Service Instructions

Centurion Q50, Q100, Q200
& Ceramco 7.0

DENTSPLY Ceramco
Yucaipa, CA

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

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

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

* Transducer Path consisting of the thermocouple, operational amplifier, 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 table 2-3, 2-4, Troubleshooting, for a more detailed look at voltage levels.

* 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, 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 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 compensation IC is connected to the IC amplifier circuit.

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 a voltage by a current to voltage transformer. The voltage is then rectified and compared to a reference voltage.

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 S004 and S005).

1.2.2.2 LCD Display
The 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 (Q100)
The 11 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 an 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 a peripheral driver (U12) which in turn converts and latches it to parallel data. This parallel data is then used to drive several peripheral devices (See S003). U12-13 is connected to an opto isolator (U14). The isolator's output is connected to the gate of the muffle triac. The muffle triac may be activated and deactivated when the AC sine wave passes through 0 volts. U10 accesses U16 0.5 msec before zero crossing to turn the triac off or on.

1.2.5 Vacuum Control

1.2.5.1 General Description
The microprocessor (U10) sends a serial digital signal to an octal peripheral driver (U12) which in turn converts and latches it to parallel data. This parallel data is then used to drive several peripheral devices (See S003). U12-13, and U12-14 are connected to 12V dc normally closed solenoids which in turn control the flow of vacuum. At the command to pull vacuum 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.

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 D1 and D2 and filtered by capacitor C3. This provides unregulated positive DC voltage for the switching regulator U4. The capacitor C42 protects against high voltage transients on the AC line that could otherwise couple into the transformer secondary. The output U9-2 is a pulse train with a period T of typically 19.2usec. The catch diode D3 is a Schottky device which provides a return path for the load current when the output switch is off. Inductor L2 and capacitor C5 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 U2 to generate the +5V. The capacitor C6 provides additional filtering. The constant current source U1 as well as the 1.23V reference diode D24 generates its output from this supply.

1.2.7 Motor Drive Control

1.2.7.1 General Description
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 motor when the motor has stalled.

SECTION 2
TROUBLESHOOTING

2.1 FACTORY REPAIR

DENTSPLY Ceramco maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the furnace. 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 at 909.795.2461.

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 furnace 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 furnace 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 furnace for damage. Finally, ensure that the fuses F1, F2 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 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. Section 2.4 gives component troubleshooting information.

2.2.2 Understanding the error codes
The microprocessor of the furnace 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 front panel 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 D3, U1 or U2 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 U12 is accessed at every line voltage zero crossing (TP5=0) by the microprocessor (U10-2). 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 R27.
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 U2-2 (+5V). 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 transferred 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 it is an indication that the motor movement is very slow. This can occur due to excessive friction. 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.

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 5.

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

When replacing plastic fittings, care must be taken not to cross thread. Torque fittings to at least 25 in-lbs (3.0 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 cloth, 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 (Q100 & Q200 ONLY)

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 (Q50, Q100, Q200 & Ceramco 7.0)

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:

* U7-6 = .7V, check D6
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 checks 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 Err 4 appears on the display. Check all vacuum hose connections, and operation of the vacuum pump (plug into outlet to check).
Otherwise check:

* U7-1 : .5V at medium vacuum level
* Check U6

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) or run program 102.
* 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 be displayed at power up and 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)

To operate the motor under an Err6 condition 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 U3-7 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
* Check "AC+" or "AC-" at power up.

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 U11-5 is monitored and any abnormal behavior from the devices' specs is answered with an error code.

* Replace device

If Err8 occurs at power up, the program number might be scrambled. Reprogram EEPROM.
Turn furnace off. Hold down °C/°F key and power up.

Err 9 TC input short/reversed. The control monitors the increase in temperature if less than 64°C. If no increase in muffle temperature is detected during a 60 second period, the power relays open and the Err9 code is displayed.

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

Err 15 Motor jam
This error code is called whenever the muffle is requested to go to its open position and exceeds 12 seconds of travel after pressing start.

* Mechanical obstruction
* At up position D51, D52 on
* Check +12 V.

Err 18 Triac driver input short

* Check U14-1,2 diode
  U14-2 shorted to ground?

Err 19 No line frequency detected

* Check TP5, 100 or 120 Hz pulse train
* Remove Power
  D4-5 diode check
  U15-2 = .7V, check D6
  Check F2.

2.6 Block Diagram

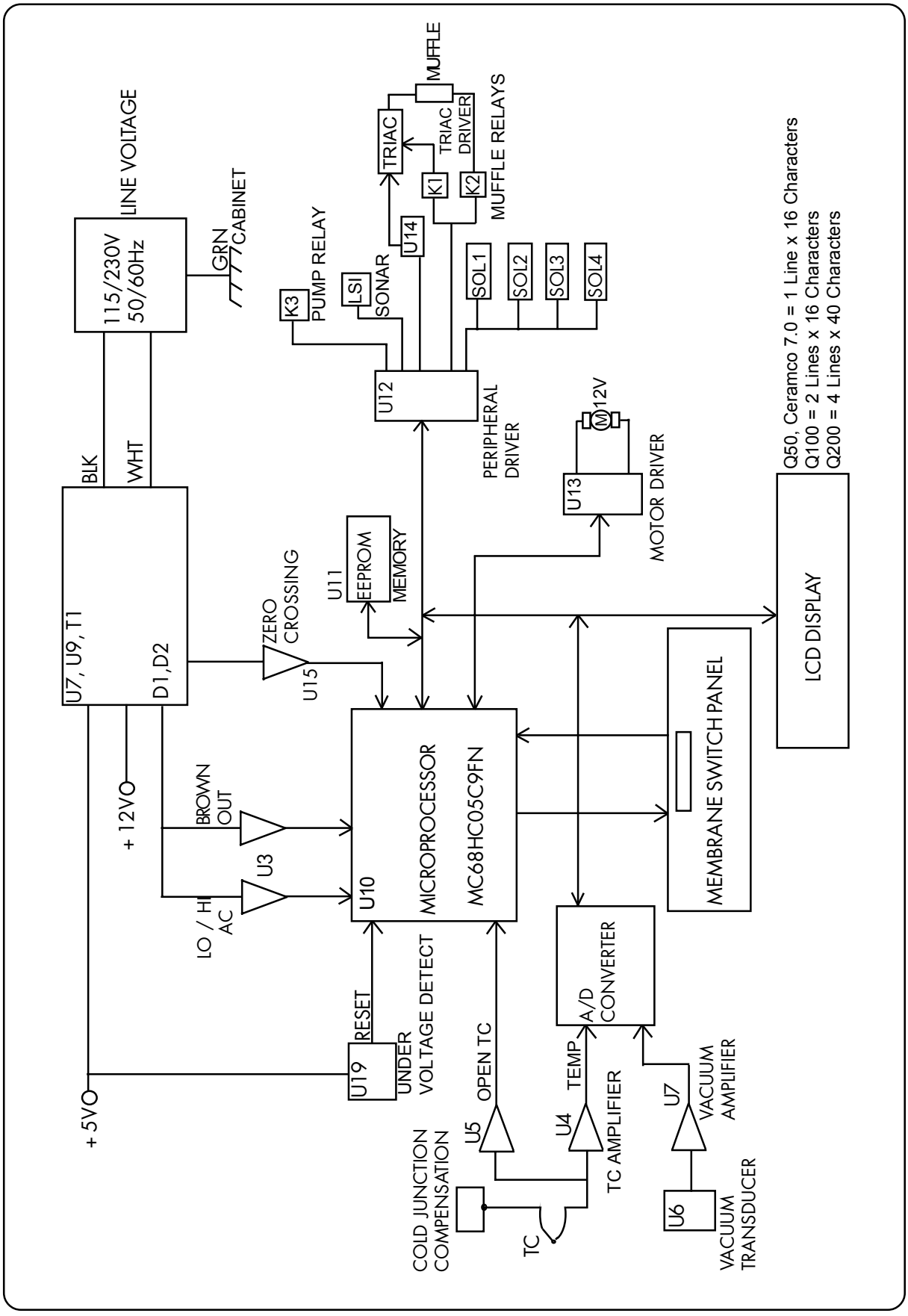


Fig. 2-1 TROUBLESHOOTING BLOCK DIAGRAM

2.7 Diagnostic Tables

Circuit guide	Troubleshooting Tables	Schematic Diagrams
Power Supply & Relay Control	2-3, 2-4	S001
Temperature & Vacuum	2-8	S002
Microprocessor & Peripheral Control	2-5,2-6,2-7,2-8	S003
Display Board Q100	2-9	S004
Display Board Q50, Ceramco 7.0	2-9	S005
Display Module Q200	(stand alone, not serviceable - replacement, see page 4.2)	

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. Furnace is in TEST mode Motor connector J5 loose Furnace is running a firing cycle. Press Stop key.

Table 2-2 Furnace Setup Common Errors

Output Voltage	Voltage Tolerance	Output Ripple	Test At	Input Ripple	Test At
+12V	+/-350mV	0.02Vac	U2-1	3Vac	D1-K
+ 5V	+/-250mV	0.02Vac	U2-3	3Vac	U2-1

Table 2-3 Power Supply Voltages

Fault	Setup	Check	Results desired
No dc output and no dc to U1-1 (15-30V)	Power off	F1 T1 winding D1, 2 C3	< 1 ohm Not shorted or open Not shorted or open Not shorted
Low or no +12V dc output	Power off	D3	Not shorted or open
	Disconnect J3 turn Power on	C5 U1-2 U2	Not shorted Pulse train of 50kHz No excessive heat

Table 2-4 Power Supply

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

Table 2-5 Microprocessor

Fault	Setup	Check	Results desired
All Y outputs high	N/A	U12-11 U12-5,7,6	No stuck bits
	Turn furnace Off then On	Display	No Error codes Display OK
	Turn furnace Off	D12,13	Not shorted or open
U12-11 (Reset) low	N/A	U3-7	digital low

Table 2-6 Peripheral Drive Circuit

Fault	Setup	Check	Results desired
No up or down	Furnace in idle	U13-11	+12 V
	Disconnect J5	DS1,2	DS1,2 On
	Turn furnace on		
	Press Up arrow	DS1	DS1 off, DS2 on
	Press Down arrow	DS2	DS2 off, DS1 on
	Turn furnace off	D16,17	Not shorted or open
	Turn furnace on	U13-15	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	TC red, yellow U4-2	correct connection Same mV (1-40) as IC red
		U4-6	D-1200°C = 0 - 1 Vdc
Erratic temperature display	N/A	TP2	1.23V stable
		U8	replace

Table 2-8 Analog Circuitry

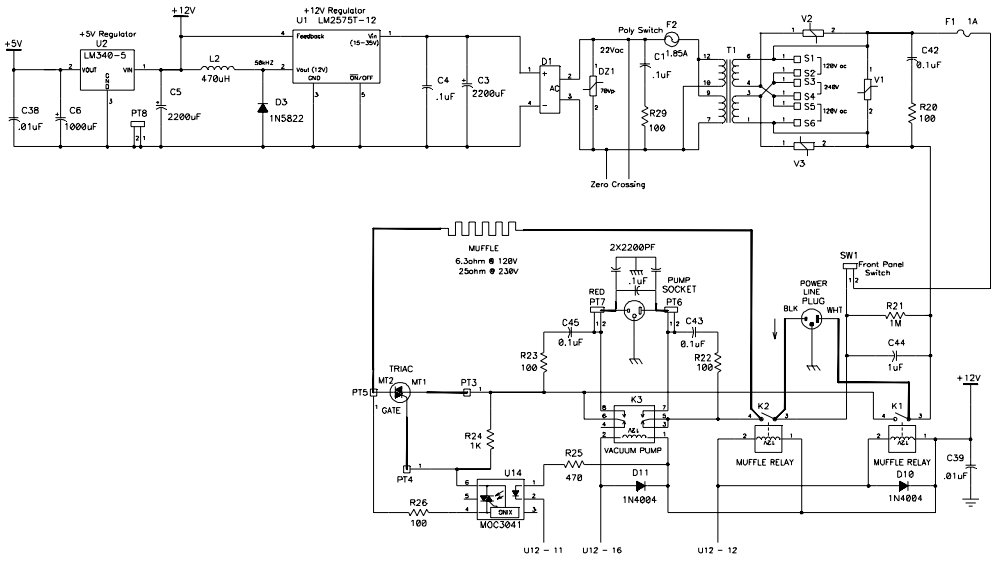
Fault	Setup	Check	Results desired
Temperature drift	Hi T = 960°C	TP1	mV dc stable
		U5-7	mV stable (.2mV/°C ambient increase typical)
Vacuum readout too high or too low	Furnace in idle	U7-1 U6-2,4	1-3 mV Same Voltage (2.5V)
	VAC calibration	Display	Adjust to gage level
	VAC cycle (101%) level reading	Display	Obtain previous gage reading.

Table 2-8 Analog Circuitry (continued)

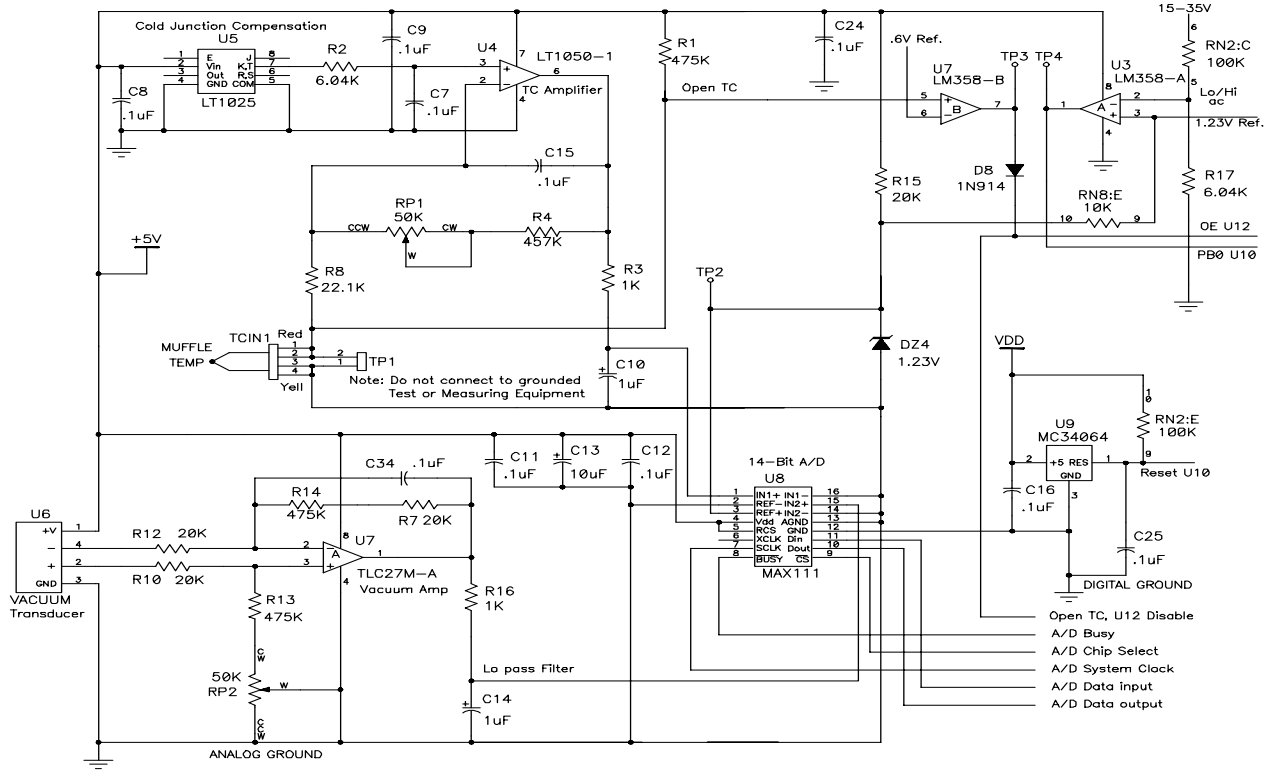
Fault	Setup	Check	Results desired
LCD dots are all on or off at power up	Furnace in idle	J2-8	See Table 2-3
		U10	See Table 2-5
		J3	Tight fit
		U2-8,2	No stuck bits
No backlight	Furnace in idle	U1-20	digital low
		J1-15	90V-100V @ 400Hz
		U1-2,4,40	No stuck bits
No LED's light up (Q100)	Perform power 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 (Q100)	Turn furnace off	LED	Not open or shorted
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

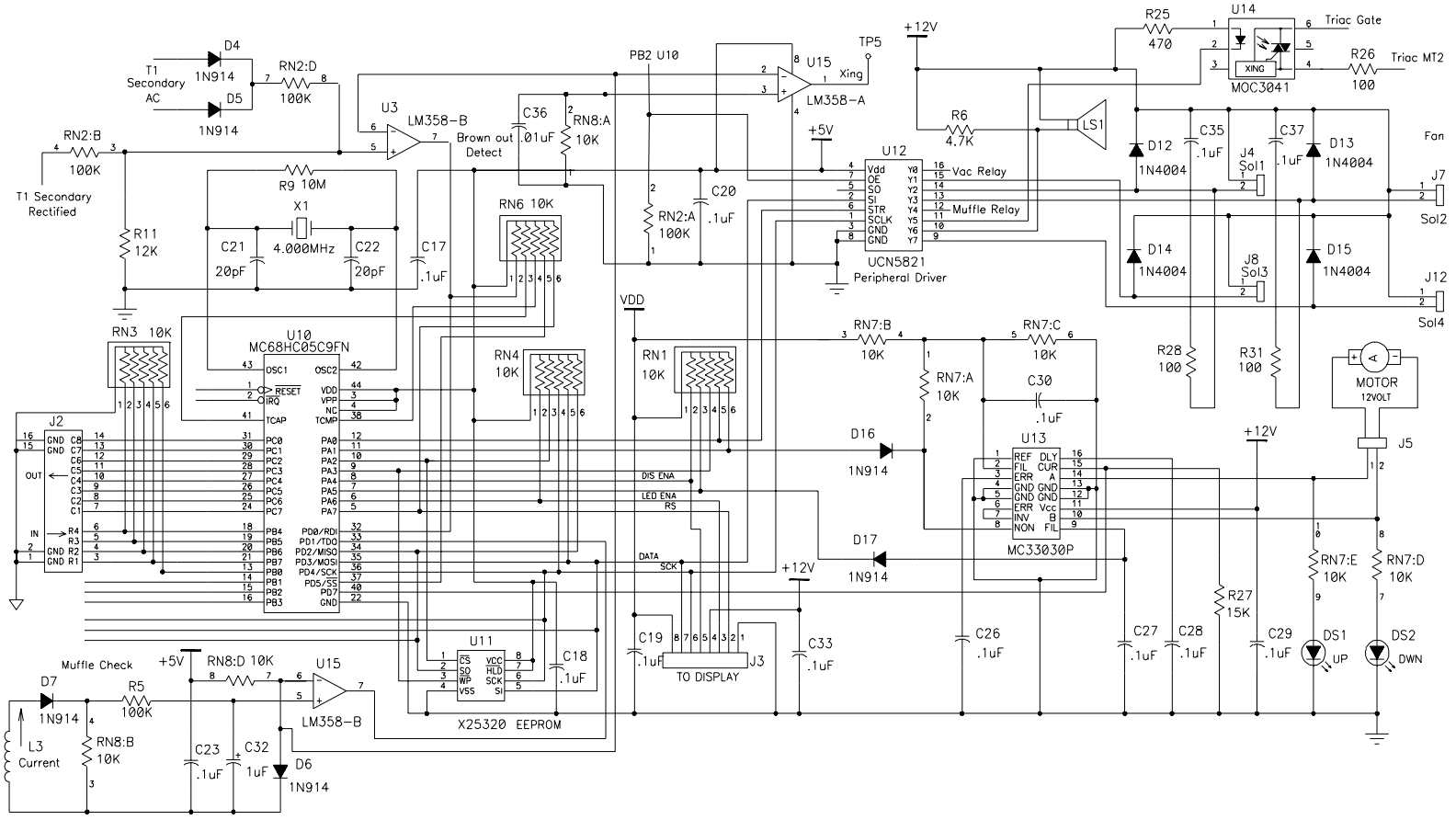
2.8 Schematics



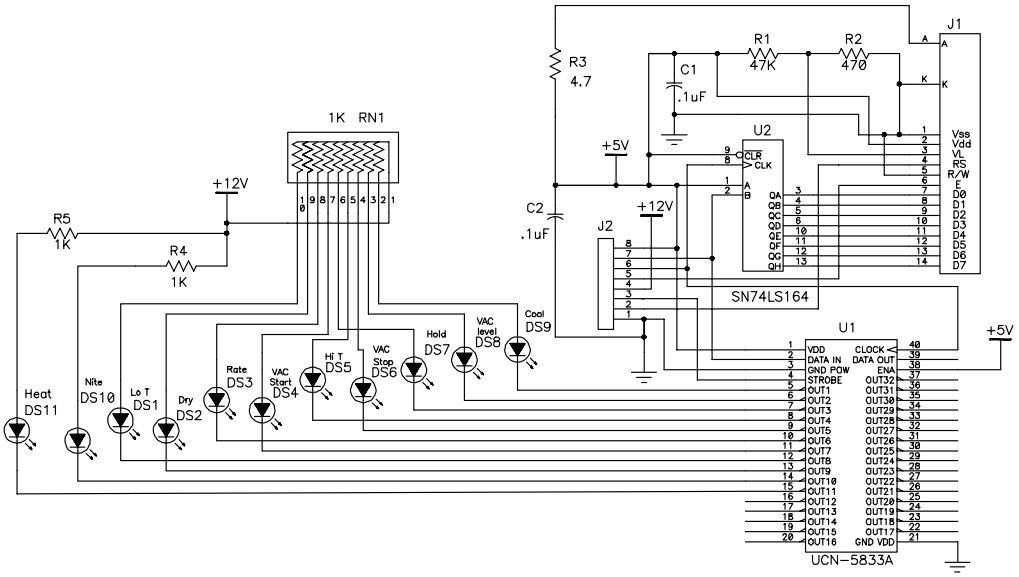
POWER SUPPLY AND RELAY CONTROL S001



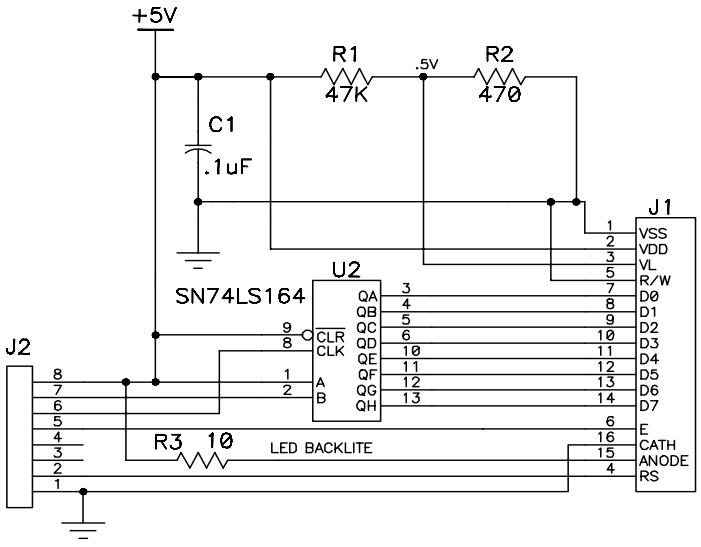
TEMPERATURE AND VACUUM S002



MICROPROCESSOR AND PERIPERAL CONTROL S003

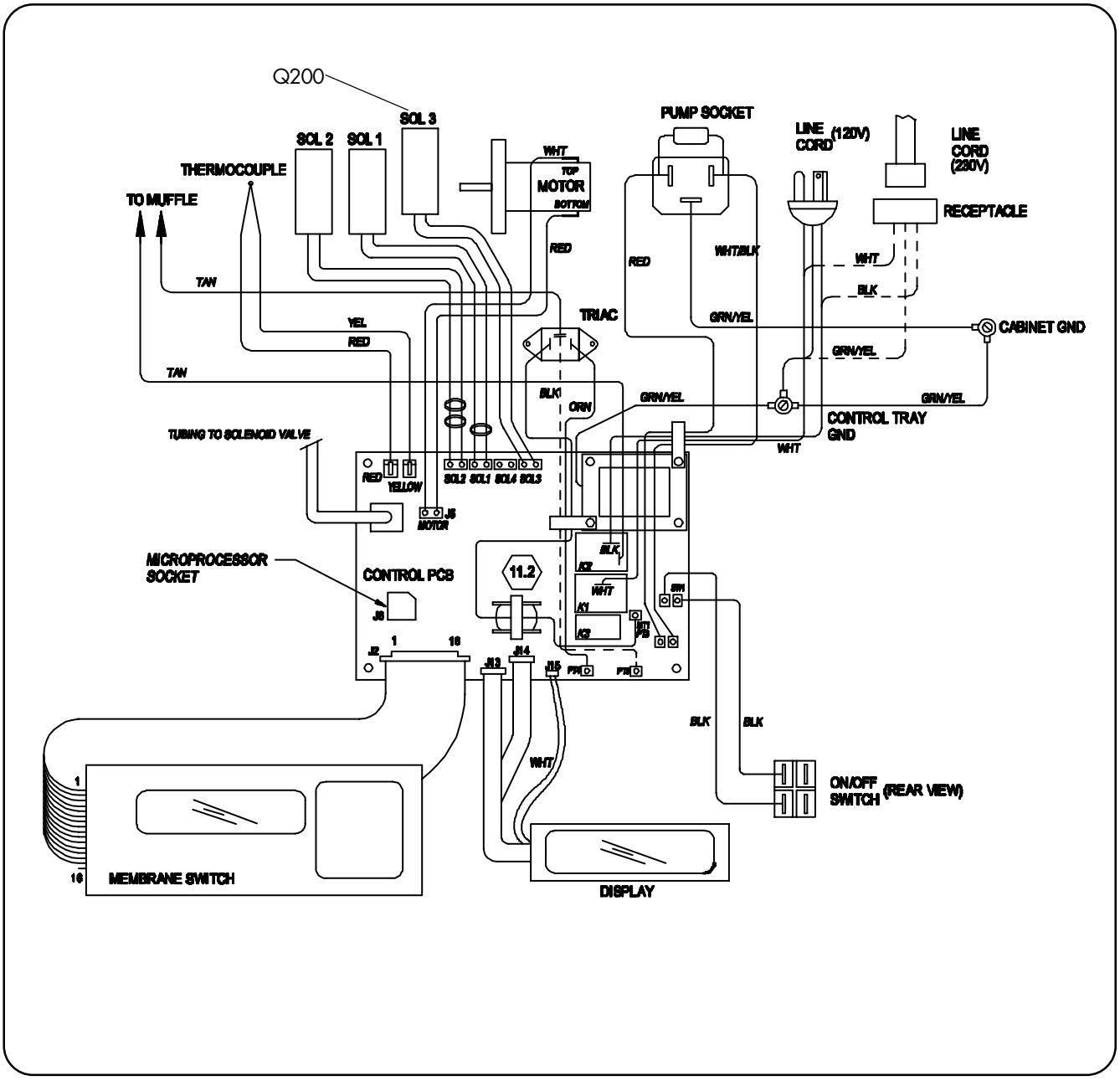


DISPLAY BOARD Q100 S004



DISPLAY BOARD Q50, Ceramco 7.0 S005

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 furnace. The furnace specifications are given in the Owner & Operator's Manual.

3.2 FACTORY REPAIR

DENTSPLY Ceramco maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the furnace. 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

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 clarify this procedure further:

It is determined that a certain porcelain overfires for a given program cycle. But, since many other program cycles have similar Hi Temp values it is desired to lower the calibration rather than 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. In summary if it desired that the furnace fire is hotter, the Tcal temp needs to be raised. If it needs to run cooler, lower the Tcal temp.

3.3.2 Vacuum (Q50, Q100 & Ceramco 7.0)

Since the atmospheric pressure varies from sea level to higher elevations, 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 760mm. Add 20mm to the factory setting for a sea level location. Or to determine exact capability of furnace with pump and altitude, run prog 88(Q50, Ceramco 7.0) and 102(Q100).

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.

Vacuum Q200

The CENTURION Q200 senses the absolute atmospheric pressure and displays it during idle mode of the firing cycle.

To adjust the pressure readout (in idle mode) obtain the local atmospheric pressure in mmHg or inHg and adjust potentiometer RP2 until the display reading matches the local pressure.

During a firing cycle the pump lowers the pressure reading. A good pump achieves this between 5 and 10 minutes (0.2 - 0.4 inHg) of pressure inside the muffle chamber.

3.4 CIRCUIT BOARD CALIBRATION

Calibration of the Q100 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 RF1 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.

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 RP2 until both readings are the same. (Note: if a reference gage is not available, RP2 use best estimate).

Vacuum Calibration using Software: Program 74/147 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.

It is recommended to run program 88(Q50, Ceramco 7.0), 102(Q100) to automatically adjust the setup V% for the local altitude. Press program number - enter. (see 3.3.2).

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

$PSI = kPa \times .14504$

$PSI = Atmospheres \times 14.696$

$PSI = kg/m^2 \times 0.0014223$

$PSI = Kg/cm^2 \times 14.223$

SECTION 4
SERVICE PARTS

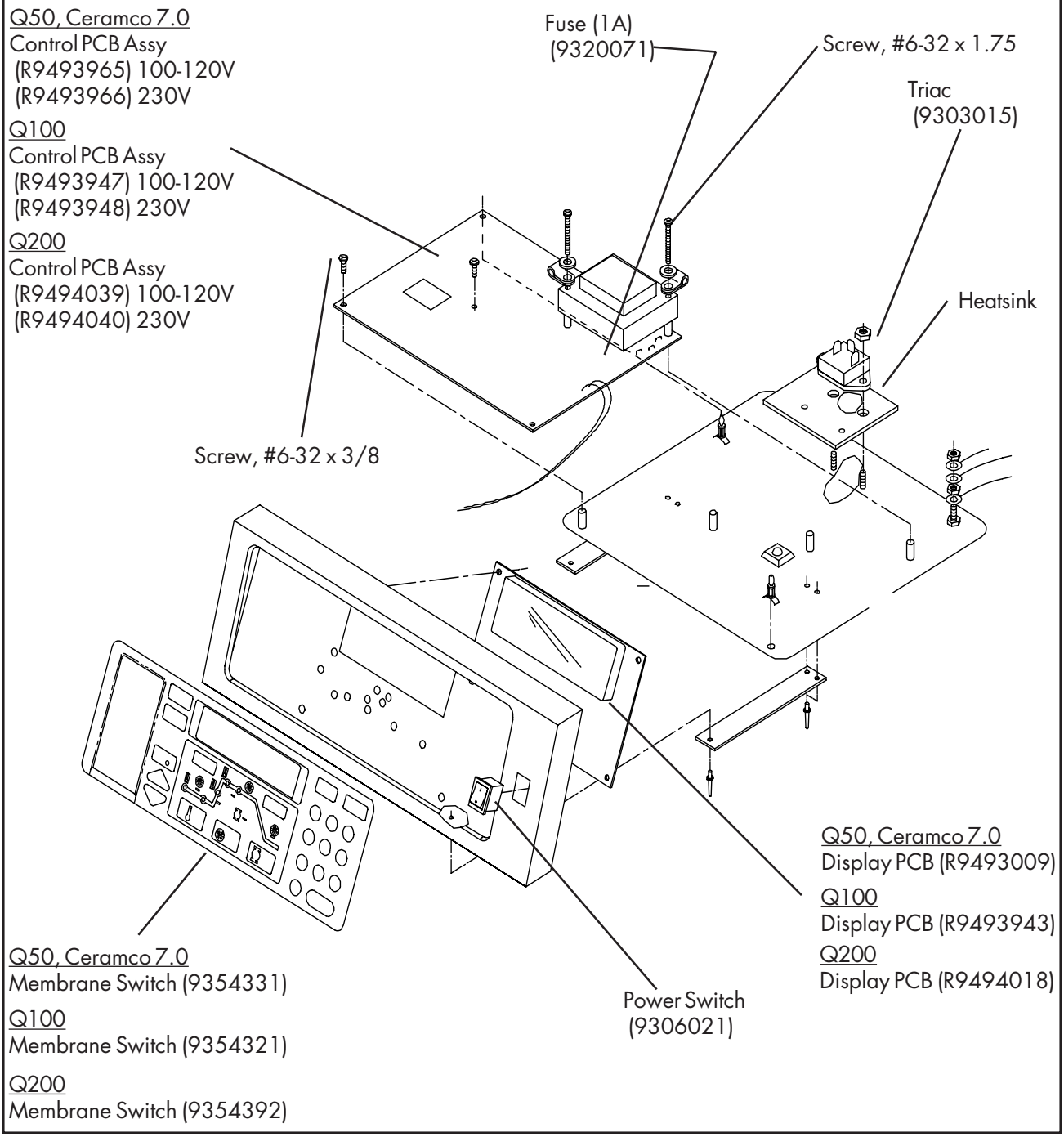
4.1 ORDERING INSTRUCTIONS

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:

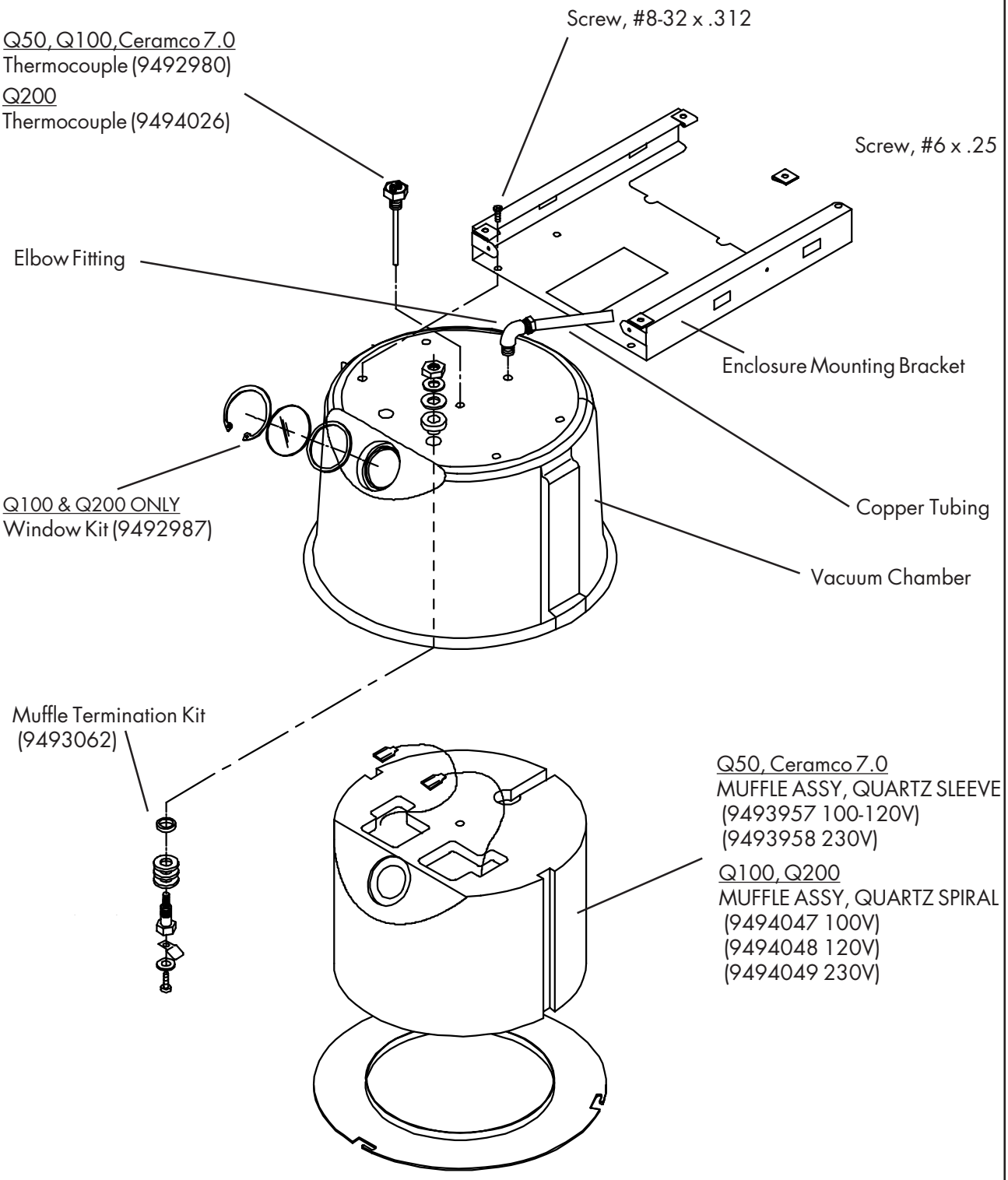
This information is needed to determine if the product is under warranty and to help us in tracking failures so that corrective action can be taken to prevent future problems.

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

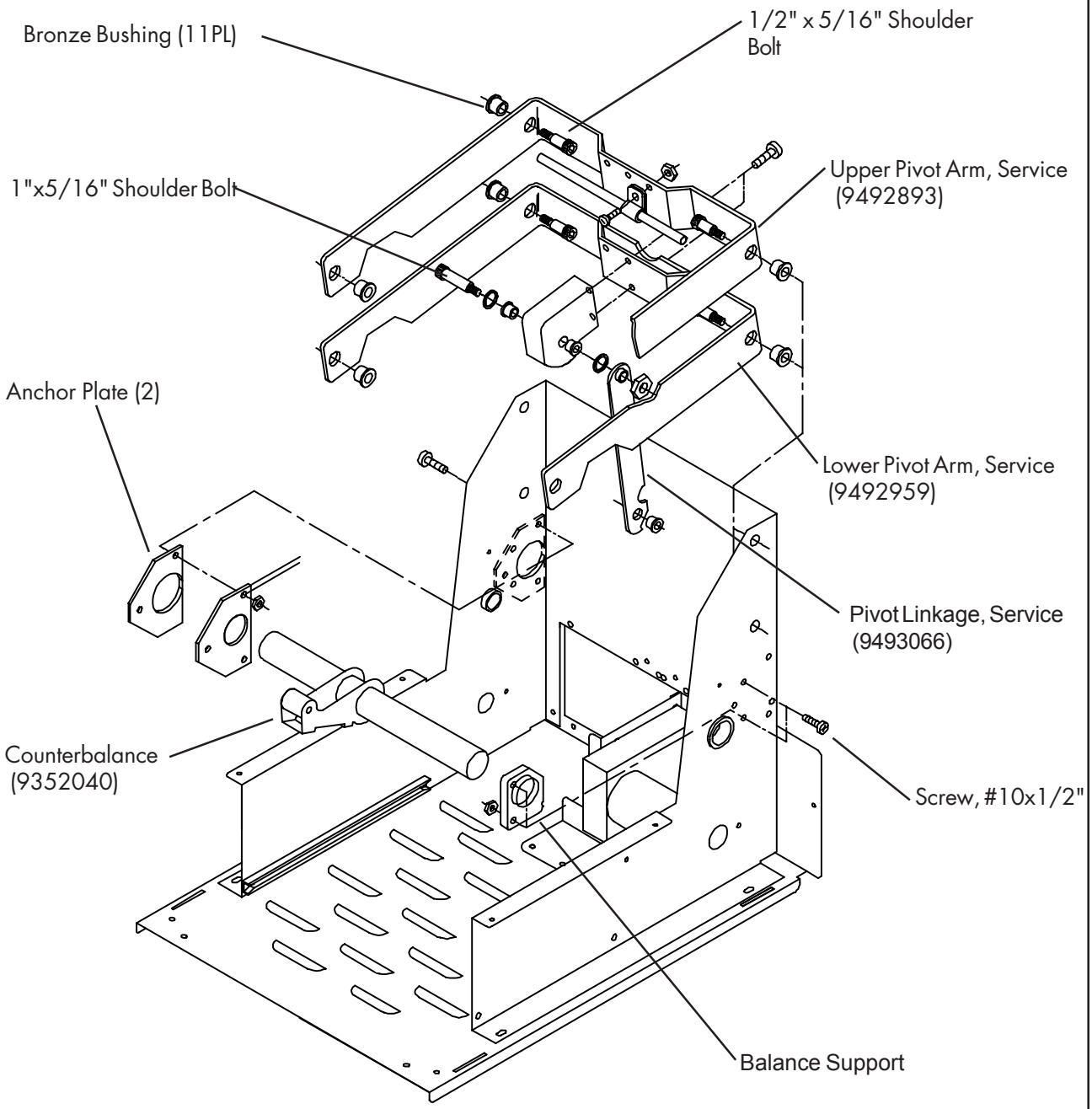
4.2 CONTROL DRAWER PARTS



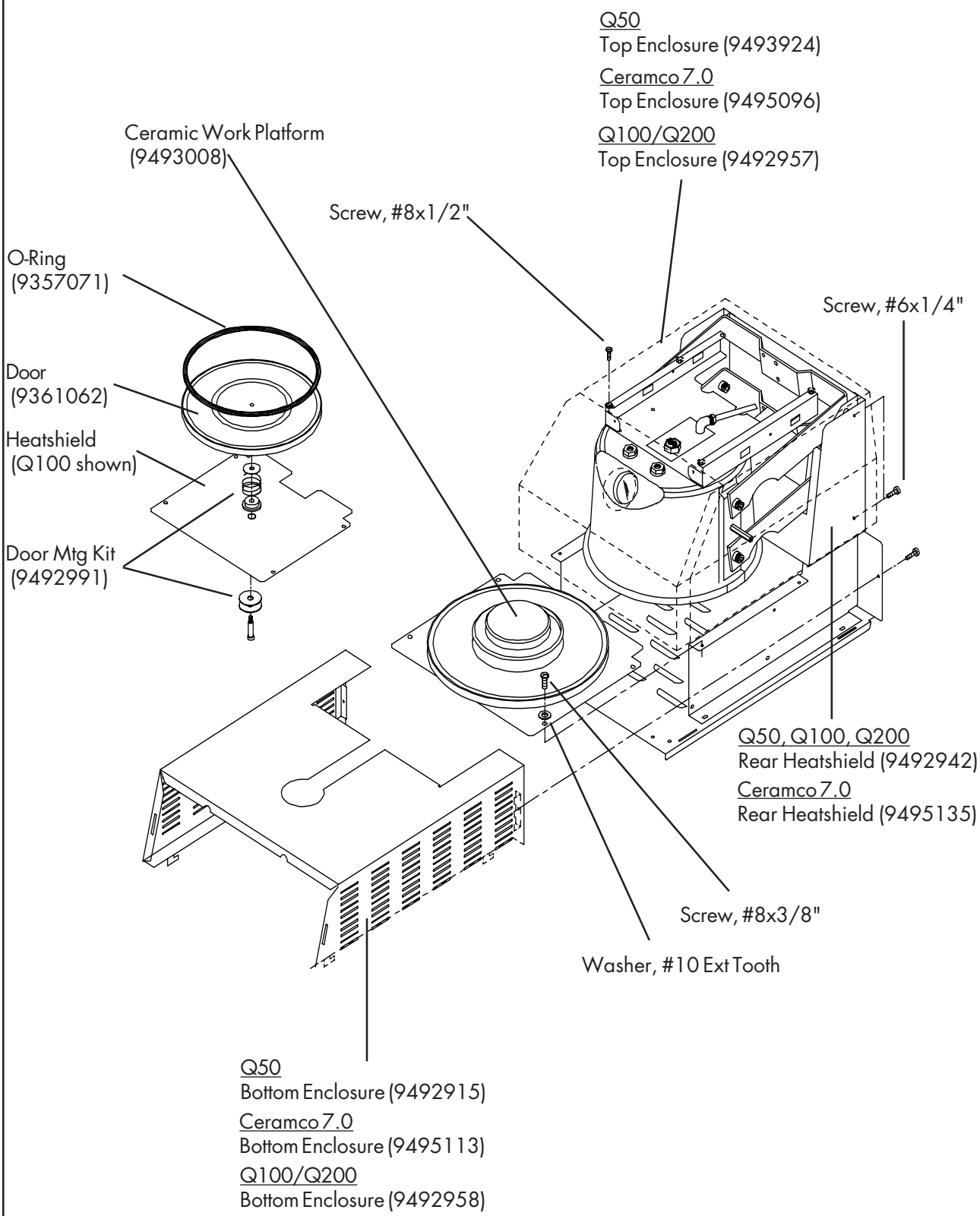
4.3 MUFFLE & VACUUM CHAMBER PARTS



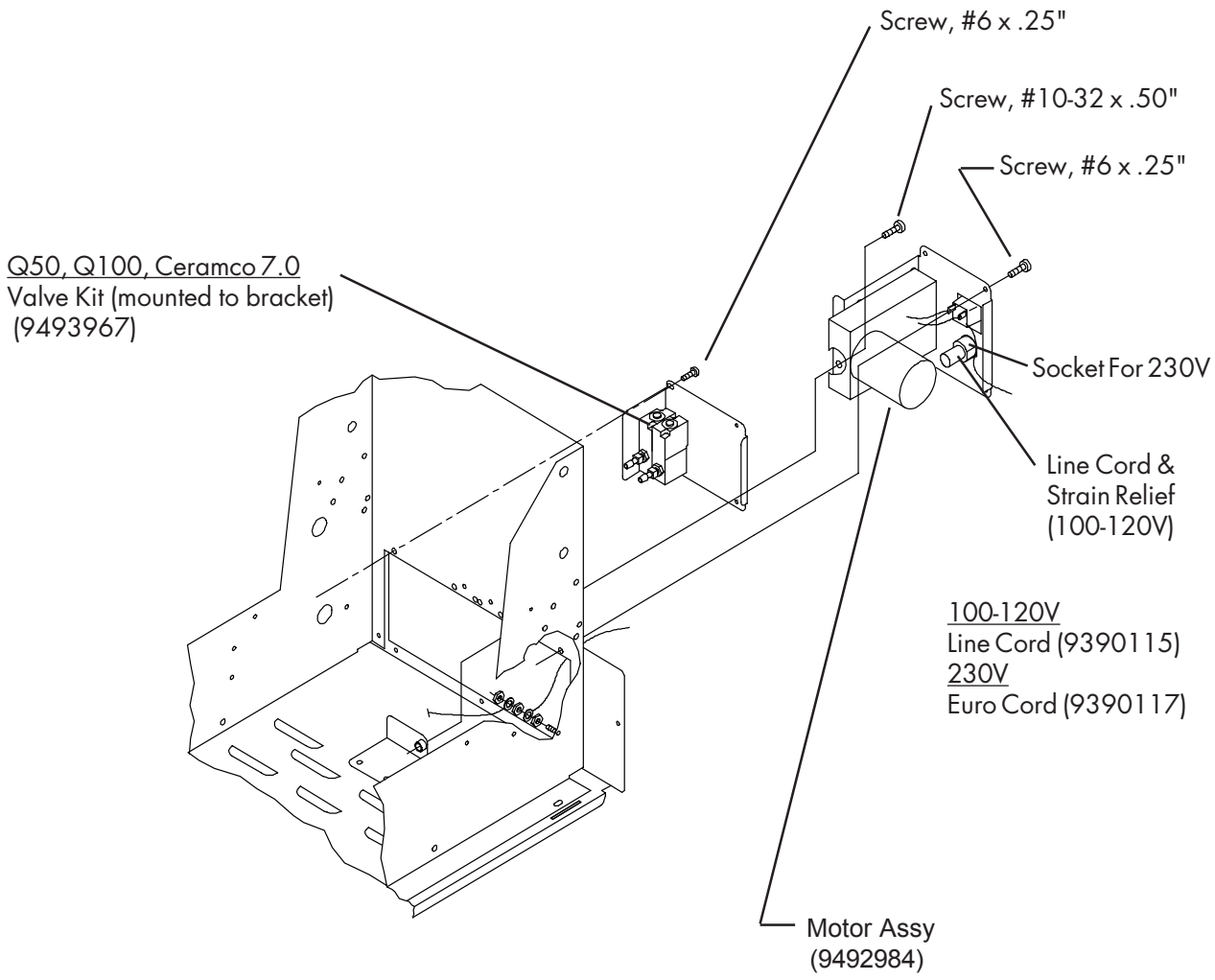
4.4 LIFT MECHANISM PARTS

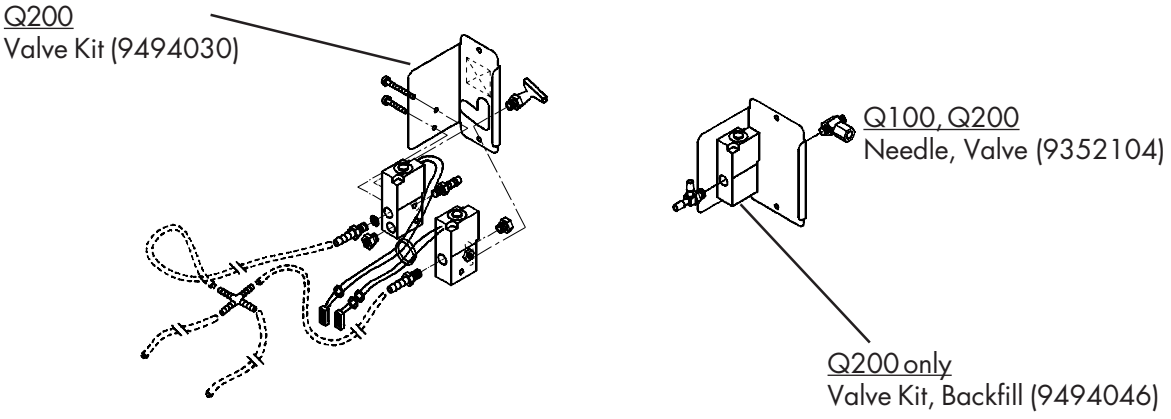


4.5 DOOR & CABINET PARTS



4.6 MOTOR & VALVE PARTS

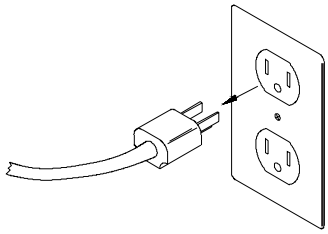




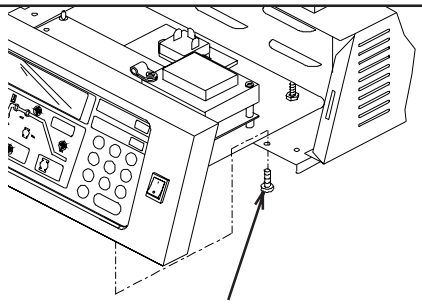
SECTION 5
DISASSEMBLY / REASSEMBLY

5.1A CONTROL DRAWER Q100, Q200

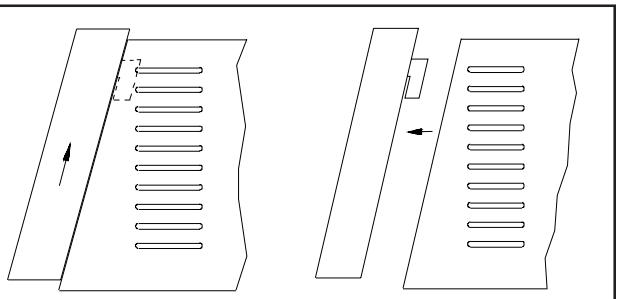
Tools : Phillips #2 screwdriver or 1/4" nut-driver



5.1.1A Disconnect power cord from wall outlet



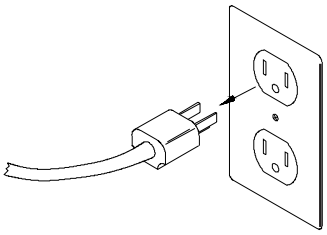
5.1.2A Remove 2 screws



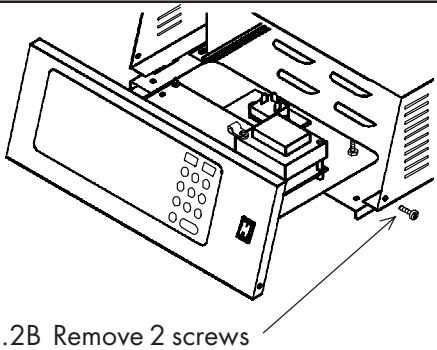
5.1.3A Slide front panel up then out to remove tabs from bottom enclosure

5.1B CONTROL DRAWER Q50, Ceramco 7.0

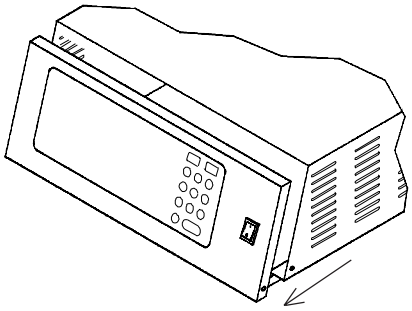
Tools : Phillips #2 screwdriver or 1/4" nut-driver



5.1.1B Disconnect power cord from wall outlet



5.1.2B Remove 2 screws



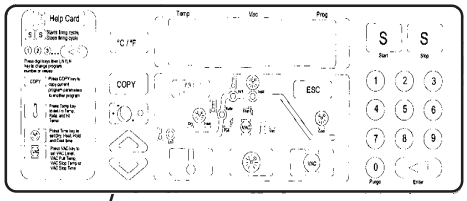
5.1.3B Slide front panel up then out to remove tabs from bottom enclosure

5.2 MUFFLE

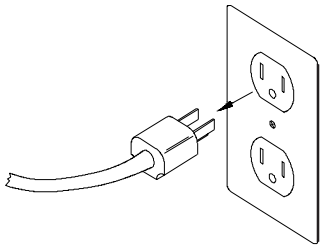
Tools: Phillips screwdriver (#2 short)
Pliers

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

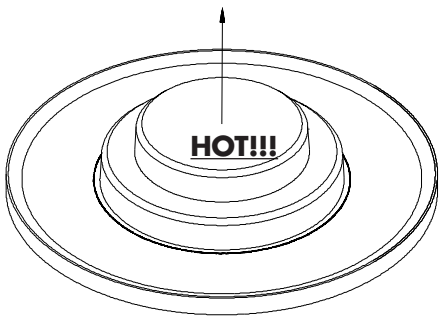
Caution:
Do not touch the quartz during muffle replacement. Handle on outer surface.



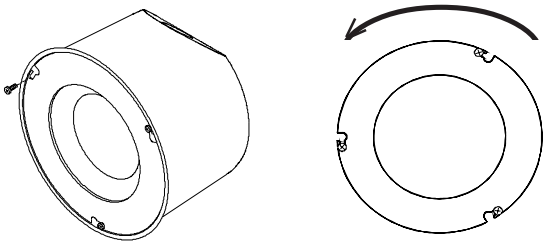
5.2.1: Press “up” key (Q100 shown)



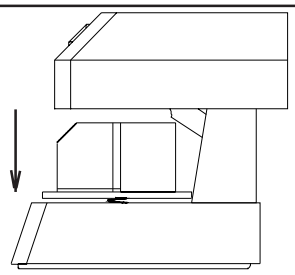
5.2.2: Disconnect power cord from wall outlet



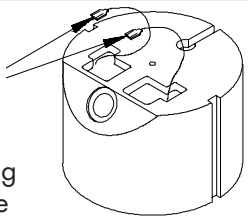
5.2.3: Remove door insulation (Allow to cool first)



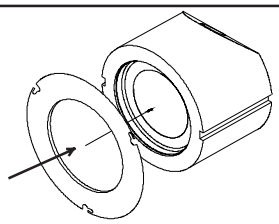
5.2.4: Turn furnace gently on it's side holding by column, not top enclosure. Loosen 3 screws and rotate ring.



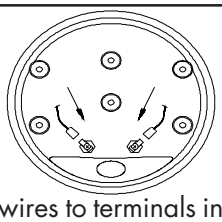
5.2.5: Slide out muffle and retaining ring



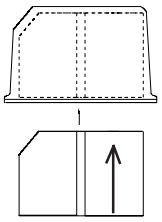
5.2.6: Disconnect terminals using pliers if needed & remove muffle



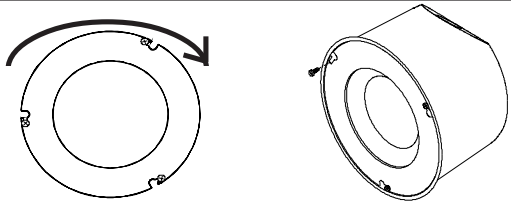
5.2.7: Center and press ring into new muffle



5.2.8: Connect muffle wires to terminals inside vacuum chamber.



5.2.9: Slide muffle and ring into chamber lining up guides

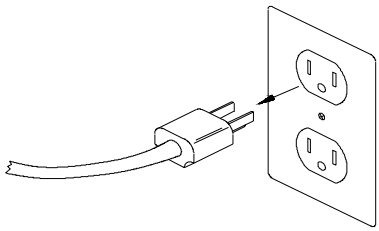


5.2.10: Rotate retaining ring into the locked position then tighten 3 screws.

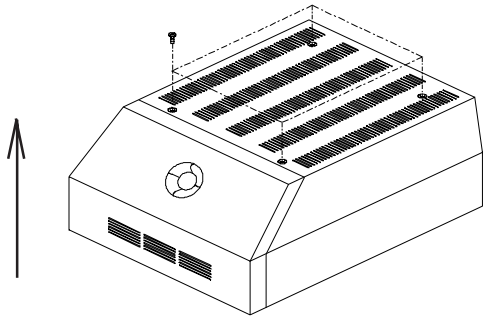
5.3 THERMOCOUPLE

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

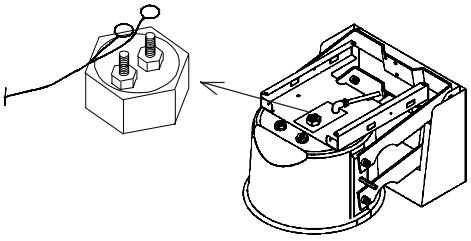
Caution:
Muffle must be in down position to prevent damage to lift mechanism.



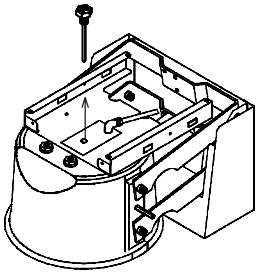
5.3.1 Disconnect power cord from wall outlet



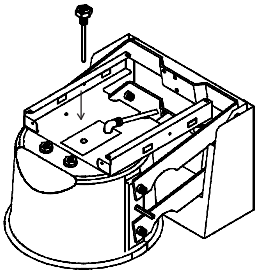
5.3.2 Remove 4 top cover screws and lift top cover off unit (Q100 shown)



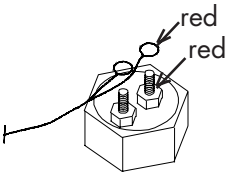
5.3.3 Remove 2 nuts and lift off wires



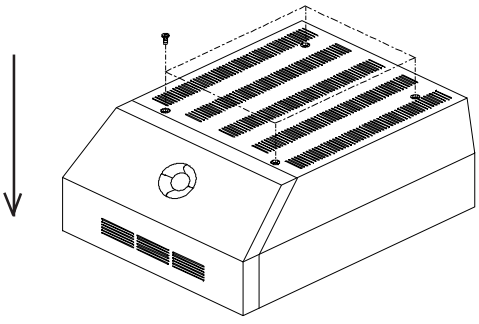
5.3.4 Remove thermocouple (use 3/4" wrench while supporting chamber)



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



5.3.6 Install wires and nuts (red to red)

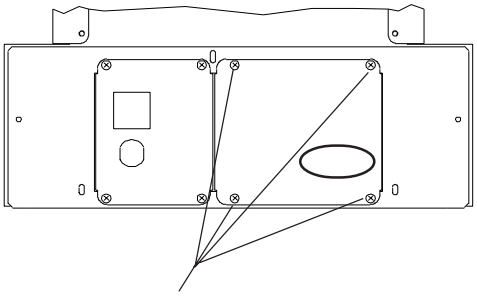


5.3.7 Install cover and 4 top screws

5.4 SOLENOID VALVES

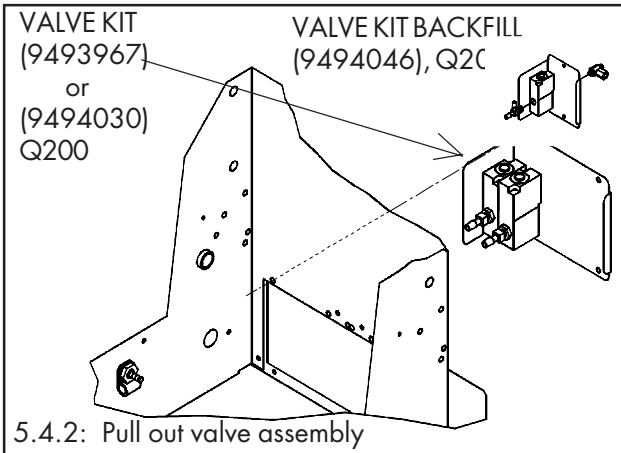
Tools: Phillips screwdriver
7/16" open end wrench
Pliers
5/16" Nutdriver

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 and pull out bracket

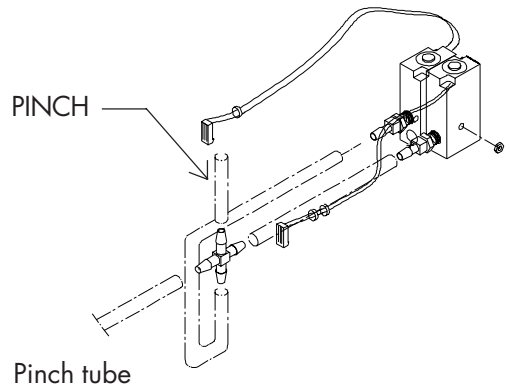
NOTE: Q200 has 2 separate brackets.



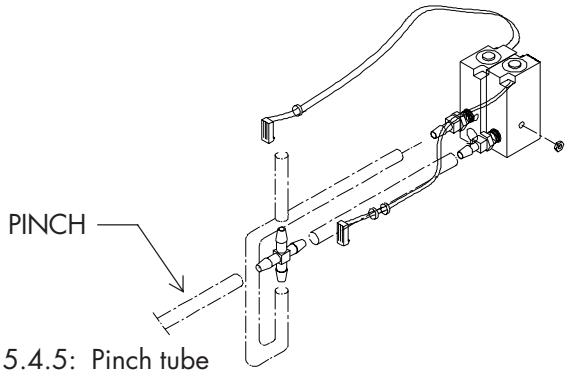
5.4.2: Pull out valve assembly

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

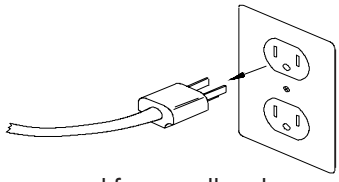
LoT= 200°C	Rate= 50°C/min	HiT= 300°C
Dry= 0:00 M	Hold= 5:00 M	Cool= 0:00 M
VAC= 80%	Pull= 200°C	Stop= 400°C



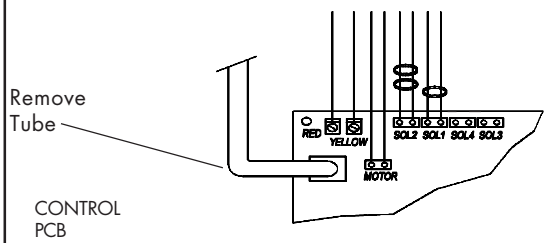
5.4.4: Pinch tube
Observe gage:
- If "VAC" level holds, then chamber leaks
- If "VAC" level drops, then leak is in valves or gage. (Proceed to step 5.4.5)



5.4.5: 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 5.4.6)



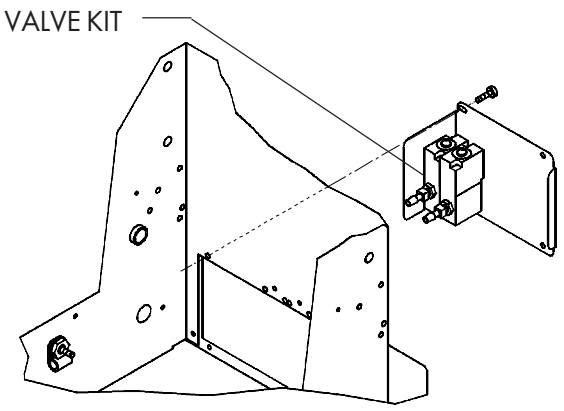
5.4.6: Remove power cord from wall outlet



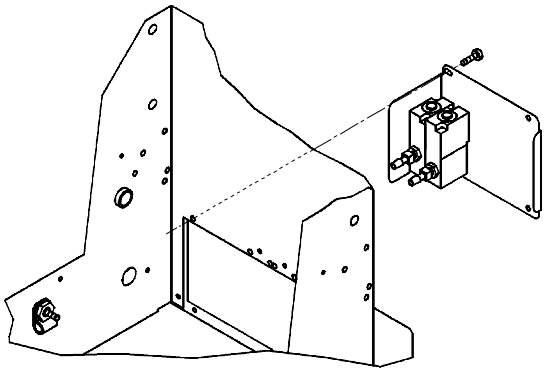
5.4.7: Follow steps 5.1.1 - 5.1.3 of CONTROL DRAWER REMOVAL, then disconnect valve wires and tubing from Control PCB.

NOTE: Q200 has 3 valve wires.

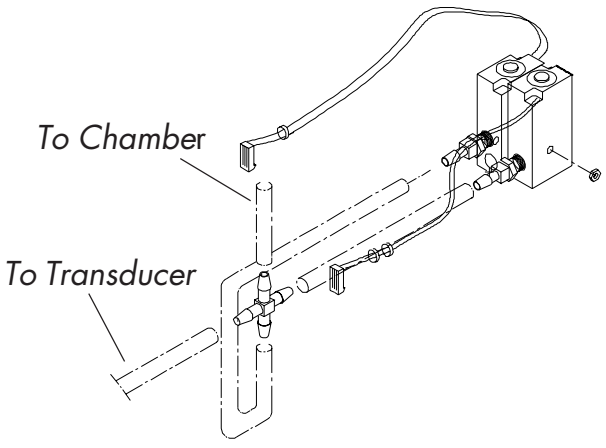
NOTE: Replacing the valve kit attached to the bracket.



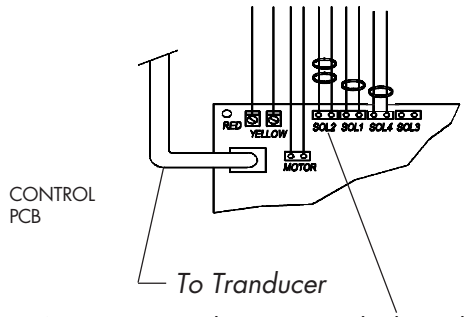
5.4.8: Disconnect tubing from chamber



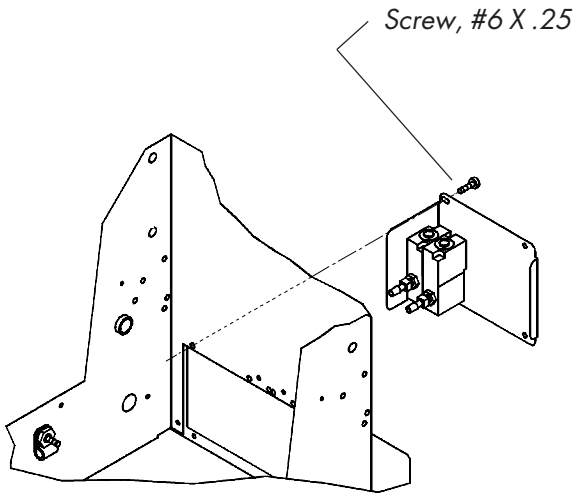
5.4.9: Replace with new valve kit



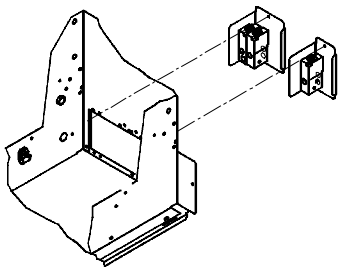
5.4.10: Replace tubing



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



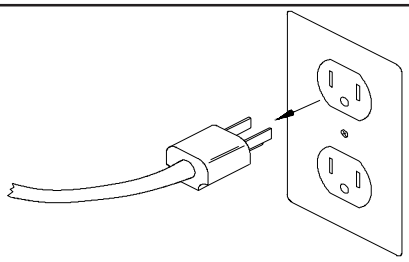
5.4.12: Mount bracket to base with 4 screws



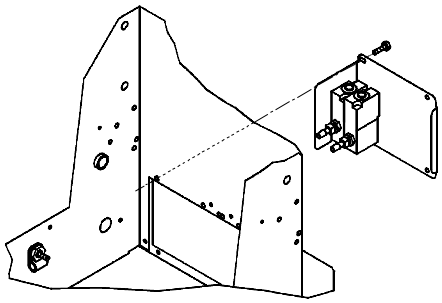
5.4.12: Q200 - Mount brackets to base with 4 screws

5.5 MOTOR

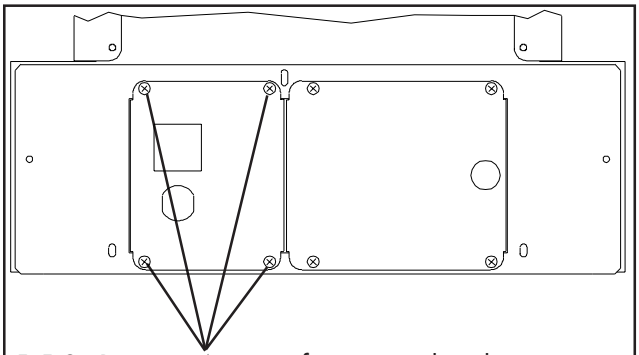
Tools: Long #2 Phillips screwdriver
5/32" Allen wrench
Large adjustable wrench (1" or 25 mm)



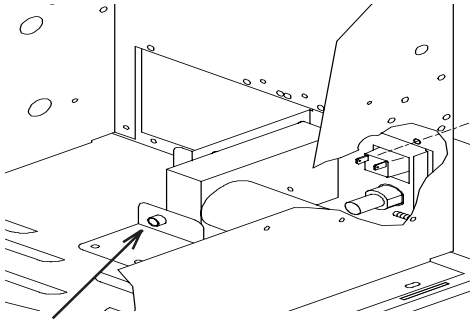
5.5.1: Disconnect line cord from wall outlet



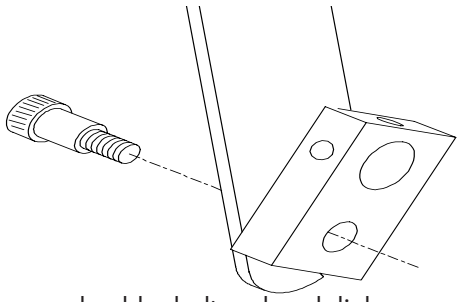
5.5.2: Remove valve bracket (4 screws) first



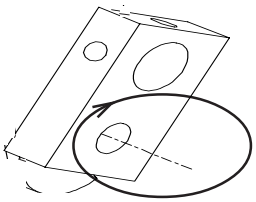
5.5.3: Remove 4 screws from motor bracket



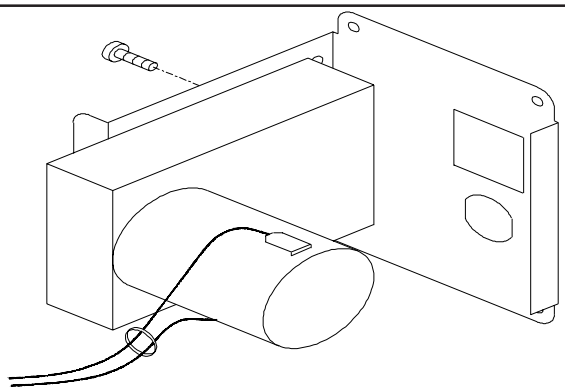
5.5.4: Remove this screw (from rear)



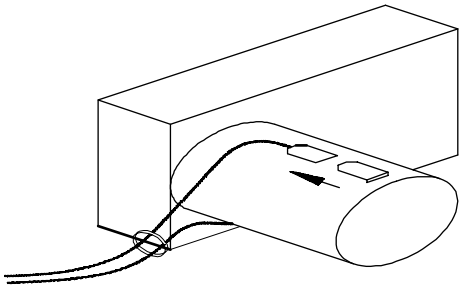
5.5.5: Remove shoulder bolt and push linkage away from block. Unloading the motor by lifting up and down on the chamber may help.



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



5.5.7: Remove motor from bracket (4 screws)



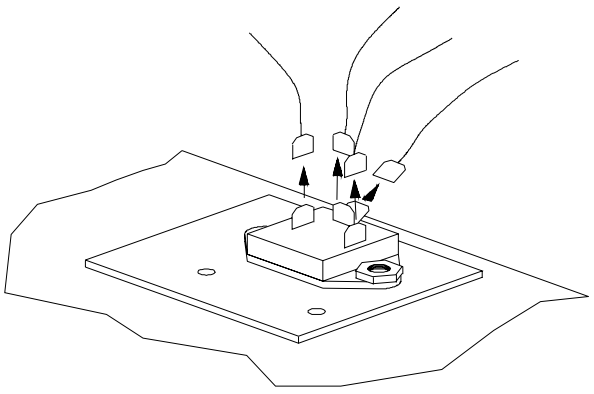
5.5.8: Disconnect motor wires

5.5.9: Install new motor by reversing steps 5.5.8 through 5.5.3. Torque all screws to 25-30 in-lb (3 N-m).

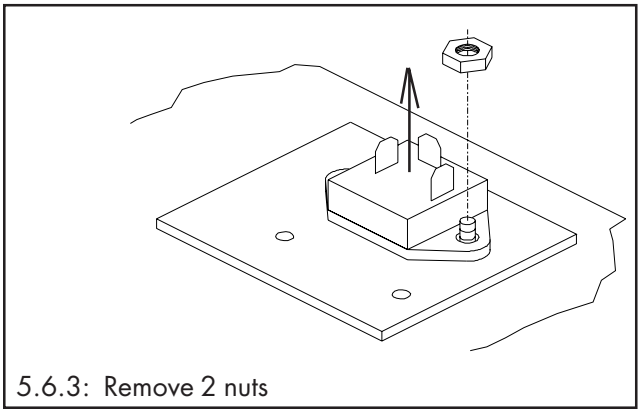
5.6 TRIAC

Tools: Phillips screwdriver
1/4" nut driver

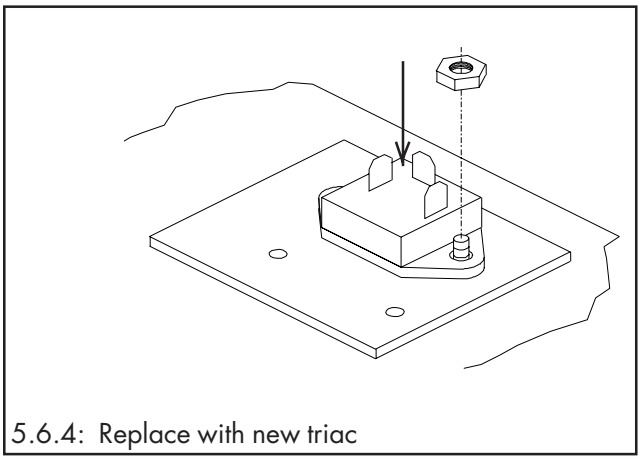
5.6.1: Follow steps 5.1.1 through 5.1.3 of CONTROL DRAWER REMOVAL.



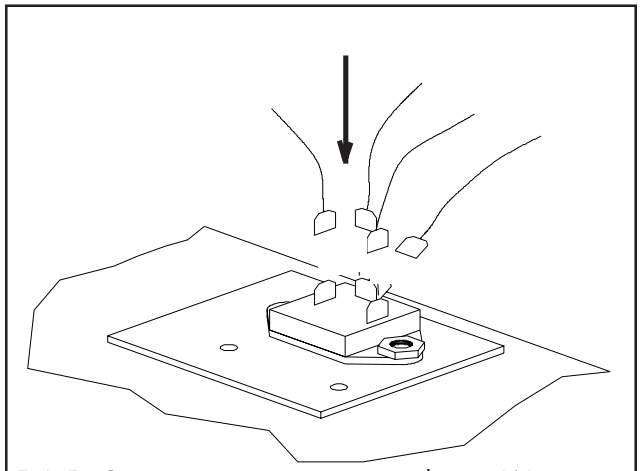
5.6.2: Disconnect wires from triac



5.6.3: Remove 2 nuts



5.6.4: Replace with new triac



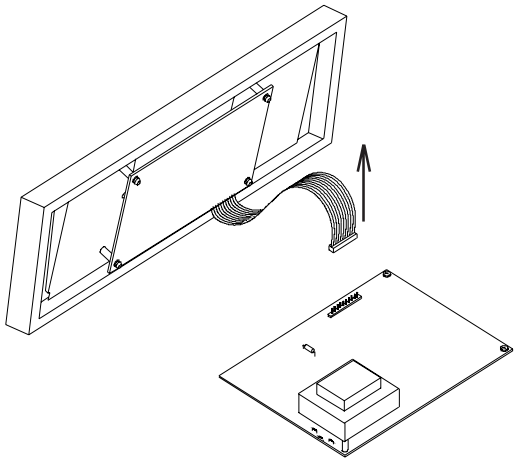
5.6.5: Connect wires to triac according to Wiring Diagram page 2-16. Make sure connections are tight

5.7 DISPLAY BOARD

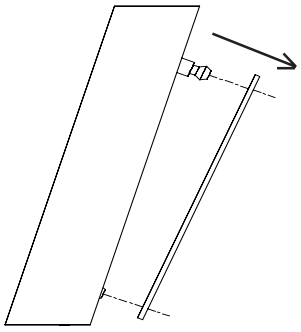
Tools: Phillips screwdriver

CAUTION!
Use proper ESD grounding techniques when handling electronic components

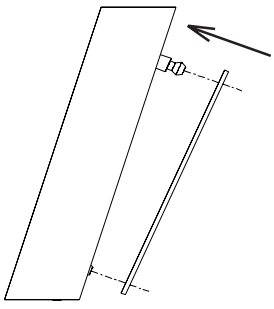
5.7.1: Follow steps 5.1.1 though 5.1.3 of CONTROL DRAWER REMOVAL



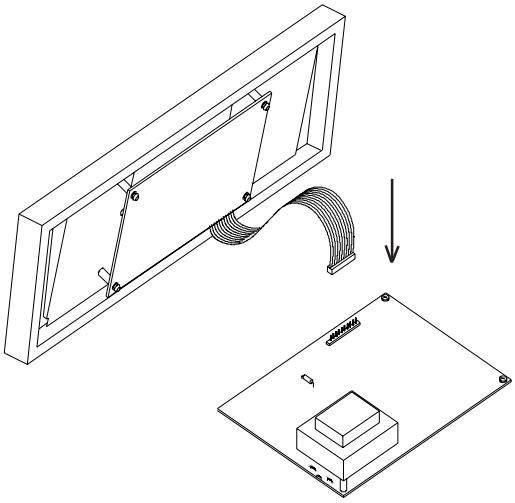
5.7.2: Disconnect grey ribbon connector



5.7.3: Remove from snap-on standoffs



5.7.4: Replace with new Display PCB



5.7.5: Connect grey ribbon connector

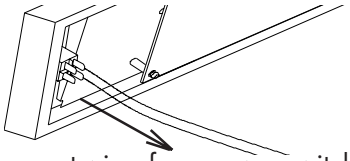
5.7.6: Reassemble Control Module

5.8 CONTROL BOARD

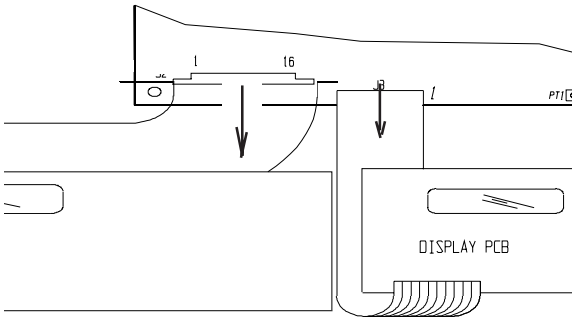
Tools: Phillips screwdriver; Slotted screwdriver
Needle nose pliers

CAUTION!
Use proper ESD grounding techniques when handling electronic components

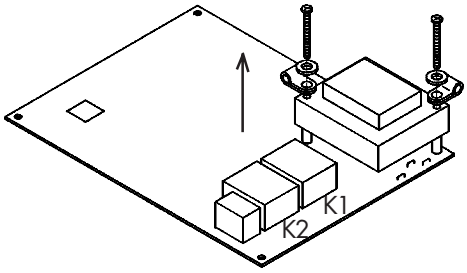
5.8.1: Follow steps 5.1.1 through 5.1.3 of CONTROL DRAWER REMOVAL.



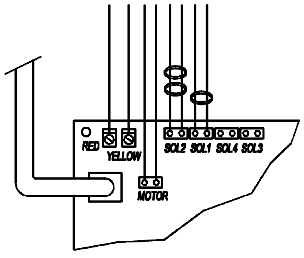
5.8.2: Disconnect wires from power switch



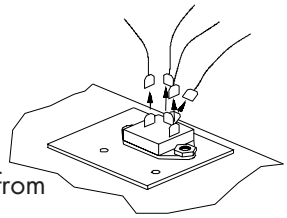
5.8.3: Disconnect ribbon connectors



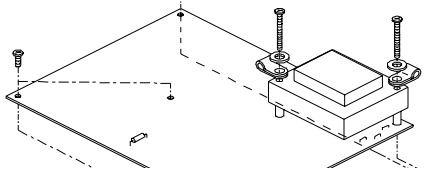
5.8.4: Remove wires from relays K1 and K2 using caution not to damage relays



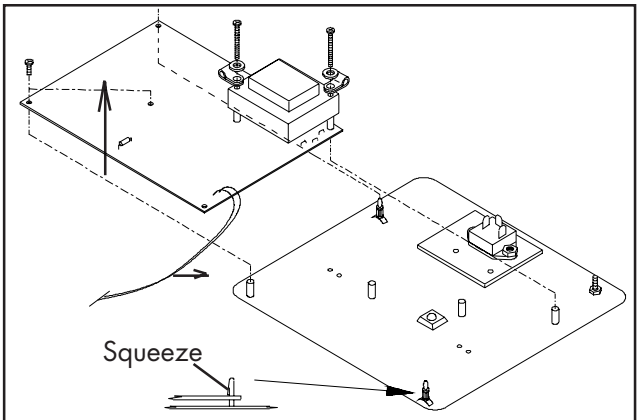
5.8.5: Disconnect MOTOR(VPC) , SOL1, SOL2, SOL3 (Q200), YEL, RED wires and Vacuum hose (VPC).



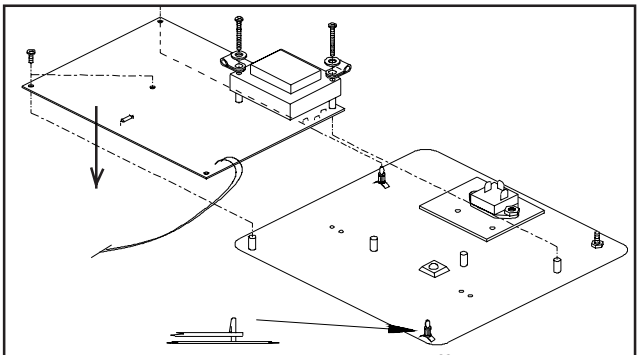
5.8.6: Disconnect wires from triac



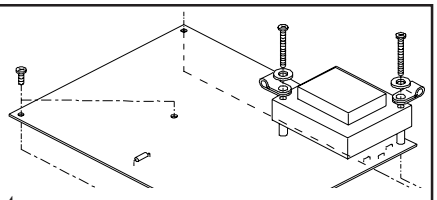
5.8.7: Remove 4 screws



5.8.8: Lift board off standoffs



5.8.9: Press new board over standoffs



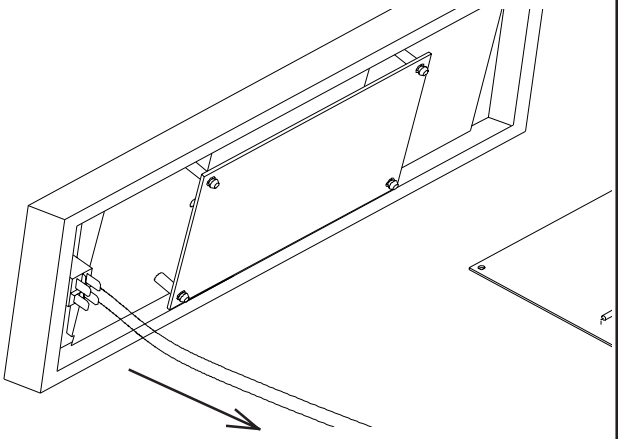
5.8.10: Secure 4 screws

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

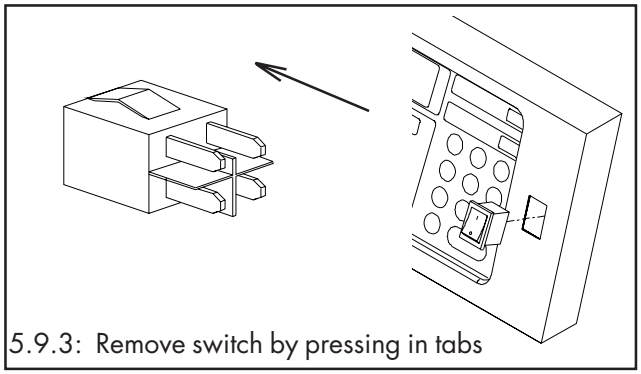
5.9 POWER SWITCH

Tools: Slotted screwdriver

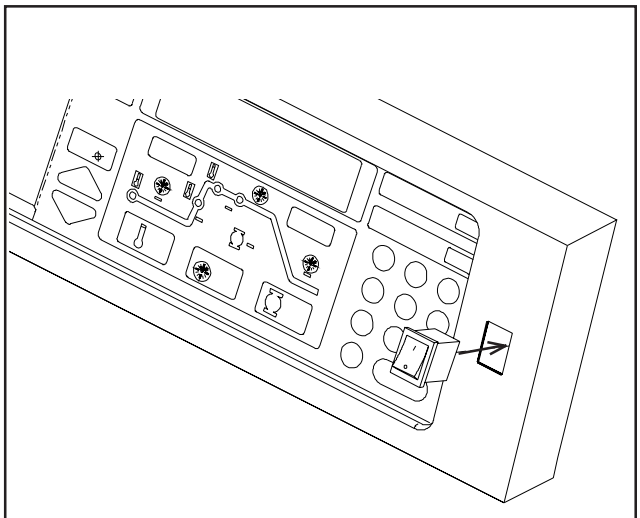
5.9.1: Follow steps 5.1.1 through 5.1.3 of CONTROL DRAWER REMOVAL



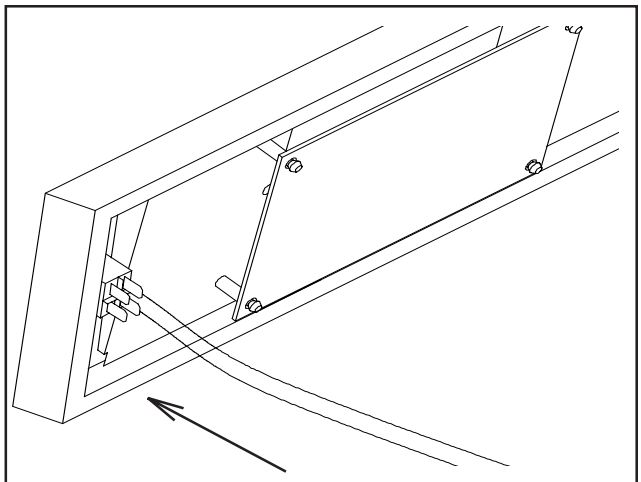
5.9.2: Disconnect switch wires



5.9.3: Remove switch by pressing in tabs



5.9.4: Press in new switch

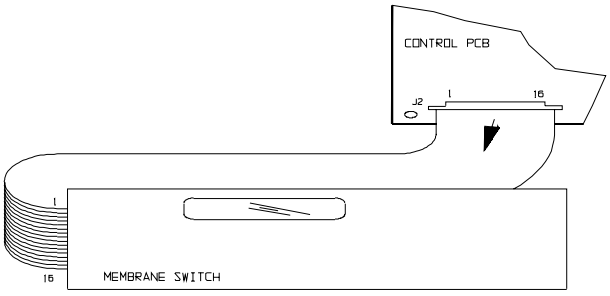


5.9.5: Connect switch wires to side shown

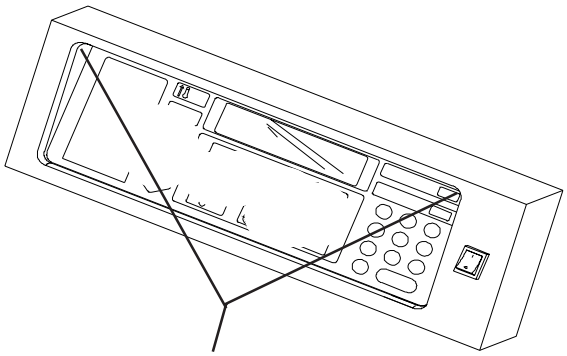
5.10 MEMBRANE SWITCH:

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

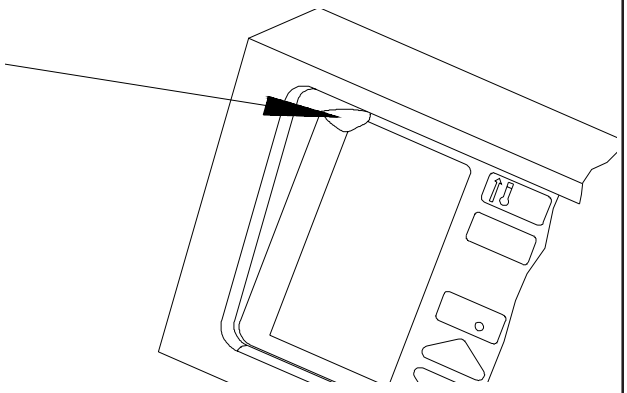
5.10.1: Follow steps 5.1.1 through 5.1.3 of CONTROL DRAWER REMOVAL.



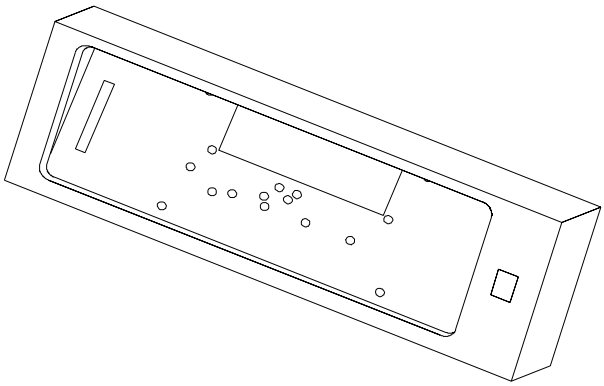
5.10.2: Disconnect ribbon cable



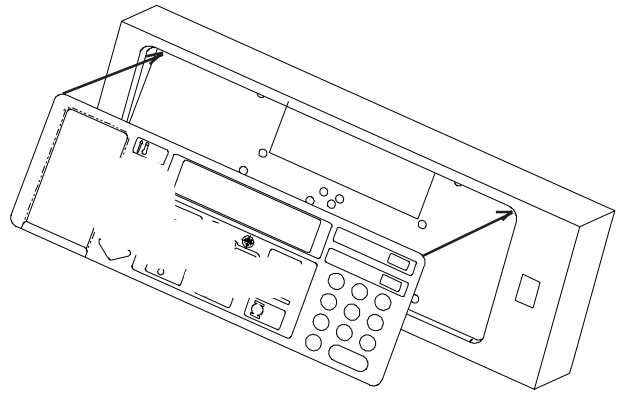
5.10.3: Pencil fine outline around two upper corners



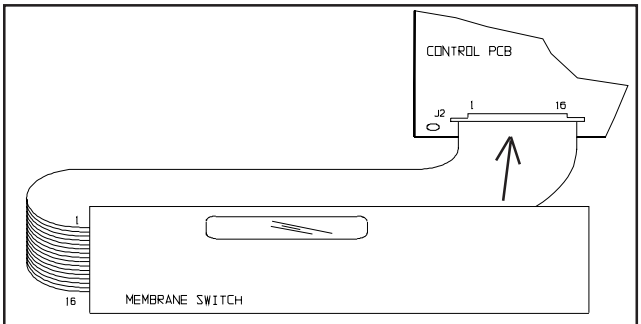
5.10.4: Peel off membrane switch (use knife if needed)



5.10.5: Clean front panel surface without removing pencil marks



5.10.6: Gently place membrane into front panel. Use penciled corners to locate.



5.10.7: Connect ribbon connector

SERVICE NOTES: