ECObus® MODBUS COMMUNICATIONS

INSTALLATION AND OPERATION INSTRUCTIONS

English

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2. INTRODUCTION

2.1 General Description

Modbus is a serial communications protocol that may be used with v9 Ecopower PCB to connect a supervisory computer to a remote terminal unit (RTU). Modbus Slave data management system, refer to Figure 1 below, can then be used to manage and control data.

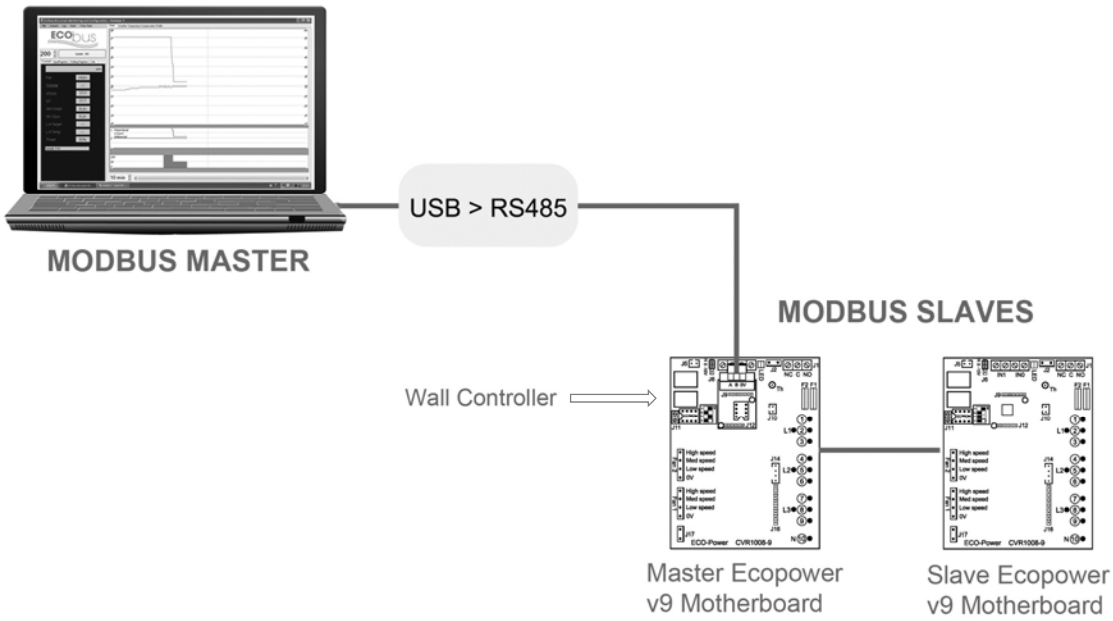

Figure 1: Modbus Slave Gateway, with slave(s) on the serial side

The Modbus Slave gateway connects to Modbus Master running at 9600 baud rate using ECObus® monitoring and configuration software. The ECObus® software communicates via a USB to RS-485 serial converter interface adaptor. We suggest adaptors with FTDI (Future Technology Devices International) chipsets are used, this cable is USB powered and USB 2.0 full speed compatible.

By default, the controller is configured to Modbus address 200. Where multiple Thermoscreens devices are used, the Modbus addresses must be modified so that each device has a unique address. This is most easily achieved by connecting each controller (one at a time) to laptop or PC running ECObus® software and modifying the Modbus address registers.

Multiple air curtains may be linked using RJ control cable with the master Ecopower PCB DIP switch setting of DIP3 to ON. Installing a single Modbus interface in the master will allow control of a string of air curtains. However, for this type of arrangement, it is not possible to monitor the state of slave units, other than a combine fault register.

2.2 Modbus Functionality

Modbus functionality
The Modbus interface allows the following functionality
1) Monitoring of current heating Power and fan levels
2) Monitoring of local fault code
3) Monitoring combined fault for multiple connected controllers
4) Live Modbus control of on/off, auto/manual, heat and fan levels
5) Live Modbus control of an auxiliary/fault/status relay.
6) Lockout of wall controller buttons
7) Read of the controller software version
8) Read of the fan runtime and over temperature trip counts for that controller.
9) Modification of Modbus baud and address. *
10) Configuration of temperature offset for special environments *
11) Configuration of custom temperature profile for weather compensation *
11) Configuration of special input modes, temperature thresholds and response times *
12) Configuration of custom door switch operation (times/heat levels) *

* requires installation of configuration 24LC32A EEPROM (Electrically Erasable Programmable Read Only Memory)

2.3 Configuration EEPROM

Fitting a configuration EEPROM (24LC32A RS Components 454-416) allows permanent changes to holding registers +20 onwards, controlling Modbus baud rate and address, times, temperature profiles and special input modes.
Without an EEPROM fitted, Modbus functional is limited to monitoring and control using the first 10 holding register.
The 24LC32A EEPROM is fitted to the 8-pin DIL socket on the v9 Ecopower PCB, refer to Figure 2.
The EEPROM must be correctly orientated with all pins aligned and fitted to 8-pin DIL socket.

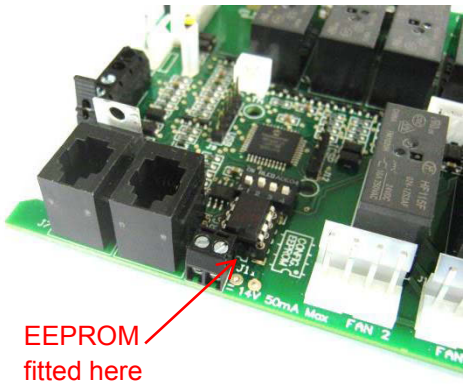

Figure 2: EEPROM Location on v9 Ecopower PCB

The EEPROM is fitted in a DIL socket, so that in the rare event of v9 Ecopower PCB replacement, the EEPROM may be refitted in the replacement board so custom settings are not lost.

3. INSTALLATION

ECObus® application software requires Microsoft Windows XP, Vista, Windows 7 or Windows 8 operating system.

Access account by typing Customer details as **'thermoscreens'** and password as **'curtain'**.

Select to download ECObus®, launch and follow instruction on screen to set-up and install the application software.

For Modbus communication, additional hardware components required are Modbus interface board T7263627 and a USB to RS-485 serial convertor adaptor cable. Modbus interface board is available from Thermoscreens. We recommend only adaptors with FTDI chipsets, such as RS Components 730-0164, are used.

Figure 3

Connect black wire from RS-485 adaptor to OV terminal on Modbus board. Follow up and connect the orange and yellow wires to terminals A and B respectively. Adaptor wires Red, Brown and Green wires are not required and can be trimmed.
For all but the shortest run, cable connections should use screened twisted pair cable (similar to R.S. 749-1627) connecting A-A, B-B and the screen to the 0V connection at both ends.

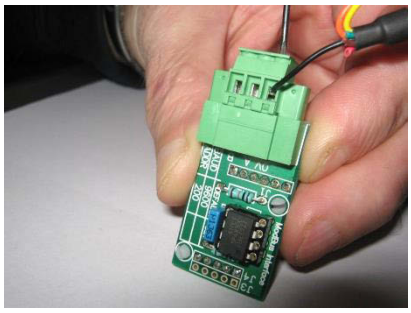

Figure 4

The Modbus interface board T7263627 is connected to a 5-pin jumper J12 and 6-pin jumper J9 on v9 Ecopower PCB. Note location of jumper pins and fixing holes as detailed in Figure 5.

Figure 5

Align the Modbus board locking clips, fitted at the bottom of the two nylon mounting pillars, with two fixing holes on Ecopower PCB, refer to Figure 6. Ensure the connectors on the Modbus board are correctly fitted to jumper pins.

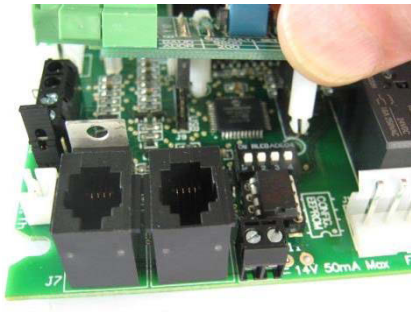

Figure 6

Refer to top view of Modbus interface board.

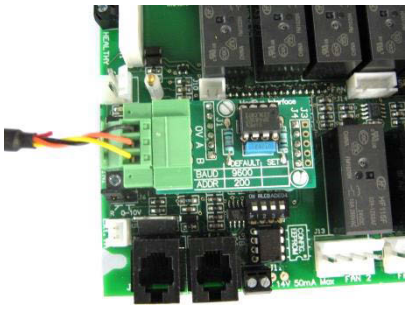

Figure 7

Connect the USB plug to laptop.

Figure 8

4. REGISTERS

4.1 Input Registers

Input registers are read-only. Access to the wall controller, temperatures and power level are provided, using Modbus command 4.

(30001) +0	Flags In	Current setting of wall controller : 8-bit binary value 1 On/Off 2 * 4 * 8 * 16 Restart on power up – wall controller dipswitch 32 Auto 64 Stop fan on cold – wall controller dipswitch 128 Don't blow cold– wall controller dipswitch * Internal use only. See also +4.
+1	Heat In	Heat set by user at wall controller. In auto (thermostatic) mode 0 Cold - - 224 Hottest In manual mode 0 Cold 128 Half Heat 255 Full Heat Not valid in weather compensation mode.
+2	Fan In	From wall controller 0 Stop 64 Low fan speed 128 Mid fan speed 192 High fan speed
+3	Spare(+3)	Internal use
+4	Flags	Operational state from wall controller or Modbus 8-bit binary value 1 On/Off 2 * 4 * 8 * 16 Restart on power up – wall controller dipswitch 32 Auto 64 Stop fan on cold – wall controller dipswitch 128 Don't blow cold– wall controller dipswitch * Internal use only.

+5	Heat	Output electrical heat. Controllers with off/half/full output 0 Cold 64 Half heat 192 Full heat Controller with proportion heating control will return a proportional value from 0 (cold) to 255 (100%).
+6	Fan	Fan speed output 0 Stop 64 Low fan speed 128 Mid fan speed 192 High fan speed
+7	Status	Binary value, combination of the following 1 Actual Temperature (AT) is from wall controller 2 External Temperature XT overridden 4 IN0 is overridden 8 IN1 is overridden 16 - 32 - 64 - 128 - 256 BMS jumper is 0-10V proportional mode 512 Leaving air thermistor sensor is fitted 1024 Leaving air temperature is controlled 2048 Heat relay 1 4096 Heat relay 2 8192 Prevent cold blow 16384 Closing water valve on power up 32768 -
+8	Dipswitches	This register is a decoding of the dipswitches and options. 10 bit binary value – sum of : 1 Interlock 2 No run-on 4 Master 8 In0 only inhibits heat in auto, for switched thermostat 16 Fan is proportional control 32 Heat is proportional control 64 Heat control is a water valve 128 256 Interlock heat and fan 23 512 Weather compensation With all dipswitches off, this register will read zero.
+9	Global Faults	Combined fault code from the local controller and any daisy-chained controller. Remote faults may take up to 60 seconds to clear. 10 bit binary value – sum of : 1 Low volts 2 Low volts, no fan 4 Overheat safety cut-out has operated, needs reset 8 Reserved 16 On-board thermistor 32 Communications timeout

		64 External thermistor 128 Overheat safety cut-out open 'now' 256 Configuration parameters invalid 512 Fan Proving
+10	Actual Temperature (AT)	Simple thermostat mode only Calculate temperature in °C *T = (85+ X)/11.4* Increasingly inaccurate beyond 15°C - 25°C.
+11	Desired Temperature (DT)	Simple thermostat mode only – Desired temperature set at the wall controller, and compared to AT (see +10) In Auto mode, calculate temperature in °C *T = (85+ X)/11.4*
+12	NTC1	On-board thermistor Value 0-1023.
+13	NTC2	Thermistor (Ext Th.) connected to J5. In weather compensation modes, the outside temperature sensor is connected here, otherwise used for ambient temperature. Value 0 - 1023.
+14	24 Volts	Internal 24 Volt rail, a very low value indicates the protective thermal over temperature trip has operated. 424 = approximate 24.0V.
+15	IN0	IN0 value : Normally resistive input inhibit mode Measures resistance or 0-10V voltage depending on jumper. Resistive mode : Short circuit gives low value (run) Resistive mode : Open circuit gives ~56000 (inhibit) 0-10V mode: 4191 counts / volt, heat control.
+16	IN1	IN1 value: Normally resistive input door switch input. Measures resistance or 0-10V voltage depending on jumper. Resistive mode : Short circuit gives low value (door closed) Resistive mode : Open circuit gives ~56000 (run) 0-10V mode: 4191 counts/volt, normally fan control.
+17	Thermistor (Leaving Air Temperature)	Approximate calculation with 100k thermistor T = 72.133 - X * 0.0014 >65000 = not fitted.
+18	Outside	For weather compensation modes only 16bit filtered value from NTC2 sensor on J5 or overridden by Modbus. Temperature in degrees C. T = 276.98 – 24.98 * LN(X)
+19	EEPROM	Optional configuration EEPROM status. Normally, with no EEPROM fitted, returns zero. 8 bit binary representing configuration EEPROM, sum of : 1 present 2 failed 4 corrupt 8 blank 16 has header 32 reserved eeprom2 64 reserved RTC 128 undefined

+20	Inhibit State	State from IN0 inhibit input and Modbus inhibit register 0 = inhibit heat and fan 1 = inhibit heat 2 = normal
+21	Leaving air temperature target	Approximate calculation *T = 72.133 - X * 0.0014*
+22	Integral	Internal use only. Calculated integral actual temperature used in P.I.D. control. Not valid for weather compensation.
+23	Power	For proportional electrical heat control, value represents power level from 0 (0%) to 65535 (100%).
+24	Water Valve Target	Water valve target position Runtime = X * 10mS
+25	Water Valve Actual	Water valve actual position Runtime = X * 10mS
+26	Spare	Reserved
+27	Local Fault	Fault code from this controller. 10 bit binary value – sum of : 1 Low volts 2 Low volts, no fan 4 Overheat safety cut-out has operated, needs reset 8 - 16 On-board thermistor 32 Communications timeout 64 External thermistor 128 Overheat safety cut-out open ‘now’ 256 Configuration parameters invalid 512 Fan Proving Also see input (+9) for global fault.
+28	Rate of Change AT	Calculated rate of change of actual temperature used in P.I.D. control. Not applicable to weather compensation modes.

4.2 Holding Registers

Holding registers may be both read and modified using Modbus commands.

Registers 0-9 are volatile (i.e. not retained on removal of power) and are used for active control of operation by a Modbus master controller.

Registers 10-19 are locked, and contain identification and usage information

Registers 20 onwards are parameters which control performance and temperature profiles. Changes to these registers are volatile (i.e. not retained on removal of power) unless a configuration EEPROM is fitted to the control PCB. To protect for unintentional changes to the EEPROM, the unlock register (+0) must be set to special value of 12345 to enable permanent changes.

Address	Function	Description
40001 +0	Unlock EE	Protects the configuration EEPROM from accidental changes. To allow permanent modifications to holding register parameters +18 onward, first set this register is set to the unlock value of 12345. A configuration EEPROM must be fitted.
+1	Modbus Heat Override	**Default value 1024** Value 0-255 = heat level, fixed heat Value 256-511 = heat level, auto. Value 512 = off Value 1024 = ignore this override Wall controller heat setting will be overridden For fixed heat appliances: 0-63 Cold, 64-127 Half heat, 128-255 Full heat For proportional heat controller appliances, 0-255 gives 0-100% fixed heat If in auto mode, the value between 256 and 511 sets the thermostat temperature in proportion to the value.
+2	Modbus Fan Override	**Default value 256** Value 0-255 = fan level, 256 = use wall controller. Modify this value to remotely set fan speed. For fixed speed fans: 0 Stop (* see note below) 64 Low fan speed 128 Mid fan speed 192 High fan speed Wall controller fan setting will be ignored when override is active. Note: To turn off the control, setting the fan to zero is not recommended – use holding registers +1 or +3 instead.
+3	Wall controller Coil Relays	**Default value 0** Sets the state of the wall controller. 16 Bits of coils relays accessible

		as a holding register. These may also be modified and read using the coil access commands. Set to the sum of the following: 1 On * 2 Off * 4 Auto * 8 Manual * 16 (reserved for) Set Cooling * 32 (reserved for) Clear Cooling * 64 Inhibit Heat 128 Inhibit Fan 256 Lock wall controller on/off button 512 Lock wall controller Auto button 1024 Lock wall controller heat buttons 2048 Lock wall controller fan buttons 4096 - 8192 - 16384 - 32768 - * Bits 0-5 are acted on when changed from 0 to 1. To simply turn the control on/off set the register to 1 (on) and 2 (off).
+4	Room temperature sensor override	Allows the Modbus controller to provide ambient indoor temperature. Simple thermostat auto mode only. Not valid for weather compensation modes. **Default value 0** Value 0 = normal sensor Value 1-255 = override by Modbus. Calculate temperature in °C T = (85+ X)/11.4
+5	External (outside) temperature sensor override	Allows the Modbus controller to provide outdoor temperature thermistor J10. Valid for full weather compensation modes, enabled by option register bit3 (+25=8). **Default value 0** Value = 0, normal sensor on J10 Value > 0, override
+6	IN0 override	Override the programmable input IN0 **Default value 1024** = don't override 0 = simulate short circuit ~890 = simulate open circuit The function of this input is defined by register +66.
+7	IN1 override	Override the programmable input IN1 **Default 1024** = don't override 0 = simulate short circuit ~890 = simulate open circuit The function of this input is defined by register +67.

+8	Thermal Trip Reset	**Default value 0** To clear a thermal trip fault, it is necessary to power down the control and power up after the thermal trip has reset. The fault condition may then be reset by writing the value 54321 to this register, then writing 12345.
+9	Aux Relay	Default value is from **(+64)** Selects the mode of the programmable aux relay RLY1. 0 : Relay off 1 : Relay on 2 : Relay energised on no local faults 3 : Relay energised on any local fault 4 : Relay energised on global no faults ** 5 : Relay energised on global any fault ** 6 : Relay energised when no local faults and switched on. 7 : Outside temperature comparator (+55,+56) 8 : Relay energised in cooling mode * Value from power-up is read from (+70), normally 4. ** Global fault is the combined fault value from slave units, any may take up to 60seconds to reset.
+10	Device	Locked, read-only device identifier. V9 Ecopower always returns 130.
+11	Software Version	Locked, read-only, 144 = 9.0
+12	Serial number High	Locked, read-only
+13	Serial number Low	Locked, read-only
+14	ID	Read-only
+15	Maxheats, Maxfans	Read only
+16	Run Hours	Operating hours with the fan running. Max value 65535 = 7.5years. Partial hours are not recorded if the power is interrupted. Read-only.
+17	Service Hours	Operating hours with the fan running. Read-only.
+18	Trip Count	Counts operations on the over-temperature protective thermostat. Read-only.
+19	Spare	-
+20	Modbus Baud	**Default value 9600** Valid values 4800, 9600, 19200, 38400. Modification only takes effect after power is removed and replaced.
+21	Modbus Address	**Default value 200** Valid values 0 - 255 Modification only takes effect after power is removed and replaced.
+22	Fan Start Time	**Default value 250** Valid 0 – 255. Duration (x0.04 seconds) to run fan at full speed on start up. Do not modify
+23	Step down time / step up time	**Default value 1,1** For relay controlled fans, adds a short delay changing speeds Do not modify
+24	Run-on cool-down time	**Default value 12000** (x 0.01 seconds = 120 seconds) Valid 0-65535 Maximum time to run fan after switch off if the elements are hot. Note: DIP switch 2 only set can disable fan run-on for water heated air curtains.

+25	Option	**Default value 0** Wall controller is required, no cooling option Bitwise value 1 Allow operation without wall controller 2 Cooling Mode Enabled (Local input) 4 Cooling mode enabled (wall switch control) 8 Enable compatibility mode and enable full weather compensation.
+26	DT Zero	**Default value 140** Not used in weather compensation modes. Offset desired room temperature range on the wall controller in auto mode. Increasing the value will make the range hotter and reducing it will make it cooler. Sensitivity is approximately 11 count/°C so, for example, a value of 118 will move the thermostat range 2°C colder.
+27	AT Zero	**Default value 712** Temperature offset adjustment. Not used in weather compensation modes or with the wall controller temperature sensor. Adjust measured of temperature range on the on-board in auto mode. Reduce value by 11 counts per degree, so for example change to 705 to make thermostat range one degree hotter.
+28	xt2on, xt2off	For weather compensation without SSR or MWV. Full heat outside temperature thresholds. Only used for weather compensation mode with 'off-half-full' heat control (paella). **Default value 159,148** Packed two byte value. 159 = 10degrees 18.42k 148 = 12degrees 16.92k Ensure xt2on is greater than xt2off.
+29	xt1on, xt1off	For weather compensation without SSR or MWV. Half heat outside temperature thresholds. Only used for weather compensation mode with 'off-half-full' heat control (paella). **Default value 133,124** Packed two byte value. 133 = 15degrees 14.74k 124 = 17degrees 13.47k Ensure xt1on is greater than xt1off.
+30	Weather comp 1	Setpoint for weather compensation profile with SSR or MWV. **Default value 0, 69** (0°C, 69%) * see weather compensation profile.
+31	Weather comp 2	Setpoint for weather compensation profile with SSR or MWV. **Default value 80, 33** (80°C, 33%) * see weather compensation profile.
+32	Weather comp 3	Setpoint for weather compensation profile with SSR or MWV. **Default value 150, 0** (15°C, 0%) * see weather compensation profile.
+33	Weather comp 4	Setpoint for weather compensation profile with SSR or MWV. **Default value 160, 0** (16°C, 0%) * see weather compensation profile.

+34	LAT0% Leaving air temperature 0%	**Default value 18** For appliances with SSR or MWV and leaving air temperature sensor fitted. Minimum outlet temperature. Value in degrees C.
+35	LAT100% Leaving air temperature 100%	**Default value 50** For appliances with SSR or MWV and leaving air temperature sensor fitted. Maximum outlet temperature. Value in degrees C.
+36	LATCOOL0% Leaving air temperature 0%	**Default value 23** For appliances with cooling option only Maximum target outlet temperature in cooling mode. Value in degrees C.
+37	LATCOOL100% Leaving air temperature 100%	**Default value 13** For appliances with cooling option only Minimum target outlet temperature in cooling mode. Value in degrees C.
+38	Fan Min	**Default value 50** For EC variable speed fans only, output to fan at low speed setting. Output 0=0%, 255=100%. Do not set fan speeds below recommended values.
+39	Fan Mid	**Default value 130** For EC variable speed fans only, output to fan at mid speed setting. See +38
+40	Fan Max	**Default value 255** For EC variable speed fans only, output to fan at high speed setting. See +38
+41	Interlock 1 fan/heat	0,0. Do not modify
+42	Interlock 2 fan/heat	192,127. Do not modify
+43	Interlock 3 fan/heat	128,127. Do not modify
+44	Thermostat differentials	0,12 Do not modify
+45	Thermostat differentials	6,18 Do not modify
+46	Thermostat differentials	12,24 Do not modify
+47	Spare	.
+48	Water Valve Deadzone, Water Valve Deadzone Cool	**Default value 45,10** Scaling 45 counts per degree. Prevent movements of water valve with small LAT temperature errors. Higher = less movements, less accurate temperature control. A low value may reduce water valve lifespan due to addition operations. Two byte values for warm and cool modes of operation.
+49	Water Valve Max	**Default value 75** (= 75 seconds) Maximum runtime of the water valve actuator.
+50	Water Valve Overclose	**Default value 75** Additional time to drive valve closed to ensure valve is shut.
+51	Heat minimum	**Default value 64** Minimum power when prevent 0kw dipswitch on wall controller set.
+52	Inhibit Delay	**Default value 40**, x 10mS = 0.4 seconds Time to act on setting inhibit by IN1.

+53	Inhibit Delay Off	**Default value 1500**, x 10mS = 15.0 seconds Time to act on releasing inhibit by IN1.
+54	Special Mode	**Default value 0** = Normal 1 = French auto, requires external temperature sensor, will inhibit heat above [ExtT1,+55], and re-enable below [ExtT0,+56].
+55	ExtT1	124 = 18.0°C
+56	ExtT0	135 = 16.0°C
+57	Doorswitch Reset Time	**Default value 30** (= 30seconds) On resetting the door switch input, the controller remains in door-open mode for this time.
+58	Doorswitch Max Standby Heat	Reduced heat output when door switch input is active (door closed) **0 = Cold (default)** 128 = max half heat 255 = no reduction
+59	Doorswitch Max Standby Fan	Reduced fan speed when door switch input is active (door closed) 0 = stop **64 = low (default)** 128 = medium 255 = no reduction
+60	Integral T/stat	**Default value 128** Stability of the room temperature control feedback loop for electrically heated air curtains with SSR only. Higher is less responsive and more stable.
+61	Integral LAT	**Default value 128** Stability of the temperature control feedback loop for electrically heated air curtains with SSR only in manual mode. Higher is less responsive and more stable.
+62	Integral Water	**Default value 8** Stability of the environment temperature control feedback loop, for modulating water air curtains. Higher is less responsive and more stable.
+63	Integral Water LAT	**Default value 64** Stability of the leaving air temperature feedback loop for modulating water air curtains. Higher is less responsive and more stable.
+64	Integral Cooling	**Default value 8** For air curtains with cooling option only. Stability of the environment temperature control feedback loop, for modulating water air curtains in cooling mode. Higher is less responsive and more stable.
+65	Integral Cooling LAT	**Default value 64** For air curtains with cooling option only. Stability of the leaving air temperature feedback loop for modulating water air curtains in cooling mode. Higher is less responsive and more stable.
+66	Differential T/stat	**Default value 0** Intake air thermostat. If non-zero, thermostatic control reacts to rate of change of temperature (PID), helping to prevent overshoot. 0 = disabled, by default.
+67	Differential T/stat WS	**Default value 15** Wall controller thermostat mode only. If non-zero, thermostatic control reacts to rate of change of temperature (PID), helping to prevent overshoot.

+68	Spare	
+69	Spare	
+70	Relay mode at power up	Aux relay control mode, copied to (+9) at start-up. Default value 4: Global healthy relay.
+71	Wall control at power-up	**Default value 0**
+72	IN0 mode	Function of IN0 programmable input. **Default value 1** (Inhibit). 0 – No function, resistance readable by Modbus. 1 – Inhibit, short-circuit to enable, 3k3 = run cold. 2 – Select by DIP4 dipswitch. Off : Simple Weather Compensation On : Door switch (global, master controls slaves). 3 – Door switch (local controller only). 4 – Door switch (global, master controls slaves) 5 – Simple weather compensation
+73	IN1 mode	Function of IN1 programmable input. **Default value 2** (DIP 4 selects simple weather compensation or door input). See +72 for function.
+74	SSR Rate	**Default value 512** Used in electrically heated air curtains with SSR control. Frequency of pulse width control.
+75	Test mode	Do not modify

4.3 Coils

Coil Relays: These are binary values that may also be modified and read using the modus coil access commands.

As an alternative, it may be simpler to access holding register +9, which contains all 16 coil bits.

+0		On *
+1		Off *
+2		Auto *
+3		Manual *
+4		Inhibit Heat
+5		Inhibit Fan
+6		
+7		
+8		Lock wall controller on/off button
+9		Lock wall controller Auto button
+10		Lock wall controller heat buttons
+11		Lock wall controller fan buttons
+12		
+13		
+14		
+15		

* Bits 0-3 are only acted on when changed from 0 to 1.

5. 7-DAY TIMER

A built-in Timer module, which is included within ECObus®, is selected by clicking the left mouse button on the '7-Day Timer' tab, see Figure 9. Click 'OK' on the 'Created event file CurtainCall.xml'.

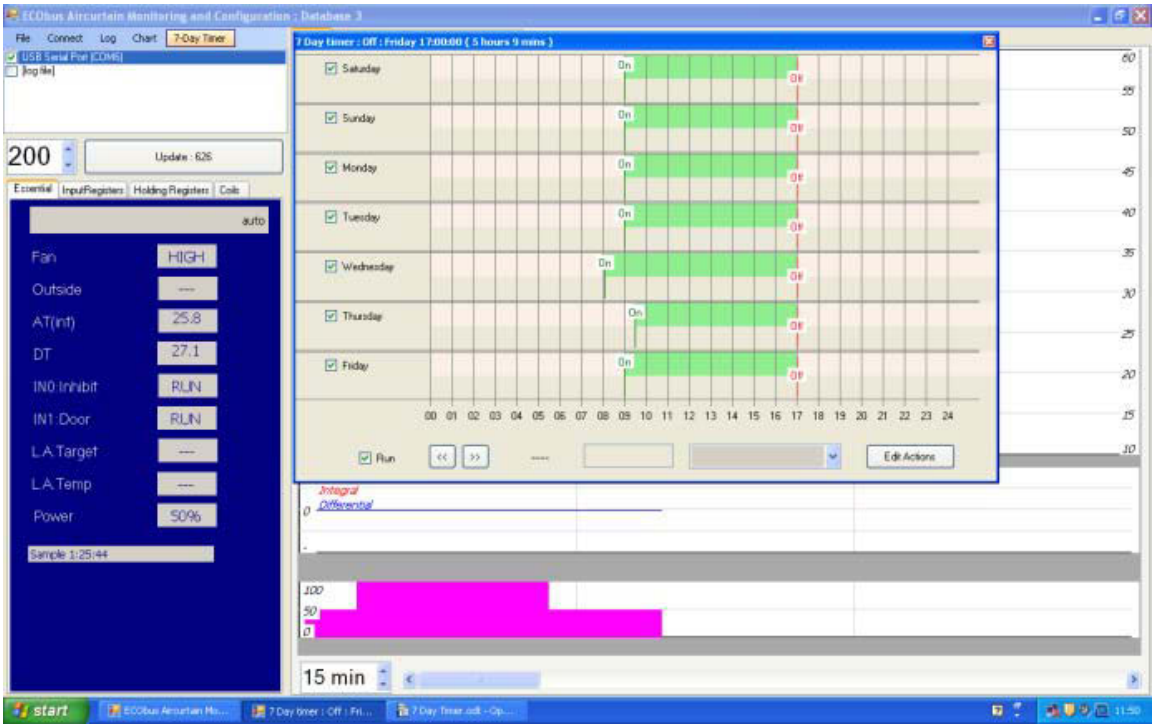

Figure 9

The air curtain is currently set to high fan-speed, automatic mode with 50% heating Power. From the computer system the current time is 11:50 am on a Friday. Press the double left arrow key and edit the Friday Off time to 11:55:00, refer to Figure 10 below.

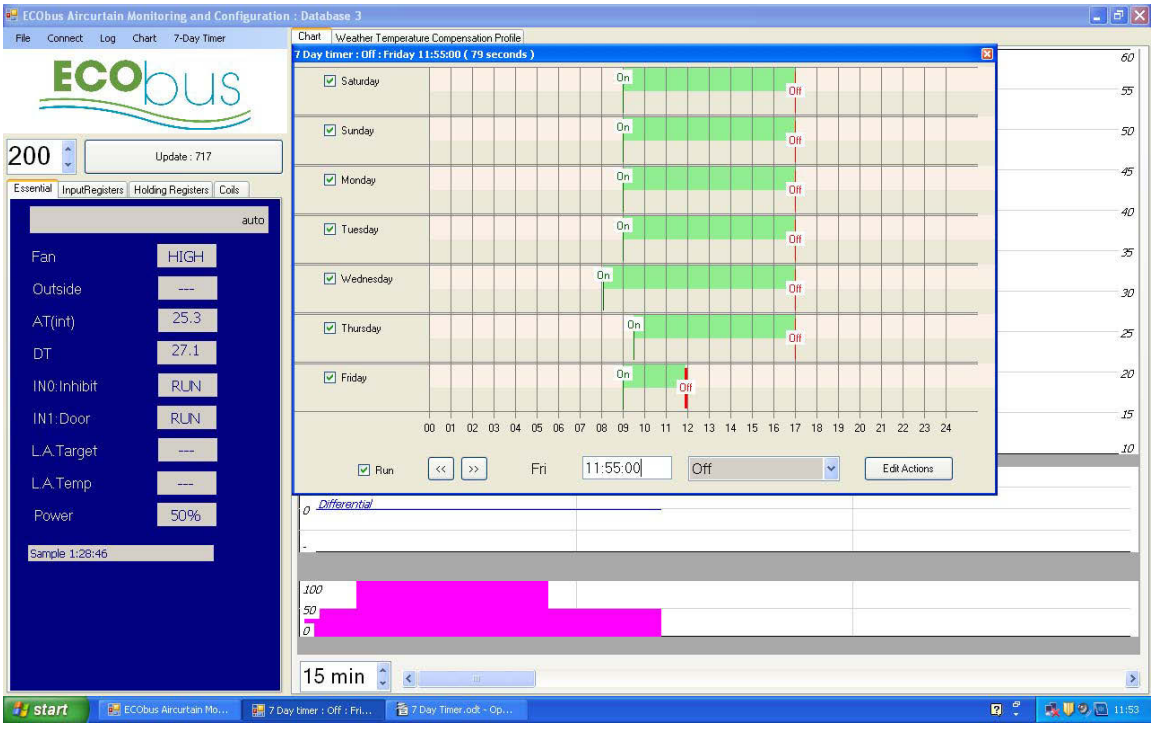

Figure 10

At 11:55am, the air curtain heating stage is disabled and a 2-minute fan over-run (purge) occurs.

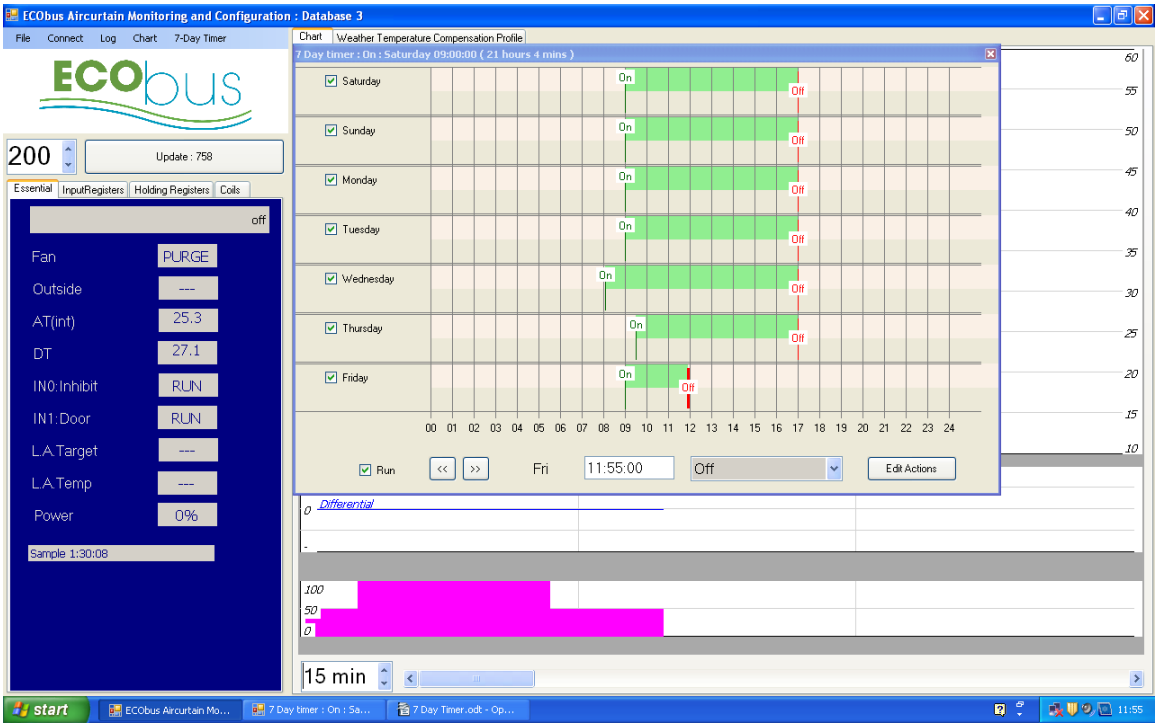

Figure 11

At 11:57am the air curtain fan stops, refer to Figure 12.

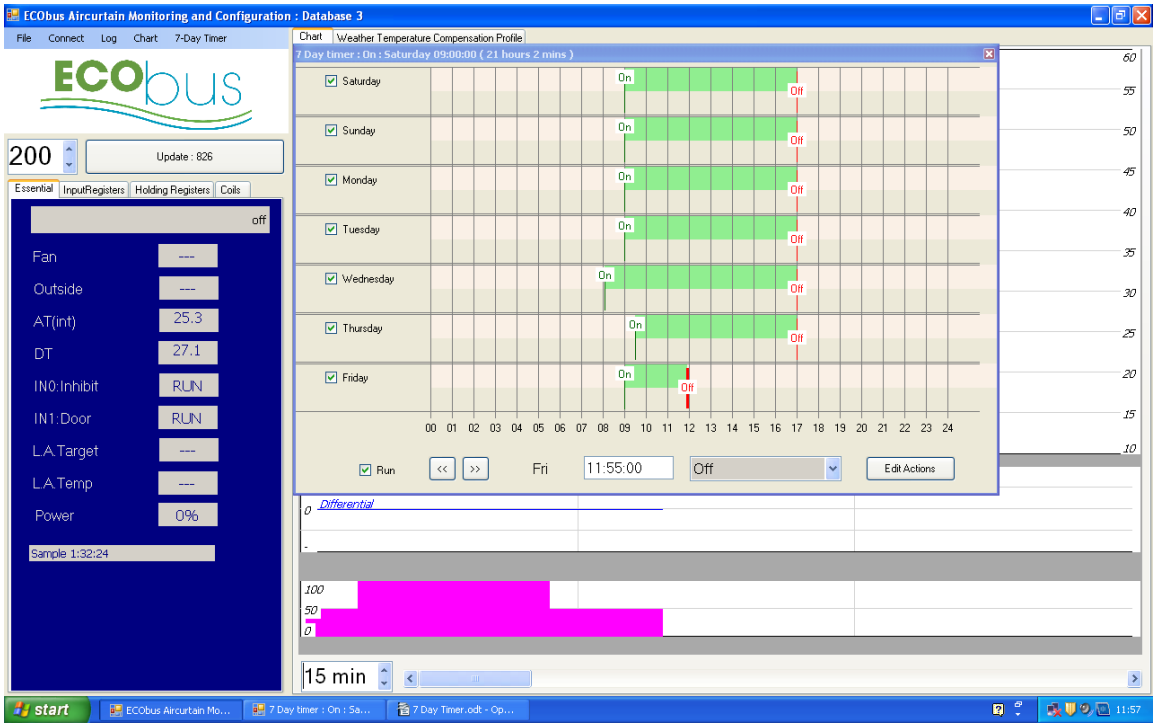

Figure 12

Notes