Manual	**M33U**
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Supersedes	**-------**

pCO control
for GAMMA/DELTA units

Operating manual

user's version

BLUE BOX
condizionamento

ICIM
ISO 9001-Cert.N.0201

CISQ

IQNet

0. CONTENTS

1. USE

The units in the GAMMA and DELTA series are chillers for treating air.
The "simplest" units, which use the refrigerant circuits to cool or heat the air, can be integrated with electric heaters, hot water coil, humidifier, and, in the case of units in the GAMMA series, with a damper module control for the air parameters.

To control the GAMMA and DELTA units a program has been developed for Pco controls with boards with eight analogue inputs. This program has been conceived to adapt to the capacity of the plant and its complexity in a modular manner.
This manual aims at being a valid aid to set up a local network for Pco, to configure a control correctly, and to get to know its operating features.

1.1 Switching on

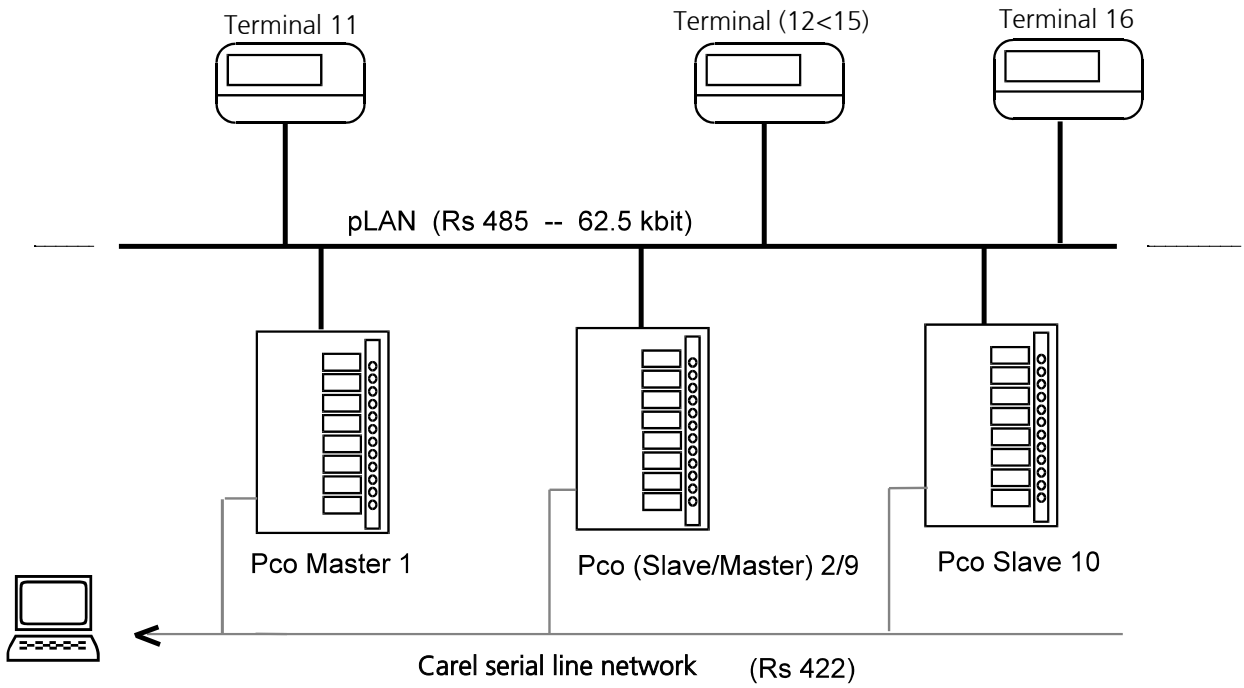
In the case of automatic operation, simply pressing the ON/OFF button makes it possible to enable or disable unit operation. If there is no automatic operation, the user can select the desired functions with the keys on the remote terminal or by means of the digital inputs.
As regards manual operating mode, the procedures for accessing the single functions are described in the paragraphs on digital inputs and remote terminal key operation.

2. LOCAL NETWORK FOR Pco

The local network for Pco permits linking up to 16 units between interface boards and terminals and to use them as a single assembly.
In the software development phase, the configuration of the network is established, identifying the number of interface boards to be used as "Master boards", the number of "Slave boards", the number of user terminals and their identification address.
Each single board can anyhow be linked by a serial connection to a supervision system and/or central help line.

2.1 Architecture of the local network for Pco

The figure shows a local network with the address indices of the single components.



The Master boards can have the address 1, 3, 5, 7 or 9, and the corresponding Slave boards must be given the address 2, 4, 6, 8 or 10.
The Master board with address 1 can correspond to the Slave board with address 2 and so on to the Master board with address 9 coupled with the Slave board with address 10.
The terminals can have the addresses between 11 and 16.
Each terminal can be configured to display a Master board and possibly the combined Slave (private terminal) or it can be configured to display all the Master boards and any combined Slaves (shared terminal).
For linking up to the network with the Carel serial line, refer to the relative documentation.

2.2 Components of the local network

The components for making a local network for Pco comprise:

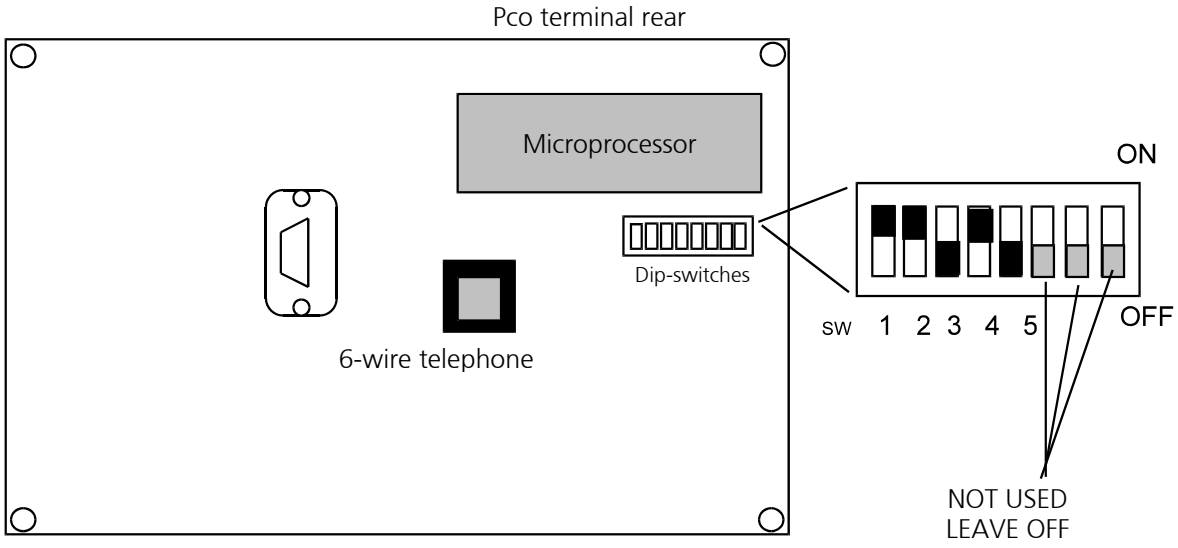
- Power board(s);
- Terminal(s);
- Address board(s);
- Three-way switches and wiring.

2.2.1 Power board(s)

The power boards making up the network are the boards with 8 analogue inputs with code PCOB000A21.
The power boards are connected to all the digital and analogue inputs and outputs. The program's eprom and the serial addressing board must be installed in the power boards.
All the power boards can be used indistinctly as a Master or Slave, the differentiation is made by means of the address.
The function of the single digital and analogue inputs and outputs varies both on the Master or slave function of the board and on the unit's configuration.
To be able to work in a local network the power boards must have jumpers J8 and J9 positioned on points 2-3 as they are normally supplied by the manufacturer.
For further information on the power boards, see the "Power Board" section.

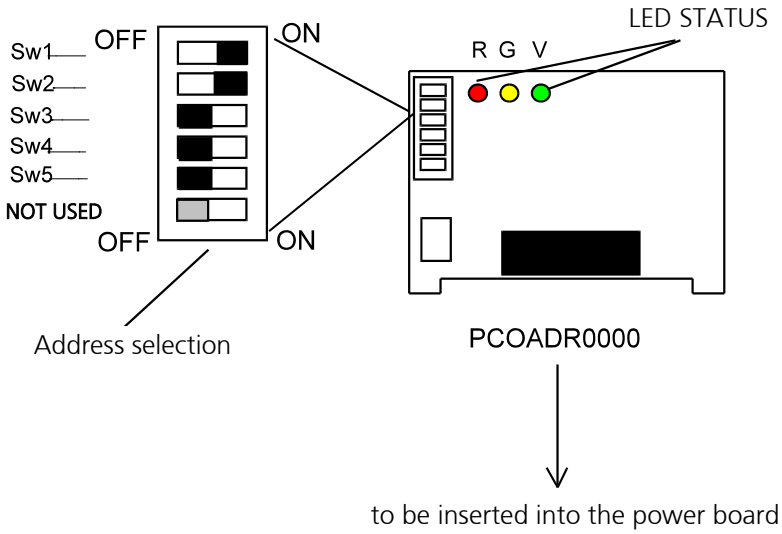
2.2.2 Terminals

The terminals used for the local network have code PCOT000CB0. On the back they have addressing dip-switches. In the phase of configuring the network, each terminal, irrespective of its address, can be selected as "private" or "shared".
Addressing is by binary numbering with the dip-switches.
Further information on the terminals is given in the "Keyboard Terminal" section.



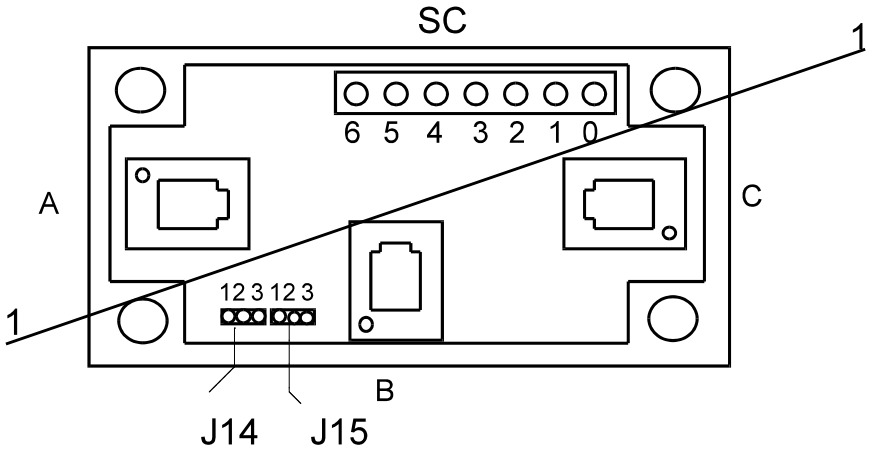
2.2.3 Address boards for the power boards

To establish whether a power board works as a Master or Slave and to identify the controlled unit, it must be addressed by installing the address board with code PCOADR0000.
Addressing is done with binary numbering with the board's dip-switches.



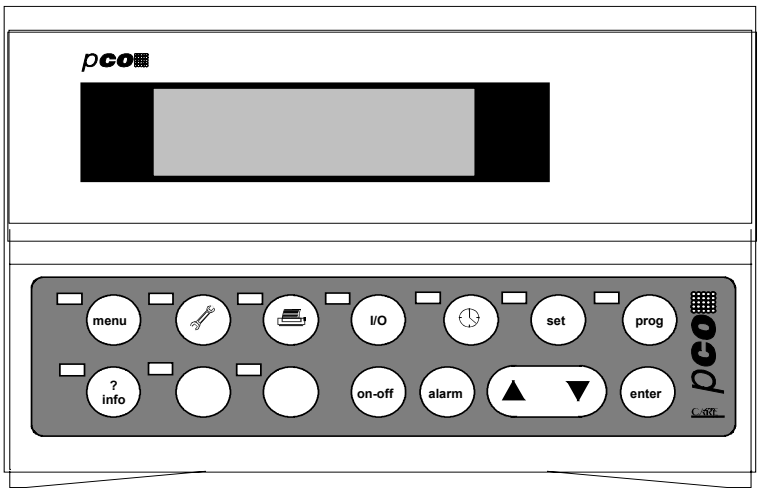
2.2.4 Three-way switches and wiring

To connect the various devices forming the network it is necessary to use the switches with code TCONN6J000.
Each three-way switch is fitted for connection with 3 telephone jacks (A, B and C) with 6 wires and with a screw terminal board (SC) with 7 terminals for cables AWG24 with 2 or 3 pairs of braided wires.
Using jumpers J14 and J15 it is possible to cut the electrical supply creating a division as in "sect. 1-1".
By connecting a power board to any one of the switch terminals, it is possible to have the supply voltage on all the others, or to divide the connector by coupling the connectors A-SC and B-C.
The terminals for the cables type AWG24 are used because they permit longer connections than telephone cables.
To use the three-way switches and cables in our specific case, see the "network connections" section.



3. The Terminal

The figure shows the *terminal* with its front door.
The *terminal* is controlled by a microprocessor. It is equipped with an LCD display with 4 lines x 20 columns, keypad and LED to make it possible to configure the unit, set its operating limits and program the control parameters (set points, differential band, alarm thresholds) and the main user operations. The connection of the *terminal* to the *network* is not essential for normal operation of the power board(s).



The terminal is used for initially programming the parameters and displaying the working data. It enables:
- configuring the network.
- programming, in the factory, the control destined for the specific unit to be governed, operations protected by password to ensure safety.
- the possibility of editing the main operating parameters in run-time
- displaying the alarms detected and calling attention to them with a 'buzzer'.
- displaying all the measurements made.

3.1.1 Technical particulars

The power supply comes from the basic board installed in the unit's electrical panel through a 6-way connector.

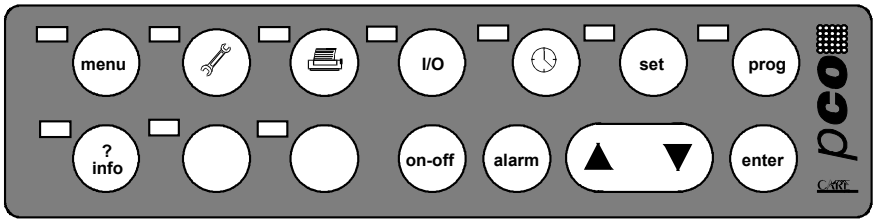
The keys are: 10 on polycarbonate
5 with translucent silicone rubber keypad.

The LED's are: 3 under the rubber buttons
10 under the polycarbonate

The buzzer is electromagnetic, self-oscillating at approximately 2 KHz, with continuous operation.

The terminal has a door on the front that opens to a maximum angle of 150 degrees. With the door closed you only access the 5 silicone rubber buttons, so the 3 LED's back-lighting them will be visible.

The pCO keypad has a small keypad of 15 buttons that with the liquid crystal display forms the interface between the operator and the system.



From the keypad it is possible to directly access the main parameters or parameter loops. The functions of the single buttons are defined as follows:

ON / OFF button 

Activates and inhibits unit operation.

ALARM button 

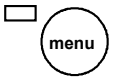
Pressed once to silence the buzzer, if active, to display the alarm message, if any, and pressed a third time to eliminate the alarm.
If there are no alarms there is the message "No Alarm Active".
The alarm mask sequence is given by pressing the UP / DOWN buttons.

UP / DOWN buttons 

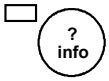
When the cursor is positioned at the top left, these buttons have the function of scrolling a group of masks; from the last one you can access the first one and vice versa.
If the cursor is in a numerical field, these buttons increase or decrease the value the cursor is positioned on.
If it is a selection field, pressing the UP / DOWN buttons displays the options available (eg. Yes / No).

ENTER button 

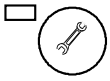
In the value setting masks, on pressing this button for the first time the cursor moves onto the first entry field.
Pressing it again confirms the set value and shifts the cursor onto the next field.
From the last field you go back to the starting position at the top left.

MENU button 

Pressing this button takes you to the first mask in the main menu loop.

INFO button 

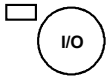
In the case of a local network connection, pressing this button enables a shared terminal to display the parameters of the various linked Master boards in rotation.

MAINT button 

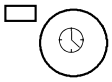
Pressing this button takes you to the first maintenance mask loop; access is only possible with a password.

PRINT button 

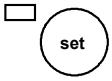
Pressing this button brings up the message “NO PRINTER INSTALLED”

I/O button 

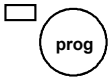
Pressing this button takes you to the first information mask loop on input and output status.

CLOCK button 

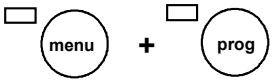
Pressing this button brings up the message “NO CLOCK INSTALLED”

SET button 

Pressing this button takes you to the first setting mask loop.

PROG button 

Pressing this button takes you to the first “service” loop; access is only possible with a password.

MENU+PROG buttons 

Pressing these buttons simultaneously takes you to the first “manufacturer” mask loop; access is only possible with a password.

3.1.2 LED's

Alongside each button there is a green LED that lights up when the associated button is pressed and indicates which group of masks the user is in.

When you enter the group of machine configuration masks by pressing the MENU+PROG buttons the PROG button LED lights up.

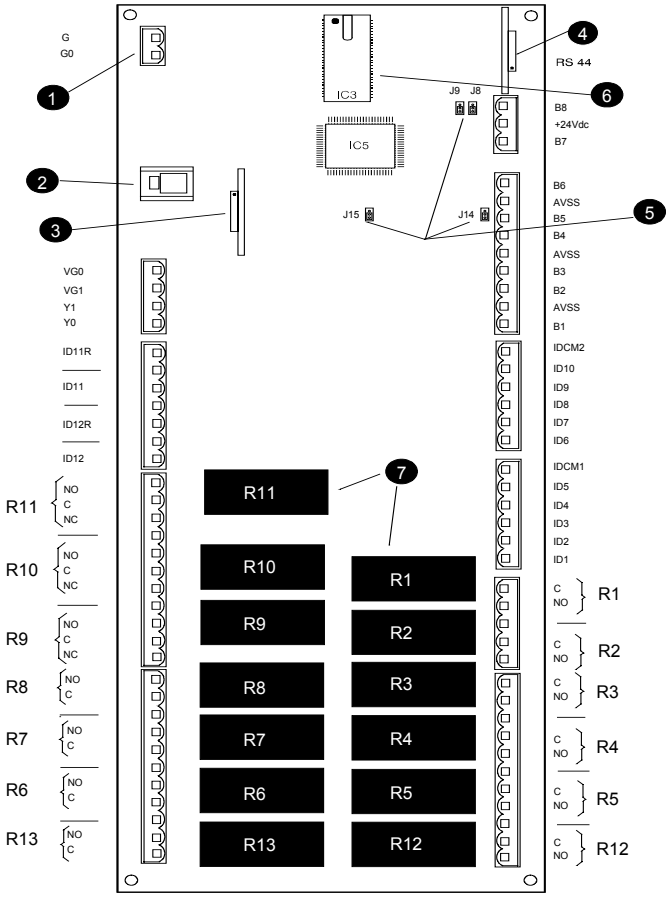
Another three LED's are located under the rubber buttons and respectively indicate:

1. ON / OFF button green LED
   indicates that the instrument is on and running.
2. ALARM button red LED
   indicates an alarm situation.
3. ENTER button yellow LED
   Indicates that the instrument is correctly supplied.

After approximately 5 minutes since last pressing any of the buttons on the keypad, the system goes back to the "Main" mask (accessible through the "MENU" button) where the value of the ambient air temperature probe and the unit status are displayed.

4. Power Boards

The power board of the control is the heart of the system since it contains the microprocessor that runs the control algorithm.
Each board can be used indistinctly either as Master or as Slave (this depends on the address given); the functions of the inputs and outputs change according to the address.



4.1.1 Typical components

(1) Connector for supply at 24 V AC
(2) Telephone-type connector for connecting to terminal (RS485)
(3) Clock board (option not available)
(4) RS422 optoisolated board for supervision/hot-line serial link
(5) Pin strip with which:
- J8 : positioned on 1-2 it permits connecting the board to a terminal or to the supervisor, whereas positioned on 2-3 it permits local network connection only;
- J9 : positioned on 1-2 it enables remote resetting by the supervisor;
- J14 : positioned on 1-2 it permits setting the input B5 on voltage, whereas positioned on 2-3 on current;
- J15 : positioned on 1-2 it permits setting the input B6 on voltage, whereas positioned on 2-3 on current;

(6) Eprom containing the program

(7) Output relays

Rxx:	Relay output connectors
No:	Normally open contact
Nc:	Normally closed contact
C:	Common reference for the contacts
ID :	Digital inputs
IDCM:	Common ref. for digital inputs
Bx :	Analogue input
AVSS:	Analogue input reference
Yx:	Analogue outputs
VG1/0:	Analogue output supply 24V

For the address board, see the sections dedicated to the network.

4.1.2 Technical and mechanical particulars

Plate on 16.5 DIN modules	107 x 292.5 mm
Fixing	6 fasteners 4 mm included in the optional DIN guide support package

Terminal board

type	removable male / female connectors
Maximum current	16 A
Maximum voltage	250 V AC
Maximum cable section	2.5 mm ^{2}

4.1.3 Network connections

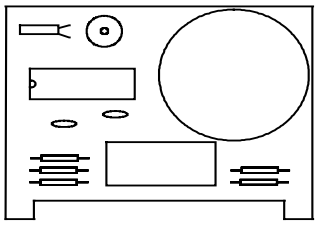
Type	Dedicated asynchronous half duplex with 2 wires
Connector	6-way telephone type
Driver	Balanced differential CMR 7 V (type RS422)

4.2 Mounting serial board and eprom

In addition to the address boards essential for network operation, a board for connecting to the Carel serial network can be installed.

4.2.1 RS422 optoisolated serial board

This RS422 serial board makes is possible to connect the Pco in a network. This makes the Blue Box remote supervision and hot-line services available.
To use it, connect it to the connector (4) that can be seen on the power board.



Cod. PCOSER0000

4.2.2 Mounting the eprom

The eprom must be located on the basic board, in other words on the board where the inputs and outputs are.

The eprom should be mounted by making the reference marks of the chip and base match.
Referring to the figure alongside:

Take great care when fitting:

- An arrow on the label shows the exact position for fitting the eprom.
- At the correct eprom polarity, the reference mark on the eprom must match that on the socket when fitting it on.

Special care should be taken also when fitting it on in order to prevent bending or breaking the component's feet. And take special care not to touch the feet so as to avoid electrostatic discharges that damage the component even though this may not be immediately apparent.

5. I/O

The same power board can be used both as Master and as Slave. The diversification must be made with the address given on the address board.
The differentiation between the Master and Slave boards involves different functioning in the network, and particularly different input and output control.

5.1 List of Master board inputs and outputs

5.1.1 Analogue inputs

TERMINAL	No.	DESCRIPTION
J2 - 1	B1	Room air temperature
J2 - 2	B2	Ambient air temperature
J2 - 3	B3	Delivery air temperature
J2 - 4	B4	Coil water temperature
J2 - 5	B5	Circuit 1 condensation/evaporation pressure (4/20 mA)
J2 - 6	B6	Circuit 2 condensation/evaporation pressure (4/20 mA)
J1 - 7	B7	
J1 - 8	B8	Room air relative humidity (0/1 V)

5.1.2 Digital inputs

TERMINAL	No.	DESCRIPTION
J4 - 1	ID1	No air flow
J4 - 2	ID2	Clogged filter alarm
J4 - 3	ID3	Remote on/off control
J4 - 4	ID4	Heater 1 alarm
J4 - 5	ID5	Heater 2 alarm
J4 - 6	IDCM1	Common
J3 - 1	ID6	Compressor 1 low pressure
J3 - 2	ID7	Compressor 1 high pressure
J3 - 3	ID8	Compressor 2 low pressure
J3 - 4	ID9	Compressor 2 high pressure
J3 - 5	ID10	Summer/winter selector
J3 - 6	IDCM2	Common
J21 - 1	ID11R	Common under voltage
J21 - 2	ID.24	Main fan thermal cut-out
J21 - 3	ID.230	
J21 - 5	ID12R	Common under voltage
J21 - 6	ID.24	Humidifier alarm
J21 - 7	ID.230	

5.1.3 Digital outputs

TERMINAL	No.	DESCRIPTION
J5 - 4 / J5 - 5	NO1/C1	Main fan
J5 - 1 / J5 - 2	NO2/C2	Not used
J6 - 10 / J6 - 11	NO3/C3	Cycle reversal valves
J6 - 7 / J6 - 8	NO4/C4	Fans 1 condenser ON/OFF operation
J6 - 4 / J6 - 5	NO5/C5	Fans 2 condenser ON/OFF operation
J24 - 7 / J24 - 8	NO6/C6	Compressor 1
J24 - 4 / J24 - 5	NO7/C7	Compressor 2
J24 - 1 / J22 - 2	NO8/C8	Heater 1 / Opens 3 hot point valve
J22 - (9/10/11)	NO9/C9 /NC9	Heater 2 / Closes 3 hot point valve
J22 - (5/6/7)	NO10/C10/ NC10	Humidifier control
J22 - (1/2/3)	NO11/C11/ NC11	General alarm

5.1.4 Analogue outputs

TERMINAL	No.	DESCRIPTION
J20 - 3	Y0	Damper control
J20 - 4	Y1	Water valve control / humidifier control

5.2 List of Slave board inputs and outputs

5.2.1 Analogue inputs

TERMINAL	No.	DESCRIPTION
J2 - 1	B1	
J2 - 2	B2	
J2 - 3	B3	
J2 - 4	B4	
J2 - 5	B5	Circuit 3 condensation/evaporation pressure (4/20 mA)
J2 - 6	B6	Circuit 4 condensation/evaporation pressure (4/20 mA)
J1 - 7	B7	Ambient air relative humidity (0/1 V)
J1 - 8	B8	Delivery air relative humidity (0/1 V)

5.2.2 Digital inputs

TERMINAL	No.	DESCRIPTION
J4 - 1	ID1	Low pressure compressor 3 / thermal cut-out compressor 1
J4 - 2	ID2	HIgh pressure compressor 3 / oil compressor 1
J4 - 3	ID3	Low pressure compressor 4 / thermal cut-out compressor 2
J4 - 4	ID4	HIgh pressure compressor 4 / oil compressor 2
J4 - 5	ID5	Fast air change demand
J4 - 6	IDCM1	Common
J3 - 1	ID6	Heater 3
J3 - 2	ID7	Heater 4
J3 - 3	ID8	Auxiliary fan thermal cut-out
J3 - 4	ID9	Hot water pump alarm
J3 - 5	ID10	Warm air burner or boiler alarm
J3 - 6	IDCM2	Common
J21 - 1	ID11R	Common under voltage
J21 - 2	ID.24	
J21 - 3	ID.230	
J21 - 5	ID12R	Common under voltage
J21 - 6	ID.24	
J21 - 7	ID.230	

5.2.3 Digital outputs

TERMINAL	No.	DESCRIPTION
J5 - 4 / J5 - 5	NO1/C1	Auxiliary fan
J5 - 1 / J5 - 2	NO2/C2	1st capacity step compressor 1
J6 - 10 / J6 - 11	NO3/C3	2nd capacity step compressor 1
J6 - 7 / J6 - 8	NO4/C4	1st capacity step compressor 2
J6 - 4 / J6 - 5	NO5/C5	2nd capacity step compressor 2
J24 - 7 / J24 - 8	NO6/C6	Compressor 3
J24 - 4 / J24 - 5	NO7/C7	Compressor 4
J24 - 1 / J22 - 2	NO8/C8	Heater 3
J22 - (9/10/11)	NO9/C9 /NC9	Heater 4
J22 - (5/6/7)	NO10/C10/ NC10	Hot water pump
J22 - (1/2/3)	NO11/C11/ NC11	Warm air burner or boiler

5.2.4 Analogue outputs

TERMINAL	No.	DESCRIPTION
J20 - 3	Y0	Exhaust air damper control
J20 - 4	Y1	Fan adjustment

6. PROGRAM DESCRIPTION

6.1 Generally

The main goal of the control is to keep ventilation, temperature and humidity at the set values "tr" and "ur". The control will be able to use single or a combination of functions to maintain ideal conditions.
The main functions for the control comprise:

- Ventilation;
- Control of dampers to change air and for free cooling;
- Up to 4 hermetic compressors or 2 semi-hermetic ones with the possibility of cooling and heat pump operation;
- A modulating valve with a 0-10V signal to control a hot water coil;
- Alternatively to the modulating valve, a 3-point valve can be used;
- Up to 4 electric heaters;
- A humidifier (from analogue output 0-10V or with ON-OFF signal);
- A boiler with relative circulator;
- Alternatively to the boiler, a warm air burner can be controlled;
- By combining cooling and heating, air dehumidification can be controlled.

In addition to permitting connection to a local network, the program permits supervision/hot-line for total remote control of systems, even belonging to different local networks, to make action immediate and optimized in the event of faults.

6.1.1 Ventilation:

The main fan will be enabled after closing the external interlock and pressing the "ON" button. This will make air circulate in the room through the chiller.
Crossing through the chiller the air will be filtered by the filters installed in front of the evaporating coil.
The operation of the main fan and the verification of the flow of air through the chiller will be essential to permit any other function.
Any change in the conditions of the air (need to change temperature and humidity) may be enabled only after the "tra" delay.
If it is necessary to have two different air flow rates available (for example heating operation of warm air burners or heating coil or during dehumidification), a greater capacity will be accomplished by activating both the main fan and the auxiliary fan, whereas a lesser capacity will be obtained with the operation of just the main fan.
Passing from one flow rate to the other will be automatic on enabling the associated function.
The combination of decreasing the air flow with any other function must be envisaged and enabled in the appropriate masks.

6.1.2 Changing air:

Changing the air in a room will be accomplished by using the dampers.
During operation of the unit, a minimum air change will be maintained.
It will be possible to set two damper opening values corresponding to the minimum air change, the lesser one for normal operation, the greater one for fast air change.
The possibility of having "fast" air change available may be structured in special conditions of crowding in the rooms controlled.
Passing from the lesser to the greater value will be automatic on closing the digital input "fast air change request". The return to the minimum value will be made on opening this same digital input.
Opening the dampers, their positioning on the minimum air change value may (if envisaged in the apprpriate mask) be delayed after starting to permit the system to get fully into operation.
If the conditions of the external air permit the control to enable the free-cooling function, the time for initially getting up to full operation will be ignored and the dampers will immediately come into control.

6.1.3 Free cooling operation:

When the conditions of the external air permit it, the control will enable the free cooling function.
The free cooling function will make it possible to use external air to cool the room, allowing energy savings and partially or totally limiting the use of the compressors.
Favourable conditions for enabling the free cooling function occur when the difference between the temperature of the room air and the external air temperature is greater than the "free cooling differential ".
With the free cooling function active, opening the dampers will be in proportion to the cooling demand.
If the free cooling function is not sufficient to maintain the desired temperature, the compressors will be activated. Compressor activation must anyhow respect the minimum value of the delivery air so as to avoid putting air that is too cold into the room.

6.1.4 Cooling:

Cooling the air in the room to maintain the set temperature and/or humidity will be accomplished (when the free cooling function is not possible) by using the compressors.
Enabling compressor operation on cooling will take place in proportion to the increase in the room air temperature, compared to the relative set and to the inside of its differential.
The compressors will anyhow need to be activated in compliance with the relative timing.

6.1.5 Heating:

Heating the air in the room to maintain the set temperature and/or humidity will be accomplished by using either the compressors operating as a heat pump, or a hot water coil or a warm air burner or electric heaters.
Hot water may be produced either by a boiler installed on board the machine or by an external source.
If there is a boiler on board the machine, there will also be the relative circulator.
The after-heating procedures for dehumidification are given in the description of dehumidification.
The heating devices will be enabled in proportion to the decrease in temperature of the room air, compared to the winter temperature set and the inside of the relative differentials.

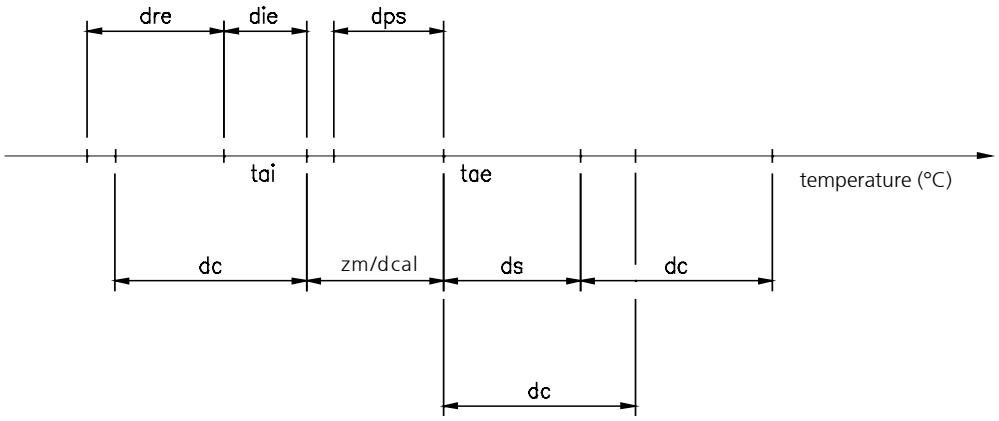
6.1.6 Humidification:

In order to maintain the value of the relative humidity within the set limits, the air will be humidified by activating the digital output or the analogue output of the humidifier.
The choice of using the digital or analogue output to humidify the air will be decided in the appropriate mask.
Using the analogue output for humidification will exclude the possibility of using the analogue output for the water valve.

6.1.7 Dehumidification:

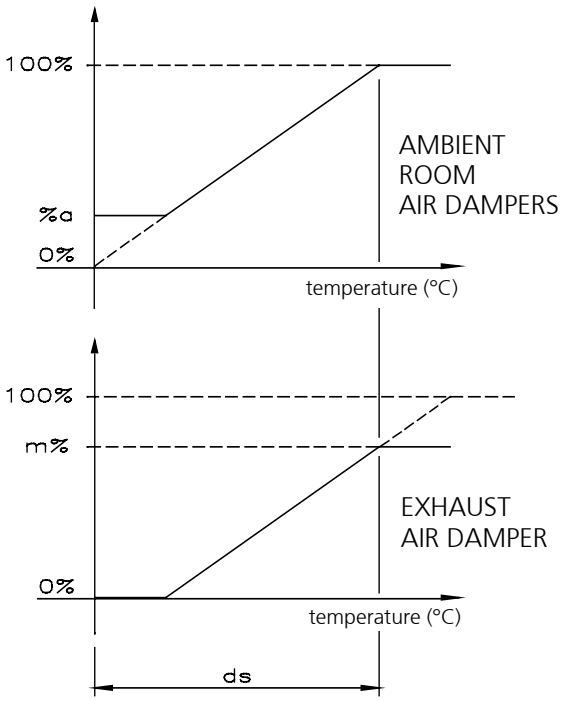
To decrease the relative humidity of the air, it is necessary to cool it under dew temperature and possibly heat it afterwards.
Therefore compressor operation on cooling will also be possible under the set temperature.
The number of active compressors in the phase of dehumidification depends on the value of the relative humidity measured in the pick-up sensor compared to the set, it will increase in proportion to the increase in the relative humidity inside the differential.
Since in the phase of dehumidification the compressors will be allowed to operate even if the room air temperature falls under the set point (and therefore enters the dead zone), before being put into the room the air will be suitably heated afterwards.
Heating the air afterwards, which can only take place in the dehumidification phase, will either be done by the electric heaters or by a hot water coil.
The steps of the electric heaters activated or the opening of the hot water valve will increase as the room air temperature decreases compared to the operation set point. The change will take place in proportion to the inside of the post-heating differential.
The number of active compressors for dehumidification will decrease in proportion to the activation of the step of heaters or opening of the hot water valve (see graph). In this way there will be a balance between the power used for cooling the air and that used for heating it, in order to permit dehumidification without excessively lowering the temperature of the air with respect to the set range.

7. DIAGRAM OF MAIN PARAMETERS THAT CAN BE SET



7.1.1 Temperature control parameters.

The figure shows the summer reference set with the differentials of the dampers and of the compressors on cooling, the dead zone, the winter set with the differentials of the compressors on heating and of the heaters or warm air burner.

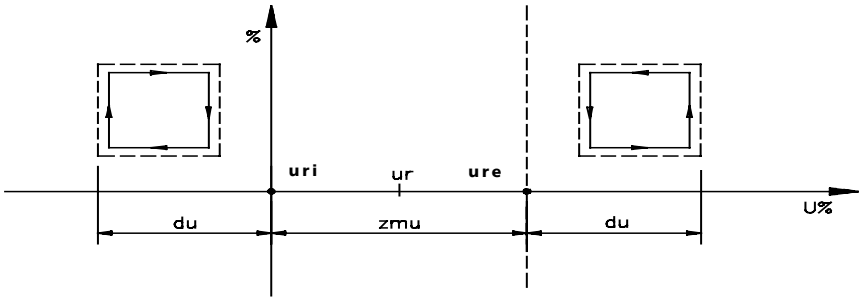


7.1.2 Damper operation.

The figure shows damper operation with the relative differential and the values of opening air change, or full opening in the case of the exhaust damper.

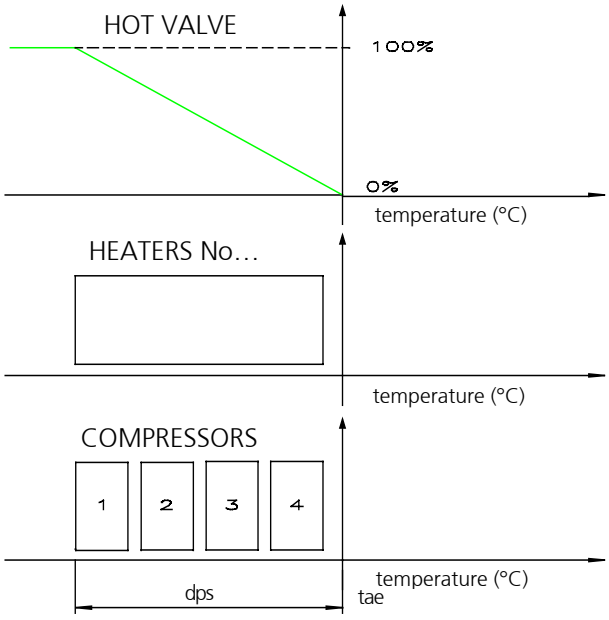
When the control governs with a single output, all the dampers will follow the curve shown at the top of the diagram referring to the output Y1 of the first board.

When there is a different control of the exhaust damper, it will follow the curve shown at the bottom of the diagram referring to the output Y0 of the second board.



7.1.3 Humidity control parameters.

The diagram shows enabling humidification and dehumidification.



7.1.4 Control of dehumidification as air temperature changes.

Dehumidification is controlled inside the post-heating differential.

The compressors in the dehumidification phase are forced to operate also at lower values than the summer set. The number of compressors enabled varies inside of the post-heating differential inversely to the enabling of the heaters or the opening of the hot water valve.

7.2 COMPRESSOR OPERATION

7.2.1 Timing.

The compressors will be switched on as the room air temperature varies with respect to the set range, inside the relative differential.
Compressor operation is subordinate to respecting the typical times of the compressors and the interlock of the relative digital inputs.
Every compressor can be activated when all the relative digital inputs are closed.
Once activated, a compressor must work for the "minimum operating time", unless a digital input opens, in which case it will need to be stopped.
When a compressor is stopped in normal operation, it must stay stopped for the set "minimum stop time".
To be able to restart after each stop, a compressor must in any case wait for the "switch-on delay" to pass.
Consecutive activation of two compressors will be delayed by the "compressor delay" in order to avoid high current peaks.
If the compressors have any capacity steps, the compressors will always start with the minimum load (stepped compressors), while the capacity steps will be inserted gradually, observing the "capacity step delay".
When the digital inputs relative to compressor safety trip there follows a response from the control that differentiates according to the severity of the alarm reported. We will then have:
- The low pressure switch input opening will always be ignored either due to the delay in "rla" starting or due to the delay during "rdo" operation. After this delay the relative compressor will be stopped.
- The oil differential pressure switch input opening will be ignored due to the relative "rdo" delay. After this delay the relative compressor will be stopped.
- The thermal cut-out or high pressure switch input opening will immediately shut down the relative compressor.

7.2.2 Step condensation control.

The condenser fans will be activated by two digital outputs; on starting any of the compressors both fans will normally start.
In the case of there being condensation control, the fan outputs will be activated when the pressure read by one of the analogue inputs relative to condensation exceeds the condensation steps increased by the relative differential. The fan outputs will be de-activated when the pressure read by all the analogue inputs relative to condensation will be lower than the condensation set.

7.2.3 Continuous condensation control.

The analogue output dedicated to the speed governor will change its signal as the pressures read by the analogue inputs relative to condensation change their signal, taking the greater of them as reference.
The change will take place as of "scp1" and will increase inside the differential of the condensation sets "dct"; in heat pump operation the control will force the output to the utmost.

7.2.4 Reversing operation.

When it is envisaged to operate the compressors on both cooling and heating, swapping over operation will be delayed by a time "tra3" that can be set in the service mask area.
As regards heating or cooling the air in the case of compressor cycle reversal not being involved, using hot and cold water coils or heaters instead, enabling can take place upon demand from the control without any delay.

7.2.5 Controlling capacity steps within the differential.

In units with semi-hermetic compressors (mono- or bi-compressor), it will be possible to control up to 2 digital outputs to step each compressor.

Within the operating differential there will be a set and an additional differential for each compressor and for each capacity step; the divisions are given in the following table:

No. comp./steps	1/0	1/1	1/2	2/0	2/1	2/2
comp.1 (set/diff.)	50/100%	25/50%	25/50%	25/50%	12.5/25%	12.5/25%
step 1 (set/diff.)	/	75/50%	62.5/25%	/	37.5/25%	31.2/12.5%
step 2 (set/diff.)	/	/	87.5/25%	/	/	43.7/12.5%
comp.2 (set/diff.)	/	/	/	75/50%	62.5/25%	62.5/25%
step 1 (set/diff.)	/	/	/	/	87.5/25%	81.2/12.5%
step 2 (set/diff.)	/	/	/	/	/	93.7/12.5%

7.2.6 Defrosting.

Since the compressors could be enabled for heat pump operation, it will be necessary when certain conditions occur to defrost the condensing/evaporator coil.

The need for defrosting will be detected by the analogue input of the compressors in operation.

If any of the compressors are operating with the pressure value read at the input of the relative evaporation pressure lower than the value of "ps" (defrosting required pressure), and this operation continues for longer than "rd" (defrosting delay), a defrosting cycle will start.

In any case, a new defrosting cycle can only commence if "tcs" (defrosting cycle time) has passed, except of course for the first defrosting.

Unit defrosting will be carried out as follows:

Switching on, respecting the relative delays of all the compressors in the unit that are not stopped with an alarm, and running them for at least 1 minute;

Forcing the compressors to their full potential if there are any capacity steps and running at full potential for at least one minute;

Reversing the refrigeration cycle by opening the digital output of the 4-way valves and stopping the condensing/evaporating fans;

When any of the analogue inputs reaches the end-of-defrosting value the fan outputs will be activated and after "riv" (4-way valve reversing delay) the 4-way valve supply output will be closed.

If the condensing/evaporating coil defrosting time exceeds "tmd" (maximum defrosting time) defrosting will be completed by the control activating the fans and after "riv" supplying the 4-way valve.

Defrosting can be forced by the protected mask in the service area, in this case the only difference is that "tcs" (defrosting cycle time) will not be observed.

7.3 Unit operation

7.3.1 Configuration:

In the testing phase the address of each component must be set (master board, any slave boards and terminals).
After configuring the network, the type of unit the control will need to handle will be configured. This will take place in the masks of the manufacturer area enabling the functions to be controlled:
- For cooling with compressors it will be necessary to specify their number, type (hermetic or semi-hermetic), the number of capacity steps per compressor and the type of capacity step.
- For heating, if the compressors can operate as a heat pump or if to heat the air there is a valve to control a hot water coil and if there is a hot water coil it will be necessary to specify whether the servo-control will be controlled by digital outputs or by an analogue output.
If there is a hot water coil, a boiler can be envisaged and automatically the relative circulator.
A hot air burner can be controlled from the same output controlling the boiler.
Alternatively to the hot water valve controlled by digital outputs, there can be electric heaters whose number will need to be specified;
- For humidifying, a humidifier.
- For dehumidifying, if the combination of the previously configured devices permits it, it will only need to be activated.

7.3.2 Operating limits:

When it has been decided what type of unit the control will be called upon to handle, you will need to set the limits within which the parameters to be controlled, the timing for general unit control and specific compressor timing can vary.
The operation timing can be set in a menu of masks protected by a password in the service area.
Correction of the values read by the probes and the timing for maintenance can be set in a menu of masks protected by a password in the maintenance area.

7.3.3 Use:

When all the unit's operating parameters and the relative limits have been configured, it will be possible to start up the unit.
Unit operation can be automatic or manual depending on the user's needs, clearly within the limits of the configured functions.
In any case the digital input of the external interlock will need to be closed and the ON button pressed on the front of the control.
On starting up the unit the control will enable fan operation (either the main fan or the main and the auxiliary fans depending on the configuration and the function in course).
On starting up the unit the no-flow alarm input will be ignored for the delay "tra1".
If the no-flow alarm continues for longer than "tra1" the control will show the alarm, no other outputs will be enabled, but the fan output will stay enabled.
When the no-flow alarm has been reset, the "tra1" delay will automatically be zeroed, thereby permitting a fresh attempt at starting up the unit.
After the time "tra", during which the air parameters will be stabilized, the control will start work enabling the configured devices to take and maintain the air parameters within the envisaged operating range.
On pressing the "set" button, the user will be able to access the parameters to set the temperature and humidity set points, select the type of operation, in the case of manual operation, set the time for reaching full rate "tra4", and the percentages of opening the dampers for the air change.

7.4 States of operation

7.4.1 Unit on "stop":

In the condition of the machine being off (no electricity supplied), the dampers will be fully closed, all the digital outputs open.

7.4.2 Unit on "stand-by":

When the unit is powered, the control will display the set parameters (sets, ambient temperature, any alarms and other parameters that can be detected by the configured analogue inputs), the dampers and the water valve will be fully shut, all the digital outputs will be open, there will be no demand for humidification.

7.4.3 Ventilation:

In addition to what has been displayed on "stand-by" the control will restrict itself to closing the digital output(s) to run the fans, if there are the conditions for enabling the free cooling function this will be enabled.
Damper opening will be as required by the free cooling function if it has been enabled and there are the conditions for free cooling, or damper opening will correspond to the minimum set opening value "%a".

7.4.4 Cooling:

After a time "tra" during which the main fan has started running correctly, if the room air temperature "ta" is higher than the summer set "tae", the control will be called on to cool the air in the room.
If the free cooling function has been configured, and there are the conditions for the function to be activated, cooling will be accomplished mainly with the free cooling function.
In free cooling operation, damper opening will be in proportion to the inside of the differential "ds";
If free cooling operation has not been configured or there are not the conditions for free cooling, or the free cooling function is not able in a set integration time "ti" to reverse the trend of the change in room temperature "ta", the compressors will be called upon to act.
If a time has been envisaged for the system to reach its operating level, the dampers will be kept closed during this time.

7.4.5 Heating:

After a time "tra" since the main fan started working correctly, if the room temperature "ta" is lower than the winter set "tai", the control will be called upon to heat the air in the room.
This must be accomplished by the compressors working as a heat pump, by the water coil on heating, or by enabling the electric heaters, depending on the configuration made.
If a combination of heating devices has been envisaged in the unit's configuration, compatibly with the use of the respective outputs, each of these devices will be activated according to its differential values.
If configured, the boiler will always be active in heating operation.
The boiler output can alternatively be used as a hot air burner.
If it is envisaged to use a hot air burner, the output enabling it will be linked to the fourth step of the electric heaters.
If a time has been envisaged for the system to reach its operating level, the dampers will be kept closed during this time.

7.4.6 Dehumidification:

So there can be dehumidification, during configuration provision must have been made for the humidity pick-up sensor and at least one device for heating and one for cooling must be available at the same time.
If the relative humidity of the room air is greater than the humidity set "ur", plus "zmu", the control will be called upon to dehumidify the room.
The manner in which dehumidification takes place has been described in the general description section.

7.4.7 Humidification:

If the relative humidity in the room is less than the set humidity "ur", and half of the dead area "zmu", the control will be called upon to humidify the room.
Humidification will be carried out by enabling the humidifier.

7.4.8 Free cooling:

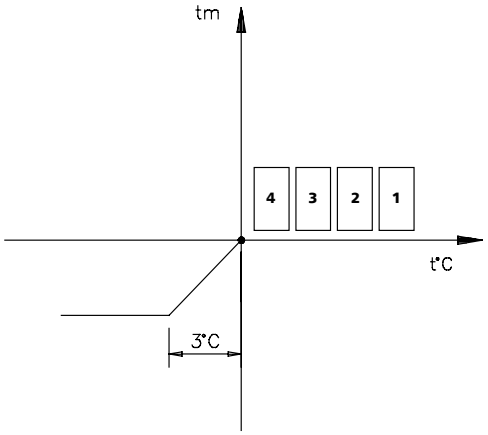
Free cooling to cool the air in the room.
The necessary condition to enable free cooling is that the temperature of the ambient air is lower than the set temperature "te".
If, though the free cooling function is enabled, the room air temperature "ta" within a set time "ti" fails to reach the set value "tr" the compressors or cooling coil will be forced to intervene.
The delivery air temperature "tm" with the free cooling function enabled must anyhow be greater than the set limit value "lm".
To maintain the delivery air temperature during operation "only" on free cooling, or during free cooling and cooling operation, higher than the limit temperature "lm", the control will switch off the compressors or close the cold water valve.
If, in spite of switching off the compressors or closing the cold water valve, the delivery temperature should continue to fall the control will progressively close the dampers.

7.4.9 Enthalpic free cooling:

For the enthalpic control of free cooling to be available, during the configuration phase provision must have been made for the room and ambient air temperature and humidity probes.
The necessary condition to enable enthalpic free cooling is that the enthalpy of the ambient air is favourable with respect to the internal air compared to the enthalpy set.
The enthalpic set point values are calculated with the set temperature and humidity values. The ambient enthalpy values are calculated with the temperature and humidity values read by the inputs B1 (room air temperature) and B8 (room air relative humidity); the ambient air enthalpy values are calculated with the temperature and humidity values read by the inputs B2 (ambient air temperature) and B7 of the second board (ambient air relative humidity).

7.4.10 Delivery air temperature limit:

The delivery air temperature, on cooling, is managed by the control with reference to the minimum limit,
The control is made by gradually switching off the compressors on reaching the minimum set temperature, and then closing the dampers within a fixed differential of 3°C if the temperature of the air should continue to fall.



7.4.11 Anti-freeze procedure:

If the delivery air temperature should fall under the anti-freeze temperature, in order to prevent the water coil icing, the control will force the hot water valve open 30% and enable the circulating pump output and if the boiler is controlled its output will also be enabled to function.

8. SETTING PARAMETERS AND ENABLING

8.1 Parameters to set

The table shows parameters that can be accessed and their factory-set values.
These values may be changed according to user requirements within the operating limits.

value	description	default values
tae	summer temperature set	26 °C
tai	winter temperature set	20 °C
ure	summer humidity set	50 %
uri	winter humidity set	45 %

9. PARAMETER ACCESSIBILITY

It is possible to access the unit's operating parameters through the mask loops.

Besides the possibility of changing the temperature and humidity set points, it is possible to display the values read by the temperature and humidity probes, the status of the analogue outputs, of the digital inputs and outputs, and other information on the unit's operation and the version of the program installed.

The loops available, with their relative masks, are described in the following paragraphs.

10. SET PARAMETERS

- To access the "free" parameters it will be necessary to press the "set" button, after which it will be possible to move with the direction keys inside the loop of masks with the accessible parameters.
On pressing the "enter" button in a mask, the cursor, which was initially positioned at top left, will go under the variable parameters. With the direction keys it will be possible to vary the selected parameter that must be confirmed by pressing the "enter" button again. After being positioned under all the variable parameters inside the mask, the cursor will again go back to the top left and at that stage it will be possible with the direction keys to change mask.

10.1 Set mask sequence

Set Point Temperature 26.0°C Relat.Humid. 50.0 %

In this mask you can set the temperature and humidity values of the sets for automatic operation

Temperature Set point Summer 26.0°C Winter 20.0°C

In this mask you can set the temperature values of the sets for summer and winter operation

Humidity Set Point Summer 50.0 % Winter 45.0 %

In this mask you can set the humidity values of the summer and winter sets

If manual operation is envisaged, the following masks will be available:

Fan Enabled NO Cooling Enabled NO Heating Enabled NO Free Cooling En. NO

In the case of manual operation it will be possible to select the desired functions, in any case the first function activated must be ventilation.

Enthalpy F. Cool. NO Dehumidification NO Humidification NO

11. MENU

- The loop of masks of the initial menu will always be displayed right from the control being powered up.
If any other loop of masks has been enabled, after 120 seconds the masks of the initial menu will automatically be displayed.
On pressing the "menu" button you go back from any mask loop to that of the initial menu.

11.1 Main menu mask sequence

Operating SUM. Room Temp. 00.0°C Room Humidity 00.0 % Unit OFF	Indicates the function the unit is carrying out The value read by input B1 The value read by input B8 Unit status
Set Point Temperature 26.0 °C Humidity 50.0 % Control AUTOMATIC	The values set in the temperature and humidity set points and the function and operating mode are shown

If the possibility has been envisaged of manual operation in swapping over the summer/winter function instead of through the terminal or a digital input one of the following masks will appear depending on the conditions

Summer Operation through Digital Input
Summer Operation through Terminal
Winter Operation through Digital Input
Winter Operation through Terminal

12. I/O

- The input/output status mask loop will be displayed by pressing the "I/O" button.

12.1 I/O mask sequence

Air Temperature Room 00.0 °C Ambient 00.0 °C Delivery 00.0 °C	Value read by input B1 first board Value read by input B2 first board Value read by input B3 first board
Water Temp. 00.0 °C Pressure C1 00.0 C2 00.0 C3 00.0 C4 00.0	Value read by input B4 first board Value read by inputs B5 and B6 of the first board and B5 and B6 of the second board
Air Humidity Room 00.0 % Ambient 00.0 % Delivery 00.0 %	Value read by input B8 first board Value read by input B7 second board Value read by input B8 second board
Hour Running Unit 00000 Heating 00000 Cooling 00000	Number of hours of operation of the unit (ventilation ON) Number of hours of operation on heating Number of hours of operation on cooling
Compressor Running Hours C1 00000 C2 00000 C3 00000 C4 00000	Number of hours of operation of each compressor present
Electric Heater Running Hours R1 00000 R2 00000 R3 00000 R4 00000	Number of hours of operation of each heater present
Running Hours Humidification 00000 Dehumidificat. 00000 Free Cooling 00000	Number of hours of operation on humidification Number of hours of operation on dehumidification Number of hours of operation on free cooling
Running Hours Hot W. Valve 00000 Burner 00000	Number of hours of operation of the hot valve and warm air burner, if present
Board 1 Ind.=1 Digital Input Status (1.....12): CCCCC CCCCC CC	Status of digital inputs of the first board and its address in the local network; this is for reference when several boards are controlled with one shared terminal.

Board 1 Digital Output Status (1.....11): AxAAA AAAAA A	Status of the digital outputs of the first board
Board 2 Digital Input Status (1.....12): CCCCC CCCCC XX	Status of the digital inputs of the second board
Board 2 Digital Output Status (1.....11): AAAAA AAAAA A	Status of the digital outputs of the second board
Dampers: 000 % I Water Valve: 000 % I	Damper opening percentage; Y0 first board Graph of opening percentage Water valve opening percentage; Y1 first board Graph of opening percentage
Humidific: 000 % I	Humidifier percentage; Y1 first board Graph of opening percentage
Exhaust Damper: 000 % I Fan Speed: 000 % I	Exhaust damper opening percentage; Y0 second board Graph of opening percentage Speed control voltage; Y1 first board Graph of opening percentage
U.T.A. Gamma/Delta BLUE BOX Cod.: DBBB0ICRTA Ver. 1.412 20/03/98	Eprom identification mask
Testing Date gg/mm/aaaa Inspector Code 0000	Identification mask of the day of testing and the inspector code

13. ? Info

- The "? Info" button will be used in the case of the terminal in the network being shared by several units to change over reading between the enabled units.
The change will take place cyclically between the configured units every time the button is pressed, and the display will show the mask left by the last change.

14. PRINTER

- The "printer" mask will be displayed by pressing the button with a printer drawn on it:

14.1 Printer mask

The mask indicates no printer is connected

15. CLOCK

- The "clock" mask will be displayed by pressing the button with a clock drawn on it:

15.1 Clock mask

The mask indicates no clock has been installed

16. ALARMS

- After the occurrence of one or more alarms, the general alarm relay will be energized, the "alarm" button will light up red, the control will buzz, "ALL" will be displayed at the top right of any mask, after pressing the "alarm" button once the control will stop buzzing, pressing it a second time will display the alarm with one of the following masks.
To eliminate the alarm mask, in the case of the alarms not being merely warnings, you will first need to eliminate the cause of the alarm so that the corresponding digital input closes, after which you will need to press the "alarm" button again.
The alarm relay will stay energized until this last operation has been completed and there are no other alarms

16.1 Alarm masks

No Alarm	This mask appears after pressing the "alarm" button when no alarm is active.
Main Fan Alarm	This alarm corresponds to opening the input ID11 of the first board, and it will cause all the active outputs of the compressors and heaters as well as that of the main fan to open immediately.
Auxiliary Fan Alarm	This alarm corresponds to opening the input ID8 of the second board and it will cause the auxiliary fan output to open immediately
Eeprom Damaged	This alarm will appear if the working eeprom gets damaged
Clogged Filter Alarm	This alarm will appear on opening the input ID2 of the first board, and will be for notification only.
Air Flow Switch Alarm	This alarm will appear after opening the input ID1 of the first board when the output 1 of the first board is closed. It will anyhow be delayed, and the delay time will be zeroed in the case of resetting the alarm. This alarm will open all the digital and analogue outputs except for the outputs of the fans that will continue to function.
Compressor 1 Low Pressure	The alarm corresponding to opening the digital input ID6 of the first board; when it comes up the control will open digital output No.6 of the first board, observing the relative delays.
Compressor 1 High Pressure	The alarm corresponding to opening the digital input ID7 of the first board; when it comes up the control will open digital output No.6 of the first board instantly.

Compressor 2 Low Pressure	The alarm corresponding to opening the digital input ID8 of the first board; when it comes up the control will open digital output No.7 of the first board, observing the relative delays.
Compressor 2 High Pressure	The alarm corresponding to opening the digital input ID9 of the first board; when it comes up the control will open digital output No.7 of the first board instantly.
Compressor 3 Low Pressure	The alarm corresponding to opening the digital input ID1 of the second board; when it comes up the control will open digital output No.6 of the second board, observing the relative delays.
Compressor 3 High Pressure	The alarm corresponding to opening the digital input ID2 of the second board; when it comes up the control will open digital output No.6 of the second board instantly.
Compressor 4 Low Pressure	The alarm corresponding to opening the digital input ID3 of the second board; when it comes up the control will open digital output No.7 of the second board, observing the relative delays.
Compressor 4 High Pressure	The alarm corresponding to opening the digital input ID4 of the second board; when it comes up the control will open digital output No.7 of the second board instantly.
Compressor 1 Thermal Overload Protection	The alarm corresponding to opening the digital input ID1 of the second board; when it comes up the control will open digital output No.6 of the first board instantly.
Compressor 1 Oil Differential Pressure Switch	The alarm corresponding to opening the digital input ID2 of the second board; when it comes up the control will open digital output No.6 of the first board instantly.
Compressor 2 Thermal Overload Protection	The alarm corresponding to opening the digital input ID3 of the second board; when it comes up the control will open digital output No.7 of the first board instantly.
Compressor 2 Oil Differential Pressure Switch	The alarm corresponding to opening the digital input ID4 of the second board; when it comes up the control will open digital output No.7 of the first board instantly.
Hot Water Low Temperature	This alarm will appear when it is envisaged to use the hot water valve (heating and post-heating) and the water temperature is less than “tmi”; this alarm will make the water re-circulate while keeping the valve’s servo-control closed.

Defrost End Maximum Time Overcome	This alarm will appear when in heat pump operation defrosting will have ended due to the maximum time. This alarm involves no action being taken by the control and it will stay active until the next regularly terminated defrosting.
Humidifier Alarm	The alarm corresponding to opening the digital input ID12 of the first board; when it comes up the control will open digital output No.10 of the first board.
Electric Heater 1 Alarm	The alarm corresponding to opening the digital input ID4 of the first board; when it comes up the control will open digital output No.8 of the first board.
Electric Heater 2 Alarm	The alarm corresponding to opening the digital input ID5 of the first board; when it comes up the control will open digital output No.9 of the first board.
Electric Heater 3 Alarm	The alarm corresponding to opening the digital input ID6 of the second board; when it comes up the control will open digital output No.8 of the second board.
Electric Heater 4 Alarm	The alarm corresponding to opening the digital input ID7 of the second board; when it comes up the control will open digital output No.9 of the second board.
Water Pump Alarm	The alarm corresponding to opening the digital input ID9 of the second board; when it comes up the control will open digital output No.9 of the second board.
Boiler or Burner Alarm	The alarm corresponding to closing the digital input ID10 of the second board; when it comes up the control will keep the digital output No.11 of the second board closed
Temperature out of Operating Limits	This alarm will appear when the input B1 measures a lower value than "mti" decreased by the temperature differential, or a higher value than "Mte" increased by the temperature differential.
Humidity out of Operating Limits	This alarm will appear when the input B8 measures a lower value than "mui" decreased by the humidity differential, or a higher value than "Mue" increased by the humidity differential.
Antifreeze Alarm	This alarm will appear when the delivery air temperature is less than the anti-freeze value. This alarm will enable output No.10 of the second board and open the hot water valve to the value "ava"

Room Temperature Probe Faulty or not Connected	This alarm will appear when the control finds abnormal values reading the input B1 of the first board
Ambient Temperature Probe faulty or not Connected	This alarm will appear when the control finds abnormal values reading the input B2 of the first board if it has been configured for the probe.
Delivery Temperature Probe Faulty or not Connected	This alarm will appear when the control finds abnormal values reading the input B3 of the first board if it has been configured for the probe.
Water Temperature Probe Faulty or not Connected	This alarm will appear when the control finds abnormal values reading the input B4 of the first board if it has been configured for the probe.
Room Humidity Probe Faulty or not Connected	This alarm will appear when the control finds abnormal values reading the input B8 of the first board if it has been configured for the probe.
Ambient Humidity Probe Faulty or not Connected	This alarm will appear when the control finds abnormal values reading the input B7 of the second board if it has been configured for the probe.
Delivery Humidity Probe Faulty or not Connencted	This alarm will appear when the control finds abnormal values reading the input B8 of the second board if it has been configured for the probe.
Compres. 1 Pressure Probe Faulty or not Connected	This alarm will appear when the control finds abnormal values reading the input B5 of the first board if it has been configured for the probe.
Compres. 2 Pressure Probe Faulty or not Connected	This alarm will appear when the control finds abnormal values reading the input B6 of the first board if it has been configured for the probe.
Compres. 3 Pressure Probe Faulty or not Connected	This alarm will appear when the control finds abnormal values reading the input B5 of the second board if it has been configured for the probe.
Compres. 4 Pressure Probe Faulty or not Connected	This alarm will appear when the control finds abnormal values reading the input B6 of the second board if it has been configured for the probe.

Slave Board not Connected	This alarm will appear when the control detects no signal from the slave board, if the configuration envisages the functions that required it to be used.
Unit Needs Maintenance	This alarm will appear when the unit's hours of operation exceed the number of hours set for maintenance. This alarm will be for notification only.

NOTE:

The information contained in this documentation may be modified without prior notice and it is in no way binding for BLUE BOX s.r.l.

I DATI TECNICI POSSONO ESSERE MODIFICATI SENZA PREAVVISO.
TECHNICAL DATA MAY CHANGE WITHOUT NOTICE.

BLUE BOX
condizionamento

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