Controller manual

EN

Service

10-06-2024

Series:

Kappa Rev Series
Kappa Rev LGW Series
Kappa Evo Series
Omega Rev LC
Omega Sky LC

BlueBox by Swegon

Page intentionally blank

Contents

1 INTRODUCTION

1.1 General

Some information on the use of this manual.

1.1.1 Purpose of the 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.

1.1.2 IPG315D controller functions

The software application for the electronic microprocessor controller of the iPro IPG315D series was designed to manage refrigerant units and heat pumps.

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

By management of refrigerant units we mean safe control of operation of their component parts, during their various operating stages.

There are various sizes of modules in the iPro electronic microprocessor controller family. Through flexibility of the software, this allows their use to be optimized by using those that have the necessary number of inputs and outputs for each application.

The IPG315D board is connected to the various modules and communicates with them through a high speed, highly reliable field bus.

The user interface of the controller is a graphic LCD display having 8 multifunction buttons.

1.1.3 Recommendations for digital security

This unit is designed for connection to an Ethernet network.

Unit networking must be implemented by technicians who can take the appropriate security measures required to prevent system violations.

In particular:

- We recommend that access to the unit controller be restricted to the network inside the organization. System exposure to the Internet is strongly not recommended.
- If remote access is required, the connection must be encrypted via SSL/TLS or VPN and through a firewall configuration within the internal IT environment.
- The authorization to use a remote access must only be granted to equipment that the organization has supplied and approved, as specified in the previous item.

1.2 Digital Services

The information below is referred to the units controlled by advanced controllers, set up for connection to Swegon cloud services.

1.2.4 Product data sheet Digital Services

1.2.4.1 Connectivity

The product is equipped with functionality that, when enabled, will connect to the Swegon INSIDE Cloud when given access to the internet. Such connection is made either through the building's local internet access point or by using a supplied modem. When connecting through the building's internet access point, the local firewall must be configured to allow traffic according to the firewall settings.

The functionality is by default disabled and can be enabled in the product. By enabling this functionality the customer agrees to the general terms and conditions for Digital Service, DS-23.

The customer can disable the connection to the Swegon INSIDE Cloud in the product user interface at any time.

1.2.4.2 Which data is sent

Through the connection to Swegon INSIDE Cloud, the product will exchange data to Swegon INSIDE Cloud about certain actions and parameter settings of the product. Each data point has different thresholds for when to send data to Swegon, therefore the data sent depends on the data point type and configuration. The data is sent in intervals, at which point the data is aggregated together with other data from that interval.

1.2.4.3 Who has access to the data

The data sent to Swegon INSIDE Cloud is used by Swegon for purposes of performance, functionality and development of the product.

Consequently, Swegon has the right to use the data sent from all products connected to Swegon INSIDE Cloud.

The data is used in accordance with Swegon's DS-23 general terms and conditions, and our sales agreement with the customer.

1.2.4.4 Requirements

To connect a product to Swegon INSIDE Cloud, a secure internet connection via the property's internal network or via Swegon's external modem is required.

In addition to a secure internet connection, a valid certificate for each individual product is also required to approve them to share data with INSIDE Cloud.

Some products will come with a valid certificate out of the factory, while other products need to be equipped with a certificate to authorize the product to share data.

To find out if the product is INSIDE Ready (i.e. ready to share data) or not visit INSIDE Ready | www.swegon.com.

1.2.4.5 Safety

The Swegon INSIDE product is connected to azure IoT Hub.

The connection uses MQTT and is secured using TLS and client certificates (MTLS). DigiCert is used as registration authority and key management.

DigiCert is used as registration authority and key management.

The Swegon cloud platform uses Azure SaaS offerings for hosting of applications and APIs.

Digital services communicate with Swegon Cloud using standard technologies such as Rest APIs and message Queues.

Users and authorization is handled by an internal identity provider.

1.2.4.6 Firewall settings for Swegon Cloud

Swegon cloud solution is using Microsoft Azure services and certificates from DigiCert to secure the connection.

If the firewall in front of the products is allowing outbound traffic to internet it will work.

If the firewall is set up to control outbound traffic the following ports and destinations must be allowed.

f only filtering on ports, 443 and 8883 are used.

Domain (including sub domain)	Port	Protocol	Notes
***.azure-devices-provisioning.net** (dps-Swegon-Cloud-common-we.azure-devices-provisioning.net global.azure-devices-provisioning.net)	443 8883	https mqtt	Azure Device Provisioning Service
***.azure-devices.net** (iot-SwegonCloud-prod-we. azure-devices.net)	443 8883	https mqtt	Azure IoT Hub
***.blob.core.windows.net** (stswciotfilestorageprod. blob.core.windows.net)	443	https	Azure storage
clientauth.one.digicert.com	443	https	DigiCert Enrolment over Secure Transport (EST) for certificate enrolment and reenrolment

Additional instructions on how to make the connection to **"Swegon INSIDE Cloud"** are available in the controller manual.

1.3 "Service" branch

In the “Service” branch, which is password-protected, access is gained to loops of screens are accessed for programming and managing the controller and the various functions present in the unit.

Login using personal credentials is necessary to browse password-protected menus. After login, it is possible to gain access to a protected menu for the following thirty minutes without having to enter the password again.

When access to a password-protected branch is activated, the symbol “**LOGOUT**” may appear on the bottom left-hand side of some screens.

When the “**LOGOUT**” button is clicked, the password must be entered again.

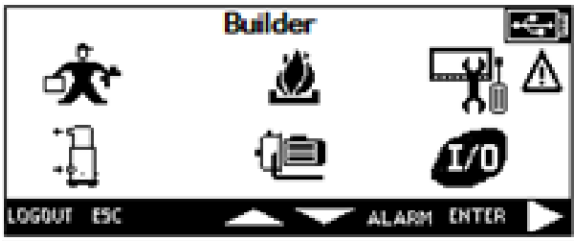


Fig. 1 "Service" screen

In the service branch, the loops of screens that allow access to the various functions are identified by the following icons:

-  branch of screens regarding the parameters for programming the functions of the unit;
-  or  branches of screens regarding management of the compressors;
-  branch of screens regarding management of auxiliary heating;
-  branch of screens regarding management of the pumps;
-  branch of screens regarding management of the files for programming and updates;
-  branch of screens regarding the status of the inputs and outputs of the controller.

The presence of icons is linked to the active functions in the controller.

To enter a branch of screens, with buttons  and  the selection is made, and is to be confirmed with button ENTER .

1.3.1 Programming the Parameters

After selecting icon  and on confirming with button ENTER you will access a set of branches of screens for setting the parameters that regard the functions of the unit.

With buttons and you can scroll the individual branches, with buttons and you can go to the next or previous screen of the same branch.

The screens of the parameters of the selected branch are accessed with the enter button.

The following branches are present:

- “ST : Thermoregulation”, in which the parameters of group “ST” are stored;
- "CF : Configuration", in which the parameters of group "CF" are located;
- "SP : Machine set-up", in which the parameters of group "SP" are located;
- “SD: Dynamic Setpoint”, in which the parameters of group “SD” are stored;
- "ES : ES and automatic ON/OFF", in which the parameters of group "ES" are located;
- "AH: Auxiliary heating", in which the parameters of group "AH" are located;
- "CO : Compressor", in which the parameters of group "CO" are located;
- "SL : Stepless control", in which the parameters of group "SL" are located;
- "PA : Water pump", in which the parameters of group "PA" are located;
- “PD: Pump Down”, in which the parameters of group “PD” are stored;
- “UN: Unloading”, in which the parameters of group “UN” are stored;
- "FA : Ventilation", in which the parameters of group "FA" are located;
- “AR: Anti-freeze Heaters”, in which the parameters of group “AR” are stored;
- “DF: Defrost”, in which the parameters of group “DF” are stored;
- “RC: Heat Recovery”, in which the parameters of group “RC” are stored;
- "FC : Free-cooling function", in which the parameters of group "FC" are located;
- "PAL : Alarm parameters", in which the parameters of group "PAL" are located;
- “ET: Electronic Valve”, in which the parameters of group “ET” are stored;
- "CA : Calibration of analogue inputs", in which the parameters of group "CA" are located;
- "MS : Multilogic", in which the parameters of group "MS" are located;
- "MS_FC : Multi Free", in which the parameters of group "MS_FC" are located;
- “ENV : Envelope”, in which the parameters of group “ENV” are stored;
- "ACS = Hot Sanitary Water” in which the parameters of the “ACS” unit are stored;
- “FMG: Flowzer”, in which the parameters of group “FMG” are stored;
- “SML: SmartLink+”, in which the parameters of group “SML” are stored;

Whereas the branches are always present in the menu, the parameters in them are linked to activation of the relevant function in the unit.

In each screen, when a parameter is selected, its description appears on the last line.

The parameters involved are shown in the descriptions of the functions.

1.3.2 Compressors

After selecting icon  and on confirming with button ENTER you will access the screens that allow you to activate and deactivate the individual compressors and reset the number of hours of operation and the number of starts.

In each screen, with buttons ▶ and ◀ you can go to the next or previous screen of the same loop.

In units with multi-compressor refrigerant circuits, with buttons ▲ and ▼ you can change the selection of the compressor. On reaching the last one, you will be taken to the next screen, whereas from the first you will be taken to the previous one.

With button ENB/DIS operation of the selected compressor is enabled or disabled.

With button RESET HOURS the partial hours of operation of the selected compressor are set to zero.

you will access the main screen of the maintenance loop.

With button RESET STARTS the number of starts of the selected compressor is set to zero.

The compressors of one refrigerant circuit are present in each screen.

With button ESC you return to the previous menu.

Check that the compressor you want to work on is selected before pressing the buttons of the above functions.

1.3.3 Auxiliary heating

Icon  is present in the main screen of the "Service" branch only if management of it is included.

On selecting it and confirming with button ENTER you will access the screens where the main control parameters are summarized.

The parameters present depend on the operating mode set for auxiliary heating with the “AH” parameters of the “Parameter Programming” branch that can be accessed from icon  that is also present in the main screen of the service branch

You can move around the screen with buttons ▲ and ▼ , and using these buttons, you can change the value after selecting it with button SET .

With the same button SET the changed value should be confirmed.

With button ESC you will return to the main screen of the service branch.

1.3.4 Water pumps

Icon  is present in the main screen of the "Service" branch only if there is provision for management of at least one pump in the controller.

On selecting it and confirming with button ENTER you will access the screens that allow you to activate and deactivate the individual pumps and reset the number of hours of operation.

The number of screens making up the branch is linked to the number of pumps present in the unit.

In each screen, with buttons ▶ and ◀ you can go to the next or previous screen of the same branch.

With buttons ▲ and ▼ you can change the selection of the pump.

With button ENB/DIS operation of the selected pump is enabled or disabled.

With button RESET HOURS the partial hours of operation of the selected pump are set to zero.

With button ESC you return to the previous menu.

1.3.5 "Control panel"

After selecting icon  and on confirming with button ENTER you will access the "Control panel" screen in which there are controls for managing the programming files and the settings of the serial communication of the controller.

The functions of this branch are described in the "Control panel" chapter regarding installation of the software.

1.3.6 Status of inputs and outputs

After selecting icon  and on confirming with button ENTER you will access a set of branches of screens that allow you to see the status of the digital and analogue inputs and outputs of all the boards that manage the unit.

The following branches are present in the "I/O status" screen:

- "Analogue inputs";
- "Digital inputs";
- "Digital outputs";
- "Analogue outputs";

With buttons  and  you can scroll the individual branches, and on confirming with button ENTER you will access the relevant screens.

1.3.6.1 "Analogue inputs"

In this set of screens, you can see the status of the analogue inputs.

The first screen shows the inputs of the Master board.

With buttons  and  you will access the screens where the analogue inputs of the expansion boards are shown.

With button XEV you will access the screens where the analogue inputs of the drivers that manage the expansion valves are shown.

For each input, there may be:

- The value read from the input;
- "N.C.", if the input is not configured via software;
- "N.P.", if the input is not present in the board;
- "ERR" if a sensor is not connected to the input or the sensor is not working;
- "ON", if the input is configured as digital and is closed;
- "OFF", if the input is configured as digital and is open;

Each input is identified with the prefix "Pb" that refers to the reference shown in the relevant board.

1.3.6.2 "Digital inputs"

In this set of screens, you can see the status of the digital inputs.

The first screen shows the inputs of the Master board.

With buttons  and  you will access the screens where the digital outputs of the expansion boards are shown.

For each output, there may be:

- "Closed";
- "Open";
- "N.C.", if the input is not configured via software.

Each input is identified with the prefix "DI" that refers to the reference shown in the relevant board.

1.3.6.3 "Digital outputs"

In this set of screens, you can see the status of the digital outputs.

The first screen shows the outputs of the Master board.

With buttons ◀ and ▶ you will access the screens where the digital outputs of the expansion boards are shown.

For each output, there may be:

- "ON", if the output is closed;
- "OFF", if the output is open;
- "N.C.", if the output is not configured via software.

Each output is identified with the prefix "RL" that refers to the reference shown in the relevant board.

1.3.6.4 "Analogue outputs"

In this set of screens, you can see the status of the analogue outputs.

The first screen shows the outputs of the Master board.

With buttons ◀ and ▶ you will access the screens where the analogue outputs of the expansion boards are shown.

For each output, there may be:

- The value present on the output;
- "N.C.", if the output is not configured via software;
- "ON", if the output is configured as digital and is closed;
- "OFF", if the output is configured as digital and is open;

Each output is identified with the prefix "OUT" that refers to the reference shown in the relevant board.

2 SOFTWARE FUNCTIONS

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, from common functions present in all units to functions dedicated to specific operations.

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

2.1 Unit ON/OFF function management

The unit can be switched on and off using the keypad, with an external OK signal through a digital input, via a serial port from the BMS, or using the WEB pages.

The unit switch-on/off procedures are illustrated in the FAQ section.

The controller uses different procedures to manage the unit On-Off function, based on the control signal used.

After the unit receives the OK signal to get started, irrespective of its source, the controller enables the pump, where fitted, and thermoregulation, in accordance with the safety times of the compressors. The logics used to start the different components and the corresponding setup parameters are illustrated in the next chapters.

The unit stop procedure varies depending on the source of the stop control signal.

If the control signal is output by the user interface or via WEB pages, the controller instantly stops the compressors and the pump, if fitted, after a few seconds.

If the control signal is output by a digital input or via a serial port from the BMS, unit stopping is not instant. In this case, the controller starts a stopping procedure which consists in the completion of any active cycle, for instance completion of a defrost cycle or the oil recovery procedure, in compliance with the safety times required for the switch-off of the compressors and the pump, if fitted.

If the unit switch-off signal comes from a digital input or from a serial port in the BMS, the unit will continue to operate for a few minutes, as is normal.

2.2 Set point management

The control set point mainly depends on parameters ST1 and ST4.

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

Parameter	Min.	Max.	UM	Description
ST1	ST2	ST3	°C	Chiller - Setpoint
ST2	-50	ST3	°C	Chiller - Minimum Setpoint
ST3	ST2	110	°C	Chiller - Maximum Setpoint
ST4	ST5	ST6	°C	Heat Pump - Setpoint
ST5	-50	ST6	°C	Heat pump - Minimum Setpoint
ST6	ST5	110	°C	Heat Pump - Maximum Setpoint

There are additional functions that allow an offset to be changed (added or subtracted) at these set point values.

If the Active Set Point in the chiller function is called SA_CHILLER and the Active Set Point in the heat pump function is called SA_HEATPUMP, we obtain:

- SA_CHILLER = ST1 + DynamicSetPoint Offset + Energy_Saving_Offset;
- SA_HEATPUMP = ST4 + DynamicSetPoint Offset + Energy_Saving_Offset.

Even though, in the following descriptions of the various operations, ST1 and ST4 are shown as reference, the controller really uses the actual active set points "SA_CHILLER" and "SA_HEATPUMP".

If the calculated set point in chiller mode is lower than the minimum set point ST2, then SA_CHILLER=ST2. The same applies if the set point is higher than the maximum set point in chiller mode: SA_CHILLER=ST3.

If the calculated set point in heat pump mode is lower than the minimum set point ST5, then SA_ HEATPUMP =ST5. The same applies if the set point is higher than the maximum set point in heat pump mode: SA_HEAT_PUMP=ST6.

2.2.1 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
SD1	0	6	-	Dynamic Setpoint type
SD2	0	2	-	States of the unit in which it is active
SD10	0	55	°C	Outside air - Compensation Activation Temperature CH
SD11	0	15	°C	Outdoor temperature - Intervention band compensation in chiller mode
SD12	-10	15	°C	Outdoor temperature - Max increase/decrease setpoint in chiller mode
SD13	-50	110	°C	Dinamic Setpoint probe - Max increase/decrease setpoint in chiller mode
SD14	ST2	ST3	°C	Dinamic setpoint Digital input - Setpoint active with remote digital in chiller mode
SD20	0	55	°C	Outside air - Compensation Activation Temperature HP
SD21	0	15	°C	Outdoor temperature - Intervention band compensation in heat pump mode
SD22	-10	15	°C	Outdoor temperature - Max increase/decrease setpoint in heat pump mode
SD23	-50	110	°C	Dinamic Setpoint probe - Max increase/decrease setpoint in heat pump mode
SD24	ST5	ST6	°C	Dinamic setpoint Digital input - Setpoint active with remote digital open in heat pump mode

Depending on parameter SD1, up to 6 types of dynamic set points can be managed:

- from external air probe;
- from 4-20mA signal;
- from 0-1V signal;
- from 0-10V signal;
- from 0-20mA signal;
- from digital input.

2.2.2 Dynamic set point from external air probe

To obtain the set point change from external air probe, it is necessary to have parameter SD1=1.

In chiller operating mode, the parameters involved are shown in the table.

Parameter	Value	UM	Description
ST1	7	°C	Chiller - Setpoint
SD1	1	-	Dynamic Setpoint type
SD10	30	°C	Outside air - Compensation Activation Temperature CH
SD11	5	°C	Outdoor temperature - Intervention band compensation in chiller mode
SD12	5	°C	Outdoor temperature - Max increase/decrease setpoint in chiller mode

With reference to the values set in the table, this corresponds to the graphical representation of the set point change as regards the air temperature value shown in the figure.

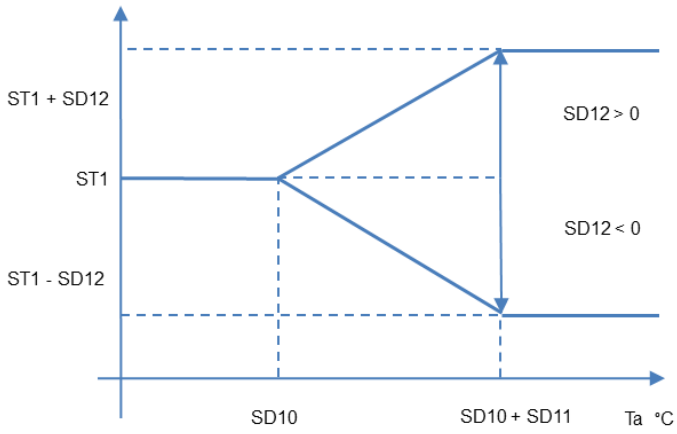


Fig. 2 Change in set point as the air temperature changes in chiller operating mode

Where "Ta" is the value of the outside air temperature.

The following is obtained:

- If the outside air temperature is < SD10, the offset value to add to ST1 is 0;
- If the outside air temperature is > SD10 + SD11, the offset value to add to ST1 is SD12;
- If the outside air temperature is >= SD10 and <= SD10 + SD11, the offset value to add to ST1 can vary between 0 and SD12.

With the values in the table, the set point will be:

- SA_CHILLER = ST1 + 0.0 = 7.0°C;
- SA_CHILLER = ST1 + 5.0 = 12.0°C;
- SA_CHILLER = ST1 + (from 0.0 to 5.0) = from 7.0°C to 12.0°C.

In heat pump operating mode, the parameters involved are indicated in the table.

Parameter	Value	UM	Description
ST4	40	°C	Heat Pump - Setpoint
SD1	1	-	Dynamic Setpoint type
SD20	15	°C	Outside air - Compensation Activation Temperature HP
SD21	5	°C	Outdoor temperature - Intervention band compensation in heat pump mode
SD22	5	°C	Outdoor temperature - Max increase/decrease setpoint in heat pump mode

With reference to the values set in the table, this corresponds to the graphical representation of the set point change as regards the air temperature value shown in the figure.

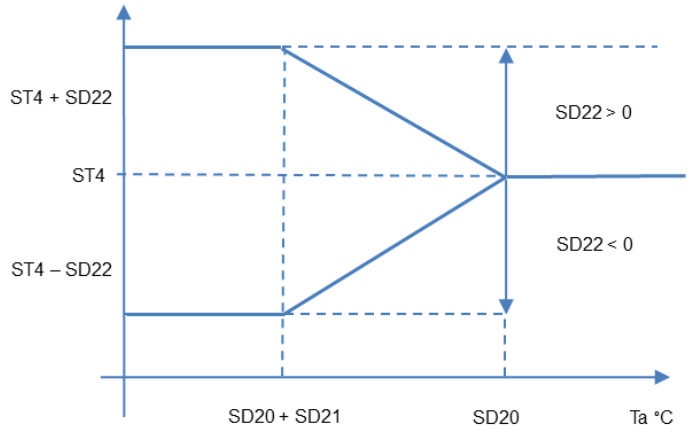


Fig. 3 Change in set point as the air temperature changes in heat pump operating mode

Where "Ta" is the value of the outside air temperature.
The following is obtained:

- If the outside air temperature is > SD20, the offset value to add to ST4 is 0;
- If the outside air temperature is < SD20 - SD21, the offset value to add to ST4 is SD22;
- If the outside air temperature is <= SD20 and >= SD20 - SD21, the offset value to add to ST4 can vary between 0 and SD22.

With the values in the table, the set point will be:

- SA_HEAT_PUMP = ST4 + 0.0 = 40.0°C;
- SA_HEAT_PUMP = ST4 + 5.0 = 45.0°C;
- SA_HEAT_PUMP = ST4 + (from 0.0 to 5.0) = from 40.0°C to 45.0°C.

2.2.3 Dynamic set point from signal

The type of signal used is 4-20mA, 0-1V, 0-10V and 0-20mA.

To obtain the set point change from signal, it is necessary to have parameter SD1=2/3/4/5 respectively for the 4 types of signal.

In chiller operating mode, the parameters involved are shown in the table.

Parameter	Value	UM	Description
ST1	7	°C	Chiller - Setpoint
SD1	4	-	Dynamic Setpoint type
SD13	5	°C	Dinamic Setpoint probe - Max increase/decrease setpoint in chiller mode

With reference to the values set in the table, this corresponds to the graphical representation of the set point change shown in the figure.

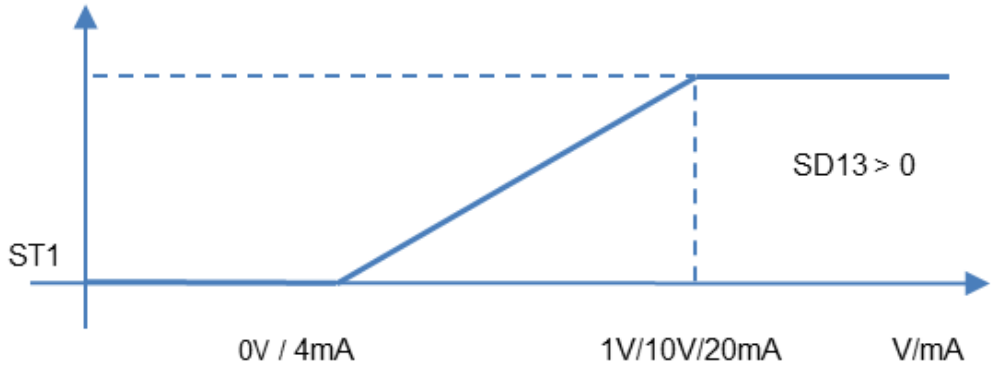


Fig. 4 Change in set point as the analogue signal changes in chiller operating mode

Where "V/mA" is the value of the analogue signal.
The following is obtained:

- If the analogue input reads the signal at the minimum value (0V), the offset value to add to ST1 is 0;
- If the analogue input reads the signal at the maximum value (10V), the offset value to add to ST1 is SD13;
- If the analogue input reads the signal between the minimum and maximum value (0-10V), the offset value to add to ST1 can vary from 0 to SD13.

With the values in the table, the set point will be:

- SA_CHILLER = ST1 + 0.0 = 7.0°C;
- SA_CHILLER = ST1 + 5.0 = 12.0°C;
- SA_CHILLER = ST1 + (from 0.0 to 5.0) = from 7.0°C to 12.0°C.

In heat pump operating mode, the parameters involved are indicated in the table.

Parameter	Value	UM	Description
ST4	40	°C	Heat Pump - Setpoint
SD1	4	-	Dynamic Setpoint type
SD23	5	°C	Dinamic Setpoint probe - Max increase/decrease setpoint in heat pump mode

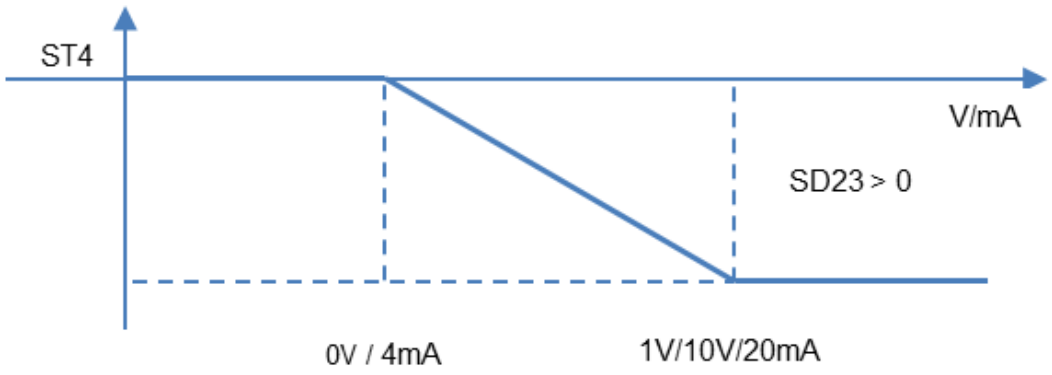


Fig. 5 Change in set point as the analogue signal changes in heat pump operating mode

Where "V/mA" is the value of the analogue signal.
The following is obtained:

- If the analogue input reads the signal at the minimum value (0V), the offset value to subtract from ST4 is 0;
- If the analogue input reads the signal at the maximum value (10V), the offset value to subtract from ST4 is SD23;
- If the analogue input reads the signal between the minimum and maximum value (0-10V), the offset value to subtract from ST4 can vary from 0 to SD23.

With the values in the table, the set point will be:

- SA_HEAT_PUMP = ST4 - 0.0 = 40.0°C;
- SA_HEAT_PUMP = ST4 - 5.0 = 35.0°C;
- SA_HEAT_PUMP = ST4 - (from 0.0 to 5.0) = from 40.0°C to 35.0°C.

2.2.4 Dynamic set point from digital input (dual set point)

To obtain the set point change from digital input, it is necessary to have parameter SD1=6.

The parameters involved in chiller and heat pump operation are shown in the table.

Parameter	Value	UM	Description
ST1	7	°C	Chiller - Setpoint
ST4	40	°C	Heat Pump - Setpoint
SD1	6	-	Dynamic Setpoint type
SD14	12	°C	Dinamic setpoint Digital input - Setpoint active with remote digital in chiller mode
SD24	45	°C	Dinamic setpoint Digital input - Setpoint active with remote digital open in heat pump mode

When the digital input dedicated to this function is closed, the change to the second set point takes place. With the values in the table, the set point will be:

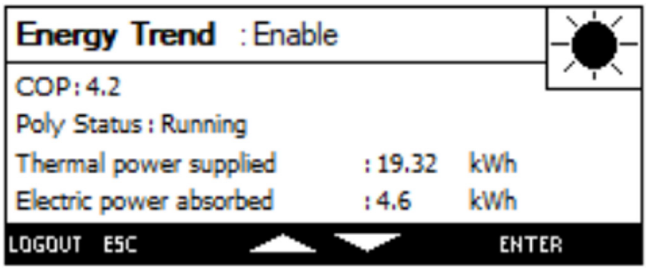
- In chiller operating mode, with digital input open SA_CHILLER = ST1 = 7.0°C;
- In chiller operating mode, with digital input closed SA_CHILLER = SD14 = 12.0°C;
- In heat pump operating mode, with digital input open SA_HEAT PUMP = ST4 = 40.0°C;
- In heat pump operating mode, with digital input closed SA_HEAT PUMP = SD24 = 45.0°C.

2.3 Energy Trend

The function “Energy trend” is featured on units as an option.

This function estimates the unit operational efficiency (“EER” when operating in cooling mode or “COP” when operating in heating mode) as the current operating conditions and the set parameters change.

If you wish to access the data estimated by the function, go to the main menu and select the function “ENERGY TREND” with the arrow, after which press the button “ENTER” to confirm.



The “EER” or “COP” values and the delivered and absorbed power values used for the calculation are not measured, but only estimated using models referred to unit operation.

The direct measurement of these values may be different from the values displayed in the controller screen.

The function is only active after a long enough time has elapsed for parameter stabilization within the intended unit operating range and it is updated as these values change.

In special cases of unit operation, such as free cooling, heat recovery, use of a supplementary source and production of domestic hot water (“ACS” function), the efficiency estimation process is suspended and the controller resets the values to zero.

The purpose of this function is to give the user information as required to optimise unit use.

Whenever efficiency reduction is checked over a prolonged period of time, a message is output to warn the user about the need, if any, to perform unscheduled maintenance.

2.3.5 Logs

The measured operating values are not only viewed on the display, but they are also recorded in the controller memory over time.

The values are recorded in the “logs”.

“EnergyTrendHours” is used to record the values concerning the energy absorbed and generated on an hourly basis, and the number of minutes the unit has been in operation every hour.

“EnergyTrendHistory” is used to record the values concerning the energy absorbed and generated on a daily basis, and the number of hours the unit has been in operation every day.

The “logs” can be downloaded from a USB pen drive or the WEB pages. These are “.txt” text files that can be easily added to a spreadsheet.

In the files, an initial line shows the acronyms that identify the values recorded in each column.

The values recorded are whole numbers. The value may in some cases need to be divided by 100 in order for it to match the unit of measurement.

The tables below are useful to interpret the values stored in the “logs”.

File "EnergyTrendHours.txt"

Reference	Description	U of M	(*)k
DATE_TIME	Date and time, expressed as yyyymmddhh		1
EN_IN_CH	Energy absorbed on an hourly basis in chiller mode	[kWh]	100
EN_OUT_CH	Energy generated on an hourly basis in chiller mode	[kWh]	100
EER_AVG	Average hourly EER		100
EN_IN_HP	Energy absorbed on an hourly basis in heat pump mode	[kWh]	100
EN_OUT_HP	Energy generated on an hourly basis in heat pump mode	[kWh]	100
COP_AVG	Average daily COP		100
EN_IN_DHW	Energy absorbed on an hourly basis in ACS mode	[kWh]	100
EN_OUT_DHW	Energy generated on an hourly basis in ACS mode	[kWh]	100
COP_AVG	Average hourly COP for ACS		100
MIN_CH	Minutes of operation in chiller mode	[min]	1
MIN _HP	Minutes of operation in heat pump mode	[min]	1
MIN _DHW	Minutes of operation in ACS mode	[min]	1
MIN _OUT_OF_SIM	Minutes in which unit operation could not be simulated	[min]	1

(*) k = conversion coefficient by which the values in the column are divided

Each line is referred to an hour of operation.

The columns “minutes of operation” show the minutes within the hour in which the function was active.

The values are entered in the history log at minute “00” of each hour in the day.

In the event of a power failure to the unit, the data recorded in the hour are lost.

The calculation of the EER and COP values is not managed in “domestic hot water”mode - the corresponding columns are always “0”, and the hours of operation are counted.

The controller memory can store the hourly values recorded for over 12 months.

As soon as the memory is filled up, the new records overwrite the oldest records.

If the operating data need to be used for yearly analyses, we recommend downloading the log “EnergyTrendHours.txt” at least once a year.

File "EnergyTrendHistory.txt"

Reference	Description	U.M
DATE	Date type yyyymmdd	
EN_IN_CH	Energy absorbed on a daily basis in chiller mode	[kWh]
EN_OUT_CH	Energy generated on a daily basis in chiller mode	[kWh]
EER_AVG	Average daily EER	
EN_IN_HP	Energy absorbed on a daily basis in heat pump mode	[kWh]
EN_OUT_HP	Energy generated on a daily basis in heat pump mode	[kWh]
COP_AVG	Average daily COP	
EN_IN_DHW	Energy absorbed on a daily basis in ACS mode	[kWh]
EN_OUT_DHW	Energy generated on a daily basis in ACS mode	[kWh]
COP_AVG	Average daily COP for ACS	
H_CH	Daily hours of operation in chiller mode	[h]
H_HP	Daily hours of operation in heat pump mode	[h]
H_DHW	Daily hours of operation in ACS mode	[h]
H_OUT_OF_SIM	Daily hours in which unit operation could not be simulated	[h]

The values in all columns except for the “DATE” column must be divided by 100.
Each line is referred to a day of operation.

The columns “hours of operation” show the hours within the day in which the function was active.

The values are entered in the history log at “00:00” each day.

In the event of a power failure to the unit, the data recorded in the hour are lost.

The calculation of the EER and COP values is not managed in “domestic hot water”mode - the corresponding columns are always “0”, and the hours of operation are counted.

The controller memory can store the values recorded on a daily basis, which cover the total operating values of the unit.

2.4 Smart Grid ready

The two digital inputs provided help override thermoregulation to operation in hot mode. This function does not trigger when thermoregulation is operating in cold mode.

Units are always provided with this function although it is not enabled.

When the function is enabled, the status of the two featured digital inputs combined activates the 4 operating modes listed in the table.

Operating mode	Status DI1	Status DI2	Description
1	Closed	Open	Thermoregulation in hot mode is disabled for as long as the condition persists, but in any case the max. time set in parameter “AH18” is never exceeded.
2	Open	Open	Thermoregulation follows the demand of the stored operating setpoint.
3	Open	Closed	Thermoregulation follows the demand of dedicated “setpoint 1”.
4	Closed	Closed	Thermoregulation follows the demand of dedicated “setpoint 2”.

The parameters involved are shown in the table.

Parameter	Min	Max	UM	Description
SP21	0	2	-	Smart Grid Enable 0 = disabled 1 = enabled without supplementary source 2 = enabled with supplementary source
AH18	1	999	min.	Maximum override time to OFF
AH19	ST5	ST6	°C	Setpoint1 in operating mode 3
AH20	ST5	ST6	°C	Setpoint2 in operating mode 4

The value in parameter “SP21” is set to “0” (function disabled) in the factory. The value in parameter “AH18” is set to 120 minutes.

The values in parameters “AH19” and “AH20” are set with the same value as parameter “ST4”.

The installer is responsible for enabling the function and setting up suitable values for operation.

2.4.1 Enable

All water heating units are configured to manage this function.

The units are shipped from the factory with the function disabled via software.

The function is enabled using parameter “SP21”.

When the function is enabled, the operation of the digital inputs in the terminal board is active. The wiring diagram shows the involved terminals.

All units are configured to manage this function.

The units are shipped from the factory with the function disabled via software.

The function is enabled using parameter “SP21”.

When the function is enabled, the operation of the digital inputs in the terminal board is active. The wiring diagram shows the involved terminals.

2.4.2 Operating mode 1

Activation of this operating mode requires that digital input “1” is closed and output “2” is open. After mode activation, the controller stops thermoregulation in hot mode as long as the condition persists; in any case the time setpoint value stored in parameter “AH18” is never exceeded.

If the status of the digital inputs does not change and consequently the operating mode fails to change, the controller will restart normal thermoregulation operation in hot mode after the time set in parameter “AH18” has elapsed.

As soon as normal operation is restored, a change in the digital input status is required for the next stop.

If the “ACS” function is featured, this operating mode stops it.

If a seasonal mode change occurs during operation in heating mode or where the “ACS” function is enabled in cooling mode, the unit performs thermoregulation in cooling mode.

2.4.3 Operating mode 2

Activation of this operating mode requires that both digital input “1” and “2” are open. When it is activated, the controller controls thermoregulation in hot mode following the active operating setpoint.

This combination of digital inputs prevents the “Smart Grid Ready” from having an impact on unit operation.

2.4.4 Operating mode 3

Activation of this operating mode requires that digital input “1” is open and output “2” is closed.

When it is activated, the controller overrides thermoregulation in heating mode to “setpoint1” which is set with the value in parameter “AH19”.

This setpoint value prioritises all the settings that are used to control the variation of the operating setpoint.

If the unit is operating in cooling mode, the override process is ignored.

The override process may at all times be stopped by stopping the unit.

2.4.5 Operating mode 4

Activation of this operating mode requires that digital input “1” and “2” are closed.

If thermoregulation in hot mode was not active when “setpoint2” was overridden, the function will be ignored.

When it is activated, the controller overrides thermoregulation in heating mode to “setpoint2” which is set with the value in parameter “AH20”.

When parameter “SP21” is set to “2” in this operating mode, the supplementary sources fitted in the unit are started without taking into account the outside air temperature threshold “AH2”.

This setpoint value prioritises all the settings that are used to control the variation of the operating setpoint.

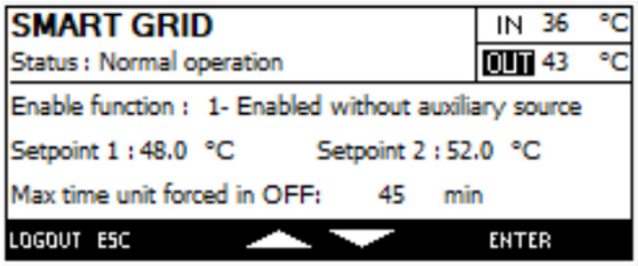
If the unit is operating in cooling mode, the override process is ignored.

The override process may at all times be stopped by stopping the unit.

2.4.6 References on user interface

The function can be managed using the parameters described above or using the user interface.

When “setpoint” is selected in the main screen, a click on the “Smart Grid ready” icon and entry of the relevant password give access to a screen where the two setpoint values and the maximum overriding time of hot mode shutdown are enabled and set up.



The main screen shows whether the “Smart Grid ready” function (identified by acronym “SM-GR”) is enabled and it is in “overridden stop” condition.

If the acronym “SG1” or “SG2” appears in the main screen, the setpoint displayed is the setpoint connected to the status of the digital inputs of the function.

The “ON/OFF” screen shows whether the unit is “OFF” following an override due to the “Smart Grid ready” function.

2.5 Swegon Inside

Starting from the second half of 2023, the manufactured units have been provided with digital certificates which offer the possibility to enable the “Swegon Inside” function.

This function gives the user safe access to the identification and operating parameters of the unit via the cloud.

Access requires that the user creates his/her own account on our website (https://www.swegon.com/it/support/software/).

To create the account, scroll the website page down until the header “Software for connected products”.

Click the link “Create account for INSIDE portal”, fill out the form with the required information, and then press “SUBMIT”.

The information you need to enter is found in the unit nameplate on the side of the electric panel or in the decal affixed inside the door of the electrical panel: alternatively, you can press the Info button in the controller.

Registration is confirmed by email to the address specified. A few days are required for the function to be activated.

After a few days have elapsed, data can be read in the section of the Swegon website (https://www.swegon.com/it/support/software/) named “Software for connected products” by clicking the link “Go to INSIDE portal” where you have to log in.

The certificate requires that the connection is activated within two years from its issue.

A connection between a fixed unit IP and the Internet is required.

If you wish to enable the “Swegon Inside” function on units that were manufactured before week 24 of 2023, the minimum requirements below must be checked:

1. controller iPro, code MIDX125A or MIDX126A, with App Version 711.138.129;
2. user interface code MIDX130A;
3. App Version 711.138.129;
4. HMI Version 7*.*.*;
5. Web Version 711.146.42.

If problems are experienced, please contact the Swegon after-sales service network.

2.6 Thermoregulation

The thermoregulation of the unit depends on parameter ST9 that determines on which temperature probe the controller must guarantee maintenance of the temperature set as the set point, and on parameter ST11 that determines the type of control.

With the combination of settings, it is possible to have:

- ST9 = 0 and ST11 = 0 - proportional input registration;
- ST9 = 5 and ST11 = 1 - output registration with neutral zone and PID;
- ST9 = 5 and ST11 = 2 - output registration with neutral zone and PID for units featuring inverter compressors;

2.6.1 Proportional inlet control

The parameters involved in proportional thermoregulation on evaporator inlet probe are shown below.

Parameter	Min	Max	UM	Description
ST1	ST2	ST3	°C	Chiller - Setpoint
ST2	-50	ST3	°C	Chiller - Minimum Setpoint
ST3	ST2	110	°C	Chiller - Maximum Setpoint
ST4	ST5	ST6	°C	Heat Pump - Setpoint
ST5	-50	ST6	°C	Heat pump - Minimum Setpoint
ST6	ST5	110	°C	Heat Pump - Maximum Setpoint
ST7	0.1	25.5	°C	Chiller - Proportional control band
ST8	0.1	25.5	°C	Heat pump - Proportional control band
CO4	1	999	sec.	Minimum time between two activation different compressors
CO5	1	999	sec.	Min. time between de-activation of 2 compressors/Min. Time between step decrement

Proportional control is applied in units with screw compressors with control of the temperature measured on the evaporator inlet probe.

In the case of screw compressors, their number of capacity reductions is the number of steps.

Parameter	Min	Max	UM	Description
CF7	1	3	-	Steps per compressor to circuit 1
CF8	1	3	-	Steps per compressor to circuit 2
CF9	1	3	-	Steps per compressor to circuit 3
CF10	1	3	-	Steps per compressor to circuit 4

The number of steps to be activated is calculated with the following formula:

ST7/(CF7 + CF8 + CF9 + CF10)

The proportional band is divided by the number of compressors or capacity reductions present in the configuration parameters (defined by the manufacturer). Each step will therefore have the same weight.

Consecutive activation of steps takes place with a delay equal to the value of parameter CO4. But deactivation takes place according to the value of parameter CO5.

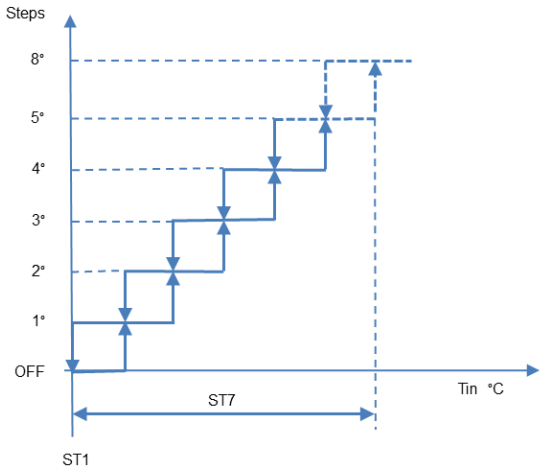


Fig. 6 Graphical representation of steps in Chiller operating mode

Example of proportional control in chiller mode. “Tin” indicates the water temperature at the inlet of the unit.
In the case of Heat Pump, the following formula is used to calculate the number of resources to be activated:
ST8/(CF7 + CF8 + CF9 + CF10)

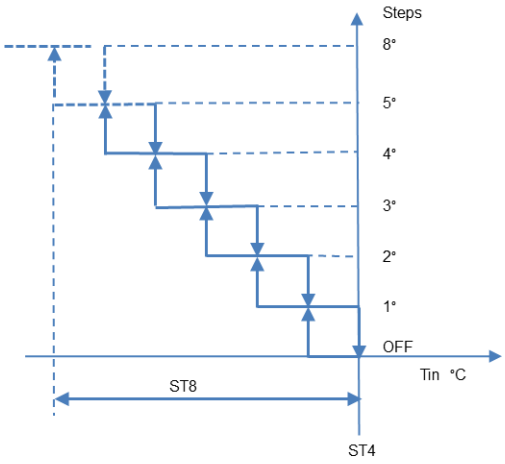


Fig. 7 Graphical representation of steps in Heat Pump operating mode

As can be seen in the graphs, the greater the distance of the water temperature (in these cases measured on the inlet of the unit) from the setpoint, the greater the number of resources/compressors enabled.

2.6.2 Outlet control with neutral zone and PID

The reference probe is placed on the common outlet of the evaporator. The resources (compressors and capacity reductions) are activated/deactivated depending on a set point and a differential, complying with the reference delays.

Parameter	Min.	Max.	UM	Description
ST1	ST2	ST3	°C	Chiller - Setpoint
ST2	-50	ST3	°C	Chiller - Minimum Setpoint
ST3	ST3	50°C	°C	Chiller - Maximum Setpoint
ST4	ST5	ST6	°C	Heat Pump - Setpoint
ST5	-50	ST5	°C	Heat pump - Minimum Setpoint
ST6	ST5	999	°C	Heat Pump - Maximum Setpoint
ST18	0.1	25.5	°C	With NZ or PID, Chiller - Activation zone offset
ST19	0.1	25.5	°C	With NZ or PID, Heat Pump - Activation zone offset
ST20	0.1	25.5	°C	With NZ or PID, Chiller - De-activation zone offset
ST21	0.1	25.5	°C	With NZ or PID, Heat Pump - De-activation zone offset
ST22	ST23	999	Sec	With ZN or PID, Chiller - Maximum activation time
ST23	0	ST22	Sec	With NZ or PID, Chiller - Min. activation time
ST24	ST25	999	Sec	With ZN or PID, Chiller - Maximum de-activation time
ST25	0	ST24	Sec	With NZ or PID, Chiller - Min. de-activation time
ST26	ST27	999	Sec	With ZN or PID, Heat pump - Maximum activation time
ST27	0	ST26	Sec	With NZ or PID, Heat Pump - Minimum activation time
ST28	ST29	999	Sec	With ZN or PID, Heat Pump - Maximum de-activation time
ST29	0	ST28	Sec	With ZN or PID, Heat pump - Minimum de-activation time
ST30	0.1	25.5	°C	With NZ or PID, Chiller - Neutral zone band
ST31	0.1	25.5	°C	With NZ or PID, Heat Pump - Neutral zone band
ST32	-50	110	°C	Limit threshold for operation in chiller mode (prevention)

Example of control with neutral zone in chiller mode

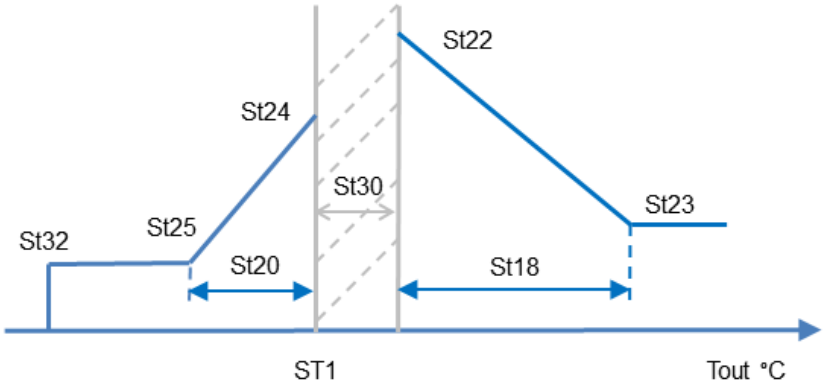


Fig. 8 Graphical representation of operation in chiller mode and outlet control

As long as the reference water temperature is more than (>) ST1 + ST30, the compressors of the unit will be activated complying with the delays included in parameters ST22 and ST23.

If the water temperature is included in the values that determine the neutral zone, the compressors will be activated only if at least one compressors of the unit is already on.

If the reference temperature is less than (<) ST1 and more than (>) ST1 – ST20, then the capacity of the compressors is progressively reduced and the compressors are progressively deactivated complying with the delays included in parameters ST24 and ST25.

If the temperature is < ST32, the compressors are switched off immediately. In this case, no alarm signal is shown.

Example of control with neutral zone in heat pump mode

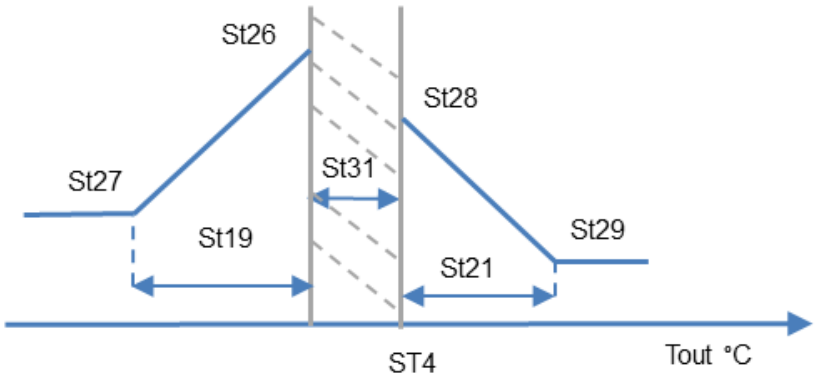


Fig. 9 Graphical representation of operation in heat pump mode and outlet control

As long as the reference water temperature is less than (<) ST4 - ST31, the compressors of the unit will be activated complying with the delays included in parameters ST27 and ST26.

If the water temperature is included in the values that determine the neutral zone, the compressors will be activated only if at least one compressors of the unit is already on.

If the reference temperature is more than (>) ST4 and less than (<) ST4 + ST21, then the capacity of the compressors is progressively reduced and the compressors are progressively deactivated complying with the delays included in parameters ST28 and ST29.

2.7 Limitation of refrigeration capacity

There are some operating conditions for which the refrigeration capacity of the unit can be limited automatically or necessarily.

Limitation can be done in 4 different ways:

- from pressure probe (always present)
- from amperometric transformer (accessory)
- from digital input (accessory);
- from BMS.

All the parameters involved with this function are shown in the table.

Parameter	Min	Max	UM	Description
UN1	0	1	-	Unloading from digital input
UN2	0	1	-	Unloading from Supervision
UN3	0	1	-	Unloading from low/high pressure transducer
UN4	0	1	-	Unloading from Amperometric Transformer
UN5	0.0	99.9	bar	High pressure - Unloading Setpoint in chiller mode
UN6	0.0	25.5	bar	High pressure - Unloading differential in chiller mode
UN7	0.0	99.9	bar	High pressure - Unloading Setpoint in heat pump mode
UN8	0.0	25.5	bar	High pressure - Unloading differential in heat pump mode
UN9	0.0	99.9	bar	Low pressure - Unloading Setpoint in chiller mode
UN10	0.1	25.5	bar	Low pressure - Unloading differential in chiller mode
UN11	0.0	99.9	bar	Low pressure - Unloading Setpoint in heat pump mode
UN12	0.1	25.5	bar	Low pressure - Unloading differential in heat pump mode
UN13	0	100	%	Max. percentage circuit limit with capacity reduction
UN14	0	100	%	Inverter scroll - Unloading Percentage
UN17	0	999	min	Capacity reduction activation time limit
UN18	0	999	min	Time between two capacity reductions of the same circuit
UN19	0	500	A	Minimum full-scale value of 4mA current probe
UN20	50	1000	A	Maximum full-scale value of 20mA current probe
UN21	10	1000	A	Current capacity reduction threshold
UN22	0	500	A	Current capacity reduction differential
CO10	0	999	s	Screw - Pushbutton valve ON time (0= scroll compr.)
CO11	0	999	s	Screw - Pushbutton valve OFF time
SL6	1	50	0,1 s	Pulse duration (ON)
SL7	1	50	0,1 s	Pulse duration (OFF)
ST13	0	100	%	Unit capacity limit (On/Off compressors and inverter)
ST23	0	60	s	With NZ or PID, Chiller - Min. activation time
ST25	0	60	s	With NZ or PID, Chiller - Min. de-activation time

2.7.1 Limitation of refrigeration capacity from pressure probe

In some operating situations of the unit (too high condensing pressures or too low evaporating pressures) it may be useful to limit the capacity of the compressor.

The parameters involved in limitation of refrigeration capacity with reference to condensing pressure are shown in the table.

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

Parameter	Value	UM	Description
UN3	1	-	Unloading from low/high pressure transducer
UN5	17.0	Bar	High pressure - Unloading Setpoint in chiller mode
UN6	4.0	Bar	High pressure - Unloading differential in chiller mode
UN7	17.0	Bar	High pressure - Unloading Setpoint in heat pump mode
UN8	4.0	Bar	High pressure - Unloading differential in heat pump mode
UN14	65	%	Inverter scroll - Unloading Percentage
UN17	2	Min	Capacity reduction activation time limit
UN18	2	Min	Time between two capacity reductions of the same circuit
CO10	5	Sec	Screw - Pushbutton valve ON time (0= scroll compr.)
CO11	10	Sec	Screw - Pushbutton valve OFF time

Activation of capacity reduction in the circuit takes place when the following conditions are verified:

- in chiller operating mode, when the condensing pressure is higher than UN5;
- in heat pump operating mode, when the condensing pressure is higher than UN7;

Deactivation of capacity reduction in the circuit takes place when the following conditions are verified:

- in chiller operating mode, when the condensing pressure is lower than UN5 - UN6;
- in heat pump operating mode, when the condensing pressure is lower than UN7 - UN8.

The parameters involved in limitation of refrigeration capacity with reference to evaporating pressure are shown in the table.

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

Parameter	Value	UM	Description
UN3	1	-	Unloading from low/high pressure transducer
UN9	0.4	Bar	Low pressure - Unloading Setpoint in chiller mode
UN10	0.5	Bar	Low pressure - Unloading differential in chiller mode
UN11	0.4	Bar	Low pressure - Unloading Setpoint in heat pump mode
UN12	0.5	Bar	Low pressure - Unloading differential in heat pump mode
UN14	65	%	Inverter scroll - Unloading Percentage
UN17	2	Min	Capacity reduction activation time limit
UN18	2	Min	Time between two capacity reductions of the same circuit
CO10	5	Sec	Screw - Pushbutton valve ON time (0= scroll compr.)
CO11	10	Sec	Screw - Pushbutton valve OFF time

Activation of capacity reduction in the circuit takes place when the following conditions are verified:

- in chiller operating mode, when the evaporating pressure is lower than UN9;
- in heat pump operating mode, when the evaporating pressure is lower than UN11.

Deactivation of capacity reduction in the circuit takes place when the following conditions are verified:

- in chiller operating mode, when the evaporating pressure is higher than UN9 + UN10;
- in heat pump operating mode, when the evaporating pressure is higher than UN11 + UN12;

Cooling capacity limitation in units with stepless compressors takes place with management of the “UP” and “DOWN” valves and parameters “CO10” and “CO11”.

Graphical representation of management of up and down valves

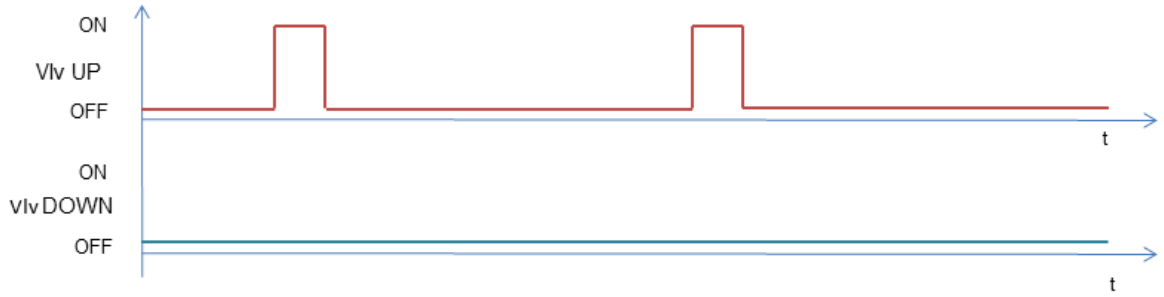


Fig. 10 Management of up and down valves without limitation of active refrigeration capacity

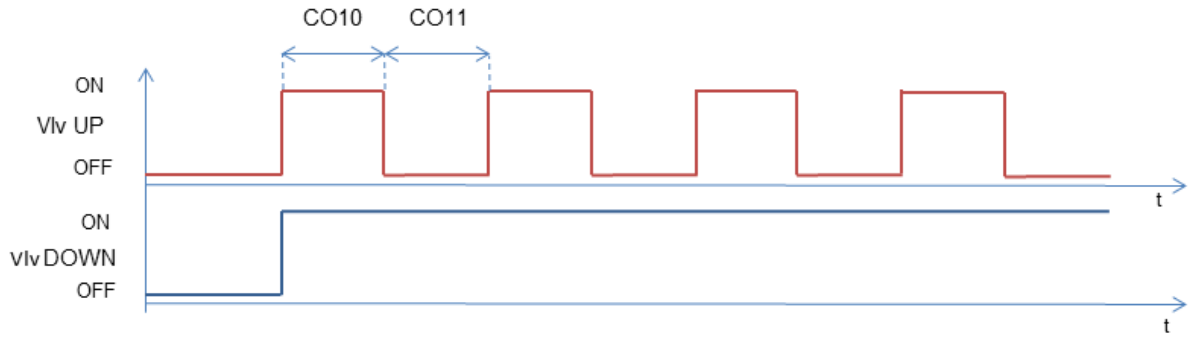


Fig. 11 Management of up and down valves with limitation of active refrigeration capacity

Cooling capacity limitation in units with several steps per circuit depends on the value set in parameter “UN13”.
The controller uses the percentage set in parameter “UN13” to calculate the number of steps to activate in the circuit.

The value of parameter “UN13” refers to the operating percentage (0 = the whole circuit deactivated; 100 = no capacity reduction).

2.7.2 Limitation of refrigeration capacity from amperometric transducer

Limitation of refrigeration capacity can be carried out through an amperometric transducer that measures the current drawn by the unit.

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
UN4	1	-	Unloading from Amperometric Transformer
UN19	50	A	Minimum full-scale value of 4mA current probe
UN20	500	A	Maximum full-scale value of 20mA current probe
UN21	250	A	Current capacity reduction threshold
UN22	50	A	Current capacity reduction differential
SL6	10	0,1 s	Pulse duration (ON)
SL7	10	0,1 s	Pulse duration (OFF)
ST23	40	s	With NZ or PID, Chiller - Min. activation time

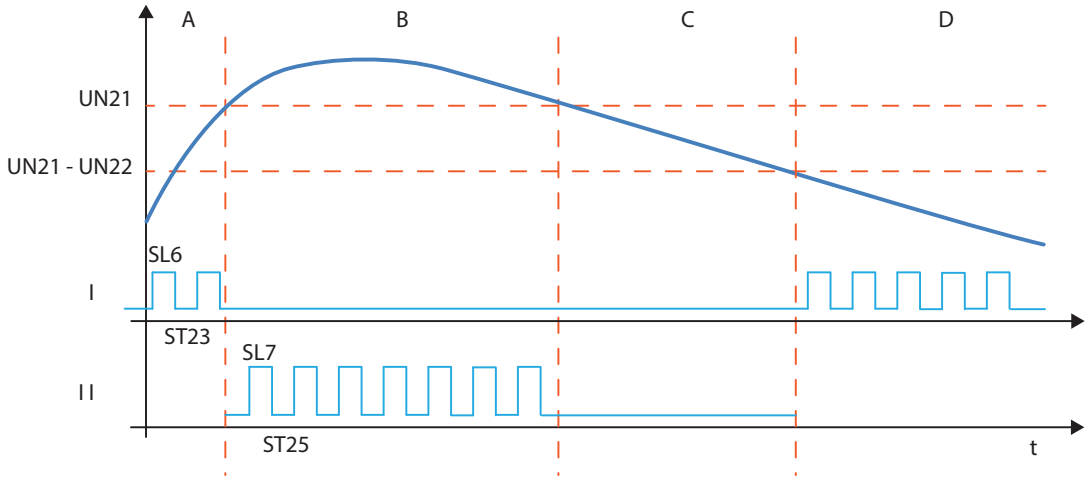


Fig. 12 Graphical representation of limitation of refrigeration capacity by the drawn current

Capacity reduction management

I - management of up pulses

II - management of down pulses

Activation of forcing of capacity reduction of the unit takes place when the value of the current measured on the measurement input is > UN21 (stage B). During this stage, the controller activates the down pulses until the value of the current returns to < UN21.If the value of the current is between UN21 and UN21 - UN22 (stage C), the controller does not carry out any change in capacity.

When the value of the current is < UN21 - UN22 (stage D), the controller leaves the forcing of capacity reduction, and management of refrigeration capacity demand returns to thermoregulation.

Forcing of capacity reduction can continue indefinitely.

2.7.3 Limitation of refrigeration capacity from digital input

Limitation of refrigeration capacity can be carried out from digital input.

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
UN1	1	-	Unloading from digital input
CO10	5	Sec	Screw - Pushbutton valve ON time (0= scroll compr.)
CO11	10	Sec	Screw - Pushbutton valve OFF time

Management of the up and down valves is the same as for capacity reduction due to pressure as described above.

Forcing of capacity reduction can continue indefinitely.

Cooling capacity limitation in units with several steps per circuit depends on the value set in parameter “UN13”.

The controller uses the percentage set in parameter “UN13” to calculate the number of steps to activate in the circuit.

The value of parameter “UN13” refers to the operating percentage (0 = the whole circuit deactivated; 100 = no capacity reduction).

2.7.4 Limitation of refrigeration capacity from BMS

Limitation of refrigeration capacity can be carried out from BMS.

The parameters involved are shown in the table.

Parameter	Value	UM	Description
UN2	1	-	Unloading from Supervision
CO10	5	Sec	Screw - Pushbutton valve ON time (0= scroll compr.)
CO11	10	Sec	Screw - Pushbutton valve OFF time
SP6	1	-	Enable BMS supervision writings

To enable capacity reduction from BMS, parameter SP6 must also be enabled.

The variable (Capacity Limit) that enables the function is shown below.

Group	Type	Addr.	Description
Capacity Limit	5	51536	0 = OFF; 1 = ON

Management of the up and down valves is the same as for capacity reduction due to pressure as described above.

Forcing of capacity reduction can continue indefinitely.

Cooling capacity limitation in units with several steps per circuit depends on the value set in parameter “UN13”.

The controller uses the percentage set in parameter “UN13” to calculate the number of steps to activate in the circuit.

The value of parameter “UN13” refers to the operating percentage (0 = the whole circuit deactivated; 100 = no capacity reduction).

2.8 Circuits and compressors

To meet the thermoregulation request from the system, the controller activates and deactivates the compressors of the circuits present in the unit as required.

The management of individual compressors, and also of the combination of compressors, takes place according to the setting of the relevant parameters.

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

Parameter	Min	Max	UM	Description
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	Minimum time between two activation different compressors
CO5	1	999	s	Min. time between de-activation of 2 compressors/Min. Time between step decrement
CO12	1	999	s	Screw - Valve activation time 25%
CO13	1	999	s	Screw - Valve deactivation time 25%
CO15	0	4	-	Method of selection of circuits in the unit
CO16	0	1	-	Criteria for selection of compressors in the selection of circuits
CO17	1	999	s	Screw - Minimum compressor time at 50%
CO36	0,1	100	%	Inverter - Decrase/incrase power step Termoregolation

2.8.1 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
CO12	90	s	Screw - Valve activation time 25%
CO13	15	s	Screw - Valve deactivation time 25%
CO17	60	s	Screw - Minimum compressor time at 50%

The procedure for activating each compressor at the request of the thermoregulation involves starting at 25% of its capacity.

This condition is maintained for the time set in parameter CO12, and after this time has elapsed, the capacity of the compressor changes to 50% and remains stable for the time set in parameter CO17.

After the time set in parameter CO17 has elapsed, the compressor follows the thermoregulation request and varies its capacity between 50 and 100%.

When the thermoregulation request requires a compressor to be switched off, after reaching the minimum control capacity of 50%, the compressor is kept at 25% for the time set in parameter CO13 before being stopped.

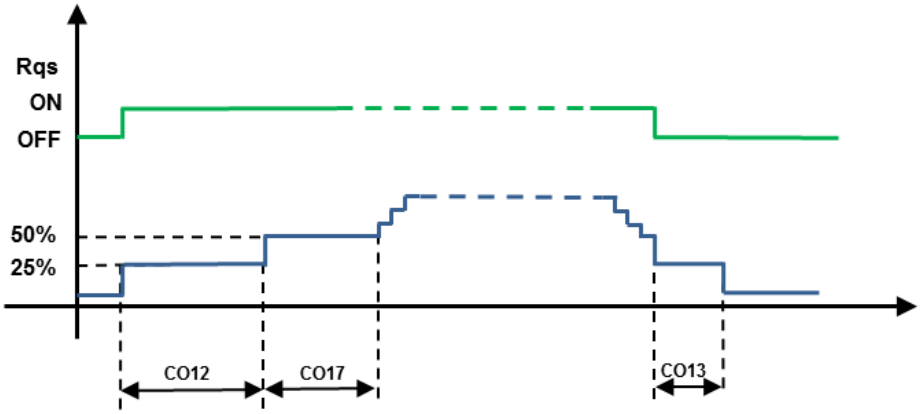


Fig. 13 Procedure for starting/stopping stepless compressors

The management of several compressors also takes place complying with delay times.

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
CO1	300	s	Minimum ON time
CO2	300	s	Minimum OFF time
CO3	90	10 s	Minimum time between 2 activations of the same compressor
CO4	90	s	Minimum time between two activation different compressors
CO5	10	s	Min. time between de-activation of 2 compressors/Min. Time between step decrement
CO7	20	s	Delay for activation of loads on unit switch-on (pumps, compressors)
CO15	2	-	Method of selection of circuits in the unit
CO16	0	-	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.

The choice of circuit to be activated takes place through parameter CO15

The graph for the actual thermoregulation request and the respective switch-ons and switch-offs of the compressors is shown below.

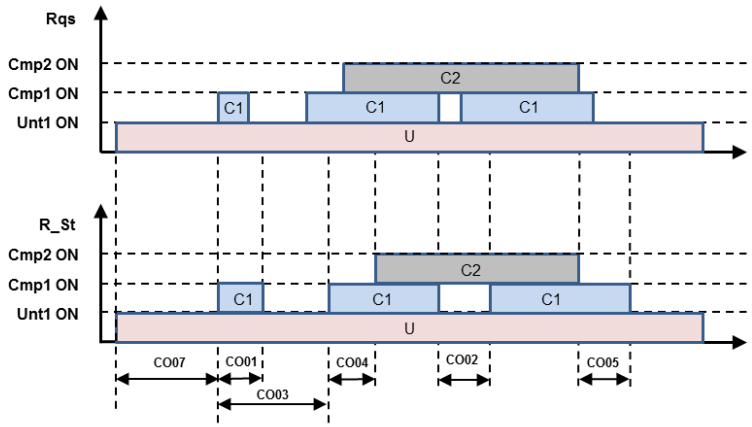


Fig. 14 Compressor management times

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

2.8.2 Capacity management of stepless compressors

Cooling capacity modulation takes place with capacity reduction, if not with speed modulation by inverter.

For all compressors having cooling capacity modulation with capacity reduction, the starting and stopping procedures are the same.

For compressors where capacity reduction is stepped, the capacity of the compressors can also have the capacity reduction step of 75% in addition to 100%.

For stepless compressors, where capacity can be managed continuously from 50 to 100%, the increase and decrease take place through small movements of the capacity control slide valve.

The movements of the capacity control slide valve take place using oil pressure and two solenoid valves, one of which opens when an increased is required and the other opens when a decrease is required, by intervals called pulses.

The compressors do not have a feedback signal regarding capacity reduction status and therefore slide valve travel is managed with a number of pulses that will reasonably ensure a gradual change from 50 to 100% of cooling capacity.

The time that elapses between two consecutive pulses varies according to the thermoregulation request.

The table shows the parameters involved in capacity modulation of the compressors.

Parameter	Min	Max	UM	Description
SL2	1	250	-	Number of pulses required to consider compressor 1 100% charged
SL3	1	250	-	Number of pulses required to consider compressor 2 100% charged
SL4	1	250	-	Number of pulses required to consider compressor 3 100% charged
SL5	1	250	-	Number of pulses required to consider compressor 4 100% charged
SL6	1	999	0.1 sec	Pulse duration (ON)
SL7	1	999	0.1 sec	Pulse duration (OFF)
SL8	1	999	sec	Frequency of compressor switch-off during overridden switch-off
SL9	1	999	min	Frequency of UP pulses in neutral zone
SL10	1	999	min	Delay in high frequency UP pulse activation during starting
SL11	1	999	sec	Pulse ON time during SL10
SL12	1	999	sec	Pulse OFF time during SL10

2.8.3 Management of controlled capacity with control at outlet

Capacity variation takes place with pulses.

While the duration of pulses for increasing and decreasing the capacity is constant, the frequency depends on the reference water temperature in the respective activation and deactivation off-sets.

In the activation off-set and the deactivation off-set, the frequency of the pulses varies between the maximum and minimum delay of the control in progress.

The more the temperature moves away from the control set point, the more the time decreases between two consecutive pulses, and therefore the frequency increases.

For example, considering the capacity increase in cooling mode, in off-set "St18", the frequency of the pulses increases by the value set in parameter "St22" to the value of parameter "St23".

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
SL2	50	-	Number of pulses required to consider compressor 1 100% charged
SL3	50	-	Number of pulses required to consider compressor 2 100% charged
SL6	10	0.1 sec	Pulse duration (ON)
SL9	5	min	Frequency of UP pulses in neutral zone
ST22	60	sec	With ZN or PID, Chiller - Maximum activation time
ST23	40	sec	With NZ or PID, Chiller - Min. activation time
ST24	20	sec	With ZN or PID, Chiller - Maximum de-activation time
ST25	10	sec	With NZ or PID, Chiller - Min. de-activation time

The illustration graphically shows the described example and the case of capacity decrease in cooling mode.

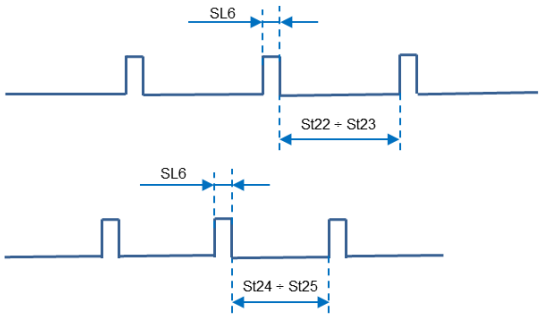


Fig. 15 Capacity increase and decrease frequency

After at least one compressor has started, if the reference water temperature value is in the neutral zone, the controller continues with the pulses for increasing the capacity.

In this case, the frequency with which the pulses are given depends on the value of parameter "SL9".

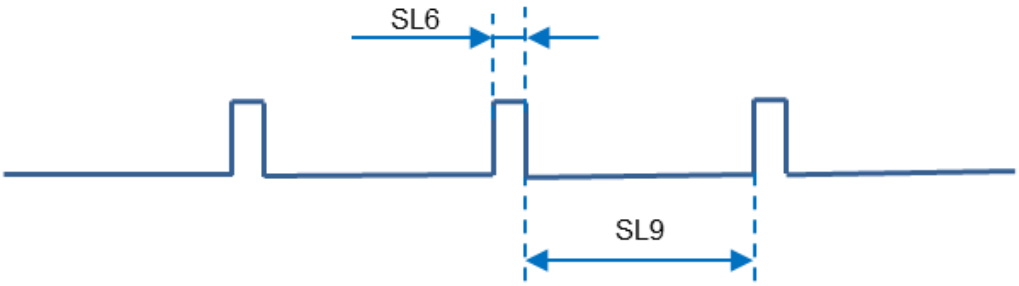


Fig. 16 Frequency for increasing the capacity in neutral zone

The examples described refer to operation in cooling mode.

The same logics apply to operation in heating mode with relevant parameters.

2.8.4 Capacity management on starting and stopping

Management by the control is different from that described in the previous chapter when the reference water temperature is not within the activation and deactivation differentials and the neutral zone.

During starting, to ensure that system operation reaches nominal conditions more quickly, if the reference water temperature does fall within the activation differential within the delay time set in parameter "SL10", the duration of the pulses for increasing the capacity changes from "SL6" to "SL11".

This condition is maintained until the reference water temperature value falls within the neutral zone.

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
SL11	3	sec	Pulse ON time during SL10
SL12	10	sec	Pulse OFF time during SL10

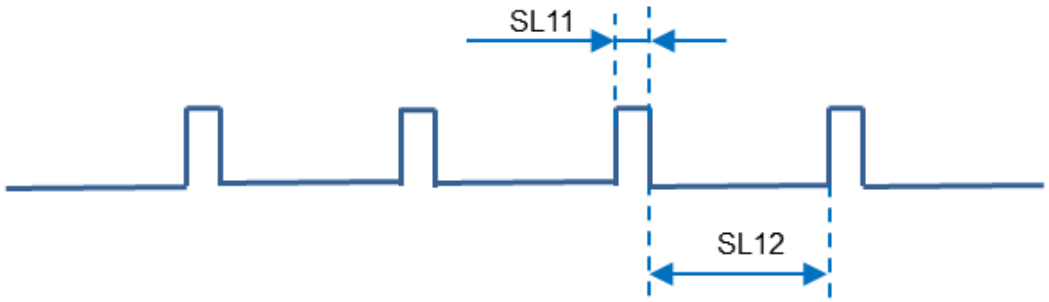


Fig. 17 Frequency for increasing the capacity during starting

When system demand is decreasing, if the reference water temperature value changes quickly and goes beyond the switch-off differential, forced switch-off is activated.

Forced switch-off prevents the water temperature from reaching values that could cause the protective devices to be tripped.

With activation of the forced switch-off procedure, irrespective of the number of pulses for capacity reduction already sent, the controller stops the compressor after the delay time set in parameter "CO13".

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
CO13	15	sec	Screw - Valve deactivation time 25%
SL8	60	sec	Frequency of compressor switch-off during overridden switch-off

2.8.5 Activation of the compressors between the circuits

In addition to controlling the switching on of the compressors, the controller manages their activation as regards the circuits present in the unit.

The application developed for the controller includes various management criteria.

According to unit type and system requirements, the most suitable one can be selected.

2.8.6 Balance sequence criteria

Parameter CO15 set to "2".

The controller ensures distribution of capacity to all the configured circuits.

Example of unit with 2 circuits.

With parameter C016 = 0, when the capacity demand increases, the compressor that has the lowest number of hours of operation is activated first. After starting, the activated compressor remains at the minimum capacity step. With an increase in demand, the second compressor is activated. The next increase in demand is followed simultaneously by both compressors.

With a reduction in demand, after both compressors are at the minimum capacity step, the one that has the highest number of hours of operation is deactivated.

In case of a subsequent increase in demand, management of the compressors as described for activation is repeated.

With parameter C016 = 1, when the capacity demand increases, the compressor that has the lowest number of switch-ons is activated first. The logic with which the compressors follow thermoregulation is as described above.

With a reduction in demand, after both compressors are at the minimum capacity step, the one that has the highest number of switch-ons is deactivated.

In case of a subsequent increase in demand, management of the compressors as described for activation is repeated.

2.8.7 Saturation sequence criteria (only for stepless compressors)

Parameter CO15 set to "4".

The controller ensures saturation of the resources of a compressor before activating the next one.

Example of unit with 2 circuits.

With parameter C016 = 0, when the capacity demand increases, the compressor that has the lowest number of hours of operation is activated first. The activated compressor follows the thermoregulation until it reaches its maximum refrigeration capacity. With a further increase in refrigeration capacity by the thermoregulation, the active compressor is taken to minimum capacity and the second one is activated. The next increase in demand is followed simultaneously by both compressors.

With a reduction in demand, after both compressors are at the minimum capacity step, the one that has the highest number of hours of operation is deactivated.

In case of a subsequent increase in demand, management of the compressors as described for activation is repeated.

With parameter C016 = 1, when the capacity demand increases, the compressor that has the lowest number of switch-ons is activated first. The activated compressor follows the thermoregulation until it reaches its maximum refrigeration capacity. With a further increase in refrigeration capacity by the thermoregulation, the active compressor is taken to minimum capacity and the second one is activated. The next increase in demand is followed simultaneously by both compressors.

With a reduction in demand, after both compressors are at the minimum capacity step, the one that has the lowest number of starts is deactivated.

The next increase in demand is followed simultaneously by both compressors.

2.8.8 Management of compressors with inverter

When a compressor is started up, the controller keeps the inverter at the start-up value for as long as the “start-up time” setpoint in parameter “CO20”.

After the “start-up time” has elapsed, the inverter regulation reaches the required thermoregulation with a step-by-step sequence. The value of each single step is defined in parameter “CO21”.

After the start-up procedure is completed, the compressors with inverter operate following the thermoregulation demand, as determined by a PID algorithm. A factor indicating the capacity required by the system, called count, is then generated by the controller.

The parameters involved are shown in the table.

Thermoregulation in units featuring inverter compressors is checked with reference to the output water temperature from the unit, including a neutral area and the PID (ST9 = 5 and ST11 = 2).

Parameter	Min.	Max.	UM	Description
ST1	ST2	ST3	°C	Chiller - Setpoint
ST4	ST5	ST6	°C	Heat Pump - Setpoint
ST30	0,1	25.5	°C	With NZ or PID, Chiller - Neutral zone band
ST31	0,1	25.5	°C	With NZ or PID, Heat Pump - Neutral zone band
CO20	0	1000	s	Inverter - Start-up time
CO21	0	10000	0.01%	Inverter - Value of single inverter step
CO36	0,1	100,0	0,1 %	Inverter - Decrase/incrase power step Termoregolation

Where the count is present is highlighted in the image.

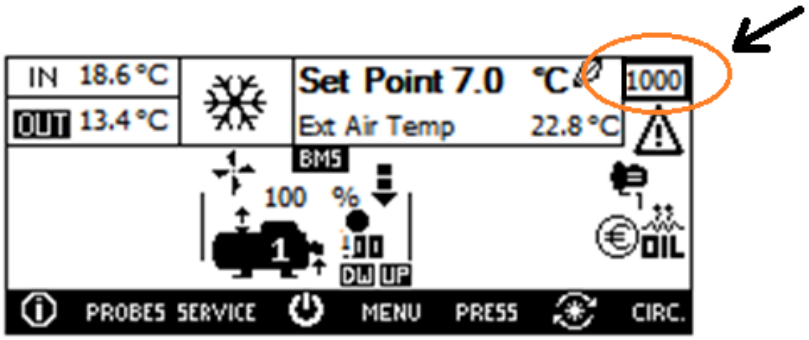


Fig. 18 Count of capacity demand

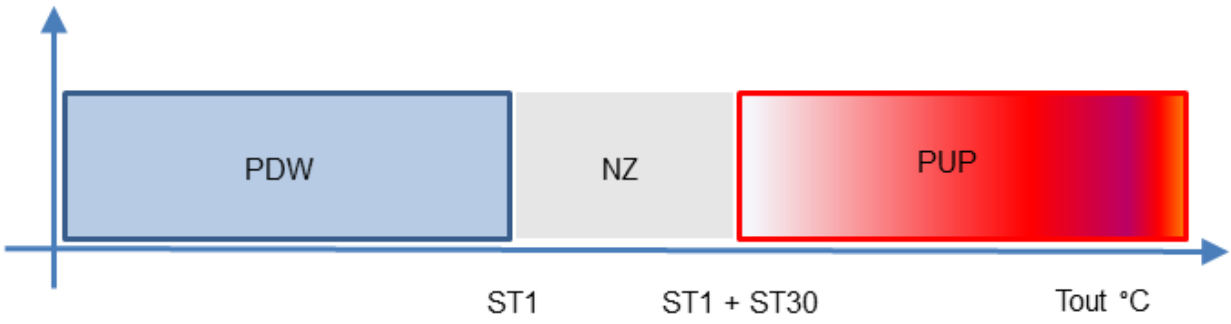


Fig. 19 Representation of the operating zones

where

PDW = Deactivation zone

NZ = Neutral zone

PUP = Activation zone

In the activation zone, the count increases with the times indicated in the thermoregulation chapter. Calculation of the count involves parameter CO36.

2.9 Ventilation

Unit ventilation is controlled in continuous mode with modulation of a 0-10V signal.

For each circuit, there is a digital output for activation of ventilation and an analogue output with modulating circuit for control of a speed adjuster.

Ventilation of the unit is controlled by the FA parameters. The parameters involved are shown in the table.

Parameter	Min	Max	UM	Description
FA2	0	1	-	Ventilation operating mode
FA3	0	999	s	Ventilation Speed Up at start
FA4	0	2	-	Single or separate ventilation
FA5	0	999	s	Chiller - Pre-ventilation time before compressor start-up
FA6	0	100	%	Chiller - Min. speed
FA7	30	100	%	Chiller - Max. speed
FA8	-50.0	110.0	°C	Chiller - Condensation setpoint for min. speed
FA9	-50.0	110.0	°C	Chiller - Condensing temperature for max. speed
FA11	0.1	25.5	°C	Chiller - Cut-off differential
FA12	0.1	25.5	°C	Chiller - Cut-off override
FA13	0	999	s	CUT-OFF delay
FA14	0	100	%	Heat pump - Minimum speed
FA24	0	100	%	Chiller - 4th step fans percentage
FA25	0	100	%	Heat pump - 1st step fans percentage
FA26	0	100	%	Heat pump - 2nd step fans percentage
FA27	0	100	%	Heat pump - 3rd step fans percentage
FA28	0	100	%	Heat pump - 4th step fans percentage
FA29	0	1	-	Night shift - Enables function (only chiller mode)
FA30	0.0	50.0	°C	Night shift - Temperature differential at min. speed in chiller mode
FA31	0.0	50.0	°C	Night shift - Temperature differential at max. speed in chiller mode
FA32	00:00	24:00	hr	Night shift - Start of time band (0÷ 24)
FA33	00:00	24:00	hr	Night shift - End of time band (0÷ 24)
FA34	0	1	-	Night shift - Enable on Monday
FA35	0	1	-	Night shift - Enable on Tuesday
FA36	0	1	-	Night shift - Enable on Wednesday
FA37	0	1	-	Night shift - Enable on Thursday
FA38	0	1	-	Night shift - Enable on Friday
FA39	0	1	-	Night shift - Enable on Saturday
FA40	0	1	-	Night shift - Enable on Sunday
FA41	0	1	-	Floating condensation - CH - Enable
FA42	-50.0	FA43	°C	Floating condensation - CH - Min. outside temperature
FA43	FA42	110.0	°C	Floating condensation - CH - Max. outside temperature
FA44	-50.0	FA8	°C	Floating condensation - CH - Condensing temperature for min. speed at min. outside temperature
FA45	-50.0	FA9	°C	Floating condensation - CH - Condensing temperature for max. speed at min. outside temperature
FA46	0.1	FA11	°C	Floating condensation - CH - Cut-off differential at min. outside temperature
FA47	0.1	FA12	°C	Floating condensation - CH - Cut-off override at min. outside temperature
FA48	0.0	110.0	°C	Chiller - Max. condensing temperature limit
PAL80	0	999	s	Fan overload - delay alarm
PAL81	0	60	-	Fan overload - Maximun number alarms in one hours

2.9.1 Ventilation in common or separate

Ventilation is managed according to the configuration of the unit.

The parameter involved is shown in the table.

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

Parameter	Min	Max	UM	Description
FA4	0	2	-	Single or separate ventilation

Depending on parameter FA4, ventilation management is:

FA4 = 0. Ventilation is managed in common for all the refrigerant circuits in the unit. The controller will meet the highest of the condensing temperatures in chiller operating mode and the lowest of the evaporating temperatures in heat pump operating mode.

FA4 = 1. Ventilation is managed separately for each individual refrigerant circuit present in the unit.

FA4 = 2. Ventilation is managed in common for pairs of refrigerant circuits in the unit (circuits 1 and 2, circuits 3 and 4). The controller will meet the highest of the condensing temperatures of the pair of circuits in chiller operating mode and the lowest of the evaporating temperatures of the pair of circuits in heat pump operating mode.

If ventilation in common is activated, there will be only one digital input for all the safety devices.

If separate ventilation is activated, there will be one digital input dedicated to the safety devices of each circuit.

2.9.2 Ventilation management with speed adjuster

With speed adjuster, ventilation is managed in continuous mode.

For each refrigerant circuit, there is a digital output for activation of ventilation and an analogue output with modulating circuit for control of a speed adjuster.

The parameters involved in the chiller operating mode are shown in the table.

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

Parameter	Value	UM	Description
FA2	0	-	Ventilation operating mode
FA3	2	s	Ventilation Speed Up at start
FA5	0	s	Chiller - Pre-ventilation time before compressor start-up
FA6	30	%	Chiller - Min. speed
FA7	100	%	Chiller - Max. speed
FA8	32.0	°C	Chiller - Condensation setpoint for min. speed
FA9	50.0	°C	Chiller - Condensing temperature for max. speed

The function with relevant parameters is shown graphically below.

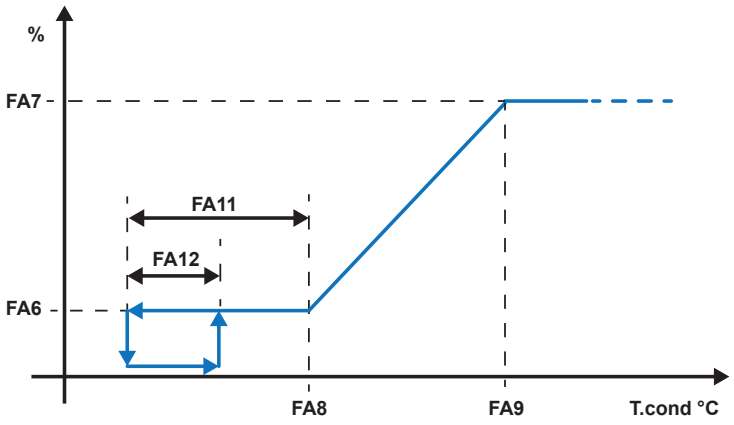


Fig. 20 Analogue output for control of the speed adjuster

In chiller operating mode, ventilation is activated when the condensing temperature is higher than FA8 - FA11 + FA12 and is deactivated when the condensing temperature is lower than FA8 - FA11.When the condensing temperature is between values FA8 and FA9, the analogue output modulates between the percentages of values FA6 and FA7.

The parameters involved in the heat pump operating mode are shown in the table.

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

Parameter	Value	UM	Description
FA2	0	-	Ventilation operating mode
FA3	2	s	Ventilation Speed Up at start
FA5	0	s	Chiller - Pre-ventilation time before compressor start-up
FA14	30	%	Heat pump - Minimum speed
FA15	100	%	Heat pump - Maximum speed
FA16	12.0	°C	Heat pump - Evaporation temperature for minimum speed
FA17	0.0	°C	Heat pump - Evaporation temperature for maximum speed
FA19	3.0	°C	Heat pump - Cut-off differential
FA20	1.0	°C	Heat pump - Cut-off override

The function with relevant parameters is shown graphically below.

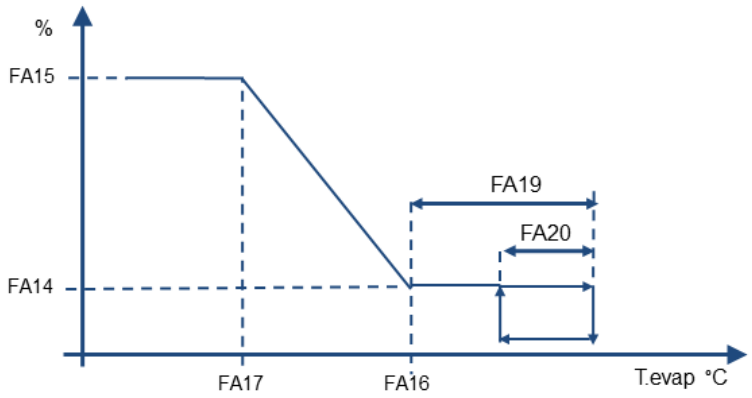


Fig. 21 Analogue output for control of the speed adjuster

In heat pump operating mode, ventilation is activated when the evaporating temperature is lower than FA16 + FA19 - FA20 and is deactivated when the evaporating temperature is higher than FA16 + FA19.When the evaporating temperature is between values FA16 and FA17, the analogue output modulates between the percentages of values FA14 and FA15.

2.9.3 Floating condensation control

This function is used for the dynamic recalculation of the ventilation control ramp as the outside air temperature varies.

The function “Floating condensation control” is only available in cooling mode.

This function is featured in software versions starting from 1.105.90.

The table below shows the operating parameters involved. The function is not enabled by default at the factory. To enable it, access must be gained to the relevant parameters using “Service” level credentials.

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

Parameter	Value	UM	Description
FA1	4	-	Type of ventilation control
FA2	0	-	Ventilation operating mode
FA3	2	s	Ventilation Speed Up at start
FA5	0	s	Chiller - Pre-ventilation time before compressor start-up
FA6	30	%	Chiller - Min. speed
FA7	100	%	Chiller - Max. speed
FA8	32.0	°C	Chiller - Condensation setpoint for min. speed
FA9	50.0	°C	Chiller - Condensing temperature for max. speed
FA11	6.0	°C	Chiller - Cut-off differential
FA12	5.0	°C	Chiller - Cut-off override
FA41	0	-	Floating condensation - CH - Enable
FA42	5.0	°C	Floating condensation - CH - Min. outside temperature
FA43	35.0	°C	Floating condensation - CH - Max. outside temperature
FA44	25.0	°C	Floating condensation - CH - Condensing temperature for min. speed at min. outside temperature
FA45	40.0	°C	Floating condensation - CH - Condensing temperature for max. speed at min. outside temperature
FA46	1.0	°C	Floating condensation - CH - Cut-off differential at min. outside temperature
FA47	1.0	°C	Floating condensation - CH - Cut-off override at min. outside temperature
FA48	60.0	°C	Chiller - Max. condensing temperature limit

The graph below shows the standard function for condensation control.

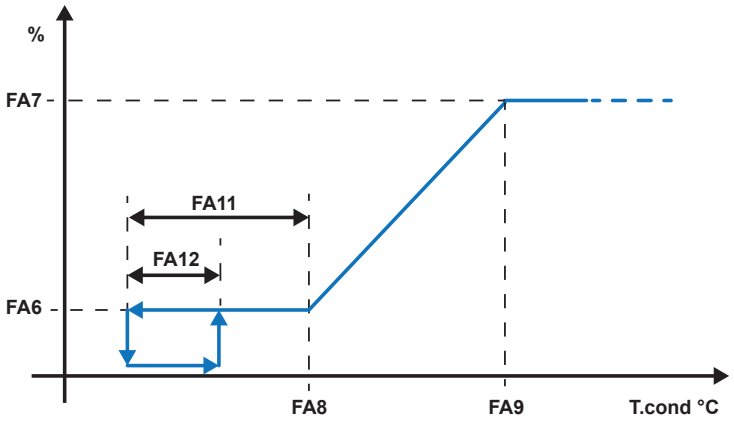


Fig. 22 Analogue output for control of the speed adjuster

When floating condensation is enabled, the control parameters relating to the condensing temperature (“F8”, “F9”, “F11” and “F12”) are replaced by coefficients.

Coefficients vary according to the air temperature within the range of setpoints in parameters “FA42” and “FA43”.

The four coefficients in use are termed “x”, “y”, “t” and “z” for easier function description.

The controller calculates the coefficients with reference to parameters “FA42” and “FA43”. Each coefficient is calculated by interpolation of a pair of parameters:

- coefficient “x” is calculated by interpolation of parameters “FA8” and “FA44”;
- coefficient “y” is calculated by interpolation of parameters “FA9” and “FA45”;
- coefficient “t” is calculated by interpolation of parameters “FA11” and “FA46”;
- coefficient “z” is calculated by interpolation of parameters “FA12” and “FA47”.

The graph below shows coefficient interpolation. The graphs are made using as reference the setpoints of the parameters listed in the previous table.

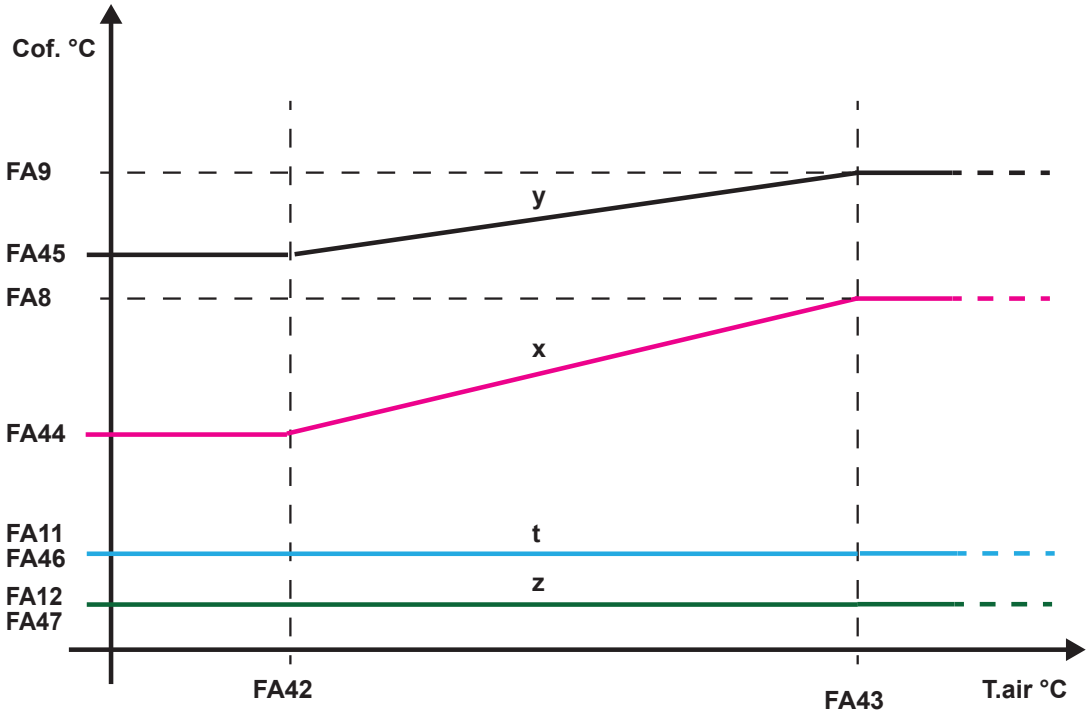


Fig. 23 Coefficient interpolation

When values are replaced by coefficients, the curve of the analogue output for condensation control runs as shown in the figure.

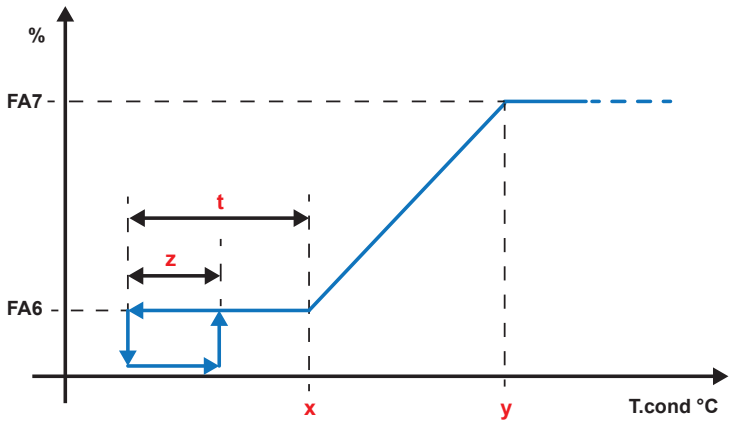


Fig. 24 Coefficient interpolation

When operating in cooling mode only, condensation control requires that ventilation is activated when the condensing temperature is higher than “x” - “t” + “z” and it is deactivated when the condensing temperature is lower than “x” - “t”.When the condensing temperature is between values “x” and “y”, the analogue output modulates between the percentages of values FA6 and FA7.

2.9.4 Night Shift System

Through the setting of daily time bands, the additional "Night Shift System" function allows the unit to be operated in high efficiency mode or in low noise mode as required.

The function can be activated only for condensing control and with proportional ventilation control.

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

Parameter	Value	UM	Description
FA6	30	%	Chiller - Min. speed
FA7	100	%	Chiller - Max. speed
FA8	32.0	°C	Chiller - Condensation setpoint for min. speed
FA9	50.0	°C	Chiller - Condensing temperature for max. speed
FA29	1	-	Night shift - Enables function (only chiller mode)
FA30	2.0	°C	Night shift - Temperature differential at min. speed in chiller mode
FA31	10.0	°C	Night shift - Temperature differential at max. speed in chiller mode
FA32	8:30	h	Night shift - Start of time band (0÷ 24)
FA33	14:10	h	Night shift - End of time band (0÷ 24)
FA34	1	-	Night shift - Enable on Monday
FA35	1	-	Night shift - Enable on Tuesday
FA36	1	-	Night shift - Enable on Wednesday
FA37	1	-	Night shift - Enable on Thursday
FA38	1	-	Night shift - Enable on Friday
FA39	0	-	Night shift - Enable on Saturday
FA40	0	-	Night shift - Enable on Sunday
FA41	0	-	Floating condensation - CH - Enable
FA42	5.0	°C	Floating condensation - CH - Min. outside temperature
FA43	35.0	°C	Floating condensation - CH - Max. outside temperature
FA44	25.0	°C	Floating condensation - CH - Condensing temperature for min. speed at min. outside temperature
FA45	40.0	°C	Floating condensation - CH - Condensing temperature for max. speed at min. outside temperature
FA46	1.0	°C	Floating condensation - CH - Cut-off differential at min. outside temperature
FA47	1.0	°C	Floating condensation - CH - Cut-off override at min. outside temperature
FA48	60.0	°C	Chiller - Max. condensing temperature limit

The function with relevant parameters is shown graphically below.

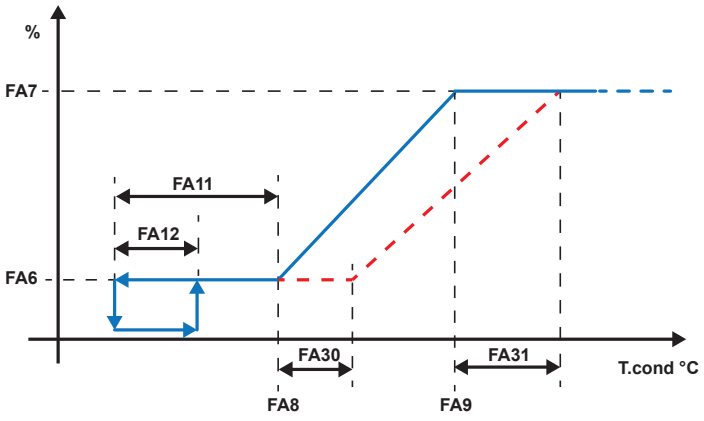


Fig. 25 Analogue output used to control the speed controller with/without “Night Shift System”

In the time bands when the function is active the analogue output for condensation control changes the reference values (“FA8” and “FA9”), i.e. it increases them by the setpoints in parameters “FA30” and “FA31” respectively.

Condensation control takes place at the values resulting from the sum of “FA8” + “FA30” and “FA9” + “FA31”.

The max. limit value of the condensing temperature resulting from the sum “FA9” + “FA31” is in any case limited by the setpoint in parameter “FA48”.

2.9.5 Night Shift System with floating condensation control

The controller offers the possibility to enable these two functions at the same time. Unit operation is the result of the two functions summed.

The function with relevant parameters is shown graphically below.

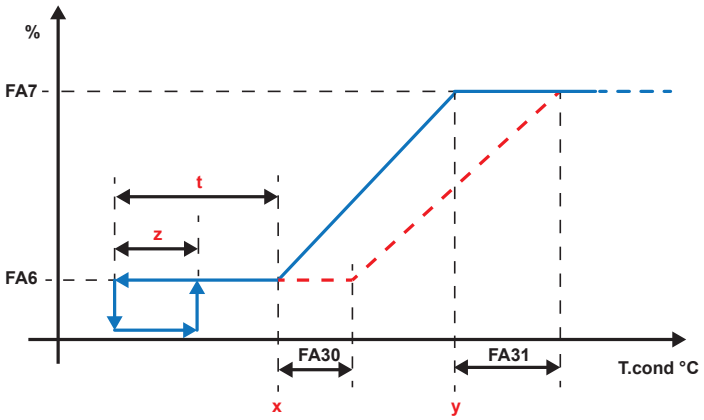


Fig. 26 Analogue output used to control the speed controller with “Night Shift System” and floating condensation

Under floating condensation control conditions the condensing temperature values within which the control is performed switch from parameters “FA8” and “FA9” to coefficients “x” and “y”. The calculation of the coefficients for floating condensation control is described in the relevant section.

In time bands when both functions are enabled the analogue output for condensation control changes the reference values. The controller increases the values of coefficients “x” and “y” by the setpoints in parameters “FA30” and “FA31”.

Condensation control takes place at the values resulting from the sum of “x” + “FA30” and “y” + “FA31”.

The max. limit value of the condensing temperature resulting from the sum “y” + “FA31” is in any case limited by the setpoint in parameter “FA48”.

2.9.6 Fan stop prevention function

This function is intended to prevent a fan stop as a result of forming ice.

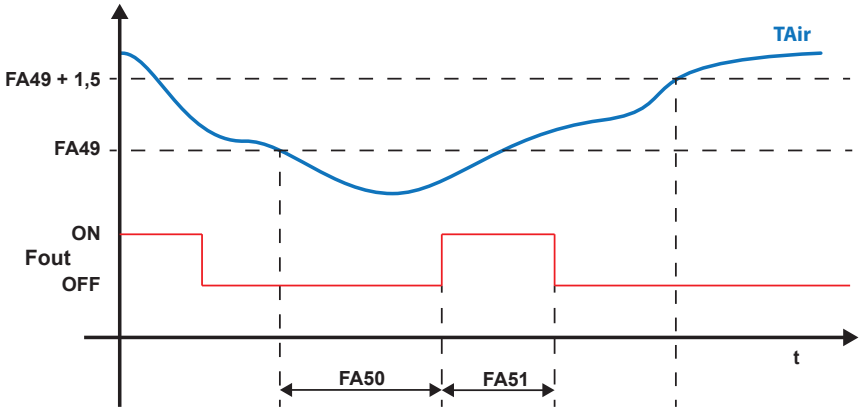
The function gets activated when the air temperature value is below the activation threshold.

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
FA49	0,0	°C	Fan stop prevention function - Activation threshold
FA50	240	min	Fan stop prevention function - Time between cycles (0 = disabled)
FA51	30	s	Fan stop prevention function - Operating time

A graphical representation of the function is shown below.



In addition to the references present in the table, the abbreviations in the graph are:

- Tair = air temperature;
- Fout = status of fan outputs;

In order for the function to get started, the setpoint value in parameter “FA50” must be other than zero.

If the air temperature value is smaller than the value stored in the activation threshold (“FA49”) and fan activation is not required for as long as the time set in parameter “FA50”, the controller forces the fans to get activated at max. speed for as long as the time value set in parameter “FA51”.

The function gets activated automatically even if the unit is OFF, provided that the necessary conditions are in place.

The function gets de-activated when the air temperature value exceeds the threshold in parameter “FA49” by 1.5°C.

The counter of parameter “FA50” is reset if the controller starts ventilation following a thermoregulation demand.

If the temperature probe experiences a malfunction, the function is disabled.

2.9.7 Ventilation alarms

The alarms regarding this function are shown in the table.

Alarm code	**AL35..AL40**
Reason for activation	The digital input is ignored for the delay set in parameter PAL80
	AL35; with digital input of circuit 1 open
	AL36; with digital input of circuit 2 open
	AL37; with digital input of circuit 3 open
	AL38; with digital input of circuit 4 open
	AL39; with digital input of circuits 1 and 2 open
	AL40; with digital input of circuits 3 and 4 open
Reset	According to the setting of parameter PAL81
Alarm icon	Flashing
AlarmLog	YES
Buzzer	YES
Devices	**Behaviour in the event of an alarm**
Fan in alarm	Follows its control (stopping takes place electro-mechanically)
The other devices	They follow their control

Parameter PAL81 determines the number of automatic resets of the fan alarms in one hour.

With the parameter set to "0", the reset is manual; with the parameter set to "60" the reset is always automatic.

2.10 User-side pumps

Management of the pumps in the unit takes place based on the number of pumps configured.

The application manages the pumps through the setting of the PA parameters. The parameters involved are shown in the table.

Parameter	Min	Max	UM	Description
PA1	0	2	-	Users - Pump management
PA2	0	999	10 s	User - Compressor activation delay from pump start-up
PA3	0	999	10 s	Users - Pump Off delay from switch-off of compressors
PA4	0	999	10 s	Users - Pump Off delay from keypad / BMS / remote input switch-off
PA5	0	4	-	Users - Type of rotation of pumps
PA6	0	1	-	Users - Manual reversal of pumps
PA7	0	999	h	Users - Number of hours of pump operation to carry out a rotation
PA8	0	999	s	Users - Period of pumps ON simultaneously after rotation of pumps
PA9	0	2	-	Users - Antifreeze - Action of pumps in case of antifreeze alarm with unit off
PA10	1	5	-	Users - Antifreeze - Selection of antifreeze probe
PA11	-50.0	110.0	°C	Users - Antifreeze - Pump activation threshold on antifreeze probe
PA12	0.1	25.5	°C	Users - Antifreeze - Pump deactivation differential on antifreeze probe
PA13	0	1	-	User - Anti-sticking Enable anti-sticking function
PA14	0	999	s	Users - Pulse - Pump switch-off delay
PA15	0	999	m	Users - Pulse - Interval of time in which the pump is on with compressors off
PA16	0	999	m	Users - Pulse - Interval of time in which the pump is off with compressors off
PA17	0	999	m	Users - Pump shutdown delay by remote digital input
PA18	0	9999	10 h	Users - Threshold Hour meter pumps
PA39	0	999	s	Users - Delay for pump activation from permission for valve opening
PA40	0	999	s	Off time of pumps during rotation (VFPP)
PA42	0	999	s	Users - Delay for valve closing from pump deactivation
PA49	0	1	-	User - Enabling pumps rotation only with compressors off

Parameter PA1 determines the way in which the controller manages the pumps and therefore water circulation in the unit:

- 0 = Water circulation in the unit is not managed;
- 1 = Activation of water circulation (activation of a pump) follows activation of the unit;
- 2 = Activation of water circulation (activation of a pump), follows the status of the compressors and therefore the thermoregulation request.

If parameter PA1 = 2 (activation of water circulation follows thermoregulation) management of water circulation depends on parameter PA13:

- 0 = the pump is deactivated after delay PA3 and is activated with the thermoregulation request.
- 1 = the pump is deactivated after delay PA14; while the thermoregulation request is not present, the "Pulse" function is active.

2.10.1 Management of unit without pumps or with one pump

The parameters involved in activating the unit with one pump are shown in the table.

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

Parameter	Value	UM	Description
PA1	1 or 2	-	Users - Pump management
PA2	6	10 s	User - Compressor activation delay from pump start-up
PA3	3	10 s	Users - Pump Off delay from switch-off of compressors
PA4	6	10 s	Users - Pump Off delay from keypad / BMS / remote input switch-off
PA17	1	m	Users - Pump shutdown delay by remote digital input

A graphical example is shown below of the sequence with which the following takes place: the switching on of the unit of the pump (parameter PA1 = 1 or 2) and of the compressors and their switching off when the switching off of the unit takes place from the keypad (pump delay PA4) and from remote OK signal (pump delay PA17).

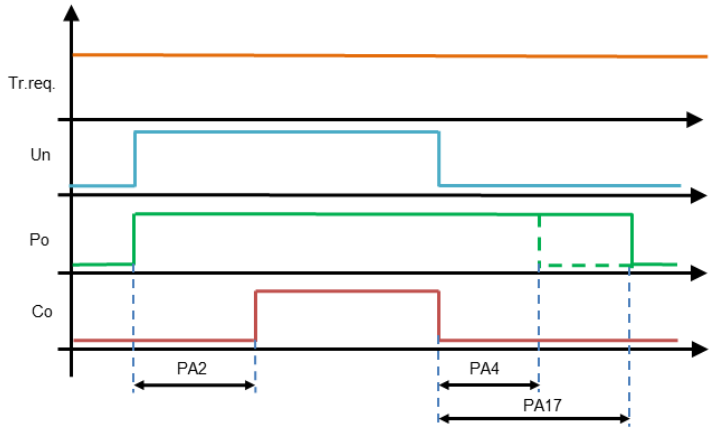


Fig. 27 Graph of the switching on and switching off of the unit, pump and compressor

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

- Un = status of the unit
- Th.req. = thermoregulation request
- Po = status of the pump;
- Co = status of the compressors.

If management of at least one pump by the controller is not contemplated (parameter PA1 = 0), on starting, delay PA2 is not managed and, on switching off, delays PA4 and PA17 are not managed.

2.10.2 Management of 2 pumps

In the version with 2 pumps, these are always with one on standby while the other is working. The switching between pumps (to balance the hours of operation of each one), can be manual or automatic. In any case, switching takes place in case of breakdown.

The parameters involved in the management of two pumps are shown in the table.

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

Parameter	Value	UM	Description
PA1	1 or 2	-	Users - Pump management
PA5	3	-	Users - Type of rotation of pumps
PA6	0	-	Users - Manual reversal of pumps
PA7	8	h	Users - Number of hours of pump operation to carry out a rotation
PA8	5	s	Users - Period of pumps ON simultaneously after rotation of pumps

Even if the unit is configured with double pump, parameter PA1 is always complied with.

The value of parameter PA5 determines the type of rotation of the pumps that can be:

- 0 = not managed;
- 1 = manual rotation; activation of the pump takes place in accordance with parameter PA6;
- 2 = rotation by number of starts; the pump with the lowest number of starts is activated;
- 3 = rotation by number of hours of operation; the pump with the lowest number of hours of operation is activated, and rotation between the pumps is forced when the active one reaches the number of hours set in parameter PA7.
- 4 = rotation by number of hours and starts; the pump with the lowest number of hours and starts is activated.

When parameter PA5 = 1, the pumps are activated in accordance with parameter PA6:

- PA6 = 0; the controller always activates pump 1;
- PA6 = 1; the controller always activates pump 2.

If the value of parameter PA5 is different from "0" or "1", forced rotation takes place automatically in case of breakdown.

If the value of parameter PA5 is "1" due to a flow switch alarm in case of breakdown of the pump selected with parameter PA6, rotation does not take place and the unit will stop.

The diagram below graphically shows the automatic rotation and the status of the thermoregulation request with the alarm of one of the pumps and of both of them.

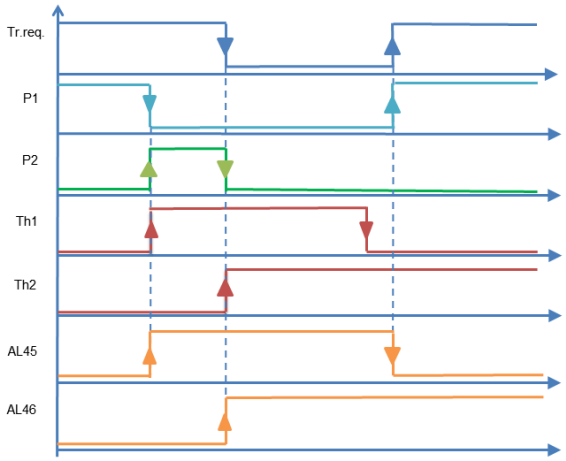


Fig. 28 Graphical representation of the alarms of the pumps

The graph shows:

1. the unit running with thermoregulation request (Tr.req = on) and pump 1 active (P1 = on);
2. operation of the thermal overload protection of pump 1 (Th1 = on) with activation of the relevant alarm (AL45 = on), deactivation of pump 1 (P1 = off) and activation of pump 2 (P2 = on);
3. operation of the overload protection of pump 2 (Th2 = on) with activation of the relevant alarm (AL46 = on), deactivation of pump 2 (P2 = off) and of thermoregulation (Tr.req = off);
4. reset of the overload protection of pump 1 (Th1 = off);
5. reset of the alarm of pump 1 (AL45 = off), activation of thermoregulation (Tr.req = on), activation of pump 1 (P1 = on).

2.10.3 Pump switching after compressor switch-off

Special conditions apply by which automatic rotation between pumps must take place with a delay between the stop of one pump and the start of the other.

In these cases, the pumps must be rotated when the compressors are off.

As soon as the number of operating hours is achieved, the controller waits for thermoregulation to be met or for the unit to be “OFF”, before rotating the pumps.

Pump rotation in the second case takes place upon re-start.

The table shows the parameters involved in the management of this function.

Parameter	Value	UM	Description
PA1	1	-	Users - Pump management
PA5	3	-	Users - Type of rotation of pumps
PA7	8	h	Users - Number of hours of pump operation to carry out a rotation
PA8	0	s	Users - Period of pumps ON simultaneously after rotation of pumps
PA40	5	s	Off time of pumps during rotation (VFPP)
PA49	1	-	User - Enabling pumps rotation only with compressors off

The value of parameter “PA8” (time of simultaneous pump operation during rotation) must be set to “0”.

The diagram below shows a graphic representation of automatic pump rotation with the compressors not running.

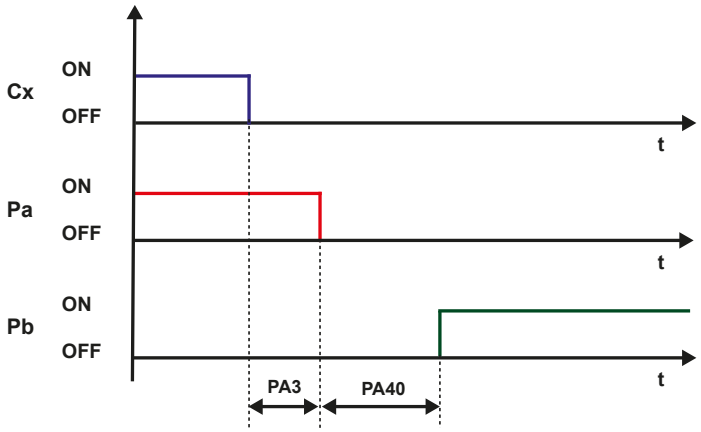


Fig. 29 Graph illustrating pump rotation after compressor switch-off

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

- Cx = last compressor in operation
- Pa = pump in operation
- Pb = pump in standby

2.10.4 Management of the pumps in antifreeze function

With the controller, there is the possibility of using system water circulation to prevent freezing of the heat exchanger during periods when the machine is stopped.

So that water circulation can impede freezing of the exchanger, the unit must be electrically powered and circulation must not be prevented by the status of valves and taps.

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
PA1	1 or 2	-	Users - Pump management
PA9	1	-	Users - Antifreeze - Action of pumps in case of antifreeze alarm with unit off
PA10	5	-	Users - Antifreeze - Selection of antifreeze probe
PA11	4.0	°C	Users - Antifreeze - Pump activation threshold on antifreeze probe
PA12	4.0	°C	Users - Antifreeze - Pump deactivation differential on antifreeze probe

The value of parameter PA9 determines water circulation in unit OFF conditions or in any case with pumps deactivated:

- 0 = always deactivated
- 1 = activated at the same time as the antifreeze heaters
- 2 = activated with reference to the values of parameters PA11 and PA12

The value of parameter PA10 identifies the reference for activating the antifreeze protection and alarm that can be:

- PA10 = 1; the value read by the probe placed at the outlet of evaporator 1;
- PA10 = 2; the lowest value read out of the probes placed at the outlets of evaporator 1 and evaporator 2;
- PA10 = 3; the lowest value read out of the probes placed at the outlets of evaporator 3 and evaporator 4;
- PA10 = 4; the lowest value read out of the probes placed at the outlets of evaporator 1, evaporator 2, evaporator 3 and evaporator 4;
- PA10 = 5; the lowest value read out of the probes placed at the outlets of evaporator 1, evaporator 2, evaporator 3 and evaporator 4 and at the outlet in the common section;
- PA10 = 6; the value read by the external air probe.

If one of the set probes has an error, it is excluded. If only one probe is set, then the pump will stay switched off.

2.10.5 Pulse Function

The “Pulse” function allows the pump to be switched on and switched off based on some set times when the request for starting up the compressors from thermoregulation is not present.

This function combines activation of the pump of the unit with the thermoregulation request.

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
PA1	2	-	Users - Pump management
PA13	1	-	User - Anti-sticking Enable anti-sticking function
PA14	60	s	Users - Pulse - Pump switch-off delay
PA15	5	m	Users - Pulse - Interval of time in which the pump is on with compressors off
PA16	5	m	Users - Pulse - Interval of time in which the pump is off with compressors off

The function is shown graphically in the diagram below.

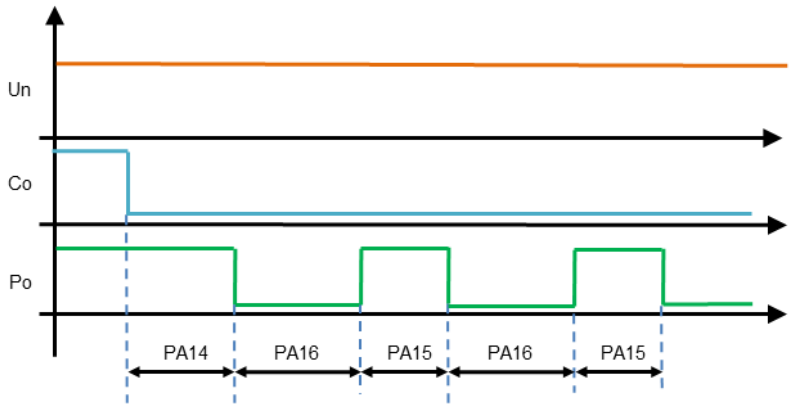


Fig. 30 "Pulse" function

In addition to the parameters of the table, the following abbreviations are present in the graph:

- Un = status of the unit
- Co = status of the compressors
- Po = status of the pumps.

2.10.6 Pump alarms

The alarms that regard the pumps are shown below.

Pump maintenance

Alarm code	**AL143 maintenance of pump 1; AL144 maintenance of pump 2**
Reason for activation	This is detected when the work hours exceed the value of parameter PA18
Reset	On deletion of the hours in the Service menu
Alarm icon	Flashing
AlarmLog	Yes
Buzzer	Yes
Devices	**Behaviour in the event of an alarm**
Pump in alarm	Follows its control
The other devices	They follow their control

Thermal overload protection of pumps

Alarm code	**AL45 Thermal overload protection of pump 1; AL46 Thermal overload protection of pump 2**
Reset	With digital input closed
Reset mode	Always manual
Alarm icon	Flashing
AlarmLog	Yes
Buzzer	Yes
Devices	**Behaviour in the event of an alarm**
Pump	Operation of the pump in alarm is prevented
The other devices	They follow their control

2.11 User-side pump

The controller can control a water circulation valve.

The water circulation valve is controlled by the controller in connection with the user-side pump.

The control process consists in the following:

- pump start-up is delayed so that the valve can open fully;
- valve closing is delayed after pump switch-off.

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
PA39	90	s	Users - Delay for pump activation from permission for valve opening
PA42	90	s	Users - Delay for valve closing from pump deactivation

Below is a graphic illustration of the sequence followed to open and close the valve with respect to pump start-up and stop.

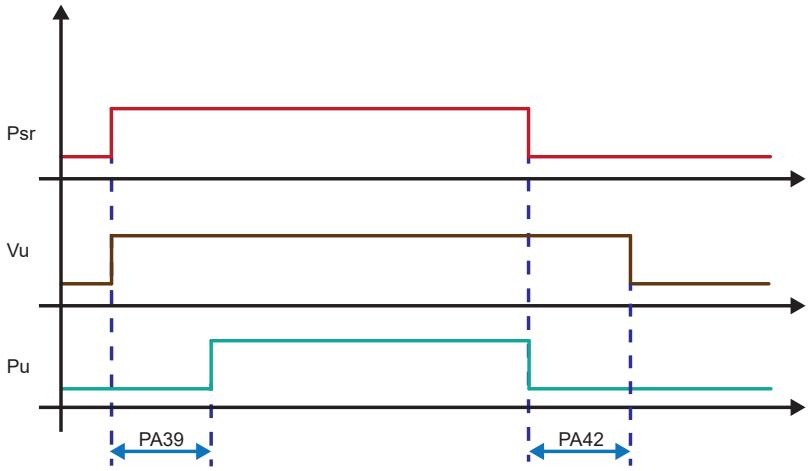


Fig. 31 Graph showing delayed valve opening and closing

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

- Psr = request for pump start-up
- Vu = status of user-side valve
- Pu = status of user-side pump

The valve is always controlled in connection with the pump, irrespective of the control type selected in parameter PA1.

2.12 Heat recovery pumps

Management of the heat recovery pumps of the unit takes place based on the number of pumps configured.

The heat recovery pumps are managed by the controller through the setting of the PA parameters. The parameters involved are shown in the table.

Activation of the pump is linked to the setting of parameter "PA43" to "1".

The number of pumps present is factory set whereas the type of rotation depends on parameter "PA45"

Parameter	Min	Max	UM	Description
PA36	0	999	10 h	Source/Recovery - Pump hour counter threshold
PA43	0	1	-	Recovery - Recovery Pump Management
PA44	0	999	s	Recovery - Disactivation pump delay
PA45	2	3	-	Recovery - Type of rotation and activation pumps
PA46	0	999	hr	Recovery - Number of pump operating hours to make a rotation
PA47	0	999	s	Recovery - Contemporary time ON pump after pump rotation

2.12.1 Management of one or two heat recovery pumps

Irrespective of the number of pumps managed by the controller, parameter "PA43" must be set to "1".

The controller manages water circulation in the heat recovery exchanger when it activates the heat recovery valve.

If just one pump is factory configured, the controller manages heat recovery only if the pump is not in alarm condition.

If two pumps are configured, at the time the heat recovery valve is activated, the pump is activated according to the setting of parameter "PA45".

With parameter "PA45" (rotation of operation due to reaching the number of hours of operation) set to "3", when the number of hours of operation reaches the value set in parameter "PA46", if both pumps are available, the controller rotates them.

During rotation of operation, the controller keeps both pumps operating for the time set in parameter "PA47".

At the end of heat recovery, the controller keeps the pump that is running operating for the time set in parameter "PA44".

2.12.2 Heat recovery pump alarms

The alarms regarding the heat recovery pumps are shown below.

Maintenance of recovery pumps/desuperheater

Alarm code	**AL241 maintenance of pump 1; AL242 maintenance of pump 2**
Reason for activation	This is detected when the work hours exceed the value of parameter PA36
Reset	Upon deletion of the hours in the Service or Maintenance menu
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Pump in alarm	Follows its control
The other devices	They follow their control

Thermal overload protection in recovery pumps/desuperheater

Alarm code	**AL243 Thermal overload protection of pump 1; AL244 Thermal overload protection of pump 2**
Reset	With digital input closed
Reset mode	Always manual
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Pump	Operation of the pump in alarm is prevented
Recovery	Prevented if a back-up pump is not available
The other devices	They follow their control

2.13 Liquid injection valve

To activate this function, the PTC discharge probe must be configured for each circuit present in the unit.

All the parameters involved with this function are shown in the table.

Parameter	Value	UM	Description
CO51	110	°C	Control of discharge temperature - Activation Setpoint of the liquid injection solenoid valve
CO52	10.0	°C	Screw - Differential activation of the liquid injection solenoid valve (discharge temp.)

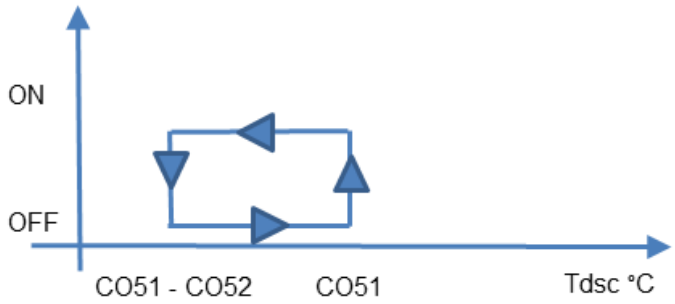


Fig. 32 Graphical representation of injection valve operation

When the temperature of the discharge gas (Tdsc) reaches the value of parameter CO51, injection of liquid is activated and remains active until the temperature falls to the value given by the difference CO51 - CO52.

2.14 Oil return

The oil return function consists of the increase in cooling capacity of the circuit when it remains at reduced capacity for a long time.

The increase in cooling capacity causes an increase in the speed of the refrigerant in the exchangers and facilitates oil return to the compressor.

The parameters involved are shown in the table.

Parameter	Min	Max	UM	Description
CO46	0	180	min	Oil return - Inverter: Delay in compressor override activation (0=disab.)
CO47	0	180	min	Oil return - Scroll ON/OFF: delay in procedure activation - Inverter: compressor override duration
CO48	45	55	%	Oil return - Inverter: Percentage capacity override during oil return function
CO49	25	CO48	%	Oil return - Inverter: Percentage activation threshold for oil return function

The function is present on all units.

The capacity reduction value that activates the function is factory set.

2.14.1 Oil return for compressors managed with inverter

All the parameters involved with this function are shown in the table.

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

Parameter	Value	UM	Description
CO46	50	min	Oil return - Inverter: Delay in compressor override activation (0=disab.)
CO47	2	min	Oil return - Scroll ON/OFF: delay in procedure activation - Inverter: compressor override duration
CO48	55	%	Oil return - Inverter: Percentage capacity override during oil return function
CO49	28	%	Oil return - Inverter: Percentage activation threshold for oil return 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.

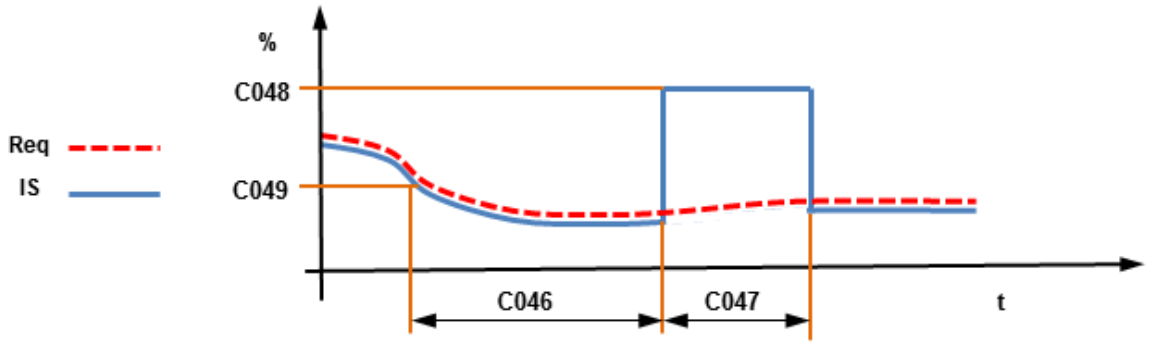


Fig. 33 Forcing of frequency for oil recovery

In addition to the parameters, the illustration also shows the abbreviations "IS", which refers to the inverter frequency trend, and "Req", which refers to the thermoregulation request.

2.15 Heat recovery

Parameter	Min	Max	UM	Description
RC3	0	999	s	DC - Forced unloading time before entering in recovery
RC4	0	999	s	DC - Forced unloading time after entering in recovery
RC5	0	999	m	DC/DS - Minimun On time
RC6	0	999	m	DC - Minimum waiting time between two recoveries / DS - Waiting time before VDO enabling
RC7	0.0	99.9	bar	DC - High pressure threshold to exit from recovery
RC8	0.1	25.5	bar	DC - High pressure differential to exit from recovery
RC9	0	999	s	DC - Fans deactivation delay after entering in recovery
RC11	-50.0	45.0	°C	DC/DS - Minimum setpoint
RC12	28.0	110.0	°C	DC/DS - Maximum setpoint
RC13	28.0	45.0	°C	DC/DS - Setpoint
RC14	0.1	25.5	°C	DC/DS - Differential
RC15	0	9	-	Probe selection entry/exit DC/DS
RC16	0 = NO	1 = YES	-	Enable DC/DS circuit 1
RC17	0 = NO	1 = YES	-	Enable DC/DS circuit 2
RC18	0 = NO	1 = YES	-	Enable DC/DS circuit 3
RC19	0 = NO	1 = YES	-	Enable DC/DS circuit 4
RC20	0.0	99.9	bar	Setpoint activation air coil drain valve
RC21	0.1	25.5	bar	Differential deactivation air coil drain valve

2.15.1 Enabling and activation of recovery

With the relevant digital input closed, activation of recovery depends on the temperature value read by the probe that controls it (RC15) compared to the recovery setpoint (RC13) and relevant differential (RC14).

The recovery differential is divided into the same number of steps as refrigerant circuits present in the unit.

A graphical representation is shown below.

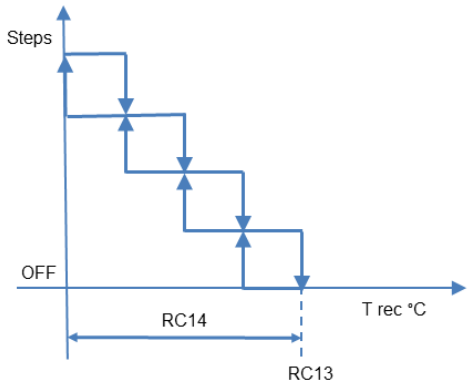


Fig. 34 Graph of recovery activation

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

- T rec = recovery water temperature.

2.15.2 Recovery management

In addition to activation, the controller manages heat recovery and checks the suction and delivery pressures, and with delays.

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
RC3	60	s	DC - Forced unloading time before entering in recovery
RC4	60	s	DC - Forced unloading time after entering in recovery
RC5	2	m	DC/DS - Minimun On time
RC6	5	m	DC - Minimum waiting time between two recoveries / DS - Waiting time before VDO enabling
RC7	16.0	bar	DC - High pressure threshold to exit from recovery
RC8	4.0	bar	DC - High pressure differential to exit from recovery
RC9	5	s	DC - Fans deactivation delay after entering in recovery
RC11	28.0	°C	DC/DS - Minimum setpoint
RC12	45.0	°C	DC/DS - Maximum setpoint
RC13	42.0	°C	DC/DS - Setpoint
RC14	3.0	°C	DC/DS - Differential
RC20	1.0	bar	Setpoint activation air coil drain valve
RC21	0.3	bar	Differential deactivation air coil drain valve

In addition to the request by thermoregulation for recovery and possible closing of the external OK signal, before activating the recovery exchanger, the controller checks that:

- the minimum delay between two activations has elapsed (RC6);
- the forced capacity reduction time before activation has elapsed (RC3).

If the thermoregulation request is met in chiller operating mode while a circuit is in recovery mode, switching off always takes place with recovery deactivated.

2.15.3 Recovery alarms

The alarms that regard recovery are shown below.

Alarm code	**AL207.. AL210 circuit 1 .. 4 recovery disabled**
Reason for activation	This is detected if the delivery pressure exceeds threshold RC7
Reset	When the delivery pressure is lower than value RC7 - RC8 for time RC9
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Buzzer	Yes
Devices	**Behaviour in the event of an alarm**
Circuit in alarm	Recovery deactivated
The other circuits and devices	They follow their control

2.16 Desuperheater

The function of the desuperheater is to recover a portion of the heat generated by the superheated gas at the compressor exhaust and to use it to heat water.

For correct refrigerant circuit operation, the superheated gas must not, however, be cooled to such extent that it condensates. This is why the desuperheater can only be supplementary to the main source used for the production of hot water in the system in which it is incorporated.

As the controller is intended to provide for safe management of the refrigerant unit, it uses the desuperheater at best by controlling the following:

- a digital output which the installer can use to manage a pump or a valve;
- one or two pumps, including their safety devices and the pump rotation logics in connection with the hours of operation and alarms, if any.

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
RC5	0	m	DC/DS - Minimun On time
RC6	0	m	DC - Minimum waiting time between two recoveries / DS - Waiting time before VDO enabling
RC11	-50.0	°C	DC/DS - Minimum setpoint
RC12	28.0	°C	DC/DS - Maximum setpoint
RC13	28.0	°C	DC/DS - Setpoint
RC14	0.1	°C	DC/DS - Differential
RC15	0	-	Probe selection entry/exit DC/DS
RC16	0 = NO	-	Enable DC/DS circuit 1
RC17	0 = NO	-	Enable DC/DS circuit 2
RC18	0 = NO	-	Enable DC/DS circuit 3
RC19	0 = NO	-	Enable DC/DS circuit 4
RC22	-99.9	°C	DS - Minimum difference between condensation converted temperature and DS temperature
RC23	-99.9	°C	DS - Differential: difference between condensation converted temperature and DS temperature

2.16.1 Desuperheater activation

If the relevant icon is tapped on screen and the relevant digital input is closed, the desuperheater is enabled based on the water reference temperature setpoint and the condensing temperature.

A graphical representation is shown below.

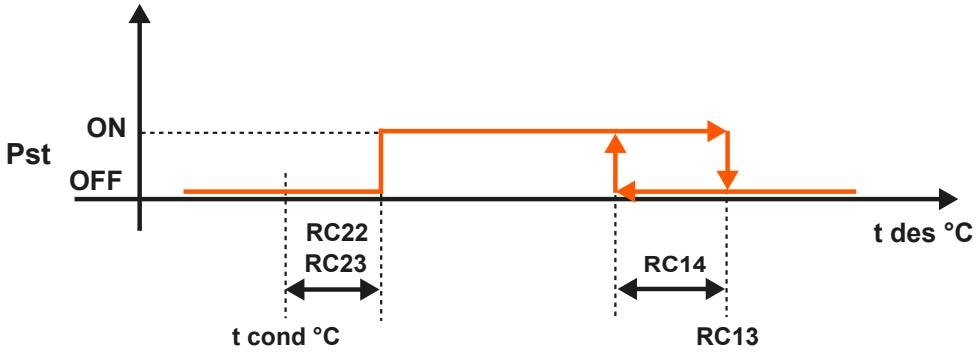


Fig. 35 Desuperheater activation graph

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

- Pst = desuperheater OK signal status;
- t cond = condensing temperature;
- t des = water reference temperature.

2.16.2 Desuperheater management

When the water reference temperature exceeds the setpoint value stored in parameter “RC13”, the controller stops the OK signal that enables desuperheater operation. The signal is output again when the water reference temperature is smaller than the value resulting by subtracting the setpoint in “RC13” and the “RC14” differential value.

When the reference value of the water temperature is lower than the condensing temperature (“t cond”) plus the differential value “RC22” (operation in cooling mode) or the differential value “RC23” (operation in heating mode), the controller stops outputting the OK signal to enable desuperheater operation in order to prevent the refrigerant from condensing inside the desuperheater.

Parameters “RC22” and “RC23” may take both positive and negative values. The graph shows the “RC22” and “RC23” parameters having equal and positive values.

The controller starts outputting the OK signal to the desuperheater again as soon as the conditions for re-activation are met for at least as long as the time set in parameter “RC6”.

If desuperheater pumps are fitted, their management is described in the chapter titled “Recovery pumps”.

2.17 Antifreeze control in recovery system/desuperheater

During operation of the units, or while they are in stand-by conditions and the ambient temperature is below zero, the water inside the exchangers can freeze.

Ice formation inside the exchangers can irreparably damage them.

The controller runs dedicated processes to prevent the formation of ice in the heat exchangers.

The parameters involved are shown in the table.

Parameter	Min	Max	UM	Description
AR12	-50.0	110.0	°C	Activation setpoint of DC/DS heaters
AR13	0.1	25.5	°C	Deactivation differential of DC/DS heaters
AR14	0	3	-	DC/DS antifreeze type

2.17.1 Antifreeze control in recovery system/desuperheater

The output used to enable the antifreeze function gets activated when the temperature value read by the reference probe reaches the setpoint value. Deactivation takes place when the activation temperature plus the differential is reached.

The reference probe installed to control the antifreeze function reads the temperature of water at the heat exchanger inlet. If multiple heat exchangers are fitted, they must be connected to a manifold.

The relevant parameters are shown in the table.

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

Parameter	Value	UM	Description
AR12	3.0	°C	Activation setpoint of DC/DS heaters
AR13	1.0	°C	Deactivation differential of DC/DS heaters
AR14	1	-	DC/DS antifreeze type

A graphical representation is shown below.

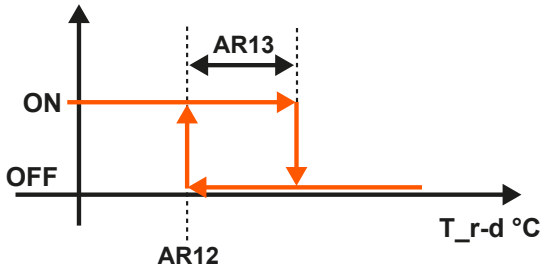


Fig. 36 Antifreeze control

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

- ON = antifreeze function enabled;
- OFF = antifreeze function disabled;
- T_r-d = temperature read by the reference probe.

The value stored in parameter “AR14” defines the function that is used to prevent the formation of ice in the heat exchanger:

- 0 = no function;
- 1 = enable antifreeze heater;
- 2 = enable OK signal output to external pump;
- 3 = enable unit pumps in antifreeze function.

2.17.2 Management of the pumps in antifreeze function

The controller features an option by which water is circulated to prevent freezing of the heat exchanger provided that the conditions to enable the antifreeze function are in place (parameter “AR14” = 3).

So that water circulation can impede freezing of the exchanger, the unit must be electrically powered and circulation must not be prevented by the status of valves and taps.

If an error is experienced with the reference probe that controls the antifreeze function, the antifreeze function does not get enabled.

2.18 Pump down

This function causes the refrigerant circuit to stop following the closing of the expansion valve and the reaching of the suction pressure at the switch-off threshold in pump down.

The parameters involved are shown in the table.

Parameter	Min	Max	UM	Description
PD1	0	6	-	Enables pump down function
PD2	0.0	99.9	bar	Deactivation threshold
PD4	0	999	s	Maximum time in pump down at start-up and switch-off
PD7	0	60	-	Maximum number of pump down activations per hour during procedure stop

2.18.1 Pump down during switch-off

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
PD1	1	-	Enables pump down function
PD2	2.0	bar	Deactivation threshold
PD4	30	s	Maximum time in pump down at start-up and switch-off
PD7	3	-	Maximum number of pump down activations per hour during procedure stop

A graphical representation is shown below.

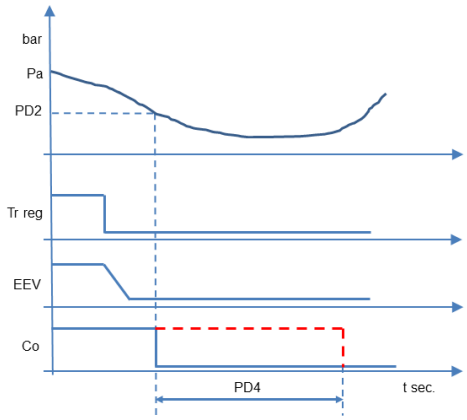


Fig. 37 Pump down

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

- Pa = suction pressure
- Tr reg = thermoregulation request
- EEV = electronic expansion valve
- Co = OK signal to the refrigerant circuit.

The stages of the graph are as follows:

- the request for refrigerant circuit operation by thermoregulation ends;
- the controller forces the closing of the electronic expansion valve;
- the suction pressure decreases;
- on reaching the value set in parameter PD2, the controller stops the refrigerant circuit;
- in any case, when delay PD4 has elapsed, irrespective of the suction pressure value, the controller stops the refrigerant circuit with alarm message.

2.18.2 Pump down alarms

The alarms regarding pump down are shown below.

Alarm code	**AL122.. AL125 pump down alarm for circuits 1 .. 4**
Reason for activation	When PD1 is different from "0" and the switching off of a refrigerant circuit is required
Reset	Automatic, and becomes manual after PD7 occurrences/hour
Reset mode	Only the service personnel may reset the manual alarm.
Alarm icon	Flashing
AlarmLog	Yes
Buzzer	Yes
Devices	**Behaviour in the event of an alarm**
Circuit in alarm	Deactivated
The other circuits and devices	They follow their control

2.19 Refrigerant leak detection management

This function manages refrigerant leaks.

Leaks are controlled through a refrigerant detector whose sensor is installed in the compressor compartment of the unit.

On the controller, for each refrigerant circuit of the unit, there are digital inputs to which the refrigerant detectors are connected.

If the amount of refrigerant measured by the sensor exceeds the alarm threshold, the detector opens a digital input of the controller of the unit.

Depending on the settings, in case of refrigerant leaks, the controller stops the relevant circuit in pump down or just gives a warning.

2.19.1 Stop due to refrigerant leak

A graphical representation is shown below.

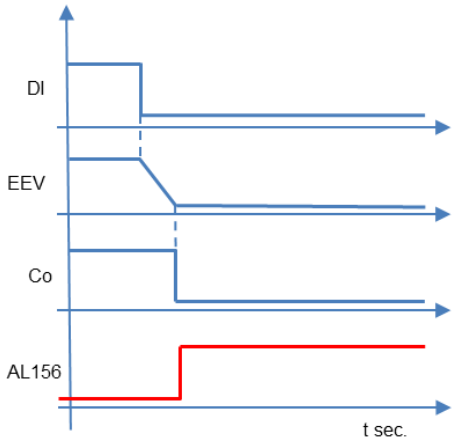


Fig. 38 Leak detector

The abbreviations of the graph indicate:

- DI = digital input regarding the refrigerant detector
- EEV = electronic expansion valve
- Co = OK signal to the refrigerant circuit
- ALL = activation of the alarm.

The stages of the graph are as follows:

- opening of the digital input of the controller by the refrigerant detector;
- the controller forces the closing of the electronic expansion valve;
- when the electronic expansion valve closes, the controller stops the refrigerant circuit involved;
- with the stopping of the circuit, the alarm is signalled.

2.19.2 Refrigerant leak warning

With management of just the refrigerant leak warning, when the digital input of the controller is opened by the leak detector, the alarm is activated while the refrigerant circuit continues with normal operation.

2.19.3 Refrigerant leak alarms

The refrigerant leak alarms are shown below.

Alarm code	**AL156.. AL159 refrigerant leak alarm of circuits 1 .. 4**
Reason for activation	When PD1 = "5" and digital input of the controller regarding the refrigerant detector is open
Reset	Automatic, and becomes manual after PD7 occurrences/hour
Reset mode	Only the service personnel may reset the manual alarm.
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Circuit in alarm	Depending on the setting, it is stopped or follows the control
The other circuits and devices	They follow their control

2.20 Free Cooling

Free cooling is the function that allows air temperature to be used to cool the user water.

Depending on the set parameters, the controller can manage this function in various ways.

In any case, when conditions are suitable, the controller activates the free cooling resources before the compressors and deactivates them after deactivating the compressors.

The parameters involved are shown in the table.

Parameter	Min	Max	UM	Description
FC1	0	4	-	Freecooling type
FC2	0.1	25.5	°C	Differential close 3way valve freecooling / NG pump off
FC6	Di-sables	Enables	-	Enables no-glycol free cooling
FC7	-50.0	110.0	°C	Temperature differential to activate freecooling from water end outdoor temp
FC8	0.1	25.5	°C	Hysteresis for switching off free cooling
FC9	0	0	%	Minimum speed of free cooling fans
FC10	0	100	%	Maximum speed of free cooling fans
FC11	0	999	s	Speed-up time of free cooling fans
FC17	-50.0	110.0	°C	Maximum outdoor air temperature threshold for freecooling off
FC18	-50.0	110.0	°C	Minimum outside air temperature limit for deactivation of compressors
FC19	0	999	s	Delay activation fan steps above neutral zone (Falling Time)
FC20	0	999	s	Delay activation fan steps above neutral zone (Raising Time)
FC21	1.0	100.0	%	Increase percentage of free cooling steps with neutral zone (0..100%)
FC22	0.1	25.5	°C	Fan activation differential (only with proportional control)
FC23	0	999	s	Compressor activation delay after reaching full free cooling capacity
FC25	-50.0	110.0	°C	FC valve activation differential

2.20.1 Free cooling with air/water coil

When conditions are suitable, the user water goes through an air/water coil before going through the evaporator.

The diversion is normally made through a 3-way valve.

With the flow through the air/water coil, the need to activate the compressors is reduced up to the complete stopping of them.

By modulating the air flow rate of the air/water coil, the controller keeps the water temperature stable at the outlet of the unit.

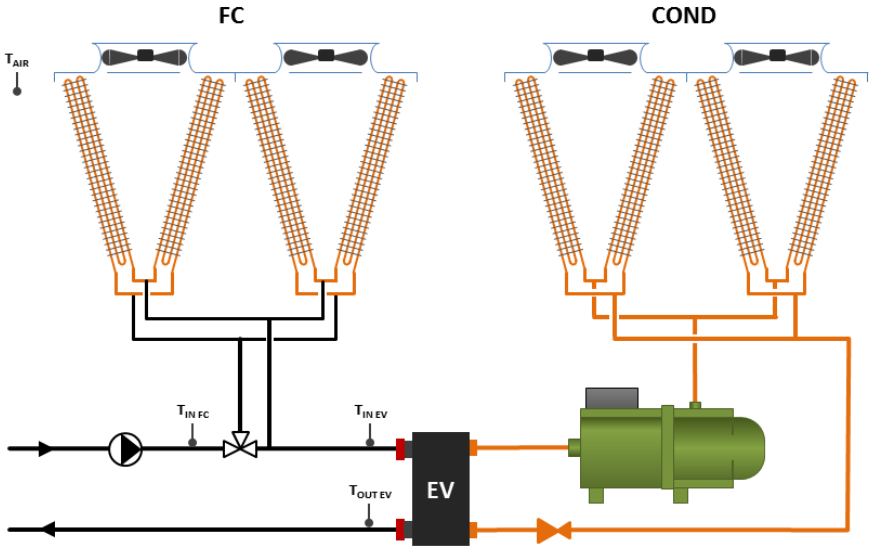


Fig. 39 Diagram in principle of the hydraulic free cooling circuit

The abbreviations of the diagram indicate:

- COND = condenser of the unit
- FC = air water coil for free cooling
- EV = evaporator of the unit
- Tair = ambient air temperature
- Tin_fc = water temperature at the inlet of the unit
- Tin_ev = water temperature at the inlet of the evaporator
- Tout_ev = water temperature at the outlet of the evaporator.

The parameters involved in the management of the function are shown in the table.

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

Parameter	Value	UM	Description
FC1	3	-	Freecooling type
FC7	5.0	°C	Temperature differential to activate freecooling from water end outdoor temp
FC8	2.0	°C	Hysteresis for switching off free cooling

The function is active if the following conditions are verified:

- unit in ON state
- the function is enabled from the keypad
- the air temperature is lower than parameter FC17
- the difference between the temperatures (Tin_un - Tair) must be higher than parameter FC7.

A graphical representation is shown below.

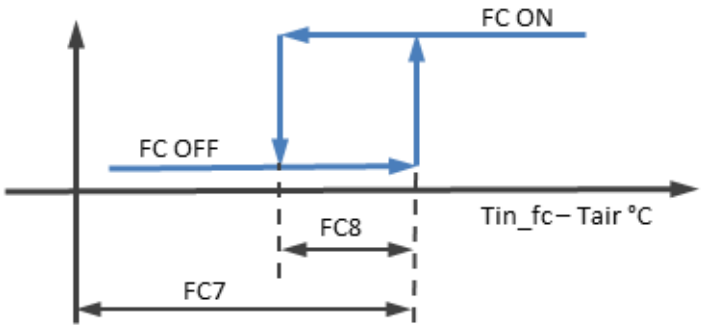


Fig. 40 Temperature conditions for enabling the free cooling function

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

- FC ON = free cooling active
- FC OFF = free cooling not active
- Tin_fc - Tair = difference in temperature between the water returning from the system and the ambient air.

2.20.2 Thermoregulation with the free cooling function

When the function is active, the controller uses the free cooling resources for water cooling before activating the compressors.

According to the settings, the controller can manage the resources with reference to the water temperature at the inlet or outlet of the unit.

In the first case, with activation of free cooling, the proportional band is divided in half; the controller activates the free cooling ventilation in the first half, and the steps of the compressors in the second half.

A graphical representation is shown below.

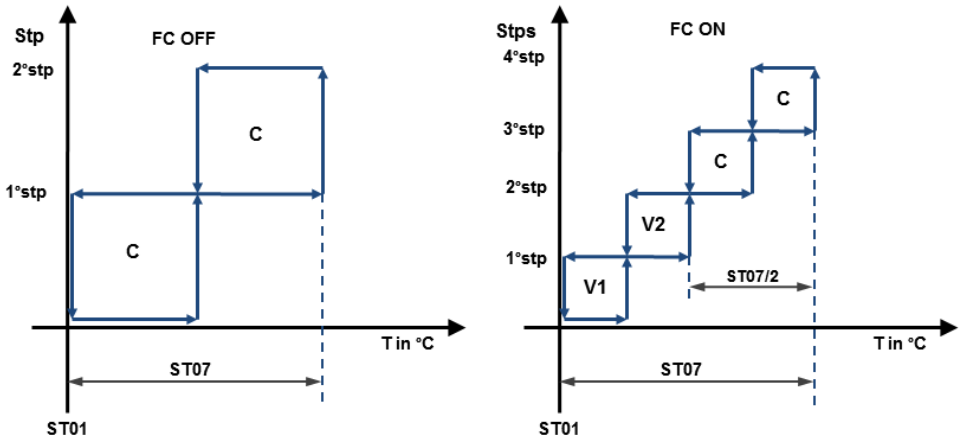


Fig. 41 Division of the proportional band with activation of free cooling

If the speed adjuster for the free cooling fans is present, the controller increases their speed up to the maximum in the first half of the proportional band before activating the compressors.

The parameters involved in the management of the function 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	7	°C	Chiller - Setpoint
ST7	5.0	°C	Chiller - Proportional control band
FC9	20	%	Minimum speed of free cooling fans
FC10	100	%	Maximum speed of free cooling fans
FC22	0.2	°C	Fan activation differential (only with proportional control)

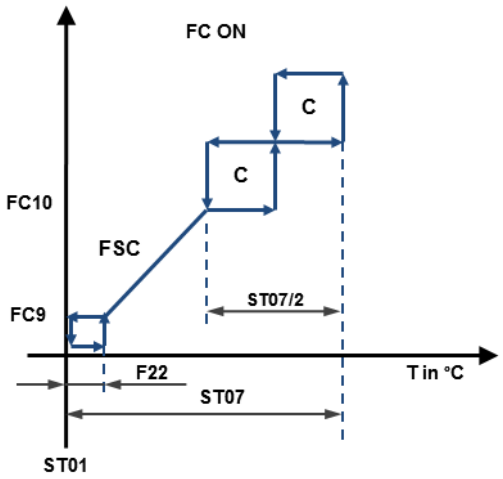


Fig. 42 Resource management with speed controller

In the case of control at outlet, when the water temperature is above the neutral zone, the controller activates the ventilation first, whereas when it is below the neutral zone, it deactivates the ventilation last.

The parameters involved in the management of the function 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	7	°C	Chiller - Setpoint
ST30	2.0	°C	With NZ or PID, Chiller - Neutral zone band
FC19	10	s	Delay activation fan steps above neutral zone (Falling Time)
FC20	10	s	Delay activation fan steps above neutral zone (Raising Time)
FC23	60	s	Compressor activation delay after reaching full free cooling capacity

A graphical representation is shown below.

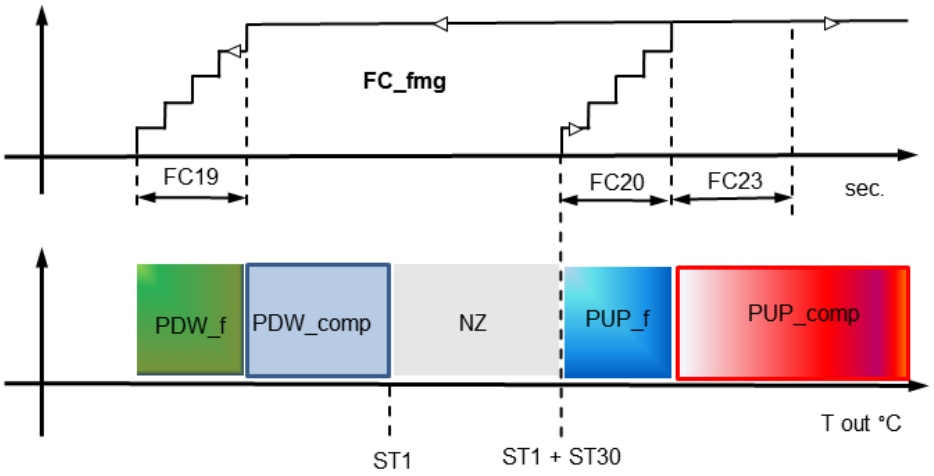


Fig. 43 Management of free cooling with control at outlet

In addition to the parameters present in the table, the abbreviations in the graphs are:

- T out = outlet water temperature
- PUP_comp = increase in capacity with activation of the compressors
- PUP_f = increase in capacity with activation of free cooling
- NZ = neutral zone
- PDW_comp = decrease in capacity with deactivation of the compressors
- PDW_f = decrease in capacity with deactivation of free cooling
- FC_fmg = times in free cooling management.

2.20.3 3-way valve management

When conditions are suitable for free cooling, the 3-way valve diverts the flow of water to make it go through the free cooling coil before the evaporator.

The 3-way valve can be an on-off or modulating valve.

To prevent the water temperature at the outlet of the unit from reaching values that are too low, the controller manages the 3-way valve and modulates its opening up to complete closing.

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	7	°C	Chiller - Setpoint
ST30	2	°C	With NZ or PID, Chiller - Neutral zone band
FC1	3	-	Freecooling type
FC2	3.0	°C	Differential close 3way valve freecooling / NG pump off
FC25	0.5	°C	FC valve activation differential

With the free cooling function active, valve management is as follows:

- it opens when the reference water temperature is higher than the set point plus the dead zone;
- during control, it is fully open when the reference temperature is higher than (ST1 - FC25);
- fully closed when the reference temperature is lower than (ST1 - FC2);
- when the reference water temperature is between (ST1 - FC2) and (ST1 - FC25), if a modulating valve is managed, its opening will be proportional to the temperature value, and if an on-off valve is managed, its status will depend on the condition it comes from.

A graphical representation is shown below.

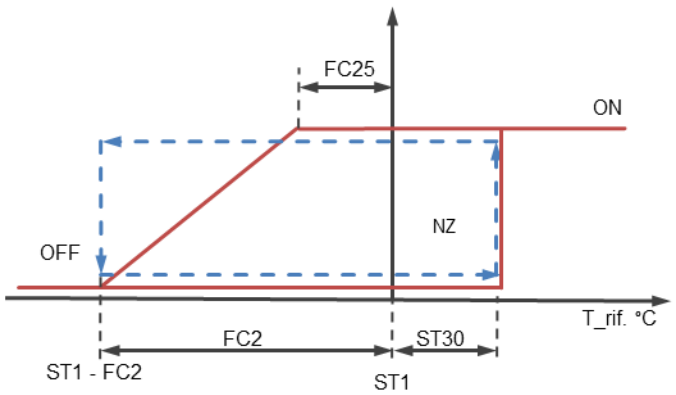


Fig. 44 3-way valve management

2.20.4 Stopping of compressors

In free cooling units, the use of compressors to meet the thermoregulation request is limited by the air temperature.

The use of the compressors to meet the thermoregulation demand is limited by the air temperature.

Generally, when the air temperature value is low, the thermoregulation request is met by the free cooling function.

During starting of the system, particular conditions can occur for which activation of the compressors may be temporarily required.

In these cases, the controller prevents their activation and leaves the free cooling function to meet the thermoregulation request.

The air temperature value below which compressor activation is prevented is set in parameter FC18.

A graphical representation is shown below.

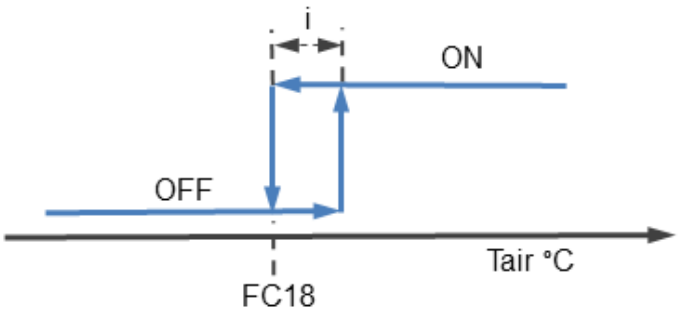


Fig. 45 Stopping of compressors

The abbreviations of the graph indicate:

- FC18 = compressor stopping temperature
- i = hysteresis (parameter set from code)
- Tair = air temperature

2.20.5 Free cooling with No Glycol

In systems where user-side water cooling is exploited through an air/water exchanger, an adequate percentage of glycol must be present to prevent freezing.

"No Glycol" free cooling allows free cooling to be exploited without having to put glycol in the water of the entire system.

Thermal exchange between the hydraulic circuit of the system of use and that of the free cooling circuit takes place by means of a water/water decoupling exchanger.

The water of the system of use flows through the decoupling circuit all the time; the 3-way valve is therefore not present as in the previous cases.

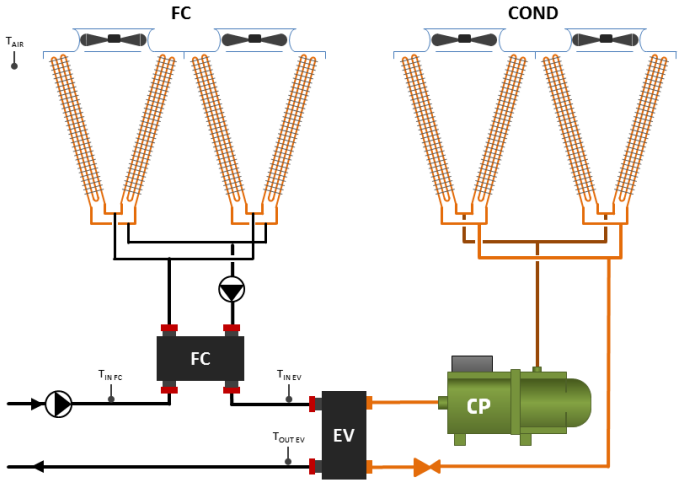


Fig. 46 Diagram of "No Glycol" free cooling unit with dampers

The abbreviations in the figure indicate:

- FC = free cooling coil with damper
- COND = condensing coil with damper
- NG = decoupling exchanger
- CP = compressor
- EV = evaporator
- Tin fc = free cooling inlet temperature
- Tair = air temperature;
- T in ev = evaporator inlet temperature
- T out ev = evaporator outlet temperature.

The parameters involved in the management of the function are shown in the table.

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

Parameter	Value	UM	Description
FC1	3	-	Freecooling type
FC2	3.0	°C	Differential close 3way valve freecooling / NG pump off
FC6	1	-	Enables no-glycol free cooling
FC7	5.0	°C	Temperature differential to activate freecooling from water end outdoor temp
FC8	2.0	°C	Hysteresis for switching off free cooling
FC9	30	%	Minimum speed of free cooling fans
FC10	100	%	Maximum speed of free cooling fans
FC11	5	s	Speed-up time of free cooling fans
FC18	-10.0	°C	Minimum outside air temperature limit for deactivation of compressors
FC19	15	s	Delay activation fan steps above neutral zone (Falling Time)
FC20	15	s	Delay activation fan steps above neutral zone (Raising Time)
FC21	5	%	Increase percentage of free cooling steps with neutral zone (0..100%)
FC22	0.1	°C	Fan activation differential (only with proportional control)
FC23	60	s	Compressor activation delay after reaching full free cooling capacity
FC25	0.1	°C	FC valve activation differential
FC26	1	-	Water/water units - FC-NG - inverter pump - Minimum speed
FC28	20	s	Water/water units - FC-NG - Drycooler - Integrative factor Ki

With parameter FC6, the “No Glycol” function is enabled.

In the free cooling hydraulic circuit, consisting of the decoupling exchanger and free cooling coil, there is the free cooling pump for water circulation.

Free cooling pump management is done with parameters FC2 and FC25, which are the same as those that manage the 3-way valve.

According to the operating status of the unit, the controller manages the components of the system.

The operating states are the following.

- Without free cooling active (the pump and free cooling fans are off)
- Mixed, free cooling and compressors (the pump and free cooling fans are in operation, the controller modulates the capacity of the compressors based on the temperature of the reference probe)
- Only free cooling (the pump and free cooling fans are in operation, the controller modulates the free cooling fans based on the temperature of the reference probe).

2.20.6 Free cooling alarms

The free cooling function alarms are shown below.

Alarm code	**AL050 free cooling pump circuit breaker alarm**
Reason for activation	With opening of the relevant digital input
Reset	Manual
Reset mode	Only after closing of the digital input
Alarm icon	Flashing
AlarmLog	Yes
Buzzer	Yes
Devices	**Behaviour in the event of an alarm**
Free cooling pump	Deactivated
Free cooling function	Deactivated
The other circuits and devices	They follow their control

Alarm code	**AL145 free cooling pump maintenance warning**
Reason for activation	This is detected when the work hours exceed parameter PA18
Reset	Manual
Reset mode	On reset of hours from the Service menu
Alarm icon	Flashing
AlarmLog	Yes
Buzzer	No
Devices	**Behaviour in the event of an alarm**
Free cooling pump	Follows the control
The other circuits and devices	They follow their control

Alarm code	**AL41 .. 44 free cooling fan overload protection alarm**
Reason for activation	With opening of the relevant digital inputs
Reset	Manual after PAL81 occurrences/hour
Reset mode	Only after closing of the inputs
Alarm icon	Flashing
AlarmLog	Yes
Buzzer	Yes
Devices	**Behaviour in the event of an alarm**
Free cooling fans	They follow the control, the fans in alarm are stopped electro-mechanically
Free cooling function	Follows the control
The other circuits and devices	They follow their control

Alarm code	**AL5 free cooling flow switch alarm**
Reason for activation	With free cooling active, digital input of the flow switch open after the relevant delays
Reset	Manual
Alarm icon	Flashing
AlarmLog	Yes
Buzzer	Yes
Devices	**Behaviour in the event of an alarm**
Free cooling function	Deactivated
The other circuits and devices	They follow their control

2.21 Defrost

Defrosting is a procedure in which frost accumulation on the condensing/evaporating coil is prevented and/or any frost that has formed is removed during operation in heat pump mode of an air/water unit.

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 involved are shown in the table.

Parameter	Min	Max	UM	Description
DF1	0	2	-	Defrost 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
DF14	0	1	-	Moving defrost - Enable under partial load
DF15	-1.00	1.00	-	DF16
DF16	-100.0	100.0	-	Moving defrost - Parameter B with partial 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
DF20	No	Yes	-	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
DF23	-10.0	10.0	s	Adaptive defrost - d parameter - Minimum value
DF24	-10.0	10.0	°C	Adaptive defrost - d parameter - Maximum value
DF25	-5.0	25.0	°C	Max. setpoint for defrost start (DF10 + DF25)
DF26	-25.0	50.0	°C	Protective defrost - Trigger threshold for external air temperature
DF27	0	24	°C	Protective defrost - Cumulative time (0 = Disabled)
DF28	0.0	65.0	hr	Adaptive defrost - End defrost setpoint - Minimum value
DF29	0.0	65.0	°C	Adaptive defrost - End defrost setpoint - Maximum value
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	300	s	Minimum defrost duration time
DF51	10	999	s	Maximum defrost time
DF52	0	100	s	Inverter - Pre defrost percentage
DF53	0	100	%	Inverter - Percentage during defrost
DF54	0	100	%	Inverter - Percentage after defrost
DF60	0	999	°C	Time end defrost (dripping time)
DF61	0	2	s	Defrost exit method
DF62	0	999	-	Capacity reduction time in compressors at end of defrost cycle (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.

2.21.1 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.

The air flow through the coils, and therefore ventilation, is the characteristic that poses the main limitation on the choice of the way in which defrost cycles take place.

The relevant parameters are shown in the table.

Parameter	Value	UM	Description
dF2	0	-	Defrost entry method
dF3	0	-	End-of-defrost exit method

The values of parameter “DF2” identify how the defrost cycle is started and they can be as follows:

- 0 = independent. When the conditions are suitable, each circuit carries out a defrost cycle on its own.
- 2 = simultaneous. When the conditions are suitable for one circuit, all the circuits present in the unit carry out a defrost cycle together.
- 3 = simultaneous in pairs (circuits 1 and 2), (circuits 3 and 4). When the conditions are suitable for one circuit, both circuits of the pair carry out a defrost cycle together.

The values of parameter dF3 that identify how the end of the defrost cycle takes place can be as follows:

- 0 = independent. When a circuit reaches the end-of-defrost condition, it ends its defrost cycle.
- 2 = simultaneous. When a circuit reaches the end-of-defrost condition, it ends the defrost cycle for all the circuits.
- 3 = simultaneous in pairs (circuits 1 and 2), (circuits 3 and 4). When a circuit reaches the end-of-defrost condition, it ends the defrost cycle for both circuits of the pair.

2.21.2 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 defrost start threshold 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 passed since the previous defrost of the same circuit;
- in case of defrost cycles in separate circuits, the time set in parameter dF19 must have passed since the defrost of 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	Fixed evaporating threshold to start defrost
dF11	120	s	Defrost start delay
dF17	10	min	Delay to defrost after the unit is switched on
dF18	30	min	Time interval between two defrost cycles of the same circuit
dF19	10	min	Time interval between two defrost cycles of different circuits

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

2.21.3 Check of conditions for the defrost cycle at sliding evaporating temperature

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

Unlike the defrost cycle at fixed evaporating temperature, the defrost cycle at sliding evaporating temperature is linked to the air temperature and to correction coefficients A and B.

The conditions for starting a defrost cycle are as follows:

- the evaporating temperature value must be lower than the sliding defrost start threshold;
- 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 passed since the previous defrost of the same circuit;
- in case of defrost cycles in separate circuits, the time set in parameter dF19 must have passed since the defrost of 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	2	-	Defrost method
dF11	120	s	Defrost start delay
dF12	0.70	-	Moving defrost - Parameter A with full load
dF13	14.0	-	Moving defrost - Parameter B with full load
dF15	0.70	-	DF16
dF16	13.0	-	Moving defrost - Parameter B with partial load
dF17	10	min	Delay to defrost after the unit is switched on
dF18	30	min	Time interval between two defrost cycles of the same circuit
dF19	10	min	Time interval between two defrost cycles of different circuits

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

2.21.4 Type of defrost

After verifying that there are conditions requiring a defrost, the controller selects the most efficient type of defrost as regards the operating conditions of the unit.

The choice of the type of defrost depends on the ambient air temperature.

If the ambient air temperature is higher than the value set in parameter dF34, the controller starts an air defrost otherwise it starts the procedure for a defrost with refrigeration cycle reversal.

2.21.5 Air defrost

The parameters involved in an air defrost are shown in the table.

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

Parameter	Value	UM	Description
dF34	15.0	°C	Outside air temperature limit for air defrost
dF51	300	s	Maximum defrost time

The air defrost takes place with the stopping of the compressors of the refrigeration circuits involved and keeping ventilation at maximum.

The air defrost cycle ends when the maximum defrost duration time has elapsed.

2.21.6 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.

The cycle reversals envisaged with the value of parameter dF30 are:

- 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.

2.21.7 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.

Parameter	Value	UM	Description
dF45	1 - Yes	-	Ventilation during defrost
dF46	43.0	°C	Defrost ventilation activation threshold
dF47	3.0	°C	Defrost ventilation deactivation differential
dF48	5.0	°C	Reverse ventilation deactivation threshold for coil temperature (DF45 = 1)
dF49	48.0	°C	End-of-defrost threshold for condensing temperature
dF50	10	s	Minimum defrost duration time
dF51	300	s	Maximum defrost 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 the gradual increase in condensing pressure;
- measurement of coil temperature to check the state of defrost;
- if reverse ventilation is enabled, maintenance of the condensing pressure value below the end-of-defrost threshold, otherwise if reverse ventilation is not enabled, the end-of-defrost threshold is reached;
- maintenance of the condensing pressure below the end-of-defrost threshold is done with activation of reverse ventilation;
- when the end-of-defrost temperature is reached on the coil, the reverse ventilation action is prevented and the condensing pressure is allowed to reach the end-of-defrost threshold;
- checking that the defrost time does not exceed the maximum duration; if this happens, the defrost stops;
- 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.

When simultaneous defrost cycles are to be carried out, reverse ventilation is stopped only when the temperature of all the coils involved has exceeded the end-of-defrost temperature threshold.

If the temperature probe is not present in the coil, reverse ventilation is not enabled.

2.21.8 Preparation and new cycle reversal

Whatever way a defrost with refrigeration cycle reversal is ended (due to reaching the end-of-defrost threshold or due to reaching the time limit), the next stage is preparation for a new reversal of the refrigeration cycle and then resumption of operation in heating 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
dF60	15	s	Time end defrost (dripping time)
dF61	1	-	Defrost exit method
dF63	0	s	Time compressors are OFF during end of defrost (if DF61=2)

When defrosting of the coil is finished, the next steps that the controller manages are the following:

- activation of ventilation to lower the condensing pressure and preparation of the envisaged defrost exit method;
- after the time set as ventilation advance has passed, the controller reverses the refrigeration cycle again, through the 4-way valve, and the circuit resumes operation in heating mode.

2.21.9 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	-	Enable manual defrost - from keypad
dF21	-20.0	°C	Evaporating temperature threshold for activating a forced defrost
dF22	10	s	Delay time for forced defrost

When parameter dF20 is enabled, a defrost can be forced 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, ignoring the set delays, when the evaporating temperature reaches the threshold set in the value of parameter dF21 and is maintained for the time set in parameter dF22.

2.21.10 Defrost alarms

If, within the defrost time limit, the condensing temperature has not reached the end-of-defrost threshold, the controller ends the defrost in progress in any case.

In the alarm pages, the controller records and displays the defrost cycles that end when the time limit is reached without stopping any compressors.

The defrost time limit alarm automatically disappears from the active alarm screens, when a defrost ends normally with reaching of the end-of-defrost temperature threshold.

The defrost alarms are shown below.

Alarm code	**AL186 .. AL191 defrost alarm**
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
Devices	**Behaviour in the event of an alarm**
The other circuits and devices	They follow their control

2.22 Anti Ice Circuit

In order to prevent ice from forming at the base of the air exchanger working as an evaporator, the last supply is used for the operation of the Anti-Ice Circuit.

The controller manages this part of the exchanger through a digital outlet that powers a solenoid valve.

The solenoid valve is powered when the air exchanger works as an evaporator and during defrosting if the temperature of the air is lower than the activation threshold, but it is always powered when the exchanger works as a condenser

When conditions are suitable for activation, the function can be activated with a pause-work cycle depending on parameters "CO34" and "CO35".

If only one of the two parameters is set to "zero", when conditions are suitable, the function is always active.

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
CO34	120	s	Force time On solenoid valve YV.V, Anti-Ice Circuit (0 = disabled)
CO35	480	s	Anti-ice circuit - Time to OFF with spillage from valve YV.V
CO68	5.0	°C	Anti-Ice Circuit – Minimum YV.V activation threshold
CO69	1.0	°C	Anti-Ice Circuit – YV.V activation differential

While the air exchanger is working as an evaporator, this function is automatically deactivated when the temperature of the air exceeds the activation threshold by the relevant differential.

2.23 Anti-freeze heaters

During operation of the units, or while they are in stand-by conditions and the ambient temperature is below zero, the water inside the exchangers can freeze.

Ice formation inside the exchangers can irreparably damage them.

To prevent ice formation inside the exchangers, the controller can manage auxiliary heaters.

The parameters involved are shown in the table.

Parameter	Min	Max	UM	Description
AR1	-50.0	110.0	°C	Users - Anti-freeze heaters activation setpoint
AR2	0.1	25.5	°C	Users - Anti-freeze heaters activation differential

2.23.1 Heater set point and differential

Activation of the output of the heaters takes place when the temperature value read by the reference probe reaches the set point value. Deactivation takes place when the activation temperature plus the differential is reached.

The relevant parameters are shown in the table.

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

Parameter	Value	UM	Description
AR1	4.0	°C	Users - Anti-freeze heaters activation setpoint
AR2	2.0	°C	Users - Anti-freeze heaters activation differential

A graphical representation is shown below.

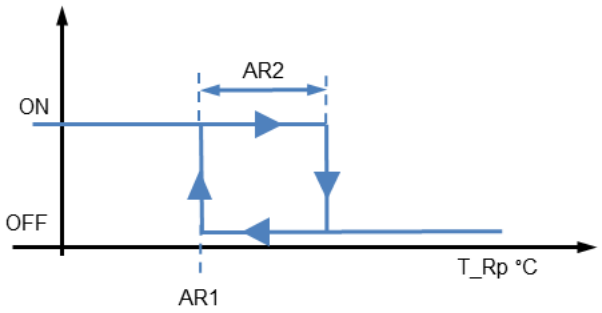


Fig. 47 Management of heater outputs

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

- ON = heater output active
- OFF = heater output not active
- T_Rp = temperature read by the reference probe.

2.23.2 Reference probe

Depending on the unit, there can be one or more reference probes for activation of the heater output.

The number of probes present is linked to the type of unit and to the number of water exchangers.

For air/water units, the cases can be the following:

- in the case of one exchanger, the reference probe is the one installed on the water outlet;
- in the case of more than one exchanger, the reference probes are those installed on the outlet of each exchanger and the one installed in the common section at the outlet of the unit.

If there is more than one reference probe for management of the antifreeze heaters, only one of them needs to read the activation temperature in order for the heaters to be activated.

2.24 Heater in condensate drip tray

This function is intended to prevent freezing of the water that forms in the condensate drip tray during the defrost cycles.

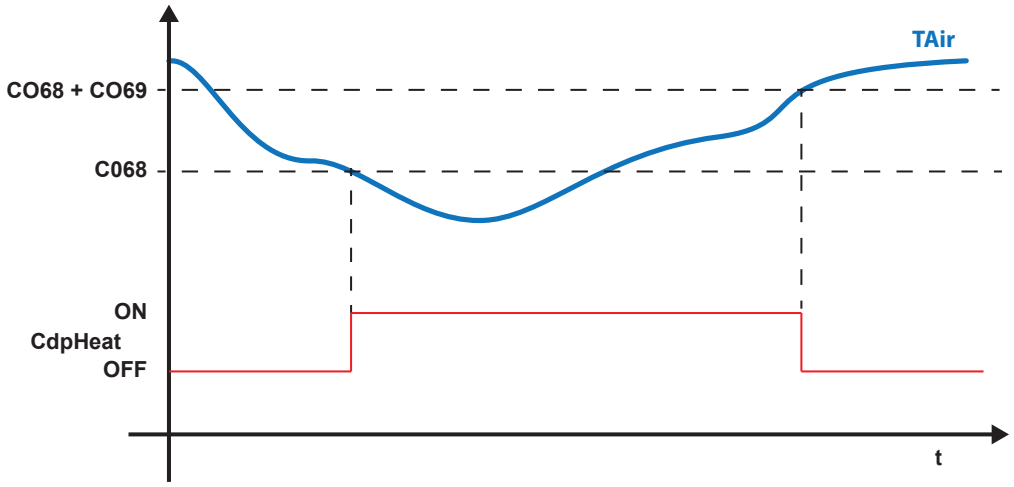
The function gets activated when the air temperature value is below the activation threshold.

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
CO68	0,0	°C	Anti-Ice Circuit – Minimum YV.V activation threshold
CO69	2,0	°C	Anti-Ice Circuit – YV.V activation differential

A graphical representation of the function is shown below.



In addition to the references present in the table, the abbreviations in the graph are:

- Tair = air temperature;
- CdpHeat = Status of output in condensate drip tray heater

If the value of the air temperature is smaller than the setpoint stored in the activation threshold (“CO68”), the controller enables the output in the condensate drip tray heater.

The function gets de-activated when the air temperature value exceeds the differential setpoint in parameter “CO69” with respect to the threshold set in parameter “CO68”.

If the necessary conditions are met, the function is active irrespective of the unit operating status.

The function is always active if the temperature probe experiences a malfunction.

2.25 Fast Restart

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.

The Fast Restart function allows a quick restart of the unit in case of a blackout.

The quick restart after a blackout depends on the thermoregulation request. The reference water temperature must be above the activation off-set.

The Fast Restart function does not in any case damage the integrity 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.

Parameter	Min	Max	UM	Description
CO3	0	999	10 s	Minimum time between 2 activations of the same compressor
CO4	1	999	s	Minimum time between activation of 2 compressors
CO12	0	999	s	Screw - Valve activation time 25%
CO17	0	999	s	Screw - Minimum compressor time at 50%
CO20	0	1000	s	Inverter - Start-up time
CO21	0	10000	0,01%	Inverter - Value of single inverter step
CO31	0	3600	s	Fast Restart - 25% valve activation time after a restart following a power failure
CO36	1	1000	0,1%	Inverter - Decrase/incrase power step Termoregolation
CO54	0	999	s	Fast Restart - Minimum OFF time (override CO2)
CO55	0	9999	10 s	Fast restart - Minimum time between 2 activations of one single compressor (override CO3)
CO56	0	9999	s	Fast Restart - Delay between activation of 2 compressors (override CO4)
CO58	0	9999	s	Fast Restart - 25% valve activation time after compressor activation (override CO12)
CO59	0	9999	s	Fast Restart - Compressor time at 50% activation (override CO17)
CO88	0	60	s	Fast Restart - With ZN or PID - Minimum activation time (override ST23/ ST27)
CO89	0	1000	s	Fast Restart - Inverter - Start-up time (override CO20)
CO90	0	10000	0,01%	Fast Restart - Inverter - Value of single inverter step (override CO21)
CO91	0	0	6386	steps
PAL33	0	999	-	Fast restart - Low/High voltage - Maximum number of alarms in one hour
PAL66	0	999	-	Maximum number of AL192 activations in 24h with 'Fast restart' enabled
SL10	0	999	min	Delay in long UP pulse activation during starting (0 = disabled)

2.25.1 Fast Restart with UPS

Activation of the Fast Restart function with the presence of an UPS, which keeps the controller electrically powered, allows maximum reduction of the delay in restarting the compressors of the unit.

This is possible because the controller starts the count of the minimum OFF time when the switch-off occurs due to blackout.

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

When the digital input is closed, and therefore the alarm is over, before starting the compressor, the controller activates the capacity valve at 25% for as long as the time set in parameter CO31.

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	300	s	Minimum OFF time
CO3	90	10 s	Minimum time between 2 activations of the same compressor
CO28	2	-	Fast Restart - Enabling of UPS / Fast Restart
CO31	60	s	Fast Restart - 25% valve activation time after a restart following a power failure
CO54	90	s	Fast Restart - Minimum OFF time (override CO2)
CO55	9	10 s	Fast restart - Minimum time between 2 activations of one single compressor (override CO3)
CO56	90	s	Fast Restart - Delay between activation of 2 compressors (override CO4)
CO58	20	s	Fast Restart - 25% valve activation time after compressor activation (override CO12)
CO59	20	s	Fast Restart - Compressor time at 50% activation (override CO17)

2.25.2 Fast Restart without UPS

Activation of the Fast Restart function without the presence of an UPS allows a quicker restart of the compressors anyway in case of blackout.

When the black out is over, before starting the compressor, the controller activates the capacity valve at 25% for as long as the time set in parameter CO31.

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	300	s	Minimum OFF time
CO3	90	10 s	Minimum time between 2 activations of the same compressor
CO28	3	-	Fast Restart - Enabling of UPS / Fast Restart
CO31	60	s	Fast Restart - 25% valve activation time after a restart following a power failure
CO54	90	s	Fast Restart - Minimum OFF time (override CO2)
CO55	9	10 s	Fast restart - Minimum time between 2 activations of one single compressor (override CO3)
CO56	90	s	Fast Restart - Delay between activation of 2 compressors (override CO4)
CO58	20	s	Fast Restart - 25% valve activation time after compressor activation (override CO12)
CO59	20	s	Fast Restart - Compressor time at 50% activation (override CO17)

2.25.3 Thermoregulation with Fast Restart

With the Fast Restart function enabled, the controller uses some dedicated parameters to respond quickly to a blackout if a thermoregulation demand is present and the reference water temperature is outside the “activation offset”.

The Fast Restart thermoregulation parameters replace the parameters used in normal operating conditions.

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
CO88	1	s	Fast Restart - With ZN or PID - Minimum activation time (override ST23/ST27)
CO89	5	s	Fast Restart - Inverter - Start-up time (override CO20)
CO90	250	0,01%	Fast Restart - Inverter - Value of single inverter step (override CO21)
CO91	2312	steps	Fast Restart - Chiller - Valve pre-positioning before compressor starting (override ET24)

The Fast Restart thermoregulation parameters stop being a replacement of standard operating parameters as soon as the reference water temperature goes back to “activation offset” range.

2.25.4 Fast Restart alarms

Some alarms and warnings are linked to this function:

- The alarms are linked to power supply problems of the unit. This is the case where there is an UPS that keeps the controller powered. When normal conditions are restored, the alarm resets automatically for a limited number of times in one hour and over the span of a day.
- Another is the warning that the maximum number of Fast Restarts without UPS has been reached. The warning automatically resets at the next midnight.

The Fast Restart function is stopped when the manual reset condition of the power supply alarm is reached and when the maximum number of Fast Restarts for the day is reached.

With the stopping of the Fast Restart function, at the next power supply or black out alarms, the unit will start with normal times.

The alarms are shown below.

Alarm for power supply with UPS in 24 hours

Alarm code	**AL192**
Reason for activation	With digital input open
Reset	With digital input closed
Reset mode	Automatic with number of occurrences per hour smaller than or equal to PAL66
	Manual with number of occurrences per hour greater than PAL66
Alarm icon	Flashing
AlarmLog	YES
Devices	**Behaviour in the event of an alarm**
All devices	OFF

Alarm for power supply with UPS in an hour

Alarm code	**AL201**
Reason for activation	With digital input open
Reset	With digital input closed
Reset mode	Automatic with number of occurrences per hour smaller than or equal to PAL33
	Manual with number of occurrences per hour greater than PAL33
Alarm icon	Flashing
AlarmLog	YES
Devices	**Behaviour in the event of an alarm**
All devices	OFF

The limit for Fast Restart without UPS in 24 hours has been reached

Alarm code	**AL239**
Reason for activation	The number of Fast Restarts with automatic reset has been exceeded
Reset	After the next midnight
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	YES
Devices	**Behaviour in the event of an alarm**
All devices	In case of blackout, the unit restarts without the Fast Restart function

2.26 Auxiliary heating

This function allows management of a heating device to supplement operation in heat pump mode or as an alternative to it.

The controller can manage up to 4 digital outputs to obtain 4 steps and a 0/10 V analogue output.

Activation of this function is possible only for units that can operate in heat pump mode.

According to the settings, the ways the function is managed are:

- auxiliary heating with the same set point as operation in heat pump mode;
- auxiliary heating with set point linked to operation in heat pump mode;
- auxiliary heating with set point independent of operation in heat pump mode;

With these ways of management, there are the conditions for activation of heating and deactivation of compressor operation, linked to the outside air temperature and delays.

Also, with parameter AH15, activation of auxiliary heating can be forced during a defrost.

The parameters that manage the function are shown in the table.

Parameter	Min	Max	UM	Description
AH2	-50.0	110.0	°C	Outside air setpoint for activation
AH3	0.1	25.5	°C	Outside air differential for de-activation
AH4	0	999	min	Auxiliary heating activation delay
AH5	-50.0	110.0	°C	Integration - Outside air setpoint required to disable compressors
AH6	0.1	25.5	°C	Integration - Outside air differential required to enable compressors
AH7	0	999	min	Integration - Delay in compressor switch-off
AH8	0	2	-	Type of temperature control
AH9	-50.0	110.0	°C	Heating ON/OFF - Main probe setpoint on hot side
AH10	0.1	25.5	°C	Heating ON/OFF - Proportional band
AH11	-50.0	110.0	°C	Heating 0-10V - Main probe setpoint on hot side
AH12	0.1	25.5	°C	Heating 0-10V - Proportional band
AH13	0	0	%	Heating 0-10V - Minimum value
AH14	0	100	%	Heating 0-10V - Maximum value
AH15	0	1	-	Heating 0-10V - Enable minimum opening if temperature exceeds setpoint
AH16	0	1	-	Enables auxiliary heating during defrost

2.26.1 Conditions as the air temperature changes

The air temperature intervenes in the activation of auxiliary heating and in the deactivation of the compressors in heat pump operating mode.

For activation of auxiliary heating, the air temperature must be lower than parameter AH2 for time AH4.

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
AH2	5.0	°C	Outside air setpoint for activation
AH3	1.0	°C	Outside air differential for de-activation
AH4	5	min	Auxiliary heating activation delay

As regards air temperature, with the setting of parameter AH5, it is possible to decide on deactivation of the operation of the compressors after delay AH7.

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
AH5	0.0	°C	Integration - Outside air setpoint required to disable compressors
AH6	1.0	°C	Integration - Outside air differential required to enable compressors
AH7	5	min	Integration - Delay in compressor switch-off

A graphical representation is shown below.

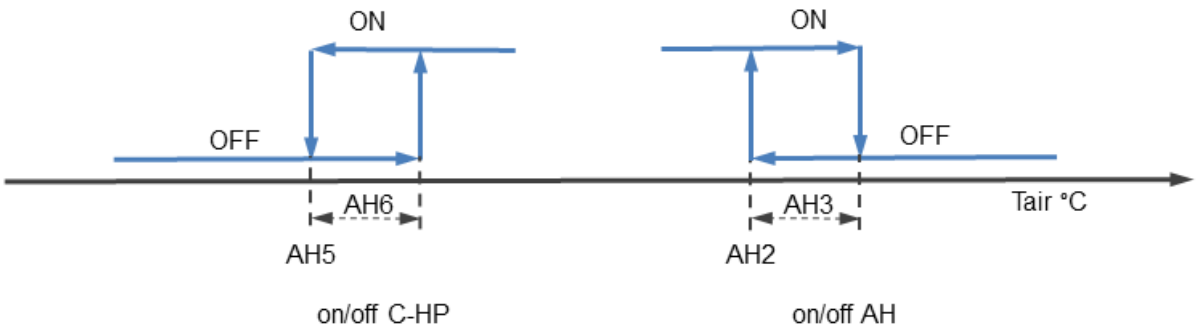


Fig. 48 Air conditions for management of auxiliary heating and compressors

In addition to the references present in the table, the abbreviations in the graph are:

- Tair = air temperature;
- on/off C-HP = air temperature condition for deactivation of the compressors in heat pump operating mode;
- on/off AH = air temperature condition for activation of auxiliary heating.

In the case of alarms regarding the probes involved in control, the outputs relevant to the function will always be deactivated.

2.26.2 Auxiliary heating with the same set point as operation in heat pump mode

This control function is used to activate auxiliary heating, through both the digital outputs and the analogue output, with the same operating set point and differential in heat pump mode of the compressors; auxiliary heating will be substitutive to operation in heat pump mode of the unit.

With activation of the first step of auxiliary heating, the switching off of the compressors will be forced.

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
AH8	0	-	Type of temperature control
AH9	ST4	°C	Heating ON/OFF - Main probe setpoint on hot side
AH10	ST8 or ST10	°C	Heating ON/OFF - Proportional band
AH11	ST4	°C	Heating 0-10V - Main probe setpoint on hot side
AH12	ST8 or ST10	°C	Heating 0-10V - Proportional band
AH13	0	%	Heating 0-10V - Minimum value
AH14	100	%	Heating 0-10V - Maximum value

A graphical representation is shown below.

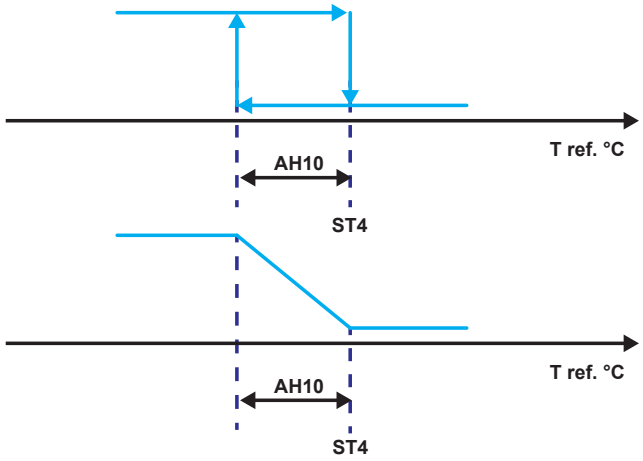


Fig. 49 Digital and analogue output of auxiliary heating with the same set point as operation in heat pump mode

In addition to the references present in the table, T ref = reference water temperature.

2.26.3 Auxiliary heating with set point linked to operation in heat pump mode

This control function is used to activate auxiliary heating with off-sets from the set point of the compressors in operation in heat pump mode; in this way, changing the set point of the compressors automatically changes the activation of auxiliary heating.

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
AH8	2	-	Type of temperature control
AH9	4.0	°C	Heating ON/OFF - Main probe setpoint on hot side
AH10	2.0	°C	Heating ON/OFF - Proportional band
AH11	5.0	°C	Heating 0-10V - Main probe setpoint on hot side
AH12	2.0	°C	Heating 0-10V - Proportional band
AH13	0	%	Heating 0-10V - Minimum value
AH14	100	%	Heating 0-10V - Maximum value

A graphical representation is shown below.

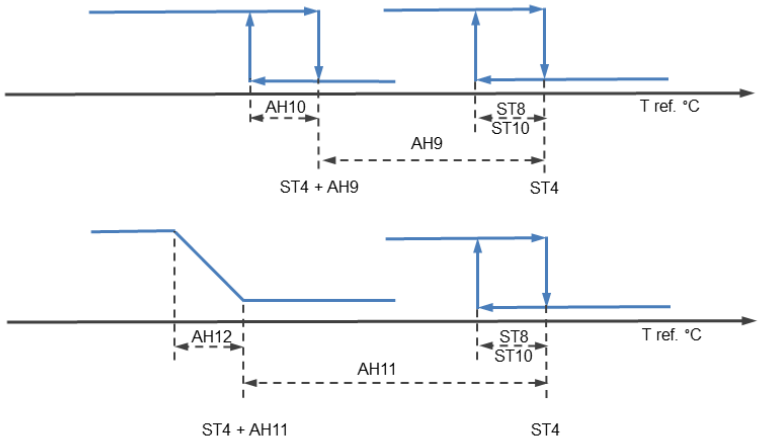


Fig. 50 Digital and analogue output of auxiliary heating with off-set

In addition to the references present in the table, T ref = reference water temperature.

2.26.4 Auxiliary heating with independent set point

This control function is used to activate auxiliary heating with its own set points and differentials; in this way, its management is not linked to the set point of the compressors in operation in heat pump 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
AH8	1	-	Type of temperature control
AH9	37.0	°C	Heating ON/OFF - Main probe setpoint on hot side
AH10	2.0	°C	Heating ON/OFF - Proportional band
AH11	36.0	°C	Heating 0-10V - Main probe setpoint on hot side
AH12	2.0	°C	Heating 0-10V - Proportional band
AH13	0	%	Heating 0-10V - Minimum value
AH14	100	%	Heating 0-10V - Maximum value

A graphical representation is shown below.

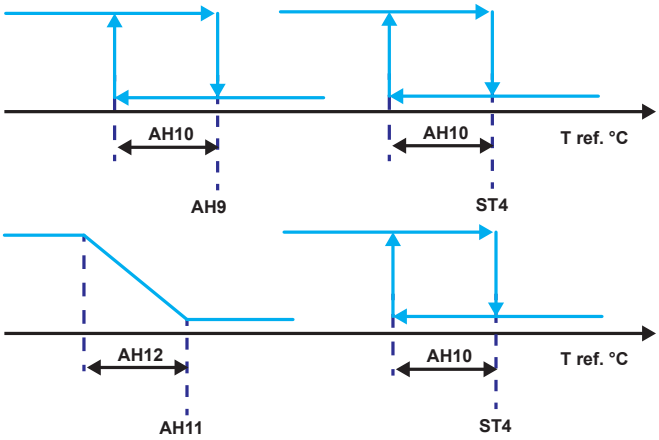


Fig. 51 Digital and analogue output of auxiliary heating with independent set point

In addition to the references present in the table, T ref = reference water temperature.

2.27 Flowzer

The “Flowzer” function is designed to define the speed setpoints for the pump fitted in the unit that help meet the demand received from different system types.

Specific logics have been developed according to which the controller manages the hydraulic systems connected to the unit.

The management logics are intended to increase system efficiency and save energy for water circulation at the same time.

With the help of these logics, the circulating water fulfils the demands of the system, without exceeding the design flow rate limits and without jeopardising correct operation of the cooling unit.

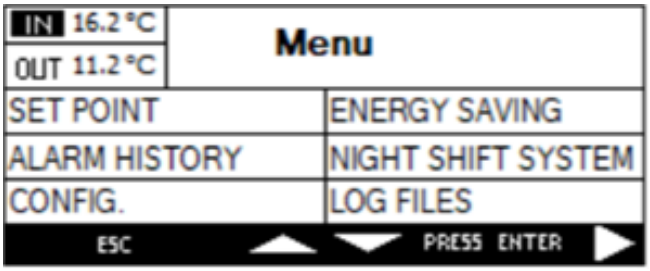
Each management logic refers to a specific system type and it requires some arrangements both at the time of installation and at start-up.

The parameters involved with this function are shown below.

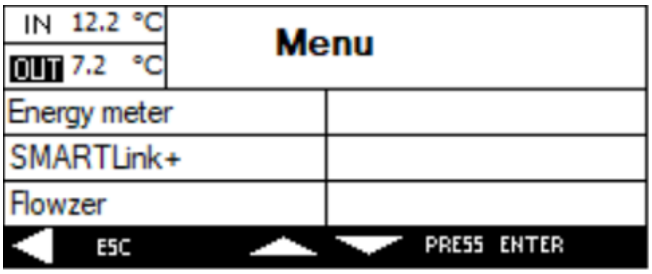
Parameter	Min	Max	UM	Description
FMG1	0.0	100.0	%	Common - Min. pump speed
FMG2	0.0	100.0	%	Common - Max. pump speed
FMG4	0.0	100.0	%	Common - Pump speed at start-up
FMG5	10	999	s	Common - Pump start-up time
FMG6	0.0	15.0	°C	DT/VPS - Setpoint
FMG7	0.0	15.0	°C	DT/VPS - Neutral zone
FMG9	0.0	100.0	%	Common - Setup parameter - Pump speed increase %
FMG10	1	999	s	Common - Setup parameter - Time between pump speed increases
FMG11	0.0	100.0	%	Common - Setup parameter - Pump speed decrease %
FMG12	1	999	s	Common - Setup parameter - Time between pump speed decreases
FMG13	0.0	100.0	%	Common - Emergency - LΔp / HΔp - % increase/decrease
FMG14	0	999	s	Common - Emergency - LΔp / HΔp - Time between increase/decrease
FMG15	6.0	100.0	°C	VPS - Setup parameter - Setpoint of second pump speed increase threshold
FMG16	1	999	s	VPS - Setup parameter - Second threshold - Increase time
FMG18	0	10000	-	PID - Coefficient - Kp
FMG19	0	10000	-	PID - Coefficient - Ki
FMG20	0	10000	-	PID - Coefficient - Kd
FMG42	0	1	-	Common - Pump in manual mode
FMG43	0.0	999.0	kPa	VD/VDE/VFPP - Cooling - System - Pressure difference threshold
FMG44	0.0	999.0	kPa	VD/VDE/VFPP - Cooling - System - Differential
FMG45	0.0	999.0	kPa	VD/VDE/VFPP - Heating - System - Pressure difference threshold
FMG46	0.0	999.0	kPa	VD/VDE/VFPP - Heating - System - Differential
FMG47	10	9999	l	VFPP - Cooling - Volume in litres
FMG48	10	9999	l	VFPP - Heating - Volume in litres
FMG52	0	1	-	VFPP - Through time
FMG53	1	999	s	VFPP - Through time in manual mode
FMG54	50.0	100.0	%	Common - Pump - Speed in manual mode
FMG55	0.0	100.0	%	VFPP/DT - Valve - Min. opening
FMG56	0.0	100.0	%	VFPP/DT - Valve - Max. opening
FMG57	0.0	100.0	%	VFPP/DT - Valve - Open in manual mode
FMG58	0	100	%	VFPP/DT - Valve - Min. opening with temp. diff. in heat exchanger smaller than min. value
FMG59	0.0	100.0	%	VFPP/DT - Valve - Setup parameter - % increase
FMG60	1	999	s	VFPP/DT - Valve - Setup parameter - Time between increases
FMG61	0.0	100.0	%	VFPP/DT - Valve - Setup parameter - % decrease
FMG62	1	999	s	VFPP/DT - Valve - Setup parameter - Time between decreases
FMG63	0	1	-	VFPP/DT - Valve - Open in manual mode
FMG64	0.0	100.0	%	VP - Cooling - Inverter pump %
FMG65	0.0	100.0	%	VP - Free Cooling - Inverter pump %
FMG66	0.0	100.0	%	VP - Heating - Inverter pump %
PA22	0	999	kPa	User - Flowzer - Low pressure difference setpoint in heat exchanger
PA55	0	999	kPa	User - Flowzer - Pressure difference high in heat exchanger

Provision has been made for screens in units featuring this function which show the operating status. The function screens give access to the main setup parameters, which are also accessible from the overall list in the “Service” branch.

The button on the right-hand side in the “Menu” screen gives access to the screen where the “Flowzer” function is featured. Sub-menus may also be present depending on the functions set in the controller.



The arrow buttons are tapped to select the “Flowzer” function, after which the “ENTER” button must be pressed to confirm the selection.



Below are some screens associated to one of the “Flowzer” functions: they show the operating status with the main parameters.

The screens and the parameters vary according to the enabled function.

The top central part of all function screens shows the operating status.When the status is “OFF”, the pump is switched off.

If the symbol “**ML**” appears on the top central part of the screen(s), the unit is a “Master” unit in a “Multilogic” or “Multifree” installation.

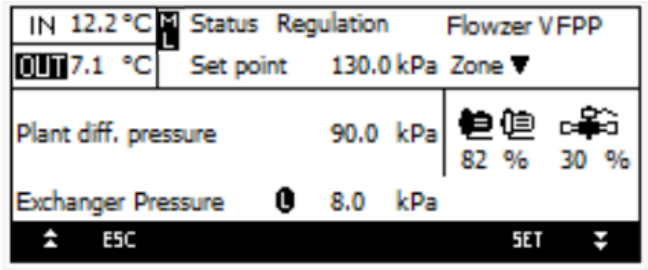


Fig. 52 Screen showing “VFPP” function loop

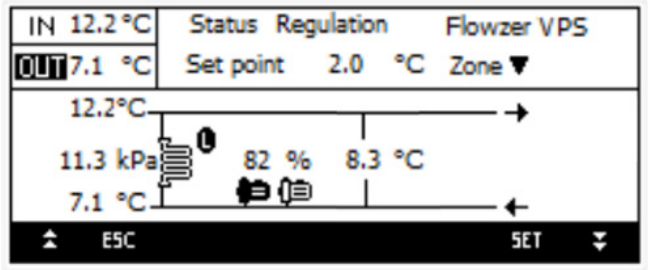


Fig. 53 Screen showing “VPS” function loop

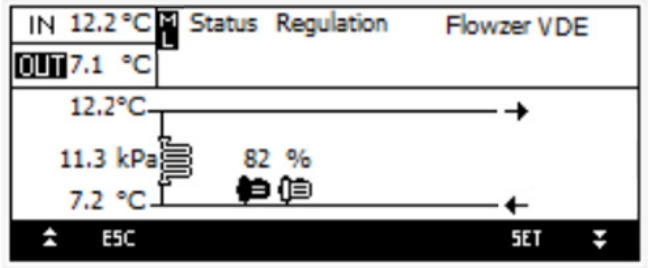


Fig. 54 Screen showing “VDE” function loop

The various setup parameters are illustrated in the next sections.

2.27.1 General

All functions have some parameters in common which are used to control the pump fitted in the unit.

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

Parameter	Value	UM	Description
FMG1	50.0	%	Common - Min. pump speed
FMG2	100.0	%	Common - Max. pump speed
FMG4	75.0	%	Common - Pump speed at start-up
FMG5	45	s	Common - Pump start-up time
FMG42	0	-	Common - Pump in manual mode
FMG54	72.0	%	Common - Pump - Speed in manual mode

As regards all Flowzer-related functions, the pump in the unit always gets started at the percentage setpoint stored in parameter “FMG4” in order to detect the operating values and determine what the system needs. The start-up speed is maintained for as long as the time set in parameter “FMG5”.

After the start-up time has elapsed, the controller manages the pump speed according to the enabled function.

Irrespective of the enabled function, the pump can be overridden to manual operation at any time by setting the value in parameter “FMG42” to “1” (“0” = automatic operation).

When operation is overridden to manual mode, the pump runs at the speed percentage set in parameter “FMG54”.

Some of the many featured functions require the installation of pressure probes in both the delivery and return lines to/from the system, a differential pressure probe on the heat exchanger side fitted in the unit and a temperature probe on the bypass pipe.

If one of the above-mentioned probes is alarmed, which causes the setup references to be lost, the controller overrides the pump to manual mode at the speed setpoint stored in parameter “FMG54”.

If a bypass valve is fitted, this one too is overridden to the opening required in manual mode, as set in parameter “FMG57”.

For operational continuity, it is important that the values set in parameters “FMG54” and “FMG57” are consistent so that the system is also operational when one of the probes used by the “Flowzer” function is alarmed.

2.27.2 “VP” function

The “VP” function requires that the pump operates at constant speed, which is made possible by the inverter fitted to control it.

The pump speed must be set up to achieve the system rated flow.

This function is useful when the flow rate of the pump aboard the unit is higher than the rated flow. The result of flow rate reduction is energy consumption saving.

The reduction of the pump speed is set as a percentage value of the nominal speed.

The parameters involved are shown below.

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

Parameter	Value	UM	Description
FMG64	75.0	%	VP - Cooling - Inverter pump %
FMG65	85.0	%	VP - Free Cooling - Inverter pump %
FMG66	72.0	%	VP - Heating - Inverter pump %

The controller is designed to set different speeds according to the type of unit and the active function.

The speed values can be viewed and edited in the screens of the Flowzer menu, as well as in the parameters listed in the table.

2.27.3 “DT” function

The “DT” function is designed to change the pump speed in order to have a constant temperature difference between the unit inlet and outlet.

The resulting effect is that the temperature of water supplied to the system is constant. When the load is reduced, the water flow rate is reduced accordingly, which results in consumption saving.

The controller keeps the flow rate through the unit within a range of safety values in order to preserve it in good operating condition.

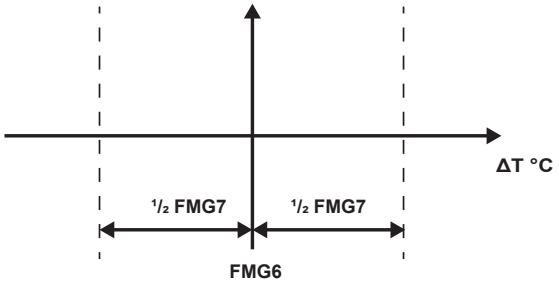
This function may be applied to different types of system, their main difference consisting in a bypass valve or a pump being fitted in the secondary circuit. The parameters in the controller depend in any case on the factory-enabled functions.

The parameters involved are shown below.

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

Parameter	Value	UM	Description
FMG6	6.0	°C	DT/VPS - Setpoint
FMG7	0.5	°C	DT/VPS - Neutral zone
FMG13	5.0	%	Common - Emergency - LΔp / HΔp - % increase/decrease
FMG14	10	s	Common - Emergency - LΔp / HΔp - Time between increase/decrease
FMG18	300	-	PID - Coefficient - Kp
FMG19	150	-	PID - Coefficient - Ki
FMG20	5	-	PID - Coefficient - Kd
FMG55	0.0	%	VFPP/DT - Valve - Min. opening
FMG56	100.0	%	VFPP/DT - Valve - Max. opening
FMG57	30.0	%	VFPP/DT - Valve - Open in manual mode
FMG58	50	%	VFPP/DT - Valve - Min. opening with temp. diff. in heat exchanger smaller than min. value
FMG59	1.0	%	VFPP/DT - Valve - Setup parameter - % increase
FMG60	35	s	VFPP/DT - Valve - Setup parameter - Time between increases
FMG61	2.0	%	VFPP/DT - Valve - Setup parameter - % decrease
FMG62	10	s	VFPP/DT - Valve - Setup parameter - Time between decreases
FMG63	0	-	VFPP/DT - Valve - Open in manual mode
PA22	8	kPa	User - Flowzer - Low pressure difference setpoint in heat exchanger
PA55	70	kPa	User - Flowzer - Pressure difference high in heat exchanger

Below is a graphical representation of the parameters set based on the setpoint difference.



The controller adjusts the pump speed to keep constant the temperature difference, which is the setpoint value in parameter “FMG6”.

The setpoint is associated to a neutral zone that is set in parameter “FMG7”.

Outside the neutral zone the controller modulates the pump speed according to the setpoints stored in the PID parameters.

If the function is not designed to manage other features than temperature difference control on the heat exchanger side fitted in the unit, the hydraulic diagram of the installation is approximately as follows.

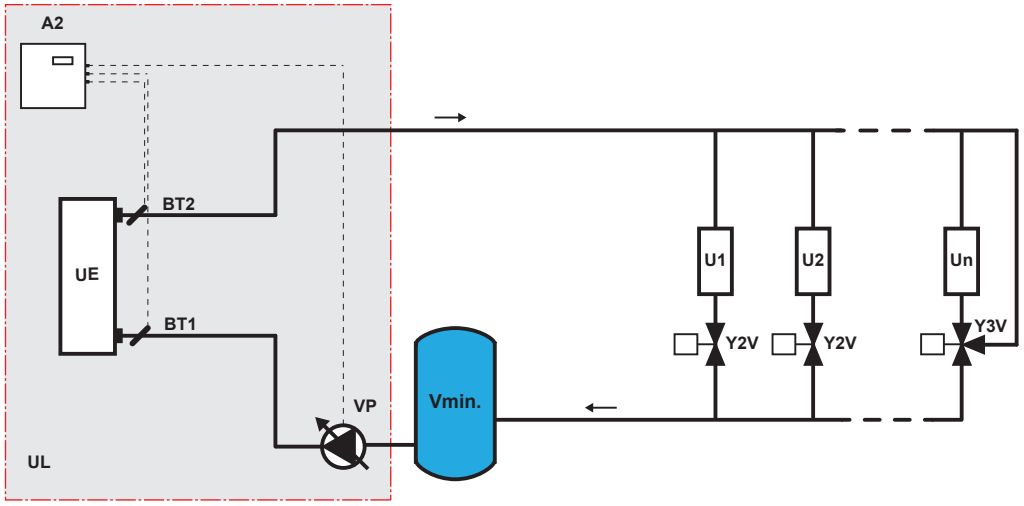


Fig. 55 Pump in unit used for water circulation in the system

If the function is designed for flow rate control on the heat exchanger side fitted in the unit, the hydraulic diagram of the installation is approximately as follows.

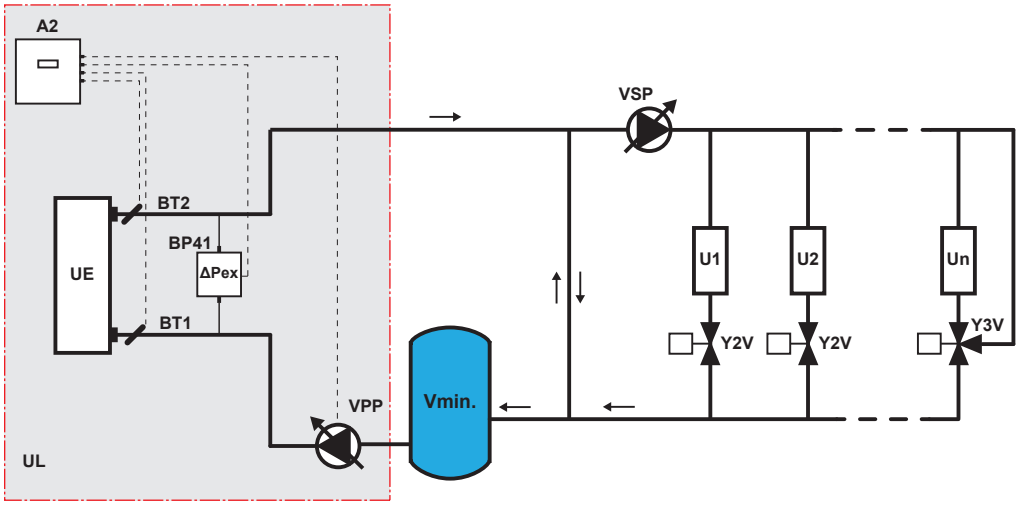


Fig. 56 System featuring one pump in primary circuit and one in secondary circuit

In this case, irrespective of the temperature difference value measured on the heat exchanger side, the controller provides for the pump speed required to keep the pressure difference between the values set in parameters “PA22” and “PA55”.

If the pressure difference on the heat exchanger side is outside the range of values set in parameters “PA22” and “PA55”, the controller changes the pump speed as needed using the setpoints in parameters “FMG13” and “FMG14”.

If the function requires management of a bypass valve to control the pressure difference on the heat exchanger side, the hydraulic diagram of the installation is approximately as follows.

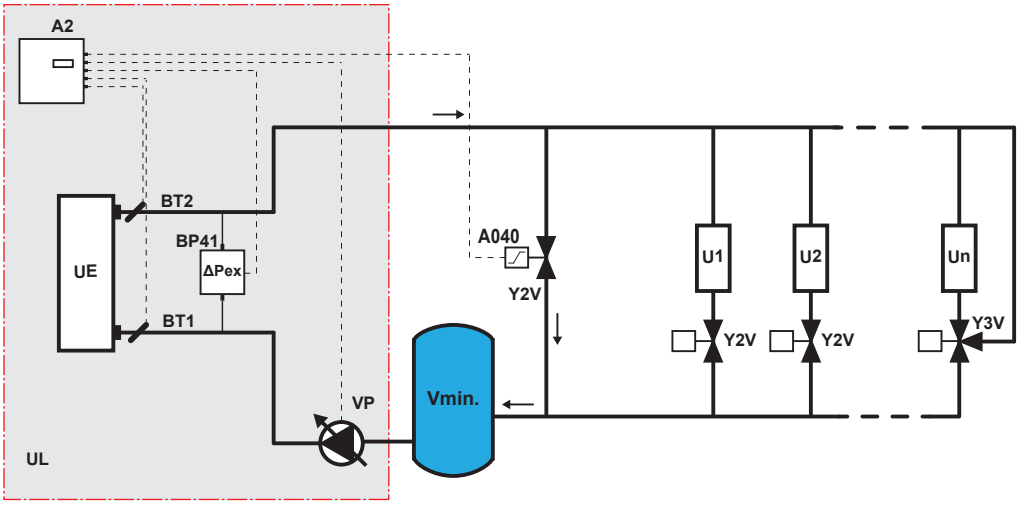


Fig. 57 Pump in unit used for water circulation in the system with bypass valve

If the pressure difference on the heat exchanger side is lower than the value in parameter “PA22”, the controller opens the bypass valve at the percentage setpoint (pre-positioning) stored in parameter “FMG58”.

When in start position or during setup operations, the controller uses the setpoints in parameters “FMG59” and “FMG60” if it senses the need to open the bypass valve.

If the pressure difference on the heat exchanger side is higher than the setpoint in parameter “PA55”, the controller uses the values set in parameters “FMG61” and “FMG62” to reduce it.

The bypass valve may be overridden to open at any time by setting the value of parameter “FMG63” to “1” in order to enable manual mode (“0” = automatic mode).

When operation is overridden to manual mode, the valve opens at the percentage set in parameter “FMG57”.

Irrespective of the setpoint, the controller manages opening of the bypass valve between the min. value set in parameter “FMG55” and the max. value set in parameter “FMG56”.

2.27.4 “VDE” function

The “VDE” function is designed to set the pump speed in order to have a constant pressure difference between the unit inlet and outlet.

The speed of the pump is set automatically to preserve the desired flow through the heat exchanger in the unit.

This function is useful when the head of the pump aboard the unit is greater than the system requires, which would result in a higher water flow circulating.

The value corresponding to the difference between the input and the output pressure needs to be monitored to ensure the correct water flow.

In heat pump units the controller is designed to offer the opportunity to set two pressure difference values: one for cooling and one for heating.

The parameters involved are shown below.

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

Parameter	Value	UM	Description
FMG43	130.0	kPa	VD/VDE/VFPP - Cooling - System - Pressure difference threshold
FMG44	2.0	kPa	VD/VDE/VFPP - Cooling - System - Differential
FMG45	130.0	kPa	VD/VDE/VFPP - Heating - System - Pressure difference threshold
FMG46	2.0	kPa	VD/VDE/VFPP - Heating - System - Differential

The controller adjusts the pump speed so as to keep constant the pressure difference, which is the setpoint value in parameter “FMG43”, for operation in cooling mode.

The value is adjusted taking as reference the differential set in parameter “FMG44”.

If the unit is a heat pump unit, the controller adjusts the pump speed in heating mode so as to keep constant the pressure difference, which is the setpoint value in parameter “FMG45”.

In heating mode the value is adjusted taking as reference the differential set in parameter “FMG46”.

Differentials work underneath and above the setpoint. The PID parameters are used to keep the setpoint.

The hydraulic diagram below shows a system featuring this function.

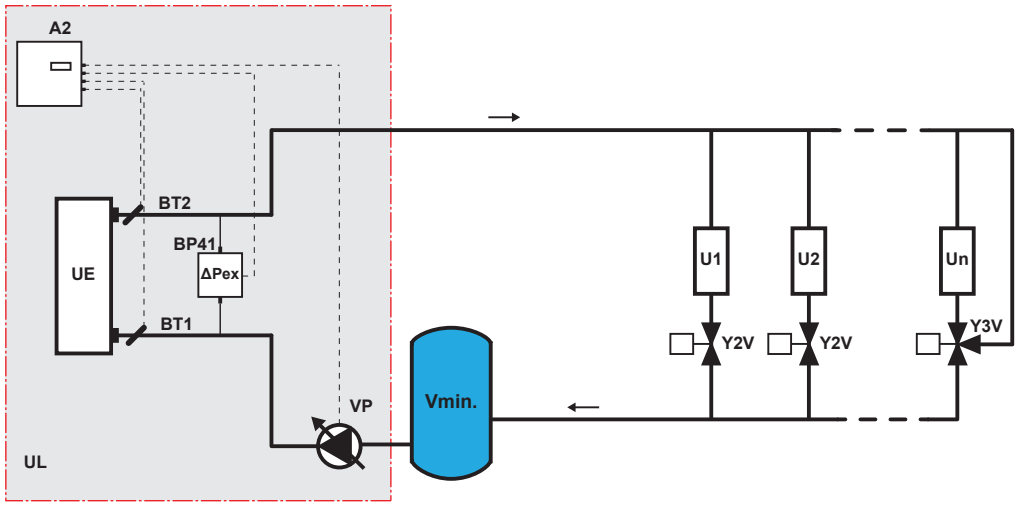


Fig. 58 System diagram with constant pressure control in unit

2.27.5 “VD” function

The “VD” function is designed to set the pump speed in order to have a constant pressure difference between the delivery and the return lines in the system.

If the pressure difference at the ends of the system is kept constant, the pump speed is set automatically in order to have the desired flow as the load changes.

A reduction in the load demand results in an increase in the pressure difference that the controller offsets by reducing the pump speed, which has an impact in terms of energy consumption saving.

In heat pump units the controller is designed to offer the opportunity to set two pressure difference values: one for cooling and one for heating.

The parameters involved are shown below.

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

Parameter	Value	UM	Description
FMG18	300	-	PID - Coefficient - Kp
FMG19	150	-	PID - Coefficient - Ki
FMG20	5	-	PID - Coefficient - Kd
FMG43	130.0	kPa	VD/VDE/VFPP - Cooling - System - Pressure difference threshold
FMG44	2.0	kPa	VD/VDE/VFPP - Cooling - System - Differential
FMG45	130.0	kPa	VD/VDE/VFPP - Heating - System - Pressure difference threshold
FMG46	2.0	kPa	VD/VDE/VFPP - Heating - System - Differential

The controller adjusts the pump speed so as to keep constant the pressure difference, which is the setpoint value in parameter “FMG43”, for operation in cooling mode.

The value is adjusted taking as reference the differential set in parameter “FMG44”.

If the unit is a heat pump unit, the controller adjusts the pump speed in heating mode so as to keep constant the pressure difference, which is the setpoint value in parameter “FMG45”.

In heating mode the value is adjusted taking as reference the differential set in parameter “FMG46”.

Differentials work underneath and above the setpoint. The PID parameters are used to keep the setpoint.

The hydraulic diagram below shows a system featuring this function.

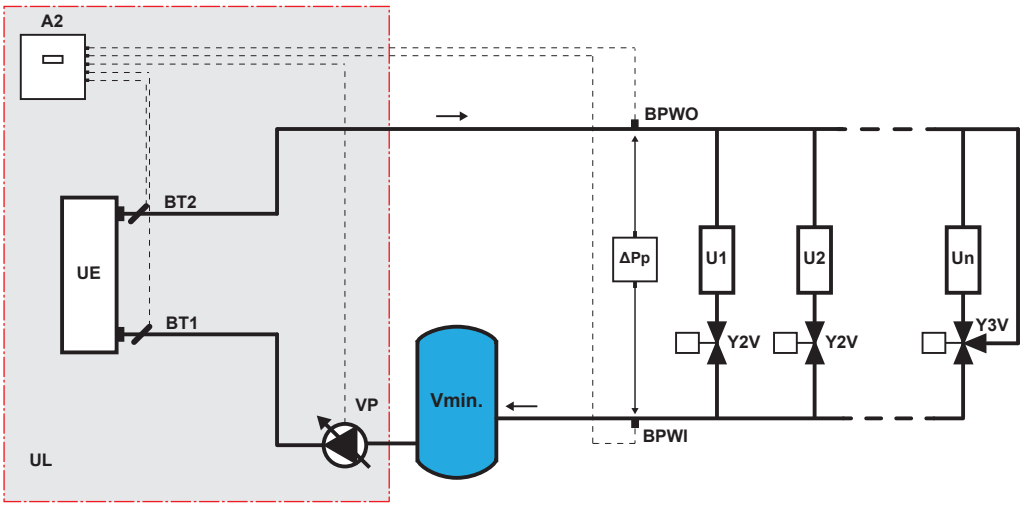


Fig. 59 System diagram with constant pressure control in system

2.27.6 “VFPP” function

The “VFPP” function is designed to control variable flow systems to the primary circuit.

As demand changes, the system keeps stable the difference in water pressure and temperature in the system delivery line.

The water flow rate and temperature are independent variables and they are not directly connected.

Pump control (only one pump in the system) provides for the necessary flow rate, while cooling capacity control ensures the correct temperature.

A reduction in the demand from the system results in an increase in the pressure difference that the controller offsets by reducing the pump speed, which has an impact in terms of energy consumption saving.

The water flow rate in the primary circuit is always adjusted within the set limits for correct operation of the refrigerant unit.

In heat pump units the controller is designed to offer the opportunity to set two pressure difference values: one for cooling and one for heating.

The parameters involved are shown below.

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

Parameter	Value	UM	Description
FMG9	2.0	%	Common - Setup parameter - Pump speed increase %
FMG10	40	s	Common - Setup parameter - Time between pump speed increases
FMG11	1.0	%	Common - Setup parameter - Pump speed decrease %
FMG12	35	s	Common - Setup parameter - Time between pump speed decreases
FMG13	5.0	%	Common - Emergency - LΔp / HΔp - % increase/decrease
FMG14	10	s	Common - Emergency - LΔp / HΔp - Time between increase/decrease
FMG43	130.0	kPa	VD/VDE/VFPP - Cooling - System - Pressure difference threshold
FMG44	2.0	kPa	VD/VDE/VFPP - Cooling - System - Differential
FMG45	130.0	kPa	VD/VDE/VFPP - Heating - System - Pressure difference threshold
FMG46	2.0	kPa	VD/VDE/VFPP - Heating - System - Differential
FMG47	700	l	VFPP - Cooling - Volume in litres
FMG48	700	l	VFPP - Heating - Volume in litres
FMG52	0	-	VFPP - Through time
FMG53	30	s	VFPP - Through time in manual mode
FMG55	0.0	%	VFPP/DT - Valve - Min. opening
FMG56	100.0	%	VFPP/DT - Valve - Max. opening
FMG57	30.0	%	VFPP/DT - Valve - Open in manual mode
FMG58	50	%	VFPP/DT - Valve - Min. opening with temp. diff. in heat exchanger smaller than min. value
FMG59	1.0	%	VFPP/DT - Valve - Setup parameter - % increase
FMG60	35	s	VFPP/DT - Valve - Setup parameter - Time between increases
FMG61	2.0	%	VFPP/DT - Valve - Setup parameter - % decrease
FMG62	10	s	VFPP/DT - Valve - Setup parameter - Time between decreases
FMG63	0	-	VFPP/DT - Valve - Open in manual mode
PA22	8	kPa	User - Flowzer - Low pressure difference setpoint in heat exchanger
PA55	70	kPa	User - Flowzer - Pressure difference high in heat exchanger

The controller adjusts the pump speed so as to keep constant the pressure difference in the system, which is the setpoint value in parameter “FMG43”, for operation in cooling mode.

The value is adjusted taking as reference the differential set in parameter “FMG44”.

If the unit is a heat pump unit, the controller adjusts the pump speed in heating mode so as to keep constant the pressure difference in the system, which is the setpoint value in parameter “FMG45”.

In heating mode the value is adjusted taking as reference the differential set in parameter “FMG46”.

Differentials work underneath the setpoint.

The speed is increased by small percentage variations at preset intervals of time using the values stored in parameters “FMG9” and “FMG10”. Speed reduction takes place in the same way, but referencing the setpoints in parameters “FMG11” and “FMG12”.

If the pressure difference on the heat exchanger side in the unit during the process to keep the pressure difference in the system constant is lower than the value in parameter “PA22”, the controller opens the bypass valve at the percentage setpoint (pre-positioning) stored in parameter “FMG58”.

When in start position or during setup operations, the controller uses the setpoints in parameters “FMG59” and “FMG60” if it senses the need to open the bypass valve any further.

Opening of the bypass valve makes it possible to circulate the necessary flow to keep the pressure difference constant on the heat exchanger side fitted in the unit.

The bypass valve starts closing again when the pressure difference on the heat exchanger side is higher than the value stored in parameter “PA22” plus the differential value. The differential value is written in the programming code.

If the pressure difference on the heat exchanger side during the process to keep the pressure difference constant in the system is higher than the setpoint in parameter “PA55”, the controller uses the values set in parameters “FMG61” and “FMG62” to reduce it.

The bypass valve may be overridden to open at any time by setting the value of parameter “FMG63” to “1” in order to enable manual mode (“0” = automatic mode).

When operation is overridden to manual mode, the valve opens at the percentage set in parameter “FMG57”.

Irrespective of the setpoint, the controller manages opening of the bypass valve between the min. value set in parameter “FMG55” and the max. value set in parameter “FMG56”.

Special conditions may exist where automatic setup of the pump speed needs to be bypassed.

If the value of parameter “FMG52” is set to “1”, the time elapsing between two pump speed changes is activated according to the value in parameter "FMG53".

The hydraulic diagram below shows a system featuring this function.

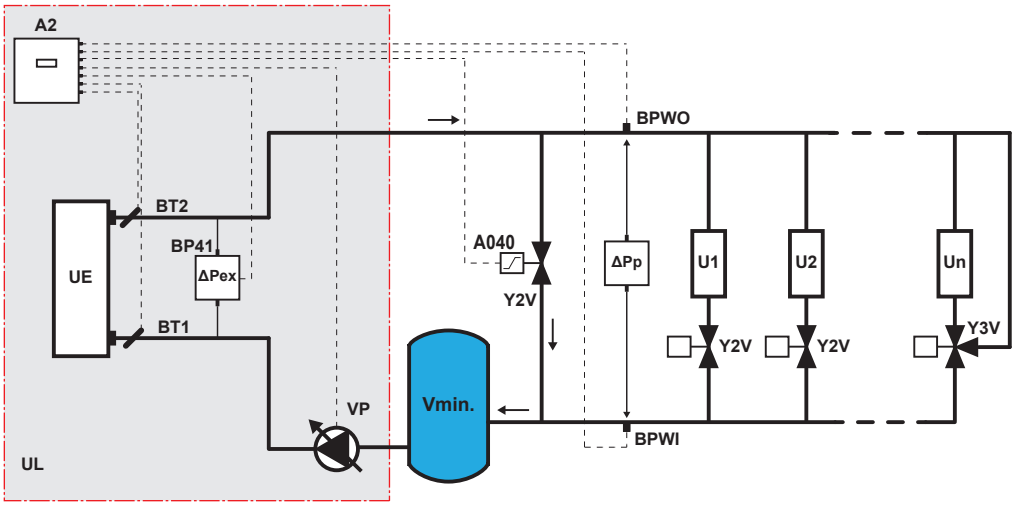


Fig. 60 System diagram with “VFPP” control

2.27.7 “VPS” function

The “VPS” function is designed for flow rate modulation to the primary circuit following that of the secondary circuit, having as reference the water temperature difference measured between the outlet of the primary circuit and the bypass pipe.

The water flow rate in the primary circuit is always set up within the limits set for correct operation of the refrigerant unit.

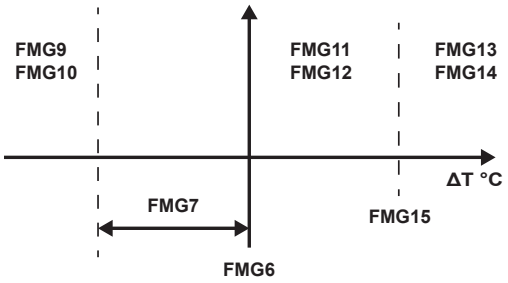
The parameters involved are shown below.

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

Parameter	Value	UM	Description
FMG6	5.0	°C	DT/VPS - Setpoint
FMG7	0.5	°C	DT/VPS - Neutral zone
FMG9	2.0	%	Common - Setup parameter - Pump speed increase %
FMG10	40	s	Common - Setup parameter - Time between pump speed increases
FMG11	1.0	%	Common - Setup parameter - Pump speed decrease %
FMG12	35	s	Common - Setup parameter - Time between pump speed decreases
FMG13	5.0	%	Common - Emergency - LΔp / HΔp - % increase/decrease
FMG14	10	s	Common - Emergency - LΔp / HΔp - Time between increase/decrease
FMG15	15.0	°C	VPS - Setup parameter - Setpoint of second pump speed increase threshold
FMG16	5	s	VPS - Setup parameter - Second threshold - Increase time

The controller adjusts the pump speed to keep the difference in the water temperature at the outlets of the primary circuit and the bypass pipe at the setpoint stored in parameter “FMG6”.

A graphical representation is shown below.



As the graph shows, the neutral zone is underneath the setpoint in parameter “FMG7”.

Underneath the neutral zone the pump speed is reduced taking small percentage variations - this value is set in parameter “FMG11” - which take place with the delay time set in parameter “FMG12”.

Above the neutral zone the pump speed is increased taking small percentage variations - this value is set in parameter “FMG11” - which take place with the delay time set in parameter “FMG12”.

If the temperature difference reaches the value set in parameter “FMG15”, the pump speed is increased with the percentage variations set in parameter “FMG13”, which takes place with the delay time set in parameter “FMG14”.

The hydraulic diagram below shows a system featuring this function.

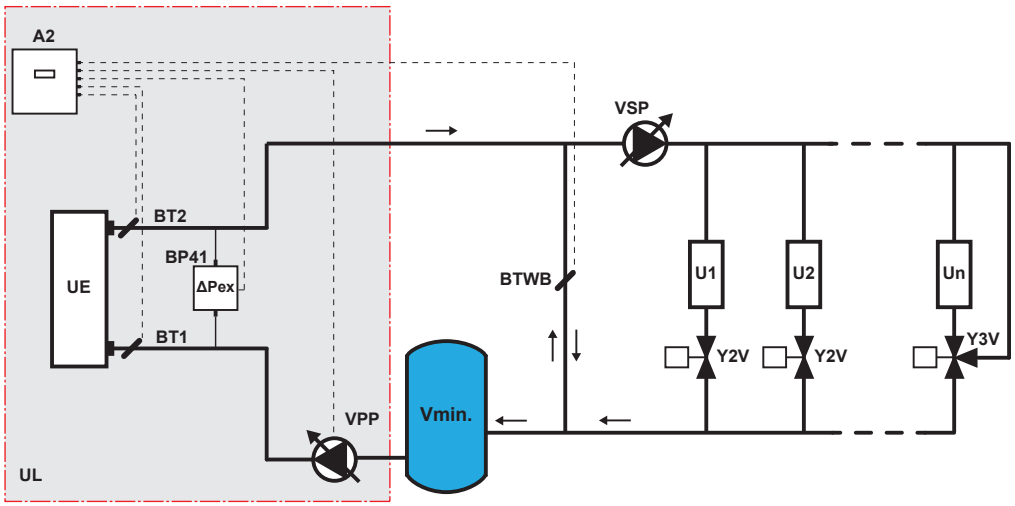


Fig. 61 System diagram with “VPS” control

2.28 SMART Link

The "SMART Link" function prepares the refrigerant units for serial connection with "GOLD" ventilated units.

Through the serial connection, the "GOLD" unit intervenes in the water temperature value of the refrigerant unit to optimize system operation and reduce energy consumption.

This function is available for both chiller units and heat pump units.

The parameters involved are shown in the table.

Parameter	Min	Max	UM	Description
SP6	0	1	-	Enable BMS supervision writings
SP11	0	1	-	Enabling of SmartLink BMS
SP12	1	247	-	BMS serial address
SP14	0	3	-	Modbus speed

For serial connection and networked operation of the two units, also consult the documentation for the GOLD unit.

2.28.1 Parametrization of the controller

Normally, in units that have the "SMART Link" function, the parameters for serial communication in the controller are factory set.

If a check is necessary, the correct values are shown in the table.

Parameter	Value	UM	Description
SP6	1	-	Enable BMS supervision writings
SP11	1	-	Enabling of SmartLink BMS
SP12	64	-	BMS serial address
SP14	3	-	Modbus speed

When these parameters are correctly set, the following symbol appears in the controller display near the setpoint value:  .

If, for any reason, it is necessary to start the refrigerant unit without the command from the "GOLD" unit, parameters SP6 and SP11 must be set to "0".

2.28.2 Serial connection

Serial connection between the refrigerant unit and the "GOLD" unit is to be carried out by the installer and must be done on the serial port RS485 of the controller at terminals 97, 98 and 99, respectively corresponding to (-), (+) and (GND).

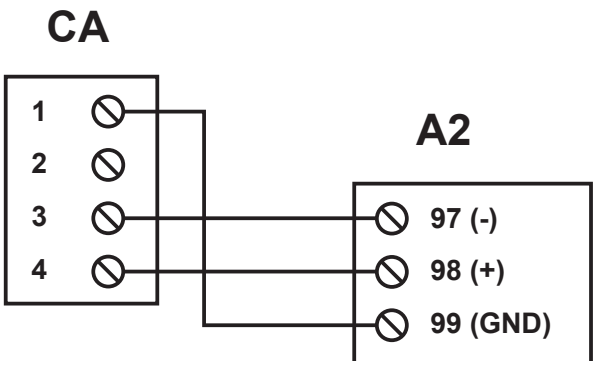


Fig. 62 Serial connection

The abbreviations shown in the illustration refer to:

- CA = cable adapter, present in the GOLD unit;
- A2 = terminal board of the serial port RS485 present in the board of the controller.

The serial connection must be made with AWG20 twisted cable (cross-section of at least 0.5 mm2), for a maximum length of 100 metres.

Adopt suitable precautions to prevent the creation of electromagnetic interference to the connection.

In particular, to avoid creating line interference that would compromise the signal, avoid running the serial cable alongside the power cables.

2.29 SMARTLink +

The “SMARTLink+” function is designed to set up the refrigerant units for connection to as many as ten ventilating units of any version whatsoever (“GOLD” units and chilled beam systems) using an Ethernet port.

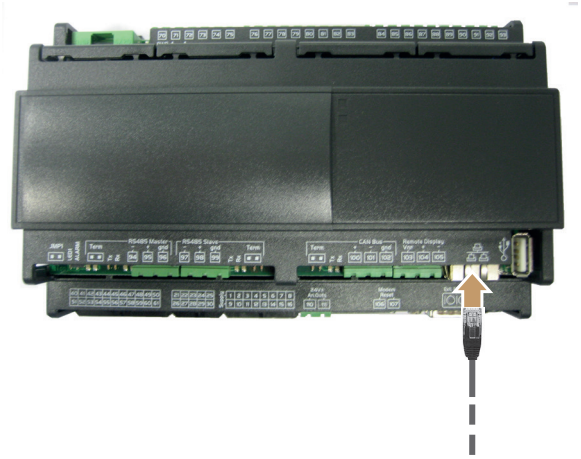
The Ethernet connection enables multiple ventilating units to be involved in the definition of the water temperature value of the refrigerant unit with a view to optimizing system operation and reducing energy consumption.

This function offers refrigerant units the possibility to be fitted in systems with either one or two hydraulic circuits (defined as “circuit A” and “circuit B” in the controller parameters).

2.29.1 Serial connection

The connection of the refrigerant unit and the ventilating units is via Modbus on a TCP/IP network.

A twisted pair network cable, CAT5, with RJ45 connector must be used for unit connection to the network. The cable may be shielded or not.



There are three possible connection options:

- direct, between a refrigerant unit and a ventilating unit;
- using a specific network for the system where only refrigerant and ventilating units are fitted;
- using the network of the installation where other devices are connected in addition to the system units.

The first case requires that the connection to the connectors is criss-crossed; the other two cases require a direct connection (also see the reference Smart Link+ guide for “GOLD” units.)

2.29.2 Function activation

Normally, units featuring the SMART Link+ function are shipped from the factory with one ventilating unit configured.

When it is started up, the refrigerant unit looks for a ventilating unit in the network whose address is IP 10.2.3.51. If the ventilating unit is not connected or its IP address is different, alarm AL386 appears.

The correct parameters for the type of system in which the unit is connected hydraulically must be set up in the controller of the refrigerant unit.

These parameters include, in sequence:

- the number of ventilating units to be controlled;
- the operating mode switch type (for heat pump units only);
- their IP address;
- the hydraulic circuit to which the ventilating units are connected (“A” is the default factory setpoint);
- activation of serial communication with the ventilating unit.

These values may be set in the “SML” parameters stored in the “Service” branch or in the function-specific screens.

Please find below a list of values set in the “SML” parameters:

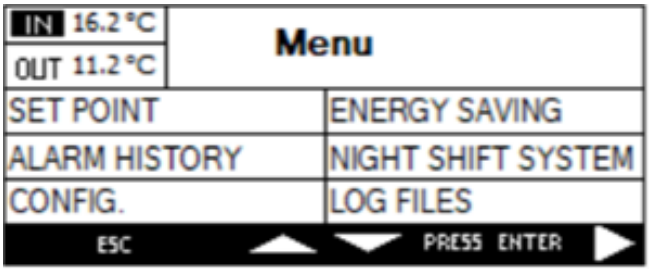
- parameter “SML1” is used to set the number of ventilating units featured;
- the hydraulic circuit to which each ventilating unit is connected is set in parameter SML2: 0 = None; 1 = Circuit A; 2 = Circuit B
- the type of user connected is set from parameter “SML13” to “SML22”: 0 = "Gold"; 1 = "SuperWise"

Parameter	Min	Max	UM	Description
SML1	0	10	-	Number of users to be controlled
SML2	0	2	-	Circuit configured
SML3	1	254	-	User 1 - IP address
SML4	1	254	-	User 2 - IP address
SML5	1	254	-	User 3 - IP address
SML6	1	254	-	User 4 - IP address
SML7	1	254	-	User 5 - IP address
SML8	1	254	-	User 6 - IP address
SML9	1	254	-	User 7 - IP address
SML10	1	254	-	User 8 - IP address
SML11	1	254	-	User 9 - IP address
SML12	1	254	-	User 10 - IP address
SML13	0	1	-	Consumer 1 - Type
SML14	0	1	-	Consumer 2 - Type
SML15	0	1	-	Consumer 3 - Type
SML16	0	1	-	Consumer 4 - Type
SML17	0	1	-	Consumer 5 - Type
SML18	0	1	-	Consumer 6 - Type
SML19	0	1	-	Consumer 7 - Type
SML20	0	2	-	Consumer 8 - Type
SML21	0	1	-	Consumer 9 - Type
SML22	0	1	-	Consumer 10 - Type
SML26	-50.0	99.9	°C	Producer - Toa - Threshold
SML27	0.0	25.0	°C	Producer - Toa - Cooling differential
SML28	0.0	25.0	°C	Producer - Toa - Heating differential

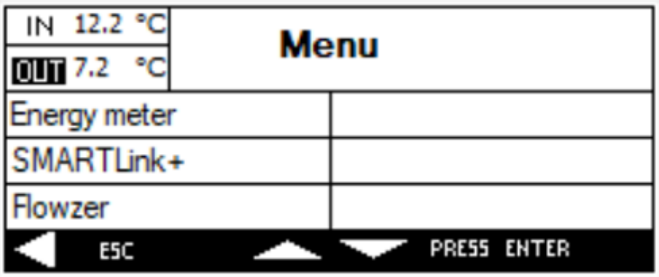
If communication between the refrigerant unit and the ventilating units is not successful with the parameters set, an alarm appears on the controller of the refrigerant unit.

The alarm only pops up if the ventilating unit is enabled.

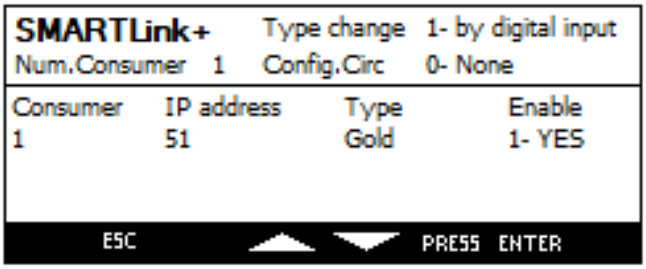
Press the button “MENU” on the main screen to access the function-specific screens.



Scroll the “MENU” screens using the arrow right until the screen with the SMART Link+ function appears.



Tap the arrow down to select the “SMART Link+” function and press “ENTER” to confirm: the first screen appears where the function parameters are set up.



Move in the various fields using the arrow buttons and press “ENTER” to confirm after entering the necessary parameters, according to the system in which the refrigerant unit is fitted.

As soon as the number of ventilating units is set up, the value entry fields are enabled.

The value to be entered in the field “IP address” is the last digit in the address (e.g. 10.2.3.xx).

The first three values of the IP address for network identification are the same numbers as in the controller.

The controller IP address set at the factory is 10.2.3.20. If it needs changing, refer to the section “IP addressing” in the controller hardware manual.

The addresses for units in the network can take values between 1 and 254.

All communications with the ventilating units are disabled by default to avoid unnecessary alarms.

2.29.3 Determination of operating mode (only for heat pump units)

The operating mode of heat pump units is connected to the value set in parameter “SP9”, which may be:

- 0 = from user interface;
- 1 = from digital input;
- 2 = from SMART Link+.

When the unit is fitted with the SMART Link+ option, the value of parameter “SP9” is set to “2” at the factory.

Parameter “SP9” must be edited at start-up or when an override is required.

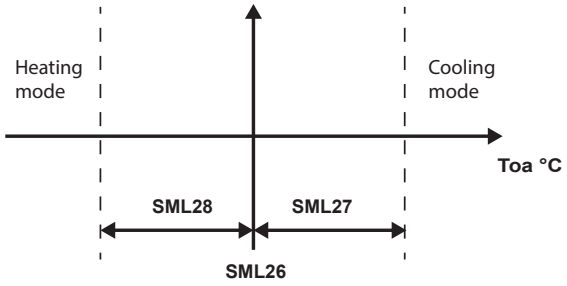
When parameter “SP9” is set to “2”, the controller establishes the operating mode type based on the demand received from the highest number of ventilating units connected.

If the number of demands for cooling is equal to the number of demands for heating, the controller establishes the operating mode to be enabled by comparing the value in parameter “SML26” with the outside air temperature.

If the outside air temperature is higher than the setpoint in parameter “SML26”, the controller sets the unit for operation in cooling mode; if it is lower, it sets the unit for operation in heating mode.

Other parameters are provided in addition to the threshold for operating mode switching (“SML26”). These include the differential for switching to cooling mode (“SML27”) and the differential for switching to heating mode (“SML28”).

A graphical representation is shown below.



When the refrigerant unit is set up for operation in heating mode, it only switches to cooling mode if the air temperature value is higher than threshold “SML26”, plus the relevant differential (“SML27”).

When the refrigerant unit is set up for operation in cooling mode, it only switches to heating mode if the air temperature value is lower than threshold “SML26”, minus the relevant differential (“SML28”).

2.29.4 Setpoint calculation

The refrigerant unit uses an algorithm to calculate the setpoint that best suits the requirements of the ventilating units. When the function is enabled, the parameter that the user uses to edit the unit setpoint is no longer effective for thermoregulation.

The setpoint calculated based on the demands of the ventilating units is in any case included between the min. and max. values of each operating mode (“ST2” and “ST3” for cooling mode; “ST5” and “ST6” for heating mode).

All serial variables in units with the “SMART Link+” function enabled are available in read only mode.

For serial connection and unit operation in the network, also consult the documentation relating to the “GOLD” unit.

2.30 Energy meter

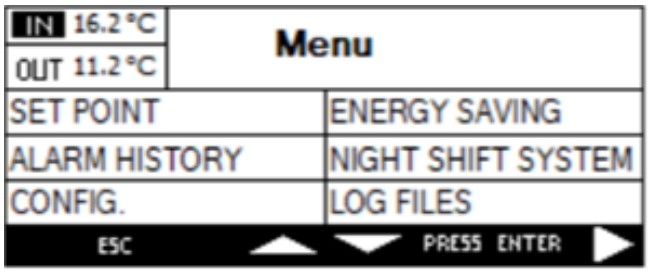
The option “Energy meter” is designed to control the main electrical parameters of the unit.

This measuring instrument is installed in the electrical cabinet of the unit and it is configured at the factory. It communicates with the controller serially.

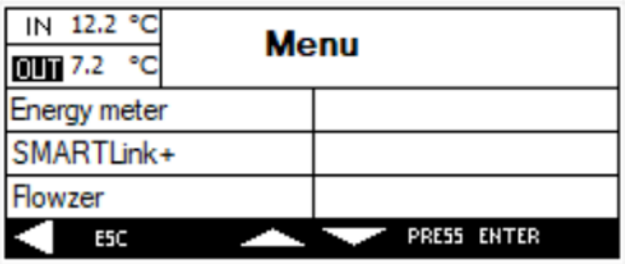
2.30.1 Viewing of measured parameters

Specific screens are provided to show the measured parameters.

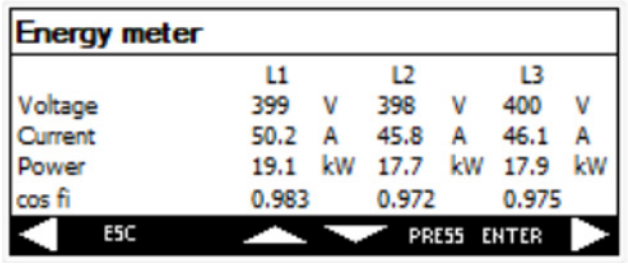
Press the button “MENU” on the main screen to access the measured parameter screens.



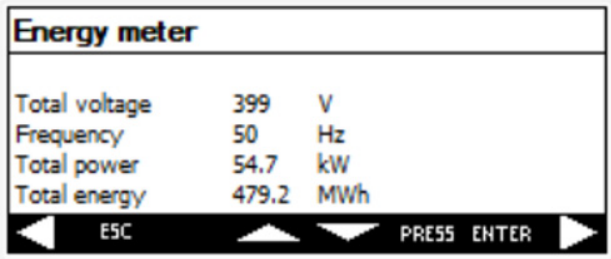
Scroll the “MENU” screens using the arrow right until the screen with the “Energy meter” function appears.



Tap the arrow down to select the “Energy meter” function and press “ENTER” to confirm: the first screen appears where the parameters measured in each phase are shown.



The total values are displayed in the screen appearing when the arrow down is tapped.



The energy value is an aggregate value over time. The reset procedure is explained in the meter manual.

Where communication with the measuring instrument fails, the controller warns about this condition causing an alarm window to appear.

2.30.2 Limitation of absorbed current using “Energy meter”

For units featuring stepless compressors

The option “Energy meter” may be integrated with an additional option that is designed to limit the electric current absorbed by the unit.

The controller uses as reference the greatest value of absorbed current on the three phases.

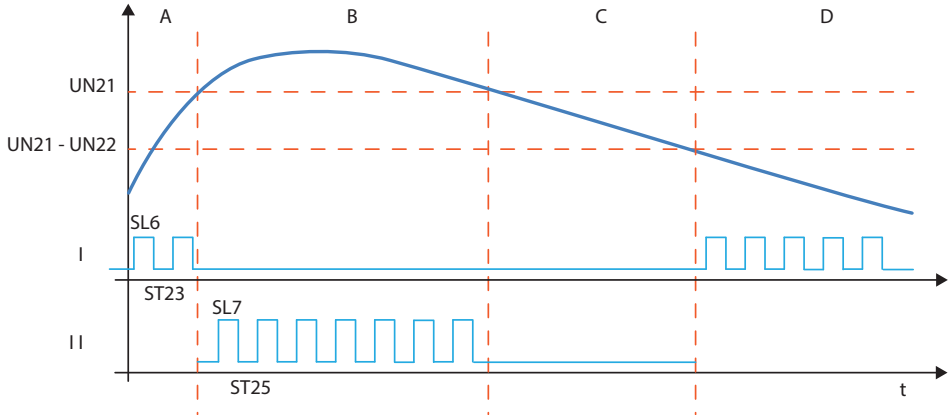
The current is limited by overriding cooling capacity reduction.

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
UN4	2	-	Unloading from Amperometric Transformer
UN17	15	min	Capacity reduction activation time limit
UN18	5	min	Time between two capacity reductions of the same circuit
UN21	250	A	Current capacity reduction threshold
UN22	50	A	Current capacity reduction differential
SL6	10	0,1 s	Pulse duration (ON)
SL7	20	0,1 s	Pulse duration (OFF)
ST23	10	s	With NZ or PID, Chiller - Min. activation time
ST25	5	s	With NZ or PID, Chiller - Min. de-activation time

A graphical representation is shown below.



Capacity reduction management

I - management of up pulses

II - management of down pulses

The override of unit capacity reduction is enabled when the greatest current value measured on the three phases is higher than the setpoint in parameter “UN21” (phase B). In this phase, the controller enables the “down” pulses according to the delay time set in parameter “ST25” until the absorbed current drops back to a lower value than the setpoint in parameter “UN21”.

If the value of current is between the value in parameter “UN21” and the difference between the values in parameters “UN21”– “UN22”(phase C), the controller does not change the capacity.

When the current absorbed by the unit is lower than the difference between the values in parameters “UN21” – “UN22” (phase D), the controller exits capacity reduction override mode and the demand for cooling capacity is managed again based on thermoregulation.

The time of the capacity reduction process may be as long as the time setpoint in parameter “UN17”. When this setpoint is exceeded, capacity is managed again based on thermoregulation, irrespective of the absorbed current.

Before a new capacity reduction cycle is started, the time set in parameter “UN18” must elapse.

2.30.3 Limitation of absorbed current using “Energy meter”

For units with inverter compressors or for hybrid units

The option “Energy meter” may be integrated with an additional option that is designed to limit the electric current absorbed by the unit.

The controller uses as reference the greatest value of absorbed current on the three phases.

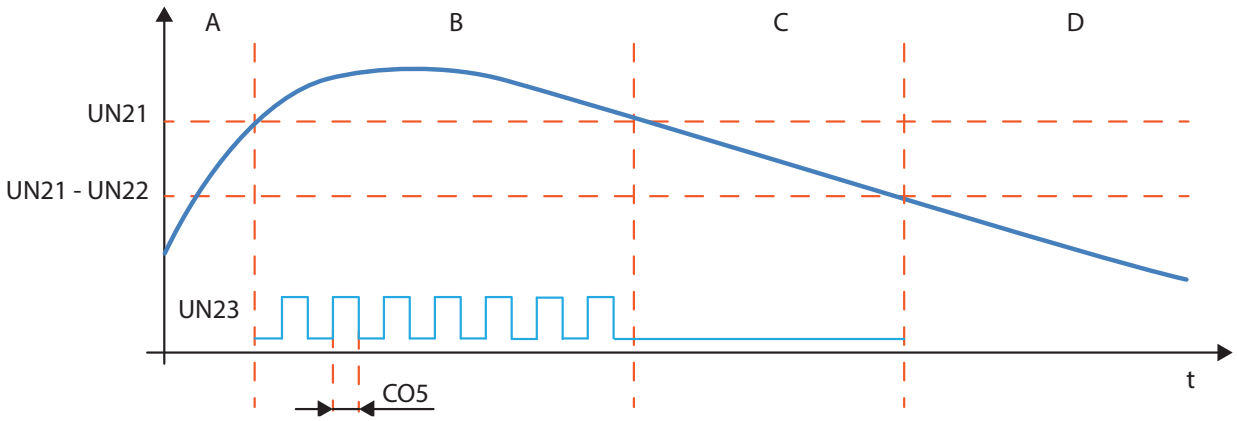
The current is limited by overriding cooling capacity reduction.

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
UN4	2	-	Unloading from Amperometric Transformer
UN17	15	min	Capacity reduction activation time limit
UN18	5	min	Time between two capacity reductions of the same circuit
UN21	250	A	Current capacity reduction threshold
UN22	50	A	Current capacity reduction differential
UN23	2,5	%	Reduction step of current unloading (inverter/hybrid)
CO5	10	s	Min. time between de-activation of 2 compressors/Min. Time between step decrement

A graphical representation is shown below.



The override of unit capacity reduction is enabled when the greatest current value measured on the three phases is higher than the setpoint in parameter “UN21” (phase B). In this phase, the controller enables the “down” pulses according to the delay time set in parameter “ST25” until the absorbed current is lower than the setpoint in parameter “UN21”.

If the value of current is between the value in parameter “UN21” and the difference between the values in parameters “UN21”– “UN22”(phase C), the controller does not change the capacity.

When the current absorbed by the unit is lower than the difference between the values in parameters “UN21” – “UN22” (phase D), the controller exits capacity reduction override mode and the demand for cooling capacity is managed again based on thermoregulation.

The time of the capacity reduction process may be as long as the time setpoint in parameter “UN17”. When this setpoint is exceeded, capacity is managed again based on thermoregulation, irrespective of the absorbed current.

Before a new capacity reduction cycle is started, the time set in parameter “UN18” must elapse.

2.31 Electronic expansion valve

The use of the electronic expansion valve allows very precise, stable and reliable control of refrigerant flow with consequent increase in efficiency.

The controller manages the electronic expansion valve and controls its opening based on the performance required by the system in all working conditions, to ensure low superheating over time that optimizes the performance of the unit and increases the benefits of floating condensation.

Also, the controller can act on the control of the electronic expansion valve to prevent the occurrence of operating conditions that can damage the compressor.

The parameters involved are shown in the table.

Parameter	Min	Max	UM	Description
Et24	45	2400	steps	Chiller - Pre-positioning of valve before the compressors start
Et25	0	999	s	Delay on starting before enabling the PID control
Et27	0	999	s	LOP function activation delay (low evaporating pressure)
Et28	0	999	s	MOP function activation delay (high evaporating pressure)
Et29	0	999	10 s	High superheating function activation delay
Et30	0	999	10 s	Low superheating function activation delay
Et31	0.0	25.5	°C	Chiller - PID, proportional coefficient
Et32	0	999	s	Chiller - PID, integral time
Et33	0	999	-	Chiller - PID, derivative time
Et34	0.0	110.0	°C	Chiller - Superheating setpoint
Et35	0.0	25.5	°C	Chiller - Neutral control zone
Et36	5.0	110.0	°C	Chiller - High superheating protection threshold
Et37	0.0	5.0	°C	Chiller - Low superheating protection threshold
Et39	-50.0	110.0	°C	Chiller - MOP protection threshold
Et41	-50.0	110.0	°C	Chiller - LOP protection threshold
Et48	0.0	25.5	°C	Heat pump - PID, proportional coefficient
Et49	0	999	s	Heat pump - PID, integral coefficient
Et50	0	999	-	Heat pump - PID, derivative coefficient
Et51	0.0	110.0	°C	Heat pump - Superheating setpoint
Et53	5.0	110.0	°C	Heat pump - High superheating protection threshold
Et54	0.0	5.0	°C	Heat pump - Low superheating protection threshold
Et56	-50.0	110.0	°C	Heat pump - MOP protection threshold
Et58	-50.0	110.0	°C	Heat pump - LOP protection threshold
Et61	1	999	s	Heat pump - Filter on the evaporating pressure
Et62	1	999	s	Heat pump - Valve position update filter
Et65	0.1	25.5	°C	Defrost - PID, proportional coefficient
Et66	0	999	s	Defrost - PID, integral coefficient
Et67	0.1	25.5	°C	Defrost - Superheating setpoint
Et68	-50.0	110.0	°C	Defrost - MOP protection threshold
Et69	-50.0	110.0	°C	Defrost - LOP protection threshold
Et70	0	999	s	Defrost - PID control delay after start of defrost
Et71	0	999	-	Defrost - Minimum valve opening percentage during defrost
Et73	0	999	-	Valve pre-positioning during capacity change of compressors
Et76	0	999	s	Low superheating alarm delay

2.31.1 Superheating management

The main parameter controlled by the electronic expansion valve is the superheating value of the gas at the outlet of the evaporator.

The PID control algorithm allows the superheating value, at the various operating conditions, to be kept close to the value of the set setpoint.

The relevant parameters are shown in the table.

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

Parameter	Value	UM	Description
Et31	10.0	°C	Chiller - PID, proportional coefficient
Et32	100	s	Chiller - PID, integral time
Et33	1	-	Chiller - PID, derivative time
Et34	5.0	°C	Chiller - Superheating setpoint
Et48	10.0	°C	Heat pump - PID, proportional coefficient
Et49	100	s	Heat pump - PID, integral coefficient
Et50	1	-	Heat pump - PID, derivative coefficient
Et51	5.0	°C	Heat pump - Superheating setpoint
Et65	10.0	°C	Defrost - PID, proportional coefficient
Et66	100	s	Defrost - PID, integral coefficient
Et67	5.0	°C	Defrost - Superheating setpoint

The values set in the controller are the result of tests and the manufacturer's experience.
Any change to these values must be approved by the manufacturer.

It might take a few minutes to reach the optimal set point.

2.31.2 Control in high superheating conditions

Prolonged continuation of the condition in which the superheating value exceeds the threshold set by the manufacturer will cause damage to the compressors.

When this condition occurs, the controller changes the opening of the expansion valve.

The relevant parameters are shown in the table.

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

Parameter	Value	UM	Description
Et29	2	10 s	High superheating function activation delay
Et36	15.0	°C	Chiller - High superheating protection threshold
Et53	15.0	°C	Heat pump - High superheating protection threshold

The values set in the controller are the result of tests and the manufacturer's experience.
Any change to these values must be approved by the manufacturer.

The high superheating condition ends when the superheating value falls by 1°C below the protection threshold.

2.31.3 Control in low superheating conditions

Prolonged continuation of the condition in which the superheating value is lower than the threshold set by the manufacturer will cause damage to the compressors.

When this condition occurs, the controller changes the opening of the expansion valve.

The relevant parameters 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	30	10 s	Low superheating function activation delay
Et37	2.0	°C	Chiller - Low superheating protection threshold
Et54	2.0	°C	Heat pump - Low superheating protection threshold
Et76	60	s	Low superheating alarm delay

The values set in the controller are the result of tests and the manufacturer's experience.

Any change to these values must be approved by the manufacturer.

The low superheating condition ends when the superheating value exceeds the protection threshold by 1°C.

In the event of an alarm, the reset is automatic for the number of occurrences in one hour set in parameter PAL4.

In the event of automatic reset, the minimum stop time is always complied with.

In the event of a low superheating alarm, make sure the valve is working correctly using the manual controls.

If the alarm persists, contact the manufacturer.

Control of the MOP ends if the low superheating condition occurs.

2.31.4 Control in MOP conditions

Prolonged continuation of the condition in which the suction pressure value exceeds the MOP (Maximum Operating Pressure) threshold set by the manufacturer will cause damage to the compressors.

When this condition occurs, the controller stops the PID superheating control and, with suitable algorithm, closes the expansion valve.

The relevant parameters are shown in the table.

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

Parameter	Value	UM	Description
Et28	10	s	MOP function activation delay (high evaporating pressure)
Et39	15.0	°C	Chiller - MOP protection threshold
Et56	15.0	°C	Heat pump - MOP protection threshold
Et68	50.0	°C	Defrost - MOP protection threshold

The values set in the controller are the result of tests and the manufacturer's experience.

Any change to these values must be approved by the manufacturer.

The MOP condition ends when the suction pressure value falls by 1°C below the protection threshold value.

2.31.5 Control in LOP conditions

The LOP (Low Operating Pressure) threshold set by the manufacturer is the suction pressure value below which the low pressure alarm intervenes with stopping of the refrigerant circuit.

When this condition occurs, the controller stops the PID superheating control and, with suitable algorithm, opens the expansion valve.

The relevant parameters are shown in the table.

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

Parameter	Value	UM	Description
Et27	1	s	LOP function activation delay (low evaporating pressure)
Et41	-30.0	°C	Chiller - LOP protection threshold
Et58	-30.0	°C	Heat pump - LOP protection threshold
Et69	-25.0	°C	Defrost - LOP protection threshold

The values set in the controller are the result of tests and the manufacturer's experience.

Any change to these values must be approved by the manufacturer.

The LOP condition ends when the suction pressure value exceeds the protection threshold by 0,1°C.

3 ALARMS

3.1 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 display is supplied with a buzzer.

The buzzer will be switched on if:

- at least one alarm is active;

The relay will be switched off if:

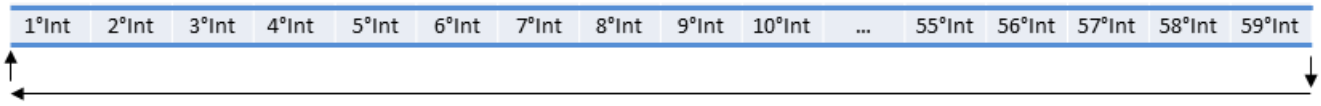
- there are no active alarms.

The buzzer will be switched off if:

- any button is pressed during an active alarm.

3.1.1 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.

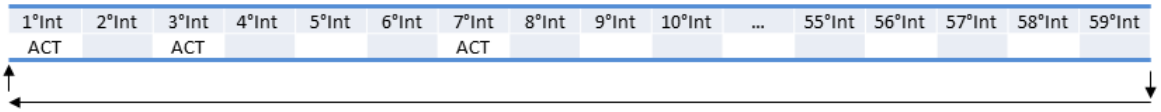


The window is sliding as regards the alarm event and always covers the last hour. During the interval of one minute, if an occurrence is detected, this time interval is considered active.

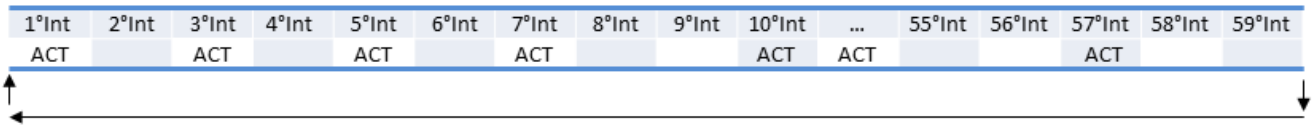
"ACT" is assigned to the active interval to record the event. The sum of the active intervals in the last hour allows the number of events/alarms per hour to be calculated.

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



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.



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.

3.2 Unit alarms

The unit alarms immediately cause all the compressors and relevant additional functions to be switched off.

3.2.1 Flow switch alarm

Management of the flow switch alarm depends on whether or not pumps are present in the unit.

If it is the controller that manages the pumps of the unit, the parameters involved are shown in the table below.

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

Parameter	Value	UM	Description
PA1	1 or 2	-	User-side pump management
PAL103	15	s	User-side flow switch; alarm delay when the pump is started
PAL105	5	s	User-side flow switch; alarm delay at steady state

Alarm code	**AL3 \ AL303**
Reason for activation	When the relevant digital input is open for a time longer than PAL103 when the unit is started or
	for a time longer than PAL105 after PAL103 has elapsed
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Anti-freeze heaters	Follows the control
The other devices	Switched off

A graphical example is shown below of flow switch alarm management with parameter PA1 = 1 or 2.

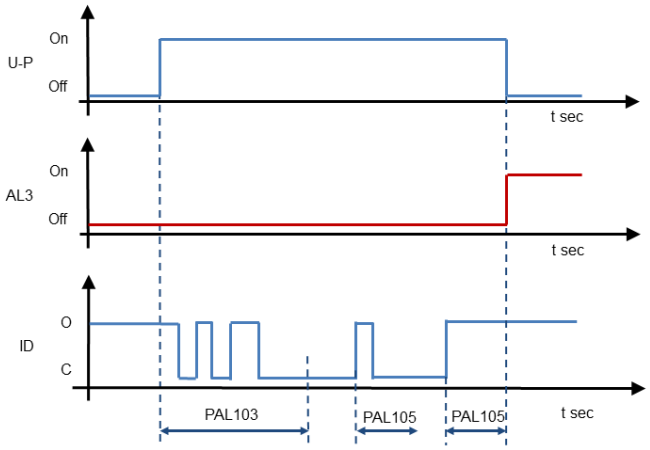


Fig. 63 Activation of flow switch alarm AL3 / AL303

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

- U/P = relating to the "unit" or "pump" device
- On = state of the device
- Off = state of the device
- ID = digital input to which the flow switch is connected
- O = open
- C = closed
- t = time.

If it is not the controller that manages the pumps of the unit, the parameters involved are shown in the table below.

Parameter	Value	UM	Description
PA1	0	-	User-side pump management
PAL58	5	s	Alarm activation delay
PAL59	2	10 s	Alarm over delay

Alarm code	AL2 \ AL302
Reason for activation	When the relevant digital input is open for a time longer than PAL58
Reset mode	Manual after closing of the digital input and after time PAL59
	With the reset of the alarm, the unit restarts
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Anti-freeze heaters	Follows the control
The other devices	Switched off

A graphical example is shown below of flow switch alarm management with parameter PA1 = 0.

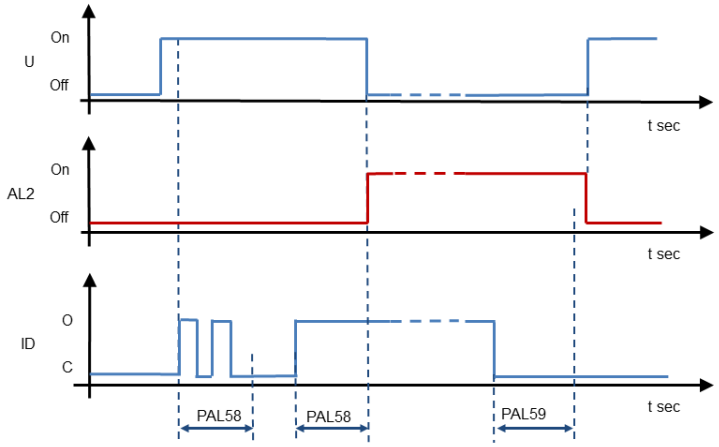


Fig. 64 Activation of flow switch alarm AL2 / AL302

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

- U = relating to the status of the unit
- On = state of the device
- Off = state of the device
- ID = digital input to which the flow switch is connected
- O = open
- C = closed
- t = time.

3.2.2 Antifreeze alarms

The antifreeze alarms depend on the number of exchangers present in the unit.

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
PAL36	3.0	°C	User-side water antifreeze - alarm threshold
PAL37	4.0	°C	User-side water antifreeze - alarm differential
PAL47	5 o 6	-	User-side water antifreeze - Selection of probe on which to check the antifreeze

The values of parameter PA47 can have the following meanings:

- 5 = antifreeze check on the water leaving each exchanger and on the common section of the user;
- 6 = antifreeze check on the water leaving the user.

The alarms are activated when the temperature value of the antifreeze probe is lower than parameter PAL36.

With the value of parameter PAL47 set to 5 the antifreeze alarm is managed with the probes installed on the water leaving each exchanger and the water leaving on the common section.

Alarm code	**AL178, AL179, AL180 and AL181 / AL378, AL379, AL380 and AL381**
Reason for activation	AL178 / AL378: antifreeze threshold reached by the probe placed at the outlet of the heat exchanger of circuit 1
	AL179 / AL379: antifreeze threshold reached by the probe placed at the outlet of the heat exchanger of circuit 2
	AL180 / AL380: antifreeze threshold reached by the probe placed at the outlet of the heat exchanger of circuit 3
	AL181 / AL381: antifreeze threshold reached by the probe placed at the outlet of the heat exchanger of circuit 4
	AL178, AL179, AL180 and AL181 / AL378, AL379, AL380 and AL381: antifreeze threshold reached by the probe placed at the outlet on the common section
Reset	When the temperature measured by the antifreeze probe is higher than the value set in parameter PAL36 plus PA37
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Anti-freeze heaters	They follow the control
Unit pump	Follows the control or switched off
The other devices	They follow the control
Compressors	AL178 / AL378, those of heat exchanger 1 switched off
	AL179 / AL379, those of heat exchanger 2 switched off
	AL180 / AL380, those of heat exchanger 3 switched off
	AL181 / AL381, those of heat exchanger 4 switched off

With the value of parameter PAL47 set to 6, the antifreeze alarm is managed with the probe installed on the water leaving the evaporator.

Alarm code	**AL217 \ AL417**
Reason for activation	The temperature measured by the antifreeze probe is lower than the value set in parameter PAL36
Reset	When the temperature measured by the antifreeze probe is higher than the value set in parameter PAL36 plus PAL37
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Anti-freeze heaters	They follow the control
Unit pump	Follows the control or switched off
The other devices	They follow the control
Compressors	Switched off

Inlet water probe antifreeze alarm

Alarm code	**AL216**
Reason for activation	The temperature measured by inlet water probe is lower than the value set in parameter PAL36
Reset	When the temperature measured by inlet water probe is higher than the value set in parameter PAL36 plus PAL3
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Buzzer	Yes
Devices	**Behaviour in the event of an alarm**
Anti-freeze heaters	They follow the control
Unit pump	Follows the control or switched off
The other devices	They follow the control
Compressors	Switched off

3.2.3 Low incoming water temperature alarm

The alarm is active only in heat pump operating 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
PAL84	3	-	Maximum number of alarms in one hour
PAL85	90	10 s	Low user-side inlet temperature alarm delay in heat pump mode
PAL86	25.0	°C	Low user-side inlet temperature alarm threshold in heat pump mode
PAL87	5.0	°C	Low user-side inlet temperature alarm differential in heat pump mode

Alarm code	AL14
Reason for activation	With unit running, if the user-side exchanger inlet water temperature is lower than parameter PAL86 for the time of parameter PAL85
Reset	When the user-side exchanger inlet water temperature is higher than parameter PAL86 plus parameter PAL87
Reset mode	Automatic for a number of interventions in one hour equal to the value of parameter PAL84, and then manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Compressors	Switched off
The other devices	They follow their control

3.2.4 High incoming water temperature alarm

The alarm is active only in chiller operating 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
PAL60	4	-	Maximum number of user-side high temperature alarms in one hour in chiller mode
PAL61	30	10 s	User-side high temperature delay in chiller mode
PAL62	30.0	°C	User-side high temperature alarm threshold in chiller mode
PAL63	5.0	°C	User-side high temperature alarm differential in chiller mode

Alarm code	AL148
Reason for activation	With unit running, if the user-side exchanger inlet water temperature > = PAL62 for PAL61 seconds
Reset	When the user-side exchanger inlet water temperature < = PAL62 - PAL63.
Reset mode	Automatic, and becomes manual after the number of occurrences/ hour of PAL60
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	No
Devices	**Behaviour in the event of an alarm**
All devices	They follow their control

3.2.5 Low ambient temperature alarm

The alarm is detected only in heat pump operating 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
PAL116	1	-	Enables the low outside air temperature alarm in heat pump mode
PAL117	60	-	Maximum number of low outside air temperature alarms in one hour
PAL118	-15.0	°C	Low outside air temperature alarm threshold
PAL119	2.0	°C	Low outside air temperature alarm differential

Alarm code	**AL34**
Reason for activation	If the outside air temperature <= parameter PAL118
Reset	When the outside air temperature >= PAL118 + PAL119
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
System pump	Follows the control
The other devices	Switched off

3.2.6 Wrong phase sequence alarm

The alarm is detected only for the time set in parameter CO7 when the controller is started.

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
CO7	25	s	Load activation delay at switch-on

Alarm code	AL55
Reason for activation	With digital input open for time CO7 seconds when the controller is switched on.
Reset	After correctly connecting the phase sequence, when the controller is next started with the digital input closed
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
All devices	Switched off

3.2.7 Maximum/minimum voltage alarm

Alarm code	AL201
Reason for activation	With digital input open
Reset	When the digital input closes
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
All devices	Switched off

3.2.8 Alarms for expansion modules not connected

If communication between the controller and the expansion module fails, the outputs of the expansion module are deactivated after 5 seconds.

Alarm code	**AL164**
Reason for activation	Non-communication between the controller and expansion module IPX306
Reset	If the module is disabled or resumes communication
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
IPX306	Outputs deactivated after 5 seconds
The other devices	Depends on the configuration

Alarm code	**AL165**
Reason for activation	Non-communication between the controller and expansion module IPX315
Reset	If the module is disabled or resumes communication
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
IPX315	Outputs deactivated after 5 seconds
The other devices	Depends on the configuration

3.2.9 Flowzer VFPP-VPS alarm

Alarm code	**AL245**
Reason for activation	Serial communication failure
	The alarm activates after the delay set on parameter "CO43"
Reset	Restoration of communication
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Pump	Stopping of the user-side pump
Unit	Stop due to flow switch alarm

3.2.10 Energy meter alarm

Alarm code	**AL246**
Reason for activation	Serial communication failure
	The alarm activates after the delay set on parameter "CO43"
Reset	Restoration of communication
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Values measured	The values get reset on the function-specific screens.
Current limitation	The function will not get enabled.
Unit	Normal operation continues.

3.2.11 “RTC” clock alarm

Alarm code	**AL211**
Reason for activation	Low level of controller battery charge
Reset	When the controller time or date is reset.
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
All devices	They follow their control

Replace the controller if the alarm is not cleared after setting the time.

3.2.12 Internal memory alarm

Alarm code	**AL1**
Reason for activation	Incorrect programming of the controller
Reset	Correct programming
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
All devices	Stopping of operation

Contact the manufacturer.

3.3 Function alarms

Alarms linked to the functions managed by the controller are described below.

3.3.1 Pump alarms

The alarms that regard the pumps are shown below.

Pump maintenance

Alarm code	**AL143 / AL443 maintenance of pump 1; AL144 / AL444 maintenance of pump 2**
Reason for activation	This is detected when the work hours exceed the set limit
Reset	Upon deletion of the hours in the Service or Maintenance menu
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Pump in alarm	Follows its control
The other devices	They follow their control

Thermal overload protection of pumps

Alarm code	**AL45 / AL345 Thermal overload protection of pump 1; AL46 / AL346 Thermal overload protection of pump 2**
Reset	With digital input closed
Reset mode	Always manual
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Pump	Operation of the pump in alarm is prevented
The other devices	They follow their control

Maintenance of recovery pumps/desuperheater

Alarm code	**AL241 maintenance of pump 1; AL242 maintenance of pump 2**
Reason for activation	This is detected when the work hours exceed the value of parameter PA36
Reset	Upon deletion of the hours in the Service or Maintenance menu
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Pump in alarm	Follows its control
The other devices	They follow their control

Thermal overload protection in recovery pumps/desuperheater

Alarm code	**AL243 Thermal overload protection of pump 1; AL244 Thermal overload protection of pump 2**
Reset	With digital input closed
Reset mode	Always manual
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Pump	Operation of the pump in alarm is prevented
Recovery	Prevented if a back-up pump is not available
The other devices	They follow their control

3.3.2 Ventilation alarms

The alarms regarding this function are shown in the table.

Alarm code	**AL35, AL36, AL37, AL38, AL39, AL40**
Reason for activation	AL35; with digital input of circuit 1 open
	AL36; with digital input of circuit 2 open
	AL37; with digital input of circuit 3 open
	AL38; with digital input of circuit 4 open
	AL39; with digital input of circuits 1 and 2 open
	AL40; with digital input of circuits 3 and 4 open
Reset	According to factory settings
Reset mode	Manual or automatic, according to the factory setting
Alarm icon	Flashing
AlarmLog	YES
Devices	**Behaviour in the event of an alarm**
Fan in alarm	Follows its control (stopping takes place electro-mechanically)
The other devices	They follow their control

3.3.3 Recovery alarms

The alarms that regard recovery are shown below.

Alarm code	**AL207, AL208, AL209, AL210 circuit 1, 2, 3, 4 recovery disabled**
Reason for activation	This is detected if the delivery pressure exceeds the set limit
Reset	When the delivery pressure is lower than value RC7 - RC8 for time RC9
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Circuit in alarm	Recovery deactivated
The other circuits and devices	They follow their control

3.3.4 Pump down alarms

The alarms regarding pump down are shown below.

Alarm code	**AL122, AL123, AL124, AL125 pump down alarm for circuits 1, 2, 3, 4**
Reason for activation	When the switching off of a refrigerant circuit is required
Reset	Automatic, and becomes manual after repeated occurrences
Reset mode	Only the service personnel may reset the manual alarm.
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Circuit in alarm	Deactivated
The other circuits and devices	They follow their control

3.3.5 Refrigerant leak alarms

The refrigerant leak alarms are shown below.

If the refrigerant leak causes hazardous conditions, the electro-mechanical management procedure is illustrated in the “Instruction Manual for Installation, Use and Maintenance”.

Alarm code	**AL156, AL157, AL158, AL159 refrigerant leak alarm of circuits 1, 2, 3, 4**
Reason for activation	When the digital input of the controller regarding the refrigerant detector is open
Reset	Automatic, and becomes manual after repeated occurrences
Reset mode	Only the service personnel may reset the manual alarm.
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Circuit in alarm	Depending on the setting, it is stopped or follows the control
The other circuits and devices	They follow their control

3.3.6 Alarms concerning refrigerant leak detector sensor maintenance

The alarms warning about maintenance of the refrigerant leak detector are shown below.

Alarm code	**AL300 Refrigerant sensor inspection/calibration about to expire**
Reason for activation	When the inspection/calibration expiry date is approaching.
Reset	Manual
Reset mode	Only the service personnel may reset the manual alarm.
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
The unit	Normal operation continues.

Alarm code	**AL322 Refrigerant sensor calibration expired**
Reason for activation	After the inspection/calibration time has expired.
Reset	Manual
Reset mode	Only the service personnel may reset the manual alarm.
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
The unit	Normal operation continues.

Alarm code	**AL342 Unit OFF - The refrigerant sensor inspection/calibration time has expired.**
Reason for activation	After the inspection/calibration time (“PAL130” = “1”) has expired (“PAL128” + “PAL129”).
Reset	Manual
Reset mode	Only the service personnel may reset the manual alarm.
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
The unit	Unit blocked

3.3.7 Free cooling alarms

The free cooling function alarms are shown below.

Alarm code	**AL50: overload alarm in free cooling pump 1; AL56: overload alarm in free cooling pump 2.**
Reason for activation	With opening of the relevant digital input
Reset	Manual
Reset mode	Only after closing of the digital input
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Free cooling pump	Disable relevant pump
Free cooling function	Disable if other pump is not available
The other circuits and devices	They follow their control

Alarm code	**AL248 and 249: free cooling pump maintenance warning message**
Reason for activation	This is detected when the work hours exceed parameter PA18
Reset	Manual
Reset mode	Upon deletion of the hours in the Service or Maintenance menu
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Free cooling pumps	Follows the control
The other circuits and devices	They follow their control

Alarm code	**AL41, AL42, AL43, AL44 free cooling fan overload protection alarm**
Reason for activation	With opening of the relevant digital inputs
Reset	Automatic, and becomes manual after repeated occurrences
Reset mode	Only after closing of the inputs
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Free cooling fans	They follow the control, the fans in alarm are stopped electro-mechanically
Free cooling function	Follows the control
The other circuits and devices	They follow their control

Alarm code	**AL5 free cooling flow switch alarm**
Reason for activation	With free cooling active, digital input of the flow switch open after the relevant delays
Reset	Manual
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Free cooling function	Deactivated
The other circuits and devices	They follow their control

3.3.8 Defrost alarms

The defrost alarms are shown below.

Alarm code	**AL186, AL187, AL188, AL189, AL190, AL191 defrost alarm**
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
Devices	**Behaviour in the event of an alarm**
The other circuits and devices	They follow their control

3.3.9 Fast Restart alarms

The alarms regarding this function are shown below.

Alarm for power supply with UPS in 24 hours

Alarm code	**AL192**
Reason for activation	With digital input open
Reset	With digital input closed
Reset mode	Automatic with number of occurrences per hour smaller than or equal to PAL66
	Manual with number of occurrences per hour greater than PAL66
Alarm icon	Flashing
AlarmLog	YES
Devices	**Behaviour in the event of an alarm**
All devices	OFF

Alarm for power supply with UPS in an hour

Alarm code	**AL201**
Reason for activation	With digital input open
Reset	With digital input closed
Reset mode	Automatic with number of occurrences per hour smaller than or equal to PAL33
	Manual with number of occurrences per hour greater than PAL33
Alarm icon	Flashing
AlarmLog	YES
Devices	**Behaviour in the event of an alarm**
All devices	OFF

The limit for Fast Restart without UPS in 24 hours has been reached

Alarm code	**AL239**
Reason for activation	The number of Fast Restarts with automatic reset has been exceeded
Reset	After the next midnight
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	YES
Devices	**Behaviour in the event of an alarm**
All devices	In case of blackout, the unit restarts without the Fast Restart function

3.3.10 Alarms relating to 2-zone function (GIT option)

Below is a list of the alarms linked to the function that is used to control up to 2 zones of the system (GIT option).

Probe error in secondary circuit

Alarm code	**AL333 Error: probe in secondary circuit 1 AL334 Error: probe in secondary circuit 2**
Reason for activation	The probe in the zone is malfunctioning or it is not connected.
Reset	As soon as correct probe operation is resumed
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Alarmed zone	The pump stops and the 3-way valve is overridden to standby position.
The other circuits and devices	They follow their control

Secondary circuit alarm

Alarm code	**AL340 Secondary circuit 1 alarmed AL341 Secondary circuit 2 alarmed**
Reason for activation	With opening of the relevant digital input
Reset	With digital input closed
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Alarmed zone	The pump stops and the 3-way valve is overridden to standby position.
The other circuits and devices	They follow their control

3.3.11 Tank thermoregulation alarms (TSS option)

The function “Thermoregulation from tank-mounted probe (TSS option)” is connected with a probe alarm.

Tank probe error

Alarm code	**AL339 Tank probe error**
Reason for activation	The probe in the zone is malfunctioning or it is not connected.
Reset	As soon as correct probe operation is resumed
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Function management	The function is disabled: the controller carries on thermoregulation with the reference probe and according to the stored setpoint.

3.3.12 Auxiliary heating alarm

With reference to auxiliary heating management, a digital input is installed to manage the display of a serious alarm, if any.

Refer to the wiring diagram for the relevant digital input.

Alarm code	**AL326 Auxiliary heating alarm**
Reason for activation	Opening of relevant digital input
Reset	Automatic upon closing of relevant digital input
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Devices	**Behaviour in the event of an alarm**
Function management	The function is disabled. If the unit is in heat pump mode, heating continues with the compressors.

3.4 Circuit alarms

The circuit alarms occur only on the compressors of the circuit involved.

3.4.1 High-pressure alarms

For each refrigerant circuit, the delivery pressure is controlled by safety pressure switches and by pressure sensors.
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	17.5	bar	High pressure alarm threshold
PAL12	2.0	bar	High pressure alarm differential
PAL13	2	-	Maximum number of alarms in one hour due to high pressure
FA2	0	-	Ventilation operating mode

Pressure switch high pressure alarm

Alarm code	**AL6 for circuit 1, AL7 for circuit 2, AL8 for circuit 3 and AL9 for circuit 4**
Reason for activation	With unit running, when the digital input opens where the relevant pressure switch is connected
Reset	When the relevant digital input closes
Reset mode	Manual
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
Ventilation	In chiller operating mode, if FA2=0, with activation of the alarm, ventilation is forced for 60 seconds at maximum speed before stopping
The other devices	They follow their control

Probe high pressure alarm

Alarm code	**AL10 for circuit 1, AL11 for circuit 2, AL12 for circuit 3 and AL13 for circuit 4**
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	Yes
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
Ventilation	If FA2=0, with activation of the alarm, ventilation is forced for 60 seconds at maximum speed before stopping
The other devices	They follow their control

3.4.2 High discharge gas temperature alarm

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	135.0	°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
FA2	0	-	Ventilation operating mode

Alarm code	**AL57 for circuit 1, AL58 for circuit 2, AL59 for circuit 3 and AL60 for circuit 4**
Reason for activation	If the value measured by the temperature probe is >= PAL50
Reset	When the value measured by the temperature probe is <= (PAL50 - PAL51)
Reset mode	Automatic, and becomes manual after PAL52 occurrences/hour
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Compressors	Only the compressors of the circuit involved are switched off
Ventilation	If FA2=0, with activation of the alarm, ventilation is forced for 60 seconds at maximum speed before stopping
The other devices	They follow their control

3.4.3 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.

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
PAL89	5.0	bar	Low pressure difference alarm threshold
PAL90	90	s	Low pressure difference alarm delay on starting of compressors
PAL91	10	s	Low pressure difference alarm delay at steady state
PAL92	2	-	Maximum number of alarms in one hour due to low pressure difference

Alarm code	**AL114 for circuit 1, AL115 for circuit 2, AL116 for circuit 3 and AL117 for circuit 4**
Reason for activation	When a compressor of the circuit starts, if the pressure difference is <= PAL89 for PAL90 seconds
	After PAL90 has elapsed, if the pressure difference is <= PAL89 for PAL91 seconds
Reset mode	Automatic, and becomes manual after PAL52 occurrences/hour
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
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

3.4.4 Probe low pressure alarm

For each refrigerant circuit, the suction pressure is controlled by a pressure sensor.

The controlled limits are different with the different operating modes.

If the value of parameter PAL5 is set to "1", pressure control is also done during defrost.

If the value of parameter PAL7 is set to "1", pressure control is also done with the unit switched off.

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	0.2	bar	Low pressure alarm threshold in chiller operating mode
PAL3	1.0	bar	Low pressure alarm differential in chiller operating mode
PAL4	2	-	Maximum number of alarms in one hour due to low pressure
PAL5	1	-	Enables the low pressure alarm during defrost
PAL6	10	s	Low pressure alarm delay during defrost
PAL7	0	-	Enables the low pressure alarm with unit switched off
PAL8	0.1	bar	Low pressure alarm threshold in heat pump operating mode / defrost mode
PAL9	1.0	bar	Low pressure alarm differential in heat pump operating mode / defrost mode
PAL10	5	s	Low pressure alarm delay at steady state (excluding defrost)

Alarm code	**AL203 for circuit 1, AL204 for circuit 2, AL205 for circuit 3 and AL206 for circuit 4**
Reason for activation	If the value measured by the pressure probe is <= PAL2 in chiller operating mode
	If the value measured by the pressure probe is <= PAL8 in heat pump operating mode and defrost mode
	The alarm is detected PAL1 seconds after the first compressor of the circuit starts.
	When delay PAL1 has elapsed, the alarm is detected after PAL10 during operation.
	During defrost, after the first reversal of the refrigeration cycle, the alarm is detected after PAL6 seconds
Reset	In chiller operating mode, when the value measured by the pressure probe is >= (PAL2 +PAL3)
	In heat pump operating mode, when the value measured by the pressure probe is >= (PAL8 +PAL9)
Reset mode	Automatic, and becomes manual after PAL4 occurrences/hour
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
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

3.4.5 Forcing of capacity reduction from low pressure probe

This function is always present in units with the value of parameter UN3 on "1".

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
UN9	0.4	bar	Low pressure capacity reduction threshold in chiller operating mode
UN10	0.5	bar	Low pressure capacity reduction differential in chiller operating mode
UN11	0.4	bar	Low pressure capacity reduction threshold in heat pump operating mode
UN12	0.5	bar	Low pressure capacity reduction differential in heat pump operating mode
UN13	50	%	Capacity reduction percentage for individual circuit
UN17	2	min	Capacity reduction activation time limit
UN18	2	min	Time between two capacity reductions of the same circuit

Alarm code	**AL193 for circuit 1, AL194 for circuit 2, AL195 for circuit 3 and AL196 for circuit 4**
Reason for activation	If the value measured by the pressure probe is < UN9 in chiller operating mode or UN12 in heat pump mode
Reset	When the value measured by the pressure probe is > (UN9 + UN10) in chiller operating mode
	When the value measured by the pressure probe is > (UN12 +UN13) in heat pump operating mode
	In any case, when the time of parameter UN17 has elapsed
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	No
Devices	**Behaviour in the event of an alarm**
All devices	Follow their control

3.4.6 Forcing of capacity reduction from high pressure probe

This function is always present in units with the value of parameter UN3 on "1".

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	17.0	bar	High pressure capacity reduction threshold in chiller operating mode
UN6	4.0	bar	High pressure capacity reduction differential in chiller operating mode
UN7	17.0	bar	High pressure capacity reduction threshold in heat pump operating mode
UN8	4.0	bar	High pressure capacity reduction differential in heat pump operating mode
UN13	50	%	Capacity reduction percentage for individual circuit
UN17	2	min	Capacity reduction activation time limit
UN18	2	min	Time between two capacity reductions of the same circuit

Alarm code	**AL197 for circuit 1, AL198 for circuit 2, AL199 for circuit 3 and AL200 for circuit 4**
Reason for activation	If the value measured by the pressure probe is > UN5 in chiller operating mode or UN7 in heat pump mode
Reset	When the value measured by the pressure probe is < (UN5 - UN6) in chiller operating mode
	When the value measured by the pressure probe is > (UN7 +UN8) in heat pump operating mode
	In any case, when the time of parameter UN17 has elapsed
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	No
Devices	**Behaviour in the event of an alarm**
All devices	Follow their control

3.4.7 Low superheating alarm

The alarm refers to the refrigerant circuits and its occurrence causes the relevant compressors to stop.

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	30	10 s	Low superheating function activation delay
Et37	2.0	°C	Chiller - Low superheating protection threshold
Et54	2.0	°C	Heat pump - Low superheating protection threshold
Et76	60	s	Low superheating alarm delay

Alarm code	**AL170 for circuit 1, AL171 for circuit 2, AL172 for circuit 3 and AL173 for circuit 4**
Reason for activation	If the measured superheating value is lower than threshold ET37 for a time longer than the sum of the values set in parameters ET30 and ET76
Automatic reset	Until the number of occurrences in one hour set in parameter PAL4 is reached
Manual reset	When the number of occurrences in one hour set in parameter PAL4 is exceeded
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	YES
Devices	**Behaviour in the event of an alarm**
Compressors	Only those of the circuit involved are switched off
The other devices	They follow their control

In the event of a low superheating alarm, make sure the valve is working correctly using the manual controls.

If the alarm persists, contact the manufacturer.

3.4.8 Expansion module XEV20D not connected alarm

If communication between the controller and an expansion module stops or there is no power to an expansion module, the valve is closed after 5 seconds.

Alarm code	**AL160 for circuit 1, AL161 for circuit 2, AL162 for circuit 3 and AL163 for circuit 4**
Reason for activation	Non-communication between the controller and relevant expansion module XEV20D
Reset	If the module is disabled or resumes communication
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Compressors	The compressors of the circuit involved are switched off
The other devices	They follow their control

3.5 Compressor alarms

The alarms of a compressor are:

- compressor overload protection
- compressor oil level
- inverter offline.
- compressor maintenance;

3.5.1 Compressor Overload Protection Alarm

Alarm code	**AL18, AL19, AL20, AL21, AL22, AL23, AL24, AL25, AL26, AL27, AL28, AL29, AL30, AL31, AL32, AL33**
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
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

The digital input activating the “compressor thermal overload protection” alarm can be used to connect the alarm contact of various devices.

To trace back the cause of the alarm, refer to the wiring diagram of the unit where the contacts of the connected devices are shown.

3.5.2 Compressor maintenance alarm

Alarm code	**AL127, AL128, AL129, AL130, AL131, AL132, AL133, AL134, AL135, AL136, AL137, AL138, AL139, AL140, AL141, AL142**
Reason for activation	This is detected when the work hours of the compressor exceed the set limit
Reset	Upon deletion of the hours in the Service or Maintenance menu
Alarm icon	Flashing
AlarmLog	YES
Devices	**Behaviour in the event of an alarm**
Compressor in alarm	Follows its control
All	They follow their control

3.5.3 Oil level alarm

Alarm code	**AL51, AL52, AL53, AL54**
Reason for activation	This is detected after the compressor is switched on
	It is detected when the digital input is open
	This is delayed by the value of "PAL14" on starting the compressor and by "PAL15" during operation
Reset	With the value of parameter "PAL16" at "0", only service personnel can reset the manual alarm
Alarm icon	Flashing
AlarmLog	YES
Devices	**Behaviour in the event of an alarm**
Compressor in alarm	Always switched off
All	They follow their control

3.5.4 Inverter blocked alarm

Alarm code	**AL309 General inverter alarm in compressor 1, AL310 General inverter alarm in compressor 2**
	The alarm code is present in the "Trip Code" part of the inverter information screen
Reason for activation	This is detected through serial communication with the inverter
Reset	With elimination of the alarm on the inverter
Reset mode	Automatic, with a number of occurrences per hour smaller than or equal to PAL23
	Manual, with a number of occurrences per hour greater than PAL23
Alarm icon	Flashing
AlarmLog	YES
Devices	**Behaviour in the event of an alarm**
Compressor in alarm	Always switched off
Other compressors	They follow their control
Other devices	They follow their control

3.5.5 Alarm for compressor operation outside envelope

Alarm code	**AL305 Inverter in compressor 1 out of envelope, AL306 Inverter in compressor 2 out of envelope,**
Reason for activation	Operating conditions outside the envisaged envelope
Reset	When the compressor is switched off
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	YES
Devices	**Behaviour in the event of an alarm**
Compressor in alarm	After switch-off, it gets restarted following the regulation.
Other compressors	They follow their control
Other devices	They follow their control

3.5.6 Inverter offline alarm

Alarm code	**AL166 for compressor 1, AL167 for compressor 2**
Reason for activation	Disconnection of the serial connection with the inverter of the relevant compressor
Reset	Restoration of the serial connection
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	YES
Devices	**Behaviour in the event of an alarm**
Compressor in alarm	Always switched off
Other compressors	They follow their control
Other devices	They follow their control

3.6 Probe error alarms

The temperatures and pressures that concern the management of the unit 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.

3.6.1 Temperature probes

Discharge gas temperature probe error

Alarm code	**AL61 for circuit 1, AL62 for circuit 2, AL63 for circuit 3 and AL64 for circuit 4**
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	Yes
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

Bypass temperature probe error

Alarm code	**AL325**
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	Yes
Devices	**Behaviour in the event of an alarm**
Unit pump	Operation at the set speed in manual mode
Bypass valve	Where fitted, operation is according to the opening percentage setpoint in manual mode.
The other devices	They follow their control

User inlet water temperature probe error

Alarm code	**AL65 \ AL265**
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	Yes
Devices	**Behaviour in the event of an alarm**
Compressors	All the compressors of the unit switched off
The other devices	They follow their control

User outlet water temperature probe error

Alarm code	**AL66 / AL266 for circuit 1, AL67 / AL267 for circuit 2, AL68 / AL268 for circuit 3 and AL69 / AL269 for circuit 4**
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	Yes
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

User common outlet water temperature probe error

Alarm code	**AL70**
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	Yes
Devices	**Behaviour in the event of an alarm**
All devices	Deactivated

Error in recovery system/desuperheater water temperature probes

Alarm code	**AL71 water temperature in common recovery inlet; AL80 water temperature in common recovery outlet**
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	Yes
Devices	**Behaviour in the event of an alarm**
Recovery	Recovery of the whole unit deactivated
The other devices	They follow their control

System return water temperature probe error

Alarm code	**AL81**
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	Yes
Devices	**Behaviour in the event of an alarm**
Free cooling function	Deactivated
The other devices	They follow their control

Ambient air temperature probe error

Alarm code	**AL83**
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	Yes
Devices	**Behaviour in the event of an alarm**
Free cooling function	Deactivated
Dynamic set point	Deactivated if depends on the air temperature
The other devices	They follow their control

Coil temperature probe error

Alarm code	**AL84 for circuit 1, AL85 for circuit 2, AL86 for circuit 3 and AL87 for circuit 4**
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	Yes
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

Suction temperature probe error

Alarm code	**AL102 for circuit 1, AL103 for circuit 2, AL104 for circuit 3 and AL105 for circuit 4**
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	Yes
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

Multilogic system inlet and outlet water temperature probe error

Alarm code	**AL149 System inlet temperature; AL150 System outlet temperature**
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	Yes
Devices	**Behaviour in the event of an alarm**
Unit	All the units change from Multilogic operation to stand-alone operation
The other devices	They follow their control

Error in secondary circuit water temperature probes

Alarm code	**AL133 Error: probe in secondary circuit 1 AL134 Error: probe in secondary 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	Yes
Devices	**Behaviour in the event of an alarm**
System valve and pump	Registration of the concerned 3-way valve is disabled: the valve opens at the standby position set in parameter “PID89”. The pump is disabled.
The other devices	They follow their control

3.6.2 Pressure probes

High pressure probe error

Alarm code	**AL94 for circuit 1, AL95 for circuit 2, AL96 for circuit 3 and AL97 for circuit 4**
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	Yes
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

Low pressure probe error

Alarm code	**AL98 for circuit 1, AL99 for circuit 2, AL100 for circuit 3 and AL101 for circuit 4**
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	Yes
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

Pressure probe error in system delivery and return lines

Alarm code	**AL323 system delivery line; AL324 system return line**
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	Yes
Devices	**Behaviour in the event of an alarm**
Unit pump	Operation at the set speed in manual mode
Bypass valve	Where fitted, operation is according to the opening percentage setpoint in manual mode.
The other devices	They follow their control

Error in pressure sensor of heat exchanger

Alarm code	**AL111 heat exchanger pressure transducer**
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	Yes
Devices	**Behaviour in the event of an alarm**
Unit pump	Operation at the set speed in manual mode
Bypass valve	Where fitted, operation is according to the opening percentage setpoint in manual mode.
The other devices	They follow their control

Dynamic set point signal error

Alarm code	**AL112**
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	Yes
Devices	**Behaviour in the event of an alarm**
Dynamic set point	The set point value will correspond to the highest limit if the measured value is higher than the maximum value
	The set point value will correspond to the lowest limit if the measured value is lower than the minimum value
The other devices	They follow their control

Amperometric transformer signal error

Alarm code	**AL113**
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	Yes
Devices	**Behaviour in the event of an alarm**
Limitation of refrigeration capacity	The limitation managed by the drawn current is deactivated
The other devices	They follow their control

3.7 System alarms

The unit can be incorporated in a system where it is required to communicate with other controllers serially.

Where communication problems occur, alarms are managed that vary according to the system type.

3.7.1 Alarms in Multilogic and Multifree systems

The alarms linked to this function trigger whenever a problem is experienced with the Master setup parameters, the network communication, the status of the featured Slave units, and the additional probes connected to the Master.

Communication alarms

AL15	**Units not aligned**
Reason for activation	It is displayed in the Master unit when one or more connected Slave units are not available for operation. AL15 appears if a Slave unit is OFF from the keyboard or a digital input or if the mode of a Slave unit is set differently from the Master.
Reset	When operation of the Slave unit that generated it is restored
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Master	Follows the control and divides the required capacity on the connected Slave units
Other units	They follow their control

AL16	**Communication error between units**
Reason for activation	It is displayed in the Slave units when there is no communication with the Master.
Reset	When communication is restored
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Master	If a Slave is not communicating, the Master follows the setpoint and splits the required capacity to the connected Slave units.
	If the Master remains isolated, it either operates autonomously or remains in standby, according to the value set in parameter MS4.
Other units	The Slave units connected follow the setting of the Master.
	Slave unit alarmed - it either operates autonomously or remains in standby, according to the value set in parameter MS47.

Probe alarms

AL149	**Err Temp. input plant (Multilogic)**
AL150	**Err Temp. output plant (Multilogic)**
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	Yes
Devices	**Behaviour in the event of an alarm**
Unit	All the units change from Multilogic operation to stand-alone operation
The other devices	They follow their control

Configuration alarms

ACF13	**Multilogic network configuration alarm**
Reason for activation	It is displayed in the Master when the priority level is not assigned correctly to the networked units.
Reset	When the priority level is assigned correctly to the units of the network
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Unit	Maintains the "OFF" state that should have been set before modifying the "MS" parameters
The other devices	They follow their control

3.7.2 Alarms in systems with Smart Link+ function

Alarms connected to this function warn about communication failure between the refrigerant unit and the ventilating units, with respect to the set-up parameters.

Communication alarms

AL386 ... AL395	**Ventilating unit AHU1 ... AHU10 offline**
Reason for activation	This alarm appears when no ventilating unit is connected to the allocated address.
Reset	Connect the ventilating unit if it is not connected.
	Set the correct serial address.
	Disable the unit connected to the alarmed address.
Reset mode	Automatic
Alarm icon	Flashing
AlarmLog	Yes
Alarm relay	Yes
Devices	**Behaviour in the event of an alarm**
Unit	Operation continues with the other units that are correctly connected.

3.8 Configuration alarms

The controller management software ensures that the configuration of the unit is consistent with that of the I/O and, in general, with the functions present.

In the event of inconsistency, the controller reports the reason through codes.

The codes managed with the descriptions of the causes generating them are shown in the table.

Code	Description
ACF1	Configuration file error
ACF2	Free cooling parameter configuration error
ACF3	ACS parameter configuration error
ACF4	inlet outlet configuration error
ACF5	On/off, set point parameter configuration error
ACF6	Circuit parameter configuration error
ACF7	Pump parameter configuration error
ACF8	Compressor parameter configuration error
ACF9	Antifreeze heater parameter configuration error
ACF10	Fan parameter configuration error
ACF11	Defrost parameter configuration error
ACF12	Auxiliary relay parameter configuration error
ACF13	Multilogic parameter configuration error
ACF14	not necessary
ACF15	Heat recovery parameter configuration error

These alarms may appear if the parameters that manage the functions or updates of the controller are changed.

If this should occur, contact the customer service centre, reporting the alarm code that appears on the display.

4 FAQ

4.1 Frequently Asked Questions

The necessary instructions for working on the controller, with regard to the main functions of the unit, are given below.

4.2 Switching the unit on and off

4.2.1 Switch the unit on and off from the keypad

In order to switch the unit on and off from the keypad, make sure the feature is active.

Press, for more than 2 seconds, the button with ⏻.

4.2.2 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 "2" present in the terminal board.

The external OK signal must be a potential-free contact.

4.2.3 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.

4.3 Changes in operation

4.3.1 Change of operating mode from cooling to heating from the keypad

In order to change the operating mode from the keypad, make sure the feature is active.

The change of operating mode takes place with the unit switched off.

If the operation takes place with the unit running, the unit will switch off automatically when the change is made.

Switch off the unit by pressing, for more than 2 seconds, the button ⏻.

With the unit switched off, press button MENU , and then confirm with ENTER and finally, press, for more than 2 seconds, the button ❄ that will become ☀ for operation in heating mode.

Press the button again ⏻ on the main screen to restart the unit.

4.3.2 Change of operating mode from heating to cooling and vice versa from external OK signal

In order to change operating mode from the external OK signal, make sure the feature is active.

The change of operating mode from the external OK signal is present as an alternative to the change from the keypad.

If there is provision in the unit for the change of operating mode from the external OK signal, it must be open for operation in cooling mode and closed for operation in heating mode.

Terminals "1" and "8" are present in the terminal board for connection of the external OK signal.

During the status change, the unit goes into standby and then into the destination mode.

The external OK signal must be a potential-free contact.

4.3.3 Change of operating mode from heating to cooling and vice versa from the BMS

The change of operating mode from the BMS is equivalent to the change from the keypad, and therefore it is an alternative to the change from digital input.

In order to switch the unit on and off from the BMS, make sure the feature is active.

See dedicated BMS management document.

4.4 Changing the setpoint

4.4.1 Change of the set point in cooling operating mode from the keypad

Press the button MENU , press twice on button ENTER .It is now possible to change the set point value, within the set limits, with buttons ▲ and ▼ .

The value must be confirmed by pressing the button ENTER .Pressing twice on the button ESC returns to the main screen.

4.4.2 Change of set point in heating operating mode from the keypad

Press the “Menu” button, after the first pressing of the button ENTER move the cursor to the winter setpoint by pressing the button ▼ and then confirm with the button ENTER .It is now possible to change the value of the set point, within the set limits, with the buttons ▲ and ▼ .

The value must be confirmed by pressing the button ENTER .Pressing twice on the button ESC returns to the main screen.

4.4.3 Change of set point in heating operating mode 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.

4.4.4 Change of the second set point in cooling operating mode from the keypad

Press the button MENU , button ENTER , button ◀ and then button ENTER .It is now possible to change the value of the second set point, within the set limits, with buttons ▲ and ▼ .

The value must be confirmed by pressing the button ENTER .On pressing button ▶ and pressing twice on button ESC returns to the main screen.

4.4.5 Change of the second set point in heating operating mode from the keypad

Press the button MENU , button ENTER , button ◀ , button ▼ and then button ENTER .It is now possible to change the value of the second set point, within the set limits, with buttons ▲ and ▼ .

The value must be confirmed by pressing the button ENTER .On pressing button ▶ and pressing twice on button ESC returns to the main screen.

4.4.6 Change of the set point from external OK signal

If the double set point from external OK signal is included in the unit, with OK signal open, the first set point is active, and with OK signal closed, the second set point is active.

Terminals "200" and "206" are present in the terminal board for connection of the external OK signal.

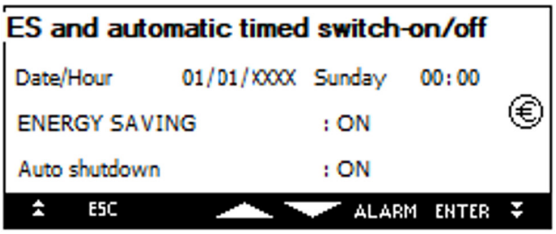
The external OK signal must be a potential-free contact.

4.4.7 Time band setup procedure

A click on the “MENU” button in the main screen gives access to the “MENU” screen.

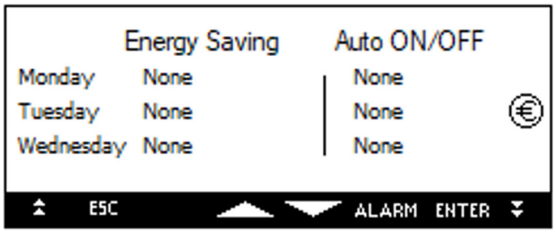
Use the “arrow down” button to select “ENERGY SAVING” and press “ENTER” to confirm and thus access the menu with the function setup screens.

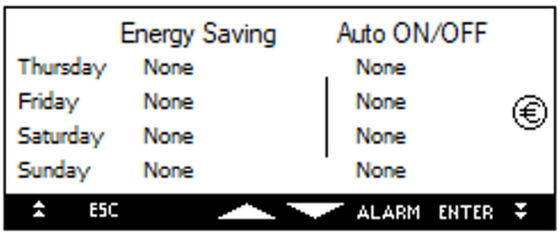
The first screen is used to enable the “Energy saving” and “Auto shutdown” functions.



The second screen is used to define the three time bands specifying the start and end time. The time can be set up in intervals of ten minutes each.

The third and the fourth screens are used to allocate each week day a time band or a combination of the three time bands contemplated for the “Energy saving” and “Auto ON/OFF” functions.





When the unit is switched to “OFF” based on the time band, the symbol of a clock appears in the main screen under the text “OFF”.

When the “Energy saving” function is active, which changes the operating setpoint of the unit, the symbol “€” appears on the right-hand side of the screen.

4.5 Managing recovery

4.5.1 Activate and deactivate recovery from the keypad

From the main screen, press button to move around in the recovery management screen.

On pressing and holding down, for 2 seconds, button recovery will be deactivated.

On pressing and holding down, for 2 seconds, button recovery will be activated.

On pressing button ESC returns to the main screen.

4.5.2 Activate and deactivate recovery from external OK signal

If activation of recovery from external OK signal is included in the unit, with OK signal closed, recovery is active and with OK signal open, recovery is not active.

Terminals "1" and "8" are present in the terminal board for connection of the external OK signal.

The external OK signal must be a potential-free contact.

If activation of recovery from external OK signal is included in the unit, so that the controller can manage recovery, the external OK signal must be closed and recovery must have been activated from the keypad.

4.5.3 Change of the recovery set point from the keypad

From the main screen, press button to move around in the recovery management screen.

After pressing button ENTER it is possible to change the recovery set point value, within the set limits, with buttons and .

The value must be confirmed by pressing the button ENTER .

On pressing button ESC returns to the main screen.

4.6 Management from BMS

4.6.1 RS485 serial connection

The connection must be made through serial port **“RS485 B”** using terminals 97, 98 and 99, based on the indicated polarities.

Terminal "99", marked with "gnd", should be used only if you are certain it is not earthed.
The serial communication works even without its connection.

Connection of the "gnd" terminal to earth will damage the controller with consequent shutting down of the unit.

4.6.2 RS485 serial line

Starting from the Master, the serial connection must be made by connecting one unit after another on the terminals of the relevant board in accordance with standard RS-485.

No more than two wires can be present on the same terminal.

The end of line impedance can be inserted using the jumper in the board only if the unit is the last slave of the serial line.
The jumper is normally inserted in only one of the two connectors.
The end of line impedance is inserted by placing the jumper on both connectors.

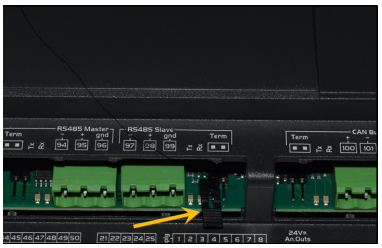


Fig. 65 Jumper inserted in only one connector

4.6.3 Enable ON/OFF from the BMS

In the service branch, if you select icon  and on confirming with button **ENTER** you will access the "Parameter Programming" branch.
In the "Parameter Programming" branch, select the "SP" group and confirm with **ENTER** .
Set parameter "SP6" to "1".

With activation of "ON/OFF" from the BMS, activation from the keypad and from digital input remain active.
To start the unit, there must be the OK signal of all of them, but to stop it, the absence of just one OK signal is sufficient.

Enabling of "ON/OFF" from the BMS prevents the change of set point from the keypad.

4.6.4 Enable the change of operating mode from the BMS

In heat pump units, for the change of operating mode from cooling to heating and vice versa from the BMS, besides setting parameter "SP6" to "1", as described in the previous point, it is necessary to also set parameter "SP9" to "0".

Enabling of the change of operating mode from the BMS prevents the change of operating mode from digital input.

Enabling of the change of operating mode from the BMS prevents the change of set point from the keypad.

4.6.5 Enable the change of set point from the BMS

In the service branch, if you select icon  and on confirming with button ENTER you will access the "Parameter Programming" branch.

In the "Parameter Programming" branch, select the "SP" group and confirm with ENTER .

Set parameter "SP6" to "1".

Refer to the dedicated BMS management document as regards the variables involved.

Enabling of "ON/OFF" from the BMS prevents the change of set point from the keypad.

4.6.6 Enable the change of operating mode from I/O

In heat pump units, to enable the change of operating mode from cooling to heating and vice versa from digital input, in the service branch, if you select icon  and on confirming with button ENTER you will access the "Parameter Programming" branch.

In the "Parameter Programming" branch, select the "SP" group and confirm with ENTER .

Set parameter "SP9" to "1".

4.6.7 Change of the settings of the "BMS" serial communication

After entering the service branch with password, using button  select icon  and confirm with button ENTER .

In the "Control panel" menu, using button  select "System information" and confirm with button ENTER.

With buttons  ,  and ENTER it is possible to move around the screen and edit the parameters.

After making the change, wait for the controller to restart, which will take about 60 seconds.

4.7 Resetting of partial counters

4.7.1 Resetting the compressor hours of operation and starts

The number of hours of operation of the compressors can be reset in the loop of screens dedicated to Service or in the Maintenance screens.

For resetting in the Service branch, see the relevant "Compressors" chapter

The "Maintenance" loop screens are present in the "info" branch.

In the "info" branch, when the screens showing the number of hours of operation of the compressors are accessed, the following icon is present:  .

When you press the button under icon  you will access the main screen of the maintenance loop.

The maintenance branch is password protected.

The password is "200".

With buttons  ,  set the correct password and confirm with button ENTER to access the first of the protected screens.

In the first screen, the following symbols are present:  and  .

With buttons  ,  select the compressor symbol in reverse video and confirm with button ENTER to access the modification screens.

With buttons  ,  select the compressor and, using button RESET HOURS reset the hours of operation.

4.7.2 Resetting the number of starts of the compressors

The number of starts of the compressors can be reset in the loop of screens dedicated to Service or in the Maintenance screens.

For resetting in the Service branch, see the relevant "Compressors" chapter

The "Maintenance" loop screens are present in the "info" branch.

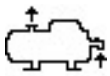
In the "info" branch, when the screens showing the number of starts of the compressors are accessed, the following icon is present:  .

When you press the button under icon  you will access the main screen of the maintenance loop.

The maintenance branch is password protected.

The password is "200".

With buttons  ,  set the correct password and confirm with button ENTER to access the first of the protected screens.

In the first screen, the following symbols are present:  and  .

With buttons  ,  select the compressor symbol in reverse video and confirm with button ENTER to access the modification screens.

With buttons  ,  select the compressor and, using button RESET STARTS the number of starts is reset.

4.7.3 Resetting of the number of hours of operation of the pumps

The number of hours of operation of the pumps can be reset in the loop of screens dedicated to Service or in the Maintenance screens.

For resetting in the Service branch, see the relevant "Pumps" chapter

The "Maintenance" loop screens are present in the "info" branch.

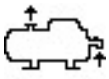
In the "info" branch, when the screens showing the number of hours of operation of the pumps are accessed, the following icon is present:  .

When you press the button under icon  you will access the main screen of the maintenance loop.

The maintenance branch is password protected.

The password is "200".

With buttons  ,  set the correct password and confirm with button ENTER to access the first of the protected screens.

In the first screen, the following symbols are present:  and  .

With buttons  ,  select the pump symbol in reverse video and confirm with button ENTER to access the modification screens.

With buttons  ,  select the pump and, using button RESET HOURS reset the hours of operation.

4.8 Controller functions

4.8.1 Updating the time and date of the controller

Since these updates require a reboot of the controller, the unit must be "OFF" in order to do them.

From the main screen, press button MENU .

Pressing twice on the button ▼ select "CONFIG", confirm with button ENTER to enter the "Configuration" screen, and confirm again with button ENTER to enter the "Date/Time" screen.

With buttons ▲ , ▼ and ENTER it is possible to move around the screen and edit the parameters.

After the parameters have been updated, when you press on button SET the changes made are confirmed and the controller is restarted.

4.8.2 Changing the IP addresses

Since these updates require a reboot of the controller, the unit must be "OFF" in order to do them.

To change an IP address, see the relevant chapter in the "Controller manual".

After making the change, wait for the controller to restart, which will take about 60 seconds.

4.8.3 Recovery of the “Service” password

The password is available on the SAP portal

4.9 Replacements

4.9.1 Replacing the electronic expansion valve driver

To replace the driver, strictly follow the instructions given below.

1. Put the unit in the off state.
2. Turn off the power to the electrical control panel.
3. Disconnect and uninstall the old driver.
4. Correctly address the new driver using the dip switches.
5. Install the new driver by connecting only the CAN-Bus connector and the power connector.

Do not connect the connector of the electronic valve.

After powering up the electrical control panel again, continue as follows.

6. Wait for the “screensaver” screen to appear on the display to be certain that the controller has fully started (during this time, the controller sends the driver the operating parameters).
7. After the controller has fully started, turn off the power to it again.
8. Complete the connection of the driver by connecting the valve connector.

Now the unit can be powered up and its operating state restored.

If necessary, this procedure can be carried out for several drivers at the same time.

4.10 WEB pages

The web server integrated in the controller is accessed through the Ethernet port. Access to these pages requires the user to know his/her IP address.

The factory-set IP address is 10.2.3.20

The set IP address is in any case displayed in one of the controller screens. The steps to access the screen with the IP address are as follows:

- go to the main screen and press the “menu” button;
- use the arrows to select “CONFIG” and press “ENTER”;
- select “SYSTEM INFORMATION” and press “ENTER” to access the screen with the IP address.

4.10.1 Access to controller WEB pages

Access to the WEB pages is gained as follows:

- open a web browser of your PC (FireFox, IE, etc.)
- in the address bar, type in 10.2.3.20 or the modified IP address;
- login

enter the Username, i.e. user1;

enter the Password, i.e. pwuser1.

It is now possible to browse the WEB pages of the controller.

4.10.2 Where to find the controller “MAC address”

Go to the user interface and follow the path: Menu -> CONFIG -> System information.

Use the WEB pages to access the “Information” screen.

4.11 Swegon Inside

4.11.1 The unit can be connected to Swegon INSIDE.

All the units are supplied with an identification certificate “ID” which is required to connect them to Swegon INSIDE.

The minimum conditions below must be checked for the connection of units manufactured before 2024 to Swegon INSIDE:

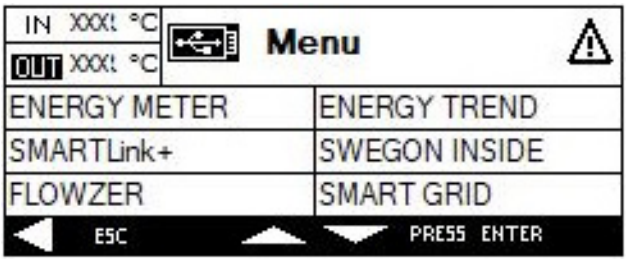
- controller iPro, code MIDX125A or MIDX126A;
- user interface, code MIDX130.
- App Version 711.138.129;
- HMI Version 7*.*.*;
- Web Version 711.146.42.

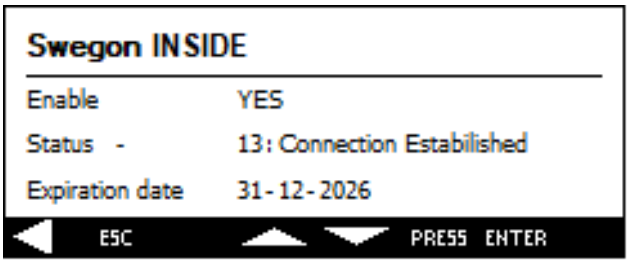
If problems are experienced, please contact the Swegon after-sales service network.

4.11.2 How to access the Swegon INSIDE screens in the unit

Access with the user interface

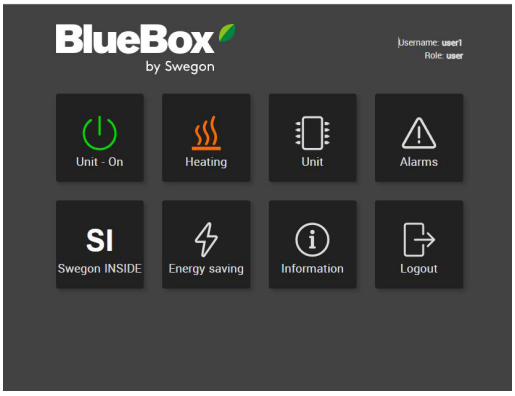
Access to this function is gained by selecting “Swegon INSIDE” in the Menu page.

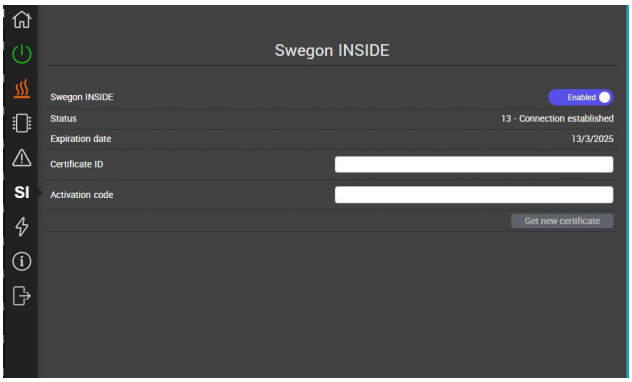




Access with the Web pages

Access to this function is gained by selecting “YES” Swegon INSIDE in the main page.

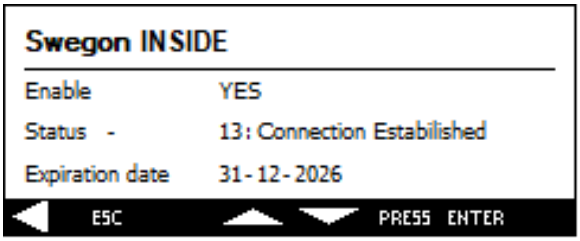




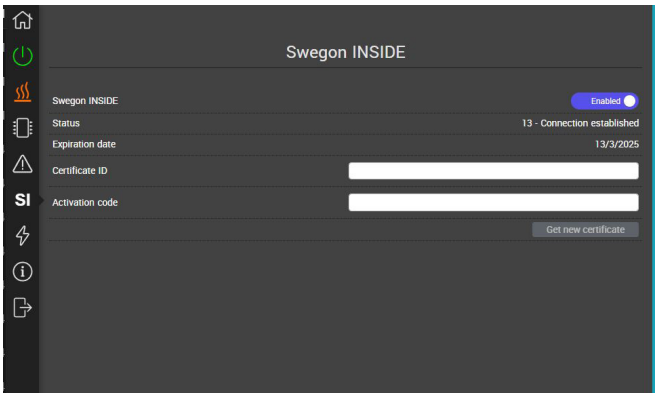
4.11.3 How to enable/disable Swegon INSIDE

Access with the user interface

The Swegon INSIDE screen is used to enable/disable Swegon INSIDE.

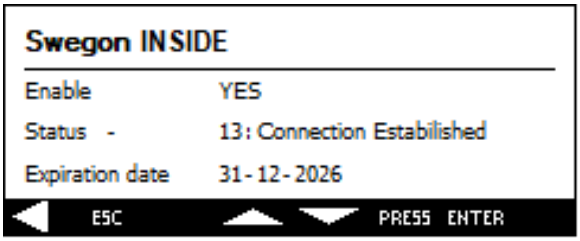


Access with the Web pages
The Swegon INSIDE screen is used to enable/disable Swegon INSIDE.

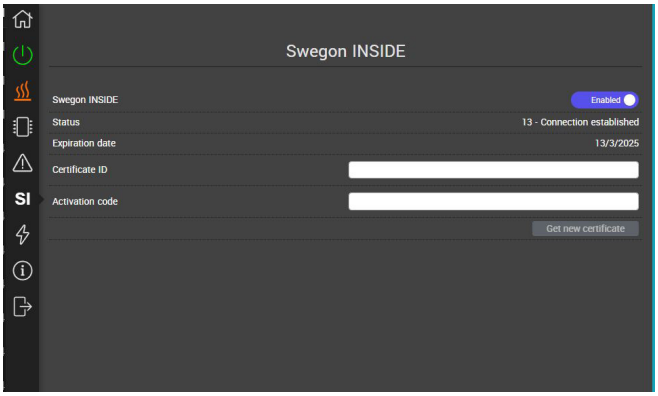


4.11.4 How to view the certificate expiry date

Access with the user interface
The expiry date of the certificate is visible in the Swegon INSIDE screen.



Access with the Web pages
The expiry date of the certificate is visible in the Swegon INSIDE screen.



4.11.5 Validity of ID certificate for connection to Swegon INSIDE

The ID certificate is valid for 2 years from the date of unit factory acceptance testing and it is renewed automatically if the connection to the Swegon INSIDE portal is made within the validity term.

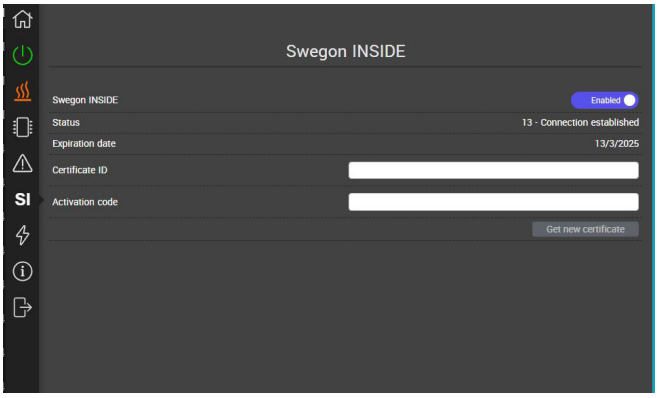
if the connection to the Swegon INSIDE portal is not made within the validity term of the ID certificate, the certificate expires.

4.11.6 What to do if the ID certificate has expired or is missing

If you need a new ID certificate, you have to access the Swegon portal - ref. section “**How to access the Swegon INSIDE portal”** - and click the link to ask for a new certificate.

Fill in the form and receive an alphanumeric code.

Enter the received information in the Swegon INSIDE web page of the unit controller.



Click “Receive new certificate”.

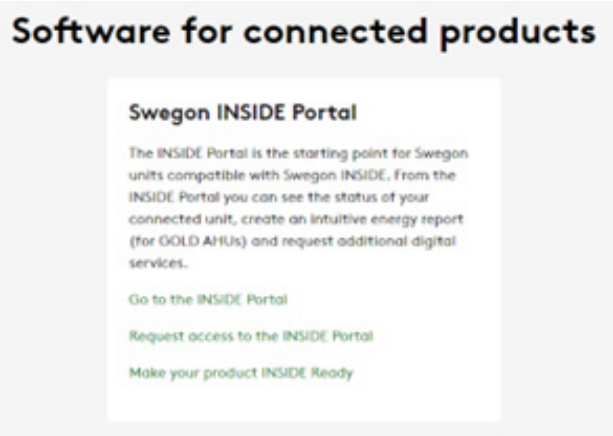
For the “Receive new certificate” field to be active, press the button on the top right-hand side to disable Swegon INSIDE.

It takes Swegon INSIDE around 30 seconds to be disabled.

4.11.7 How to gain access to the Swegon INSIDE portal

Access to the portal requires that the user creates his/her own account on our website (https://www.swegon.com/it/support/software/).

Scroll the page until “Software for connected products” and find the links required to access the portal, to create your account, and to ask for a new certificate.



Creating an account

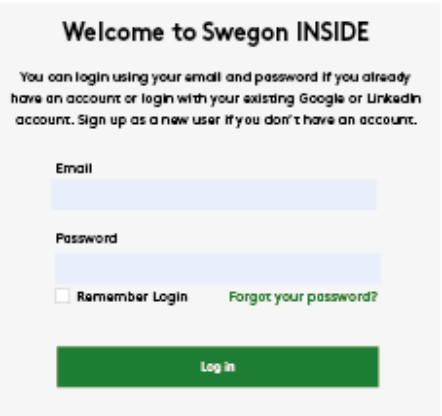
To create an account, click the link “Ask for access to INSIDE portal”, fill out the form with the required information, and then press “SUBMIT”.

Generating the request for a new certificate

To ask for a new certificate, click the link “Make your INSIDE product ready”, fill out the form with the required information, and then press “SUBMIT”.

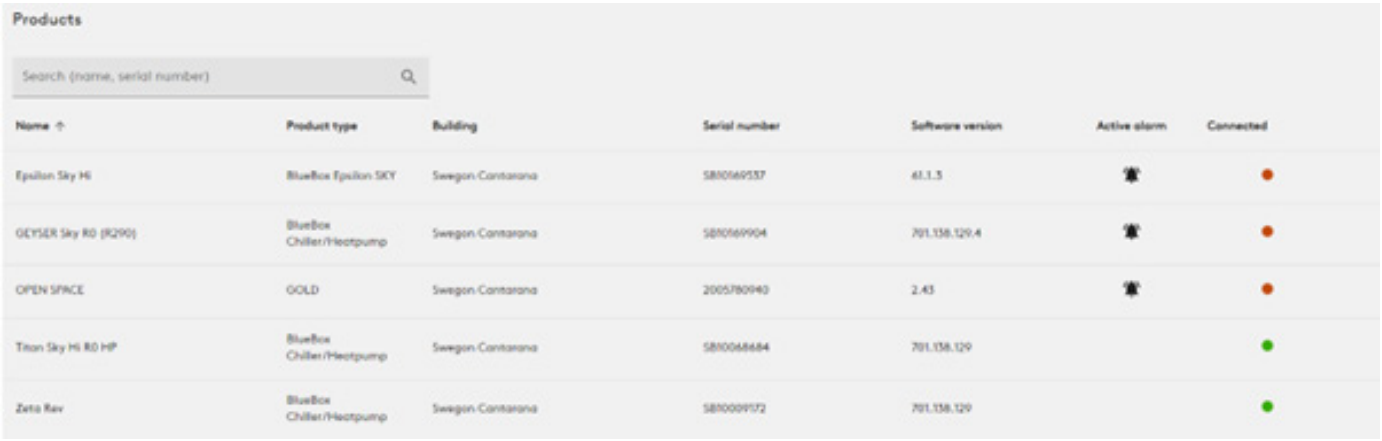
Select “Cooling & Heating” in the field “Select product”.

Create your account and register at least one unit, after which access the “log in” screen in the Swegon INSIDE portal.

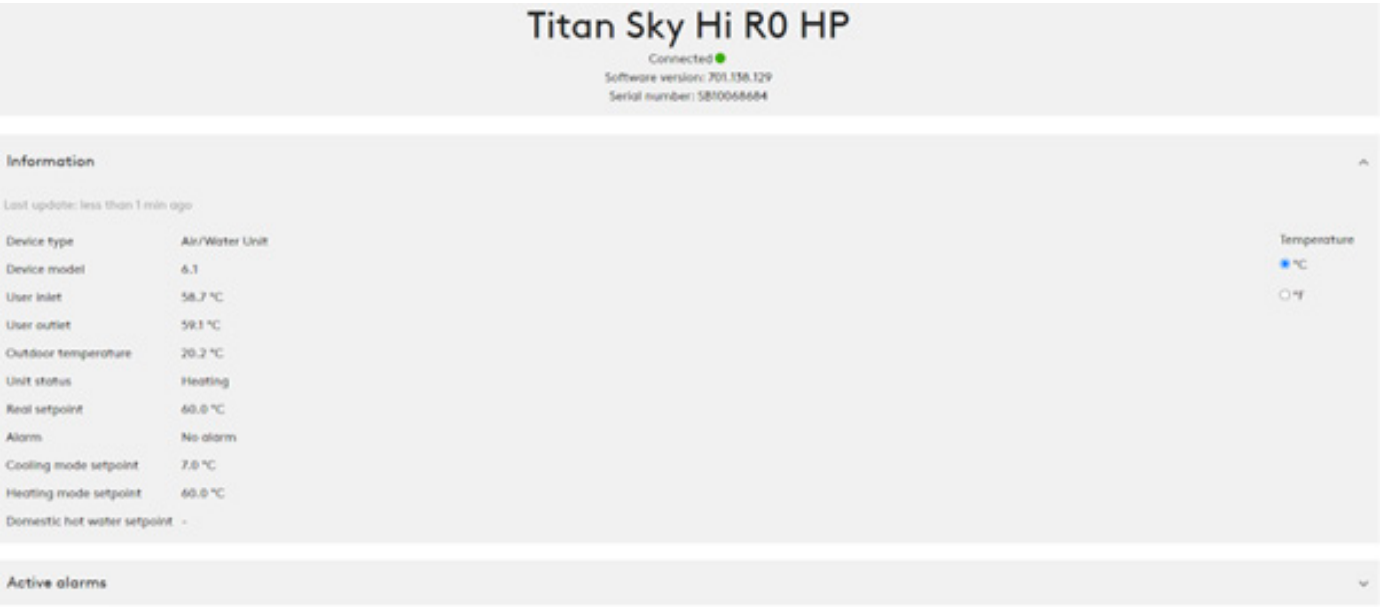


4.11.8 Information displayed in the Swegon INSIDE portal

The “Products” menu in the Swegon INSIDE portal gives access to the associated units.



The last registered operating status and active alarms, if any, are visible for units that have an active connection.



Page intentionally blank

Page intentionally blank

CM-A-S-0000-SW-KTM-V-A-EN-10-06-2024-rev10

Swegon Operations s.r.l.

Via Valletta, 5 - 30010
Cantarana di Cona, (VE) Italy - T. +39 0426 921111 - F. +39 0426 302222
www.blueboxcooling.com - info@swegon.it
Swegon Operations s.r.l. with sole shareholder - VAT no. 02481290282
Company directed and coordinated by Investment Latour (Sweden)

BlueBox by Swegon