Danfoss Electronics spa

www.danfosselectronics.com info@danfosselectronics.com

# Multipower Units User Manual

Multi Compressors
Multi Circuits

# MULTIPOWER UNITS ALGORITHM

## 1 Introduction

The algorithm here below described allows the management of cooling and heating units Air/Water, up to 2 circuits, 12 compressors.

The main algorithm's functions are as follows:

- inlet or outlet evaporator water temperature regulation
- proportional, proportional/integral or dead zone regulation
- anti freeze control
- compressors management with minimum number control
- steps or continuous condensing fan speed control
- twin pumps control
- alarms management
- setpoint management:
  - second setpoint
  - remote setpoint
  - setpoint compensation
- defrost management
- automatic change-over
- liquid valve and pump down management
- free-cooling management
- electronic expansion valve management
- emergency mode
- scheduler

# 2 Unit configuration

## 2.1 Input/Output configuration

To make the most of the hardware controller resources, you can manually assign the function performed by each controller's input and output through the software configurator "MCXShape" provided together with the application software

Follow below the complete list of the available functions that can be independently assigned to each input and output.

| **ANALOG INPUT** | | | |
|---|---|---|---|
| **Description (LCD display)** | **Code (LED display)** | **Position** | **Function** |
| Tin Evaporator | TIN | Evaporator entering water/air | Regulation of water/air temperature if the analog input is selected with "rEG" parameter |
| Tout Evaporator1 | TO1 | Evaporator 1 leaving water | Anti-freeze of evaporator 1 water |
| Tout Evaporator2 | TO2 | Evaporator 2 leaving water | Anti-freeze of evaporator 2 water |
| Tout Evap Mix | TOM | Evaporators leaving water/air temperature | Regulation of water/air temperature if the analog input is selected with "rEG" parameter |
| DischargePress1 | dP1 | High pressure side of the gas circuit. See NOTE. | Regulation of condensing pressure/temperature<br>High pressure prevention and alarm |
| DischargePress2 | dP2 | High pressure side of the gas circuit. See NOTE. | Regulation of condensing pressure/temperature<br>High pressure prevention and alarm |
| Tout | TOUt | Outdoor air | » Setpoint compensation<br>» Automatic changeover |
| Remote Set | TREM | | Setpoint change (remote setpoint) |
| Tout Condenser1 | HE1 | Condenser 1 water | » Heating regulation for water cooled heating pumps with water changeover.<br>» Water anti-freeze on the outlet of the external heat exchanger 1 (for water cooled heat pump units with refrigerant changeover) |
| Tout Condenser2 | HE2 | Condenser 2 water | Water anti-freeze on the outlet of the external heat exchanger 2 (for water cooled heat pump units with refrigerant changeover) |
| T ComboDefrostC1 | TCD1 | External heat exchanger 1 | Temperature probe for circuit 1 combined defrost (for air cooled heat pump units with refrigerant changeover) |
| T ComboDefrostC2 | TCD2 | External heat exchanger 2 | Temperature probe for circuit 2 combined defrost (for air cooled heat pump units with refrigerant changeover) |
| BoilerSafety | BOI | Boiler | Safety probe |
| SuctionPress C1 | SP1 | Suction pressure circuit 1. See NOTE. | Low pressure alarm for circuit 1 |
| SuctionPress C2 | SP2 | Suction pressure circuit 2. See NOTE. | Low pressure alarm for circuit 2 |
| Freecool Temp | FC1 | Free-cooling temperature. See NOTE. | Temperature probe for the return water before the free-cooling coil |
| Emergency | EEr | Digital input connected to MCX universal analog input | Activation of emergency mode |

| **ANALOG INPUT** | | | |
|---|---|---|---|
| **Description (LCD display)** | **Code (LED display)** | **Position** | **Function** |
| Tin Evaporator | TIN | Evaporator entering water/air | Regulation of water/air temperature if the analog input is selected with "rEG" parameter |
| Tout Evaporator1 | TO1 | Evaporator 1 leaving water | Anti-freeze of evaporator 1 water |
| Tout Evaporator2 | TO2 | Evaporator 2 leaving water | Anti-freeze of evaporator 2 water |
| Tout Evaporator3 | TO3 | Evaporator 3 leaving water | Anti-freeze of evaporator 3 water |
| Tout Evaporator4 | TO4 | Evaporator 4 leaving water | Anti-freeze of evaporator 4 water |
| Tout Evap Mix | TOM | Evaporators leaving water/air temperature | Regulation of water/air temperature if the analog input is selected with "rEG" parameter |

| | | | |
|---|---|---|---|
| DischargePress1 | dP1 | High pressure side of the gas circuit. See NOTE. | Regulation of condensing pressure/temperature<br>High pressure prevention and alarm |
| DischargePress2 | dP2 | High pressure side of the gas circuit. See NOTE. | Regulation of condensing pressure/temperature<br>High pressure prevention and alarm |
| DischargePress3 | dP3 | High pressure side of the gas circuit. See NOTE. | Regulation of condensing pressure/temperature<br>High pressure prevention and alarm |
| DischargePress4 | dP4 | High pressure side of the gas circuit. See NOTE. | Regulation of condensing pressure/temperature<br>High pressure prevention and alarm |
| Tout | TOUt | Outdoor air | » Setpoint compensation<br>» Automatic changeover |
| Remote Set | TREM | | Setpoint change (remote setpoint) |
| Tout Condenser1 | HE1 | Condenser 1 water | » Heating regulation for water cooled heating pumps with water changeover.<br>» Water anti-freeze on the outlet of the external heat exchanger 1 (for water cooled heat pump units with refrigerant changeover) |
| Tout Condenser2 | HE2 | Condenser 2 water | Water anti-freeze on the outlet of the external heat exchanger 2 (for water cooled heat pump units with refrigerant changeover) |
| Tout Condenser3 | HE3 | Condenser 3 water | Water anti-freeze on the outlet of the external heat exchanger 3 (for water cooled heat pump units with refrigerant changeover)) |
| Tout Condenser4 | HE4 | Condenser 4 water | Water anti-freeze on the outlet of the external heat exchanger 4 (for water cooled heat pump units with refrigerant changeover) |
| T ComboDefrostC1 | TCD1 | External heat exchanger 1 | Temperature probe for circuit 1 combined defrost (for air cooled heat pump units with refrigerant changeover) |
| T ComboDefrostC2 | TCD2 | External heat exchanger 2 | Temperature probe for circuit 2 combined defrost (for air cooled heat pump units with refrigerant changeover) |
| T ComboDefrostC3 | TCD3 | External heat exchanger 3 | Temperature probe for circuit 3 combined defrost (for air cooled heat pump units with refrigerant changeover) |
| T ComboDefrostC4 | TCD4 | External heat exchanger 4 | Temperature probe for circuit 4 combined defrost (for air cooled heat pump units with refrigerant changeover) |
| BoilerSafety | BOI | Boiler | Safety probe |
| SuctionPress C1 | SP1 | Suction pressure circuit 1. See NOTE. | Low pressure alarm for circuit 1 |
| SuctionPress C2 | SP2 | Suction pressure circuit 2. See NOTE. | Low pressure alarm for circuit 2 |
| SuctionPress C3 | SP3 | Suction pressure circuit 3. See NOTE. | Low pressure alarm for circuit 3 |
| SuctionPress C4 | SP4 | Suction pressure circuit 4. See NOTE. | Low pressure alarm for circuit 4 |
| Freecool Temp | FC1 | Free-cooling temperature. See NOTE. | Temperature probe for the return water before the free-cooling coil |
| Discharge Temperature C1 | dT1 | Discharge gas temperature circuit 1 | Temperature of the discharge gas for circuit 1 |
| Discharge Temperature C2 | dT2 | Discharge gas temperature circuit 2 | Temperature of the discharge gas for circuit 2 |
| Discharge Temperature C3 | dT3 | Discharge gas temperature circuit 3 | Temperature of the discharge gas for circuit 3 |
| Discharge Temperature C4 | dT4 | Discharge gas temperature circuit 4 | Temperature of the discharge gas for circuit 4 |

NOTE.
When the transducers on the low pressure side "SuctionPress Cx" are not present, the transducers "DischargePress Cx" pass on the low pressure side of the circuit in case of heat pumps with gas changeover in heating mode.
But when the transducers "SuctionPressCx are present, the couple of transducers are supposed located near the suction and discharge of the compressor and do not change function depending on the heating or cooling mode even on heat pumps with gas changeover.

| DIGITAL INPUT | | |
|---|---|---|
| **Description (LCD display)** | **Code (LED display)** | **Function** |
| Comp Overload | OC | Compressors general overload |
| Comp Overload C1 | OCL1 | Compressors overload circuit 1 |
| Comp Overload C2 | OCL2 | Compressors overload circuit 2 |
| Comp1 Overload | OC1 | Compressor 1 overload |
| Comp2 Overload | OC2 | Compressor 2 overload |
| Comp3 Overload | OC3 | Compressor 3 overload |
| Comp4 Overload | OC4 | Compressor 4 overload |
| Comp5 Overload | OC5 | Compressor 5 overload |
| Comp6 Overload | OC6 | Compressor 6 overload |
| Comp7 Overload | OC7 | Compressor 7 overload |
| Comp8 Overload | OC8 | Compressor 8 overload |
| Comp9 Overload | OC9 | Compressor 9 overload |
| Comp10 Overload | OC10 | Compressor 10 overload |
| Comp11 Overload | OC11 | Compressor 11 overload |
| Comp12 Overload | OC12 | Compressor 12 overload |
| Comp Oil Press. | DC | Compressors oil pressure |
| Comp Oil PressC1 | DCL1 | Compressors oil pressure circuit 1 |
| Comp Oil PressC2 | DCL2 | Compressors oil pressure circuit 2 |
| Comp1 Oil Press. | DC1 | Compressor 1 oil pressure |
| Comp2 Oil Press. | DC2 | Compressor 2 oil pressure |
| Comp3 Oil Press. | DC3 | Compressor 3 oil pressure |
| Comp4 Oil Press. | DC4 | Compressor 4 oil pressure |
| Comp5 Oil Press. | DC5 | Compressor 5 oil pressure |
| Comp6 Oil Press. | DC6 | Compressor 6 oil pressure |
| Comp7 Oil Press. | DC7 | Compressor 7 oil pressure |
| Comp8 Oil Press. | DC8 | Compressor 8 oil pressure |
| Comp9 Oil Press. | DC9 | Compressor 9 oil pressure |
| Comp10 Oil Press. | DC10 | Compressor 10 oil pressure |
| Comp11 Oil Press. | DC11 | Compressor 11 oil pressure |
| Comp12 Oil Press. | DC12 | Compressor 12 oil pressure |
| Heaters Overload | OH | Heaters general overload |
| Heaters Ovld C1 | OHL1 | Heaters overload circuit 1 |
| Heaters Ovld C2 | OHL2 | Heaters overload circuit 2 |
| Heater1 Overload | OH1 | Heater 1 overload |
| Heater2 Overload | OH2 | Heater 2 overload |
| Cond Fan/Pump Ovld | OFC | Condenser fans/pumps general overload |
| Cond1 Fan Ovld | FCL1 | Condenser 1 fan overload |
| Cond2 Fan Ovld | FCL2 | Condenser 2 fan overload |
| Cond Fan1/Pmp1 Ovld | OFC1 | Condenser fan/pump 1 overload |
| Cond Fan2 Overld | OFC2 | Condenser fan/pump 2 overload |
| Cond Fan3 Overld | OFC3 | Condenser fan 3 overload |
| Cond Fan4 Overld | OFC4 | Condenser fan 4 overload |
| Cond Fan5 Overld | OFC5 | Condenser fan 5 overload |
| Cond Fan6 Overld | OFC6 | Condenser fan 6 overload |
| Cond Fan7 Overld | OFC7 | Condenser fan 7 overload |
| Cond Fan8 Overld | OFC8 | Condenser fan 8 overload |
| HP | HP | High pressure |
| HP Circuit1 | HPL1 | High pressure circuit 1 |
| HP Circuit2 | HPL2 | High pressure circuit 2 |
| LP | LP | Low pressure |
| LP Circuit1 | LPL1 | Low pressure circuit 1 |

| DIGITAL INPUT | | |
|---|---|---|
| LP Circuit2 | LPL2 | Low pressure circuit 2 |
| Flow Evaporator | FPE | Evaporator flow switch |
| Evap Pump Ovld | OPE | Evaporator pumps general overload |
| Evap Pmp1/Fan Ovld | OPE1 | Evaporator pump 1/fan overload |
| Evap Pump2 Ovld | OPE2 | Evaporator pump 2 overload |
| Differential Water Pressostat | FPC | Differential Water Pressostat |
| ON/OFF | ONO | Remote ON/OFF |
| Offset from DI | SET2 | Setpoint offset by digital input (second setpoint) |
| General Overload | OVL | General overload |
| General Alarm | ALR | General alarm |
| Defrost | DEF | Start and/or stop defrost |
| Heat/Cool | HC | Heat pumps heating/cooling selection |

| DIGITAL OUTPUT | | |
|---|---|---|
| **Description (LCD display)** | **Code (LED display)** | **Function** |
| Compressor1 | C1 | Compressor 1/Inverter compressor 1 |
| Compressor2 | C2 | Compressor 2 |
| Compressor3 | C3 | Compressor 3 |
| Compressor4 | C4 | Compressor 4 |
| Compressor5 | C5 | Compressor 5 |
| Compressor6 | C6 | Compressor 6 |
| Compressor7 | C7 | Compressor 7 |
| Compressor8 | C8 | Compressor 8 |
| Compressor9 | C9 | Compressor 9 |
| Compressor10 | C10 | Compressor 10 |
| Compressor11 | C11 | Compressor 11 |
| Compressor12 | C12 | Compressor 12 |
| Heater1 | H1 | Heater 1 |
| Heater2 | H2 | Heater 2 |
| Heater3 | H3 | Heater 3 |
| Heater4 | H4 | Heater 4 |
| Evap Pump1 | PE1 | Evaporator pump 1 |
| Evap Pump2 | PE2 | Evaporator pump 2 |
| Condenser Fan1/Pump1 | FC1 | Condenser fan 1/pump 1 |
| Condenser Fan2 | FC2 | Condenser fan 2 |
| Condenser Fan3 | FC3 | Condenser fan 3 |
| Condenser Fan4 | FC4 | Condenser fan 4 |
| Condenser Fan5 | FC5 | Condenser fan 5 |
| Condenser Fan6 | FC6 | Condenser fan 6 |
| Condenser Fan7 | FC7 | Condenser fan 7 |
| Condenser Fan8 | FC8 | Condenser fan 8 |
| Inverter Cond1 | FI1 | Inverter fan condenser 1 |
| Inverter Cond2 | FI2 | Inverter fan condenser 2 |
| Alarm | ALR | Alarm |
| Warning | WAR | Warning |
| Reverse Valve C1 | HC1 | Reversing valve circuit 1 |
| Reverse Valve C2 | HC2 | Reversing valve circuit 2 |
| Boiler1 | BO1 | Boiler, heater 1 |
| Boiler2 | BO2 | Boiler, heater 2 |
| Boiler3 | BO3 | Boiler, heater 3 |
| Boiler4 | BO4 | Boiler, heater 4 |

| DIGITAL OUTPUT | | |
|---|---|---|
| Liquid Valve C1 | LV1 | Liquid valve circuit 1 |
| Liquid Valve C2 | LV2 | Liquid valve circuit 2 |
| Freecool Valve | FV1 | Free-cooling ON/OFF valve |

| ANALOG OUTPUT | | |
|---|---|---|
| **Description (LCD display)** | **Code (LED display)** | **Function** |
| InverterFanCond1 | Fc1 | Inverter or phase cutting regulator for condenser 1 fans |
| InverterFanCond2 | Fc2 | Inverter or phase cutting regulator for condenser 2 fans |
| FreecoolValve | FV1 | Free-cooling modulating valve |

## 2.2 *"H" parameters for unit configuration*

After assigning the desired function to each input and output (see the previous chapter) you have to set the "H" parameters for the unit configuration according to the input and output. For info on how to access the "H" parameters, please see chapter 3.

**Group1=CFG – Unit Config**
**Group2=EVA - Evaporator**
**H1 - Number of evaporators**
Defines the number of evaporators

**H2 - Number of circuits per evaporator**
Defines the number of refrigerant circuits per evaporator.

**H3 - Air or water cooling**
Defines if the evaporation process is managed by a pump (H3=H2O) or a fan (H3=Air).
» WATER evaporators (H3=H2O).
For each evaporator, are controlled the "Heater1", ..., "Heater4" digital outputs which are necessary to manage the anti freeze heaters on the basis of the leaving water temperature "ToutEvaporator1", "ToutEvaporator2" as described in the related chapter. The number of heaters per evaporator is defined by H5.
» AIR evaporators (H3=Air).
Only "Tout Evaporator 1" input is used to measure the supply air temperature even when more than one evaporator is present.

**H4 - Numbers of evaporator pumps**
By this parameter is possible to define the necessary digital outputs to control the pumps (or fan) on the evaporator.
» WATER evaporators (H3=H2O).
The "Evap Pump1" and "Evap Pump2" digital output are managed to control one pump or two twin pumps.
» AIR evaporators (H3=Air).
"Evap Pump1" output is used to manage fans on the evaporator.

**H5 - Number of heaters per evaporator**
Multiplied by H1, number of evaporators, defines the total number of heaters that are managed and consequently the number of digital output "Heater1", ..., "Heater4" used to drive them.

**Group2=CMP – Compressors**
**H6 - Number of compressors per circuit**
Multiplied by H2 (number of circuits per evaporator) and by H1 (number of evaporators), defines the total number of compressors that are managed and consequently the number of digital output "Compressor1", ..., "Compressor12" used to drive them.
Compressors are assigned to circuits in a sequential and balanced way, assuming that all circuits have the same number of compressors; e.g. in a system made of 2 circuits and 4 compressors, "Compressor1" and "Compressor2" output are assigned to control compressors belonging to the first circuit; "Compressor3" and "Compressor4" to the second circuit..

**H7 - Min number of comp. ON per circuit**
Minimum number of compressors ON per circuit.
Ensure that there will never be running a number of compressors of less than H7, thus always guaranteeing conditions for oil return.
The H7 compressors of each circuit are activated only when the demand is enough to call for their activation. Viceversa they are deactivated when the demand is zero.

**Group2=CND – Condenser**
Each condenser circuit is controlled by an analog input "DischargePress C1", "DischargePress C2" for temperature or pressure condensing regulation. The same input is then used for defrost control in air cooled heat pumps in heating mode.
For water cooled heat pumps with refrigerant changeover , the ""ToutCondenser1", "ToutCondenser2" probe on the output of each condenser is used for anti freeze control of the outdoor heat exchanger leaving water in heating mode.

For water cooled heat pumps with water changeover, only one probe, “ToutCondenser1”, is used for water heating control.

**H9 – Air or water cooled condenser**
Defines if fan (H9=Air) or pump (H9=H2O) is used for condensing regulation. If it’s an air cooled condenser, defrost control is performed in heating mode.

**H10 - Number of pumps or fans per condenser**
Defines the necessary digital output to control the pumps or fans on the condenser.
» Water cooled units (H9=$H_2O$).
The single “Condenser Fan1” digital output is controlled to drive a pump.
» Air cooled units (H9=AIR).
Contributes to define the total number of managed ventilation steps and thus of the corresponding ”Condenser Fan1, ..., ”Condenser Fan8” digital output used to drive them.
See the H11 parameter.

**H11 - Fans in common to all condensers**
On multi-circuits units, fans can be in common to all condensers.
If fans are not in common to all condensers (H11=NO), the following output are controlled:
» as many analog input as the condensers (H1*H2)
» as many digital output as the condensers (H1*H2), multiplied by the number of fans per condenser (H10); digital output for fans are assigned to condensers in a sequential and balanced way, assuming that all condensers have the same number of fans; e.g. in a system made of 2 condensers and 6 fans, “Cond Fan1/Pump1”, “Condenser Fan2” and “Condenser Fan3” output are assigned to control fan belonging to the first condenser; “Condenser Fan4”, “Condenser Fan5” and “Condenser Fan6” to the second condenser.
» as many analog output “InverterFanCond1”,.” InverterFanCond2” for condensing control as the condensers (H1*H2).

If fans are in common to all condensers (H11=YES) the following output are used:
» as before, as many analog inputs for condensing control as the circuits per condenser (H1*H2), but regulation is made on the one requiring the higher response from the control. Each analog input is then used for defrost control in heating mode;
» as many digital outputs as fans per condenser (H10);
» one analog output “InverterFanCond1” for fan speed regulation.

**Group2=HP – Heat Pump**
**H40 - Heat pump type**
Heat pump operation can be realised with refrigerant (H40=GAS) or water (H40= H2O) changeover. One digital output “Reverse Valve C1, .“Reverse Valve C2” per each circuit is reserved for controlling the reverse flow valve.

**Boiler number of heaters (H44)**
Defines the number of boiler heaters that are managed and consequently the number of digital output ”Boiler1”, ..., ”Boiler4” used to drive them.

**NOTE. Analog input for temperature control**
The probe used for temperature control is the one defined with the rEG parameter among any of the available analog input.
In water cooled heat pumps with water changeover (H40= $H_2O$), the single “ToutCondenser1” probe is used for temperature control in heating mode.

## *2.3 Default I/O configuration*

The default I/O assignment according to the type of MCX controller is set through the software configurator “Interface_Chiller_HP_vNN.xls”.

# 3 User Interface

## 3.1 Turning ON and OFF

Unit turning ON and OFF can be done as follow:
» by the UP key for 3s to turn it ON or OFF,
» by menu (see “3.4 - Menu navigation”),
» by parameter y01 (group1 “GEN – General”, group2 “StU – Setup”). See “3.7 - Setup functions”.
» by “ON/OFF” digital input, if present.
Note that all the above ways can turn OFF the unit. To turn it ON the digital input must be closed.
If the digital input has been configured to have “Polarity=Close” (default setting), it means that the input is in the OFF state when it is open.
» by supervisor

### Turning OFF

When the controller has been turned OFF, then all the output are deactivated (respecting all the protection times).
OFF condition is evident through “OFF” sign on the display A or “IOFF” if the “ON/OFF” digital input is active; display B keeps the value it was already showing (see the next chapter).
In case of OFF condition, the following functions are active:
» anti freeze control (see AI3 parameter, group1 “ALA – Alarms”, group2 “ICE – Ice”),
» probe alarm management (you can define through the configurator which alarms are active in the OFF state; see “APPENDIX – Configurator usage” at the end of the manual)
» possibility by parameter AOF (group1 “ALA – Alarms”, group2 “BUZ – Buzzer and relay”) to manage the alarm output.

### Turning ON

Turning ON the unit you get access to the main screen.

## 3.2 Main screen

From the main screen, pressing the ENTER key you go to the menu described in the next chapter.

The main screen is different for the LED version and for LCD version.

### 3.2.1 LED display

**Group1: GEN – General**
**Group2: dsP – Display**


The measures displayed on A and B displays are selectable by parameter dSA and dSb. Selectable values are: OFF;rEG;SEt;EIn;EOUt;Ext;FC;Pr1;Pr2;SEr
» OFF: no values

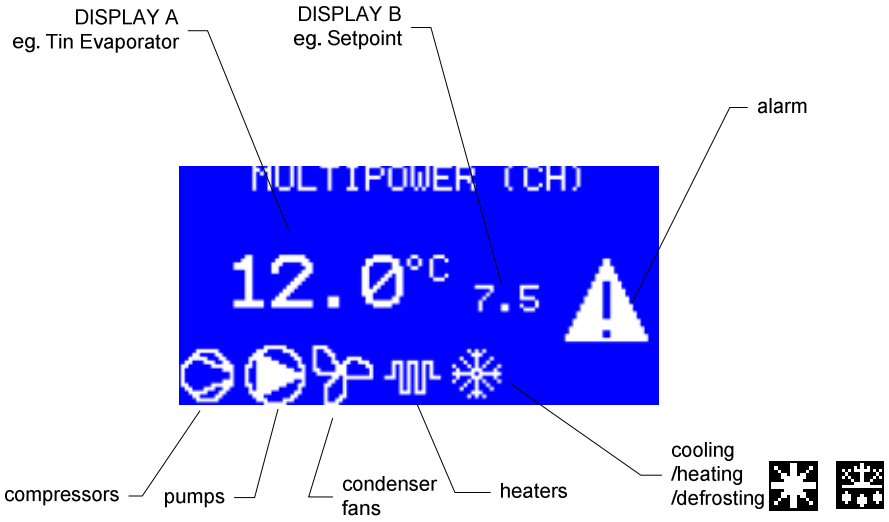
» rEG: analog input used for temperature regulation (see “5 Temperature regulation”)
» SEt: active setpoint
» EIn: evaporator inlet temperature probe
» EOUt: evaporator outlet temperature probe
» Ext: outdoor temperature probe
» FC: freecooling temperature probe
» Pr1: pressure transducer on condenser 1
» Pr2: pressure transducer on condenser 2
» SEr: analog input for remote setpoint

The value of the probe used for temperature regulation and the active setpoint are shown by default.

The meaning of all the icons is explained in the above figure.
An icon associated to an actuator follows its request status. The icon blinks when the actuator can’t change its status because of protection times (fast blinking means a request to turn it OFF; slow blinking means a request to turn it ON).
The alarm and warning icon are associated to the alarm and warning output.
If dSC=ICE, the ice icon is turned ON when the unit is in cooling mode. The sun icon is turned ON in heating mode; the opposite if dSC=SUN.

### *3.2.2 LCD Display*

On the main screen the following data are displayed:
» on the first row there is the title “MULTIPOWER (CH)” if the chiller mode is selected (parameter H40=0) or “MULTIPOWER (CH/HP)” if the heatpump mode is selected (parameter H40 different from 0).
» the main analog inputs measurements or other information (see display A and display B on the LED display version)
» the ice icon, if unit is in cooling mode, or the sun icon if it is in heating mode (this association is defined by parameter dSC) together with the icons of the main active elements: compressors, fans, heaters and pumps
» the alarm or service icon




## *3.3 Heat/cool selection*

On heat pump units the selection between heating and cooling mode is performed in the following ways:
» from keyboard by pressing the DOWN key for 3s (enabled by rE2 parameter, group1 “rEV – Reversing valve.”, group2 “CFg – Configuration”)
» from menu (see “3.4 - Menu navigation”)
» from y03 parameter, group1 “GEN – General”, group 2 “StU – Setup”. See “3.6 - Setup functions”
» from “Heat/Cool” digital input, if present
NOTE. If the digital input has been configured to have “Polarity=Close” (default setting), it means that the input is in cooling mode when it is closed.
» from “Tout” analog input, comparing the outdoor temperature with a setpoint of reference (see “13.1 - Automatic changeover”).

The priority order, from the higher to the lower level, is the following:

1) Automatic via “Tout” outdoor temperature measurement
2) Manual via the keyboard (via menu, y03 parameter or ON/OFF keys)
3) Manual via the “Heat/Cool” digital input.

A request of automatic changeover has the priority on all the others.
Whatever the selected mode is, it is always shown on display with the corresponding icon; see “3.2 - Main screen”.

## 3.4 Menu navigation

Pressing the ENTER key when the unit is ON, you go to the menu described in the following table.

| LED Display | | | LCD Display | |
|---|---|---|---|---|
| Menu code | Sub-menu code | Sub-menu code | Description | Function |
| **LOG** | | | **Login** | Defines the access level to menus and parameters.<br>Password is defined with L01, L02 and L03 parameters |
| **Str** | | | **Start** | Start functions |
| | **ON** | | **Turn ON** | Turn ON the unit |
| | **OFF** | | **Turn OFF** | Turn OFF the unit |
| | **nEt** | | **Network** | Access to network start/stop functions |
| | | **SON** | **System ON** | Turn ON all the units (master and slaves) |
| | | **SOF** | **System OFF** | Turn OFF all the units (master and slaves) |
| | **HC** | | **Heat/Cool** | Heat/cool switch |
| | **DFP** | | **Load default** | Load default parameters |
| **STA** | | | **Show comp status** | Information on compressor status |
| **PAR** | | | **Parameters** | Access to menu of parameters.<br>You need to login first.<br>For menu description see “16 - Parameters” |
| **I-O** | | | **Input/Output** | Display input and output values |
| **ALA** | | | **Alarms** | Access to alarm menu |
| | **AAL** | | **Active Alarms** | List of the active alarms |
| | **ALR** | | **Reset Alarms** | Alarms manual reset |
| | **AHS** | | **Alarm History** | Alarm history |
| | **AHC** | | **Clear AL History** | Clear alarm history |
| **EXD** | | | **EXD316** | Access to menu of EXD316, driver for electronic expansion valve |
| | **EX1** | | **EXD 316 #1** | EXD316, address 1 |
| | | **CFG** | **Config EXD1** | Access to configuration parameters of EXD316 #1 |
| | | **tSt** | **Test EXD1** | Access to information coming from EXD316 #1 |
| | | **DEF** | **Load Factory** | Load factory values into EXD316 #1 |
| | **EX2** | | **EXD 316 #2** | EXD316, address 2 |
| | | **CFG** | **Config EXD2** | Access to configuration parameters of EXD316 #2 |
| | | **tSt** | **Test EXD2** | Access to information coming from EXD316 #2 |
| | | **DEF** | **Load Factory** | Load factory values into EXD316 #2 |
| **CLK** | | | **Clock** | Clock menu |
| | **RTC** | | **Set RTC** | Set hour and date |
| | **SCH** | | **Scheduler** | Set scheduler records |
| **SER** | | | **Service** | Access to service information |
| | **INF** | | **Software info** | Information on application software |
| **HRS** | | | **Hour Counters** | Access to hour counters menu |
| | | **COH** | **Compressors** | Compressors hour counters |
| | | **EPH** | **Evap Pumps** | Evaporator pumps hour counters |
| | | **CLR** | **Reset Counters** | Reset hour counters |

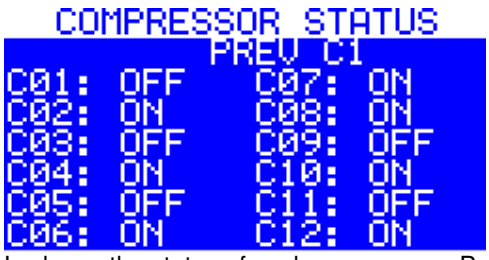
To navigate inside menus use the UP and DOWN keys. The ENTER key allows you to go down to the next level, if present; the X key allows you to go up to the previous level, up to the main screen.
To change the value of the selected parameters use the following keys:

» ENTER, to enter in changing mode (the value starts to blink),

» UP and DOWN to change value,
» ENTER again to confirm changes or X for not confirming them.

### 3.4.1 Compressor Status

**Menu: StA –Compressor Status**
Information on compressor status.




Is shown the status of each compressor. Possible values are:

**ON, OFF**
**Alarm**: if the compressor is in alarm
**CT0, CT1, CT2, CT3, CT4, CT6**: compressor is waiting for the time set with parameter CTx to elapse.
**Pdown**: compressor is in the pump-down phase

If enabled, on the second raw are displayed the same information described in “3.5.2 Rolling text”.

### 3.4.2 Login

**Menu: LOG – Login**
To insert the 4 digit password defining the access level to menus and parameters.
The current access level is then shown on the second raw of the main menu screen.

Press UP and DOWN to change the value of the selected digit.
Press ENTER to confirm the value and skip to the next digit, if present, or to login.
The LEFT and RIGHT keys, if present, allow you to move the cursor on the desired digit.

Password for the access levels from 1 to 3 are defined with L01 [1000], L02 [2000], L03 [3000] parameters, group1 “GEN - General”, group2 “PAS – Password”.
Without logging in, you get access level 0.
You can’t see parameters or menu entries belonging to a higher level then yours. What is the level of each parameter and menu is defined with the configurator (see “APPENDIX – Configurator usage” at the end of the manual).

If the inserted password is not correct you stays inside the login screen. Otherwise you get back to the main menu.

### 3.4.3 Start

**Menu: Str – Start**
Holds functions related to starting the unit.

**Sub-menu: ON – Turn ON**
Turn ON the unit.

**Sub-menu: OFF – Turn OFF**
Turn OFF the unit.

**Sub-menu: HC – Heat/Cool**
Switches the unit heat/cool status.

**Sub-menu: DFP – Load Default**
Load default parameters.

### 3.4.4 Parameters

**Menu: PAR - Parameters**
Gives access to parameters.
For a description of each parameter menu, see the relevant paragraph below.

### 3.4.5 Input and output display and configuration

**Menu I-O – Input/Output**

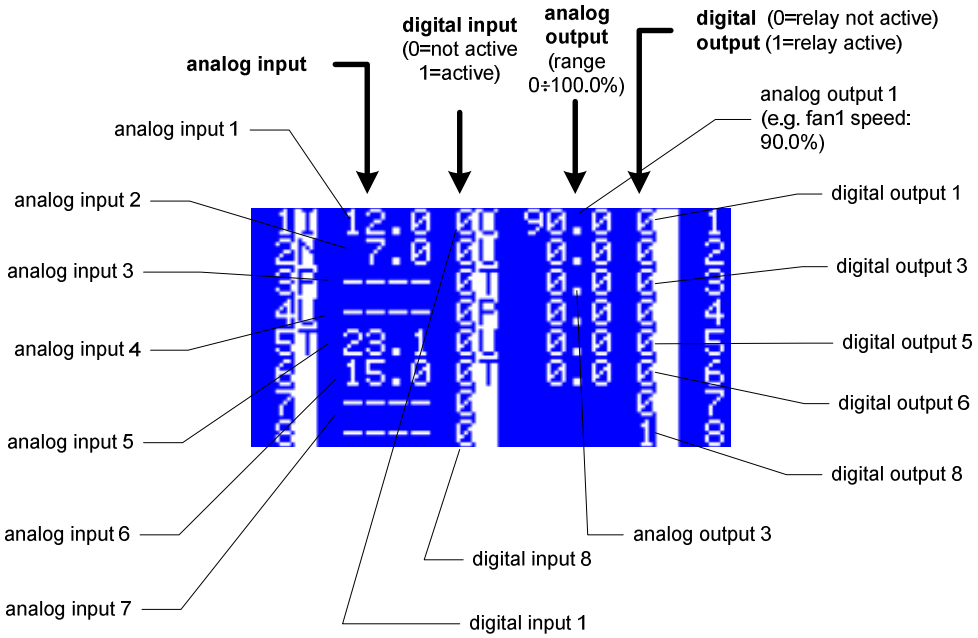
**LED display**

Shows you in sequence (using the UP and DOWN keys) all the input and output values, showing the I/O code on display A ("AI" for analog input; "AO" for analog output; "dI" for digital input and "dO" for digital output) and its value on display B (analog input that are not present or in alarm are shown with "----").

**LCD display**

You have access to three screens showing all the input and output values; each screen shows a group of 8 I/O. Use UP and DOWN keys to scroll them. The second and third screen are used with MCX15 and MCX20 only.

Below example shows the first screen.




### 3.4.6 Alarm display and configuration

**Menu: ALA – Alarms**

**Sub-menu: AAL – Active Alarms**

Shows you the active alarm screens.

Each screen is dedicated to an alarm. You can scroll among them using the UP and DOWN keys.

Each alarm is described through:

» alarm description (for LCD display only),

» alarm code,

» time since its activation in the format hours:minutes:seconds (seconds for LCD display only).

NOTE. You can access to alarm visualization also by pressing the X key from the main screen (see the "3.6 - Keyboard" paragraph).

**Sub-menu: ALR – Alarms Reset**

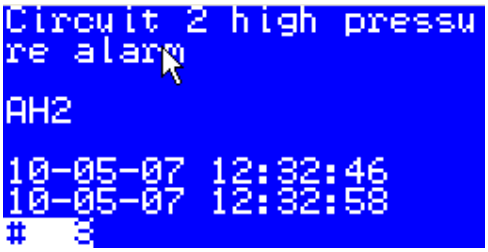
Reset of active alarms (for manually resettable alarms only).

Press ENTER to reset manually all the active alarms.

NOTE. Alarms reset can be performed also pressing X for 3s within the alarm screens (see "3.6 - Keyboard" paragraph).

**Sub-menu: AHS – Alarm History**

History of alarms.




The following information are displayed for each alarm, in order from top to bottom:
Description of the alarm
Code of the alarm
Date and time of activation
Date and time of deactivation (if any)
Record number (in reverse): #1 is the last activated alarm.
Use the UP and DOWN key to scroll the list of alarms. UP to go back and DOWN to go forward.

**Sub-menu: AHC – Clear AL History**
Clear history of alarms.

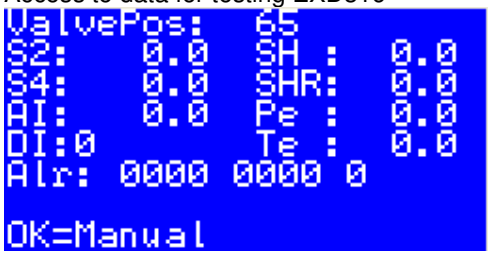
### *3.4.7 EXD (Electronic Expansion Valve driver) configuration*

**Menu: EXD – Config EXD316**
Access to configuration of four EXD316

**Sub-menu: EX1 – EXD 316 #1**
Access to configuration of first EXD316 (CAN address #1)

**Sub-menu: CFG – Config EXD1**
Access to parameters of first EXD316

**Sub-menu: tSt – Test EXD1**
Access to data for testing EXD316




ValvePos: valve opening degree
S2: value of S2 temperature sensor at evaporator outlet
S4: value of S4 temperature sensor for measuring air temperature
AI: value of external reference
DI: status of ON/OFF digital input
SH: superheat
SHR: superheat reference
Pe: evaporating pressure
Te: evaporating temperature
Alr: alarm status; one bit for each alarm from left to right (see EXD316 documentation).

- Fault in controller
- S2 sensor error
- S4 sensor error
- The input signal on terminals 17-19 is outside the range
- The input signal on terminals 21-22 is outside the range
- No refrigerant has been selected
- Check the supply voltage to the step motor
- Battery alarm

» CAN driver

Press ENTER to go to manual mode. Use UP and DOWN to set the valve opening degree. Press X to go back to automatic mode

**Sub-menu: DEF – Load Factory**

Load factory parameters on first EXD316

**Sub-menu: EX2 – EXD 316 #2**

See Sub-menu EX1

### *3.4.8 Clock configuration*

**Menu: CLK – Clock**

Access to clock and scheduler settings

**Sub-menu: RTC – Set RTC**

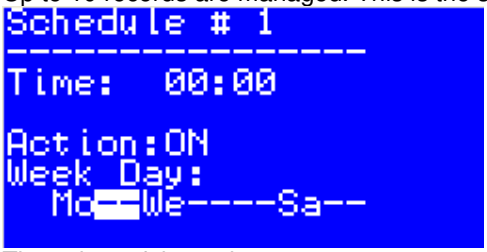
Access to configuration of hour and date of the internal real time clock

Use the UP and DOWN keys to change the field to be edited (marked with a cursor). Use the ENTER key to enter into the edit mode. UP and DOWN again to change the value. ENTER to confirm and X to abandon.

**Sub-menu: SCH – Scheduler**

Access to the configuration of the scheduler.

Up to 10 records are managed. This is the screen for the first one.




Time: time of the action start.

Action: action type. 2 types of action are managed: turn ON the unit or turn OFF the unit

Week day: day of the week of the action.

Use the ENTER key to change the field. Use UP and DOWN to modify the value.

When you are not into the edit mode (no field in reverse), use the UP and DOWN key to change the schedule record.

NOTE. The scheduler must be enabled by y08

### *3.4.9 Service*

**Menu: SER - Service**

Access to service menu.

**Sub-menu: INF – Software info**

Information about device software

### *3.4.10 Hour Counters*

**Menu: HRS – Hour Counters**

Access to hour counters.

**Sub-menu: COH – Compressors**

Access to hour counters for compressors. By clearing this timer, you also reset the timer used for compressor rotation based on run hours.

**Sub-menu: EPH – Evaporator Pumps**

Access to hour counters for evaporator pumps..

**Sub-menu: CLR – Reset Counters**

Reset all hour counters.

## 3.5 Debug information

The following chapter is directed only to users with a basic knowledge of C programming.
By code (file “AppDefine.c”) is possible to enable/disable the visualization of some information useful in the commissioning phase of the unit.

### 3.5.1 Cooling/heating demand

Removing the comment symbol // from the row
#define SHOW_POWER_REQUEST
is possible to see on the second raw of the main screen the following data marked in reverse:
REQ: <cooling/heating demand> (0-100%)
C: <circuit1 capacity/circuit2 capacity> (0-100%)

### 3.5.2 Rolling text

Removing the comment symbol // from the row
#define SHOW_ROTATE_STRING
is possible to see on the 3rd raw of the main screen the following information on a rolling text .

FREECOOLING: shows that the freecooling function is active
ONLYFREECOOLING: shows that the freecooling-only function is active
PREV C1: capacity of circuit 1 is decreased by the high pressure prevention function
PREV C2: capacity of circuit 2 is decreased by the high pressure prevention function
PREV C1&2: la capacità di entrambi i circuiti è diminuita dalla funzione di prevenzione dell’alta pressione
PUMPDOWN C1: circuit 1 is in the pump-down phase
PUMPDOWN C2: circuit 2 is in the pump-down phase
PUMPDOWN C1&2: both circuits are in the pump-down phase
EMERGENCY: shows that the emergency function is active

Eg.


Cooling demand=75%; circuit1=0%; circuit2=100%; capacity of circuit1 decreased by the prevention function

## 3.6 Keyboard

| Unit status | Key | Function | Description |
|---|---|---|---|
| | | | |
| Main screen | | Menu | Access to menus |
| | 3s | OFF | Pressed for 3 seconds, turns OFF the unit |
| | 3s | Cooling/heating switch | Pressed for 3 seconds switches between cooling and heating mode (for heat pumps only, H40 different from 0) |
| | | Alarms | Admission to the list of active alarms |
| | | | |
| Menu | | Up | Backward scroll of menu |
| | | Down | Forward scroll of menu |
| | | --> | Change to the next menu level, if present, or command execution |
| | | <-- | Go back to the previous menu level, if present, or to the main screen |

| Unit status | Key | Function | Description |
|---|---|---|---|
| | | | |
| **Login** |  | + | Increment the selected digit |
| |  | - | Decrement the selected digit |
| |  | OK | Confirm the value and skip to the next digit, if present, or execute login. |
| |  | <-- | Go back to the previous menu level, if present, or to the main screen |
| | | | |
| **Parameters - navigation** |  | Up | Backward scroll of parameters or group of parameters |
| |  | Down | Forward scroll of parameters or group of parameters |
| |  | --> | Change to the next group of parameters, if present, otherwise enter in parameter programming mode (see, Prg) |
| |  | <-- | Go back to the previous menu level, if present, or to the main screen |
| | | | |
| **Parameters - changes** |  | Prg/OK | » Enter in parameter programming mode<br>» Confirm the change |
| |  | + | Increment the parameter value |
| |  | - | Decrement the parameter value |
| |  | X | Exit from programming mode discarding the change |
| | | | |
| **Alarms - list** |  | Up | Backward scroll of the alarm list |
| |  | Down | Forward scroll of the alarm list |
| |  | <--/Reset | Go back to the main screen<br>Pressed for 5 seconds, manual reset of all the active alarms |

## *3.7 Setup functions*

**Group1: GEN – General**
**Group2: StU – Setup**

### *3.7.1 ON/OFF function*

Through the y01 parameter you decide the ON/OFF status of the unit.
» y01=OFF: unit is OFF;
» y02=ON: unit is ON.
For the other ways to turn ON and OFF the unit see the paragraph “3.1 - Turning ON and OFF” inside “User interface”.

### *3.7.2 Re-start function*

When the MCX is powered up, the unit status is decided by y02 as follows::
» y02=OFF: the unit doesn’t re-start automatically, it will remain in OFF mode;
» y02=ON: the unit re-starts automatically, even if it was in OFF mode before the power was cut out;
» y02=EQUA: the unit will return automatically to the same mode it was before the power was cut out.

### *3.7.3 Heat/cool selection*

Through the y03 parameter you decide the heating/cooling mode of the unit.
» y03=COOL: unit is in cooling mode;
» y03=HEAt: unit is in heating mode.

For the other ways to select heating and cooling mode see the paragraph “3.3 - Heat/cool selection” inside “User interface”.

### *3.7.4 Delay at power ON*

Through the y04 parameter you set the delay at power-ON (not when the unit status changes ON) before activating any output. It’s purpose is to distribute the drawn current and protect the elements and particularly the compressor against repeated starts in the event of frequent power failures. When the timer has elapsed, the controller starts to manage the output based on the other times and the other normal functions.

### *3.7.5 Change of the unit of measurement*

Through the y05 parameter you set the temperature unit of measurement used by the device between °C and °F.
NOTE. The MMI remote user interface must be restarted for any change to take effect.

### *3.7.6 Forcing parameters default values*

There are two ways for resetting parameters to their default values.
One is through the y07 parameter.
The other one is from menu “STR-Start” – “DFP-Load Default”, see “3.4.3 - Start”.

## *3.8 Accessing the BIOS menu (LCD display only)*

By pressing simultaneously the X and ENTER keys for 5 seconds at power up, you enter into a special BIOS menu; you can go through the voices of the menu using the UP and DOWN keys, confirm your selection with the ENTER key or discard it with the X key.
The menu is as follows:

APPLICATION: to exit the bios menu and return to the application
DISPLAY: to access the display setting menu
- CONTRAST: to set the LCD contrast; LEFT=decrement, RIGHT=increment
- BRIGHTNESS: to set the LCD brightness; LEFT=decrement, RIGHT=increment
- POS/NEG: to switch between positive and negative display using the ENTER key

BUZZER: to set the buzzer volume and disable it; UP=increment, DOWN=decrement
CAN: to access the CAN communication configuration menu.
- NODE ID: to set the device address on the CAN network; UP=increment, DOWN=decrement
- BAUDRATE: to set the device baud rate on the CAN network (from 10K to 1M)

# 4 Temperature setpoint management

**Group1: rEG – Regulation**
**Group2: SEt – Setpoint**
The cooling temperature setpoint is defined with SC1 parameter. It can be modified between a minimum and a maximum value, set with SCL and SCH parameters.
Similarly the heating temperature setpoint is defined with SH1 parameter. It can be modified between a minimum and a maximum value, set with SHL and SHH parameters.
For the heating/cooling selection see the paragraph “3.3 - Heat/cool selection” inside “User interface”.

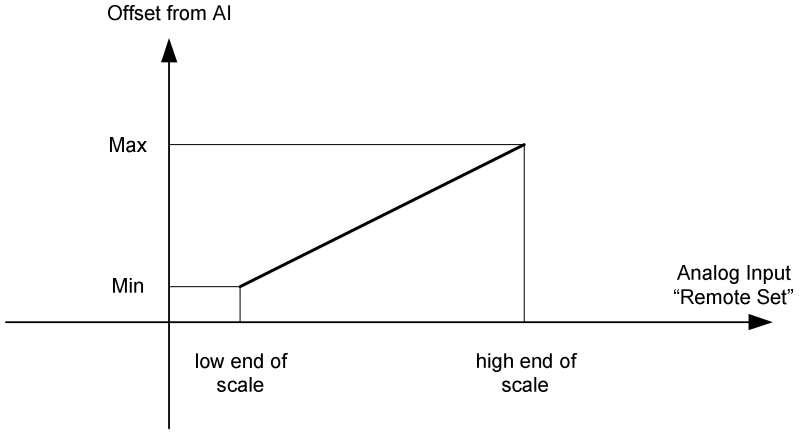
SC1 or SH1 setpoint are not the active setpoint if one of the following functions is active.

## *4.1 Offset from digital input - Secondary setpoint*

**Group1: rEG – Regulation**
**Group2: Sdl – Second setpoint**
It consists in adding a constant value (offset) to the active setpoint and differential according to the status of the “Offset from DI” digital input.
In cooling mode, the offset for the SC1 setpoint is defined with SdC parameter. In heating mode, the offset for the SH1 setpoint is defined with SdH parameter. In both cases the OFFSET for differential is SdO. According to the digital input status, the regulation uses the main or the secondary setpoint and differential.
NOTE. If the digital input has been configured to have “Polarity=Close” (default setting), it means that the main setpoint SC1 or SH1 is used when it is closed.

## *4.2 Offset from analog input – Remote setpoint*

The setpoint is calculated adding to the active setpoint an offset calculated according to the value read by the “Remote Set” analog input. For the offset calculation you define the minimum and maximum limits of the offset corresponding to the end of scale of the input signal. The “Min” and “Max” limits are defined in the analog input configuration phase.



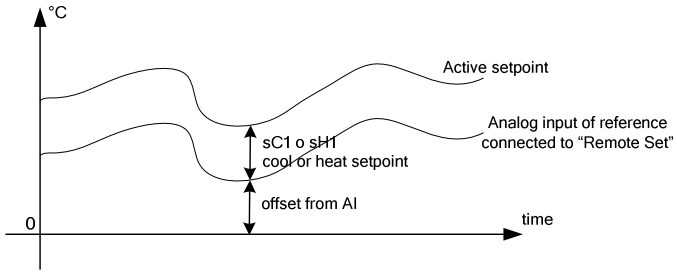

**Example**
When you configure the input from the configurator (see “APPENDIX – Configurator usage” at the end of the manual) as in the following table, you get an offset of 0 °C when the input is at 0 V and an offset of 5.0 °C when the input is at 10 V.

| | Default Setup | | | |
|---|---|---|---|---|
| | Type | Function | Min | Max |
| Analog Input 1 | 0-10 V | Remote Set | 0 | 5,0 |

### *4.2.1 Differential setpoint*

Allows you to keep constant the difference between the regulated temperature and a value of reference.

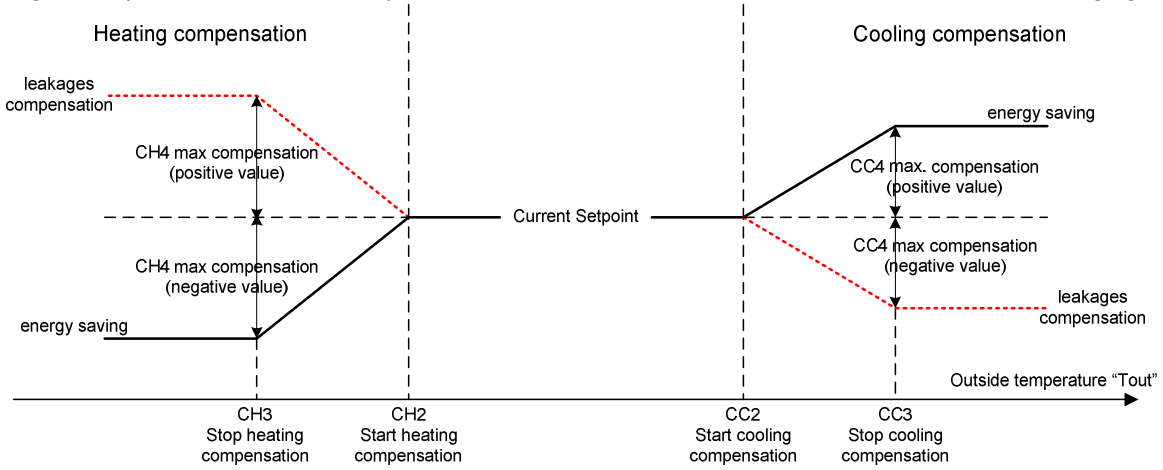
You can obtain it as a particular case of the offset from analog input (see above). In this case the reference is measured with the “Remote Set” analog input and the SC1 and SH1 setpoint must be equal to the difference in temperature that you want to obtain.




## 4.3 *Adapting the setpoint to the outside temperature (compensation)*

**Group1: rEG – Regulation**
**Group2: CPC – Compensation**

Adapting the setpoint to the outside temperature “Tout”, if enabled with CC1, is described in the following figure.



# 5 Temperature regulation

## 5.1 Selection of regulation probe in cooling mode

**Group1: rEG – Regulation**
**Group2: CFG – Configuration**

Through the rEG parameter it is possible to assign the function of regulation probe to any analog input among AI1, ..., AI8. By default it is set to AI1, corresponding to the inlet evaporator probe, “Tin Evaporator”. It must then be changed if the regulation on the outlet evaporator probe is requested, “Tout Evaporator1” for single evaporator or “Tout Evap Mix” for more evaporators.
The rEG parameter value must always be set up to the physical analog input where the control probe is connected to.

## 5.2 Selection of regulation probe in heating mode

Probes used for regulation change according to the heat pump type.
On refrigerant changeover heat pumps there is the functional switch between the evaporator and the condenser. Regulation probes are then the same than in cooling mode and are those on the internal heat exchanger, defined through the rEG parameter.
On the contrary, water changeover heat pumps are regulated with different probes depending on the way of working. In cooling mode the evaporator probe is used (see the point above). In heating mode the regulation probe is fixed and is “Tout Condenser1”.

## 5.3 Temperature regulation types

The following regulation types are available and set through the rEt parameter.

### 5.3.1 Proportional regulation (rEt=P)

**Group1: rEG – Regulation**
**Group2: PID –PID regulation**

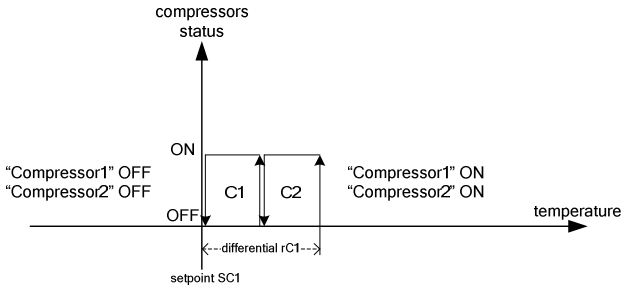
It is a proportional regulation with aside band.
A regulation band (or differential) is defined aside the setpoint, rC1 in cooling mode and rH1 in heating mode, inside of which the controller establishes its action entity proportionally to the position of the regulated value inside the band itself.

**Compressors steps management**

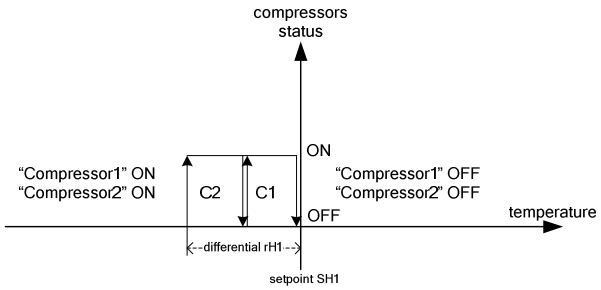
The number of regulation steps is calculated starting from the configured number of compressors H6 and eventual unloaders per compressor H7 in the following way:

- Total number of compressors results from H6*H2*H1, that is the number of compressors per circuit H6, multiplied by the number of circuits per evaporator H2 and by the number of evaporators H1.
- Total number of unloaders results from the multiplication between the total number of compressors and the number of unloaders per compressor, H7.
- Total number of load steps results from the total number of compressors plus the total number of unloaders.

The regulation band is equally divided among all the steps as per the figure below.




Regulation diagram for 2 compressors units in cooling mode




Regulation diagram for 2 compressors units in heating mode

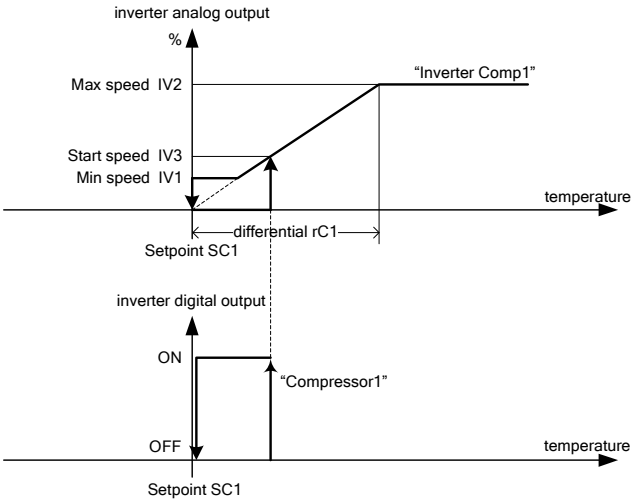
The digital output used to control compressors are "Compressor1", ..., "Compressor8". For unloaders are "Comp1 Unloader1", ..., "Comp8 Unloader8".

### Compressors with inverter management

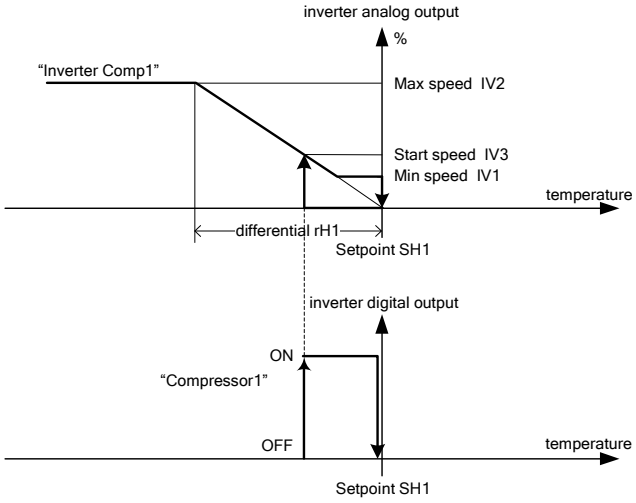
### Group1: CMP – Compressors

### Group2: INV – Inverter

The "Inverter Comp1" analog output and "Compressor1" digital output are used to drive an inverter.
It is assumed that the inverter is connected to the first compressor and when the inverter management is enabled with IV0=YES, the "Compressor1" digital output becomes the output used to eventually switch ON/OFF the inverter.
You have to define with IV1, IV2 and IV3 parameters the values in percentage corresponding to the inverter minimum, maximum and start speed; within this values the proportional action of the analog output is calculated as described in the figure below for both heating and cooling mode.



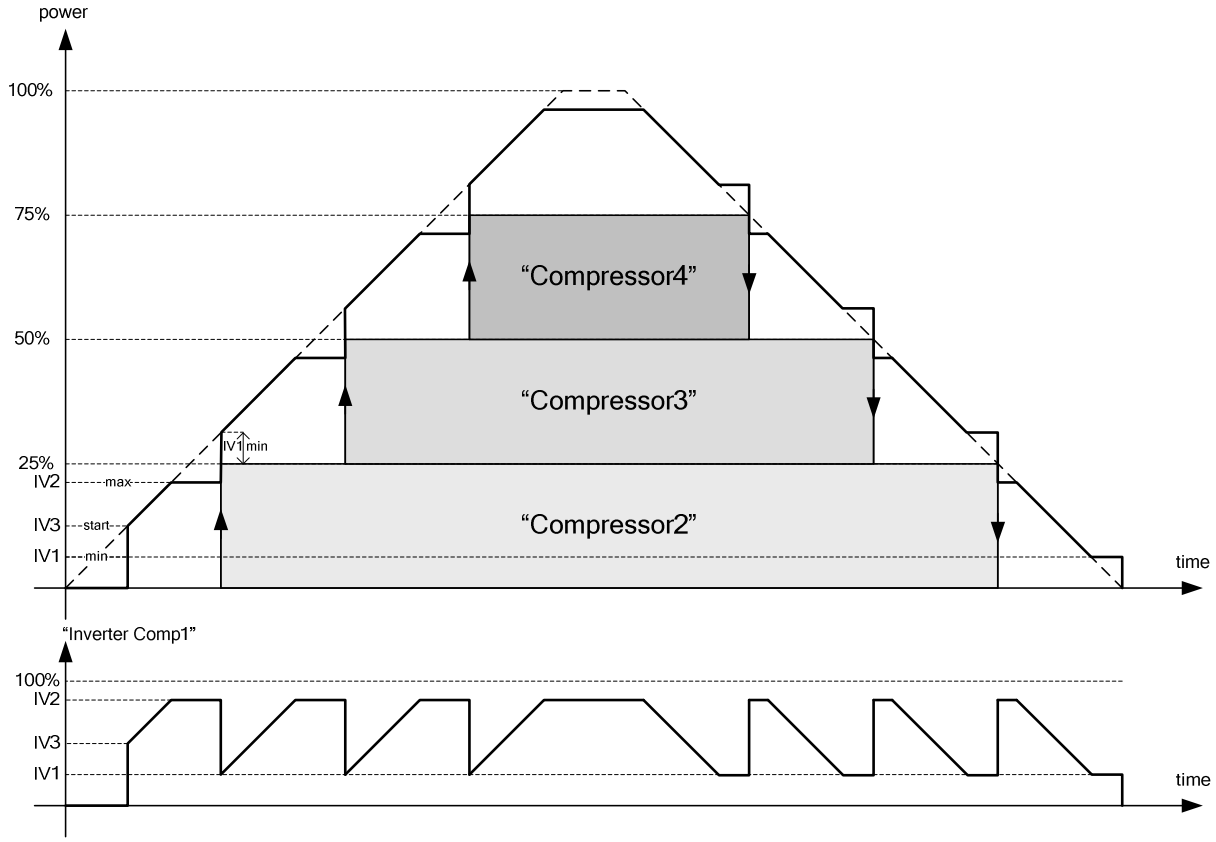

Regulation diagram for compressor with inverter units in cooling mode




Regulation diagram for compressor with inverter units in heating mode

The inverter output is activated at start speed IV3 when the cooling or heating requested power is equal or greater than the power obtained with the inverter at that speed.
Through IV4 also a minimum inverter ON time is defined. Till this time has not elapsed, the inverter will maintain its minimum speed even if it is requested to turn OFF.

When other compressors are present besides the one driven by the inverter, then the inverter is used to supply the lack of power. In any case, the power supplied will always remain below the requested one.
Compressors are assumed to have the same power.
In the below figure has been described a situation with 4 compressors, the first one with inverter management.



### 5.3.2 Proportional + Integral regulation (rEt=PI)

**Group1: rEG – Regulation**
**Group2: PID – Reg PID**

To eliminate the steady-state error typical of proportional control in order to obtain a more precise regulation, an integral regulation can be added to the proportional one (P+I). In this way it's also possible to take in consideration the time when the regulated value is far from the setpoint.
Once activated the P+I regulation, the controller increase or decrease the integral error time after time, adding it to the proportional error: the result is to gradually bring the equilibrium point near to the desired setpoint, overcoming situations of stalemate in which the steady-state error is constant, typical situation of proportional controls only.
The characteristic parameter to set is the integral time Ki (rin parameter), whose value settles the reaction speed of the P+I regulation (the lower the integral time, the faster the response of the control). The integral time is defined as the time to be elapsed for making the integral error become equal to the proportional error, with a constant proportional error.

It is possible to enable with rC2 the gradual reduction of the integral error once reached and exceeded the setpoint. The error integral in fact tend to keep the compressors turned on even if the proportional part of the error would require the shutdown. The amount of reduction is proportional to the distance from the setpoint considering the rC3 band. For example, in cooling, the reduction is zero when the control temperature is equal to the setpoint; the reduction is greatest when it is equal to setpoint-rC3.

### 5.3.3 Dead zone regulation

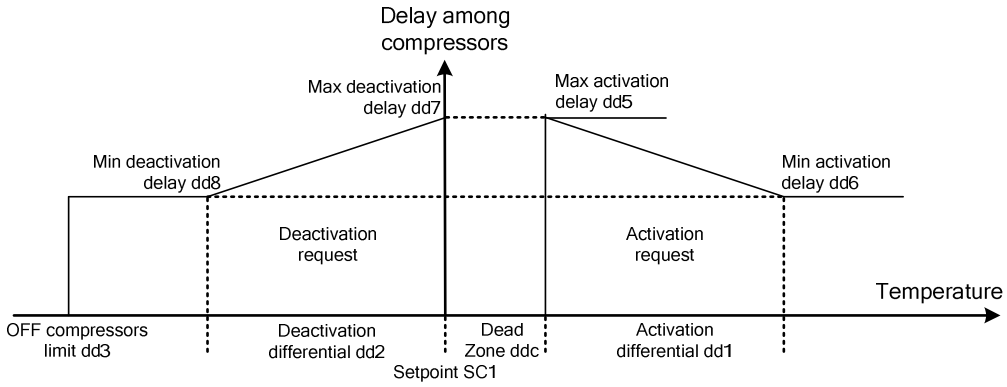
**Group1: rEG – Regulation**
**Group2: ddz – Dead zone**

It is a variable time regulation mainly used when the regulated value is the temperature of the fluid leaving the evaporator.
A dead zone ddC is defined inside which no regulating action is taken.
Outside the dead zone, compressors are activated following a variable time logic described below.

**Compressors steps management in cooling mode**

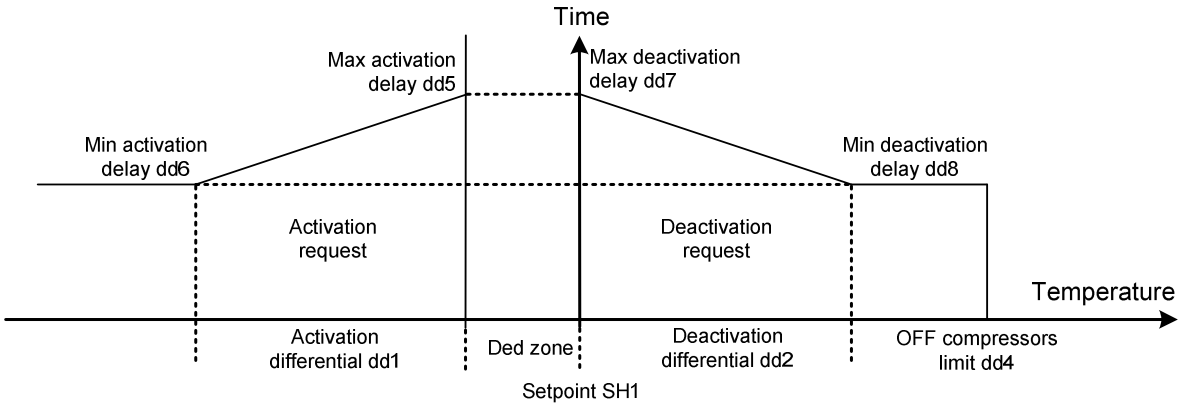
The delay between compressors activations varies between a maximum value dd5 and minimum value dd6 proportional to the temperature position inside the regulation band defined by the activation differential dd1.
Above setpoint + dead zone + activation differential, the delay among activations is equal to the minimum.

Similar action for the delay among compressors deactivations, which can varies between a maximum value dd7 and a minimum value dd8 proportional to the temperature position inside the regulation band defined by the deactivation differential dd2.
Below setpoint-differential, the delay among activations is equal to the minimum value, dd8, up to a limit threshold, dd3. Below that, all the compressors are immediately switched OFF to avoid the unit ice alarm.




**Compressors steps management in heating mode**

Analogous to the cooling management (see the figure below).
Specific parameters are defined for the dead zone ddH and for the maximum temperature limit dd4. Above that limit compressors are forced OFF in order to avoid excessive heat production.




## 5.4 *Limitazione della potenza (Modalità "Emergency")*

Involved parameters:
**Group1: rEG – Regulation**
**Group2: EEr – Emergency Mode**
Er1 - Maximum demand in emergency mode

Emergency mode is available on non heat pump units (H40=0) and it works as following:

» if Er1 >= 0 and the digital input "EEr – Emergency" is active, then the maximum demand of unit is upper limited by the parameter Er1.
» if Er1 < 0 and the digital input "EEr – Emergency" is active, then the maximum demand of each compressor is upper limited by 100-Er1%

# 6 Compressors

Through H6 parameter, it's possible to set up the number of compressors per each circuit. Considering this parameter and the number of circuits (H1*H2), it's possible to define the total number of compressors.
Some other parameters must be set up to activate and configure the here below functions.

## 6.1 Rotation

**Group1: CMP – Compressors**
**Group2: CFG – Set up**

The compressor calls are rotated (C01) in order to balance the number of compressor run hours and start-stop among the units.
Rotation is performed among compressors only, and not among load steps. If the compressor elected by the rotation algorithm to be the next to start or stop can't do it because of its protection times, it is substituted by the next one.
The available rotation types are:

» C01=LIFO (LastInFirstOut) or not enabled rotation; it means that the first compressor to start will be the last to stop.
start: C1, C2
stop: C2, C1
» C01=FIFO (FirstInFirstOut); it means that the first compressor to start will be the first to stop.
start: C1, C2
stop: C1, C2
» C01=tIME. Running hours control; the compressor to start is the one with the lowest number of run hours; the compressor to stop is the one with the highest number of run hours.

NOTE. The resolution of one second is used for the measurement of the running time. The storage of this time in non volatile memory takes place every 5 minutes. To reset the hour counter parameter, see the paragraph "6.4 - Hour counter".

If a compressor stops due to an alarm, another compressor will immediately start.

## 6.2 Load step management

**Group1: CMP – Compressors**
**Group2: ULd – Load steps**

Unloading a compressor means sharing the power load in several stages.
NOTE. From here after, when we will talk about switching ON or OFF an unloading valve, it'll mean to increase or decrease the number of load steps, independently from the unloading valve working logic.
To manage the load steps you have to set the number of load steps per compressor (H7) and the following parameters:

» Start delay C06 among unloaders or between the compressor's activation and its load step. It avoids the compressor's activation at full load.
» the way of switching ON compressors with load steps C04. If it is set to **Cp,** the software gives priority to the complete start of each single compressor; otherwise if it is set to **CCp** or **CCp1,** the software switches ON first all compressors and then all the load steps of one compressor (CCp) or alternated (CCp1).
E.g. in a system made of 2 compressors and 2 load steps, p11 and p12 are the load steps 1 and 2 of compressor 1 and p21 and p22 are the load steps 1 and 2 of compressor 2.
If C04=CCp the activation sequence is C1 C2 p11 p12 p21 p22.
If C04=CCp1, the activation sequence is C1 C2 p11 p21 p12 p22.
» the way of switching OFF compressors with load steps C05. If it is set to **ppCC,** during the compressor switching OFF phase, first are switched OFF all the load steps and then the corresponding compressors. This is useful when you need to limit the OFF numbers (and thus the ON numbers) of compressors, in order to save their life. If it is set to **pCpC**, during the compressor switching OFF phase, the complete OFF of the single compressor is privileged, in order to more frequently alternate the switched ON compressors.

NOTE. The unloading valve working logic between Normally Close (N.C.) and Normally Open (N.O.), i.e. if valves are energized or not when the compressor is at full load, is defined at the physical output configuration phase. If polarity is set to "Open" (as by default) it means that unloaders are energized at full load.

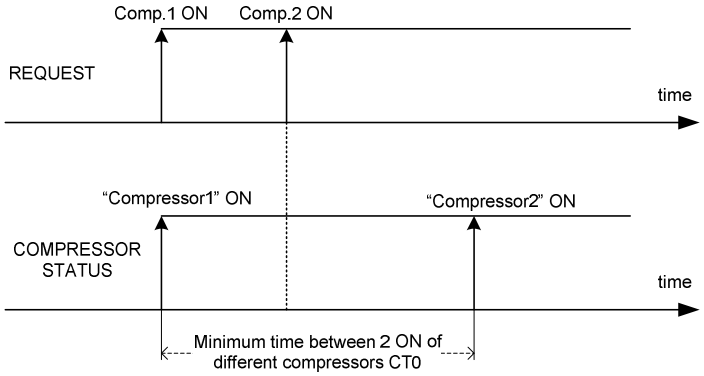
## 6.3 *Compressor delay times*

**Group1: CMP – Compressors**
**Group2: TIM – Times**

The programmable delay times that are used in the algorithm for the management of compressors and load steps have the purpose to ensure the compressor good working, and to increase their life time.
When one of this delay times is active, the icon on the display corresponding to the delayed element flashes.
The managed times are:

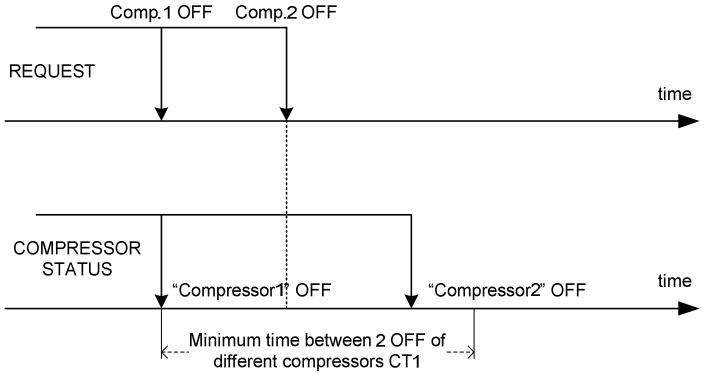
### CT0 - Minimum time between 2 ON of different compressors

It sets the minimum time that must elapse between two starts of different compressors, in order to reduce the peak of current drawn at power up.



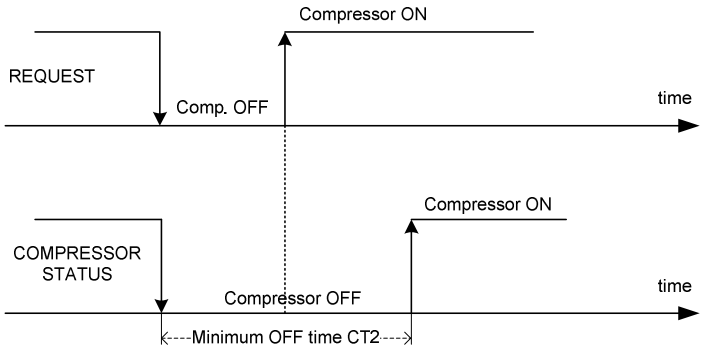

### CT1 - Minimum time between two OFF of different compressors

It sets the minimum time that must elapse between two stops of different compressors, in order to reduce the number of stops per hour.



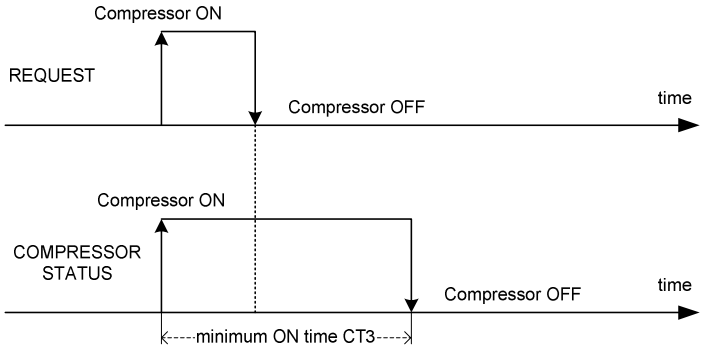

### CT2 - Minimum OFF time

It sets the minimum OFF time of a compressor. Compressor will not be able to start till the configured minimum time since the last OFF has elapsed.



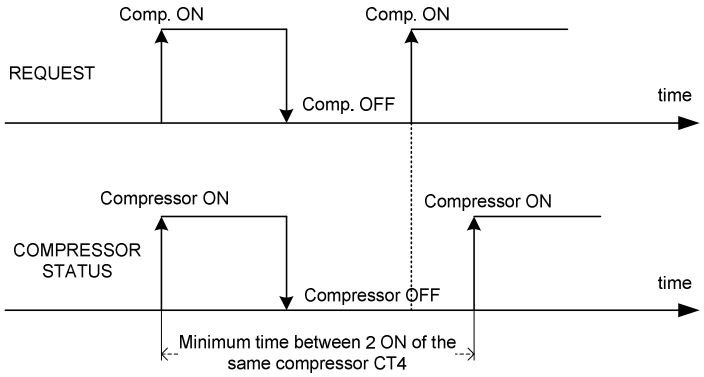

### CT3 - Minimum ON time

It sets the minimum ON time of a compressor that, once activated, must stay ON for the configured time even if it is no more requested. It's useful, for instance, to avoid lubrication problems.




### CT4 - Minimum time between two ON of the same compressor

It sets the minimum time that must elapse between two successive starts of the same compressor.
This parameter allows to limit the number of compressor starts per hour. For instance, if the maximum number of starts per hour allowed is equal to 10, it is enough to set CT4=360 seconds (6 minutes) to guarantee the limit respect.
If by mistake it is lower than the sum of the minimum ON and OFF time, it will be ignored.

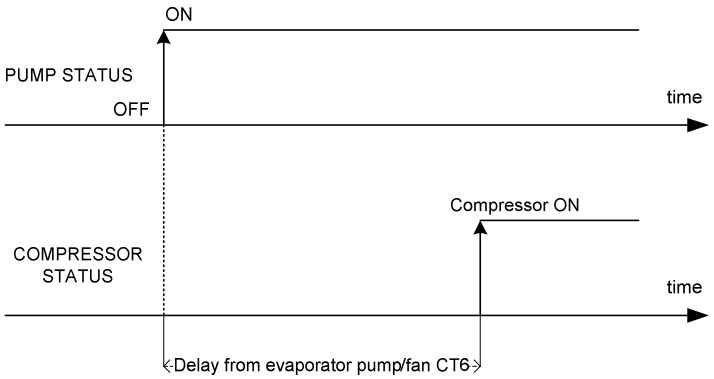



### CT5 - Maximum difference on running hours

It sets the maximum ON time of a compressor, but calculated from when there is another one OFF. The purpose is to avoid that one of the compressors could run more than the configured time while another one is OFF. Elapsed this time, the running compressor is switched off even if it should go on running and it is substituted by one of the compressors being previously OFF having the lowest number of running hours.
It takes effect only if rotation type is based on running hours (C01=tIME)

### CT6 - Delay from evaporator pump/fan

The compressor start is enabled after the configured time from the activation of the water main pump (or supply fan).




## 6.4 Hour counter

**Group1: CMP – Compressors**
**Group2: CHr – Run hours**

To evaluate the compressor condition, the control monitors its run hours (see "3 - User interface" paragraph). The limit to be monitored is defined in C50; if the compressor running time exceeds it, then the control will generate the warning H01, ..., H12, indicating the need for compressor maintenance.
It is possible to clear hour counters by menu (see "3.4.10 Hour Counters"). Clearing the hour counters you reset also the timer used for counting the rotation times when is selected the rotation type based on running hours.

## 6.5 Compressors enable

**Group1: CMP – Compressors**
**Group2: CEn – Enabling**

It is possible, through C71, ..., C82 parameters, to temporary disable each compressor. It's useful in case of service.

# 7 Liquid solenoid valve and pump-down

**Group1: CMP – Compressors**
**Group2: LVA –Liquid Valve**

It is used:

- one Digital Output to drive one liquid solenoid valve for each circuit (“Liquid Valve C1”, “Liquid Valve C2”)
- one low pressure switch (“LP Circuit1”, “LP Circuit2”) or suction pressure transducer (“SuctionPress C1”, “SuctionPress C2”) for each circuit.
- one digital input for each circuit (“Manual Pump Down C1”, “Manual Pump Down C2”) to manually activate the pump-down

NOTE. If the transducer for suction pressure is not present but there is only the transducer for the discharge pressure, in heating mode (on heat pumps with gas changeover) that is also used to control the pump-down.

## *7.1 Start-up*

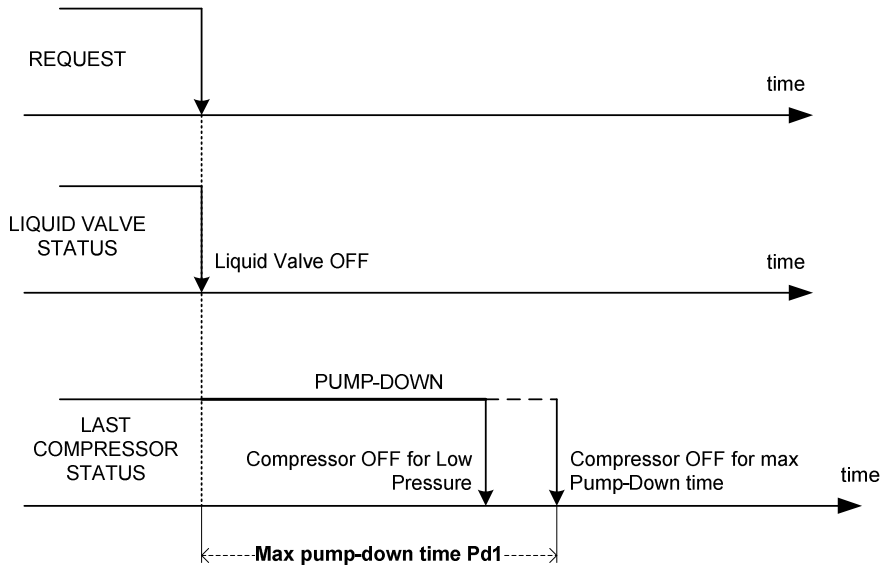
When the temperature control requires to start the first compressor of each circuit, this is the sequence:

- open the liquid valve
- wait until start-up timer Pd2 has elapsed or until suction pressure is above initial start pressure set point Pd3 (whatever comes first). This is to start before the suction pressure rise to a level where the gas turn into liquid.
- start first compressor

## *7.2 Pump-down*

If the pump-down function is enabled (maximum time Pd1 different from 0), when the temperature control requires the last H7 compressors of the circuit to be OFF or the digital input for manual pump-down is active, the liquid valve is closed and the H7 compressors keeps running. The compressors will stop for the following reasons:

- low pressure switch, or
- the suction pressure is below pump-down pressure set Pd4, or
- the pump-down maximum time Pd1 is elapsed.




NOTE.
1) Pump-down is not executed in case of OFF for alarm.
2) If suction pressure signal is missing, the suction pressure criteria's will be ignored.

# 8 Electronic Expansion Valve

The algorithm is able to manage up to 2 electronic expansion valve, model type EXD316.
It is managed one valve per circuit.

## 8.1 Connection

Connect the valve drivers to MCX using the CAN bus.
Refer to the specific document on how to connect the valve drivers to the MCX.

## 8.2 Configuration

**Group1: Exd – EXD Parameters**
**Group2: Add – Can Address**
The software manages a number of valve equal to the number of circuits (H1 * H2).
Through the ex1 parameter, set the CAN address of the first EXD driver connected.
The CAN address of the other EXD drivers, if any, must be consecutive to the first one and without gaps.
Refer to the specific document on how to set the CAN address on the EXD drivers.

If ex1 is set to 0, no EXD driver is managed. If ex1 is different from 0 and there is no driver connected having that address, an alarm is generated. See “15 Alarms”.
We suggest to set ex1 to 20 as it is the default address of the EXD drivers.

## 8.3 Alarms

A set of alarms is managed for each valve. See “15 Alarms”.

# 9 Heaters

## 9.1 Heaters in cooling mode: anti freeze control

### 9.1.1 Configuration

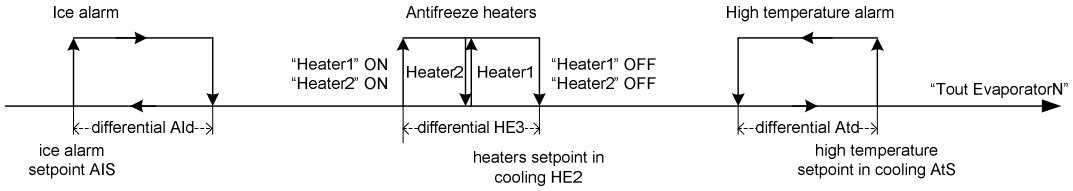
**Group1: HEA – Heaters**
**Group2: CFG – Configuration**

Anti freeze control is active on those units where water is the chilled fluid (H3=H2O) and it is made on the outlet probe of each evaporator “Tout Evaporator1”, “Tout Evaporator2”. It has the purpose to prevent evaporator icing.
On those units where air is the chilled fluid (H3=Air), heaters doesn’t have anti freeze function but they prevent to exceed the limit of low supply air temperature A07. In this case the control probe used is “Tout Evaporator1”, even if there is more than one evaporator.
By parameter HE1 you can configure if the activation of any heater on any circuit causes the shut OFF of all the active cooling elements (always respecting their delay times), while the pump keeps on running to reduce the ice danger.

### 9.1.2 Regulation

**Group1: HEA – Heaters**
**Group2: rEG – Regulation**

Anti freeze control consists in switching ON the anti freeze heaters on the affected evaporator, using the “Heater1”, ..., “Heater4” digital output, when the temperature measured by the probe on the evaporator output “Tout Evaporator1”, “Tout Evaporator2” goes below the configured limit HE2 as described in the following figure in case of 2 heaters.




### 9.1.3 Ice alarm

On water chillers (H3=H2O) we talk about ice alarm; otherwise (H3=Air) about low air temperature alarm.
There is a limit AIS and a differential AId for the circuit ice alarm (AE1, ..., AE4) different from the one for the heaters management (see figure).
It is delayed from the start up of the main pump by the AI1 time in cooling and AI2 time in heating, to provide the unit with enough time to move all the cool fluid, avoiding stops
The reset type is configurable through AIr (see “12 - Alarms”).

If the unit is OFF, the alarm condition is monitored anyway (this setting is changeable only by configurator; see “APPENDIX – Configurator usage” at the end of the manual) and through AI3 these are the possible actions:

» AI3=HOFF. No action, heaters OFF,
» AI3=HON. Only heaters ON, up to the exit of the ice alarm conditions,
» AI3=HPON.Heaters and pump ON, up to the exit of the ice alarm conditions.

### 9.1.4 High temperature warning

There is a limit AtS and a differential Atd for the high temperature warning in cooling A09, monitored by any of the evaporator outlet probes “Tout Evaporator1”, “Tout Evaporator2”.
It is delayed of 60 seconds at start up and it is activated only if there is at least one compressor ON.

## 9.2 Heaters in heating mode

### 9.2.1 Configuration

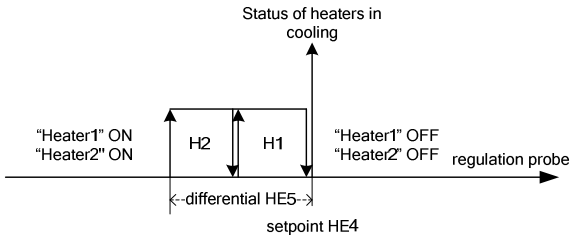
**Group1: HEA – Heaters**

**Group2: CFG – Configuration**
Heaters that are used for anti freeze in cooling mode, are used as auxiliary heaters in heating mode. On air heat pumps (H3=Air, H9=Air) they can be used to reduce the cold air flow during defrost.
Heaters are controlled from the probe used for regulation.
Through the HE1 parameter it is defined if compressors must be turned OFF (always respecting their delay times) when a heater is activated in any of the present circuits.

On water cooled (H9=H2O) refrigerant changeover heat pumps (H40=GAS) there is the management of the ice alarm on the external heat exchanger in heating mode (evaporator): the ice probe becomes the one on the external heat exchanger ("Tout Condenser1", "Tout Condenser2") and the alarm setpoint AIS is the same as in cooling mode.

### *9.2.2 Regulation*

**Group1: HEA – Heaters**
**Group2: rEG – Regulation**
Heaters management in support or during defrosts is performed as follows. Heaters are turned ON using the "Heater1", ..., "Heater4" digital output, when temperature measured by regulation probe enters in the area defined by setpoint in heating HE4 and differential HE5, as described in figure in case of 2 heaters.




## *9.3 **Boiler***

**Group1: HEA – Heaters**
**Group2: rEG – Regulation**

**Group1: ALA – Alarms**
**Group2: HTb – HT boiler**
Boiler heaters "Boiler1", ..., "Boiler4" are turned ON when temperature measured by regulation probe enters in the area defined by the active regulation setpoint in heating (SH1) and differential rH1.
They are in alternative with the heat pump, not in addition.
Boiler heaters can be activated only if the measured temperature by the "BoilerSafety" internal probe is under a specific safety limit AbS. If it is overcome, alarm A14 is generated.
To reset the alarm there is a constant differential Abd of 2 degrees to be considered.

# 10 Evaporator water pump/fan

When water is the cooled fluid (H3=H2O), then we talk about evaporator water pump. In case of air (H3=Air), we talk about evaporator fan.
On both cases the “Evap Pump1” digital output is used to drive the pump/fan. When the number of pumps H4 is equal to 2 (for water chiller only), also the “Evap Pump2” output is used to drive a second pump (see the next chapter). For air units, on the contrary, H4 must be set to 1 because software is able to manage only one evaporator fan.

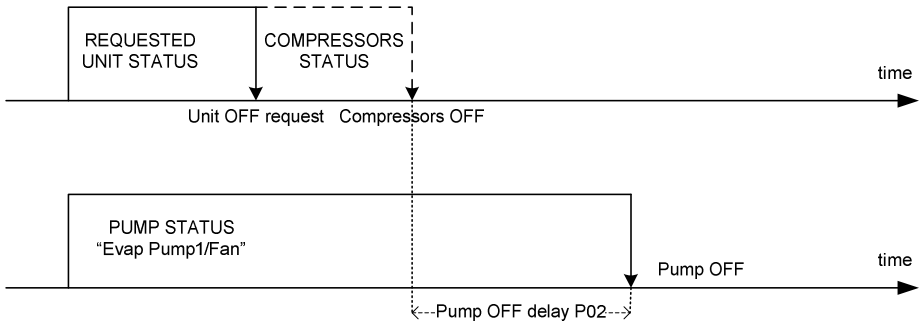
The evaporator water pump functioning, here below described, is valid for the evaporator fan too.
According to P01 parameters these are the possible pump way of working:

- P01=OFF. No regulation.
- P01=ON. Pump always ON. It is switched OFF only when the unit is OFF.
- P01=ON_C. Regulation activated on regulator call.
  The pump functioning is ON/OFF and it’s only subordinate to the compressors functioning: pump is switched ON when cooling is requested; pump is switched OFF when all compressors are OFF.
- P01=brSt. Regulation activated on regulator call and intermittent working when not requested.

Generally, the pump will be never switched OFF if all the compressors won’t first.

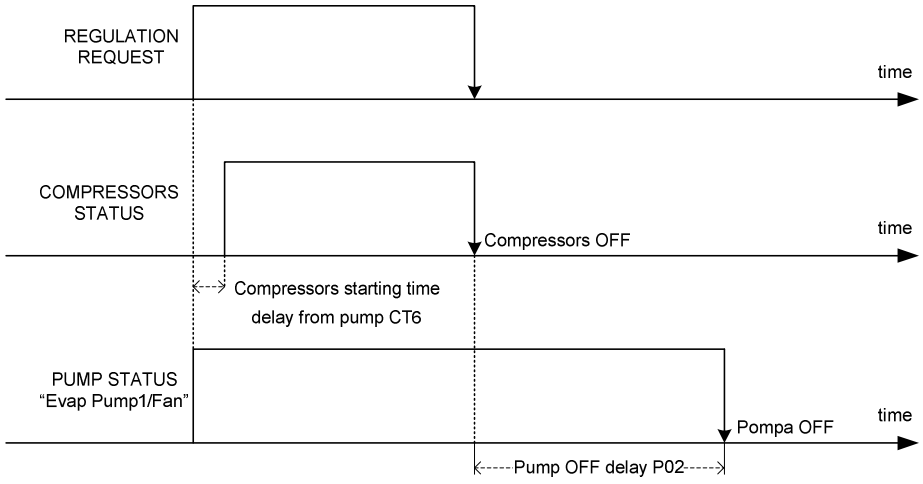
### Mode P01=ON: pump always ON

Pump functioning is prior to all the controls.
The pump will be activated as soon as the equipment will.
The pump will be switched OFF after a programmable delay P02 from the compressors switched OFF (with unit OFF).



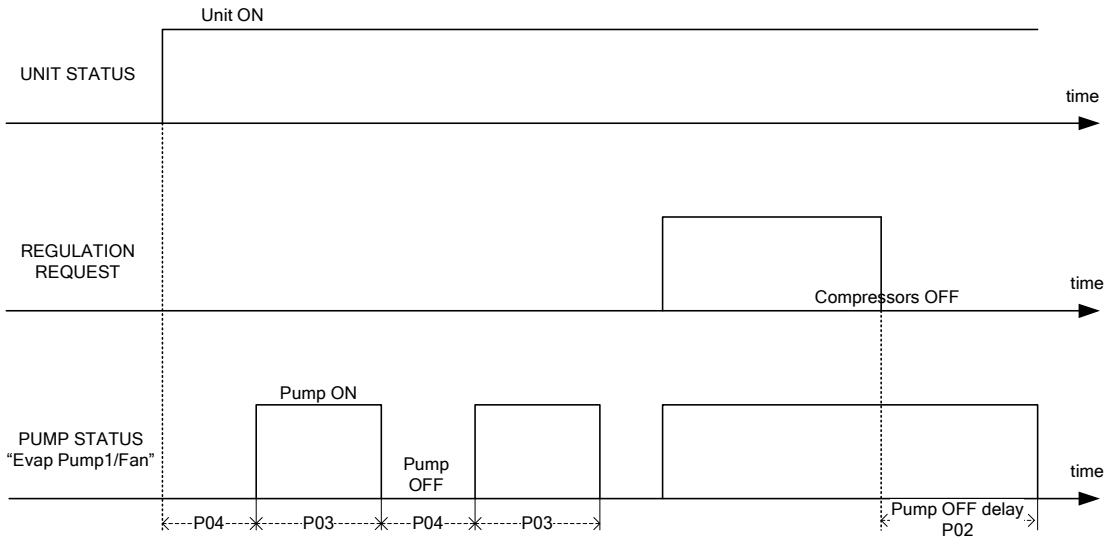

### Mode P01=ON_C: Regulation connected to the compressors functioning

The pump is switched ON or OFF based on regulation need. Deactivation is delayed by a programmable time P02 from compressors OFF.



**Mode P01=brSt: intermittent working**

When cooling isn't requested or the unit is OFF, the pump is activated with ON and OFF regular intervals, independently from compressors, as per two parameters: pulse ON time P03 and pulse OFF time P04.
When cooling or heating is requested, evaporator circulation water pump and compressor management is like P01=ON_C therefore activated on regulator call.
At the unit start, the pulse OFF time P04 has to be waited before to activate the intermittent working.




## 10.1 Evaporator twin pumps control

**Group1: EVA – Evaporators**
**Group2: P2 – Second pump**

If a second evaporator pump is present, through P21 parameter you can decide the management among the following ones:

» P21=bUP. Emergency pump.
The second pump will occur only if flow switch alarm A03 or main pump thermal overload alarm A05 are present; in that case the pumps will be rotated and the A08 warning is generated. If the alarm goes back, the unit will continue to function with the second pump. When the next alarm happens, the pumps will be rotated again. See "12 – Alarms" paragraph about the functioning when alarm persists.

» P21=Strt. Rotation to each restart.
One pump takes the place of the other one to each restart (in intermittent working mode too).

» P21=HOUr. Constrained rotation over a time limit threshold.
One pump takes the place of the other one after P22 time, which is the maximum run hours limit for forcing rotation.

In case of alarm for the operating pump (flow switch or thermal overload alarms), the second pump will occur as emergency pump mode, independently from P21.

## 10.2 Hour counter

**Group1: EVA – Evaporators**
**Group2: PHr – Run hours**

To evaluate pumps condition, the control monitors the run hours of the first and second pump (see "3 -User interface" paragraph). Once the limit to monitor has been fixed in P50, if the pump functioning time exceeds it, then the control will generate A10 or A11 warning, indicating the need for pump maintenance.
It is possible to clear hour counters by menu (see "3.4.10 Hour Counters").

# 11 Condenser fans/pumps

In the air cooled units (H9=Air), the condensing regulation is achieved by the management of the condenser battery fans. These fans can be controllod also by the freecooling function, see “12 Water free-cooling”.
In the water cooled units (H9=H2O), the condensing regulation is achieved by the management of the water pump on the condensing circuit.
In both cases it is possible to configure if a sensor is used for regulation and its type (defining if it’s a temperature or pressure regulation).

## *11.1 Air condensing unit*

In the air cooled units, the number of fans (or more precisely the number of steps, as fans could be grouped together in parallel) for each battery must be set in H10.

The digital output used for condensing step control are “Condenser Fan1”, “Condenser Fan2”, ..., Condenser Fan8”.
The output used to drive possible inverters are the “Inverter Cond1”, “Inverter Cond2” digital output to activate the inverter and the analog output “InverterFanCond1”, “InverterFanCond2” to drive them.

The number of used output is calculated as follows.
If fans are in common to all condensers (H11=NO) the following output are controlled:
» as many digital output as circuits/condensers are (H1*H2) multiplied by the number of fans per condensing circuit H10;
» as many analog and digital output for fan speed regulation as circuits/condensers are (H1*H2).

If fans are not in common to all condensers (H11=YES) the following output are used:
» as many digital output as the number of fans per condenser H10, thus not multiplied by the circuits number.
» one analog output InverterFanCond1” and one digital output “Inverter Cond1” for fan speed regulation.

### *11.1.1 Way of working*

**Group1: CNd – Condenser**
**Group2: CFG – Configuration**
According to F01 parameters these are the possible ways for condensing regulation:
» F01=OFF. No regulation.
» F01=ON. Fans always ON. They are switched OFF only when the unit is OFF.
» F01=ON_C. Regulation connected to the compressors functioning.
The fans’ functioning is ON/OFF and it’s only subordinate to the compressors functioning: fans are switched ON to the maximum speed when at least one compressor, in the relative circuit, is active.
All compressors OFF = fans OFF after time F03.
At least one compressor ON = fans ON.
» F01=Prb. Regulation connected to a temperature or pressure sensor “DischargePress C1”, “DischargePress C2”.
The sensors are put in charge to regulate the condenser fans. The fans’ functioning is subordinated to the temperature or pressure sensor values and eventually to the compressors functioning. In fact, when the compressors are switched OFF, by F02 parameter is possible to define if the fans will be or not switched OFF after F03 time independently from the condensing temperature / pressure.
The number of used input is equal to the number of condensers H8.
In case of separated condensing circuits (H11=NO) each temperature/pressure sensors manage its own fan or group of fans.
In case of single condensing circuit (H11=YES) are used as many input as the condensers are, but regulation is performed on the one requiring the highest action to the controller (each analog input is then used for defrost control on heat pump units).
The regulation could be by steps or continuous as described in the next chapters.
F01=FtO Fan is regulated on 2 fixed speed based on the external temperature. If Tout<F22, speed is set to F20. If Tout>F22+F23, speed is set to F21

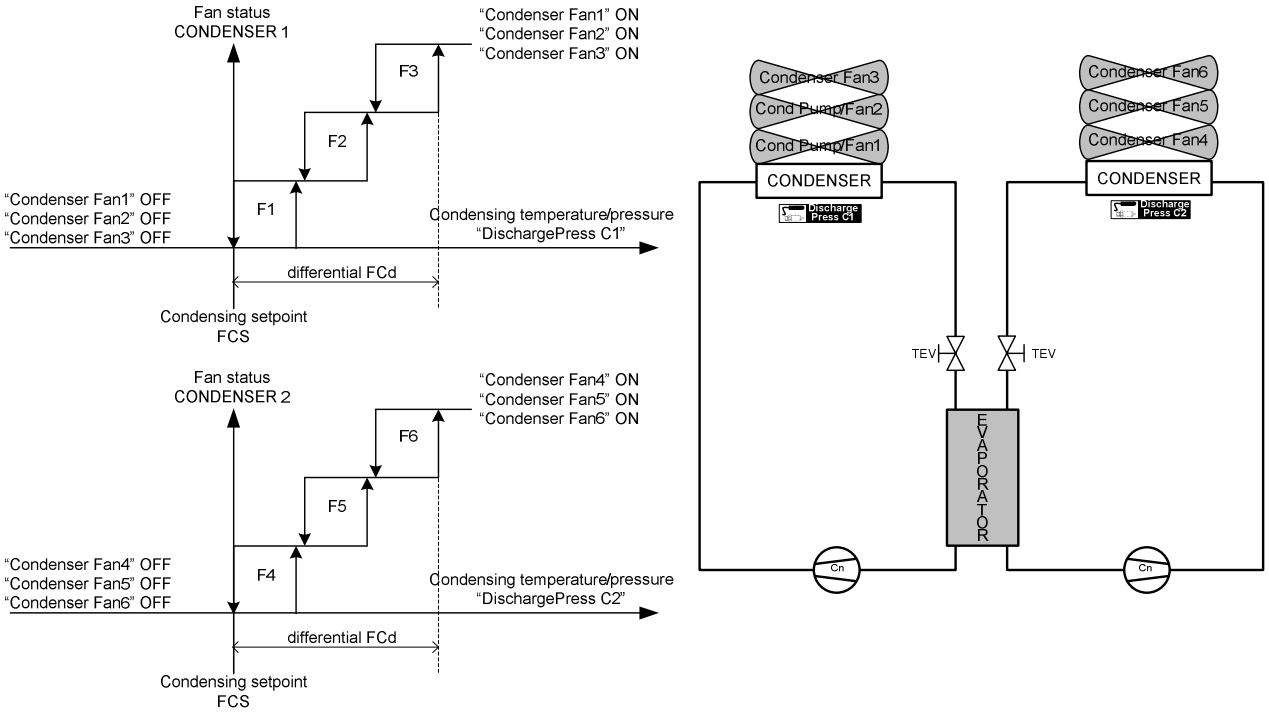
### *11.1.2 Step regulation in cooling*

**Group1: CNd – Condenser**

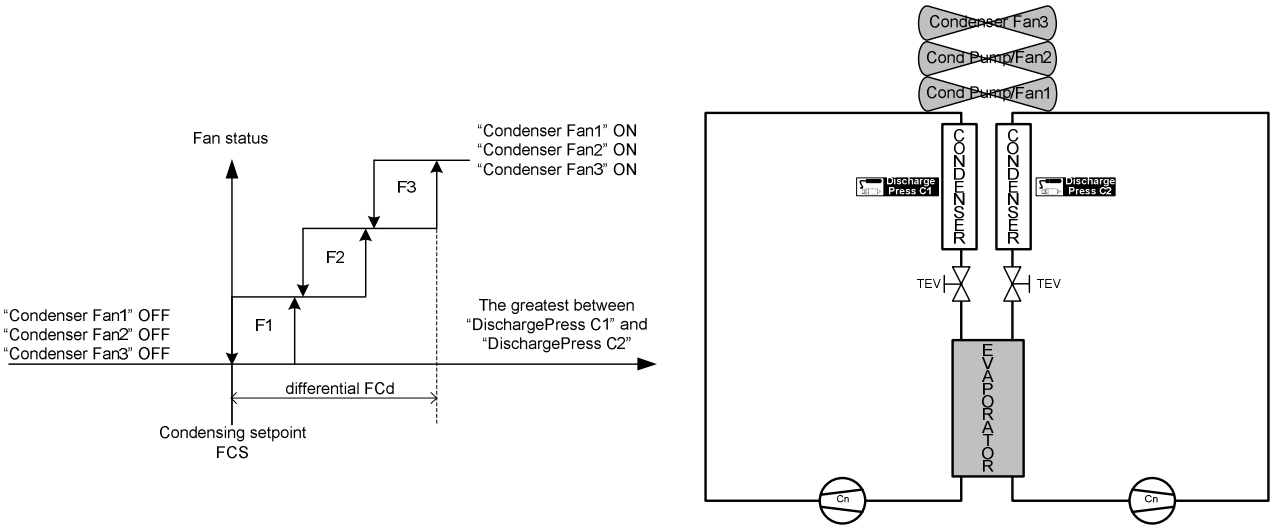
**Group2: FRG – Regulation**

Fans are driven in ON/OFF, depending on FCS setpoint and on FCd band or differential: that band is equally split among the fans of each condensing circuit.

In the following figure is represented the case of 2 condensers (H1*H2=2) with 3 fan steps each (H10=3) and separated fans (H11=NO).




In the following figure is represented the case of 2 condensers (H1*H2=2) with 3 fan steps each (H10=3) and fans in common (H11=YES).

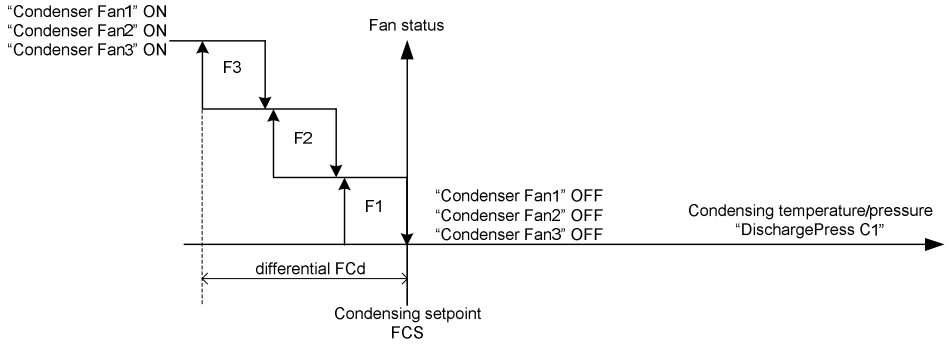



### *11.1.3 Step regulation in heating*

**Group1: CNd – Condenser**

**Group2: FRG – Regulation**

The management of fans in heating mode is analogous to the one in cooling mode. Fans are activated when the temperature on the external heat exchanger decreases.
All the related parameters are then duplicated, that are the setpoint FHS, differential FHd for control in heating.




### *11.1.4 Fan speed regulation*

**Group1: CNd – Condenser**
**Group2: FSR – Speed Control**

If enabled through F10 parameter, fan speed control is activated through one or more 0/10V analog output or PWM/PPM output (width/pulse modulation synchronous with the line) proportional to the request of pressure/temperature sensors. The output will drive an external inverter or phase-cutting device. Hereby we'll talk about inverter only.
The analog output "InverterFanCond1", "InverterFanCond2" are used to drive the inverter. The associated digital output "Inverter Cond1", "Inverter Cond2" are used to eventually switch ON and OFF the inverter.
The number of analog output is equal to the number of condensers, if H11=NO (separated condensing circuits). Otherwise the only "AIFanCond1" output is used.

In case of PPM or PWM output to manage an external device with triacs, it's necessary to set up 2 factors.
Those factors define the minimum F11 and maximum F12 inverter speed in percentage; between these two values is calculated the proportional action of the modulating output ad described in figure, for both cases of cooling and heating unit.
In case of a PPM output, it has to be set up even the pulse duration F19, which has to be applied to the triac.

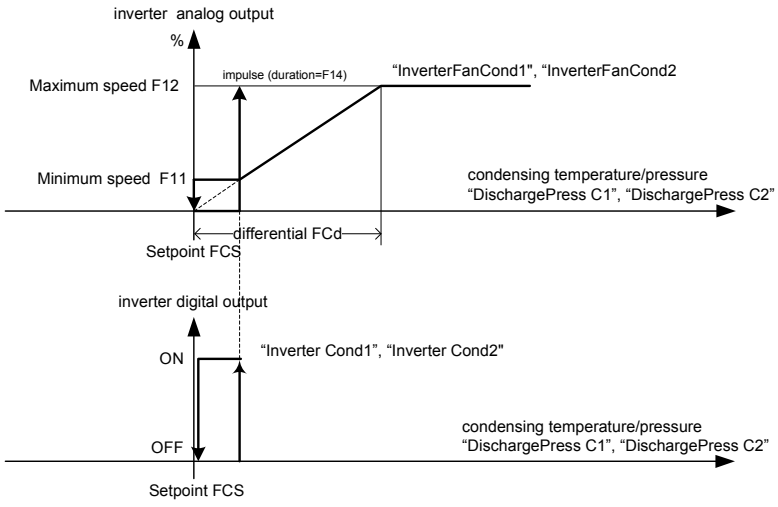



Diagram of condensing fan speed regulation in cooling

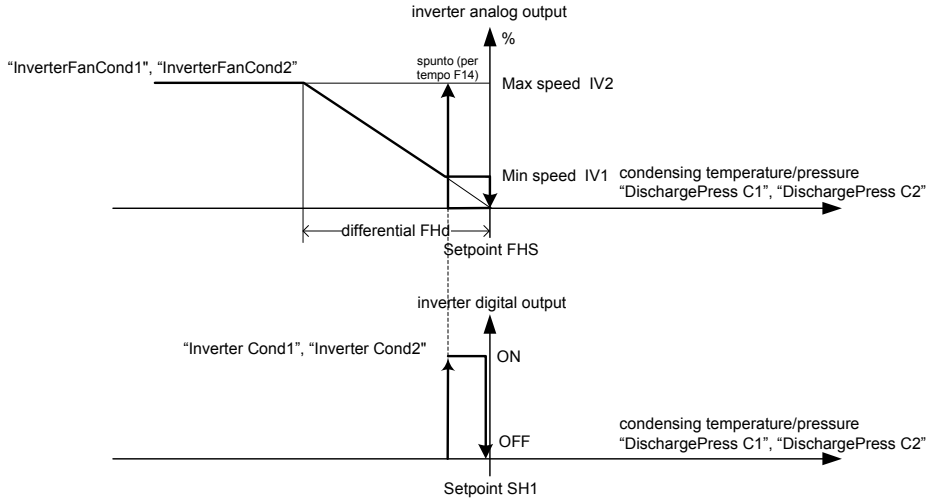



Diagram of condensing fan speed regulation in heating

The setpoint for inverter regulation is the same as the one used for step regulation.
The inverter output is activated when the requested power is greater or equal than the power obtained with the inverter at its minimum speed. The start speed is equal to the minimum speed if F14=0; otherwise through F14 the pulse time at start up is defined. During that time the inverter drives fans at their maximum speed.

### *11.1.5 Condenser probe fault*

**Group1: ALA – Alarms**
**Group2: COn – Cond probe fault**

In case of fail on the probe "DischargePress C1", "DischargePress C2" for the condensing control, the alarm on the condenser fans can change depending on the presence or not of the outside air temperature probe "Tout" (see also Alarms – analog input 1,...,16 alarm).
In case of fail on the condenser probe, through ACM it's possible to set up the following modes:

- ACM=OFF. Always OFF
- ACM=ON_C. ON if compressor ON
- ACM=Ftou. Connected to the outside temperature: in that case it's also possible to fix a setpoint ACS and a differential ACd.
  If the outside temperature is higher than the setpoint plus differential or the outside probe is not present or in error, then the fan will be forced to the maximum speed.
  If the outside temperature is lower or equal to the setpoint, then the fan will be forced to the 50% of the maximum speed.

## *11.2 Water condensing unit*

The condenser pump "Condenser Fan1" can be used in the same way as condensing fan.

## *11.3 High pressure prevention*

### *11.3.1 Parameters*

In order to prevent the alarm of high pressure a limit is defined, approaching which reduces the capacity of the compressor on the affected circuit.
We define the following parameters:
HPE – Enable HP prevention
To enable the HP prevention feature and to define its type (see "11.3.2 Operations").

HPs - High pressure prevention setpoint
High pressure threshold measured by Discharge Press C1, Discharge Press C2 input, above which the high pressure alarm prevention procedure is activated

HPd - High pressure differential

Band respect to HPs setpoint, outside of which the prevention procedure is disabled

HPt – End prevention delay
The pressure have to stay under HPs-HPd for this delay time, in order that the high pressure prevention procedure end.

### *11.3.2 Operations*

If HPE=Min, when the pressure exceeds the HPs threshold, the capacity required to the compressors present in the circuit is forced to the minimum (H7). Then the compressors decrease their capacity in respect of the timing, until they arrive to the minimum capacity, without switching off.
If HPE=time, when the pressure exceeds the HPs threshold, the capacity required to the compressors present in the circuit is gradually decreased till the minimum set by H7. The frequency of compressors deactivation is fixed (value changeable by code, file “AppDefine.c”)

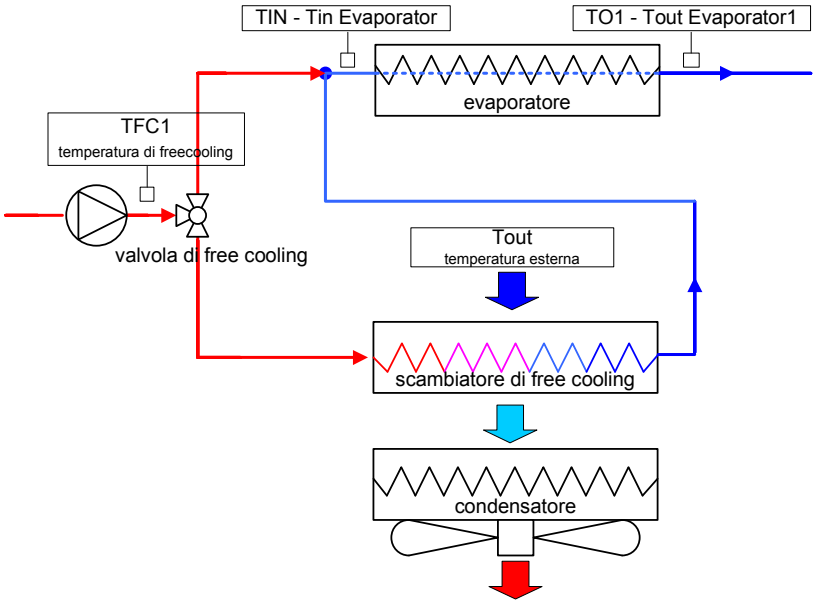
In both cases, the capacity is restored to what the regulation requires, only if the pressure decrease under HPs-HPd and stay under this value for a HPt time. If during the counting time the pressure goes above HPs-HPd, the count is reset.

# 12 Water free-cooling

## 12.1 Overview

**Group1: EVA – Evaporator**
**Group2: FRC – Freecooling**

The free-cooling regulation uses the favorable conditions of outside air temperature to contribute to the cooling water. It uses an additional coil (free-cooling coil) in which, through the free-cooling valve is deflected a certain amount of water returning from the plant if the outside air temperature conditions are favorable.
The free-cooling coil is located inside the machine upstream of the condensing coil, and with that share control of condensing fans.
The free-cooling management is active only in air / water units in cooling mode.
NOTE. In case of multiple evaporators and condensers, the free-cooling is handled only on the first evaporator and condenser.




## 12.2 Conditions of activation and deactivation of the free-cooling

### 12.2.1 Activation

The conditions of free cooling activation are:

- the free-cooling is enabled (parameter Fr0 other than NO) and the unit is an air/water machine in cooling mode,
- the water circulating pump is operating;
- the following condition which certifies the convenience of free-cooling is verified:
  TFC1 - Tout> = Fr1
- are not verified alarm conditions described in the following paragraph.

### 12.2.2 Deactivation

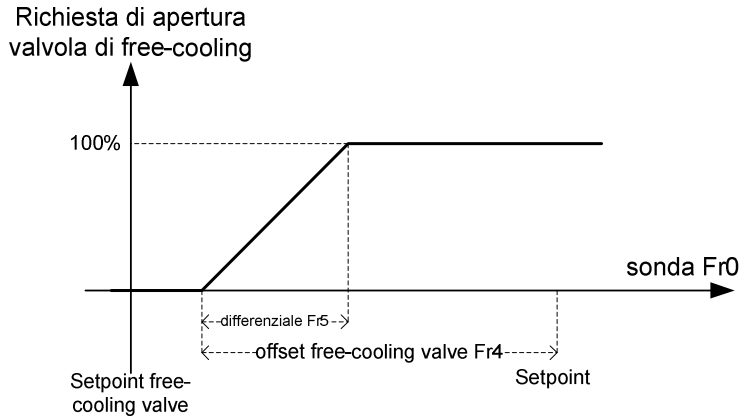
The conditions of free cooling deactivation are:

- the free-cooling is disabled (parameter Fr0 = NO), or the unit is not an air/water machine, or it is in heating mode;
- the water circulating pump is not operating;
- the free-cooling condition is no more active:
  TFC1 – Tout < Fr1 – 1,5°C
- anti freeze heaters are active;
- any of the following alarm conditions occurred:

antifreeze alarm, serious alarm from digital input, pump overload alarm, evaporator flow alarm, fault of regulation probe, anti freeze probe, free-cooling probe, outside temperature probe.

## 12.3 Free-cooling valve management

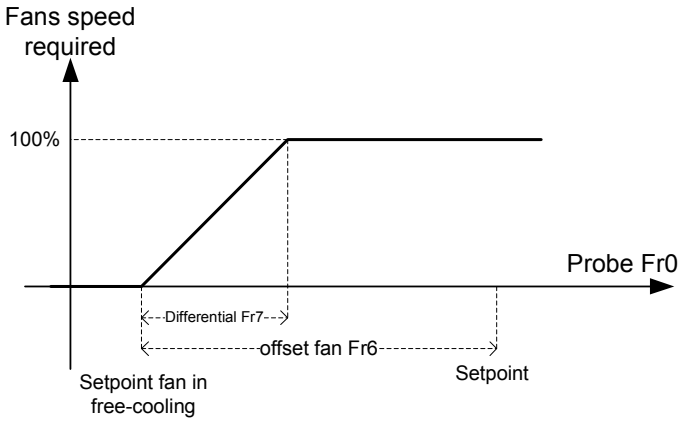
The control is based on temperature detected by the probe selected with Fr0 between the evaporator inlet probe "TIN - Tin Evaporator" (Fr0=Tin) or outlet probe "TO1 - Tout Evaporator1" (Fr0=Tout).
The set point to control the valve corresponds to that of water decreased by the offset Fr4.
The control is proportional with band Fr5.




The analog output for the free-cooling valve "FV1 - "FreecoolValve" follows the request.
The digital output for the free-cooling valve "FV1 - Freecool Valve" is active at 100% and is not active at 0% of the request.

## 12.4 Fan management in free-cooling

The fans are shared between the control of free-cooling and condensation. Priority is set through parameter Fr9.
If Fr9=Cond, in the event of start of one or more compressors the priority is given to condensation control. Fans are controlled as described in "11 Condenser fans/pumps".
If Fr9=FrEE the priority is given to freecooling control.
If Fr9=GREA (greatest) the priority is given to the greatest request.
When there is not demand for condensation control (compressor off), or when priority is given to freecooling, the control of free-cooling fans is based on temperature detected by the probe selected with Fr0 between the evaporator inlet probe "TIN - Tin Evaporator" (Fr0=Tin) or outlet probe "TO1 - Tout Evaporator1" (Fr0=Tout).
The set point to control the fans corresponds to that of water decreased by the offset Fr6.
The control is proportional with band Fr7.




The analog output for the fan on the first condenser "Fc1 - "InverterFanCond1", follows the request if enabled by F10 = YES.
Fan steps "FC1, ..., FC8" share equally the control band Fr7.

## 12.5 Compressors and free-cooling

### 12.5.1 Only free-cooling

Beyond the threshold of free-cooling activation, a second threshold Fr2 is managed for the outdoor temperature below which you can force the shutdown of the compressors because the conditions are so favorable to satisfy the cooling demand of the plant with the sole management of free-cooling.
Therefore if the compressors are running and if the condition Tout <= Fr2 persists for a time equal to Fr3, then compressors are forced off and freecooling mode is activated.
The freecooling mode end when Tout>Fr2+FrA

## 12.6 Anti freeze of the free-cooling coil

We define an antifreeze threshold based on the value of outside air temperature for the free-cooling coil protection. If the outside air temperature "Tout" is below the threshold of antifreeze Fr8, an alarm is generated, the main circulation pump is turned on and the free-cooling valve is operated as follows:
If the valve is of type 0-10V

- with unit OFF it is open at 100% of its capacity,
- with unit ON it is open at 10% of its capacity.

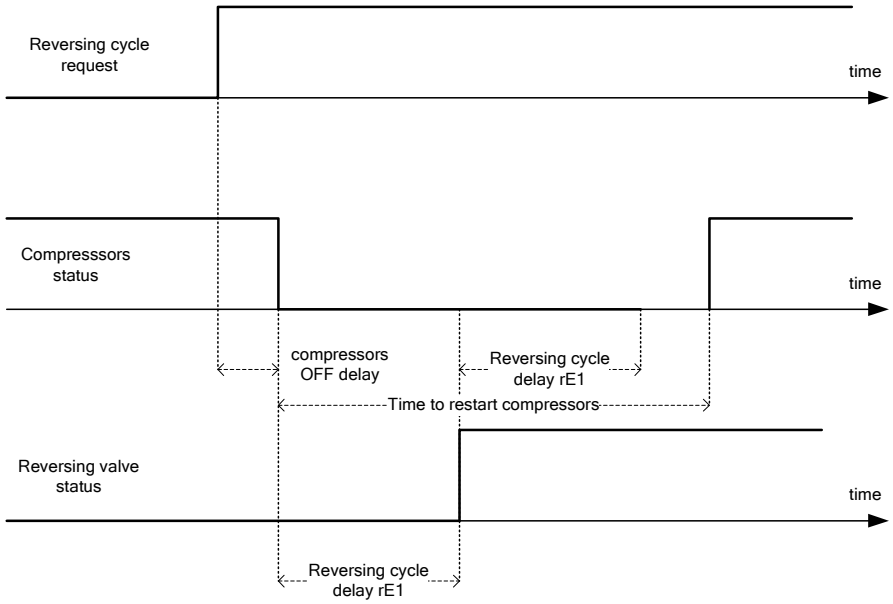
If the valve is of type ON/OFF opening is always at 100%.
The procedure stops with a fixed hysteresis of 1K.

# 13 Reversing valve

**Group1: rEV – Reversing valve**
**Group2: CFG – Configuration**

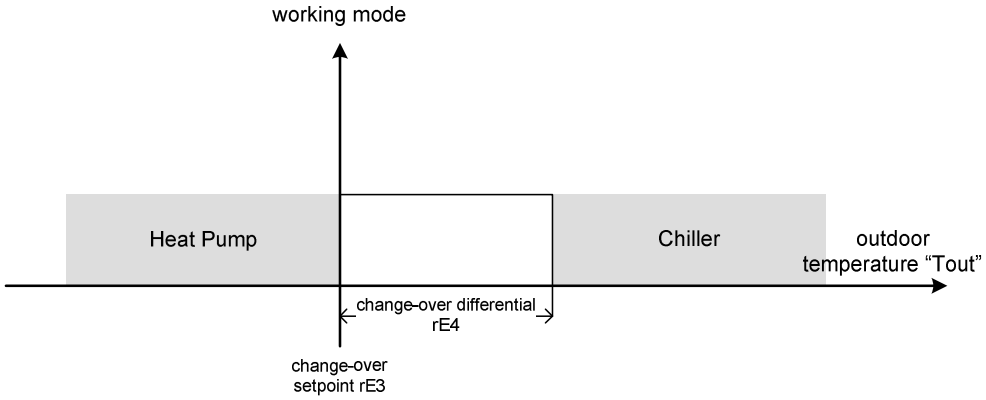
The choice between heating and cooling is described in “Heat/cool selection” inside “3.3 Heat/cool selection” chapter.
According to that selection, the “Reverse Valve C1”, “Reverse Valve C2” digital output, driving the reversing valve of each circuit, are opportunely controlled. The output working logic between Normally Close (N.C.) and Normally Open (N.O.) is defined at the physical output configuration phase. If polarity is set to “Open” (as by default) it means that relay is energized in heating mode.

Times for cycle reversing are defined by the rE1 parameter (Changeover delay) that forces compressors OFF before cycle reversion. This time is calculates since the last compressor is OFF even when there is more than one circuit, in order to make the valves rotate all together on all circuits.
This time is waited also after the valve reversion before turning ON compressors again.
If it is equal to 0, compressors are not stopped and the reversing valve is immediately reversed.




## 13.1 *Automatic change-over*

Comparing the outdoor temperature “Tout” with the change-over setpoint rE3 and differential rE4, the unit decides its way of working between heating (if under the setpoint) or cooling (beyond setpoint + differential). For outdoor temperature values within setpoint and setpoint + differential, the way of working is not changed automatically but can be changed by keyboard, digital input or supervisor. Beyond those limits is not possible to change it.
Note that rE3 parameter disenable the automatic changeover if set to 0.


working mode
Heat Pump
Chiller
outdoor
temperature “Tout”
change-over differential
rE4
change-over
setpoint rE3

# 14 Defrost

## 14.1 Description

On air cooled heat pumps (H9=Air), it is possible to activate the defrosting procedure of the outdoor heat exchanger in heating mode (evaporator).
Defrost can be executed if enabled through d01, unit is in heating mode, at least one compressor is turned ON and the condensing probe (pressure or temperature) “DischargePress C1”, “DischargePress C4” or the “Defrost” digital input is present.

Defrost is signaled by turning ON the corresponding icon on display and can be executed in the following 2 ways.

1. Reversing the cycle of the involved circuit. In this case:
   - » cycle is reversed through a 4 ways valve;
   - » the system cooling power is brought at its maximum;
   - » the way of working of the involved fan is managed by d05 parameter (see “Fan management while defrosting”).
2. If the outdoor temperature allows to do it (parameter d06 “Fan only defrost”), defrost can be performed only turning OFF compressors and turning ON fans at their maximum speed.

Defrost is prior to the compressors timers. Compressors timers are thus ignored while defrosting and compressors ON and OFF are immediate. But to avoid contemporaneous activations and to assure a gradual insertion of the cooling power only the minimum time between the activation of two compressors CT0 is respected.

On multi circuit systems, circuits start defrosting when at least one has reached the start defrost condition. Those circuits who doesn’t have any need of defrosting (that is the stop defrost condition is verified) stop and wait the end of the defrost cycle.

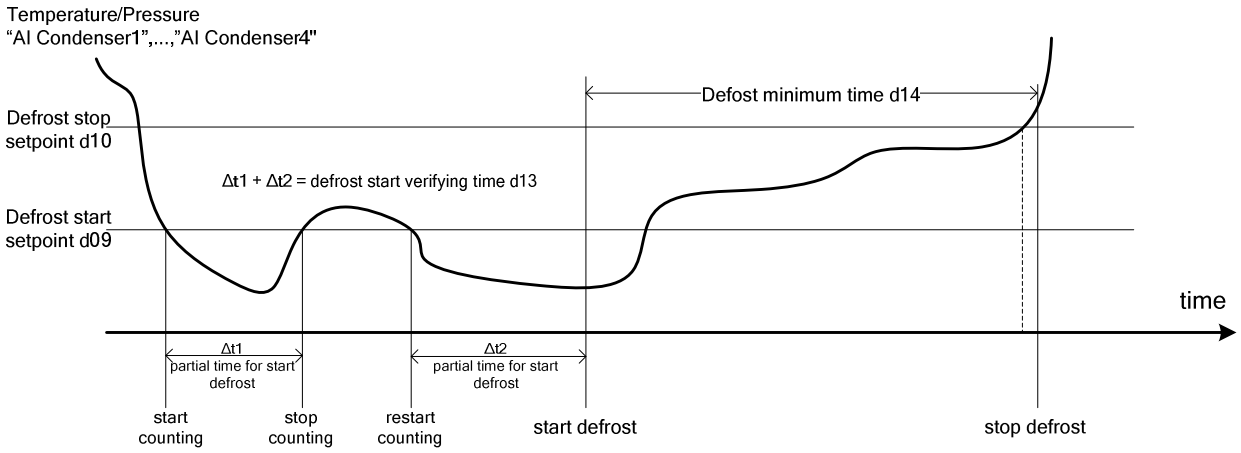
## 14.2 Parameters for defrost control

**Group1: DEF – Defrost**
**Group2: CFG – Configuration**
**Std – Start/stop set**
Defrost is configured with the following parameters:

**d01 – Defrost enable**
Defrost enable

**d02 - Defrost type**
It allows to select the way of starting and stopping defrost among:

- » d02=SpEp. Start and stop on the basis of the value measured by the temperature or pressure probe “DischargePress C1”, “DischargePress C2” used for controlling the outdoor heat exchanger.
  Defrost starts when temperature or pressure goes under a defined limit **d09** for a cumulative time defined in **d13** “Defrost start verifying time” (see the following figure).
  Defrost is stopped when temperature or pressure goes beyond a second limit **d10** or if defrost probe is defect.
- » d02=SpEt. As before but defrost stops only after the defrost maximum time d15 has elapsed.
- » d02=Comb. Start on pressure but with a confirmation of a value measured by a further temperature probe “TComboDefrostC1”, ..., “TComboDefrostC4” located on the coils (combined defrost).
  Defrost can start only if the value measured by this probe is under the limit **d11**, combined defrost temperature start setpoint, after the defrost start verifying time d13 has elapsed. Otherwise unit goes on working normally as far as this limit is exceeded.
  Combined defrost stops when the temperature probe goes beyond a further limit **d12**, combined defrost temperature stop setpoint, but only if the pressure limit d10 is reached as well.




### d03 - Defrost digital input configuration

If the "Defrost" digital input is present, it can be used to start or to stop defrost.
The input logic is defined at the physical input configuration phase. If polarity is set to "Close" (as by default) it means that input is active when open. Herby we refer to the input configured in this way.

» d03=NO. Digital input not used.
» d03=Strt. When the contact is open, it makes defrost start. When the contact is closed, the digital input is ignored and defrost starts or stops according to the way selected with d02.
» d03=End. When the contact is open, it makes defrost stop. When the contact is closed, the digital input is ignored and defrost starts or stops according to the way selected with d02.
» d03=StEn. The digital input is used for both starting defrost (when it toggles from close to open) and stopping defrost (when it toggles from open to close).

NOTE. If the stop defrost condition is on the basis of the value measured by the temperature or pressure probe, starting defrost from digital input is possible only if the stop condition is not already verified.

### d04 - Heaters management while defrosting

It states if heaters have to be activated (d04=YES) while defrosting to reduce the cold blow effect.

### d05 - Fans management while defrosting

It defines the way fans on external heat exchanger are managed while defrosting. The following choices are available:

» d05=OFF. Fans are always OFF
» d05=EqUA. Fans are managed as in cooling mode
» d05=ONdr. Fans are OFF until the stop defrost condition; after that fan are turned ON at their maximum speed for the d20 time, waiting time after defrosting (dripping time). After this time has elapsed, the cycle goes back to the heating mode and to its normal fans management.

Note**:** If the unit is Fan Defrost mode (see d06 parameter), fan management as it is here described is disabled.

### d06 - Defrost with compressors OFF (Fan only defrost)

This function allows to take advantage of the outdoor temperature "Tout" when it is adequate to defrost the outdoor coil.
In this mode, the unit turns OFF compressors and drives fans at their maximum speed, without reversing cycle.
Defrost start and stop conditions and the support heaters management stay unchanged, as described above.
If d06=0, the function is disabled. Otherwise it represents the minimum outdoor temperature to be reached for enabling the function. Fan defrost will be then executed when the start defrost condition is verified.

### d07 – Enable low pressure alarm during defrost

It allows you to disable (d07=NO) the low pressure switch control during all the defrost cycle.

### Group1: DEF – Defrost
### Group2: TIM – Times

### d13 - Defrost start verifying time

It sets the time during which the condensing temperature/pressure must stay under the defrost start setpoint d09, together with compressors ON, to activate defrost. Counting is stopped but it is not reset when temperature/pressure goes beyond that limit d09. Counter is reset at power ON or when the defrost cycle starts.

### d14 - Defrost minimum time

If this time has not elapsed, defrost goes on even if the stop defrost condition is already reached.
It is ignored in case of defrost from digital input.

### d15 - Defrost maximum time

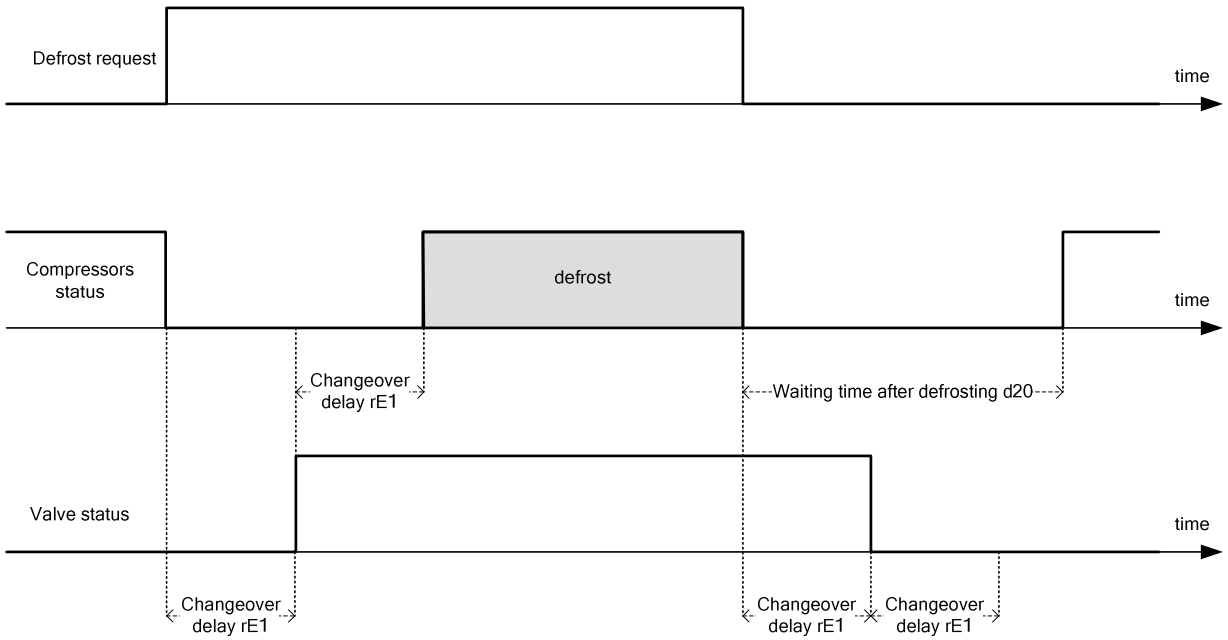
If the time ended defrost is enabled (d02=spEt), it sets the defrost endurance.
Otherwise it represents its maximum endurance, beyond which defrost is stopped and the A13 warning occurs. This warning is reset after a correct defrost cycle.

### d16 - Minimum time between 2 defrost cycles of the same circuit

It is the minimum delay between the end of one defrost cycle and the start of the following one. If it is not higher than d13, defrost start verifying time, it is ignored.
It is ignored also in case of defrost from digital input.

### d20 - Waiting time after defrosting

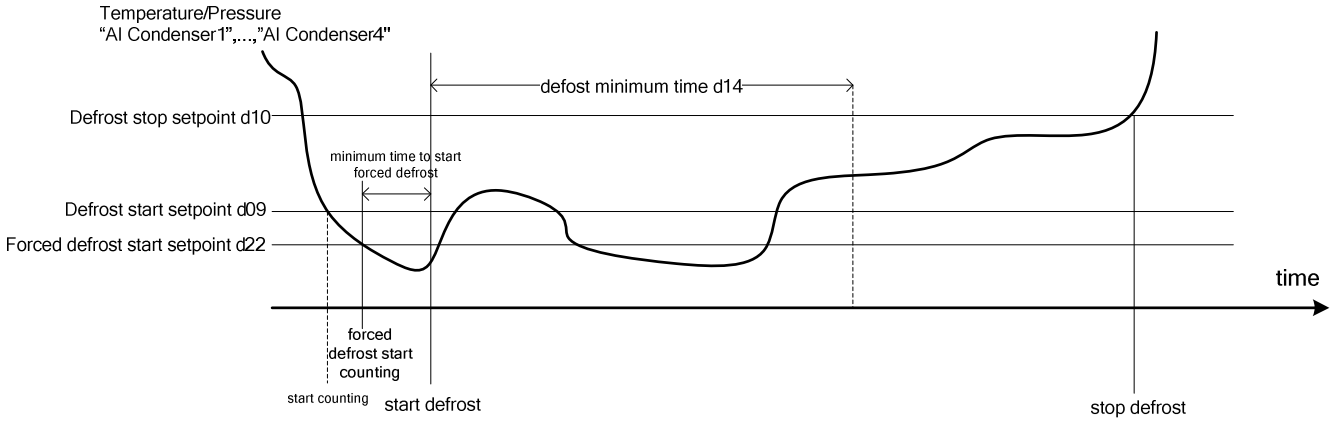
At the end of the defrost cycle, compressor is stopped for all this time if it is higher than the double of the changeover delay rE1 (see the following figure); otherwise the last one is valid. The 4 ways valve is reversed anyhow after the changeover delay; this delay allows pressures equalization after the defrost cycle and an eventual dripping of the outdoor heat exchanger (see d05 for fans management during this phase).




### Group1: DEF – Defrost
### Group2: FOr – Forced defrost

### d21 – Forced defrost, start verifying time
### d22 – Forced defrost, start setpoint

If this function is enabled, the minimum time between 2 defrost cycles is cancelled when temperature/pressure goes under d22 setpoint for d21 period of time. Counting is reset if temperature/pressure goes beyond the normal defrost setpoint while counting this time.


Temperature/Pressure
“AI Condenser1”,...,”AI Condenser4"
defost minimum time d14
Defrost stop setpoint d10
minimum time to start
forced defrost
Defrost start setpoint d09
Forced defrost start setpoint d22
time
forced
defrost start
counting
start counting
start defrost
stop defrost

# 15 Alarms

**Group1: ALA – Alarms**
**Group2: CFG – Configuration**

## 15.1 Alarm actions

When an alarm happens generally the following actions are executed.

» Buzzer activation, if present and enabled and if required by the active alarm (see Alarms table). The BUZ parameter sets the buzzer activation time in case of alarm; 0 is always OFF, 1..14 the buzzer is automatically muted after the related value in minutes, 15 is always ON.
» Alarm or warning relay activation (if present) according to what is required by the active alarm (see Alarms table).
Through the AdL parameter you define the relay activation delay. Through AOF you set the alarm relay status in case of alarms with unit on OFF state.
The relay working logic between Normally Close (N.C.) and Normally Open (N.O.) is defined at the physical output configuration phase. If polarity is set to “Open” (as by default) it means that relay is energized in case of alarm.
» Display of the alarm icon and alarm code on the LED display controllers, together with the time since its activation.
» Display of the active alarms list and of the related description on the LCD controllers. For a more detailed description of the user interface in case of alarms, see “3 - User interface”.

## 15.2 Reset types

Alarms can be of manual, automatic or semi-automatic reset type.

» If they are of manual reset type, they requires an acknowledgement to be reset; the user must press the X key for 3 seconds within the alarm screens to reset the alarm, if the alarm condition doesn’t occur anymore. Or he can reset it from menu (Menu: ALA – Alarms, Submenu: RAL – alarm Reset), see “3 - User interface”.
» If they are of automatic reset type, the alarm is reset as soon as the alarm condition disappear. The display icon stays active till it is manually reset (see the point above).
» There are alarms with automatic reset but that becomes of manual reset type after a configurable amount of activations: they are the so called semi-automatic alarms.

Buzzer is muted pressing any key even if the alarm condition is still present and stays muted till a new alarm occurs.

## 15.3 Alarm table

Each alarm is characterized by:

» enable from configurator, see “APPENDIX – Configurator usage” at the end of the manual, or from a parameter, if present;
» code: acronym to identify the alarm and that is showed on the display;
» description to display on a LCD display;
» reset type (-1=automatic, 0=manual, >0=number of occurrences for semi-automatic alarms);
» if semi-automatic alarms, the period for counting alarm occurrences; if during this time the alarm exceeds its maximum number of occurrences, it becomes a manual reset alarm;
» delay from the start-up of the related element and delay in normal functioning;
» if active even when the unit is OFF;
» action on the alarm relay, warning relay and buzzer;
» action on the single element of the unit, on all the elements of the same circuit (C), or of the whole unit (S);

as described in the following table.

| Code | Alarm Description | Source | Reset type | Semi automatic period (min) | Startup delay (s) | Steady delay (s) | Active with unit OFF | Alarm relay | Warning relay | Circuit or System | Comp | Fan or Pump Evap. | Fan or Pump Cond. | Heaters | Modbus (0x4300) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A01 | General alarm | DI “General Alarm” | -1 | 90 | 0 | 0 | NO | ON | OFF | S | OFF | OFF | OFF | OFF | 17153 |
| A02 | General overload alarm | DI “General Overload” | -1 | 90 | 0 | 0 | NO | ON | OFF | S | OFF | OFF | OFF | OFF | 17154 |
| A03 | Evaporator flow switch alarm | DI “Flow Evaporator” | AFr | 10 | AF1 | AF2 | NO | ON | OFF | S | OFF | OFF | OFF | OFF | 17155 |
| A04 | Condenser flow switch alarm | DI “Flow Condenser” | AFr | 10 | AF1 | AF2 | NO | ON | OFF | S | OFF | OFF | OFF | - | 17156 |
| A15 | General pumps alarm | DI “Evap Pumps Ovld” or both A05 and A06 alarms | 0 | 90 | 0 | 0 | NO | ON | OFF | S | OFF | OFF | OFF | OFF | 17157 |
| A05 | Evap. Pump 1/fan overload alarm | DI “Evap Pump1 Ovld” | -1 | 90 | 0 | 0 | NO | ON | OFF | | - | OFF | - | - | 17158 |
| A06 | Evaporator pump2 overload alarm | DI “Evap Pump2 Ovld” | -1 | 90 | 0 | 0 | NO | ON | OFF | | - | OFF | - | - | 17159 |
| A07 | Low air temperature alarm | “Tout Evaporator1”<=AlS | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17160 |
| A08 | Backup pump running | system | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17161 |
| A09 | High temperature warning | AI “Tout Evaporator1, 2”>=AtS | -1 | 90 | 600 | 0 | NO | OFF | ON | | | | | | 17163 |
| A10 | Evap pump/fan run hours exceeded | system P51>=P50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17164 |
| A11 | Evap pump2 run hours exceeded | system P52>=P50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17165 |
| A12 | Cond fan/pump run hours exceeded | system F16>=F17 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17166 |
| A13 | Defrost max time exceeded | system | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17167 |
| A14 | High boiler temperature alarm | AI “BoilerSafety”>=AbS | -1 | 90 | 0 | 0 | NO | ON | OFF | | - | - | - | - | 17168 |
| AE1 | Evaporator 1 ice alarm | AI “Tout Evaporator1”<=AlS | Alr | 90 | Al1 | 0 | YES | ON | OFF | C1 | OFF | ON | - | ON | 17169 |
| AE2 | Evaporator 2 ice alarm | AI “Tout Evaporator2” <=AlS | Alr | 90 | Al1 | 0 | YES | ON | OFF | C2 | OFF | ON | - | ON | 17170 |
| AH0 | General high pressure alarm | DI “HP” or system (all cicuits in HP alarm) | 0 | 90 | 0 | 0 | NO | ON | OFF | S | OFF | - | - | - | 17171 |
| AH1 | Circuit 1 high pressure alarm | DI “HP Circuit1” or AI “Condenser1”>=AHS | 0 | 90 | 0 | 0 | NO | ON | OFF | C1 | OFF | - | - | - | 17172 |
| AH2 | Circuit 2 high pressure alarm | DI “HP Circuit2” or AI “Condenser2”>=AHS | 0 | 90 | 0 | 0 | NO | ON | OFF | C2 | OFF | - | - | - | 17173 |
| AH3 | General high pressure alarm from AI | all circuits in HP alarm | 0 | 90 | 0 | 0 | NO | ON | OFF | S | OFF | - | - | - | 17174 |
| AH4 | Circuit 1 high pressure alarm from AI | AI “DischargePress C1”>=AHS | 0 | 90 | 0 | 0 | NO | ON | OFF | C1 | OFF | - | - | - | 17175 |
| AH5 | Circuit 2 high pressure alarm from AI | AI “DischargePress C 2”>=AHS | 0 | 90 | 0 | 0 | NO | ON | OFF | C2 | OFF | - | - | - | 17176 |
| AL0 | General low pressure alarm | DI “LP” or system (all circuits in LP alarm) | ALr | 90 | AL1 | 30 | NO | ON | OFF | S | OFF | - | - | - | 17177 |
| AL1 | Circuit 1 low pressure alarm | DI “LP Circuit1” or AI “Condenser1”<=ALt or ALS | ALr | 90 | AL1 | 30 | NO | ON | OFF | C1 | OFF | - | - | - | 17178 |
| AL2 | Circuit 2 low pressure alarm | DI “LP Circuit2” or AI “Condenser2” ”<=ALt or ALS | ALr | 90 | AL1 | 30 | NO | ON | OFF | C2 | OFF | - | - | - | 17179 |
| AL3 | General low pressure alarm from AI | All circuits in LP alarm from AI | ALr | 90 | AL1 | 30 | NO | ON | OFF | S | OFF | - | - | - | 17180 |
| AL4 | Circuit 1 low pressure alarm from AI | AI “SuctionPress C1”<=ALt or ALS | ALr | 90 | AL1 | 30 | NO | ON | OFF | C1 | OFF | - | - | - | 17181 |
| AL5 | Circuit 2 low pressure alarm from AI | AI “SuctionPress C2” ”<=ALt or ALS | ALr | 90 | AL1 | 30 | NO | ON | OFF | C2 | OFF | - | - | - | 17182 |
| AC0 | General compressors overload | DI “Comp Overload” or system (all the compressors in overload alarm) | 0 | 90 | 0 | 0 | NO | ON | OFF | S | OFF | OFF | OFF | OFF | 17183 |
| AC1 | Circuit 1 compressors overload | DI “Comp Overload C1” | 0 | 90 | 0 | 0 | NO | ON | OFF | C1 | OFF | - | - | - | 17184 |
| AC2 | Circuit 2 compressors overload | DI “Comp Overload C2” | 0 | 90 | 0 | 0 | NO | ON | OFF | C2 | OFF | - | - | - | 17185 |

| Code | Alarm Description | Source | Reset type | Semi automatic period (min) | Startup delay (s) | Steady delay (s) | Active with unit OFF | Alarm relay | Warning relay | Circuit or System | Comp | Fan or Pump Evap. | Fan or Pump Cond. | Heaters | Modbus (0x4300) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C01 | Compressor 1 overload alarm | DI “Comp1 Overload” | 0 | 90 | 0 | 0 | NO | ON | OFF | | C1 OFF | - | - | - | 17186 |
| C02 | Compressor 2 overload alarm | DI “Comp2 Overload” | 0 | 90 | 0 | 0 | NO | ON | OFF | | C2 OFF | - | - | - | 17187 |
| C03 | Compressor 3 overload alarm | DI “Comp3 Overload” | 0 | 90 | 0 | 0 | NO | ON | OFF | | C3 OFF | - | - | - | 17188 |
| C04 | Compressor 4 overload alarm | DI “Comp4 Overload” | 0 | 90 | 0 | 0 | NO | ON | OFF | | C4 OFF | - | - | - | 17189 |
| C05 | Compressor 5 overload alarm | DI “Comp5 Overload” | 0 | 90 | 0 | 0 | NO | ON | OFF | | C5 OFF | - | - | - | 17190 |
| C06 | Compressor 6 overload alarm | DI “Comp6 Overload” | 0 | 90 | 0 | 0 | NO | ON | OFF | | C6 OFF | - | - | - | 17191 |
| C07 | Compressor 7 overload alarm | DI “Comp7 Overload” | 0 | 90 | 0 | 0 | NO | ON | OFF | | C7 OFF | - | - | - | 17192 |
| C08 | Compressor 8 overload alarm | DI “Comp8 Overload” | 0 | 90 | 0 | 0 | NO | ON | OFF | | C8 OFF | - | - | - | 17193 |
| C09 | Compressor 9 overload alarm | DI “Comp5 Overload” | 0 | 90 | 0 | 0 | NO | ON | OFF | | C5 OFF | - | - | - | 17194 |
| C10 | Compressor 10 overload alarm | DI “Comp6 Overload” | 0 | 90 | 0 | 0 | NO | ON | OFF | | C6 OFF | - | - | - | 17195 |
| C11 | Compressor 11 overload alarm | DI “Comp7 Overload” | 0 | 90 | 0 | 0 | NO | ON | OFF | | C7 OFF | - | - | - | 17196 |
| C12 | Compressor 12 overload alarm | DI “Comp8 Overload” | 0 | 90 | 0 | 0 | NO | ON | OFF | | C8 OFF | - | - | - | 17197 |
| A31 | General oil pressure switch | DI “Comp Oil Press.” or system (all compressors in oil press. alarm) | 0 | 90 | 90 | 0 | NO | ON | OFF | S | OFF | OFF | OFF | OFF | 17198 |
| A32 | Circuit 1 oil pressure switch | DI “Comp Oil PressC1” | 0 | 90 | 90 | 0 | NO | ON | OFF | C1 | OFF | - | - | OFF | 17199 |
| A33 | Circuit 2 oil pressure switch | DI “Comp Oil PressC2” | 0 | 90 | 90 | 0 | NO | ON | OFF | C2 | OFF | - | - | OFF | 17198 |
| A41 | Compressor 1 oil pressure switch | DI “Comp1 Oil Press.” | 0 | 90 | 90 | 1 | NO | ON | OFF | | OFF | - | - | OFF | 17201 |
| A42 | Compressor 2 oil pressure switch | DI “Comp2 Oil Press.” | 0 | 90 | 90 | 1 | NO | ON | OFF | | OFF | - | - | OFF | 17202 |
| A43 | Compressor 3 oil pressure switch | DI “Comp3 Oil Press.” | 0 | 90 | 90 | 1 | NO | ON | OFF | | OFF | - | - | OFF | 17203 |
| A44 | Compressor 4 oil pressure switch | DI “Comp4 Oil Press.” | 0 | 90 | 90 | 1 | NO | ON | OFF | | OFF | - | - | OFF | 17204 |
| A45 | Compressor 5 oil pressure switch | DI “Comp5 Oil Press.” | 0 | 90 | 90 | 1 | NO | ON | OFF | | OFF | - | - | OFF | 17205 |
| A46 | Compressor 6 oil pressure switch | DI “Comp6 Oil Press.” | 0 | 90 | 90 | 1 | NO | ON | OFF | | OFF | - | - | OFF | 17206 |
| A47 | Compressor 7 oil pressure switch | DI “Comp7 Oil Press.” | 0 | 90 | 90 | 1 | NO | ON | OFF | | OFF | - | - | OFF | 17207 |
| A48 | Compressor 8 oil pressure switch | DI “Comp8 Oil Press.” | 0 | 90 | 90 | 1 | NO | ON | OFF | | OFF | - | - | OFF | 17208 |
| A49 | Compressor 9 oil pressure switch | DI “Comp9 Oil Press.” | 0 | 90 | 90 | 1 | NO | ON | OFF | | OFF | - | - | OFF | 17209 |
| A50 | Compressor 10 oil pressure switch | DI “Comp10 Oil Press.” | 0 | 90 | 90 | 1 | NO | ON | OFF | | OFF | - | - | OFF | 17210 |
| A51 | Compressor 11 oil pressure switch | DI “Comp11 Oil Press.” | 0 | 90 | 90 | 1 | NO | ON | OFF | | OFF | - | - | OFF | 17211 |
| A52 | Compressor 12 oil pressure switch | DI “Comp12 Oil Press.” | 0 | 90 | 90 | 1 | NO | ON | OFF | | OFF | - | - | OFF | 17212 |
| A60 | General cond. fan/pump overload | DI “Cond Fan/Pump Ovld” | -1 | 90 | 0 | 0 | NO | ON | OFF | S | OFF | OFF | OFF | OFF | 17213 |
| A61 | Circuit 1 cond. fans overload | DI “Cond1 Fan Ovld” | -1 | 90 | 0 | 0 | NO | ON | OFF | C1 | OFF | - | OFF | OFF | 17214 |
| A62 | Circuit 2 cond. fans overload | DI “Cond2 Fan Ovld” | -1 | 90 | 0 | 0 | NO | ON | OFF | C2 | OFF | - | OFF | OFF | 17213 |
| A53 | Circuit 3 cond. fans overload | DI “Cond3 Fan Ovld” | -1 | 90 | 0 | 0 | NO | ON | OFF | C3 | OFF | - | OFF | OFF | 17214 |
| A54 | Circuit 4 cond. fans overload | DI “Cond4 Fan Ovld” | -1 | 90 | 0 | 0 | NO | ON | OFF | C4 | OFF | - | OFF | OFF | 17215 |
| AF1 | Condenser fan/pump 1 overload | DI “Cond Fan/Pmp1 Ovld” | -1 | 90 | 0 | 0 | NO | ON | OFF | | - | - | Fan1 OFF | - | 17216 |
| AF2 | Condenser fan/pump 2 overload | DI “Cond Fan Ovld” | -1 | 90 | 0 | 0 | NO | ON | OFF | | - | - | Fan2 OFF | - | 17217 |
| AF3 | Condenser fan 3 overload alarm | DI “Cond Fan3 Overld” | -1 | 90 | 0 | 0 | NO | ON | OFF | | - | - | Fan3 OFF | - | 17218 |
| AF4 | Condenser fan 4 overload alarm | DI “Cond Fan4 Overld” | 3 | 90 | 0 | 0 | NO | ON | OFF | | - | - | Fan4 OFF | - | 17219 |

| Code | Alarm Description | Source | Reset type | Semi automatic period (min) | Startup delay (s) | Steady delay (s) | Active with unit OFF | Alarm relay | Warning relay | Circuit or System | Comp | Fan or Pump Evap. | Fan or Pump Cond. | Heaters | Modbus (0x4300) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AF5 | Condenser fan 5 overload alarm | DI “Cond Fan5 Overld” | 3 | 90 | 0 | 0 | NO | ON | OFF | | - | - | Fan5 OFF | - | 17220 |
| AF6 | Condenser fan 6 overload alarm | DI “Cond Fan6 Overld” | 3 | 90 | 0 | 0 | NO | ON | OFF | | - | - | Fan6 OFF | - | 17221 |
| AF7 | Condenser fan 7 overload alarm | DI “Cond Fan7 Overld” | 3 | 90 | 0 | 0 | NO | ON | OFF | | - | - | Fan7 OFF | - | 17222 |
| AF8 | Condenser fan 8 overload alarm | DI “Cond Fan8 Overld” | 3 | 90 | 0 | 0 | NO | ON | OFF | | - | - | Fan8 OFF | - | 17223 |
| H01 | Compressor 1 run hours exceeded | system C01>=C50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17224 |
| H02 | Compressor 2 run hours exceeded | system C02>=C50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17225 |
| H03 | Compressor 3 run hours exceeded | system C03>=C50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17226 |
| H04 | Compressor 4 run hours exceeded | system C04>=C50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17227 |
| H05 | Compressor 5 run hours exceeded | system C05>=C50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17228 |
| H06 | Compressor 6 run hours exceeded | system C06>=C50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17229 |
| H07 | Compressor 7 run hours exceeded | system C07>=C50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17230 |
| H08 | Compressor 8 run hours exceeded | system C08>=C50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17231 |
| H09 | Compressor 9 run hours exceeded | system C09>=C50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17232 |
| H10 | Compressor 10 run hours exceeded | system C10>=C50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17233 |
| H11 | Compressor 11 run hours exceeded | system C11>=C50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17234 |
| H12 | Compressor 12 run hours exceeded | system C12>=C50 | -1 | 90 | 0 | 0 | NO | OFF | ON | | - | - | - | - | 17235 |
| A71 | Analog input 1 alarm | AI1 | -1 | 90 | 10 | 10 | YES | ON | OFF | S | OFF | OFF | OFF | OFF | 17236 |
| A72 | Analog input 2 alarm | AI2 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17237 |
| A73 | Analog input 3 alarm | AI3 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17238 |
| A74 | Analog input 4 alarm | AI4 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17239 |
| A75 | Analog input 5 alarm | AI5 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17240 |
| A76 | Analog input 6 alarm | AI6 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17241 |
| A77 | Analog input 7 alarm | AI7 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17242 |
| A78 | Analog input 8 alarm | AI8 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17243 |
| A79 | Analog input 9 alarm | AI9 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17244 |
| A80 | Analog input 10 alarm | AI10 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17245 |
| A81 | Analog input 11 alarm | AI11 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17246 |
| A82 | Analog input 12 alarm | AI12 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17247 |
| A83 | Analog input 13 alarm | AI13 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17248 |
| A84 | Analog input 14 alarm | AI14 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17249 |
| A85 | Analog input 15 alarm | AI15 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17250 |
| A86 | Analog input 16 alarm | AI16 | -1 | 90 | 10 | 10 | YES | ON | OFF | | - | - | - | - | 17251 |
| A90 | General heaters overload alarm | DI “Heaters Overload” | -1 | 90 | 0 | 0 | NO | ON | OFF | S | - | - | - | OFF | 17252 |
| A91 | Circuit 1 heaters overload alarm | DI “Heaters Ovld C1” | -1 | 90 | 0 | 0 | NO | ON | OFF | C1 | - | - | - | OFF | 17253 |
| A92 | Circuit 2 heaters overload alarm | DI “Heaters Ovld C2” | -1 | 90 | 0 | 0 | NO | ON | OFF | C2 | - | - | - | OFF | 17252 |
| Ar1 | Heater 1 overload alarm | DI “Heater1 Overload” | -1 | 90 | 0 | 0 | NO | ON | OFF | | - | - | - | H1 OFF | 17255 |
| Ar2 | Heater 2 overload alarm | DI “Heater2 Overload” | -1 | 90 | 0 | 0 | NO | ON | OFF | | - | - | - | H2 OFF | 17256 |

| Code | Alarm Description | Source | Reset type | Semi automatic period (min) | Startup delay (s) | Steady delay (s) | Active with unit OFF | Alarm relay | Warning relay | Circuit or System | Comp | Fan or Pump Evap. | Fan or Pump Cond. | Heaters | Modbus (0x4300) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ar3 | Heater 3 overload alarm | DI “Heater3 Overload” | -1 | 90 | 0 | 0 | NO | ON | OFF | | - | - | - | H3 OFF | 17257 |
| Ar4 | Heater 4 overload alarm | DI “Heater4 Overload” | -1 | 90 | 0 | 0 | NO | ON | OFF | | - | - | - | H4 OFF | 17258 |
| AOF | Unit OFF | DI “ON/OFF” OFF from User interface | -1 | 90 | 0 | 0 | NO | OFF | OFF | | - | - | - | - | 17259 |
| AFC | Freeze Freecooling Alarm | AI “Tout”<=Fr8 | -1 | 90 | 0 | 0 | NO | ON | OFF | | - | - | - | - | 17260 |
| E10 | EXD1 Connection | EXD1 | -1 | 90 | 10 | 5 | NO | ON | OFF | C1 | OFF | - | - | - | 17260 |
| E11 | EXD1 EKC Error | EXD1 | -1 | 90 | 0 | 5 | NO | ON | OFF | C1 | OFF | - | - | - | 17261 |
| E12 | EXD1 S2 Error | EXD1 | -1 | 90 | 0 | 5 | NO | ON | OFF | C1 | OFF | - | - | - | 17262 |
| E13 | EXD1 S4 Error | EXD1 | -1 | 90 | 0 | 5 | NO | ON | OFF | | - | - | - | - | 17263 |
| E14 | EXD1 Pe Error | EXD1 | -1 | 90 | 0 | 5 | NO | ON | OFF | C1 | OFF | - | - | - | 17264 |
| E15 | EXD1 Ext Ref Error | EXD1 | -1 | 90 | 0 | 5 | NO | ON | OFF | C1 | OFF | - | - | - | 17265 |
| E16 | EXD1 NO Refrig. Selected | EXD1 | -1 | 90 | 0 | 5 | NO | ON | OFF | C1 | OFF | - | - | - | 17266 |
| E17 | EXD1 Valve Error | EXD1 | -1 | 90 | 0 | 5 | NO | ON | OFF | C1 | OFF | - | - | - | 17267 |
| E18 | EXD1 Battery low | EXD1 | -1 | 90 | 0 | 5 | NO | ON | OFF | C1 | OFF | - | - | - | 17268 |
| E19 | EXD1 CAN driver diagnostics | EXD1 | -1 | 90 | 0 | 5 | NO | ON | OFF | C1 | OFF | - | - | - | 17269 |
| E20 | EXD2 Connection | EXD2 | -1 | 90 | 10 | 5 | NO | ON | OFF | C2 | OFF | - | - | - | 17270 |
| E21 | EXD2 EKC Error | EXD2 | -1 | 90 | 0 | 5 | NO | ON | OFF | C2 | OFF | - | - | - | 17271 |
| E22 | EXD2 S2 Error | EXD2 | -1 | 90 | 0 | 5 | NO | ON | OFF | C2 | OFF | - | - | - | 17272 |
| E23 | EXD2 S4 Error | EXD2 | -1 | 90 | 0 | 5 | NO | ON | OFF | | - | - | - | - | 17273 |
| E24 | EXD2 Pe Error | EXD2 | -1 | 90 | 0 | 5 | NO | ON | OFF | C2 | OFF | - | - | - | 17274 |
| E25 | EXD2 Ext Ref Error | EXD2 | -1 | 90 | 0 | 5 | NO | ON | OFF | C2 | OFF | - | - | - | 17275 |
| E26 | EXD2 NO Refrig. Selected | EXD2 | -1 | 90 | 0 | 5 | NO | ON | OFF | C2 | OFF | - | - | - | 17276 |
| E27 | EXD2 Valve Error | EXD2 | -1 | 90 | 0 | 5 | NO | ON | OFF | C2 | OFF | - | - | - | 17277 |
| E28 | EXD2 Battery low | EXD2 | -1 | 90 | 0 | 5 | NO | ON | OFF | C2 | OFF | - | - | - | 17278 |
| E29 | EXD2 CAN driver diagnostics | EXD2 | -1 | 90 | 0 | 5 | NO | ON | OFF | C2 | OFF | - | - | - | 17279 |

## 15.4 Main alarms description

Here below are listed only the alarms requiring some detail not described in the previous part of the manual.

**A03 - Evaporator flow switch alarm**
**Group1: ALA – Alarms**
**Group2: FLO– Flow**
It is generated by the “Flow Evaporator” digital input.
In case of alarm:
» if there is the second pump “Evap Pump2”, the second pump operating warning A08 will be activated before the flow switch alarm A03;
» otherwise, all the compressors and all the other elements will be immediately switched OFF, ignoring their protection times.

The alarm is delayed of AF1 seconds from the pump start to wait for the water flow to reach its steady value.
It is delayed also in normal functioning of AF2 seconds to filter temporary flow changes or air bubble in the water circuit.

The reset type is configurable through AFr among:
» manual: all the outputs are OFF, including the pump. After reset, if the alarm is still active, the alarm is ignored (but always shown on display) till its delay time from start-up is elapsed to give the chance to the unit to regularly start.
» automatic: all the outputs are OFF, excluding the pump which tries to start every AF3 seconds; the alarm is ignored till its delay time from start-up is elapsed.
» semi-automatic: the pump tries to start every AF3 seconds for AFr number of times, ignoring the alarm during its delay at start up; exceeded the attempts of starting the pump, the alarm becomes manually resettable only.

**A04 – Condenser flow alarm**
**Group1: ALA – Alarms**
**Group2: FLO– Flow**
See Evaporator flow switch alarm.

**Analog input 1, ..., 16 alarms**
**Group1: ALA – Alarms**
**Group2: COn – Cond probe fault**
This alarm is delayed by 10 seconds both in power up and normal functioning.
It is detected only if the probe is used and causes the deactivation of all the functions managed by that probe.
If the fault probe is the one used for condensing control, the alarm effect on the condenser fans is set by ACM parameter and can change if there’s a probe for the outside air temperature (see “9 - Condenser fans/pumps”)

**High pressure alarm**
**Group1: ALA – Alarms**
**Group2: HP – HP**
The high pressure alarm can be caused both from a pressure switch (digital input “HP”, “HP Circuit1”, HP Circuit 2”) and from a transducer/temperature probe (analog input “DischargePress C1“, “DischargePress C2”).
General alarm AH0 is generated only by “HP” digital input or when all the circuits are in alarm.
Alarm from analog input must be enabled by AHE and is revealed even if compressors are OFF. If you are using a transducer, you have to set a setpoint AHS and a AHd differential.
Compressors belonging to the circuit in alarm are immediately switched OFF without waiting for any safety timer.
Reset type is manual.

**Low pressure alarm**
**Group1: ALA – Alarms**
**Group2: LP – LP**
The high pressure alarm can be caused both from a pressure switch (digital input “LP”, “LP Circuit1”, ”LP Circuit 2”) and from a transducer/temperature probe (analog input “SuctionPress C1”,.” SuctionPress C2”).
General alarm AL0 is generated only by “LP” digital input or when all the circuits are in alarm.
Reset type is defined through ALr. By default it is semi automatic: if the alarm happens 3 times within 90 minutes, from automatic becomes manual.

According to AL2 value, it can be detected even when compressors are OFF (AL2=YES) or only when compressors are ON (AL2=NO). In this case, alarm is delayed at compressors start up of AL1 seconds. In normal functioning is immediate.

Alarm from analog input must be enabled by ALE. If you are using a transducer, you have to set a setpoint ALt and a differential ALd.
Compressors belonging to the circuit in alarm are immediately switched OFF without waiting for any safety timer.

NOTE.
When the transducers on the low pressure side "SuctionPress Cx" are not present, the transducers "DischargePress Cx" pass on the low pressure side of the circuit in case of heat pumps with gas changeover in heating mode.

### General compressor and pump alarms

All the compressors general alarm and the evaporator pumps general alarms are generated by the related digital input but also by the activation of all the related individual alarms.

# 16 Parameters

The parameters are divided by groups, depending on the function type.
For each parameters are defined the here below features (these features could be a numeric value or could depend from the value of another parameter which is specified by an acronym).
All the described features can be modified through the configurator (see “APPENDIX – Configurator usage” at the end of the manual).

Code: acronym to identify the parameter. It clearly identifies the parameter and it is showed on the display.
Description: parameter description to display on a LCD display.
K: K indicates a not adjustable parameter (constant value equal to the default value); it isn’t showed on the display.
Min: minimum value.
Max: maximum value.
Default: factory setting value. To force parameters to get their factory setting values see “3.7.6 Forcing parameters default values”.
U.M.: indicates the unit of measurement.
Decimals: number of decimal digits.
Visibility requirements: specifies if the parameter visibility is depending on the value of another parameter.
Level: the parameters are organized on 4 levels. Levels from 1 to 3 are linked to a password. It is not allowed the access to parameters when they are on a higher level than the entering level.

» Level 0 is accessible without password
» Level 1 is easily accessible (password L01). It contains all the parameters that are not critical for the unit functioning. They are frequently modified.
» Level 2 contains all the parameter that are useful to set the unit (password L02).
» Level 3 contains all the parameters reserved to the unit manufacturer (password L03).

Text Values: list of mnemonic values that parameters can assume.

The entering to the parameters visualization and modification mode is possible from menu.
For a complete user interface description, please see “3 - User Interface” paragraph.

## *16.1 Parameters table*

See configurator (see “APPENDIX – Configurator usage” at the end of the manual).

# 17 Modbus communication

**Group1: GEN – General**
**Group2: SEr – Serial settings**
The supported protocol over the RS485 network is Modbus RTU slave.
Here follow the related parameters.

**SEr - Serial address (Modbus and CAN)**
Node serial address, valid for both CAN and Modbus network. Each node must have a unique serial address.
NOTE. SEr change the address after unit power up. SEr always overrule the BIOS setting.

**bAU – Serial baud rate (Modbus)**
- bAU=0. communication OFF
- bAU=12. baud rate=1200 baud
- bAU=24. baud rate=2400 baud
- bAU=48. baud rate=4800 baud
- bAU=96. baud rate=9600 baud
- bAU=144. baud rate=1440 baud
- bAU=192. baud rate=19200 baud (default value)
- bAU=288. baud rate=28800 baud
- bAU=384. baud rate=38400 baud

**COM – Serial settings (Modbus)**
- COM=8N1. 8 bit data, no parity, 1 stop bit
- COM=8E1. 8 bit data, parity even, 1 stop bit
- COM=8N2. 8 bit data, no parity, 2 stop bit

All the variables are exported as Holding Registers.

## *17.1 Exported variables table*

NOTE. Modbus Holding Register addresses are reported in the following table. You can calculate the corresponding message address subtracting 1 to each value.

| Code | Description | Note | Modbus message address | |
|---|---|---|---|---|
| | | | hex | Dec |
| | Command Request.<br>Note. To change a parameter from Modbus network:<br>1) write the corresponding register<br>2) write Command Request = 3 to make the change effective | 0=no command, 1=reset buzzer, 2=reset alarms, 3=reload parameters, 4=switch on/off status, 5= reload of default parameters | 0x4001 | 16385 |
| | Configuration error | | 0x4002 | 16386 |
| | Alarm notification | 0=no alarm, 1=alarms active no buzzer, 2=alarms and buzzer active | 0x4003 | 16387 |
| | System ON/OFF status | 0=OFF, 1=ON | 0x4004 | 16388 |
| | Global compressor status | 0=all OFF, 1=all OFF and at least one waiting ON, 3=at least one waiting OFF, 4=at least one ON (and none is waiting to be turned ON or OFF) | 0x4005 | 16389 |
| | Active setpoint | (High) | 0x4006 | 16390 |
| | | (Low) | 0x4007 | 16391 |
| | System time | (High) | 0x4008 | 16392 |
| | | (Low) | 0x4009 | 16393 |
| | Compressor inverter status | 0=OFF, 1=ON | 0x400A | 16394 |
| | Pump status | 0=OFF, 1=ON | 0x400B | 16395 |
| | Fan status | 0=OFF, 1=ON | 0x400C | 16396 |
| | Heater status | 0=OFF, 1=ON | 0x400D | 16397 |
| | ON/OFF digital input | 0=OFF, 1=ON | 0x400E | 16398 |

| Code | Description | Note | Modbus message address | |
|---|---|---|---|---|
| | Defrost status | 0=OFF, 1=ON | 0x400F | 16399 |
| | | | | |
| | Status of compressor 1 | 0=OFF, 1=waiting ON, 3=waiting OFF, 4=ON | 0x4021 | 16417 |
| | Status of compressor 2 | 0=OFF, 1=waiting ON, 3=waiting OFF, 4=ON | 0x4022 | 16418 |
| | Status of compressor 3 | 0=OFF, 1=waiting ON, 3=waiting OFF, 4=ON | 0x4023 | 16419 |
| | Status of compressor 4 | 0=OFF, 1=waiting ON, 3=waiting OFF, 4=ON | 0x4024 | 16420 |
| | Status of compressor 5 | 0=OFF, 1=waiting ON, 3=waiting OFF, 4=ON | 0x4025 | 16421 |
| | Status of compressor 6 | 0=OFF, 1=waiting ON, 3=waiting OFF, 4=ON | 0x4026 | 16422 |
| | Status of compressor 7 | 0=OFF, 1=waiting ON, 3=waiting OFF, 4=ON | 0x4027 | 16423 |
| | Status of compressor 8 | 0=OFF, 1=waiting ON, 3=waiting OFF, 4=ON | 0x4028 | 16424 |
| | Status of compressor 9 | 0=OFF, 1=waiting ON, 3=waiting OFF, 4=ON | 0x4029 | 16425 |
| | Status of compressor 10 | 0=OFF, 1=waiting ON, 3=waiting OFF, 4=ON | 0x402A | 16426 |
| | Status of compressor 11 | 0=OFF, 1=waiting ON, 3=waiting OFF, 4=ON | 0x402B | 16427 |
| | Status of compressor 12 | 0=OFF, 1=waiting ON, 3=waiting OFF, 4=ON | 0x402C | 16428 |
| | | | | |
| | Compressor 1 hour counter (seconds) | (High) | 0x4042 | 16450 |
| | | (Low) | 0x4043 | 16451 |
| | Compressor 2 hour counter (seconds) | (High) | 0x4044 | 16452 |
| | | (Low) | 0x4045 | 16453 |
| | Compressor 3 hour counter (seconds) | (High) | 0x4046 | 16454 |
| | | (Low) | 0x4047 | 16455 |
| | Compressor 4 hour counter (seconds) | (High) | 0x4048 | 16456 |
| | | (Low) | 0x4049 | 16457 |
| | Compressor 5 hour counter (seconds) | (High) | 0x404A | 16458 |
| | | (Low) | 0x404B | 16459 |
| | Compressor 6 hour counter (seconds) | (High) | 0x404C | 16460 |
| | | (Low) | 0x404D | 16461 |
| | Compressor 7 hour counter (seconds) | (High) | 0x404E | 16462 |
| | | (Low) | 0x404F | 16463 |
| | Compressor 8 hour counter (seconds) | (High) | 0x4050 | 16464 |
| | | (Low) | 0x4051 | 16465 |
| | Compressor 9 hour counter (seconds) | (High) | 0x4052 | 16466 |
| | | (Low) | 0x4053 | 16467 |
| | Compressor 10 hour counter (seconds) | (High) | 0x4054 | 16468 |
| | | (Low) | 0x4055 | 16469 |
| | Compressor 11 hour counter (seconds) | (High) | 0x4056 | 16470 |
| | | (Low) | 0x4057 | 16471 |
| | Compressor 12 hour counter (seconds) | (High) | 0x4058 | 16472 |
| | | (Low) | 0x4059 | 16473 |
| | Evaporator pump 1 hour counter (seconds) | (High) | 0x405A | 16474 |
| | | (Low) | 0x405B | 16475 |

| Code | Description | Note | Modbus message address | |
|---|---|---|---|---|
| | Evaporator pump 2 hour counter (seconds) | (High) | 0x405C | 16476 |
| | | (Low) | 0x405D | 16477 |
| | | | | |
| | Active differential | | 0x405E | 16478 |
| | Inverter compressor | | 0x405F | 16479 |
| | Regulation temperature | (High) | 0x4060 | 16480 |
| | | (Low) | 0x4061 | 16481 |
| | Active setpoint | (High) | 0x4062 | 16482 |
| | | (Low) | 0x4063 | 16483 |
| | Power request | (# # #,# %) | 0x4064 | 16484 |
| | Actual power | (# # #,# %) | 0x4065 | 16485 |
| | | | | |
| | **ALARMS** | | | |
| | **Alarms list** | | 0x4300 | 17152 |
| | See Alarm table | | | |
| | *first alarm* | | 0x4301 | 17153 |
| | | | | |
| | **Alarms active times** | | 0x4400 | 17408 |
| | See Alarm table | | | |
| | | | | |
| | **INPUT/OUTPUT** | | | |
| | Digital input 1-16 | 0=non active; 1=active or not present<br>(digital input "active" means in the opposite state of its polarity; e.g. if DI1 polarity is set to "Open", DI1 is active when it is closed)<br><br>DI1 0000 0001 0000 0000<br>DI2 0000 0010 0000 0000<br>DI3 0000 0100 0000 0000<br>DI4 0000 1000 0000 0000<br>DI5 0001 0000 0000 0000<br>DI6 0010 0000 0000 0000<br>DI7 0100 0000 0000 0000<br>DI8 1000 0000 0000 0000<br>DI9 0000 0000 0000 0001<br>DI10 0000 0000 0000 0010<br>DI11 0000 0000 0000 0100<br>DI12 0000 0000 0000 1000<br>DI13 0000 0000 0001 0000<br>DI14 0000 0000 0010 0000<br>DI15 0000 0000 0100 0000<br>DI16 0000 0000 1000 0000 | 0x4501 | 17665 |
| | Digital input 17-22 | DI17 0000 0001 0000 0000<br>DI18 0000 0010 0000 0000<br>DI19 0000 0100 0000 0000<br>DI20 0000 1000 0000 0000<br>DI21 0001 0000 0000 0000<br>DI22 0010 0000 0000 0000 | 0x4502 | 17666 |
| | | | | |
| | Digital Output 1-16 | DO1 0000 0001 0000 0000<br>DO2 0000 0010 0000 0000<br>DO3 0000 0100 0000 0000<br>DO4 0000 1000 0000 0000<br>DO5 0001 0000 0000 0000<br>DO6 0010 0000 0000 0000<br>DO7 0100 0000 0000 0000<br>DO8 1000 0000 0000 0000<br>DO9 0000 0000 0000 0001<br>DO10 0000 0000 0000 0010<br>DO11 0000 0000 0000 0100<br>DO12 0000 0000 0000 1000<br>DO13 0000 0000 0001 0000<br>DO14 0000 0000 0010 0000<br>DO15 0000 0000 0100 0000<br>DO16 0000 0000 1000 0000 | 0x4503 | 17667 |

| Code | Description | Note | Modbus message address | |
|---|---|---|---|---|
| | Digital Output 17-20 | DO17 0000 0001 0000 0000<br>DO18 0000 0010 0000 0000<br>DO19 0000 0100 0000 0000<br>DO20 0000 1000 0000 0000 | 0x4504 | 17668 |
| | | | | |
| | Analog input 1 | | 0x4505 | 17669 |
| | Analog input 2 | | 0x4506 | 17670 |
| | Analog input 3 | | 0x4507 | 17671 |
| | Analog input 4 | | 0x4508 | 17672 |
| | Analog input 5 | | 0x4509 | 17673 |
| | Analog input 6 | | 0x450A | 17674 |
| | Analog input 7 | | 0x450B | 17675 |
| | Analog input 8 | | 0x450C | 17676 |
| | Analog input 9 | | 0x450D | 17677 |
| | Analog input 10 | | 0x450E | 17678 |
| | Analog input 11 | | 0x450F | 17679 |
| | Analog input 12 | | 0x4510 | 17680 |
| | Analog input 13 | | 0x4511 | 17681 |
| | Analog input 14 | | 0x4512 | 17682 |
| | Analog input 15 | | 0x4513 | 17683 |
| | Analog input 16 | | 0x4514 | 17684 |
| | | | | |
| | Analog output 1 | | 0x451F | 17695 |
| | Analog output 2 | | 0x4520 | 17696 |
| | Analog output 3 | | 0x4521 | 17697 |
| | Analog output 4 | | 0x4522 | 17698 |
| | Analog output 5 | | 0x4523 | 17699 |
| | Analog output 6 | | 0x4524 | 17700 |
| | | | | |
| | **PARAMETERS** | | | |
| | **Parameters list** | | 0x2000 | 8192 |
| | See Configurator | | | |
| | *first parameter* | | 0x2001 | 8193 |