Program for pCO¹ pCO² and pCOC

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

Manual version 1.0 – 25 September 2003

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

Do we want you to save you time and money?

We can assure you that reading this manual to the full will ensure correct installation and safe use of the product described here.

IMPORTANT WARNINGS

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

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

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

All uses other than this use and the making of modifications, not expressly authorised by the manufacturer, are considered improper. The user shall be exclusively responsible for injuries and damage caused through improper use.

CONTENT

1 APPLICATIONS AND FUNCTIONS PERFORMED BY THE SOFTWARE

Type of control unit

AIR / WATER CHILLER
- Chiller only
- Chiller + Heat pump
- Chiller + Freecooling

WATER / WATER CHILLER
- Chiller only
- Chiller + Heat pump with gas reversing
- Chiller + Heat pump with water reversing

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

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

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

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

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

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

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

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

Other functions
Alarms logging
Built-in terminal management (on pCO^2 only)
Management of ratiometric probes for pressure control (on pCO^1 only)
EVD driver for piloting the EXV valve.
Multilingual management.

Accessories
Supervision with serial card RS485 (CARE1 or MODBUS protocol)

2 THE USER TERMINAL

The specified terminal has an LCD display (4 lines over 20 columns) and can be of two types: on board a built-in card with only 6 keys or external (connected by telephone cable) with 15 keys. All operations possible with the program can be carried out with both types. With the user terminal you can view the unit's operating conditions at all times and modify parameters. The terminal can be disconnected from the basic card - in fact it need not be present at all.

2.1.1 BELOW-KEY LEDS

Three LEDs are located under the rubber keys of the EXTERNAL terminal, and four under the keys of the Built-in card. They respectively indicate the following:

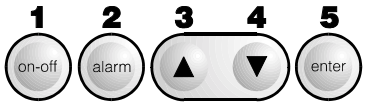
ON/OFF key (External display)	When green the LED indicates that the unit is ON; it flashes in OFF status from the supervisor or remote digital input
ENTER key (External display)	Yellow LED: the instrument is correctly powered
ALARM key (common)	Red LED - alarms are present
ENTER key (Built-in display)	Yellow LED: see ON/OFF Key (external display)
PROG key (Built-in display)	Green LED: you are in a branch of masks, other than the Menu
ESC key (Built-in display)	Green LED: you are in the Menu masks branch

2.1.2 EXTERNAL DISPLAY

How to use the keys on the external terminal

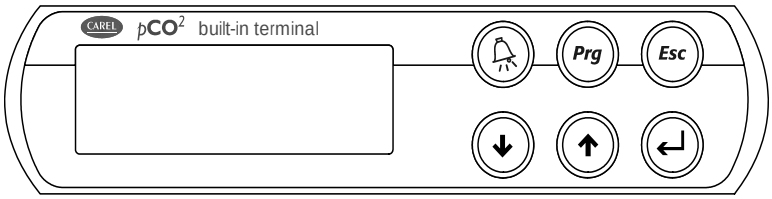
	Key	Description
	MENU	if pressed in all loops except Costr., you return to the main mask of the Menu (MU) branch if pressed in the Constructor loops, you return to the mask selected by the constructor The Menu branch displays the status of the unit, the reading of the control probes, and the current type of operation indicated by CH or HP (meaning chiller or heat pump respectively) in the bottom right corner).
	SERVICING	Sends you to the first screen of the Maintenance loop (A0) The maintenance loop makes it possible to check the state of the devices and probes, and to maintain and adjust them, and to run the Manual procedure
	PRINTER	Temporary display of the pLAN address of the displayed card
	INPUTS AND OUTPUTS	Sends you to the first mask of the I/O loop (I0) The I/O loop displays the state of the digital and analogue inputs and outputs
	CLOCK	Sends you to the first screen of the Clock loop (K0) The clock loop is used for displaying / programming time and date
	SET-POINT	Sends you to the screen for setting the temperature set-points (SU) The loop displays and sets also the winter operation set-point.
	PROGRAM	Sends you to the screen for inputting the user password (PU) The user loop is used for displaying / programming the unit's parameters
	MENU+PROG	Sends you to the mask for inputting the constructor's Password (ZU) The constructor loop enables configuration of type of unit and selection of connected devices and enabled functions.
	INFO	If pressed in the shared terminal, it switches the displayed card
	RED	With the unit OFF, it enables winter operation in machine configurations 4 and 5.
	BLUE	With the unit OFF, it enables summer operation in machine configurations 4 and 5.

How to use the silicone rubber keys:



1. **ON/OFF** key: for switching the unit on and off.
2. **ALARM** key: to view the alarms on the display, cancel them and silence the alarm buzzer
3. **UP ARROW**: has two functions: 1 it scrolls through the previous screens of the same branch when the cursor is in home position; 2 it increases the value of a settings field, when the cursor is over that field; if a selection field is involved, if you press the arrow key, the previous associated text is shown
4. **DOWN ARROW** has two functions: 1 it scrolls through the next screens of the same branch when the cursor is in home position; 2 it reduces the value of a settings field, when the cursor is over that field; if a selection field is involved, if you press the arrow key, the next associated text is shown
5. **ENTER** key: this is used for moving the cursor between the home position and the settings or selection fields, and for saving the values of the set parameters after the cursor has exited the settings fields.

2.1.3 BUILT-IN DISPLAY



ALARM	PROG	ESC
UP	DOWN	ENTER

For advice on using keys Alarm, Up Arrow, Down Arrow, and Enter in the Built-in terminal, see the external terminal
PRG + ENTER keys: temporary display of the pLAN address of the displayed card.
POWER-UP: as there is no ON/OFF key, the unit is powered up and down by pressing the Esc+Enter keys simultaneously for 20 sec. After that, a screen appears from which the operation can be performed with the Enter key.
SCREEN LOOP: as there are no keys which directly input in the mask loop, press the Prog key to show the loop list. Then use the arrow keys to locate in line with the selected loop and then press Enter to access it.

3 PLAN MANAGEMENT AMONG CARDS

The pLAN network identifies a physical connection between the cards (pCO1 pCO2 or pCOC) and the external terminals.
pLAN=**p**CO **L**ocal **A**rea **N**etwork. The purpose of the pLAN network connection between the cards is to exchange variables among the cards with a logic decided by the program, in order to make the cards work together functionally.
The variables exchanged among the cards have already been established by the program, and likewise their direction of origin and destination. Therefore, the user does not have to set them, but has only make 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 dip-switches located at the back of the external terminals, on the pCO2 cards (see figure below) and inside the drivers of the electronic valves, with all the devices powered down. In pCO1, the address is numeric and is assigned in a different way from an external terminal.

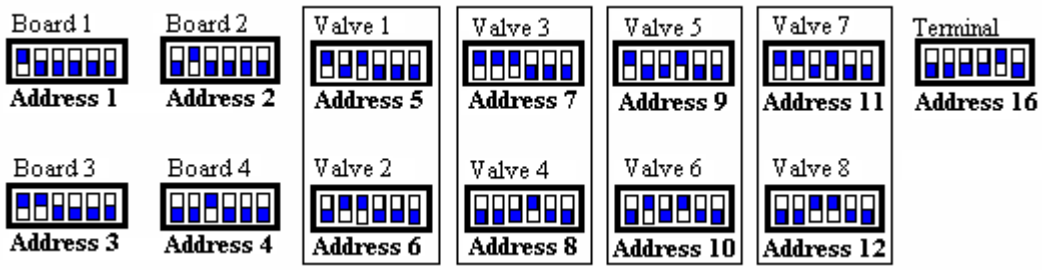
3.1.1 pCO1 ADDRESSING

Here is a description of the operations necessary for addressing pLAN from the pCO1 cards.

1. Power down the pCO1 card and connect an external terminal to the pLAN "0" address.
2. Power up the pCO1 card, by holding down the Alarm + Up keys until a mask appears
3. When the mask is shown, perform the indicated operations, i.e. insert the numeric (1,2,3…) pLAn address with the Up and Down keys and then confirm by pressing Enter.
4. Power down the pCO1 card.
5. If necessary, assign the correct pLAN address to the external terminal if specified.
6. Power up the pCO1 card.

3.1.2 ADDRESSING PCO2, EXTERNAL TERMINALS AND VALVE DRIVERS

The following are the addresses to be set on the pCO2 cards, external terminals and valve drivers. If you are using the pCO1 cards, consult the previous paragraph for the cards only, whereas the following information *does* apply to the terminals and drivers.



The main Menu mask indicated on the terminals shows the address of the connected card in the bottom left-hand corner. With the ind.16 terminal, all the cards can be controlled without any need for other terminals or in addition to them. In fact, the program enables the ind.16 terminal to access the parameters of all the connected cards, one at a time. To change over from one card to another, just press the info key.
In all the other masks of the program, you can find out the address of the connected card by pressing the printer key.

4 INSTALLING DEFAULT VALUES

When you have checked the connections between the cards and terminals, power up the pCO card/s*
When the machine is powered up, the software automatically installs the default values selected by CAREL for all the chiller and driver configuration parameters.
This section tells you how to reset default values to return to the initial conditions. Therefore, this operation need not be carried out at the first power-up.
The following procedure is used for resetting all the in-plant configuration parameters selected by CAREL:

ATTENTION! this procedure irreversibly cancels any programming done by the user

As resetting the default values is an operation that concerns each pCO* card, if there are two or more cards, repeat the operation for each card. The procedure is identical for all the cards.
These are the steps:

- simultaneously press the "menu" and "prog" keys of the LCD terminal (when pressed, both the LED above the "menu" key and the LED above the "prog" key should light up).
- Input the password using the "arrow" keys and press Enter: in this way, you enter the "constructor" configuration :

```
+--------------------+
¦Constructor         ¦
¦Input password      ¦
¦                    ¦
¦              0000  ¦
+--------------------+
```

- press the up arrow key to rapidly reach the default values installation screen:

```
+--------------------+
¦Delete memory     V0¦
¦Install global      ¦
¦default values     S¦
¦Please wait...      ¦
+--------------------+
```

- press the "enter" key to position the cursor above the letter "N", and take it to "S" with the arrow keys. The "please wait…" words appear immediately. They disappear after a few seconds. the default values have now been fully installed.

5 SELECTING THE LANGUAGE

When the unit is powered up, a screen appears by default, where you can select the language to be used (Italian/English - French/German). This mask stays active for 30 seconds. When this time has elapsed, the program automatically changes over to the main menu (M0 screen) This function can be disabled. How to disable it:

1. Go to the Program (P0 screen) branch
2. Type in the correct password.
3. Press the down arrow unit you reach the screen with reference "Pc"
4. Select "N" under item "Show language screen at start-up".

In any case, you can change the language in use at any time. To do this, go to the first screen of the "I/O" key (ref.10).

6 LIST OF INPUTS/OUTPUTS

Inputs and outputs are listed below based on unit type. A number has been associated with each type of machine. This number is the program's main parameter because it identifies the inputs and outputs configuration. Using this list of inputs and outputs, select the number you require from the numbers associated in the program configuration screens.

AIR/WATER UNIT WITH MAX. 4 SCREW COMPRESSORS (UP TO 4 CAPACITY STAGES PER COMPRESSOR)

6.1 CHILLER-ONLY UNIT - MACHINE TYPE "0"

6.1.1 DIGITAL INPUTS

	Chiller-only unit **MACHINE TYPE "0"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)
2	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)
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 2 Pressure-switch	Low Pressure 2 Pressure-switch	Low Pressure 2 Pressure-switch	Low Pressure 2 Pressure-switch	Low Pressure 2 Pressure-switch	Low Pressure 2 Pressure-switch
6	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level
7	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)
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 Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch
12	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout

6.1.2 ANALOGUE INPUTS

	Chiller-only unit **MACHINE TYPE "0"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Water temperature at Evaporator Inlet		High Pressure	High Pressure	Water temperature at Evaporator Inlet	
2	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet	Low Pressure	Low Pressure	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet
3	Delivery Temperature	Delivery Temperature	Delivery Temperature	Delivery Temperature	Condenser Temperature	Condenser Temperature
4			Voltage / Current / External Set-point	Voltage / Current		
5	Condenser Temperature	Condenser Temperature	Water temperature at Evaporator Inlet		Voltage / Current / External Set-point	Voltage / Current
6	Voltage / Current / External Set-point	Voltage / Current	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet	Delivery Temperature	Delivery Temperature
7	High Pressure	High Pressure	Condenser Temperature	Condenser Temperature	High Pressure	High Pressure
8	Low Pressure	Low Pressure			Low Pressure	Low Pressure

6.1.3 DIGITAL OUTPUTS

	Chiller-only unit **MACHINE TYPE "0"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Circulation Pump		Circulation Pump		Circulation 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	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor
5	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid
6	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1
7	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2
8	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control 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

6.1.4 ANALOGUE OUTPUTS

	Chiller-only unit **MACHINE TYPE "0"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Speed Controller	Speed Controller	Speed Controller	Speed Controller	Speed Controller	Speed Controller
2						

6.2 CHILLER UNIT + HEAT PUMP – MACHINE TYPE "1"

6.2.1 DIGITAL INPUTS

	Chiller unit + heat pump **MACHINE TYPE "1"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)
2	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)
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 Pressure-switch 1	Low Pressure Pressure-switch 2	Low Pressure Pressure-switch 1	Low Pressure Pressure-switch 2	Low Pressure Pressure-switch 1	Low Pressure Pressure-switch 2
6	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level
7	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)
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	Summer / Winter		Summer / Winter		Summer / Winter	
11	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch
12	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout

6.2.2 ANALOGUE INPUTS

	Chiller unit + heat pump **MACHINE TYPE "1"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Water temperature at Evaporator Inlet		High Pressure	High Pressure	Water temperature at Evaporator Inlet	
2	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet	Low Pressure	Low Pressure	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet
3	Delivery Temperature	Delivery Temperature	Delivery Temperature	Delivery Temperature	Condenser Temperature	Condenser Temperature
4			Voltage / Current / External Set-point	Voltage / Current		
5	Condenser Temperature	Condenser Temperature	Water temperature at Evaporator Inlet		Voltage / Current / External Set-point	Voltage / Current
6	Voltage / Current / External Set-point	Voltage / Current	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet	Delivery Temperature	Delivery Temperature
7	High Pressure	High Pressure	Condenser Temperature	Condenser Temperature	High Pressure	High Pressure
8	Low Pressure	Low Pressure			Low Pressure	Low Pressure

6.2.3 DIGITAL OUTPUTS

	Chiller unit + heat pump **MACHINE TYPE "1"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Circulation Pump		Circulation Pump		Circulation 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	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor
5	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid
6	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1
7	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2
8	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control 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-wayValve	4-wayValve	4-wayValve	4-wayValve	4-wayValve	4-wayValve
13	Fan 1	Fan 1	Fan 1	Fan 1	Fan 1	Fan 1

6.2.4 ANALOGUE OUTPUTS

	Chiller unit + heat pump **MACHINE TYPE "1"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1						
2	Speed Controller	Speed Controller	Speed Controller	Speed Controller	Speed Controller	Speed Controller

6.3 CHILLER UNIT WITH FREECOOLING – MACHINE TYPE "2"

6.3.1 DIGITAL INPUTS

	Chiller unit with freecooling **MACHINE TYPE "2"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)
2	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)
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 2 Pressure-switch	Low Pressure 2 Pressure-switch	Low Pressure 2 Pressure-switch	Low Pressure 2 Pressure-switch	Low Pressure 2 Pressure-switch	Low Pressure 2 Pressure-switch
6	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level
7	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)
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 Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch
12	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout

6.3.2 ANALOGUE INPUTS

	Chiller unit with freecooling **MACHINE TYPE "2"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Water temperature at Evaporator Inlet		High Pressure	High Pressure	Water temperature at Evaporator Inlet	
2	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet	Low Pressure	Low Pressure	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet
3	Delivery Temperature	Delivery Temperature	Delivery Temperature	Delivery Temperature	Outside Air Temperature	
4	Water Temperature at Freecooling Inlet		Voltage / Current / External Set-point	Voltage / Current	Water Temperature at Freecooling Inlet	
5	Outside Air Temperature		Water temperature at Evaporator Inlet		Voltage / Current / External Set-point	Voltage / Current
6	Voltage / Current / External Set-point	Voltage / Current	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet	Delivery Temperature	Delivery Temperature
7	High Pressure	High Pressure	Outside Air Temperature		High Pressure	High Pressure
8	Low Pressure	Low Pressure	Water Temperature at Freecooling Inlet		Low Pressure	Low Pressure

6.3.3 DIGITAL OUTPUTS

	Chiller unit with freecooling **MACHINE TYPE "2"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Circulation Pump		Circulation Pump		Circulation 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	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor
5	Liquid Solenoid	Liquid solenoid C 2	Liquid Solenoid	Liquid solenoid C 2	Liquid Solenoid	Liquid solenoid C 2
6	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1
7	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2
8	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control 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	Freecooling ON/OFF Valve		Freecooling ON/OFF Valve		Freecooling ON/OFF Valve	

6.3.4 ANALOGUE OUTPUTS

	Chiller unit with freecooling **MACHINE TYPE "2"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (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	

6.4 CHILLER-ONLY UNIT – MACHINE TYPE "3"

6.4.1 DIGITAL INPUTS

	Chiller-only unit **MACHINE TYPE "3"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)	Serious alarm (enablable)
2	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)
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 2 Pressure-switch	Low Pressure 2 Pressure-switch	Low Pressure 2 Pressure-switch	Low Pressure 2 Pressure-switch	Low Pressure 2 Pressure-switch	Low Pressure 2 Pressure-switch
6	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level	Differential / Oil Level
7	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)
8	Double Set-point		Double Set-point		Double Set-point	
9	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)
10	Condenser Pump thermal Cutout		Condenser Pump thermal Cutout		Condenser Pump thermal Cutout	
11	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch	High Pressure Pressure-switch
12	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout

6.4.2 ANALOGUE INPUTS

	Chiller-only unit **MACHINE TYPE "3"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Water temperature at Evaporator Inlet		High Pressure	High Pressure	Water temperature at Evaporator Inlet	
2	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet	Low Pressure	Low Pressure	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet
3	Delivery Temperature	Delivery Temperature	Delivery Temperature	Delivery Temperature	Water Temperature at Condenser Inlet	
4	Water temperature at Condenser Outlet	Water temperature at Condenser Outlet	Voltage / Current / External Set-point	Voltage / Current	Water temperature at Condenser Outlet	Water temperature at Condenser Outlet
5	Water Temperature at Condenser Inlet		Water temperature at Evaporator Inlet		Voltage / Current / External Set-point	Voltage / Current
6	Voltage / Current / External Set-point	Voltage / Current	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet	Delivery Temperature	Delivery Temperature
7	High Pressure	High Pressure	Water Temperature at Condenser Inlet		High Pressure	High Pressure
8	Low Pressure	Low Pressure	Water temperature at Condenser Outlet	Water temperature at Condenser Outlet	Low Pressure	Low Pressure

6.4.3 DIGITAL OUTPUTS

	Chiller-only unit **MACHINE TYPE "3"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (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	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor
5	Liquid Solenoid	Liquid solenoid C 2	Liquid Solenoid	Liquid solenoid C 2	Liquid Solenoid	Liquid solenoid C 2
6	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1
7	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2
8	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control 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						

6.4.4 ANALOGUE OUTPUTS

	Chiller-only unit **MACHINE TYPE "3"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1						
2						

6.5 CHILLER UNIT + HEAT PUMP WITH GAS REVERSING – MACHINE TYPE "4"

6.5.1 DIGITAL INPUTS

	Chiller unit + heat pump with gas reversing **MACHINE TYPE "4"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Serious alarm (Enablable)	Serious alarm (Enablable)	Serious alarm (Enablable)	Serious alarm (Enablable)	Serious alarm (Enablable)	Serious alarm (Enablable)
2	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)
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 Pressure-switch	Low Pressure Pressure-switch	Low Pressure Pressure-switch	Low Pressure Pressure-switch	Low Pressure Pressure-switch	Low Pressure Pressure-switch
6	Oil 1 differential / Oil Level	Oil 2 differential / Oil Level	Oil 1 differential / Oil Level	Oil 2 differential / Oil Level	Oil 1 differential / Oil Level	Oil 2 differential / Oil Level
7	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)
8	Double Set-point		Double Set-point		Double Set-point	
9	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)
10	Summer / Winter		Summer / Winter		Summer / Winter	
11	High pressure pressure-switch	High pressure pressure-switch	High pressure pressure-switch	High pressure pressure-switch	High pressure pressure-switch	High pressure pressure-switch
12	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout

6.5.2 ANALOGUE INPUTS

	Chiller unit + heat pump with gas reversing **MACHINE TYPE "4"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Water temperature at Evaporator Inlet		High Pressure	High Pressure	Water temperature at Evaporator Inlet	
2	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet	Low Pressure	Low Pressure	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet
3	Delivery Temperature	Delivery Temperature	Delivery Temperature	Delivery Temperature	Water Temperature at Condenser Inlet	
4	Water temperature at Condenser Outlet	Water temperature at Condenser Outlet	Voltage / Current / External Set-point	Voltage / Current	Water temperature at Condenser Outlet	Water temperature at Condenser Outlet
5	Water Temperature at Condenser Inlet		Water temperature at Evaporator Inlet		Voltage / Current / External Set-point	Voltage / Current
6	Voltage / Current / External Set-point	Voltage / Current	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet	Delivery Temperature	Delivery Temperature
7	High Pressure	High Pressure	Water Temperature at Condenser Inlet		High Pressure	High Pressure
8	Low Pressure	Low Pressure	Water temperature at Condenser Outlet	Water temperature at Condenser Outlet	Low Pressure	Low Pressure

6.5.3 DIGITAL OUTPUTS

	Chiller unit + heat pump with gas reversing **MACHINE TYPE "4"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (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	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor
5	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid
6	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1
7	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2
8	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control 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-wayValve	4-wayValve	4-wayValve	4-wayValve	4-wayValve	4-wayValve

6.5.4 ANALOGUE OUTPUTS

	Chiller unit + heat pump with gas reversing **MACHINE TYPE "4"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1						
2						

6.6 CHILLER UNIT + HEAT PUMP WITH WATER REVERSING – MACHINE TYPE "5"

6.6.1 DIGITAL INPUTS

	Chiller + Heat pump with water reversing **MACHINE TYPE "S"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Serious alarm (Enablable)	Serious alarm (Enablable)	Serious alarm (Enablable)	Serious alarm (Enablable)	Serious alarm (Enablable)	Serious alarm (Enablable)
2	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)	Evaporator Flow-switch (enablable)
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 Pressure-switch	Low Pressure Pressure-switch	Low Pressure Pressure-switch	Low Pressure Pressure-switch	Low Pressure Pressure-switch	Low Pressure Pressure-switch
6	Oil 1 differential / Oil Level	Oil 2 differential / Oil Level	Oil 1 differential / Oil Level	Oil 2 differential / Oil Level	Oil 1 differential / Oil Level	Oil 2 differential / Oil Level
7	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)	Phase Monitor (enablable)
8	Double Set-point		Double Set-point		Double Set-point	
9	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)	Evaporator Flow-switch (Enablable)
10	Summer / Winter		Summer / Winter		Summer / Winter	
11	High pressure pressure-switch	High pressure pressure-switch	High pressure pressure-switch	High pressure pressure-switch	High pressure pressure-switch	High pressure pressure-switch
12	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout	Compressor Thermal cutout

6.6.2 ANALOGUE INPUTS

	Chiller + Heat pump with water reversing **MACHINE TYPE "S"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1	Water temperature at Evaporator Inlet		High Pressure	High Pressure	Water temperature at Evaporator Inlet	
2	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet	Low Pressure	Low Pressure	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet
3	Delivery Temperature	Delivery Temperature	Delivery Temperature	Delivery Temperature	Water Temperature at Condenser Inlet	
4	Water temperature at Condenser Outlet	Water temperature at Condenser Outlet	Voltage / Current / External Set-point	Voltage / Current	Water temperature at Condenser Outlet	Water temperature at Condenser Outlet
5	Water Temperature at Condenser Inlet		Water temperature at Evaporator Inlet		Voltage / Current / External Set-point	Voltage / Current
6	Voltage / Current / External Set-point	Voltage / Current	Water temperature at Evaporator Outlet	Water temperature at Evaporator Outlet	Delivery Temperature	Delivery Temperature
7	High Pressure	High Pressure	Water Temperature at Condenser Inlet		High Pressure	High Pressure
8	Low Pressure	Low Pressure	Water temperature at Condenser Outlet	Water temperature at Condenser Outlet	Low Pressure	Low Pressure

6.6.3 DIGITAL OUTPUTS

	Chiller + Heat pump with water reversing **MACHINE TYPE "S"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (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	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor	Triangle Contactor
5	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid	Liquid Solenoid
6	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1	Capacity Control Relay 1
7	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2	Capacity Control Relay 2
8	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control Relay 3	Capacity Control 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

6.6.4 ANALOGUE OUTPUTS

	Chiller + Heat pump with water reversing **MACHINE TYPE "S"**					
N.	**pCO2 MEDIUM**		**pCO1 MEDIUM**		**pCOC MEDIUM**	
	Master (Address 1)	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**	**Master (Address 1)**	**Slave (addresses 2/3/4)**
1						
2						

7 LIST OF PARAMETERS

The table below describes program parameters along with the following additional information: screen code (screens have a code in the top right corner) to make identifying the parameter easier (screen), factory setting, upper and lower limits of the range within which values can be effected, unit of measurement, and an empty column for writing the desired value.
To find the parameter you are interested in on the terminal's display, proceed as follows:

- Locate the parameter in the table below and the code of the screen it appears on
- Using the list of screens (coming section) and screen code, call up the screen on the terminal

DESCRIPTION OF PARAMETER	SCREEN	MASTER SLAVE	FACTORY VALUE	USER VALUE	RANGE	MEASU-REMENT UNIT
						
Password inputting	A3	M/S	1234		0 to 9999	
Duty hours thresholds for evaporator pump	A4	M	10		0 to 999	hours x 1000
Reset duty hours thresholds for evaporator pump	A4	M	N.		N/Y	
Duty hours thresholds for condenser pump	A5	M	10		0 to 999	hours x 1000
Reset duty hours thresholds for condenser pump	A5	M	N.		N/Y	
Duty hours thresholds for compressor	A6	M	10		0 to 999	hours x 1000
Reset compressor duty hours	A6	M	N.		N/Y	
Adjustment of probe B1	A7	M/S	0		-9.9 to 9.9	
Adjustment of probe B2	A7	M/S	0		-9.9 to 9.9	
Adjustment of probe B3	A7	M/S	0		-9.9 to 9.9	
Adjustment of probe B4	A7	M/S	0		-9.9 to 9.9	
Adjustment of probe B5	A8	M/S	0		-9.9 to 9.9	
Adjustment of probe B6	A8	M/S	0		-9.9 to 9.9	
Adjustment of probe B7	A8	M/S	0		-9.9 to 9.9	
Adjustment 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	
Cancel alarm log	Aa	M/S	N.		N/Y	
Adjustment mode for Driver 1 valve	Ab	M/S	Automatic		Aut-Man	
Number of steps for manual opening of Driver 1 valve	Ab	M/S	0		0 to 9999	Steps
Adjustment mode for Driver 2 valve	Ac	M/S	Automatic		Aut-Man	
Number of steps for manual opening of Driver 2 valve	Ac	M/S	0		0 to 9999	Steps
Manual release of Driver 1 at start-up	Ad	M/S	No		No-Yes	
Manual release of Driver 2 at start-up	Ae	M/S	No		No-Yes	
Inputting of 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	
						
Summer set point	S1	M/S	12.0		see P1	°C
Winter set point	S1	M	45.0		see P2	°C
Second summer set-point	S2	M	45.0		see P1	°C
Second winter set point	S2	M/S	45.0		see P2	°C
		M/S				
						
User password inputting	P0	M/S	1234		0 to 9999	
Minimum limit of summer set point	P1	M/S	7.0		-99.9 / 99.9	°C
Minimum limit of summer set point	P1	M	17.0		-99.9 / 99.9	°C
Minimum limit of winter set point	P2	M	40.0		-99.9 / 99.9	°C
Minimum limit of winter set point	P2	M	50.0		-99.9 / 99.9	°C
Selection of control probe	P3	M	Input		Input / Output	
Control with probe at evaporator input	P4	M	Prop.		Prop./Prop+Int.	
Integration time	P4	M	600		0 to 9999	seconds
Control at output - summer forced power down	P5	M	5.0		-99.9 / 99.9	°C
Control at output - winter forced power down	P5	M	47.0		-99.9 / 99.9	°C
Control band	P6	M	3.0		0 to 99.9	°C
Neutral zone with modulating capacity control	P7	M/S	1.0		0 to 99.9	°C

DESCRIPTION OF PARAMETER	SCREEN	MASTER SLAVE	FACTORY VALUE	USER VALUE	RANGE	MEASU-REMENT UNIT
Delayed power up between pump and compressors	P8	M	5		0 to 999	seconds
Delayed power down of main pump	P9	M	5		0 to 999	seconds
Enable remote On/Off	Pa	M/S	N.		N/Y	
Enable On/Off from supervisor	Pa	M/S	N.		N/Y	
Enable summer / winter selection from digital input	Pb	M	N.		N/Y	
Enable summer / winter selection from supervisor	Pb	M	N.		N/Y	
Enable language mask start-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
Compressors delay in freecooling	Pe	M/S	5		0 to 500	minutes
Minimum threshold for freecooling valve start	Pf	M/S	50		0 to 100	%
Maximum threshold for freecooling valve opening	Pf	M/S	50		0 to 100	%
Defrosting starts	Pg	M/S	2.0		-99.9 / 99.9	°C/bar
Defrosting ends	Pg	M/S	12.0		-99.9 / 99.9	°C/bar
Drip-off time	Ph	M/S	10		5 to 999	seconds
Delayed defrosting start	Ph	M/S	1800		0 to 32000	seconds
Maximum defrosting time	Ph	M/S	300		0 to 32000	seconds
Cycle reversing configuration	Pi	M/S	Comp. always on		Comp. always ON Comp. OFF start of defr. Cmp. OFF end defr. Comp. OFF start/end	
Card identification number for supervision network	Pj	M/S	1		0 to 200	
Card communication speed for supervision network	Pj	M/S	19200		1200 to 19200	bps
Selection of communication serial network	Pj	M/S	Carel		Carel / Modbus	
New user password inputting	Pk	M/S	1234		0 to 9999	
						
Constructor password inputting	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) 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) 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	
Generic probe generic configuration (B4 on pCO1, B5 on pCOC, B6 on pCO2)	C3	M/S	None		No Current Voltage external Set-point	
Type of generic probe	C3	M/S	0 - 1 V		0-1 V 0-10 V 4-20mA	
Generic probe lower limit	C4	M/S	0.0		-999.9 to 999.9	°C/V/A
Generic probe upper limit	C4	M/S	0.0		-999.9 to 999.9	°C/V/A
Probe types for analogue inputs 1 and 2 (for pCO1 cards only)	C5	M/S	4-20mA		4-20mA / 0-5V	
Type of delivery temperature probe	C6	M/S	Ntc		Ntc / 4-20mA	
Delivery probe lower limit	C6	M/S	-30.0		-999.9 to 999.9	°C
Delivery probe upper limit	C6	M/S	150.0		0.0 to 999.9	°C
High pressure probe lower limit	C7	M/S	00.0		-99.9 to 99.9	bar
High pressure probe upper limit	C7	M/S	30.0		-99.9 to 99.9	bar
Low pressure probe lower limit	C8	M/S	-0.5		-99.9 to 99.9	bar
Low pressure probe upper limit	C8	M/S	7.0		-99.9 to 99.9	bar
Enable double set-point	C9	M	Disabled		Disabled / Enabled	
Number of drivers present	Ca	M/S	0		0 to 2	
Number of compressors present	Ca	M/S	1		1 to 4	
Compressor rotation	Ca	M	S		N/Y	
Type of capacity control	Cb	M/S	Steps		Step/Modul.	
Number of steps per compressor	Cb	M/S	4		1 to 4	
Enable starting restrictions	Cc	M/S	N.		N/Y	

DESCRIPTION OF PARAMETER	SCREEN	MASTER SLAVE	FACTORY VALUE	USER VALUE	RANGE	MEASU-REMENT UNIT
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 step 1 special management	Ch	M/S	N.		N/Y	
Stand-by configuration for relay 6	Ci	M/S	OFF		OFF/ON	
Stand-by configuration for relay 7	Ci	M/S	ON		OFF/ON	
Reducing configuration for relay 6	Cj	M/S	ON		OFF/ON	
Decrementing configuration for relay 7	Cj	M/S	ON		OFF/ON	
Incrementing configuration for relay 6	Ck	M/S	OFF		OFF/ON	
Incrementing configuration for relay 7	Ck	M/S	OFF		OFF/ON	
Pulse period for modulating configuration	Cl	M/S	6		0 to 99	seconds
Minimum decrementing pulse	Cl	M/S	1.5		0 to 99.9	seconds
Maximum decrementing pulse	Cl	M/S	3.0		0 to 99.9	seconds
Derivation time for modulating configuration	Cm	M/S	3			seconds
Minimum decrementing pulse	Cm	M/S	1.5		0 to 99.9	seconds
Maximum decrementing pulse	Cm	M/S	3.0		0 to 99.9	seconds
Decrement forcing time at compressor start	Cn	M/S	20		0 to 999	seconds
Enable solenoid forcing when compressor OFF	Co	M/S	N.		N/Y	
Enable pump - down	Cp	M/S	N.		N/Y	
Minimum pump - down time	Cp	M/S	50		0 to 999	seconds
Configuration of compressor power level in case of forced capacity control.	Cq	M/S	Max. power		Max. power / Min. power	
Enable condensation	Cr	M/S	No		NO/YES	
Type of condensation 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 →						
Starting restrictions - low pressure	G0	M/S				
Starting restrictions - high pressure	G0	M/S				
Starting restrictions - pressure equalisation	G0	M/S				
Enable high pressure prevention	G1	M/S	N.		N/Y	
Type of high condensation prevention	G1	M/S	Pressure		Press / Temp	
Condensation set-point	G1	M/S	20.0		0 to 99.9	bar/ °C
High condensation differential	G1	M/S	2.0		0 to 99.9	bar/ °C
Enable delivery prevention	G2	M/S	N.		N/Y	
Delivery prevention set-point	G2	M/S	90.0		0 to 999.9	°C
Delivery 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
Condensation set-point	G4	M/S	14.0		-999.9 to 999.9	bar/ °C
Condensation differential	G4	M/S	2.0		-999.9 to 999.9	bar/ °C
Inverter maximum speed	G5	M/S	10.0		0.0 to 10.0	V
Inverter maximum 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	
Alarm set-point for delivery temperature probe	G8	M/S	120.0		0 to 999.9	°C
Alarm differential for delivery temperature probe	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
Alarm set-point: difference between high and low pressure	Gb	M/S	6.0		0 to 99.9	bar
Delayed start due to low pressure difference alarm	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	90.0		0 to 999.9	A
High current alarm differential	Gd	M/S	5.0		0 to 99.9	A
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

DESCRIPTION OF PARAMETER	SCREEN	MASTER SLAVE	FACTORY VALUE	USER VALUE	RANGE	MEASU-REMENT UNIT
Pump status in case of antifreeze alarm	Gf	M	Pump ON		Pump ON /Pump 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
Cycle 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
Defrosting probe configuration	Cj	M/S	Pressure switches		Temperature Pressure switches	
Type of overall defrosting	Cj	M/S	Simultaneous		Simultaneous Separate Independent	
CAREL EXV DRIVERS →						
Driver 1 valve type	F0	M/S	Custom		0-11 (see page 8)	
Enable driver 1 battery	F0	M/S	N.		N/Y	
Percentage relationship between Refrigerating power and Driver 1 power	F1	M/S	60		0 to 100	%
Driver 2 valve type	F2	M/S	Custom		0-11 (see page 8)	
Enable driver 2 battery	F2	M/S	N.		N/Y	
Percentage relationship between Refrigerating power and Driver C2 power	F3	M/S	60		0 to 100	%
Driver 1 superheat set point during chiller operation	F4	M/S	6.0		2.0 to 50.0	°C
Driver 1 dead band during chiller operation	F4	M/S	0		0 to 9.9	°C
Driver 1 superheat set point during defrost. operation	F5	M/S	6.0		2.0 to 50.0	°C
Driver 1 dead band during defrost. operation	F5	M/S	0		0 to 9.9	°C
Driver 2 superheat set point during heat pump operation	F6	M/S	6.0		2.0 to 50.0	°C
Driver 2 dead band during heat pump operation	F6	M/S	0		0 to 9.9	°C
Driver 2 superheat set point during chiller operation	F7	M/S	2.5		0.0 to 99.9	
Driver 1 integral time during chiller operation	F7	M/S	25		0 to 999	seconds
Driver 1 derivative time during chiller operation	F7	M/S	2.0		0.0 to 99.9	seconds
Driver 2 proportional gain during defrost. operation	F8	M/S	2.5		0.0 to 99.9	
Driver 1 integral time during defrost. operation	F8	M/S	25		0 to 999	seconds
Driver 1 derivative time during defrost. operation	F8	M/S	2.0		0.0 to 99.9	seconds
Driver 2 proportional gain during heat pump operation	F9	M/S	2.5		0.0 to 99.9	
Driver 2 integral time during heat pump operation	F9	M/S	25		0 to 999	seconds
Driver 2 derivative time during heat pump operation	F9	M/S	2.0		0.0 to 99.9	seconds
Threshold for driver 1 low superheat protection during chiller operation.	Fa	M/S	4.0		-4.0 to 10.0	°C
Integral time for driver 1 low superheat protection super heat in chiller operation	Fa	M/S	1.0		0 to 25.5	seconds
Threshold for driver 1 low superheat protection during defrosting operation.	Fb	M/S	4.0		-4.0 to 10.0	°C
Integral time for low alarm protection super heat driver 1 during defrost operation	Fb	M/S	1.0		0 to 25.5	seconds
Threshold for driver 2 low super heat during pump operation	Fc	M/S	4.0		-4.0 to 10.0	°C
Threshold integral time for driver 2 low super protection during heat pump operation	Fc	M/S	1.0		0 to 25.5	seconds
Threshold for LOP protection during chiller operation	Fd	M/S	-40.0		-70.0 to 50.0	°C
Threshold Integral time for LOP protection during chiller. operation	Fd	M/S	4.0		0 to 25.5	seconds
Threshold for LOP protection during heat pump operation	Fe	M/S	-40.0		-70.0 to 50.0	°C
Threshold integral time for LOP protection during heat pump operation	Fe	M/S	4.0		0 to 25.5	seconds
Threshold for LOP protection during defrost. operation	Ff	M/S	-40.0		-70.0 to 50.0	°C
Integral time of threshold for LOP protection during defrost. operation	Ff	M/S	4.0		0 to 25.5	seconds
Delayed start MOP protection during chiller operation	Fg	M/S	30		0 to 500	seconds
Threshold for MOP protection during chiller operation	Fg	M/S	40.0		-50.0 to 99.9	°C
Threshold Integral time for LOP protection during chiller. operation	Fg	M/S	4.0		0 to 25.5	seconds
Delayed start MOP protection during heat pump operation	Fh	M/S	30		0 to 500	seconds
Threshold for MOP protection during heat pump operation	Fh	M/S	40.0		-50.0 to 99.9	°C
Threshold integral time for MOP protection during heat pump operation	Fh	M/S	4.0		0 to 25.5	seconds
Delayed start MOP protection during chiller operation	Fi	M/S	30		0 to 500	seconds
Threshold for MOP protection during chiller operation	Fi	M/S	40.0		-50.0 to 99.9	°C
Threshold Integral time for LOP protection during chiller. operation	Fi	M/S	4.0		0 to 25.5	seconds
Threshold for condensation high temperature protection during chiller operation	Fj	M/S	75.0		0 to 99.9	°C

DESCRIPTION OF PARAMETER	SCREEN	MASTER SLAVE	FACTORY VALUE	USER VALUE	RANGE	MEASU-REMENT UNIT
Integral time of threshold for condensation high temperature protection during chiller operation	Fj	M/S	4.0		0 to 25.5	seconds
Threshold for condensation high temperature protection during heat pump operation	Fk	M/S	75.0		0 to 99.9	°C
Integral time of threshold for condensation high temperature protection during heat pump operation	Fk	M/S	4.0		0 to 25.5	seconds
Threshold for condensation high temperature protection during defrost. operation	Fl	M/S	75.0		0 to 99.9	°C
Integral time of threshold for condensation high temperature protection during defrost operation	Fl	M/S	4.0		0 to 25.5	seconds
Threshold for intake high temperature during chiller operation	Fm	M/S	30.0		0 to 100.0	°C
Threshold for intake high temperature during heat pump operation	Fn	M/S	30.0		0 to 100.0	°C
Threshold for intake high temperature during 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 at opening	Fs	M/S	N.		N/Y	
Custom Valve: enable extra step at closure	Fs	M/S	N.		N/Y	
Custom Valve: current operating	Ft	M/S	250		0 to 1000	mA
Custom Valve: current stopped	Ft	M/S	100		0 to 1000	mA
Custom Valve: frequency	Fu	M/S	100		32 to 330	Hertz
Custom Valve: duty cycle	Fu	M/S	50		0 to 100	%
Minimum value of evaporat. pressure probe	Fv	M/S	-0.5		-9.9 to 10.0	Bar
Maximum value of evaporat. pressure probe	Fv	M/S	7.0		3.5 to 200.0	Bar
Delay low super heat alarm	Fw	M/S	0		0 to 3600	seconds
Delay high temperature intake alarm	Fw	M/S	0		0 to 3600	seconds
Delay LOP alarm	Fx	M/S	0		0 to 3600	seconds
Delay MOP alarm	Fx	M/S	0		0 to 3600	seconds
TIMES →						
Delayed start due to evaporator flow-switch alarm	T0	M/S	15		0 to 99	seconds
Delayed steady state operation due to evaporator flow-switch alarm	T0	M/S	3		0 to 99	seconds
Delayed start due to condenser flow-switch alarm	T1	M/S	15		0 to 99	seconds
Delayed steady state operation due to condenser flow-switch alarm	T1	M/S	3		0 to 99	seconds
Delayed start due to low pressure alarm	T2	M/S	40		0 to 99	seconds
Delayed steady state operation due to low pressure alarm	T2	M/S	0		0 to 99	seconds
Delayed start due to oil differential alarm	T3	M/S	120		0 to 999	seconds
Delayed steady state operation due to oil differential alarm	T3	M/S	10		0 to 999	seconds
Time between star / line	T4	M/S	2		0 to 999	100 seconds
Star time	T4	M/S	200		0 to 999	100 seconds
Delta / star time	T4	M/S	1		0 to 999	100 seconds
Compressor minimum ON Time / Time to reach minimum power	T5	M/S	60		0 to 9999	seconds
Compressor minimum OFF time	T5	M/S	360		0 to 9999	seconds
Time between power-ups of different compressors / Time to reach maximum power	T6	M/S	10		0 to 9999	seconds
Time between thrusts of same compressor	T6	M/S	450		0 to 9999	seconds
Time between solenoid/ capacity control 1	T7	M/S	10		0 to 9999	seconds
Time between capacity controls 1 and 2	T7	M/S	25		0 to 9999	seconds
Time between capacity controls 2 and 3	T7	M/S	300		0 to 9999	seconds
Time between capacity controls 3 and 4	T7	M/S	300		0 to 9999	seconds
INITIALISATION →						
Deletion of memory and installation of default values.	V0	M/S	N.		N/Y	
Set new Constructor password	V1	M/S	1234		0 to 9999	

8 SCREENS

Screens can be divided into 5 categories:

- **USER** screens, not password protected: they appear in all loops except "**prog**" and "**menu+prog**" and show probe values, alarms, hours of operation of the devices, time and date, and can be used to set temperature and humidity set points and for clock set-up. They are marked with the "⓪" symbol in the parameters table below.
- password-protected **USER** screens (password 1234, editable): called up by pressing the "**prog**" key, via these screens you can set the main functions (times, set points, differentials) of connected devices. Screens referring to functions that are not available are not displayed. They are marked with the "❶" symbol in the parameters table below.
- password-protected **MAINTENANCE** screens (password 1234, editable): called up by pressing the **"maintenance"** key. Via these screens you can monitor devices, set connected probes, edit hours of operation and manage devices in manual mode. They are marked with the "❷" symbol in the parameters table below.
- password-protected **MANUFACTURER** screens (password 1234, editable): called up by pressing key combination "**menu+prog**" - via these screens you can configure the air-conditioner and enable main functions, as well as choosing connected devices. They are marked with the "❸" symbol in the parameters table below.

8.1 LIST OF SCREENS

Screens appearing on the display are listed below. The table's columns represent screen loops, and the first screen (A0, B0…) is the one that appears when you press the relevant key. You can then use the arrow keys to scroll through the others. The codes (Ax, Bx, Cx…) appear in the top right corner of the screens, making them easier to identify. The meaning of the symbols ⓪, ❶… is explained in the section above. The PSW symbol indicates screens where you are required to enter passwords.

menu
⓪ M0

⓪ A0
⓪ A1
⓪ A2
⓪ A3
PSW A4
② A7
② A8
② A9
② Aa
② Ab
② Ac
② Ad
② Ae
② Af

I/O
⓪ I0
⓪ I1
⓪ I2
⓪ I3
⓪ I4
⓪ I5
⓪ I6
⓪ I7
⓪ I8
⓪ I9
⓪ Ia
⓪ Ib
⓪ Ic
⓪ Id
⓪ Ie
⓪ If
⓪ Ig
⓪ Ih
⓪ Ii
⓪ Ij
⓪ Ik

⓪ K0
⓪ K1

set
⓪ S0
⓪ S1
⓪ S2

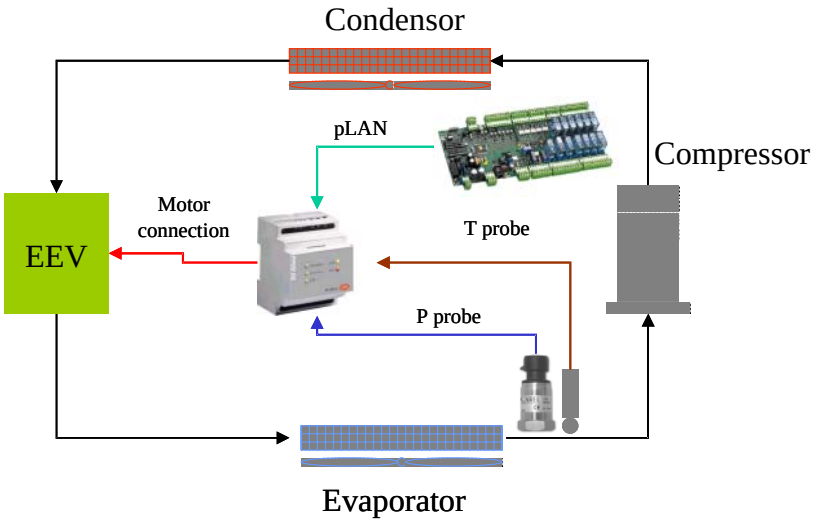
prog
PSW P0
① P1
① P2
① P3
① P4
① P5
① P6
① P7
① P8
① P9
① Pa
① Pb
① Pc
① Pd
① Pe
① Pf
① Pg
① Ph
① Pi
① Pj
① Pk

menu + prog		
PSW Z0		
CONFIGURATION	→	③ C1
		③ C2
		③ C3
		③ C4
		③ C5
		③ C6
		③ C7
		③ C8
		.....
		③ Cr
		③ Cs
PARAMETES	→	③ G0
		③ G1
		③ G2
		③ G3
		③ G4
		③ G5
		③ G6
		③ G7
		③ G8
		.....
		③ Gi
		③ Gj
CAREL EXV DRIVER	→	③ F0
		③ F1
		③ F2
		③ F3
		③ F4
		③ F5
		③ F6
		③ F7
		③ F8
		.....
		③ Fw
		③ Fx
TIMES	→	③ T0
		③ T1
		③ T2
		③ T3
		③ T4
		③ T5
		③ T6
		③ T7
INITIALISATION	→	③ V0
		③ V1

9 ELECTRONIC EXPANSION VALVE

The EV Driver module for piloting the electronic expansion valves (EEV) for the pLAN network, makes it possible to control intake superheating to enable the refrigerating unit to operate more efficiently and with greater versatility.

We say efficiently, because by improving and stabilising the flow of refrigerant to the evaporator, we increases the system's overall performance, while guaranteeing safety (low pressure pressure switch less frequently tripped, fewer returns of liquid refrigerant to the compressor,…). Furthermore, if the EEV is correctly sized, use of condensation pressure (or evaporation pressure,) either floating or at low set point, considerably increases the system's efficiency, while ensuring lower energy consumption and greater refrigerating yield. It is versatile, because the electronic expansion valve makes it possible to serve refrigerating units with a lower refrigerating capacity and in operating conditions which may differ considerably from each other.
Using an expansion valve entails the installation not only of the EVDriver and the expansion valve itself, but also of a temperature sensor and a pressure transducer, both located on the refrigerating side at the end of the evaporator (on the compressor's intake pipe). Consult the following diagram for a better understanding of the system's typical lay-out.



The priorities to be considered for optimal control of the refrigerating system: obtaining a high, constant refrigerating yield rather than very low, stable superheating.
The heart of the control is a PID control with settable coefficients for superheating.
These are the additional controls:

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

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

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

9.1 DRIVER PARAMETERS

In this section, we shall explain the essential parameters of greatest interest for setting up the driver. The screen code (see chap. "PARAMETERS LIST") is used (in brackets) to describe these parameters, in order to help you find the appropriate parameter.
Each pCO* card manages a maximum of two drivers. As they have the same configuration, this section illustrates the first driver's configuration only.

9.1.1 Valve Type and battery presence (F0)

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

- Alco (EX5, EX6, EX7, EX8)
- Sporlan (SEI 0.5, SEI 1, SEI 2, SEI 3.5, SEI 6, SEI 8,5, SEH 100, SEH 175, SEH 250)
- Danfoss (ETS50, ETS100)
- Carel E2V
- Custom valve (if none of the valves described above are the one used by the user).

9.1.2 EEV circ. percentage ratio (F1)

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

9.1.3 Super-heat set point in mode CH/HP/DF (F4/F5/F6)

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

9.1.4 PID parameters in operation CH/HP/DF (F7/F8/F6)

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

- Proportional gain
- Integrating time constant
- Derivative time constant

In this case too, the three types of operation must be configured.

9.1.5 Low super-heat threshold for operation CH/HP/DF (Fa/Fb/Fc)

The low superheating threshold and relevant integral constant for activating the low superheating protection. This protection usually leads to the closing of the electronic valve. If the integral constant is zero, the protection is disabled.
In this case too, the three types of operation must be configured.

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

The low intake pressure threshold and relevant integral constant for activating LOP protection. This protection usually leads to the opening of the electronic valve. If the integral constant is zero, the protection is disabled. In this case too, the three types of operation must be configured.

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

The high intake pressure threshold and relevant integral constant for activating MOP protection. This protection usually leads to the closing of the electronic valve. If the integral constant is zero, the protection is disabled. In this case too, the three types of operation must be configured.

9.1.8 High condensation temperature threshold in operation CH/HP/DF (Fj/Fk/Fl)

The high condensation pressure threshold and relevant integral constant for activating the protection. This protection usually leads to the closing of the electronic valve. If the integral constant is zero, the protection is disabled. In this case too, the three types of operation must be configured.

9.1.9 Refrigerant (Fp)

Type of refrigerant used in the unit:

9.1.10 Configuration of the evaporation pressure probe (Fv)

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

9.2 SPECIAL FUNCTION "IGNORE"

```
+--------------------+
|Driver 1 status   Ad|
|                    |
|Valve not shut      |
|Ignore? N           |
+--------------------+
```

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

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

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

```
+--------------------+
|AL086               |
|D1:Wait due error   |
|EEPROM/batt.rechg.or|
|open valve          |
+--------------------+
```

With the "Ignore" function, these alarms can be ignored to enable the driver to control the valve (otherwise the driver would keep the valve shut).

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

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

10 Control

There are two different modes for controlling the control thermostat:

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

In the first case, control is proportional based on the absolute value of the temperature measured by the probe; in the second case, neutral zone control is used, and is based on the period when of the temperature measured by the probe is maintained, beyond certain thresholds.

However, the choice of the control type depends on the type of compressor managed.
If the controlled compressor is of the stepped capacity control type, in that case, both types of control can be used indifferently.
If the controlled compressor is of the continuous capacity control type, in that case, control based on outlet temperature only can be used.

10.1 Inlet temperature control

Inputs used:

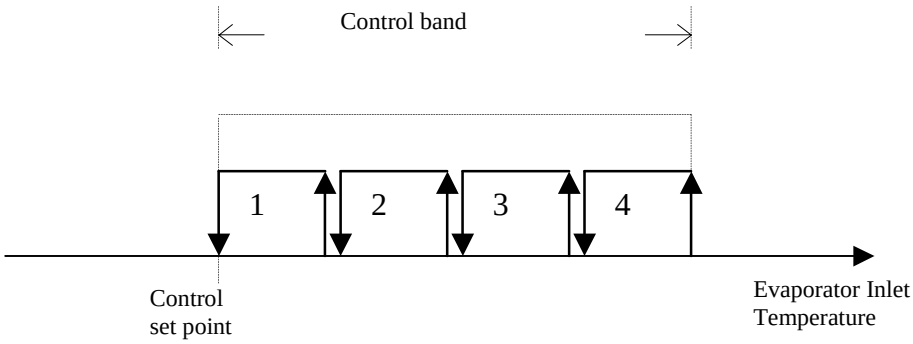
- Water temperature at evaporator inlet

Parameters used:

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

Outputs used :

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



The thermostatic control according to the values measured by the temperature probe at evaporator inlet, is based on proportional control.

According to the total number of configured compressors and capacity control steps per compressor, the set control band will be subdivided into a certain number of steps of equal amplitude.
When the activation thresholds of the individual steps is exceeded, a different compressor or capacity control steps will be activated.

To determine the different activation thresholds, the following relations must be applied:

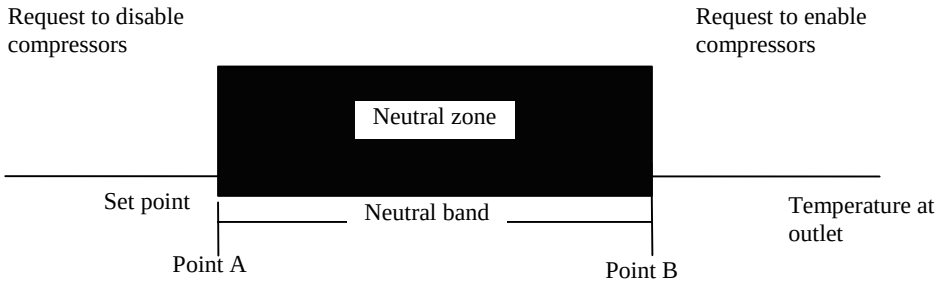
Total number of control steps :	Total number of compressors * Number of capacity control/compressor steps
Step proportional amplitude =	Proportional control band / Total number of control steps
Step activation thresholds =	Control set-point + (Step proportional amplitude * Step sequential number [1,2,3…]

10.2 Outlet temperature control

Inputs used:
- Water temperature at evaporator outlet

Parameters used:
- Type of unit
- Total number of compressors
- Type of compressor capacity control
- Number of capacity control steps
- Control set-point
- Control band for control at outlet
- Delayed starting of compressor capacity control stages
- Devices activation delay
- Devices disablement delay
- Summer limit of temperature at outlet (powers down all compressors without observing the disabling time)
- Winter limit of temperature at outlet (powers down all compressors without observing the disabling time)

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



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

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

10.3 Control of water /water chiller only units

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

Parameters used :
- Type of unit
- Total number of compressors
- Type of compressor capacity control
- Number of capacity control steps
- Control set-point
- Control band
- Type of control (inlet - outlet)
- Type of control at inlet (proportional - proportional + integral)
- Integration time (if the proportional + integral control is enabled)
- Delayed starting of compressor capacity control stages
- Devices activation delay

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

10.3.1 Description of operation :

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

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

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

Parameters used :
- Type of unit
- Total number of compressors
- Type of compressor capacity control
- Number of capacity control steps
- Control set-point
- Control band
- Type of control (inlet - outlet)
- Type of control at inlet (proportional - proportional + integral)
- Integration time (if the proportional + integral control is enabled)
- Delayed starting of compressor capacity control stages
- Devices activation delay
- Refrigerating circuit reversing valve logic

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

10.4.1 Description of operation :

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

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

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

Parameters used :
- Type of unit
- Total number of compressors
- Type of compressor capacity control
- Number of capacity control steps
- Control set-point
- Control band
- Type of control (inlet - outlet)
- Type of control at inlet (proportional - proportional + integral)
- Integration time (if the proportional + integral control is enabled)
- Delayed starting of compressor capacity control stages
- Devices activation delay
- Water circuit reversing valve logic

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

10.5.1 Description of operation :

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

11 Types of controlled compressors

11.1 Stepped capacity control

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

11.1.1 Configuration of stepped capacity control relays

The enabling sequence of the capacity control relays differs for each compressor. Therefore, the software has a facility for configuring the enabling sequence according to the needs of different compressor manufacturers.
For multi-card systems: as several compressors are housed on the same machine, it is considered that the compressors controlled by each pCO are perfectly equal and, therefore, the capacity control configuration selected on board the master card also applies to the slave cards.
The following table shows examples of the configuration of the dedicated digital outputs for the different power stages entered.
The effective status of the digital output is indicated. The relation between the data in the table and the values set on the display.
Closed = ON Open = OFF

Default configuration :

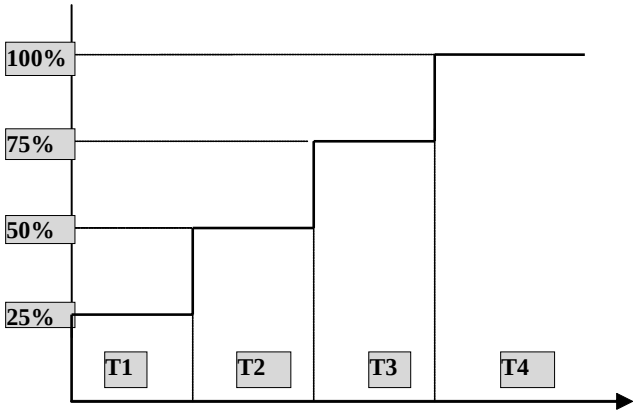
% LOAD	Relay 1	Relay 2	Relay 3
25%	CLOSED	OPEN	OPEN
50%	OPEN	OPEN	CLOSED
75%	OPEN	CLOSED	OPEN
100%	OPEN	OPEN	OPEN

Configuration example :

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

11.1.2 Stepped capacity control times

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



11.1.3 Special management of capacity control first stage

A facility is provided for enabling special management of the first stage of capacity control, managing the compressor's special requirements when it is operating at low power.
In general, the control entails the use of the first capacity control stage only at power-up and if temperature falls below the control set-point. When controlling the compressor, this type of control uses a reduced power modulation range, between the second and maximum power stages.

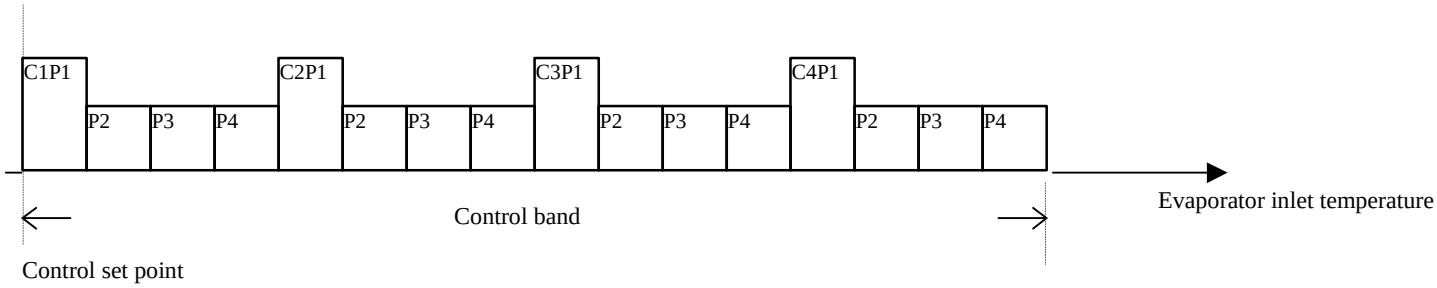
Management varies according to whether the compressor is in its starting or disabling stage. In both cases, you are recommended not work at 25% power for too long.

- Starting: after being started, if the compressor does not receive any thermostatic request for changeover to the second capacity control stage, the changeover is forced by the software after a time which can be set on the screen (T1).
- Power-down: if a reduction in the power of the circuit is requested, power is controlled between the maximum and second capacity control stage. Only if temperature drops below set-point value, the compressor is forced to operate according to the first capacity control stage for the set time (T1).

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

11.2 Stepped capacity control with control at inlet

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



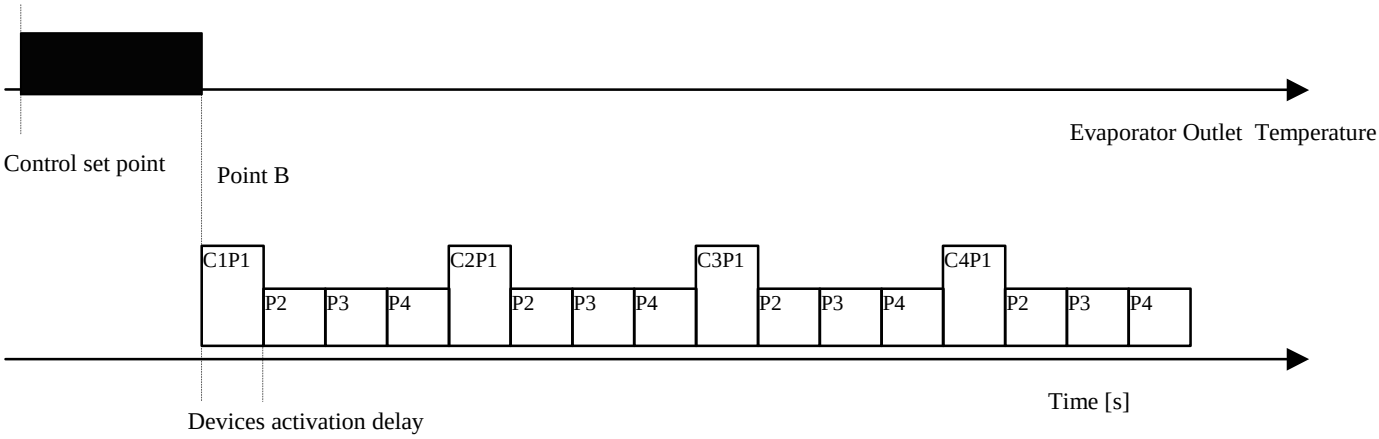
All compressors and the relevant capacity control steps will be proportionally positioned in the band. Increasing temperature values will cause the control steps to be subsequently input. Each step will be input according to the set delay times.
The compressors will be started at the first entered capacity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

11.3 Stepped capacity control with control at outlet

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

11.3.1 Activation of compressors

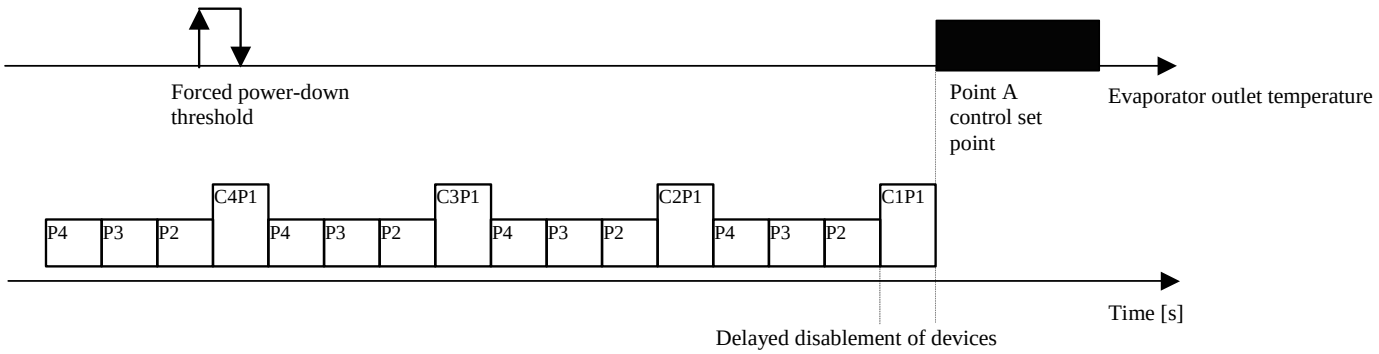
if the water temperature measured by the probe located at the evaporator outlet exceeds the threshold of Control Set-point + Control Band (Point B), the number of power stages will be increased - the power stages were input according to the set parameter known as "delay between power-up of different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



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

11.3.2 Power-down of compressors

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

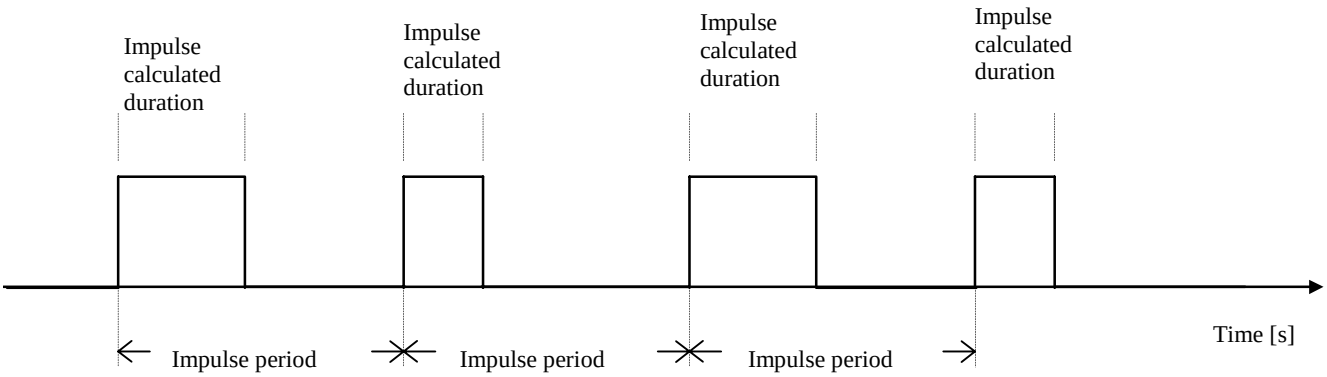


If temperature falls below the set forced power-down threshold, the compressors are powered down irrespective of the set delays, in order to prevent tripping the antifreeze alarm.

11.4 Continuous capacity control

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

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



11.4.1 Configuration of continuous capacity control relays

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

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

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

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

Default configuration :

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

The power stand-by configuration is taken on by the outputs when no variation of input power is requested, or if the maximum/minimum compressor power is reached, or because the water temperature measured by the probe located at evaporator outlet is inside the neutral control zone.

For compressor charging /discharging, the digital outputs of the pCO card are commanded alternatively according to the stand-by and charge/discharge configuration, causing the dedicated relay to pulse.

11.5 Continuous capacity control with control at outlet

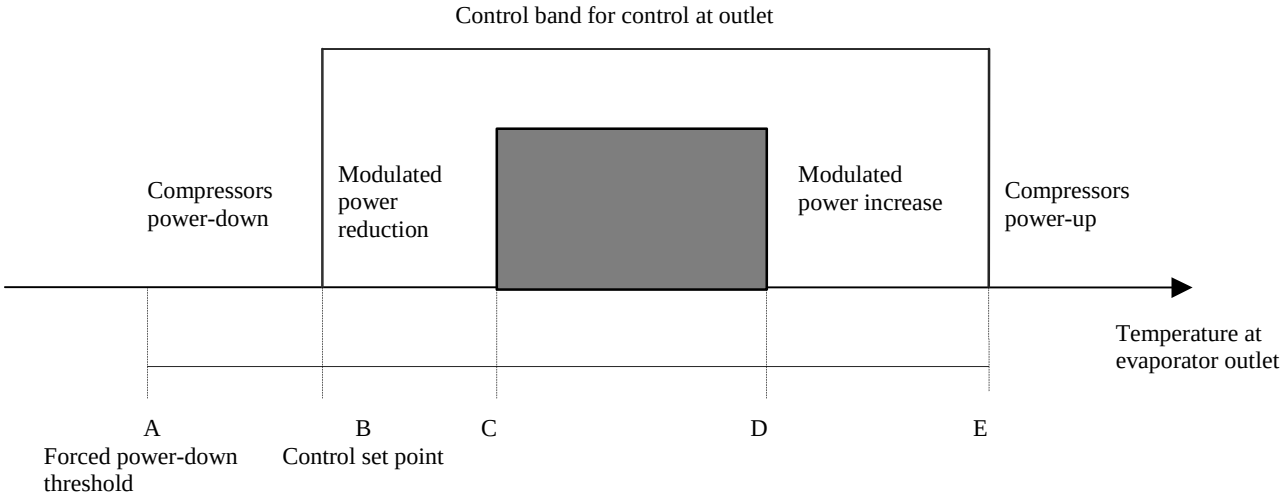
Temperature control with compressors on continuous capacity control can occur only if control at outlet is selected, according to the temperature values measured by the probe located at evaporator outlet.
To that end, further configuration parameters are input. They are specific for the particular type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

Parameters used :

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

Outputs used :

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



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

According to the set-point values, the control band with control at output and the neutral zone of compressors on continuous capacity control, points C, D and E are identified.

If the water temperature measured by the probe located at evaporator outlet exceeds point E

Point E = Control Set-point + Control Band with Control at Outlet

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

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

Point B = Control Set-point

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

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

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

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

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

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

11.5.3 Increase of compressor power

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

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

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

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

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

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

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

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

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

12 Compressor rotation

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

Rotation-free management

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

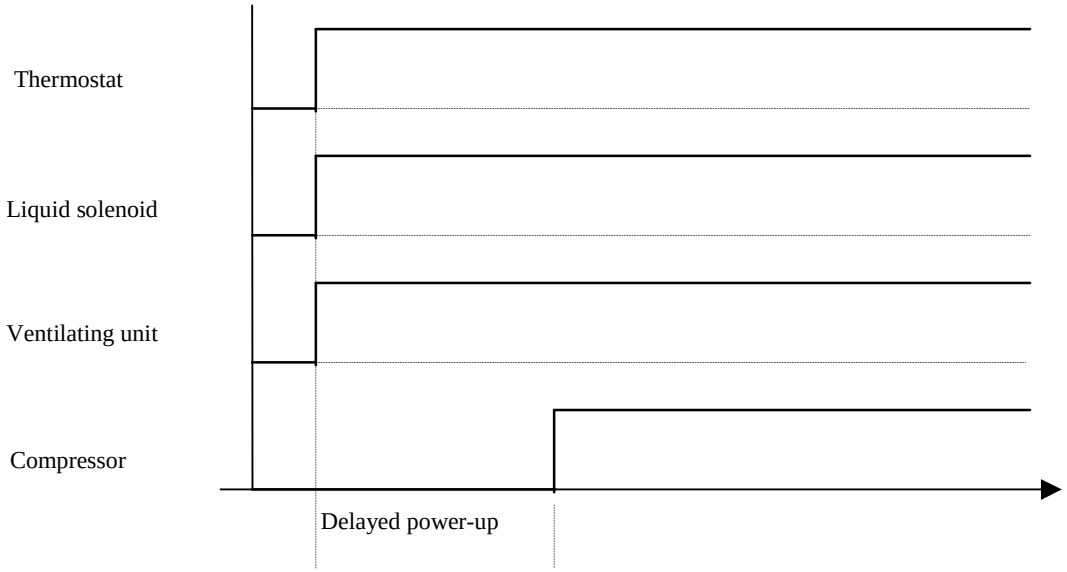
FIFO rotation management (the first compressor to be powered up is the first to be powered down):

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

13 Starting a single compressor

13.1.1 Description of operation

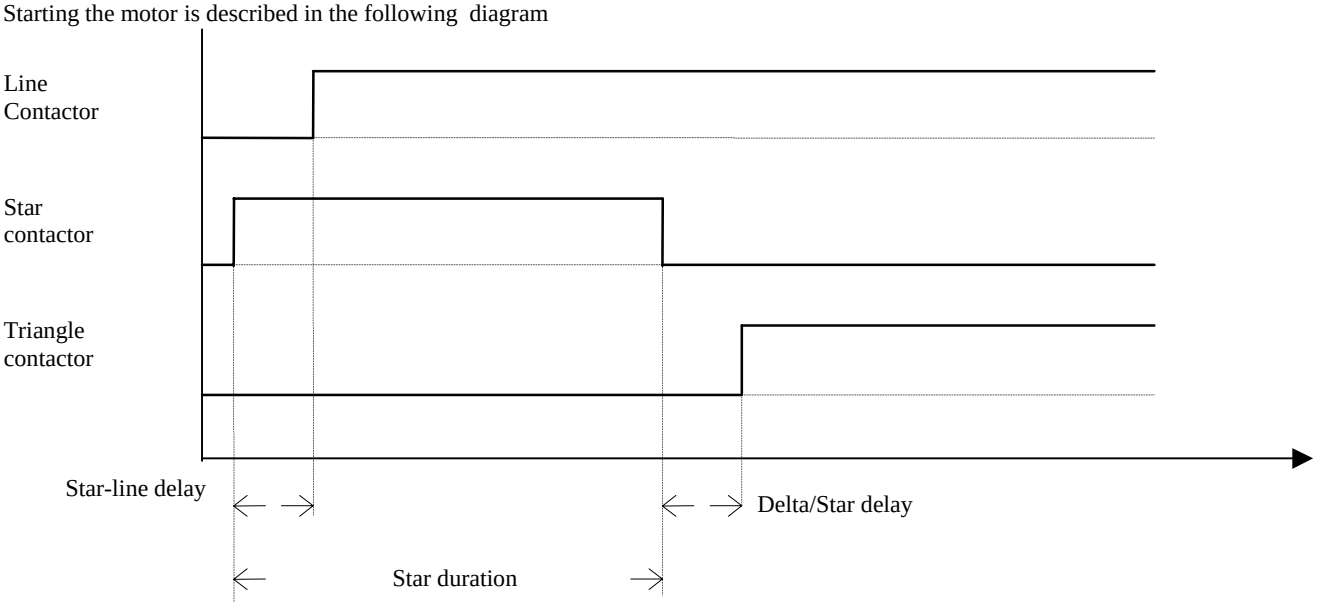
The start-up stages are described in the following graph



13.2 Starting the compressor motor

13.2.1 Delta / Star starting

Starting the motor is described in the following diagram



13.2.2 Start-up with Part - Winding

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

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

13.3 Compressor start restrictions

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

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

14 Forced capacity control

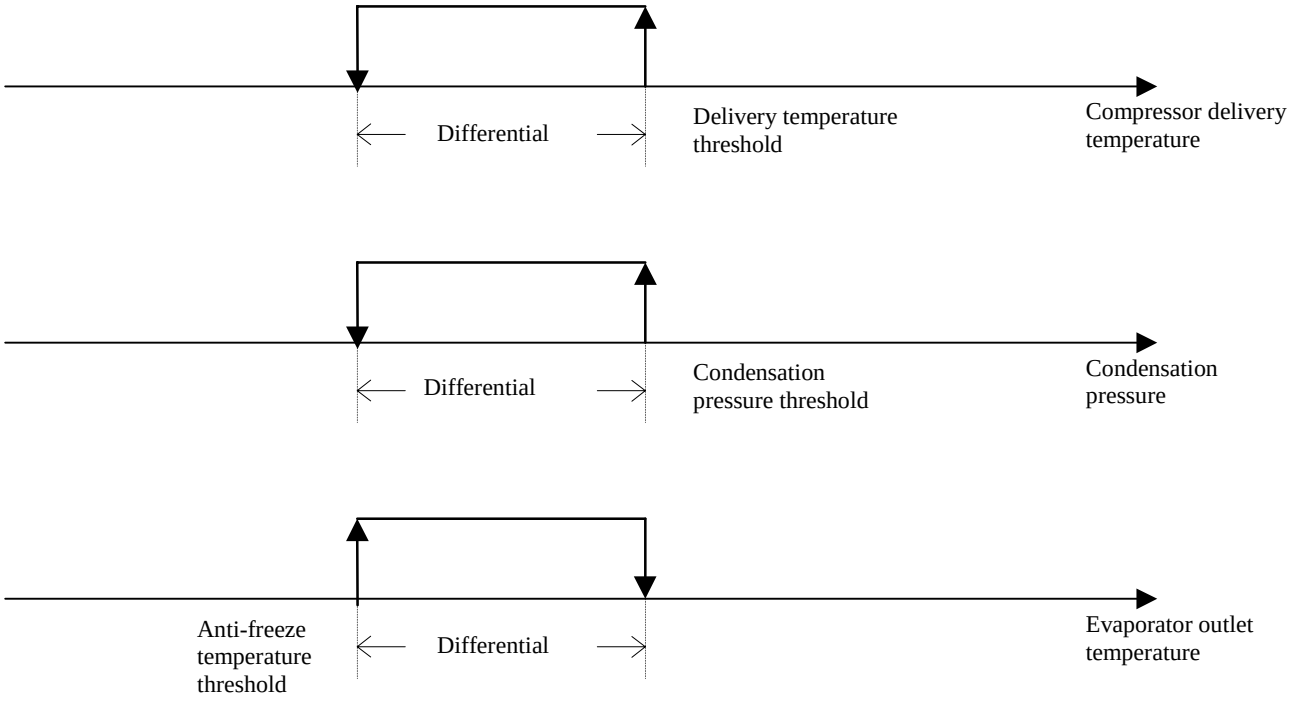
Inputs used
- Water temperature at evaporator outlet
- Compressor delivery temperature
- Condensation pressure

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

Outputs used
- All compressor capacity control relays

14.1.1 Description of operation

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



14.1.2 Compressors with stepped capacity control

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

14.1.3 Compressors with continuous capacity control.

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

15 Solenoid-valve management.

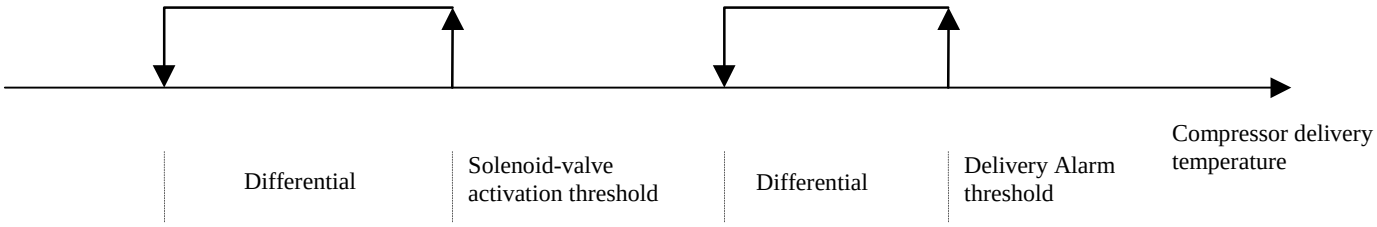
Inputs used:
- Compressor delivery temperature

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

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

15.1.1 Description of operation

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



16 Pump-down

Inputs used
- Low Pressure Pressure-switch

Parameters used
- Enable pump - down
- Pump - down maximum duration

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

16.1.1 Description of operation

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

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

17 Condensation control

Condensation can be performed in the following modes:

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

Inputs used:

- high pressure probe B7
- battery temperature probe B3

Outputs used :

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

Parameters used :

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

17.1 ON/OFF Condensation linked to operation of compressor:

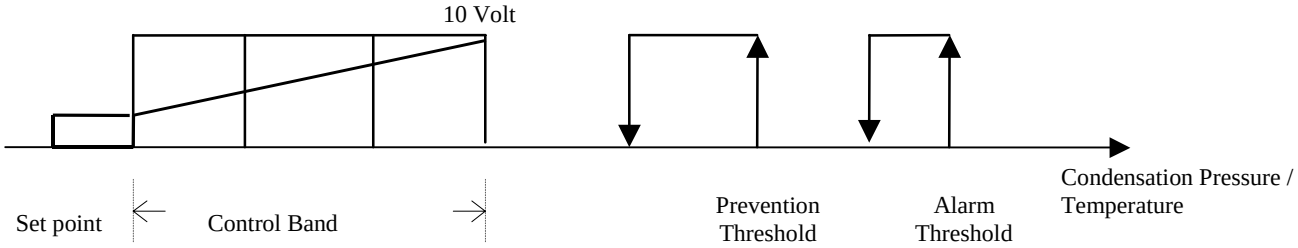
Fan operation will solely depend on compressor operation:
Compressor OFF = fan OFF
Compressor ON = fan ON

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

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

17.3 Modulating condensation linked to pressure or temperature sensor :

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



17.4 Prevent function:

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

18 Defrosting control for water/air machines

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

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

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

18.1 Types of defrosting

18.1.1 Simultaneous

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

18.1.2 Separate

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

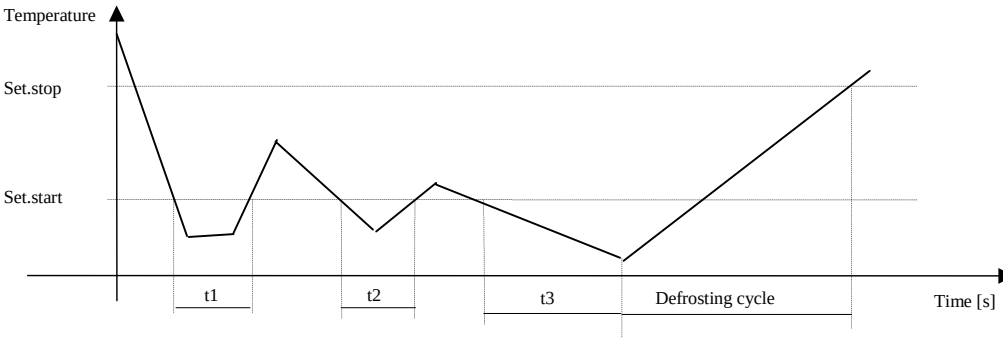
18.1.3 Independent

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

18.2 Type of defrosting start/end

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

18.3 Defrosting a circuit with time/temperature control



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

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

18.4 Defrosting a circuit with time/pressure switches control

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

18.5 Operation of fans during the defrosting stage

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

19 Free Cooling Control

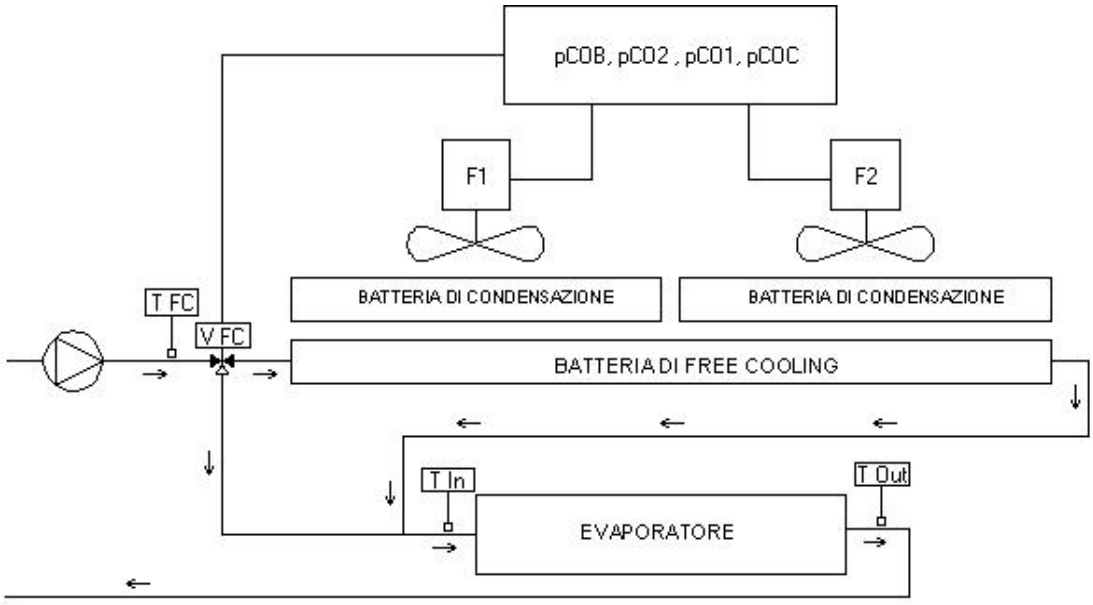
Inputs used
- Water temperature at evaporator outlet
- Water temperature at inlet of Free Cooling battery
- Outside air temperature

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

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

19.1.1 Description of operation

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



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

19.2 Free Cooling activation condition

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

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

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

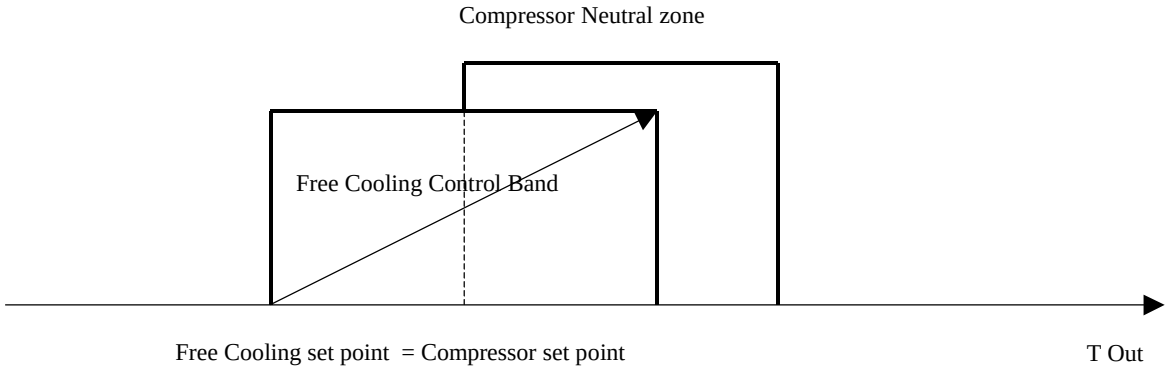
19.3 Free Cooling Thermostat

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

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

In machines controlled output with a neutral zone, the Free Cooling control set point will correspond to the control set point of the compressors.

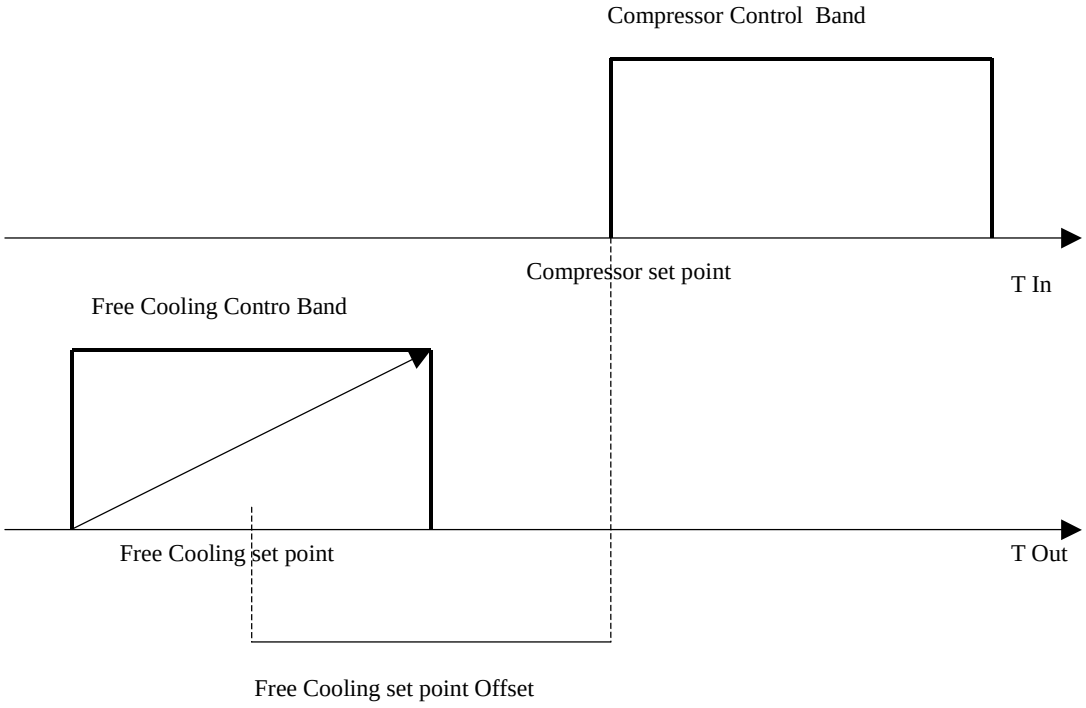
Free Cooling Set point = Compressors set Point



The proportional control band will be equally distributed at the sides of the set point.

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

Free Cooling Set point = Compressors Set-point - Offset



The proportional control band will be equally distributed at the sides of the set point.

In the Free Cooling control band, the activation thresholds for dedicated devices (e.g. valves and fans or speed variators) will be calculated in different ways according to the type of selection.
As the fans and/or speed variators are shared by Free Cooling control and condensation control, if one or more compressors in a given refrigerating circuit is/are enabled, priority will be given to condensation control to protect the circuit itself.
The Free Cooling valve will, in any event, be maintained fully open to provide as high as possible a thermal yield even at minimum ventilating capacity.
To optimise Free Cooling performance during the machine start transients and in steady state operating situations, a by-pass time is applied for thermostatic control of the compressors.

The purpose of this time is to delay the activation of the compressors in order to give Free Cooling sufficient time to reach the steady state conditions and take the machine's yield to nominal value. Only after this time has elapsed, and with the main thermostat dissatisfied, the compressors are commanded to operate. If time is set to 0, the function will be disabled.

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

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

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

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

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

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

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

19.4 Free Cooling disabling conditions

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

The Free Cooling valve will close if the Free Cooling conditions stop.

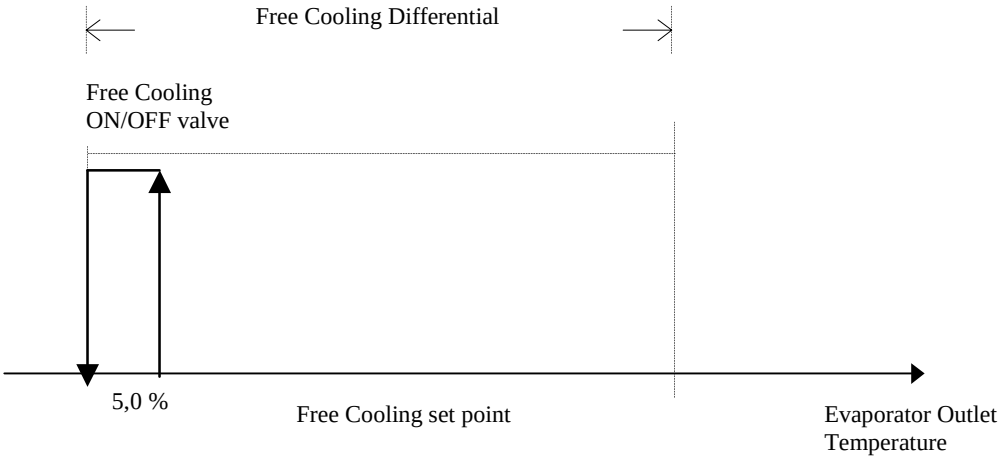
External T. $\leq$ Free Cooling Input T. – (Free Cooling Delta) + 1.5°C

The Free Cooling valve will close if the Free Cooling thermostat is satisfied.

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

19.5 Free Cooling ON/OFF valve

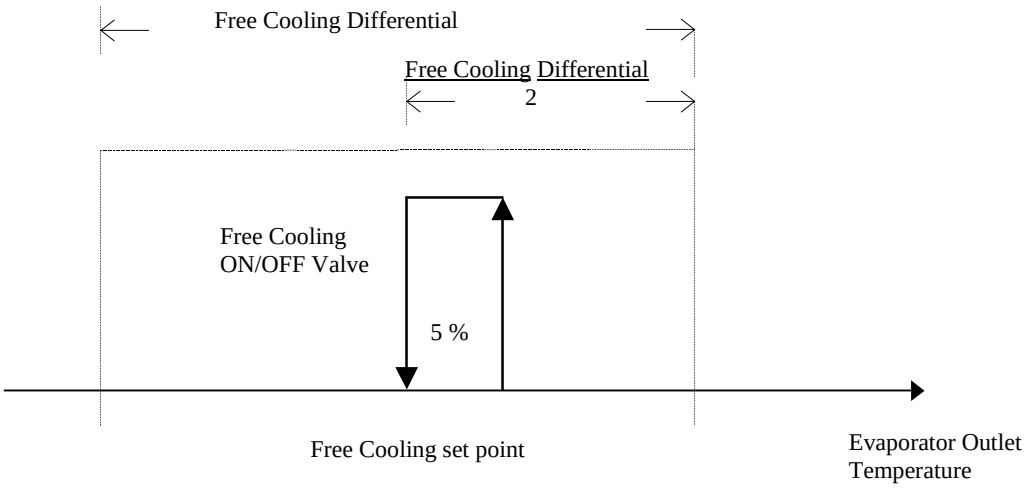
19.5.1 Proportional control



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

Control Set point - Free Cooling Differential +5.0% Free Cooling Differential
The step amplitude is fixed at 5.0% of the set Free Cooling control differential.

19.5.2 Proportional + integral control



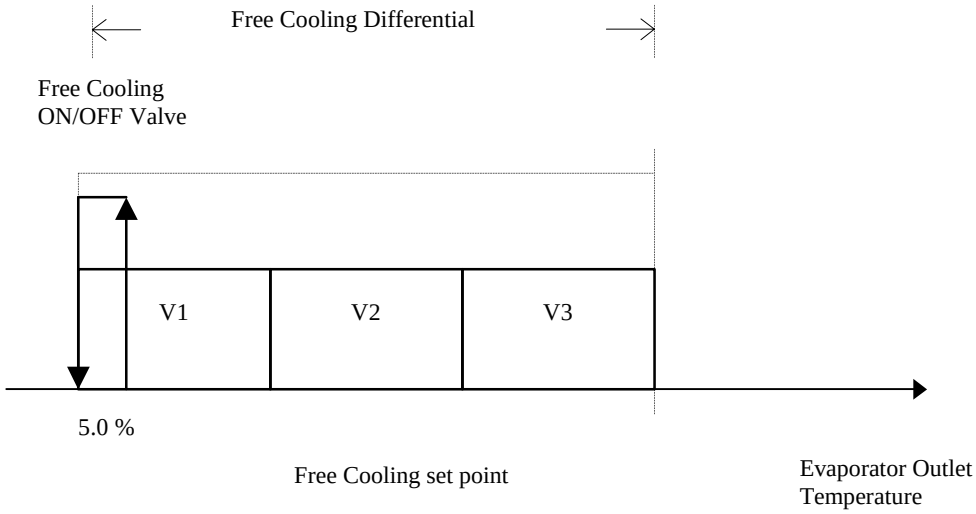
If temperature conditions favour Free Cooling control, the Free Cooling ON/OFF valve will be activated as soon as temperature exceeds the activation threshold of the individual step, identified by a temperature value of:

Control Set point + 5.0% Free Cooling Differential

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

19.6 Free Cooling ON/OFF valve with stepped condensation

19.6.1 Proportional control



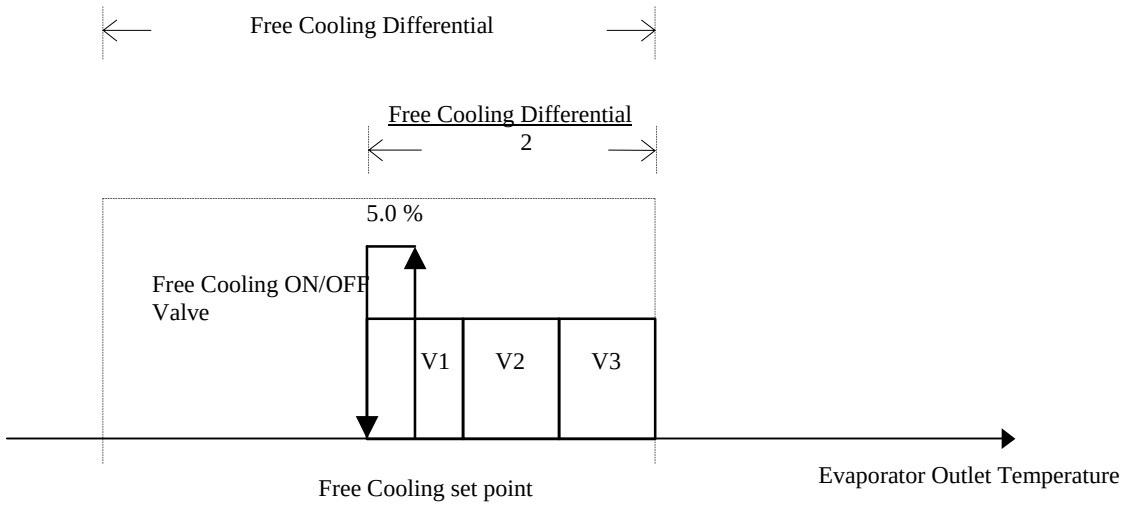
Here is an example of Free Cooling control with ON/OFF valve and three condensation steps.

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

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

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

19.6.2 Proportional + integral control



Here is an example of Free Cooling control with ON/OFF valve and three condensation steps.

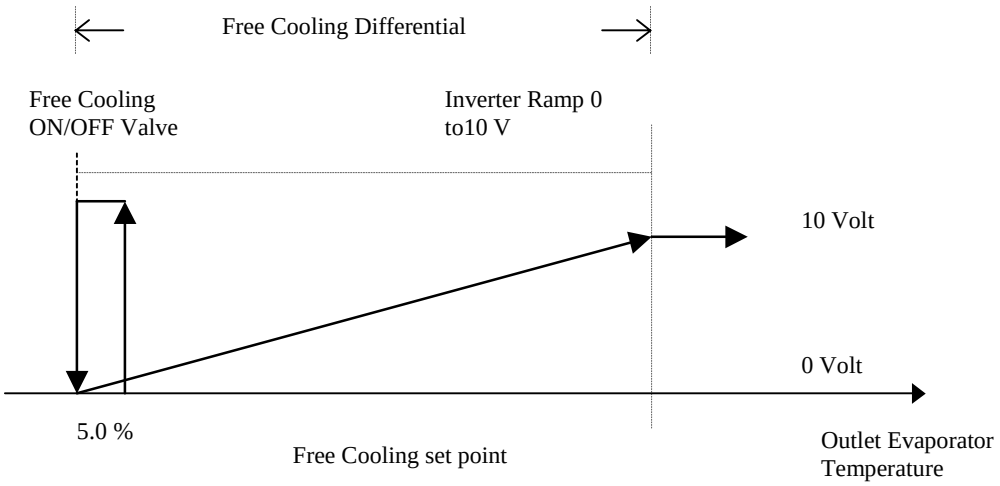
The devices, whether they are valve or fans, will be activated in the second half of the control differential through the effect of the integrating control. Their activation will be tied to the set integrating constant: the slower it is, the greater the value attributed to the specific parameter.
The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

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

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

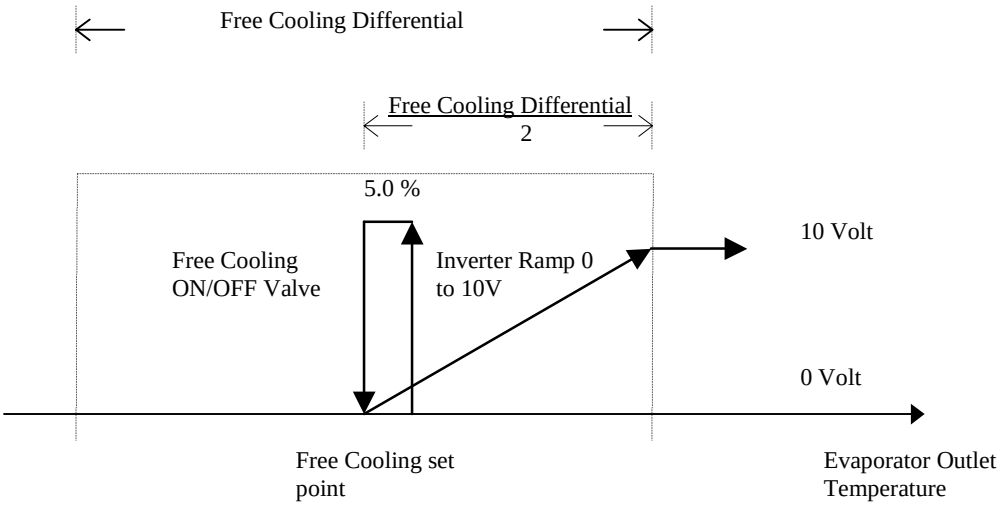
19.7 Free Cooling ON/OFF valve with inverter controlled condensation

19.7.1 Proportional control



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

19.7.2 Proportional + integral control



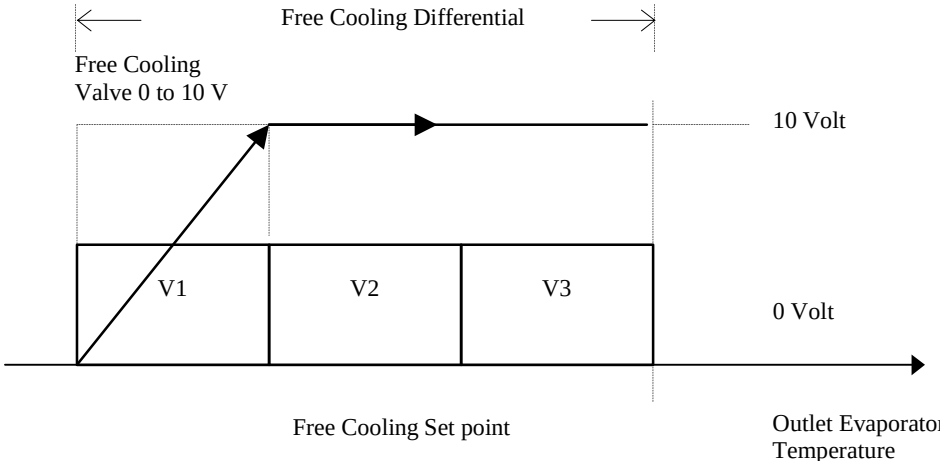
The devices, whether they are valve or fans, will be activated in the second half of the control differential through the effect of the integrating control. Their activation will be tied to the set integrating constant: the slower it is, the greater the value attributed to the specific parameter.
The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

19.8 0-10 Volt Free Cooling ON/OFF valve

The Free Cooling valve is proportionally commanded in a different way depending on whether condensation control is in steps or by inverter. The control diagrams of the two different situations are shown below.

19.9 0-10 Volt Free Cooling ON/OFF valve with stepped condensation

19.9.1 Proportional control

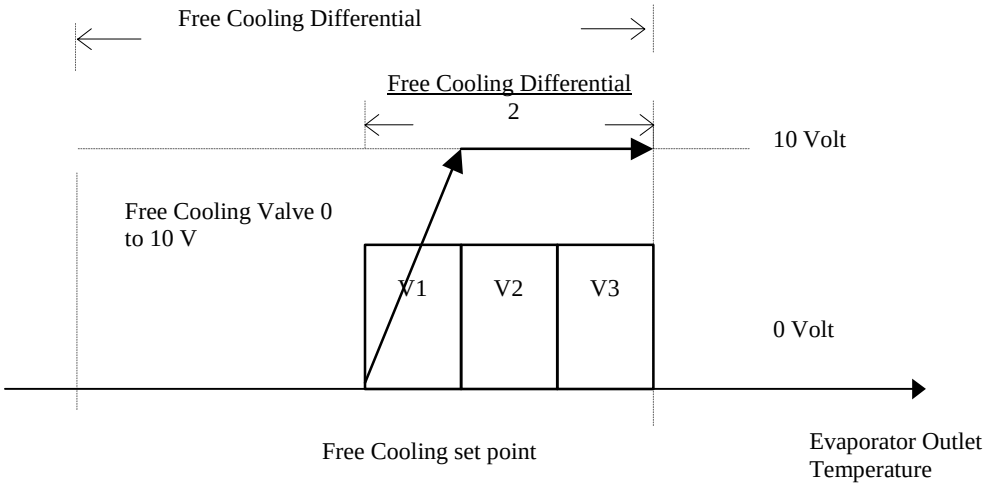


The proportional control ramp of the Free Cooling valve will be calculated inside the first activation step of the condensation fans. In this way, when the first fan is enabled, the valve will be completely open, and, therefore, water flow in the Free Cooling battery (exchanger) will be at maximum level.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

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

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

19.9.2 Proportional + integral control



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

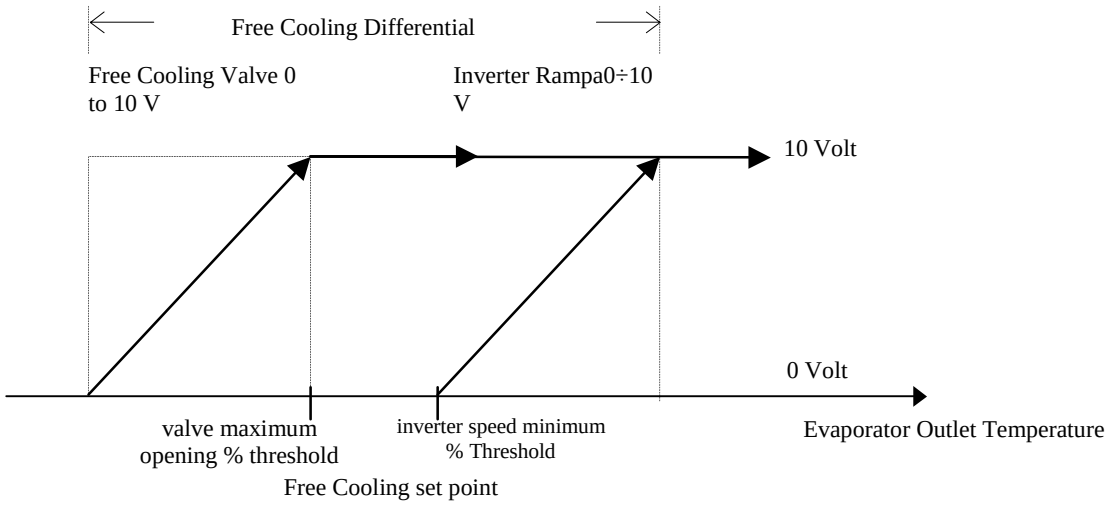
To calculate the amplitude of each step, use the following relation:

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

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

19.10 0-10 Volt Free Cooling valve with inverter controlled condensation

19.10.1 Proportional control



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

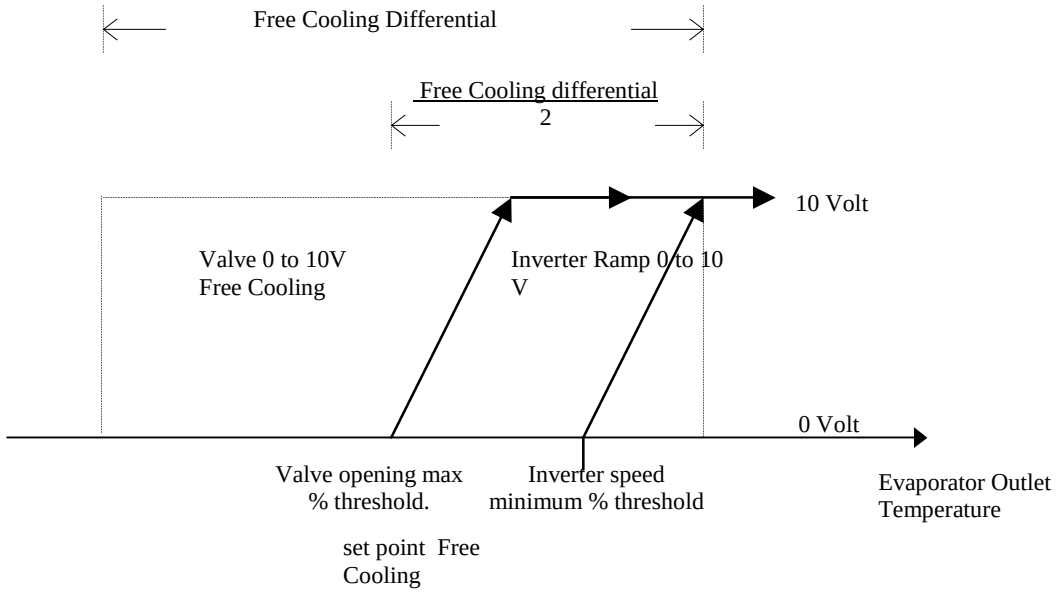
The control proportional ramp of the condensation inverter will be calculated inside the area determined by the thresholds:
Control Set point -Free Cooling Differential/2 + inverter speed minimum % Threshold
Control Set point + Free Cooling Differential/2

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

Example

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

19.10.2 Proportional + integral control



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

20 Alarms

Alarms are divided into three categories
Warning-only alarms (only warning on display and buzzer, warning on display, buzzer, alarm relay)
Circuit alarms (only disable relevant circuit, warning on display, buzzer, alarm relay)
Serious alarms (disable whole system, warning on display, buzzer, alarm relay)

20.1 Serious alarms

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

20.2 Circuit alarms

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

20.3 Warning only alarms

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

20.4 Pressure differential alarm management

Inputs used
- Low pressure transducer
- High pressure transducer

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

Outputs used
- General alarm relays
- All compressor outputs

20.4.1 Description of operation

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

20.5 Antifreeze control

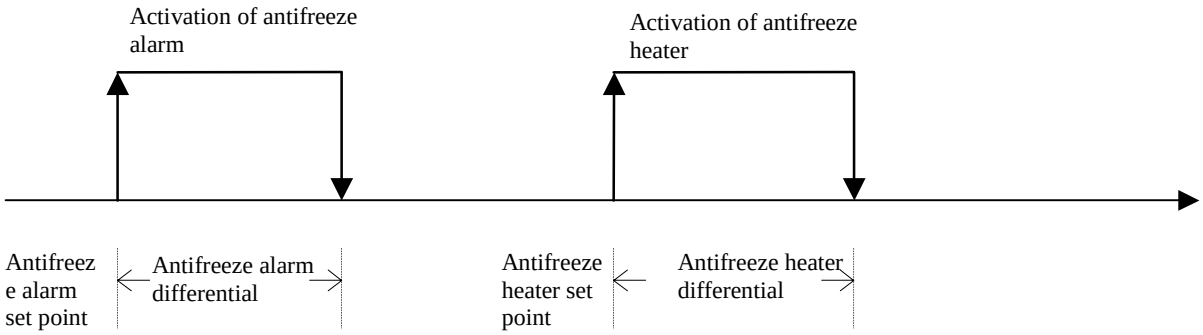
Inputs used:
- Water temperature at evaporator outlet
- Water temperature at condenser outlet

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

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

20.5.1 Description of operation

Every pCO unit is able to manage antifreeze control providing the water temperature probe at evaporator/condenser outlet is connected and enabled according to the type of unit being controlled.



Antifreeze control is always enabled, even if the machine is OFF, both in summer and winter operating modes.
For type 5 machines with reversing of the water circuit, the antifreeze control always controls water temperature at evaporator outlet, shifting control to the evaporator or condenser according to the operating mode (summer-winter).

The antifreeze alarms is a system alarm in multi-card systems. If present on any unit, it will totally shut down the machine.

A control parameter is provided, which enables you to select whether to keep the main circulation pump ON or OFF in the event of an antifreeze alarm

20.6 pCO alarms table

Code	Alarm description	OFF Compressors	OFF Fans	OFF Pump	OFF System	Reset	Delay	Separation
011	Serious Alarm	*	*	*	*	Manual		Mst/Slv
012	Phase Monitor Alarm	*	*	*	*	Manual		Mst/Slv
018	Evaporator Pump thermal Cutout	*	*	*	*	Manual		Mst
019	Condenser Pump thermal Cutout	*	*	*	*	Manual		Mst
013	Evaporator Flow-switch	*	*	*	*	Manual	Settable	Mst/Slv
014	Condenser Flow-switch	*	*	*	*	Manual	Settable	Mst/Slv
031	Antifreeze Alarm	*	*		*	Manual		Mst/Slv
001	Unit 1 Offline	*	*	*	*	Automatic	50 / 30 s	Slv
002	Unit 2 Offline	*	*	*	*	Automatic	50 / 30 s	Mst
003	Unit 3 Offline	*	*	*	*	Automatic	50 / 30 s	Mst
004	Unit 4 Offline	*	*	*	*	Automatic	50 / 30 s	Mst
020	Compressor Thermal cutout	*				Manual		Mst/Slv
015	Oil Differential Pressure Switch	*	*			Manual	Settable	Mst/Slv
032	Low Pressure Differential	*				Manual	Settable	Mst/Slv
017	Low Pressure 2 Pressure-switch	*	*			Manual	Settable	Mst/Slv
016	High Pressure Pressure-switch	*	*			Manual		Mst/Slv
034	Low Transducer Pressure	*				Manual		Mst/Slv
033	High Transducer Pressure	*	*			Manual		Mst/Slv
021	Fan 1 Thermal cutout		*			Manual		Mst/Slv
022	Fan 2 Thermal cutout		*			Manual		Mst/Slv
036	High Voltage					Manual		Mst/Slv
037	High Current					Manual		Mst/Slv
051	Evap. Pump Maintenance					Manual		Mst
052	Cond. Pump Maintenance					Manual		Mst
053	Compressor Maintenance					Manual		Mst/Slv
060	B1 Probe Failed	*	*	*	*	Automatic	10 s	Mst
061	B2 Probe Failed	*	*	*	*	Automatic	10 s	Mst/Slv
062	B3 Probe Failed					Automatic	10 s	Mst/Slv
063	B4 Probe Failed					Automatic	10 s	Mst/Slv
064	B5 Probe Failed					Automatic	10 s	Mst/Slv
065	B6 Probe Failed					Automatic	10 s	Mst/Slv
066	B7 Probe Failed					Automatic	10 s	Mst/Slv
067	B8 Probe Failed					Automatic	10 s	Mst/Slv
041	32KB Clock Card Failed					Manual		Mst/Slv

20.7 Driver card alarms

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

21 Alarm log

The alarm log can store the standard chiller's operating state when alarms are generated or at particular times. Each set of data stored is an event that can be viewed by selecting it from the list of logged events. The log proves useful when troubleshooting because a "snapshot" is taken of the system when the alarm occurs, which can later be used to help determine possible causes and how to remedy the trouble.
There are two kinds of log in the program, the STANDARD log and ADVANCED log.

21.1 Standard log

The pCO* boards' considerable buffer space means events can be saved in the STANDARD log, which is always available on the various boards. If there is no clock card (optional extra on pCO1 and pCOC, built-in feature on pCO2), the STANDARD log just gives the alarm code.
The maximum number of events that can be logged is 100. Once the hundredth alarm is reached, i.e. the last available slot in the memory is taken, the oldest alarm (00) is erased as it is overwritten with the next alarm, and so on for subsequent events. Logged events cannot be deleted by the user unless installing factory settings. The STANDARD log screen can be called up by pressing the MAINTENANCE key, and looks like this:

```
+--------------------+
¦      Alarm log   A2¦
¦Event number      00¦
¦Alarm code       000¦
¦Date  00:00 00/00/00¦
+--------------------+
```

For each alarm, the following data are stored relating to the standard chiller at the time of the alarm:

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

The chronological event number indicates the "seniority" of the event with respect to the 100 available storage slots. The alarm with number 00 is the first to occur after the STANDARD logs are enabled, and hence the oldest.
If you move the cursor onto the chronological number, you can run through the alarm log, from 0 to 99, using the arrow keys.
For instance, if you are on position 00, pressing the down arrow will not take you anywhere.
If 15 alarms have been logged, for instance, and you are on position 014, pressing the up arrow will not take you anywhere.

21.2 Advanced log

Events are logged on the 1MB or 2MB memory expansion module, which is a permanent appendix to the board. Advantages and features are listed below:

- Event-based log: a typical event-based log is the alarm log. When an alarm occurs, the alarm generated is stored along with significant data (temperatures, pressures, set points etc.).
- Time-based log: a typical event[*sic! probably* time]-based log is the temperatures/pressure log. Temperature and pressure values are stored at regular intervals.
- Log log: this is the log of the last alarms/temperatures/pressures stored before a serious alarm. Unlike data stored in the event- and time-based logs, these data are not overwritten when the memory is full.
- You have the option of choosing the values to be saved at any time as well as the method used to save them. Using the "WinLOAD" utility program, you can define the values to be saved and the method used to save them with the aid of a practical Wizard. WinLOAD does not need application software files as it can procure all the information required directly from the pCO1 – pCO2 board's resident application software.
- 1MB of dedicated FLASH memory. With this system, data are saved to the 1MB FLASH memory included in the memory expansion module (code PCO200MEM0). By way of example, 1MB of memory can hold 5,000 alarm events with 5 values for each alarm, and 6 months of recording 2 values - for instance, temperature and pressure - saved every 5 minutes.
- Option of defining up to 7 different log configurations. Usually, each controller will have one alarm log and one log for control values (temperature/humidity/pressure) configured, in addition to a number of "log logs".
- Stored data can be consulted either via the (separate or built-in) LCD terminal or via a connected PC.
- "Black box" operating mode. The memory expansion module containing the logs can be removed from the controlled unit's pCO² and inserted in another pCO², via which the stored data can be consulted. The host pCO² does not need to contain the same software as the original.
- Stored data reliability. Data are saved to a FLASH memory that does not need batteries, which are liable to run down. If previously stored data are not compatible with new software following an upgrade, all data are erased (you are prompted to confirm first).

21.3 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 1 Thermal cutout
AL:022 Condenser 2 Thermal cutout
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 delivery temperature alarm
AL:036 High voltage alarm
AL:037 High current alarm
AL:041 Alarm: clock card failed or disconnected
AL:051 Evaporator pump maintenance
AL:052 Condenser pump maintenance
AL:053 Compressor Maintenance
AL:060 Probe B1 failed or not connected
AL:061 Probe B2 failed or not connected
AL:062 Probe B3 failed or not connected
AL:063 Probe B4 failed or not connected
AL:064 Probe B5 failed or not connected
AL:065 Probe B6 failed or not connected
AL:066 Probe B7 failed or not connected
AL:067 Probe B8 failed or not connected
AL:101 Diver 1 probe status
AL:102 Diver 1 EEPROM error
AL:103 Diver 1 stepped motor error
AL:104 Diver 1 battery error
AL:105 High pressure (MOP) driver 1
AL:106 Low pressure (LOP) driver 1
AL:107 Low super-heat alarm, driver 1
AL:108 Valve not shut while driver 1 being disabled
AL:109 Driver 1 high intake temperature
AL:110 Standby due to EEPROM /battery recharge / or open valve error, driver 1
AL:111 LAN disconnected, driver 1
AL:201 Diver 2 probe error
AL:202 Diver 2 EEPROM error
AL:203 Diver 2 stepped motor error
AL:204 Diver 2 battery error
AL:205 High pressure (MOP) driver 2
AL:206 Low pressure (LOP) driver 2
AL:207 Low super-heat alarm, driver 2
AL:208 Valve not shut while driver 2 being disabled
AL:209 Driver 2 high intake temperature
AL:210 Standby due to EEPROM /battery recharge / or open valve error, driver 2
AL:211 LAN disconnected, driver 2

21.4 Short summary of alarms coming from driver

- probe error (temperature and/or pressure probe malfunctioning or failed)
- stepper motor error (valve motor connections fault)
- EEPROM error (EEPROM reading or writing malfunction)
- battery error (battery malfunction)
- high pressure on EXV driver (operating pressure has exceeded max. MOP threshold)
- high pressure on EXV driver (operating pressure has exceeded max. LOP threshold)
- superheat low alarm (overheating alarm)
- valve not closed during switch-off (valve not fully closed after last blackout)
- high intake temperature alarm (operating temperature has exceeded max. threshold)
- stand-by for error concerning EEPROM/battery charging or open valve (the system is blocked due to a problems at driver start-up - see the special "ignore" function)
- LAN disconnected (malfunction or fault in 4485 communication between pCO* and driver)

22 Supervisor

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

22.1.1 Key

A Analogue variables
D Digital variables
I Entire variable

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

Type	Direction	Address	Description
A	OUT	1	Analogue input 1 value
A	OUT	2	Analogue input 2 value
A	OUT	3	Analogue input 3 value
A	OUT	4	Analogue input 4 value
A	OUT	5	Analogue input 5 value
A	OUT	6	Analogue input 6 value
A	OUT	7	Analogue input 7 value
A	OUT	8	Analogue input 8 value
A	OUT	9	Analogue output 1 value
A	OUT	10	Analogue output 2 value
A	IN/OUT	11	Summer temperature set-point
A	IN/OUT	12	Winter temperature set-point
A	IN/OUT	13	Condensation set-point
A	IN/OUT	14	Temperature control band
I	OUT	1	Status of unit
I	OUT	2	pLAN address of unit
I	IN/OUT	3	Type of fan management
I	IN/OUT	4	Unit configuration type
I	IN/OUT	5	Number of compressors
I	IN/OUT	6	Number of fans
D	OUT	1	Status of unit
D	OUT	2	Digital output 1 value
D	OUT	3	Digital output 2 value
D	OUT	4	Digital output 3 value
D	OUT	5	Digital output 4 value
D	OUT	6	Digital output 5 value
D	OUT	7	Digital output 6 value
D	OUT	8	Digital output 7 value
D	OUT	9	Digital output 8 value
D	OUT	10	Digital output 9 value
D	OUT	11	Digital output 10 value
D	OUT	12	Digital output 11 value
D	OUT	13	Digital output 12 value
D	OUT	14	Digital output 13 value
D	OUT	15	Enable evaporator flow-switch alarm
D	OUT	16	Enable probe 1
D	OUT	17	Enable probe 2
D	OUT	18	Enable probe 3
D	OUT	19	Enable probe 4
D	OUT	20	Enable probe 5
D	OUT	21	Enable probe 6
D	OUT	22	Enable probe 7
D	IN/OUT	23	Enable probe 8
D	IN/OUT	24	ON/OFF from Supervisor
D	IN/OUT	25	Enable starting restrictions
D	IN/OUT	26	Type of compressor capacity control
D	OUT	27	Summer/Winter selection from digital input
D	OUT	28	
D	OUT	29	Summer/Winter operation
D	OUT	30	Selection of condensation with inverter
D	OUT	45	
D	OUT	46	Antifreeze alarm
D	OUT	47	Compressor thermal overload alarm
D	OUT	48	Evaporator flow-switch alarm
D	OUT	49	Condenser flow-switch alarm
D	OUT	50	High pressure alarm from pressure switch

Type	Direction	Address	Description
D	OUT	51	Oil level alarm
D	OUT	52	Low pressure alarm from pressure switch
D	OUT	53	High pressure alarm from transducer
D	OUT	54	Serious alarm from digital input
D	OUT	55	Fan 1 thermal cutout alarm
D	OUT	56	Fan 2 thermal cutout alarm
D	OUT	57	Evaporator pump thermal cutout alarm
D	OUT	58	Card 1 offline alarm
D	OUT	59	Slave 1 Offline alarm
D	OUT	60	Slave 2 Offline alarm
D	OUT	61	Slave 3 Offline alarm
D	OUT	62	Alarm: Probe 1 failed or not connected
D	OUT	63	Alarm: Probe 2 failed or not connected
D	OUT	64	Alarm: Probe 3 failed or not connected
D	OUT	65	Alarm: Probe 4 failed or not connected
D	OUT	66	Alarm: Probe 5 failed or not connected
D	OUT	67	Alarm: Probe 6 failed or not connected
D	OUT	68	Alarm: Probe 7 failed or not connected
D	OUT	69	Alarm: Probe 8 failed or not connected
D	OUT	70	Condenser pump duty hours alarm
D	OUT	71	Compressor duty hours alarm
D	OUT	72	Condenser pump thermal cutout alarm
D	OUT	73	Clock alarm
D	OUT	74	Phase monitor alarm
D	OUT	75	Low pressure alarm from transducer
D	OUT	76	High voltage alarm
D	OUT	77	High current alarm
D	OUT	78	Evaporator pump duty hours alarm
D	OUT	79	Values inputting error
D	OUT	80	High delivery temperature alarm
D	OUT	81	Pressure differential alarm
D	OUT	82	Diver 1 probe alarm
D	OUT	83	Alarm: driver 1 EEPROM error
D	OUT	84	Alarm: driver 1 stepped motor valve error
D	OUT	85	Alarm: driver 1 battery error
D	OUT	86	Driver 1 high pressure alarm (MOP)
D	OUT	87	Driver 1 low pressure alarm (LOP)
D	OUT	88	Driver 1 low superheat alarm
D	OUT	89	Alarm - valve not shut after driver 1 black-out
D	OUT	90	Driver 1 high intake temperature alarm
D	OUT	91	Diver 2 probe alarm
D	OUT	92	Alarm: driver 2 EEPROM error
D	OUT	93	Alarm: driver 2 stepped motor valve error
D	OUT	94	Alarm: driver 2 battery error
D	OUT	95	Driver 2 high pressure alarm (MOP)
D	OUT	96	Driver 2 low pressure alarm (LOP)
D	OUT	97	Driver 2 low superheat alarm
D	OUT	98	Alarm - valve not shut after driver 2 black-out
D	OUT	99	Driver 2 high intake temperature alarm
D	OUT	100	Standby due to EEPROM /battery recharge / or open valve error, driver 1
D	OUT	101	Standby due to EEPROM /battery recharge / or open valve error, driver 2

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