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C E N T U R IO N

VPC, VPM, INTERVAC, VPC II & VPQ

VACUUM FURNACE SERVICE MANUAL

CSA TüV CE

SAFETY FIRST

* Don’t bypass the power cord’s ground lead with two-wire extension cords or plug adaptors

* Don’t disconnect green and yellow safety-earth ground wire that connects the ground lug of the power receptacle to the chassis ground.

* Don’t plug in the power cord until directed by the installation instructions.

* Don’t repair the furnace unless you are a qualified electronics technician and know how to work with hazardous voltages.

* Pay attention to the WARNING statements. They point out situations that can cause injury.

* Pay attention to CAUTION statements. They point out situations that can cause equipment damage.

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SECTION 1
CIRCUIT DESCRIPTION

1.1 INTRODUCTION

[ ] - Denotes Particular Model Only

The purpose of this section is to familiarize the user or service personnel with the circuit level operation of the CENTURION. This knowledge is necessary to aid in troubleshooting of a unit failure and may also allow the user to gain greater insight into the CENTURION's versatility for particular applications.

The block diagram of the CENTURION is shown on page 2-6. The operational description that follows is separated into seven functional blocks:

* Transducer Path consisting of the thermocouple, [vacuum transducer], operational amplifier, Multiplexer, constant current source, millivolt source, A/D converter, and overtemperature protection circuit.

* Display Communication consisting of the display connector and display board assembly.

* Front Panel Control consisting of the power ON/OFF switch, and membrane switch panel.

* Muffle Control consisting of the peripheral driver, opto-triac driver, muffle triac, and relays K1, K2.

* Vacuum Control consisting of the peripheral driver, solenoids, and relay K3.

* Power Supply
Refer to figure 2-1, Troubleshooting block diagram, for a more detailed look at circuit block interaction.

* Motor Drive Control
Consisting of the motor drive I.C., 12VDC motor and connector .

1.2 DETAILED CIRCUIT DESCRIPTION

1.2.1 Transducer Path

1.2.1.1 General Description
All signal paths are filtered, fed through an 8 channel multi-plexer, amplified, and converted to a digital signal. The microprocessor accesses this digital signal at regular time intervals and calculates the respective variables.

1.2.1.2 Thermocouple
The muffle temperature is derived from a Platinel Thermocouple (type "K") which generates an output of up to 50mV. This signal is compared with a maximum allowable temperature signal to produce an error code in case of missing thermocouple outputs.

1.2.1.3 Reference Voltage
A reference voltage path is obtained from a reference diode which is adjusted to obtain a temperature reading of 960°C.

1.2.1.4 Cold Junction Compensation
To reduce the Seebeck effect typically associated with thermocouple connections a constant current source is configured as a thermometer to produce a 0.2mV/°C change at its output.

1.2.1.5 [Vacuum Transducer]
The vacuum inside the muffle is sensed by a pressure transducer which outputs a differential voltage.

1.2.1.6 Current Transformer
The muffle ac current is converted to millivolts by a current to voltage transformer. The voltage is then rectified and its magnitude properly divided. This signal is compared with a maximum allowable current signal to produce an error code, in case of extremely high current draws due to excessive line voltages or reduced muffle resistances.

1.2.2 Display Communication

1.2.2.1 General Description
The display board converts serial data to 8-bit parallel data. Each byte transferred is either a command or a data byte depending on the state of the two control bits RS and E (DIS ENA). The LED's are accessed by two control bits strobed and LED ENA (see schematic S009).

1.2.2.2 LCD Display
The 16 character by 2 lines LCD module is controlled by the microprocessor via its Serial Peripheral Interface (SPI) port. The display is updated every 0.5 sec or when a corresponding front panel key has been activated.

1.2.2.3 [LED Display]
The 10 status LED's are controlled by a serial input, latched driver integrated circuit. After the serial data is received, the strobe signal latches this data. The state of the LED's can only be changed by accepting new data.

1.2.3 Front Panel Control

1.2.3.1 General Description
The front panel switches are arranged in a 8x4 matrix. The microprocessor scans the entire matrix every 50 msec by setting one column at a time to a logic 0 and

then reading the rows. Once a contact closure has been detected this value is stored. At the next scan the closure is compared with the stored value and if a match has been established the command is carried out. This prevents erroneous data due to contact bounce.

1.2.4 Muffle Control

1.2.4.1 General Description
The microprocessor (U10) sends a serial digital signal to an octal peripheral driver (U16) which in turn converts and latches it to parallel data. This parallel data is then used to drive several peripheral devices (See S006). U16-13 is connected to an opto isolator (U8). The isolator's output is connected to the gate of the muffle triac. The muffle triac may be activated anytime during an ac cycle, but once activated it can only be opened when the ac sine wave passes through 0 volts. U10 accesses U16 0.5 msec before zero crossing to turn the triac off. At this time a value calculated by the control routine determines how much time should elapse before the triac is turned on again.

To ensure proper operation and to prevent runaway conditions the outputs of U16 are read via the serial out port (U16-9).

1.2.5 Vacuum Control

1.2.5.1 General Description [VPC]
The microprocessor (U10) sends a serial digital signal to an octal peripheral driver (U16) which in turn converts and latches it to parallel data. This parallel data is then used to drive several peripheral devices (See S006). U16-2, and U16-3 are connected to 12V dc normally closed solenoids which in turn control the flow of vacuum. At the command to achieve vacuum in the muffle solenoid 1 is opened to allow passage to the muffle and relay K3 is closed to activate the vacuum pump. Once the desired level of vacuum has been reached solenoid 1 closes and K3 is deactivated. To release the vacuum from the muffle solenoid 2 is opened. U10 determines the time for solenoid 2 to be deactivated again once it can no longer detect a vacuum.

With Intervac units, operation is the same except that the third solenoid (SOL 3) is also opened when the command to pull vacuum is issued.

1.2.5.2 General Description [VPM]
Vacuum is controlled manually through a series of 3 membrane keys on the control panel. These keys may be activated at any time (Start Vac, Hold Vac, Release Vac). The solenoids are actuated as described above in Sec 1.2.5.1

1.2.6 Power Supply

1.2.6.1 General Description
Two DC power supply voltages are generated on the control circuit board; +12V and +5V. These voltages are generated either from 115Vac or 230Vac.

1.2.6.2 +12V Power Supply
Refer to schematic S001. The transformer T1 provides an AC voltage with a ground referenced center tap. This voltage is rectified by diodes D41 and D42 and filtered by capacitor C40. This provides unregulated positive DC voltage for the switching regulator U9. The capacitor C42 protects against high voltage transients on the AC line that couple into the transformer secondary. The output U9-2 is a pulse train with a period T of typically 19.2usec. The catch diode D43 is a Schottky device which provides a return path for the load current when the output switch is off. Inductor L2 and capacitor C46 filter and stabilize the +12V regulated DC voltage.

1.2.6.3 +5V Power Supply
Refer to schematic, S001 page 2-11. DC voltage from the output of U9 is used by the +5V linear regulator U7 to generate the +5V. The capacitor C48 provides additional filtering. The constant current source U2 as well as the 1.23V reference diode D1 generate their outputs from this supply.

1.2.7 Motor Drive Control

1.2.7.1 General Description [VPC]
The +12VDC motor which moves the muffle vertically is controlled by a 16 pin motor controller/driver I.C. This I.C. provides all necessary functions for a complete closed loop system. A two wire cable connects the motor to the 1 Amp H-(bridge) switch on the I.C. The microprocessor (U10) activates the H-switch through two input pins. If both are low the motor will turn in one direction, if both are high the motor turns in the opposite direction. A third pin sends a signal from the motor controller/driver I.C. to the microprocessor when the motor has stalled. The microprocessor then determines if the motor has travelled the full travel or if the motor has been stalled before the end of normal travel. If the motor has been stalled the microprocessor displays an Err 15 code.

SECTION 2
TROUBLESHOOTING

2.1 FACTORY REPAIR

Ney Dental International maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the CENTURION. If a unit is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to minimize turnaround time. Call factory for RMA number before shipping.

2.2 BEFORE YOU START

Since no troubleshooting guide can possibly cover all the potential problems, the aim of this guide is to give a methodology which, if applied consistently, will lead to the problem area. Therefore it is necessary to familiarize yourself with the CENTURION by reviewing the functional description and the detailed circuit description (Section 1) in conjunction with the schematics (Section 2.8). Successful troubleshooting depends upon understanding the circuit operation within each functional block as well as the block relationships.

> WARNING:
> With covers removed, dangerous voltage points may be exposed. Contact with any of these points could cause serious injury.

The intent of this section is to provide the information to return the CENTURION to proper operation. Information is divided into two parts. Part one contains the overall furnace troubleshooting block diagram (figure 2-1) which is useful in isolating defective blocks within the furnace. Part two consists of a series of circuit guides (table 2-1), one for each block shown in figure 2-1, that provides settings and measurements for troubleshooting an individual block. Also, each circuit guide references related schematics and circuit descriptions.

Inspect the components, wiring and circuit boards of the CENTURION for damage. Finally, ensure that the fuses are intact and the internal power supplies, +12V, and +5V are good.

2.2.1 Isolating a problem

To successfully troubleshoot this furnace, the symptoms must first be identified, the faulty block isolated, the block analyzed, and the defective component located and replaced.

To identify the symptoms, use the front panel switches and measurement results from the Test Points. For example if the motor is not responding to the key switch command, are any other peripheral controls defective or not responding?

Once the symptom is identified use figure 2-1 to isolate the circuit block. After the block is isolated, refer to the appropriate functional circuit guide(table 2-1).

The circuit guide provides some but not necessarily all of the possible failure modes for a particular circuit. Where applicable, a furnace setup procedure is given to help isolate the problem for a particular failure mode. Paragraph 2.4 gives component troubleshooting information.

2.2.2 Understanding the error codes

The microprocessor of the CENTURION constantly checks for proper circuit operation. If it detects a faulty signal an error code will be displayed on the second line of the display. In some cases, a program cycle will be aborted and the muffle travels to its up position. All peripherals will be disabled. In order to troubleshoot, the furnace must be turned off, then on again.

2.2.3 Troubleshooting digital circuits

Most of the digital circuits in this furnace are dynamic. Even with no change made to the frontpanel keys, internal circuits are running and lines are changing states. This makes troubleshooting difficult without the use of powerful tools.

There is, however, a technique using an oscilloscope which will usually helps isolate an abnormal signal. The basis for this technique is looking for stuck bits. A normal digital signal will switch between a logical “1” (high) and a logical “0” (low). A stuck bit may not switch at all. It may always be high, always low, or always between logic levels in an undefined state. A stuck bit may also switch between high or low levels and an undefined state.

2.3 TROUBLESHOOTING GUIDES

Refer to table 2-1 for functional circuit guide information

2.3.1 Power Supply

To determine a faulty power supply use table 2-3. To troubleshoot a faulty power supply use the procedures listed in table 2-4. If the desired results are obtained in each of the steps in table 2-4, replace D43, U9 or U7 as appropriate.

2.3.2 Microprocessor

Generally, when the furnace is totally nonfunctional, i.e., display is unintelligible, no display, random relay clicking, no key response, or the front panel LED’s stay on at power up, the problem is in the microprocessor section.

However, before troubleshooting this section, check the appropriate dedicated circuits for correct operation. Detailed reading of the circuit description is also very helpful before attempting to find and correct a problem. Use table 2-5 to troubleshoot the microprocessor.

2.3.3 Peripheral Drive

The peripheral driver U16 is accessed at every line voltage zero crossing (TP1=0) by the microprocessor (U10-32,33). The logic state of the eight output drivers, Y0 -Y7, is latched into the shift register at time t0 on the high to low transition of SIOE. Input data present at the SI input is clocked into the shift register on the high to low transition of SCLK.
Use table 2-6 to troubleshoot the peripheral driver.

2.3.4 [Motor Drive]

The motor driver U13 is accessed by the microprocessor to lift or lower the muffle. Two LED's are connected across the internal power H-switch to indicate its state. When both LED's are either on or off the motor is deactivated. If one of the LED's is on the motor is activated. U13-15 provides a feedback to the microprocessor to indicate an overcurrent condition which is set at approximately 450mA by resistor R26.
Use table 2-7 to troubleshoot the motor driver.

2.3.5 Analog Circuitry

The reference voltages used to control temperature and compare voltage signals are derived from the output of U7-2 (+5V), U9, and D1. See section 2.4 for troubleshooting individual components.
Use table 2-8 to troubleshoot the analog circuitry.

2.3.6 Display Board

Serial data present on the input of U1-2 and U2-2 is transfered to the shift register on the logic "0" to logic "1" transition of the Clock input pulse. Information present at any register of U1 is transferred to its respective latch when the Strobe is high (U1-4). A serial to parallel conversion takes place. As long as the Strobe is held high ("1") the latches will accept new data. The LCD display module will accept valid data on D0 - D7 when the Enable (J1-6) goes from a high to low transition.
Use table 2-9 to troubleshoot the display circuit board.

2.4 TROUBLESHOOTING COMPONENTS

2.4.1 Diode

A diode (except a zener) is defective if there is greater than 1 Vdc (typically 0.7 Vdc) forward voltage across it.

2.4.2 Operational Amplifier

Generally the "+" and "-" inputs of an operational amplifier will have less than 15 mV voltage difference when operating under normal conditions. (U3, U4:B, U15:B). When the output of the amplifier is connected to the "-" input (voltage follower connection), the output should be the same voltage as the "+" input voltage; otherwise, the amplifier is defective (U17:A).

If the output voltage stays at maximum positive (typically 1/3 of the supply voltage), the "+" input voltage should be more positive than the "-" input voltage (U17:B, U18:A, U4:A). If the output voltage stays at minimum (typically 1-5 mV), the "-" input voltage should be more positive than the "+" input voltage (U15:A).

2.4.3 Triac

The gate to power line return voltage (K1) under load measures typically 1-2 Vac, while the MT2 to return voltage measures between 1.3-1.8 Vac.

A triac without connections can be checked for a go-no go condition with an ohmmeter. The gate to MT1 resistance for a power triac (20-40A) should be between 50 and 100 ohms; there should be infinite resistance between MT1 and MT2.

2.4.4 Capacitor

Shorted capacitors have 0V across their terminals.

Open capacitors can be located by using a good capacitor connected in parallel with the capacitor under test and observing the resulting effect.

Leaking capacitors will often have a decreased voltage across their terminals.

2.4.5 Logic levels

Microprocessor:	High	+3.5	-	+5.0V
	Low	0.0	-	+1.0V
74LSXXX:	High	+2.0	-	+5.0V
	Low	0.0	-	+0.5V
4XXX:	High	+3.5	-	+5.0V
	Low	0.0	-	+1.5V

2.4.6 [Motor]

If Err 15 occurs frequently it is an indication that the motor might be producing excessive current spikes. This can occur as the brushes become worn. Refer to section 2.3.4 to determine whether both of the motor LED's are on or off when this message occurs.

Objects placed on top of the cabinet can cause the motor to work harder thus producing this error message. Remove any objects placed on the top enclosure.

Err 15 can also occur if the valves release slowly. Run a cycle without vacuum to determine if the error still occurs. If so, check for obstructions in one of the tubing lines.

2.4.7 Valves

Much of the information needed for troubleshooting the valves is in Sec 5.4. It is important to note that vacuum leaks may not always be an indication of a bad valve. Before replacing a valve, isolate both sides of the valve as described in Sec. 5.4 to verify that the leak is indeed in the valve and not in the chamber or the vacuum transducer.

Indications of a leaky valve can be Err 4 or Err 15.

It may be possible to clean contaminants from the valve by blowing high pressure (>50psi) air through all the ports.

When replacing a plastic fitting, care must be taken not to cross thread. Torque fittings to at least 12 in-lbs (1.5 N-m).

2.4.8 Chamber Leaks

If it was determined in Sec 2.4.7 or Sec 5.4.5 that there is a chamber leak, then the following procedure should be performed:

a. A likely source for a vacuum leak in the chamber is due to an obstruction at the door O-ring seal. With a clean rag, wipe away any material around the O-ring.

b. Next, check that there are no obstructions which prevent the chamber from closing all the way. Press the "up" then "down" keys. If the chamber does not close entirely, remove the door insulation and try again as the door insulation may have moved out of position.

c. If the unit still does not pull vacuum, press down on the top cover while in a "VAC" cycle after the pump turns on. If vacuum still does not pull, the leak is elsewhere in the chamber.

d. Check the vacuum hose connections, thermocouple seal, muffle termination connections and the view window seal. Check the tightness of the muffle termination connections as these can take a "set" after extended time at high temperatures. Tighten to 12-15 in-lbs (1.5 N-m).

2.4.9 [Reflective Window]

The reflective window has a very delicate hi-tech reflective coating on the outer surface. Any abrasive material or skin oils can cause permanent damage to this surface. If this surface should become dirty, clean according to the following instructions:

- Allow the furnace to cool to below 100 degrees C
- Cleaning should be done with deionized or distilled water and optical tissue.

CAUTION!
Ordinary tissue may contain wood fiber which can scratch the window

If the window must be replaced because of damage or a leak as described in section 2.4.8, use the following procedure:

- Disconnect power cord from wall outlet
- Remove the four (4) top cover screws and lift off top cover (see sec 5.3.3)
- Remove retaining ring (P/N 9352044 sec 4.2)
- Remove window. If stuck, remove muffle (see Sec 5.2) and knock out window from the inside
- Remove old O-ring and clean out O-ring groove
- Replace window, O-ring and retaining ring. Make sure that retaining ring is fully installed
- Replace top cover and four (4) screws

2.5 ERROR CODES

NOTE: [xxx] references do not apply to the VPC II furnace.

Err 1 Muffle Over Temperature
The controller monitored a temperature above 1220°C.This could mean a faulty thermocouple (mV reading too high) or an erratic thermocouple performance (the temperature readout is not stable at elevated temperatures).

Err 2 Open TC Detected
To check for open TC, turn power to furnace off and short TC input terminals. Turn power back on. If ERR 2 disappears, then replace TC. Other possible causes:

-Vac pump noise may have reprogrammed Setup parameters. Check calibration parameters and program values.
Note: VPC II, and Intervac furnaces have a program to reset EEPROM to factory preset settings.
See Err8.

- TP3 >> 40 mV
- TP4 >> 50 mV
Change PCB if problem persists.

Err 3 Tmax Over Temp
The controller monitored a temperature above Tmax + 20°C. This could mean:

* The Tmax was set up too low for this program.
* The destination temperature is relatively low compared to the programmed heat rate, eg. too much temperature overshoot.

Err 4 No VACUUM
After the start of a vacuum pump request the controller check for a vacuum level of at least 40 mm before the Vac Strt LED is turned off. The absence of this reading during a specified time will generate an audible warning signal before the cycle is aborted. Check all vacuum hose connections, and operation of the vacuum pump (plug into outlet to check).
Otherwise check:

* TP6 > 50 mV at medium vacuum level
* TP5,7 > 50 kHz at medium vacuum level
* Remove U10 and ground pins 14,15
pin 13 to pin 40 (+5V)
* TP6 = Volts at U1-14,15 = U1-3 (U1 is OK)
* Check U6 (see Schematic 5.1.1)

Err 5 Low VAC
The controller uses the Setup Vac Cal constant to calculate the programmed vacuum level. It tries to reach this level and will stop pumping when no more increase in vacuum can be detected. If this level cannot be reached the processor checks to see if the vacuum level is at least within 100 mm of the requested value.

* VAC calibration set to high (Setup)
(For each 500m elevation subtract 30mm from 740mm)
* Pump lost its performance
* Hose connections, Fittings
Check for kinked hoses, loose muffle terminals
* See Err4

Err 6 Open muffle (Low or no AC current)
This error code will only be displayed at power up. If the muffle wire should open during idle mode, the display will eventually show ERR 6 at a low temperature. Turn the furnace off, then on again to verify this diagnostic. Otherwise check:

* Power relays click on at power up
* Line Voltage within specifications
* Muffle resistance present
* Continuous wiring
* MT2 to MT1: < 2Vac (on muffle triac)
* TP9 : > 20 mV
* U1-5 = U1-3 = TP9 reading

To operate the motor under an Err6 condition:
- Turn furnace off
- Hold #1 key down, and turn on
- Wait for relay to "click" and release key
- Use muffle movement key

Err 7 Low Line Voltage
When the line voltage drops below the required operating level for the microprocessor and its peripherals, the processor receives a signal from U18:A-1 and terminates its normal operation. This error is most likely displayed after power outages or the power line is downloaded by other high power equipment.

* Turn the furnace off, then on again
* TP10 > 15V +/- .5V ripple
* Check the first two digits of the second line during test.

* 45 to 50 indicates low line voltage (less than 80% of rated line voltage)
* U9-1 x .1 V = TP10
* U18:A-2: 1.25V
* U18:A-1: > 2.5 V

Err 8 EEPROM read/write error
Program parameters entered during the idle mode are transferred and stored in a 16K-bit Electrically Erasable Programmable Read Only Memory (EEPROM) device. The serial data on U14-5 is monitored and any abnormal behavior from the devices' specs is answered with an error code. Press ENTER and check:

* Data, Clock train on U14-5,6
* Replace device

If Err8 occurs at power up, the program number might be scrambled. Reprogram EEPROM. (Refer to service notice N9335-1 in back of manual)

Note: VPC II, and Intervac furnaces have a program to reset EEPROM to factory preset settings. On these furnaces, to completely re-program the EEPROM, call program 59, press ESC and then call program 159. The display will show EEPROM <ENTER>. Press ENTER to reset.

Err 9 TC input short/reversed. The control monitors the increase in temperature during the 0°C - 100°C range. If no increase in muffle temperature is detected during a 30 second period, the power relays open and the Err code is displayed.

* Check for correct TC polarity on circuit board
* Check for shorts on top of Thermocouple

Err 12 Over current (Excess AC line current detected)
This error may also occur when a vacuum pump draws excessive current at turn on (electrical noise).

* Turn the furnace off, then on again
* Check the first two digits of the second line during TEST.
* 85 TO 90 indicates high line voltage (greater than 120% of rated line voltage)
* Check muffle resistance
* Remove U10 (uP)
  U15:A-2 : 1.25V
  U15:A-1 :< .5V
  U17:B-5 : .7V
  TP8 :>2.5V

Err 13 [Solenoid 2 disconnected or open]
or
Err 14 [Solenoid 1 disconnected or open]

* check solenoid resistance 30-40 ohms
* Check crimp connections
* Check solenoid continuity with ohmmeter
* Test with a 10K ohm resistor across J4 / J7
  DS23 or DS24 should be on
* Check other outputs of U16 (Sonar)
* Check +12V (D46,47,48 cathode)

Err 15 Motor jam
This error code is called whenever the muffle is requested to go to its first or second dry position and exceeds 12 seconds of travel.

* Mechanical obstruction
* Motor current > 500 mA
* Slow VAC release

Err 16 [Muffle relay open]

Err 17 [Pump relay open]

* Check +12 V
  D44, D45 Cathode to ground
* Check resistance of relay coils

Err 18 Triac driver input short

* Check U8-1,2 diode
  U8-2 shorted to ground?

Err 19 No line frequency detected

* Check TP1, 100 or 120 Hz pulse train
* Remove Power
  U11-1,2 diode check (2)
  R41 resistance check

2.6 Block Diagram

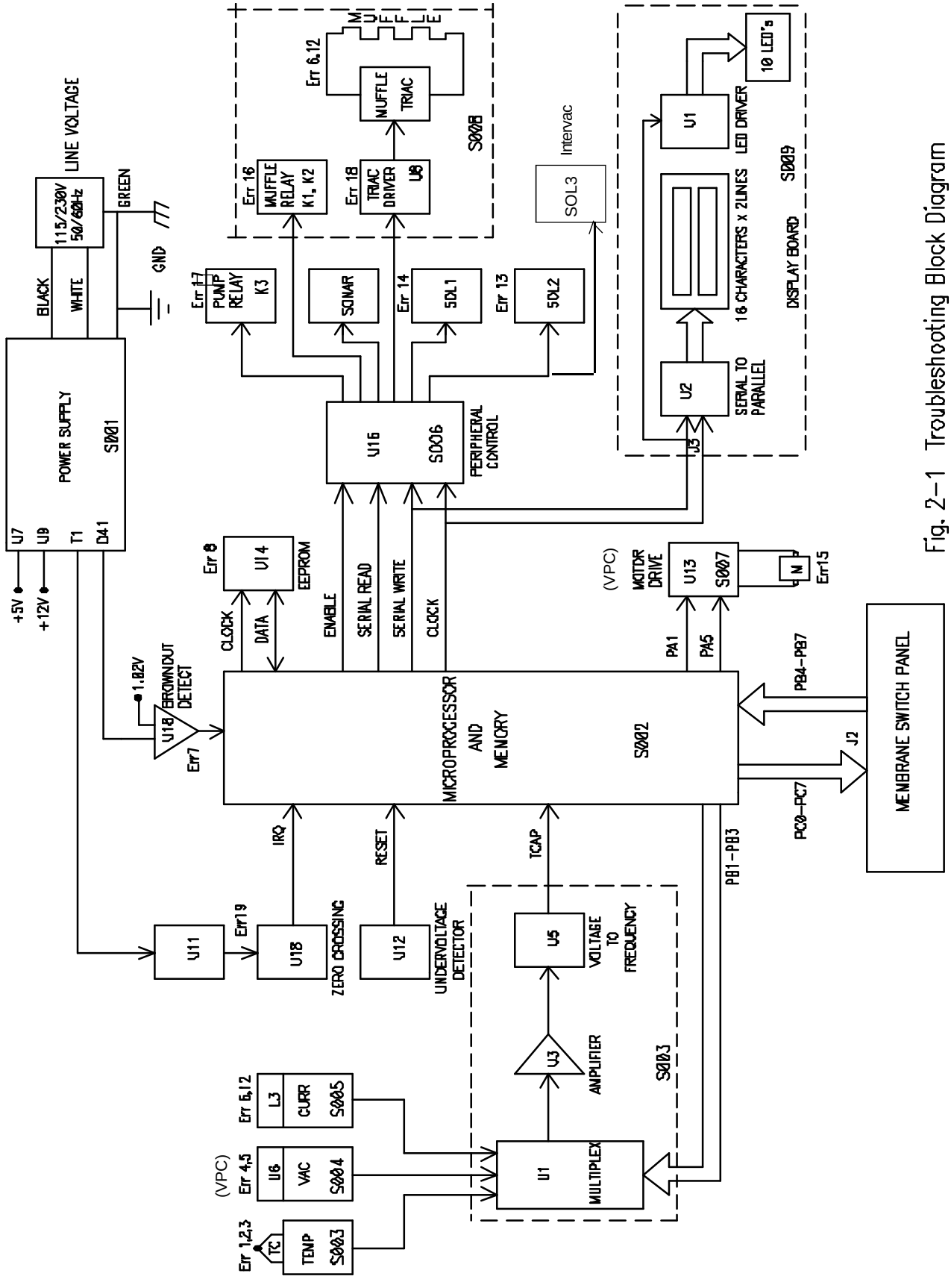


Fig. 2-1 Troubleshooting Block Diagram

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2.7 Diagnostic Tables

Circuit guide	Paragraph	Troubleshooting Tables	Schematic Diagrams
Power Supply	1.2.6, 2.3.1	2-3, 2-4	S001
Microprocessor	1.2.2, 2.3.2	2-5	S002
Temperature	1.2.1, 2.3.5	2-8	S003
[Vacuum]	1.2.5, 2.3.5	2-8	S004
Current Sense	1.2.1.6	2-2	S005
Peripheral	2.3.3	2-6	S006
[Motor]	2.3.4	2-7	S007
Triac	1.2.4	2-6	S008
Display	1.2.2	2-9	S009

Table 2-1 Functional Circuit guides

Symptom	Possible Setup Error
Display blank	No line voltage Power switch failure J3 disconnected
No or little Vacuum	Check door insulation fit Rotate door 90 degrees Pump electrical connections Pump hose connections
Press muffle up but muffle comes down again when in Nite Mode	Temperature is approximately 100°C Press ESC
Muffle does not heat after power up	One of the membrane keys made contact during power up. Turn furnace off then on again
No muffle movement after key is pressed	Possible Vacuum inside chamber. Rotate knob or press red button on back of unit Furnace is in TEST mode Motor connector J5 loose Furnace is running a firing cycle. Press S/S key and retry.

Table 2-2 Furnace Setup Common Errors

Output Voltage	Voltage Tolerance	Output Ripple	Test At	Input Ripple	Test At
+12V	+/-350mV	0.02Vac	U7-1	3Vac	U9-1
+ 5V	+/-250mV	0.02Vac	TP2	3Vac	U7-1

Table 2-3 Power Supply Voltages

Fault	Setup	Check	Results desired
No dc output and no dc to U9-1 (15-30V)	Power off	F1, F2	< 1 ohm
		T1 winding	Not shorted or open
		D40,41,42	Not shorted or open
		C40,41	Not shorted
Low or no +12V dc output	Power off	D43	Not shorted or open
	Disconnect J3 turn Power on	C46	Not shorted
		U9-2	Pulse train of 50kHz
		U7	No excessive heat

Table 2-4 Power Supply

Fault	Setup	Check	Results desired
Nonfunctional operation	N/A	U10-39	4MHz, sinusoid
		X1	approximately 0-4V
		U10-1,3,34,40	>4.5V
		U10-2	TP1 waveform
		U10-16thru28	digital low
		U10-12thru15	No stuck bits
		U10-4thru11	No stuck bits
		U10-29,30	digital high
		U10-31,32,33	No stuck bits
	Disconnect J3	Listen	Relay clicks,Sonar
Non-responsive to membrane switches	Disconnect J2	+5V to U10-16	
		U10-17	
		U10-18	
		U10-19	Sonar beeps
		U10-21thru28	low strobe

Table 2-5 Microprocessor

Fault	Setup	Check	Results desired
All Y outputs high	N/A	U16-11 U16-5,7,6	 No stuck bits DS23,24 are On
	Turn furnace Off then On	Display/ LED's	No Error codes Display OK
	Turn furnace Off	D46,47	Not shorted or open
U16-11 (Reset) low	N/A	TP8 U4:A-1	digital high digital high

Table 2-6 Peripheral Drive Circuit

Fault	Setup	Check	Results desired
No up or down	Furnace in idle Disconnect J5 Turn furnace on Press Up arrow Press Down arrow Turn furnace off Turn furnace on	U13-11 DS20,21 DS21 DS20 D21,26 U13-15	+12 V DS20,21 On DS21 off, DS20 on DS20 off, DS21 on Not shorted or open digital high
		Membrane keys	Other keys respond
At up or down position one LED stays off	Add mA meter in series at J5	Stall current	> 550 mA at up or down
	N/A	U13-15	High to low at up or down

Table 2-7 [Motor Drive Circuit]

Fault	Setup	Check	Results desired
Muffle heats but display shows same temperature	N/A	JYELL1 U1-13,3 U1-9,10,11 TP5,7	TC yellow connected Same mV (1-40) No stuck bits same frequency (1 - 50kHz)
Erratic temperature display	N/A	TP2 TP3 TP4 D1-K TP5	See Table 2-3 39.7mV stable 50 - 55mV stable 1.23V stable Stable frequency (No sweeping)

Table 2-8 Analog Circuitry

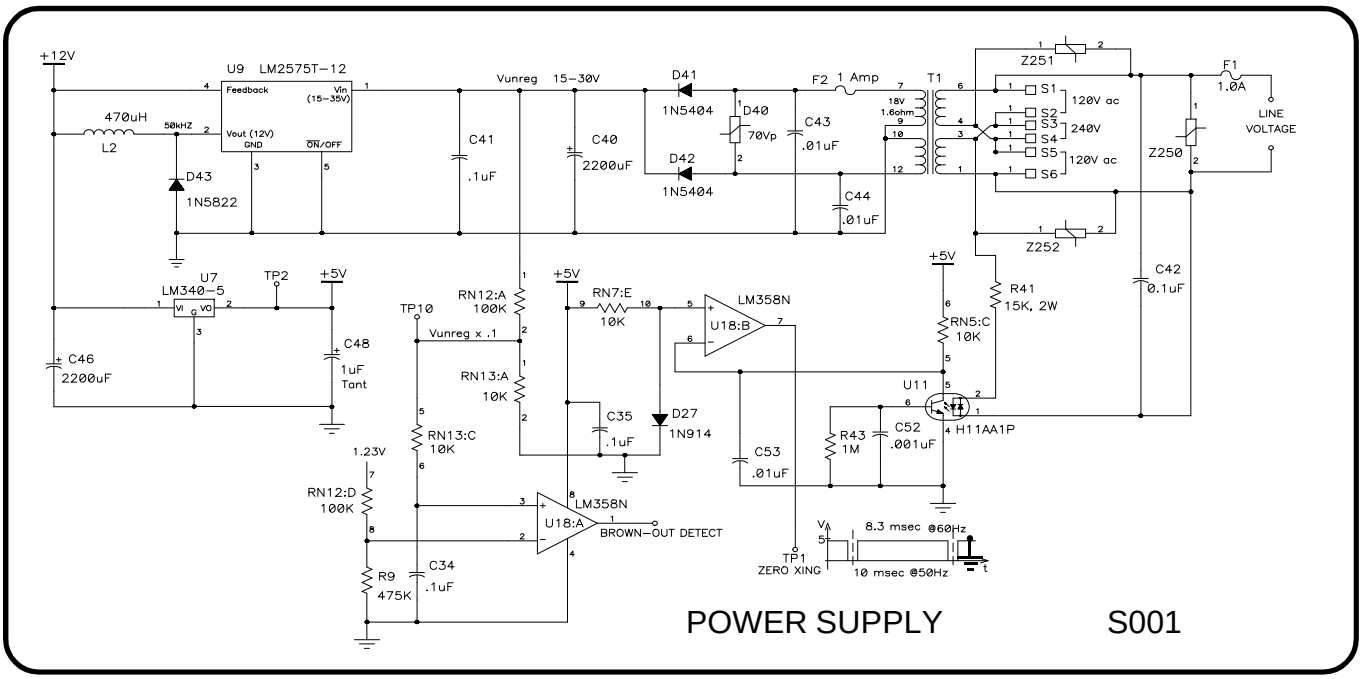
Fault	Setup	Check	Results desired
Temperature drift	Hi T = 960°C	JYELL1	39-40mV stable
(difficult to to calibrate)	Hold = 20:00M VAC = 0 %		(.1 -.2mV increase during first 5 Min.)
		TP4	50-55 mV stable (.2mV/°C ambient increase typical)
		U2-1 (center)	Apprx. 120mV stable
Vacuum readout too high or too low	Furnace in idle	TP6 U6-2,4	1-3 mV Same Voltage (2.5V)
	VAC calibration (See 3.4.2)	Display	Adjust to gage level
	VAC cycle (101%) level reading	Display	Obtain previous gage
Err2 during VAC cycle but TC is good	Change Pump oil or pump	N/A	No Err2 at pump turn on
	Turn furnace off	Tighten TC wires	No Err2 at elevated temperatures
		Solenoid	Approx. 35 ohms each resistance
		TP2	See Table 2-3

Table 2-8 Analog Circuitry (continued)

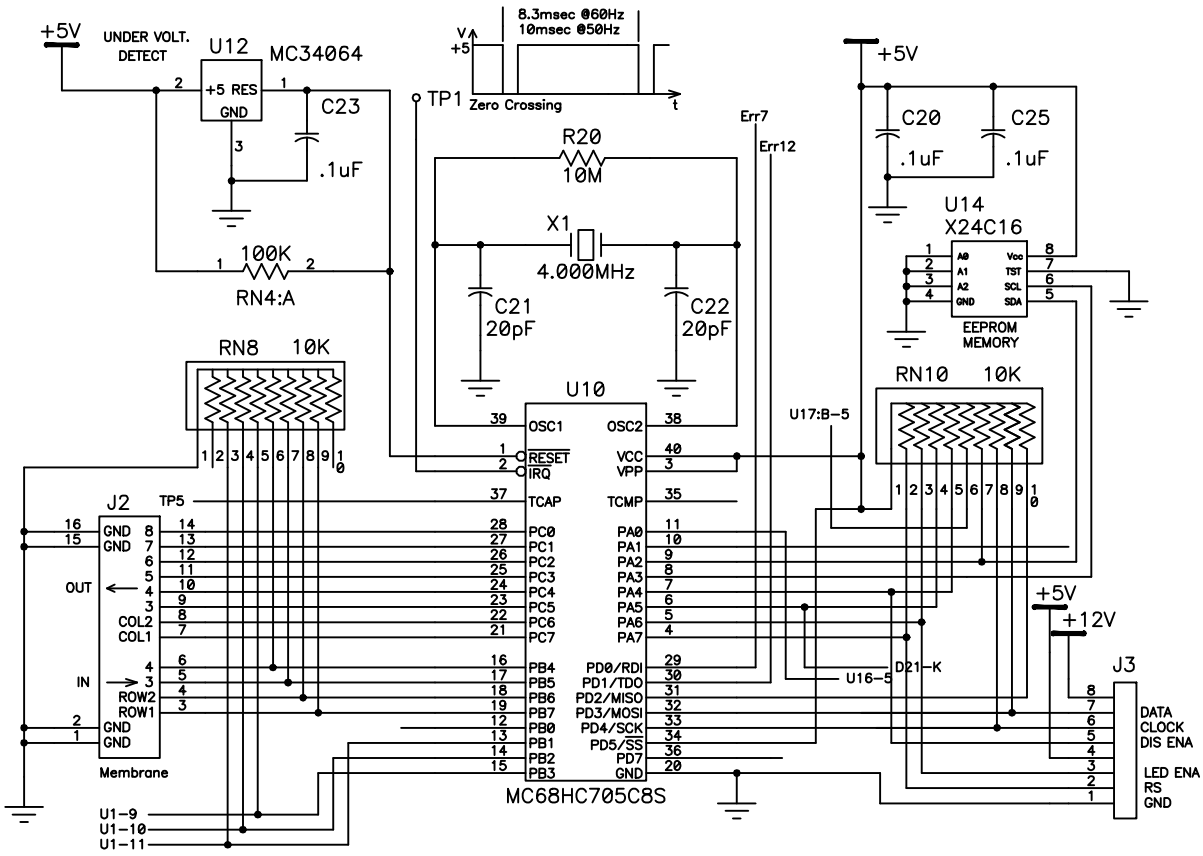
Fault	Setup	Check	Results desired
LCD dots are all on or off at power up	Furnace in idle	J2-8	See Table 2-3
		U10	See Table 2-5
		J3	Tight fit
		U2-8,2	No stuck bits
No backlight	Furnace in idle	U1-20	digital low
		J1-15	90V-100V @ 400Hz
		U1-2,4,40	No stuck bits
No LED's light up	Perform power up	Front panel	LED's turn off one by one (Nite on)
	N/A	J2-4	See table 2-3
One LED does not come on	Turn furnace off	LED	Not open or shorted
LCD display dim	N/A	Life of Display	Backlight dimmer with age
LCD display dark	Turn furnace off	Temperature on panel	Less than 40°C
	Turn furnace on	Temperature on panel	LCD lighter shade

Table 2-9 Display Board

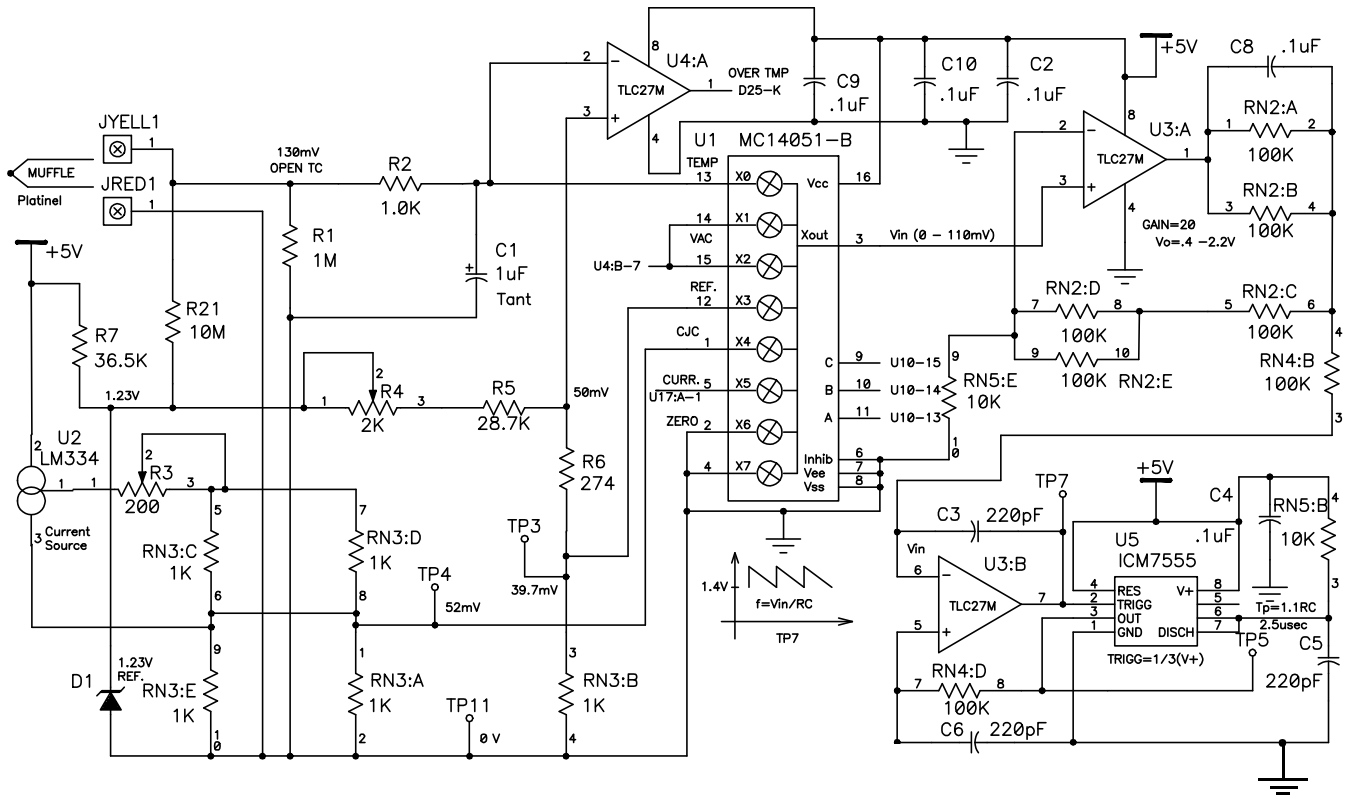
2.8 Schematics



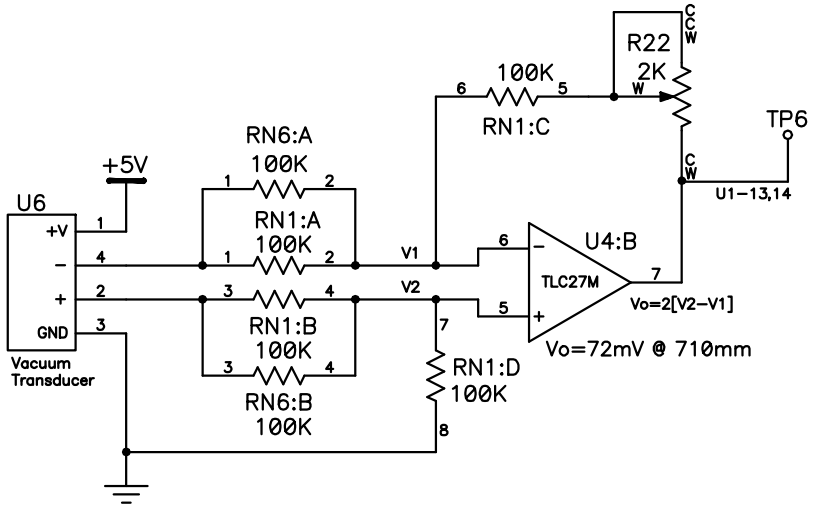
POWER SUPPLY S001



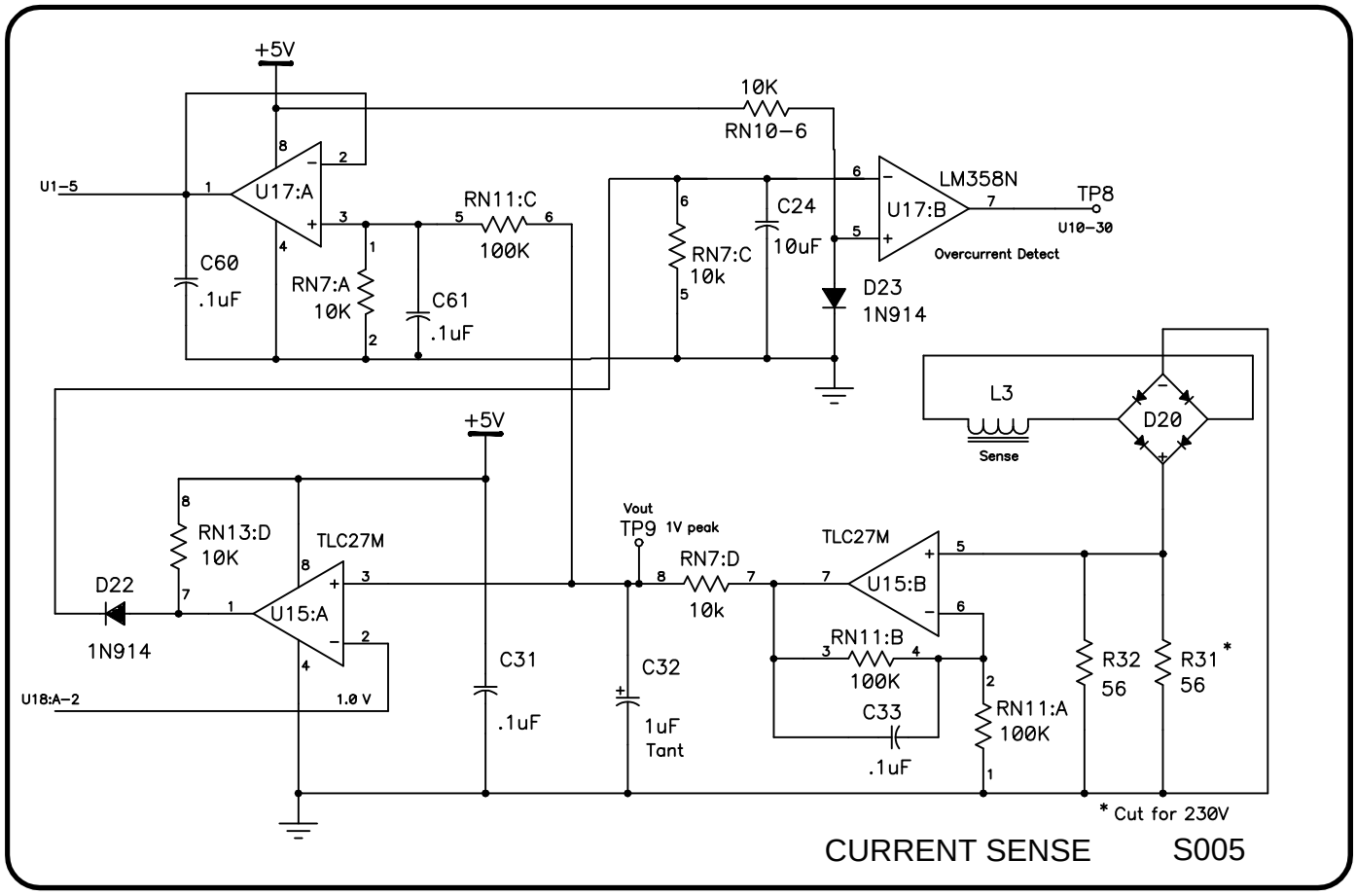
MICROCOMPUTER and SUPPORT CIRCUITRY S002

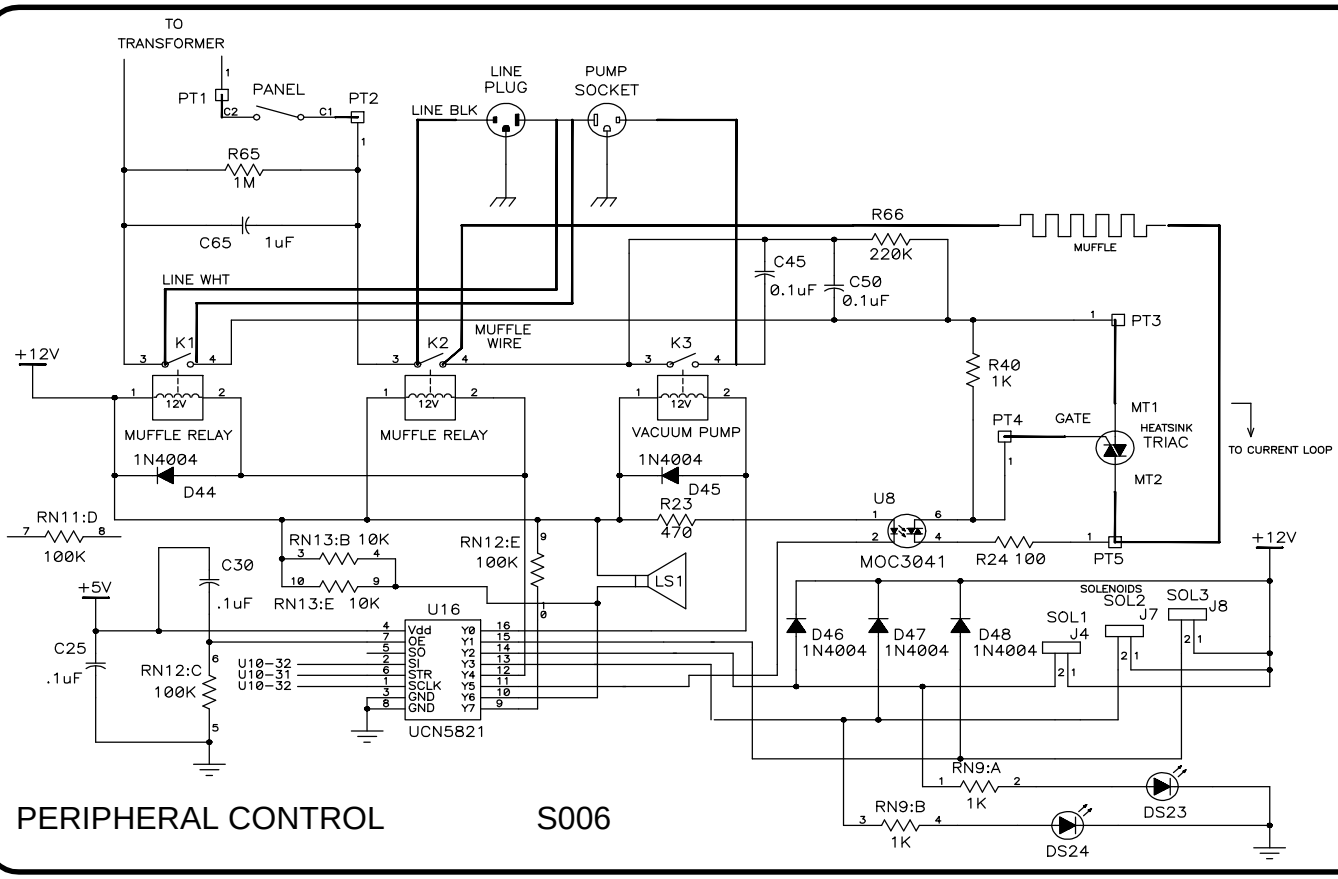


TEMPERATURE MEASUREMENT S003

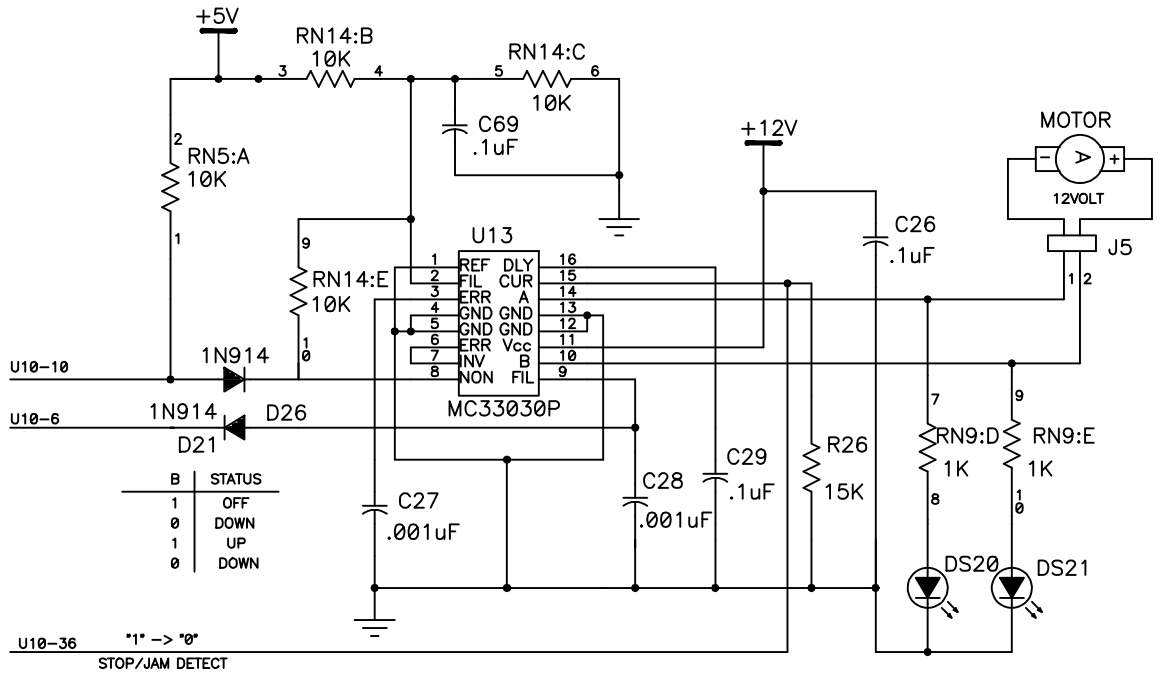


VACUUM MEASUREMENT S004

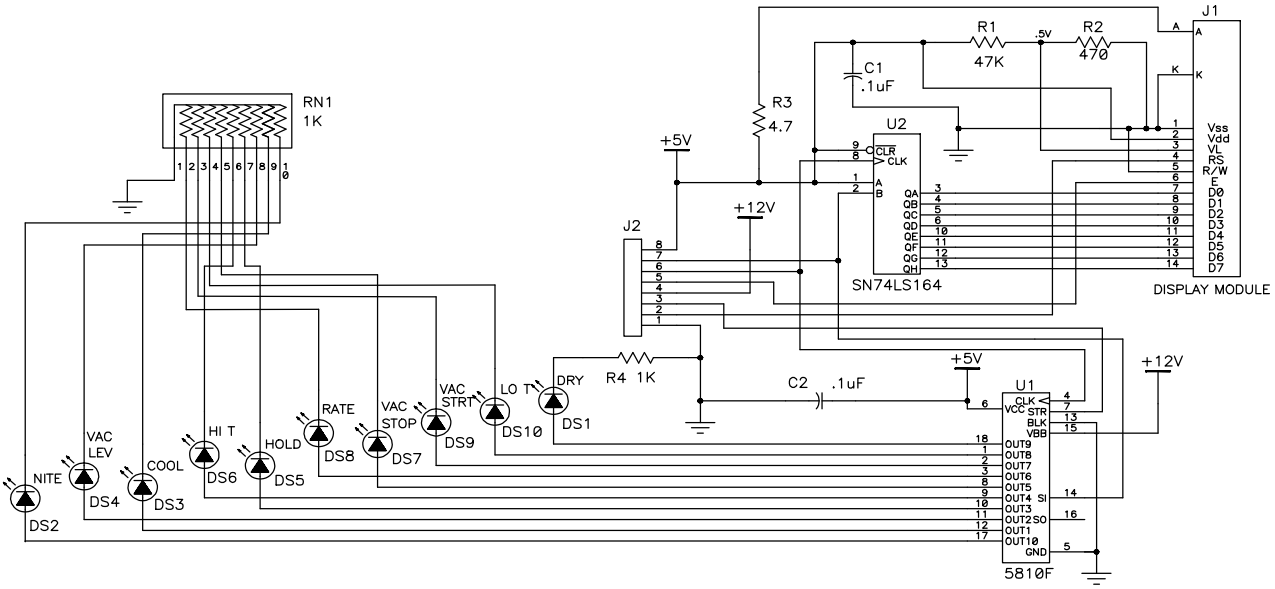

+5V
10K
RN10-6
U1-5
U17:A
RN11:C
100K
C60
.1uF
RN7:A
10K
C61
.1uF
RN7:C
10k
C24
10uF
U17:B
LM358N
TP8
U10-30
Overcurrent Detect
D23
1N914
L3
Sense
D20
+5V
RN13:D
10K
TLC27M
D22
1N914
U15:A
U18:A-2
1.0 V
C31
.1uF
Vout
TP9 1V peak
C32
1uF
Tant
RN7:D
10k
TLC27M
U15:B
RN11:B
100K
C33
.1uF
RN11:A
100K
R32
56
R31 *
56
* Cut for 230V
CURRENT SENSE S005


TO
TRANSFORMER
PT1
PANEL
PT2
LINE
PLUG
PUMP
SOCKET
LINE BLK
R65
1M
C65 1uF
LINE WHT
K1
K2
K3
MUFFLE
WIRE
R66
220K
MUFFLE
C45
0.1uF
C50
0.1uF
PT3
+12V
R40
1K
MUFFLE RELAY
MUFFLE RELAY
VACUUM PUMP
1N4004
D44
1N4004
D45
PT4
GATE
MT1
HEATSINK
TRIAC
MT2
TO CURRENT LOOP
RN11:D
100K
RN13:B 10K
RN13:E 10K
C30
.1uF
RN12:E
100K
R23
470
U8
MOC3041
R24 100
PT5
+12V
+5V
LS1
SOLENOIDS
SOL2
SOL3
J8
J7
SOL1
J4
C25
.1uF
RN12:C
100K
U10-32
U10-31
U10-32
U16
UCN5821
D46
1N4004
D47
1N4004
D48
1N4004
RN9:A
1K
DS23
RN9:B
1K
DS24
PERIPHERAL CONTROL S006

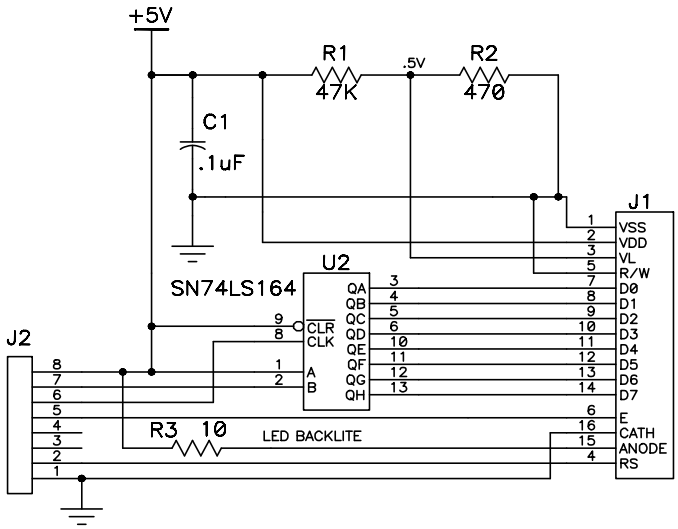
9310



MOTOR CONTROL S007

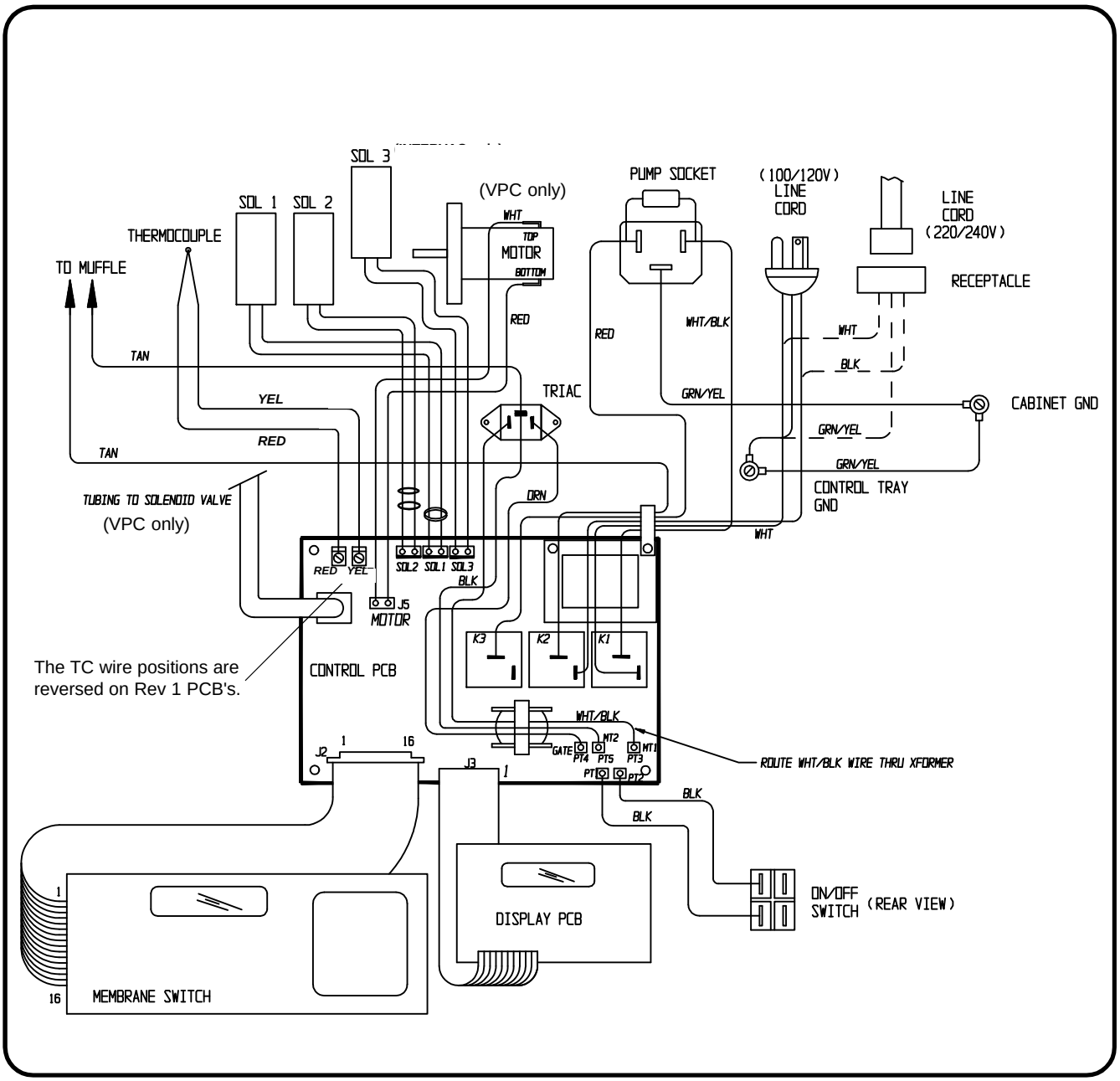


DISPLAY BOARD VPC S009



DISPLAY BOARD VPM S010

2.9 WIRING DIAGRAM



SECTION 3
ADJUSTMENTS/CALIBRATION

3.1 SCOPE

This section gives the procedures to be used for the calibration and specification verification of the CENTURION. The furnace specifications are given in the Owner & Operator's Manual.

3.2 FACTORY REPAIR

NEY Dental International maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the CENTURION. If a unit is returned to the factory for calibration or repair, a detailed description of the specific problem should be included to minimize turnaround time.

3.3 ADJUSTMENT/CALIBRATION

3.3.1 Temperature

To calibrate the furnace (or to verify its calibration) by means of the silver coupon method refer to the owners manual. However, in most cases the temperature error at or near 960°C is known and this error can now be corrected by using the Tcal Setup feature. Simply ask yourself: What is the real muffle temperature when the display shows 960°C? Subtract this value from 960°C and add it to the Tcal setting. The following example should clearify this procedure further:

It is determined that a certain porcelain overfires for a given program cycle. But, since many other program cycles have similiar Hi Temp values it is desired to lower the calibration rather then to reprogram every Hi Temp. It is now estimated that a lowering of the Hi Temp by 5°C would eliminate the overfiring, thus, the muffle temperature at a display reading of 960°C is actually 965°C. The new setup temperature Tcal is now found by the following calculation:

Tcal = Tcal + (960°C - 965°C)

or in this case:

Tcal = Tcal - 5°C

If the Tcal is still at its factory setting of 960°C reprogram it to 955°C. If it has been modified previously, let's say to 950°C reprogram it to 945°C. If the porcelain underfires simply add the result obtained from the equation to the setup Tcal. The limits for Tcal are 860°C to 1060°C.

3.3.2 [Vacuum]

Since the atmospheric pressure varies from sea level to higher elavations and the vacuum transducer obtains absolute readings, it is necessary to adjust the Vcal setup for a particular geographic location. The factory setting is done for this location and determined to correspond to 710mm Hg (This takes into consideration a strong vacuum pump). For higher elevations the following adjustments for Vcal should be made:

For each 300m of additional elevation subtract 20mm from 710mm. Add 20mm to the factory setting for a sea level location.

Should a value be known which a particular vacuum pump is able to obtain at this location, enter this value for Vcal. For example, a firing cycle with a VAC setting of 101% showed a maximum vacuum of 680mm on the display. Enter the setup mode (Owner's Manual) and program the new Vcal value. This new Vcal value represents the maximum value (100%) the vacuum pump is able to obtain at this location. If the VAC level should be changed to 50% the pump would stop at a display reading of 340mm.

3.3.3 Lift Drag Adjustment (VPM only)

The lift drag force is controlled by a set of friction washers on each of the upper pivot arms (see fig.4.4.2). A wave spring should maintain a relatiely constant force even after several thousand cycles. If the drag becomes too stiff (too hard to open and close furnace) or too loose (muffle won't stay in pre-dry or up positions) an adjustment can be made using the following procedure:

Tools required: Phillips screwdriver, 5/32" allen wrench, 7/16" open end wrench.

- Uplug the furnace from the wall outlet.
- Remove the four (4) screws on the top enclosure
- Loosen the lock-nuts on both sides of the rear column.
- Turn the allen head screws on the upper inside of the column either clockwise to tighten or counterclock wise to loosen the drag force. Note: Equal adjustment should be made on each side. Turn screws only 1/6 of a revolution at a time when making adjustment.
- Tighten lock nut while holding screw to prevent from rotating.

3.4 CIRCUIT BOARD CALIBRATION

Calibration of the CENTURION circuit board is performed in two steps: Software and hardware.

3.4.1 Required Test Equipment

-4 1/2 digit millivoltmeter
-Temperature calibrator; Type K
-Pot adjustment tool
-Vacuum gage (0 - 760mm)

WARNING
With covers removed, dangerous voltage points may be exposed. Contact with any of these points could cause serious injury.

CAUTION
Observe antistatic procedures when touching circuit board components.

3.4.2 Temperature
Enter the setup mode (Owner's Manual page12) and enter 960°C for Tcal. Disconnect the muffle thermocouple from the control circuit board and connect the temperature calibrator on its place. Set the output of the calibrator to 960°C. Adjust R4 to read 960°C on the furnace display. Instead of a calibrator, a low output impedance mV source set to 38.8 mV can be used.

A ± 5°C calibration can be obtained without the temperature calibrator by performing the following sequence: Leave the control thermocouple connected and adjust R4 to read 39.7mV at TP3. Adjust R3 to read 52mV at TP4.

3.4.3 [Vacuum]
Enter the setup mode (see Owner's Manual) and enter the Vcal value for this particular location (see 3.3.2). Disconnect the Vacuum hose from the transducer (U6 on the control circuit board) and connect its end to a standard reference vacuum gage. Reconnect the other end from the gage to the vacuum transducer. Run a vacuum cycle with a level setting of 101% (Pump stays on). Compare the reading of the gage with the reading of the furnace display and adjust R22 until both readings are the same. (Note: if a reference gage is not available, use best estimate) If it was necessary to turn R22 more than 2 turns abort the cycle and check the calibration by repeating this procedure.

Vacuum Calibration using Software: Program 147 will automatically place the control into a 101% Vac cycle. At Enter, the muffle closes and the vacuum is pulled until the control cannot detect anymore Vac increase.

At this time, the display prompts: Vcal=____. The operator can now key in a new value taken from a second reference gage or their best estimate. At Enter, the cycle is aborted.

3.5 CONVERSIONS

3.5.1 Temperature

$$°C = \frac{(°F - 32°F)}{1.8}$$

$$°F = (1.8 \times °C) + 32°F$$

The 32°F number is not used in rate conversions.

3.5.1.1 Example:

If temperature is 50°C, the rate in °F would be:

$$1.8 \times 50°C = 90°F$$

3.5.2 Vacuum

1 in (inch) = 25.4mm

$$VAC\ \% = 100 \times \frac{\text{(Desired vacuum level)}}{\text{(Vcal level in Setup)}}$$

3.5.3 Pressure

PSI = kPa x .14504

PSI = Atmospheres x 14.696

PSI = kg/m² x 0.0014223

PSI = Kg/cm² x 14.223

SECTION 4
SERVICE PARTS

4.1 ORDERING INSTRUCTIONS

To order parts, select the part number required from the exploded view drawings in section 4.2.1 through section 4.6.2. When ordering parts please have the following information available:

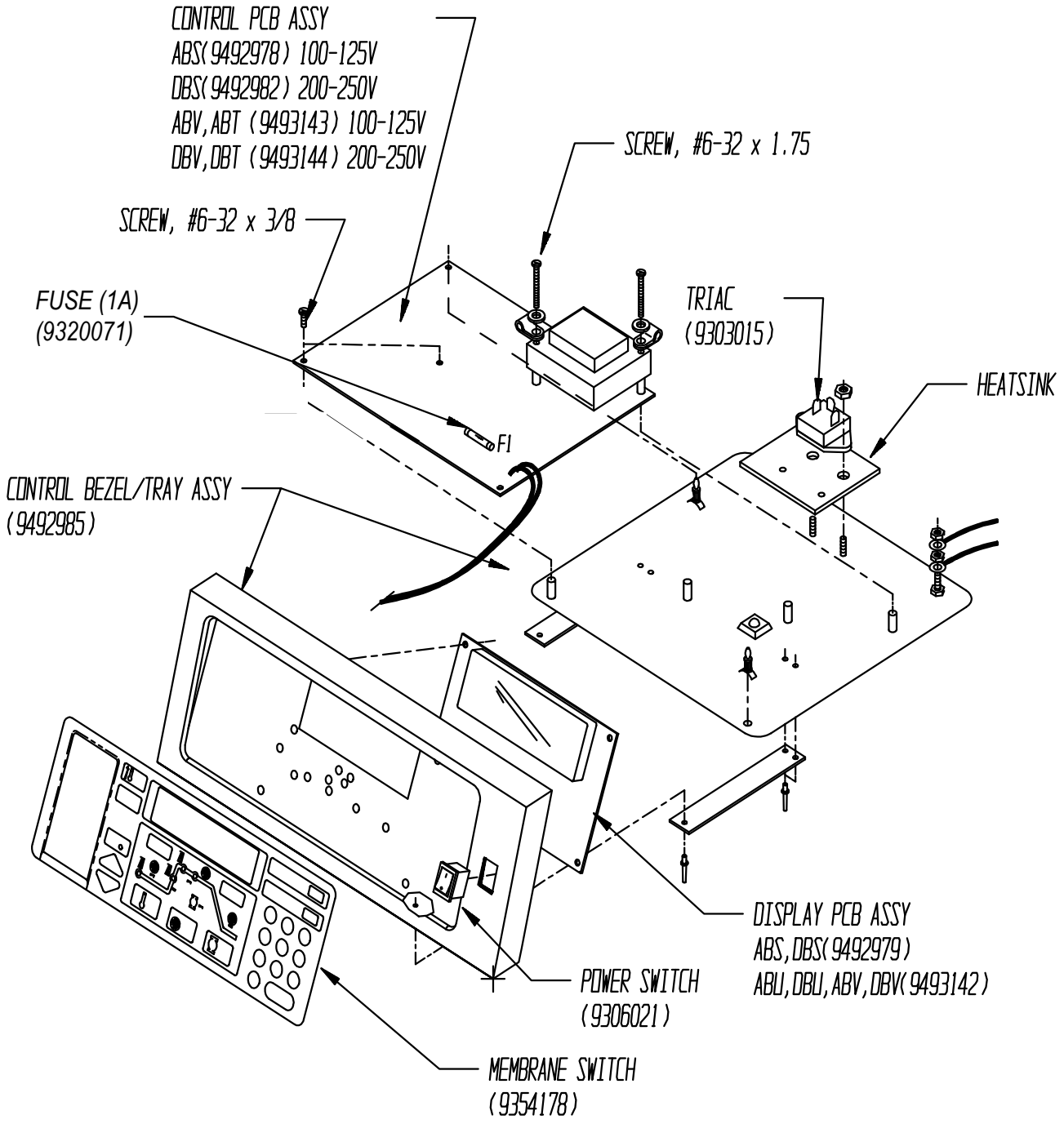
This information is needed to determine if the product is under warranty and to help us in tracking failures so that corrective action can be taken to prevent future problems.

1. Serial Number of Furnace
2. Date Purchased
3. Where Purchased
4. Symptom of Failure
5. Part Number of replacement part
6. Preferred Method of Shipment

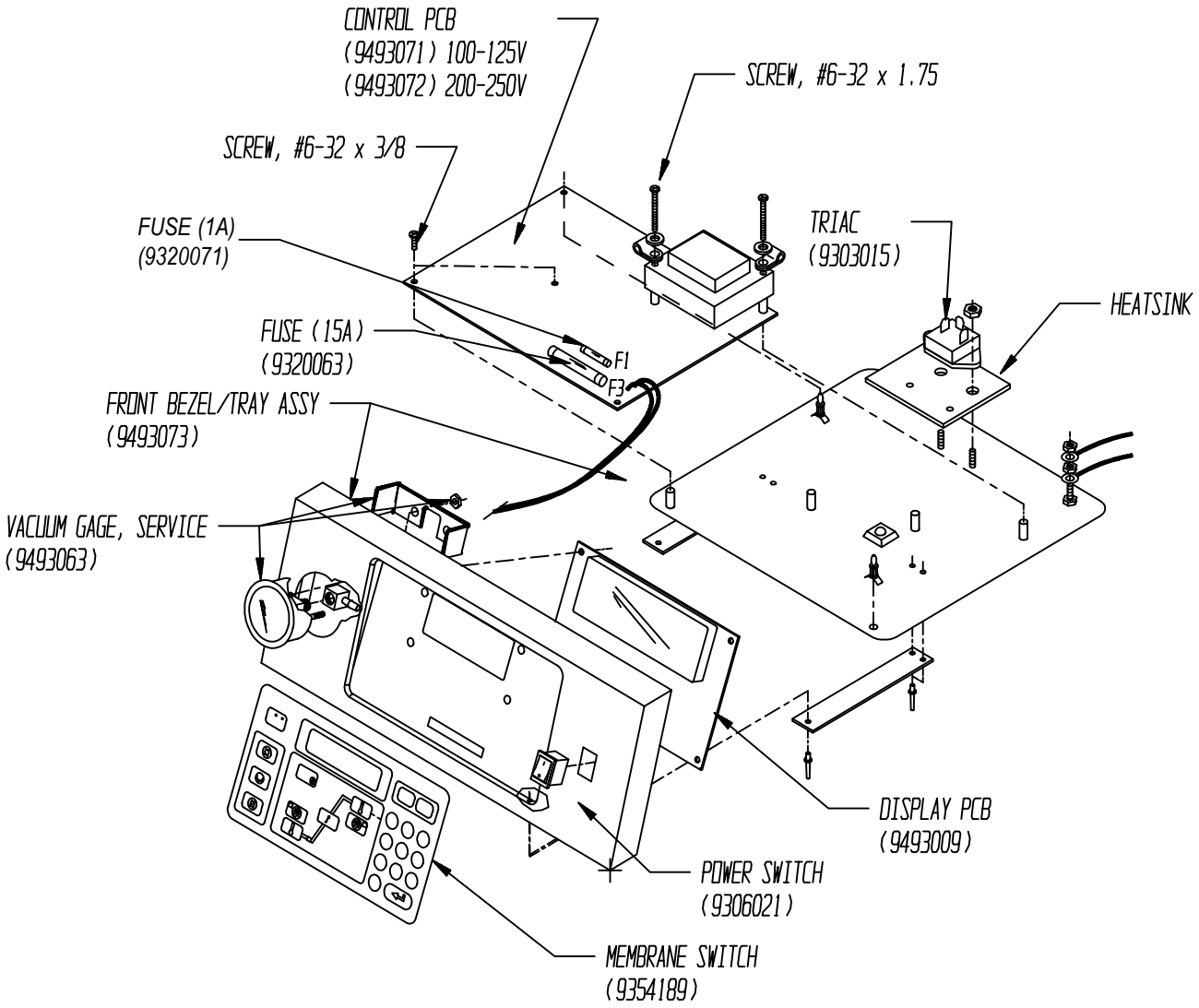
	VPC	VPC II	VPQ	INTERVAC	VPM
SERIAL NUMBERS:	**ABS,DBS**	**ABV DBV**	**ABW DBW**	**ABU,DBU**	**ABT,DBT**
Control Drawer Parts: (p. 4-2,3)					
Membrane Switch	9354178	9354178		9354178	9354189
Triac	9303015	9303015		9303015	9303015
Display PCB Assy	9493142	9493142		9493142	9493009
Control PCB Assy (100-125V)	9493143	9493143		9493143	9493071
Control PCB Assy (200-250V)	9493144	9493144		9493144	9493072
Power Switch	9306021	9306021		9306021	9306021
Fuse, 15A, 250V	9320063	9320063		9320063	9320063
Fuse, 1A, 250V	9320071	9320071		9320071	9320071
Front Bezel/Tray	9492985	9492985		9492985	9493073
Vacuum Gage, service	-	-		-	9493063
Muffle & Vacuum Chamber Parts: (p.4-4)					
Muffle, service (100-125V)	9492976	9492976		9492976	9492976
Muffle, service (200-250V)	9492977	9492977		9492977	9492977
Quartz muffle (100-125V)	9493697	9493697		9493697	9493697
Quartz muffle (200-250V)	9493698	9493698		9493698	9493698
Muffle Retaining Ring	9492902	9492902		9492902	9492902
Muffle Termination Kit	9493062	9493062		9493062	9493062
Vacuum Window Kit	9492987	9492987		9492987	9493070
Thermocouple	9492980	9492980		9492980	9492980
Lift Mechanism Parts: (p.4-5,6)					
Counterbalance	9352040	9352040		9352040	-
Gas Spring	-	-		-	9352058
Pivot Linkage, service	9493066	9493066		9493066	-
Upper Pivot Arm, service	9493067	9493067		9493067	9493064
Lower Pivot Arm, service	9493068	9493068		9493068	9493067
Friction Washer	-	-		-	9901053
Door & Cabinet Parts: (p.4-7,8)					
Top Enclosure	9492957	9492957		9492957	9493017
Bottom Enclosure	9492958	9492958		9492958	9492958
Column Cover	9492942	9492942		9492942	9493015
Door	9492885	9492885		9492885	9492885
Door O-Ring	9357071	9357071		9357071	9357071
Door Mounting Kit	9492991	9492991		9492991	9492991
Ceramic Work Platform	9493008	9493008		9493008	9493008
Motor & Valves Parts: (p.4-9,10)					
Valve Kit	9492983	9493074		9493074	9493074
Venturi/Valve Kit	-	-		9493145	-
Motor Assy	9492984	9492984		9492984	-
Line Cord, USA (100-125V)	9390115	9390115		9390115	9390115
Line Cord, EURO (200-250V)	9390117	9390117		9390117	9390117
Other Parts/Assy:					
Accy Kit	9492920	9493140		9493140	9493019
Side Shelf	9492932	9492932		9492932	9492932
Side Shelf Ceramic Tray	9390017	9390017		9390017	9390017
Hardware Kit, Assorted Fasteners	9492988	9492988		9492988	9492988
Tool Kit	9492989	9492989		9492989	9492989
Magnetic Log Cards, pkg of 5	9492975	9492975		9492975	9492975
Box & Supports	9493069	9493069		9493069	9493069

9628

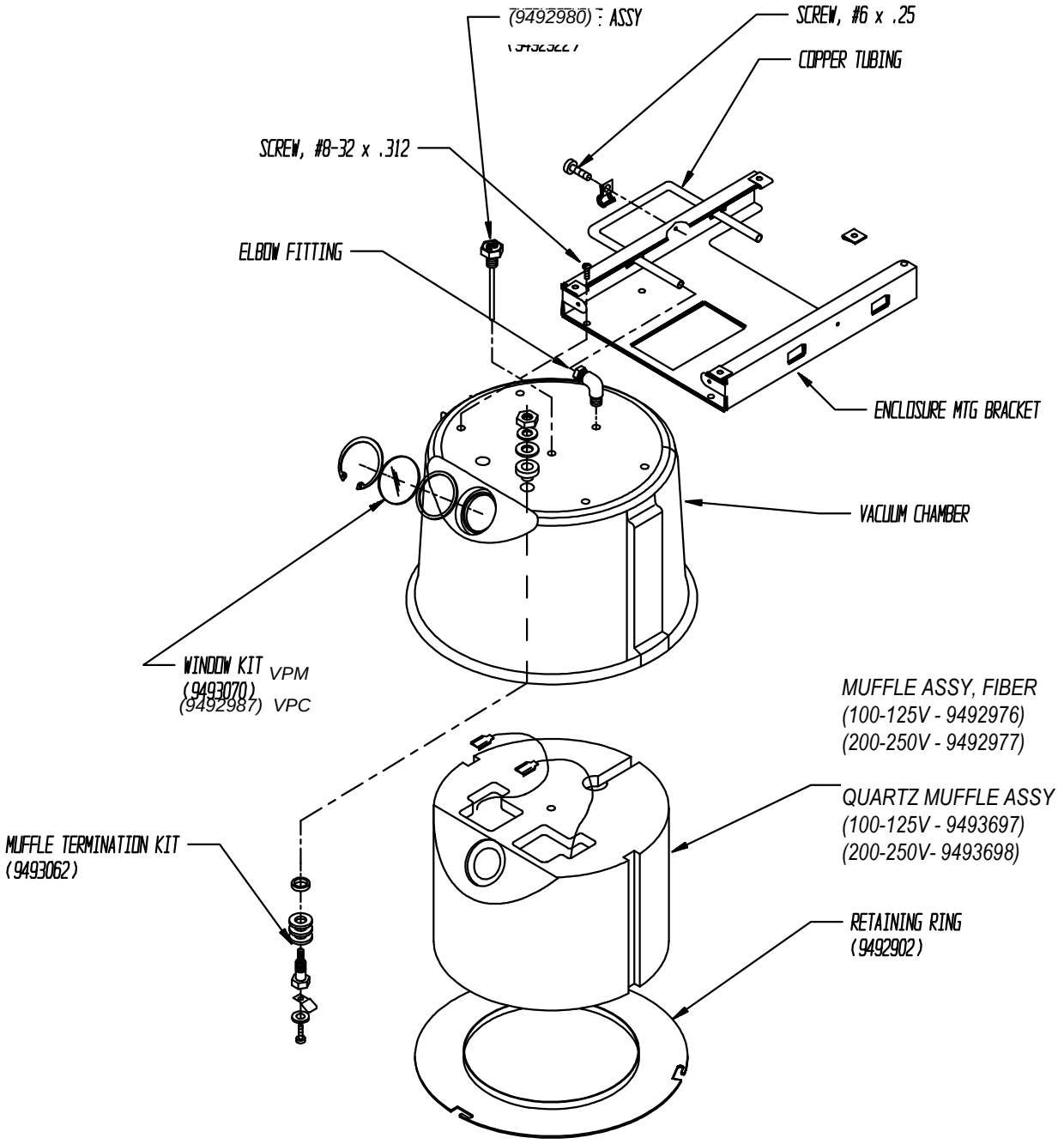
4.2 VPC CONTROL DRAWER PARTS



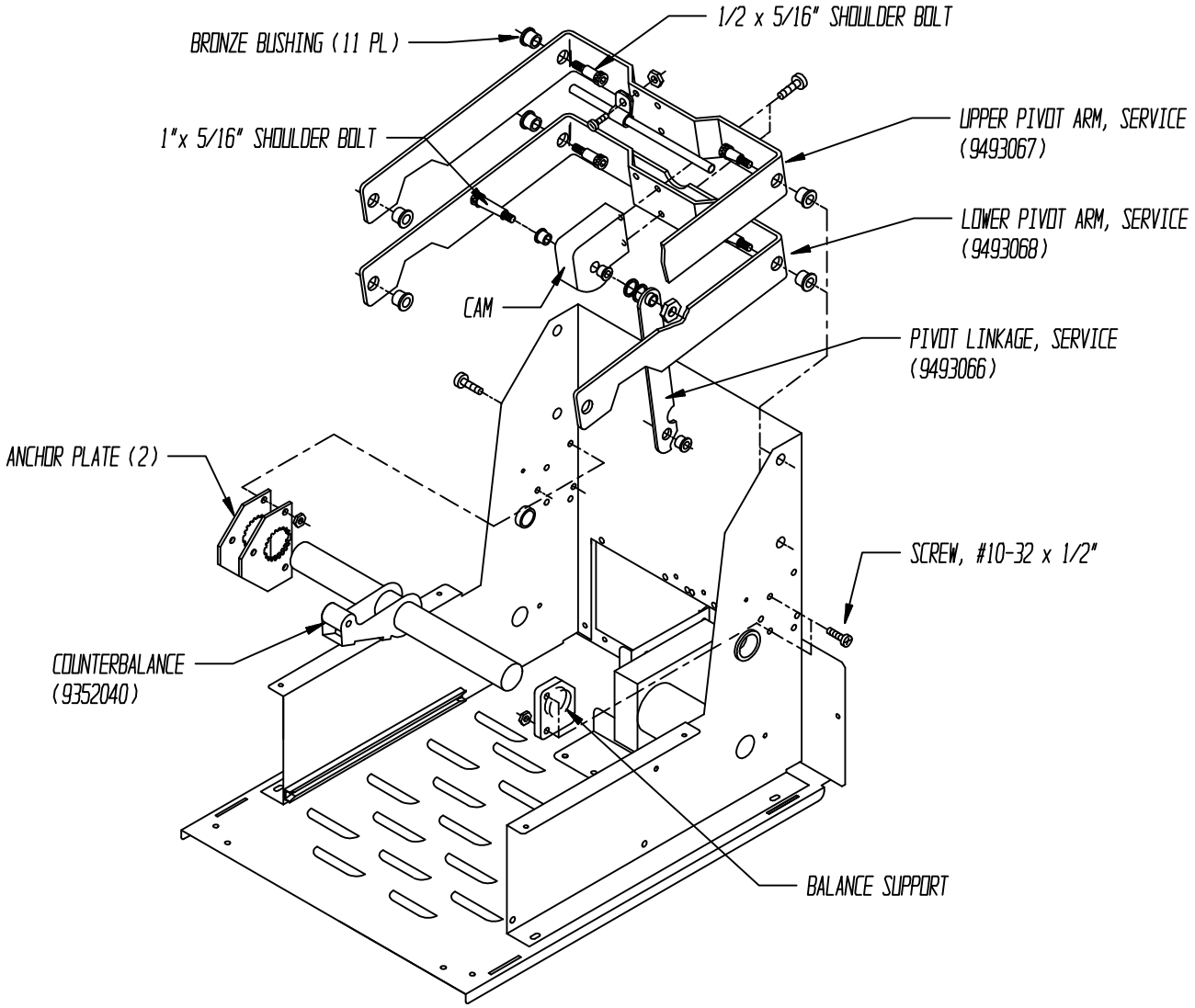
4.3 VPM CONTROL DRAWER PARTS



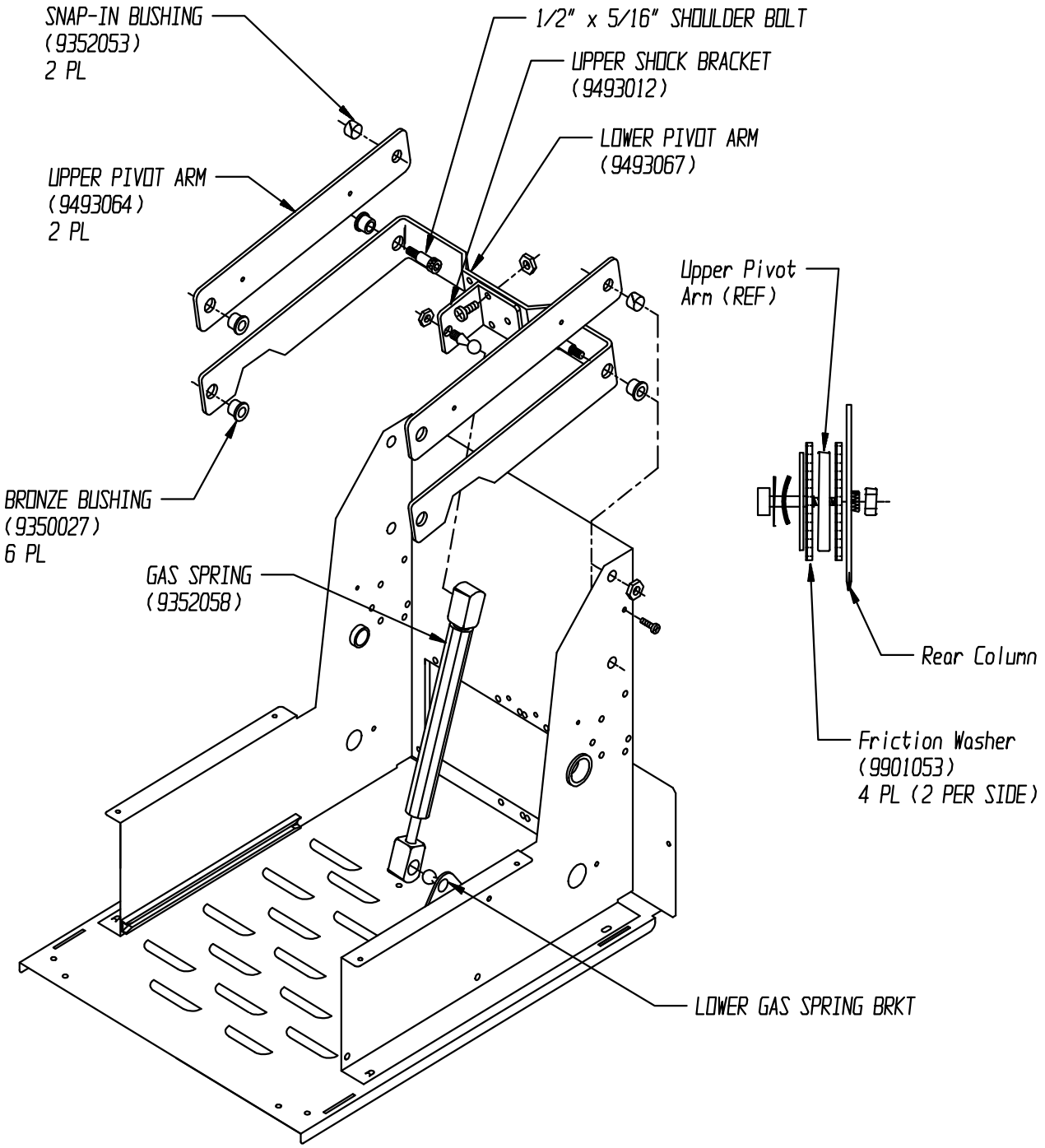
4.4 MUFFLE & VACUUM CHAMBER PARTS



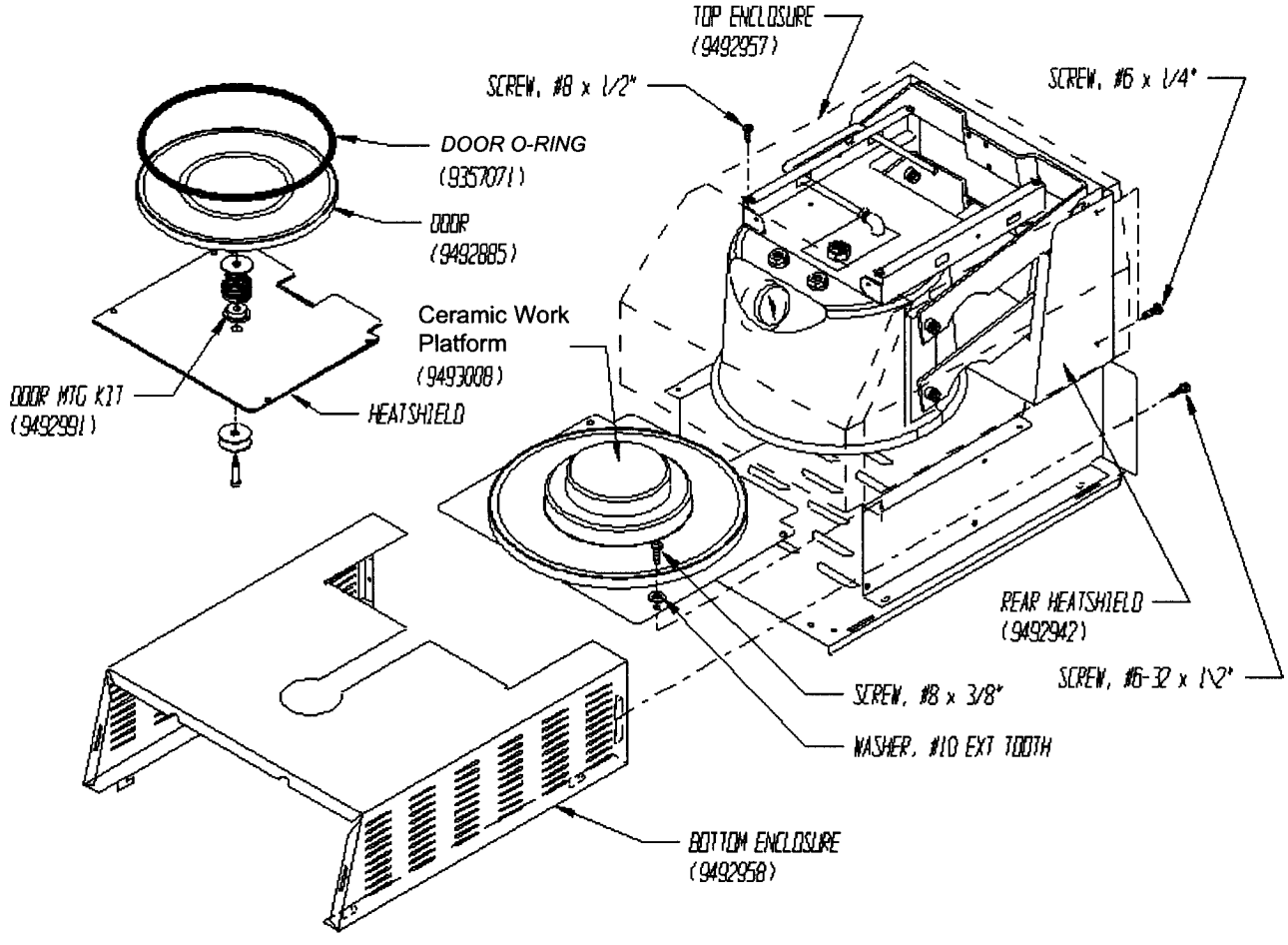
4.5 VPC LIFT MECHANISM PARTS



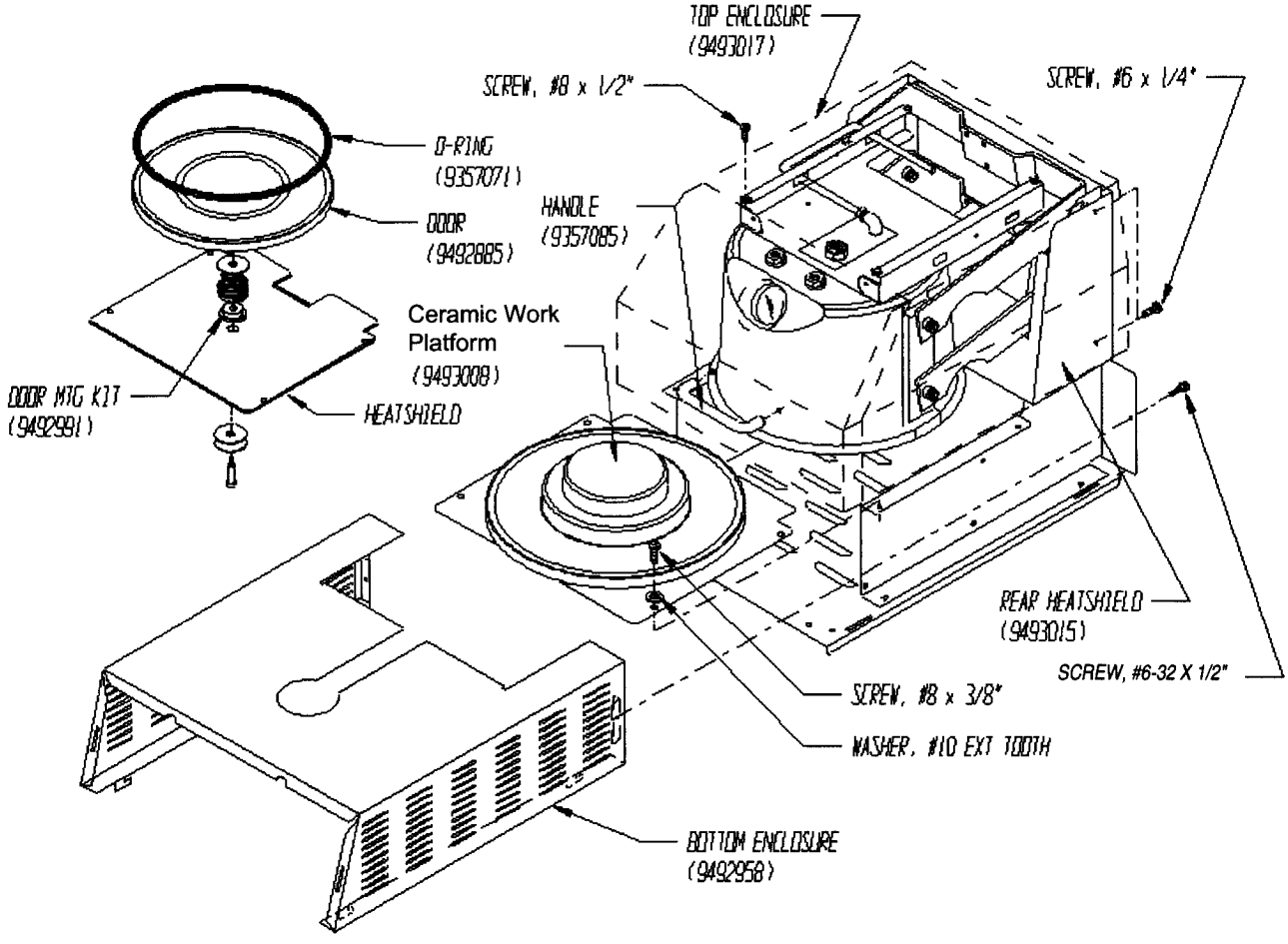
4.6 VPM LIFT MECHANISM PARTS



4.7 VPC DOOR & CABINET PARTS

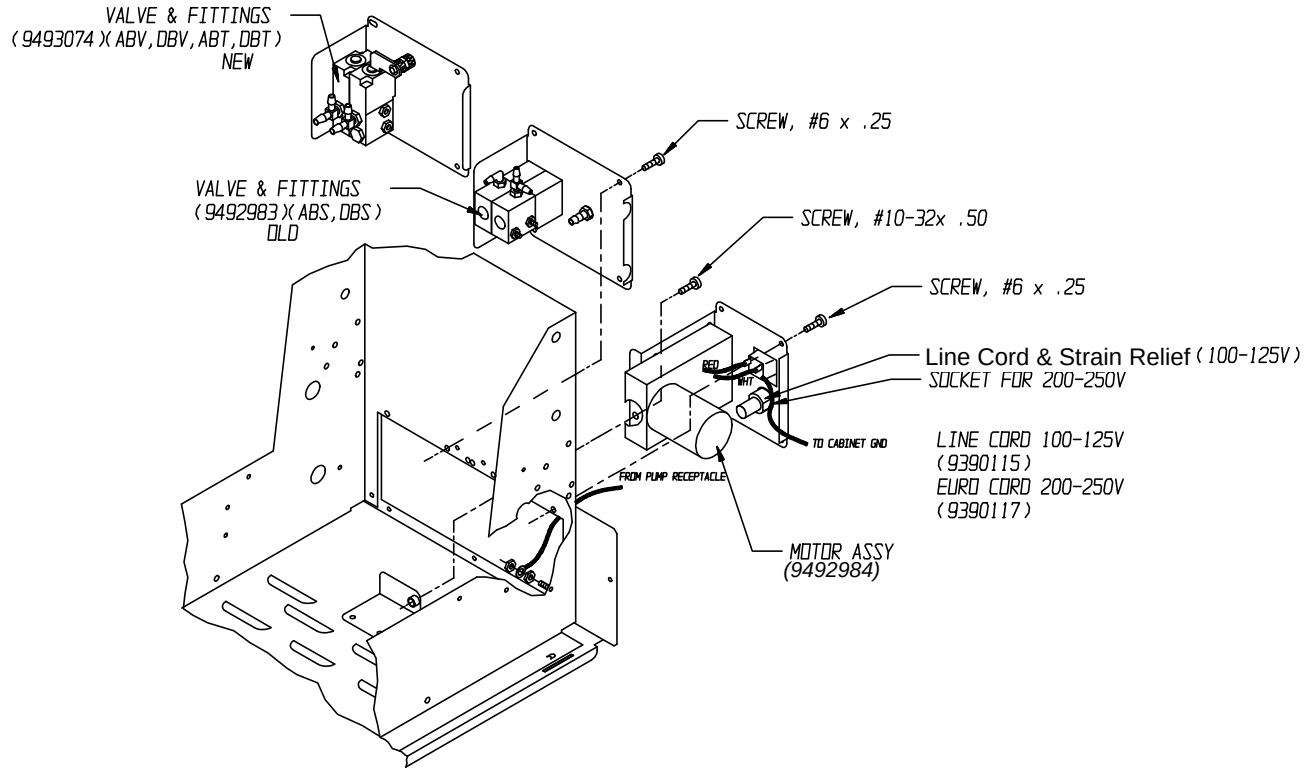


4.8 VPM DOOR & CABINET PARTS

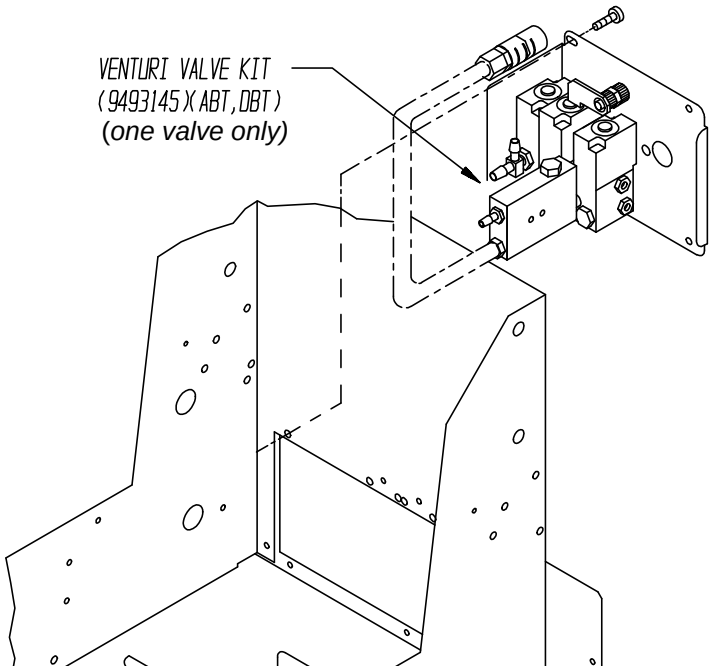


9628

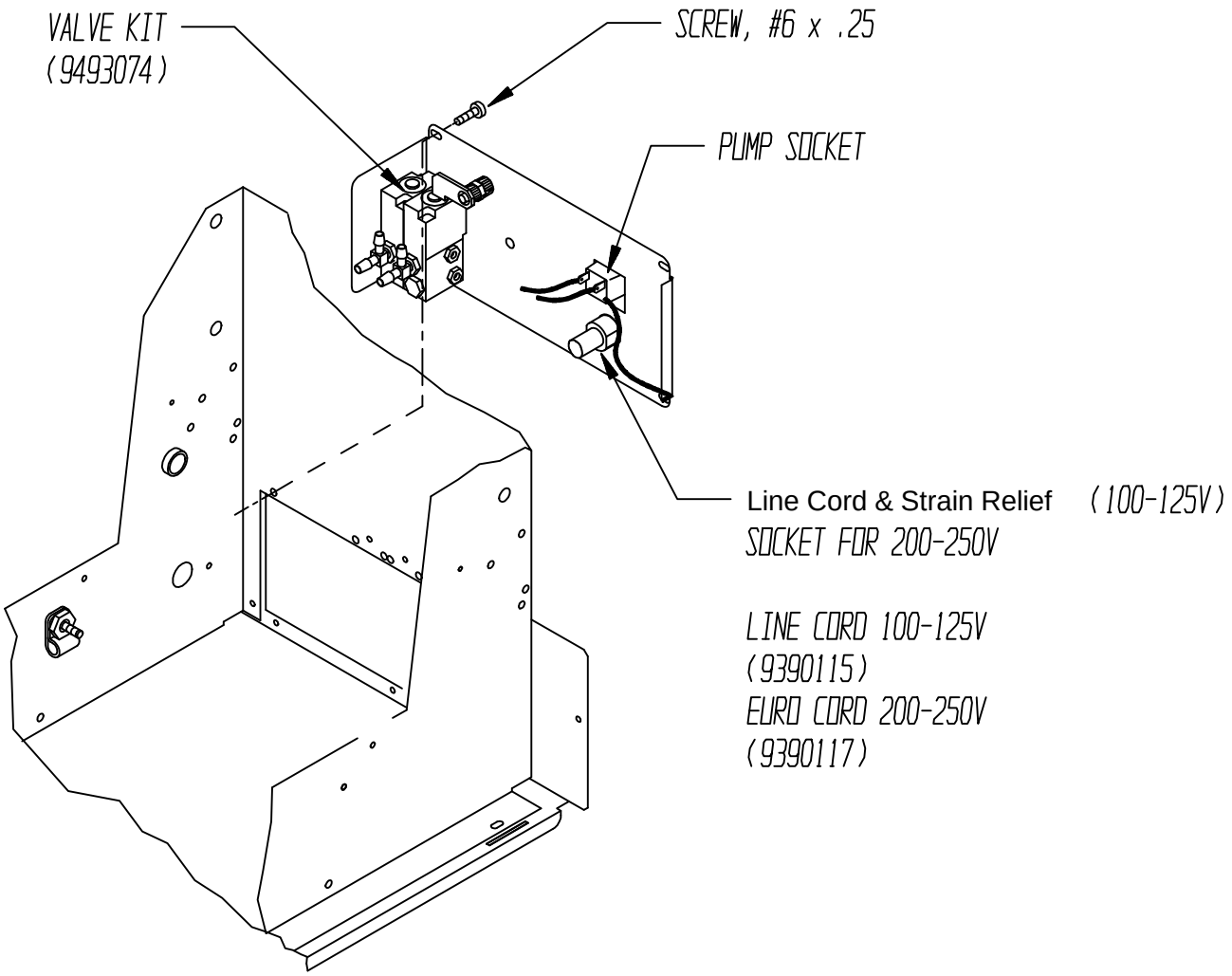
4.9 VPC MOTOR & VALVE PARTS



4.9.1 VENTURI VALVE PARTS

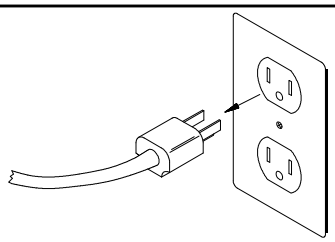


4.10 VPM VALVE PARTS

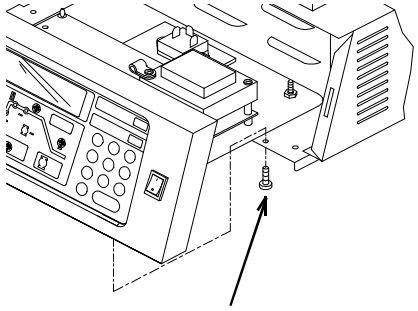


5.1 CONTROL DRAWER

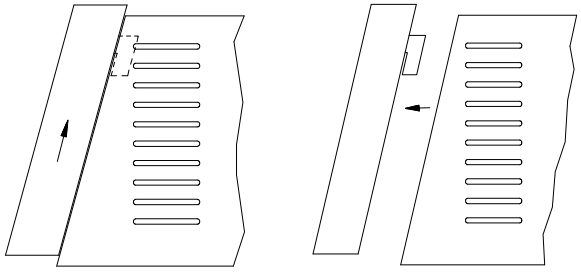
Tools : Phillips #2 screwdriver or 1/4" nut-driver



5.1.1: Disconnect power cord from wall outlet.



5.1.2: Remove 2 screws



5.1.3: Slide front panel up then out to remove tabs from bottom enclosure

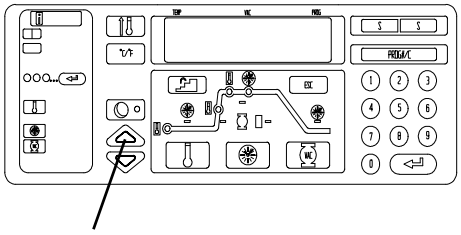
5.2 MUFFLE

Tools: Phillips screwdriver (#2 short)
Pliers

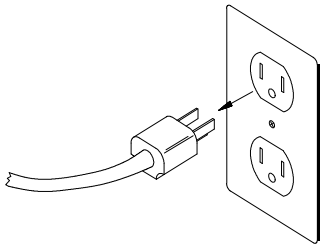
Set-up: Move Muffle to "up" position. Allow to cool.

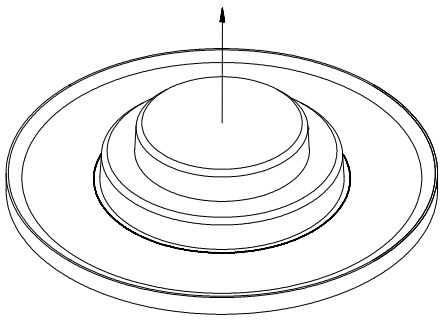
Note: To bypass Err6, Press "UP" key while turning on power.(VPC only)

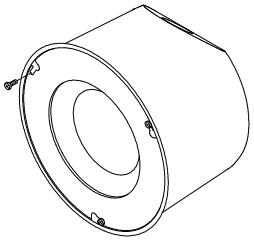
Caution:
Do not touch the quartz spiral during muffle replacement. Handle on outer surface.

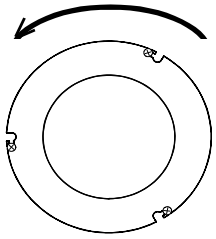


5.2.1: Press “up” key (VPC only)

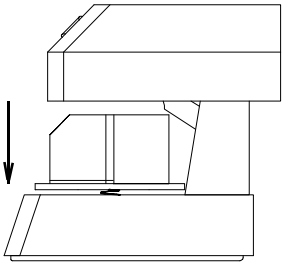




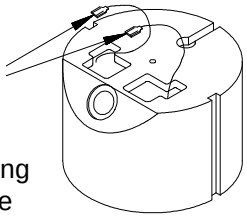




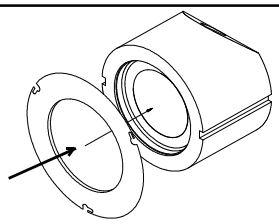
5.2.4: Turn furnace gently on it's side holding by column, not top enclosure. Loosen 3 screws and rotate ring.



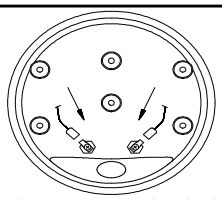
5.2.5: Slide out muffle and retaining ring



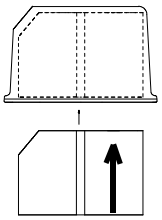
5.2.6: Disconnect terminals using pliers if needed & remove muffle



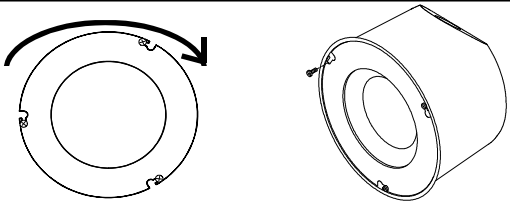
5.2.7: Center and press ring into new muffle



5.2.8: Connect muffle wires to terminals inside vacuum chamber.



5.2.9: Slide muffle and ring into chamber lining up guides



5.2.10: Rotate retaining ring into the locked position then tighten 3 screws.

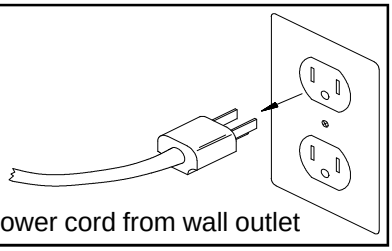
9628

5.3 THERMOCOUPLE

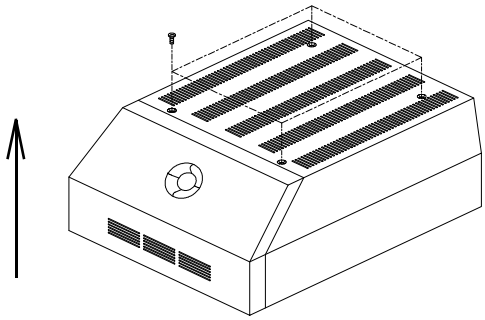
Tools: 3/4" wrench or adjustable wrench
3/16" nut driver
#2 Phillips screwdriver

Caution:
Muffle must be in down position to prevent damage to lift mechanism.

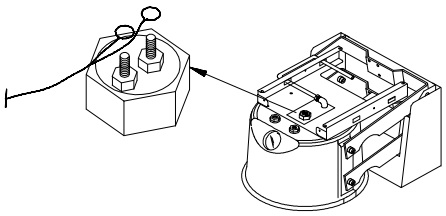
5.3.1: (VPC only) If muffle is in "up" position, bypass Err2 using the following steps:
- Follow steps 5.1.1 through 5.1.3 of CONTROL DRAWER REMOVAL.
- Place jumper wire between red and yellow thermocouple connections on CONTROL PCB
- Slide in control drawer
- Plug in power cord
- Turn on power to furnace
- Press "down" key
- Turn off power and remove line cord and jumper wire.
- Install CONTROL DRAWER(sec 5.1.1 to 5.1.3)



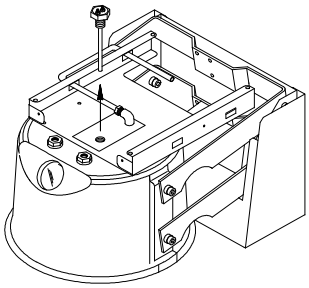
5.3.2: Disconnect power cord from wall outlet



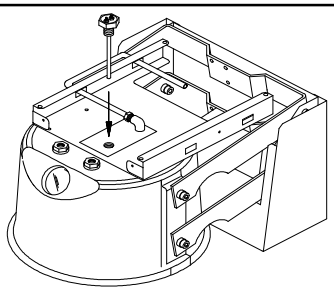
5.3.3: Remove 4 top cover screws and lift top cover off unit



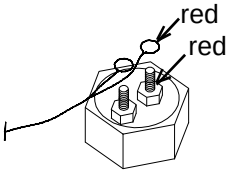
5.3.4: Remove 2 nuts and lift off wires



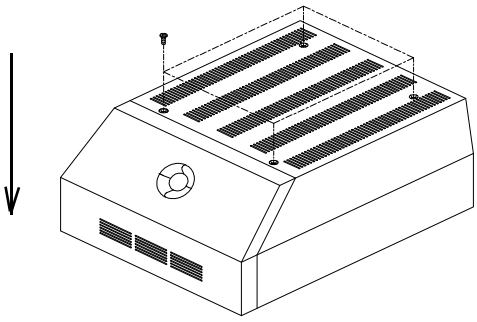
5.3.5: Remove thermocouple (use 3/4" wrench while supporting chamber)



5.3.6: Replace with new thermocouple (Torque to maximum of 80 in-lbs or 9 N-m)



5.3.7: Install wires and nuts (red to red)



5.3.8: Install cover and 4 top screws

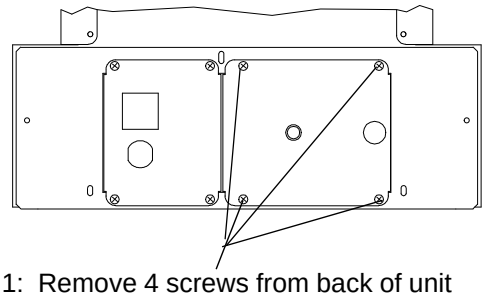
9629

5.4 SOLENOID VALVES (VPC)

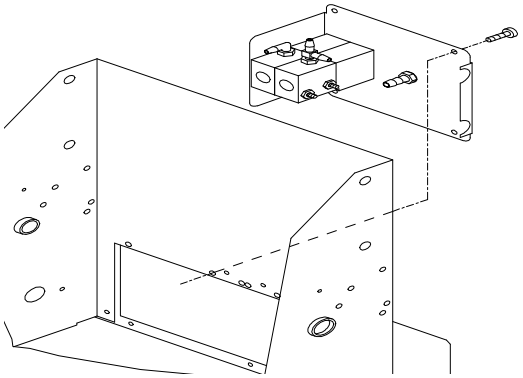
(S/N prefix ABS, DBS)

Tools: Phillips screwdriver
7/16" open end wrench
Pliers
5/16" Nutdriver

This procedure should be done if there is an excess vacuum leak in the system producing Err4 and Err5. Refer to Sec. 2.4.7 for troubleshooting guides.



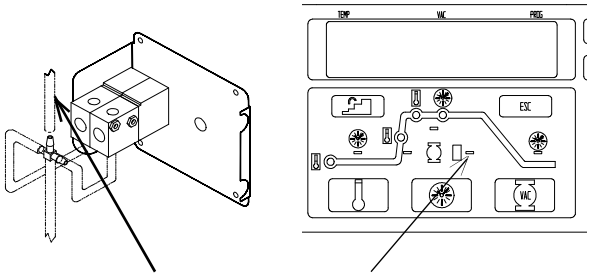
5.4.1: Remove 4 screws from back of unit



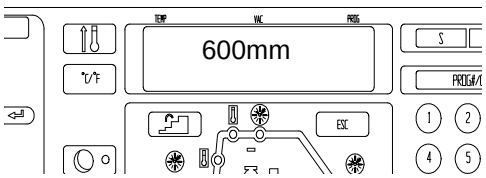
5.4.2: Pull out valve assembly

5.4.3: Start a cycle on an unused program using the following recommended parameters:

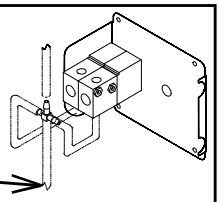
LoT= 200°C	Rate= 50°C/mi	HiT= 300°C
Dry= 0:00 M	Hold= 5:00 M	Cool= 0:00 M
VAC= 80%	Pull= 200°C	Stop=400°C



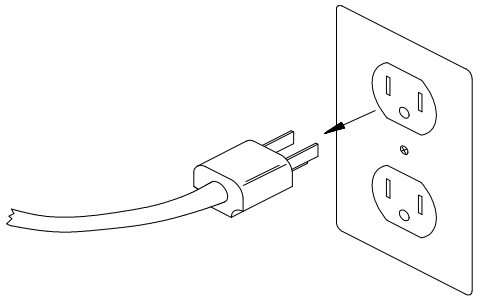
5.4.4: Pinch tube when pump LED turns off



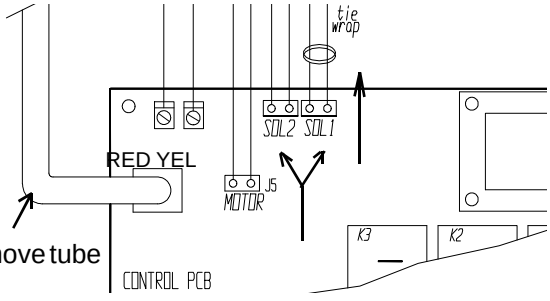
5.4.5: Observe display:
- If level holds, then chamber leaks (sec. 2.4.7)
- If "VAC" level drops, then leak is in valve(s), hose or transducer (Go to 5.4.6)



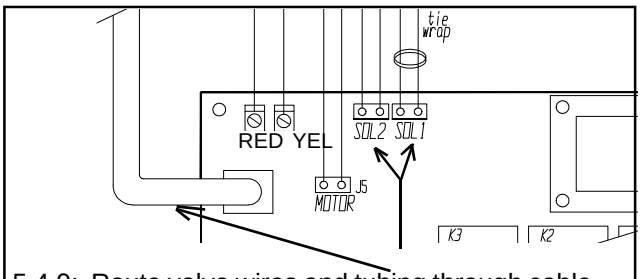
5.4.6: Pinch tube
Observe display:
- If "VAC" level drops, then transducer leaks
- If "VAC level holds, then leak is in valves



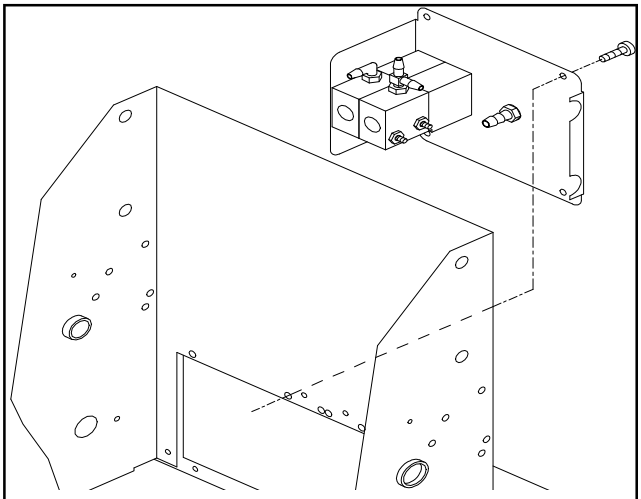
5.4.7: Remove power cord from wall outlet



5.4.8: Follow steps 5.1.1 through 5.1.3 of CONTROL DRAWER REMOVAL; Disconnect valve wires and tubing from Control PCB.



5.4.9: Route valve wires and tubing through cable guide and connect to Control PCB



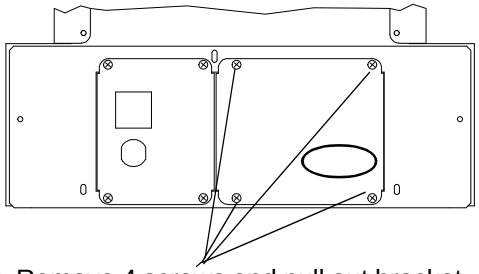
5.4.10: Mount valve assembly to base (4 screws)

5.5 SOLENOID VALVES (VPC II, VPQ, VPM)

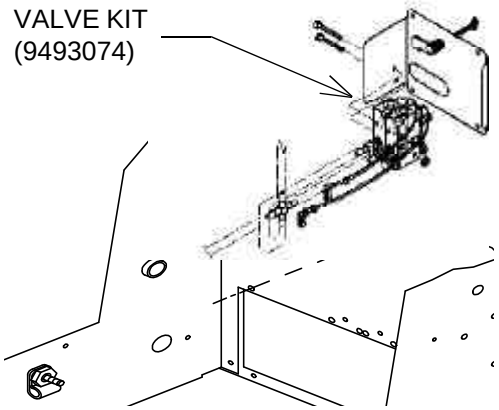
(S/N prefix ABV,DBV,ABT, DBT, ABW, DBW)

Tools: Phillips screwdriver
7/16" open end wrench
Pliers
5/16" Nutdriver

This procedure should be done if there is an excess vacuum leak in the system producing Err4 Err5, Err13 or Err14. Refer to Sec. 2.4.7 for trouble-shooting guides.



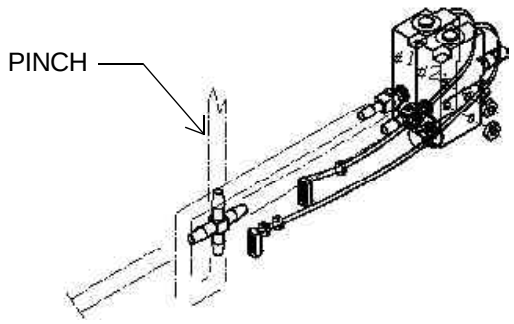
5.5.1: Remove 4 screws and pull out bracket



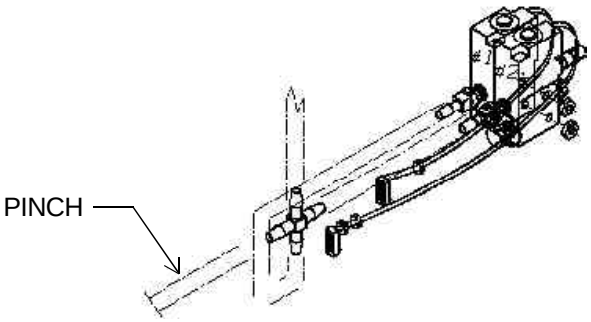
5.5.2: Pull out valve assembly

5.5.3: Start a cycle on an unused program using the following recommended parameters:

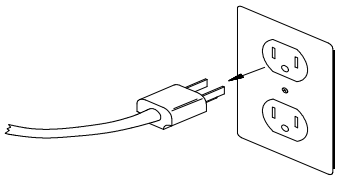
LoT= 200°C	Rate= 50°C/min	HiT= 300°C
Dry= 0:00 M	Hold= 5:00 M	Cool= 0:00 M
VAC= 80%	Pull= 200°C	Stop= 400°C



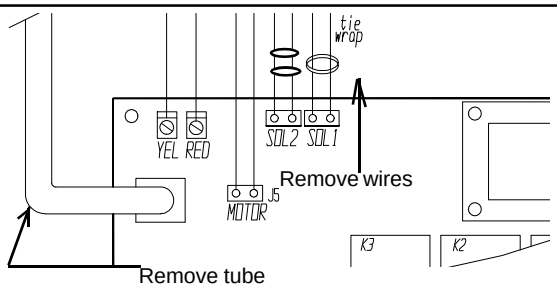
5.5.4: Pinch tube
Observe gage:
- If "VAC" level holds, then chamber leaks
- If "VAC" level drops, then leak is in valves or gage.(Proceed to step 5.5.6)



5.5.5: Pinch tube
Observe display:
- If "VAC" level drops, then transducer leaks
- If "VAC level holds, then leak is in valves (Replace valve kit. Proceed to step 5.5.7)

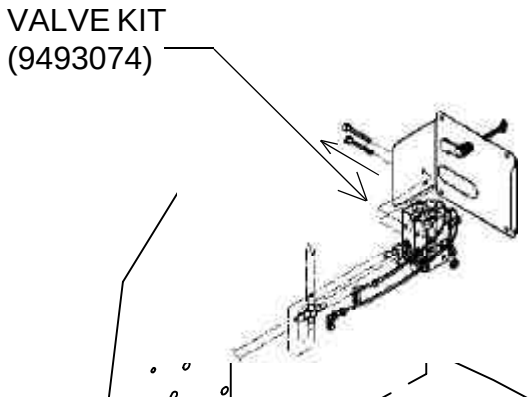


5.5.6: Remove power cord from wall outlet

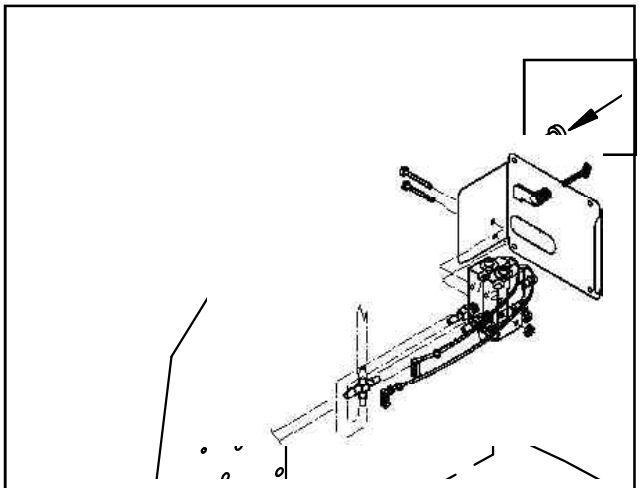


5.5.7: Follow steps 5.1.1 - 5.1.3 of CONTROL DRAWER REMOVAL, then disconnect valve wires and tubing from Control PCB.

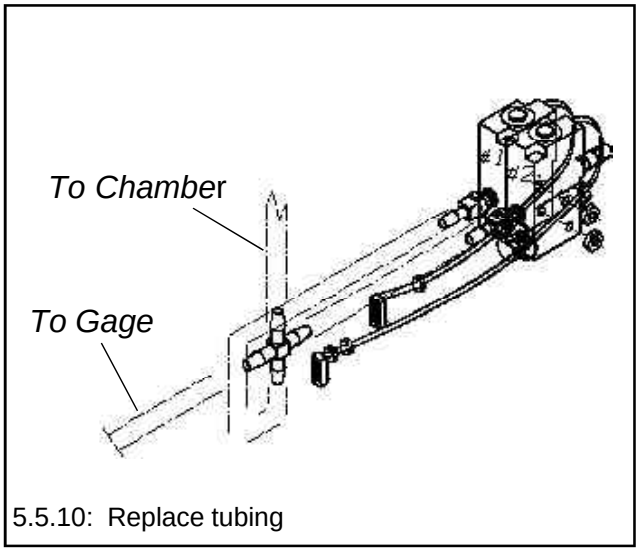
9631



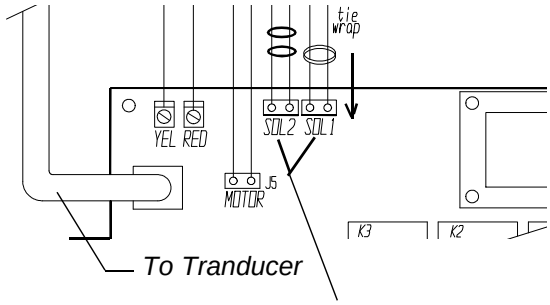
5.5.8: Remove valve kit from bracket by removing 2 screws



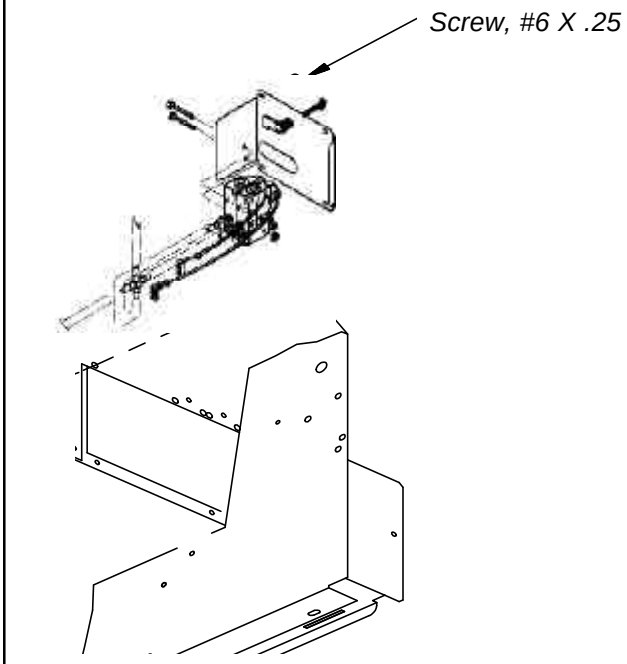
5.5.9: Replace with new valve kit



5.5.10: Replace tubing



5.5.11: Route valve wires and tubing thru cable guide and connect to Control PCB.



5.5.12: Mount bracket to base with 4 screws

5.6 SOLENOID VALVES (INTERVAC)

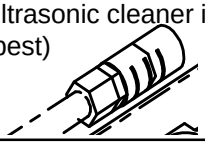
Tools: Phillips screwdriver
5/16" Nutdriver

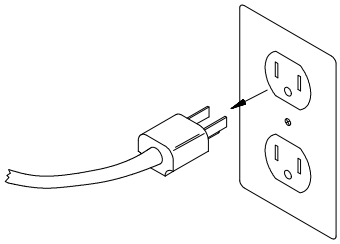
This procedure should be done if the internal venturi vacuum pump is not pulling high enough vacuum or no vacuum (Err4 or Err 5).

5.6.1: Check that the vacuum tubes are connected for the Intervac pump (see operation manual).

5.6.2: Check compressor performance. Minimum air requirements for the pump are 80 psi and 4 cfm. Most 1.5 HP compressors will handle these requirements. AIR MUST BE DRY/FILTERED!

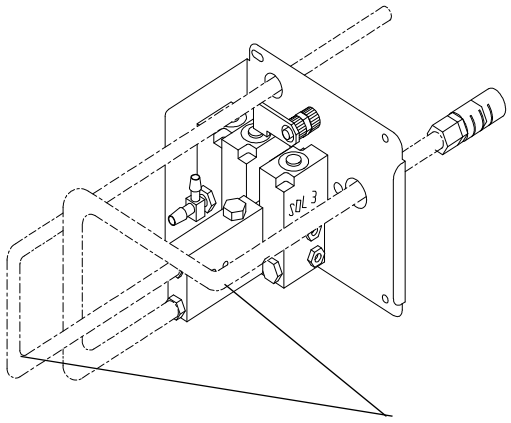
5.6.3: Check the Muffler filter to see if it has become clogged with dirt. If so, remove and clean. (If an ultrasonic cleaner is available, this will work best)





5.6.4: Remove power cord from wall outlet

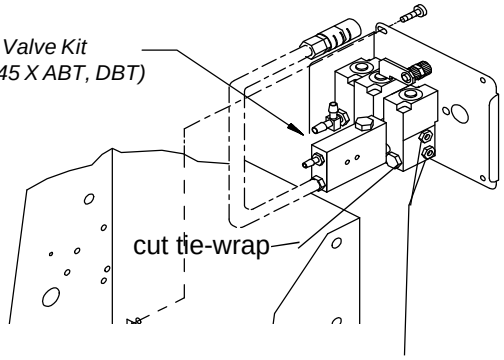
5.6.5: Follow steps 5.5.1 and 5.5.2 of valve servicing procedure.



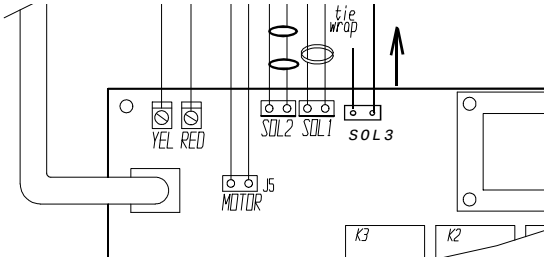
5.6.6: Check for kinks or restrictions in tubes, any restrictions can affect pump performance.



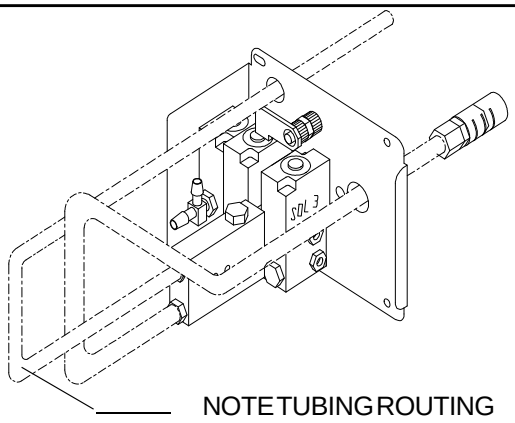
5.6.7: If these steps are ineffective in correcting the problem, then replace Venturi/Vaccum pump assy. First, remove muffler/filter from end of tube



5.6.8: Remove two nuts from side of valve



5.6.9: Follow steps 5.1.1 - 5.1.3 of CONTROL DRAWER REMOVAL, then disconnect SOL 3 valve wires from Control PCB.



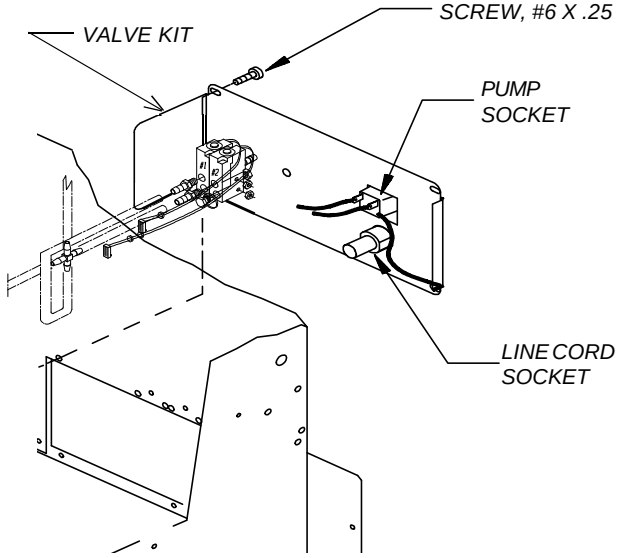
5.6.10: Reverse steps 5.6.9 thruough 5.6.7 to replace with new valve kit. NOTE TUBE ROUTING!

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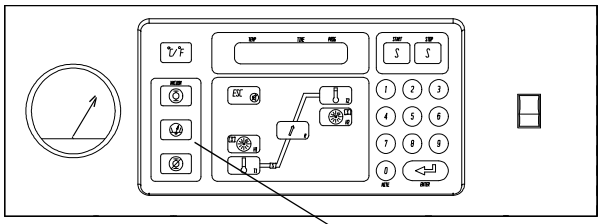
5.7 SOLENOID VALVES (VPM)

Tools: Phillips screwdriver
7/16" open end wrench
Pliers
5/16" Nutdriver

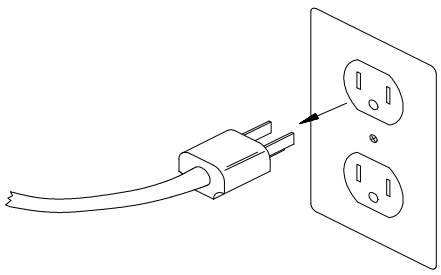
This procedure should be done if there is an excess vacuum leak in the system producing Err4 Err5, Err13 or Err14. Refer to Sec. 2.4.7 for trouble-shooting guides.



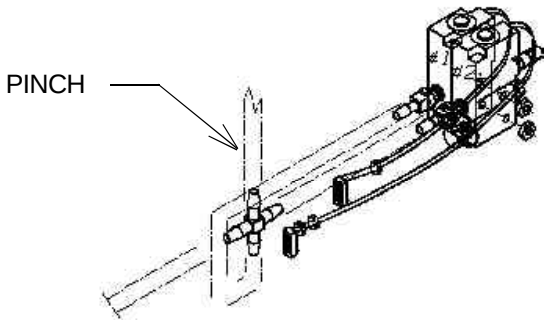
5.7.1: Remove 4 screws and pull out bracket



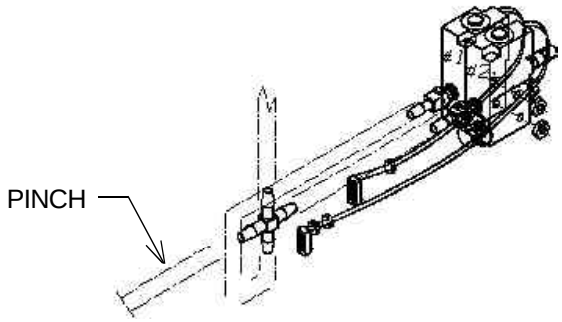
5.7.2: Pull vacuum and place in "HOLD"



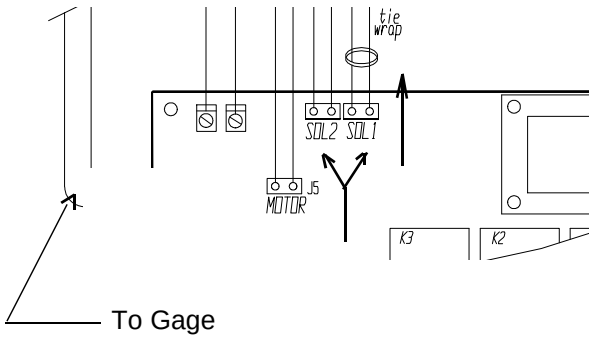
5.7.3: Remove power cord from wall outlet



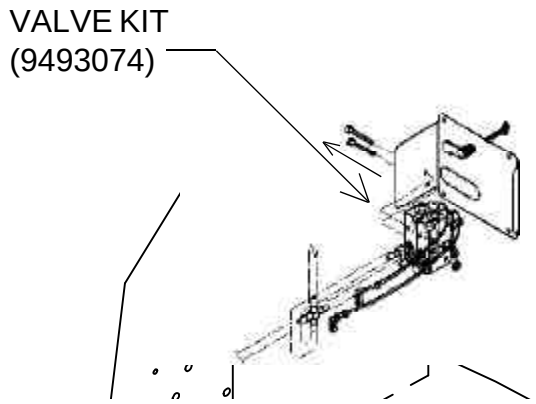
5.7.4: Pinch tube
Observe gage:
- If "VAC" level holds, then chamber leaks
- If "VAC" level drops, then leak is in valves or gage. (Proceed to step 5.5.5)



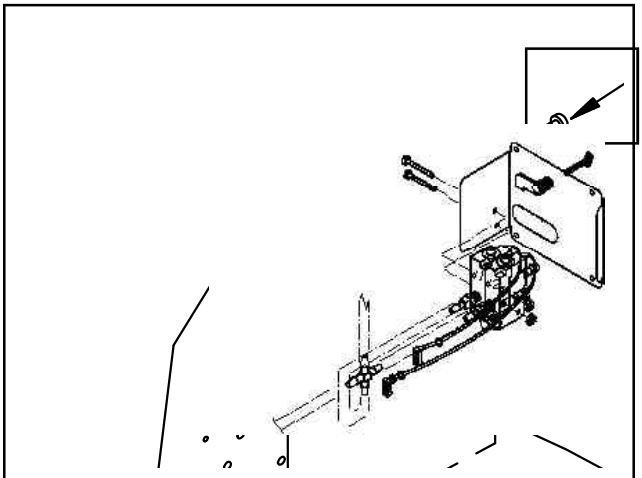
5.7.5: Pinch tube
Observe gage:
- If "VAC" level drops, then gage leaks
- If "VAC level holds, then leak is in valves (Replace valve kit. Proceed to step 5.5.6)



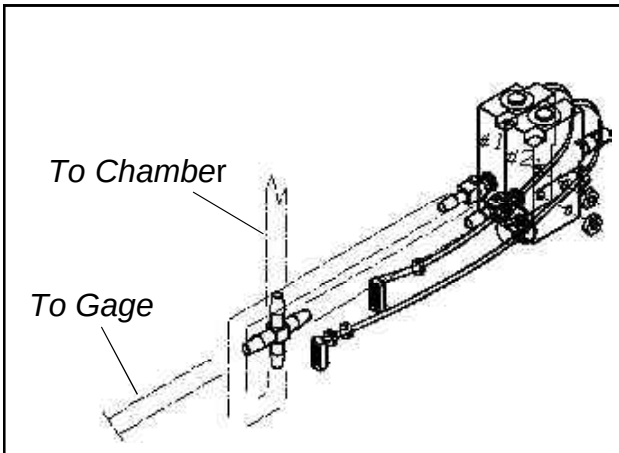
5.7.6: Follow steps 5.1.1 - 5.1.3 of CONTROL DRAWER REMOVAL, then disconnect valves wires from Control PCB and tubing from gage.



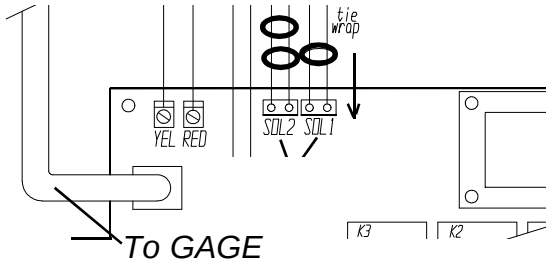
5.7.7: Disconnect tubing from valve kit. Remove valve kit from bracket by removing 2 screws.



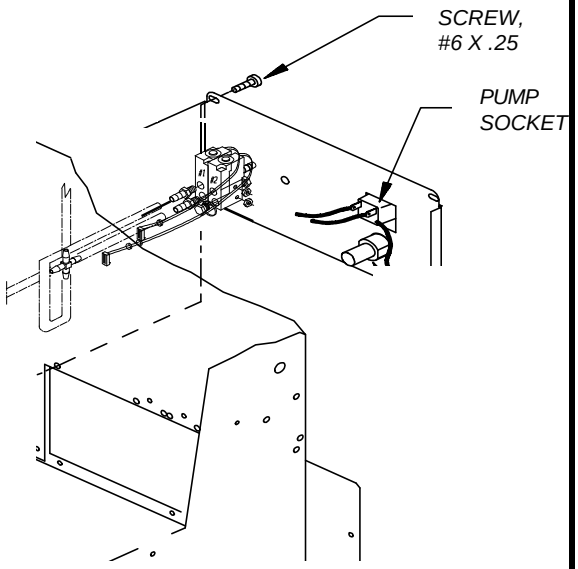
5.7.8: Replace with new valve kit



5.7.9: Reconnect tubing



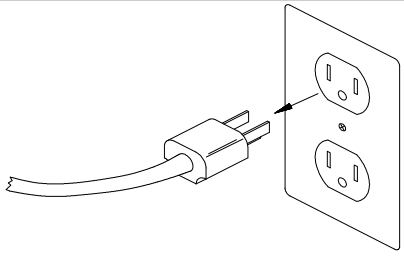
5.7.10: Route valve wires and tubing through cable guide and connect to Control PCB.



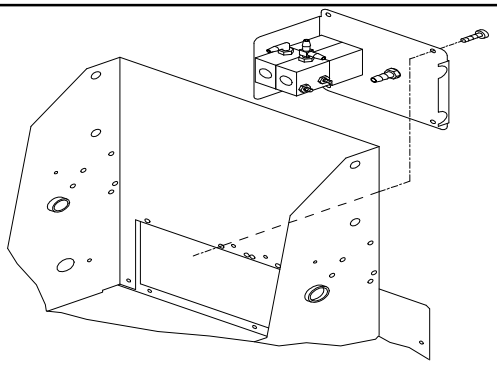
5.5.11: Mount bracket to base with 4 screws

5.8 MOTOR (VPC, INTERVAC)

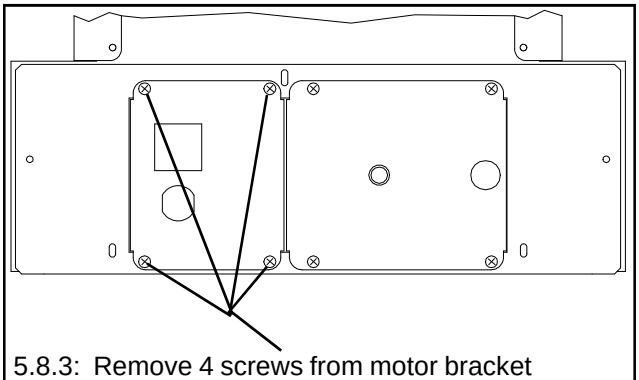
Tools: Long #2 Phillips screwdriver
5/32" Allen wrench
Large adjustable wrench (1" or 25 mm)



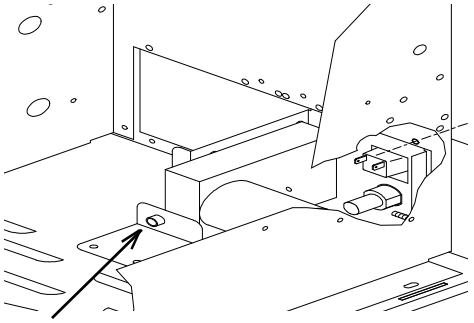
5.8.1: Disconnect line cord from wall outlet



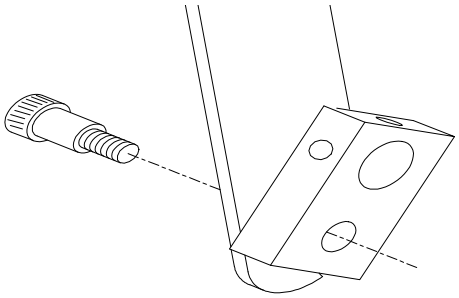
5.8.2: Remove valve bracket (4 screws) first.



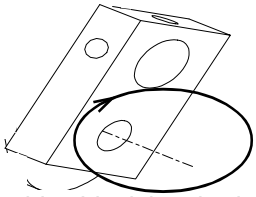
5.8.3: Remove 4 screws from motor bracket



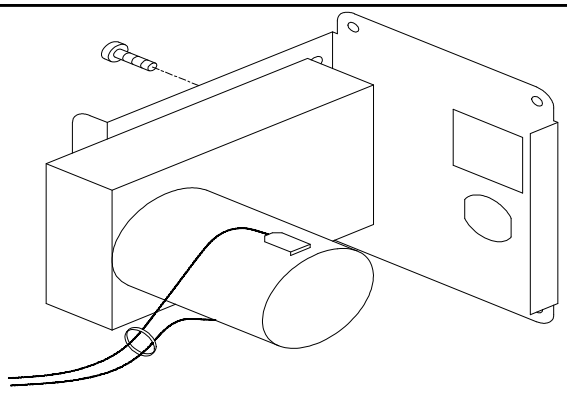
5.8.4: Remove this screw (from rear)



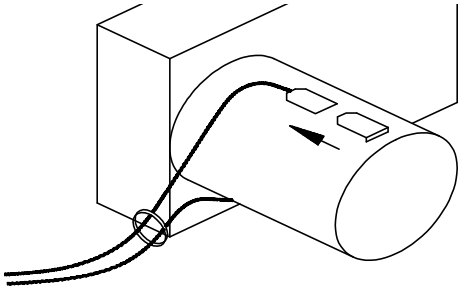
5.8.5: Remove shoulder bolt and push linkage away from block. Unloading the motor by lifting up and down on the chamber may help.



5.8.6: Rotate drive block into horizontal position with large adjustable wrench



5.8.7: Remove motor from bracket (4 screws)



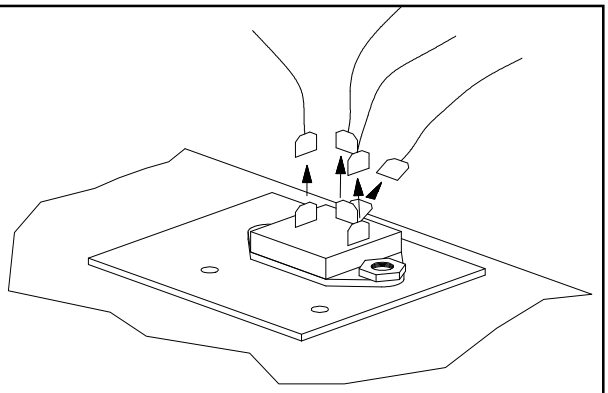
5.8.8: Disconnect motor wires

5.8.9: Install new motor by reversing Steps 5.8.8 through 5.8.3. Torque all screws to 25-30 in-lb (3 N-m).

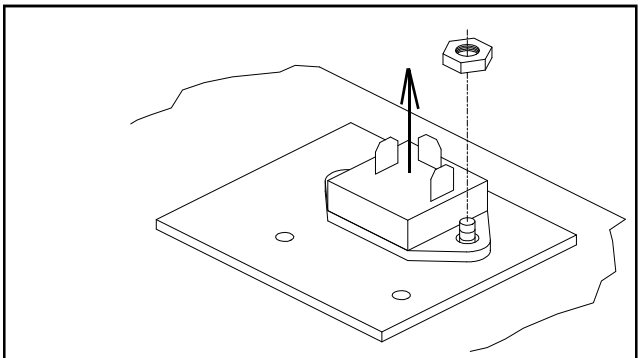
5.9 TRIAC

Tools: Phillips screwdriver
1/4" nut driver

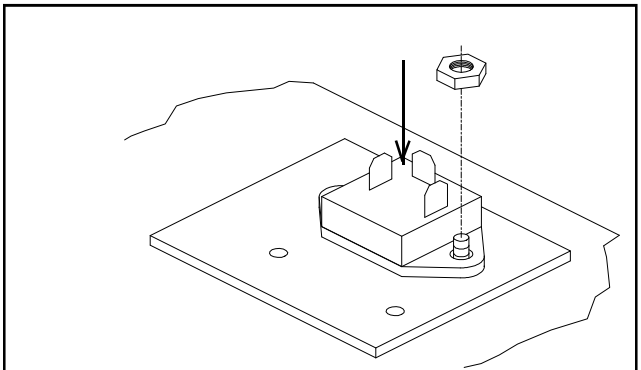
5.9.1: Follow steps 5.1.1 through 5.1.3 of CONTROL DRAWER REMOVAL.



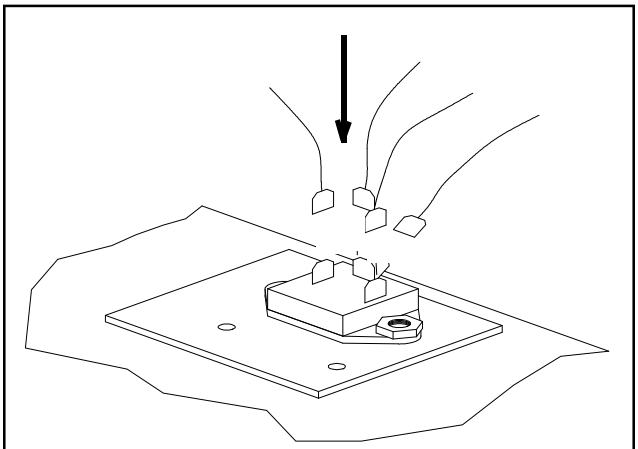
5.9.2: Disconnect wires from triac



5.9.3: Remove 2 nuts



5.9.4: Replace with new triac



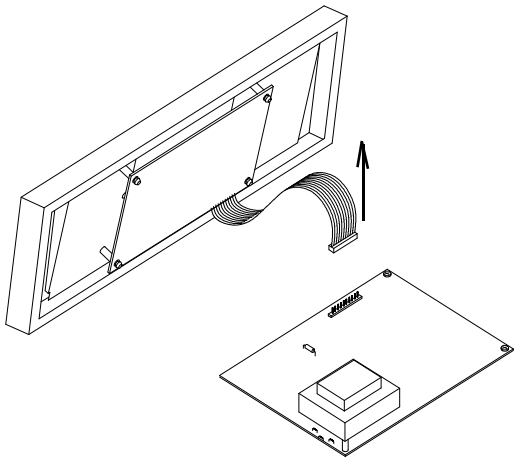
5.9.5: Connect wires to triac according to Wiring Diagram page 2-16. Make sure connections are tight

5.10 DISPLAY BOARD

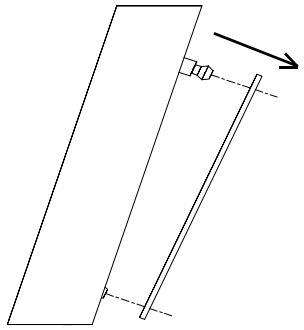
Tools: Phillips screwdriver

CAUTION!
Use proper ESD grounding techniques when handling electronic components

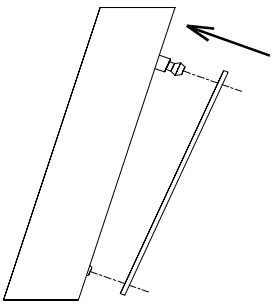
5.10.1: Follow steps 5.1.1 though 5.1.3 of CONTROL DRAWER REMOVAL



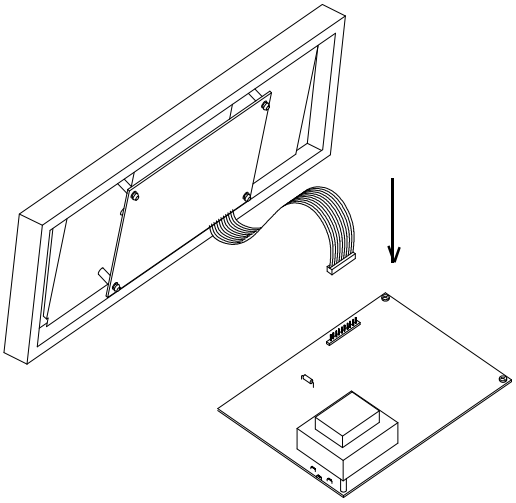
5.10.2: Disconnect grey ribbon connector



5.10.3: Remove from snap-on standoffs



5.10.4: Replace with new Display PCB



5.10.5: Connect grey ribbon connector

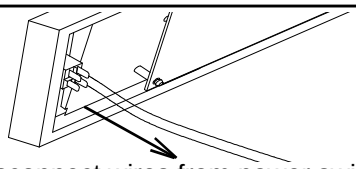
5.10.6 Reassemble Control Module

5.11 CONTROL BOARD

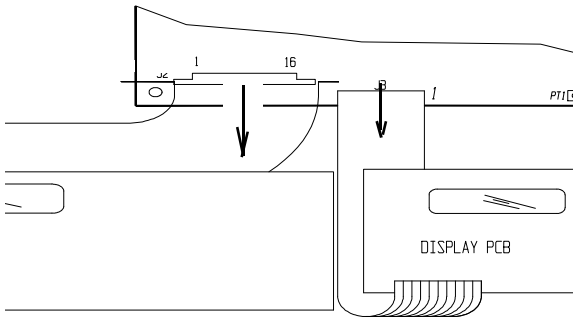
Tools: Phillips screwdriver; Slotted screwdriver
Needle nose pliers

CAUTION!
Use proper ESD grounding techniques when handling electronic components

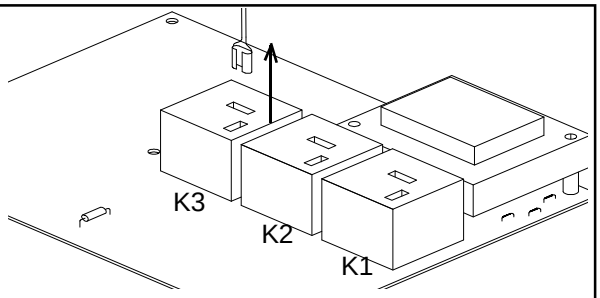
5.11.1: Follow steps 5.1.1 through 5.1.3 of CONTROL DRAWER REMOVAL.



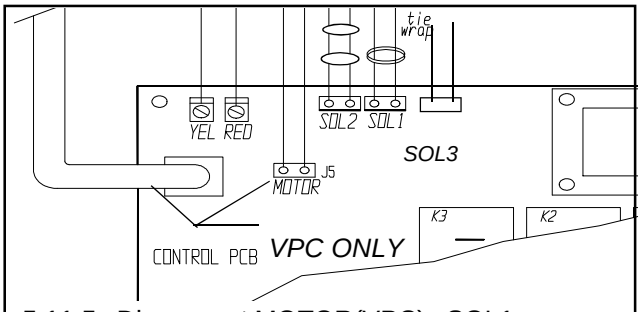
5.11.2: Disconnect wires from power switch



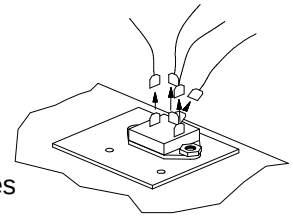
5.11.3: Disconnect ribbon connectors



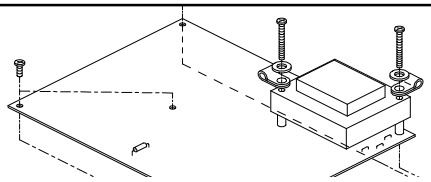
5.11.4: Remove wires from relays K1,K2, and K3 using caution not to damage relays



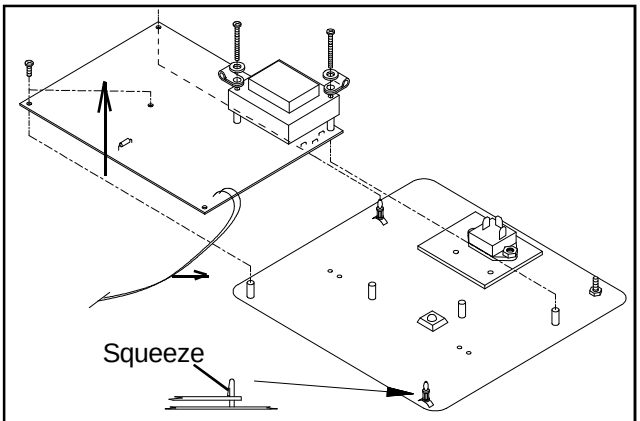
5.11.5: Disconnect MOTOR(VPC) , SOL1, SOL2, SOL 3, YEL, RED wires and Vacuum hose (VPC).



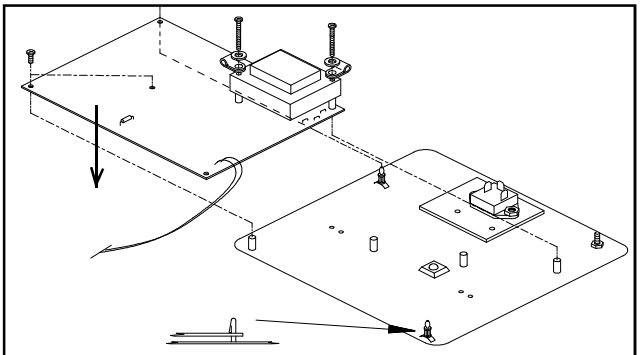
5.11.6: Disconnect wires from triac



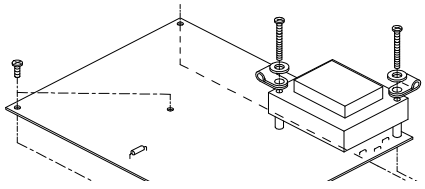
5.11.7: Remove 4 screws



5.11.8: Lift board off standoffs



5.11.9: Press new board over standoffs



5.11.10: Secure 4 screws

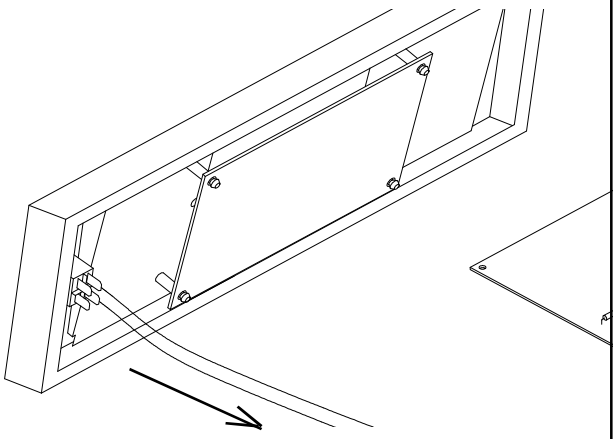
5.11.11: Wire according to wiring diagram. Make sure wires pass through cable clamps as shown and switch wires mount to left side of switch.

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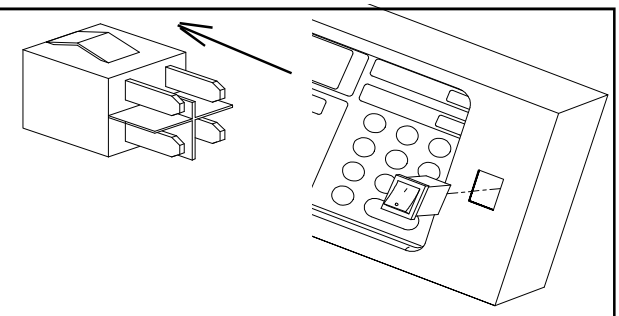
5.12 POWER SWITCH

Tools: Slotted screwdriver

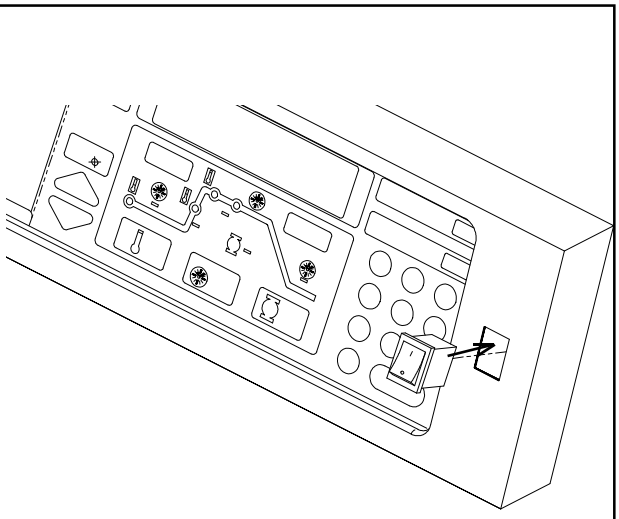
5.12.1: Follow steps 5.1.1 through 5.1.3 of CONTROL DRAWER REMOVAL



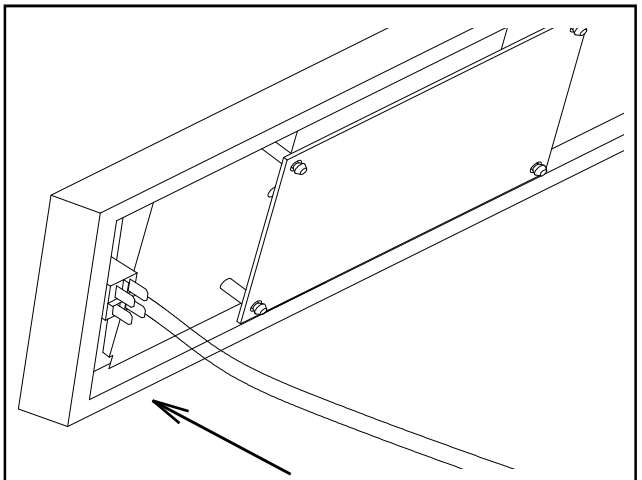
5.12.2: Disconnect switch wires



5.12.3: Remove switch by pressing in tabs.



5.12.4: Press in new switch

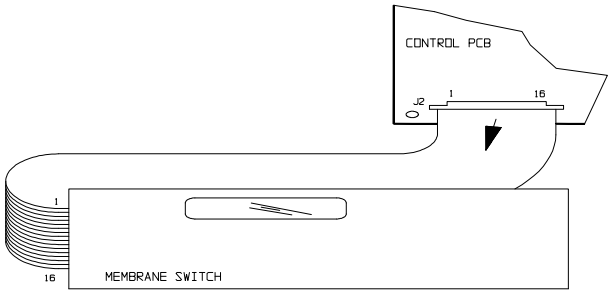


5.12.5: Connect switch wires to side shown

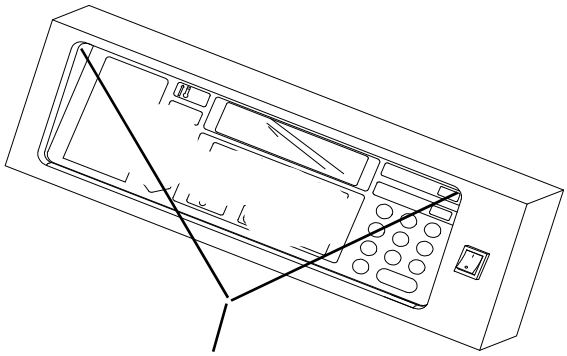
5.13 MEMBRANE SWITCH:

Tools: Phillips screwdriver or 1/4" nut driver
Knife of other sharp edged device
Fine point pencil

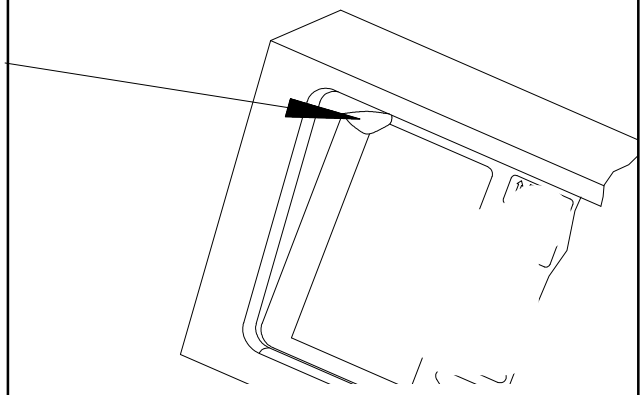
5.13.1: Follow steps 5.1.1 through 5.1.3 of CONTROL DRAWER REMOVAL.



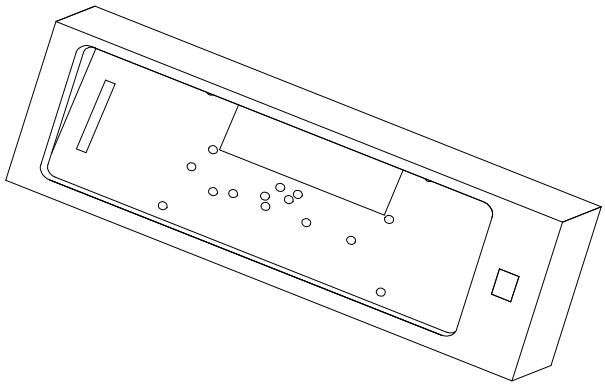
5.13.2: Disconnect ribbon cable



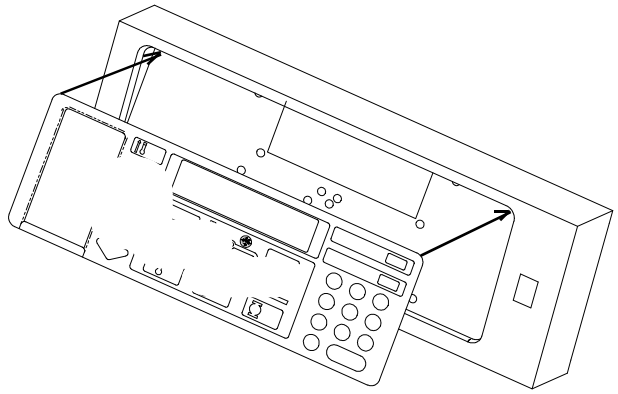
5.13.3: Pencil fine outline around two upper corners (VPC shown).



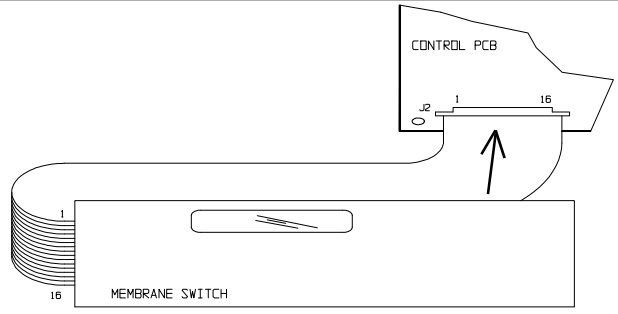
5.13.4: Peel off membrane switch (Use knife if needed).



5.13.5: Clean front panel surface without removing pencil marks (VPC shown)



5.13.6: Gently place membrane into front panel. Use penciled corners to locate. (VPC shown)



5.13.7: Connect ribbon connector (VPC shown)

CENTURION SERVICE NOTES: