



# **UNIT CONTROLLER 7 (UC7) Operation & Installation**

## **Hydronic Units**

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**Issue:** 7

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**Note:**

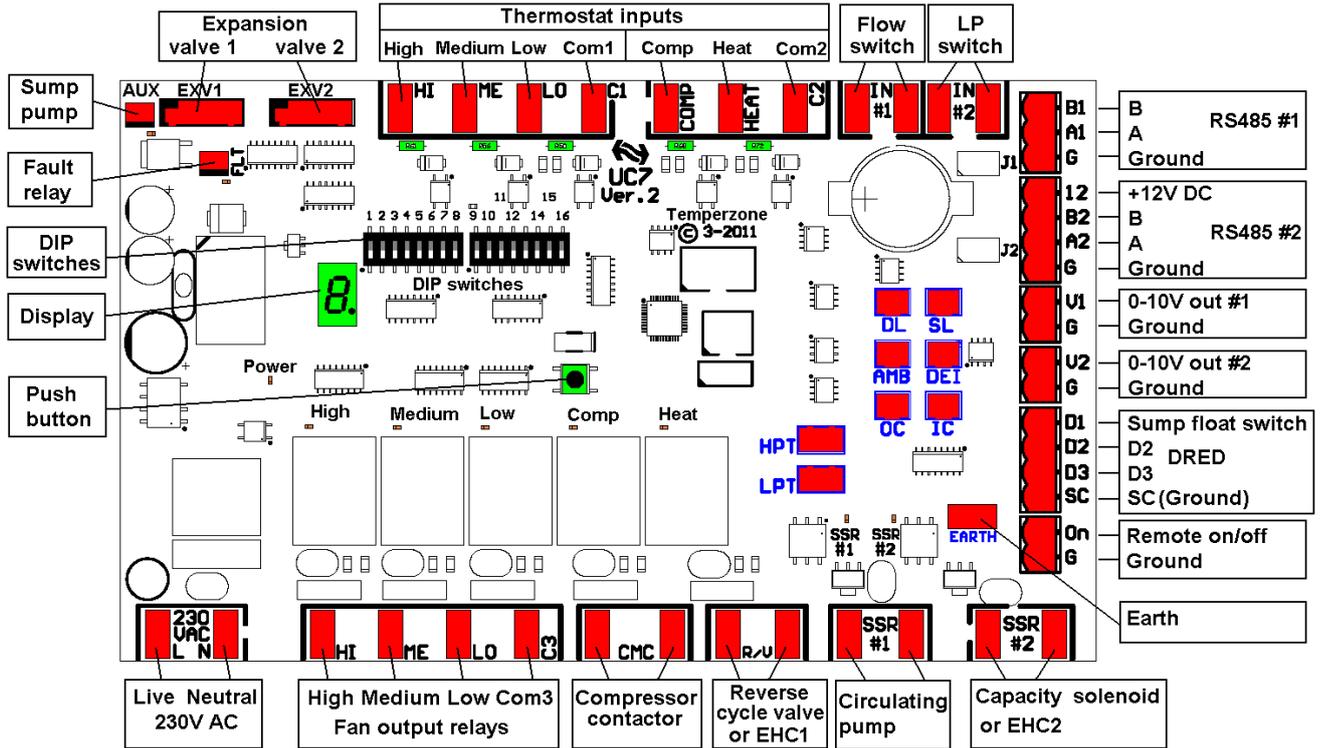
**The information in this document applies to UC7 controllers programmed with software version 4.95 or later.**

To find out the software version number:

- Turn on mains power to the UC7 controller and observe the display.
- First the display will show the characters “UC7”, followed by the software version.

**1. Connections, hydronic unit**

The drawing below shows all possible connections for hydronic units. Most units do not require the use of all input /output signals.



**2. Functions assigned to SSR1, SSR2 and AUX**

System	Digital	Tandem	SSR1	SSR2	AUX	Notes
Hydronic, RV or cooling only			WFP	CCH	SPP	
	•		WFP	CAP	SPP	No CCH
		•	WFP	CMC2	SPP	No CCH
	•	•	Configuration not allowed			
Hydronic with electric heating			WFP	EHC2	SPP	No CCH
	•		Configurations not allowed			
		•				

**Shaded cells indicate configurations that must not be selected!**

Legend:

- CCH = Crank case heater
- CMC2 = Compressor 2 contactor (tandem system)
- CAP = Capacity solenoid (digital scroll compressor)
- WFP = Water flow pump (circulating pump)
- SPP = Sump pump
- EHC2 = Electric heating contactor 2 (hydronic unit with electric heating)

### 3. Input and output signals

#### 3.1. Temperature sensor inputs

**Note:**

If pressure transducers are connected to the HPT and LPT inputs then there is no need for temperature sensors on the tube-in-tube coil and indoor coil (OC and IC).

Connector	Function	Notes
DL	Compressor discharge line	Red
SL	Compressor suction line	Blue (not always required)
AMB	Ambient (reverse-cycle and cool-only models)	Yellow or black (not always required)
	Supply air (models with electric heating)	Black (must be present)
DEI	-	Not used
OC	Tube-in-tube coil (water-refrigerant heat exchanger)	Yellow (not always required)
IC	Indoor coil	Yellow (not always required)

#### 3.2. Pressure transducers:

Connector	Function	Default pressure range	Output voltage
HPT	High pressure	0 to 4500kPa	0.5 to 4.5V
LPT	Low pressure	0 to 1730kPa (fixed capacity compressors)	0.5 to 4.5V
		0 to 3450kPa (digital scroll compressors)	

**Hydronic reverse cycle unit only:**

The high pressure transducer on HPT must switch to the suction side when the unit is heating.

#### 3.3. Switch input IN #1, water flow verification switch

Water circulation flow switch.

The flow verification switch must activate less than 15 seconds after the water circulation pump output has activated (output SSR1, refer section 3.9). If no flow verification switch is provided then input IN#1 must be shorted (looped).

If more than one hydronic unit uses the signal from one common flow switch, and/or the flow switch is located more than 10m away from the unit, then an isolating relay should be used. In the latter case connect the normally open relay contacts to IN#1 and the relay coil to the (external) signal from the flow switch.

#### 3.4. Switch input IN #2, LP switch

LP switch.

#### 3.5. Remote On/Off

A remote On/Off signal ('dry' or 'voltage-free' contacts) can be connected to the "On" and "G" terminals.

To turn the unit **on** the remote on/off input must be **closed-circuit**.

If no remote On/Off function is needed then the terminals must be connected (looped).

When the unit is off by the remote on/off signal the display will show a slowly flashing – symbol.

### 3.6. Switched signal type thermostats

Signals from a thermostat that provides switched signals normally connect to the following input signals:

- COMP
- HEAT (not required for cool-only installations)
- HIGH – MEDIUM – LOW (indoor fan speed)

If DIP switch 3 is set to ON, then the signals must be:

- COOL
- HEAT
- HIGH – MEDIUM – LOW (indoor fan speed)

If a communicating thermostat is used (for example a TZT-100), or the unit is controlled by a BMS via Modbus over RS485, then terminals COMP, HEAT, HI, ME, LO, C1, C2 can be left un-connected.

**Important note for version 3 boards (part number 201 000 403):**

UC7 version 3 boards will accept 24V AC or 12V DC control signals on inputs HI, ME, LO, COMP and HEAT. These boards **cannot** accept 230V AC control signals!

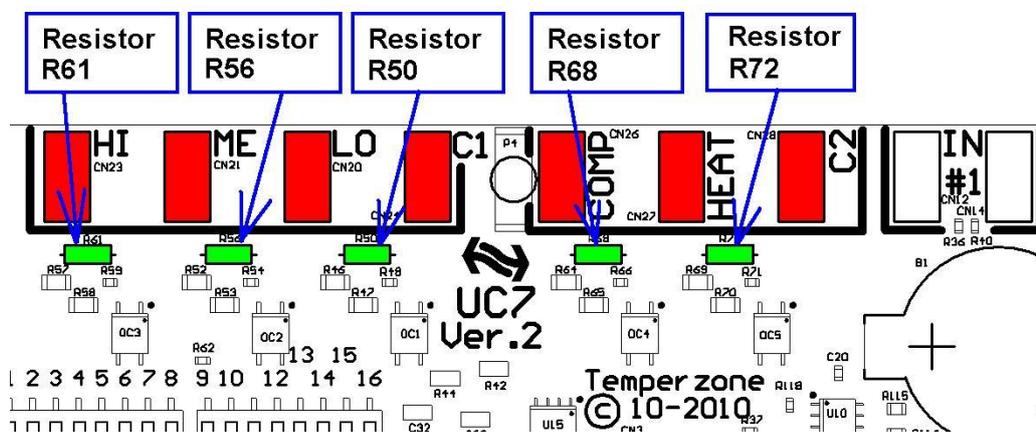
**Important note for version 2 boards (part number 201 000 390):**

A new UC7 version 2 board accepts 24V (AC or DC) signals from the thermostat.

It is allowed to connect 230V AC signals to inputs HI, ME, LO, COMP and HEAT. When 230V AC is applied for the first time to any one of these inputs a small amount of smoke is likely to come from resistors R61, R56, R50, R68 or R72. **This is normal and will only occur once!**

(These five resistors are special fusible types, designed for this purpose.)

**Once 230V AC has been applied to any of these inputs, they will no longer respond to 24V AC signals!**

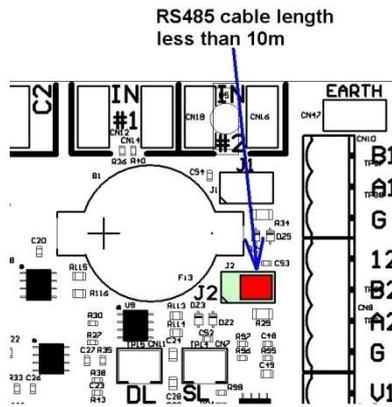
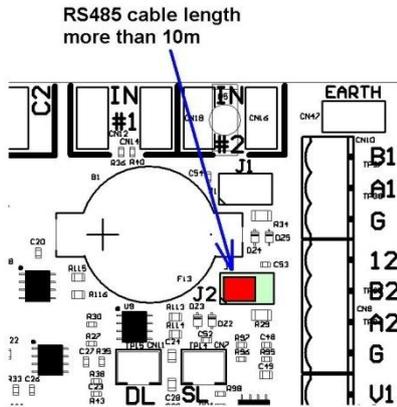


Signal level:	Terminals "C1" and "C2" must connect to:
24V AC or DC	24V common
230V AC	Mains neutral

### 3.7. Digitally communicating thermostat

Use shielded twisted pair suitable for RS485 to connect a digitally communicating thermostat. The UC7 supports the Temperzone TZT-100 thermostat. Other thermostats can be added on request.

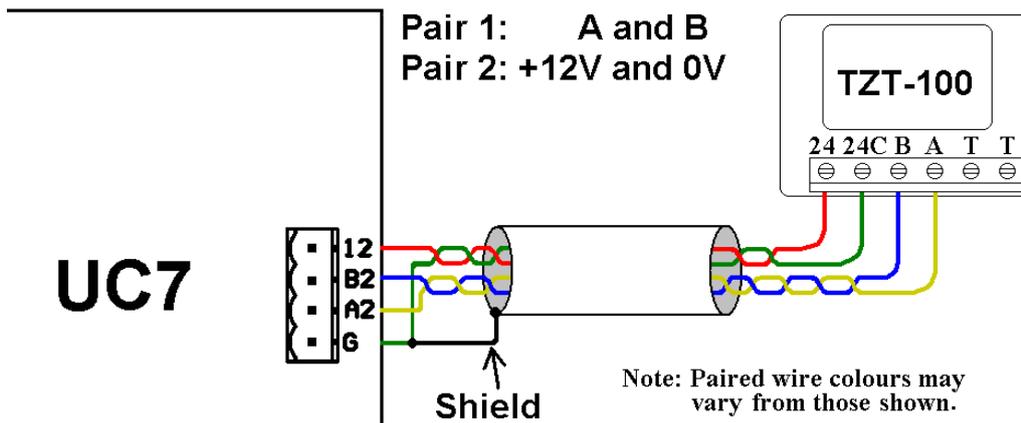
Connect the twisted pair wires to terminals “B2” (-) and “A2” (+).



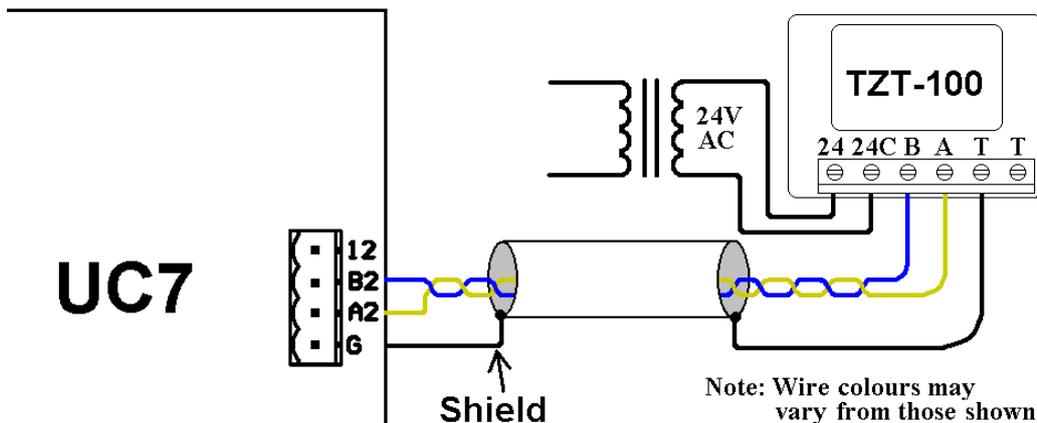
If the distance between the thermostat and the UC7 is greater than 10m and the UC7 is located at one end of the cable then place jumper “J2” on the centre and left pins

Otherwise place jumper “J2” on the centre and right pins.

The UC7 provides 12V DC power on terminal “12” that may be used to power the thermostat. Terminal “G” is ground return for the 12V DC power. For this application it is recommended to use a shielded cable with twisted pairs. The correct connections are shown here:



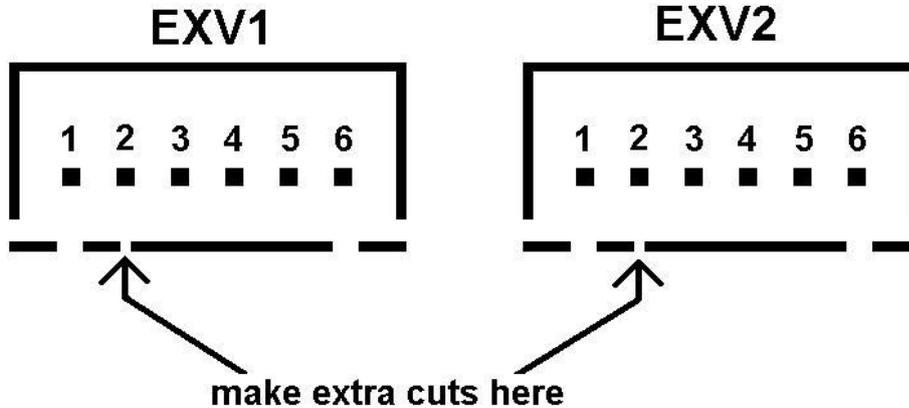
The TZT-100 thermostat can also be powered by an **isolated** 24V AC power source as shown below:



In this case the 24V AC supply common should NOT be earthed elsewhere in the system, otherwise differences in earth potentials can lead to unreliable communications between the thermostat and the UC7.

### 3.8. Electronic expansion valves

The UC7 can control up to two electronic expansion valves (EXV) via connectors EXV1 and EXV2. The expansion valves must be 12V unipolar types. The connectors must be compatible with JST type XH and have either 5 pins or 6 pins. If the valve connectors have 5 pins then use a small sharp knife to (very carefully!) make a cut in the white plastic of the headers about 2mm beside the leftmost slot, then insert the connector so that pin 1 (leftmost) remains unconnected.



DIP switches 7 and 8 on UC7 board define how the outputs EXV1 and EXV2 are operated. Refer to section 4 (DIP switch selections) for more details.

### 3.9. Water circulating pump and flow control valve

Solid state relay output SSR1 can be used to control a water circulating pump. The output is activated prior to starting of the compressor and de-activates when the compressor stops.

A 0-10V signal is available on output V1 for the control of a water flow control valve (optional). When used the valve is closed (0V signal) when the compressor is off. When the unit is cooling the signal will control the valve to obtain an optimum condensing pressure & temperature. When the unit is heating (reverse cycle units) the valve is directed fully open (10V signal).

### 3.10. Sump pump and sump float switch

A sump pump can be controlled via the AUX output terminal. Connect AUX to a standard Temperzone relay board, then use the relay contacts switch on and off the sump pump motor.

Input D1 should connect to a sump float switch. The other terminal of the sump float switch should connect to 'SC' or 'G'. The sump float switch must have normally closed contacts.

### 3.11. DRED inputs D2 and D3

Inputs D2 and D3 are available as DRED inputs. The DRED level for input D2 is configurable with default level 2 (50% maximum energy consumption).

Optionally, the DRED level can be communicated to the UC7 by a BMS via RS485 serial communications. If this option is used then all three DRED levels are available.

If a BMS control the DRED level via RS485, or when no DRED function is required, then inputs D2 and D3 can be left open circuit.

*Note: Terminal SC is internally directly connected to 'G' and 'EARTH'.*

### 3.12. Mains power

Connect 230V AC mains live to terminal **L**, neutral to terminal **N**.

**NOTE:**

The **EARTH** terminal on the UC7 controller board **MUST** always directly connect to a unit earth stud located close to the controller.

### 3.13. Optional 0-10V analogue input

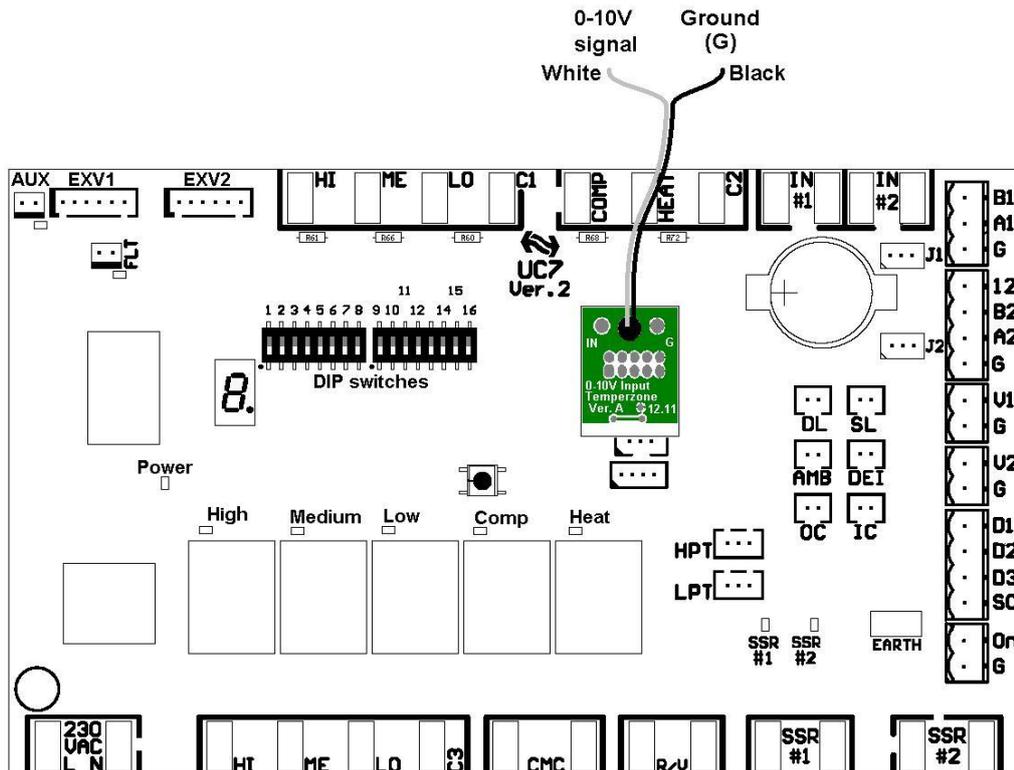
Units equipped with a digital scroll compressor are capable of variable duty. The required duty can be set in three ways:

- Automatic, only in combination with the TZT-100 thermostat
- Via Modbus, for example by a BMS
- Via an optional 0-10V analogue input

The 0-10V input comes as a small plug-in-board and connects directly to the UC7 controller via the 10-pin header pins on the circuit board. The controller automatically detects the presence of the 0-10V input board when power is applied.

Note: The 0-10V input is not electrically isolated; the terminal “G” is directly connected to the controller EARTH terminal. If the 0-10V signal source is located remotely from the unit then it is recommended to use a suitable 0-10V isolating amplifier.

**IMPORTANT:** The 0-10V plug-in board must be connected to the controller in the correct orientation!



## 4. DIP switch selections

Table 1, DIP switch functions for switches 1 to 13.

Switch		Function
<b>1</b>		<b>Indoor air flow</b>
<b>OFF</b>		Variable indoor air flow: Indoor fan performs a warm start when unit starts heating. Indoor fan speed may vary from thermostat request.
<b>ON</b>		Fixed indoor air flow: Indoor fan follows thermostat request even when heating starts. Indoor fan speed follows thermostat request.
<b>2</b>		<b>Compressor type</b>
<b>OFF</b>		Fixed capacity.
<b>ON</b>		Digital scroll.
<b>3</b>		<b>Thermostat type</b>
<b>OFF</b>		Provides COMP and HEAT signals
<b>ON</b>		Provides COOL and HEAT signals.
		Note: A communicating thermostat is automatically detected regardless of the setting of DIP switch 3. The communicating thermostat must be set to COMP & HEAT type operation.
<b>4</b>		<b>Hydronic unit type</b>
<b>OFF</b>		Reverse cycle or cooling only. For cooling only: Leave the HEAT input disconnected and disable heating mode on the thermostat.
<b>ON</b>		Cooling + electric heating.
<b>5</b>	<b>6</b>	<b>Indoor fan selection</b>
<b>OFF</b>	<b>OFF</b>	Three speed fan (HI/ME/LO relay outputs).
<b>ON</b>	<b>OFF</b>	One speed fan (ME relay output).
<b>OFF</b>	<b>ON</b>	0-10V EC fan (V2 output). <i>Choose this option when the UC7 does not control the indoor fan.</i>
<b>ON</b>	<b>ON</b>	Modbus over RS485 EC fan (A2 and B2 outputs).

<b>7</b>	<b>8</b>	<b>Electronic expansion valve operating mode</b>	
<b>OFF</b>	<b>OFF</b>	No electronic expansion valves (e.g. accurators, TX valves...).	
<b>ON</b>	<b>OFF</b>	One valve or two parallel electronic expansion valves (as required), positions always identical. If the unit is suitably equipped then this setting is also the 'High Efficiency Mode'.	
<b>OFF</b>	<b>ON</b>	Two electronic expansion valves:      Cooling: EXV1 regulates, EXV2 fully open Heating: EXV1 fully open, EXV2 regulates  (This option should also be selected if the UC7 controls an outdoor or an indoor unit only. Use EXV1 output for an indoor unit, EXV2 output for an outdoor unit.)	
<b>ON</b>	<b>ON</b>	Advanced dry mode. This option must only be selected on units suitably equipped. Dry mode has no influence on the unit when heating.	
<b>9</b>	<b>10</b>	<b>Electronic expansion valve type</b>	<b>How to recognise the valve type</b>
<b>OFF</b>	<b>OFF</b>	Dunan DPF series	removable black coil
<b>ON</b>	<b>OFF</b>	Zhe Jiang Sanhua DPF series	non-removable metal coil
<b>OFF</b>	<b>ON</b>	Carel E2V series (& E3V series with unipolar coil)	removable red coil
<b>ON</b>	<b>ON</b>	Custom series	-
<b>11</b>	<b>12</b>	<b>System number</b>	
<b>OFF</b>	<b>OFF</b>	1 (master system, select this for all hydronic units)	
<b>ON</b>	<b>OFF</b>	2 (do not select)	
<b>OFF</b>	<b>ON</b>	3 (do not select)	
<b>ON</b>	<b>ON</b>	4 (do not select)	
<b>13</b>	<b>Function of DIP switches 14, 15 and 16</b>		
<b>ON</b>	Switch 13 must be ON.		
<b>14</b>	<b>15</b>	<b>16</b>	<b>Custom options</b>
<b>ON</b>	<b>OFF</b>	<b>OFF</b>	Hydronic unit (water to air)  <b>All other combinations for DIP switches 14, 15 and 16 are reserved and must not be selected.</b>

## 5. Test mode

To activate test mode follow these steps:

- Apply power to the unit and wait until the power-on sequence is successfully completed.
- Ensure the thermostat is 'OFF' (COMP and HEAT signals must be OFF).
- Press and hold the UC7 push button (2 to 4 seconds) until the display shows the letter 't', then release the button.

Test mode will start immediately. The following outputs are activated one by one in the following order, for a duration of 4 seconds each and with a pause between each output:

- R/V
- Water valve low
- Water valve medium
- Water valve high
- Indoor fan low
- Indoor fan medium
- Indoor fan high
- SSR1
- SSR2
- AUX
- CMC

If the unit has high and low pressure transducers then the pressure readings from the two sensors is compared just before the CMC output is activated. The two pressure readings are expected to be approximately equal. If the ratio of the two pressure readings exceeds value 1.5 then a fault will be reported.

After the sequence has completed the UC7 returns to normal mode and the display will show a blinking decimal point.

## 6. Commissioning mode

To activate commissioning mode follow these steps:

- Apply power to the unit and wait until the power-on sequence is successfully completed.
- Ensure the thermostat is 'OFF' (COMP and HEAT signals must be OFF).
- Press and hold the UC7 push button (6 to 8 seconds) until the display shows the letter 'c', then release the button.

Commissioning mode will start immediately and end after 30 minutes. When the 30 minutes have expired the UC7 automatically returns to normal mode. During commissioning mode some safety times are reduced to:

- Minimum On-Off time ('Run'-time): 10 seconds
- Minimum Off-On time ('Off'-time): 20 seconds
- Minimum On-On time: 30 seconds
- Heat/cool change-over time: 40 seconds
- De-ice mode hold-off time 60 seconds

## 7. Set-up mode

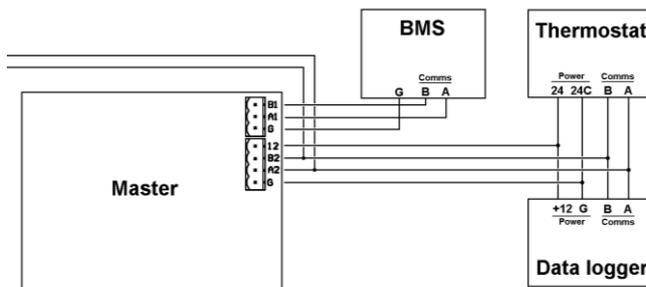
In setup mode it is possible to change the modbus address of the UC7 controller. The default modbus address of the temperzone UC7 controller is **44**. The procedure to change the address is as follows:

- Turn mains power on.
- Ensure the thermostat and the compressor are off.
- Press on hold down the pushbutton on the controller board. Hold the button down until the display shows “S”, only then release the button. The controller is now in “setup” mode.
- The display will show the 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.

NOTE: If the address was changed then the controller will save a new address in non-volatile memory (i.e. the new address will be retained even after mains power has been switched off).

## 8. Control by BMS and data logging

It is possible to remotely control a unit with a UC7 controller, for example by a building management system (BMS). The correct connections are shown below:



Temperzone has available a low cost data logger specifically designed for use with temperzone units. The Temperzone data logger connects to the same terminals as a communicating thermostat. The Data logger connections are shown above. Note that a BMS, communication thermostat and data logger are all optional and can be omitted or added as desired. The UC7 controller automatically configures itself when power is applied to the unit.

For more details about remote control and data logging capabilities see documentation titled ***“Temperzone UC7 modbus communications”***.

## 9. Display messages (normal operation)

The display on the UC7 can show the following messages:

Display	Meaning
<b>UC7 4.91</b>	Name and software version (shown only after power-on)
<b>0</b> (flashing)	Expansion valves are zeroing (shown only after power-on)
<b>dELAY</b>	The unit waits for a random delay time (up to 30s, occurs only after power-on)
<b>•</b> (flashing)	Ready (normal operation)
<b>—</b> (slowly flashing)	Unit is OFF by Remote On/Off signal (software version 4.3 onwards)
<b>dE-ICE</b>	De-icing the outdoor coil
<b>c</b>	Commissioning mode (lasts for 30 minutes)
<b>t</b>	Test mode (lasts about 1 minute)
<b>HOLD</b>	The compressor is held-on or held-off by a safety timer
<b>dr</b>	DRED energy consumption restriction is active

In addition to the messages shown above, it is possible to use the display to monitor pressures and temperatures while the unit is in normal mode or in commissioning mode. This is available regardless whether the compressor is on or off.

Repeatedly press the pushbutton to cycle the display through the options (in a round robin fashion). After 2 minutes the display will automatically return to a flashing dot (or “c”).

Button press	Display	Meaning
0	<b>• or c</b>	No temperature display (default)
1	<b>SLP</b>	Suction line pressure (kPa)
2	<b>Et</b>	Evaporating temperature (°C)
3	<b>SLt</b>	Suction line temperature (°C)
4	<b>SSH</b>	Suction side superheat (K)
5	<b>dLP</b>	Discharge line pressure (kPa)
6	<b>Ct</b>	Condensing temperature (°C)
7	<b>dLt</b>	Discharge line temperature (°C)
8	<b>dSH</b>	Discharge side superheat (K)
9	<b>• or c</b>	Back to button press 0

Pressures are shown in kPa. Divide by 6.895 (roughly 7) to convert to PSI.

Temperatures are shown in whole degrees Celsius. If the indicated temperature is below 0°C then a minus sign is shown before the value. If the unit has one or two pressure transducers then the condensing and/or evaporating temperatures shown are converted from pressure readings.

## 10. Faults

Display	Meaning
LP	Low pressure protection is active
HP	High pressure protection is active
HI-t	High temperature protection is active
LO-t	Water freeze protection is active
nO-FLO	The water flow verification switch does not operate
FLOOD	Sump flood alarm active
FROSt	Indoor coil frost protection is active
HI-SL	High suction line temperature protection is active
Lo-dSH	Low discharge superheat protection active
Hi-dSH	High discharge superheat protection is active
OL	Overload protection is active (input IN#2 is open circuit)

Display	Meaning
F10	Outdoor fan fault (no serial communications)
F11	Indoor fan fault (no serial communications)
F12	Low pressure transducer fault (will show as LP)
F13	High pressure transducer fault (will show as HP)
F14	Suction line temperature sensor fault
F15	Discharge line temperature sensor fault
F16	De-Ice temperature sensor fault (not used on hydronic models)
F17	Water-refrigerant heat exchanger temperature sensor fault
F18	Indoor coil temperature sensor fault
F19	Supply air temperature sensor fault (models with electric heating elements only)
F20	Superheat is unknown
F21	Thermostat fault (no serial communications)
F22	System 1 or BMS fault (no serial communications)
F23	Not used on hydronic models
F24	Not used on hydronic models
F25	Not used on hydronic models
F26	Invalid DIP switches setting
F27	Invalid fan selection
F28	Not used on hydronic models
F29	Microcontroller temperature exceeds +100 °C
F30	Supply voltage out of bounds (+3.3V on controller PCB)
F31	Not used on hydronic models
F32	0-10V input fault
F33	High discharge superheat protection active
F34	Problem with pressure transducer readings
F35	Reverse cycle valve fault
F36	Invalid DIP switch setting on TZT-100 thermostat

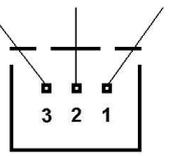
## 11. Specifications

*Notes:*

- All input and output signals from/to the UC7 are isolated from the mains inputs (L and N).
- Relay outputs HI, ME, LO, C3, CMC, HEAT, SSR1 and SSR2, as well as inputs HI, ME, LO, C1, COMP, HEAT and C2, are isolated from all other circuits. These inputs and outputs can be connected to external 24V AC or 230V AC live circuits.
- All other input and output signals from/to the UC7 are electrically referenced to the EARTH terminal.
- Any input signal that is referenced to EARTH and that needs to connect to a circuit external to the temperzone unit should be isolated by a suitable means, for example a relay. Typical examples of this are the remote On/Off input, DRED inputs, the IN#1 input (when used for the Flow switch).
- For safety, and to ensure correct operation of the unit, the EARTH terminal must directly connect to a unit earth stud located close to the controller board.

<b>Mains input</b> L and N	230V AC 50Hz nominal	190V AC minimum	250V AC maximum
<b>Output relays</b> Applies to: HI, ME, LO, CMC and R/V outputs	250V AC, 5A maximum, resistive load 250V AC, 2.5A maximum, inductive load		
<b>Solid state output relays</b> Applies to: SSR1 and SSR2 outputs	12V AC minimum, 250V AC maximum (AC only!) 0.25A maximum (continuous) 2.5A maximum (peak, 0.5s)		
<b>AUX and FLT outputs</b> Designed to operate a relay with 12V DC coil.	Open collector and +12VDC output OFF state: leakage current 0.5mA maximum ON state: 12V DC, 100mA maximum		
<b>EXV1 and EXV2 outputs</b> Designed to operate unipolar electronic expansion valves: 5-wire and 6-wire types.	Open collector and +12VDC output OFF state: leakage current 0.5mA maximum ON state: 12V DC, 275mA maximum per winding		
<b>Isolated inputs</b> Applies to: HI, ME, LO, COMP and HEAT inputs	<b>When configured for 24V input signals:</b> Maximum input voltage OFF state: 3V AC/DC Minimum input voltage ON state: 18V AC/DC Absolute maximum input voltage: 40V AC/DC Input impedance: 4.7kΩ		
	<b>When configured for 230V AC input signals:</b> Maximum input voltage OFF state: 30V AC Minimum input voltage ON state: 180V AC Absolute maximum input voltage: 300V AC Input impedance: 200kΩ		

Continued on the next page.

<p><b>IN#1 and IN#2</b>  <b>DRED inputs D1, D2, D3</b>  <b>Remote On/Off input</b></p>	<p>Designed to be operated by isolated voltage free contacts.                  Open circuit voltage: 3.3V DC typical                  Closed circuit current: 3.3mA DC typical</p>
<p><b>V1 and V2 outputs</b></p>	<p>Provide 0-10V DC output.                  Maximum load: 6.5kΩ                  Maximum short circuit output current: 30mA</p>
<p><b>Temperature sensor inputs</b>                  DL: red                  SL, DEI: blue                  AMB: yellow or black                  OC, IC: yellow</p>	<p>Designed to connect to standard Temperzone thermistor temperature sensors.</p>
<p><b>Pressure transducer inputs</b>                  signal +5V 0V</p> 	<p>Power: 5.0V DC, maximum current 50mA                  Signal: 0.5V at the lowest pressure                  4.5V at the highest pressure                  Pressure ranges:                  LPT, unit with a fixed capacity compressor:                  0 to 1730 kPa (0-17.3 bar, 0-251 PSI)                  LPT, unit with a digital scroll compressor:                  0 to 3450 kPa (0-34.5 bar, 0-500 PSI)                  HPT, all units:                  0 to 4500 kPa (0-45.0 bar, 0-653 PSI)</p>
<p><b>Controller working ambient temperature range</b></p>	<p>-10 to +65°C</p>
<p><b>Modbus RS485 serial communications format</b></p>	<p>Baud rate 19200                  Data bits 8                  Parity even                  Stop bits 1</p>