



UNIT CONTROLLER 7 (UC7) Modbus Communications

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1. Introduction

Temperzone air conditioning units equipped with a UC7 controller board provide a facility to communicate with external devices, such as a Building Management System (BMS) or a data logging device. Communications follow standard modbus format.

A modbus master connected to the UC7 via RS485 is able to do the following:

- Turn the compressor on and off.
- Read and control the indoor fan speed.
- Read and control cooling, heating or fan only.
- Read and control the capacity.
- Enable and disable de-humidification mode.
- Enable and disable quiet operating mode.
- Monitor temperatures, pressures, states of other input signals.
- Observe unit safety timers.
- Observe the state of the outputs such as CMC relay, R/V relay etc.
- Observe information on reported faults.
- Restart a locked out unit.
- If the unit has a master system plus one or more slave systems then all of the above information is also available for all slave systems.

Regardless whether the unit is controlled by a thermostat or a BMS, safety features built into the unit will always be applied. For example: A compressor may be held off until a minimum off-time has expired and this delay will always be applied independent of the request of a thermostat and/or a BMS.

2. Data format

The Modbus mode is RTU half duplex using serial communications over RS485.

Baud rate	Data bits	Parity	Stop bits
19200	8	Even	1

To check the software version installed on the UC7 controller:

- Switch off mains power to the unit, wait a couple of seconds, then switch mains power back on.
- Watch the display on the controller circuit board as it is powered up. It will first show the characters "UC7" followed by the software version, e.g. "5.2".

3. Available modbus functions

The UC7 accepts the following modbus function codes:

- Function code 03: Read holding registers
- Function code 06: Write single register
- Function code 16: Write multiple register

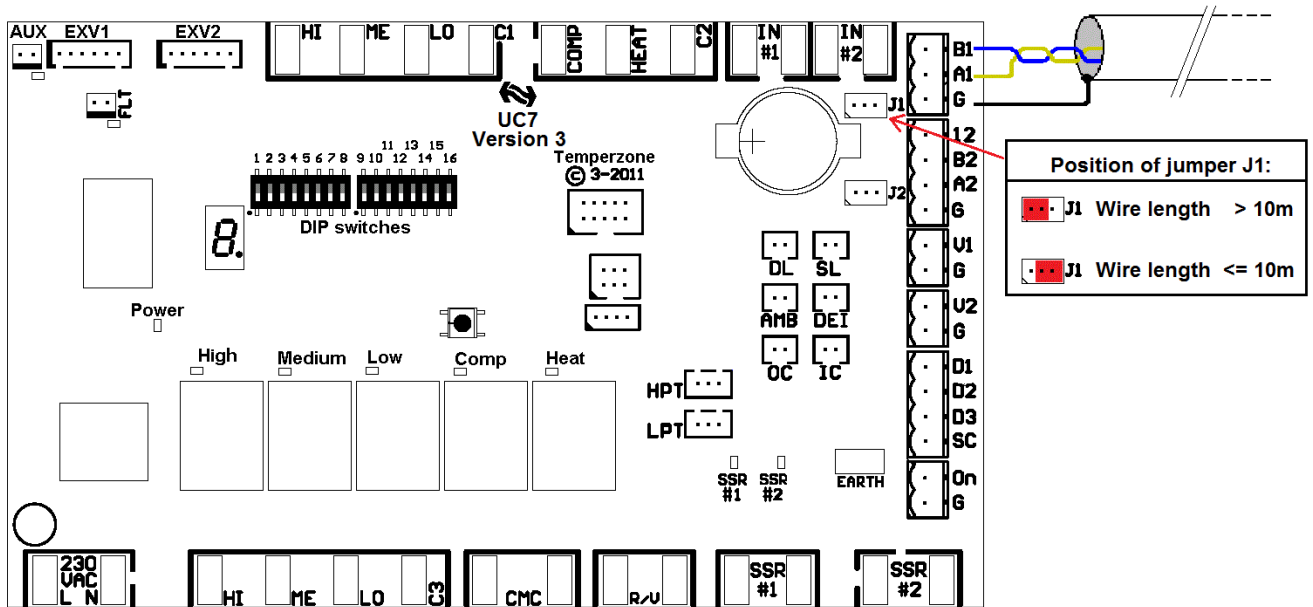
Read access through function 03 is limited to a maximum of 25 registers per function call.

Write access through functions 06 and 16 is allowed to a restricted set of holding registers.

4. Connections

Modbus communications with the UC7 are handled via RS485. It is recommended to use a shielded twisted pair cable. Recommended wire gauges are 24AWG to 18 AWG (0.5 to 1.0mm wire diameter).

The external device must be a modbus master and should connect to terminals A1 (+) and B1 (-), as shown below. The shield wire should connect to terminal G.



Up to a maximum of 99 units can be connected on a common RS485 bus in daisy-chain fashion.

When the RS485 cable ends at the unit and the length of the RS485 cable is relatively long (more than about 10m), then place jumper J1 on the left two pins. When the unit is not at the end of the RS485 cable, or where the cable length is 10m or less, place jumper J1 on the right two pins.

The maximum cable length is 1000m.

It is recommended to use an isolated RS485 interface. An isolated interface ensures maximum safety and reliability, especially when the RS485 cable length is long.

If the modbus master (BMS) has an available USB port, a variety of isolated USB to RS485 converters are readily available at low cost.

5. Changing the device modbus device address

The default modbus device address of the Temperzone UC7 controller is **44**.

The controller offers a facility to view and change the modbus device address. The procedure is as follows:

- Turn mains power on.
- Ensure the thermostat and the compressor are off.
- Press and hold down the pushbutton on the controller board until the display shows the letter “A”, then release the button. The controller is now in “modbus address selection” mode.
- The display will show the current modbus device address. Subsequent button presses will increase the address. After address 99 the address will cycle back to 1 in round-robin fashion.
- When the button has not been pressed for more than 30 seconds the controller will leave setup mode and return to normal mode.

If the address was changed during address selection mode then the controller will save the new address in non-volatile memory. The new modbus device address will be retained even after mains power has been switched off.

6. List of holding registers

6.1. Temperatures

The following registers represent temperatures ⁽¹⁾. Divide by 100 to obtain temperature in °C. Temperatures are signed numbers and may read negative. Negative numbers are represented in standard binary two’s-complement 16-bit word format.

Register	Function	Units	Type
1	Outdoor coil temperature ⁽²⁾	0.01°C	Read only
2	Indoor coil temperature ⁽²⁾		
3	Outdoor ambient temperature		
4	Suction line temperature		
5	Discharge line temperature		
6	De-ice sensor temperature		
7	Evaporating temperature ⁽²⁾		
8	Condensing temperature ⁽²⁾		
9	Controller circuit board temperature		
10	Suction side superheat	0.01 Kelvin	
11	Discharge side superheat		

Note 1: Many units do not have all temperature sensors fitted. A read of a holding register where no temperature sensor is present returns value -10000 (that is: -100.00°C).

Note 2: *If a unit is fitted with pressure transducers on the compressor discharge- and suction- lines then evaporating and condensing temperatures are calculated from pressure readings. If no temperature sensors are fitted on the indoor- and/or outdoor- coils then the reported indoor- and outdoor- coil temperature may be copies of the calculated evaporating- and condensing- temperatures (which one depends on whether the unit is cooling or heating).*

6.2. Pressures

The following two registers represent pressures in kPa ⁽³⁾.

Register	Function	Units	Type
13	Compressor suction line pressure	kPa	Read only
14	Compressor discharge line pressure		

Note 3: *Not all models are fitted with pressure transducers. A read of a register where no pressure transducer is present can either return a pressure that is calculated using the evaporating or condensing temperatures as measured by temperature sensors that may be fitted to the indoor- and outdoor coils, or return value -200 if no coil temperature is known.*

6.3. Registers with write access

A modbus master device, such as a BMS, can gain write access to one or more holding registers by writing a '1' to the corresponding bit in the "Write-enable" register 101. Write access is available only for selected registers. The default state of all registers is read-only.

Notes:

When a BMS has written **any** of the write-enable bits to value 1, then the BMS should control and/or request information from the unit **at least once every 5 minutes** (i.e. either reading-of or writing-to a holding register is considered sufficient to maintain contact).

If 5 minutes expire without the BMS making contact then the controller takes the following actions:

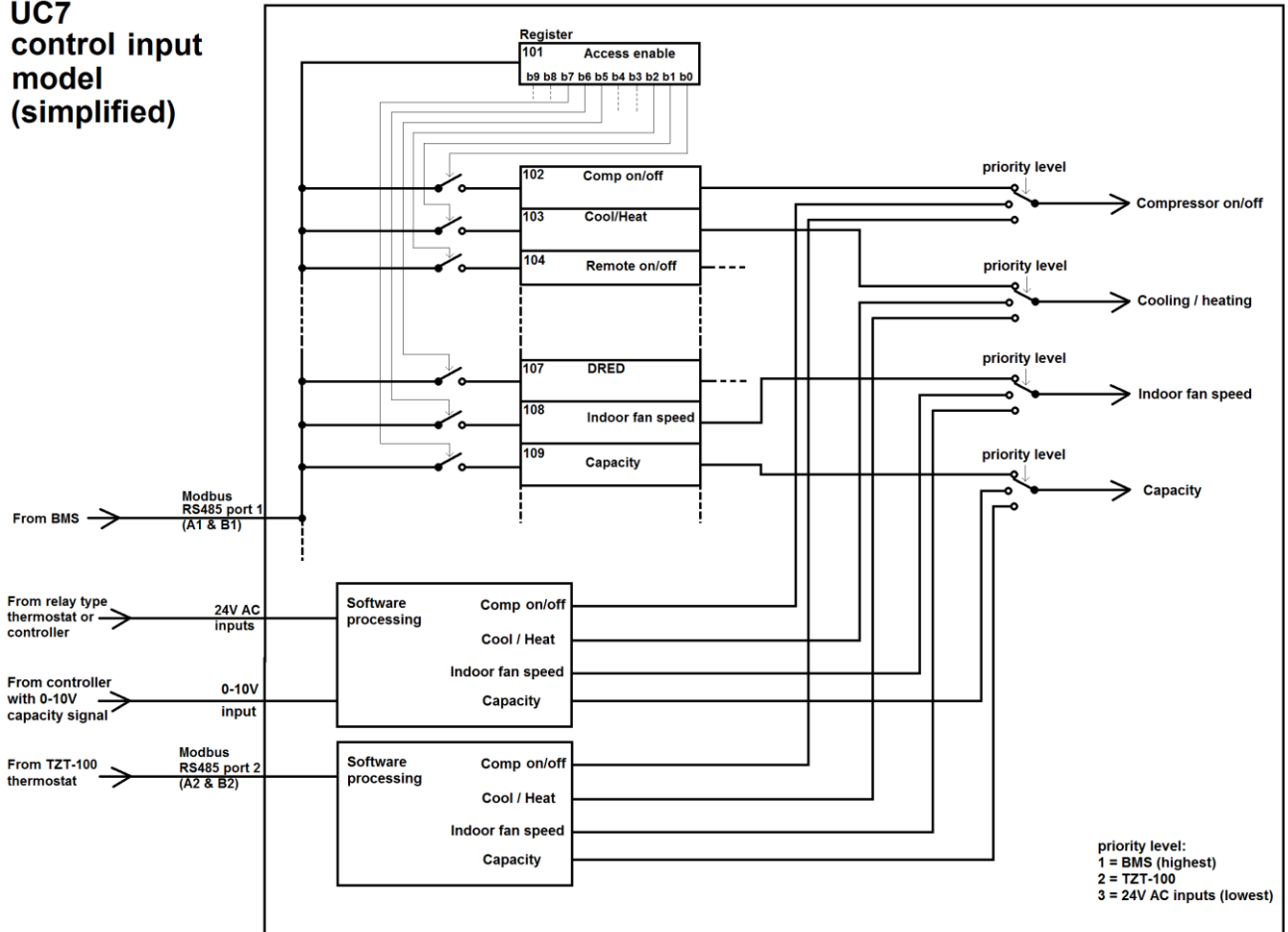
- The fault relay is activated and a fault code is shown on the display.
- If the BMS controls the compressor on/off the unit will stop.
- If the BMS does NOT control the compressor on/off the unit continues operating using the last known parameters.
- The indoor fan continues running at the last requested speed.

The diagram below is a simplified schematic representation of the input control logic on the UC7. Individual bits in access-enable register 101 control ‘switches’ that allow or disallow writing of the other control registers 102 ... 112.

(Note: Contents of all of the control registers can always be read regardless of the bits in the access-control registers.)

Software in the UC7 then automatically selects which of the various input signals are used for control of the compressor, cooling or heating, the indoor fan speed, capacity and so on.

**UC7
control input
model
(simplified)**



Default values are highlighted.

Register	Function	Notes	Type
101	Write-enable ^(4, 5) Bit 0: Comp Bit 1: Heat Bit 2: Remote On/Off Bit 3: Indoor fan mode Bit 4: EXV mode Bit 5: DRED Bit 6: Indoor fan speed Bit 7: Capacity Bit 8: Reserved, do not use Bit 9: Quiet mode Bit 10: De-humidification mode Bit 11 to 15: Reserved	All bits: default value: 0 0 = BMS control disabled 1 = BMS control enabled	Read / write
102	Compressor on/off (Comp) ⁽⁶⁾	Refer to note 6	
103	Cooling/Heating (Heat)	0 = cooling 1 = heating	
104	Remote on/off	0 = off 1 = on	
105	Indoor fan mode	Refer to chapter 7	
106	EXV mode ⁽⁷⁾	0 = accurators (no electronic expansion valve) 1 = single or parallel expansion valve(s) 2 = series expansion valves 3 = dual expansion valves and split indoor coil	
107	DRED	0 to 3 (as per DRED standard)	
108	Indoor fan speed	Refer to chapter 7	
109	Capacity ⁽⁸⁾	0% (off), 16% to 100% (on)	
110	Reserved	Do not use	
111	Quiet mode enable	0 = off 1 = on	
112	De-humidification mode enable	0 = off 1 = on	

Notes:

4: When a BMS requires control over a particular signal, then the BMS needs to first write the bit for that signal in register 101 to 1 (enabled). As soon as a BMS has written a bit in this register to 1, other inputs signals to the controller no longer have control over that input signal.

For example: If the BMS writes value 1 to bits 0 and 1, then the BMS has assumed control over the signals Comp and Heat. The unit will no longer respond to a thermostat (if one is connected).

In situations where both a thermostat and a BMS are connected to the unit, the above actions could be confusing to a user. We recommend that, where possible, the installer disables functions on the thermostat that are controlled by a BMS.

- 5: When mains power is removed from the unit all bits in register 101 will always be reset to the default value 0 (write disabled). To re-gain control over a unit after mains power has been interrupted, a BMS must first re-write to register 101.
- 6: If a unit has multiple compressors and multiple UC7 controllers that are connected in master-slave fashion, then the value written to COMP allows individual control over all compressors in the unit. The value of COMP is used as follows:
 Bit 0 = Master compressor on/off
 Bit 1 = Slave 1 compressor on/off
 Bit 2 = Slave 2 compressor on/off
 Bit 3 = Slave 3 compressor on/off

Examples:

COMP value	Slave 3 (bit 3)	Slave 2 (bit 2)	Slave 1 (bit 1)	Master (bit 0)	
0	0	0	0	0	All compressors off
1	0	0	0	1	Only the master compressor on
3	0	0	1	1	Master and slave 1 compressors on
15	1	1	1	1	All compressors on

7: CARE MUST BE EXERCISED WHEN CHANGING THE EXPANSION VALVE MODE OF A UNIT!

Only selected Temperzone unit models are equipped with dual electronic expansion valves and a split indoor coil. A BMS should **never** write the value of register EXV-Mode to dual electronic expansion valves when the unit that does not offer that option. It is also not allowed to switch from parallel mode to series mode or vice versa. The default mode is factory-set by UC7 DIP switches 7 and 8.

- 8: Capacity only has meaning on units with a digital scroll compressor, variable speed compressor and/or multiple compressor units where the UC7 controllers are connected in master-slave arrangement. The way the value written to capacity is interpreted depends on the unit type as follows:

Single fixed capacity compressor	Capacity is ignored.
Multiple fixed capacity compressors	To be determined
One variable capacity compressor	The compressor operates at the required capacity. (The compressor can be switched on or off via COMP.)
One variable capacity compressor and one or more fixed capacity compressors	The variable capacity compressor operates at the required capacity. (Compressors can be switched on or off individually via COMP.)
Multiple variable capacity compressors	All compressors operate at the required capacity. (Compressors can be switched on or off individually via COMP.)

If Capacity is written to less than 16% the unit will operate at the minimum capacity of 16%. Some variable speed compressors have a minimum capacity different from 16%, refer to the unit documentation for the correct value.

6.4. Safety timers

The following registers are safety timers in seconds. These timers, when not zero, can hold the compressor on or off.

Register	Function	Type
201	Minimum On-Off time (minimum run time)	Read only
202	Minimum Off-On time (minimum off time)	
203	Minimum On-On time (minimum time between compressor starts)	
216	Cooling hold-off time (minimum time between heating --> cooling)	
217	Heating hold-off time (minimum time between cooling --> heating)	

6.5. Controller board output signals

Register	Function	Type
401	Outdoor fan speed 0 (stop) to 1000 (high speed)	Read only
402	Indoor fan speed 0 (stop) to 1000 (high speed)	
403	Expansion valve 1 position 0 (closed) to 480, 960 or 4000 (open) ^(9, 10)	
404	Expansion valve 2 position 0 (closed) to 480, 960 or 4000 (open) ^(9, 10)	
405	Unit capacity 0 to 1000	
406	Digital output signals Bit 0: CMC 0 = off, 1 = on Bit 1: R/V 0 = cooling, 1 = heating Bit 2: SSR1 (solid state relay 1) Bit 3: SSR2 (solid state relay 2) Bit 4: AUX (AUX relay output) Bit 5: DRED 0 = compressor <u>may</u> be on 1 = compressor <u>will</u> be off All other bits are reserved.	
407	Unit mode 0 = Start-up 1 = Off 2 = Cooling start 3 = Cooling run 4 = Cooling end 5 = Heating start 6 = Heating run 7 = Heating end 8 = De-ice start 9 = De-ice run 10 = De-ice dry 11 = De-ice end 12 = Lock-out All other codes are reserved.	

Note 9: Position numbers reported for the expansion valves depend on the type of valve fitted to the unit: Dunan DPF = 480, Carel E2V or E3V = 960, Sanhua DPF = 4000.

Note 10: Expansion valve openings are also reported as percentages (0-100%) in modbus registers 26 and 26.

6.6. Thermostat signals

The following registers represent temperatures as reported by a communicating thermostat ⁽¹¹⁾. Divide by 100 to obtain temperature in degrees Celsius (16 bit signed numbers).

Address	Function	Units	Type
511	Set point temperature	0.01°C	Read only
512	Room temperature		

Note 11: If no communicating thermostat is connected then a read of these registers will return value -10000.

6.7. UC7 controller information registers

Register 601 can be used to identify the Temperzone UC7 controller.

Address	Function	Type
601	UC7 controller ID code Value 203	Read only
602	UC7 software version Example: 520 = version 5.20	

6.8. Fault status

Address	Function	Type
901	Faults 0 = no fault, 1 = fault Bit 0: HP Bit 1: LP Bit 2: Overload Bit 3: Frost protection Bit 4: Freeze protection (hydronic models only) Bit 5: High temperature protection Bit 6: High suction line temperature/pressure protection Bit 7: Flood protection (hydronic models only) Bit 8: Water flow protection (hydronic models only) Bit 9: Low discharge superheat protection Bit 10: No communications with outdoor fan speed controller Bit 11: No communications with indoor fan speed controller Bit 12: Low pressure transducer fault Bit 13: High pressure transducer fault Bit 14: Suction line temperature sensor fault Bit 15: Discharge line temperature sensor fault	Read only

Address	Function	Type
902	<p>Faults 0 = no fault, 1 = fault</p> <p>Bit 0: De-ice temperature sensor fault</p> <p>Bit 1: Outdoor coil temperature sensor fault</p> <p>Bit 2: Indoor coil temperature sensor fault</p> <p>Bit 3: Ambient temperature sensor fault</p> <p>Bit 4: Superheat is unknown</p> <p>Bit 5: No communications with the thermostat</p> <p>Bit 6: No communications with UC7 master board</p> <p>Bit 7: No communications with UC7 slave 1 board</p> <p>Bit 8: No communications with UC7 slave 2 board</p> <p>Bit 9: No communications with UC7 slave 3 board</p> <p>Bit 10: Problem with reading the DIP switches</p> <p>Bit 11: Illegal combination of indoor- & outdoor- fan selection</p> <p>Bit 12: Reserved</p> <p>Bit 13: UC7 controller board temperature is too high</p> <p>Bit 14: UC7 controller supply voltage fault</p> <p>Bit 15: A slave system reports a fault</p>	Read only
903	<p>Faults 0 = no fault, 1 = fault</p> <p>Bit 0: 0-10V Analogue input fault</p> <p>Bit 1: High discharge superheat protection</p> <p>Bit 2: Problem with readings from the pressure transducers</p> <p>Bit 3: Reverse cycle valve fault</p> <p>Bit 4: Invalid DIP switch settings on TZT-100 thermostat</p> <p>Bit 5: No communications with the indoor unit controller (IUC)</p> <p>Bit 6: The indoor unit controller (IUC) reports a fault</p> <p>Bit 7: The variable speed compressor driver reports a fault</p> <p>Bit 8: Prolonged operation outside compressor safe working envelope</p> <p>Bits 9 to 15: Reserved</p>	

6.9. Unit history

Address	Function	Type
1001	UC7 modbus address	Read only
1002	Reserved	
1003	Running hours	
1004	Running minutes	
1005	Cooling cycles	
1006	Heating cycles	
1007	De-ice cycles	
1008	HP trip events	
1009	LP trip events	
1010	Frost protection events	
1011	Freeze protection events (hydronic models only)	
1012	High temperature protection events	
1013	High suction line temperature protection events	
1014	Overload protection events	
1015	Low discharge superheat protection events	
1016	High discharge superheat protection events	
1017	Number of power-on reset events	
1018	Reserved	
1019	Reserved	
1020	Reserved	
1021	Indoor coil temperature sensor faults	
1022	Outdoor coil temperature sensor faults	
1023	Outdoor ambient temperature sensor faults	
1024	Discharge line temperature sensor faults	
1025	Suction line temperature sensor faults	
1026	De-ice temperature sensor faults	
1027	High pressure transducer faults	
1028	Low pressure transducer faults	
1029	High board temperature faults	
1030	Reverse cycle valve faults	

7. The indoor fan

Primary modbus control registers for the indoor fan are registers 105 (indoor fan mode) and 108 (indoor fan speed). Control details are given in the following sections.

Note 12: *In all cases, if certain temperatures and/or pressures are well outside compressor safe operating values, the controller may protect the compressor by changing the indoor fan speed to a value different from that written to the fan speed register (108).*

If the application must never allow the indoor fan speed to change regardless of compressor operating conditions then the controlling BMS may directly connect to the indoor fan, bypassing the UC7 controller. It is the responsibility of the customer to ensure unit reliability. In this case it must be noted that, should the controller detect sustained running outside safe operating conditions, additional safety protection mechanisms may operate and, if the mechanisms operate repeatedly, the unit may eventually be locked out.

7.1. Indoor fan operating mode

Modbus register 105 controls the following aspects of the indoor fan (default values highlighted):

Bit	Value	
	0	1
0	auto-speed	fixed-speed
1	fan-auto mode	fan-on mode
2	fan is off during de-ice cycles ⁽¹³⁾	fan continues running during de-ice cycles
3	fan may be kept off briefly when heating starts (warm start) ⁽¹³⁾	fan runs when heating starts (no warm-start)

Explanation of terms:

Auto-speed: The controller is allowed to change the indoor fan speed to a value different from the value given in the fan speed register (108) in order to obtain an optimum evaporating- or condensing- temperature.

Fixed speed: The indoor fan speed remains equal to the value set in the fan speed register (108).

Fan-auto mode: The controller may protect the compressor by **fully stopping** the fan if temperatures and/or pressures are well outside compressor safe operating values

Fan-on mode: The controller may protect the compressor by changing the fan speed **but never slower than minimum** if temperatures and/or pressures are well outside compressor safe operating values.

Warm start: If commands are sent to the controller to switch the reverse cycle valve to the heating position and to start the indoor fan, but the compressor is still off and/or the indoor coil temperature / condensing temperature is below 26°C, then the indoor fan will be kept off. The fan will only start when the compressor is on and the indoor coil / condensing temperature is 26°C or warmer. This feature can be used to prevent cold drafts when the controller requires heating mode.

Note 13: *Fan off during de-ice and warm start are allowed only when DIP switch 1 on the UC7 is set to the **OFF**-position. This is to retain compatibility with older software versions.*

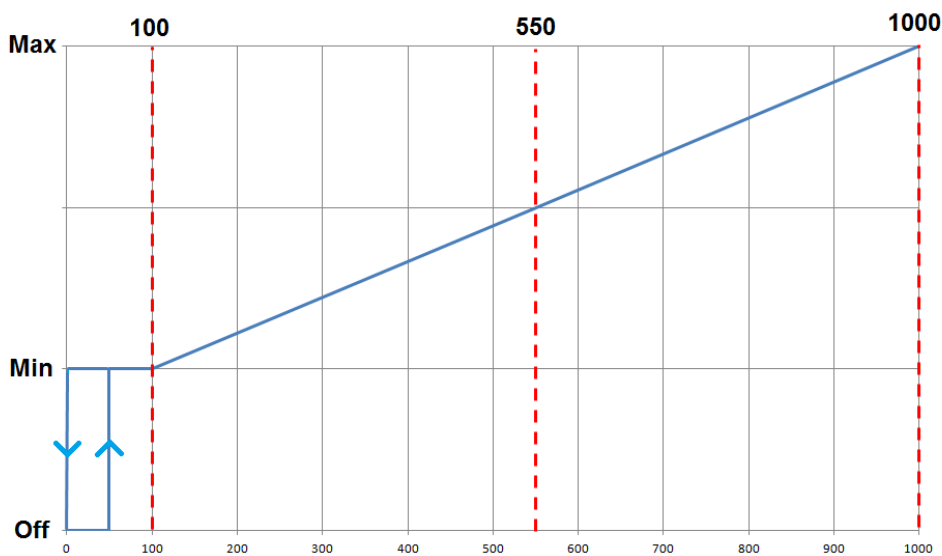
7.2. Control of variable speed fans

When the unit has a variable speed (0-10V) indoor fan then control is as follows:

- If the fan is off, then a value of 50 or higher starts the fan. For values from 0 to 49 the fan remains off.
- For values from 50 to 100 the indoor fan runs on minimum speed.
- For values from 100 to 1000 the indoor fan speed linearly varies from minimum to maximum.

The minimum and maximum speed can be set using the button and display on the UC7 controller. For more information refer to document “Temperzone UC7 Operation and Installation - Air-to-Air units”, issue 8 or later.

Below is a graphical representation of the conversion from 0-1000 to Off-Minimum-Maximum.



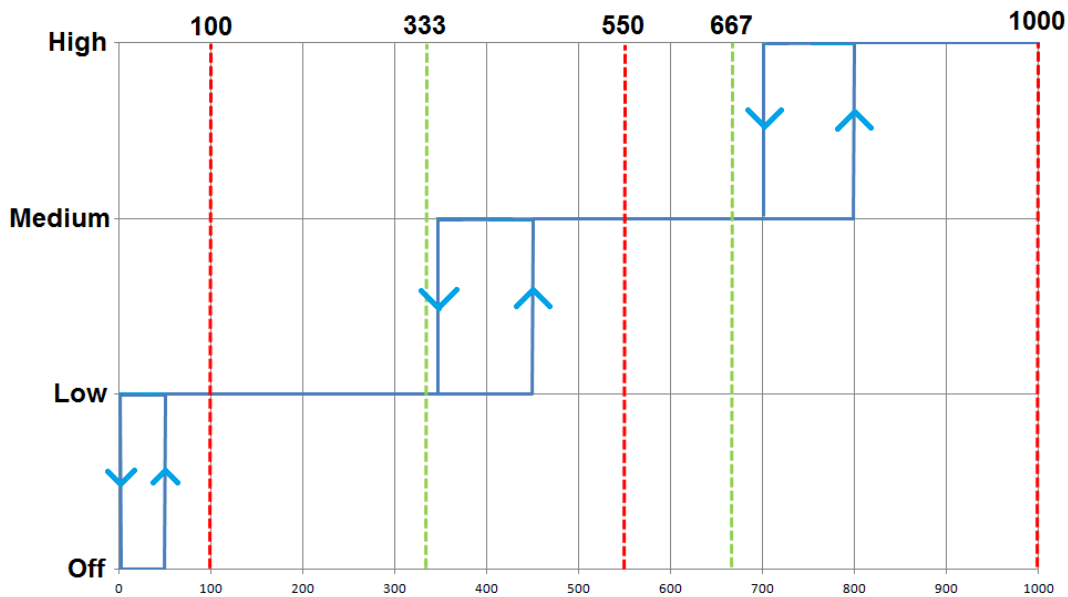
7.3. Control of three speed fans

When the unit has a 3-speed indoor fan then hysteresis is applied as follows:

- If the fan is off, then a value of 50 and higher starts the fan. For values from 0 to 49 the fan remains off.
- If fan speed is low, then a value of 0 stops the fan, a value of 450 and higher switches fan speed up. For values from 1 to 449 the fan speed remains low.
- If fan speed is medium, then a value of 349 or lower reduces fan speed, a value of 800 or higher increases fan speed to high. For values from 350 to 799 the fan speed remains medium.
- If fan speed is high, then a value of 699 or lower reduces fan speed. For values from 700 to 1000 the fan speed remains high.

Thus: Value 0 always stops the indoor fan, 100 runs the fan on low speed, 550 runs the fan on medium speed and 1000 runs the fan on high speed. The controller also remains compatible with values 0 (stop), 333 (low), 667 (medium) and 1000 (high) that were used on earlier software versions.

Below is a graphical representation of the conversion from 0-1000 to Off-Low-Medium-High.



7.4. Control of single speed fans

- If a single speed fan is off, then any value from 50 to 1000 starts the fan. For values from 0 to 49 the fan remains off.
- To stop a running single speed fan use value 0; any other value leaves the fan on.

Thus: Value 0 always stops a single speed indoor fan; values 50 to 1000 start the fan.

8. Quiet mode

Quiet mode can reduce the amount of air-handling-noise from the outdoor fan(s). The method used to obtain a quieter outdoor fan is by setting a different target for condensing or evaporating temperatures (when cooling or heating, respectively).

To gain control over quiet mode on/off:

- Write value 1 to bit 9 of write-enable register 101.

Once the BMS has assumed control over quiet mode:

- Write value 0 to register 111 to disable quiet mode, value 1 to enable.

Enabling quiet mode can be effective when a unit is cooling and the outdoor ambient temperature is below about 35°C. Higher outdoor ambient temperatures reduce the effectiveness; quiet mode is not effective for outdoor ambient temperatures above about 40°C.

Similarly, enabling quiet mode can be effective when a unit is heating and the outdoor ambient temperature is above about 15°C. Lower outdoor ambient temperatures reduce the effectiveness; when the outdoor ambient temperature is below about 10°C then enabling quiet mode will have no effect.

If a unit is equipped with a variable speed- or a digital scroll- compressor then reducing the unit duty (capacity < 100%) can also aid in achieving quieter outdoor fans.

9. De-humidification

De-humidification mode can increase the amount of moisture that is removed by the unit from the supply air, and so provide more cooling comfort.

The UC7 controller offers a number of methods by which de-humidification is achieved. Which method is used depends on the user requirements and preferences and the unit capabilities. An explanation of the various de-humidification methods and how to enable and disable follows here:

Conventional de-humidification mode: Available on all models. This method slowly varies the indoor fan speed in order to achieve a low indoor coil evaporating temperature and so reduce the moisture content of the supply air. It shall be clear that this method is not suitable for applications where the volume of supply air must remain constant.

To select conventional de-humidification mode:

- Write value 1 to bits 3 and 10 of register 101 (write-enable) to gain control over registers 105 (indoor fan mode) and 112 (de-humidification mode).
- Write value 0 to bit 0 of register 105 (indoor fan mode) to allow variable indoor fan speed.
- Write value 0 or 1 to register 112 to disable/enable de-humidification.

Note: Selected unit models are fitted with dual expansion valves and a split indoor coil. These models should have value **1** written to register 106 (EXV mode), otherwise the unit may operate in super de-humidification mode.

Advanced de-humidification mode: Available only on selected models with dual expansion valves and a split indoor coil. Suitable for applications where the volume of supply air must remain constant.

To select advanced de-humidification mode:

- Write value 1 to bits 3 and 10 of register 101 (write-enable) to gain control over registers 105 (indoor fan mode) and 112 (de-humidification mode).
- Write value 1 to bit 0 of register 105 (indoor fan mode) to select fixed indoor fan speed.
- Ensure register 106 (EXV mode) contains value 3 (dual expansion valves). If not then write value 3 to this register after first gaining write access (write value 1 to bit 4 of register 101).
- Write value 0 or 1 to register 112 to disable/enable de-humidification.

Super de-humidification mode: Available only on selected models with dual expansion valves and a split indoor coil. This mode uses combination of advanced- and conventional- de-humidification modes as described above. The controller will first attempt to control the indoor coil evaporating temperature by means of the electronic expansion valves alone whilst the indoor fan speed is kept constant. Only when the desired evaporating temperature cannot be achieved with the use of the electronic expansion valves then the controller will also slowly vary the indoor fan speed. Therefore this mode may not be suitable for applications where the volume of supply air must remain constant.

To select super de-humidification mode:

- Write value 1 to bits 3 and 10 of register 101 (write-enable) to gain control over registers 105 (indoor fan mode) and 112 (de-humidification mode).
- Write value 0 to bit 0 of register 105 (indoor fan mode) to allow variable indoor fan speed.
- Ensure register 106 (EXV mode) contains value 3 (dual expansion valves). If not then write value 3 to this register after first gaining write access (write value 1 to bit 4 of register 101).
- Write value 0 or 1 to register 112 to disable/enable de-humidification.

10. Lockout

Lockout can occur when a certain fault condition repeats three times within a sliding 12 hour window. When a unit is locked out it will not run the compressor or the indoor- and outdoor- fans. Faults that have occurred longer than 12 hours ago are removed from the count. Fault counts are reset to zero every time the unit switches off normally, either by the thermostat or BMS or by mains power off.

For example: If a unit operates under marginal running conditions that occasionally cause the indoor coil frost protection to operate once when the unit starts, this will not lead to a lockout situation since the frost protection counter is reset to zero every time the thermostat switches the unit off.

Lockout condition can be identified via modbus by reading the value of register 407 (unit mode). The value indicating lockout condition is 12.

There are two methods to restart a locked out unit:

1. Switch mains power to the controller off, wait for a few seconds and then switch power back on.
2. Use modbus function 6 (write one holding register) to write value 21930 (hexadecimal 0x55aa) to register 1901, followed by value 3855 (hexadecimal 0x0f0f) to this same register. The second write must be made within 10 seconds following the first write.

Note: *When mains power is applied to a controller that was locked out the display will show the cause of the previous lockup for 20 seconds. This message will stop appearing after the unit has completed at least one full normal cooling or heating cycle.*

11. Multiple compressor units

If a unit has multiple compressors each of which is controlled by a separate UC7 controller and the controllers are connected in a master-slave arrangement, then a BMS or data logging system can access all of the information as described in the previous pages for each of the systems.

Information on each of the slave systems can be obtained via the RS485 connection to the master. No separate connections are necessary.

All that is required to read information from a slave unit is to add a fixed offset to the modbus holding register address. The register address offset values are:

System	Offset
Master	0
Slave 1	2000
Slave 2	4000
Slave 3	6000

Some examples:

To obtain the evaporating temperature for the master system read register 7.

To obtain the evaporating temperature for slave 1 system read register $7 + 2000 = 2007$.

To obtain the evaporating temperature for slave 2 system read register $7 + 4000 = 4007$.

To obtain the evaporating temperature for slave 3 system read register $7 + 6000 = 6007$.

Note: *Only modbus function 03 (read N registers) can be used.*

When information from a slave system is requested the master controller needs to relay the message to the correct slave system, receive the reply from the slave and then forward the reply to the BMS or data logger. Because of the extra message handling the reply can be delayed by up to 1 second. This delay is not present when requesting information from the master system.

12. Notes

Beside the holding registers listed in this document, many other registers exist in the UC7 controller that can be read via the modbus connection.

In the interest of unit reliability and safety, registers that are not described in this document are read-only. Functions of undocumented registers may change without notice when new software versions are released.

Additional information is available on the Temperzone internet web site:

<http://www.temperzone.biz/?brand=1>

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