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MCX air handling unit user manual

The best solution of air treatment
with your MCX air handling unit

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1.0 Introduction

The algorithm is aimed at controlling the main types of air treatment units.

It can run on the entire line of MCX systems and envisages the use of a remote MMI interface, Modbus communication and EXC06 expansion.

It can handle the following main functions:

- control of heating and cooling coils using PID logic and cascade control;
- control of fans according to air pressure using PID logic;
- humidity control;
- air quality control;
- "*free-cooling*" and "*free-heating*";
- energy recovery;
- limiting of supply temperature and humidity;
- management of ON/OFF, 3-point, 0/10 V valves;
- management of ON/OFF and 0/10 V dampers,
- frost protection.

The type of AHU to be controlled is defined by configuring the parameters and defining the inputs and outputs to be used to control the various elements that make up the AHU.

Both the parameters and the inputs and outputs can be configured from the instrument user interface or from a PC using the "*mcxs configuration*" file and the MCXShape tool, (see the MCXShape user manual).

In the latter case, it is possible to generate as many binary application files as the number of configurations desired and, after loading them into the MMIMYK accessory, select the configuration to download into the MCX on a case-by-case basis.

2.0 User interface

2.1 Keyboard

Key	Function
	UP
	DOWN
	ENTER
	ESC

Tab 1 [User interface - Keyboard]

Keys are used to access directly some special functions and to navigate through the user interface menu.

2.1.1 Direct access to special functions

- The key for 1 s: access the alarms screen, (see 2.4.1 "Displaying and managing alarms").
- The key for 3 s: access the main setpoint, (see 6.4 "Main setpoint").
- The key for 1 s: access the menu.
- The key for 3 s: switch between ON/OFF status, (see 2.2 "Turning the unit ON and OFF").

2.1.2 Menu navigation

Press the key for 1 s to access the menu. Use the and keys to navigate through the menu; pressing the key lets you descend a level in the menu, if this is possible, and pressing the key lets you move up a level.

Use the following keys to modify the selected parameters: the key to enter the modification mode, the and keys to modify the value, the key to confirm the modification and the key to abandon it without confirming.

2.2 Turning the unit ON and OFF

The instrument can be switched from OFF to ON and vice versa in the following ways:

- pressing the key and keeping it pressed for 3 s;
- using the digital "*ONF - ON/OFF*" input, if present; remember, the digital input acts on the status change;

Note

if, during the input configuration phase, you set "Polarity=N.C.", the unit is OFF when the input is open;

- from a Modbus supervisor through "*coil 129*", (see 16.1 "Table of exported variables").

When is OFF, the machine mode is indicated as OFF on the main screen.
Passing from OFF to ON turns on the main screen.

GEN			General	Min	Max	Value	U.M.	Text Value
	ODL		Out Delay					
		dOt	Digital output delay	0	9999	0	SEC	
		AOt	Analog output delay	0	9999	0	SEC	

Tab 2 [User interface - General parameters]

2.3 Main screen

From the main screen, press the key and keep it pressed for 1 s to access the menu, (see 2.4 "Menu-based navigation").

Note

After five minutes of inactivity, the main screen is automatically shown;

The main screen varies depending on whether a LED or LCD display is being used.

2.3.1 LED display

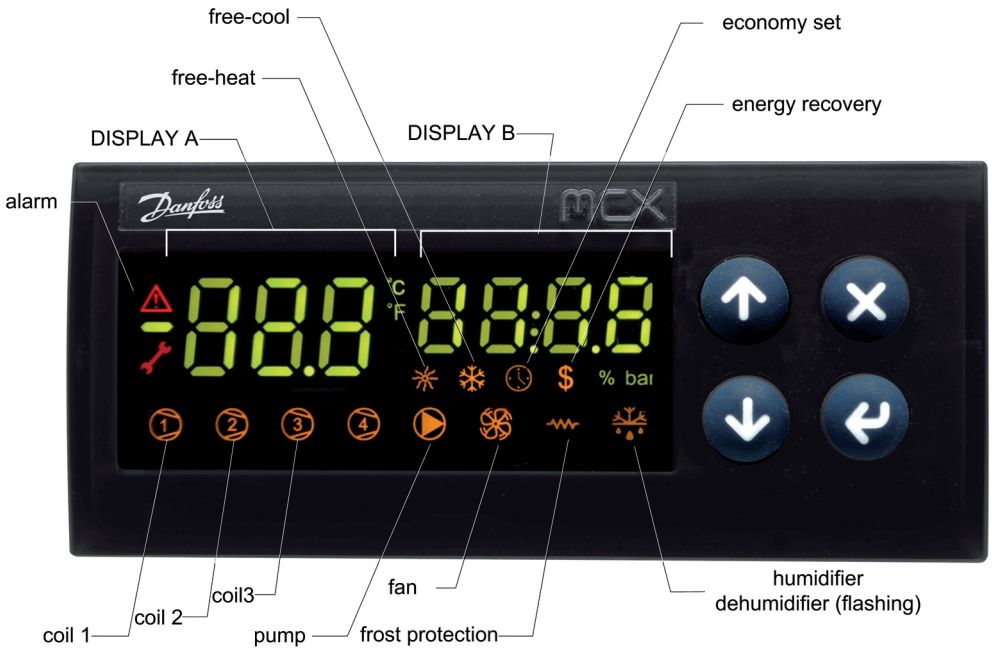


Fig 1 [User interface - LED display]

GEN			General	Min	Max	Value	U.M.	Text Value
	dSP		Display					
		dSA	Display A value	0	19	4=SUP		NO;AUTO;StH;StC;SUP;REt;OUt; tH1;tH2;tC1;tC2;bAR;SHU;RHU; CO2;VOC;MIX;TREM;AMb;Ax1
		dUA	Unit of measure A	0	3	1=°C	°C	NO;°C ;RH%;bAR
		dSb	Display B value	0	19	1=AUTO		NO;AUTO;StH;StC;SUP;REt;OUt; tH1;tH2;tC1;tC2;bAR;SHU;RHU; CO2;VOC;MIX;TREM;AMb;Ax1
		dUb	Unit of measure B	0	3		°C	NO;°C ;RH%;bAR
		Log	Logo	0	3	1=1		NO;1;2;3
		Ver	Parameter version	0	999	26		

Tab 3 [User interface - LED display - General parameters]

Using "*dSA*" and "*dSB*", you can choose which setpoint and probe reading values are to be shown on displays A and B respectively.
"*dUA*" and "*dUb*" establishes the unit of measure used on the display A and B.
The choices are: none, °C, RH %, bar.

The meaning of the icons is indicated in the figure.
The icon associated with a given function follows the trend in activation/deactivation for that function.

The "*Log*" parameter defines the logo displayed at the application startup. The corresponding bitmap "*STARTLOGODX_x.bmp*" are placed in the "*BIN\Graph*" folder.
The "*Ver*" parameter indicates the release of the "*mcxs configuration*" file.

2.3.2 LCD display

The first screen displays:

- the measurement detected by the two analog inputs,
  (see "display A" and "display B" for the version with LED display);
- the symbols of the main active functions, (see figure).

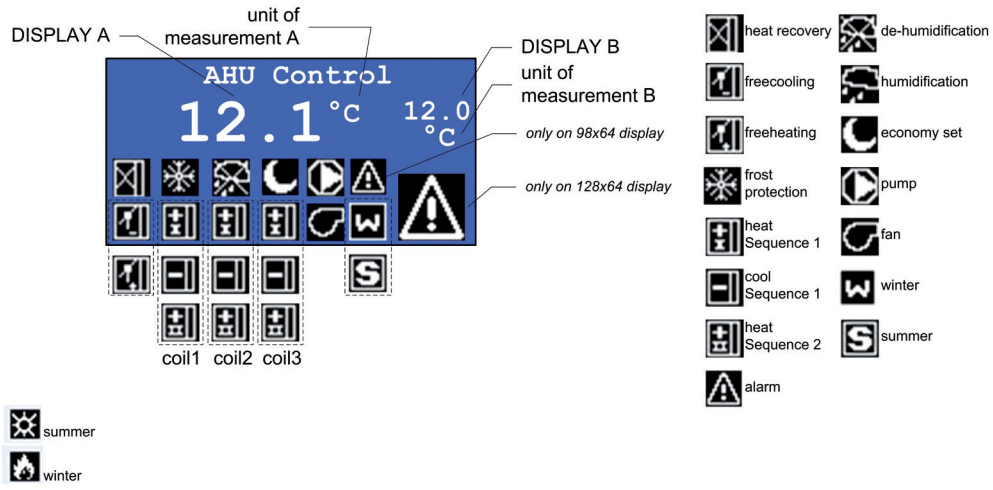


Fig 2 [User interface - LCD display]

On the right side of the main icons there is a bar indicating the percentage output of that element.

2.4 Menu-based navigation

Press the key for 1 s to access the menu described in the table below.

Menu		Submenu		Submenu		Function	Notes
LED cod	LCD description	LED cod	LCD description	LED cod	LCD description		
ALA	Alarms					Accesses the alarms menu	
		AAL	Active			Lists all currently active alarms	
		SAL	Historic			Presents the alarms history	
		RAL	Reset			Used to reset alarms that are reset manually	
LOG	Login					Login	Specifies the degree of access to menus and parameters. The password is the one indicated by the parameters "*L01*", "*L02*" and "*L03*"

Menu		Submenu		Submenu		Function	Notes
LED cod	LCD description	LED cod	LCD description	LED cod	LCD description		
PAR	Parameters					Accesses the parameters menu	You must login first. For a description of the parameters menu, (see "15.0 "Parameters")
		….				Parameters menu	(See the "*mcxs configuration*" file) with the MCXShape tool
IO	Input/ Output						
		IOd	I/O Values			Displays the input and output values	
		IOC	I/O Config			Accesses the input/output configuration menu	(Only if enabled in the "*mcxs configuration*" file through the MCXShape tool)
				dI	Digital Input	Configuration of the digital inputs	
				dO	Digital Output	Configuration of the digital outputs	
				AI	Analog Input	Configuration of the analog inputs	
				AO	Analog Output	Configuration of the analog outputs	
Utl	Utilities					Accesses the utilities function	
		COM	Commis-sioning			Enable commissioning screen	
		DEF	Load Default			Load default parameters	
		RTC	Clock Setup			Set date and hour	Only for models fitted with real time clock
		LON	Lock Fan			Stop and lock fans	
		LOF	Unlock Fan			Unlock fans	
		WIN	Winter			Sets the winter operating mode	
		SUM	Summer			Sets the summer operating mode	
		SW	Info			Software Info	

Tab 4 [User interface - Menu-based navigation]

Use the ↑ and ↓ keys to navigate through the menu; pressing the ↵ key lets you descend a level in the menu, if this is possible, and pressing the ✕ key lets you move up a level.

Use the following keys to modify the selected parameters: the ↵ key, to enter the modification mode, ↑ and ↓ keys to modify the value, the ↵ key to confirm the modification and the ✕ key to abandon it without confirming.

2.4.1 Displaying and managing alarms

Menu: ALA – Alarms

Sub-menu: AAL – Active
Displays the active alarms.

Screen with description of the alarm (LCD), alarm code and number of active alarms.

Note that you can go to the alarm screen pressing the ↑ key directly from the main screen.

Each screen is dedicated to a specific alarm. Use the ↑ and ↓ keys to move from one screen to the next.

Press the ↵ key to reset the alarm currently displayed. To reset all alarms keep the ↵ key pressed for 5 s or use the sub-menu "*RAL – Reset*".

Sub-menu: SAL – History
Displays the history of the alarms which are no longer active.

The screens present the alarm code, description (LCD) and duration in days, hours, minutes and seconds.

Each screen is dedicated to a specific alarm. Use the ↑ and ↓ keys to move from one screen to the next.

Pressing the ↓ and ↵ keys simultaneously voids the alarms history.

Sub-menu: RAL – Reset
Resets the alarms.

Press the ↵ key to manually reset all active alarms.

2.4.2 Login

Menu: LOG – Login
Insert the 4-digit password that defines the level of access to the menus and parameters.

Press the ↑ and ↓ keys to modify the value of the digit selected.

Press the ↵ key to confirm the value and move on to the next digit, if present, or to login.

The ← and → keys, if present, make it possible to move the cursor to the desired digit.

The passwords for access levels 1 through 3 are defined, respectively with parameters "*L01*", "*L02*" and "*L03*".

GEN			General	Min	Max	Value	U.M.	Text Value
	dSP		Password					
		L01	Level 1	0	9999	1000		
		L02	Level 2	0	9999	2000		
		L03	Level 3	0	9999	3000		

Tab 5 [User interface - Login - General parameters]

If you have not logged in, the access level is 0.

This level does not let you display any parameters and menus belonging to higher access levels.
The level for a given menu and the parameters is defined in the "*mcxs configuration*" file through the MCXShape tool configuration file, (see MCXShape user manual).

2.4.3 Parameters

Menu: PAR - Parameters
Provides access to the parameters.
For a description of the parameters management submenus, (see 15 "Parameters").

2.4.4 Displaying the input/output values

Menu: IO – Input/Output

Sub-menu: IOd – I/O Values

LED Display

The input and output values are displayed in sequence (the ↑ and ↓ keys), indicating the input/output tags on display A ("*AI*" for analog inputs; "*AO*" for analog outputs; "*dI*" for digital inputs and "*dO*" for digital outputs) while the value is shown on display B (analog inputs which are not present or are in alarm mode are indicated with ----).

LCD Display

It is used to call up the three screens that display all inputs and outputs; each screen can display a group of 8 input/output. Use the ↑ and ↓ keys to move from one screen to the next.
The second and third screens are only for the MCX15B and MCX20B.

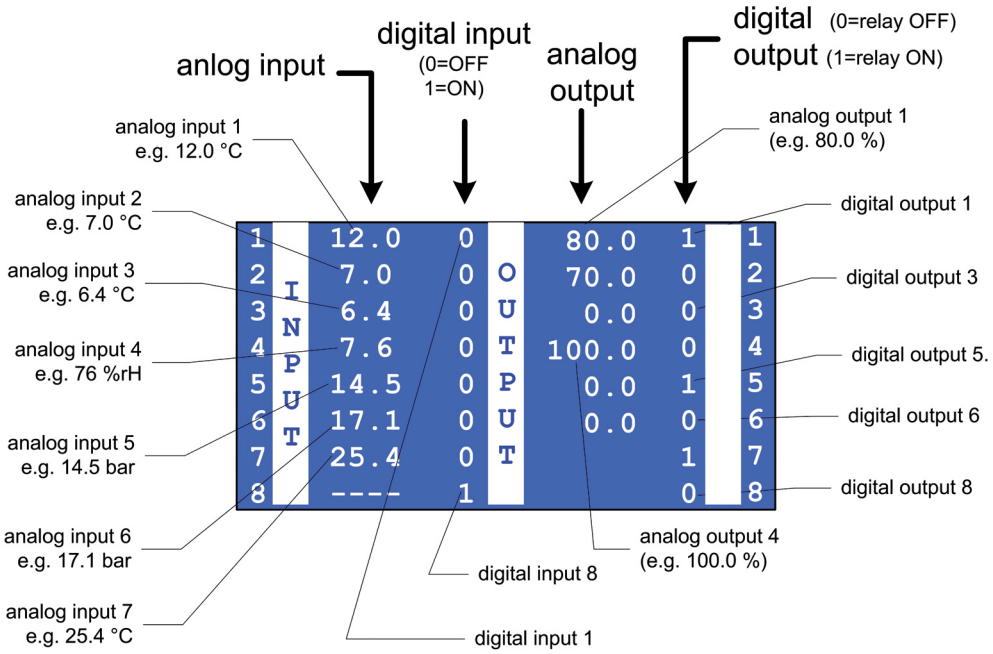


Fig 3 [User interface - Input/output values - LCD display]

Sub-menu: IOC – I/O Config

If enabled in the "*mcxs configuration*" file through the MCXShape tool, makes it possible to access the input/output configuration screens.
For each input/output for the instrument, it is possible to set the type, work field, polarity and function performed.

2.4.5 Utilities

Menu: Utl – Utilities

Sub-menu: COM – Commissioning
Enable the commissioning screen.
A new screen is enabled with detailed information on the unit status.

By pressing the and keys you switch among the following sets of information.

Sub-menu: DEF – Load Default
Load default parameters.

Submenu: RTC – Real Time Clock
Sets date and time on models fitted with real time clock.

Press the and keys to select a field. Press the key to start modifying the value.

Press the and keys to change the value. Press the key to confirm the change or the key to exit without saving it.

Sub-menu: LON – Lock fan
Stop and lock fans.

Sub-menu: LOF – Unlock fan
Unlock fans.

Sub-menu: WIN – Winter
Sets the winter operating mode.

Sub-menu: SUM – Summer
Sets the summer operating mode.

MCX screens	Values description	
DAMPER SEQUENCE	Damper Sequence	
PB · PE · PE ·	control probe	power out
DC · DH ·	cooling active set	heating active set
P1 · P2 ·	changeover probe 1	changeover probe 2

MCX screens	Values description	
HEATS1 · HEATS2 ·	Heat Sequence 1	Heat Sequence 2
PB · PB ·	control probe	control probe
ST · ST ·	active set	active set
P% · P% ·	power out	power out

MCX screens	Values description	
COOLS1 · HUMIDIF ·	Cool Sequence 1	Humidification
PB · PB ·	control probe	control probe
ST · ST ·	active set	active set
P% · P% ·	power out	power out

MCX screens	Values description	
SUPPLY LIMITS	Supply Limits	
TL . HL .	supply temp. low limit power	supply humidity low limit power
TH . HH .	supply temp. high limit power	supply humidity high limit power
ML . IL .	reserved	reserved

MCX screens	Values description	
CASCADE CONTROL	Cascade Control	
TR . TS .	return temperaturepower	supply temperaturelimit power
SH . SUH .	return set heatpower	supply set heat
SC . SUC .	return set cool	supply set cool

MCX screens	Values description	
DEHUMIDIFICATION	Dehumidification	
PP . TC .	control probe	cooling probe
ST . DW .	max humidity set	dew point
P% . CP% .	dehumidification power	cool seq. 1 power by dehum

MCX screens	Values description	
FROST PROTECTION	Frost protection / Frost prevention (if unit is OFF)	
PB . P% .	probe FP1/TC2	antifrost power
ST .	setpoint FP2/ FP4	
BD .	proportional band FP3/FP5	

MCX screens	Values description	
POWER MANAGER [%]	Power manager	
H1P DEHP	heat seq. 1 power	dehumidification power
H2P HUMP	heat seq. 2 power	humidification power
C1P RECP	cool seq. 1 power	recovery (mixing) power

Tab 6 [User interface - MCX screen]

3.0 Configuring the AHU software

The type of AHU to be controlled is defined by configuring the parameters described later in the manual and defining the inputs and outputs to be used to control the various elements that make up the AHU.

Both the parameters and the inputs and outputs can be configured from the instrument user interface, (see 2 "User interface") or from a PC using the "*mcxs configuration*" file and the MCXShape tool, (see MCXShape user manual).

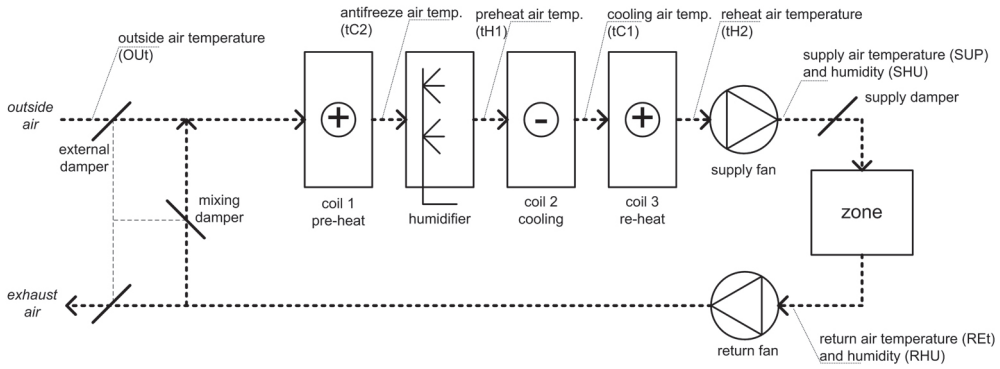


Fig 4 [Configuring the AHU software - Configuration overview]

3.1 Configuration overview

The main steps to adapt the AHU software to your application are as follows.

1. Using the "*mcxs configuration*" file and the MCXShape tool define the input and output you need. (See 3.2 "Input/output configuration") for the list of all the input and output available.
2. Temperature control.
   Assign a temperature control sequence to each of your heating/cooling coils and the actuator type. (See 4 "Coils control").
   Two heating sequences and one cooling sequence are available. For each sequence define the control probe, the setpoint and the PID control parameters.
   (See 6.2 "Heat and cool control sequences").
3. In case of dampers or energy recovery define their control probe, setpoint and changeover conditions. (See 6.1 "Damper control sequences").
   Humidity control
   Define the control probe, setpoint and the way dehumidification is performed.
   (See 11 "Humidity control").
   Supply limits.
   Define the humidity and temperature supply limits which should not be exceeded.
   (See 10 "Controlling the supply temperature limits"), and
   (see 11.4 "Controlling the supply humidity limits").
   Fans control.
   Define the control type, the control probe and if necessary the PID control parameters.
   (See 12 "Supply and return fans").

3.2 Input/output configuration

Below is a complete list of the functions available;
these functions can be assigned independently for each input/output.

ANALOG INPUTS		
Code (LED and LCD)	Description (LCD)	Function
SUP	Supply Temp	Supply air temperature
REt	Return Temp	Return air temperature
OUt	Outside Temp	Outside air temperature
tH1	Preheat Temp	Pre-heating temperature
tH2	Reheat Temp	Re-heating temperature
tC1	Cooling Temp	Cooling temperature
tC2	AntiFreeze	Antifreeze temperature
bAR	Air Pressure	Air pressure
SHU	Sup. Humidity	Supply air humidity
RHU	Ret. Humidity	Return air humidity
CO2	CO2	Air carbon dioxide (CO2) measurement
VOC	VOC	Air volatile organic compounds (VOC) measurement
MIX	Mixed Air	Mixed air temperature
TREM	Remote Set	Setpoint change (remote setpoint)
AMb	Ambient temperature	AI_Tambient
Ax1	Auxiliary Probe 1	Auxiliary temperature

Tab 7 [Configuring the AHU software - Analog inputs configuration]

DIGITAL INPUTS		
Code (LED and LCD)	Description (LCD)	Function
ASF	SupFan Alarm	Supply Fan alarm
SSS	SupFan SafeSW	Supply Fan safety switch (port open)
ASR	RetFan Alarm	Return Fan alarm
CSR	MixDamp Closed	Mixing Damper closed
SSR	RetFan SafeSW	Return Fan safety switch
CSE	ExtDamp Closed	External Damper closed
ONF	ON/OFF	Remote ON/OFF
AFI	Fire Alarm	Fire alarm

DIGITAL INPUTS		
Code (LED and LCD)	Description (LCD)	Function
AAI	Freeze Alarm	Freeze alarm
CH	Summer/Winter	Summer/winter selection
SFW	Supply Flow	Supply flow alarm
RFW	Return Flow	Return flow alarm
SFI	Supply Filter	Supply air filter plugged
RFI	Return Filter	Return air filter plugged
PU1	Coil1 Pump	Coil 1 pump alarm
PU2	Coil2 Pump	Coil 2 pump alarm
PU3	Coil3 Pump	Coil 3 pump alarm
HUM	Humidifier Alarm	Humidifier alarm
REC	Recovery Alarm	Energy recovery alarm
GEN	Generic Alarm	Generic alarm
bA1	Coil1 Alarm	Coil 1 alarm
bA2	Coil2 Alarm	Coil 2 alarm
bA3	Coil3 Alarm	Coil 3 alarm
LOF	Lock Fan	Lock/unlock fans
COE	Comf/Eco	Comfort/economy selection
FDI	FreeHeatCool	Free-heat/free-cool changeover
GD1	Aux alrm 1	Auxiliary alarm 1
GD2	Aux alrm 2	Auxiliary alarm 2
GD3	Aux alrm 3	Auxiliary alarm 3
GD4	Aux alrm 4	Auxiliary alarm 4

Tab 8 [Configuring the AHU software - Digital inputs configuration]

ANALOG OUTPUTS		
Code (LED and LCD)	Description (LCD)	Function
SUF	Supply Fan	Supply Fan control
REF	Return Fan	Return Fan control
RDA	Mixing damper	Mixing damper control
EDA	External Damper	External damper control
HUA	Humidifier	Humidifier control
bA1	Coil1	Coil 1 control

ANALOG OUTPUTS		
Code (LED and LCD)	Description (LCD)	Function
bA2	Coil2	Coil 2 control
bA3	Coil3	Coil 3 control
DHU	Dehumidifier	Dehumidifier control
ERA	Recovery	Energy recovery control

Tab 9 [Configuring the AHU software - Analog outputs configuration]

DIGITAL OUTPUTS		
Code (LED and LCD)	Description (LCD)	Function
ALA	Alarm	Alarm
WAR	Warning	Warning
SUF	Supply Fan	Supply Fan control
REF	REF	Return Fan control
RDD	Mixing Damper	Mixing Damper control
EDD	External Damper	External Damper control
SFL	SupplyFanLow	Low supply fan speed
SFH	SupplyFanHigh	High supply fan speed
RFL	ReturnFanLow	Low return fan speed
RFH	ReturnFanHigh	High return fan speed
dEU	Dehumidifier	External dehumidifier control
HUM	Humidifier	External humidifier control
HUP	HumidPump	Humidifier pump control
ERD	Recovery	Energy recovery control
ERP	Recovery Pump	Energy recovery pump control
b1	Valve1ONOFF	Controls the ON/OFF valve of coil 1
b1O	Valve1Open	Controls opening of 3-point valve of coil 1
b1C	Valve1Close	Controls closing of 3-point valve of coil 1
b11	Coil1Step1	Controls step 1 of coil 1
b12	Coil1Step2	Controls step 2 of coil 1
b13	Coil1Step3	Controls step 3 of coil 1
CP1	Coil1Pump	Coil1 pump control
b2	Valve2ONOFF	Controls the ON/OFF valve of coil 2

DIGITAL OUTPUTS		
Code (LED and LCD)	Description (LCD)	Function
b2O	Valve2Open	Controls opening of 3-point valve of coil 2
b2C	Valve2Close	Controls closing of 3-point valve of coil 2
b21	Coil2Step1	Controls step 1 of coil 2
b22	Coil2Step2	Controls step 2 of coil 2
b23	Coil2Step3	Controls step 3 of coil 2
CP2	Coil2Pump	Coil 2 pump control
b3	Valve3ONOFF	Controls the ON/OFF valve of coil 3
b3O	Valve3Open	Controls opening of 3-point valve of coil 3
b3C	Valve3Close	Controls closing of 3-point valve of coil 3
b31	Coil3Step1	Controls step 1 of coil 3
b32	Coil3Step2	Controls step 2 of coil 3
b33	Coil3Step3	Controls step 3 of coil 3
CP3	Coil3Pump	Coil 3 pump control
dEF	Defrost	Defrost activation
HRE	HeatRequest	Request of heating
CRE	CoolRequest	Request of cooling
G01	Aux alarm 1	Auxiliary alarm 1
G02	Aux alarm 2	Auxiliary alarm 2
G03	Aux alarm 3	Auxiliary alarm 3
G04	Aux alarm 4	Auxiliary alarm 4

Tab 10 [Configuring the AHU software - Digital outputs configuration]

4.0 Coils control

4.1 Assign a control sequence to a coil

There are maximum 3 heating and/or cooling coils composing the AHU.
For each of them it is possible to define its function through the following parameters.

COI			Coils	Min	Max	Value	U.M.	Text Value
	CL1		Coil 1					
		b10	Coil 1 function	0	5	4=H1C1		OFF;HS1;HS2;CS1;H1C1;H2C1
	CL2		Coil 2					
		b40	Coil 2 function	0	5	2=HS2		OFF;HS1;HS2;CS1;H1C1;H2C1
	CL3		Coil 3					
		b70	Coil 3 function	0	5	0=OFF		OFF;HS1;HS2;CS1;H1C1;H2C1

Tab 11 [Coils control - Coils parameters]

Possible values are:

- OFF Coil not used.
- HS1 Heating coil controlled with "*Heat Sequence 1*".
- HS2 Heating coil controlled with "*Heat Sequence 2*".
- CS1 Cooling coil controlled with "*Cool Sequence 1*".
- H1C1 Unique coil for heating or cooling, depending on winter/summer selection.
- Heating is controlled with "*Heat Sequence 1*" and cooling with "*Cool Sequence 1*".
- H2C1 Unique coil for heating or cooling, depending on winter/summer selection.
  Heating is controlled with "*Heat Sequence 2*" and cooling with "*Cool Sequence 1*".

For more detail, (see 6.2 "Heat and cool control sequences"), coils are controlled with heating and cooling control sequences according to the following figure.

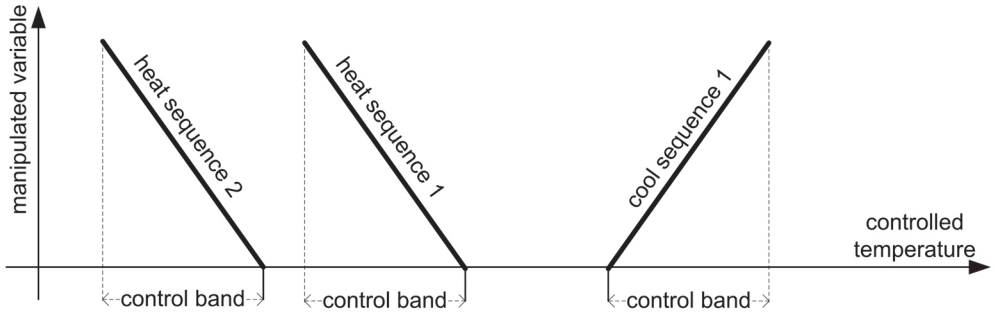


Fig 5 [Coils control - Assign a control sequence to a coil 01]

It is possible to configure more coils controlled with the same control sequence.
In this case they share equally the control band.

Example

Three coils for heating controlled with heat sequence 1; "b10=b40=b70=HS1".

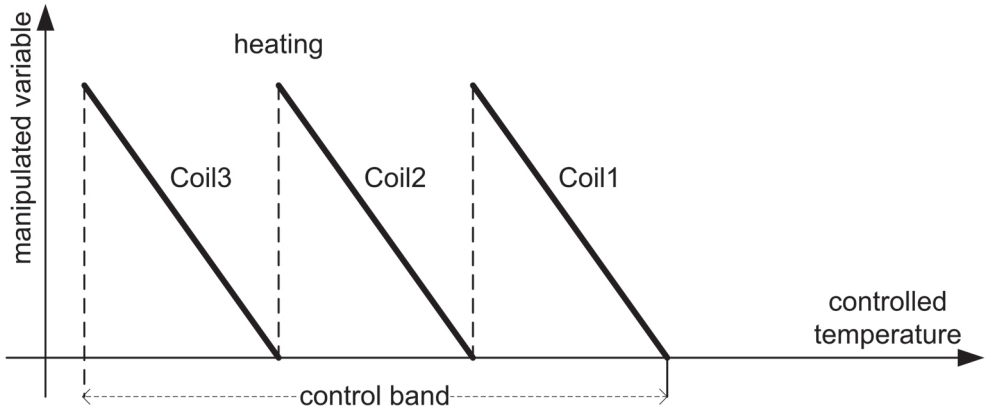


Fig 6 [Coils control - Assign a control sequence to a coil 02]

When a sequence is connected to another one and the integral and/or PID derivative time is different from 0, then when the first sequence reaches 100 % the second sequence is activated.

Vice versa when the second sequences reaches 0 % and stay for 5 s then the first sequence start to decrease.

4.2 Coil output management

The following parameters set the way coil output are managed according to the load demand calculated by the associated temperature control sequences,
(see 6.2 "Heat and cool control sequences").

Through "*b11*", "*b41*", "*b71*" you can define the actuator type for each coil, whether it is a water coil controlled trough a valve or it is a step controlled coil (e.g. electric resistances).
In this case there are 3 possible way of control:

- linear step switch;
- variable step switch;
- binary step switch.

4.3 Valve control

If "*b11, b41, b71=VALVE*", coil is a water coil controlled through a valve. The valve can be ON/OFF, 0/10 V modulating or 3-points valve. Depending on the type of valve to be operated, the following outputs are used:

Coil	Type of valve	Type of output	Output used	
Coil1	ON/OFF	Digital output	b1	Valve1ONOFF
	0/10 V	Analog output	bA1	Coil1
	3-points	Digital output	b1O b1C	Valve1Open to open Valve1Close to close
Coil2	ON/OFF	Digital output	b2	Valve2ONOFF
	0/10 V	Analog output	bA2	Coil2
	3-points	Digital output	b2O b2C	Valve2Open to open Valve2Close to close
Coil3	ON/OFF	Digital output	b3	Valve3ONOFF
	0/10 V	Analog output	bA3	Coil3
	3-points	Digital output	b3O b3C	Valve3Open to open Valve3Close to close

Tab 12 [Coils control - Valve control]

Note

If one of the above output is present, then it is automatically driven by the software, without the need of enabling it.

4.3.1 ON/OFF and 0/10 V valve control

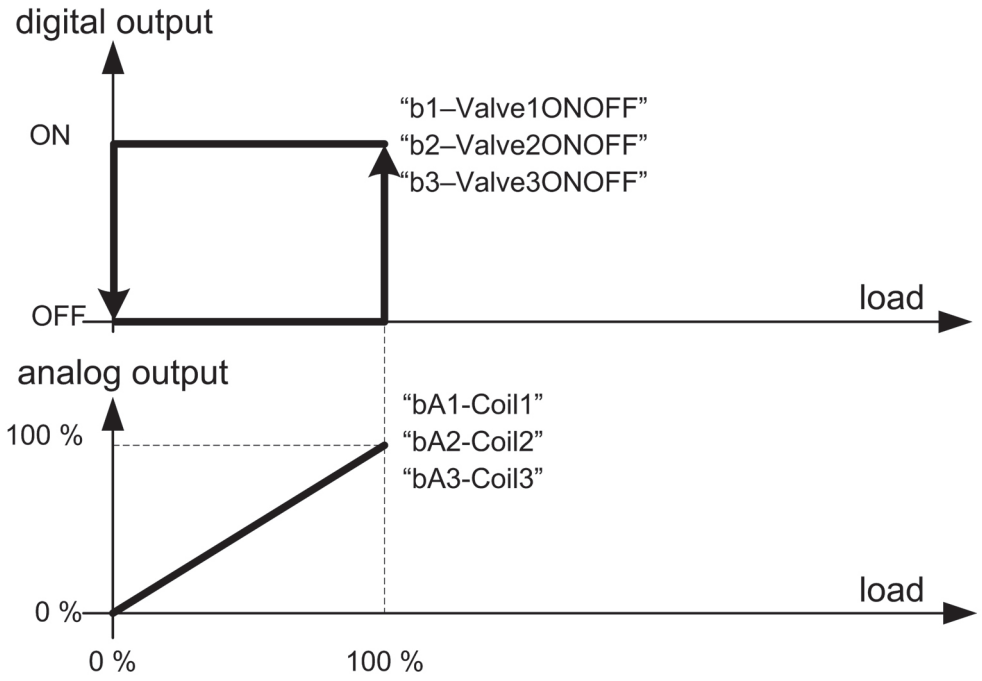


Fig 7 [Coils control - ON/OFF and 0/10 V valve control]

4.3.2 3-point valve control

This is a valve with 3 electrical contacts plus the power supply:

- common;
- open;
- close.

The following parameters are used to configure a 3 point valve.

COI			Coils	Min	Max	Value	U.M.	Text Value
	CL1		Coil 1					
		b13	Valve full excursion time	0	9999	75	SEC	
		b14	Valve minimum variation	0	50	2	%	
		b15	Valve forcing period	0	9999	60	MIN	
		b16	Valve range	0	50	2	%	
	CL2		Coil 2					
		b43	Valve full excursion time	0	9999	75	SEC	
		b44	Valve minimum variation	1	50	2	%	
		b45	Valve forcing period	0	9999	60	MIN	

COI			Coils	Min	Max	Value	U.M.	Text Value
		b46	Valve range	1	50	2	%	
	CL3		Coil 3					
		b73	Valve full excursion time	0	9999	20	SEC	
		b74	Valve minimum variation	0	50	2	%	
		b75	Valve forcing period	0	9999	60	MIN	
		b76	Valve range	1	50	2	%	

Tab 13 [Coils control - 3-point valve control - Coils parameters]

b13, b43, b73 – Valve full excursion time
Indicates the time the valve takes to go from fully closed to fully open. The valve control algorithm uses this time to calculate the activation time for the outputs "*Valve1-2-3 Open*" and "*Valve1-2-3 Close*".

Depending on the length of time the contact is activated, the extent to which the valve is opened varies from 0 % to 100 % of the excursion time. The relays are never activated simultaneously, thus the valves either open, or close, or remain still.

To obviate the lack of feedback that provides exact information on the valve opening step, the following rules apply:

- when the instrument is turned ON, the valve is closed or open all the way for an amount of time equal to the excursion time + 25 %, and the position of the valve is realigned before regulation is started.
- whenever the temperature regulation requires opening or closing a valve all the way, the program increases the opening or closing relay activation time by 25 % to ensure that the valve opens or closes all the way.

b14, b44, b74 – Valve minimum variation
This is the minimum shift performed with the valve.

b15, b45, b75 - Valve forcing period
If the valve is fully open or fully closed, the opening or closing command is periodically sent for a time equal to 25 % of the full excursion time. The frequency of this command is defined in this parameter.

b16, b46, b76 – Valve range
If the valve is commanded to a position lower than this parameter (as a percentage of the fully open or fully closed position), the valve will open or close all the way.

"b15=5 %" means that a request for a 4 % position will cause the valve to fully close and a request for 96 % will cause it to open all the way.

4.4 Step control

If "*b11, b41, b71= LIN STEP*" or "*VAR STEP*" or "*BIN STEP*", coil is step controlled.

To activate the steps (e.g. electric resistances or rows), use the following outputs:

Coil	Type of output	Output used	
Coil1	Digital output	b11 b12 b13	Coil1Step1 Coil1Step2 Coil1Step3
	Analog output	bA1	Coil1
Coil2	Digital output	b21 b22 b23	Coil2Step1 Coil2Step2 Coil2Step3
	Analog output	bA2	Coil2
Coil3	Digital output	b31 b32 b33	Coil3Step1 Coil3Step2 Coil3Step3
	Analog output	bA3	Coil3

Tab 14 [Coils control - Step control]

4.4.1 Linear step switch

If "*b11, b41, b71= LIN STEP*", coil is step controlled in a linear way.

When linear step switch is selected, you have to set the number of steps, 1..3, for each coil.

COI			Coils	Min	Max	Value	U.M.	Text Value
	CL1		Coil 1					
		b12	Number of steps	0	3	1		
	CL2		Coil 2					
		b42	Number of steps	0	3	2		
	CL3		Coil 3					
		b72	Number of steps	0	3	3		

Tab 15 [Coils control - Linear step switch - Coils parameters]

Linear step control is described in the following figure in case of 2 steps. Up to 3 steps are managed.

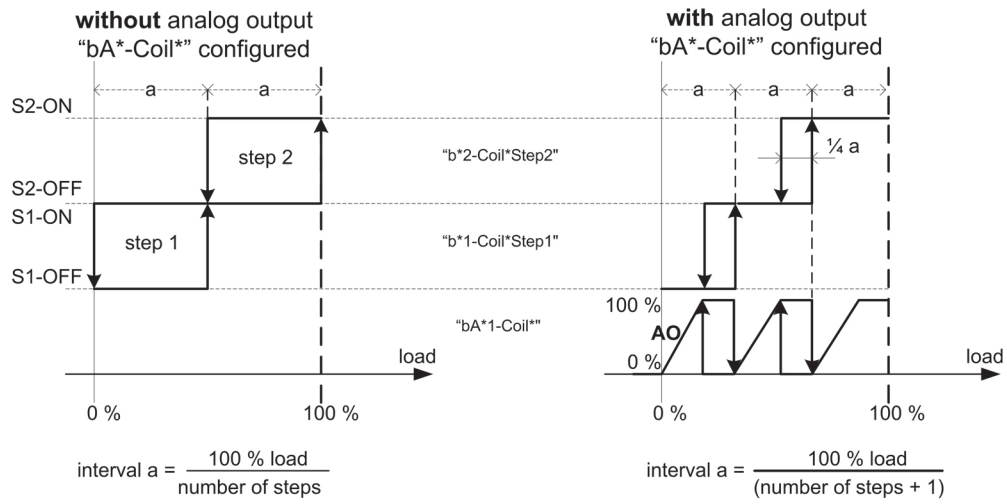


Fig 8 [Coils control - Linear step switch]

4.4.2 Variable step switch

If "*b11, b41, b71=VAR STEP*", coil is step controlled in a variable way.

When variable step switch is selected, you have to set the number of steps (1..3) for each coil and for each step (of each coil) the ON and OFF switching point in % of the load demand.

COI			Coils	Min	Max	Value	U.M.	Text Value
	CL1		Coil 1					
		b12	Number of steps	0	3	3		
		b17	Step 1 ON	0,0	100,0	33,0	%	
		b18	Step 1 OFF	0,0	100,0	0,0	%	
		b19	Step 2 ON	0,0	100,0	66,0	%	
		b20	Step 2 OFF	0,0	100,0	33,0	%	
		b21	Step 3 ON	0,0	100,0	100,0	%	
		b22	Step 3 OFF	0,0	100,0	66,0	%	
	CL2		Coil 2					
		b42	Number of steps	0	3	3		
		b47	Step 1 ON	0,0	100,0	33,0	%	
		b48	Step 1 OFF	0,0	100,0	0,0	%	
		b49	Step 2 ON	0,0	100,0	66,0	%	
		b50	Step 2 OFF	0,0	100,0	33,0	%	
		b51	Step 3 ON	0,0	100,0	100,0	%	
		b52	Step 3 OFF	0,0	100,0	66,0	%	

COI			Coils	Min	Max	Value	U.M.	Text Value
	CL3		Coil 3					
		b72	Number of steps	0	3	3		
		b77	Step 1 ON	0,0	100,0	33,0	%	
		b78	Step 1 OFF	0,0	100,0	0,0	%	
		b79	Step 2 ON	0,0	100,0	66,0	%	
		b80	Step 2 OFF	0,0	100,0	33,0	%	
		b81	Step 3 ON	0,0	100,0	100,0	%	
		b82	Step 3 OFF	0,0	100,0	66,0	%	

Tab 16 [Coils control - Variable step switch - Coils parameters]

Variable step control is described in the following figure in case of 2 steps. Up to 3 steps are managed.

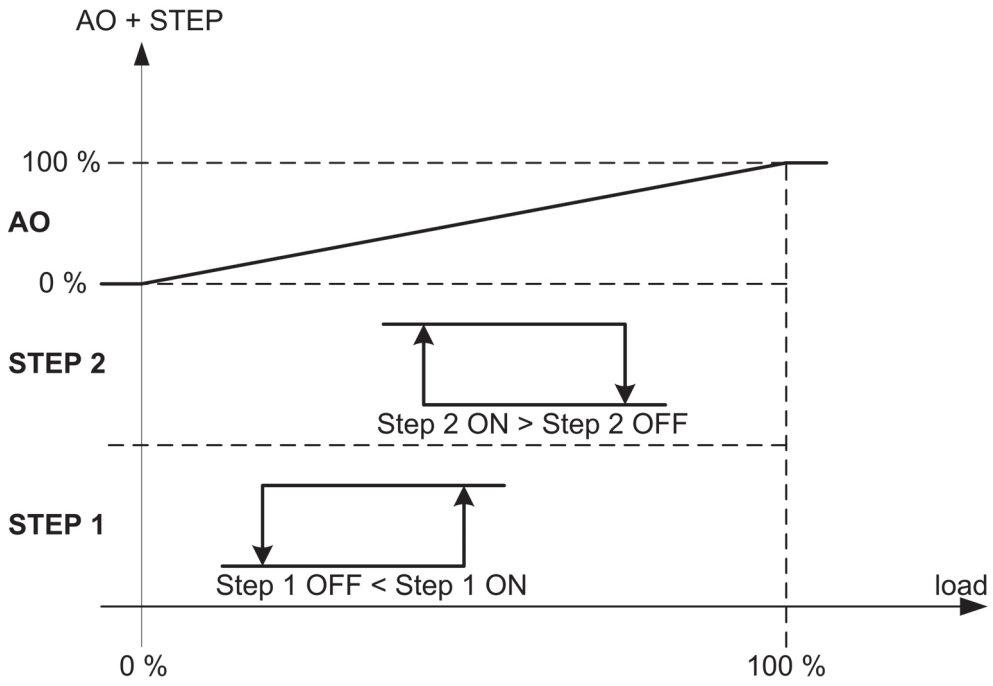


Fig 9 [Coils control - Variable step switch]

4.4.3 Binary step switch

If "*b11, b41, b71=LIN STEP*", coil is step controlled in a binary way.

When binary step switch is selected, you have to set the number of steps, 1..3, for each coil.

COI			Coils	Min	Max	Value	U.M.	Text Value
	CL1		Coil 1					
		b12	Number of steps	0	3	3		
	CL2		Coil 2					
		b42	Number of steps	0	3	3		
	CL3		Coil 3					
		b72	Number of steps	0	3	3		

Tab 17 [Coils control - Binary step switch - Coils parameters]

Binary step control is described in the following figure in case of 2 steps. Up to 3 steps are managed.

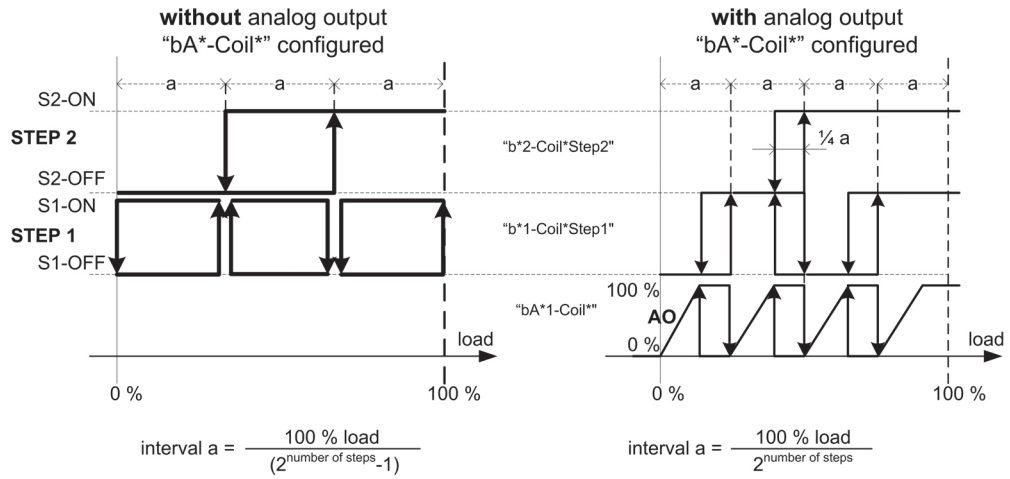


Fig 10 [Coils control - Binary step switch]

4.5 Locking sequences

For each coil it is possible to lock the cooling or heating control if the outside temperature measured with the "*OUT – Outside Temp*" probe goes beyond the following limits.

COI			Coils	Min	Max	Value	U.M.	Text Value
	CL1		Coil 1					
		b29	Cooling lock	-40,0	100,0	-30,0	°C	
		b30	Heating lock	-40,0	100,0	90,0	°C	
	CL2		Coil 2					
		b59	Cooling lock	-40,0	100,0	-30,0	°C	
		b60	Heating lock	-40,0	100,0	90,0	°C	
	CL3		Coil 3					
		b89	Cooling lock	-40,0	100,0	-30,0	°C	
		b90	Heating lock	-40,0	100,0	90,0	°C	

Tab 18 [Coils control - Locking sequences - Coils parameters]

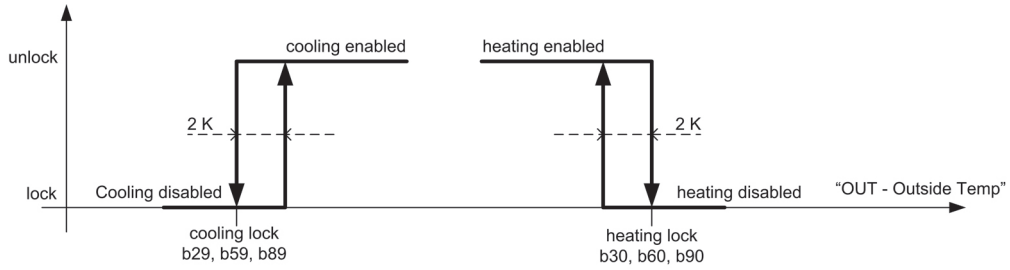


Fig 11 [Coils control - Locking sequences]

4.6 Pumps control

Is possible to managed one pump for each coil through the following digital output:

Coil	Type of output	Output used	
Coil 1	Digital output	CP1	Coil1Pump
Coil 2		CP2	Coil2Pump
Coil 3		CP3	Coil3Pump

Tab 19 [Coils control - Pumps control]

If present, the pumps are activated when request is sent to the corresponding coil.
You can define the load percentage to switch ON the pump via "*PON*" parameter and to switch it OFF, via "*POF*" parameter.

Example

Pump switches ON at 5 % and OFF at 0 %.

You can also define a switch OFF delay "*POd*" for the pumps.

PUM			Pumps	Min	Max	Value	U.M.	Text Value
	STU		Setup					
		POd	Pump delay at OFF	0	9999	1	SEC	
		PON	Power request activation	0,0	100,0	5,0	%	
		POF	Power request deactivation	0,0	100,0	0,0	%	
		PFr	Outside temperature ON	-50,0	10,0	4,0	°C	

Tab 20 [Coils control - Pumps control - Pumps parameters]

4.6.1 Pumps winter start

All the configured pumps will be operated if the outside temperature goes below a fixed limit "*PFr*" to prevent freezing. The "*ice*" blinking icon signals this function.

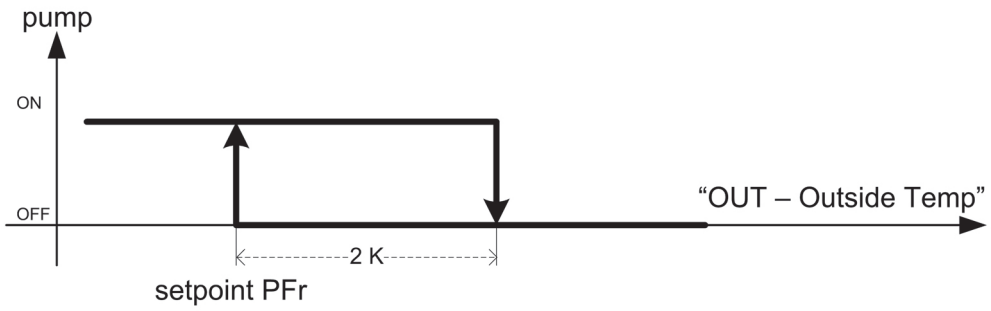


Fig 12 [Coils control - Pumps winter start]

(See 9 "Frost protection") for further actions to prevent frost.

4.7 Heat/cool selection

The selection between the 2 possible modes is as follows.

COI			Coils	Min	Max	Value	U.M.	Text Value
	HCC		HeatCool Coil					
		HC1	Winter/Summer probe selection	0	10	7=tC2		NO;SUP;REt;OUt;tH1;tH2;tC1;tC2; MIX;SUM;WIN
		HC2	Setpoint	-15,0	90,0	21,0	°C	
		HC3	Hysteresis	0,1	90,0	3,0	K	

Tab 21 [Coils control - Heat/cool selection - Coils parameters]

1. If "*HC1=NO*", change mode "*Heat/Cool*" can be done:
   - from the digital input "*CH - Summer/Winter*", if present. With "*input polarity=N.O.*", when the input is open the summer mode is selected and thus coil is used for cooling;
   - from the "*Utilities*" menu (see 2.4.5 "Utilities").

2. If "*HC1<>NO*", change mode is done:
   - from a comparison between the probe defined in "*HC1*" and the setpoint "*HC2*", (see figure). When this mode is enabled ("*HC1*" other than 0) it has priority over all the others. The PID of the cooling sequences in winter mode and the PID of the heating sequences in summer mode will be disabled if the parameter Winter/Summer probe selection "*HC1*" is set to return "*RET*".

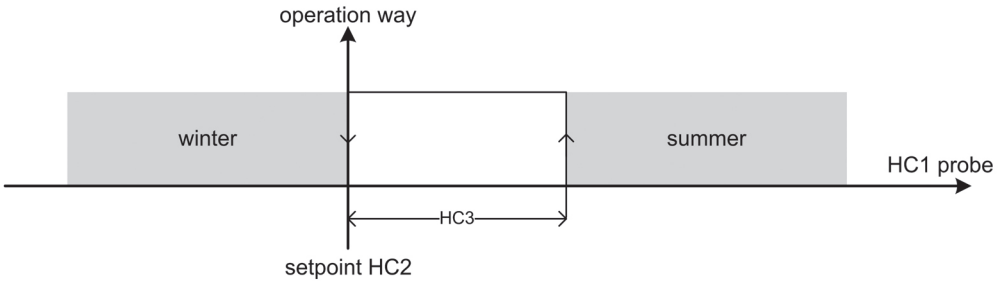


Fig 13 [Coils control - Heat/cool selection]

3. If "*HC1=SUM*", application works only in Summer mode.
4. If "*HC1=WIN*", application works only in Winter mode.

Note

Summer/winter selection has influence over the way of controlling fans.
(See 12.1 "Type of supply and return fans").

4.8 Cooling coil defrost control

COI			Coils	Min	Max	Value	U.M.	Text Value
	dEF		Defrost					
		dE1	Probe selection	0	7	0=NO		NO;SUP;REt;OUt;tH1;tH2;tC1;tC2
		dE2	Setpoint	-15,0	90,0	5,0	°C	
		dE3	Hysteresis	0,1	20,0	2,0	K	

Tab 22 [Coils control - Cooling coil defrost control - Coils parameters]

If enabled ("*dE1*" other than 0), the control is performed according to the value read on the probe selected with "*dE1*", and comparing the reading to setpoint "*dE2*" and hysteresis "*dE3*".

If the temperature is lower than the setpoint, a defrost output "*DEF - Defrost*" is activated.
It is disabled when the value is above the setpoint + hysteresis.

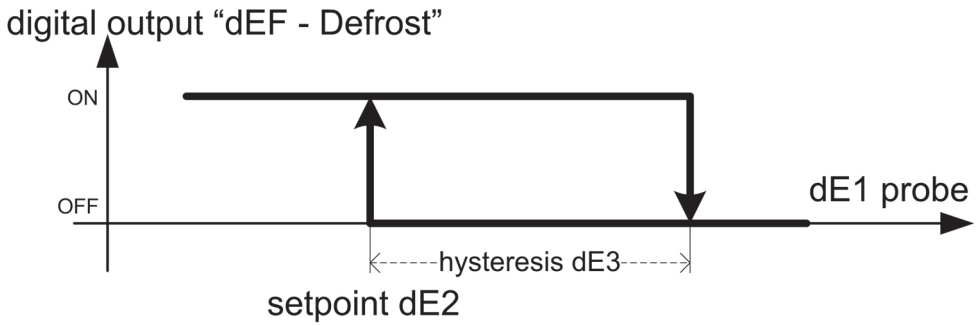


Fig 14 [Coils control - Cooling coil defrost control]

4.9 Heat/cool request

Is possible to managed 2 output signaling heat and cool request.

Type of output	Output used	
Digital output	HRE	HeatRequest
	CRE	CoolRequest

Tab 23 [Coils control - Heat/cool request]

"*HRE – HeatRequest*" is ON when the load demand from "*Heat Sequence*" 1 or 2 is greater than 0.

"*HCE – CoolRequest*" is ON when the load demand from "*Cool Sequence*" 1 is greater than 0.

5.0 Dampers and energy recovery control

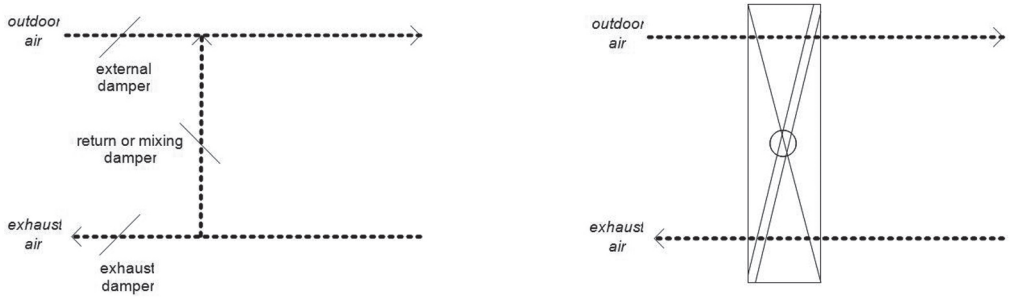


Fig 15 [Dampers and energy recovery control - Damper sequence]

Dampers and energy recovery unit are both controlled with the same control sequence, called "*Damper Sequence*", (see 6.1 "Damper control sequences").

5.1 External and mixing dampers

The external damper load demand "*Pext*" is calculated by the damper sequence, (see 6.1 "Damper control sequences").

The mixing damper load demand "*Pmix*" is calculated as antagonistic to the external damper "*Pmix=100-Pext*".

External and mixing dampers can be ON/OFF or modulating.
If they are not mechanically linked, a separated output for each damper is available.

Depending on the type of damper to be operated, the following outputs are used:

Type of damper	Type of output	Output used	
ON/OFF	Digital output	RDD	Mixing Damper
		EDD	External Damper
0/10 V	Analog output	RDA	Mixing Damper
		EDA	External Damper

Tab 24 [Dampers and recovery control - External and mixing dampers]

In case of coil alarm or fan alarm, the external damper is completely closed (0 V on analog output). This is important in winter period. Cold air should not go to room and to coils in case of fan alarm.

5.1.1 ON/OFF dampers

If dampers are of the ON/OFF type, they are controlled by the digital outputs "*RDD - Mixing Damper*" and "*EDD - External Damper*".

Since their operation is mutually antagonistic, opening one closes the other. Opening occurs when the demand is for more than 50 %. When both require 50 %, the mixing damper opens.

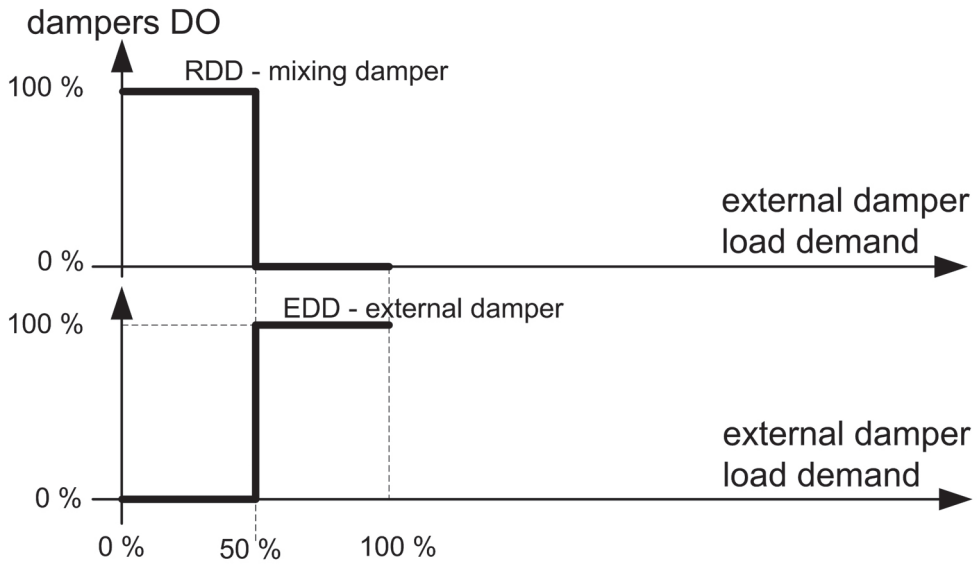


Fig 16 [Dampers and energy recovery control - ON/OFF dampers]

5.1.2 0/10 V dampers

If dampers are of the modulating type, they are controlled by the analog outputs "*RDA - Mixing Damper*" and "*EDA - External Damper*". Since their operation is mutually antagonistic, if the external damper is opened to 25 %, the mixing damper will be opened to 75 %, as described in the following figure.

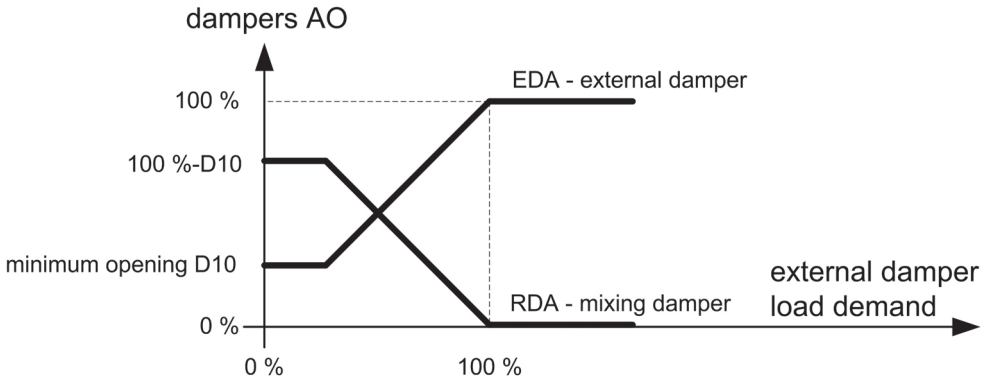


Fig 17 [Dampers and energy recovery control - 0/10 V dampers]

5.1.3 Damper locked

The external damper locked alarm "*A02*" and mixing damper locked alarm "*A05*" indicates that the digital input used to monitor damper opening "*CSE - ExtDamp Closed*" and "*CSR - MixDamp Closed*" signals that the damper is closed and, at the same time, the damper control is active for at least 3 s.

5.2 Energy recovery

The energy recovery load demand is calculated by the damper sequence as it is for the mixing damper, (see 6.1 "Damper control sequences").

It is possible to manage the following output as described in the table.

Type of output	Output used	
Digital output	ERD	Recovery
	ERP	Recovery Pump
Analog output	ERA	Recovery

Tab 25 [Dampers and recovery control - Energy recovery]

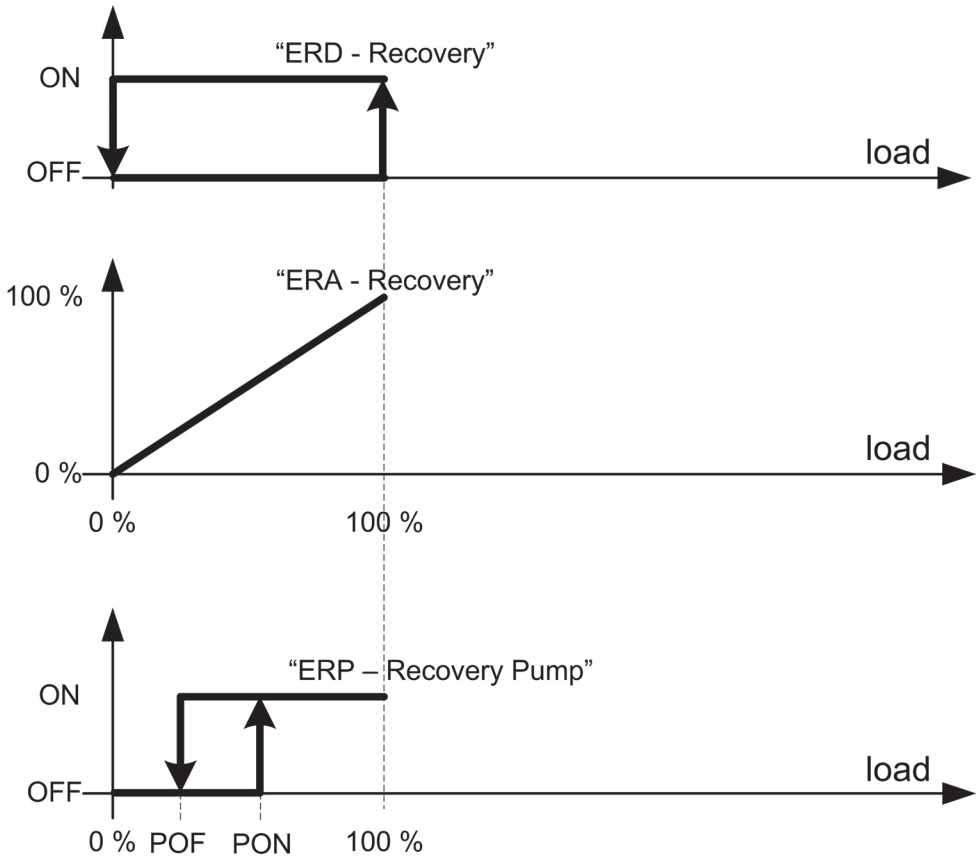


Fig 18 [Dampers and energy recovery control - Energy recovery]

(See 4.6 "Pumps control") for how to control the recovery pump.

6.0 Temperature control sequences

To control temperature are managed some control sequences. Two are dedicated to dampers, the others are, two for heating and one for cooling process. Must be assigned to the desired coil.

6.1 Damper control sequences

Damper sequences are used to manage the external damper, mixing damper and energy recovery. The mixing damper and the energy recovery are antagonistic to the external damper.
Hereafter we refer mainly to the external damper.

There are two control sequences dedicated to dampers, one for heating in winter time and one for cooling in summer time.
The damper control sequences are configured using the following parameters:

TCT			Temp Control	Min	Max	Value	U.M.	Text Value
	DAP		Damper Setup					
		D01	Control probe	0	9	1=SUP		NO;SUP;REt;OUt;tH1;tH2;tC1; tC2;MIX;AMb
		D07	Changeover probe 1	0	9	1=REt		SUP;REt;OUt;tH1;tH2; tC1;tC2;MIX;AMb;DI
		D08	Changeover probe 2	0	9	2=OUt		SUP;REt;OUt;tH1;tH2;tC1; tC2;MIX;AMb;SET
		D09	Offset changeover (MECHSET)	-99,0	20,0	0,3	K	
		D10	Minimum opening ext damper	0	D11	10	%	
		D11	Maximum opening ext damper	D10	100	100	%	
		D12	Recovery output inversion	0	1	0=NO		
		D13	External damper output inversion	0	1	0=NO		
	DAC		Damper Cool Seq.					
		D02	Cool setpoint selection	0	3	0=MAIN		MAIN;CASCADE;LS1;LS2;
		D21	Control type	0	2	0=CHP		CHP;INV;DIR
		D04	Offset	-20,0	20,0	0,0	K	
		D06	Proportional band	0,1	20,0	5,0	K	
		D16	Integral time	0	9999	300	SEC	
		D17	Derivative time	0	9999	0	SEC	
	DAH		Damper Heat Seq.					
		D03	Heat setpoint selection	0	2	0=MAIN		MAIN;CASCADE;LS1;LS2;

TCT			Temp Control	Min	Max	Value	U.M.	Text Value
		D23	Control type	0	2	0=CHP		CHP;INV;DIR
		D05	Offset	-20,0	20,0	0,0	K	
		D20	Proportional band	0,1	20,0	5,0	K	
		D18	Integral time	0	9999	300	SEC	
		D19	Derivative time	0	9999	0	SEC	

COI			Coils	Min	Max	Value	U.M.	Text Value
	DMP		Damper					
		d00	Damper function	0	3	3=AUTO		NO;DCS;DHS;AUTO

Tab 26 [Temperature control sequences - Temperature control parameters]

First with "*D01*" you have to define the control probe used to control the dampers.

Then for each damper sequence you have to define the following control parameters:

- "*D02*", "*D03*": is the setpoint used by the damper sequence.
  Possible values are:
  - **MAIN**: main active temperature setpoint "*ATS*" ("*STH*" for heating and "*STC*" for cooling, eventually compensated), (see 6.4 "Main setpoint").
  - **CASCADE**: supply temperature setpoint coming from the cascade controller, (see 7 "Cascade control").
  - **LS1**: local setpoint "*LS1*", (see 6.5 "Local setpoint").
  - **LS2**: local setpoint "*LS2*", (see 6.5 "Local setpoint").
- "*D21*", "*D23*": is the control type, direct or inverse. In the inverse control type, as temperature increases, the external damper closes. In the direct control type, as temperature increases, the external damper opens.
  (see 6.1.1 "Control type (free-cooling/free-heating) selection").
- "D04", "D05": offset of the setpoint. Through the offset "*D04*" and "*D05*" you can define the modulation starting point of the damper in cooling and in heating respect to the selected setpoint.

Note

In the next figures are displayed positive values of the offset.

- ("*D06*", "*D16*", "*D17*")
  ("*D20*", "*D18*", "*D19*"): PID parameters for damper control.

The parameter "*d00*" set the sequence used to control the damper; possible selections are:

- "*d00=NO*": no damper control;
- "*d00=DCS*": damper cool sequence.

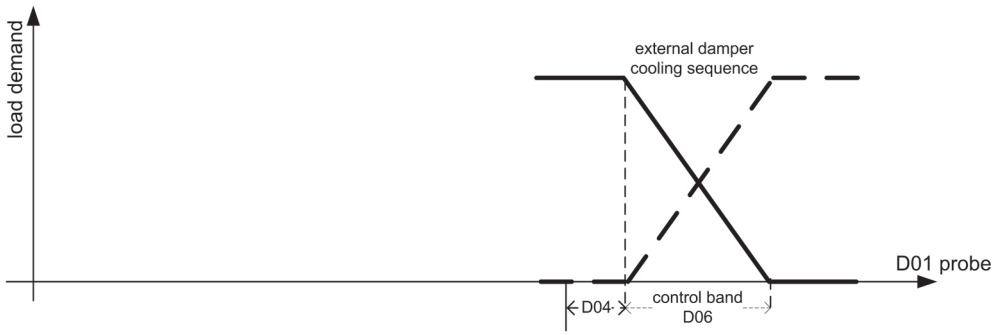


Fig 19 [Temperature control sequences - d00=DCS]

- "*d00=DHS*": damper heat sequence;

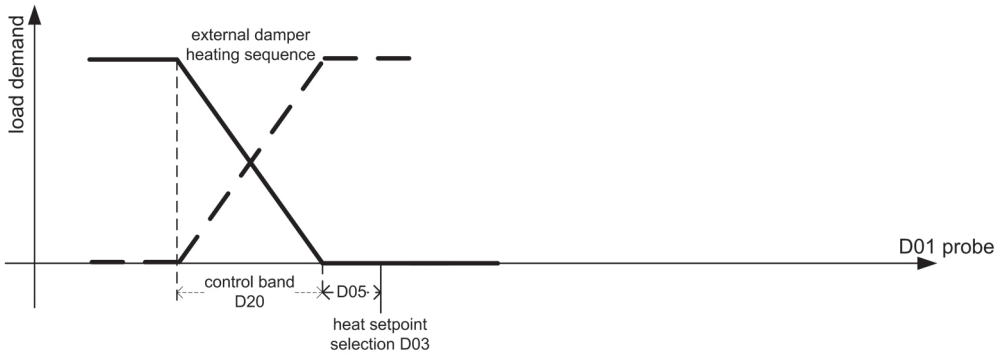


Fig 20 [Temperature control sequences - d00=DHS]

- *"d00=AUTO"*: the used sequence (damper heat sequence or damper cool sequence) is set by the summer/winter definition (see next figure).

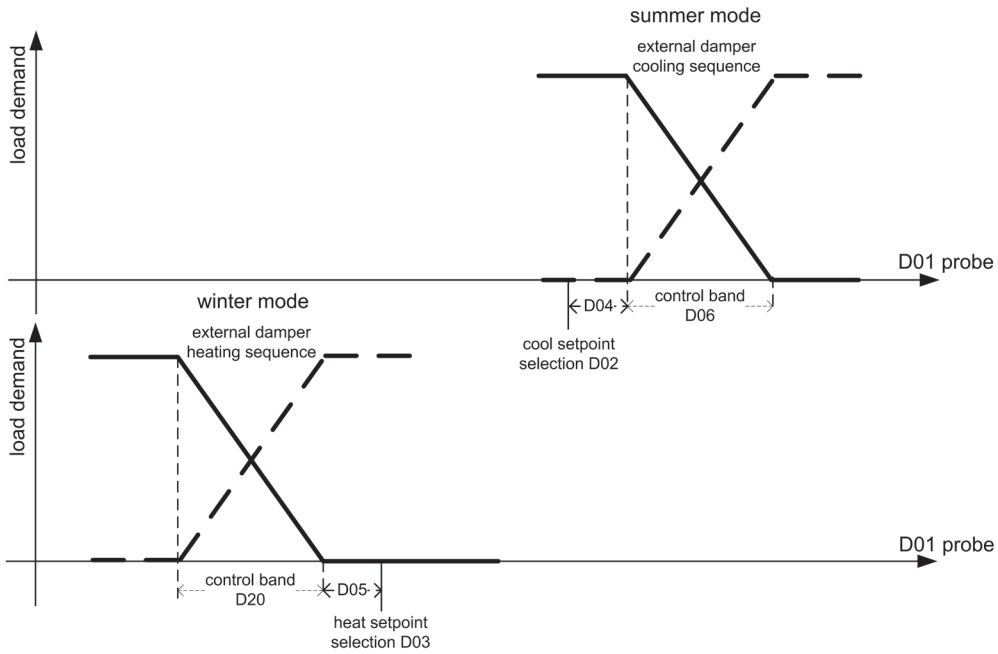


Fig 21 [Temperature control sequences - d00=AUTO]

Note

At start up all the I/O are blocked until the "dOt" and "AOt" time is elapsed. After that the external damper analog output is set to 10 V for a fixed time of 5 s. Then input/output are controlled as requested by the control algorithm.

6.1.1 Control type (free-cooling/ free-heating) selection

The selection between direct or inverse control type is obtained through "*D21*" parameter for the damper cooling sequence and through "*D23*" parameter for the damper heating sequence in the following ways.

- "*D21, D23=CHP*": The control type (direct or inverse) is automatically defined by the changeover condition (free-cool and free-heat).

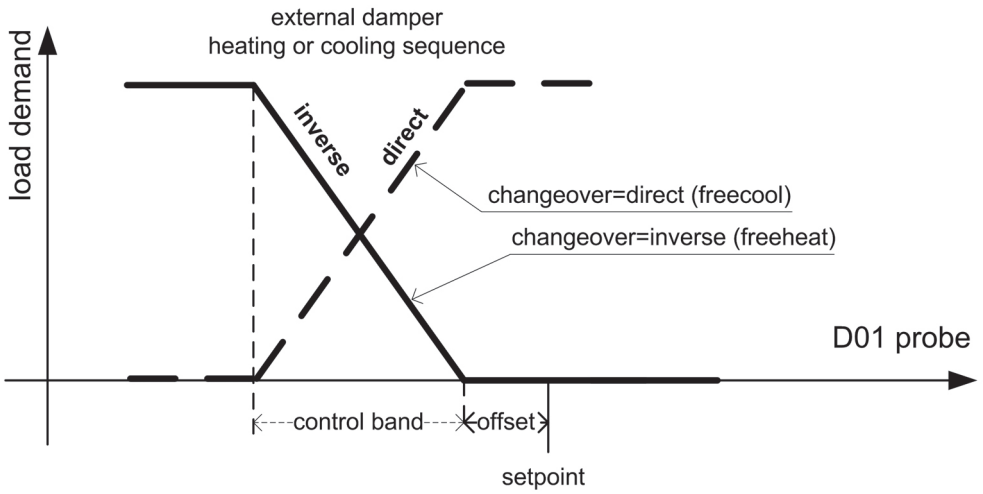


Fig 22 [Temperature control sequences - D21, D23=CHP]

- "*D21, D23=INV*": Inverse control type (free-heat only). As temperature decreases, the external damper opens but only if the changeover condition is inverse (it means that it is convenient to open the damper). If the inverse control mode is selected but the changeover condition is direct, the damper is fixed to its minimum opening.

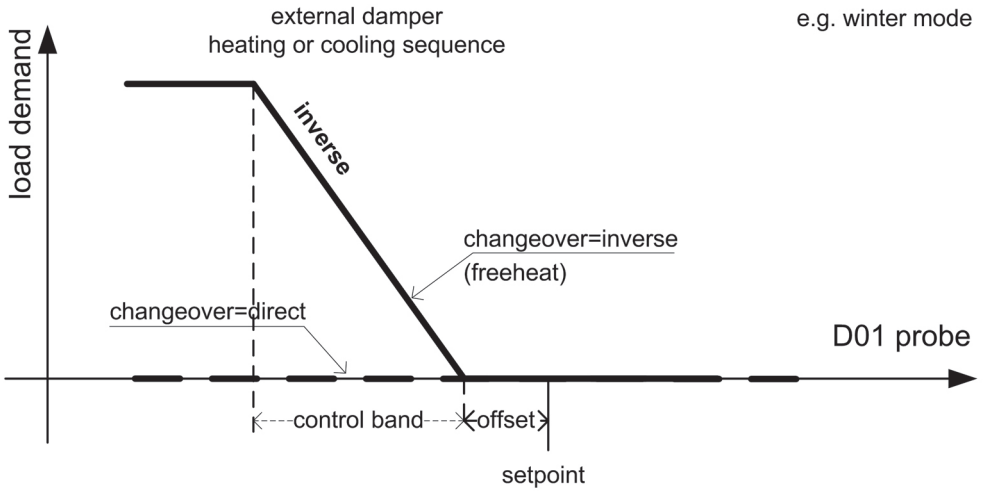


Fig 23 [Temperature control sequences - D21, D23=INV]

- *"D21, D23=DIR"*: Direct control type (free-cool only). As temperature increase, the external damper opens but only if the changeover condition is direct (it means that it is convenient to open the damper).
  If the direct control mode is selected but the changeover condition is inverse, the damper is fixed to its minimum opening.

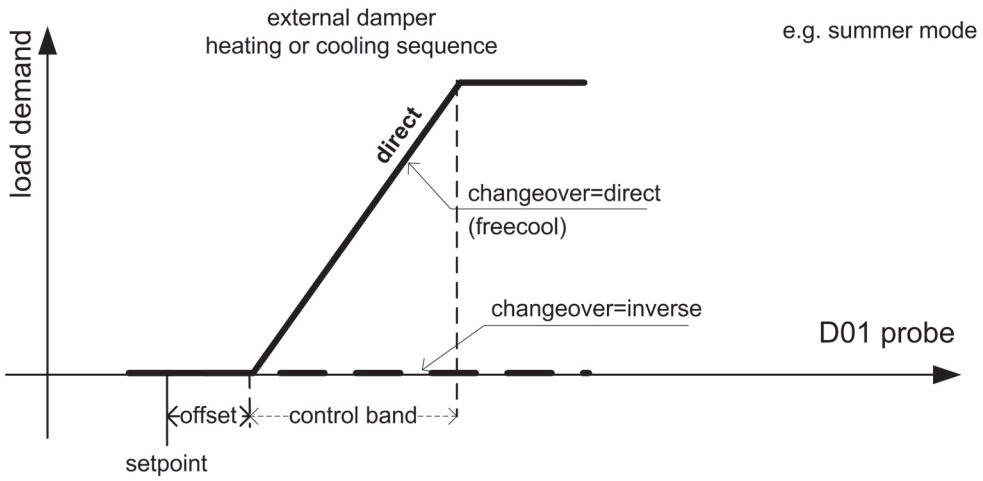


Fig 24 [Temperature control sequences - D21, D23=DIR]

Changeover condition
The condition to define if it's convenient to open or to close the damper is defined in the following way:

- from the comparison of two probes assigned through parameters "*D07*" and "*D08*":
  - if "*D07*" is different from "*DI*" and "*D07*" is different from SET;
  - if "*D07>=D08+D09*" then changeover=direct (free-cool);
  - If "*D07<=D08*" then changeover=inverse (free-heat);

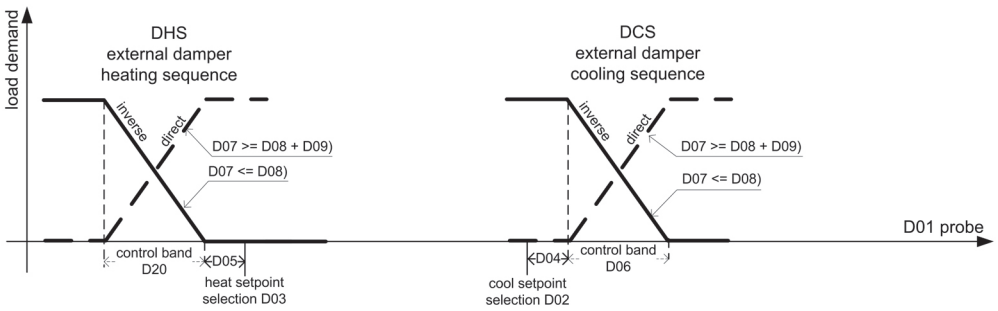


Fig 25 [Temperature control sequences - Changeover condition]

  - If "*D07=DI*", through digital input "*FDI - FreeHeatCool*";

Note

if, during the input configuration phase, you set "Polarity=N.C"., free-heat is selected when the input is open.

- if "*D08=SET*", then probe selected with "*D07*" is compared to parameter "*D09*";
- if probe "*D07<=D09*" then changeover=inverse (free-heating);
- if probe "*D07>=D09+2,0*" then changeover=direct (free-cooling).

The changeover condition is signalled by the icon for free-heat and by the icon for free-cool.

Note

If any of the selected input for defining the changeover condition is not available the damper stays open at its minimum position.

6.1.2 Minimum and maximum opening

For granting a minimum amount of fresh air, it is possible to define a minimum opening of the external damper with "*D10*" (when load demand is 0 %).

Parameter "*D11*" sets the maximum opening of the external damper (when load demand is 100 %).

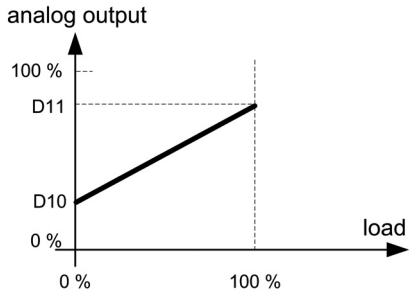


Fig 26 [Temperature control sequences - Minimum and maximum opening]

6.2 Heat and cool control sequences

There are 2 possible heat control sequences, "*HS1*" and "*HS2*", and 1 cool control sequence, "*CS1*", which can be used to control coils, (see 4.1 "Assign a control sequence to a coil").

Each control sequence is configured using the following parameters:

TCT			Temp Control	Min	Max	Value	U.M.	Text Value
	HS1		Heat Sequence 1					
		H11	Control probe	0	9	1=SUP		NO;SUP;REt;OUt;tH1;tH2; tC1;tC2;MIX;AMb
		H12	Setpoint selection	0	4	MAIN		MAIN;CASC;LS1;LS2;DHS
		H13	Offset	0,0	15,0	0,0	K	
		H14	Proportional band	0,1	20,0	5,0	K	
		H15	Integral time	0	9999	300	SEC	

TCT			Temp Control	Min	Max	Value	U.M.	Text Value
		H16	Derivative time	0	9999	0	SEC	
	CS1		Cool Sequence 1					
		C11	Control probe	0	9	1=SUP		NO;SUP;REt;OUt;tH1; tH2;tC1;tC2;MIX;AMb
		C12	Setpoint selection	0	4	MAIN		MAIN;CASC;LS1;LS2;DCS
		C13	Offset	0,0	10,0	0,0	K	
		C14	Proportional band	0,1	20,0	5,0	K	
		C15	Integral time	0	9999	300	SEC	
		C16	Derivative time	0	9999	0	SEC	
		C17	Lock condition	0	3	ALL		NO;HS1;HS2;ALL
	HS2		Heat Sequence 2					
		H21	Control probe	0	9	1=SUP		NO;SUP;REt;OUt;tH1; tH2;tC1;tC2;MIX;AMb
		H22	Setpoint selection	0	5	HS1		MAIN;CASC;LS1;LS2,DHS;HS1
		H23	Offset	0,0	10,0	0,0	K	
		H24	Proportional band	0,1	20,0	5,0	K	
		H25	Integral time	0	9999	300	SEC	
		H26	Derivative time	0	9999	0	SEC	

Tab 27 [Temperature control sequences - Temperature parameters]

For each control sequence you have to define respectively:

- "*H11*", "*C11*", "*H21*": the control probe;
- "*H12*", "*C12*", "*H22*": the setpoint used.

Possible values for "*H12*" are:

- **MAIN**: main setpoint (STH for heating and STC for cooling, eventually compensated), (see 6.4 "Main setpoint").
- **CASC**: supply temperature setpoint coming from the cascade controller, (see 7 "Cascade control").
- **LS1**: local setpoint "*LS1*", (see 6.5 "Local setpoint").
- **LS2**: local setpoint "*LS2*", (see 6.5 "Local setpoint").
- **DHS**: connected to the "*Dumper Heat Sequence*".

Possible values for "*C12*" are:

- **MAIN**: main setpoint (STH for heating and STC for cooling, eventually compensated), (see 6.4 "Main setpoint").
- **CASC**: supply temperature setpoint coming from the cascade controller, (see 7 "Cascade control").
- **LS1**: local setpoint "*LS1*", (see 6.5 "Local setpoint").
- **LS2**: local setpoint "*LS2*", (see 6.5 "Local setpoint").
- **DCS**: connected to the "*Dumper Cool Sequence*".

Possible values for "*H22*" are:

- **MAIN**: main setpoint (STH for heating and STC for cooling, eventually compensated), (see 6.4 "Main setpoint").
- **CASC**: supply temperature setpoint coming from the cascade controller, (see 7 "Cascade control").
- **LS1**: local setpoint "*LS1*", (see 6.5 "Local setpoint").
- **LS2**: local setpoint "*LS2*", (see 6.5 "Local setpoint").
- **DHS**: connected to the Dumper "*Heat Sequence*".
- **HS1**: connected to "*Heat Sequence 1*".

- "*H13*", "*C13*", "*H23*": offset of the used setpoint. (See 6.3 "Connection of setpoint sequences");
- "*H14*", "*C14*", "*H24*": proportional band of the PID control;
- "*H15*", "*C15*", "*H25*": integral time of the PID control;
- "*H16*", "*C16*", "*H26*": derivative time of the PID control.

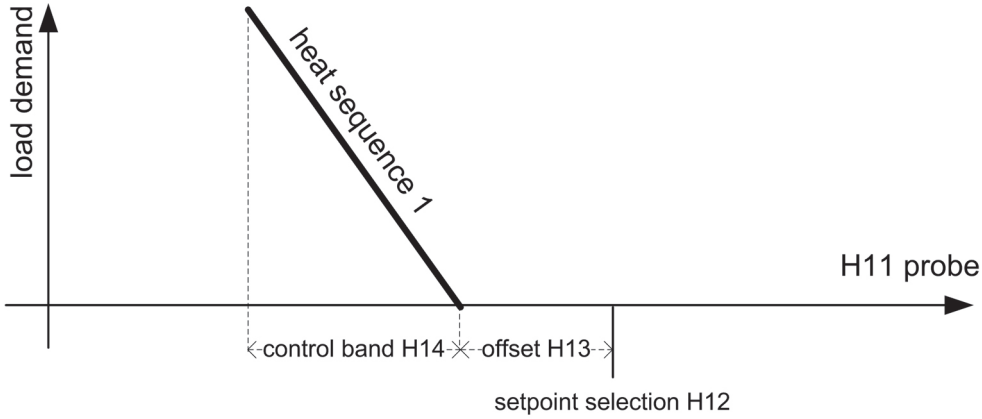


Fig 27 [Temperature control sequences - Heat control sequences 1]

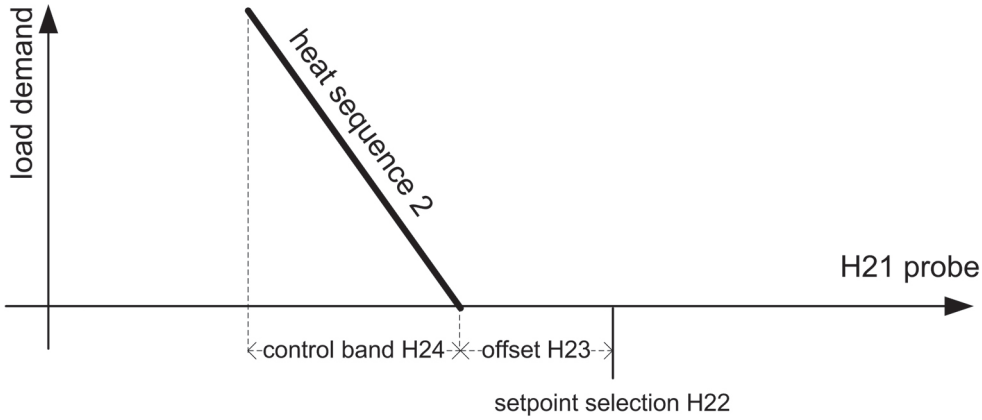


Fig 28 [Temperature control sequences - Heat control sequences 2]

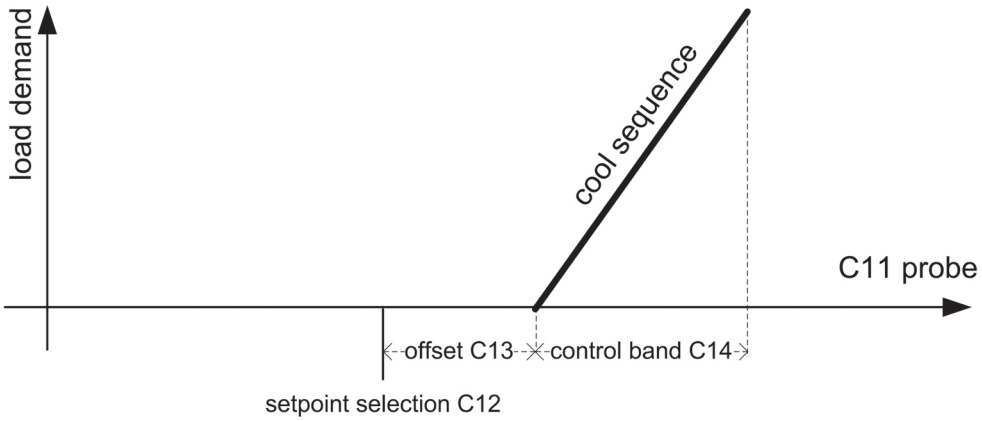


Fig 29 [Temperature control sequences - Cool sequences]

Note

In the previous figures are displayed positive values of the offset.

For the cool sequence 1 you have to define also if you want to block it (through "*C17*"-Lock condition) if one heating sequence is working.

- If "*C17=NO*": the cool sequence is not locked and it is possible to have heating and cooling together. This could happen during frost protection, (see 9 "Frost protection"). when heating is started and cooling is reduced steplessly.
- If "*C17=HS1*": cool sequence is blocked if Heat Sequence 1 is working.
- If "*C17=HS2*": cool sequence is blocked if Heat Sequence 2 is working.
- If "*C17=ALL*": cool sequence is blocked if Heat Sequence 1 or Heat Sequence 2 is working.

6.3 Connection of setpoint sequences

To facilitate interconnections among sequences, it is possible to automatically make one sequence start when the preceding one is at 100 % and to make it use automatically the same control probe. The probe used is the one used by the preceding sequence.

When selecting the setpoint for a sequence ("*D02*", "*H12*", "*H22*", "*C12*"), set it to the reference of the preceding sequence, using the following values:

- *LS1*: connection to the Local Setpoint 1. Possible for all the sequences.
- *FRC*: connection to the Free-cool Sequence. Possible only for Cool Sequence 1.
- *HS1*: connection to the Heat Sequence 1. Possible only for Heat Sequence 2.

In the next figure you can see the result of the following settings:

- H12=DHS: setpoint of the Heat Sequence 1 connected to Damper Heat Sequence.
- H22=HS1: setpoint of the Heat Sequence 2 connected to Heat Sequence 1.
- C12=DCS: setpoint of the Cool Sequence 1 connected to Damper Cool Sequence.

The control probe is forced for all the sequences to the one used by dampers.

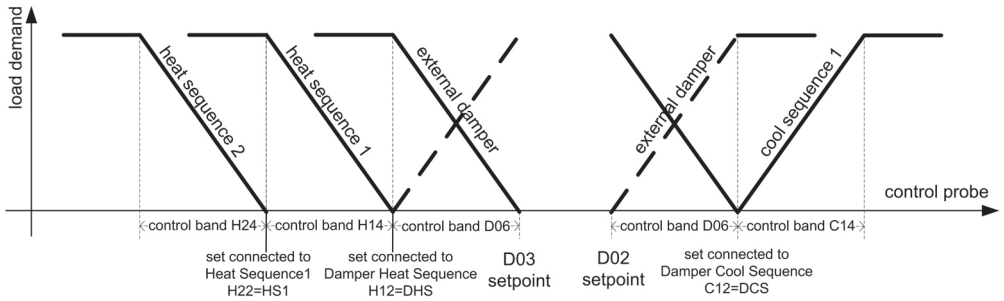


Fig 30 [Temperature control sequences - Connection of setpoint sequences]

6.4 Main setpoint

SET			Setpoint	Min	Max	Value	U.M.	Text Value
	MST		Main Setpoint					
		STH	Setpoint heat	15,0	90,0	21,0	°C	
		STC	Setpoint cool	15,0	90,0	24,0	°C	
		HUM	Min setpoint humidity	0,0	100,0	40,0	%	
		DEH	Max setpoint humidity	0,0	100,0	60,0	%	
	EST		Economy Setpoint					
		ES1	Economy set enable	0	1	NO		NO;YES
		ES2	Offset set heat economy	-15,0	90,0	-3,0	°C	
		ES3	Offset set cool economy	-15,0	90,0	2,0	°C	
	COM		TempCompensation					
		TC1	Probe selection	0	8	0=NO		NO;SUP;REt;OUt;tH1; tH2;tC1;tC2;AMb
		TC2	Winter end temperature	-15,0	90,0	-5,0	°C	
		TC3	Winter start temperature	-15,0	90,0	5,0	°C	
		TC4	Winter offset	-10,0	10,0	-2,0	K	
		TC5	Summer start temperature	-15,0	90,0	31,0	°C	
		TC6	Summer end temperature	-15,0	90,0	38,0	°C	
		TC7	Summer offset	-10,0	10,0	7,0	K	

Tab 28 [Temperature control sequences - Setpoint parameters]

The main temperature setpoint are "*STH*" for heating and "*STC*" for cooling temperature control. In order to avoid setpoint overlapping, "*STH*" is limited upwards by "*STC*" and "*STC*" is limited downwards by "*STH*".

The active temperature setpoint (hereafter "*ATS*") is then:

- "*ATS=STH*" in heating;
- "*ATS=STC*" in cooling.

Through parameters "*D02*", "*D03*", "*H12*", "*H22*", "*C12*", they can be assigned to the specific sequence, (see 6.0 "Temperature control sequences").

The main humidity setpoint are HUM for humidifying and DEH for dehumidifying control.

Main setpoint are accessible from the user interface in an shorten way, by pressing the key for 3 s.

Main setpoint are affected by economy mode and temperature compensation.

6.4.1 Economy mode

The economy mode can be enabled by "*ES1=YES*" or via digital input "*COE – Comf/Eco*".

By enabling the economy mode, the main temperature setpoint are changed by "*ES2*" and "*ES3*" quantity.

The Active Temperature Setpoint (ATS) becomes:

- "*ATS=STH+ES2*" in heating;
- "*ATS=STC+ES3*" in cooling.

6.4.2 Temperature compensation

The setpoint can be compensated according to the value of a probe defined with "*TC1*" parameter. If "*TC1=NO*", compensation is not enabled.

The way "*ATS*" is related to the "*TC1*" probe values is described in the following figure.

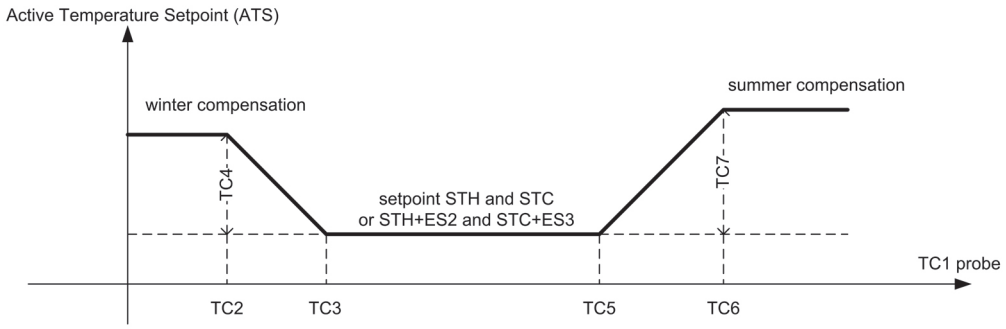


Fig 31 [Temperature control sequences - Temperature compensation]

Note

The diagram corresponds to positive values of "TC4", "TC7" and "TC2" < "TC3" < "TC5" < "TC6".

Typically the probe used for compensation is the outside probe "*OUT – Outside Temp*" (TC1=OUT) and then we can talk about summer and winter compensation.

6.5 Local setpoint

SET			Setpoint	Min	Max	Value	U.M.	Text Value
	LST		Local Setpoint					
		LS1	Local set1	-15,0	90,0	22,0	°C	
		LS2	Local set2	-15,0	90,0	22,0	°C	

Tab 29 [Temperature control sequences - Local setpoint - Setpoint parameters]

Is possible to define two local setpoint "*LS1*" and "*LS2*" which are not affected by economy mode and compensation and are not accessible from the user interface in a shorten way.

Through parameters "*D02*", "*D03*", "*H12*", "*H22*", "*C12*", they can be assigned to the specific sequence, (see 6.0 "Temperature control sequences").

6.6 Remote setpoint management

One of the analog input can be managed as remote setpoint. It should be configured as 0/5 V.

The working range is set by two new parameters, so it doesn't care what you write inside Min and Max fields of MCXShape.

SET			Setpoint	Min	Max	Value	U.M.	Text Value
	RST		Remote Setpoint					
		RSE	Remote set enable	0	1	56Rel	°C	
		RMA	Max range remote set	-90,0	90,0	10,0	°C	
		RMI	Min range remote set	-90,0	90,0	0,0	°C	

Tab 30 [Temperature control sequences - Remote setpoint - Setpoint parameters]

A variable resistor can be connected between +5 V and GND and to the "*Remote Set*" analog input to change the value of the actual setpoint.

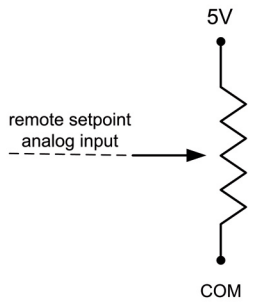


Fig 32 [Temperature control sequences - Remote setpoint management]

Note

If you set the "Remote Set" analog input as 0/10 V, then you need to power the variable resistor with +12 V from MCX.

The parameter "*RSE*" enables the remote setpoint:

- "*RSE=NO*": not enabled;
- "*RSE=REL*": Relative remote setpoint. An offset is added to the actual setpoint.

You set the range of the offset to be added, using the "*RMI*" and "*RMA*" parameters

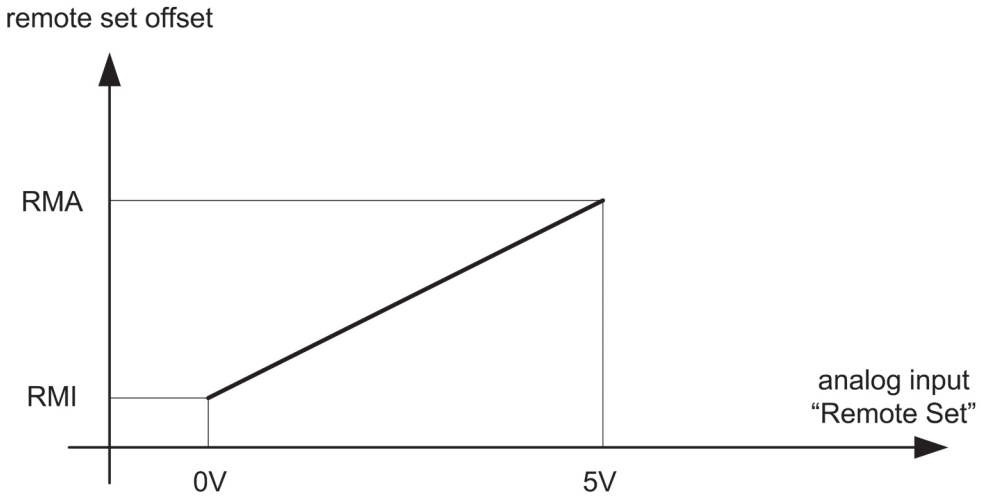


Fig 33 [Temperature control sequences - RSE parameters]

Example

RMI=0,0 °C
RMA=10,0 °C
You get an offset of 0 °C when the input is at 0 V and an offset of 10.0 °C when the input is at 5 V.
This offset is then added to the actual setpoint
(calculated from "STH" or "STC"+compensation+economy selection).

6.7 Manual control

GEN			General	Min	Max	Value	U.M.	Text Value
	man		Manual Out					
		DAM	Damper sequence value	0,0	100,0	0,0	%	
		HS1	HS1 sequence value	0,0	100,0	0,0	%	
		HS2	HS2 sequence value	0,0	100,0	0,0	%	
		CSM	CS1 sequence value	0,0	100,0	0,0	%	

Tab 31 [Temperature control sequences - Manual control - General parameters]

Is possible to force each sequence to a fixed value (manual control) through parameters "*DAM*", "*HS1*", "*HS2*", "*CS1*".

7.0 Cascade control

Cascade control uses the output of the return temperature controller to manipulate the setpoint of the supply temperature controller.

SCT			Supply Control	Min	Max	Value	U.M.	Text Value
	CAS		Cascade Control					
		CS1	Proportional component	0,0	100,0	5,0	K	
		CS2	Integral time	0	9999	300	SEC	
		CS3	Min delta supply limit	0,0	60,0	50,0	K	
		CS4	Max delta supply limit	0	60,0	50,0	K	
	STL		TemperatureLimit					
		TL1	Supply temp low limit	-15,0	90,0	16,0	°C	
		TL2	Supply temp high limit	-15,0	90,0	35,0	°C	

Tab 32 [Cascade control - Supply control parameters]

Cascade regulation is used by a sequence when its selected setpoint is "*CASCADE*". ("*D02, D03, H12, H22, C12=CASCADE*"). In this case it is not possible to select the control probe used by the control sequence, as it is fixed to the return and supply temperature.
Setpoint for supply temperature control is calculated on the basis of the return temperature and main setpoint heat and cool, as described in the following figure, with PI logic and with the following limits: "*Return_Temperature – CS3 <= Setpoint_of_supply_Temperature <= Return_Temperature + CS4*".

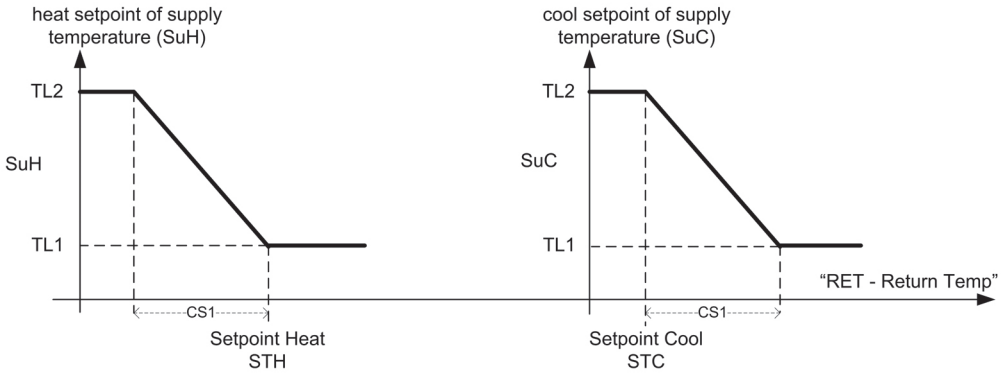


Fig 34 [Cascade control - Temperature]

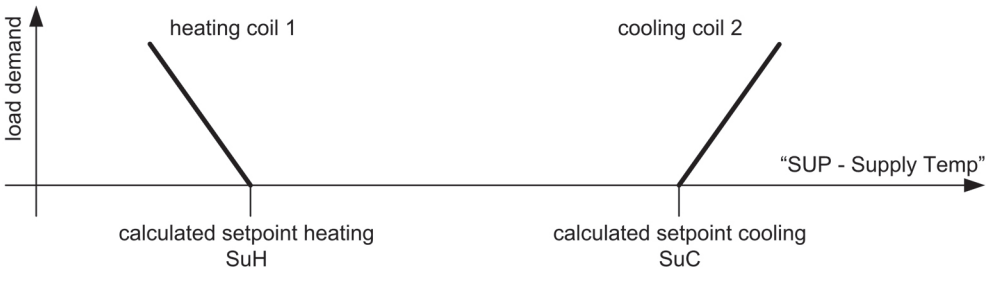


Fig 35 [Cascade control - Setpoint]

8.0 Examples

8.1 Example 1

Control of the saturation temperature with preheating coil and dampers.

Return temperature control with cooling and reheating coil.

Dampers control comparing return and outside temperature.

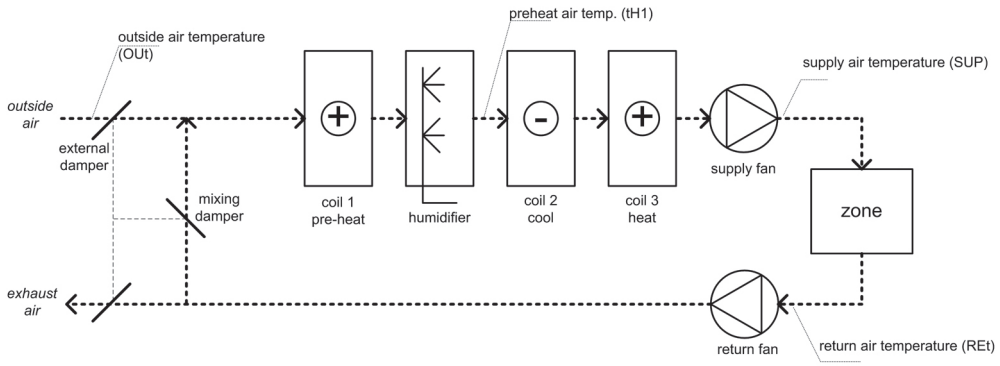


Fig 36 [Examples - Example 1]

Dampers

- *"D01–control probe=tH1"* (preheat probe);
- *"D03–heat setpoint selection=LS1"* (saturation temperature setpoint);
- *"D23–control type=CHP"* (automatic changeover);
- *"D07–changeover probe 1=RET"* (return probe);
- *"D08–changeover probe 2=OUT"* (outside probe);
- *"d00–damper function=DHS"* (damper heat sequence).

Preheating coil

- *"b10–coil 1 function=HS1"* (heat sequence 1);
- *"H11–control probe=tH1"* (preheat probe);
- *"H12–setpoint selection=DHS"* (connected to the damper heat sequence).

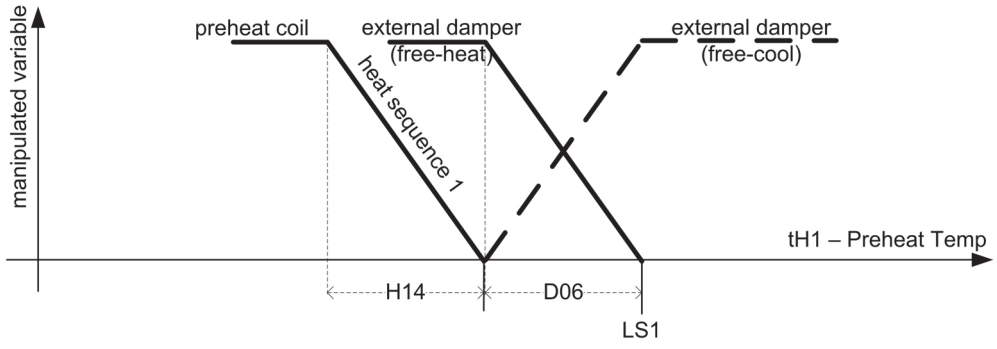


Fig 37 [Examples - Dampers and preheating coil]

Cooling coil

- *"b40–coil 2 function=CS1"* (cool sequence 1);
- *"C11–control probe=RET"*
- *"C12–setpoint selection=MAIN"* (set cool STC).

Reheating coil

- "*b70–coil 3 function=HS2*" (heat sequence 2);
- "*H21–control probe=RET*"
- "*H22–setpoint selection=MAIN*" (set heat STH).

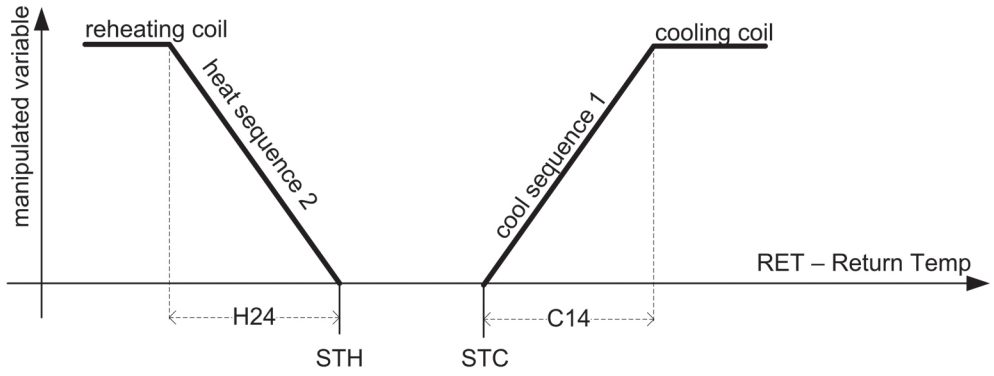


Fig 38 [Examples - Cooling and reheating coil]

8.2 Example 2

Control of the return temperature with cascade control through heating coil, cooling coil and dampers.
Dampers control comparing return and outside temperature.

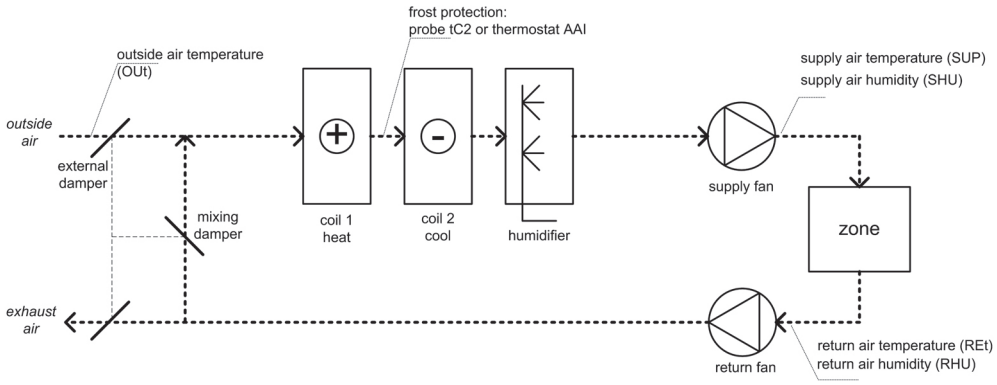


Fig 39 [Examples - Example 2]

Dampers

- "*D01–control probe=Any Value*" (room/supply control in CASCADE);
- "*D02–cool setpoint selection=CASCADE*"
- "*D07–changeover probe 1=RET*" (return probe);
- "*D08–changeover probe 2=OUT*" (outside probe);
- "*d00–damper function=AUTO*" (damper heat sequence or cool sequence according to winter/summer).

Heating coil

- "*b10–coil 1 function=HS1*" (heat sequence 1);
- "*H11–control probe=Any Value*" (room/supply control in CASCADE);
- "*H12–setpoint selection=DHS*" (connected to the damper heat sequence).

Cooling coil

- *"b40–coil 2 function=CS1"* (cool sequence 1);
- *"C11–control probe=SUP"* (room/supply control in CASCADE);
- *"C12–setpoint selection=DCS"* (connected to the damper cool sequence).

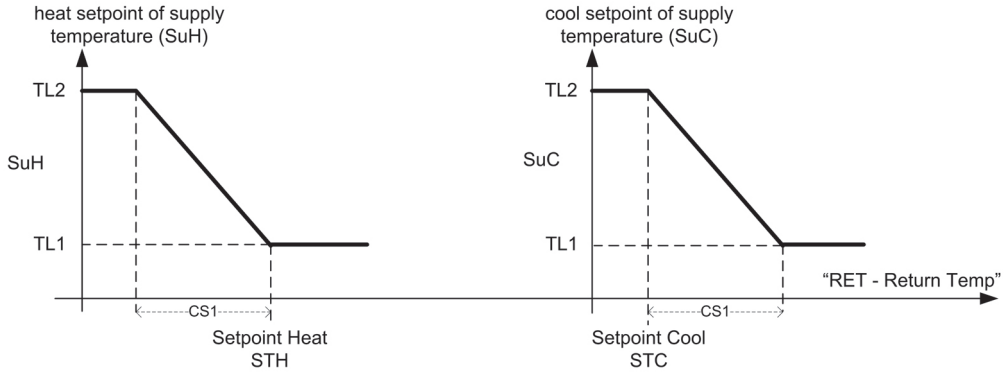


Fig 40 [Examples - Dampers, heating coil and cooling coil 1]

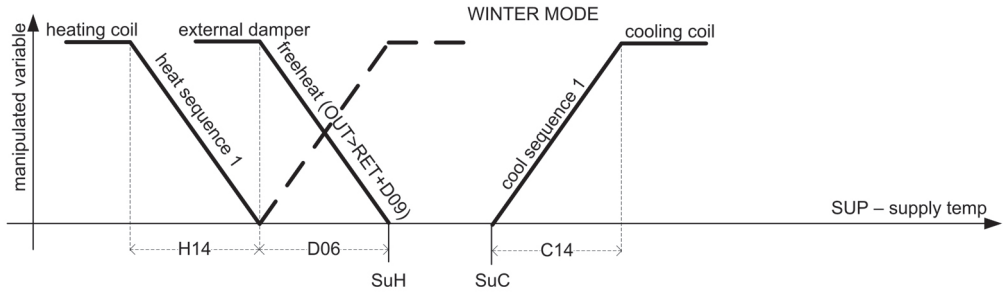


Fig 41 [Examples - Dampers, heating coil and cooling coil 2]

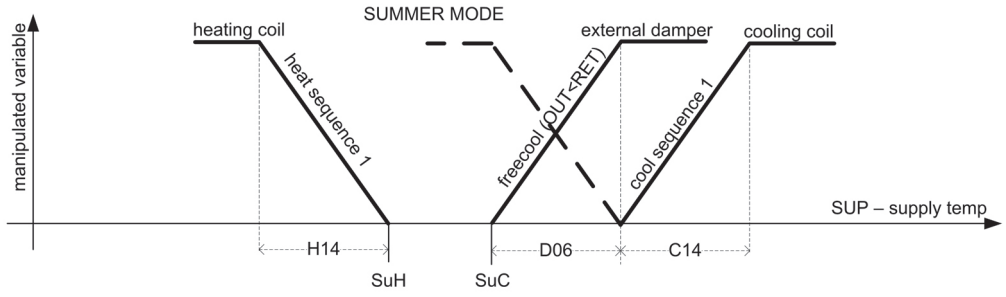


Fig 42 [Examples - Dampers, heating coil and cooling coil 3]

9.0 Frost protection

To enable the frost protection function you have first to define with "*FP1*" the probe used for controlling the temperature.

FRO			Frost	Min	Max	Value	U.M.	Text Value
	FPP		Frost Protection					
		FP1	Probe selection	0	2	2=tC2		NO;OUT;tC2
		FP2	Alarm setpoint	5,0	90,0	5,0	°C	
		FP3	Proportional band	0,1	20,0	1,0	K	
		FP7	Heating seq. 1 enable	0	1	1=YES		NO;YES
		FP8	Heating seq. 2 enable	0	100	0=NO		NO;YES
		FP9	Fan Power on frost Alarm	0,0	100,0	0,0	%	

Tab 33 [Frost protection - Frost parameters]

When the selected probe temperature is close to the alarm setpoint "*FP2*", the heat actuators are activated proportionally as described in the following figure.

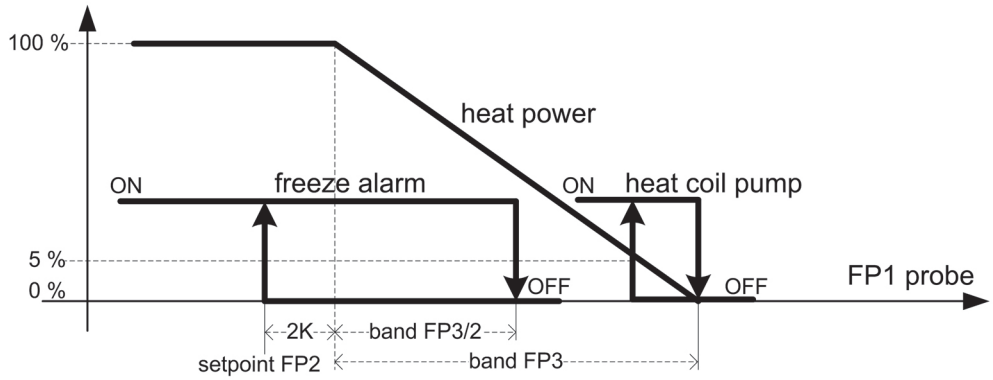


Fig 43 [Frost protection - Alarm setpoint FP2]

When the temperature goes below the alarm setpoint "*FP2*", then the "*A07 - Freeze Alarm*" is generated and heat power is set to 100 %, cool power to 0 %, the external damper goes to its minimum position and the heat recovery is OFF.

It is possible disable the heating sequence 1 and/or 2 in case of frost alarm (code "*A07*") by using the parameters "*FP7*" and "*FP8*".

The parameter "*FP9*" is used to set the fan speed in case of frost alarm.

Note

To set the fan speed the parameter "F05" must be set to "YES").

The "A07 - Freeze Alarm" is generated also by the thermostat (digital input) "AAI - Freeze Alarm" and when the "FP1" probe is fault.
(See 14.3 "Alarms table").

If the "A07 - Freeze Alarm" is set in the "mcxs configuration" file to be active even when the unit is OFF, then all the actions on the heating actuators described above are active even when the unit is OFF.

9.1 Frost prevention in OFF

FRO			Frost	Min	Max	Value	U.M.	Text Value
	FPR		Frost Protection					
		FP4	Setpoint OFF	-15,0	90,0	10,0	°C	
		FP5	Proportional band	0,1	20,0	1,0	SEC	
		FP6	Integral time	0	9999	120	SEC	

Tab 34 [Frost protection - Frost prevention in OFF - Frost parameters]

When the unit is OFF, the controllers works to maintain the "*FP1*" probe to the value set with the "*FP4*" setpoint OFF with PI logic.
This function acts on both the heat sequences but the heat recovery and the external damper remain closed.

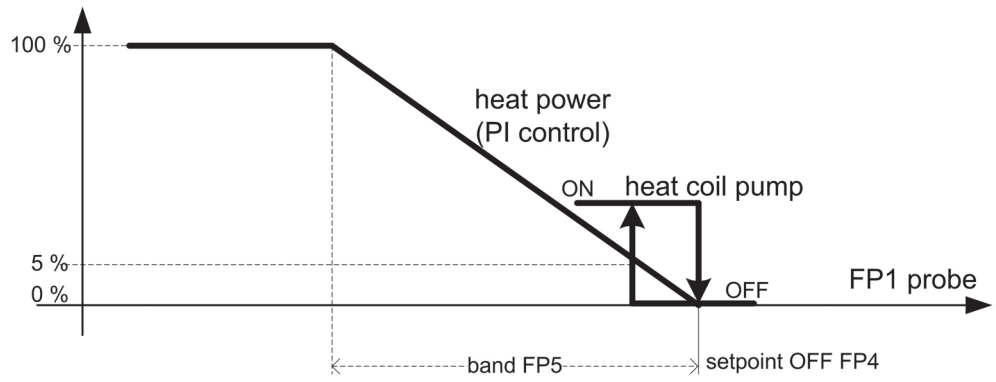


Fig 44 [Frost protection - Frost prevention in OFF]

10.0 Controlling the supply temperature limits

SCT			Supply Control	Min	Max	Value	U.M.	Text Value
	STL		TemperatureLimit					
		TL1	Supply temp low limit	-15,0	90,0	16,0	°C	
		TL2	Supply temp high limit	-15,0	90,0	35,0	°C	
		TL3	Supply temp low limit enable	0	1	1=YES		NO;YES
		TL4	Band	0,1	20,0	3,0	K	
		TL5	Supply temp high limit enable	0	1	1=YES		NO;YES
		TL6	Band	0,1	20,0	3,0	K	

Tab 35 [Controlling the supply temperature limits - Supply control parameters]

10.1 Supply temperature limits in cascade control

For the way supply temperature is limited in the cascade control, (see 7.0 "Cascade control").

10.2 Supply temperature lower limit

This function protects the environment and the people therein from the infeed of air that is too cold. The function is enabled with "*TL3*" and requires setting the lower limit "*TL1*" beyond which the supply temperature must not drop.

Operation in cooling mode
When the supply temperature "*SUP - Supply Temp*" drops below the lower limit "*TL1*" increased by band "*TL4*", the cooling device and any damper to feed in outside air (free-cooling) are limited in a manner proportional to amount the supply temperature differs from the limit setpoint.
Below the setpoint, the limitation is total.

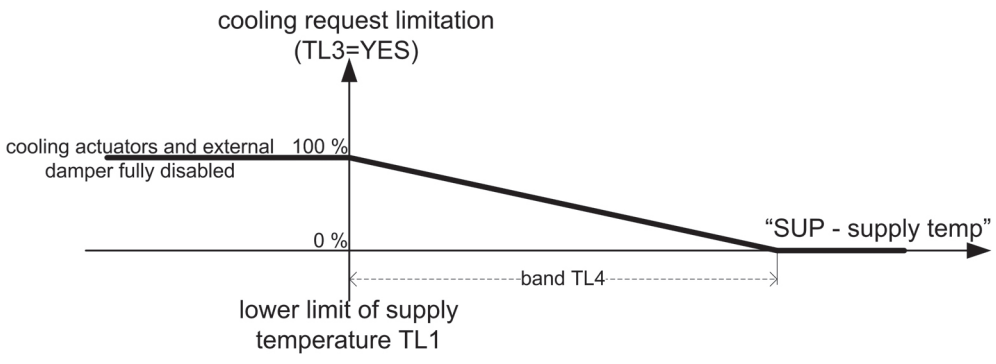


Fig 45 [Controlling the supply temperature limits - Operation in cooling mode]

Operation in dehumidification mode
Limitation is ON/OFF as described in the figure

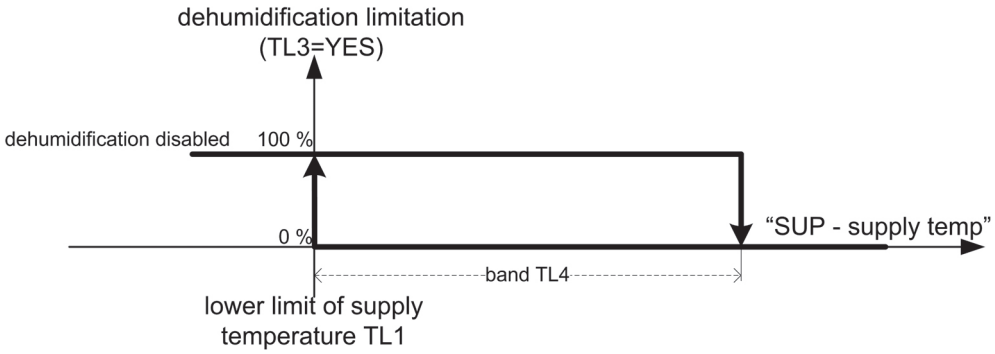


Fig 46 [Controlling the supply temperature limits - Operation in dehumidification mode]

10.3 Supply temperature upper limit

This function protects the environment and the people therein from the infeed of air that is too hot.

The function is enabled with "*TL5*" and requires setting the upper limit "*TL2*" beyond which the supply temperature must not rise.

The behavior mirrors what follows for the lower supply limit. When the supply temperature "*SUP - Supply Temp*" rises above the upper limit "*TL2*" decreased by band "*TL6*", the heating device and any damper to feed in outside air (free-heating) are limited in a manner proportional to amount the supply temperature differs from the limit setpoint. Above the setpoint, the limitation is total.

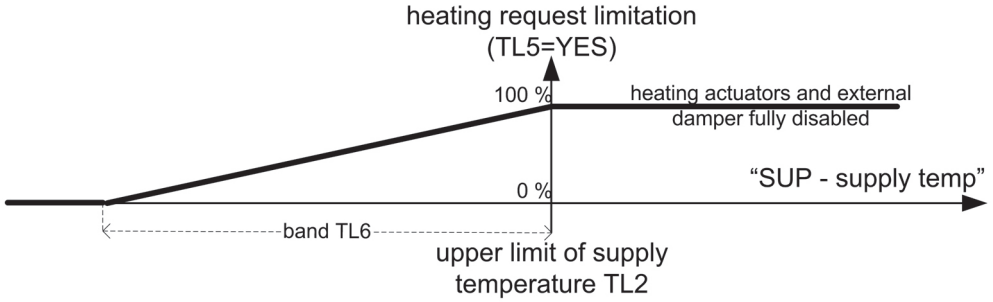


Fig 47 [Controlling the supply temperature limits - Supply temperature upper limit]

11.0 Humidity control

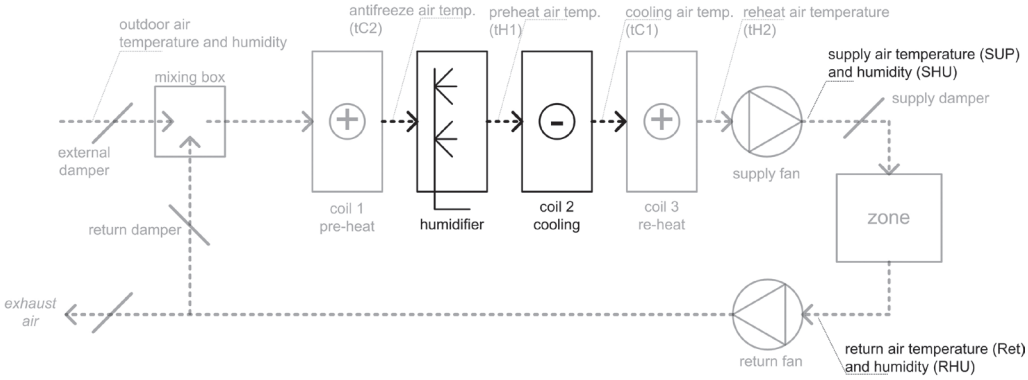


Fig 48 [Humidity control]

SET			Setpoint	Min	Max	Value	U.M.	Text Value
	MST		Main Setpoint					
		HUM	Min setpoint humidity	0,0	100,0	40,0	%	
		DEH	Max setpoint humidity	0,0	100,0	60,0	%	

HCT			Humidity Control	Min	Max	Value	U.M.	Text Value
	REG		Regulation					
		U01	Control probe	0	2	0=NO		NO;SHU;RHU
		U02	Humidification proportional band	0,0	20,0	5,0	%	
		U03	Humidification integral time	0	9999	0	SEC	
		U04	Humidification derivative time	0	9999	0	SEC	
		U05	Dehumidification prop. band	0,0	20,0	5,0	%	
		U06	Dehumidification integral time	0	9999	0	SEC	
		U07	Dehumidification derivative time	0	9999	0	SEC	

Tab 36 [Humidity control - Humidity parameters]

11.1 Control sequences

Parameter "*U01*" is used to enable humidity control and defines the probe used for control,

Example

supply humidity "SHU – Sup. Humidity" (U01=SUP) and return "RHU – Ret. Humidity" (U01=REt).

The humidification and dehumidification process is controlled by the selected probe with PID logic based on the following setpoint:

- minimum setpoint HUM;
- maximum setpoint DEH.

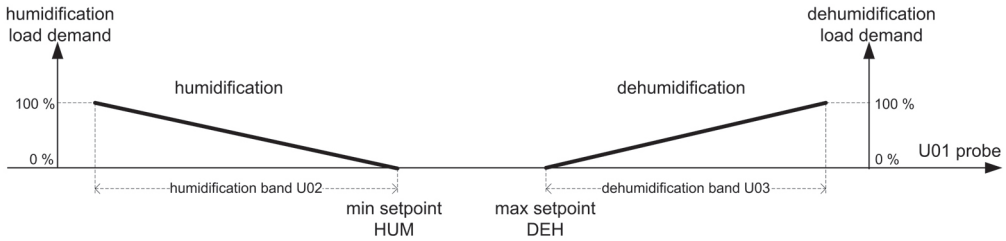


Fig 49 [Humidity control - Control sequences]

11.2 Humidifier control

The software can handle both ON/OFF and modulating humidifiers, respectively using the digital output "*HUM – Humidifier*" and the analog output "*HUA – Humidifier*".

Is possible to manage also a pump with the digital output "*HUP – HumidPump*".

Type of output	Output used	
Digital output	HUM	Humidifier
	HUP	HumidPump
Analog output	HUA	Humidifier

Tab 37 [Humidity control - Humidifier control]

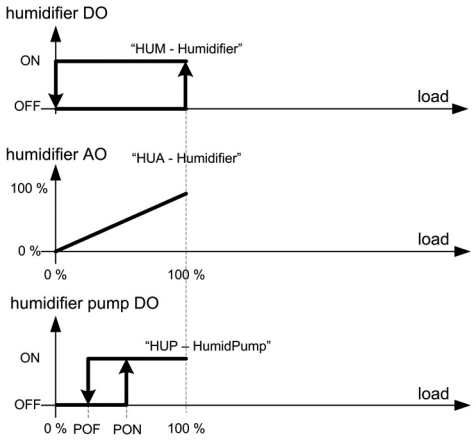


Fig 50 [Humidity control - Humidifier control]

If present, the pump is activated when request is sent to the humidifier. You can define the load percentage to switch ON the pump, via "*PON*" parameter, and to switch it OFF, via "*POF*" parameter.

Example

Pump switches ON at 5 % and OFF at 0 %.

You can also define a switch OFF delay "*POd*" for the pumps.

PUM			Pumps	Min	Max	Value	U.M.	Text Value
	STU		Setup					
		POd	Pump delay at OFF		9999	1	SEC	
		PON	Power request activation	0,0	100,0	5,0	%	
		POF	Power request deactivation	0,0	100,0	0,0	%	

Tab 38 [Humidity control - Pumps parameters]

Note

Humidification pump is not activated in case of winter start.

11.3 Dehumidifier control

Dehumidification can be performed:

5. With an outside dehumidifier activated by the digital output "*DEU – Dehumidifier*" and analog output "*DHU – Dehumidifier*".

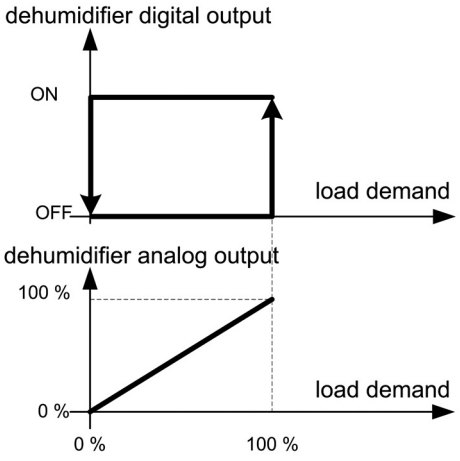


Fig 51 [Humidity control - Dehumidifier control]

6. Activating the cooling coil, (see 11.3.1 "Cooling coil in dehumidifucation").

11.3.1 Cooling coil in dehumidification

HCT			Humidity Control	Min	Max	Value	U.M.	Text Value
	CCD		Cooling Coil					
		U08	Enable in dehumidification	0	1	YES		NO;YES
		U09	Control type in dehumidification	0	2	0=MAX		MAX;DEW POINT;PROP

Tab 39 [Humidity control - Humidity control parameters]

If a dehumidification request will activate the cooling coil, depends on "*U08*", cooling coil enable in dehumidification:

- If "*U08=NO*" then cooling coils are not activated regardless of the dehumidification request;
- If "*U08=YES*" then cooling coil is activated in the following ways according to "*U09*", Control type in dehumidification;
- If "*U09=MAX*" then cooling coil is activated at 100 % when the dehumidification load demand is 100 %.

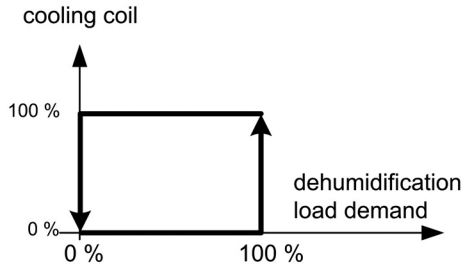


Fig 52 [Humidity control - Cooling coil in dehumidification]

If "*U09=DEW POINT*", when the dehumidification load demand is 100 % then cooling coil is controlled using the "*tC1*" probe to reach the dew point setpoint (calculated on the basis of the cooling coil temperature setpoint and maximum humidity setpoint "*DEH*").

If "*tC1*" probe is not present, cooling coil is activated at 100 % till there is request of dehumidification.

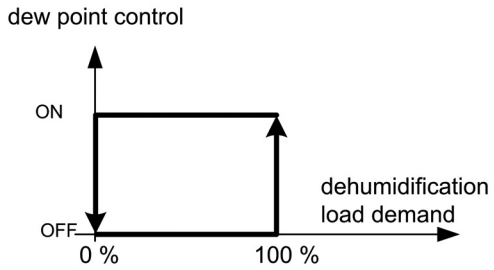


Fig 53 [Humidity control - Cooling coil in dehumidification 2]

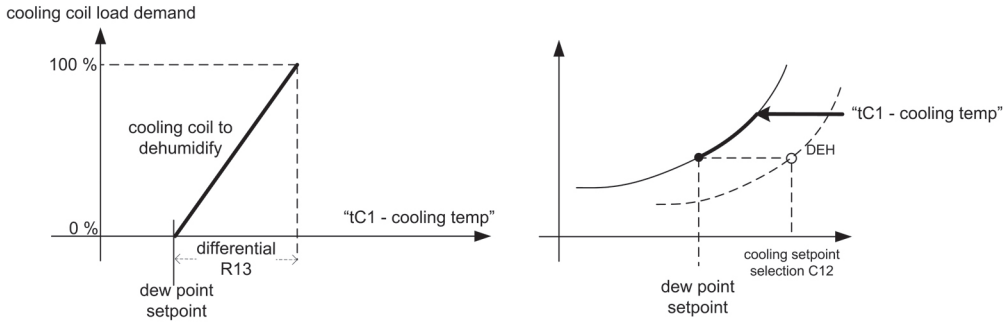


Fig 54 [Humidity control - Cooling coil in dehumidification 3]

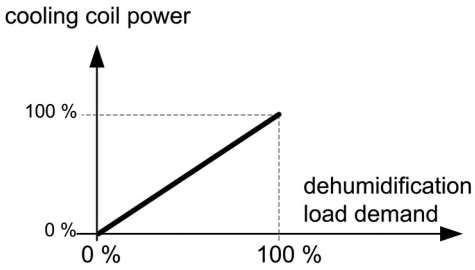


Fig 55 [Humidity control - Cooling coil in dehumidification 4]

11.4 Controlling the supply humidity limits

SCT			Supply Control	Min	Max	Value	U.M.	Text Value
	SHL		Humidity Limit					
		HL1	Supply humidity low limit	0,0	100,0	30,0	%	
		HL2	Supply humidity high limit	0,0	100,0	70,0	%	
		HL3	Supply humidity low limit enable	0	1	0=NO		NO;YES
		HL4	Band	1,0	10,0	5,0	%	
		HL5	Supp. humidity high limit enable	0	1	0=NO		NO;YES
		HL6	Band	1,0	10,0	5,0	%	

Tab 40 [Humidity control - Supply control parameters]

11.4.1 Upper limit

Control of the upper limit for supply humidity prevents the onset of condensation in the supply ducts.

The function is enabled with "*HL5*" and requires setting the upper limit "*HL2*" beyond which the supply humidity must not rise.

In the case of a modulating humidifier, as the supply humidity reaches the upper limit "*HL2*" decreased by band "*HL6*", the controller limits the output to the humidifier in a manner proportional to the amount the supply temperature differs from the setpoint limit. If the unit has an ON/OFF humidifier, it is turned off directly by the upper limit and reactivated after the differential is reached.

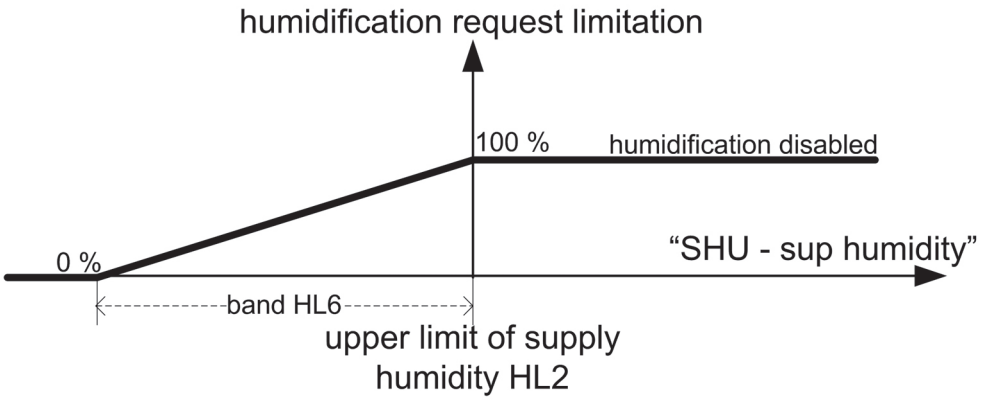


Fig 56 [Humidity control - Upper limit]

11.4.2 Lower limit

This function protects the environment and the people therein from the infeed of air that is too dry.

The function is enabled with "*HL3*" and requires setting the lower limit "*HL1*" beyond which the supply temperature must not drop and the limit band "*HL4*".

The behavior mirrors what follows for the upper supply limit.

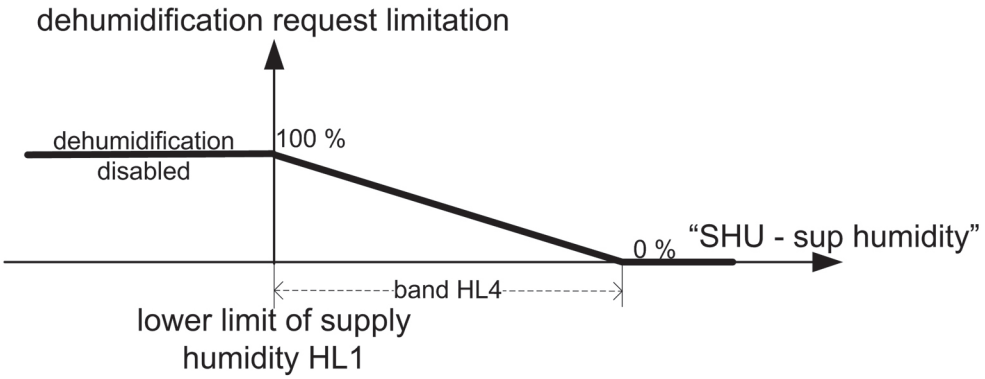


Fig 57 [Humidity control - Lower limit]

12.0 Supply and return fans

FAN			Fans	Min	Max	Value	U.M.	Text Value
	GEN		General					
		F00	Fan control type Summer	0	3	Fix		ONOF;REQ;PId;Fix
		F01	Fan control type Winter	0	3	Fix		ONOF;REQ;PId;Fix
		F02	Minimum speed	0,0	100,0	10,0	%	
		F08	Nominal Speed	0,0	100,0	30,0	%	
		F03	Maximum speed	0,0	100,0	100,0	%	
		F04	Coils OFF with fan OFF	0	1	YES		NO;YES
		F05	Stop fans for antifreeze	0	1	YES		NO;YES
		F06	Stop all fans at any fan alarm	0	1	YES		NO;YES
		F07	Stop all fans for coil alarm	0	1	YES		NO;YES
	SUF		Supply Fan					
		SF1	Time at maximum speed at startup	0	9999	20	SEC	
		SF2	Anti resonance	0,0	100,0	0,0	%	
		SF3	Anti resonance zone	0,0	50,0	0,0	%	
		SF4	Fan delay at startup	0	9999	5	SEC	
		SF5	Fan delay at OFF	0	9999	5	SEC	
	REF		Return Fan					
		RF1	Time at maximum speed at startup	0	9999	0	SEC	
		RF2	Anti resonance	0,0	100,0	0,0	%	
		RF3	Anti resonance zone	0,0	50,0	0,0	%	
		RF4	Fan delay at startup	0	9999	5	SEC	
		RF5	Fan delay at OFF	0	9999	5	SEC	
	REG		PID Regulation					
		Fr0	Action of regulation	1	4	Cr2		NV;dIR;Cr1;Cr2
		Fr1	Summer probe	0	5	AX1		SUP;Ret;bAR;CO2;VOC;AX1
		Fr9	Winter probe	0	5	SUP		SUP;Ret;bAR;CO2;VOC;AX1
		Fr2	Summer Setpoint	-15,0	110,0	24,0		
		Fr8	Winter Setpoint	-15,0	110,0	21,0		

FAN			Fans	Min	Max	Value	U.M.	Text Value
		Fr3	Proportional band	0,1	20,0	5,0		
		Fr4	Integral time	0	9999	300	SEC	
		Fr5	Derivative time	0	9999	0	SEC	
		Fr6	Summer Setpoint Mode	0	1	0=SEq1		SEq1;Fr2
		Fr7	Winter Setpoint Mode	0	1	0=SEq1		SEq1;Fr8
	FTC		Supply Temp. Compensation					
		FT1	Mode	0	3	1=Heat		No ;Heat;Cool;Heat/Cool
		FT2	Offset to shift setpoint	0,0	15,0	0,0	K	
		FT3	Proportional band	0,1	20,0	5,0	K	
		FT4	Integral time	0	9999	300	SEC	
		FT5	Derivative time	0	9999	0	SEC	
		FT6	Enabling delay	0	9999	5	SEC	

Tab 41 [Supply and return fans - Fans parameters]

The type of supply fan control is defined using parameter "*F00* and "*F01*" in summer and winter.

The return fan, if present, is assumed to be controlled as the supply fan.

Each fan functions only if its dampers are open.

12.1 Type of supply and return fans

The parameters to set the way fan is controlled are "*F00*", "*F01*" – Fan control type in summer and winter:

- If "*F00=ONOF*" the fan starts when the unit is turned on (after delay time "*SF4*" has elapsed) and always remains on except in the case of fan alarms, fire and antifreeze, (see 12.3 "Fans and antifreeze").
  The fan is controlled using the digital output "*SUF - Supply Fan*".
- If "*F00=REQ*" the fan is only activated when temperature or humidity control action is requested. The following 3 digital outputs are used to control the fan; they have been conceived to run a fan with a star-delta connection arranged for 2 operating speeds:
  - "*SUF - Supply Fan*": is activated when a control action is requested (line contactor);
  - "*SFL - SupplyFanLow*": is activated as indicated in the figure (star contactor);
  - "*SFH - SupplyFanHigh*": is activated as indicated in the figure (delta contactor).
- Then the analog output "*SUF - Supply Fan*" is used, activated in a manner proportional to the demand.

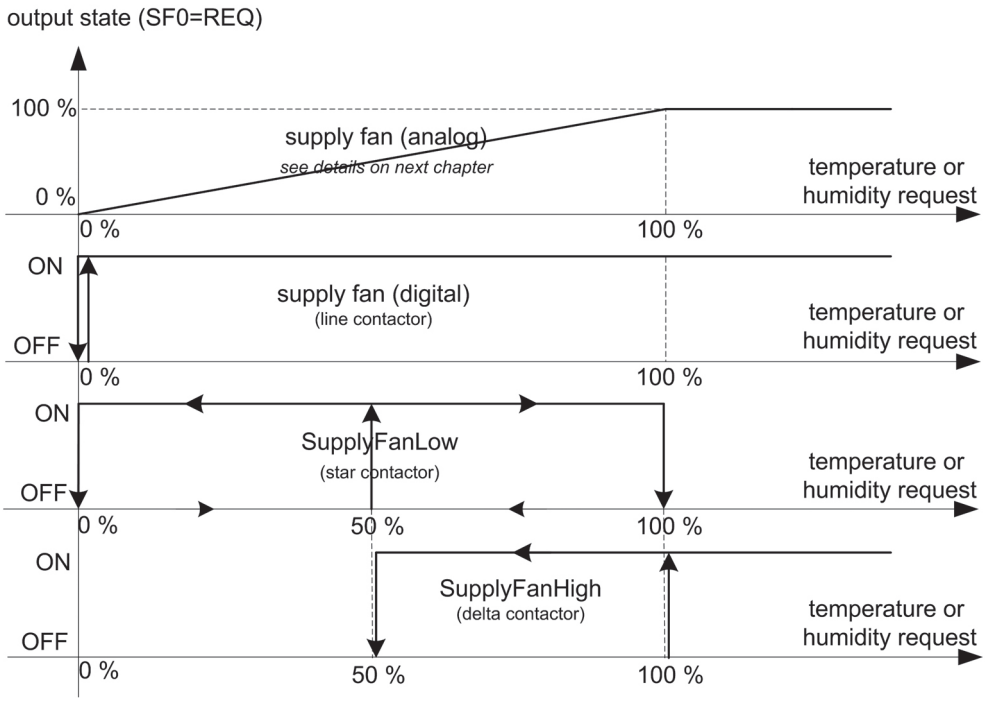


Fig 58 [Supply and return fans - Type]

- If "*F00=PID*" the fan modulates its speed with PID control (parameters "*Fr3*"-"*Fr6*") according to a setpoint defined by "*Fr6*" in summer and "*Fr7*" in winter and the value of a control probe, defined by "*Fr1*", "*Fr9*" from among the following probes: return temperature (Fr1=REt), supply temperature (Fr1=SUP) air pressure "*bAR – Air Pressure*" (Fr1=bAR), "*CO2*" and "*VOC*" (Fr1=CO2, Fr1=VOC), auxiliary probe 1 (Fr1=Ax1).

The control type is defined in "*Fr0*" from among the following possibilities:

- "*Fr0=INV*" inverse control, i.e. heating.
- "*Fr0=DIR*" direct control, i.e. cooling.
- "*Fr0=CO1*" direct or inverse control according to the operating mode: summer/winter. Direct in summer, inverse in winter.
- "*Fr0=CO2*" direct or inverse control according to the operating mode: summer/winter. Inverse in summer, direct in winter.

The outputs indicated in the previous point are used to control the fan.

Note

The fan is never stopped if temperature or humidity control action is requested. In this case the fan is set to its minimum speed.

In case of a reference probe failure, the fan is forced to its maximum speed:

- If "*F00=Fix*" the fan speed is fixed at F08 – Nominal speed.

The action of alarms on the fans is defined by "*F06*", "*F07*". If "*F06=YES*", all fans are stopped at any fan alarm. If "*F07=YES*", all fans are stopped at any coil alarm.

In case of coil alarm from digital input "*Coil1 Alarm*", "*Coil2 Alarm*", "*Coil3 Alarm*", fans work during time "*SF5*", and after that fans will be stopped.

In case of manual reset of coil alarm fans will not start after an attempt of resetting the alarm if the alarm condition is still present.

Return fan output
As with the supply fan, the outputs used to control the return fan are the digital outputs "*REF - Return Fan*", "*RFL - REt. Fan Low Sp.*", "*RFH - REt. Fan High Sp*" and the analog output "*REF - Return Fan*".

12.2 Fan speed configuration

In the case of "*F00=REQ*" and "*F00=PID*" control, the fan speed configuration parameters are described in the figure below where, for the sake of convenience, only the supply fan is indicated.

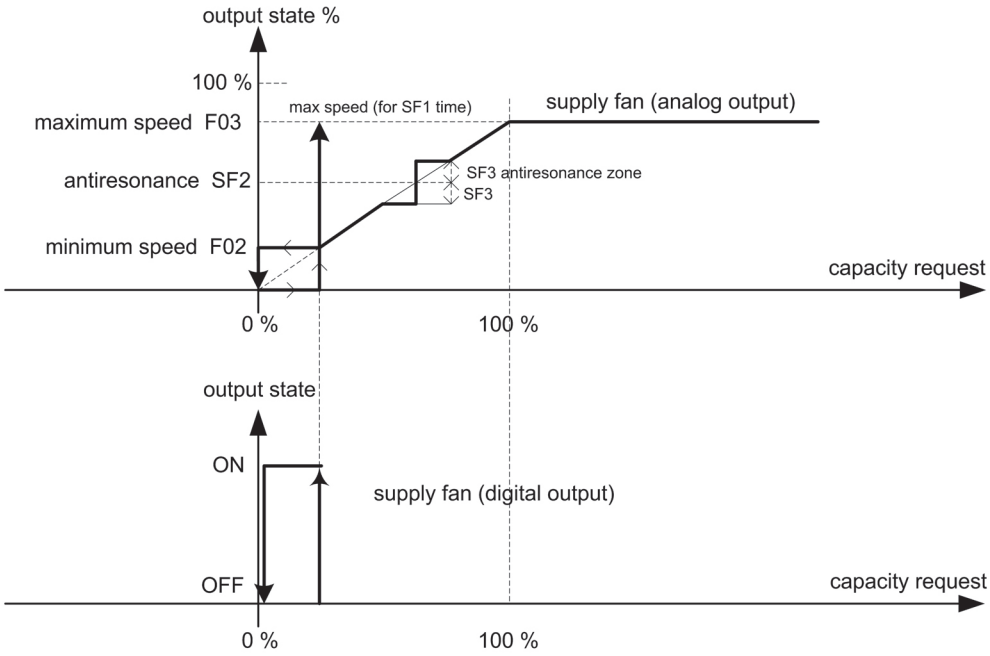


Fig 59 [Supply and return fans - Fan speed configuration]

The percentage values corresponding to the minimum and maximum fan speeds are defined with "*F02*" and "*F03*"; within these values, the modulation output action is calculated as described in the figure.

The fan output is activated when the capacity requested is equal to or greater than that which can be obtained with the fan at minimum speed.

Supply fan
The starting speed is the minimum rate if "*SF1=0*"; otherwise "*SF1*" defines the starting breakaway time during which the fan runs at maximum speed "*F03*".

In "*SF2*" it is possible to define a percentage speed you wish to avoid because it corresponds to the resonance frequency. In this case, the fan will avoid speeds that fall between "*SF2*"-"*SF3*" and "*SF2*"+"*SF3*", as described in the figure.

To allow the damper to open, the supply fan is activated after a delay "*SF4*" has elapsed after the AHU is started up. Then is delayed of "*SF5*" time when the unit is turned off.

Note

To avoid that coils are working while the fan is not running, the coil power is limited to zero until the fan is able to start at its minimum speed.

Return fan
Like the supply fan, the start-up speed is minimum if "*RF1=0*"; otherwise "*RF1*" defines the start-up breakaway time during which the fan runs at maximum speed "*F03*".

In "*RF2*" it is possible to define a percentage speed you wish to avoid because it corresponds to the resonance frequency. In this case, the fan will avoid speeds that fall between "*RF2*"-"*RF3*" and "*RF2*"+"*RF3*".

To allow the damper to open, the return fan is activated after a delay "*RF4*" has elapsed after the AHU is started up. Then is delayed of the "*RF5*" time when the unit is turned off.

12.3 Fans and antifreeze

In case of water coils and antifreeze alarm, is necessary to stop fans.

Parameter "*F04*": for stopping regulation if FAN is OFF, must be set to NO.
Parameter "*F05*": for stopping FAN if antifreeze alarm is ON, must be set to YES.

In case of antifreeze alarm the external damper is completely closed (not to its minimum position),
In case of error on the antifreeze probe, the fans are stopped.

12.4 Fans lock

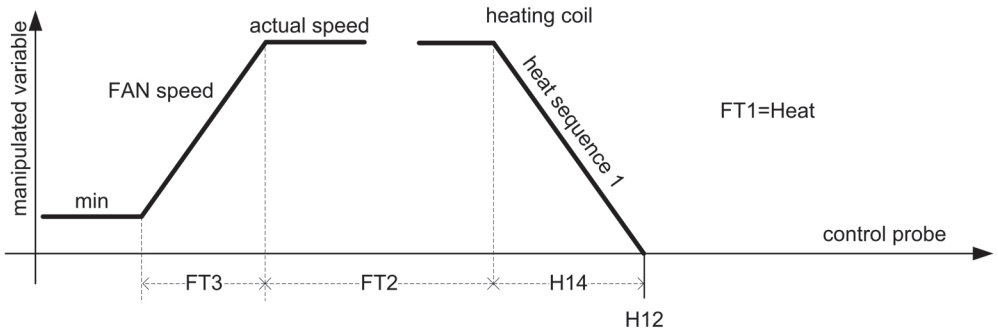
Is possible to lock/unlock fans through the digital input "*LOF-Lock Fan*" or through the user interface, (see 2.4.5 "Utilities").

12.5 Supply temperature compensation with fans

The "*Supply temperature compensation*" with fans is enabled with "*FT1*".

If "*FT1=Heat*" then if the heating coil controlled with Heating Sequence 1 is not enough to control the supply temperature (this means that the coil remains at 100 % for more than "*FT6*" seconds) the speed of the fans is decreased using PID logic in order to try to help the heating coil.

The setpoint used by the PID control loop is an offset from the "*HS1*" setpoint, as described in the figure below.
Until the compensation is active (PID output greater than 0) the coil remains at 100 %.



Similar behavior when "*FT1=Cool*" (Cooling Sequence 1) or "*HeCo*" (heating/cooling)

Fig 60 [Supply and return fans - Supply temperature compensation with fans]

13.0 Air quality control

Control of the air quality is performed according to the readings detected by the "*C02*" (carbon dioxide) and "*VOC*" (Volatile Organic Compound) probes connected to the analog inputs "*CO2*" – "*CO2*" and "*VOC*" - "*VOC*". Without these probes, it is still possible to achieve a timed air changeover.

AIR			Air Quality	Min	Max	Value	U.M.	Text Value
	ACH		Air Change					
		P01	AirChange period	0	9999	0	MIN	
		P02	AirChange duration	0	9999	30	SEC	
	CO2		CO2-VOC Control					
		P00	CO2 control type	0	2	3=FaDa		NO;FAN;DAP;FaDa
		P03	CO2 setpoint	0,0	100,0	50,0	%	
		P04	CO2 prop. band	1,0	10,0	10,0	%	
		P07	VO2 control type	0	2	3=FaDa		NO;FAN;DAP;FaDa
		P05	VOC setpoint	0,0	100,0	50,0	%	
		P06	VOC prop. band	1,0	10,0	10,0	%	

Tab 42 [Air quality control - Air quality parameters]

Whether requested by the "*VOC*" or "*CO2*" probes or set to be performed at certain intervals, air changeover has priority over damper management. This means that the outside air damper can be opened even if the outside temperature conditions are not favorable to free-cooling/free-heating.
If both air quality measurement probes are not present, air changeover is regulated through "*P01*", interval between air changes, and "*P02*" duration of the external damper opening.

If both probes, "*VOC*" and "*CO2*", are present, the damper is controlled by the higher of the two signals detected.
With the parameter "*P00*" and "*P07*" it is possible to choose the actuators to control:
only damper "*DAP*", only fan "*FAN*", fan and damper "*FaDa*".
A setpoint for "*CO2*" control is defined in "*P03*" with its relative differential "*P04*" and a setpoint for the "*VOC*" control is defined in "*P05*" with its relative differential "*P06*".
The "*CO2*" and "*VOC*" control changes the minimum limit of the external damper and change the minimum limit of the fan speed in order to supply more fresh air.

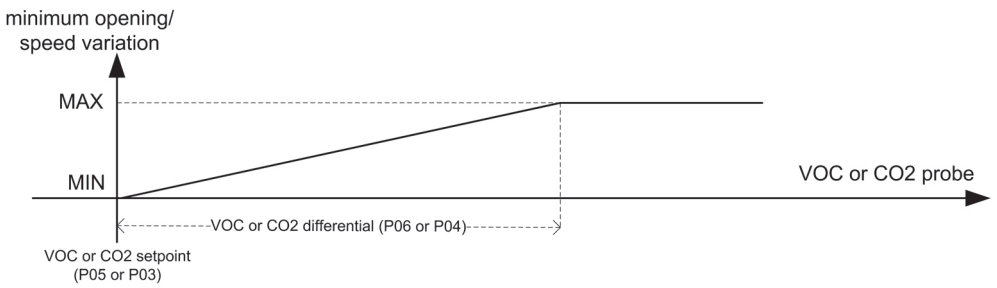


Fig 61 [Air quality control - Air quality]

14.0 Alarms

14.1 Actions following an alarm

When an alarm occurs, the following actions generally ensue (according to what defined through the "*mcxs configuration*" file):

- the buzzer sounds, if present and if envisaged by the specific alarm, (see 14.3 "Alarms table");
- the alarm relay "*ALA - Alarm*" or the warning "*WAR - Warning*" is activated depending on what is envisaged by the specific alarm, (see 14.3 "Alarms table").
  The "*mcxs configuration*" file can be used to define whether the alarm is activated when the unit is OFF. In the absence of a alarm condition, the Normally Closed (N.C.) and Normally Open (N.O.) state of the alarm relay is defined when the physical output is configured.
  If the polarity is "N.O." (default setting), the relay is powered in case of an alarm;
- the alarm icon is displayed along with the code for the alarm and its description (only for units with LCD display). For a complete description of the user interface in the case of alarms,
  (see 2.0 "User interface").

14.2 Types of reset

In the "*mcxs configuration*" file through the MCXShape tool it is possible to set how the alarms are to be reset:

- manually;
- automatically;
- semi-automatically.

Manual
a specific procedure is required to resetting them if the alarm condition doesn't exists any more: from the menu (Menu: ALA – Alarms, Sub-menu: RAL – Reset Alarms) to reset all alarms present or by pressing the key from within the alarms display screen to reset only the currently displayed alarm, (see 2.0 "User interface").

Automatic
the alarm is deactivated and the signal disappears as soon as the alarm conditions cease.

Semi-automatic
it means that reset reverts from automatic to manual after it has occurred a certain (configurable) number of times.

The buzzer is silenced the first time any button is pressed, even if the alarm condition remains in effect; it will remain silent until a new alarm occurs.

14.3 Alarms table

Each alarm is characterized by:

- code: ID tag that unequivocally identifies the alarm and which is displayed on the screen;
- description: displayed only on LCD displays;
- source of the alarm;
- type of reset: (-1=automatic, 0=manual, >0=number of occurrences for semi-automatic alarms);
- if semi-automatic alarms, the period for counting alarm occurrences: if during this time the alarm exceeds its maximum number of occurrences, it becomes a manual reset alarm;
- delays for detecting the alarm after start-up and when in steady operation;
- whether it is active even when the machine is in standby mode;
- how it affects the alarm relay, warning and buzzer;
- how it affects the unit actuators.

as described in the table below.

The columns in grey contain data that can be modified in the "*mcxs configuration*" file through the MCXShape tool.

Note

In the "mcxs configuration" file, using the MCXShape tool, is possible add parameters that can be used to enable or delay the alarms, as for example parameters "Ga1", "Ga2", "Ga3" and "Ga4", used to delay auxiliary alarms "GA1", "GA2", "GA3" and "GA4".

Cod	Description	Source	Type of reset	Semi autom. period (min)	Delay at start-up	Oper. delay	Active with unit OFF	Alarm relay	Warn. relay	Buzzer	Actuators OFF
A01	Supply fan alarm	Digital input "*SupFan Alarm*"	-1 (automatic)	0	0	0	YES	YES	YES	YES	Supply fan
A02	External damper locked	Digital input "*ExtDamp Closed*" and output "*External Damper*" active	-1 (automatic)	0	0	3	NO	YES	YES	YES	Supply fan
A03	Supply fan safety switch	Digital input "*SupFan SafeSW*"	-1 (automatic)	0	0	0	NO	YES	YES	YES	Supply fan
A04	Return fan alarm	Digital input "*RetFan Alarm*"	-1 (automatic)	0	0	0	NO	YES	YES	YES	Return fan
A05	Mixing damper locked	Digital input "*MixDamp Closed*" and output "*Mixing Damper*" active	-1 (automatic)	0	0	3	NO	YES	YES	YES	Return fan
A06	Return fan safety switch	Digital input "*RetFan SafeSW*"	-1 (automatic)	0	0	0	NO	YES	YES	YES	Return fan
A07	Freeze alarm	Digital input "*Freeze Alarm*" or Analog input (defined in FP1) <= FP2 or in error	3	10	0	0	YES	YES	YES	YES	(See 9.0 "Frost protection")
A08	Fire alarm	Digital input "*Fire Alarm*"	0 (manual)	0	0	0	YES	YES	YES	YES	All
A09	Supply air flow alarm	Digital input "*Supply Flow*"	0 (manual)	0	10	5	NO	YES	YES	YES	Supply fan
A10	Return air flow alarm	Digital input "*Return Flow*"	0 (manual)	0	10	5	NO	YES	YES	YES	Return fan
A11	Supply filter alarm	Digital input "*Supply Filter*"	0 (manual)	0	10	5	NO	YES	YES	YES	None
A12	Return filter alarm	Digital input "*Return Filter*"	0 (manual)	0	10	5	NO	YES	YES	YES	None
A13	Pump 1 overload	Digital input "*Coil1 Pump*"	-1 (automatic)	0	0	0	NO	YES	YES	YES	Pump 1

Cod	Description	Source	Type of reset	Semi autom. period (min)	Delay at start-up	Oper. delay	Active with unit OFF	Alarm relay	Warn. relay	Buzzer	Actuators OFF
A14	Pump 2 overload	Digital input "*Coil2 Pump*"	-1 (automatic)	0	0	0	NO	YES	YES	YES	Pump 2
A15	Pump 3 overload	Digital input "*Coil3 Pump*"	-1 (automatic)	0	0	0	NO	YES	YES	YES	Pump 3
A16	Coil 1 alarm	Digital input "*Coil1 Alarm*"	0	0	0	0	YES	YES	YES	YES	Coil 1
A17	Coil 2 alarm	Digital input "*Coil2 Alarm*"	0	0	0	0	NO	YES	YES	YES	Coil 2
A18	Coil 3 alarm	Digital input "*Coil3 Alarm*"	0	0	0	0	NO	YES	YES	YES	Coil 3
A19	Humidifier alarm	Digital input "*HumidifierAlarm*"	-1 (automatic)	0	0	0	NO	YES	YES	YES	Humidifier and pump
A20	Recovery alarm	Digital input "*RecoveryAlarm*"	-1 (automatic)	0	0	0	NO	YES	YES	YES	Recovery and pump
A21	Generic alarm	Digital input "*Generic Alarm*"	-1 (automatic)	0	0	0	NO	YES	YES	YES	None
AEX	No connection with EXC Module	Communication error with EXC extension	-1 (automatic)	0	30	5	NO	YES	YES	YES	
E01	Analog Input 1 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E02	Analog Input 2 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E03	Analog Input 3 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E04	Analog Input 4 fault	Probe open or short circuited	0	0	20	10	YES	YES	YES	NO	Actuators involved
E05	Analog Input 5 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E06	Analog Input 6 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E07	Analog Input 7 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E08	Analog Input 8 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E09	Analog Input 9 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E10	Analog Input 10 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E11	Analog Input 11 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved

Cod	Description	Source	Type of reset	Semi autom. period (min)	Delay at start-up	Oper. delay	Active with unit OFF	Alarm relay	Warn. relay	Buzzer	Actuators OFF
E12	Analog Input 12 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E13	Analog Input 13 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E14	Analog Input 14 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E15	Analog Input 15 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
E16	Analog Input 16 fault	Probe open or short circuited	-1 (automatic)	0	20	10	NO	YES	YES	NO	Actuators involved
GA1	Aux Alarm 1	Auxiliary alarm 1	-1 (automatic)	0	Ga1	Ga1	NO	NO	NO	NO	None
GA2	Aux Alarm 2	Auxiliary alarm 2	-1 (automatic)	0	Ga2	Ga2	NO	NO	NO	NO	None
GA3	Aux Alarm 3	Auxiliary alarm 3	-1 (automatic)	0	Ga3	Ga3	NO	NO	NO	NO	None
GA4	Aux Alarm 4	Auxiliary alarm 4	-1 (automatic)	0	Ga4	Ga4	NO	NO	NO	NO	

Tab 43 [Alarms - Alarms table]

15.0 Parameters

The parameters are broken down into groups according to the type of function performed.

The characteristics described below are defined for each parameter; these can take on numerical values or can depend on that of another parameter specified in the tag.

All characteristics described is contained in the "*mcxs configuration*" file and the values can be modified through the MCXShape tool, (see MCXShape user manual).

- **Label**: ID tag for the parameter. Unequivocally identifies the parameter.
- **Description**: describes the parameter shown on the LCD display.
- **Min**: lowest possible value for the parameter.
- **Max**: highest possible value for the parameter.
- **Default**: factory-installed value.
- **U.M**: indicates the unit of measure.
- **Decimals**: number of decimal points.
- **Level**: the parameters are organized in 4 levels. Levels 1 to 3 are associated with a password. It is not possible to display parameters of a level higher than the access level; on the other hand, it is possible to view parameters belonging to levels lower than or equal to the access level.
  - level 0 can be accessed without a password;
  - level 1, easy access, groups together the parameter which are not critical for machine function and which are frequently modified;
  - level 2 groups together all parameter which are useful during machine installation;
  - level 3 groups together all parameter reserved for the manufacturer.
- **Enabled**: if not checked, indicates a parameter that cannot be modified (constant with default value); does not appear on the display.
- **Text Values**: list of mnemonic values that can be assumed by the parameter.

The parameter display and modification mode is accessed from the Menu.
For a complete description of the user interface, (see 2.0 "User interface").

15.1 Parameters table

(See the "*mcxs configuration*" file) for the complete list of parameters, (see MCXShape user manual).

The "*mcxs configuration*" file is part of the application pack that can be downloaded from the site *www.danfoss.com/mcx*.

16.0 Modbus communication

The communication protocol supported by the RS485 network is the Modbus RTU slave.

GEN			General	Min	Max	Value	U.M.	Text Value
	SEr		Modbus					
		Add	Modbus address	1	254	1		
		bAU	Baudrate	0	8	6=192		0;12;24;48;96;144; 192;288;384
		COM	Settings	0	2	0=8N1		8N1;8E1;8N2

Tab 44 [Modbus communication - General parameters]

The following communications settings can be set:

SEr - Serial address (Modbus and CAN)
Serial node address setting, valid both for the Modbus and CAN networks.
Each node on the network must have an unequivocal address.

bAU – Serial Baudrate (Modbus)
- "*bAU=0*" communication disabled.
- "*bAU=12*" baudrate=1200 baud.
- "*bAU=24*" baudrate=2400 baud.
- "*bAU=48*" baudrate=4800 baud.
- "*bAU=96*" baudrate=9600 baud.
- "*bAU=144*" baudrate=1440 baud.
- "*bAU=192*" baudrate=19200 baud (default value).
- "*bAU=288*" baudrate=28800 baud.
- "*bAU=384*" baudrate=38400 baud.

COM – Serial settings
- "*COM=8N1*" 8 data bits, no parity, 1 stop bit.
- "*COM=8E1*" 8 data bits, parity even, 1 stop bit.
- "*COM=8N2*" 8 data bits, no parity, 2 stop bits.

The exported variables are of the "*Holding Register*" or "*Coil*" type.

16.1 Table of exported variables

The exported variables are present in the "*mcxs configuration*" file and can be printed using the MCXShape tool, (see MCXShape manual).

Table index

Image index