Scientific Ltd

GP SERVICE MANUAL

(ZP21)

INCUBATORS, OVENS, COOLED TROPICOOL & CSL CABINET

CONTHERM SCIENTIFIC LIMITED
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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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SCIENTIFIC LIMITED

STATEMENT of CONFORMITY

These **CONTHERM** cabinet conform to the following standards:

- **Electrical Safety:** Complies with AS/NZS3350:1:1994
- **EMC:** Complies with EN 61326-1:1997

CONTENTS

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 3cm from any wall (including roof).

b) CABINET 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 cabinet 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

This Service manual covers GP cabinets from 50 litres to 400 litres in capacity and ONLY fully applies to cabinets fitted with the ZP21 Control system (from Jan 2004), however many of the generic troubleshooting procedures will be applicable to earlier cabinets. The ZP21 controller may be identified by its GREEN 7 segment L.E.D display.

All Contherm specifications are quoted for an ambient temperature of 20°C.

- **Construction -** High quality stainless steel interior, full fibreglass insulation, with non-jar magnetic door catch (incubators) and corrosive resistant epoxy powder coated exterior.

- **Safety -** Fitted with an independent user adjustable Hi-Limit completely separate from normal controls.

- **Convection -** All units come with mechanical convection fan systems.

- **Electrical -** All quoted at 20°C - ZP21 Micro-Controller mechanical Convection.
  - Complies with AS/NZS3350:1:1994 220-250V AC M.E.N
- **EMC** - Complies with EN 61326-1:1997

PERFORMANCE: (Typical)

a) **Temperature:**

Nominal Ranges:	Incubators	AMB+5°C – 100.0°C
	Ovens	AMB+5°C – 300.0°C
	Cooled Incubators	0°C – 50.0°C
	Tropicool Incubators	AMB-5°C – 50.0°C
	CSL Incubators	+20°C – 40.0°C
	6000CP Series (Lights OFF)	+5°C - 50.0°C
	(Lights ON)	+10°C – 50.0°C
Temporal Variation (Varies with cabinet)		± 0.2°C to ± 0.5°C
Spatial Variation (Varies with cabinet)		± 0.5°C to ± 1.5°C
Initial Overshoot		+2.0°C
Reproducibility		±0.4°C
Dial resolution		0.1°C
Operating Ambient		10°C - 35°C
Mains Voltage Range		220-250 AC 50Hz

b) Timer:

Timing range	1 minute - 99 hours 59 minutes
Timing Resolution	1 minute

NB: Timer does not start timing down **UNTIL** within 2.5°C of the temperature **SET POINT**.

SECTION 3 OPERATING INSTRUCTIONS

These appliances are NOT intended for use by young children or infirm persons without supervision.

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

1) Install shelf runners: Fit lug into selected slot at rear of cabinet sidewall and clip down into front slot to lock into place. Check heights of runners are parallel.
2) Fit Shelves. Maximum shelf loading is 30Kg/shelf, maximum total for cabinet is 100Kg.
3) Select a location handy to a 10amp electrical outlet.

4) Bench Units - Place on solid top with clearance underneath to allow ventilation around entire cabinet.
5) Ensure a space of at least 150mm is allowed at the rear of the cabinet for air circulation.

NB: Ensure **ALL** of the distinctly coloured cable ties (If fitted inside cabinet) are **REMOVED BEFORE** operating the incubator.

NB: These cabinets are **NOT** suitable for operating with high humidity conditions present inside. Humidity levels should be such that water does not condense on the walls, floor or inside the outer door.

OPERATING CONTROLLER:

1) Plug cabinet into 220-250V Mains outlet.

2) Turn on main switch - The LED should show all 8888s then display the current temperature in the cabinet. Do NOT press any buttons until after the 8888's have gone from the display.

3) Press and HOLD the temperature button (top) UNTIL the 'SET' LED comes ON then RELEASE. The `SET' LED above the LED display should now be ON!

4) While the 'SET' LED is On use the 'UP' & DOWN' buttons to adjust the SET POINT to the desired temperature.

5) WAIT for the display to return to normal; the 'SET' LED will then go off.

The centre button may be used for several purposes depending on the cabinet type. For an oven it is used to set the 'RAMP' rate, for a 'COOLED' & '6000CP' incubators it is used to select the program step to run ('P1 or P2'), and for 'CSL' incubators it is used to Set & Display the %RH. Use in a similar way to the Temperature setting button.

NB:LIGHTING (6000CP Series) WILL COME ON WHEN PROGRAM No2 IS SELECTED!

6) The TIMER must now be set to run the cabinet - use the SAME method as for the temperature EXCEPT press the 'TIME' button instead. To obtain the special '**[.]**' symbol for continuous operation, first adjust the timer down until '0.00' is reached, then press the down button once more to get '99:59' then the 'up' button to go 1 step above '99:59' the special '**[.]**' symbol should now be shown.

NB: the symbol ` **[.]** ' means run **CONTINUOUSLY**.
Setting the TIMER to **0.00** turns the cabinet **OFF**.
If the cabinet has **TURNED OFF** after the completion of a TIMED operating period it is only necessary to PRESS and HOLD the TIMER button until the 'SET' led comes on to **REPEAT** the TIMED run.

7) The cabinet will now attempt to obtain the SET POINT and control until the TIMER runs out of time. The cabinet **WILL NOT OPERATE** if the **TIMER** has been set to **0.00**.

8) To look at the current TIME press the 'TIME' button for 2 seconds - the amount of time left will now be displayed continuously.
To display the TEMPERATURE continuously - press the 'TEMP' button for 2 seconds.

9) To CANCEL any Alarm (ie. 1- - -) PRESS and HOLD the 'TEMP' button until the 'SET' LED comes ON.

Ensure the mechanical user HI-LIMIT is set correctly as described in the following section. The cabinet usually leaves the factory with the user HI-LIMIT set fully anticlockwise, if left in this position the HI-LIMIT will not allow the cabinet to heat and control correctly.

FAN MOTOR

The fan motor on a standard Incubator may 'PULSE' when the ambient temperature is very close to the set point temperature, this is due to the 'Thermoguard' mode of operation as the controller attempts to lower the heating effect of the fan – a mechanical 'pulse' sound may also be heard.

NB: Standard Incubators (1000 series) are NOT suitable for operating with high humidity conditions present inside the cabinet. Humidity levels should be such that water does not form on the walls, floor or inside the outer door.

MECHANICAL HI-LIMIT MONITOR
The mechanical hi-limit is provided as a secondary safety device to protect the cabinet from over temperature in the event of electronic controller failure.

To set the Mechanical Hi-Limit
Turn the Hi-Limit control FULLY CLOCKWISE.
Allow the cabinet to stabilise at the required operating temperature (for at least 1 hour), then turn the Hi-Limit control anti-clockwise until the **MONITOR** neon comes on (or a slight 'click' is felt). Now turn the Hi-Limit control **SLOWLY CLOCKWISE** until the **MONITOR** neon goes off (or a slight 'click' is felt), then advance the Hi-limit clockwise 1-2 scale markings. This will set the Hi-Limit trip point about 3 - 4^{o}C above the current cabinet temperature.

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 the three-pin plug supplied must be inserted ONLY into a standard three-pin power outlet that is effectively earthed through the normal building wiring.

Extension cords are NOT recommended.

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

This appliance should be periodically tested according to the procedures prescribed in **AS/NZS 3760**.
The basic safety checks and tests on electrical appliances required by **AS/NZS 3760** are:

1. A visual check to ensure that there is no mechanical damage to the supply cord, that controls etc. are in good working order and that no parts are missing.
2. An earth continuity test.
3. An insulation resistance test.

In order to provide evidence of compliance, a label (signed and dated by the person testing the equipment) may be placed on the tested appliance.

ALARMS
All alarms are indicated by a number and three dashes on the LED display and are accompanied by an audible alarm.
To **CANCEL** any Alarm (ie 1---) PRESS and HOLD the `TEMP' button until the 'SET' LED comes ON.

ALARM MEANING

1--- This means the cabinet is OVER or UNDER temperature. If UNDER temperature it could be due to the door being opened, otherwise check the cabinet to determine if the Internal fan is still operating and that the MECHANICAL Hi-Limit control is not interfering with normal operation.

3--- Preset alarm - The cabinet has lost its control settings due to an internal memory failure. Reset all control settings as desired and check the calibration setting.

4--- This means that the TEMPERATURE sensing probe has failed (1000Ω RTD). The connections to the probe and the probe condition should be investigated.

5--- The HUMIDITY sensing probe has failed, - this alarm will also display if the relative humidity falls below 15% RH. The probe should be checked and if necessary replaced. At higher temperatures this alarm may occur if the doors are left OPEN. (CSL Incubators ONLY).

6--- The relative humidity has fallen below 50%RH for 60 minutes. Ensure timer is correctly set and that there is sufficient water in the water tray inside the cabinet at bottom. (CSL Incubators ONLY).

9--- This is a WATCHDOG alarm - The Electronic PCB has failed - Replace the controller.

CALIBRATION

Calibration should be carried out at 20.0^{o}C (Cooled Inc), 37^{o}C (Incubators) or 150^{o}C (Ovens) or at the temperature of interest, with the thermometer in the center of the working chamber with the chamber empty and any lighting OFF. **NB:** A cooled incubator will typically cool to a minimum temperature of 15^{o}C below the current ambient temperature (Lighting OFF if fitted), the calibration temperature must be within the achievable operating range of the cooled incubator.

1) Place the Calibration Thermometer probe in the workspace centre, close the door and set the controller for 37.0^{o}C or the temperature of interest, allow at least 1 hour to stabilise.

2) Read the temperature on the Calibration Thermometer.

3) To calibrate the cabinet -

   a) Press and HOLD the `TEMP' button until the 'SET' LED comes ON and then release. The 'SET' led should now be ON.

   b) WHILE the 'SET' led is ON: Press BOTH `UP' & `DOWN' buttons **TOGETHER** - a beep will be heard and the word ` CAL' will appear briefly on the LED display. Adjust the reading on the LED display using the `UP' & `DOWN' buttons until it agrees with the Calibration Thermometer.

      NB: If when attempting to press BOTH buttons together, the temperature SET POINT adjusts either up or down - it means you are NOT pressing BOTH buttons at the SAME TIME! - if the 'SET' led is still on you should attempt 3(b) again, if the 'SET' led is OFF you should repeat from 3 (a).

   c) WAIT for a further beep to occur, the LED display will briefly show `----' and then the **CALIBRATION CONSTANT**, this will be a number in the range 0.0 to 19.9. This figure SHOULD BE NOTED as it may be used to return to this calibration setting. The LED will then briefly show another '---' the controller will then resume its role of normal operation.

      NB: If a '[[[[' sign appears on the display the cabinet is OUTSIDE its calibration display range and calibration should be performed at a slightly higher temperature.

4) Allow to stabilise again - the temperature should now be correct. If NOT repeat the procedure.

   NB: The calibration can only be performed within limits, if the calibration cannot be achieved a further fault exists.

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 at the specified ambient of +20^{o}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.

Check Spatial Variation @ 37^{o}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)

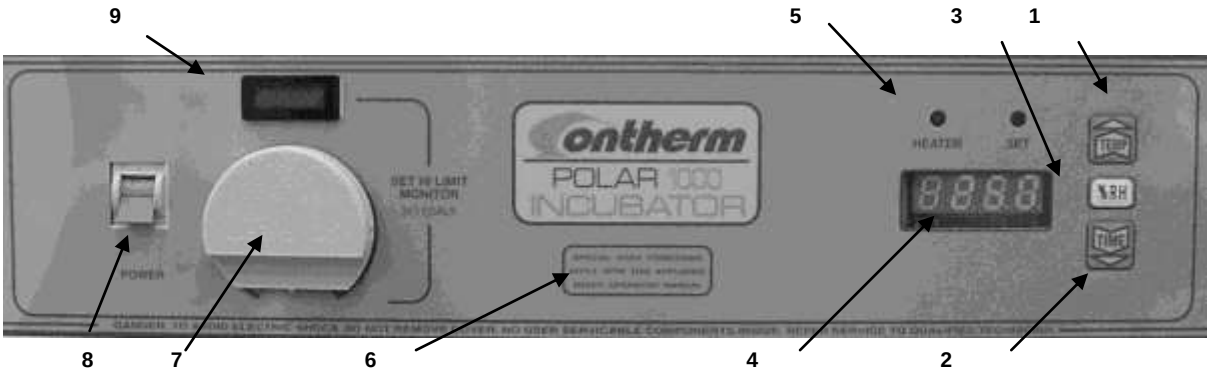
Spatial performance is tested by placing suitable (calibrated) test probes (usually thermocouples) in the eight specified positions and recording the readings for up to 1 hour AFTER the cabinet has FULLY STABILISED.
The cabinet has fully stabilised when the average temperature is no longer increasing or decreasing over time.

The sensors must be no closer than 30mm to any wall or roof and must be above the lowest shelf position by at least 30mm.

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.

CONTROL LAYOUT



1 Temperature adjustment button.
(Also used to adjust set points)

2 Time adjustment button.
(Also used to adjust set points)

3 %RH Selection Button (Program on 6000 Series, Ramp on Ovens)

4 LED Display - Gives readout of temperature in degrees centigrade OR elapsed time in hours and minutes.

5 LED Indicators - Left LED indicates when the heating element is ON. Right LED indicates when controller is in SET mode.

6 Refer "Caution" Instructions.

7 Mechanical Hi-limit set Adjustment Knob (No Scale).

8 Mains Switch and Circuit Breaker (6A-10A) combined.

9 Hi-Limit Monitor Neon- will come on if power is being applied to heater element while mechanical Hi-Limit is tripped.

SECTION 4 THEORY OF OPERATION

These CONTHERM General Purpose Cabinets uses a single chip microprocessor electronic PID controller with a 1000Ω Resistance RTD probe as the temperature sensing element. The LED display gives a direct readout of SET POINT or Cabinet temperature in degrees centigrade.

The operation of the ZP21 controller is based on the change of resistance with temperature.

The RTD probe is fed from a 1.05mA constant current source and the output is amplified to provide a final output of 10mV/^{o}C. This output is sent to a hi-resolution A/D converter.

The outputs of the Microprocessor are used to switch zero crossing triac drivers (containing an led and a small triac internally), which in turn drive the heater triac and other devices. The zero-crossing driver ensures that radiated interference is kept to a minimum. An internal WATCHDOG monitors program execution and RESETs the microprocessor in the event of program failure.

Incoming AC mains power is conditioned by a varistor and inductor filter to prevent mains `spikes' from causing damage, then goes through a double wound transformer to reduce the AC to 10 volts and provide isolation.

The +5 Volt supply is stabilised by a standard 3 terminal regulator.

The type of cabinet (OVEN,INCUBATOR,MC or ,MCP) is selected by special button sequences during the power on period and retained by the eerom IC.

COOLING is provided by either a standard refrigeration compressor or a peltier cooling device. The cooling compressor runs continuously. An automatic defrost is provided at temperatures below 20^{o}C. Peltier devices (Tropicool models) run continuously.

On CSL models the Humidity is measured by a capacitive sensor and controlled by adjusting the DEW POINT on the refrigeration system evaporator.

Calibration of the temperature is performed via the adjustment buttons and is retained in a eerom IC, settings will typically be retained for up to 100 years even in the absence of power.

SECTION 5 CUSTOMER MAINTENANCE

REFRIGERATION MAINTENANCE

The following information relates to COOLED incubators.
If the unit is going to be stored for some period after the refrigeration has been used for some length, a drying out period is necessary to remove moisture from the element well. This could be done by setting a temperature of approximately +35^{o}C and have the unit operating with the door slightly ajar to allow for the drying out of the moisture in the interior.
Once the unit is suitably dried it can be closed up and stored without further problems.

REFRIGERATION DATA: (6000CP Series)

MODEL	6150CP	6200CP	6300CP	6400CP
COMPRESSOR:				
Matsushita	SB43	SD51	SD51	SD51
Electrolux	GL45AA	GL60AA	GL60AA	GL60AA
CONDENSER:	S12/21	S12/21	S16/21	S20/21
COOLING COIL:	G6/18HG	G6/22HG	G8/22HG	G10/22HG
DEFROST VALVE:	IF FITTED:	COMMON TO ALL	.....	SPORLAN E3S120
CRANKCASE VALVE: KVL12/SPORLAN CRO	IF FITTED:	COMMON TO ALL	.....	DANFOSS
REFRIGERANT:		COMMON TO ALL	.....	R134a
REFRIGERANT CONTROL:				
Capillary Type	5/044	5/044	5/044	6/044
DRYER:		COMMON TO ALL	.....	Sweat Type 245/XH9
COMP COOLING FAN:		COMMON TO ALL	.....	SUNON 2123 HTB

The refrigeration System is designed to maintain the internal cabinet temperature of +5^{o}C - +50^{o}C with ambients of up to +20^{o}C, if the ambient temperature rises the lowest achievable temperature will rise also, the cabinet will typically achieve a temperature of about 15^{o}C below ambient (LIGHTS OFF). The lowest achievable temperature with lights ON will deteriorate even further due to the door cooling fan circulating air at the higher ambient.

REFRIGERATION DATA: (Cooled Incubators)

MODEL	1050CP	1100CP	1150CP	1200CP	1300CP	1400CP
COMPRESSOR: Electrolux	GL45AA	GL45AA	GL45AA	GL60AA	GL60AA	GL60AA
CONDENSER:	S8/19	S10/19	S12/21	S12/21	S16/21	S20/21
COOLING COIL:	G4/12HG	G6/15HG	G6/18HG	G6/22HG	G8/22HG	10/22HG
DEFROST VALVE:	IF FITTED: COMMON TO ALL			SPORLAN E3S120/ALCO RB252		
EVAP VALVE:	IF FITTED: COMMON TO ALL			DANFOSS KVP12		
CRANKCASE VALVE:	IF FITTED: COMMON TO ALL			DANFOSS KVL12/SPORLAN CRO		
REFRIGERANT:	COMMON TO ALL R134a					
REFRIGERANT CONTROL: Capillary Type	5/044	5/044	5/044	5/044	5/044	6/044
DRYER:	COMMON TO ALL. Sweat Type 245/XH9					
COMP COOLING FAN:	COMMON TO ALL SUNON 2123HTB					

Typical Components of the system are shown on the schematic diagram.

The condensate water from the cooling coil is evaporated by the compressor Heat Dissipation Tray mounted on the top of the compressor dome, (Except CSL models where the water is returned to the water tray inside the cabinet). If moisture collects inside the cabinet check that the collection tray trough outlet located inside the cabinet is not blocked.

The refrigeration system condenser located on the External rear of the cabinet is cooled by natural convection, therefore, it is important to ensure no obstructions are placed to prevent normal ventilation around the cabinet. The condenser will slowly collect a layer of dust, therefore it is recommended that once a year it is brushed clean with a small broom. Additional Compressor cooling is provided by the Compressor cooling fan which draws air over the compressor and blows it towards the condenser.

REFRIGERATION DATA: (CSL Incubators)

1200CSL

COMPRESSOR:	L'Unite AZ1335Y
CONDENSER:	S12/21
COOLING COIL:	G6/22/HG
HOT-GAS VALVE:	Sporlan XWG
REFRIGERANT:	R134a
REFRIG CONTROL:	Capillary Type 5/044
DRYER:	Sweat Type 245/XH9
EVAP VALVE:	Danfoss KVP12

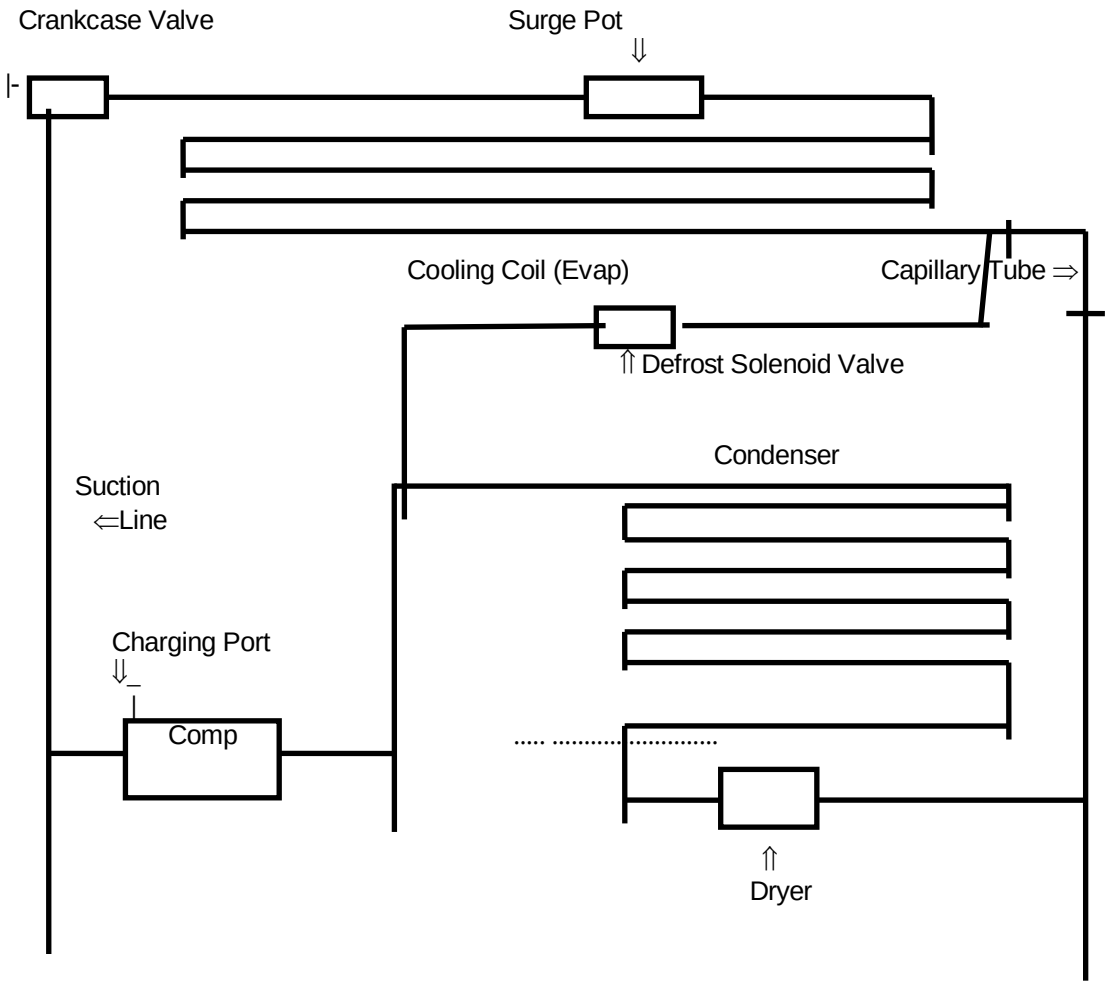
1300CSL		**1400CSL**
COMPRESSOR:	L'Unite AZ1339Y	L'Unite AZ1339Y
CONDENSER:	S16/21	S20/21
COOLING COIL:	G8/22/HG	G10/22/HG
HOT-GAS VALVE:	Sporlan XWG	Sporlan XWG
REFRIGERANT:	R134a	R134a
REFRIG CONTROL:	Capillary Type 5/044	Capillary Type 6/044
DRYER:	Sweat Type 245/XH9	Sweat Type 245/XH9
EVAP VALVE:	Danfoss KVP12	Danfoss KVP12

The Refrigeration System is designed to maintain the internal Cabinet Temperature of 20^{o}C - 40^{o}C with ambients up to 20^{o}C.

NB: In a CSL type incubator the temperature of the evaporator is controlled by pulsing the HOT-GAS solenoid valve so that the desired relative humidity may be achieved.

No attempt will be made to control the humidity if the correct temperature cannot be controlled.

REFRIGERATION SCHEMATIC DIAGRAM (Typical)



COMPONENT LOCATION

Inside Cabinet Behind False Back: Cooling Coil, Surge Pot

Outside cabinet on rear wall : Compressor, Condenser, Dryer, Defrost Solenoid Valve, Crankcase Valve, Compressor cooling fan.

MAINTENANCE

The epoxy powder coated mild steel exterior is resistant to corrosion and spillage's and should be wiped with a damp cloth occasionally to maintain its appearance.

The inside of the outer door is powder coated mild steel and is susceptible to moisture. If left wet for long periods rust spots may occur.

The fan motor bearings do not require lubrication under normal conditions.

The stainless steel interior and shelves should be kept clean with a damp cloth. Take care that the temperature probe is not damaged during cleaning of the interior base.
Any spillage or breakage within the cabinet should be cleaned up immediately with the cabinet switched off and unplugged at the mains.

NB: These cabinets are **NOT** suitable for operating with high humidity conditions present inside. Humidity levels should be such that water does not condense on the walls, floor or inside the outer door.

ROUTINE MAINTENANCE

Suggested to be checked Annually:

- Check glass door gaskets for damage (cuts and splits), replace if necessary.
- Check glass door(s) seal correctly onto gaskets, if split glass doors check door alignment on center seal, adjust door hinge if required.
- Wipe out floor of cabinet to remove any water stains.
- Check controller overlay for damage, replace if necessary.
- Check basic cabinet control functions and that user hi-limit control is set appropriately.

ELECTRICAL SAFETY

This appliance should be tested for insulation and earthing continuity at regular intervals according to **AS/NZS 3760**.
The basic safety checks and tests on electrical appliances required by **AS/NZS 3760** are:

1. A visual check to ensure that there is no mechanical damage to the supply cord, that controls etc. are in good working order and that no parts are missing.
2. An earth continuity test.
3. An insulation resistance test.

In order to provide evidence of compliance, a label (signed and dated by the person testing the equipment) may be placed on the tested appliance.

TROUBLESHOOTING:

A) **CABINET COMPLETELY DEAD:**
- Check wall socket and wall socket circuit breakers.

B) **LARGE TEMPERATURE VARIATION IN CABINET, CONTROLLER `HEATER' LED PULSING :**
- Internal fan not operating (Check for air movement inside cabinet).
- Cabinet OVERLOADED with samples, remove some samples to allow for better air movement.
- Look for HI-LIMIT Monitor neon coming on, if so indicates mechanical Hi-Limit is set too low.

C) **CABINET NOT CONTROLLING AT TEMPERATURE, 'HEATER' LED NOT FLASHING :**
- Check that the timer has been correctly set, if the timer is set to '0:00' the cabinet will NOT operate.

The ZP21 PCB is equipped with a green "HEARTBEAT" LED adjacent to the large buzzer. When the cabinet is operating this LED should be PULSING about once per second. There are also TWO small glass fuses to protect the PCB. **REMOVE ALL** power from the unit (By removing the mains plug) **BEFORE** attempting to check these fuses.

REMOVAL AND REPLACEMENT OF ZP21 CONTROLLER PCB

The following should only be carried out by suitably qualified electrical personnel.

NB: ENSURE that power cord has been **REMOVED** from the wall socket **BEFORE** attempting to remove the PCB.

a) Loosen the two black plastic fasteners holding the cabinet lid down by turning anticlockwise so that the pop up. Lift the lid up at the front and remove from cabinet.

b) Remove the two self tapping screws at either end of the control panel and rotate the panel up so that it rests on the cabinet top.

c) **ENSURE POWER CORD is REMOVED** from wall socket then Unplug socket from Controller PC Board. NOTE connections from side 10way socket to sensor probe etc so that they can be correctly reinstalled, then disconnect probe etc from socket.

d) Using suitable socket undo four 4mm securing nuts. Carefully NOTE position and size of SPACERS

e) Remove PC Board.
List FULLY all fault details, carefully pack, return to Agent for repair. ALWAYS supply contact details and FULL physical return address.
The refitting of the controller should be done in the reverse order as above, taking care when reconnecting the sensor etc that they are connected to the correct socket holes.

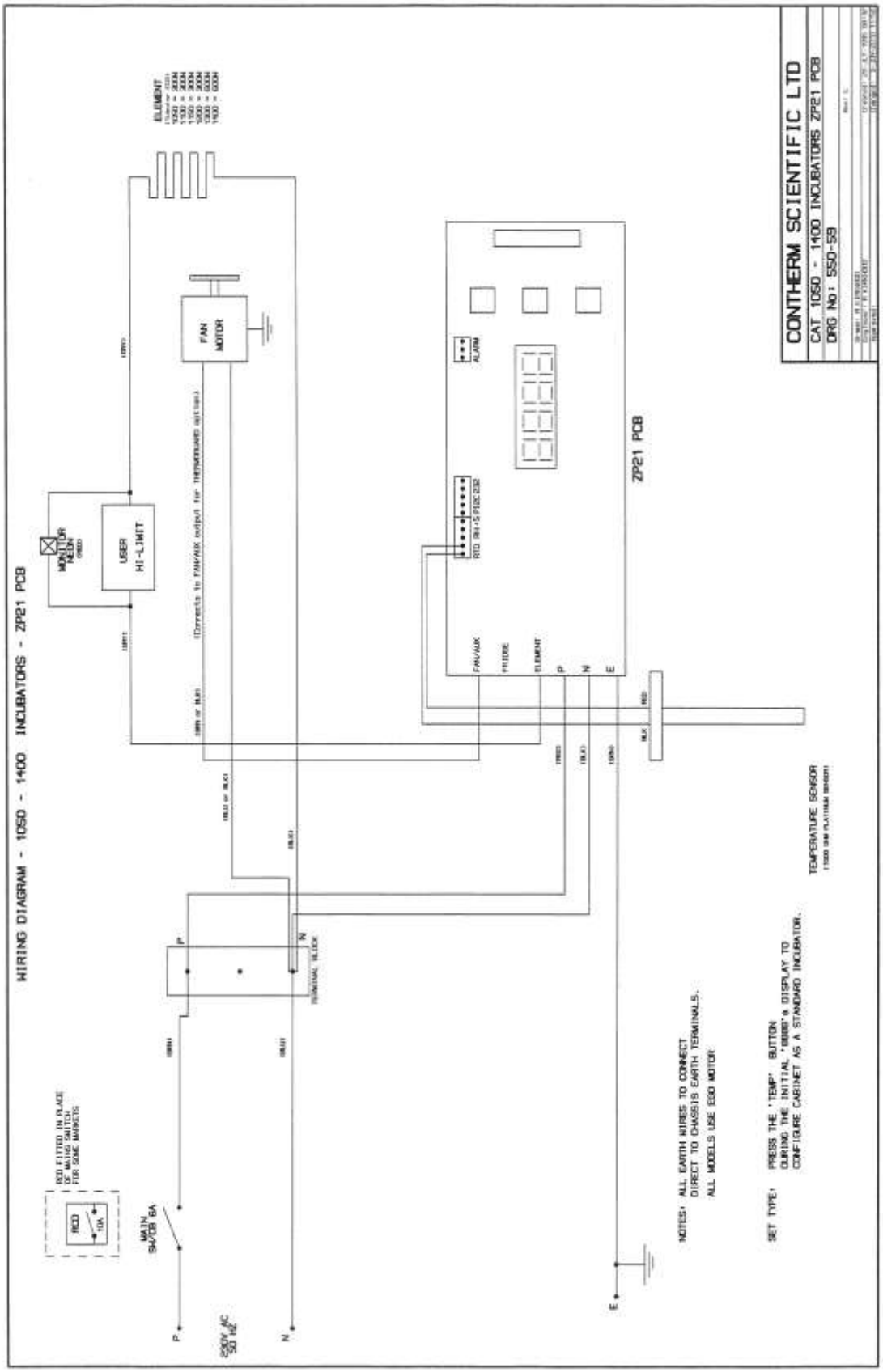
f) Carry out Insulation (use 500V insulation tester) and earth continuity check BEFORE applying power to cabinet. (as per **AS/NZS 3760** – In-service safety inspection and testing of electrical equipment).
The basic safety checks and tests on electrical appliances required by **AS/NZS 3760** are:

1. A visual check to ensure that there is no mechanical damage to the supply cord, that controls etc. are in good working order and that no parts are missing.
2. An earth continuity test.
3. An insulation resistance test.

In order to provide evidence of compliance, a label (signed and dated by the person testing the equipment) may be placed on the tested appliance.

N.B: Check for loose wires that may have been missed, particularly the earth wires.

ELECTRICAL GP LAYOUT ZP21 1050 – 1400 Drawing 550-59



SECTION 6 PARTS LISTS AND SPARES

Shelves	Cat 1050		GP1056
	Cat 1100		GP1057
	Cat 1150		GP1058
	Cat 1200/1300/1400		GP1061
Shelf Support Brackets (State Model when ordering)			GP1064
Hinges:Glass Door			GP1006
Glass door Catch			
Fan Motor	E.G.O		GP1000
Elements	Cat 1050/1100	300W	ELEMEGO300
	Cat 1150/1200	300W	ELEMEGO300
	Cat 1300/1400	600W	ELEMEGO600
Temperature Sensor: 1000Ω RTD			GP1307
Hi-Limit Thermostat: Incubator			GP1021
Hi-Limit Monitor Neon			GP1033
Control Knob			GP1324
Control Circuit Board: ZP21			GP1306
Mains Switch / Circuit breaker (6A)			
Monitor Neon			GP1073
Control Panel Overlay			

SPARE PARTS LIST: 6150 – 6400 CP Cooled Incubators

Shelves	Cat 6150CP	GP1310
	Cat 6200/6300/6400CP	GP1311
Shelf Support Brackets (MUST be in pairs) (State Model when ordering)		GP1305
Hinges:Glass Door		GP1006
Complete Glass Door Catch		GP1008
Fan Motor	E.G.O	GP1000
Elements	All Models: 600W	ELEMEGO600
Temperature Sensor: 1000Ω RTD		GP1307
Hi-Limit Thermostat: Incubator		GP1021
Control Knob		GP1324
Control Circuit Board: ZP21		GP1306

ZP21 Auxiliary fuse 1Amp 20x5mm Antisurge (Farnell 533-713)

ZP21 Power fuse 100mA 20x5mm slow-blow (100ma-SB-GDL)

Mains Switch / Circuit breaker (6A)

Monitor Neon GP1073

Muffin Fan (Door Cooling type A12T30HTB)

Adjustable Foot GP1063

SPARE PARTS LIST: 1050 - 1400 Incubators

Shelves	Cat 1050		GP1056
	Cat 1100		GP1057
	Cat 1150		GP1058
	Cat 1200/1300/1400		GP1061
Shelf Support Brackets (State Model when ordering)			GP1064
Hinges:Glass Door			GP1006
Complete Glass Door Catch			GP1008
Fan Motor	(E.G.O)		GP1000
Elements	Cat 1050/1100	250W	ELEMEGO250
	Cat 1150/1200/1300/1400	400W	ELEMEGO400
Temperature Sensor: 1000Ω RTD			GP1307
Hi-Limit Thermostat: Incubator			GP1021
Control Knob			GP1324
Control Circuit Board: ZP21			GP1306

ZP21 Auxiliary fuse 1Amp 20x5mm Antisurge (Farnell 533-713)

ZP21 Power fuse 100mA 20x5mm slow-blow (100ma-SB-GDL)

Mains Switch / Circuit breaker (6A)

Monitor Neon	GP1073
Adjustable Foot	GP1063

SPARE PARTS LIST: 2050-2400 Ovens

Shelves	Cat 2050		GP2051
	Cat 2100		GP2052
	Cat 2150		GP2053
	Cat 2200/2300/2400		GP2054
Shelf Support Brackets (State Model when ordering)			GP2064
Fan Motor	(E.G.O)		GP1000
Elements	Cat 2050	800W	ELEMEGO800
	Cat 2100	1000W	ELEMEGO1000
	Cat 2150	1250W	ELEMEGO1250
	Cat 2200	1250W	ELEMEGO1250
	Cat 2300	1500W	ELEMEGO1500
	Cat 2400	1750W	ELEMEGO1750
Special Element		2000W	ELEMEGO2000
Temperature Sensor: 1000Ω RTD			GP2307
Hi-Limit Thermostat: Oven			GP2022
Mains Switch / Circuit breaker (10A)			
Control Knob			GP2324
Control Circuit Board: ZP21			GP2306
ZP21 Auxiliary fuse 1Amp 20x5mm Antisurge (Farnell 533-713)			
ZP21 Power fuse 100mA 20x5mm slow-blow (100ma-SB-GDL)			
Solid State Relay 'OPTO 22' 240A10 AC Control (CAT 2300, 2400 ONLY)			GP1188
Monitor Neon			GP2073
Seal			GP1190
Adjustable Foot			GP1063

SPARE PARTS LIST: 1050-1400 CSL Incubators

Shelves	Cat 1200-1400CSL	GP1056/1061
Shelf Support Brackets (State Model when ordering)		GP1064/1400
Hinges:Glass Door		GP1006
Complete Glass Door Catch		GP1008
Fan Motor	(E.G.O)	GP1000
Elements	250W	ELEMEGO250
	400W	ELEMEGO400
Temperature Sensor: 1000Ω RTD		GP1307
Hi-Limit Thermostat: Incubator		GP1021
Complete Control Panel: COOLED Incubators		GP1035
Control Knob		GP1324
Control Circuit Board: ZP21		GP1306

ZP21 Auxiliary fuse 1Amp 20x5mm Antisurge (Farnell 533-713)

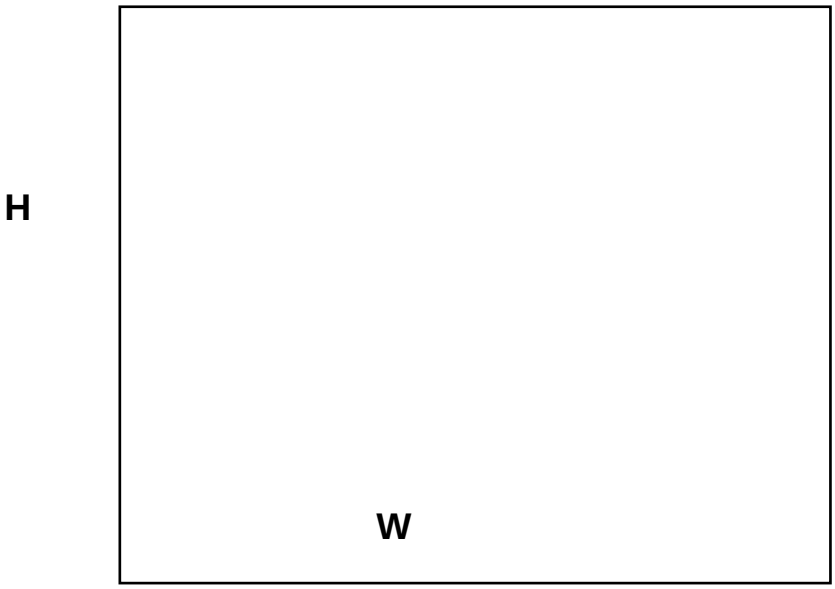
ZP21 Power fuse 100mA 20x5mm slow-blow (100ma-SB-GDL)

Mains Switch / Circuit breaker (10A)

Monitor Neon	GP1073
Hycal 3602-C Humidity Sensor	GP1068
Adjustable Foot	GP1063

GLASS DOOR SIZES

(If purchasing independently)



5.0mm Toughened Clear Floated - All edges arased.

Cat.1050	374mm H x 432mm W	
Cat.1100	495mm H x 507mm W	
Cat.1150	571mm H x 587mm W	
Cat.1200	636mm H x 700mm W	
Cat.1300	462mm H x 700mm W	2off
Cat.1400	614mm H x 700mm W	2off

NOTE: If replacement doors are required hole placement and dimensions vary on each size

When ordering a replacement glass door it is best to measure the original door including any hole sizes and placement to ensure the new door will fit correctly.

SECTION 7 SERVICING STANDARD INCUBATORS

All testing performed in this section MUST ONLY be carried out by suitably qualified electrical personnel.

Contherm standard GP incubators come in a range of sizes from 50L to 400L, these BIOCELL incubators have the Cat Nos: 1050, 1100, 1150, 1200, 1300 & 1400. Whenever you have to contact Contherm regarding one of these cabinets ALWAYS ensure that you have the Appliance No (Serial No) so that the exact cabinet can be identified.

For the cabinet to operate correctly, the user must have set a TEMPERATURE to operate at, a TIME to run for (usually '[:]') and must ensure the mechanical hi-limit has been adjusted to allow the cabinet to achieve the desired conditions.

The GP incubator is fitted with a toughened glass door and is designed to operate over a temperature range of about 5°C above ambient to +100°C. These incubators are optimized to operate at 37°C and it must be remembered that if operating at higher temperatures that the Spatial Variation (the range of temperatures measured throughout the cabinet) will grow larger as the differential between the cabinet temperature and ambient increases.

COMMON PROBLEMS:

- No Controller DISPLAY: *Usually caused by the Cabinet being SWITCHED OFF either at the cabinet main switch or at the wall socket. Could also be caused by the FUSE on the cabinet or ZP21 PCB having blown.*

The main switch on the cabinet has an illuminated neon (although this may be quite dim if the cabinet is 4-5 years old). If the main switch neon is ON then there is power from the wall socket and the main switch is on.
Turn the power OFF at the wall socket and check the cabinet fuse (Use a screwdriver flat blade to slightly rotate the fuse carrier to the left – it should 'pop' out). If the fuse has blown replace it with a standard 10Amp fast blow fuse. If the fuse blows a second time investigate the fault. The ZP21 PCB also has a small (100Ma) mains input fuse that could have failed. Unplug the cabinet from the wall socket before attempting to check this fuse.
If there is no power to the wall socket because an RCD (residual current device) protecting the circuit has tripped, it is most likely to be caused by the heating element in the cabinet absorbing moisture (usually only occurs when the cabinet has not been used for some time). The cabinet should be unplugged from the wall socket and the element only checked for insulation resistance with a 500V insulation tester. The result must be at least 1MΩ. (Elements are at least 9.9MΩ when they leave the factory). When testing the whole cabinet for insulation resistance ALWAYS test between the Phase & Neutral pins on the plug joined together and the EARTH pin. (This is to avoid 500V DC being applied to the cabinet electronic circuitry).

Cabinet does not HEAT or Temperature is too LOW: *Usually caused by the TIMER not being set for a run time, OR by the user mechanical hi-limit being set too low so as to prevent power from reaching the heating element.*
Look at the 'HEATER' L.E.D on the front of the controller to the top left of the display, if this 'HEATER' led is NOT on then the controller is NOT attempting to increase the temperature in the cabinet and the most likely cause is the TIMER being set to '0:00'.
If the 'HEATER' led is ON then observe the 'MONITOR' neon adjacent to the mechanical hi-limit knob, if the 'MONITOR' neon is ON the mechanical hi-limit is set too low and is preventing power from reaching the heating element. Turn the knob clockwise fully to allow the cabinet to attain the desired temperature and refer to the operating manual for instructions on how to correctly set the user hi-limit.

- Cabinet temperature is TOO HIGH: ***Usually caused by the addition of a 'LIVE' load in the cabinet OR because the desired temperature cannot be achieved due to the ambient conditions.***

Look at the 'HEATER' L.E.D on the front of the controller to the top left of the display, if the current temperature is above the set point then this led should be OFF (or initially pulsing) showing that the controller is not attempting to apply power to the heating element.
If the 'HEATER' led is OFF and the monitor hi-limit neon is ON brightly there could be a failure of the ZP21 control system.
When the cabinet is operating close to ambient conditions (I.E Set Point is 35^{o}C and ambient is 34^{o}C) a 'pulsing' sound may be heard coming from the motor inside the top of the cabinet. This is due to the 'THERMOGUARD' feature of Contherm's incubators which slows down the fan (reducing the self heating effect) as the ambient approaches the cabinet set point.
NB**: A standard incubator CANNOT lower the temperature BELOW the ambient temperature as it is NOT fitted with any cooling capability.**
Some users may contact you for service when an incubator has been working normally during colder weather (WINTER) and fails to hold the set point temperature when the ambient temperatures increase (SUMMER). The only solutions are to purchase an incubator with some cooling capacity (Tropicool or Cooled) or to move the cabinet to a cooler location (air-conditioned room).
Any device which uses power (a 'LIVE' load) placed inside the incubator may cause the cabinet to heat beyond its set point.

- Poor Temperature control or Performance: ***Usually due to internal circulating fan problems, sensing probe problems or impeded airflow inside the cabinet (overloaded by samples).***

When a cabinet performs poorly (large fluctuations at the control point) it is usually due to not having sufficient air circulating over the internal temperature sensing probe (1000Ω RTD). The cabinet fan should be running freely and circulating air down the false back and then vertically through the shelves past the temperature probe protruding about 20mm into the workspace back to the fan inlet.
Ensure the temperature probe is clearly visible and protruding about 20mm into the workspace. The small RTD sensor is held inside the stainless probe by a short piece of heatshrink tubing, if this becomes loose the sensor may not be fully down inside the stainless sheath. Check the positioning of the samples inside the cabinet, there must be sufficient space for the air to flow up through the samples and shelves back to the fan inlet. It is also worthwhile checking the glass door to ensure it is sealing correctly on its gasket.

- Cabinet incorrectly CONFIGURED: ***The cabinet type (Incubator, Oven etc) is initially configured in the factory by a special sequence of key presses. If a user inadvertently alters the cabinet type unexpected results may occur.***

Confirm that the cabinet is correctly configured as an incubator by carrying out the following operation and button sequence:
Turn the cabinet main switch OFF. Wait 30 seconds. HOLD down BOTH the 'UP' and 'DOWN' buttons together. While keeping the buttons held down turn the cabinet main switch back on and wait until the '8888's appear on the led display. Release the two buttons and then immediately press the 'UP' button only. If carried out correctly two 'beeps' will be heard. The cabinet should now be correctly configured as an incubator. Confirm the configuration by checking that the maximum allowed set point temperature is 100^{o}C. If not correct repeat the procedure.

SECTION 8 SERVICING STANDARD OVENS

All testing performed in this section MUST ONLY be carried out by suitably qualified electrical personnel.

Contherm standard GP Ovens come in a range of sizes from 50L to 400L, these THERMOTEC ovens have the Cat Nos: 2050, 2100, 2150, 2200, 2300 & 2400. Whenever you have to contact Contherm regarding one of these cabinets ALWAYS ensure that you have the Appliance No (Serial No) so that the exact cabinet can be identified.

For the cabinet to operate correctly, the user must have set a TEMPERATURE to operate at, a TIME to run for (usually '[.]') and must ensure the mechanical hi-limit has been adjusted to allow the cabinet to achieve the desired conditions.

The GP oven is designed to operate over a nominal temperature range of about 5^{o}C above ambient to +250^{o}C with short term operation up to a nominal +300^{o}C. If operating for any length of time above +250^{o}C a Heavy Duty (HD) model should be specified as this has special additional features to allow reliable operation at the higher temperatures. Operating at higher temperatures will also shorten motor bearing life. Whenever a cabinet has finished operating at temperatures above 150^{o}C it should be left with the timer off for a cool down period to ensure that the internal circulating fan stays on until it has cooled down to ambient conditions. This will greatly prolong the life of the fan motor bearings. These ovens are optimized to operate at 105^{o}C and it must be remembered that if operating at higher temperatures that the Spatial Variation (the range of temperatures measured throughout the cabinet) will grow larger as the differential between the cabinet temperature and ambient increases.

SAFETY HAZARDS:
There are several safety hazards that should be taken into account when operating this appliance due to the fact that it may be operated at high temperatures.

- ALWAYS ensure there is sufficient clearance above the oven VENT as high temperature air may be discharged at this location.
- The VENT may present a BURN hazard as it may attain relatively high temperatures, do NOT touch the vent tube until it has cooled down after oven operation.
- When opening the oven door HOT AIR may be discharged.
- Do NOT place anything directly on top of the oven especially above the oven vent as a FIRE hazard may exist if the material is combustible.
- The cabinet must be UNPLUGGED from the electrical supply BEFORE carrying out any routine maintenance.

COMMON PROBLEMS:

- No Controller DISPLAY: *Usually caused by the Cabinet being SWITCHED OFF either at the cabinet main switch or at the wall socket. Could also be caused by the FUSE on the cabinet or ZP21 PCB having blown.*

The main switch on the cabinet has an illuminated neon (although this may be quite dim if the cabinet is 4-5 years old). If the main switch neon is ON then there is power from the wall socket and the main switch is on.
Turn the power OFF at the wall socket and check the cabinet fuse (Use a screwdriver flat blade to slightly rotate the fuse carrier to the left – it should 'pop' out). If the fuse has blown replace it with a standard 10Amp fast blow fuse. If the fuse blows a second time investigate the fault. The ZP21 PCB also has a small (100Ma) mains input fuse that could have failed. Unplug the cabinet from the wall socket before attempting to check this fuse.
If there is no power to the wall socket because an RCD (residual current device) protecting the circuit has tripped, it is most likely to be caused by the heating element in the cabinet absorbing moisture (usually only occurs when the cabinet has not been used for some time). The cabinet should be unplugged from the wall socket and the element only checked for insulation resistance with a 500V insulation tester. The result must be at least 1MΩ. (Elements are at least 9.9MΩ when they leave the factory).

When testing the whole cabinet for insulation resistance ALWAYS test between the Phase & Neutral pins on the plug joined together and the EARTH pin. (This is to avoid 500V DC being applied to the cabinet electronic circuitry).

- Cabinet does not HEAT or Temperature is too LOW: *Usually caused by the TIMER not being set for a run time, OR by the user mechanical hi-limit being set too low so as to prevent power from reaching the heating element.*

Look at the 'HEATER' L.E.D on the front of the controller to the top left of the display, if this 'HEATER' led is NOT on then the controller is NOT attempting to increase the temperature in the cabinet and the most likely cause is the TIMER being set to '0.00'.
If the 'HEATER' led is ON then observe the 'MONITOR' neon adjacent to the mechanical hi-limit knob, if the 'MONITOR' neon is ON the mechanical hi-limit is set too low and is preventing power from reaching the heating element. Turn the knob clockwise fully to allow the cabinet to attain the desired temperature and refer to the operating manual for instructions on how to correctly set the user hi-limit.

- Cabinet temperature is TOO HIGH: *Usually caused by the addition of a 'LIVE' load in the cabinet OR because the desired temperature cannot be achieved due to the ambient conditions.*

Look at the 'HEATER' L.E.D on the front of the controller to the top left of the display, if the current temperature is above the set point then this led should be OFF (or initially pulsing) showing that the controller is not attempting to apply power to the heating element.
If the 'HEATER' led is OFF and the monitor hi-limit neon is ON brightly there could be a failure of the ZP21 control system.
When the cabinet is operating close to ambient conditions (I.E Set Point is 40^{o}C and ambient is 34^{o}C) the oven may not achieve the set point due to self heating from the fan motor. An oven is not really designed for 'incubation' temperatures. A realistic minimum operating temperature for an oven is 50^{o}C.
NB: An oven CANNOT lower the temperature BELOW the ambient temperature as it is NOT fitted with any cooling capability.
Any device which uses power (a 'LIVE' load) placed inside the incubator may cause the cabinet to heat beyond its set point.

- Poor Temperature control or Performance: *Usually due to internal circulating fan problems, sensing probe problems or impeded airflow inside the cabinet (overloaded by samples).*

When a cabinet performs poorly (large fluctuations at the control point) it is usually due to not having sufficient air circulating over the internal temperature sensing probe (1000Ω RTD). The cabinet fan should be running freely and circulating air down the false back and then vertically through the shelves past the temperature probe protruding about 20mm into the workspace back to the fan inlet.
Ensure the temperature probe is clearly visible and protruding about 20mm into the workspace. The small RTD sensor is held inside the stainless probe by a short piece of heatshrink tubing, if this becomes loose the sensor may not be fully down inside the stainless sheath. Check the positioning of the samples inside the cabinet, there must be sufficient space for the air to flow up through the samples and shelves back to the fan inlet. It is also worthwhile checking the glass door to ensure it is sealing correctly on its gasket.

- Cabinet incorrectly CONFIGURED: *The cabinet type (Incubator, Oven etc) is initially configured in the factory by a special sequence of key presses. If a user inadvertently alters the cabinet type unexpected results may occur.*

Confirm that the cabinet is correctly configured as an oven by carrying out the following operation and button sequence:
Turn the cabinet main switch OFF. Wait 30 seconds. HOLD down BOTH the 'UP' and 'DOWN' buttons together. While keeping the buttons held down turn the cabinet main switch back on and wait until the '8888's appear on the led display. Release the two buttons and then immediately press the 'RAMP' button only. If carried out correctly two 'beeps' will be heard. The cabinet should now be correctly configured as an oven. Confirm the configuration by checking that the maximum allowed set point temperature is 300^{o}C. If not correct repeat the procedure.

- Temperature Calibration is INCORRECT: *The ZP21 controller has a facility for a single OFFSET correction to the temperature reading, the offset correction factor is stored in EEROM so that it is not lost when power is removed from the cabinet.*

Carry out the Temperature Calibration procedure as follows:
Calibration should be carried out at 150.0^{o}C or at the temperature of interest, with the thermometer in the center of the working chamber with the chamber empty.
The calibration temperature must be within the achievable operating range of the incubator.

1) Place the Calibration Thermometer probe in the workspace center, close the door and set the controller for 150.0^{o}C or the temperature of interest, allow at least 1 hour to stabilise.
2) Read the temperature on the Calibration Thermometer.
3) To calibrate the cabinet -
   a) Press and HOLD the `TEMP' button until the 'SET' LED comes ON and then release. The 'SET' led should now be ON.
   b) WHILE the 'SET' led is ON: Press BOTH `UP' & `DOWN' buttons TOGETHER - a beep will be heard and the word ` CAL' will appear briefly on the LED display. Adjust the reading on the LED display using the `UP' & `DOWN' buttons until it agrees with the Calibration Thermometer.
   NB: If when attempting to press BOTH buttons together, the temperature SET POINT adjusts either up or down - it means you are NOT pressing BOTH buttons at the SAME TIME! - if the 'SET' led is still on you should attempt 3(b) again, if the 'SET' led is OFF you should repeat from 3 (a).
   c) WAIT for a further beep to occur, the LED display will briefly show `----' and then the CALIBRATION CONSTANT, this will be a number in the range 0.0 to 19.9. This figure SHOULD BE NOTED as it may be used to return to this calibration setting. The LED will then briefly show another '---' and the controller will resume its role of normal operation.

4) Allow to stabilise again - the temperature should now be correct. If NOT repeat the procedure.

NB: The calibration can only be performed within limits, if the calibration cannot be achieved a further fault exists.

SECTION 9 SERVICING COOLED INCUBATORS

All testing performed in this section MUST ONLY be carried out by suitably qualified electrical personnel.

Contherm GP Cooled incubators come in a range of sizes from 50L to 400L, these POLAR incubators have the Cat Nos: 1050CP, 1100CP, 1150CP, 1200CP, 1300CP & 1400CP. Whenever you have to contact Contherm regarding one of these cabinets ALWAYS ensure that you have the Appliance No (Serial No) so that the exact cabinet can be identified.

For the cabinet to operate correctly, the user must have set a TEMPERATURE to operate at, a TIME to run for (usually '[.]') and must ensure the mechanical hi-limit has been adjusted to allow the cabinet to achieve the desired conditions.

The GP Cooled incubator is fitted with a toughened glass door and is designed to operate over a temperature range of about 0^{o}C to $+50^{o}$C. These incubators are optimized to operate at 20^{o}C and it must be remembered that if operating at higher temperatures that the Spatial Variation (the range of temperatures measured throughout the cabinet) will grow larger as the differential between the cabinet temperature and ambient increases. Also note that a refrigerated cabinet will tend to 'dry out' samples more because of the dehumidifying effect of the refrigeration system.

The cooling system is a standard hermetically sealed refrigeration system, fitted with a HOT-GAS bypass solenoid (used to DEFROST) the evaporator and a Crankcase Pressure Regulator valve set to limit the maximum pressure that the compressor can operate on. The DEFROST solenoid should be energised for 1 minute every 3 hours when the set point temperature is between $+10^{o}$C and $+19.8^{o}$C, for 2 minutes every 2 hours when the set point is set below $+10^{o}$C and there is NO DEFROST if the temperature is set above $+19.8^{o}$C. If the cabinet main switch is turned OFF then back ON again a 'click' should be heard as the DEFROST solenoid is activated briefly during the POWER On sequence (Note that the Fridge Compressor may not start running for several minutes after switch ON). When the cabinet is 'DEFROSTING', Hot-Gas from the refrigeration system will be bypassed into the evaporator coil causing its temperature (and therefore the cabinet's temperature) to rise, hopefully melting any small amount of ice that may have formed.

COMMON PROBLEMS:

- No Controller DISPLAY: *Usually caused by the Cabinet being SWITCHED OFF either at the cabinet main switch or at the wall socket. Could also be caused by the FUSE on the cabinet or ZP21 PCB having blown.*

The main switch on the cabinet has an illuminated neon (although this may be quite dim if the cabinet is 4-5 years old). If the main switch neon is ON then there is power from the wall socket and the main switch is on.
Turn the power OFF at the wall socket and check the cabinet fuse (Use a screwdriver flat blade to slightly rotate the fuse carrier to the left – it should 'pop' out). If the fuse has blown replace it with a standard 10Amp fast blow fuse. If the fuse blows a second time investigate the fault. The ZP21 PCB also has a small (100Ma) mains input fuse that could have failed. Unplug the cabinet from the wall socket before attempting to check this fuse.
If there is no power to the wall socket because an RCD (residual current device) protecting the circuit has tripped, it is most likely to be caused by the heating element in the cabinet absorbing moisture (usually only occurs when the cabinet has not been used for some time). The cabinet should be unplugged from the wall socket and the element only checked for insulation resistance with a 500V insulation tester. The result must be at least 1MΩ. (Elements are at least 9.9MΩ when they leave the factory). When testing the whole cabinet for insulation resistance ALWAYS test between the Phase & Neutral pins on the plug joined together and the EARTH pin. (This is to avoid 500V DC being applied to the cabinet electronic circuitry).

- Cabinet does not HEAT or Temperature is too LOW: *Usually caused by the TIMER not being set for a run time, OR by the user mechanical hi-limit being set too low so as to prevent power from reaching the heating element.*

Look at the 'HEATER' L.E.D on the front of the controller to the top left of the display, if this 'HEATER' led is NOT on then the controller is NOT attempting to increase the temperature in the cabinet and the most likely cause is the TIMER being set to '0.00'. When the timer is set to '0.00' the DEFROST solenoid will turn on and OFF at 30 second intervals to try and prevent the refrigeration system from freezing the cabinet contents.
If the 'HEATER' led is ON then observe the 'MONITOR' neon adjacent to the mechanical hi-limit knob, if the 'MONITOR' neon is ON the mechanical hi-limit is set too low and is preventing power from reaching the heating element. Turn the knob clockwise fully to allow the cabinet to attain the desired temperature and refer to the operating manual for instructions on how to correctly set the user hi-limit.

- Cabinet temperature is TOO HIGH: *Could be caused by the addition of a 'LIVE' load in the cabinet OR because the desired temperature cannot be achieved due to the ambient conditions OR due to a problem with the refrigeration system.*

If the cabinet has a valid time set and has been able to achieve the current conditions previously in similar ambient conditions the problem is most likely due to a failure in one of the refrigeration system components.
Look at the 'HEATER' L.E.D on the front of the controller to the top left of the display, if the current temperature is above the set point then this led should be OFF (or initially pulsing) showing that the controller is not attempting to apply power to the heating element.
If the 'HEATER' led is OFF and the monitor hi-limit neon is ON brightly there could be a failure of the ZP21 control system.
NB: Any device which uses power (a 'LIVE' load) placed inside the incubator may cause the cabinet to heat beyond its set point. The performance of the refrigeration system and the lowest achievable temperature is highly dependent on the ambient temperature. All Contherm cabinets are quoted with an ambient temperature of +20^{o}C.

- Cabinet incorrectly CONFIGURED: *The cabinet type (Incubator, Oven etc) is initially configured in the factory by a special sequence of key presses. If a user inadvertently alters the cabinet type unexpected results may occur.*

Confirm that the cabinet is correctly configured as a cooled incubator by carrying out the following operation and button sequence:
Turn the cabinet main switch OFF. Wait 30 seconds. HOLD down BOTH the 'UP' and 'DOWN' buttons together. While keeping the buttons held down turn the cabinet main switch back on and wait until the '8888's appear on the led display. Release the two buttons and then immediately press the 'PROG' & 'TIME' buttons TOGETHER. If carried out correctly two 'beeps' will be heard. The cabinet should now be correctly configured as a Cooled incubator. Confirm the configuration by checking that the maximum allowed set point temperature is 50^{o}C. If not correct repeat the procedure.

- Poor Temperature control or Performance: *Usually due to internal circulating fan problems, sensing probe problems or impeded airflow inside the cabinet (overloaded by samples).*

When a cabinet performs poorly (large fluctuations at the control point) it is usually due to not having sufficient air circulating over the internal temperature sensing probe (1000Ω RTD). The cabinet fan should be running freely and circulating air down the false back and then vertically through the shelves past the temperature probe protruding about 20mm into the workspace back to the fan inlet.
Ensure the temperature probe is clearly visible and protruding about 20mm into the workspace. The small RTD sensor is held inside the stainless probe by a short piece of heatshrink tubing, if this becomes loose the sensor may not be fully down inside the stainless sheath. Check the positioning of the samples inside the cabinet, there must be sufficient space for the air to flow up through the samples and shelves back to the fan inlet. Check that the refrigeration evaporator coil (inside the cabinet behind the false back) has not completely ICED up thus preventing any airflow inside the cabinet. It is also worthwhile checking the glass door to ensure it is sealing correctly on its gasket.

- Temperature Calibration is INCORRECT: *The ZP21 controller has a facility for a single OFFSET correction to the temperature reading, the offset correction factor is stored in EEROM so that it is not lost when power is removed from the cabinet.*

Carry out the Temperature Calibration procedure as follows:
Calibration should be carried out at 20.0^{o}C or at the temperature of interest, with the thermometer in the center of the working chamber with the chamber empty.
The calibration temperature must be within the achievable operating range of the incubator.

1) Place the Calibration Thermometer probe in the workspace center, close the door and set the controller for 20.0^{o}C or the temperature of interest, allow at least 1 hour to stabilise.
2) Read the temperature on the Calibration Thermometer.
3) To calibrate the cabinet -
   a) Press and HOLD the `TEMP' button until the 'SET' LED comes ON and then release. The 'SET' led should now be ON.
   b) WHILE the 'SET' led is ON: Press BOTH `UP' & `DOWN' buttons TOGETHER - a beep will be heard and the word ` CAL' will appear briefly on the LED display. Adjust the reading on the LED display using the `UP' & `DOWN' buttons until it agrees with the Calibration Thermometer.
   NB: If when attempting to press BOTH buttons together, the temperature SET POINT adjusts either up or down - it means you are NOT pressing BOTH buttons at the SAME TIME! - if the 'SET' led is still on you should attempt 3(b) again, if the 'SET' led is OFF you should repeat from 3 (a).
   c) WAIT for a further beep to occur, the LED display will briefly show `----' and then the CALIBRATION CONSTANT, this will be a number in the range 0.0 to 19.9. This figure SHOULD BE NOTED as it may be used to return to this calibration setting. The LED will then briefly show another '---' and the controller will resume its role of normal operation.
   NB: If a '[[[[' sign appears on the display the cabinet is OUTSIDE its calibration display range and calibration should be performed at a slightly higher temperature.

4) Allow to stabilise again - the temperature should now be correct. If NOT repeat the procedure.

NB: The calibration can only be performed within limits, if the calibration cannot be achieved a further fault exists.

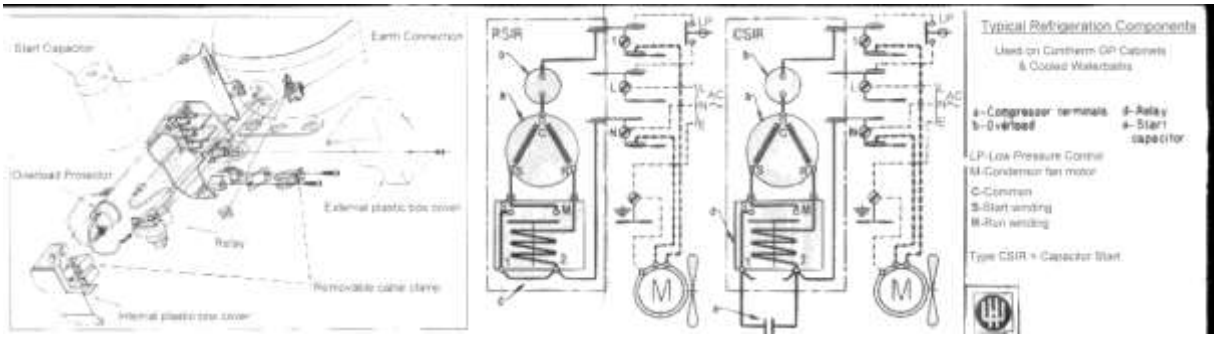
Investigating the performance of the refrigeration system: Problems with the refrigeration system are perhaps the hardest to diagnose, the following information should be used as a guide.

1. Check that the Internal circulating fan is running continuously.
2. Check that the cooling fan adjacent to the refrigeration compressor is running continuously. This fan should draw air over the compressor and discharge it towards the condenser attached to the rear of the cabinet. (I.E. Airflow is from left to right when looking at the fan from the rear).
3. Check that the refrigeration compressor is running continuously. Usually you can feel the vibration of the compressor running and should also feel that the rear condenser is quite warm and the compressor is relatively hot. If the compressor is starting or stopping it is indicative of a compressor problem which should be looked at by a refrigeration engineer.
4. Check that the DEFROST (Hot-Gas) solenoid is NOT energised. (Feel the copper pipe either side of the valve inlet and outlet, if they are both hot the valve may be stuck open or energised).
5. Turn the cabinet user HI-LIMIT knob fully anti-clockwise (this prevents the cabinet heater from working) and leave the cabinet for 1 hour. It should be able to cool AT LEAST 15^{o}C BELOW the ambient temperature. If the cabinet is able to achieve this it is likely that the refrigeration system is working correctly.

Condenser Defrost Solenoid

Suction line Compressor Cooling fan CPR Valve

If there is power to the compressor, and the compressor is not running – check the overload, starting relay and motor windings. See a TYPICAL diagram below for compressor components (some components will differ with different refrigeration plant).



To check the Overload: remove all power from the cabinet. Remove the overload from the compressor plastic box. Check that there is continuity between the overload terminals (ie a short circuit). If the overload is open circuit it is faulty.

To check the starting Relay: remove all power from the cabinet. Remove the relay from the

compressor plastic box. When the relay is in its normal (upright) position the two contacts will not be connected (contacts 'S' & 'M' in the diagram), when the relay is inverted (turned upside down) you should feel & hear a slight 'clunk', and the two contacts should now be connected. If it works as above check the relay coil for continuity (between points 'M' & '2' on the relay diagram). If this all checks out the relay is OK. (Some relays may be marked differently).

To check the compressor motor windings: remove all power from the cabinet. Remove all connections from the compressor motor windings. Measure the resistance from the motor 'C' terminal to the 'R' terminal (the 'run' winding) it should have a low resistance. Measure the resistance from the 'C' terminal to the 'S' terminal (the Start winding) it should have a slightly higher resistance. Measure the resistance from the 'S' terminal to the 'R' terminal it should measure the combined resistance of the two windings.
Check the insulation from the 'C' terminal to the metal casing (earth). This should be checked with an insulation tester at 500V DC. There must be a least 2MΩ between the terminals and ground (earth).

If the either of the compressor motor windings is open circuit OR the compressor has an insulation fault to earth the compressor is faulty and should be replaced.

A 'Crankcase Pressure Regulator' valve is usually attached just above the refrigeration compressor. - The Crankcase Pressure Regulator does NOT affect the lowest temperature the cabinet can achieve (unless it is faulty). The Crankcase Pressure Valve is to protect the compressor from the higher pressures generated when operating at higher temperatures

Refrigerant Gas Charge
The refrigeration system is charged with a suitable R134a refrigerant. The correct system gas charge is achieved by stopping the internal circulating fan motor and charging until a 'full coil of frost' is obtained after about 30 minutes. To check the frosting the internal top cover and rear duct must be removed thus exposing the refrigeration system cooling coil (evaporator) to view. The frost line should cover the complete evaporator including the internal 'surge pot' and may just be seen exiting the rear wall of the chamber but should not reach the compressor dome, this ensures that a correct charge is in the system. If refrigerant has 'leaked' from the system, the source of the 'leak' must be found and rectified before the system is recharged.

'Frosted' Evaporator & 'Frosted' Surge Pot compressor

'Frost' appearing on line to

A 'QUICK' check of the possible gas charge may be done as follows:

- Turn the cabinet user HI-LIMIT fully ANTICLOCKWISE (to stop power reaching the heating element).
- Disconnect power to the internal circulating fan by removing one fan motor wire. (to stop the fan).
- Turn the power to the cabinet back on.
- Wait for 30 minutes. This to allow time for frost to build up of the fridge evaporator inside the cabinet behind the false back.
- Check the suction line into the compressor (copper pipe on the LHS of the compressor), feel the copper pipe where it just exits the black insulation sleeve. Does it feel very cold and 'sweaty' (moisture on the surface of the pipe). If so this is a 'reasonable' indication that the gas charge is normal. (This method is NOT a sure test, only a guide, a full check involves removing the covers and checking for a 'full coil of frost' as in charging the system above).

Crankcase Pressure Regulator Valve:
Fitted just above the compressor on the rear of the cabinet is a Sporlan Crankcase Pressure Regulator Valve (CPR). The purpose of this valve is to limit the maximum operating suction pressure of the refrigeration compressor.
This valve has an adjustment screw located under the RED Plastic Cap on the left-hand side of the valve.
It is HIGHLY UNLIKELY that the factory setting on this valve has altered.
NB: Any adjustment of this valve must ONLY be carried out by a qualified Refrigeration Engineer.
To Check or Adjust the setting of this valve the following procedure should be followed:

- Fit a Suction Service Gauge to the Compressor Access Valve.
- Satisfy yourself that the refrigeration system has a full gas charge (See Refrigerant Gas Charge above).
- Allow the cabinet interior to stabilise at 20^{o}C or above.

The Suction Service Gauge should now be indicating 13/14 PSI, if NOT adjust the valve as follows:

- If the CPR adjusting screw is turned ANTICLOCKWISE the suction pressure will DECREASE.
- If the CPR adjusting screw is turned CLOCKWISE the suction pressure will INCREASE.

Allow time for pressure to stabilise. Once satisfied that it is correct, replace the RED Plastic Cap over the CPR adjusting screw. REMOVE the Suction Service Gauge and REFIT the cap to the compressor access valve (Ensure cap has the neoprene rubber sealing washer inside before refitting).

- Leak test ALL fittings with an Electronic Leak Detector.

Replacing a refrigeration Compressor (Only to be carried out by a Refrigeration Engineer)
If the need to replace the refrigeration compressor arises, the operating manual should be consulted to ensure the correct type is fitted. If the exact model can not be obtained ensure the replacement is of the same or similar capacity as the original. A replacement compressor should come complete with NEW electrics, do NOT be tempted to re-use the old components with the replacement system.
When replacing a refrigeration compressor or if refrigerant has been completely lost from the system, it is ESSENTIAL to replace the system drier and ensure no moisture is present before completely evacuating the fridge system using an external vacuum pump. The system should then be recharged with new refrigerant.

SECTION 10 SERVICING TROPICOOL INCUBATORS

All testing performed in this section MUST ONLY be carried out by suitably qualified electrical personnel.

Contherm GP Tropicool incubators come in a range of sizes from 50L to 400L, these BIOCELL incubators have the Cat Nos: 1050T, 1100T, 1150T, 1200T, 1300T & 1400T. Whenever you have to contact Contherm regarding one of these cabinets ALWAYS ensure that you have the Appliance No (Serial No) so that the exact cabinet can be identified.

For the cabinet to operate correctly, the user must have set a TEMPERATURE to operate at, a TIME to run for (usually '[.]') and must ensure the mechanical hi-limit has been adjusted to allow the cabinet to achieve the desired conditions.

The GP Tropicool incubator is fitted with a toughened glass door and is designed to operate over a temperature range of about 5^{o}C below ambient to +50^{o}C. These incubators are optimized to operate at 37oC and it must be remembered that if operating at higher temperatures that the Spatial Variation (the range of temperatures measured throughout the cabinet) will grow larger as the differential between the cabinet temperature and ambient increases.

COMMON PROBLEMS:

- No Controller DISPLAY: *Usually caused by the Cabinet being SWITCHED OFF either at the cabinet main switch or at the wall socket. Could also be caused by the FUSE on the cabinet or ZP21 PCB having blown.*

The main switch on the cabinet has an illuminated neon (although this may be quite dim if the cabinet is 4-5 years old). If the main switch neon is ON then there is power from the wall socket and the main switch is on.
Turn the power OFF at the wall socket and check the cabinet fuse (Use a screwdriver flat blade to slightly rotate the fuse carrier to the left – it should 'pop' out). If the fuse has blown replace it with a standard 10Amp fast blow fuse. If the fuse blows a second time investigate the fault. The ZP21 PCB also has a small (100Ma) mains input fuse that could have failed. Unplug the cabinet from the wall socket before attempting to check this fuse.
If there is no power to the wall socket because an RCD (residual current device) protecting the circuit has tripped, it is most likely to be caused by the heating element in the cabinet absorbing moisture (usually only occurs when the cabinet has not been used for some time). The cabinet should be unplugged from the wall socket and the element only checked for insulation resistance with a 500V insulation tester. The result must be at least 1MΩ. (Elements are at least 9.9MΩ when they leave the factory). When testing the whole cabinet for insulation resistance ALWAYS test between the Phase & Neutral pins on the plug joined together and the EARTH pin. (This is to avoid 500V DC being applied to the cabinet electronic circuitry).

- Cabinet does not HEAT or Temperature is too LOW: *Usually caused by the TIMER not being set for a run time, OR by the user mechanical hi-limit being set too low so as to prevent power from reaching the heating element.*

Look at the 'HEATER' L.E.D on the front of the controller to the top left of the display, if this 'HEATER' led is NOT on then the controller is NOT attempting to increase the temperature in the cabinet and the most likely cause is the TIMER being set to '0:00'.
If the 'HEATER' led is ON then observe the 'MONITOR' neon adjacent to the mechanical hi-limit knob, if the 'MONITOR' neon is ON the mechanical hi-limit is set too low and is preventing power from reaching the heating element. Turn the knob clockwise fully to allow the cabinet to attain the desired temperature and refer to the operating manual for instructions on how to correctly set the user hi-limit.

- Cabinet temperature is TOO HIGH: *Usually caused by the addition of a 'LIVE' load in the cabinet OR because the desired temperature cannot be achieved due to the ambient conditions.*

Look at the 'HEATER' L.E.D on the front of the controller to the top left of the display, if the current temperature is above the set point then this led should be OFF (or initially pulsing) showing that the controller is not attempting to apply power to the heating element.
If the 'HEATER' led is OFF and the monitor hi-limit neon is ON brightly there could be a failure of the ZP21 control system.
Any device which uses power (a 'LIVE' load) placed inside the incubator may cause the cabinet to heat beyond its set point. A Tropicool Incubators has very limited capacity to cope with any internal 'LIVE' loads (Such as Shaking or Stirring devices).
The Tropicool incubator typically cools to 5^{o}C to 8^{o}C BELOW the current ambient temperature (Amount of cooling depends on model).
The cooling element in a Tropicool incubator is a solid state PELTIER device. The Peltier device operates from a 12V D.C power supply situated inside the top lid of the cabinet and when running draws about 5A @ 12V. Heat is removed from the Hot side of the peltier by a small muffin fan, it is therefore most important that this fan is operating and that there is sufficient space behind the unit to allow the air to move freely. The two 'Butterfly' wings at the sides of the Peltier device should be folded so that they prevent the cabinet from being pushed too close to a wall at the rear.

- Poor Temperature control or Performance: *Usually due to internal circulating fan problems, sensing probe problems or impeded airflow inside the cabinet (overloaded by samples).*

When a cabinet performs poorly (large fluctuations at the control point) it is usually due to not having sufficient air circulating over the internal temperature sensing probe (1000Ω RTD). The cabinet fan should be running freely and circulating air down the false back and then vertically through the shelves past the temperature probe protruding about 20mm into the workspace back to the fan inlet.
Ensure the temperature probe is clearly visible and protruding about 20mm into the workspace. The small RTD sensor is held inside the stainless probe by a short piece of heatshrink tubing, if this becomes loose the sensor may not be fully down inside the stainless sheath. Check the positioning of the samples inside the cabinet, there must be sufficient space for the air to flow up through the samples and shelves back to the fan inlet. It is also worthwhile checking the glass door to ensure it is sealing correctly on its gasket.

- Cabinet incorrectly CONFIGURED: *The cabinet type (Incubator, Oven etc) is initially configured in the factory by a special sequence of key presses. If a user inadvertently alters the cabinet type unexpected results may occur.*

Confirm that the cabinet is correctly configured as a Tropicool incubator by carrying out the following operation and button sequence:

- Turn the cabinet main switch OFF. Wait 30 seconds. HOLD down BOTH the 'UP' and 'DOWN' buttons together. While keeping the buttons held down turn the cabinet main switch back on and wait until the '8888's appear on the led display. Release the two buttons and then immediately press the 'TEMP' & 'TIME' buttons TOGETHER. If carried out correctly two 'beeps' will be heard. The cabinet should now be correctly configured as a Tropicool incubator. Confirm the configuration by checking that the maximum allowed set point temperature is 50^{o}C. If not correct repeat the procedure.

Temperature Calibration is INCORRECT: *The ZP21 controller has a facility for a single OFFSET correction to the temperature reading, the offset correction factor is stored in EEROM so that it is not lost when power is removed from the cabinet.*

Carry out the Temperature Calibration procedure as follows:
Calibration should be carried out at 37.0^{o}C or at the temperature of interest, with the thermometer in the center of the working chamber with the chamber empty.
The calibration temperature must be within the achievable operating range of the incubator.

1) Place the Calibration Thermometer probe in the workspace center, close the door and set the controller for 37.0^{o}C or the temperature of interest, allow at least 1 hour to stabilise.
2) Read the temperature on the Calibration Thermometer.
3) To calibrate the cabinet -
   a) Press and HOLD the `TEMP' button until the 'SET' LED comes ON and then release. The 'SET' led should now be ON.
   b) WHILE the 'SET' led is ON: Press BOTH `UP' & `DOWN' buttons TOGETHER - a beep will be heard and the word ` CAL' will appear briefly on the LED display. Adjust the reading on the LED display using the `UP' & `DOWN' buttons until it agrees with the Calibration Thermometer.
   NB: If when attempting to press BOTH buttons together, the temperature SET POINT adjusts either up or down - it means you are NOT pressing BOTH buttons at the SAME TIME! - if the 'SET' led is still on you should attempt 3(b) again, if the 'SET' led is OFF you should repeat from 3 (a).
   c) WAIT for a further beep to occur, the LED display will briefly show `----' and then the CALIBRATION CONSTANT, this will be a number in the range 0.0 to 19.9. This figure SHOULD BE NOTED as it may be used to return to this calibration setting. The LED will then briefly show another '---' and the controller will resume its role of normal operation.
4) Allow to stabilise again - the temperature should now be correct. If NOT repeat the procedure.

NB: The calibration can only be performed within limits, if the calibration cannot be achieved a further fault exists.

SECTION 11 SERVICING 6000CP INCUBATORS

All testing performed in this section MUST ONLY be carried out by suitably qualified electrical personnel.

Contherm 6000CP Series of programmable Cooled incubators (fitted with lights and a cooling fan in the outer door), come in a range of sizes from 150L to 400L, these BIOSYN incubators have the Cat Nos: 6150CP, 6200CP, 6300CP & 6400CP. Whenever you have to contact Contherm regarding one of these cabinets ALWAYS ensure that you have the Appliance No (Serial No) so that the exact cabinet can be identified. Typical light output @ 300mm and 20^{o}C is 60μE (four lamps on).

For the cabinet to operate correctly, the user must have set a TEMPERATURE to operate at, a TIME to run for (usually '[:]') and must ensure the mechanical hi-limit has been adjusted to allow the cabinet to achieve the desired conditions.

The 6000CP Cooled incubator is fitted with a toughened glass door and is designed to operate over a temperature range of about +5^{o}C to +50^{o}C (Lights OFF) or +10^{o}C to +50^{o}C (Lights ON). These incubators are optimized to operate in a Day/Night mode typically between +15^{o}C and +25^{o}C. The 6000 range comes with a fan cooled outer door fitted with either two (30μE) or four (60μE) fluorescent lamps. The lighting is always ON when the cabinet is operating on Prog No2 and OFF on Prog No1. It must be remembered that if operating at higher temperatures that the Spatial Variation (the range of temperatures measured throughout the cabinet) will grow larger as the differential between the cabinet temperature and ambient increases. Also note that a refrigerated cabinet will tend to 'dry out' samples more because of the dehumidifying effect of the refrigeration system.

The cooling system is a standard hermetically sealed refrigeration system, fitted with a HOT-GAS bypass solenoid (used to DEFROST) the evaporator and a Crankcase Pressure Regulator valve set to limit the maximum pressure that the compressor can operate on. The DEFROST solenoid should be energised for 1 minute every 3 hours when the set point temperature is between +10^{o}C and +19.8^{o}C, for 2 minutes every 2 hours when the set point is set below +10^{o}C and there is NO DEFROST if the temperature is set above +19.8^{o}C. If the cabinet main switch is turned OFF then back ON again a 'click' should be heard as the DEFROST solenoid is activated briefly during the POWER On sequence (Note that the Fridge Compressor may not start running for several minutes after switch ON). When the cabinet is 'DEFROSTING', Hot-Gas from the refrigeration system will be bypassed into the evaporator coil causing its temperature (and therefore the cabinet's temperature) to rise, hopefully melting any small amount of ice that may have formed.

COMMON PROBLEMS:

- No Controller DISPLAY: *Usually caused by the Cabinet being SWITCHED OFF either at the cabinet main switch or at the wall socket. Could also be caused by the FUSE on the cabinet or ZP21 PCB having blown.*

The main switch on the cabinet has an illuminated neon (although this may be quite dim if the cabinet is 4-5 years old). If the main switch neon is ON then there is power from the wall socket and the main switch is on.
Turn the power OFF at the wall socket and check the cabinet fuse (Use a screwdriver flat blade to slightly rotate the fuse carrier to the left – it should 'pop' out). If the fuse has blown replace it with a standard 10Amp fast blow fuse. If the fuse blows a second time investigate the fault. The ZP21 PCB also has a small (100Ma) mains input fuse that could have failed. Unplug the cabinet from the wall socket before attempting to check this fuse.
If there is no power to the wall socket because an RCD (residual current device) protecting the circuit has tripped, it is most likely to be caused by the heating element in the cabinet absorbing moisture (usually only occurs when the cabinet has not been used for some time). The cabinet should be unplugged from the wall socket and the element only checked for insulation resistance with a 500V insulation tester. The result must be at least 1MΩ. (Elements are at least 9.9MΩ when they leave the factory).

When testing the whole cabinet for insulation resistance ALWAYS test between the Phase & Neutral pins on the plug joined together and the EARTH pin. (This is to avoid 500V DC being applied to the cabinet electronic circuitry).

- Cabinet does not HEAT or Temperature is too LOW: *Usually caused by the TIMER not being set for a run time, OR by the user mechanical hi-limit being set too low so as to prevent power from reaching the heating element.*

Look at the 'HEATER' L.E.D on the front of the controller to the top left of the display, if this 'HEATER' led is NOT on then the controller is NOT attempting to increase the temperature in the cabinet and the most likely cause is the TIMER being set to '0.00'. When the timer is set to '0.00' the DEFROST solenoid will turn on and OFF at 30 second intervals to try and prevent the refrigeration system from freezing the cabinet contents.
If the 'HEATER' led is ON then observe the 'MONITOR' neon adjacent to the mechanical hi-limit knob, if the 'MONITOR' neon is ON the mechanical hi-limit is set too low and is preventing power from reaching the heating element. Turn the knob clockwise fully to allow the cabinet to attain the desired temperature and refer to the operating manual for instructions on how to correctly set the user hi-limit.

- Cabinet temperature is TOO HIGH: *Could be caused by too high an ambient temperature OR due to a problem with the refrigeration system OR outer door cooling fan.*

If the cabinet has a valid time set and has been able to achieve the current conditions previously in similar ambient conditions the problem is most likely due to a failure in one of the refrigeration system components.
Look at the 'HEATER' L.E.D on the front of the controller to the top left of the display, if the current temperature is above the set point then this led should be OFF (or initially pulsing) showing that the controller is not attempting to apply power to the heating element.
If the 'HEATER' led is OFF and the monitor hi-limit neon is ON brightly there could be a failure of the ZP21 control system.
NB: Because these cabinets are fitted with lighting in the outer door, any problems due to a deterioration in the refrigeration system or higher ambient temperatures may cause the cabinet to heat beyond its set point. The performance of the refrigeration system and the lowest achievable temperature is highly dependent on the ambient temperature. At higher ambient temperatures some of the door lighting may have to be removed or the cabinet relocated to a cooler environment in order to allow control at the desired temperatures, this is especially true of the larger models (1300CP & 1400CP). All Contherm cabinets are quoted with an ambient temperature of $+20^{o}$C.

- Poor Temperature control or Performance: *Usually due to internal circulating fan problems, sensing probe problems or impeded airflow inside the cabinet (overloaded by samples).*

When a cabinet performs poorly (large fluctuations at the control point) it is usually due to not having sufficient air circulating over the internal temperature sensing probe (1000Ω RTD). The cabinet fan should be running freely and circulating air down the false back and then vertically through the shelves past the temperature probe protruding about 20mm into the workspace back to the fan inlet.
Ensure the temperature probe is clearly visible and protruding about 20mm into the workspace. The small RTD sensor is held inside the stainless probe by a short piece of heatshrink tubing, if this becomes loose the sensor may not be fully down inside the stainless sheath. Check the positioning of the samples inside the cabinet, there must be sufficient space for the air to flow up through the samples and shelves back to the fan inlet. Check that the refrigeration evaporator coil (inside the cabinet behind the false back) has not completely ICED up thus preventing any airflow inside the cabinet. It is also worthwhile checking the glass door to ensure it is sealing correctly on its gasket.

- Cabinet incorrectly CONFIGURED: *The cabinet type (Incubator, Oven etc) is initially configured in the factory by a special sequence of key presses. If a user inadvertently alters the cabinet type unexpected results may occur.*

Confirm that the cabinet is correctly configured as a 6000CP Series incubator by carrying out the following operation and button sequence:
Turn the cabinet main switch OFF. Wait 30 seconds. HOLD down BOTH the 'UP' and 'DOWN' buttons together. While keeping the buttons held down turn the cabinet main switch back on and wait until the '8888's appear on the led display. Release the two buttons and then immediately press the 'PROG' & 'TIME' buttons TOGETHER. If carried out correctly two 'beeps' will be heard. The cabinet should now be correctly configured as a Programmable Cooled incubator. Confirm the configuration by checking that the maximum allowed set point temperature is 50^{o}C. Also confirm that when the centre 'PROG' button is pressed the display shows 'P1' or 'P2'. If not correct repeat the procedure.

- Temperature Calibration is INCORRECT: *The ZP21 controller has a facility for a single OFFSET correction to the temperature reading, the offset correction factor is stored in EEROM so that it is not lost when power is removed from the cabinet.*

Carry out the Temperature Calibration procedure as follows:
Calibration should be carried out at 20.0^{o}C or at the temperature of interest, with the thermometer in the center of the working chamber with the chamber empty.
The calibration temperature must be within the achievable operating range of the incubator.

1) Place the Calibration Thermometer probe in the workspace center, close the door and set the controller for 20.0^{o}C or the temperature of interest, allow at least 1 hour to stabilise.
2) Read the temperature on the Calibration Thermometer.
3) To calibrate the cabinet -
   a) Press and HOLD the `TEMP' button until the 'SET' LED comes ON and then release. The 'SET' led should now be ON.
   b) WHILE the 'SET' led is ON: Press BOTH `UP' & `DOWN' buttons TOGETHER - a beep will be heard and the word ` CAL' will appear briefly on the LED display. Adjust the reading on the LED display using the `UP' & `DOWN' buttons until it agrees with the Calibration Thermometer.
   NB: If when attempting to press BOTH buttons together, the temperature SET POINT adjusts either up or down - it means you are NOT pressing BOTH buttons at the SAME TIME! - if the 'SET' led is still on you should attempt 3(b) again, if the 'SET' led is OFF you should repeat from 3 (a).
   c) WAIT for a further beep to occur, the LED display will briefly show `----' and then the CALIBRATION CONSTANT, this will be a number in the range 0.0 to 19.9. This figure SHOULD BE NOTED as it may be used to return to this calibration setting. The LED will then briefly show another '---' and the controller will resume its role of normal operation.
   NB: If a '[[[[' sign appears on the display the cabinet is OUTSIDE its calibration display range and calibration should be performed at a slightly higher temperature.

4) Allow to stabilise again - the temperature should now be correct. If NOT repeat the procedure.

NB: The calibration can only be performed within limits, if the calibration cannot be achieved a further fault exists.

- Lighting does NOT come on in Prog No2: *Could be caused by faulty lamps/starter/ballast OR fuse failure in the light fitting OR 1amp fuse has failed in ZP21 PCB.*

If NONE of the lights come on check the Door Cooling Fan is operating. If the cooling fan is not operating the most likely cause is failure of the 1Amp Antisurge fuse on the ZP21 PCB. Ensure ALL power is removed from the cabinet before checking or replacing this fuse. Always use a high quality ceramic Antisurge fuse as a replacement as this fuse must cope with any inrush surge to the lighting system.

If only the lamps in one fitting do not work, remove ALL power from the cabinet and check the fuse inside the fitting. Replace with the same type if blown. Swap lamps to determine if a lamp or starter is faulty.

If the lamps work in the other fitting try swapping starters, if the starter works the ballast in the fitting may be faulty. The lamps, starter, ballast and fuses should be readily available from any reputable electrical supplier.

Investigating the performance of the refrigeration system: Problems with the refrigeration system are perhaps the hardest to diagnose, the following information should be used as a guide.

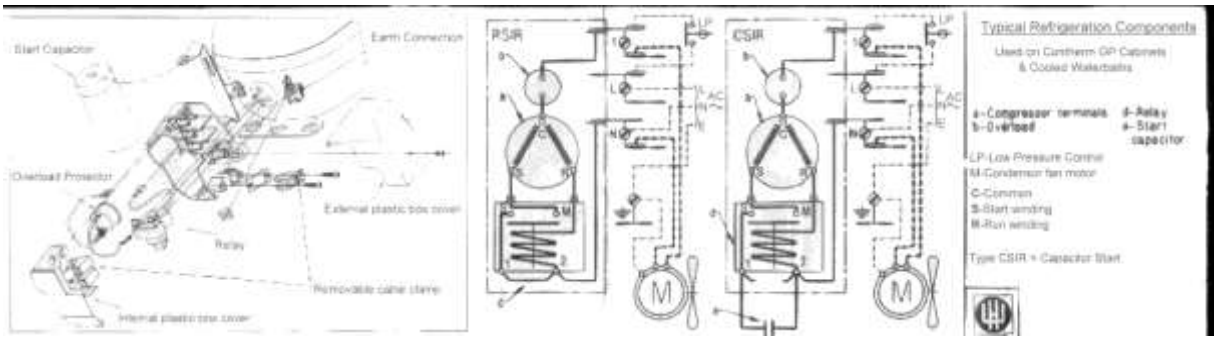
6. Check that the Internal circulating fan is running continuously.
7. Check that the cooling fan adjacent to the refrigeration compressor is running continuously. This fan should draw air over the compressor and discharge it towards the condenser attached to the rear of the cabinet. (I.E. Airflow is from left to right when looking at the fan from the rear).
8. Check that the refrigeration compressor is running continuously. Usually you can feel the vibration of the compressor running and should also feel that the rear condenser is quite warm and the compressor is relatively hot. If the compressor is starting or stopping it is indicative of a compressor problem which should be looked at by a refrigeration engineer.
9. Check that the DEFROST (Hot-Gas) solenoid is NOT energised. (Feel the copper pipe either side of the valve inlet and outlet, if they are both hot the valve may be stuck open or energised).
10. Turn the cabinet user HI-LIMIT knob fully anti-clockwise (this prevents the cabinet heater from working) and leave the cabinet for 1 hour. It should be able to cool AT LEAST 15^{o}C BELOW the ambient temperature. If the cabinet is able to achieve this it is likely that the refrigeration system is working correctly.

Condenser Defrost Solenoid

Suction line Compressor

Cooling fan CPR Valve

If there is power to the compressor, and the compressor is not running – check the overload, starting relay and motor windings. See a TYPICAL diagram below for compressor components (some components will differ with different refrigeration plant).



To check the Overload: remove all power from the cabinet. Remove the overload from the compressor plastic box. Check that there is continuity between the overload terminals (ie a short circuit). If the overload is open circuit it is faulty.

To check the starting Relay: remove all power from the cabinet. Remove the relay from the compressor plastic box. When the relay is in its normal (upright) position the two contacts will not be connected (contacts 'S' & 'M' in the diagram), when the relay is inverted (turned upside down) you should feel & hear a slight 'clunk', and the two contacts should now be connected. If it works as above check the relay coil for continuity (between points 'M' & '2' on the relay diagram). If this all checks out the relay is OK. (Some relays may be marked differently).

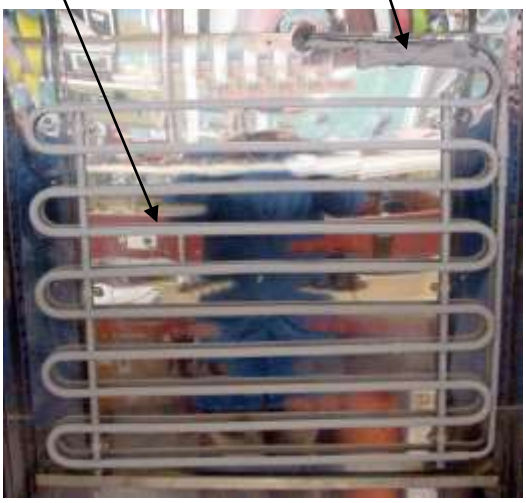
To check the compressor motor windings: remove all power from the cabinet. Remove all connections from the compressor motor windings. Measure the resistance from the motor 'C' terminal to the 'R' terminal (the 'run' winding) it should have a low resistance. Measure the resistance from the 'C' terminal to the 'S' terminal (the Start winding) it should have a slightly higher resistance. Measure the resistance from the 'S' terminal to the 'R' terminal it should measure the combined resistance of the two windings.
Check the insulation from the 'C' terminal to the metal casing (earth). This should be checked with an insulation tester at 500V DC. There must be a least 2MΩ between the terminals and ground (earth).

If the either of the compressor motor windings is open circuit OR the compressor has an insulation fault to earth the compressor is faulty and should be replaced.

A 'Crankcase Pressure Regulator' valve is usually attached just above the refrigeration compressor. - The Crankcase Pressure Regulator does NOT affect the lowest temperature the cabinet can achieve (unless it is faulty). The Crankcase Pressure Valve is to protect the compressor from the higher pressures generated when operating at higher temperatures

Refrigerant Gas Charge
The refrigeration system is charged with a suitable R134a refrigerant. The correct system gas charge is achieved by stopping the internal circulating fan motor and charging until a 'full coil of frost' is obtained after about 30 minutes. To check the frosting the internal top cover and rear duct must be removed thus exposing the refrigeration system cooling coil (evaporator) to view. The frost line should cover the complete evaporator including the internal 'surge pot' and may just be seen exiting the rear wall of the chamber but should not reach the compressor dome, this ensures that a correct charge is in the system. If refrigerant has 'leaked' from the system, the source of the 'leak' must be found and rectified before the system is recharged.

'Frosted' Evaporator & 'Frosted' Surge Pot



'Frost' on line to compressor

A 'QUICK' check of the possible gas charge may be done as follows:

- Turn the cabinet user HI-LIMIT fully ANTICLOCKWISE (to stop power reaching the heating element).
- Disconnect power to the internal circulating fan by removing one fan motor wire. (to stop the fan).
- Turn the power to the cabinet back on.
- Wait for 30 minutes. This to allow time for frost to build up of the fridge evaporator inside the cabinet behind the false back.
- Check the suction line into the compressor (copper pipe on the LHS of the compressor), feel the copper pipe where it just exits the black insulation sleeve. Does it feel very cold and 'sweaty' (moisture on the surface of the pipe). If so this is a 'reasonable' indication that the gas charge is normal. (This method is NOT a sure test, only a guide, a full check involves removing the covers and checking for a 'full coil of frost' as in charging the system above).

Crankcase Pressure Regulator Valve:
Fitted just above the compressor on the rear of the cabinet is a Sporlan Crankcase Pressure Regulator Valve (CPR). The purpose of this valve is to limit the maximum operating suction pressure of the refrigeration compressor.
This valve has an adjustment screw located under the RED Plastic Cap on the left-hand side of the valve.
It is HIGHLY UNLIKELY that the factory setting on this valve has altered.
NB: Any adjustment of this valve must ONLY be carried out by a qualified Refrigeration Engineer.
To Check or Adjust the setting of this valve the following procedure should be followed:

- Fit a Suction Service Gauge to the Compressor Access Valve.
- Satisfy yourself that the refrigeration system has a full gas charge (See Refrigerant Gas Charge above).
- Allow the cabinet interior to stabilise at 20^{o}C or above.

The Suction Service Gauge should now be indicating 13/14 PSI, if NOT adjust the valve as follows:

- If the CPR adjusting screw is turned ANTICLOCKWISE the suction pressure will DECREASE.
- If the CPR adjusting screw is turned CLOCKWISE the suction pressure will INCREASE.

Allow time for pressure to stabilise. Once satisfied that it is correct, replace the RED Plastic Cap over the CPR adjusting screw. REMOVE the Suction Service Gauge and REFIT the cap to the compressor access valve (Ensure cap has the neoprene rubber sealing washer inside before refitting).

- Leak test ALL fittings with an Electronic Leak Detector.

Replacing a refrigeration Compressor (Only to be carried out by a Refrigeration Engineer)
If the need to replace the refrigeration compressor arises, the operating manual should be consulted to ensure the correct type is fitted. If the exact model can not be obtained ensure the replacement is of the same or similar capacity as the original. A replacement compressor should come complete with NEW electrics, do NOT be tempted to re-use the old components with the replacement system.
When replacing a refrigeration compressor or if refrigerant has been completely lost from the system, it is ESSENTIAL to replace the system drier and ensure no moisture is present before completely evacuating the fridge system using an external vacuum pump. The system should then be recharged with new refrigerant.

SECTION 12 SERVICING CSL INCUBATORS

All testing performed in this section MUST ONLY be carried out by suitably qualified electrical personnel.

Contherm CSL incubators come in a range of sizes from 200L to 400L, these STABILITY incubators have the Cat Nos: 1200CSL, 1300CSL & 1400CSL. Whenever you have to contact Contherm regarding one of these cabinets ALWAYS ensure that you have the Appliance No (Serial No) so that the exact cabinet can be identified.

For the cabinet to operate correctly, the user must have set a TEMPERATURE to operate at, a TIME to run for (usually '[:]') and must ensure the mechanical hi-limit has been adjusted to allow the cabinet to achieve the desired conditions.

The CSL incubator is fitted with a toughened glass door and is designed to operate over a temperature range of about 25°C to +40°C with a humidity range of from 55% to 80%. These incubators are optimized to operate at 25°C and it must be remembered that if operating at higher temperatures that the Spatial Variation (the range of temperatures measured throughout the cabinet) will grow larger as the differential between the cabinet temperature and ambient increases. Also note that a refrigerated cabinet will tend to 'dry out' samples more because of the dehumidifying effect of the refrigeration system.

The cooling system is a standard hermetically sealed refrigeration system, fitted with a HOT-GAS bypass solenoid. The HOT-GAS solenoid is used to control the relative humidity in the cabinet by controlling the DEW POINT of the refrigeration evaporator. A Crankcase Pressure Regulator valve is also used to limit the maximum pressure that the compressor can operate on. The HOT-GAS solenoid will pulse On and OFF at a varying ratio to control the relative humidity in the cabinet. If the cabinet main switch is turned OFF then back ON again a 'click' should be heard as the HOT-GAS solenoid is activated briefly during the POWER On sequence

COMMON PROBLEMS:

- No Controller DISPLAY: *Usually caused by the Cabinet being SWITCHED OFF either at the cabinet main switch or at the wall socket. Could also be caused by the FUSE on the cabinet or ZP21 PCB having blown.*

The main switch on the cabinet has an illuminated neon (although this may be quite dim if the cabinet is 4-5 years old). If the main switch neon is ON then there is power from the wall socket and the main switch is on.
Turn the power OFF at the wall socket and check the cabinet fuse (Use a screwdriver flat blade to slightly rotate the fuse carrier to the left – it should 'pop' out). If the fuse has blown replace it with a standard 10Amp fast blow fuse. If the fuse blows a second time investigate the fault. The ZP21 PCB also has a small (100Ma) mains input fuse that could have failed. Unplug the cabinet from the wall socket before attempting to check this fuse.
If there is no power to the wall socket because an RCD (residual current device) protecting the circuit has tripped, it is most likely to be caused by the heating element in the cabinet absorbing moisture (usually only occurs when the cabinet has not been used for some time). The cabinet should be unplugged from the wall socket and the element only checked for insulation resistance with a 500V insulation tester. The result must be at least 1MΩ. (Elements are at least 9.9MΩ when they leave the factory). When testing the whole cabinet for insulation resistance ALWAYS test between the Phase & Neutral pins on the plug joined together and the EARTH pin. (This is to avoid 500V DC being applied to the cabinet electronic circuitry).

- Cabinet does not HEAT or Temperature is too LOW: *Usually caused by the TIMER not being set for a run time, OR by the user mechanical hi-limit being set too low so as to prevent power from reaching the heating element.*

Look at the 'HEATER' L.E.D on the front of the controller to the top left of the display, if this 'HEATER' led is NOT on then the controller is NOT attempting to increase the temperature in the cabinet and the most likely cause is the TIMER being set to '0:00'. When the timer is set to '0:00' the DEFROST solenoid will turn on and OFF at 30 second intervals to try and prevent the refrigeration system from freezing the cabinet contents.
If the 'HEATER' led is ON then observe the 'MONITOR' neon adjacent to the mechanical hi-limit knob, if the 'MONITOR' neon is ON the mechanical hi-limit is set too low and is preventing power from reaching the heating element. Turn the knob clockwise fully to allow the cabinet to attain the desired temperature and refer to the operating manual for instructions on how to correctly set the user hi-limit.

- Cabinet temperature is TOO HIGH: *Could be caused by the addition of a 'LIVE' load in the cabinet OR because the desired temperature cannot be achieved due to the ambient conditions OR Door Heater Simmerstat is set too high OR due to a problem with the refrigeration system.*

If the cabinet has a valid time set and has been able to achieve the current conditions previously in similar ambient conditions the problem is most likely due to a failure in one of the refrigeration system components.
Look at the 'HEATER' L.E.D on the front of the controller to the top left of the display, if the current temperature is above the set point then this led should be OFF (or initially pulsing) showing that the controller is not attempting to apply power to the heating element.
If the 'HEATER' led is OFF and the monitor hi-limit neon is ON brightly there could be a failure of the ZP21 control system.
NB: Any device which uses power (a 'LIVE' load) placed inside the incubator may cause the cabinet to heat beyond its set point. The performance of the refrigeration system and the lowest achievable temperature is highly dependent on the ambient temperature. All Contherm cabinets are quoted with an ambient temperature of +20^{o}C.

Check the setting of the outer door heating simmerstat (Located behind the control panel attached to the firewall). This simmerstat controls the amount of heat supplied to the silicon wire heating element inside the outer door. If set too high it may cause the cabinet to overheat.

- Poor Temperature control or Performance: *Usually due to internal circulating fan problems, sensing probe problems or impeded airflow inside the cabinet (overloaded by samples).*

When a cabinet performs poorly (large fluctuations at the control point) it is usually due to not having sufficient air circulating over the internal temperature sensing probe (1000Ω RTD). The cabinet fan should be running freely and circulating air down the false back and then vertically through the shelves past the temperature probe protruding about 20mm into the workspace back to the fan inlet.
Ensure the temperature probe is clearly visible and protruding about 20mm into the workspace. The small RTD sensor is held inside the stainless probe by a short piece of heatshrink tubing, if this becomes loose the sensor may not be fully down inside the stainless sheath. Check the positioning of the samples inside the cabinet, there must be sufficient space for the air to flow up through the samples and shelves back to the fan inlet. It is also worthwhile checking the glass door to ensure it is sealing correctly on its gasket.

- Cabinet incorrectly CONFIGURED: *The cabinet type (Incubator, Oven etc) is initially configured in the factory by a special sequence of key presses. If a user inadvertently alters the cabinet type unexpected results may occur.*

Confirm that the cabinet is correctly configured as a CSL incubator by carrying out the following operation and button sequence:
Turn the cabinet main switch OFF. Wait 30 seconds. HOLD down BOTH the 'UP' and 'DOWN' buttons together. While keeping the buttons held down turn the cabinet main switch back on and wait until the '8888's appear on the led display. Release the two buttons and then immediately press the 'TIME' button only. If carried out correctly two 'beeps' will be heard. The cabinet should now be correctly configured as a CSL incubator. Confirm the configuration by checking that the maximum allowed set point temperature is 50^{o}C. Also check by pressing the centre '%RH' button, the current Humidity value should be displayed. If not correct repeat the procedure.

- Temperature Calibration is INCORRECT: *The ZP21 controller has a facility for a single OFFSET correction to the temperature reading, the offset correction factor is stored in EEROM so that it is not lost when power is removed from the cabinet.*

Carry out the Temperature Calibration procedure as follows:
Calibration should be carried out at 20.0^{o}C or at the temperature of interest, with the thermometer in the center of the working chamber with the chamber empty.
The calibration temperature must be within the achievable operating range of the incubator.

1) Place the Calibration Thermometer probe in the workspace center, close the door and set the controller for 20.0^{o}C or the temperature of interest, allow at least 1 hour to stabilise.
2) Read the temperature on the Calibration Thermometer.
3) To calibrate the cabinet -
   a) Press and HOLD the `TEMP' button until the 'SET' LED comes ON and then release. The 'SET' led should now be ON.
   b) WHILE the 'SET' led is ON: Press BOTH `UP' & `DOWN' buttons TOGETHER - a beep will be heard and the word ` CAL' will appear briefly on the LED display. Adjust the reading on the LED display using the `UP' & `DOWN' buttons until it agrees with the Calibration Thermometer.
   NB: If when attempting to press BOTH buttons together, the temperature SET POINT adjusts either up or down - it means you are NOT pressing BOTH buttons at the SAME TIME! - if the 'SET' led is still on you should attempt 3(b) again, if the 'SET' led is OFF you should repeat from 3 (a).
   c) WAIT for a further beep to occur, the LED display will briefly show `----' and then the CALIBRATION CONSTANT, this will be a number in the range 0.0 to 19.9. This figure SHOULD BE NOTED as it may be used to return to this calibration setting. The LED will then briefly show another '---' and the controller will resume its role of normal operation.
   NB: If a '[[[[' sign appears on the display the cabinet is OUTSIDE its calibration display range and calibration should be performed at a slightly higher temperature.

4) Allow to stabilise again - the temperature should now be correct. If NOT repeat the procedure.

NB: The calibration can only be performed within limits, if the calibration cannot be achieved a further fault exists.

- Humidity Calibration is INCORRECT: *The ZP21 controller has a facility for a single OFFSET correction to the humidity reading, the offset correction factor is stored in EEROM so that it is not lost when power is removed from the cabinet. May also be caused by condensation on the humidity sensing probe.*

Carry out the Humidity Calibration procedure as follows:
Calibration should be carried out at 25.0^{o}C and 65%RH with the hygrometer in the center of the working chamber and with the chamber empty. Ensure the internal water tray on the cabinet floor has plenty of water and is located fully to the rear of the chamber so that air from the rear duct passes directly over the water tray.
The calibration humidity must be within the specified operating range of the incubator.

1) Place the Calibration Hygrometer probe in the workspace center, close the door and set the controller for 25.0^{o}C , allow at least 2 hours to stabilise.
2) Read the Relative Humidity on the Calibration Hygrometer.
3) To calibrate the humidity readout on the cabinet -
   a) Press and HOLD the `%RH' button until the 'SET' LED comes ON and then release. The 'SET' led should now be ON.
   b) WHILE the 'SET' led is ON: Press the '%RH' button again - a beep will be heard and the word ` CAL' will appear briefly on the LED display. Adjust the number on the LED display using the `UP' & `DOWN' buttons. A higher number raises the reading on the cabinet display while a lower number lowers it. The range of numbers is from 0.0 to 6.0.
   When the calibration is correct note down the final number used.
4) Allow to stabilise again - the humidity should now be correct. If NOT repeat the procedure.

NB: The cabinet controller will use a combination of the temperature on the fridge evaporator (controlled by the ON / OFF ratio of the Hot-Gas solenoid) and power to the heating element to ensure that the temperature gets to within ±0.5^{o}C of the set point. No attempt will be made to control the relative humidity (controlled by changing the ON/OFF ratio of the Hot-Gas solenoid) until the temperature is within this range. When the Hot-Gas solenoid is ON the temperature of the fridge evaporator rises (and with it the DEW POINT and the RH). When the Hot-Gas solenoid is OFF the temperature of the fridge evaporator falls (and with it the DEW POINT and the RH). Thus by controlling the ON/OFF ratio of the Hot-Gas solenoid the average temperature of the evaporator, and therefore the relative humidity, may be controlled.

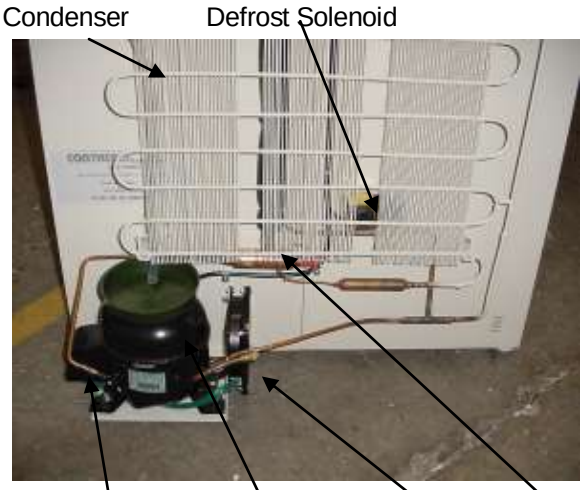
NB: The cabinet is designed to give correct operation over the temperature range from 25^{o}C to 40^{o}C and 55%RH to 80%RH in a +20^{o}C ambient. While settings outside this range may be achievable the results cannot be guaranteed.

- LOW WATER Alarm (6---): *Usually caused by insufficient water in the internal water tray located on the floor of the cabinet.*

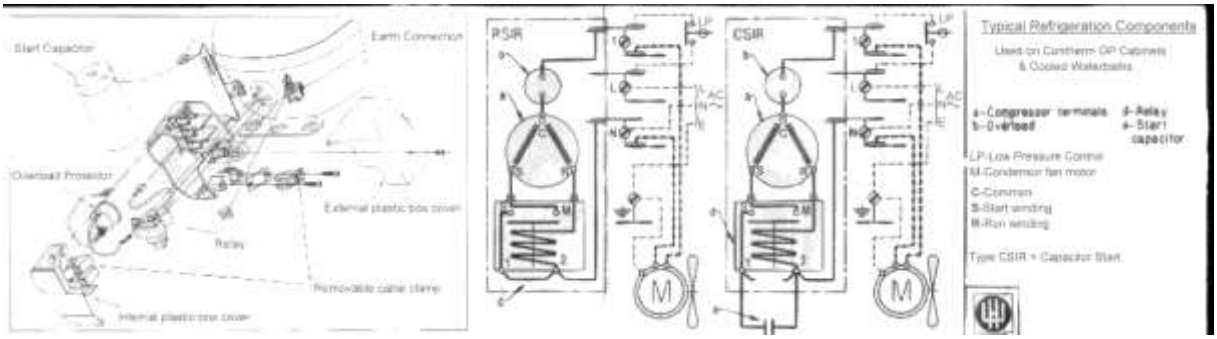
Check the water level in the internal tray and if very low or empty fill it to within 1 cm of the tray top. The water tray must be located on the floor of the cabinet and pushed back against the back wall to allow air from the rear duct to pass over it.

Investigating the performance of the refrigeration system: Problems with the refrigeration system are perhaps the hardest to diagnose, the following information should be used as a guide.

1. Check that there is sufficient water in the internal humidity tray located on the floor of the cabinet.
2. Check that the Internal circulating fan is running continuously.
3. Check that the cooling fan adjacent to the refrigeration compressor is running continuously. This fan should draw air over the compressor and discharge it towards the condenser attached to the rear of the cabinet. (I.E. Airflow is from left to right when looking at the fan from the rear).
4. Check that the refrigeration compressor is running continuously. Usually you can feel the vibration of the compressor running and should also feel that the rear condenser is quite warm and the compressor is relatively hot. If the compressor is starting or stopping it is indicative of a compressor problem which should be looked at by a refrigeration engineer.
5. Under normal conditions the Hot-Gas solenoid should be pulsing On and OFF at regular intervals. If the cabinet CANNOT cool down to the desired temperature, then, after a period of about an hour the Hot-gas solenoid should stay De-energised to allow the full cooling to take effect. Feel the copper pipe either side of the valve inlet and outlet, if they are both hot the valve may be mechanically stuck open If after being given a light tap with a screwdriver the cabinet begins to cool normally again it is indicative of a 'sticking' problem with the Hot-Gas solenoid.
6. Set the temperature to a low setting such as +15^{o}C and leave the cabinet for 2 hours. It should be able to cool to below +20^{o}C. If the cabinet is able to achieve this it is likely that the refrigeration system is working correctly.



If there is power to the compressor, and the compressor is not running (or starts and stops) – check the overload, starting relay and motor windings. See a TYPICAL diagram below for compressor components (some components will differ with different refrigeration plant).



To check the Overload: remove all power from the cabinet. Remove the overload from the compressor plastic box. Check that there is continuity between the overload terminals (ie a short circuit). If the overload is open circuit it is faulty.

To check the starting Relay: remove all power from the cabinet. Remove the relay from the compressor plastic box. When the relay is in its normal (upright) position the two contacts will not be connected (contacts 'S' & 'M' in the diagram), when the relay is inverted (turned upside down) you should feel & hear a slight 'clunk', and the two contacts should now be connected. If it works as above check the relay coil for continuity (between points 'M' & '2' on the relay diagram). If this all checks out the relay is OK. (Some relays may be marked differently).

To check the compressor motor windings: remove all power from the cabinet. Remove all connections from the compressor motor windings. Measure the resistance from the motor 'C' terminal to the 'R' terminal (the 'run' winding) it should have a low resistance. Measure the resistance from the 'C' terminal to the 'S' terminal (the Start winding) it should have a slightly higher resistance. Measure the resistance from the 'S' terminal to the 'R' terminal it should measure the combined resistance of the two windings.
Check the insulation from the 'C' terminal to the metal casing (earth). This should be checked with an insulation tester at 500V DC. There must be a least 2MΩ between the terminals and ground (earth).

If the either of the compressor motor windings is open circuit OR the compressor has an insulation fault to earth the compressor is faulty and should be replaced.

A 'Crankcase Pressure Regulator' valve is usually attached just above the refrigeration compressor. - The Crankcase Pressure Regulator does NOT affect the lowest temperature the cabinet can achieve (unless it is faulty). The Crankcase Pressure Valve is to protect the compressor from seeing the higher pressures generated when operating at higher temperatures

Refrigerant Gas Charge
The refrigeration system is charged with a suitable R134a refrigerant. The correct system gas charge is achieved by stopping the internal circulating fan motor and charging until a 'full coil of frost' is obtained after about 30 minutes. To check the frosting the internal top cover and rear duct must be removed thus exposing the refrigeration system cooling coil (evaporator) to view. The frost line should cover the complete evaporator including the internal 'surge pot' and may just be seen exiting the rear wall of the chamber but should not reach the compressor dome, this ensures that a correct charge is in the system. If refrigerant has 'leaked' from the system, the source of the 'leak' must be found and rectified before the system is recharged.

'Frosted' Evaporator & 'Frosted' Surge Pot

'Frost' on line to compressor

A 'QUICK' check of the possible gas charge may be done as follows:

- Turn the cabinet user HI-LIMIT fully ANTICLOCKWISE (to stop power reaching the heating element).
- Disconnect power to the internal circulating fan by removing one fan motor wire. (to stop the fan).
- Turn the power to the cabinet back on.
- Wait for 30 minutes. This to allow time for frost to build up of the fridge evaporator inside the cabinet behind the false back.
- Check the suction line into the compressor (copper pipe on the LHS of the compressor), feel the copper pipe where it just exits the black insulation sleeve. Does it feel very cold and 'sweaty' (moisture on the surface of the pipe). If so this is a 'reasonable' indication that the gas charge is normal. (This method is NOT a sure test, only a guide, a full check involves removing the covers and checking for a 'full coil of frost' as in charging the system above).

Crankcase Pressure Regulator Valve:
Fitted just above the compressor on the rear of the cabinet is a Sporlan Crankcase Pressure Regulator Valve (CPR). The purpose of this valve is to limit the maximum operating suction pressure of the refrigeration compressor.
This valve has an adjustment screw located under the RED Plastic Cap on the left-hand side of the valve.
It is HIGHLY UNLIKELY that the factory setting on this valve has altered.
NB: Any adjustment of this valve must ONLY be carried out by a qualified Refrigeration Engineer.
To Check or Adjust the setting of this valve the following procedure should be followed:

- Fit a Suction Service Gauge to the Compressor Access Valve.
- Satisfy yourself that the refrigeration system has a full gas charge (See Refrigerant Gas Charge above).
- Allow the cabinet interior to stabilise at 20^{o}C or above.

The Suction Service Gauge should now be indicating 13/14 PSI, if NOT adjust the valve as follows:

- If the CPR adjusting screw is turned ANTICLOCKWISE the suction pressure will DECREASE.
- If the CPR adjusting screw is turned CLOCKWISE the suction pressure will INCREASE.

Allow time for pressure to stabilise. Once satisfied that it is correct, replace the RED Plastic Cap over the CPR adjusting screw. REMOVE the Suction Service Gauge and REFIT the cap to the compressor access valve (Ensure cap has the neoprene rubber sealing washer inside before refitting).

- Leak test ALL fittings with an Electronic Leak Detector.

Replacing a refrigeration Compressor (Only to be carried out by a Refrigeration Engineer)
If the need to replace the refrigeration compressor arises, the operating manual should be consulted to ensure the correct type is fitted. If the exact model can not be obtained ensure the replacement is of the same or similar capacity as the original. A replacement compressor should come complete with NEW electrics, do NOT be tempted to re-use the old components with the replacement system.
When replacing a refrigeration compressor or if refrigerant has been completely lost from the system, it is ESSENTIAL to replace the system drier and ensure no moisture is present before completely evacuating the fridge system using an external vacuum pump. The system should then be recharged with new refrigerant.

REPLACING MAJOR PARTS

There are several items that may need replacement during the life of the cabinet, these include the following: Fan Motor, Glass door catch, Glass door, temperature sensor, fuse holder, main switch, monitor neon, ZP21 PCB.

Always remove power from the cabinet before attempting to replace any parts, and ensure that electrical safety tests for EARTHING and INSULATION are performed (as per AS/NZS 3760) before returning the cabinet to service.

REPLACING the FAN MOTOR:
The fan motor may have to be replaced if the bearings fail or if it is noisy in operation. When a noise seems to be coming from the fan motor, it is worthwhile checking to ensure that the problem does not lie with the fan ROTOR before changing the motor assembly. Two main types of fan motor are used in this series of cabinets:

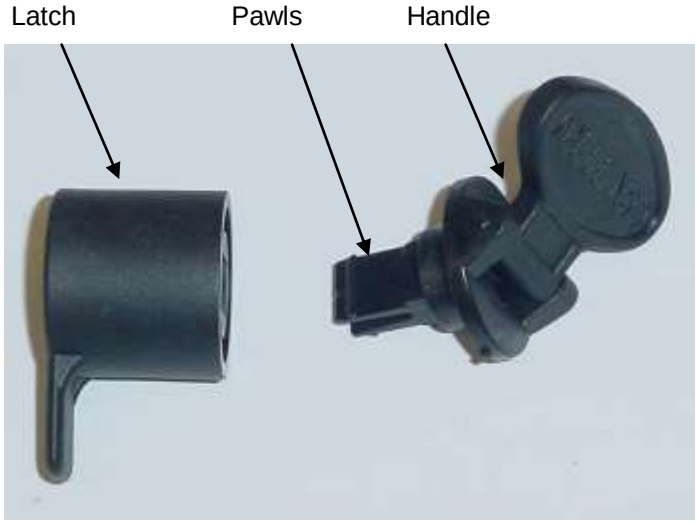
S.E.L Motor (CAT GP1010) or E.G.O motor (CAT GP1000)

Both of these motors are interchangeable (Although the wiring connections may require altering slightly between the models). The E.G.O motor has the wires connected by spade terminals while the S.E.L motor is wired directly to the ZP21 PCB and terminal block. CSL models only use the S.E.L motor.

To replace the motor:

- Open the cabinet outer and inner doors. Remove any samples and shelves from within the cabinet. Remove the two or three self tapping screws along the front of the inner top element cover, carefully lower the front of the cover down ensuring that it comes clear of the sensor probe, then draw it towards you out of the chamber thus exposing the motor internal rotor.
- Remove the three rotor access ring retaining screws and lift the ring clear.
- Remove the rotor retaining nut (turn CLOCKWISE to loosen) and remove the motor rotor, note position of rotor spacer/washer either under retaining nut or under rotor – ensure it is replaced in the same way.
- Remove the top outer lid from the cabinet.
- Disconnect the motor from the cabinet wiring.
- Remove the motor hold down screws and lift the motor clear of the cabinet.
- Use the reverse procedure to replace the motor and return the cabinet to original condition.

REPLACING an inner glass door catch:
The inner glass door is fitted with an extruded plastic door catch, if there is too much tension on the latch one of the plastic handle gripping pawls may break. The catch is supplied complete with both the handle and latch. If the latch part is broken, the handle must be freed from the latch by using a pair of long nosed pliers to gently squeeze the pawls together to allow the handle to be withdrawn from the latch. If ongoing problems are experienced with breaking handles or latches the amount of tension on the glass door should be looked at.



Complete Glass Door Catch

REPLACING an inner glass door:

Occasionally the need may arise to replace the toughened inner glass door, if this occurs the existing door must be accurately measured, noting the exact positions of the two holes for the door hinges and the larger hole for the plastic door catch.

Standard sizes for the inner glass doors are listed below, these should however ALWAYS be checked against the existing glass door before ordering. It is best to get the glass door locally if possible to avoid the risk of damage due to shipping.

Standard Incubators 5.0mm Toughened Clear Floated - All edges arased.

Cat.1050	374mm H x 432mm W	
Cat.1100	495mm H x 507mm W	
Cat.1150	571mm H x 587mm W	
Cat.1200	636mm H x 700mm W	
Cat.1300	462mm H x 700mm W	2off
Cat.1400	614mm H x 700mm W	2off

Cooled Incubators 5.0mm Toughened Clear Floated - All edges arased.

Cat.1050CP	374mm H x 432mm W	
Cat.1100CP	495mm H x 507mm W	
Cat.1150CP	571mm H x 587mm W	
Cat.1200CP	636mm H x 700mm W	
Cat.1300CP	462mm H x 700mm W	2off
Cat.1400CP	614mm H x 700mm W	2off

Tropicool Incubators 5.0mm Toughened Clear Floated - All edges arased.

Cat.1050T	374mm H x 432mm W	
Cat.1100T	495mm H x 507mm W	
Cat.1150T	571mm H x 587mm W	
Cat.1200T	636mm H x 700mm W	
Cat.1300T	462mm H x 700mm W	2off
Cat.1400T	614mm H x 700mm W	2off

6000CP Series Incubators 5.0mm Toughened Clear Floated - All edges arased.

Cat.6150CP	571mm H x 587mm W	
Cat.6200CP	636mm H x 700mm W	
Cat.6300CP	462mm H x 700mm W	2off
Cat.6400CP	614mm H x 700mm W	2off

CSL Incubators 6.0mm Drawn Sheet - All edges arased.

Cat.1200CSL	636mm H x 700mm W
Cat.1300CSL	934mm H x 700mm W
Cat.1400CSL	1236mm H x 700mm W

To remove the glass door, remove the two machine screws and nuts holding the hinges to the glass door, carefully prise the hinges free and remove.

REPLACING outer door hinges or hinge pins:

The outer door is held on by two or more GP door hinges. While it is very unlikely that an actual door hinge will be damaged it is possible to damage or break one of the plastic door hinge pins. The door hinge pin is a firm fit in the lower hinge and a slightly looser fit in the upper hinge.

Door Hinge **Hinge Pin**

REPLACING cabinet adjustable feet:

The cabinet is supported by four adjustable feet. The cabinet may be leveled by screwing the adjustable feet in or out. If an adjustable foot is damaged or broken it may be ordered as a spare part and replaced.

Adjustable foot.

REPLACING a heating Element:

It is possible that if the cabinet has not been used for some time, that the main heating element may absorb some moisture from the surrounding air causing the insulation resistance of the element to become very low. When this condition occurs it may cause tripping of an associated RCD device when power is applied to the element. The best method is to replace the heating element with a new one of exactly the same type and wattage. It is also possible to restore the insulation resistance by drying the element out in a drying oven, usually at 150°C for 48hours. The insulation resistance should be rechecked (using a 500V insulation tester) and if satisfactory (> 1MΩ) it can be returned to service. If the cabinet is operated continuously it should not cause any further problems.

To replace the heating element.

- **Remove the top outer lid from the cabinet.**
- **Disconnect the element from the cabinet wiring.**
- **Open the cabinet outer and inner doors. Remove any samples and shelves from within the cabinet. Remove the two or three self tapping screws along the front of the inner top element cover, carefully lower the front of the cover down ensuring that it comes clear of the sensor probe, then draw it towards you out of the chamber thus exposing the element.**
- **Remove the two self-tapping screws holding the element clips in place or unfold the curled clips to allow removal of the element.**
- **Use the reverse procedure to replace the element and return the cabinet to original condition.**

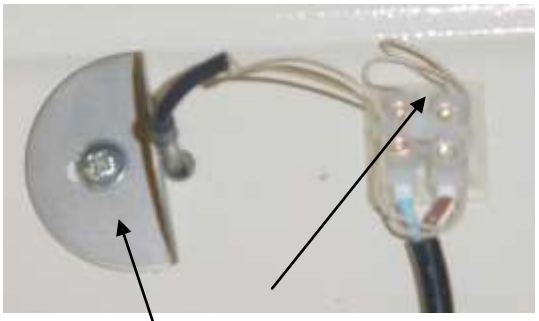
Typical GP Finned Element

REPLACING the Temperature Sensor:

A faulty Temperature Sensor (Stainless steel sheath containing the 1000Ω RTD sensor) is usually indicated by a Fault Alarm Code 4---. If the RTD sensing element goes open circuit, the cabinet will indicate a high temperature thus turning the heating element off and sounding the sensor fail alarm.

To replace the sensor , remove the top outer lid from the cabinet. Locate the small white 2way terminal block into which the sensor wires are terminated. Loosen the terminations and pull the wires out of the terminal block, remove the single self tapping screw holding the Temperature Sensor to the cabinet top, withdraw vertically up. Replace by a reversal of the above (it doesn't matter which way round the wires are connected into the terminal block) ensuring that the stainless steel probe fits correctly through the hole in the inside top cover so that it protrudes about 20mm into the cabinet workspace. Reassemble and test.

RTD Temperature Sensor ZP21



REPLACING the Humidity Sensor: (CSL Incubators ONLY)

A faulty Humidity Sensor (Stainless steel sheath containing the Honeywell HIH-3602 Capacitive Sensor) is usually indicated by a Fault Alarm Code 7---. If the capacitive sensing element fails, the cabinet may indicate wildly fluctuating humidities or just stay at 100% as well as sounding the sensor fail alarm.

To replace the sensor (CAT GP1068), remove the top outer lid from the cabinet. Locate the small white 3way terminal block into which the sensor wires are terminated. Loosen the terminations and pull the wires out of the terminal block, remove the single self tapping screw holding the Humidity Sensor to the cabinet top, withdraw vertically up. Replace by a reversal of the above (ensure the wires are reconnected exactly as before) ensuring that the stainless steel probe fits correctly through the hole in the inside top cover so that it protrudes about 20mm into the cabinet workspace. Reassemble and test.

GP1068 Humidity Probe CSL

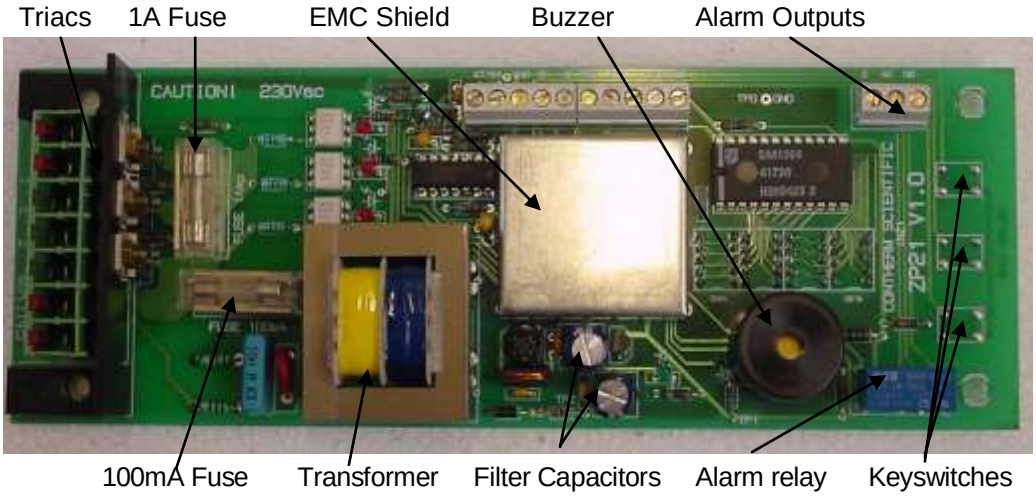
SECTION 13 SERVICING the ZP21 PCB

REPLACING the ZP21 Controller PCB:
If the fault can be traced to the ZP21 Control PCB, the PCB may need to be replaced. We do not recommend local servicing of this PCB as it will usually be more cost effective to replace the board with a new or exchange-repair board.

Most common hardware problems on this PCB are likely to be:

- Blown Fuses. There are two fuses located on the ZP21 PCB itself. The 100mA slow blow fuse is designed to protect the PCB transformer & electronic circuitry, the 1A ceramic delay fuse is designed to protect any auxiliary devices powered via the ZP21's two on board triacs.
- Failure of the main electrolytic filter capacitors. These capacitors tend to 'dry out' over a period of several years and thus become ineffective in filtering the main power supply. The values are 470μF 25V. Whenever a board more than 5 years old is serviced it is recommended that the two filter capacitors also be replaced.
- Failure of the small tactile keyswitches may occur where someone has damaged the switch by pressing too hard or with a sharp object (such as a pencil). A switch may either fail open (not respond to being pressed) or closed (usually due to the overlay depressing the switch continuously). A new switch must be obtained and soldered onto the PCB.

A competent electronics engineer could check some of the PCB operation referring to the schematic diagram (500-47) supplied with this manual. It must be noted however that DANGEROUS VOLTAGES exist on this PCB and suitable precautions must be taken to ensure the safety of personnel undertaking any attempted repair. We stress that it is better to return the whole PCB to Contherm (with a detailed description of the fault and the App No of the cabinet) for repair.



To remove the ZP21 PCB proceed as follows. Remove the top lid from the cabinet and then remove the two self tapping screws that retain the front control panel in place. Carefully tilt the control panel forwards until access can be gained to the control panel components. Unplug the large green terminal at the LHS of the PCB. Loosen the two screws connecting the sensor probe to the PCB. Remove the four 4mm nuts noting that there are nylon washers fitted to the keyswitch end of the PCB and stainless steel washers fitted to the other end. Gently lift the PCB clear of the control panel and replace it with a new or ex-change repair PCB using the reverse procedure. Ensure the 4mm nuts fitted to the large socket end are tightened firmly. Reassemble the cabinet and test.

Description of ZP21 Electronic circuit operation:
The ZP21 PCB is based on a Motorola 68HC705JP7 Microcontroller. The Microcontroller operates at 4Mhz and contains the program code for the basic range of GP controllers, the actual sections of code executed are determined by the settings stored in EEROM non-volatile memory (X2402).
The PCB mains input is protected by a 100mA fuse and a 275L Varistor which condition the input to a 230V to 2x10V transformer. There are two output supplies used by the system, a regulated +5V supply on **TP1** and an unregulated –7V supply on **TP2** (used for the Op-Amps).
The micro communicates with both non-volatile ram (X2402) and the L.E.D display driver (SAA1064) via an implementation of the I^2C bus protocol. All Led's, buzzer, buttons and triac opto drivers (MOC3063) are controlled directly off the micro bus. The external Alarm relay is buffered by a BC337 transistor. The Zero-Crossing triac drivers (MOC3063) power the three output triacs (STA600W), ELEMENT, FRIDGE and FAN/AUX.
The current through the two auxiliary triacs is protected by a 1Amp Fuse. The three main triacs rely on the black anodised heatsink for thermal dissipation. The 7-segment display is controlled directly by the display chip (SAA1064).
Temperature is measured using a 1000Ω RTD sensor (3.908Ω/^{o}C). The sensor is supplied with a constant (1.05mA) current to ensure it is essentially linear over the entire 0 – 300^{o}C possible temperature range. The output from this sensor can be measured at **TP4** as 10mV/^{o}C. There is an internal offset correction applied to this input of 50^{o}C (500mV) therefore the typical output at +20^{o}C should be about 700mV.
The temperature output voltage is processed by one of the microcontroller's A/D inputs where any internal offset (Calibration) constants are applied before displaying the result on the L.E.D display.

Relative Humidity (CSL Models ONLY) is measured using a Honeywell HIH-3602 or similar capacitive sensor which is buffered by a non-inverting op-amp (1/4 LM324). The signal from this sensor is typically a constant offset of 800mV + 30mV/%RH and may be measured at **TP3**. The humidity output voltage is processed by one of the microcontroller's A/D inputs where any internal offset (Calibration) constants are applied before displaying the result on the L.E.D display.
All test point voltages mentioned above are referred to **TP0** (Ground).

One section of the LM324 is configured as a buffer for a simulated RS232 output, which can be used to communicate with an external PC (1200Baud, 8, N, 1).

The operational type of cabinet is chosen by the following button sequence:
Turn the cabinet OFF at the main switch. Wait 30 seconds. Hold down BOTH the 'UP' & 'DOWN' buttons together and turn the main switch back On while keeping these two buttons depressed. As soon as the 8888's appear on the L.E.D display release the two buttons and press the appropriate button(s) to select the correct cabinet operating mode.

'TEMP' = Standard Incubator. 'TEMP' & 'TIME' = Tropicool Incubator.
'PROG' & 'TIME' = Cooled Incubator (Now used for ALL models of Cooled incubators).
'RAMP' = Standard Oven. 'TIME' = CSL Incubator.

NB: Selecting a mode that is **DIFFERENT** from the factory supplied and intended type may cause unexpected results and /or damage to the cabinet. **ONLY** attempt to select the original design type of cabinet operation.

SCHEMATIC DIAGRAM ZP21 (500-47)