![PRODUAL measure-be sure.]

HLS34 Modbus FCU/VAV Controller

The HLS34 is specifically designed for individual room temperature and zone control applications. The controllers have built-in RS-485 channel for Modbus communication. The controllers can be connected to any supervisory software/system that supports Modbus RTU.

The HLS34 has built-in display and unique touch sensitive buttons for adjusting the user parameters and to configure the controller. The controller supports 0..10V actuators, 3-point controlled actuators and thermic actuators. One of the controller 0..10Vdc outputs can be configured for fan speed control via FCRY3 relay module.

The controller has DAY (default) and NIGHT (only via Modbus) operating modes. When in the NIGHT mode the controller can be overridden to the temporary DAY mode via hardware input, by touching day extension button.

The controller has also a CO_2 measurement input for boosting the ventilation (fan speed) in case of high CO_2 level in the room space.


Model Types	Model	Description
	HLS34	Modbus FCU/VAV Controller

Technical Data		
	Power supply	24Vac/dc (20…28V) , <1VA
		NOTE! If using DC-voltage only 0..10V outputs are operational
	Inputs	Built-in Temperature Sensor
		Ext. NTC10 e.g. TEK NTC10 (for control or measurement only)
		1 x Potential-Free (PIR – normally closed)
		1 x Analogue (CO_2 measurement)
	Outputs	2 x 0..10Vdc (Heating/Cooling Actuators, VAV or Fan Speed Control)
		4 x 24Vac Triacs, 1A maximum (3-Point Actuators / Thermic Actuators)
	Communications	RS-485 Modbus RTU, 9600/19200/38400 bps, 8 data bits, Parity None, 1 Stop Bit (Up to 128 devices per segment)
	Display	LCD Display
	Buttons	4 touch sensitive buttons
	Wiring Terminals	1.5 mm^2
	Operating conditions	0..95% rH non-condensing
		Temperature 0..50 ºC
	Protection Class	IP20
	Standards	2004/108/EY(EMC)
		EN61000-6-3: 2001 (Emission)
		EN61000-6-2: 2001 (Immunity)
	Mounting	By the screws on the wall or on the flush mounting box
	Housing	ABS Plastics
	Dimensions	87W x 86H x 32D mm

CONTROLLER PARAMETER

Set point	Day mode 21ºC (default)
	Night mode 17 ºC (default)
	NOTE! Day mode limit deviation is possible to change [± 16°C].
	Limit deviation (default) [± 3°C].
Dead zone	Day mode 0.3°C (default) [Dz = 0...3°C],
	Night mode 6°C (default) [Dz = 0…10°C].
Proportional band	2°C (default) [Xp = 1...32°C]. Also via Modbus.
Integration time	300 s. (default) [Tn = 50...5000 s.]
Actuator running time for 3-point actuator	180 s. (default) [Mt = 30...300 s.]
Control mode	PI (default) [P/PI]

WORKING DIAGRAM

The HLS34 is specifically designed for controlling individual room temperature and zone control applications. Basic installation is illustrated in the picture below.
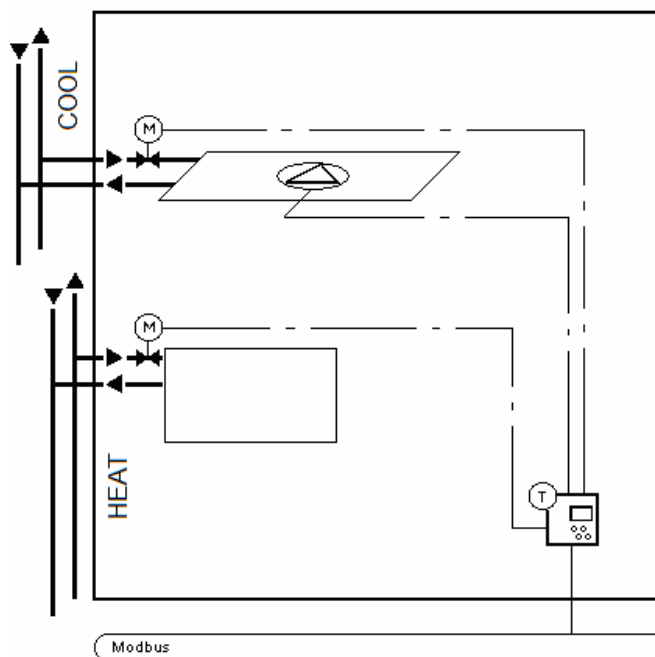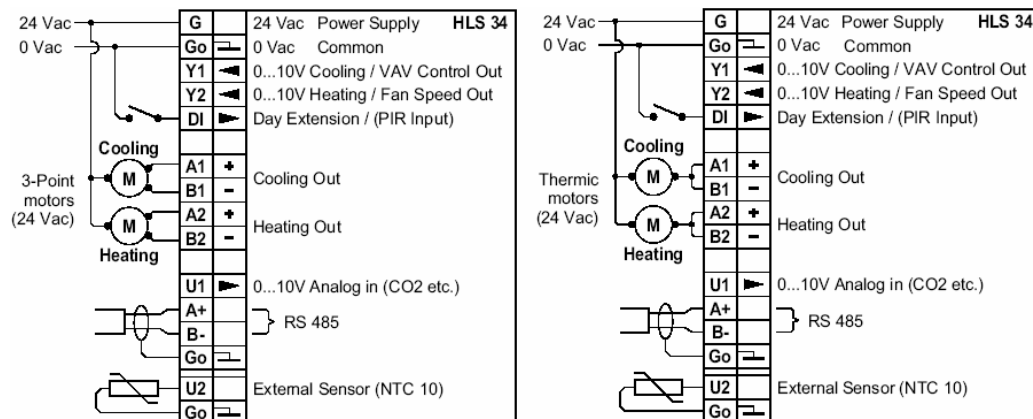

Temperature is detected by the internal sensor of the HLS34. If an external temperature sensor such as return air sensor or remote room sensor is required, this can be connected to the wiring terminals provided on the controller. The external sensor type is NTC10.
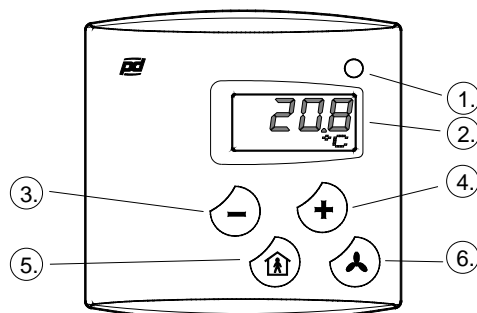
WIRING TERMINALS

The electrical installation, device connection and commissioning can only be carried out by qualified professionals and according to the local wiring regulations!
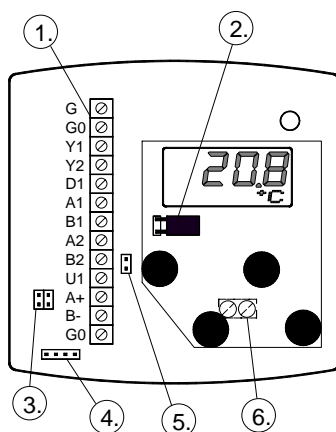

		HLS 34
24 Vac	G	24 Vac Power Supply
0 Vac	Go	0 Vac Common
	Y1	0...10V Cooling / VAV Control Out
	Y2	0...10V Heating / Fan Speed Out
	DI	Day Extension / (PIR Input)
3-Point motors (24 Vac) Cooling	A1 +	Cooling Out
	B1 –	
Heating	A2 +	Heating Out
	B2 –	
	U1	0...10V Analog in (CO_2 etc.)
	A+	RS 485
	B-	
	Go	
	U2	External Sensor (NTC 10)
	Go	

		HLS 34
24 Vac	G	24 Vac Power Supply
0 Vac	Go	0 Vac Common
	Y1	0...10V Cooling / VAV Control Out
	Y2	0...10V Heating / Fan Speed Out
	DI	Day Extension / (PIR Input)
Thermic motors (24 Vac) Cooling	A1 +	Cooling Out
	B1 –	
Heating	A2 +	Heating Out
	B2 –	
	U1	0...10V Analog in (CO_2 etc.)
	A+	RS 485
	B-	
	Go	
	U2	External Sensor (NTC 10)
	Go	

USER MODE

HLS34 display indicates room temperature. There are four (4) touch sensitive buttons in the controller.

1. Status LED
2. LCD display
3. Setpoint adjustment (-)
4. Setpoint adjustment (+)
5. Day extension button
6. Fan speed overdrive button
   - OFF = 0 V
   - SPEED 1 = 3 V
   - SPEED 2 = 6 V
   - SPEED 3 = 10 V
   - AUTO 3 - 10 V

PROGRAMMING MODE

1. Wiring terminals.
2. Configuration mode jumper.
   - Set = User mode
   - Removed = Programming mode
3. Modbus enable jumpers.
   - Both on = on the bus
   - Both off = off the bus
4. Socket for HLS34 configuration tool.
5. Bus termination (120 ohm).
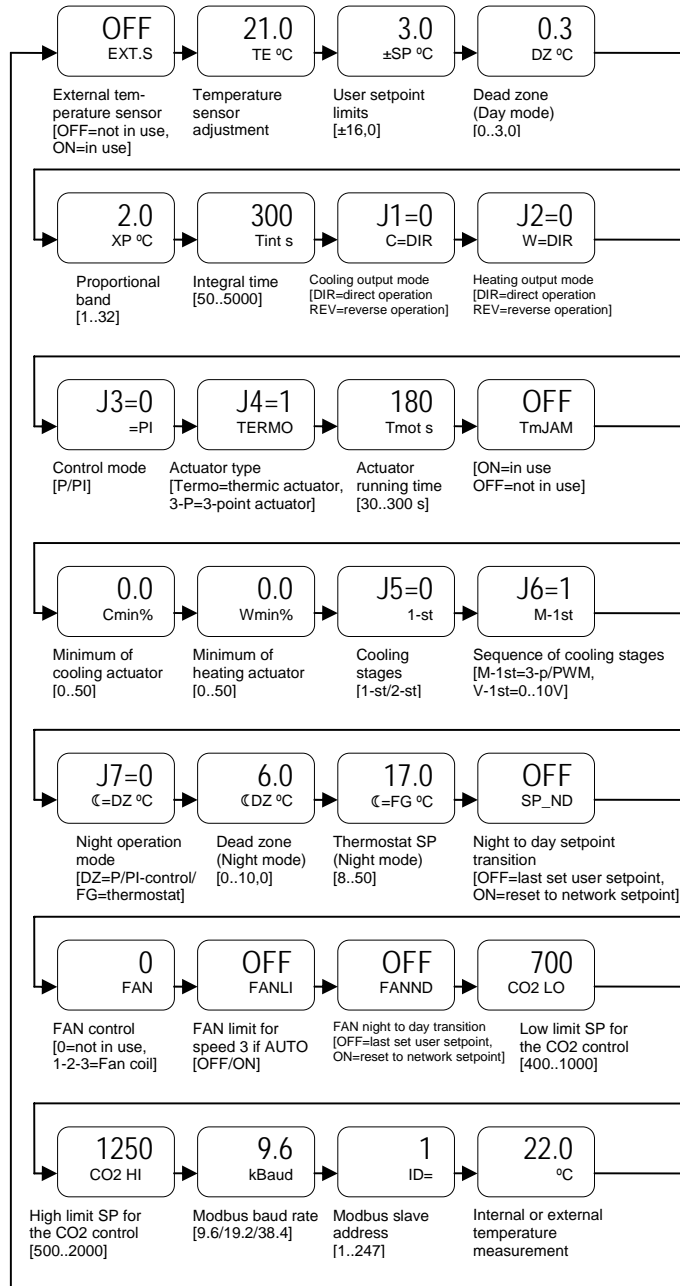6. External sensor terminals. Access when display is removed.

The controller is parameterised locally via a configuration mode, or using HLS34 Handheld Configuration Tool (Produal HLS 34 Ser). The HLS34 handheld tool allows quick configuration of large number of controllers.
To configure the controller locally, first remove the top cover. A CONFIGURATION MODE JUMPER is located below the LCD display. When the jumper is set the controller is in normal operation. By removing the jumper the controller enters to the configuration mode. Once the configuration has been completed, by setting the jumper the controller returns to the normal operation.
NOTE! The controller is supplied with the configuration jumper unset i.e. in the configuration mode

MENU

Push ⌂-button to proceed in the menu. ⌂-button goes forward and ⌂-button backward. Change values by ⊕ or ⊖ -buttons. Parameters will be saved at the end.

OFF	21.0	3.0	0.3
EXT.S	TE ºC	±SP ºC	DZ ºC
External temperature sensor [OFF=not in use, ON=in use]	Temperature sensor adjustment	User setpoint limits [±16,0]	Dead zone (Day mode) [0..3.0]

2.0	300	J1=0	J2=0
XP ºC	Tint s	C=DIR	W=DIR
Proportional band [1..32]	Integral time [50..5000]	Cooling output mode [DIR=direct operation REV=reverse operation]	Heating output mode [DIR=direct operation REV=reverse operation]

J3=0	J4=1	180	OFF
=PI	TERMO	Tmot s	TmJAM
Control mode [P/PI]	Actuator type [Termo=thermic actuator, 3-P=3-point actuator]	Actuator running time [30..300 s]	[ON=in use OFF=not in use]

0.0	0.0	J5=0	J6=1
Cmin%	Wmin%	1-st	M-1st
Minimum of cooling actuator [0..50]	Minimum of heating actuator [0..50]	Cooling stages [1-st/2-st]	Sequence of cooling stages [M-1st=3-p/PWM, V-1st=0..10V]

J7=0	6.0	17.0	OFF
☾=DZ ºC	☾DZ ºC	☾=FG ºC	SP_ND
Night operation mode [DZ=P/PI-control/ FG=thermostat]	Dead zone (Night mode) [0..10,0]	Thermostat SP (Night mode) [8..50]	Night to day setpoint transition [OFF=last set user setpoint, ON=reset to network setpoint]

0	OFF	OFF	700
FAN	FANLI	FANND	CO2 LO
FAN control [0=not in use, 1-2-3=Fan coil]	FAN limit for speed 3 if AUTO [OFF/ON]	FAN night to day transition [OFF=last set user setpoint, ON=reset to network setpoint]	Low limit SP for the CO2 control [400..1000]

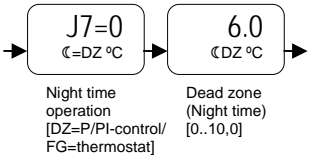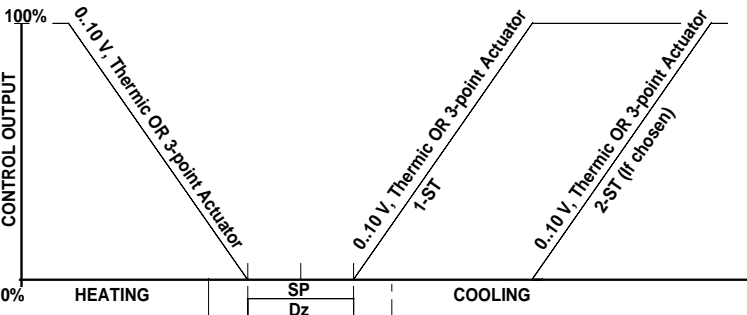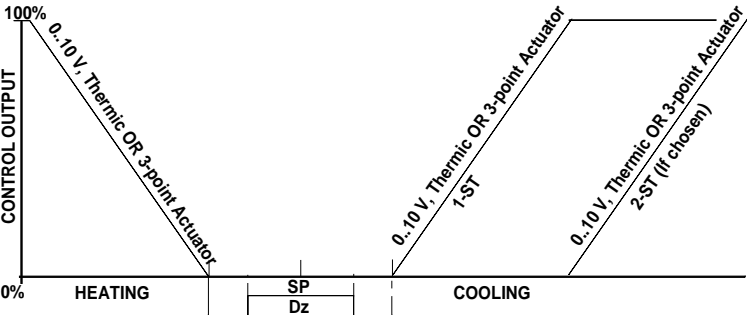| 1250	9.6	1	22.0
CO2 HI	kBaud	ID=	ºC
High limit SP for the CO2 control [500..2000]	Modbus baud rate [9.6/19.2/38.4]	Modbus slave address [1..247]	Internal or external temperature measurement

OPERATION MODES

HLS 34 can be switched between DAY and NIGHT modes. NIGHT mode is only possibly to enable by Modbus.

NIGHT Changeover to DAY: Via the DAY EXTENSION input typically connected to PIR. The user can also change NIGHT mode to DAY mode by pressing "MAN IN THE HOUSE" (occupancy) button on the unit. After 2-hours (adjustable) DAY mode returns automatically back to the NIGHT mode. Permanent DAY mode is possible set via Modbus. When in DAY mode the controller operates the valve outputs according to the below diagram.

The controller DAY setpoint (SP) is deviated according to "User setpoint limits" [±16,0]. Range is limited at the commissioning stage (default ±3°C). If range has been set ± 0 then adjustment causes "DENY" message to display.

HLS34 has two operation strategies for night function:
1. Expanded Dead Zone
2. Frost Guard

STRATEGY	OPERATION
1.	In the DAY mode the temperature is controlled to the setpoint using P/PI-control. The controller has adjustable dead zone (DZ) between heating and cooling modes. In the NIGHT mode the temperature is controlled to the setpoint using P/PI-control, but the deadzone around the controller is expanded to NDz value. Therefore at the night time the controller energy consumption is reduced. NOTE! It is also possible to set the night deadzone to smaller value than day deadzone.

	When the controller returns to the DAY MODE from NIGHT, the controller DAY setpoint can return to the DAY setpoint programmed previous day, or the DAY SP can be reset to the SPnetwork Modbus Network Setpoint. This is a configurable option (configuration parameter SP_ND). If no network setpoint is available 21°C is used as default.
2.	 In the DAY mode the temperature is controlled to the setpoint using P/PI-control. The controller has adjustable dead zone (DZ) between heating and cooling modes. The configuration parameter J7 = 1 sets the frost guard (FG) operation during the night time. In the NIGHT mode the controller controls to the frost guard (FG) setpoint. If the temperature falls below the NIGHT setpoint, the heating valve is opened and the fan is overridden on (if fan speed control has been enabled). The NIGHT setpoint is adjustable via Modbus network or in the configuration mode.

FAN COIL CONTROL

Fan coil control can be enabled during the commissioning (configuration parameter FAN).
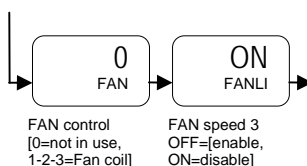
FAN mode	Operating
FAN = 0	Fan coil control NOT IN USE. Output Y2 (0..10 V) controls heating actuator.
FAN = 1	Fan coil control is controlled by needs of cooling.
FAN = 2	Fan coil control is controlled by needs of heating.
FAN = 3	Fan coil control is controlled by needs of cooling and heating.

When fan speed control is enabled the Heating Analogue output is converted operate as the control signal to the (Produal FCRY 3) fan speed control relay module.

For example when FAN = 2 with FCRY 3 controls the fan speed output by needs of heating:

Temp within Dz	Valve actuator closed and fan closed after 5 min. timeout.	Y2 = 0 V FCRY 3: Fan speed = OFF
Temp<Dz marginal	Valve actuator opens	Y2 = 3 V FCRY 3: Fan speed = 1
Temp<<Dz marginal	Valve actuator opens more than 25%	Y2 = 6 V FCRY 3: Fan speed = 2
Temp<<<Dz marginal	Valve actuator opens more than 50%	Y2 = 10 V FCRY 3: Fan speed = 3

Automatic Speed 3 control is disabled as default. However, the user can manually override speed 3 on through the keypad. Typically speed 3 causes a higher level fan noise and therefore it is recommended that this is manual override option operated by the user. Automatic Speed 3 control can be enabled during the commissioning via basic settings. When the controller switches to NIGHT mode or the temperature is within the dead zone, the fan is automatically switched OFF after 5 minutes timeout.


```
    0              ON
   FAN           FANLI

FAN control     FAN speed 3
[0=not in use,  OFF=[enable,
1-2-3=Fan coil] ON=disable]
```

VENTILATION BOOST (CO2 Control)

If HDK or HDH CO2 transmitter is connected to the controller analogue input U1, the controller can be enabled to boost the fan speed / switch the fan On in case of high CO2 content in the occupancy space. This is a very useful feature to provide demand based ventilation. High CO2 level overrides the fan speed set by the temperature based fan speed control. Controller works as a fresh air solution.

DAY EXTENSION VIA DIGITAL INPUT

The controller has hardware digital input that can be connected to a momentary push button contact (Produal PJP 1) or to a PIR sensor (Produal LA24) to override the controller to DAY operation. These are typically used out of hours to provide comfort control. Alternatively PIR input can be used as the primary means of switching between DAY and NIGHT modes.

NOTE! The digital input is activated when it is first time closed. The controller is supplied with the digital input as open contact.

DAY EXTENSION VIA KEYPAD

The controller can be overridden to DAY operation by pressing the "MAN IN THE HOUSE" occupancy button. When pressed the controller is overridden to DAY mode for the period of two hours. The extension time is adjustable between 1..480 minutes via Modbus network.

VAV CONTROL WITH FRESH AIR DEMAND BOOST

The controller can also be used as Variable Air Volume controller by connecting the VAV Box damper to the output Y1. The output Y1 is then modulated according to temperature demand in the room space. If HDK or HDH CO2 transmitter is connected to the controller analogue input U1, the controller can increase the fresh air demand i.e. overdrive the analogue output Y1 when the CO2 content in the room space exceeds the acceptable limit. The CO2 influence is set via configuration parameters CO2 LO (e.g. 750 ppm) and CO2 HI (e.g. 1250 ppm). Between the CO2 limits the influence is calculated using linear relationship i.e. when CO2 measurement is at CO2 HI setpoint, the CO2 influence is 100% Y1=10V).

SERVICE ALARM

If controller do not reach setpoint during 120 hours change state of SERVICE ALARM in ON in Modbus registers.

THERMIC ACTUATOR JAM

If TmJAM=ON then the thermic actuator is opened and closed for 5 minutes once a day.

3-POINT ACTUATOR POSITIONING

When the position indicator is in minimum or in maximum position, actuator starts in every 5 minutes motion towards the margin (5 seconds long) and updates the real position.

NOTE! It is very important to set as accurate as possible actuator running time to get best process control.

HEATING AND COOLING LIMITS

There is possibility to set minimum position WMIN% (heating motor) CMIN% (cooling motor) to the actuator (voltage, 3-point and thermic). In this case the device will not, in any situation, control the actuator under these limits.

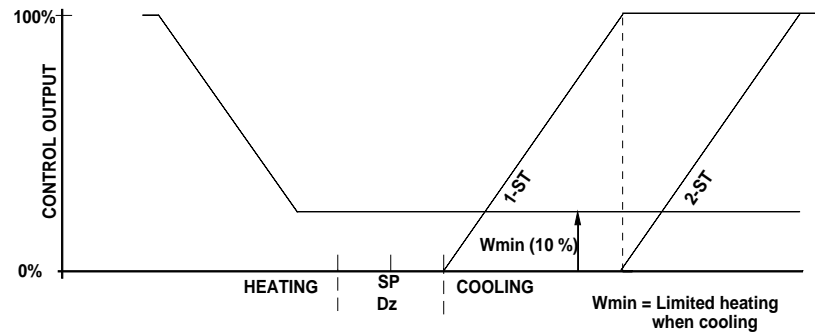**BUS TERMINATION**

— BUS TERMINATION 120ohm.
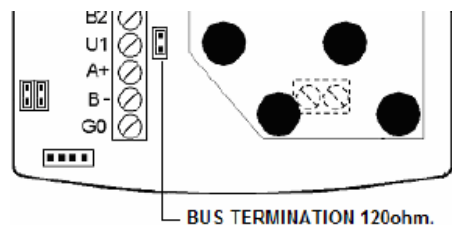
HEATING AND COOLING LIMITS

Heating limit of radiators is one way to prevent discomfort of chilly air that flows down the window in the office. There is possibility limit heating output up to 50% when cooling.
If cooling stages [1-st] selected. Both heating and cooling limits are allowed.
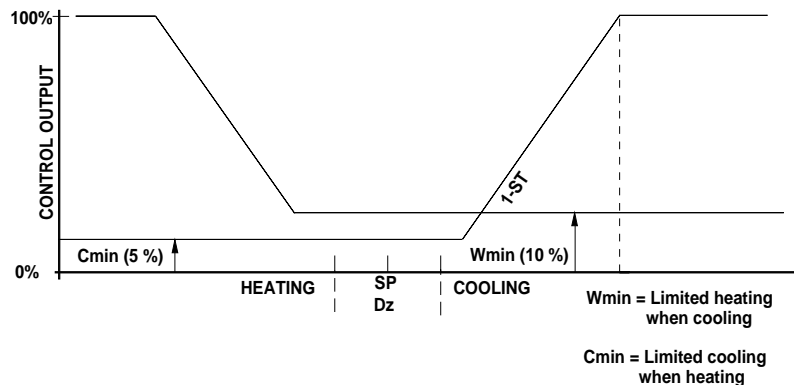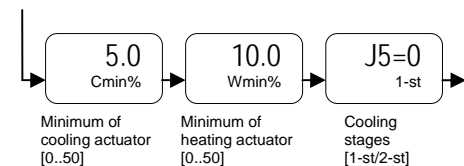
NOTE! If cooling stages [2-st] is selected cooling limit is not allowed.

```
  ┌─────────┐   ┌─────────┐   ┌─────────┐
  │   0.0   │→  │  10.0   │→  │  J5=1   │→
  │  Cmin%  │   │  Wmin%  │   │   2-st  │
  └─────────┘   └─────────┘   └─────────┘
  Minimum of    Minimum of    Cooling
  cooling actuator  heating actuator  stages
  [0..50]       [0..50]       [1-st/2-st]
```


Wmin (10 %)

HEATING   SP   COOLING
          Dz

1-ST   2-ST

Wmin = Limited heating
when cooling

CONTROL OUTPUT
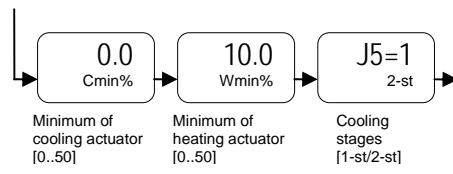
NETWORK DIAGRAM

Up to 128 HLS34 controllers can be connected to a single network segment. The diagram below illustrated the typical installation where the room controllers are connected on the floor level to the Netbiter embedded web-server. Each Netbiter holds a time schedule for the floor to switch the controller between day and night operation modes.
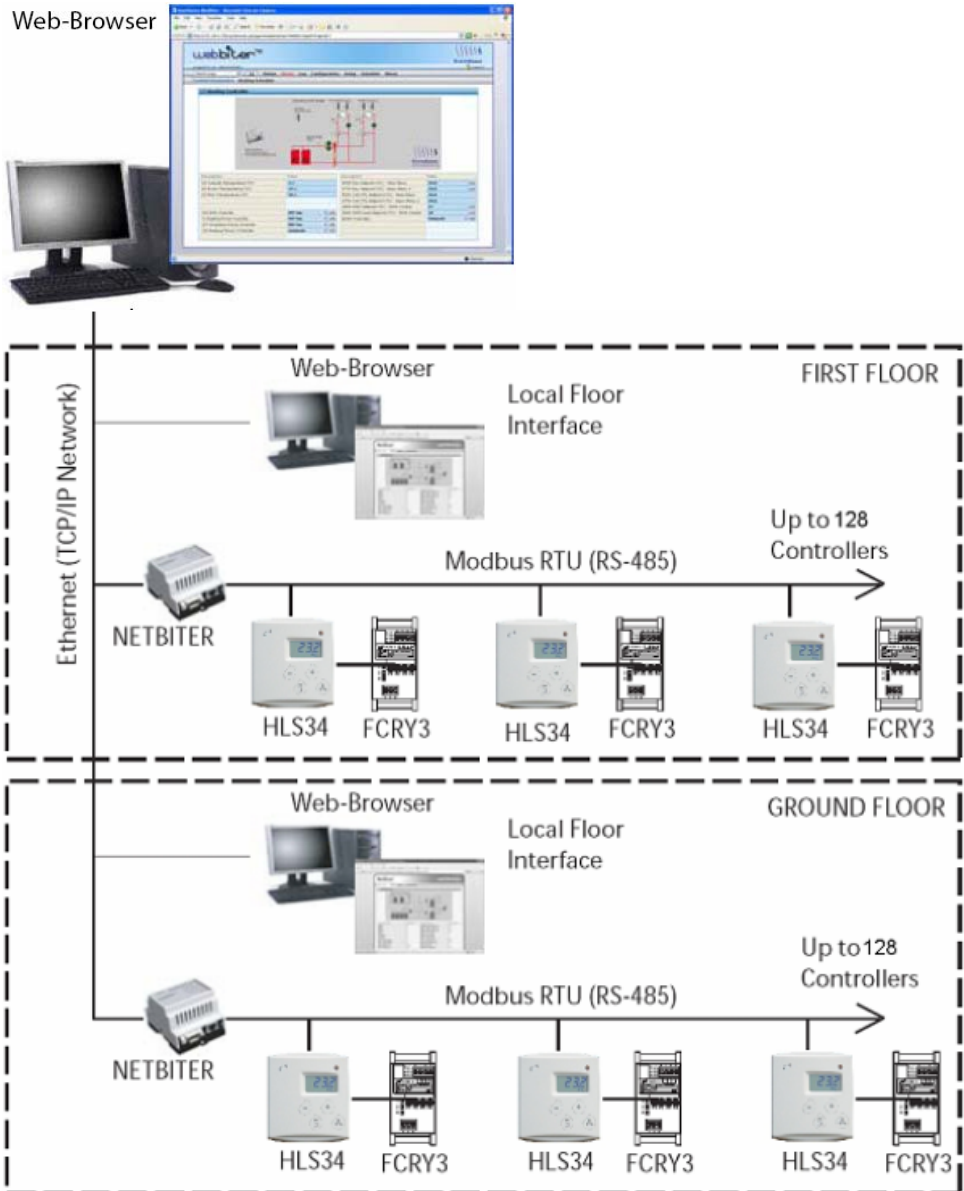
HLS34 VER.1.3 The controller supports the following Modbus registers and function codes.

Register	Parameter Description	Data Type	Value	Range
	FUNCTION CODE 01 - READ COILS			
2	Overdrive enable	Bit0	On - Off	On - Off
3	NIGHT	Bit1	On - Off	On - Off
4	SERVICE ALARM	Bit2	On - Off	On - Off
6	FAN Speed 1	Bit4	On - Off	On - Off
7	FAN Speed 2	Bit5	On - Off	On - Off
8	FAN Speed 3	Bit6	On - Off	On - Off
9	FAN Speed 4 (Auto)	Bit7	On - Off	On - Off
	FUNCTION CODE 02 - READ DISCRETE INPUTS			
10002	Occupied by PIR	Bit0	On - Off	On - Off
10003	Occupied by Man in House	Bit1	On - Off	On - Off
10004	DAY EXTENSION (NIGHT mode to DAY-mode)	Bit2	On - Off	On - Off
10005	External Sensor used	Bit3	On - Off	On - Off
10006	Current FAN Speed 1	Bit4	On - Off	On - Off
10007	Current FAN Speed 2	Bit5	On - Off	On - Off
10008	Current FAN Speed 3	Bit6	On - Off	On - Off
	FUNCTION CODE 03 - READ HOLDING REGISTERS			
40003	Coils 16 - 01	16 bit		
40004	FAN Speed by Modbus	Signed 16	0 - 1 - 2 - 3 - 4	0 - 1 - 2 - 3 - 4
40005	Overdrive Cooling	Signed 16	0-1000	0,0 … 100,0 (%)
40006	Overdrive Heating	Signed 16	0-1000	0,0 … 100,0 (%)
40007	Day Setpoint by Modbus	Signed 16	80-500	8,0 … 50,0 (C)
40008	Night Setpoint by Modbus	Signed 16	80-500	8,0 … 50,0 (C)
40009	XP	Signed 16	10-320	1,0 … 32,0 (C)
40010	Tint	Signed 16	50-5000	50 … 5000 (s)
40011	Cooling minimum	Signed 16	0-500	0,0 … 50,0 (%)
40012	Heating minimum	Signed 16	0-500	0,0 … 50,0 (%)
40013	DAY EXTENSION period	Signed 16	1-480	1 … 480 (minutes)
	FUNCTION CODE 04 - READ INPUT REGISTERS			
30002	Discrete Inputs 16 - 01	16 bit		
30003	Coils 16 - 01	16 bit		
30004	FAN Speed by Modbus	Signed 16	0 - 1 - 2 - 3 - 4	0 - 1 - 2 - 3 - 4
30005	Overdrive Cooling	Signed 16	0-1000	0,0 … 100,0 (%)
30006	Overdrive Heating	Signed 16	0-1000	0,0 … 100,0 (%)
30007	Day Setpoint by Modbus	Signed 16	80-500	8,0 … 50,0 (C)
30008	Night Setpoint by Modbus	Signed 16	80-500	8,0 … 50,0 (C)
30009	XP	Signed 16	10-320	1,0 … 32,0 (C)
30010	Tint	Signed 16	50-5000	50 … 5000 (s)
30011	Cooling minimum	Signed 16	0-500	0,0 … 50,0 (%)
30012	Heating minimum	Signed 16	0-500	0,0 … 50,0 (%)

300**13**	DAY EXTENSION period	Signed 16	1-480	1 … 480 (minutes)
300**14**	Temperature	Signed 16	-600-600	-60,0 … 60,0 (C)
300**15**	External Temperature	Signed 16	-600-600	-60,0 … 60,0 (C)
300**16**	CO2	Signed 16	0-2000	0 … 2000 (ppm)
300**17**	Effective Setpoint	Signed 16	50-5000	5,0 …50,0 (C)
300**18**	Current Cooling	Signed 16	0-1000	0,0 … 100,0 (%)
300**19**	Current Heating	Signed 16	0-1000	0,0 … 100,0 (%)
300**20**	Current FAN Speed	Signed 16	0 - 1 - 2 - 3	0 - 1 - 2 - 3

FUNCTION CODE 05 - WRITE SINGLE COIL

2	Overdrive mode (Cooling or Heating)	Bit0	On - Off	On - Off
3	NIGHT-mode	Bit1	On - Off	On - Off
4	SERVICE ALARM	Bit2	On - Off	On - Off
6	FAN Speed 1	Bit4	On - Off	On - Off
7	FAN Speed 2	Bit5	On - Off	On - Off
8	FAN Speed 3	Bit6	On - Off	On - Off
9	FAN Speed 4 (Auto)	Bit7	On - Off	On - Off

FUNCTION CODE 06 - WRITE SINGLE REGISTER

400**3**	Coils 16 - 01	16 bit		
400**4**	FAN Speed by Modbus	Signed 16	0 - 1 - 2 - 3 - 4	0 - 1 - 2 - 3 - 4
400**5**	Overdrive Cooling	Signed 16	0-1000	0,0 … 100,0 (%)
400**6**	Overdrive Heating	Signed 16	0-1000	0,0 … 100,0 (%)
400**7**	Day Setpoint by Modbus	Signed 16	80-500	8,0 … 50,0 (C)
400**8**	Night Setpoint	Signed 16	80-500	8,0 … 50,0 (C)
400**9**	XP	Signed 16	10-320	1,0 … 32,0 (C)
400**10**	Tint	Signed 16	50-5000	50 … 5000 (s)
400**11**	Cooling minimum	Signed 16	0-500	0,0 … 50,0 (%)
400**12**	Heating minimum	Signed 16	0-500	0,0 … 50,0 (%)
400**13**	DAY EXTENSION period	Signed 16	1-480	1 … 480 (minutes)

FUNCTION CODE 15 - WRITE MULTIPLE COILS

2	Overdrive mode (Cooling or Heating)	Bit0	On - Off	On - Off
3	NIGHT-mode	Bit1	On - Off	On - Off
4	SERVICE ALARM	Bit2	On - Off	On - Off
6	FAN Speed 1	Bit4	On - Off	On - Off
7	FAN Speed 2	Bit5	On - Off	On - Off
8	FAN Speed 3	Bit6	On - Off	On - Off
9	FAN Speed 4 (Auto)	Bit7	On - Off	On - Off

FUNCTION CODE 16 - WRITE MULTIPLE REGISTERS

400**3**	Coils 16 - 01	16 bit		
400**4**	FAN Speed by Modbus	Signed 16	0 - 1 - 2 - 3 - 4	0 - 1 - 2 - 3 - 4

40005	Overdrive Cooling	Signed 16	0-1000	0,0 … 100,0 (%)
40006	Overdrive Heating	Signed 16	0-1000	0,0 … 100,0 (%)
40007	Day Setpoint by Modbus	Signed 16	80-500	8,0 … 50,0 (C)
40008	Night Setpoint	Signed 16	80-500	8,0 … 50,0 (C)
40009	XP	Signed 16	10-320	1,0 … 32,0 (C)
40010	Tint	Signed 16	50-5000	50 … 5000 (s)
40011	Cooling minimum	Signed 16	0-500	0,0 … 50,0 (%)
40012	Heating minimum	Signed 16	0-500	0,0 … 50,0 (%)
40013	DAY EXTENSION period	Signed 16	1-480	1 … 480 (minutes)

FUNCTION CODE 22 - MASK WRITE REGISTER

40002	Coils 16 - 01	16 bit		AND 0 … 0xFFFF
				OR 0 … 0xFFFF