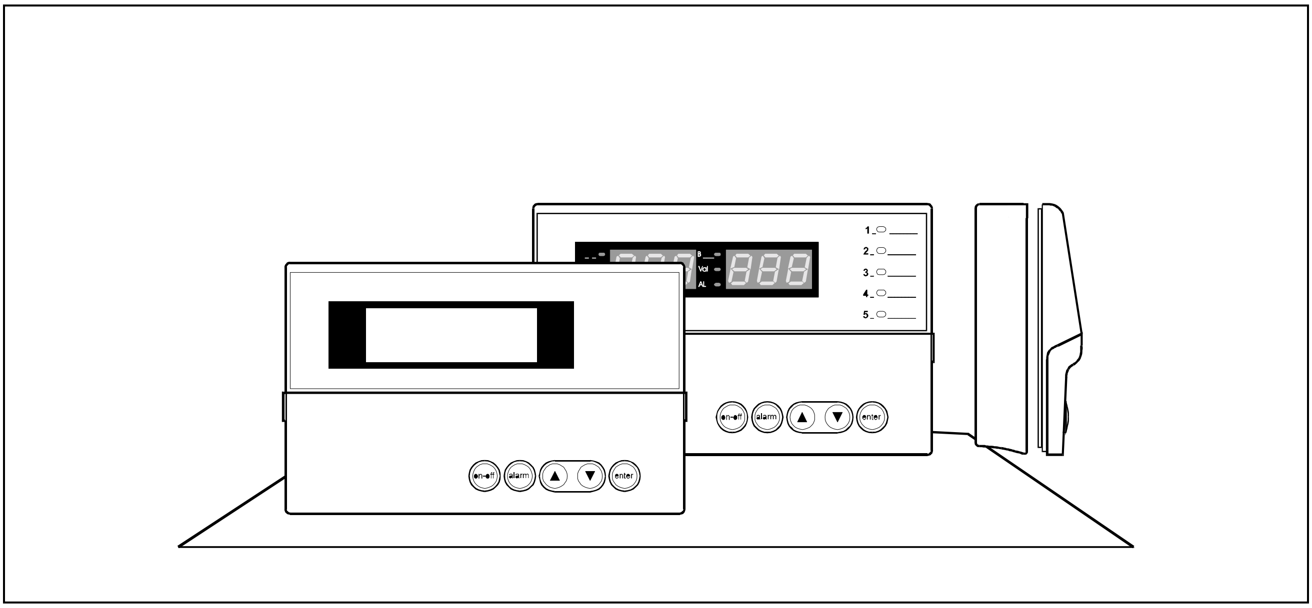
pLAN application software



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

Manual version: 3.0 – 10/12/2003

Program code: **EPSTDEMSCA**

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READ AND SAVE THESE INSTRUCTIONS

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

IMPORTANT WARNINGS

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

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

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

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

INDEX

1. Applications and functions performed by system

1.1 Type of units controlled

1.1.1 AIR / WATER CHILLER

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

1.1.2 WATER / WATER CHILLER

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

1.2 Type of control

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

1.3 Type of compressors

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

1.4 Maximum number of compressors

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

1.5 Compressor call rotation

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

1.6 Condenser control

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

1.7 Type of defrosting

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

1.8 Safety devices for each refrigerator circuit

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

1.9 System safety devices

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

1.10 Number of accessories

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

2. Structure of the master/slave system

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

2.1 Functions of the master

Temperature control
Calling of the compressors, maximum 4 screw compressors (start, stop, alarms, EXV)
Management of 1 screw compressor (start, stop, alarm, EXV)
Management of system alarms
Circuit alarm management
Logging of alarms
Communication with external supervisor

2.2 Functions of the slaves

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

2.3 Electronic expansion valves

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

2.4 Control probe

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

2.5 Setting the system addresses

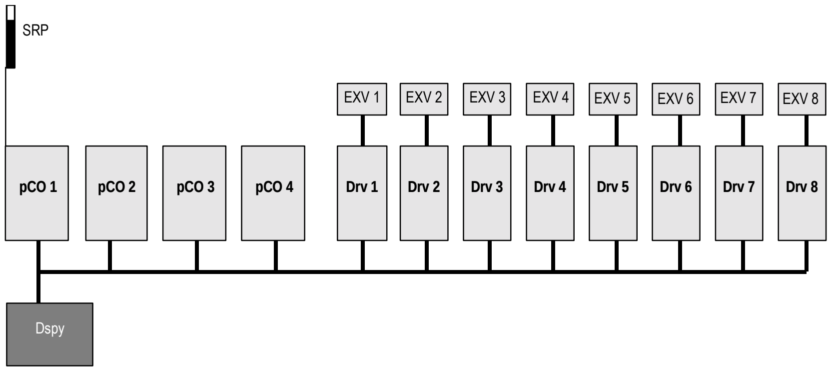


Fig. 2.1 Architecture of the Master-Slave system

SRP	System control probe
PCO 1…4	pCO boards
Drv 1…8	Electronic expansion valve control driver
EXV 1…8	Electronic expansion valves

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

2.5.1 Specific unit addresses

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

3. List of inputs/outputs

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

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

3.1.1 CHILLER ONLY (UNIT TYPE "0")

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

Table 3.1 Digital inputs, unit "0"

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

Table 3.2 Analogue inputs, unit "0"

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

Table 3.3 Digital outputs, unit "0"

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

Table 3.4 Analogue outputs, unit "0"

3.1.2 CHILLER + HEAT PUMP (UNIT TYPE "1")

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

Table 3.5 Digital inputs, unit "1"

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

Table 3.6 Analogue inputs, unit "1"

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

Table 3.7 Digital outputs, unit "1"

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

Table 3.8 Analogue outputs, unit "1"

3.1.3 CHILLER + FREECOOLING (UNIT TYPE "2")

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

Table 3.9 Digital inputs, unit "2"

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

Table 3.10 Analogue inputs, unit "2"

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

Table 3.11 Digital outputs, unit "2"

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

Table 3.12 Analogue outputs, unit "2"

3.2 WATER/WATER units with maximum 4 screw compressors (up to 4 steps per comp.)

3.2.1 CHILLER-ONLY (UNIT TYPE "3")

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

Table 3.13 Digital inputs, unit "3"

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

Table 3.14 Analogue inputs, unit "3"

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

Table 3.15 Digital outputs, unit "3"

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

Table 3.16 Analogue outputs, unit "3"

3.2.2 CHILLER + HEAT PUMP WITH REVERSAL ON REFRIGERANT CIRCUIT (UNIT TYPE "4")

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

Table 3.17 Digital inputs, unit "4"

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

Table 3.18 Analogue inputs, unit "4"

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

Table 3.19 Digital outputs, unit "4"

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

Table 3.20 Analogue outputs, unit "4"

3.2.3 CHILLER + HEAT PUMP WITH REVERSAL ON WATER CIRCUIT (UNIT TYPE "5")

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

Table 3.21 Digital inputs, unit "5"

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

Table 3.22 Analogue inputs, unit "5"

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

Table 3.23 Digital outputs, unit "5"

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

Table 3.24 Analogue outputs, unit "5"

4. Control

Two distinct temperature control modes are available:

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

The first type involves proportional control based on the absolute temperature measured by the probe; the second type involves dead zone control based on the time the temperature measured by the probe remains over specific thresholds. The selection of the type of control in any case related to the type of compressor managed. If the compressor controlled features stepped capacity control, both types of control can be used, as desired. If the compressor controlled features continuous capacity control, then only outlet temperature control is possible.

4.1 Control set point

Inputs used:

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

Parameters used:

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

4.1.1 Description of operation

The temperature control functions are based on the setting of two fundamental parameters: the set point and control band. The control set point can be changed in special unit operating conditions. There are four different methods for changing the control set point:

1. Setting on the screen: by accessing the special screen, the user can on set the value of the parameter.
2. Variation from the supervisor: if connected to a supervisor system, by accessing the corresponding addresses, the cooling or heating set point can be modified.
3. Variation from digital input: by enabling the management of the second set point; the status of the dedicated digital input will allow value of the set point set on the special screen to be replaced by the corresponding parameter configured by the user.
4. Variation from analogue input: by enabling the control of the remote set point from analogue input (0-1V), the compensation of the control set point will be activated, with a proportional value calculated between the two limits for the conversion of the set input signal.

All the above conditions may exist together, and condition "1" is in any case always present, while the others may be enabled or disabled as required.

4.2 Inlet temperature control

Inputs used:

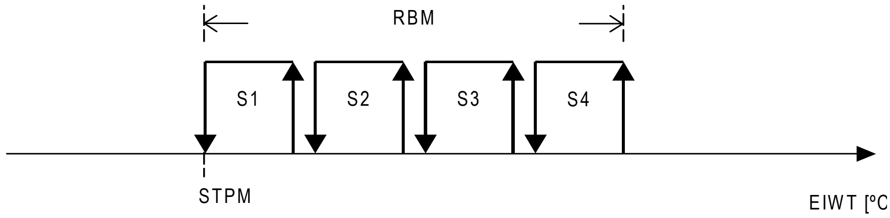
- Evaporator water inlet temperature

Parameters used:

- Type of unit
- Total number of compressors
- Type of compressor capacity control
- Number of capacity-control steps
- Control set point
- Proportional band for inlet control
- Type of control (proportional or proportional + integral)
- Integration time (if proportional + integral control enabled)

Outputs used:

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



STPM	Control Set point
RBM	Control band
EIWT	Evaporator water inlet temperature
S 1…4	Control steps

Fig. 4.1 Temperature control proportional to the reading of inlet probe

4.2.1 Description of operation

Temperature control according to the values measured by the temperature probe located at the evaporator inlet is proportional. Depending on the total number of compressors configured and the number of capacity steps per compressor, the control band set will be divided into a series of steps of the same amplitude. When the activation thresholds for the various steps are exceeded, a compressor or capacity step will be activated.
The following relationships are applied to determine the various activation thresholds.

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

4.3 Outlet temperature control

Inputs used:
- Evaporator water outlet temperature

Parameters used:
- Type of unit
- Total number of compressors
- Type of compressor capacity control
- Number of capacity-control steps
- Control set point
- Control band for outlet control
- Compressor capacity step activation delays
- Device activation delay
- Device stop delay
- Outlet temperature limit in cooling
- Outlet temperature limit in heating

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

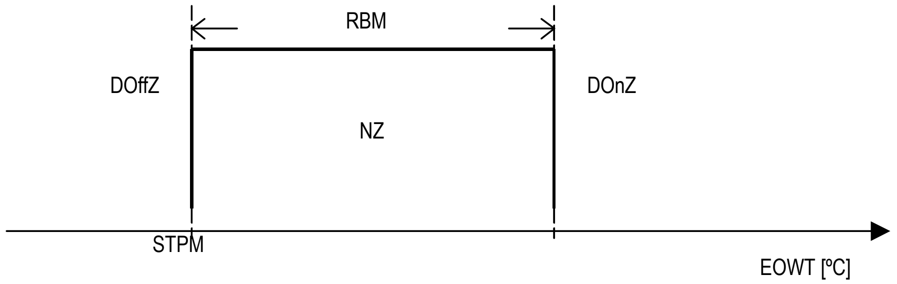


Fig. 4.2 Temperature control with dead zone based on reading from the outlet probe

STPM	Control set point
RBM	Control band
NZ	Dead zone
EOWT	Evaporator Water Outlet Temperature
DonZ	Device start zone
DoffZ	Device shutdown zone

4.3.1 Description of operation

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

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

4.4 Control of water/water chiller-only units

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

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

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

4.4.1 Description of operation:

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

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

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

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

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

4.5.1 Description of operation:

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

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

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

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

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

4.6.1 Description of operation:

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

4.7 Cooling / Heating Operation

Inputs used:
- Cooling/Heating digital input
- Supervisor serial network

Parameters used:
- Type of unit
- Enable change cooling/heating from digital input
- Enable change cooling/heating from supervisor serial network
- 4 way reversing valve logic for reversing the refrigerant / water cycle

Outputs used:
- Valve for reversing the refrigerant / water circuit

4.7.1 Description of operation

In chiller + heat pump units, operation can be changed from cooling to heating or vice-versa as described below. The variation in operating mode is possible only when the unit is off (circulating pump off). “Cooling” operation refers to the unit in chiller mode (production of cold water). “Heating” operation refers to the unit in heat pump mode (production of hot water). The order that are the different conditions are listed in represents the increasing priority for the activation of each (1 = maximum priority).

1. Digital input: if enabled by user parameter, switching is possible by controlling the dedicated digital input.
2. Supervisor: if enabled by user parameter, switching is possible by controlling the dedicated parameter via the serial line.
3. Keypad: the operating mode can be selected using the blue and red buttons
   Blue button   “cooling” operation
   Red button   heating” operation

Whatever mode is selected, the type of operation is displayed by the LEDs located on the blue and red buttons on the display:
- the LED located on the blue button indicates the setting of “cooling” operating mode
- the LED located on the red button indicates the setting of “heating” operating mode

5. Types of compressors controlled

5.1 Stepped capacity control

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

5.1.1 Stepped capacity control relay configuration

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

Default configuration:

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

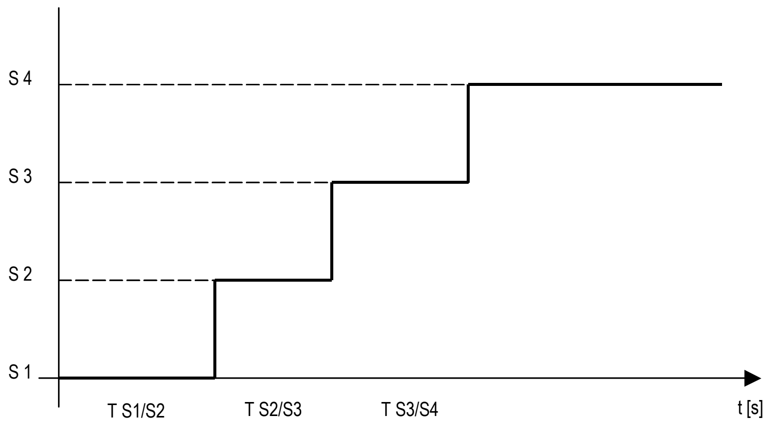
Example configuration:

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

In the event of compressor shutdowns when the unit is on, the capacity-control relays will be activated according to the configuration of the first capacity step; in this way, the residual gas will flow to the compressor, allowing it to be restated at minimum capacity. When the unit is shutdown, all the capacity-control relays will be off.

5.1.2 Stepped capacity control times

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



TS1/S2 Delay time between first and second capacity control steps
TS2/S3 Delay time between second and third capacity control steps
TS3/S4 Delay time between third and fourth capacity control steps
S 1…4 Capacity-control steps
t Time

Fig. 5.1 Capacity control step activation times

5.1.3 Specific management of the first capacity step

The first capacity step can be managed specifically so as to respond to the special needs of the compressor when working at low capacity. In general, this involves a narrowing of the capacity modulation field, using the first capacity step only during the start-up phase, and if the temperature falls below the control set point. The type of management differs according to whether the compressor is starting or stopping, and in both cases avoids working at 25% capacity for too long:

- Start: once started, if the compressor does not receive a request to switch to the second capacity step, the second step is forced on by the software, following a time that can be set on the screen (TS1/S2).
- Stop: if a decrease in the capacity of the circuit is requested, this will remain between the maximum and the second capacity step, and only if the temperature falls below the set point will the compressor be forced to operate at the first capacity step for the set time (TS1/S2)

If shut-down with pump-down is enabled, the compressor will shut-down at the second level of capacity and then switch off completely at the end of the procedure.
If the function is disabled, the first capacity step is treated just like the other steps, and the compressor will be able to operate at this capacity for an indefinite time.

5.2 Stepped capacity control with inlet control

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

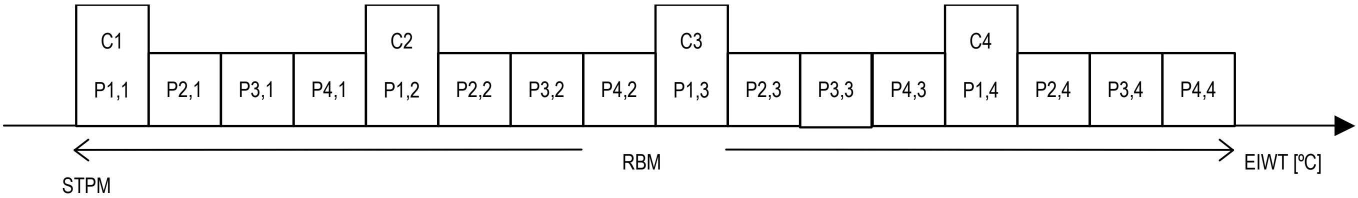


Fig. 5.2 Compressor capacity control steps with proportional control

STPM	Control set point
RBM	Control band
EIWT	Evaporator water inlet temperature
C 1…4	Compressors
P 1…4.1…4	Compressor capacity-control steps

All the compressors and the corresponding capacity steps are positioned proportionally across the band.
Increasing temperature values will lead to the activation of the successive step, following the set delay times relating to the capacity-control steps second as described.

The compressor starts at the first capacity step. If specific management of the first capacity step is enabled, the compressor will behave as described in the corresponding section. In any case, the delay times for the capacity-control steps will be applied as described.

5.3 Stepped capacity control with outlet control

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

5.3.1 Compressor activation

If the water temperature measured by the probe located at the evaporator outlet rises above the threshold represented by the control dead zone (NZ), then the number of active capacity-control steps will be increased, according to the set "minimum compressor off time".

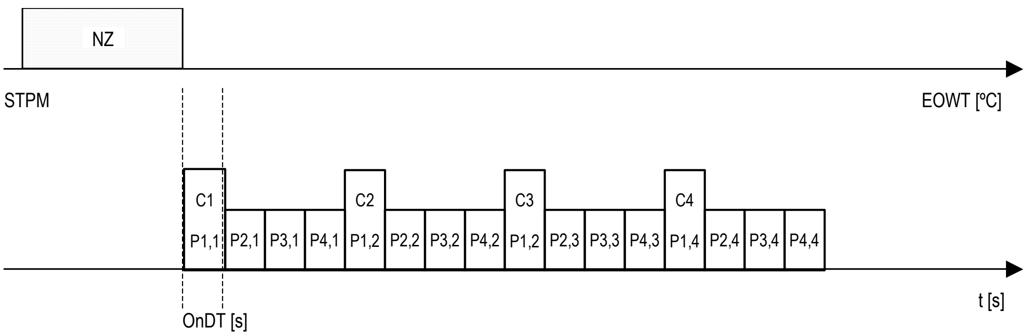


Fig. 5.3 Compressor capacity control steps with dead zone control [activation]

STPM	Control set point
NZ	Dead zone
EOWT	Evaporator Water Outlet Temperature
C 1…4	Compressors
P 1…4.1…4	Compressor capacity-control steps
t	Time

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

5.3.2 Compressor deactivation

If the water temperature measured by the probe located at the evaporator outlet falls below the Control set point (STPM), then the number of capacity-control steps will be decreased, according the set "minimum compressor on time".

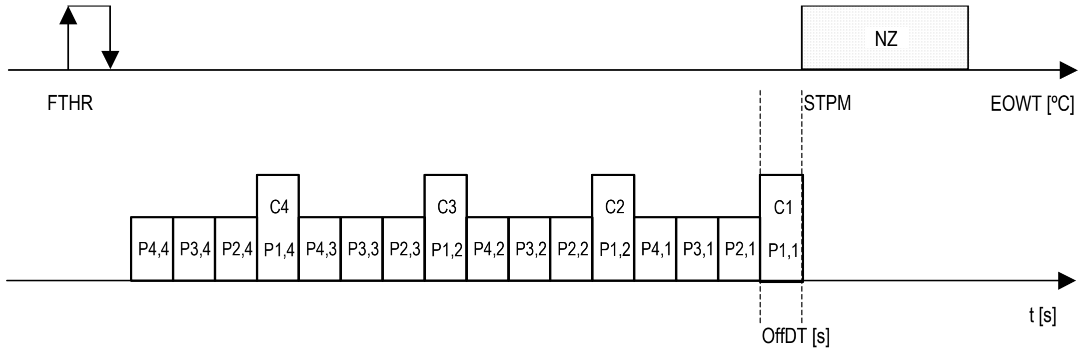


Fig. 5.4 Compressor capacity control steps with dead zone control [deactivation]

STPM	Control set point
NZ	Dead zone
EOWT	Evaporator Water Outlet Temperature
FTHR	Forced shutdown threshold
C 1…4	Compressors
P 1…4.1…4	Compressor capacity-control steps
t	Time

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

5.4 Continuous capacity control

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

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

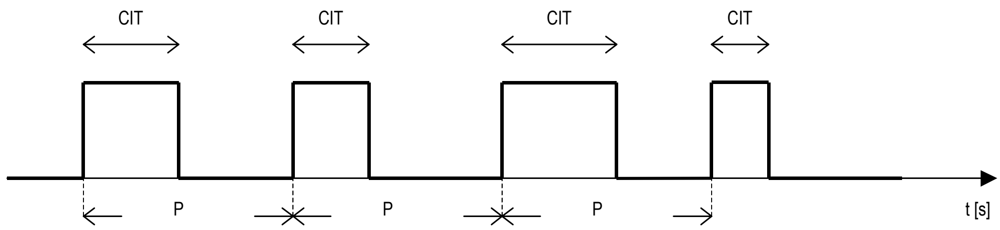


Fig. 5.5 Capacity variation impulses for compressors with continuous capacity control

P	Period of the impulses
CIT	Calculated duration of the impulse
t	Time

5.4.1 Continuous capacity-control relay configuration

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

Default configuration:

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

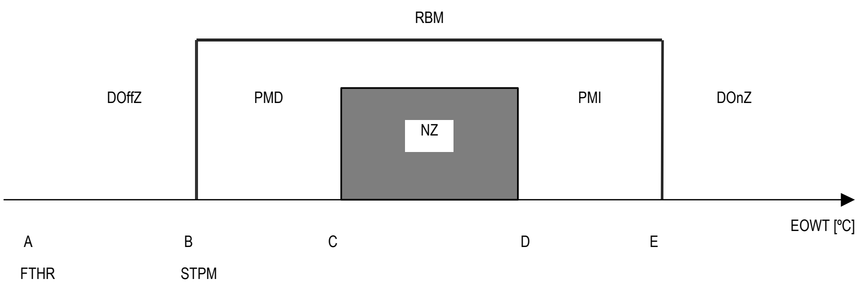
The stand-by capacity configuration refers to the status of the outputs when no variation in capacity is requested, either because the maximum/minimum compressor capacity has been reached, or because the water temperature measured by the probe located at the evaporator outlet is within the dead zone.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

5.5 Continuous capacity control with outlet control

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

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

Outputs used:
- Compressor capacity-control relay 1
- Compressor capacity-control relay 2



STPM	Control set point
RBM	Control band
NZ	Dead zone
DOnZ	Device start-up zone
DOffZ	Device shutdown zone
PMI	Modulating increase capacity zone
PMD	Modulating decrease capacity zone
FTHR	Forced shutdown threshold
EOWT	Evaporator Water Outlet Temperature

Fig. 5.6 Continuous compressor capacity control

5.5.1 Continuous capacity control according to points on the graph

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

Point E = STPM + RBM

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

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

Point b = STPM

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

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

Point D = (STPM + RBM – $\frac{(RBM - NZ)}{2}$

Point C = Point D – NZ

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

5.5.2 Compressor activation (temperature greater than point E)

The compressors are started sequentially with a frequency dictated by the set "time required to reach the maximum capacity". As there is no absolute measurement of the effective capacity, when the compressor is started it performs a forced discharge cycle for a set time (capacity-control relays energised continuously according to the capacity discharge configuration). This forced discharge cycle will be performed whenever the compressor is restarted following a power failure on the board, the shutdown of the unit from the keypad or digital input, a system alarm or an alarm relating to the specific device. The shut-down of the compressor due to the normal control cycle does not involve any prior discharge in the starting phase.
Subsequently the compressor capacity will be increased, with impulses of the maximum duration.

5.5.3 Increase in compressor capacity

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

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

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

5.5.5 Derivation of the control temperature (temperature greater than point D)

If the temperature values measured by the probe located at the evaporator outlet are in the increase capacity zone (above point D), derivative control is effected on the controlled value, so as to analyse the trend and optimise the response of the system.
The derivation time is set; this time will be used for sampling the temperatures.
A comparison is made between the variation in temperature and a fixed hysteresis of 0.2 ºC.
Sampled temperature value – Current temperature value ⇔ 0.2 ºC
Three different situations may arise:

- the difference is greater than 0.2 ºC: the temperature is falling; the increase capacity procedure will be stopped, awaiting the re-evaluation of the temperature values on the next sampling
- the difference is equal to 0.2 ºC: the temperature is stationary; the increase capacity procedure will be stopped, awaiting the re-evaluation of the temperature values on the next sampling
- the difference is less than 0.2 ºC: the temperature is rising; the increase capacity procedure is allowed to continue, awaiting the re-evaluation of the temperature values on the next sampling.

The setting of the derivation time depends on the characteristics of the system being controlled; in principle, it should be set so as to be able to appreciate the contribution of one or more capacity increase impulses. The higher the setting of this time, the slower the response of the controller to the variations in the temperature of the system, and smother the variation in the capacity of the compressors.

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

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

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

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

5.5.8 Compressor deactivation (temperature less than point B)

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

6. Compressor rotation

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

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

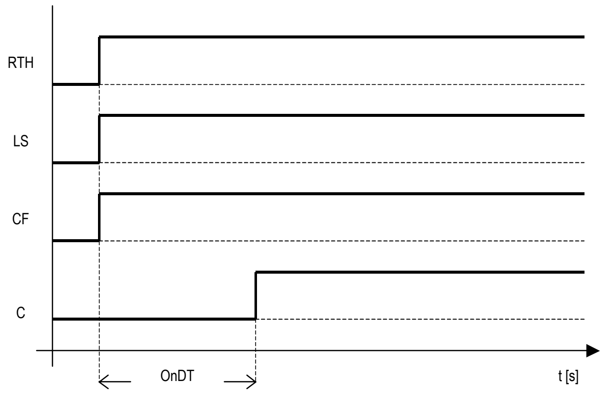
Management with FIFO rotation (the first compressor that starts will be the first to stop):
- Start: C1,C2,C3,C4.
- Stop: C1,C2,C3,C4.

7. Start-up of an individual compressor

7.1 Start-up of the refrigerant circuit

7.1.1 Description of operation

The start-up phases are described in the following graph



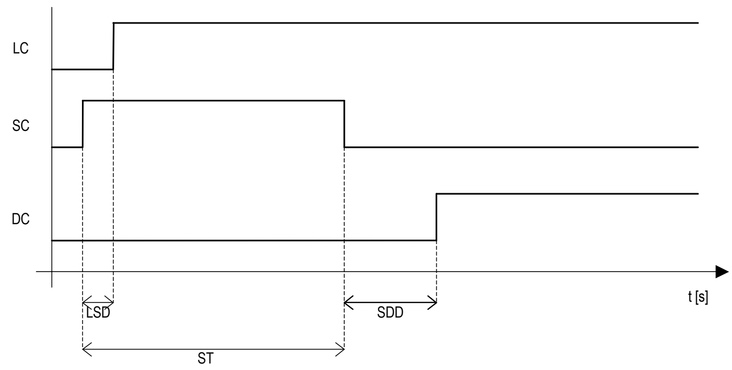
RTH	Temp. control request
LS	Liquid solenoid
CF	Condenser fans
C	Compressor
OnDT	Device activation delay
t	Time

Fig. 7.1 Start-up of the refrigerant circuit

7.2 Compressor motor starting

7.2.1 Star - Delta starting

The starting of the motor is described in the following diagram



LC	Line contactor
SC	Star contactor
DC	Delta contactor
LSD	Line-star switching delay
ST	Star duration
SDD	Star-delta switching delay
t	Time

Fig. 7.2 Star - Delta compressor starting

7.2.2 Part-Winding starting

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

Example:

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

7.3 Compressor start limits

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

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

8. Capacity control safety function

<u>Inputs used</u>

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

<u>Parameters used</u>

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

<u>Outputs used</u>

- All compressor capacity control relays

8.1.1 Description of operation

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

- The high outlet temperature threshold has been exceeded
- The high pressure threshold has been exceeded
- The antifreeze temperature threshold has been exceeded.

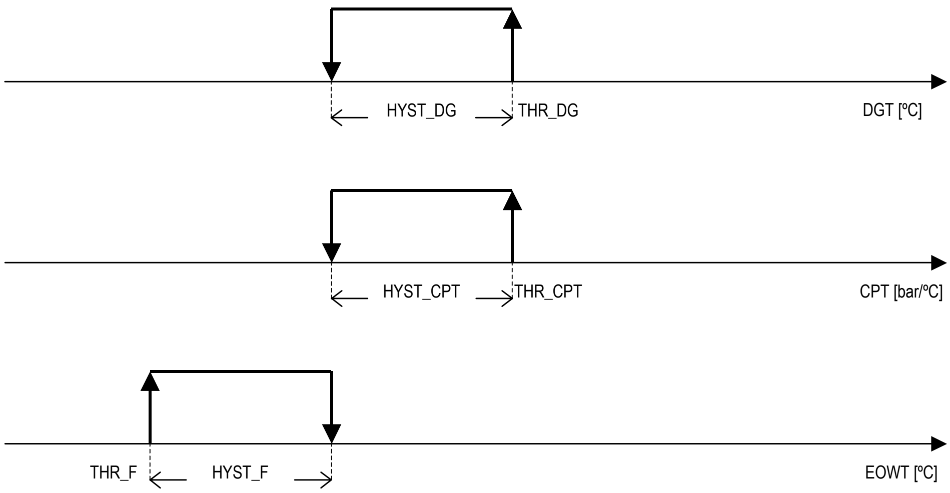


Fig. 8.1 Compressor capacity control safety function

THR_DG	Compressor gas discharge threshold
HYST_DG	Compressor gas discharge hysteresis
DGT	Compressor gas discharge temperature
THR_CPT	Condensing pressure/temperature threshold
HYST_CPT	Condensing pressure/temperature hysteresis
CPT	Condensing pressure/temperature
THR_F	Antifreeze threshold
HYST_F	Antifreeze hysteresis
EOWT	Evaporator Water Outlet Temperature

8.1.2 Compressors with stepped capacity control

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

8.1.3 Compressors with continuous capacity control

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

9. Solenoid valve management

Inputs used:
- Compressor outlet temperature

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

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

9.1.1 Description of operation

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

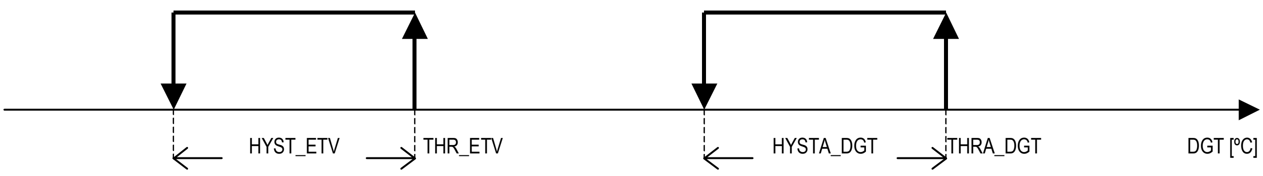


Fig. 9.1 Activation of the liquid injection / economiser solenoid valve

THR_ETV	Liquid injection/economiser solenoid valve threshold
HYST_ETV	Liquid injection/economiser solenoid valve hysteresis
THRA_DGT	Compressor gas discharge temperature alarm threshold
HYSTA_DGT	Compressor gas discharge temperature alarm hysteresis
DGT	Compressor gas discharge temperature

10. Pump-down

Inputs used
- Low pressure switch

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

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

10.1.1 Description of operation

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

The activation of the pump-down function involves the operation of the compressor at the minimum capacity available.
For compressors with stepped capacity control, there are two distinct situations, according to whether the special management of the first capacity control step is enabled or not:
- if disabled, the pump-down will be performed at minimum capacity, and then the compressor will be stopped
- if enabled, the pump-down will be performed at the second capacity step, and then the compressor will be stopped

For compressors with continuous capacity control, the compressor discharges continuously.

11. Condenser control

Inputs used:

- High pressure probe B7
- Coil temperature probe B3

Outputs used:

- Fan 1
- Fan 2
- Fan speed control AOUT1

Parameters used:

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

11.1 ON/OFF condenser control linked to compressor operation:

With this type of condenser control, the operation of the fans is subordinate only to the operation of the compressors:
Compressor off = fan off
Compressor on = fan on
The pressure transducers do not need to be installed.

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

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

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

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

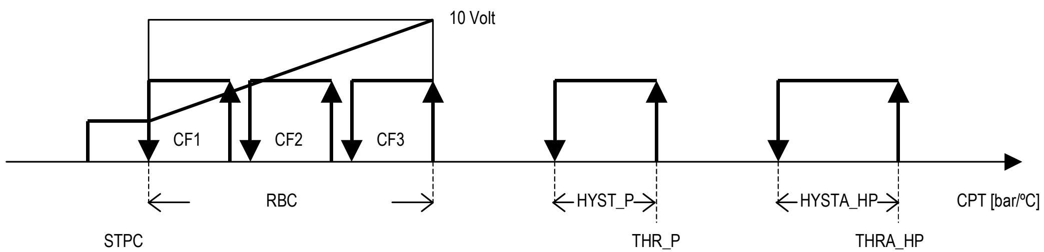


Fig. 11.1 Condenser control and alarms

STPC	Condenser control set point
RBC	Condenser control band
THR_P	High condensing press/temp prevention threshold
HYST_P	High condensing press/temp prevention hysteresis
THRA_HP	High condensing press/temp alarm threshold
HYSTA_HP	High condensing press/temp prevention alarm hysteresis
CPT	Condensing Pressure / Temperature
CF 1…3	Condenser fans

11.4 Prevent function:

This function can be enabled from the manufacturer branch, and is used to avoid the circuits being shut-down due to high pressure alarms. With the compressor on, when this threshold is reached the compressor is forced to capacity-control operation, until the pressure falls below the set point minus the set differential. With the compressor off, when this threshold is reached the fans are forced on, until the pressure falls below the set point minus the set hysteresis.

12. Defrost control for Water/Air units

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

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

Outputs used:
- Compressors
- Reverse cycle solenoid electrovalve
- Fans.

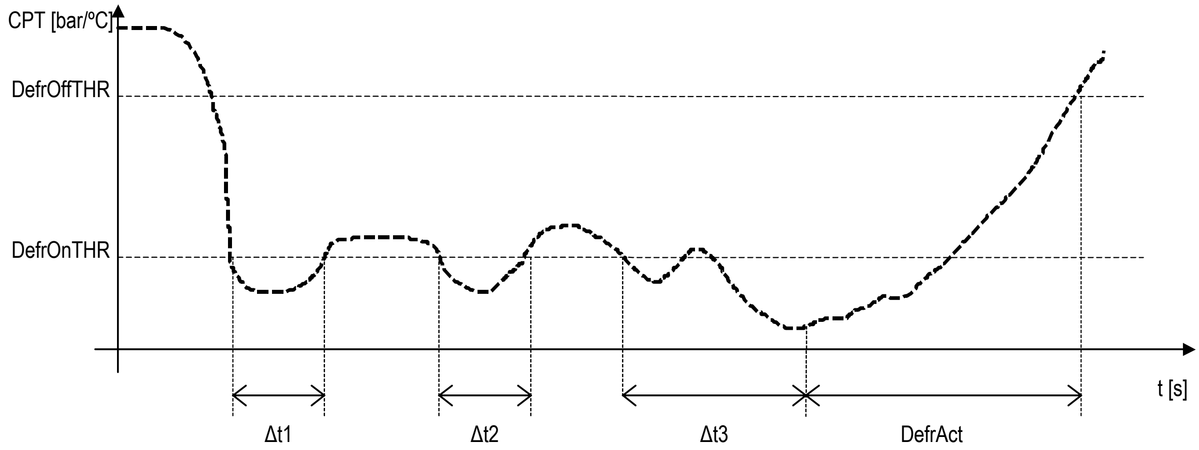


Fig. 12.1 Defrost control

DefrOffTHR	End defrost threshold
DefrOnTHR	Start defrost threshold
CPT	Condensing pressure/temperature
Δt 1…3	Partial duration of the pressure/temperature in the defrost activation zone
DefrAct	Defrost active
t	Time

12.1 Types of defrost:

12.1.1 Simultaneous

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

12.1.2 Separate

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

12.1.3 Independent

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

12.2 Type of end and start defrost:

Defrosting can be managed either by the coil temperature probe B3 or alternatively by the high pressure probe B7; the user can choose, on the screen, one of the two probes.
The compressor can have four different start/end defrost actions, which can be selected when starting/ending a defrost cycle. The user can decide whether to reverse the cycle with the compressor on or off, thus protecting, if necessary, the compressor from abrupt variations in pressure due to the reversal of the refrigerant circuit. These stops and starts ignore the compressor safety times.

- *None:* The compressor is on when the cycle is reversed at the start/end of the defrost.
- *Start defrost*: The compressor is stopped, before the cycle is reversed, only at the start of the defrost
- *End defrost*: The compressor is stopped , before the cycle is reversed, only at the end of the defrost.
- *Start/end defrost*: The compressor is stopped, before the cycle is reversed, both at the start and end of the defrost.

12.3 Defrosting a circuit with time/temperature control

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

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

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

12.4 Defrosting a circuit with time/pressure switch control:

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

12.5 Fan operation during defrost:

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

13. Freecooling control

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

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

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

13.1.1 Description of operation

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

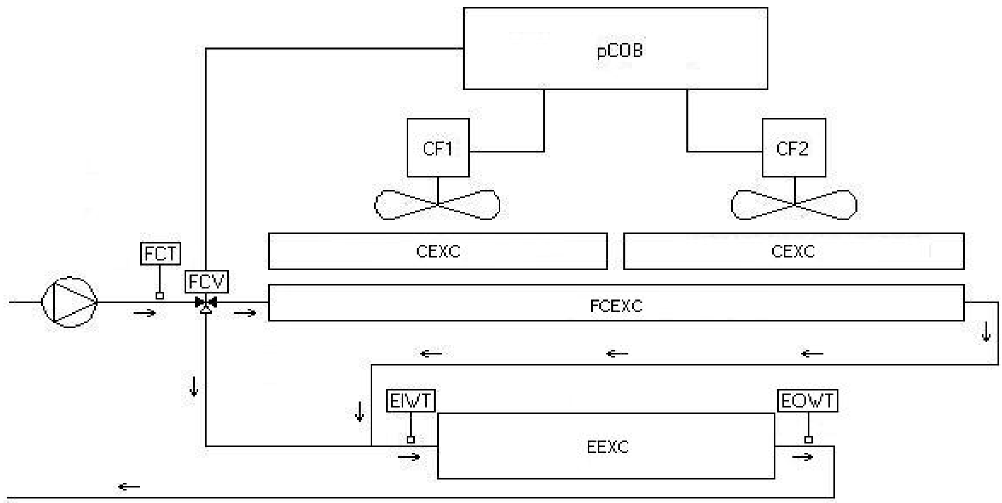


Fig. 13.1 Operating diagram of unit with freecooling control

FCT	Freecooling coil water inlet temperature
FCV	Freecooling valve
EIWT	Evaporator water inlet temperature
EOWT	Evaporator water outlet temperature
Pcob	PCOB control and management board
CF 1…2	Condenser fans
CEXC	Condenser exchanger coil
FCEXC	Freecooling exchanger coil
EEXC	Evaporator exchanger coil

13.2 Activation of the freecooling function

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

Outside temp. ≤ Freecooling IN temp. – Freecooling delta

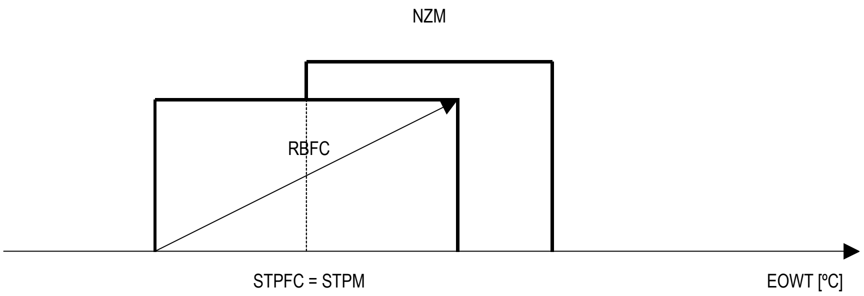
If this condition is true, the freecooling function will be enabled, by activating/deactivating the dedicated devices.

13.3 Freecooling thermostat

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

STPFC = STPM

The proportional band will be equally distributed both sides of the set point



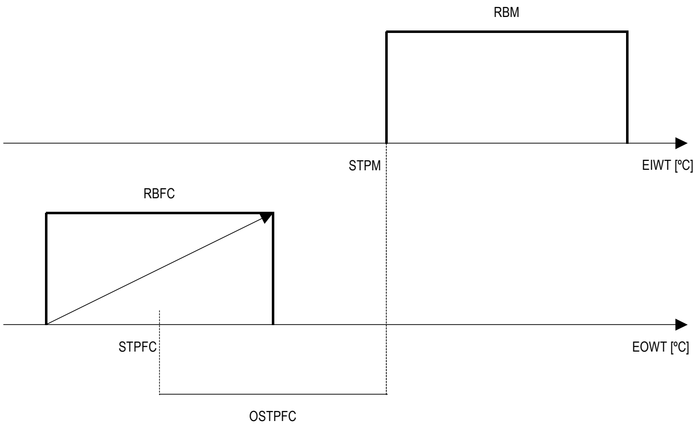
NZM Control dead zone
RBFC Freecooling control band
STPFC Freecooling control set point
STPM Control set point
EOWT Evaporator water outlet temperature

Fig. 13.2 Freecooling with outlet control

In units with inlet control and side proportional band, the freecooling control set point will consider an offset from the compressor control set point so as to compensate for the presence of the evaporator coil

STPFC = STPM – OSTPFC

The proportional band will be equally distributed both sides of the set point



RBM Control band
STPM Control set point
EIWT Evaporator water inlet temperature
RBFC Freecooling control band
STPFC Freecooling control set point
OSTPFC Freecooling control set point offset
EOWT Evaporator water outlet temperature

Fig. 13.3 Freecooling with inlet control

In the freecooling band, the activation thresholds are calculated for the dedicated devices, such as valves, fans or speed controllers, depending on the mode selected. As the fans and/or speed controllers are shared between the freecooling function and the condenser control, if one or more compressors in a certain refrigerant circuit start, priority will be given to the condenser control so as to safeguard the circuit. The freecooling valve will in any case be kept completely open, so as to increase the contribution even at minimum fan speed.
In order to optimise the efficiency of the freecooling function during the transitory start-up phase of the unit, and in stable operation, a bypass time for the compressor control is envisaged.
This time has the purpose of delaying the start of the compressors so as to allow the freecooling function enough time of reach stable conditions and bring the capacity to the rated value; only after this time, if the main thermostat is not satisfied, will the compressors start. If the time is set to 0 the function will be disabled.

During the operation of the unit, the same parameter is used by the freecooling control to re-evaluate the operating conditions of the unit according to the value measured by the outside temperature probe.
A further temperature delta is also set, which identifies a second threshold; below this value, the efficiency of the freecooling coil is considered high enough to be able to completely satisfy the thermal load of the system with the sole combined operation of valve and fans.
If the compressors are on, and the outside temperature falls below the “maximum delta” set, according to the relationship:

Outside T ≤ Freecooling inlet T – Freecooling “maximum delta”

and the condition persists for a continuous time equal to the set compressor bypass time, then the compressors will be stopped and operation will switch to freecooling only to satisfy the load, with less energy consumption.
Once the compressor bypass time elapses, the request will be evaluated again.

An antifreeze threshold is also envisaged, based on the outside air temperature, for the protection of the exchanger in operation in cold environments. If the outside air temperature is lower than the set threshold, the valve controlling the flow of water into the freecooling exchanger will be opened, and the main pump started (if off), so as to circulate the fluid and prevent frost forming on the exchanger.

For 0-10V valves, the degree of opening will depend on the operating status of the unit:

- with the unit off, it will be opened to 100%
- with the unit on, it will be opened to 10%

On/off valves will always be fully open, independently of the operating mode of the unit. All the procedures will end as soon as the outside air temperature exceeds the fixed hysteresis of 1.0ºC above the set threshold.

13.4 Deactivation of the freecooling function

There are two main causes of the closing of the freecooling valve, the first depending on the outside temperature conditions, and the second depending on the temperature control request.

The freecooling valve will be closed if the freecooling conditions are no longer present

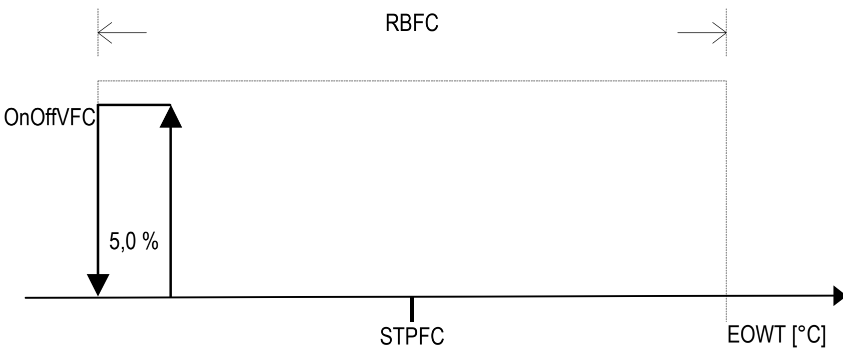
Outside T ≥ (Freecooling T– (Freecooling delta) + 1.5ºC

The freecooling valve will be closed the freecooling thermostat if satisfied.

To ensure the safety of the installation, the reading of the water temperature probe located at the evaporator outlet is controlled. Based on the thresholds set, an antifreeze pre-alarm is monitored, which activates any post-heaters and totally deactivates the freecooling devices, as well as an antifreeze alarm, which completely shuts down the unit.
Other system safety devices, such as: serious alarm from digital input, pump thermal overload, control probe fault, antifreeze control probe fault, evaporator flow switch alarm, Phase Monitor alarm, will cause the complete shutdown of the unit, and consequently deactivate the freecooling function.

13.5 ON/OFF freecooling valve

13.5.1 Proportional control



RBFC	Freecooling control band
STPFC	Freecooling control set point
EOWT	Evaporator water outlet temperature
OnOff_VFC	On/Off freecooling valve

Fig. 13.4 On/Off freecooling valve - proportional control

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

STPFC – RBFC + 5.0 % RBFC

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

13.5.2 Proportional + integral control

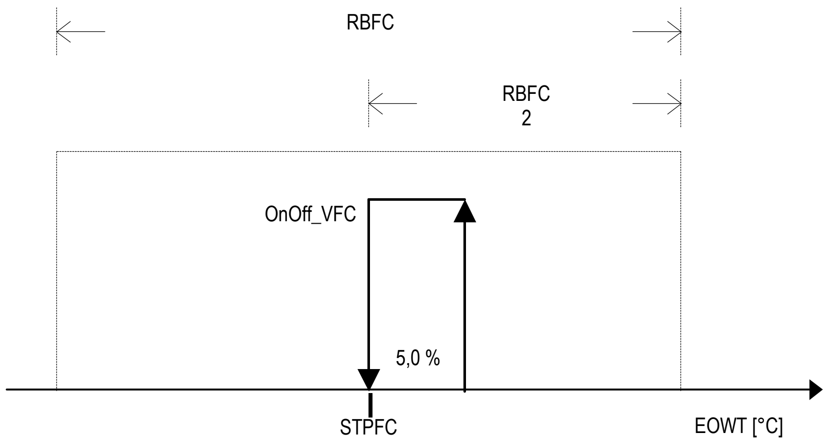


Fig. 13.5 On/Off freecooling valve - proportional + integral control

RBFC	Freecooling control band
STPFC	Freecooling control set point
EOWT	Evaporator water outlet temperature
OnOff_VFC	On/Off freecooling valve

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

STPFC + 5.0 % RBFC

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

13.6 ON/OFF freecooling valve with stepped condenser control

13.6.1 Proportional control

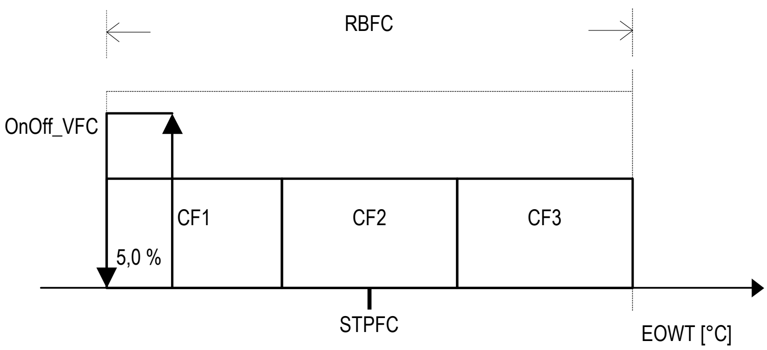


Fig. 13.6 On/Off freecooling valve - condenser control by steps - proportional control

RBFC	Freecooling control band
STPFC	Freecooling control set point
EOWT	Evaporator water outlet temperature
OnOff_VFC	On/Off freecooling valve
CF 1…3	Condenser fans

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

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

$$CFn = \frac{RBFC}{(\text{No. Master Fans x Number of Boards})}$$

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

13.6.2 Proportional + integral control

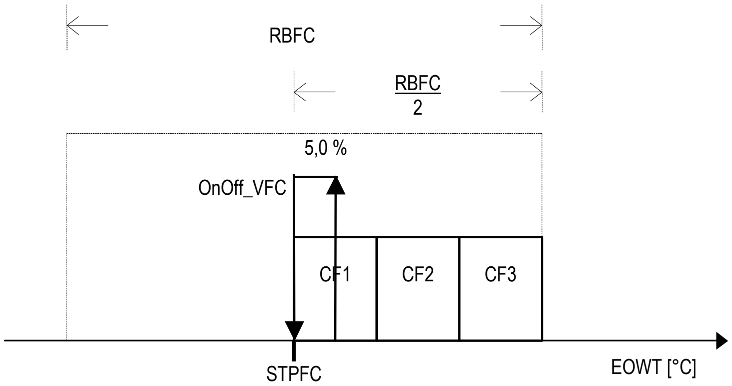


Fig. 13.7 On/Off freecooling valve - condenser control by steps - proportional + integral control

RBFC	Freecooling control band
STPFC	Freecooling control set point
EOWT	Evaporator water outlet temperature
OnOff_VFC	On/Off freecooling valve
CF 1…3	Condenser fans

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

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

$$CFn = \frac{RBFC}{(\text{No. Master Fans x Number of Boards})}$$

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

13.7 ON/OFF freecooling valve with condenser inverter

13.7.1 Proportional control

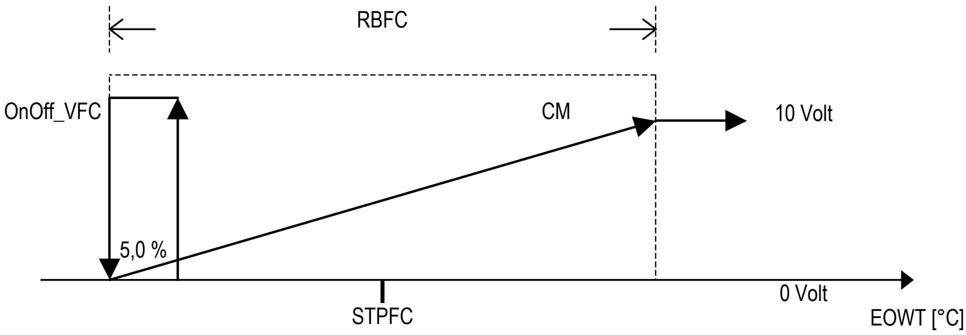


Fig. 13.8 On/Off freecooling valve - proportional condensing control - proportional control

RBFC	Freecooling control band
STPFC	Freecooling control set point
EOWT	Evaporator water outlet temperature
OnOff_VFC	Freecooling On/Off valve
CM	Modulating condenser control

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

13.7.2 Proportional + integral control

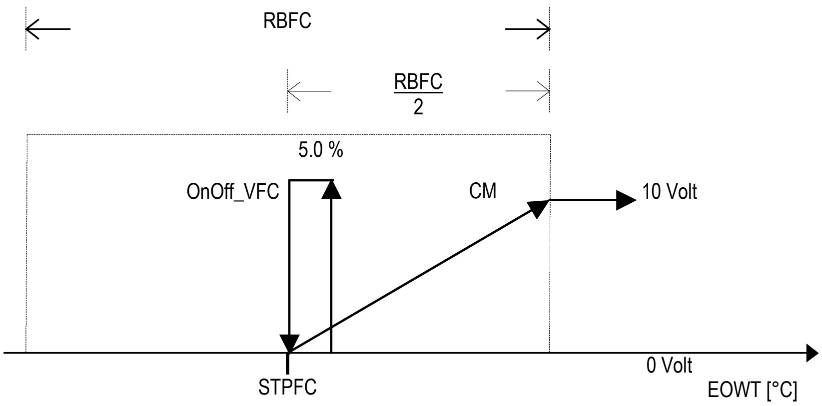


Fig. 13.9 On/Off freecooling valve - proportional condenser control - proportional + integral control

RBFC	Freecooling control band
STPFC	Freecooling control set point
EOWT	Evaporator water outlet temperature
OnOff_VFC	Freecooling On/Off valve
CM	Modulating condenser control

The devices, either valves or fans, will be activated in the second half of the control differential, due to the integral control. They will be activated according to the integration constant set, and their activation will be slower as the value attributed to the specific parameter increases. The amplitude of the valve control step will be equal to 5.0% of the control differential. All the proportional outputs relating to the different components of the system will be controlled in parallel.

13.8 0-10 Volt freecooling valve

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

13.9 0-10 Volt freecooling valve with stepped condenser control

13.9.1 Proportional control

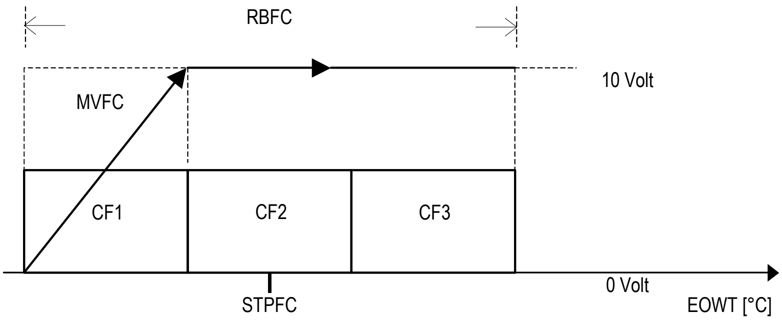


Fig. 13.10 0-10V freecooling valve - condenser control by steps - proportional control

RBFC	Freecooling control band
STPFC	Freecooling control set point
EOWT	Evaporator water outlet temperature
MCFC	Modulating freecooling valve
CF 1…3	Condenser fans

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

$$CFn = \frac{RBFC}{(\text{No. Master Fans x Number of Boards})}$$

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

13.9.2 Proportional + integral control

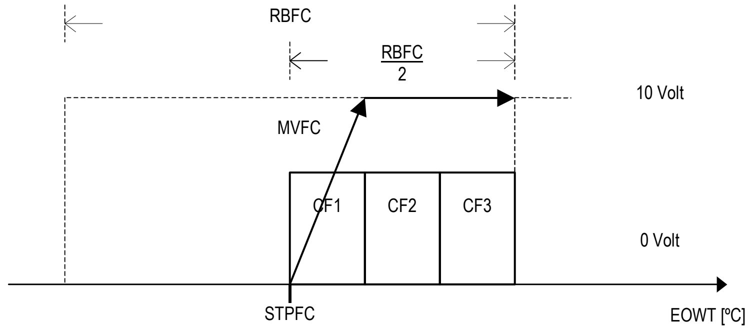


Fig. 13.11 0-10V freecooling calve - condenser control by steps - proportional + integral control

RBFC	Freecooling control band
STPFC	Freecooling control set point
EOWT	Evaporator water outlet temperature
MCFC	Modulating freecooling valve
CF 1…3	Condenser fans

The devices, either valves or fans, will be activated in the second half of the control differential, due to the integral control. They will be activated according to the integration constant set, and their activation will be slower as the value attributed to the specific parameter increases. The proportional ramp of control of the freecooling valve will be calculated inside the first fan activation step, in this way, when the first fan is started, the valve will be completely open, and thus there will be maximum water flow through the freecooling coil. The activation steps of the fans will be positioned proportionally inside the freecooling differential.

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

$$CFn = \frac{RBFC}{(\text{No. Master Fans x Number of Boards})}$$

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

13.10 0-10 Volt freecooling valve with condenser inverter

13.10.1 Proportional control

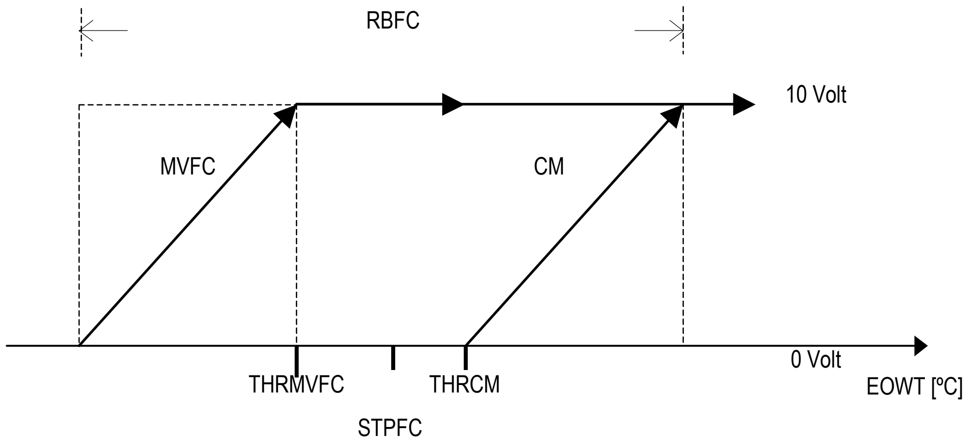


Fig. 13.12 0-10V freecooling valve - proportional condenser control - proportional control

RBFC	Freecooling control band
STPFC	Freecooling control set point
EOWT	Evaporator water outlet temperature
MVFC	Modulating freecooling valve
CM	Modulating condenser control
THRMVFC	Maximum valve opening threshold, percentage
THRCM	Modulating condenser control minimum speed threshold, percentage

The proportional control ramp of the freecooling valve will be calculated inside the area determined by the thresholds:
STPFC – RBFC / 2
STPFC – RBFC / 2 + THRMVFC

STPFC –RBFC / 2 + THRCM
STPFC + RBFC / 2

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

Example

Control set point:	12.0ºC
Freecooling differential:	4.0ºC
Freecooling valve threshold %:	40%
Condenser inverter threshold %:	80%
Freecooling valve proportional control area =	10.0 - 11.6 ºC
Control set point – Freecooling differential / 2 =	10.0ºC
Maximum valve opening threshold % =	1.6ºC
Condenser inverter proportional control area =	13.2 - 16.0 ºC
Control set point – Freecooling differential / 2 =	10.0ºC
Control set point –Freecooling differential / 2 + Minimum inverter speed threshold % =	13.2ºC

13.10.2 Proportional + integral control

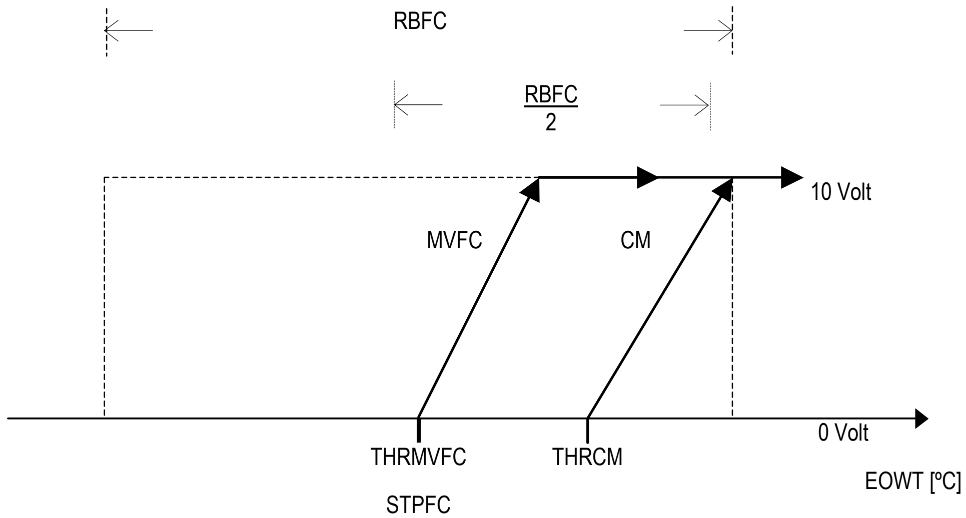


Fig. 13.13 0-10V freecooling valve - proportional condenser control - proportional + integral control

RBFC	Freecooling control band
STPFC	Freecooling control set point
EOWT	Evaporator water outlet temperature
MVFC	Modulating freecooling valve
CM	Modulating condenser control
THRMVFC	Maximum valve opening threshold, percentage
THRCM	Modulating condenser control minimum speed threshold, percentage

The devices, either valves or fans, will be activated in the second half of the contorl differential, due to the integral control. They will be activated according to the integration constant set, and their activation will be slower as the value attributed to the specific parameter increases.

14. Alarms

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

14.1 Serious alarms

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

14.2 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

14.3 Signal-only alarms

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

14.4 Pressure differential alarm management

Inputs used
- Low pressure transducer
- High pressure transducer

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

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

14.4.1 Description of operation

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

14.5 Antifreeze control

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

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

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

14.5.1 Description of operation

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

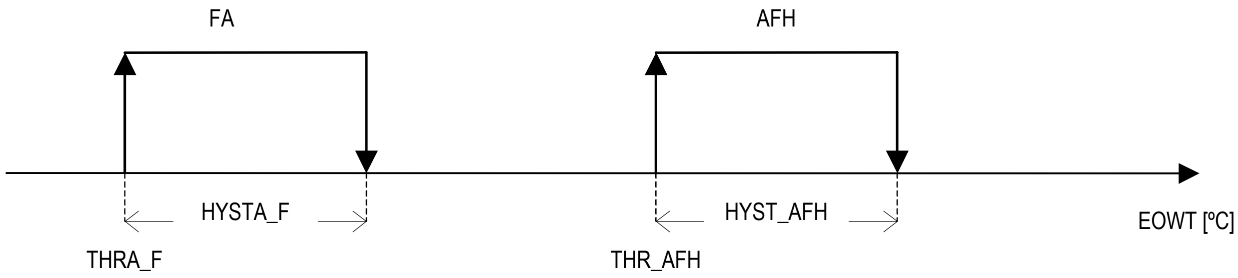


Fig. 14.1 Antifreeze heater control – antifreeze alarm

THRA_F	Antifreeze alarm threshold
HYSTA_F	Antifreeze alarm hysteresis
FA	Antifreeze alarm
THR_AFH	Antifreeze heater threshold
HYST_AFH	Antifreeze heater hysteresis
AFH	Antifreeze heater
EOWT	Evaporator water outlet temperature

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

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

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

14.5.2 Antifreeze heater

Each circuit features the control of an antifreeze heater to prevent the alarm and consequently the shut-down of the unit.
This heater is activated and deactivated according to a threshold and hysteresis set specifically for each circuit. The activation of the heater in any of the circuits will cause the shut-down of the active cooling devices, either compressors or freecooling devices.

14.6 Table of pCO alarms

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

Table 14.1 Table of alarms

14.7 Driver alarms

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

Example:

M_Drv1_Alarm107

```
AL:107       D:1 U:2

  Super heat alarm

```

When an alarm screen relating to one of the driver boards appears, in the upper left the message “Driver” appears; in addition, on the right, “D:” indicates the driver while “U:” indicates the pCO board connected to the driver indicated.
In the example, the alarm is from driver no. 1, which is connected via pLAN to pCO board no. 1.

14.8 Driver board alarms

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

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

Manuf_Drv_110

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

Manuf_Drv_120

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

15. Alarm log

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

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

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

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

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

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

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

AL:001 Unit no.1 Offline
AL:002 Unit no.2 Offline
AL:003 Unit no.3 Offline
AL:004 Unit no.4 Offline
AL:011 Serious alarm from digital input
AL:012 Alarm monitor phase
AL:013 Evaporator flow switch alarm
AL:014 Condenser flow switch alarm
AL:015 Oil level alarm
AL:016 High pressure alarm (pressure switch)
AL:017 Low pressure alarm (pressure switch)
AL:018 Evaporator pump thermal overload
AL:019 Condenser pump thermal overload
AL:020 Compressor thermal overload
AL:021 Condenser fan 1 thermal overload
AL:022 Condenser fan 2 thermal overload
AL:030 Freecooling coil antifreeze
AL:031 Antifreeze alarm
AL:032 Low differential pressure alarm
AL:033 High pressure alarm (transducer)
AL:034 Low pressure alarm (transducer)
AL:035 High outlet temperature alarm
AL:036 High voltage alarm
AL:037 High current alarm
AL:041 32kB clock card broken or not connected
AL:051 Evaporator pump maintenance
AL:052 Condenser pump maintenance
AL:053 Compressor maintenance
AL:060 Probe B1 broken or not connected
AL:061 Probe B2 broken or not connected
AL:062 Probe B3 broken or not connected
AL:063 Probe B4 broken or not connected
AL:064 Probe B5 broken or not connected
AL:065 Probe B6 broken or not connected
AL:066 Probe B7 broken or not connected
AL:067 Probe B8 broken or not connected
AL:101 Probe error
AL:102 Stepper motor error
AL:103 EEPROM error
AL:104 Battery error
AL:105 High pressure
AL:106 Low pressure
AL:107 Super-heat alarm
AL:108 Valve not closed during shut-down
AL:109 Wait valve re-opening
AL:110 Wait battery recharge
AL:111 Wait EEPROM reboot
AL:201 Probe error
AL:202 Stepper motor error
AL:203 EEPROM error
AL:204 Battery error
AL:205 High pressure
AL:206 Low pressure
AL:207 Super-heat alarm
AL:208 Valve not closed during shut-down
AL:209 Wait valve re-opening
AL:210 Wait battery recharge
AL:211 Wait EEPROM reboot

16. First start-up

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

16.1 Installing the default values

16.1.1 pCO board

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

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

Before performing this operation, make sure that power is supplied to any drivers connected to the network, as if they are not powered in this phase they will not be initialised and may not work properly. Press the MENU and PROG buttons together

`M_Pw_Manuf`

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

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

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

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

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

16.1.2 EXV driver

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

To initialise an individual driver, access the manufacturer screens dedicated to the drivers, and then access the configuration parameters for the driver in question.
On the screen
`Manuf_Drv_280`

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

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

16.2 Switching the unit On/Off

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

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

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

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

16.2.1 System On/Off

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

16.2.2 Circuit On/Off

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

17. User Interface

17.1 Table of Parameters

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

No.	Description	Master/Slave	Default	Limits
47	Discharge config. of the capacity-control relays for continuous capacity control	Mst	ON/ON	ON/OFF
48	Charge configurat. of the capacity-control relays for continuous capacity control	Mst	OFF/OFF	ON/OFF
49	Capacity control impulse period	Mst/Slv	6 s	0 - 99 s
50	Minimum duration of the discharge impulse	Mst/Slv	1.5 s	0.0 - 99.9 s
51	Maximum duration of the discharge impulse	Mst/Slv	3.0 s	0.0 - 99.9 s
52	Derivation time for the temperature in increase capacity zone	Mst/Slv	3.0 s	2.0 - 999 s
53	Minimum duration of the charge impulse	Mst/Slv	1.5 s	0.0 - 99.9 s
54	Maximum duration of the charge impulse	Mst/Slv	3.0 s	0.0 - 99.9 s
55	Forced discharge time at compressor start	Mst/Slv	30 s	0 - 999 s
56	Enable forced solenoid discharge when compressor off	Mst/Slv	N	Y/N
57	Enable pump-down	Mst/Slv	N	Y/N
58	Maximum pump-down time	Mst/Slv	50 s	0 - 999 s
59	Compressor capacity control safety configuration	Mst/Slv	MINIMUM CAPACITY	MINIMUM / MAXIMUM CAPACITY
60	Select high condensing temper./pressure prevention for capacity control safety function	Mst/Slv	PRESSURE	PRESSURE / TEMPERATURE
61	Enable capacity control safety for high condensing pressure	Mst/Slv	N	Y/N
62	High pressure threshold for capacity control safety	Mst/Slv	20.0 bars	0.0 - 99.9
63	High pressure differential for capacity control safety	Mst/Slv	2.0 bars	0.0 - 99.9
64	Enable capacity control safety for high outlet temperature	Mst/Slv	S	Y/N
65	High outlet temperature threshold for capacity control safety	Mst/Slv	90.0°C	0.0 - 999.9°C
66	High outlet temperature differential for capacity control safety	Mst/Slv	5.0°C	0.0 - 99.9°C
67	Antifreeze temperature threshold for capacity control safety	Mst/Slv	6.0°C	-99.9 - 99.9°C
68	Antifreeze temperature differential for capacity control safety	Mst/Slv	1.0°C	0.0 - 99.9°C
69	Enable condenser control	Mst/Slv	N	N / PRESSURE / TEMPERATURE
70	Type of condenser control	Mst/Slv	INVERTER	STEPS / INVERTER
71	Number of condenser fans	Mst/Slv	1	1 - 2
72	Condenser control set point	Mst/Slv	14.0 bars	0.0 - 999.9 bars
73	Condenser control differential	Mst/Slv	2.0 bars	0.0 - 999.9 bars
74	Voltage at maximum inverter speed	Mst/Slv	10.0 V	0.0 - 10.0 V
75	Voltage at minimum inverter speed	Mst/Slv	3.0 V	0.0 - 10.0 V
76	Inverter speed-up time	Mst/Slv	10 s	0 - 99 s
77	Enable serious alarm from digital input	Mst/Slv	N	Y/N
78	Enable Phase Monitor alarm	Mst/Slv	N	Y/N
79	Evaporator flow switch alarm delay at start	Mst/Slv	15 s	0 - 99 s
80	Evaporator flow switch alarm delay when stable	Mst/Slv	3 s	0 - 99 s
81	Condenser flow switch alarm delay at start	Mst	15 s	0 - 99 s
82	Condenser flow switch alarm delay when stable	Mst	3 s	0 - 99 s
83	High outlet temperature alarm set point	Mst	120.0°C	0.0 - 999.9°C
84	High outlet temperature alarm differential	Mst	5.0°C	0.0 - 99.9°C
85	High pressure alarm set point	Mst/Slv	21.0 bars	0.0 - 99.9 bars
86	High pressure alarm differential	Mst/Slv	2.0 bars	0.0 - 99.9 bars
87	Low pressure alarm set point	Mst/Slv	1.0 bars	-99.9 - 99.9 bars
88	Low pressure alarm differential	Mst/Slv	0.5 bars	-99.9 - 99.9 bars
89	Enable low pressure differential alarm	Mst/Slv	N	Y/N
90	Low pressure differential alarm set point	Mst/Slv	6.0 bars	0.0 - 99.9 bars
91	Low pressure differential alarm differential	Mst/Slv	2.0 bars	0.0 - 99.9 bars
92	Low pressure alarm delay at start	Mst/Slv	40 s	0 - 999 s
93	Low pressure alarm delay when stable	Mst/Slv	0 s	0 - 999 s
94	Oil differential alarm delay at start	Mst/Slv	120 s	0 - 999 s
95	Oil differential alarm delay when stable	Mst/Slv	10 s	0 - 999 s
96	High voltage alarm set point	Mst/Slv	440.0 V	0.0 - 999.9 V
97	High voltage alarm differential	Mst/Slv	5.0 V	0.0 - 99.9 V
98	High current alarm set point	Mst/Slv	90.0 A	0.0 - 999.9 V

No.	Description	Master/Slave	Default	Limits
99	High current alarm differential	Mst/Slv	5.0 A	0.0 - 99.9 V
100				
101				
102	Antifreeze alarm set point	Mst/Slv	3.0°C	-99.9 - 99.9°C
103	Antifreeze alarm differential	Mst/Slv	1.0°C	-99.9 - 99.9°C
104	Select pump control mode for antifreeze alarm	Mst/Slv	PUMP ON	PUMP ON / OFF
105	Solenoid valve activation threshold (Economizer/oil-cooler/liquid-injection)	Mst/Slv	80.0°C	0.0 - 999.9°C
106	Solenoid valve activation differential	Mst/Slv	10.0°C	0.0 - 99.9°C
107	Antifreeze heater activation set point	Mst/Slv	5.0°C	-99.9 - 99.9°C
108	Antifreeze heater differential	Mst/Slv	1.0°C	-99.9 - 99.9°C
109	Reverse cycle valve logic	Mst/Slv	N.O.	N.C. / N.O.
110	Type of freecooling valve (ON/OFF; modulating 0/10V)	Mst	0/10V	ON/OFF – 0/10V
111	Outside temperature antifreeze threshold for freecooling coil	**Mst**	-2.0 ºC	-99.9 - 99.9 ºC
112	Defrost probe configuration	Mst/Slv	TEMPERATURE	PRESSURE SWITCHES TEMPERATURE PRESSURE
113	Global defrost configuration	Mst/Slv	SIMULTANEOUS	INDEPENDENT SIMULTANEOUS SEPARATE
114	Enable 32kB clock card for alarm log function	Mst/Slv	N	Y/N
115	Supervisor system communication speed	Mst/Slv	19200 bps	1200/2400/4800/9600/19200 bps
116	Serial communication ID	Mst/Slv	1	1 - 200
117	Reset all parameters and install default values	Mst/Slv	N	Y/N
118	Set new manufacturer password	Mst/Slv	1234	0 - 9999
		Mst/Slv		
	User parameters			
119	Cooling set point upper limit	Mst	17.0°C	-99.9 - 99.9°C
120	Cooling set point lower limit	Mst	7.0°C	-99.9 - 99.9°C
121	Heating set point upper limit	Mst	50.0°C	-99.9 - 99.9°C
122	Heating set point lower limit	Mst	40.0°C	-99.9 - 99.9°C
123	Type of control Select probe for the control: water inlet (P/PI) water outlet (dead zone)	Mst	INLET	INLET / OUTLET
124	Type of inlet control	Mst	PROPORTIONAL	PROPORTIONAL / PROPORTIONAL + INTEGRAL
125	Integration time (for PI inlet control)	Mst	600 s	0 - 999 s
126	Cooling threshold for forcing OFF steps with outlet control (chiller operation, avoid antifreeze alarm)	Mst	10.0°C	-99.9 - 99.9°C
127	Heating threshold for forcing OFF steps with outlet control (heat pump operation)	Mst	47.0°C	-99.9 - 99.9°C
128	Temperature control band	Mst	3.0°C	0.0 - 99.9°C
129	Dead zone for continuous capacity control	Mst/Slv	1.0°C	0.0 - 99.9°C
130	Minimum time between pump/fan start and compressor start	Mst	5 s	0 - 999 s
131	Pump/fan off delay	Mst	5 s	0 - 999 s
132	Enable ON/OFF from digital input	Mst/Slv	N	Y/N
133	Enable ON/OFF from supervisor	Mst/Slv	N	Y/N
134	Enable cooling/heating from digital input	Mst	N	Y/N
135	Enable cooling/heating from supervisor	Mst	N	Y/N
136	Type of freecooling control	Mst	PROPORTIONAL + INTEGRAL	PROPORTIONAL / PROPORTIONAL + INTEGRAL
137	Integration time (with proportional+integral control)	Mst	150 s	0 - 9999 s
138	Freecooling control set point offset	Mst	5.0°C	0.0 - 99.9°C
139	Minimum temperature difference for freecooling activation	Mst	2.0°C	0.0 - 99.9°C
140	Maximum temperature difference to switch to pure freecooling	Mst	10.0 ºC	0.0 - 99.9 ºC
141	Temperature differential for fan control in Freecooling	Mst	3.0°C	2.0 - 99.9°C

No.	Description	Master/Slave	Default	Limits
142	Compressor control bypass for freecooling activation	Mst	5 min	0 - 500 min
143	Maximum Freecooling valve opening threshold	Mst/Slv	50%	25 - 100%
144	Minimum inverter speed threshold in freecooling	Mst/Slv	50%	0 - 75%
145	Start defrost threshold	Mst/Slv	2.0°C	-99/99
146	End defrost threshold	Mst/Slv	12.0°C	-99/99
147	Dripping time	Mst/Slv	10 s	0 - 999 s
148	Minimum time between defrosts	Mst/Slv	1800 s	0 - 30000 s
149	Maximum defrost time	Mst/Slv	300 s	0 - 30000 s
150	Configure compressor operation when reversing cycle	Mst/Slv	COMP ON	COMP ON / COMP OFF START / COMP OFF END / COMP OFF START-END
151	Set new user password	Mst/Slv	1234	0 - 9999
	Maintenance parameters			
152	Evaporator pump operating hour threshold	Mst	10000	0 - 999999
153	Condenser pump operating hour threshold	Mst	10000	0 - 999999
154	Compressor operating hour threshold	Mst/Slv	10000	0 - 999999
155	Enable software filter for protection against electromagnetic disturbance	Mst/Slv	N	Y/N
156	Filter delay on analogue inputs	Mst/Slv	5 s	0 - 9 s
157	Filter delay on digital inputs	Mst/Slv	1 s	0 - 9 s
158	Probe calibration B1	Mst/Slv	0.0	-9.9 - 9.9
159	Probe calibration B2	Mst/Slv	0.0	-9.9 - 9.9
160	Probe calibration B3	Mst/Slv	0.0	-9.9 - 9.9
161	Probe calibration B4	Mst/Slv	0.0	-9.9 - 9.9
162	Probe calibration B5	Mst/Slv	0.0	-9.9 - 9.9
163	Probe calibration B6	Mst/Slv	0.0	-9.9 - 9.9
164	Probe calibration B7	Mst/Slv	0.0	-9.9 - 9.9
165	Probe calibration B8	Mst/Slv	0.0	-9.9 - 9.9
166	Enable compressor no.1	Mst	S	Y/N
167	Enable compressor no.2	Mst	S	Y/N
168	Enable compressor no.3	Mst	S	Y/N
169	Enable compressor no.4	Mst	S	Y/N
170	Delete entire alarm log memory	Mst/Slv	N	Y/N
171	Set new maintenance password	Mst/Slv	1234	0 - 9999
	Set point parameters			
172	Cooling set point	Mst	12.0°C	Set point minimum/maximum limit
173	Heating set point	Mst	45.0°C	Set point minimum/maximum limit
174	Second cooling set point	Mst	12.0°C	Set point minimum/maximum limit
175	Second heating set point	Mst	45.0°C	Set point minimum/maximum limit
	Clock parameters			
176	Control hours	Mst/Slv		0 - 23
177	Control minutes	Mst/Slv		0 - 59
178	Control day	Mst/Slv		0 - 31
179	Control month	Mst/Slv		0 - 12
180	Control year	Mst/Slv		0 - 99

Table 17.1 Unit parameter settings

18. Driver software configuration

18.1 Configuration branches

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

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

18.2 User interface (Driver)

18.2.1 Password screens

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

Manuf_PW_Drv

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

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

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

Carel_PW_Drv

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

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

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

18.3 Manufacturer parameters

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

Table 18.1 Manufacturer driver parameters

18.4 CAREL parameters

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

Table 18.2 Carel driver parameters

18.5 Maintenance parameters

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

Table 18.3 Driver maintenance parameters

19. Driver control

The control algorithm offers the following functions:

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

Superheating is still controlled in these circumstances.

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

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

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

19.1 Request management - "Capacity" parameter

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

Capacity = number of active steps / "steps present" * 100

"Steps present" is the total number of steps present in the refrigerant circuit, and is a driver configuration parameter.

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

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

19.2 Control algorithm

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

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

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

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

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

Other significant parameters used during control are:

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

19.3 Valve pre-positioning management

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

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

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

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

pCO: Compressor configuration

M_Manuf45

```
Unit configuration
N. local drivers  1
N. compressors    2
Comp. rotation    N
```

Driver: Configuration driver 1

Manuf_Drv_10

```
Manufacturer D:1 U:
Regulation mode
REGULATION OFF
Present stages   004
```

19.3.1 Compressors with continuous capacity control

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

19.4 Special “Ignore” function

Maint_Drv_50

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

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

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

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

WARNING!
Ignoring the alarms is an operation that requires a great deal of awareness regarding the unit operating status. It is thus recommended to carefully check that the system will not be damaged, malfunction or become unreliable (e.g.: if “battery recharge” is signalled, it probably means that the battery is not charged or alternatively is not connected, etc; this, in the event of a power failure, will not allow the valve to close and the valve would thus stay open even when the system restarts).

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

Maint_Drv_50

```
Maintenance  D:1 U:

NO WARNINGS
          N
```

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

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

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

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

20. Supervisor

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

20.1.1 Key

A Analogue variable
D Digital variable
I Integer variable

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

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

Type	Direction	Address	Description
D	OUT	14	Status of digital output 13
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	OUT	23	Enable probe 8
D	IN / OUT	24	ON/OFF from supervisor
D	OUT	25	Enable limits at start
D	OUT	26	Type of compressor capacity control
D	OUT	27	Select Cooling/Heating from digital input
D	OUT	28	Unit enabled for heat pump operation
D	OUT	29	Cooling/Heating operation
D	OUT	30	Select condenser inverter
D	IN/OUT	31	Select Cooling/Heating from the supervisor
D	OUT	45	Generic alarm signal
D	OUT	46	Antifreeze alarm
D	OUT	47	Compressor thermal overload alarm
D	OUT	48	Evaporator flow switch alarm
D	OUT	49	Condenser flow switch alarm
D	OUT	50	High pressure alarm from pressure switch
D	OUT	51	Oil level alarm
D	OUT	52	Low pressure alarm from pressure switch
D	OUT	53	High pressure alarm from transducer
D	OUT	54	Serious alarm from digital input
D	OUT	55	Fan 1 thermal overload alarm
D	OUT	56	Fan 2 thermal overload alarm
D	OUT	57	Pump thermal overload alarm evaporator
D	OUT	58	Board 1 Offline alarm
D	OUT	59	Slave 1 Offline alarm
D	OUT	60	Slave 2 Offline alarm
D	OUT	61	Slave 3 Offline alarm
D	OUT	62	Probe 1 broken or not connected alarm
D	OUT	63	Probe 2 broken or not connected alarm
D	OUT	64	Probe 3 broken or not connected alarm
D	OUT	65	Probe 4 broken or not connected alarm
D	OUT	66	Probe 5 broken or not connected alarm
D	OUT	67	Probe 6 broken or not connected alarm
D	OUT	68	Probe 7 broken or not connected alarm
D	OUT	69	Probe 8 broken or not connected alarm
D	OUT	70	Condenser pump operating hours alarm
D	OUT	71	Compressor operating hours alarm
D	OUT	72	Condenser pump thermal overload alarm
D	OUT	73	Clock alarm
D	OUT	74	Phase monitor alarm
D	OUT	75	Low pressure alarm from transducer
D	OUT	76	High voltage alarm
D	OUT	77	High current alarm
D	OUT	78	Evaporator pump operating hours alarm
D	OUT	79	Value entry error
D	OUT	80	High outlet temperature alarm
D	OUT	81	Pressure differential alarm
D	OUT	82	Driver 1 probe alarm
D	OUT	83	Valve driver 1 stepper motor error alarm
D	OUT	84	Driver 1 EEPROM error alarm
D	OUT	85	Driver 1 battery error alarm
D	OUT	86	Driver 1 high pressure alarm
D	OUT	87	Driver 1 low pressure alarm
D	OUT	88	Driver 1 high superheat alarm
D	OUT	89	Driver 1 valve not closed after blackout alarm
D	OUT	90	Driver 1 valve open at unit restart alarm

Type	Direction	Address	Description
D	OUT	91	Driver 1 Wait battery recharge
D	OUT	92	Driver 1 wait EEPROM error reset
D	OUT	93	Driver 2 probe alarm
D	OUT	94	Valve driver 2 stepper motor error alarm
D	OUT	95	Driver 2 EEPROM error alarm
D	OUT	96	Driver 2 battery error alarm
D	OUT	97	Driver 2 high pressure alarm
D	OUT	98	Driver 2 low pressure alarm
D	OUT	99	Driver 2 high superheat alarm
D	OUT	100	Driver 2 valve not closed after blackout alarm
D	OUT	101	Driver 2 valve open at unit restart alarm
D	OUT	102	Driver 2 Wait battery recharge
D	OUT	103	Driver 2 wait EEPROM error reset

Table 20.1 Supervisor database

21. Keypad

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

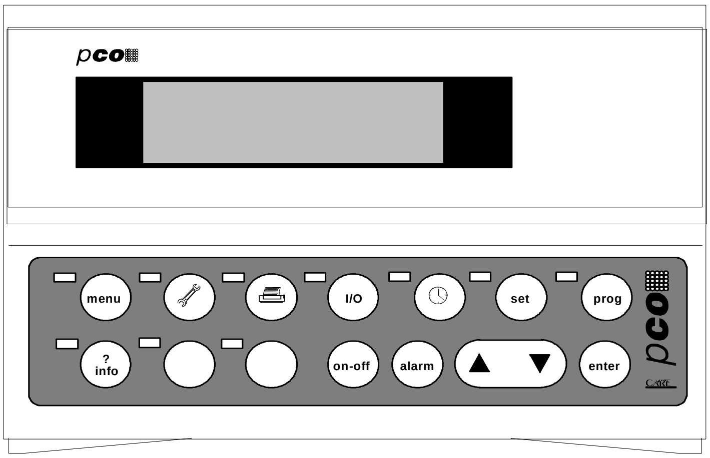
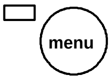
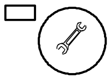
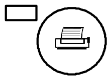
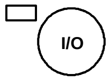
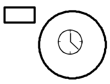
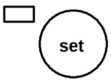
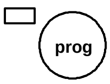
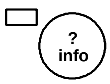
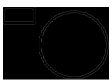
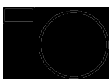


Fig. 21.1 Display, front view

The terminal is used for:

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

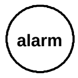
Each of the buttons is associated to specific functions or accesses groups of screens for displaying/setting the unit configuration parameters:

MENU button		Accesses the screen M_MAINMASK
MAINT button		Accesses the screen M_MAINT5
PRINT button		NOT FEATURED
I/O Button		Accesses the screen M_INOUT5
CLOCK button		Accesses the screen m_Not_Available if the clock function is disabled; screen m_CLOCK10 if the clock function is enabled
SET button		Accesses the screen M_SETPOINT5
PROG button		The password is required. If entered correctly, accesses the screen M_USER5
INFO button		Switches the control of the terminal from one pCO board to another pCO board
RED button		In chiller + heat pump configuration, when the unit is off, switches to heating operation
BLUE button		In chiller + heat pump configuration, when the unit is off, switches to cooling operation

ON / OFF button

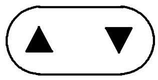
Activates and deactivates the controlled devices

ALARM button



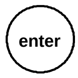
Opens the first active alarm screen and stops the alarm buzzer.
If an alarm screen is displayed, pressing it again resets the condition and displays the first screen. If there are no active alarms, opens the NO ACTIVE ALARMS screen. The list of active alarm screens scan be scrolled by pressing the arrow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

UP/DOWN buttons



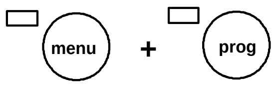
When the cursor is HOME (cursor in position 0,0 on the display) these buttons have the function of scrolling the screens in a group.
From the last screen, the first is accessed, and vice-versa. If the cursor is positioned on a numeric field, these buttons modify the value of the selected parameter.
If the cursor is positioned on a selection field, the available options are displayed (e.g. YES / NO).

ENTER button



In the screens for setting the values, pressing the button once moves the cursor to the first active field. Pressing it again confirms the set value and moves the cursor to the following field. From the last field it then returns to the HOME position.

MENU+PROG buttons



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

21.1 LEDs

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

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

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

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

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

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

22. List of screens

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

22.1 Menu Button

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

22.2 Maintenance Button

```
M_Maint5
+--------------------+
|Hour counter     U: |
|Pump evap.    000000|
|Pump cond.    000000|
|Compressor    000000|
+--------------------+

M_Maint10
+--------------------+
|Alarms history      |
|AL000 00:00 00/00/00|
|T.In 00.0 T.Out 00.0|
|HP   00.0 LP    00.0|
+--------------------+

Maint_PW_Drv
+--------------------+
|EXV driver       U: |
|Insert maintenance  |
|password            |
|               0000 |
+--------------------+

M_Pw_Maint
+--------------------+
|Insert          U:  |
|maintenance         |
|password            |
|               0000 |
+--------------------+

M_Maint20
+--------------------+
|Evaporator pump  U: |
|hour counter        |
|Threshold   000x1000|
|Req.reset   N 000000|
+--------------------+

M_Maint23
+--------------------+
|Condensator pump U: |
|hour counter        |
|Threshold   000x1000|
|Req.reset   N 000000|
+--------------------+

M_Maint25
+--------------------+
|Compressor       U: |
|hour counter        |
|Threshold   000x1000|
|Req.reset   N 000000|
+--------------------+

M_Maint45
+--------------------+
|Filters config.  U: |
|Enable            N |
|Anal.delay time   0s|
|Dig.delay time    0s|
+--------------------+

M_Maint50
+--------------------+
|Inputs probes    U: |
|offset              |
|B1: 0.0    B2: 0.0  |
|B3: 0.0    B4: 0.0  |
+--------------------+

M_Maint55
+--------------------+
|Inputs probes    U: |
|offset              |
|B5: 0.0    B6: 0.0  |
|B7: 0.0    B8: 0.0  |
+--------------------+

M_Maint60
+--------------------+
|Compressors enable  |
|                    |
|C1:N C2:N C3:N C4:N |
|                    |
+--------------------+

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

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

22.2.1 Drivers

```
Drivers_Menu
+--------------------+
|Drivers config.  U: |
|                    |
|Driver 1          ->|
|Driver 2          ->|
+--------------------+

Drivers_Waiting
+--------------------+
|Maintenance         |
|Driver 1 Unit       |
|                    |
|ENTER to continue   |
+--------------------+

Maint_Drv_10
+--------------------+
|Maintenance  D:1 U: |
|Time after last     |
|battery test    000h|
|battery use     000h|
+--------------------+

Maint_Drv_20
+--------------------+
|Maintenance  D:1 U: |
|Batt.resistance 000ô|
|Capacity        000%|
|Valve position  0000|
+--------------------+

Maint_Drv_30
+--------------------+
|Maintenance  D:1 U: |
|Suction             |
|Temperature   00.0ßC|
|Pressure     00.0bar|
+--------------------+

Maint_Drv_40
+--------------------+
|Maintenance  D:1 U: |
|Calculated evaporat.|
|Temperature   00.0ßC|
|Super-heat    00.0ßC|
+--------------------+

Maint_Drv_50
+--------------------+
|Maintenance  D:1 U: |
|                    |
|NO WARNINGS         |
|          N         |
+--------------------+

Maint_Drv_60
+--------------------+
|Insert another   U: |
|drivers maintenance |
|password            |
|               0000 |
+--------------------+
```

22.3 Print Button

```
M_Not_Available
+--------------------+
|                    |
|   Not available    |
|   device           |
|                    |
+--------------------+
```

22.4 I/O Button

```
M_InOut5
+--------------------+
|    CAREL S.p.A.    |
| Brugine (PD) Italy |
|CODE: EPSTDEMSCA    |
|Ver.3.312 20/06/2003|
+--------------------+

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

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

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

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

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

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

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

M_InOut60
+--------------------+
|Drv1 Valve Pos. 0000|
|Super-heat    00.0ßC|
|Suct.temp.    00.0ßC|
|Suct.press.  00.0bar|
+--------------------+

M_InOut65
+--------------------+
|Drv2 Valve Pos. 0000|
|Super-heat    00.0ßC|
|Suct.temp.    00.0ßC|
|Suct.press.  00.0bar|
+--------------------+

M_InOut70
+--------------------+
|Drv1 battery state  |
|                    |
|Drv2 battery state  |
|DISCONNECTED        |
+--------------------+
```

22.5 Clock Button

```
M_Clock10
+--------------------+
|Clock config.       |
|                    |
|Time           00:00|
|Date        00/00/00|
+--------------------+
```

22.6 Set Button

```
M_Setpoint5
+--------------------+
|Actual setpoint     |
|Inlet               |
|              00.0ßC|
|                    |
+--------------------+

M_Setpoint10
+--------------------+
|Summer              |
|setpoint      00.0ßC|
|Winter              |
|setpoint      ----ßC|
+--------------------+

M_Setpoint15
+--------------------+
|Summer double       |
|setpoint      00.0ßC|
|Winter double       |
|setpoint      ----ßC|
+--------------------+
```

22.7 Prog Button

```
M_Pw_User
+--------------------+
|Insert           U: |
|user password       |
|                    |
|               0000 |
+--------------------+

M_User5
+--------------------+
|Summer temperature  |
|setpoint limits     |
|Low           00.0ßC|
|High          00.0ßC|
+--------------------+

M_User15
+--------------------+
|Winter temperature  |
|setpoint limits     |
|Low           00.0ßC|
|High          00.0ßC|
+--------------------+

M_User17
+--------------------+
|Regulat.temperature |
|                    |
|Type          INLET |
|                    |
+--------------------+

M_User20
+--------------------+
|Inlet regulation    |
|                    |
|Type            PROP|
|Integration t. 0000s|
+--------------------+

M_User23
+--------------------+
|Outlet regulation   |
|force off           |
|Summer        00.0ßC|
|Winter        00.0ßC|
+--------------------+

M_User25
+--------------------+
|Temperature band    |
|              00.0ßC|
|                    |
|                    |
+--------------------+

M_User27
+--------------------+
|Modulation band     |
|                    |
|Neutral zone  00.0ßC|
|                    |
+--------------------+

M_User30
+--------------------+
|Time between main   |
|pump/fan and comp.  |
|start               |
|                000s|
+--------------------+

M_User35
+--------------------+
|Delay on switching  |
|the main pump off   |
|                    |
|                000s|
+--------------------+

M_User40
+--------------------+
|Digital input remote|
|on / off          N |
|Supervisory remote  |
|on / off          N |
+--------------------+

M_User42
+--------------------+
|Digital input remote|
|Summer / Winter   N |
|Supervisory remote  |
|Summer / Winter   N |
+--------------------+

M_User451
+--------------------+
|Freecool.parameters |
|Reg.type        PROP|
|Integration t. 0000s|
|Setp.offset   00.0ßC|
+--------------------+

M_User45
+--------------------+
|Delta min     00.0ßC|
|Delta max     00.0ßC|
|Diff.         00.0ßC|
|Comps delay   000min|
+--------------------+

M_User46
+--------------------+
|Freecooling max.vlv |
|open threshold  000%|
|Freecooling min.inv.|
|start threshold 000%|
+--------------------+

M_User50
+--------------------+
|Defrost parameters  |
|                    |
|Start        00.0   |
|Stop         00.0   |
+--------------------+

M_User55
+--------------------+
|Defrost parameters  |
|Drip time       000s|
|Delay time    00000s|
|Maximum time  00000s|
+--------------------+

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

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

22.8 Menu+Prog Button

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

M_Manuf5
+--------------------+
|Unit config.: 00 U: |
|WATER/AIR           |
|CHILLER             |
|                    |
+--------------------+

M_Manuf10
+--------------------+
|Probes enable    U: |
|B1: N  B2: N  B3: N |
|B4: N  B5: N  B6: N |
|B7: N  B8: N        |
+--------------------+

M_Manuf15
+--------------------+
|Probe 5 type config.|
|NONE                |
|Discharge probe type|
|      0/1V          |
+--------------------+
```

```
M_Manuf20
+--------------------+
|Multiple analog.in 5|
|                    |
|Minimum      000.0  |
|Maximum      000.0  |
+--------------------+

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

M_Manuf35
+--------------------+
|High pressure probe |
|configuration       |
| 4mA         00.0bar|
|20mA         00.0bar|
+--------------------+

M_Manuf40
+--------------------+
|Low  pressure probe |
|configuration       |
| 4mA         00.0bar|
|20mA         00.0bar|
+--------------------+

M_Manuf43
+--------------------+
|                    |
|Enable double       |
|setpoint          N |
|                    |
+--------------------+

M_Manuf45
+--------------------+
|Unit configuration  |
|N.local drivers   0 |
|N.compressors     0 |
|Comp.rotation     N |
+--------------------+

M_Manuf50
+--------------------+
|Compressor config   |
|Type of unloads STEP|
|Stages per          |
|compressor       0  |
+--------------------+

M_Manuf55
+--------------------+
|Compressor config.  |
|T.Star/Line 000s/100|
|T.Star      000s/100|
|T.Star/Delta000s/100|
+--------------------+

M_Manuf60
+--------------------+
|Enable start        |
|restrictions      N |
|                    |
|                    |
+--------------------+

M_Manuf63
+--------------------+
|Start restriction   |
|Low press.   00.0bar|
|High press.  00.0bar|
|Equal.press. 00.0bar|
+--------------------+

M_Manuf65
+--------------------+
|Minimum compressors |
|power-on time  0000s|
|Minimum compressors |
|power-off time 0000s|
+--------------------+

M_Manuf70
+--------------------+
|Min time betw.diff. |
|comp.starts    0000s|
|Min time betw.same  |
|comp.starts    0000s|
+--------------------+

M_Manuf75
+--------------------+
|Stage   1           |
|Logic relay 1    N  |
|Logic relay 2    N  |
|Logic relay 3    N  |
+--------------------+

M_Manuf80
+--------------------+
|Stage   2           |
|Logic relay 1    N  |
|Logic relay 2    N  |
|Logic relay 3    N  |
+--------------------+

M_Manuf85
+--------------------+
|Stage   3           |
|Logic relay 1    N  |
|Logic relay 2    N  |
|Logic relay 3    N  |
+--------------------+

M_Manuf90
+--------------------+
|Stage   4           |
|Logic relay 1    N  |
|Logic relay 2    N  |
|Logic relay 3    N  |
+--------------------+

M_Manuf93
+--------------------+
|Enable particular   |
|management of       |
|stage 1           N |
|                    |
+--------------------+

M_Manuf95
+--------------------+
|Time SOL/S1    0000s|
|Time S1/S2     0000s|
|Time S2/S3     0000s|
|Time S3/S4     0000s|
+--------------------+

M_Manuf97
+--------------------+
|Standby config.     |
|                    |
|Relay 6          N  |
|Relay 7          N  |
+--------------------+

M_Manuf98
+--------------------+
|Decrement config.   |
|                    |
|Relay 6          N  |
|Relay 7          N  |
+--------------------+

m_manuf99
+--------------------+
|Increment config.   |
|                    |
|Relay 6          N  |
|Relay 7          N  |
+--------------------+

M_Manuf100
+--------------------+
|Modulation config.  |
|Pulse period     00s|
|Min pulse D.   00.0s|
|Max pulse D.   00.0s|
+--------------------+

M_Manuf105
+--------------------+
|Modulation config.  |
|Derivation time 000s|
|Min pulse I.   00.0s|
|Max pulse I.   00.0s|
+--------------------+

M_Manuf110
+--------------------+
|Modulation config.  |
|                    |
|Time force decr.for |
|start compress. 000s|
+--------------------+

M_Manuf115
+--------------------+
|Enable force        |
|solenoid ON with    |
|compressor OFF    N |
|                    |
+--------------------+

M_Manuf120
+--------------------+
|Pump down config.   |
|                    |
|Enable            N |
|Maximum time    000s|
+--------------------+

M_Manuf123
+--------------------+
|Compressor          |
|Safety unloader step|
|configuration       |
|MINIMUM POWER       |
+--------------------+

M_Manuf125
+--------------------+
|Prevent high cond.  |
|PRESSURE          N |
|Setpoint     00.0bar|
|Diff.        00.0bar|
+--------------------+

M_Manuf130
+--------------------+
|Discharge temp.     |
|prevent           N |
|Setpoint     000.0ßC|
|Diff.         00.0ßC|
+--------------------+

M_Manuf135
+--------------------+
|Freeze prevent      |
|                    |
|Setpoint      00.0ßC|
|Diff.         00.0ßC|
+--------------------+

M_Manuf140
+--------------------+
|Condensation        |
|Enable        NONE  |
|Type          INV.  |
|Number Fans   0     |
+--------------------+

M_Manuf150
+--------------------+
|Condensation        |
|                    |
|Setpoint     00.0 ßC|
|Diff.        00.0 ßC|
+--------------------+

M_Manuf155
+--------------------+
|Inverter            |
|Max.speed      00.0V|
|Min.speed      00.0V|
|Speed up time    00s|
+--------------------+
```

```
M_Manuf160
+--------------------+
|Enable of           |
|seriuos alarm     N |
|Enable phase        |
|alarm             N |
+--------------------+

M_Manuf165
+--------------------+
|Enable evaporator   |
|flow alarm        N |
|Enable condensator  |
|flow alarm        N |
+--------------------+

M_Manuf170
+--------------------+
|Flow alarm delays   |
|Evaporator          |
|Startup delay    00s|
|Run delay        00s|
+--------------------+

M_Manuf175
+--------------------+
|Flow alarm delays   |
|Condensator         |
|Startup delay    00s|
|Run delay        00s|
+--------------------+

M_Manuf178
+--------------------+
|Discharge temp.     |
|alarm               |
|Setpoint     000.0ßC|
|Diff.         00.0ßC|
+--------------------+

M_Manuf180
+--------------------+
|Transducers high    |
|pressure alarm      |
|Setpoint     00.0bar|
|Diff.        00.0bar|
+--------------------+

M_Manuf185
+--------------------+
|Transducer low      |
|pressure alarm      |
|Setpoint     00.0bar|
|Diff.        00.0bar|
+--------------------+

M_Manuf187
+--------------------+
|Low differential    |
|pressure alarm  N   |
|Setpoint     00.0bar|
|Startup delay   000s|
+--------------------+

M_Manuf190
+--------------------+
|Low pressure alarm  |
|delays              |
|Startup delay   000s|
|Run delay       000s|
+--------------------+

M_Manuf195
+--------------------+
|Oil level alarm     |
|delays              |
|Startup delay   000s|
|Run delay       000s|
+--------------------+

M_Manuf200
+--------------------+
|Alarm               |
|high current        |
|Setpoint      000.0 |
|Diff.          00.0 |
+--------------------+

M_Manuf210
+--------------------+
|Antifreeze alarm    |
|                    |
|Setpoint      00.0ßC|
|Diff.         00.0ßC|
+--------------------+

M_Manuf211
+--------------------+
|Antifreeze alarm    |
|                    |
|If antifreeze alarm |
|MAIN PUMP OFF       |
+--------------------+

M_Manuf215
+--------------------+
|Electrovalve        |
|management          |
|Setpoint     000.0ßC|
|Diff.         00.0ßC|
+--------------------+

M_Manuf220
+--------------------+
|Antifreeze heater   |
|                    |
|Setpoint      00.0ßC|
|Diff.         00.0ßC|
+--------------------+

M_Manuf230
+--------------------+
|Logic of valves     |
|Reversing (4way)N.C.|
|Freecooling   ON/OFF|
|Antifreeze Te 00.0ßC|
+--------------------+

M_Manuf235
+--------------------+
|Defrost config.     |
|                    |
|Probe   PRESSOSTATS |
|Global  SIMULTANEOUS|
+--------------------+

M_Manuf240
+--------------------+
|                    |
|Clock board 32k     |
|Enable            N |
|                    |
+--------------------+

M_Manuf242
+--------------------+
|Supervisor System   |
|Comunication speed: |
|1200 (RS485/RS422)  |
|Identificat.No.: 000|
+--------------------+

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

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

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

22.8.1 Drivers

```
Drivers_Menu
+--------------------+
|Drivers config.  U: |
|                    |
|Driver 1          ->|
|Driver 2          ->|
+--------------------+

Drivers_Waiting
+--------------------+
|Maintenance         |
|Driver 1 Unit       |
|                    |
|ENTER to continue   |
+--------------------+

Carel_PW_Drv
+--------------------+
|CAREL EXV Driver U: |
|reserved parameters |
|Insert password     |
|               0000 |
+--------------------+

Manuf_Drv_10
+--------------------+
|Manufacturer D:1 U: |
|Regulation mode     |
|REGULATION OFF      |
|Present stages   000|
+--------------------+

Manuf_Drv_20
+--------------------+
|Manufacturer D:1 U: |
|Gas type       -----|
|Used valve type     |
|EX-7 OR LOWER CAP.  |
+--------------------+

Manuf_Drv_30
+--------------------+
|Manufacturer D:1 U: |
|Comp.capacity 0000KW|
|Super-heat          |
|Setpoint      00.0ßC|
+--------------------+

Manuf_Drv_40
+--------------------+
|Manufacturer D:1 U: |
|Valve opening when  |
|screw compressor    |
|switches ON     000%|
+--------------------+

Manuf_Drv_50
+--------------------+
|Manufacturer D:1 U: |
|En.probe error     N|
|En.step motor fail N|
|En.Eeprom error    N|
+--------------------+

Manuf_Drv_60
+--------------------+
|Manufacturer D:1 U: |
|En.battery error   N|
|En.high pressure   N|
|En.low pressure    N|
+--------------------+

Manuf_Drv_70
+--------------------+
|Manufacturer D:1 U: |
|                    |
|En.low super-heat  N|
|En.valve not close N|
+--------------------+

Manuf_Drv_80
+--------------------+
|Manufacturer D:1 U: |
|Alarms delays       |
|High pressure  0000s|
|Super-heat     0000s|
+--------------------+
```

```
Manuf_Drv_90
+--------------------+
|Manufacturer D:1 U: |
|Switch off compress.|
|if probe error      |
|Delay        ----sec|
+--------------------+

Manuf_Drv_100
+--------------------+
|Manufacturer D:1 U: |
|Switch off compress.|
|if eeprom error     |
|Delay        ----sec|
+--------------------+

Manuf_Drv_110
+--------------------+
|Manufacturer D:1 U: |
|Switch off compress.|
|if battery error   N|
|Delay        ----sec|
+--------------------+

Manuf_Drv_120
+--------------------+
|Manufacturer D:1 U: |
|Switch off compress.|
|if low pressure    N|
|Delay        ----sec|
+--------------------+

Manuf_Drv_130
+--------------------+
|Manufacturer D:1 U: |
|Enable alarm when   |
|valve is open after |
|power failure      N|
+--------------------+

Manuf_Drv_140
+--------------------+
|Manufacturer D:1 U: |
|Operating pressure  |
|Min.set      00.0bar|
|Max.set      00.0bar|
+--------------------+

Manuf_Drv_150
+--------------------+
|Manufacturer D:1 U: |
|Propor.factor   00.0|
|Integr.factor   00.0|
|Differ.factor   00.0|
+--------------------+

Manuf_Drv_160
+--------------------+
|Manufacturer D:1 U: |
|                    |
|Max valve steps 0000|
|Max pos.adjust 00000|
+--------------------+

Manuf_Drv_170
+--------------------+
|Manufacturer D:1 U: |
|Pressure probe conf.|
|4mA          00.0bar|
|20mA         00.0bar|
+--------------------+

Manuf_Dvr_180
+--------------------+
|Manufacturer D:1 U: |
|                    |
|Evaporator output   |
|press.set    00.0bar|
+--------------------+

Manuf_Drv_190
+--------------------+
|Manufacturer D:1 U: |
|Superheat hysteresis|
|after max pressure  |
|alarm         00.0ßC|
+--------------------+

Manuf_Drv_200
+--------------------+
|Manufacturer D:1 U: |
|Superheat hysteresis|
|after low pressure  |
|alarm         00.0ßC|
+--------------------+

Manuf_Drv_210
+--------------------+
|Manufacturer D:1 U: |
|Valve closing to min|
|position when super-|
|heat below    00.0ßC|
+--------------------+

Manuf_Drv_220
+--------------------+
|Manufacturer D:1 U: |
|                    |
|Valve regulation    |
|VALVE OFF           |
+--------------------+

Manuf_Drv_230
+--------------------+
|Manufacturer D:1 U: |
|Compressor status   |
|input type          |
|pLAN                |
+--------------------+

Manuf_Drv_240
+--------------------+
|Manufacturer D:1 U: |
|In case of pLAN     |
|failure             |
|USE 0-1V COMP.STATUS|
+--------------------+

Manuf_Drv_250
+--------------------+
|Manufacturer D:1 U: |
|Restart after power |
|failure             |
|ALWAYS              |
+--------------------+

Manuf_Drv_260
+--------------------+
|Manufacturer D:1 U: |
|Press.probe   4-20mA|
|Temp.probe 1 type   |
|NTC 103-AT (CAREL)  |
+--------------------+

Manuf_Drv_270
+--------------------+
|Manufacturer D:1 U: |
|                    |
|pLAN existence     N|
|Battery existence  N|
+--------------------+

Manuf_Drv_280
+--------------------+
|Manufacturer D:1 U: |
|Install default     |
|values             N|
|                    |
+--------------------+

Manuf_Drv_290
+--------------------+
|Insert another   U: |
|drivers manufacturer|
|password            |
|               0000 |
+--------------------+

Carel_Drv_10
+--------------------+
|CAREL        D:1 U: |
|No.of samples for   |
|calculating analog  |
|inputs average  0000|
+--------------------+

Carel_Drv_20
+--------------------+
|CAREL        D:1 U: |
|Av.time pos.err. 000|
|Sys.stab.up lim.  00|
|Sys.stab.low lim. 00|
+--------------------+

Carel_Drv_30
+--------------------+
|CAREL        D:1 U: |
|Steps Nr.below which|
|valve is considered |
|closed          0000|
+--------------------+

Carel_Drv_40
+--------------------+
|CAREL        D:1 U: |
|Stepper motor       |
|Max.current    0.75A|
|Frequency     0000Hz|
+--------------------+

Carel_Drv_50
+--------------------+
|CAREL        D:1 U: |
|                    |
|Calculated valve    |
|position        0000|
+--------------------+

Carel_Drv_60
+--------------------+
|CAREL        D:1 U: |
|                    |
|Sampling time 0000ms|
|System stability  00|
+--------------------+

Carel_Drv_70
+--------------------+
|CAREL        D:1 U: |
|                    |
|INT37-reserved 00000|
|INT44-test     00000|
+--------------------+

Carel_Drv_80
+--------------------+
|Insert another   U: |
|drivers CAREL       |
|password            |
|               0000 |
+--------------------+
```

22.9 Alarm Button

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

M_Alarm190
+--------------------+
|AL:033          U: |
|    High pressure   |
|       alarm        |
|    (transducer)    |
+--------------------+

M_Alarm200
+--------------------+
|AL:034          U: |
|    Low pressure    |
|       alarm        |
|    (transducer)    |
+--------------------+

M_Alarm210
+--------------------+
|AL:035          U: |
|   High discharge   |
|  temperature alarm |
|                    |
+--------------------+

M_Alarm220
+--------------------+
|AL:036          U: |
|   High voltage     |
|      alarm         |
|                    |
+--------------------+

M_Alarm230
+--------------------+
|AL:037          U: |
|   High current     |
|      alarm         |
|                    |
+--------------------+

M_Alarm240
+--------------------+
|AL:041          U: |
|   32k clock board  |
|    fault  or not   |
|     connected      |
+--------------------+

M_Alarm250
+--------------------+
|AL:051          U: |
|   Evaporator pump  |
|   maintenance      |
|                    |
+--------------------+

M_Alarm260
+--------------------+
|AL:052          U: |
|   Condensator pump |
|   maintenance      |
|                    |
+--------------------+

M_Alarm270
+--------------------+
|AL:053          U: |
|    Compressor      |
|    maintenance     |
|                    |
+--------------------+

M_Alarm280
+--------------------+
|AL:060          U: |
|   B1 probe fault   |
|  or not connected  |
|                    |
+--------------------+

M_Alarm290
+--------------------+
|AL:061          U: |
|   B2 probe fault   |
|  or not connected  |
|                    |
+--------------------+

M_Alarm300
+--------------------+
|AL:062          U: |
|   B3 probe fault   |
|  or not connected  |
|                    |
+--------------------+

M_Alarm310
+--------------------+
|AL:063          U: |
|   B4 probe fault   |
|  or not connected  |
|                    |
+--------------------+

M_Alarm320
+--------------------+
|AL:064          U: |
|   B5 probe fault   |
|  or not connected  |
|                    |
+--------------------+

M_Alarm330
+--------------------+
|AL:065          U: |
|   B6 probe fault   |
|  or not connected  |
|                    |
+--------------------+

M_Alarm340
+--------------------+
|AL:066          U: |
|   B7 probe fault   |
|  or not connected  |
|                    |
+--------------------+

M_Alarm350
+--------------------+
|AL:067          U: |
|   B8 probe fault   |
|  or not connected  |
|                    |
+--------------------+
```

22.9.1 Driver

```
M_Drv1_Alarm101
+--------------------+
|AL:101       D:1 U: |
|                    |
|    Probe error     |
|                    |
+--------------------+

M_Drv1_Alarm102
+--------------------+
|AL:102       D:1 U: |
|                    |
|  Step motor error  |
|                    |
+--------------------+

M_Drv1_Alarm103
+--------------------+
|AL:103       D:1 U: |
|                    |
|   Eeprom error     |
|                    |
+--------------------+

M_Drv1_Alarm104
+--------------------+
|AL:104       D:1 U: |
|                    |
|   Battery error    |
|                    |
+--------------------+

M_Drv1_Alarm105
+--------------------+
|AL:105       D:1 U: |
|                    |
|   High pressure    |
|                    |
+--------------------+

M_Drv1_Alarm106
+--------------------+
|AL:106       D:1 U: |
|                    |
|   Low pressure     |
|                    |
+--------------------+

M_Drv1_Alarm107
+--------------------+
|AL:107       D:1 U: |
|                    |
|  Super heat alarm  |
|                    |
+--------------------+

M_Drv1_Alarm108
+--------------------+
|AL:108       D:1 U: |
|  Valve not closed  |
|  during power OFF  |
|                    |
+--------------------+

M_Drv1_Alarm109
+--------------------+
|AL:109       D:1 U: |
| Waiting for valve  |
|   open restart     |
|                    |
+--------------------+

M_Drv1_Alarm110
+--------------------+
|AL:110       D:1 U: |
| Waiting for battery|
|   charged restart  |
|                    |
+--------------------+

M_Drv1_Alarm111
+--------------------+
|AL:111       D:1 U: |
| Waiting for eeprom |
|    error restart   |
|                    |
+--------------------+

M_Drv2_Alarm201
+--------------------+
|AL:201       D:2 U: |
|                    |
|    Probe error     |
|                    |
+--------------------+

M_Drv2_Alarm202
+--------------------+
|AL:202       D:2 U: |
|                    |
|  Step motor error  |
|                    |
+--------------------+

M_Drv2_Alarm203
+--------------------+
|AL:203       D:2 U: |
|                    |
|   Eeprom error     |
|                    |
+--------------------+

M_Drv2_Alarm204
+--------------------+
|AL:204       D:2 U: |
|                    |
|   Battery error    |
|                    |
+--------------------+

M_Drv2_Alarm205
+--------------------+
|AL:205       D:2 U: |
|                    |
|   High pressure    |
|                    |
+--------------------+

M_Drv2_Alarm206
+--------------------+
|AL:206       D:2 U: |
|                    |
|   Low pressure     |
|                    |
+--------------------+

M_Drv2_Alarm207
+--------------------+
|AL:207       D:2 U: |
|                    |
|  Super heat alarm  |
|                    |
+--------------------+

M_Drv2_Alarm208
+--------------------+
|AL:208       D:2 U: |
|  Valve not closed  |
|  during power OFF  |
|                    |
+--------------------+

M_Drv2_Alarm209
+--------------------+
|AL:209       D:2 U: |
| Waiting for valve  |
|   open restart     |
|                    |
+--------------------+

M_Drv2_Alarm210
+--------------------+
|AL:210       D:2 U: |
| Waiting for battery|
|   charged restart  |
|                    |
+--------------------+

M_Drv2_Alarm211
+--------------------+
|AL:211       D:2 U: |
| Waiting for eeprom |
|    error restart   |
|                    |
+--------------------+
```

Technology & Evolution

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