akribis

USER GUIDE

HLS 45

Produal

Distributed by AKRIBIS



This user guide is for devices with the software version 1.1.9 or newer.

MOUNTING

The device can be installed in dry surroundings (IP20) by screws on the wall surface or on the standard flush mounting box. The recommended installation height is 150…180 cm.

The device position should be selected carefully. All the error factors that can affect to the measurements should be eliminated as well as possible. The following list defines the typical measurement error factors.

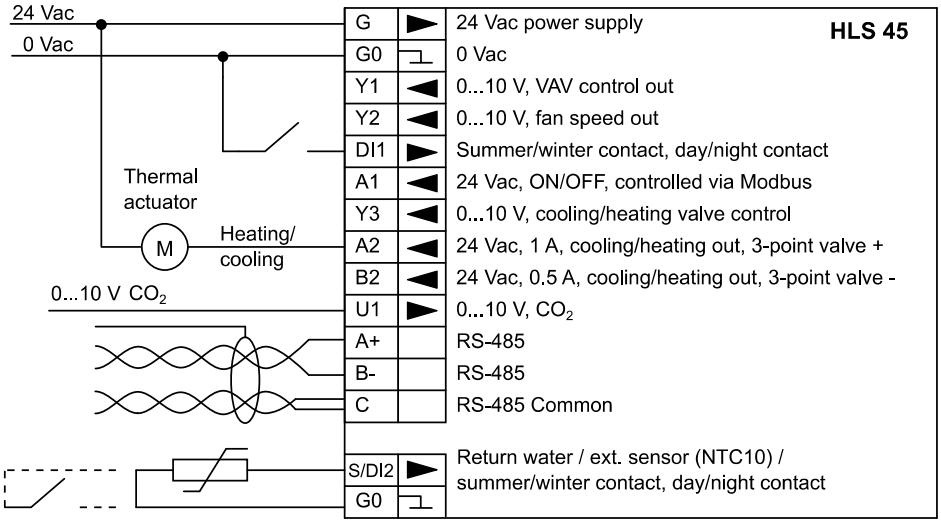
- direct sun light
- occupant proximity
- air flow coming from windows or doors
- air flow coming from ventilation nozzles
- air flow coming from the flush mounting box
- differential temperature caused by external wall

WIRING



Device connection and commissioning can only be carried out by qualified professionals. Always make the connections while the power is switched off.

NOTE: The supply voltage potential must be the same in the controller and in the connected 24 Vac actuators.



The maximum triac output current is 1 A. It is recommended to connect maximum of 4 thermal actuators to the same controller output. The total current consumption must not exceed 1 A.

The triac outputs are protected with fuses that can only be changed by the manufacturer.

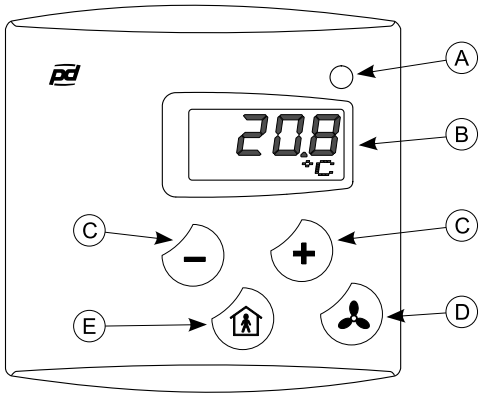
NOTE: Unused inputs and outputs can also be used for transferring other measuring and control information over the Modbus.

OPERATING AFTER A POWER FAILURE

- The controller settings remain over the power failure.
- Overdrives made over the Modbus are cleared during the power failure.

Information is subject to change without prior notice.

USER MODE



A. Indicator light
   - red = heating
   - green = cooling
   - flashing red = internal or external temperature sensor failure

B. Display
   - temperature or set point
   - fan speed

C. Set point change buttons

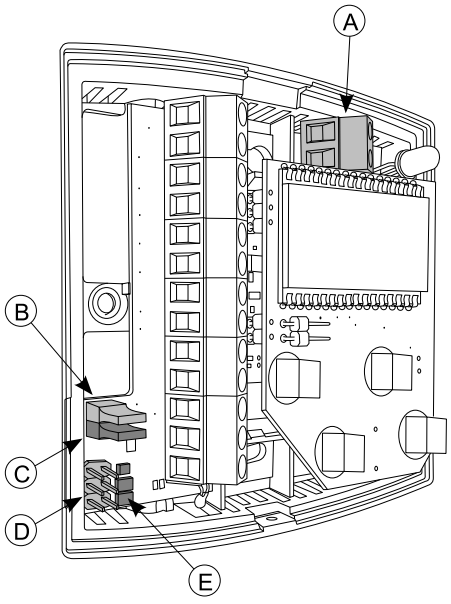
   The set point changes in larger steps when the buttons are quickly pressed several times in a row.

D. Fan speed control button
   - 0 = STOP
   - 1 = Speed 1
   - 2 = Speed 2
   - 3 = Speed 3
   - A = AUTO

E. “Man in house” button

COMMISSIONING

NOTE: All the settings and parameters must be checked during the commissioning. This way you can ensure the correct function in the selected application.



A. Terminals for external sensor or DI contact

B. Bus termination (120 Ω)
   - closed = terminated
   - open = no termination

C. Configuration mode selector
   - closed = configuration mode
   - open = user mode (factory setting)

D. Terminal for commissioning tool

E. Indicator lights
   - green PWR = supply voltage OK
   - yellow TX = transmission from controller
   - yellow RX = bus activity

Every controller must have a unique bus address (1...247). All controllers inside the same segment can be controlled by sending a common command to address zero (broadcast). The function can be used for testing during commissioning or common control of the day/night mode changes.

The controller settings can be supplied with controller buttons or by using the HLS 45-SER commissioning tool. The commissioning tool settings can be loaded to the controller or the controller settings can be loaded to the configuration tool and then to other controller.

Configuration through the menu:

1. Remove the cover.
2. Set configuration mode selector to closed position.
3. Make the settings required by the process.
4. Set the configuration mode selector to open position.
   The controller returns to the user mode.

   IMPORTANT: Set the configuration mode selector to open position after commissioning. The commissioning mode lowers the controller performance.

For configuration with the HLS 45-SER commissioning tool, see the commissioning tool instructions.

HLS 45-SER

HLS 45-SER commissioning tool contains fixed factory settings (PRSET 1) and memory slots for 9 user defined solutions (SET 1...9). All parameters of SET 1...9 can be changed for a best possible room control solution.

Configuring via Modbus

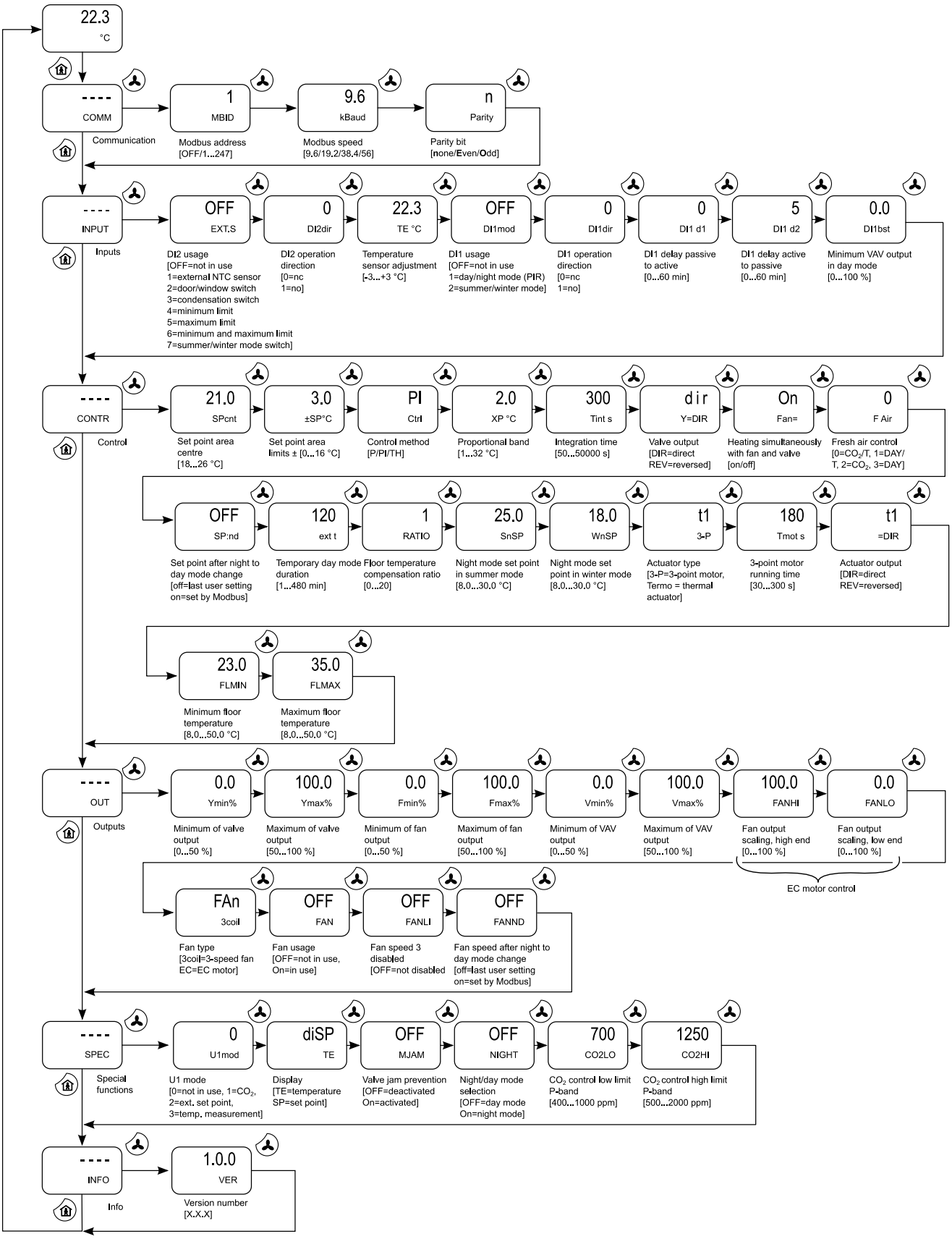
1. Write the settings to the device via Modbus.
2. Set Modbus register 22 value to 1.
   The configuration values are now stored to non-volatile memory.

NOTE: Controller stores the configuration values hourly to non-volatile memory. This ensures that the most recent device settings remain after power failure.

Information is subject to change without prior notice.

MENU

Menu is activated by setting the configuration mode selector to the closed position. You can proceed in the menu by touching the ⌂ or ⚙ buttons. The values can be changed with the ⊕ and ⊖ buttons. The value is accepted with the ⚙ button. The following menu structure contains the factory settings.

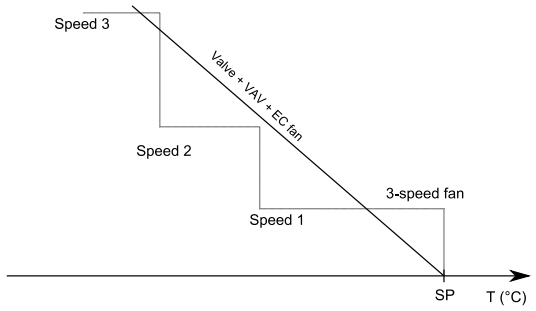


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CONTROL METHODS

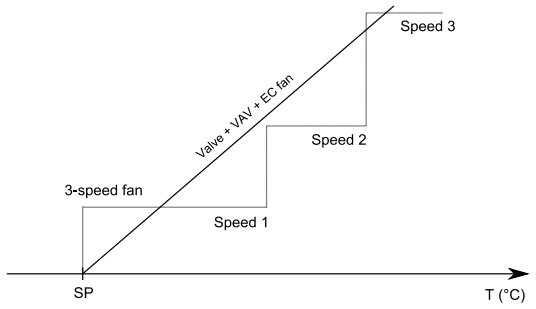
Winter mode (heating)

See page 13, Control to the summer and winter modes



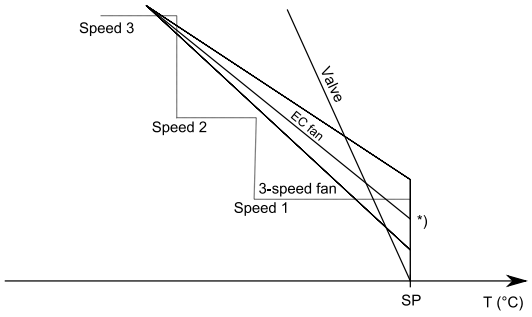
Summer mode (cooling)

See page 13, Control to the summer and winter modes



Control method: valve opens before the fan speed increases (winter mode in the figure)

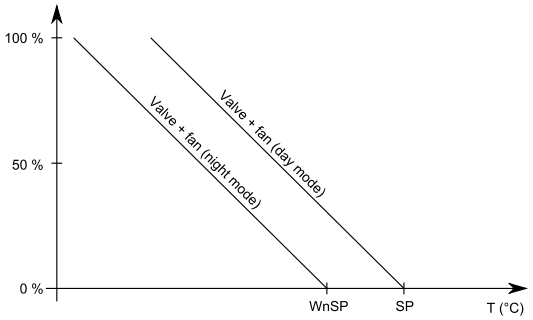
Parameter	Description	choose
Fan=	Fan stage simultaneously with the valve stage	OFF
FANLO	Fan output scaling, low end *)	e.g. 20 %



Night mode set point (winter mode in the figure)

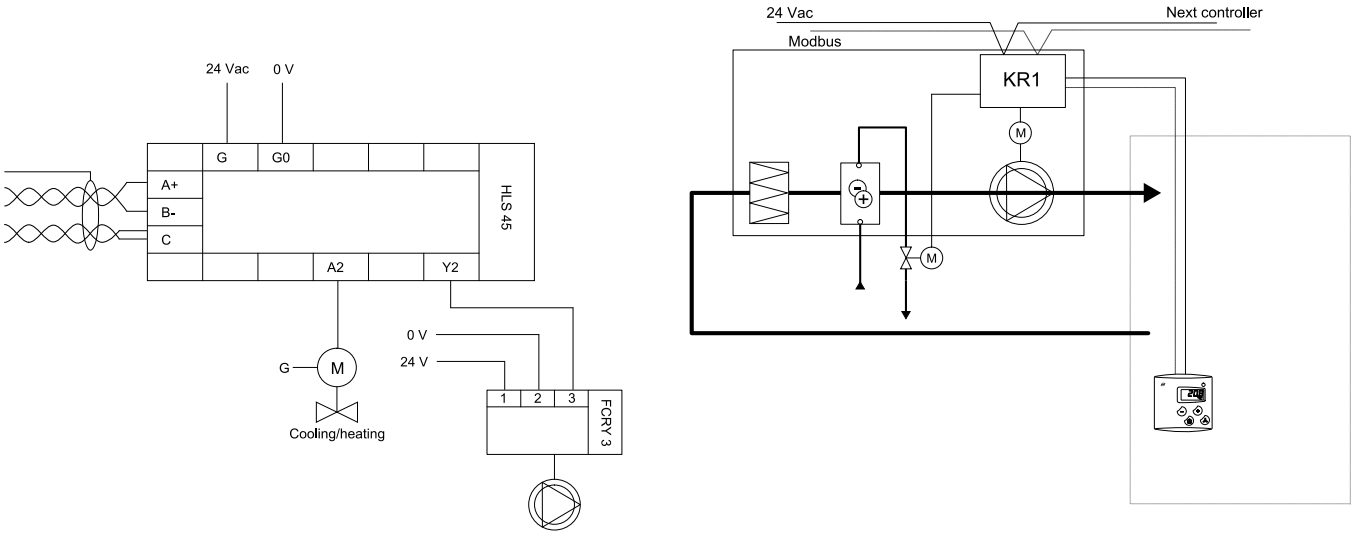
See page 13, Control to the day and night modes.

Parameter	Description	choose
SPcnt	Centre of user set point area	e.g. 23°C
WnSP	Night mode set point in winter mode	e.g. 18°C



APPLICATION EXAMPLE 1: HEATING AND COOLING WITH 2-PIPE FAN COIL UNIT

Principle diagram:



Input	DI1	U1	S/DI2

Output	Y1	Y2	A2	B2	Y3
Thermal actuator			x		
FCRY 3 relay or EC fan		x			

Note the following parameters:

Parameter	Modbus register	Description	factory setting	Min	Max	
MJAM	13	Valve jam prevention	OFF	ON	OFF	Valves can jam when they are kept on the same position for a long time. The valve jam prevention function can be activated in these kind of situations. When the MJAM parameter is in “ON” position, valves are opened and closed for 5 minutes once a day.
Fmax%	40024	Maximum fan output	100.0	50.0	100.0	To avoid noise coming from fan, the maximum fan speed output (EC fan) can be limited.
FANHI	40027	Fan output scaling, high end	100	0	100	The high end of the scaled EC fan control signal (0…10 V)
FANLO	40028	Fan output scaling, low end	0	0	100	The low end of the scaled EC fan control signal (0…10 V)
FAN	40029	Fan usage	0	0	1	0:not in use, 1:in use
FAn	14	Fan type	3coil	3coil	EC	3coil = 3-speed fan, EC = EC fan
FANLI	15	Fan speed 3 disabled	ON	OFF	ON	When FANLI=ON, the fan speed 3 in the automatic mode is disabled (e.g. due the noise). However, the user can manually engage the speed 3. When FANLI=OFF, the fan speed 3 is allowed in the automatic mode.

Fan control

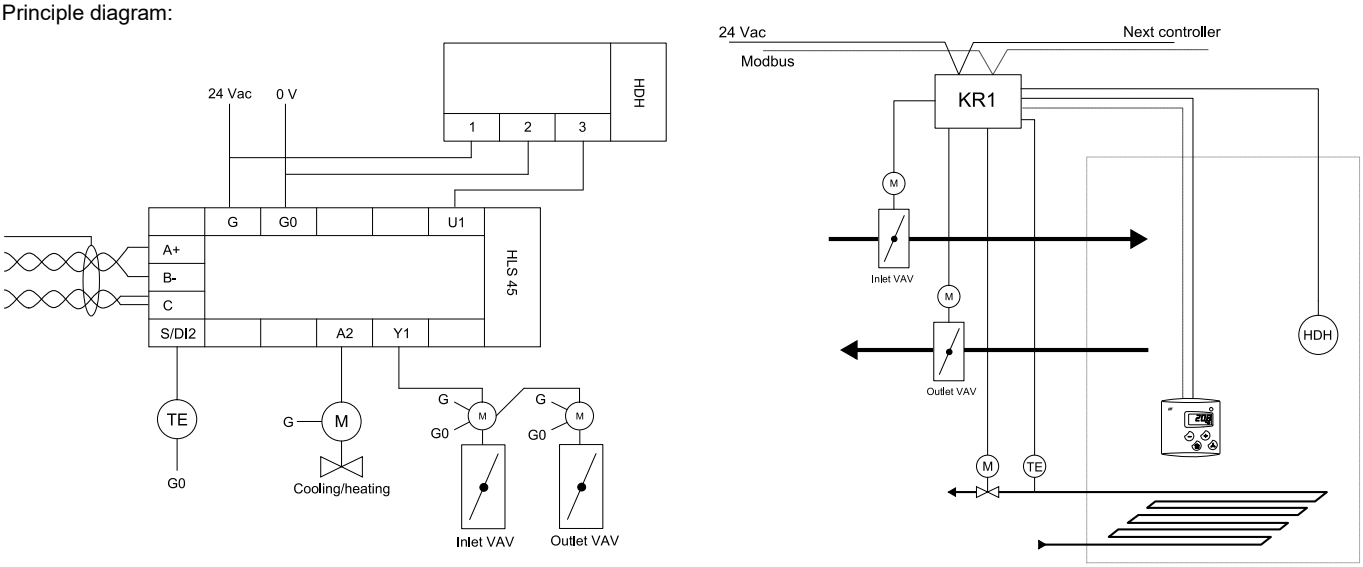
- The fan can be 3-speed or 0…10 V controlled (EC motor). In the manual mode, the EC motor works so that the switch position is 0 = 0 %, 1 = 33 %, 2 = 66 % and 3 = 100 % of the scaled control signal.
- With the FCRY 3 relay module connected to the Y2 output you can control the speed of fan coil or 3-speed fan. For example, when the FAN and Fan= parameters are ’ON’, the fan works like following:
    - Temperature reaches the set point, the valve closes and after 5 minutes the fan stops.
    - Temperature goes below the set point, the valve starts to open and the fan is controlled to the speed 1 (Y2 = 3 V)
    - The temperature still decreases, valve opens over 70 %. The fan is controlled to the speed 2 (Y2 = 6 V)
    - The temperature still decreases, valve opens over 90 %. The fan is controlled to the speed 3 (Y2 = 10 V)

Accordingly in cooling situation, the controller functions according to the cooling demand (temperature increases).

Information is subject to change without prior notice.

APPLICATION EXAMPLE 2: FLOOR HEATING AND COOLING, DEMAND BASED VENTILATION (CO_2)

Principle diagram:



Input	DI1	U1	S/DI2
HDH CO_2 transmitter		x	

Output	Y1	Y2	A2	B2	Y3
Thermal actuator			x		
VAV	x				

Note the following parameters:

Parameter	Modbus register	Description	factory setting	Min	Max	
EXT.S	40007	External temperature sensor / DI2 contact input	OFF	OFF	7	OFF=not in use, 1= external NTC sensor, 2=DI2 door/window contact (prevents both heating and cooling), 3=DI2 condensation switch (prevents cooling), 4=minimum limit, 5=maximum limit, 6=minimum and maximum limit, 7=summer/winter mode switch
U1mod	40020	U1 mode	0	0	3	0= not in use, 1=CO_2 measurement, 2= external set point, 3= temp. measurement with 0…10 V transmitter **NOTE:** External sensor (Ext. S) is not available, if the U1mod parameter value is ”3”.
Vmin%	40025	Minimum of VAV output	0.0	0.0	50.0	Minimum of VAV output The minimum level of fresh air level can be set to ensure the adequate ventilation, for example to remove moisture in situations where the ventilated space is not occupied.
CO2LO	40030	Low limit P-band for CO_2 control	700	400	1000	
CO2HI	40031	High limit P-band for CO_2 control	1250	500	2000	
F Air	40014	Fresh air control	0	0	3	0=CO_2 / T, 1=DAY/T, 2=CO_2 3=DAY
DI1bst	40019	Minimum VAV output in day mode	0 %	0 %	100 %	Minimum VAV output when the controller is in the day mode
FLMIN	40038	Return water minimum temperature	23,0 °C	8,0 °C	50,0 °C	
FLMAX	40039	Return water maximum temperature	35,0 °C	8,0 °C	50,0 °C	
RATIO	40033	Floor temperature compensation ratio	1	0	20	Room temperature set point correction factor when the floor temperature is higher than FLMAX or lower than FLMIN.

Improving the fresh air usage according to the carbon dioxide level

A CO_2 concentration (and temperature) controlled ventilation can be implemented by connecting a CO_2 transmitter to the U1 input. The control area can be defined by setting the low limit (CO2LO; factory setting 700 ppm) and high limit (CO2HI; factory setting 1250 ppm).

CO_2 concentration based fresh air usage improvement requires following:

- F Air parameter is ”0” or ”2”
- U1mod parameter is ”1” (CO_2 measurement)
- CO_2 transmitter is connected to the U1 input

NOTE: When the F Air parameter is ”0”, the Y1 output is defined as maximum selection according to the CO_2 concentration or temperature.

Improving fresh air usage according to the day mode

As an alternative, the fresh air supply can be improved according to the day mode. Day mode based fresh air usage improvement requires following:

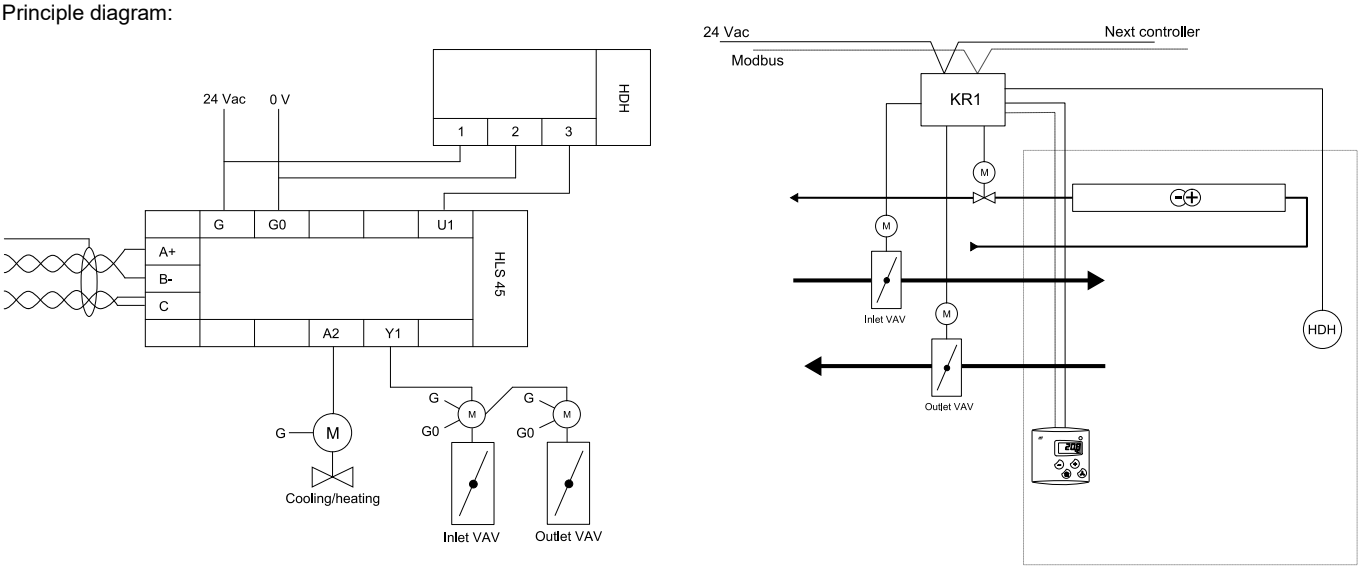
- F Air parameter is ”1” or ”3”
- Day mode control: PIR, card switch, Modbus or ”man in house” button
- The DI1bst parameter (minimum VAV output when the controller is in the day mode) has a non-zero value (for example 80 %)

NOTE: When the F Air parameter is ”1”, the Y1 output is defined as maximum selection according to the previously mentioned controls or temperature.

Information is subject to change without prior notice.

APPLICATION EXAMPLE 3: HEATING AND COOLING WITH BEAM, DEMAND BASED VENTILATION (CO_2)

Principle diagram:



Input	DI1	U1	S/DI2
HDH CO_2 transmitter		x	
(PIR occupancy)			(x)

Output	Y1	Y2	A2	B2	Y3
Thermal actuator			x		
VAV	x				

Note the following parameters:

Parameter	Modbus register	Description	factory setting	Min	Max	
MJAM	13	Valve jam prevention	OFF	ON	OFF	Valves can jam when they are kept on the same position for a long time. The valve jam prevention function can be activated in these kind of situations. When the MJAM parameter is in “ON” position, valves are opened and closed for 5 minutes once a day.
Vmin%	40025	Minimum of VAV output	0.0	0.0	50.0	Minimum of VAV output The minimum level of fresh air level can be set to ensure the adequate ventilation, for example to remove moisture in situations where the ventilated space is not occupied.

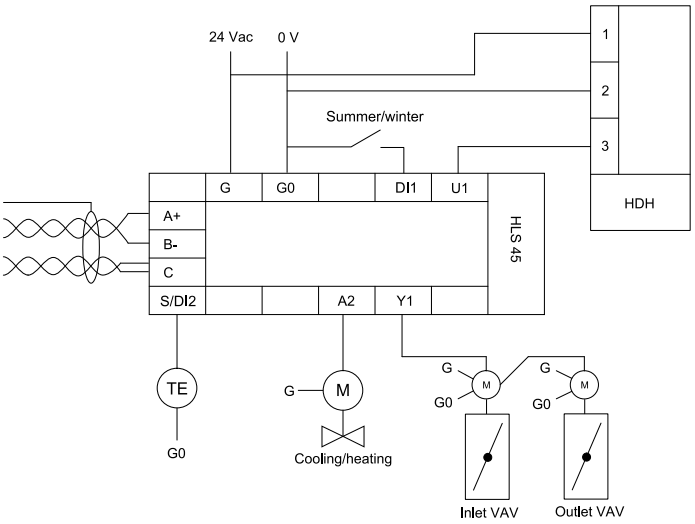
If you use CO_2 measurement or occupancy detectors, note the following parameters:

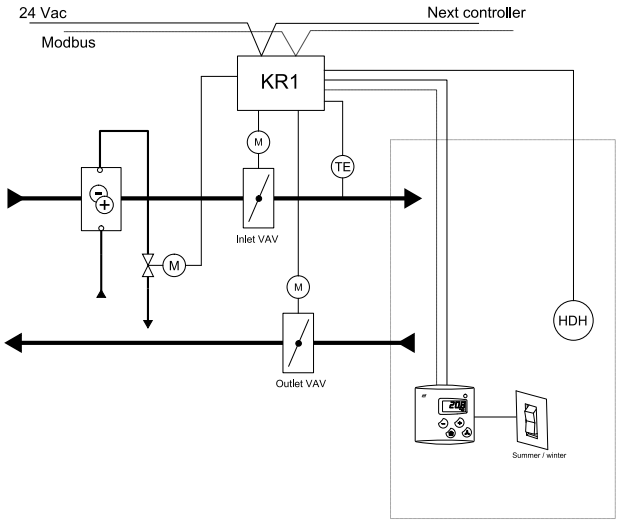
Parameter	Modbus register	Description	factory setting	Min	Max	
U1mod	40020	U1 mode	0	0	3	0= not in use, 1=CO_2 measurement, 2= external set point, 3= temp. measurement with 0…10 V transmitter **NOTE:** External sensor (Ext. S) is not available, if the U1mod parameter value is ”3”.
CO2LO	40030	Low limit P-band for CO_2 control	700	400	1000	Low limit P-band for CO_2 control
CO2HI	40031	High limit P-band for CO_2 control	1250	500	2000	High limit P-band for CO_2 control
F Air	40014	Fresh air control	0	0	3	0=CO_2 / T, 1=DAY/T, 2=CO_2 3=DAY
DI1bst	40019	Minimum VAV output in day mode	0 %	0 %	100 %	Minimum VAV output when the controller is in the day mode

Information is subject to change without prior notice.

APPLICATION EXAMPLE 4: SUPPLY AIR HEATING WITH MINIMUX/MAXIMUM LIMITATION, DEMAND BASED VENTILATION (CO_2)

Principle diagram:





Input	DI1	U1	S/DI2
HDH CO_2 transmitter		(x)	
Summer/winter switch	x		
Temperature measurement			x

Output	Y1	Y2	A2	B2	Y3
Thermal actuator			x		
EC fan		x			

Note the following parameters:

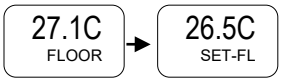
Parameter	Modbus register	Description	factory setting	Min	Max	
EXT.S	40007	External temperature sensor / DI2 contact input	OFF	OFF	7	OFF=not in use, 1= external NTC sensor, 2=DI2 door/window contact (prevents both heating and cooling), 3=DI2 condensation switch (prevents cooling), 4=minimum limit, 5=maximum limit, 6=minimum and maximum limit, 7=summer/winter mode switch
F Air	40014	Fresh air control	0	0	3	0=CO_2 / T, 1=DAY/T, 2=CO_2 3=DAY
DI1mod	40015	DI1 mode	0	0	1	0= not in use, 1=night/day mode switch, 2= summer/winter switch
DI1dir	18	DI1 operation direction (nc/no)	0	0	1	0 = nc, 1 = no
DI1 d1	40016	DI1 delay passive to active	0	0	60	The delay in minutes, when moving from night mode to day mode
DI1 d2	40017	DI1 delay active to passive	5	0	60	The delay in minutes, when moving from day mode to night mode
U1mod	40020	U1 mode	0	0	3	0= not in use, 1=CO_2 measurement, 2= external set point, 3= temp. measurement with 0…10 V transmitter **NOTE:** External sensor (Ext. S) is not available, if the U1mod parameter value is "3".
CO2LO	40030	Low limit P-band for CO_2 control	700	400	1000	
CO2HI	40031	High limit P-band for CO_2 control	1250	500	2000	
FLMIN	40038	Return water minimum temperature	23,0 °C	8,0 °C	50,0 °C	
FLMAX	40039	Return water maximum temperature	35,0 °C	8,0 °C	50,0 °C	

Information is subject to change without prior notice.

CHANGING FLOOR TEMPERATURE SET POINTS IN USER MODE

You can change the floor temperature set points in user mode, if the EXT.S parameter value is ”4”, ”5” or ”6”.

1. Push the button over five seconds.
   The floor temperature shows on the display for three seconds and after that the floor temperature appears on the display.



2. Adjust the set point with and buttons.

Note the following parameters:

Parameter	Modbus register	Description	factory setting	Min	Max	
EXT.S	40007	External temperature sensor / DI2 contact input	OFF	OFF	7	OFF=not in use, 1= external NTC sensor, 2=DI2 door/window contact (prevents both heating and cooling), 3=DI2 condensation switch (prevents cooling), 4=minimum limit, 5=maximum limit, 6=minimum and maximum limit, 7=summer/winter mode switch
FLMIN	40038	Return water minimum temperature	23,0 °C	8,0 °C	50,0 °C	
FLMAX	40039	Return water maximum temperature	35,0 °C	8,0 °C	50,0 °C	

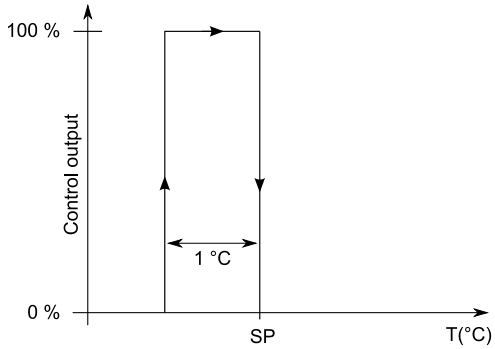
THERMOSTAT MODE

By choosing the thermostat mode, the actuators can be controlled by a thermostat type control. (Ctrl parameter is TH). The thermostat function hysteresis is 1 °C.

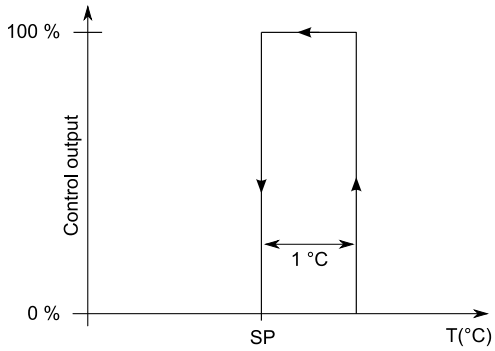
In the night mode the controller works according to the chosen function, either in thermostat mode or in the controller that is based to the night mode set point.

The thermostat mode affects to the outputs A2, B2 and Y3.

Actuator function in winter mode:



Actuator function in summer mode.



Input	DI1	U1	S/DI2

Output	Y1	Y2	A2	B2	Y3
Thermal actuator			x	x	x

Note the following parameters:

Parameter	Modbus register	Description	factory setting	Min	Max	
SPcnt	40009	Centre of user set point area	21.0	18.0	26.0	Centre of user set point area
±SP °C	40010	Use set point area limits	±3.0	±0	±16	The user can adjust the set point within these limits.
Ctrl	40011	Control method	PI	P	TH	P = P control, PI = PI control, TH = Thermostat mode

Information is subject to change without prior notice.

ELECTRIC HEATER CONTROL

The controller can control an electric heater by using a solid state relay PR 50/440 between the A2 output and the heater. The relay must be equipped with a PRMK auxiliary card.

IMPORTANT: The controller is not equipped with a heater overheating protector. The overheating protection must be included in the heater itself. The overheating alarm signal can be read by DI input, but the signal does not deactivate the heater control.

The overheating alarm signal can be connected to the DI1 or DI2 input, and the signal can then be read via the Modbus. DI input must be set to ”not in use” position (DI1mod = 0 or EXT.S = OFF).

Input	DI1	U1	S/DI2
Overheating alarm	(x)		(x)

Output	Y1	Y2	A2	B2	Y3
Thermal actuator				x	
24 Vac controlled solid state relay			x		

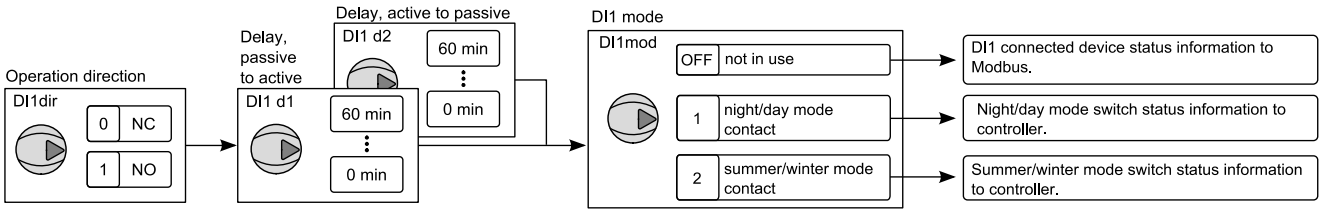
Note the following parameters:

Parameter	Modbus register	Description	factory setting	Min	Max	
EXT.S	40007	External temperature sensor / DI2 contact input	OFF	OFF	7	OFF=not in use, 1= external NTC sensor, 2=DI2 door/window contact (prevents both heating and cooling), 3=DI2 condensation switch (prevents cooling), 4=minimum limit, 5=maximum limit, 6=minimum and maximum limit, 7=summer/winter mode switch
DI2dir	19	DI2 operation direction (nc/no)	1	0	1	0 = nc, 1 = no
DI1mod	40015	DI1 mode	0	0	1	0= not in use, 1=night/day mode switch, 2= summer/winter switch
DI1dir	18	DI1 operation direction (nc/no)	0	0	1	0 = nc, 1 = no

USAGE AND FUNCTIONS OF THE DI1 DIGITAL INPUT

DI1 input can be used to control the controller to the day/night mode by using a home/away switch, card reader or motion detector. The DI1 input can also be used to control the controller to the summer/winter mode by using a contact.

The DI1 input can be used to read other device statuses via the Modbus if the input is not needed for the room control.



Parameter	Modbus register	Description	factory setting	Min	Max	
DI1mod	40015	DI1 mode	0	0	1	0= not in use, 1=night/day mode switch, 2= summer/winter switch
DI1dir	18	DI1 operation direction (nc/no)	0	0	1	0 = nc, 1 = no
DI1 d1	40016	DI1 delay passive to active	0	0	60	The delay in minutes, when moving from night mode to day mode
DI1 d2	40017	DI1 delay active to passive	5	0	60	The delay in minutes, when moving from day mode to night mode

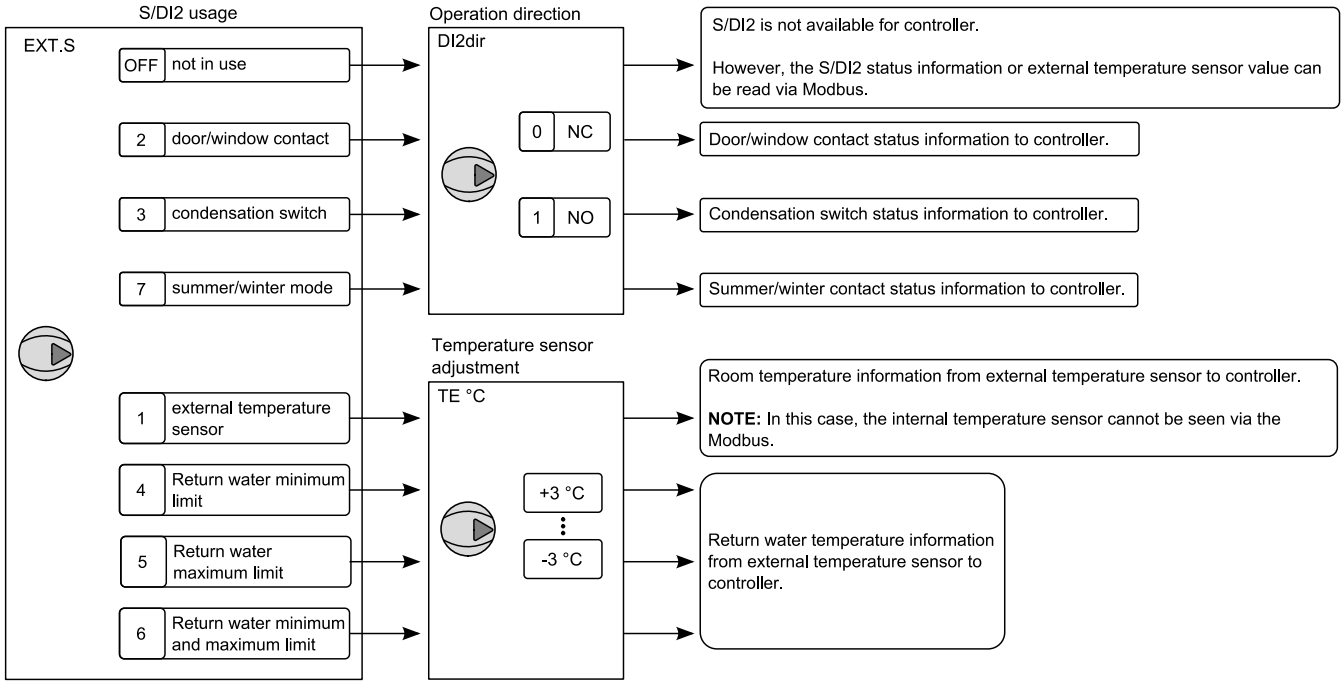
USAGE AND FUNCTIONS OF THE DI2 DIGITAL INPUT

S/DI2 input can be used to control the controller by using a door/window contact, dew point guard with relay output or return water temperature. The input can also be used for measuring room temperature or return water temperature.

In the door/window contact case the controller prevents cooling and heating when the door or window is open. This way the energy loss and cooling beam condensation problems can be avoided.

In the condensation switch case, the cooling is prevented when the contact activates.

The S/DI2 input can be used to read other device statuses via the Modbus if the input is not needed for the room control.



Note the following parameters:

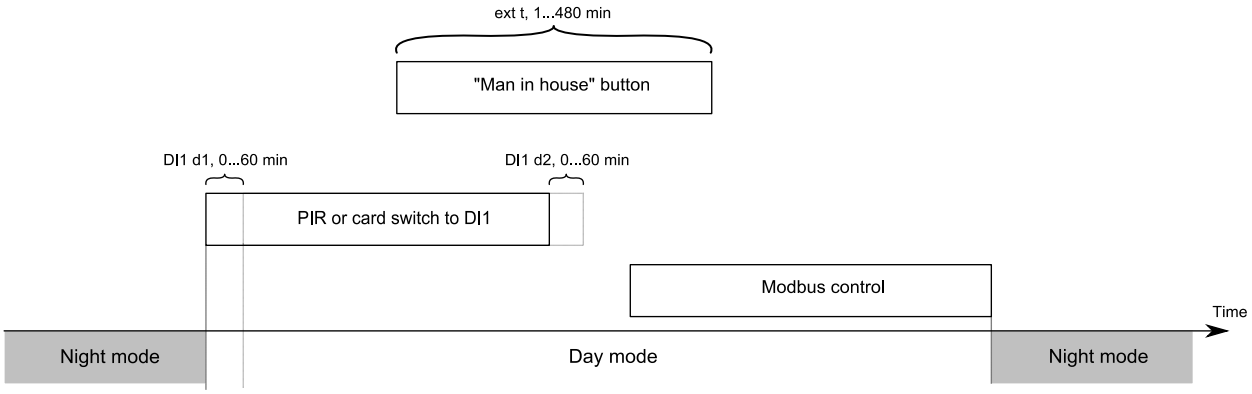
Parameter	Modbus register	Description	factory setting	Min	Max	
EXT.S	40007	External temperature sensor / DI2 contact input	OFF	OFF	7	OFF=not in use, 1= external NTC sensor, 2=DI2 door/window contact (prevents both heating and cooling), 3=DI2 condensation switch (prevents cooling), 4=minimum limit, 5=maximum limit, 6=minimum and maximum limit, 7=summer/winter mode switch
DI2dir	19	DI2 operation direction (nc/no)	1	0	1	0 = nc, 1 = no
TE ºC	40008	Temperature sensor adjustment	0.0	-3.0	+3.0	The temperature measurement can be adjusted if needed **NOTE:** Eliminate all error factors that can affect to the temperature measurement before changing this parameter. The parameter cannot be reset to the factory value.

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CONTROL TO THE DAY AND NIGHT MODES

- NIGHT parameter is ”OFF”: The controller is in fixed day mode.
- NIGHT parameter is ”On”: The controller moves to day mode when the first control requests the day mode. The controller moves to the night mode when the last control requests the night mode.

  Example:



When the controller moves to the day mode, following happens:

1. The fresh air usage is improved (DI1bst parameter defines the improvement amount, 0…100 %).
   Fresh air usage improvement can be prevented by setting the DI1bst parameter value to 0 %.
2. The temperature set point defined by the SP:nd parameter becomes effective.

Note the following parameters:

Parameter	Modbus register	Description	factory setting	Min	Max	
EXT.S	40007	External temperature sensor / DI2 contact input	OFF	OFF	7	OFF=not in use, 1= external NTC sensor, 2=DI2 door/window contact (prevents both heating and cooling), 3=DI2 condensation switch (prevents cooling), 4=minimum limit, 5=maximum limit, 6=minimum and maximum limit, 7=summer/winter mode switch
DI2dir	19	DI2 operation direction (nc/no)	1	0	1	0 = nc, 1 = no
DI1mod	40015	DI1 mode	0	0	1	0= not in use, 1=night/day mode switch, 2= summer/winter switch
DI1dir	18	DI1 operation direction (nc/no)	0	0	1	0 = nc, 1 = no
DI1 d1	40016	DI1 delay passive to active	0	0	60	The delay in minutes, when moving from night mode to day mode
DI1 d2	40017	DI1 delay active to passive	5	0	60	The delay in minutes, when moving from day mode to night mode
ext t	40018	Duration of temporary day mode, minutes	120	1	480	
DI1bst	40019	Minimum VAV output in day mode	0 %	0 %	100 %	Minimum VAV output when the controller is in the day mode
SP:nd	12	The effective set point after night mode to day mode change	OFF	OFF	On	OFF = The last value set by the user On = The value from Modbus
NIGHT	9	Night/day mode selection	OFF	OFF	On	OFF = the controller is in fixed day mode, On = the controller is in the night mode if not separately controlled to the day mode.

CONTROL TO THE SUMMER AND WINTER MODES

The device is in winter mode unless one of the controls requests the summer mode.

The controller can be controlled to the summer and winter modes by following ways:

- By changing the register 21 value through the Modbus (0 = winter mode, 1 = summer mode).
- By changing the position of the switch that is connected to the DI1 or S/DI2 input.

Note the following parameters:

Parameter	Modbus register	Description	factory setting	Min	Max	
EXT.S	40007	External temperature sensor / DI2 contact input	OFF	OFF	7	OFF=not in use, 1= external NTC sensor, 2=DI2 door/window contact (prevents both heating and cooling), 3=DI2 condensation switch (prevents cooling), 4=minimum limit, 5=maximum limit, 6=minimum and maximum limit, 7=summer/winter mode switch
DI2dir	19	DI2 operation direction (nc/no)	1	0	1	0 = nc, 1 = no
DI1mod	40015	DI1 mode	0	0	1	0= not in use, 1=night/day mode switch, 2= summer/winter switch
DI1dir	18	DI1 operation direction (nc/no)	0	0	1	0 = nc, 1 = no
	21	Summer mode	0	0	1	0 = winter mode (the device is in winter mode unless the DI1 or DI2 requests the summer mode.) 1 = summer mode

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TEMPERATURE SET POINT

The temperature set point can be one of the following:

1. Set with the controller buttons (parameters SPcnt and ±SP °C).
2. Set by external 0...10 V signal (U1mod parameter must be ”2”).
   The external set point 0...10 V signal range is the same as the set point area defined in the menu (parameters SPcnt and ±SP °C).
3. Set via the Modbus.
4. Night mode set point (parameters SnSP and WnSP), if the night set point function is selected for the night mode (nI OP parameter is ”SP”).

The change from night mode to day mode affects also to the temperature set point. With the Sp:nd parameter you can select the set point to be used after the change. The set point can be the latest user given value or to be read via Modbus. The user given value can be the 0...10 V signal connected to the U1 input or the value set by the controller buttons.

The controller uses the latest value as the set point (set by user or set via the Modbus). The effective set point can be displayed by pushing the - or + button. The set point shows continuously on the display, if the dISP parameter value is SP.

Parameter	Modbus register	Description	factory setting	Min	Max	
SPcnt	40009	Centre of user set point area	21.0	18.0	26.0	Centre of user set point area
±SP °C	40010	Use set point area limits	3.0	0	16	The user can adjust the set point within these limits (+/-°C)
SnSP	40034	Night mode set point in summer mode	25.0	8.0	30.0	
WnSP	40035	Night mode set point in winter mode	18.0	8.0	30.0	
SP:nd	12	The effective set point after night mode to day mode change	OFF	OFF	On	OFF = The last value set by the user On = The value from Modbus
U1mod	40020	U1 mode	0	0	3	0= not in use, 1=CO_2 measurement, 2= external set point, 3= temp. measurement with 0…10 V transmitter **NOTE:** External sensor (Ext. S) is not available, if the U1mod parameter value is ”3”.
dISP	17	Value shown on the display	TE	TE	SP	TE = temperature, SP= set point
	40002	Set point by Modbus	21.0	8.0	50.0	**NOTE:** When changing the Modbus set point, the changed set point becomes effective also when the night mode is active.

When the set point area centre (parameter SPcnt) is changed via the Modbus, the user set point deviation is kept unchanged.

Example:

1. SPcnt parameter value is 21 °C and the user has changed the set point to 23 °C (deviation is +2 °C).
2. SPcnt parameter value is changed to 22 °C via the Modbus (register 40009).

→ The controller takes 24 °C as the effective set point (22 °C + 2 °C = 24 °C).

Usage examples

The set point is wanted to return to a constant value (e.g. 21 °C), when the controller moves from night mode to day mode (hotels for example).

Set the parameters according to the following table.

Parameter	Modbus register	Description	Value
SP:nd	12	The effective set point after night mode to day mode change	On
	40002	Set point by Modbus	210

The set point is wanted to return to user set point value, when the controller moves from night mode to day mode (offices for example).

Set the parameters according to the following table.

Parameter	Modbus register	Description	Value
SP:nd	12	The effective set point after night mode to day mode change	Off

The set point is wanted to stay at the value given via Modbus (e.g. 21 °C).

Set the parameters according to the following table.

Parameter	Modbus register	Description	Value
SPcnt	40009	Centre of user set point area	21.0
±SP °C	40010	Use set point area limits	0

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FAN SPEED

The fan speed (output Y2) can be controlled by following ways (the most recently changed value is effective):

1. The value set by user with the controller button (0 - 1 - 2 - 3 - A, A = automatic).
2. Set via the Modbus.

The parameter FANND defines which of the above values is set effective after night mode to day mode change.

Note the following parameters:

Parameter	Modbus register	Description	factory setting	Min	Max	
FANLI	15	Fan speed 3 disabled	ON	OFF	ON	When FANLI=ON, the fan speed 3 in the automatic mode is disabled (e.g. due the noise). However, the user can manually engage the speed 3. When FANLI=OFF, the fan speed 3 is allowed in the automatic mode.
FANND	16	The effective fan speed after night mode to day mode change	OFF	OFF	On	OFF = The last value set by the user On = The value from Modbus
	40001	Fan speed set by Modbus	0	0	4	0=off, 1=speed 1, 2=speed 2, 3=speed 3, 4=automatic

The fan speed can also be controlled by using output over drives via the Modbus, see page 16, Output overdrives

SENSOR SELECTION

The temperature information can be imported to the controller by using following methods:

1. Controller internal temperature measurement (EXT.S parameter is ”0”, ”2”, ”3”, ”4”, ”5”, ”6” or ”7”)
2. External temperature measurement with NTC10 sensor (EXT.S parameter is ”1”)
3. External 0...10 V temperature measurement (U1mod parameter is ”3”)

NOTE: If the EXT.S parameter value is 1 and the external sensors is faulty, controller uses internal temperature sensor measurement for controlling. Also, the indicator light flashes in red and the Modbus alarm register (10007) is set to 1.

NOTE: If the EXT.S parameter value is 4, 5 or 6 and the floor temperature sensor is faulty, controller uses internal temperature sensor measurement for controlling. Also, the indicator light flashes in red and the Modbus alarm register (10007) is set to 1.

NOTE: The external 0…10 V temperature transmitter range must be 0…+50 °C.

The set point can be read from one controller and then fed to other controllers in cases where multiple controllers are located in the same space.

Note the following parameters:

Parameter	Modbus register	Description	factory setting	Min	Max	
EXT.S	40007	External temperature sensor / DI2 contact input	OFF	OFF	7	OFF=not in use, 1= external NTC sensor, 2=DI2 door/window contact (prevents both heating and cooling), 3=DI2 condensation switch (prevents cooling), 4=minimum limit, 5=maximum limit, 6=minimum and maximum limit, 7=summer/winter mode switch
TE ºC	40008	Temperature sensor adjustment	0.0	-3.0	3.0	The temperature measurement can be adjusted if needed **NOTE:** Eliminate all error factors that can affect to the temperature measurement before changing this parameter. The parameter cannot be reset to the factory value.
U1mod	40020	U1 mode	0	0	3	0= not in use, 1=CO_2 measurement, 2= external set point, 3= temp. measurement with 0…10 V transmitter **NOTE:** External sensor (Ext. S) is not available, if the U1mod parameter value is ”3”.

OUTPUT LIMITATIONS

It is possible to limit minimum and maximum values of each output separately. The controller does not drive the output outside the given limits. For example, setting the heating output minimum limit is one way to prevent discomfort of chilled air that flows down the window. The limits can be over driven only by controlling the outputs directly via the Modbus (Modbus overdrive).

Input	DI1	U1	S/DI2

Output	Y1	Y2	A2	B2	Y3
	x	x	x	x	x

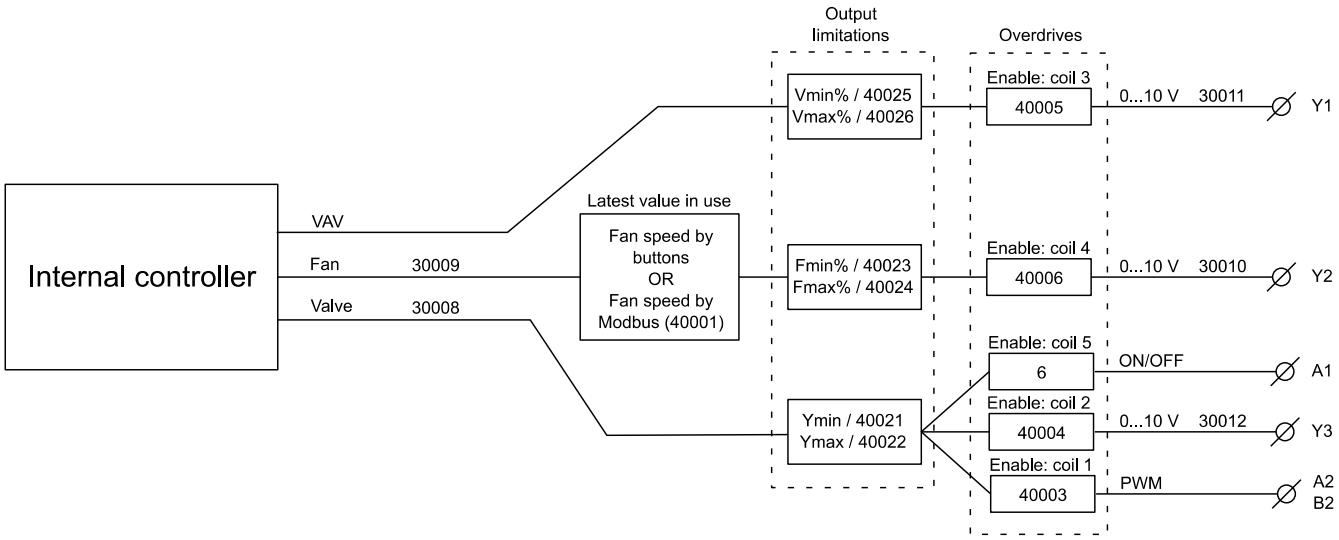
Note the following parameters:

Parameters	Modbus register	Description	factory setting	Min	Max	
Ymin%	40021	Minimum valve output	0.0	0.0	50.0	
Ymax%	40022	Maximum valve output	100.0	50.0	100.0	
Fmin%	40023	Minimum fan output	0.0	0.0	50.0	
Fmax%	40024	Maximum fan output	100.0	50.0	100.0	
Vmin%	40025	Minimum of VAV output	0.0	0.0	50.0	
Vmax%	40026	Maximum of VAV output	100.0	50.0	100.0	

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OUTPUT OVERDRIVES

All outputs can be over driven separately by the Modbus.



Coils

Register	Parameter description	Data Type	Value	Range	Default
1	Valve PWM/3P overdrive enable (A2, B2)	Bit	Off=0, On=1	Off - On	0
2	Valve 0…10 V overdrive enable (Y3)	Bit	Off=0, On=1	Off - On	0
3	VAV overdrive enable (Y1)	Bit	Off=0, On=1	Off - On	0
4	FAN overdrive enable (Y2)	Bit	Off=0, On=1	Off - On	0
5	A1 overdrive enable **NOTE:** Set the value to 1 to enable A1 output control.	Bit	Off=0, On=1	Off - On	0
6	A1 24 Vac ON/OFF control **NOTE:** A1 output state changes only if A1 overdrive is enabled (coil 5 value is 1).	Bit	Off=0, On=1	Off - On	0

Input registers

Register	Parameter description	Data Type	Value	Range	Default
3000**8**	Current valve control (controller)	Signed 16	0…1000	0 …10.00 V	
3000**9**	Current fan Speed (controller)	Signed 16	0…4	0 - 1 - 2 - 3 - 4	
3001**0**	Fan speed (connector Y2)	Signed 16	0…1000	0 …10.00 V	
3001**1**	VAV control (connector Y1)	Signed 16	0…1000	0 …10.00 V	
3001**2**	Cooling control (connector Y3)	Signed 16	0…1000	0 …10.00 V	

Holding registers

Register	Parameter description	Data Type	Value	Range	Default
4000**1**	Fan speed by Modbus	Signed 16	0…4	0 - 1 - 2 - 3 - 4	0
4000**3**	Overdrive valve PWM by Modbus (A2, B2)	Signed 16	0…1000	0,00…100,0 %	0
4000**4**	Overdrive valve 0...10 V by Modbus (Y3)	Signed 16	0…1000	0…10.00 V	0
4000**5**	Overdrive VAV by Modbus (Y1)	Signed 16	0…1000	0 …10.00 V	0
4000**6**	Overdrive FAN by Modbus (Y2)	Signed 16	0…1000	0…10.00 V	0
4002**1**	Minimum of valve actuator	Signed 16	0…500	0,0…50,0 %	0
4002**2**	Maximum of valve actuator	Signed 16	500…1000	50,0…100,0 %	1000
4002**3**	Minimum of fan output	Signed 16	0…500	0,0…50,0 %	0
4002**4**	Maximum of fan output	Signed 16	500…1000	50,0…100,0 %	1000
4002**5**	Minimum of VAV output	Signed 16	0…500	0,0…50,0 %	0
4002**6**	Maximum of VAV output	Signed 16	500…1000	50,0…100,0 %	1000

SERVICE ALARM

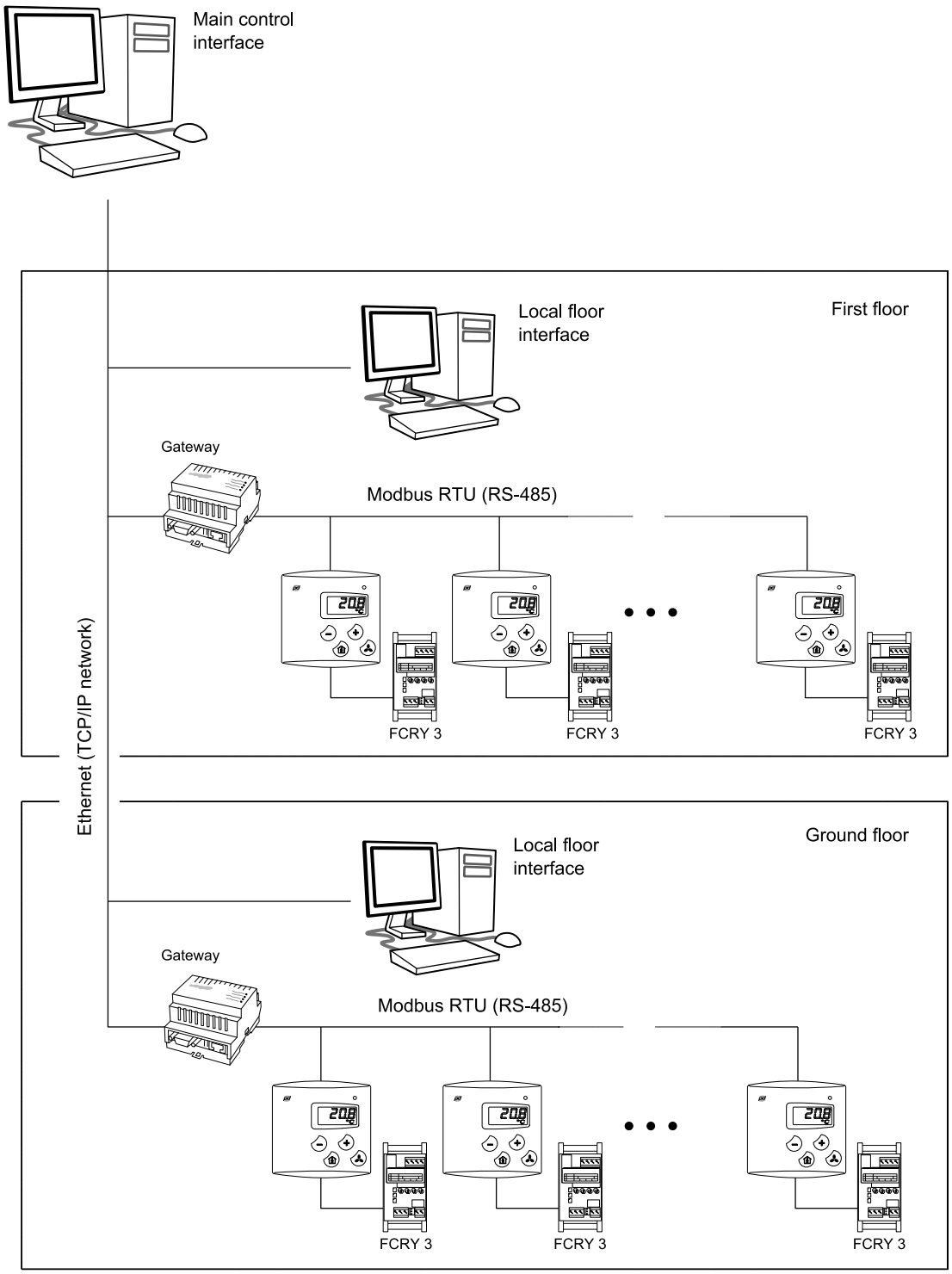
If the controller does not reach the set point in 120 hours, the Modbus register SERVICE ALARM bit changes to ”ON” position. The alarm is for information purposes only and does not affect to the controller functions. The alarm can be reset via the Modbus.

Register	Parameter description	Data Type	Value	Range	Default
7	SERVICE ALARM RESET	Bit	Off=0, On=1	Off - On	0

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NETWORK DESCRIPTION

Up to 247 controllers can be connected to a single network segment. The following diagram illustrates a typical installation where the room controllers are connected on the floor level to a gateway server.



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MODBUS REGISTERS AND FUNCTION CODES

The device supports the following Modbus registers and function codes. The parameter memory durability allows at least 1 million writing cycles.

The controls marked with * are stored in the volatile memory. These controls are returned to factory defaults after a power failure.

Supported MODBUS functions:

0x01	Read Coils
0x02	Read Discrete Inputs
0x03	Read Holding Registers
0x04	Read Input Registers
0x05	Write Single Coil
0x06	Write Single Register
0x0F	Write Multiple Coils
0x10	Write Multiple Registers
0x17	Read/Write Multiple Registers

NOTE: If you try to write a parameter value that is beyond the parameter value range, the value will be replaced by the nearest acceptable value. For example, if you write 270 to the register 40009, the value will be replaced by 260.

Coils

Register	Parameter description	Data Type	Value	Range	Default
1	*Valve PWM/3P overdrive enable (A2, B2)	Bit	0 - 1	0 = Off, 1 = On	0
2	*Valve 0…10 V overdrive enable (Y3)	Bit	0 - 1	0 = Off, 1 = On	0
3	*VAV overdrive enable (Y1)	Bit	0 - 1	0 = Off, 1 = On	0
4	*FAN overdrive enable (Y2)	Bit	0 - 1	0 = Off, 1 = On	0
5	*A1 overdrive enable **NOTE:** Set the value to 1 to enable A1 output control.	Bit	0 - 1	0 = Off, 1 = On	0
6	*A1 24 Vac ON/OFF control **NOTE:** A1 output state changes only if A1 overdrive is enabled (coil 5 value is 1).	Bit	0 - 1	0 = Off, 1 = On	0
7	*Service alarm reset	Bit	0 - 1	0 = Off, 1 = On	0
8	*Cooling/heating disabled	Bit	0 - 1	0 = Off, 1 = On	0
9	Night mode	Bit	0 - 1	0 = Off, 1 = On	0
10	Valve output mode	Bit	0 - 1	0 = Direct 1 = reversed	0
11	Fan stage simultaneously with valve stage	Bit	0 - 1	0 = Off, 1 = On	1
12	Effective set point after night mode to day mode change	Bit	0 - 1	0 = user 1 = Modbus	0
13	Valve jam prevention	Bit	0 - 1	0 = Off, 1 = On	0
14	Fan type	Bit	0 - 1	0 = 3-speed fan 1 = EC fan	0
15	Fan speed 3 disabled	Bit	0 - 1	0 = Off, 1 = On	0
16	Effective fan speed after night mode to day mode change	Bit	0 - 1	0 = User 1 = Modbus	0
17	Display	Bit	0 - 1	0 = Temperature 1 = Setpoint	0
18	DI1 operation direction	Bit	0 - 1	0 = NC 1 = NO	0
19	DI2 operation direction	Bit	0 - 1	0 = NC 1 = NO	0
20	Valve operation direction	Bit	0 - 1	0 = NC 1 = NO	0
21	Summer mode	Bit	0 - 1	0 = winter mode 1 = summer mode	0

Register	Parameter description	Data Type	Value	Range	Default
22	Save current configuration to non-volatile memory. The register value changes to 0 automatically after saving.	Bit	0 - 1	0 = Off, 1 = On	0

Discrete inputs

Register	Parameter description	Data Type	Value	Range
1000**1**	Occupied by PIR	Bit	0 - 1	0 = Off, 1 = On
1000**2**	Occupied by “man in a house”	Bit	0 - 1	0 = Off, 1 = On
1000**3**	DAY EXTENSION	Bit	0 - 1	0 = Off, 1 = On
1000**4**	DI1 input state	Bit	0 - 1	0 = Off, 1 = On
1000**5**	DI2 input state	Bit	0 - 1	0 = Off, 1 = On
1000**6**	CO_2 overdrives	Bit	0 - 1	0 = Off, 1 = On
1000**7**	Internal or external temperature sensor failure. Value 1 = failure.	Bit	0 - 1	0 = Off, 1 = On

Input registers

Register	Parameter description	Data Type	Value	Range	Default
3000**1**	DISCRETE INPUTS (16 - 1)	Unsigned 16	16 bits	16 bits	
3000**2**	COILS (16 - 1)	Unsigned 16	16 bits	16 bits	
3000**3**	COILS (32 - 17)	Unsigned 16	16 bits	16 bits	
3000**4**	Temperature	Signed 16	-600…600	-60.0…60.0 °C	
3000**5**	External Temperature	Signed 16	-600…600	-60.0…60.0 °C	
3000**6**	CO_2	Signed 16	0…2000	0…2000 ppm	
3000**7**	Effective set point	Signed 16	50…500	5.0…50.0 °C	
3000**8**	Current valve control (controller)	Signed 16	0…1000	0 …10.00 V	
3000**9**	Current FAN Speed (controller)	Signed 16	0 - 1 - 2 - 3 - 4	0 = OFF 1 = speed 1 2 = speed 2 3 = speed 3 4 = automatic	
3001**0**	FAN speed (connector Y2)	Signed 16	0…1000	0 …10.00 V	
3001**1**	VAV control (connector Y1)	Signed 16	0…1000	0 …10.00 V	
3001**2**	Valve control (connector Y3)	Signed 16	0…1000	0 …10.00 V	
3001**3**	U1 input value	Signed 16	0…1000	0 …10.00 V	
3001**4**	EXT NTC Value (connector)	Signed 16	-600…600	-60.0…60.0 °C	
3001**5**	VAV/Boosting control	Signed 16	0 - 1- 2	0 = CO_2 1 = Temperature 2 = PIR	
3001**6**	Set point by user	Signed 16	±SP ºC	±SP ºC	
3001**7**	Fan control by user	Signed 16	0 - 1 - 2 - 3 - 4	0 = OFF 1 = speed 1 2 = speed 2 3 = speed 3 4 = automatic	
3001**8**	User set point deviation	Signed 16	±SP	±SP	

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Holding registers

Register	Parameter description	Data Type	Value	Range	Default
4000**1**	FAN speed by Modbus	Signed 16	0 - 1 - 2 - 3 - 4	0 = OFF 1 = speed 1 2 = speed 2 3 = speed 3 4 = automatic	0
4000**2**	Set point by Modbus	Signed 16	80…500	8,0…50,0 °C	210
4000**3**	*Overdrive valve PWM by Modbus (A2, B2)	Signed 16	0…1000	0,00…100,0 %	0
4000**4**	*Overdrive valve 0...10 V by Modbus (Y3)	Signed 16	0…1000	0…10.00 V	0
4000**5**	*Overdrive VAV by Modbus (Y1)	Signed 16	0…1000	0…10.00 V	0
4000**6**	*Overdrive FAN by Modbus (Y2)	Signed 16	0…1000	0…10.00 V	0
4000**7**	External temperature sensor / DI2 input	Signed 16	0 - 1 - 2 - 3 - 4 - 5 - 6 - 7	0 = not in use 1 = ext. temp. sensor 2 = door/window 3 = condensation switch 4 = floor min. limit 5 = floor max limit 6 = min. and max. limits 7 = summer/winter switch	0
4000**8**	Temperature sensor adjustment	Signed 16	-30…30	-3,0…3,0 °C	0
4000**9**	Centre of user set point area	Signed 16	180…260	18,0…26,0 °C	210
400**10**	User set point area limits	Signed 16	0… 160	0,0…16,0 °C	30
400**11**	Control mode	Signed 16	0…2	P - PI - Th	1
400**12**	Proportional band	Signed 16	10…320	1,0…32,0 °C	20
400**13**	Integral time	Signed 16	50…5000	50…5000 s	300
400**14**	Fresh air control	Signed 16	0 - 1 - 2 - 3	0 = CO_2 / T 1 = day mode / T 2 = CO_2 3 = day mode	0
400**15**	DI1 mode	Signed 16	0 - 1 - 2	0 = not in use 1 = day/night mode switch 2 = summer/winter switch	0
400**16**	DI1 delay passive to active	Signed 16	0…60	0…60 min	0
400**17**	DI1 delay active to passive	Signed 16	0…60	0…60 min	5
400**18**	Duration of temporary day mode	Signed 16	1…480	1…480 min	120
400**19**	Minimum VAV output in day mode	Signed 16	0…1000	0,0…100,0 %	0
400**20**	U1 mode	Signed 16	0 - 1 - 2 - 3	0 = not used 1 = CO_2 2 = Temp set point 3 = Temp measurement	0
400**21**	Minimum of valve actuator	Signed 16	0…500	0,0…50,0 %	0
400**22**	Maximum of valve actuator	Signed 16	500…1000	50,0…100,0 %	1000
400**23**	Minimum of fan output	Signed 16	0…500	0,0…50,0 %	0
400**24**	Maximum of fan output	Signed 16	500…1000	50,0…100,0 %	1000
400**25**	Minimum of VAV output	Signed 16	0…500	0,0…50,0 %	0
400**26**	Maximum of VAV output	Signed 16	500…1000	50,0…100,0 %	1000
400**27**	Fan output scaling, high end	Signed 16	0…1000	0,00…100,0 %	1000

Information is subject to change without prior notice.

Register	Parameter description	Data Type	Value	Range	Default
400**28**	Fan output scaling, low end	Signed 16	0…1000	0,00…100,0 %	0
400**29**	Fan usage	Signed 16	0 - 1	0 = off 1 = on	0
400**30**	Low limit P-band for CO_2 control	Signed 16	400…1000	400…1000 ppm	700
400**31**	High limit P-band for CO_2 control	Signed 16	500…2000	500…2000 ppm	1250
400**32**	Reserved (not in use)	Signed 16	-	-	0
400**33**	Floor temperature compensation ratio	Signed 16	0…20	0…20	1
400**34**	Summer mode night set point	Signed 16	80…300	8,0…30,0 °C	250
400**35**	Winter mode night set point	Signed 16	80…300	8,0…30,0 °C	180
400**36**	3-speed motor running time	Signed 16	30…300	30…300 s	180
400**37**	Actuator type	Signed 16	0 - 1	0 = 3-speedf 1 = thermal	0
400**38**	Minimum floor temperature	Signed 16	80…500	8,0…50,0 °C	230
400**39**	Maximum floor temperature	Signed 16	80…500	8,0…50,0 °C	350
400**40**	Reserved (not in use)	Signed 16	-	-	0
400**41**	Reserved (not in use)	Signed 16	-	-	0