



INSTRUCTION MANUAL

CAT 630

PLANT GROWTH CHAMBER

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WARRANTY STATEMENT

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CONTHERM Scientific Company will guarantee CONTHERM equipment for a period of twelve months from the date of installation against faulty workmanship and fabricated materials. This guarantee covers the replacement of component parts found to be defective and authorised labour charges during this period.

Should a malfunction occur or condition develop beyond reasonable acceptance the company will accept responsibility for returning the unit to its factory specification at no cost to the Purchaser providing that the operating instructions have been observed and the defect is due solely to faulty design, material and workmanship. That the defective part be returned, freight paid to the nearest sales service office. Units outside the warranty period will be accepted and repairs will be covered under an extension of the above for 90 days.

In remote installations where it is not possible for the company's or agents' engineers to attend, authority may be given to allow the Purchaser to arrange such service.

The Purchaser is required to remit the purchase price of the unit to the supplier within the terms of that supplier's condition of sale. CONTHERM Scientific Company will accept no liability or shall its agents for consequent damage of any kind due to a malfunction or component failure.

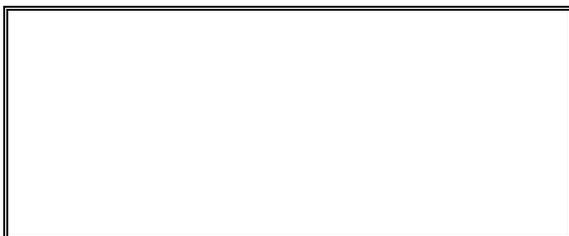
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STATEMENT of CONFORMITY

This **CONTHERM** cabinet conforms to the following standards:

- **Electrical Safety:** Designed to AS/NZS 3350.1:1994
- **EMC:** Complies with AS/NZS 2064: 1997



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IMPORTANT

All electrical servicing **must** be carried out by suitably qualified personnel only.

SECTION 1 DEFINITION OF TERMS

For the purpose of our standard specifications the following definitions shall apply:

- a) **WORKING SPACE**
That portion of the internal space which is above the lowest shelf and not less than 5cm from any wall (including roof).
- b) **CHAMBER TEMPERATURE**
That temperature at the centre of the working space.
- c) **SPATIAL VARIATION**
The difference between the midrange of all measured temperatures obtained at one site and that at another site for those sites which give the greatest difference.
- d) **TEMPORAL VARIATION**
The maximum value of the temperature range obtained for the standard site with the greatest range throughout the test interval.
- e) **TEMPERATURE OVERSHOOT**
Any excess of actual over desired chamber temperature during a heating up period.
- f) **TEMPERATURE REPRODUCIBILITY**
Temperature regained without alteration to controls.
- g) **TEST INTERVAL**
Interval of time to which the steady state characteristics apply (Max 1 hour).

NB: All the above apply with an empty chamber.
For definitions and test methods refer: **AS2853 : 1986** (and Appendices)

SECTION 2 INTRODUCTION AND SPECIFICATIONS

The CONTHERM CAT630 Plant Growth Chamber has been expressly designed to give the widest choice of operating conditions consistent with high reliability and low cost, the addition of microprocessor control gives additional versatility and resolution while improving the degree of temperature control.

All specifications are quoted for a cabinet temperature of 20°C with an ambient temperature of 20°C with all lighting off.

- **Construction** - Combination of High quality stainless steel and zinc plated mild steel, epoxy coated exterior, full fibreglass insulation, interior of marine grade etch-primed aluminium coated with polyester U/V stabilised hi-gloss white, with full access door, magnetic and locking door catch.
- **Safety** - Fitted with an independent factory set Hi-Limit completely separate from normal controls. Overtemperature and fan fail protection on light loft.
- **Convection** - All units come with mechanical convection fan systems.
- **Electrical** - Designed to AS/NZS 3350.1:1994 230/240V AC M.E.N
- **EMC** - Complies with AS/NZS 2064: 1997

PERFORMANCE:

a) Temperature:

Nominal Range (LIGHTS OFF)	0°C	-	40.0°C
(LIGHTS ON)	10°C	-	40.0°C
Temporal Variation			±1.0°C
Spatial Variation			±2.5°C
Initial Overshoot			+2.0°C
Reproducibility			±0.5°C
Dial resolution			0.1°C
Operating Ambient			10°C - 35°C
Mains Voltage Range			230-240 AC 50Hz

NB: The lowest temperature performance is only achievable in a maximum ambient of +20°C

- b) Lighting:**
 Maximum Light Intensity: 650uE
 (Measured 900mm from glass loft)
- Day-night Lighting:**
 Automatic control in nominal 90uE increments with manual switch selection of lamps to be controlled.
- c) Relative Humidity:**
 Display Resolution: 1% RH
 Display Range: 0 - 100%RH
 Control Range: (Typical) 40 - 90%RH
 (Depends on temperature, Ambient and Lighting Settings)
 Accuracy: (typical @ 20°C, 50 - 90%RH) ± 5%RH
- d) Carbon Dioxide: (If fitted)**
 Range: 0 - 2000PPM
 Control Range (additive): Ambient+5° - 2000PPM
 Fluctuation (@25Kpa / 5PSI) ± 30PPM
NB: Temperature 10°C to 40°C and max humidity of 85%RH
- e) Timer:**
 Timing Range: 1 minute - 99hours 59 minutes
 Timing Resolution: 1 minute
- Manual or Timed operation:
NB: The symbol '[:|]' means run continuously.
- f) Refrigeration:**
 Automatic control, Hot and Cold cycle.
- Used for Dry temperature control and Dehumidification with automatic Hot Gas Defrost. Defrost may be programmed to occur automatically or manually.
- g) Programmable:**
 Up to nine user programs may be set and run in conjunction with a 999 or continuous cycle counter.
- h) Computer:**
 An RS232c computer connection is provided. Contherm PLCS5 Communications (**PLCSCOMM**) program sold separately.

SECTION 3 INSTALLATION

The CAT630 Plant Growth Chamber is designed to be installed into a suitable well ventilated room with a minimum clear space of at least 1000mm on all sides to allow access for servicing. Sufficient frontal space should also be allowed for the main access door to be fully opened (2000mm).

Drains are required to carry away waste water from the humidifying system and it is STRONGLY recommended that the exhaust air from the lighting loft be ducted away from the room housing the cabinet. If the ducting is by an indirect route or much longer than 1000mm external exhaust fans may be required. The main water pressure for the humidity system must NOT exceed 60PSI.

The cabinet requires a 230/240Volt 50HZ 35Amp Single phase EARTHED electricity supply.

Total electrical load is 32A @ 240V (8.0Kw).

The mains power connection is located at the rear of the cabinet.
The approximate heat load (Lighting OFF) is 2.8Kw, Lighting ON is 6.5Kw

The cabinet must be correctly wired to the electricity supply by a registered electrical tradesperson in accordance with local electricity regulations. The cabinet MUST be EARTHED via the supply protective earth wire system.

The cabinet should be thoroughly inspected for any signs of mechanical damage that may have occurred in transit before any attempt is made to apply power to the unit.

FOR YOUR SAFETY

WARNING: To prevent FIRE or SHOCK hazard, DO NOT expose this product to rain or any type of moisture.

WARNING: This cabinet must be correctly wired to the electricity supply by a registered electrical tradesperson in accordance with local electricity regulations. The cabinet MUST be EARTHED via the supply protective earth wire system.

The cabinet requires a 230/240Volt 50HZ 35Amp Single phase EARTHED electricity supply.

Total electrical load is 32A @ 240V (8.0Kw).

SECTION 4 OPERATING INSTRUCTIONS

This appliance is NOT intended for use by young children or infirmed persons without supervision.

To set up unit for operation after unpacking and checking for damage proceed as follows:

- 1) Follow any installation procedures (See SECTION 3).

OPERATING CONTROLLER:

- 1) Ensure drain hose is correctly connected to waste drain.
- 2) Connect mains pressure water (60PSI MAX) to water inlet.
- 3) Apply power at wall main switch.
- 4) Turn on front panel main SWITCH/RCD breaker - The mains neon should now be on and the green LED displays on the control panel will be illuminated.
- 5) When power is FIRST applied to the cabinet the display will most likely show an 03 (Preset) Alarm. This is due to the fact that power has been removed from the cabinet for more than 48 hours. Use the method described in this manual to cancel the special 03 Alarm.
- 6) If cabinet is being run for the first time OR if a new humidity filter cartridge has been fitted, remove the humidity spray nozzles (lift floor section to access) and use diagnostic 03 to run water through the system to flush out excess carbon from the filter and then refit the nozzles and prime the system.
- 7) Set program(s) to desired operating parameters.
- 8) Confirm factory calibration by monitoring the temperature, Humidity etc with your own calibrated instruments and make adjustments as per the CALIBRATION section if necessary.

NB: DISCONNECT chamber from mains power **BEFORE** changing filter cartridge or working on mains water supply.

WARNING!!

This cabinet contains discharge lamps (**METAL HALIDE**).

ALL POWER to the light loft **MUST** be **OFF** when **EXAMINING** or **REPLACING ANY** lamp in the loft space. The lamps **MUST** also be allowed to **COOL** before attempting replacement. **PROTECTIVE EYE_WEAR MUST** be worn when carrying out **ANY** lamp maintenance due to the risk of a lamp breakage.

DO NOT touch **METAL HALIDE** lamps with fingers or skin and keep away any inflammable goods during operation and immediately after the lamp is switched off.

DO NOT scratch bulb or subject lamp to undue pressure which could result in lamp breakage.

METAL HALIDE lamps can cause **SERIOUS** skin burn and eye inflammation from shortwave ultraviolet radiation if the outer envelope of the lamp is broken or punctured.

When **INSTALLING** and **REPLACING** a lamp, power **MUST** be **OFF**, to avoid possible electric shock resulting in injury or death.

Recommended ambient temperature for **METAL HALIDE** lamps is -5°C to $+40^{\circ}\text{C}$.

METAL HALIDE lamps are **DISCHARGE** lamps and require a certain time to restart and achieve full brightness after a power interruption.

DO NOT leave the top loft cover(s) open when operating this cabinet - leaving covers open will greatly reduce air cooling for the lamps and severely shorten their life. **DO NOT OPEN** the loft covers to **REPLACE** any lamps unless all power to the light loft is **OFF**.

The light loft air filter (located at the light baffle air intake) should be removed and washed at regular intervals (not exceeding three months) to remove dust buildup. If the filter becomes severely blocked the light loft cooling air will be reduced possibly causing the loft air/temperature safety switches to operate.

ALARMS

There are TWO main types of alarm used in the PLCS5 control system.

- a) **STANDARD ALARMS:** 01,02,04,05,06,07,08,10,11,12
These alarm numbers indicate a problem with cabinet control, IE over-temperature, low water, faulty sensor etc.
To **CANCEL** these alarms press the DIAGNOSTIC select button THREE times. (Some of these alarms can also be cancelled by pressing ANY button). ENSURE that note is taken of the alarm indication and that any indicated problem is attended to.
- b) **03 & 09 ALARMS:** 03,09
These alarms are SPECIAL and can ONLY be cancelled by using the SPECIAL procedure outlined below. These alarms indicate EITHER that the cabinet MAY have lost some of its settings (03) most likely due to being disconnected from the power for more than 48 hours, or that INTERFERENCE (09) to the cabinets internal operating system has occurred, due to external electrical interference or electronic system malfunction.

To ensure that the required settings and CALIBRATION factors are checked it is necessary to EXAMINE ALL the program settings and TEMPERATURE and HUMIDITY calibration factors. If there was more than one program running the settings for the additional programs should also be checked but this is NOT essential in order to cancel the alarm.

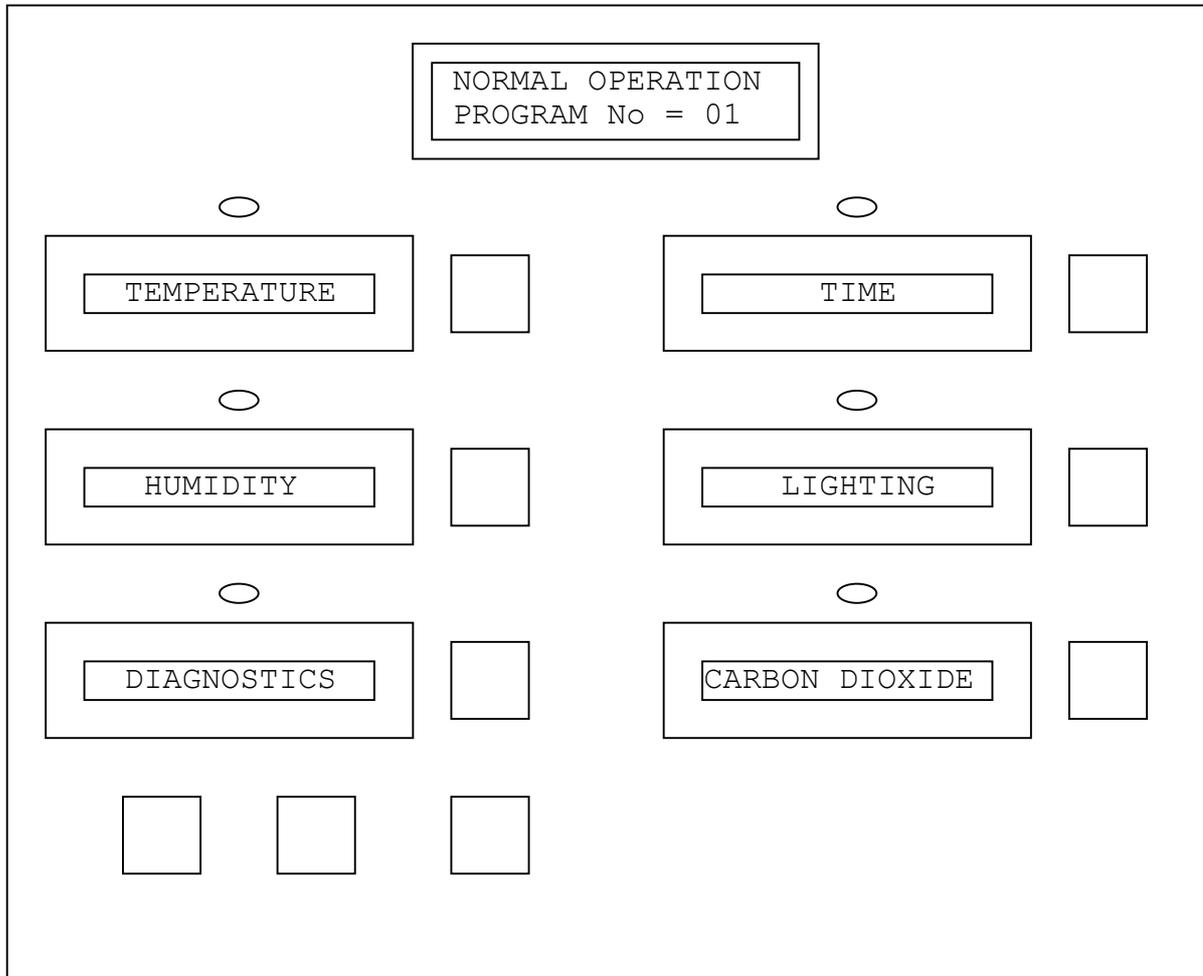
The following procedure is recommended:

- 1) Press the 'SELECT' button adjacent to the green temperature display and confirm the SET POINT is correct, if not then adjust it using the 'UP' and 'DOWN' buttons. Press 'SELECT' again if the 'SET' LED above the display is ON so that it goes OFF. - REPEAT for all the other Green display parameters (TIME, HUMIDITY, LIGHT etc).
- 2) Press the 'SELECT' button adjacent to the red 'DIAGNOSTICS/ALARMS' display and using the 'UP' button obtain diagnostic No20 (Calibrate Temp), check that the current value is correct. (Check against the Factory Cal Factor - on front cover of manual, or other known Cal Factor), if NOT correct press 'SELECT' again and adjust Cal Factor using the 'UP' and 'DOWN' buttons. Press the 'SELECT' button a third time to exit the DIAGNOSTIC routines.

- 3) Press the 'SELECT' button adjacent to the red 'DIAGNOSTICS/ALARMS' display and using the 'UP' button obtain diagnostic No21 (Calibrate RH), check that the current value is correct. (Check against the Factory Cal Factor - on front cover of manual, or other known Cal Factor), if NOT correct press 'SELECT' again and adjust Cal Factor using the 'UP' and 'DOWN' buttons. Press the 'SELECT' button a third time to exit the DIAGNOSTIC routines.
- 4) Press the 'PROG' button adjacent to the 'UP' button and step through the three program settings (Select program, Set cycle counter and Set max prog number).
- 5) Having carried out all of the above pressing any parameter button will now cancel the alarm. (IE, press the 'TEMPERATURE' select button. If the red LED above the 'TEMPERATURE' parameter display is ON press the 'SELECT' button again.

SPECIAL NOTES

- 1) To ensure correct refrigeration operation and longest life, the fridge condenser **MUST** be kept free of dust by regular cleaning, at least once every 3 months (use a nylon brush).
- 2) Unless changed by the customer an automatic defrost cycle will be started every four hours when running at low temperatures. This defrost is necessary to keep the refrigeration evaporator free of ice buildup which would otherwise impair the ability of the cabinet to maintain its operating temperatures. The defrost sequence is designed to minimise any changes to the cabinet temperature during the defrost period but some change in conditions cannot be avoided.
- 3) The light loft air filter (located at the light baffle air intake) should be removed and washed at regular intervals (not exceeding three months) to remove dust buildup. If the filter becomes severely blocked the light loft cooling air will be reduced possibly causing the loft air/temperature safety switches to operate.



CONTROLLER OPERATION:

The PLCS5 Control System is Contherm's latest offering in a series of Microprocessor based Control Systems. The front control panel is fitted with a two line by 16 character LCD display to allow the controller to be easily setup for all operations. An additional recessed Control/Monitor Panel is fitted at the top RHS of the cabinet.

- 1) The LCD display shows information on the current status of the cabinet (NORMAL OPERATION, DEFROSTING, STOPPED, FAULT etc) and also displays prompts when setting parameters, changing programs etc.
- 2) In NORMAL operation the values displayed in the boxes for the installed parameters represent the current value measured by the Controller.
- 3) The 'UP' and 'DOWN' buttons below the DIAGNOSTIC/ALARM display are used to make any adjustments to the Controller set points.
- 4) The 'SET' led's will illuminate if the selected parameter has been selected for adjustment.
- 5) The 'SELECT' buttons are used to 'select' a parameter for adjustment.

- 1) **MAIN SW/RCD** allows power to flow to the cabinet. The RED 'MAIN POWR' neon will be illuminated when this breaker is ON and the cabinet is connected to the Main power supply. The combined MAIN SW/RCD is a RCD device which should be tested at least when the cabinet is about to be setup for the next experimental run. Test the RCD device by pressing the 'TEST' button - the RCD circuit breaker should switch to the OFF position. (It is best to conduct this test with the lighting OFF.)
To RESET the circuit breaker push the lever to the 'ON' position. If the lever will not stay in the 'ON' position an electrical fault is present.
If the RCD trips with the small 'flag' showing this means that the tripping was due to excessive 'earth leakage'. The cause MUST be investigated DO NOT attempt to BYPASS the RCD device.
- 2) **FRID SW** switch (If fitted) allows the refrigeration system to operate. If this switch is OFF the HOT & COLD solenoids will not function and the refrigeration compressor will pump down and turn off. If this switch is NOT fitted then the refrigeration may be turned off via the DIAGNOSTIC selection No41 (00=OFF)
When the refrigeration system is operating it MAY cycle the **HOT GAS** solenoid (Red Neon 2a will come on) OR the **COLD LIQUID** solenoid (Blue neon 2b will come on) to achieve the desired temperature and humidity.
HOT GAS SOLENOID. Neon 2a is illuminated when the refrigeration HOT-GAS (HOT CYCLE) solenoid is energised. When this solenoid is energised the refrigeration is trying to HEAT the cabinet, in normal operation this solenoid may be energised on a regular cycle. The solenoid may be tested via the DIAGNOSTIC system by selection number 4 (TEST HOT SOLN).
LIQUID SOLENOID NEON. Neon 2b is illuminated when the refrigeration LIQUID solenoid (COLD CYCLE) is energised. When this solenoid is energised the refrigeration system is trying to COOL the cabinet.
The solenoid may be tested via the DIAGNOSTIC system by selection number 5 (TEST COLD SOLN).
- 3) **HEATER NEON.** This neon will be illuminated whenever power is being applied to the HEATING ELEMENTS. When the cabinet has stabilised at Temperature this neon is usually pulsing at a steady rate.
- 4) **HUMIDITY** system.(If HUMIDITY CONTROL FITTED) This switch allows the HUMIDITY pump/solenoid to operate. The GREEN neon will be illuminated whenever power is applied to the humidity spray system. This will inject a very fine mist of water into the internal circulating fan system air which will then be rapidly dispersed into the chamber in order to RAISE the Relative Humidity level. The system may be tested or primed via the DIAGNOSTIC system by selection number 3 (TEST RH INJECT).

- 5) **LIGHTING** switch (5).
This switch allows the cabinet LIGHTS to function, the CLEAR neon (5a) will illuminate whenever the controller has selected any lighting to come on. If this switch is OFF NO LIGHTING (Except VIEWING LIGHTS when switched to 'MAN') will function.
- The other switches (fitted with small RED neons) are used to enable a particular METAL HALIDE lamp to work, if the individual switch is OFF that lamp will NOT function under automatic control.
- 6) **RS232** PORT. (Front RHS of cabinet – 9PIN 'D')
This is a simplified RS232 Communications interface - suitable for connecting to a standard IBM compatible PC.
Software for use with this port is available from CONTHERM at extra cost.
- 7) **VIEWING** Lights. If the Main lighting switch is OFF, the VIEWING Light Switch will enable two INFRA-RED lamps inside the internal chamber to operate in the 'MAN' position to allow the internal contents to be seen. When this switch is the 'AUTO' position the viewing lights will be automatically switched on when the main lighting comes on to provide INFRA-RED supplement.
- 8) **LOFT AIR FAIL** neon. This neon will come on if there is insufficient air movement out of the lighting air discharge duct. The switch works by detecting the low pressure caused by air moving through the light loft. If this neon is ON the LIGHTS will NOT function.
- 9) **HI-LIMIT MONITOR** neon. This neon will come on if the internal factory set cabinet temperature HI-LIMIT has tripped. This can only be manually reset by a service technician and is located inside the main service wiring panel. This cutout is set to trip at about +45°C.

SETTING UP

The following example shows how to set the cabinet for the shown conditions:

Program No 1

Temperature = 20.0°C
Humidity = 70.0%
Time = 6:00 (SIX HOURS)
Lights = OFF (00 µE)

Program No 2

Temperature = 15.0°C
Humidity = 70.0%
Time = 6:00 (SIX HOURS)
Lights = ON (720 µE)

No of Cycles = 10

- 1) Press the button marked 'PROG' (adjacent to the UP & DOWN buttons), the LCD display will say 'SELECT PROGRAM', use the UP & DOWN buttons to adjust the Program Number to '01'. Press the 'PROG' button AGAIN, the LCD display will then say 'SET CYCLE COUNT', use the UP & DOWN buttons to set the cycle counter to '00'. (This ensures that the cabinet will stay OFF until we are ready to run it!). Press the 'PROG' button a third time, the LCD display will say 'SET MAX PROG No'. Since we are going to have TWO Programs, use the UP & DOWN buttons to set the MAX PROG No to '02'. This will allow only Programs 1 & 2 to be considered when running the cabinet. Press the 'PROG' button once more (or just wait for 20 seconds) to return the Controller to its 'NORMAL OPERATION' mode.

NB: The number of cycles is the number of times the Controller will swap from Program No 1 to Program No 2. After each Program swap the number of cycles is decremented. When the Cycle Counter reaches 00 the Controller will switch the cabinet OFF.

When the Program advances from one Program to the next it continues to select the next highest Program number until it EXCEEDS the MAXIMUM SET PROGRAM number at which time it DECREMENTS the Cycle Counter and selects Program number 1 again.

All of the selected parameters change SIMULTANEOUSLY when the Program changes from one to the next, and the TIME setting for each Program starts to DECREMENT IMMEDIATELY.

SET UP PROGRAM NUMBER 1:

a) Set TEMPERATURE

Press the `SELECT' button adjacent to the TEMPERATURE display - The display will blank for 2 seconds, the `SET' led above the display will turn on (indicating that this parameter is now in the set mode) and the Current Set Point will be displayed. The LCD display at the top of the panel will be showing `SET TEMPERATURE'.

Use the `UP' and `DOWN' buttons (below the Diagnostic/Alarm display) to adjust the Set Point to 20.0oC. When the adjustment is complete you can exit the Temperature Set mode by pressing the `SELECT' button again OR just wait (20 seconds) without pressing any buttons and the Controller will automatically return to normal operation.

b) Set TIME

The TIME display shows how long the cabinet will run this Program before it changes to the second Program.

Press the `SELECT' button adjacent to the TIME display - The display will blank for 2 seconds, the `SET' led above the display will turn on (indicating that this parameter is now in the set mode) and the Current Set Point will be displayed. The LCD display at the top of the panel will be showing `SET TIMER'. Use the `UP' and `DOWN' buttons (below the Diagnostic/Alarm display) to adjust the set point to 6:00. When the adjustment is complete you can exit the Timer Set mode by pressing the `SELECT' button again OR just wait (20 seconds) without pressing any buttons and the Controller will automatically return to normal operation.

NB: The `|:' symbol means `run continuously' and if this symbol is selected the Timer will stay at this setting INDEFINITELY.

c) Set HUMIDITY. (If HUMIDITY CONTROL option fitted).

Press the `SELECT' button adjacent to the HUMIDITY display - The display will blank for 2 seconds, the `SET' led above the display will turn on (indicating that this parameter is now in the set mode) and the Current Set Point will be displayed. The LCD display at the top of the panel will be showing `SET HUMIDITY'. Use the `UP' and `DOWN' buttons (below the Diagnostic/Alarm display) to adjust the set point to 70.0.

When the adjustment is complete you can exit the humidity set mode by pressing the `SELECT' button again OR just wait (20 seconds) without pressing any buttons and the Controller will automatically return to normal operation.

NB: To set the HUMIDITY to OFF (ie NO Humidity Control attempted) set the RH set point = 0.0, this will also disable the LOW WATER alarm from sounding again even if the water level is LOW.

d) Set LIGHTING.

Press the `SELECT' button adjacent to the LIGHTING display. The display will blank for 2 seconds, the `SET' led above the display will turn on (indicating that this parameter is now in the set mode) and the Current Set Point will be displayed. The LCD display at the top of the panel will be showing `SET LIGHTING'. Use the `UP' and `DOWN' buttons (below the Diagnostic/Alarm display) to adjust the set point to 'OFF' (00 μ E).

When the adjustment is complete you can exit the Lighting Set mode by pressing the `SELECT' button again OR just wait (20 seconds) without pressing any buttons and the Controller will automatically return to normal operation.

CAUTION: If your cabinet has been fitted with a SPECIAL lighting arrangement as requested by you please observe any extra specified precautions, especially note that **ULTRA-VIOLET** and **HI-INTENSITY** lights are **HARMFUL** to the eyes and **MUST NOT** be viewed directly or for extended periods.

SETUP PROGRAM NUMBER 2:

Before the Set Points for the next Program can be entered the Program number must be changed to Program number 2.

SELECT PROGRAM No 2

Press the 'PROG' button (at the bottom of the panel adjacent to the 'UP' and 'DOWN' buttons) and look at the LCD display (top of the panel), the display will show the words 'SELECT PROGRAM'. Use the 'UP' and 'DOWN' buttons to adjust the Program number (shown on the lower line of the LCD display) until it reads 'No = 02'.

Press the 'PROG' button AGAIN. The top line of the LCD display will now show 'SET CYCLE COUNT' and the lower line will show the number of cycles on the Cycle Counter. The number of Cycles was set earlier and so the LCD should display 'No CYCLES = 00'. Press the 'PROG' button TWICE to return to normal operation, you should now adjust the set points for Program Number 2 in the same way as for Program Number 1.

You must now decide which Program (1 OR 2) that you wish the cabinet to START on, let us say it is Program No 1.

Press the 'PROG' button and use the Up & Down buttons to select Program Number 1.

Press the 'PROG' button again and set the number of cycles = '10' (using the Up & Down buttons), press the 'PROG' button twice more and the cabinet should start running from Program Number 1.

The cabinet will run Program Number 1 for the Set Timer duration and then change to Program Number 2 and run it also for its Set Timer duration, after which the Cycle Counter will be decremented by one and the Cycle repeated until the Cycle Counter becomes = '00' when the cabinet will turn OFF.

NB: When the lighting display is set for 'On' (or if display is in μE , any figure greater than 00) this means the lights will be turned ON for the duration of this Program, a setting of 'OFF' (00 μE) will turn the lights OFF.

Any **MANUAL** light switches must be in the appropriate position for the lights to function correctly.

The main lighting switch must also be ON for the lights to work.

If the chamber is fitted with AUTOMATIC lamp control, the rate at which the lights will turn ON or OFF is determined by the lighting ramp rate (DIAG No 39).

If HUMIDITY CONTROL is NOT fitted or desired the HUMIDITY set point **MUST** be set to 0.0%RH to avoid any attempt by the refrigeration system to control the humidity.

SPECIAL PROGRAMMING HINTS

It is possible to use one of the Programs ABOVE the maximum program number to act as a PRECONDITIONING Program. If say, the MAX PROGRAM NUMBER is set at 02, this would mean that as the Program changes from one program to the next any Program number ABOVE 02 would NOT be selected. We could, therefore, setup Program Number 3 as a Preconditioning Program and when starting the Program run, start with this Program Number. This Program would run and stabilise the cabinet at its selected settings and when the timer for Program Number 3 expired the Controller would automatically select Program Number 1 to run, Program Number 3 would NOT RUN AGAIN however, because its number is ABOVE the MAX program number.

When setting up Program Set points from the Controller it is best to FIRST set the Cycle Counter to `00' to ensure the Program does NOT change as you are entering the new settings.

SECTION 5 CALIBRATION

Final calibration for the PLCS5 range of cabinets is achieved by adjusting the CALIBRATION FACTORS for TEMPERATURE and HUMIDITY, these adjustments are made through the front panel DIAGNOSTIC section.

The CAL FACTORS are stored in the internal memory of the controller and are held up by a SUPERCAP which will store the factors for a maximum of 72 hours in the absence of power. If power to the controller has been interrupted for a prolonged period (more than 48 hours) the CAL FACTORS should be checked to see if they are still valid, this should ALWAYS be done if a PRESET alarm (03) has occurred.

If the CAL FACTORS are lost the controller will set them to the default value (50). This could result in a temperature error of up to $\pm 5.0^{\circ}\text{C}$ or a humidity error of up to $\pm 5\%$ RH.

The factory CAL FACTORS for the cabinet are noted on the inside front cover of the instruction manual and also on the test report that comes with the cabinet.

To CALIBRATE the control system use the DIAGNOSTIC controls. These services are attained by Pressing the 'SELECT' button adjacent to the 'DIAGNOSTICS/ALARMS' display, and following the instructions on the LCD (top of panel) display.

When first entered the 'DIAGNOSTICS/ALARMS' display may be blank indicating that no diagnostics features have yet been selected, by using the 'UP' and 'DOWN' buttons various diagnostic tests may be carried out.

When you have made your selection - Press the 'SELECT' button again to move to the 'ADJUST VALUE' mode, and if required adjust the CAL FACTOR value, press the 'SELECT' button a THIRD time to exit the DIAGNOSTIC mode.

- 20 - CALIBRATE TEMPERATURE.** This selection will allow the internal calibration VALUE to be changed, this in turn will change the temperature calibration for the cabinet. The minimum value is `00' and the maximum value is `99' when calibrated this value should be NOTED and WRITTEN down so that it may be replaced if the controller loses the value (this will occur if power has been removed from the controller for more than 3 days!). Use the up & down buttons to adjust the calibration value.
EG: If the display was reading 2.0°C too low, then INCREASE the calibration value by 20 (20=2.0°C) to obtain the correct calibration. ALWAYS calibrate with any lighting set to OFF.
- 21 - CALIBRATE HUMIDITY.** This selection will allow the internal humidity calibration VALUE to be changed, this in turn will change the HUMIDITY calibration for the cabinet, the minimum value is `00' and the maximum value is `99' when calibrated this value should be NOTED and WRITTEN down so that it may be replaced if the controller loses the value (this will occur if power has been removed from the controller for more than 3 days!). Use the up & down buttons to adjust the calibration value.
EG: If the display was reading 2.0% too low, then INCREASE the calibration value by 20 (20=2.0%) to obtain the correct calibration. This calibration value is normally 50, and may only be used to make SMALL adjustments to the humidity calibration. ALWAYS calibrate with any lighting set to OFF.
- * 22 - CALIBRATE CARBON DIOXIDE.** The VAISALA Co2 unit (If fitted) must be returned to the factory for calibration.

The temperature should be recorded on a daily basis by placing a thermometer in the workspace so that it can be read and the long term temperature performance can then be plotted to give an assurance of correct temperature performance.

VERIFYING CABINET PERFORMANCE

There are two basic tests that may be carried out to verify cabinet performance.

NB: These tests MUST be carried out with the cabinet EMPTY and all lighting OFF at the specified ambient of +20°C.

TEMPORAL PERFORMANCE:

The cabinet should be set to operate at the Contherm specified calibration conditions.

Temporal performance is tested by placing a suitable (calibrated) test probe in the centre of the workspace and recording the readings for up to 1 hour AFTER the cabinet has FULLY STABILISED.

The cabinet has fully stabilised when the average temperature is no longer increasing or decreasing over time.

The result should be within the quoted specification.

This result is a function of the cabinet control system, sensor and airflow.

SPATIAL PERFORMANCE:

The cabinet should be set to operate at the Contherm specified calibration conditions. All lighting must be OFF and the humidity set to OFF (0.0)

Check Spatial Variation @ 20°C

(Refer manual for specification, 8 points as per diagram)

[6R] [4C] [3R] TOP

[8C] [1C] [] CEN

[2F] [7C] [6F] BOT

(Where F=Front, C=Center, R=rear)

Spatial performance is tested by placing suitable (calibrated) test probes (usually thermocouples) in the eight specified positions and recording the readings for up to 1 hour AFTER the cabinet has FULLY STABILISED.

The cabinet has fully stabilised when the average temperature is no longer increasing or decreasing over time.

The sensors must be no closer than 50mm to any wall or roof and must be above floor by at least 50mm.

The result should be within the quoted specification.

This result is a function of the cabinet design and air distribution.

The spatial test must be performed with all doors, vents etc CLOSED and the measuring sensors must be very closely matched at the specified temperature.

SECTION 6 THEORY OF OPERATION

The key to the versatility of operation of the PLCS5 controller is based on the use of a Microprocessor Control System and multiplexed analog inputs controlled by this system.

Analog input information is amplified by conventional circuitry and filtered before being sent to a multi-channel multiplexer/AD converter.

The Microprocessor, on direction of its ROM based program, selects an input to be converted by the A/D converter to digital form. The information obtained is then acted upon to up-date the display, control heaters, solenoids, etc and the next input is then selected. This sequence of events is repeated continuously unless interrupted by a special event or by user intervention.

Time pulses for timed events are obtained from the internal crystal controlled microprocessor clock.

Two internal circulating fans mix air within the chamber by drawing it in through the top mounted sensor box and refrigeration evaporator, then over the heating elements and past the humidity injection point to where it is then discharged under the perforated floor back into the chamber. The chamber WILL NOT operate correctly if the fans are not running OR if the airflow is heavily impeded by placement of product within the chamber.

Temperature is controlled by HEATING the air via a sheathed elements and by COOLING the air via the refrigeration system evaporator. The temperature of the refrigeration evaporator is controlled by altering the on/off ratio of the HOT-GAS and COLD LIQUID solenoid valves.

The typical ON/OFF cycle is about 10 seconds, if the HOT valve is on for 5 seconds (50%) then it is OFF for the other five seconds and the evaporator temperature is at a medium level. The cold valve is continuously energised whenever the fridge is running. When the cabinet has stabilised at the desired temperature (within $\pm 0.5^{\circ}\text{C}$) then the temperature of the evaporator may be varied (by changing the solenoid ON/OFF ratio) to help achieve the desired humidity. The temperature of the fridge evaporator sets the DEW POINT for the humidity (the temperature at which water condenses out of the air). Raising the temperature of the evaporator (by HOT-GASSING for LONGER) raises the DEW point and therefore helps to RAISE the humidity in the cabinet.

The main source of water for humidity control is via the humidity injection system water spray nozzles. This system sprays a VERY FINE CONICAL mist of water into the airstream under the floor. The fine mist of water is picked up and mixed into the air by the fans and this raises the humidity level inside the chamber. The pump spray on time is very short (about 1 second) every 30 seconds.

If a system is struggling to raise the humidity, first ensure that the temperature is stable (within $\pm 0.5^{\circ}\text{C}$), and if so lift up a couple of the perforated floor railings at the right hand side of the floor and using DIAGNOSTIC No3 (water inject) test spray the nozzles. It is best to do this with the system TIMER set to OFF so that the cabinet is stopped. A FINE conical mist of water should be seen (almost as fine as smoke). If the water just dribbles out or is a small JET of water then that nozzle is BLOCKED and must be cleaned (using compressed air) or replaced to get the humidity working correctly.

Whenever a problem is encountered with the humidity system, ALWAYS make sure that the TEMPERATURE control is correct first, because if the TEMPERATURE control is not right the humidity system will not control correctly.

Temperature is measured by the chamber air being drawn (at about 0.5M/S) through the sensor box mounted at the top RHS attached to the refrigeration evaporator cover. The actual temperature sensor is a solid state device (LM35DZ) which is a linear temperature to voltage converter at $+10\text{mV} / ^{\circ}\text{C}$. To cope with the offset due to operating at negative temperatures (-50°C) there is an OFFSET voltage to this device of 500mV (50°C). The output of this sensor at a chamber temperature of $+20^{\circ}\text{C}$ is about 700mV ($500\text{mV} + 20 \times 10\text{mV} = 700\text{mV}$).

Humidity is usually measured using a HONEYWELL capacitive humidity sensor which is laser trimmed when supplied and the only offset adjustment is via the PLCS5 Diagnostic No21.

Humidity sensors are extremely reliable unless they have actual water condensing on them, in which case usually allowing them to dry out fixes the problem.

If a problem is encountered where the temperature is a very long way out of calibration and cannot be corrected by the Diagnostic Calibration Routines – check for any moisture deposits on the pcb surface.

Hi-Limit and Safety Capillary Thermostats: There are two additional mechanical levels of safety to prevent the chamber overheating.

On the RHS of the cabinet monitor panel there is a user adjustable 'HI-LIMIT' thermostat, this should be set to operate just above your normal operating temperature. When this control is interfering with the normal operation (as when the cabinet overheats) the red 'monitor' neon will come on and the 'HEATER' neon will turn off as this control prevents power from reaching the heating elements. If the monitor neon is coming on also check that the internal circulating fan motors are running.

The second overtemperature limit is a factory adjusted manual reset limit which when activated will remove power from the cabinet electronics. The small red button must be depressed to reset this device.

The fridge compressor runs all the time unless the timer is set to '0:00' when BOTH the HOT & COLD valves will be turned OFF and the fridge system will shut down a few minutes later on the LOW PRESSURE cutout.

The temperature in the cabinet is sensed by a solid state temperature sensor and controlled by a PID algorithm to a resolution of 0.1°C.

After first turning on power to the unit a RESET operation is performed, this operation tests the condition of retained data in the RTC RAM (Random Access Memory) which contains any set points, correct factors, etc and by computing a CHECKSUM determines if the data has been held by the SUPERCAP or corrupted (if cabinet has been turned off for more than 48 hours).

If the data is incorrect, all the control points are set to their "Preset" values.

SECTION 6 DIAGNOSTICS

The PLC55 controller has a limited number of diagnostic services inbuilt. These services are attained by Pressing the `SELECT' button adjacent to the DIAGNOSTICS/ALARMS' display and following the instructions on the LCD (top of panel) display.

When first entered the `DIAGNOSTICS/ALARMS' display will be blank indicating that no diagnostics features have yet been selected, by using the `UP' and `DOWN' buttons various diagnostic tests may be carried out.

When you have made your selection - Press the `SELECT' button again to move to the 'ADJUST VALUE' mode, and if required adjust the test value, press the 'SELECT' button a THIRD time to exit the DIAGNOSTIC mode and execute the selected test.

- 01 - Test CO2 INJECT.** This selection will force the CO2 solenoid (if fitted) to turn on for a duration of 10 seconds to enable its operation to be confirmed.
- 02 - Test FAN PAUSE.** This selection will stop the internal circulating fans (and the heating elements) for a period of 30 seconds.
- 03 - Test RH INJECT.** This selection will run the HUMIDITY system continuously for a period to enable the nozzles to fully prime. The length of time the pump/solenoid will run for may be changed by `adjusting' the value, a value of 30 represents about 5 seconds of humidity spray time.
- 04 - Test HOT SOLN.** This selection will cause the HOT refrigeration solenoid to be energised for a period of ten seconds, the COLD solenoid will be turned OFF during this period.
- 05 - Test COLD SOLN.** This selection will cause the COLD solenoid to be energised for a period of ten seconds, the HOT solenoid will be turned OFF during this period.
- 06 - Test DEFROST.** This selection will set the next defrost to occur immediately, the defrost will work as an entirely standard defrost. When a defrost occurs the internal circulating fans will stop and the refrigeration system will enter a 'full hot gas' cycle for 4 minutes, during this time the 'HOT GAS SOLENOID' will be energised. After the 4 minutes the 'COLD LIQUID' solenoid will be energised for 30 seconds to PRE-COOL the evaporator, the fans will then start and normal operation will resume. The LCD display will alternate between 'NORMAL OPERATION' & 'DEFROSTING NOW' during the defrost period.

07 - Test FRIDGE PULLDOWN. This selection will cause the fridge to turn the COLD solenoid on and keep the circulating fan running, all other functions (except for lighting which can be turned on or off as desired) are inhibited. The fridge will continue to pull down to its lowest possible temperature until this test is cancelled! When the test is running the LCD display will show `FRIDGE PULLDOWN' and a warning `BEEP' will sound every minute until the test is cancelled.

To run this test, CHANGE the VALUE to 01. To CANCEL the test change the value to 00. The default value is 00 and this will be set whenever the mains power is turned off.

08 - Test FRIDGE GAS CHARGE. This selection will NOT function on this model cabinet. The gas charge must be checked by a refrigeration engineer.

If this test is run it will be ignored.

09 - TEST ELECTRONICS. This selection will allow various components on the PLCS5 INTERFACE and DISPLAY PCB's to be tested. The particular test performed depends on the VALue selected.

VALue	Test carried out	FAIL ALARM
00	No tests carried out	none
01	Test real time clock tick (IC 8583)	91
02	Test RTC RAM storage (IC 8583)	92
03	Test CPU RAM storage (IC 68HC705C9)	93
04	Test EEROM storage (IC 24C02 or 2814)	94
05	Test A/D Converter (IC 145051)	95
06	Test Output porta (IC 2803,OPTO's)	none
07	Test LED displays - VISUAL TEST ONLY	none
08	Test RS232 Computer port	none
09	Test AUDIBLE alarm	none
10	Perform ALL of the above tests	various
11	Test serial printer	none

If a test with a fail alarm is performed and the test fails the fail alarm code will be displayed on the DIAGNOSTIC led's.

If there is more than one failure mode (running test value 10),the intermediate fail alarms will be only displayed briefly and the last failure alarm will stay on the display.

If a test fails the operation of the IC in that area should be investigated, IE a **91** FAIL ALARM could mean that the crystal for the RTC clock chip (8583) has broken OR that the chip itself is faulty. If the **94** ALARM appears check that the INTERFACE PCB has the eeprom chip (24C02 or 2814) fitted, the earlier versions of firmware (< V2.0) did not use this chip.

- 10 - RAW CO2 VOLTAGE.** This selection will place the value of the RAW voltage coming from the co2 sensor (same as test point #6) onto the co2 display for about 1 second, **NB:** A reading of 56.1 represents a voltage of 0.561 Volts DC. The value should be between 0.400 Volts (40.0) and 1.600 Volts (160.0).
To run this test, CHANGE the VALUE to 01.
- 20 - CALIBRATE TEMPERATURE.** This selection will allow the internal calibration VALUE to be changed, this in turn will change the temperature calibration for the cabinet, the minimum value is `00' and the maximum value is `99'. When calibrated this value should be NOTED and WRITTEN down so that it may be replaced if the controller loses the value. (this will occur if power has been removed from the controller for more than 3 days!). Use the up & down buttons to adjust the calibration value.
EG: If the display was reading 2.0°C too low, then **INCREASE** the calibration value by 20 (20=2.0°C) to obtain the correct calibration.
- 21 - CALIBRATE HUMIDITY.** This selection will allow the internal humidity calibration VALUE to be changed, this in turn will change the HUMIDITY calibration for the cabinet, the minimum value is `00' and the maximum value is `99'. When calibrated this value should be NOTED and WRITTEN down so that it may be replaced if the controller loses the value (this will occur if power has been removed from the controller for more than 3 days!). Use the up & down buttons to adjust the calibration value.
EG: If the display was reading 2.0% too low, then **INCREASE** the calibration value by 20 (20=2.0%) to obtain the correct calibration. This calibration value is normally 50, and may only be used to make SMALL adjustments to the humidity calibration.
- 22 - CALIBRATE CARBON DIOXIDE.** The VAISALA Co2 unit (If fitted) must be returned to the factory for calibration.

- 30 - AUDIBLE ALARM** - This selection allows the AUDIBLE alarm to be DISABLED or ENABLED. A value of 00 = DISABLED, 01 = ENABLED. The DEFAULT setting is ENABLED (01).
- 31 - DEFROST INTERVAL** - This selection allows the DEFROST INTERVAL to be varied, or DISABLED altogether. The DEFAULT value is 04, this give a defrost lasting four minutes every at 4HR intervals. The INTERVAL may be set from 01 to 99 hours. The defrost may be INHIBITED altogether by setting the VALUE to 00.
- 32 - DOOR HEATER.** - There is NO door heater fitted to this cabinet, this setting will have NO effect.
- 33 - DOOR SWITCH?** - This selection allows the DOOR AJAR SWITCH to be ENABLED or BYPASSED. A value of 00 = BYPASSED/DISABLED, 01 = ENABLED. The DEFAULT setting is DISABLED (00). There is NO door ajar switch fitted to this cabinet.
- 34 - PRINTING INTERVAL** - This selection allows the standard interval (in minutes) between lines of recorded data being output to the serial printer (if fitted). If this interval is set for 00, all output to the printer will be inhibited.
- 35 - SETUP PASSCODE** - This selection allows the user to prevent unauthorised access to the cabinet's set points by using a PASSCODE (00 - 99). If the cabinet has been removed from the mains power for more than 72 hours the current passcode will be 00 (This will allow access without entering a PASSCODE).
TO SETUP A PASSCODE: Use this selection to select your desired passcode BEFORE changing or examining a SETPOINT, once this is done that same number MUST be entered before any future access will be allowed to change any settings. The PASSCODE number will be automatically returned to 00 two minutes after any buttons have been pressed. Once a PASSCODE is in effect it will remain so until cancelled (using Diagnostic routine 36) **or** by discharging the SUPERCAP backup device (This occurs after 72 hours without power).
- 36 - CANCEL PASSCODE** - This selection allows the user to REMOVE a passcode from use and revert back to a no passcode condition. To use this selection the original passcode (if any) must be known.
TO CANCEL A PASSCODE: Set the value = 01.
- 37 - SET REAL CLOCK** - This selection allows the user to SETUP the internal REAL TIME CLOCK to the true time of day. Use the UP & DOWN buttons to set the value to the correct time. (MUST be done before using REAL TIME MODE).

- 38 - SET TIMER MODE** - This selection allows the user to choose between ELAPSED (mode 0) time and REAL (mode 1) time. REAL time settings are ONLY applicable to programmable cabinets (NOT CO2). When using the REAL TIME mode the program changeovers can be synchronized to the actual time of day. **ELAPSED TIME MODE:** Set the value = 00 (Default setting).
REAL TIME MODE: Set the value = 01.
- 39 - LIGHT RAMP RATE** - This selection allows the user to SETUP the rate at which the lighting (If Fitted!) will be turned ON or OFF (in uE / min). A higher setting for this value will cause the lights to come on (or go off) at a faster rate.
A value of 00 means DO NOT turn the lights ON.
- 40 - SET LIGHT MODE** - If set to 00 the lights will switch to the amount set in one step, if set to 01 the lights will RAMP up or down to the desired setting at the RATE set by DIAG routine No 39.
- 41 - USE FRIDGE?** - This selection allows the user to DISABLE the refrigeration system. When the fridge is DISABLED there will be NO DEHUMIDIFICATION as this function is handled by the refrigeration system, the cabinet will also take a much longer time to drop in temperature and the lowest achievable temperature will depend on the ambient room conditions. A value of 00 means DISABLE the fridge, a value of 01 means ENABLE the fridge.
- 42 - RH PROBE CORRECT** - This selection allows the user to set a TEMPERATURE CORRECTION factor for the Capacitive Humidity Probe. The factor may be set from 0 to 5. A setting of 2 means that a correction of 0.2%RH will be added to the current humidity reading for every degree above 20.0°C. The recommended setting for the HYCAL probe is 0.
- 43 - CPU VERSION No** - This selection allows the user to view the current FIRMWARE version fitted to the CPU. This is a READ ONLY value and is set into the CPU when it is programmed in the factory.
- 44 - HUMIDITY EFFORT** – Not Used.
- 45 - DELAY TIMER STRT** - This selection allows the user to delay the elapsed timer from running until the chamber is within $\pm 2^{\circ}\text{C}$ of the desired set point. 0=Timer starts immediately, 1= Timer is DELAYED until set point is reached.

Precision Environmental Chamber Communication Protocols

The computer must connect to the cabinet using the following basic protocol for communication.

Baud Rate = 2400 Baud.
Data Bits = 8
Stop Bits = 1
Parity = none.

There are only six commands that the cabinet will respond to:

- '1' - Request current readings from cabinet.
- '2' - Request current SETTINGS from cabinet
- '3' - Ask to USE SETTINGS just sent to Cabinet.
- '4' - Monitor commands - reserved for Contherm use only.
- '5' - Upload SETTINGS into a selected Cabinet program.
- '6' - SETUP to Run from a selected Cabinet program.

The commands are in the form of ASCII text.

NB: The temperature reading is OFFSET by 50.0°C (0500) so that the system can handle negative temperatures.

Therefore: -50.0°C = '0000'. 0.0°C = 0000 + 0500 = 0500 '0500'.
+25.0°C = 0250 + 0500 = 0750 '0750'

REQUEST CURRENT TEMPERATURE etc

To request current readings from the cabinet command '1' would be sent, eg:
"1+CR+LF" (where CR=carriage return & LF = line feed)

The cabinet would typically reply thus :

"0750022006500000000011013300000001"

This is in the form [TEMP][TIME][RH][CO2][O2][LIGHT]
[PROG][CYCLES][ALARM][STATUS][N/A][RAMP]

The first reading of 0750 represents a temperature of 25.0°C the next reading of 0220 represents time of 02:20, 0650=Relative Humidity of 65.0%, The CO2 and O2 readings are only applicable for CARBON DIOXIDE and OXYGEN cabinets and are thus normally ZERO's, the LIGHT = 11 (11=On,00=OFF) then program number (01), number of cycles (33), any alarm (ie 01=over/under temperature) the only other relevant number is the measured RAMP Rate (01=+0.1oC/min).

REQUEST CURRENT SET POINTS etc

To obtain the current cabinet settings you would send command '2'
("2+CR+LF").

The cabinet would typically reply thus :

"07500220075000000022110100770000"

This is in the form [TEMP][TIME][RH][CO2][O2/RAMP]
[LIGHT][PROG][CYCLES][VERSION][RESERVED]

The VERSION (77)= Firmware V7.7. RESERVED = 0000

CHANGING THE CURRENT CABINET SETTINGS

To CHANGE the current cabinet settings you would send the ASCII string as follows:

```
"%0750022007500000002211000001%"
```

This is in the form %[TEMP][TIME][RH][CO2][O2/RAMP]
[LIGHT][RESERVED][PROG]%

Then send command '3' ("3+CR+LF") to request that the cabinet operate at the settings you have just sent.

Command '4' : Monitor Commands: - These perform operations on the internal status of the cabinet CPU and RAM and their use is reserved for Contherm's testing purposes only.

Command '5' : Allows a SPECIFIC program number's SETTINGS to be Uploaded to the cabinet to run at a later time.

To CHANGE a cabinets specific program setting you would first send an ASCII string as follows:

```
"%075002200750000000221111000401%"
```

This is in the form %[TEMP][TIME][RH][CO2][O2/RAMP]
[LIGHT][LIGHT][MAXPROG][THISPROG][CYCLES]%

Then send command '5' ("5+CR+LF") to request that the cabinet UPDATE the desired program (THISPROG=01..09) to SETUP at the settings you have just sent.

Command '6' : Allows a the cabinet to START operating from a SPECIFIC program to be Selected and run now.

To Run the Cabinet from a SPECIFIC Program number you would first send an ASCII string as follows:

```
"%093304%"
```

This is in the form %[RUNMAX][RUNCYCLES][RUNSTART]

Then send command '6' ("6+CR+LF") to request that the cabinet Setup the Maximum number of Program to run, the number of cycles and the program number to START running from.

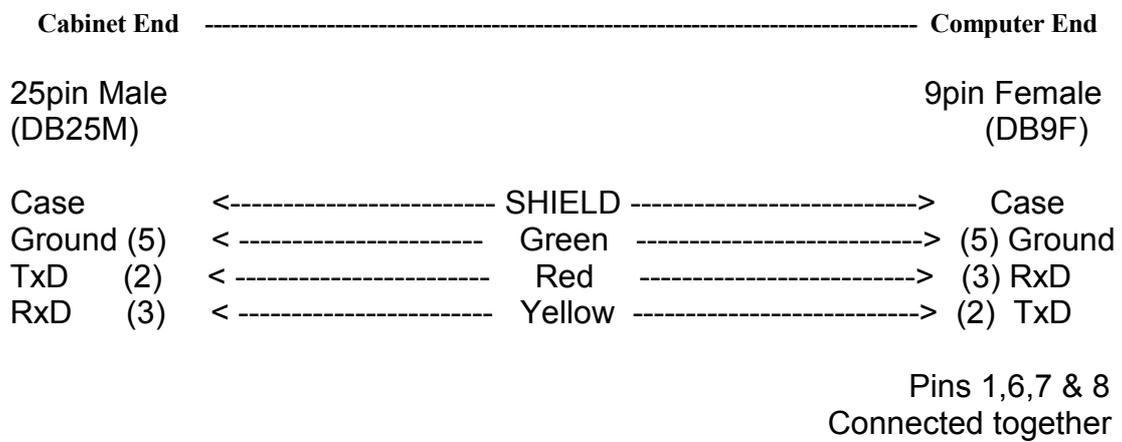
RUNNING CABINET UNDER CONTROL OF PC

To run the cabinet under the control of a PC you would typically do something like the following:

- 1) Send an ASCII string "%010001%" such as
%[RUNMAX][RUNCYCLES][RUNSTART]% to put the cabinet into a 'single program' mode.
- 2) Change the current settings to those desired and use the command '3' to update them.
- 3) REPEAT step 2 above when you want to change the cabinet settings (Set the time to an amount larger than the time to the next program change).

This cabinet is fitted with a 25pin 'D' connector female socket at the rear. The socket is used for 'RS232' type one way communications as per the protocols detailed above. The cabinet is normally connected to a Personal Computer via a special 3 meter serial cable.

Connections for communications cable



SECTION 7 TROUBLESHOOTING AND MAINTENANCE

If a FAULT/ALARM code is displayed on the RED led display, consult the FAULT CODE section first to see if there is an easy remedy.

- 1) **NO MAINS NEON WHEN MAINS SWITCH/RCD TURNED ON.**
 - Cabinet not connected to mains
 - Main RCD circuit breaker tripped. If trip is due to excessive earth leakage ensure cause is investigated.
 - No power at electrical supply.

- 2) **MAINS NEON ON - No LCD/LED Display.**
 - Controller Circuit Breaker Tripped.
 - Internal preset HI-LIMIT tripped (inside cabinet RHS panel), check to see if HI-LIMIT MONITOR neon is on.
 - Interface power supply failure.(look at LED's)
 - Call Service Engineer

- 3) **CONTROLLER ON - But will not operate correctly**
 - Check that SET POINTS are correct.
 - Check for INTERNAL fan operation.
 - CHECK DETAILED TROUBLESHOOTING SECTION

- 4) **NO LIGHTS - Lights must be set for normal operation, check that main lighting switch is in the ON position and that the light intensity is set to other than 00. Check that if the lighting mode is 01 (DIAG No 40) then a light ramp rate (DIAG 39) is set to other than 00.**
 - 20A lighting circuit breaker has tripped (on front cabinet control panel.)
 - If a particular lamp is not on it could be due to its individual fuse blown (round red neon on gear tray will be on), or the automatic light control fuse has blown (on PLCSLITE pcb) - **DO NOT** attempt to change **ANY** fuse on the **PLCSLITE** pcb unless **ALL** power to the chamber is **OFF**.

N.B: When the need arises to contact a Service Engineer always note the type of Controller, i.e., CAT630, and Program Version, i.e., Vers7.2, also Cabinet Serial Number.
(The Program Version, etc. will be indicated on the inside front cover of this manual.

DETAILED TROUBLESHOOTING SECTION

NO DISPLAYS OR LEDS (Mains NEON on, HI-LIMIT MONITOR neon ON)

- NON-RESET Hi-Limit Tripped if MONITOR HI-LIMIT neon is ON. (Inside RHS cabinet side panel)
Controller Circuit Breaker Tripped.
- Power Supply Failure on Interface PCB.

Remove cabinet RHS cover . (**ENSURE ALL POWER to the cabinet is OFF!**)

Locate Hi-Limit mounting plate - press small RED button to see if Hi-Limit has tripped.

If Hi-Limit is OK then look at interface board. The heartbeat led (nearest 40pin IC) should be pulsing at about a two second rate, if not then look at the power supply leds.

Both Red power supply LEDs should be on, if not, then one of the power supplies has failed - if **NO LEDS** are on then Check the 100mA transformer fuse on the interface PCB. **REMOVE ALL** power from cabinet **BEFORE** checking any fuses.

DISPLAY ON BUT NOTHING ELSE WORKING

- Check that cabinet has not turned OFF (Look at LCD display). If so ensure TIMER has been set for a time (also program counter if running multiple programs).
- PLCS5 INTERFACE PCB Fuse has blown. **REMOVE ALL POWER** from cabinet and remove RHS cover check 2Amp fuse on interface PCB.

DISPLAY ON BUT SHOWING RUBBISH!

The only power supplied to the display PCB comes from the 5 volt regulator on the interface PCB. If the LED displays are illuminated it is a good indication that the 5v power supply is present.

- Bad connection in cable from interface pcb.
- Ingress of moisture onto display PCB.
There are two separate data links to the display PCB, the SPI data link (works the led displays) and the IIC data link (works the LCD display). The SPI link uses the connections SLT, MOS, SCK, the IIC link uses SCL & SDA. Check the wiring connections for the appropriate area. The cabinet should be able to operate without the display PCB connected.
- If the TOP line of the LCD is showing ALL segments and the BOTTOM line is blank, suspect either the SCL or SDA wires between the Interface PCB and the display PCB.
- Faulty Reset (turn Mains power off for 10 sec)

ALARM SOUNDING AND FAULT LED DISPLAYING '01'

- Hi/Lo limit alarm
- Measure temperature inside cabinet and ensure temperature is less than 2°C above/below set point. Could be caused by faulty triac or heater element, this condition can also be caused by addition of any 'live' load addition to cabinet interior. Check also that fridge evaporator has not iced up. Sometimes this may occur if the cabinet overshoots when heating up.

CABINET WILL NOT HEAT/COOL TO TEMPERATURE

- Door left open.
- Check for correct SET POINTS especially timer (|=manual)
- Faulty element/fridge
- Already at temperature
- Look at state of CONTROL panel neons.
- Check that element is coming on (look at 'Heat' NEON on cabinet)
- Check that fridge is enabled DIAGNOSTIC No41

REFRIGERATION PROBLEMS

- Ensure Fridge condenser is kept free from dust build-up.
 - Ensure main cabinet circulation fans are running!
 - Main Fridge does not come on
(Under normal circumstances the CONDENSER fan motor will be on when the fridge is running)
 - Cabinet not in use (Timer = 0:00 OR cycle counter set to 0).
 - Refrigeration evaporator has ICED UP.
 - Faulty fridge solenoid
- NB:** At least ONE of the refrigeration solenoids **MUST** be ON in order for the refrigeration system to operate. Look at the state of the neons on the CONTROL panel.
- Faulty low pressure cutout in fridge compartment.
 - Refrigeration system has lost some/all refrigerant.
 - Fault on interface board.

FRIDGE IS ON BUT LITTLE/NO COOLING EFFECT

- Check that power is not being applied to main heating element. (Look at heater NEON)- if so is Temperature set point correct?
- Check that Internal fans are operating.
- Check that refrigeration evaporator is not ICED UP.
- Check that COLD solenoid is ON and HOT solenoid goes OFF.
- Check fridge condenser for dust buildup.
- Possible loss of refrigerant.
- Compressor not working (Thermal overload)

FRIDGE DOES NOT GO OFF

NB: The refrigeration SHOULD be on under most circumstances unless the refrigeration has been DISABLED via DIAGNOSTIC No41.
The fridge will NOT turn off unless BOTH refrigeration solenoids (HOT & COLD) are OFF. (Both neons should be off!).

- Allow more time for Fridge to pump down. (especially at low temperatures)
- Faulty low pressure cutout in fridge compartment
- Faulty fridge solenoid(s) (Check using DIAGNOSTIC No4 & No5)
- Faulty interface board

CONTROL PARAMETERS NOT RETAINED AFTER MAINS FAILURE

- Supercap discharged. (After 48 hours with no power)

The SUPERCAP will keep the real time clock chip (RTC) and any set points in memory for about 48 hours without external power being supplied.

TEMPERATURE CONTROL NOT TIGHT ENOUGH

- Circulation Fan stopped or airflow impaired
- Check that refrigeration evaporator has not ICED UP.
- Sensor faulty or airflow through sensor box impaired.
- Humidity system not working (nozzles blocked).

Sensor unit relies on good airflow for correct operation, unit must be correctly attached to front of inside refrigeration evaporator.

INACCURATE READINGS ON ANY PARAMETER

- Not correctly calibrated
- Out of range (% RH best accuracy between 15-40°C)
- Faulty sensor
- Component failure

NB: If the TEMPERATURE is NOT correctly calibrated see the DIAGNOSTIC tests (TEST No 20) to calibrate the cabinet, the calibration should be carried out EITHER at 20.0°C OR for CRITICAL APPLICATIONS at the temperature of interest. **NB:** All lighting MUST be OFF. In particular the calibration factors should be checked if power has been removed from the cabinet for more than 48 hours.

The cabinet may have difficulty achieving some HUMIDITY settings (especially if the ambient temperature is high and the lights are ON) if in doubt reset the cabinet for more easily achieved Temperatures/Humidities.

MAINTENANCE SCHEDULE No1

This schedule should be carried out at intervals of about **2000** running **hours**, in adverse conditions the cleaning procedures should be carried out more frequently. After 2000 hours of running a maintenance alarm (No13 or 14) may occur. Cancel the alarm and then carry out the following procedures.

- Turn the lighting OFF using the Lighting switch on the main panel OR by setting the intensity to 0.0, then turn the chamber **OFF** using the '**TEST**' button on the **RCD** circuit breaker, this checks operation of the **RCD** device.
- Turn the main power to the unit off at the main supply switch and if possible lock in the off position OR remove the chamber power cable from the wall socket.
- Open the lower door and using a brush and/or vacuum cleaner remove any dust buildup from the refrigeration condenser fins.
- Remove the Loft-air filter and thoroughly wash and dry it before replacing it back into position on the loft air intake system.
- Check that the under floor humidity nozzles are spraying a good cone of fine mist (use DIAGNOSIC No3).
- If pump system then remove pump main inlet filter, inspect and clean then replace. If steam injection replace the water inlet filter (P2006) – ensure flow direction is correct.
- Check that the electronics service compartment muffin cooling fan is operating.
- Restore power to the system.

MAINTENANCE SCHEDULE No2

At intervals of about 8000 running hours the following procedures should be carried out in **ADDITION** to the procedures listed above.

- Drain any water from the water reservoir system and clean and inspect the tank and hoses for leaks and deterioration, replace / clean as necessary. Replace the activated charcoal filter (remember to flush the system with the nozzles removed after installing a new filter cartridge) Use **DIAGNOSTIC** No3.
- If a pump type delivery system is fitted the pump should be **OVERHAULED** (brushes, diaphragms etc) to ensure ongoing reliability.
- All plastic hoses should be **REPLACED**.

REFRIGERATION SYSTEM

The Refrigeration System is designed to operate continuously.

The System is started when either the HOT or COLD solenoid valves are opened by the PLCS5 control system. Opening either of these valves will allow refrigeration Pressure into the Cooling Coil and Low Pressure Switch which will close and allow the Refrigeration Compressor and Condenser Fan Motor to start up.

After the initial start up period (approx one 20 seconds) depending on whether a cooler or warmer temperature is required the Hot Gas Solenoid Valve will open and close to help in achieving the required Cabinet Temperature.

The Hot Gas solenoid operates on a 16 second cycle, i.e., if the Hot gas solenoid is on for 10 seconds it will be off for 6 seconds. When the Hot gas solenoid is on for 16 seconds it will stay on ALL the time (Off time = 0 seconds), this is FULL HOT GAS.

If the fridge is DISABLED via DIAGNOSTIC No41 then both Solenoid Valves will close and the Refrigeration Compressor will automatically pump down and turn off on the Low Pressure Switch. This could take up to 5 minutes.

It is also possible should the Pressure inside the Cooling Coil rise during a Hot Cabinet temperature period for the Refrigeration System to turn on automatically and pump itself out and stop again on the Low Pressure Switch (neither Solenoid Valve will open).

IMPORTANT

As the Refrigeration Unit located under the Cabinet is Air cooled it is essential that an unimpeded Air Flow over the unit is maintained.

Allow **AT LEAST** 1000mm of clear space **ON ALL SIDES** of the cabinet.

Air is drawn through front Grille of the cabinet over the Condenser Fins, through the Fan, over the Compressor and exhausted through the rear of the cabinet.

Dust and dirt will collect on the Air Entry side of the Condenser Fins so it is essential that once every three months the Front Grille is removed and the Condenser Fins brushed downwards with a small hearth brush.

If the cabinet is located in a dusty position this procedure should be carried out more regularly. Failure to keep the Condenser clean will result in the overheating of the Refrigeration Unit and may void the refrigeration warranty.

REFRIGERANT CHARGE

The refrigeration system is charged with **R134a** refrigerant and polyester oil. **NO other substitutes should be used.** The refrigeration charge must be checked by a suitably qualified refrigeration engineer.

HI/LOW SAFETY PRESSURE CONTROL

This control is wired in Series with the Refrigeration Compressor and condenser fan motor, and the low part as such is only used as a pump-out control when the PLCS Controller is set outside the refrigeration limits. Its function is not to cycle the Refrigeration Compressor to maintain cabinet temperature.

Temperature control is achieved by the PLCS Controller pulsing the Hot Gas Valve.

The HI part as such is used as a high pressure safety cutout in the event of a high pressure buildup (IE, condenser fan motor failure, clogged condenser).

Pressure Control Settings should be -

LP Cut In	30 psi
LP Cut out	0 psi
HP Cut out	200 psi

NOTE:1: Cut Out is Cut In - Differential

NOTE:2: To evacuate the system **either** the liquid **or** the Hot Gas Solenoid **must** be energized to allow the complete system to be exposed to the vacuum pump.

REFRIGERATION COMPONENTS

UNIT:	1HP AIR COOLED SEALED HOT GAS
COMPRESSOR:	L'UNITE CAJ4511Y
FAN MOTOR:	RO930 REALCOLD
REFRIGERANT:	R134a 2.3Kg
REFRIGERANT CONTROL:	TX VALVE FLICA TMVXBL2.5
DRYER:	SWEAT TYPE 053 3/8
CONDENSER:	AIR COOLED C8009 STEELFORT
LIQUID SOLENOID VALVE:	SPORLAN XUP RAPID ACTION
HOT GAS SOLENOID VALVE:	SPORLAN XUP RAPID ACTION
HP/LP CONTROL:	RANCO 017/8701

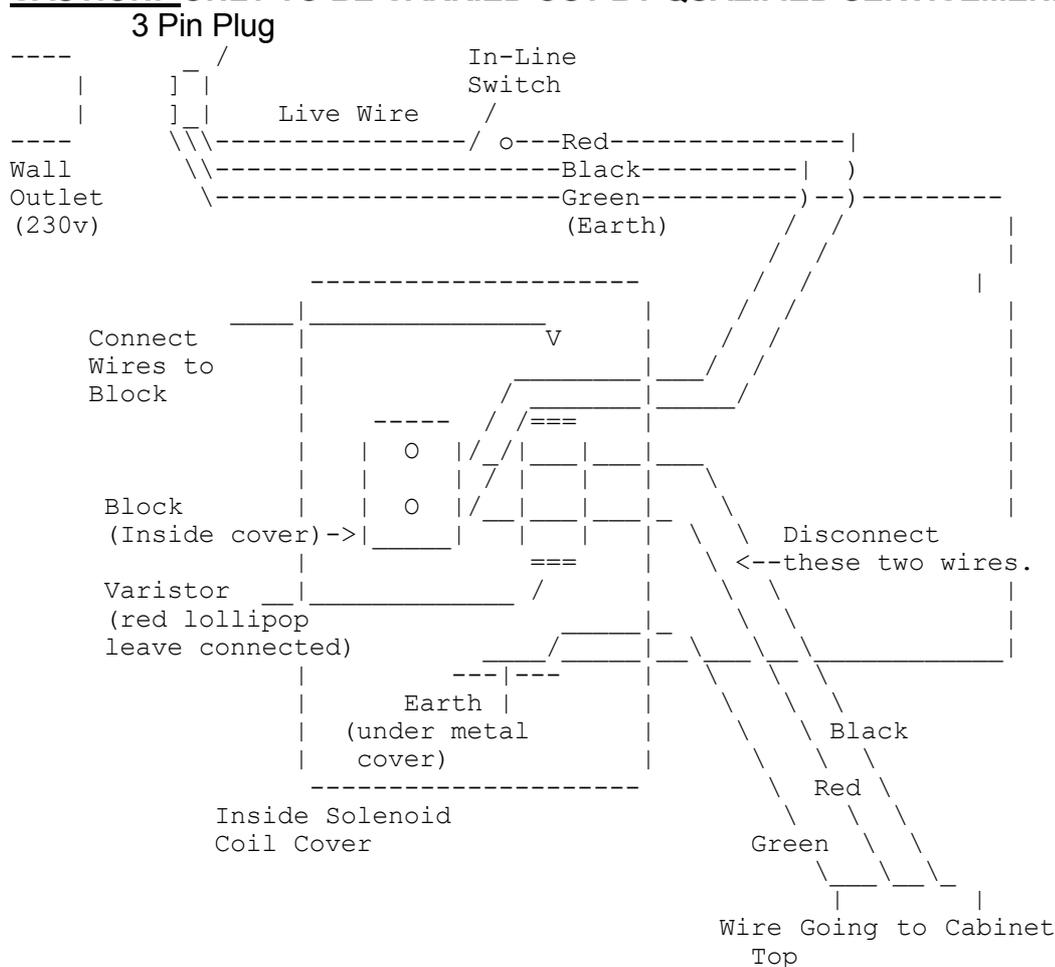
EVACUATION OF REFRIGERATION SYSTEM

To evacuate the system EITHER the liquid OR the hot gas solenoid must be energised to allow the complete system to be exposed to the vacuum pump.

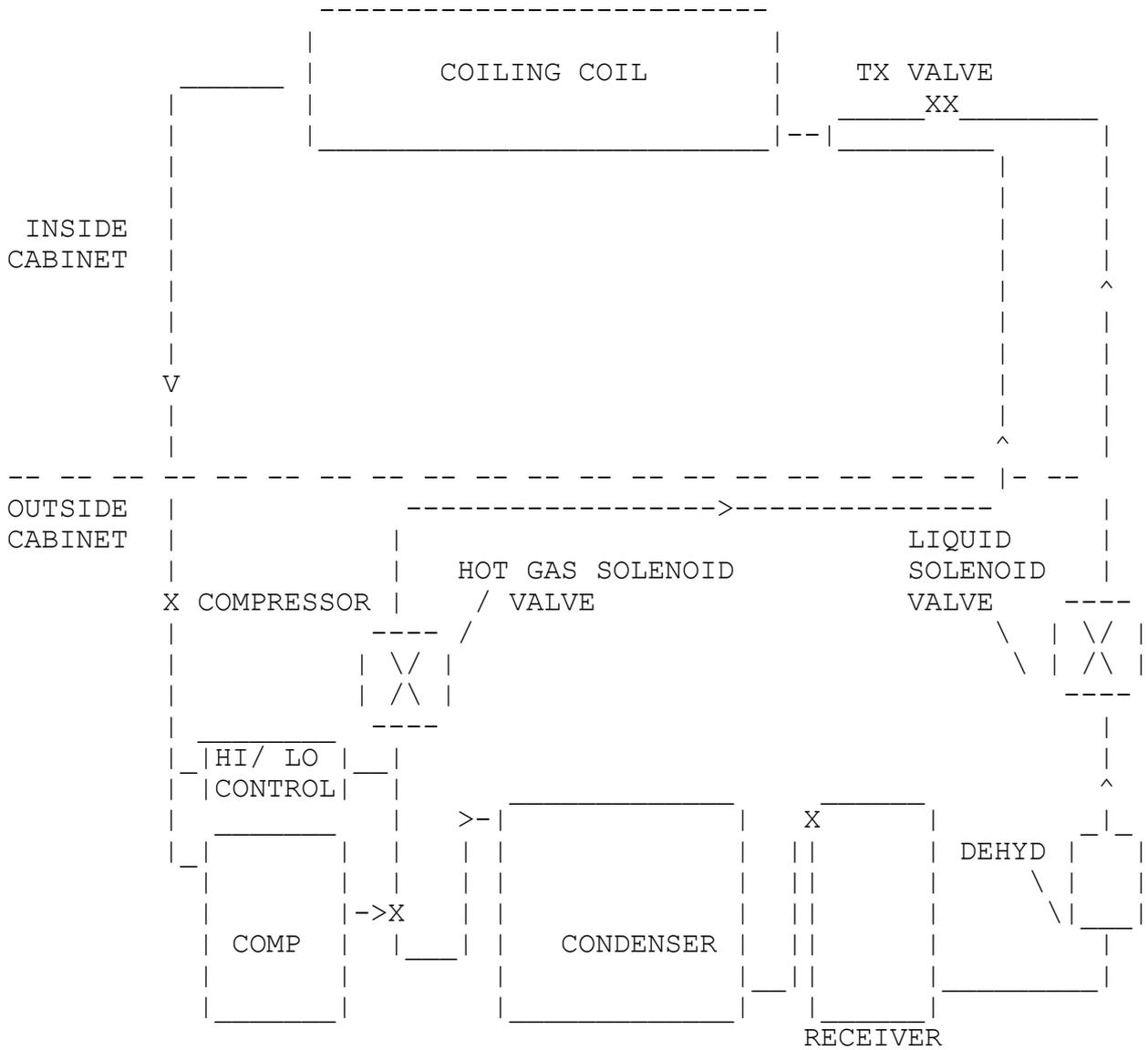
TO ENERGISE either solenoid valve to facilitate evacuation of the system:

- 1) Turn unit OFF at Mains and remove Mains Plug.
- 2) Remove cover from either solenoid coil and disconnect 2 (red and black) wires from connector block insides cover.
- 3) Wire plug from Mains (230v) with an In-line switch to connector strip inside solenoid cover, connect earth to metal of solenoid
- 4) To energise solenoid - plug wire into outlet and switch on!
- 5) System can now be evacuated with either solenoid open.

CAUTION: ONLY TO BE CARRIED OUT BY QUALIFIED SERVICEMEN.



REFRIGERATION SCHEMATIC DIAGRAM



SECTION 9 PARTS LISTS

DESC	CONTHERM REF
Micro Parts PLCS5 SET	CPU - LPLANT
PLCSLITE PCBs V1.0	PLCSLITE PCB
PLCS 'OPTO 22' 240A10 x 8	RELAY SS10A
HEATING OPTO 240A25	RELAY ss25A
Fan Motors: (Internal 300mm) x 2	ZIEL EBM
Fan Motors: (Light Loft 350mm) x1	ZIEL EBM
Fan Motor: (Electronics Cooling) x1	SUNON 150mm
Elements: 1x 870w (Precision)	P1013
1x 1250w (Precision)	P1014
Filter – Activated Charcoal Type: KDC-10	
Water Injection Solenoid	
Spray Nozzles (x2) – SF2TIP	P1184
Loft Air switch (HONEYWELL C6065A1028)	AIR SWITCH1
Hi-Limit Switch (non-Reset)	P132
Hi-Limit Switch (Resetable)	P021
Fuses 5x20mm 5A (T) Ceramic Anti-surge (Metal Halides)	HPI/T FUSE5
Fuse 2Amp Fast Blow (Controller) 2AMP	FUSE
RCD Circuit Breaker 32A (30mA Leakage trip)	CIRCUIT BRK8
Circuit Breaker 20A x1	
Circuit Breaker 10A x2	

DESC**CONTERM REF**

Contactora (main) 40A ABB B25-30-10	CONTACTOR 9
Contactora (Lighting) 25A SK 812001 AM	CONTACTOR 5
Lamps x8 400W Metal Halide HPI/T	HPI/T L400W
Lampholder NZI CAT 929 Ceramic Base	HPI/T HOLDR
Ballast – BHL-400-I32	HPI/T CHOKE
Ignitor – SI 51/52 400-1000W	HPI/T IGNIT
Capacitor (PF Corr) 25uF 250v	HPI/T CAP25
Fuse Holder (Gear Tray)	HPI/T FHOLD
Round RED neon IND9000 RED	NEON 2
<u>Front Panel Switches PDL</u>	
With Small RED neon - PDL 580M 16N	SWITCH 8
Plain Switch - PDL 581M 16	SWITCH 9
Switch retaining clip - PDL 533	SWITCH 8A
<u>Front Panel Neons</u>	
Square Clear neon - PDL 510MN	NEON 4
Square Green Neon - PDL 510MN	NEON 5
Square Red Neon - PDL 510MN	NEON 6
Square Amber Neon - PDL 510MN	NEON 7

SECTION 10 FAULT/ALARM CODES

These codes will be shown on the Controller ALARM Display, the RED DISPLAY will come on and the buzzer will sound. Read the information to see if further action is required. To cancel the alarm, Press the 'DIAGNOSTIC/ALARM' button.

Code Problem	Remedy
01 Over/Under Temp fault - temperature in chamber more Than 2°C above/Below the set point.	Alarm will stop when fault is removed.
02 Low CO ₂ in Chamber - Not enough CO ₂ to maintain CO ₂ set point.	Check bottle, hoses, for blockage or Faulty solenoid.
03 Chamber now running on <u>Preset</u> Values. (Most likely due to power being removed for more than 48 Hours).	If Preset values are your Working values, cancel the alarm else update the set points. CHECK CAL FACTORS.(See CAL SECTION)
04 Main temperature sensor (in sensor box) broken or Damaged.	Call Service Engineer. Check sensor with meter. Could also be electronic fault in controller, or broken sensor wire, etc.
05 Humidity sensor (in sensor box), broken or Damaged.	Call Service Engineer. Check sensor with meter. Could also be electronic fault in controller or broken sensor wire, etc.
06 Low water level in Humidity Reservoir.	Top up level in Humidity Reservoir, open bottom door to top up.
07 CO ₂ Sensor. Damaged or broken, range (20-170%) raw CO ₂ .	Call Service Engineer.

08 Moderate Noise

Check wiring of Mains.
If only very occasional
alarm will not cause any
problems.

09 Severe Noise on Mains
check mains wiring and
outside interference.

As above but serious,
earthing. Look for
CHECK CAL FACTORS.

13 Maintenance Service
No1 Due (Occurs every
2000 running hours).

Carry out Standard
Maintenance Schedule
and cancel alarm.

14 Maintenance Service
No2 Due (Occurs every
8000 running hours).

Carry out Comprehensive
Maintenance Schedule
and cancel alarm.

CONTHERM SCIENTIFIC LTD
CERTIFICATE OF CONFORMANCE



This certifies that the CONTHERM equipment specified below has passed quality and performance tests according to our standard methods and procedures and has been approved for despatch to our customers. Contherm calibration equipment is traceable to a YSI Model 60 gallium melting point temperature standard.

CAT.No: 630 [R]/[RHS]
(Plant Growth Chamber)

App No:

Date:/...../.....

FACTORS

TEST RESULTS

CALIBRATION

Test Temperature: Temperature []
Probe Position: Humidity [/]
Date of Test:
Actual Recorded Temperature
Temporal Variation Passed []

ELECTRICAL TESTS

Earthing: [] Ω Insulation: [] $M\Omega$
Leakage: [] Ma

The electrical tests are satisfactory: []

Signature of Test Personnel

CONTHERM SCIENTIFIC LIMITED
NEW ZEALAND

PACKING INSTRUCTIONS
 Installation Quality Check List (IQ)
 (Leave with Cabinet & Retained by Customer)



CAT.No: 630 [R]/[RHS]
 (Plant Growth Chamber)

App No:

Date:/...../.....

<u>Accessories Supplied</u>	<u>Qty</u>	<u>(IQ)Checked</u>
Operating Manual	[]	[]
Other.....	[]	[]
Cabinet Undamaged when Packed <i>(No dents, scratches or obvious damage)</i>	[]	When Received []
Certificate of Conformance Completed <i>(Factory test sheet attached)</i>	[]	[]
Ensure cabinet has been fully tested and approved for packing .	[]	[]
Ensure data plates are fitted.	[]	[]
Interior and exterior clean.	[]	[]
Cabinet Installed as per installation Instructions: <i>(See SECTION 3 of the operating manual)</i>		[]

Installation Verification (IQ) Satisfactory: [Y][N]

PACKED BY

(IQ)CHECKED BY

Date:/...../.....

Date:/...../.....

OPERATION VERIFICATION INSTRUCTIONS

Operational Quality Check List (OQ)
(Retained by Customer)



CAT.No: 630 [R]/[RHS]
(Plant Growth Chamber)

App No:

Date:/...../.....

<u>Operation.....</u>	<u>(OQChecked)</u>	<u>Comments</u>
LED & LCD Displays working <i>(Manual SECTION 4)</i>	[]	
Check operation of RCD device <i>(Use the 'TEST' button – Manual Section 4)</i>	[]	
Able to adjust SET POINTS <i>(Manual SECTION 4 – set for 20.0°C)</i>	[]	
Check operation of lights <i>(Set intensity to 0, 60, 120, 180 – all switches on)</i>	[]	
Temperature stabilises @ 20°C <i>(Allow cabinet to stabilise at temperature for 1 hour)</i>	[]	
Check HI-LIMIT Control <i>(Manual SECTION 4 – turn anticlockwise when stabilised)</i>	[]	
Check Alarm Operation <i>(Bypass door switch, Open door for 30mins after cabinet stabilised)</i>	[]	
Check Alarm Cancellation <i>(Manual SECTION 4 – Press 'temp' button until 'set' led on)</i>	[]	
Calibrate at temperature at 20°C <i>(Manual SECTION 5 – Calibration @ 20 or temperature of interest)</i>	[]	
Calibrate Humidity at 20°C, 80% RH <i>(Manual SECTION 5 – Calibration @ 20 or temperature of interest)</i>	[]	

Operational Performance (OQ) Satisfactory: [Y][N]

(OQ)CHECKED BY

Date:/...../.....

PERFORMANCE VERIFICATION INSTRUCTIONS

Performance Quality Check List (PQ)
(Retained by Customer)



CAT.No: 630 [R]/[RHS]
(Plant Growth Chamber)

App No:

Date:/...../.....

Operation.....

(PQChecked)

Comments

Check Temporal Variation @ 20°C

[]

(Refer manual for specification, cabinet empty, center only, see verifying cabinet performance in the manual)

Performance Verification (PQ) Satisfactory: [Y][N]

(PQ)CHECKED BY

Date:/...../.....

CONTHERM SCIENTIFIC
CUSTOMER INSTALLATION REPORT



Please fill in and return to:

**CONTHERM SCIENTIFIC LIMITED
DEVELOPMENT SECTION
P.O. BOX 30605
LOWER HUTT
NEW ZEALAND**

- 1) Did your chamber arrive in good condition? **YES / NO**

- 2) Any difficulties experienced in setting up? **YES / NO**
Comments:

- 3) Is this your first CONTHERM purchase? **YES / NO**

- 4) Any previous problems of a specific nature with CONTHERM products? **YES / NO**
Comments:

- 5) Any suggestions for improvements or special features you would like to see -
Comments:

6) **Chamber Details** **Catalogue No:** **CAT 630 [R]/[RHS]**

Appliance No:

Date Installed:

Company:

.....

.....

COUNTRY:

Contact Name:

PHONE: **Email:**