Energy XT PRO
BaseLine Application [A00043xx]

SUMMARY

1 HOW TO USE THIS MANUAL

To facilitate use of the manual, customers may find the following useful:

Call-outs

Callout column:
Callouts on the topics described are placed to the left of the text to allow the user to find the desired information quickly.

Cross references

Cross references:
All the words in *italics* are listed in the index with a reference to the page where they are described in more detail;
the text below serves as an example:
"activation of the alarm stops the compressors"
The italics indicate that under Compressors in the index there is a reference to the page where compressors are described in more detail.
If the online Help on the PC is used, the words in italics become proper hyperlinks (automatic links activated with a click of the mouse) that connect the different sections in the manual and allow you to navigate through the document.

Highlighted icons

Some parts of the text are highlighted in the callout column using icons that have the following meanings:

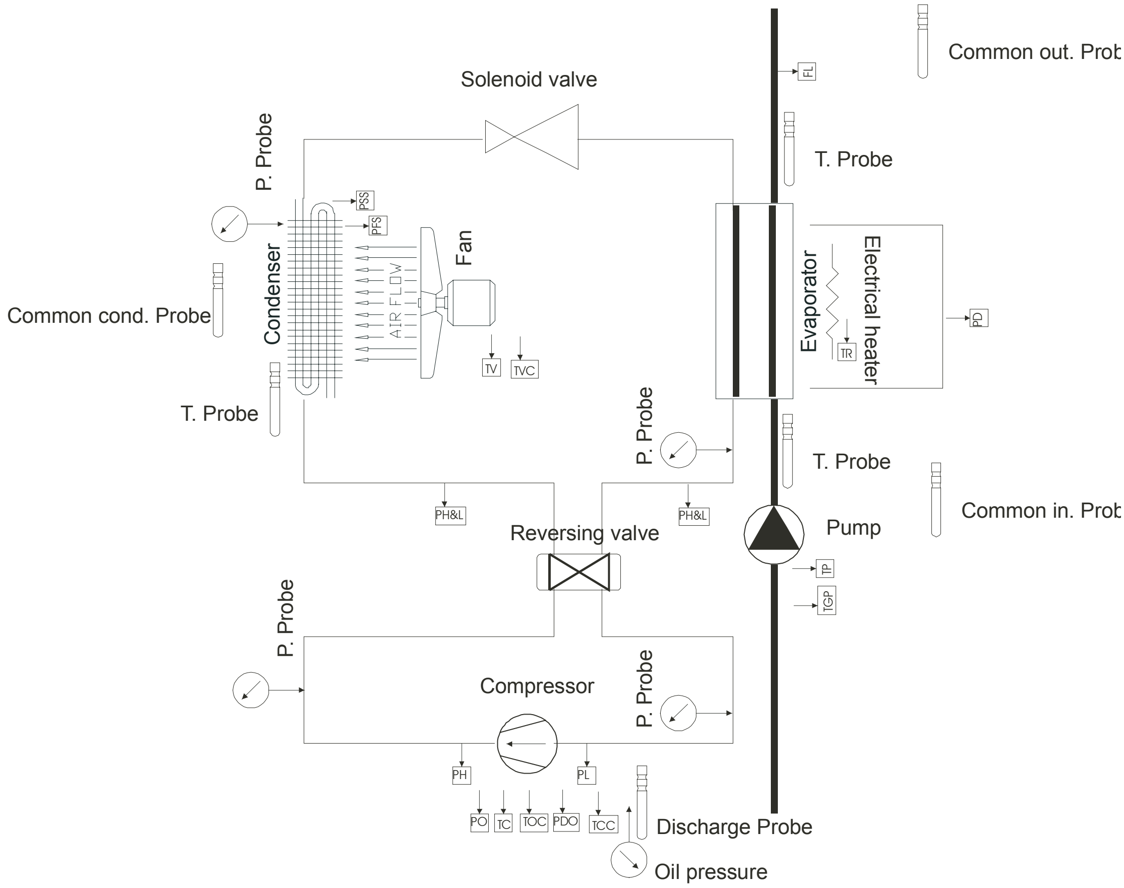
Note: draws attention to a specific topic that users should take into account.

Tip: highlights a suggestion that helps users to understand and use the information on the topic described.

Warning! : **highlights information that may damage the system or place persons, equipment, data, etc at risk if not known. These sections must always be read prior to use.**

2 SYSTEM CONFIGURATION

The Base-line chiller is a “water-air” type machine, which contains the following components:



Number of circuits	4
Number of evaporators	2
Number of condensers	4
Number of fan blocks	2

Number of fans per block	4 stepped or 1 continuous
Number of compressors	4 continuous
Number of pumps	2
Number of resistors	2

Compressor type

The application can manage up to 4 modulated compressors.

3 FUNCTIONS

Depending on parameter TREG_TEMP_SENS, heat regulation may be applied according to the water temperature at the outlet from the thermodynamic system, or the water at the inlet of the thermodynamic system.
The regulation setpoint is also calculated according to the status of parameter (TREG_TEMP_SENS); the following tables show the behaviour and status of the heat regulator according to the setting of the parameter:

Cold Mode

	TREG_TEMP_SENS	
	=ENTRY_SENSOR	=EXIT_SENSOR
heat regulation setpoint	CH_ENTRY_OFFSET+ CH_TSET_TEMP+ Dynamic setpoint correction	CH_TSET_TEMP+ Dynamic setpoint correction
Heat regulation sensor	PLAN_TEMP_INWATER_SENS_PHY	PLAN_TEMP_OUTWATER_SENS_PHY

Hot Mode

	TREG_TEMP_SENS	
	=ENTRY_SENSOR	=EXIT_SENSOR
heat regulation setpoint	HP_TSET_TEMP- CH_ENTRY_OFFSET+ Dynamic setpoint correction	HP_TSET_TEMP+ Dynamic setpoint correction
Heat regulation sensor	PLAN_TEMP_INWATER_SENS_PHY	PLAN_TEMP_OUTWATER_SENS_PHY

3.1 Types of heat regulation

The type of heat regulation applied can be selected by setting the TREG_FUNCTION parameter.
The Base-Line application allows the uses of two different methods:

- *Proportional heat regulation*
- *PI heat regulation*

3.1.1 Refrigeration power steps of the compressors

For this application, continuous screw compressors are used. Below we describe the working assumptions that have been made in order to "quantify" *compressor* power in steps, and so apply *PROPORTIONAL heat regulation* (P.I.).
In particular, we briefly explain the operation of continuous screw compressors.

Each *compressor* must be associated with at least 3 (three) digital outputs, configured as

- *compressor* startup = KOMP_ACC_DO_i_PHY, i = *compressor* number "i"
- charging valve = KOMP_CHARGE_DO_i_PHY, i = *compressor* number "i"
- discharge valve = KOMP_DISCH_DO_i_PHY, i = *compressor* number "i"

We speak of three outputs, although, with part-winding or star-delta starting, the number of outputs could go up to 4 and 5 outputs respectively. In this application, there are 3 outputs.
The following table shows the number of continuous screw compressors that can be managed with the Energy XT PRO product:

Compressor type	**Type of *compressor* startup.**	**DO for *compressor***	**Number of compr. managed**
Continuous screw	Simple	3	4
Continuous screw	Part-winding or vacuum type	4	3
Continuous screw	Star-delta	5	2

The opening of the charging valve causes the slide valve to move to the suction side, increasing the rate of gas flow and therefore the *compressor* power; the opening of the discharge valve causes the slide valve to move to the discharge side, reducing the rate of gas flow and the power therefore falls to the minimum rated power of the *compressor*, typically 25%.
In maximum power conditions, the charging valve can remain open, and in minimum power conditions, the discharge valve can remain open.
As in the case of modulated screw compressors, the slide valve should be at the minimum power position when starting and when going down.

And now, a few definitions:

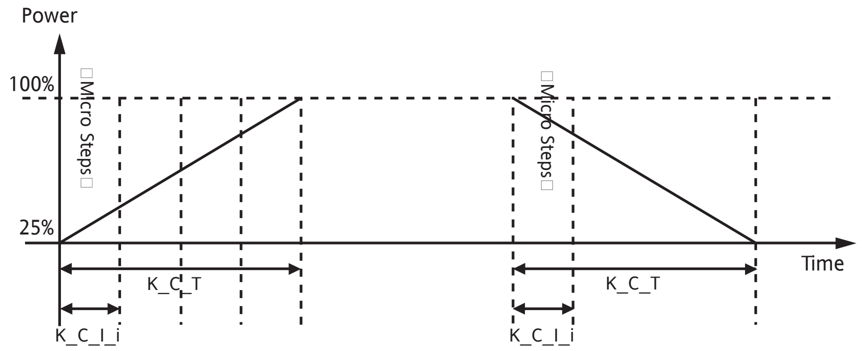
KOMP_CHARGEDISCH_IMPULSE_i = charge/discharge pulse of *compressor* number "i" (typically 0.5s, but must be configurable between 0 and 20s with a 1/10s resolution)

KOMP_CHARGEDISCH_TIME = total charge/discharge time of the compressors (from minimum to maximum extension, configurable between 0 and 250s)

Tpc = pause time when charging (configurable from 0 to 200s, with 1s resolution)
Tps = pause time when discharging (configurable from 0 to 200s, with 1s resolution)

If we assume that the *compressor* power output increases in a roughly linear way from minimum to maximum position (if not, let's assume that any resulting error is acceptable), then it is possible to divide the change in *compressor* power output between minimum (25% power output) and maximum position (100% power output) into intervals of equal power, which can be called “micro-steps”:

“The “micro-steps” for *compressor* "i" = KOMP_CHARGEDISCH_TIME / KOMP_CHARGEDISCH_IMPULSE_i



K_C_T	KOMP_CHARGEDISCH_TIME
K_C_I_i	KOMP_CHARGEDISCH_IMPULSE_i

Since the *compressor* goes up to 25% of its power output at startup, we can say that the first step is a “macro-step”. Consequently, the total number of *power steps* of the *compressor* becomes:

KOMP_STEP_i = 1 + KOMP_CHARGEDISCH_TIME / KOMP_CHARGEDISCH_IMPULSE_i; i = *compressor* number "i"

From the above, to ensure heat regulation and the integrity of the compressors, we can say that the following rules apply for machine *parameters:*

- MIN_OFFON_TIME ≥ KOMP_CHARGEDISCH_TIME
- CH_INC_STEP_TIME ≥ max(KOMP_CHARGEDISCH_IMPULSE_j ; j = 1...KompNo) + Tpc
- HP_INC_STEP_TIME ≥ max(KOMP_CHARGEDISCH_IMPULSE_j ; j = 1...KompNo) + Tpc
- CH_DEC_STEP_TIME ≥ max(KOMP_CHARGEDISCH_IMPULSE_j ; j = 1...KompNo) + Tps
- HP_DEC_STEP_TIME ≥ max(KOMP_CHARGEDISCH_IMPULSE_j ; j = 1...KompNo) + Tps
- PUMPGROUP_STARTUP_DELAY_TIME ≥ KOMP_CHARGEDISCH_TIME
- DF_INTER_STEP_TIME ≥ max(CH_INC_STEP_TIME, HP_INC_STEP_TIME, CH_DEC_STEP_TIME, HP_DEC_STEP_TIME)

These ensure that the compressors will operate in all functional cases. The following are particular cases arising from the *parameters* listed above.

***Compressor* "i" going down:**
MIN_OFFON_TIME ≥ KOMP_CHARGEDISCH_TIME
KOMP_CHARGE_DO_i_PHY = false
KOMP_DISCH_DO_i_PHY = true

Power stages of *compressor* "i"
CH_INC_STEP_TIME ≥ max(KOMP_CHARGEDISCH_IMPULSE_j ; j = 1...KompNo) + Tpc
HP_INC_STEP_TIME ≥ max(KOMP_CHARGEDISCH_IMPULSE_j ; j = 1...KompNo) + Tpc
KOMP_CHARGE_DO_i_PHY = true for time KOMP_CHARGEDISCH_IMPULSE_i, otherwise false
KOMP_DISCH_DO_i_PHY = false

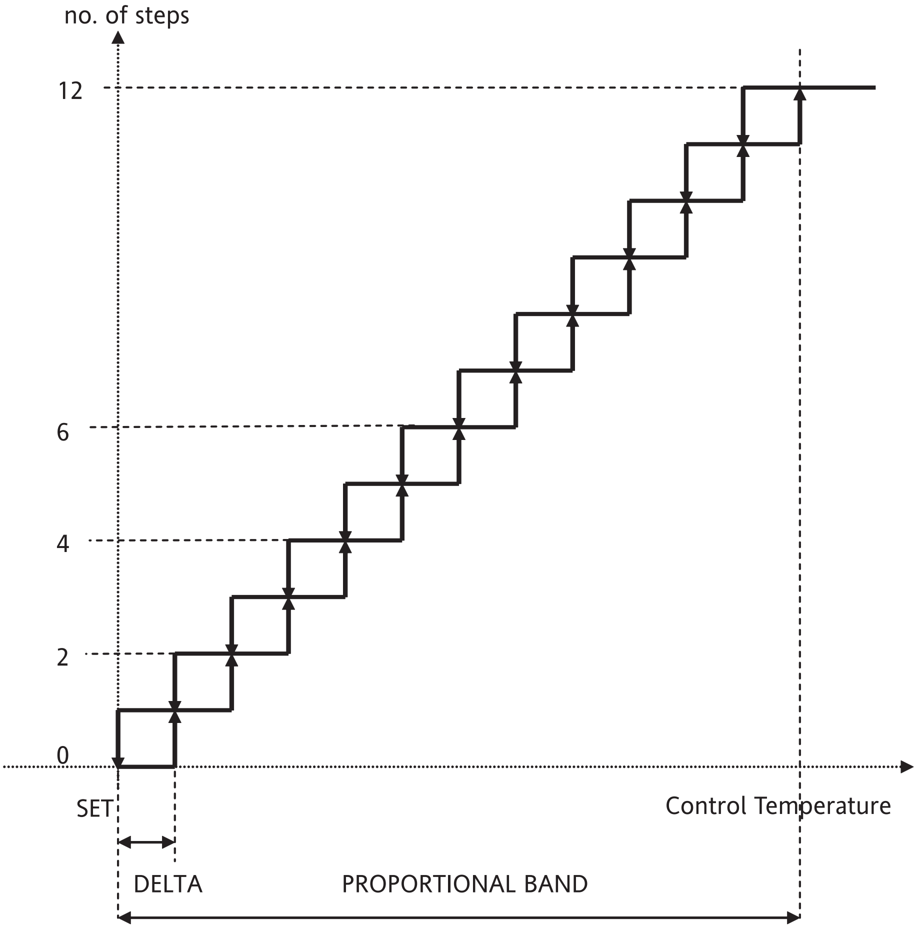
CH_DEC_STEP_TIME ≥ max(KOMP_CHARGEDISCH_IMPULSE_j ; j = 1...KompNo) + Tps
HP_DEC_STEP_TIME ≥ max(KOMP_CHARGEDISCH_IMPULSE_j ; j = 1...KompNo) + Tps
KOMP_CHARGE_DO_i_PHY = false
KOMP_DISCH_DO_i_PHY = true for time KOMP_CHARGEDISCH_IMPULSE_i, otherwise false

Compressors at machine startup (particularly after a Power-On or reset):
PUMPGROUP_STARTUP_DELAY_TIME ≥ KOMP_CHARGEDISCH_TIME
KOMP_CHARGE_DO_j_PHY = false ; j = 1...KompNo
KOMP_DISCH_DO_j_PHY = true ; j = 1...KompNo

3.1.2 Proportional heat regulation

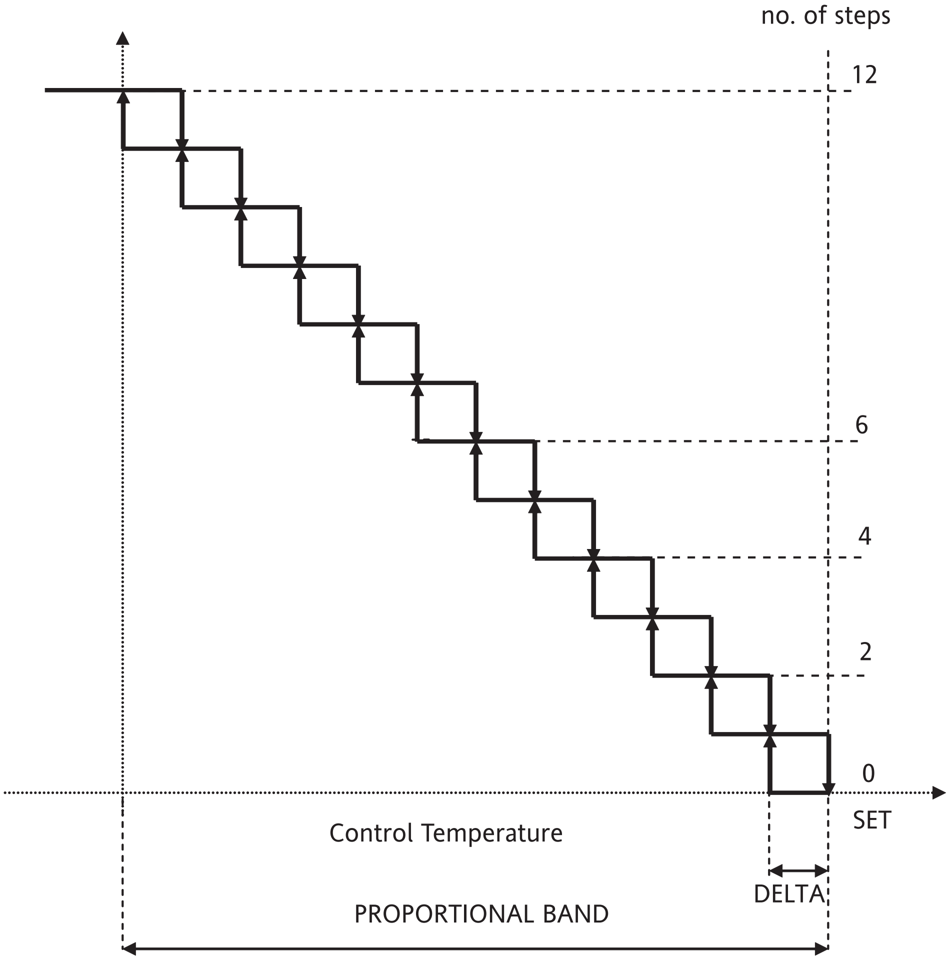
With this type of heat regulation, a specific number of refrigeration resources (*power steps*) is activated in order to reach the temperature indicated by the setpoint selected for heat regulation. Obviously, the number of *power steps* in order to reach the heat regulation setpoint is directly proportional to the difference between the temperature measured by the sensor and the temperature to be reached (setpoint).
The temperature interval between application of one power step and the next depends on the proportional band (CH_PROP_BAND/HP_PROP_BAND) and the number of resources present. Refer to the table below:

Cold Mode



SET:	Heat regulation setpoint
PROPORTIONAL BAND:	CH_PROP_BAND
DELTA:	CH_PROP_BAND/∑(KOMP_STEP_i +1) (where i=1... number of compressors)
Regulation temperature	Temperature measured by heat regulation sensor
Number of steps	[regulation temperature – SET]/DELTA

Hot Mode



SET:	Heat regulation setpoint
PROPORTIONAL BAND:	HP_PROP_BAND
DELTA:	HP_PROP_BAND/∑(KOMP_STEP_i +1) (where i=1... number of compressors)
Regulation temperature	Temperature measured by heat regulation sensor
Number of steps	[SET-regulation temperature]/DELTA

3.1.3 PI heat regulation

A PID type continuous regulator, and the digital version obtained by DISCRETIZATION of the transfer function, produces a *control* signal which is equal to the sum of three quantities:

P(n) proportional to error;
I(n) proportional to the error integral;
D(n) proportional to the error derivative.

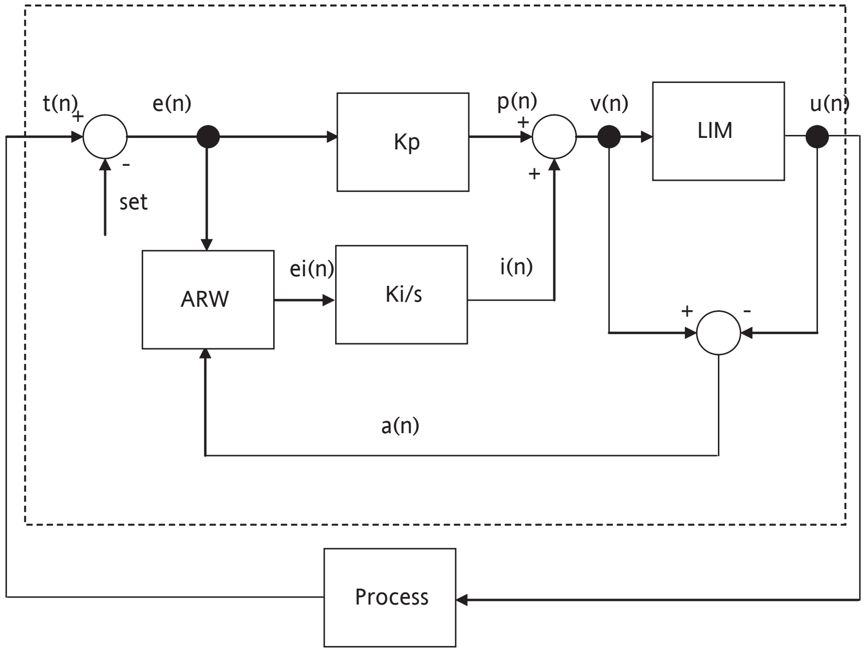
The basic PID controller is characterized by the ideal transfer function from the following:

input e(t) = ***HeatRegulationSetPoint***(t) - ***HeatRegulationSensor*** in Cold Mode or ***HeatRegulationSetPoint*** - ***HeatRegulationSensor***(t) in Hot Mode, i.e. the system error, equal to the difference between the process variable measured (in this case the temperature) and the reference signal (***HeatRegulationSetPoint***)
and the *control* signal u(t) applied to the actuator or directly to the process to be controlled.

In this case a PI type regulator can be used; in particular, the following can be set by parameter:

whether integral component Ki is to be taken into account (PI_INTEGRAL_COMPONENT_FLAG)
whether proportional component Kp is to be taken into account(PI_PROP_COMPONENT_FLAG)
additional time constant Ki
the value of proportional band Bp (CH_PROP_BAND/ HP_PROP_BAND)

The block diagram below shows the P.I. regulator implemented, with a an explanation of the different blocks.



$u(n) = LIM(\ v(n)\ ) = LIM\ (Kp \bullet e(n) + Ki \bullet \sum ei(n)\ ) = LIM(\ P(n) + I(n)\ )$

Where:
Kp = 1000/Bp
Ki = Kp•Tc/Ti
Tc ≤ Ti ≤ Timax

u(n) = LIM(v(n))	u(n) = v(n)	se 0 < v(n) < 1000
	u(n) = 0	if v(n) ≤ 0
	u(n) = 1000	if v(n) ≥ 1000
ei(n) = ARW(a(n))	ei(n) = ei(n)	if a(n) = 0
	ei(n) = 0	if a(n) ≠ 0

The application uses the following correspondence between *parameters* and sensors:

Bp	CH_PROP_BAND/ HP_PROP_BAND
Ti	PI_INTEGRAL_CONSTANT
Timax	Upper limit of PI_INTEGRAL_CONSTANT
Tc	Application cycle time applied in ISaGRAF
set	Value of ***HeatRegulationSetPoint***
t(n)	regulation water temperature measured by ***HeatRegulationSensor***

Modbus address (hex)	Parameter Category and Name	Parameter description	Range	De-fault	trans	C/H	vis	Description of code conversion	UM
260	TREG_FUNCTION	Heat regulation type 0=Proportional 1=Time-proportional 2=P.I.	0…2	0	17	C	V	0=PROPORTIONAL, 1=TIME_PROPORTIONAL 2=PI	num
261	TREG_TEMP_SENS	Selection of sensor for heat regulation	0…1	0	18	C	V	0=ENTRY_SENSOR 1=EXIT_SENSOR	num
262	PI_INTEGRAL_COMPONENT_FLAG_HOT	User flag for integral component of P.I. heat regulator.	0…1	1	6	H	V	0=NO, 1=YES	flag
263	PI_INTEGRAL_CONSTANT_HOT	Value of time integral for integral component of P.I. heat regulator.	1…900	600	0	H	V		sec
264	PI_PROP_COMPONENT_FLAG_HOT	User flag for proportional component of P.I. heat regulator.	0…1	1	6	H	V	0=NO, 1=YES	flag
270	CH_TSET_TEMP_HOT	Cold setpoint	CH_MIN_TSET_TEMP… CH_MAX_TSET_TEMP	7.0	0	H	V		°C
271	CH_MIN_TSET_TEMP	Minimum value of cold setpoint	-50.0…80.0	5.0	0	C	V		°C
272	CH_MAX_TSET_TEMP	Maximum value of cold setpoint	-50.0…80.0	25.0	0	C	V		°C
273	CH_ENTRY_OFFSET_HOT	Cold setpoint offset if heat regulation is through water inlet temperature sensor of the primary *circuit*	0.0…15.0	0.0	0	H	V		°C
274	CH_PROP_BAND_HOT	Cold proportional band	CH_MIN_PROP_BAND… CH_MAX_PROP_BAND	5.0	0	H	V		°C
275	CH_MIN_PROP_BAND	Minimum value of cold proportional band	0.0…25.0	0.0	0	C	V		°C
276	CH_MAX_PROP_BAND	Maximum value of cold proportional band	0.0…25.0	20.0	0	C	V		°C
277	CH_INC_STEP_TIME_HOT	Time between upward steps (increments in refrigeration power)	0…300	10	0	H	V		sec
278	CH_DEC_STEP_TIME_HOT	Time between downward steps (decrements in refrigeration power)	0…300	10	0	H	V		sec
280	HP_TSET_TEMP_HOT	Hot setpoint	HP_MIN_TSET_TEMP… HP_MAX_TSET_TEMP	40.0	0	H	V		°C
281	HP_MIN_TSET_TEMP	Minimum value of hot setpoint	-50.0…150.0	30.0	0	C	V		°C
282	HP_MAX_TSET_TEMP	Maximum value of hot setpoint	-50.0…150.0	50.0	0	C	V		°C
283	HP_ENTRY_OFFSET_HOT	Offset of hot setpoint if heat regulation is through the water inlet temperature sensor of the primary *circuit*	0.0…15.0	5.0	0	H	V		°C
284	HP_PROP_BAND_HOT	Hot proportional band	HP_MIN_PROP_BAND… HP_MAX_PROP_BAND	5.0	0	H	V		°C
285	HP_MIN_PROP_BAND	Minimum value of hot proportional band	0.0…150.0	5.0	0	C	V		°C
286	HP_MAX_PROP_BAND	Maximum value of hot proportional band	0.0…150.0	5.0	0	C	V		°C
287	HP_INC_STEP_TIME_HOT	Time between upward steps (power increments) in Hot mode	0…300	10	0	H	V		sec
288	HP_DEC_STEP_TIME_HOT	Time between downward steps (power decrements) in Hot mode	0…300	10	0	H	V		sec

3.2 Pump Down

Pump-down is a special start and stop procedure for the *circuit*.
In the stop phase, before the *circuit* goes off, the valve on the gas *circuit* upstream of the *evaporator* (usually called the solenoid valve) is closed, so that the last *compressor* to be started continues to draw gas from the *evaporator* and causes the gas pressure to fall to the pump-down stop value; when it reaches this value, the *compressor* goes off.
This allows the *evaporator* to be kept practically empty during *compressor* stop phases and so prevent any rise in *evaporator* temperature from bringing the minimum pressure up to values that are too high for the *compressor* and the *evaporator*.

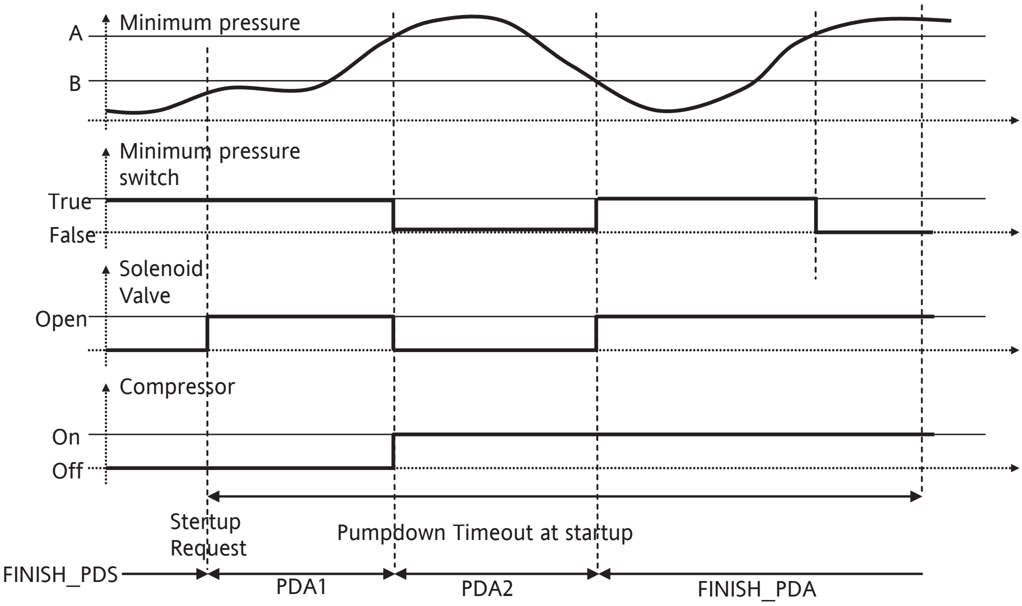
The pump-down procedure is controlled by means of a minimum pressure switch.

3.2.1 Pump-down at start-up

The first *compressor* in a *circuit* must be started as described below, if PD_FUNCTION = ON_START o PD_FUNCTION=FULL:

- The solenoid valve opens. This causes the pressure in the *circuit* to begin rising [PDA1].
- When the pressure goes above reference value “A”, the solenoid valve closes and the *compressor*. With minimum delay, the pressure begins to fall [PDA2].
- When the pressure again reaches (or goes below) reference value “B”, the solenoid valve opens again [FINISH_PDA].

In the example, the activation/deactivation thresholds of the minimum pressure switch correspond to the start/stop values of the solenoid valve, controlled by the minimum pressure transducer.



Minimum pressure switch	CIR_PRES_MIN_DI_i_PHY, i=*circuit* number "i".
Solenoid valve	CIR_SOLENOID_VALVE_DO_i_PHY, i=*circuit* number "i".
Compressor	KOMP_ACC_DO_j_PHY, j=first *compressor* started in *circuit* number "i".
Pump-down timeout at start-up	PD_OFFON_MAX_TIME.

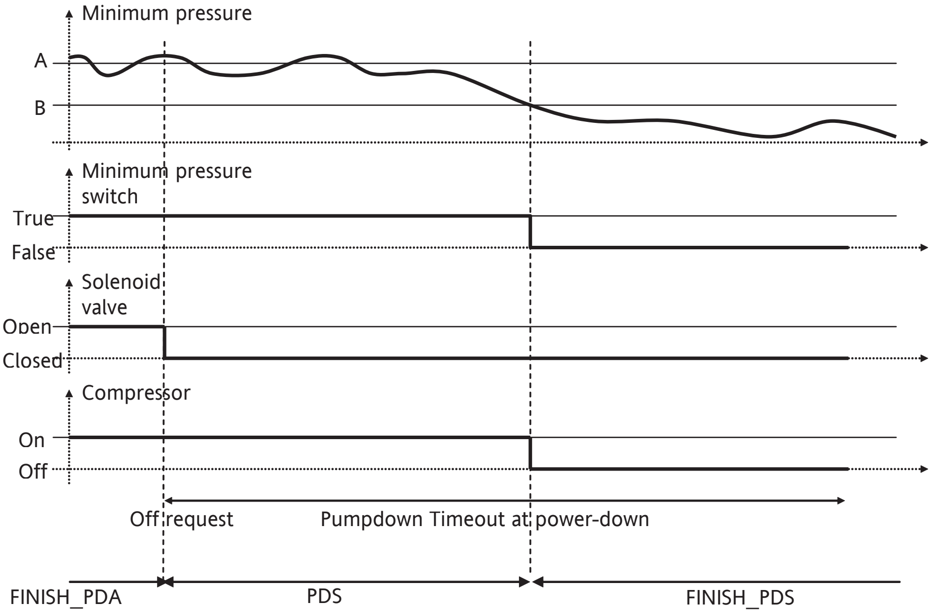
In PDA1 or PDA2, if the *circuit* compressors are not available, the switch goes straight to FINISH_PDS with the *circuit* compressors stopped and the solenoid valve closed.
However, if the *pump-down timeout* of the start-up phase expires in PDA1 or PDA2, the switch goes straight to FINISH_PDA with the compressors controlled by the heat regulator and the solenoid valve open. In this case, only a non-blocking alarm signal is sent. The alarm is reset as soon as a pump-down sequence (start or stop) has been completed correctly. In any case, the alarm is reset when exiting configuration mode and when the system is started/stopped.

If there is a *circuit*-blocking alarm while pump-down is active for that *circuit*, the pump-down sequence is stopped and the solenoid valve is closed, unless a minimum pressure alarm is present (in this case the valve is open).

3.2.2 Pump-down when going down

The last *compressor* in a *circuit* must be switched off as described below, if PD_FUNCTION=FULL:

- The solenoid valve closes. This causes the pressure to begin to fall [PDS]
- When the pressure in the *circuit* goes below reference value B, the *compressor* goes off [FINISH_PDS]



Minimum pressure switch	CIR_PRES_MIN_D_i_PHY, i=*circuit* number "i".
Solenoid valve	CIR_SOLENOID_VALVE_DO_i_PHY, i=*circuit* number "i".
Compressor	KOMP_ACC_DO_j_PHY, j=first *compressor* started in *circuit* number "i".
Pump-down timeout at start-up	PD_ONOFF_MAX_TIME.

In PDS, if the *circuit* compressors are not available, or the *pump-down timeout* expires during the going-down phase, the switch goes straight to FINISH_PDS with the *circuit* compressors off and the solenoid valve closed. If the *pump-down timeout* expires during the going-down phase, only a non-blocking alarm signal is sent. The alarm is reset as soon as a pump-down sequence (start or stop) has been completed correctly. In any case, the alarm is reset when exiting configuration mode and when the system is started/stopped

If there is a *circuit*-blocking alarm while pump-down is active for that *circuit*, the pump-down sequence is stopped and the solenoid valve is closed, unless a minimum pressure alarm is present (in this case the valve is open)

3.2.3 Pump-down timeout

If the pump-down procedure at start-up (phases PDA1 and PDA2) is not completed within time PD_OFFON_MAX_TIME, only a *pump-down timeout* signal is sent, without blocking the resources on the *circuit*.
If the pump-down procedure in the going-down phase (phase PDS) is not completed within time PD_ONOFF_MAX_TIME, only a *pump-down timeout* signal is sent, without blocking the resources on the *circuit*.
The alarm is reset as soon as a pump-down sequence (start or stop) has been completed correctly. In any case, the alarm is reset when exiting configuration mode and when the system is started/stopped.

3.2.4 Solenoid valve control

Solenoid valve	CIR_SOLENOID_VALVE_DO_i_PHY, i=*circuit* number "i".

If pump-down is not enabled (PD_FUNCTION = PD_NONE) for all circuits, the solenoid valve is always open.

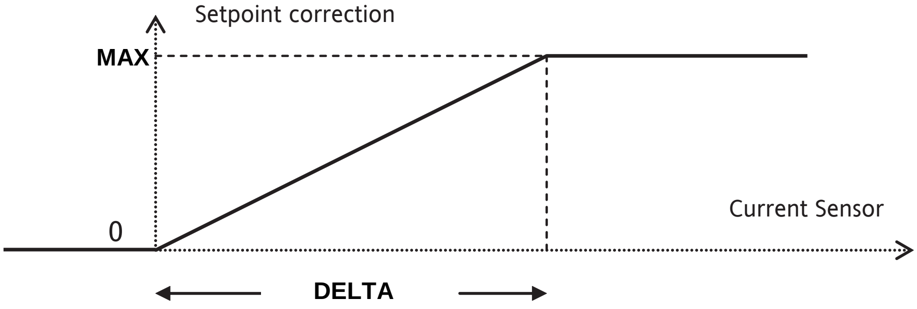
If enabled, the solenoid valve is open only during phases PDA1 and FINISH_PDA for circuits where the pump-down procedure is running. If there is an alarm that blocks the *circuit*, or the compressors belonging to that *circuit* are not available, the solenoid valve is closed, except if there is a minimum pressure alarm in the *circuit* that is holding the valve open.

Note: the solenoid valve is open when the corresponding relay is not energized, and closed when it is energized

Modbus address [hex]	Parameter Category and Name	Parameter description	Range	default	trans	C/H	vis	Description of code conversion	UM
490	PD_FUNCTION	Selects the pump-down type: not active (NO_PD), at start-up (ON_START), or at start-up and going down (FULL)	0…2	2	15	C	V	0=NO_PD, 1=ON_START, 2=FULL	num
491	PD_OFFON_MAX_TIME	Maximum pump-down time at start-up	0…1800	10	0	C	V		sec
491	PD_ONOFF_MAX_TIME	Maximum pump-down time when going down	0…1800	10	0	C	V		sec

3.3 Dynamic setpoint

The *dynamic setpoint* function is used to change the setpoint in automatic mode according to a given input signal at the controller.



DELTA	300
MAX	DTSET_CHILLER_MAX_OFFSET;
Current sensor	PLAN_CURR_DTSET_SENS
Setpoint correction	(Current sensor * MAX) / DELTA;

The signed correction to the setpoint is added to the current value of the heat regulation setpoint.

If one of the following conditions is present :

- Function disabled (DTSET_FUNCTION <> CURRENT_FUNCTION);
- Current sensor error

The setpoint correction is always 0.

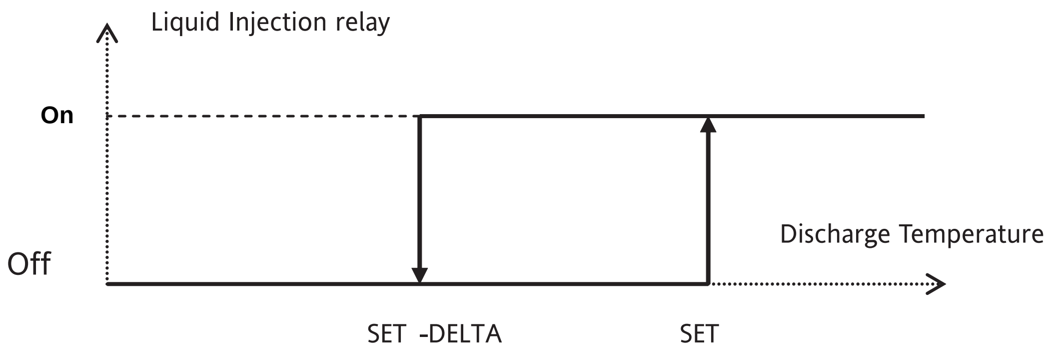
If none of the above conditions are present, the setpoint correction is controlled by the function described in Fig. 3.3.3.
If parameter DTSET_CHILLER_MAX_OFFSET is set to a negative value, the progression shown in the diagram occurs around the horizontal axis.

Note: current sensor PLAN_CURR_DTSET_SENS_PHY must be configured in the BIOS with the value 4mA set to 0.0 Bar and value 20mA set to 30.0 Bar. This is necessary so that the current sensor works in ISaGRAF within the conversion range 0-300

Modbus address [hex]	Parameter Category and Name	Parameter description	Range	default	trans	C/H	vis	Description of code conversion	UM
2A0	DTSET_FUNCTION	Enable *dynamic setpoint* function 0=not enabled or none 1=in temperature (not supported) 2=in current	0..2	2	19	C	V	0=NO_PD, 1=ON_START, 2=FULL	num
2A1	DTSET_CHILLER_MAX_OFFSET	Maximum offset of *dynamic setpoint* from cold setpoint	-30.0...30.0	6.0	0	C	V		°C

3.4 Compressor liquid injection

One relay is allocated and controlled for each *compressor*, and performs the liquid injection function.



SET	LI_TSET_TEMP
DELTA	LI_DELTA_TEMP
Discharge temperature	KOMP_TEMP_DISCHARGE_SENS_i_PHY, i = *compressor* number "i"
Liquid injection relay	KOMP_IL_DO_i_PHY, i = *compressor* number "i"

If one of the following conditions is present *:*

- Function disabled (LI_ENABLE_FLAG=false);
- Discharge temperature error;
- *compressor* alarm;
- system Off;
- *compressor* deselected;

The liquid injection relay is remains Off.

If none of the above conditions is present, the state of the liquid injection relay is controlled by the hysteresis function described in Fig. 3.3.4.
In particular, the relay is On if Discharge temperature >=SET, Off if Discharge temperature <(SET-DELTA), and unchanged in the other cases.

The hysteresis function is set to Off in the following cases*:*

- System started or going down;
- exit from configuration mode;
- by a reset;

Modbus address [hex]	Parameter Category and Name	Parameter description	Range	default	trans	C/H	vis	Description of code conversion	UM
310	LI_ENABLE_FLAG	Enable liquid injection function	0…1	1	6	C	V	0=NO 1=YES	flag
311	LI_TSET_TEMP	Setpoint for liquid injection function	0.0…150.0	115.0	0	C	V		°C
312	LI_DELTA_TEMP	Liquid injection delta function	0.0…10.0	10.0	0	C	V		°C

3.5 Condensation control

In this system, the *fans* are grouped into 2 batteries maximum, which *control* the condensation in the various circuits. Each *circuit* has its own maximum pressure sensor and its own operating dynamics, whereas ventilation is controlled by all circuits belonging to the battery concerned.

To define which circuits belong to which battery, it is necessary to set the CIR_*FANS*_i *parameters*, where i =*circuit* number "i".
For example, in the default machine, the *parameters* are set with the values shown in the following table*:*

CIR_*FANS*_1	1	CIR_*FANS*_5	0
CIR_*FANS*_2	1	CIR_*FANS*_6	0
CIR_*FANS*_3	2	CIR_*FANS*_7	0
CIR_*FANS*_4	2	CIR_*FANS*_8	0

This corresponds to a total of 2 batteries of *fans*, the first for circuits 1 and 2, and the second for circuits 3 and 4.

IMPORTANT NOTE: the table must be completed from top to bottom, with values in strictly ascending order.

When the system is not Off, the *fans* in the battery are set at maximum/minimum (for chiller/pump) by ventilation requests from each *circuit* in the fan battery (largest of the maximum pressures of each *circuit*). If there is an error in one of the sensors, its value is not taken into account in calculating the maximum/minimum. However, if there is an error in all the sensors, the *fans* are always switched Off unless they are still initializing, i.e. during the time when the *fans* are forced to full power (PANS_CH_INIT_MAX_POWER_TIME/ *FANS*_HP_INIT_MAX_POWER_TIME)

The *fans* are always stopped when the system is Off.

A single thermal input is provided per battery of *fans* irrespective of the number of *fans* in each battery.
If the thermal protection in a battery is actuated, the *circuit* is immediately blocked.

The fan *control* is digital (ON/OFF *control* in steps) or continuous (by means of analog outputs, one per fan battery). The parameter used to select the *control* type (digital or continuous) is *FANS*_*CONTROL*_FUNCTION.

The *fans* can be activated*:*

- irrespective of the status of the compressors;
- if at least one *compressor* in the *circuit* belonging to the battery is On;

The above can be selected by setting the parameter *FANS*_KOMP_DEPENDENCY_FLAG as required

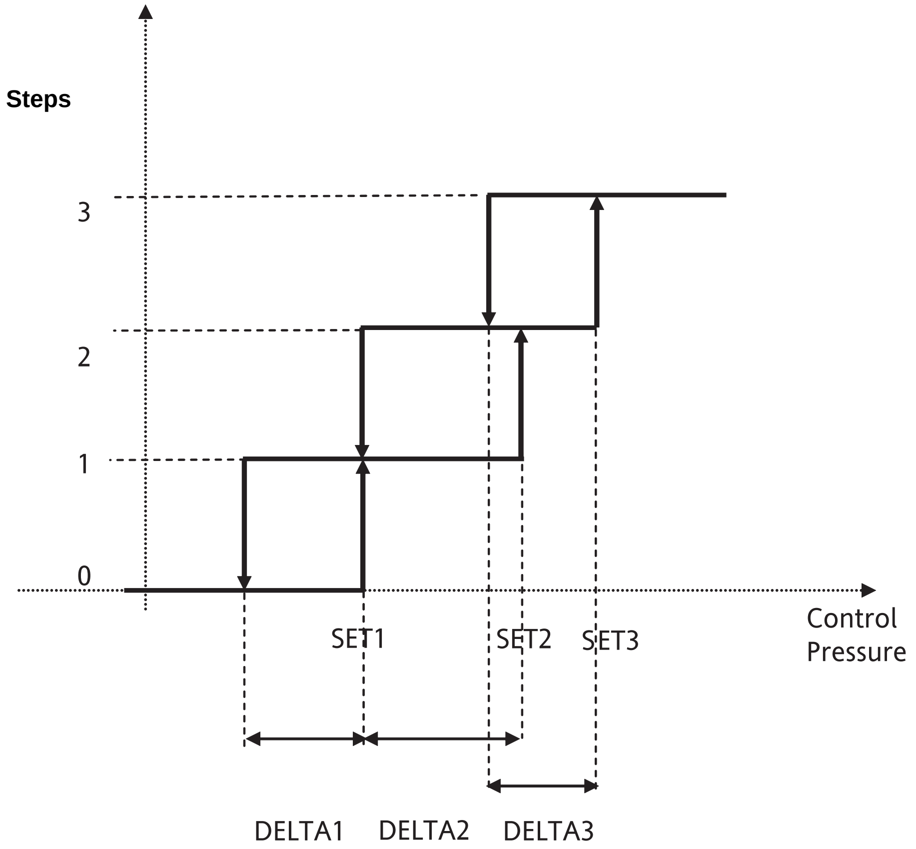
3.5.1 Fan control by steps

Fan control by steps is used when there are more than one *fans* for each condenser, and parameterFANS_*CONTROL*_FUNCTION=DIGITAL.
The number of steps per battery is defined by the *parameters* *FANS*_NO_1, *FANS*_NO_2 (each step corresponds to one fan). *FANS*_NO_i i=battery number "i" is taken into account only if the battery concerned exists (see CIR_*FANS*_j, j=*circuit* number "j").

The time for which the fan battery is forced to maximum power when the first fan of the battery starts can be configured using parameter *FANS*_CH_INIT_MAX_POWER_TIME.

Cold Mode

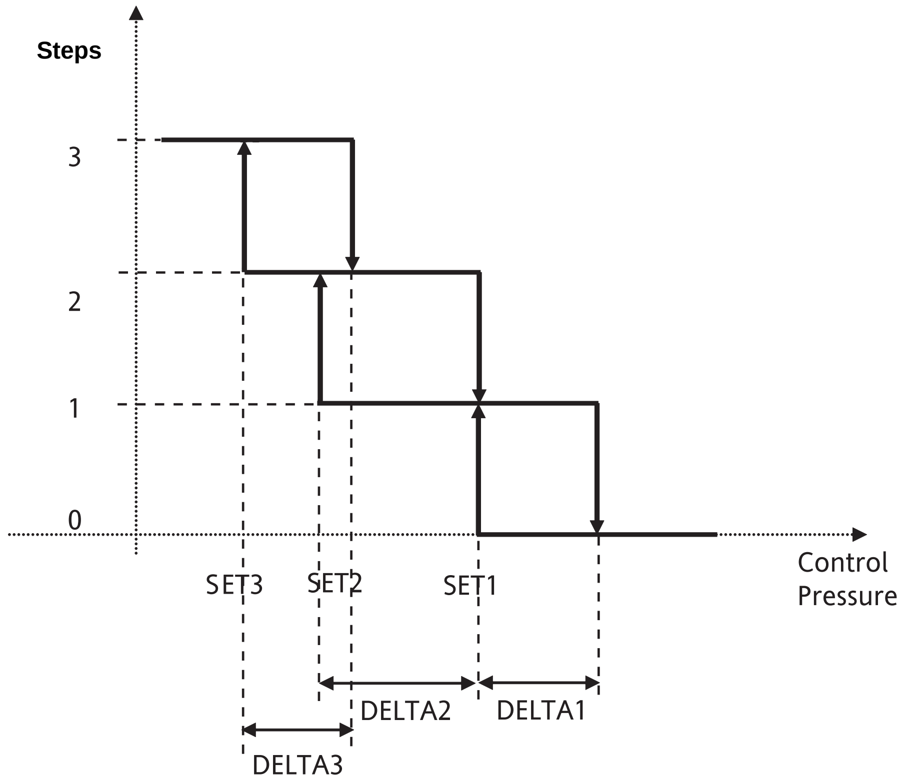
Step number "n" is inserted when the *control* pressure reaches the setpoint configured with parameter *FANS*_CSTART_SETn_PRES
Step number "n" is removed when the *control* pressure reaches the value set in parameter *FANS*_CSTART_SETn_PRES - *FANS*_CSTOP_DELTAn_PRES



SETn	*FANS*_CSTART_SETn_PRES
DELTAn	*FANS*_CSTOP_DELTAn_PRES
Control pressure	MAX(CIR_PRES_MAX_SENS_i_PHY), i = *circuit* number "i" of the battery
Steps	*FANS*_ACCj_DO_i_PHY, j=fan number "j" of battery number "i" i=battery number "i".

Hot Mode

Step number "n" is inserted when the *control* pressure is equal to or below the setpoint configured with parameter *FANS*_HSTART_SETn_PRES.
Step number "n" is switched off when the *control* pressure reaches the value defined by *FANS*_HSTART_SETn_PRES + *FANS*_HSTOP_DELTAn_PRES



SETn	*FANS*_HSTART_SETn_PRES
DELTAn	*FANS*_HSTOP_DELTAn_PRES
Control pressure	MIN(CIR_PRES_MAX_SENS_i_PHY), i = *circuit* number "i" of the battery
Steps	*FANS*_ACCj_DO_i_PHY, j=fan number "j" of battery number "i" i=battery number "i".

Note: If there is an error in all the maximum pressure sensors of the circuits belonging to a battery, all the *fans* in the battery concerned are stopped.:

3.5.1.1 Fans with the same/different power output

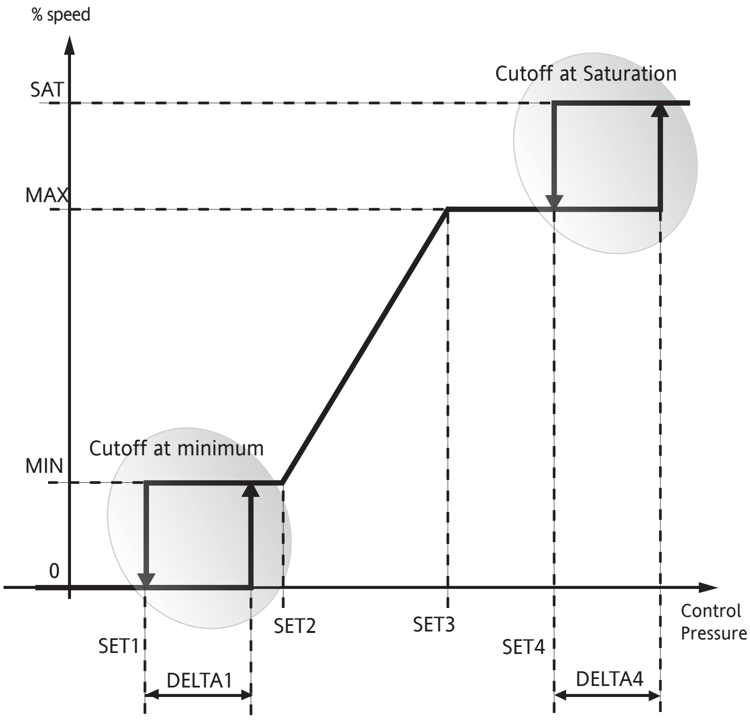
If the *fans* belonging to one condenser are all the same, the steps are inserted continuously (if 3 steps are requested, 3 *fans* are active).
If the *fans* have different power outputs (this option is configured with parameter *FANS*_ASYMMETRICAL_FLAG), the *fans* are activated alternately (when fan 3 is On, fan 2 is Off).

3.5.2 Fan control in Continuous mode

Continuous fan *control* is used when there is a fan that can be controlled in continuous mode for each condenser, and parameter *FANS_CONTROL*_FUNCTION = CONT. The *FANS*_NO_i *parameters* (where i=fan battery "i") are not taken into account as each fan battery is automatically associated with its own unique analog output.

Cold Mode

Below is shown how the ventilation behaves in chiller mode when the initialization time and Cutoff bypass time are zero and parameter CUTOFF_CH_ENABLED_FLAG is set to YES. See also the section on MINIMUM VENTILATION STARTING TIME



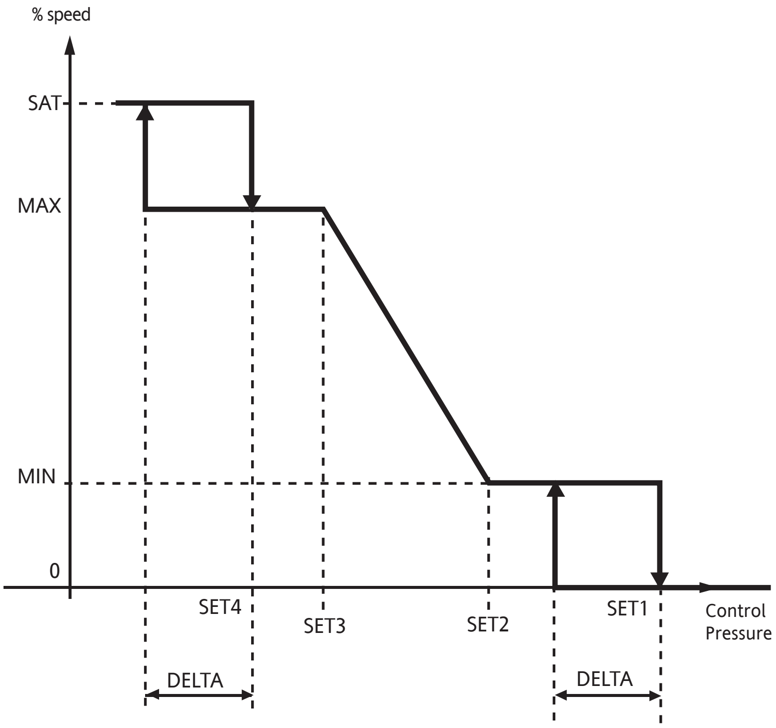
SET1	CUTOFF_CH_SETPOINT1_PRES
DELTA1	CUTOFF_CH_DELTA1_PRES
SET2	*FANS*_CH_START_PRES
SET3	*FANS*_CH_SATURATION_PRES
SET4	CUTOFF_CH_SETPOINT2_PRES
DELTA4	CUTOFF_CH_DELTA2_PRES
SAT	*FANS*_CH_SAT_SPEED
MIN	*FANS*_CH_MIN_SPEED
MAX	*FANS*_CH_MAX_SPEED
Control pressure	MAX(CIR_PRES_MAX_SENS_i_PHY), i = *circuit* number "i" of the fan battery (the sensors with errors are not taken into account for the maximum calculation)
Speed *:*	*FANS*_CTRL_AO_j_PHY, % speed of fan battery number "j".

If parameter CUTOFF_CH_ENABLED_FLAG = NO, the diagram changes, and there is no Cutoff hysteresis :

- Cutoff at minimum: the fan speed changes from 0 to MIN when the *control* pressure reaches SET2 “from below”. If the *control* pressure reaches SET2 “from above”, the speed changes from MIN to 0.
- saturation cutoff: when the *control* pressure reaches SET3 “from below”, fan speed is at MAX. If the *control* pressure reaches SET3 “from above”, there is continuous *control* between MAX and MIN

Hot Mode

Below is shown how the heat pump ventilation behaves when the initialization time and Cutoff bypass time are zero and parameter CUTOFF_CH_ENABLED_FLAG is set to YES.
See also the section on Minimum Ventilation Starting Time.



SET1	CUTOFF_HP_SETPOINT1_PRES
DELTA	CUTOFF_HP_DELTA1_PRES
SET2	*FANS*_HP_START_PRES
SET3	*FANS*_HP_SATURATION_PRES
SET4	CUTOFF_HP_SETPOINT2_PRES
DELTA4	CUTOFF_HP_DELTA2_PRES
SAT	*FANS*_HP_SAT_SPEED
MAX	*FANS*_HP_MAX_SPEED
MIN	*FANS*_HP_MIN_SPEED
Control pressure	MAX(CIR_PRES_MAX_SENS_i_PHY), i = *circuit* number "i" of the fan battery (the sensors with errors are not taken into account for the maximum calculation)
Speed *:*	*FANS*_CTRL_AO_j_PHY, % speed of fan battery number "j".

If parameter CUTOFF_CH_ENABLED_FLAG = NO, the diagram changes, and there is no Cutoff hysteresis *:*

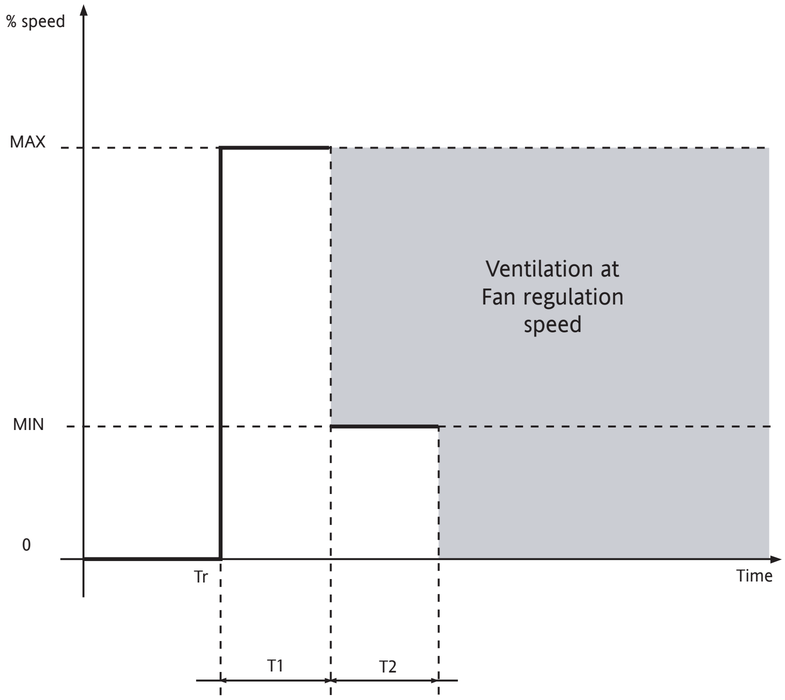
- Cutoff at minimum: the fan speed changes from 0 to MIN when the *control* pressure reaches SET2 "from above". If the *control* pressure reaches SET2 "from below", the speed changes from MIN to 0.
- saturation cutoff: when the *control* pressure reaches SET3 "from below", fan speed is at MAX. If the *control* pressure reaches SET3 "from above", there is continuous *control* between MAX and MIN.

Note that if the time during which *fans* are forced to full power (*FANS*_CH_INIT_MAX_POWER_TIME/*FANS*_HP_INIT_MAX_POWER_TIME) is still running, the *fans* are controlled at SAT power if Cutoff is enabled, and at MAX power if Cutoff is not enabled .

Note: If there is an error in all the maximum pressure sensors of the circuits belonging to a battery, all the *fans* in the battery concerned are stopped.

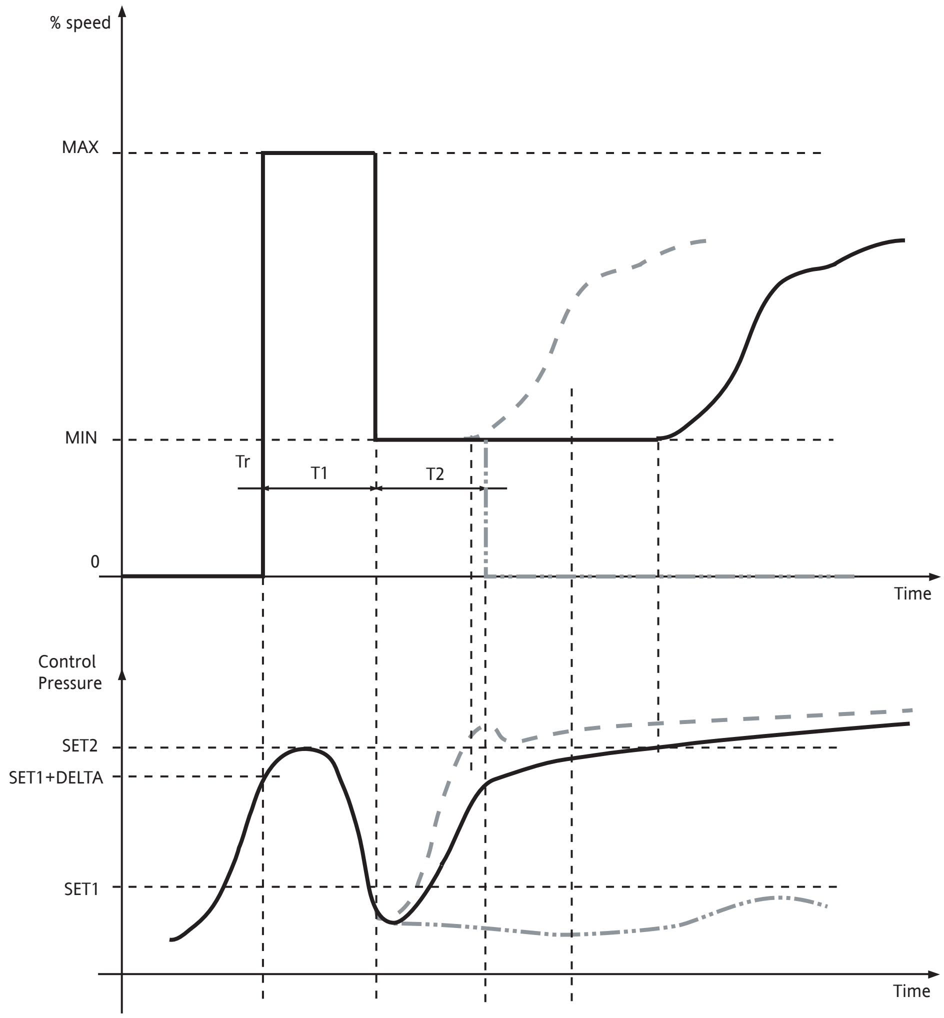
3.5.2.2 Ventilation minimum On time

After initialization, for the time set by parameter (*FANS*_CH_MIN_ON_TIME/*FANS*_HP_MIN_ON_TIME), the *fans* operate at least at minimum speed; after this time, the *fans* can be stopped by a request from the fan regulator. The *fans* are also stopped if there is a fan blocking alarm.
The following diagram illustrates the above



Tr	Moment at which ventilation is requested
T1	*FANS*_CH_INIT_MAX_POWER_TIME/ *FANS*_HP_INIT_MAX_POWER_TIME
T2	CUTOFF_CH_BYPASS_TIME/ CUTOFF_HP_BYPASS_TIME
MAX	*FANS*_CH_MAX_SPEED /*FANS*_HP_MAX_SPEED
MIN	*FANS*_CH_MIN_SPEED /*FANS*_HP_MIN_SPEED

The following diagram shows the effect of initialization and minimum On time on the fan speed following a ventilation On request. For the sake of simplicity, the example is related to chiller mode only:



Tr	Moment at which ventilation is requested
T1	*FANS*_CH_INIT_MAX_POWER_TIME
T2	CUTOFF_CH_BYPASS_TIME
MAX	*FANS*_CH_MAX_SPEED
MIN	*FANS*_CH_MIN_SPEED
SET1	CUTOFF_CH_SETPOINT_PRES
DELTA	CUTOFF_CH_DELTA_PRES
SET2	*FANS*_CH_START_PRES

Modbus address [hex]	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
208	CIR_*FANS*_1	Associate *circuit* 1 with the fan group indicated	1…2	1	0	C	V		num
209	CIR_*FANS*_2	Associate *circuit* 2 with the fan group indicated	0…2	1	0	C	V		num
20A	CIR_*FANS*_3	Associate *circuit* 3 with the fan group indicated	0…2	2	0	C	V		num
20B	CIR_*FANS*_4	Associate *circuit* 4 with the fan group indicated	0…2	2	0	C	V		num
20C	CIR_*FANS*_5	Associate *circuit* 5 with the fan group indicated	0…2	0	0	C	V		num
20D	CIR_*FANS*_6	Associate *circuit* 6 with the fan group indicated	0…2	0	0	C	V		num
20E	CIR_*FANS*_7	Associate *circuit* 7 with the fan group indicated	0…2	0	0	C	V		num
20F	CIR_*FANS*_8	Associate *circuit* 8 with the fan group indicated	0…2	0	0	C	V		num
219	*FANS*_ASYMMETRICAL_FLAG	*Fans* all the same (NO) or with increasing power output (YES). Changes the order of activation / deactivation of the fan relays	0…1	0	6	C	V	0=NO, 1=YES	flag
21A	*FANS*_NO_1	Number of *fans* in battery 1	1…4	3	0	C	V		num
21B	*FANS*_NO_2	Number of *fans* in battery 2	1…4	3	0	C	V		num
21C	*FANS*_NO_3	Number of *fans* in battery 3	1…4	1	0	C	N		num
21D	*FANS*_NO_4	Number of *fans* in battery 4	1…4	1	0	C	N		num
21E	*FANS*_NO_5	Number of *fans* in battery 5	1…4	1	0	C	N		num
21F	*FANS*_NO_6	Number of *fans* in battery 6	1…4	1	0	C	N		num
220	*FANS*_NO_7	Number of *fans* in battery 7	1…4	1	0	C	N		num
221	*FANS*_NO_8	Number of *fans* in battery 8	1…4	1	0	C	N		num
340	*FANS*_KOMP_DEPENDENCY_FLAG	If set to NO, the *fans* in the batteries operate independently of the status of the compressors belonging to the circuits in which the batteries are controlling the condensation, otherwise at least one of these compressors must be On so that fan *control* can be actuated for the batteries.	0…1	1	6	C	V	0=NO, 1=YES	flag
341	*FANS*_CH_INIT_MAX_POWER_TIME	Time during which the *fans* in the batteries are operating at full power% each time the battery is started	0…120	60	0	C	V		sec
342	*FANS*_HP_INIT_MAX_POWER_TIME	Time during which the *fans* in the batteries are operating at full power% each time the battery is started in Hot mode	0…120	60	0	C	V		sec
343	*FANS*_*CONTROL*_FUNCTION	Selects the type of fan *control* and actuation	0…1	0	31	C	V	0=CONT, 1=DIGITAL	flag
344	CUTOFF_CH_ENABLED_FLAG	Enable CUTOFF for chiller	0…1	1	6	C	V	0=NO, 1=YES	flag
345	CUTOFF_HP_ENABLED_FLAG	Enable CUTOFF for heat pump	0…1	1	6	C	V	0=NO, 1=YES	flag
360	*FANS*_CSTART_SET1_PRES	Setpoint for activating ventilation step 1	0.0…50.0	13.0	0	C	V		Bar
361	*FANS*_CSTART_SET2_PRES	Setpoint for activating ventilation step 2	0.0…50.0	15.0	0	C	V		Bar
362	*FANS*_CSTART_SET3_PRES	Setpoint for activating ventilation step 3	0.0…50.0	17.0	0	C	V		Bar

Modbus address [hex]	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
363	*FANS*_CSTART_SET4_PRES	Setpoint for activating ventilation step 4	0.0…50.0	19.0	0	C	V		Bar
364	*FANS*_CSTART_SET5_PRES	Setpoint for activating ventilation step 5	0.0…50.0	0.0	0	C	V		Bar
365	*FANS*_CSTART_SET6_PRES	Setpoint for activating ventilation step 6	0.0…50.0	0.0	0	C	V		Bar
366	*FANS*_CSTART_SET7_PRES	Setpoint for activating ventilation step 7	0.0…50.0	0.0	0	C	V		Bar
367	*FANS*_CSTART_SET8_PRES	Setpoint for activating ventilation step 8	0.0…50.0	0.0	0	C	V		Bar
368	*FANS*_CSTOP_DELTA1_PRES	Delta for deactivation of ventilation step 1	0.0…10.0	2.0	0	C	V		Bar
369	*FANS*_CSTOP_DELTA2_PRES	Delta for deactivation of ventilation step 2	0.0…10.0	2.0	0	C	V		Bar
36A	*FANS*_CSTOP_DELTA3_PRES	Delta for deactivation of ventilation step 3	0.0…10.0	2.0	0	C	V		Bar
36B	*FANS*_CSTOP_DELTA4_PRES	Delta for deactivation of ventilation step 4	0.0…10.0	2.0	0	C	V		Bar
36C	*FANS*_CSTOP_DELTA5_PRES	Delta for deactivation of ventilation step 5	0.0…10.0	0.0	0	C	V		Bar
36D	*FANS*_CSTOP_DELTA6_PRES	Delta for deactivation of ventilation step 6	0.0…10.0	0.0	0	C	V		Bar
36E	*FANS*_CSTOP_DELTA7_PRES	Delta for deactivation of ventilation step 7	0.0…10.0	0.0	0	C	V		Bar
36F	*FANS*_CSTOP_DELTA8_PRES	Delta for deactivation of ventilation step 8	0.0…10.0	0.0	0	C	V		Bar
3A0	*FANS*_CH_MIN_ON_TIME	Minimum On time for ventilation in chiller mode at minimum speed at least	0…120	30	0	C	V		sec
3A1	CUTOFF_CH_SETPOINT1_PRES	Pressure value under which the CUTOFF switches off chiller mode ventilation	0.0…60.0	8.0	0	C	V		Bar
3A2	CUTOFF_CH_DELTA1_PRES	Pressure value to be added to CUTOFF_CH_SETPOINT2_PRES. If the ventilation *control* pressure goes above the total, the ON/OFF *control* (due to CUTOFF at minimum) becomes continuous in chiller mode	0.0…10.0	1.0	0	C	V		Bar
3A3	*FANS*_CH_START_PRES	Pressure value at which modulated ventilation *control* begins in chiller mode. The fan speed is expressed as a percentage, and is equal to the value of parameter *FANS*_CH_MIN_SPEED	0.0…60.0	10.0	0	C	V		Bar
3A4	*FANS*_CH_SATURATION_PRES	Pressure value at which fan speed goes up to the maximum value defined by parameter *FANS*_CH_MAX_SPEED in chiller mode	0.0…60.0	20.0	0	C	V		Bar
3A5	*FANS*_CH_MIN_SPEED	Percentage value of the minimum fan speed in chiller mode	0…100	20	0	C	V		%
3A6	*FANS*_CH_MAX_SPEED	Percentage value of the maximum fan speed in chiller mode at end of gradient.	0…100	80	0	C	V		%
3A7	CUTOFF_CH_SETPOINT2_PRES	Pressure value below which the saturation CUTOFF changes the *control* from ON/OFF (due to saturation CUTOFF) to continuous in chiller mode	0.0…60.0	21.0	0	C	V		Bar
3A8	CUTOFF_CH_DELTA2_PRES	Pressure value to be added to CUTOFF_CH_SETPOINT2_PRES. If the ventilation *control* pressure goes above the total, the fan speed will be equal to the value of parameter *FANS*_CH_SAT_SPEED.	0.0…10.0	1.0	0	C	V		Bar
3A9	*FANS*_CH_SAT_SPEED	Percentage value of the maximum fan speed in chiller mode	0…100	90	0	C	V		%
3C0	*FANS*_HSTART_SET1_PRES	Setpoint for activating ventilation step 1	0.0…50.0	12.0	0	C	V		Bar
3C1	*FANS*_HSTART_SET2_PRES	Setpoint for activating ventilation step 2	0.0…50.0	10.0	0	C	V		Bar
3C2	*FANS*_HSTART_SET3_PRES	Setpoint for activating ventilation step 3	0.0…50.0	8.0	0	C	V		Bar

Modbus address [hex]	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
3C3	*FANS*_HSTART_SET4_PRES	Setpoint for activating ventilation step 4	0.0...50.0	6.0	0	C	V		Bar
3C4	*FANS*_HSTART_SET5_PRES	Setpoint for activating ventilation step 5	0.0...50.0	0.0	0	C	V		Bar
3C5	*FANS*_HSTART_SET6_PRES	Setpoint for activating ventilation step 6	0.0...50.0	0.0	0	C	V		Bar
3C6	*FANS*_HSTART_SET7_PRES	Setpoint for activating ventilation step 7	0.0...50.0	0.0	0	C	V		Bar
3C7	*FANS*_HSTART_SET8_PRES	Setpoint for activating ventilation step 8	0.0...50.0	0.0	0	C	V		Bar
3C8	*FANS*_HSTOP_DELTA1_PRES	Delta for deactivation of ventilation step 1	0.0...10.0	2.0	0	C	V		Bar
3C9	*FANS*_HSTOP_DELTA2_PRES	Delta for deactivation of ventilation step 2	0.0...10.0	2.0	0	C	V		Bar
3CA	*FANS*_HSTOP_DELTA3_PRES	Delta for deactivation of ventilation step 3	0.0...10.0	2.0	0	C	V		Bar
3CB	*FANS*_HSTOP_DELTA4_PRES	Delta for deactivation of ventilation step 4	0.0...10.0	2.0	0	C	V		Bar
3CC	*FANS*_HSTOP_DELTA5_PRES	Delta for deactivation of ventilation step 5	0.0...10.0	0.0	0	C	V		Bar
3CD	*FANS*_HSTOP_DELTA6_PRES	Delta for deactivation of ventilation step 6	0.0...10.0	0.0	0	C	V		Bar
3CE	*FANS*_HSTOP_DELTA7_PRES	Delta for deactivation of ventilation step 7	0.0...10.0	0.0	0	C	V		Bar
3CF	*FANS*_HSTOP_DELTA8_PRES	Delta for deactivation of ventilation step 8	0.0...10.0	0.0	0	C	V		Bar
400	*FANS*_HP_MIN_ON_TIME	Minimum On time for ventilation in free cooling at minimum speed at least	0...120	30	0	C	V		sec
401	CUTOFF_HP_SETPOINT1_PRES	Pressure value above which the CUTOFF switches off ventilation in pump mode	0.0...60.0	22.0	0	C	V		Bar
402	CUTOFF_HP_DELTA1_PRES	Pressure value to be subtracted from CUTOFF_CH_SETPOINT_PRES. If the ventilation *control* pressure goes below the difference, the ON/OFF *control* (due to CUTOFF) becomes continuous in pump mode	0.0...10.0	1.0	0	C	V		Bar
403	*FANS*_HP_START_PRES	Pressure value at which modulated fan *control* is started in pump mode. The fan speed is expressed as a percentage, and is equal to the value of parameter *FANS*_CH_MIN_SPEED	0.0...60.0	20.0	0	C	V		Bar
404	*FANS*_HP_SATURATION_PRES	Pressure value at which ventilation goes up to the maximum value defined by parameter *FANS*_CH_MAX_SPEED in pump mode	0.0...60.0	10.0	0	C	V		Bar
405	*FANS*_HP_MIN_SPEED	Minimum fan speed in pump mode, expressed as a percentage	0...100	40	0	C	V		%
406	*FANS*_HP_MAX_SPEED	Maximum fan speed in pump mode, expressed as a percentage	0...100	80	0	C	V		%
407	CUTOFF_HP_SETPOINT2_PRES	Pressure value above which the saturation CUTOFF changes the *control* from ON/OFF (due to CUTOFF at saturation) to continuous in pump mode.	0.0...60.0	9.0	0	C	V		Bar
408	CUTOFF_HP_DELTA2_PRES	Pressure value to be subtracted from CUTOFF_HP_SETPOINT2_PRES. If the ventilation *control* pressure is below this value, the fan speed will be equal to parameter *FANS*_HP_SAT_SPEED.	0.0...10.0	1.0	0	C	V		Bar
409	*FANS*_HP_SAT_SPEED	Maximum fan speed in pump mode, expressed as a percentage.	0...100	90	0	C	V		%

3.6 Hydraulic pumps control

The system allows the pumps in the pump group to be controlled individually, to ensure circulation of the intermediate fluid (the controller starts/stops the individual pumps).
The number of pumps managed is the number defined with the PUMPS_NO parameter; in this case, it is set to 2.

3.6.1 Hours of pump usage

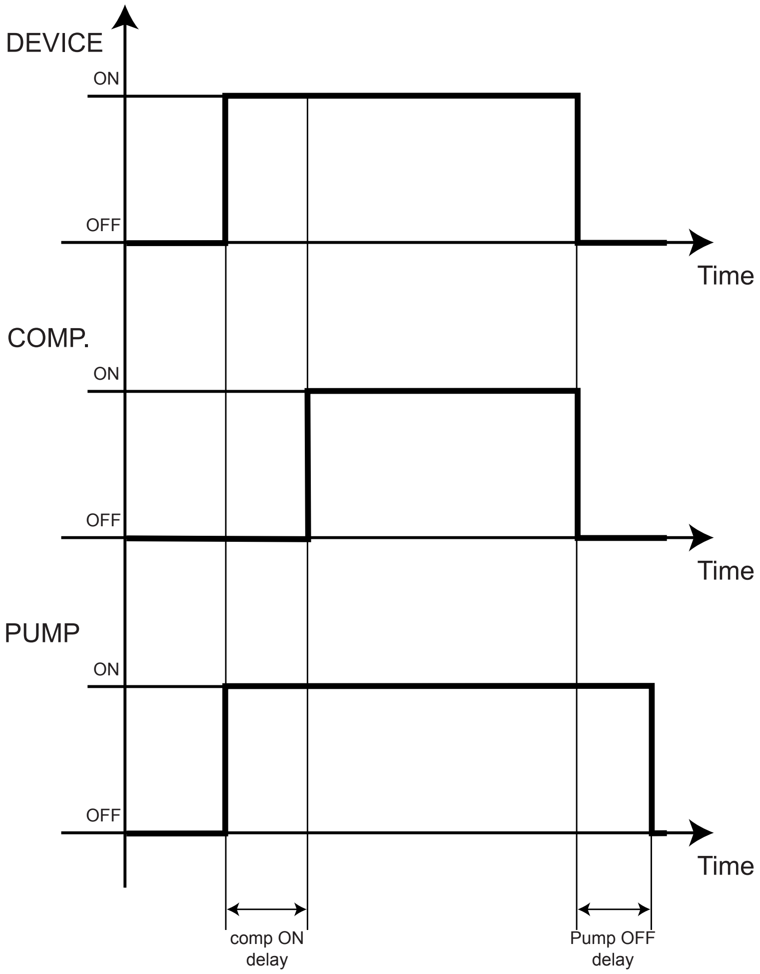
The operating time of the pumps is stored every hour in EEPROM, in the two following *parameters :*

- PUMP_USAGE_DAYS_i, : days of use of pump number "i"
- PUMP_USAGE_HOUR_i, : hours of use of pump number "i"

3.6.2 Continuous operation

With *continuous operation*, the pump group is always active.

- The pump is started when the device is switched on
- The *compressor* is activated at delay time (PUMPGROUP_STARTUP_DELAY_TIME) after the pump is started
- The pump is stopped at delay time (PUMPGROUP_STOP_DELAY_YIME) after the last *compressor* is switched off.



STRUM.	Device status
COMPR.	*Compressor* status
PUMP	Pump statuses
Comp ON delay	PUMPGROUP_STARTUP_DELAY_TIME
Pump OFF delay	PUMPGROUP_STOP_DELAY_TIME

NOTE: the pump group can be activated even with the device Off, in cases where activation of the *antifreeze* resistors has been requested. (See paragraph on. *Antifreeze*)

3.6.2.1 Swap timer

While a pump is in operation, a counter counts the running time (set by parameter PUMPS_ALTERNATION_TIME), at the end of which the active pump is stopped and the second pump is activated
If the second pump is not available when the alternation time has elapsed, the pump currently selected remains active until the second one becomes available

Modbus address [hex]	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
222	PUMPS_NO	Number of pumps in the system	1…2	2	0	C	V		num
463	PUMPS_ALTERNATION_TIME	Associate *circuit* 2 with the fan group indicated	1…1000	72	0	C	V		hours
464	PUMPGROUP_STARTUP_DELAY_TIME	Time delay between system ON (which causes activation of the selected pump) and the start of heat regulation	KOMP_CHARGEDISCH_TIME…2000	60	0	C	V		sec
465	PUMPGROUP_STOP_DELAY_TIME	Time for which the active pump must remain On after there has been a system Off request and the last *compressor* goes off	0…2000	60	0	C	V		sec
480	PUMP_USAGE_DAYS_1	Days of use of pump 1	0…32000	0	0	C	V		num
481	PUMP_USAGE_DAYS_2	Days of use of pump 2	0…32000	0	0	C	V		num
482	PUMP_USAGE_HOUR_1	Hours of use of pump 1	0…24	0	0	C	V		hours
483	PUMP_USAGE_HOUR_2	Hours of use of pump 2	0…24	0	0	C	V		hours

3.7 Selection of refrigeration resources

3.7.1 Availability

For each component level in the system (*evaporator*, *circuit*, *compressor*), the minimum *availability* (taken as the sum of minimum availabilities) and maximum *availability* (taken as the sum of maximum availabilities) of the subsystems is calculated in cascade, from the compressors to the evaporators.
Each time there is an alarm in a subsystem, the minimum and maximum availabilities are reset.
If a subsystem is counting safety protection times, the maximum and minimum availabilities are blocked and retain the value of their power output at the time they are blocked.

Example
If we have a *circuit* that has 2 compressors with 4 power stages, and we indicate in square brackets the minimum and maximum *availability* and accessibility of a component, we have a situation where *:*

- a *circuit* with an alarm, with *availability* [0,0] and accessibility time [0,0].
- an Off *circuit*, where the compressors cannot be started due to safety protection times, with *availability* [0,0] and accessibility [0, 8]
- a *circuit* where one *compressor* is On and blocked at level 2 and the other is disabled, where *circuit availability* is [2,2] and accessibility is [0,4].

3.7.2 Control

For each component level of the system (*evaporator*, *circuit*, *compressor*) parameter (EV_SELECTION_FUNCTION, CIR_SELECTION_FUNCTION, KOMP_SELECTION_FUNCTION) can be used to set the selection policy applied by the heat regulator for distributing refrigeration resources: the policies available are Saturation and Balancing.

The selection policies are based mainly on the hours of operation of the compressors.
For elements at higher hierarchical levels than the *compressor* (*circuit*, *evaporator*), the hours of use are taken as the sum of hours of use of the compressors contained in the component.

With the use of hermetically and semi-hermetically sealed compressors, the minimum unit of refrigeration power now managed by heat regulators, usually called a “step”, corresponds to one power stage of the *compressor* in the case of modulated compressors, or to the *compressor* itself if is not modulated. For continuous screw compressors, refer to the section on REFRIGERATION *POWER STEPS* OF COMPRESSORS

The selection policies are applied in cascade to the system components. When there is a request from the heat regulator to activate/deactivate a step, the request is assigned to the best *evaporator* (according to the *evaporator* selection policy configured with the EV_SELECTION_FUNCTION parameter), and then to the best *evaporator circuit* (according to the selection policy configured with the CIR_SELECTION_FUNCTION parameter), and finally to the best *compressor* on the *circuit* (according to the *compressor selection* policy configured with the KOMP_SELECTION_FUNCTION parameter).

3.7.3 Balancing characteristics

The **balancing** (irrespective of the component to which it is applied) is subject to the following rules*:*

1. staticity: if the current assignments of refrigeration resources meet the current request, they are not changed;
2. within the same *control* cycle, requests to increment/decrement by more than one step are managed as sequences of increments/decrements of one step, as described at points 3) and 4);
3. when there is a request to increment by one step, the components that can be incremented are taken into consideration, and the one at the smallest distance from its minimum *availability* value is selected. If there are more than one at equal distance, the one with least hours of use is selected;
4. when there is a request to decrement by one step, the components that can be decremented are taken into consideration, and the one at the largest distance from its minimum *availability* value is selected'. If there are more than one at equal distance, the component with the highest hours of use is selected;
5. resources are allocated taking account of the levels of *availability* of the components controlled.

3.7.4 Compressor

A *compressor* is said to be *saturated* if it is at its maximum power output (maximum number of *power steps* that can be supplied). For compressors with power stages, the current activation level of the *compressor* is defined as the number of steps being supplied by the *compressor* at the time (for example, a *compressor* with 3 stages will have a maximum of 4 activation levels/steps).
For compressors located within the same *circuit*, the activation requirements (increments/decrements) are as follows. A continuous screw *compressor* is said to be saturated when its slide valve is in the maximum opening position.

3.7.4.1 Compressor saturation

The saturation policy attempts to distribute resources to the smallest possible number of compressors that is compatible with the constraints imposed by the other requirements, for example: protection times for compressors, maximum number of start-ups within one hour. The resulting allocation is intended to have the largest possible number of compressors switched off at any one time.

3.7.4.2 Compressor balancing

The balancing policy attempts to distribute resources equally over the largest possible number of compressors that is compatible with the constraints imposed by the other requirements, for example safety protection times, maximum number of start-ups within one hour. The resulting allocation is intended to have the greatest possible equalization of power output levels in the compressors at any one time.

3.7.5 Circuit

A *circuit* is said to be saturated when it is at its maximum power output (sum of the maximum numbers of *power steps* that can be supplied by the compressors belonging to the *circuit*) A *circuit* is said to be active or On if at least one *compressor* is activated at one step; it is said to be Off if none of the compressors are activated. The activation level of a particular *circuit* is defined as the total number of *power steps* that the compressors are supplying at the time (for example, a *circuit* that has 2 compressors with 4 power stages can supply up to 8 activation levels/steps).
For circuits located within the same *evaporator*, the requirements for activation levels are as follows.

3.7.5.3 Circuit saturation

The saturation policy attempts to distribute resources equally over the smallest possible number of circuits that is compatible with the constraints imposed by the other requirements, for example safety protection times, maximum number of start-ups within one hour. The resulting allocation is intended to have the largest possible number of circuits deactivated at any one time.

3.7.5.4 Circuit balancing

The balancing policy attempts to distribute resources equally over the largest possible number of circuits that is compatible with the constraints imposed by the other requirements, for example safety protection times, maximum number of start-ups within one hour. The resulting allocation is intended to have *circuit* power output levels equalized as much as possible at any one time.

3.7.6 Evaporator

An *evaporator* is said to be saturated when it is at its maximum power output (total of the maximum numbers of *power steps* that can be supplied by the circuits belonging to the *evaporator*) An *evaporator* is said to be active or On if at least one *circuit* is activated; it is said to be Off if none of the circuits is activated. The activation level of an *evaporator* is defined as the total number of *power steps* that the circuits are supplying at the time (for example, an *evaporator* that has 2 circuits, and 2 compressors with 4 power stages per *circuit*, can supply up to 16 activation levels/steps). For evaporators located within the same system, the requirements for activation levels are as follows.

3.7.6.5 Evaporator saturation

The saturation policy attempts to distribute resources to the smallest possible number of evaporators that is compatible with the constraints imposed by the other requirements, for example: protection times for compressors, maximum number of start-ups within one hour. The resulting allocation is intended to have the largest number of evaporators deactivated at any one time.

3.7.6.6 Evaporator balancing

The balancing policy attempts to distribute resources equally over the largest possible number of evaporators that is compatible with the constraints imposed by the other requirements, for example safety protection times, maximum number of start-ups within one hour. The resulting allocation is intended to have *circuit* power output levels equalized as much as possible at any one time.

Modbus address [hex]	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
240	EV_SELECTION_FUNCTION	Sets the selection policy for refrigeration power resources at *evaporator* level	0…1	1	28	C	V	0=SATURATION, 1=BALANCING	flag
241	CIR_SELECTION_FUNCTION	Sets the selection policy for refrigeration power resources at *circuit* level	0…1	1	29	C	V	0=SATURATION, 1=BALANCING	flag
242	KOMP_SELECTION_FUNCTION	Sets the selection policy for refrigeration power resources at *compressor* level	0…1	0	30	C	V	0=SATURATION, 1=BALANCING	flag

3.8 Compressor management

3.8.1 Compressor configuration

The compressors are configured by setting parameter KOMP_CIRC_EV_i to associate *compressor* number "i" with:

- the *circuit* that corresponds to the unit value of parameter KOMP_CIRC_EV_i;
- the *evaporator* that corresponds to the value plus ten of parameter KOMP_CIRC_EV_i;

For example, in the default machine, the *parameters* are set with the values shown in the following table:

KOMP_CIR_EV_1	11
KOMP_CIR_EV_2	12
KOMP_CIR_EV_3	21
KOMP_CIR_EV_4	22
KOMP_CIR_EV_5	0
KOMP_CIR_EV_6	0
KOMP_CIR_EV_7	0
KOMP_CIR_EV_8	0

This represents 4 compressors in all; the first belongs to the first *circuit* of the first *evaporator*, the second to the second *circuit* of the first *evaporator*, the third to the first *circuit* of the second *evaporator*, the fourth to the second *circuit* of the second *evaporator*.

IMPORTANT NOTE: the table must be completed from top to bottom, with values in strictly ascending order.

3.8.2 Compressor timing

The On and Off times of a *compressor* must meet the following requirements:

- Minimum Off-On time (parameter MIN_OFFON_TIME). This is the minimum time that must elapse between one switch-off and the next start-up;
- Minimum On-Off time (parameter MIN_ONOFF_TIME). This is the minimum time that must elapse between one start-up and the next switch-off;

Times between *compressor* start-ups must meet the following requirement:

- Minimum time between *compressor* start-ups (parameter SOFTSTART_TIME). This is to ensure that the electrical power line is not subjected to simultaneous start-ups of more than one compressors

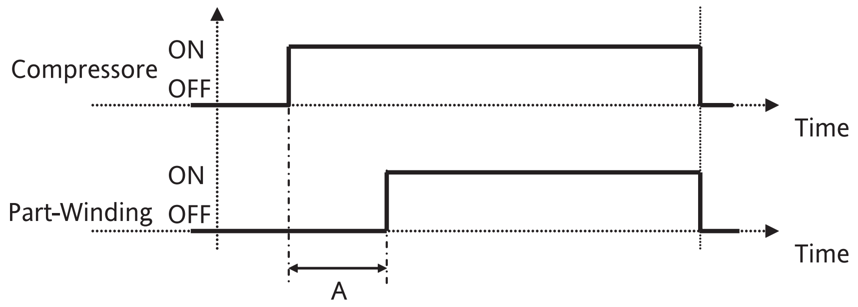
3.8.3 Hours of use of compressors

The operating time of the compressors is stored every hour in EEPROM, on the two following *parameters* :

- KOMP_USAGE_DAYS_i, days of use of *compressor* number "i"
- KOMP_USAGE_HOUR_i, hours of use of *compressor* number "i"

3.8.4 Part-winding start-up

Each *compressor* is associated with a relay used to limit current peaks when the *compressor* is started; relay operation is described in Fig.3.7.4.



Compressor	KOMP_ACC_DO_i_PHY, i=*compressor* number "i";
Part-winding	KOMP_PW_DO_i_PHY, i=*compressor* number "i";
A	PAR_TMR_BIOS_2

3.8.5 Power steps

See the section on REFRIGERATION *POWER STEPS* OF COMPRESSORS.

3.8.6 Compressor selection

Compressors can be de-selected individually using the *parameters* KOMP_SELEZ_i_HOT, where i=*compressor* number "i"

- the *compressor availability* is set to zero
- all the *compressor*'s alarms are set to zero.
- its alarms are not managed

3.8.7 Maximum number of start-ups per hour

Parameter MAX_STARTS_PER_HOUR_NO defines the maximum number of starts allowed for the *compressor* in one hour.
When the maximum number of start-ups in the last hour reaches the maximum value, the *availability* of this *compressor* is set to zero.
The number of start-ups is stored with a time resolution of 3600/32 seconds.
The *compressor* will become available again only when the number of starts stored over the past hour falls below MAX_STARTS_PER_HOUR_NO. This can be known with certainty only when the last start-up took place more than one hour previously.
The number of start-ups is always set to zero:

- by changing from On to Off (using the keypad or the remote ON/OFF);
- at the next Power On;
- when exiting from configuration mode;

Modbus address **[hex]**	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
200	KOMP_CIR_EV_1	Associate *compressor* 1 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	11…24	11	0	C	V		num
201	KOMP_CIR_EV_2	Associate *compressor* 2 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	12	0	C	V		num
202	KOMP_CIR_EV_3	Associate *compressor* 3 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	21	0	C	V		num
203	KOMP_CIR_EV_4	Associate *compressor* 4 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	22	0	C	V		num
204	KOMP_CIR_EV_5	Associate *compressor* 5 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	0	0	C	V		num
205	KOMP_CIR_EV_6	Associate *compressor* 6 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	0	0	C	V		num
206	KOMP_CIR_EV_7	Associate *compressor* 7 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	0	0	C	V		num
207	KOMP_CIR_EV_8	Associate *compressor* 8 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	0	0	C	V		num
210	KOMP_CHARGEDISCH_IMPULSE_1	Duration of charge/discharge pulse for *compressor* 1	0.0…20.0	1.0	0	C	V		Sec
211	KOMP_CHARGEDISCH_IMPULSE_2	Duration of charge/discharge pulse for *compressor* 2	0.0…20.0	1.0	0	C	V		Sec
212	KOMP_CHARGEDISCH_IMPULSE_3	Duration of charge/discharge pulse for *compressor* 3	0.0…20.0	1.0	0	C	V		Sec
213	KOMP_CHARGEDISCH_IMPULSE_4	Duration of charge/discharge pulse for *compressor* 4	0.0…20.0	1.0	0	C	V		Sec
214	KOMP_CHARGEDISCH_IMPULSE_5	Duration of charge/discharge pulse for *compressor* 5	0.0…20.0	1.0	0	C	V		Sec
215	KOMP_CHARGEDISCH_IMPULSE_6	Duration of charge/discharge pulse for *compressor* 6	0.0…20.0	1.0	0	C	V		Sec
216	KOMP_CHARGEDISCH_IMPULSE_7	Duration of charge/discharge pulse for *compressor* 7	0.0…20.0	1.0	0	C	V		Sec
217	KOMP_CHARGEDISCH_IMPULSE_8	Duration of charge/discharge pulse for *compressor* 8	0.0…20.0	1.0	0	C	V		Sec
218	KOMP_CHARGEDISCH_TIME	Duration of charge/discharge pulse for compressors	0…250	60	0	C	V		sec
2F0	MIN_OFFON_TIME_HOT	Safety protection time from *compressor* OFF to ON	0…500	60	0	H	V		sec
2F1	MIN_ONOFF_TIME_HOT	Safety protection time from *compressor* ON to OFF	MIN_OFFON_TIME…500	10	0	H	V		sec
2F2	MAX_STARTS_PER_HOUR_NO_HOT	Maximum number of *compressor* start-ups in one hour	0…20	6	0	H	V		num
2F3	CPWR_UPDOWN_MIN_TIME_HOT	Safety protection time between downward power stages	0…300	10	0	H	V		sec
2F4	CPWR_DOWNUP_MIN_TIME_HOT	Safety protection time between upward power stages	0…300	10	0	H	V		sec
320	KOMP_SELEZ_1_HOT	Select *compressor* 1	0…1	1	6	H	V	0=NO, 1=YES	flag
321	KOMP_SELEZ_2_HOT	Select *compressor* 2	0…1	1	6	H	V	0=NO, 1=YES	flag
322	KOMP_SELEZ_3_HOT	Select *compressor* 3	0…1	1	6	H	V	0=NO, 1=YES	flag
323	KOMP_SELEZ_4_HOT	Select *compressor* 4	0…1	1	6	H	V	0=NO, 1=YES	flag
324	KOMP_SELEZ_5_HOT	Select *compressor* 5	0…1	1	6	H	V	0=NO, 1=YES	flag
325	KOMP_SELEZ_5_HOT	Select *compressor* 6	0…1	1	6	H	V	0=NO, 1=YES	flag
326	KOMP_SELEZ_7_HOT	Select *compressor* 7	0…1	1	6	H	V	0=NO, 1=YES	flag
327	KOMP_SELEZ_8_HOT	Select *compressor* 8	0…1	1	6	H	V	0=NO, 1=YES	flag

Modbus address **[hex]**	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
330	KOMP_USAGE_DAYS_1	Days of use of *compressor* 1	0…32000	0	0	C	V		day
331	KOMP_USAGE_DAYS_2	Days of use of *compressor* 2	0…32000	0	0	C	V		day
332	KOMP_USAGE_DAYS_3	Days of use of *compressor* 3	0…32000	0	0	C	V		day
333	KOMP_USAGE_DAYS_4	Days of use of *compressor* 4	0…32000	0	0	C	V		day
334	KOMP_USAGE_DAYS_5	Days of use of *compressor* 5	0…32000	0	0	C	V		day
335	KOMP_USAGE_DAYS_6	Days of use of *compressor* 6	0…32000	0	0	C	V		day
336	KOMP_USAGE_DAYS_7	Days of use of *compressor* 7	0…32000	0	0	C	V		day
337	KOMP_USAGE_DAYS_8	Days of use of *compressor* 8	0…32000	0	0	C	V		day
338	KOMP_USAGE_HOUR_1	Hours of use of *compressor* 1	0…24	0	0	C	V		hour
339	KOMP_USAGE_HOUR_2	Hours of use of *compressor* 2	0…24	0	0	C	V		hour
33A	KOMP_USAGE_HOUR_3	Hours of use of *compressor* 3	0…24	0	0	C	V		hour
33B	KOMP_USAGE_HOUR_4	Hours of use of *compressor* 4	0…24	0	0	C	V		hour
33C	KOMP_USAGE_HOUR_5	Hours of use of *compressor* 5	0…24	0	0	C	V		hour
33D	KOMP_USAGE_HOUR_6	Hours of use of *compressor* 6	0…24	0	0	C	V		hour
33E	KOMP_USAGE_HOUR_7	Hours of use of *compressor* 7	0…24	0	0	C	V		hour
33F	KOMP_USAGE_HOUR_8	Hours of use of *compressor* 8	0…24	0	0	C	V		hour

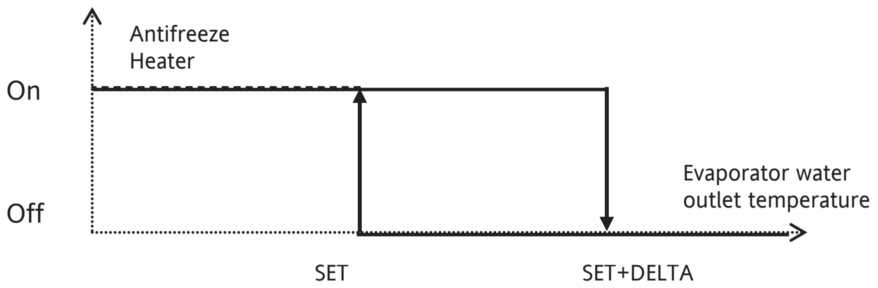
3.9 Antifreeze

3.9.1 Antifreeze function

If the machine is:

- started when cold (or going off from Cold mode) and parameter AFPR_COOLING_ENABLED_FLAG=yes;
- started when hot (or going down from Hot mode) and parameter AFPR_HEATING_ENABLED_FLAG=yes;
- started in Hot mode and at least one *circuit* of the machine is defrosting with the compressors On and parameter AFPR_ENABLED_DURING_*DEFROST*=yes;
- Off and parameter AFPR_OFF_STDBY_ENABLE_FLAG=yes (in this case, the *parameters* of the hot or cold mode currently selected will be used).
-

The controller enables an algorithm to prevent the *antifreeze alarm*s from monitoring the outlet temperature at each *evaporator*. This algorithm activates the *antifreeze* resistors according to the hysteresis function, where Set temperature is configured by AFPR_CHILLING_TSET/ AFPR_HEATING_TSET and Delta temperature is configured by AFPR_DELTA_TEMP as shown in the table.



SET	AFPR_CHILLING_TSET/ AFPR_HEATING_TSET
DELTA	AFPR_DELTA_TEMP
Water temperature at *evaporator* outlet	EV_TEMP_OUTWATER_SENS_i_PHY, i = *evaporator* number "i"
Antifreeze resistor	EV_HEATER_DO_i_PHY, i = *evaporator* number "i"

In particular, the *antifreeze* resistor is On if water temperature < SET, Off if water temperature >= (SET+DELTA), and unchanged in the other cases.

It at least one *evaporator* requires its *antifreeze* resistor to be switched on, the *antifreeze* resistors will be switched on in all the evaporators.
The *antifreeze* resistors are always off when in configuration mode, or if there is an error in the outlet water sensor of the *evaporator*, or if there is an alarm when parameter AF_USE_RESISTOR_FLAG is set to NO.
The hysteresis function is always re-initialized at Power On, when system status changes from Off to Cold, and when exiting configuration mode.

Errors in this sensor cause the system to be blocked (including pump group and *antifreeze* resistors).

Note: activation of the resistors causes a request for activation of the pumps in the pump group in order to allow water to circulate in the primary *circuit*.

Modbus address [hex]	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
2B0	AF_ENABLE_FLAG	Enable *antifreeze function*	0…1	1	6	C	V	0=NO, 1=YES	flag
2B1	AF_USE_RESISTOR_FLAG	Enable use of the resistors if there is an *antifreeze alarm*	0…1	1	6	C	V	0=NO, 1=YES	flag
2C0	AFPR_COOLING_ENABLED_FLAG	Enable *antifreeze* prevention function if the system is On or going down (in Cold or Going Down mode)	0…1	1	6	C	V	0=NO, 1=YES	flag
2C1	AFPR_OFF_STDBY_ENABLE_FLAG	Enable *antifreeze* prevention function if the system is Off (Off mode)	0…1	1	6	C	V	0=NO, 1=YES	flag
2C2	AFPR_CHILLING_TSET	*Antifreeze* prevention setpoint	-50.0…150.0	5.0	0	C	V		°C
2C3	AFPR_DELTA_TEMP	*Antifreeze* prevention delta	-50.0…150.0	2.0	0	C	V		°C

3.10 Operating mode management

The machine operating status can have one of the three following values:

- OFF
- ON (in cold/hot mode)
- GOING DOWN

The user can select these using the keypad (PUSH: ON/) or a dedicated digital input PLAN_ON_DI_PHY. The system operating status selected on the keypad is stored in EEPROM so that it can be restored at the next Power On (after a power failure) or when the value of PLAN_ONOFF_DI_PHY changes from true false.

The digital input always takes priority when PLAN_ON_DI_PHY=true and causes the machine to be switched if On in Cold mode, or keeps it Off.

If PLAN_ON_DI_PHY=false, the system is switched On/ from the keypad using the ON/ toggle switch. Note that the Going Down phase cannot be stopped by an ON/ request from the keypad, which is therefore ignored.

The following table shows some special conditions for changes of system status.

	Active status	Status in EEPROM	Timer 1	Timer 2	Remote ON	
A	On	On	Not active	Not active	False->True	system changes to Going Down
B	On	On	Active	Not active	False->True (*)	system changes to Going Down mode and Timer 2 is re-started
C	Going down	On	Not active	Not active	True->False	system starts immediately (the heat regulator takes *control* of resources)
D	Going down	On	Not active	On	True->False	system starts and Timer 2 is re-started (the compressors remain until Timer 1 stops and are then controlled by the heat regulator).

Timer 1	PUMPGROUR_STARTUP_DELAY_TIME
Timer 2	PUMPGROUR_STOP_DELAY_TIME
Remote ON	PLAN_ONOFF_DI_PHY

(*) or the ON/ button is pressed

The machine operating status changes from GOING DOWN to OFF when all compressors are OFF, the pump is OFF and dripping has ended (if defrosting was active).

Note if there is a power failure during the Going Down phase, the machine starts from Off at the next Power On.

3.11 Mode change management (SUMMER/WINTER)

Summer/winter mode can be selected either by digital input PLAN_MODE_DI_PHY if parameter PLAN_MODE_DI_ENABLE_FLAG is enabled, or from the keypad by changing parameter PLAN_MODE_MANUAL.
The digital input has priority over the PLAN_MODE_MANUAL parameter.
The mode can be changed either with the machine either Off or On: in the latter case, the machine goes down automatically and then re-starts in the new mode.
In both cases, i.e. if the machine is On or Off, all machine statuses and alarms are re-initialized.
Once initiated, the mode change procedure cannot be stopped by another mode change. The machine will therefore go Off in the current mode, go into the last mode selected, then re-start (unless Off is requested by digital input or by the status in EEPROM). Therefore, if a machine Off is requested during the mode change procedure (for example by digital input), when the machine goes Off, the *reverse cycle valve*s will go into the status corresponding to the last mode selected, and the machine will remain Off

Modbus address [hex]	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
223	PLAN_MODE_DI_ENABLE_FLAG	Enable mode setting by digital input	0…1	1	6	C	V	0=NO, 1=YES	flag
249	PLAN_MODE_MANUAL	Summer/winter mode from keypad	0…1	0	27	C	V	0=CHILLER 1=HEAT PUMP	num

4 DEFROST

The *defrost* function is active only in Hot mode, and is used to prevent ice forming on the surface of the evaporation element, which occurs most frequently when the ambient temperature is very low, considerably reducing thermodynamic efficiency and causing a risk of damage to the machine.

4.1 Types of defrost

Defrosting can be carried out in the reverse cycle, and in one mode, called “Standard” mode”.
This is similar to the one applied in the ECH400 device and is enabled by setting parameter DF_FUNCTION to “Standard”. The *defrost* function can be disabled by setting parameter DF_FUNCTION to “None”. Reverse cycle defrosting requires one *reverse cycle valve* on each *circuit*
(CIR_INVERSION_VALVE_DO_i_PHY, i = *circuit* number "i"). If a *circuit* is defrosting, its *reverse cycle valve* is deactivated (CIR_INVERSION_VALVE_DO_i_PHY = FALSE, i = number of *defrost circuit*).
The figure below illustrates the *Defrost* and Drip times and shows how the *reverse cycle valve functions*. For the *Circuit* and *Fans*, please refer to the next sections

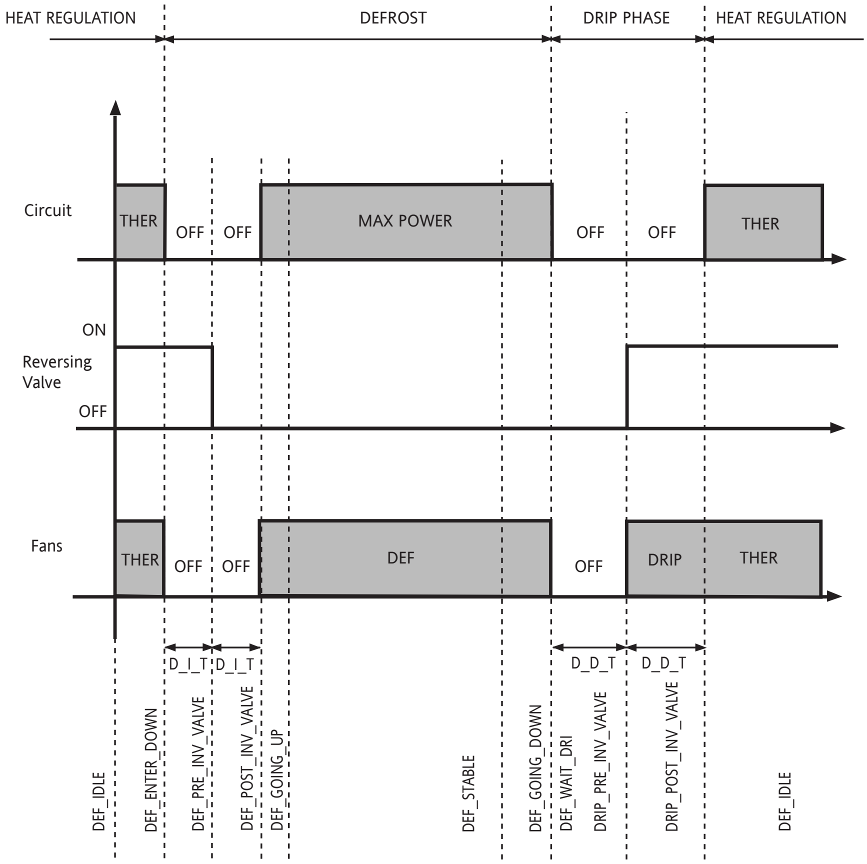


Fig. 4.1

D_I_T:	DF_INVERSION_TIME
D_D_T:	DF_DRIP_TIME

4.2 Conditions for starting the defrost function

The conditions required for going into *defrost* are as follows:

- When the pressure detected by the maximum pressure sensor on *circuit* "i" (CIR_PRES_MAX_SENS_i_PHY) goes below the value of parameter DF_START_PRES (*defrost* start pressure) and the *circuit* is supplying at least one power step, the *defrost* delay time counter is started and counts the time value set with parameter DF_START_DELAY_TIME.
- If the pressure goes back above the value of parameter DF_START_PRES (*defrost* start pressure) or the *circuit* is not supplying any *power steps*, the delay time counter is stopped.
- The counter of the *defrost* delay time (DF_START_DELAY_TIME) is reset after a *defrost* cycle, after a Power Down, after a mode change, or if the system is started or stopped from the keypad.
- The *defrost* delay time counter (DF_START_DELAY_TIME) is reset if the pressure goes above the value of parameter DF_STOP_PRES (*defrost* stop pressure).
- When the delay time count is completed, if the pressure detected by the *defrost* sensor is still below the value set by parameter DF_START_PRES (*defrost* start pressure) and the other conditions for starting the *defrost* are still present (*circuit* is supplying at least one power step), then the circuits start to switch Off; after they have switched Off, *defrost* runs for the maximum time set by parameter DF_MAX_DURATION_TIME and minimum time set by parameter DF_MIN_DURATION_TIME. When defrosting starts, the *compressor* safety protection times are reset with the values set for the *defrost* function by parameter (DF_INTER_STEP_TIME). The number of *compressor* start-ups per hour is set to zero and re-armed, to count the number of start-ups during *defrost*. The *compressor* safety protection times (minimum ON time and minimum OFF time) are then “disabled” until the *defrost* stop conditions are detected. The purpose of this is to make the defrosting process as rapid as possible.
- The time from the end of the last *defrost* of the *circuit* until the start of the next *defrost* must be at least the value set by parameter DF_MIN_REST_TIME.
- The delay time count between defrosts (DF_MIN_REST_TIME) is “reset” after a Power Down, after an operating mode change, and after the system is started or stopped from the keypad.

If more than one circuits belong to the same fan battery and one of them goes into *defrost*, all the other circuits are forced into *defrost* without taking account of time DF_START_DELAY_TIME (simultaneous *defrost*)

4.3 Control during defrost

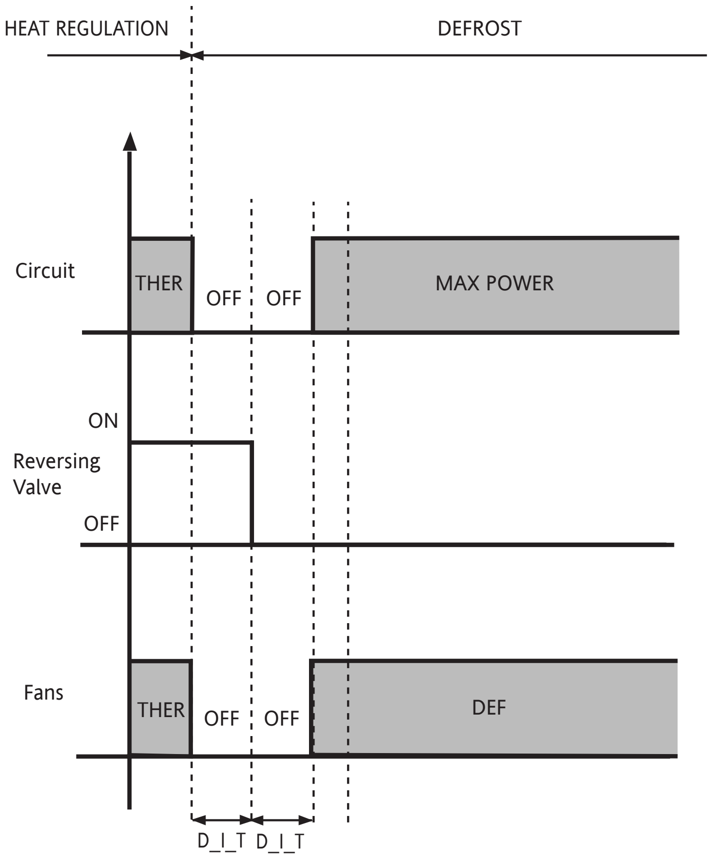


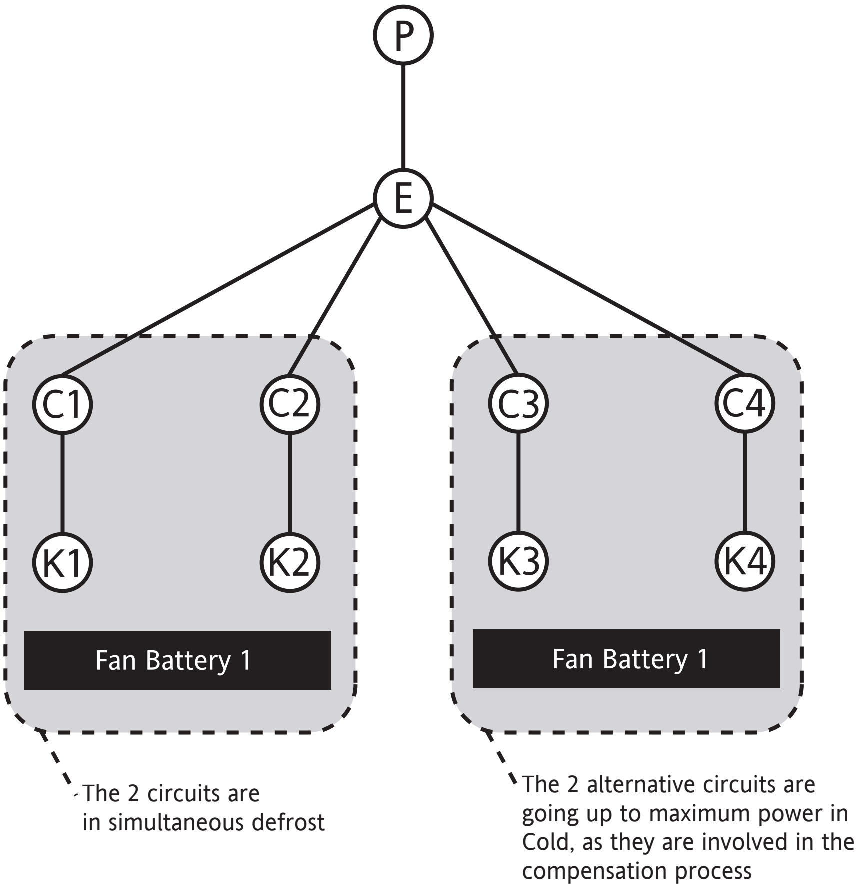
Fig.4.3

D_I_T:	DF_INVERSION_TIME

4.3.1 Circuit

At the start of *defrost*, if time DF_INVERSION_TIME is different from zero, heat regulation is carried out as shown in Figure 4.3: at the start of *defrost*, the *circuit* is powered down (DEF_IDLE?DEF_ENTER_DOWN). When it has gone Off (its compressors are Off), the delay time in parameter DF_INVERSION_TIME (DEF_ENTER_DOWN → DEF_PRE_INV_VALVE) is

counted, after which the *reverse cycle valve* for the *circuit* is reversed (CIR_INVERSION_VALVE_DO_i_PHY, i = number of the *circuit*). Another delay time is then counted, for time DF_INVERSION_TIME (DEF_PRE_INV_VALVE→ DEF_POST_INV_VALVE), after which the *circuit* re-starts (DEF_PRE_INV_VALVE→ DEF_GOING_UP).
If DF_INVERSION_TIME = 0, any *compressor*(s) that may be On in the *circuit* to be defrosted will remain On (DEF_IDLE → DEF_GOING_UP).
In *defrost*, the compressors in the *circuit* being defrosted are activated at full power until they reach their maximum power output (DEF_GOING_UP→ DEF_STABLE). The time defined by parameter DF_INTER_STEP_TIME is applied between the *power steps* of the compressors (MAX POWER zone of the *Circuit* in the Figure).
Note that if at least one *circuit* has not yet reached full power in *defrost*, and the conditions for stopping *defrost* are detected for any of the circuits, defrosting is stopped and the circuits are switched off, applying the times between steps for *defrost* (DF_INTER_STEP_TIME) and the following drip phase.
Obviously, the compressors in circuits not involved in the *defrost* are (or remain) activated by the heat regulator, according to the standard heat regulation policies. This is unless there is a request for the compensation function by the DF_MAX_POWER_FLAG parameter, which activates the compressors at full power in the alternative circuits that are not in *defrost*.
The alternative circuits are those belonging to the same *evaporator* block in which the *defrost circuit* is located, but which are not connected to the fan battery involved in the defrosting.
Below is an example of a 1-4-4 reversible machine, where parameter DF_MAX_POWER_FLAG is set to YES :



4.3.2 Reverse cycle valve

At start of *defrost*, the *reverse cycle valve* is actuated as described in the Compressors section.
From the time that the valve is reversed, the bypass time defined by parameter DF_BYPASS_MIN_TIME is counted for minimum pressure alarms on the *circuit* involved.
Note that each time there is a change of position of the *reverse cycle valve* on the *circuit*, the minimum pressure alarm bypass time is set to whichever value of A_MIN_PRES_BYPASS_TIME and DF_BYPASS_MIN_TIME is the largest.

4.3.3 Fans

At the start of *defrost*, if time DF_INVERSIONE_TIME is different from zero, the *fans* are forced Off for twice the value of that parameter (fan OFF zones in Figure 4.3). After this time has elapsed, if the pressure detected (the highest of the values CIR_PRES_MAX_SENS_i_PHY detected by the sensors, where "i" is the number of the circuits involved in the *defrost*) goes above 'start *fans* in *defrost*' threshold DF_MAX_FANSP_PRES, the *fans* are activated at full power. If the pressure goes below (DF_MAX_FANSP_PRES-DF_MAX_FANSP_DELTA_PRES) the *fans* are stopped (*fans* DEF zone shown in Figure 4.2). If DF_INVERSIONE_TIME = 0, the *fans* do not go through the forced Off phase, but are controlled directly as in *defrost*.

4.4 Conditions for stopping the defrost function

Defrosting is stopped :

- When the current *defrost* has reached the maximum duration defined by DF_MAX_DURATION_TIME (maximum *defrost* time).
- If the *defrost* pressure goes above DF_STOP_PRES (*defrost* pressure) and time DF_MIN_DURATION_TIME has elapsed (minimum *defrost* time).

The conditions described above are evaluated when the defrosting power is rising (DEF_GOING_UP) or stable at maximum (DEF_STABLE). The minimum safety protection times for which the compressors remain ON and OFF are applied again: the ON time for the next start-up and the OFF time for each *compressor* coming out of *defrost*

4.5 Control while coming out of defrost and during the drip time

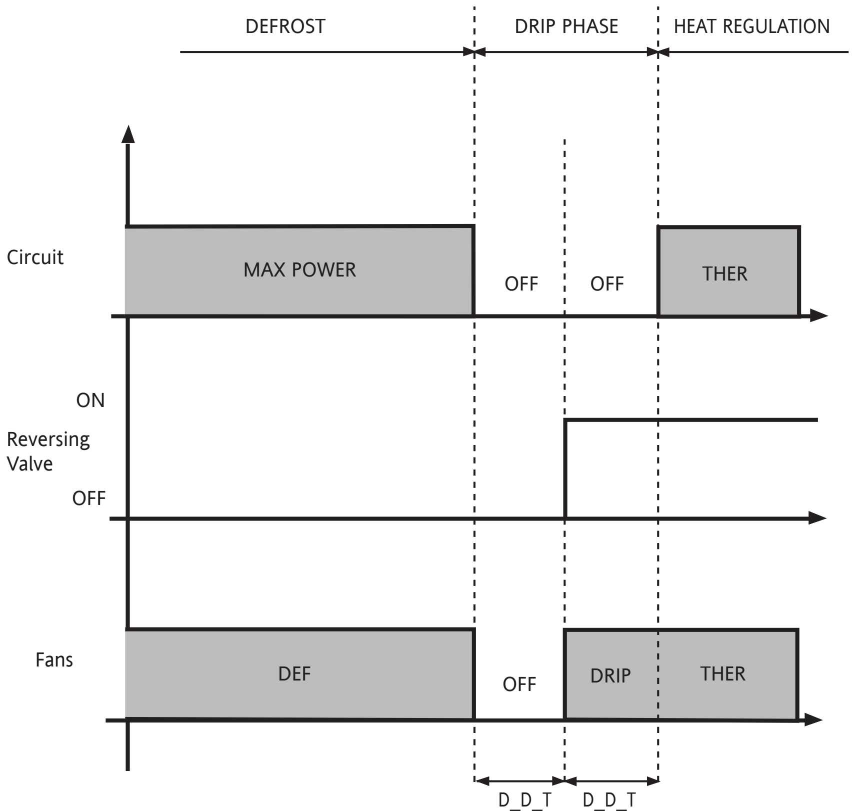


Fig. 4.5

D_D_T:	DF_DRIP_TIME

4.5.1 Circuit

At the end of *defrost*, if time DF_DRIP_TIME <> 0, heat regulation is carried out as shown in the figure.
The *power steps* of compressors in the *circuit* that is coming out of *defrost* are switched off, applying the time set by parameter DF_INTER_STEP_TIME (DEF_STABLE→DEF_GOING_DOWN). When the *circuit* is Off, delay time DF_DRIP_TIME (DEF_GOING_DOWN→DRIP_PRE_INV_VALVE), is counted, after which the *circuit*'s *reverse cycle valve* is reversed (CIR_INVERSION_VALVE_DO_i_PHY, i = number of the *circuit*). Another delay time defined by DF_DRIP_TIME (DRIP_PRE_INV_VALVE→ DRIP_POST_INV_VALVE) is then counted, after which the *circuit* comes back under *control* of the heat regulator (*circuit* THER zone shown in Figure 4.5 DRIP_POST_INV_VALVE→ DEF_IDLE).
Timer DF_MIN_REST_TIME is then started.
If DF_DRIP_TIME = 0, any compressors that are On on the *circuit* being defrosted come immediately under the *control* of the heat regulator (DEF_STABLE→ DEF_IDLE). In the case of simultaneous *defrost* and if DF_DRIP_TIME<>0, and if a *circuit* has completed the *defrost* cycle (DEF_GOING_DOWN→ DEF_WAIT_DRIP) and the *compressor*(s is/are Off, these remain Off until the last *circuit* has finished defrosting (DEF_WAIT_DRIP→ DRIP_PRE_INV_VALVE) The circuits in which the compensation function was active come back under *control* of the Hot mode heat regulator after the drip time has ended. However, if DF_DRIP_TIME=0, all circuits come back under *control* of the heat regulator only when the last *circuit* goes off.

4.5.2 Reverse cycle valve

At the end of *defrost*, the *reverse cycle valve* is reversed as described in the Compressors section.
From the time that the valve is reversed, the bypass time defined by parameter DF_BYPASS_MIN_TIME is counted for minimum pressure alarms on the *circuit* involved.
Note that each time the position of the valve on the *circuit* changes, the bypass time for minimum pressure alarms is still controlled by parameter A_MIN_PRES_BYPASS_TIME.

4.5.3 Fans

During the drip time, the *fans* are switched Off before the *reverse cycle valve* is reversed. From the time that the valve is reversed and for time DF_DRIP_TIME, the *fans* are controlled according to parameter DF_DRIP_*FANS*_MAXPOWER_FLAG (*Fans* DRIP zone in the Figure).
If DF_DRIP_*FANS*_MAXPOWER_FLAG=NO, the *fans* are forced Off.
If DF_DRIP_*FANS*_MAXPOWER_FLAG=YES, the *fans* are forced to full power.
At the end of time DF_DRIP_TIME, the *fans* are controlled by the fan regulator in Hot mode (*Fans* THER zone in the Figure)

4.6 ON/OFF control during defrost

If the system is switched Off after activating the *defrost* start procedure, but before the circuits involved in the *defrost* change from Off to On to go up to maximum power (DEF_ENTER_DOWN, DEF_PRE_INV_VALVE, DEF_POST_INV_VALVE), the system immediately comes out of *defrost* and skips the drip phase (DEF_IDLE). The circuits are then immediately ready to go into a new *defrost* cycle, since the time between successive defrosts has not been initiated.

If the system is switched Off while the circuits are going up to full power in *defrost* (DEF_GOING_UP), or are already stable at full power (DEF_STABLE), the circuits are powered down (DEF_GOING_UP→ DEF_GOING_DOWN) and go into the drip phase.
If the system does not go through the Off phase, then the time between successive defrosts is applied, otherwise, at the next start-up of the machine, the circuits are immediately ready for to go into *defrost* if necessary.

In particular, in the following situations:

system changes from On to Off ;
at the next Power On;
when exiting from configuration mode;

the delay time between one *defrost* and the next (DF_MIN_REST_TIME) is reset, in order to
to allow an immediate *defrost* if necessary, and the delay time for starting to *defrost*
(DF_START_DELAY_TIME) is reset

Modbus address (hex)	Parameter Category and Name	Parameter description	Range	default	trans	C/H	vis	Description of code conversion	UM
420	DF_FUNCTION	Enable *defrost:* NONE=not enabled ECH400=enabled in ECH400 mode	4…5	4	23	C	V	4=standard 5=NONE	num
421	DF_MAX_POWER_FLAG	Enable maximum power request for circuits not in *defrost*.	0…1	0	6	C	V	0=NO 1=YES	flag
422	DF_DRIP_*FANS*_MAXPOWER_FLAG	Enable ventilation at maximum power during the drip cycle	0…1	0	6	C	V	0=NO 1=YES	flag
423	DF_MIN_REST_TIME	Minimum time between successive defrosts	0…1000	240	0	C	V		min
424	DF_DRIP_TIME	Drip time	0…1000	20	0	C	V		sec
425	DF_INTER_STEP_TIME	Time between steps during Energy 400 *defrost*	0…1000	30	0	C	V		sec
426	DF_INVERSION_TIME	Time between*:* - *circuit* going off for defrosting and the turning of the *reverse cycle valve* - change of position of the *reverse cycle valve* and time the *circuit* goes into *Defrost*.	0…1000	30	0	C	V		sec
427	DF_START_PRES	Pressure value at which defrosting is activated if pressure remains below this value for time DF_START_DELAY_TIME	0.0…50.0	3.0	0	C	V		bar
428	DF_START_DELAY_TIME	Time before starting to *defrost* when pressure remains below value DF_START_PRES	0…60	30	0	C	V		min
429	DF_STOP_PRES	Pressure value at which defrosting stops	0.0…5.0	12.0	0	C	V		bar
42A	DF_MIN_DURATION_TIME	Minimum time for which defrosting is to continue	0…30	5	0	C	V		min
42B	DF_MAX_DURATION_TIME	Maximum time for which defrosting is to continue	0…60	30	0	C	V		min
42C	DF_BYPASS_MIN_TIME	Bypass time for minimum pressure alarm at the start of *defrost*	0…30	5	0	C	V		min
42D	DF_MAX_FANSP_PRES	Pressure value beyond which the *fans* go up to maximum power during *defrost*	0.0…50.0	10.0	0	C	V		bar
42E	DF_MAX_FANSP_DELTA_PRES	Hysteresis delta relative to parameter DF_MAX_FANSP_PRES	0.0…10.0	2.0	0	C	V		bar

5 DIAGNOSTICS

5.1 Heat regulation alarms

5.1.1 High temperature alarm

If the temperature value measured by the inlet water sensor of the primary *circuit* (PLAN_TEMP_INWATER_SENS) remains just above the temperature set by the parameter A_HIGHT_THRESHOLD_TEMP for at least the time set by by the parameter A_HIGHT_BYPASS_TIME and the machine has been set to cold mode, then the *high temperature alarm* is generated. This is a system blocking alarm. The alarm is re-armed manually.

If one of the following conditions is present :

- Function disabled (A_HIGHT_ENABLE_FLAG=false);
- error in water inlet sensor of primary *circuit*;
- system Off;

the alarm remains Off.

The alarm is reset and re-armed:

- manually if re-settable
- the system is started or going down;
- exit from configuration mode;
- by a reset;

5.1.2 Low temperature alarm

If the temperature value measured by the inlet water sensor of the primary *circuit* (PLAN_TEMP_INWATER_SENS) remains just below the temperature set by by the parameter A_LOWT_THRESHOLD_TEMP for at least the time set by the parameter A_LOWT_BYPASS_TIME and the machine has been set to Hot mode, then the *low temperature alarm* is generated. This is a system blocking alarm.
The alarm is re-armed manually.

If one of the following conditions is present :

- Function disabled (A_LOWT_ENABLE_FLAG=false);
- error in water inlet sensor of primary *circuit*;
- system Off;

the alarm remains Off.

The alarm is reset and re-armed:

- manually if re-settable
- the system is started or going down;
- exit from configuration mode;
- by a reset

5.1.3 Water inlet sensor error

If heat regulation is performed through the inlet water temperature sensor (TREG_TEMP_SENS = ENTRY_SENS) or if the *high temperature alarm control* is enabled (A_HIGHT_ENABLE_FLAG), an error condition in this sensor causes the system to be blocked. In the other cases, error management is not enabled for the inlet water sensor.

5.1.4 Outlet water sensor error

If heat regulation is performed through the outlet water temperature sensor (TREG_TEMP_SENS = EXIT_SENS), an error condition in this sensor causes the system to be blocked. If heat regulation is performed through the inlet water temperature sensor, error management is not enabled for the outlet water sensor.

5.1.5 Dynamic setpoint current sensor error

If *dynamic setpoint* current management is enabled (DTSET_FUNCTION = DTSET_CURR), an error condition in this sensor does not block the system. If the *dynamic setpoint* is not enabled, error management is not enabled for the outlet water sensor.

5.1.6 Related parameters

Modbus address [hex]	Parameter Category and Name	Range	def	vis	trans	UM	C/H	Description of code conversion	Parameter description
245	A_HIGHT_BYPASS_TIME	1…99	15	V	0	min	H		*High temperature alarm* bypass time
248	A_LOWT_BYPASS_TIME	1…99	15	V	0	min	H		Bypass time for system *low temperature alarm*
243	A_HIGHT_ENABLE_FLAG	0…1	1	V	6	flag	C	0=NO, 1=YES	Enable system *high temperature alarm* (the alarm monitors the inlet water temperature on the primary *circuit*)
244	A_HIGHT_THRESHOLD_TEMP	-15.0…50.0	18.0	V	0	°C	H		System high tempe-rature alarm setpoint
246	A_LOWT_ENABLE_FLAG	0…1	1	V	6	flag	C	0=NO, 1=YES	Enable system *low temperature alarm* (this alarm monitors the inlet water temperature on the primary *circuit*)
247	A_LOWT_THRESHOLD_TEMP	-15.0…50.0	30.0	V	0	°C	H		Set point for system *low temperature alarm*

5.2 Circuit management alarms

5.2.1 Errors and alarms in circuit maximum pressure sensor

The *circuit* maximum pressure alarm monitors the digital input for maximum pressure CIR_PRES_MAX_DI_i_PHY and for the maximum pressure sensor CIR_PRES_MAX_SENS_i_PHY, i=*circuit* number "i".

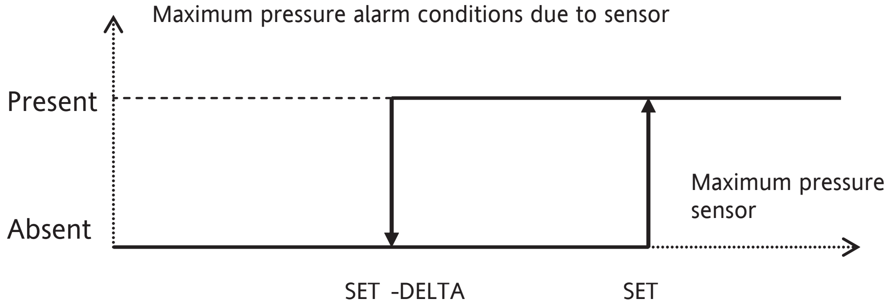


Fig 5.2.1

SET	A_MAX_PRES
DELTA	A_MAX_DELTA_PRES
Maximum pressure	CIR_PRES_MAX_SENS_i_PHY, i = *circuit* number "i"

When the system is Off , the alarm remains Off.
When the system is started in Cold mode, or when going down, the alarm is controlled by the hysteresis function shown in Fig 5.2.1, in OR logic with the status of digital input CIR_PRES_MAX_DI_i_PHY .
For the hysteresis function in particular, an alarm condition is Present if sensor >=SET, Absent if sensor <(SET-DELTA), and unchanged in the other cases.

The resulting alarm condition is used to generate an alarm, reset manually, which blocks the *circuit* concerned..

The hysteresis function is set to Absent in the following cases:

- System started or going down;
- exit from configuration mode;
- by a reset;
- error in maximum pressure sensor;

If there is an error in the *circuit* maximum pressure sensor, the *circuit* concerned is blocked. If the maximum pressure switch is not actuated, only the sensor error is displayed, otherwise the maximum pressure alarm is displayed. In the latter case, if the pressure switch is reset, the maximum pressure alarm is reset automatically. In all cases, the *circuit* is blocked by the sensor error.

5.2.2 Circuit minimum pressure alarm

Management of the minimum pressure alarm condition is enabled if:

- machine is started or going off
- pumpdown is not enabled;
- pumpdown is enabled and the FINISH_PDA or FINISH_PDS phases are active with the solenoid valve open;

This algorithm activates the minimum pressure alarm by monitoring minimum pressure digital input CIR_PRES_MIN_DI_i_PHY, i=*circuit* number "i".

The alarm is bypassed for time A_MIN_PRES_BYPASS_TIME which is loaded each time there is a change in the power applied to the *circuit* not due to the alarm itself . Please also refer to the section on Defrosting.

The alarm is re-armed automatically. If the number of responses from the alarm in one hour is above the value of parameter MAX_MINP_ALARMS_NO, the alarm then has to be re-armed manually. Start-ups are stored in memory with a time resolution of 3600/32 seconds.

When an alarm is present, the *circuit* is switched off.

Alarm management is always re-initialized and the alarm is reset:

- if the alarm is reset manually
- when system status changes from Off to Cold
- when exiting from configuration mode.
- at Power On

5.2.3 Related parameters

Modbus address [hex]	Parameter Category and Name	Range	def	vis	trans	UM	C/H	Description of code conversion	Parameter description
2E0	A_MAX_PRES	0.0…50.0	28.0	V	0	Bar	C		Setpoint for *circuit* maxi-mum pressure alarm
2E1	A_MAX_DELTA_PRES	0.0…10.0	2.0	V	0	Bar	C		Delta for *circuit* maxi-mum pressure alarm
2E2	MAX_MINP_ALARMS_NO	0…20	3	V	0	Num	H		Maximum number of minimum pressure alarms in the hour before the alarm changes from automatic to manual
2E3	A_MIN_PRES_BYPASS_TIME	0…500	120	V	0	Sec	H		Bypass time for minimum pressure alarm

5.3 Fans thermal alarm

A single thermal input is provided per battery of *fans* irrespective of the number of *fans* in each battery.
A response by the thermal protection of the fan battery always causes the immediate blocking of the battery and all compressors belonging to the same circuits as the *fans* concerned. The alarm is re-armed manually.

5.4 Hydraulic pump control alarms

5.4.1 Flow switch alarm

Management of this alarm is enabled if the machine is started in Cold mode or going down, or if the heating resistors are On (*antifreeze* or frost prevention).

The controller responds to the *flow switch alarm* signals after a certain time delay. For example, the *flow switch alarm* must be present for a certain period before becoming "effective", i.e. before it is processed and managed by the controller. In the following paragraphs, we distinguish between "*flow switch alarm*" (the flow switch is sending an alarm signal to the controller, but the controller has not yet gone into the "*flow switch alarm*" phase) and "logic alarm" (the controller has gone into *flow switch alarm* management phase).

A_FS_BYPASS_STARTUP_TIME defines the time interval, when the pumps are started, during which *flow switch alarm*s are ignored.

Parameter **A_FS_ENTRY_TIME** defines the time interval, during normal operation of the pumps (after time **A_FS_BYPASS_STARTUP_TIME** has elapsed), during which the occurrence or persistence of a *flow switch alarm* is ignored. The alarm will become effective and automatic if it persists after the defined time interval has elapsed.
Parameter **A_FS_EXIT_TIME** defines the time interval (after a flow switch logic alarm has occurred) for which the *flow switch alarm* must not recur continuously until the logic alarm condition is considered to have been reset.
A_FS_AUTOMATIC2MANUAL_TIME defines the time for which the logic alarm must persist until the alarm management changes from automatic to manual.

5.4.2 Pump thermal alarm

Management of this alarm is enabled if the machine is started or going down, or if the heating resistors are On (*antifreeze* or frost prevention).
The *pump thermal alarm* is a manual reset alarm, which blocks the pump currently in use.

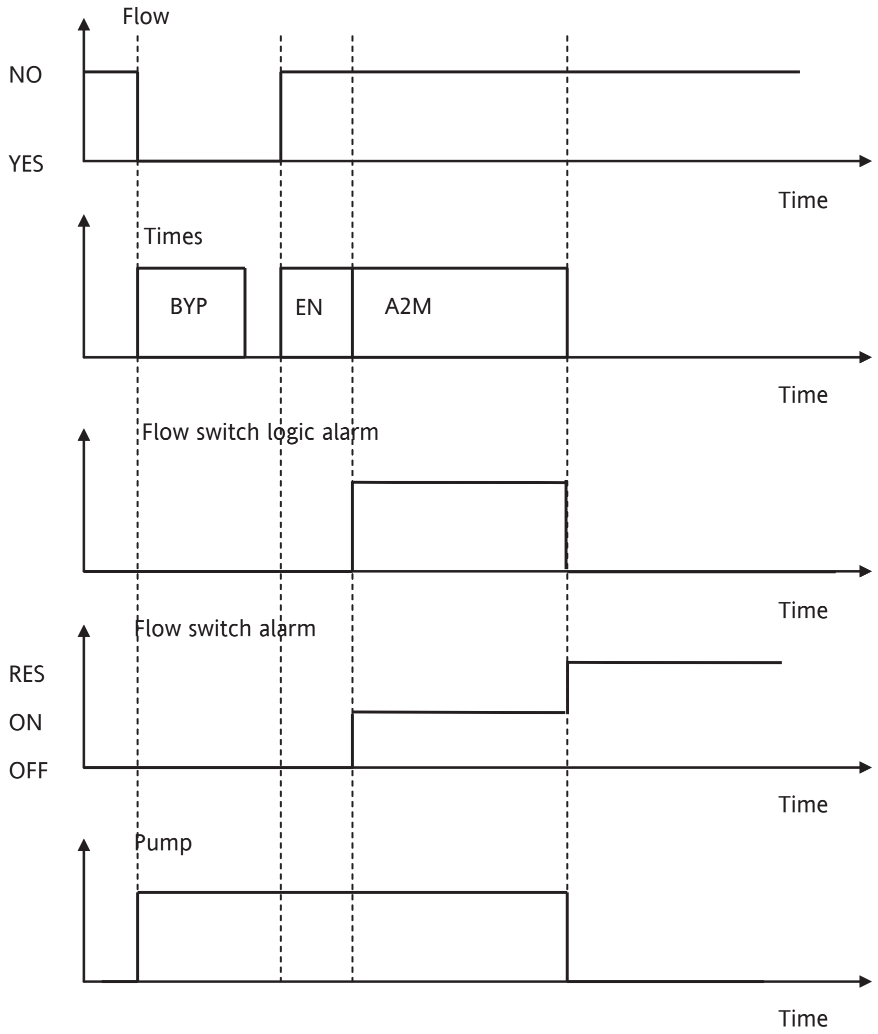
5.4.3 Pump management if there is a pump thermal protection or flow switch alarm

If there is a flow switch logic alarm or a pump thermal protection has been actuated, the system behaves differently depending on whether one or two pumps are present.

5.4.3.1 PUMPS_NO=1

If the pump thermal protection is actuated, the system is blocked immediately and thermal protection manual alarm is activated. When the pump thermal protection is deactivated, the alarm must be reset so that the pump can become available again and allow the system to restart.

Flow switch alarm **always active**

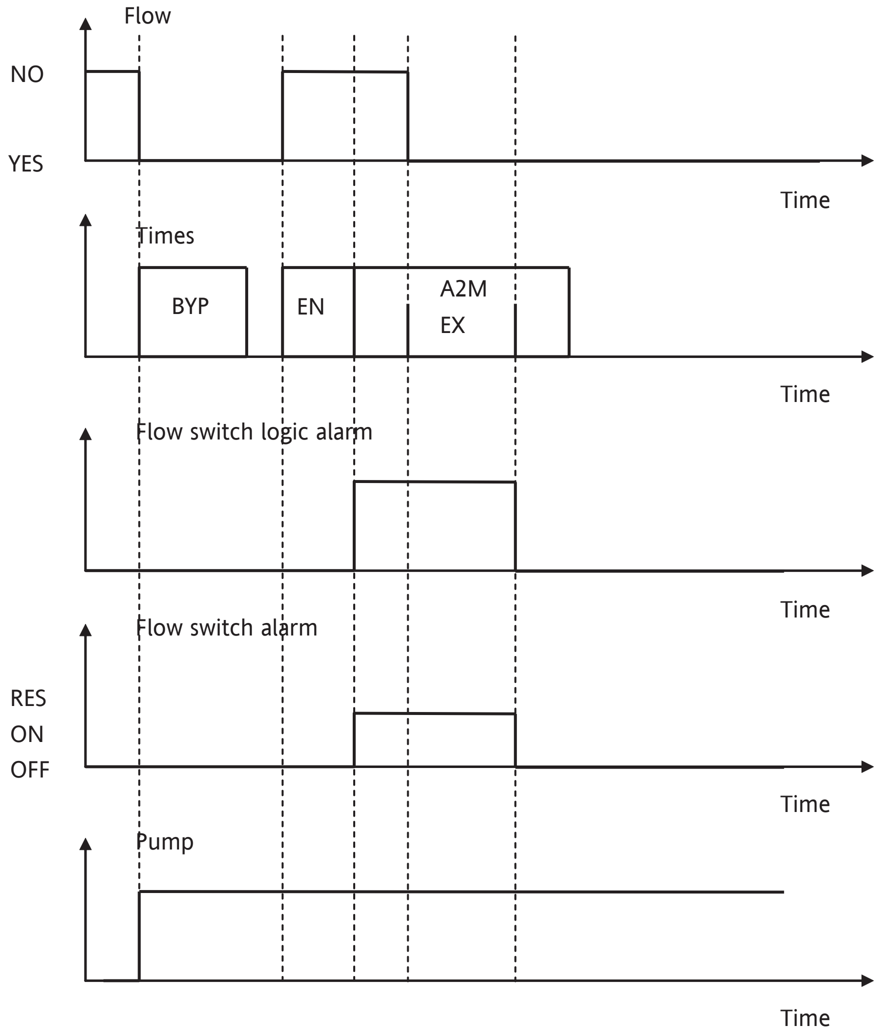


Flow	PUMP_A_FLOW_DI_PHY
Pump 1	PUMP_ACC_DO_1_PHY

Note that the system is also blocked as soon as the pump goes off.

- The alarm condition is reset :
- by a manual reset
- by changing from On to Off (using the remote ON/OFF keypad);
- at the next Power On;
- when exiting from configuration mode;

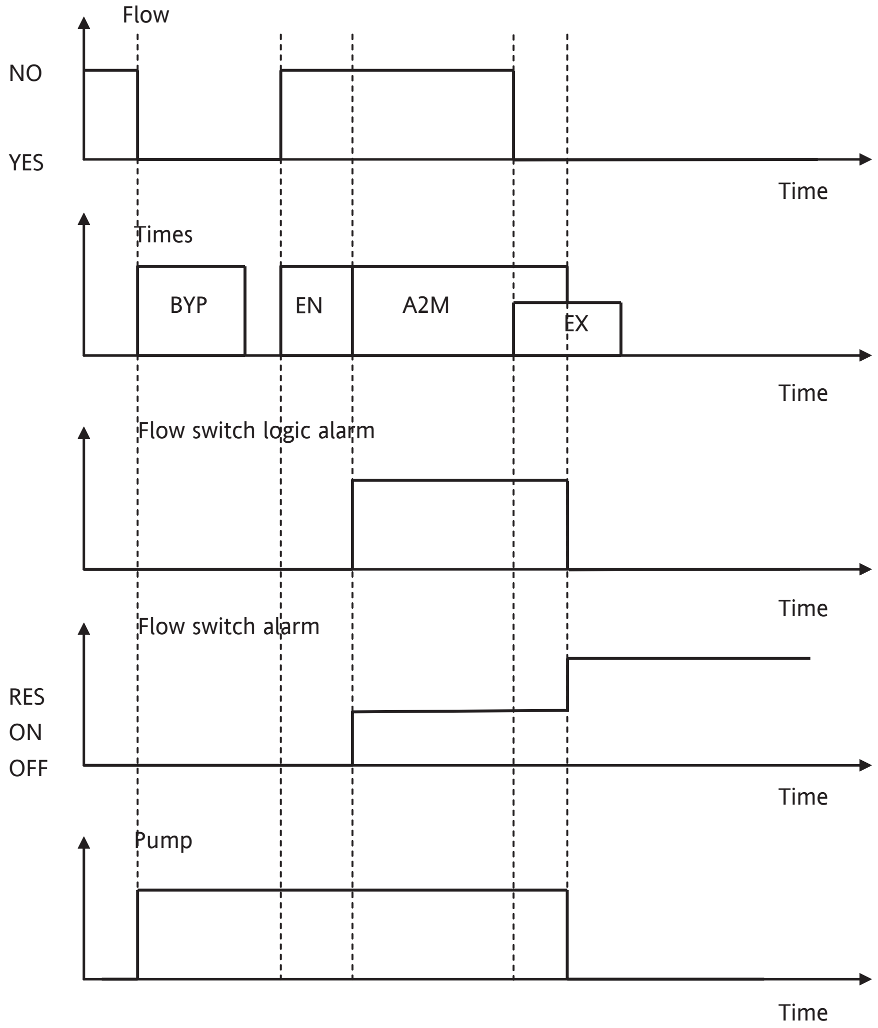
Flow switch logic alarm rest before time A_FS_AUTOMATIC2MANUAL_TIME has elapsed



Flow	PUMP_A_FLOW_DI_PHY
Pump 1	PUMP_ACC_DO_1_PHY

In this case, the alarm goes into automatic mode without blocking the system.

Flow switch logic alarm reset after time A_FS_AUTOMATIC2MANUAL_TIME has elapsed



Flow	PUMP_A_FLOW_DI_PHY
Pump 1	PUMP_ACC_DO_1_PHY

Note that the system is also blocked as soon as the pump goes off.

The alarm condition is reset :

- by manually resetting the *flow switch alarm*;
- by changing from ON to Off (using the remote ON/OFF keypad)
- at the next Power On;
- when exiting from configuration mode;

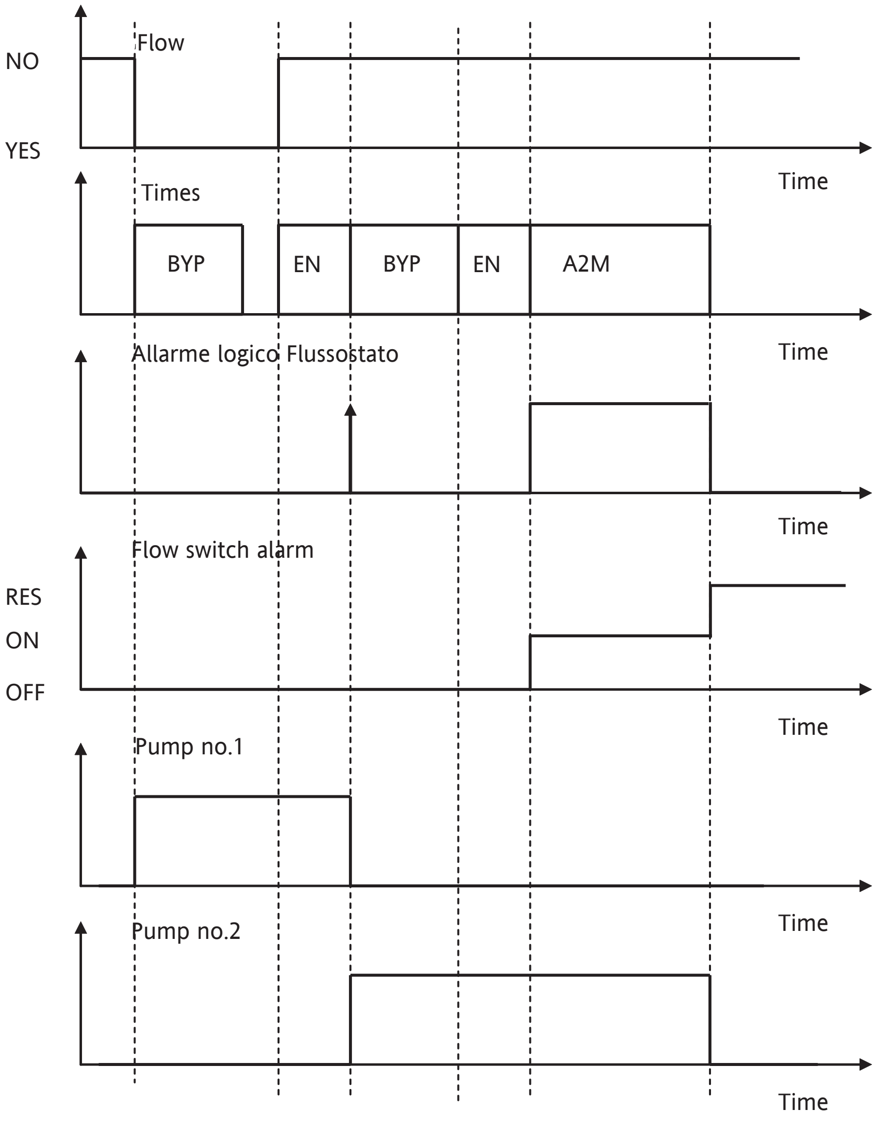
5.4.3.2 PUMPS_NO=2

If the pump thermal protection is actuated or there is a flow switch logic alarm, and there is another pump available, the system tries to use the other pump to ensure that water continues to flow in the primary *circuit*.
Otherwise (if no other pump available), the system behaves as in the case where *PUMPS_NO=1*.

5.4.4 Pump not available alarm

If there has been a pump "swap due to alarm" in the pump group, for example because of a *flow switch alarm*, and the second pump is able to ensure the flow, a "not available" alarm is declared for the first pump. This alarm can always be reset manually.

Flow switch alarm **always active**

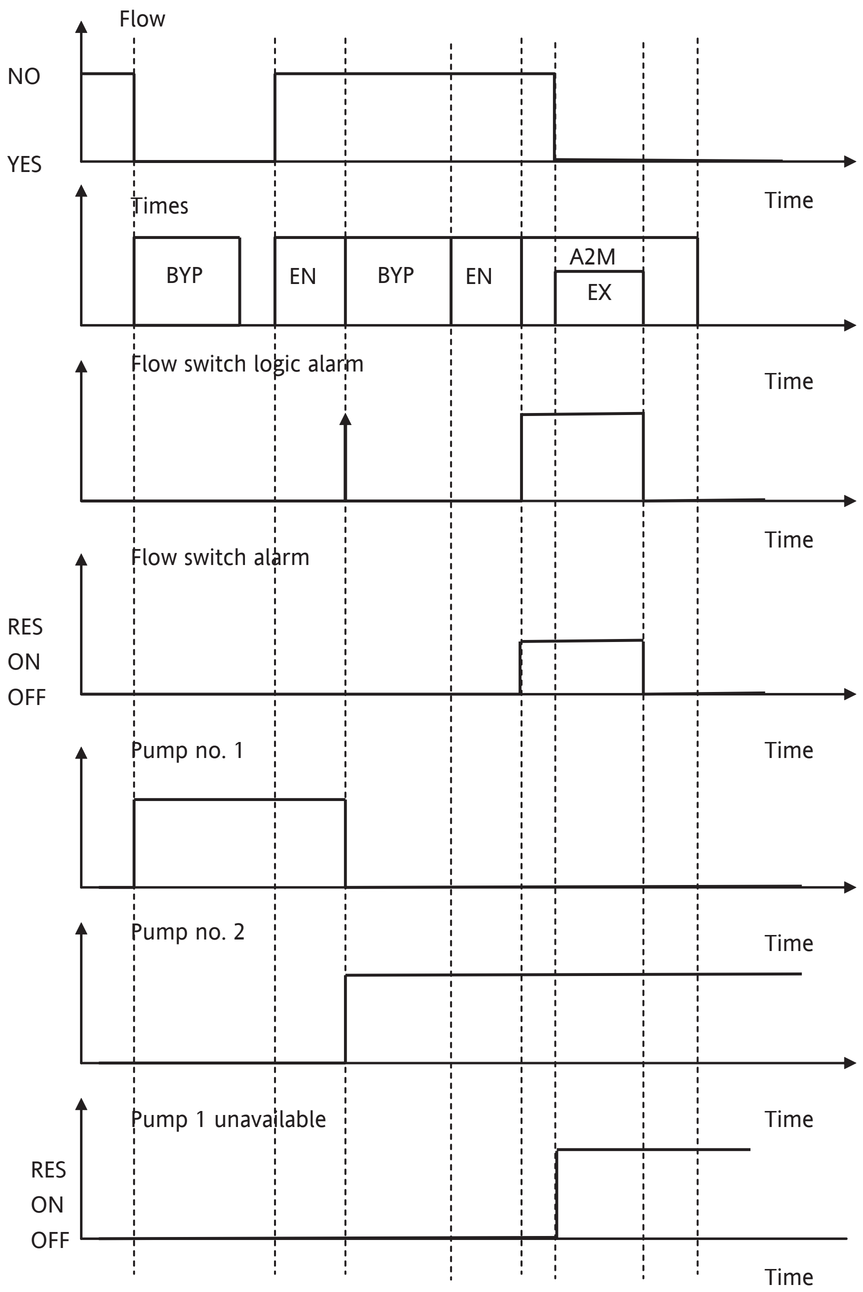


Flow	PUMP_A_FLOW_DI_PHY
Pump 1	PUMP_ACC_DO_1_PHY
Pump 2	PUMP_ACC_DO_2_PHY

Note that the system is also blocked when pump 2 goes off.
The alarm condition is reset :

- by resetting the alarm manually
- by changing from On to Off (using the remote ON/OFF keypad);
- at the next Power On;
- when exiting from configuration mode;

Flow switch logic alarm reset before time A_FS_AUTOMATIC2MANUAL_TIME has elapsed



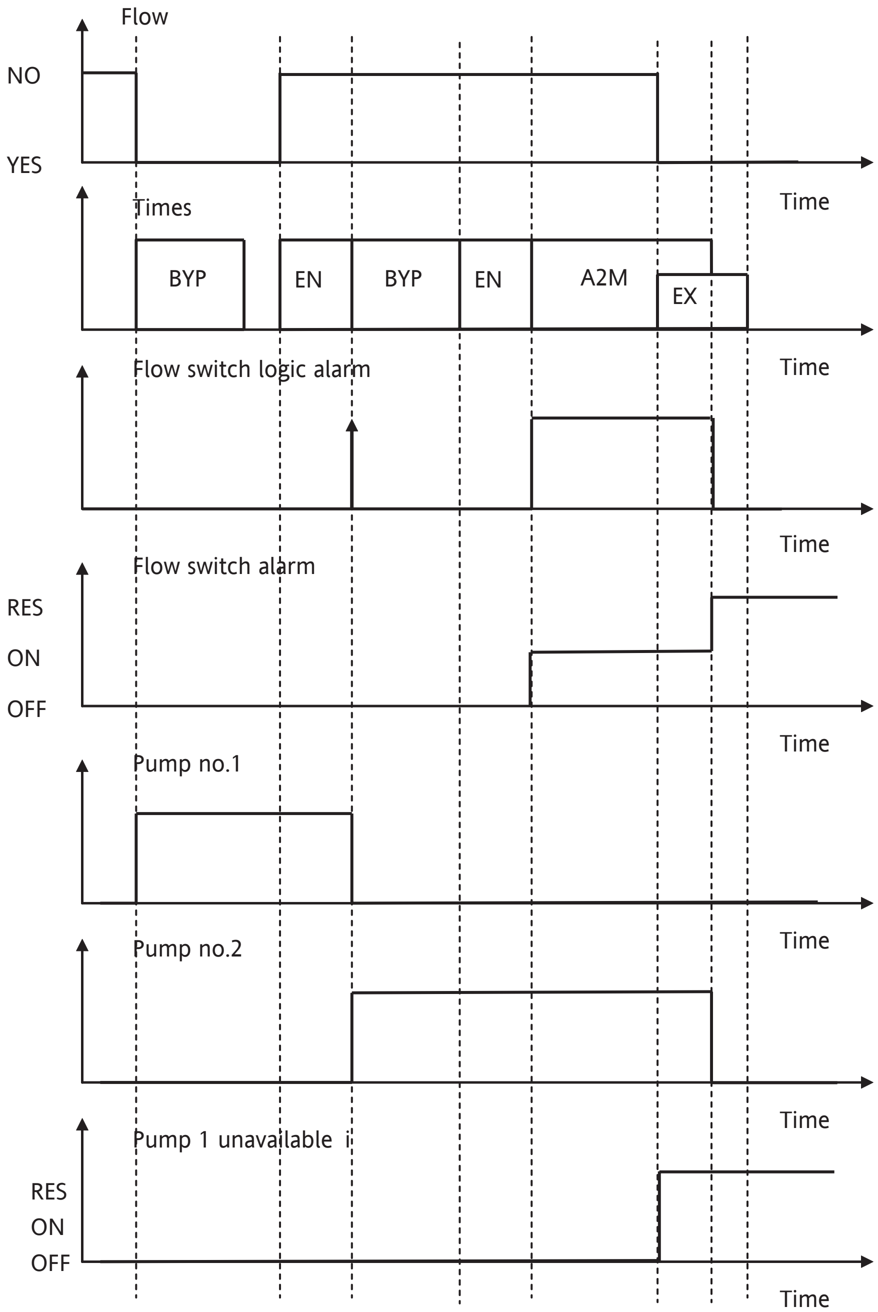
Flow	PUMP_A_FLOW_DI_PHY
Pump 1	PUMP_ACC_DO_1_PHY
Pump 2	PUMP_ACC_DO_2_PHY

Note that when pump 1 goes off, the system is not blocked but pump 2 is activated if available.
Since the second pump ensures the flow, the "Pump 1 not available" alarm is sent but the system continues to function normally. The alarm is reset manually.

This alarm is reset :

- manually;
- by changing from On to Off (using the remote ON/OFF keypad);
- at the next Power On;
- when exiting from configuration mode;

Flow switch logic alarm reset after time A_FS_AUTOMATIC2MANUAL_TIME has elapsed



Flow	PUMP_A_FLOW_DI_PHY
Pump 1	PUMP_ACC_DO_1_PHY
Pump 2	PUMP_ACC_DO_2_PHY

Note that when pump 1 goes off, the system is not blocked but pump 2 is activated if available.
Since the second pump does not ensure the flow, the pump and the system are blocked (when the second pump goes off), the "Pump 1 not available" alarm is sent (re-settable), and the *flow switch alarm* becomes re-settable

The *flow switch alarm* and *pump not available alarm* are reset *:*

- manually;
- by changing from On to Off (using the keypad or the remote ON/OFF);
- at the next Power On;
- when exiting from configuration mode;

and the system resumes normal operation.

5.4.5 Related parameters

Modbus address [hex]	Parameter Category and Name	Range	def	vis	trans	UM	C/H	Description of code conversion	Parameter description
460	A_FS_BYPASS_STARTUP_TIME	1…99	30	V	0	Ifc	C		Bypass time for *flow switch alarm*
461	A_FS_ENTRY_TIME	0…60	10	V	0	Sec	C		Time for which a physical alarm condition continues in the flow switch before the alarm is treated as Present
462	A_FS_EXIT_TIME	0…60	10	V	0	Sec	C		Time for which a physical non-alarm condition continues in the flow switch before the alarm is treated as Not Present
466	A_FS_AUTOMATIC2MANUAL_TIME	1…60	20	V	0	Sec	C		Time after which a *flow switch alarm* changes from automatic to manual (must be greater than time A_FS_EXIT_TIME)
222	PUMPS_NO	1…2	2	V	0	Num	C		Number of pumps in the system

5.5 Compressor control alarms

5.5.1 Compressor thermal protection alarm

Management of this alarm is enabled by parameter A_KOMP_THER_ENABLE_FLAG, and is active if the machine is started in Going Down or Cold mode and the *compressor* has been selected.
The *compressor* thermal alarm is reset manually and blocks the *compressor* currently in use.

The alarm is reset *:*

- manually;
- by changing from On to Off;
- at the next Power On;
- when exiting from configuration mode;

5.5.2 Compressor discharge temperature alarm

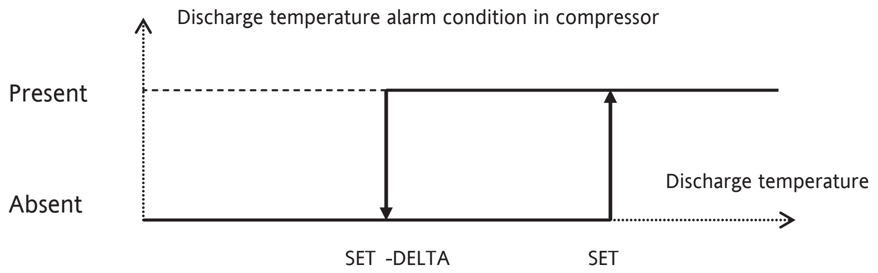


Fig 5.5.2

SET	A_DISCHARGE_TEMP
DELTA	A_DISCHARGE_DELTA_TEMP
Discharge temperature	KOMP_TEMP_DISCHARGE_SENS_i_PHY, i = *compressor* number "i"

If one of the following conditions is present *:*

- function disabled (A_DISCHARGE_ENABLE_FLAG =false);
- sensor discharge temperature error;
- system Off;
- *compressor* deselected;

the alarm remains Off.

If none of the above conditions is present, the alarm is controlled by the hysteresis function shown in Fig 5.5.2, where the alarm condition is used to generate a manual reset alarm.

The hysteresis function is set to Off in the following cases:

- System started or going down;
- exit from configuration mode;
- by reset;

5.5.3 Error in compressor discharge temperature sensor

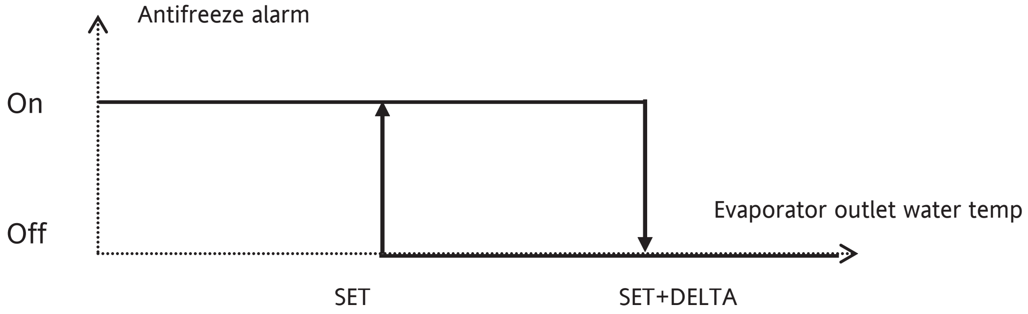
Sensor errors are managed if the *compressor discharge temperature alarm* is enabled, or the liquid injection function is enabled and the *compressor* is selected.
If there is an error in a sensor, the *compressor* associated with that sensor is blocked.

5.5.4 Related parameters

Modbus address [hex]	Parameter Category and Name	Range	def	vis	trans	UM	C/H	Description of code conversion	Parameter description
2F8	A_KOMP_THER_ENABLE_FLAG	0...1	1	V	6	Flag	C	0=NO; 1=YES	Enable *compressor* thermal alarm
2F6	A_DISCHARGE_TEMP	40.0...150.0	125.0	V	0	°C	C		Setpoint for *compressor discharge temperature alarm*
2F7	A_DISCHARGE_DELTA_TEMP	0...30.0	30.0	V	0	°C	C		Delta for *compressor discharge temperature alarm*
2F5	A_DISCHARGE_ENABLE_FLAG	0...1	1	V	6	Flag	C	0=NO; 1=YES	Enable *compressor discharge temperature alarm*

5.6 Antifreeze alarm

Management of the *antifreeze alarm* condition is enabled by the AF_ENABLE_FLAG parameter, irrespective of whether the machine is started in Cold mode, going down, or Off.
The algorithm activates the *antifreeze alarm* by monitoring the outlet temperature of each *evaporator*, according to the hysteresis function where "set" is AF_CH_SET_TEMP/AF_HEATING_SET_TEMP and "delta" is AF_CH_DELTA_TEMP/AF_HEATING_DELTA_TEMP, as shown in the figure.



SET	AF_CH_SET_TEMP/AF_HEATING_SET_TEMP
DELTA	AF_CH_DELTA_TEMP/AF_HEATING_DELTA_TEMP
Water temperature at *evaporator* outlet	EV_TEMP_OUTWATER_SENS_i_PHY, i = *evaporator* number "i"

In particular, the *antifreeze alarm* is On if water temperature < SET, Off if water temperature >= (SET+DELTA), unchanged in the other cases.

The alarm is by-passed for time AF_CHILLING_BYPASS_TIME/AF_HEATING_BYPASS_TIME which is loaded at Power On, when starting in Cold mode, when exiting configuration mode, and after resetting an *antifreeze alarm* condition (when the alarm is reset manually) or an alarm condition in the *evaporator* outlet water sensor.

The alarm is re-armed automatically. If the number of alarm responses in one hour is above the value of parameter MAX_AF_ALARMS_NO, the alarm becomes a manual reset alarm.
When the alarm occurs (an alarm in any one of the evaporators is enough), the system is switched off and the *antifreeze* heating resistors (in all evaporators) are switched on if parameter AF_USE_RESISTOR_FLAG=yes.
Notice
Switching on the resistors causes a request for activation of one of the pumps in the pump group, in order to allow water to circulate in the primary *circuit*.

Alarm management is always re-initialized at Power On, when system status changes from Off to On and when exiting configuration mode If the system changes from On to Off, *antifreeze alarm*s are not reset.

Errors in this sensor cause the system to be blocked (including pump group and *antifreeze* resistors).

5.6.1 Antifreeze sensor errors

Errors in the sensor that monitors the *evaporator* outlet water temperature are managed, with the machine started or going off, if AFPR_COOLING_ENABLED_FLAG=yes, and also with the machine Off if AFPR_OFF_STDBY_ENABLE_FLAG =yes. If AF_ENABLE_FLAG=yes (*antifreeze* enabled), an error in this sensor is processed irrespective of the current operating mode of the system.
Errors in this sensor cause the system to be blocked (including pump group and *antifreeze* resistors).

5.6.2 Related parameters

Modbus address [hex]	Parameter Category and Name	Range	def	vis	trans	UM	C/H	Description of code conversion	Parameter description
2B0	AF_ENABLE_FLAG	0…1	1	V	6	Flag	C	0=NO; 1=YES	Enable *antifreeze function*
2B2	AF_CH_SET_TEMP	-50.0…150.0	3.0	V	0	°C	C		*Antifreeze alarm* setpoint
2B3	AF_CH_DELTA_TEMP	0.0…10.0	4.0	V	0	°C	C		*Antifreeze alarm* delta
2B4	AF_CHILLING_BYPASS_TIME	0…1000	30	V	0	Sec	C		Bypass time for *antifreeze alarm*
2B6	AF_HEATING_SET_TEMP	-50.0…150	1.0	V	0	°C	C		*Antifreeze alarm* setpoint in Hot mode
2B7	AF_HEATING_DELTA_TEMP	0.0…10.0	4.0	V	0	°C	C		*Antifreeze alarm* delta in Hot mode
2B8	AF_HEATING_BYPASS_TiME	0…1000	30	V	0	sec	C		*Antifreeze* heating alarm bypass time
2B5	MAX_AF_ALARMS_NO	0…1000	0	V	0	Num	C		Maximum number of *antifreeze alarms* in the hour preceding the *antifreeze alarm* change from automatic to manual
2B1	AF_USE_RESISTOR_FLAG	0…1	1	V	6	Flag	C		Enable use of the resistors if there is an *antifreeze alarm*

5.7 Management of defrost alarms

Three situations can occur:

Situation 1:
If at least one of the following conditions is present:

- system alarm (high/low temperature, inlet/outlet water sensor and expansion timeout),
- pump group alarm (flow switch blocking alarm, one of the pumps will not start);
- *evaporator* alarm (*antifreeze*);
- *circuit* and/or *compressor* alarm that prevents any of the compressors in the fan battery from starting or remaining On;
- fan battery thermal alarm, the *defrost* function always stops, and remains ready for immediate re-start (DEF_IDLE).

Situation 2:
In the case of simultaneous *defrost*, if a *circuit* is in *defrost* and at maximum power output (DEF_STABLE) and an alarm is activated, or if there is an alarm in all the compressors connected to that *circuit*, the alarm *circuit* is switched off immediately (DEF_STABLE→ DEF_GOING_UP). If the alarm is reset and the *defrost* function is still running, the *circuit* again goes up to maximum power (DEF_GOING_UP→ DEF_STABLE).

Situation 3
In the case of simultaneous *defrost*, if the *defrost* output is running and the circuits are at maximum power and going down to drip point (DEF_GOING_DOWN), if there is an alarm in one of the circuits or an alarm in all the compressors connected to that *circuit*, then this *circuit* immediately begins waiting for the drip point (DEF_GOING_DOWN→ DEF_WAIT_DRIP) and until the last has completed
the going down phase.
If it is not a simultaneous *defrost* and there is an alarm in one of the circuits, or an alarm in all the compressors connected to that *circuit*, then the *circuit* goes immediately into drip mode (DEF_GOING_DOWN→ DRIP_PRE_INV_VALVE).

5.8 Table of Alarms

MODBUS (HEX)	Name	List of BaseLine Machine Alarms	Action	Input	System	Num.	Reset
04F0	PlanHTempA	High temperature in heat regulation	Blocks the system	Analog	PLANT	1	Manual
04F1	PlantLTempA	Low temperaturein heat regulation	Blocks the system	Analog	PLANT	1	Manual
04F2	EvAfA	*Evaporator antifreeze*	Blocks the system and starts the pump if resistors are enabled	Analog	EV	2	Event bounded
0513	KompDisA	*Compressor* discharge temperature	Blocks the *compressor*	Analog	KOMP	8	Manual
04F3	CirHPrA	*Circuit* maximum pressure	Blocks the *circuit*	Analog+ Digital	CIR	8	Manual
04FB	CirLPrA	*Circuit* minimum pressure	Blocks the *circuit*	Digital	CIR	8	Event bounded
050B	KompTherA	*Compressor* thermal protection	Blocks the *compressor*	Digital	KOMP	8	Manual
051B	FansTherA	Fan group thermal protection	Blocks the circuits	Digital	FANGROUP	2	Manual
051D	FlowA	Primary flow switch	Blocks the system	Digital	PUMPGROUP	1	Time bounded
051E	PumpTherA	Pump thermal protection	Blocks the pump	Digital	PUMP	2	Manual
0520	PumpUnavailableA	Pump not available	Makes the pump unavailable	Log	PUMP	2	Manual
0502	CirPdA	*Pump-down timeout*	Non-blocking	Time	CIR	8	Automatic
0139	VAR_BOO_BIOS_1	Internal expansion timeout	Blocks the system	Time	PLANT	1	Automatic
013A	VAR_BOO_BIOS_2	External expansion 1 timeout	Blocks the system	Time	PLANT	1	Automatic
013B	VAR_BOO_BIOS_3	External expansion 2 timeout	Blocks the system	Time	PLANT	1	Automatic
013C	VAR_BOO_BIOS_4	External expansion 3 timeout	Blocks the system	Time	PLANT	1	Automatic
013D	VAR_BOO_BIOS_5	External expansion 4 timeout	Blocks the system	Time	PLANT	1	Automatic

5.9 Errors Table

MODBUS (HEX)	Name	List of sensor errors in BaseLine machine	Input	System	Num.	Action	Reset
0522	PlanTempInWaterSensErr	Heat regulation inlet sensor error	Ana	PLANT	1	Blocks the system	Automatic
0523	PlanTempOutWaterSensErr	Heat regulation outlet sensor error	Ana	PLANT	1	Blocks the system	Automatic
0525	EvTempOutWaterSensErr	*Antifreeze* sensor error	Ana	EV	2	Blocks the system	Automatic
0527	CirPresMaxSensErr	*Circuit* maximum sensor error	Ana	CIR	8	Blocks the *circuit*	Automatic
052F	KompTempDischargeSensErr	*Compressor* discharge sensor error	Ana	KOMP	8	Blocks the *compressor*	Automatic
0524	PlanCurrDtsetSensErr	*Dynamic setpoint* sensor error	Ana	PLANT	1	Disconnects dynamic regulation	Automatic

6 PARAMETERS

Parameters table

Modbus address (hex)	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
	Structural								
200	KOMP_CIR_EV_1	Associate *compressor* 1 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	11…24	11	0	C	V		num
201	KOMP_CIR_EV_2	Associate *compressor* 2 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	12	0	C	V		num
202	KOMP_CIR_EV_3	Associate *compressor* 3 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	21	0	C	V		num
203	KOMP_CIR_EV_4	Associate *compressor* 4 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	22	0	C	V		num
204	KOMP_CIR_EV_5	Associate *compressor* 5 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	0	0	C	V		num
205	KOMP_CIR_EV_6	Associate *compressor* 6 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	0	0	C	V		num
206	KOMP_CIR_EV_7	Associate *compressor* 7 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	0	0	C	V		num
207	KOMP_CIR_EV_8	Associate *compressor* 8 with *circuit* UNIT VALUE of *evaporator* UNIT PLUS TEN	0…24	0	0	C	V		num
208	CIR_*FANS*_1	Associate *circuit* 1 with the fan group indicated	1…2	1	0	C	V		num
209	CIR_*FANS*_2	Associate *circuit* 2 with the fan group indicated	0..2	1	0	C	V		num
20A	CIR_*FANS*_3	Associate *circuit* 3 with the fan group indicated	0…2	2	0	C	V		num
20B	CIR_*FANS*_4	Associate *circuit* 4 with the fan group indicated	0…2	2	0	C	V		num
20C	CIR_*FANS*_5	Associate *circuit* 5 with the fan group indicated	0…2	0	0	C	V		num
20D	CIR_*FANS*_6	Associate *circuit* 6 with the fan group indicated	0…2	0	0	C	V		num
20E	CIR_*FANS*_7	Associate *circuit* 7 with the fan group indicated	0…2	0	0	C	V		num
20F	CIR_*FANS*_8	Associate *circuit* 8 with the fan group indicated	0…2	0	0	C	V		num
210	KOMP_CHARGEDISCH_IMPULSE_1	Duration of charge/discharge pulse for *compressor* 1	0.0…20.0	1.0	0	C	V		Sec
211	KOMP_CHARGEDISCH_IMPULSE_2	Duration of charge/discharge pulse for *compressor* 2	0.0…20.0	1.0	0	C	V		Sec
212	KOMP_CHARGEDISCH_IMPULSE_3	Duration of charge/discharge pulse for *compressor* 3	0.0…20.0	1.0	0	C	V		Sec
213	KOMP_CHARGEDISCH_IMPULSE_4	Duration of charge/discharge pulse for *compressor* 4	0.0…20.0	1.0	0	C	V		Sec
214	KOMP_CHARGEDISCH_IMPULSE_5	Duration of charge/discharge pulse for *compressor* 5	0.0…20.0	1.0	0	C	V		Sec
215	KOMP_CHARGEDISCH_IMPULSE_6	Duration of charge/discharge pulse for *compressor* 6	0.0…20.0	1.0	0	C	V		Sec
216	KOMP_CHARGEDISCH_IMPULSE_7	Duration of charge/discharge pulse for *compressor* 7	0.0…20.0	1.0	0	C	V		Sec
217	KOMP_CHARGEDISCH_IMPULSE_8	Duration of charge/discharge pulse for *compressor* 8	0.0…20.0	1.0	0	C	V		Sec
218	KOMP_CHARGEDISCH_TIME	Duration of charge/discharge pulse for compressors	0…250	60	0	C	V		sec
210	KOMP_STAGE_1	Number of power stages of *compressor* 1	0…3	2	0	C	V		num
211	KOMP_STAGE_2	Number of power stages of *compressor* 2	0…3	2	0	C	V		num
212	KOMP_STAGE_3	Number of power stages of *compressor* 3	0…3	2	0	C	V		num
213	KOMP_STAGE_4	Number of power stages of *compressor* 4	0…3	2	0	C	V		num
214	KOMP_STAGE_5	Number of power stages of *compressor* 5	0…3	2	0	C	V		num

Modbus address (hex)	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
215	KOMP_STAGE_6	Number of power stages of *compressor* 6	0…3	2	0	C	V		num
216	KOMP_STAGE_7	Number of power stages of *compressor* 7	0…3	2	0	C	V		num
217	KOMP_STAGE_8	Number of power stages of *compressor* 8	0…3	2	0	C	V		num
218	KOMP_TYPE	*Compressor type*. Affects the way in which the activation/deactivation sequence is applied to the relays associated with the power stages of the compressors	0…1	0	12	C	V	0=SEMI-HERMETIC, 1=SCREW	num
219	*FANS*_ASYMMETRICAL_FLAG	*Fans* all the same (NO) or with increasing power (YES). Changes the order of activation / deactivation of the fan relays	0…1	0	6	C	V	0=NO, 1=YES	flag
21A	*FANS*_NO_1	Number of *fans* in battery 1	1…4	3	0	C	V		num
21B	*FANS*_NO_2	Number of *fans* in battery 2	1…4	3	0	C	V		num
21C	*FANS*_NO_3	Number of *fans* in battery 3	1…4	1	0	C	N		num
21D	*FANS*_NO_4	Number of *fans* in battery 4	1…4	1	0	C	N		num
21E	*FANS*_NO_5	Number of *fans* in battery 5	1..4	1	0	C	N		num
21F	*FANS*_NO_6	Number of *fans* in battery 6	1…4	1	0	C	N		num
220	*FANS*_NO_7	Number of *fans* in battery 7	1…4	1	0	C	N		num
221	*FANS*_NO_8	Number of *fans* in battery 8	1…4	1	0	C	N		num
222	PUMPS_NO	Number of pumps in the system	1…2	2	0	C	V		num
223	PLAN_MODE_DI_ENABLE_FLAG	Enable mode setting by digital input	0…1	1	6	C	V	0=NO 1=YES	flag
	High Level								
240	EV_SELECTION_FUNCTION	Sets the selection policy for refrigeration power resources at *evaporator* level	0…1	1	28	C	V	0=SATURATION, 1=BALANCING	flag
241	CIR_SELECTION_FUNCTION	Sets the selection policy for refrigeration power resources at *circuit* level	0…1	1	29	C	V	0=SATURATION, 1=BALANCING	flag
242	KOMP_SELECTION_FUNCTION	Sets the selection policy for refrigeration power resources at *compressor* level	0…1	0	30	C	V	0=SATURATION, 1=BALANCING	flag
243	A_HIGHT_ENABLE_FLAG	Enable system *high temperature alarm* (the alarm monitors the inlet water temperature on the primary *circuit*)	0…1	1	6	C	V	0=NO, 1=YES	flag
244	A_HIGHT_THRESHOLD_TEMP_HOT	System *high temperature alarm* setpoint	-15.0…50.0	18.0	0	H	V		°C
245	A_HIGHT_BYPASS_TIME_HOT	Bypass time for system *high temperature alarm*	1…99	15	0	H	V		min
246	A_LOWT_ENABLE_FLAG	Enable system *low temperature alarm* (the alarm monitors the inlet water temperature on the primary *circuit*)	0…1	1	6	C	V	0=NO, 1=YES	flag
247	A_LOWT_THRESHOLD_TEMP_HOT	Setpoint for system *low temperature alarm*	-15.0…50.0	30.0	0	H	V		°C
248	A_LOWT_BYPASS_TIME_HOT	Bypass time for system *low temperature alarm*	1…99	15	0	H	V		min
249	PLAN_MODE_MANUAL	Summer/winter mode from keypad	0…1	0	27	C	V	0=CHILLER 1=HEATPUMP	num

Modbus address (hex)	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
24A	SOFTSTART_TIME_HOT	Time between *compressor* startups	0...10	2	0	H	V		sec
	Configuration of heat regulation								
260	TREG_FUNCTION	Heat regulation type	0...2	0	17	C	V	0=PROPORTIONAL 1=TIME PROPORTIONAL 2=PI	num
261	TREG_TEMP_SENS	Selection of sensor for heat regulation	0...1	0	18	C	V	0=ENTRY_SENSOR, 1=EXIT_SENSOR	num
262	PI_INTEGRAL_COMPONENT_FLAG_HOT	User flag for integral component of P.I. heat regulator.	0...1	1	6	H	V	0=NO, 1=YES	flag
263	PI_INTEGRAL_CONSTANT_HOT	Value of time integral for integral component of P.I. heat regulator	1...900	600	0	H	V		sec
264	PI_PROP_COMPONENT_FLAG_HOT	User flag for proportional component of P.I. heat regulator	0...1	1	6	H	V	0=NO, 1=YES	flag
	Heat regulation								
270	CH_TSET_TEMP_HOT	Cold setpoint	CH_MIN_TSET_TEMP... CH_MAX_TSET_TEMP	7.0	0	H	V		°C
271	CH_MIN_TSET_TEMP	Minimum value of cold setpoint	-50.0...80.0	5.0	0	C	V		°C
272	CH_MAX_TSET_TEMP	Maximum value of cold setpoint	-50.0...80.0	25.0	0	C	V		°C
273	CH_ENTRY_OFFSET_HOT	Offset from cold setpoint if heat regulation is through the inlet water temperature sensor of the primary *circuit*	0.0...15.0	0.0	0	H	V		°C
274	CH_PROP_BAND_HOT	Cold proportional band	CH_MIN_PROP_BAND... CH_MAX_PROP_BAND	5.0	0	H	V		°C
275	CH_MIN_PROP_BAND	Minimum value of cold proportional band	0.0...25.0	0.0	0	C	V		°C
276	CH_MAX_PROP_BAND	Maximum value of cold proportional band	0.0...25.0	20.0	0	C	V		°C
277	CH_INC_STEP_TIME_HOT	Time between upward steps (increments in refrigeration power)	0...300	10	0	H	V		sec
278	CH_DEC_STEP_TIME_HOT	Time between downward steps (decrements in refrigeration power)	0...300	10	0	H	V		sec
	Heat regulation heat pump								
280	HP_TSET_TEMP_HOT	Hot setpoint	HP_MIN_TSET_TEMP... HP_MAX_TSET_TEMP	40.0	0	H	V		°C
281	HP_MIN_TSET_TEMP	Minimum value of hot setpoint	-50.0...150.0	30.0	0	C	V		°C
282	HP_MAX_TSET_TEMP	Maximum value of hot setpoint	-50.0...150.0	50.0	0	C	V		°C
283	HP_ENTRY_OFFSET_HOT	Offset of hot setpoint if heat regulation is through the water inlet temperature sensor of the primary *circuit*	0.0...15.0	5.0	0	H	V		°C
284	HP_PROP_BAND_HOT	Hot proportional band	PH_MIN_PROP_BAND... HP_MAX_PROP_BAND	5.0	0	H	V		°C
285	HP_MIN_PROP_BAND	Minimum value of hot proportional band	0.0...150.0	5.0	0	C	V		°C

Modbus address (hex)	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
286	HP_MAX_PROP_BAND	Maximum value of hot proportional band	0.0...150.0	5.0	0	C	V		°C
287	HP_INC_STEP_TIME _HOT	Time between upward steps (power increments) in Hot mode	0...300	10	0	H	V		sec
288	HP_DEC_STEP_TIME_HOT	Time between downward steps (power decrements) in Hot mode	0...300	10	0	H	V		sec
	Dynamic setpoint								
2A0	DTSET_FUNCTION	Enable *dynamic setpoint* function 0=not enabled or none 1=in temperature (not supported) 2=in current	0...2	2	19	C	V	0=NONE, 1=TEMP_FUNCTION, 2=CURRENT_FUNCTION	num
2A1	DTSET_CHILLER_MAX_OFFSET	Maximum offset of *dynamic setpoint* from cold setpoint	-30.0...30.0	6.0	0	C	V		°C
2A2	DTSET_HEATPUMP_MAX_OFFSET	Maximum offset of the *dynamic setpoint* from the hot setpoint	-30.0...30.0	5.0	0	C	V		°C
	Antifreeze								
2B0	AF_ENABLE_FLAG	Enable *antifreeze function*	0...1	1	6	C	V	0=NO, 1=YES	flag
2B1	AF_USE_RESISTOR_FLAG	Enable use of the resistors if there is an *antifreeze alarm*	0...1	1	6	C	V	0=NO, 1=YES	flag
2B2	AF_CH_SET_TEMP	*Antifreeze alarm* setpoint	-50.0...150.0	3.0	0	C	V		°C
2B3	AF_CH_DELTA_TEMP	*Antifreeze alarm* delta	0.0...10.0	4.0	0	C	V		°C
2B4	AF_CHILLING_BYPASS_TIME	Bypass time for *antifreeze alarm*	0...1000	30	0	C	V		sec
2B5	MAX_AF_ALARMS_NO	Maximum number of *antifreeze alarm*s in the hour before the *antifreeze alarm* changes from automatic to manual	0...1000	0	0	C	V		num
2B6	AF_HEATING_SET_TEMP	*Antifreeze alarm* setpoint in Hot mode	-50.0...150.0	1.0	0	C	V		°C
2B7	AF_HEATING_DELTA_TEMP	*Antifreeze alarm* delta in Hot mode	0.0...10.0	4.0	0	C	V		°C
2B8	AF_HEATING_BYPASS_TIME	Bypass time for *antifreeze alarm* in Hot mode	0...1000	30	0	C	V		sec
	***Antifreeze* prevention**								
2C0	AFPR_COOLING_ENABLED_FLAG	Enable *antifreeze* prevention function if the system is On or going down (in Cold or Going Down mode)	0...1	1	6	C	V	0=NO, 1=YES	flag
2C1	AFPR_OFF_STDBY_ENABLE_FLAG	Enable *antifreeze* prevention function if the system is Off (Off mode)	0....1	1	6	C	V	0=NO, 1=YES	flag
2C2	AFPR_CHILLING_TSET	*Antifreeze* prevention setpoint	-50.0...150.0	5.0	0	C	V		°C
2C3	AFPR_DELTA_TEMP	*Antifreeze* prevention delta	-50.0...150.0	2.0	0	C	V		°C
2C4	AFPR_ENABLED_DURING_*DEFROST*	Enable *antifreeze* prevention if system is defrosting	0...1	0	6	C	V	0=NO 1=YES	flag
2C5	AFPR_ENABLED_DURING_HEATING	Enable *antifreeze* prevention function if the system is On or Going Down in Hot mode	0...1	0	6	C	V	0=NO 1=YES	flag
2C6	AFPR_HEATING_TSET	*Antifreeze* prevention setpoint in Hot mode	-50.0...150.0	5.0	6	C	V		°C
	Circuit								

Modbus address (hex)	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
2E0	A_MAX_PRES	Setpoint for *circuit* maximum pressure alarm	0.0…50.0	28.0	0	C	V		Bar
2E1	A_MAX_DELTA_PRES	Delta for *circuit* maximum pressure alarm	0.0…10.0	2.0	0	C	V		Bar
2E2	MAX_MINP_ALARMS_NO_HOT	Maximum number of minimum pressure alarms in the hour before the alarm changes from automatic to manual	0…20	3	0	H	V		num
2E3	A_MIN_PRES_BYPASS_TIME_HOT	Bypass time for minimum pressure alarm	0…500	120	0	H	V		sec
	Compressor								
2F0	MIN_OFFON_TIME_HOT	Safety protection time from *compressor* OFF to ON	0…500	60	0	H	V		sec
2F1	MIN_ONOFF_TIME_HOT	Safety protection time from *compressor* ON to OFF	MIN_OFF_ON_TIME…500	10	0	H	V		sec
2F2	MAX_STARTS_PER_HOUR_NO_HOT	Maximum number of *compressor* startups in one hour	0…20	6	0	H	V		num
2F3	CPWR_UPDOWN_MIN_TIME_HOT	Safety protection time between downward power stages	0…300	10	0	H	V		sec
2F4	CPWR_DOWNUP_MIN_TIME_HOT	Safety protection time between upward power stages	0…300	10	0	H	V		sec
2F5	A_DISCHARGE_ENABLE_FLAG	Enable *compressor discharge temperature alarm*	0.….1	1	6	C	V	0=NO, 1=YES	flag
2F6	A_DISCHARGE_TEMP	Setpoint for *compressor discharge temperature alarm*	40.0…150.0	125.0	0	C	V		°C
2F7	A_DISCHARGE_DELTA_TEMP	Delta for *compressor discharge temperature alarm*	0.0…30.0	30.0	0	C	V		°C
2F8	A_KOMP_THER_ENABLE_FLAG	Enable *compressor* thermal alarm	0…1	1	6	C	V	0=NO, 1=YES	flag
	Liquid injection								
310	LI_ENABLE_FLAG	Enable liquid injection function	0…1	1	6	C	V	0=NO, 1=YES	flag
311	LI_TSET_TEMP	Setpoint for liquid injection function	0.0…150.0	115.0	0	C	V		°C
312	LI_DELTA_TEMP	Delta for liquid injection function	0.0…10.0	10.0	0	C	V		°C
	Compressor selection								
320	KOMP_SELEZ_1_HOT	Select *compressor* 1	0…1	1	6	H	V	0=NO, 1=YES	flag
321	KOMP_SELEZ_2_HOT	Select *compressor* 2	0…1	1	6	H	V	0=NO, 1=YES	flag
322	KOMP_SELEZ_3_HOT	Select *compressor* 3	0…1	1	6	H	V	0=NO, 1=YES	flag
323	KOMP_SELEZ_4_HOT	Select *compressor* 4	0…1	1	6	H	V	0=NO, 1=YES	flag
324	KOMP_SELEZ_5_HOT	Select *compressor* 5	0…1	1	6	H	V	0=NO, 1=YES	flag
325	KOMP_SELEZ_6_HOT	Select *compressor* 6	0…1	1	6	H	V	0=NO, 1=YES	flag
326	KOMP_SELEZ_7_HOT	Select *compressor* 7	0…1	1	6	H	V	0=NO, 1=YES	flag
327	KOMP_SELEZ_8_HOT	Select *compressor* 8	0…1	1	6	H	V	0=NO, 1=YES	flag
	***Compressor* usage time**								
330	KOMP_USAGE_DAYS_1	Days of use of *compressor* 1	0…32000	0	0	C	V		day
331	KOMP_USAGE_DAYS_2	Days of use of *compressor* 2	0…32000	0	0	C	V		day
332	KOMP_USAGE_DAYS_3	Days of use of *compressor* 3	0…32000	0	0	C	V		day
333	KOMP_USAGE_DAYS_4	Days of use of *compressor* 4	0…32000	0	0	C	V		day
334	KOMP_USAGE_DAYS_5	Days of use of *compressor* 5	0…32000	0	0	C	V		day
335	KOMP_USAGE_DAYS_6	Days of use of *compressor* 6	0….32000	0	0	C	V		day

Modbus address (hex)	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
336	KOMP_USAGE_DAYS_7	Days of use of *compressor* 7	0…32000	0	0	C	V		day
337	KOMP_USAGE_DAYS_8	Days of use of *compressor* 8	0…32000	0	0	C	V		day
338	KOMP_USAGE_HOUR_1	Hours of use of *compressor* 1	0…24	0	0	C	V		hour
339	KOMP_USAGE_HOUR_2	Hours of use of *compressor* 2	0…24	0	0	C	V		hour
33A	KOMP_USAGE_HOUR_3	Hours of use of *compressor* 3	0…24	0	0	C	V		hour
33B	KOMP_USAGE_HOUR_4	Hours of use of *compressor* 4	0…24	0	0	C	V		hour
33C	KOMP_USAGE_HOUR_5	Hours of use of *compressor* 5	0..24	0	0	C	V		hour
33D	KOMP_USAGE_HOUR_6	Hours of use of *compressor* 6	0…24	0	0	C	V		hour
33E	KOMP_USAGE_HOUR_7	Hours of use of *compressor* 7	0…24	0	0	C	V		hour
33F	KOMP_USAGE_HOUR_8	Hours of use of *compressor* 8	0…24	0	0	C	V		hour
	Configuration of fan regulator								
340	*FANS*_KOMP_DEPENDENCY_FLAG	If NO, the *fans* in the battery operate independently of the status of the compressors belonging to the circuits in which the batteries are controlling the condensation, otherwise at least one of these compressors must be On so that fan *control* can be actuated for the batteries.	0…1	1	6	C	V	0=NO, 1=YES	flag
341	*FANS*_CH_INIT_MAX_POWER_TIME	Time for which the *fans* in the batteries are operating at full power each time the battery is started	0…120	60	0	C	V		sec
342	*FANS*_HP_INIT_MAX_POWER_TIME	Time for which the *fans* in the batteries are operating at full power each time the battery is started in Hot mode.	0…120	60	0	C	V		sec
343	*FANS_CONTROL*_FUNCTION	Selection of fan *control* and actuation type	0…1	0	31	C	V	0=CONT, 1=DIGITAL	flag
344	CUTOFF_CH_ENABLED_FLAG	Enable CUTOFF in chiller mode	0…1	1	6	C	V	0=NO, 1=YES	flag
345	CUTOFF_HP_ENABLED_FLAG	Enable CUTOFF in heat pump mode	0…1	1	6	C	V	0=NO, 1=YES	flag
	Digital fan regulator in chiller mode								
360	*FANS*_CSTART_SET1_PRES	Setpoint for activating ventilation step 1	0.0…50.0	13.0	0	C	V		Bar
361	*FANS*_CSTART_SET2_PRES	Setpoint for activating ventilation step 2	0.0…50.0	15.0	0	C	V		Bar
362	*FANS*_CSTART_SET3_PRES	Setpoint for activating ventilation step 3	0.0…50.0	17.0	0	C	V		Bar
363	*FANS*_CSTART_SET4_PRES	Setpoint for activating ventilation step 4	0.0…50.0	19.0	0	C	V		Bar
364	*FANS*_CSTART_SET5_PRES	Setpoint for activating ventilation step 5	0.0..50.0	0.0	0	C	V		Bar
365	*FANS*_CSTART_SET6_PRES	Setpoint for activating ventilation step 6	0.0…50.0	0.0	0	C	V		Bar
366	*FANS*_CSTART_SET7_PRES	Setpoint for activating ventilation step 7	0.0…50.0	0.0	0	C	V		Bar
367	*FANS*_CSTART_SET8_PRES	Setpoint for activating ventilation step 8	0.0…50.0	0.0	0	C	V		Bar
368	*FANS*_CSTOP_DELTA1_PRES	Delta for deactivation of ventilation step 1	0.0…10.0	2.0	0	C	V		Bar

Modbus address (hex)	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
369	*FANS*_CSTOP_DELTA2_PRES	Delta for deactivation of ventilation step 2	0.0...10.0	2.0	0	C	V		Bar
36A	*FANS*_CSTOP_DELTA3_PRES	Delta for deactivation of ventilation step 3	0.0...10.0	2.0	0	C	V		Bar
36B	*FANS*_CSTOP_DELTA4_PRES	Delta for deactivation of ventilation step 4	0.0...10.0	2.0	0	C	V		Bar
36C	*FANS*_CSTOP_DELTA5_PRES	Delta for deactivation of ventilation step 5	0.0...10.0	0.0	0	C	V		Bar
36D	*FANS*_CSTOP_DELTA6_PRES	Delta for deactivation of ventilation step 6	0.0...10.0	0.0	0	C	V		Bar
36E	*FANS*_CSTOP_DELTA7_PRES	Delta for deactivation of ventilation step 7	0.0...10.0	0.0	0	C	V		Bar
36F	*FANS*_CSTOP_DELTA8_PRES	Delta for deactivation of ventilation step 8	0.0...10.0	0.0	0	C	V		Bar
	Continuous fan regulator in chiller mode								
3A0	*FANS*_CH_MIN_ON_TIME	Minimum On time for ventilation in chiller mode at minimum speed at least	0...120	30	0	C	V		sec
3A1	CUTOFF_CH_SETPOINT1_PRES	Minimum pressure value under which the CUTOFF switches off chiller mode ventilation	0.0...60.0	8.0	0	C	V		Bar
3A2	CUTOFF_CH_DELTA1_PRES	Pressure value to be added to CUTOFF_CH_SETPOINT1_PRES. If the ventilation *control* pressure goes above the total, the ON/OFF *control* (due to CUTOFF at minimum) becomes continuous in chiller mode	0.0...10.0	1.0	0	C	V		Bar
3A3	*FANS*_CH_START_PRES	Pressure value at which modulated fan *control* is started in chiller mode. Fan speed expressed as a percentage, and equal to the value of parameter *FANS*_CH_MIN_SPEED	0.0...60.0	10.0	0	C	V		Bar
3A4	*FANS*_CH_SATURATION_PRES	Pressure value at which ventilation goes up to the maximum speed defined by parameter *FANS*_CH_MAX_SPEED in chiller mode	0.0...60.0	20.0	0	C	V		Bar
3A5	*FANS*_CH_MIN_SPEED	Minimum fan speed in chiller mode, expressed as a percentage	0...100	20	0	C	V		%
3A6	*FANS*_CH_MAX_SPEED	Maximum fan speed in chiller mode at end of gradient, expressed as a percentage.	0...100	80	0	C	V		%
3A7	CUTOFF_CH_SETPOINT2_PRES	Pressure value below which saturation CUTOFF changes the *control* from ON/OFF (due to CUTOFF at saturation) to continuous in chiller mode	0.0...60.0	21.0	0	C	V		Bar
3A8	CUTOFF_CH_DELTA2_PRES	Pressure value to be added to CUTOFF_CH_SETPOINT2_PRES. If the ventilation *control* pressure goes above the total, the fan speed will be equal to the value of parameter *FANS*_CH_SAT_SPEED.	0.0...10.0	1.0	0	C	V		Bar
3A9	*FANS*_CH_SAT_SPEED	Percentage value of the maximum fan speed in chiller mode	0...100	90	0	C	V		%
	Digital fan regulator in heat pump mode								
3C0	*FANS*_HSTART_SET1_PRES	Setpoint for activating ventilation step 1	0.0...50.0	12.0	0	C	V		Bar

Modbus address (hex)	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
3C1	*FANS*_HSTART_SET2_PRES	Setpoint for activating ventilation step 2	0.0...50.0	10.0	0	C	V		Bar
3C2	*FANS*_HSTART_SET3_PRES	Setpoint for activating ventilation step 3	0.0...50.0	8.0	0	C	V		Bar
3C3	*FANS*_HSTART_SET4_PRES	Setpoint for activating ventilation step 4	0.0...50.0	6.0	0	C	V		Bar
3C4	*FANS*_HSTART_SET5_PRES	Setpoint for activating ventilation step 5	0.0..50.0	0.0	0	C	V		Bar
3C5	*FANS*_HSTART_SET6_PRES	Setpoint for activating ventilation step 6	0.0...50.0	0.0	0	C	V		Bar
3C6	*FANS*_HSTART_SET7_PRES	Setpoint for activating ventilation step 7	0.0...50.0	0.0	0	C	V		Bar
3C7	*FANS*_HSTART_SET8_PRES	Setpoint for activating ventilation step 8	0.0...50.0	0.0	0	C	V		Bar
3C8	*FANS*_HSTOP_DELTA1_PRES	Delta for deactivation of ventilation step 1	0.0...10.0	2.0	0	C	V		Bar
3C9	*FANS*_HSTOP_DELTA2_PRES	Delta for deactivation of ventilation step 2	0.0...10.0	2.0	0	C	V		Bar
3CA	*FANS*_HSTOP_DELTA3_PRES	Delta for deactivation of ventilation step 3	0.0...10.0	2.0	0	C	V		Bar
3CB	*FANS*_HSTOP_DELTA4_PRES	Delta for deactivation of ventilation step 4	0.0...10.0	2.0	0	C	V		Bar
3CC	*FANS*_HSTOP_DELTA5_PRES	Delta for deactivation of ventilation step 5	0.0...10.0	0.0	0	C	V		Bar
3CD	*FANS*_HSTOP_DELTA6_PRES	Delta for deactivation of ventilation step 6	0.0...10.0	0.0	0	C	V		Bar
3CE	*FANS*_HSTOP_DELTA7_PRES	Delta for deactivation of ventilation step 7	0.0...10.0	0.0	0	C	V		Bar
3CF	*FANS*_HSTOP_DELTA8_PRES	Delta for deactivation of ventilation step 8	0.0...10.0	0.0	0	C	V		Bar
	Continuous fan regulator in heat pump mode								
400	*FANS*_HP_MIN_ON_TIME	Minimum On time for ventilation in heat pump mode at minimum speed at least	0...120	30	0	C	V		sec
401	CUTOFF_HP_SETPOINT1_PRES	Pressure value under which the CUTOFF switches off pump mode ventilation	0.0...60.0	22.0	0	C	V		Bar
402	CUTOFF_HP_DELTA1_PRES	Pressure value to be subtracted from CUTOFF_CH_SETPOINT_PRES. If the ventilation *control* pressure goes below the difference, the ON/OFF *control* (due to CUTOFF) becomes continuous in pump mode	0.0...10.0	1.0	0	C	V		Bar
403	*FANS*_HP_START_PRES	Pressure value at which modulated fan *control* is started in pump mode ventilation. Fan speed expressed as a percentage, and equal to the value of parameter *FANS*_CH_MIN_SPEED	0.0...60.0	20.0	0	C	V		Bar
404	*FANS*_HP_SATURATION_PRES	Pressure value at which ventilation goes up to the maximum speed defined by parameter *FANS*_CH_MAX_SPEED in pump mode	0.0...60.0	10.0	0	C	V		Bar
405	*FANS*_HP_MIN_SPEED	Minimum fan speed in pump mode, expressed as a percentage	0...100	40	0	C	V		%
406	*FANS*_HP_MAX_SPEED	Maximum fan speed in pump mode, expressed as a percentage.	0...100	80	0	C	V		%
407	CUTOFF_HP_SETPOINT2_PRES	Pressure value above which saturation CUTOFF changes the *control* from ON/OFF (due to CUTOFF at saturation) to continuous in pump mode	0.0...60.0	9.0	0	C	V		Bar
408	CUTOFF_HP_DELTA2_PRES	Pressure value to be subtracted from CUTOFF_HP_SETPOINT2_PRES. If the ventilation	0.0...10.0	1.0	0	C	V		Bar

Modbus address (hex)	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
		control pressure is below this value, the fan speed will be equal to parameter FANS_HP_SAT_SPEED.							
409	FANS_HP_SAT_SPEED	Maximum fan speed in pump mode, expressed as a percentage.	0…100	90	0	C	V		%
	Defrost								
420	DF_FUNCTION	Enable *defrost:* NONE=not enabled ECH400=enabled in ECH400 mode	4…5	4	23	C	V	4=standard 5=NONE	num
421	DF_MAX_POWER_FLAG	Enable full power request for circuits not in *defrost*.	0…1	0	6	C	V	0=NO 1=YES	flag
422	DF_DRIP_FANS_MAXPOWER_FLAG	Enable ventilation at full power during drip time	0…1	0	6	C	V	0=NO 1=YES	flag
423	DF_MIN_REST_TIME	Minimum time between successive defrosts	0…1000	240	0	C	V		min
424	DF_DRIP_TIME	Drip time	0…1000	20	0	C	V		sec
425	DF_INTER_STEP_TIME	Time between *power steps* of the compressors in Energy 400 *defrost*	0…1000	30	0	C	V		sec
426	DF_INVERSION_TIME	Time to elapse between: - the time the *circuit* goes off for defrosting and when the *reverse cycle valve* changes position - turning of the *reverse cycle valve* and starting of the *Defrost circuit*.	0…1000	30	0	C	V		sec
427	DF_START_PRES	Pressure value at which *defrost* is activated if the pressure remains below this value for time DF_START_DELAY_TIME	0.0…50.0	3.0	0	C	V		Bar
428	DF_START_DELAY_TIME	Delay time before start of *defrost* when the pressure remains below value DF_START_PRES	0…60	30	0	C	V		min
429	DF_STOP_PRES	Pressure value at which *defrost* is stopped	0.0…5.0	12.0	0	C	V		Bar
42A	DF_MIN_DURATION_TIME	Minimum time for which *defrost* is to continue	0…30	5	0	C	V		min
42B	DF_MAX_DURATION_TIME	Maximum time for which *defrost* is to continue	0…60	30	0	C	V		min
42C	DF_BYPASS_MIN_TIME	Bypass time for minimum pressure alarm at the start of *defrost*	0…30	5	0	C	V		min
42D	DF_MAX_FANSP_PRES	Pressure value above which the *fans* are to go up to full power in *defrost*	0.0…50.0	10.0	0	C	V		Bar
42E	DF_MAX_FANSP_DELTA_PRES	Hysteresis delta relative to parameter DF_MAX_FANSP_PRES	0.0…10.0	2.0	0	C	V		Bar
	Pump group and flow switch								
460	A_FS_BYPASS_STARTUP_TIME	Bypass time for *flow switch alarm*	1…99	30	0	C	V		sec
461	A_FS_ENTRY_TIME	Time for which a physical alarm condition continues in the flow switch before the alarm is treated as Present	0…60	10	0	C	V		sec
462	A_FS_EXIT_TIME	Time for which a physical non-alarm condition continues in the flow switch before the alarm is treated as Not Present	0…60	10	0	C	V		sec

Modbus address (hex)	Parameter Category and Name	Parameter description	Range	def	trans	C/H	vis	Description of code conversion	UM
463	PUMPS_ALTERNATION_TIME	Pump alternation time	1…1000	72	0	C	V		hours
464	PUMPGROUP_STARTUP_DELAY_TIME	Time that is to elapse between system ON (when the selected pump is activated) and the start of heat regulation	KOMP_CHARGEDISCH_TIME …2000	60	0	C	V		sec
465	PUMPGROUP_STOP_DELAY_TIME	Time for which the active pump is to remain On after there has been a system Off request and the last *compressor* has gone Off	1…60	20	0	C	V		sec
466	A_FS_AUTOMATIC2MANUAL_TIME	Time after which a *flow switch alarm* changes from automatic to manual (must be longer than time A_FS_EXIT_TIME)	1…60	20	0	C	V		sec
	Pump usage time								
480	PUMP_USAGE_DAYS_1	Days of use of pump 1	0…32000	0	0	C	V		day
481	PUMP_USAGE_DAYS_2	Days of use of pump 2	0…32000	0	0	C	V		day
482	PUMP_USAGE_HOUR_1	Hours of use of pump 1	0…24	0	0	C	V		hour
483	PUMP_USAGE_HOUR_2	Hours of use of pump 2	0…24	0	0	C	V		hour
	Pump down								
490	PD_FUNCTION	Selects the pump-down type: not active (NO_PD), at startup (ON_START), or at startup and going down (FULL)	0…2	2	15	C	V	0=NO_PD 1=ON_START 2=FULL	num
491	PD_OFFON_MAX_TIME	Maximum pump-down time at startup	0…1800	10	0	C	V		sec
492	PD_ONOFF_MAX_TIME	Maximum pump-down time when going down	0…1800	10	0	C	V		Sec
	Statuses in EEPROM								
4D0	PLAN_STATUS_HOT	Store system status in EEPROM. 0=Off, 2=On	0..2	0	0	H	N		num

7 APPENDIX

7.1 User variables

Name	Ind. Modbus [hex]	Inf	Sup	Trans	UM	Description of trans.	Description
PlanStatus_UI	5F0	0	3	7	0	0=MODE_SPENTO, 1=MODE_CHILLER, 2=MODE_HEATPUMP 3=MODE_SPEGNIMENTO	System status
CombineAlarm_UI	5F1	0	42	7	0	38=MODE_AL_HARDWARE, 39=MODE_AL_RTC, 40=MODE_AL_CONFIGURATION, 42=MODE_STR_NULL	HW alarm present
PlanTempInWaterSens_1_UI	5F2	-50.0	150.0	0	°C		Inlet water temperature of primary *circuit*
PlanTempOutWaterSens_1_UI	5F3	-50.0	150.0	0	°C		Outlet water temperature of primary *circuit*
PlanPowPerc_UI	5F4	0	100	0	%		Percentage power output from system
PumpStatus_1_UI	5F5	0	1	5	0	0=OFF, 1=ON	Pump 1 status
PumpStatus_2_UI	5F6	0	1	5	0	0=OFF, 1=ON	Pump 2 status
KompStatus_1_UI	5F7	0	9	8	0	0=CMP_0, 1=CMP_25, 2=CMP_33, 3=CMP_50, 4=CMP_6, 5=CMP_75, 6=100, 7=CMP_ALLARME, 8=CMP_DESELEZIONATO, 9=CMP_TEMPI_SICUREZZA	*Compressor* 1 status
KompStatus_2_UI	5F8					"	*Compressor* 2 status
KompStatus_3_UI	5F9					"	*Compressor* 3 status
KompStatus_4_UI	5FA					"	*Compressor* 4 status
KompStatus_5_UI	5FB					"	*Compressor* 5 status
KompStatus_6_UI	5FC					"	*Compressor* 6 status
KompStatus_7_UI	5FD					"	*Compressor* 7 status
KompStatus_8_UI	5FE					"	*Compressor* 8 status
KompTempDischargeSens_1_UI	5FF	-50.0	150.0		°C		*Compressor* 1 discharge temperature
KompTempDischargeSens_2_UI	600	-50.0	150.0		°C		*Compressor* 2 discharge temperature
KompTempDischargeSens_3_UI	601	-50.0	150.0		°C		*Compressor* 3 discharge temperature

Name	Ind. Modbus [hex]	Inf	Sup	Trans	UM	Description of trans.	Description
KompTempDischargeSens_4_UI	602	-50.0	150.0		°C		*Compressor* 4 discharge temperature
KompTempDischargeSens_5_UI	603	-50.0	150.0		°C		*Compressor* 5 discharge temperature
KompTempDischargeSens_6_UI	604	-50.0	150.0		°C		*Compressor* 6 discharge temperature
KompTempDischargeSens_7_UI	605	-50.0	150.0		°C		*Compressor* 7 discharge temperature
KompTempDischargeSens_8_UI	606	-50.0	150.0		°C		*Compressor* 8 discharge temperature
CirPowPerc_1_UI	607	0	100	0	%		Percentage power output from *circuit* 1
CirPowPerc_2_UI	608						Percentage power output from *circuit* 2
CirPowPerc_3_UI	609						Percentage power output from *circuit* 3
CirPowPerc_4_UI	60A						Percentage power output from *circuit* 4
CirPowPerc_5_UI	60B						Percentage power output from *circuit* 5
CirPowPerc_6_UI	60C						Percentage power output from *circuit* 6
CirPowPerc_7_UI	60D						Percentage power output from *circuit* 7
CirPowPerc_8_UI	60E						Percentage power output from *circuit* 8
CirStatus_1_UI	60F	0	4	9	0	0=CIRC_POTENZA, 1=CIRC_ALLARME, 3=CIRC_POMPDOWN	*Circuit* 1 status
CirStatus_2_UI	610					"	*Circuit* 2 status
CirStatus_3_UI	611					"	*Circuit* 3 status
CirStatus_4_UI	612					"	*Circuit* 4 status
CirStatus_5_UI	613					"	*Circuit* 5 status
CirStatus_6_UI	614					"	*Circuit* 6 status
CirStatus_7_UI	615					"	*Circuit* 7 status
CirStatus_8_UI	616					"	*Circuit* 8 status
CirPresMaxSens_1_UI	617	-50.0	150.0		Bar		Maximum pressure sensor *circuit* 1
CirPresMaxSens_2_UI	618	-50.0	150.0		Bar		Maximum pressure sensor *circuit* 2
CirPresMaxSens_3_UI	619	-50.0	150.0		Bar		Maximum pressure sensor *circuit* 3
CirPresMaxSens_4_UI	61A	-50.0	150.0		Bar		Maximum pressure sensor *circuit* 4
CirPresMaxSens_5_UI	61B	-50.0	150.0		Bar		Maximum pressure sensor *circuit* 5
CirPresMaxSens_6_UI	61C	-50.0	150.0		Bar		Maximum pressure sensor *circuit* 6
CirPresMaxSens_7_UI	61D	-50.0	150.0		Bar		Maximum pressure sensor *circuit* 7
CirPresMaxSens_8_UI	61E	-50.0	150.0		Bar		Maximum pressure sensor *circuit* 8
FansPowPerc_1_UI	61F	0	100	0	%		Percentage power output from fan battery 1
FansPowPerc_2_UI	620	0	100	0	%		Percentage power output from fan battery 2

7.2 User menu item visibility

Index	Var. MenuMaker PRO	Var. Dictionary	Mb Add.	Function	Description
0	BIOS	VAR_ANA_BIOS_4	380		
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16		VAR_ANA_BIOS_5	381		
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30	USERDVFUNCTION_0			Pump 1	Visibility of pump menu items

Index	Var. MenuMaker PRO	Var. Dictionary	Mb Add.	Function	Description
31	USERDVFUNCTION_1			Pump 2	
32	USERDVFUNCTION_2	VAR_ANA_BIOS_6	382	*Circuit* 1	Visibility of circuits menu items
33	USERDVFUNCTION_3			*Circuit* 2	
34	USERDVFUNCTION_4			*Circuit* 3	
35	USERDVFUNCTION_5			*Circuit* 4	
36	USERDVFUNCTION_6			*Circuit* 5	
37	USERDVFUNCTION_7			*Circuit* 6	
38	USERDVFUNCTION_8			*Circuit* 7	
39	USERDVFUNCTION_9			*Circuit* 8	
40	USERDVFUNCTION_10			*Compressor* 1	Visibility of *compressor* menu items
41	USERDVFUNCTION_11			*Compressor* 2	
42	USERDVFUNCTION_12			*Compressor* 3	
43	USERDVFUNCTION_13			*Compressor* 4	
44	USERDVFUNCTION_14			*Compressor* 5	
45	USERDVFUNCTION_15			*Compressor* 6	
46	USERDVFUNCTION_16			*Compressor* 7	
47	USERDVFUNCTION_17			*Compressor* 8	
48	USERDVFUNCTION_18	VAR_ANA_BIOS_7	383	*Fans* battery 1	Visibility of *fans* menu items
49	USERDVFUNCTION_19			*Fans* battery 2	
50	USERDVFUNCTION_20			Cold mode	Set/delta visibility in Cold mode
51	USERDVFUNCTION_21			Hot mode	Set/delta visibility in Hot mode
52	USERDVFUNCTION_22				
53	USERDVFUNCTION_23				
54	USERDVFUNCTION_24				
55	USERDVFUNCTION_25				
56	USERDVFUNCTION_26				
57	USERDVFUNCTION_27				
58	USERDVFUNCTION_28				
59	USERDVFUNCTION_29				
60	USERDVFUNCTION_30				
61	USERDVFUNCTION_31				
62	USERDVFUNCTION_32				
63	USERDVFUNCTION_33				

7.3 User functions

Index	Var. MenuMaker PRO	Var. Dictionary	Mb Add.	Function
0	BIOS	VAR_BOO_BIOS_17	14C	
1		VAR_BOO_BIOS_18	14D	
2		VAR_BOO_BIOS_19	14E	
3		VAR_BOO_BIOS_20	14F	
4		VAR_BOO_BIOS_21	150	
5		VAR_BOO_BIOS_22	151	
6		VAR_BOO_BIOS_23	152	
7		VAR_BOO_BIOS_24	153	
8		VAR_BOO_BIOS_25	154	
9	USER FUNCTION 0	VAR_BOO_BIOS_26	155	Alarm reset
10	USER FUNCTION 1	VAR_BOO_BIOS_27	156	Reset hours pump 1
11	USER FUNCTION 2	VAR_BOO_BIOS_28	157	Reset hours pump 2
12	USER FUNCTION 3	VAR_BOO_BIOS_29	158	Reset hours *compressor* 1
13	USER FUNCTION 4	VAR_BOO_BIOS_30	159	Reset hours *compressor* 2
14	USER FUNCTION 5	VAR_BOO_BIOS_31	15A	Reset hours *compressor* 3
15	USER FUNCTION 6	VAR_BOO_BIOS_32	15B	Reset hours *compressor* 4
16	USER FUNCTION 7	VAR_BOO_BIOS_33	15C	Reset hours *compressor* 5
17	USER FUNCTION 8	VAR_BOO_BIOS_34	15D	Reset hours *compressor* 6
18	USER FUNCTION 9	VAR_BOO_BIOS_35	15E	Reset hours *compressor* 7
19	USER FUNCTION 10	VAR_BOO_BIOS_36	15F	Reset hours *compressor* 8

7.4 I/O map

The tables below describe the wiring for the maximum machine that can be defined with the current application.

7.4.1 XTMRH

NO1	KOMP_ACC_DO_1_PHY	Startups *compressor* 1
NO2	KOMP_CHARGE_DO_1_PHY	Charge *compressor* 1
NO3	KOMP_DISCH_DO_1_PHY	Discharge *compressor* 1
NO4	KOMP_ACC_DO_2_PHY	Startups *compressor* 2
NO5	KOMP_CHARGE_DO_2_PHY	Charge *compressor* 2
NO6	KOMP_DISCH_DO_2_PHY	Discharge *compressor* 2
NO7	KOMP_ACC_DO_3_PHY	Startups *compressor* 3
NO8	KOMP_CHARGE_DO_3_PHY	Charge *compressor* 3
NO9	KOMP_DISCH_DO_3_PHY	Discharge *compressor* 3
NO10	KOMP_ACC_DO_4_PHY	Startups *compressor* 4
NO11	KOMP_CHARGE_DO_4_PHY	Charge *compressor* 4
NO12	KOMP_DISCH_DO_4_PHY	Discharge *compressor* 4
NO13	EV_HEATER_DO_1_PHY	Primary *antifreeze* heater *evaporator* 1
NO14	EV_HEATER_DO_2_PHY	Primary *antifreeze* heater *evaporator* 2
NO15	PLAN_CUMALARM_DO_PHY	Cumulative machine alarm
NO20	PUMP_ACC_DO_1_PHY	Primary water *circuit* pumps
AI1	PLAN_TEMP_INWATER_SENS_PHY	Inlet water temperature sensor of primary *circuit*
AI2	EV_TEMP_OUTWATER_SENS_1_PHY	Primary outlet water temperature sensor *evaporator* 1
AI3	EV_TEMP_OUTWATER_SENS_2_PHY	Primary outlet water temperature sensor *evaporator* 2
AI4	PLAN_TEMP_OUTWATER_SENS_PHY	Primary outlet water common temperature sensor
AI5	CIR_PRES_MAX_SENS_1_PHY	Maximum pressure analog sensor *circuit* 1
AI6	CIR_PRES_MAX_SENS_2_PHY	Maximum pressure analog sensor *circuit* 2
AI7	CIR_PRES_MAX_SENS_3_PHY	Maximum pressure analog sensor *circuit* 3
AI8	CIR_PRES_MAX_SENS_4_PHY	Maximum pressure analog sensor *circuit* 4
AI9	PLAN_CURR_DTSET_SENS_PHY	Current sensor for dynamic Tset
AI13	KOMP_TEMP_DISCHARGE_SENS_1_PHY	Discharge temperature analog sensor *compressor* 1
AI14	KOMP_TEMP_DISCHARGE_SENS_2_PHY	Discharge temperature analog sensor *compressor* 2
AI15	KOMP_TEMP_DISCHARGE_SENS_3_PHY	Discharge temperature analog sensor *compressor* 3
AI16	KOMP_TEMP_DISCHARGE_SENS_4_PHY	Discharge temperature analog sensor *compressor* 4
IDL1	CIR_PRES_MAX_DI_1_PHY	Maximum pressure switch *circuit* 1
IDL2	CIR_PRES_MAX_DI_2_PHY	Maximum pressure switch *circuit* 2
IDL3	CIR_PRES_MAX_DI_3_PHY	Maximum pressure switch *circuit* 3
IDL4	CIR_PRES_MAX_DI_4_PHY	Maximum pressure switch *circuit* 4
IDL5	CIR_PRES_MIN_DI_1_PHY	Minimum pressure switch *circuit* 1
IDL6	CIR_PRES_MIN_DI_2_PHY	Minimum pressure switch *circuit* 2
IDL7	CIR_PRES_MIN_DI_3_PHY	Minimum pressure switch *circuit* 3
IDL8	CIR_PRES_MIN_DI_4_PHY	Minimum pressure switch *circuit* 4
IDL9	KOMP_A_THER_DI_1_PHY	Digital temperature input *compressor* motor 1
IDL10	KOMP_A_THER_DI_2_PHY	Digital temperature input *compressor* motor 2
IDL11	KOMP_A_THER_DI_3_PHY	Digital temperature input *compressor* motor 3
IDL12	KOMP_A_THER_DI_4_PHY	Digital temperature input *compressor* motor 4
IDL13	PUMP_A_FLOW_DI_PHY	Primary *circuit* flow switch
IDL14	*FANS*_A_THER_DI_1_PHY	Thermal alarm fan battery 1
IDL15	*FANS*_A_THER_DI_2_PHY	Thermal alarm fan battery 2
IDL16	PLAN_ONOFF_DI_PHY	Remote ON/OFF
IDL17	PUMP_A_THER_DI_1_PHY	Primary *circuit* thermal alarm pump 1
IDL18	PUMP_A_THER_DI_2_PHY	Primary *circuit* thermal alarm pump 2
IDL19	PLAN_MODE_DI_PHY	Summer/Winter Mode
AO1	*FANS*_CTRL_AO_1_PHY	Speed *control* for analog fan associated with fan battery 1
AO2	*FANS*_CTRL_AO_2_PHY	Speed *control* for analog fan associated with fan battery 2

7.4.2 XTEH (address 1)

NO1	PUMP_ACC_DO_2_PHY	Primary water *circuit* pumps
NO2	KOMP_IL_DO_1_PHY	Liquid injection *compressor* 1
NO3	KOMP_IL_DO_2_PHY	Liquid injection *compressor* 2
NO4	KOMP_IL_DO_3_PHY	Liquid injection *compressor* 3
NO5	KOMP_IL_DO_4_PHY	Liquid injection *compressor* 4

NO6	CIR_SOLENOID_VALVE_DO_1_PHY	Solenoid valve *circuit* 1
NO7	CIR_SOLENOID_VALVE_DO_2_PHY	Solenoid valve *circuit* 2
NO8	CIR_SOLENOID_VALVE_DO_3_PHY	Solenoid valve *circuit* 3
NO9	CIR_SOLENOID_VALVE_DO_4_PHY	Solenoid valve *circuit* 4
NO10	*FANS*_ACC1_DO_1_PHY	Fan battery 1, start fan 1
NO11	*FANS*_ACC2_DO_1_PHY	Fan battery 1, start fan 2
NO12	*FANS*_ACC3_DO_1_PHY	Fan battery 1, start fan 3
NO13	*FANS*_ACC4_DO_1_PHY	Fan battery 1, start fan 4
NO14	*FANS*_ACC1_DO_2_PHY	Fan battery 2, start fan 1
NO15	*FANS*_ACC2_DO_2_PHY	Fan battery 2, start fan 2

7.4.3 XTEH (address 2)

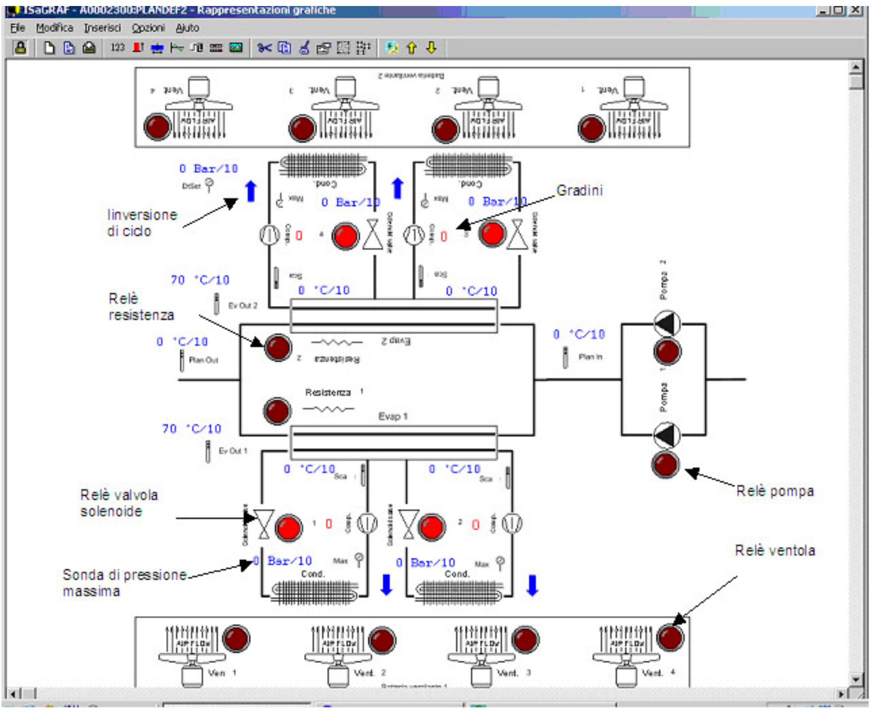
NO1	*FANS*_ACC3_DO_2_PHY	Fan battery 2, start fan 3
NO2	*FANS*_ACC4_DO_2_PHY	Fan battery 2, start fan 4
NO7	CIR_INVERSION_VALVE_DO_1_PHY	*Reverse cycle valve circuit* 1
NO8	CIR_INVERSION_VALVE_DO_2_PHY	*Reverse cycle valve circuit* 2
NO9	CIR_INVERSION_VALVE_DO_3_PHY	*Reverse cycle valve circuit* 3
NO10	CIR_INVERSION_VALVE_DO_4_PHY	*Reverse cycle valve circuit* 4

7.5 SpotLight

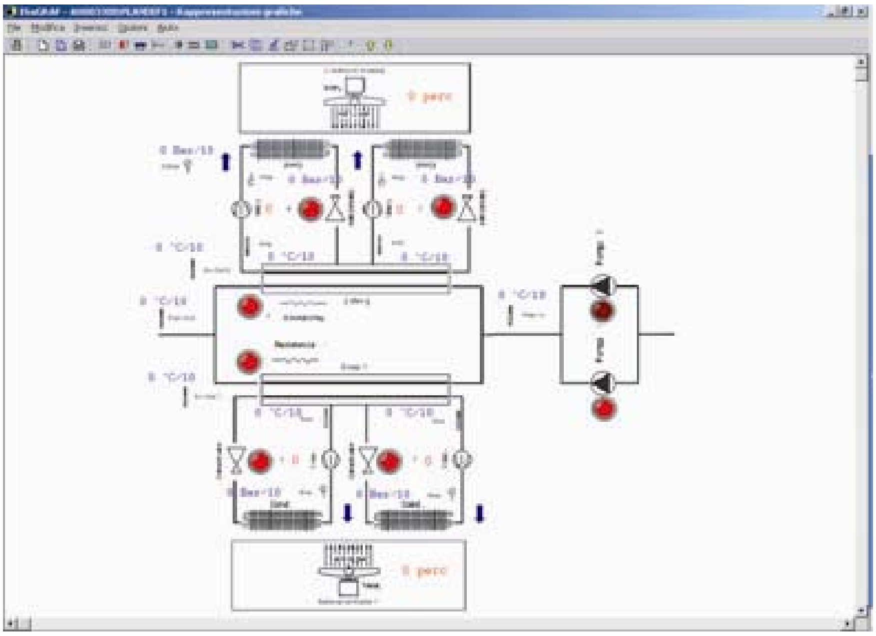
The SpotLiht function in ISaGRAF can be used to activate the PLANDEF mimic panel. This is used to display:

- Sensor values
- Refrigeration power stages for each *compressor*
- Status of solenoid valves
- Status of resistors
- Status of water circulating pumps in primary *circuit*
- Status of *fans* in the two fan batteries
- *Reverse cycle valve* (BLUE arrows for chiller or *defrost* and RED for pump)

Picture of PLANDEF *spotlight*



Picture of PLANDEF1 *spotlight*: defalut machine with analogic *fans*



8 USE OF THE DEVICE

8.1 Permitted Use

This unit is used to *control* small, medium and large sized chillers with 1 to 8 compressors and circuits.

For safety purposes, the *control* device must be installed and used in accordance with the instructions supplied. Users must not be able to access parts with dangerous voltage levels under normal operating conditions. The unit must be resistant to water and dust, depending on the specific application, and be accessible only by using special tools. This unit can be fitted on domestic appliances and/or similar units used for air conditioning.
In accordance with the reference standards, this unit is classified:

- as an automatic electronic *control* device to be installed in a standalone configuration or on other units with regard to manufacturing;
- As a Type 1 *control* unit in relation to its manufacturing tolerances and derivatives with regard to its automatic operating characteristics;
- As a Class 2 device with regard to protection against electric shocks (referring to the parts that can be accessed during normal use: front keypad);
- As a Class A device with regard to software class and structure

8.2 Unpermitted Use

The use of the unit for applications other than those described is forbidden.
Please note that the relay contacts supplied are functional and may be subject to failure (since the electronics controlling them may short *circuit* these relays or leave them open). For this reason, any protection devices needed to comply with product requirements or dictated by common sense due to obvious safety reasons should be installed externally.

9 RESPONSIBILITY AND RESIDUAL RISKS

Eliwell Controls s.r.l. shall not be liable for any damages deriving from:

- installation/use other than that prescribed which does not comply with the safety standards specified in the regulations and/or herein;
- use on equipment that does not guarantee adequate protection against electric shock, water or dust when assembled.
- use on equipment that allows dangerous parts to be accessed without the use of tools;
- Installation/use on equipment that is not compliant with the standards and regulations in force.

10 DISCLAIMER

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