

CON THERM

SERVICE MANUAL

CAT 650

GROWTH CHAMBER

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IMPORTANT

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

SECTION 1 OVERVIEW

The Contherm **CAT 650** Plant Growth chamber contains a number of subsystems which work together to control the temperature, humidity and lighting intensity inside the chamber to a predefined set of conditions.

The PLCS5 Control Subsystem issues commands to the various devices used to indirectly control the fans, heaters, lights and refrigeration system to achieve the desired result within the chamber.

The main controller consists of a microprocessor controlled PLCS5 Interface PCB, PLCS5 Display PCB and an input sensor box.



Most of the control devices are contained within three sections in the service compartment inside the front RHS of the chamber.

The service compartment is accessed by unlocking the two full height service doors at the RHS end of the chamber.

NB: This area must only be accessed by suitably qualified service personnel as there is danger due to the presence of mains voltage wiring and connectors.

The service compartment topmost section contains the refrigeration evaporator, the three internal air circulating fans and their associated heating elements along with the

sensors for safety over temperature cutouts. This area is accessed by removing the screws holding the plenum chamber plug covers in place and removing the plug covers by lifting them out of the service compartment.

The middle section houses the main wiring looms, the main switches, circuit breakers and contactors along with the lighting ballasts for the loft metal halide lamps, the PLCS5 Interface PCB, the lighting control pcb's and the electronics cooling fan.

The lower section contains the refrigeration system complete with its condensing unit, condenser fan and refrigeration solenoids, the CO2 injection solenoid (if fitted) and inside a smaller compartment the humidity water supply solenoid and mains water filters.

The very top section of the chamber (Light Loft) houses the metal halide and tungsten lamps along with the air pressure detection switch and two loft over temperature safety cutouts. The air pressure detection switch will trip if any of the loft lids are opened or if both loft cooling fans stop or the loft airflow is severely impeded. The loft over temperature safety cutouts are set to trip if the loft air exceeds 45°C.

The area under the floor is sloped towards the control chamber end to assist in draining. There are four fog-jet spray nozzles under the floor to raise humidity levels, the floor can be lifted in small sections.

CAT 650 Service Compartment end view



SECTION 2 SPECIFICATIONS

The CONTHERM CAT650 Plant Growth Chamber has been expressly designed to give the widest choice of operating conditions consistent with high reliability, 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 and latching door catches.
- **Safety** - Fitted with independent factory set Hi-Limits completely separate from normal controls. Overtemperature, Air open and fan fail protection on light loft. RCD, Phase loss and Phase rotation detection on electrical system.
- **Convection** - All units come with mechanical convection fan systems.
- **Electrical** - All quoted at 20°C – PLCS5 Controller, Mechanical Convection.
- Designed to AS/NZS3350.1:1994 400-415V 3N~ 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			400-415 AC 50Hz 3N~

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

b) Lighting:

Maximum Light Intensity: @500mm from glass loft 850 μ E
@900mm from glass loft 650 μ E

Day-night Lighting:

Automatic control in 80 μ E 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 – Lighting OFF) 40 - 90%RH
(Depends on temperature, Ambient and Lighting Settings)
Accuracy: (typical @ 20°C, 50 - 90%RH) \pm 5%RH

d) Carbon Dioxide: (If fitted)

Range: 0 - 2000PPM
Control Range (additive): Ambient+50 - 2000PPM
Fluctuation (@25Kpa / 5PSI) \pm 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:

One RS232c computer connection is provided.

SECTION 3 INSTALLATION

The CAT 650 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. If the water tank is mains fed the main water pressure must **NOT** exceed 60PSI.

The cabinet requires a 400-415V 50HZ 3 phase + Neutral + EARTH electricity supply.

Total electrical load is 24A/PH (17KVA)

Connection terminals for the mains supply are provided at the rear of the cabinet.

The approximate heat load (Lighting OFF) is 5.5Kw, Lighting ON is 15Kw
Approximate air ventilation volumes are 1m³/sec for the light loft and a further 0.7m³/sec for the refrigeration condenser.

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.

NB: A means of **DISCONNECTION** from the supply with a separation of at least 3mm in all poles **MUST** be provided in the fixed wiring to this chamber.

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.

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

FOR YOUR SAFETY

To ensure safe operation this chamber must be correctly connected to a suitable 3 phase + neutral + earth supply by a qualified electrician. The chamber must be effectively earthed through the normal building wiring.

The fact that the equipment operates satisfactorily does **NOT** imply that the power supply is earthed and that the installation is completely safe. For your safety, if in any doubt about the effective earthing of the power supply, consult a qualified electrician.

SECTION 4 OPERATING INSTRUCTIONS

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 at rear of chamber.
- 2) If the cabinet is fitted with CO₂ control food grade CO₂ must be supplied to the cabinet by a suitable two stage CO₂ regulator with the output pressure set to 5PSI for correct operation.
- 3) Ensure WATER INLET is connected to mains pressure (max 60PSI) water. **ENSURE DRAINS** are also connected! Apply power at wall isolating switch.
- 4) Turn on front panel main RCD switch and the three circuit breakers – Turn the control main switch ON - the mains neon should now be on and the green LED displays on the control panel will be illuminated. If the cabinet display does not come on, the phase rotation sequence may have to be changed (ONLY on initial installation).
- 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 on page 10 of this manual to cancel the special 03 Alarm.
The controller settings are 'LOCKED OUT' until the door handle on the main control panel is unlocked and rotated anticlockwise 90° to the intermediate position where the main door is still physically closed but the controller is unlocked for setting.
The main door must be OPENED to change any of the main switch settings. All cabinet front doors are similarly keyed and when closed and locked inhibit unauthorised adjustments to any cabinet settings.
- 6) Set program(s) to desired operating parameters.
- 7) Confirm factory calibration by monitoring the temperature, Humidity etc with your own calibrated instruments and make adjustments as per the CALIBRATION section if necessary.

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**. (Loss of loft air will turn the lights **OFF** if the covers are opened during operation).

ALARMS

There are TWO main type of alarms 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.

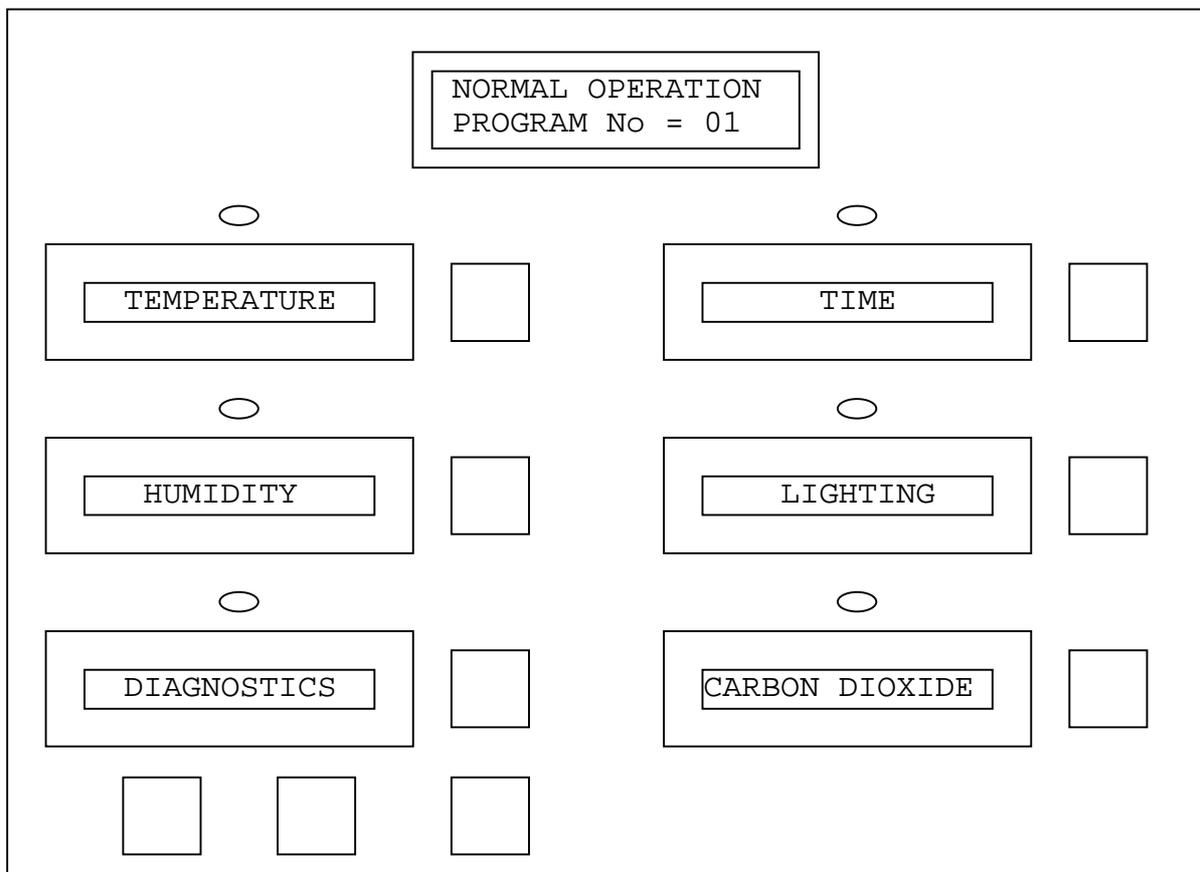
The following procedure is recommended:

- 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 , CARBON DIOXIDE 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.



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 Control/Monitor Panel is fitted at the front 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.

CONTROL / MONITOR PANEL

Additional Neon indicators and switches are fitted to the main control panel to provide overall control of various functions and to give a visual indication of cabinet operation.

	[HAL]	[HAL]
	[1]	[2]
	[HAL]	[HAL]
	[3]	[4]
	[HAL]	[HAL]
	[5]	[6]
O		
USER	[HAL]	[HAL]
HI-LIMIT	[7]	[8]
	[HAL]	[HAL]
	[9]	[10]
	[HAL]	[HAL]
	[11]	[12]

[]	[]
[VIEW]	[VIEW]
[1]	[2]

[USER]	[HI]	[LOFT]
[HI]	[LIMIT]	[AIR]
[LIMIT]	[FAIL]	[FAIL]

- FRIDGE -

[HEAT]	[HOT]	[COLD]	[HUMD]	[LITE]
[3]	[2a]	[2b]	[4a]	[5a]
[NEON]				
	[]		[HUMD]	[LITE]
	[CO2]		[4]	[5]
	[SOLN]		[SW]	[SW]
[]	[]	[]	[MAIN]	[MAIN]
[L1]	[L2]	[L3]	[SW]	[SW]
[NEON]	[NEON]	[NEON]	[NEON]	[]

[] [CB] [CB] [CB]

[RCD] [25A] [25A] [25A]

- 1) **MAIN SW** switch allows power to flow to the cabinet. The neon to the left will be illuminated when this switch is ON and the cabinet is connected to the Main power supply. Located at the lower LHS of the panel is an **RCD** device which should be tested by service personnel 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 and turn all the power to the cabinet OFF. (**ALWAYS** conduct this test with the lighting **OFF**. To **RESET** the circuit breaker lift 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 due to excessive 'earth leakage', the cause **MUST** be investigated. **DO NOT** attempt to **BYPASS** the **RCD** device. Adjacent to the **RCD** device are the three main 25A circuit breakers, if any of these trip due to excessive current the whole cabinet will be turned OFF.

There is no fridge on/off switch fitted, however the refrigeration may be turned off via the DIAGNOSTIC selection No41 (00=OFF). The refrigeration system is normally running ALL the time unless the timer is set to 0:00.

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.

- 2) **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) **HEAT 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. If the **USER HI-LIMIT** is set **TOO LOW** the 'HI-LIMIT' neon will come on in place of the **HEAT** neon.

4) **HUMIDITY.** (If HUMIDITY CONTROL FITTED) This switch allows the HUMIDITY SOLENOID to operate. The GREEN neon will be illuminated whenever power is applied to the humidity solenoid. This will allow mains water pressure to 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 solenoid may be tested 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 will function.

The other switches (fitted with small RED neons) are used to enable particular METAL HALIDE lamps to work, if the switch is OFF those lamps will NOT function under automatic control.

6) **VIEWING** Lights. The viewing light switches allow for the lights to be turned on at any time for cabinet contents viewing by switching to the 'MAN' position, if set to the 'AUTO' position they may be used as automatic infra-red supplement.

7) **HI-LIMIT** neon. This neon will come on if the Hi-LIMIT is restricting the flow of power to the Heating Elements.

8) **LOFT AIR FAIL** neon. This neon will come on if there is insufficient air movement out of the lighting air discharge duct, or if the loft temperature is excessive or if the loft access covers are open. If this neon is ON the LIGHTS will NOT function.

9) **CO2 SOLENOID** neon. This neon will come on when the CO₂ solenoid is energised to allow CO₂ gas to flow into the chamber. This will occur if the CO₂ SET POINT is higher than the current CO₂ level and the cabinet is at the correct temperature. (ONLY if CO₂ option is fitted to the cabinet).

10) **POWER** neons (L1, L2 & L3). These neons monitor the three phase power to the cabinet and should be illuminated if all three phases are present even if the mains switch is OFF. This shows that the cabinet is still connected to the incoming building main power.

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 (960 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.

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 uE).

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.

If the Metal Halide lamps are switched off they may take up to 15 minutes to restart as the gas must cool before they will restrike.

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 uE, any figure greater than 00) this means the lights will be turned ON for the duration of this Program, a setting of `OFF' (00µE) 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.

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 must 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 cannot be calibrated in the field – if calibration is incorrect it must be returned to the Factory for recalibration.

The temperature should be recorded on a daily basis by placing a thermometer in the work space so that it can be read and the long term temperature performance can then be plotted to give an assurance of correct temperature performance. Always take the reading when the lighting is OFF.

SECTION 5 CONTROL SUBSYSTEM

The Control Subsystem is based on the operation of the PLCS5 microprocessor controller, and utilises the following basic components:

1. PLCS5INT – Main controller interface PCB
2. PLCS5DSP – Display PCB mounted on the control panel door
3. PLCSLITE – Lighting control PCB, there are three of these each controlling the lights on one phase of the power supply.
4. SENSOR box – mounted inside the chamber just below the refrigeration evaporator in the return air.

The PLCS5 Control System uses a HONEYWELL (HYCAL) Humidity sensor (HIH-3610) to measure the relative humidity and a LM35D Solid state temperature sensor to measure the temperature. If the chamber is fitted with CO2 control, these two small component are mounted inside the VAISALA CO2 (GMW20) sensor box, which is fastened on the inside of the chamber just below the refrigeration evaporator, otherwise they are contained within a larger stainless steel sensor box also mounted just below the refrigeration evaporator.

Power to the sensors is derived from the PLCS5 Interface PCB, and if CO2 is fitted the CO2 sensor is additionally powered from a small 24V A.C transformer mounted adjacent to the PLCS5INT PCB.

PLCS5INT PCB

This circuit board contains all of the control logic circuits that determine the correct functioning of the chamber.

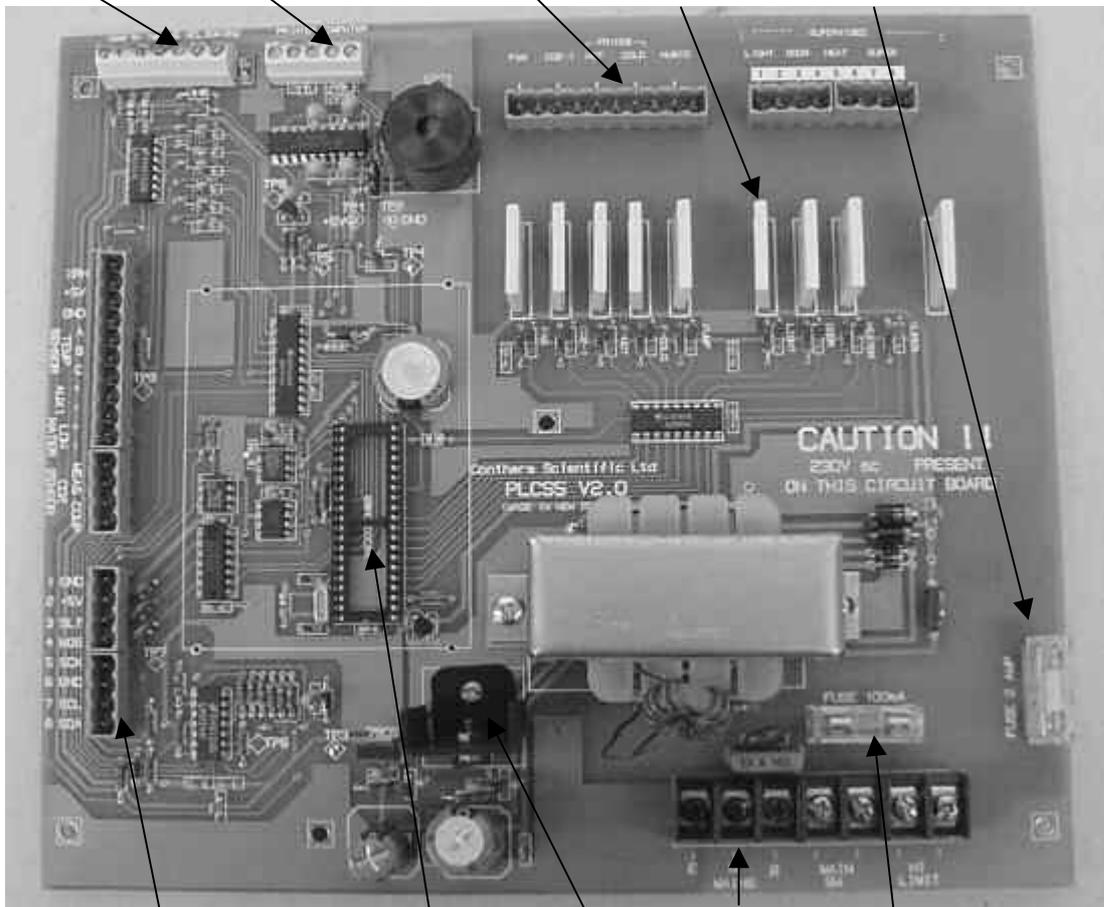
The PLCS5INT contains a Motorola 68HC705C9A microprocessor, 10bit A/D converter, E²rom memory, RTC clock, analog circuits, I/O circuits and low power Triacs to power the appropriate outputs.

User settings are retained in memory for 48 hours without power via a Supercap backup device.

The PLCS5INT PCB uses both SPI and I²C buses to communicate with the remote DISPLAY and PLSCLITE PCB's.

The control system is provided with a number of Diagnostic tests which can be used to both customize and test various parts of the system (See section 9).

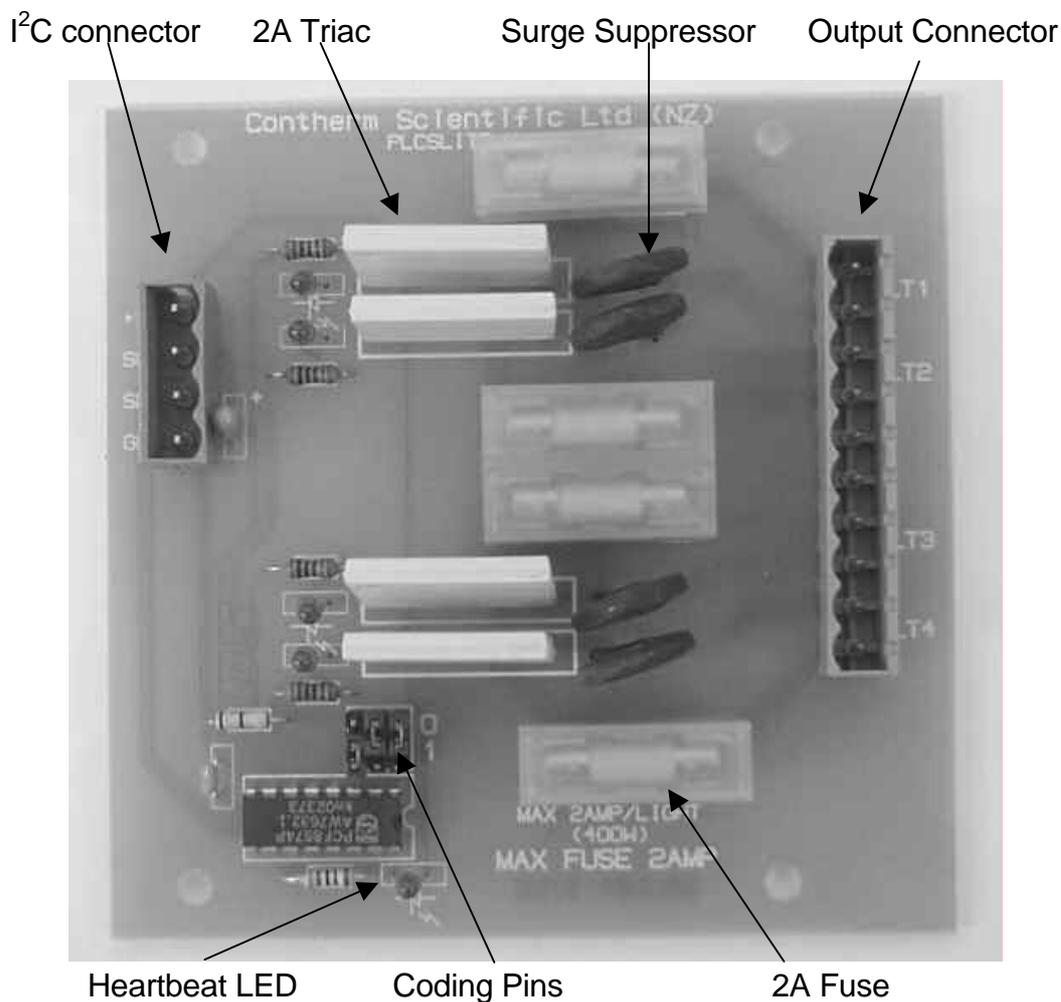
I²C bus RS232 Output Connectors Triacs 2A Fuse



Display Connector 68HC705C9A μ P +5V Mains 100mA Fuse

PLCS5INT PCB

PLCSLITE PCB



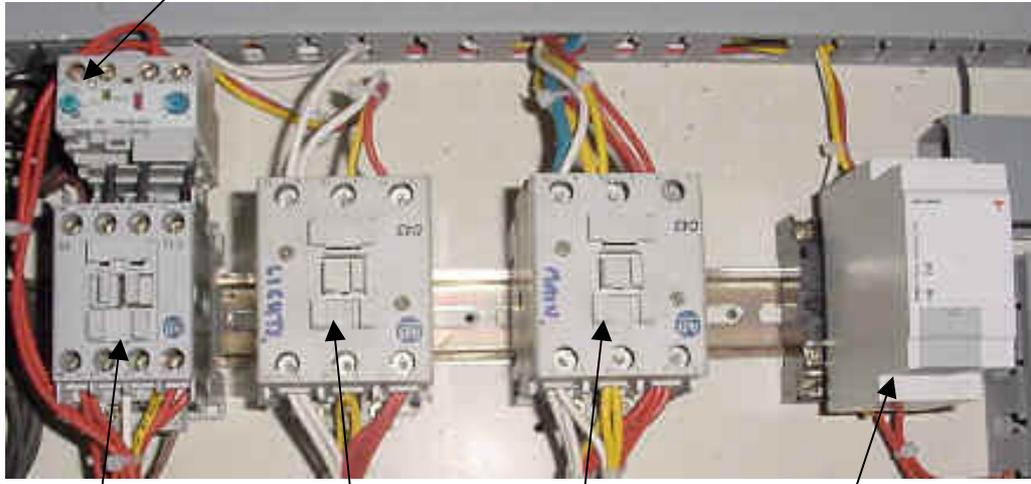
The function of the PLCSLITE PCB is to control the Power Opto-Triacs located on each Metal Halide lamp gear tray so that the individual lamps may be turned on or off via microprocessor control. The PLCSLITE pcb communicates with the main PLCSINT pcb via the I₂C bus. When the PLCSLITE pcb is correctly wired its 'heartbeat' led will be 'blinking' on and off. The other four leds directly in front of the white opto-triacs will be on or off as that particular triac (lamp) is selected. Each PLCSLITE pcb has a unique address which is determined by the coding pin positions on any particular board.

The three PLCSLITE pcbs each control 8 lamps per phase, and are located at the LHS of the first three gear trays inside the service compartment. Ensure **ALL** power to the cabinet is **OFF BEFORE** working on or replacing fuses on any of these PCB's.

CONTACTORS

The main contactors, lighting contactor, refrigeration contactor and phase detection relay are all mounted on a din rail just inside the LHS of the service compartment.

Fridge Overload



Refrigeration

Lighting

Mains

Phase Loss Relay

The Phase loss/rotation relay detects the presence of all three phases of the mains supply and also the sequence of rotation, should a phase drop out or the sequence alter, the contacts on this relay will cause the mains contactor to switch off removing power from the chamber.

Providing all three phases are present and the RCD and circuit breakers are intact the mains contactor will be energised when the main switch is turned on.

The lighting contactor will be energised if the cabinet is on normal operation, a lighting value has been set, all the loft safety devices are intact (ie loft air etc) and the light switch is on. Air flow through the lighting loft is detected by a pressure switch. The light loft is also fitted with two user-resettable HI-LIMIT switches which will trip if the temperature in the light loft exceeds 45°C. The light loft cover above the switch must be raised so that the switch can be reset using the RED reset button.

The refrigeration solenoid will be energised when the fridge overload has not tripped and there is sufficient pressure in the system to keep the Hi/Lo pressure switch closed.

SECTION 6 REFRIGERATION SUBSYSTEM

The Refrigeration Subsystem consists of the following items

Refrigeration Compressor – A 2HP 3PH compressor charged with R134a refrigerant

1. Condensing Unit and Fan
2. Liquid receiver
3. Hi/Lo pressure cutout control
4. Hot-gas rapid action solenoid valve
5. Liquid rapid action solenoid valve
6. Liquid line Dehydrator
7. Liquid line moisture indicating Sight Glass

The above parts are mounted on a rigid painted steel baseplate which is securely bolted to the cabinet structure

8. Finned evaporating unit
9. Expansion valve

The above parts are mounted inside the plenum chamber.

10. Refrigeration control contactor & overload

The above part is mounted inside the RHS service panel

Temperature control of the evaporator temperature is achieved by modulating the on/off times of the 'HOT-GAS' and 'COLD-LIQUID' valves. The operation of these valves may be monitored on the front control panel by the associated neon lights. The temperature of the refrigeration evaporator is also used to obtain the DEHUMIDIFICATION side of the Humidity control function.

The refrigeration system normally runs the whole time the cabinet is operating, when the compressor is running the condenser fan motor is also operating. If it is desired to shut the refrigeration system OFF this must be done using Diagnostic No41. When the value of this diagnostic is set to 00 the fridge will be disabled and both of the solenoid valves will turn off resulting in the refrigerant being pumped out of the system into the receiver and the compressor stopping via the Lo pressure cutout control.

When the refrigeration system is OFF neither the cabinet temperature nor the humidity level will be able to be correctly controlled.

REFRIGERATION COMPONENTS

Compressor Condenser Condenser Fan Liquid Receiver Dryer



Hi/Lo Cutout HOT-GAS Soln COLD-LIQUID Soln Sight Glass

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 Contactor to operate and power the Refrigeration Compressor and Condenser Fan Motor.

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. **NB:** When the HOT valve is OPEN the COLD valve is CLOSED and vice versa.

The Hot Gas solenoid operates on a 16 second cycle, IE 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 at the RH end of the Cabinet is Air cooled it is essential that an unimpeded Air Flow over the unit is maintained.

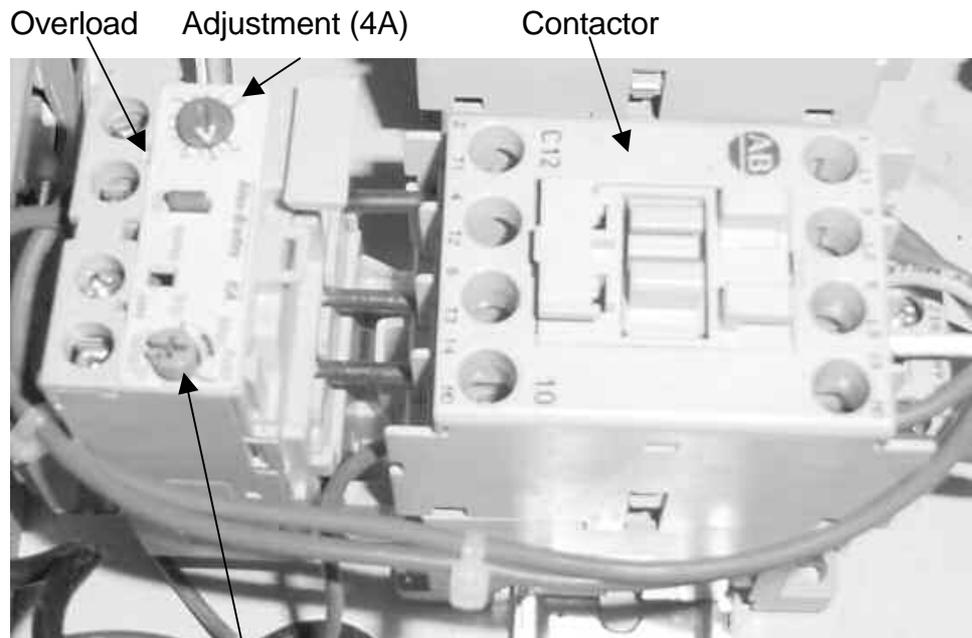
Allow **AT LEAST** 1000mm of clear space **ON ALL SIDES** of the cabinet.

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 door is opened 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 may result in the overheating of the Refrigeration Unit and may void any warranty.

Refrigeration Contactor & Overload



Overload

Reset Button (Push to reset)

The Refrigeration Contactor & Overload is designed to switch power onto the compressor system and to protect it against excessive current. The current setting is factory adjusted to 4Amp this must NOT be changed as the maximum full load current taken by the compressor is 3.9A/PH. The tripping mode should be left set to manual so that if it trips it must be manually reset which will draw attention to any possible problem.

The contactor is of type : **AB 100-12* 10 25A (230V ~ 50hz coil)**

The Overload is of type : **AB 193-EA4EB 1.6A – 5.0A**

The contactor and overload are located inside the service area mounted on a din-rail at the LHS.

REFRIGERANT CHARGE

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

REFRIGERATION CONTACTOR & OVERLOAD

The cabinet is fitted with a 3PH contactor and overload to switch power to the refrigeration system via the High/Low safety pressure control. The overload is set at 4.0Amps. If the overload trips due to excessive current, the RESET button will pop out and must be manually reset to allow the refrigeration system to operate. The overload mode should always be set to the 'manual' position.

HIGH/LOW SAFETY PRESSURE CONTROL

This control is wired in Series with the Refrigeration Compressor and condenser fan motor, and 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 and the Cold liquid valve..

Pressure Control Settings should be -

LP Cut In	30 psi
LP Cut out	0 psi
HP Cut out	220 psi

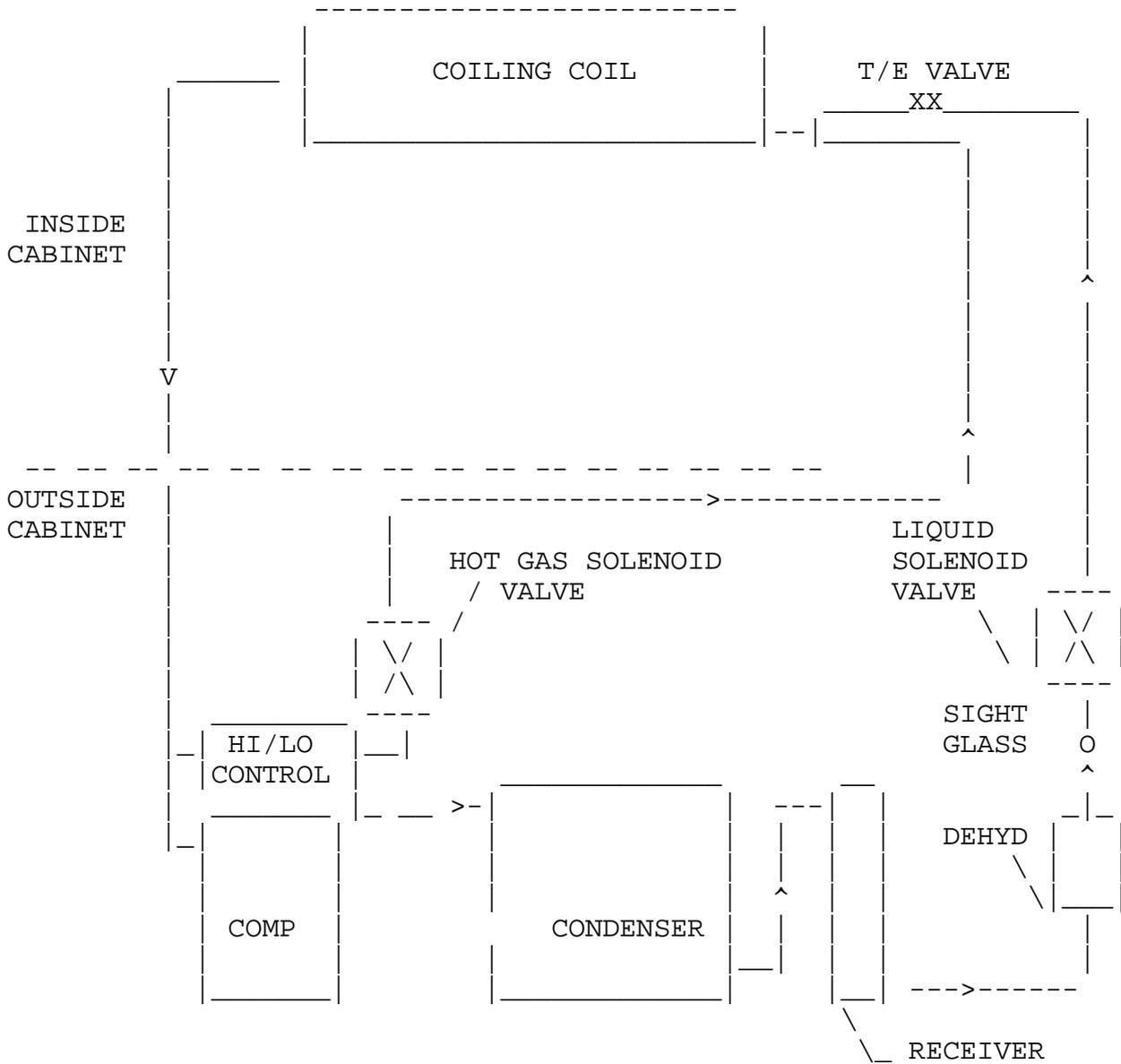
NOTE:1: Cut Out is Cut In – Differential (for LP settings)

NOTE:2: 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.

REFRIGERATION COMPONENTS

UNIT:	2 HP 3PH AIR COOLED SEALED HOT GAS
COMPRESSOR:	L'UNITE TFH4525H
REFRIGERANT:	R134a 3.6Kg
REFRIGERANT CONTROL:	FLICA TMVXBL 3 TX Valve
DRYER:	SWEAT TYPE Carly 3/8 ODS
CONDENSER:	AIR COOLED
LIQUID SOLENOID VALVE:	SPORLAN XUP RAPID ACTION
HOT GAS SOLENOID VALVE:	SPORLAN XUP RAPID ACTION
HP/LP CONTROL:	RANCO 017/8701

REFRIGERATION SCHEMATIC DIAGRAM



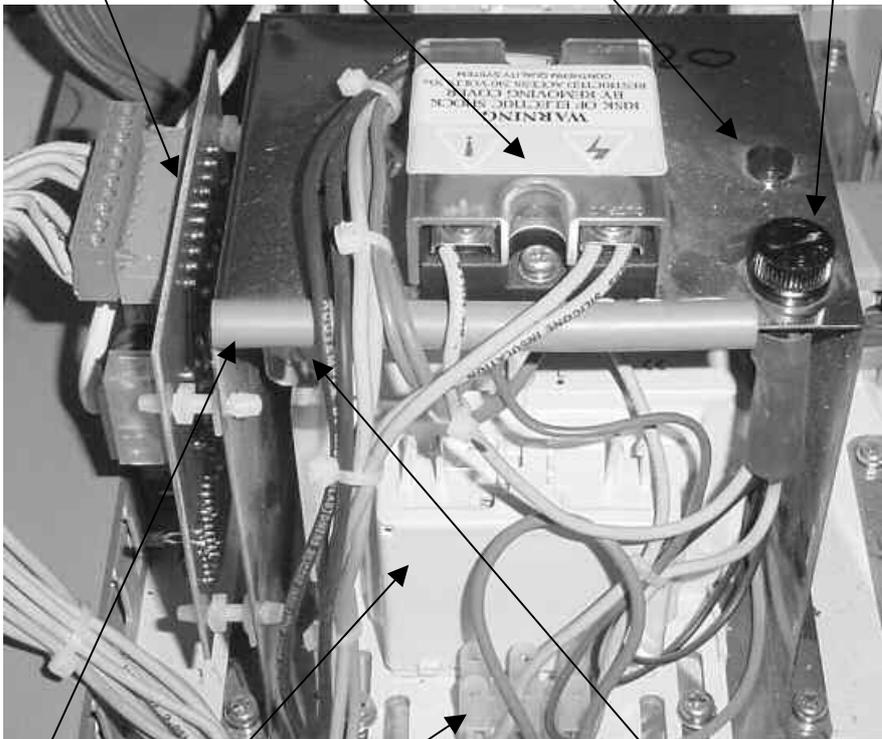
SECTION 7 LIGHTING SUBSYSTEM

The Lighting Subsystem consists primarily of the following items:

1. Lighting Contactor
2. Loft Fans
3. 24 x 400W Metal Halide lamps
4. 4 x 100W tungsten standard bulbs
5. Lamp Ballasts, fuses, capacitors and ignitors
6. Loft Air detection and Overtemperature thermostats
7. PLCSLITE PCB's

The Metal Halide lamps provide the hi intensity lighting required for plant growth. The lamps are located inside a separate light loft at the top of the chamber, access to the lights is via removable covers on top of the chamber. **NB:** Observe special precautions when removing or installing any lamps (see warning next page). Do **NOT** attempt to gain access to the light loft unless **ALL** power to the chamber is **OFF**.

PLCSLITE pcb Power Opto-Triac Neon Indicator 5A Fuse



Gear tray Ballast Ballast Connector Capacitor Ignitor (not shown)

The above picture shows a complete gear tray for a Metal halide lamp, this particular gear tray is also fitted with one of the PLCSLITE pcbs.

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**. (Loss of loft air may turn the lights **OFF** if the covers are opened during operation).

LOFT AIR SAFETY SWITCHES

When the main metal halide lamps are on it is essential that there is sufficient cooling air drawn through the light loft to effectively cool the lamps.

There are two basic types of safety switch associated with the Loft Air. If any of these trip the power will be removed from the lighting contactor coil resulting in all automatic lighting being turned OFF.

LOFT AIR DETECTION SWITCH (HONEYWELL C6065A1028) – This is a differential pressure switch for the range 4-10mm of H₂O and measures the pressure difference between the low pressure air stream over the loft and the outside ambient air.

If a loft cover is substantially lifted this switch will detect the loss of pressure and trip. If one of the fans fails while the chamber is operating the switch will not allow the light to come on the next time they are activated, if both fans fail the switch will trip.

LOFT OVERTEMPERATURE LIMIT THERMOSTAT - (EGO) These manual reset hi-limit thermostats are set to trip if the temperature of the air in the loft goes above about +45°C. The small RED reset button must be depressed to reset them.

If any of the above safeties are activated the chamber lights will not start and the 'LOFT AIR FAIL' red neon will be illuminated on the front control panel.

To ensure that there is sufficient air through the light loft CLEAN the LOFT AIR INLET filters (located under the inlet duct at the LHS of the chamber), by washing them at regular intervals – especially before the start of any new experiment. Also check that the loft air exhaust vent allows the spent air to flow freely.

The typical temperature rise of air through the light loft is 10°C allowing for a maximum ambient of around 35°C

SECTION 8 HUMIDITY SUBSYSTEM

The Humidity Subsystem utilizes the following components:

1. Water injection solenoid
2. Mains water Filter & Cartridge
3. Mist Injection spray nozzles (Located under the floor)
4. Drains

The mains pressure water system for the humidity spray is semi-enclosed inside its own compartment on the RHS of the service area.

When the desired humidity is set above the current humidity, the PLCS5 controller will open the water solenoid valve for about 1 second allowing a fine mist of water to be injected through four nozzles under the floor of the cabinet where it will be picked up by the internal cabinet airstream thus increasing the relative humidity inside the chamber.

If the cabinet is struggling to achieve a humidity setting, the PLCS5 controller will try to adjust the temperature of the fridge evaporator either warmer or cooler (using the HOT-GAS or COLD-LIQUID solenoid valves) so as to decrease or increase its dehumidification effect, providing that the temperature of the cabinet can still be maintained.

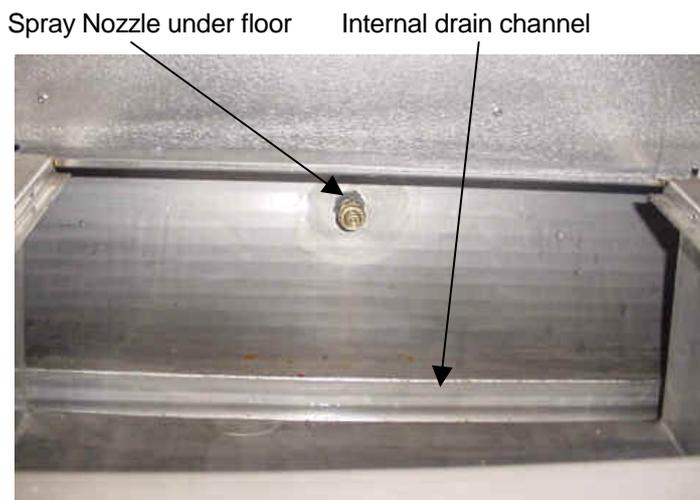


Shutoff Valve Bleed Valve Filter Water Solenoid

Humidity Spray Nozzle Cleaning Procedure

The following procedure should be carried out whenever the filter cartridge is replaced or if any of the nozzle become blocked.

- Set the chamber controls so that the cabinet is OFF (I.E, set the timer OR cycle counter to 0:00 or 00).
- Remove the first 2-3 floor partitions inside the chamber nearest the plenum end to gain access to the four spray nozzle heads.



- Using a spanner (two spanners if there is any danger of twisting the pipework to the spray head) – remove the spray head nut and remove the nozzle from the cabinet. Repeat until all four nozzles have been removed.
- Unscrew the centre jet from the nozzle and reverse blow with compressed air to ensure the nozzle is free of any blockage, repeat for all nozzles. Reassemble the nozzle.
- BEFORE replacing the nozzle back in the chamber, use DIAGNOSTIC '03' to pump some water through the pipework to ensure that the pipes are clear – immediately after replacing the cartridge carbon residue may appear, repeat the flushing until clear water is freely discharged from ALL nozzles. We recommend that you set the value of DIAG '03' to 60) for this.
- Replace the nozzles back into the chamber.
- BEFORE replacing the floor partitions, run diagnostic '03' again, a fine 'conical mist' of water should be seen emerging from each nozzle, if after a few attempts this cannot be attained, the faulty nozzle(s) must be removed again and cleaned.

Humidity Control on the CAT650

The CAT650 Plant growth chamber attempts to raise the relative humidity inside the unit by injecting an amount of water into the airstream using four 'fog-jet' nozzles located under the removable floor at the plenum end of the chamber. The fine 'conical mist' of water is mostly picked up by the recirculating air and carried through the holes in the floor and the 'jetstream' at the top left hand side into the chamber. The achievable relative humidity level depends on a number of factors, the main one being the temperature of the refrigeration system evaporator.

To lower the relative humidity the system relies on controlling the temperature of the fridge evaporator via the 'HOT-GAS' and 'COLD-LIQUID' solenoid valves. If the humidity is too high, the system attempts to lower it by decreasing the on time of the 'HOT-GAS' solenoid which will in turn lower the evaporator temperature and thereby lowering the DEW POINT formed by water condensing on the evaporator.

The upper and lower limits of the evaporator temperature will be determined by other factors, such as if the lights are on or off and the ambient temperature conditions.

All Temperature and Humidity calibrations MUST be carried out with the lighting OFF.

SECTION 9 DIAGNOSTICS

The PLCS5 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 operate the HUMIDITY solenoid continuously for a period to enable the system to fully prime. The length of time the solenoid will operate for may be changed by `adjusting' the value, a value of 30 represents about 5 seconds of 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). – **DOES NOT** apply to this cabinet. 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 ideally 50.
- 22 - CALIBRATE CARBON DIOXIDE.** (If cabinet is a CO₂ cabinet). This selection will force the cabinet to perform a CO₂ MANUAL-CAL.
To Force an MANUAL-CAL change the VALUE from 00 to 01.
The MANUAL-CAL will take place as soon as the cabinet reaches the current temperature set point. The MANUAL-CAL will assume that there is **NO** carbon dioxide gas in the cabinet! – **DOES NOT** apply to this cabinet.
- 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 synchronised 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 3 means that a correction of 0.3%RH will be removed from the current humidity reading for every degree above 20.0°C. The recommended setting for the standard probe is 3. Increasing this factor will INCREASE the humidity in the chamber at elevated temperatures. If cabinet is **HI-TEMP** or **HYCAL** set factor to 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.

SECTION 10 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 LCD/LED Display.**
 - Cabinet not connected to mains (Look at Phase neons)
 - Loss of one Phase (look at Phase neons)
 - Phase rotation incorrect (swap two phases – ONLY on initial installation).
 - Main **RCD** circuit breaker tripped - trip is due to excessive earth leakage ensure cause is investigated.
 - One of the three 25A circuit breakers has tripped.
 - Internal factory preset HI-LIMIT tripped (inside cabinet RHS panel) – Front panel HI LIMIT FAIL neon should be ON
 - No power at electrical supply.(Look at Phase neons).
 - Interface power supply failure.
 - Call Service Engineer

- 2) **CONTROLLER ON** - But cannot adjust settings or will not operate correctly
 - Controller door must be unlocked to change settings.
 - Ensure door switch is bypassed if 'outer door ajar' alarm occurs.
 - Check that SET POINTS are correct.
 - Check for INTERNAL circulating fan operation.
 - CHECK DETAILED TROUBLESHOOTING SECTION

- 3) **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. The loft fans must also be working to allow the lighting to operate.
 - Check that LOFT AIR FAIL neon is OFF.
 - If a particular lamp is not on it could be due to a faulty lamp or its individual 5A fuse blown (round red neon on gear tray will be on, if so turn lights OFF and replace the fuse), 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., CAT650, 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

To be carried out by suitable qualified personnel **ONLY**.

NO DISPLAYS OR LEDS (Mains NEONs on)

- NON-RESET Hi-Limit Tripped (inside RHS cabinet side panel) – HI-LIMIT FAIL neon should be ON.
 - Power Supply Failure on Interface PCB.
 - Mains phase rotation incorrect or phase missing.
- 1) Open maintenance doors on cabinet RHS. (Service personnel ONLY!!)
Press small RED button on Hi-Limit(s) 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 open RHS maintenance doors, 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.
- If bright segments in display the controller must be turned off then on again.

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.

CABINET WILL NOT HEAT/COOL TO TEMPERATURE

- MAIN Door partially open.
- Check for correct SET POINTS esp timer (|=manual)
- Faulty element(s)/fridge
- Already at temperature – Check temperature settings.
- Look at state of CONTROL panel neons esp 'USER HI LIMIT'.
- Check that elements are coming on (look at `Heat' NEON on cabinet).

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 current OverLoad has tripped.

FRIDGE IS ON BUT LITTLE/NO COOLING EFFECT

- Ensure that power is not being applied to main heating elements. (Look at heater NEON)- if so is Temperature set point correct?
- Check that Internal circulating 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 or Current 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. (esp low temps)
- 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 48hours without external power being supplied.

TEMPERATURE CONTROL NOT TIGHT ENOUGH

- Circulation Fans stopped or airflow impaired
- Check that refrigeration evaporator has not ICED UP.
- Sensor faulty or airflow through sensor box impaired.

Sensor unit relies on good airflow for correct operation, unit must be correctly attached to front wall just below the refrigeration evaporator.

INACCURATE READINGS ON ANY PARAMETER

- Not correctly calibrated
- Out of range (% RH most accurate 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 higher 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.

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. **NB:** When the HOT valve is OPEN the COLD valve is CLOSED and vice versa.

The Hot Gas solenoid operates on a 16 second cycle, IE 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 at the RH end of 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 opened 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.

SECTION 11 PARTS LISTS

<u>DESC</u> <u>REF</u>	<u>CONTERM</u>
Micro Parts PLCS5INT PLCS5DSP	CPU - PLANT650
PLCSLITE PCBs V1.0	PLCSLITE PCB
PLCSLITE 'OPTO 22' 240A10 x 24	240A10
Fan Motors: (Internal) x3	ZIEHL EBM
Fan Motors: (Light Loft) x2	ZIEHL EBM
Elements: 3x 1500W Finned	P013
Door Hinges - Special Aluminium	HINGE 650
Water Filter - Activated Charcoal Type: KDC-10	
Spray Nozzels (x4) - SF2TIP	SPRAY HUM 8
Loft Air switch (HONEYWELL C6065A1028)	
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)	FUSE 2AMP
RCCD Circuit Breaker 4P 25A (30mA) BPA 425/030 606163	RCD DIFFJMP
Circuit Breakers (3x) 25A MCB HAGER	
Contactora (main) 45A CA-3-43-N-11	CONTACTOR 9
Contactora (Lighting) 45A CA-3-43-N-11	CONTACTOR 9

DESC
REF

CONTHERM

Refrigeration Contactor	AB 100-12* 10 25A	
Refrigeration Contactor O/L	AB 193-EA4EB	1.6A – 5.0A
Lamps x24 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 Blue neon	- PDL 510MN	NEON 3
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 cabinet more than 2°C above/Below the set point.	Alarm will stop when fault is removed.
02 Low CO ₂ in Cabinet - Not enough CO ₂ to maintain CO ₂ set point.	Check bottle, hoses, for blockage or faulty solenoid.
03 Cabinet now running on <u>Preset Values</u> . (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 RHS door to top up.
07 CO ₂ Sensor. Damaged or broken, or out of calibration range (20-170%) raw CO ₂ .	Call Service Engineer. Check thermistor sensors and wiring to sensor box.

- | | | |
|-----------|--|--|
| 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 earthing. Look for outside interference.
CHECK CAL FACTORS. | As above but serious, |
| 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. |