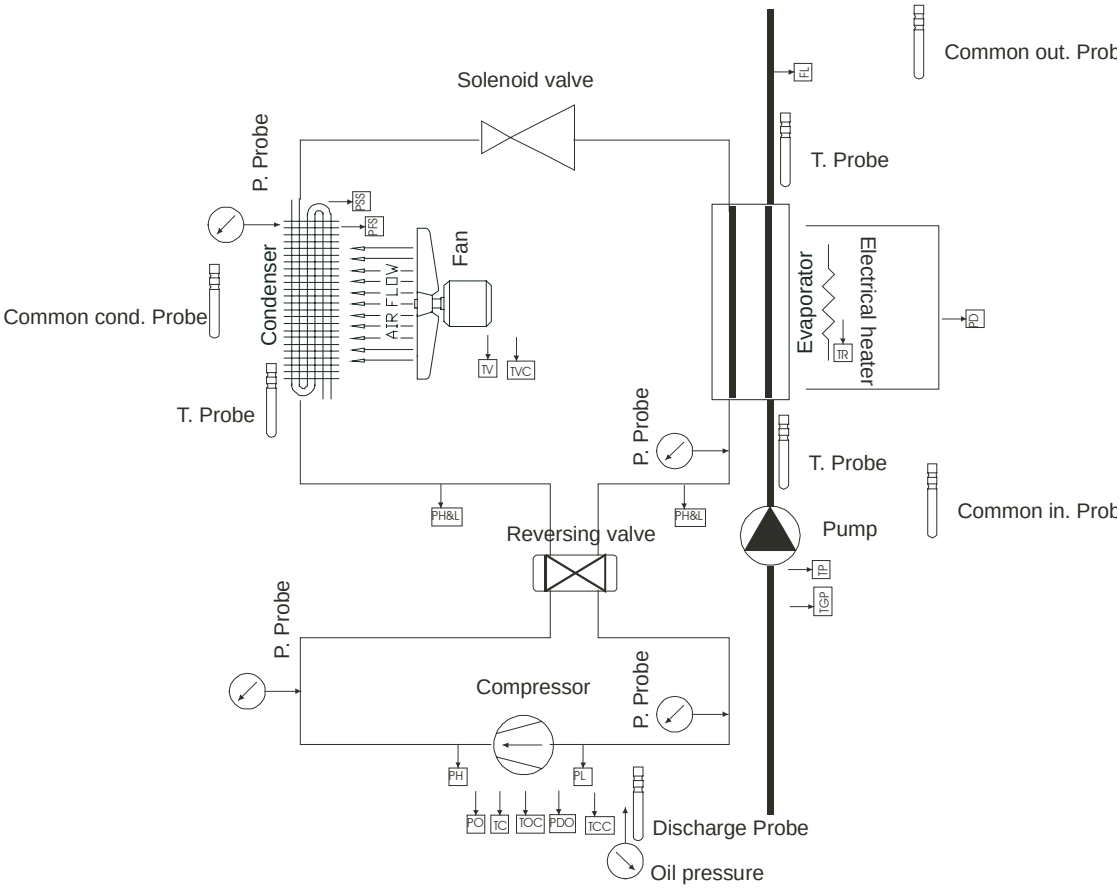
Energy XT PRO
BaseLine Application
[A00003xx-A00013xx]

SUMMARY

1 HOW TO USE THIS MANUAL

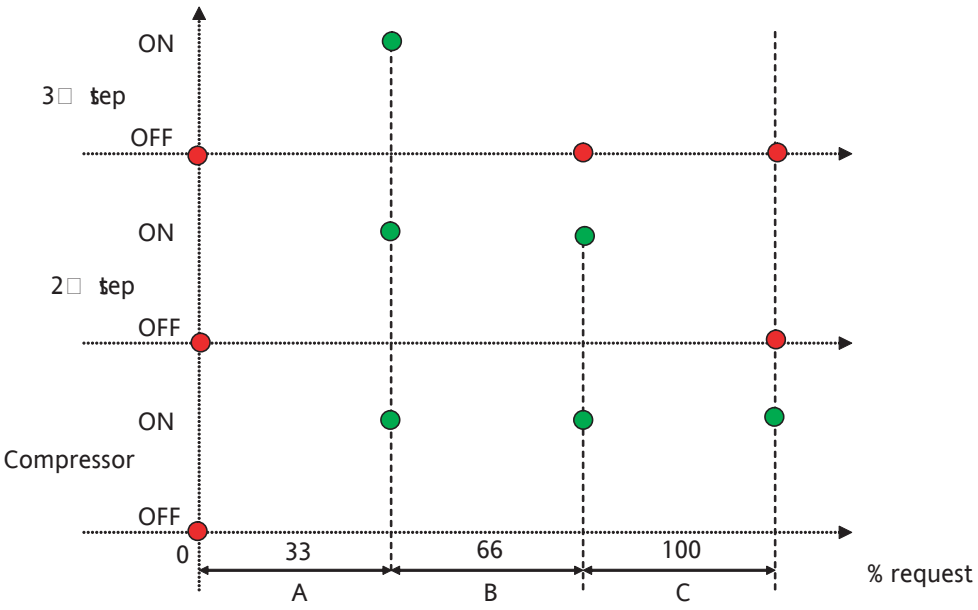
The Base-line chiller is a water/air machine consisting of the following components:



n° of circuits	4	n° of fans per block	3
n° of evaporators	2	n° of compressors	4
n° of condensers	4	n° of pumps	2
n° of fan blocks	2	n° of heaters	2

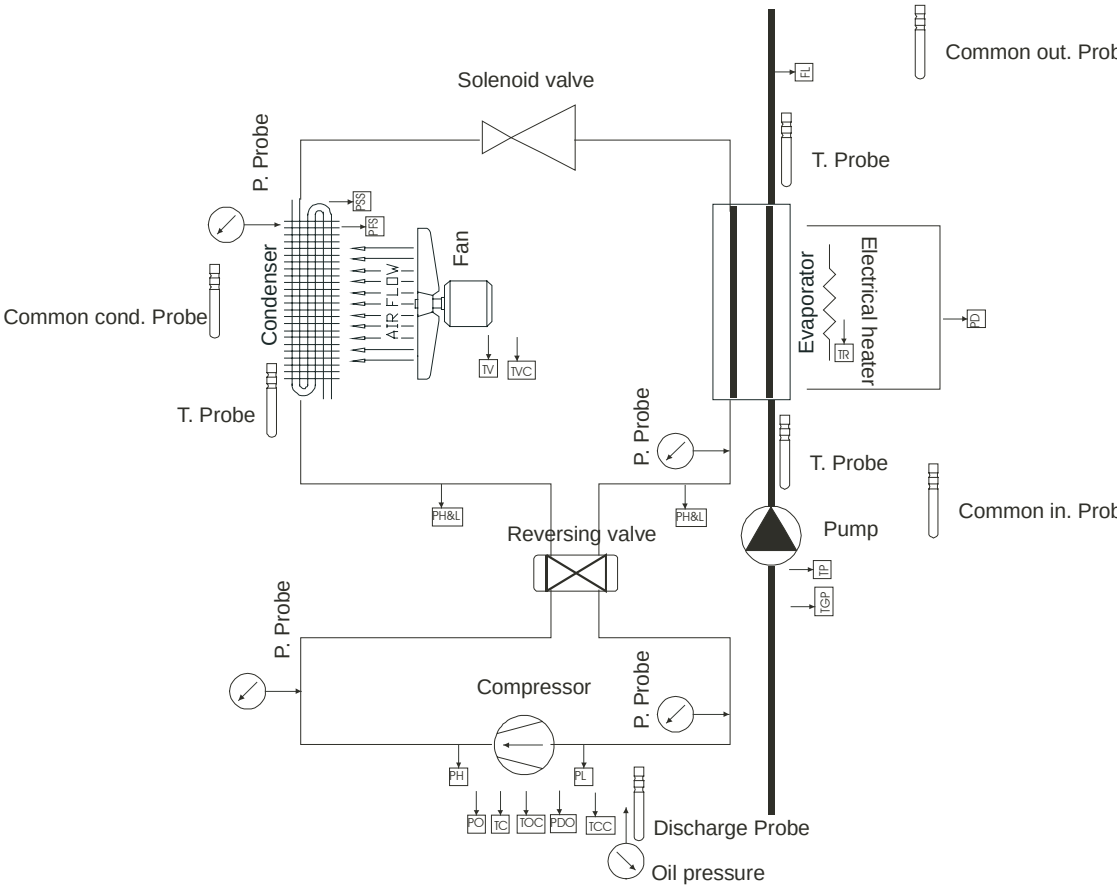
Compressor type

The application handles up to 4 reciprocating compressors with 3 *capacity steps*:


ON
3□ step
OFF
ON
2□ step
OFF
ON
Compressor
OFF
0
33
66
100
A
B
C
% request

2 SYSTEM CONFIGURATION

The Base-line chiller is a water/air machine consisting of the following components:



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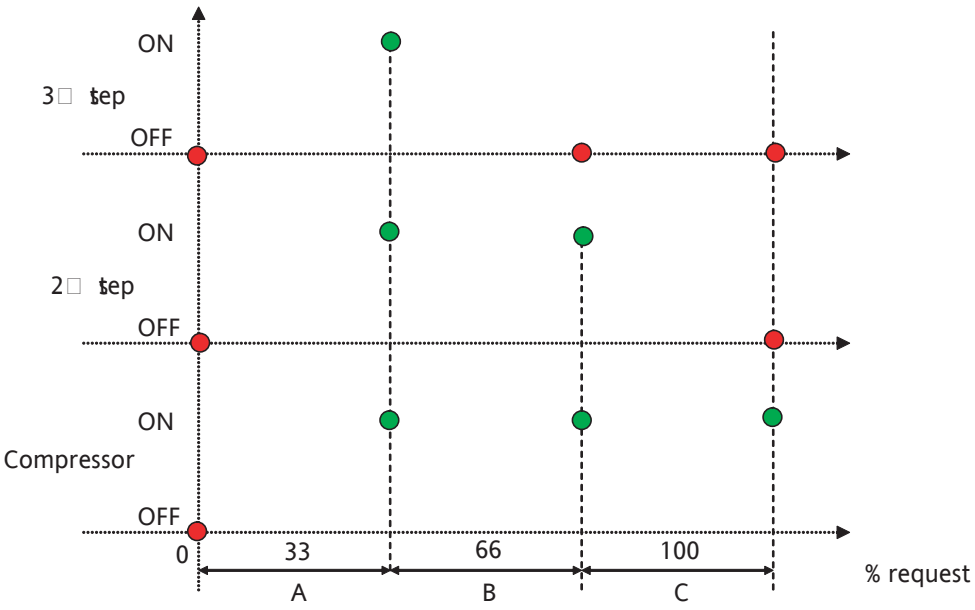

ON
3□ step
OFF
ON
2□ step
OFF
ON
Compressor
OFF
0
33
66
100
A
B
C
% request

3 FUNCTIONS

3.1 Temperature control

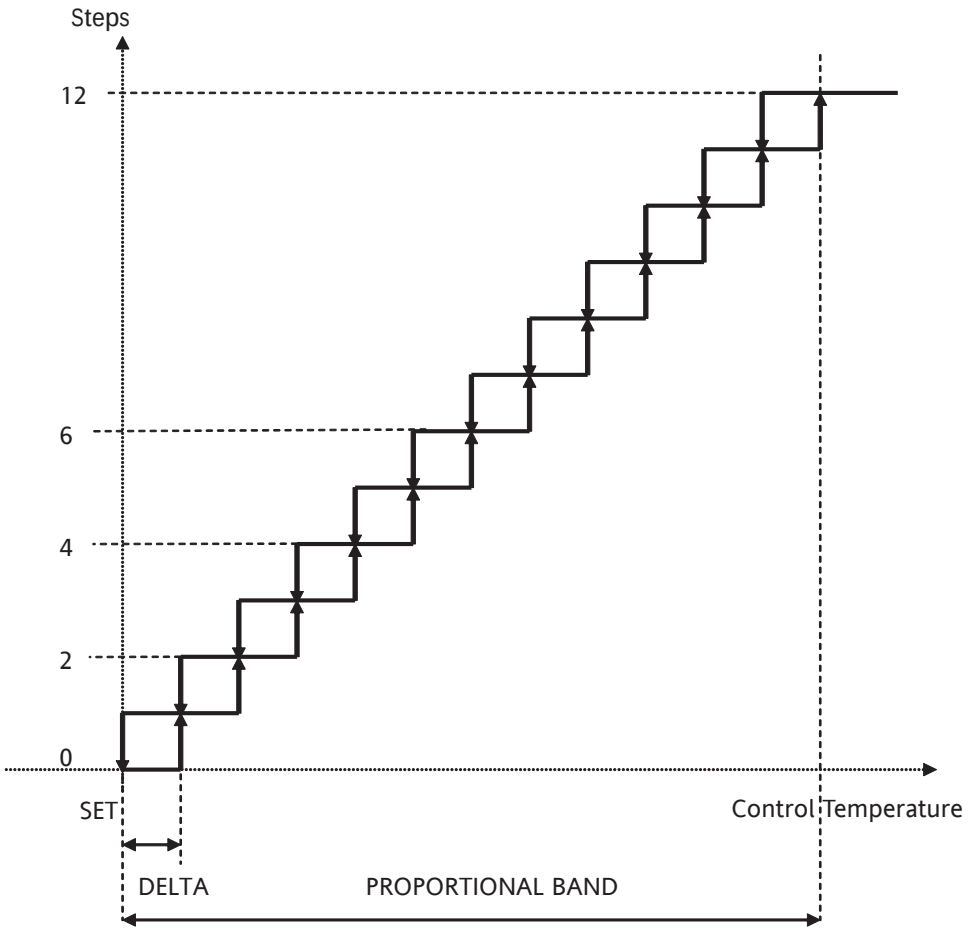
Depending on parameter TREG_TEMP_SENS, temperature control can be based on the temperature of the thermodynamic system outlet water or the thermodynamic system inlet water.
According to the status of the same parameter (TREG_TEMP_SENS) the control set point is also calculated. The behaviour of the status of the temperature controller according to the value of the parameter is described below:

	TREG_TEMP_SENS	
	=ENTRY_SENSOR	**=EXIT_SENSOR**
temperature control set point	CH_ENTRY_OFFSET+ CH_TSET_TEMP+ Dynamic set point correction	CH_TSET_TEMP+ Dynamic set point correction
temperature control probe	PLAN_TEMP_INWATER_SENS_PHY	PLAN_TEMP_OUTWATER_SENS_PHY

3.1.1 Types of temperature control

By setting the parameter TREG_FUNCTION, you can select the type of *temperature control* you want to use.
The Base-Line application uses two different methods:

Proportional *temperature control*
PI *temperature control*
Proportional *temperature control*
In this type of *temperature control*, a specific number of cooling resources (power steps) is enabled in order to reach the temperature indicated by the set *temperature control* set point. Obviously, the number of power steps needed to reach the *temperature control* set point is in direct proportion to the difference between the temperature measured by the probe and the temperature to be reached (set point).
The temperature range between the insertion of one step and the other varies according to the proportional band (CH_PROP_BAND) and the number of available resources. For further information, refer to the diagram below:



SET :	*Temperature control* set point
PROPORTIONAL BAND:	CH_PROP_BAND
DELTA:	CH_PROP_BAND/∑(KOMP_STEP_i +1) (Where i=1... n° compressors)
Control temperature	Temperature read by *temperature control* probe
n° of steps	[*Control* temperature– SET]/DELTA

PI temperature control
A continuous PID controller and the related digital version obtained through **discretization** of its transfer function generates a *control* signal that is equivalent to the sum total of three items:

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

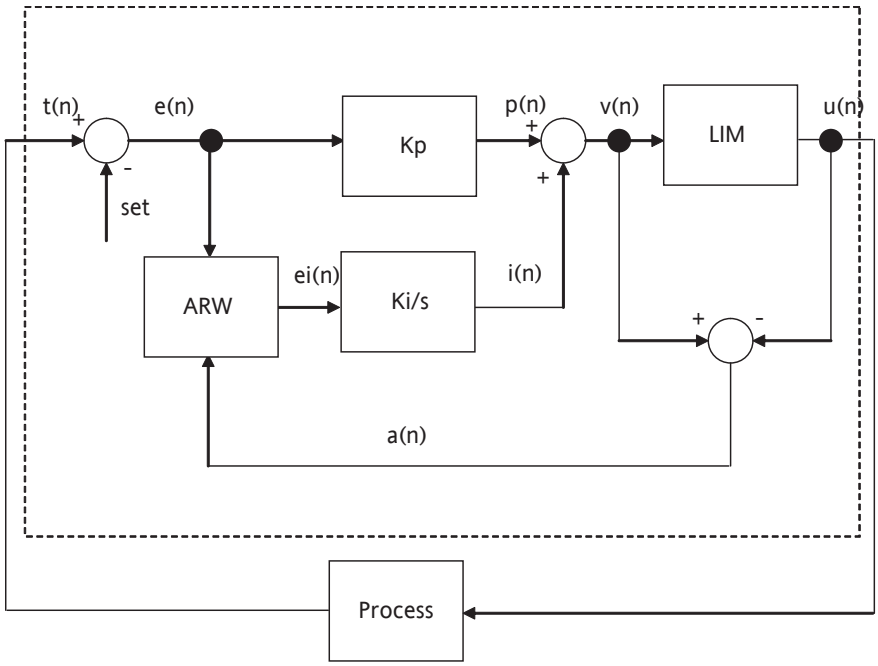
The base PID controller offers an ideal transfer function between:

Input e(t) = *temperature control* probe(t) – *temperature control* set point, i.e. the system error, equivalent to the difference between the measured process variable (in our case, a temperature) and a reference signal (*temperature control* set point)
and the *control* signal u(t), applied to the actuator or directly to the process to be controlled.

In our case, a PI type controller can be used; in particular, you can select from the parameter:

whether to take into account the integral component Ki (PI_INTEGRAL_KOMPONENT_FLAG)
whether to take into account the proportional component Ki (PI_PROP_COMPONENT_FLAG)
the integrative time constant value Ki
the value of the proportional band Bp (CH_PROP_BAND)

A block diagram of the controller P.I. with an explanation of the blocks is included below



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

Where
Kp = 1000/Bp
Ki = Kp•Tc/Ti
$Tc \leq Ti \leq Timax$
u(n) = LIM(v(n)) u(n) = v(n) if $0 < v(n) < 1000$
u(n) = 0 if $v(n) \leq 0$
u(n) = 1000 if $v(n) \geq 1000$

ei(n) = ARW(a(n)) ei(n) = ei(n) if a(n) = 0
ei(n) = 0 if $a(n) \neq 0$

In the application the parameters correspond to these sensors:

Bp	CH_PROP_BAND
Ti	PI_INTEGRAL_CONSTANT
Timax	Maximum value of PI_INTEGRAL_CONSTANT
Tc	Cycle time of application set in ISaGRAF
set	***Temperature control SetPoint*** value
t(n)	Temperature of *control* water measured by ***Temperature Control Probe***

Modbus address (hex)	Category and name of parameter	Description of parameter	Range	Default	trans	C/H	vis	Description of transcode	UM
245	A_HIGHT_BYPASS_TIME	System *high temperature alarm* bypass time	1...99	15	0	H	V		Min
260	TREG_FUNCTION	Type of *temperature control* 0=Proportional 1=Time-proportional 2=P.I.	0...2	0	17	C	V	0=PROPORTIONAL, 1=TIME_PROPORTIONAL, 2=PI	Num
262	PI_INTEGRAL_COMPONENT_FLAG	Flag for integral component of P.I. *temperature controll*er	0...1	1	6	H	V	0=NO, 1=YES	Flag
263	PI_INTEGRAL_CONSTANT	Value of Integral Time of integral component of P.I. *temperature controll*er	1...900	600	0	H	V		Sec
264	PI_PROP_COMPONENT_FLAG	Flag for proportional component of P.I. *temperature controll*er	0...1	1	6	H	V	0=NO, 1=YES	Flag
270	CH_TSET_TEMP	Cool set point	CH_MIN_TSET_TEMP... CH_MAX_TSET_TEMP	7.0	0	H	V		°C
271	CH_MIN_TSET_TEMP	Cool set point minimum value	-50.0...80.0	5.0	0	C	V		°C
272	CH_MAX_TSET_TEMP	Cool set point maximum value	-50.0...80.0	25.0	0	C	V		°C
273	CH_ENTRY_OFFSET	Cool set point offset for *temperature control* on primary circuit water inlet temperature sensor	0.0...15.0	0.0	0	H	V		°C
274	CH_PROP_BAND	Cool proportional band	CH_MIN_PROP_BAND... CH_MAX_PROP_BAND	5.0	0	H	V		°C
275	CH_MIN_PROP_BAND	Minimum value of cool proportional band	0.0...25.0	0.0	0	C	V		°C
276	CH_MAX_PROP_BAND	Maximum value of cool proportional band	0.0...25.0	20.0	0	C	V		°C
277	CH_INC_STEP_TIME	Step increase time (increase in cooling power)	0...300	10	0	H	V		Sec
278	CH_DEC_STEP_TIME	Step decrease time (decrease in cooling power)	0...300	10	0	H	V		Sec

3.2 Pump Down

The *pump down* is a special circuit start/stop procedure.
During the stop phase, the valve commonly referred to as a solenoid valve on the gas circuit upstream of the evaporator is closed before being disabled to allow the last *compressor* that is on to reduce the gas pressure to the *pump down* value while continuing to suck gas from the evaporator. The *compressor* switches off as soon as this low pressure value is reached.
This makes sure that the evaporator is practically empty while the *compressor* is switched off and prevents a rise in temperature of the evaporator itself causing low pressure to rise to values that are too high for the *compressor* and/or evaporator.

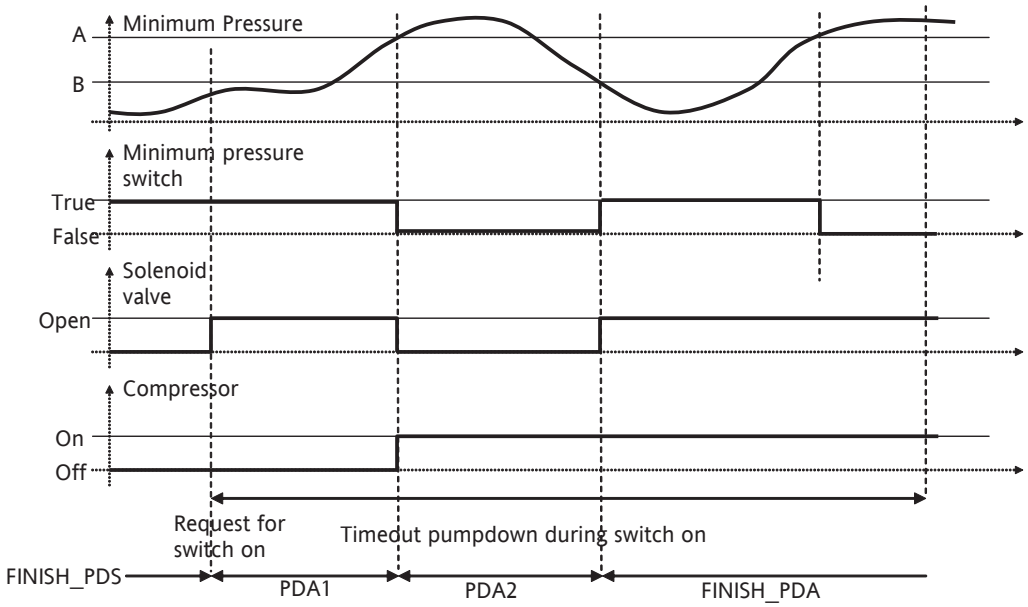
The *pump down* procedure is handled by the minimum pressure pressure switch.

3.2.1 Pump-down during switch-on

The first *compressor* in a circuit must be switched on as below if PD_FUNCTION = ON_START or PD_FUNCTION=FULL:

- The solenoid valve opens. As a result, the pressure in the circuit starts to increase [PDA1].
- When the pressure exceeds the reference pressure "A", the solenoid value is closed and the *compressor* is switched on. After a minimum delay, the pressure starts to decrease [PDA2].
- When the pressure is again the same as (it falls below) the reference pressure "B", the solenoid valve opens again [FINISH_PDA].

In the example, the enabling and disabling thresholds of the minimum pressure switch correspond to the start-up and shutdown values of the solenoid valve controlled by the minimum pressure transducer.



Minimum pressure switch	CIR_PRES_MIN_DI_i_PHY, i=i-nth circuit.
Solenoid valve	CIR_SOLENOID_VALVE_DO_i_PHY, i=i-nth circuit.
Compressor	KOMP_ACC_DO_j_PHY, j=first *compressor* when the i-nth circuit is switched on.
Pumpdown timeout during switch-on	PD_OFFON_MAX_TIME.

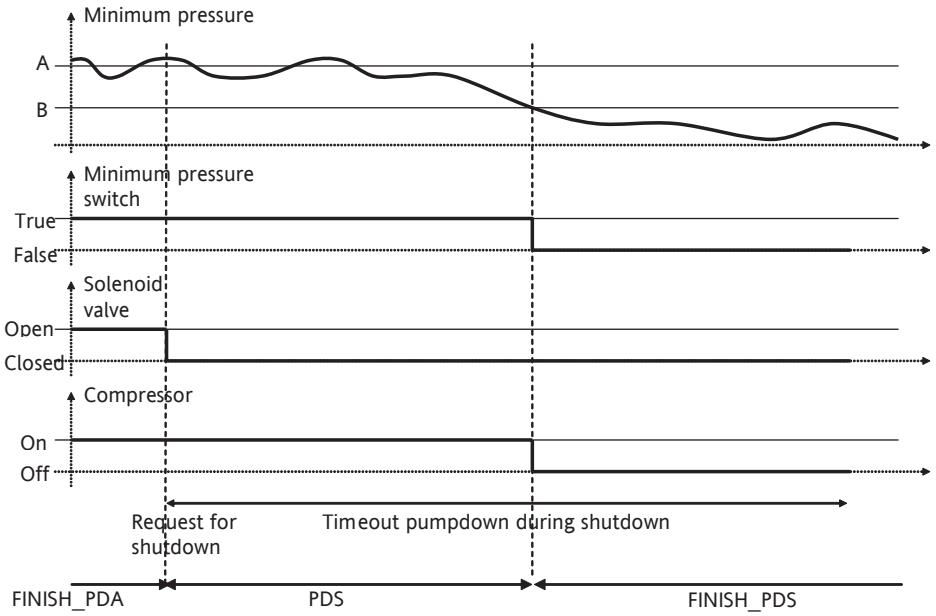
If in PDA1 o in PDA2 the circuit compressors are not available, the status goes directly to FINISH_PDS with the circuit compressors off and the solenoid valve closed.
If, on the other hand, in PDA1 o in PDA2 the pumpdown timeout during switch-on expires, the status goes directly to FINISH_PDA with the circuit compressors energized by the *temperature controll*er and the solenoid valve closed. In this case, only an alarm signal is given that does not block the machine. The alarm is reset as soon as a pumpdown sequence is executed correctly (start-up or shutdown). The alarm is in any case reset when exiting the configuration mode or when the system is switched on/off.

If an alarm that shuts down the system is present on the circuit in which the pumpdown is active, the pumpdown sequence is interrupted and the solenoid valve is closed unless a minimum pressure alarm is present (in this case, it is open).

3.2.2 Pump-down shutdown

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

- The solenoid valve closes. As a result, the pressure starts to decrease [PDS]
- When the circuit pressure falls below the reference value B the *compressor* is switched off [FINISH_PDS]



Minimum pressure switch	CIR_PRES_MIN_D_i_PHY, i=i-nth circuit.
Solenoid valve	CIR_SOLENOID_VALVE_DO_i_PHY, i=i-nth circuit.
Compressor	KOMP_ACC_DO_j_PHY, j=first *compressor* when the i-nth circuit is switched on.
Pumpdown timeout during switch-on start	PD_ONOFF_MAX_TIME.

If in PDS the circuit compressors are not available or the pumpdown timeout during shutdown expires, the status goes directly to FINISH_PDS with the circuit compressors off and the solenoid valve closed. If the pumpdown timeout during shutdown expires, only an alarm signal is given that does not block the machine. The alarm is reset as soon as a pumpdown sequence is executed correctly (start-up or shutdown). The alarm is in any case reset when exiting the configuration mode or when the system is switched on/off.

If an alarm that shuts down the system is present on the circuit in which the pumpdown is active, the pumpdown sequence is interrupted and the solenoid valve is closed unless a minimum pressure alarm is present (in this case, it is open).

3.2.3 Pump-down timeout

If the *pump-down during switch-on* procedure (phases PDA1 e PDA2) is not completed within the PD_OFFON_MAX_TIME period of time only a pumpdown timeout signal is given without blocking the circuit resources.
If the pump-down during shutdown procedure (phase PDS) is not completed within the PD_ONOFF_MAX_TIME period of time only a pumpdown timeout signal is given without blocking the circuit resources.
The alarm is reset as soon as a pumpdown sequence is executed correctly (start-up or shutdown). The alarm is in any case reset when exiting the configuration mode or when the system is switched on/off.

3.2.4 Control of solenoid valve

Solenoid valve	CIR_SOLENOID_VALVE_DO_i_PHY, i=i-nth circuit.

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

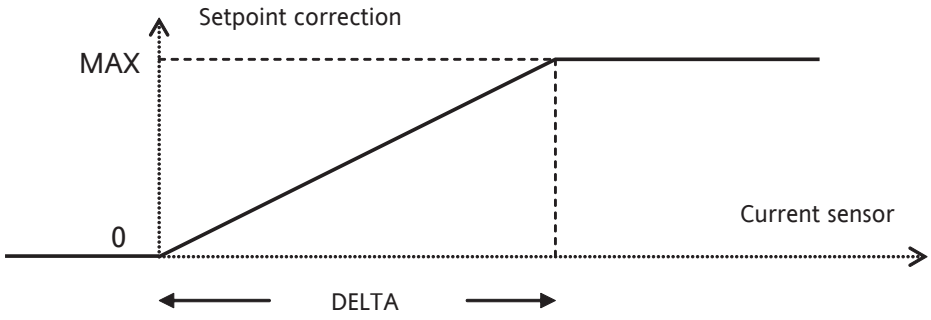
If it is enabled, on the other hand, the solenoid valve is only open in the PDA1 and FINISH_PDA phases for the circuits in which the pumpdown procedure is in course. In the presence of an alarm that blocks the circuit or unavailability of the compressors in the circuit, the solenoid valve is closed unless there is a minimum alarm in the circuit that keeps the valve open.

Note: The solenoid valve is open when the relative relay is de-energized and closed when it is energized.

Modbus address	Category and name of parameter	Description of parameter	Range	Default	trans	C/H	vis	Description of transcode	UM
0x490	PD_FUNCTION	Selection of type of pumpdown: not active (NO_PD), during start-up (ON_START) or during start-up and shutdown (FULL)	0...2	2	15	C	V	0=NO_PD, 1=ON_START, 2=FULL	Num
0x491	PD_OFFON_MAX_TIME	Maximum pumpdown time during start-up	0...1800	10	0	C	V		Sec
0x491	PD_ONOFF_MAX_TIME	Maximum pumpdown time during shutdown	0...1800	10	0	C	V		Sec

3.3 Dynamic set point

The *dynamic set point* function is used to modify the set point automatically according to a specific input signal on the controller.



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

The set point correction is added with sign to the current value of the *temperature control* set point.

If one of the following conditions occurs:

- Function disabled (DTSET_FUNCTION <> CURRENT_FUNCTION);
- Faulty current sensor;

The set point correction is always 0.

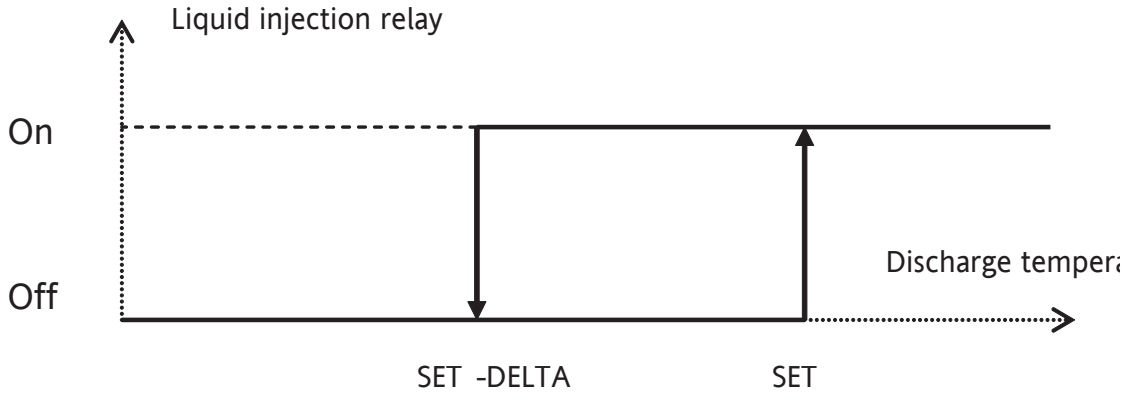
If none of the above conditions occurs, the set point correction is controlled by the function in Fig. 3.3.3.
If the parameter DTSET_CHILLER_MAX_OFFSET is set to a negative value, this causes the illustrated trend to rotate on its horizontal axis.

Note: The PLAN_CURR_DTSET_SENS_PHY current probe must be configured in BIOS with the 4mA value at 0.0 Bar and the 20mA value at 30.0 Bar. This is necessary so that the current probe works in ISaGRAF within the transformation range of 0-300

Modbus address	Category and name of parameter	Description of parameter	Range	Default	trans	C/H	vis	Description of transcode	UM
0x2A0	DTSET_FUNCTION	Enables *dynamic set point* function 0=disabled or none 1= temperature (not supported) 2=current	0..2	2	19	C	V	0=NO_PD, 1=ON_START, 2=FULL	Num
0x2A1	DTSET_CHILLER_MAX_OFFSET	Maximum offset value that *dynamic set point* can add to cool set point	-30.0...30.0	6.0	0	C	V		°C

3.4 Compressor liquid injection

This involves assigning and energizing a relay for each *compressor* that injects liquid.



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

If one of the following conditions occurs:

- Function disabled (LI_ENABLE_FLAG=false);
- Faulty discharge temperature;
- *Compressor* is in alarm mode
- System off;
- *Compressor* deselected;

The liquid injection relay is always Off.

If none of the above conditions occurs, the status of the liquid injection relay is controlled by the hysteresis function in Fig. 3.3.4.
In particular, the liquid injection relay is On if discharge temperature < SET, Off if discharge temperature <(SET-DELTA) and unchanged in other cases.

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

- when machine is switched on or off
- when exiting configuration mode;
- From reset;

Modbus address	Category and name of parameter	Description of parameter	Range	Default	trans	C/H	vis	Description of transcode	UM
0x310	LI_ENABLE_FLAG	Liquid injection function enable	0...1	1	6	C	V	0=NO 1=YES	Flag
0x311	LI_TSET_TEMP	Liquid injection function set point	0.0...150.0	115.0	0	C	V		°C
0x312	LI_DELTA_TEMP	Liquid injection function delta	0.0...10.0	10.0	0	C	V		°C

3.5 Condensation control

In this system the fans are mostly grouped together on 2 fan groups that *control* condensation on the different circuits. Each circuit has its own maximum pressure sensor and operating sequence whereas the fans are controlled by all the circuits that belong to the same fan group.

To define which circuits belong to a specific fan group, the parameters CIR_FANS_i, i =i-nth circuit must be set.
For example, for the default machine, the values of the set parameters are as 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 having a total of 2 fan groups – the first includes circuits 1 and 2 and the second, circuits 3 and 4.

IMPORTANT: The table must be completed from top to bottom with ascending values.

When the system is not off, the fan group fans are set to the maximum of the ventilation requests for each single circuit in the fan group (the maximum pressure maximum for each single circuit). If one of these probes is faulty, its value will not be considered in the calculation of the maximum value. If all the probes are faulty, the fans are always switched off unless the fan forcing time at maximum power is not still enabled.

When the system is off, the fans are always off.

A single fan thermal switch input is provided for each fan group irrespective of the number of fans per fan group.
Intervention of the fan group thermal switch always causes an immediate shutdown.

Control of the fans is digital (stepped ON/OFF *control*).

Fans can be enabled:

- regardless of the status of the compressors;
- if at least one circuit *compressor* belonging to the fan group is on;

This choice is made by setting the parameter FANS_KOMP_DEPENDENCY_FLAG

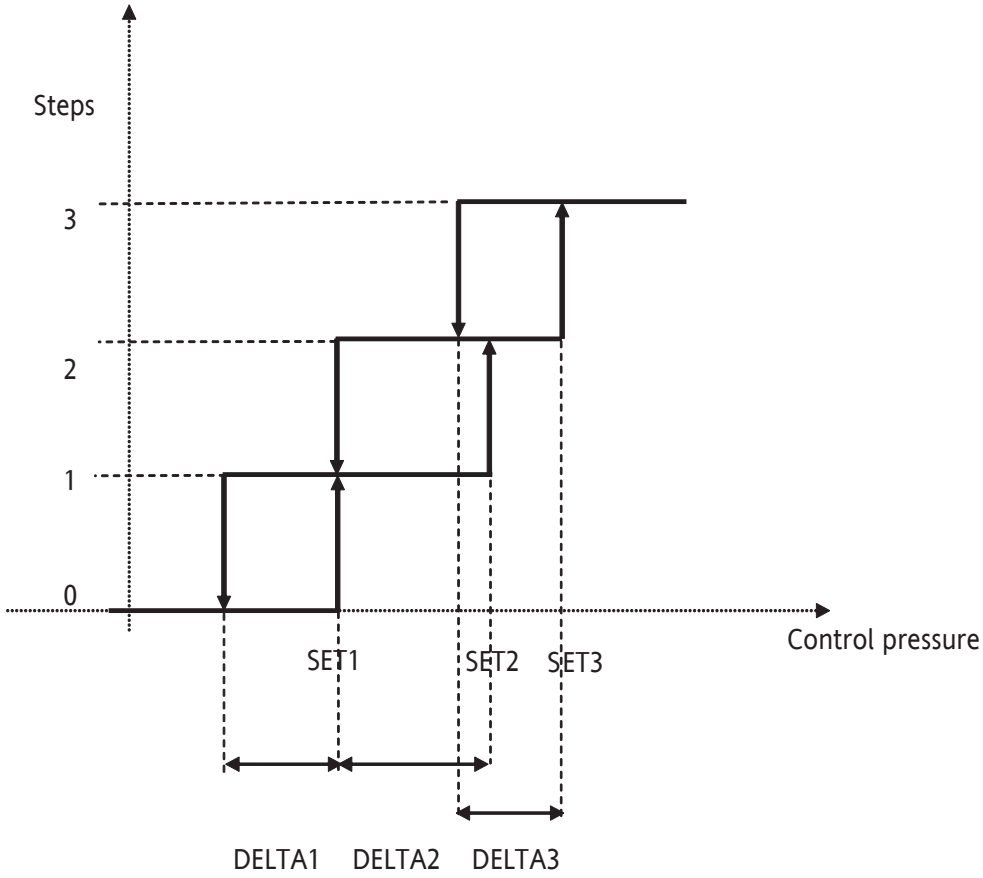
3.5.1 Stepped fan control:

Stepped *control* of the fans is used when there are several fans for each condenser.
The number of steps for each fan group is determined by parameters FANS_NO_1, FANS_NO_2 (a fan corresponds to each step). FANS_NO_i i=i-nth fan group is only received if the fan group it belongs to exists (see CIR_FANS_j, j=j-nth circuit).

You can establish how long the fan group must be forced at maximum power when the first fan in that unit is switched on with the parameter FANS_CH_INIT_MAX_POWER_TIME.

The n-th step is enabled when the *control* pressure reaches the set point set with parameter FANS_CSTART_SETn_PRES

The n-th step is disabled when the *control* pressure reaches the value specified in 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 = i-nth *compressor* of fan group
Steps	FANS_ACCj_DO_i_PHY, j= j-nth fan of n-th fan group i=i-nth fan group.

Fans with same/different power

If the fans of the same capacitor are all equal, they are enabled in a continuous mode (if three steps are required, three fans are active).

If the fan power is different (this option can be set using the FANS_ASIMMETRICAL_FLAG parameter), the fans are alternatively enabled (enabling fan 3, fan 2 is disabled).

Modbus address	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
0x208	CIR_FANS_1	Association of circuit 1 to fan group indicated	1...2	1	0	C	V		Num
0x209	CIR_FANS_2	Association of circuit 2 to fan group indicated	0...2	1	0	C	V		Num
0x20A	CIR_FANS_3	Association of circuit 3 to fan group indicated	0...2	2	0	C	V		Num
0x20B	CIR_FANS_4	Association of circuit 4 to fan group indicated	0...2	2	0	C	V		Num
0x20C	CIR_FANS_5	Association of circuit 5 to fan group indicated	0...2	0	0	C	V		Num
0x20D	CIR_FANS_6	Association of circuit 6 to fan group indicated	0...2	0	0	C	V		Num
0x20E	CIR_FANS_7	Association of circuit 7 to fan group indicated	0...2	0	0	C	V		Num
0x20F	CIR_FANS_8	Association of circuit 8 to fan group indicated	0...2	0	0	C	V		Num
0x219	FANS_ASYMMETRICAL_FLAG	Fans all the same (NO) or with increasing power (YES). Intervenes on the enabling/disabling sequence of the fan relays	0...1	0	6	C	V	0=NO, 1=YES	Flag
0x21A	FANS_NO_1	Number of fans in fan group 1	1...4	3	0	C	V		Num
0x21B	FANS_NO_2	Number of fans in fan group 2	1...4	3	0	C	V		Num
0x21C	FANS_NO_3	Number of fans in fan group 3	1...4	1	0	C	N		Num
0x21D	FANS_NO_4	Number of fans in fan group 4	1...4	1	0	C	N		Num
0x21E	FANS_NO_5	Number of fans in fan group 5	1...4	1	0	C	N		Num
0x21F	FANS_NO_6	Number of fans in fan group 6	1...4	1	0	C	N		Num
0x220	FANS_NO_7	Number of fans in fan group 7	1...4	1	0	C	N		Num
0x221	FANS_NO_8	Number of fans in fan group 8	1...4	1	0	C	N		Num
0x340	FANS_KOMP_DEPENDENCY_FLAG	If NO then the fan group fans work irrespective of the status of the compressors that belong to the circuits in which the units *control* condensation. If not, there must be at least one *compressor* on among those that belong to the circuits in which the units *control* condensation so that the unit fans can be controlled.	0...1	1	6	C	V	0=NO, 1=YES	Flag
0x341	FANS_CH_INIT_MAX_POWER_TIME	Length of time that the fan group fans go to 100% each time the group is switched on	0...120	60	0	C	V		Sec
0x360	FANS_CSTART_SET1_PRES	Fan 1 step start set point	0.0....30.0	13.0	0	C	V		Bar
0x361	FANS_CSTART_SET2_PRES	Fan 2 step start set point	0.0...30.0	15.0	0	C	V		Bar
0x362	FANS_CSTART_SET3_PRES	Fan 3 step start set point	0.0...30.0	17.0	0	C	V		Bar
0x363	FANS_CSTART_SET4_PRES	Fan 4 step start set point	0.0...30.0	19.0	0	C	V		Bar
0x364	FANS_CSTART_SET5_PRES	Fan 5 step start set point	0.0...30.0	0.0	0	C	V		Bar
0x365	FANS_CSTART_SET6_PRES	Fan 6 step start set point	0.0...30.0	0.0	0	C	V		Bar
0x366	FANS_CSTART_SET7_PRES	Fan 7 step start set point	0.0...30.0	0.0	0	C	V		Bar
0x367	FANS_CSTART_SET8_PRES	Fan 8 step start set point	0.0...30.0	0.0	0	C	V		Bar
0x368	FANS_CSTOP_DELTA1_PRES	Fan 1 step stop delta	0.0...10.0	2.0	0	C	V		Bar
0x369	FANS_CSTOP_DELTA2_PRES	Fan 2 step stop delta	0.0...10.0	2.0	0	C	V		Bar
0x36A	FANS_CSTOP_DELTA3_PRES	Fan 3 step stop delta	0.0...10.0	2.0	0	C	V		Bar

Modbus address	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
0x36B	FANS_CSTOP_DELTA4_PRES	Fan 4 step stop delta	0.0...10.0	2.0	0	C	V		Bar
0x36C	FANS_CSTOP_DELTA5_PRES	Fan 5 step stop delta	0.0...10.0	0.0	0	C	V		Bar
0x36D	FANS_CSTOP_DELTA6_PRES	Fan 6 step stop delta	0.0...10.0	0.0	0	C	V		Bar
0x36E	FANS_CSTOP_DELTA7_PRES	Fan 7 step stop delta	0.0...10.0	0.0	0	C	V		Bar
0x36F	FANS_CSTOP_DELTA8_PRES	Fan 8 step stop delta	0.0...10.0	0.0	0	C	V		Bar

3.6 Control of hydraulic pumps

The system individually checks the pumps in the pump group to allow circulation of the intermediate fluid (the controller switches on/off the individual pumps).
The number of pumps controlled is equal to parameter PUMPS_NO, in this case set to 2.

3.6.1 Pump usage hours

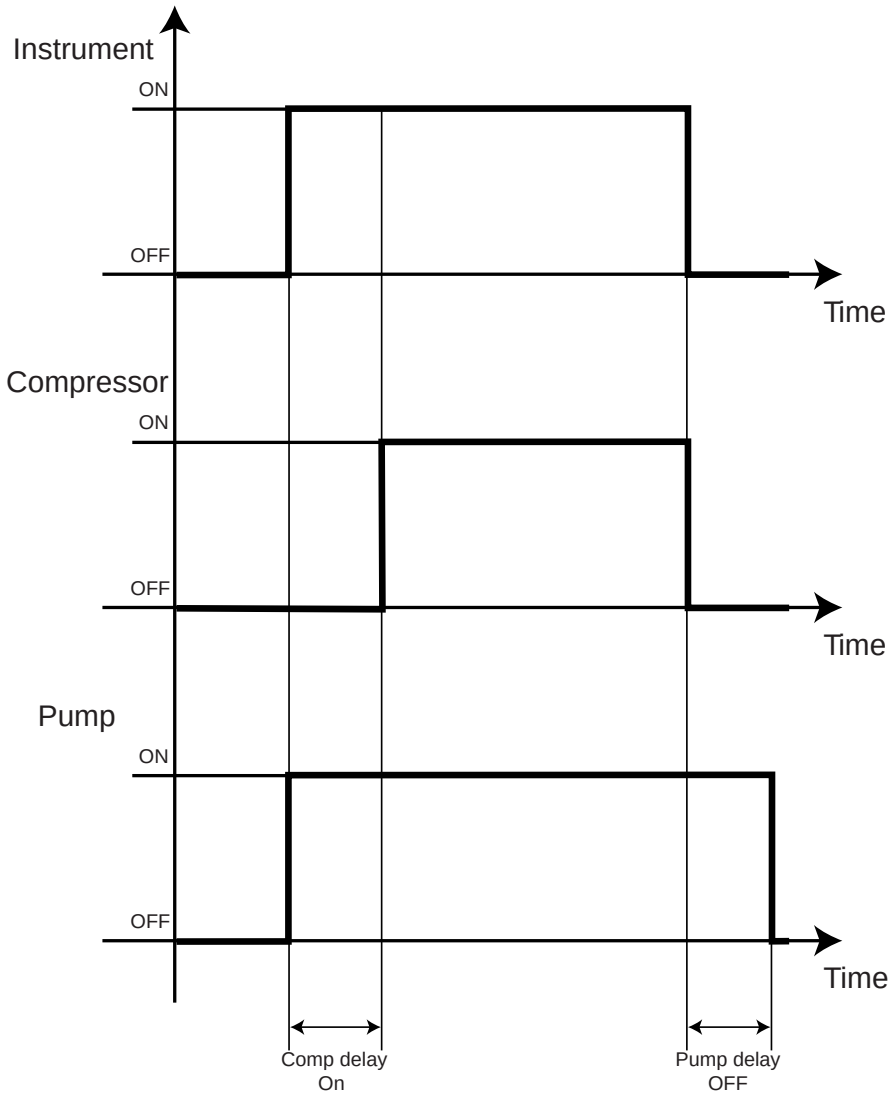
The operating time of the pumps is stored in the EEPROM every hour on two parameters:

- PUMP_USAGE_DAYS_i, : i-nth pump usage days
- PUMP_USAGE_HOUR_i, : i-nth *pump usage hours*

3.6.2 Continuous operation

For *continuous operation* the pump group is always active.

- The pump is switched on when the instrument starts up
- The *compressor* is activated with a delay (PUMPGROUP_STARTUP_DELAY_TIME) after the pump starts up
- The *compressor* is turned off with a delay (PUMPGROUP_STOP_DELAY_TIME) after the last *compressor* is turned off



STRUM.	Status of the instrument
COMP.	Status of the *compressor*
PUMP	Status of pump
Comp. delay ON	PUMPGROUP_STARTUP_DELAY_TIME
Pump delay OFF	PUMPGROUP_STOP_DELAY_TIME

NOTE: The pump group can also be enabled when the instrument is off if there is an enable request from the antifreeze heaters. (See par. Antifreeze

3.6.2.1 Time swap

While a pump is operating, the rotation time counting is activated (defined by the parameter PUMPS_ALTERNATION_TIME) and when this expires, the enabled pump is switched off and the second pump in the circuit is enabled.
If the second pump is not available when the rotation time expires, the pump that is currently selected will remain active until the second pump is available.

Modbus address [hex]	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
222	PUMPS_NO	Number of pumps in system	1...2	2	0	C	V		Num
463	PUMPS_ALTERNATION_TIME	Association of circuit 2 to fan group indicated	1...1000	72	0	C	V		Hours
464	PUMPGROUP_STARTUP_DELAY_TIME	Time that must elapse between the system ON (that causes the selected pump to be enabled) and the start of *temperature control*	0...2000	60	0	C	V		Sec
465	PUMPGROUP_STOP_DELAY_TIME	Time the enabled pump must stay on after the system shutdown has been requested and the last *compressor* has been switched 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 Choice of cooling resources

3.7.1 Availability

For each level of system components (EVAPORATOR, CIRCUIT, *COMPRESSOR*) the minimum *availability* (as sum total of the minimum availabilities) and maximum *availability* (as sum total of the maximum availabilities) of the subsystems is calculated from the compressors towards the evaporators.
If a subsystem is in alarm mode, its minimum and maximum *availability* is always reset.
If a subsystem is counting the safety times, its minimum and maximum *availability* is blocked and assumes the same value as the power supplied at that moment.

example
Let's assume that the circuit has 2 compressors with 3 *capacity steps* (i.e. levels 0,1,2,3,4) and that the minimum/maximum *availability* and reachability level of a component is indicated in square brackets :

- a circuit in alarm mode has *availability* [0,0] and reachability range [0,0].
- a powered off circuit with compressors that cannot be powered on because of safety times, has *availability* [0,0] and reachability [0, 8]
- a circuit with a *compressor* powered on at level 2 and blocked on that level and the other powered off, has *availability* [2,2] and reachability [0,4].

3.7.2 Control

For each level of system component (EVAPORATOR, CIRCUIT, *COMPRESSOR*), the selection policy that the *temperature control* will follow when distributing cooling resources can be established by the parameter (EV_SELECTION_FUNCTION, CIR_SELECTION_FUNCTION, KOMP_SELECTION_FUNCTION). The available modes are saturation and balancing.

The selection policy is mainly based on the operating hours of the compressors.
For operating hours of components with a higher hierarchical level than the *compressor* (CIRCUIT, EVAPORATOR), the total operating hours of the compressors that form part of the component must be taken into account.

To date, the minimum cooling power unit managed by the *temperature control*, for hermetic and semi-hermetic compressors, generically referred to as "step", corresponds to a capacity step of the *compressor* if it is part-loading or to the *compressor* itself if it is one-step.

Selection policies are cascade enabled depending on the components of the system. As soon as the *temperature control* issues a request to enable/disable a step, this request is transmitted to the best EVAPORATOR (depending on the evaporator selection policy specified in EV_SELECTION_FUNCTION), then to the best EVAPORATOR CIRCUIT (depending on the circuit selection policy specified in CIRCUIT_SELECTION_FUNCTION) and finally to the best CIRCUIT *COMPRESSOR* (depending on the *compressor* selection policy specified in KOMP_SELECTION_FUNCTION).

3.7.3 Balancing characteristics

Balancing follows the rules described below, regardless of the components to which it is applied.

1. staticity: assigned cooling resources are not changed if they meet the current request;

2. increase/decrease requests that involve more than one step are managed, within the same *control* cycle, as increase/decrease sequences by one step as described in points 3) and 4);.

3. every time a one step increase request is received, the system searches for all the components that can be increased and selects the one that is closest to the minimum *availability* value. If the distance is equal, the system selects the component with the lowest number of usage hours.

4. every time a one step decrease request is received, the system searches for the components that can be decreased and selects the one that is furthest away from the minimum *availability* value. If the distance is equal, the system selects the component with the highest number of usage hours.

5. resources are allocated in accordance with the levels of *availability* of the controlled components.

3.7.4 Compressor

A *saturated compressor* is a *compressor* that is supplying its maximum power (maximum number of steps that can be supplied). If the *compressor* is configured with *capacity steps*, the *compressor* power on level can be viewed as the number of steps that the *compressor* is supplying (a *compressor* with 3 *capacity steps*, for example, will supply a maximum of 4 power on levels/steps).
The requirements for the enabling of steps (increase/decrease) at *compressor* level that are part of the same circuit are described below.

Modbus address	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
0x240	EV_SELECTION_FUNCTION	Selection of selection policy for cooling power resources at evaporator level	0...1	1	28	C	V	0=SATURATION, 1=BALANCING	Flag
0x241	CIR_SELECTION_FUNCTION	Selection of selection policy for cooling power resources at circuit level	0...1	1	29	C	V	0=SATURATION, 1=BALANCING	Flag
0x242	KOMP_SELECTION_FUNCTION	Selection of selection policy for cooling power resources at *compressor* level	0...1	0	30	C	V	0=SATURATION, 1=BALANCING	Flag

3.8 Compressor control

3.8.1 Configuration of compressors

The compressors are defined with parameters KOMP_CIRC_EV_i and the i-nth *compressor* association

- with the circuit that corresponds to the units of the value of the parameter KOMP_CIRC_EV_i;
- to the evaporator that corresponds to the tens of the value of the parameter KOMP_CIRC_EV_i;

For example, for the default machine, the values of the set parameters are as 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 corresponds to having a total of 4 compressors. 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: The table must be completed from top to bottom with ascending values.

3.8.2 Compressor timing

The start-up and shutdown of a *compressor* must meet the following requirements:

- Minimum shutdown-start-up time (MIN_OFFON_TIME parameter). This is the minimum time that must elapse between the shutdown and subsequent start-up.
- Minimum start-up-shutdown time (MIN_ONOFF_TIME parameter). This is the minimum time that must elapse between the start-up and subsequent shutdown.

The start-up and shutdown of the *capacity steps* of a *compressor* must meet the following requirements:

- Capacity step safety time with power decrease (parameter CPWR_UPDOWN_MIN_TIME). This is the minimum time that must elapse between the shutdowns of the *capacity steps* of the same *compressor*.
- Capacity step safety time with power increase (parameter CPWR_DOWNUP_MIN_TIME). This is the minimum time that must elapse between the start-ups of the *capacity steps* of the same *compressor*.

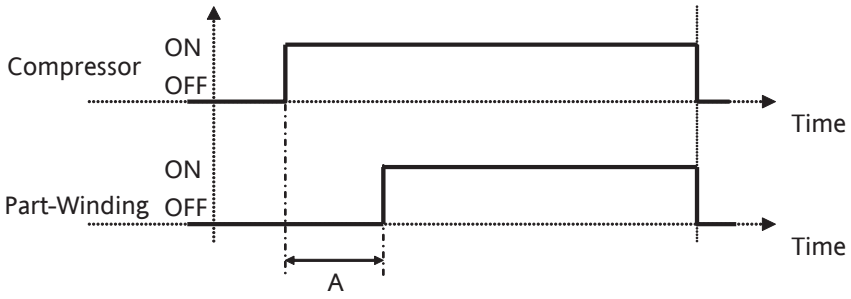
3.8.3 Compressor usage hours

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

- KOMP_USAGE_DAYS_i, i-nth *compressor* usage days
- KOMP_USAGE_HOUR_i, i-nth *compressor usage hours*

3.8.4 Part Winding Start-up

A relay used to limit the current peak when the *compressor* is started up whose operating is described in Fig.3.7.4 is associated to each *compressor*.



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

3.8.5 Capacity steps

The configuration of a system with power modulated compressors is defined with the parameters KOMP_STAGE_i, i=i-nth *compressor* If KOMP_STAGE_i =0 the system does not *control* compressors with *capacity steps*. Alternatively, KOMP_STAGE_i must be set to the number of *capacity steps* of each i-nth *compressor*.
The parameter KOMP_TYPE defines the capacity step action mode

Parameter	Explanation
KOMP_STAGE_i	Selection of the number of *capacity steps* of the i-nth *compressor*
KOMP_TYPE	Capacity step action mode: SEMI-HERMETIC SCREW

KOMP_STAGE_i=0

There are no *capacity steps* and the *compressor* can supply 0% to 100% of its power

KOMP_STAGE_i=1 (2 *temperature control* steps)

There is 1 capacity step and the *compressor* can supply 0%, 50% or 100% of its power.

Power	ACC	Semi-hermetic			Screw		
		PARZ 1	PARZ 2	PARZ 3	PARZ 1	PARZ 2	PARZ 3
100%	ON						
50%	ON	ON			ON		
0%							

KOMP_STAGE_i=2 (3 *temperature control* steps)

There are 2 *capacity steps* and the *compressor* can supply 0%, 33%, 66% or 100% of its power.

Power	ACC	Semi-hermetic			Screw		
		PARZ 1	PARZ 2	PARZ 3	PARZ 1	PARZ 2	PARZ 3
100%	ON						
66%	ON		ON			ON	
33%	ON	ON	ON		ON		
0%							

KOMP_STAGE_i=3 (4 *temperature control* steps)

There are 3 *capacity steps* and the *compressor* can supply 0%, 25%, 50%, 75%or 100% of its power.

Power	ACC	Semi-hermetic			Screw		
		PARZ 1	PARZ 2	PARZ 3	PARZ 1	PARZ 2	PARZ 3
100%	ON						
75%	ON			ON			ON
50%	ON		ON	ON		ON	

25%	ON	ON	ON	ON	ON		
0%							

ACC	KOMP_ACC_DO_i_PHY, i=i-nth *compressor*
PARZ1	KOMP_PARZ1_DO_i_PHY, i=i-nth *compressor*
PARZ2	KOMP_PARZ2_DO_i_PHY, i=i-nth *compressor*
PARZ3	KOMP_PARZ3_DO_i_PHY, i=i-nth *compressor*

3.8.6 Selection of compressors

The compressors can be individually deselected with parameters KOMP_SELEZ_i_HOT with i=i-nth *compressor*. Deselection leads to:

- resetting of *compressor availability*
- resetting of all alarms, if present.
- Its alarms are not managed

3.8.7 Maximum number of start-ups in an hour

The parameter MAX_STARTS_PER_HOUR_NO defines the maximum number of start-ups that a *compressor* may have in an hour. When the number of start-ups in the last hour reaches this value, the *compressor availability* is reset.
Start-ups are stored with a time resolution of 3600/32 seconds.
The *compressor* will become available again only after the number of start-ups memorized in the last hour becomes lower than MAX_STARTS_PER_HOUR_NO. This will occur when the oldest start-up took place more than an hour before. The number of start-ups is always reset:
by going from cool mode to off (using keyboard or remote ON/OFF);
at next power on
when exiting the configuration mode;

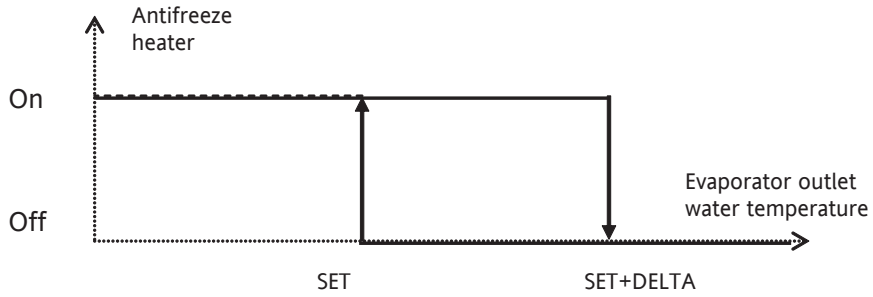
Modbus address	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
0x200	KOMP_CIR_EV_1	Association of *compressor* 1 with UNITS circuit of TENS evaporator	11...24	11	0	C	V		Num
0x201	KOMP_CIR_EV_2	Association of *compressor* 2 with UNITS circuit of TENS evaporator	0...24	12	0	C	V		Num
0x202	KOMP_CIR_EV_3	Association of *compressor* 3 with UNITS circuit of TENS evaporator	0...24	21	0	C	V		Num
0x203	KOMP_CIR_EV_4	Association of *compressor* 4 with UNITS circuit of TENS evaporator	0...24	22	0	C	V		Num
0x204	KOMP_CIR_EV_5	Association of *compressor* 5 with UNITS circuit of TENS evaporator	0...24	0	0	C	V		Num
0x205	KOMP_CIR_EV_6	Association of *compressor* 6 with UNITS circuit of TENS evaporator	0...24	0	0	C	V		Num
0x206	KOMP_CIR_EV_7	Association of *compressor* 7 with UNITS circuit of TENS evaporator	0...24	0	0	C	V		Num
0x207	KOMP_CIR_EV_8	Association of *compressor* 8 with UNITS circuit of TENS evaporator	0...24	0	0	C	V		Num
0x210	KOMP_STAGE_1	Number of *capacity steps* for *compressor* 1	0...3	2	0	C	V		Num
0x211	KOMP_STAGE_2	Number of *capacity steps* for *compressor* 2	0...3	2	0	C	V		Num
0x212	KOMP_STAGE_3	Number of *capacity steps* for *compressor* 3	0...3	2	0	C	V		Num
0x213	KOMP_STAGE_4	Number of *capacity steps* for *compressor* 4	0...3	2	0	C	V		Num
0x214	KOMP_STAGE_5	Number of *capacity steps* for *compressor* 5	0...3	2	0	C	V		Num
0x215	KOMP_STAGE_6	Number of *capacity steps* for *compressor* 6	0...3	2	0	C	V		Num
0x216	KOMP_STAGE_7	Number of *capacity steps* for *compressor* 7	0...3	2	0	C	V		Num
0x217	KOMP_STAGE_8	Number of *capacity steps* for *compressor* 8	0...3	2	0	C	V		Num
0x218	KOMP_TYPE	Type of *compressor*. Intervenes on the method of implementing the enabling/disabling sequence of the relays associated with *compressor capacity steps*	0...1	0	12	C	V	0=SEMI-HERMETIC, 1=SCREW	Num
0x2F0	MIN_OFFON_TIME	*Compressor* safety time from OFF to ON	0...500	60	0	H	V		Sec
0x2F1	MIN_ONOFF_TIME	*Compressor* safety time from ON to OFF	0...500	10	0	H	V		Sec
0x2F2	MAX_STARTS_PER_HOUR_NO	Maximum number of *compressor* start-ups in the hour	0...20	6	0	H	V		Num
0x2F3	CPWR_UPDOWN_MIN_TIME	Capacity step safety time with power decrease	0...300	10	0	H	V		Sec
0x2F4	CPWR_DOWNUP_MIN_TIME	Capacity step safety time with power increase	0...300	10	0	H	V		Sec
0x320	KOMP_SELEZ_1_HOT	Select *compressor* 1	0...1	1	6	H	V	0=NO, 1=YES	Flag
0x321	KOMP_SELEZ_2_HOT	Select *compressor* 2	0...1	1	6	H	V	0=NO, 1=YES	Flag
0x322	KOMP_SELEZ_3_HOT	Select *compressor* 3	0...1	1	6	H	V	0=NO, 1=YES	Flag
0x323	KOMP_SELEZ_4_HOT	Select *compressor* 4	0...1	1	6	H	V	0=NO, 1=YES	Flag
0x324	KOMP_SELEZ_5_HOT	Select *compressor* 5	0...1	1	6	H	V	0=NO, 1=YES	Flag
0x325	KOMP_SELEZ_5_HOT	Select *compressor* 6	0...1	1	6	H	V	0=NO, 1=YES	Flag
0x326	KOMP_SELEZ_7_HOT	Select *compressor* 7	0...1	1	6	H	V	0=NO, 1=YES	Flag
0x327	KOMP_SELEZ_8_HOT	Select *compressor* 8	0...1	1	6	H	V	0=NO, 1=YES	Flag
0x330	KOMP_USAGE_DAYS_1	Days of use of *compressor* 1	0...32000	0	0	C	V		day
0x331	KOMP_USAGE_DAYS_2	Days of use of *compressor* 2	0...32000	0	0	C	V		day
0x332	KOMP_USAGE_DAYS_3	Days of use of *compressor* 3	0...32000	0	0	C	V		day
0x333	KOMP_USAGE_DAYS_4	Days of use of *compressor* 4	0...32000	0	0	C	V		day

Modbus address	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
0x334	KOMP_USAGE_DAYS_5	Days of use of *compressor* 5	0...32000	0	0	C	V		day
0x335	KOMP_USAGE_DAYS_6	Days of use of *compressor* 6	0...32000	0	0	C	V		day
0x336	KOMP_USAGE_DAYS_7	Days of use of *compressor* 7	0...32000	0	0	C	V		day
0x337	KOMP_USAGE_DAYS_8	Days of use of *compressor* 8	0...32000	0	0	C	V		day
0x338	KOMP_USAGE_HOUR_1	Hours of use of *compressor* 1	0...24	0	0	C	V		hour
0x339	KOMP_USAGE_HOUR_2	Hours of use of *compressor* 2	0...24	0	0	C	V		hour
0x33A	KOMP_USAGE_HOUR_3	Hours of use of *compressor* 3	0...24	0	0	C	V		hour
0x33B	KOMP_USAGE_HOUR_4	Hours of use of *compressor* 4	0...24	0	0	C	V		hour
0x33C	KOMP_USAGE_HOUR_5	Hours of use of *compressor* 5	0...24	0	0	C	V		hour
0x33D	KOMP_USAGE_HOUR_6	Hours of use of *compressor* 6	0...24	0	0	C	V		hour
0x33E	KOMP_USAGE_HOUR_7	Hours of use of *compressor* 7	0...24	0	0	C	V		hour
0x33F	KOMP_USAGE_HOUR_8	Hours of use of *compressor* 8	0...24	0	0	C	V		hour

3.9 Anti-freeze

3.9.1 Antifreeze function

If the parameter AFPR_COOLING_ENABLED_FLAG=yes and the machine is on in cooling or shutdown mode, the controller enables an algorithm for the prevention of antifreeze alarms by monitoring the output temperature of each evaporator. This algorithm activates the antifreeze heaters according to the hysteresis function with set point AFPR_CHILLING_TSET and delta AFPR_DELTA_TEMP as indicated in the figure.
The function can also be enabled when the machine is off using the parameter AFPR_OFF_STDBY_ENABLE_FLAG.



SET	AFPR_CHILLING_TSET
DELTA	AFPR_DELTA_TEMP
Evaporator outlet water temperature	EV_TEMP_OUTWATER_SENS_i_PHY, i = i-nth evaporator
Antifreeze heater	EV_HEATER_DO_i_PHY, i = i-nth evaporator

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

If at least one evaporator requires its antifreeze heater to be switched on, all the antifreeze heaters for all the evaporators are switched on.
The antifreeze heaters are always off if the configuration mode is enabled or if the evaporator outlet water probe is faulty or an antifreeze alarm is present with the parameter AF_USE_RESISTOR_FLAG set to NO.
The hysteresis function is always restarted at power on when the status of the system goes from off to cool and when exiting configuration mode.

An error in this probe blocks the system (pump group and antifreeze heaters included).

Note: Switching on the heaters activates the request for activation of one of the pumps in the pump group so that water can circulate in the primary circuit.

Modbus address	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
0x2B0	AF_ENABLE_FLAG	Enable *antifreeze function*	0...1	1	6	C	V	0=NO, 1=YES	Flag
0x2B1	AF_USE_RESISTOR_FLAG	Enable use of electric heaters if antifreeze alarm is generated	0...1	1	6	C	V	0=NO, 1=YES	Flag
0x2C0	AFPR_COOLING_ENABLED_FLAG	Enable antifreeze prevention function if system is on or shutdown (in cool or shutdown mode)	0...1	1	6	C	V	0=NO, 1=YES	Flag
0x2C1	AFPR_OFF_STDBY_ENABLE_FLAG	Enable antifreeze prevention function if system is off (off mode)	0...1	1	6	C	V	0=NO, 1=YES	Flag
0x2C2	AFPR_CHILLING_TSET	Antifreeze prevention set point	-50.0...150.0	5.0	0	C	V		°C
0x2C3	AFPR_DELTA_TEMP	Antifreeze prevention delta	-50.0...150.0	2.0	0	C	V		°C

3.10 Operating mode control

The machine operating modes can be

- OFF
- COOLING
- SHUT DOWN

They can be selected by the user from the keyboard (PUSH: ON/OFF) or from the dedicated digital input PLAN_ONOFF_DI_PHY. The operating mode of the system selected from the keyboard is memorized in EEPROM so that it can be reset at the next power on (after a power failure) or when the status of PLAN_ONOFF_DI_PHY goes from true->false.

The digital input always has priority when PLAN_ONOFF_DI_PHY=true and causes the machine to be switched off if it is on in cool mode or keeps it off.

If PLAN_ONOFF_DI_PHY=false switching on/off the system is controlled from the keyboard with the ON/OFF toggle button. Note that the shutdown phase cannot be interrupted with an ON/OFF request from the keyboard and the request will be ignored.

A table that indicates some special conditions of mode change *control* operating is included below.

	Active mode	Mode in EEPROM	Timer 1	Timer 2	Remote ON/OFF	
A	Cooling	Cooling	Not active	Not active	False->True	the system goes into shutdown mode
B	Cooling	Cooling	Active	Not active	False->True (*)	the system goes into shutdown mode and Timer 2 is restarted
C	Shutdown	Cooling	Not active	Not active	True->False	the system immediately goes into cool mode (the *temperature controll*er resumes *control* of the resources)
D	Shutdown	Cooling	Not active	Active	True->False	the system goes into cool mode and Timer 2 is restarted (the compressors stay off until Timer 1 expires and are then controlled by the *temperature controll*er).

Timer 1	PUMPGROUR_STARTUP_DELAY_TIME
Timer 2	PUMPGROUR_STOP_DELAY_TIME
Remote ON/OFF	PLAN_ONOFF_DI_PHY

(*)or the ON/OFF button is pressed

Note If there is a power failure during shutdown of the machine, the machine restarts in off mode at the next power on.

4 DIAGNOSTICS

4.1 Temperature control alarms

4.1.1 High temperature alarm

If the temperature value measured by the primary circuit water inlet probe (PLAN_TEMP_INWATER_SENS) is slightly higher than the temperature set by the parameter A_HIGHT_THRESHOLD_TEMP for at least the A_HIGHT_BYPASS_TIME period of time, then a *high temperature alarm* is generated. This is an alarm that shuts down the system. It is a alarm that is reset manually.

If one of the following conditions occurs:

- Function disabled (A_HIGHT_ENABLE_FLAG=false);
- faulty water inlet probe on the primary circuit;
- System off;

the alarm is always off.

The alarm is reset:

- Manually if it is resettable
- when machine is switched on or off
- when exiting configuration mode;
- From reset;

4.1.2 Water inlet probe error

If *temperature control* on the water inlet temperature sensor is enabled (TREG_TEMP_SENS = ENTRY_SENS) or if the *control* of the *high temperature alarm* is enabled (A_HIGHT_ENABLE_FLAG), the error condition for this sensor blocks the system. In other cases *control* of the inlet water probe error is not enabled.

4.1.3 Water outlet probe error

If *temperature control* occurs on the water outlet temperature sensor (TREG_TEMP_SENS = EXIT_SENS), the error condition for this sensor blocks the system. If *temperature control* on the water inlet temperature sensor is enabled, *control* of the outlet water probe error is not enabled.

4.1.4 Current probe for dynamic set point error

If the *dynamic set point control* is enabled (DTSET_FUNCTION = DTSET_CURR), the error condition for this sensor does not block the system. If the *dynamic set point* is not enabled, *control* of the outlet water probe error is not enabled.

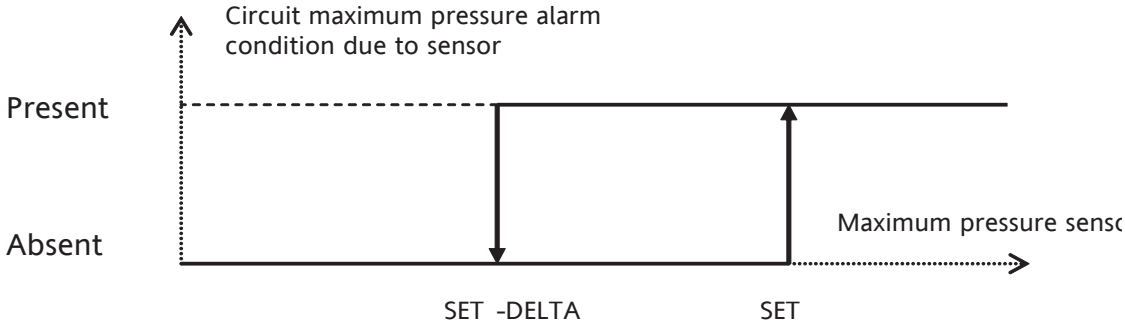
4.1.5 Parameters involved

Modbus address	Category and name of parameter	Range	def	vis	trans	UM	C/H	Description of transcode	Description of parameter
0x243	A_HIGHT_ENABLE_FLAG	0...1	1	V	6	Flag	C	0=NO, 1=YES	Enables system *high temperature alarm* (alarm monitors temperature of water entering primary circuit)
0x244	A_HIGHT_THRESHOLD_TEMP	-15.0...50.0	18.0	V	0	°C	H		System *high temperature alarm* set point
0x261	TREG_TEMP_SENS	0...1	0	V	18	Num	C	0=ENTRY_SENSOR, 1=EXIT_SENSOR	Selects sensor for *temperature control*
0x2A0	DTSET_FUNCTION	0...2	2	V	19	Num	C	0=NONE, 1=TEMP_FUNCTION, 2=CURRENT_FUNCTION	Enables *dynamic set point* function 0=disabled or none 1= temperature (not supported) 2=current

4.2 Circuit control alarms

4.2.1 Circuit maximum pressure probe alarm and error

The circuit maximum pressure alarm monitors the maximum pressure digital input CIR_PRES_MAX_DI_i_PHY and maximum pressure sensor CIR_PRES_MAX_SENS_i_PHY, i=i-nth circuit.



SET	A_MAX_PRES
DELTA	A_MAX_DELTA_PRES
Maximum pressure	CIR_PRES_MAX_SENS_i_PHY, i = i-nth circuit

When the system is off, the alarm is always off.
When the system is on in cool or shutdown mode, the alarm is controlled by the hysteresis function in Fig 3.2.1 in OR with the status of the digital input CIR_PRES_MAX_DI_i_PHY .
For hysteresis in particular, the alarm condition is present if sensor >=SET, absent if sensor <(SET-DELTA) and unchanged in other cases.

The resulting alarm condition is used to generate a manually reset alarm blocking the relevant circuit.

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

- when machine is switched on or off
- when exiting configuration mode;
- From reset;
- Faulty maximum pressure sensor;

If the maximum pressure sensor for the circuit being tested is faulty, that circuit is blocked. If the maximum pressure switch does not intervene, only a probe error is displayed. Otherwise, the maximum pressure alarm is also displayed. In this situation, if the pressure switch resets, the maximum pressure alarm is automatically reset. In any case, the circuit is blocked due to a probe error.

4.2.2 Circuit minimum pressure alarm

Control of the minimum pressure alarm condition is always enabled if:

- Cool or shutdown mode is enabled (machine on);
- pumpdown is not enabled;
- pumpdown is enabled and the phases FINISH_PDA or FINISH_PDS are activated with the solenoid valve open;

This algorithm activates the minimum pressure alarm by monitoring the minimum pressure digital input CIR_PRES_MIN_DI_i_PHY, i=i-nth circuit.

The alarm is bypassed for the A_MIN_PRES_BYPASS_TIME period of time that is loaded each time the power applied to the circuit that is not due to the alarm itself is changed.

The alarm is reset automatically. If the number of alarms in an hour exceeds the value of the parameter MAX_MINP_ALARMS_NO, the alarm becomes manually resettable. Start-ups are stored with a time resolution of 3600/32 seconds.

The circuit is switched off as soon as an alarm is activated.

Alarm management is always restarted and the alarm reset when:

- the alarm is manually reset
- when the status of the system goes from off to cool
- when exiting the configuration mode.
- at power on

4.2.3 Parameters involved

Modbus address	Category and name of parameter	Range	def	vis	trans	UM	C/H	Description of transcode	Description of parameter
0x2E0	A_MAX_PRES	0.0...50.0	28.0	V	0	Bar	C		Circuit maximum pressure alarm set point

0x2E1	A_MAX_DELTA_PRES	0.0...10.0	2.0	V	0	Bar	C		Circuit maximum pressure alarm delta
0x2E2	MAX_MINP_ALARMS_NO	0...20	3	V	0	Num	H		Maximum number of minimum pressure alarms per hour before the alarm goes from automatic to manual
0x2E3	A_MIN_PRES_BYPASS_TIME	0...500	120	V	0	Sec	H		Minimum pressure alarm bypass time

4.3 Fan thermal switch alarm

A single fan thermal switch input is provided for each fan group irrespective of the number of fans per fan group. Intervention of the fan group thermal switch protection always causes immediate blocking of the fan group and all the compressors that belong to the fan group circuits. It is a alarm that is reset manually.

4.4 Water pump control alarms

4.4.1 Flow switch alarm

Control of this alarm is enabled if the machine is on in cool or shutdown mode or if the electric heaters are on (antifreeze or antifreeze prevention).

The controller does not respond immediately to some *flow switch alarm*s. The *flow switch alarm*, for example, must be present for a specific length of time before it becomes “effective” and can be processed and managed by the controller. In the following paragraphs, alarms are divided into "*flow switch alarm*s" (that occur when the flow switch sends an alarm signal to the controller, but the latter has not yet reached the status "alarm from flow switch") and "logical alarms" (the controller has reached a status that allows it to *control* the alarms generated by the flow switch).

A_FS_BYPASS_STARTUP_TIME defines the interval of time, when the pumps are started up, during which activation of the *flow switch alarm* is ignored.

The **A_FS_ENTRY_TIME** parameter defines the interval of time (once the **A_FS_BYPASS_STARTUP_TIME** period of time has elapsed), during normal operating of the pumps, during which activation and the continuation of a *flow switch alarm* is ignored. The alarm becomes active and automatic if it persists after this interval of time has expired.

The **A_FS_EXIT_TIME** parameter defines, after activation of a logical *flow switch alarm*, the period of time during which the *flow switch alarm* must not persist before the logical alarm condition is considered to be reset.

A_FS_AUTOMATIC2MANUAL_TIME defines how long a logical alarm must last before its *control* switches from automatic to manual.

4.4.2 Thermal pump switch alarm

Control of this alarm is enabled if the machine is on in cool or shutdown mode or if the electric heaters are on (antifreeze or antifreeze prevention).
The pump thermal switch alarm is a manually reset alarm that blocks the pump currently in use.

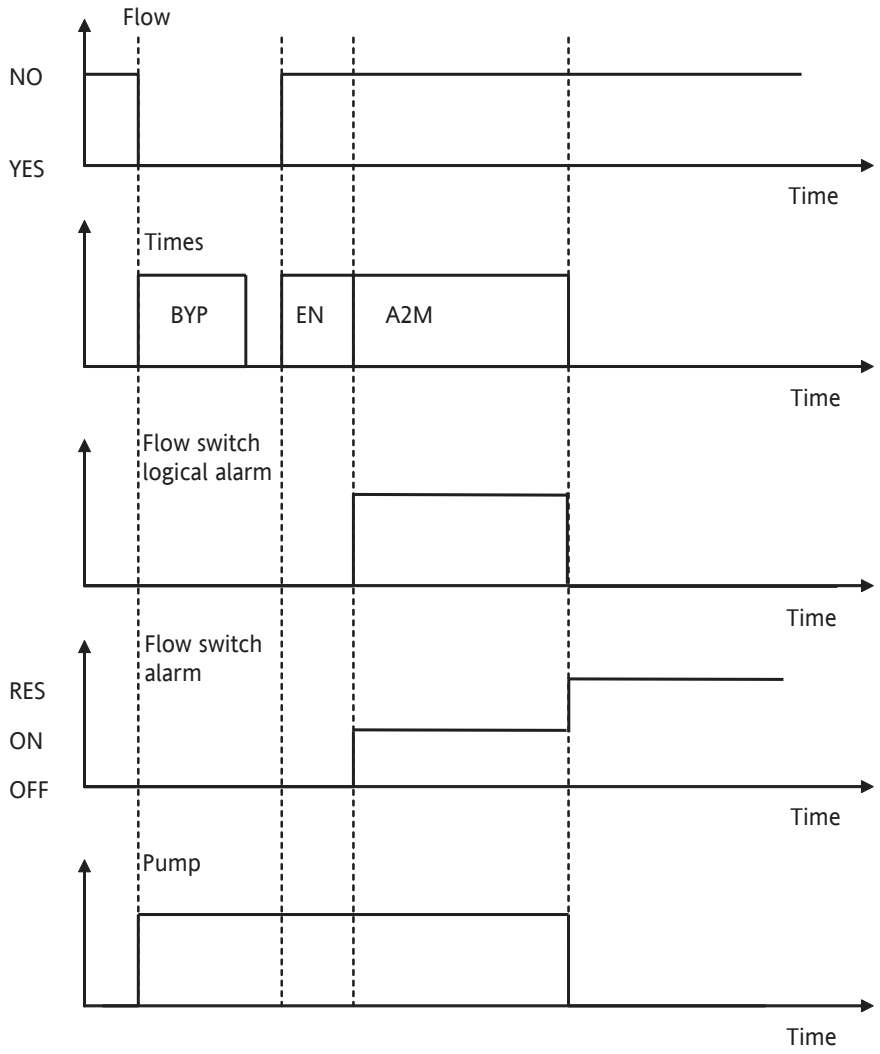
4.4.3 Pump control in presence of flow switch or pump thermal switch alarm

If a flow switch logical alarm is present or the pump thermal switches intervene, the behaviour of the system varies according to whether there are one or two pumps.

4.4.3.1 PUMPS_NO=1

When the pump thermal switch intervenes, the system is immediately blocked and the pump thermal switch manual alarm is activated. When the pump thermal switch is disabled, the alarm must be reset so that the pump can be made available and allow the system to restart.

Flow switch logical alarm always active

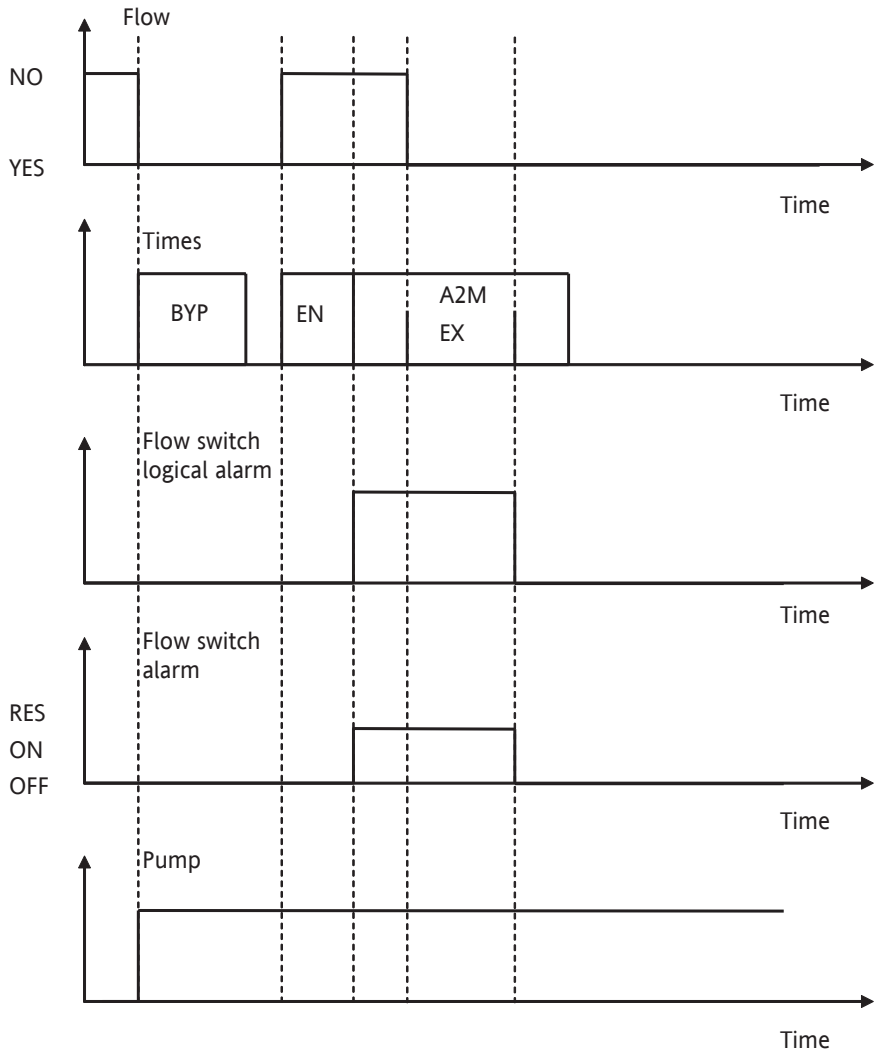


Flow	PUMP_A_FLOW_DI_PHY
Pump	PUMP_ACC_DO_1_PHY

Note that as soon as the pump is switched off, the system is blocked.

- The alarm situation is reset:
- by manually resetting the alarm
- by going from cool mode to off (using keyboard or remote ON/OFF);
- at next power on
- when exiting the configuration mode;

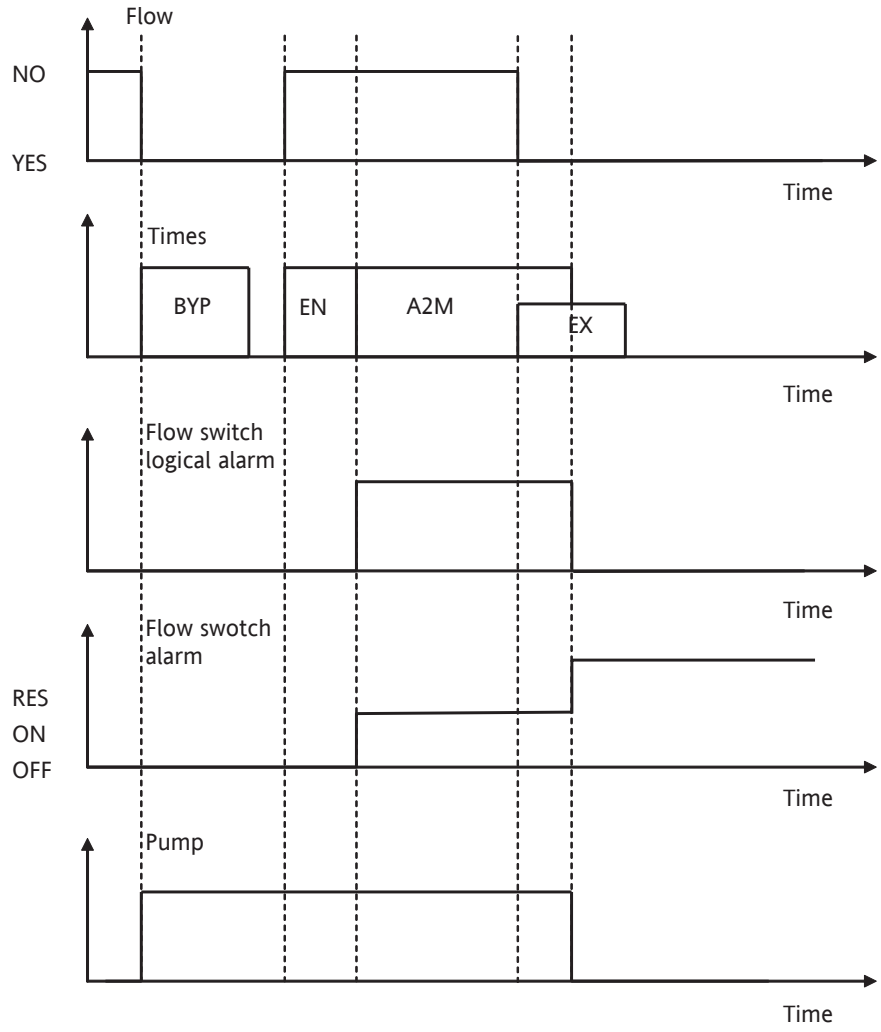
Flow switch logical alarm that resets before A_FS_AUTOMATIC2MANUAL_TIME period of time elapses



Flow	PUMP_A_FLOW_DI_PHY
Pump	PUMP_ACC_DO_1_PHY

In this situation the alarm resets automatically without blocking the system.

Flow switch logical alarm that resets after A_FS_AUTOMATIC2MANUAL_TIME period of time elapses



Flow	PUMP_A_FLOW_DI_PHY
Pump	PUMP_ACC_DO_1_PHY

Note that as soon as the pump is switched off, the system is blocked.

The alarm situation is reset:

- by manually resetting the *flow switch alarm*;
- by going from cool mode to off (using keyboard or remote ON/OFF);
- at next power on
- when exiting the configuration mode;

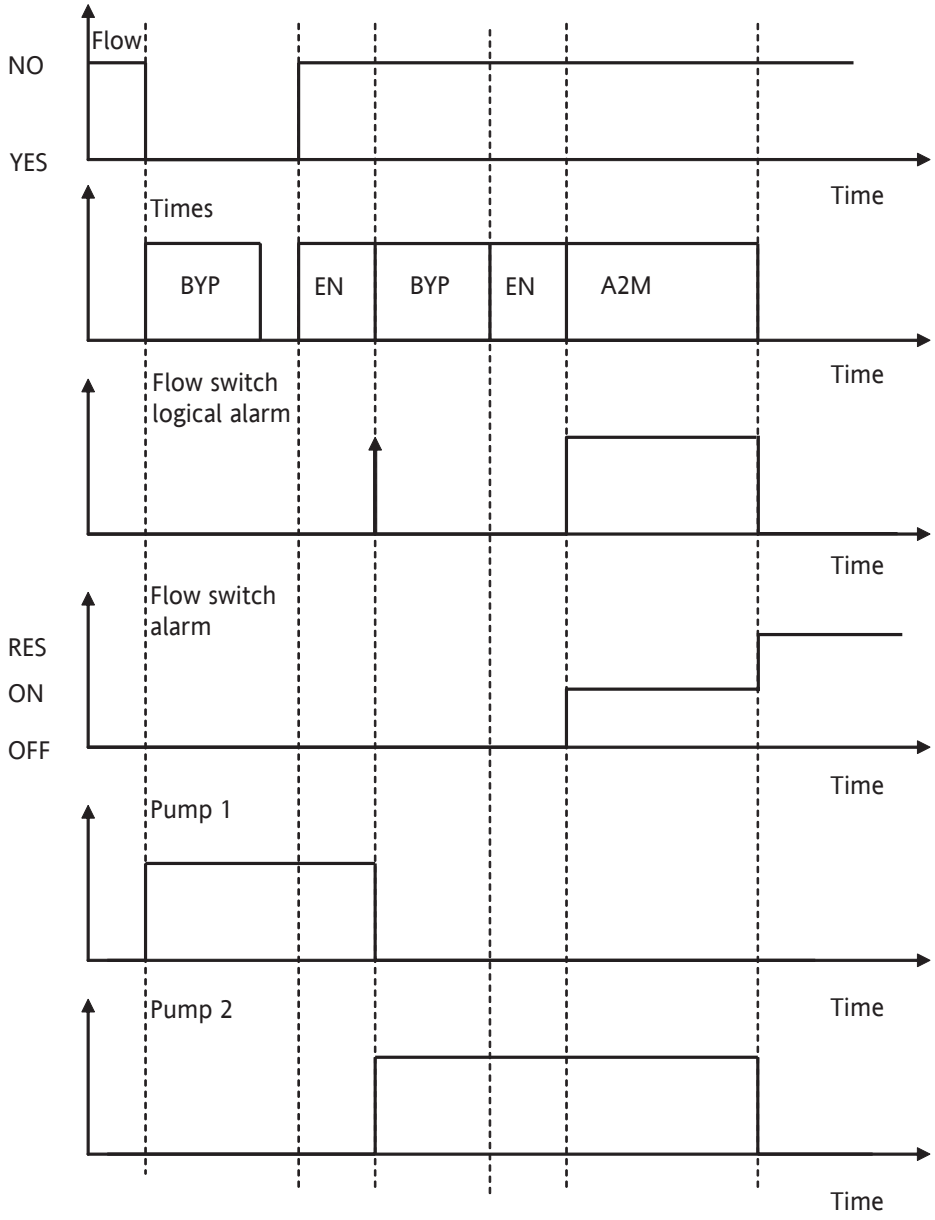
4.4.3.2 PUMPS_NO=2

When the pump thermal switch or the flow switch logical alarm intervene and there is another pump available, the system tries to use this pump to guarantee the flow of water in the primary circuit.
If not (no pump is available) the system behaves as in *PUMPS_NO=1*.

4.4.4 Pump alarm not available

If the pump group has effected an “alarm swap” between pumps, caused by the flow switch, for example, and the second pump can produce the flow, the first becomes an unavailability alarm. This alarm can always be manually reset.

Flow switch logical alarm always active

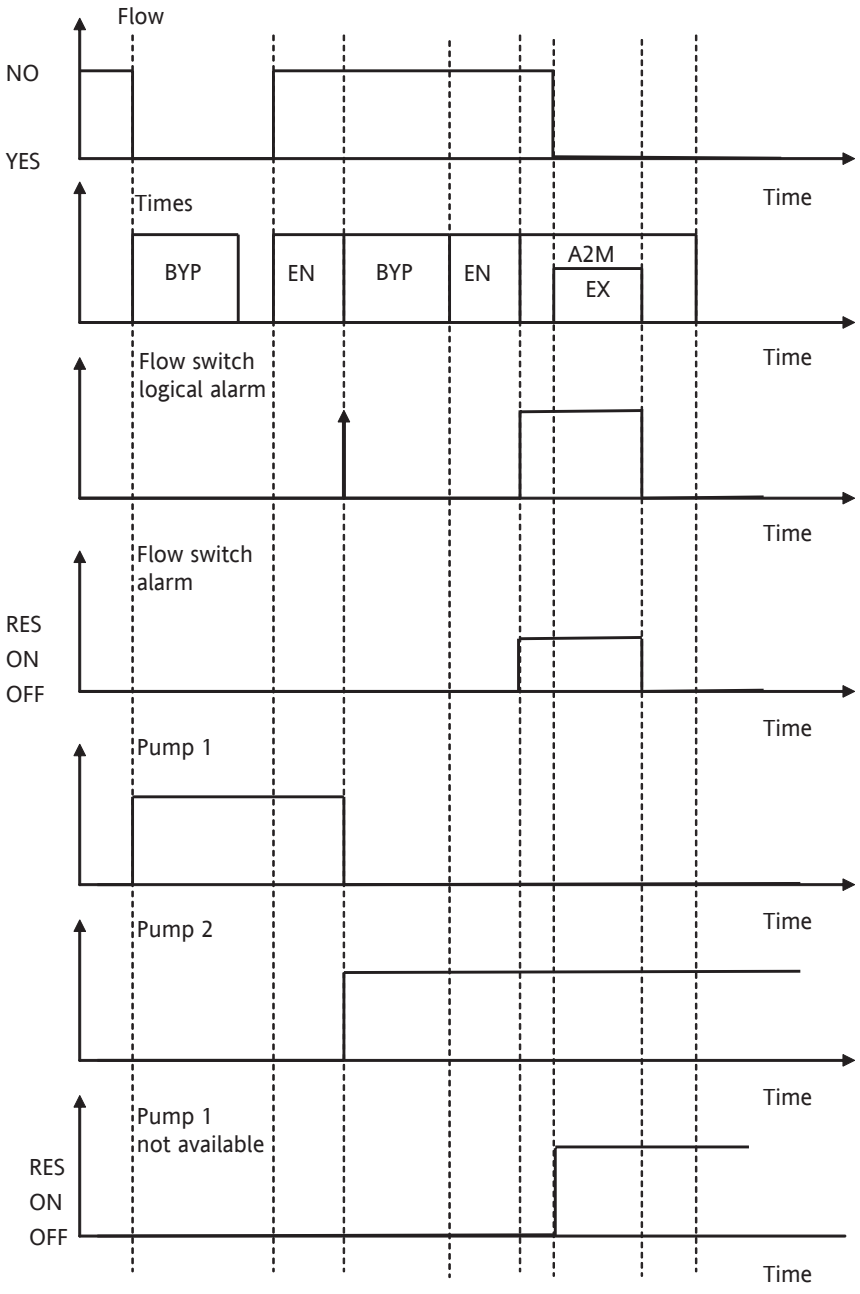


Flow	PUMP_A_FLOW_DI_PHY
Pump 1	PUMP_ACC_DO_1_PHY
Pump 2	PUMP_ACC_DO_2_PHY

Note that as soon as pump 2 is switched off, the system is blocked.
The alarm situation is reset:

- by manually resetting the alarm
- by going from cool mode to off (using keyboard or remote ON/OFF);
- at next power on
- when exiting the configuration mode;

Flow switch logical alarm that resets before A_FS_AUTOMATIC2MANUAL_TIME period of time elapses



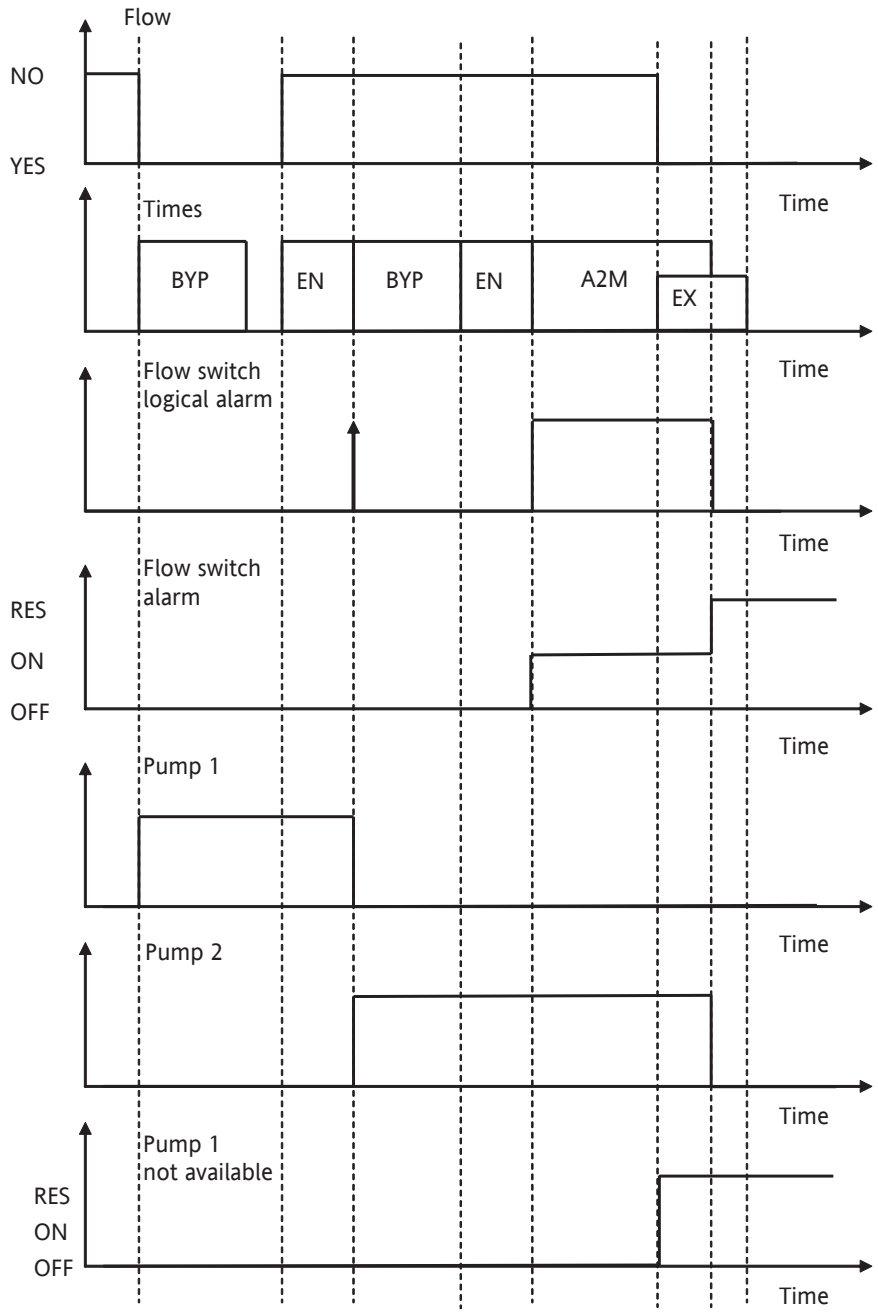
Flow	PUMP_A_FLOW_DI_PHY
Pump 1	PUMP_ACC_DO_1_PHY
Pump 2	PUMP_ACC_DO_2_PHY

Note that as soon as pump 1 is switched off, the system is not blocked and the second available pump is switched on. Since the second pump guarantees the flow, the Pump 1 not available manually reset alarm is signalled and the system continues normal operating.

This alarm will be reset:

- manually;
- by going from cool mode to off (using keyboard or remote ON/OFF);
- at next power on
- when exiting the configuration mode;

Flow switch logical alarm that resets after A_FS_AUTOMATIC2MANUAL_TIME period of time elapses



Flow	PUMP_A_FLOW_DI_PHY
Pump 1	PUMP_ACC_DO_1_PHY
Pump 2	PUMP_ACC_DO_2_PHY

Note that as soon as pump 1 is switched off, the system is not blocked and the second available pump is switched on. Since the second pump also does not guarantee the flow, the pump and the system are blocked (when the second pump is switched off, the Pump 1 not available manually reset alarm is signalled and the *flow switch alarm* becomes resettable.

This flow switch and pump not available alarm will be reset:

- manually;
- by going from cool mode to off (using keyboard or remote ON/OFF);
- at next power on
- when exiting the configuration mode;

and the system will continue normal operating.

4.4.5 Parameters involved

Modbus address	Category and name of parameter	Range	def	vis	trans	UM	C/H	Description of transcode	Description of parameter
0x460	A_FS_BYPASS_STARTUP_TIME	1...99	30	V	0	Sec	C		*Flow switch alarm* bypass time
0x461	A_FS_ENTRY_TIME	0...60	10	V	0	Sec	C		Flow switch holding time in physical alarm condition until the alarm can be received as present
0x462	A_FS_EXIT_TIME	0...60	10	V	0	Sec	C		Flow switch holding time in physical non-alarm condition until the alarm can be received as not present
0x466	A_FS_AUTOMATIC2MANUAL_TIME	1...60	20	V	0	Sec	C		Time after which the *flow switch alarm* goes from automatic to manual (must be longer than A_FS_EXIT_TIME period of time)
0x222	PUMPS_NO	1...2	2	V	0	Num	C		Number of pumps in system

4.5 Compressor control alarms

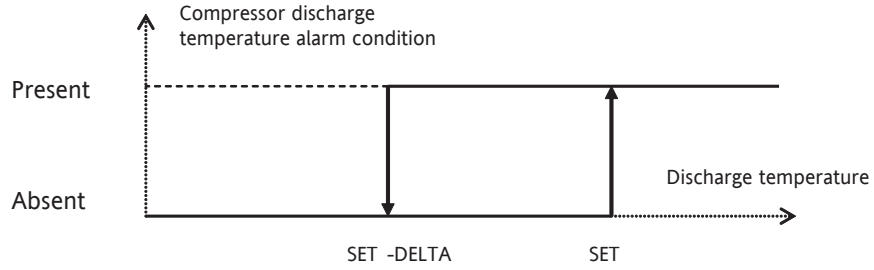
4.5.1 Compressor thermal alarms

Control of this alarm is enabled by the parameter A_KOMP_THER_ENABLE_FLAG and it is active if the machine is switched on in cool or shutdown mode and the *compressor* is selected.
The *compressor* thermal switch alarm is a manually reset alarm that blocks the *compressor* currently in use.

The alarm is reset:

- manually;
- by going from cool mode to off ;
- at next power on
- when exiting the configuration mode;

4.5.2 Compressor discharge temperature alarm



SET	A_DISCHARGE_TEMP
DELTA	A_DISCHARGE_DELTA_TEMP
Discharge temperature	KOMP_TEMP_DISCHARGE_SENS_i_PHY, i = i-nth *compressor*

If one of the following conditions occurs:

- Function disabled (A_DISCHARGE_ENABLE_FLAG =false);
- Faulty discharge temperature sensor;
- System off;
- *Compressor* deselected;

the alarm is always off.

If none of the above conditions occur, the alarm is controlled by the hysteresis function in Fig 3.7.9 in which the alarm condition is used to generate a manually reset alarm.

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

- when machine is switched on or off
- when exiting configuration mode;
- From reset;

4.5.3 Compressor discharge temperature probe error

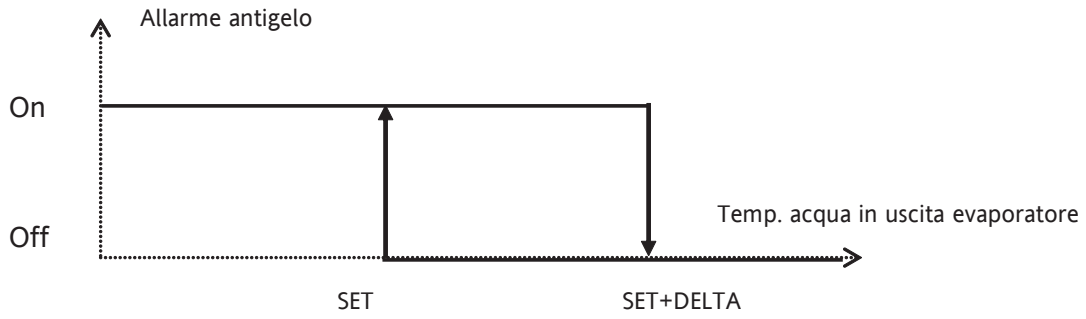
If the *compressor discharge temperature alarm* is enabled or the liquid injection function enabled and the *compressor* is selected, the probe error is managed.
If there is a probe error, the *compressor* associated with it is blocked.

4.5.4 Parameters involved

Modbus address	Category and name of parameter	Range	def	vis	trans	UM	C/H	Description of transcode	Description of parameter
0x2F8	A_KOMP_THER_ENABLE_FLAG	0...1	1	V	6	Flag	C	0=NO; 1=YES	*Compressor* thermal switch alarm enabling
0x2F6	A_DISCHARGE_TEMP	40.0...150.0	125.0	V	0	°C	C		*Compressor discharge temperature alarm* set point
0x2F7	A_DISCHARGE_DELTA_TEMP	0...30.0	30.0	V	0	°C	C		*Compressor discharge temperature alarm* delta
0x2F5	A_DISCHARGE_ENABLE_FLAG	0...1	1	V	6	Flag	C	0=NO; 1=YES	*Compressor discharge temperature alarm* enabling

4.6 Anti-freeze alarm

The *control* of the antifreeze alarm is enabled via the AF_ENABLE_FLAG parameter irrespective of whether the machine is in cool mode, shut down or off.
This algorithm activates the antifreeze alarm by monitoring the output temperature of each evaporator according to the hysteresis function with set point AF_CH_SET_TEMP and delta AF_CH_DELTA_TEMP as shown in the figure.



SET	AF_CH_SET_TEMP
DELTA	AF_CH_DELTA_TEMP
Temperature of evaporator outlet water	EV_TEMP_OUTWATER_SENS_i_PHY, i = i-nth evaporator

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

The alarm is bypassed for the AF_CHILLING_BYPASS_TIME period of time that is loaded at power on, start-up in cool mode, when exiting the configuration mode and returning from the antifreeze alarm (when alarm is reset if manual) or the evaporator outlet water probe condition.

The alarm is reset automatically. If the number of alarms in an hour exceeds the value of the parameter MAX_AF_ALARMS_NO, the alarm becomes manually resettable.
When the alarm is activated (any one of the evaporator alarms is sufficient) the system is switched off and the antifreeze heaters (of all the evaporators) are switched on if the parameter AF_USE_RESISTOR_FLAG=yes.

Note
Switching on the heaters activates the request for activation of one of the pumps in the pump group so that water can circulate in the primary circuit.

Alarm management is always restarted at power on when the status of the system goes from off to cool and when exiting configuration mode. If the system goes from cool mode to off mode, an antifreeze alarm, if present, is not reset.

An error in this probe blocks the system (pump group and antifreeze heaters included).

4.6.1 Antifreeze probe error

The probe error that monitors the temperature of the evaporator outlet water is controlled in cool or shutdown mode if AFPR_COOLING_ENABLED_FLAG=yes and also when the machine is in off mode if AFPR_OFF_STDBY_ENABLE_FLAG =yes.
If AF_ENABLE_FLAG=yes (antifreeze enabled) the error of this probe is always received irrespective of the system operating mode.
An error in this probe blocks the system (pump group and antifreeze heaters included).

4.6.2 Parameters involved

Modbus address	Category and name of parameter	Range	def	vis	trans	UM	C/H	Description of transcode	Description of parameter
0x2B0	AF_ENABLE_FLAG	0...1	1	V	6	Flag	C	0=NO; 1=YES	Enable *antifreeze function*
0x2B2	AF_CH_SET_TEMP	-50.0...150.0	3.0	V	0	°C	C		Antifreeze alarm set point
0x2B3	AF_CH_DELTA_TEMP	0.0...10.0	4.0	V	0	°C	C		Antifreeze alarm delta
0x2B4	AF_CHILLING_BYPASS_TIME	0...1000	30	V	0	Sec	C		Antifreeze alarm bypass time
0x2B5	MAX_AF_ALARMS_NO	0...1000	0	V	0	Num	C		Maximum number of antifreeze alarms in hour before antifreeze alarm goes from automatic to manual
0x2B1	AF_USE_RESISTOR_FLAG	0...1	1	V	6	Flag	C		Enable use of electric heaters if antifreeze alarm is generated
0x2C0	AFPR_COOLING_ENABLED_FLAG	0...1	1	V	6	Flag	C	0=NO 1=YES	Enable antifreeze prevention function if system is on or shutdown (in cool or shutdown mode)
0x2C1	AFPR_OFF_STDBY_ENABLE_FLAG	0..1	1	V	6	Flag	C	0=NO 1=YES	Enable antifreeze prevention function if system is off (off mode)

4.7 Alarm Table

Name	BaseLine Machine alarm list	Action	Input	System	Num	Resetting
PlanHTempA	High temperature in *temperature control*	blocks the system	Analogue	PLANT	1	Manual
EvAfA	Evaporator antifreeze	blocks the system and starts up the pump if heaters are enabled	Analogue	EV	2	Event bounded
KompDisA	*Compressor* discharge temperature	blocks the *compressor*	Analogue	KOMP	8	Manual
CirHPrA	Maximum circuit pressure	blocks the circuit	Analogue+ Digital	CIR	8	Manual
CirLPrA	Minimum circuit pressure	blocks the circuit	Digital	CIR	8	Event bounded
KompTherA	*Compressor* thermal switch	blocks the *compressor*	Digital	KOMP	8	Manual
FansTherA	Fan group thermal switch	blocks the circuits	Digital	FANGROUP	2	Manual
FlowA	Primary flow switch	blocks the system	Digital	PUMPGROUP	1	Time bounded
PumpTherA	Pump thermal switch	blocks pump	Digital	PUMP	2	Manual
PumpUnavailableA	Pump not available	makes the pump unavailable	Log	PUMP	2	Manual
CirPdA	*Pump-down timeout*	does not block system	Time	CIR	8	Automatic
VAR_BOO_BIOS_1	Internal expansion timeout	blocks the system	Time	PLANT	1	Automatic
VAR_BOO_BIOS_2	External expansion timeout 1	blocks the system	Time	PLANT	1	Automatic
VAR_BOO_BIOS_3	External expansion timeout 2	blocks the system	Time	PLANT	1	Automatic
VAR_BOO_BIOS_4	External expansion timeout 3	blocks the system	Time	PLANT	1	Automatic
VAR_BOO_BIOS_5	External expansion timeout 4	blocks the system	Time	PLANT	1	Automatic

4.8 Error table

Name	List of BaseLIne machine probe errors	Input	System	Num	Action	Resetting
PlanTempInWaterSensErr	Input *temperature control* probe error	Ana	PLANT	1	blocks the system	Automatic
PlanTempOutWaterSensErr	Output *temperature control* probe error	Ana	PLANT	1	blocks the system	Automatic
EvTempOutWaterSensErr	*Antifreeze probe error*	Ana	EV	2	blocks the system	Automatic
CirPresMaxSensErr	Circuit maximum probe error	Ana	CIR	8	blocks the circuit	Automatic
KompTempDischargeSensErr	*Compressor* discharge probe error	Ana	KOMP	8	blocks the *compressor*	Automatic
PlanCurrDtsetSensErr	*Dynamic set point* sensor probe error	Ana	PLANT	1	excludes dynamic *control*	Automatic

5 PARAMETRS

Table of parameters

Modbus address (hex)	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
	Structural								
200	KOMP_CIR_EV_1	Association of *compressor* 1 with UNITS circuit of TENS evaporator	11...24	11	0	C	V		Num
201	KOMP_CIR_EV_2	Association of *compressor* 2 with UNITS circuit of TENS evaporator	0...24	12	0	C	V		Num
202	KOMP_CIR_EV_3	Association of *compressor* 3 with UNITS circuit of TENS evaporator	0...24	21	0	C	V		Num
203	KOMP_CIR_EV_4	Association of *compressor* 4 with UNITS circuit of TENS evaporator	0...24	22	0	C	V		Num
204	KOMP_CIR_EV_5	Association of *compressor* 5 with UNITS circuit of TENS evaporator	0...24	0	0	C	V		Num
205	KOMP_CIR_EV_6	Association of *compressor* 6 with UNITS circuit of TENS evaporator	0...24	0	0	C	V		Num
206	KOMP_CIR_EV_7	Association of *compressor* 7 with UNITS circuit of TENS evaporator	0...24	0	0	C	V		Num
207	KOMP_CIR_EV_8	Association of *compressor* 8 with UNITS circuit of TENS evaporator	0...24	0	0	C	V		Num
208	CIR_FANS_1	Association of circuit 1 to fan group indicated	1...2	1	0	C	V		Num
209	CIR_FANS_2	Association of circuit 2 to fan group indicated	0..2	1	0	C	V		Num
20A	CIR_FANS_3	Association of circuit 3 to fan group indicated	0...2	2	0	C	V		Num
20B	CIR_FANS_4	Association of circuit 4 to fan group indicated	0...2	2	0	C	V		Num
20C	CIR_FANS_5	Association of circuit 5 to fan group indicated	0...2	0	0	C	V		Num
20D	CIR_FANS_6	Association of circuit 6 to fan group indicated	0...2	0	0	C	V		Num
20E	CIR_FANS_7	Association of circuit 7 to fan group indicated	0...2	0	0	C	V		Num
20F	CIR_FANS_8	Association of circuit 8 to fan group indicated	0...2	0	0	C	V		Num
210	KOMP_STAGE_1	Number of *capacity steps* for *compressor* 1	0...3	2	0	C	V		Num
211	KOMP_STAGE_2	Number of *capacity steps* for *compressor* 2	0...3	2	0	C	V		Num
212	KOMP_STAGE_3	Number of *capacity steps* for *compressor* 3	0...3	2	0	C	V		Num
213	KOMP_STAGE_4	Number of *capacity steps* for *compressor* 4	0...3	2	0	C	V		Num
214	KOMP_STAGE_5	Number of *capacity steps* for *compressor* 5	0...3	2	0	C	V		Num
215	KOMP_STAGE_6	Number of *capacity steps* for *compressor* 6	0...3	2	0	C	V		Num
216	KOMP_STAGE_7	Number of *capacity steps* for *compressor* 7	0...3	2	0	C	V		Num
217	KOMP_STAGE_8	Number of *capacity steps* for *compressor* 8	0...3	2	0	C	V		Num
218	KOMP_TYPE	Type of *compressor*. Intervenes on the method of implementing the enabling/disabling sequence of the relays associated with *compressor capacity steps*	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). Intervenes on the enabling/disabling sequence of the fan relays	0...1	0	6	C	V	0=NO, 1=YES	Flag
21A	FANS_NO_1	Number of fans in fan group 1	1...4	3	0	C	V		Num
21B	FANS_NO_2	Number of fans in fan group 2	1...4	3	0	C	V		Num
21C	FANS_NO_3	Number of fans in fan group 3	1...4	1	0	C	N		Num
21D	FANS_NO_4	Number of fans in fan group 4	1...4	1	0	C	N		Num

Modbus address (hex)	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
21E	FANS_NO_5	Number of fans in fan group 5	1..4	1	0	C	N		Num
21F	FANS_NO_6	Number of fans in fan group 6	1...4	1	0	C	N		Num
220	FANS_NO_7	Number of fans in fan group 7	1...4	1	0	C	N		Num
221	FANS_NO_8	Number of fans in fan group 8	1...4	1	0	C	N		Num
222	PUMPS_NO	Number of pumps in system	1...2	2	0	C	V		Num
	High Level								
240	EV_SELECTION_FUNCTION	Selection of selection policy for cooling power resources at evaporator level	0...1	1	28	C	V	0=SATURATION, 1=BALANCING	Flag
241	CIR_SELECTION_FUNCTION	Selection of selection policy for cooling power resources at circuit level	0...1	1	29	C	V	0=SATURATION, 1=BALANCING	Flag
242	KOMP_SELECTION_FUNCTION	Selection of selection policy for cooling power resources at *compressor* level	0...1	0	30	C	V	0=SATURATION, 1=BALANCING	Flag
243	A_HIGHT_ENABLE_FLAG	Enables system *high temperature alarm* (alarm monitors temperature of water entering primary circuit)	0...1	1	6	C	V	0=NO, 1=YES	Flag
244	A_HIGHT_THRESHOLD_TEMP	System *high temperature alarm* set point	-15.0...50.0	18.0	0	H	V		°C
245	A_HIGHT_BYPASS_TIME	System *high temperature alarm* bypass time	1...99	15	0	H	V		Min
	Configuration of *temperature control*								
260	TREG_FUNCTION	Type of *temperature control* 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	Selects sensor for *temperature control*	0...1	0	18	C	V	0=ENTRY_SENSOR, 1=EXIT_SENSOR	Num
262	PI_INTEGRAL_COMPONENT_FLAG	Flag for integral component of P.I. *temperature controll*er	0...1	1	6	H	V	0=NO, 1=YES	Flag
263	PI_INTEGRAL_CONSTANT	Value of Integral Time of integral component of P.I. *temperature controll*er	1...900	600	0	H	V		Sec
264	PI_PROP_COMPONENT_FLAG	Flag for proportional component of P.I. *temperature controll*er	0...1	1	6	H	V	0=NO, 1=YES	Flag
	Temperature control								
270	CH_TSET_TEMP	Cool set point	CH_MIN_TSET_TEMP... CH_MAX_TSET_TEMP	7.0	0	H	V		°C
271	CH_MIN_TSET_TEMP	Cool set point minimum value	-50.0...80.0	5.0	0	C	V		°C
272	CH_MAX_TSET_TEMP	Cool set point maximum value	-50.0...80.0	25.0	0	C	V		°C
273	CH_ENTRY_OFFSET	Cool set point offset for *temperature control* on primary circuit water inlet temperature sensor	0.0...15.0	0.0	0	H	V		°C
274	CH_PROP_BAND	Cool proportional band	CH_MIN_PROP_BAND ... CH_MAX_PROP_BAND	5.0	0	H	V		°C

Modbus address (hex)	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
275	CH_MIN_PROP_BAND	Minimum value of cool proportional band	0.0...25.0	0.0	0	C	V		°C
276	CH_MAX_PROP_BAND	Maximum value of cool proportional band	0.0...25.0	20.0	0	C	V		°C
277	CH_INC_STEP_TIME	Step increase time (increase in cooling power)	0...300	10	0	H	V		Sec
278	CH_DEC_STEP_TIME	Step decrease time (decrease in cooling power)	0...300	10	0	H	V		Sec
	Dynamic set point								
2A0	DTSET_FUNCTION	Enables *dynamic set point* function 0=disabled or none 1= temperature (not supported) 2=current	0...2	2	19	C	V	0=NONE, 1=TEMP_FUNCTION, 2=CURRENT_FUNCTION	Num
2A1	DTSET_CHILLER_MAX_OFFSET	Maximum offset value that *dynamic set point* can add to cool set point	-30.0...30.0	6.0	0	C	V		°C
	Anti-freeze								
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 electric heaters if antifreeze alarm is generated	0...1	1	6	C	V	0=NO, 1=YES	Flag
2B2	AF_CH_SET_TEMP	Anti-frost alarm set point	-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	Antifreeze alarm bypass time	0...1000	30	0	C	V		Sec
2B5	MAX_AF_ALARMS_NO	Maximum number of antifreeze alarms in hour before antifreeze alarm goes from automatic to manual	0...1000	0	0	C	V		Num
	Antifreeze prevention								
2C0	AFPR_COOLING_ENABLED_FLAG	Enable antifreeze prevention function if system is on or shutdown (in cool or shutdown mode)	0...1	1	6	C	V	0=NO, 1=YES	Flag
2C1	AFPR_OFF_STDBY_ENABLE_FLAG	Enable antifreeze prevention function if system is off (off mode)	0....1	1	6	C	V	0=NO, 1=YES	Flag
2C2	AFPR_CHILLING_TSET	Antifreeze prevention set point	-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
	Circuit								
2E0	A_MAX_PRES	Circuit maximum pressure alarm set point	0.0...50.0	28.0	0	C	V		Bar
2E1	A_MAX_DELTA_PRES	Circuit maximum pressure alarm delta	0.0...10.0	2.0	0	C	V		Bar
2E2	MAX_MINP_ALARMS_NO	Maximum number of minimum pressure alarms per hour before the alarm goes from automatic to manual	0...20	3	0	H	V		Num
2E3	A_MIN_PRES_BYPASS_TIME	Minimum pressure alarm bypass time	0...500	120	0	H	V		Sec
	Compressor								
2F0	MIN_OFFON_TIME	*Compressor* safety time from OFF to ON	0...500	60	0	H	V		Sec
2F1	MIN_ONOFF_TIME	*Compressor* safety time from ON to OFF	0...500	10	0	H	V		Sec
2F2	MAX_STARTS_PER_HOUR_NO	Maximum number of *compressor* start-ups in the hour	0...20	6	0	H	V		Num

Modbus address (hex)	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
2F3	CPWR_UPDOWN_MIN_TIME	Capacity step safety time with power decrease	0...300	10	0	H	V		Sec
2F4	CPWR_DOWNUP_MIN_TIME	Capacity step safety time with power increase	0...300	10	0	H	V		Sec
2F5	A_DISCHARGE_ENABLE_FLAG	*Compressor discharge temperature alarm* enabling	0.....1	1	6	C	V	0=NO, 1=YES	Flag
2F6	A_DISCHARGE_TEMP	*Compressor discharge temperature alarm* set point	40.0...150.0	125.0	0	C	V		°C
2F7	A_DISCHARGE_DELTA_TEMP	*Compressor discharge temperature alarm* delta	0.0...30.0	30.0	0	C	V		°C
2F8	A_KOMP_THER_ENABLE_FLAG	*Compressor* thermal switch alarm enabling	0...1	1	6	C	V	0=NO, 1=YES	Flag
	Liquid injection								
310	LI_ENABLE_FLAG	Liquid injection function enable	0...1	1	6	C	V	0=NO, 1=YES	Flag
311	LI_TSET_TEMP	Liquid injection function set point	0.0...150.0	115.0	0	C	V		°C
312	LI_DELTA_TEMP	Liquid injection function delta	0.0...10.0	10.0	0	C	V		°C
	Selection of compressors								
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
	***Compressor* use 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
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

Modbus address (hex)	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
	Configuration of fan controller								
340	FANS_KOMP_DEPENDENCY_FLAG	If NO then the fan group fans work irrespective of the status of the compressors that belong to the circuits in which the units *control* condensation. If not, there must be at least one *compressor* on among those that belong to the circuits in which the units *control* condensation so that the unit fans can be controlled.	0...1	1	6	C	V	0=NO, 1=YES	Flag
341	FANS_CH_INIT_MAX_POWER_TIME	Length of time that the fan group fans go to 100% each time the group is switched on	0...120	60	0	C	V		Sec
	Digital fan controller								
360	FANS_CSTART_SET1_PRES	Fan 1 step start set point	0.0...30.0	13.0	0	C	V		Bar
361	FANS_CSTART_SET2_PRES	Fan 2 step start set point	0.0...30.0	15.0	0	C	V		Bar
362	FANS_CSTART_SET3_PRES	Fan 3 step start set point	0.0...30.0	17.0	0	C	V		Bar
363	FANS_CSTART_SET4_PRES	Fan 4 step start set point	0.0...30.0	19.0	0	C	V		Bar
364	FANS_CSTART_SET5_PRES	Fan 5 step start set point	0.0..30.0	0.0	0	C	V		Bar
365	FANS_CSTART_SET6_PRES	Fan 6 step start set point	0.0...30.0	0.0	0	C	V		Bar
366	FANS_CSTART_SET7_PRES	Fan 7 step start set point	0.0...30.0	0.0	0	C	V		Bar
367	FANS_CSTART_SET8_PRES	Fan 8 step start set point	0.0...30.0	0.0	0	C	V		Bar
368	FANS_CSTOP_DELTA1_PRES	Fan 1 step stop delta	0.0...10.0	2.0	0	C	V		Bar
369	FANS_CSTOP_DELTA2_PRES	Fan 2 step stop delta	0.0...10.0	2.0	0	C	V		Bar
36A	FANS_CSTOP_DELTA3_PRES	Fan 3 step stop delta	0.0...10.0	2.0	0	C	V		Bar
36B	FANS_CSTOP_DELTA4_PRES	Fan 4 step stop delta	0.0...10.0	2.0	0	C	V		Bar
36C	FANS_CSTOP_DELTA5_PRES	Fan 5 step stop delta	0.0...10.0	0.0	0	C	V		Bar
36D	FANS_CSTOP_DELTA6_PRES	Fan 6 step stop delta	0.0...10.0	0.0	0	C	V		Bar
36E	FANS_CSTOP_DELTA7_PRES	Fan 7 step stop delta	0.0...10.0	0.0	0	C	V		Bar
36F	FANS_CSTOP_DELTA8_PRES	Fan 8 step stop delta	0.0...10.0	0.0	0	C	V		Bar
	Pump group and flow switch								
460	A_FS_BYPASS_STARTUP_TIME	*Flow switch alarm* bypass time	1...99	30	0	C	V		Sec
461	A_FS_ENTRY_TIME	Flow switch holding time in physical alarm condition until the alarm can be received as present	0...60	10	0	C	V		Sec
462	A_FS_EXIT_TIME	Flow switch holding time in physical non-alarm condition until the alarm can be received as not present	0...60	10	0	C	V		Sec
463	PUMPS_ALTERNATION_TIME	Rotation time of pumps	1...1000	72	0	C	V		hour
464	PUMPGROUP_STARTUP_DELAY_TIME	Time that must elapse between the system ON (that causes the selected pump to be enabled) and the start of *temperature control*	0...2000	60	0	C	V		Sec

Modbus address (hex)	Category and name of parameter	Description of parameter	Range	def	trans	C/H	vis	Description of transcode	UM
465	PUMPGROUP_STOP_DELAY_TIME	Time the enabled pump must stay on after the system shutdown has been requested and the last *compressor* has been switched off	0...2000	60	0	C	V		Sec
466	A_FS_AUTOMATIC2MANUAL_TIME	Time after which the *flow switch alarm* goes from automatic to manual (must be greater than the time A_FS_EXIT_TIME)	1...60	20	0	C	V		Sec
	Pump use 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_1	Hours of use of pump 2	0...24	0	0	C	V		hour
	Pump Down								
490	PD_FUNCTION	Selection of type of pumpdown: not active (NO_PD), during start-up (ON_START) or during start-up and shutdown (FULL)	0...2	2	15	C	V	0=NO_PD, 1=ON_START, 2=FULL	Num
491	PD_OFFON_MAX_TIME	Maximum pumpdown time during start-up	0...1800	10	0	C	V		Sec
492	PD_ONOFF_MAX_TIME	Maximum pumpdown time during shutdown	0...1800	10	0	C	V		Sec
	Status in EEPROM								
4D0	PLAN_STATUS	Storage of system status in EEPROM. 0=Off, 2=On	0..2	0	0	H	N		Num

6 USE OF THE DEVICE

6.1 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

6.2 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.

7 RESPONSABILITY AND RESIDUAL RISKS

Eliwell & Controlli 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.

8 DISCLAIMER

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9 ANALITIC INDEX

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