ESIE21-02

Operation manual

Daikin R32 Rooftops UATYA-B

25 kW 190 kW

Disclaimer

Version log

Version code	Description	Date
ESIE21-02	Document release	March 2021

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Contents

1 INTRODUCTION

1.1 General

Some information on the use of this manual.

The purpose of this manual is to provide all information regarding the software functions of the controller for the units listed on the cover and it is complementary to the controller installation and programming manual.

This manual is the “SERVICE” version, that is, it is intended only for after-sales service technicians and Factory technicians.

Information regarding installation of the units and relevant tests and checks for the first starting is not given in this manual.

It is taken for granted that the unit has been installed correctly, the tests and checks prior to start-up have been carried out and that routine maintenance is carried out, according to the information given in the “Installation, operation and maintenance” manual for the units.

We thank in advance all those who will wish to let us know of any errors, omissions, sections requiring further explanation or operations that have not been included.

1.1.1 c.pCO controller functions

The software application for the electronic microprocessor controller, series c.pCO, was designed to manage Rooftop units.

Through appropriate configuration, this gives the possibility of managing a wide range of units with relevant specific functionalities.

Management of Rooftop units means monitoring that all component parts operate safely throughout the various operating cycles.

The family of c.pCO electronic microprocessor controllers includes various module sizes. The software is flexible to the extent that the use of modules is optimized, meaning the modules used for reach application are those having the necessary number of inputs and outputs.

The c.pCO board is connected to the various modules and communicates with them via a high speed, highly reliable field bus.

The controller user interface consists in a colour, 4.3” touch-screen display.

2 THE SCREENS

The user interface gives access to all information and setup parameters relating to unit operation. The manual describes the access procedure to the desired information and to the parameter pages where the various functions can be set up.

2.1 Screen tree

The user interface gives access to all information and setup parameters relating to unit operation. The manual describes the access procedure to the desired information and to the parameter pages where the various functions can be set up.

As explained in the description of icons, the home page gives direct access to the most significant information and functions. Most parameters and settings are featured in the screen, which are broken down in one main menu and various sub-menus.

A tree diagram of the screens is provided below to help the user browse and easily locate the screens of the user interface.

- Setpoint
  * Unit
  * Ventilation
  * Humidification Dehumidification
  * Dampers
  * Auxiliary heating
  * Post-heating gas
  * Environment air renewal
- Probes
- I/O
  * Universal inputs
  * Digital inputs
  * Driver 1
  * Analog outputs
  * Digital outputs
  * Driver 2
- Language
  * English
  * Italian
  * Swedish
  * German
  * French
  * Spanish
  * Polish
- Alarm history
- Charts
- Login
- Configuration
  * Date hour
  * Backlight
  * Network
  * HMI
  * Led
  * Font
- Parameters
  * ST - Mechanical cooling
  * STH - Mechanical heating
  * SFA - Temperature control ventilation
  * SP - Setup
  * FA - Supply ventilation
  * RFA - Return ventilation
  * PAL - Alarms
  * CF - Configuration
  * CO - Compressors
  * ET - Electronic thermostatic valve
  * PID - PID parameters
  * ES - Energy Saving
  * UN - Unloading
  * DF - Defrost
  * HU - Humidity
  * PD - Pump Down
  * SD - Dynamic setpoint
  * DA - Dampers
  * EFA - External ventilation
  * CA - Calibration probes
  * RA - Transducer probe full scale
  * ENV - Envelope
- Files management
  * Saving timelog.txt
  * Loading .conf
  * Saving actual.conf
  * Download files to USB key
- Maintenance
  * Reset hours/starts
  * Disabling
- Service
  * Reset hours/starts
  * Disabling
- pGD1 Emulator

2.1.1 Screen menu

A click on the “Menu” button in the home page gives access to the main menu.

The arrow icon buttons featured in the main menu are used to scroll all lower level menus.

Access to lower level menus is allowed based on the user’s credentials. Some users have free access, while others have to log in with the profile they are accredited for.

Access to the various menus is gained by clicking the colour area containing the menu description.

For easier understanding and use, texts are shown to explain the meaning of the values and parameters featured in the screens.

3 SOFTWARE FUNCTIONS

3.1 Introduction

For management of the units, special software is loaded into the controller.

The software consists of a combination of functions dedicated to the conditions in which the units may have to work.

The following chapters describe all the functions managed by the software, ranging from ordinary functions featured in all units to functions dedicated to specific versions or models.

Some of the functions described here may be available only on specific versions or sizes, or according to the selected accessories.

The software is designed to control rooftop units that are used to air-condition large spaces characterised by highly varying human transit/stay, in which the air temperature, humidity and quality need to be monitored.

Great attention was given to an important aspect such as “Energy Saving”, which is why peculiar registrations were added that help the units make use of favourable environmental conditions for energy saving purposes.

In describing the various functions, competence in operation of the units and knowledge of the relevant hydraulic or refrigerant circuits are taken for granted. All the descriptions, settings and parameters given refer to units that are correctly installed as described in the relevant documentation.

3.2 Set point management

The control setpoint mainly depends on parameters “ST1” and “STH1”.

The relevant settable minimum and maximum setpoint parameters are shown below.

Parameter	Min	Max	UM	Description
ST1	ST2	ST3	°C	Mechanical cooling - Temperature setpoint
ST2	10.0	ST3	°C	Min. return air temperature setpoint
ST3	ST2	35.0	°C	Max. return air temperature setpoint
STH1	STH2	STH3	°C	Mechanical heating / Auxiliary heating in winter mode - Temperature setpoint
STH2	5.0	STH3	°C	Mechanical heating / Auxiliary heating in winter operating - Min. temperature setpoint
STH3	STH2	55.0	°C	Mechanical heating / Auxiliary heating in winter operating - Max. temperature setpoint

Provision has been made for ancillary functions that are designed to either add or subtract an offset value to/from these setpoints.

Any automatic variation of the setpoint must be within the corresponding limits.

Parameter “SD2” is used to set the operating mode in which setpoint variation is enabled. There is only one function available and this is the function enabled at the factory.

3.2.1 Dynamic Set Point

The dynamic set point is a function enabled by the manufacturer.

The reference parameters in managing the dynamic set point are described below.

Parameter	Min	Max	UM	Description
ST1	ST2	ST3	°C	Mechanical cooling - Temperature setpoint
STH1	STH2	STH3	°C	Mechanical heating / Auxiliary heating in winter mode - Temperature setpoint
SD2	0	2	-	States of the unit in which it is active
SD10	0.0	55.0	°C	Mechanical cooling - External air temperature - Activation threshold for compensation
SD11	0.0	15.0	°C	Mechanical cooling - External air temperature - Activation differential
SD12	-10.0	15.0	°C	Mechanical cooling - External air temperature - Max increase / decrease of the setpoint
SD20	0.0	55.0	°C	Mechanical heating - External air temperature - Activation threshold for compensation
SD21	0.0	15.0	°C	Mechanical heating - External air temperature - Activation differential
SD22	-10.0	15.0	°C	Mechanical heating - External air temperature - Max increase / decrease of the setpoint

3.2.2 Dynamic setpoint from external air probe in cooling mode

The setpoint value entered in parameter “ST1” is “compensated” against the external air temperature.

The parameters concerned are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
ST1	27.0	°C	Mechanical cooling - Temperature setpoint
SD2	1	-	States of the unit in which it is active
SD10	25.0	°C	Mechanical cooling - External air temperature - Activation threshold for compensation
SD11	15.0	°C	Mechanical cooling - External air temperature - Activation differential
SD12	-5.0	°C	Mechanical cooling - External air temperature - Max increase / decrease of the setpoint

A graphical representation is shown below.

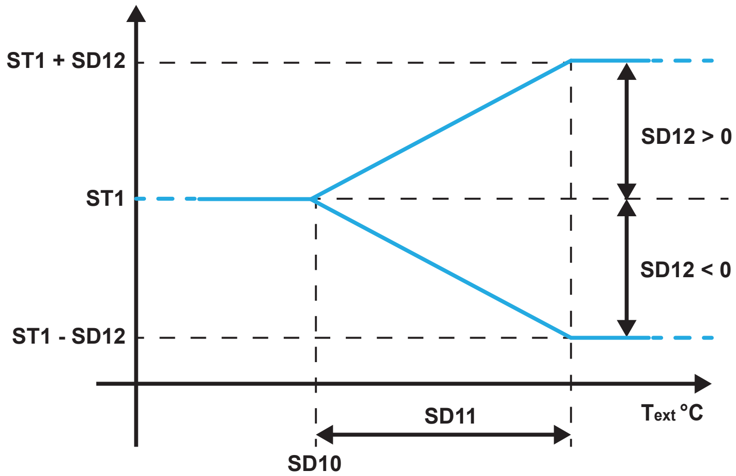


Fig. 1 Change in setpoint as the air temperature changes in cooling mode

Where “T_{ext}” is the value of the external air temperature.

When this function is enabled, the setpoint value that the controller uses to manage the air temperature in cooling mode is as follows:

- if the external air temperature is lower than the setpoint in parameter “SD10”, the value of the control setpoint is the value stored in parameter “ST1”;
- if the external air temperature is higher than the setpoint in parameter “SD10”, plus the value in parameter “SD11”, the value of the control setpoint is given by the sum of the values stored in parameters “ST1” and “SD12”;
- if the external air temperature is between the values of parameter “SD10” and the sum of the values stored in parameters “SD10” and “SD11”, the value of the control setpoint varies proportionally between the value stored in parameter “ST1” and the sum of the values stored in parameters “ST1” and “SD12”.

Parameter “SD12” can have positive or negative values. When the value is negative, parameter “SD12” has to be subtracted from the value of parameter “ST1”.

3.2.3 Dynamic setpoint from external air probe in heating mode

The setpoint value entered in parameter “STH1” is “compensated” against the external air temperature.

The parameters concerned are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
STH1	40	°C	Mechanical heating / Auxiliary heating in winter mode - Temperature setpoint
SD20	15.0	°C	Mechanical heating - External air temperature - Activation threshold for compensation
SD21	10.0	°C	Mechanical heating - External air temperature - Activation differential
SD22	5.0	°C	Mechanical heating - External air temperature - Max increase / decrease of the setpoint

A graphical representation is shown below.

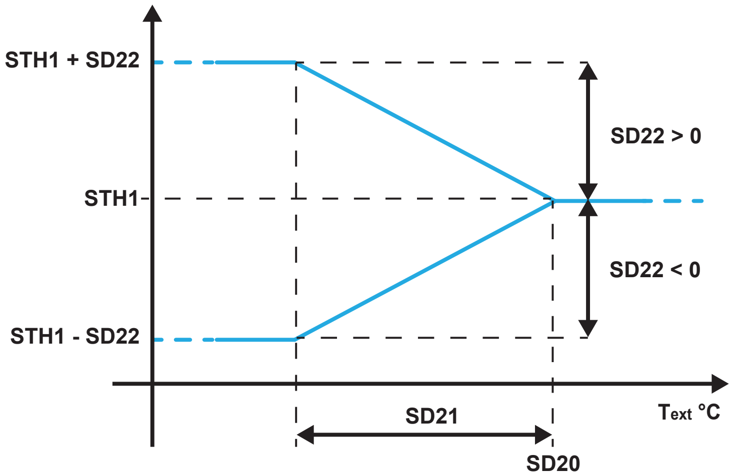


Fig. 2 Change in setpoint as the air temperature changes in heating mode

Where “T_{ext}” is the value of the external air temperature.

When this function is enabled, the setpoint value that the controller uses to manage the air temperature in heating mode is as follows:

- if the external air temperature is higher than the setpoint in parameter “SD20”, the value of the control setpoint is the value stored in parameter “STH1”;
- if the external air temperature is lower than the setpoint in parameter “SD20”, minus the value in parameter “SD21”, the value of the control setpoint is given by the sum of the values stored in parameters “STH1” and “SD22”;
- if the external air temperature is between the values of parameter “SD20” and the difference of the values stored in parameters “SD20” and “SD21”, the value of the control setpoint varies proportionally between the value stored in parameter “STH1” and the sum of the values stored in parameters “STH1” and “SD22”.

Parameter “SD22” can have positive or negative values. When the value is negative, parameter “SD22” has to be subtracted from the value of parameter “STH1”.

3.3 Temperature control

Cooling and heating devices are controlled according to the temperature value measured by a reference probe. The measured temperature is compared with the desired value (setpoint "ST1" for cooling and setpoint "STH1" for heating), after which the difference between these values is calculated and the most suitable devices are started, based on this difference.

The proportional band identifies the control range of the air conditioner system and it can be set up with independent values for heating and cooling mode.

The dead zone identifies the range around the setpoint within which the devices are not enabled (it is used to prevent oscillations in the setup value).

The diagram below shows the behaviour of heating and cooling devices.

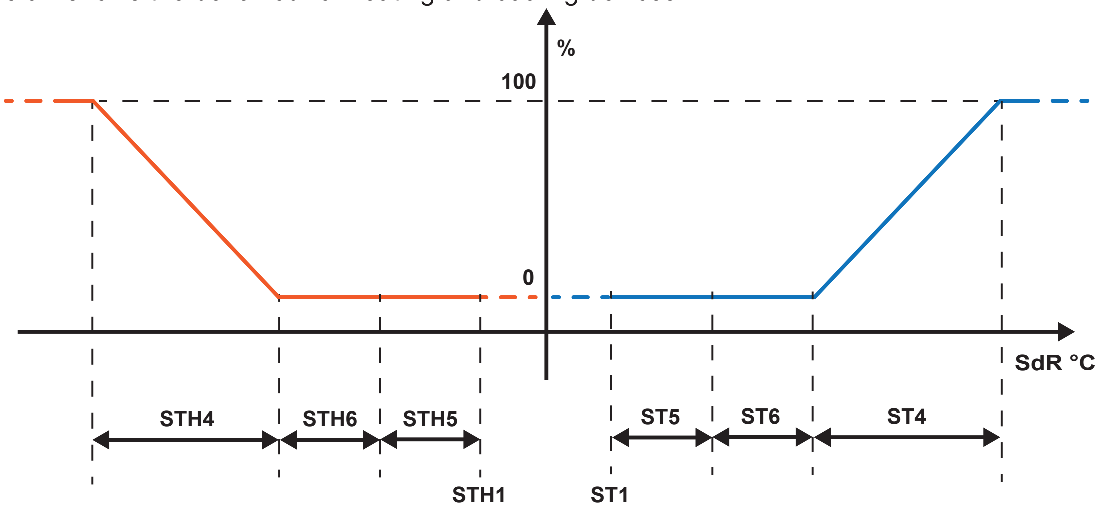


Fig. 3 Graphical representation of temperature control devices

Parameter	Min	Max	UM	Description
ST1	ST2	ST3	°C	Mechanical cooling - Temperature setpoint
ST2	11.0	ST3	°C	Min. return air temperature setpoint
ST3	ST2	35.0	°C	Max. return air temperature setpoint
ST4	0.0	25.0	°C	Proportional control - Cooling - Activation differential
ST5	0.0	25.0	°C	Proportional control - Cooling - Neutral activation area
ST6	0.0	25.0	°C	Proportional control - Cooling - Offset
ST9	0	7	-	Control probe
ST11	0	2	-	Type of temperature control
PID70	0	10000	-	Mechanical cooling - Kp
PID71	0	10000	-	Mechanical cooling - Ki
PID72	0	10000	-	Mechanical cooling - Kd
PID76	0.0	25.0	°C	Mechanical cooling - Dead band
PID78	0	2	-	Mechanical cooling - Dead band position
STH1	10.0	35.0	°C	Mechanical heating / Auxiliary heating in winter mode - Temperature setpoint
STH2	10.0	35.0	°C	Mechanical heating / Auxiliary heating in winter operating - Min. temperature setpoint
STH3	10.0	35.0	°C	Mechanical heating / Auxiliary heating in winter operating - Max. temperature setpoint
STH4	0.0	25.0	°C	Mechanical heating - Proportional - Activation differential
STH5	0.0	25.0	°C	Mechanical heating - Proportional - Activation neutral zone
STH6	0.0	25.0	°C	Mechanical heating - Proportional - Offset
STH9	0	1	-	Mechanical heating / Auxiliary heating in winter operating - Regulation probe
STH11	0	2	-	Mechanical heating - Type of temperature control
STH21	0	10000	-	Mechanical heating - PID - Kp
STH22	0	10000	-	Mechanical heating - PID - Ki
STH23	0	10000	-	Mechanical heating - PID - Kd
STH27	0.0	25.0	°C	Mechanical heating - PID - Dead band
STH29	0	2	-	Mechanical heating - PID - Dead band position

The value set in parameter “ST9” determines which control probe is to be used:

- 0 = temperature probe on air delivery line;
- 1 = temperature probe on air return line;

The value set in parameter “ST11” determines the type of temperature control, as follows:

- 0 = proportional.
- 1 = "Cascade";
- 2 = PID.

3.3.1 Thermoregulation in cooling mode

The thermoregulation of the unit depends on parameter “ST9”, which identifies the reference probe for the temperature setpoint (parameter “ST1”), and on parameter “ST11” which determines the type of temperature/humidity control.

In proportional control mode, the controller activates the available resources as the value read by the reference probe increases in comparison to the setpoint value.

When “Cascade” temperature/humidity control is selected, the controller uses it to enable the resources and at the same time monitor the air temperature in the delivery line.

In PID control mode, the controller activates the available resources as the demand increases. The controller calculates the demand and checks the value measured by the probe against the setpoint value and according to its variation over time using the parameters set in the PID.

Proportional temperature control

If parameter “ST11” is set to “0”, proportional control is enabled.

The parameters involved in proportional temperature control are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
ST1	24.0	°C	Temperature setpoint
ST2	18.0	°C	Min. air temperature setpoint
ST3	28.0	°C	Max. air temperature setpoint
ST4	2.0	°C	Proportional control - Cooling - Activation differential
ST5	0.1	°C	Proportional control - Cooling - Neutral activation area
ST6	0.1	°C	Proportional control - Cooling - Offset

A graphical representation is shown below.

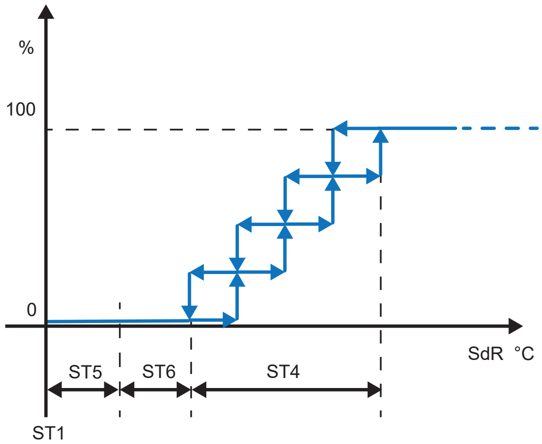


Fig. 4 Graphical representation of cooling demand

In addition to the parameters listed in the table, the abbreviations in the graph are:

- SdR = reference probe;
- % = percentage demand value.

“cascade” temperature control.

If parameter “ST11” is set to “1”, “Cascade” control is enabled.

This function fulfils the system demand and keeps the air temperature in the delivery line within comfort values.

For this purpose, a virtual setpoint is calculated from the stored setpoint, as corrected with the air temperature in the return line.

The setpoint is corrected dynamically as the air temperature changes in the return line.

The parameters involved in cascade temperature control are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
ST42	24.0	°C	Cascade control - Unit setpoint
ST43	0.5	°C	Mechanical cooling - Cascade control - Mode switching offset
ST44	4.0	°C	Mechanical cooling - Cascade control - Operating differential
ST45	15.0	°C	Mechanical cooling - Cascade control - Min. delivery setpoint

The graph below illustrates cascade control.

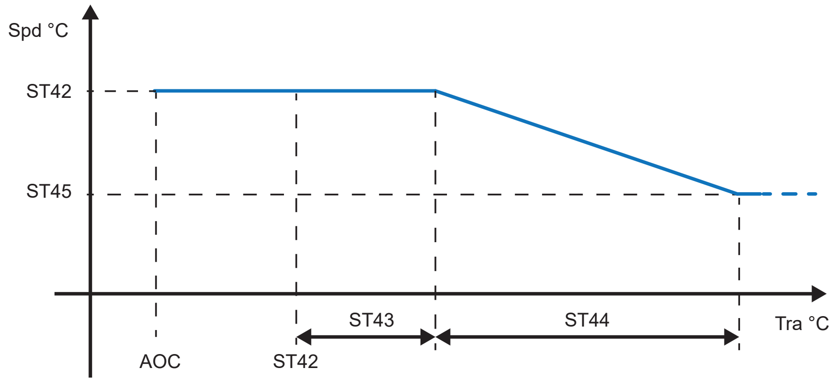


Fig. 5 Change of air delivery setpoint with “cascade” control in cooling mode

In addition to the parameters listed in the table, the abbreviations in the graph are:

- Spd = air setpoint in delivery line;
- Tra = air temperature in return line;
- AOC = automatic mode switching.

If the air temperature in the return line is higher than the sum of the setpoints in parameters “ST42”+ “STH43”, the value of the air setpoint in the delivery line is reduced gradually to go from the value in parameter “ST42” to the value in parameter “STH45”, within the differential set in parameter “STH44”.

Temperature control with a PID controller

If the value of parameter “ST11” is set to “2”, the temperature is controlled using a PID controller.

The parameters involved are shown in the table. Access to these parameters is for service technicians only.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
ST1	27.0	°C	Temperature setpoint
ST2	10.0	°C	Minimum temperature setpoint
ST3	35.0	°C	Maximum temperature setpoint
ST4	2.0	°C	Proportional control - Cooling - Activation differential
ST5	0.0	°C	Proportional control - Cooling - Neutral activation area
ST6	0.0	°C	Proportional control - Cooling - Offset
ST9	1	-	Control probe
ST11	2	-	Type of temperature control
PID70	3000	-	Mechanical cooling - Kp
PID71	100	-	Mechanical cooling - Ki
PID72	5	-	Mechanical cooling - Kd
PID76	0.2	°C	Mechanical cooling - Dead band
PID78	0	-	Mechanical cooling - Dead band position
PID87	0	-	Mechanical cooling - Manual override (0 = Disabled)
PID90	0.0	%	Mechanical cooling - Min. output
PID91	100.0	%	Mechanical cooling - Max. output

The use of a PID controller is strongly recommended for delivery temperature control.

The control of the air temperature in the delivery line requires the unit to have modulating cooling and heating devices.

3.3.2 Thermoregulation in heating mode

The thermoregulation of the unit in heating mode depends on parameter “ST9”, which identifies the reference probe for the temperature value in the setpoint (parameter “STH1”), and on parameter “ST11” which determines the type of temperature control.

In proportional control mode, the controller activates the available resources as the value read by the reference probe decreases in comparison to the setpoint value.

When “Cascade” control is selected, the controller enables the resources and at the same time monitors the air temperature in the delivery line.

In PID control mode, the controller activates the available resources as the demand increases. The controller calculates the demand and checks the value measured by the probe against the setpoint value and according to its variation over time using the parameters set in the PID.

Proportional temperature control

If parameter “ST11” is set to “0”, proportional control is enabled.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
STH1	20.0	°C	Mechanical heating / Auxiliary heating in winter mode - Temperature setpoint
STH2	15.0	°C	Mechanical heating / Auxiliary heating in winter operating - Min. temperature setpoint
STH3	40.0	°C	Mechanical heating / Auxiliary heating in winter operating - Max. temperature setpoint
STH4	2.0	°C	Mechanical heating - Proportional - Activation differential
STH5	0.0	°C	Mechanical heating - Proportional - Activation neutral zone
STH6	0.0	°C	Mechanical heating - Proportional - Offset

A graphical representation is shown below.

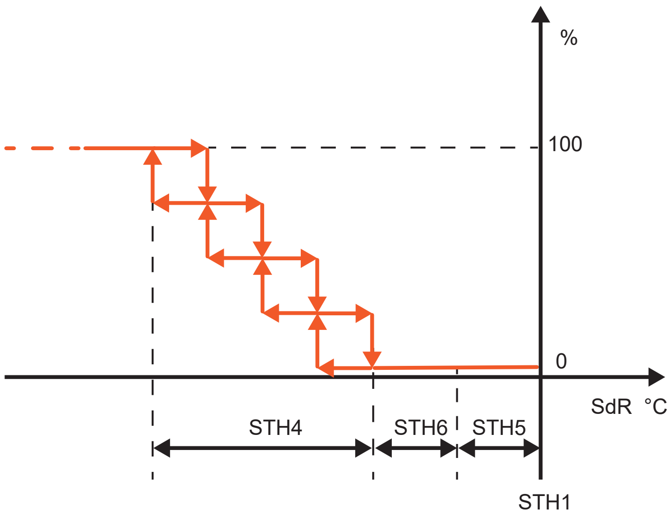


Fig. 6 Graphical representation of stepped heating demand

In addition to the parameters listed in the table, the abbreviations in the graph are:

- SdR = reference probe;
- % = percentage demand value.

Temperature monitoring with Cascade control

If parameter “ST11” is set to “1”, “Cascade” control is enabled.

This function fulfils the system demand and keeps the air temperature in the delivery line within comfort values.

For this purpose, a virtual setpoint is calculated from the stored setpoint, as corrected with the air temperature in the return line.

The setpoint is corrected dynamically as the air temperature changes in the return line.

The parameters involved in cascade temperature control are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
ST42	24.0	°C	Cascade control - Unit setpoint
STH46	0.5	°C	Mechanical heating - Cascade control - Mode switching offset
STH47	4.0	°C	Mechanical heating - Cascade control - Operating differential
STH49	30.0	°C	Mechanical heating - Cascade control - Max. air setpoint in delivery line

The graph below illustrates cascade control.

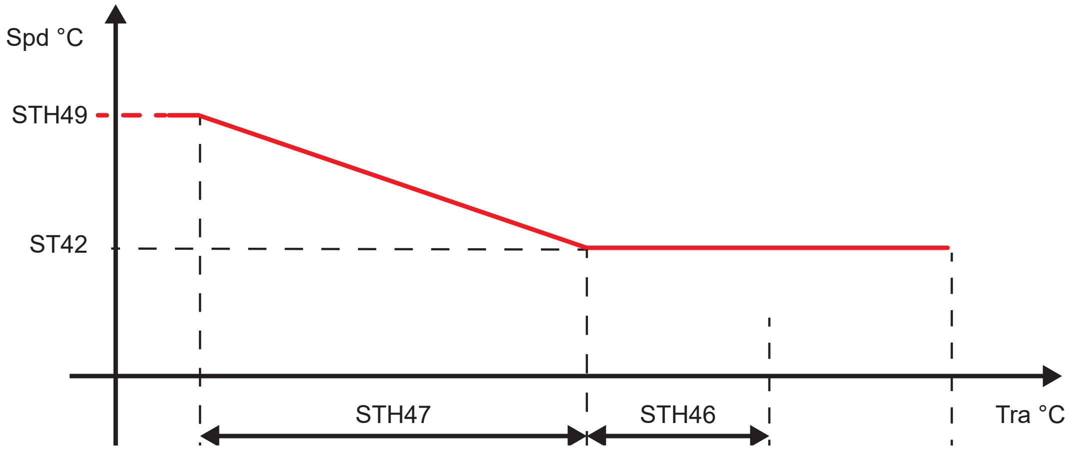


Fig. 7 Change of air setpoint in delivery line with “cascade” control in heating mode

In addition to the parameters listed in the table, the abbreviations in the graph are:

- Spd = air setpoint in delivery line;
- Tra = air temperature in return line;
- AOC = automatic mode switching.

If the air temperature in the return line is lower than the difference between the setpoints in parameters “ST42” - “STH46”, the value of the air setpoint in the delivery line is increased gradually from the value in parameter “ST42” to the value in parameter “STH49”, within the differential set in parameter “STH47”.

Temperature control with a PID controller

If the value of parameter “STH11” is set to “2”, temperature is controlled using a PID controller.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
STH21	3000	-	Mechanical heating - PID - Kp
STH22	100	-	Mechanical heating - PID - Ki
STH23	5	-	Mechanical heating - PID - Kd
STH27	0.4	°C	Mechanical heating - PID - Dead band
STH29	2	-	Mechanical heating - PID - Dead band position
STH38	0	-	Mechanical heating - PID - Manual override (0 = Disabled)
STH41	0.0	%	Mechanical heating - PID - Min. output
STH42	100.0	%	Mechanical heating - PID - Max. output

The use of a PID controller is strongly recommended for delivery temperature control.

3.3.3 Disabling heating sources depending on external air temperature

The value of the external air temperature is used as reference to disable the heating sources in the unit. The heating sources are disabled when the temperature is either high or low.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
STH14	-20.0	°C	Mechanical heating - Deactivation threshold for low external air temperature
STH15	30.0	°C	Mechanical heating - Deactivation threshold for high external air temperature
STH123	-30.0	°C	Auxiliary heating - Deactivation threshold for low external air temperature
STH124	50.0	°C	Auxiliary heating - Deactivation threshold for high external air temperature

Heating generated using the refrigerant circuit is disabled when:

- the external air temperature is low - it drops below the setpoint in parameter “STH14”; heating is enabled again when the temperature value rises above the setpoint in parameter “STH14”, plus +1°C;
- the external air temperature is high - it rises above the setpoint in parameter “STH15”; heating is enabled again when the temperature value drops below the setpoint in parameter “STH15”, minus +1°C.

Auxiliary heating is disabled when:

- the external air temperature is low - it drops below the setpoint in parameter “STH123”.Auxiliary heating is enabled again when the temperature value rises above the setpoint in parameter “STH123”, plus +1°C;
- the external air temperature is high - it rises above the setpoint in parameter “STH124”. Auxiliary heating is enabled again when the temperature value drops below the setpoint in parameter “STH124”, minus +1°C.

3.3.4 Pre-heating coil

The controller is designed to manage a pre-heating coil: the temperature is set up based on the temperature sensed by the mixed air probe.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
STH1	20.0	°C	Mechanical heating / Auxiliary heating in winter mode - Temperature setpoint
STH141	0.0	°C	Preheating - Temperature offset
STH142	2.0	°C	Preheating - Activation differential
STH143	0	%	Preheating - Minimum request
STH144	100	%	Preheating - Maximum request

A graphical representation is shown below.

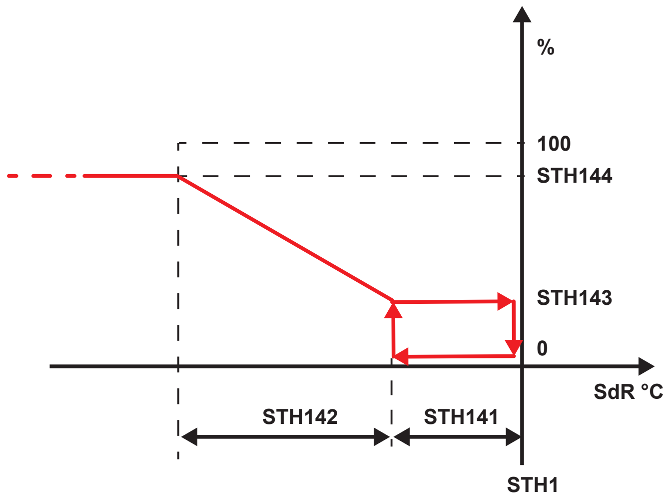


Fig. 8 Graphical representation of proportional heating demand

In addition to the parameters listed in the table, the abbreviations in the graph are:

- Sdr = mixed air probe;
- %Av= valve opening percentage.

If the temperature of the mixed air is lower than the setpoint in parameter “STH1”, minus the “offset” value stored in parameter “STH141”, the controller increases the valve opening percentage to the coil, within the differential set in parameter “STH142”.

Temperature control ranges between the min. value stored in parameter “STH143” and the max. value in parameter “STH144”.

3.4 humidity control

Humidity control devices are managed according to the value measured by the reference probe. The measured value is compared with the desired value (setpoint), after which the system calculates the difference between these values and then enables the most suitable devices based on this difference.

The proportional band identifies the control range of the air conditioner system and it is set up with the same values for both humidification and de-humidification.

The dead zone identifies the range around the setpoint within which the devices are not enabled (it is used to prevent oscillations in the setup value).

The diagram below shows the behaviour of humidification and de-humidification devices.

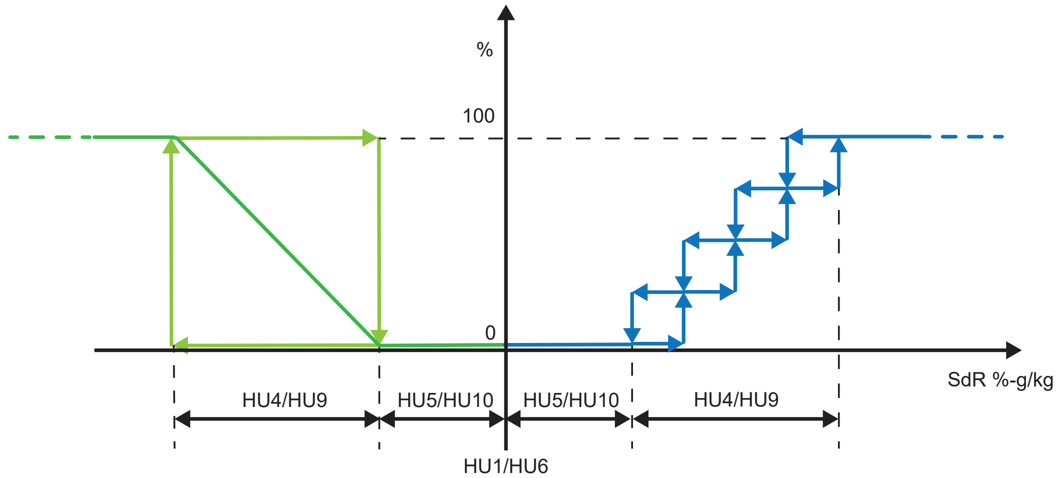


Fig. 9 Graphical representation of humidity control devices

The parameters involved are shown in the table.

Parameter	Min	Max	UM	Description
HU1	HU2	HU3	%	Relative humidity setpoint
HU2	0.0	HU3	%	Min. relative humidity setpoint
HU3	HU2	100.0	%	Max. relative humidity setpoint
HU4	0.0	25.0	%	Relative humidity control differential
HU5	0.0	10.0	%	Relative humidity control neutral area
HU6	HU7	HU8	g/kg	Absolute humidity setpoint
HU7	0.0	HU8	g/kg	Min. absolute humidity setpoint
HU8	HU7	100.0	g/kg	Max. absolute humidity setpoint
HU9	0.0	10.0	g/kg	Absolute humidity control differential
HU10	0.0	10.0	g/kg	Absolute humidity control neutral area
HU11	0	1	-	Humidity value control type
HU12	0	1	-	Humidity control type
HU13	0	2	-	Humidifier type
HU14	0	5	-	Control probe
HU15	0	115	-	CPY model
HU16	0	999	s	PID control - Humidification / De-humidification - Delay to reset with condition met (0 = Disabled)
PID24	0	10000	-	Humidity control for humidification - Kp
PID25	0	10000	-	Humidity control for humidification - Ki
PID26	0	10000	-	Humidity control for humidification - Kd
PID30	0.0	25.0	%	Humidity control for humidification - Dead band
PID39	0	1	-	Humidity control for humidification - Moving average (0 = disabled; 1 = enabled)
PID41	0	10000	-	Humidity control for humidification - Manual override (0 = Disabled)
PID44	0	10000	-	Humidity control for humidification - Min. output
PID45	0	10000	-	Humidity control for humidification - Max. output

The value set in parameter "HU11" identifies the reference humidity value, as follows:

- 0 = relative humidity;
- 1 = absolute humidity.

Normally, absolute humidity control helps obtain a higher level of precision in maintaining the desired humidity setpoint, if compared to relative humidity control.

The value set in parameter "HU12" identifies the type of humidity control, as follows:

- 0 = proportional.
- 1 = PID.

The value set in parameter HU14" identifies the control probe type, as follows:

- 0 = relative humidity probe on air return line;

3.4.1 Relative humidity control with proportional control

If parameter "HU11" is set to "0", humidity control is performed according to the relative humidity value.

Relative humidity is managed according to parameter "HU14", which identifies the probe on which the controller must guarantee maintenance of the entered setpoint, and on parameter "HU12" that determines the type of humidity control.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
HU1	58.0	%	Relative humidity setpoint
HU2	35.0	%	Min. relative humidity setpoint
HU3	65.0	%	Max. relative humidity setpoint
HU4	5.0	%	Relative humidity control differential
HU5	0.5	%	Relative humidity control neutral area

A graphical representation is shown below.

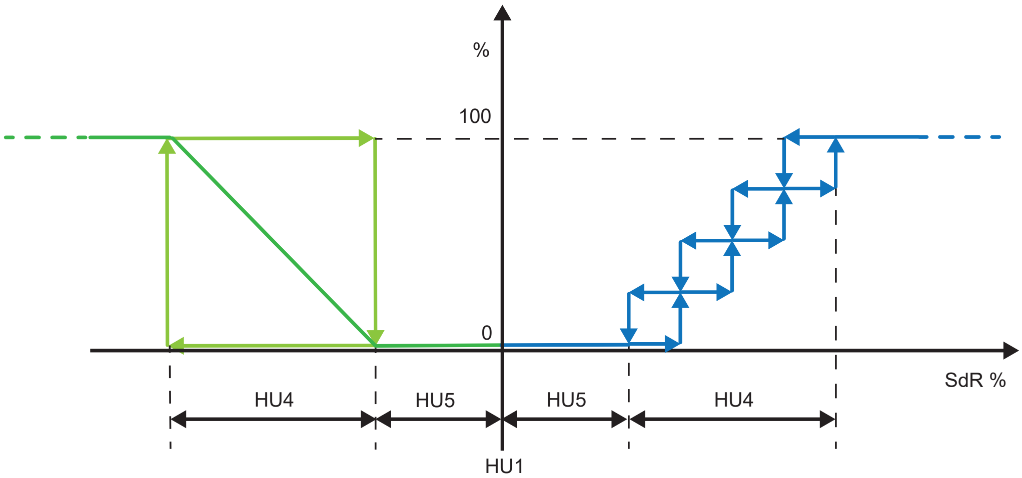


Fig. 10 Relative humidity control

3.4.2 Relative humidity control with PID control

If parameter “HU11” is set to “0”, humidity control is performed according to the relative humidity value.

Relative humidity is managed according to parameter “HU14”, which identifies the probe on which the controller must guarantee maintenance of the entered setpoint, and on parameter “HU12” that determines the type of humidity control.

If the value in parameter “HU12” is set to “1”, the controller calculates the demand and checks the value measured by the probe against the setpoint value and according to its variation over time using the parameters set in the PID.

The parameters relating to humidity PID control are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PID24	500	-	Humidity control for humidification - Kp
PID25	75	-	Humidity control for humidification - Ki
PID26	2000	-	Humidity control for humidification - Kd
PID30	1.0	%	Humidity control for humidification - Dead band
PID39	1	-	Humidity control for humidification - Moving average
PID41	0	-	Humidity control for humidification - Manual override (0 = Disabled)
PID44	0	-	Humidity control for humidification - Min. output
PID45	100	-	Humidity control for humidification - Max. output

3.4.3 Absolute humidity control with proportional control

If parameter “HU11” is set to “1”, humidity control is performed according to the absolute humidity value.

The controller calculates the absolute humidity value based on the relative humidity and temperature readings.

Absolute humidity is managed according to parameter “HU14”, which identifies the probe on which the controller must guarantee maintenance of the entered setpoint, and on parameter “HU12” that determines the type of humidity control.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
HU6	500	g/kg	Absolute humidity setpoint
HU7	75	g/kg	Min. absolute humidity setpoint
HU8	2000	g/kg	Max. absolute humidity setpoint
HU9	1000	g/kg	Absolute humidity control differential
HU10	1.0	g/kg	Absolute humidity control neutral area
HU11	0	-	Humidity value control type
HU12	1	-	Humidity control type

A graphical representation is shown below.

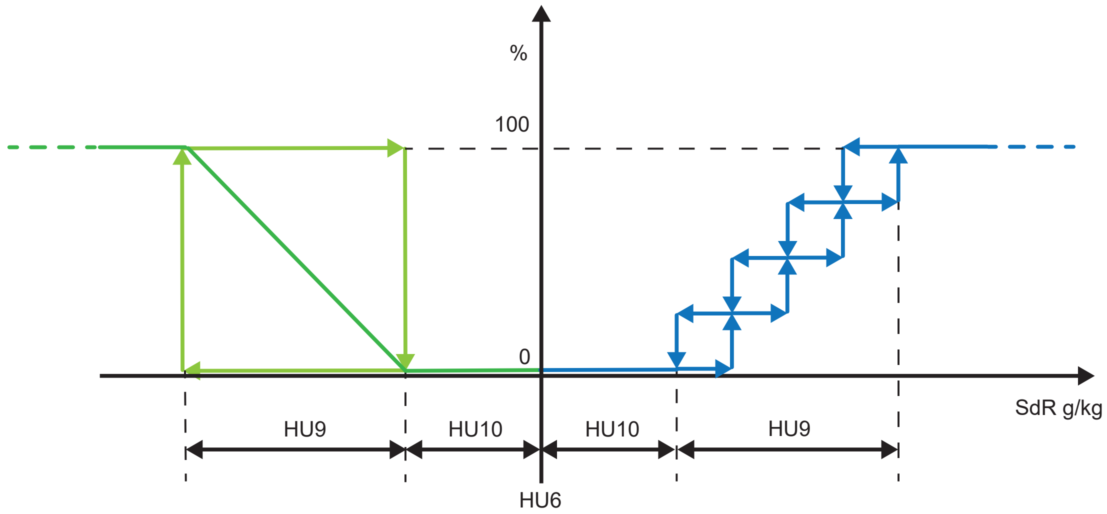


Fig. 11 Absolute humidity control

3.4.4 Absolute humidity control with PID control

If parameter “HU11” is set to “1”, humidity control is performed according to the absolute humidity value.

The controller calculates the absolute humidity value based on the relative humidity and temperature readings.

Absolute humidity is managed according to parameter “HU14”, which identifies the probe on which the controller must guarantee maintenance of the entered setpoint, and on parameter “HU12” that determines the type of humidity control.

If the value in parameter “HU12” is set to “1”, the controller calculates the demand and checks the value measured by the probe against the setpoint value and according to its variation over time using the parameters set in the PID.

The parameters relating to absolute humidity PID control are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PID24	500	-	Humidity control for humidification - Kp
PID25	75	-	Humidity control for humidification - Ki
PID26	2000	-	Humidity control for humidification - Kd
PID30	1.0	g/kg	Humidity control for humidification - Dead band
PID39	1	-	Humidity control for humidification - Moving average
PID41	0	-	Humidity control for humidification - Manual override (0 = Disabled)
PID44	0	-	Humidity control for humidification - Min. output
PID45	100	-	Humidity control for humidification - Max. output

3.5 Air humidification

The controller can manage air humidification using a built-in humidifier in the unit.

The controller is set up at the factory with all the parameters required to control the installed humidifier.

3.5.1 Ancillary built-in humidifier functions

Humidifier control includes some ancillary functions, a description of which is given below.

3.5.1.1 Manual water drain

The manual water drain function is designed to fully empty the cylinder in the humidifier. This function is enabled only through the web page. Access to this page requires the operator to log in with a Service level password. If the humidifier is producing steam, enabling of the function causes steam production to be stopped instantly.

3.5.1.2 Pre-washing

The pre-washing function is used to wash the water lines and the humidifier cylinder. The cylinder is filled and then emptied 3 times in order to wash away impurities from the pipes and cylinder, if any. We recommend enabling this function especially after connecting the water lines or after cylinder replacement. This function is enabled only through the web page. Access to this page requires the operator to log in with a Service level password. If the humidifier is producing steam, enabling of the function causes steam production to be stopped instantly.

3.5.1.3 Water drainage before machine shutdown

The function for water drainage before a machine shutdown is enabled in order to avoid water stagnation in the humidifier cylinder, which may lead to the formation of algae or bacteria (e.g. Legionella), if the cylinder is filled with water for over 72 consecutive hours without producing steam. The cylinder is drained and remains as such until it receives a signal requesting the production of steam. The function is always active and the shutdown interval is fixed.

3.6 Air dehumidification

Air dehumidification is required during the cooling cycle, where it occurs naturally.

If dehumidification is required simultaneously with cooling, the controller starts the compressors, based on which of the two demands is greater.

The possibility exists that the temperature setpoint is reached before the humidity setpoint is achieved. If this is the case, the controller pushes cooling even further so as to cause the temperature to drop below the setpoint.

However, to prevent an excessive drop of the air temperature in the room, the controller uses the heating devices fitted in the unit to post-heat the air.

3.6.1 Cooling limitation in dehumidification cycle

The air temperature in the room may drop to excessively low levels during the dehumidification cycle.

A function is featured in the controller to limit excessive cooling of the air in the room.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
ST21	24.0	°C	Dehumidification - Return temperature limitation - activation threshold
ST22	2.0	°C	Dehumidification - Return temperature limitation - deactivation differential
ST23	3.0	%	Dehumidification - Limitation of return temperature - decrement Step
ST24	15	s	Dehumidification - Limiting the return temperature - Time between the decreases

If the air temperature in the return line is lower than the setpoint stored in parameter “ST21”, the controller limits the cooling capacity by the percentage value set in parameter “ST23”: this operation is repeated each time that the time value set in parameter “ST24” elapses.

Cyclic reduction of the cooling capacity continues until the temperature in the return line exceeds the sum of the setpoint values in parameters “ST21” and “ST22”.

As soon as the air temperature in the return line exceeds the sum of the setpoints in parameters “ST21” and “ST22”, the limitation ceases and the dehumidification cycle can continue, based on the demand coming from the control logic.

If the limitation function is enabled, the corresponding alarm is active (“AL26” - Limitation of air temperature in return line enabled).

If the probe sensing the air temperature in the return line is in error, the limitation is disabled.

3.7 Priority between temperature and humidity control

The control of the air temperature in one room is closely connected to humidity control. In some installations both temperature and humidity need to be controlled, so there must be no excessive deviation from the setpoint of one of these two variables.

This is why the controller features a function that prioritises either temperature or humidity or enables the system to give priority automatically.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
ST11	0	-	Type of temperature control
ST15	0	-	Cooling / Dehumidification operating mode
ST17	5	%	Offset for changeover to new operating mode (only with ST15 = 0)
HU12	1	-	Humidity control type

The value set in parameter “ST15” determines whether the priority is given:

- 0 = automatically;
- 1 = to cooling;
- 2 = to de-humidification.

Temperature and humidity may also be managed with a different control type. For instance: temperature may be controlled proportionally and humidity with a PID control, or vice versa.

In both cases, the controller converts the demand into a 0 to 100.0% value and prioritises thermoregulation, based on the two demands and the set values.

Automatic priority

When the controller is started up, priority is given to the demand for either cooling or dehumidification based on which of the two is higher.

Once attributed, priority is kept until the other demand is either higher or equal to the demand plus the percentage value set in parameter “ST17”.

Example using parameter “ST17” set to 5%

- Upon start-up, the cooling demand is 50% and the de-humidification demand is 48%. Priority is given to cooling: compressor thermoregulation is at 50%.
- If, during operation, the temperature drops and humidity stays unaltered, the cooling demand drops to 47% after a while and the de-humidification demand increases to 50%. Priority is still given to cooling because the difference between the two demands does not exceed the percentage value set in parameter “ST17”. The controller enables resources, based on the cooling demand at 47%.
- If the temperature drops to 45% and humidity stays unaltered after a while, the difference between the two demands now equals the percentage value set in parameter “ST17”. The controller shifts the priority from cooling to de-humidification. The controller enables resources, based on the de-humidification demand at 50%.

Priority to cooling

When priority is given to cooling, the cooling demand is always prioritised, irrespective of the value.

In other words, if the cooling demand is 50%, for instance, and the de-humidification demand is 100%, the controller enables resources at 50%.

Priority to de-humidification

When priority is given to de-humidification, the de-humidification demand is always prioritised, irrespective of the value.

In other words, if the de-humidification demand is 50%, for instance, and the cooling demand is 100%, the controller enables resources at 50%.

3.8 Tips for PID controller setup

If temperature or humidity is managed using a PID controller, the controller parameters must be setup correctly for proper operation. The controller is supplied with factory default parameters, which may require adjustment for adaptation to a specific installation and peculiar work conditions.

Below is a list of the essential parameters for PID controller operation:

- Kp = proportional coefficient;
- Ki = integral coefficient;
- Kd = derivative coefficient.

Proper selection of Kp, Ki, and Kd values enables having different PID controller configurations and different responses from the controlled actuator, which are summarised in the table below.

Coef.	Control function	Main purpose	Coefficient effect on system	
			Increases	**Decreases**
Kp	A deviation of the controlled value (error variation) determines a variation of the actuator output that is proportional to the deviation value.	The output must vary linearly, according to the controlled value.	Worsens system stability.	Improves system stability.
			Speeds up system response.	Slows down system response.
Ki	A deviation of the controlled value (error variation) determines a variation of the actuator output that is proportional to the deviation speed.	The control setpoint must be achieved as quickly as possible, thus cancelling the intrinsic offset of the proportional component.	Worsens system stability.	Improves system stability.
			Speeds up system response.	Slows down system response.
Kd	A deviation of the controlled value (error variation) determines a variation of the actuator output that is proportional to the deviation variation speed.	The system reaction time must be reduced to go back to the control setpoint.	Improves system stability.	Worsens system stability.
			Slows down system response.	Speeds up system response.

Each action of the three components (proportional, integral and derivative) is limited by a minimum and a maximum value. This is required so that, in specific transients, none of the three actions is neatly predominant over the others as this would cause system instability.

Correct setup of the three coefficients and of the limit values of the related actions contributes to optimising the actuator response to changes in the controlled value.

On the other hand, incorrect parameter setup may cause a worsened actuator response or instability in the system.

Our recommendation is as follows.

- Change one coefficient at a time and check the effect of the change on the system after a certain amount of time (we recommend after at least 10 minutes) in as stable as possible boundary conditions.
- The value by which each parameter is changed (increased or reduced) must not exceed half the previous value. For instance. The proportional coefficient Kp for temperature control is set to 500 and the system response needs to be speeded up. The new Kp value must not exceed 750. If, on the other hand, the system response needs to be slowed down for greater stability, the new Kp value must not be inferior to 250.

3.9 Room ventilation

Unit start-up causes activation of the ventilation system.

After ventilation is started on the delivery side and, where provided, on the return side, the controller authorises start-up of the other components, depending on the temperature regulation requirement.

When the unit is switched off, the fans are the last devices to stop after the delay time set on the controller has elapsed.

The controller features functions that are designed to control ventilation in the room by setting the fan speed. These functions take as reference the temperatures, flow rates or pressures.

3.9.1 Ventilation in delivery line

The table shows the ventilation parameters for the various functions connected.

Parameter	Min	Max	UM	Description
FA3	0	999	s	Unit switch-off duration
FA4	0	999	s	Ventilation deactivation delay in unit switch-off
FA5	0	999	s	Unit switch-on duration without external air damper
FA6	0	999	s	Unit swicth-on duration with external air damper
FA7	0	100	%	Minimum speed
FA8	15	100	%	Maximum speed
FA9	0	100	%	Manual override (0 = Disabled)
FA11	375	900	10 m^3/h	Fixed speed in de-humidification mode (0 = Disabled)
FA19	0	999	s	Thermoregulation delay in cooling / heating / humidification mode from unit On
FA20	0	999	s	Fast restart - Thermoregulation delay in cooling / heating / humidification mode from unit On
FA25	375	900	10 m^3/h	Leak detector - Flow rate setpoint
FA26	375	900	10 m^3/h	Constant air flow control - Flow rate setpoint
FA27	0	900	10 m^3/h	Constant air flow control - Min. flow rate setpoint
FA28	375	9999	10 m^3/h	Constant air flow control - Max. flow rate setpoint
FA33	10.0	100.0	Pa	Constant pressure control - Pressure setpoint
FA34	0.0	100.0	Pa	Constant pressure control - Min. pressure setpoint
FA35	10.0	3270.0	Pa	Constant pressure control - Max. pressure setpoint
FA36	0.0	3270.0	Pa	Constant pressure control - Neutral area
FA37	0.0	3270.0	Pa	Constant pressure control - Differential required for decrement
FA38	0.0	3270.0	Pa	Constant pressure control - Differential required for increment
FA39	15	999	s	Constant pressure control - Max. increment time
FA40	0	60	s	Constant pressure control - Min. increment time
FA41	15	999	s	Constant pressure control - Max. decrement time
FA42	0	60	s	Constant pressure control - Min. decrement time
FA43	1	100	%	Constant pressure control - Max. increment amplitude
FA44	0	5	%	Constant pressure control - Min. increment amplitude
FA45	1	100	%	Constant pressure control - Max. decrement amplitude
FA46	0	5	%	Constant pressure control - Min. decrement amplitude
FA47	0	9999	10h	Threshold for “fan operating hours exceeded” alarm (0 = Disabled)
FA49	-50.0	50.0	Pa	Constant pressure difference control - Pressure delta setpoint
FA50	-3270.0	50.0	Pa	Constant pressure difference control - Min. pressure difference setpoint
FA51	-50.0	3270.0	Pa	Constant pressure difference control - Max. pressure difference setpoint
FA52	0.0	3270.0	Pa	Constant pressure difference control - Neutral area
FA53	0.0	3270.0	Pa	Constant pressure difference control - Differential required for decrement
FA54	0.0	3270.0	Pa	Constant pressure difference control - Differential required for increment
FA55	15	999	s	Constant pressure difference control - Max. increment time
FA56	0	60	s	Constant pressure difference control - Min. increment time
FA57	15	999	s	Constant pressure difference control - Max. decrement time
FA58	0	60	s	Constant pressure difference control - Min. decrement time
FA59	1	100	%	Constant pressure difference control - Max. increment amplitude
FA60	0	5	%	Constant pressure difference control - Min. increment amplitude
FA61	1	100	%	Constant pressure difference control - Max. decrement amplitude

Parameter	Min	Max	UM	Description
FA71	0	825	10 m^3/h	Variable air flow control - Cooling / Heating - Min. flow rate setpoint
FA72	300	9999	10 m^3/h	Variable air flow control - Cooling / Heating - Max. flow rate setpoint
FA73	0.0	25.0	°C	Variable air flow control - Cooling / Heating - Differenzial
FA74	0.0	25.0	°C	Variable air flow control - Cooling / Heating - Neutral zone
FA75	0.0	25.0	°C	Variable air flow control - Cooling / Heating - Offset
FA76	0	9999	10 m^3/h	Variable / constant air flow control - Cooling / Heating - New air flow setpoint when the temperature setpoint is reached
FA77	0	1	-	Variable / constant air flow control - Cooling / Heating - Enabling of new air flow setpoint when the temperature setpoint is reached
FA81	0	9999	10 m^3/h	Variable / constant air flow control - Defrost - New air flow setpoint
FA82	0	1	-	Variable / constant air flow control - Defrost - Enabling of new air flow setpoint

3.9.2 Constant flow ventilation control

This function is designed to control the air flow rate in the room at a constant value. The controller modulates the fan to keep the air flow rate measured by the unit at a constant and equal value to the setpoint under changing work conditions (for instance, progressive filter fouling, changes in the opening of temperature/humidity control dampers, if any, etc.).

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
FA26	750	10 m^3/h	Constant air flow control - Flow rate setpoint
FA27	375	10 m^3/h	Constant air flow control - Min. flow rate setpoint
FA28	900	10 m^3/h	Constant air flow control - Max. flow rate setpoint
PID47	25	-	Air flow control for supply ventilation - Kp
PID48	15	-	Air flow control for supply ventilation - Ki
PID49	0	-	Air flow control for supply ventilation - Kd
PID53	50	10m3/h	Air flow control for supply ventilation - Dead band
PID55	1	-	Air flow control for supply ventilation - Dead band position
PID64	0	-	Air flow control for supply ventilation - Manual override (0 = Disabled)

The flow rate is measured indirectly by reading the difference in pressure measured on the fan nozzle. Units with multiple fans only have the pressure difference measurement tap installed in one fan.

The controller calculates the air flow rate using the formula below.

$$Q = nk\sqrt{\Delta p}$$

Fig. 12 Formula for air flow rate calculation

where

- Q = calculated air flow rate (m^3/h);
- n = number of fans in the unit;
- k = constant relating to nozzle type;
- ΔP = pressure difference measured by controller (Pa).

The calculated value is compared with the setpoint stored in parameter “FA26”. The controller uses the PID components to change the analogue fan-controlling signal in order to achieve and keep the setpoint.

The dead band value stored in parameter “PID53” is provided to stabilise ventilation system operation.

The speed of the fans will, in any case, be set within the range of the minimum and maximum values stored in parameters "FA7" and "FA8" respectively in order to keep the stored flow rate setpoint.

Special conditions

If the device sensing the differential pressure on the fan nozzle experiences a malfunction, the controller will override the output that controls ventilation at the average value measured in the last 30 minutes.

If the unit has been in operation for less than 30 minutes, the controller will stop the unit and it will output the corresponding alarm.

3.9.3 Variable flow ventilation control

This function is used to change the air flow rate in the room as the temperature measured by the probe in the air return line changes with respect to the temperature setpoint.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
ST1	27.0	°C	Mechanical cooling - Temperature setpoint
STH1	20.0	°C	Mechanical heating / Auxiliary heating in winter mode - Temperature setpoint
FA71	300	10 m^3/h	Variable air flow control - Cooling / Heating - Min. flow rate setpoint
FA72	825	10 m^3/h	Variable air flow control - Cooling / Heating - Max. flow rate setpoint
FA73	2.0	°C	Variable air flow control - Cooling / Heating - Differenzial
FA74	0.0	°C	Variable air flow control - Cooling / Heating - Neutral zone
FA75	0.0	°C	Variable air flow control - Cooling / Heating - Offset
FA76	0	10 m^3/h	Variable / constant air flow control - Cooling / Heating - New air flow setpoint when the temperature setpoint is reached
FA77	0	-	Variable / constant air flow control - Cooling / Heating - Enabling of new air flow setpoint when the temperature setpoint is reached
FA81	0	10 m^3/h	Variable / constant air flow control - Defrost - New air flow setpoint
FA82	0	-	Variable / constant air flow control - Defrost - Enabling of new air flow setpoint
PID47	25	-	Air flow control for supply ventilation - Kp
PID48	15	-	Air flow control for supply ventilation - Ki
PID49	0	-	Air flow control for supply ventilation - Kd
PID53	50	10 m^3/h	Air flow control for supply ventilation - Dead band
PID55	1	-	Air flow control for supply ventilation - Dead band position
PID64	0	-	Air flow control for supply ventilation - Manual override (0 = Disabled)

The temperature setpoint used to calculate the flow rate setpoint is the cooling or heating temperature setpoint, depending on which of the two operating modes is enabled.

The flow rate is measured indirectly by reading the difference in pressure measured on the fan nozzle. Units with multiple fans only have the pressure difference measurement tap installed in one fan.

The controller calculates the air flow rate using the formula below.

$$Q = nk\sqrt{\Delta p}$$

Fig. 13 Formula for air flow rate calculation where

- Q = calculated air flow rate (m³/h);
- n = number of fans in the unit;
- k = constant relating to nozzle type;
- ΔP = pressure difference measured by controller (Pa).

Below is a graphic representation of the flow rate variation as the temperature measured by the reference probe changes.

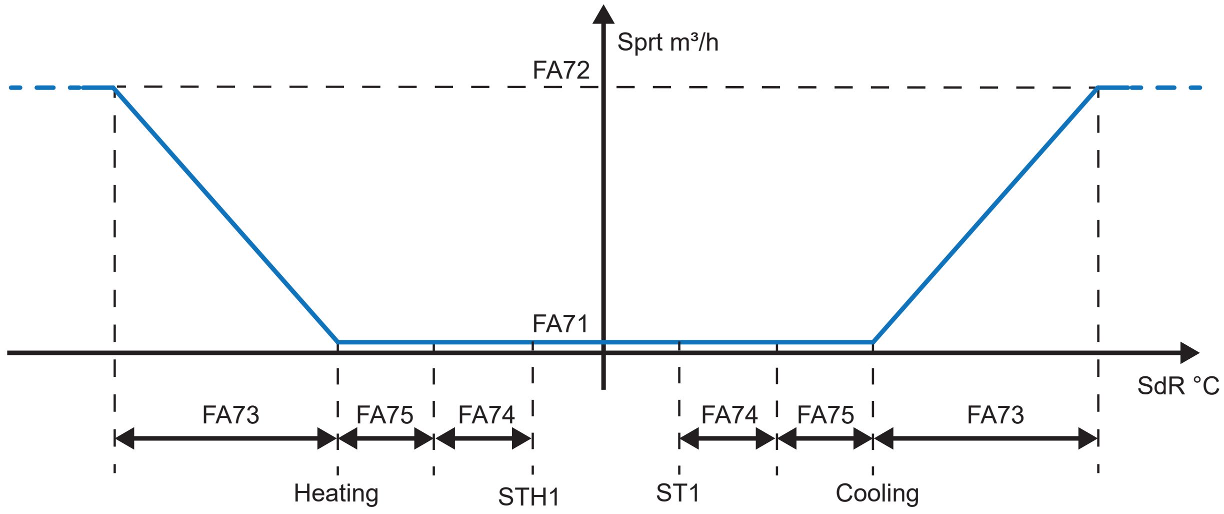


Fig. 14 Graphic representation of flow setpoint calculation

In addition to the parameters listed in the table, the abbreviations in the graph are:

- SdR = reference temperature probe;
- Sprt = flow rate setpoint;
- Heating = heating demand;
- Cooling = cooling demand.

The controller modulates the flow rate between the min. setpoint stored in parameter “FA71” - when the temperature measured by the probe on the return line is equal to the temperature setpoint stored in parameter “ST1” or “STH1” (depending on enabled operating mode) or in the neutral zone - and the max. value set in parameter “FA72” - when the reference temperature corresponds to the max. temperature required for either the heating or cooling cycle.

The controller varies the air flow setpoint proportionally within the min. and max. temperature values demanded in both heating and cooling mode and it attempts to achieve and keep this setpoint via a PID component.

The dead band value stored in parameter “PID53” is provided to stabilise ventilation system operation.

3.9.4 Ventilation control at constant pressure

This function is used to change the fan speed, keeping constant the pressure at the reference point in the air channel, with respect to the setpoint value.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
FA7	30	%	Minimum speed
FA8	100	%	Maximum speed
FA15	1	-	Variable air flow control
FA33	30.0	Pa	Constant pressure control - Pressure setpoint
FA34	10.0	Pa	Constant pressure control - Min. pressure setpoint
FA35	100.0	Pa	Constant pressure control - Max. pressure setpoint
FA36	2.0	Pa	Constant pressure control - Neutral area
FA37	5.0	Pa	Constant pressure control - Differential required for decrement
FA38	5.0	Pa	Constant pressure control - Differential required for increment
FA39	30	s	Constant pressure control - Max. increment time
FA40	15	s	Constant pressure control - Min. increment time
FA41	40	s	Constant pressure control - Max. decrement time
FA42	20	s	Constant pressure control - Min. decrement time
FA43	10	%	Constant pressure control - Max. increment amplitude
FA44	1	%	Constant pressure control - Min. increment amplitude
FA45	10	%	Constant pressure control - Max. decrement amplitude
FA46	1	%	Constant pressure control - Min. decrement amplitude

Below is a graphical representation of the parameters involved in ventilation control in order to achieve and keep the pressure value stored in the setpoint at the measurement point.

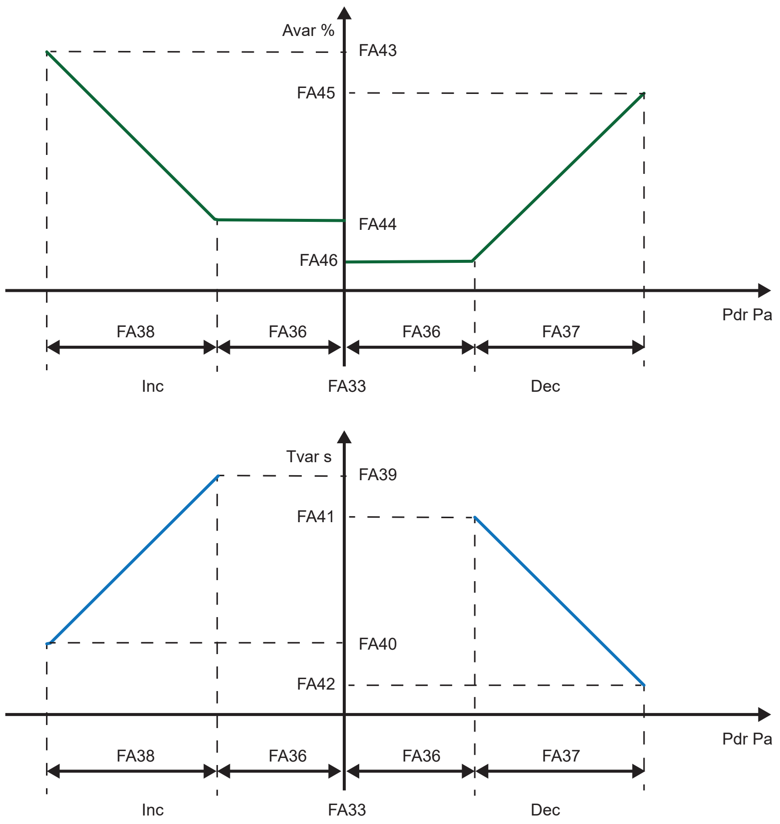


Fig. 15 Images showing the percentage and time variation as pressure changes

In addition to the parameters listed in the table, the abbreviations in the graph have the following meanings:

- PdR = pressure measured at the reference point;
- Avar = percentage value of "amplitude" variation;
- Tvar = delay between two consecutive demands for ventilation variation;
- Inc = increment;
- Dec = decrement.

The controller measures the pressure value at the reference point and compares it with the setpoint value stored in parameter "FA33".

A dead zone exists below and above the setpoint which corresponds to the value set in parameter "FA36".

If the measured value is lower than the setpoint minus the dead zone ("FA33" - "FA36"), the controller calculates the percentage increment and the delay between the two ventilation variations using the values set in the relevant temperature/humidity control parameters.

If the measured value is higher than the setpoint plus the dead zone ("FA33" + "FA36"), the controller calculates the percentage decrement and the delay between the two ventilation variations using the values set in the relevant temperature/humidity control parameters.

The percentage ventilation is always limited by the minimum and maximum values set in parameters "FA7" and "FA8" respectively.

According to the values shown in the graphs, the greater the distance between the measured value and the setpoint, the higher the speed percentage variation and the shorter the time between two consecutive variations. On the other hand, the smaller the distance between the measured value and the setpoint, the smaller the speed percentage variation and the longer the time between two consecutive variations.

If the temperature/humidity control parameters need to be edited, the new entered values must be consistent with the set parameters.

Special conditions

If the device sensing the pressure at the reference point experiences a malfunction, the controller will override the output that controls ventilation at the average value measured in the last 30 minutes.

If the unit has been in operation for less than 30 minutes, the controller will stop the unit and it will output the corresponding alarm.

3.9.5 Ventilation control with constant pressure difference

This function is used to change the fan speed, keeping constant the difference in the pressure values measured between the reference point in the air channel and the room, with respect to the setpoint value.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
FA7	30	%	Minimum speed
FA8	100	%	Maximum speed
FA16	1	-	Constant pressure difference control
FA49	10.0	Pa	Constant pressure difference control - Pressure delta setpoint
FA50	-50.0	Pa	Constant pressure difference control - Min. pressure difference setpoint
FA51	50.0	Pa	Constant pressure difference control - Max. pressure difference setpoint
FA52	2.0	Pa	Constant pressure difference control - Neutral area
FA53	5.0	Pa	Constant pressure difference control - Differential required for decrement
FA54	5.0	Pa	Constant pressure difference control - Differential required for increment
FA55	30	s	Constant pressure difference control - Max. increment time
FA56	15	s	Constant pressure difference control - Min. increment time
FA57	40	s	Constant pressure difference control - Max. decrement time
FA58	20	s	Constant pressure difference control - Min. decrement time
FA59	10	%	Constant pressure difference control - Max. increment amplitude
FA60	1	%	Constant pressure difference control - Min. increment amplitude
FA61	10	%	Constant pressure difference control - Max. decrement amplitude
FA62	1	%	Constant pressure difference control - Min. decrement amplitude

Below is a graphical representation of the parameters involved in ventilation control in order to achieve and keep the pressure difference stored in the setpoint at the measurement point.

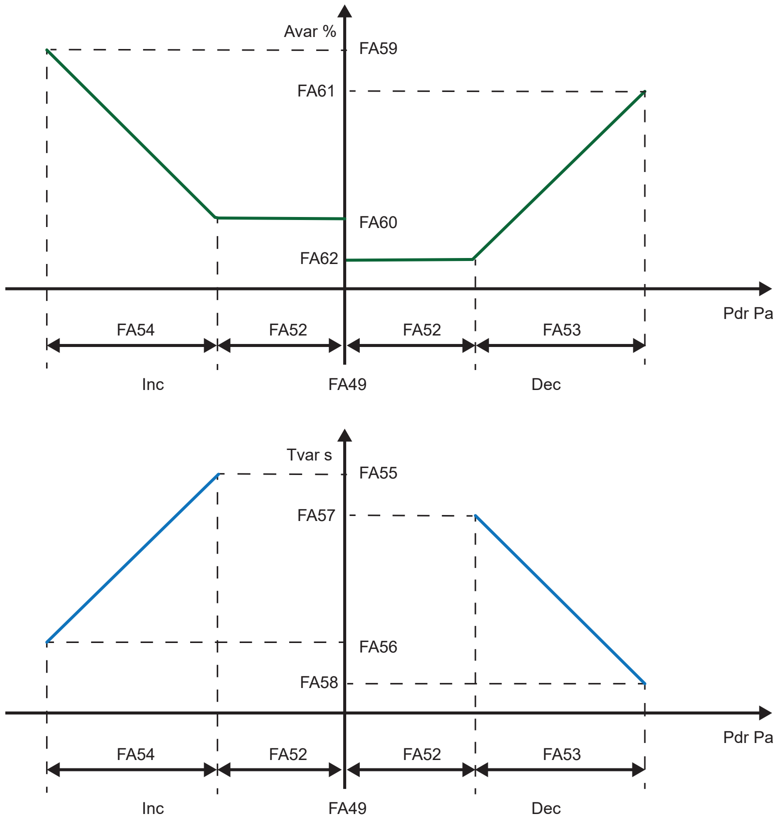


Fig. 16 Images showing the percentage and time variation as the pressure difference changes

In addition to the parameters listed in the table, the abbreviations in the graph have the following meanings:

- PdR = pressure measured at the reference point;
- Avar = percentage value of "amplitude" variation;
- Tvar = delay between two consecutive demands for ventilation variation;
- Inc = increment;
- Dec = decrement.

The controller measures the pressure difference at the reference point and compares it with the setpoint value stored in parameter "FA49".

A dead zone exists below and above the setpoint which corresponds to the value set in parameter "FA52".

If the measured value is lower than the setpoint minus the dead zone ("FA49" - "FA52"), the controller calculates the percentage increment and the delay between the two ventilation variations using the values set in the relevant temperature/humidity control parameters.

If the measured value is higher than the setpoint plus the dead zone ("FA49" + "FA52"), the controller calculates the percentage decrement and the delay between the two ventilation variations using the values set in the relevant temperature/humidity control parameters.

The percentage ventilation is always limited by the minimum and maximum values set in parameters "FA7" and "FA8" respectively.

According to the values shown in the graphs, the greater the distance between the measured pressure difference and the setpoint, the higher the speed percentage variation and the shorter the time between two consecutive variations. On the other hand, the smaller the distance between the measured pressure difference and the setpoint, the smaller the speed percentage variation and the longer the time between two consecutive variations.

If the temperature/humidity control parameters need to be edited, the new entered values must be consistent with the set parameters.

Special conditions

If the device sensing the pressure difference at the reference point experiences a malfunction, the controller will override the output that controls ventilation at the average value measured in the last 30 minutes.

If the unit has been in operation for less than 30 minutes, the controller will stop the unit and it will output the corresponding alarm.

3.9.6 Min. and max. temperature limitation in delivery line

If the temperature in the delivery line is very low in cooling mode or very high in heating mode, the controller is engaged to limit the temperature values.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
ST27	0	-	Cooling - Limitation of flow temperature - Sequence limitation devices
ST28	10.0	°C	Cooling - Limitation of flow temperature - activation threshold
ST29	0.5	°C	Cooling - Limitation supply temperature - deactivation differential
ST30	0.5	%	Cooling - Limitation of flow temperature - decrement Step
ST31	20	s	Cooling - Limitation supply temperature - Time between the decreases
STH129	0	-	Mechanical heating with auxiliary heating - Priority
STH154	0	-	Heating - Supply air limitation - Devices limitation sequence
STH155	45.0	°C	Heating - Supply air limitation - Activation threshold
STH156	2.0	°C	Heating - Supply air limitation - Deactivation differential
STH157	3.0	%	Heating - Supply air limitation - Step of decrease
STH158	15	s	Heating - Supply air limitation - Time between decreases

3.9.6.1 Min. temperature limitation in delivery line

If the temperature in the delivery line is lower than the setpoint in parameter “ST28”, the cooling capacity of the unit is limited.

Parameter “ST27” is used to set the sequence following which the devices are involved in the limitation process.

The limitation percentage is the value defined in parameter “ST30” and it is repeated for as long as the time stored in parameter “ST31”.

If the air temperature value in the delivery line rises again above the sum of the setpoints in parameters “ST28” and “ST29”, cooling capacity limitation is stopped and all the devices in operation follow the thermoregulation demand.

3.9.6.2 Max. temperature limitation in delivery line

If the temperature in the delivery line is higher than the setpoint in parameter “STH155”, the heating capacity of the unit is limited.

Parameters “STH154” and “STH129” are used to set the sequence following which the devices are involved in the limitation process.

The limitation percentage is the value defined in parameter “STH157” and it is repeated for as long as the time stored in parameter “STH158”.

If the air temperature value in the delivery line drops again below the value resulting from the difference between the setpoints in parameters “STH155” and “STH156”, heating capacity limitation is stopped and all the devices in operation follow the thermoregulation demand.

3.9.7 Special conditions

There are some operating modes during which the controller adjusts ventilation in a special way.

3.9.7.1 Ventilation management during defrosting

For enhanced room comfort during the defrost cycle, the fan in the delivery line follows the setpoint in parameter “FA81”. This only applies when either a constant or variable flow control is featured and parameter “FA82” is set to “1”.

Reduced air flow during the defrost cycle enhances room comfort, but it also reduces the efficiency of the defrost cycle.

Great attention should be paid when setting reduced flow parameters.

Very low flow values may cancel the defrost cycle efficiency.

3.9.7.2 Ventilation management during dehumidification

In cases when priority is given to dehumidification or when the dehumidification function only is enabled and ventilation is controlled based on the flow rate (constant or variable/percentage), operation is set to follow the dehumidification flow rate setpoints.

The setpoint value is entered in parameter “FA11”.

3.9.8 Ventilation in return line

The table shows the ventilation parameters for the various functions connected.

Parameter	Min	Max	UM	Description
RFA4	0	999	s	Delay time to fan switch-off
RFA6	0	999	s	Delay time to return fan switch-on from On unit
RFA7	0	100	%	Minimum speed
RFA8	15	100	%	Maximum speed
RFA9	0	100	%	Manual override (0 = Disabled)
RFA11	375	900	10 m^3/h	Fixed speed in de-humidification mode (0 = Disabled)
RFA25	375	900	10 m^3/h	Leak detector - Flow rate setpoint
RFA26	375	900	10 m^3/h	PID - Constant air flow control - Flow rate setpoint
RFA27	0	900	10 m^3/h	PID - Constant air flow / pecentage air flow control - Min. flow rate setpoint
RFA28	375	9999	10 m^3/h	PID - Constant air flow / pecentage air flow control - Max. flow rate setpoint
RFA29	0	9999	10 m^3/h	PID - Constant air flow control - New air flow setpoint when the temperature setpoint is reached
RFA30	0	1	-	PID - Constant air flow control - Enabling of new air flow setpoint when the temperature setpoint is reached
RFA31	0	9999	10 m^3/h	PID - Constant air flow control - Defrost - New air flow setpoint
RFA32	0	1	-	PID - Constant air flow control - Defrost - Enabling of new air flow setpoint
RFA33	10.0	100.0	Pa	Constant pressure control - Pressure setpoint
RFA34	0.0	100.0	Pa	Constant pressure control - Min. pressure setpoint
RFA35	10.0	3270.0	Pa	Constant pressure control - Max. pressure setpoint
RFA36	0.0	3270.0	Pa	Constant pressure control - Neutral area
RFA37	0.0	3270.0	Pa	Constant pressure control - Differential required for decrement
RFA38	0.0	3270.0	Pa	Constant pressure control - Differential required for increment
RFA39	15	999	s	Constant pressure control - Max. increment time
RFA40	0	60	s	Constant pressure control - Min. increment time
RFA41	15	999	s	Constant pressure control - Max. decrement time
RFA42	0	60	s	Constant pressure control - Min. decrement time
RFA43	1	100	%	Constant pressure control - Max. increment amplitude
RFA44	0	5	%	Constant pressure control - Min. increment amplitude
RFA45	1	100	%	Constant pressure control - Max. decrement amplitude
RFA46	0	5	%	Constant pressure control - Min. decrement amplitude
RFA47	0	9999	10h	Threshold for “fan operating hours exceeded” alarm (0 = Disabled)
RFA49	-50.0	50.0	Pa	Constant pressure difference control - Pressure delta setpoint
RFA50	-3270.0	50.0	Pa	Constant pressure difference control - Min. pressure difference setpoint
RFA51	-50.0	3270.0	Pa	Constant pressure difference control - Max. pressure difference setpoint
RFA52	0.0	3270.0	Pa	Constant pressure difference control - Neutral area
RFA53	0.0	3270.0	Pa	Constant pressure difference control - Differential required for decrement
RFA54	0.0	3270.0	Pa	Constant pressure difference control - Differential required for increment
RFA55	15	999	s	Constant pressure difference control - Max. increment time
RFA56	0	60	s	Constant pressure difference control - Min. increment time
RFA57	15	999	s	Constant pressure difference control - Max. decrement time
RFA58	0	60	s	Constant pressure difference control - Min. decrement time
RFA59	1	100	%	Constant pressure difference control - Max. increment amplitude
RFA60	0	5	%	Constant pressure difference control - Min. increment amplitude
RFA61	1	100	%	Constant pressure difference control - Max. decrement amplitude
RFA62	0	5	%	Constant pressure difference control - Min. decrement amplitude
RFA67	0	10000	-	PID - Constant air flow / pecentage air flow control - Kp
RFA68	0	10000	-	PID - Constant air flow / pecentage air flow control - Ki
RFA69	0	10000	-	PID - Constant air flow / pecentage air flow control - Kd

Parameter	Min	Max	UM	Description
RFA75	0	2	-	PID - Constant air flow / pecentage air flow control - Dead band position
RFA84	0	10000	-	PID - Constant air flow / pecentage air flow control - Manual override (0 = Disabled)
RFA120	-100	100	%	PID - Pecentage air flow control - Air flow setpoint increment / decrement compared to the supply ventilation air flow setpoint

3.9.9 Constant flow ventilation control

This function is designed to control the air flow rate in the room at a constant value. The controller modulates the fan to keep the air flow rate measured by the unit at a constant and equal value to the setpoint under changing work conditions (for instance, progressive filter fouling, changes in the opening of temperature/humidity control dampers, if any, etc.).

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
RFA26	750	10 m^3/h	PID - Constant air flow control - Flow rate setpoint
RFA27	375	10 m^3/h	PID - Constant air flow / pecentage air flow control - Min. flow rate setpoint
RFA28	900	10 m^3/h	PID - Constant air flow / pecentage air flow control - Max. flow rate setpoint
RFA67	10	-	PID - Constant air flow / pecentage air flow control - Kp
RFA68	15	-	PID - Constant air flow / pecentage air flow control - Ki
RFA69	0	-	PID - Constant air flow / pecentage air flow control - Kd
RFA73	50	10m3/h	PID - Constant air flow / pecentage air flow control - Dead band
RFA75	1	-	PID - Constant air flow / pecentage air flow control - Dead band position
RFA84	0	-	PID - Constant air flow / pecentage air flow control - Manual override (0 = Disabled)

The flow rate is measured indirectly by reading the difference in pressure measured on the fan nozzle. Units with multiple fans only have the pressure difference measurement tap installed in one fan.

The controller calculates the air flow rate using the formula below.

$$Q = nk\sqrt{\Delta p}$$

Fig. 17 Formula for air flow rate calculation

where

- Q = calculated air flow rate (m^3/h);
- n = number of fans in the unit;
- k = constant relating to nozzle type;
- ΔP = pressure difference measured by controller (Pa).

The calculated value is compared with the setpoint stored in parameter “RFA26”. The controller uses the PID components to change the analogue fan-controlling signal in order to achieve and keep the setpoint.

A dead band value stored in parameter “RFA73” is provided to stabilise operation of the ventilation system.

The speed of the fans will, in any case, be set within the range of the minimum and maximum values stored in parameters “RFA7” and “RFA8” respectively in order to keep the flow rate setpoint.

3.9.10 Ventilation control at constant pressure

This function is used to change the fan speed, keeping constant the pressure at the reference point in the air channel, with respect to the setpoint value.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
RFA7	30	%	Minimum speed
RFA8	100	%	Maximum speed
RFA33	30.0	Pa	Constant pressure control - Pressure setpoint
RFA34	10.0	Pa	Constant pressure control - Min. pressure setpoint
RFA35	100.0	Pa	Constant pressure control - Max. pressure setpoint
RFA36	2.0	Pa	Constant pressure control - Neutral area
RFA37	5.0	Pa	Constant pressure control - Differential required for decrement
RFA38	5.0	Pa	Constant pressure control - Differential required for increment
RFA39	60	s	Constant pressure control - Max. increment time
RFA40	15	s	Constant pressure control - Min. increment time
RFA41	60	s	Constant pressure control - Max. decrement time
RFA42	15	s	Constant pressure control - Min. decrement time
RFA43	5	%	Constant pressure control - Max. increment amplitude
RFA44	1	%	Constant pressure control - Min. increment amplitude
RFA45	5	%	Constant pressure control - Max. decrement amplitude
RFA46	1	%	Constant pressure control - Min. decrement amplitude

Below is a graphical representation of the parameters involved in ventilation control in order to achieve and keep the pressure value stored in the setpoint at the measurement point.

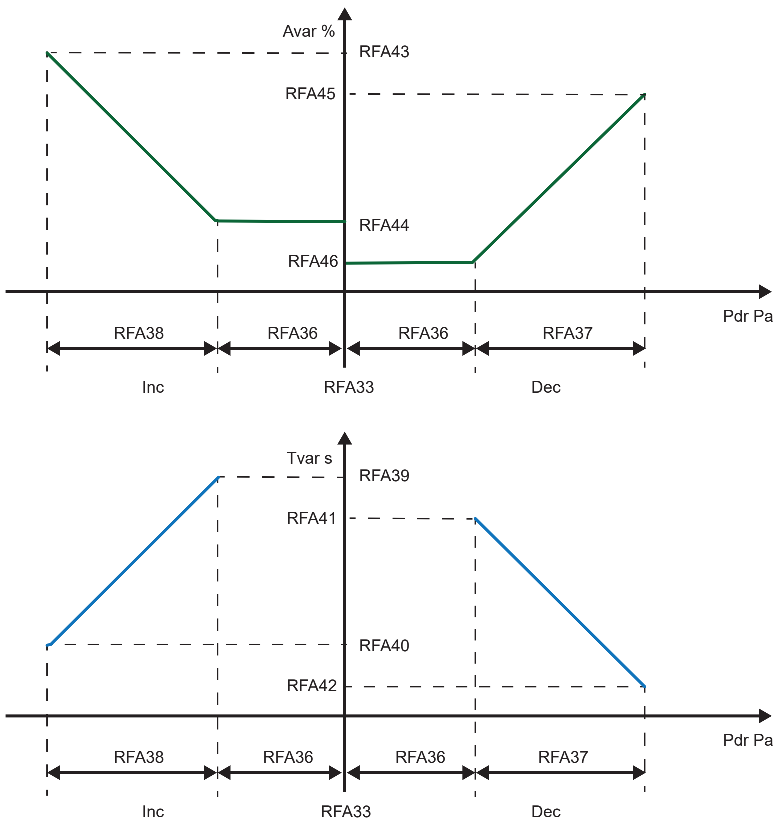


Fig. 18 Images showing the percentage and time variation as pressure changes

In addition to the parameters listed in the table, the abbreviations in the graph have the following meanings:

- PdR = pressure measured at the reference point;
- Avar = percentage value of “amplitude” variation;
- Tvar = delay between two consecutive demands for ventilation variation;
- Inc = increment;
- Dec = decrement.

The controller measures the pressure value at the reference point and compares it with the setpoint value stored in parameter “RFA33”.

A dead zone exists below and above the setpoint which corresponds to the value set in parameter “RFA36”.

If the measured value is lower than the setpoint minus the dead zone (“RFA33” - “RFA36”), the controller calculates the increment percentage and the delay between the two ventilation variations using the values set in the relevant setup parameters.

If the measured value is higher than the setpoint plus the dead zone (“RFA33” + “RFA36”), the controller calculates the decrement percentage and the delay between the two ventilation variations using the values set in the relevant setup parameters.

The ventilation percentage is always limited by the minimum and maximum values set in parameters “RFA7” and “RFA8” respectively.

According to the values shown in the graphs, the greater the distance between the measured value and the setpoint, the higher the speed percentage variation and the shorter the time between two consecutive variations. On the other hand, the smaller the distance between the measured value and the setpoint, the smaller the speed percentage variation and the longer the time between two consecutive variations.

If the temperature/humidity control parameters need to be edited, the new entered values must be consistent with the set parameters.

Special conditions

If the device sensing the pressure at the reference point experiences a malfunction, the controller will override the output that controls ventilation at the average value measured in the last 30 minutes.

If the unit has been in operation for less than 30 minutes, the controller will stop the unit and it will output the corresponding alarm.

3.9.11 Ventilation control with constant pressure difference

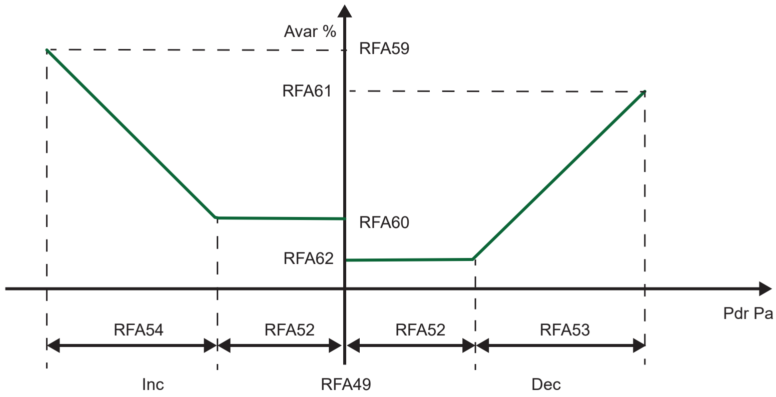
This function is used to change the fan speed, keeping constant the difference in the pressure values measured between the reference point in the air channel and the room, with respect to the setpoint value.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
RFA7	30	%	Minimum speed
RFA8	100	%	Maximum speed
RFA49	10.0	Pa	Constant pressure difference control - Pressure delta setpoint
RFA50	-50.0	Pa	Constant pressure difference control - Min. pressure difference setpoint
RFA51	50.0	Pa	Constant pressure difference control - Max. pressure difference setpoint
RFA52	2.0	Pa	Constant pressure difference control - Neutral area
RFA53	5.0	Pa	Constant pressure difference control - Differential required for decrement
RFA54	5.0	Pa	Constant pressure difference control - Differential required for increment
RFA55	60	s	Constant pressure difference control - Max. increment time
RFA56	15	s	Constant pressure difference control - Min. increment time
RFA57	60	s	Constant pressure difference control - Max. decrement time
RFA58	15	s	Constant pressure difference control - Min. decrement time
RFA59	5	%	Constant pressure difference control - Max. increment amplitude
RFA60	1	%	Constant pressure difference control - Min. increment amplitude
RFA61	5	%	Constant pressure difference control - Max. decrement amplitude
RFA62	1	%	Constant pressure difference control - Min. decrement amplitude

Below is a graphical representation of the parameters involved in ventilation control in order to achieve and keep the pressure difference stored in the setpoint at the measurement point.



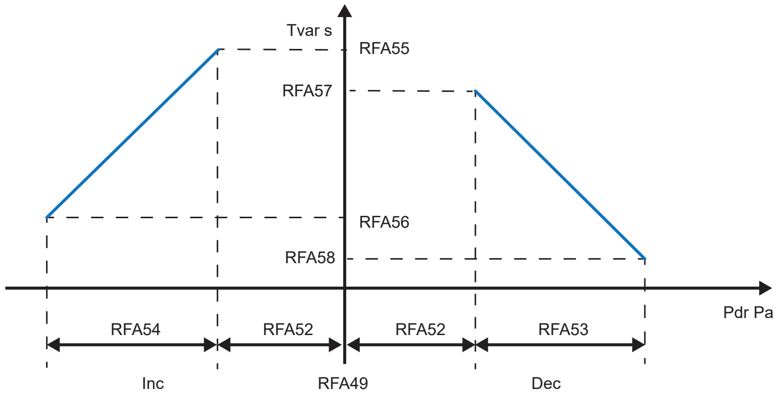


Fig. 19 Images showing the percentage and time variation as the pressure difference changes

In addition to the parameters listed in the table, the abbreviations in the graph have the following meanings:
- PdR = pressure measured at the reference point;
- Avar = percentage value of “amplitude” variation;
- Tvar = delay between two consecutive demands for ventilation variation;
- Inc = increment;
- Dec = decrement.

The controller measures the pressure difference at the reference point and compares it with the setpoint value stored in parameter “RFA49”.

A dead zone exists below and above the setpoint which corresponds to the value set in parameter “RFA52”.

If the measured value is lower than the setpoint minus the dead zone (“RFA49” - “RFA52”), the controller calculates the increment percentage and the delay between the two ventilation variations using the values set in the relevant setup parameters.

If the measured value is higher than the setpoint plus the dead zone (“RFA49” + “RFA52”), the controller calculates the decrement percentage and the delay between the two ventilation variations using the values set in the relevant control parameters.

The ventilation percentage is always limited by the minimum and maximum values set in parameters “RFA7” and “RFA8” respectively.

According to the values shown in the graphs, the greater the distance between the measured pressure difference and the setpoint, the higher the speed percentage variation and the shorter the time between two consecutive variations. On the other hand, the smaller the distance between the measured pressure difference and the setpoint, the smaller the speed percentage variation and the longer the time between two consecutive variations.

If the temperature/humidity control parameters need to be edited, the new entered values must be consistent with the set parameters.

Special conditions

If the device sensing the pressure difference at the reference point experiences a malfunction, the controller will override the output that controls ventilation at the average value measured in the last 30 minutes.

If the unit has been in operation for less than 30 minutes, the controller will stop the unit and it will output the corresponding alarm.

3.9.12 Ventilation control based on a percentage of the delivery value

This ventilation function is used to set the speed of the fans in the return line at a fixed percentage value to the fan speed in the delivery line.

This function is designed to change the speed of the fans in the return line by defining a percentage air flow increment/ decrement to the air flow setpoint value of the fan in the delivery line.

Parameter “RFA120” must be filled with the percentage variation value. The speed is lower if the setpoint is negative or higher if the setpoint is positive. If the parameter setpoint is zero, the fans have all the same speed.

For instance. If the value of parameter “RFA120” is set to “-10”, the speed of the fans in the return line is 10% lower than the speed of the fans in the delivery line.

If ventilation control in the **delivery line** is set to variable flow, the controller automatically overrides ventilation control in the return line to a value which is equal to the percentage difference set in parameter “RFA120”.

3.9.13 Special conditions

There are some operating modes during which the controller adjusts ventilation in a special way.

3.9.13.1 Ventilation management during defrosting

For enhanced room comfort during the defrost cycle, the fan in the return line follows the setpoint in parameter “RFA31”. This only applies when constant flow control is featured or when variable flow control is featured in the delivery line and parameter “RFA32” is set to “1”.

Reduced air flow during the defrost cycle enhances room comfort, but it also reduces the efficiency of the defrost cycle.

Great attention should be paid when setting reduced flow parameters.

Very low flow values may cancel the defrost cycle efficiency.

3.9.13.2 Ventilation management during dehumidification

In cases when priority is given to dehumidification or when the dehumidification function only is enabled and ventilation is controlled based on the flow rate (constant or variable/percentage), operation is set to follow the dehumidification flow rate setpoints.

The setpoint value is entered in parameter “RFA11”.

3.10 Power supply control

Units may be supplied with devices for protection against incorrect connections of the phase sequence or voltage variations outside the required limits during operation.

Protections consist in relays which output an alarm signal to one digital input in the controller through an electric contact (the digital input concerned is shown in the wiring diagram).

The unit can be fitted with one relay to monitor correct phase sequence or one relay to monitor the power voltage or one relay to manage both these functions.

Parameter “CF17” is set up at the factory depending on the featured relay to manage the relevant function.

3.10.1 Phase sequence

A dedicated relay is fitted to manage incorrect connection of the phase sequence to the unit. If the phase sequence is connected incorrectly, the relay opens an electric contact that triggers alarm “AL55” on the controller display.

Incorrect connection of the phase sequence may be experienced upon unit installation or when work is performed on the power supply line.

Power supply must be swithced off to the unit to make the connection correctly. The alarm is cleared as soon as the unit is switched on again.

3.10.2 Min. / Max. voltage

The controller is designed to manage potential conditions where the variation of the power voltage to the unit experiences a significant deviation from the expected values.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
CF17	1	-	Power alarm management

When the min. and max. voltage relay trips, the controller stops the unit and causes an alarm message to appear on the display.

The value entered in parameter “CF17” and the supply or not of emergency power (“ultracap”), which is required to keep the controller in operation, affect the alarm displayed and unit restarting.

If parameter “CF17” is set to “0”, alarm “AL55” appears; if the parameter is set to “1”, alarm “AL201” appears.

Both alarms are reset automatically as soon as power is restored to nominal values; normal unit operation, on the other hand, is delayed by the time setpoint in parameter “CO30”.

Where emergency power is available, the unit is restarted quickly (“Fast Restart” function).

3.10.3 Fast Restart

Activation of the “Fast Restart” function, provided that an “ultracap” is fitted to keep the controller electrically powered, is designed to minimise as much as possible the delay experienced in restarting the compressors fitted in the unit.

This is possible because the controller starts counting the minimum time to OFF as soon as a switch-off is started due to a blackout.

The controller detects problems with the main power supply through a digital input and manages them as alarms.

To protect the integrity of the compressors, the controller manages the maximum number of starts per hour by means of the delay between two consecutive starts.

Quick restart after a blackout depends on the thermoregulation demand. As soon as the demand for cooling or dehumidification is received, the min. off time and the time between two consecutive activations of one single compressor are shortened.

The “Fast Restart” function does not jeopardise the conditions of the compressors as it limits the number of quick starts over the space of an hour or a day.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
CO2	180	s	Min. switch-off time
CO3	30	10s	Minimum time between 2 activations of the same compressor
CO4	30	s	Min. time between activation of 2 compressors
CO28	0	-	Fast Restart - Enable function
CO30	5	s	Fast Restart - Delay in alarm clearing AL201 / AL192 (voltage failure)
CO54	30	s	Fast Restart - Min. switch-off time
CO55	3	10s	Fast restart - Min. time between 2 activations of one single compressor
CO56	30	s	Fast restart - Min. time between activation of 2 compressors
FA19	20	s	Thermoregulation delay in cooling / heating / humidification mode from unit On
FA20	10	s	Fast restart - Thermoregulation delay in cooling / heating / humidification mode from unit On
PAL33	2	-	Fast restart - Max. number of alarms per hour
PAL66	4	-	Fast restart - Max. number of alarms in last 24 hours

After clearing a “no voltage” alarm that causes the unit to stop, the unit can be restarted in a shorter time than a standard start-up procedure if parameter “CO28” is set in such way as to enable the “Fast Restart” function and an “ultracap” is fitted to power the controller.

The delay within which the controller activates a demand for thermoregulation after unit start-up must be reduced from the value in parameter “FA19” to that in parameter “FA20”.

The times the controller uses for normal start-up set in parameters “CO2”, “CO3” and “CO4” are replaced with the corresponding values in parameters “CO54”, CO55” and “CO56”.

The number of fast restarts is limited over an hour by the value in parameter “PAL33” and over twenty-four hours by the value in parameter “PAL66”.

If the “Fast Restart” function is stopped, the unit is started up according to standard times the next time a power failure or blackout alarm triggers.

If the max. number of restarts over an hour or twenty-four hours is achieved, alarm messages - “AL191” and “AL192” respectively - are activated, which are reset automatically after the relevant monitoring time.

Warning messages appearing to warn about the max. number of fast restarts over an hour (“AL191”) or twenty-four hours (“AL192”) having been achieved cannot be reset manually.

3.11 Circuits and compressors

The start-up procedure and operating sequence are defined according to the number of refrigerant circuits and the number of compressors featured.

Units may be supplied with either one or two refrigerant circuits and each circuit can fit either one or two compressors. One of the compressors in the unit can be variable speed and inverter-controlled type.

All the parameters involved in these management methods are shown in the table.

Parameter	Min	Max	UM	Description
CF12	0	2	-	Compressor type in circuit 1
CO1	0	999	s	Minimum ON time
CO2	0	999	s	Minimum OFF time
CO3	0	999	10 s	Minimum time between 2 activations of the same compressor
CO4	1	999	s	Time between the activation of 2 compressors
CO5	1	999	s	Time between the deactivation of 2 compressors
CO16	0	1	-	Criteria for selection of compressors in the selection of circuits

3.11.1 Starting and stopping of the compressors

Except in particular conditions, the compressors are started and stopped following a precise procedure.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
CF12	0	-	Compressor type in circuit 1
CO1	120	s	Minimum ON time
CO2	180	s	Minimum OFF time
CO3	30	10 s	Minimum time between 2 activations of the same compressor
CO4	30	s	Time between the activation of 2 compressors
CO5	15	s	Time between the deactivation of 2 compressors
CO16	1	-	Criteria for selection of compressors in the selection of circuits

After the unit has started, even though there is a thermoregulation request, the controller ensures compliance with the minimum OFF time of the compressors.

Below is the graph showing the actual thermoregulation demand and the respective compressor switch-ons and switch-offs in units featuring 2 ON/OFF compressors.

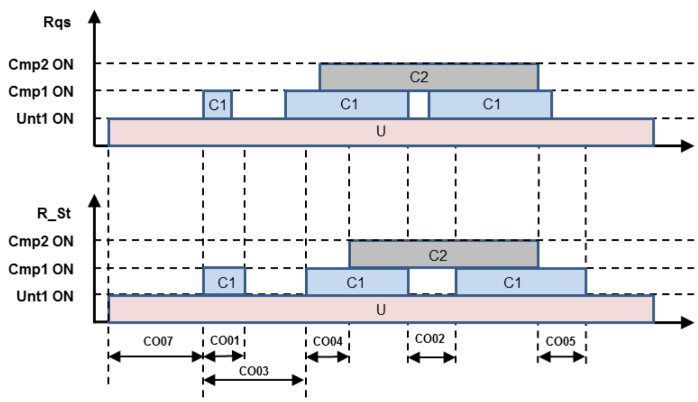


Fig. 20 Compressor management times

In the graph, beside the parameters of the function, there are the abbreviations that refer to:

- Rqs = thermoregulation request
- R_St = actual status
- Unt = reference to the unit
- Cmp1 = reference to compressor 1
- Cmp2 = reference to compressor 2

The controller starts up the compressors following the principle of the lower number of starts.

When the unit fits an inverter compressor (parameter “CF12” = 1), the inverter compressor gets started first and stops last. If the unit has at least other two compressors in addition to the inverter compressor, their start-up sequence follows the principle of the lower number of starts.

Excluding the inverter compressor, the other compressors are stopped in the same order as they have been started: the first compressor to get started is also the first to stop.

3.11.2 Management of compressor with inverter

The controller is designed for managing one inverter compressor on both single- and dual-circuit units.

The refrigerant circuit can consist of just the inverter compressor or of one inverter compressor and one ON/OFF compressor.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Min.	UM	Description
CO20	120	s	Inverter - Min. time before start-up
CO21	25	0,01%	Inverter - Step
CO22	1000	ms	Inverter - Ramp time
CO24	8	-	Inverter - Type of configured compressor

Below is a graphical representation of the operating sequence of an inverter compressor and an on/off compressor, based on the thermoregulation demand variation.

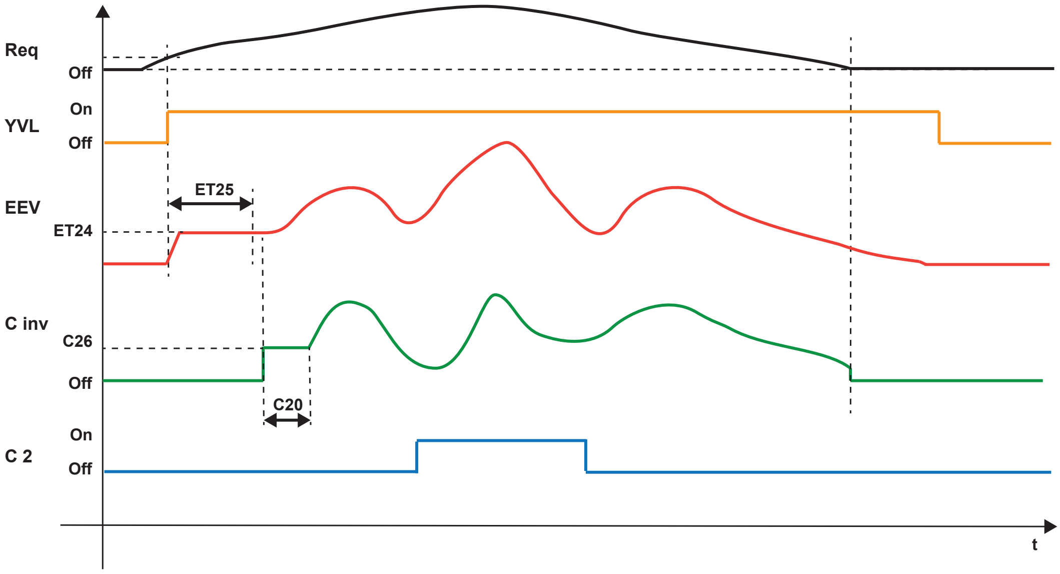


Fig. 21 Compressor start-up

In addition to the parameters present in the table, the other abbreviations in the graph indicate:

- Req = thermoregulation demand;
- YVL = status of solenoid valve in liquid line;
- EEV = status of electronic expansion valve;
- C inv = status of inverter compressor;
- C2 = status of ON/OFF compressor.
- t = time.

When the thermoregulation demand exceeds the percentage required for starting the inverter compressor, the controller feeds the solenoid valve in the liquid line (where fitted) and commands the electronic expansion valve to get pre-positioned at the number of pitches set in parameter “ET24”.

Irrespective of the thermoregulation demand, the percentage start-up speed is kept for the time set in parameter “CO20”. Once the time set in parameter “CO20” has elapsed, the compressor speed follows the thermoregulation demand.

If the thermoregulation demand exceeds the ON/OFF compressor activation value in the course of thermoregulation, the controller reduces the speed of the inverter compressor to the min. speed setpoint, after which it starts the ON/OFF compressor, on condition that the delays related to the functions of parameters “CO02”, “CO03” and “CO04” are met.

After ON/OFF compressor start-up, the variation of the thermoregulation demand will be fulfilled by changing the inverter compressor speed.

As the controller has no other compressors to start, the inverter compressor speed will be modulated from the min. to the max. value.

During thermoregulation the controller stops the ON/OFF compressor after the min. time of operation set in parameter “CO1” is met, if the thermoregulation demand causes the inverter compressor speed to drop below the min. value.

If the thermoregulation demand continues to drop, the inverter compressor will follow the decreasing demand and will consequently reduce its speed.

The speed of the inverter compressor will drop until the min. value and it will be kept unaltered until the thermoregulation demand goes down to zero.

When the thermoregulation demand is completed, the controller stops the inverter compressor. after a short delay, it closes the electronic expansion valve and the solenoid valve in the fluid line (where fitted).

In refrigerant circuits featuring an inverter compressor and an on-off compressor, when the inverter compressor resumes operation after an alarm while the on-off compressor is in operation, the controller resets the demand to the on-off compressor and stops it, after which it initiates a start-up procedure prioritising the inverter compressor.

3.11.3 Capacity reduction override

The unit capacity may need to be limited in some operating conditions.

Capacity limitation may be connected to the pressure values measured on the intake and delivery lines. All parameters concerning capacity reduction override are shown in the table.

Parameter	Min.	Max.	UM	Description
UN5	0.10	99.90	bar	High pressure - Prevention threshold
UN6	0.10	99.90	bar	High pressure - Prevention differential
UN9	0.10	99.90	bar	Low pressure - Prevention threshold
UN10	0.10	99.90	bar	Low pressure - Prevention differential
UN13	0	100	%	Max. percentage limit in circuit 1 with capacity reduction
UN14	0	100	%	Inverter scroll - Capacity reduction percentage override
UN15	0	100	%	Max. percentage limit in circuit 2 with capacity reduction
UN17	0	999	min	Capacity reduction activation time limit
UN18	0	999	min	Time between two capacity reductions of the same circuit

Capacity reduction induced by low pressure probe

The controller offers the opportunity to override reduction capacity in the refrigerant circuit in order to keep the intake pressure at higher values so as to prevent triggering alarms resulting from low pressure in the circuit.

The parameters involved are shown in the table.

Parameter	Value	UM	Description
UN9	6.50	bar	Low pressure - Prevention threshold
UN10	2.00	bar	Low pressure - Prevention differential
UN13	50	%	Max. percentage limit in circuit 1 with capacity reduction
UN14	42	%	Inverter scroll - Capacity reduction percentage override
UN15	50	%	Max. percentage limit in circuit 2 with capacity reduction
UN17	2	min	Capacity reduction activation time limit
UN18	2	min	Time between two capacity reductions of the same circuit

A graphical representation of capacity reduction due to low pressure is shown below.

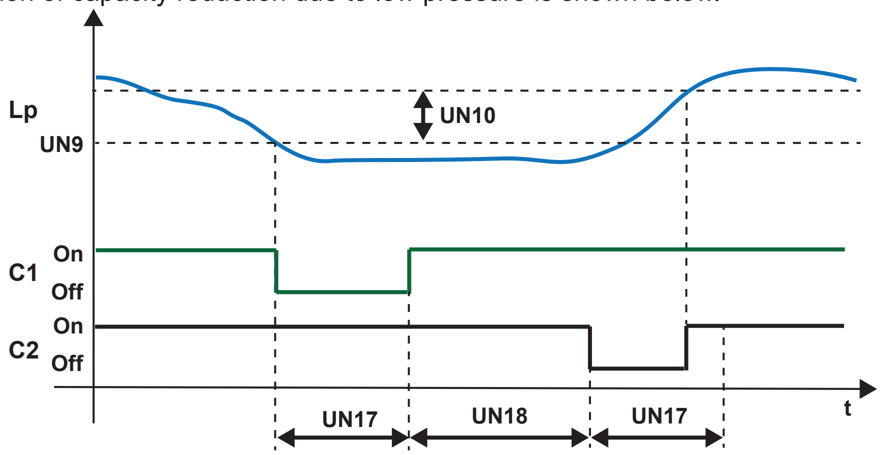


Fig. 22 Capacity reduction due to low pressure

In addition to the parameters present in the table, the other abbreviations in the graph indicate:

- Lp = variation of low pressure value;
- C1 = status of compressor 1;
- C2 = status of compressor 2.
- t = time

When the intake pressure value measured is lower than the setpoint in parameter “UN9”, the controller overrides capacity reduction in the corresponding refrigerant circuit.

The capacity reduction override depends on the type and number of compressors featured in the circuit.

If only one compressor is fitted in the circuit and it is inverter controlled, capacity is reduced by the setpoint value stored in parameter “UN14”. The value of parameter “UN13” in this case must be set to “100”.

If two compressors are fitted in the circuit and they are on-off type, capacity is reduced by the setpoint value stored in parameter “UN13”. The correct value to set in parameter “UN13” to switch off one of the two compressors is “50”.

If the circuit is fitted with one inverter-controlled and one on-off compressor and capacity needs to be reduced in the inverter compressor, the value in parameter “UN13” must be set to “100” and the value in parameter “UN14” must be set at the percentage value at which the inverter compressor is required to reduce its capacity. If capacity reduction is required to switch off the on-off compressor and to bring the inverter compressor to the speed setpoint recorded in parameter “UN14”, the value in parameter “UN13” must be set to “50” and the value in parameter “UN14” must be set at the percentage value at which the inverter compressor is required to reduce its capacity.

Capacity reduction override in circuits featuring one on-off compressor only is not managed.

The capacity reduction override is stopped when the intake pressure is higher than the setpoint value in parameter “UN9”, plus the value in parameter “UN10”, or after the time setpoint stored in parameter “UN17” has elapsed.

If the capacity reduction override is stopped after the time set in parameter “UN17”, but the condition persists for the time set in parameter “UN18”, the override is restored.

Capacity reduction induced by high pressure probe

The controller offers the opportunity to override reduction capacity in the refrigerant circuit in order to limit the delivery pressure and consequently prevent triggering alarms for high pressure in the circuit.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
UN5	37.00	bar	High pressure - Prevention threshold
UN6	2.0	bar	High pressure - Prevention differential
UN13	50	%	Max. percentage limit in circuit 1 with capacity reduction
UN14	42	%	Inverter scroll - Capacity reduction percentage override
UN15	50	%	Max. percentage limit in circuit 2 with capacity reduction
UN17	2	min	Capacity reduction activation time limit
UN18	2	min	Time between two capacity reductions of the same circuit

A graphical representation of capacity reduction due to low pressure is shown below.

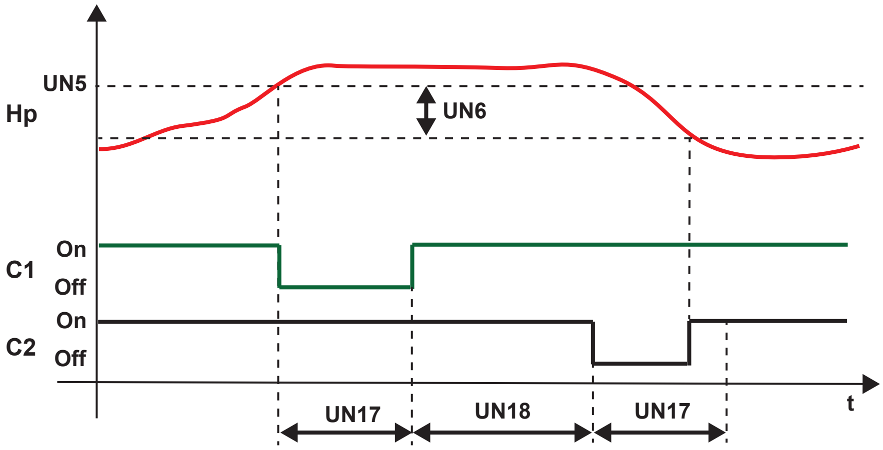


Fig. 23 Capacity reduction due to high pressure

In addition to the parameters present in the table, the other abbreviations in the graph indicate:

- Hp = variation of high pressure value
- C1 = status of compressor 1;
- C2 = status of compressor 2.
- t = time

When the delivery pressure value measured is higher than the setpoint in parameter “UN5”, the controller overrides capacity reduction in the corresponding refrigerant circuit.

The capacity reduction override depends on the type and number of compressors featured in the circuit.

If only one compressor is fitted in the circuit and it is inverter controlled, capacity is reduced by the setpoint value stored in parameter “UN14”. The value of parameter “UN13” in this case must be set to “100”.

If two compressors are fitted in the circuit and they are on-off type, capacity is reduced by the setpoint value stored in parameter “UN13”. The correct value to set in parameter “UN13” to switch off one of the two compressors is “50”.

If the circuit is fitted with one inverter-controlled and one on-off compressor and capacity needs to be reduced in the inverter compressor, the value in parameter “UN13” must be set to “100” and the value in parameter “UN14” must be set at the percentage value at which the inverter compressor is required to reduce its capacity. If capacity reduction is required to switch off the on-off compressor and to bring the inverter compressor to the speed setpoint recorded in parameter “UN14”, the value in parameter “UN13” must be set to “50” and the value in parameter “UN14” must be set at the percentage value at which the inverter compressor is required to reduce its capacity.

If the unit consists of two refrigerant circuits, the first circuit behaves as described above.

The second refrigerant circuit always features two on-off compressors and capacity is reduced by the setpoint value stored in parameter “UN15”. The correct value to set in parameter “UN15” to switch off one of the two compressors is “50”.

The capacity reduction override in circuits featuring one ON/OFF compressor only is not managed.

The capacity reduction override is stopped when the delivery pressure is lower than the setpoint value in parameter “UN5”, minus the value in parameter “UN6”, or after the time setpoint stored in parameter “UN17” has elapsed.

If the capacity reduction override is stopped after the time set in parameter “UN17”, but the condition persists for the time set in parameter “UN18”, the override is restored.

3.12 Circuits and compressors - Functions

The controller is fitted with functions that get activated in special conditions in order to ensure correct compressor operation.

All the parameters involved in these control functions are shown in the table.

Parameter	Min	Max	UM	Description
CO46	0	180	min	Oil return function - Delay in activation of “override compressors to ON”
CO47	0	180	min	Oil return function - Override compressors to ON time with function active
CO48	25	100	%	Oil return function - Capacity override percentage with function active
CO49	25	100	%	Oil return function - Percentage inverter threshold to activate function

If parameters “CO46” and “CO66” are set to “0”, the corresponding functions are disabled.

3.12.1 Oil return for compressors managed with inverter

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
CO46	30	min	Oil return function - Delay in activation of “override compressors to ON”
CO47	3	min	Oil return function - Override compressors to ON time with function active
CO48	75	%	Oil return function - Capacity override percentage with function active
CO49	35	%	Oil return function - Percentage inverter threshold to activate function

If the required cooling capacity involves operation of the compressor at a percentage lower than the value set in parameter "CO49", after the delay time set in parameter "CO46" has elapsed, the controller forces the operating percentage of the compressor to the value set in parameter "CO48" for a minimum time equal to the value set in parameter "CO47".

A graphical representation of the function is shown in the illustration.

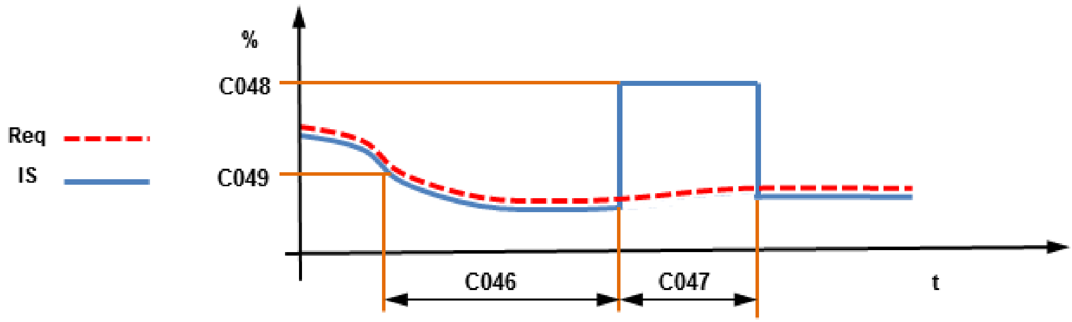


Fig. 24 Forcing of frequency for oil recovery

In addition to the parameters in the table, the following abbreviations appear in the figure:

- "IS" = refers to the inverter frequency trends;
- "Req" = refers to the thermoregulation demand.

When operating in on-off mode below the value stored in parameter “CO49”, the count of the delay relating to parameter “CO46” is in any case increased. The count of the delay relating to parameter “CO46” is only reset when the value is achieved due to an override or during normal operation according to the value set in parameter “CO48”.

If the inverter compressor is connected in parallel with ON/OFF compressors, the minimum refrigerant speed required for oil return is normally always guaranteed when an ON/OFF compressor is running at the same time as the inverter compressor.

3.13 Damper management

In addition to air change in the room, the controller can also manage other functions connected to comfort enhancement and system economy.

The functions the controller can handle vary according to the number of dampers fitted in the unit:

- units with 2 dampers - for fresh air with free cooling / free heating only;
- units with 3 dampers with fresh air, extraction and free cooling / free heating;
- units with 4 dampers with fresh air, extraction and built-in heat recovery system in addition to free cooling / free heating.

Dampers can be set either linearly or proportionally.

Units with two dampers

The dampers featured in 2-damper units include: a damper for fresh external air and a damper for recirculated air.

Normally, their operation is complementary, i.e. the percentage opening of the external air damper is equal to the percentage closing of the recirculated air damper.

Units with three dampers

The dampers featured in 3-damper units include: a damper for fresh air, a damper for exhaust air and a damper for recirculated air.

Normally, the external air damper opens at the same percentage as the exhaust air damper and the recirculated air damper is complementary to the other two. So, the percentage opening of the external air damper and the exhaust air damper is equal to the percentage closing of the recirculated air damper.

Units with four dampers

Units with four dampers feature the same dampers as 3-damper units plus one. The fourth damper is used for external air.

It is used to cause the external air to flow through the heat recovery system, when heat recovery is enabled, and it is closed in free cooling mode.

If the heat recovery system is not sized to provide for a 100% air flow in the unit, a fifth damper is actually fitted. This is an extra exhaust damper that is used by the unit in free cooling mode to bypass the heat recovery system.

The parameters involved are shown in the table.

Parameter	Min	Max	UM	Description
DA1	0	1	-	All dampers - Management mode
DA5	0	1	-	External air - FC / FH - Enabling mode
DA6	0.0	10.0	°C	External air - FC / FH - Temperature-based control - Temperature diff. required for enabling
DA7	0.0	1000.0	kJ/kg	External air - FC / FH - Enthalpy-based control - Enthalpy diff. required for enabling
DA8	-100.0	100.0	°C	External air - Summer / Winter FC - Temperature offset for regulation
DA9	0.0	100.0	°C	External air - Summer / Winter FC - Temperature diff. for regulation
DA10	-100.0	100.0	°C	External air - Winter FH - Offset for regulation
DA11	0.0	100.0	°C	External air - Winter FH - Diff. For regulation
DA12	0	100	%	External air - FC / FH - Min opening
DA13	30	100	%	External air - FC / FH - Max opening
DA14	0	1	-	External air - Heating - Closed in defrost
DA18	0	1	-	All dampers - Control mode
DA19	0	2500	ppm	External air - Environment air renewal - CO2 concentration setpoint for activation
DA20	0	2500	ppm	External air - Environment air renewal - CO2 concentration offset for regulation
DA21	0	2500	ppm	External air - Environment air renewal - CO2 concentration diff. for regulation
DA23	0.0	100.0	%	External air - Environment air renewal - VOC concentration setpoint for activation
DA24	0.0	100.0	%	External air - Environment air renewal - VOC concentration offset for regulation
DA25	0.0	100.0	%	External air - Environment air renewal - VOC concentration diff. for regulation

Parameter	Min	Max	UM	Description
DA28	0.00	99.90	bar	External air - Opening limitation - Summer oper. - Max cond. press. threshold for activation
DA29	0.00	99.90	bar	External air - Opening limitation - Summer oper. - Max cond. press. diff. for activation
DA30	0.00	99.90	bar	External air - Opening limitation - Summer oper. - Max evap. press. threshold for activation
DA31	0.00	99.90	bar	External air - Opening limitation - Summer oper. - Max evap. press. diff. for activation
DA32	0.00	99.90	bar	External air - Opening limitation - Winter oper. - Min cond. press. threshold for activation
DA33	0.00	99.90	bar	External air - Opening limitation - Winter oper. - Min cond. press. diff. for activation
DA34	0.00	99.90	bar	External air - Opening limitation - Winter oper. - Min evap. press. threshold for activation
DA35	0.00	99.90	bar	External air - Opening limitation - Winter oper. - Min evap. press. diff. for activation
DA36	0	60	%	External air - Opening limitation - Min opening for cond. press.
DA37	0	100	%	External air - Opening limitation - Max opening for cond. press.
DA38	0	60	%	External air - Opening limitation - Min opening for evap. press.
DA39	0	100	%	External air - Opening limitation - Max opening for evap. press.
DA40	0.00	50.00	bar	External air - Opening limitation - Deactivation diff. for cond. press.
DA41	0.00	30.00	bar	External air - Opening limitation - Deactivation diff. for evap. press.
DA43	0.0	50.0	°C	External air - Opening reduction for external air temperature - Summer temperature threshold
DA44	-20.0	16.0	°C	External air - Opening reduction for external air temperature - Winter temperature threshold
DA45	0	100	%	External air - Opening reduction for external air temperature - Min opening
DA46	0	300	s	External air - Opening reduction for external air temperature - Activation delay
DA48	0	100	%	External air - Dehumidification - Min opening
DA52	0	3	-	External air - Start up - Configuration
DA53	0	1	-	External air - Start up - Thermoregulation
DA54	0	999	min	External air - Start up - Wash duration
DA55	0	999	min	External air - Start up - Recirculation duration
DA61	0	10000	-	External air - PID - Adaptive control - Kp
DA62	0	10000	-	External air - PID - Adaptive control - Ki
DA63	0	10000	-	External air - PID - Adaptive control - Kd
DA67	0.0	25.0	°C	External air - PID - Adaptive control - Dead band
DA69	0	2	-	External air - PID - Adaptive control - Dead band position
DA91	0	100	%	Recirculation air - Min opening
DA92	10	100	%	Recirculation air - Max opening

3.13.1 Damper control

The controller can control the dampers in two different ways: “standard” and “adaptive”.

When dampers are required to stay in a fixed position, for instance to provide for the correct flow of fresh air, system conditions may exist in which the damper signal cannot guarantee the desired air percentage.

3.13.1.1 Standard control

Standard control requires that the dampers stay in their position irrespective of the actual fresh air percentage.

3.13.1.2 Adaptive control

Adaptive control corrects damper opening based on the necessary fresh air percentage. This control requires that the mixed air probe is fitted.

The controller uses the values of the air temperature in the return line, the external air temperature and the corresponding damper opening percentage to calculate the theoretical value of mixed air.

The controller compares the calculated mixed air value with the value actually measured and then uses a PID to correct the damper signal until the difference is cancelled.

3.13.2 Damper management

The controller can manage damper control either linearly or proportionally.

Linear control enables opening of the damper with a tilt angle that is equal to the required opening percentage.

Proportional control is designed to open the dampers so that the air can flow, i.e. at the required percentage of the max. possible opening.

All units featuring dampers are set by default to run a proportional control.

3.13.3 Unit start-up

When the unit is started up, specific damper adjustments may be required for some management functions.

If no washing or recycling cycle is to be run at unit start-up, the controller opens the dampers at the percentage value set for air changing, irrespective of their number.

3.13.4 Washing

Washing means changing the air in the room and it consists in exhausting all the air in the return line and only letting external air flow into the room.

If washing is required at unit start-up, parameter “DA52” must be set to “1”.

While the washing cycle is in progress, the controller keeps the exhaust air and external air dampers open at their max. opening percentage and it keeps the recirculated air damper in closed position for the time setpoint in parameter “DA54”.

If the value in parameter “DA53” is set to “0”, the washing cycle takes place without any thermoregulation of the air. If the value in parameter “DA53” is set to “1”, thermoregulation is active.

If the washing cycle is run with thermoregulation active, the position of the dampers may be affected by conditions resulting from compressor operation.

While the washing cycle is in progress, a button flashes on the main screen: it is pressed to stop the cycle manually before the time set in parameter “DA54” elapses.

3.13.5 Recirculation

Full air recycling at system start-up or after a washing cycle is intended to achieve the temperature and humidity setpoints more quickly.

If air recycling only is required at unit start-up, parameter “DA52” must be set to “2”.

If parameter “DA52” is set to “3”, a washing cycle is performed before recycling.

While recirculating is in progress, the controller keeps the exhaust air and external air dampers closed and it keeps the recirculated air damper open for the time setpoint stored in parameter “DA55”.

If the value in parameter “DA53” is set to “0”, the washing cycle takes place without any thermoregulation of the air. If the value in parameter “DA53” is set to “1”, thermoregulation is active.

While recycling is in progress, a button flashes on the main screen which is pressed to stop the cycle manually before the time set in parameter “DA55” elapses.

3.13.6 Free cooling

If the external air temperature value is favourable, the cooling demand in the room is fulfilled with air changing, either totally or partially.

The free cooling function manages units with either 2 or 3 dampers:

- recirculated air damper;
- external air damper;
- exhaust air damper.

In 2-damper units air is exhausted using extractors or other equipment and these are managed by the controller in the unit.

The parameters concerned are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
DA1	1	-	All dampers - Management mode
DA5	0	-	External air - FC / FH - Enabling mode
DA6	1.0	°C	External air - FC / FH - Temperature-based control - Temperature diff. required for enabling
DA7	1.0	kJ/kg	External air - FC / FH - Enthalpy-based control - Enthalpy diff. required for enabling
DA8	-2.0	°C	External air - Summer / Winter FC - Temperature offset for regulation
DA9	2.0	°C	External air - Summer / Winter FC - Temperature diff. for regulation
DA12	30	%	External air - FC / FH - Min opening
DA13	100	%	External air - FC / FH - Max opening

A graphical representation is shown below.

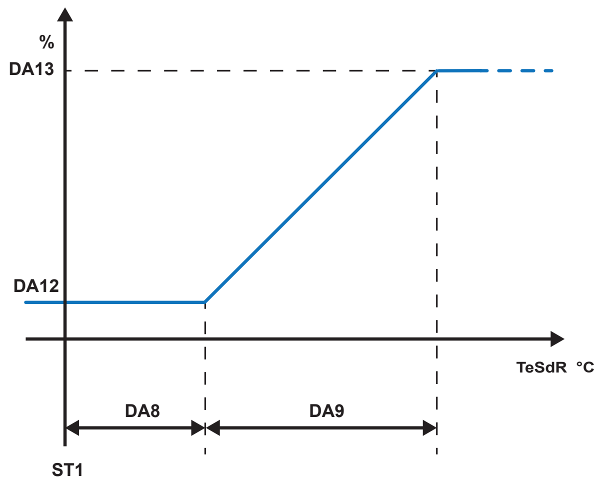


Fig. 25 Damper command in free cooling mode

In addition to the parameters listed in the table, the abbreviations in the graph are:

- TeSdR = temperature sensed by probe in air return line;
- % = opening signal percentage for external/exhaust air.

If the external air temperature is lower than the temperature in the return line minus the value set in parameter "DA6", the unit is enabled for operation in free cooling mode.

If operation in free cooling mode is enabled and the reference air temperature for thermoregulation is higher than the setpoint value in parameter "ST1" plus the offset value stored in parameter "DA8", the controller increases the external air percentage within the differential set in parameter "DA9".

The setpoint ranges between the min. value stored in parameter "DA12" and the max. value in parameter "DA13".

Damper opening may be limited with respect to the max. value set in parameter "DA13" as a result of problems with temperature or pressure, as described in the chapter on limitations.

Thanks to the factory set parameters ("DA8" = -2; "DA9" = 2), the free cooling function keeps 100% outside air until the setpoint is achieved.

When the reference air temperature is lower than the setpoint value, the free cooling function reduces the opening of the outside air damper to the min. value.

A graphical representation is shown below.

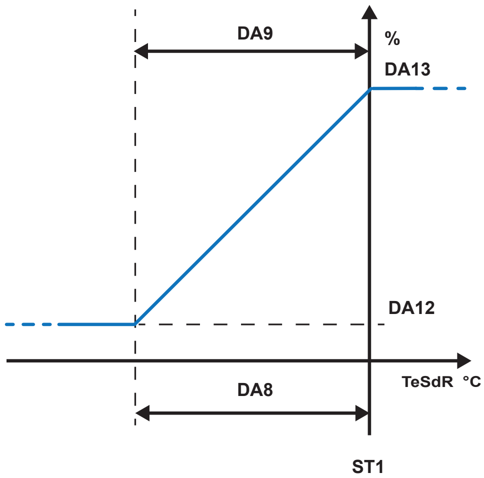


Fig. 26 Damper command in free cooling mode

3.13.6.1 Winter free cooling

Free cooling may also be enabled when the unit is operating in heating mode through parameter "DA4".

Winter free cooling is enabled if the air temperature in the return line is higher than the value in the summer setpoint "ST1" and the conditions required for free cooling are met.

3.13.7 Free heating

If the external air temperature value is favourable, the heating demand in the room is fulfilled with air changing, either totally or partially.

The unit configuration to manage the free heating function is the same as for free cooling.

The parameters concerned are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
DA1	1	-	All dampers - Management mode
DA5	0	-	External air - FC / FH - Enabling mode
DA6	1.0	°C	External air - FC / FH - Temperature-based control - Temperature diff. required for enabling
DA7	1.0	kJ/kg	External air - FC / FH - Enthalpy-based control - Enthalpy diff. required for enabling
DA10	2.0	°C	External air - Winter FH - Offset for regulation
DA11	2.0	°C	External air - Winter FH - Diff. For regulation
DA12	30	%	External air - FC / FH - Min opening
DA13	100	%	External air - FC / FH - Max opening

A graphical representation is shown below.

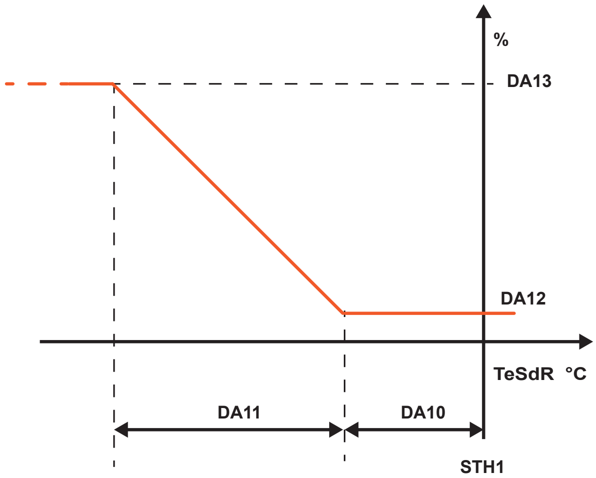


Fig. 27 Damper command in free heating mode

In addition to the parameters listed in the table, the abbreviations in the graph are:

- TeSdR = temperature sensed by probe in return line
- % = opening signal percentage for external/exhaust air.

If the external air temperature is higher than the temperature in the return line plus the value set in parameter “DA6”, the unit is enabled for operation in free heating mode.

If operation in free heating mode is enabled and the reference air temperature for thermoregulation is lower than the setpoint value in parameter “STH1” minus the offset value stored in parameter “DA10”, the controller increases the external air percentage within the differential set in parameter “DA11”.

The setpoint ranges between the min. value stored in parameter “DA12” and the max. value in parameter “DA13”.

Damper opening may be limited with respect to the max. value set in parameter “DA13” as a result of problems with temperature or pressure, as described in the chapter on limitations.

Thanks to the factory set parameters (“DA10” = -2; “DA11” = 2), the free cooling function keeps 100% external air until the setpoint is achieved.

When the reference air temperature is higher than the setpoint value, the free heating function reduces the opening of the outside air damper to the min. value.

A graphical representation is shown below.

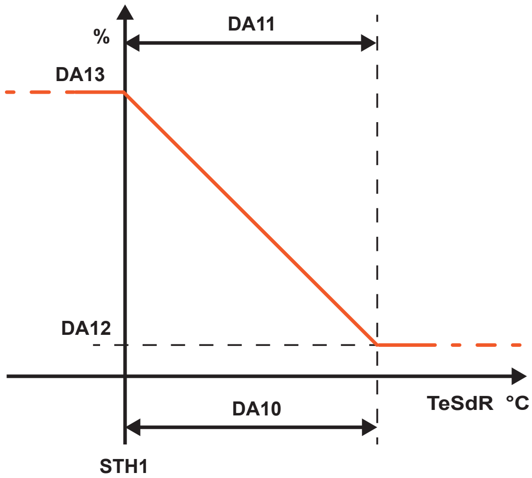


Fig. 28 Damper command in free heating mode

3.13.8 Enthalpy-based free cooling and free heating

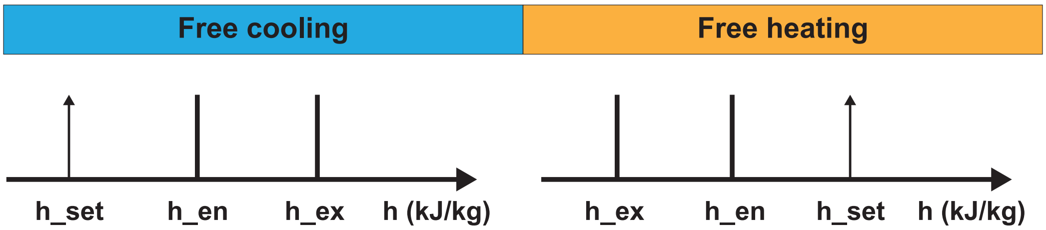
Free cooling and free heating in systems where the controller manages both temperature and humidity may be run by comparing the room enthalpy and the external air enthalpy.

This function is enabled using parameter “DA5”: the activation differential is set in parameter “DA7”.

The controller takes the enthalpy setpoints in cooling and heating mode from the corresponding temperature and humidity setpoints and it takes the room enthalpy and external air enthalpy values from the corresponding temperature and humidity probes.

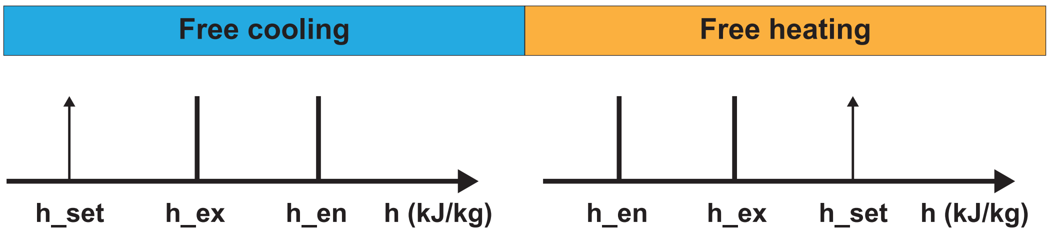
The comparison of the enthalpy values taken from the setpoints and the values from the probes helps check three conditions required for cooling and heating:

the external air enthalpy “h_ex” is higher than the room enthalpy “h_en”, which in turn is higher than enthalpy setpoint “h_set” during operation in cooling mode; or the external air enthalpy “h_ex” is lower than the room enthalpy “h_en”, which in turn is lower than the enthalpy setpoint “h_set” during operation in heating mode. Enthalpy-based free cooling or free heating is not advantageous in these cases;

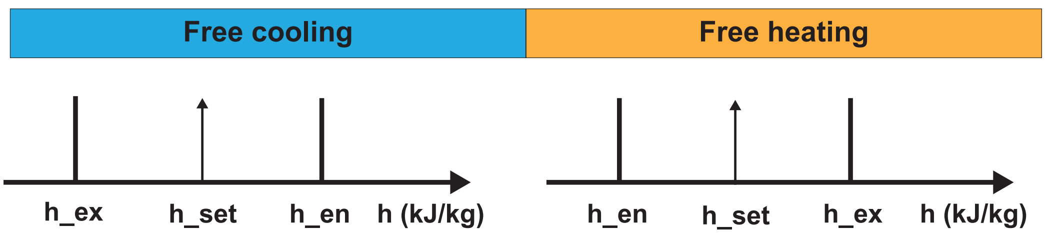


the room enthalpy “h_en” is higher than the external air enthalpy “h_ex”, which in turn is higher than enthalpy setpoint “h_set” during operation in cooling mode; or the room enthalpy “h_en” is lower than the external air enthalpy “h_ex”, which in turn is lower than the enthalpy setpoint “h_set” during operation in heating mode. Enthalpy-based free cooling is advantageous in these cases when the difference between the measured enthalpy values is greater than the setpoint in parameter “DA7”.

Free cooling is active for as long as the room enthalpy value “h_en” equals the external air enthalpy value “h_ex”, increased (first case) and reduced (second case) by the differential value set in parameter “DA7”;



the room enthalpy “h_en” is higher than the enthalpy setpoint “h_set” for operation in cooling mode, which in turn is higher than the external air enthalpy “h_ex”; or the room enthalpy “h_en” is lower than the enthalpy setpoint “h_set” for operation in heating mode, which in turn is lower than the external air enthalpy “h_ex”. Enthalpy-based free cooling is advantageous in the first case, whereas enthalpy-based free heating is advantageous in the second case.



Damper opening may be limited with respect to the max. value set in parameter “DA13” as a result of problems with temperature or pressure, as described in the chapter on limitations.

3.13.9 Air change in the room

The external air damper helps the controller manage air change in the room by keeping the dampers open at min. percentage during unit operation.

If a probe is fitted to detect the air quality in the room, the controller can increase the air change rate.

The air quality parameters that the controller can manage include CO_2 “quantity of carbon dioxide” and VOC “volatile organic compounds”.

This is an essential function in rooms where people's traffic/stay varies significantly during the day.

The parameters concerned are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
DA12	30	%	External air - FC / FH - Min opening
DA13	100	%	External air - FC / FH - Max opening
DA19	700	ppm	External air - Environment air renewal - CO2 concentration setpoint for activation
DA20	0	ppm	External air - Environment air renewal - CO2 concentration offset for regulation
DA21	100	ppm	External air - Environment air renewal - CO2 concentration diff. for regulation
DA23	50.0	%	External air - Environment air renewal - VOC concentration setpoint for activation
DA24	0.0	%	External air - Environment air renewal - VOC concentration offset for regulation
DA25	5.0	%	External air - Environment air renewal - VOC concentration diff. for regulation

3.13.10 Co_2 control

Below is a graphical representation with reference to the quantity of CO_2 in the air.

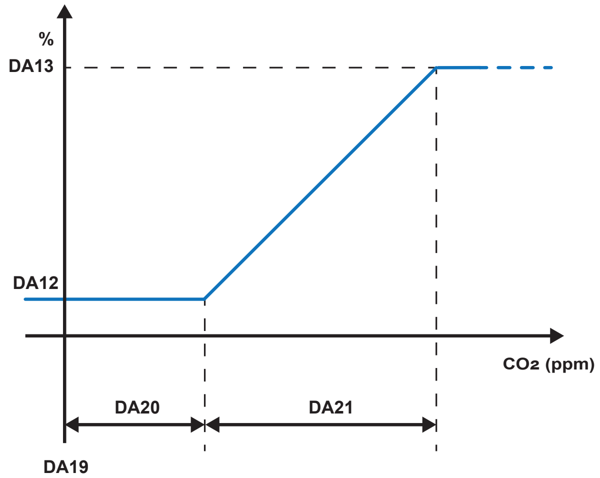


Fig. 29 Damper command for air change with Co_2 probe

In addition to the parameters listed in the table, the abbreviations in the graph are:

- CO_2 = quantity of CO_2 in the air;
- %As = damper opening percentage.

If the CO_2 probe is fitted and the quantity of CO_2 is higher than the setpoint in parameter “DA19” plus the offset value stored in parameter “DA20”, the controller increases the percentage of external air within the differential set in parameter “DA21”.

The setpoint ranges between the min. value stored in parameter “DA12” and the max. value in parameter “DA13”.

Damper opening may be limited with respect to the max. value set in parameter “DA13” as a result of problems with temperature or pressure, as described in the chapter on limitations.

3.13.11 VOC control

Below is a graphical representation with reference to the quantity of VOC in the air.

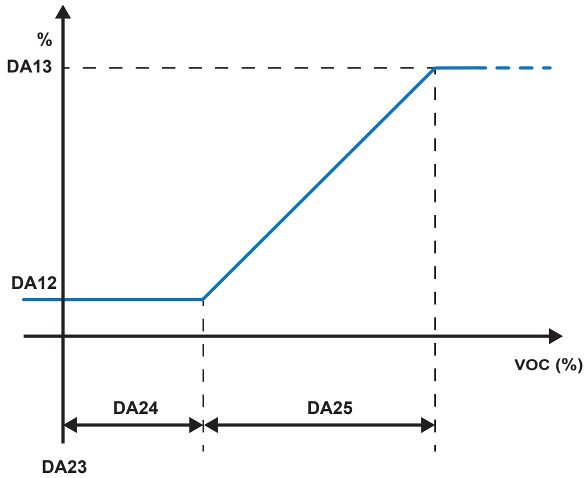


Fig. 30 Damper command for air change with VOC probe

In addition to the parameters listed in the table, the abbreviations in the graph are:

- VOC = quantity of VOC in the air;
- %As = damper opening percentage.

If the VOC probe is fitted and the quantity of VOC is higher than the setpoint in parameter “DA23” plus the offset value stored in parameter “DA24”, the controller increases the percentage of external air within the differential set in parameter “DA25”.

The setpoint ranges between the min. value stored in parameter “DA12” and the max. value in parameter “DA13”.

Damper opening may be limited with respect to the max. value set in parameter “DA13” as a result of problems with temperature or pressure, as described in the chapter on limitations.

If the unit is designed for air change based on both CO_2 and “VOC” control, the dampers are opened depending on which of the two demands is higher.

3.14 Limitation of damper operation

The damper opening setpoint may be limited by operation of the refrigerant circuit or by conditions relating to air comfort in the room.

If damper opening is greater than normally required for air change (e.g. during a washing cycle with thermoregulation enabled or upon request of the air quality probes), conditions may be experienced that are critical for refrigerant circuit operation.

3.14.1 Limitation based on condensing pressure in heating mode

When a refrigerant circuit in the unit is operating in cooling mode, the condensing pressure may limit the damper control signal.

The parameters concerned are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
DA12	30	%	External air - FC / FH - Min opening
DA13	100	%	External air - FC / FH - Max opening
DA28	35.80	bar	External air - Opening limitation - Summer oper. - Max cond. press. threshold for activation
DA29	2.00	bar	External air - Opening limitation - Summer oper. - Max cond. press. diff. for activation
DA36	0	%	External air - Opening limitation - Min opening for cond. press.
DA37	60	%	External air - Opening limitation - Max opening for cond. press.
DA40	2.00	bar	External air - Opening limitation - Deactivation diff. for cond. press.

A graphical representation is shown below.

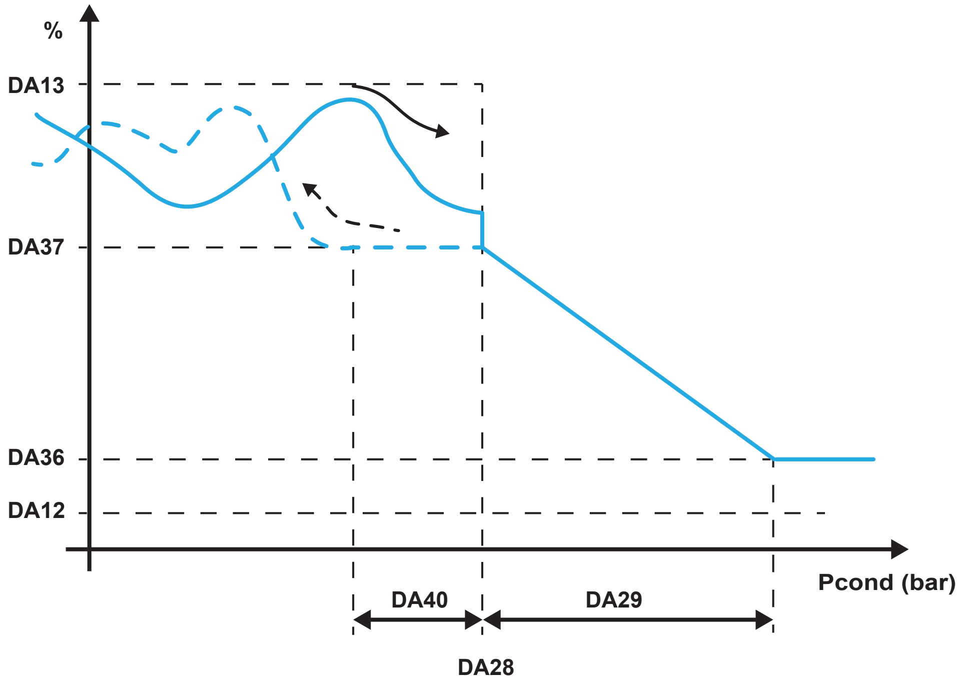


Fig. 31 Damper command in free cooling mode

In addition to the parameters listed in the table, the abbreviations in the graph are:

- Pcond = condensing pressure;
- As% = opening signal percentage for external/exhaust air.

In normal operating conditions the signal controlling the external air and exhaust air dampers can range from the min. setpoint stored in parameter “DA12” to the max. setpoint in parameter “DA13” (opening of the recirculated air damper is complementary).

If the condensing pressure increases and reaches the setpoint stored in parameter “DA28”, the value of the damper opening signal is limited.

Within differential “DA29” the signal is limited linearly between the min. and max. setpoint values stored in parameters “DA36” and “DA37” respectively.

After limiting the damper opening value, the signal is fixed at the value set in parameter “DA37” for the entire differential stored in parameter “DA40”, if the condensing pressure drops below the setpoint in parameter “DA28”.

The damper opening signal starts following the ongoing opening percentage again only after condensing pressure values drop below the difference “DA28” – “DA40”.

3.14.2 Limitation based on evaporating pressure in cooling mode

When a refrigerant circuit in the unit is operating in cooling mode, the evaporating pressure may limit the damper control signal.

The parameters concerned are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
DA12	30	%	External air - FC / FH - Min opening
DA13	100	%	External air - FC / FH - Max opening
DA30	12.00	bar	External air - Opening limitation - Summer oper. - Max evap. press. threshold for activation
DA31	2.00	bar	External air - Opening limitation - Summer oper. - Max evap. press. diff. for activation
DA38	0	%	External air - Opening limitation - Min opening for evap. press.
DA39	60	%	External air - Opening limitation - Max opening for evap. press.
DA41	2.00	bar	External air - Opening limitation - Deactivation diff. for cond. press.

A graphical representation is shown below.

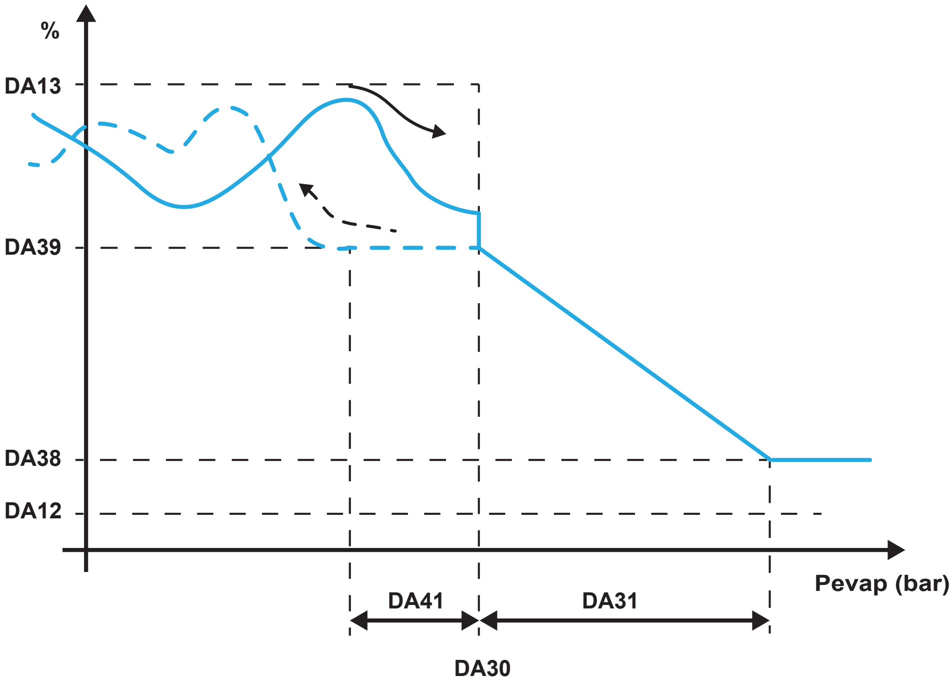


Fig. 32 Damper command in free cooling mode

In addition to the parameters listed in the table, the abbreviations in the graph are:

- Pevap = evaporating pressure;
- As% = opening signal percentage for external/exhaust air.

In normal operating conditions the signal controlling the external air and exhaust air dampers can range from the min. setpoint stored in parameter "DA12" to the max. setpoint in parameter "DA13" (opening of the recirculated air damper is complementary).

If the evaporating pressure increases and reaches the setpoint stored in parameter "DA30", the value of the damper opening signal is limited.

Within differential "DA31" the signal is linearly limited between the min. and max. setpoint values stored in parameters "DA38" and "DA39" respectively.

After limiting the damper opening value, the signal is fixed at the value set in parameter "DA39" for the entire differential stored in parameter "DA41", if the evaporating pressure drops below the setpoint in parameter "DA30".

The damper opening signal starts following the ongoing opening percentage again only after evaporating pressure values drop below the difference "DA30" – "DA41".

3.14.3 Limitation based on evaporating pressure in heating mode

When a refrigerant circuit in the unit is operating in heating mode, the evaporating pressure may limit the damper control signal.

The parameters concerned are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
DA12	30	%	External air - FC / FH - Min opening
DA13	100	%	External air - FC / FH - Max opening
DA30	7.00	bar	External air - Opening limitation - Winter oper. - Min evap. press. threshold for activation
DA31	2.00	bar	External air - Opening limitation - Winter oper. - Min evap. press. diff. for activation
DA38	0	%	External air - Opening limitation - Min opening for evap. press.
DA39	60	%	External air - Opening limitation - Max opening for evap. press.
DA41	2.00	bar	External air - Opening limitation - Deactivation diff. for cond. press.

A graphical representation is shown below.

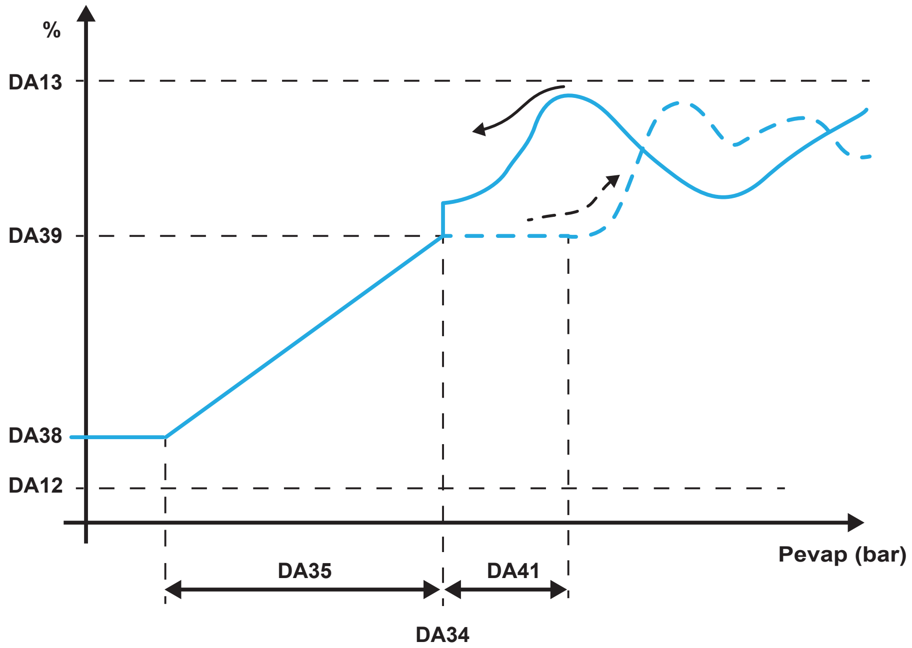


Fig. 33 Damper command in free cooling mode

In addition to the parameters listed in the table, the abbreviations in the graph are:

- Pevap = evaporating pressure;
- As% = opening signal percentage for external/exhaust air.

In normal operating conditions the signal controlling the external air and exhaust air dampers can range from the min. setpoint stored in parameter “DA12” to the max. setpoint in parameter “DA13” (opening of the recirculated air damper is complementary).

If the evaporating pressure decreases and reaches the setpoint stored in parameter “DA34”, the value of the damper opening signal is limited.

Within differential “DA35” the signal is linearly limited between the min. and max. setpoint values stored in parameters “DA38” and “DA39” respectively.

After limiting the damper opening value, the signal is fixed at the value set in parameter “DA39” for the entire differential stored in parameter “DA41”, if the evaporating pressure rises above the setpoint in parameter “DA34”.

The damper opening signal starts following the ongoing opening percentage again only after the evaporating pressure values rise above the sum “DA34”+ “DA41”.

3.14.4 Limitation based on condensing pressure in heating mode

When a refrigerant circuit in the unit is operating in heating mode, the condensing pressure may limit the damper control signal.

The parameters concerned are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
DA12	30	%	External air - FC / FH - Min opening
DA13	100	%	External air - FC / FH - Max opening
DA32	10.00	bar	External air - Opening limitation - Winter oper. - Min cond. press. threshold for activation
DA33	1.00	bar	External air - Opening limitation - Winter oper. - Min cond. press. diff. for activation
DA36	0	%	External air - Opening limitation - Min opening for cond. press.
DA37	60	%	External air - Opening limitation - Max opening for cond. press.
DA40	2.00	bar	External air - Opening limitation - Deactivation diff. for cond. press.

A graphical representation is shown below.

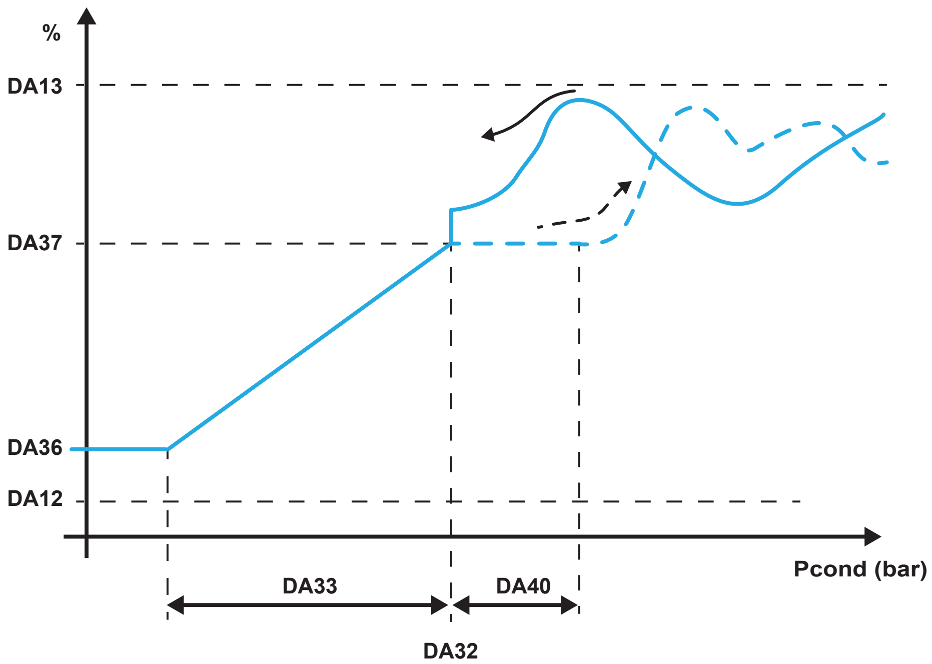


Fig. 34 Damper command in free cooling mode

In addition to the parameters listed in the table, the abbreviations in the graph are:

- Pcond = condensing pressure;
- As% = opening signal percentage for external/exhaust air.

In normal operating conditions the signal controlling the external air and exhaust air dampers can range from the min. setpoint stored in parameter "DA12" to the max. setpoint in parameter "DA13" (opening of the recirculated air damper is complementary).

If the condensing pressure decreases and reaches the setpoint stored in parameter "DA32", the value of the damper opening signal is limited.

Within differential "DA33" the signal is linearly limited between the min. and max. setpoint values stored in parameters "DA36" and "DA37" respectively.

After limiting the damper opening value, the signal is fixed at the value set in parameter "DA37" for the entire differential stored in parameter "DA40", if the condensing pressure rises above the setpoint in parameter "DA32".

The damper opening signal starts following the ongoing opening percentage again only after the condensing pressure values rise above the sum "DA32"+ "DA40".

If the demand for damper opening limitation comes from the condensing and evaporating pressure values simultaneously, the air flow is controlled using the lowest signal of the two.

If defrosting is started following the drop in the temperature converted from the evaporating pressure, safe air flow control (ref. last graph) is met only if parameter "DA14" is equal to 0.

The function that limits damper opening as a result of the condensing and evaporating pressure has priority over all the other functions (free cooling, free heating, CO_2 and VOC).

3.14.5 Min. opening in relation to external air temperature

In addition to the normal min. opening percentage of the external air and exhaust air dampers set in parameter "DA12", the controller includes the possibility to set the min. opening value in connection with the external air temperature.

If the temperature is lower than the setpoint in parameter "DA44" or higher than the setpoint in parameter "DA43", the new min. opening percentage of the dampers after the delay time set in parameter "DA46" is the value stored in parameter "DA45".

3.14.6 Min. opening in connection with dehumidification

The min. opening percentage of the external air dampers and the exhaust air dampers during normal operation is the value set in parameter "DA12"; during the dehumidification cycle the reference percentage is the setpoint stored in parameter "DA48".

If the dehumidification function is enabled simultaneously with the function that reduces the min. damper opening percentage in connection with the external air temperature, the controller adjusts the dampers according to the lower value between the percentages set in parameters "DA45" and "DA48".

3.14.7 Management of external air damper during defrosting

For continuous comfort in the room, the external air and exhaust air dampers can be overridden to close using the value set in parameter "DA14". This is the case when defrosting takes place reversing the refrigeration cycle, for as long as the coil of the 4-way valve in the refrigerant circuit is de-energised. As a consequence, the recirculated air damper is fully open.

3.15 Source-side ventilation

The controller manages source-side ventilation with reference to the active compressors and the operating pressures.

The parameters concerned are shown in the table.

Parameter	Min	Max	UM	Description
EFA3	0	60	s	Ventilation Speed Up at start
EFA5	0	999	s	Pre-ventilation time before compressor start-up
EFA6	0	60	%	Cooling - Min. speed
EFA7	30	100	%	Cooling - Maximum speed with only one active compressor on two
EFA8	30	100	%	Cooling - Maximum speed with two active compressors
EFA9	0.0	45.0	°C	Cooling - Condensation setpoint for min. speed/opening
EFA10	20.0	52.0	°C	Cooling - Condensation temperature with only one active compressor on two
EFA11	20.0	99.9	°C	Cooling - Condensation temperature for max. speed/opening
EFA12	0.0	25.0	°C	Cooling - Cut-off differential
EFA13	0.0	25.0	°C	Cooling - Offset
EFA14	0	60	%	Heating - Min. speed
EFA15	30	100	%	Heating - Average speed
EFA16	30	100	%	Heating - Max. speed
EFA17	-6.0	110.0	°C	Heating - Evaporation setpoint for min. speed/opening
EFA18	-12.0	15.0	°C	Heating - Evaporation temperature for average speed/opening
EFA19	-50.0	-6.0	°C	Heating - Evaporation temperature for max. speed/opening
EFA20	0.0	25.0	°C	Heating - Cut-off differential
EFA21	0.0	25.0	°C	Heating - Offset
EFA30	20.0	57.0	°C	Cooling - Night shift - Temperature at min. speed
EFA31	46.0	70.0	°C	Cooling - Night shift - Temperature at max. speed
EFA32	0	144	-	Cooling - Night shift - Beginning of time band (0÷24)
EFA33	0	144	-	Cooling - Night shift - End of time band (0÷24)
EFA34	0	1	-	Cooling - Night shift - Enable on Monday
EFA35	0	1	-	Cooling - Night shift - Enable Tuesday
EFA36	0	1	-	Cooling - Night shift - Enable Wednesday
EFA37	0	1	-	Cooling - Night shift - Enable Thursday
EFA38	0	1	-	Cooling - Night shift - Enable Friday
EFA39	0	1	-	Cooling - Night shift - Enable Saturday
EFA40	0	1	-	Cooling - Night shift - Enable Sunday

3.15.1 Condensation control

During compressor operation in cooling mode the controller adjusts source-side ventilation to manage the condensing pressure. The adjustment varies according to whether one or two compressors are in operation in the circuit.

The adjustment is based on the condensing temperature value achieved through the conversion of the corresponding pressure in the refrigerant circuit.

Units featuring two refrigerant circuits have an independent speed adjustment function in each circuit.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
EFA6	30	%	Cooling - Min. speed
EFA7	60	%	Cooling - Maximum speed with only one active compressor on two
EFA8	100	%	Cooling - Maximum speed with two active compressors
EFA9	20.0	°C	Cooling - Condensation setpoint for min. speed/opening
EFA10	45.0	°C	Cooling - Condensation temperature with only one active compressor on two
EFA11	52.0	°C	Cooling - Condensation temperature for max. speed/opening
EFA12	5.0	°C	Cooling - Cut-off differential
EFA13	10.0	°C	Cooling - Offset

A graphical representation is shown below.

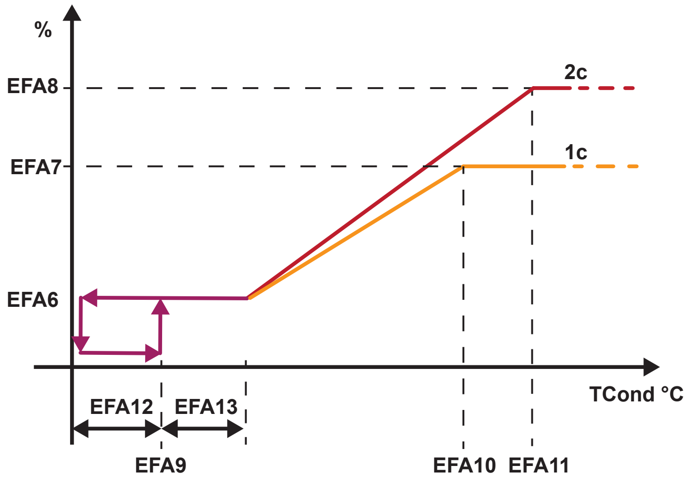


Fig. 35 Graphical representation of air condensation control

In addition to the parameters listed in the table, the abbreviations in the graph are:

- Tcond = Condensing temperature
- % = percentage value of signal for fan control
- 1c = one compressor in operation
- 2c = two compressors in operation

When the compressor is started up and the condensing temperature reaches the value stored in parameter "EFA9", the controller starts ventilation at max. speed for as long as the time set in parameter “EFA3”, after which it switches ventilation back to the min. speed as specified in parameter “EFA6”.

If the condensing temperature rises to the value resulting from the sum of parameters “EFA9” + “EFA13”, the controller starts adjusting the fan speed.

When only one compressor is in operation in the refrigerant circuit, ranging between the condensing temperature value resulting from the sum of parameters “EFA9” + “EFA13” and the value in parameter “EFA10”, the fan speed varies proportionally between values “EFA6” and “EFA7”.

When both compressors are in operation in the refrigerant circuit, ranging between the condensing temperature value resulting from the sum of parameters “EFA9” + “EFA13” and the value in parameter “EFA11”, the fan speed varies proportionally between values “EFA6” and “EFA8”.

Irrespective of the number of compressors in operation, the fan speed is kept constant at the setpoint in parameter “EFA6” from the value below the condensing temperature - sum of parameters “EFA9” + “EFA13” - to the value resulting from the difference between parameters “EFA9” - “EFA12”.

If the condensing temperature value drops below the difference between parameters “EFA9” - “EFA12”, the controller stops ventilation.

Where capacity reduction is overridden due to high pressure, ventilation control is performed as in cases when both compressors are in operation.

3.15.2 Night Shift System function

This function is designed to add a different ventilation unit setup, typically to reduce the condenser noise levels. The function may be activated according to time bands and selected weekdays.

This function is normally used to reduce the noise levels during nightly hours.

Units are released from the factory with this function disabled.

The function is only enabled during compressor operation in cooling mode.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
EFA6	30	%	Cooling - Min. speed
EFA7	60	%	Cooling - Maximum speed with only one active compressor on two
EFA8	100	%	Cooling - Maximum speed with two active compressors
EFA9	20.0	°C	Cooling - Condensation setpoint for min. speed/opening
EFA10	45.0	°C	Cooling - Condensation temperature with only one active compressor on two
EFA11	52.0	°C	Cooling - Condensation temperature for max. speed/opening
EFA30	46.0	°C	Cooling - Night shift - Temperature at min. speed
EFA31	57.0	°C	Cooling - Night shift - Temperature at max. speed
EFA32	23:00	-	Cooling - Night shift - Beginning of time band (0÷24)
EFA33	6:00	-	Cooling - Night shift - End of time band (0÷24)
EFA34	1	-	Cooling - Night shift - Enable on Monday
EFA35	1	-	Cooling - Night shift - Enable Tuesday
EFA36	1	-	Cooling - Night shift - Enable Wednesday
EFA37	1	-	Cooling - Night shift - Enable Thursday
EFA38	1	-	Cooling - Night shift - Enable Friday
EFA39	1	-	Cooling - Night shift - Enable Saturday
EFA40	1	-	Cooling - Night shift - Enable Sunday

The default values must be changed by service technicians, based on the installation requirements.

A graphical representation is shown below.

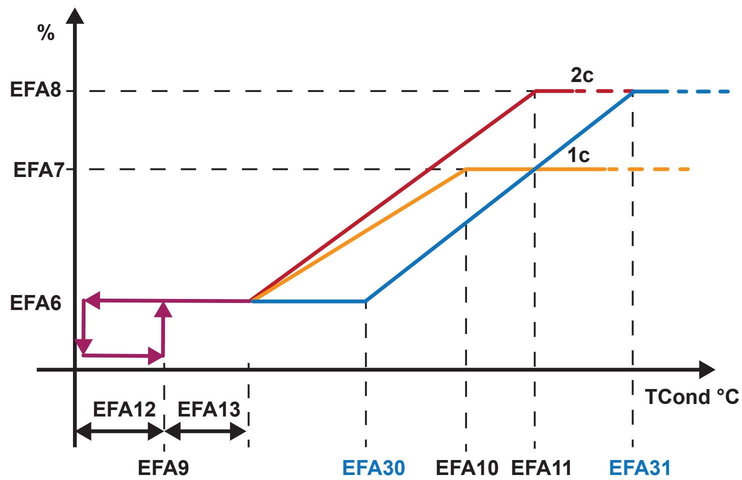


Fig. 36 Control of normal fan speed and with "Night Shift System" function

In addition to the parameters listed in the table, the abbreviations in the graph are:

- Tcond = Condensing temperature
- % = percentage value of signal for fan control
- 1c = one compressor in operation
- 2c = two compressors in operation

When the Night Shift System function is enabled during the set time bands and on the selected days, the ventilation speed varies proportionally between the min. (“EFA6”) and max. (“EFA8”) values as the condensing temperature varies within the setpoints stored in parameters “EFA30” and “EFA31”. The controller keeps the max. ventilation value if the condensing temperature exceeds the value set in parameter “EFA31”.

Ventilation is always stopped as soon as the difference between the values in parameters “EFA9” and “EFA12” is achieved.

The control is not affected by the number of compressors in operation.

3.15.3 Evaporation control

During compressor operation in cooling mode the controller adjusts source-side ventilation to manage the evaporating pressure. The adjustment varies according to whether one or two compressors are in operation in the circuit.

The adjustment is based on the evaporating temperature value calculated by conversion of the corresponding pressure in the refrigerant circuit.

Units featuring two refrigerant circuits have an independent speed adjustment function in each circuit.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
EFA14	30	%	Heating - Min. speed
EFA15	60	%	Heating - Average speed
EFA16	100	%	Heating - Max. speed
EFA17	15.0	°C	Heating - Evaporation setpoint for min. speed/opening
EFA18	-6.0	°C	Heating - Evaporation temperature for average speed/opening
EFA19	-12.0	°C	Heating - Evaporation temperature for max. speed/opening
EFA20	5.0	°C	Heating - Cut-off differential
EFA21	15.0	°C	Heating - Offset

A graphical representation is shown below.

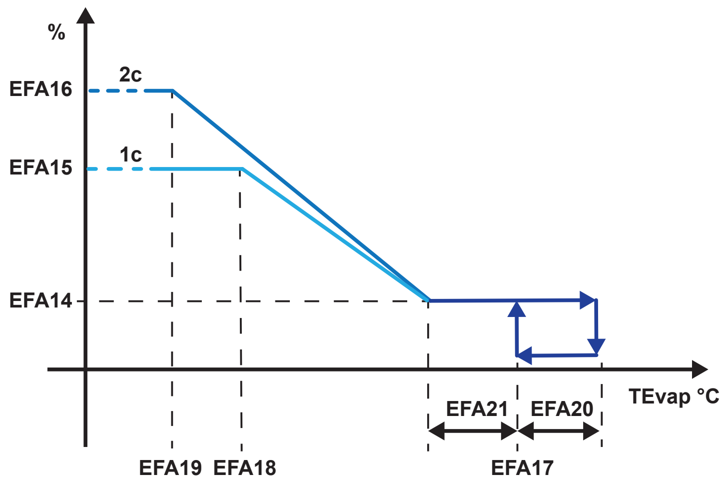


Fig. 37 Graphical representation of air condensation control

In addition to the parameters listed in the table, the abbreviations in the graph are:

- Tcond = Condensing temperature
- % = percentage value of signal for fan control
- 1c = one compressor in operation
- 2c = two compressors in operation

When a compressor is started up and the evaporating temperature reaches the value stored in parameter “EFA17”, the controller starts ventilation at max. speed for as long as the time set in parameter “EFA3”, after which it switches ventilation back to the min. speed, as specified in parameter “EFA14”.

If the evaporating temperature drops to the value resulting from the difference between parameters “EFA17” - “EFA21”, the controller starts adjusting the fan speed.

When only one compressor is in operation in the refrigerant circuit, ranging between the evaporating temperature value resulting from the difference of parameters “EFA17”- “EFA21” and the value in parameter “EFA18”, the fan speed varies proportionally between values “EFA14” and “EFA15”.

When both compressors are in operation in the refrigerant circuit, ranging between the evaporating temperature value resulting from the difference between parameters “EFA17” - “EFA21” and the value in parameter “EFA19”, the fan speed varies proportionally between values “EFA14” and “EFA16”.

Irrespective of the number of compressors in operation, the fan speed is kept constant at the setpoint in parameter “EFA14” from above the evaporating temperature resulting from the difference between parameters “EFA17”- “EFA21” to the value resulting from the sum of parameters “EFA17”+ “EFA20”.

If the evaporating temperature value is higher than the sum of parameters “EFA17”+ “EFA20”, the controller stops ventilation.

Where capacity reduction is overridden due to low pressure, ventilation control is performed based on the value envisaged in cases when both compressors are in operation.

3.16 Auxiliary heating

In addition to the heating effect achieved using the refrigerant circuit, the controller can handle other sources of heating such as electric heaters and a hot water coil with an OK signal to a boiler or a burner.

The logic featured in the controller is set up at the factory, based on the unit configuration.

The function to enable heating and the operating logics can be customised.

The parameters concerned are shown in the table.

Parameter	Min	Max	UM	Description
STH53	5.0	27.0	°C	Auxiliary heating - CO unit - Temperature threshold on return line for winter operation
STH54	20.0	55.0	°C	Auxiliary heating - CO unit - Temperature threshold on return line for summer operation
STH55	0	3	-	Auxiliary heating - Configuration
STH56	0	1	-	Auxiliary heating - Summer oper. - Regulation probe
STH57	0	1	-	Auxiliary heating - Summer oper. - Type of temperature control
STH58	10.0	35.0	°C	Auxiliary heating - Summer oper. - Setpoint
STH59	0.0	25.0	°C	Auxiliary heating - Summer oper. - Proportional - Temperature offset
STH60	0.0	25.0	°C	Auxiliary heating - Summer oper. - Proportional - Activation differential
STH61	0	100	%	Auxiliary heating - Summer oper. - Proportional - Minimum request
STH62	0	100	%	Auxiliary heating - Summer oper. - Proportional - Maximum request
STH64	0	10000	-	Auxiliary heating - Summer oper. - PID - Kp
STH65	0	10000	-	Auxiliary heating - Summer oper. - PID - Ki
STH66	0	10000	-	Auxiliary heating - Summer oper. - PID - Kd
STH70	0.0	25.0	°C	Auxiliary heating - Summer oper. - PID - Dead band
STH72	0	2	-	Auxiliary heating - Summer oper. - PID - Dead band position
STH81	0	10000	-	Auxiliary heating - Summer oper. - PID - Manual override (0 = Disabled)
STH84	0.0	100.0	%	Auxiliary heating - Summer oper. - PID - Min. output
STH85	0.0	100.0	%	Auxiliary heating - Summer oper. - PID - Max. output
STH91	0	1	-	Auxiliary heating - Winter oper. - Type of temperature control
STH93	0.0	25.0	°C	Auxiliary heating - Winter oper. - Proportional - Temperature offset
STH94	0.0	25.0	°C	Auxiliary heating - Winter oper. - Proportional - Activation differential
STH95	0	100	%	Auxiliary heating - Winter oper. - Proportional - Minimum request
STH96	0	100	%	Auxiliary heating - Winter oper. - Proportional - Maximum request
STH98	0	10000	-	Auxiliary heating - Winter oper. - PID - Kp
STH99	0	10000	-	Auxiliary heating - Winter oper. - PID - Ki
STH100	0	10000	-	Auxiliary heating - Winter oper. - PID - Kd
STH104	0.0	25.0	°C	Auxiliary heating - Winter oper. - PID - Dead band
STH106	0	2	-	Auxiliary heating - Winter oper. - PID - Dead band position
STH118	0.0	100.0	%	Auxiliary heating - Winter oper. - PID - Min. output
STH119	0.0	100.0	%	Auxiliary heating - Winter oper. - PID - Max. output
STH123	-100.0	100.0	°C	Auxiliary heating - Deactivation threshold for low external air temperature

Parameter	Min	Max	UM	Description
STH119	0.0	100.0	%	Auxiliary heating - Winter oper. - PID - Max. output
STH123	-100.0	100.0	°C	Auxiliary heating - Deactivation threshold for low external air temperature
STH124	-100.0	100.0	°C	Auxiliary heating - Deactivation threshold for high external air temperature
STH126	0	100	%	Mechanical heating with auxiliary heating - Percentage threshold of priority source demand for second source activation
STH127	0	999	s	Mechanical heating with auxiliary heating - Delay in demand activation from lower priority source
STH128	0	999	s	Mechanical heating with auxiliary heating - Delay in demand de-activation from lower priority source since min. value achieved
STH129	0	2	-	Mechanical heating with auxiliary heating - Priority
STH130	0	2	-	Auxiliary heating - Heating devices - Priority
STH132	0	100	%	Mechanical heating with auxiliary heating - Demand for auxiliary heating during defrosting (0 = Disabled)
STH133	0	100	%	Mechanical heating with auxiliary heating - Percentage threshold of second source demand for de-activation
STH136	-30.0	10.0	°C	Auxiliary heating - Anti-freeze function - External air temperature threshold for activation
STH137	0	100	%	Auxiliary heating - Anti-freeze function - Percentage demand with function active
STH138	0	100	%	Auxiliary heating - Hot water valve - Min. opening
STH139	0	100	%	Auxiliary heating - Hot water valve - Max. opening
STH140	0	999	s	Auxiliary heating - Delay in OK signal to pump

3.16.1 Controlled devices

The controller controls the devices installed in the unit, which may include:

- electrical heaters, divided by either one or two power steps;
- a hot water coil with an analogue signal to control opening of a valve and a digital OK signal to control a pump that gets started with the delay value set in parameter “STH140”. This management logic includes the anti-freeze function;
- a boiler that is controlled by an analogue signal and a digital OK signal which gets enabled as soon as an analogue demand is received. This management logic includes a digital input through which the controller receives alarms from the boiler, if any, as well as an anti-freeze function;
- a burner that is controlled by an analogue signal and a digital OK signal which gets enabled as soon as an analogue demand is received. This management logic includes a digital input through which the controller receives alarms from the burner, if any.

Parameter “STH55” is used to enable auxiliary heating for:

- summer operation only, in which case it serves as post heating during the dehumidification cycle;
- winter operation only, in which case it serves either as single source, if the refrigerant circuit does not feature cycle reversal, or as an integration to heating where the latter is implemented by the refrigerant circuit;
- both summer and winter operation.

Anti-freeze function

The anti-freeze function, which is included in versions featuring a hot water coil and a boiler, is enabled when the unit is in operation, no heating demand is present and the external air temperature is lower than the setpoint in parameter “STH136”.

In versions with a hot water coil, when the anti-freeze function gets enabled, the controller opens the relevant control valve at the value set in parameter “STH137” and it enables the circulation pump.

The circulation pump gets activated after the delay in valve opening, as set in parameter “STH140”.

In versions with a boiler, when the anti-freeze function gets enabled, the controller outputs to the boiler the demand signal as set in parameter “STH137” and an OK signal for activation.

The anti-freeze function is disabled when the outside air temperature has exceeded the value set in parameter “STH136” by 1 °C.

3.16.2 Post heating

When the value in parameter “STH55” is “1”, auxiliary heating is configured for summer operation only and serves as post heating during dehumidification. The control can either be proportional or PID, depending on the value set in parameter “STH57”. The value in parameter “STH56” identifies the probe taken as reference for the control which is performed according to parameter “STH58”.

3.16.3 Single source for winter heating

When the value in parameter “STH55” is “2”, auxiliary heating is configured for activation in winter operation only.

If the unit is not fitted with a 4-way valve for cycle reversal - refrigerant circuit only used for cooling -, auxiliary heating is the only source of heating in winter mode.

The control can either be proportional or PID, depending on the value set in parameter “STH91”. The value in parameter “ST9” identifies the probe taken as reference for the control which is performed according to parameter “STH1”.

3.16.4 Auxiliary heating and heating by refrigerant circuit

When the value in parameter “STH55” is “2”, auxiliary heating is configured for activation in winter operation only.

If a 4-way valve is configured, the refrigerant circuit too can operate as heating source.

Each source is managed according to a dedicated control mode (either proportional or PID). The value in parameter “ST9” identifies the probe taken as reference for the control which is performed according to parameter “STH1”.

The reference probe and the setpoint are common to both sources.

The activation of the two heating sources is prioritised according to the setpoint stored in parameter “STH129”, which may be:

- “STH129” = 0 - heating by refrigerant circuit is prioritised over auxiliary heating;
- “STH129” = 1 - auxiliary heating is prioritised over heating by refrigerant circuit;
- “STH129” = 2 - both heating sources have the same priority. If the sources have the same priority, the controller uses them together to manage the relevant demand.

3.16.4.1 Demand distribution with different priorities

If the two sources do not have the same priority, the controller fulfils the heating demand by starting the prioritised source first and then the other.

The demand to the prioritised source can rise until the value stored in parameter “STH126”.

After the setpoint in parameter “STH126” is achieved, the controller stops the demand to the prioritised source and it starts the second source, after the time set in parameter “STH127” has elapsed.

As soon as the second source reaches the setpoint in parameter “STH133”, for as long as the time in parameter “STH128”, the controller starts increasing the demand to the prioritised source too.

A fixed demand may be set for auxiliary heating during the defrost cycle, equal to the setpoint in parameter “STH132”.

3.16.5 Auxiliary heating in both winter and summer operation

When the value in parameter “STH55” is “3”, auxiliary heating is configured for both winter and summer operation.

The operating mode is as described in the above sections.

The air temperature in the return line determines the operating mode:

- if the air temperature in the return line is lower than the setpoint in parameter “STH1”, the unit operates in winter mode;
- if the value is higher than the setpoint in parameter “ST1”, the unit operates in summer mode.

3.17 Defrosting

During operation in heat pump mode, defrosting is the process used to prevent frost build-up on the condensing/evaporating coil and/or to remove any frost that may have formed.

An effective defrost cycle ends with a completely clean condensing/evaporating coil.

The controller manages defrosting differently according to the settings made and the air temperature conditions.

The parameters concerned are shown in the table.

Parameter	Min	Max	UM	Description
DF1	0	2	-	Defrost method
DF2	0	4	-	Defrost entry method
DF3	0	4	-	End-of-defrost exit method
DF10	-50.0	110.0	°C	Fixed evaporating threshold to start defrost
DF11	0	999	s	Defrost start delay
DF12	-1.00	1.00	-	Moving defrost - Parameter A with full load
DF13	-100.0	100.0	-	Moving defrost - Parameter B with full load
DF17	0	999	min	Delay to defrost after the unit is switched on
DF18	0	999	min	Time interval between two defrost cycles of the same circuit
DF19	0	999	min	Time interval between two defrost cycles of different circuits
DF20	0	1	-	Enable manual defrost - from keypad
DF21	-50.0	110.0	°C	Evaporating temperature threshold for activating a forced defrost
DF22	0	999	s	Delay time for forced defrost
DF25	-5.0	25.0	°C	Max. setpoint for defrost start (DF10 + DF25)
DF30	0	2	-	Defrost entry method
DF31	0	999	s	Forcing time of circuit at 100% on entering defrost mode (if DF30 = 0)
DF32	0	999	s	Forcing time of circuit at minimum on entering defrost mode (if DF30 = 1)
DF33	0	999	s	Forcing time of circuit OFF on entering defrost mode (if DF30 = 2)
DF34	-50.0	110.0	°C	Outside air temperature limit for air defrost
DF49	-50.0	110.0	°C	End-of-defrost threshold for condensing temperature
DF50	1	360	s	Minimum defrost duration time
DF51	90	999	s	Maximum defrost time
DF52	33	88	%	Inverter - Pre defrost percentage
DF53	33	88	%	Inverter - Percentage during defrost
DF54	33	88	%	Inverter - Percentage after defrost
DF61	0	2	-	Defrost exit method
DF62	0	999	s	Time compressors are with capacity reduction during end of defrost (if DF61 = 1)
DF63	0	999	s	Time compressors are OFF during end of defrost (if DF61 = 2)

Activation of simultaneous or separate defrost of the refrigerant circuits and the start conditions at fixed or sliding evaporating pressure are done at the factory.

The stages of a defrost cycle are as follows:

- check of defrost start conditions (at fixed or sliding evaporating pressure);
- check of type of defrost to carry out (with air or with refrigeration cycle reversal);
- preparation for cycle reversal;
- refrigeration cycle reversal and defrost of the condensing/evaporating coil;
- check of complete defrosting;
- preparation and new cycle reversal with return to operation in heating mode.

To complete defrost management, in addition to the main stages, the controller gives the possibility of manual forcing by operators or automatic forcing when particular conditions occur.

For optimised defrosting and constant comfort in the rooms the controller can adjust the dampers and the air flow rate.

3.17.1 Simultaneous or separate defrost

Taking for granted that parameter “DF1” is different from “0” and defrost is enabled, the procedure to defrost multi-circuit units depends on their construction.

3.17.2 Check of conditions for the defrost cycle at fixed evaporating temperature

By measuring the operating values of the unit, the controller checks whether there are the conditions for which a defrost is necessary.

The conditions for starting a defrost cycle are as follows:

- the evaporating temperature value must be lower than the threshold to start the defrost cycle, as set in parameter “DF10”;
- the condition must be maintained for at least the time set in parameter “DF11”;
- the unit must have been running for at least the time set in parameter “DF17”;
- the time set in parameter “DF18” must have elapsed since performance of the last defrost cycle in the same circuit;
- if the defrost cycles have been performed in separate circuits, the time set in parameter “DF19” must have elapsed since defrosting was performed in the last circuit.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
DF1	1	-	Defrost method
DF10	-12.0	°C	Defrost start evaporating temperature
DF11	120	s	Time defrost condition is maintained
DF17	10	min	Delay to first defrost after the unit is switched on
DF18	30	min	Minimum delay between two defrost cycles of the same circuit
DF19	10	min	Minimum delay between two defrost cycles of different circuits

Do not change the set values without the manufacturer's approval.

3.17.3 Preparation for cycle reversal

If an air defrost cannot be done, the controller carries out a defrost with refrigeration cycle reversal by operating a 4-way valve.

Depending on the set parameters, refrigeration cycle reversal can take place in different ways linked to the value of parameter “DF30”.

Depending on the value set in parameter “DF30” cycle reversals may include:

- 0 = with 100% of the refrigeration capacity before reversal;
- 1 = with capacity reduction to the minimum refrigeration capacity before reversal;
- 2 = with compressor(s) not running.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
DF30	1	-	Defrost entry method
DF31	60	s	Forcing time of circuit at 100% on entering defrost mode (if DF30=0)
DF32	30	s	Forcing time of circuit at minimum on entering defrost mode (if DF30=1)
DF33	20	s	Forcing time of circuit OFF on entering defrost mode (if DF30=2)

Depending on the value set in parameter DF30, before refrigeration cycle reversal, the controller maintains the condition for the time set in the values of parameters DF31 or DF32 or DF33.

3.17.4 Refrigeration cycle reversal and defrost

With reversal of the refrigeration cycle and the stopping of ventilation, defrosting of the coil starts.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
DF49	48.0	°C	Condensing temperature threshold for end of defrost
DF50	10	s	Minimum defrost duration time
DF51	300	s	Maximum defrost duration time

In these conditions, the heat produced by the delivery gas warms the coil and melts the frost present. The checks and actions carried out by the controller during this stage are as follows:

- checking that defrosting has not been stopped accidentally and that it continues for at least the minimum time;
- management of gradual increase in condensing pressure until the end-of-defrost pressure is achieved;
- checking that the defrost time does not exceed the maximum duration. If this happens, the defrost cycle is stopped;
- indifferently of the conditions that lead to the end of the defrost (due to reaching the end-of-defrost threshold or due to reaching the time limit), the next action is preparation for return of operation in heating mode.

3.17.5 Forcing of a defrost cycle

The starting of a defrost can take place normally or through manual or automatic forcing.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
DF20	1 - Yes	-	Enables manual defrost from the keypad
DF21	-20.0	°C	Evaporating temperature threshold for activating a forced defrost
DF22	10	s	Delay to starting forced defrost

When parameter “DF20” is enabled, a defrost cycle can be overridden from the keypad.

If operating conditions make it necessary, the operator can force the controller, from the keypad, to carry out defrost cycles without needing to comply with the set delays.

So that a defrost can take place, sufficient thermal inertia must in any case be present in the system.

Failing this, the protective devices may trip, and if this happens repeatedly, the compressors can be damaged.

The controller activates a “forced” defrost cycle, ignoring the set delays, when the evaporating temperature reaches the threshold setpoint in parameter “DF21” and maintains it for the time set in parameter “DF22”.

3.17.6 Management of auxiliary heating during defrost cycle

Irrespective of the auxiliary heating type in the unit, the controller can enable it during the defrost cycle to preserve comfort in the room, where this is required for winter operation.

The controller outputs the demand to the auxiliary heating function at the percentage value set in parameter “STH132”.

3.17.7 Special management logics during defrosting

There are some operating modes during which the controller adjusts ventilation in a special way.

3.17.7.1 Ventilation management during defrosting

For enhanced room comfort during the defrost cycle, the fan in the delivery line follows the setpoint in parameter “FA81”. This only applies when either a constant or variable flow control is featured and parameter “FA82” is set to “1”.

For enhanced room comfort during the defrost cycle, the fan in the return line follows the setpoint in parameter “RFA31”. This only applies when constant flow control is featured or when variable flow control is featured in the delivery line and parameter “RFA32” is set to “1”.

Reduced air flow during the defrost cycle enhances room comfort, but it also reduces the efficiency of the defrost cycle.

Great attention should be paid when setting reduced flow parameters.

Very low flow values may cancel the defrost cycle efficiency.

3.17.7.2 Management of external air damper during defrosting

For continuous comfort in the room, the external air and exhaust air dampers can be overridden to close using the value set in parameter “DA14”. This is the case when defrosting takes place reversing the refrigeration cycle, for as long as the coil of the 4-way valve in the refrigerant circuit is de-energised. As a consequence, the recirculated air damper is fully open.

3.18 Other functions

The unit can be managed automatically based on time bands. The controller manages a set of useful functions for unit operation.

3.18.1 Management of control probe error

The temperature control probes include a probe that measures the air temperature in the delivery line and a probe that measures the air temperature in the return line.

If a fault is experienced during unit operation, the controller features an emergency management function in order to provide for service continuity.

Where a fault occurs, the controller takes as reference the average calculated using the values measured in the past thirty minutes.

The controller stops the unit if the available measurements cover a shorter period than thirty minutes.

3.18.2 Heater in condensate drip tray

The condensate drip tray may be supplied with a heater to prevent water in it from freezing.

The controller starts the heater in the condensate drip tray as soon as the air temperature is lower than the setpoint in parameter “STH146”.

The heater is active until the air temperature exceeds the value resulting from the sum of the setpoints in parameters “STH146” and “STH147”.

If the setpoint in parameter “STH148” is “0”, the heater is only enabled when the unit is in operation; when it is set to “1”, the heater is also enabled when the unit is off.

3.18.3 "Leak detector" management

The controller manages a refrigerant gas detector serially and it monitors its correct operation.

If malfunctions or refrigerant leaks are identified, the controller triggers alarm messages and safety procedures.

The purpose of the safety procedures is to blow away any refrigerant detected using the fans.

In addition to identifying refrigerant leaks, the controller also manages the following:

- correct serial communication;
- fault events experienced by the detector sensor;
- maintenance of the detector sensor.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
FA25	750	10m3/h	Leak detector - Flow rate setpoint
RFA25	750	10m3/h	Leak detector - Flow rate setpoint
PAL20	2	-	Refrigerant leak - Action in presence of an alarm
PAL21	5	s	Refrigerant leak - Delay upon activation
PAL22	5	min	Refrigerant leak - Delay upon de-activation
PAL23	0	-	Refrigerant leak - Max. number of alarms per hour

The controller activates a “refrigerant leak” alarm if it senses leaking refrigerant for the time set in parameter “PAL21”.

When the “refrigerant leak” alarm is active, the controller:

- it stops all devices in operation, except for the fans (in both delivery and return lines, where applicable);
- sets the dampers for total air recycling;
- it overrides ventilation in the delivery line according to the setpoint in parameter “FA25”;
- it overrides ventilation in the return line according to the setpoint in parameter “RFA25”;

- closes the digital output to control an area damper and additional ventilation, which are not incorporated in the unit. The control corresponds to terminals “666” and “667” in the terminal board of the electrical cabinet;
- it activates alarm “AL154” to warn about refrigerant gas having been detected in the air.

In the event of a serial communication failure with the gas detector, a sensor malfunction or the need to replace it, the controller:

- it sets the dampers for total air recycling;
- overrides ventilation in the delivery line with an air flow equal to at least the setpoint in parameter “FA25”;
- overrides ventilation in the return line with an air flow equal to the setpoint in parameter “RFA25”;
- closes the digital output to control an area damper and additional ventilation, which are not incorporated in the unit. The control corresponds to terminals “666” and “667” in the terminal board of the electrical cabinet;
- activates the relevant alarm messages.

The operating conditions connected to the alarms of the gas detector are kept for the time set in parameter “PAL22”, including when their triggering causes are resolved.

If one of the conditions above applies together with a ventilation alarm, the controller closes an additional digital output to warn about failure to perform the safety procedure correctly.

The digital output in the controller corresponds to terminals “668” and “669” that represent the the potential-free contact in the terminal board of the electrical cabinet.

The controller starts the procedure following an alarm connected to the gas detector, including when the unit is in “OFF” mode.

3.18.4 Management of operating mode switching

The way in which units designed for operation in both heating and cooling mode switch from one mode to another is set in parameter “SP40”.

The values parameter “SP40” can take and their functions include:

- 0 - cooling mode only: used in units designed for operation in cooling mode only;
- 1 - heating mode only: used in units designed for operation in heating mode only;
- 2 - From keypad: the user interface is used for mode switching;
- 3 - Depending on time bands: this option must be selected to enable operation by time bands;
- 4 - Depending on air temperature in return line: this option enables automatic switching based on the air temperature in the return line and the setpoints in parameters “ST1” (cooling) and “STH1” (heating). Automatic switching only works if the control is based on the air temperature in the return line;
- 5 - From digital input: this option enables switching by an external potential-free contact. When the contact is closed, the unit works in heating mode; when the contact is open, the unit works in cooling mode. Refer to the wiring diagram to connect the contact;
- 6 - From BMS management system: this option enables mode switching serially. When serial management is active (“SP6” = “1”), the BMS is the only system that can be used to make all adjustments.

3.18.5 Automatic mode switching

Management of available resources based on air temperature in return line

When the setpoint in parameter “SP40” is “4”, mode switching takes place automatically according to the values set in parameters “ST1” and “STH1”. The value set in parameter “ST1” must be higher than the setpoint in parameter “STH1”.

If the setpoint in parameter “ST1” is lower than the setpoint in parameter “STH1”, the software automatically corrects the value in parameter “ST1” to make it equal to the value in parameter “STH1” plus 1.0 °C.

If the setpoint in parameter “STH1” is higher than the setpoint in parameter “ST1”, the software automatically corrects the value in parameter “STH1” to make it equal to the value in parameter “ST1” minus 1.0 °C.

In units designed for cooling mode only parameters “STH53” and “STH54” are used to manage summer/winter operation of auxiliary heating.

When the unit is started up for the first time and after each software update, the unit operates in cooling mode. When power is restored after a blackout, the operating mode is the same as originally set.

Management of available resources based on air temperature in delivery line

Automatic mode switching as a result of air monitoring in the delivery line is not featured.

When air monitoring is performed in the delivery line, the values parameter “SP40” can take and their functions include:

- 2 - From keypad: the user interface is used for mode switching;
- 3 - Depending on time bands: this option must be selected to enable operation by time bands;
- 5 - From digital input: this option enables switching by an external potential-free contact.
- 6 - From BMS management system: this option enables mode switching serially.

If the value of parameter “SP40” is set to “4” by mistake, with air monitoring in the delivery line, the software automatically corrects the selection to “2”.

Cascade control

The Cascade function refers to the setpoint value entered in parameter “ST42”. This value is also used as reference for automatic mode switching when parameter “SP40” is set to “4”, together with parameters “ST43” and “STH46”.

The reference temperature is the air temperature in the delivery line. Mode switching takes place as follows:

- if the air temperature in the return line is higher than the sum of the setpoints in parameters “ST42” and “ST43”, the controller sets unit operation in cooling mode;
- if the air temperature in the return line is lower than the difference between the setpoints in parameters “ST42” and “STH46”, the controller sets unit operation in heating mode;
- if the air temperature in the return line is included between the sum of parameters “ST42” and “ST43” and the difference of parameters “ST42” and “STH46”, the controller keeps the unit running in the last set mode.

3.18.6 Flow rate reduction upon achievement of temperature setpoint

In applications specifically designed for this purpose, the controller features the possibility to reduce the air flow rate when the temperature setpoint is achieved.

The parameters involved are shown in the table.

This function is disabled and the second flow setpoint is blank when the unit is released from the factory.

Parameter	Value	UM	Description
FA76	0	10m3/h	Variable / constant air flow control - Cooling / Heating - New air flow setpoint when the temperature setpoint is reached
FA77	0	-	Variable / constant air flow control - Cooling / Heating - Enabling of new air flow setpoint when the temperature setpoint is reached
RFA29	0	10m3/h	PID - Constant air flow control - New air flow setpoint when the temperature setpoint is reached
RFA30	0	-	PID - Constant air flow control - Enabling of new air flow setpoint when the temperature setpoint is reached

“FA” parameters refer to the flow rate in the delivery line; “RFA” parameters refer to the flow rate in the return line.

If the value set in parameters “FA76” and “RFA29” is = “0”, the ventilation system is switched off as soon as the temperature setpoint is achieved.

3.18.7 Activation according to time bands

The unit may be managed automatically according to time bands. The time band management logic is designed to stop the unit, to edit the setpoint and to switch among operating modes.

The parameters concerned are shown in the table.

Parameter	Min	Max	UM	Description
ES1	0	144	h	Time band 1 - Start
ES2	0	144	h	Time band 1 - End
ES3	0	144	h	Time band 2 - Start
ES4	0	144	h	Time band 2 - End
ES5	0	144	h	Time band 3 - Start
ES6	0	144	h	Time band 3 - End
ES7	0	15	-	Setpoint variation - Monday
ES8	0	15	-	Setpoint variation - Tuesday
ES9	0	15	-	Setpoint variation - Wednesday
ES10	0	15	-	Setpoint variation - Thursday
ES11	0	15	-	Setpoint variation - Friday
ES12	0	15	-	Setpoint variation - Saturday
ES13	0	15	-	Setpoint variation - Sunday
ES14	-25.0	25.0	°C	Setpoint variation - Mechanical cooling - Offset
ES16	-25.0	25.0	°C	Setpoint variation - Mechanical heating - Offset
ES18	0	15	-	Unit switch-off - Monday
ES19	0	15	-	Unit switch-off - Tuesday
ES20	0	15	-	Unit switch-off - Wednesday
ES21	0	15	-	Unit switch-off - Thursday
ES22	0	15	-	Unit switch-off - Friday
ES23	0	15	-	Unit switch-off - Saturday
ES24	0	15	-	Unit switch-off - Sunday
ES26	0	144	h	Time band 4 - Start
ES27	0	144	h	Time band 4 - End
ES31	0	15	-	Heating mode activation - Monday
ES32	0	15	-	Heating mode activation - Tuesday
ES33	0	15	-	Heating mode activation - Wednesday
ES34	0	15	-	Heating mode activation - Thursday
ES35	0	15	-	Heating mode activation - Friday
ES36	0	15	-	Heating mode activation - Saturday
ES37	0	15	-	Heating mode activation - Sunday

The pairs of start and end parameters are used to set as many as 4 time bands.

Each day of the week can be matched with a combination of the set time bands in order to edit the setpoint, switch the unit off and switch between operating modes.

The setpoint is edited within the selected time band by way of applying an offset to the active operating value.

The active operating value is given by the value set in the relevant parameter and external offsets, if any.

The offset value can be either positive or negative. When it is positive, it is added; when it is negative, it is subtracted.

Two offset values can be set: one for operation in cooling mode and one in heating mode.

If the controller manages auxiliary heating, the setpoint in parameter “STH58” is maintained when the time bands are activated in cooling mode; when they are activated in heating mode, the setpoint varies according to the offset value.

In order for cooling/heating switching to work with time bands, the value in parameter “SP40” must be set to “3”.

3.19 Enabled functions

The controller offers the opportunity to enable some functions that are managed by the software.

The parameters concerned are shown in the table.

Parameter	Min	Max	UM	Description
SP37	0	1	-	Enable heater 1
SP38	0	1	-	Enable heater 2
SP39	0	1	-	Enable fire / smoke alarm
SP46	0	1	-	Enable static pressure / differential pressure probe
SP48	0	1	-	Enable CO2 air quality probe

3.19.1 Option management

The unit may be fitted with some options.

After installation, option management must be enabled in the controller.

Refer to the instructions supplied with the installation kit and to the wiring diagram for the necessary connections.

Options that require enabling in the controller include:

- heaters;
- fire/smoke alarm;
- static pressure/differential pressure probe;
- CO_2 air quality probe.

These functions are enabled in the screens containing the “SP - Setup” parameters. Access to these screens requires entry of “Service” credentials.

When a function is enabled, the inputs and outputs required for operation are automatically activated.

Refer to the instructions supplied with the option for the installation procedure. Refer to the wiring diagram for the electrical connections.

The controller must be restarted to make any change active.

When an option is enabled, a request for controller restart appears automatically in the form of a message on the display.

A countdown appears in the message window, which can be bypassed - the restart procedure is started immediately - or delayed. If none of the two actions above is selected, the controller gets restarted at the end of the countdown.

If the restart procedure is delayed, the controller will automatically display a restart message after a few seconds.

The controller may also be restarted by de-energising and then re-energising it.

4 ALARMS

4.1 Introduction

The active alarms generated by the application software can activate a relay, if suitably configured.

The relay is switched on if:

- there is an active alarm;
- there is an alarm that has not been reset;

The relay will be switched off if:

- there are no active alarms.

4.1.1 Automatic/Manual procedure and alarm reset

The holding of the alarms takes place considering a time window of 1 hour. The hour is divided into 60 intervals of 1 minute each.

1°Int	2°Int	3°Int	4°Int	5°Int	6°Int	7°Int	8°Int	9°Int	10°Int	...	55°Int	56°Int	57°Int	58°Int	59°Int

The window is sliding as regards the alarm event and always covers the last hour. During the interval of one minute, if an occurrence is detected, this time interval is considered active.

"ACT" is assigned to the active interval to record the event. The sum of the active intervals in the last hour allows the number of events/alarms per hour to be calculated.

If the sum of the active intervals does not exceed the respective threshold value of occurrences/hour, they are deleted.

Two examples are given below with threshold of occurrences/hour = 5

1°Int	2°Int	3°Int	4°Int	5°Int	6°Int	7°Int	8°Int	9°Int	10°Int	...	55°Int	56°Int	57°Int	58°Int	59°Int
ACT		ACT				ACT									

In the first example, since the number of active intervals is 3, which is lower than the threshold of occurrences/hour set to 5, the events are deleted.

1°Int	2°Int	3°Int	4°Int	5°Int	6°Int	7°Int	8°Int	9°Int	10°Int	...	55°Int	56°Int	57°Int	58°Int	59°Int
ACT		ACT		ACT		ACT			ACT	ACT			ACT		

In the second example, the number of active intervals is 7, and therefore exceeds the threshold of occurrences/hour set to 5. In this case, the alarm becomes a manual reset alarm and therefore the work of technical personnel will be necessary.

Even if the alarm is no longer active, only a manual reset will cause the deletion of the alarm from the display and from the list of active alarms.

Alarms that merely notify, that is, no output is energized/de-energized are also managed in the application. These are called WARNINGS.

4.1.2 File “alarm.conf”

This file is used to customise management of each alarm according to:

- the seriousness of the alarm, based on which a digital output is associated;
- the alarm being enabled with the unit off;

As regards the alarm seriousness, the available selections affect the closing of digital outputs and they include:

- 0 = no warning message;
- 1 = non serious alarm designed to trigger activation of corresponding digital output;
- 2 = serious alarm designed to trigger activation of corresponding digital output;
- 3 = serious alarm designed to trigger activation of both digital outputs.

The options for the alarm with the unit off include:

- 0 = alarm enabled;
- 1 = alarm disabled.

The file can be accessed and edited using any text editor.

Refer to the chapter on programming procedures for the upload of the “alarm.conf” file into the controller and its editing.

4.2 Unit alarms

4.2.1 Air flow alarm

The air flow test is performed using either a mechanical differential or a differential pressure transducer.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PAL115	5.0	Pa	Constant flow rate - Differential flow switch - Alarm threshold
PAL116	15	s	Constant flow rate - Differential flow switch - Alarm delay upon fan start-up
PAL118	5	s	Constant flow rate - Differential flow switch - Alarm delay at steady state

Air flow alarm from differential pressure transducer

Alarm code	AL5
Reason for activation	When the pressure value measured by the differential pressure transducer is lower than the setpoint in parameter “PAL115” after delay “PAL116” upon unit start-up or “PAL118” at steady state
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	The controller stops the operation of the unit.

4.2.2 Dirty filters alarm

Alarm code	AL14
Reason for activation	With the unit running, upon opening of the digital input to which the relevant safety device is connected
Reset	When the relevant digital input closes
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	They follow their control

4.2.3 Humidity alarm

When the humidity control function is featured, the controller checks that the humidity values are within the required operating range.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PAL77	80.0	%	Return air humidity - High humidity threshold
PAL78	0.5	%	Return air humidity - High humidity differential
PAL79	10.0	%	Return air humidity - Low humidity threshold
PAL80	0.5	%	Return air humidity - Low humidity differential
PAL81	60	-	Return air humidity - Max. number of alarms per hour

High return air humidity alarm

Alarm code	AL12
Reason for activation	When the relative humidity value measured by the probe on the air return line is greater than the setpoint in parameter “PAL77”
Reset	When the relative humidity value measured by the probe on the return line is lower than the difference between “PAL77” and “PAL78”
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL78”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	They follow their control

Low return air humidity alarm

Alarm code	AL13
Reason for activation	When the relative humidity value measured by the probe on the air return line is lower than the setpoint in parameter “PAL79”
Reset	When the relative humidity value measured by the probe on the return line is greater than the sum of “PAL79” and “PAL80”
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL78”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	They follow their control

4.2.4 Return temperature alarm

The controller always checks that the return air temperature values are within the required operating range.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PAL82	35.0	°C	Return air - High temperature threshold
PAL83	5.0	°C	Return air - High temperature differential
PAL84	15.0	°C	Return air - Low temperature threshold
PAL85	5.0	°C	Return air - Low temperature differential
PAL86	60	-	Return air - Max. number of alarms per hour

High return air temperature alarm

Alarm code	AL28
Reason for activation	When the temperature value measured by the probe on the return line is greater than the setpoint in parameter “PAL82”
Reset	When the temperature value measured by the probe on the return line is lower than the difference between “PAL82” and “PAL83”
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL86”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	They follow their control

Low return air temperature alarm

Alarm code	AL29
Reason for activation	When the temperature value measured by the probe on the return line is lower than the setpoint in parameter “PAL84”
Reset	When the temperature value measured by the probe on the return line is greater than the difference between “PAL84” and “PAL85”
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL86”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	They follow their control

Limitation of air temperature in return line active

Alarm code	AL26
Reason for activation	When the temperature value measured by the probe on the return line is lower than the setpoint in parameter “ST21”.
Reset	When the temperature value measured by the probe on the return line is greater than the sum of “ST21” + “ST22”.
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Dehumidification demand	It follows the function designed to limit the air temperature in the return line.

4.2.5 Delivery temperature alarm

The controller always checks that the delivery air temperature values are within the required operating range.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PAL87	40.0	°C	Return air - High temperature threshold
PAL88	5.0	°C	Return air - High temperature differential
PAL89	15.0	°C	Delivery air - Low temperature threshold
PAL90	3.0	°C	Delivery air - Low temperature differential
PAL91	60	-	Delivery air - Max. number of alarms per hour

High delivery air temperature alarm

Alarm code	**AL30**
Reason for activation	When the temperature value measured by the probe on the delivery line is greater than the setpoint in parameter “PAL87”
Reset	When the temperature value measured by the probe on the delivery line is lower than the difference between “PAL87” and “PAL88”
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL91”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	They follow their control

Low delivery air temperature alarm

Alarm code	**AL31**
Reason for activation	When the temperature value measured by the probe on the delivery line is lower than the setpoint in parameter “PAL89”
Reset	When the temperature value measured by the probe on the delivery line is greater than the sum of “PAL89” plus “PAL90”
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL91”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	They follow their control

Limitation due to low air temperature in delivery line

Alarm code	**AL32**
Reason for activation	When the temperature value measured by the probe on the delivery line is lower than the setpoint in parameter “SFA34”
Reset	When the temperature value measured by the probe on the delivery line is greater than the sum of “SFA34” plus “SFA35”
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Cooling demand	It follows the function designed to limit the air temperature in the delivery line.

4.2.6 Low external air temperature alarm

Alarm code	**AL27**
Reason for activation	If the outside air temperature drops below the value set in parameter “STH14”.
Reset	When the outside air temperature rises above the value resulting from the sum of parameter “STH14” and “1°C”.
Reset mode	Automatic; switches to manual after trip occurrences per hour set in “PAL135”.
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Mechanical heating	The controller stops it.
The other devices	They follow their control

4.2.7 Thermal overload switch alarm in ventilation unit

Ventilation in delivery line - Thermal overload switch alarm

Alarm code	**AL35**
Reason for activation	When the system demands ventilation unit activation and the digital input corresponding to the alarm is open after the time set in parameter “PAL25” has elapsed
Reset	When the digital input closes
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL26”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	The controller stops the operation of the unit.

Ventilation in return line - Thermal overload switch alarm

Alarm code	**AL36**
Reason for activation	When the system demands ventilation unit activation and the digital input corresponding to the alarm is open after the time set in parameter “PAL25” has elapsed
Reset	When the digital input closes
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL26”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	The controller stops operation of the fans in the return line.

External ventilation - Thermal overload switch alarm

Alarm code	**AL33 for circuit 1; AL34 for circuit 2**
Reason for activation	When the system demands ventilation unit activation and the digital input corresponding to the alarm is open after the time set in parameter “PAL47” has elapsed.
Reset	When the digital input closes
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL48”.
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Source-side fans	The alarm is displayed for warning purposes only. The fans concerned are stopped electro-mechanically.
The other devices	They follow their control

4.2.8 Power supply alarm

The controller is designed to control either the phase sequence or min. and max. power voltage monitoring through a digital input. The type of monitoring process is selected at the factory and it is set in parameter “CF17” (0 = phase sequence or min./max. voltage; 1 = min./max. Voltage or blackout).

Phase sequence or min./max. voltage alarm

Alarm code	**AL55**
Reason for activation	When the corresponding digital input is open.
Reset	Cut off and restore power to the controller.
Reset mode	Always automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	Operation is inhibited.

Min./Max. voltage alarm - Blackout

Alarm code	**AL201**
Reason for activation	When the corresponding digital input is open.
Reset	Upon closing of the digital input, after the delay set in parameter “CO30”
Reset mode	Always automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	All outputs are disabled.

Fast Restart alarms

Alarm code	**AL191 Max. number of fast starts in 1 hour achieved**
Reason for activation	As soon as the number of start-ups set in parameter “PAL33” is achieved.
Reset	One hour after alarm “AL201” causing the activation has tripped.
Reset mode	Automatic only
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	All outputs are disabled.

Alarm code	**AL192 Max. number of fast starts in twenty-four hours achieved**
Reason for activation	As soon as the number of start-ups set in parameter “PAL33” is achieved.
Reset	One hour after alarm “AL201” causing the activation has tripped.
Reset mode	Automatic only
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	All outputs are disabled.

4.2.9 Ventilation unit maintenance alarm

The controller records the number of operating hours of the fans featured in the unit and outputs a message to warn about the need for maintenance.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
FA47	1000	h	Threshold for “compressor operating hours exceeded” alarm (0 = disabled)
RFA47	1000	h	Threshold for “compressor operating hours exceeded” alarm (0 = disabled)

Ventilation in delivery line

Alarm code	**AL135**
Reason for activation	This is detected when the operating hours of the fans in the delivery line exceed the limit set in parameter “FA47”.
Reset	Upon deletion of the hours in the Service or Maintenance menu
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Fans	They follow the control
The other devices	They follow their control

Ventilation in return line

Alarm code	**AL183**
Reason for activation	This is detected when the operating hours of the fans in the return line exceed the limit set in parameter “RFA47”.
Reset	Upon deletion of the hours in the Service or Maintenance menu
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Fans	They follow the control
The other devices	They follow their control

4.2.10 EEprom error alarm

Alarm code	**AL210**
Reason for activation	EEprom memory error in controller
Reset	Controller replacement
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	All outputs are disabled.

4.2.11 Alarm: access error to internal memory

Alarm code	**AL212**
Reason for activation	Configuration file reading error
Reset	Start the board again and make sure that no USB peripheral is connected.
	If the problem persists, the board needs re-programming.
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	All outputs are disabled.

4.2.12 Internal memory error alarm

Alarm code	**AL1**
Reason for activation	Non-conforming hardware
Reset	Start the board again and make sure that no USB peripheral is connected.
	If the alarm persists, replace the controller with a new one provided by the unit manufacturer.
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
All devices	The controller will not work.

4.2.13 External alarm

A digital input is featured in the controller to manage an external signal. The signal is managed by the controller according to the option set in parameter “PAL60” (0 = warning only; 1 = unit stop; 2 = only ventilation unit in operation).

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PAL57	0	s	Activation delay
PAL58	0	s	De-activation delay
PAL59	0	-	Max. number of alarms in one hour
PAL60	0	-	Action in presence of an alarm

External alarm

Alarm code	**AL209**
Reason for activation	When the relevant digital input is open, after the delay setpoint in parameter “PAL57”
Reset	Upon closing of the digital input after the delay set in parameter “PAL58”
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL59”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	Based on setpoint in parameter “PAL60”

4.2.14 c.pCOe communication error alarm

c.pCOe boards are extensions that are serially connected to the master board.

Alarm code	**AL52 for extension 1; AL53 for extension 2; AL54 for extension 3**
Reason for activation	When the master fails to communicate with the corresponding extension.
Reset	As soon as serial communication is restored.
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	Unit operation stop

4.3 Function alarms

Alarms linked to the functions managed by the controller are described below.

4.3.1 Fire/smoke alarm

When the controller senses special conditions in the room, it behaves accordingly, based on the set parameters. The room conditions are detected by sensors installed in the room and the sensed information is sent to the controller through digital inputs.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PAL43	5	s	Fire/Smoke - Activation delay
PAL44	1	s	Fire/Smoke - De-activation delay
PAL45	0	-	Fire/Smoke - Max. number of alarms per hour
PAL46	0	-	Fire/Smoke - Action in presence of an alarm

The values parameter "PAL46" can have are the following:

- 0 = warning message only;
- 1 = full unit stop;
- 2 = unit stop, excluding ventilation unit.

Fire/smoke alarm

Alarm code	AL159
Reason for activation	When the relevant digital input is open after the delay setpoint in parameter "PAL43"
Reset	Upon closing of the digital input after the delay set in parameter "PAL44"
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in "PAL45"
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on "alarm.conf" file
Devices	**Behaviour in the event of an alarm**
All devices	According to setpoint in parameter "PAL46"
Fire damper	Closing of digital output for fire damper control

4.3.2 Electronic valve driver alarm

Communication error alarm

Alarm code	**AL160 for circuit 1; AL161 for circuit 2**
Reason for activation	Serial communication error between controller and drivers
Reset	Automatic
Reset mode	As soon as serial communication is restored
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Involved circuit	Stop
The other devices	They follow their control

4.3.3 Humidifier alarms

The controller manages different alarms which are dependant on the connected humidifier.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	**Value**	**UM**	**Description**
PAL73	1	s	CPY humidifier - General alarm - Alarm delay upon activation
PAL74	5	-	CPY humidifier - General alarm - Max. number of alarms per hour
PAL75	1	s	CPY humidifier - General warning message - Alarm delay upon activation
PAL76	5	-	CPY humidifier - General warning message - Max. number of alarms per hour

CPY humidifier – General alarm

Alarm code	**AL162**
Reason for activation	General alarm in CPY board after the delay set in parameter “PAL73”
Reset	As soon as the alarm in the CPY board is cleared.
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL74”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Humidifier	According to parameters set in CPY board
The other devices	They follow their control

CPY humidifier – General warning message

Alarm code	**AL163**
Reason for activation	General alarm in CPY board after the delay set in parameter “PAL75”
Reset	As soon as the alarm in the CPY board is cleared.
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL76”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Humidifier	According to parameters set in CPY board
The other devices	They follow their control

CPY humidifier – Communication error alarm

Alarm code	**AL164**
Reason for activation	Communication error with CPY board
Reset	As soon as serial communication with CPY board is restored.
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Humidifier	According to parameters set in CPY board
The other devices	They follow their control

4.3.4 Heater alarms

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PAL34	5	s	Activation delay
PAL35	5	-	Max. number of alarms in one hour

Thermal overload switch

Alarm code	**AL250 for heater 1; AL251 for heater 2**
Reason for activation	Upon opening of the relevant digital input after the delay set in parameter “PAL34”
Reset	As soon as the relevant digital input closes.
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL35”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Heaters	The controller stops the involved heaters.
The other devices	They follow their control

4.3.5 Defrost cycle ended due to max. time achieved

Alarm code	**AL184 for circuit 1; AL185 for circuit 2**
Reason for activation	If a defrost ends due to time limit instead of due to condensing temperature threshold
Reset	Automatic
Reset mode	At the next defrost ended with exceeding of the condensation threshold
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
The other circuits and devices	They follow their control

4.3.6 “Leak detector” alarms

Refrigerant leak alarm

Alarm code	**AL154**
Reason for activation	After the time set in parameter “PAL21”, when the refrigerant detector warns about a leak.
Reset	Always manual with parameter “PAL23” = “0”
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Dampers and ventilation	When operating fully with outside air and if the digital OK signal for one area damper and additional ventilation are not featured in the unit.
Other devices	All disabled

Refrigerant leak sensor - Malfunction alarm

Alarm code	**AL151**
Reason for activation	When the controller identifies a sensor malfunction.
Reset	After the sensor is back to normal operating conditions.
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Dampers and ventilation	When operating fully with outside air and if the digital OK signal for one area damper and additional ventilation are not featured in the unit.
Other devices	They follow their control

Refrigerant leak sensor - Maintenance almost required

Alarm code	**AL152**
Reason for activation	Sensor replacement is close to being needed.
Reset	After sensor replacement
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Other devices	Warning only (all devices follow their setting)

Refrigerant leak sensor - Maintenance alarm

Alarm code	**AL153**
Reason for activation	When the hours of operation required to replace the sensor are achieved.
Reset	After sensor replacement
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Dampers and ventilation	When operating fully with outside air and if the digital OK signal for one area damper and additional ventilation are not featured in the unit.
Other devices	They follow their control

Refrigerant leak sensor - Communication error alarm

Alarm code	**AL165**
Reason for activation	Whenever serial communication is lost between the controller and the refrigerant gas detector.
Reset	After serial communication is restored.
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Dampers and ventilation	When operating fully with outside air and if the digital OK signal for one area damper and additional ventilation are not featured in the unit.
Other devices	They follow their control

4.3.7 General boiler and burner alarms

Boiler - Generic alarm

Alarm code	**AL258**
Reason for activation	With opening of the relevant digital input
Reset	As soon as the relevant digital input closes.
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL38”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Boiler	The controller stops boiler management.
Other devices	They follow their control

Burner - Generic alarm

Alarm code	**AL259**
Reason for activation	With opening of the relevant digital input
Reset	As soon as the relevant digital input closes.
Reset mode	Always automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Burner	The controller stops burner management.
Other devices	They follow their control

4.4 Circuit alarms

The circuit alarms occur only on the compressors of the circuit involved.

4.4.1 High-pressure alarms

The delivery pressure in each refrigerant circuit is controlled by safety pressure switches and by pressure transducers.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PAL11	39.00	bar	High pressure alarm threshold
PAL12	4.00	bar	High pressure alarm differential
PAL13	0	-	Maximum number of alarms in one hour due to high pressure

Pressure switch high pressure alarm

Alarm code	AL6 for circuit 1; AL7 for circuit 2
Reason for activation	With the unit running, when the digital input opens to which the relevant safety devices are connected
Reset	When the relevant digital input closes
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
The other devices	They follow their control

High pressure alarm from transducers

Alarm code	AL10 for circuit 1 and AL11 for circuit 2
Reason for activation	With unit running, if the value measured by the pressure probe is >=PAL11
Reset	When the value measured by the pressure probe is <= (PAL11 - PAL12)
Reset mode	Automatic, and becomes manual after PAL13 occurrences/hour
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
The other devices	They follow their control

4.4.2 Low pressure alarms

The intake pressure in each refrigerant circuit is controlled by low pressure switches and transducers.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PAL1	15	s	Low pressure alarm delay on starting of the circuit
PAL2	4.5	bar	Low pressure alarm threshold during operation
PAL3	2.0	bar	Low pressure alarm differential during operation
PAL4	5	-	Maximum number of alarms in one hour due to low pressure
PAL10	5	s	Low pressure alarm delay at full operating speed

Low pressure alarm from transducers

Alarm code	**AL203 for circuit 1; AL204 for circuit 2**
Reason for activation	With unit running, if the value measured by the pressure probe is <=PAL2
Reset	When the value measured by the pressure probe is > than the difference between PAL2 and PAL3
Reset mode	Automatic, and becomes manual after PAL4 occurrences/hour
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
The other devices	They follow their control

4.4.3 High discharge gas temperature alarm

The controller senses the exhaust gas temperature and, where this exceeds the set threshold, it manages the alarm and stops the compressors featured in the circuit. To be more precise, if an inverter compressor is fitted, the controller tries to reduce the exhaust temperature and the compressor speed, before the stop threshold is achieved, taking the compressor envelope as reference.

The parameter involved is shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PAL50	110.0	°C	Delivery gas high temperature alarm threshold
PAL51	30.0	°C	Delivery high temperature alarm differential
PAL52	2	-	Maximum number of alarms in one hour due to high delivery temperature

Alarm code	**AL57 for circuit 1, compressor 1; AL58 for circuit 2, compressor 1; AL59 for circuit 1, compressor 2; AL60 for circuit 2, compressor 2.**
Reason for activation	If the value measured by the temperature probe is >= PAL50
Reset	When the value measured by the temperature probe is <= than the difference between PAL50 and PAL51
	When the value detected by the temperature probe is back within the limit required by the compressor envelope.
Reset mode	Automatic, and becomes manual after PAL52 occurrences/hour
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
The other devices	They follow their control

4.4.4 Alarm for low difference between high and low pressure

Checking of the difference between high and low pressure values takes place when at least one compressor of the circuit involved is running.

Upon compressor start-up, a certain difference must be generated between high and low pressure in order to ensure correct compressor rotation and oil return to the compressor.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PAL92	3.00	bar	Low pressure difference alarm threshold
PAL93	60	s	Low pressure difference alarm delay on starting of compressors
PAL94	90	s	Low pressure difference alarm delay at steady state
PAL95	2	-	Maximum number of alarms in one hour due to low pressure difference

Alarm code	**AL114 for circuit 1; AL115 for circuit 2**
Reason for activation	Upon start-up of one compressor in the circuit, if the pressure difference is <= than PAL92 for the number of seconds set in PAL93
	After the time in PAL93 has elapsed, if the pressure difference is <= than PAL92 for the seconds set in PAL94
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL95”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
The other devices	They follow their control

4.4.5 Low superheating alarm

Where an electronic expansion valve is fitted, the controller manages the superheating of the intake gas to the compressor.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
Et30	300	s	Low superheating alarm delay
Et37	2.0	°C	Low superheating protection threshold
PAL4	5	-	Maximum number of alarms in one hour due to low pressure

Alarm code	**AL170 for circuit 1; AL171 for circuit 2**
Reason for activation	If the measured superheating value is lower than threshold ET37 for a time longer than the setpoint in parameter ET30
Reset	When the measured superheating value is higher than or equal to threshold ET37 +1°C for 1 second
Reset mode	Automatic until the number of trip occurrences in one hour set in parameter PAL4 is reached
	Manual as soon as the number of trip occurrences in one hour set in parameter PAL4 is exceeded
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
The other devices	They follow their control

4.5 Compressor alarms

4.5.1 Compressor maintenance alarm

The controller records the number of operating hours of the compressors and outputs a message to warn about the need for maintenance.

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
CO53	1000	h	Threshold for "compressor operating hours exceeded" alarm (0 = disabled)

Alarm code	**AL127 for compressor 1 in circuit 1; AL128 for compressor 2 in circuit 1; AL131 for compressor 1 in circuit 2; AL132 for compressor 2 in circuit 2.**
Reason for activation	This is detected when the operating hours of the compressor exceed the limit set in parameter "CO53".
Reset	Upon deletion of the hours in the Service or Maintenance menu
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on "alarm.conf" file
Devices	**Behaviour in the event of an alarm**
Compressors	They follow the control
The other devices	They follow their control

4.5.2 Alarm for compressor operation outside envelope

This alarm is only managed where the featured compressor is an inverter-controlled compressor.

Alarm code	**AL247 for the compressor in circuit 1**
Reset	One second after the compressor resumes operation inside the envelope
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on "alarm.conf" file
Devices	**Behaviour in the event of an alarm**
Compressors	The inverter-controlled compressor switches off.
The other devices	They follow their control

4.5.3 Compressor inverter alarm

The parameters involved are shown in the table.

The values of the parameters are representative. In specific cases, different values can be set.

Parameter	Value	UM	Description
PAL14	5	s	Alarm delay at start-up
PAL15	3	s	Alarm delay at steady state
PAL16	2	-	Max. number of alarms in one hour
PAL17	0	-	Enable alarm when compressors off
PAL24	10	s	Alarm delay upon activation

Inverter blocked

Alarm code	**AL51**
Reason for activation	Alarm via serial signal from inverter
	If “PAL17” = 0 (no compressor activation request), the alarm is active after the delay set in “PAL15”
	If “PAL17” = 1 (with compressor activation request), the alarm is active after the delay set in “PAL14” upon start-up and the sum of “PAL14” and “PAL15” at steady state
Reset	Upon resetting of the alarm coming from inverter
Reset mode	Automatic; switches to manual after the trip occurrences per hour set in “PAL16”
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Compressors	Involved compressor stop
The other devices	They follow their control

Communication error

Alarm code	**AL166**
Reason for activation	Communication error with inverter after time setpoint in “PAL24”
Reset	As soon as communication is restored
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Compressors	Involved compressor stop
The other devices	They follow their control

In refrigerant circuits featuring an inverter compressor and an on-off compressor, when the inverter compressor resumes operation after an alarm while the on-off compressor is in operation, the controller resets the demand to the on-off compressor and stops it, after which it initiates a start-up procedure prioritising the inverter compressor.

4.5.4 Compressor thermal overload switch alarms

Alarm code	**AL18..AL21**
Reason for activation	The alarm is detected after the compressor is switched on
	It is detected when the relevant digital input is open
Reset	When the digital input closes
Reset mode	Always manual; after repeated occurrences, only the service personnel can reset the alarm
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Compressor in alarm	Always switched off
Compressors not in alarm	According to case, they follow their control or
	all compressors of the same circuit are switched off
Ventilation	If in common with other compressors, it follows its control, otherwise it stops
Other devices	They follow their control

4.6 Probe error alarms

The temperature, pressure and humidity values affecting unit management are measured through the analogue inputs of the controller.

The software application manages the signals detected by the analogue inputs and checks that they fall within the set operating range. If the detected signal is outside the operating range, the controller indicates the error and acts accordingly.

The alarms generated by the controller as a result of incorrect reading of the analogue inputs are shown below.

4.6.1 Temperature probes

Return and delivery air temperature

Alarm code	**AL65 (return air), AL70 (delivery air)**
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
If probe is involved in temperature control	If the unit has been running for the past thirty minutes, the controller uses the temperature value calculated as the average of the measured values for the control, otherwise the unit stops.
If probe is not involved in temperature control	If the unit has been running for the past thirty minutes, the controller uses the temperature value calculated as the average of the measured values for the control, otherwise it stops the functions referencing the values read by the probe.
The other devices	They follow their own setup parameters if the unit stays operational and they do not depend on the probe reading.

Mixing air temperature

Alarm code	**AL91**
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Functions involved	Management of air pre-heating and adaptive damper control are inhibited.
The other devices	They follow their control

External air temperature

Alarm code	**AL80**
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Air-induced free cooling	If the unit has been running for the past thirty minutes, the controller uses the temperature value calculated as the average of the measured values for the control, otherwise free cooling stops.
Water-induced free cooling	If the unit has been running for the past thirty minutes, the controller uses the temperature value calculated as the average of the measured values for the control, otherwise the ventilation unit in the dry cooler stops.
The other devices	They follow their own setup parameters if the fan stays operational, otherwise they stop.

Exhaust gas temperature

Alarm code	**AL61 for circuit 1, compressor 1; AL62 for circuit 2, compressor 1; AL63 for circuit 1, compressor 2; AL64 for circuit 2, compressor 2.**
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
The other devices	They follow their control

Intake temperature

Alarm code	**AL102 for circuit 1; and AL103 for circuit 2**
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
The other devices	They follow their control

4.6.2 Humidity probes

Return air humidity

Alarm code	**AL78**
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
humidity control	Humidity control is stopped.
The other devices	They follow their control

External air humidity

Alarm code	**AL79**
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
All devices	They follow their own setup parameters: if the probe experiences a fault, all the tests required to start the functions connected to the external humidity value are bypassed.

4.6.3 Pressure probes

Condensing pressure

Alarm code	AL94 for circuit 1; AL95 for circuit 2
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on "alarm.conf" file
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
The other devices	They follow their control

Evaporating pressure

Alarm code	AL98 for circuit 1; AL99 for circuit 2
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on "alarm.conf" file
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
The other devices	They follow their control

Delivery air differential pressure

Alarm code	AL106
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on "alarm.conf" file
Devices	**Behaviour in the event of an alarm**
Unit fan	If the unit has been running for the past thirty minutes, the fan keeps the speed value calculated as the average of the measured values, otherwise the unit stops.
The other devices	They follow their own setup parameters if the fan stays operational, otherwise they stop.

Differential air pressure in return line

Alarm code	AL72
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on "alarm.conf" file
Devices	**Behaviour in the event of an alarm**
Unit fan	If the unit has been running for the past thirty minutes, the fan keeps the speed value calculated as the average of the measured values, otherwise the unit stops.
The other devices	They follow their own setup parameters if the fan stays operational, otherwise they stop.

Static pressure in delivery line / Differential pressure in aisle

Alarm code	**AL107**
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Unit fan	If the unit has been running for the past thirty minutes, the fan keeps the speed value calculated as the average of the measured values, otherwise the unit stops.
The other devices	They follow their own setup parameters if the fan stays operational, otherwise they stop.

Static pressure in return line / Differential pressure in aisle

Alarm code	**AL73**
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Unit fan	If the unit has been running for the past thirty minutes, the fan keeps the speed value calculated as the average of the measured values, otherwise the unit stops.
The other devices	They follow their own setup parameters if the fan stays operational, otherwise they stop.

4.6.4 Air quality probes

Air quality: CO_2 and VOC

Alarm code	**AL74 for Co_2 probe; AL75 for VOC probe**
Reason for activation	When the value measured by the analogue input is outside the set operating range
Reset	When the value measured by the analogue input falls within the set operating range
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Based on “alarm.conf” file
Devices	**Behaviour in the event of an alarm**
Air change	Air change is not allowed if it is dependant on the value of a malfunctioning probe.
The other devices	They follow their control

5 FAQ

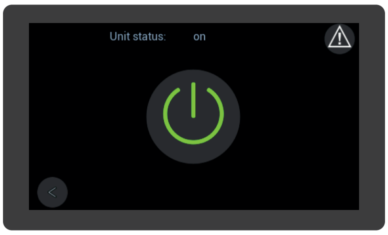
5.1 Frequently Asked Questions

The necessary instructions for working on the controller, with regard to the main functions of the unit, are given below.

5.2 Switching the unit on and off

5.2.1 Switch the unit on and off from the display.

Use the “On/Off” icon on the main screen to go to the page where the buttons to start and stop the unit are featured.



The top area of the screen shows the status of the unit: the “On/Off” icon is provided in the central area.

A tap on the icon changes the status of the unit from “on” to “off” and vice versa.

5.2.2 Switch the unit on and off from external OK signal

In order to switch the unit on and off from external OK signal, make sure the feature is active.

To switch the unit on, close the external OK signal. To switch it off, open it.

The external OK signal should be connected to terminals "1" and "56" in the terminal board.

In order to switch the unit on and off from external OK signal, make sure the feature is active.

To switch the unit on, close the external OK signal. To switch it off, open it.

The external OK signal should be connected to terminals "1" and "2" present in the terminal board.

The external OK signal must be a potential-free contact.

5.2.3 Switch the unit on and off from the BMS

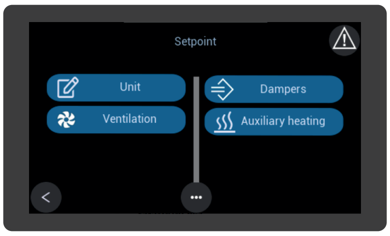
In order to switch the unit on and off from the BMS, make sure the feature is active.

See dedicated BMS management document.

5.3 Change of set points

5.3.1 Setpoint editing from display

Go to the main menu and press “Setpoint” to access the screens where functions are displayed whose setpoints need to be managed.



Go to the “Setpoint” sub menu and select the function whose setpoint is to be changed.

Scroll the parameters until the desired parameter setpoint is achieved.

Select the setpoint parameter to enable the edit keypad.

Set the new value and apply the green tick to confirm.

Units featuring mode switching have a setpoint for cooling “ST7” and a setpoint for heating “STH7”.

The setpoint for cooling “ST7” must necessarily be higher than the setpoint for heating “STH7”.

5.3.2 Setpoint editing from BMS

Setpoints can be edited from the BMS only if this function is enabled.

See dedicated BMS management document.

5.4 Change language

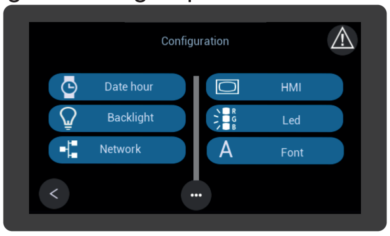
When in the main menu, press “Languages” to access the screens in which the available languages are displayed.

If the language you are looking for is not in the screen, use the arrows to find it.

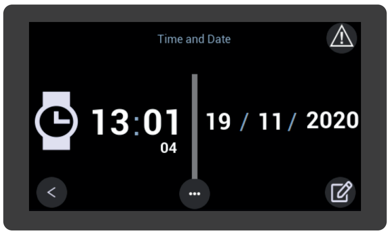
The selected language becomes active as soon as it is selected.

5.5 Changing the date and time

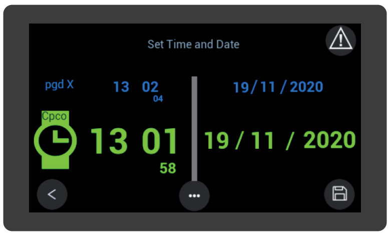
Scroll the main menu until you find the “Configurations” group and select it.



Select “Date and Time” in the “Configurations” menu and access the screen where it is possible to edit the date and time setpoints.



Select the write icon in the bottom right-hand side to access the edit screen.



When a green value is tapped, a virtual keypad appears: use the keypad to set the new values. After entering the new value, tick it to confirm it.

After changing the values, tap the Save icon on the bottom right-hand side to save the new setpoints.

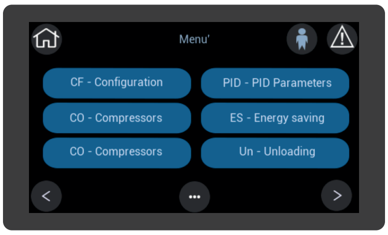
The arrow on the left is used to go back to the previous screen without saving the changed parameters.

5.6 Setting of time bands

Access to the screen where the time bands are set up requires entry of a password.

Scroll the main menu until you find the “Parameters” group and select it.

Scroll the “Parameters” menu until you find the “ES Energy saving” group.



After selecting “ES Energy saving”, access is gained to the group of parameters used to set up the time bands.

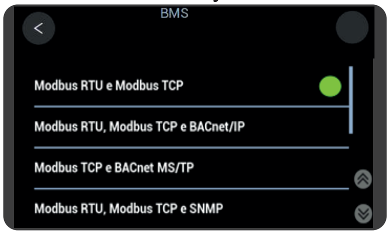
Refer to the relevant chapter for more information on the parameter setup logic.

5.7 Replacing the serial protocol

A password-protected access is required to set the replacement of the serial protocol.

Scroll the main menu until you find the “Configuration” group and select it.

When in the “Configuration” menu, select “Network” followed by “BMS”.



The menu can be used to check the protocols set: a different protocol may be enabled, when required, by clicking the protocol text. The active protocol is highlighted by a green circle on the right.

When the protocol is replaced, the controller must be restarted.

When an option is enabled, a request for controller restart appears automatically in the form of a message on the display.

A countdown appears in the message window, which can be bypassed - the restart procedure is started immediately - or delayed. If none of the two actions above is selected, the controller gets restarted at the end of the countdown.

If the restart procedure is delayed, the controller will automatically display a restart message after five minutes.

The controller may also be restarted by de-energising and then re-energising it.

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