InClimate®

Functionality setup and Modbus description

Version 7300 Software

Version 7.300

Senmatic A/S

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Table of contents

InClimate functionality setup

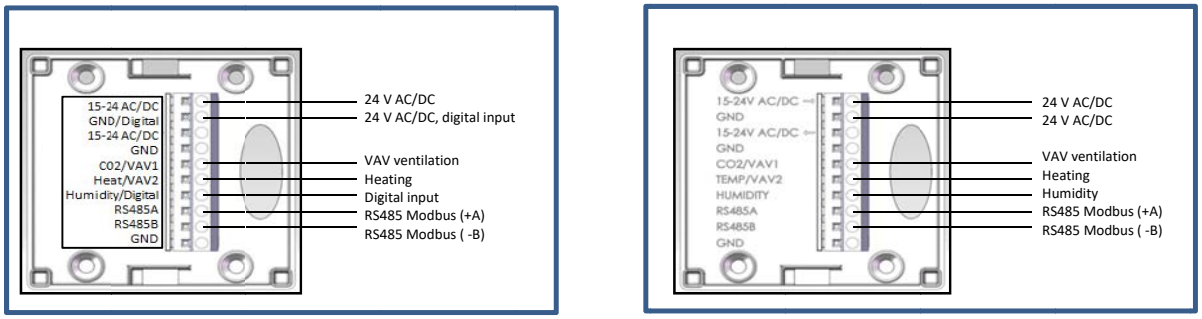
This document describes the various running modes for which the InClimate PCB can be set up. The setup is done by means of a dip switch, see table 1.
The table lists the functions that can be used in the various modes. Many of the functions have to be set up through software. This is followed by a more detailed description.

This version applies for InClimate with software 7200 or higher.

This document uses the following terms:

- CO2/VAV1 is called Vout1.
- TEMP/VAV2 is called Vout2.
- HUMIDITY is called Vout3. Only available for version 307-001/002/003/004

Connection diagram



307-051, 307-052, 307-053, 307-054

307-001, 307-002, 307-003, 307-004

Figure 1 Connection diagram

Table 1 - Dip switch setup for InClimate

Mode Switch pos.	Mode description	InClimate functions and various other functions are adjustable through Modbus or the InClimate programming tool (item number 307-009)	CO2 VAV1 0-10V	Temp VAV2 0-10V	Humi-dity 0-10V
0 	Transmitter mode.	a. No adjustment options for temperature and CO_2. *Pure transmitter mode.*	CO_2 0-2000 PPM	Temp. 0-50°C	Humidity 0-100% Only 307-001/003
1 	Transmitter mode with setup function	a. No adjustment options for temperature and CO_2. *Pure transmitter mode*. b. Scale button can be used as setup function. *0-10V is read out on Humidity/ VAV3, only applies for 307-001/003*	CO_2 0-2000 PPM	Temp. 0-50°C	Setup func. kun 307-001/002/003/004
2 	Standalone *Three PI regulators control VAV1 and VAV2*. There are *PI parameters for CO_2 and temperature for VAV1 and there are PI parameters for VAV2 temperature for heat valve regulation.*	a. Fixed set point of 21 °C. The temperature can be adjusted +/- 3 °C. b. CO2 can be adjusted between 600 to 1200 ppm on the internal potentiometer. *Standard setting is 800 PPM.* Possibility for choosing VAV control parameter. *Vout1 is controlled through CO2 and temperature, where the highest calculated PI value is deciding.* *1=Vout1 is only controlled by temperature, CO_2 set point is ignored.* *2=Vout1 is only controlled by CO_2, temperature set point is ignored.* *c.* Mulighed for VAV1 minimum voltage of 0 to 10V for ventilation damper. *0=Standard 0V, 20=2V, 55=5,5V, etc.* *d.* Possibility of window functionality. *The window function works through the sensor constantly checking the temperature change over a period of 5 minutes. If for example the temperature has dropped more than five degrees during this period, the sensor will shut off the heat. (VAV2). The heat will be turned off for 20 minutes. The desired temperature change can be set, standard 5°C.* e. Possibility of choosing dead zone functionality. *Standard 0°C, can be activated and changed to +/-10°C.*	VAV control.	Temp. control.	No output
3 	Standalone PI adjustment *See mode 2.*	a. The temperature is adjustable between 5°C and 30°C. Other setting options – see mode 2.	VAV control.	Temp. control.	No output
4 	Modbus. *(Also as Standalone) Data is communicated with BMS terminal.*	a. Possibility of digital input etc. *Standard setup is "0", for register 40003 for AC. See program guide* b. Standard fixed set point is 21°C and temperature is adjustable +/- 3°C. *Set point (temp and CO_2) can be local or changed via Modbus or local temperature set point and CO2 via Modbus. 0=Standard local, 1=via Modbus, 2= Local temperature set point and CO_2 set point via Modbus.* Possibility of adjustment of centre point and ± span of the temperature potentiometer by means of the local set point. Standard 21°C ±3°C c. Local PI regulator. *PI regulators control VAV1 and VAV2. There are PI parameters for CO_2 and temperature for VAV1 and there are PI parameters for VAV2 temperature for heat valve regulation.* d. Possibility of choosing VAV1 control-parameters. *0=Vout1 (standard) is controlled through CO2 and temperature, where the highest calculated PI-value is deciding.* *1=Vout1 is controlled solely through temperature. CO2 set-point is ignored.* *2=Vout1 is controlled solely through CO2. Temperature set-point is ignored.* *e.* VAV minimum voltage 0 to 10.0V for ventilation damper. *0=Standard 0 ; 20=2V ; 55=5,5V ; etc.* *f.* Forced opening of VAV1. *0=Standard, 1=Forced opening of VAV1 in Unoccupied mode.* *g.* Possibility of choosing window function: The window function works through the sensor constantly checking the temperature change over a period of 5 minutes. If for example the temperature has dropped more than five degrees during this period, the sensor will shut off the heat. (VAV2). The heat will be turned off for 20 minutes. The desired temperature change can be set, standard 5°C. *h.* Optional choice of 3 full dead zone functionalities: *0=Occupied, standard +/- 1°C* *1=Standby, standard +/- 3°C* *2=Unoccupied, standard +/- 6°C, possibility of forced opening of the VAV1 damper* i. Possibility of choosing downdraft function: *Possibility of opening the VAV2 heat valve percentage-wise depending on outdoor temperature.*	VAV control.	Temperature control.	No output
5 	Modbus. *Controlled from the BMS system*	a. Digital input is optional. *Standard setting is "0" for register 40003 is AC. See program guide page 3* b. No adjustment possibilities for temperature, RH and CO_2. *All sensor values are read out via Modbus and all output for InClimate are controlled from BMS terminal.*	Controlled from BMS	Controlled from BMS	*Humidity output* only 307-001/002/003/004

7 	Forced opening	a. Forced opening (VAV1, VAV2, VAV3) 10V *VAV3 cannot be used for InClimate with digital input.*	VAV 1	VAV 2	VAV 3

Digital input

Selection guide for digital input in register 40004

Digital input, choice of below options:

1. Extended operation (normally open or normally closed switch)
2. PIR Sensor or window relay (normally open or normally closed switch)

0	Operation switch	NO
1	Operation switch	NC
2	Pir sensor / window relay	NO
3	Pir sensor / window relay	NC

Table 2, Register 40004

Selection guide for device type in register 40003

Following set-up options are available in register 40003:

1. AC or DC (Default ”0” = AC)
2. CO_2
3. RH
4. Digital input,
5. Blind cover, temperature offset for blind cover to be done according to the mounting instructions for blind cover in register 40035.

Selection device type guide												
Device type 40003				With digital input with 2 x 0-10V				Without digital input with 3 x 0-10V				
				307-051 Temp-CO2-RH	307-052 Temp-CO2	307-053 Temp - RH	307-054 Temp	307-001 Temp-CO2-RH	307-002 Temp-CO2	307-003 Temp - RH	307-004 Temp	
0	AC	100	DC								X	
1	AC + CO_2	101	DC + CO_2						X			
2	AC + CO_2 + RH	102	DC + CO_2 + RH					X				
3	AC + RH	103	DC + RH							X		
4	AC + Digital input	104	DC + Digital input				X					
5	AC + CO_2 + Digital input	105	DC + CO_2 + Digital input		X							
6	AC + CO_2 + RH + Digital input	106	DC + CO_2 + RH + Digital input	X								
7	AC + RH + Digital input	107	DC + RH + Digital input			X						
8	AC + blind cover l	108	DC + blind cover								X	
9	AC + CO_2 + blind cover	109	DC + CO_2 + blind cover						X			
10	AC + CO_2 + RH + blinddæksel	110	DC + CO_2 + RH + blind cover					X				
11	AC + RH + blind cover	111	DC + RH + blind cover							X		
12	AC + Digital input blind cover	112	DC + Digital input + blind cover				X					
13	AC + CO_2 + Digital input + blind cover	113	DC + CO_2 + Digital input + blind cover		X							
14	AC + CO_2 + RH + Digital input + blinddæksel	114	DC + CO_2 + RH + Digital input + blind cover	X								
15	AC + RH + Digital input + blind cover	115	DC + RH + Digital input + blind cover			X						

Table 3, Register 40003

Mode 0, Transmitter mode

In this Mode, InClimate runs as a transmitter. Measured data is sent out on the three outputs.

- Vout1 CO_2 signal 0 to 10V @ 0 – 2000 ppm.
- Vout2 Temperatur 0 to 10V @ 0 til 50°C.
- Vout3 Humidity 0 to 10V @ 0 to 100 % rh(Does not apply for InClimate with digital input).

Mode 1, Transmitter with setup function

In this Mode, InClimate runs as a simple transmitter. However, only CO_2 and temperature are sent on two of the outputs. The temperature scale position is sent on Vout3.

- Vout1 CO_2 signal 0 to 10V @ 0 – 2000 PPM.
- Vout2 Temperature 0 to 10V @ 0 to 50°C.
- Vout3 Setup function 0 to 10V @ potentiometer position. Can be used for anything. (Does not apply for InClimate with digital input).

Mode 2, PI Regulator 1

The following list shows possible functions in Mode 2.

- Vout1 and Vout2 are controlled by PI regulators. PI parameters are set up via Modbus.
- Choice of which parameters that are to control Vout1, CO_2 and temperature or CO_2 alone or temperature alone.
- Choice of whether minimum VAV output (Vout1) is to be a voltage from 0V (standard) to 10V.
- Window function that shuts off the heat (Vout2) when detecting a significant drop in temperature over a short period of time.

In this Mode, three PI regulators controlling 2 outputs are used. There is one output for a VAV damper, Vout1, and one output for a heat valve, Vout2.

The parameters for the PI regulators can be changed in order to fine-adjust the PI regulation. There are parameters for CO2 and temperature respectively for the VAV PI regulator and there are PI parameters for temperature for heat valve regulation. See appendix for more detailed description. The relevant telegrams for MODE 2 are available in the Modbus protocol description.

Vout1, VAV output

Vout1 is a 0 to 10V or an “optional level” to 10V signal to a VAV damper controlled by needs for cooling/ventilation. The voltage to the VAV damper is generated by two PI regulators in the software based on CO_2 and temperature set points and measurements. The decision of whether it should be 0 to 10V or an “optional level” to 10V is carried out by writing to register 40033. 0 is standard in 40033. If 35 is written in register 40033, the output on the VAV will be 3.5V.

The standard set point for temperature is 21 °C. ±3 °C.

The set point for CO_2 is 800 ppm, can be adjusted from 600 ppm to 1200 ppm.

The parameters for the VAV temperature PI regulator can be changed by writing to the registers 40009, 40010 and 40011.

The parameters for the VAV CO_2 PI regulator can be changed by writing to the registers 40012, 40013 and 40014.

Choice of PI control parameters for Vout1

The PI regulator for Vout1 can be set in 3 different ways. It can be chosen which way the PI regulator is to be set by writing to register 40032. See the Modbus protocol.

- Vout1 is controlled through CO_2 and temperature, where the highest calculated PI value is deciding.
- Vout1 is controlled solely through temperature. CO_2 set point is ignored.
- Vout1 is controlled solely through CO_2. Temperature set point is ignored.

Vout2, Heat output.

Vout2 is used to control a heat valve through a software PI regulator.

Input for this PI regulator is the set point and the temperature measurement. The output is a 0 – 10V signal.

The set point can be adjusted to 21°C ±3°C.

The parameters for the PI regulator can be changed by writing to the registers 40015, 40016 and 40017.

Window function

A window function is associated with this output. The window function can be selected/deselected through register 40034.

The window function works as follows: the sensor is constantly checking the temperature change over a period of 5 minutes. If for example the temperature has dropped more than five degrees during this period, the sensor will shut off the heat, because a window must be open. The heat will be turned off for 20 minutes. The desired temperature change can be set through register 40035.

See Appendix 2 for more detailed description.

Dead zone

A possibility of running with dead zone or comfort zone, which it is also called, is implemented. MODE 2 runs with 1 level of dead zone. The function can be activated by changing register 40025 from 0 to 1. In register 40026, you determine when you start cooling, which is a positive offset from the set point.

In register 40027, you determine when you start heating, which is a negative offset from the set point. See Appendix 3, Deadzone

Mode 3, PI Regulator 2

The following list shows possible functions in Mode 3.

- Vout1 and Vout2 are controlled by PI regulators. PI parameters are set up via Modbus.
- Choice of which parameters that are to control Vout1, CO_2 and temperature or CO_2 alone or temperature alone.
- Choice of whether minimum VAV output (Vout1) is a voltage from 0V(standard) to 10V.
- Window function that shuts off the heat (Vout2) when detecting a significant drop in temperature over a short period of time.

In this Mode, three PI regulators controlling 2 outputs are used. There is one output for a VAV damper, Vout1, and one output for a heat valve, Vout2.

The parameters for the PI regulators can be changed in order to fine-adjust the PI regulation. There are parameters for CO_2 and temperature respectively for the VAV PI regulator and there are PI parameters for temperature for heat valve regulation, see Appendix 1 for more detailed description. The relevant telegrams for MODE 3 are available in the Modbus protocol description.

Vout1, VAV output

Vout1 is a 0 to 10V or an “optional level” to 10V signal to a VAV damper controlled by needs for cooling/ventilation. The voltage to the VAV damper is generated by two PI regulators in the software based on CO_2 and temperature set points and measurements. The decision of whether it should be 0 to 10V or an “optional level” to 10V is carried out by writing to register 40033. 0 is standard in 40033. If 35 is written in register 40033, the output on the VAV will be 3.5V to 10V.

The set point for temperature can be adjusted from 5°C to 30°C.

The set point for $CO_2$is 800 ppm, can be adjusted from 600 PPM to 1200 ppm.

The parameters for the VAV temperature PI regulator can be changed by writing to the registers 40009, 40010 and 40011.

The parameters for the VAV CO_2 PI regulator can be changed by writing to the registers 40012, 40013 and 40014.

Choice of PI control parameters for Vout1

The PI regulator for Vout1 can be set in 3 different ways. It can be chosen which way the PI regulator is to be set by writing to register 40032. See the Modbus protocol.

- Vout1 is controlled through CO_2 and temperature, where the highest calculated PI value is deciding.
- Vout1 is controlled solely through temperature. CO_2 set point is ignored.
- Vout1 is controlled solely through CO_2. Temperature set point is ignored.

Vout2, Heat output

Vout2 is used to control a heat valve through a software PI regulator.

Input for this PI regulator is the set point and the temperature measurement. The output is a 0 – 10V signal.

The set point can be adjusted from 5°C to 30°C.

The parameters for the PI regulator can be changed by writing to the registers 40015, 40016 and 40017.

Window function

A window function is associated with this output. The window function can be selected/deselected through register 40034.

The window function works as follows: the sensor is constantly checking the temperature change over a period of 5 minutes. If for example the temperature has dropped more than five degrees during this period, the sensor will shut off the heat, because a window must be open. The heat will be turned off for 20 minutes. The desired temperature change can be set through register 40035.

See Appendix 2 for more detailed description.

Dead zone

A possibility of running with dead zone or comfort zone, which it is also called, is implemented. MODE 2 runs with 1 level of dead zone. The function can be activated by changing register 40025 from 0 to 1. In register 40026, you determine when you start cooling, which is a positive offset from the set point.

In register 40027, you determine when you start heating, which is a negative offset from the set point. See Appendix 3, Deadzone

Mode 4, Local PI regulator, advanced functions via Modbus

The following list shows possible functions in Mode 4.

- Vout1 and Vout2 are controlled by PI regulators. PI parameters are set up via Modbus.
- Option for change of span and centre point for temperature potentiometer.
- Choice of set points being local (potentiometers) or via Modbus, communication from central unit or local temperature set-point and CO_2 set-point via Modbus.
- Additional choice of down draft function.
- Additional choice of advanced dead zone handling.
- Choice of which parameters that are to control Vout1, CO_2 and temperature or CO_2 alone or temperature alone.
- Choice of whether minimum VAV output (Vout1) is a voltage from 0V(standard) to 10V.
- Window function that shuts off the heat (Vout2) when detecting a significant drop in temperature over a short period of time.

In this Mode, three PI regulators controlling 2 outputs are used. There is one output for a VAV damper, Vout1, and one output for a heat valve, Vout2.

The parameters for the PI regulators can be changed in order to fine-adjust the PI adjustment. There are parameters for CO2 and temperature respectively for the VAV PI regulator and there are PI parameters for temperature to heat valve regulation. See Appendix 1 for more detailed description. The relevant telegrams for MODE 4 are available in the Modbus protocol description.

Change of span and center point for temperature potentiometer

The center position of the set point for temperature can be changed. This applies for the span as well. This is done by writing to register 40019 and 40020.

Local set points or set points from central unit

You can choose that the set points should be local or that they should be distributed from a central unit via Modbus or that the temperature set point is set locally by means of the setup function and CO2 set point is distributed via Modbus. You can choose this in register 40018. Relevant set points are written to register 40204 and 40205. If you choose that the set points should be sent from a central unit, you can use the temperature potentiometer as a setup function.

PIR sensor or window switch

Are connected InClimate on terminal 7 and 2.

When the PIR sensor or the window switch is/become active, the dead zone for VAV1 temperature is changed to dead zone occupied (Register 40208 is changed from 1 to 0), with a time delay according to register 40038. Register 40038 is default set for 180 seconds.

There will be on change of the control of CO_2.

Deadzone

A possibility of running with dead zone working on 3 levels is implemented. Dead zone means that a comfort zone is introduced, where there is no ventilation or heat on radiators.

It requires communication with a central system to benefit fully from the dead zone function. The central system is to control the levels. There are 3 levels.

- Occupied, where the dead zone parameters are narrow. I.e. a narrow comfort zone.
- Standby, where the dead zone parameters are increased slightly. I.e. the comfort is a bit larger.
- Unoccupied, where the dead zone parameters are increased further. The comfort zone is large. In Unoccupied mode, there is also an option of forced opening of the VAV damper.

Setup of dead zone can be carried out by writing to registers 40025 to 40031. In 40208, you write which dead zone level you want, and in 40209, you write whether you want the VAV damper to be fully open in Unoccupied zone. To activate the function register 40025 must be changed from 0 to 1.

If you do not have a central system, but want to run with a type of dead zone, you can choose dead zone. The system will always run in Occupied zone with the comfort zone set up in register 40026.

Vout1, VAV output.

Vout1 is a 0 to 10V or an “optional level” to 10V signal to a VAV damper controlled by needs for cooling/ventilation. The voltage to the VAV damper is generated by two PI regulators in the software based on CO_2 and temperature set points and measurements. The decision of whether it should be 0 to 10V or an “optional level” to 10V is carried out by writing to register 40033. 0 is standard in 40033. If 35 is written in register 40033, the output on the VAV will be 3.5V to 10V.

As a default, the set point for temperature is set at 21 °C. ±3 °C. Please be aware that this can be changed, which means that center point and span are different. . You can also have chosen for set points to be communicated from a central location via Modbus.

The set point for CO_2 is 800 ppm, can be adjusted from 600 PPM to 1200 ppm. This set point can also be set up to be communicated via Modbus.

Minimum VAV output, Vou1, 0 to 10V.

You can choose whether the minimum voltage should be 0V any voltage between 0 and 10.0V. Some VAV controllers use 2V as the minimum voltage. Register 40033 is used for this purpose.

Change of PI parameters for VAV temperature PI regulator.

The parameters for the VAV temperature PI regulator can be changed by writing to the registers 40009, 40010 and 40011.

Change of PI parameters for CO2 PI regulator.

The parameters for the VAV CO_2 PI regulator can be changed by writing to the registers 40012, 40013 and 40014.

Choice of PI control parameters for Vout1.

The PI regulator for Vout1 can be set in 3 different ways. It can be chosen which way the PI regulator is to be set by writing to register 40032. See the Modbus protocol.

- Vout1 is controlled through CO_2 and temperature, where the highest calculated PI value is deciding.
- Vout1 is controlled solely through temperature. CO_2 set point is ignored.
- Vout1 is controlled solely through CO_2. Temperature set point is ignored.

Vout2, Heat output.

Vout2 is used to control a heat valve through a software PI regulator.

Input for this PI regulator is the set point and the temperature measurement. The output is a 0 – 10V signal.

As a default, the set point for temperature is set at 21 °C. ±3°C. Please be aware that this can be changed, which means that center point and span are different. You can also have chosen for set points to be communicated from a central location via Modbus.

Change of PI parameters for Vout2, heating PI regulator.

The parameters for the PI regulator can be changed by writing to the registers 40015, 40016 and 40017.

Window function.

A window function is associated with this output. The window function can be selected/off - ignored through register 40034. The window function works as follows: the sensor is constantly checking the temperature change over a period of 5 minutes. If for example the temperature has dropped more than five degrees during this period, the sensor will shut off the heat, because a window must be open. The heat will be turned off for 20 minutes. The desired temperature change can be set through register 40035.

See Appendix 2 for detailed description.

Downdraft function.

A downdraft function is implemented. This ensures that the heat valve is always a bit open, depending on the outdoor temperature. This requires a central system with an outdoor temperature sensor. This temperature is continuously written to register 40207.

The setup for the downdraft function is written in the registers 40021 to 40024.

Mode 5, Modbus transmitter mode

In Mode 5, InClimate is controlled from a central unit. It does not generate any output voltages itself. It continuously measures CO2, temperature and humidity. These parameters can be read via Modbus.

The relevant telegrams for MODE 5 are available in the Modbus protocol description.

Output voltages from InClimate are controlled from a central unit. Output voltages are controlled by writing to registers 40201, 40202 and 40203.

The temperature potentiometer can be used as a setup function.

PIR sensor, window switch or operation push button

Connected to InClimate on terminal 7 and 2.

When the PIR sensor changes from inactive to active or from active to inactive, register 30012 changes status from 0 to 1 or from 1 to 0 (Without time delay).

In connection with Modbus communication a communication delay (polling) occurs depending on baud rate and the number of InClimate. In order to ensure that the BMS registers changes in register 30012, the value is kept in register 40037. Register 40037, default 30 seconds.

Mode 7, Forced opening of outputs

Forced opening of the 3 outputs. All outputs are set to 10V. This mode is used in connection with installation of the system and fault finding. VAV3 cannot be used for InClimate with digital input.

Appendix 1, PI band

There is a wish for a P band of 2°C and an integral time of 15 minutes. Based on this information, some theoretical equations can be set up.

P band =2 °C.

Integral time Ti=15 minutes = 900 seconds.

Gain is calculated on the basis of the following formula:

$$Kp = \frac{\Delta P}{\Delta \in} = \frac{100}{2} = 50$$

Integral gain, Ki; can now be expressed through proportional gain, Kp; sample time, Ts; and integral time, Ti. All times are in seconds.

$$Ki = \frac{Kp * Ts}{Ti} = \frac{50 * 5}{900} = 0{,}2778$$

In the same way, Kp and Ki are calculated for CO_2 and heating respectively.

In practice, you might want to tune the PI regulators through known methods. This could be the Ziegler–Nichols method. Or you can do it manually, depending on preference and experience.

Appendix 2, Window functionality

An option of shutting off the heat if Δt is < -XX degrees within 5 minutes is implemented. The heat will be turned off for 20 minutes. See example on Figure 2.

1. This functionality can be selected/turned off - ignored through set point 40034.
2. XX are degrees, which can be set through set point 40035.

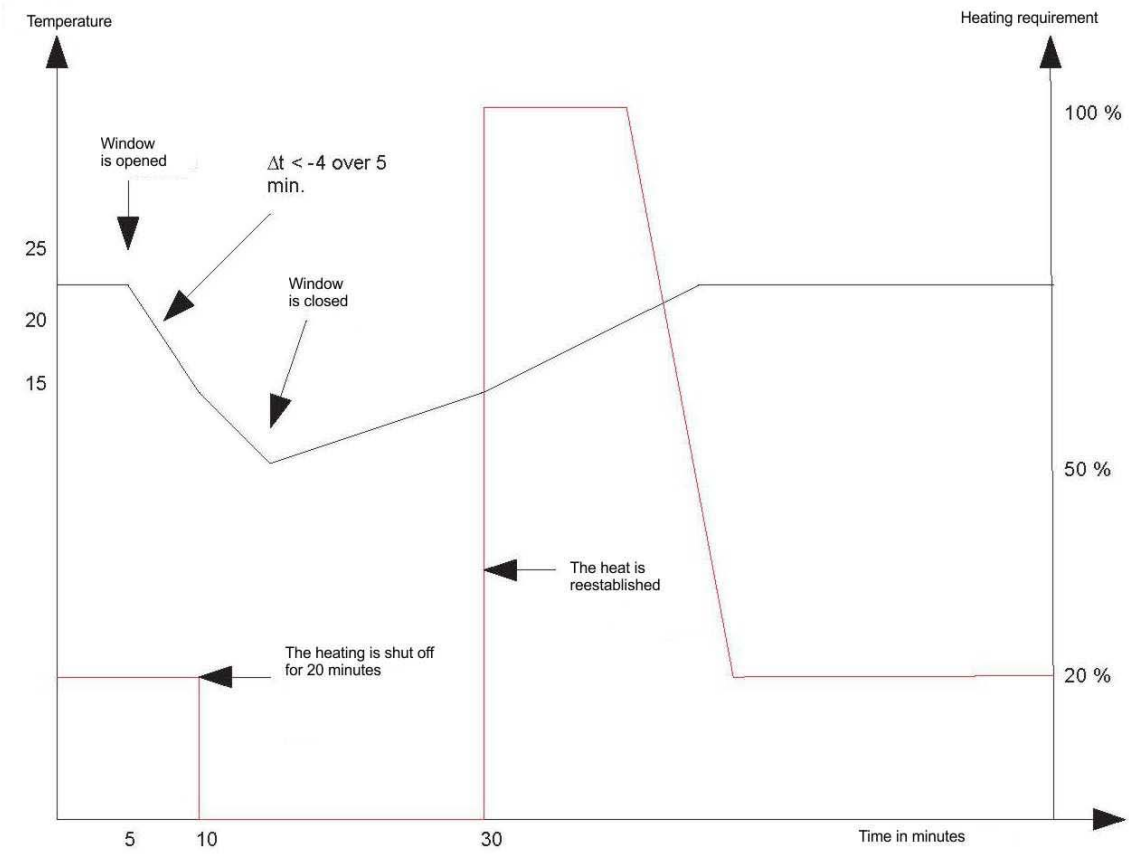


Figure 2 Hypothetical example of window functionality.

This figure illustrates an example of the window functionality.

The system is set to shut off the heat if the temperature change Δt is more than -4°C during 5 minutes. The heat will be shut off for 20 minutes.

Appendix 3, Deadzone

A dead zone with three levels is implemented. (Remember to change register 40025 to 1). Zone 1 is called Occupied, zone 2 is called standby and zone 3 is called Unoccupied, see Figure 3. It is possible to set the limits for the zones asymmetrically compared to temperature set point, Figure 4. The shaded area in the 2 figures is also referred to the comfort zone. In order to activate the function register 40025 is changed from 0 to 1.

1. There are three set points for when cooling is permitted. The set point for cooling activity can never be lower than the temperature set point. The registers used are 40026, 40028 and 40030.
2. There are three set points for when heating is permitted. The set point for heating activity can never be higher than the temperature set point. The registers used are 40027, 40029 and 40031.
3. The settings of the three zones follow the temperature set point. If the temperature set point is changed from 21 °C to 22 °C, the limits for the three zones are also changed 1 °C in positive direction, and vice versa if the temperature set point is lowered. All settings are carried out via modbus.
4. A modbus telegram, 40208, defines the zone in which the system runs.
5. A PIR function is implemented. A modbus telegram informs of the fact that there are people in the room. This should result in the dead zone changing from standby or Unoccupied to Occupied. This is controlled from a central system. The change is carried out by writing to register 40208.
6. There is an option of full ventilation with the VAV damper when the system is in the Unoccupied zone. This is carried out by writing to register 40209.
7.

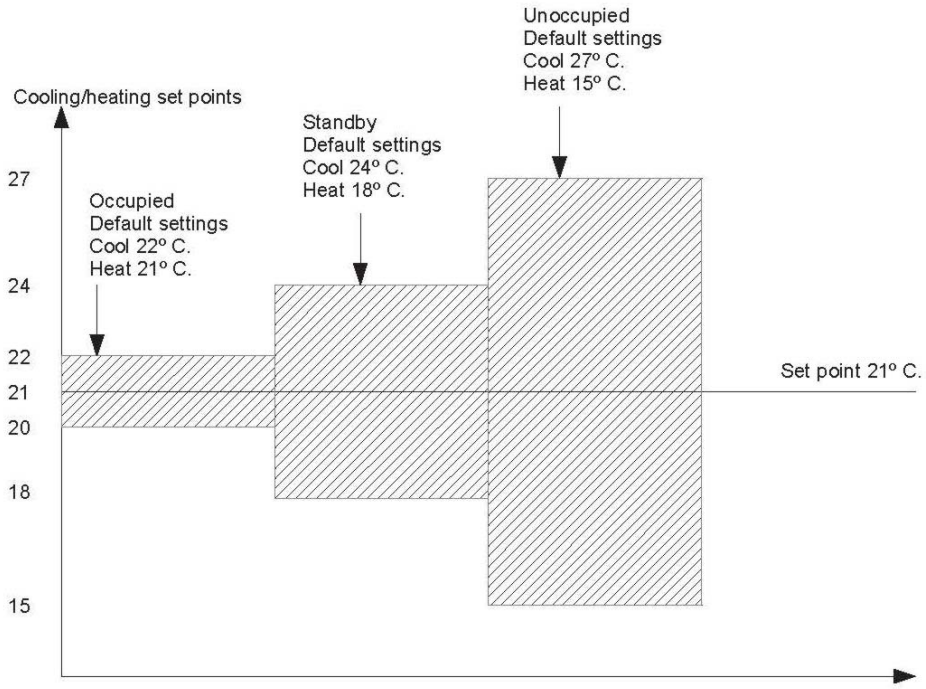


Figure 3 Various dead zones in InClimate.

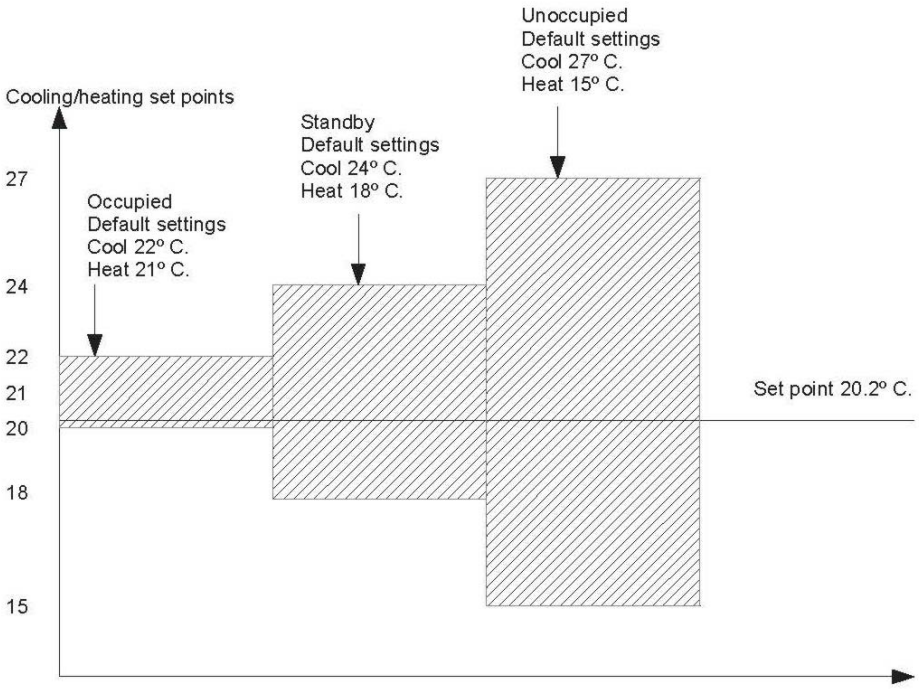


Figure 4 Zone settings asymmetrical compared to set point

Appendix 4, Down draft

A downdraft function is implemented. This is a functionality that sets the minimum heating requirement depending on the outdoor temperature. In some cases, this functionality will overrule the PI regulator. This means that the heating might be on even though the PI regulator is not requesting this. It can also be the PI regulator that decides the level of the heating requirement. The one with the highest requirement wins.

1. The downdraft function is chosen by writing to register 40021.
2. There is a set point in which the outdoor temperature can be written. This is used for calculation of the heating need. Register 40207 is used for this purpose.
3. There is a set point that defines the minimum heat requirement, 0 – 100%. Register 40022 is used for this purpose.
4. There is a set point that defines the outdoor temperature for minimum heat requirement. Register 40023 is used for this purpose.
5. There is a set point that defines the outdoor temperature for 0% heat requirement. Register 40024 is used for this purpose.

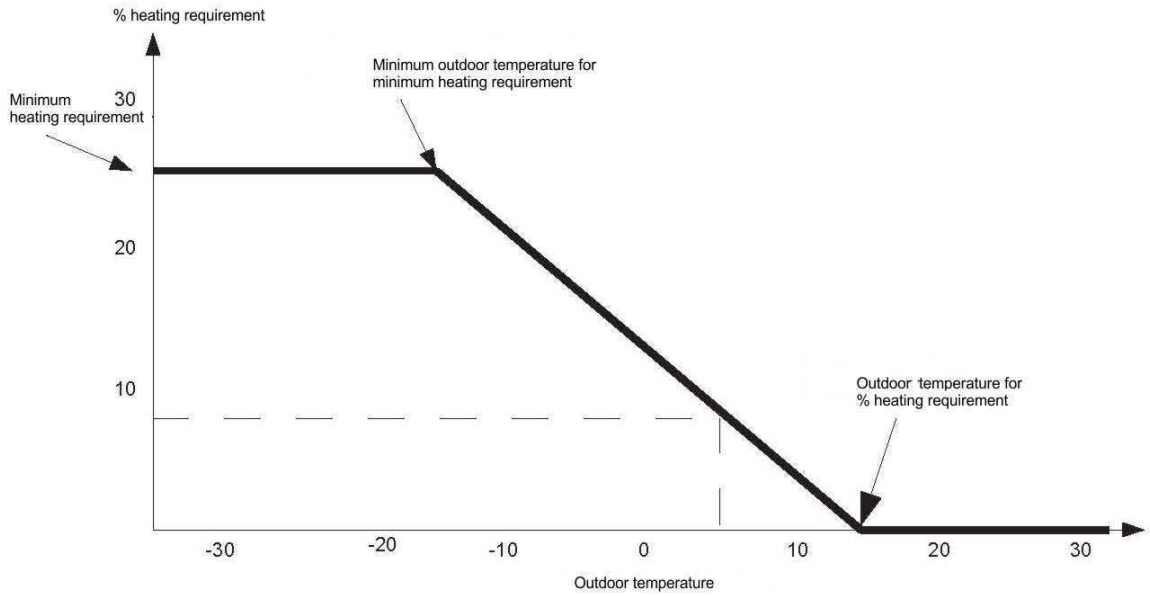


Figure 5 Downdraft function

The figure shows a typical setup of the downdraft function. This InClimate is set to start at 15°C and have full function at -15°C. Full function is set at 25%.

This means that if the outdoor temperature is over 15°C, this function does not contribute to heating. If the temperature is below 15°C and above -15°C, the heating contribution is calculated on the basis of a linear function determined by the values you have set up in the registers. And if the temperature is below -15°C, the heat valve will always be at least 25% open.

The dotted line is meant as an example. The outdoor temperature is 5°C, which results in a heating requirement of approx. 8,3%.

Functionality changes

Version	Date	Description
0-6.3		Development versions
7.0	01-09-12	Initial release version.
7.01	13-09-12	Telegram references added
7.1	16-09-13	Telegram 40018 updated Telegram 40033 updated
7.2	Juni 2015	Digital versions implemented New registers 30012 + 40037 + 40038 AC/DC version can be selected via software.

Modbus beskrivelse

This protocol description refers to InClimate sensors with software version 7200

Serial setup

The physical layer of InClimate Modbus consists of a 2-wire RS485 serial line.

The default setup of the serial line is the following:

1 startbit, 8 databit, even parity, 1 stopbit., Baudrate 19200.

The default address of InClimate is 247 (0xF7 HEX).

Data addresses of Modbus.

All data addresses of the modbus refer to 0. This means that Holding register 40001 refers to address 0x0000 (0 decimal numbers).

Holding register 40108 refers to 0x06B hex (107 decimal numbers).

This means that Holding register 40001 to register 49999 will refer to data register 0x0000 to 0x270E hex (0 to 9998 in decimal numbers).

The input registers are addressed in the same way.

Setup of InClimate.

All changes written to the EEprom in the InClimate are considered to be a “change of setup”. For that reason InClimate is reset in connection with such a writing. This means that data polled via Modbus may be “0” up to 5 seconds after a reset. If writing is done to a EEprom setting register and data are not change in relation to the data stored in the InClimate, the new data written are ignored and no reset is done.

Protocol description

FUNCTION CODE 04 READ INPUT REGISTERS (Dynamic data)					
Register	**Data address.**	**Description**	**Type**	**Value**	**Range (System value)**
30001	0	Temperature	Signed 16	0 - 500	0,0 - 50,0 (°C)
30002	1	CO_2	Unsigned 16	0 - 65535	Calibrated range 400 to 2000 (ppm). However the sensor will provide data beyond this range.
30003	2	rh	Signed 16	0 - 1000	0,0 - 100,0 (%)
30004	3	Set point Temperature	Signed 16	50 - 300	5,0 - 30,0 (°C)
30005	4	Set point CO_2	Signed 16	600 - 1200	600 - 1200 (ppm)
30006	5	Set point Humidity(If present)	Signed 16	0 - 1000	0,0 - 100,0 (%RH)
30007	6	Output Out1 (VAV)	Signed 16	0 - 1000	0,0 - 100,0 (%)
30008	7	Output Out2 (Heat source)	Signed 16	0 - 1000	0,0 - 100,0 (%)
30009	8	Output Out3	Signed 16	0 - 1000	0,0 - 100,0 (%)
30010	9	MODE	Signed 16	0 - 7	0 – 7
30011	10	Potentiometer value	Signed 16	0 - 1000	0 - 100 (%)
30012	11	Digital Input value	Signed 16	0-1	0 = not activated 1 = activated

FUNCTION CODE 03 - READ HOLDING REGISTERS (Holding registers, Settings) FUNCTION CODE 16 – WRITE MULTIPLE REGISTERS (Holding registers, Settings)														
Register	**Data address.**	**Mode 0**	**Mode 1**	**Mode 2**	**Mode 3**	**Mode 4**	**Mode 5**	**Description**	**Type**	**Value**	**Range (System value)**	**Factory settings**	**Destination**	**Read write mode**
40001								Reserved						
40002								Reserved						
40003	2	0	1	2	3	4	5	Device Number	Signed 16	0-15 100-115	0-15 100-115	0	EEPROM setting	Read / write
40004	3					4	5	Digital type	Signed 16	0-3	0=NO 1=NC 2=NO 2=NC	0	EEPROM setting	Read / write
40005	4	0	1	2	3	4	5	Firmware version	Signed 16	0 - 65536	0 - 65,536	Build version	EEPROM setting	Read only
40006	5	0	1	2	3	4	5	Baud Rate	Unsigned 16	96, 192, 384, 576, 1152	96 = 9600 baud, 192 =19200 baud, 384 = 38400 baud, 576 = 57600 baud, 1152 = 115200 baud	19200	EEPROM setting	Read / Write
40007	6	0	1	2	3	4	5	Modbus Address	Signed 16	1 - 247	1-247	247	EEPROM setting	Read / Write
40008	7	0	1	2	3	4	5	Parity	Signed 16	0 - 2	0 = Even Parity 1 = Odd Parity 2 = No Parity	0	EEPROM setting	Read / Write
40009	8	-	-	2	3	4	-	Proportional Gain KP VAV Temperature	Unsigned 16	0 - 65535	0 – 6553,5	500	EEPROM setting	Read / Write
40010	9	-	-	2	3	4	-	Integral Gain KI VAV Temperature	Unsigned 16	0 - 65535	0 – 6,5535	2778	EEPROM setting	Read / Write
40011	10	-	-	2	3	4	-	Integral windup limit VAV Temperature	Signed 16	0 - 65535	0 - 65535	100	EEPROM setting	Read / Write
40012	11	-	-	2	3	4	-	Proportional Gain KP CO2	Unsigned 16	0 - 65535	0 - 6553,5	20	EEPROM setting	Read / Write
40013	12	-	-	2	3	4	-	Integral Gain KI CO2	Unsigned 16	0 - 65535	0 - 6,5535	110	EEPROM setting	Read / Write
40014	13	-	-	2	3	4	-	Integral windup limit CO2	Signed 16	0 - 65535	0 - 65535	2500	EEPROM setting	Read / Write

FUNCTION CODE 03 - READ HOLDING REGISTERS (Holding registers, Settings) FUNCTION CODE 16 – WRITE MULTIPLE REGISTERS (Holding registers, Settings)														
Register	**Data address.**	**Mode 0**	**Mode 1**	**Mode 2**	**Mode 3**	**Mode 4**	**Mode 5**	**Description**	**Type**	**Value**	**Range (System value)**	**Factory settings**	**Destination**	**Read write mode**
40015	14	-	-	2	3	4	-	Proportional Gain KP Heat	Unsigned 16	0 - 65535	0 - 6553,5	500	EEPROM setting	Read / Write
40016	15	-	-	2	3	4	-	Integral Gain KI Heat	Unsigned 16	0 - 65535	0 – 6,5535	2778	EEPROM setting	Read / Write
40017	16	-	-	2	3	4	-	Integral windup limit Heat	Signed 16	0 - 65535	0 - 65535	100	EEPROM setting	Read / Write
40018	17	-	-	-	-	4	-	Local Set point	Signed 16	0-2	0 = Local Set point 1 = Set point from Modbus 2 = Local Temperature Set point, CO_2 set point from Modbus	0	EEPROM setting	Read / Write
40019	18	-	-	-	-	4	-	Center position of temperature potentiometer.	Signed 16	0 - 300	0 – 30°C. Only in MODE 4.	21	EEPROM setting	Read / Write
40020	19	-	-	-	-	4	-	Span of temperature potentiometer.	Signed 16	0 – 20	0 – ±20°C. Only in MODE 4.	3	EEPROM setting	Read / Write
40021	20	-	-	-	-	4	-	Downdraft function active	Signed 16	0 - 1	0 = No downdraft function 1 = downdraft function active	0	EEPROM setting	Read / Write
40022	21	-	-	-	-	4	-	Downdraft heat demand.	Signed 16	0 - 1000	0 – 100%	10°C	EEPROM setting	Read / Write
40023	22	-	-	-	-	4	-	Downdraft low temperature.	Signed 16	-500 - 500	-50°C - 50°C.	-10°C	EEPROM setting	Read / Write
40024	23	-	-	-	-	4	-	Downdraft high temperature.	Signed 16	-500 - 500	-50°C - 50°C.	10°C	EEPROM setting	Read / Write

FUNCTION CODE 03 - READ HOLDING REGISTERS (Holding registers, Settings) FUNCTION CODE 16 – WRITE MULTIPLE REGISTERS (Holding registers, Settings)														
Register	**Data address.**	**Mode 0**	**Mode 1**	**Mode 2**	**Mode 3**	**Mode 4**	**Mode 5**	**Description**	**Type**	**Value**	**Range (System value)**	**Factory settings**	**Destination**	**Read write mode**
40025	24	-	-	2	3	4	-	Deadzone Function active	Signed 16	0 - 1	0 = No deadzone function 1 = deadzone function active	0	EEPROM setting	Read / Write
40026	25	-	-	2	3	4	-	Deadzone Occupied Cool temperature	Signed 16	0 - 200	0°C - 20°C. Can never be lower than temperature setpoint. Value is stored as temperature setpoint.	1°C	EEPROM setting	Read / Write
40027	26	-	-	2	3	4	-	Deadzone Occupied Heat temperature	Signed 16	-200 - 0	-20°C - 0°C. Can never be higher than temperature setpoint.	-1°C	EEPROM setting	Read / Write
40028	27	-	-	-	-	4	-	Deadzone Standby Cool temperature	Signed 16	0 - 200	0°C - 20°C. Can never be lower than temperature setpoint.	3°C	EEPROM setting	Read / Write
40029	28	-	-	-	-	4	-	Deadzone Standby Heat temperature	Signed 16	-500 - 0	-20°C - 0°C. Can never be higher than temperature setpoint.	-3°C	EEPROM setting	Read / Write
40030	29	-	-	-	-	4	-	Deadzone Unoccupied Cool temperature	Signed 16	0 - 200	0°C - 20°C. Can never be lower than temperature setpoint.	6°C	EEPROM setting	Read / Write
40031	30	-	-	-	-	4	-	Deadzone Unoccupied Heat temperature	Signed 16	-200 - 0	-20°C - 0°C. Can never be higher than temperature setpoint.	-6°C	EEPROM setting	Read / Write

FUNCTION CODE 03 - READ HOLDING REGISTERS (Holding registers, Settings) FUNCTION CODE 16 – WRITE MULTIPLE REGISTERS (Holding registers, Settings)														
Register	**Data address.**	**Mode 0**	**Mode 1**	**Mode 2**	**Mode 3**	**Mode 4**	**Mode 5**	**Description**	**Type**	**Value**	**Range (System value)**	**Factory settings**	**Destination**	**Read write mode**
40032	31	-	-	2	3	4	-	VAV Output Control	Signed 16	0 - 2	0: VAV controlled by CO2 and Temperature. 1: VAV controlled by temperature only. 2: VAV controlled by CO2 only.	0	EEPROM setting	Read / Write
40033	32	-	-	2	3	4	-	Minimum VAV output	Signed 16	0 - 100	0 -10.0V	0	EEPROM setting	Read / Write
40034	33	-	-	2	3	4	-	Window functionality active.	Signed 16	0 - 1	0 = Not Active. 1 = Active.	0	EEPROM setting	Read / Write
40035	34	-	-	2	3	4	-	Window functionality level.	Signed 16	-200 – -5	-20°C - -0,5°C If Δt (falling temperature) > setting over a time period on 5 minutes, heat is turned off for 20 minutes.	-5°C	EEPROM setting	Read / Write
40036	35	0	1	2	3	4		Temperature offset	Signed 16	-100 - 100	-10°C - 10°C.	0°C	EEPROM setting	Read / Write
40037	36	-	-	-	-	-4	5	Dititalt input Pulling delay	Signed 16	10-1200	Time delay 10-1200 sec	30 sec	EEPROM setting	Read / Write
40038	37	-	-	-	-	4	5	Digital input Dead zone Time delay	Signed 16	0-600	Time delay 10-600 sec	180 sec	EEPROM setting	Read / Write
40039-40199	38 - 199	-	-	-	-	-	-	Reserved						
40201	200	-	-	-	-	-	5	Output Out1 (VAV) Set output 1 value	Signed 16	0 - 1000	0,0 - 100,0 (%)	0	Dynamic data Mode 5	Read / Write
40202	201	-	-	-	-	-	5	Output Out2 (Heat source)	Signed 16	0 - 1000	0,0 - 100,0 (%)	0	Dynamic data	Read / Write

FUNCTION CODE 03 - READ HOLDING REGISTERS (Holding registers, Settings) FUNCTION CODE 16 – WRITE MULTIPLE REGISTERS (Holding registers, Settings)														
Register	**Data address.**	**Mode 0**	**Mode 1**	**Mode 2**	**Mode 3**	**Mode 4**	**Mode 5**	**Description**	**Type**	**Value**	**Range (System value)**	**Factory settings**	**Destination**	**Read write mode**
								Set output 2 value					Mode 5	
40203	202	-	-	-	-	-	5	Output Out3 Set output 3 value	Signed 16	0 - 1000	0,0 - 100,0 (%)	0	Dynamic data Mode 5	Read / Write
40204	203	-	-	-	-	4	-	Set point Temperature	Signed 16	50 - 300	5,0 - 30,0 (C)	21	Dynamic data Mode 5	Read / Write
40205	204	-	-	-	-	4	-	Set point CO_2	Signed 16	600 - 1200	600 - 1200 (PPM)	800	Dynamic data Mode 5	Read / Write
40206	205	-	-	-	-	-	-	Set point Humidity	Signed 16	0 - 1000	0,0 - 100,0 (%RH)	40	Dynamic data Mode 5	Read / Write
40207	206	-	-	-	-	4	-	Outdoor temperature for downdraft function	Signed 16	-500 - 500	-50°C - 50°C.	20°C	Dynamic data	Read / Write
40208	207	-	-	2	3	4	-	Deadzone level	Signed 16	0 - 1 - 2	0 = Occupied zone 1 = Standby 2 = Unoccupied	0	Dynamic data	Read / Write
40209	208	-	-	-	-	4	-	Deadzone force VAV open.	Signed 16	0 - 1	0 = VAV normal opr. 1 = VAV forced open if Deadzone level = Unoccupied.	0	Dynamic data	Read / Write

Modbus changes

Version	Date	Description
0-5.0		Development versions
6.0	22-02-12	Initial version
6.1	12-06-12	Serial setup and data addressing added.
7.0	01-09-12	Release of Protocol version 7.00
7.01	13-09-12	Modes added
7.1	16-09-13	Telegram 40018 updated Telegram 40033 updated
7.2	30-06-15	General update for digital input versions 30012 digital input 40003 changed to device version 40004 changed to setup of digital input 40037 Pulling time delay 40038 Time delay