A GUIDE TO TROUBLESHOOTING CONTHERM CHAMBER PROBLEMS

Almost all of Contherm's products are designed to achieve and maintain a controlled environment for product testing or lifetime simulation.
When a problem occurs with one of these products it can be frustrating to locate the cause simple because of the time factor involved of stabilising the chamber at the normal operating settings. Many of the common problems stem from the same causes.

CHRONOLOGY:	**1980**	**1982**	**1984**	**1986**	**1988**	**1990**	**1992**	**1994**	**1996**	**1998**	**2000**	**2002**	**2004**
Water Baths:		ZP13A			ZP17A				ZP17B				
Analog GP Ovens & Incubators		ZP13A			ZP17A				ZP17B				
Digital GP Ovens & Incubators					ZP19				ZP20			ZP21	
Designer Series Ovens & Incubators													ZP21LC
Precision CO2 Incubators		PLCS				PLCS4	PLCS5		ZP22				
Precision Environ (HS/RHS/LT)		PLCS				PLCS4	PLCS5						
Plant Growth		PLCS				PLCS4	PLCS5						

GENERAL

Whenever you are working on a Contherm chamber always get the MODEL No: CAT 1050 etc
AND the APPLIANCE No: 97123 (first two digits=year, next three=cabinet manufacture number)
This information will tell us exactly what was fitted to the cabinet at time of manufacture.

There is often confusion over what type of temperature sensor goes with what type of PCB
The general rule is:

ZP13,ZP13A = Diode sensor (type IN914 or IN4148) standard signal diode.
ZP17,ZP17A,ZP17B = Thermocouple Type 'K'
ZP19,ZP20 = Thermocouple Type 'K'
ZP21 = 1000Ω RTD (Platinum resistance 0.00390Ω/Ω/^{o}C
ZP21LC/WB = 1000Ω RTD (Platinum resistance 0.00390Ω/Ω/^{o}C
ZP22 = LM35CAZ or LM35D – Solid state integrated temperature sensor
PLCS = Diode sensor (two type IN914 diode in series)
PLCS4, PLCS5 = LM35CAZ or LM35D – Solid state integrated temperature sensor

COMMON PROBLEMS

PLCS

PLCS (Precision Logic Control System) – This controller was Contherm's first attempt at a microprocessor based control unit, the control unit is contained in a separate box connected to the Interface PCB (located inside the chamber top) by a 'flying' 22way ribbon cable.
To make any changes to the set points a small 'lockout' pin is fitted into an audio jack socket on the RHS of the control unit.

Most of the problems are NOT in the control unit, they are usually in the Interface PCB.

1) 9volt rechargeable battery (inside control unit) no longer hold a charge, if the power goes off all the settings are lost and a '3---' alarm sounds every minute. – replace the battery with a new rechargeable one.
2) The cabinet starts alarming for no reason, sometimes intermittently but other times continuously – The two large filter capacitors on the Interface PCB have dried up (3300uF 16v & 1000uF 25v) replace them with new ones. We do this routinely on any unit we service.
3) The cabinet does not operate at all (the controller lights are on) – The TIME is not set or has expired, reset the timer to manual operation.

ZP13A

ZP13A – This is an analog control system with proportional control. The PCB is located directly behind the control panel and has two red LED's and a large control knob to set the temperature. The original dial ranges were 0-80 & 70-200. One of the LED's (monitor) should be on whenever the PCB has power applied to it while the other LED (heater) comes on when power is applied to the heating element. These boards used a LM324 op amp and a CA3059 (zero crossing triac driver ic) to control the heating element. The CA3059 has a fairly high failure rate. Calibration is achieved by a small trimmer potentiometer located at one end of the PCB. There are two soldered links to change the PCB from Incubator (L) to Oven (H) mode. The temperature sensor is an IN914 signal diode (transistor in waterbaths).

1) The cabinet does not control correctly or not at all. The most likely problem is due to the 100uF 16v capacitor drying out. Replace this component whenever you have to work on the PCB. The next most likely problem is due to failure of the CA3059 IC.

ZP17A, ZP17B

ZP17A, ZP17B – This is an analog control system with proportional control. The PCB is located directly behind the control panel and has two red LED's and a large control knob to set the temperature. The original dial ranges were 0-100 & 0-200. One of the LED's (monitor) should be on whenever the PCB has power applied to it while the other LED (heater) comes on when power is applied to the heating element. These boards used a LM324 op amp and a ICL7650/52 (chopper stabilised amp) to measure the temperature and a MOC3043/63 (zero crossing triac driver) to control the heating element. Calibration is achieved by a small trimmer potentiometer located at one end of the PCB. There is an onboard jumper to change the PCB mode from Incubator (L) to Oven (H). The temperature sensor is a type 'K' thermocouple.
The ZP17B was designed to give greater clearances on the mains connector which is also much heavier (30A instead of 12A).

1) The cabinet does not control correctly or not at all. The most likely problem is due to the 470uF 16v capacitor drying out. Replace this component whenever you have to work on the PCB.

2) The mains terminal on the connector burns out (ZP17A only). – Replace BOTH the connector & socket, recommend upgrading to a ZP17B.

ZP19

ZP19 – This is a digital control system with PID control. The PCB is located directly behind the control panel and has two red LED's and a large LCD digital display & two/three buttons. The incubator range is 0-100 and the oven range is 0-300. One of the LED's (monitor) should be on whenever the PCB has power applied to it while the other LED (heater) comes on when power is applied to the heating element. These boards used a Motorola 6805E2 microprocessor, LM324 op amp and a ICL7650/52 (chopper stabilised amp) to measure the temperature and a MOC3043/63 (zero crossing triac driver) to control the heating element. Calibration is achieved by a calling up a 'CAL' routine by first selecting the temperature set point and then pressing BOTH the 'UP' & 'DOWN' buttons together. The type of cabinet is determined by the type of EPROM fitted Incubator, Oven, MCP). The temperature sensor is a type 'K' thermocouple. Settings are retained in E^2ROM.

1) The cabinet does not control correctly or not at all. The most likely problem is due to the 470uF 16v capacitor drying out. Replace this component whenever you have to work on the PCB.

2) The cabinet main connector gets burnt or the triac fails due to overheating (oven sizes greater than 240). Replace the main connector & socket – recommend upgrading to a ZP20 PCB.

ZP20

ZP20 – This is a digital control system with PID control and an extra triac output which can be used to control a fridge solenoid. This controller was designed to give greater track clearances and to upgrade the mains connector from 12A to 30A. It can be fitted into the same physical space as the ZP19 but the WIRING TO THE MAINS CONNECTOR IS DIFFERENT. The PCB is located directly behind the control panel and has two red LED's and a large LCD digital display & two/three buttons. The incubator range is 0-100 and the oven range is 0-300. One of the LED's (Set) comes on whenever the set points are being displayed while the other LED (heater) comes on when power is applied to the heating element. These boards used a Motorola CPU 68HC705P6 microcontroller, LM324 op amp and a ICL7650/52 (chopper stabilised amp) to measure the temperature and two MOC3043/63 (zero crossing triac drivers) to control the heating element & fridge solenoid. Calibration is achieved by a calling up a 'CAL' routine by first selecting the temperature set point and then pressing BOTH the 'UP' & 'DOWN' buttons together. The type of cabinet is determined by a special button sequence when the cabinet is first turned on & the '8888's are shown on the LCD display. The temperature sensor is a type 'K' thermocouple.

Cabinet Type by pressing the following button combinations during the '8888's sequence.
'TEMP = Standard Incubator
'TEMP' + 'TIME' = Cooled Incubator
'PROG' + 'TIME' = MCP Incubator
'RAMP' = Standard Oven

1) This PCB has proved to be extremely reliable! – the main problem is due to customers accidentally changing the 'sex' of the cabinet by pressing the 'TEMP' button immediately after turn on thereby changing a standard oven to an incubator. The incubator display shows temperature to 0.1°C while the oven only displays to the whole degree. 'Re-sex' the cabinet using the button combinations given earlier

ZP22

ZP22 – This is a digital CO_2 control system with PID control and an extra triac outputs which can be used to control the fan, co2 solenoids 1&2 and the door heater as well as the main element. This controller uses special combined triac & triac drivers and feeds all devices from the live lines. A separate LED display panel is fitted to the front door of the incubator. The incubator temperature range is Amb+5 to 50 and the co2 control range is 0% – 20%. This board uses a Motorola CPU 68HC705P6 microcontroller, LM324 op amp and an internal A/D converter to measure the temperature and five MOC2A60 or equivalent (triac/triac drivers) to control the output devices. Calibration is achieved by a calling up a 'CAL' routine by first selecting the temperature set point and then pressing BOTH the 'UP' & 'DOWN' buttons together. The temperature sensor is an LM35CAZ or LM35D solid state sensor and the CO_2 is measured by 'thermal conductivity' using a special thermistor sensor. The Co2 measuring sensor can be 'dummied' by substituting a 560Ω resistor.
A small trimmer potentiometer on the interface board sets the 'center' level for the thermistors at 500mv (± 50mV) when the cabinet is stabilised at operating temperature. Either a ZP10a PCB (early units) or a HONEYWELL HYCAL humidity sensor measures humidity.

ZP21

ZP21 – This is a digital control system with PID control and three triac outputs which can be used to control a fridge solenoid and lighting. This controller was designed to give a clearer display and PHASE fed outputs. It CANNOT be used to replace a ZP20 as the triacs are PHASE driven and the WIRING TO THE MAINS CONNECTOR IS DIFFERENT. The PCB is located directly behind the control panel and has two red LED's and a small LED digital display & three buttons. The incubator range is 0-100 and the oven range is 0-300. One of the LED's (Set) comes on whenever the set points are being displayed while the other LED (heater) comes on when power is applied to the heating element. These boards used a Motorola CPU 68HC705JP7 microcontroller, LM324 op amp and a 1000Ω RTD to measure the temperature with a higher resolution A/D subsystem, also has onboard facilities to measure RH, a separate Alarm output relay and three MOC3043/63 (zero crossing triac drivers) to control the heating element & AUX outputs. Calibration is achieved by a calling up a 'CAL' routine by first selecting the temperature set point and then pressing BOTH the 'UP' & 'DOWN' buttons together. The type of cabinet is determined by a special button sequence when the cabinet is first turned on & the '8888's are shown on the LCD display. The temperature sensor is a 1000Ω RTD. The resolution of the display is 0.1^{o}C in either Oven or Incubator modes.

Cabinet Type by turning power on while holding down BOTH the 'TEMP' and 'TIME' buttons together, releasing the buttons as soon as the 8888's appear and then pressing the following button combinations during the '8888's sequence.
'TEMP = Standard Incubator
'TEMP' + 'TIME' = Cooled Incubator
'PROG' + 'TIME' = MCP Incubator
'RAMP' = Standard Oven
'TIME' = Stability Incubator (CSL)

PLCS4/PLCS5

PLCS4/5 – These are digital control systems with PID control and an extra triac outputs which can be used to control a variety of devices. While the PLCS5 can fit into the same physical space as the earlier PLCS4 the WIRING is TOTAL DIFFERENT. The PLCS4 controller uses discrete traces and discrete triac drivers and returns the control device to the NEUTRAL line while the PLCS5 controller uses special combined triac & triac drivers and feeds all devices from the PHASE lines. A separate LED display panel (the same one is used for both PLCS4 & PLCS5) is fitted to the front door of the incubator. The incubator temperature range is dependent on the type of cabinet & microcontroller fitted and can range from $-40^{o}C$ to $+100^{o}C$. This board uses a Motorola CPU 68HC705C8/C9A microcontroller, LM324 op amp and an internal A/D converter to measure the temperature and multiple MOC2A60 or equivalent (triac/triac drivers PLCS5) to control the output devices. Calibration is achieved by a calling up a ‘CAL’ routine via the ‘DIAGNOSTIC’ button on the front panel. The temperature sensor is an LM35CAZ or LM35D solid state sensor and the humidity sensor is usually the ZP10a PCB. Humidity is injected into the chamber by ‘pump mist injection’. Settings are stored in RAM held up by a ‘SUPERCAP’. The set points are typically retained for 3 days without power. Calibration factors are stored in E^2ROM.

1) The most common problem with these control systems is failure of the water pump for humidity injection. Early pumps were 12V DC units (powered by a ‘battery charger’). These were superceded by a 230V AC unit, which has again been replaced in the last year or so by a 12V DC unit.

2) The latest units are fitted with a Steam Injection System – this consists of a small (200W) spiral wound heating element around a solid grooved block. The water is injected into the block (held at about $+250^{o}C$ by the heater) via a small pump located in the same position as the original mist injection pump. The water rapidly turns to steam and is allowed to enter the cabinet via a small rubber hose.

3) Later units (after January 2004) are fitted with new black triacs (Omron) which have a higher surge rating than the slim white triacs.