



UNIT CONTROLLER 6 (UC6)

Operation and Installation

Date: 1 November 2012

Issue: 1

Contents

1. Introduction.....	3
2. Features	3
3. Lower board connections	4
3.1. Power supply terminals	5
3.2. Output terminals	5
3.3. Input terminals.....	6
4. Upper board connections.....	8
4.1. Digital input signals.....	8
4.2. Digital output signals.....	9
4.3. Analogue output signals	9
4.4. Communication ports	10
4.4.1. Temperzone TZT-100 thermostat connection	10
4.5. Electronic expansion valves	11
5. Operation.....	11
5.1. Remote on/off.....	11
5.2. Variable duty units	11
5.3. Outdoor fan control	12
5.4. Indoor fan control.....	12
5.5. Heating mode	12
5.6. Outdoor coil de-ice control.....	13
5.7. Crankcase heater.....	13
5.8. Electronic expansion valve control	14
5.9. Demand response management	14
6. Protection functions	14
6.1. Minimum compressor run time	14
6.2. Minimum compressor off time.....	14
6.3. Minimum compressor cycle time	14
6.4. Delay time between compressor 1 and compressor 2 start.....	15
6.5. High pressure protection (HP).....	15
6.6. Loss of refrigerant protection (LOR)	15
6.7. Indoor coil frost protection (FROST).....	16
6.8. High discharge line temperature protection (HDT).....	16
6.9. Compressor lock-out	16
6.10. Sensor alarm	17
6.11. Loss of RS485 communications alarm	17
7. Test mode.....	17
8. Commissioning mode	17
9. Display summary	18

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 μ PC 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 1 or 2 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
- Outdoor coil De-ice management
- Reversing valve change over management
- Digital scroll compressor management
- Variable speed compressor management
- Crankcase heater control
- BMS interface with optional board
- DRED input and control

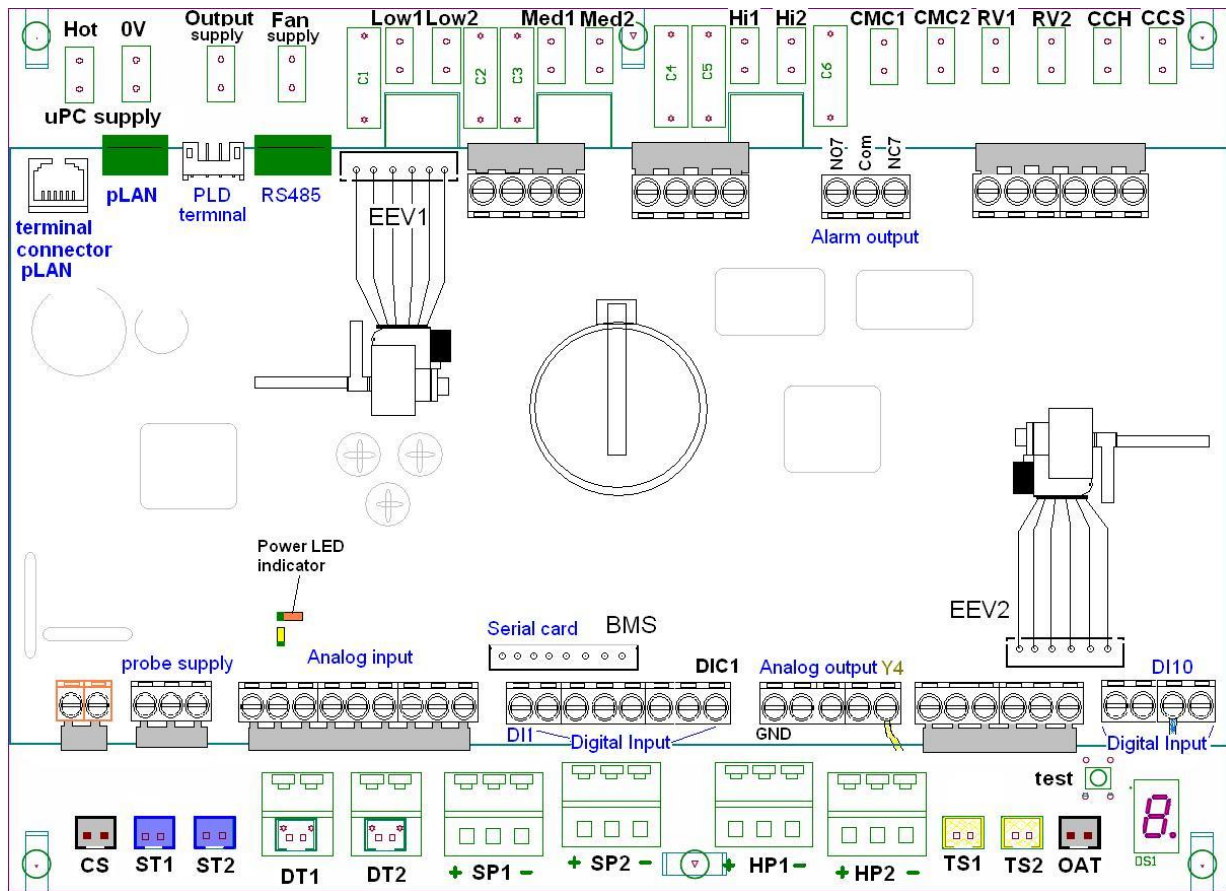
Safety functions:

- Compressor minimum cycle time, minimum run time, minimum off time.
- High pressure protection via HP switch or high pressure transducer
- Low pressure protection via LP switch or low pressure transducer
- Loss of refrigerant protection
- Indoor coil frost 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 (uPC supply)	24V AC HOT	<i>Do not inadvertently connect 230V AC to these pins!</i>
0V (uPC 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 or 10 or 12V DC

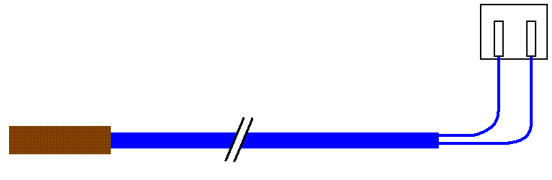

3.2. Output terminals

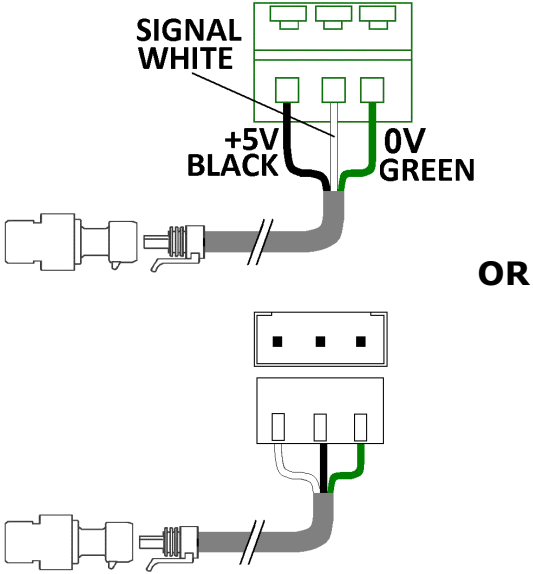


When the UC6 is configured to control indoor fan speed:		
Terminal	Signal	Notes
Low1	Indoor fan(s) Low speed terminal	When active these outputs electrically connect to the Fan supply terminal.
Low2		
Med1	Indoor fan(s) Medium speed terminal	
Med2		
Hi1	Indoor fan(s) High speed terminal	
Hi2		

When the UC6 is configured NOT to control indoor fan speed:		
Terminal	Signal	Notes
Low1	System 1 indoor fan off during an outdoor coil de-ice cycle.	When active these outputs electrically connect to the Fan supply terminal.
Low2		
Med1	System 1 indoor fan off during an outdoor coil de-ice cycle.	
Med2		
Hi1	No function.	

Terminal	Signal	Notes
CMC1	Compressor 1 CMC1	When active these outputs electrically connect to the Output supply terminal.
CMC2	Compressor 2 CMC2	
RV1	Reversing valve1	
RV2	Reversing valve2	
CCH	Crankcase Heater	
CCS	Compressor capacity solenoid (compressor modulating valve)	

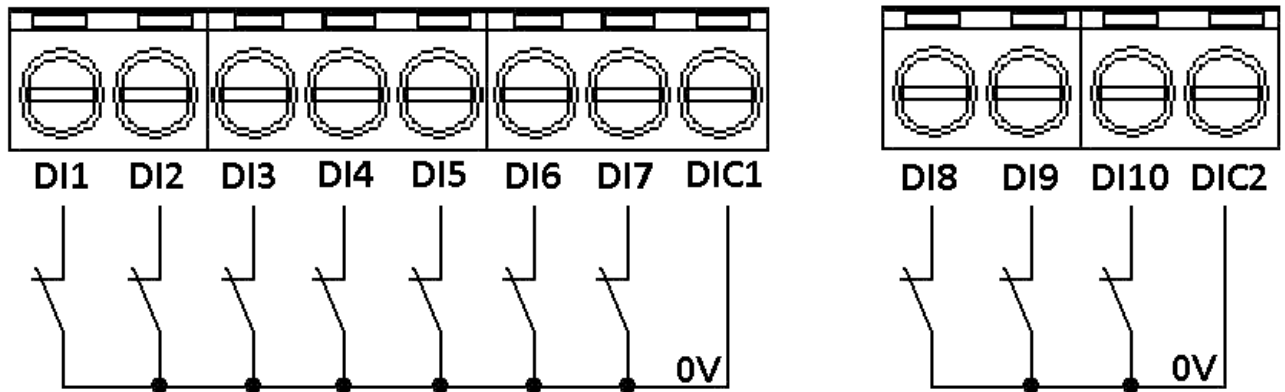
3.3. Input terminals

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 1 suction line temperature	NTC blue wires 
ST2	Compressor 2 suction line temperature	
DT1	Compressor 1 discharge line temperature	NTC red wires 
DT2	Compressor 2 discharge line temperature	

Terminal	Signal	Notes
SP1	Compressor 1 suction line pressure	<p>0-5V transducer</p> 
SP2	Compressor 2 suction line pressure	
HP1	Compressor 1 discharge line pressure	
HP2	Compressor 2 discharge line pressure	
TS1	Compressor 1 outdoor(mid) coil temperature sensor	<p>NTC Mid-coil: yellow wires De-ice : blue wires</p> 
TS2	Compressor2 outdoor(mid) coil temperature sensor	
OAT	Outdoor air temperature	<p>NTC black wires</p> 

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 to control 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 NOT configured to control indoor fan speed:	
DI	Signal
1	No function
2	No function
3	No function

DI	Signal	Notes
4	Reverse cycle request	Heat
5	Compressor 1 request Or overload input 1	Without TZT-100: Comp1 With TZT-100: Overload input 1
6	Compressor 2 request or overload input 2	Without TZT-100: Comp2 With TZT-100: Overload input 2
7	Remote on/off	This input must be closed circuit to allow the UC6 to switch compressors and fans on.

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.

When the UC6 is configured for Quiet mode:		
DI	Signal	Notes
8	DRED1	When activated the compressors will be switched off. The indoor fan is allowed to continue.
9	Quiet mode	Quiet mode is enabled when this input is made active.

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	System 1 outdoor fan speed	System 1 0-10V outdoor fan speed control (if used)
Y3	System 2 outdoor fan speed	System 2 0-10V outdoor fan speed control (if used)
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 / CAREL RS485	Thermostat, Inverter
pLAN	UC6 service tool	Programmable graphic display
PLD ¹	Fieldbus (RS485 or Tlan)	Supervisory System
BMS ²	RS485 MODBUS (BACnet 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.

Note 2: Current software supports only BMS via RS485 MODBUS. BACnet or Ethernet options can be made available on request.

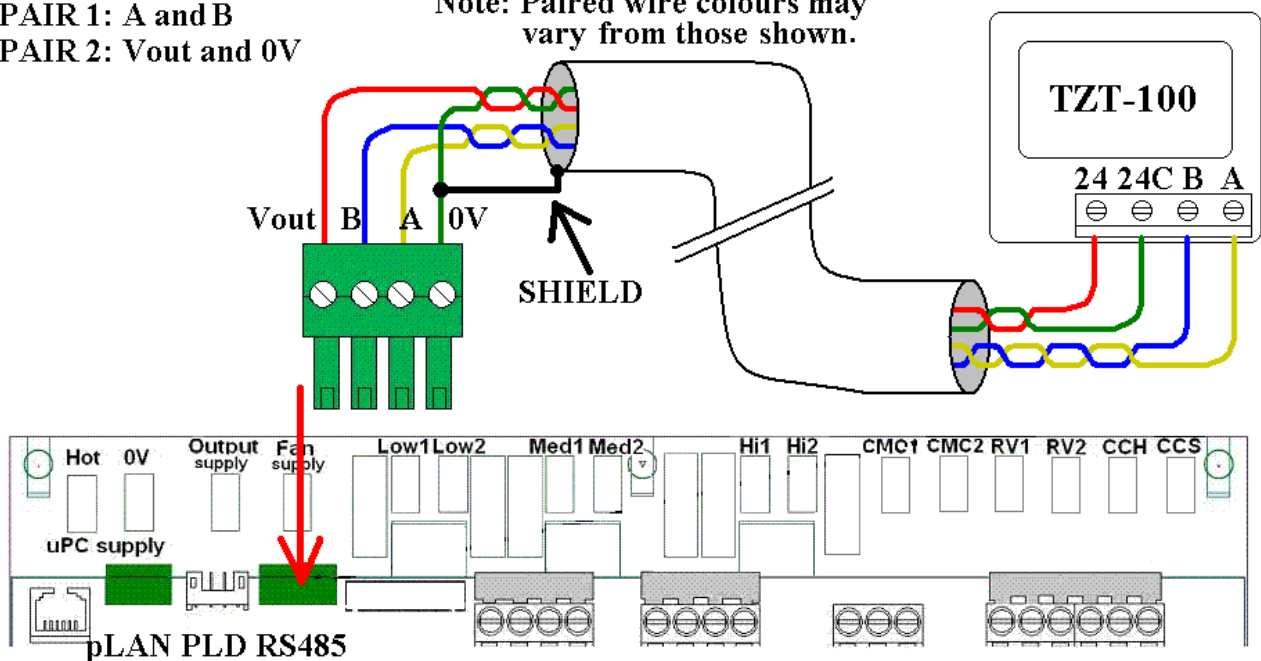
4.4.1. Temperzone TZT-100 thermostat connection

The UC6 can connect directly to the temperzone TZT-100 thermostat using a shielded cable with two twisted pair wires suitable for RS85 serial communications. The drawing below shows connection details.

PAIR 1: A and B

PAIR 2: Vout and 0V

Note: Paired wire colours may vary from those shown.



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 unit where one of the two compressors is 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).

For digital scroll compressors the capacity output signal (compressor modulating valve control signal) is on output **CCS**.

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. Outdoor fan control

When a unit is in cooling mode the UC6 can control condensing temperature by regulating the speed of multiple outdoor fans via two 0-10V signals.

When a unit is in heating mode the UC6 normally commands the outdoor fans to run at high speed.

When a unit is de-icing the outdoor coil the outdoor fans stop.

The outdoor fan speed control signals are:

Y2 for system 1 outdoor fan(s)

Y3 for system 2 outdoor fan(s)

The UC6 determines the condensing temperatures either by converting the high pressure readings (as reported by the high pressure transducers connected to inputs **HP1** and **HP2**) to a condensing temperature, or by measuring the outdoor mid-coil temperatures (temperature sensors connected to **TS1** and **TS2**).

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:
 - DI1: Low
 - DI2: Medium
 - 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
 - Low1 and Low2
 - Med1 and Med2
 - 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** and **RV2**. 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.

5.6. Outdoor coil de-ice control

When a unit is in heating mode and the outdoor coil temperature falls below freezing point then ice may start forming on the outdoor coil. If the amount of ice continues to build up then the UC6 may start an outdoor coil de-ice cycle.

The de-ice cycle ends as soon as the outdoor coil reaches a temperature sufficiently high to ensure that all ice has melted. If operating conditions are particularly severe then it is possible that the required temperature cannot be reached. In the latter case the duration of a de-ice cycle is limited to a maximum of 10 minutes.

The UC6 will not start a new de-ice cycle until a "hold-off period" has expired since the end of the last de-ice cycle. The nominal duration of the hold-off period is half an hour. The duration of the "de-ice hold-off period" may vary automatically, for example when the UC6 detects that little ice is being formed on the outdoor coil.

At the start of a de-ice cycle the compressor is first stopped (or slowed down for a variable speed compressor). After one minute the reversing valve is changed to cooling mode and the compressor is restarted (or speed is increased). During the de-ice cycle the outdoor fan is stopped. At the end of a de-ice cycle the compressor is stopped again (or slowed down). The outdoor fan is started 90 seconds before the compressor to remove water from the outdoor coil. Normal heating mode resumes after that.

If a unit is configured to operate in "commercial" mode the compressor is not stopped at the start of a de-ice cycle.

On most two compressor units the de-ice cycle as described above applies to each individual system. The UC6 will not allow both systems to de-ice at the same time. Exceptions to this rule exist, for example for units with a common outdoor fan chamber must de-ice the two outdoor coils at the same time. Temperzone configures each unit to the correct de-ice strategy.

Display indication during a de-ice cycle	number 8
--	-----------------

5.7. 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.

5.8. *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.

Temperzone has selected optimum EEV control parameters to guarantee best unit performance when cooling and when heating.

5.9. *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
Display indication with DRM2 or DRM3 active	letter C

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. Delay time between compressor 1 and compressor 2 start

The UC6 does not allow both compressors in the unit to start at the same time even when the compressor run request is received at the same time; a brief time delay (normally 40 seconds) is inserted. This delay reduces the unit peak inrush current.

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

6.5. High pressure protection (HP)

If high pressure transducers are connected to inputs **HP1** and **HP2** then a compressor is switched off when the discharge line pressure reading exceeds 42.0bar.

Instead of high pressure transducers some systems may be fitted with high pressure switches. These also connect to inputs **HP1** and **HP2**. When a high pressure switch activates (electrical circuit opens) the compressor is stopped.

Similarly, if the condensing temperature reported by an outdoor coil temperature sensor (connected to **TS1** and **TS2**) reports a coil temperature above +66°C (cooling mode) the compressor is switched off.

The UC6 will automatically reduce capacity of a digital scroll 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)
--	----------------------------

6.6. Loss of refrigerant protection (LOR)

When a compressor is running the UC6 continuously monitors the various temperatures. 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 mid-coil temperatures (**TS1**, **TS2**), suction temperatures (**ST1**, **ST2**) and discharge line pressures (**HP1** and **HP2**, if present).

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)
--	----------------------------

6.7. Indoor coil frost protection (FROST)

When the unit is cooling the evaporating temperature in the indoor coil must remain above -10°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**, **DT2**) 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. 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, then restore power.
2. Use a UC6 service tool service tool to manually reset the lock-out condition.

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

6.10. 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)

6.11. 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 1/10th 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 C
--	-----------------

9. Display summary

	Description	Notes	Section
0	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		6.6
4	High pressure alarm		6.5
5	Temperature sensor signal out of range	Sensor may be faulty, disconnected or short circuit.	6.10
6	Pressure transducer signal out of range	Transducer may be faulty, disconnected, short circuit, inadvertently swapped with another transducer or the wrong type is fitted.	6.10
7	Indoor coil frost alarm		6.7
8	Outdoor coil de-ice cycle is active		5.6
9	High discharge line temperature alarm		6.8
A	Test mode		7
b	D.R.E.D. active (reduced capacity operation)		5.9
C	RS485 Modbus communications alarm	Check connections with TZT-100 thermostat and/or compressor inverter	6.11
d	Unit is OFF by remote on/off signal OR Overload alarm	When a TZT-100 thermostat is used then inputs DI5 and DI6 are used as overload input signals	5.1
E	Commissioning mode		8
F	Lock out (Repetitive fault has caused shut down)	Any below events will trigger the Alarm lockout LED digit 1.Frost_lockout_comp1/2 2.HP_lockout_comp1/2 3.HT_lockout_comp1/2 4.REF_lockout_comp1/2	6



www.temperzone.co.nz