UNIT CONTROLLER 6 (UC6)
Operation and Installation
Hydronic

Date: 12 October 2015

Issue: 1

Contents

1. Introduction

The temperzone Unit Controller 6 (UC6) is the successor to the OUC4 controller. The UC6 provides increased capability and flexibility in indoor-, outdoor- and packaged units. The complete controller combines the µPC controller board from Carel plus an interface board to connect temperzone standard sensors and plugs.

The UC6 receives requests such as "Unit On/Off", "Start compressors", "Activate HEAT (Reverse Cycle)" and transfers these requests to the outputs after enforcing safety timers. The UC6 ensures unit safety by continuously monitoring input signals such as pressures and temperatures. Beside the normal controls and unit safety the UC6 has many other functions, for example head pressure control, capacity control, superheat control, serial communications and more.

2. Features

The UC6 has the following features:

Normal controls:
- One controller can manage two complete refrigeration circuits
- Two drivers for uni-polar electronic expansion valves (EEV)
- Outdoor fan control
- Reversing valve change over management
- Variable speed compressor management
- Crankcase heater control
- BMS interface with optional board(BACnet/IP, Ethernet, MS/TP)
- DRED input and control

Safety functions:
- Compressor minimum cycle time, minimum run time, minimum off time.
- High pressure protection via high pressure transducer
- Low pressure protection via low pressure transducer
- Loss of refrigerant protection
- Indoor coil frost protection
- No water flow protection
- Water float protection
- Low water output temperature protection
- Repeat fault lock out
- Error code display
- Alarm logging

Commissioning functions:
- Commissioning mode
- Automatic test sequence

3. Lower board connections
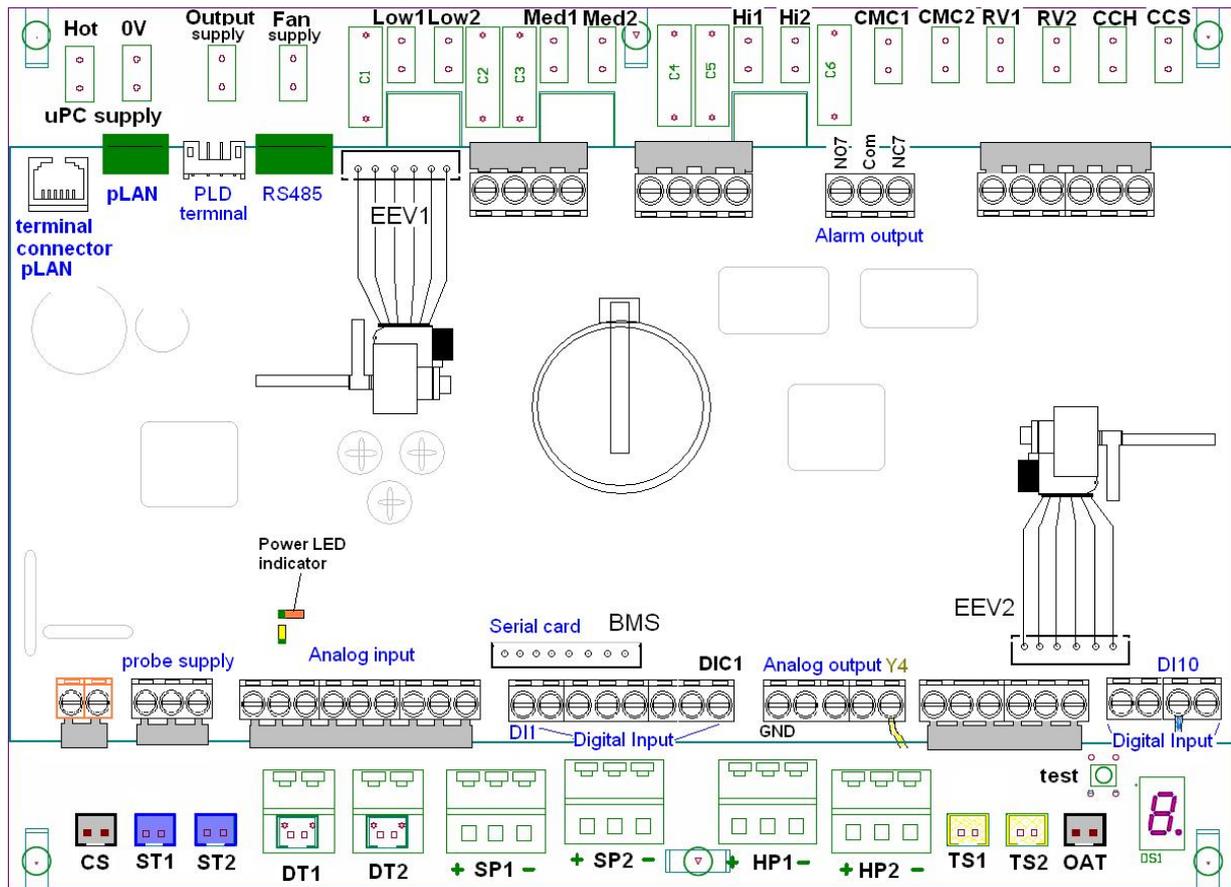
The paragraphs on the following pages give details how the UC6 should be connected both for packaged units and for the outdoor unit of a split system.

Care must be taken that the correct connections are made as the UC6 can be configured in various modes.

Important:

- The UC6 controller must be mounted inside an electrical panel.

- To minimise electrical interference low power signal wires from temperature sensors, pressure transducers and low voltage control signals must be kept physically separate from wiring and cables that carry mains power.

  Never run power cables and signal cables in the same conduits.

- Contact temperzone if the controller has malfunctioned. Do not attempt to repair the controller.

3.1.   Power supply terminals

The UC6 is powered by 24V ±10% AC. A class 2 safety transformer with a minimum rating of 24VA must be used in the installation. The power supply to the UC6 controller must **not** be used to power other electrical devices. If the 24V secondary winding of the transformer is earthed then make sure that the earthed wire connects to terminal "µPC supply 0V".

A yellow LED indicates when the UC6 is powered.

Terminal	Signal	Notes
HOT (µPC supply)	24V AC HOT	*Do **not** inadvertently connect 230V AC to these pins!*
0V (µPC supply)	24V AC COMMON	
Output supply	Relay common power supply for switched output signals: CMC1 CMC2 RV1 RV2 CCH CCS	This terminal normally connects to 230V AC phase.
Fan supply	Power supply for fan control terminals.	Depending on the connections to the fan or fan controller this terminal normally connects to 24V AC HOT **or** 230V AC phase

3.2.   Output terminals

When the UC6 is configured as three speed indoor fan:		
Terminal	**Signal**	**Notes**
Low1	Indoor fan(s) Low speed terminal	
Low2		
Med1	Indoor fan(s) Medium speed terminal	When active these outputs electrically connect to the <u>Fan supply</u> terminal.
Med2		
Hi1	Indoor fan(s) High speed terminal	
Hi2		

When the UC6 is configured indoor fan as EC motor:		
Terminal	**Signal**	**Notes**
Low1	No function.	
Low2		
Med1	No function.	
Med2		
Hi1/Hi2	Active to turn on the EC fan contact	

Terminal	**Signal**	**Notes**
CMC1	Compressor On/Off	
CMC2	Circulation pump control	
RV1	Reversing valve/Electric heater circuit1(if fitted)	When active these outputs electrically connect to the Output supply terminal.
RV2	Condensate pump	
CCH	Crankcase Heater/Electric heater circuit2(if fitted)	
CCS	Water Pump	

3.3.   Input terminals

Terminal	**Signal**	**Notes**
CS	This input can have one of two functions: (1) 0 to 1V Analogue input (2) Return or supply air temperature	For variable capacity systems For fixed capacity systems
ST1	Compressor suction line temperature	NTC blue wires
ST2	NA	
DT1	Compressor discharge line temperature	NTC red wires
DT2	Electric heater temperature sensor (if used)	

Terminal	Signal	Notes
SP1	Compressor suction line pressure	0-5V transducer
SP2	NA	
HP1	Compressor discharge line pressure	
HP2	NA	
TS1	Water In temperature	NTC Blue wires
TS2	Water Out temperature	
OAT	Outdoor air temperature	NTC black wires
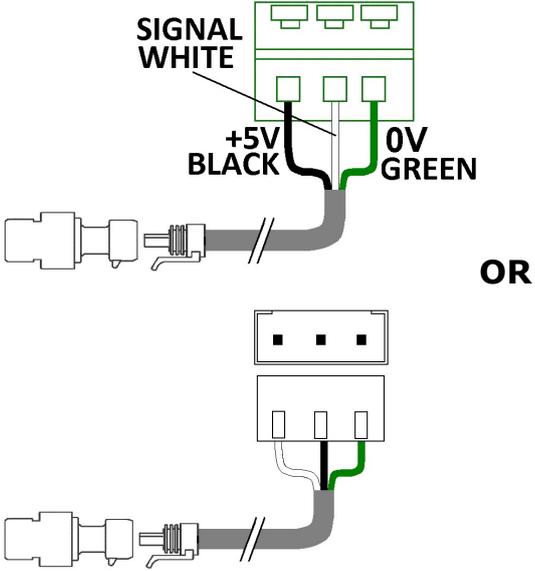
4. Upper board connections

DIGITAL INPUT CONNECTIONS
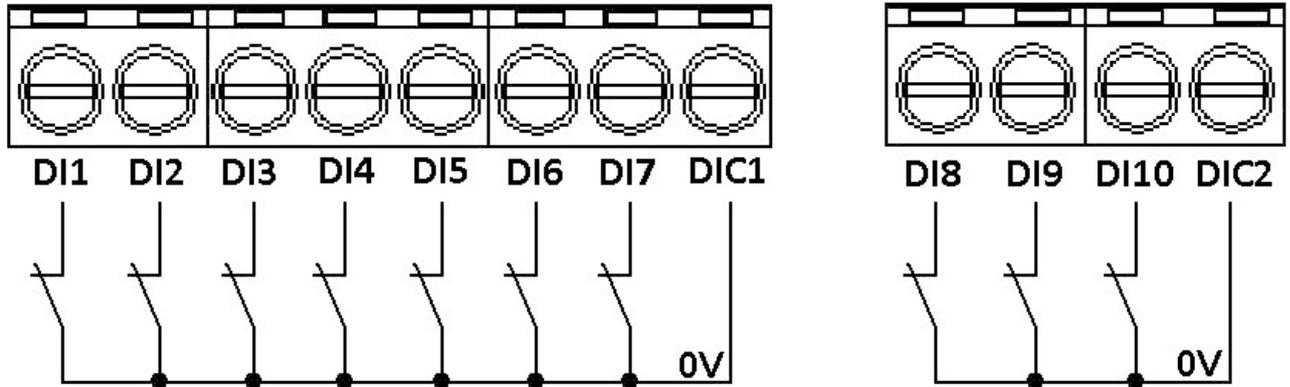
The digital input port common pins DIC1 and DIC2 are internally directly connected to the local board 0V.

4.1.   Digital input signals

When the UC6 is configured as three indoor fan speed:	
DI	**Signal**
1	Indoor fan LOW speed input
2	Indoor fan MEDIUM speed input
3	Indoor fan HIGH speed input

When the UC6 is configured as EC fan motor:	
DI	**Signal**
1	Active the indoor fan contact
2	
3	

DI	Signal	Notes
4	Reverse cycle request	Heat
5	Compressor request Or overload input	Without TZT-100: Compressor With TZT-100: Overload input
6	Water Float Switch	Input Normally close. If the float switch is activated, there may be a water leak from the pipe. It will stop the compressor immediately.
7	Remote on/off	This input must be **closed circuit** to allow the UC6 to switch compressors and fans on.
9	Water verification	Water Flow Verification Switch when there are water flow through the pipe switch is closed

When the UC6 is configured for DRED function:		
DI	**Signal**	**Notes**
8	DRED1	When activated the compressors will be OFF. The indoor fan is allowed to continue.
9	DRED2 or DRED3 (configurable via UC6 service interface)	DRED2 active: Total unit energy consumption will be reduced to less than 75% of rating. DRED3 active: Total unit energy consumption will be reduced to less than 50% of rating.

DI	**Signal**	**Notes**
10	Push button	Press and hold the push button on the lower board **1 to 5 seconds** to start test mode. Test mode can only be activated when both compressors are OFF. Press and hold the push button on the lower board **10 to 15 seconds** to start commissioning mode.

4.2.   Digital output signals

DO	**Signal**	**Notes**
NO7	Normally open	Alarm output relay
C3	Common	
NC7	Normally closed	

4.3.   Analogue output signals

AOUT	**Signal**	**Notes**
Y1	Indoor fan speed	0-10V (if used)
Y2	Water flow Valve	0-10V control water flow
Y4	LED display control	Controls the 1-digit LED display used to show alarm codes.

4.4.   Communication ports

Several types of communication ports are available on the UC6.

COMM PORT	Signal	Notes
RS485[1]	MODBUS RS485	Thermostat, Inverter
pLAN	UC6 service tool	Programmable graphic display
PLD[1]	Fieldbus (RS485 or TLan)	Supervisory System
BMS	RS485 MODBUS (BACnet/IP,MS/TP or Ethernet optional)	Available only with additional plug-in module connected to the "BMS" connector (adjacent to the Digital Input connector).

Note 1: *Connectors to the UC6 show R+/T+ for signal A, R-/T- for signal B.*

4.4.1.   Temperzone TZT-100 thermostat connection

The UC6 can connect directly to the temperzone TZT-100 thermostat using a shielded cable with two twisted pair wires suitable for RS485 serial communications. The drawing below shows connection details.
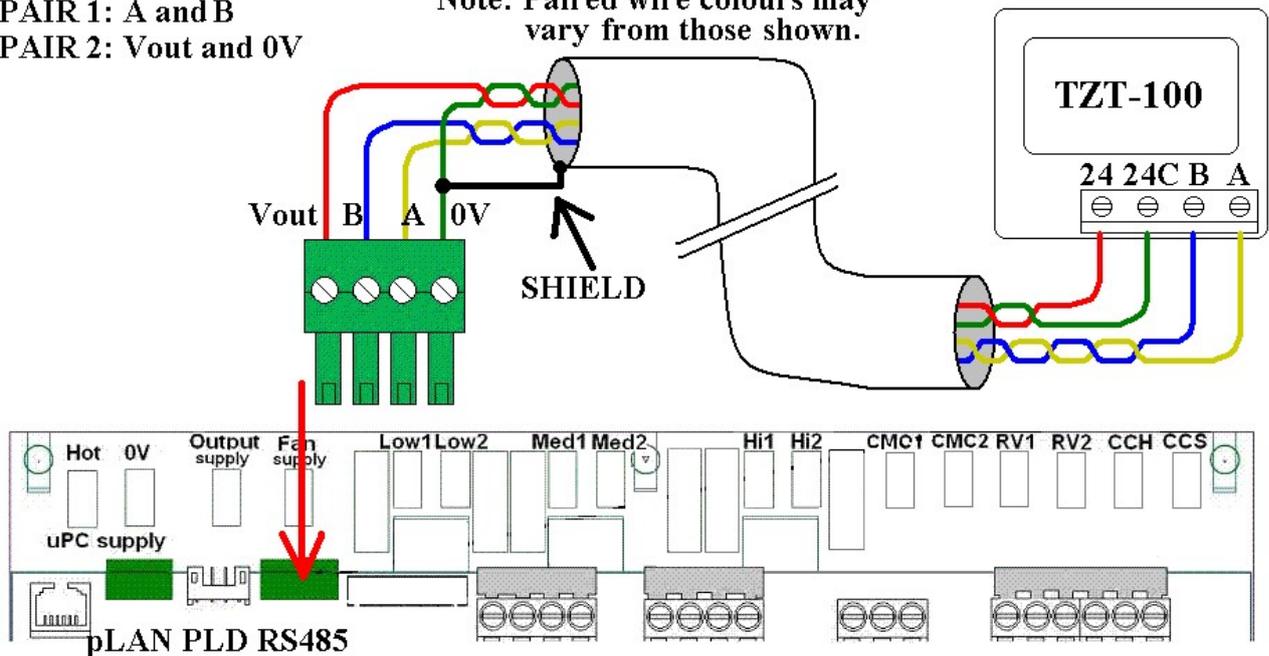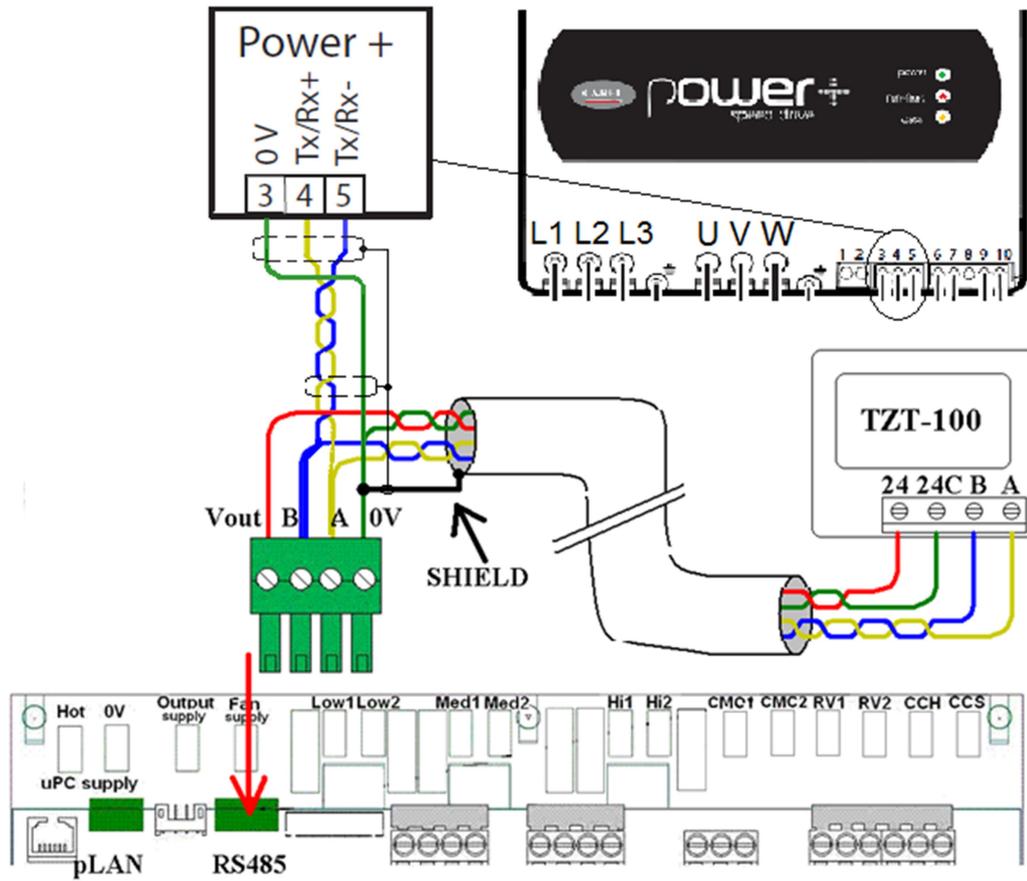
4.4.2.   Power+ inverter driver connection

BLDC compressor driver Power+ is connected to UC6 at same port with TZT-100 using a shielded cable. See the details at below drawing.

4.5.   Electronic expansion valves

The UC6 has two drivers to control electronic expansion valves (EEV).
The EEV outputs are **EEV1** and **EEV2**

Note: Only one valve must be connected to each connector.

EEV type	6-wire uni-polar stepper motor
Motor supply voltage	12V DC±10%
Motor winding current	0.3A maximum (each winding)
Motor winding resistance	40Ω minimum
Maximum power each EEV	7W
EEV step frequency	Set by temperzone software

5. Operation

5.1.   Remote on/off

The remote on/off function can be enabled or disabled by using a UC6 service tool.

When the function is enabled the remote on/off signal must connect to input **DI7,** signal return is **DIC1**. The remote on/off signal must be an external voltage free switched relay contact.

The unit is active when DI7 is connected to DIC1.

5.2.   Variable duty units

The UC6 can control a variable speed compressor or a digital scroll compressor. Temperzone pre-configures the unit to the correct compressor type; a UC6 service tool is required if the compressor type configuration must be changed.

The capacity input signal must connect to input **CS** (0-1V, duty 10% per 0.1V).

The minimum compressor duty is:
> 20 to 30% for a variable speed compressor (depends on compressor model)
> 16% for a digital scroll compressor

When a capacity signal is present on input CS that is lower than the minimum duty (for example 0.0V) then the compressor will continue to operate on minimum duty. Safety functions may place further restrictions on the minimum duty and may act at any operating condition.

5.3.   Water flow valve Y2

When a unit is in cooling, the Water Flow Valve is used to regulate the condensing temperature via the 0-10V signals Y2.

When a unit is in heating mode the Water Flow Valve remains fully open.

The condensing temperature is converting from the high pressure reading from **HP1.**

5.4.   *Indoor fan control*

The UC6 can be used to control the indoor fan speed. The configuration of the UC6 can be set using a UC6 service tool. If the UC6 is configured to control the indoor fan then the following applies.

Indoor fan control input signals are:
- If the UC6 is configured to use digital input signals then the indoor fan control signals are:
  - o DI1: Low
  - o DI2: Medium
  - o DI3: High
- If the system uses a temperzone TZT-100 thermostat then the indoor fan input signals are received from the TZT-100 through the RS485 communications cable.

Two types of outputs are available for indoor fan speed control:
- Relays to control a three speed indoor fan motor
  - o Low1 and Low2
  - o Med1 and Med2
  - o Hi1   and Hi2
- A 0-10V signal on analogue output Y1 for electronically controlled fans.

5.5.   *Heating mode*

When input **DI4** is made active the unit is placed in heating mode. The reversing valves are connected to outputs **RV1**. If the unit was cooling when the input signal changed the compressors will be stopped first and the change-over of the reversing valves will be delayed to prevent "gas rush". The length of the delay is adjustable by using a UC6 service tool.

If heating mode is requested but the compressors are not started within 5 minutes then the reversing valves are switched off again to save power. They will re-activate as soon as a compressor run request is received. The duration of the 5 minute timeout is adjustable by using a UC6 service tool.

If the compressor is configured as **cooling only** and electric heater is fitted then **RV1** is used to switch the electric heater on.

5.6.   *Crankcase heater*

Crankcase heaters are controlled by output **CCH**.

The crankcase heaters are activated when the following conditions are met:

> Mains power has just been turned on
>   OR:
> One or both compressor(s) is (are) OFF
> The compressor(s) has (have) not run for at least one hour
> The outdoor ambient temperature is below +7°C.

5.7.   *Electronic expansion valve control*

On units equipped with electronic expansion valves (EEV) the EEV are used to regulate suction side superheat. The EEV connect to outputs **EEV1** and **EEV2**

Suction side superheat is defined by the difference between the evaporating temperature and the compressor suction line temperature. The evaporating temperature normally is calculated from the suction line pressure.

HWP291 is a single compressor with two coils system unit. EEV1 and EEV2 operate synchronized by same a pair of control signal (suction temperature and pressure). Temperzone has selected optimum EEV control parameters to guarantee best unit performance when cooling and when heating.

5.8. Demand response management

The UC6 provides 2 or 3 inputs (depends on unit configuration) for the D.R.E.D. function. D.R.E.D. stands for "Demand Response Enabling Device". The aim of the function is to have a measure of control over the total energy that is consumed by the unit as measured over a half hour period. Refer to Australian draft standard AS4755.3.1 for detailed information.

The UC6 achieves compliance to the standard by "duty cycling" or stopping one or two compressors.

Inputs for the DRED function are:
    DI8   DRM1
    DI9   DRM2 or DRM3 (configurable)

If the unit is configured with Quiet mode enabled then input DI9 is not available for the DRED function.

Display indication with DRM1 active	letter **b**

6. Protection functions

6.1. Minimum compressor run time

Minimum time that a compressor must run when started. This ensures that an adequate amount of compressor lubricating oil is returned to the compressor after start up.

Display indication when timer is active	number **2**

6.2. Minimum compressor off time
Minimum time that a compressor must remain off after it has stopped. This time ensures that a compressor is not re-started while there still is a high pressure differential across the compressor.

Display indication when timer is active	number **1**

6.3. Minimum compressor cycle time
A compressor is allowed a maximum of 10 starts per hour (one start per 6 minutes). This limits the amount of stress on the compressor motor.

Display indication when timer is active	number **1**

6.4. High pressure protection (HP)
If high pressure transducers are connected to inputs **HP1** then a compressor is switched off when the discharge line pressure reading exceeds 42.0bar.

The UC6 will automatically reduce capacity of a variable compressor before the maximum value of 42bar / 66°C is reached.

When a compressor is stopped due to high pressure it is held off for a period of 3 minutes, after which it is allowed to restart (provided pressure has fallen well below the maximum).

If three consecutive trips occur then the unit will be "locked out". The trip counter is reset to 0 when there has been no compressor run request for longer than 60 minutes.

Display indication when protection is active	number **4** (flashing)

6.5.   Loss of refrigerant protection (LOR)

When a compressor is running the UC6 continuously monitors the various temperatures and pressures. The controller software applies logic that enables it to determine whether the system has an adequate amount of refrigerant. Signals used for this check are suction temperatures **ST1** and suction line pressures **SP1**.

The check is not made during the first 5 minutes after a compressor is started to allow pressures and temperatures to settle.

If the compressor is a variable speed type or a digital scroll type then the check is made only when the capacity is at 100%.

When a compressor is stopped due to loss of refrigerant it is held off for a period of 3 minutes, after which it is allowed to restart.

If three consecutive trips occur then the unit will be "locked out". The trip counter is reset to 0 when there has been no compressor run request for longer than 60 minutes.

Display indication when protection is active	number **3** (flashing)

6.6.   High suction line temperature (HiST)

When the suction line temperature is above 30°C and continuously for 15 minutes, stop the compressor.

If the compressor is a digital scroll type then the check is made only when the capacity is at 100%.

When a compressor is stopped due to high suction temperature, it is held off for a period of 3 minutes, after which it is allowed to restart.

If three consecutive trips occur then the unit will be "locked out"

Display indication when protection is active	number **4** (flashing)

6.7.   Indoor coil frost protection (FROST)

When the unit is cooling the evaporating temperature in the indoor coil must remain above -4°C (adjustable from -10°C to -2°C by using a UC6 service tool).

If this temperature falls below the threshold then some amount of ice (frost) is likely to have formed on the indoor coil.

When indoor coil frost protection is activated the compressor is stopped for 15 minutes, after which it is allowed to restart.

If three consecutive trips occur then the unit will be "locked out". The trip counter is reset to 0 when there has been no compressor run request for longer than 60 minutes.

Display indication when protection is active	number **7** (flashing)

6.8.   High discharge line temperature protection (HDT)

The controller monitors the discharge line temperature (inputs **DT1**) and should it rise above 110°C the compressor will be stopped.

When high temperature protection is activated the compressor is stopped for at least 3 minutes. The compressor is allowed to restart after 3 minutes provided that the discharge line temperature has fallen to below 100°C.

If three consecutive trips occur then the unit will be "locked out". The trip counter is reset to 0 when there has been no compressor run request for longer than 60 minutes.

Units with a variable compressor or digital scroll compressor will automatically reduce capacity before the discharge temperature rises close to the threshold.

Display indication when protection is active	number **9** (flashing)

6.9.   No Water Flow Protection

If the Water Flow Verification Switch input (**Din_9**) is opened during the compressor running cycle, stop the compressor immediately and report a fault. This fault will be recovered automatically after the Water Flow Verification Switch contact is closed for certain time.

If the Water Flow Verification Switch input is opened 3 times within 2 hours, the compressor will be lockout.

Display indication when no water flow	number **8**

6.10.   Water Float Protection

Normally the Float Switch (**Din_6**) should not ever be activated because the condensate pump is running at all the time. If the float switch is activated, there may be a water leak from the pipe then the compressor will stop immediately and the condensate pump will keep running until the float switch resets.

Display indication when Water Float	number **8**

6.11.   Low output water temperature protection

If the output water temperature is blow 2°C for a contain time, stop the compressor. Minimum output water temperature and the delay time are configurable variables on UC6 service tools Service Configuration page.

Display indication when Water Float	number **8**

6.12.   Compressor lock-out

Certain faults (as outlined in the preceding paragraphs) can cause the unit to be "locked out" if they occur three consecutive times while the compressor-run request has remained active. When a unit is locked out the compressor is not allowed to start until the lock-out is manually reset. Lock-out protects the unit from repeatedly starting the compressor when a serious fault exists that requires the attention of a service technician.

When a unit is locked out the alarm relay output (**NO7, NC7**) will be active.

A unit that is locked out can be reset by either of the following two methods:
1. Remove mains power from the unit for at least 3 seconds, and then restore power.
2. Use a UC6 service tool to manually reset the lock-out condition.

Display indication when protection is active	letter **F** (flashing)

6.13.   Sensor alarm

If the signal of a temperature sensor or pressure transducer is out of normal operating range the UC6 will generate an alarm. The sensor may be faulty, disconnected or short circuit.

Display indication temperature sensor alarm	number **5** (flashing)
Display indication pressure transducer alarm	number **6** (flashing)

6.14.   Loss of RS485 communications alarm

If the UC6 does not receive correct responses from a device that connects via the RS485 Modbus serial communications port then an alarm is generated. Examples of such devices are: a TZT-100 thermostat, a Carel Power+ inverter.

Display indication for communications fault	letter **C** (flashing)

7. Test mode

Test mode can only be activated when both compressors are OFF.

To start test mode press and hold down the push button on the lower board **between 1 and 5 seconds**.

In test mode each output is activated for 5 to 10 seconds, one output at a time. When test mode completes the unit automatically returns to normal operation.

Display indication during test mode	letter **A**

8. Commissioning mode

To start commissioning mode press and hold down the push button on the lower board **between 10 and 15 seconds**.

In commissioning mode all time delays are reduced to $1/10^{th}$ their standard value to enable rapid diagnostic testing.

Commissioning mode automatically completes after 30 minutes and the unit will return to normal operation. Cycling mains power off and on again also ends commissioning mode.

Display indication during commissioning mode	letter **S.e.r**

9. Display summary

	Description	Notes	Section
	Normal operation		
1	Compressor timer active	Compressor is held OFF until timer expires	6.2 6.3 6.4
2	Compressor timer active	Compressor is held ON until timer expires	6.1
3	Loss of refrigerant alarm		6.5
4	High pressure alarm Or High Suction temp. alarm	Stop the compressors if HP exceeds the 42 bar threshold. Or Suction temperature is above 30°C continuously for 15 minutes.	6.4 6.6
5	Temperature sensor signal out of range	A temperature sensor may be faulty, disconnected or short circuit.	6.13
6	Pressure transducer signal out of range	A transducer may be faulty, disconnected, short circuit, inadvertently swapped with another, or the wrong type is fitted.	6.13
7	Indoor coil frost alarm	In the cooling cycle, if the evaporator temperature is less than -4°C (adjustable between -2 and 10°) for a period of time, the compressor will stop for 15 mins.	6.8
8	Water Flow Verification Water Float Low water output temperature	If the Water Pump is active for a certain time, Water Flow Verification Switch is open, stop compressor. If Water Float switch is open, stop compressor If the water output temperature is below 2°C stop compressor	6.9 6.10 6.11
9	High discharge line temperature alarm	If the discharge line temperature rises above 110°C the compressor will be stopped.	6.9
A	Test mode	Unit is in test mode	7
b	D.R.E.D. active (reduced capacity operation)	One of the 3 possible DRM modes is activated.	5.8
C	RS485 Modbus communications alarm	Check connections with TZT-100 thermostat and/or any inverter compressor driver in the unit.	6.14
d	Unit turned OFF by an external On/Off signal, Phase Rotation error, or an Open Circuit Overload.	When a TZT-100 thermostat is used then inputs DI5 and id used as overload input signals. Usually these monitor condenser fan overloads.	5.1

S.e.r	Commissioning mode	Or service mode. resets after 30 Minutes.	8
F	Lock out (A repetitive fault has caused the system to shut down)	The specific repetitive fault that caused the lockout is identifiable: 1.Frost lockout 2.HP lockout 3.HT lockout 4.Loss of refrigerant lockout 5.Water flow verification switch failure lock out	6.12

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