5 broken or disconnected alarm
D	OUT	67	Probe 6 broken or disconnected alarm
D	OUT	68	Probe 7 broken or disconnected alarm
D	OUT	69	Probe 8 broken or disconnected alarm
D	OUT	70	Condenser pump operating hour alarm
D	OUT	71	Compressor operating hour 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 operating hour alarm
D	OUT	80	High outlet temperature alarm
D	OUT	81	Differential pressure alarm
D	OUT	82	Probe driver 1 alarm
D	OUT	83	EEPROM error driver 1
D	OUT	84	Valve step motor error driver 1
D	OUT	85	Battery error driver 1
D	OUT	86	High pressure driver 1 (MOP)
D	OUT	87	Low pressure driver 1 (LOP)
D	OUT	88	Low superheat driver 1
D	OUT	89	Valve not closed after blackout driver 1
D	OUT	90	High suction temperature driver 1
D	OUT	91	Probe driver 2 alarm
D	OUT	92	EEPROM error driver 2
D	OUT	93	Valve step motor error driver 2
D	OUT	94	Battery error driver 2
D	OUT	95	High pressure driver 2 (MOP)
D	OUT	96	Low pressure driver 2 (LOP)
D	OUT	97	Low superheat driver 2
D	OUT	98	Valve not closed after blackout driver 2
D	OUT	99	High suction temperature driver 2
D	OUT	100	Standby for EEPROM error, battery recharge or valve open driver 1
D	OUT	101	Standby for EEPROM error, battery recharge or valve open driver 2

CAREL

Technology & Evolution

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

Agency:

Cod: +030221241 Rel. 1.1 – 26/09/05