ERT 400
Electronic Control for Roof Top, Close Control

CONTENTS

1 HOW TO USE THIS MANUAL

This manual is designed to permit quick, easy reference with the following features:

References
References column**:**
A column to the left of the text contains references to subjects discussed in the text to help you locate the information you need quickly and easily.

Cross references
Cross references:
All words written in *italics* are referenced in the subject index to help you find the page containing details on this subject; supposing you read the following text:
"when the alarm is triggered, the compressors will be shut down"
The italics mean that you will find a reference to the page on the topic of *compressors* listed under the item *compressors* in the index.
If you are consulting the manual "on-line" (using a computer), words which appear in italics are hyperlinks: just click on a word in italics with the mouse to go directly to the part of the manual that discusses this topic.

Icons for emphasis
Some segments of text are marked by icons appearing in the references column with the meanings specified below:

Take note: information on the topic under discussion which the user ought to keep in mind

Tip: a recommendation which may help the user to understand and make use of the information supplied on the topic under discussion.

Warning! : **information which is essential for preventing negative consequences for the system or a hazard to personnel, instruments, data, etc., and which users MUST read with care.**

2 INTRODUCTION

ERT400 is a unit designed for:

- medium-sized roof-top units
- air handling units
- close controls, packaged units
- water/air and air/air chillers

2.1 Main characteristics

Configurability

- Management of 1, 2, 3, 4 *compressors*
- Management of 1, 2, 3 capacity steps per compressor
- Management of 1,2 circuits
- Cold/heat pump

I/O configurability

- Up to 13 configurable relays
- 15 configurable *digital inputs*
- 0-10 V analogue outputs

Up to 8 *Analogue Inputs* configurable as:

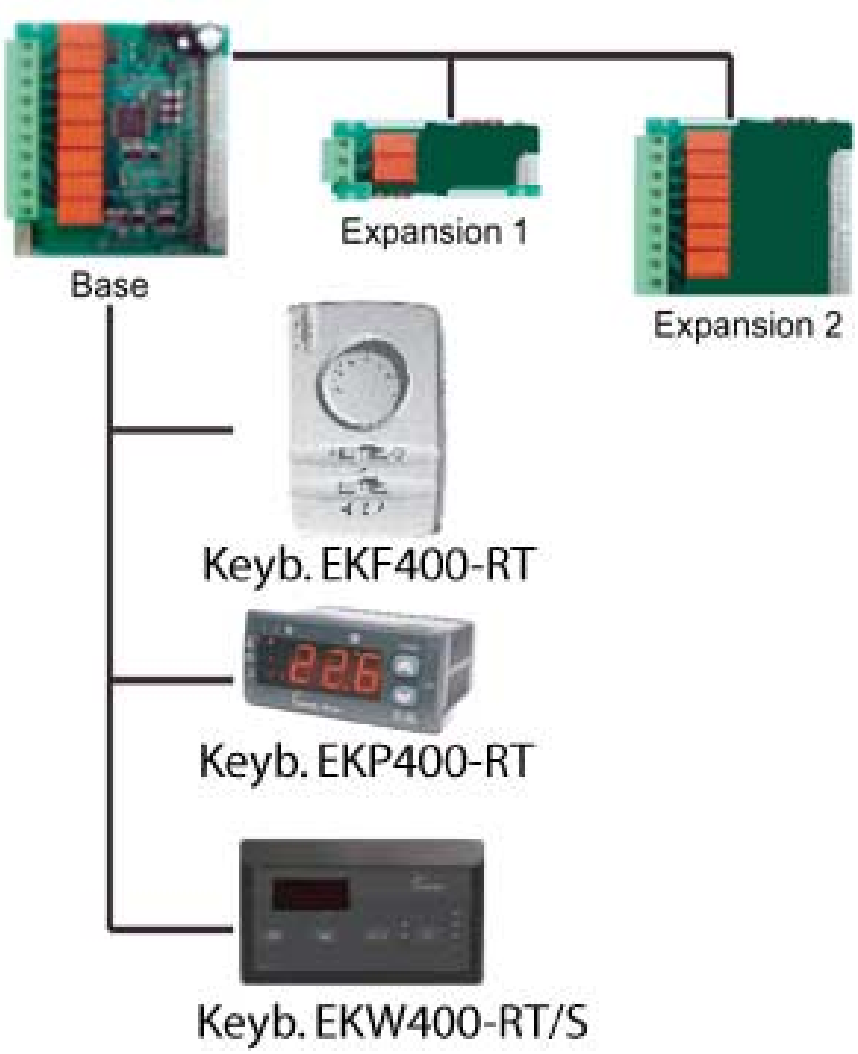
- 3 NTC or *Digital Inputs*
- 2 NTC or 4-20 mA Inputs
- 1 0-5V or Digital Input
- 2 4-20 mA or *Digital Inputs*

Available functions

- Operating mode: cool, heat, fan
- Automatic change-over based on temperature of inlet air
- *Dynamic set point*
- Thermodynamic optimization of circuits
- Temperature control
- Heat pump
- Control of *reversing valve*
- Control of *defrosting*
- Control of condensation
- Control of ventilation
- Control of electric heaters
- Control of *humidification*/*dehumidification*
- Temperature/*Enthalpy*
- Control of *air pollution* (CO2)
- Proportional control of *hot water coil*
- "*NIGHT*" function
- Economy function (ECO)

2.2 Components and models

Energy 400 RT consists of a base module with resources that can be extended using special expansion modules. It is controlled by using special *keyboards* connected to it.



Components and *accessories*

Base = Master Card
Expansion 1 = EXP402 expansion card
Expansion 2 = EXP405RH expansion card
Keyb. EKF400-RT = 'simplified' wall keyboard
Keyb. EKP400-RT = panel keyboard
Keyb. EKW400-RT/S =wall keyboard

Models available

Different models with different types of terminals that use Modbus or Televis communication *protocols* are available for some elements: refer to the summary table below:

BASE	Relay basic model: Molex quick plug-in terminals on low voltage, Faston connectors on relay connections, screw connectors on keyboard	With Modbus protocol	Code MW324060
		With TELEVIS protocol	Code MW324050
EXPANSION 1	Single model		Code MW324100
EXPANSION 2	Model with plug-in terminals: plug-in screw terminals on high and low voltage		Code MW324115
KEYBOARD EKW400-RT/S	Single model		code MW324630
KEYBOARD EKP400-RT	Single model		code MW324680
KEYBOARD EKF400-RT	Single model		Code MW324700

2.3 Diagnostics

ERT 400 has an effective alarm system and protection *functions*:

- High and low pressure digital *alarms*
- Single compressor shut-down alarm
- Condenser fan thermal switch alarm
- *Evaporator fan* thermal switch alarm
- Worn filter alarm:
- Outlet air temperature too cold alarm
- High and low inlet temperature alarm
- Heat pump shut down when external temperature is too low

2.4 Protocols

ERT 400 can be fitted with 2 different types of communication protocol:

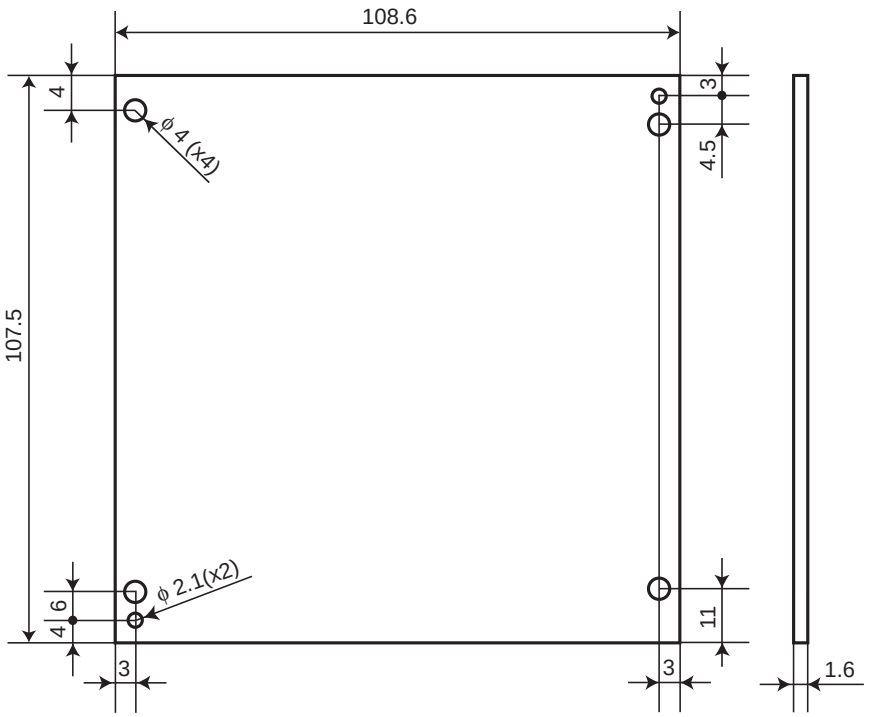
- Eliwell protocol for integration with Televis system
- Modbus protocol

3 MECHANICAL MOUNTING

3.1 Dimensions

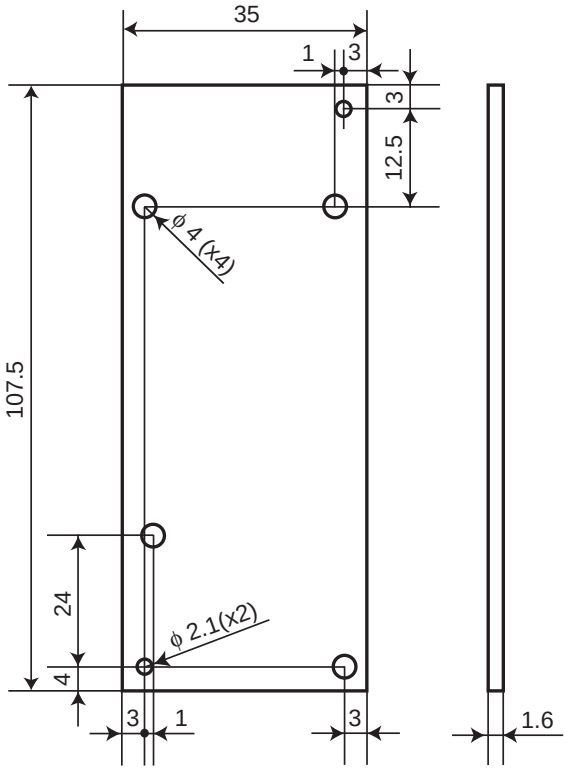
Dimensions of base module

***Dimensions* of power board (base module)**

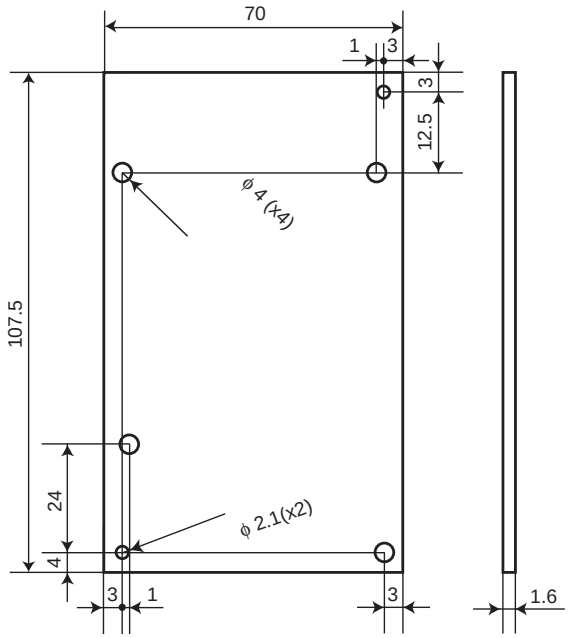


***Dimensions of expansion module*s**

Dimensions of expansion module EXP 402

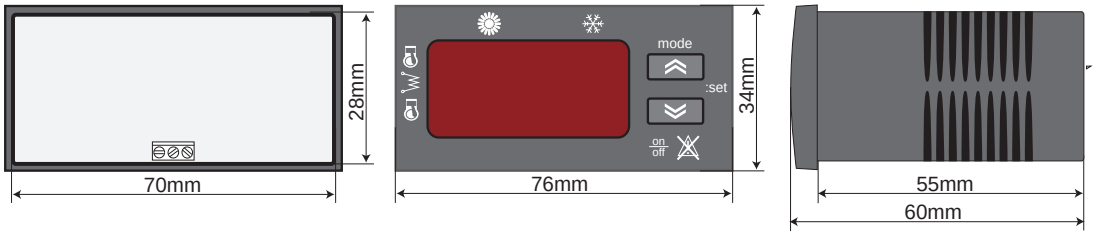


Dimensions of expansion module EXP 405

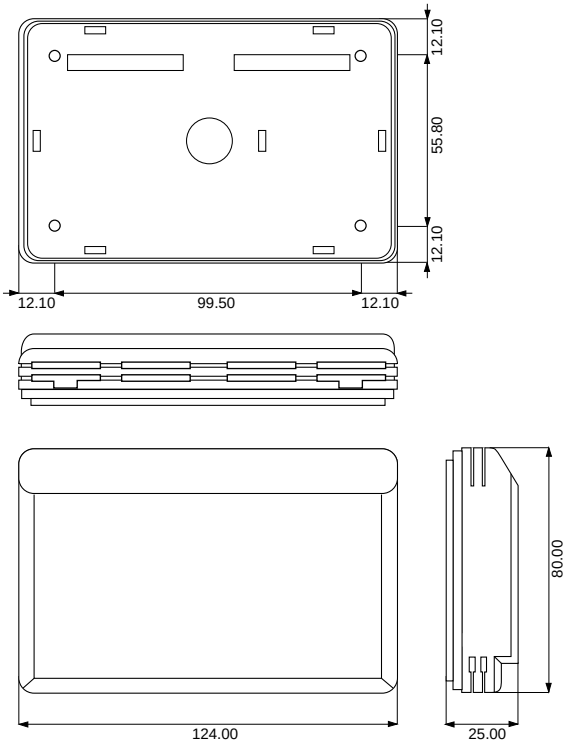


Dimensions **of** ***keyboards***

Dimensions of EKP 400 keyboard



Dimensions of EKW 400 keyboard



Dimensions of EKF400 keyboard

3.2 Mechanical assembly of keyboards

3.2.1 EKW 400 keyboard connections

The remote keyboard is connected by way of a screw terminal block situated inside the front section (see the base unit/keyboard connection diagram) which can be accessed by removing the front (with a screwdriver or a similar tool),as shown in the figure.
The connections between the terminal block of the remote keyboard and the main unit are shown in the keyboard-base unit connection diagram. The cables must pass through the central hole in the rear section (see the EKW *dimensions*

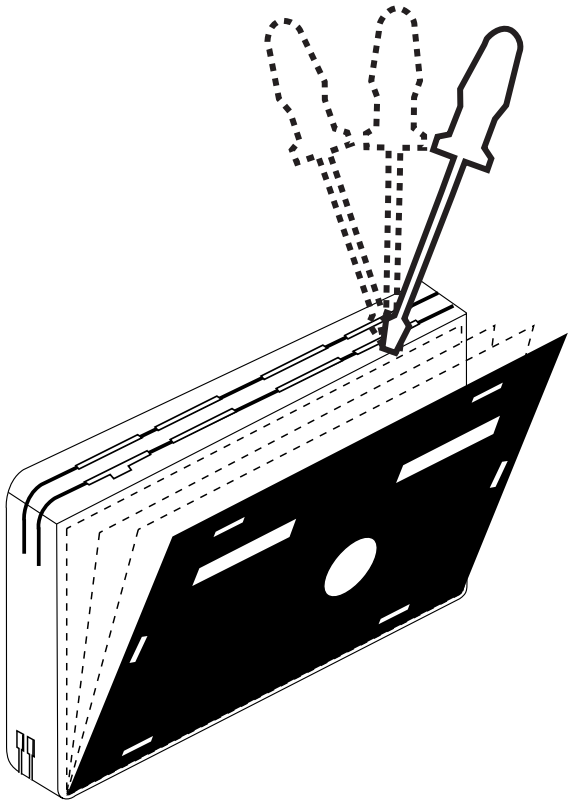
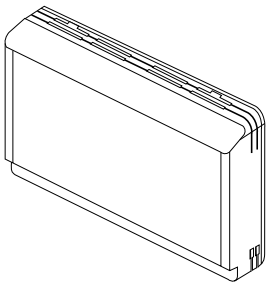


diagram).

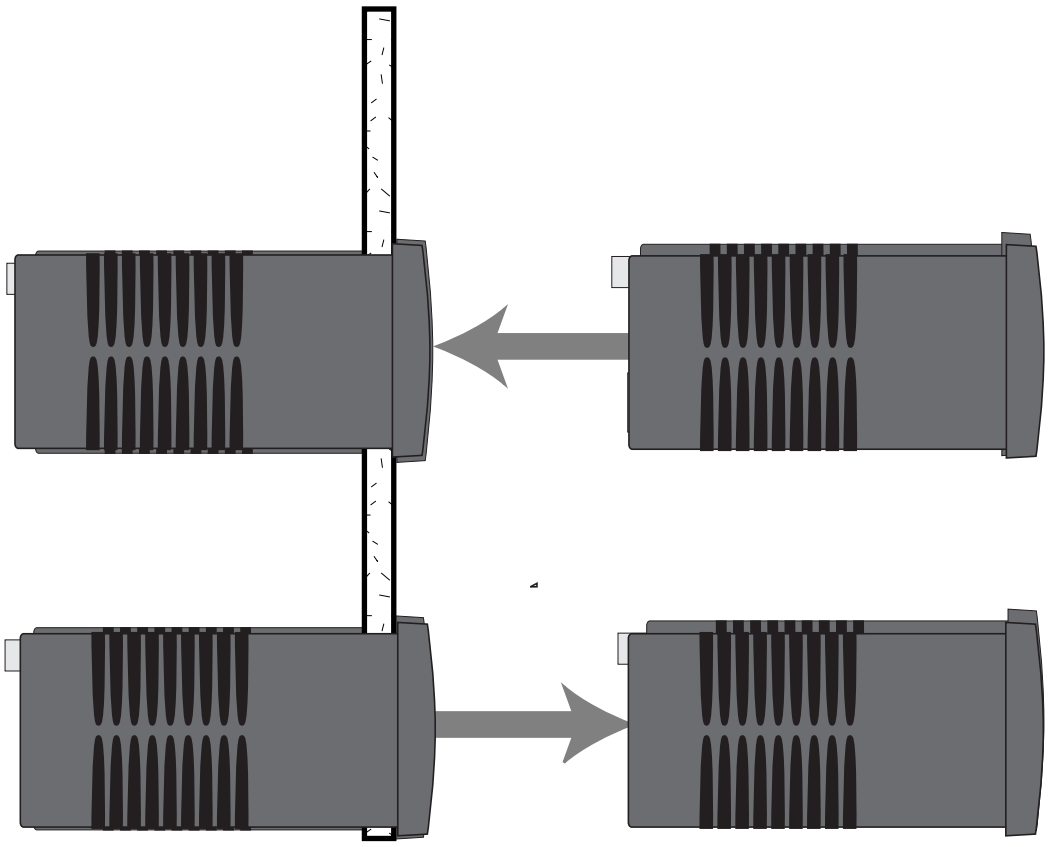
3.2.2 Mechanical assembly of EKW 400 keyboard



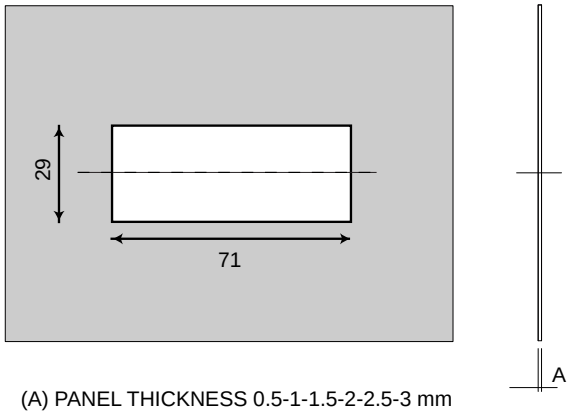
The keyboard is designed to be wall-mounted (see diagram). After removing the front part, drill four 4 mm diameter holes in the wall at the recommended distances (see the EKW *dimensions* diagram). Fix the black rear side to the wall with four screws. After carrying out the necessary connections, close the front section of the keyboard by simply pushing it in place.

3.2.3 Mechanical assembly of EKP 400 keyboard

The keyboard is designed to be panel-mounted (see diagram).
Drill a 29x71 mm hole, insert a tool and fix it in place with the brackets provided. Do not assemble the keyboard in excessively dirty and/or dirty locations because it is designed to be used in locations with normal degrees of pollution.



Always make sure that the area near the *cooling* slits of the device is adequately ventilated.



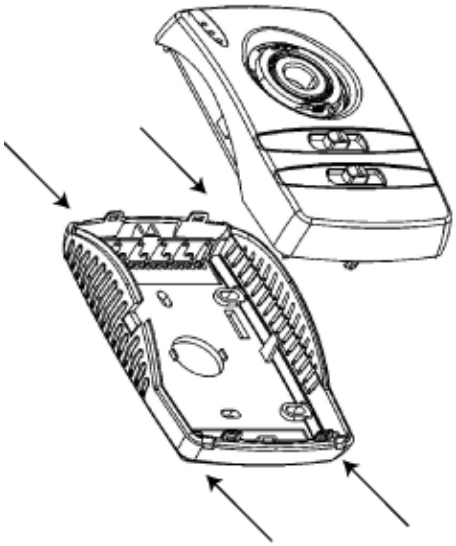
(A) PANEL THICKNESS 0.5-1-1.5-2-2.5-3 mm

3.2.4 Panel cut-out

3.2.5 Mounting of EKF400

EKF 400 for wall mounting consists of two parts:
the first (connector master card) is fastened to the wall and contains only the connectors;
the second (main interface) contains the electronics and all the controls and can be connected to the first part with a simple snap-on connector.

This makes *installation* easy and removes the risk of damaging the electronic parts during *installation*.
Use a small screwdriver to separate the connector master card from the main interface. Place the screwdriver in the special holes (in the side of the container) and twist slightly until the two parts come apart.

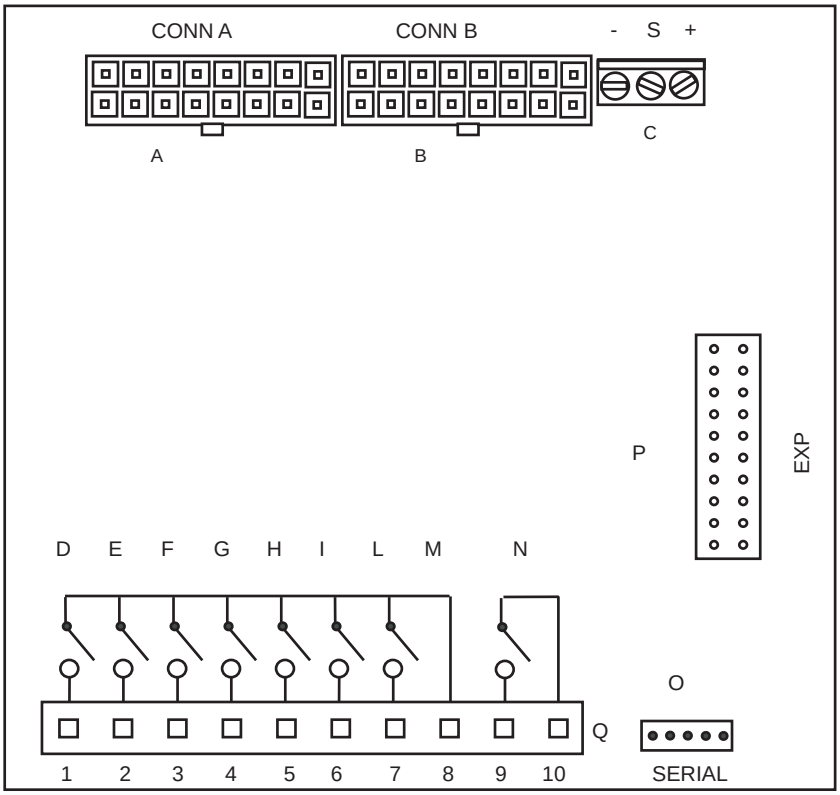


4 INSTALLATION

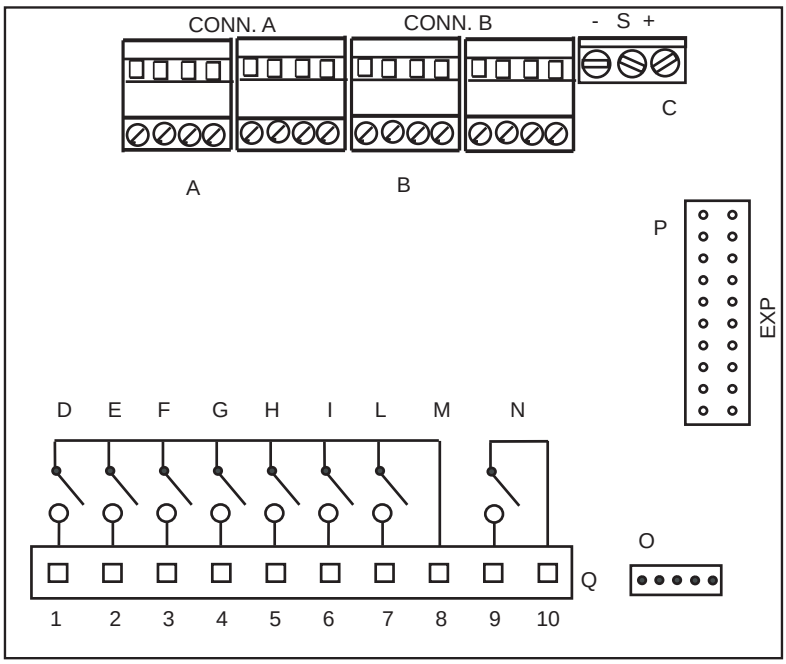
Before performing any operations, make sure that an adequate external *transformer* has been installed on the unit. Always follow the instructions given below when connecting the cards:
Do not apply *loads* exceeding those indicated in this specification to the outputs;
Connect the *loads* following the directions given in the wiring diagram;
Always use separate cables for high and low voltage *loads*.

4.1 Wiring diagrams

Connection of base unit



Base unit– Model with part plug-in terminals

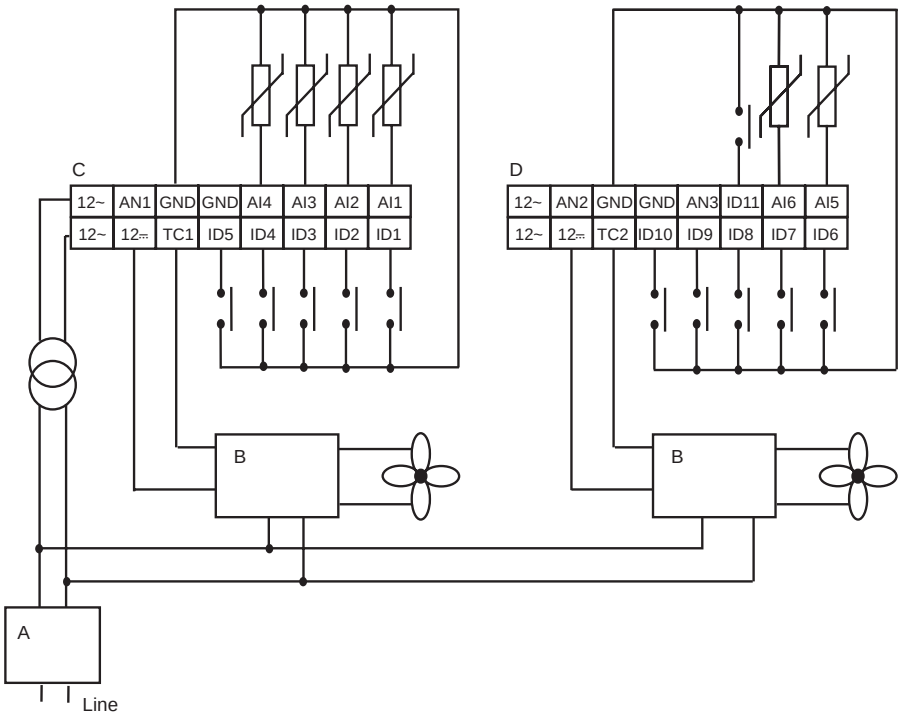


Base unit – Model with plug-in terminals

A: Connector A	AIx: Analogue input x IDx: Digital input x ANx: 4...20 mA output for fan control in circuit x TCx: Output for external fan modules circuit x NC: not connected 12 V dc GND
B: Connector B	
C: Connection to remote keyboard	
D: Compressor, relay 1	
E...L: configuration relay E...L	
M: alarm relay	
N: shared alarm relay	
O: serial	
P: connection to expansion module	
Q: relay outputs not powered	1: compressor, relay 1 2...7: configuration of relays 2...7 8: shared 9: alarm relay 10: shared alarm relay

Wiring diagram with NTC

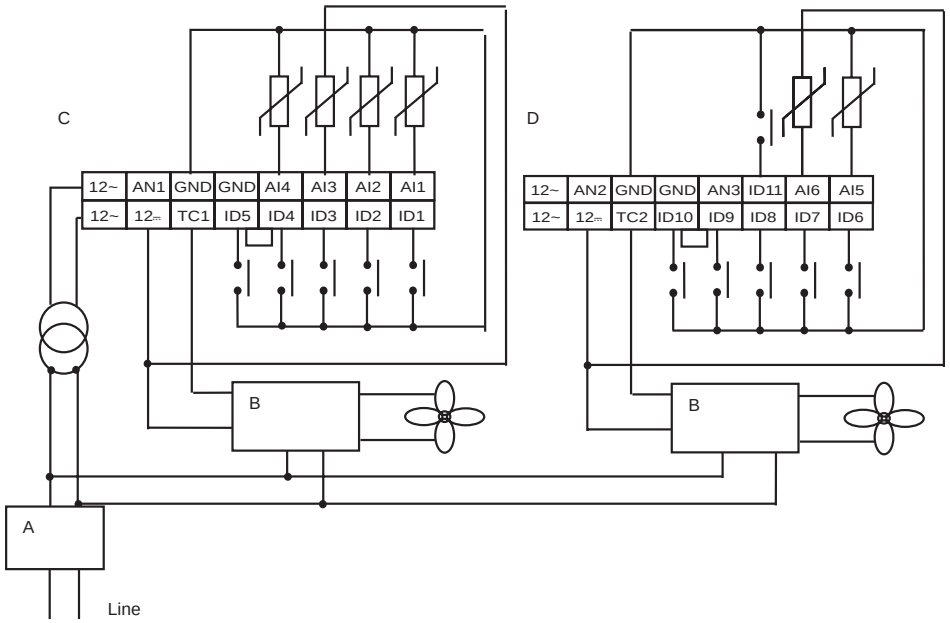
2 examples of NTC probe and pressure probe connections are shown below:



Connection with NTC sensors

A: LC filter (using only CF Control)	
B: Phase cutting fan module	
C: Connector A	AIx: Analogue input x IDx: Digital input x ANx: 0-10VDC output for fan control in circuit x TCx: Output for external fan modules circuit x NC: not connected 12 V dc GND
D: Connector B	

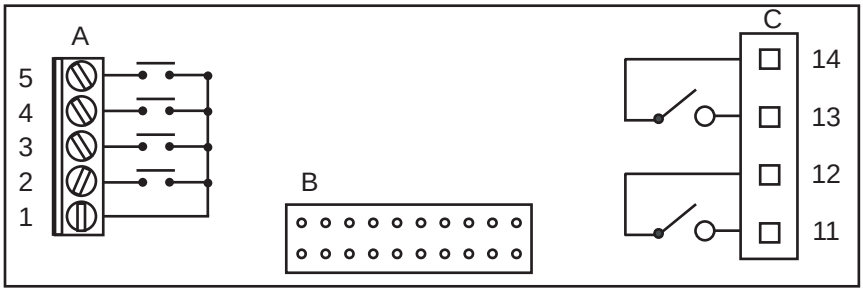
Wiring diagram with pressure probes



Connection with 4...20mA inputs

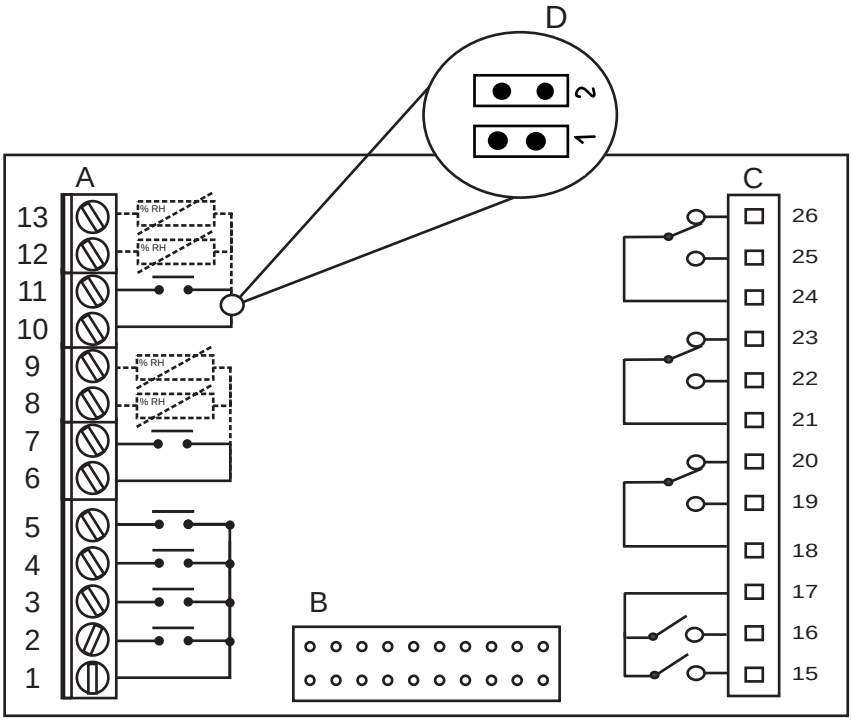
A: LC filter (using only CF Control)	
B: Phase cutting fan module	
C: Connector A	AIx: Analogue input x IDx: Digital input x ANx: 0-10VDC output for fan control in circuit x TCx: Output for external fan modules circuit x NC: not connected 12 V dc GND
D: Connector B	

Exp 402 expansion module connections (type 1)



Exp 402 expansion module (type 1)

A: Screw connectors	1: Shared Digital Input 2...5: *Digital inputs* 12...15
B: Connection to base module	
C: Relay outputs not powered	11: relay 9 configurable 13: relay 10 configurable 12-14: shared



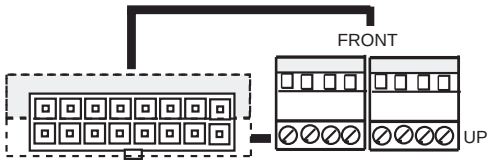
Exp 405RH expansion module connections (type 2)

Exp 405 RH expansion module (type 2)

A: Screw connectors	1: common for ID12...ID15 2...5: *Digital inputs* ID12...ID15 6-7: AI7 if configured as digital input 6-8: AI7 if configured as 4-20mA input 10-11: AI8 if configured as digital input 10-12: AI8 if configured as 4-20mA input
B: Connection to base module	
C: Relay outputs not powered	15: relay 9 configurable 16: relay 10 configurable 17: common relays 15-16 18-19-20: relay 11 SPDT* configurable 21-22-23: relay 12 SPDT* configurable 24-25-26: relay 13 SPDT* configurable
D: Jumper function	if Jumper J1 inserted: input AI7 = 4-20mA

	if Jumper J1 not inserted:AI7 = Digital input if Jumper inserted: input AI8 = 4-20mA if Jumper J2 not inserted:AI8 = Digital input

*Single point double terminal



The previous diagrams refer to cards with molex connectors;
The pin configuration is the same for plug-in connectors (Phoenix), the only difference being that the first row of terminals is situated in the front part of the connector.

The devices are configured according to the values of the *parameters* associated with the inputs and outputs.

4.2 Configuration of analogue inputs

Analogue inputs

There are 6 *analogue inputs* on the base unit (2 on the 405RH expansion module):

- 3 NTC or *Digital Inputs*
- 2 NTC or 4-20ma Inputs
- 1 0-5v or digital Input
- 2 4...20mA or *digital Inputs*

The inputs can be configured as in the following table.

Analogue inputs: configuration table

Probe	Parameter	Value 0	Value 1	Value 2	Value 3
AI 1	*H11*	No probe	NTC input Inlet air	Multi-functional digital input	Not permitted
AI 2	*H12*	No probe	NTC input Anti-freeze / Temperature control	Multi-functional digital input	Not permitted
AI 3	*H13*	No probe	NTC input condensation circuit 1	4-20mA input condensation circuit 1	4-20mA external environment humidity input
AI 4	*H14*	No probe	NTC input external temperature	Multi-functional digital input	Not permitted
AI 5	*H15*	No probe	Multi-functional digital input	0-5 V input Filter differential pressure	0-5Vdc CO2 input
AI 6	*H16*	No probe	NTC input condensation circuit 2	4-20mA input condensation Circuit 2	4-20mA recirculated air humidity input
AI 7 exp.	*N11*	No probe	4-20mA recirculated air humidity input	Multi-functional digital input **	Not permitted
AI 8 exp.	*N12*	No probe	4-20mA external environment humidity input*	4-20mA CO2 input*	Multi-functional digital input **

(*) The jumper on the expansion module must be installed
(**) The jumper on the expansion module must not be installed

All *parameters* related to inputs configured as *digital inputs*.

If the inputs AI3, AI6, AI7 or AI8 are defined as 4-20mA inputs, the following *parameters* are also significant:

H17 = Pressure bottom scale value (kPa*10) for inputs AI3, AI6 if configured for condensation control (external heat exchanger)

- *H21* = Pressure top scale value (% rh) for inputs AI3-6-7-8 if configured for humidity control.
- *H22* = Pressure top scale value (% rh) for inputs AI3-6-7-8 if configured for humidity control.

If input AI5 is configured as 0-5V input (*H15*=2 or 3), the bottom scale value is given by:

- Par *H34* = Bottom scale value (measurement unit related to sensor used) for input AI5.

4.3 Configuration of digital inputs

Digital inputs

There are 11 voltage-free *digital inputs* on the base unit (4 on the expansion module).
AI1-2-4-5 and 7-8 (405RH expansion module) can also be added if these are configured as *digital inputs* using the *parameters H11*-12-14-15, *N11*-12.

Digital inputs: polarity

Digital input polarity is defined by special *parameters*:

- ID1, ID2, ID3, ID4 is defined by parameter *H18*,
- ID5, ID6, ID7, ID8 is defined by parameter *H19*
- ID9, ID10, ID11 is defined by parameter *H20*
- AI1-2-4-5, if configured as multifunctional *digital inputs*, is defined by parameter *H73*
- ID12,ID13,ID14,ID15 on the expansion module is defined by parameter *N01*
- AI7-8 on the 405RH expansion module is defined by parameter *N13*

Refer to the following tables:

H18	ID1	ID2	ID3	ID4
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

H19	ID5	ID6	ID7	ID8
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

H20	ID9	ID10	ID11
0	0	0	0
1	1	0	0
2	0	1	0
3	1	1	0
4	0	0	1
5	1	0	1
6	0	1	1
7	1	1	1
8	0	0	0
9	1	0	0
10	0	1	0
11	1	1	0
12	0	0	1
13	1	0	1
14	0	1	1
15	1	1	1

H73	AI1	AI2	AI4	AI5
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

N01	ID12	ID13	ID14	ID15
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1
10	0	1	0	1
11	1	1	0	1
12	0	0	1	1
13	1	0	1	1
14	0	1	1	1
15	1	1	1	1

N13	AI7	AI8
0	0	0
1	1	0
2	0	1
3	1	1

0= Active with closed contact
1= Active with open contact

1- If all inputs must be active with open contact, set *H18*=*H19*=*H20*
2- Inputs on base unit active with closed contact. All inputs for expansion module active with open contacts (useful when determining accident disconnection of the expansion module)

The *digital inputs* perform the *functions* described below by setting the *parameters* from *H23* to *H33* and from *N02* - *N05* (expansion). *Parameters H74...H77*, *N14-N15* (*analogue inputs* configured as *digital inputs*).

Digital inputs: setting

Parameter value	Description
0	Disabled input
1	Internal fan protection low criticality
2	Remote OFF
3	Remote Heat/Cool
4	Thermal switch of compressor 1
5	Thermal switch of compressor 2
6	Thermal switch of compressor 3
7	Thermal switch of compressor 4
8	Thermal switch of external fans (condensation) circuit 1
9	Thermal switch of external fans (condensation) circuit 2
10	High pressure circuit 1
11	High pressure circuit 2
12	Low pressure circuit 1
13	Low pressure circuit 2
14	*End of defrosting* circuit 1
15	*End of defrosting* circuit 2
16	Window input (economy *set point*)
17	Fire/smoke alarm
18	*Damper* forced open
19	Humidifier alarm
20	Thermal switch of electric heaters 1 and 2
21	Thermal switch of electric heaters 3 and 4
22	Request 1 *cooling* step
23	Request 1 *heating* step
24	Request 2 step
25	Internal fan protection high criticality

If several inputs are configured with the same value, the *functions* associated with the input perform a *logical OR* between the inputs

A digital input configured as below sets off an alarm:

1	**internal fan protection low criticality – immediate intervention and configurable *reset***
4...7	**thermal switch of compressor – immediate intervention and configurable *reset***
8...9	**external fan thermal switch (condensation) on circuit – configurable *reset***
10...11	**high pressure on circuit – *manual reset***
12...13	**low pressure on circuit – immediate intervention and configurable *reset***
17	**Fire/smoke alarm – automatic *reset***
19	**humidifier alarm – automatic *reset***
20...21	**thermal switch of electric heaters – *manual reset***
25	**internal fan protection high criticality – *manual reset***

The digital input configured as remote 2 – OFF also activates an alarm according to parameter *A32*

For further details, refer to the Diagnostic section

EKF400 RT: Digital Inputs

The keyboard has 2 *digital inputs* (terminals) that are not configurable for remote control:

- IDR1 : *Night* Purging
- IDR2 : ECO

It operates as indicated in the table below:

	IDR2 OPEN	**IDR2 CLOSED**
IDR1 OPEN	Activates selection from keyboard	Economy
IDR1 CLOSED	*Night* Purging	Remote OFF

The *digital inputs* have priority over the keyboard except in OFF status when the conditioner is switched off irrespective of the state of the inputs.

If moving the slide switches causes several configuration *digital inputs* to close (e.g. both cool and heat modes are active), the device does not effect a change-over.
This is to prevent undefined states.

The control is fitted with jumpers that select if the *control probe* is on the base unit or the remote keyboard.

4.4 Power output configuration

Power outputs

The base module has 8 *power outputs* (relays) of which 6 are fully configurable:

- **NO1 -** compressor 1. 5 A resistive (125/230VAC)(¼ HP 230VAC, 1/8 HP 125VAC);
- **NO2 -** configurable, 5 A resistive (125/230VAC)(¼ HP 230VAC, 1/8 HP 125VAC);
- **NO3 -** configurable, 5 A resistive (125/230VAC)(¼ HP 230VAC, 1/8 HP 125VAC);
- **NO4 -** configurable, 5 A resistive (125/230VAC)(¼ HP 230VAC, 1/8 HP 125VAC);
- **NO5 -** configurable, 5 A resistive (125/230VAC)(¼ HP 230VAC, 1/8 HP 125VAC);
- **NO6 -** configurable, 5 A resistive (125/230VAC)(¼ HP 230VAC, 1/8 HP 125VAC);
- **NO7 -** configurable, 5 A resistive (125/230VAC)(¼ HP 230VAC, 1/8 HP 125VAC);
- **NO8 –** cumulative alarm, 5 A 125VAC/230VAC Res; ¼ HP 230VAC, 1/8 HP 125VAC;

- **NO9 -** configurable, 5 A resistive (125/230VAC)(¼ HP 230VAC, 1/8 HP 125VAC);
- **NO10 -** configurable, 5 A resistive (125/230VAC)(¼ HP 230VAC, 1/8 HP 125VAC);
- **NO11 -** configurable, 8 A resistive (125/230VAC)(¼ HP 230VAC, 1/8 HP 125VAC) (Exp 405RH expansion module);
- **NO12 -** configurable, 8 A resistive (125/230VAC)(¼ HP 230VAC, 1/8 HP 125VAC) (Exp 405RH expansion module);
- **NO13 -** configurable, 8 A resistive (125/230VAC)(¼ HP 230VAC, 1/8 HP 125VAC); (Exp 405RH expansion module);

The outputs NO2...NO7 can be configured with the *parameters H35* ... *H40* with values assigned as indicated below:

Value	**Description**
0	Disabled
1	Reverse valve circuit 1
2	Reverse valve circuit 2
3	Condenser fan circuit 1
4	Condenser fan circuit 2
5	Hot water pump
6	*Evaporator fan*
7	Power step 2
8	Power step 3
9	Power step 4
10	Humidifier
11	Heater step 1
12	Heater step 2

13	Heater step 3
14	Heater step 4
15	*Damper*
16	Defrost relay

Polarity of relays

The polarity of outputs NO2 ... NO5 can be configured with the *parameters H41 ... H45*, the polarity of output NO8 can be configured with the parameter *H45*:

- 0= relay on for active output
- 1= relay off for active output

The other relays have relay on polarity if the output is active

Outputs on expansion boards

The *power outputs* on the expansion boards can be configured with the *parameters N06, N07, N08* ... N10** (* for Exp 405RH expansion module) in the same way as above.

The outputs on the expansion boards have relay on polarity if the output is active

If several outputs are configured with the same resource, the outputs will be activated in parallel.

The maximum load on the different outputs at the same time MUST NOT exceed 8A

4.5 Low voltage output configuration

Low voltage outputs

The base module has 5 *low voltage outputs*:

- **TC1 -** PWM output for external module – fan control on first circuit.
- **TC2 -** PWM output for external module – fan control on second circuit.
- **AN1 -** 0-10Vdc output fan control on first circuit
- **AN2 -** 0-10Vdc output fan control for second circuit/hot water valve
- **AN3** – 0-10 Vdc output for *damper* control (*freecooling*)

Although outputs AN1 and AN2 have separate connections, they can be used instead of TC1 and TC2 and are selected by means of *parameters H46* and *H47*

Configuration of fan outputs

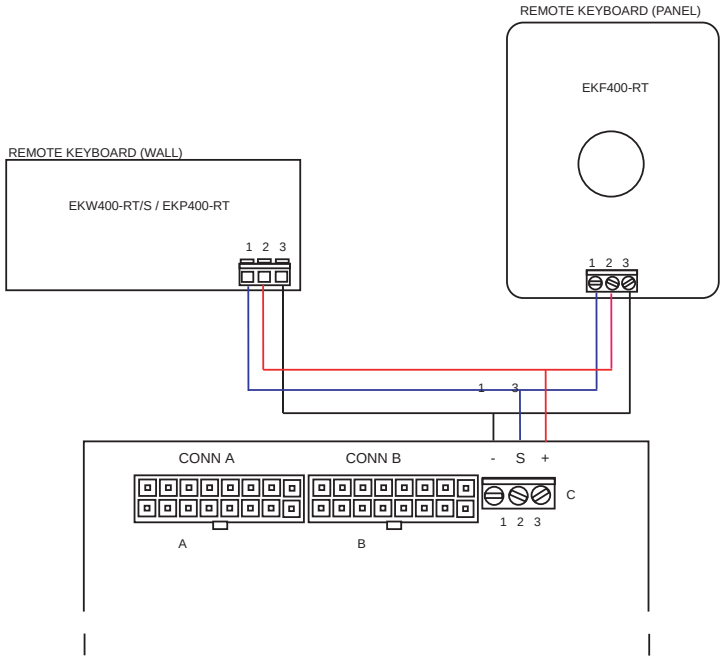
.	Value		
	0	**1**	**2**
H46	PWM output circuit 1	0-10Vdc output fan 1	Not permitted
H47	PWM output circuit 2	0-10Vdc output fan 2	0-10Vdc output hot water valve

4.6 Remote keyboard output

The base unit has an asynchronous *serial output* that enables it to be connected to the remote keyboard:

- 12 Vdc
- 2400 baud
- parity: EVEN
- 8 data bits
- 1 stop bit

Please refer to the connection diagram below:

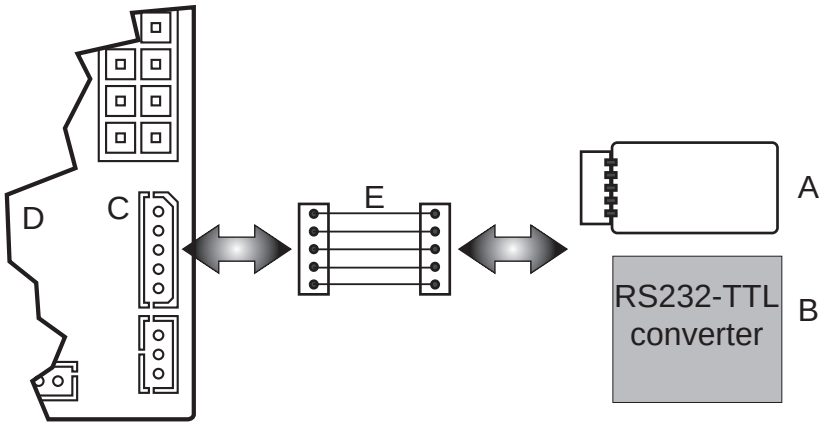


4.7 Serial output

The base unit has an asynchronous *serial output* that enables it to be connected to a Personal Computer or *Copy Card*

For connection to a PC, a special interface module (RS232-TTL) is necessary

A PC or *Copy Card* is connected by a 5-way TTL cable (30 cm) as shown in the diagram below:



A: *Copy Card device* B: interface module RS232-TTL	E: Connection by TTL cable
C: *serial output*	D: base module

4.7.1 Copy Card device

Data is downloaded and uploaded as follows.

UPLOAD (data copied from UNIT to *COPY CARD*)

Programming *parameters* are uploaded to the *Copy Card*.

This operation can be performed as described below.

- Insert the *Copy Card* when the unit is on
- Go to menu PSS
- The message - - - is displayed.
- Enter the password that corresponds to the value of parameter *H70*
- Press both keys for a few minutes until PSS reappears on the *display*
- Disconnect the *Copy Card*

The *Copy Card* is formatted before the UPLOAD.
This operation deletes all the data on the *Copy Card*.
This operation is irreversible.

DOWNLOAD (data copied from a *COPY CARD* to a UNIT)

Programming *parameters* are loaded into the unit.

This operation can be performed as described below.

- Insert the *Copy Card* when the unit is off.
- Turn the unit on.
- *Occ* is displayed when uploading is completed.
- *Err* is displayed if the copy operation fails.
- Turn the unit off.
- Disconnect the *Copy Card*
- Turn the unit on.

4.8 Units of measurement

Parameter *H66* can be used to *display* the temperature in °C or °F:

Units of measurement: selection

H66	Unit of measurement
0	°C degrees
1	°F degrees

Remember the relationship between the two *units of measurement*: °F = °C x 9/5 + 32

5 USER INTERFACE

The *user interface* consists of *keyboards* that can be connected to the unit: each type of keyboard provides different controls and *functions*.

Three types of keyboard can be connected:

- EKF400-RT ('simplified' wall mounted)
- EKW400-RT/S (wall mounted)
- EKP400-RT (recessed/panel)

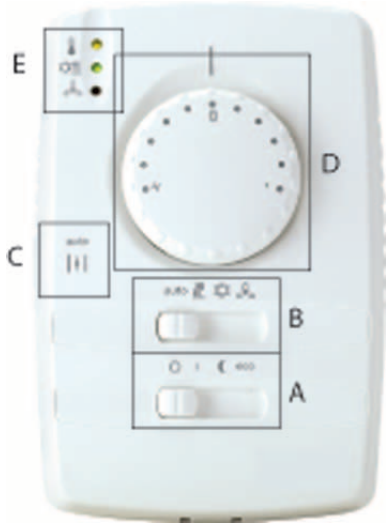
Up to 2 of the above *keyboards* can be connected to the same unit as described in paragraph 6.5.

ERT 400 can also be used without a keyboard and the *parameters* are checked by interfacing with a PC or are downloaded from a *Copy Card*.

The EKF EKW *keyboards* have an internal sensor that can be used instead of input *A11* for temperature control. If this is the case, the following conditions must be complied with:

1) EKP - *H80*=0 always; regulation only on AI1
2) EKF - *H80*=0 indifferent (*parameters* are not accessible)
   - Jumper closed, regulation on EKF probe
   - Jumper open, regulation only on AI1
3) EKW
   - *H80*=0 regulation on AI1
   - *H80*=1 regulation on EKW probe
4) EKP+EKW-*H80*=0 always; regulation only on AI1
5) EKP+EKF-*H80*=0 always; regulation only on AI1
6) EKW+EKF:
   - EKF jumper closed; *H80* indifferent — regulation on EKF probe
   - EKF jumper open; *H80*=1 — regulation on EKW probe
   - EKF jumper open; *H80*=0 — regulation on AI1 (base unit probe)

5.1 EKF400-RT keyboard



A: MACHINE STATE	D: KNOB
B: OPERATING MODE	E: STATUS *LED*
C: *DAMPER* MODE	

The switch is used to set the unit to one of 4 possible states:

- **1**: ON
- **0**: Standby

- eco: Economy mode
- : *Night* Purging

The switch can be used to set the unit to one of 4 possible *operating modes*:

- : Fan
- : Cool
- : Heat
- auto: *Auto*

auto

The slide control is used to control the way the *damper* is opened:

- auto : automatically controlled by unit
- : *damper* forced open

The state can also be set using the digital input; *digital inputs* on the EKF are called IDR1, IDR2
Refer to the table below:

IDR1	IDR2	STATE
OPEN	OPEN	"STATUS" SELECTOR SET FOR "*NIGHT*" OR "ECO"
OPEN	CLOSED	"ECO"
CLOSED	OPEN	"*NIGHT*"
CLOSED	CLOSED	"OFF"

- If the "ECO" and "*NIGHT*" states are forced, the machine can still be switched off using the status selector
- The "ECO" state can also be activated using the digital input (on base or expansion module) with corresponding parameter =16
- The "*Damper* forced open" state can also be activated using the digital input (on base or expansion module) with corresponding parameter =18
- The "OFF" state can also be activated using the digital input (on base or expansion module) with corresponding parameter =2

Status *LED*:

This *LED* indicates if the temperature has been reached:
- GREEN: control resources ON
- not lit: control resources OFF

This *LED* indicates the operating mode:
- GREEN: *cooling* mode
- RED: *heating* mode
- NOT LIT: standby

This *LED* indicates the state of the evaporation fan:
- NOT LIT: fan OFF
- GREEN: fan operating correctly
- GREEN BLINKING: dirty filters
- RED BLINKING: clogged filters
- RED: alarm condition – one or more of the *alarms* specified in the diagnostic chapter are present

The <Filters clogged / dirty> conditions are only indicated if the filter differential pressure analogue input is enabled and the correct alarm *parameters* have been set

THERMOSTAT

The knob is used to set a deviation from the *set point* (according to the heat / cool mode in use);
the deviation is algebraically added to the active *set point*; the maximum value (from halfway point to each of the limit switches) is factory-set (+/- 5°C)

5.2 EKP400-RT keyboard

A: COMPRESSOR *LED*	C: MODE *LED* (heat/cool)
B: RESISTANCE/BOILER *LED*	D:SET *BUTTONS*

5.2.1 Buttons

Only selects the operating mode if *H49*= 0 and no EKF400 RT keyboard is connected. If the heat mode is activated (*H48*=0), each time you press the button the following sequence appears:

- ***Stand-by*** → **cool** → **heat** → ***stand-by***

If the heat mode is not activated (*H48*=1)

- ***Stand-by*** → **cool** → ***stand-by***

In Menu mode, the button becomes the *SCROLL UP* or UP (value increase) button.

It resets the *alarms* and changes the *set point*.

Press the button once to *reset* all inactive *alarms* that can be *reset* manually.

If the button is pressed for 2 seconds, the unit *displays* the *set point* of the set mode. The value can be changed by pressing the UP or DOWN *buttons*. The value is saved by pressing the two *buttons* or when timed out.

In Menu mode it *displays* the next *label* or decreases the displayed value (depending on context)

Buttons pressed simultaneously. If you press both *buttons* simultaneously and release them after 2 seconds, you go down one level in the *display* menu. To move up one level, press both *buttons* simultaneously for more than 2 seconds.
If the last level of a menu is displayed, press the button and release it within two seconds to go up one level.

5.2.2 Displays

The unit *displays* information on its status, configuration and *alarms* on the *display* and the LEDs on the front panel.

5.2.3 Display

In Normal mode, the unit *displays*:

- The control temperature, in tenths of Celsius degrees with a decimal point or in Fahrenheit with no decimal point.
- The alarm code, if at least one is activated. If several *alarms* are active, the unit *displays* the first alarm listed in the *Alarm Table*.
- If temperature control is not based on the *analogue inputs* and is linked to the status of a digital input (AI1 or AI2 configured as *digital inputs*), the "On" or "Off" *label* will be displayed, depending on whether temperature control is active or not.
- In Menu mode, what the unit *displays* depends on its position. Special labels and codes are used to help users identify the function set.
- Decimal point: when the operating hours are displayed, it indicates that the value must be multiplied x 100.

5.2.4 LED

Compressor 1 *LED*.

- ON if compressor 1 is active
- OFF if compressor 1 is inactive
- BLINKING at a rate of 1Hz (1 *blink* per second) if *safety timing* is in progress
- BLINKING slowly if compressor is *defrosting*

Compressor 2 *LED* (or capacity step)

- ON if compressor (capacity step) is active
- OFF if compressor (capacity step) is inactive
- BLINKING at a rate of 1Hz (1 *blink* per second) if *safety timing* is in progress
- BLINKING slowly if compressor is *defrosting*

Compressor 2 *LED* (or capacity step)

- ON if compressor (capacity step) is active
- OFF if compressor (capacity step) is inactive
- BLINKING at a rate of 1Hz (1 *blink* per second) if *safety timing* is in progress
- BLINKING slowly if compressor is *defrosting*

Compressor 2 *LED* (or capacity step)

- ON if compressor (capacity step) is on
- OFF if compressor (capacity step) is off
- BLINKING at a rate of 1Hz (1 *blink* per second) if *safety timing* is in progress
- BLINKING slowly if compressor is *defrosting*

Resistance/Boiler *LED*

- ON if the internal anti-freeze electric heater or the boiler are on
- OFF if the internal anti-freeze electric heater or the boiler are off

Heating LED

- ON if the unit is in *Heating* mode.

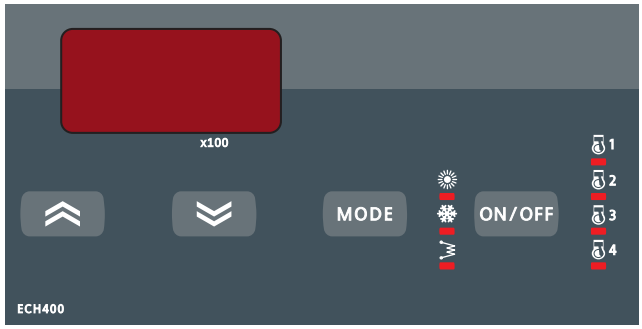
Cooling LED

- ON if the controller is in *Cooling* mode

If HEAT or COOL LEDs are not lit, the controller is in STANDBY mode.

5.3 EKW400-RT/S keyboard

This is the same version as the EKP400 RT keyboard for wall mounting.



The *displays*, *buttons* and *functions* are identical but the UP and DOWN *buttons* (value increase and decrease) are separated by MODE and ON/OFF *buttons*.

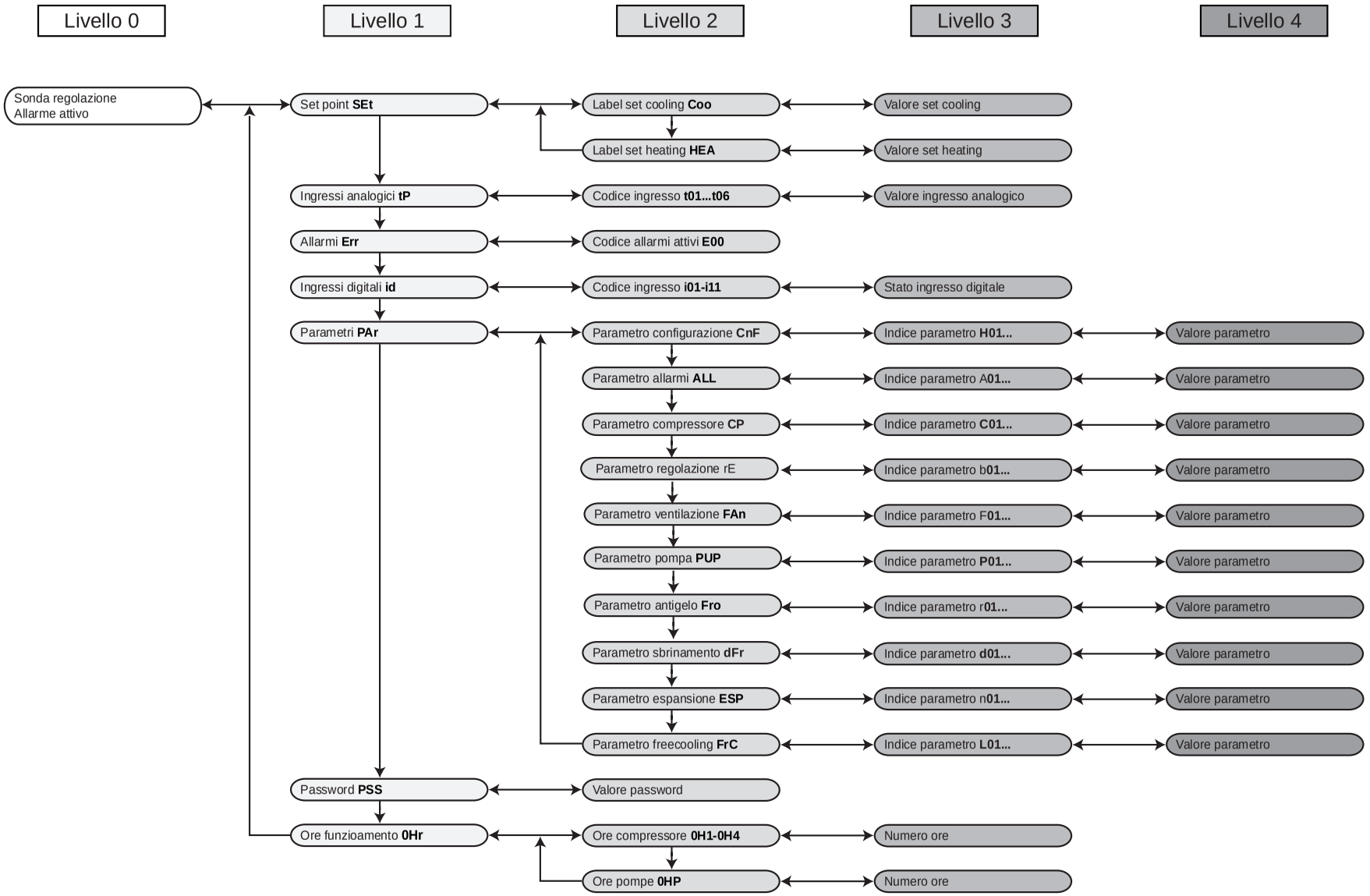
The temperature sensor is always present on this keyboard

5.4 Programming of parameters – Menu levels

Unit *parameters* can be changed using a Personal Computer (with special software, interface module and suitable cables) or a keyboard.
If a keyboard is used, the *parameters* can be accessed through a hierarchy of levels by simultaneously pressing the “Mode” and “On-off” *buttons* (as described above).
Each menu level is identified by a mnemonic code on the *display*.

Menu structure

It is structured as shown in the following diagram:



5.4.1 Visibility of parameters and submenus

By using a PC, an interface key (*Copy card*), suitable cables and the “Param Manager” software, you can prevent specific *parameters* and entire submenus from being displayed or changed.
Each parameter can be associated to a "visibility value" as described below.

Label

Value	Description
0003	The parameter or *label* is always visible
0258	The parameter or *label* is visible if the user password has been entered correctly (password = *H69*).
0770	The parameter or *label* is visible if the user password has been entered correctly (password = *H69*). The parameter cannot be changed.
0768	The parameter can be only displayed using a PC

Visibility of some *parameters* or labels is already preset.
For further information, see the instructions related to "Param. Manager".

6 SYSTEM CONFIGURATION

This chapter explains how to configure the *parameters* of the different *loads* according to the type of plant that has to be controlled.

6.1 Compressors

ERT 400 is able to control plants with a maximum of two *cooling* circuits and 1 to 4 *compressors*.
Each compressor is energized by a device relay (*power outputs*).
Each capacity step requires an additional output.
The first compressor must be connected to output NO1; the other outputs (NO2...NO7) (NO9...NO13 on the expansion module) can be freely assigned by setting the values of *parameters H35* .... *H40* (*N06* ... N010 if the expansion module is present).
The *compressors* are turned on and off according to the measured temperatures and the *temperature control functions* set (see chapter *Control of Compressors – Temperature Controller*).

A compressor is turned off if:

- no relay is associated with the compressor
- A compressor shut-down alarm has been generated (refer to *alarm table*)
- *safety timing* is in progress
- the delay between pump on and compressor on is in progress
- there is a delayed start up between two *compressors*
- pre-ventilation is in *Cooling* mode
- ERT 400 is on *stand-by* or off
- the *control probe* is not on the base unit (AI1) or the EKF400RT keyboard.

6.2 Configuration of compressors

Power steps

Turning on another compressor (or capacity step) is considered a power step.

It is very important to identify the index of the active compressor so that the *digital inputs* connected to the compressor *alarms* can be set correctly. For example, by setting a unit with 2 circuits and one compressor per circuit (see table below) *compressors* 1 and 3 are enabled; if the digital input of the thermal switch of compressor 2 is activated and connected to the compressor on the second circuit (compressor 3), even if the alarm is displayed, the compressor is not turned off since the compressor index is not 2.
The capacity steps are turned off if the compressor to which they are related is in alarm mode.
The LEDs of the activated *compressors* refer to the step index.

Compressors without capacity steps

Compressors without capacity steps (*H07*=0) can be configured as follows:

		Number of *compressors* per circuit	
		1 (*H06*=1)	**2 (*H06*=2)**
Number of circuits	**1 (*H05*=1)**	NO1=Comp.1 circ.1 (alarm index 1)	NO1=Comp.1 circ.1 (alarm index 1) Step2 = Comp.2 circ.1 (alarm index 2)
	2 (*H05*=2)	NO1=Comp.1 circ.1 (alarm index 1) Step3= Comp.1 circ.2 (alarm index 3)	NO1=Comp.1 circ.1 (alarm index 1) Step2 = Comp.2 circ.1 (alarm index 2) Step3= Comp.3 circ.2 (alarm index 3) Step4 = Comp.4 circ.2 (alarm index 4)

		Number of *compressors* per circuit	
		3 (*H06*=3)	**4 (*H06*=4)**
Number of circuits	**1 (*H05*=1)**	NO1=Comp.1 circ.1 (alarm index 1) Step2 = Comp.2 circ.1 (alarm index 2) Step3= Comp.3 circ.1 (alarm index 3)	NO1=comp. 1 circ.1 (alarm index 1) Step2 = Comp.2 circ.1 (alarm index 2) Step3= Comp.3 circ.1 (alarm index 3) Step4= Comp.4 circ.1 (alarm index 4)
	2 (*H05*=2)	Configuration error	Configuration error

Compressors with 1 capacity step

Compressors with 1 capacity step (*H07*=1) can be configured as follows:

		Number of *compressors* per circuit	
		1 (*H06*=1)	**2 (*H06*=2)**
Number of circuits	**1 (*H05*=1)**	NO1=Comp.1 circ.1 (alarm index 1) Step2 = Capacity step 1 comp.1 circ.1	NO1=Comp.1 circ.1 (alarm index 1) Step2 = Capacity step 1 comp.1 circ.1 Step3 = Comp.2 circ.1 (alarm index 2) Step4 = Capacity step 1 comp.2 circ.1
	2 (*H05*=2)	NO1=Comp.1 circ.1 (alarm index 1) Step2 = Capacity step 1 comp.1 circ.1 Step3= Comp.1 circ.2 (alarm index 3) Step4 = Capacity step 1 comp.3 circ.2	Configuration error

Compressors with 2 or 3 capacity steps

Compressors with 2 or 3 capacity steps (*H07*=2 or *H07*= 3) can be configured as follows:

		Number of *compressors* per circuit	
		2 capacity steps per compressor 1 (*H06*=1 and *H07*=2)	**3 capacity steps per compressor 2 (*H06*=2 and *H07*=3)**
Number of circuits	**1 (*H05*=1)**	NO1=Comp.1 circ.1 (alarm index 1) Step2 = Capacity step 1 comp.1 circ.1 Step4 = Capacity step 2 comp.1 circ.1	NO1=Comp.1 circ.1 (alarm index 1) Step2 = Capacity step 1 comp.1 circ.1 Step3 = Capacity step 2 comp.1 circ.1 Step4 = Capacity step 3 comp.1 circ.1
	2 (*H05*=2)	Configuration error	Configuration error

Unbalanced circuits

If 2 circuits and 2 *compressors* are set per circuit a special combination of “unbalanced” *compressors* can be configured with 2 *compressors* in the first circuit and 1 in the second.
This configuration is activated by setting *H79*= 1.

		Number of *compressors* per circuit
		2 *compressors* per circuit *H06*=2
Number of circuits	**2 (*H05*=2)**	NO1=Comp.1 circ.1 (alarm index 1) Step2 = Comp.2 circ.1 (alarm index 2) Step3= Comp.1 circ.2 (alarm index 3)

6.2.1 Compressor start/shutdown sequence (or power step)

Depending on the temperature conditions detected by the *probes*, the *temperature control functions* on the “ERT 400” device may require the activation or de-activation of the *compressors*/capacity steps (of the *power steps*).
The sequence with which *compressors*/capacity steps (steps) are activated/de-activated can be determined by using the corresponding *H08* and *H09* parameter values as explained below.

		Parameter value	
Par.	**Description**	**0**	**1**
H08	Step start-up sequence	Depending on operating hours	Fixed start-up sequence
H09	Circuit balancing	Circuit saturation	Circuit balancing

A start sequence that varies according to the operating hours means that if 2 *compressors* are available, the one with fewer operating hours is turned on first whereas the one with more operating hours is turned off first. In a fixed start-up sequence, the first compressor to be turned on is the one with the lower index (compressor 1 is turned on before compressor 2) whereas the first compressor to be turned off is the one with the higher index.

The circuit balancing parameter is only significant if there are 2 circuits and 2 steps per circuit. If *H09*=0 is selected, all the *power steps* on one circuit are turned on followed by those of the other circuit. When *H09*=1 (balancing), the *power steps* are turned on so that both circuits supply the same amount of power or that the maximum difference is equivalent to one step.

The different combinations are described in detail below :

Compressors: start-up based on operating hours and saturation of circuits

H08=0 *H09*=0	
EXAMPLE 1 COMPRESSOR WITH ONE CAPACITY STEP PER CIRCUIT	**EXAMPLE 2 *COMPRESSORS* PER CIRCUIT**
The first compressor to be turned on is the one with the lowest number of operating hours followed by the capacity step linked to the circuit, the compressor of the other circuit and finally the capacity step of this circuit. The first item to be shut down is the compressor capacity step with the highest number of operating hours followed by the related compressor, the capacity step of the other compressor and finally the last compressor. Example: Let's imagine that the system is configured as follows: **NO1=Compressor 1 circuit 1** **Step2 = Capacity step of compressor 1** **Step3 = Compressor 3 circuit 2** **Step4 = Capacity step of compressor 3** If **hours comp.1 > hours comp.3** the start-up sequence is: **Step3→Step4→NO1→Step2** The shutdown sequence is: **Step2→NO1→Step4→Step3**	If all the *compressors* are off, the first item to be turned on is the circuit that has the lowest number of average operating hours. In this circuit, the first compressor to be started is the one with the lowest number of operating hours followed by the other compressor in the same circuit: this saturates the circuit. The next step is selected from the two *compressors* on the other circuit with less hours. Example: Let's imagine that the system is configured as follows: **NO1=Compressor 1 circuit 1** **Step2 = Compressor 2 Circuit 1** **Step3 = Compressor 3 circuit 2** **Step4 = Compressor 4 Circuit 2** If **Hours of comp. 1 > Hours of comp. 2** **Hours of comp. 4 > Hours of comp. 3** **(hours comp.1 + hours comp.2)/2>(hours comp.4 + hours comp.3)/2** the start-up sequence is: **Step3→Step4→Step2→NO1** The shutdown sequence is: **NO1→Step2→Step4→Step3**

Compressors: start-up based on operating hours and balancing of circuits

H08=0 and *H09*=1	
EXAMPLE 1 COMPRESSOR WITH ONE CAPACITY STEP PER CIRCUIT	**EXAMPLE 2 *COMPRESSORS* PER CIRCUIT**
The first compressor to be turned on is the one with fewer operating hours followed by the compressor on the other circuit, the capacity step on the first circuit and the remaining capacity step. The first item to be shut down is the compressor capacity step with less operating hours followed by the other compressor, the compressor with more operating hours and finally the remaining compressor. Example: Let's imagine that the system is configured as follows: **NO1=Compressor 1 circuit 1** **Step2 = Capacity step of compressor 1** **Step3 = Compressor 3 circuit 2** **Step4 = Capacity step of compressor 3** If **hours comp.1 > hours comp.3** the start-up sequence is **Step3→NO1→Step4→Step2** The shutdown sequence is **Step2→Step4→NO1→Step3**	If all the *compressors* are off, the first item to be turned on is the circuit that has the lowest average operating hours. The average is calculated as the ratio between the total hours of *compressors* available and the number of *compressors* on the circuit. In this circuit, the first compressor to be started is the one with fewer operating hours followed by the compressor on the other circuit with fewest hours, the compressor on the first circuit and finally the last compressor. Example: Let's imagine that the system is configured as follows: **NO1=Compressor 1 circuit 1** **Step2 = Compressor 2 Circuit 1** **Step3 = Compressor 3 circuit 2** **Step4 = Compressor 4 Circuit 2** If **hours of comp. 1 > hours of comp. 2** **hours of comp. 4 > hours of comp. 3** **(hours comp.1 + hours comp.2)/2>(hours comp.4 + hours comp.3)/2** the start-up sequence is **Step3→Step2→Step4→NO1** The shutdown sequence is **NO1→Step4→Step2→Step3**

Compressors: fixed start-up sequence and saturation of circuits

H08=1 and *H09*=0	
EXAMPLE 1 COMPRESSOR WITH ONE CAPACITY STEP PER CIRCUIT	**EXAMPLE 2 *COMPRESSORS* PER CIRCUIT**
The first compressor to be turned on is the one with the lowest index, followed by the capacity step, the compressor on the other circuit and its capacity step. The first item to be shut down is the capacity step of the compressor with the highest index, followed by the compressor, the capacity step on the other compressor and the last compressor. Example: Let's imagine that the system is configured as follows: **NO1=Compressor 1 circuit 1** **Step2 = Capacity step of compressor 1** **Step3 = Compressor 3 circuit 2** **Step4 = Capacity step of compressor 3** the start-up sequence is **NO1→Step2→Step3→Step4** The shutdown sequence is **Step4→Step3→Step2→NO1**	As above.

Compressors: fixed start-up sequence and balancing of circuits

H08=1 and *H09*=1	
EXAMPLE 1 COMPRESSOR WITH ONE CAPACITY STEP PER CIRCUIT	**EXAMPLE 2 *COMPRESSORS* PER CIRCUIT**
The first compressor to be turned on is the one with the lowest index, followed by the compressor on the other circuit, the capacity step on the first circuit and the capacity step on the second one. The sequence is reversed during shutdown. Example: Let's imagine that the system is configured as follows: **NO1=Compressor 1 circuit 1** **Step2 = Capacity step of compressor 1** **Step3 = Compressor 3 circuit 2** **Step4 = Capacity step of compressor 3** the start-up sequence is **NO1→Step3→Step2→Step4** The shutdown sequence is **Step4→Step2→Step3→NO1**	As above.

If the compressor with the lowest index is not available in the fixed start-up sequence, the first compressor to be turned on is the one with the highest index.

If the compressor becomes available and the power requested is equal to the power supplied, the unit remains in the last operating status: the compressor with the highest index is not turned off to enable the one with the lowest index.

If a compressor is shut down by an alarm or is counting *safety timing*, it is not available and is therefore bypassed by the selection algorithm.

6.2.2 Compressor timing

Safety timing

The compressor start and stop operations should be compliant with the safety times set by the user using the *parameters* described below.

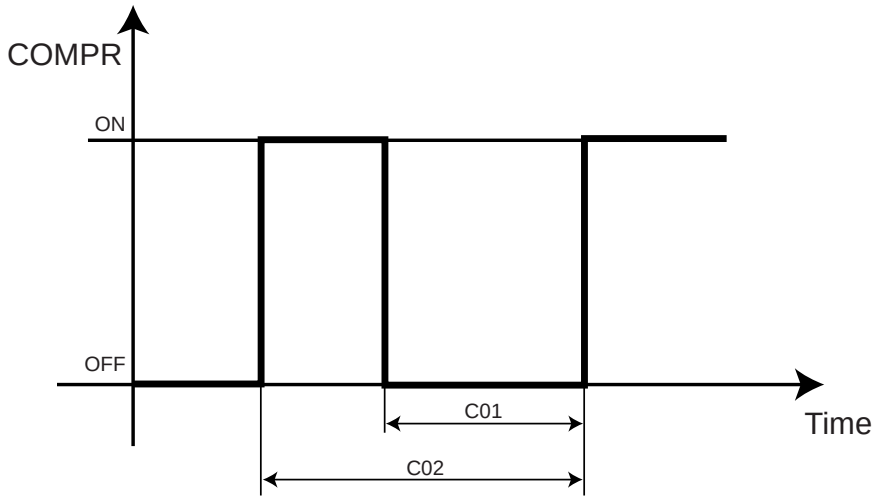
On/off timing

The interval between the start and stop of a compressor must be compliant with the safety interval controlled by parameter *C01* (safety time of compressor start/stop);
This interval of time also applies to the start up of “ERT 400”.

On/on timing

The interval between a start operation and the next must be compliant with the safety interval controlled by parameter *C02* (safety time of compressor start/stop)

Off-on and on-on sequence 1 comp.

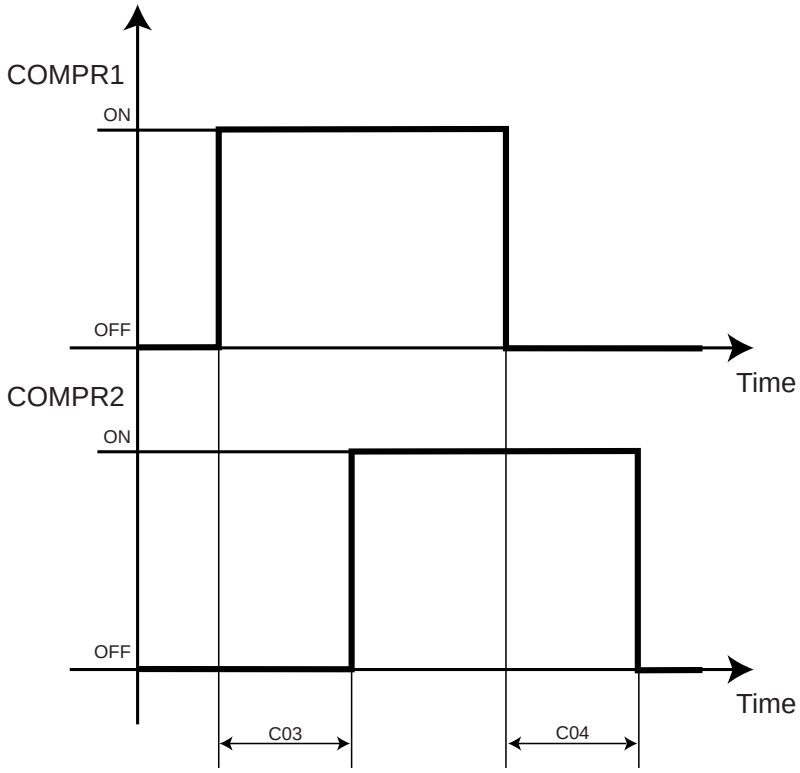


COMPR: Compressor
Time: Time

On-on and off-off timing 2 comp.

If the machine has several *power steps*, the interval of time between 2 compressor starts (*C03*) and stops (*C04*) is also observed. Time *C05* (delay of capacity step start-up) is always observed between the start of a compressor or capacity step and the shut-down of another compressor or capacity step on the machine. The maximum safety time among all those available is always observed. The stop time between *compressors* is not observed if a compressor shut-down alarm is generated. In this case, the compressor is shut down immediately.

On-on and off-off 2 comp sequence.



COMPR1: Compressor 1
COMPR2: Compressor 2
Time: Time

During *defrosting* only the *d14* time is observed and the other timing signals are ignored. This *safety timing* is active between the *compressors*, between the capacity steps and between the *compressors* and capacity steps.

6.3 Condensation fan

This involves the fan unit located outside near the heat exchanger that normally serves as a condenser. Obviously, in heat pump operating mode, the heat exchanger operates as an evaporator.

The "ERT 400" has 3 connection/configuration modes for the *condensation fans*:

Mode	Output	Characteristics	Description
TC	*Low voltage outputs*	Control signal for *CF modules* (500w, 1500w, 2200w)	Connection to *CF modules*
Standard command	*Low voltage outputs*	4-20mA or 0-10V	Standard command for fan control by way of external module (inverter)

*** Do not exceed the maximum permitted load**

The fan will be turned off if:
- a condensing fan shut-down alarm has been generated (refer to *alarm table*)
- ERT 400 is on *stand-by* or off

6.3.1 Control probes

Condensation can be regulated by controlling the circuit pressure or controlling the temperature of the exchanger coil.
The *analogue inputs* (*probes*) used for controlling are:
- AI3 for circuit 1
- AI6 for circuit 2

If *A13* is configured as a temperature input (*H13*= 1) the condensation on circuit 1 is regulated according to the temperature and all the regulator *parameters* must be considered as temperature values.

If ST3 is configured as current input, condensation is regulated according to the exchanger pressure and the *parameters* must be considered pressure values.

The same applies for ST6 and the second circuit.

6.3.2 Configuration of fan

There are two possibilities:
- Module connected to a power output (TK mode) ....

- Module connected to a low voltage output (TC mode or Standard Command)

Fan on high voltage outputs

If some of the relays have been configured as *condensation fan* outputs (*H35-H40* and *N06*-N010=3 or 4) they are on if the output of the regulator of each fan is greater than 0 and off in all other cases.

Fan on low voltage outputs

The type of analogue output that the fan control module(s) is/are connected to must first be configured correctly:
the *parameters* used for this operation are *H46* for the first circuit and *H47* for the second one as show in the following table:

Parameter value	Circuit 1 – *H46*	Circuit 2 – *H47*
0	Enables TC output for the cutting phase	Enables TC output for the cutting phase
1	Enables output 4-20 mA (0-10V) AN1	Enables output 4-20 mA (0-10V) AN2

The *PICK-UP*, *PHASE SHIFT* AND *IMPULSE DURATION parameters* are important.

Pick-up

Every time the external fan is started, the exchanger fan is supplied with maximum voltage. Therefore, the fan runs at maximum speed for a time equivalent to *F02* counted in tenths of seconds after which it continues at the speed set on the regulator.
F02 = Fan *pick-up* time (in tenths of a second)

Phase shift

If defines the delay that can be used to compensate for the different electric characteristics of the fan motors:
F03 = duration, in microseconds * 200, of fan *phase shift*.

Impulse duration

It defines the duration, in microseconds * 10, of the impulse that energizes the TC output
F04= duration of triac energizing impulse

6.3.3 Configuration of fan regulator

The fan regulator can be configured to generate a proportional output (0-100%) or “ON OFF” output by setting the values of parameter *F01*:

F01 = Selects the type of output on regulator

Configuration of fan: selection of the type of output

***F01* = 0**	Proportional fan output (from 0 to 100% depending on *parameters*).
***F01* = 1**	Fan “on-off” output; in this mode the regulator performs the same calculations as the proportional output. The only difference is that if it reads a value above 0, the regulator output becomes 100.
***F01* = 2**	On-off operation set by the compressor; in this mode the output is 0 if no circuit compressor is on and 100% if at least one circuit compressor is on.

If some of the relays have been configured as *condensation fan* outputs (*H35-H40* and *N06*-N010=3 or 4) they are on if the output of the regulator of each fan is greater than 0 and off in all other cases.

6.4 Reversing valves

Reversing valve

The *reversing valve* can only be used with a "heat pump".
ERT 400 can control a maximum of 2 *reversing valves* on plants with 2 circuits.

The *reversing valve* on circuit 1 is only active if:
- a relay (*power outputs*) is configured as *reversing valve* circuit 1 (*H35- H40* or *N06* and *N10*= 1).

The *reversing valve* on circuit 2 is only active if:
- a relay (*power outputs*) is configured as *reversing valve* circuit 2 (*H35- H40* or *N06* and *N10*= 2)
- There are 2 circuits.

Both *reversing valves* are active only if
the heat pump is active (*H10*=1)

The *reversing valve* is off in Off and standby modes
The valve is OFF in *cooling* and ON in *heating* modes. In *defrosting* mode the valve is OFF (see relevant paragraph).

If the relay (*power outputs*) configured as *reversing valve* is an output ranging between NO2 and NO5, the polarity of the valves can be reversed with *parameters H41- H44*.

6.5 Anti-freeze/integrated electric heaters

ERT 400 can control up to 4 *anti-freeze/integrated electric heaters*.

The electric heater output is only active if the relays (*power outputs*) are configured as electric heater 1-4 (*H35- H40* or *N06- N10*= 11 - 14) .

Parameter *r05* sets the number of electric heaters present;
Refer to the summary table below:

r05	Electric heater 1	Electric heater 2	Electric heater 3	Electric heater 4
0				
1	X			
2	X		X	
3	X	X	X	
4	X	X	X	X

If the outputs are configured as follows, they control the activation and de-activation of the electric heaters according to the *r01* ... *r06* configuration *parameters* as described below.

Configuration

Parameter	Description	Value	
		0	1
r01	Configuration in *Defrosting* mode	On only when requested by the regulator	Always on in *Defrosting* mode
r02	Configuration in *Cooling* mode	Off in *Cooling* mode	On in *Cooling* mode (depending on the anti-freeze electric heaters regulator)
r03	Configuration in *Heating* mode	Off in *Heating* mode	On in *Heating* mode (depending on the anti-freeze electric heaters regulator)
r06	Configuration in OFF or STANDBY	Off in OFF and STANDBY	Electric heaters on in OFF and STANDBY

Configuration of electric heater probe

The *r04* parameter selects which probe the electric heaters regulate.

Value of *r04 parameters*	Description
0	Electric heater off
1	Regulation on AI1
2	Regulation on AI2
3	Regulation on AI4

If the selected probe is missing or configured as digital input, the electric heaters are turned off.

6.5.1 Electric heaters in Defrosting mode

The *r01* parameter can be used to decide whether to activate the electric heaters during *defrosting*. All the electrical heaters will be activated in parallel
r01: configuration of electrical heaters/*hot water coil* in *defrosting*

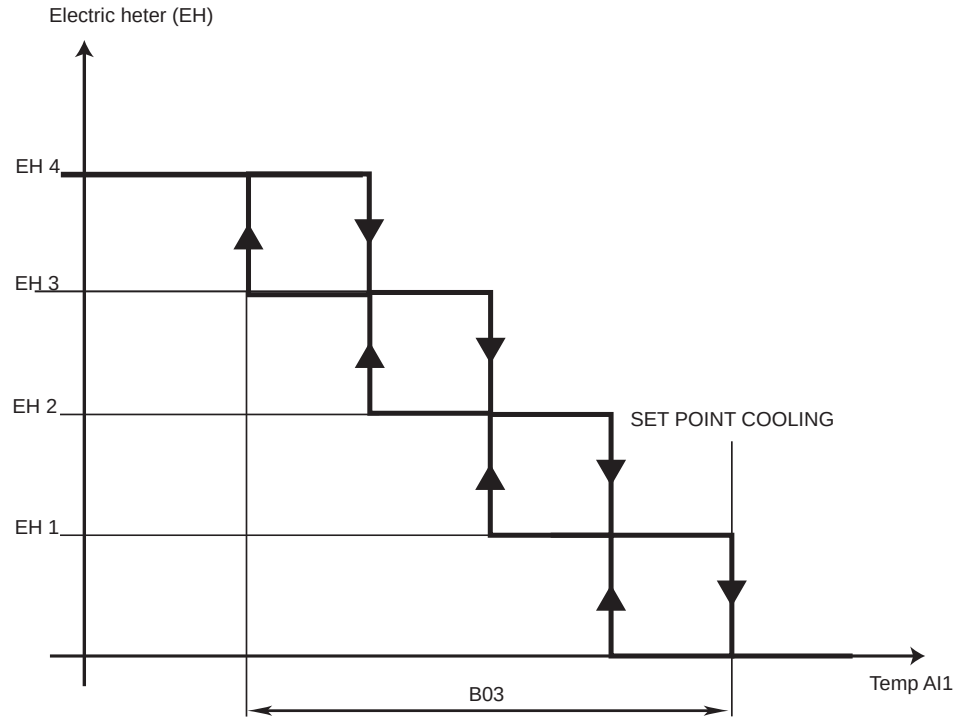
- 0 = On only when requested by the antifreeze/integrated regulators
- 1 = always on

6.5.2 Integrated electric heaters

If *r15* =1 the electric heaters act as both antifreeze and integrated electrical heaters.
The paragraph on Integrated Electric heater Controller describes how they operate

6.5.3 Electric heaters in dehumidification mode

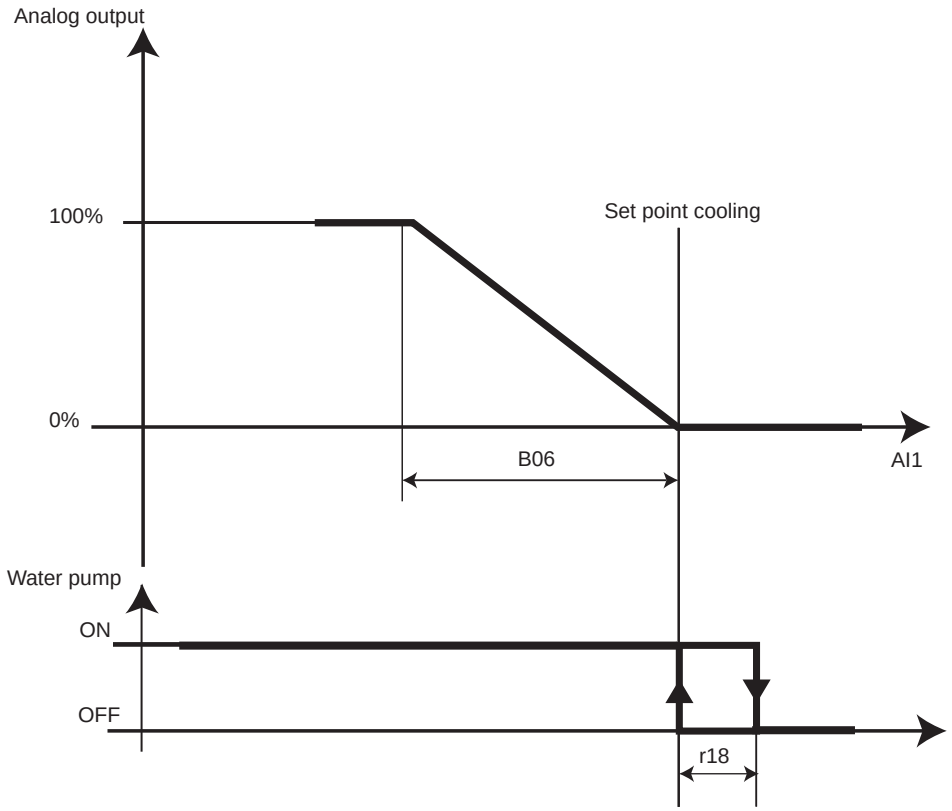
ERT 400 can control the *electric heaters in dehumidification mode*;
In this case, the function is enabled with parameter *r16*;
The control *set point* is the *cooling set point*. See the diagram below:



EHx: electric heater x	TEMP AI1: AI1 probe temperature

6.5.4 Hot water coil in Dehumidification mode

The hot water valve is enabled in *dehumidification* mode with *r16* = 1;
The control *set point* is the *cooling set point*.



See the diagram below:

Analog output: Analogue output	TEMP AI1: AI1 probe temperature

Water pump: Water pump	

6.6 Condensation/Defrosting probes

"ERT 400" can control the *defrosting* of one or two circuits depending on plant configuration.

Defrosting probes

Defrosting is activated if:
- it has been stated by parameter "Enable *defrosting*" (*d01* = 1)
- the condensation probe of the first circuit is present (and connected to analogue input AI3) with parameter set as *H13* = 1 (NTC probe) or *H13* = 2 (4-20mA probe) and AI4 = 1
- a *reversing valve* is present

For plants with 2 circuits, *defrosting* can be carried out separately or together (on plants with one condenser), depending on parameter *F22* (type of condensation).

Separate or single condensation

***F22* = 0**	separate
***F22* = 1**	single

The *defrosting* input and output changes according to the condensation probe values which can be configured as follows:

	1 circuit	**2 circuits separate *defrosting***	**2 circuits single *defrosting* (*)**
Defrosting circuit 1	AI3	AI3	MIN(AI3;AI6)
Defrosting circuit 2	---	AI6	MIN(AI3;AI6)

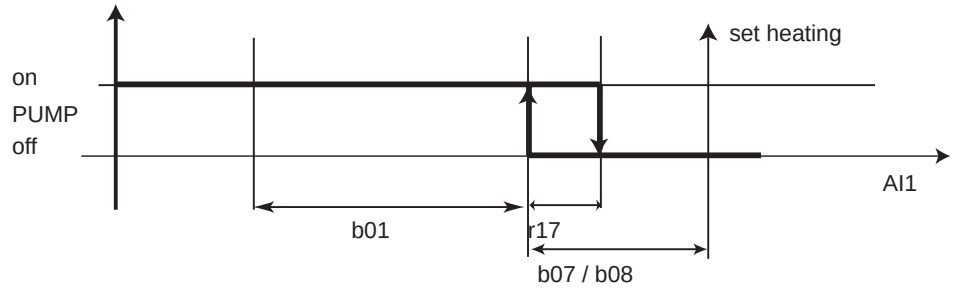
(*) If A and B are *control probes*, MIN(A;B) stands for the minimum value between A and B if A and B are present. Value A is taken if B is not present. A must always be declared present.

6.7 Hot water coil

The *hot water coil* unit consists of a 0-10Vdc modulating output and a water circulation pump.

The analogue output is active if parameter *H47* = 2;
the integrated pump is active if one of the *parameters H35- H40* and *N06- N10* is set to 5 and the device is in antifreeze or *heating* mode.

See the diagram below:



SET *HEATING*: *Heating set point*	AI1: AI1 probe
PUMP: Hot water pump	

6.8 Evaporator fan

The fan is only active if at least one relay is configured as *evaporator fan* output (*H35- H40* or *N06-* N010= 6) .

The fan will be turned off if
- a fan shut-down alarm has been generated
- it is in off mode.

It is active in OFF mode if the electric heater or *hot water coil* regulator in antifreeze mode requires *heating*.

Pump-fan delay at start up

If the machine goes from OFF to ON (using the keyboard or remote input) and the conditioner is in *heating* mode, the fan observes a delay in activation of the hot water pump set with parameter *P01*.

This function prevents any cold water from freezing the water coil.

If the unit is OFF and the electric heater or *hot water coil* regulator in antifreeze mode requires *heating*, the fan observes a delay in activation of the hot water pump set with parameter *P01*.

When going from OFF to ON and when *heating* is necessary in integration or antifreeze mode, the hot water pump is always activated and the fan is switched on after a period of *P01*.

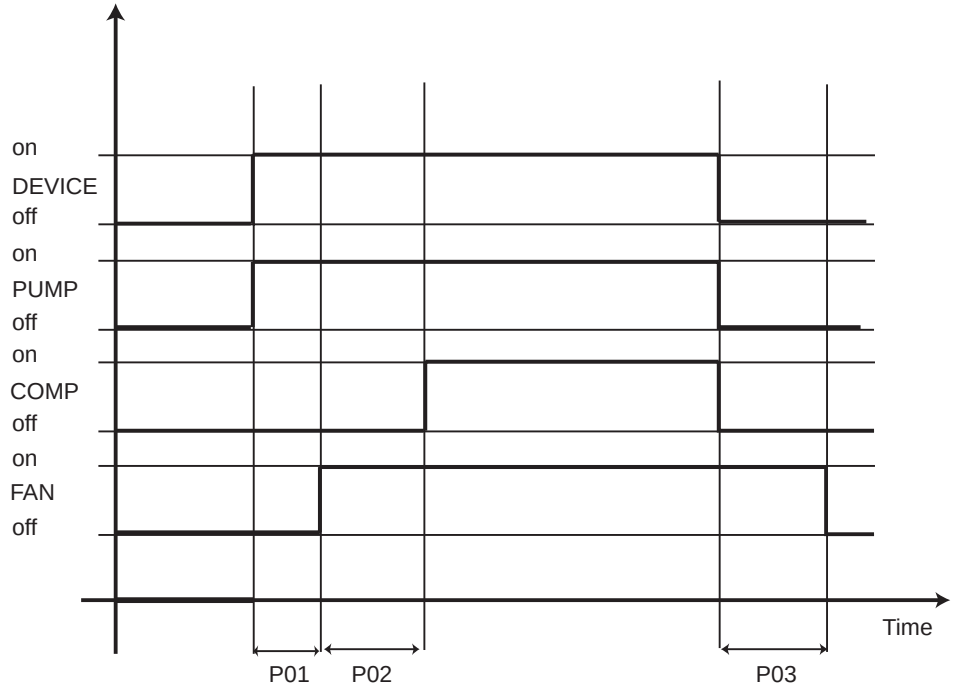
Fan ON compressors ON delay

The *compressors* are activated with a delay in fan start up set using parameter *P02*

When passing from ON to OFF (with keyboard or remote input) the fan is turned off with a delay set with parameter PO3 after shutdown of the last compressor or electric heater

If *heating* is not necessary when passing from OFF to ON, there is no delay.

See the diagram below:



DEVICE: ERT 400	COMP: Compressor
PUMP: Hot water pump	FAN: *Evaporator fan*

6.9 Damper opening digital input

If a digital input (*digital inputs*) is configured as *damper* input (*H23* - *H33* and PaN02 - PaN05=18) with input active, the *damper* is forced to maximum opening (100%).
This function has priority over everything else including *alarms*.

This function is useful when the operator notices that air circulation in an environment is insufficient and decides to force the *damper* to maximum opening.

7 TEMPERATURE CONTROL FUNCTIONS

Once the ERT 400 has been configured, it is ready to control the *loads* according to the temperatures and pressures measured by the *probes* and the *temperature control functions* set using special *parameters*.

Operating modes

There are 6 *operating modes*:
- *Cooling*
- *Heating*
- *Stand-by*
- *Night*
- *Auto*
- Off

Cooling

Cooling: this is the "summer" operating mode; in this mode the unit is configured to generate cold air.

Heating

Heating: this is the "winter" operating mode; in this mode the unit is configured to generate hot air.

Night

Night: this is the "*night*-time" operating mode; the unit controls air circulation (during *night* hours)

Auto

Auto: this is the automatic operating mode: the unit automatically controls the *heating* or *cooling* state according to the values detected by the *probes*

Stand-by

Stand-by: in this mode the unit does not perform *temperature control functions* and all the *alarms* remain active.

Device off (Off)

Off: the unit is off.

Stand-by mode can only be selected with the EKW400-RT/S or EKP400RT keyboard
"*Night*" and "*auto*" modes can only be selected with the EKF400 RT keyboard

The operating mode varies according to the keyboard settings and the following.

***Parameters*:**
- Operating mode selection parameter (*H49*)
- Presence of heat pump parameter (*H10*)
- *Heating* mode disabling parameter (*H48*)
- *Heating*/*cooling* time parameter (*H72*)

Operating mode selection parameter (*H49*)
- 0= Selection from keyboard
- 1= Selection from digital input
- 2= Automatic selection of mode

If *H49* = 2 the mode setting is always automatic and cannot be set using a keyboard.

In *auto* mode, set with a parameter (*H49*=2) or keyboard, there is a minimum holding time during which even if the regulator requests a change-over this is not allowed.
The holding time can be set using parameter *H72*.
The timer begins counting from when the last load shuts down because the temperature controller is satisfied.

With EKF keyboard

The *heating* mode is only enabled if the parameter *H48*=0. If not, with the selector on *Heating*, the unit is on Standby.
If the parameter *H49*=0 the mode set on this keyboard restricts the mode on the other *keyboards*.

With EKP/EKW keyboards

The operating mode varies according to the keyboard settings and the following.

***Parameters*:**
Configuration parameter for AI1 (*H11*) (see *Analogue inputs: configuration table*)
Configuration parameter for AI2 (*H12*) (see *Analogue inputs: configuration table*)
Operating mode selection parameter (*H49*)
Presence of heat pump parameter (*H10*)

Operating mode selection parameter (*H49*)
0= Selection from keyboard
1= Selection from digital input (see *Digital Inputs*)

Presence of heat pump parameter (*H10*)
0= Heat pump not present
0= Heat pump present

Operating modes: configuration table

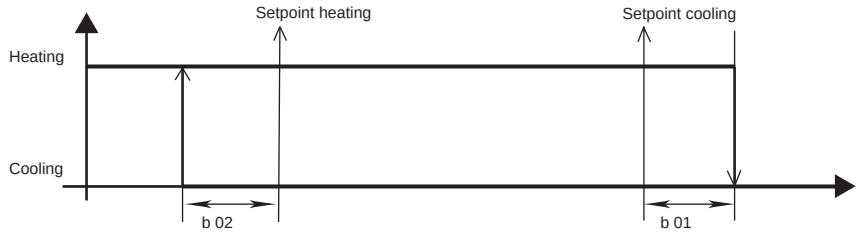
The combination of *parameters* generates the following rules:

Operating mode	Mode selection parameter *H49*	AI1 configuration parameter *H11*	AI2 configuration parameter *H12*
The operating mode is selected using the keyboard	0	Not 2	Not 2
The operating mode is selected using the digital input	1	Not 2	Not 2
If input AI1 is active, the operating mode is	Any	2	Not 2

Operating mode	Mode selection parameter *H49*	AI1 configuration parameter *H11*	AI2 configuration parameter *H12*
heating; otherwise it is *stand-by*			
If input AI2 is active, the operating mode is *Cooling*; otherwise it is *stand-by*	Any	Not 2	2
If input AI1 is active, the operating mode is *heating*; if AI2 is active, the operating mode is *Cooling*; if AI1 and AI2 are both active, the operating mode signals an error; if none of them are active, the unit is in *stand-by*	Any	2	2

7.1.1 Auto operating mode

In automatic mode, the unit goes to *heating* mode if the AI1 temperature is lower than the heat *set point* minus the **Regulation band for *compressors* in *heating* mode**. It goes to cool mode if the temperature is greater than the cool *set point* plus the **Regulation band for *compressors* in *cooling* mode**



7.1.2 Night purging operating mode:

This function can only be activated with the EKF400RT keyboard, using the slide switch or the digital input on the back.
The function is enabled if:

- the temperature probe *H14*=1 is present; if not, the unit goes into Standby mode
- the temperature read by the external probe is greater than *L24*
- *L23*>0; if *L23*=0 the unit goes directly into Standby mode

If the conditions listed above are not present:

- the *damper* is opened to 100%
- the *evaporator fan* is activated for a period set on *L23*.
- all other regulators are disabled.

There are three ways of deactivating the function:

- with a time-out; in this case, at the end of the period *L23*, the unit goes into Standby mode
- when the external temperature drops i.e. when the probe value AI4< *L24* the function is deactivated and the unit goes into Standby mode
- with a function change (ECO, ON, OFF)

If the unit goes into Standby mode, it remains in this mode until the condition that activated the function disappears (the digital input is opened or the slide switch moved)

7.1.3 Economy operating mode

The economy function can be activated with the EKF400 RT keyboard, using the slide switch or the digital input on the back.

If the function is activated:

- the *L25* value is added to the *cooling set point*
- the *L25* value is subtracted from the *heating set point*.

The function is active until the condition that activated it disappears (the digital input is opened or the slide switch moved)

7.1.4 Fan operating mode

This function can only be activated with the EKF400 RT keyboard, using the slide switch or the digital input on the back.

If the function is activated:

- the *evaporator fan* is switched on
- the only active regulator is the *economizer* if it is parameter enabled (see section on *economizer*)

The unit will stay in FAN mode until the condition that activated the function disappears (the slide switch is moved to heat, cool or *auto* or the digital input is closed)

7.2 Control probe

The temperature controller calculates the load to be supplied through the *compressors* for both *Heating* and *Cooling* modes.

The *control probe* is:
- probe ST1 connected to the base unit if *H80*=0 (regulation on EKW enabled)
- the probe on the EKF remote keyboard if the DIP SWITCH on the EKF keyboard is closed
- the probe on the EKW keyboard if the keyboard is connected, *H80*=1 and the dip switch on EKF is open

do not enable the probe on EKW if the EKP keyboard is installed. If this is the case, all the *keyboards* are periodically *reset*.

If the EKF remote keyboard is present the value set by the potentiometer is added to the regulation *set point* parameter.

7.3 Digital regulation

ERT 400 can be connected to 1 *heating* step + 1 *cooling* step or 2 *heating* step and 2 *cooling* step type digital thermostats. If this is the case, the thermostat does not inform the ERT of the temperature probe reading but sends digital signals:
- 1st *cooling* step request
- 2nd *cooling* step request
- 1st *heating* step request
- 2nd *heating* step request

As a result ERT 400 activates the resources.

Digital regulation is active if
- the parameter *H78*=1 (*digital regulation* enabled)
- some *digital inputs* are configured as *heating*/*cooling* step request *digital inputs* (*H23*- *H33* *N02*- *N05* =22-24).

In heat pump operating, the electric heaters are considered steps that are less important then *compressors*, i.e. they are only activated once the available *compressors*/capacity steps have been activated
The *hot water coil* is not activated.

The tables below define the activation sequence of the resources according to the state of the *digital inputs*:

Digital regulation user activation

Example 2 *compressors*, heat pump present (reverse cycle)

	Comp1	Comp2	Electric heater 1	Electric heater
1st *cooling* step request	X (change-over)			
2nd *cooling* step request	X	X		
1st *heating* step request	X (change-over)			
2nd *heating* step request	X	X		

Example *compressors*, heat pump not present or disabled (ST4< *r12*)

	Comp1	Comp2	Electric heater 1	Electric heater 2
1st *cooling* step request	X			
2nd *cooling* step request	X	X		
1st *heating* step request			X (if present)	
2nd *heating* step request			X (if present)	X (if present)

Example with 1 compressor heat pump present

	Comp1	Comp2	Electric heater 1	Electric heater 2
1st *cooling* step request	X			
2nd *cooling* step request	X			
1st *heating* step request	X			
2nd *heating* step request	X		X (if present)	

The EKF400 RT keyboard is ignored.

7.4 Configuring the set points

Provided that the unit is not configured as a condensing unit, activation or de-activation of the *loads* varies dynamically according to the selected *temperature control functions*, the temperature/pressure values measured by the *probes* and the configured *set points*.

Set points

Two *set points* are defined.
Cooling set point : this is the reference *set point* when the unit is regulated in *Cooling* mode
Heating set point : this is the reference *set point* when the device is regulated in *Heating* mode

Set points are changed by modifying the relative *parameters*:
- *G01 cooling set point*
- *G02 heating set point*

The *set points* can be changed:
- from the EKW400 RT/S or EKP400RT *keyboards* by accessing the "SET" submenu (see menu layout)
- from a PC with special interfacing (hardware-software)

Set points can be assigned values in a *range* determined by *parameters H02* – *H01* (*Heating*) and *H04* – *H03* (*Cooling*)

With the EKF400RT keyboard the *set points* can only be modified by +-5 C° using the thermostat

7.5 Dynamic set point

The regulator can be used to change the *set point* automatically according to external conditions.
This is done by adding a positive or negative value (offset) to the *set point* depending on the temperature of the external probe:

This function has two purposes: to save energy or operate the machine in particularly harsh outdoor temperatures.

The *dynamic set point* is active if:
- The activation parameter is: *H50* = 1
- the AI4 probe (*analogue inputs*) is configured as external temperature input (*H14* = 3)
- one of the *digital inputs* is configured as Window Input: in these circumstances if the input is active the maximum offset in *cooling* (*H51*) or *heating* (*H52*) is added to the *set point*

Regulation parameters

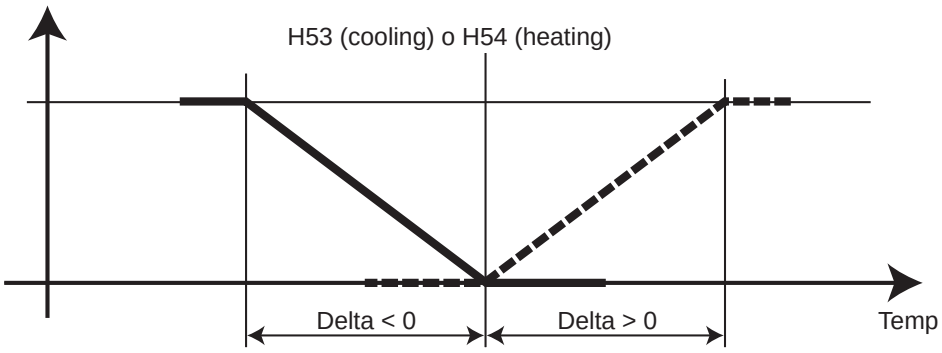
Dynamic set point control *parameters*:

H51= Max. offset in *Cooling* mode	*H52*= Max. offset in *Heating* mode
H53= External temperature *set point* in *Cooling* mode	*H54*= External temperature *set point* in *Heating* mode
H55= Temperature delta in *Cooling* mode	*H56*= Temperature delta in *Heating* mode

The interaction of these *parameters* is illustrated in the graphs below:

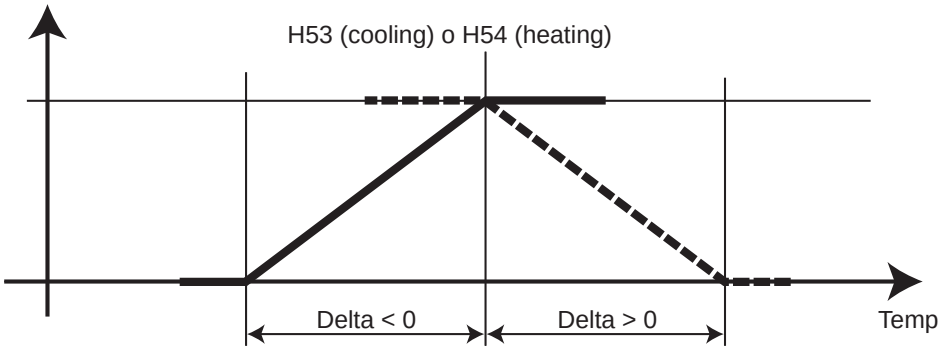
Modification based on outdoor temperature with positive offset

Positive offset



Modification based on outdoor temperature with negative offset

Negative offset



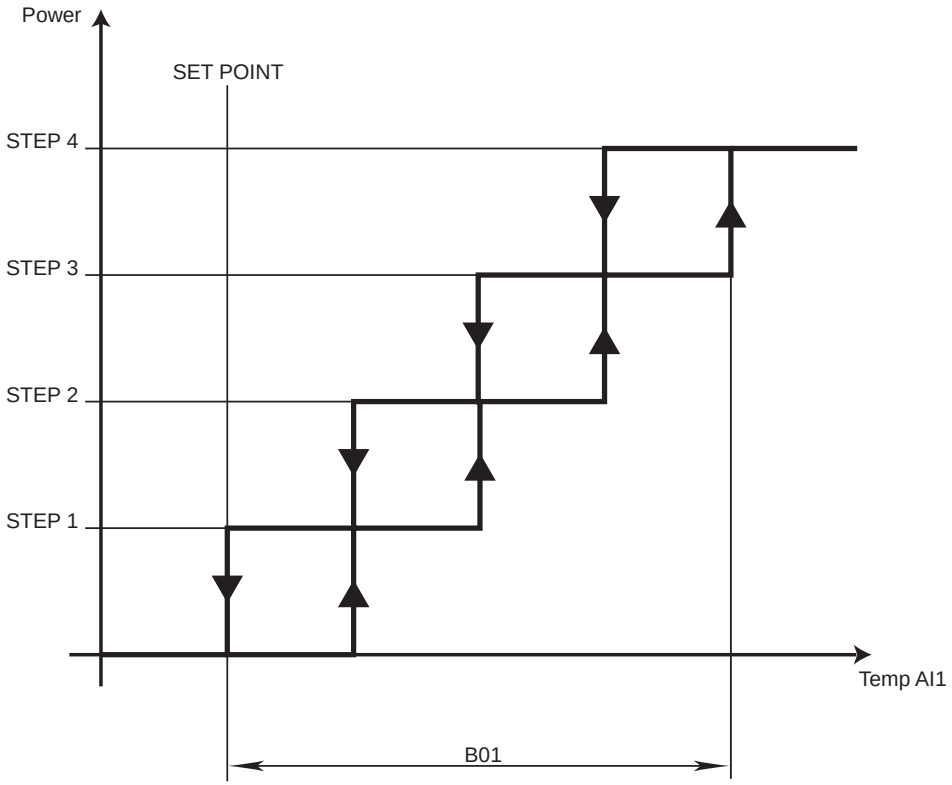
Temp: temperature

7.6 Load control

How to set the *parameters* used to control the *loads* according to the temperature/pressure conditions detected by the *probes* is described below.

7.6.1 Control of compressors – temperature controller

The temperature controller calculates the load to be supplied through the *compressors* for both *Heating* and *Cooling* modes. Temperature controller in *Cooling* mode
TEMPERATURE CONTROLLER IN *COOLING* MODE
If probe AI1 (*analogue inputs*) is configured as an NTC inlet air input (*H11*= 1), the compressor is controlled in accordance with the ambient temperature and *SET POINT*.
- AI1 = Temperature of inlet water or air
- SET COOL= *Cooling set point* entered using keyboard
- *B01* = regulator proportional band in *cooling* mode



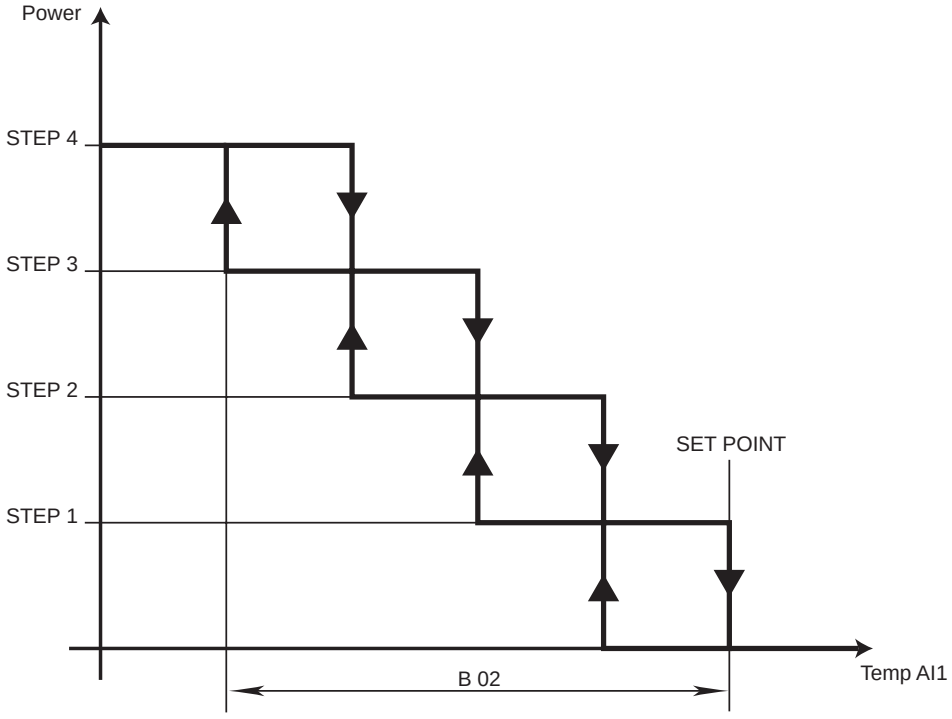
Power: power	STEP 1: 1st step	STEP 2: 2nd step
STEP 3: 3rd step	STEP 4: 4th step	Temp AI1: AI1 probe temperature

Temperature controller in Heating mode

TEMPERATURE CONTROLLER IN HEATING MODE

If probe AI1 (*analogue inputs*) is configured as an NTC inlet air input (*H11*= 1), the compressor is controlled in accordance with the ambient temperature and *SET POINT*.

- AI1 = temperature of inlet water or air
- SET HEAT= *Cooling set point* entered using keyboard
- *B02* = regulator proportional band in *heating* mode



Power: power	STEP 1: 1st step	STEP 2: 2nd step
STEP 3: 3rd step	STEP 4: 4th step	Temp AI1: AI1 probe temperature

7.6.2 Condensation fan control

The *condensation fan control* varies according to the temperature or condensation pressure of the circuit.
The regulator will be on if:

- at least one probe per circuit is configured as a condensation probe (pressure or temperature). Otherwise, the fan for the circuit activates and de-activates according to the circuit *compressors*.

The fan control may be carried out independently of the compressor or every time a request is received from the *compressors*.
The operating mode is set with parameter *F05*:

	Value	
	0	**1**
***F05*: fan output mode**	The fan is off if all the circuit *compressors* are off	Control of condensation is carried out independently of the compressor

The cut-off is bypassed for the amount of time (***F12***) calculated from compressor start-up. If the regulator requests the cut-off during this period, the fan will run at minimum speed.

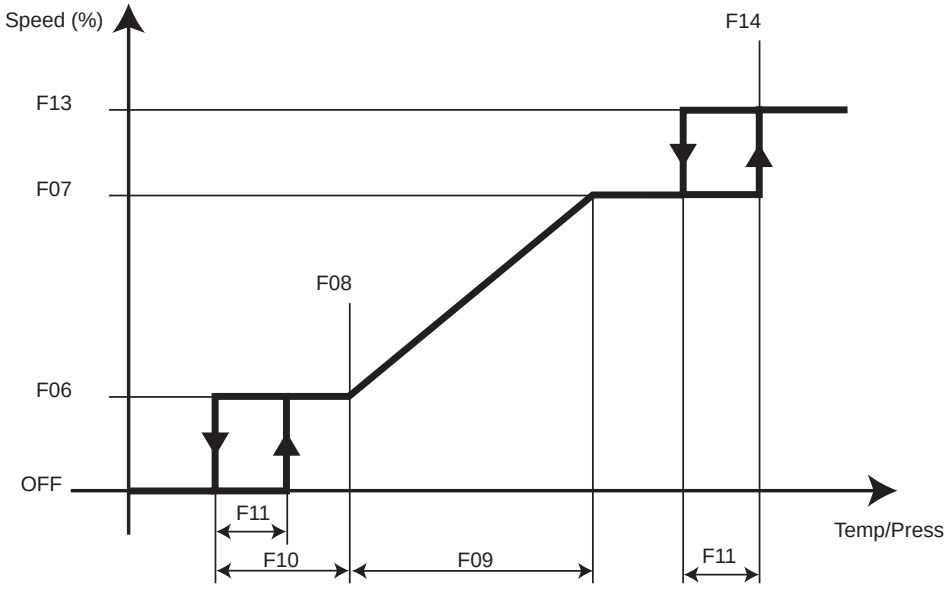
If parameter *F05* is set to 1, the condensation control is linked to the condensation temperature or pressure, depending on how the following *parameters* are set:

Cooling mode

CONDENSATION FAN CONTROL IN *COOLING* MODE
F06 = Minimum fan speed in *COOLING* mode
F07 = Maximum fan silent speed in *COOLING* mode
F08 = Minimum fan speed temperature/pressure *set point* in *COOLING* mode
F09 = Proportional band. Fan in *COOLING* mode.
F10 = Fan cut-off delta
F11 = Cut-off *hysteresis*
F13 = Maximum fan speed in *COOLING* mode
F14= Maximum fan speed temperature/pressure *set point* in *COOLING* mode

An example of interaction of these *parameters* is shown in the figure below:

Fan control in Cooling mode: diagram



Speed: speed
Temp: temperature
Press: pressure

If the *Cooling* mode is activated and ***F05***= 0 (if the compressor is off, the fan is also off) to), parameter ***F21*** **(**pre-ventilation of external fan) is also activated. Before switching on the circuit *compressors*, the fan is operated for a period of *F21*. Its ventilation speed is proportional to the condensation temperature. However, during this interval of time, if the regulator requests cut-off, the fan returns to the minimum set speed.

This parameter prevents the compressor from starting at excessively high condensation speeds.

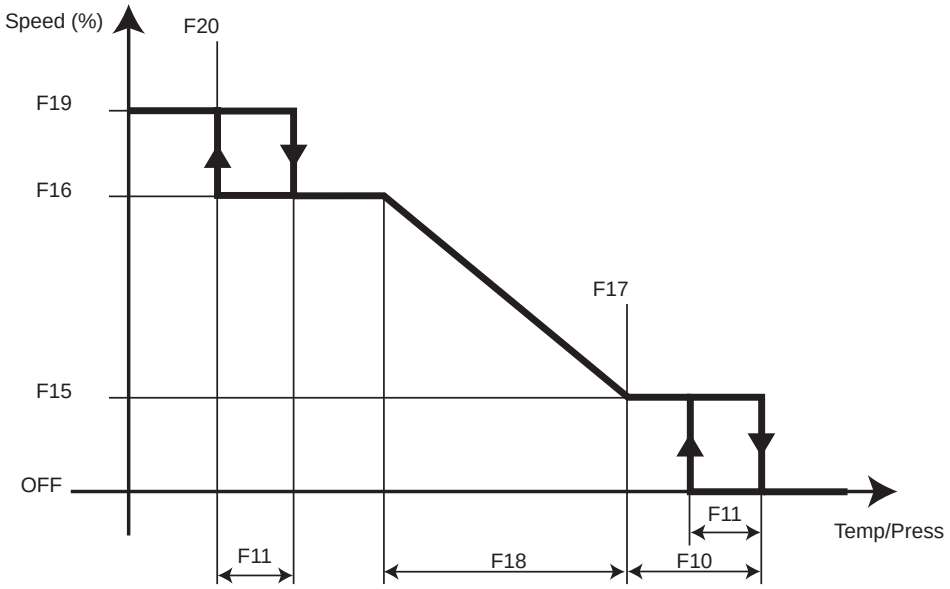
Heating mode

CONDENSATION FAN CONTROL IN *HEATING* MODE
F15 = Minimum fan speed in *HEATING* mode
F16 = Maximum silent speed of fan in *HEATING* mode
F17 = Minimum fan speed temperature/pressure *set point* in *HEATING* mode
F18 = Proportional band Fan in *HEATING* mode
F10 = Fan cut-off delta
F11 = Cut-off *hysteresis*

F19 = Maximum fan speed in *HEATING* mode
F20 = Maximum fan speed temperature/pressure *set point* in *HEATING* mode

An example of interaction of these *parameters* is shown in the figure below:

Fan control in Heating mode: diagram



Speed: speed
Temp: temperature
Press: pressure

If the circuit is in *Defrosting* mode and the condensation pressure is below (*F23*- *F24*), the fan is switched OFF. If the pressure is above *F23*, it is switched ON. In the coil drainage phase, when parameter *d07* is not 0, the fans run at the maximum speed in order to quickly disperse the water from the coil.

The cut-off is bypassed for a period of time (***F12***) calculated from compressor start-up.
If the regulator requests a cut-off during this interval of time, the fan runs at minimum speed.

The fan will always be turned off if:
a condensing fan shut-down alarm has been generated (refer to *alarm table*).
ERT 400 is on *stand-by* or off

7.6.3 Single or separate condensation

Parameter *F22* can be used to configure the units with 2 circuits and a single condenser.

	Value	
	0	**1**
***F22*: type of condensation**	separate condensers	single condensation

If *F22* = 0, the two fans operate independently and are regulated by the condensation pressure/temperature and the status of the circuit *compressors*.

If *F22*= 1, the outputs of the 2 fans are in parallel and regulation is effected on:
- the maximum value between the condensation *probes* of the circuits in *Cooling* mode
- the minimum value between the condensation *probes* of the circuits in *Cooling* mode

7.6.4 Control of anti-freeze electrical heaters

ERT 400 can control 4 anti-freeze electric heaters;

The electric heaters serve two purposes – they prevent ice from forming (in the exchangers and the environment) and act as regulators.

If they are used to prevent the formation of ice all the electric heaters are activated at the same time.

They are switched off if an alarm that shuts down the evaporation fan is present.

Each electric heater has its own *set point* for the *Heating* and *Cooling* modes, and can therefore be activated using the following *parameters*:

- *r07*: electrical heater *set point* in *Heating* mode
- *r08*: electrical heater *set point* in *Cooling* mode

The two anti-freeze electrical heater *set points* fall between minimum and maximum values which the user may set using the following *parameters*:

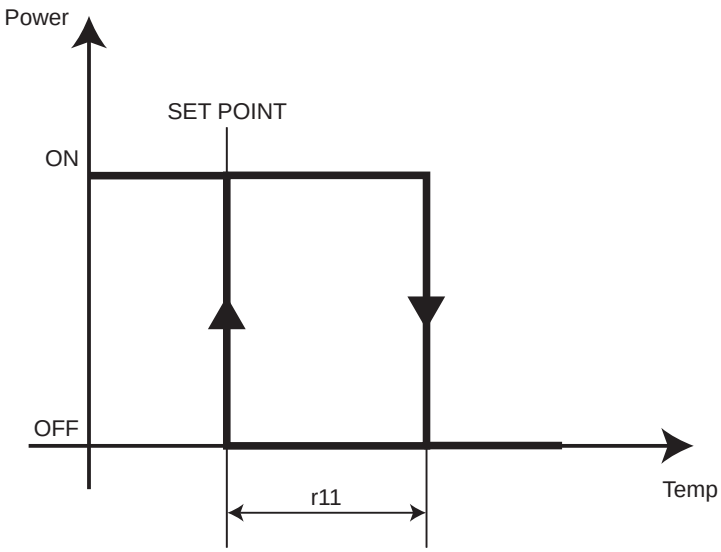
- *r09*: maximum *set point* of anti-freeze electrical heaters
- *r10*: minimum *set point* of anti-frost electrical heaters

If the off, *stand-by* and "*night*" *operating modes* control is effected on the *cooling set point*, using the same *control probe*.

Parameter *r11* determines the *hysteresis* for the *set points* of the *anti-freeze/integrated electric heaters*.

An example of operation is shown in the diagram below:

Diagram of the anti-freeze/integrated electric heaters

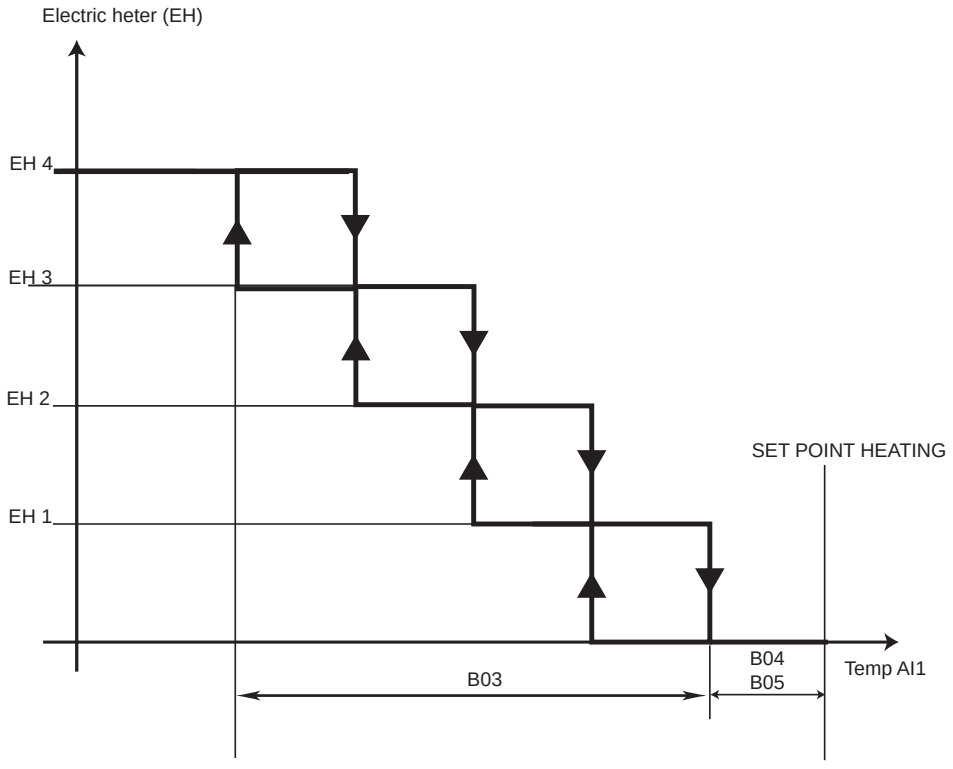


Power: power
Temp: temperature

7.6.5 Control of integrated electrical heaters

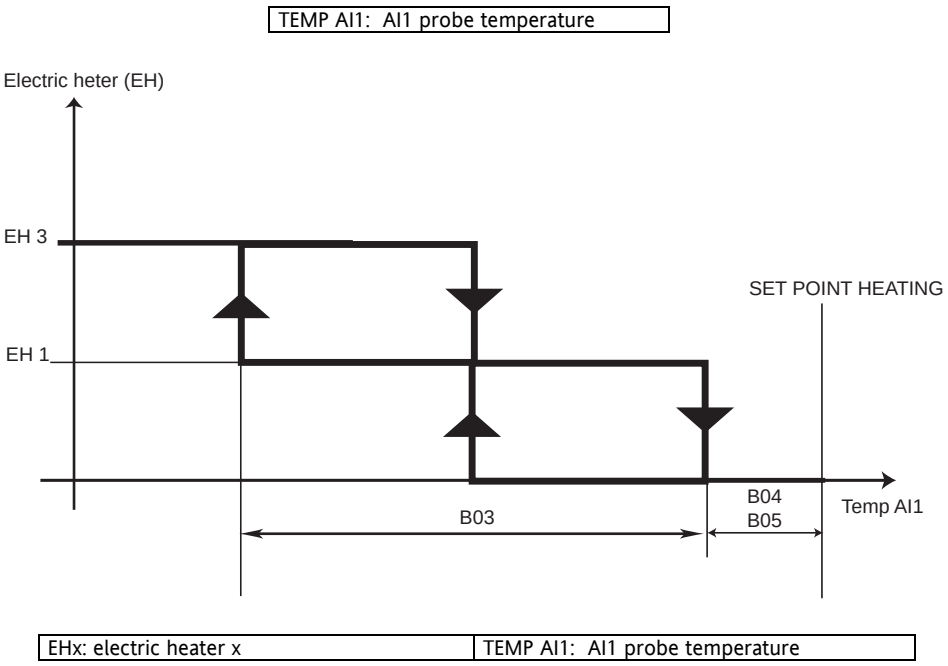
If *r15*= 1 the electric heaters are enabled to perform regulation as integrated heaters in *Heating* mode.
If this is the case, in addition to being activated on the anti-freeze regulator, the electric heaters operate as in the diagrams below:

Example with 4 electric heaters (r05=4)



EHx: electric heater x

Example with 2 electric heaters (r05=2)



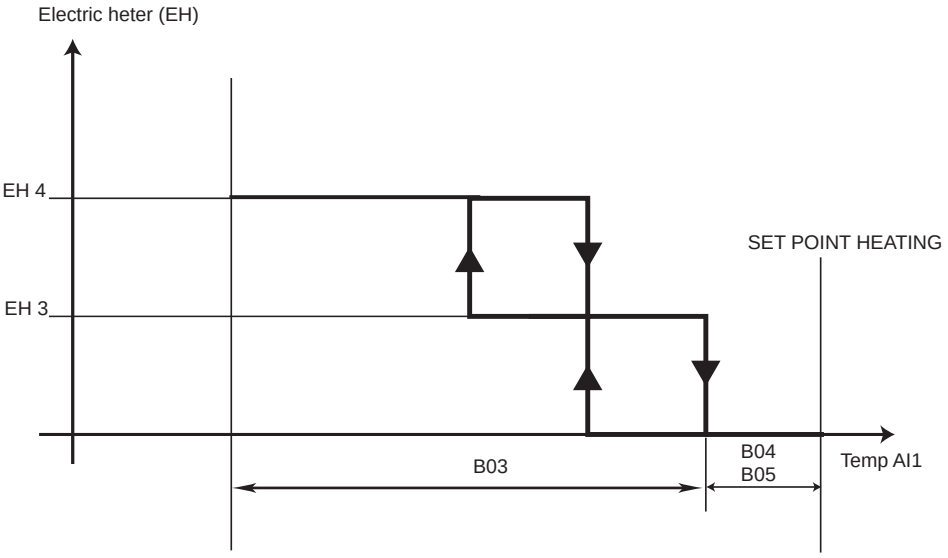
The cases in which *r05* = 3 and *r05* = 1 can be easily deduced.

The *hysteresis* for each step is determined by the regulation band divided by the number of electric heaters present.
There are 2 deltas for the *heating set point*:

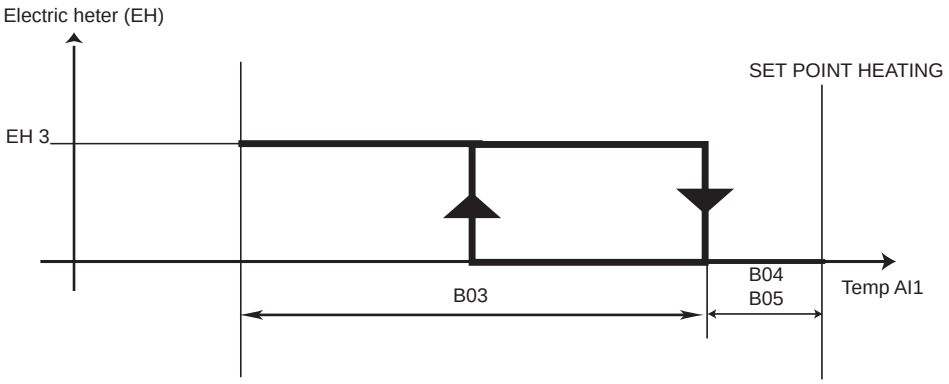
- *b04* is the delta with the activated heat pump (external temperature <Heat pump activation *set point*)
- *b05* is the delta with the disabled heat pump.

If the digital input of the thermal switch of electric heaters 1 and 2 is activated, electric heaters 1 and 2 are off and regulation is as below:

Example of r05=4



Example of r05=2



EHx: electric heater x	TEMP AI1: AI1 probe temperature

If the heat pump is disabled because the external temperature is too cold, parameter *B04* is put to *B05* and regulation takes place on the *heating set point*.

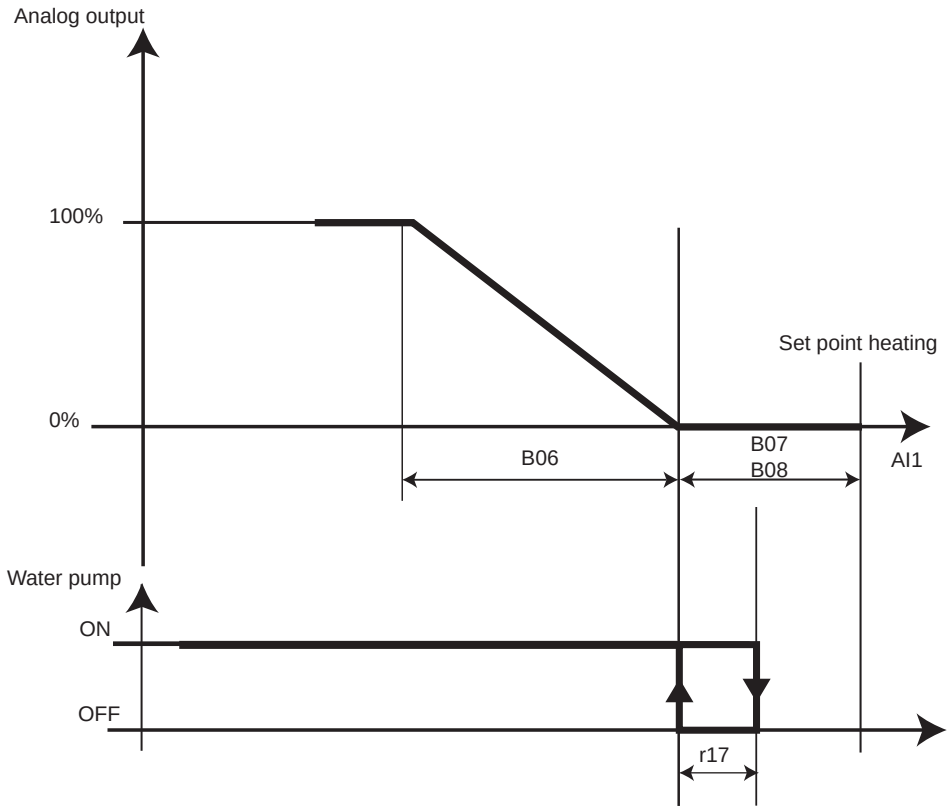
7.6.6 Control of hot water coil in anti-freeze mode

The *hot water coil* serves two purposes – it prevents ice from forming (in the exchangers and the environment) and acts as a regulator.
It is activated in anti-freeze mode if *r11*= 1 according to the same rules as the anti-freeze electric heaters. if present, the water pump is activated and the valve fully opened.

7.6.7 Control of integrated hot water coil (heating)

The integrated hot water valve is regulated according to the following *parameters*:

- Temperature of inlet air
- *Heating set point*
- *B06* = Regulation band for hot water valve on electric heaters in *heating* mode
- *B07* = -Regulation delta hot water valve with pump activated
- *B08* = -Regulation delta hot water valve with pump not activated
- *r17* = *Hysteresis* for deactivation of hot water pump



See the diagram below:

Analog output: analogue output	TEMP AI1: AI1 probe temperature
Water pump: water pump	

The pump has a minimum activation time equal to *r18*.
In heat pump mode, the active parameter is *B07*
When the heat pump is not activated, the active parameter is *B08*

If the hot water pump is activated when the fan is switched off, there is a delay between activation of the pump and the fan.

8 FUNCTIONS

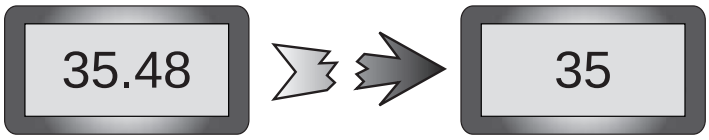
8.1 Recording of operating hours

The device stores the number of operating hours for the following in the *non volatile memory*:
- fan
- *compressors*

Internal resolution is in minutes.
The values can be displayed by accessing the menu called Ohr (see menu layout).
The whole value is displayed for values below 999 whereas the hours/100 value along with the decimal point is displayed for values above 999.

For example, 1234 hours are displayed as follows:

The hours can be *reset* by pressing the DOWN button for two seconds (see *buttons*) while the operating hours are displayed.



In the event of a power failure, the last fraction of hour recorded is set to 0 and the duration is rounded off by default:

8.2 Defrosting

The *defrosting* function is only active in *Heating* mode.
This function is used to prevent the formation of ice on the surface of the external heat exchanger.
The formation of ice on the external heat exchanger often occurs when the external air is very cold and humid.
This condition significantly reduces the thermodynamic performance of the unit and could cause it severe damage.
Defrosting is only possible if:
- *d01* = 1 (Enable *defrosting*)
- There is a condensation probe on the first circuit (*H13*= 1 or *H13* = 2)
- A *reversing valve* is present

When there are 2 circuits, *defrosting* may occur separately or together

The *defrosting* regulator controls the *compressors* on the circuit.
Circuit *compressors* cannot therefore be used by the temperature controller until *defrosting* has terminated on that circuit.
For single *defrosting* on two circuits, please note that even if one circuit has completed *defrosting* (and the compressor is off), it cannot be used by the temperature controller.

The input and output of *defrosting* changes according to the values of the condensation *probes* (see *defrosting probes*) and the settings for the following *parameters*:

8.2.1 Start of Defrosting

The activation of the *defrosting* phase is essentially determined by 2 *parameters*:
- *d02* : *start of defrosting* temperature/pressure
- *d03* : *defrosting* time

When the probe detects temperature/pressure values that are below the value of parameter *d02* and the compressor is on, it starts counting (timer) the number of minutes set on parameter *d03* and the *defrosting* phase then starts.

Interruption of timer

Timing is interrupted if:
- The temperature/pressure rises above the value set for parameter *d02*
- The compressor is off
-

Timer reset

The timer is *reset* if:
- the *defrosting* cycle has ended
- the “ERT 400” has been shut down
- the operating mode has changed (see *operating modes*)
- the temperature rises above the value set for parameter *d04* (*end of defrosting* temperature/pressure)

Defrosting: control of compressors

During *defrosting*, all *compressors* are controlled as follows:
- single *defrosting*: all *compressors* are turned on at full power
- separate *defrosting* all *compressors* in the circuit are turned on at full power
- at start up a time of *d14* is observed

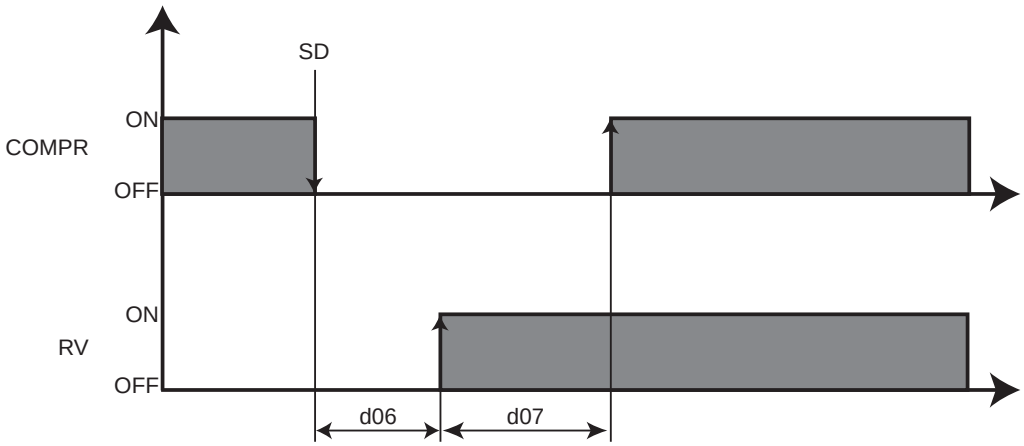
During the *defrosting* phases, the safety intervals of *compressors* and capacity steps are bypassed and only parameter *d11* is taken into account (delay between *defrosting* of circuits). This delay is valid both for activation of the *compressors* and capacity steps.

Defrosting can only occur if the following conditions are present:
- The safety timers of the circuit *compressors* must be set to 0
- After the last *defrosting*, the delay between the *defrosting* operations of circuits must have elapsed (*d11*)

If the unit has 2 circuits and single *defrosting*, the following conditions must be present:
- the circuit that is not the one requesting the *start of defrosting* must have a compressor with a safety time set to = 0 (see safety timer) so that both circuits can start simultaneously.

Defrosting start sequence

At *defrosting* start up, if the 4 way compressor-valve waiting time *d06* = 0 and the valve-compressor waiting time *d07*=0, the compressor remains on; if not, regulation is performed as shown below.



COMPR: compressor	RV: *reversing valve*	SD: *start of defrosting*

8.2.2 Control during defrosting

During the *defrosting* cycle, *loads* are controlled as follows.

Compressors

The *compressors* on the circuit being defrosted are turned on at full power or remain in this status.

Reversing valve

the *reversing valve* of the *defrosting* circuit operates in the same way as in the summer cycle.
When the valve is reversed, the timer starts counting a bypass time for the minimum pressure time on the circuit which is equivalent to the "bypass minimum time in *Cooling* mode" (*A01*).

Condensation fans

If the condensation pressure is below (*F23*-*F24*), the fan is OFF, if it is above *F23*, it is ON at full power. During the coil drainage phase the fans run at maximum speed in order to remove the water from the coil quickly. this function can be deactivated by setting *d10* = 0.

Evaporation fans

In the following situations
- there is a unit with single condensation (*F22*= 1)
- parameter *P04*= 1 (fan shut down in *defrosting*)

the fan will be turned off

In all other situations, it is always on

8.2.3 End of Defrosting

The de-activation of *defrosting* can be regulated by the temperature/pressure value of the analogue *probes* AI3...*A18* (*analogue inputs*) or the digital input (*digital inputs*).
The configuration *parameters* are:
- *d12* : Probe for *end of defrosting* circuit 1
- *d13* : Probe for *end of defrosting* circuit 2

Configuration parameters

These *parameters* can acquire the values and meanings shown in the following table:

Value of *parameters*	Description
0	*End of defrosting* on digital input
1	*End of defrosting* on AI3
2	*End of defrosting* on AI6

If *d09*=0 (*end of defrosting* from digital input), the unit also takes into account the digital input configured as "*End of defrosting* circuit 1" (*digital inputs*); if *d10*=0, it takes into account the "*End of defrosting* circuit 2" (*digital inputs*).
In this configuration, as soon as the input is activated, circuit *defrosting* is deactivated.

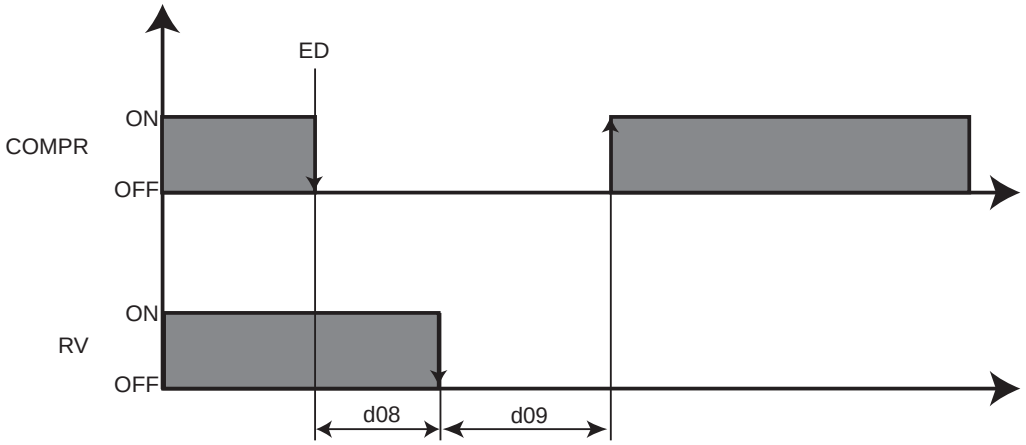
If an analogue input is selected for the *end of defrosting*, it ends when the pressure/temperature rises above parameter *d04* (*end of defrosting* temperature/pressure).

If the input is not configured, *defrosting* only ends when the limit set for parameter *d05* is exceeded (maximum *defrosting* time).
Defrosting ends if it exceeds the duration set with parameter *d05*.

Coil drainage time

At the *end of defrosting* regulation is performed as shown in the diagram below:

Defrosting end sequence



COMPR: compressor	RV: *reversing valve*	ED: *End of defrosting*

During this cycle the compressor safety times except delay *d14* are ignored.

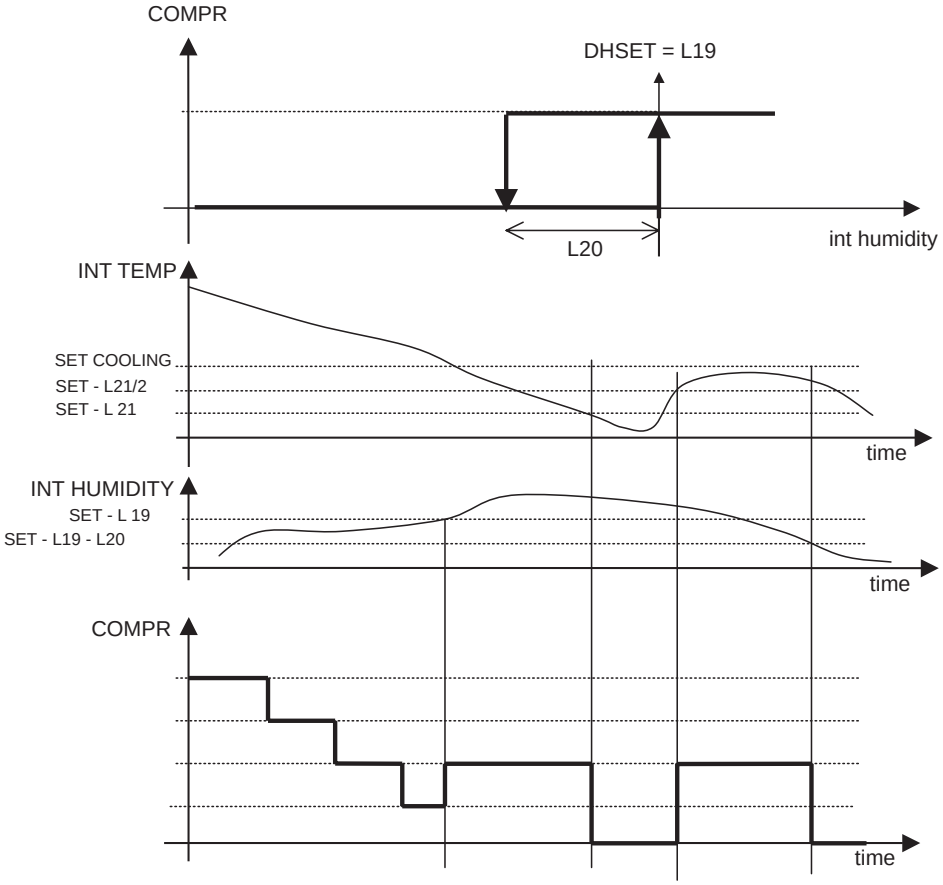
8.3 Dehumidification

The function is activated in the following conditions:

- *cooling* mode active
- number of active steps during *dehumidification* greater than 0 (*L22* > 0)
- an ambient humidity probe is present
-

Regulation is effected by activating a number of *compressors* (steps) as specified in parameter *L22* when relative humidity exceeds *set point L19*.
The *hysteresis* is equal to parameter *L20*.
If the inside temperature is lower than the *cooling set point* – *L21*, the function is not active.
Dehumidification is reactivated when the temperature goes above *set point L21*/2

Refer to the following diagrams if there are 2 active steps during *dehumidification*:



COMPR: compressor	DHSET: *dehumidification set point*	time: time
INT HUMIDITY: internal humidity	SET *COOLING*: *cooling set point*	INT TEMP: inside temperature

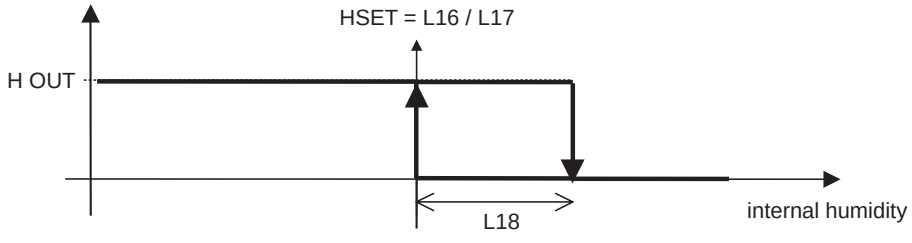
8.4 Humidification

The humidifying function activates a humidifier by way of a relay output if the ambient humidity is too low.
The function is activated in the following conditions;

- a relay is configured as humidifier output (*H35- H40* and *N06- N10* = 10)
- an ambient humidity probe is present
- parameter *L16* (humidify *set point*) is greater than 0
- no humidifier alarm is present

The function has two different *set points*: one for *heating* mode (*L16*) and one for *cooling* mode (*L17*).
The *hysteresis* is the same for both modes (*L18*)

Please refer to the diagram below:



H OUT: *humidification* relay output	HSET: *humidification set point*	INT HUMIDITY: internal humidity

8.5 Economizer

Freecooling
Freeheating

Mixing recirculated air with air from outside to heat or cool the environment can often be useful;
This practice is commonly referred to as "*freecooling*" and "*freeheating*"

Damper

The external air enters the external environment through a *damper* that mixes it with the recirculated air from inside. *Damper* control is proportional.
The function is only activated if:

- free-*cooling* is enabled (*L01*=1)
- the AI1 probe is configured as NTC/inlet air analogue input (*H11* = 1)
- the AI4 probe is configured as NTC/outdoor temperature analogue input (*H14* = 1)
- An analogue or digital output is used as *damper* control:
  - AN3: a 0-10Vdc dedicated output; control is proportional
  - A relay (*power outputs*) is configured as *damper* control (*H35*– H 40 = 15 or *N06*- *N10* = 15 on expansion module).
- outdoor temperature exceeds *L08* + *L09* (*freecooling*/*freeheating* block conditions)

If the outdoor temperature (AI4) goes below the value set in *L08*, the *economizer* is disabled and the *damper* goes to minimum opening (*L07*); when the temperature goes above *L08* + *L09* the function is reactivated and *damper* opening is controlled by the *economizer* once more.

Opening and closing of the *damper* depends on the *parameters* that have been set as shown in the following sub-sections:

The *freecooling set point* and *freeheating set point* variables are mutually exclusive in that the *damper* controller either regulates the *freecooling set point* or the *freeheating set point* and both are never used at the same time

If the *damper* is controlled by relays, it is disabled if the proportional output of the *economizer* is less or equal to parameter *L07* and is activated if the proportional output is at 100% (maximum opening).

The *damper* is switched OFF if *alarms* that determine its closure are active.

8.5.1 Freecooling/Freeheating in Cooling mode

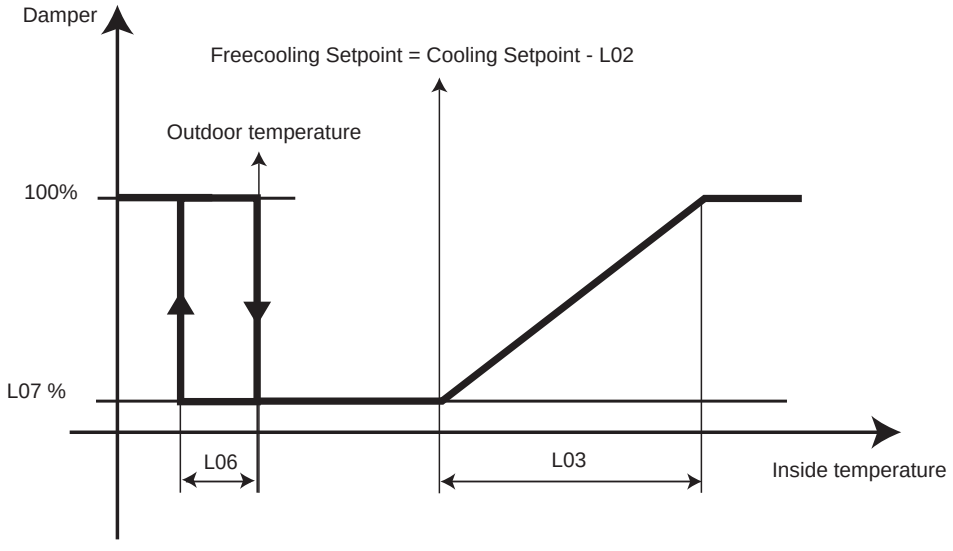
2 cases may arise:

OUTDOOR TEMPERATURE < *COOLING* SETPOINT

The *freecooling set point* is calculated by subtracting the value in parameter *L02* from the *cooling set point* (*freecooling* offset in *cooling* mode).
In line with the *freecooling* value, the *damper* is positioned at minimum opening (*L07*).
If the indoor temperature falls below the *freecooling set point* and below the outdoor temperature value, the *damper* is fully opened to heat the environment and the indoor temperature is brought close to the *cooling set point*.

If the *freecooling set point* were to coincide with the *cooling set point*, the *damper* would close as the same time as the *compressors* are switched off and any energy saved by using colder outdoor air would be lost. For this reason, *FREECOOLING* SETPOINT = *COOLING* SETPOINT – *L02*.

Please refer to the diagram below:

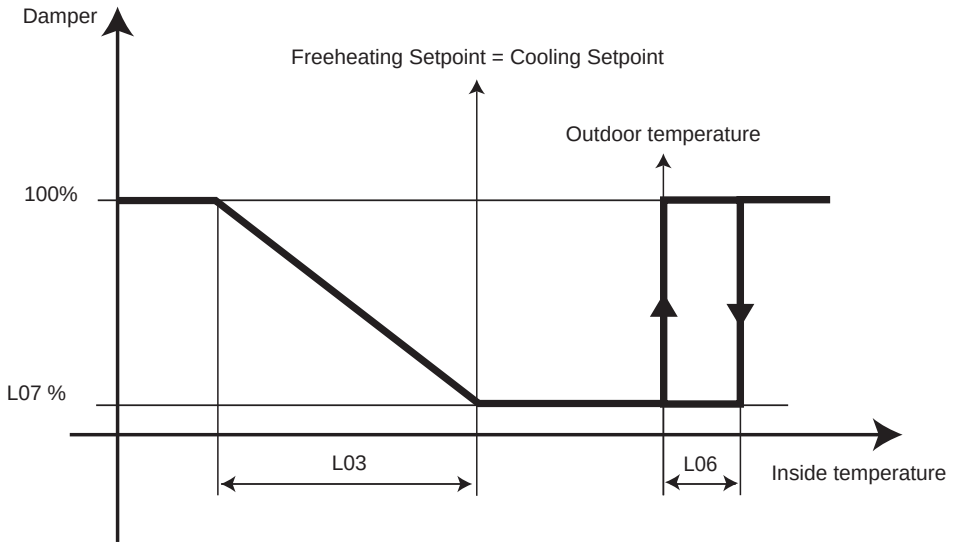


Damper= *Damper*	Outdoor temperature = Outdoor temperature	**Ins**ide Temperature = inside temperature

OUTDOOR TEMPERATURE > *COOLING* SETPOINT

In these conditions the outdoor temperature cannot be used to cool the environment unless the indoor temperature is higher than the outdoor temperature (if so, the *damper* is completely open).
Outdoor air can however be used to heat the environment if the indoor temperature is below the *cooling set point*. If this is the case, the *freeheating set point* is the same as the *cooling set point*

Please refer to the diagram below:



Damper= *Damper*	Outdoor temperature = Outdoor temperature	**Ins**ide Temperature = inside temperature

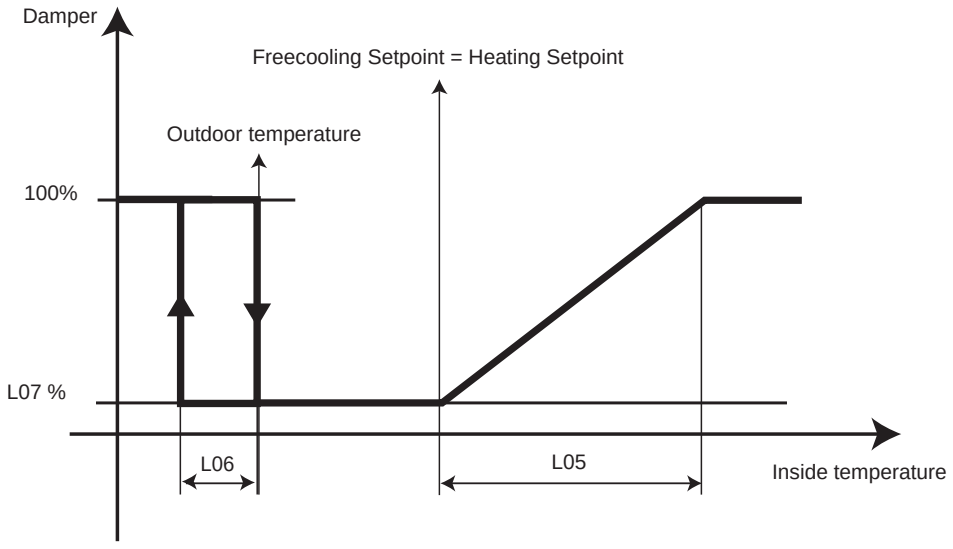
8.5.2 Freecooling/Freeheating in Heating mode

For *heating* mode, the same logics apply but the other way round when calculating the *freecooling* and *freeheating set points*

OUTDOOR TEMPERATURE < *HEATING* SETPOINT

In these conditions the outdoor temperature cannot be used to heat the environment unless the indoor temperature is lower than the outdoor temperature (if this is the case, the *damper* is completely open).
Outdoor air can however be used to cool the environment if the indoor temperature is higher than the *cooling set point*. If this is the case, the *freecooling set point* is the same as the *heating set point*.

Please refer to the diagram below:



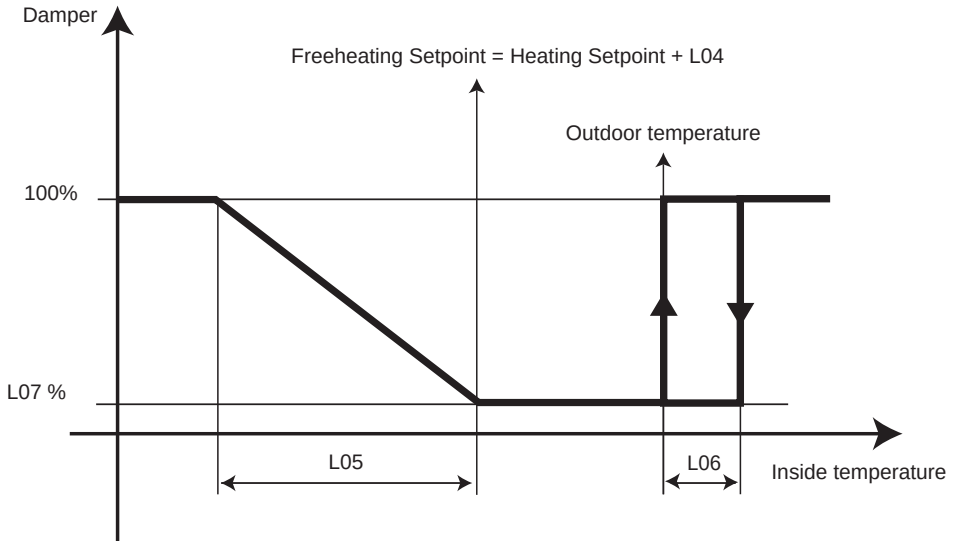
Damper= *Damper*	Outdoor temperature = Outdoor temperature	**Ins**ide Temperature = inside temperature

OUTDOOR TEMPERATURE > *HEATING* SETPOINT

The *freeheating set point* is calculated by subtracting the value in parameter *L04* from the *heating set point* (*freecooling* offset in *heating* mode).
In line with the *freeheating* value, the shutter is positioned at minimum opening.
If the indoor temperature rises above the *freeheating set point* and above the outdoor temperature value, the shutter is fully opened to cool down the environment and the indoor temperature is brought close to the *heating set point*.

If the *freeheating set point* were to coincide with the *heating set point*, the shutter would close as the same time as the *compressors* are switched off and any energy saved by using warmer outdoor air would be lost. For this reason, *FREEHEATING* SETPOINT = *HEATING* SETPOINT + *L04*.

Please refer to the diagram below:



Damper= *Damper*	Outdoor temperature = Outdoor temperature	Inside Temperature = inside temperature

8.5.3 Freecooling/Freeheating in Enthalpy

The ERT 400 *economizer* can also regulate the *enthalpy* of the air as well as the temperature
(*Enthalpy* is a thermodynamic property that takes into account both the temperature and the humidity of the air).

Enthalpic regulation is only possible if:

- free-*cooling* is enabled (*L01*=1)
- the AI4 probe is configured as NTC/external temperature analogue input (*H14* = 1)
- the AI3 probe is configured as 4-20mA external environment humidity input (*H13* = 3) or the AI8 probe (expansion) is configured as 4-20mA external environment humidity input (*N12* = 1)
- the AI6 probe is configured as 4-20mA recirculated environment humidity input (*H16* = 3) or the AI7 probe (expansion) is configured as 4-20mA recirculated environment humidity input (*N11* = 1)

If no probe has been configured as an external air humidity probe, then by setting the parameter *L15* to a value that is not 0, this value is considered to be the external air humidity needed to calculate the *enthalpy*.

If probe AI4 is present and *freecooling* is enabled, the control performs temperature *freecooling* at least. If the 2 humidity *probes* are also present, *freecooling* becomes enthalpic. The external humidity probe is considered present even if there is no probe but the hypothetical humidity is not 0 (*L15*) .

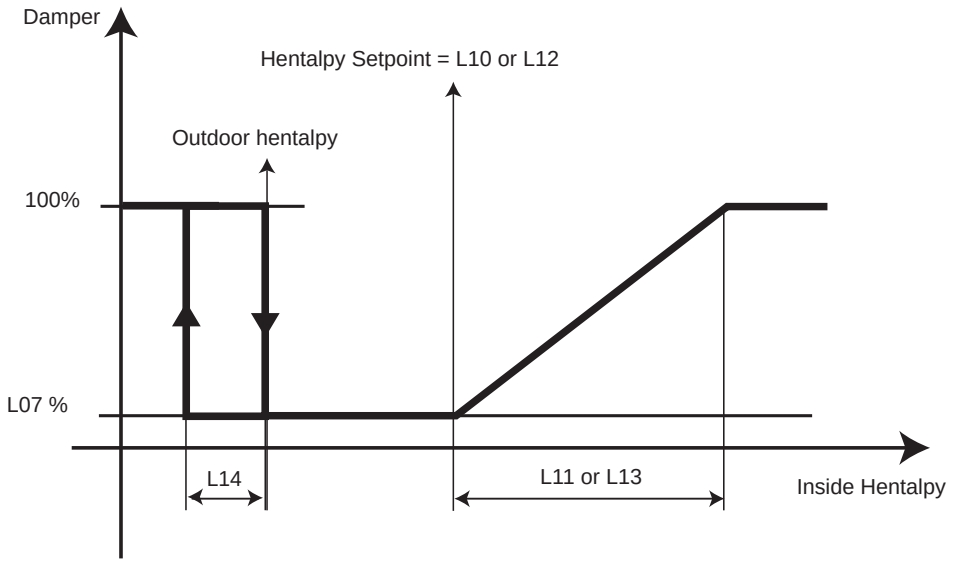
Regulation in *heating* or *cooling* mode is the same. The difference lies in the *set point parameters* and the regulation band

2 cases may arise:

OUTDOOR *ENTHALPY* < *ENTHALPY* SETPOINT

The *enthalpy set point* is set using parameter *L10* (*enthalpy set point* in *cooling* mode) / *L12* (*enthalpy set point* in *heating* mode. In line with the *set point* value, the *damper* is positioned to minimum opening
If the indoor *enthalpy* falls below the *set point* and below the outdoor *enthalpy* value, the shutter is fully opened and the indoor *enthalpy* is brought close to the *set point*.

Please refer to the diagram below:

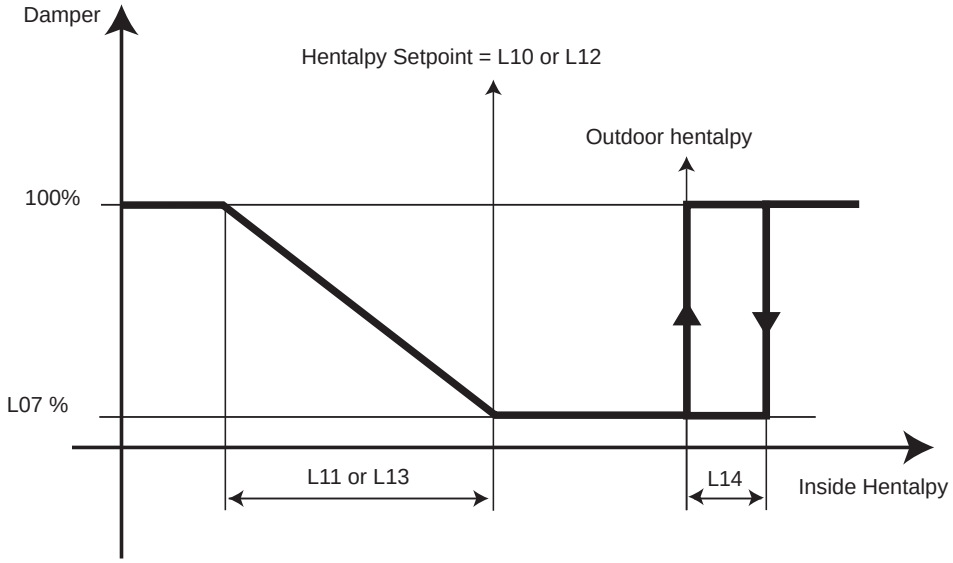


Damper= *Damper*	Outdoor hentalpy = Outdoor *enthalpy*	Inside hentalpy = inside *enthalpy*

OUTDOOR *ENTHALPY* > *ENTHALPY* SETPOINT

In these conditions the outdoor *enthalpy* cannot be used to lower the environment *enthalpy* unless the indoor *enthalpy* is higher than the outdoor *enthalpy* (if so, the *damper* is completely open). Outdoor air can however be used to increase the environment *enthalpy* if it is lower than the *set point*.

Please refer to the diagram below:



Damper= *Damper*	Outdoor hentalpy = Outdoor *enthalpy*	Inside hentalpy = inside *enthalpy*

8.6 Air Pollution

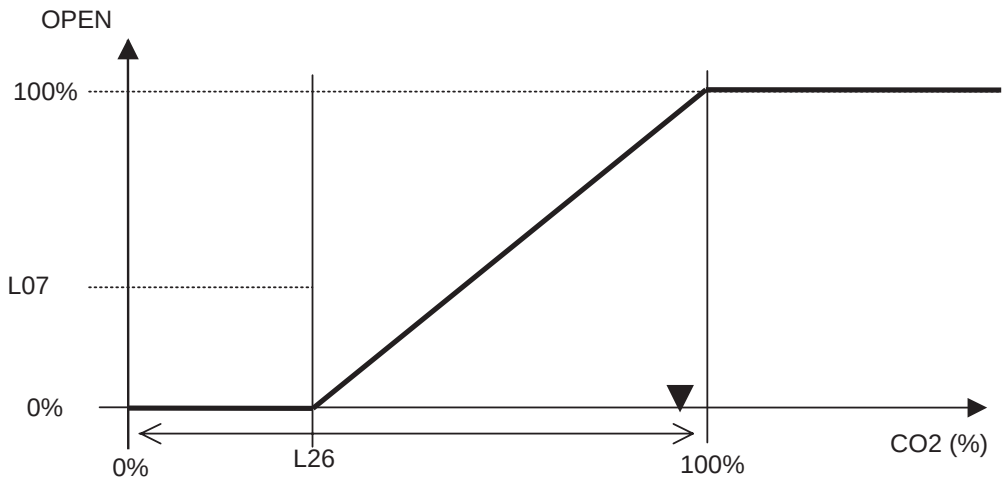
This function controls the opening of the *damper* on the *economizer* according to the quantity of CO2 (carbon dioxide) in the air.
The position of the *damper* will be determined by the maximum value required by the *air pollution* function and the value required by the *economizer*.
The function supports 2 types of sensor:

- the first with 4-20mA output to be connected to the AI8 input
- the second with a 0-5 Vdc output to be connected to the AI5 input.

The function is activated in the following conditions;

- the *economizer* is enabled
- the *air pollution* function is enabled i.e. the AI8 probe (4-20mA) is configured as CO2 input (*N12*=1) or the AI5 probe (0-5 Vdc) is set as CO2 input (*H15*= 3)

Please refer to the diagram below:



OPEN: *Damper* opening (%)	CO2: Carbon dioxide (%)

8.7 Loss of voltage

If there is a *loss of voltage* the control returns to the state prior to the *loss of voltage*.
If *defrosting* is underway, the procedure is cancelled.
All timing in progress is cancelled and restarted.

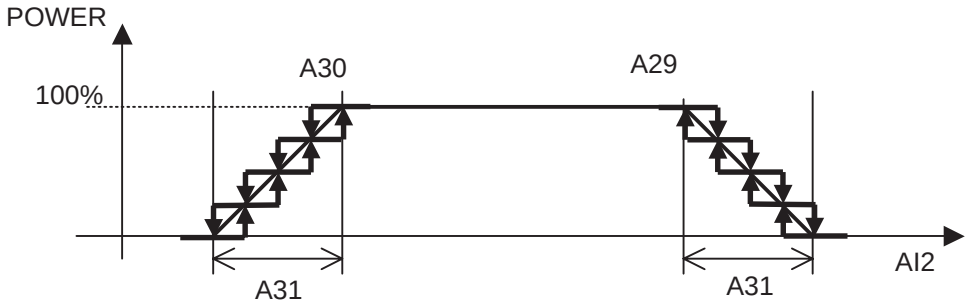
8.8 Heat pump shut-down

This function shuts down the heat pump if the outdoor temperature is below *r13*.
The pump is reactivated when the outdoor temperature rises above *r13* + *r14*.
The function is active if *r12*= 1 (activation of *heat pump shut-down*) and the AI4 probe (*analogue inputs*) is configured as outdoor temperature input (*H14* =1).

If the *integrated electric heaters* and the *hot water coil* are activated, the regulation deltas are changed according to the *heating set points* .

8.9 Output temperature control

If the output temperature read by the AI2 probe (*H12*=1) is too high or too low, the outputs are proportionally deactivated so that the temperature falls within the established limits
Please refer to the diagram below:



POWER: Power (%)	AI2: Analogue input 2

If probe *A12* is not present the function is disabled.

All the active outputs (*compressors*, electric heaters, water valve and *hot water coil*) can supply maximum power from this regulator. There is no overriding and all outputs behave in the same way.

9 PARAMETERS

The *parameters* can be set so that the ERT400 is fully configurable.
Parameters can be changed with:

- Keyboard (only EKW400-RT/S and EKP400-RT)
- PC (if the special connection and "Param manager" software are available)
- *Copy Card*

All the *parameters* are described in detail and divided into categories in the following chapters.

9.1 Description of parameters

All the *parameters* are described in detail and divided into categories in the following chapters.

9.1.1 Configuration parameters (CnF)

These *parameters* define the unit characteristics.

If one or more *parameters* in this category is changed, the controller must be turned off and on again to operate correctly.

G01 **"*Cooling*" *set point***
Sets the *set point* in *Cooling* mode

G02 **"*Heating*" *set point***
Sets the *set point* in *Heating* mode

H01 **Maximum "*heating*" *set point***
Sets the maximum *set point* in "*heating*" mode

H02 **Minimum "*Heating*" *set point***
Sets the minimum *set point* in *Heating* mode

H03 **Maximum "*Cooling*" *set point***
Sets the maximum *set point* in *Cooling* mode

H04 **Minimum "*cooling*" *set point***
Sets the minimum *set point* in *Cooling* mode

H05 **Number of circuits on the unit** * Selects the number of *cooling* circuits.
0= Not admitted
1= 1 *Cooling* circuit
2= 2 *Cooling* circuits

H06 **Number of *compressors* per circuit (*)**
0= No compressor
1= 1 Compressor
2= 2 *Compressors*
3= 3 *Compressors*
4= 4 *Compressors*

H07 **Number of capacity steps per circuit (*)**
0= No capacity step
1= 1 Capacity step per compressor
2= 2 Capacity steps per compressor
3= 3 Capacity steps per compressor

H08 **Compressor start-up sequence**
0= Based on operating hours
1= Fixed start-up sequence

H09 **Compressor selection algorithm**
0= Circuit saturation
1= Circuit balancing

H10 **Presence of heat pump**
0= Pump not present
1= Pump present

H11 **Configuration of input AI1**
Configures analogue input AI1
0= No probe
1= NTC inlet air input
2= Multi-functional digital input

H12 **Configuration of input AI2**
Configures analogue input AI2
0= No probe
1= Anti-freeze / Temperature control NTC input
2= Multi-functional digital input

H13 **Configuration of input AI3**
Configures analogue input AI3
0= No probe
1= NTC input for condensation circuit 1
2= 4...20 mA input for condensation circuit 1
3= 4...20 mA external environment humidity input

H14 **Configuration of input AI4**
Configures analogue input AI4
0= No probe
1= NTC input for external temperature
2= Multi-functional digital input

H15 **Configuration of input AI5**
Configures analogue input AI5
0= No probe
1= Multi-functional digital input

2 = 0-5V input Filter differential pressure
3 = CO2 0-5Vdc input

H16 **Configuration of input AI6**
Configures analogue input AI6
0= No probe
1= NTC condensation input circuit 2
2= 4...20 mA input for condensation circuit 2
3= 4...20 mA humidity input recirculated air

H17 **Pressure bottom scale value**
Pressure value associated with an analogue input value (AI3 or AI6) of 20mA (if configured as current input). Example: if a pressure transducer configured with 0-30.0 Bar/4-20mA threshold is used, it is necessary to set *H17*=300.

H18 **Polarity of *digital inputs* ID1,ID2,ID3,ID4**

H19 **Polarity of *digital inputs* ID5,ID6,ID7,ID8**

H20 **Polarity of *digital inputs* ID9,ID10,ID11**

H21 **Humidity top scale value**
Minimum humidity value; sets a value that corresponds to a current of 4mA.

H22 **Humidity bottom scale value**
Maximum humidity value; sets a value that corresponds to a current of 20mA.

H23 **Configuration of digital input ID1**
0=Disabled input
1=Differential pressure switch / *evaporator fan* thermal switch
2=remote OFF
3=Remote Heat/Cool
4=Thermal switch compressor 1
5=Thermal switch compressor 2
6=Thermal switch compressor 3
7=Thermal switch compressor 4
8=Thermal switch of fan circuit 1
9=Thermal switch of fan circuit 2
10=High pressure circuit 1
11=High pressure circuit 2
12=Low pressure circuit 1
13=Low pressure circuit 2
14=*End of defrosting* circuit 1
15=*End of defrosting* circuit 2
16=Window input
17=Smoke
18=*Damper* open
19=Humidifier alarm
20=Thermal switch of electric heaters 1 and 2
21=Thermal switch of electric heaters 3 and 4
22 =Request 1 *cooling* step
23=Request 1 *heating* step
24=Request 2 steps
25=Thermal switch of *evaporator fan*

H24 **Configuration of digital input ID2**
As for *H23*

H25 **Configuration of digital input ID3**
As for *H23*

H26 **Configuration of digital input ID4**
As for *H23*

H27 **Configuration of digital input ID5**
As for *H23*

H28 **Configuration of digital input ID6**
As for *H23*

H29 **Configuration of digital input ID7**
As for *H23*

H30 **Configuration of digital input ID8**
As for *H23*

H31 **Configuration of digital input ID9**
As for *H23*

H32 **Configuration of digital input ID10**
As for *H23*

H33 **Configuration of digital input ID11**
As for *H23*

H34 **Differential pressure bottom scale value**
Par *H34* **=** Maximum fan filter differential pressure value; sets the value corresponding to a 5Vdc voltage expressed in millibar; the value corresponding to a voltage of 0V will be 0 millibar.

H35 **Configuration of output NO2 (relay)**
0 = Disabled
1= *Reversing valve* circuit 1
2= *Reversing valve* circuit 2
3 = Condenser fan circuit 1
4 = Condenser fan circuit 2
5 = Hot water pump
6 = *Evaporator fan*
7= Power step 2
8= Power step 3
9= Power step 4
10 = Humidifier

11 = 1 step electric heaters
12 = 2 step electric heaters
13 = 3 step electric heaters
14 = 4 step electric heaters
15 = *Damper*
16 = Defrost relay

H36 **Configuration of output NO3 (relay)**
As for *H35*

H37 **Configuration of output NO4 (relay)**
As for *H35*

H38 **Configuration of output NO5 (relay)**
As for *H35*

H39 **Configuration of output NO6 (relay)**
As for *H35*

H40 **Configuration of output NO7 (relay)**
As for *H35*

H41 **Polarity of output NO2 (relay)**

H42 **Polarity of output NO3 (relay)**

H43 **Polarity of output NO4 (relay)**

H44 **Polarity of output NO5 (relay)**

H45 **Polarity of alarm relay output**
The relay output can be set for the corresponding outputs.
0= Relay on with open output
1= Relay on with inactive output

H46 **Configuration of analogue output 1 (AN1 or TC1)**
The output to control *condensation fan*s can be configured with 2 types of signals
0= Cutting phase fan control signal
1= 4-20mA output

H47 **Configuration of analogue output 2 (AN2 or TC2)**
The output to control *condensation fan*s can be configured with 2 types of signals
0= Cutting phase fan control signal
1= 4-20mA output

H48 **Activation of *heating* mode**
0= the *Heating* mode is activated
1= the *Heating* mode is not activated: with the selector on *Heating*, the unit is in Standby.

H49 **Selection of operating mode**
0= Selection from keyboard
1= Selection from digital input
2 = Automatic selection

H50 **Activation of *dynamic set point***
If activated, this function can be used to change the working set-point automatically according to the outdoor temperature or analogue 4-20mA input. This parameter is not relevant if *H13*≠3 or *H14*≠3.
0= Function de-activated
1= Function activated

H51 **Maximum dynamic offset in *Cooling* mode**
This is the maximum value that is added to the *set point* configured in *Cooling* mode (Coo) when the *DYNAMIC SET POINT* function is activated.

H52 **Maximum dynamic offset in *Heating* mode**
This is the maximum value that is added to the *set point* configured in *Heating* mode when the *DYNAMIC SET POINT* function is activated.

H53 **Outdoor temperature *set point* in *Cooling* mode**
This parameter is only relevant if the *dynamic set point* function is activated and if probe AI4 is configured as outdoor temperature probe.

H54 **Outdoor temperature *set point* in *Heating* mode**
This parameter is only relevant if the *dynamic set point* function is activated and if probe AI4 is configured as outdoor temperature probe.

H55 **Outdoor pressure differential in *Cooling* mode**
This parameter is only relevant if the *dynamic set point* function is activated and if probe AI4 is configured as outdoor temperature probe.

H56 **Outdoor pressure differential in *Heating* mode**
This parameter is only relevant if the *dynamic set point* function is activated and if probe AI4 is configured as outdoor temperature probe.

H57 **Offset AI1,**
This parameter can be used to compensate the error that may occur between the temperature (or pressure) read and the actual value.

H58 **Offset AI2,**
as for *H57*

H59 **Offset AI3**
These *parameters* can be used to compensate for the error that may occur between the temperature (or pressure) read and the actual value.

H60 **Offset AI4**
as for *H57*

H61 **Offset AI5**
as for *H57*

H62 **Offset AI6**
as for *H57*

H63 **Offset AI7**
as for *H57*

H64 **Offset AI8**
as for *H57*

H65 **Mains frequency**
Mains frequency 50 Hz
Mains frequency 60 Hz

H66 **°C or °F selection**
0= °C
1= °F

H67 **Serial address of series**

H68 **Serial address of device**
These *parameters* can be used to address the device if it connected to a personal computer or a supervision system. These *parameters* are normally set to 0.

H69 **User password**
Can be used enter the password required to access second level *parameters*. It can also be used to copy the *parameters* of the unit onto the *Copy Card*.

H70 **Password for parameter writing**
It represents the value that the password must acquire to copy the *parameters* onto the *Copy Card*.

H71 **Keyboard presence**

H72 **Holding time in *heating* or *cooling* mode**
Minimum status (*heating cooling*) holding time even if the temperature control requests a *change over*. Time expressed in minutes.

H73 **Polarity AI1, AI2, AI3, AI4**
0= Relay on with open input
1= Relay on with inactive input

H74 **Configuration of AI1 if digital**
As for *H23*

H75 **Configuration of AI2 if digital**
As for *H23*

H76 **Configuration of AI3 if digital**
As for *H23*

H77 **Configuration of AI4 if digital**
As for *H23*

H78 **Activates *digital regulation***
0=*digital regulation* not activated
1= digital activation activated

H79 **Activates unbalanced circuits**
0=unbalanced circuits not activated
1=unbalanced circuits activated

H80 **Activates probe on remote keyboard**
0=*control probe* on local keyboard
1= *control probe* on remote keyboard

9.1.2 Alarm Parameters (ALL)

A01 **Low pressure pressure switch by-pass time.**
The delay between start-up of compressor and start-up of low pressure digital alarm *diagnostics*. It is expressed in seconds

A02 **Number of low pressure events per hour**
Number of low pressure digital alarm events per hour. If exceeded, the alarm will switch from automatic *reset* to *manual reset*.

A03 **Pressure switch bypass time from fan start-up**
Delay between start-up of fan and start-up of pressure switch alarm *diagnostics*. It is expressed in seconds

A04 **Active flow switch input time**
Time that flow switch digital input must remain *active* in order to generate the flow switch alarm. The timer starts after the flow switch bypass time. It is expressed in seconds.

A05 **Inactive flow switch input time**
Time that flow switch digital input must remain *inactive* in order to *reset* the alarm. It is expressed in seconds.

A06 **Number of pressure switch events per hour**
Number of pressure switch digital alarm events per hour. If exceeded, the alarm will switch from automatic *reset* to *manual reset*. The external fan is de-activated when the alarm switches from automatic to *manual reset*.

A07 **Compressor thermal switch by-pass time from compressor start-up**
The delay between start-up of compressor and start-up of compressor thermal switch digital alarm *diagnostics*. It is expressed in seconds

A08 **Number of compressor thermal switch events per hour**
Number of compressor thermal switch digital alarm events per hour. If exceeded, the alarm will switch from automatic *reset* to *manual reset*.

A09 **Number of condensing fan thermal switch events per hour**
Number of condensing fan thermal switch digital alarm events per hour. If exceeded, the alarm will switch from automatic *reset* to *manual reset*.

A10 **Anti-freeze alarm by-pass time**
The delay between machine start-up (selection of operating mode or switching from OFF->ON) and start-up of compressor thermal switch digital alarm *diagnostics*. It is expressed in seconds. This bypass time is only active in *Heating* mode.

A11 **Anti-freeze alarm *set point***
Temperature below which the anti-freeze alarm is activated.

A12 **Anti-freeze alarm *hysteresis***
Differential for *A11* anti-freeze alarm temperature limit; also acts as differential (with sign inverted) for *A15* over-temperature alarm.

A13 **Number of anti-freeze alarm events per hour**
Number of anti-freeze alarm events per hour. If exceeded, the alarm will switch from automatic *reset* to *manual reset*.

A14 **Anti-freeze alarm probe**
This parameter can be used to disable the alarm or select the alarm *control probe*
0 = alarm inactive
1 = AI1 probe on base unit or remote keyboard
2 = probe AI2
3 = probe AI3

A15 **Activation of fan shut-down with anti-freeze alarm**
0 = fan not shut down
1 = fan shut down

A16
Fan status with fire alarm
0 = fan off and *damper* closed
1 = fan on and *damper* closed
2 = fan on and *damper* open
3 = fan off and *damper* open

A17 **Compressor status caused by over-temperature alarm**
Disables shut-down of *compressors* if temperature is too high

A18 **Duration of over-temperature**
Determines the time elapsing before high temperature alarm is activated

A19 **Deactivation of *compressors* with high temperature**
Determines the status of the *compressors* if high temperature alarm is activated:
0=*compressors* on
1=*compressors* off

A20 **Dirty *fan operating hours* threshold**
Determines the time (measured in hours*100) after which the dirty filter alarm is generated

A21 **Clogged *fan operating hours* threshold**
Determines the time (measured in hours*100) after which the clogged filter alarm is generated

A22
Activate fan shut-down with clogged filters
Determines shut-down of the fan if clogged filter fan is generated
0=fan on
1=fan off

A23 **Filter differential pressure bypass time from fan start-up**
Determines the delay between start-up of fan and start-up of alarm *diagnostics*:

- Worn filters
- Dirty filters
- *Evaporator fan* shut down

A24 **Shut-down fan differential pressure *set point***
ST5 value below which the shut-down fan error is generated

A25 **Dirty fan differential pressure *set point***
Minimum value of ST5 (*A25* – *A26*) *range* in which the dirty filter error is generated.

A26 **Worn fan differential pressure *set point***
Maximum value of ST5 (*A25* – *A26*) *range* in which the dirty filter error is generated. If this value is exceeded, the worn filter alarm is activated.

A27 **Duration of differential pressure activated by dirty or clogged fan alarm**
Determines the duration of the dirty or worn filter alarm

A28 **Duration of differential pressure activated by shut-down fan alarm**
Determines the duration of the shut-down fan alarm.

A29 **Maximum temperature of outlet air**
Maximum value for values read by AI2. If exceeded, the outputs are proportionally deactivated so that the temperature falls within the specified limits.

A30 **Minimum temperature of outlet air**
Maximum value for values read by AI2. If exceeded, the outputs are proportionally deactivated so that the temperature falls within the specified limits.

A31 **Outlet air regulation band**
Temperature band related to *A30* and *A29* temperature limits in which the maximum power of the *installation* is regulated according to the air temperature in order to control the temperature of the outlet air.

A32 **Alarm relay status with remote ON/OFF**
Determines activation of the remote ON/OFF alarm function
1=alarm relay ON

9.1.3 Compressor parameters (CP)

C01 **Safety time OFF-ON**
It represents the minimum time that must pass between the shutdown and start-up of the compressor. It is expressed in tenths of seconds.

C02 **Safety time ON-ON**
It represents the minimum time that must pass between two subsequent starts of the compressor. It is expressed in tenths of seconds.

C03 **Compressor start interval**
It can be used to set a delay for the start of two *compressors*.

C04 **Compressor shutdown interval**
It can be used to set a delay for the shutdown of two *compressors*.

C05 **Interval between capacity steps**
It can be used to set a delay between the activation of the compressor and capacity steps.

9.1.4 Regulator (RE)

b01 **Regulation band for *compressors* in *cooling* mode**
See *Control of compressors – temperature controller*

b02 **Regulation band for *compressors* in *heating* mode**
See *Control of compressors – temperature controller*

b03 **Regulation band for *integrated electric heaters***
See *Control of integrated electrical heaters*

b04 **Regulation delta for *integrated electric heaters* with heat pump activated**
See *Control of integrated electrical heaters*

b05 **Regulation delta for *integrated electric heaters* with heat pump not activated**
See *Control of integrated electrical heaters*

b06 **Regulation band for integrated *hot water coil***
See Control of integrated *hot water coil*

b07 **Regulation delta *hot water coil* with heat pump activated**
See Control of integrated *hot water coil*

b08 **Regulation delta *hot water coil* with heat pump not activated**
See Control of integrated *hot water coil*

9.1.5 Ventilation parameters (FAn)

F01 ***Configuration of fan outputs***
0= Proportional fan output (from 0 to 100% depending on *parameters*)
1= Fan "on-off" output; in this mode the regulator performs the same calculations as the proportional output. The only difference is that if it reads a value above 0, it outputs 100.
2 = On-off operation on compressor request. In this mode, if the output is 0 and no circuit compressor is on, it is 100% if at least one circuit compressor is on.

F02 **Fan *pick-up* time**
Time during which the fan runs at maximum speed after start-up. This is expressed in tenths of seconds.

F03 **Fan *phase shift***
This parameter calibrates the fan control output according to the different types of fans, adjusting the current/voltage *phase shift* of each fan.
It is measured in microseconds * 200

F04 **Duration of triac activation impulse**
It changes the length of the triac command impulse.

F05 **Operation on compressor request**
0= If the compressor and fan are off
1= The condensation control operates independently of the compressor

F06 **Minimum speed in *Cooling* mode**
Minimum proportional regulation for the fan in *Cooling* mode. It is expressed as a percentage, from 0 to 100%, of the supply voltage.

F07 **Maximum silent speed in *Heating* mode**
Maximum proportional regulation for the fan in *Heating* mode. It is expressed as a percentage from 0 to 100% of the supply voltage.

F08 **Minimum fan speed temperature/pressure *set point* in *Cooling* mode**
Condensation temperature/pressure value below which the fan runs at minimum speed in *Cooling* mode.

F09 **Proportional band in *Cooling* mode**
Difference in temperature/pressure that corresponds to a variation from minimum silent to maximum silent of the fan speed in *Cooling* mode (*F07*).

F10 **Fan cut-off differential**
Condensation temperature/pressure differential as compared to the temperature/pressure *set point* (*F08* or *F14*) above which the fan is turned off.

F11 ***Hysteresis* cut-off .**
Condensation temperature/pressure differential for the cut-off feature.

F12 **Cut-off bypass time**
It sets a delay between activation of the cut-off function and the compressor start up. It is expressed in seconds.

F13 **Maximum speed in *Cooling* mode**
It sets a speed step in relation to a specific temperature/pressure value in *Cooling* mode.

F14 **Maximum fan speed temperature/pressure *set point* in *Cooling* mode**
Condensation temperature/pressure value related to the speed of fan referred to in parameter *F13*.

F15 **Minimum speed in *Heating* mode**
Minimum proportional regulation for the fan in *Heating* mode. It is expressed as a percentage from 0 to 100% of the supply voltage.

F16 **Maximum silent speed in *Heating* mode**
Maximum proportional regulation for the fan in *Heating* mode. It is expressed as a percentage from 0 to 100% of the supply voltage.

F17 **Minimum fan speed temperature/pressure *set point* in *Heating* mode**
Condensation temperature/pressure value above which the fan runs at minimum speed in *Heating* mode.

F18 **Proportional band in *Heating* mode**
Temperature/pressure differential that corresponds to a variation from minimum silent to maximum silent of the fan speed in *Heating* mode (*F16*).

F19 **Maximum speed in *Heating* mode**
It sets a speed step in relation to a specific temperature/pressure value in *Heating* mode.

F20 **Maximum fan speed temperature/pressure *set point* in *Heating* mode**
Condensation temperature/pressure value related to the speed of fan referred to in parameter *F19*.

F21 **Pre-ventilation in *Cooling* mode**
It sets a pre-ventilation time in *Cooling* mode before the compressor starts up.

F22 **Separate or single ventilation**
Parameter *F22* can be used to configure the units with 2 circuits and a single condenser.

Parameter *F22*, type of condensation
0= Separate condensers
1= Single condenser
If *F22* = 0, the two fans are independent and vary according to the condensation pressures/temperatures and the status of the *compressors*. If *F22*= 1, the outputs of the 2 fans are in parallel and regulation is effected using:
the maximum value between the condensation *probes* of the circuits in *Cooling* mode
the minimum value between the condensation *probes* of the circuits in *Cooling* mode
If one of the 2 circuits has no condensation probe, a configuration alarm is generated.

F23 **Fan activation temperature/pressure *set point* in *Defrosting* mode**
If the temperature/pressure measured during the *defrosting* cycle exceeds the "Start fans in *Defrosting* mode" threshold (*F23*), fans are activated at full power.

F24 ***Hysteresis* of fan activation in *Defrosting* mode**
Condensation temperature/pressure differential for regulation of the fan in *Defrosting* mode.

9.1.6 Pump / evaporator fan parameters (PUP)

P01 **pump ON compressor ON delay**
It sets a delay between the start up of the pump and the compressor. It is expressed in tenths of seconds.

P02 **Fan ON compressor ON delay**
It sets a delay between the start up of the fan and the compressor. It is expressed in seconds.

P03 **Unit OFF fan OFF delay**
It sets a delay between the shutdown of the unit and the fan. It is expressed in seconds

P04 **Activation of fan shut-down in *Defrosting* mode**

9.1.7 Anti-freeze/boiler parameters (FRO)

r01 **Configuration of *electric heaters in Defrosting mode***
Determines the operation of the electric heaters when the anti-freeze function is activated
0=On only when requested by temperature controller
1=Always on in *Defrosting* mode

r02 **Configuration of electric heaters activated in *Cooling* mode**
Determines electric heater operating in *Cooling* mode
0=Off in *Cooling* mode
1=On in *cooling* mode (depending on the anti-freeze electric heater regulators)

r03 **Configuration of electric heaters activated in *Heating* mode**
Determines electric heater operating in *Heating* mode
0=Off in *Heating* mode
1=On in *Heating* mode (depending on the anti-freeze electric heater regulator)

r04 **Configuration of *control probe* for antifreeze electric heaters**
Determines the *control probe* of the electric heaters in *Heating* mode
0= Not present
1=Regulation on probe AI1
2=Regulation on probe AI2
3= Regulation on probe AI5

r05 **Number of electric heaters present**
0=No electric heater present
1= 1 electric heater present (1)
2= 2 electric heaters present (1-3)
3= 3 electric heaters present (1-2-3)
4= 4 electric heaters present (1-2-3-4)

r06 **Configuration of electric heaters in OFF or *Stand-by* mode**
Determines the status of electric heaters when the unit is in OFF or *Stand-by* mode
0=Always off in OFF or *stand-by*
1=On in OFF or *stand-by* (depending on the anti-freeze electric heater regulator)

r07 **Anti-freeze/boiler electric heater *set point* in *Heating* mode**
It represents the temperature, in *Heating* mode, below which anti-freeze electric heaters are activated.

r08 **Anti-freeze/boiler electric heater *set point* in *Cooling* mode**
It represents the temperature, in *Cooling* mode, below which anti-freeze electric heaters are activated.

r09 **Maximum *set point* limit for anti-freeze electric heaters**
Sets the maximum *set point* for anti-freeze electric heaters.

r10 **Minimum *set point* limit for anti-freeze electric heaters**
Sets the minimum *set point* for anti-freeze electric heaters.

r11 **Anti-freeze electric heater *hysteresis***
Anti-freeze electric heater *hysteresis*

r12 **Activation of *heat pump shut-down***
See *Heat pump shut-down*

r13 ***Heat pump shut-down set point***
See *Heat pump shut-down*

r14 ***Heat pump shut-down hysteresis***
See *Heat pump shut-down*

r15 **Enable *integrated electric heaters* in *heating* mode**
0= *Integrated electric heaters* not activated
1= *Integrated electric heaters* activated

r16 **Activate electric heaters/H_2O valve in *dehumidification***
0=Hot water valve in *dehumidification* not activated
1=Hot water valve in *dehumidification* activated

r17 **Hot water pump deactivation *hysteresis***

r18 **Minimum activation time of hot water pump**

See Control of integrated *hot water coil*

r19 **Activate *hot water coil* in anti-freeze mode**
0=*Hot water coil* in anti-freeze mode not activated
1=*Hot water coil* in anti-freeze mode activated

9.1.8 Defrosting parameters (dFr)

d01 **Activation of *defrosting***
0= *Defrosting* de-activated
1= *Defrosting* activated

d02 ***Start of defrosting* temperature/pressure**
It represents the temperature/pressure below which the *defrosting* cycle is activated.

d03 ***Defrosting* interval (request time)**
It represents the time interval during which the probe remains below the *defrosting* start temperature/pressure. It is expressed in minutes.

d04 ***End of defrosting* temperature/pressure**
It represents the temperature/pressure above which *defrosting* starts.

d05 **Maximum *defrosting* time (time out)**
It represents the maximum duration of *defrosting*. It is expressed in minutes.

d06 **Compressor-valve waiting time (anti-vent)**
It represents the waiting time, at the beginning of the *defrosting* cycle, between the shutdown of the compressor and the reversing of the 4 way valve.

d07 **Valve-compressor waiting time at *start of defrosting***
It represents the waiting time, at the beginning of the *defrosting* cycle, between the reversing of the 4 way valve and shutdown of the compressor.

d08 **Compressor-valve waiting time at *start of defrosting***
It represents the waiting time, at the end of the *defrosting* cycle, between the shutdown of the *compressors* and the reversing of the 4 way valve.

d09 **Valve-compressor waiting time at *start of defrosting***

d10 **Activation of fan at *end of Defrosting***
It activates the fans during phases *d08* and *d09*

d11 ***Defrosting* interval**
It represents the interval between the end of a *defrosting* cycle and the next one (not dependant on the circuit that has performed the *defrosting* operation)

d12 **Probe for *end of defrosting* circuit 1**

d13 **Probe for *end of defrosting* circuit 2**
These *parameters* can be assigned the values and meanings shown in the following table:

Value of *parameters*	Description
0	*End of defrosting* on digital input
1	*End of defrosting* on AI3
2	*End of defrosting* on AI4
3	*End of defrosting* on AI6

d14 **Delayed start of *compressors* in *defrosting* mode**
This is the only safety limit observed by both the capacity steps and the *compressors* during the *defrosting* phases.

9.1.9 Expansion module parameters (ESP)

N01 **Polarity of ID12 ID13 ID14 ID15**
As for *H23*

N02 **Configuration of ID12**
As for *H23*

N03 **Configuration of ID13**
As for *H23*

N04 **Configuration of ID14**
As for *H23*

N05 **Configuration of ID15**
As for *H23*

N06 **Configuration of relay 9**
As for *H23*

N07 **Configuration of relay 10**
As for *H23*

N08 **Configuration of relay 11**
As for *H23*

N09 **Configuration of relay 12**
As for *H23*

N10 **Configuration of relay 13**
As for *H23*

N11 **Configuration of ST7**
As for *H23*

N12 **Configuration of ST8**
As for *H23*

N13 **Polarity of ST7 ST8**
As for *H23*

N14 **Configuration of ST7 if digital**
As for *H23*

N15 **Configuration of ST8 if digital**
As for *H23*

9.1.10 Freecooling / Humidity parameters (FrC)

L01 **Enable free-*cooling***
0=*Freecooling*/*freeheating* not enabled
1=*Freecooling*/*freeheating* enabled

L02 ***Freecooling*** **offset in** ***Cooling*** **mode**
The *freecooling set point* is calculated by subtracting the value in parameter *L02* measured in °C from the *cooling set point*.

L03 ***Freecooling*****/*****Freeheating*** **band in** ***Cooling*** **mode**
See *Economizer*

L04 ***Freecooling*** **offset in** ***Heating*** **mode**
See *Economizer*

L05 ***Freecooling*****/*****Freeheating*** **band in** ***Heating*** **mode**
See *Economizer*

L06 ***Freecooling*****/*****freeheating*** **activation delta**
See *Economizer*

L07 **Minimum** ***damper*** **opening**
See *Economizer*

L08 ***Freecooling*** **shut-down** ***set point***
See *Economizer*

L09 ***Freecooling*** **shut-down delta**
See *Economizer*

L10 **Enthalpic** ***freecooling*****/*****freeheating set point*** **in** ***Cooling*** **mode**
Freecooling/*freeheating set point* in *Cooling* mode; measured in Kj/Kg

L11 **Enthalpic** ***freecooling*****/*****freeheating*** **band in** ***Cooling*** **mode**
See *Freecooling/Freeheating in Enthalpy*

L12 **Enthalpic** ***freecooling*****/*****freeheating set point*** **in** ***Heating*** **mode**
Freecooling/*freeheating set point* in *Heating* mode; measured in Kj/Kg

L13 **Enthalpic** ***freecooling*****/*****freeheating*** **band in** ***Heating*** **mode**
See *Freecooling/Freeheating in Enthalpy*

L14 ***Freecooling*****/*****freeheating*** **activation delta in** ***enthalpy***
See *Freecooling/Freeheating in Enthalpy*

L15 **External humidity simulation**
In *Freecooling/Freeheating in Enthalpy* with no humidity probe, it replaces the reading by setting a constant value measured as a %

L16 **Humidify** ***set point*** **in** ***Heating*** **mode**
See *humidification*

L17 **Humidify** ***set point*** **in** ***Cooling*** **mode**
See *humidification*

L18 **Humidify** ***hysteresis***
See *humidification*

L19 **Dehumidify** ***set point***
See *Dehumidification*

L20 **Dehumidify** ***hysteresis***
See *Dehumidification*

L21 **Dehumidify shut-down temperature differential**
See *Dehumidification*

L22 **Number of active steps in** ***dehumidification***
See *Dehumidification*

L23 ***NIGHT*** **function activation time**
See *Night* purging

L24 ***NIGHT*** **function activation** ***set point***
See *Night* purging

L25 **ECO offset in** ***Heating*****/*****Cooling*** **mode**
If the EKF400 RT keyboard is used, the value is added to/subtracted from the *cooling*/*heating set point*. It is measured in °C

L26 **Minimum** ***damper*** **opening CO_2** ***set point***
See *Air Pollution*

9.1.11 Table of parameters

The following table summarizes all the ERT 400 *parameters*.

Table of set point parameters

SET POINT PARAMETERS				
Par.	Description	Min.	Max.	Unit of measurement
G01	*Cooling set point*	*H04*	*H03*	C
G02	*Heating set point*	*H02*	*H01*	C

Table of configuration parameters

CONFIGURATION *PARAMETERS**				
Par.	Description	Min.	Max.	Unit of measurement
H01	Maximum *Heating set point*	*G02*	*G01*	C
H02	Minimum *Heating set point*	-40.0	*G02*	C
H03	Maximum *cooling set point*	*G01*	90,0	C
H04	Minimum *cooling set point*	*G02*	*G01*	C
H05	Number of circuits on unit	0	2	Num
H06	Number of *compressors* per circuit	0	4	Num
H07	Number of capacity steps per circuit	0	3	Num
H08	Compressor start-up sequence	0	1	Flag
H09	Circuit balancing	0	1	Flag
H10	Presence of heat pump	0	1	Flag
H11	ST1 configuration	0	2	Num
H12	ST2 configuration	0	2	Num
H13	ST3 configuration	0	3	Num
H14	ST4 configuration	0	2	Num
H15	ST5 configuration	0	2	Num
H16	ST6 configuration	0	3	Num
H17	Pressure bottom scale value	0	350	KPa*10
H18	Polarity of ID1 ID2 ID3 ID4	0	15	Num
H19	Polarity of ID5 ID6 ID7 ID8	0	15	Num
H20	Polarity of ID9 ID10 ID11	0	15	Num
H21	Humidity top scale value	0	100	%
H22	Humidity bottom scale value	0	100	%
H23	Configuration of ID1	0	25	Num
H24	Configuration of ID2	0	25	Num
H25	Configuration of ID3	0	25	Num
H26	Configuration of ID4	0	25	Num
H27	Configuration of ID5	0	25	Num
H28	Configuration of ID6	0	25	Num
H29	Configuration of ID7	0	25	Num
H30	Configuration of ID8	0	25	Num
H31	Configuration of ID9	0	25	Num
H32	Configuration of ID10	0	25	Num
H33	Configuration of ID11	0	25	Num
H34	Differential pressure bottom scale value	0	255	Num
H35	Configuration of relay 2	0	16	Num
H36	Configuration of relay 3	0	16	Num
H37	Configuration of relay 4	0	16	Num
H38	Configuration of relay 5	0	16	Num
H39	Configuration of relay 6	0	16	Num
H40	Configuration of relay 7	0	16	Num
H41	Polarity RL2	0	1	Flag
H42	Polarity RL3	0	1	Flag
H43	Polarity RL4	0	1	Flag
H44	Polarity RL5	0	1	Flag
H45	Polarity of alarm relay	0	1	Flag
H46	Configuration of output fan 1	0	1	Flag
H47	Configuration of output fan 2	0	2	Flag
H48	Disabling *heating* mode	0	1	Flag
H49	Selection of operating mode	0	2	Num
H50	Activation of *dynamic set point*	0	1	Flag
H51	Offset in *Cooling* mode with *dynamic set point*	-50.0	80,0	C
H52	Offset in *Heating* mode with *dynamic set point*	-50.0	80,0	C
H53	Ext. temp. *set point* in *Cooling* mode with *dynamic set point*	-127	127	C
H54	Ext. temp. *set point* in *Heating* mode with *dynamic set point*	-127	127	C
H55	Ext. temp. delta in *Cooling* mode with *dynamic set point*	-50.0	80,0	C
H56	Ext. temp. delta in *Heating* mode with *dynamic set point*	-50.0	80,0	C
H57	Offset ST1	-12.7	12,7	C
H58	Offset ST2	-12.7	12,7	C
H59	Offset ST3	-127	127	C/10-Kpa*10
H60	Offset ST4	-12.7	12,7	C

H61	Offset ST5	-12.7	12,7	C
H62	Offset ST6	-127	127	C/10-Kpa*10
H63	Offset ST7	-12.7	12,7	C
H64	Offset ST8	-12.7	12,7	C
H65	0=50 Hz 1=60 Hz	0	1	Flag
H66	0= °C 1=°F	0	1	Flag
H67	Serial address of series	0	14	Num
H68	Serial address of device	0	14	Num
H69	User password	0	255	Num
H70	*Copy card* password	0	255	Num
H71	Keyboard present	0	1	Flag
H72	Holding time in *heating* or *cooling* mode	0	255	Minutes
H73	Polarity ST1 ST2 ST4 ST5	0	15	Num
H74	Configuration of ST1 if digital	0	24	Num
H75	Configuration of ST2 if digital	0	24	Num
H76	Configuration of ST4 if digital	0	24	Num
H77	Configuration of ST5 if digital	0	24	Num
H78	Activates *digital regulation*	0	1	Num
H79	Activates unbalanced circuits	0	1	Num
H80	Activates probe on remote keyboard	0	1	Num

* If one or more *parameters* in this category is changed, the controller must be turned off and on again after the change is made in order to operate correctly.

Table of Alarm Parameters

ALARM *PARAMETERS*				
Par.	Description	Min.	Max.	Unit of measurement
A01	Bypass time for low pressure pressure switch	0	255	Seconds
A02	Number of low pressure events per hour	0	255	Num
A03	Pressure switch bypass from fan start	0	255	Seconds
A04	Input activation time with active pressure switch	0	255	Seconds
A05	Input activation time with pressure switch not active	0	255	Seconds
A06	*Number of events per hour* for pressure switch	0	255	Num
A07	Compressor thermal switch by-pass activated by compressor	0	255	Seconds
A08	Number of events/hour of thermal switches of *compressors* 1 and 2	0	255	Num
A09	Number of fan thermal switch events per hour	0	255	Num
A10	Anti-frost alarm from ON-OFF bypass	0	255	Minutes
A11	Anti-freeze alarm activation *set point*	-127	127	C
A12	Anti-freeze alarm *hysteresis*	0	25,5	C
A13	*Number of events per hour* for anti-freeze alarm	0	255	Num
A14	Anti-freeze alarm probe	0	3	Num
A15	Activation of fan shut-down with anti-freeze alarm	0	1	Flag
A16	Fan status with fire alarm	0	3	Num
A17	Over-temperature *set point*	0	255	C
A18	Duration in over-temperature	0	255	S*10
A19	Deactivation of *compressors* with high temperature	0	1	Flag
A20	Dirty *fan operating hours* threshold	0	999	hours*100
A21	Clogged *fan operating hours* threshold	0	999	hours*100
A22	Activate fan with clogged filter shut-down	0	1	Flag
A23	Fan activated filter differential pressure bypass	0	255	Seconds
A24	Shut-down fan differential pressure *set point*	0	255	Num
A25	Dirty fan differential pressure *set point*	0	255	Num
A26	Clogged fan differential pressure *set point*	0	255	Num
A27	Duration of differential pressure activated by dirty or clogged filter signal	0	255	Seconds
A28	Duration of differential pressure activated by shut-down fan signal	0	255	Seconds
A29	Maximum temperature of outlet air	-127	127	C
A30	Minimum temperature of outlet air	-127	127	C
A31	Outlet air regulation band	0	25,5	C
A32	Alarm relay status with remote ON/OFF	0	1	Flag

Table of Compressor Parameters

COMPRESSOR *PARAMETERS*				
Par.	Description	Min.	Max.	Unit of measurement
C01	Safety time for on/off	0	255	Seconds*10
C02	*Safety timing* between two subsequent starts	0	255	Seconds*10
C03	Compressor/Compressor start-up interval	0	255	Seconds
C04	Compressor/Compressor shutdown interval	0	255	Seconds
C05	Interval between capacity steps	0	255	Seconds

Table of Regulator Parameters

REGULATOR *PARAMETERS*				
Par.	Description	Min.	Max.	Unit of measurement
b01	Regulation band for *compressors* in *cooling* mode	0	25,5	C
b02	Regulation band for *compressors* in *heating* mode	0	25,5	C
b03	Regulation band for *integrated electric heaters*	0	25,5	C
b04	Regulation delta for *integrated electric heaters* with heat pump active	0	25,5	C
b05	Regulation delta for *integrated electric heaters* with heat pump not active	0	25,5	C
b06	Regulation band for integrated *hot water coil*	0	25,5	C
b07	Regulation delta *hot water coil* with heat pump activated	0	25,5	C
b08	Regulation delta *hot water coil* with heat pump not activated	0	25,5	C

Table of Fan Parameters

FAN *PARAMETERS*				
Par.	Description	Min.	Max.	Unit of measurement
F01	Fan output mode	0	2	Num
F02	Fan *pick-up* time	0	255	Seconds/10
F03	Fan *phase shift*	0	100	microseconds * 200
F04	Duration of triac activation impulse	0	255	uS*100
F05	Operation on compressor request	0	1	Flag
F06	Minimum speed in *Cooling* mode	0	100	%
F07	Maximum silent speed in *Cooling* mode	0	100	%
F08	Set minimum temperature/pressure of fan speed in *Cooling* mode	-500	800	C/10-Kpa*10
F09	Proportional band in *Cooling* mode	0	255	C/10-Kpa*10
F10	Delta cut-off	0	255	C/10-Kpa*10
F11	*Hysteresis* cut-off .	0	255	C/10-Kpa*10
F12	Cut-off bypass time	0	255	Seconds
F13	Max speed in *Cooling* mode	0	100	%
F14	Maximum temperature/pressure of fan speed *set point* in *Cooling* mode	-500	800	C/10-Kpa*10
F15	Minimum speed in *Heating* mode	0	100	%
F16	Maximum silent speed in *Heating* mode	0	100	%
F17	Minimum temperature/pressure *set point* of fan speed in *Heating* mode	-500	800	C/10-Kpa*10
F18	Proportional band in *Heating* mode	0	255	C/10-Kpa*10
F19	Maximum speed in *Heating* mode	0	100	%
F20	Maximum temperature/pressure *set point* of fan speed in *Heating* mode	-500	800	C/10-Kpa*10
F21	Pre-ventilation in *Cooling* mode	0	255	Seconds
F22	Separate or single ventilation	0	1	Flag
F23	Fan activation temperature/pressure *set point* in *Defrosting* mode	-500	800	C/10-Kpa*10
F24	Fan activation *hysteresis* in *Defrosting* mode	0	255	C/10-Kpa*10

Table of Pump / Evaporator Fan Parameters

PUMP / *EVAPORATOR FAN PARAMETERS*				
Par.	Description	Min.	Max.	Unit of measurement
P01	Hot water pump ON fan ON delay	0	255	Seconds*10
P02	*Fan ON compressors ON delay*	0	255	Seconds
P03	Unit OFF fan OFF delay	0	255	Seconds
P04	Activation of fan shut-down in *Defrosting* mode	0	1	Flag

Table of Electric Heaters/Hot H_2O Coil Parameters

ELECTRIC HEATERS/*HOT WATER COIL PARAMETERS*				
Par.	Description	Min.	Max.	Unit of measurement
r01	Configuration of *electric heaters in Defrosting mode*	0	1	Flag
r02	Configuration of anti-freeze electric heaters activated in *Cooling* mode	0	1	Flag
r03	Configuration of electric heaters activated in *Heating* mode	0	1	Flag
r04	Configuration of *control probe* for antifreeze electric heaters	0	3	Num
r05	Number of electric heaters present	0	4	Num
r06	Configuration of electric heaters in OFF and *Stand-by* mode	0	1	Flag
r07	Electric heaters/*hot water coil set point* in *Heating* mode	Pr09	Pr10	C
r08	Electric heaters/*hot water coil set point* in *cooling*/off mode	Pr09	Pr10	C
r09	Max. electric heater *set point*	Pr10	127	C
r10	Min. electric heater *set point*	-127	Pr09	C
r11	Anti-freeze electric heater *hysteresis*	0	25,5	C
r12	Activation of *heat pump shut-down*	0	1	Flag

r13	*Heat pump shut-down set point*	-127	127	C
r14	*Heat pump shut-down hysteresis*	0	25,5	C
r15	Enable *integrated electric heaters* in *heating* mode	0	1	Flag
r16	Activate electric heaters/H_2O valve in *dehumidification*	0	1	Flag
r17	Hot water pump deactivation *hysteresis*	0	25,5	C
r18	Minimum activation time of hot water pump	0	255	Seconds*10
r19	Activate *hot water coil* in anti-freeze mode	0	1	Flag

Table of Defrosting Parameters

DEFROSTING PARAMETERS				
Par.	Description	Min.	Max.	Unit of measurement
d01	Activation of *defrosting*	0	1	Flag
d02	*Start of defrosting* temperature/pressure	-500	800	C/10-Kpa*10
d03	*Defrosting* interval	0	255	Minutes
d04	*End of defrosting* temperature/pressure	-500	800	C/10-Kpa*10
d05	Maximum *defrosting* time	0	255	Minutes
d06	Compressor-valve waiting time at *start of defrosting*	0	255	Seconds
d07	Valve-compressor waiting time at *start of defrosting*	0	255	Seconds
d08	Compressor-valve waiting time at *start of defrosting*	0	255	Seconds
d09	Valve-compressor waiting time at *start of defrosting*	0	255	Seconds
d10	Activation of fan at *end of Defrosting*	0	1	Flag
d11	Delay between circuit *defrosting*	0	255	Minutes
d12	Probe for *end of defrosting* circuit 1	0	2	Num
d13	Probe for *end of defrosting* circuit 2	0	2	Num
d14	Delayed start of *compressors* in *defrosting* mode	0	255	Seconds

Table of Expansion Module Parameters

EXPANSION MODULE *PARAMETERS*				
Par.	Description	Min.	Max.	Unit of measurement
N01	Polarity of ID12 ID13 ID14 ID15	0	15	Num
N02	Configuration of ID12	0	24	Num
N03	Configuration of ID13	0	24	Num
N04	Configuration of ID14	0	24	Num
N05	Configuration of ID15	0	24	Num
N06	Configuration of relay 9	0	15	Num
N07	Configuration of relay 10	0	15	Num
N08	Configuration of relay 11	0	15	Num
N09	Configuration of relay 12	0	15	Num
N10	Configuration of relay 13	0	15	Num
N11	Configuration of ST7	0	2	Num
N12	Configuration of ST8	0	3	Num
N13	Polarity of ST7 ST8	0	3	Num
N14	Configuration of ST7 if digital	0	24	Num
N15	Configuration of ST8 if digital	0	24	Num

Table of Freecooling / humidity parameters

FREECOOLING*/HUMIDITY *PARAMETERS				
Par.	Description	Min.	Max.	Unit of measurement
L01	Enable free-*cooling*	0	1	Flag
L02	*Freecooling* offset in *Cooling* mode	0	25,5	C
L03	*Freecooling*/*Freeheating* band in *Cooling* mode	0	25,5	C
L04	*Freecooling* offset in *Heating* mode	0	25,5	C
L05	*Freecooling*/*Freeheating* band in *Heating* mode	0	25,5	C
L06	*Freecooling*/*freeheating* activation delta	0	25,5	C
L07	Minimum *damper* opening	0	100	%
L08	*Freecooling* shut-down *set point*	-127	127	C
L09	*Freecooling* shut-down delta	0	25,5	C
L10	Enthalpic *freecooling*/*freeheating set point* in *Cooling* mode	0	255	KJ/Kg
L11	Enthalpic *freecooling*/*freeheating* band in *Cooling* mode	0	255	KJ/Kg
L12	Enthalpic *freecooling*/*freeheating set point* in *Heating* mode	0	255	KJ/Kg
L13	Enthalpic *freecooling*/*freeheating* band in *Heating* mode	0	255	KJ/Kg
L14	*Freecooling*/*freeheating* activation delta in *enthalpy*	0	255	KJ/Kg
L15	External humidity simulation	0	100	%
L16	Humidify *set point* in *heating* mode	0	100	%
L17	Humidify *set point* in *Cooling* mode	0	100	%
L18	Humidify *hysteresis*	0	100	%
L19	Dehumidify *set point*	0	100	%
L20	Dehumidify *hysteresis*	0	100	%
L21	Dehumidify shut-down temperature differential	0	25,5	C
L22	Number of active steps in *dehumidification*	0	4	Num
L23	*NIGHT* function activation time	0	255	Min*10
L24	*NIGHT* function activation *set point*	-127	127	°C
L25	ECO offset in *Heating*/*Cooling* mode	-12,7	12,7	°C

L26	Minimum *damper* opening CO_2 *set point*	0	100	%

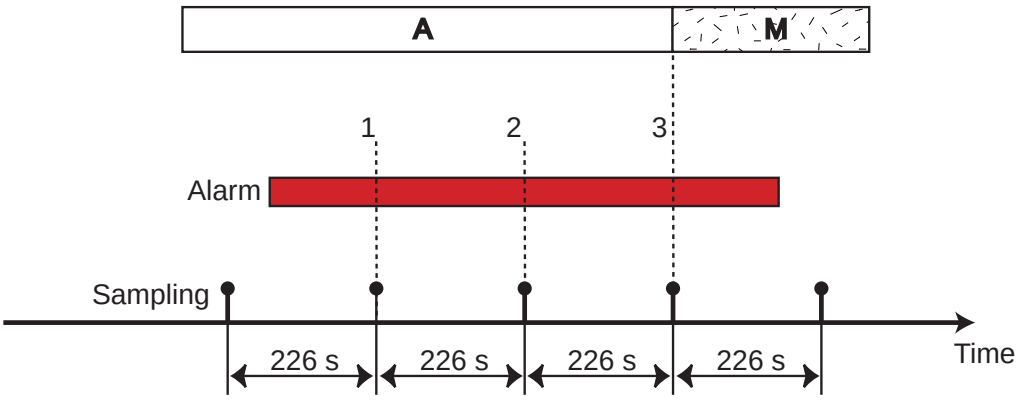
10 DIAGNOSTICS

Alarms

ERT 400 can perform a complete self-*diagnostics* of the system by reporting a series of *alarms*.
Alarms can be activated and *reset* using *parameters A01 - A32*.
Some *alarms* can be de-activated for a preset interval of time configured with the relative parameter.

Number of events per hour

The unit is also able to count the actual events for specific *alarms*: if the number of *alarms* over the last hour exceeds the threshold set for the parameter, the alarm switches from automatic to *manual reset* mode.
Alarms are sampled every 226 seconds.
Example: if the number of events is set to 3, the duration of the alarm must be set on a value ranging from 2*226 seconds to 3*226 seconds to allow switching from automatic to *manual reset*.



A: automatic *reset*	M: *manual reset*
Alarm: alarm	Sampling: sampling
Time: time	

Alarms occurring several times within the set sampling period (226 seconds) will be counted once only.

To *reset alarms* configured for *manual reset*, press and release key ON-OFF.

A *manual reset* shuts down corresponding *loads*, thus prompting the operator to take the necessary corrective action (*reset* the alarm using the ON-OFF control).
This type of manually *reset* alarm is used to signal potential problems that could damage the system.

10.1 List of alarms

The activation of an alarm have two effects:
· It stops the *loads* involved
· It is displayed on the keyboard

The signal consists of an "Enn" code (where nn stands for a two digit number that identifies the type of alarm; i.e. E00, E25, E39....).
The following table lists all possible *alarms* with their codes and block of *loads*.
---> X indicates load(s) OFF

CODE	TYPE	DESCRIPTION	Single COMP.	Comp/ circuit	All COMP.	Cond. fan/circuit	All cond. fan	Internal fan	Elect. heater 1-2	Elect. heater 3-4	humid.	Valve + H_2O pump	Damp.	By pass	*Reset*
E00	Remote Off	activated by digital input configured as “remote off” RL ALL activated if *A32*=1 Apex A – anti-freeze load is handled if enabled with *r06*			X		X	X[A]	X[A]	X[A]	X	X	X		Automatic
E01	HIGH pressure circ 1	activated by digital input configured as “High pressure circuit...”		X (1)											Manual
E02	LOW pressure circ. 1	activated by digital input configured as “Low pressure circuit...” Apex F – only if *F22*=0		X (1)		X[F]								Not activated for *A01* with compressor start up or valve reversing, circuit related	automatic *reset* up to number of events/hour *A02*
E03	Thermal switch compressor 1	activated by digital input configured as “Thermal switch...”	X											Not activated for *A07* with compressor start up	automatic *reset* up to number of events/hour equal to *A08*
E04	Thermal switch (condensation) circ. 1	activated by digital input configured as “Thermal switch of fan circuit...” Apex G – only if *F22*=1		X (1)	X[G]	X	X[G]	X							automatic *reset* up to number of events/hour *A09*

CODE	TYPE	DESCRIPTION	Single COMP.	Comp/ circuit	All COMP.	Cond. fan/circuit	All cond. fan	Internal fan	Elect. heater 1-2	Elect. heater 3-4	humid.	Valve + H_2O pump	Damp.	By pass	*Reset*
E05	Anti-freeze	enabled with relative input with *A14* activated if input value < *A11 hysteresis A12* shutdown of *condensation fan*s and *compressors* on unit Apex H – only if *A15*=1			X		X	X [H]	X [H]	X [H]	X [H]		X [H]	not active for *A10* from activation of heat mode only starting with *stand-by* or remote off	automatic *reset* up to number of events/hour equal to *A13* for *manual reset*: *reset* is also possible for *change over*, remote off
E06	Failure of probe AI2	activated if input... configured as analogue has short circuited, tripped or is out of *range*			X		X	X	X	X	X	?	X		
E07	Failure of probe AI3	activated if input... configured as analogue has short circuited, tripped or is out of *range*			X		X	X					X		
E13	Thermal switch compressor 2	activated by digital input configured as “Thermal switch...”	X											Not activated for *A07* with compressor start up.	automatic *reset* up to number of events/hour equal to *A08*
E21	HIGH pressure circ 2	activated by digital input configured as “High pressure circuit...”		X (2)											Manual
E22	LOW pressure circ.2	activated by digital input configured as “Low pressure circuit...” automatic *reset* up to number of events/hour *A02* Apex F – only if *F22* = 0		X (2)		X [F]								Not activated for *A01* with compressor start up or valve reversing, circuit related	

CODE	TYPE	DESCRIPTION	Single COMP.	Comp/ circuit	All COMP.	Cond. fan/circuit	All cond. fan	Internal fan	Elect. heater 1-2	Elect. heater 3-4	humid.	Valve + H_2O pump	Damp.	By pass	*Reset*
E23	Thermal switch compressor 3	activated by digital input configured as "Thermal switch..."	X											Not activated for *A07* with compressor start up.	automatic *reset* up to number of events/hour equal to *A08*
E24	Thermal switch (condensation) circ. 2	activated by digital input configured as "Thermal switch of fan circuit..." Apex G – only if *F22* = 1		X (2)	X [G]	X	X [G]								automatic *reset* up to number of events/hour *A09*
E26	Failure of probe AI5	activated if input... configured as analogue has short circuited, tripped or is out of *range*			X		X	X	X	X	X	X	X		
E27	Failure of probe AI6	activated if input... configured as analogue has short circuited, tripped or is out of *range*			X		X	X							
E33	Thermal switch compressor 4	activated by digital input configured as "Thermal switch..."	X											Not activated for *A07* with compressor start up.	automatic *reset* up to number of events/hour equal to *A08*
E40	Failure of probe AI1	activated if input... configured as analogue has short circuited, tripped or is out of *range*			X		X	X	X	X	X	X	X		

CODE	TYPE	DESCRIPTION	Single COMP.	Comp/ circuit	All COMP.	Cond. fan/circuit	All cond. fan	Internal fan	Elect. heater 1-2	Elect. heater 3-4	humid.	Valve + H_2O pump	Damp.	By pass	*Reset*
E41	Differential pressure switch/thermal switch	activated by digital input configured as "INTERNAL FAN PROTECTION LOW CRITICALITY" activated after period in alarm state for *A04* shutdown after period in normal state for *A05* Apex J – if *A06* = 20 signal only			X[J]		X[J]	X[J]	X[J]	X[J]	X[J]	X[J]	X[J]	Not active for *A03* from activation of internal fan	automatic *reset* up to number of events/hour equal to *A06*
E42	Failure of probe AI4	activated if input configured as analogue has short circuited, tripped or is out of *range*			X		X	X	X	X	X	X	X		
E43	*Evaporator fan* thermal switch INTERNAL FAN PROTECTION HIGH CRITICALITY	using digital input configured as "INTERNAL FAN PROTECTION HIGH CRITICALITY" immediate activation			X				X	X	X	X			Manual
E45	Configuration	active if at least one of the following conditions occurs: - configuration of number of *compressors* / capacity steps > 4 - keyboard declared present (*H71*=1) but there is no communication between keyboard and base unit.			X		X	X	X	X	X	X	X		

CODE	TYPE	DESCRIPTION	Single COMP.	Comp/ circuit	All COMP.	Cond. fan/circuit	All cond. fan	Internal fan	Elect. heater 1-2	Elect. heater 3-4	humid.	Valve + H_2O pump	Damp.	By pass	*Reset*
E46	High temperature	active if probe value AI1 > *A17* for time *A18* in *cooling* mode *hysteresis A12* Apex K – if *A19* = 1			X[K]		X		X	X		X			Automatic
E48	AI7 probe fault	activated if input configured as analogue has short circuited, tripped or is out of *range*													
E49	Failure of probe AI8	activated if input configured as analogue has short circuited, tripped or is out of *range*													
E62	Dirty filters	signal only enabled if AI5 configured (*H15*=2) activated if value AI5> *A25* and <*A26*, for time equal to *A27* also activated by number of internal *fan operating hours* equal to *A20*												not activated if internal fan is off and for *A23* from activation of fan	Manual

CODE	TYPE	DESCRIPTION	Single COMP.	Comp/ circuit	All COMP.	Cond. fan/circuit	All cond. fan	Internal fan	Elect. heater 1-2	Elect. heater 3-4	humid.	Valve + H_2O pump	Damp.	By pass	*Reset*
E61	Clogged filters	enabled if AI5 configured (*H15*=2) active if value AI5> *A26*, for time equal to *A27* also activated by number of internal *fan operating hours* equal to *A21* Apex L – if *A22* = 1, if not, signal only			X L		X L	X L	X L	X L	X L	X L	X L	not activated if internal fan is off and for *A23* from activation of fan	Manual
E60	*Evaporator fan* shut down	enabled if AI5 configured (*H15*=2) active if value AI5< *A24*, for time equal to *A28*			X		X	X	X	X	X	X	X	not activated if internal fan is off and for *A23* from activation of fan	Manual
E63	Thermal switch of electric heaters 1-2	Activated by digital input configured as “thermal switch of electric heaters...” immediate activation							X						Manual
E64	Thermal switch of electric heaters 3-4	Activated by digital input configured as “thermal switch of electric heaters...” immediate activation								X					Manual
E65	Humidifier	Activated by digital input configured as “humidifier protection”									X				Automatic

CODE	TYPE	DESCRIPTION	Single COMP.	Comp/ circuit	All COMP.	Cond. fan/circuit	All cond. fan	Internal fan	Elect. heater 1-2	Elect. heater 3-4	humid.	Valve + H_2O pump	Damp.	By pass	*Reset*
E66	Smoke	enabled if digital input configured as "Fire/smoke alarm" or if AI8 configured for determination of CO_2 (*N12*=2) – threshold? Apex M – *evaporator fan* and *damper* are subject to *A16*			X		X	X^M	X	X	X	X	X^M		Automatic

Note 1: the outputs defined as capacity steps are in x if the compressor that they belong to is in alarm mode.

Note 2: alarm E41 is useful when any digital state needs to be displayed without blocking other *loads*

Alarm Table

Please note that the outputs defined as capacity steps are off if the compressor that they belong to is in alarm mode.

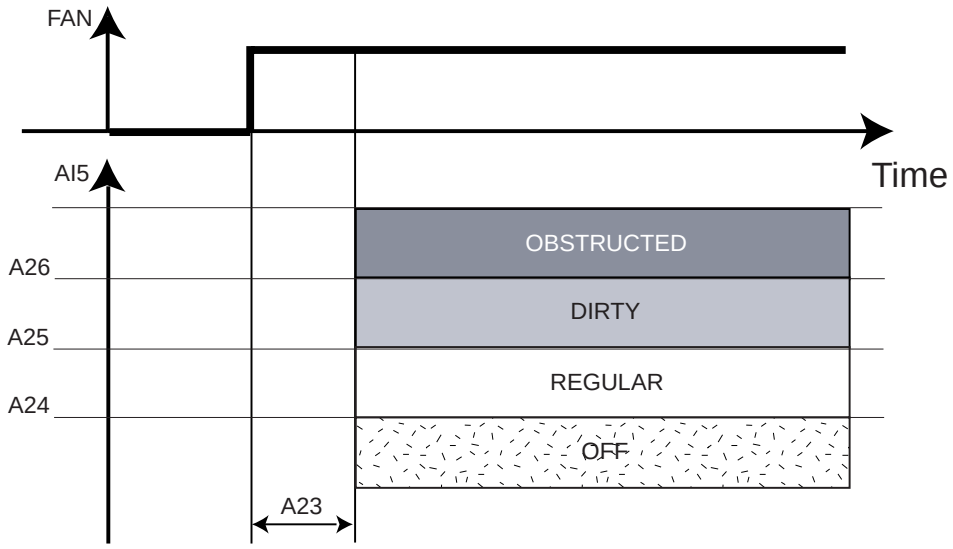
- If it belongs to circuit 1 **(1)**
- If it belongs to circuit 2 **(2)**

- Only if *A15* = 1 **(Apex H)**
- If *A06* is not 20 otherwise, signal only **(Apex J)**
- f *A19* = 1 otherwise, signal only **(Apex K)**
- f *A22* = 1 otherwise, signal only **(Apex L)**
- f *r06* = 0 otherwise ON in anti-freeze mode **(Apex A)**
- If separate condensation *F22*=0 **(Apex F)**
- If single condensation *F22*=1 **(Apex G)**
- If *A16*=0 or *A16*=3 **(Apex M)**
- If *A16*=0 or *A16*=1 **(Apex N)**

(*)
If input AI5 is declared present (*H15*=1) the *alarms* related to the differential pressure of the filter are activated. There are three types of signalling:

- Clogged filters
- Dirty filters
- Fan shutdown

None of these *alarms* is active if the fan is deactivated (unit OFF) and reading of the input is bypassed for a period of time equal to *A23* from activation of the fan.
See the diagram below:



FAN: *Evaporator fan*	OBSTRUCTED: Clogged filter
AI5: probe AI5 (*analogue inputs*)	DIRTY: Dirty filter
Time: time	REGULAR: Correct operating
	OFF: Fan shut-down

Fan Operating Hours

If the number of operating hours of the fan reaches the parameter *A20* a dirty filter alarm is generated. *A20* must be greater than 0 for the alarm to be activated.
If the number of operating hours reaches the parameter *A21* a clogged filter alarm is generated.
A21 must be greater than 0 for the alarm to be activated.
By setting *A22*= 1, the clogged filters alarm blocks all the unit *loads*.

10.2 Table of digital alarms

Alarm Name	Bypass activation event	Bypass time	Activation time	Deactivation time	*Number of events per hour*
High pressure alarm, circuit	None	Not present	Not present	Not present	*Manual reset*
Low pressure alarm	Enabling of one compressor on the circuit or reversal of 4-way valve	*A01*	Not present	Not present	*A02*
Pressure switch/*evaporator fan* thermal switch alarm	Fan activated	*A03*	*A04*	*A05*	*A06*
Evaporator fan thermal switch	None	Not present	Not present	Not present	*Manual reset*
Thermal switch of *compressors* 1,2,3,4	Start up of one of the *compressors*	*A07*	Not present	Not present	*A08*
Thermal switch of fan 1,2	None	Not present	Not present	Not present	*A09*
Electric heaters 1-2	None	Not present	Not present	Not present	*Manual reset*
Electric heaters 3-4	None	Not present	Not present	Not present	*Manual reset*
Humidifier	None	Not present	Not present	Not present	automatic
Smoke	None	Not present	Not present	Not present	Automatic *reset*

10.3 Table of analogue alarms

Alarm Name	Event	Bypass time	Activation *SET POINT*	Duration	*Hysteresis*	*Number of events per hour*	*Control probe*
Anti-freeze alarm	On Off, input in *Heating* mode, remote on off	*A10*	*A11*	N/A	*A12* positive	*A13*	If *A14* = 0 alarm not active If *A14* = 1 probe AI1 If *A14* = 2 probe AI2 If *A14* = 3 probe AI4
High temperature alarm on regulation system	None	Not present	*A17*	*A18*	*A12* negative	Automatic *reset*	AI1
Dirty filters	Fan activated	*A23*	*A25*	*A27*	N/A	*Manual reset*	AI5
Clogged filters	Fan activated	*A23*	*A26*	*A27*	N/A	*Manual reset*	AI5
Fan shut down	Fan activated	*A23*	*A24*	*A28*	N/A	*Manual reset*	AI5

11 TECHNICAL FEATURES

11.1 Technical data

	Typical	Min.	Max.
Supply voltage	12V~	10.8V~	13.2V~
Supply frequency	50Hz/60Hz	---	---
Power	11VA	---	---
Insulation class	1	---	---
Degree of protection	Front IP0	---	---
Operating ambient temperature	25°C	-10°C	60°C
Operating ambient humidity (non condensing)	30%	10%	90%
Ambient storage temperature	25°C	-20°C	85°C
Ambient storage humidity (non condensing)	30%	10%	90%

11.2 Electromechanical data

110/230 V digital outputs	8 relays 5 A, resistive; ¼ hp 230V~; 1/8 hp 125V~ **The total current on the relays should not exceed 10°** 2 relays 5 A, resistive; ¼ hp 230V~; 1/8 hp 125V~ normally open (exp. type 1) 2 relays 5A resistive normally open. Shared. (exp. type 2) 3 change-over relays 8 A resistive (exp. type 2)
Analogue outputs	2 energizing triac or 4-20 mA configurable outputs 1 0-10Vdc output 2 12Vdc power supplies min. current 46 mA (exp. type 2) 2 5 Vdc power supplies min. current 10mA (exp. type 2)
Analogue inputs	n° 4 NTC R_{25} 10KΩ, reading *range* –30°C ÷ 90°C 2 configurable inputs 4-20mA / NTC R_{25} 10KΩ, reading *range* –30°C ÷ 90°C 2 4-20mA or NTC R_{25} 10KΩ hardware configurable inputs (jumpers) (exp. type 2).
Digital inputs	11 voltage free *digital inputs* 4 voltage free *digital inputs* (expansion modules)
Terminals and connectors	1 10-way connector, high voltage, step 7.5 2 16-way snap-on connectors, low voltage, step 4,2, AWG 16-28 1 5-way connector, step 2,5, remote control and *copy card*, AWG 24-30 1 20-way connector for expansion connection 1 3-way screw terminal for remote keyboard 1 5-way connector, *digital inputs*, step 5 (exp. type 1) 1 4-way connector, step 7.5, relay output (exp. type 1) 1 20-way connector with base unit (exp. type 1) 1 12-way connector, high voltage, pitch 5 (exp. type 2) 1 flat cable welded to 20-way PCB for connection to base unit (exp. type 2) 1 13-way screw terminal for low voltage contacts (exp. type 2)
Serial connections	1 serial connection 9600 1 serial connection 2400 (*remote keyboard output*)

Transformer

The unit must be powered by an adequate *transformer* with the following characteristics:

- Primary voltage: 230V~±10%; 110V~±10%
- Secondary voltage: 12V~
- Supply frequency: 50Hz; 60Hz
- Power: 11VA

11.3 Standards

The unit complies with the following European Union Directives:
EU Directive 73/23/EEC and subsequent amendments
EU Directive 89/336/EEC and subsequent amendments

and is compliant with the following harmonized *standards*
LOW VOLTAGE: EN60335, where applicable
EMISSIONS: EN50081-1 (EN55022)
IMMUNITY: EN50082-1 (IEC 1000-4-2/3/4/5)

12 USE OF THE DEVICE

12.1 Permitted use

This product is used to control roof top controllers.

To ensure safety, the controller must be installed and operated in accordance with the instructions supplied, and access to high voltage components must be prevented under regular operating conditions. The device shall be properly protected against water and dust and shall be accessible by using a tool only. The device is suitable for incorporation in a household appliance and/or similar air conditioning device.
According to the reference regulations, it is classified:

- In terms of construction, as an automatic electronic control device to be incorporated with independent assembly or integrated;
- In terms of automatic operating features, as a type 1 action control device, with reference to manufacturing tolerances and drifts;
- As a class 2 device in relation to protection against electrical shock;
- As a class A device in relation to software structure and class.

12.2 Forbidden use

Any use other than the *permitted use* is forbidden.
Please note that relay contacts supplied are functional and are subject to fault (in that they are controlled by an electronic component and be shorted or remain open); protection devices recommended by product *standards* or suggested by common sense in response to evident safety requirements shall be implemented outside of the instrument.

13 RESPONSIBILITY AND RESIDUAL RISKS

Eliwell & Controlli srl shall not be held liable for any damage incurred as a result of:
installation/use other than those intended, and, in particular, failure to comply with the safety instructions specified by applicable regulations and/or provided in this document;
use with equipment which does not provide adequate protection against electric shocks, water and dust under the effective conditions of *installation*;
use with equipment which permits access to hazardous parts without the use of tools;
installation/use with equipment which does not comply with current regulations and legislation.

14 DISCLAIMER

This manual and its contents remain the sole property of **Eliwell & Controlli s.r.l.** and shall not be reproduced or distributed without authorization. Although great care has been exercised in the preparation of this document, **Eliwell & Controlli s.r.l.**, its employees or its vendors, cannot accept any liability whatsoever connected with its use**Eliwell & Controlli s.r.l.** reserves the right to make any changes or improvements without prior notice.

15 GLOSSARY

Logical OR

Several inputs that are linked in an OR relation is equivalent to a single input with the following status:
- active if at least one input is active;
- inactive if no input is active.

Scroll up

Scrolling up a menu means viewing all the *parameters* from the bottom to the top (08 -> 09 -> 10 ....).

Stand-by

Means that the unit is in waiting mode and that all the *functions* are temporarily interrupted.

Reset

Means to restore to zero.

Resetting

Resetting an alarm means correcting the error condition and re-activating the alarm so that it can emit new signals.

Manual reset

A manually resettable alarm can only be *reset* using the keyboard.

Scroll down

Scrolling down a menu means viewing all the *parameters* from top to bottom (10 -> 09 -> 08 ....).

BLINK

This term generally refers to LEDs.

Average hours

The average is calculated as the ratio between the total hours of *compressors* available and the number of *compressors* on the circuit.

Loads

These identify the various devices in a plant such as *compressors*, fans, hydraulic pump and anti-freeze electric heaters.

Set Point

This represents the reference value (that can be set by the user) that defines the operating status of the plant. A typical example is the thermostat that regulates the temperature in our homes: to maintain a temperature of 20 °C, we must set a *set point* of 20°C (the *heating* system will start if the ambient temperature measured is below 20°C and will be turned off otherwise.

Range

This represents a set of values; i.e. *Range* 1...100 includes all the values between 1 and 100.

Hysteresis

Hysteresis is generally defined in connection with a *set point* to avoid frequent oscillations in the status of the controlled load.
Example: let's define a *set point* of 20 °C on a probe that detects ambient temperature so that the compressor starts every time the limit value is exceeded.
When ambient temperature reaches values that are close to the *set point* (20 °C), a phase of instability occurs during which the relay, which starts the compressor, frequently changes its status from ON to OFF. This condition can severely damage system operating.
To prevent this problem, *hysteresis* is defined as a tolerance *range* in which no status change occurs; in our specific case, if *hysteresis* of 1 °C is set, the compressor starts at 21 °C (*set point* + *hysteresis*) and stops at 19 °C (*set point* - *hysteresis*).

Non volatile memory

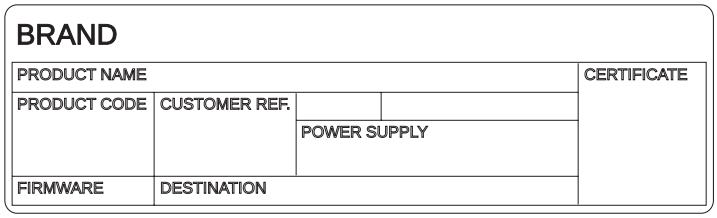
This memory stores the data even when the unit is turned off (as opposed to a volatile memory that deletes the data as soon as the unit is turned off).

Change over

This term indicates the switching of an operating mode (example: from *Cooling* to *Heating* mode).

Label

The *label* found on the inside of the device is illustrated below:



It contains the following information:

- BRAND : brand of the manufacturer
- PRODUCT NAME : name of the product
- PRODUCT CODE : product ID
- CUSTOMER REF. : customer code
- POWER SUPPLY : power supply of the device
- FIRMWARE : software version
- DESTINATION : where device will be used
- CERTIFICATE : product certification

Enthalpy

Enthalpy is a thermodynamic property that takes into account both the temperature and the humidity of the air. In simpler terms, if is like heat that is subtracted from or added to air to go from one humidity or temperature value to another.
Enthalpy is calculated using special tables or hygrometric formulas.
The first of these can be used to calculate the saturation pressure of steam and is called Liley's equation.

Pg = exp(14.43509-5333.3/T)

Where T is absolute temperature
From the definition of relative humidity we have:

Pv=RH*Pg

Where Pv is the steam pressure and RH relative humidity
The specific humidity is given by the formula

$\omega = 0.622*Pv/(P-Pv)$

where P is atmospheric pressure

The *enthalpy* is given by the formula

$h=1.005*t+ \omega*(2500+1.86*t)$ KJ/Kg

where t is expressed in degrees Celsius.
Using the previous formula as a starting point, *enthalpy* can be roughly calculated without resorting to floating point arithmetic .
Liley's formula is calculated at between 15°C and 40°C with second order polynomial interpolation to give:

Pg= 0.005756*t^2-0.08636*t+1.7017

16 COMPONENTS AND ACCESSORIES (APPENDIX)

16.1 Accessories

Name	Code		Description
MODULE CF-05	**MW991000**		**Open board (assembly on back of board) for control of fan speed by phase cutting.** **Characteristics of this model:** • **power 500W; maximum current 10A** • **Faston connectors**
MODULE CF-15	**MW991100**		**Open board (assembly on back of board) for control of fan speed by phase cutting.** **Characteristics of this model:** • **power 1500W; maximum current 8A** • **Faston connectors**
MODULE CF-22	**MW991200**		**Open board (assembly on back of board) for control of fan speed by phase cutting.** **Characteristics of this model:** • **power 2200W; maximum current 10A** • **Faston connectors**
MODULE CF-REL	**MW991300**		**Open board to switch *condensation fans* ON/OFF** **Characteristics of this model:** • **maximum current 6A** • **Faston connectors**
PCInterface 2150	**PCI5A3000000**		**RS232-RS485/TTl converter with 12V~ auxiliary output**
TRANSFORMER	**TF411210**		*Transformer* **230V~/12A 5,6VA**
COPY CARD	**MW320500**		**Parameter programming key**
THREE-PHASE FAN REGULATOR			**L D 312 42 0T1 12A 420V~ Triac (PWM) S00 Box: IP55** **L D 320 42 0T1 20A 420V~ Triac (PWM) S00 Box: IP55** **L D 312 42 0T1 12A 420V~ Triac (PWM) G00 Box: IP22** **L D 320 42 0T1 20A 420V~ Triac (PWM) G00 Box: IP22**
WIRING (*)	**COLV0100**		**Wiring (connector + 1m long cables) for connection of low voltage inputs and outputs.**
EMC FILTER **(**)**	**FT111201**		**LC mains filter.**
PROBE	**SN691150**		**Temperature probe NTC 103AT 1.5 m Immersion probe.**
	SN8S0A1500		**Temperature probe NTC 6X40, 1.5 m SILICONE**
	SN8S0A3000		**Temperature probe NTC 6X40, 3 m SILICONE**
Cable RS 232	**1500128**		**Length 1.8 m (**)**
TTL cable	**1500180**		**Length 0.3 m (30 cm) (****)**
Param Manager	**SLP05MX000000**	**+**	**Software used to control unit from a PC**
	PCI5A3000000		**Param Manager + Interface module also called PCI**
FRONT PROTECTION(*****)	**PR111120**		**Rubber front sheath to guarantee a high degree of protection from external atmospheric agents.**
Bus Adapter 150	**BA10000R3700**		**Interface module for multipoint ModBus**
TD transducers			**Several models: see List of fan modules or contact the Sales Office**
Humidity *probes*	**SN52-0000**		**<EWHS300>**
	SN56-0000		**<EWHS280>**

16.1.1 Keyboards

There are 3 different types of keyboard:

EKW400-RT/S

Display	3 digits with sign 8 LEDs (including the decimal point)
Analogue inputs	1 ambient temperature NTC
Terminals	1 3-way screw connector
Keys	4 keys
Dimensions	122x80 mm
Mounting	Wall-mounted
Functions	Changing operating mode, setting *parameters*, displaying analogue and *digital inputs*; cannot be used to set *auto* and fan modes

EKP400-RT

Display	3 digits with sign 8 LEDs (including the decimal point)
Analogue inputs	None
Terminals	1 3-way screw connector
Keys	2 keys
Dimensions	34x76 mm
Mounting	Panel-mounted using special fixing hole
Functions	Changing operating mode, setting *parameters*, displaying analogue and *digital inputs*; cannot be used to set *auto* and fan modes

EKF400-RT

LEDs	3 LEDs
Analogue inputs	1 ambient temperature NTC 1 potentiometer for modifying *set point*
Digital inputs	2 clean contacts ECONOMY FAN MODE
Terminals	2 Screw connectors 4-way for *digital inputs* 3-way for communication with base unit
Buttons/switches	2 4-position slides 1 2-position slide knob for modifying *set point* +/-5°C
Dimensions	110x80 mm
Mounting	Wall-mounted
Functions	All *operating modes* can be set including *Auto*, Fan; Eco, *Night*, open *Damper functions* can also be activated

(*) No cable for version /V.
(**) *EMC filter* is used if the fan is to be modulated (i.e. by phase cutting)
(***) Other lengths available on request. It is advisable to use a 1.8 m long cable. The maximum length varies according to the data transmission speed.
(****) Other lengths available on request. It is advisable to use a 0.3 m long cable. Longer lengths may be used depending on the electromagnetic disturbance in the environment.
(*****) Front protection only applies to the EKP keyboard.

16.1.2 CF Modules

CF series units are optional modules that can be connected to main control modules in order to allow the fans to be adjusted with currents ranging from 2 A to 10 A.
These modules can be supplied as "open cards" and in several models:

- CF-REL for ordinary ON/OFF commands
- CF-05 for cutting phase commands up to maximum powers of 500 W
- CF-15 for cutting phase commands up to maximum powers of 1,500 W
- CF-22 for cutting phase commands up to maximum powers of 2,200 W

CF modules: technical specifications

Supply voltage: 230V~.
Type of current on load:

- CF-05: 500 W max.
- CF-15: 1500 W max.
- CF-22: 2200 W max.

Maximum absorption current:

- CF-05: 2.5 A max current at 230 V~
- CF-15: 8 A max current at 230 V~
- CF-22: 12 A max current at 230 V~

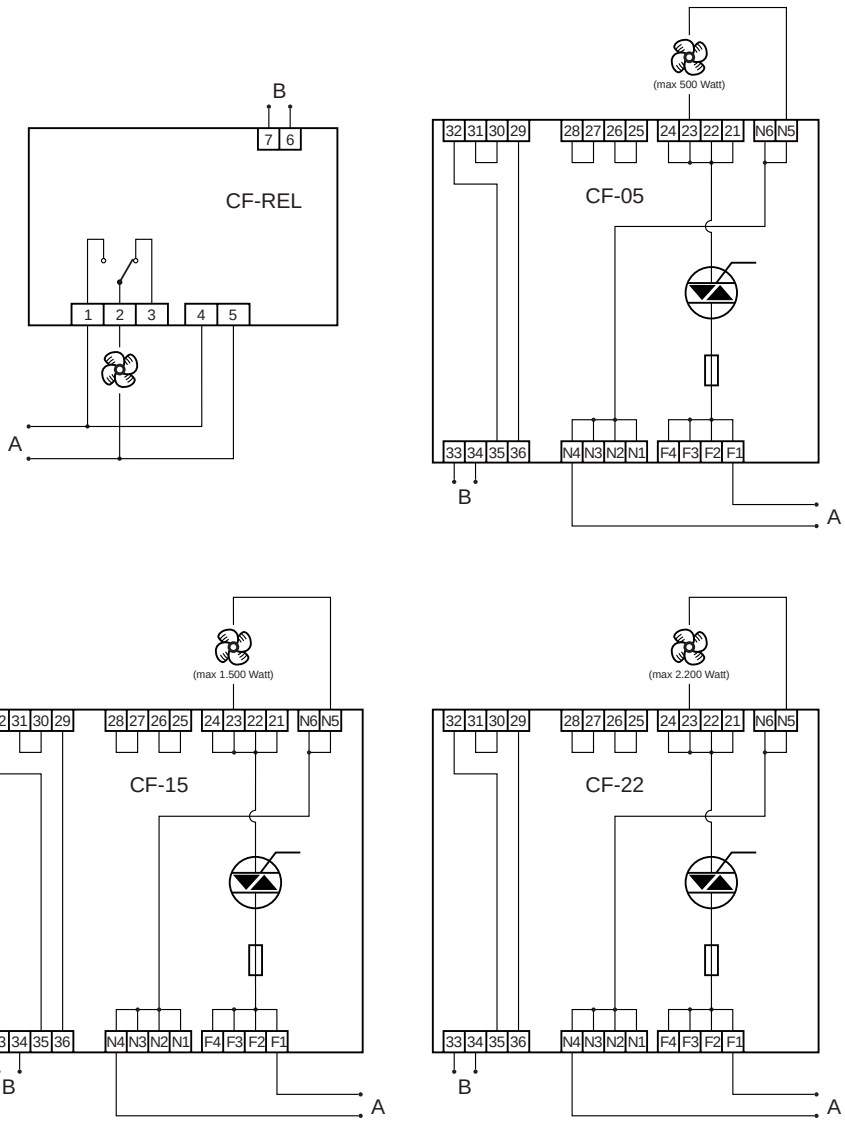
Values and types of fuses:

- CF-05: 5x20 2.5 A lagged
- CF-15: 5x20 8 A lagged
- CF-22: 5x20 12 A lagged

The ratings for the fuse refer to the maximum load (this is the fuse supplied as standard). This fuse has been specifically designed to protect the power components of the fan module. A fuse with a higher capacity should never be used. The value of the fuse must always be dimensioned in function of the fan and of the load being controlled (though the value must always be below the maximum one). If correctly dimensioned, the fuse also protects the load.

- Power employed: varying, depending on model (500W/1500W/2200W).
- Type of control signal: impulse modulation.
- Protection class: IP00 (open card).

CF modules: connections

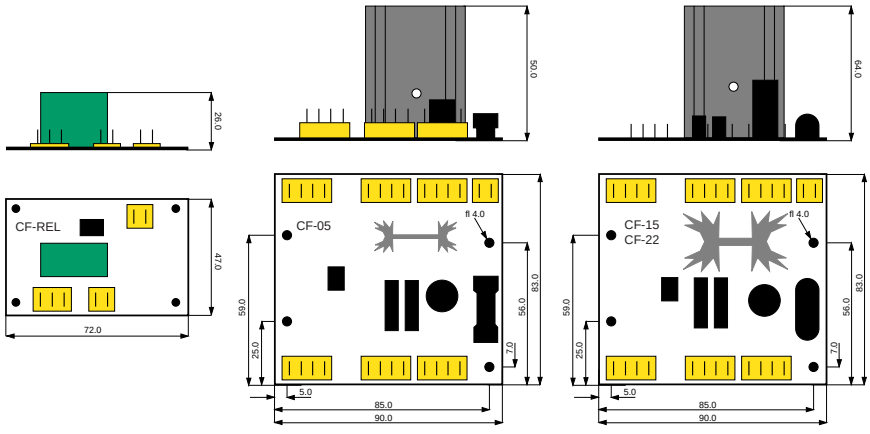


A: Power supply	B: Control signal

Perform all operations on the connections when the unit is OFF. All operations must be performed by qualified personnel only.

CF modules: mechanical assembly

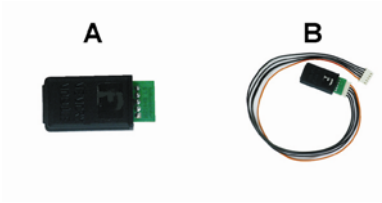
Power cards are designed to be fitted on the rear of boards.
The *dimensions* of the card models are shown in the following layout:



16.1.3 Copy Card

This device is used to upload and download the device parameter map.

Copy Card photo



copy Card

A: *Copy Card* viewed from below: *dimensions* 4x2x1.3 cm
B: *Copy Card* and TTL cable (length 30 cm)
C: *Copy Card*, viewed from 3/4

The following conventions are usually applicable:

- **UPLOAD means copying *parameters* from a unit to COPYCARD**
- **DOWNLOAD means copying the *parameters* from a *COPY CARD* to a unit**

16.2 Probes

A: Humidity probe EWHS280: *dimensions* 103x25 mm
B: Humidity probe EWHS300: *dimensions* 80x80x52 mm
C: Pressure probe EWPA007
D: NTC temperature probe

16.2.1 EMC filter

If the fans are regulated by means of the cutting phase, it is necessary to install a noise filter upstream from the power supply. This filter removes the electromagnetic noise this control emits into the mains.

Param Manager

If you have an adequate Personal Computer running Windows 95 or a higher version, the Param Manager software, and an adequate interface module and proper wiring, it is possible to control all the device *parameters* by means of a Personal Computer.

The unit is easy to program thanks to a series of interfaces that offer a logical, controlled, fast and simple approach.

→ **For further information, see the Param Manager manual.**

PCInterface interface module
This device enables the controller to interface with the PC.
→ **For information on how to connect the device, see the Param Manager Manual.**
→ **For information on the technical specifications of *PCI2150*, see the instruction sheet.**

PCI2150

The PC must be connected with the interface module, and the interface module with the device, with no power on to any of the devices, and in compliance with current safety regulations. It is also important to avoid electroshocks, especially on the open metal surfaces of each unit. It is therefore necessary to adopt special measures to convey electrostatic currents to the ground.

17 ANALITIC INDEX

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