LCA - LCW - LCR

pCO ADVANCED MICROPROCESSOR USER MANUAL

GB

CE

COMPANY
WITH QUALITY SYSTEM
CERTIFIED BY DNV
ISO 9002

Galletti
AIR CONDITIONING

Index

1. General description of the application

The operation of LCA and LCA-H units (heat pump model) is managed by application software installed in the controller on the unit. The main features of the application program are described below.

1.1 Types of units controlled

The software is designed to control air/water chiller units (LCA model), also models with operation as a heat pump (LCA-H model).

1.2 Maximum number of compressors

From 1 to 4 hermetic scroll compressors, up to 2 cooling circuits.

1.3 Types of regulation

Proportional regulation or proportional regulation with integral action on the evaporator input temperature. Possibility of adjusting the setpoint remotely.

1.4 Condensation

Condensation can be carried out in the following modes:

- on/off based on compressor operation (without pressure transducers);
- on/off or modulating based on the pressure transducer reading (when high pressure transducers are enabled);

1.5 Compressor operating turnover

Turnover of all compressors according to a FIFO logic.
Selection of balanced turnover of all compressors according to a FIFO logic.

1.6 Defrosting modes (LCA-H model)

Defrosting can be simultaneous or separated among the circuits.

1.7 Safety devices on each cooling circuit

- High pressure (pressure switch).
- Low pressure (pressure switch).
- Compressor thermal switch.

1.8 System safety features

- Serious alarm (shuts the whole unit down)
- Evaporator flow switch (shuts the whole unit down).
- Pump thermal switch
- Condensation fan thermal switch
- Remote on/off input without alarm signalling.

1.9 Optional accessories

- Supervision by means of RS485 serial board.
- Alarm history building with clock board.

2 Regulation logic

2.1 Inlet temperature regulation

Inputs used:
- Evaporator inlet water temperature

Parameters used:
- Regulation setpoint
- Proportional band for input temperature regulation.
- Type of regulation (proportional or proportional + integral)
- Integration time (if proportional + integral regulation is enabled)

Outputs used:
- Compressor On/Off

Regulation diagram with two compressors:

2 = C1 e C2 On

1 = C1 On e C2 Off

0 = C1 e C2 Off

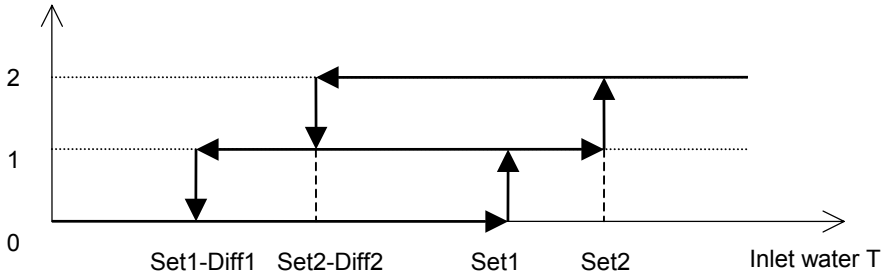


Figure 0: Regulation diagram with two compressors

2.1.1 PROPORTIONAL regulation

On the basis of the setpoint entered from the mask (ref. mask *M_SETPOINT5, page* 21), if the secondary setpoint or the remote setpoint is active, a proportional band is calculated with a width equal to the differential set from the mask (ref. mask *M_USER25, page* 21).
Inside this band the positions of the device regulation steps are calculated according to the number of compressors.

2.1.2 PROPORTIONAL + INTEGRAL Regulation

Proportional + integral regulation uses the same parameters as simple proportional regulation; it calculates the steps at which the devices are cut in on the basis of the setpoint, the differential and the integration time set from the mask (ref. mask *M_USER20, page* 21). The integral action is doubled if the conditions have not changed after the time set.

2.1.3 Setpoint

Main Setpoint
From the mask M_SETPOINT15 (see page) it is possible to set the main setpoint for the summer (LCA) and winter (LCA-H) operating modes.

Secondary Setpoint
From the mask M_MANUF28 (see page 23) it is possible to select the ID 14 digital input configuration for the management of serious alarms or the secondary setpoint. If secondary setpoint management is selected, the M_SETPOINT10 (see page 21) is enabled for the setting of the summer and winter setpoints controlled by the digital input.

With the digital input open, the setpoint entered from the M_SETPOINT5 mask (see page 21) will be used; with the digital input closed, the secondary setpoint will be used.
An "R" will appear in the upper right corner of the setpoint masks to indicate the activation of the secondary setpoint.

Remote Setpoint
From the M_USER24 mask (see page 21) it is possible to enable the remote setpoint function that uses an analog input. The signal will be converted between the minimum and maximum values set from the mask. The read value will then be added to the setpoint value resulting from the secondary setpoint management.

2.2 Compressor times and configuration

The unit enables the control of hermetic scroll compressors. Mask *M_MANUF20* (see 5.1.7 Manufacturer menu
page 23) is used for configuration purposes; from the mask it is necessary to set the number of compressors per circuit and the number of circuits.
Most of the operations performed by the pCO[1] are conditioned by programmable delays. Some of them serve to delay the triggering of some alarms or to assure the proper functioning of the compressors, thereby lengthening their lives and guaranteeing system stability.

2.2.1 Compressor operation turnover

The compressor operation turnover makes it possible to balance the number of hours of operation and the number of starts-stops of the various compressors. The turnover is carried out according to a FIFO logic, meaning that the first compressor to start will also be the first to stop. During the initial start-up period this behaviour may result in big differences between the operating hours of the compressors. However, at full capacity operation the number of hours will be very similar.

Management without FIFO turnover (with four compressors):
- Start-up: C1,C2,C3,C4.
- Stop: C4,C3,C2,C1.

Management with FIFO turnover (with four compressors):
- Start-up: C1,C2,C3,C4.
- Stop: C1,C2,C3,C4.

If the turnover function is enabled it is possible to select the balanced turnover , which always follows a FIFO logic, i.e. the odd devices are activated first and then the even ones:
- Start-up: C1, C3, C2, C4.
- Stop: C1, C3, C2, C4.

2.2.2 Minimum compressor “ON” time

(ref. mask *M_MANUF40,* 5.1.7 see Manufacturer menu
, page 23)

This determines the minimum time (in seconds) the devices must continue running: therefore, once activated they must stay on for the set length of time.

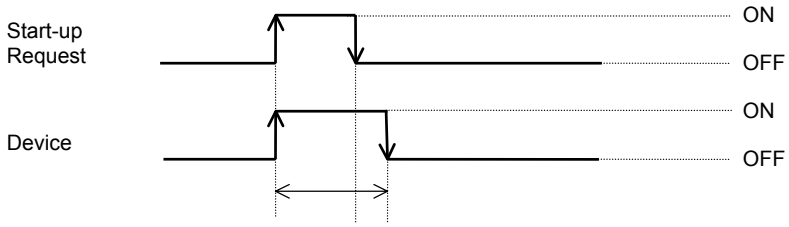


Figure 0: Minimum compressor on time

2.2.3 Minimum compressor “OFF” time

(ref. mask *M_MANUF40,* 5.1.7 see Manufacturer menu
, page 23)

This determines the minimum time the devices must remain off. After they are shut off, the compressors cannot start up again until the set time has elapsed.

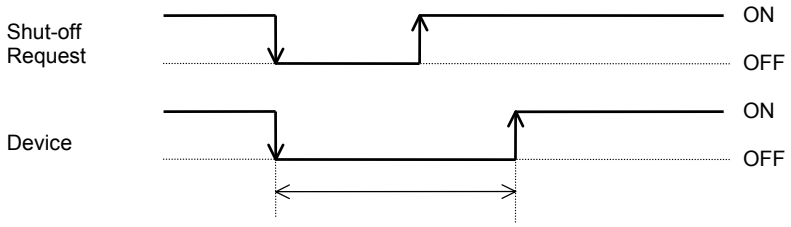


Figure 0: Minimum compressor off time

2.2.4 Delay between two start-up requests

(ref. mask *M_MANUF45,* 5.1.7 see Manufacturer menu
, page 23)

This determines the minimum time that must elapse between two device starts irrespective of the read measurement or setpoint. This parameter makes it possible to limit the number of starts per hour. If, for instance, the maximum allowed number of starts per hour is 10, setting a value of 360 seconds will ensure that this limit is complied with.

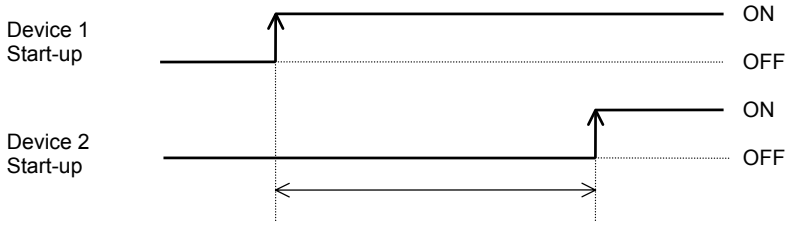


Figure 0: Delay between two start-up requests

2.2.5 Delay between two successive start-ups of the same compressor

(ref. mask *M_MANUF45,* 5.1.7 see Manufacturer menu
, page 23)

This establishes the minimum time that must elapse between two starts of the same device, irrespective of the read measurement or the setpoint. This parameter makes it possible to limit the number of starts per hour. If, for instance, the maximum allowed number of starts per hour is 10, setting a value of 360 seconds will ensure that this limit is complied with.

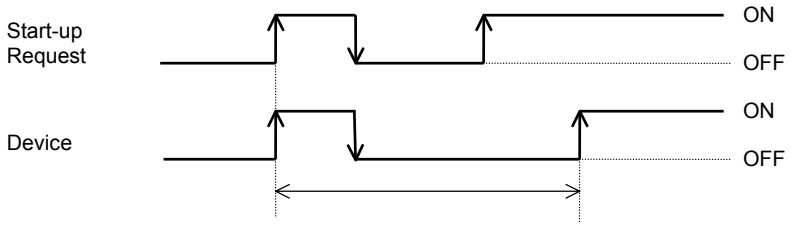


Figure 0: Delay between two successive start-ups of the same compressor

2.3 Condensation Control

Condensation can be regulated according to the following modes
- on/off based on compressor operation (without pressure transducers);
- on/off or modulating based on the pressure transducer reading (when high pressure transducers are enabled);

Inputs used:
- High pressure probe of first circuit (B5 analog input)
- High pressure probe of second circuit (B6 analog input)

Parameters used:
- Condensation control selection: none/pressure
- Number of fans
- Type of condensation coil (Single / Separate)
- Condensation Setpoint
- Condensation Differential
- Enabling of prevent function
- Prevent Setpoint
- Prevent Differential
- Delay in device reactivation after triggering of prevent function
- Output voltage relative to minimum inverter speed
- Output voltage relative to maximum inverter speed
- Inverter speed-up time

Outputs used:
- Fans (NO9 digital output)
- Fan speed regulation (Y1 analog output)

2.3.1 Settings

For condensation it is necessary to set:
- the type of regulation by means of the “Abilit.“ (Enable) code in the *M_MANUF50* mask (see page 23). The selection is made between *NO / TEMPERATURE* for choosing regulation either on the basis of the compressor status or on the basis of the values read by the pressure transducers;
- the type of devices used by specifying the “Tipo” (Type) code in the *M_MANUF50* mask (see page 23). The selection is made between *INVERTER / GRADINI (STEPS)* for choosing either the modulating or the ON/OFF type regulation;
- the number of fans connected if step regulation is selected, by entering a value for “N. Ventilatori” (No. of fans) in the *M_MANUF55* mask (see page 23);
- the type of condenser by means of the “Condensatore” (Condenser) code in the *M_MANUF55* mask (see page 23). The selection is made between *SINGLE / SEPARATE;*
- the condensation setpoint and the differential, to be entered in the *M_MANUF60* mask (see page 23). The setting generates a proportional band (setpoint / setpoint + differential) from which it calculates the position of the various fan activation steps or the modulating output value according to the selection made;
- the minimum and maximum speeds of the inverter by specifying the “Max.velocità” (Max. Speed), ”Min.velocità” (Min. Speed) codes in the *M_MANUF70* mask (see page 23); the proportional action of the modulating output is calculated within the range of these values;

- the minimum operating time of the inverter by specifying the “Tempo min ON" (Min. ON Time) code on the *M_MANUF70* mask (see page 23);
- enabling of the prevent function by means of the “Abilit." Prevenzione ALTA PRESSIONE (“Enable” HIGH PRESSURE prevention) code in the *M_MANUF80* mask (see page 23). The prevent function will be executed according to the modes specified below in this section;
- the prevent setpoint and differential (ref. *M_MANUF80* mask , see page 23);
- the delay in compressor restarts after triggering of the prevent function (ref. *M_MANUF81* mask page 23);

Condensation on/off based on compressor operation
If *NO* is selected in the *M_MANUF50* mask (see page 23*)* the fans’ operation will depend only on the operation of the compressors.

Condensation on/off based on pressure sensor
If *PRESSURE* is selected in the *M_MANUF50* mask *(see page* 23*),* the fans’ operation will depend only on the pressure read by the pressure sensors, according to the selected setpoint and differential band. With pressure values lower or equal to the setpoint all fans will be turned off; with pressure values higher than the setpoint + differential band, all fans will be turned on. It will be possible to select the condensation function either with a single coil or separate coil. In the case of single coil condensation, the fans will be controlled by the highest pressure; with separate coil condensation each pressure sensor will control its respective fan.

Modulating condensation based on pressure sensor
If this type of condensation is chosen, the fans will be controlled in a manner proportional to the readings of the pressure sensor. It will be possible to select the condensation function either with a single or separate coil. In the case of a single coil, the inverter will be controlled by the highest pressure; with a separate coil each pressure sensor will control its respective inverter. The graph below shows fan operation after the setpoint and the differential band have been set.

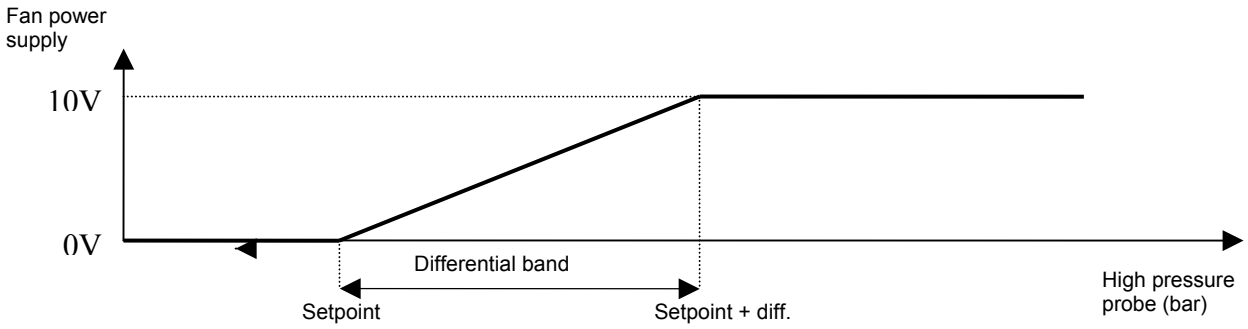


Figure 0: Modulating condensation based on pressure sensor

If the minimum fan speed is assigned to a power supply value higher than 0V (the graph shows a case where the minimum speed has been assigned to 3V) a 1 bar hysteresis (default) is applied in order to avoid repeated start-ups and stops.

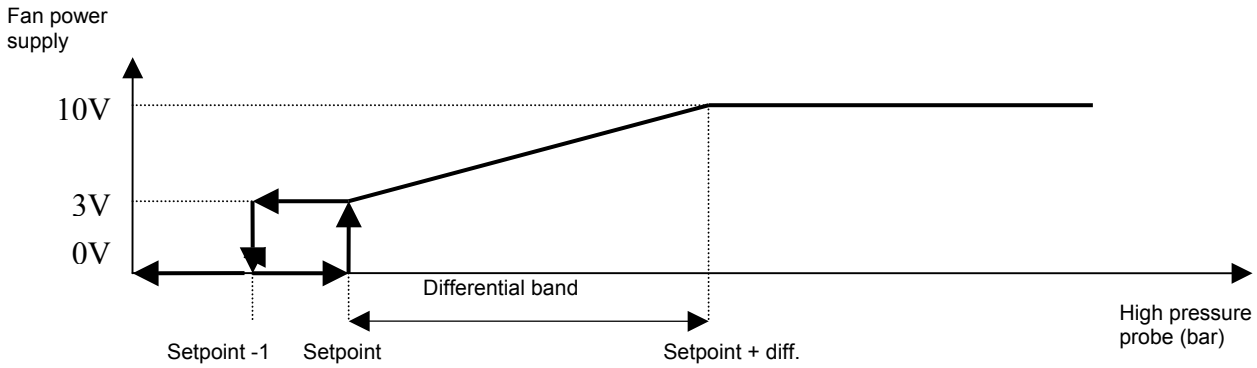


Figure 0: Modulating condensation with 1 bar Hysteresis

2.3.2 High pressure alarm

If the pressure value exceeds the high pressure alarm setpoint selected in the *M_MANUF85* mask (see page 23) an alarm will be signalled and the circuit concerned will be deactivated. The alarm will turn off when the pressure drops below the setpoint – differential value.

2.3.3 Prevent function

Selecting this function requires access to a factory-set password. It serves to prevent circuits from being blocked due to the triggering of the high pressure alarm. It can be set only on units having two compressors per circuit.
Setpoint and differential values must be selected from the *M_MANUF80* mask (see page 23). The prevent function shuts off the compressors, thereby dividing the power supplied to the cooling circuit. When the condensation pressure exceeds the prevent function activation value (setpoint), the function is triggered and remains active until the value detected goes below the prevent function deactivation value (setpoint – differential). At this point a delay is activated (settable from the *M_MANUF81* mask on page 23) which lengthens the prevent action, thus delaying any restart of the compressors.

2.4 Defrost control

Inputs used:
- High pressure probe of first circuit (B5 analog input)
- High pressure probe of second circuit (B6 analog input)

Parameters used:
- Inputs used for defrosting
- Defrosting modes (simultaneous / separate)
- Start defrost setting
- End defrost setting
- Defrost delay time
- Maximum defrost time
- Drip time
- Reverse cycle with compressors off (No / Input / Output / Input-Output)

Outputs used:
- Compressor 1
- Compressor 2
- Compressor 3
- Compressor 4
- Reversing solenoid valve – cycle 1
- Reversing solenoid valve – cycle 2
- Fans

The defrosting function requires the setting of some parameters protected by a factory-set password (ref. *M_MANUF130* mask page 23), i.e.:

- *PRESSURE* defrosting probe*;*
- Defrosting mode (*SIMULTANEOUS / SEPARATE*)*;*
- Cooling cycle reverse with compressors turned off (*NO / INPUT /OUTPUT / INPUT-OUTPUT*)*;*

as well as some parameters protected by a user password (ref. *M_USER50 / 55* mask – see page 23), i.e.:

- start/end defrost threshold;
- defrost activation delay time;
- maximum defrost time;
- drip time at the end of defrosting cycle;

Defrosting of one circuit under pressure control:
The defrosting cycle starts when the coil temperature/pressure remains below the start defrost threshold for a total time (t1+t2+t3) equal to the defrost delay time and if at least one compressor of the circuit concerned is on.

- compressors are or are not turned off according to the selection made from the mask and the cooling cycle is reversed by means of the 4-way valves.
- the fans are forced into the OFF mode.

The circuit terminates the defrosting cycle when the threshold is exceeded, i.e. when the temperature/pressure value exceeds the end defrost setpoint or when the maximum time set from the mask has elapsed if the temperature/pressure value has not exceeded the end defrost setpoint.

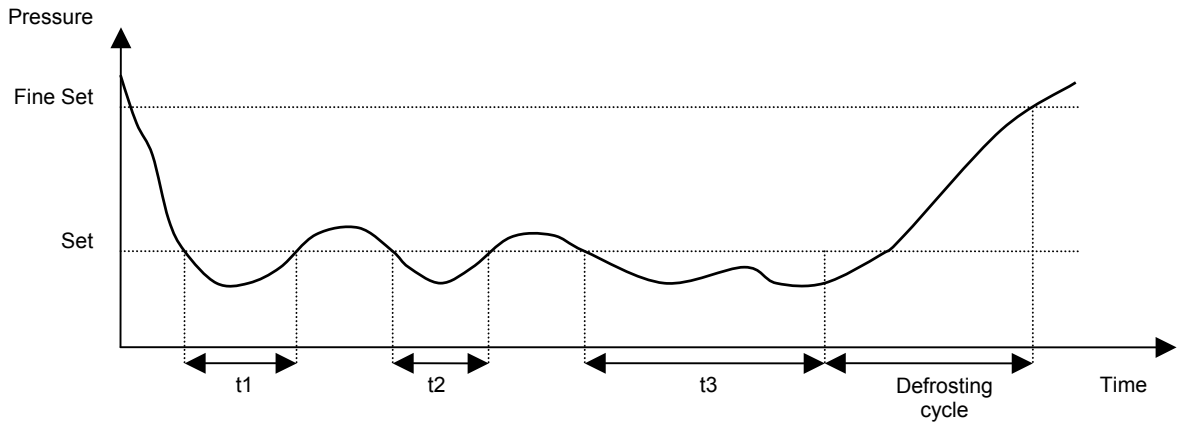


Figure 0: Defrosting cycle

Simultaneous defrosting mode
Even if only one circuit requires defrosting, all circuits are forced into the defrosting mode. Circuits not requiring defrosting (temperature/pressure higher than the end defrost threshold) stop and remain on stand-by. As soon as the defrosting cycle has terminated, all the compressors can start up again in the heat pump mode.

Separate defrosting mode
In this defrosting mode each cooling circuit undergoes a defrosting cycle separately. The first circuit requiring defrosting starts a defrosting cycle, whereas the other circuits remain on standby until the first circuit has completed its defrosting cycle, even if they too require defrosting. When the defrosting cycle of the first circuit is finished, the following circuit will be defrosted, while the other circuits wait their turn.

2.5 Antifreeze regulation

Inputs used

- Evaporator outlet water temperature probe.

Parameters used:

- Enabling of outlet line probe;
- Antifreeze alarm setpoint;

- Antifreeze alarm differential;

Outputs used:
- Antifreeze alarm;

Each pCO[1] unit can manage antifreeze regulation provided that the outlet temperature probe is connected and enabled.

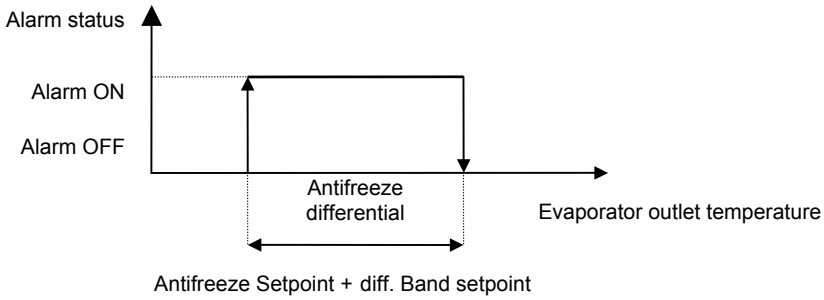


Figure 0: Antifreeze regulation

3 Start-up and configuration

3.1 Terminal with keyboard and display

Figure 0: Terminal

The user *terminal* is shown in the picture. It consists of a 4 line x 20 column LCD, keyboard and LEDs controlled by a microprocessor: from the terminal the user can set the control parameters (setpoint, differential band, alarm thresholds, etc.) and perform fundamental operations.
The following main operations can be performed via the terminal:

- initial machine configuration;
- modification of main operating parameters;
- display of machine status and of all measured data;
- display of the alarms detected and a 'buzzer' (that can be disabled);

The terminal and the pCO[1] controller are connected via a 6-way telephone cable. **This connection is not essential for standard controller operation.**

3.2 Display

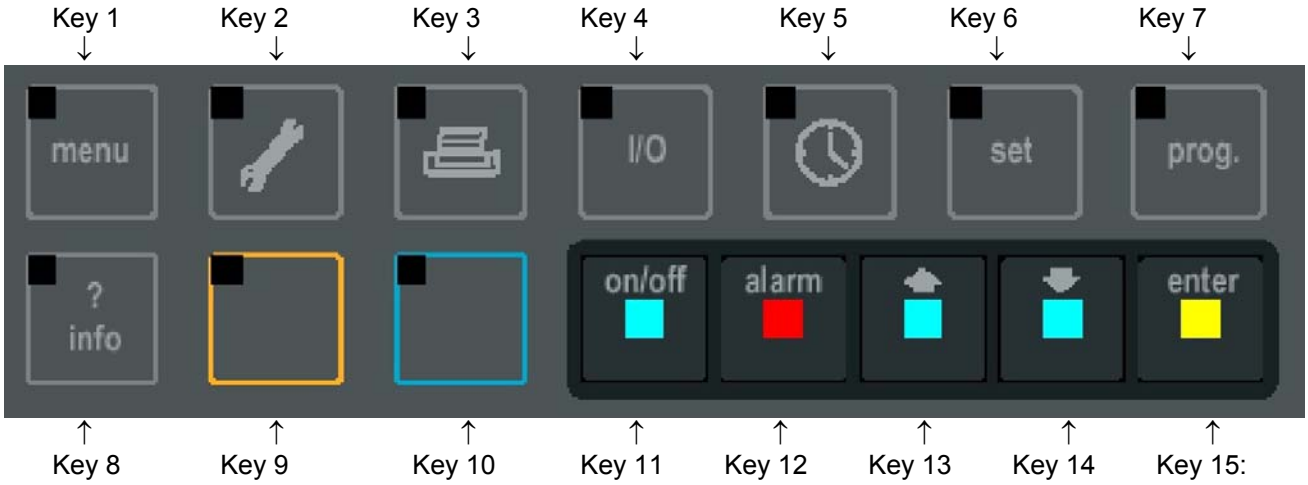
The display used is of the 4 line x 20 column LCD type. The data and information regarding operation alternate as successive windows called *masks*. It is possible to move around inside the masks using the terminal keys as described below:

3.2.1 Moving around inside the masks

```
x           Line0
Home        Line1
            Line2
            Line3
```

If the cursor is positioned in the top left-hand corner (Home) pressing the ▲ ▼ keys allows the user to access the successive masks associated with the selected branch. If a mask includes fields for setting values, pressing the *ENTER* key will cause the cursor to move into these fields. Once a parameter setting field is reached it is possible to change its value, within the set limits, by pressing the ▲ ▼ keys. Once the desired value has been set, pressing the *ENTER* key again will store it in the memory.

3.3 Keyboard



Key 1: Accesses the mask displaying the fundamental machine data and status.

Key 2: Accesses device maintenance data (hours of service of a device and hour meter reset, alarm history, manual operating procedure).

Key 3: Function not active.

Key 4: Accesses the masks displaying digital and analog input/output statuses.

Key 5: Accesses the clock programming mask (if a clock board is included).

Key 6: Accesses the setpoint display / setting masks.

Key 7: Accesses the user parameter programming masks (thresholds, delays etc.).

Key 1 + Key 7: By pressing these keys at the same time the user accesses the machine configuration (number of devices connected to the pCO1, programming of the full scale values, etc.).

Key 8: Displays data concerning the software used.

Key 9: For selecting the winter mode (LCA-H model, not available on the LCA model).

Key 10: For selecting the summer mode (LCA-H model, this mode is always active on the LCA model).

Key 11: This key allows the unit to be switched on and off. The green LED illuminating the key indicates the unit status.

Key 12: This key is used for displaying alarms, resetting them manually and silencing the buzzer. If the key is lit (red LED) it means that at least one alarm has been detected. Pressing the key once will silence the buzzer and cause a mask to appear which describes the alarm that is active. Pressing a second time will reset the alarm signalling function.

Key 13: this key enables the setting of control parameters as well as movement from one mask to another (not backlit).

Key 14: this key enables the setting of control parameters as well as movement from one mask to another (not backlit).

Key 15: used for moving the cursor inside the masks and saving parameter settings. The key is constantly backlit (yellow light) to indicate that the power supply is on.

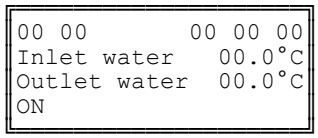
NOTE: The LEDs alongside each key come on when the respective function is activated.

3.4 Starting up the unit for the first time

When the microprocessor is connected to the power supply, the main menu will be displayed (M_Main). It contains the following information:

- current date and time;
- evaporator inlet water temperature;
- evaporator outlet water temperature;
- unit status;

M_Main



3.5 General description of menus

General description of the menus featured in the application; all the masks are shown and described in the chapter 5

Main menu

The main menu is displayed when the unit is started up and consists of the two masks described in the section 3.4 Starting up the unit for the first time

Maintenance menu

The maintenance menu can be accessed by pressing key 2. It shows the compressor and pump hour meters as well as the alarm history if a clock board has been installed.
If the maintenance password is entered (given to maintenance personnel directly by Galletti S.p.a) it will be possible to set the device hour meter alarm thresholds, clear the hour meter, set the probes, set the pump type and turnover time and enable the buzzer.

I/O Menu

The I/O menu can be accessed by pressing key 4 and shows the system's inputs and outputs.

Clock menu

The clock menu can be accessed by pressing key 5 and contains the time and date configuration.

Setpoint Menu

The Setpoint menu can be accessed by pressing key 6 and allows management of fixed and variable setpoints.

User menu

The User menu can be accessed by pressing key 7 and contains the configuration of user parameters. It is password protected.

Manufacturer menu

The Manufacturer menu can be accessed by pressing key 1 + key 7 together and contains the configuration of factory-set parameters. It is password protected.

Alarm menu

The Alarm menu can be accessed by pressing key 12 and gives information about the alarms that have been triggered.

4 Alarm management

The alarms are divided into three categories:

1. Warnings only (with display of warning message and buzzer or display of warning message, buzzer and alarm relay)
2. Circuit alarms (with deactivation of the circuit concerned, display of alarm message, buzzer and alarm relay);
3. Serious alarms (with shut down of the whole system, display of alarm message, buzzer and alarm relay).

Warnings
- Unit maintenance warning;
- Compressor maintenance warning;
- Clock board failure or disconnection;

Circuit alarms
- High pressure/pressure switch alarm: immediate shut down of the compressor and manual resetting
- Low pressure alarm with automatic/manual resetting (see description of its operation)
- Compressor thermal switch alarm with immediate shut down of the compressor and manual resetting;
- Fan thermal switch alarm, with fan stop and manual resetting.

Serious Alarms
- lack of water flow digital input alarm, delayed at start-up and at full capacity operation;
- evaporator antifreeze alarm, evaporator outlet probe function with activation setpoint and reset differential, with manual resetting
- serious alarm from digital input. Immediate shut down of the unit and manual resetting.

The alarms are reset manually by pressing the alarm key twice.

4.1 Main alarm table

Alarm Description	Compr. Off	Fan Off	Pump Off	System Off	Reset Auto/Man	Delay
Serious alarm	*	*	*	*	Man.	No
Antifreeze alarm	*	*		*	Man.	No
Thermal switch-Pump 1	*	*	*	*	Man.	No
Thermal switch-Pump 2	*	*	*	*	Man.	No
Evaporator flow switch	*	*			Man.	settable
Low pressure Press. switch C1						
Low pressure Press. switch C2	*				Man.	settable
High pressure Press. switch C1						
High pressure Press. switch C2	*				Man.	no
Fan thermal switch 1						
Fan thermal switch 2						
Probe failure B1					Auto.	60 sec.
Probe failure B2					Auto.	60 sec.
Probe failure B3					Auto.	60 sec.
Probe failure B4					Auto.	60 sec.
Probe failure B5					Auto.	60 sec.

Probe failure B6					Auto.	60 sec.
Maint. Pump 1					Man.	-
Maint. Pump 2					Man.	-
Maint. Compressor 1					Man.	-
Maint. Compressor 2					Man.	-
Maint. Compressor 3					Man.	-
Maint. Compressor 4					Man.	-
Phase direction	*	*	*	*	Man.	-

4.2 Alarm history

The unit has an alarm history function. To activate this function it is necessary to install the optional clock board, provided with 32k memory, and enable its use from the mask (ref. mask *M_MANUF27* 5.1.7 see Manufacturer menu
, page 23)
Alarms are memorised according to priorities decided at the programming stage. Each alarm has been attributed a priority code (the lower the code, the higher the priority); in this way if two alarms with different priorities are tripped at the same time, only the alarm with the lower code is stored (ref. 5.1.8 Alarm menu
).
In addition to the alarm code, the function stores the date and time, evaporator inlet and outlet temperatures, setpoint and band used at the moment the alarm is activated (ref. mask *M_MAINT17* see page).

M_Maint17

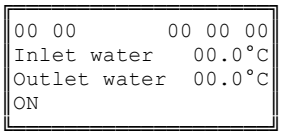
```
History alarm   0000
AL000 00:00 00/00/00
Set  00.0 Band  00.0
T.In 00.0 T.out 00.0
```

A maximum number of 1600 alarms can be stored. After this limit is reached memorisation will again start from the beginning, i.e. the oldest alarm will be overwritten with the new data.

5 Menu tree structure

5.1.1 Main menu

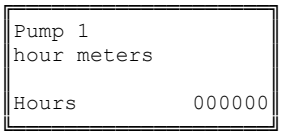
M_Main



The main information regarding the chiller's operation is displayed here. If the (optional) clock board has been installed, the current date and time will also be displayed

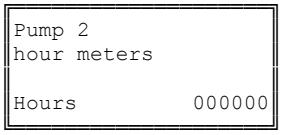
5.1.2 Maintenance menu

M_Maint5

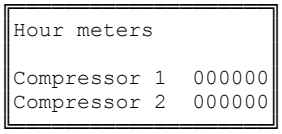


Pressing the *MAINTENANCE* key provides access to these masks, which display the number of hours of work performed by each device. These values will be stored in the flash memory of the pCO[1] board; data are recorded at three-hour intervals.
This function is provided whether or not a clock board is installed on the pCO[1].
If the number of working hours of a device equals the set threshold, the relative alarm is triggered.

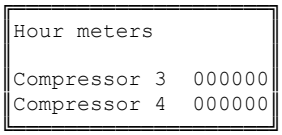
M_Maint6



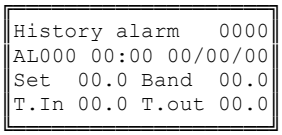
M_Maint10



M_Maint15

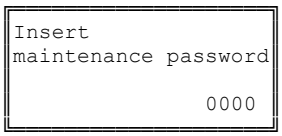


M_Maint17



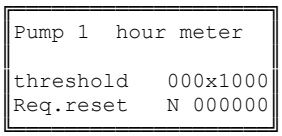
This is the alarm history mask.

M_Pw_Maint



The maintenance password is required for viewing the following masks. The password is only available on request.

M_Maint20



In these masks it is possible to modify the value of the device maintenance alarm threshold and reset the hour meter of each device after it has undergone maintenance

M_Maint21

```
Pump 2  hour meter

threshold   000x1000
Req.reset   N 000000
```

M_Maint25

```
Compressor 1
hour meter
Threshold   000x1000
Req.reset   N 000000
```

M_Maint30

```
Compressor 2
hour meter
Threshold   000x1000
Req.reset   N 000000
```

M_Maint35

```
Compressor 3
hour meter
Threshold   000x1000
Req.reset   N 000000
```

M_Maint40

```
Compressor 4
hour meter
Threshold   000x1000
Req.reset   N 000000
```

M_Maint45

```
Filters config.
Enable            N
Anal. delay time  0s
Dig. delay time   0s
```

From this mask it is possible to enable the software filters applied on analog inputs. The detected input value is transmitted to the control if it maintains the value for a time equal to or greater than the time set.

M_Maint50

```
Inputs probes offset
B1: 0.0    B2: 0.0
B3: 0.0    B4: 0.0
B5: 0.0    B6: 0.0
```

Here it is possible to set probe offset values to be added to or subtracted from readings. (See 17 flap for installation of clock board (optional) .
)

M_Maint60

```
Pump sequence  type


AUTOMATIC
```

M_Maint65

```
Pump sequence  time


           000 hours
```

M_Maint70

```
Pump sequence
selection

SEQUENCE 1
```

M_Maint75

```
Erase historical
memory board
                N
```

This mask only appears if the clock board has been configured and the unit is off. Selecting S activates the procedure of erasing all the historical data. During this operation, a stand-by message will appear on the last line of the mask and no other operation will be possible until erasure is complete.

M_Maint100

```
Insert another
maintenance
password
             0000
```

5.1.3 I/O Menu

This set of masks provides a complete display of the statuses of the analog and digital inputs and outputs connected to the microprocessor.

M_InOut10

```
Digital inputs
CCCCCCCCCCC
Digital outputs
OOOOOOOOOOOO
```

M_InOut15

```
Analog inputs

B1:          00.0°C
B2:          00.0°C
```

M_InOut20

```
Analog inputs

B3:          00.0°C
B4:          00.0°C
```

M_InOut25

```
Analog inputs
B5:          00.0bar
B6:          00.0bar
B7:          00.0°C
```

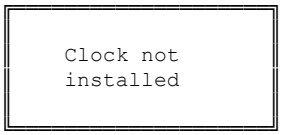
M_InOut35

```
Analog outputs

Y0:            00.0V
Y1:            00.0V
```

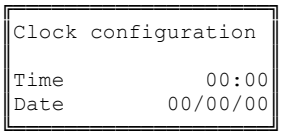
5.1.4 Clock menu

M_Clock5



When the clock key is pressed, this mask will be displayed if the clock board has not been configured in the manufacturer branch (ref. mask *M_MANUF27*

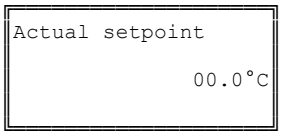
M_Clock10



When the clock key is pressed, if the clock board has been configured in the manufacturer branch (ref. mask *M_MANUF27*) this mask is displayed; from here it is possible to set the current date and time.

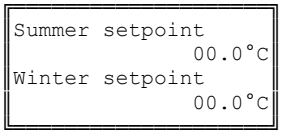
5.1.5 Setpoint Menu

M_Setpoint1

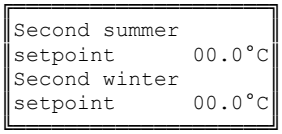


By pressing the SET key it is possible to access the following masks in order to view the summer and winter setpoints and active differentials

M_Setpoint5



M_Setpoint10

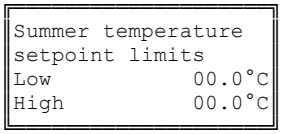


5.1.6 User menu

User menu access is password protected.

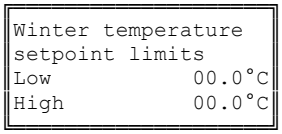
User password: 100

M_User5

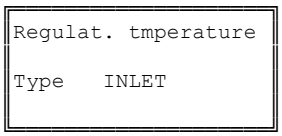


In these masks it is possible to select the minimum and maximum summer and winter setpoint values that may be set.

M_User15



M_User17



M_User20

```
Inlet regulation

Type      PROP.
Integration t. 0000s
```

If inlet regulation is selected, it is possible to choose whether to adopt a proportional or a proportional + integral type of regulation. In the latter case an integration time will also be set.

M_User22

```
Outlet regulation

Time on        0000s
Time off       0000s
```

M_User23

```
Outlet regulation
force off
Summer        00.0°C
Winter        00.0°C
```

M_User24

```
External setpoint
Enable           N
Min.          00.0°C
Max.          00.0°C
```

M_User25

```
Temperature band
              00.0°C
```

This mask enables the temperature regulation band to be set; on the basis of this value, according to the type of regulation selected, the proportional band or neutral zone will be calculated.

M_User30

```
Time between
main pump/fan
and compressors
start          000s
```

In this mask it is possible to set the minimum delay between the pump start and compressor start

M_User35

```
Delay on switching
the main
pump/fan off
               000s
```

In this mask the pump shut off delay can be set.

M_User40

```
Digital input remote
on / off         N
Digital input remote
Summer / Winter  N
```

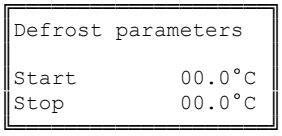
In this mask it is possible to set/enable the digital input remote on/off command. The summer/winter switching is not available.

M_User42

```
Supervisory remote
on / off         N
Supervisory remote
Summer / Winter  N
```

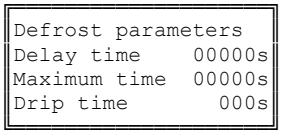
In this mask it is possible to set/enable the remote on/off command from the supervisory system. The summer/winter function is not available.

M_User50

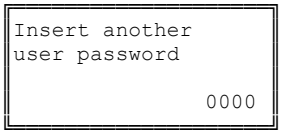


In this mask it is possible to set the defrost regulation parameters.

M_User55



M_User60

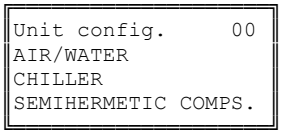


Here it is possible to change the user access password.

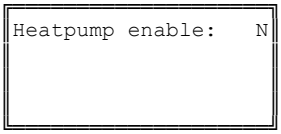
5.1.7 Manufacturer menu

User menu access is password protected. The password is only available on request.

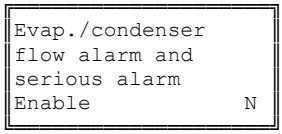
M_Manuf5



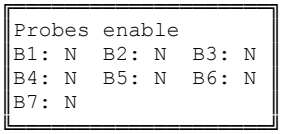
M_Manuf6



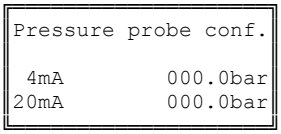
M_Manuf7



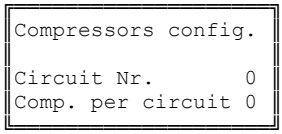
M_Manuf10



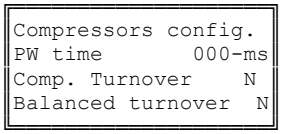
M_Manuf15



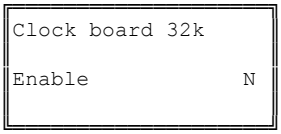
M_Manuf20



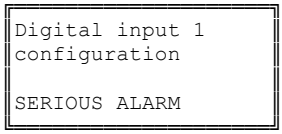
M_Manuf25



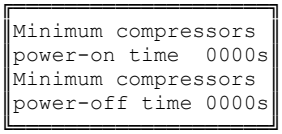
M_Manuf27



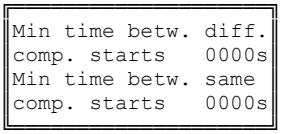
M_Manuf28



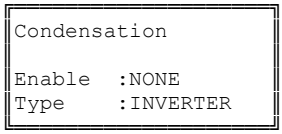
M_Manuf40



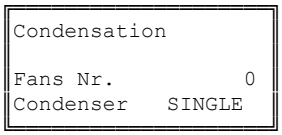
M_Manuf45



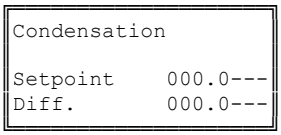
M_Manuf50



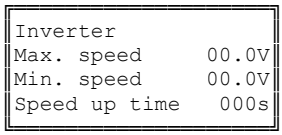
M_Manuf55



M_Manuf60



M_Manuf70



M_Manuf80

```
Prevent
                    N
Setpoint      00.0---
Diff.         00.0---
```

M_Manuf81

```
Prevent

Devices exit
delay           000 s
```

M_Manuf85

```
Transducers high
pressure alarm
Setpoint      00.0bar
Diff.         00.0bar
```

M_Manuf90

```
Low pressure alarm

Startup delay   000s
Run delay       000s
```

M_Manuf91

```
Low pressure alarm
Events Nr.          0
Period          0000s
Timeout start   000s
```

M_Manuf100

```
Antifreeze alarm

Setpoint      00.0°C
Diff.         00.0°C
```

M_Manuf105

```
Antifreeze heater

Setpoint      00.0°C
Diff.         00.0°C
```

M_Manuf110

```
Evaporat. flow alarm

Startup delay   000s
Run delay       000s
```

M_Manuf125

```
Reversing valve
logic
                  N.C.
```

M_Manuf130

```
Defrost config.
Probe  TEMPERATURE
Type   SIMULTANEOUS
Off Comp:         NO
```

M_Manuf132

```
Supervisory System
Communication speed:
1200  (RS485/RS422)
Indentificat.Nr.:000
```

M_Manuf135

```
Reset all parameters
to default values  N
```

M_Manuf190

```
Insert another
manufacturer
password
               0000
```

5.1.8 Alarm menu

Each mask gives information about a specific alarm situation. The activation of the masks is accompanied by the sounding of the buzzer and tripping of the general alarm signalling relay. By pressing the *ALARM* key once the user can access the first active mask and then scroll all alarms using the ▲ ▼ keys. Pressing the *ALARM* a second time will clear the alarm message. Each mask shows the code used in the alarm history to identify the particular event (ref. 4.2 Alarm history page 17)

M_Alarm00

```
    No alarms
     detected
```

M_Alarm5

```
AL:002
    Freeze alarm
```

M_Alarm10

```
AL:016
   Compressor 1/2
      overload
```

M_Alarm20

```
AL:018
   Compressor 3/4
      overload
```

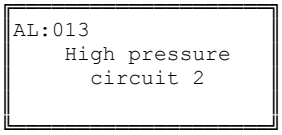
M_Alarm30

```
AL:005
   Evaporator flow
        alarm
```

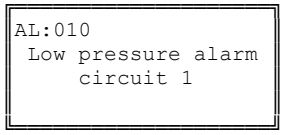
M_Alarm40

```
AL:012
    High pressure
      circuit 1
```

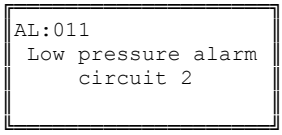
M_Alarm45



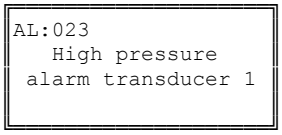
M_Alarm60



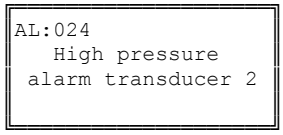
M_Alarm65



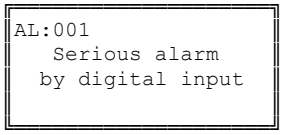
M_Alarm70



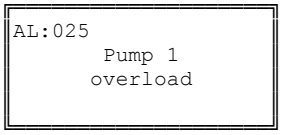
M_Alarm75



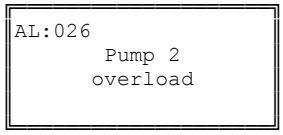
M_Alarm80



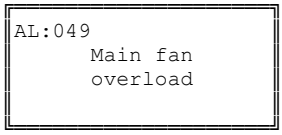
M_Alarm210



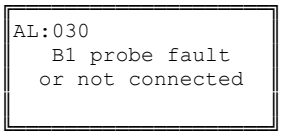
M_Alarm220



M_Alarm100



M_Alarm130



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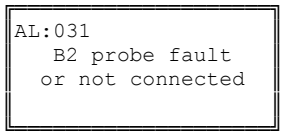

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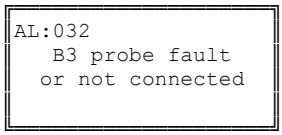

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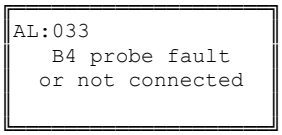

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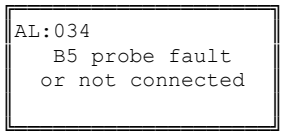

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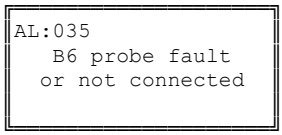

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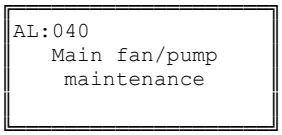

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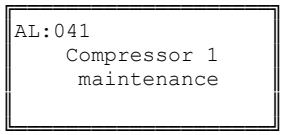

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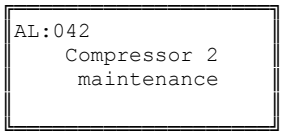

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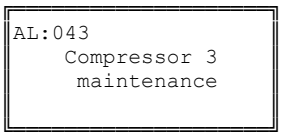

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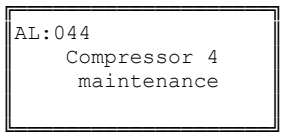

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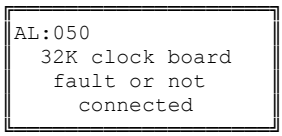

6 Application setting parameters

6.1 Table of default settings

Category	Description	Default
Probe management	Enable probe 1	Y
	Enable probe 2	Y
	Enable probe 3	Y
	Enable probe 4	N
	Enable probe 5	S
	Enable probe 6	S
	Enable probe 7	N
	Enable probe 8	N
	Setting of probe 1	0
	Setting of probe 2	0
	Setting of probe 3	0
	Setting of probe 4	0
	Setting of probe 5	0
	Setting of probe 6	0
	Pressure probe minimum value 0V	0 bar
	Pressure probe maximum value 5V	30 bar
Inputs/Outputs management	Enable compressor 1	Y
	Enable compressor 2	Y
	Enable compressor 3	Y
	Enable compressor 4	Y
	Enable remote on/off by digital input	N
	Configuration of digital input 14	Serious alarm
	Enable filters	N
	Digital filter delay	2 s
Circuit configuration	Unit configuration	02
	No. of compressors	1
Setting parameters	Summer setpoint	12 ºC
	Winter setpoint	40°C
	Secondary summer setpoint	12 ºC
	Secondary winter setpoint	40°C
	Summer minimum setpoint limit	7 ºC
	Summer maximum setpoint limit	17 ºC
	Winter minimum setpoint limit	40 ºC
	Winter maximum setpoint limit	50 ºC
	Temperature regulation band	4 ºC
	Temperature regulation type	inlet
	Inlet temperature regulation	proportional
	Integration time	600 s
	Cycle reversing valve logic	N.C.
Main pump/fan management	Main pump/fan turn-off delay	5 s
	Delay time between starts of pump/fan compressors	5 s
	Pump sequence time	24 h
	Pump maintenance type	AUTO
Compressor parameters	Enable turnover	Y
	Enable balanced turnover	N
	Minimum compressor run time	60 s
	Minimum compressor stop time	360 s
	Minimum time between start ups of different compressors	10 s

	Minimum time between start ups of same compressor	450 s
Condensation regulation	Condensation setpoint	14 bar
	Condensation differential	7 bar
	Type of condenser	single
	Type of condensation regulation	pressure
	Number of condensation fans	1
	Type of device cut in	inverter
	Enable high pressure prevent	Y
	Prevent setpoint	26.5 bars
	Prevent differential	2 bars
	Maximum fan speed inverter output voltage	10 V
	Minimum fan speed inverter output voltage	0 V
	Minimum inverter start up time	0 s
	Delay in device start up after triggering of prevent function	10 s
Defrosting management	Type	Simultaneous
	Probe	Pressure
	Defrost start threshold	2 bars
	Defrost end threshold	12 bars
	Defrost activation delay	1800 s
	Maximum defrosting time	300 s
	Compressor shut down for defrosting	NO
	Drip time	10 s
Remote setpoint management	Enable remote setpoint	N
	Remote minimum setpoint limit	0 ºC
	Remote maximum setpoint limit	5 ºC
Hour meter management	Hour threshold – pump 1	10000 h
	Hour threshold – pump 2	10000 h
	Hour threshold – compressor 1	10000 h
	Hour threshold – compressor 2	10000 h
	Hour threshold – compressor 3	10000 h
	Hour threshold – compressor 4	10000 h
Antifreeze management	Antifreeze alarm setpoint	4 ºC
	Antifreeze alarm differential	1 ºC
Flow switch management	Evaporator flow switch alarm delay at start up	20 s
	Evaporator flow switch alarm delay at full capacity operation	10 s
Transducer high pressure alarm management	High pressure alarm setpoint	27 bars
	High pressure alarm differential	2 bars
Low pressure alarm management	Low pressure alarm delay at start up	120 s
	Low pressure alarm delay at full capacity operation	0 s
	Number of low pressure alarm activations	3
	Alarm activation sampling period	3600 s
	Timeout	20 s
Supervisor management	Enable supervisor summer/winter selection	N
	Enable supervisor on/off function	N
	Baud rate	19200 bps
	Ident	1
Password	Maintenance password	-
	User password	100
	Manufacturer password	-

7 Architecture of the control system

7.1 Microprocessor layout

Connector description

1. connector to the power supply [G(+), G0(-)];
2. fuse 250 Vac, 2A delayed (T2 A);
3. universal analog inputs NTC, 0/1 V, 0/5 V, 0/20 mA, 4/20 mA;
4. passive analog inputs NTC and ON/OFF
5. passive analog inputs NTC
6. Yellow LED indicating power supply on and 3 indicator LEDs;
7. 0/10 V analogue outputs and PWM phase-cut outputs;
8. digital inputs at 24 Vac/Vdc;
9. digital inputs at 230 Vac or 24 Vac/Vdc;
10. connector with Vref for 5V power supply to probes and V Term for power supply to terminal;
11. connector for all standard terminals in the pCO series and for downloading the application program;
12. pLAN local network connector;
13. connector for connection to the programming key;
14. digital outputs to relay;
15. flap for selection of analog input type;
16. flap for installation of serial board:
    - RS485 for supervisor (optional)
    - Gateway (protocol converter, optional)
17. flap for installation of clock board (optional) .

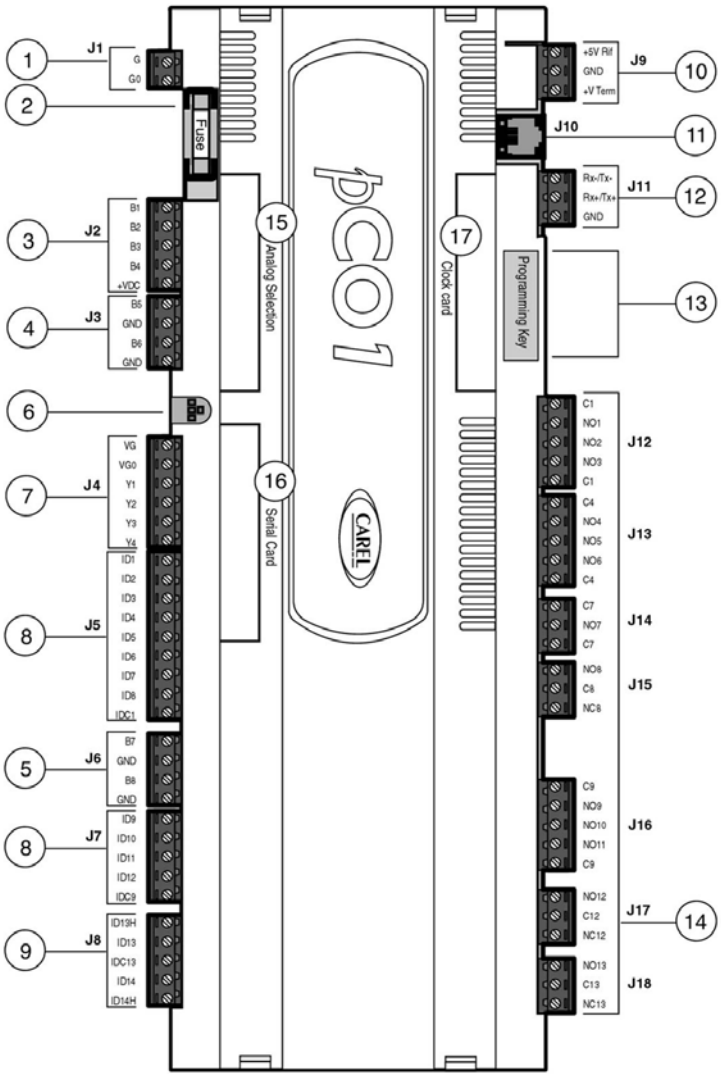

Figure 0: Layout microprocessore

7.2 Description of inputs and outputs

Conn.	Code	Description	Signal
J1-1	G	power supply +24 Vdc or 24 Vac	
J1-2	G0	power supply reference	
J2-1	B1	universal analog input 1 (NTC, 0..1 V, 0..10 V , 0..20 mA, 4..20 mA)	Condensation pressure probe 1
J2-2	B2	universal analog input 2 (NTC, 0..1 V, 0..10 V, 0..20 mA, 4..20 mA)	Condensation pressure probe 2
J2-3	B3	universal analog input 3 (NTC, 0..1 V, 0..10 V, 0..20 mA, 4..20 mA)	Remote adjustment of setpoint
J2-4	B4	universal analog input 4 (NTC, 0..1 V, 0..10 V, 0..20 mA, 4..20 mA)	
J2-5	+VDC	power supply for active probes 21 Vdc (max 200 mA)	
J3-1	B5	analog input 5	NTC temperature probe at evaporator inlet
J3-2	GND	shared analog inputs	
J3-3	B6	analog input 6	NTC temperature probe at evaporator outlet
J3-4	GND	shared analog inputs	
J4-1	VG	power supply for optoisolated analog output at 24 Vdc	
J4-2	VG0	power supply for optoisolated analog output at 0 Vac/Vdc	
J4-3	Y1	analog output n. 1 0..10 V	Condensation fan control
J4-4	Y2	analog output n. 2 0..10 V	
J4-5	Y3	analog output n. 3 0..10 V	
J4-6	Y4	analog output n. 4 0..10 V	
J5-1	ID1	digital input no. 1 at 24 Vac/Vdc	High pressure switch - circuit 1
J5-2	ID2	digital input no. 2 at 24 Vac/Vdc	High pressure switch - circuit 2
J5-3	ID3	digital input no. 3 at 24 Vac/Vdc	Low pressure switch - circuit 1
J5-4	ID4	digital input no. 4 at 24 Vac/Vdc	Low pressure switch - circuit 2
J5-5	ID5	digital input no. 5 at 24 Vac/Vdc	Thermal switch compressors 1 and 2
J5-6	ID6	digital input no. 6 at 24 Vac/Vdc	Thermal switch compressors 3 and 4
J5-7	ID7	digital input no. 7 at 24 Vac/Vdc	Thermal switch-Pump 1
J5-8	ID8	digital input no. 8 at 24 Vac/Vdc	Thermal switch-Pump 2
J5-9	IDC1	shared digital inputs from 1 to 8 (negative pole if the unit is DC powered)	
J6-1	B7	analog input 7	
J6-2	GND	shared analog inputs	
J6-3	B8	analog input 8	
J6-4	GND	shared analog inputs	
J7-1	ID9	digital input no. 9 at 24 Vac/Vdc	Water flow switch
J7-2	ID10	digital input no. 10 at 24 Vac/Vdc	General fan alarm
J7-3	ID11	digital input no. 11 at 24 Vac/Vdc	Phase direction alarm
J7-4	ID12	digital input no. 12 at 24 Vac/Vdc	Remote On/Off
J7-5	IDC9	shared digital inputs from 9 to 12 (negative pole if the unit is DC powered)	
J8-1	ID13H	digital input 13 at 230 Vac	
J8-2	ID13	digital input no. 13 at 24 Vac/Vdc	Summer/Winter (LCA-H)
J8-3	IDC13	shared digital inputs 13 and 14 (negative pole if the unit is DC powered)	
J8-4	ID14	digital input 14 at 24 Vac/Vdc	Serious alarm/secondary setpoint
J8-5	ID14H	digital input 14 at 230 Vac	
J9-1	+5V Rif	Reference voltage for pressure probe power supply	
J9-2	GND	shared analog inputs	
J9-3	+V Therm	Terminal supply voltage	
J10		six-way telephone-type connector for connection to standard	

		user terminal	
J11-1	TX-	RX-/TX- connector for RS485 serial connection to pLAN network	
J11-2	TX+	RX+/TX+ connector for RS485 serial connection to pLAN network	
J11-3	GND	GND connector for RS485 serial connection to pLAN network	
J12-1	C1	shared relay: 1, 2, 3	
J12-2	NO1	normally open contact relay no. 1	ON/OFF compressor 1
J12-3	NO2	normally open contact relay no. 2	ON/OFF compressor 2
J12-4	NO3	normally open contact relay no. 3	ON/OFF compressor 3
J12-5	C1	shared relay: 1, 2, 3	
J13-1	C4	shared relay: 4, 5, 6	
J13-2	NO4	normally open contact relay no. 4	ON/OFF compressor 4
J13-3	NO5	normally open contact relay no. 5	ON/OFF pump 1
J13-4	NO6	normally open contact relay no. 6	ON/OFF pump 2
J13-5	C4	shared relay: 4, 5, 6	
J14-1	C7	shared relay no. 7	
J14-2	NO7	normally open contact relay no. 7	ON/OFF antifreeze heaters
J14-3	C7	shared relay no. 7	
J15-1	NO8	normally open contact relay no. 8	Remote general alarm (on relay for remote control and indicator light)
J15-2	C8	shared relay no. 8	
J15-3	NC8	normally closed contact relay no. 8	
J16-1	C9	shared relays no. 9, 10, 11	
J16-2	NO9	normally open contact relay no. 9	ON/OFF condenser fans
J16-3	NO10	normally open contact relay no. 10	4-way valve position -circuit 1 (LCA-H)
J16-4	NO11	normally open contact relay no. 11	4-way valve position -circuit 2 (LCA-H)
J16-5	C9	shared relays no. 9, 10, 11	
J17-1	NO12	normally open contact relay no. 12	
J17-2	C12	shared relay no. 12	
J17-3	NC12	normally closed contact relay no. 12	
J18-1	NO13	normally open contact relay no. 13	On/Off Unit
J18-2	C13	shared relay no. 13	
J18-3	NC13	normally closed contact relay no. 13	
J23-1	E-	Terminal E- for RS485 serial connection to I/O expansion modules	
J23-2	E+	Terminal E+ for RS485 serial connection to I/O expansion modules	
J23-3	GND	Terminal GND for RS485 serial connection to I/O expansion modules	

7.3 Optional boards

7.3.1 RS485 serial board for supervisory function

For the serial connection to a local or remote supervision system it is necessary to install an RS485 serial board, available on request (see Figure 0: RS485).

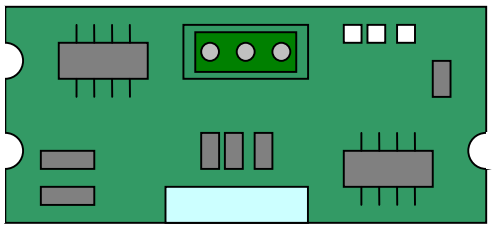

Figure 0: RS485 Serial Board

Connection to the local supervisor computer

The connection to the local supervisor computer is made via a RS485 serial line and communication takes place via the proprietary Carel protocol. A RS485/RS232 converter is needed for connecting to the serial port of the PC.

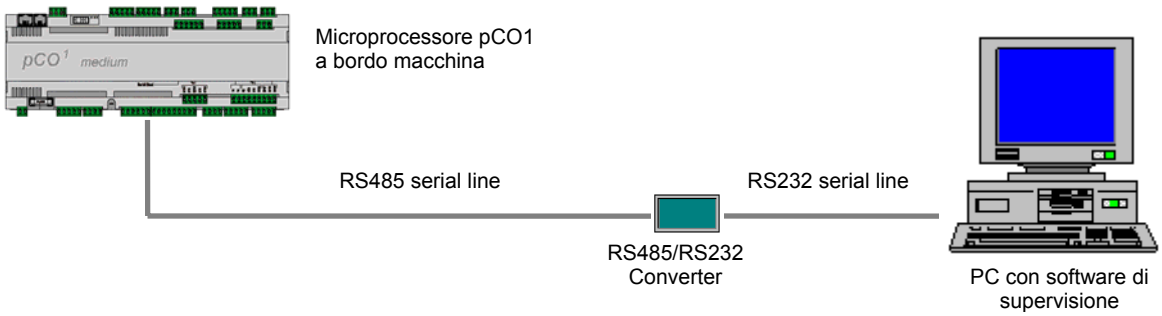

Figure 0: Connessione tra microprocessore e computer locale di supervisione

7.3.2 Clock board

The serial connection to a local or remote supervision system requires the installation of an RS485 serial board, available on request (see Figure 0: Scheda orologio).

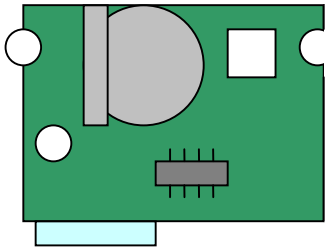

Figure 0: Scheda orologio

7.4 Technical data

General specifications

operating conditions	-10T60 °C 90% R H not condensing
protection rating	IP20, IP40 on front panel only
heat and fire resistance class	class D (UL94 - V0)
Immunity against over voltages	Class 1
number of manoeuvring cycles of automatic operations (e.g.: relay)	100 000
Class and structure of software	Class A

Electrical specifications

power supply (controller with connected terminal)	22 to 38 Vdc and 24 Vac ±15% 50/60 Hz. Maximum power consumption: 13 W
terminal block	with extractable male/female connectors maximum voltage: 250 Vac; cable size (2mm): min 0.5 to max 2,5
CPU	H8S2322 16 bits 14 MHz
program memory (on FLASH MEMORY)	16 bit organisation: 1 MByte (expandable to 2 MByte)
data memory (static RAM)	8 bit organisation: 128 kByte (expandable to 512 MByte)
Serial Board	16 bits organisation 4 kByte (upper limit: 400,000 recordings per memory location)
useful pCO1 cycle with applications of medium complexity	0.5 s

Analog inputs

number	8
Analog conversion	A/D converter 10 bit CPU built-in
type	*Passive:* NTC (inputs B5. B6, B7, B8) or clean contact digital input (5mA), selectable via dip-switch (B5-B6) *Universal:* NTC (see passive type), voltage 0 to 1 Vdc or 0 to 5 Vdc, current 0 to 20 mA or 4 to 20 mA , selectable via dip-switch (B1, B2, B3, B4)

Digital inputs

number	14
type	- optoisolated inputs at 24 Vac 50/60 Hz or 24 Vdc (ID1 to ID12) - optoisolated inputs at 24 Vac 50/60 Hz or 230 Vac (ID13 to ID14)

Analog outputs

number	4
type	- optoisolated 0 to10 Vdc outputs (Y1 and Y2) - optoisolated PWM outputs phase-cut with 5 V pulse (Y3 and Y4)
power supply	external power supply 24 Vac/Vdc
output resolution	8 bit
maximum load	1kΩ (10 mA) at 0 to 10V and 470 Ω (10 mA) at PWM

Digital outputs

number	13
Type	-with electromechanical relays

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