C O N T H E R M

SERVICE MANUAL

CAT PLCS4

PRECISION INCUBATORS

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1994/5:94
(WP:SERVICEP.002)

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 only free of charge of components parts found to be defective 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, the Company shall service the affected component and despatch, freight prepaid, within ten working days of receipt. 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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CONTENTS

SECTION: 1: Definition of Terms

SECTION: 2: Introduction & Specifications

SECTION: 3: Operating Instructions

SECTION: 4: Calibration

SECTION: 5: Theory of Operation

SECTION: 6: Diagnostics

SECTION: 7: Troubleshooting and Maintenance

SECTION: 8: Parts Lists for Spares and Accessories

SECTION: 9: Fault Codes

SECTION: 10: Circuit Diagrams

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) TEMPERATURE VARIATION:
The difference at any moment between the temperature at the centre of the working space and at any other point in the working space.

d) TEMPERATURE FLUCTUATION:
The short term changes in temperature at any point in the working space.

e) TEMPERATURE DRIFT:
Any long term changes in cabinet temperature during continuous operation of the closed cabinet.

f) TEMPERATURE OVERSHOOT:
Any excess of actual over desired cabinet temperature during a heating up period.

g) TEMPERATURE REPRODUCIBILITY:
Temperature regained without alteration to controls.

N.B.: All the above apply with an **empty** Cabinet.

SECTION: 2: INTRODUCTION

This manual is designed to be used by SERVICE personnel who are already familiar with the basic operation & use of the Contherm range of precision cabinets. The first sections of this manual are essentially a repeat of the standard customer's instruction manual.

SPECIFICATIONS

All specifications are quoted for
Cabinet Temperature ..... 20°C
with Ambient Temperature ..... 20°C

MECHANICAL:

Construction: ..... High quality stainless steel interior, poured foam insulation, with non-jar magnetic door catch 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 - PLCS4 Controller - Mechanical Convection.

a) Temperature -
Nominal Range:
RHSLT . ..... -40°C - 70°C
RHS . ..... -10°C - 70°C
CO2 . ..... AMB + 80°C - 50°C
Temperature Fluctuation: . . .(30 minutes)± 0.5°C
Temperature Variation: ..... ± 2.0°C
Initial Overshoot: . ..... + 2.0°C
Temperature Reproducibility: .. .. ± 0.3°C
Settability: ..... 0.1°C
Operating Ambient: ..... 10°C - 25°C
Mains Voltage Range:. . . . . 210-270 AC 50Hz
NB: Lowest quoted temperature ONLY achievable in a maximum ambient of +20°C.

b) **Relative Humidity** - (**OPTION**)
Display Resolution: 1% RH Unit
Display Range: 0 - 100% RH Units
Control Range: Typically 40-95% RH Units
Accuracy - as calibrated, typically: +± 5% RH Units (over 20 - 60°C and 50 -90% RH)

c) **Timer** -
Timing range : 1 minute - 99 hours 59 minutes
Timing Resolution : 1 minute

Manual or Timed Operation:
(**NB:** The symbol `|:|' means `run continuously').

d) **Refrigeration** - (**OPTION**)
Automatic control, hot and cold cycle.

Used for Dry Temperature control and Dehumidification with Automatic Hot Gas Defrost.
Defrost may also be initiated manually via DIAGNOSTIC selection.

e) * **Day-night Lighting -** (**OPTION**)

Manual Lighting: Lights controlled via Panel Mounted On/Off Switch.

Automatic control: Lights selectable for either ON or OFF via programmable control settings.

f) **Programmable** - up to nine (9) User Programs may be set and run in conjunction with a 99 cycle counter.

g) * **Ramping facility -** (**OPTION**)
allows controlled cabinet Ramp rates from 0.1°C to the maximum achievable in 0.1°C increments.

h) **Computer -**
RS232c computer output to enable reading and changing of current program settings.

SPECIAL FEATURES

A) Temperature Section -

Ease of Operation
All parameters displayed on different LED readouts.

Displays correctly colour coded to minimize confusion.
Separate set point selection for each parameter.

Automatic Setting of Hi-Limit Alarm to +2°C above Set Point.
Automatic Control of Refrigeration.

B) Diagnostic selection to aid in troubleshooting of problems.

C) Full Alarm Facilities -
Both VISUAL (coloured RED) and AUDIBLE alarms and alarm codes.

D) Directly heated glass inner door, providing a good seal for the chamber contents while minimising condensation.

E) Outer door fitted with a DOOR AJAR switch to turn off the
internal circulating fan and heating element to minimize
loss of internal atmosphere during door openings.

SECTION: 3: OPERATING INSTRUCTIONS

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

Preparation before Operating:

1) Visually check for any signs of damage to cabinet or components. In the event of any discernible damage notify the Carrying Agent immediately.

2) For best results an independent line to Main Board is recommended (this is especially important if the cabinet is to be operated in an electrically noisy environment), with a rating at least equal to that shown on the Data Plate.

3) Ensure that Pump Spray tank (inside base of cabinet) is filled with Distilled Water before attempting Humidity operation. If Humidity operation is attempted without filling tank a LOW WATER LEVEL alarm will sound (Alarm 6---).

To Fill Tank: Open lower hinged door, lift lid off tank at LHS top and CAREFULLY fill to with 50mm of tank top with DISTILLED water. Replace lid and close door.

4) Install shelves in desired positions.

5) Read Controller Operating Section before using Controller.

6) Turn cabinet Main switch ON, (Panel at top RHS of cabinet)

7) Set Program(s) to desired operating parameters.

8) CONFIRM factory calibration by monitoring temperature, humidity etc with your own calibrated thermometers and make adjustments as per the CALIBRATION section if necessary. NB: The factory calibration factors need to be checked if power has been removed from the cabinet for more than 48 hours.

ALARMS

There are TWO main types of alarm used in the PLCS4 control system:

A) **STANDARD ALARMS:** - 01,02,04,05,06,07,08,10,11,12
These alarm numbers indicate a problem with cabinet control, IE over-temperature, low water, faulty sensor etc.
To **CANCEL** these alarms press the DIAGNOSTIC select button THREE times. (Some of these alarms can also be cancelled by pressing ANY button). ENSURE that note is taken of the alarm indication and that any indicated problem is attended to.

B) **03 & 09 ALARMS:** - 03,09
These alarms are SPECIAL and can ONLY be cancelled by using the SPECIAL procedure outline below. These alarms indicate EITHER that the cabinet MAY have lost some of its settings (03) most likely due to being disconnected from the power for more than 48 hours, OR that INTERFERENCE (09) to the cabinets internal operating system has occurred, due to external electrical interference or electronic system malfunction.

To ensure that the required settings and CALIBRATION factors are checked it is necessary to EXAMINE ALL the program settings and cycle counter for PROGRAM No1 AND the temperature & HUMIDITY calibration factors. If there was more than one program running the settings for the additional programs should also be checked but this is NOT essential in order to cancel the alarm.

The following procedure is recommended:

1) Press the 'SELECT' button adjacent to the temperature green led parameter display and examine each parameter setting. If the setting is NOT correct adjust it using the 'UP" and 'DOWN' buttons. Press 'SELECT' again if the 'SET' led above the display is still on so that the 'SET' led goes off, repeat for EACH of the other green led parameters.

2) Press the 'SELECT' button adjacent to the 'Diagnostics/Alarms' red led display and using the 'UP' button obtain diagnostic No20 (Calibrate Temp), check that the current value is correct.
(Check against the factory Cal Factor - on front cover of manual, OR other known Cal factor), if NOT correct, press 'SELECT' again and adjust cal factor using 'UP' and 'Down' buttons. If the red led above the display is ON press the 'SELECT' button again to make it go off.

3) Press the 'SELECT' button adjacent to the 'Diagnostics/Alarms' red led display and using the 'UP' button obtain diagnostic No21 (Calibrate RH), check that the current value is correct.
(Check against the factory Cal Factor - on front cover of manual, OR other known Cal factor), if NOT correct, press 'SELECT' again and adjust cal factor using 'UP' and 'Down' buttons. If the red led above the display is ON press the 'SELECT' button again to make it go off.

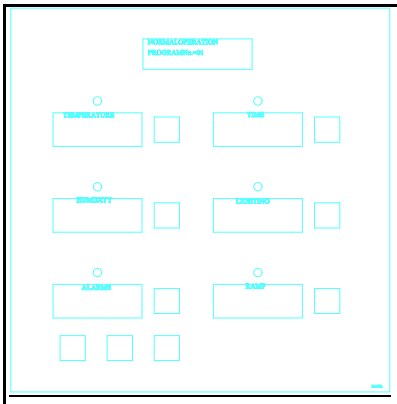
4) Press the 'PROG' button just adjacent to the 'UP' button and step through the three program settings (select program, set cycle count and set max prog No).

5) Having carried out all of the above pressing any parameter button will now cancel the alarm. (ie press the 'TEMPERATURE' select button. If the red led above the 'TEMPERATURE' parameter display is ON press the 'SELECT button again.

N.B. 1) To ensure correct refrigeration operation and longest life, the fridge condenser MUST be kept free of dust by regular cleaning, at least once every 3 months (use a nylon brush).
A clear space OF **AT LEAST** 100mm MUST be allowed around the entire sides and top of the cabinet to allow for correct ventilation of the refrigeration and fan motors.

2) Unless changed by the customer an automatic defrost cycle will be started every four hours when running at low temperatures. This defrost is necessary to keep the refrigeration evaporator free of ice buildup which would otherwise impair the ability of the

cabinet to maintain its operating temperatures. The defrost sequence is designed to minimise any changes to the cabinet temperature during the defrost period but some change in conditions cannot be avoided.



CONTROLLER OPERATION:

The PLCS4 Control System is Contherm's latest offering in a series of Microprocessor based Control Systems. The front control panel is fitted with a two line by 16 character LCD display to allow the controller to be easily setup for all operations. An additional recessed Control/Monitor Panel is fitted at the top RHS of the cabinet.

1) The LCD display shows information on the current status of the cabinet (NORMAL OPERATION, DEFROSTING, STOPPED, FAULT etc) and also displays prompts when setting parameters, changing programs etc.

2) In NORMAL operation the values displayed in the boxes for the installed parameters represent the current value measured by the Controller.

3) The `UP' and `DOWN' buttons below the DIAGNOSTIC/ALARM display are used to make any adjustments to the Controller set points.

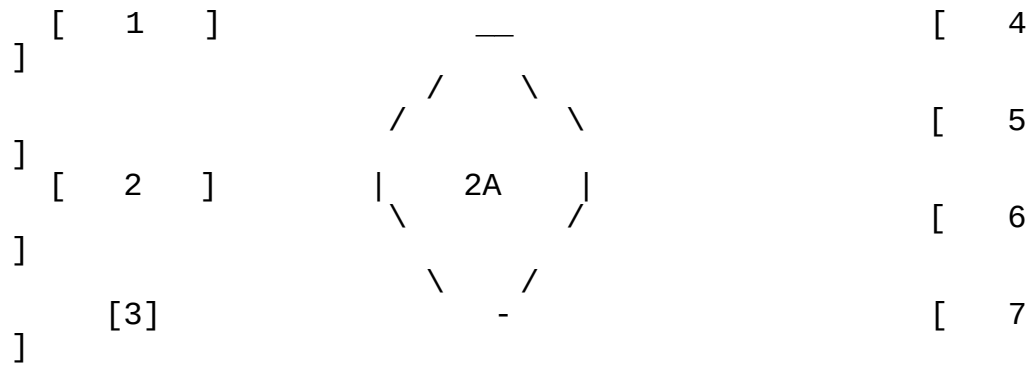
4) The `SET' led's will illuminate if the selected parameter has been selected for adjustment.

5) The `SELECT' buttons are used to `select' a parameter for adjustment.

Additionally there MAY be a LOCKOUT key which will prevent ANY of the control panel buttons from working when in the LOCKED position.
(The LOCKED position is when the key is able to be removed).

CONTROL / MONITOR PANEL

An additional Control/Monitor (CM) panel is fitted at the top RHS of the cabinet. This panel contains the Cabinet Main ON/OFF Switch, User settable ELEMENT High Limit, Main Circuit breaker and various monitoring neons to aid in determining the exact state of operation.



1) - **MAIN ON/OFF** switch allows power to flow to the cabinet. The Green neon will be illuminated when this switch is ON and the cabinet is plugged into the Mains.
NOTE: Latest versions may have a thermal-magnetic circuit breaker fitted in place of the main switch.

2) - **MONITOR** neon. This RED neon indicates if the USER ELEMENT LIMIT has tripped, when the neon is illuminated NO POWER will be supplied to the cabinet heating elements (this is an additional safety against inadvertent cabinet overheating).

2A) - **USER ELEMENT HI-LIMIT.** This is a mechanical thermostat which directly monitors the temperature of the cabinet ELEMENT, if the temperature EXCEEDS this setting the power to the element will be switched OFF and the associated monitor neon will illuminated when the controller attempts to provide power to the element. This thermostat should be set to operate JUST ABOVE the highest temperature that the User's samples will safely withstand.

TO SET THE USER HI-LIMIT: With the cabinet stabilised at the highest temperature of interest, advance the HI-LIMIT knob **CLOCKWISE** so that when the HEATER neon (6) is ON the **MONITOR** neon (2) is OFF, then turn the HI-LIMIT knob SLOWLY anticlockwise until the MONITOR neon comes on. When the HEATER neon attempts to come on, advance the knob clockwise again until the MONITOR neon is JUST off when the heater neon comes on, the User HI-LIMIT is now set.

3) - **MAIN CIRCUIT BREAKER.** This circuit breaker is designed to protect the cabinet against long term electrical overload or short circuit conditions and will remove power to the cabinet.

TO RESET CIRCUIT BREAKER: Press the small RED plunger INWARDS and then release.

4) - **HOT GAS SOLENOID.** This neon is illuminated when the refrigeration HOT-GAS (HOT CYCLE) solenoid is energized. When this solenoid is energized the refrigeration is trying to HEAT the cabinet, the effect of this solenoid will override the effect of the LIQUID solenoid, in normal operation this solenoid may be energized on a regular cycle. The solenoid may be tested via the DIAGNOSTIC system by selection number 4 (TEST HOT SOLN).

5) - **LIQUID SOLENOID NEON.** This neon is illuminated when the refrigeration LIQUID solenoid (COLD CYCLE) is energized. When this solenoid is energized the refrigeration system is trying to COOL the cabinet, this neon should be illuminated whenever the Temperature Set point is below +60.0oC and the cabinet is on but NOT in a Defrost.
The solenoid may be tested via the DIAGNOSTIC system by selection number 5 (TEST COLD SOLN).

NB: If EITHER of the refrigeration solenoids are energized the Main Refrigeration Compressor will run.

6) - **HEATER NEON.** This neon will be illuminated whenever power is being applied to the HEATING ELEMENTS. When the cabinet has stabilised at Temperature this neon should be pulsing at a steady rate.

7) - **HUMIDITY** pump. This neon will be illuminated whenever power is applied to the humidity spray pump. This pump will inject a very fine mist of water directly into the internal circulating fan system which will then be rapidly dispersed into the air in order to RAISE the Relative Humidity level. The pump may be tested via the DIAGNOSTIC system by selection number 3 (TEST RH INJECT).

The NEONs on the CONTROL/MONITOR panel have been provided both for control purposes and as a troubleshooting aid, for instance, if the cabinet does not seem to be cooling when you expect it to cool, just by looking at the state of the neons the current state of operation can be determined (Heater should be off,

LIQUID neon should be on, HOT-GAS neon should be OFF OR possible on intermittently).

SETTING UP

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

Program No 1
- Temperature = 20.0°C
- Humidity = 70.0%
- Time = 6:00 (SIX HOURS)
- Lights = OFF (0000)

Program No 2
- Temperature = 15.0°C
- Humidity = 70.0%
- Time = 6:00 (SIX HOURS)
- Lights = ON (1111)

No of Cycles = 10

1) Press the button marked `PROG' (adjacent to the UP & DOWN buttons), the LCD display will say `SELECT PROGRAM', use the UP & DOWN buttons to adjust the Program Number to `01'. Press the `PROG' button AGAIN, the LCD display will then say `SET CYCLE COUNT', use the UP & DOWN buttons to set the cycle counter to `00'. (This ensures that the cabinet will stay OFF until we are ready to run it!).
Press the `PROG' button a third time, the LCD display will say `SET MAX PROG No'. Since we are going to have TWO Programs, use the UP & DOWN buttons to set the MAX PROG No to `02'. This will allow only Programs 1 & 2 to be considered when running the cabinet. Press the `PROG' button once more (or just wait for 10 seconds) to return the Controller to its `NORMAL OPERATION' mode.

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

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

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

SET UP PROGRAM NUMBER 1:

a) Set TEMPERATURE

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

Use the `UP' and `DOWN' buttons (below the Diagnostic/Alarm display) to adjust the Set Point to 20.0oC. When the adjustment is complete you can exit the Temperature Set mode by pressing the `SELECT' button again OR just wait (10 seconds) without pressing any buttons and the Controller will automatically return to normal operation.

b) Set TIME

The TIME display shows how long the cabinet will run this Program before it changes to the second Program.
Press the `SELECT' button adjacent to the TIME display - The display will blank for 2 seconds, the `SET' led above the display will turn on (indicating that this parameter is now in the set mode) and the Current Set Point will be displayed. The LCD display at the top of the panel will be showing `SET TIMER'. Use the `UP' and `DOWN' buttons (below the Diagnostic/Alarm display) to adjust the set point to 6:00. When the adjustment is complete you can exit the Timer Set mode by pressing the `SELECT' button again OR just wait (10 seconds) without pressing any buttons and the Controller will automatically return to normal operation.

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

c) Set HUMIDITY

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

OR just wait (10 seconds) without pressing any buttons and the Controller will automatically return to normal operation.

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

d) Set LIGHTING (Used for viewing purposes only).

Press the `SELECT' button adjacent to the LIGHTING display. The display will blank for 2 seconds, the `SET' led above the display will turn on (indicating that this parameter is now in the set mode) and the Current Set Point will be displayed. The LCD display at the top of the panel will be showing `SET LIGHTING'. Use the `UP' and `DOWN' buttons (below the Diagnostic/Alarm display) to adjust the set point to 'OFF'
When the adjustment is complete you can exit the Lighting Set mode by pressing the `SELECT' button again OR just wait (10 seconds) without pressing any buttons and the Controller will automatically return to normal operation.

SETUP PROGRAM NUMBER 2:

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

SELECT PROGRAM No 2

Press the `PROG' button (at the bottom of the panel adjacent to the `UP' and `DOWN' buttons) and look at the LCD display (top of the panel), the display will show the words `SELECT PROGRAM'. Use the `UP' and `DOWN' buttons to adjust the Program number (shown on the lower line of the LCD display) until it reads `No = 02'.
Press the `PROG' button AGAIN. The top line of the LCD display will now show `SET CYCLE COUNT' and the lower line will show the number of cycles on the Cycle Counter. The number of Cycles was set earlier and so the LCD should display `No CYCLES = 00'. Press the `PROG' button TWICE to return to normal operation, you should now adjust the set points for Program Number 2 in the same way as for Program Number 1.

You must now decide which Program (1 OR 2) that you wish the cabinet to START on, let us say it is Program Number 1.
Press the `PROG' button and use the Up & Down buttons to select Program Number 1.
Press the `PROG' button again and set the number of cycles = `10' (using the Up & Down buttons), press the `PROG' button twice more and the cabinet should start running from Program Number 1.

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

NB: When the lighting display is set for `On' this means the lights will be turned ON for the duration of this Program, a setting of `OFF' will turn the lights OFF.
Any MANUAL light switches must be in the appropriate position for the lights to function correctly.

SPECIAL PROGRAMMING HINTS

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

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

SECTION: 4: CALIBRATION

Final calibration for the PLCS4 range of cabinets is achieved by adjusting the CALIBRATION FACTORS for TEMPERATURE and HUMIDITY, these adjustments are made through the front panel DIAGNOSTIC section.

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

If the CAL FACTORS are lost the controller will set them to the default value (50). This could result in a temperature error of up to +- 5.0°C or a humidity error of up to +- 5% RH.
The factory CAL FACTORS for the cabinet are noted on the inside front cover of the instruction manual and also on the test report that comes with the cabinet.

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

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

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

20 - CALIBRATE TEMPERATURE. This selection will allow the internal calibration VALUE to be changed, this in turn will change the temperature calibration for the cabinet, the minimum value is `00' and the maximum value is `99' when calibrated this value should be NOTED and WRITTEN down so that it may be replaced if the controller loses the value (this will occur if power has been removed from the controller for more than 3 days!). Use the up & down buttons to adjust the calibration value.

EG: If the display was reading 2.0°C too low, then INCREASE the calibration value by 20 (20=2.0°C) to obtain the correct calibration.

21 - CALIBRATE HUMIDITY. This selection will allow the internal humidity calibration VALUE to be changed, this in turn will change the HUMIDITY calibration for the cabinet, the minimum value is `00' and the maximum value is `99' when calibrated this value should be NOTED and WRITTEN down so that it may be replaced if the controller loses the value (this will occur if power has been removed from the controller for more than 3 days!). Use the up & down buttons to adjust the calibration value.

EG: If the display was reading 2.0% too low, then INCREASE the calibration value by 20 (20=2.0%) to obtain the correct calibration. This calibration value is normally 50, and must only be used to make SMALL adjustments to the humidity calibration. If large adjustments are required they should be performed using the screwdriver adjustment on the sensor box to alter the capacitive trimmer on the ZP10a PCB.

* 22 - CALIBRATE CARBON DIOXIDE. (If cabinet is a CO2 cabinet) This selection will force the cabinet to perform a CO2 MANUAL-CAL. To Force a MANUAL-CAL change the VALUE from 00 to 01.
The MANUAL-CAL will take place as soon as the cabinet reaches the current temperature set point. The MANUAL-CAL will assume that there is NO carbon dioxide gas in the cabinet!.

The temperature should be recorded on a daily basis by placing a thermometer in the work space so that it can be read without opening the inner glass doors and the long term temperature performance can then be plotted to give an assurance of correct temperature performance.

SECTION: 5: THEORY OF OPERATION

The key to the versatility of operation of the P.L.C.S. controller is based on the use of a Microprocessor Control System and multiplexed analog inputs controlled by this system (Fig.2).

Analog input information is amplified by conventional circuitry and filtered before being sent to an eleven channel multiplexer/AD convertor.

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

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

BASIC OPERATION

The P.L.C.S. is a microprocessor based control unit capable of measuring and controlling temperature, relative humidity, carbon dioxide concentration and lighting.

The temperature in the cabinet is sensed by a solid state temperature sensor and controlled by a PID algorithm to a resolution of 0.1°C.
The humidity conditions are sensed by a capacitive sensor probe which will control the relative humidity in the cabinet by fog-jet mist injection and by varying the refrigeration evaporator temperature to obtain the desired humidity.

Carbon dioxide sensing (if fitted) is by means of a temperature and humidity compensated thermal conductivity detector.

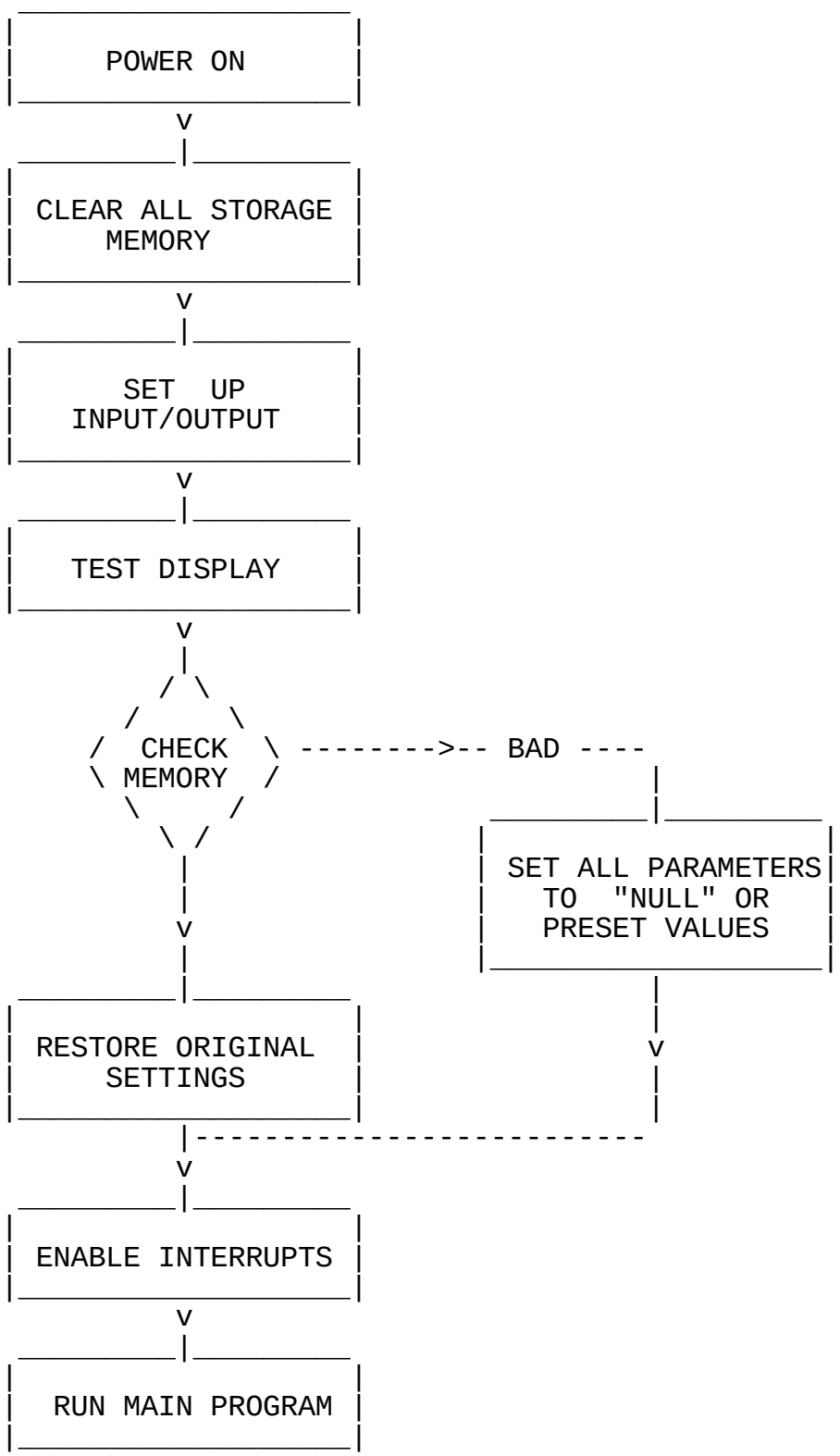
After first turning on power to the unit a RESET operation is performed, this operation tests the condition of retained data in the RTC RAM (Random Access Memory) which contains any set points, correct factors, etc and by computing a CHECKSUM determines if the data has been held by the SUPERCAP or corrupted (if cabinet has been turned off for more than 3 days).

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

Every 1/100th second after initial turn on a TIMER Interrupt occurs, this signal is derived from the RTC clock and is used for timekeeping functions.

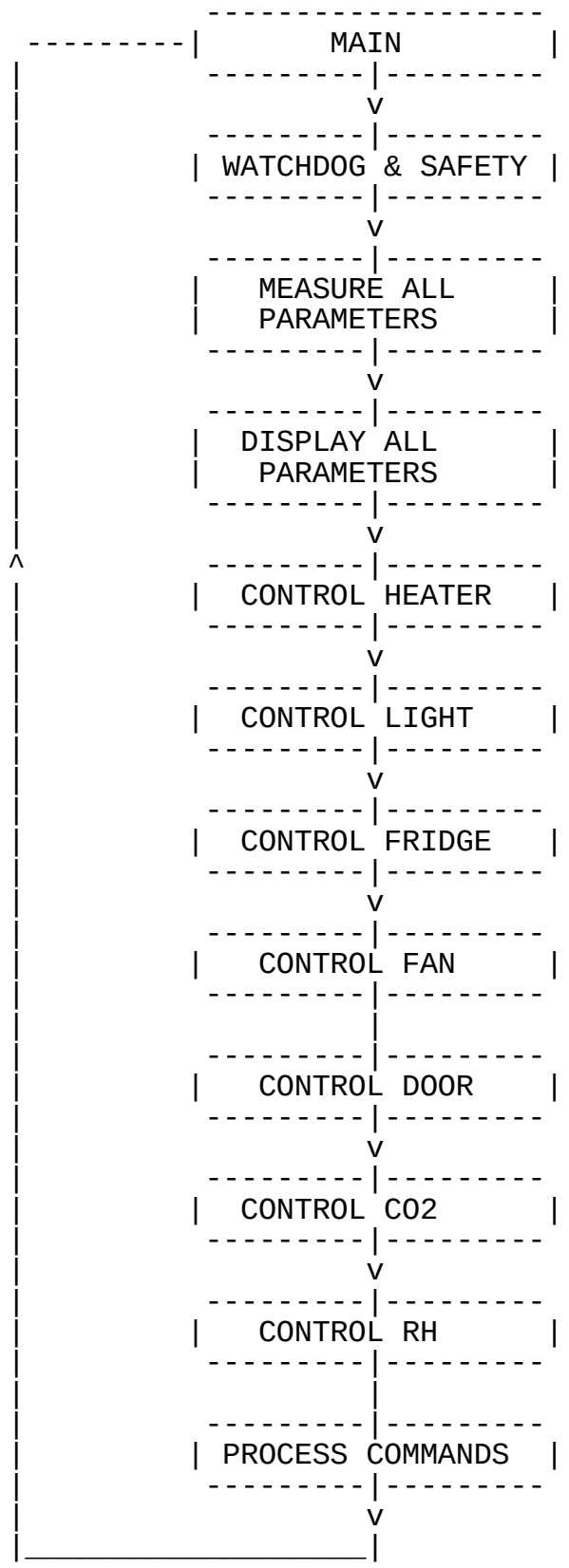
The unit is now "IDLING" and measures the correct parameters in turn about once every 0.6 seconds.

START UP - POWER ON PROGRAM

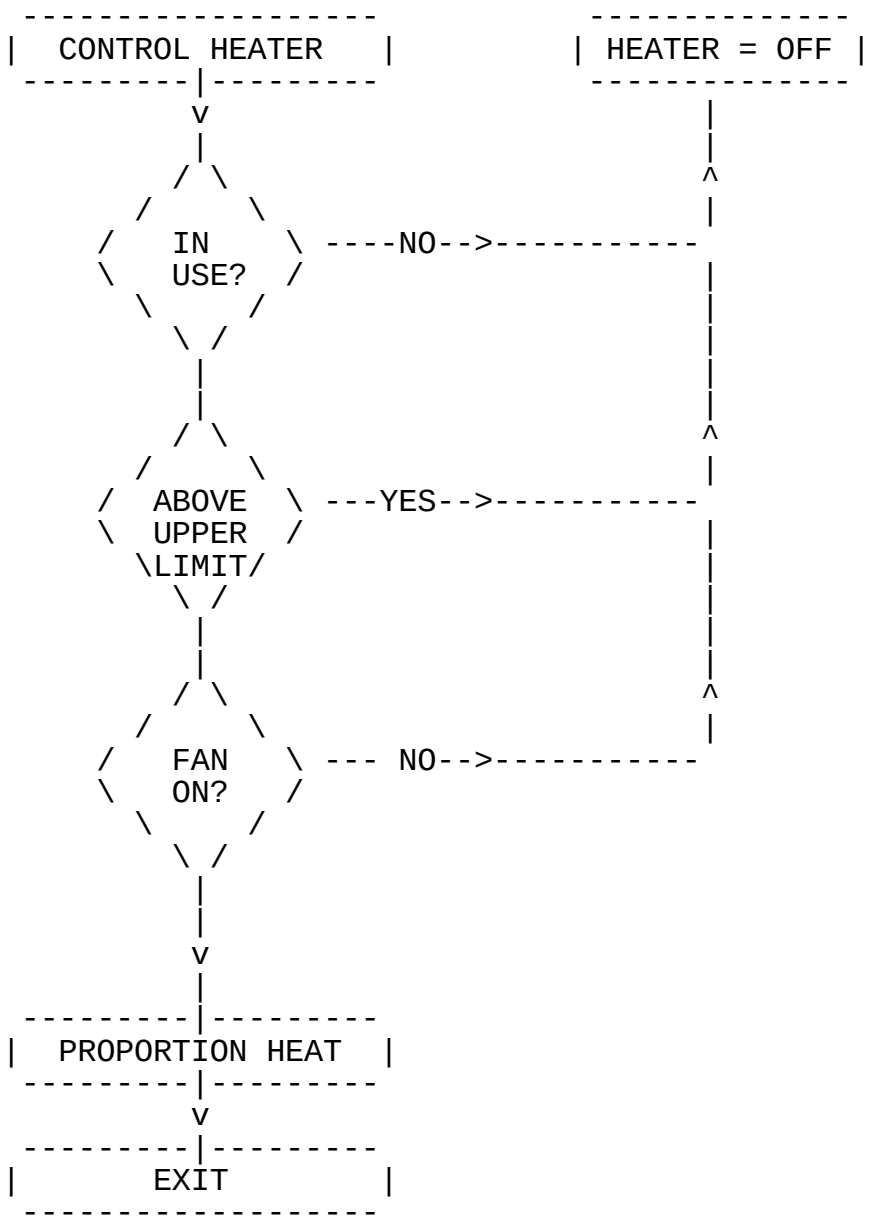


This is the START UP Program, it is run whenever the power is first applied to the system.

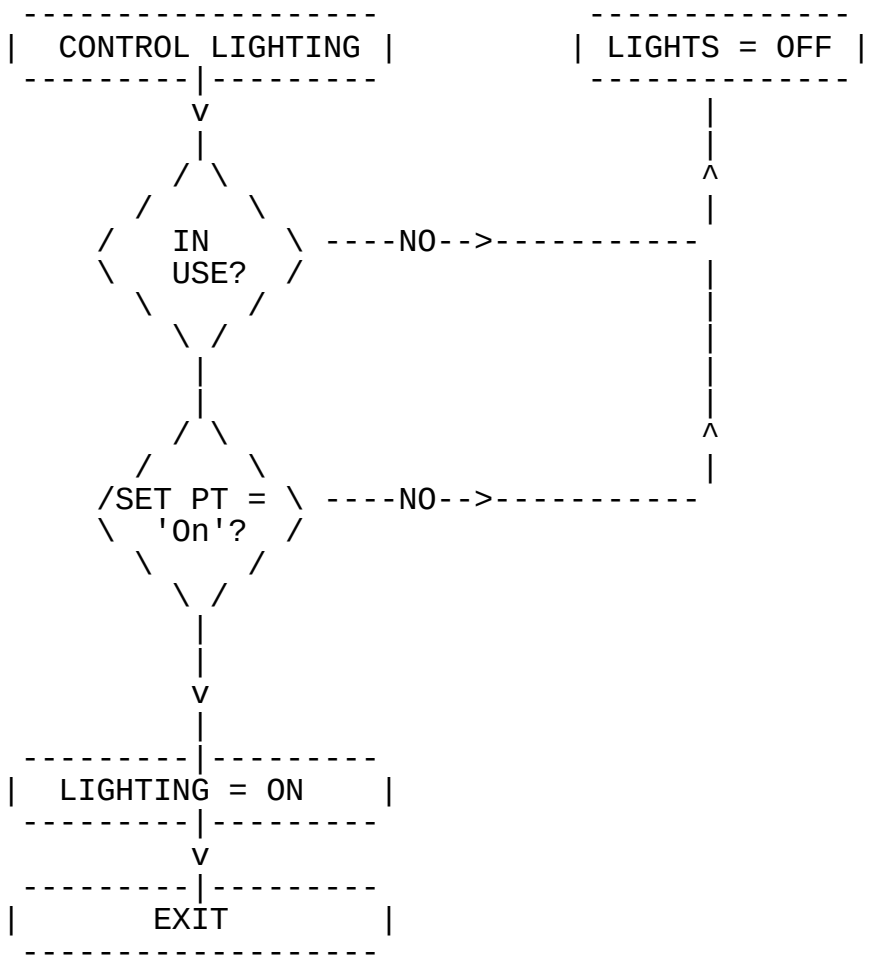
MAIN PROGRAM This program runs CONTINUOUSLY.



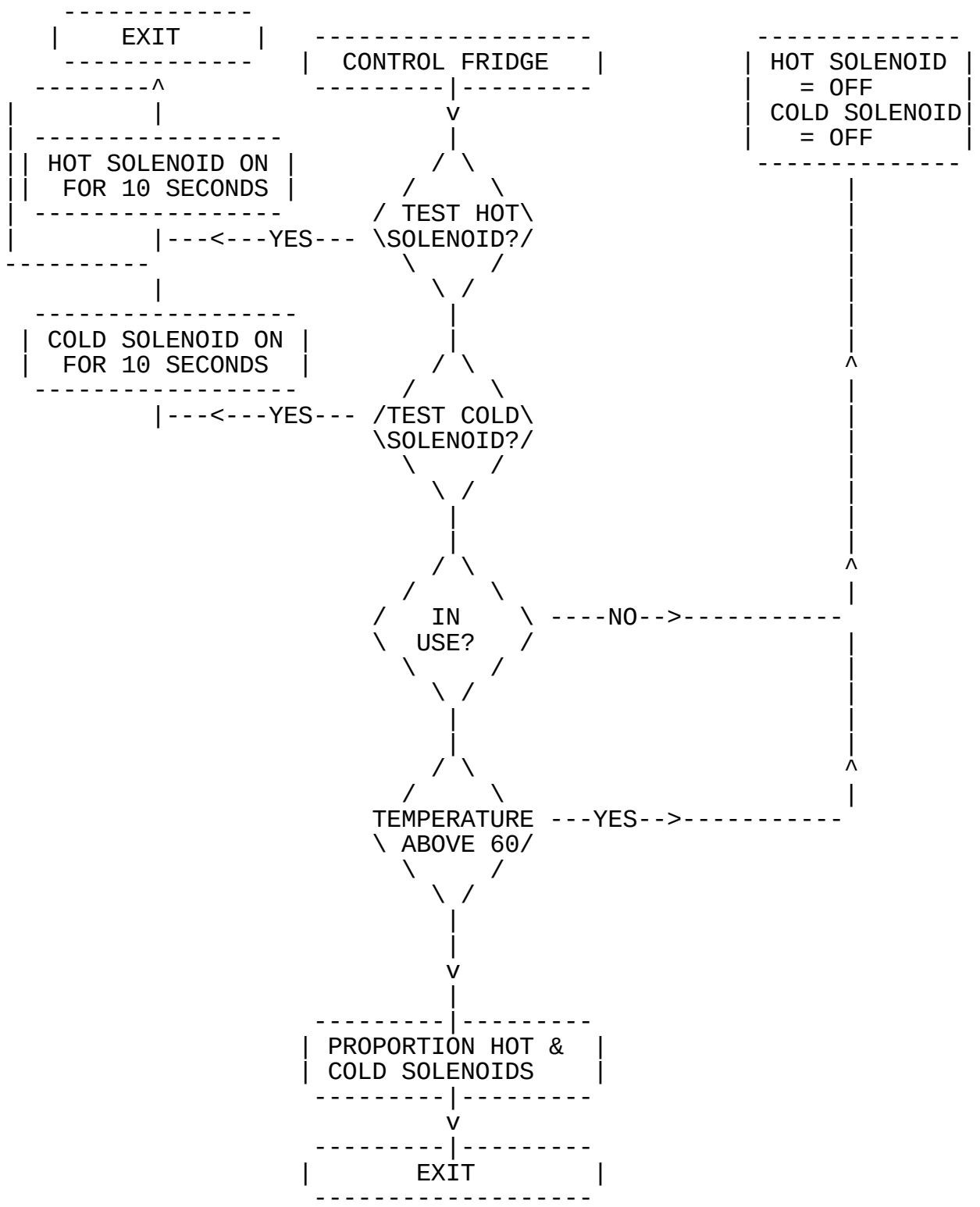
CONTROL HEATER



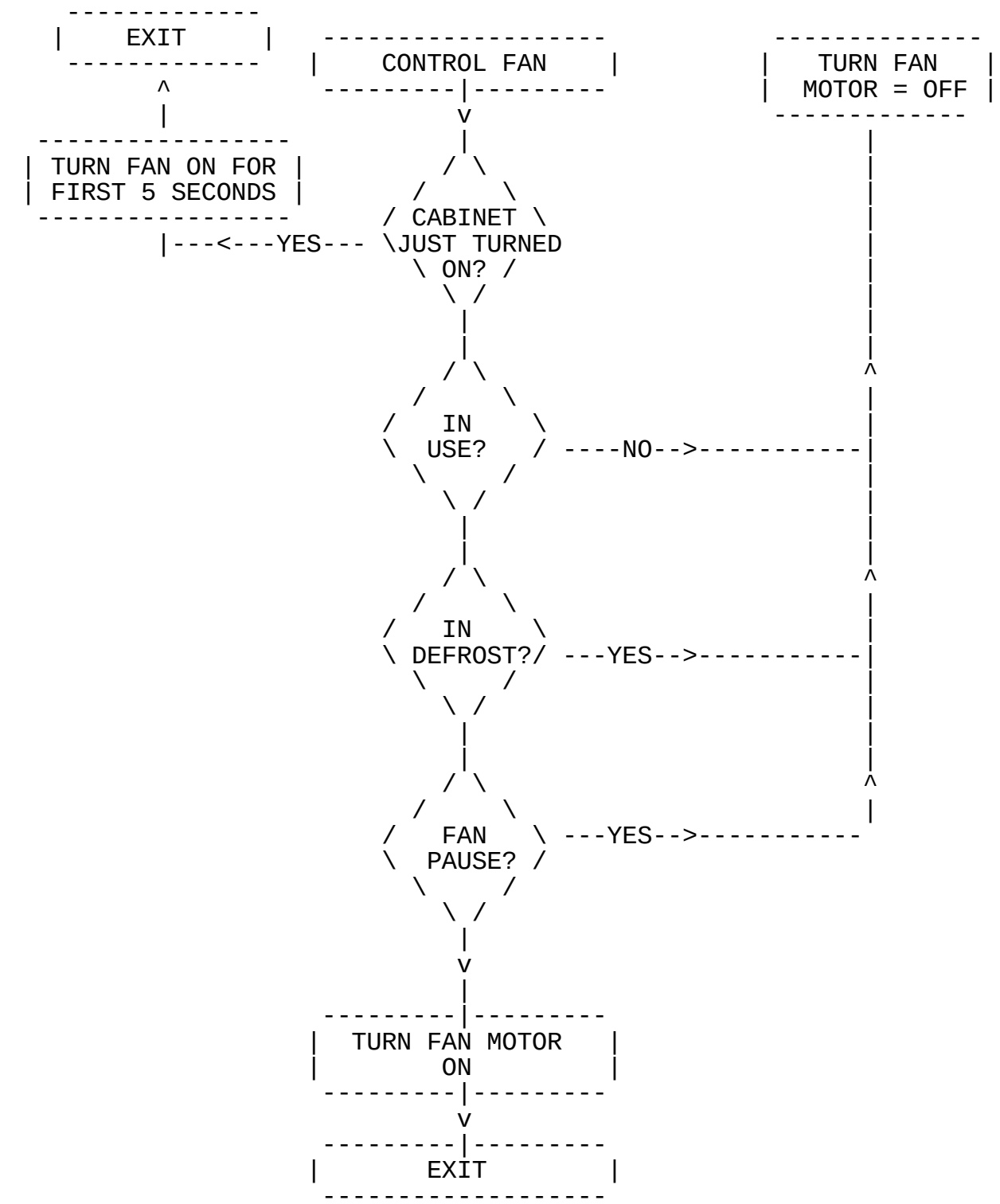
CONTROL LIGHTING



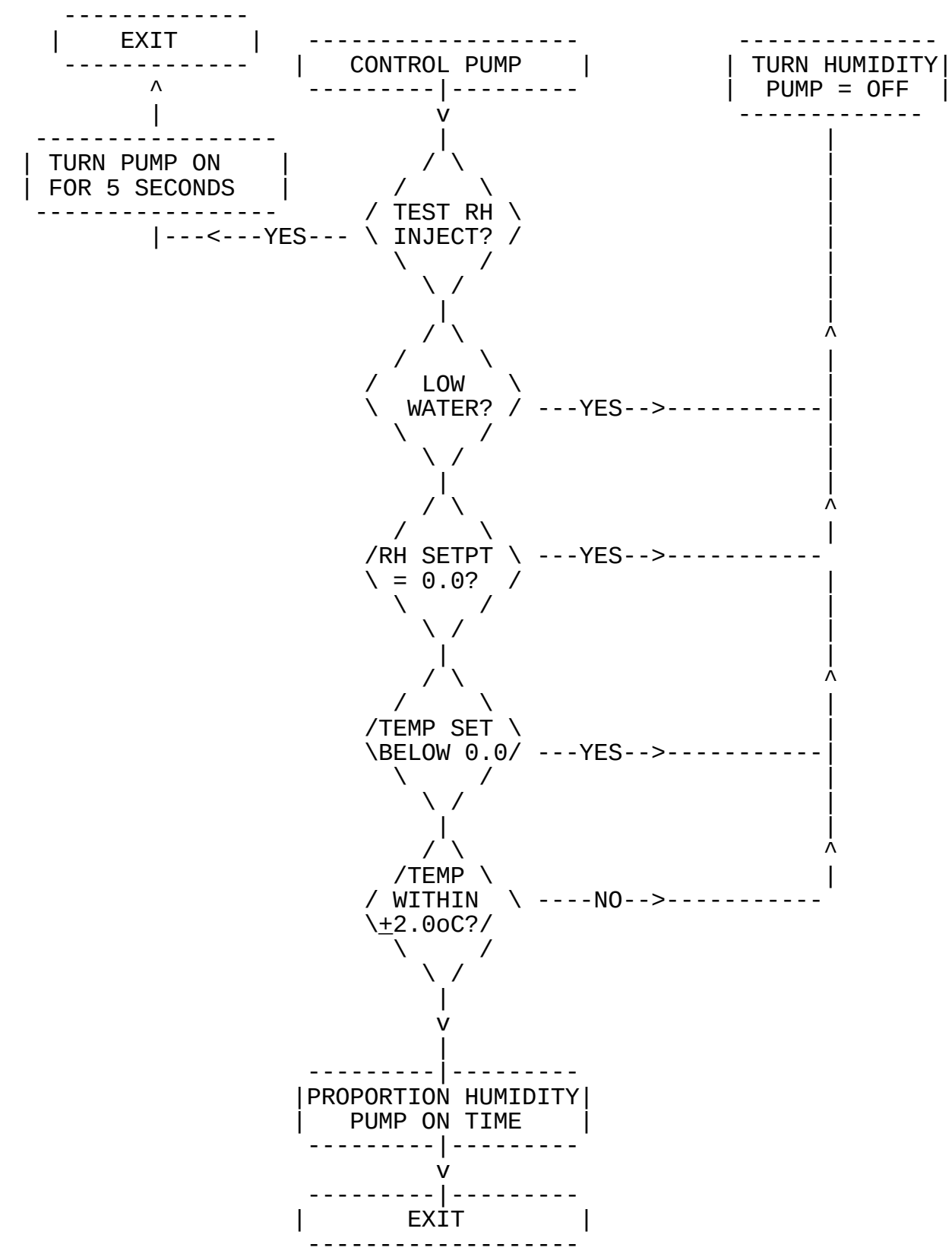
CONTROL REFRIGERATION



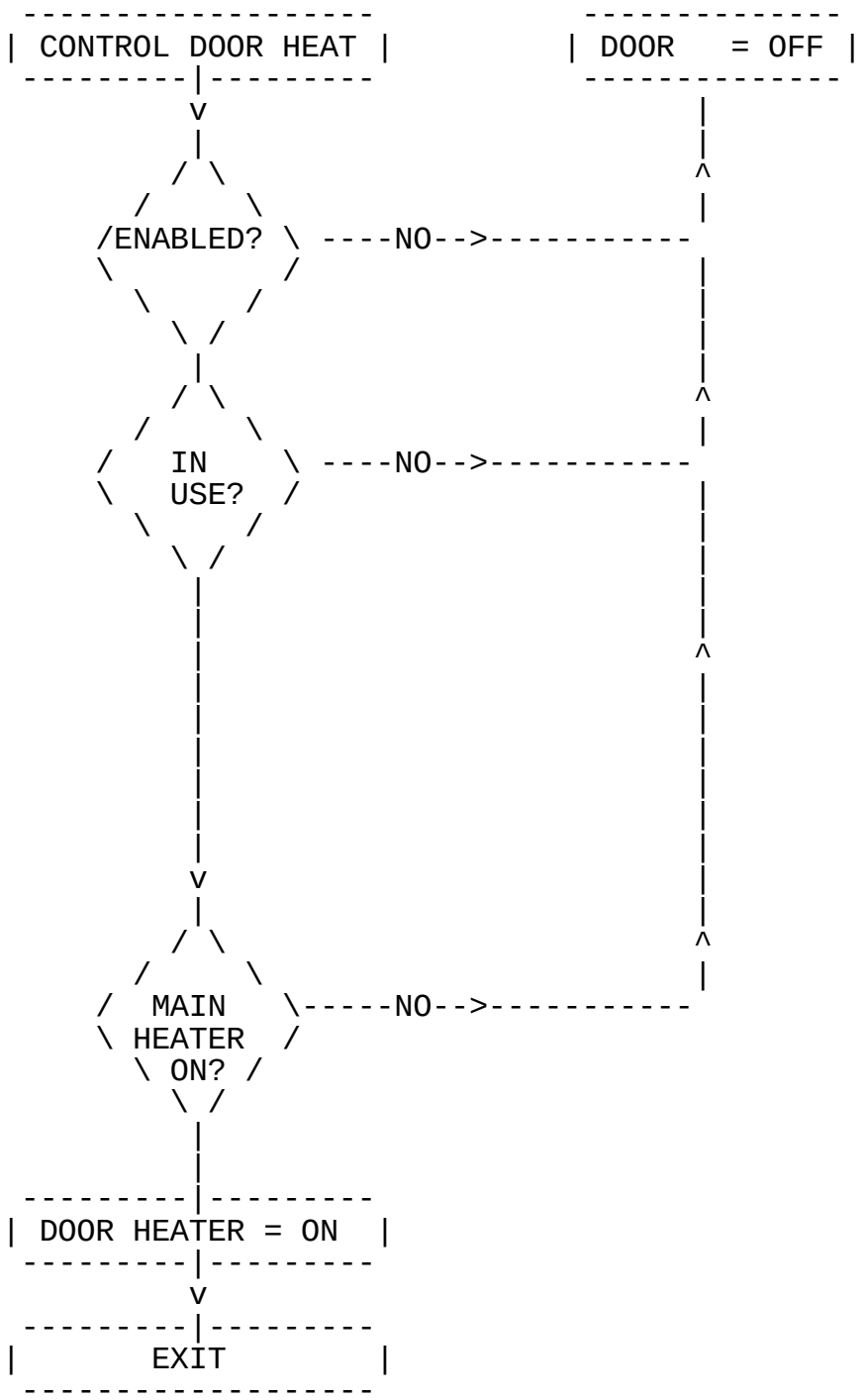
CONTROL FAN MOTOR



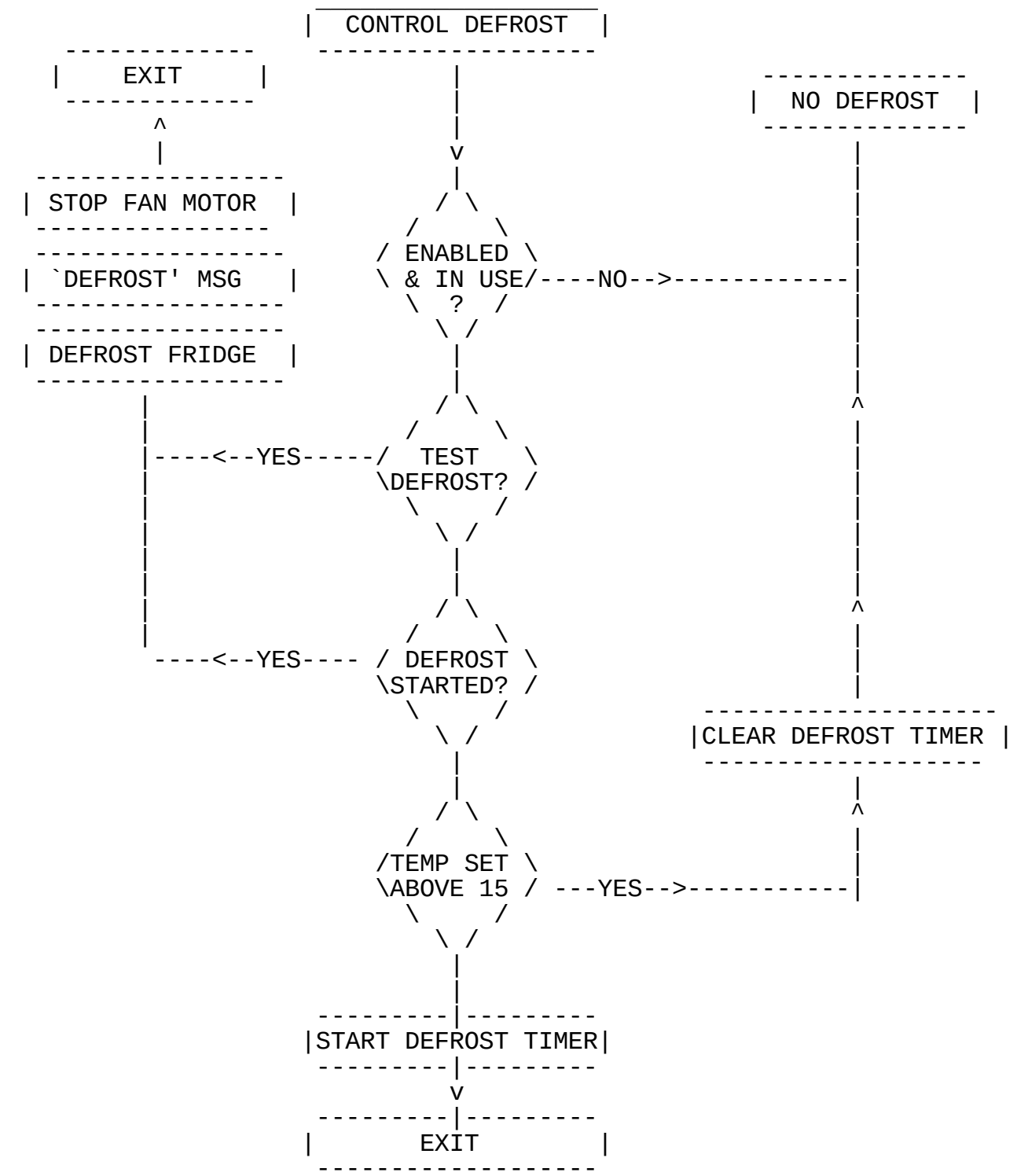
CONTROL HUMIDITY



CONTROL DOOR HEATER



CONTROL FRIDGE DEFROST CYCLE



SECTION: 6: DIAGNOSTICS

The PLCS4 controller has a limited number of diagnostic services inbuilt. These services are attained by Pressing the `SELECT' button adjacent to the `DIAGNOSTICS/ALARMS' display and following the instructions on the LCD (top of panel) display.

When first entered the `DIAGNOSTICS/ALARMS' display will be blank indicating that no diagnostics features have yet been selected, by using the `UP' and `DOWN' buttons various diagnostic tests may be carried out.
When you have made your selection - Press the `SELECT' button again to move to the 'ADJUST VALUE' mode, and if required adjust the test value, press the 'SELECT' button a THIRD time to exit the DIAGNOSTIC mode and execute the selected test.

01 - Test CO2 INJECT. This selection will force the CO2 solenoid (if fitted) to turn on for a duration of 10 seconds to enable its operation to be confirmed.

02 - Test FAN PAUSE. This selection will stop the internal circulating fans (and the heating elements) for a period of 30 seconds.

03 - Test RH INJECT. This selection will run the HUMIDITY pump continuously for a period to enable the pump system to fully prime. The length of time the pump will run for may be changed by `adjusting' the value, a value of 30 represents about 5 seconds of spray time.

04 - Test HOT SOLN. This selection will cause the HOT refrigeration solenoid to be energised for a period of ten seconds, the COLD solenoid will be turned OFF during this period.

05 - Test COLD SOLN. This selection will cause the COLD solenoid to be energised for a period of ten seconds, the HOT solenoid will be turned OFF during this period.

06 - Test DEFROST. This selection will set the next defrost to occur immediately, the defrost will work as an entirely standard defrost.

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

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

08 - Test FRIDGE GAS CHARGE. This selection will cause the fridge to turn the COLD solenoid ON and STOP the internal circulating fan! ALL other operations are inhibited! The fridge evaporator will go as cold as possible and the gas charge can be observed after a period of 20 - 30 minutes by how far the evaporator has frosted. NB: The cooling coil drain tray must be lowered to clearly see the evaporator. (See refrigeration charging section). When this test is running the LCD display will show `FRIDGE GAS CHARGe' and a warning `beep' will sound every minute until the test is cancelled.

To run this test, CHANGE the VALUE to 01. To CANCEL the test change the value to 00. The default value is 00 and this will be set whenever the mains power is turned off. (**NB:** NOT ALLOWED on RLT Models).

09 - TEST ELECTRONICS. This selection will allow various components on the PLCS4 INTERFACE and DISPLAY PCB's to be tested. The particular test performed depends on the VALue selected.

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

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

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

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

10 - RAW CO2 VOLTAGE. This selection will place the value of the RAW voltage coming from the co2 sensor (same as test point #6) onto the co2 display for about 1 second, NB: A reading of 56.1 represents a voltage of 0.561 Volts DC. The value should be between 0.400 Volts (40.0) and 1.600 Volts (160.0).

To run this test, CHANGE the VALUE to 01.

20 - CALIBRATE TEMPERATURE. This selection will allow the internal calibration VALUE to be changed, this in turn will change the temperature calibration for the cabinet, the minimum value is `00' and the maximum value is `99'. When calibrated this value should be NOTED and WRITTEN down so that it may be replaced if the controller loses the value. (this will occur if power has been removed from the controller for more than 3 days!). Use the up & down buttons to adjust the calibration value.

EG: If the display was reading 2.0°C too low, then **INCREASE** the calibration value by 20 (20=2.0°C) to obtain the correct calibration.

21 - CALIBRATE HUMIDITY. This selection will allow the internal humidity calibration VALUE to be changed, this in turn will change the HUMIDITY calibration for the cabinet, the minimum value is `00' and the maximum value is `99'. When calibrated this value should be NOTED and WRITTEN down so that it may be replaced if the controller loses the value (this will occur if power has been removed from the controller for more than 3 days!). Use the up & down buttons to adjust the calibration value.

EG: If the display was reading 2.0% too low, then **INCREASE** the calibration value by 20 (20=2.0%) to obtain the correct calibration. This calibration value is normally 50, and must only be used to make SMALL adjustments to the humidity calibration, if large adjustments are required they should be performed using

the screwdriver adjustment on the sensor box to alter the capacitive trimmer on the ZP10a PCB.

22 - CALIBRATE CARBON DIOXIDE. (If cabinet is a CO2 cabinet). This selection will force the cabinet to perform a CO2 MANUAL-CAL.

To Force an MANUAL-CAL change the VALUE from 00 to 01.

The MANUAL-CAL will take place as soon as the cabinet reaches the current temperature set point. The MANUAL-CAL will assume that there is **NO** carbon dioxide gas in the cabinet!.

30 - AUDIBLE ALARM - This selection allows the AUDIBLE alarm to be DISABLED or ENABLED. A value of 00 = DISABLED, 01 = ENABLED.

The DEFAULT setting is ENABLED (01).

31 - DEFROST INTERVAL - This selection allows the DEFROST INTERVAL to be varied, or DISABLED altogether.

The DEFAULT value is 04, this give a defrost lasting four minutes every at 4HR intervals.

The INTERVAL may be set from 01 to 99 hours.
The defrost may be INHIBITED altogether by setting the VALUE to 00.

32 - DOOR HEATER. - This selection allows the DOOR HEATER to be ENABLED or DISABLED. A value of 00 = DISABLED, 01 = ENABLED.

The DEFAULT setting is ENABLED (01).

33 - DOOR SWITCH? - This selection allows the DOOR AJAR SWITCH to be ENABLED or BYPASSED. A value of 00 = BYPASSED, 01 = ENABLED.

The DEFAULT setting is ENABLED (01). When this switch is BYPASSED the cabinet cannot detect the outer door being opened.

34 - PRINTING INTERVAL - This selection allows the standard interval (in minutes) between lines of recorded data being output to the serial printer (if fitted). If this interval is set for 00, all output to the printer will be inhibited.

35 - SETUP PASSCODE - This selection allows the user to prevent unauthorised access to the cabinet's set points by using a PASSCODE (00 - 99). If the cabinet has been removed from the mains power for more than 72 hours the current passcode will be 00 (This will allow access without entering a PASSCODE).

TO SETUP A PASSCODE: Use this selection to select your desired passcode BEFORE changing or examining a SETPOINT, once this is done that same number MUST be entered before any future access will be allowed to change any settings. The PASSCODE number will be automatically returned to 00 two minutes after any buttons have been pressed. Once a PASSCODE is in effect it will remain so until cancelled (using Diagnostic routine 36) **or** by discharging the SUPERCAP backup device (This occurs after 72 hours without power).

36 - CANCEL PASSCODE - This selection allows the user to REMOVE a passcode from use and revert back to a no passcode condition. To use this selection the original passcode (if any) must be known.

TO CANCEL A PASSCODE: Set the value = 01.

37 - SET REAL CLOCK - This selection allows the user to SETUP the internal REAL TIME CLOCK to the true time of day. Use the UP & DOWN buttons to set the value to the correct time. (MUST be done before using REAL TIME MODE).

38 - SET TIMER MODE - This selection allows the user to choose between ELAPSED (mode 0) time and REAL (mode 1) time. REAL time settings are ONLY applicable to programable cabinets (NOT CO2). When using the REAL TIME mode the program changeovers can be synchronised to the actual time of day.

ELAPSED TIME MODE: Set the value = 00 (Default setting).

REAL TIME MODE: Set the value = 01.

39 - LIGHT RAMP RATE - This selection allows the user to SETUP the rate at which the lighting (If Fitted!) will be turned ON or OFF. A higher setting for this value will cause the lights to come on (or go off) at a slower rate.

A value of 00 means turn the lights all ON or OFF together.

SECTION: 7: TROUBLESHOOTING & MAINTENANCE

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

1) **NO MAINS NEON WHEN MAINS SWITCH TURNED ON.**

- Cabinet not plugged in
- Check power at electrical outlet

2) **MAINS NEON ON - No LCD/LED Display.**

- Cabinet circuit breaker tripped (TOP RHS of cabinet)
- Internal preset HI-LIMIT tripped (inside cabinet top)
- Interface power supply failure.(look at LED's)
- Cable to display unit unplugged.
- Call Service Engineer

- Power Supply Failure on Interface PCB.

Remove cabinet top and cover and look at interface board. The heartbeat led (nearest 40pin IC) should be pulsing at about a two second rate, if not then look at the power supply leds. Both Red power supply LEDs should be on, if not, then one of the power supplies has failed - this could be caused by a faulty power regulator or a short circuit in the unit. Check the fuse on the interface board and hi-limit if NO LEDs on. If the fuse (1amp) has blown the mains power led (interface pcb front RHS) will still be on.

3) **DISPLAY ON BUT SHOWING RUBBISH -**

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

- Bad connection in cable from interface pcb.

There are two separate data links to the display PCB, the SPI data link (works the led displays) and the IIC data link (works the LCD display). The SPI link uses the connections SLT,MOS,SCK, the IIC link uses SCL,SDA. Check the wiring connections for the appropriate area.

- If the TOP line of the LCD is showing ALL segments and the BOTTOM line is blank, suspect either the SCL or SDA wires between the Interface PCB and the display PCB.

- Faulty Reset (turn Mains power off for 10 sec)

4) **MONITOR NEON PULSING - Cabinet NOT attaining temperature.**

- USER ELEMENT Mechanical Hi-Limit tripped (adjust correctly)

5) **CONTROLLER ON - But will not operate correctly**

- Check that OUTER DOOR is NOT ajar.(look at LCD display)
- Check that SET POINTS are correct.
- Check for INTERNAL fan operation, (HOLD DOOR AJAR SWITCH)
- CHECK DETAILED TROUBLESHOOTING SECTION

6) **CONTROLLER 'BEEPS' AT INTERVALS -** This could be due to the fact that the outer door has been left AJAR for more than 10 minutes, or if a fridge PULLDOWN or similar test is in operation.

7) **ALARM SOUNDING AND FAULT LED DISPLAYING '01'**

- Hi/Lo limit alarm
- Measure temperature inside cabinet and ensure Temperature is less than 2oC above/below set point. Could be caused by faulty triac or heater element, this condition can also be caused by addition of boiling water for humidification or any `live' load addition to cabinet interior.

8) **CABINET WILL NOT HEAT/COOL TO TEMPERATURE**

- Door open, OUTER DOOR AJAR.
- Check for correct SET POINTS esp timer (|:|=manual)
- Faulty element/fridge
- Already at temperature
- Look at state of CONTROL/MONITOR panel neons.
- Check that element is coming on (look at `Heater' NEON on cabinet).

9) **REFRIGERATION PROBLEMS**

Ensure Fridge condenser is kept free from dust build-up.
Ensure main cabinet circulation fan is running!.

- Main Fridge does not come on

(Under normal circumstances the CONDENSER fan motor will be on when the fridge is running)

Actual temperature greater than 60oC when heating (RHS only).
Cabinet not in use (Timer = 0:00 OR cycle counter set to 0).
Faulty fridge solenoid

NB: At least ONE of the refrigeration solenoids MUST be ON in order for the refrigeration system to operate, look at the state of the neons on the CONTROL/MONITOR panel.

Faulty low pressure cutout in fridge compartment.
Refrigeration system has lost some/all refrigerant.
Fault on interface board.

9a) **FRIDGE IS ON BUT LITTLE/NO COOLING EFFECT**

- Check that power is not being applied to main heating element. (Look at heater NEON)
- Check that Internal fan is operating.
- Check that COLD solenoid is ON and HOT solenoid stays OFF.
- Check fridge condenser for dust buildup.
- Possible loss of refrigerant.
- Compressor not working (Thermal overload)

9b) **FRIDGE DOES NOT GO OFF**

NB: The refrigeration SHOULD be on under most circumstances unless the temperature set point & actual temperature is above +60.0oC. The fridge will NOT turn off unless BOTH refrigeration solenoids (HOT & COLD) are OFF (Both neons should be off!).

- Allow more time for Fridge to pump down. (esp low temps)
- Faulty low pressure cutout in fridge compartment
- Faulty fridge solenoid
- Faulty interface board

10) **CONTROL PARAMETERS NOT RETAINED AFTER MAINS FAILURE**

- Supercap discharged. (After 3 days with no power)

The SUPERCAP will keep the real time clock chip (RTC) and any set points in memory for about 3 days without external power being supplied.

11) **TEMPERATURE CONTROL NOT TIGHT ENOUGH**

- Circulation Fan stopped or airflow impaired
- Sensor faulty or airflow through sensor box impaired.

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

12) **INACCURATE READINGS ON ANY PARAMETER**

- Not correctly calibrated
- Out of range (% RH only between 20-60oC)
- Faulty sensor
- Component failure

NB: If the TEMPERATURE is NOT correctly calibrated see the DIAGNOSTIC tests (TEST No 20) to calibrate the cabinet, the calibration should be carried out EITHER at 40.0oC OR for CRITICAL APPLICATIONS at the temperature of interest.

13) **SENSOR PROBLEMS -**

The temperature sensor is a special integrated circuit (LM35) which gives an output of +10.0mV/°C. To allow for temperature below 0.0°C the sensor output is offset by 50.0°C (500mV) to give a maximum allowable sensing range of -50.0°C to +150.0°C. When the cabinet temperature is reading +20.0°C the output from the temperature sensor should be about 700mV.

The RH sensor is a capacitive sensor attached to the ZP10a PCB, this sensor outputs a voltage (on the WHITE wire) of 10mV/%RH and is essentially linear over the range. RH calibration is carried out by ADJUSTING the GREEN trimmer capacitor located immediately behind the RH sensor, DO NOT ADJUST the preset potentiometer as this affects the GAIN of the system and once disturbed will need to be reset using special calibration capacitors.
If a FAULT/ALARM code is displayed on the RED led display, consult the FAULT CODE section first to see if there is an easy remedy.

REFRIGERATION SYSTEM

The Refrigeration System is designed to operate when the PLCS Controller is set for any temperature below 60°C, down to the PLCS4 lower limit.
The System is started when either the HOT or COLD solenoid valves are opened by the PLCS4 control system. Opening either of these valves will allow refrigeration Pressure into the Cooling Coil and Low Pressure Switch which will close and allow the Refrigeration Compressor and Condenser Fan Motor to start up. (Note Condenser fan motor has a delayed start.)
After the initial start up period (approx one 20 seconds) depending on whether a cooler or warmer temperature is required the Hot Gas Solenoid Valve will open and close to help in achieving the required Cabinet Temperature.

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

When a temperature above 60°C is set on the PLCS4 Controller, or if the cabinet is selected to turn OFF, both Solenoid Valves will close and the Refrigeration Compressor will automatically pump down and turn off on the Low Pressure Switch. This could take up to 5 minutes.
It is also possible should the Pressure inside the Cooling Coil rise during a Hot Cabinet temperature period for the Refrigeration System to turn on automatically and pump itself out and stop again on the Low Pressure Switch (neither Solenoid Valve will open).

IMPORTANT
As the Refrigeration Unit located under the Cabinet is Air cooled it is essential that an unimpeded Air Flow over the unit is maintained.
Allow **AT LEAST** 100mm of clear space **ON ALL SIDES** of the cabinet.

Air is drawn through front Grille of the cabinet over the Condenser Fins, through the Fan, over the Compressor and exhausted through the rear of the cabinet.
Dust and dirt will collect on the Air Entry side of the Condenser Fins so it is essential that once every three months the Front Grille is opened and the Condenser Fins brushed downwards with a small hearth brush.
If the cabinet is located in a dusty position this

procedure should be carried out more regularly. Failure to keep the Condenser clean will result in the overheating of the Refrigeration Unit.

REFRIGERANT CHARGE (A typical LT system is demonstrated here)

NB: The latest refrigeration systems may be charged with the new environmentally friendly R134a refrigerant, if so ths will be clealy marked on the rear access panels to the refrigeration compartment. Use **ONLY** the correct type of gas for the particular system under investigation.

The refrigeration system is charged with R502 refrigerant, for a quick check of the refrigeration gas charge a moisture indicating sightglass is located in the liquid line in the refrigeration unit compartment, this is only intended as an indicator and an accurate reading should be undertaken by a qualified refrigeration engineer.

The air cooled condenser is located behind the lower front door (grille), to properly clean or inspect open the door, the condenser fins should be brushed vertically with a soft brush (hearth type) with the excess dust/dirt being vacuumed away.

HI/LOW SAFETY PRESSURE CONTROL

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

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

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

Pressure Control Settings should be -

LOW PART		**HIGH PART**	
Cut In	25 psi	Cut out	260 psi
Differential	30 psi	Differential	FIXED

REFRIGERATION COMPONENTS (Typical RLT)

UNIT:	3/4HP AIR COOLED SEALED HOT GAS
COMPRESSOR:	L'UNITE CAJ 2446 L
FAN MOTOR:	ELCO 20 Watt
REFRIGERANT CHARGE:	2.7Kg R502
REFRIGERANT CONTROL:	Sporlan FR 1/4Z T/E valve
LIQUID LINE DEHYDRATOR:	MUELLER model 032 1/4F
CONDENSER:	PATTON CKACS-75 Air Cooled
LIQUID RECEIVER:	R/E MODEL F277 (Marine Tested)
SAFETY PRESSURE VALVE:	HENRY model 350 psi
LIQUID SOLENOID VALVE:	SPORLAN XUP RAPID ACTION
HOT GAS SOLENOID VALVE:	SPORLAN XUP RAPID ACTION
COMPRESSOR PRESS VALVE:	ALCO OPR6
HI/LOW SAFETY CONTROL:	RANCO model 017-6711

REFRIGERATION COMPONENTS (Typical RHS)

UNIT:	1/4HP AIR COOLED SEALED HOT GAS
COMPRESSOR:	L'UNITE AEZ4430Y
FAN MOTOR:	SMEN 5 WATT
REFRIGERANT:	R134a
REFRIGERANT CONTROL:	CAPILLARY TUBE 6/044
DRYER:	SWEAT TYPE X250/HX9
CONDENSER:	AIR COOLED X20/380
LIQUID SOLENOID VALVE:	ALCO 100RB2S2
HOT GAS SOLENOID VALVE:	SPORLAN XUP RAPID ACTION
L/P CONTROL:	RANCO 016/6713

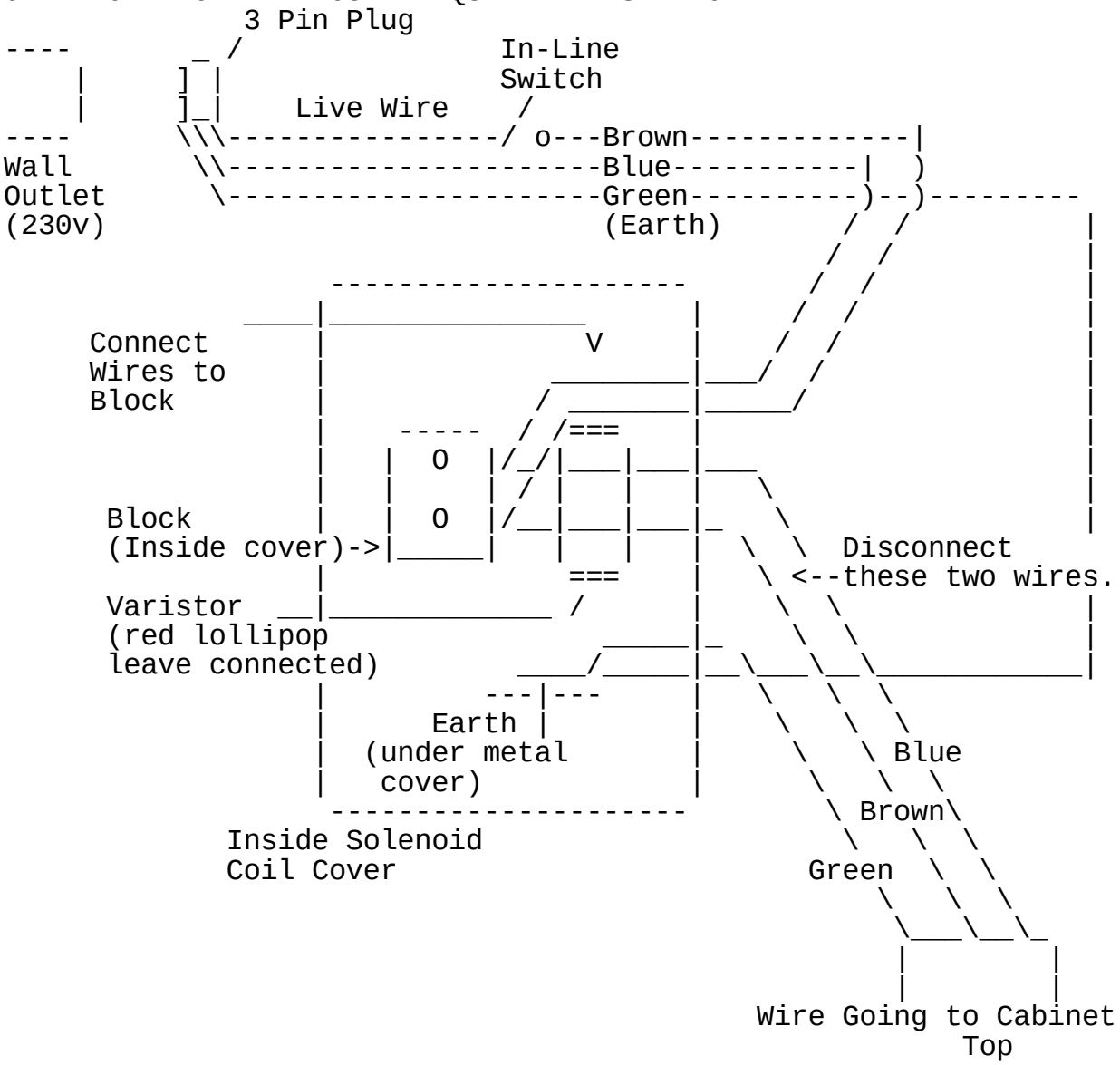
EVACUATION OF REFRIGERATION SYSTEM

To evacuate the system EITHER the liquid OR the hot gas solenoid must be energised to allow the complete system to be exposed to the vacuum pump.
TO ENERGISE either solenoid valve to facilitate evacuation of the system:

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

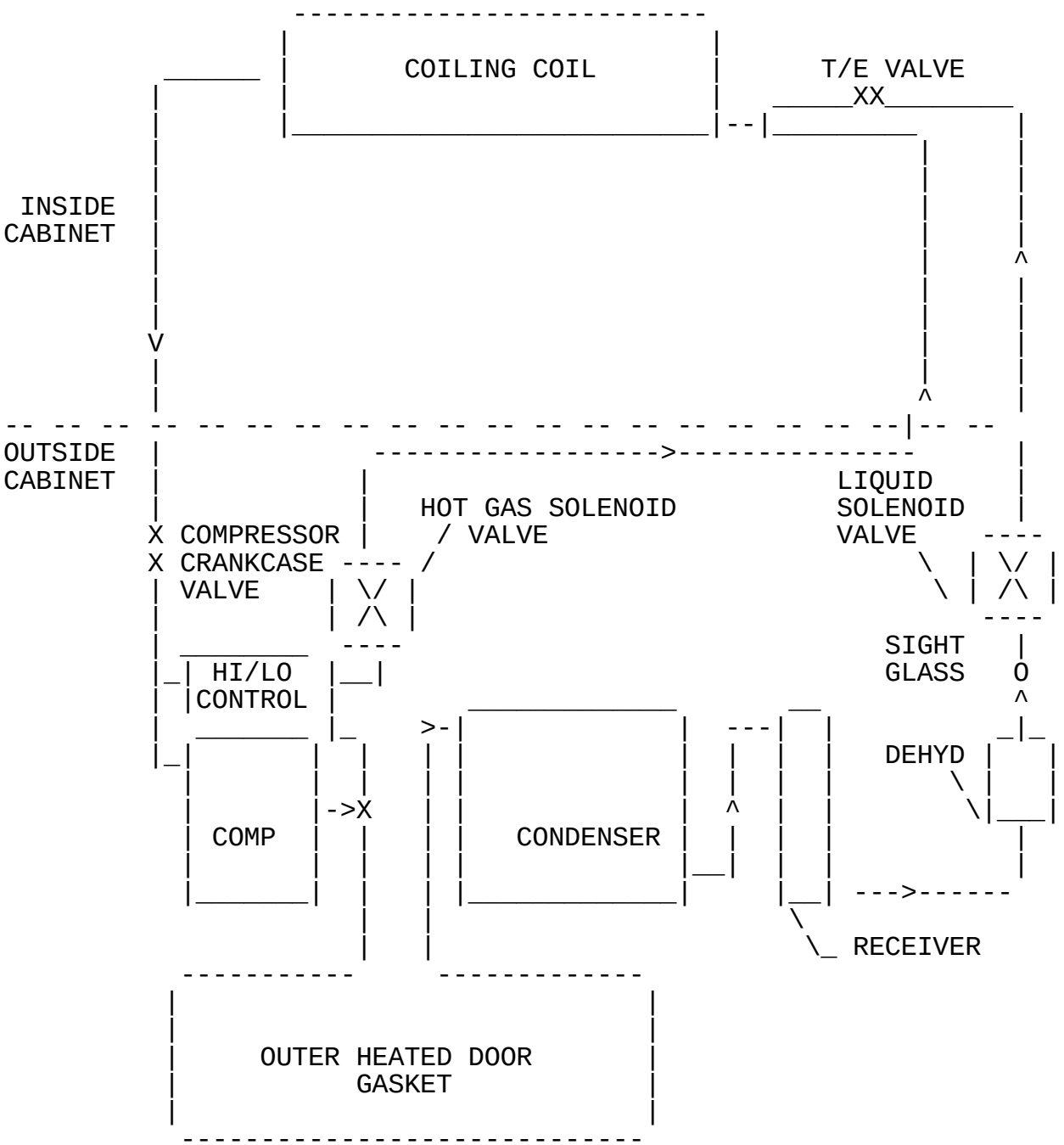
CAUTION

ONLY TO BE CARRIED OUT BY QUALIFIED SERVICEMEN.



WIRING FOR MANUAL OPERATION OF SOLENOID VALVES.

REFRIGERATION SCHEMATIC DIAGRAM



SECTION: 8: PARTS LIST

Micro Parts - Refer to Agent

Shelves:	Stainless Steel	Cat 180/190RHSLT	P101
Fan Motor:		All Models	P007
Rotor:		All Models	P009

SECTION: 9: FAULT CODES

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

Code	Problem	Remedy
01	Over/Under Temp fault - Temperature in cabinet more than 2°C above/Below the set point.	Alarm will stop when fault is removed.
02	Low CO2 in Cabinet - Not enough CO2 to maintain CO2 set point.	Check bottle, hoses, for blockage or faulty solenoid.
03	Cabinet now running on Preset Values. (Most likely due to the power being removed for more than 48 Hours).	If Preset values are your working values, cancel the alarm else update set points. CHECK CAL FACTORS.(See CAL SECTION)
04	Main temperature sensor (in sensor box) broken or damaged.	Call Service Engineer. Check sensor with meter. Could also be electronic fault in controller, or broken sensor wire, etc.
05	Wet (humidity sensor) in sensor box, broken or damaged.	Call Service Engineer. Check sensor with meter. Could also be electronic fault in controller or broken sensor wire, etc.
06	Low water level in Humidity Reservoir.	Top up level in Humidity Reservoir, open bottom door to top up.
07	CO2 Sensor. Damaged or broken, or out of calibration range (20-170%) raw CO2.	Call Service Engineer. Check thermistor sensors and wiring to sensor box.
08	Moderate Noise	Check wiring of Mains. If only very occasional alarm will not cause any problems.

09	Severe Noise on Mains	As above but serious, check mains wiring and earthing. Look for outside interference. CHECK CAL FACTORS.

SECTION: 10: CIRCUIT & LAYOUT DIAGRAMS