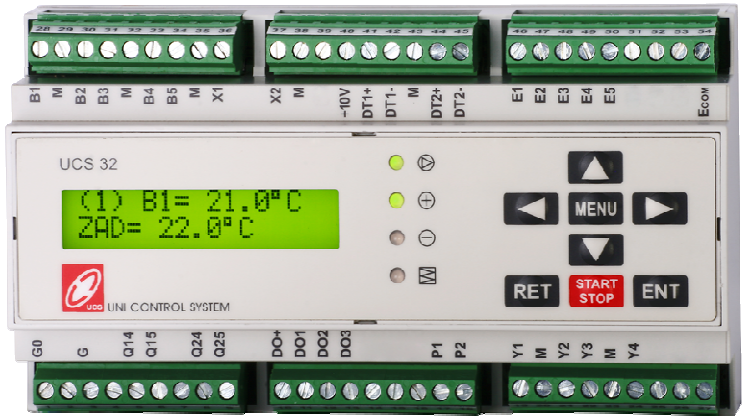
CAUTION: Read this manual carefully before installation

UNIVERSAL MICROPROCESSOR-BASED CONTROLLERS

UCS 30 SERIES

UCS 34

UCS 32



User Manual

Ver.5.5/14

UNI CONTROL SYSTEM
Ul. Chmielna 81/82
80-748 Gdańsk, Poland
Tel: +48 (0)58 305 19 87
Fax: +48 (0)58 305 19 87

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1 UCS SERIES OVERVIEW

	UCS10 series			UCS20 series			UCS30 series	
	UCS11	**UCS12**	**UCS13**	**UCS21**	**UCS22**	**UCS23**	**UCS32**	**UCS34**
Number of inputs	**7**	**7**	**7**	**11**	**11**	**11**	**12**	**16**
- Resistive PT1000	3	3	3	5	5	5	5 *	5 *
- Analog 0-10V	1	1	1	2	2	2	2	3
- Digital	3	3	3	4	4	4	5	8
Number of outputs	**7**	**7**	**7**	**8**	**8**	**8**	**11**	**16**
- Analog 0-10V	2	2	2	3	3	3	4	6
- Relay	3	4	5	3	4	5	2	2
- Digital (Triac)	-	-	-	-	-	-	3	6
- Modulated PWM	2	1	-	2	1	-	2	2

Functions	**UCS10**	**UCS20**	**UCS30**
Temperature control	**x**	**x**	**x**
Primary heating	x	x	x
Secondary heating	x	x	x
Water heater control	x	x	x
Electric heater control	x	x	x
Chilled water cooler control	x	x	x
Compressor control	x	x	x
Cascade control with min./max limiting	x	x	x
Preliminary heating function	x	x	x
Fast heating function	x	x	x
Venting function	-	-	x
“FREE COOLING” function	-	x	x
ECO mode	x	x	x
Active frost protection	x	x	x
Electric heater overheating protection	x	x	x
Compressor frost protection	-	-	x
Humidity control (humidification and dehumidification)	**x**	**x**	**x**
Cascade control with min./max limiting	-	x	x
2 additional controllers with 2 control loops each one (e.g. pressure control ...)	**x**	**x**	**x**
Cascade control with min./max limiting	-	-	x
Fans control	**x**	**x**	**x**
One single-speed fan control	x	x	x
Two-speed control or control in star-delta system of supply and exhaust air fans	-	x	x
Individual control of supply and exhaust air fans	-	x	x
Inverter control	x	x	x
Common fan pressure alarm	x	-	-
Individual pressure alarms for supply and exhaust air fans	-	x	x
Engine alarm (thermic)	-	x	x
Heat recovery units (exchangers) and mixed air damper control	**x**	**x**	**x**
Exchanger protection	x	x	x
Pump control	**x**	**x**	**x**
Pump starting by low outdoor temperatures	x	x	x
Periodic pump and valve exercising	-	x	x
Pump failure alarm	-	x	x
Real time clock with week scheduler	**x**	**x**	**x**
System operation programs controlled by programmable events	**-**	**2**	**2**
Fan speed control within scheduler and programs	-	x	x
Enable/disabling processes and device control within scheduler and programs	-	x	x
Other functions			
Outdoor compensation	-	x	x
User function	-	x	x
Arithmetical functions e.g. average, difference, max., min. of 2 channels	-	-	x
Time relays	-	x	x
Remote setting of the desired temperature value	x	x	x
Remote setting of the desired humidity value	-	-	x
Other alarms			
Fire alarm	x	x	x
Overall filter alarm	-	x	-
4 separate filter alarms	-	-	x

x: available -: not available *)only PT1000

2 TECHNICAL FEATURES

2.1 A LOT OF INPUTS AND OUTPUTS

	UCS32	UCS34
Number of inputs	**12**	**16**
- Resistive PT1000	5	5
- Analog 0-10V	2	3
- Digital	5	8
Number of outputs	**11**	**16**
- Analog 0-10V	4	6
- Relay	2	2
- Digital (Triac)	3	6
- PWM (Pulse Width Modulation)	2	2
Number of time relays	1	3

2.2 VERY FLEXIBLE AND RICH SOFTWARE

The controllers have built-in functions that enable total control over HVAC systems.

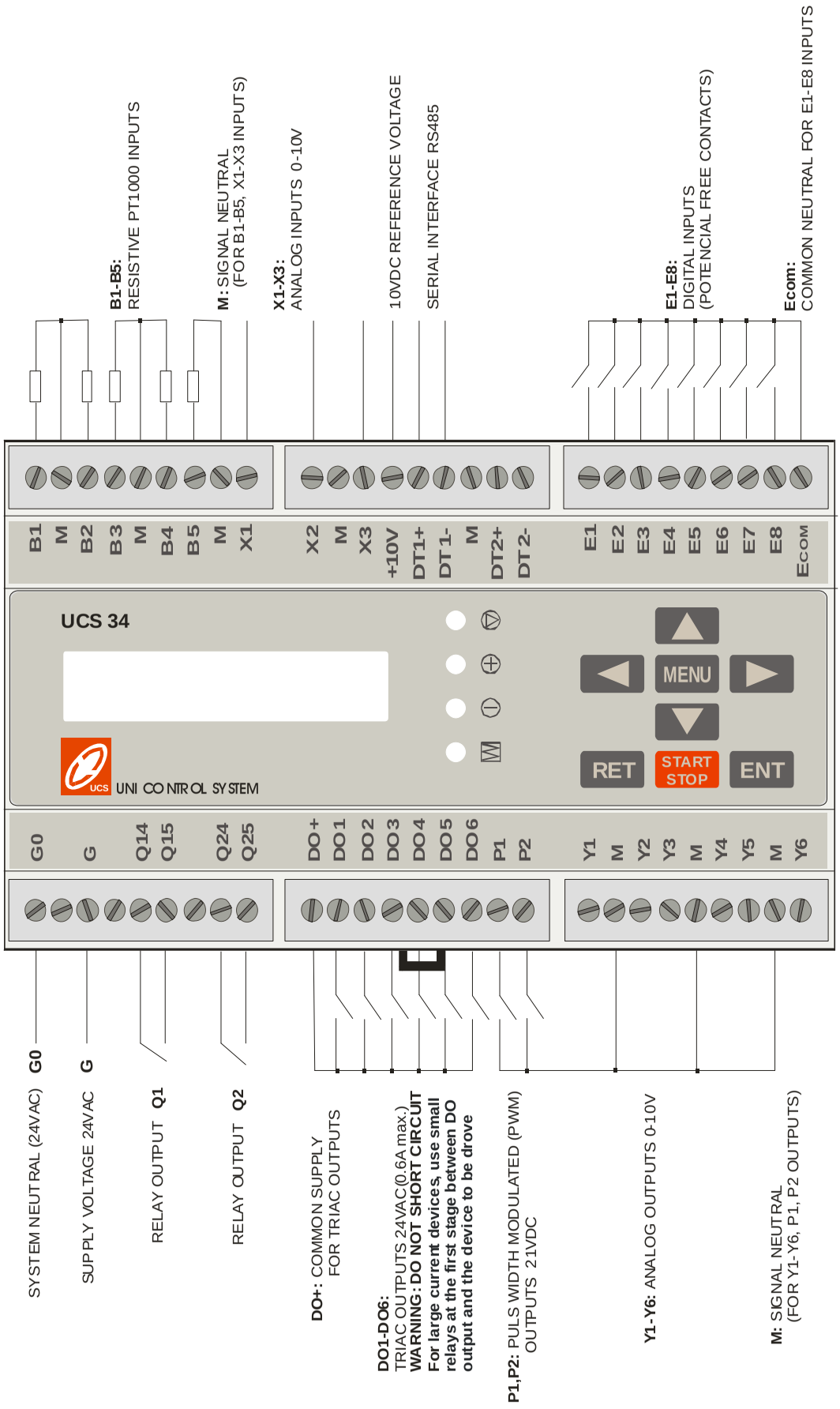
Some of the functions are listed below:

- Temperature control
  - Primary and secondary heating control (hot water and electric heaters)
  - Electric heat current valves driving
  - Cooling control (chilled water and compressors)
  - Cascade control with min./max limiting
  - Preliminary heating function
  - Fast heating function
  - Heat retention at shutdown
  - Free cooling function
- Humidity control (humidification and dehumidification)
  - Cascade control with min./max limiting
- A second controller with two control loops (for pressure control, temperature control, etc.)
- Fan control
  - Individual control of supply and exhaust air fans
  - Single or two-speed control of supply and exhaust air fans
  - Fan control in star-delta system
- Heat recovery units (exchangers) and mixed air damper control
- Cool recovery (exchangers, dampers)
- Pump control
- Periodic pump exercising
- Pump failure alarm with automatic pump stop
- Active frost protection
- Overheating protection
- Exchanger protection
- Compressor frost protection
- Fan pressure alarm
- Filter alarm
- Up to 4 separate filter input
- Outdoor compensation
- Arithmetical functions e.g. average, difference, max., min. of 2 channels

- Real time clock with week scheduler
- Password protection of settings and different login levels
- Data retention protection against power failure
- Display language select (with English being the basic language)
- RS485 serial interface
- Communication by MODBUS protocol

3 TECHNICAL DATA

3.1 WIRING DIAGRAM



3.2 TERMINALS

G-G0 Power supply 24VAC

M Analog signal ground (galvanic connection with G0) for B1-B5 and X1-X3 inputs and Y1-Y6 outputs

B1-B5 Resistive PT1000 inputs

X1-X3 Analog inputs 0-10VDC

E1-E8 Digital inputs, potential-free contacts

Ecom Common ground for digital inputs E

- Do not apply voltage to the E1... E8 digital inputs. The reference signal for these inputs is the Ecom input, which should be applied to E1...E8 through a contact.
- **Caution: E1** is an alarm input for overheating protection of electric heaters (heater thermostat connection). The default setting for E1 when not assigned to any function is high temperature thermostat connection. Open contact means overheating alarm while closed contact means no alarm. To override this function, assign E1 input to any function.

Q1,Q2 Relay outputs - closing contacts

DO1-DO6 Digital outputs - triac

DO+ Common supply 24V AC for digital outputs DO1-DO6

- When active, the DO1... DO6 outputs short to ground G0. When inactive, they disconnect. Common supply for these outputs is the analog input DO+ (24V AC)
  Connect the device to be controlled directly to DO+ and DO1... DO6 without applying voltage.
- **CAUTION: Do not short-circuit DO+ and DO1... DO6 or DO+ and ground M or G0. When driving devices that draw large current, use small relays at the first stage between the DO1-DO6 output and the device to be drove.**

Y1-Y6 Analog outputs 0-10VDC

P1, P2 Modulated outputs 21V DC: electric heat current valves driving
Connect the device to be controlled (e.g. a semiconductor relay) to P1(+) and M(-) or P2(+) and M(-)

+10V 10V reference voltage. Suitable for use as power supply for X inputs when configured as digital inputs.

DT1+, DT1- Serial interface RS485

3.3 GENERAL DATA

Supply voltage:	24VAC ± 10%, 50/60Hz
Power consumption:	6VA (outputs P1, P2, and DO1…DO6 while not under load)
Ambient temperature:	0...50°C
Storage temperature:	-25...50°C

Inputs:

Resistive B1...B5	PT1000, range: -25 …+70°C
Analog X1...X3	Range: 0-10V Input impedance: 500kΩ min.
Digital E1...E8	Input signal: potential free contacts

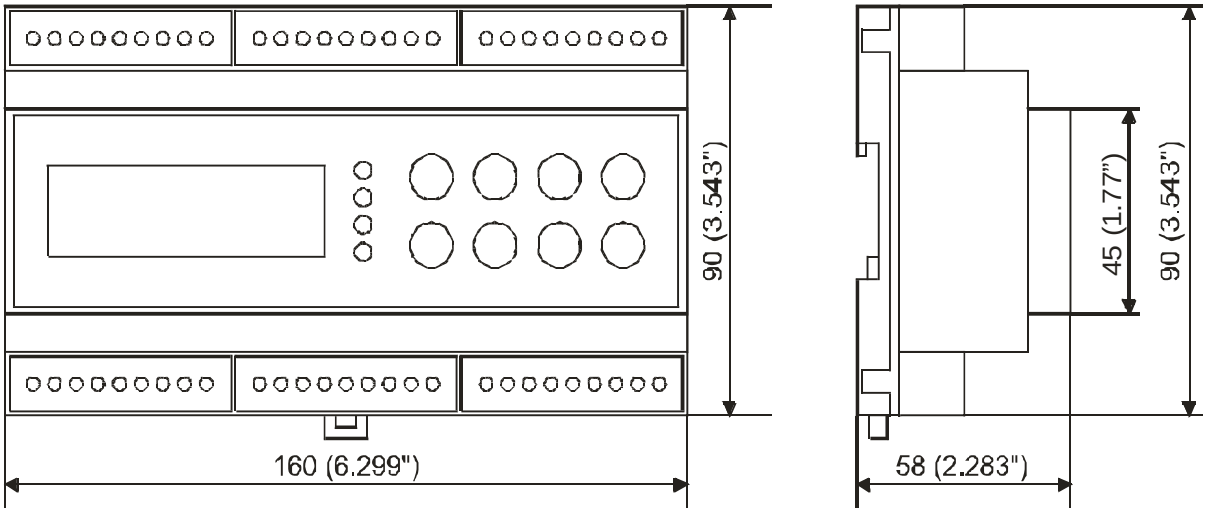
Outputs:

Analog Y1..Y6	0-10V / 2mA
PWM P1, P2	21V ± 2VDC / 50mA (max.) Output resistance: 200Ω
Relay Q1, Q2	250VAC, 2.5A / resistive load
Digital DO1...DO6	Triac, 24VAC / 0.6A max

CE

This product conforms to the requirements of European EMC standards PN-EN 61000-6-1 and PN-EN 61000-6-3 and carries the CE mark.

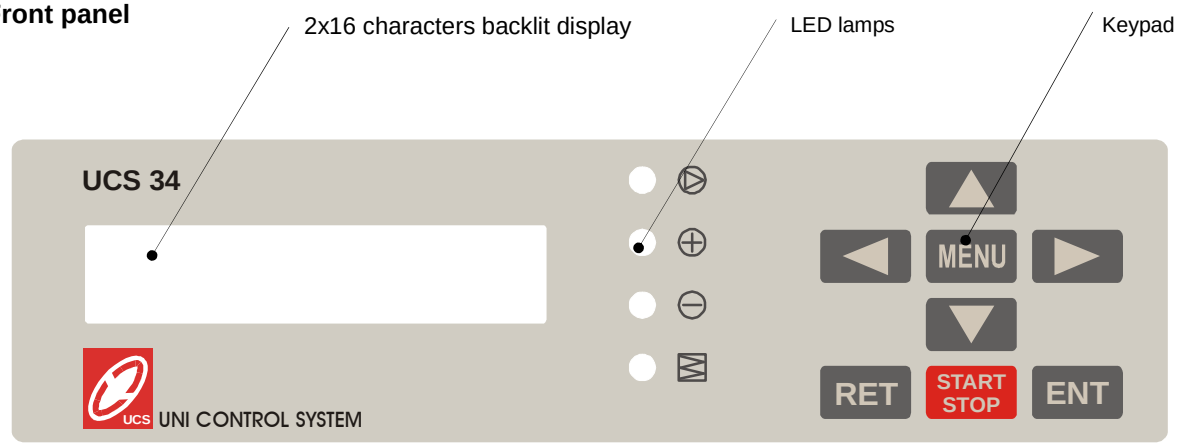
3.4 DIMENSIONS



Dimensions in mm (inch) Wymiary w mm (cale) Размеры в mm (дюймы)

4 THE FRONT PANEL

Front panel

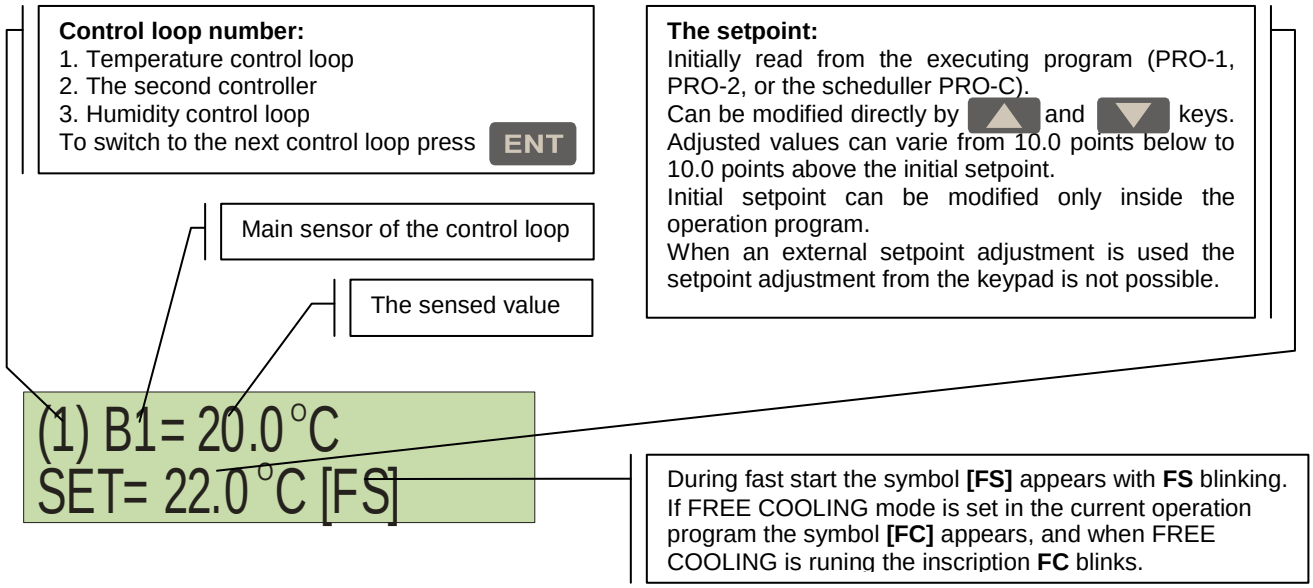


4.1 DISPLAY

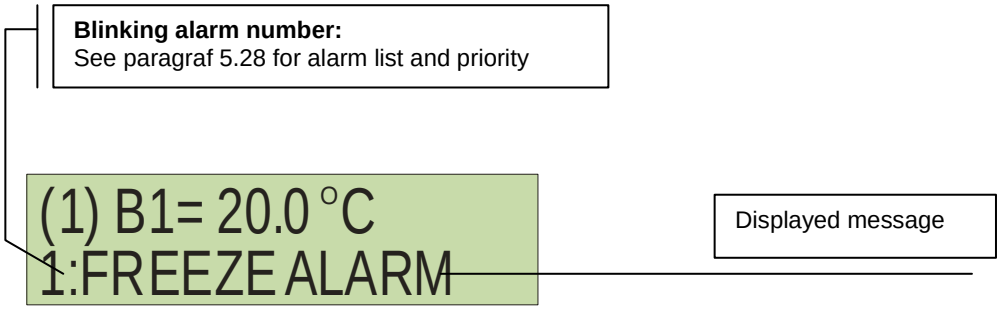
The UCS30 series controllers are equipped with a liquid crystal display (2x16 char). All information (menu system, set values, actual input and output values, and alarms) is displayed in one of the two languages (English and Polish) selected in the menu system.

4.1.1 The main display mode

- **The display when the system is runing**



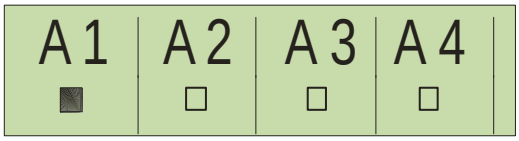
- **The display during alarm**



4.1.2 The view mode

- **Alarms view**

A view example with alarm A1 activated:



Alarm list:
A1- Frost protection alarm
A2- Engine alarm (thermic)
A3- Supply fan pressure alarm
A4- Exhaust fan pressure alarm
A5- Fire alarm
A6- High temperature
A7- Exchanger alarm
A8- Compressor frost protection
A9- Pump failure
A10- Filter alarm
For more detail see paragraf 5.29

To switch to alarms view press ◄ from the main display mode.

To view next alarms list press ▼ or ▲.

To switch back to the main display mode press RET .

- **Inputs view**

To switch to inputs view press ► from the main display mode and then use ▼ or ▲ to select items.

To switch back to the main display mode press RET .

- **Outputs view**

To switch to ouputs view press ► from the input view and then use ▼ or ▲ to select items.

To switch back to the main display mode press RET .

4.2 LED LAMPS

Four bi-color LED lamps on the front panel indicate the operation of the system and alarms. The lamps are assigned to the following functions: fans, heating, cooling, and filters. The green color indicates good operation while the red one indicates a failure (see chapter 5.28). The LED lamps combined with the display provide an easy and comfortable way to read information from the controller.

4.2.1 Led lamps description:

LED lamp	Role	Red colour	Green colour
	System and fans operation	- Supply fan pressure alarm - Exhaust fan pressure alarm - Engine alarm - Fire alarm	Good operation
	Heating process	- Frost protection alarm - High temperature	
	Cooling process	Compressor frost protection alarm	
	Filters and pumps operation	- Filter alarm - Pump failure alarm	

4.3 KEYPAD

8 key buttons on the front panel enable easy adjusting and reading of all parameters. All functions and parameters can be configured directly through the keypad without need for additional software or external PC.

Menu button: Provides access to the menu system. When pressed, the menu section *PRO-C* (week scheduler) is displayed.

1. Shifts to the next menu item during navigation in the menu system
2. Decreases the value of adjusted parameters in the menu system
3. Decreases the current desired value in direct mode
4. Shifts to the next item during input/output view or alarms view

1. Shifts to the previous menu item during navigation in the menu system
2. Increases the value of adjusted parameters in the menu system
3. Increases the current desired value when visible in the main display mode (the display mode after power-up)
4. Shifts to the previous item during input/output view or alarms view

Shifts the cursor to the next position during parameters setting, or troggles between input and output view in the main display mode (the display mode after power-up).

Shifts the cursor to the previous position during parameters setting, or switches to the alarms view in the main display mode.

Selects a menu item when navigating in the menu system, confirms the adjusted value when setting parameters.

1. Returns to the main display mode (exit programming mode)
2. Shift up one level in the menu system
3. Cancel parameter value modifications not yet confirmed by the 

key.

Turns the system on and off.

5 CONTROLLER FUNCTIONS

The UNI CONTROL SYSTEM UCS32 and UCS34 controllers are universal process control devices for use in large HVAC systems (temperature, humidity, pressure control etc.). The controllers have built-in serial interface that makes them suitable for network communication.

The controllers provide multiple functions, such as active frost protection, exchanger control (plate heat exchanger, rotating exchanger or glycol heat recovery system), cascade control with limiting functions and many others.

All functions and features can be directly set from the keypad and there is no need for additional software or external PC.

The controllers are suitable for controlling both water and electric heaters. They provide among others: a week scheduler, general purpose timers, display language select and many other functions. They are very advanced and easy to use devices that can operate in various configurations of air-handling systems.

5.1 DIFFERENCES BETWEEN UCS32 AND UCS34 MODELS

The main difference between UCS32 and UCS34 controllers is the number of inputs and outputs and the number of time-relays (see table in chapter 1). All other functions are identical for both models.

5.2 POWER-UP AND STARTUP

After power-up, the controller for a few seconds reads and analyzes the configuration parameters. A “0” code error message (no parameter configuration) will be displayed if the controller is not configured. If the controller is configured, it will start to operate according to the previously set configuration.

In order to configure the controller, access the *LOC* parameter and enter the password. After a correct password is entered, the parameters can be adjusted. To access the *LOC* parameter press MENU and then press ▲.

5.2.1 Power-up: *START* parameter

The *START* parameter defines what kind of action to take by the controller after power-up: Running the system, or getting into STANDBY mode. There are two options:

- ***START* = AUTO** (default value):

  The controller starts automatically the system immediately after power-up if the remote control input *RCON* is not defined. If the *RCON* parameter is defined the system will be started only after a signal is applied to the *RCON* input or after using the START STOP key.

- ***START* = MAN:**

  The controller switches the system to the state before power-down if the remote control input *RCON* is not defined i.e.

  a) If the system was in the running state before power-down, it will be started by the controller.

  b) If the system was stopped manually using the START STOP key it will stay in STANDBY mode until the operator has started it manually using the START STOP key.

If the *RCON* parameter is defined the system will be started only after a signal is applied to the *RCON* input or after using the START STOP key.

Notice: If the *RCON* parameter is defined, after power-up the system will be started only after a command from the operator, independently of the setting of the parameter *START*.

5.2.2 Running and stopping the system

To switch the system ON press START STOP and then press ENT and hold for about 3 seconds until the system starts.

To switch the system OFF press START STOP and then press ENT. If the fan-OFF delay is set, the fans will continue to run for a time defined in the parameter *STOP*.

5.3 SECURITY PASSWORD AND ACCESS LEVELS

The controller parameters are password-protected with 4 access levels. The access level is defined by the **LOC** parameter in the menu system (default setting is 1) that can adopt following values:

- **0**: all parameters are visible and can be adjusted without entering the password.
- **1**: all parameters are visible, but only a few of them can be adjusted without entering the password. These parameters are: desired temperature SV1, desired values SV2, SV3 and desired humidity SVH and the real time clock setting of day (DAY) and time (H:M).
- **2**: Only the basic parameters are displayed (see LOC=1) and can be adjusted without entering the password.
- **3**: Only the basic parameters are displayed (see LOC=1) and can be adjusted only after entering the password.

5.3.1 Entering the password

In order to enter the password, press MENU key, then shift to the LOC parameter using ▲ key and then press ENT. The controller will ask for the password. After the correct password is given, access to all parameters will be granted until the user has exited the menu system.

5.3.2 Password setting: *CODE parameter*

The controller is provided initially with the password set to **0000**. However, the password should be changed due to safety measures. In order to change the password, access the CODE menu item using the old password and enter the new one. After setting the new password, the old one is no longer valid.

5.4 SETTING APPLICATIONS AND CONFIGURING THE CONTROLLER

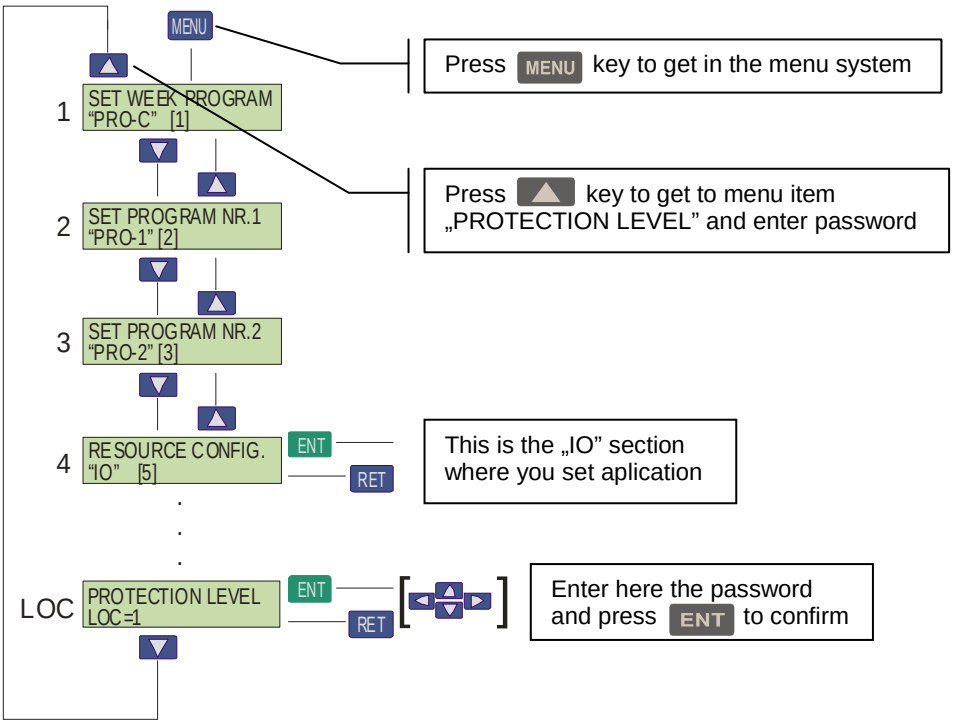
UCS controllers are configurable devices and provide a wide range of implemented functions related to heating, ventilation and air conditioning systems (HVAC). Unlike freely programmable controllers, they don't require any external programming tools or self-designed control algorithms. They have built-in suitable algorithms and functions, which enable complete HVAC system control. **Creating own applications is done simply by configuring the controller step by step using the menu system**.

UCS controllers provide flexible configuration and a rich set of functions. This enables setting almost any kind of applications (even some of the atypical applications requiring freely programmable controllers), which is an advantage over typical dedicated controllers.

Applications can be entered in the section „*IO*" (no. 5, „RESOURCE CONFIG.) in the menu system. After the process has been initiated by the user, the controller takes over, and parameters can be entered step by step.

Before setting applications it is necessary to shut down the system (unless it is already OFF) and wait for the fans to switch OFF (see chapter 5.2.2). Remember to enter the password if the *LOC* parameter value is different than zero (see chapter 5.3). After entering the password, switch to section *„IO"*, position *RTD1* and initiate programming by pressing ENT . From now on, the controller takes over. First, the previous application is erased by zeroing all corresponding parameters. This operation takes a few seconds. Next, a parameter name is displayed and the user can enter its value into the flashing field. After confirmation by pressing ENT the controller displays the next parameter, and the user can enter a new value. The set of parameters and the order in which they are displayed depend on previously entered parameter values. The controller instantly analyses entered data and decides which parameters to display. After completing the sequence the controller displays the first parameter (*RTD1*), but without the flashing value field. To exit section *IO* press RET.

Diagram example



5.4.1 Parameter list from the „*IO*” section:

Nr	Name	Text on the display	Meaning	Range	I/O type
1	RTD1	MAIN TEMP SENSOR	**Main sensor - control loop PID1:** Must be defined for control.	B, X	Analog input
2	SQ1+	PRI HEAT CONTROL	Primary heating sequence:	Q, DO, P, Y	Output
3	SQ1-	COOLING CONTROL	Cooling sequence		
4	HUM	HUMIDITY SENSOR	Humidity sensor	B, X	Analog input
5	SQH+	HUMIDIFYING CONT	Humidifying sequence	Q, DO, P, Y	Output
6	SQH -	DEHUMIDIF CONTR.	Dehumidifying sequence		
7	SQ++	SEC HEAT CONTROL	**Secondary heating sequence:** When heating and dehumidifying are running simultaneously, the preliminary heating sequence *SQ1+* switches off and the secondary *SQ++* switches on.		
8	RTD2	SENSOR FOR REG 2	Feedback sensor for controller 2 (control loop PID2)	B, X	Analog input
9	SQ2+	PID2+ OUTPUTS	**Sequence for positive error:** This sequence runs when the desired value *SV2* is greater than the sensed value at input *RTD2*.	Q, DO, P, Y	Output
10	SQ2-	PID2- OUTPUTS	**Sequence for negative error:** This sequence runs when the desired value *SV2* is lower than the sensed value at input *RTD2*.		
11	SQ3+	PID3+ OUTPUTS	**Sequence for positive error:** This sequence runs when the desired value *SV3* is greater than the sensed value at input *RTD3*.	Q, DO, P, Y	Output
12	SQ3-	PID3- OUTPUTS	**Sequence for negative error:** This sequence runs when the desired value *SV3* is lower than the sensed value at input *RTD3*.		
13	DAMP	ON/OFF DAMPERS	**ON/OFF Dampers control:** Output *DAMP* switches on at start of the system and switches off at stop of the system and the fans.	Q, DO	Digital output
14	DACO	RECIRCUL.DAMPERS	Mixed air dampers control	Q, DO, Y	Output
15	HTOUT	EL.HEATER SUPPLY	**Electric heaters power supply:** Digital output *HTOUT* switches on when either output P1 is active or P2. It switches off when neither of P1, P2 is active. This output can be used to power supply electric heaters.	Q, DO,	Digital output
16	RTDL1	LIMIT SENSOR (1)	Limit sensor for control loop PID1 (main controller).	B, X	Analog input
17	RTDL2	LIMIT SENSOR (2)	Limit sensor for control loop PID2		
18	RTDL3	LIMIT SENSOR (3)	Limit sensor for control loop PID3		
19	HUML	HUM.LIMIT SENSOR	Humidity limit sensor		
20	FPAL	FROST PROT ALARM	**Frost thermostat:** After an alarm condition on input *FPAL* the controller switches off the fans, and drives the heaters to the maximum value. According to the settings, switching on the system may be done automatically after alarm is over or manually after clearing alarm. Clearing alarm: press ENT for about 5 sec.	X, E	Digital input
21	FPROT	FROST PRO SENSOR	**Frost sensor:** After an alarm condition on input *FPROT* the controller switches off the fans, and drives the heaters to the maximum value. According to the settings, switching on the system may be done automatically after alarm is over or manually after clearing alarm. Clearing alarm: press ENT for about 5 sec.	B, X	Analog input
22	APROT	COMPRESSOR PROT.	**Compressor frost protection:** After an alarm condition on input *APROT* the controller switches off the compressor, whereas the system still operates.	B, X, E	Input
23	FCO1	SUPPLY FAN(STAR)	**Supply fan control:** Output *FCO1* defines the outputs sequence for supply fan control (see section 6.16). In star-delta systems, it controls the fan In the star system, while In multi-speed fan systems it controls the speeds.	Q, Y	Output
24	DTA1	SUPP. FAN(DELTA)	**Supply fan control in delta system**	Q, DO	Digital output
25	GCON1	SUPP.FAN/II GEAR	***FOR OLD VERSIONS*** ***Supply fan control – higher speed***		
26	FCO2	EXTR. FAN(STAR)	**Extract fan control:** Output *FCO1* defines the outputs sequence for	Q, Y	Output

			extract fan control (see section 6.16). In star-delta systems, it controls the fan In the star system, while In multi-speed fan systems it controls the speeds.		
27	DTA2	EXTR. FAN(DELTA)	**Extract fan control in delta system**	Q, DO	Digital output
28	GCON2	EXTR.FAN/II GEAR	***FOR OLD VERSIONS*** ***Extract fan control – higher speed***		
29	IGEAR	GEAR CONTROL INP	**Gear select input:** Low state: low speed; High state: high speed	X, E	Digital input
30	PRES1	SUP.FAN PRESSURE	**Supply fan pressure control input**. High state: fan pressure alarm; the system switches off. Clearing alarm: After starting the system, alarm is automatically cleared.		
31	PRES2	EXT.FAN PRESSURE	**Extract fan pressure control input**. High state: fan pressure alarm; the system switches off. Clearing alarm: After starting the system, alarm is automatically cleared.		
32	FANP	FAN ALARM INPUT	**Engine protection input (thermic):** High state: engine alarm; the system switches off. Clearing alarm: After starting the system, alarm is automatically cleared.		
33	FIRE	FIRE ALARM INPUT	**Fire alarm input:** High state: engine alarm; the system switches off. Switching on the system is possible only after clearing alarm manually. Clearing alarm: press ENT for about 5 sec.		
34	OUTD	OUTDOOR TEMPERAT	Outdoor sensor	B, X	Analog input
35	ECON	EXCHANGER CONTR.	Exchanger control	Q, Y	Output
36	EPRO	EXCHANGER SENSOR	**Exchanger frost protection sensor input**	B, X, E	Input
37	ROTAL	ROTOR ALARM IN.	**Watchdog input for rotary exchanger**	X, E	Digital input
38	GEX	GROUND EXCH SENS	**Ground heat exchanger sensor input**	B, X	Analog input
39	ALOUT	ALARM OUTPUT	**Alarm output:** Digital output that is activated when an alarm occurs. This output may be set for all alarms or for some selected alarms (In this case 4 maximum)	Q, DO	Digital output
40	RCON	REMOT START/STOP	**System remote control input:** Digital input for switching ON/OFF the system.	X, E	Digital input
41	REM1	REMOTE CONTROL 1	**Temperature set point adjustment:** Analog input for setting the temperature desired value.	B, X	Analog input
42	REM2	REMOTE CONTROL 2	**Humidity set point adjustment:** Analog input for setting the humidity desired value.		
43	MAN	MANUAL MOD INPUT	**Manual mode input:** Digital input for activating the manual mode program „ZMAN” (see chap. 5.8).	X, E	Digital input
44	PALM	PUMP ALARM INPUT	**Pump alarm input:** Hight state: pump alarm; the system switches off. Switching on the system is possible only after clearing alarm manually. Clearing alarm: press ENT for about 5 sec.		
45	PFILT	PRELIMINARY FILT	Preliminary filter alarm input		
46	EFILT	FINE FILTER	Fine filter alarm input		
47	AFILT	ABSOLUTE FILTER	Absolute filter alarm input		
48	XFILT	EXTRACT FILTER	Extract filter alarm input		
49	TMOFF	DIS.TERMOST.MODE	Digital input for disabling the „TERMO” function (ECO mode)		
50	FCOFF	DIS.FREE COOLING	Digital input for disabling the „FREE COOLING” function		
51	VENT	ENABLE ONLY FANS	**Input for venting:** High state on input *VENT* disables heating, cooling, and all other process and devices except fans and ON/OFF dampers.		

5.5 INPUTS

The controllers have resistive inputs suitable for PT1000 sensor connection, analog voltage inputs 0-10V and digital inputs. The analog inputs 0-10V can also be used as digital inputs. The input active level can be defined for the digital inputs.

5.5.1 Input parameter list:

Section			Name	Default value	Range	Description
INP	B1...B5		OFS	0.0°C	0.0÷9.9	Offset
	X1..X3,E1..E8		ACT	HI	LO/HI	Input active level
	X1...X3	LR	LRi	00	00÷90%	Low range limit of the input signal
			LRV	00.0	-99.9÷99.9	Low range limit of displayed values
		HR	HRi	100	10÷100%	High range limit of the input signal
			HRV	100.0	001.0÷999.9	High range limit of displayed values

5.5.2 Shifting down the input characteristic

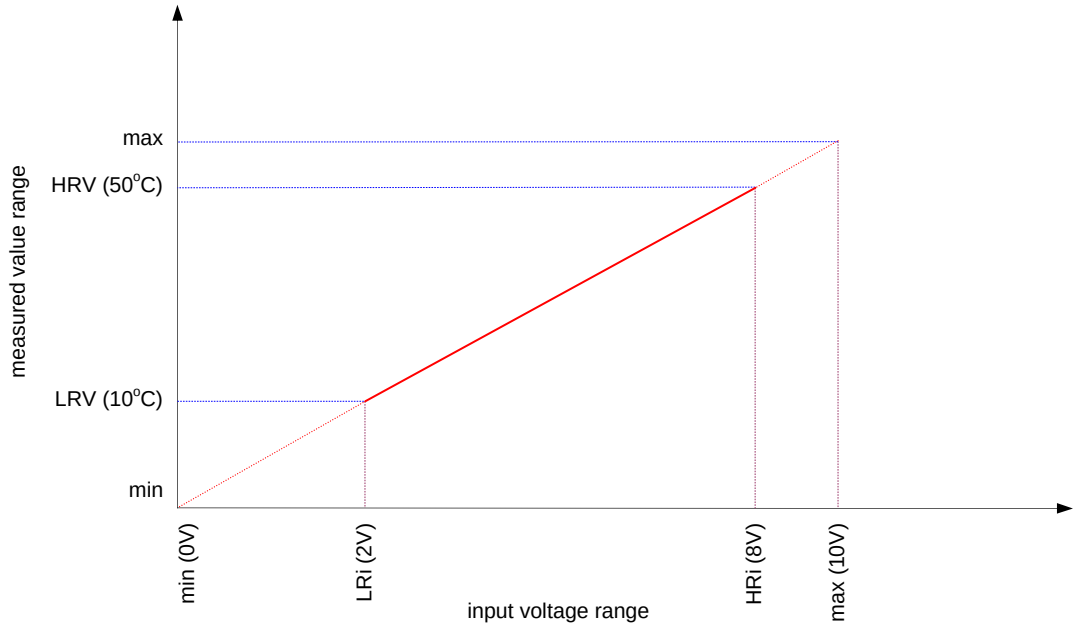
The *OFS* parameter (offset) can be used to decrease the measured resistive input B value. If the PT1000 sensor is too far away from the controller and the measuring circuit does not include a compensation wire, the measuring wire resistance may cause an error resulting in a constant shift of the measured characteristics. This problem can be solved by subtracting the shift value (offset defined by OFS parameter) from the measured value.

5.5.3 Input signal range: *LRi , HRi*

A input signal range can be set for the analog 0-10V inputs. The *Lri* parameter defines the low signal range limit whereas the *Hri* parameter defines the high signal range limit. The values are in % of the maximum 10V range, e.g. for a 2-8V signal the correct setting is LRi=20 and HRi=80.

5.5.4 Displayed value range: *LRV*, *HRV*

A displayed value range should be defined for the analog inputs X according to the given input signal range. The *LRV* parameter defines the low range limit whereas the *HRV* parameter defines the high range limit. For a 2-8V input signal range, the displayed value 0.0 stands for 2V whereas the value 100.0 stands for 8V. The correct setting in this case is *LRV* = 0.0 and *HRV* = 100.0.
The picture below shows the relation between the *LRi, HRi, LRV* and *HRV* parameters.



5.6 OUTPUTS

There are several types of outputs: relay output (Q), PWM (pulse width modulation) outputs (P) and analog 0-10V outputs (Y). The signal range and signal direction can be defined separately for each output.

5.6.1 Output parameter list:

Section	Name	Default value	Range	Description
OUT	LR	00.0	00.0÷99.9	Low range limit of the output signal
	HR	100.0	001.0÷101.0	High range limit of the output signal
	RA	DIRECT	DIRECT/REVERSE	Output signal direction
	PE	000 (NO)	0-100%, NO,YES	Input mode during periodic pump and valve exercising

5.6.2 Output signal range: *LR*, *HR*

The LR and LH parameters have different meaning according to the type of output:

- For analog outputs Y:

  The parameters define the range limits in % of the maximum 10V range. The *LR* parameter defines the low range limit whereas the HR parameter defines the high range limit, e.g. for a 3÷10V input actuator control, the correct setting is *LR* = 30.0 and *HR* = 100.0.

- For PWM outputs P:

  The PWM (pulse width modulation) outputs give a periodic signal with an adjustable impulse width. The period is defined by the *CYCL* parameter. The *LR* parameter defines the minimum whereas the *HR* parameter defines the maximum impulse width (time) in % of the period length. If

for example, a P output is used for electric heater control, it is possible to limit the average power output using the HR parameter. A setting of *HR* = 80.0 will limit the power consumption to 80%. Setting the *LR* parameter defines the low power consumption range limit.

- For digital outputs :

  a) When two digital outputs are used to drive a 3-point floating actuator, the high range limit *HR* of the Qx output defines the time needed to set the valve from the fully closed position to the fully opened position, whereas the low range limit *LR* defines the offset position in seconds. If for example the actuator has a 5 min opening time, the correct setting is *HR* = 300.0. For a setting of *LR* = 60.0 the controller will not close the valve entirely, but leave it 20% open in the minimum position.

  b) When outputs are connected in sequence and a digital output (Q or DO) is next to a Y or P output, for a linear operation, e.g. Y1+Q1, the *HR* parameter defines the digital output switch-on level (% of the main signal – Y in this example), whereas the *LR* parameter defines the switch-off level.

  Example: *SQ1*+ = Y1+Q1

  – Valve actuator control with heater pump start

5.6.3 Output signal direction: *RA*

The *RA* parameter defines the direction of the output signal (direct or reverse):

- For 0-10V analog outputs Y:

  RA = DIRECT: Rising signal direction from 0V to 10V, in other words, the „+" on the actuator corresponds to the „Y" on the controller, the „-„ (or ground) on the actuator corresponds to the „M" on the controller.

  RA = REVERSE: Falling signal direction from 10V to 0V.

- For PWM outputs P:

  RA = DIRECT: P output active (high) state means current flow between the „+" and „-„ outputs.

  RA = REVERSE: P output active state means no current flow.

- For digital outputs:

  RA = DIRECT: For single digital outputs, the output contacts will be closed when ON and opened when OFF. For three-point outputs (ex. QxLx), the positive direction (+) will switch the Qx output ON and the Lx output OFF. For the negative direction it is the other way around.

  RA = REVERSE: For single digital outputs, the output contacts will be closed when OFF and opened when ON. For three-point outputs (ex. QxLx), the positive direction (+) will switch the Qx output OFF and the Lx output ON. For the negative direction it is the other way around.

5.7 ARITHMETICAL OPERATIONS

The UCS30 controllers enable arithmetical operations on 2 inputs. Following operations are available:

- ***AVR*** function: 2 input measurement average

  Ex. AVR(B1,B2) = (B1+B2)/2

- ***DIF*** function: 2 input difference

  Ex. DIF(B1,B2) = B1-B2

- ***MAX*** function: maximum of the 2 input values

  Ex. MAX(B1,B2) = B1, if B1 is bigger than B2 or inversely

- ***MIN*** function: minimum of the 2 input values

  Ex. MIN(B1,B2) = B1, if B1 is smaller than B2 or inversely

In order to setup the operation, enter the first operand and press the key to switch to the second operand. Then, enter the second operand and press the key to switch to the operator.

5.8 REAL TIME CLOCK AND OPERATION PROGRAMS

5.8.1 Real time clock with week scheduler

The UCS30 controllers have a built-in real time clock and a week schedule can be set. For each day it is possible to set up to 3 time programs, which are controlled by the clock in automatic operation mode (AUTO) and additionally one program for the manual operation mode (MAN). A time program (time zone) is defined by a start-time and a stop-time. The desired temperature, humidity values etc. are set within each time program. Also outdoor compensation may be set ON or OFF individually for each time program. To make the configuration of the week schedule fast and easy, 4 global time programs have been defined, valid for all weekdays. All values set within these time programs are copied to every weekday program settings. This way it is possible to configure the time programs for all weekdays at once in case the settings for all days are equal.

5.8.2 Scheduler and real time clock parameter list:

Section	Name	Default value	Range	Description
ZON1, ZON2, ZON3, ZMAN	SV1	022.0°C	-20.0÷50.0°C	Desired value for the main controller
	SV2	022.0	-99.9÷999.9	Desired value for controller 2
	SV3	022.0	-99.9÷999.9	Desired value controller 3
	SVH	50.0%	00.0÷99.9%	Desired humidity
	TERMO	OFF	OFF, 0÷50.0°C	Enable or disable the “TERMO” function (ECO mode)
	FCOOL	OFF	OFF, ON	Enable or disable the “FREECOOLING” function
	COR	000	-10÷10°C	Correction value of the outdoor compensation
	CPEN	OFF	ON/OFF	Enable or disable of the outdoor compensation
	SPD1	50%	20 ÷ 100%	Defined fan speed for gear 1
	SPD2	100%	20 ÷ 100%	Defined fan speed for gear 2
	SPD3	100%	20 ÷ 100%	Defined fan speed for gear 3
	SPD4	100%	20 ÷ 100%	Defined fan speed for gear 4

	GEAR	*IGEAR* input or GEAR 1	*IGEAR* gear, GEAR 1, GEAR 2, GEAR 3, GEAR 4	Fan gear select
	FCOEF	1.0	0.1÷2.00	Exhaust fan (FCO2) and inlet fan (FCO1) speed ratio. FCO2 = FCO1 x FCOEF
	CTRL	AUTO	AUTO, CASCADE, SUPPLY, ROOM/EXH	**Select the control type:** **- AUTO**: If a limit sensor is defined the control type will be cascade control with min./max limiting. If no supply sensor is defined then the control type will be room/exhaust control. **- CASCADE**: Cascade control **- SUPPLY**: Supply control **- ROOM/EXH**: Room/exhaust control. **Beware:** The control type selection function is available also for PID section, and the setting in PID section has higher priority this means the setting in this section will be valid if there is no setting in **PID** section (section 5.29). This is: HCTRL = AUTO and CCTRL = AUTO
	REG1	OFF	OFF, HEATING, COOLING, H/C	**Turn off heating/cooling process** - OFF: No process is turn off - HEATING: Turn off heating process - COOLING: Turn off cooling process - H/C: Turn off both heating and cooling processes
	REG2	OFF	OFF, R2+, R2-, R2+/R2-	**Turn off process in PID loop nr 2** - OFF: No process is turn off - R2+: Turn off the positive process - R2-: Turn off the negative process - R2+/R2-: Turn off both positive and negative processes
	REG3	OFF	OFF, R3+, R3-, R3+/R3-	**Turn off process in PID loop nr 3** - OFF: No process is turn off - R3+: Turn off the positive process - R3-: Turn off the negative process - R3+/R3-: Turn off both positive and negative processes
	REGH	OFF	OFF, HUMIDIF, DEHUM., H/D	**Turn off humidification / dehumidification process** - OFF: No process is turn off - HUMIDIF: Turn off humidification process - DEHUM.: Turn off dehumidification process - H/D: Turn off both humidification and dehumidification processes

	EX-DA	OFF	OFF, EXC, DAMPER, EXC/DAM	**Turn off exchanger / recirculation dampers** - OFF: No device is turn off - EXC: Turn off exchanger - DAMPER: Turn off damper - EXC/DAM: Turn off both exchanger and damper
	DAMPD	OFF	OFF, ON	**Turn off dampers:** - OFF: No device is turn off - ON: Turn off exchanger
	FANDI	OFF	OFF, SUPPLY, EXTRACT	**Turn off supply / extract fan** - OFF: No fan is turn off - SUPPLY: Turn off supply fan - EXTRACT: Turn off extract fan
	REMDI	OFF	OFF, ON	**Switching off the remote setting via RS485 of the desired values SV1, SV2, SV3, SVH, the speed and gear of fans**. - OFF: The remote setting for the desired values is not switch off; it means remote setting can be made. - ON: The remote setting of the desired values is switch off. Only settings made within the time zone are valid. Desired values setting cannot be made remotely through the serial interface or the analog input defined by parameters REM1 or REM2.
	H1OFS	0%	0÷100%	**Heating control level:** When the heating process is switch off by setting *REG1=HEATING* or *REG1=H/C*, then the parameter *H1OFS* defines the constant control level of heating. The value can be set from 0 to 100% of the maximum heating level. To absolutely switch off heating process set *H1OFS=0*.
	H1LR	0%	0÷100%	**Heating sequence low range (primary + secondary heating):** When heating sequence is active, parameter *H1LR* define his minimum control level. *H1LR* must not be greater than *H1HR*. **Caution:** If primary and secondary heating are available then parameter *H1LR* concerns both sequences serially connected.

	H1HR	100%	0÷100%	**Heating sequence high range (primary + secondary heating):** When heating sequence is active, parameter H1HR define his minimum control level. *H1HR* must not be lower than *H1LR*. **Caution:** If primary and secondary heating are available then parameter *H1HR* concerns both sequences serially connected.
	C1OFS	0%	0÷100%	**Cooling control level:** When cooling process is switch off by setting *REG1=COOLING* or *REG1=H/C*, then parameter C1OFS defines the constant control level for cooling. The value can be set from 0 to 100% of the maximum cooling level. To absolutely switch off cooling process set *C1OFS=0*.
	H2OFS	0%	0÷100%	**Positive sequence control level of PID2 loop:** When positive process of PID2 loop is switch off by setting *REG2=R2+* or *REG2=R2+/R2-*, then parameter *H2OFS* defines the constant control level for the process. The value can be set from 0 to 100% of the maximum sequence level. To absolutely switch off the process set *H2OFS = 0*.
	C2OFS	0%	0÷100%	**Negative sequence control level of PID2 loop:** When negative process of PID2 loop is switch off by setting *REG2=R2-* or *REG2=R2+/R2-*, then parameter *C2OFS* defines the constant control level for the process. The value can be set from 0 to 100% of the maximum sequence level. To absolutely switch off the process set *C2OFS = 0*.
	H3OFS	0%	0÷100%	**Positive sequence control level of PID3 loop:** When positive process of PID3 loop is switch off by setting *REG3=R3+* or *REG2=R3+/R3-*, then parameter *H3OFS* defines the constant control level for the process. The value can be set from 0 to 100% of the maximum sequence level. To absolutely switch off the process set *H3OFS = 0*.

	C3OFS	0%	0÷100%	**Negative sequence control level of PID3 loop:** When negative process of PID3 loop is switch off by setting *REG3=R3-* or *REG3=R3+/R3-*, then parameter *C3OFS* defines the constant control level for the process. The value can be set from 0 to 100% of the maximum sequence level. To absolutely switch off the process set *C3OFS = 0*.
	HOFS+	0%	0 ÷ 100%	**Humidifying control level:** When humidifying process is switch off by setting *REGH=HUMIDIF* or *REGH=H/D*, then parameter *HOFS+* defines the constant control level for humidifying. The value can be set from 0 to 100% of the maximum humidifying level. To absolutely switch off humidifying process set *HOFS+ = 0*.
	HOFS-	0%	0 ÷ 100%	**Dehumidifying control level:** When dehumidifying process is switch off by setting *REGH=DEHUM* or *REGH=H/D*, then parameter *HOFS-* defines the constant control level for dehumidifying. The value can be set from 0 to 100% of the maximum dehumidifying level. To absolutely switch off dehumidifying process set *HOFS- = 0*.
	DAOFS	0%	0÷100%	**Damper opening level:** When dampers are switch off by setting *EX-DA = DAMPER* or *EX-DA = EXC/DAM*, parameter *DAOFS* defines the constant dampers control value. To absolutely switch off dampers set *DAOFS=0*.
	DALR	0%	0-100%	**Minimum damper opening level:** When dampers are enabled, parameter *DALR* defines the minimum dampers driving level. *DALR* cannot be higher or equal *DAHR*.
	DAHR	100%	0-100%	**Maximum damper opening level:** When dampers are enabled, parameter *DAHR* defines the maximum damper driving level. *DAHR* cannot be lower or equal *DALR*.
	EXOFS	0%	0÷100%	**Exchanger driving level:** When exchanger is switch off by setting *EX-DA = EXC* or *EX-DA = EXC/DAM*, parameter *EXOFS* defines the constant exchanger control level.

	EXLR	0%	0÷100%	**Minimum exchanger driving level:** When exchanger is enabled, parameter *EXLR* defines the minimum exchanger driving level. *EXLR* cannot be higher or equal *EXHR*.
	EXHR	100%	0÷100%	**Maximum exchanger driving level:** When exchanger is active, parameter *EXHR* defines the maximum exchanger driving level. *EXHR* cannot be lower or equal *EXLR*.
	FANSP	50%	20÷100%	Fan starting speed
	GEAR	*IGEAR* INPUT OR GEAR 1	IGEAR INPUT, GEAR 1, GEAR 2, GEAR 3, GEAR 4	Fan speed select
	ZOUT	??	Q1,Q2,DO1..DO6	Digital output signaling program execution.
	RUN	00.00	00.00÷23.59	Start time (unavailable in manual mode)
	STOP	00.00	00.00÷23.59	Stop time (unavailable in manual mode)
RTC	H:M	Time		Hours and minutes
	DAY	Week day	MONDAY, TUESDAY, WEDNESDAY, THURSDAY, FRIDAY, SATURDAY, SUNDAY	Week day

5.8.3 System operation programs and their execution

Additionally to the scheduler, specific operation programs can be executed by predefined events, like a signal on a digital input, alarm triggering or reaching a given level of an input/output analog signal. Up to 2 events can be programmed logically connected by *AND* or *OR* operators. In case of two analog inputs, arithmetic operations can be performed (see chapter 5.6). The operators are defined as described in chapter 5.6.

In case of executing several programs simultaneously, the executing order is:

1. Manual operation (section ZMAN)
2. Program nr 1 (section PRO-1)
3. Program nr 2 (section PRO-2)
4. Real time clock (sections ZON1, ZON2, and ZON3)

5.8.4 System operation programs parameter list:

Section	Name	Default value	Range	Description
PRO-1, PRO-2	PRIN	??	B1...B5, X1...X3, E1...E8, A1…A11, R1+, R1-, R2+, R2-, RH+, RH-, P1, P2, Y1, Y2, Y3, Y4, Y5, Y6	Program executing events: System operation program control signals must be defined in this item. Up to 2 signals can be programmed and a logical operator ***AND*** or ***OR*** can be selected. In case of two analog inputs, the operators are ***AVR***, ***DIF***, ***MAX***, ***MIN***. **A1…A11, R1+, R1-, R2+, R2-, RH+, RH-**: alarms (see alarm list and symbols in paragraph 6.29.2)
	OFF1	0	-25÷100	**First analog signal:** signal value lower or equal to this value results in a logical **0**
	ON1	0	-25÷100	**First analog signal:** signal value higher or equal to this value result in a logical **1**.
	OFF2	0	-25÷100	**Second analog signal:** signal value lower or equal to this value results in a logical **0**
	ON2	0	-25÷100	**Second analog signal:** signal value higher or equal to this value result in a logical **1**.
PROG	SV1	022.0°C	-20.0÷50.0°C	Desired value for the main controller
	SV2	022.0	-99.9÷999.9	Desired value for controller 2
	SV3	022.0	-99.9÷999.9	Desired value controller 3
	SVH	50.0%	00.0÷99.9%	Desired humidity
	TERMO	OFF	OFF, 0÷50.0°C	Enable or disable the “TERMO” function (ECO mode)
	FCOOL	OFF	OFF, ON	Enable or disable the “FREECOOLING” function
	COR	000	-10÷10°C	Correction value of the outdoor compensation
	CPEN	OFF	ON/OFF	Enable or disable of the outdoor compensation
	SPD1	50%	20 ÷ 100%	Defined fan speed for gear 1
	SPD2	100%	20 ÷ 100%	Defined fan speed for gear 2
	SPD3	100%	20 ÷ 100%	Defined fan speed for gear 3
	SPD4	100%	20 ÷ 100%	Defined fan speed for gear 4
	GEAR	*IGEAR* input or GEAR 1	Wejście *IGEAR*, GEAR 1, GEAR 2, GEAR 3, GEAR 4	Fan gear select
	FCOEF	1.0	0.1÷2.00	Exhaust fan (FCO2) and inlet fan (FCO1) speed ratio. FCO2 = FCO1 x FCOEF

	CTRL	AUTO	AUTO, CASCADE, SUPPLY, ROOM/EXH	**Select the control type:** **- AUTO**: If a limit sensor is defined the control type will be cascade control with min./max limiting. If no supply sensor is defined then the control type will be room/exhaust control. **- CASCADE**: Cascade control **- SUPPLY**: Supply control **- ROOM/EXH**: Room/exhaust control. **Beware:** The control type selection function is available also for PID section, and the setting in PID section has higher priority this means the setting in this section will be valid if there is no setting in PID section (section 5.29). This is: HCTRL = AUTO and CCTRL = AUTO
	REG1	OFF	OFF, HEATING, COOLING, H/C	**Turn off heating/cooling process** - OFF: No process is turn off - HEATING: Turn off heating process - COOLING: Turn off cooling process - H/C: Turn off both heating and cooling processes
	REG2	OFF	OFF, R2+, R2-, R2+/R2-	**Turn off process in PID loop nr 2** - OFF: No process is turn off - R2+: Turn off the positive process - R2-: Turn off the negative process - R2+/R2-: Turn off both positive and negative processes
	REG3	OFF	OFF, R3+, R3-, R3+/R3-	**Turn off process in PID loop nr 3** - OFF: No process is turn off - R3+: Turn off the positive process - R3-: Turn off the negative process - R3+/R3-: Turn off both positive and negative processes
	REGH	OFF	OFF, HUMIDIF, DEHUM., H/D	**Turn off humidification / dehumidification process** - OFF: No process is turn off - HUMIDIF: Turn off humidification process - DEHUM.: Turn off dehumidification process - H/D: Turn off both humidification and dehumidification processes
	EX-DA	OFF	OFF, EXC, DAMPER, EXC/DAM	**Turn off exchanger / recirculation dampers** - OFF: No device is turn off - EXC: Turn off exchanger - DAMPER: Turn off damper - EXC/DAM: Turn off both exchanger and damper
	DAMPD	OFF	OFF, ON	**Turn off dampers:** - OFF: No device is turn off - ON: Turn off exchanger

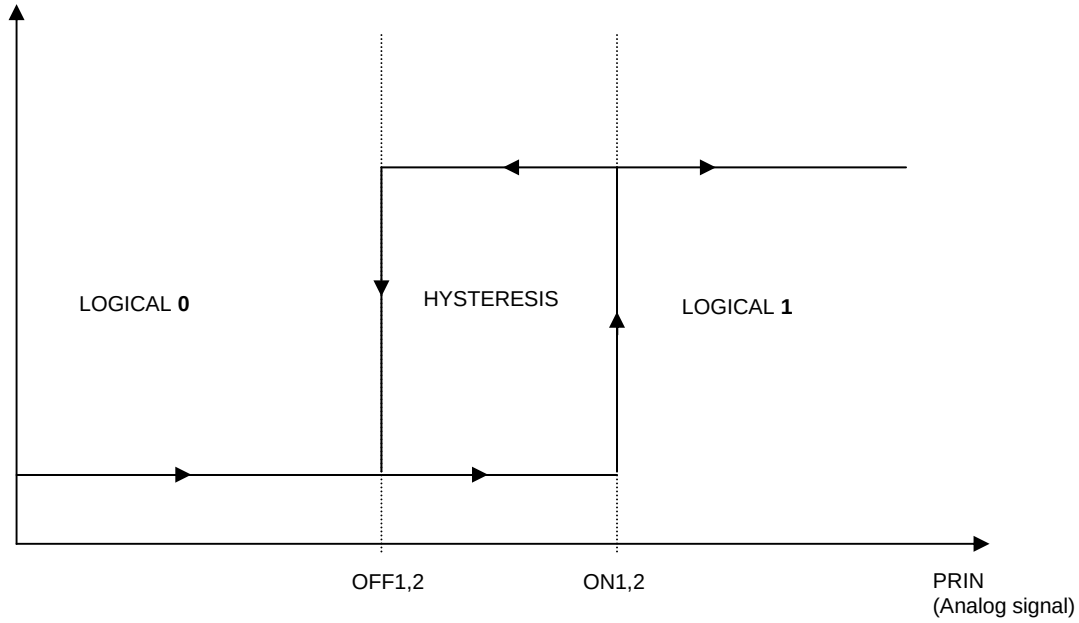
	FANDI	OFF	OFF, SUPPLY, EXTRACT	**Turn off supply / extract fan** - OFF: No fan is turn off - SUPPLY: Turn off supply fan - EXTRACT: Turn off extract fan
	REMDI	OFF	OFF, ON	**Switching off the remote setting via RS485 of the desired values SV1, SV2, SV3, SVH, the speed and gear of fans**. - OFF: The remote setting for the desired values is not switch off; it means remote setting can be made. - ON: The remote setting of the desired values is switch off. Only settings made within the time zone are valid. Desired values setting cannot be made remotely through the serial interface or the analog input defined by parameters REM1 or REM2.
	H1OFS	0%	0÷100%	**Heating control level:** When the heating process is switch off by setting *REG1=HEATING* or *REG1=H/C*, then the parameter *H1OFS* defines the constant control level of heating. The value can be set from 0 to 100% of the maximum heating level. To absolutely switch off heating process set *H1OFS=0*.
	H1LR	0%	0÷100%	**Heating sequence low range (primary + secondary heating):** When heating sequence is active, parameter *H1LR* define his minimum control level. *H1LR* must not be greater than *H1HR*. **Caution:** If primary and secondary heating are available then parameter *H1LR* concerns both sequences serially connected.
	H1HR	100%	0÷100%	**Heating sequence high range (primary + secondary heating):** When heating sequence is active, parameter H1HR define his minimum control level. *H1HR* must not be lower than *H1LR*. **Caution:** If primary and secondary heating are available then parameter *H1HR* concerns both sequences serially connected.
	C1OFS	0%	0÷100%	**Cooling control level:** When cooling process is switch off by setting *REG1=COOLING* or *REG1=H/C*, then parameter C1OFS defines the constant control level for cooling. The value can be set from 0 to 100% of the maximum cooling level. To absolutely switch off cooling process set *C1OFS=0*.

	H2OFS	0%	0÷100%	**Positive sequence control level of PID2 loop:** When positive process of PID2 loop is switch off by setting *REG2=R2+* or *REG2=R2+/R2-*, then parameter *H2OFS* defines the constant control level for the process. The value can be set from 0 to 100% of the maximum sequence level. To absolutely switch off the process set *H2OFS = 0*.
	C2OFS	0%	0÷100%	**Negative sequence control level of PID2 loop:** When negative process of PID2 loop is switch off by setting *REG2=R2-* or *REG2=R2+/R2-*, then parameter *C2OFS* defines the constant control level for the process. The value can be set from 0 to 100% of the maximum sequence level. To absolutely switch off the process set *C2OFS = 0*.
	H3OFS	0%	0÷100%	**Positive sequence control level of PID3 loop:** When positive process of PID3 loop is switch off by setting *REG3=R3+* or *REG2=R3+/R3-*, then parameter *H3OFS* defines the constant control level for the process. The value can be set from 0 to 100% of the maximum sequence level. To absolutely switch off the process set *H3OFS = 0*.
	C3OFS	0%	0÷100%	**Negative sequence control level of PID3 loop:** When negative process of PID3 loop is switch off by setting *REG3=R3-* or *REG3=R3+/R3-*, then parameter *C3OFS* defines the constant control level for the process. The value can be set from 0 to 100% of the maximum sequence level. To absolutely switch off the process set *C3OFS = 0*.
	HOFS+	0%	0 ÷ 100%	**Humidifying control level:** When humidifying process is switch off by setting *REGH=HUMIDIF* or *REGH=H/D*, then parameter *HOFS+* defines the constant control level for humidifying. The value can be set from 0 to 100% of the maximum humidifying level. To absolutely switch off humidifying process set *HOFS+ = 0*.
	HOFS-	0%	0 ÷ 100%	**Dehumidifying control level:** When dehumidifying process is switch off by setting *REGH=DEHUM* or *REGH=H/D*, then parameter *HOFS-* defines the constant control level for dehumidifying. The value can be set from 0 to 100% of the maximum dehumidifying level. To absolutely switch off dehumidifying process set *HOFS- = 0*.

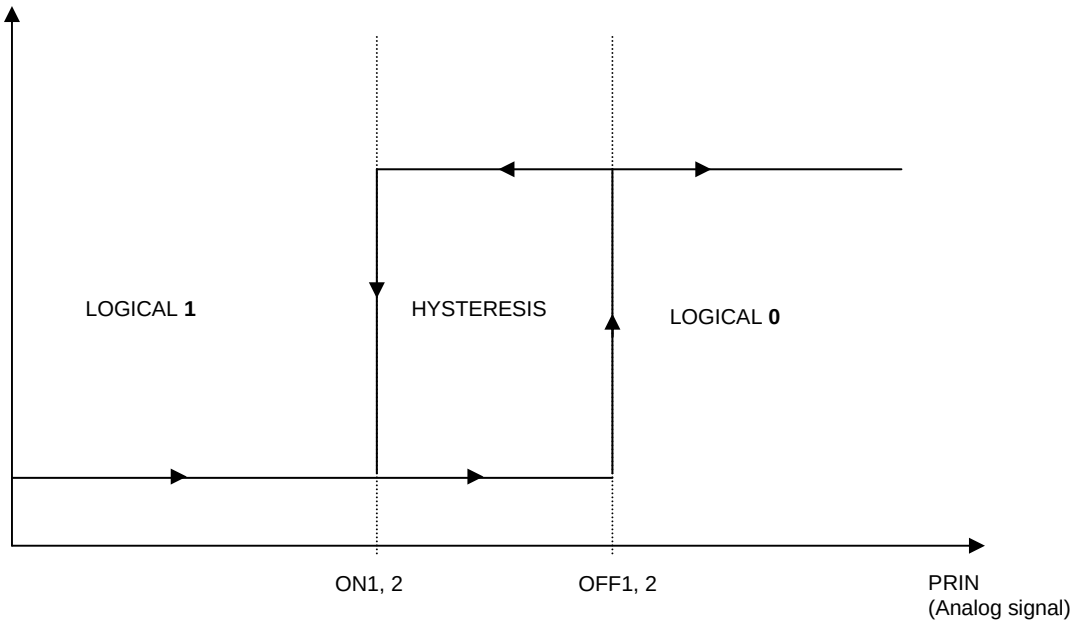
	DAOFS	0%	0÷100%	**Damper opening level:** When dampers are switch off by setting *EX-DA = DAMPER* or *EX-DA = EXC/DAM*, parameter *DAOFS* defines the constant dampers control value. To absolutely switch off dampers set *DAOFS=0*.
	DALR	0%	0-100%	**Minimum damper opening level:** When dampers are enabled, parameter *DALR* defines the minimum dampers driving level. *DALR* cannot be higher or equal *DAHR*.
	DAHR	100%	0-100%	**Maximum damper opening level:** When dampers are enabled, parameter *DAHR* defines the maximum damper driving level. *DAHR* cannot be lower or equal *DALR*.
	EXOFS	0%	0÷100%	**Exchanger driving level:** When exchanger is switch off by setting *EX-DA = EXC* or *EX-DA = EXC/DAM*, parameter *EXOFS* defines the constant exchanger control level.
	EXLR	0%	0÷100%	**Minimum exchanger driving level:** When exchanger is enabled, parameter *EXLR* defines the minimum exchanger driving level. *EXLR* cannot be higher or equal *EXHR*.
	EXHR	100%	0÷100%	**Maximum exchanger driving level:** When exchanger is active, parameter *EXHR* defines the maximum exchanger driving level. *EXHR* cannot be lower or equal *EXLR*.
	FANSP	50%	20÷100%	Fan starting speed
	GEAR	*IGEAR* INPUT OR GEAR 1	IGEAR INPUT, GEAR 1, GEAR 2, GEAR 3, GEAR 4	Fan speed select
	ZOUT	??	Q1,Q2,DO1..DO6	Digital output signaling program execution.

5.8.5 Event setting by analog signal

a. Event setting by analog signal when OFF1, 2 < ON1, 2



b. Event setting by analog signal when OFF1, 2 > ON1, 2



5.9 FROST PROTECTION SYSTEM

The UCS30 controllers are equipped with a built-in active frost protection system for the water heaters. The frost protection alarm is indicated by a red LED on the panel and a text message on the display. After the frost protection alarm has occurred, the controller switches OFF the fan(s) and drives the heater output to its maximum value. After the alarm has gone OFF, the system is restarted if the parameter ***FOVER* = AUTO**. If however, ***FOVER* = MAN**, the valves will be closed and the system will remain stopped (in stand-by) until the user has switched it ON manually. The frost protection system applies to the main controller, but it can also be assigned to controller 2 by setting the parameter ***FPAL2* = ON**. Then, after the alarm has occurred, the heater outputs controlled by controller 2 will be driven to their maximum value.

If the system is equipped with an outdoor sensor, the ***FPDIS*** parameter defines the outdoor temperature, above which the frost protection system will by blocked. If there's a need for the frost protection system to run non-stop, regardless of the outdoor temperature, the *FPDIS* parameter setting should be FPDIS=50. When this setting is entered an "OFF" text message will be displayed.
There are three frost alarm sources:

5.9.1 Frost protection sensor

The ***FPROT*** parameter (***IO*** section) defines the frost protection sensor input and must be configured. The alarm temperature is defined by the ***FMIN*** parameter (default value 5°C) and can be adjusted. The frost protection system switch-on threshold for the RUN (control) mode is defined as 5°C above the alarm level. For the STAND-BY mode the switch-on threshold is defined by the ***FSTND*** parameter and must be set at least 7°C above the alarm level.

The FSTND parameter can be switched OFF depending on the outdoor temperature set by the ***FSOFF*** parameter. When the outdoor temperature exceeds the value set in *FSOFF*, the switch-on threshold will be set 5°C above the alarm value.

In order to completely switch OFF the *FSTND* parameter regardless of the outdoor temperature, set *FSOFF = 0* (message „OFF" after confirmation)

When the temperature measured at the ***FPROT*** input falls below the threshold value, the frost protection system will start increasing the heating sequence output (PI control) in order to increase the temperature to the threshold value. If the temperature falls below the threshold value and does not return to the desired level for a time defined by the ***FDEL*** parameter (default is **60 sec**), the controller will stop the fan(s), set the heating output to the maximum value and indicate alarm. For an instant frost protection alarm, the correct setting is ***FDEL*=0**.

5.9.2 Frost protection thermostat

A digital input can be defined as a frost protection thermostat input using the ***FPAL*** parameter in the menu system section ***IO***. When the thermostat detects a low temperature level it's output becomes active. If the thermostat outputs stays active for a time longer then defined by the ***FADEL*** parameter (default is **60 sec**), the controller will stop the fan(s) and set the heating output to the maximum value.

5.9.3 Limit sensor (supply air sensor)

If the system is equipped with a duct sensor used as a limit sensor, the sensor input must be defined by the ***RTDL*** parameter in the menu system section ***IO***. When it is defined, the temperature measured by the ***RTDL*** sensor will be taken into account in the frost protection system. When the temperature reaches the threshold value set in the ***AMIN*** parameter (default is **5ºC**) and stays below the threshold value for a time longer than defined by the ***ADEL*** parameter (default is **60sec**), the controller will recognize a frost emergency and start the frost protection system. Frost emergency detected by the limit sensor will be canceled when the temperature arises 1°C beyond ***AMIN*** value.

5.9.4 Clearing the frost protection alarm:

If ***FOVER*** parameter setting is ***FOVER* = MAN**, the controller remains in the alarm state even after there is no more alarm signal. In order to clear the alarm, press ENT and hold for about 5 seconds. After the alarm has been cleared, the system can be restarted.

If the setting is ***FOVER* = AUTO** then after alarm signal is off, the alarm state will be cleared and the system restarted.

5.9.5 Frost alarm parameters:

Section	Name	Default value	Range	Description
IO	FPAL	??	??,X1..X3,E1...E8	Frost protection thermostat input
	FPROT	??	??,B1…B5,X1…X3	Frost protection sensor input
FPAR	FMIN	05°C	0-15°C	Frost protection alarm trip threshold (sensor input)
	FPST	OFF	0-99°C	System starting conditions after preliminary heating: If at the end of the preliminary heating the temperature sensed by the frost protection sensor is not higher than the value FPST, the system will not be started and alarm information will be displayed as following: “LOW WATER TEM” (Low water temperature).
	FSTND	07°C	7-50°C	The frost protection sensor min. threshold temperature is set to FMIN+FSTND for the STAND-BY mode
	FSOFF	OFF(0°C)	0-50°C	Outdoor temperature, above which the FSTND parameter is OFF. In order to switch it OFF regardless of the outdoor temperature, set FSOFF=0.
	FDEL	000 sec	0-600 sec	Time-lag for frost protection alarm trip (sensor input)
	FADEL	000 sec	0-600 sec	Time-lag for frost protection alarm trip (thermostat input)
	FOVER	MAN	AUTO/MAN	Freeze over conditions **AUTO:** Self alarm clearing and automatic system restart after alarm condition is off. **MAN:** System can be restarted only manually after a manual alarm clearing.
	FPAL2	OFF	ON/OFF	Frost protection setting for controller 2

	FPDIS	OFF(50°C)	0-50°C	Frost protection system switch-off threshold temperature (outdoor). In order to disable frost protection system turn-off by the outdoor sensor, set FPDIS=50°C (text message "OFF" on the display).

5.10 LIMIT SENSORS

If the system is equipped with at least one duct sensor used as a *limit* sensor, the sensor inputs must be defined using the parameters ***RTDL1*** (for the main controller) and ***RTDL2*** (for controller 2) in the menu system section ***IO***. The limit sensor should be located in the supply air duct after the air handling unit, e.g. a heater. After the suitable limit sensor has been defined, the limit parameters in the section ***TLIM1*** or/and ***TLIM2*** of the menu system will be activated.

5.10.1 Temperature limit parameter list:

Section	**name**	**Default value**	**Range**	**Description**
IO	RTDL1	??	B1..B5, X1..X3	Limit sensor input (supply air sensor)
TLIM1	AMIN	08°C	0-15°C	Frost protection alarm trip threshold at the limit sensor
	MIN	15°C	0-50°C	Minimum supply air temperature
	MAX	35°C	20-50°C	Maximum supply air temperature
	REL	06°C	0-50°C	Maximum temperature difference between the main sensor *RTD1* and the limit sensor *RTDL1*
	ALIM	07°C	0-20°C	Minimum refrigerating temperature „MIN" offset
	LHYS	AUTO	OFF(20°C), AUTO(0°C), 0-20°C	Limit sensor heating-cooling hysteresis
	ADEL	060 sec	0-600 sec	Time-lag for the frost protection alarm to trip after the supply air temperature has decreased below *AMIN*

5.10.2 Controller 2 and troller 3 limit parameter list:

Section	Name	Default value	Range	Description
IO	RTDL2	??	B1..B5, X1..X3	Limit sensor input (air supply sensor)
TLIM2, TLIM3	MIN	15	0-50	Minimum limit value
	MAX	35	20-50	Maximum limit value
	REL	06	0-50	Maximum difference between the main sensor *RTDx* and the limit sensor *RTDLx, x=2, 3*
	ALIM	07°C	0-20°C	Minimum refrigerating unit temperature „MIN" offset
	LHYS	0°C	OFF(20°C), AUTO(0°C), 0-20°C	Limit sensor hysteresis (dead zone)

AMIN, ADEL

The ***AMIN*** parameter defines the minimum temperature value measured at the ***RTDL1*** input. When the temperature drops and stays below the threshold value set in the ***AMIN*** parameter longer than the time set in the ***ADEL*** parameter (in sec), the frost protection alarm trips.

REL, MIN, MAX, ALIM:

The ***MIN*** and ***MAX*** parameters define the minimum and maximum limit values (e.g. supply air temperature limit values). The controller tries to maintain the desired *SV1* or *SV2* values while keeping the limit sensor values *RTDL1* or *RTDL2* within the *MIN* and *MAX* defined range. For REL≠0 the low limit changes according to the main value (measured by the main sensor RTD1 or RTD2) and is defined as MIN = T – REL, T being the main value.

For refrigerating units it is sometimes necessary to lower the minimum temperature limit to enable cooling. The ***ALIM*** parameter defines the temporary ***MIN*** parameter offset (in °C) during the cooling process.

LHYS:

When a value measured inside the duct (temperature or another value) exceeds the ***MAX*** value and the first control loop is turned off, the second control loop will be triggered as soon as the measured value exceeds ***MAX+LHYS***.

Similarly, when a value measured inside the duct drops below the ***MIN*** value and the second control loop is turned off, the first control loop will be triggered as soon as the measured value drops below ***MIN-LHYS***.

When *LHYS=0* (text message „AUTO”), the heating-cooling hysteresis ***HYS1*** (for the main controller) or ***HYS2*** (for controller 2) will be set as valid.

When *LHYS=20* (text message „OFF”), the control loops will not be switched when the limit is exceeded.

5.11 HUMIDITY LIMIT SENSOR

If the system is equipped with a humidity sensor used as a *limit* sensor, the sensor input must be defined using the ***HUML*** parameter in the menu system section ***IO***. When the limit sensor is defined, the ***HLIM*** menu system section will be activated.

5.11.1 Humidity limit parameter list:

Section	Name	Default value	Range	Description
IO	HUML	??	B1...B5, X1...X3	Humidity limit sensor input (humidity sensor inside the duct)
HLIM	HMIN	50%	0-80%	Minimum humidity
	HMAX	100%	20-100%	Maximum humidity
	HHYS	AUTO	OFF(20°C), AUTO(0°C), 0-20°C	Limit sensor humidification-dehumidification hysteresis

HHYS:

When the humidity value measured in the duct exceeds the ***HMAX*** value and humidification is switched OFF, dehumidification will be started as soon as the duct air humidity exceeds ***HMAX+HHYS***.

Similarly, when the duct air humidity drops below the ***HMIN*** value and dehumidification is switched OFF, humidification will be started as soon as the duct air humidity drops below ***HMIN-HHYS***.

When ***HHYS=0*** (text message „AUTO”), the humidification-dehumidification hysteresis ***HYS3*** will be set as valid.

When ***HHYS=20*** (text message „OFF”), the control loops will not be switched when the limit is exceeded.

5.12 PROCES CONTROL SEQUENCES – heating, cooling, etc.

The control of the heating, cooling, humidification process etc. can be done by assigning controller outputs to functional blocks called *heating, cooling sequences* etc. accordingly. Every block can contain up to 6 items (outputs) **separated by „+" characters**. Within every block, the outputs form the primary, secondary control loop etc. according to the output sequence. The outputs are driven in turn according to their sequence. If there are several digital outputs, a linear (sequential) or binary connection can be selected.

5.12.1 Primary heating control sequence: *SQ1+*

After defining the main sensor *RTD1*, the primary heating control sequence must be defined. If there are no heating devices, the correct setting is *SQ1+* = ??. Otherwise, the sequence must be defined by entering control outputs and possible serial connections. Configuration examples are shown below:

1) Water heating: *SQ1+* = Y1
2) Smooth electric heater control: *SQ1+* = P1
3) 2 sections connected in series : *SQ1+* = Q1+Q2, set operation mode to *LIN*
4) 2 sections, binary connection: *SQ1+* = Q1+Q2, set operation mode to *BIN*
5) PWM and digital output sections combination: *SQ1+* = P1+Q1+P1+Q2. According to the set operation mode, digital outputs Q1 and Q2 will be driven in series or in binary mode.

5.12.2 Secondary heating control sequence: *SEC+*

In systems where both heating and dehumidification are present, a secondary heater is necessary. If this is the case, the output driving the secondary heater must be defined as *SEC+*. If, during heating, the dehumidification occurs, the controller switches heating control to the secondary heater.

5.12.3 Cooling control sequences: *SQ1-*

Similar to *SQ1+*.

5.12.4 Positive control sequence of controller 2: *SQ2+*

After setting a feedback sensor for controller 2 (parameter *RTD2*), a positive control sequence can be defined. The control operation depends only on the values measured by *RTD2, RTDL2,* desired value *SV2,* and PID control parameters.

5.12.5 Negative control sequence of controller 2: *SQ2-*

Similar to *SQ2+*.

5.12.6 Positive control sequence of controller 3: *SQ3+*

After setting a feedback sensor for controller 3 (parameter *RTD3*), a positive control sequence can be defined. The control operation depends only on the values measured by *RTD3, RTDL3,* desired value *SV3,* and PID control parameters.

5.12.7 Negative control sequence of controller 3: *SQ3-*

Similar to *SQ2+*.

5.12.8 Humidification control sequence: *SQH+*

After setting a humidity sensor (parameter *HUM*), the humidification control sequence must be defined.

5.12.9 Dehumidification control sequence: *SQH-*

The dehumidification process consists in humidity outdropping while decreasing the air temperature below the “dew-point”. , If the cooling sequence is already defined the controller does not allow setting a sequence other than the cooling sequence. In this case the only available values are “??” (no dehumidification) or SQ1- (cooling).

5.13 COMPRESSOR CONTROL

The controllers provide functions allowing compressor control. There are three parameters in the menu system section ***AGR*** defined for this purpose. This section will be activated when outputs have been defined for the cooling sequence.

A protection input can be defined for the refrigerating unit using the ***APROT*** parameter in the menu system section ***IO***. The unit will be turned OFF when the frost protection alarm is tripped.

5.13.1 Compressor control parameter list:

Section	Name	Default value	Range	Description
IO	APROT	??	B1..B5, X1..X3, E1..E8	Compressor frost alarm input
AGR	ALON	2°C	0-30°C	Temperature value, below which the frost protection alarm is tripped.
	AHIST	5°C	0-30°C	Compressor frost protection alarm hysteresis. The alarm switches OFF when the *APROT* input temperature has risen back above the *ALON+AHIST* value and after the time defined in the *ALMT* parameter has elapsed since alarm trip.
	ALMT	10min	1-30min	The time, after which the compressor frost protection alarm can be switched OFF. (See *AHIST* parameter)
	AOFF	16°C	0-30°C	The outdoor temperature, below witch the compressor is turned off
	OFFTM	08 min	0-30 min	Minimum OFF time
	ONTM	08 min	0-30 min	Minimum ON time

APROT, ALON, AHIST, ALMT:

When the ***APROT*** parameter is defined, there can be two situations depending on the kind of inputs:

- Digital input: when there's an active signal on the *APROT* input, the controller turns the compressor(s) OFF and indicates alarm. The unit will be turned back ON after the alarm signal on the *APROT* input is gone and no sooner then the time set in the *ALMT* parameter (in minutes).
- Analog input: when the temperature measured on the *APROT* input drops below the *ALON* value, the controller turns the compressor(s) OFF and indicates alarm. The unit will be turned back ON when the temperature rises back above the *ALON* + *AHIST* value and no sooner then the time set in the *ALMT* parameter (in minutes).

AOFF:

The *AOFF* parameter defines the outdoor temperature (measured on the *OUTD* input), below which the refrigerating unit is to be turned OFF. For *AOFF=0* (text message „OFF" on the display) the unit lock function is deactivated and the unit continues to run regardless of the outdoor temperature.

OFFTM:

The *OFFTM* parameter defines the minimum required time between turning the refrigerating unit OFF and back ON. For O*FFTM* = 0 (text message „OFF" on the display) there is no OFF time control. The OFF time is counted separately for each digital output, i.e. if several outputs are set in series for the cooling process, the OFF times will be counted separately.

ONTM:

The *ONTM* parameter defines the minimum required time between turning the refrigerating unit ON and back OFF. For *ONTM* = 0 (text message „OFF" on the display) there is no ON time control. The ON time is counted separately for each digital output, i.e. if several outputs are set in series for the cooling process, the ON times will be counted separately.

5.14 EXCHANGER CONTROL – HEAT/COLD EXCHANGE SYSTEMS

In order to configure the controller for exchanger control, the exchanger control input must be set using the ***ECON*** parameter in the menu section ***IO***.

When using exchangers, a problem of condensed moisture freezing can arise on the exchanger in the exhaust air section, when the exhaust air is cooled down to the “dew-point”. The condensed moisture in form of water drops is gathered on the exchanger. In low temperature conditions the exchanger becomes frosted thus increasing the pressure drop. The exchanger can be defrosted through lowering heat exchange intensity. The frost protection system sensor input must be defined in the *EPRO* parameter. When the *EPRO* parameter is set, the protection system trip threshold must be defined (*ELIM* parameter). If the value measured at the *EPRO* input decreases below the *ELIM* threshold, the defrosting system is turned ON, i.e. the controller sets the *ECON* output to LOW.

Frosting can be detected in several ways:

- A temperature sensor connected to one of the inputs B1…B5. The *ELIM* parameter defines the temperature value, below which the protection system trips.
- A sensor connected to the analog input X. A differential pressure transducer or a temperature sensor can be used. When using a temperature sensor, the ACT parameter must be set to define the *ELIM* threshold exceed direction. For *ACT* = Hi, the protection system trips when the value measured at the *EPRO* input is higher than the *ELIM* value. For *ACT* = Lo, the protection system trips when the measured value drops below the *ELIM* value.
- A thermostat connected to the binary input E1...E4 or to the analog input X **(remember, the X input signal voltage must not be higher than 10VDC)**. In this case, the *ACT* parameter active state must be set. For *ACT* = Hi, the system trips when there’s an active signal at the assigned input. For *ACT* = Lo, the lack of signal is treated as active state and causes system reaction.

5.14.1 Heat/cold exchange system control

The heat/cold exchange system control signal is driven first. When the signal reaches its maximum value, the heating or cooling sequence control is started. In case of a frost protection alarm, the system control signal is set to the low state (decreasing the heat exchange intensity). If the system is equipped with an outdoor temperature sensor, the heat/cold exchange system control conditions are:

- For the heating process: $RTD1 \geq OUTD + COND$
- For the cooling process : $RTD1 \leq OUTD - COND$

5.14.2 Exchanger control parameter list:

Section	Name	Default value	Range	Description
IO	EPRO	??	B1...B5, X1...X3, E1…E8	Exchanger frost protection sensor input
	ECON	??	Q1, Q2, DO1...DO6, P1, P2, Y1...Y6	Exchanger control outputs
EPAR	ELIM	05°C	0-20°C	Frost protection threshold temperature
	COND	5°C	2-9°C	Exchanger control conditions
	ETIME	10min	0-99min	Time, after which the exchanger can be restarted after an exchanger alarm.
	DEFTI	OFF	0-99min	Exchanger defrost time: during that time the supply fan is OFF, and the extract fan runs at the highest speed. If the value is 0, no defrosting cycle will start
	DEFCY	OFF	0-99min	Time before a new defrost cycle can start. If the value is 0, the defrost cycle will continue until exchanger alarm has been canceled
	EMODE	G+C	H+C, HEATING, COOLING	Assigning the exchanger to heating, cooling or both functions

5.15 DAMPER CONTROL

The UCS30 controllers are suitable for damper system control. The most common application of dampers is to shut off the intake of undesirable outside air to the air handling plant or to mix the return air with the outside air. The UCS30 controller enables setting the mixed air proportions. These proportions are set separately for the heating and cooling process, accordingly in the *HDAMP* and *CDAMP* parameters in the *RPAR* (recirculation parameters) menu system section.

5.15.1 Damper operation modes and conditions (economizer).

The economizer function is used with air recirculation systems**.** It consists in heating/cooling process energy usage optimization through proper fresh and recirculated air damper control. The *DTLIM* parameter defines the minimum difference between the indoor and outdoor temperature.

If the parameter ***ODACT* = ON, two damper operation modes can be programmed separately for heating and cooling:**

a. Damper opening supplies fresh air (default mode):

Following parameters must be set:

- For heating: *HMODE = NORMAL*

  This means, that the supply of fresh air for the heating process is possible only under the condition *OUTD* $\geq$ *IDAMP + DTLIM*.

  Caution: during frost alarm dampers will be closed

- For cooling: *CMODE = NORMAL*

  This means, that the supply of fresh air for the cooling process is possible only under the condition *OUTD* $\leq$ *IDAMP – DTLIM*.

b. Damper opening supplies recirculated air:

Following parameters must be set:

- For heating: *HMODE = REVERSE*

  This means, that the supply of recirculated air for the heating process is possible only under the condition *IDAMP* $\geq$ *OUTD + DTLIM*.

  Caution: during frost alarm dampers will be opened.

- For cooling: *CMODE = REVERSE*

  This means, that the supply of recirculated air for the cooling process is possible only under the condition *IDAMP* $\leq$ *OUTD – DTLIM*.

If *ODACT* = OFF, the outdoor sensor values are not taken into account in the damper control process. Dampers are constantly driven (open).

Caution: IDAMP parameter is set by default to RTD1 that is the main sensor. The value can be changed in section “RPAR”.

Damper operation modes and conditions:

ODACT	HEATING		COOLING	
	HMODE	**Damper control condition**	**CMODE**	**Damper control condition**
ON	NORMAL	OUTD ≥ IDAMP+DTLIM	NORMAL	OUTD ≤ IDAMP -DTLIM
	REVERSE	IDAMP ≥ OUTD+DTLIM	REVERSE	IDAMP ≤ OUTD-DTLIM
OFF	Dampers constantly open			

5.15.2 Damper control coefficients: HDAMP, CDAMP

These coefficients can be used to define the damper control conditions according to the heating and/or cooling sequence. The value range for these parameters is 0÷99%. When the parameter value is zero, the *DACO* output will be driven at the end, i.e. after the sequence (heating or cooling) has reached the maximum level. When the value is 99 the *DACO* output will be driven first. For values between 0 and 99, the control signal is divided into proportions set in the *HDAMP* (*CDAMP*) parameter, e.g. for *HDAMP*=30, the control signal is divided into following proportions: 30% for the *DACO* output, 70% for the SQ1+ sequence.

5.15.3 Damper control parameter list:

Section	Name	Default value	Range	Description
IO	DACO	??	Q1, Q2, DO1…DO6, P1, P2, Y1...Y6	Damper control output
RPAR	ODACT	ON	ON/OFF	Activate or deactivate the outdoor sensor in the damper control system
	DTLIM	2°C	1-10°C	Minimum difference between the outdoor and the indoor temperature
	HDAMP	00	00-99 %	Mixing coefficient for the heating process
	CDAMP	00	00-99 %	Mixing coefficient for the cooling process
	HMODE	NORMAL	NORMAL, REVERSE	Damper operation mode for the heating process
	CMODE	NORMAL	NORMAL, REVERSE	Damper operation mode for the cooling process
	IDAMP	RTD1	RTD1, B1..B5,X1..X3	The temperature sensor to which the outdoor temperature is compared. IDAMP is set by default to RTD1 that is the main sensor

5.16 FAN CONTROL

UCS30 controllers have a built-in fan pressure control and are suitable for individual control of two fans (supply air and exhaust air fan) in a regular or star-delta system. The controllers are also suitable for multi-speed fans control (up to 4 speed-fans).

Caution: 3-speed and 4-speed fans control is available from version 5.4. Older versions (5.3 and less) can control only two-speed fans.

5.16.1 Fan control outputs: *FCO1(2), DTA1(2)*

The *FCO1* and *FCO2* parameters define the outputs (digital or analog 0-10V) used to start and stop the supply-exhaust unit engines (*FCO1* for the supply fan, *FCO2* for the exhaust fan). In indirect start-up systems (star-delta), the *FCO1* and *FCO2* outputs control the fans in star system. In two-speed fan systems they control the first (lower) speed.

To control a multi-speed fan, assign more than one digital output to parameter *FCO1* or *FCO2*. To control fans in star-delta systems assign a digital output to parameter *DTA1* or *DTA2*.

Caution: To control two-speed fans in old versions (5.3 and lower), a digital output should be assigned to parameter *GCON1* or *GCON2*.

a. Star-delta system start-up: *DTA1(2)* is defined

After start digital output *GCON1* is switched on. After a time *STIM* sec has elapsed, output FCO1 is switched off and after an interval of *STDT* msec digital output DTA1 is energized. If there are two fans defined in the system, the *FANR* parameter defines the time delay between the exhaust and supply fans, i.e. between switching ON *DTA1* output and *FCO2* output.

b. Multi-speed fans:

UCS30 controllers are suitable for multi-speed fan control (up to 4 speeds). For each parameter *FCO1* and *FCO2* up to 4 digital outputs can be assigned for speed control. Digital outputs control the speed of the fan according to their position in the list. The first output in the list control the first speed and the last output in the list control the highest speed.

For ex. setting FCO1 = DO1+DO2 means that output DO1 controls the first speed and output DO2 controls the second speed of the supply fan. If we invert the items positions in the list and we set FCO1 = DO2+DO1, the output DO2 will control the first speed and output DO1 the second speed.

For 3-speed fans assign 3 digital outputs and for 4-speed fans 4 digital outputs, e.g. FCO1 = DO3+DO4+DO2, or FCO1 = DO3+DO4+DO2+DO1.

If the first item in the list is an analog output e.g. Y1, then we can control a fan using an inverter. At that moment it is possible to add only one more digital output for the second item in the list e.g. FCO1 = Y1+Q1. This output will act as a start signal for the inverter.

Adding an item to the list is done by shifting right the cursor position by pressing  .

After setting parameters FCO1 and FCO2 for controlling multi-speed fans, parameter IGEAR is activated for defining digital inputs to remotely select fan speeds. If the number of speeds is greater than 2, then it is possible to assign 2 inputs to parameter IGEAR e.g. IGEAR = E1,E2. Adding the second input to the list is done by shifting right the cursor position by pressing  .

Fan speeds can be selected within the system operation programs by setting the desired speed in the parameter *GEAR* (GEAR 1, GEAR 2, GEAR 3 or GEAR 4) or remotely through digital inputs defined by parameter *IGEAR* in *IO* section.

When digital inputs are used for speed select, the speeds of the fans will be set according to the input signal level as indicated in the table bellow (example for IGEAR = E1,E2).

E2	E1	GEAR
0	0	1
0	1	2
1	0	3
1	1	4

When a higher speed than the first is selected at start-up, the controller will first switch to the first speed. After a time set in the *SP12* parameter (in seconds) the higher speed will be switched on.

5.16.2 Fan control using an inverter

Instead of digital outputs, the analog 0-10V outputs can be used to smoothly control the fan speed with an inverter. In such systems, the fan can be used for additional control, apart from the main heating and cooling control sections.

The fan start-up speed is defined by the *FANOFS* parameter in the time zones. The maximum speed and direction variation is set in the parameters *HFAN* (for the heating process) and *CFAN* (for the cooling process) in the menu system section *„MOTOR”*.

When there are two fans in the system (supply and exhaust) their speed ratio can be set. This ratio is defined by the *FCOEF* parameter in the section *„MOTOR”*.

Fan speed *FCO2* = *FCOEF* x fan speed *FCO2*.

Inverter control parameter list:

Section	Name	Default value	Range	Description
MOTOR	HFAN	0	-100÷100%	Maximum fan speed variation for the heating process (+): upward variation (-): downward variation When the heating sequence is finished, the controller will start to control the fan speed.
	CFAN	0	-100÷100%	Maximum fan speed variation for the cooling process. (+):upward variation (-):downward variation When the cooling sequence is finished, the controller will start to control the fan speed.
	FCOEF	1.0	0.1÷1.0	FCO2 and FCO1 fan speed relation FCO2 = FCO1xFCOEF
ZON1, ZON2, ZON3	FANSP	50%	20÷100%	Fan start-up speed

5.16.3 Pressure control using fans

There are systems, in which temperature and pressure control must be performed simultaneously, using the fans for pressure control as well as additional temperature control in case of insufficient heater or cooler efficiency. In such case, pressure is controlled by a separate control loop. Its output controls the fans („*SQ2+*" sequences of the second fan). Within this control loop, the minimum (*MIN*) and maximum (*MAX*) pressure value (section „*TLIM2*") and the desired value can be set. Within the inverter parameters (section „*MOTOR*"), the fan speed switch direction can be set separately for heating (parameter *HFAN*) and cooling (parameter *CFAN*). In this case, the sign of the value entered in *HFAN* or *CFAN* is most important. The value itself has no meaning, because the minimum and maximum fan speeds are defined by the minimum and maximum pressure value. If *HFAN* or *CFAN* equals zero, the controller uses the default speed control – slower for heating or faster for cooling.

The first controller stabilizes the temperature; the second controller stabilizes the desired pressure. When the first controller is requested to switch the fan speed in order to reheat or cool down, the speed switch will be performed by the second controller within the limits.

To enable such operation mode, switch on the parameter *PRCTR* in the section *PID* (i.e. set *PRCTR=ON*).

5.16.4 Two-level temperature control using two-speed fans

Two-speed fans can be used to perform a two-level temperature control, by which specific fan speeds present the control levels. Two parameters must be set to enable this operation mode: *SPCTR* and *GSEL* in the section *PID.* They can be set separately for heating and cooling. The heating and (or) cooling sequence should be defined the usual way, and PI control should be set in the section *PID* (i.e. parameters *PBAND* and *INT* are enabled, that is their values are higher than zero). The signal value for the heating or cooling control loop is divided by the controller into two control levels, corresponding with two fan speeds. The parameter *SPCTR* defines this division, i.e. the level switching threshold. The parameter *GSEL* defines which fan speed is the II control level. To disable this operation mode, *SPCTR = 0* must be set (text message „OFF" on the display).

E.g. *SPCTR = 50%* means, that the I and II control levels are evenly divided.

GSEL = II SPEED means, that within the range below *SPCTR* value (I control level) the I fan speed is switched on, however within the range above *SPCTR* value (II control level) the II fan speed is switched on. The I fan speed (I control level) is switched back on only after the signal value drops below *SPCTR* value (50%) diminished by the hysteresis value equal 1/3 *SPCTR*.

Caution:

- Two-level temperature control using two-speed fans is possible only in the automatic mode (the system controlled by the real time clock). In manual mode or in PRO-1 and PRO-2 programs, this function is inactive and switching fan speeds proceeds according to the fixed program.

- Two-level temperature control is unavailable in case of using the „FREE COOLING" function.

Two-level temperature control parameters

Section	name	Default value	Range	Description
PI1+,PI1-	SPCTR	OFF	0÷100 %	Control levels division
	GSEL	GEAR 2	GEAR 1, GEAR 2	Fan speed selection for the second control level

5.16.5 Fan pressure control: *PRES1, PRES2, PREST*

The *PRES1* parameter defines the supply air pressure control input, the *PRES2* parameter defines the exhaust air pressure control input. If there is no signal on the *PRES1* or *PRES2* input for a time longer than defined in the *PREST* parameter, system shut-down will follow. Alarm mode will be set and the text message „ PRESSURE AL.-1" or "PRESSURE AL.-2" will be displayed. **After system restart, the alarm will be cleared.**

5.16.6 Fan engine alarm: *FANP*

The *FANP* parameter defines the fan engine alarm input. When an active signal appears on the *FANP* input, the controller immediately stops the fans and the whole system and indicates alarm. **After system restart, the alarm will be cleared.**

5.16.7 Fan control parameter list:

Section	Name	Default value	Range	Description
IO	FCO1	??	Q1,Q2,Q3,DO1..DO6	Supply fan control output - star system or lowest speed
	DTA1	??	Q1,Q2,Q3,DO1..DO6	Supply fan control output - delta system
	GCON1	??	Q1,Q2,Q3,DO1..DO6	Supply fan control output - star system or highest speed
	FCO2	??	Q1,Q2,Q3,DO1..DO6	Exhaust fan control output - star system or lowest speed
	DTA2	??	Q1,Q2,Q3,DO1..DO6	Extract fan control output - delta system
	GCON2	??	Q1,Q2,Q3,DO1..DO6	Extract fan control output – highest speed
	PRES1	??	X1..X3,E1..E8	Supply air fan pressure control input
	PRES2			
	FANP	??	X1..X3,E1..E8	Fan alarm control input
	IGEAR	??	X1..X3,E1..E8	Fan speed (gear) control input
FAN1	STIM	20 sec	10-99 sec	Running time in star system or second to first speed switch time
	STDT	0030 msec	30-999 msec	Pause between the star and the delta system or first to second speed switch time
	FANR	20 sec	10-99 sec	Time-lag between the supply air fan and the exhaust fan switch-on
FAN2	STIM	20 sec	10-99 sec	Running time in star system or second to first speed switch time
	STDT	0030 msec	30-999 msec	Pause between the star and the delta system or first to second speed switch time
	SP12	10 sec	5-99 sec	Lower to higher speed switch time
	SPM	ZEGAR	CLOCK – binary input	Fan speed control signal source for automatic mode

	PREST	010 sec	10-999	Pressure control delay
	STDEL	0 sec	0-300 sec	Fan-ON delay (supply fan)
	STOP	0 sec, 30 sec for electric heating	0-300 sec	Fan-OFF delay.
PRO-C, PRO-1, PRO-2	GEAR	I GEAR	I GEAR/II GEAR	Fan speed selection in the system operation programs

5.17 THREE-POINT ACTUATORS CONTROL

Three-point actuators can be controlled using two binary outputs, one for upward and one for downward control. Such outputs are separated by the '**:**' character. The output on the left of '**:**' drives the opening of the valve, whereas the right-side output controls the closing. During configuration, the sections are separated by the '+' character. In order to setup a three-point control, enter the first binary output and find the next one behind the '**:**' character (instead of the '+' character).

After setting the three-point output **Qx:Qy**, the actuator closing time (in sec.) must be set using the ***HR*** parameter for the binary output **Qx** (section ***OUT***). The ***LR*** parameter defines the minimum actuator (valve) opening level and should be set to zero for the actuator (valve) to be fully closed. For *LR*≠0 the actuator will be left open at the point defined by the *LR* parameter.

Example: The primary heating sequence *SQ1+ = DO1:DO2* means, that the DO1 output opens the valve while the DO2 output closes it. DO1 and DO2 are never energized at the same time. Setting *HR* = 60 sec for the *DO1* output means, that an actuator with the maximum closing (opening) time of 60 seconds will be used. Setting *LR* = 6 sec mean that when closing, the valve will be left opened at 10%. If however the setting is *SQ1+ = DO1+DO2*, the DO1 and DO2 outputs will be connected in series. DO1 and DO2 can be energized at the same time.

5.18 CIRCULATION PUMP CONTROL

5.18.1 Circulation pump control parameter list

Section	Name	Default value	Range	Description
PPAR	PUMP	-5°C	-25-50°C	Outdoor temperature, below which the circulation pump is started
	PTEST	6°C	2-50°C	Outdoor temperature, above which the periodic pump starting function is activated. The function is disabled, when the outdoor temperature drops below 2°C under the PTEST value.
	PPER	168 h	10-999 h	Pump and valve starting period (in hours)
	PTIME	OFF	0FF-99 sec	Pump and valve starting time (in seconds). For 0 (text message "OFF"), the periodic pump and valve starting function is disabled.

	PMIN	10 sec	0-99 sec	Minimum pump starting time during periodic pump testing (in seconds)
	PDEL	1 min	0-99 min	System start time delay after pump stop (in minutes)
	PADEL	0 sec	0-99 sec	Pump alarm trip delay (in seconds)
OUT	PE	000 (NO)	0-100%, NO,YES	Output state during periodic pump and valve starting
IO	PALM	??	X1..X3, E1..E8	Pump alarm input

Binary outputs can be set to control circulation pumps. A binary output (**Q** or **DO**) can be assigned to the analog output **Y** or a three-point output, so that it is switched ON and OFF according to the analog (or three-point) signal. The binary output must be set next to the analog (or three-point) output and the binary output high range limit (*HR* parameter) must be lower than 100%. The parameter *HR,* when lower than 100%, defines the value (in %) of the analog or three-point output at witch the digital output contact should be closed. The *LR* parameter defines the value at witch the digital output contact should be open. If the analog output controls the valve actuator and the binary output controls the circulation pump, the pump can be turned ON and OFF according to the valve opening level.

Example: *SQ1+* = Y1+Q1, *HR*(Q1) = 5, *LR*(Q1) = 0.

Y1 is an analog 0-10V output controlling the valve actuator. Q1 is a digital output controlling the circulation pump. When the output signal at Y1 reaches 0.5V (valve open at 5%), the Q1 output is switch on starting the circulation pump. On the other hand, when closing the valve, the output stops the circulation pump when the signal at Y1 decreases to 0V.

For a three-point output the settings will be different, e.g. *SQ1+* = DO1:DO2+Q1, *HR* and *LR* of the Q1 output being lower than 100%.

5.18.2 Circulation pump failure alarm:

One digital input can be defined as circulation pump failure alarm input. The input is defined by the ***PALM*** parameter in the system menu section ***IO***. An active signal at the *PALM* input causes the controller to turn off the whole system and indicate pump failure alarm. In order to clear the alarm, press ENT and hold it for apr. 5 seconds. After the alarm has been cleared, the system can be restarted.

5.18.3 Starting the circulation pump in low outdoor temperature conditions.

The pump must be started in low outdoor temperature conditions to enable water circulation. The *PUMP* parameter defines the outdoor temperature, below which the pump is started. This function requires using an outdoor sensor. **The pump is started even if the system is not running.**

5.18.4 Pump and valve starting cycle.

In order to prevent jamming, the pumps and valves must be periodically started for some time.

The periodic pump starting function requires using an outdoor temperature sensor and can be activated only in the STANDBY system mode.

The *PE* parameter in the menu system section *OUT* is used to set the outputs to be energized during periodic pump and valve starting. *PE* defines the control signal value in % for analog outputs. For digital outputs it can be set to *YES* or *NO.*

The *PTEST* parameter defines the outdoor temperature, above which the periodic pump starting function is activated. The function is deactivated when the outdoor temperature has dropped back below 2°C under the *PTEST* value, or when the outdoor temperature sensor has not been defined, or when the system has been restarted.

The *PPER* parameter defines the time period (in hours) between turning the pumps and valves OFF and back ON. The *PTIME* parameter defines the pump and valve starting time in seconds. For *PTIME* = 0 (text message „OFF") the periodic pump starting function is disabled. The cycle begins with the period *PPER* and ends with the pump starting time *PTIME*. A pump starting indication message is displayed during *PTIME*.

When the controller receives the system start command during the *PPER* period, the system will be started only if the *PDEL* time (in minutes) has elapsed since starting the pumps. In different case the controller will wait for the *PDEL* time to elapse and then start the system. A countdown is displayed while waiting for the *PDEL* time to elapse.

When the controller receives the system start command while the pumps are running and if the minimum pump running time *PMIN* (in seconds) has elapsed, the pumps will be stopped. Next, the controller will wait for the *PDEL* (minutes) time to elapse before starting the system. If the system start command is received before the *PMIN* time has elapsed, the controller will wait for it to elapse and stop the pumps. Next, after the *PDEL* time has elapsed, the system will be started.

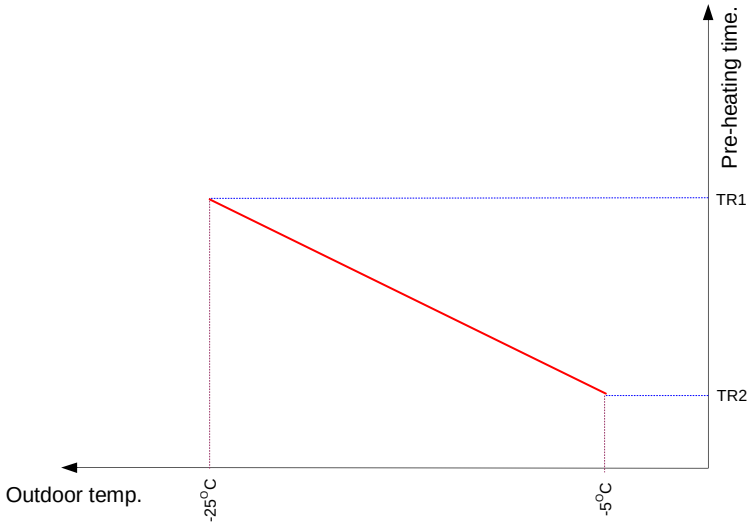
Caution: The countdown for the *PMIN* time is not indicated. The message indicating the running of the pumps is displayed until the pumps are stopped.

5.19 PRELIMINARY HEATING

For systems equipped with a water heater operating in low outdoor temperature conditions a problem can arise while starting the system – several seconds after system start-up the device is tuned off by the frost protection thermostat (sensor). In such cases, it is necessary to pre-heat the water heater before starting the fan section. Described parameters enable setting of preliminary heating time depending on the outdoor temperature according to the defined characteristic curve. During preliminary heating, the controller forces the heating valves fully open. The following illustration explains defining the preliminary heating curve.

5.19.1 Water heater preliminary heating characteristic curve coordinates:

Section	Name	Default value	Range	Description
PREH	ODT1	000°C	-25÷0°C	Outdoor temperature 1 (low range)
	TR1	00 min	0÷10 min	Heating time 1
	ODT2	000°C	-25÷0°C	Outdoor temperature 2 (high range)
	TR2	00 min	0÷10 min	Heating time 2



5.20 FAST START / DESIRED VALUE FAST INCREASING

The UCS30 series controllers (UCS32, UCS34) provide a fast start function. It consists in temporary increasing/decreasing of the desired value at system start-up. After a short time the original desired value is restored. The increasing/decreasing offset and duration are defined by the *FAST* and *FSTM* parameters in the section *PID*. When the *FSTM* parameter is set to „AUTO", the fast start procedure is stopped after the main temperature has reached the original desired value.

In case of serial control, the „*FSLIM*" parameter defines the increasing/decreasing offset of the limit value. Increasing or decreasing the limit may be necessary for the sensor not to block the desired value increasing/decreasing effect.

The desired value increasing function can be used separately for each process. The settings are made in the *PID* section. For heating, humidification processes and the positive sequences, the desired value is **increased**. For cooling, dehumidification processes and the negative sequences, the desired value is **decreased**. The goal is to accelerate the process. The word „*increasing*" used in the title and at the beginning of the paragraph is only conventional. The fast desired value increasing function for the heating process is simply a fast heating function.

When the system is equipped with an outdoor sensor, the „*FSDIS*" parameter defines the outdoor temperature above (or below) which the fast start function is disabled.

5.20.1 Desired value fast increasing parameter list:

Section	Name	Default value	Range	Description
PI1+,PI1-, PI2+,PI2-, PI3+,PI3-	FAST	0	0÷30	Desired value increasing (decreasing) offset
	FSLIM	0	0÷30	Limit increasing (decreasing) offset
	FSDIS	0	-20÷30	Outdoor temperature above (below) which the fast start function is disabled
	FSTM	AUTO	0÷30 min	Fast start duration

5.21 FREE COOLING

The principle of the FREE COOLING function is using the cool outdoor air to cool down the room. This function requires using an outdoor sensor. When FREE COOLING is enabled, the heaters, coolers and exchangers are OFF. When the main temperature exceeds the desired value *FCHYS*, the fans are switched ON in order to cool down the room, under the condition however, that the outdoor temperature is lower than the main temperature by the value set in *DTON*. The fans are switched OFF when following conditions are met:

- The main temperature has dropped back to the desired value
- The main temperature hasn't dropped during the time *FCTIM* minutes.
- The main temperature has dropped to the outdoor temperature level.

The fans can be switched ON again only after the time *FCTIM* minutes.

5.21.1 „FREE COOLING" parameter list:

Section	Name	Default value	Range	Description
PRO, FLAG1, FLAG2	FCOOL	OFF	ON/OFF	Turns FREE COOLING ON/OFF within the time zones and programs
IO	FCOFF	??	X1..X3, E1..E8	Digital input used for turning OFF the FREE COOLING function. A signal on the *FCOFF* input turns OFF the function, whereas lack of signal turns it ON under the condition, that *FCOOL* = *ON* within the current time zone or executed program.
FCPAR	FCHYS	000°C	-25÷0°C	The fan switch-ON hysteresis while FREE COOLING is ON. When the main temperature exceeds the desired value by the value *FCHYS*, the fans are switched ON, under the condition however, that the outdoor temperature is lower then the main temperature by the value set in *DTON*.
	DTON	00 min	0÷10 min	Fan switch-ON condition while FREE COOLING is ON: outdoor temperature must be lower than the main temperature by the value set in *DTON*.
	FCTIM	000°C	-25÷0°C	Fan operating time: if during the time set in *FCTIM* (min) the main temperature doesn't drop, the fans will by switched OFF. They can be switched back ON only after the time set in *FCTIM* (minutes).

5.22 "TERMO" mode (ECO MODE)

The principle of "TERMO" mode is, that when the controlled temperature (sensed by the main sensor *RTD1*) reaches the desired value *SV1*, the system is switched OFF until the temperature has dropped back below (heating) or exceeded (cooling) the desired value, **but not before 1 minute after switch-off.** The system restart hysteresis is the value of the parameter *TERMO*.

The "TERMO" mode is set separately for every system operation program (week scheduler and operation programs).

To switch the "TERMO" mode ON, set the appropriate hysteresis *TERMO*; to switch it OFF, set *TERMO = 0* ("OFF" will be displayed after confirming).

The "TERMO" mode can be remotely switched ON or OFF using a digital input defined in the *TMOFF* parameter in the section *IO*. A signal on the *TMOFF* input turns the thermostat function ON, whereas lack of signal on the input turns the function ON only if the parameter *TERMO = ON*.

After turning OFF the "TERMO" mode, if the system was switched OFF by it, the system will be started again, **but not sooner than 1 minute after switch-off**.

5.23 ELECTRIC HEATING – PWM OUTPUTS

The UCS30 series controllers are equipped with two PWM (Pulse Width Modulation) outputs marked P1 and P2, which can be used to drive solid state relays (SSR). These are frequency controlled open collector outputs. The control frequency can be set using the *CYCL* parameter in the system menu section *PID*. The *CYCL* defines the pulse period and can adopt values from 1 sec. (1 Hz frequency) up to 60 sec. (60 Hz frequency). The PWM outputs enable continuous electric heater power output control.

5.23.1 Electric heater supply: parameter *HTOUT*

The parameter *HTOUT* defines the digital output used to supply the electric heaters. The *HTOUT* is switched ON when there's a signal on one of the inputs P1 or P2. The output is switched OFF when there's no signal on P1 and P2. This output is used to supply voltage to the electric heaters during heating and to cut off the voltage during standby (safety reasons).

5.23.2 Cool down time: *STOP* parameter

When electric duct heaters are used, the fans should continue to run for some time after system switch-off in order to cool down the heaters. The cool down time can be set using the *STOP* parameter (in seconds). It defines the time the fan continues to operate after the electrical supply to the duct heaters has been switched off.

5.24 OUTDOOR COMPENSATION

5.24.1 Outdoor condensation curve parameters: *SET(1,2,3), COMP(1,2,3,4)*

Provided the outdoor sensor input has been defined *(OUTD),* the outdoor characteristic curve can be set (menu section *COMP*). In order to set the curve, the curve coordinates must be entered (*SET; COMP*). When SET3 = SET2 the COMP3 and COMP4 parameters will not be accessible.

5.24.2 Outdoor compensation curve within the time zones: *CPEN, COR*

Provided an outdoor sensor has been defined, a compensation characteristic curve can be defined by setting the *CPEN* parameter to ON or OFF.

The compensation characteristic correction within each time zone can be made using the *COR* parameter. The *COR* value shifts the curve up (*COR > 0*) or down (*COR < 0*). When a remote sensor is defined (parameter *REM* in menu section *IO*), the correction value will be read from the remote signal, instead of the *COR* parameter.

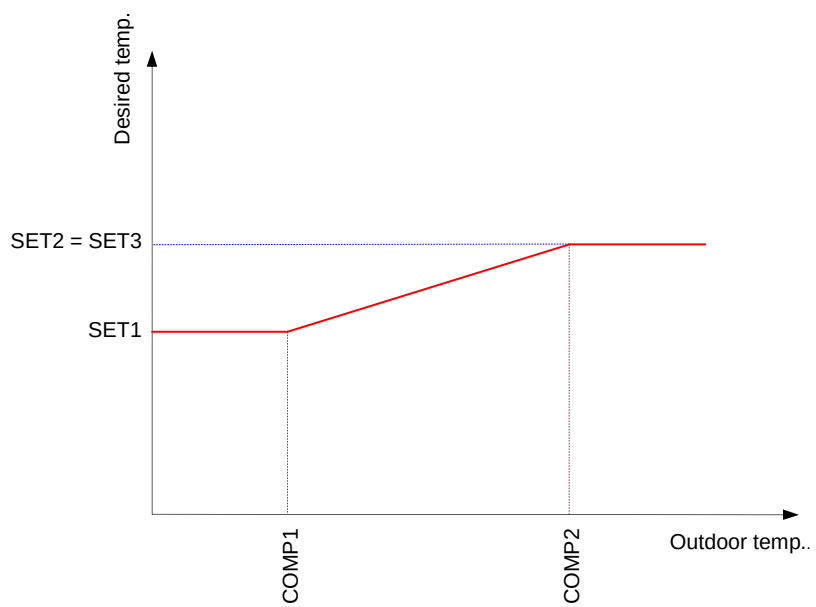
The pictures below demonstrate the setup and correction of the compensation characteristic curve.

5.24.3 Outdoor compensation parameter list:

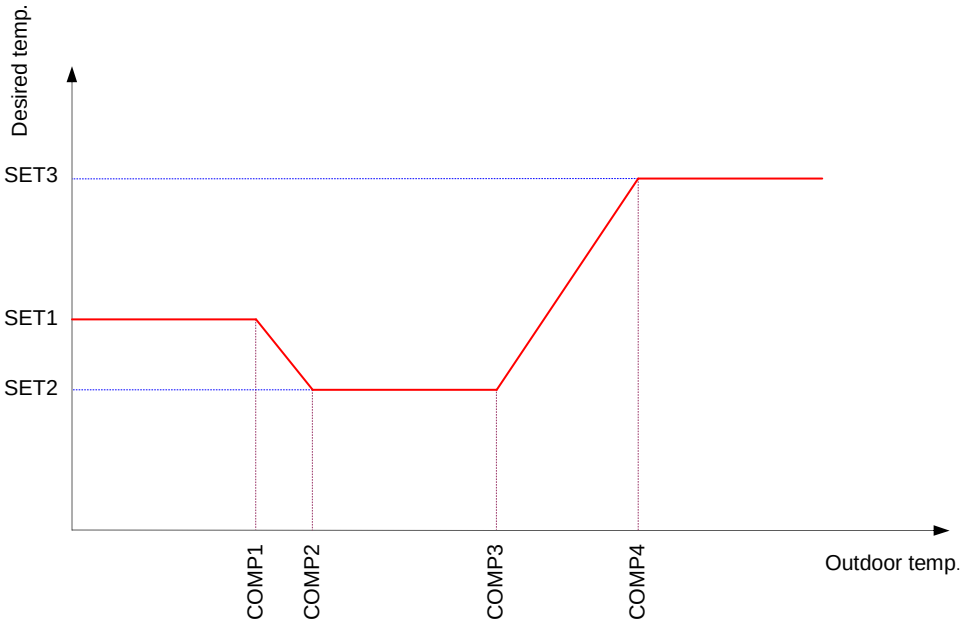
Section	Name	Default value	Range	Description
COMP	SET1,SET2,SET3	18,25,25 °C	10-35°C	Remote values
	COMP1, COMP2, COMP3, COMP4	-5,15,0,0 °C	-25÷70°C	Outdoor temperature
PRO	COR	00°C	-10÷10°C	Correction of outdoor compensation
	CPEN	OFF	ON/OFF	Enable or disable compensation

5.24.4 The outdoor compensation characteristic curve illustration:

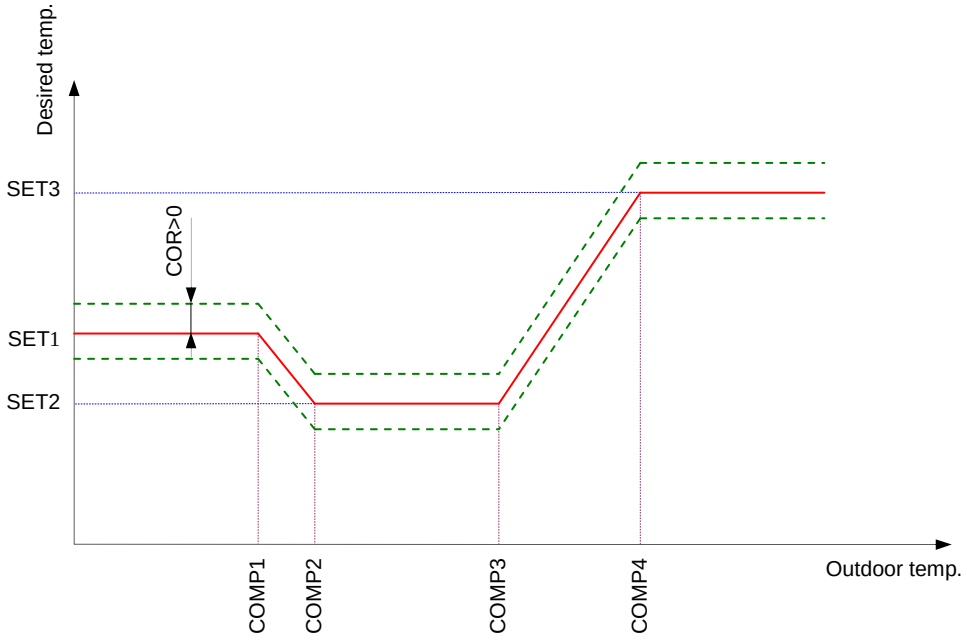
a)



b)


Desired temp.
SET3
SET1
SET2
COMP1
COMP2
COMP3
COMP4
Outdoor temp.

c)


Desired temp.
SET3
COR>0
SET1
SET2
COMP1
COMP2
COMP3
COMP4
Outdoor temp.

5.25 TIME RELAYS

The UCS30 series controllers have built-in time relays which can be used when building control enclosures. The UCS34 model is equipped with 3 time relays whereas the UCS32 with only one. The time relays are controlled by three parameters:

5.25.1 Time relay input: *TIN* parameter

This can be one of the digital inputs, one of the alarm states or the system switch-on signal. Possible *TIN* values are listed below:

TIN	Description
X1...X3, E1...E8	**Binary input** The time relay is energized when an active signal appears at the selected binary input.
SYS	**System switch-on signal** The time relay is energized at system start-up.
A1…A10, R1+, R1-, R2+, R2- RH+, RH-, A17	**Alarms:** see paragraph 6.29.2 for alarm list The time relay is energized when alarm is tripped.

5.25.2 Time relay output: *TOUT* parameter

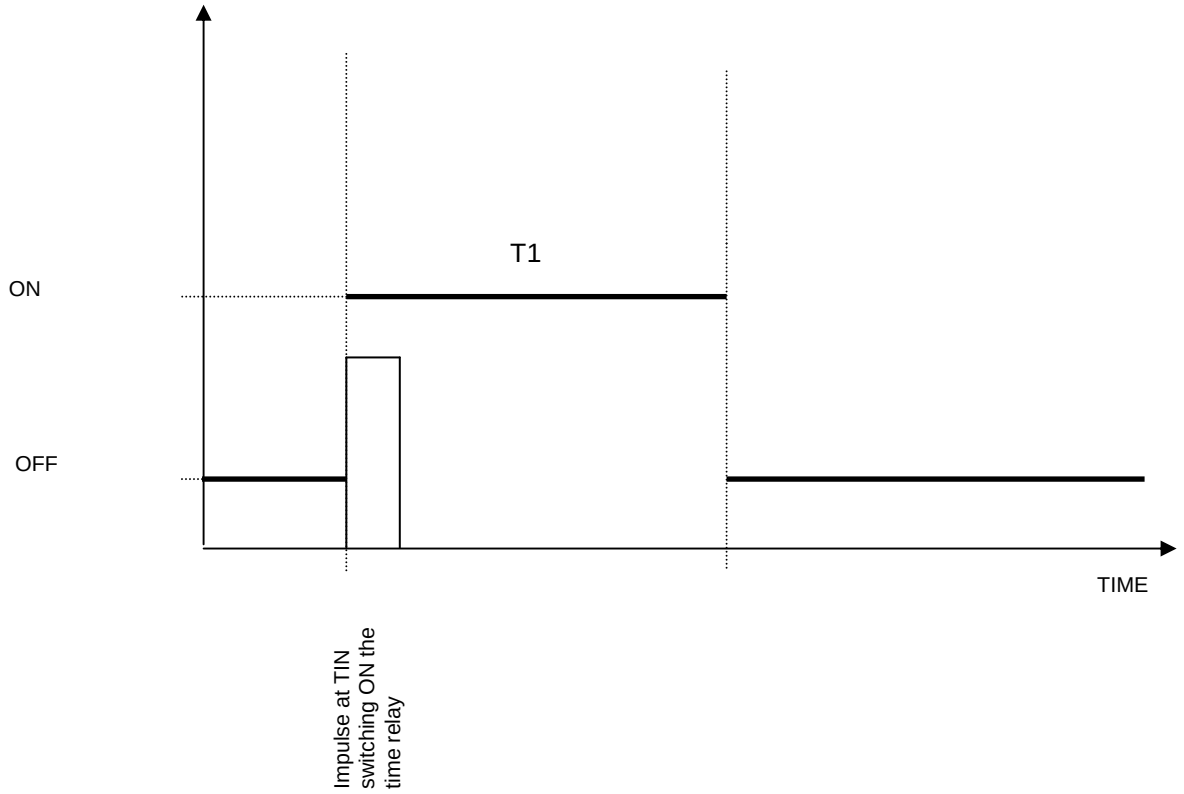
This is one of the digital outputs (relay or triac) defined by the *TOUT* parameter. The output is switched ON or OFF according to the selected function.

5.25.3 Time relay function: TFUN parameter

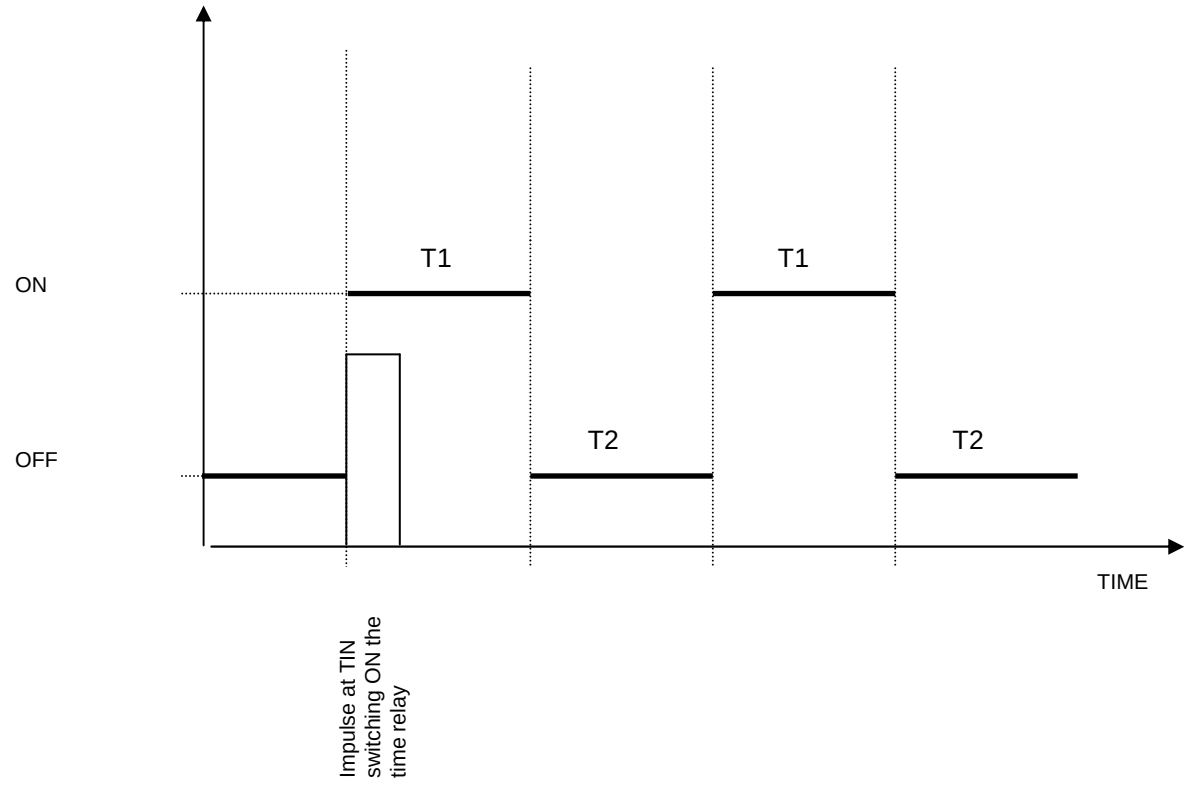
4 functions are available:

a. R function: time-delayed switch-off / chopper control

- Relay operation for T1 ≠ 0, T2 = 0

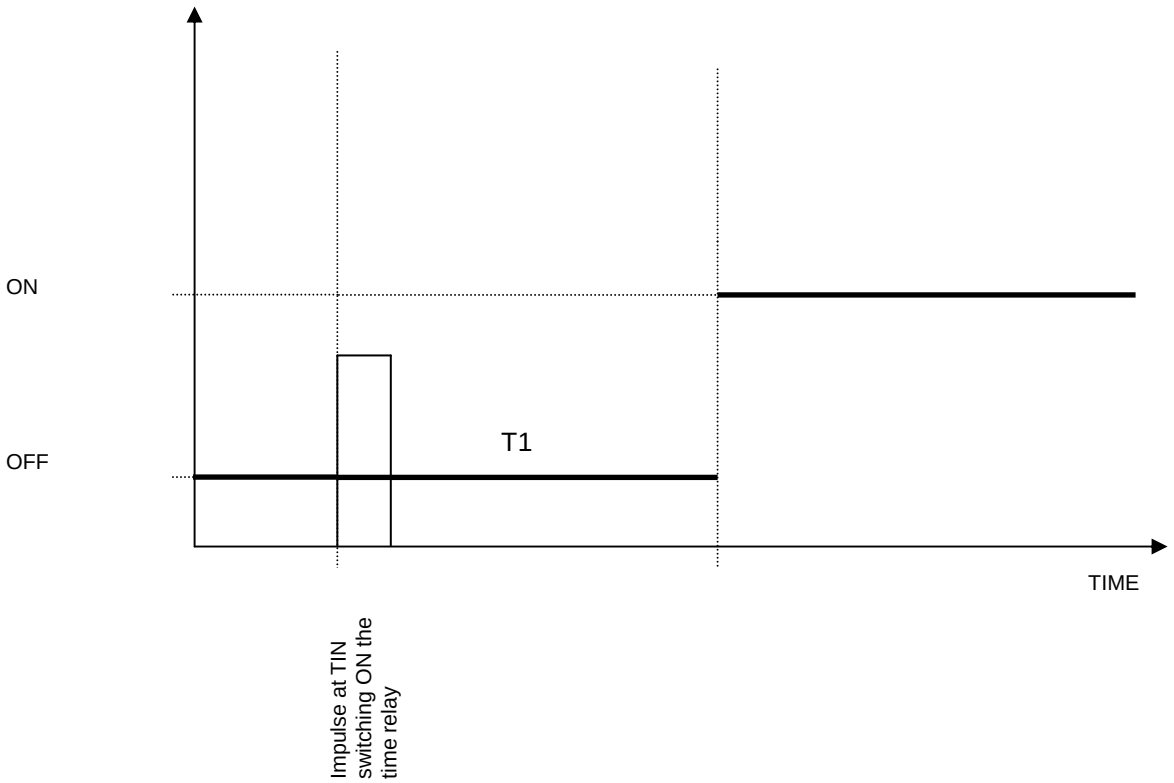


- Time relay operation for T1 ≠ 0, T2 ≠ 0

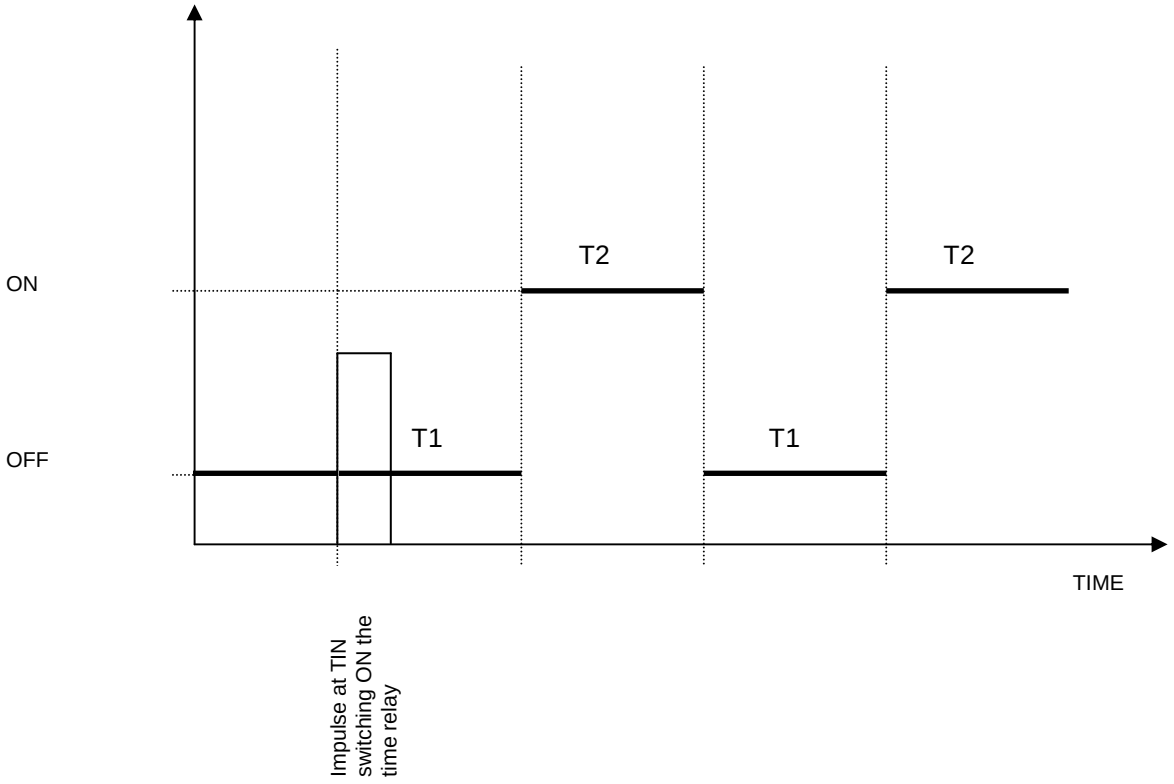


b. E function: time-delayed switch-on / chopper control

- Time relay operation for T1 ≠ 0, T2 = 0

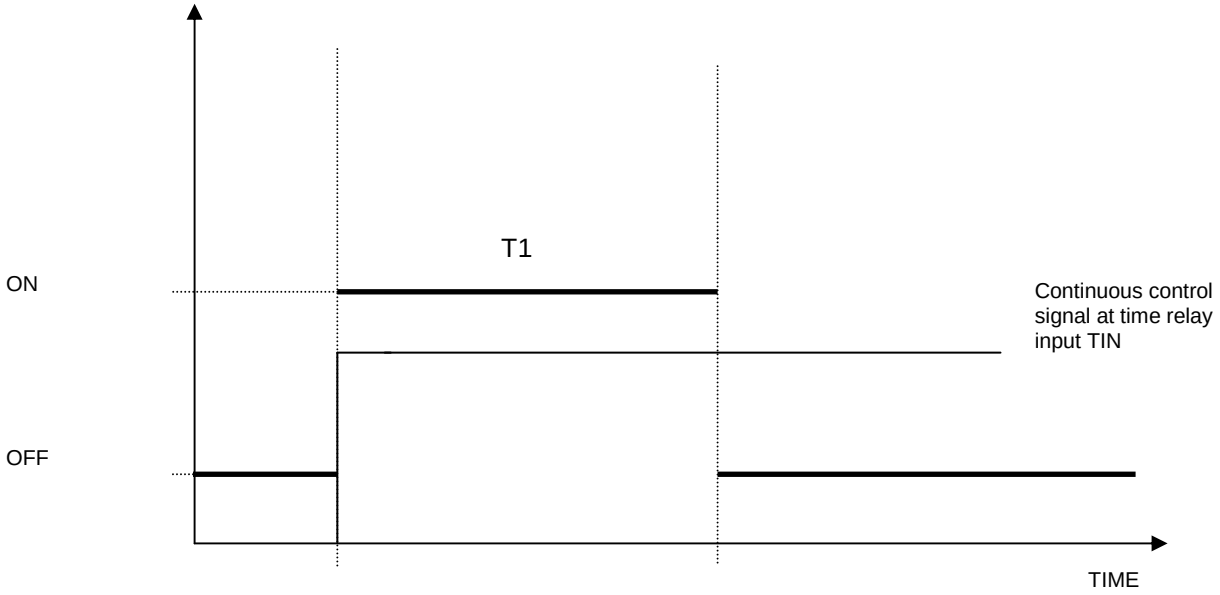


- Time relay operation for T1 ≠ 0, T2 ≠ 0

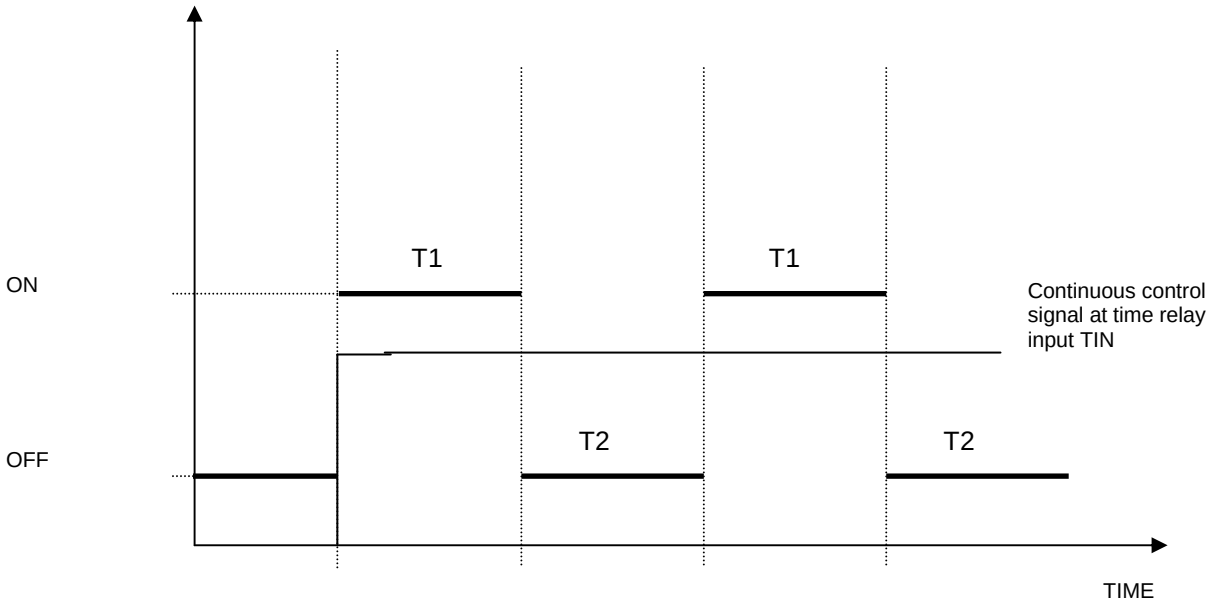


c. Rs function: continuous control

- Time relay operation for T1 ≠ 0, T2 = 0

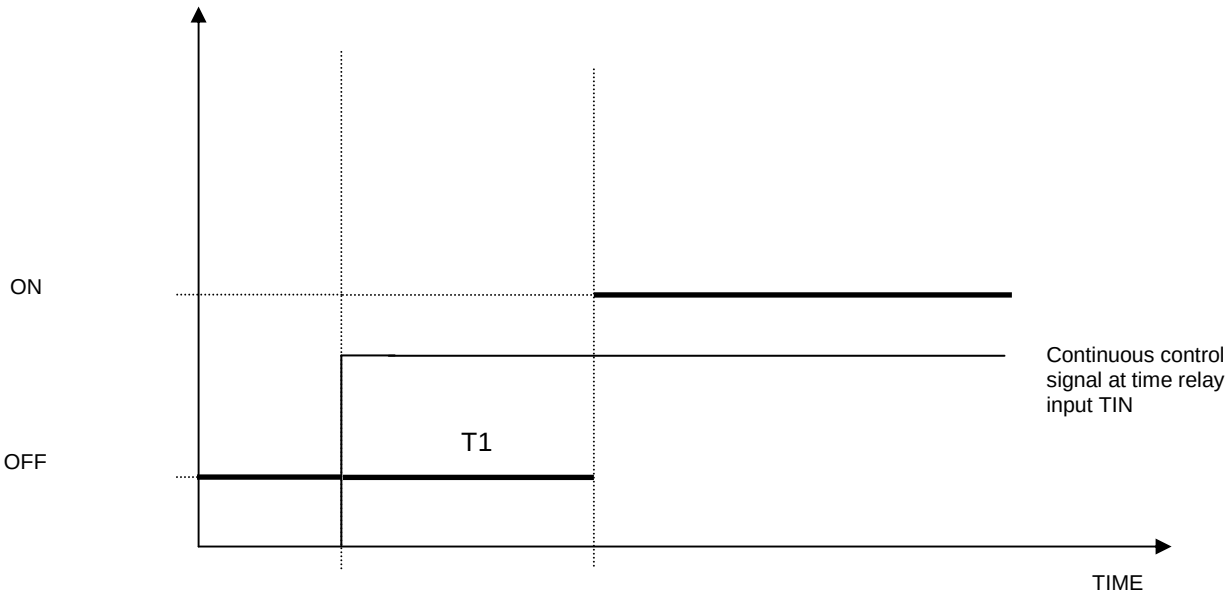


- Time relay operation for T1 ≠ 0, T2 ≠ 0

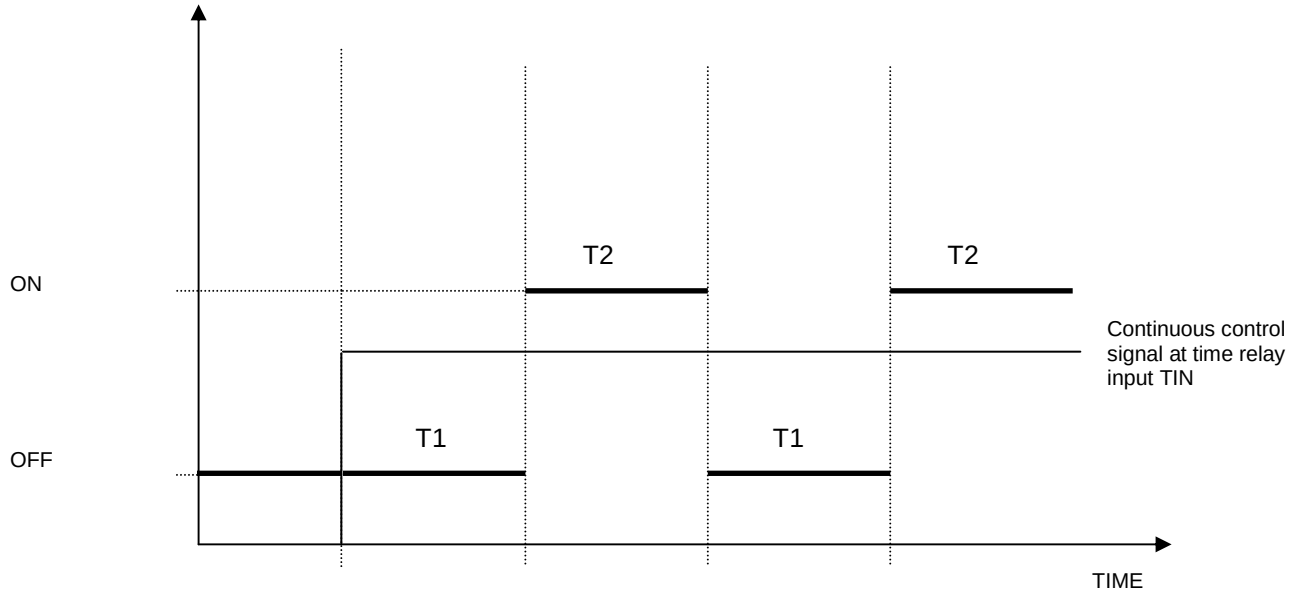


d. Es function: continuous control

- Time relay operation for T1 ≠ 0, T2 = 0



- Time relay operation for T1 ≠ 0, T2 ≠ 0



5.25.4 Time units: PRESC parameter

Three time units can be set for the parameters T1 and T2. The time units are defined by the parameter *PRESC* as follow:

- PRESC = MIN:SEC: times are in minutes and seconds
- PRESC = HOUR:MIN: times are in hours and minutes
- PRESC = DAY:HOUR: times are in days and hours

5.26 USER FUNCTION

5.26.1 User function input and output: *INPV, OUTV*

Any sensing input *INPV* (also inputs already assigned to other functions during resource configuration) can be used to control any output (also outputs already assigned to other functions during resource configuration). **This function has the highest priority within the control algorithm** (e.g. temperature or humidity). It means that the input-output relations defined using a suitable characteristic, ultimately control the output signal value *OUTV*.

5.26.2 User function coordinates: *YVAL(1,2,3), XVAL(1,2,3,4)*

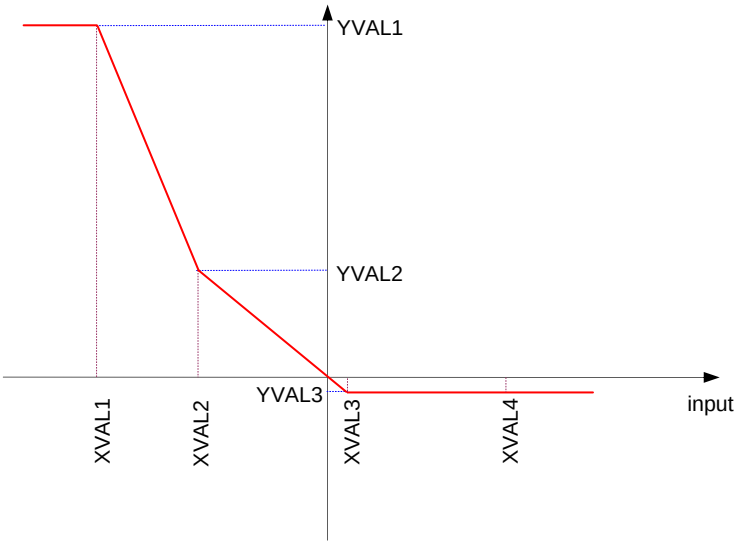
Input-output relations must be defined for the sensed input *INPV* and the control output *OUTV* by entering the characteristic curve coordinates *OUTV* = f(*INPV*). This can be done by setting the *XVAL* and *YVAL* parameters. When, for a certain input signal value range, the output signal value is negative, it means that for this input signal range the output should be calculated by the control algorithm (e.g. temperature or humidity). When *YVAL3* = *YVA2*, the *XVAL3* and *XVAL4* are not visible. If the *INPV* input is a binary input (*INPV* = E1, 2, 3, 4), the input coordinates will not be accessible and will be set by the controller to *XVAL1* = 0 (low state) and *XVAL2* = 1 (high state), while the output coordinates *YVAL1* and *YVAL2* will be visible and adjustable. After the coordinates *YVAL1* and *YVAL2* have been set, the controller automatically sets *YVAL3* = *YVAL2* (see diagram c).
Characteristic examples are shown on following diagrams.

5.26.3 User function parameter list:

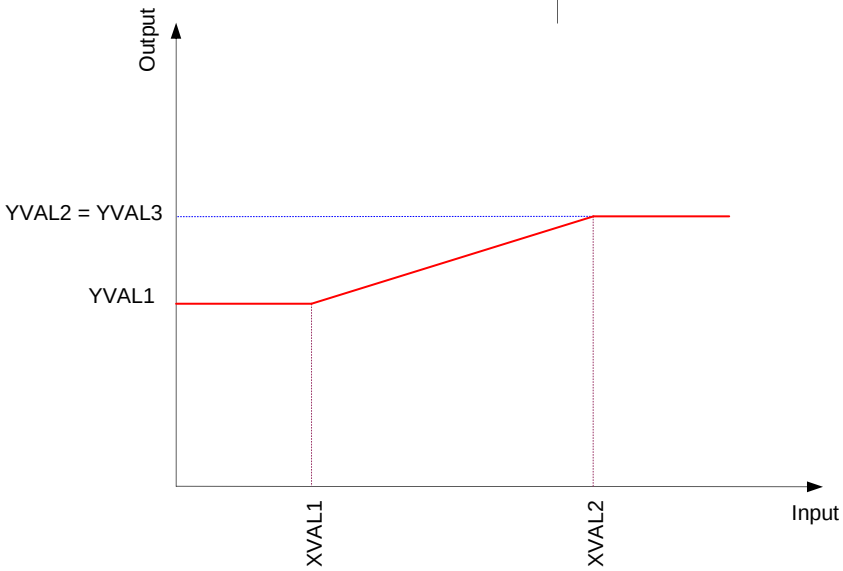
Section	Name	Default value	Range	Description
USER	INPV	??	B1..B5,X1..X3,E1..E8	Sensed input
	OUTV	??	Q1,Q2,DO1..DO6,P1,P2,Y1..Y6	Control output
	YVAL1,YVAL2, YVAL3	0,0,0	-100÷100	Output coordinates
	XVAL1,XVAL2, XVAL3,XVAL4	0,0,0,0	-25÷99.9	Input coordinates

5.26.4 Illustration of the user function:

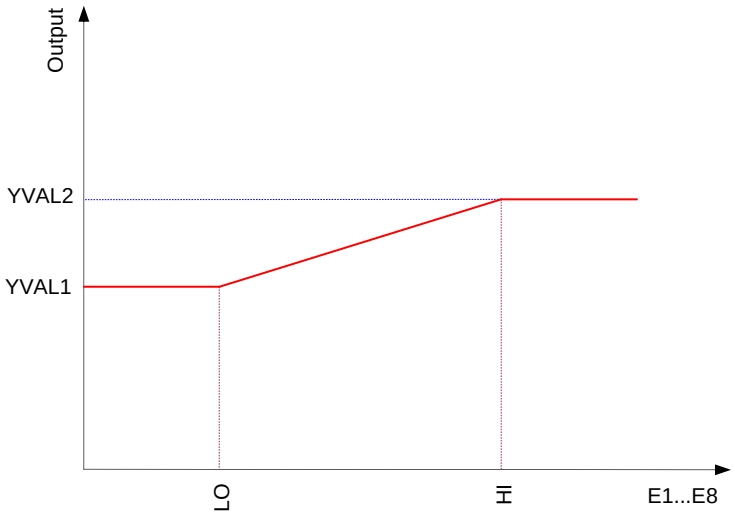
a)



b)



c)



5.27 REMOTE CONTROL SYSTEM

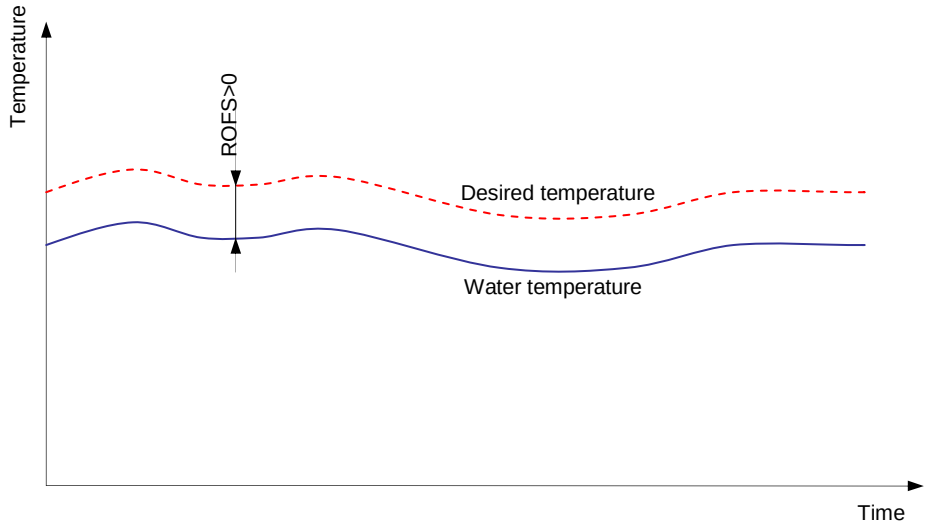
There is a set of parameters that can be used for remote system control. The controller can be configured to cooperate with e.g. a remote control device.

5.27.1 Temperature setpoint adjustment:

A temperature setpoint adjustment can be connected to one of the inputs B1…B5, X1...X3. After the *REM1* (*REM1* different than „??”) function has been activated, the desired temperature value *SV1* is no longer valid, and will be defined by the value measured at the *REM1* input. High and low range limits can be set for the remote desired value using the *RLL* parameter (low range limit – default value 15°C) and the *RHL* parameter (high range limit – default value 35°C). When the remote setting value is lower than *RLL* the desired value *SV1* will be equal *RLL*. When the remote setting value is higher than *RHL* the desired value *SV1* will be equal *RHL*.

Instead of a room temperature setpoint adjustment, an active sensor related to a different control circuit can be connected. A change of the value measured by this sensor will result in changing the desired temperature value.

A good example of such system configuration is a swimming pool application. A water temperature sensor can be used instead of the setpoint adjustment. This enables the system to maintain the air temperature several degrees (offset defined by the *ROFS* parameter) higher than the water temperature. The diagram below shows the desired value changes in time.



5.27.2 Humidity setpoint adjustment:

A humidity setpoint adjustment can be connected to one of the inputs B1…B5, X1...X3. After the *REM2* (*REM2* different than „??”) function has been activated, the desired humidity value *SVH* is no longer valid, and will be defined by the value measured at the *REM2* input. High and low range limits can be set for the remote desired value using the *RLL* and *RHL* parameters. When the remote setting value is lower than *RLL* the desired value *SVH* will be equal *RLL*. When the remote setting value is higher than *RHL* the desired value *SVH* will be equal *RHL*.

5.27.3 Remote START/STOP of the controller:

The controller can be remotely switched ON by activating the binary input set in the *RCON* parameter. When *RCON* is deactivated, the controller will be switched OFF. This parameter is dedicated to systems equipped with the remote control. The remote control using the *RCON* input has the same effect as the START STOP key on the controller keypad. After the *RCON* input has been defined, the START STOP key can be used to switch the controller OFF or ON. However after power-up, the system will not start until the *RCON* input isn't active.

5.27.4 Remote control system parameter list:

Section	Name	Default value	Range	Description
IO	RCON	??	X1...X3, E1...E8	Remote START?STOP input
	REM1	??	B1...B5, X1...X3	Input for the remote desired temperature value setting
	REM2	??	B1...B5, X1...X3	Input for the remote desired humidity value setting
RLIM1	RLL	15°C	0÷40°C	Low limit of the remote value
	RHL	35°C	0÷100°C	High limit of the remote value
	ROFS	0°C	-9÷9°C	Offset added to the remote value
RLIM2	RLL	0	0÷40	Low limit of the remote value
	RHL	100	0÷100	High limit of the remote value

5.28 ALARMS AND ALARM OUTPUT

All alarms are indicated by displaying adequate text messages and a LED common for all alarms. Furthermore, an output can be defined (e.g. digital output) to be activated during alarm.

5.28.1 Alarm output: *ALOUT*

The alarm output set in the *ALOUT* parameter can be activated by any alarm assigned to the appropriate binary input (E1 ÷ E8). Alarms activating the *ALOUT* output can be selected by setting the appropriate alarm numbers in the 4-digit field *ALM*. For example, setting the "1" digit in any of the four fields means selecting frost protection alarm (ALM=0100 A1), setting the "3" digit – selecting the supply fan pressure alarm (ALM=3000 A3), etc...

Alarm numbers not higher than 9 can be set in particular fields. In order to assign all available alarm functions to the output *ALOUT*, set ALM=0000. When ALM=0000 every alarm activates the *ALOUT* output.

5.28.2 Alarm list in priority order

No	Full name	Short name	Displayed message	LED signal	Effects
5	Fire alarm	A5	FIRE ALARM	◁▷	System OFF Clearing alarm: press ENT for about 5 sec.
1	Frost protection alarm	A1	FREEZE ALARM	⊕	System OFF Clearing alarm: press ENT for about 5 sec. **Chapter 5.9, 5.10**
6	High temperature	A6	Hi TEMPERATURE	⊕	Heaters OFF, System ON **Chapter 3.2**
3	Supply fan pressure alarm	A3	PRESSURE AL.-1	◁▷	System OFF Clearing alarm: After starting the system, alarm is automatically cleared. **Chapter 5.16.5**
4	Exhaust fan pressure alarm	A4	PRESSURE AL.-2	◁▷	System OFF Clearing alarm: After starting the system, alarm is automatically cleared. **Chapter 5.16.5**
2	Engine alarm (thermic)	A2	ENGINE ALARM	◁▷	System OFF Clearing alarm: After starting the system, alarm is automatically cleared. **Chapter 5.16.6**
9	Pump failure	A9	PUMP FAILURE	⋈	System OFF Clearing alarm: press ENT for about 5 sec. **Chapter 5.18.2**
19	Low water temperature	A17	LOW WATER TEM		System OFF
8	Compressor frost protection	A8	COMPRES. ALARM	⊖	Compressor OFF, System ON **Chapter. 5.13.1**
22	Rotary exchange alarm	A22	ROTOR ALARM		Exchanger OFF system ON
7	Exchanger alarm	A7	EXCH. ALARM	Message only	Exchanger OFF system ON **Chapter 5.14**
10	Filter alarm	A10	FILTER ALARM	⋈	Alarm display only
11	Heating control error	R1+	[ER]		Alarm display only
12	Cooling control error	R1-	[ER]		Alarm display only
13	Control error –controller 2, loop 1	R2+	[ER]		Alarm display only
14	Control error –controller 2, loop 2	R2-	[ER]		Alarm display only
15	Humidifying control error	RH+	[ER]		Signalization only
16	Dehumidifying control error	RH-	[ER]		Alarm display only

17	Low water temperature	A17	LOW WATER TEM		System OFF

5.29 CONTROL PARAMETERS

The control parameters (Pband, integral time, derivative time, hysteresis...) are set separately for each process: heating, cooling, humidification, dehumidification, and all other controller processes.

5.29.1 Control parameter list:

Section	Name	Default value	Range	Description
PI1+,PI1-, PI2+,PI2-, PI3+,PI3- PI4+,PI4-	PBAND	030.0	0÷999.9	Proportional band
	INT	0100 SEC	0÷6000	Integral time
	DIFF	OFF	0÷3600	Derivative time
	HYST	2.0	1÷50.0	ON/OFF hysteresis
	CYCL	01 SEC	1÷60	Control cycle time
	DEV+	OFF	0÷10.0	Positive control error: desired value – measured value is positive Measured value drop below the desired value by DEV+ triggers alarm. This alarm is not indicated, but it can be programmed to execute a defined system operation program (PRO-1 or PRO-2)
	DEV-	OFF	0÷10.0	Negative control error: desired value – measured value is negative. Measured value increase above the desired value by DEV- triggers alarm. This alarm is not indicated, but it can be programmed to execute a defined system operation program (PRO-1 or PRO-2)
PID	HYS1	3.0	1÷9.9	Neutral zone PID1 loop
	HYS2	3.0	1÷9.9	Neutral zone PID2 loop
	HYS3	3.0	1÷9.9	Neutral zone PID3 loop
	HYS4	3.0	1÷9.9	Neutral zone PID4 loop
	UNIT1		C, %RH, %, Pa, m3/h, ppm, m/sec	Unit for PID1 loop
	UNIT2			Unit for PID2 loop
	UNIT3			Unit for PID3 loop
	UNIT4			Unit for PID4 loop

	HCTRL	AUTO	AUTO, CASCADE, SUPPLY, ROOM/EXH	**Control type for Winter mode (cooling process is disabled):** **- AUTO**: If a limit sensor is defined the control type will be cascade control with min./max limiting. If no supply sensor is defined then the control type will be room/exhaust control. **- CASCADE**: Cascade control **- SUPPLY**: Supply control **- ROOM/EXH**: Room/exhaust control. **Beware:** The control type for winter mode is active only if the winter mode is defined (see section **5.30**) by setting the parameter **CTRIN** menu section **PI1+**.
	CCTRL	AUTO	AUTO, CASCADE, SUPPLY, ROOM/EXH	**Control type for Summer mode (heating process is disabled):** **- AUTO**: If a limit sensor is defined the control type will be cascade control with min./max limiting. If no supply sensor is defined then the control type will be room/exhaust control. **- CASCADE**: Cascade control **- SUPPLY**: Supply control **- ROOM/EXH**: Room/exhaust control. **Beware:** The control type for summer mode is active only if the summer mode is defined (see section **5.30**) by setting the parameter **CTRIN** menu section **PI1-**.
	HSV	0°C	-20 ÷ 20°C	**Shift value of the desired value for Winter mode** HSV is the value to be added to the desired value for the winter mode.
	CSV	0°C	-20 ÷ 20°C	**Shift value of the desired value for summer mode** CSV is the value to be added to the desired value for the winter mode.
	PRCTR	OFF	OFF,ON	Pressure control (see section **5.16.3**)

5.29.2 Proportional band: *PBAND*

To explain the concept of „proportional band", let's assume, that only a proportional controller is used (no integral or derivative element), a temperature sensor is used to control the room temperature and a valve is used to control warm water flow (heating only) to the radiator. The difference between the measured and the desired temperature is converted into a valve actuator control signal. The valve opening level is directly proportional to the temperature error (difference). When the measured temperature equals the desired temperature, the temperature difference is zero and so is the valve control signal – the valve is closed. As the room temperature drops below the desired value, the valve is opened proportionally to the temperature difference until fully open. The measured-desired

temperature difference at this point is called the proportional band (range). The proportional band is usually given in measured value units, e.g. °C, %RH, Pa, etc. It can also be given in % of the controller measuring range. For the UCS controllers, the proportional band is given in the measuring units.

With proportional control, there is a constant relation between the input signal (measured-desired temperature difference in the above example) and the output signal (valve actuator control signal). The input signal affects the output signal directly and without delay (theoretically). For a constant input signal, the wider the P controller proportional band, the less amplified the output signal. Selecting the proper proportional band depends on two opposite effects.

In order to achieve the minimum error, the proportional band value (PBAND) should be as small as possible. If so, even a very small temperature value change will cause a considerable change of the control signal value. On the other hand, if the proportional band is too small it could result in control instability and oscillations. In the example above, a slight temperature value change could cause the valve to open too wide transferring too much heat into the room. The room temperature would rise too high, resulting in fully closing the valve and such cycle could be repeated over and over.

A high proportional band value provides good stability, but allows only very small control signal value changes, causing slow reaction to disturbances.

Thus, the proportional band value selection requires a compromise between stability and error.

Setting *PBAND* = 0 means On/Off control. When this value is entered, the controller displays the message *PBAND* = ON/OFF and turns OFF the integral (*INT* = OFF) and derivative (*DIFF* = OFF) elements.

5.29.3 Integral time: *INT*

When using integration, the control signal value is increased or decreased at a speed proportional to the control error, until the error has reached the *zero* value. When the error is zeroed the control signal value remains constant. Adding an integral element to the proportional controller enables complete elimination of stationary control error.

The amount of integration effect is defined by the integration time. It can be described as the time needed for the integration element to add to the output a signal equal to the proportional element output signal. A long integration time causes slow output signal changes. A combination of a proportional (P) and an integral (I) controller is well known as the PI control method and is the most frequently used method in air conditioning systems. In PI control, the P element causes the initial signal jump, as in the P controller. Then, the integral element I increases or decreases the output signal at a constant speed.

P band selection is done as described before, but higher values are available. When selecting the integration time, the plant time constant must be considered.

The integral time is given in seconds, and setting *INT* = 0 means turning the integral element OFF, indicated by displaying the text message „OFF”.

5.29.4 Derivative time: *DIFF*

If large and fast value changes occur in the plant, the PI controller may be to slow to react. The control signal must be accelerated. Such effect can be achieved by the differentiation operation. The error changing speed is read and a output impulse is generated on its basis. The amount of differentiation is defined by the derivative time. A short derivative time has little effect, and a long time has a strong effect. The derivative effect usually stabilizes the process, but a strong effect (long time) may increase oscillations.

The derivative time is given in seconds and setting *DIFF* = 0 means turning the derivative element OFF, indicated by displaying the text message “OFF”.

For air conditioning related processes, the PI control method is good enough. Adding differentiation may only complicate selection of the optimal values: *PBAND*, *INT*, and *DIFF*.

5.29.5 Binary control hysteresis: *HYST* (ON/OFF control)

For binary control, the control signal can adopt only two possible values. This control method is used for large time constant and small dead zone processes. The control signal is set to its maximum value (100%), when the measured value has dropped below the desired value (SV) by a certain offset *HYST* called the hysteresis. When the SV value is exceeded by the *HYST* value, the control signal is set to zero. For the heating process, the hysteresis direction is opposite to the cooling process. The *HYST* parameter is given in the measured value unit, e.g. °C for temperature processes %RH for humidity etc.

To set the ON/OFF control, set *PBAND* = 0.

5.29.6 Control cycle time: *CYCL*

For PWM outputs, the impulse period (control cycle time) can be defined (in seconds). It is especially important in case of electric heater control. For weak power networks, frequent starting/stopping of the heaters can cause a serious problem. If this is the case, the heater control cycle must be increased, to decrease their switch-on frequency. On the other hand, a long control period causes deterioration of the control quality – the current flow control becomes unsmooth. The shorter the control period, the smoother the control. Thus, the control cycle times should be as short as possible (1÷5 sec), unless there are problems concerning heavy power network load.

5.29.7 Hysteresis between processes or dead zones: *HYS1, HYS2, HYS3*

An additional hysteresis *HYS1* has been defined for the cooling/heating process. It is used to switch between both processes. Hysteresis have also been defined for controller 2 and the humidification - dehumidification processes (*HYS2* and *HYS3*).

5.29.8 Measurement units: *UNIT1, UNIT2, UNIT3, UNIT4*

For each PID loop a measurement unit can be set to be displayed. The following units are available:

- **Empty character‘ ‘**: No measurement unit
- **C**: Temperature unit Celsius

- **%RH**: Relative humidity unit
- **%**: Percent
- **Pa**: Pressure unit
- **m3/h**: Flow unit
- **ppm**: Concentration unit
- **m/sec**: Speed unit

5.30 ENABLING AND DISABLING CONTROL LOOPS

A control input and control conditions can be defined for each of the six control loops. The input is defined by the *CTRIN* parameter and it can be one of the analog or digital controller inputs or one of the alarm states.

a) For analog inputs, two additional parameters must be defined - *CTROFF* and *CTRON*. These parameters define the control ON and OFF values respectively. There are two possibilities:

- CTROFF ≤ CTRON: Control will be switched ON when the value measured at *CTRIN* is higher than or equal *CTRON*. Control will be switched OFF when the value is lower than or equal CTROFF.
- CTROFF > CTRON: Control will be switched ON when the value measured at *CTRIN* is lower than or equal *CTRON*. Control will be switched OFF when the value is higher than or equal CTROFF.

b) For digital inputs or alarm states only the *CTROFF* parameter must be set:

- CTROFF = HI: Control will be switched ON when the digital input or the alarm state defined by the CTRIN parameter is active. Otherwise, control will be switched OFF.
- CTROFF = LO: Control will be switched OFF when the digital input or the alarm state defined by the CTRIN parameter is inactive. Otherwise, control will be switched ON.

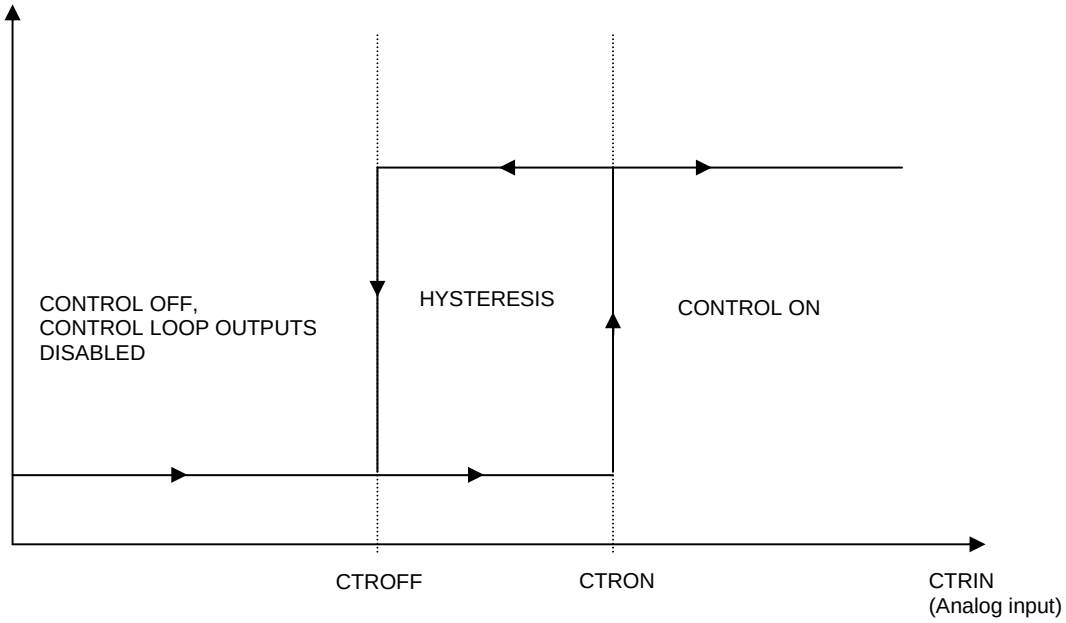
Caution : Switching control ON/OFF applies only to the control loop, for which the parameters CTRIN, CTRON and CTROFF have been defined. When control is OFF only the control loop outputs will by disabled. The fan driving outputs will not be disabled and the system will not be turned OFF.

Heating can be switched ON and OFF by activating or deactivating a defined heating control input, e.g. a digital input. With the heating OFF, the fans continue to run thus enabling only the **ventilation function**.

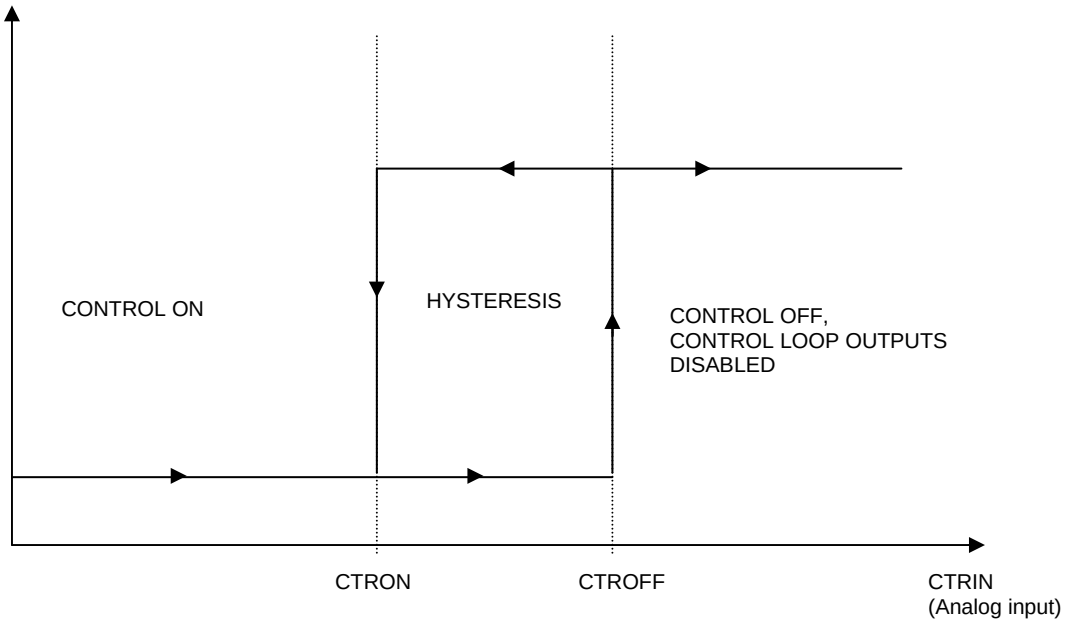
5.30.1 Enabling and disabling control loops parameter list:

Section	Name	Default value	Range	Description
PI1+,PI1-, PI2+,PI2-, PI3+,PI3-	CTRIN	??	B1...B5, X1...X3, E1...E8, A1…A10	Control loop input
	CTROFF	0	-20÷60	CTRIN input value, at which control is switched OFF
	CTRON	0	-20÷60	CTRIN input value, at which control is switched ON

Control characteristics for CTROFF < CTRON



Control characteristics for CTROFF > CTRON



5.31 OTHER PARAMETERS

5.31.1 *EXIT*: exit programming mode

EXIT = AUTO (default value): the controller exits the programming mode and switches back to the input and output state indication mode when no key is pressed for 2 seconds

EXIT = MAN: the controller stays in the programming mode until the operator exits manually.

5.31.2 *RESET*: resetting configuration parameters (default parameters)

This function enables setting default parameter values, i.e. values set by the manufacturer. After pressing ENT the controller will ask to confirm again. Press ENT to confirm or press RET to cancel. Operation completion is indicated with a “CLEARED” text message.

After resetting, the controller configuration parameters are set to their default values shown in the tables above. All inputs are zeroed and after exiting the programming mode without configuring the controller, a configuration error message will be displayed.

6 THE MENU SYSTEM

The menu system of the controller is hierarchically organized (multi-layer system). The adjustable parameters are grouped function-wise which makes finding required parameters fast and easy. For example, the menu item PRO contains all parameters applying to the week program. Within the PRO section, the parameters are grouped function-wise under ZONE1, ZONE2, ZONE3, MON, TUE…SUN. Furthermore, inside the MON…SUN items, there is another function-wise grouped item layer etc.

All other parameters are organized in the same way.