HARVEY®

Service Manual

Models MC8 & MC10

Steam Sterilizer

LT1203X2 • 2/16/02

Table of Contents

Safety Information

Alert Signals

These symbols with related notes appear throughout this manual.

Warning
Warnings alert you to a possibility of personal injury.

Caution
Cautions alert you to a possibility of damage to the equipment.

Note
Notes alert you to pertinent facts and conditions.

Hot Surface
Hot surfaces alert you to a possibility of personal injury if you come in contact with a surface during use or for a period of time after use.

NOTE:
This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can rediate radiofrequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

General Specifications

	MC8	MC10
Cabinet Size	13-1/2” W x 16” H x 22” L (330 mm W x 406mm H x 559mm L)	16” W x 18” H x 23” L (406mm W x 457mm H x 584mm L)
Chamber Size	8” diameter x 14-1/2” usable depth (203mm diameter x 368mm)	10” diameter x 15-1/2” usable depth (254mm diameter x 393mm)
Tray Sizes	Two 14” x 6-1/4” x 7/8” (356mm x 135mm x 22mm)	One 15-1/4” x 9” x 1-1/4” (387mm x 228mm x 32mm)
Shipping Weight	72 lbs (33 kg)	92 lbs (42 kg)
Heater Wattage	1350 Watts	1425 Watts
Electrical Rating	115 VAC, 50/60 Hz, 12 Amps or 230 VAC, 50/60 Hz, 6 Amps (See Note)	115 Vac, 50-60 Hz, 12 Amps or 230 VAC, 50/60 Hz, 6 Amps (See Note)
Reservoir Capacity	3000 ml (approx. 3 quarts)	4000 ml (approx. 4 quarts)
Maximum Rated Operating Pressure	45 psi (310 kPa)	45 psi (310 kPa)

Environmental Conditions

Operation	10° to 40°C (50° to 104°F) 30% to 70% relative humidity, non-condensing	10° to 40°C (50° to 104°F) 30% to 70% relative humidity, non-condensing
Storage and Transport	-20° to 60°C (-4° to 140°F) 10% to 100% relative humidity	-20° to 60°C (-4° to 140°F) 10% to 100% relative humidity

Printer (Optional)

Electrical Rating	9 VAC; 1 WATT (idle), 10 Watts (running)	9 VAC; 1 Watt (idle), 10 Watts (running)

Non-Recirculating Water Accessory (Optional)

Size	6-3/4” W x 13-1/2” H 15-1/4” L (171mm W x 343mm H x 387mm L)	6-3/4” W x 13-1/2” H 15-1/4” L (171mm W x 343mm H x 387mm L)
Capacity	11.36 L (approx. 3 gallons)	11.36 L (approx. 3 gallons)

General Information

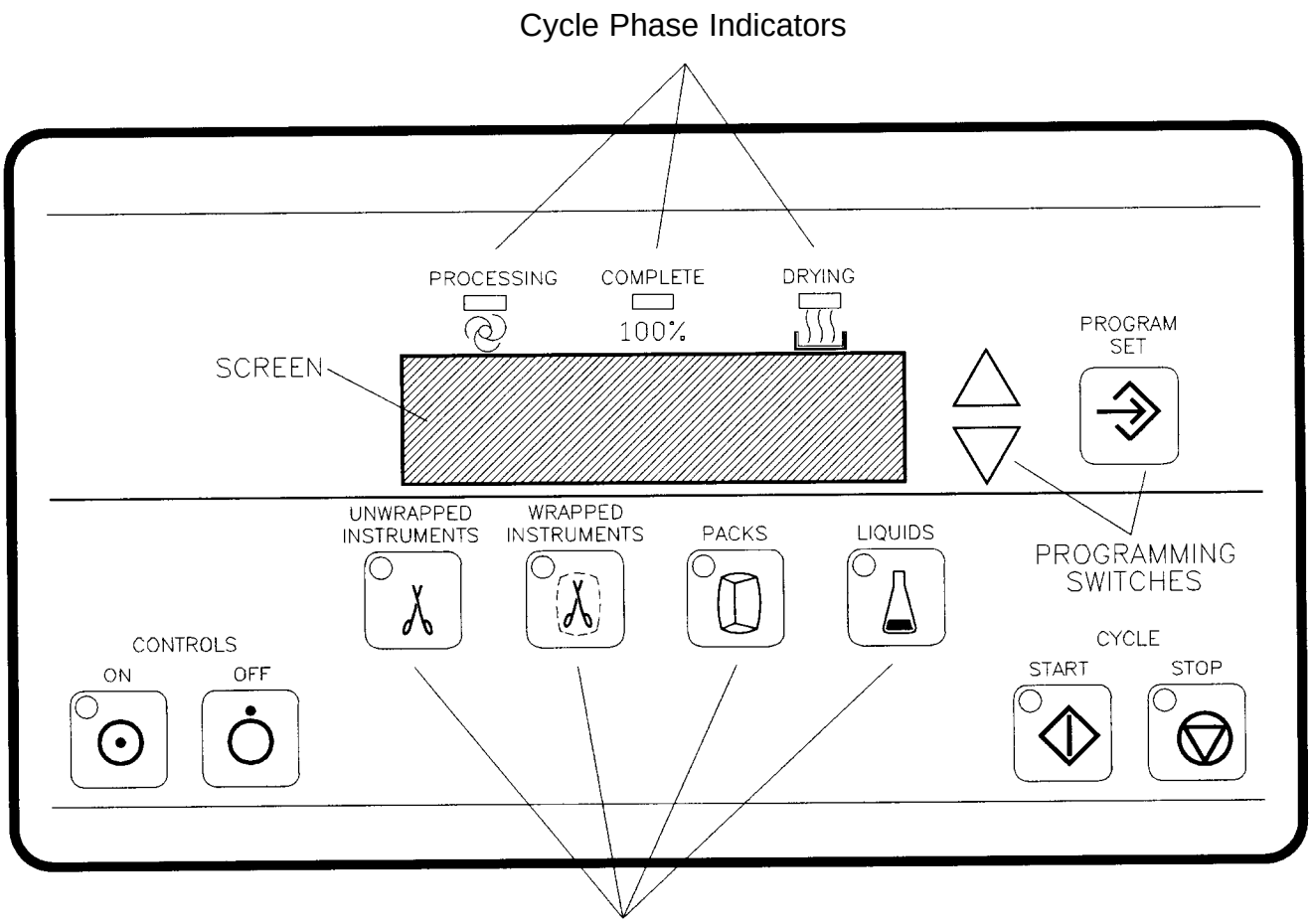


Figure 1
Control Panel

Note
When the power cord is plugged in and the controls are OFF, the Control Panel will display the time.

Note
Cycle times are adjustable from minimum allowable exposure time up to 99 minutes.

Controls ON/OFF

- CONTROLS ON: Turns ON the Control Panel.
- CONTROLS OFF: Turns OFF the Control Panel.

Cycle Select Switches

- UNWRAPPED INSTRUMENTS: Selects cycle for unwrapped instruments (3 minute exposure at 135°C).
- WRAPPED INSTRUMENTS: Selects cycle for wrapped instruments (5 minute exposure at 135°C).
- PACKS: Selects cycle for linen packs (30 minutes exposure at 121°C).
- LIQUIDS: Selects cycle for liquids and glassware (30 minute exposure at 121°C, slow exhaust).

Cycle Start/Stop

- CYCLE START: Starts the selected processing cycle.
- CYCLE STOP: Stops the cycle in progress.

Programming Switches

- PROGRAM/SET: Used to set clock/calendar, select cycle parameters in memory.
- UP AND DOWN ARROWS: Used with the PROGRAM/SET switch to select operating procedures.

Display Window

A two-line LCD displays cycle parameters, counts down exposure and drying times, and displays messages.

Cycle Phase Indicators

- PROCESSING: Indicates load is being processed at selected time and temperature.
- COMPLETE: Indicates processing cycle is complete.
- DRYING: Indicates load is drying for selected time.

Principles of Operation

Note
For detailed cycle information, refer to the cycle phase diagrams in the **Service Data** section.

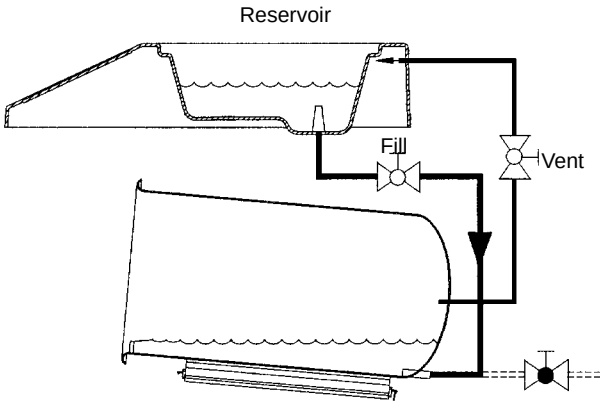


Figure 2
Fill Phase

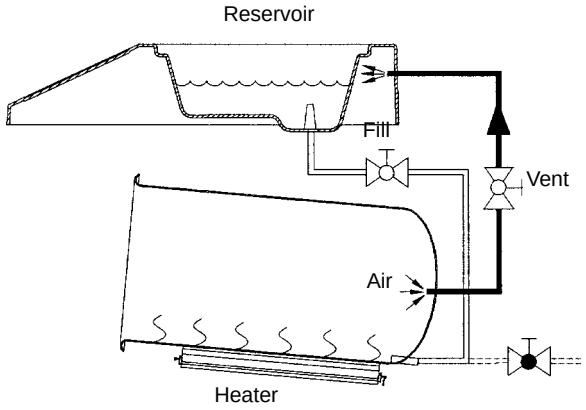


Figure 3
Air Removal Phase

Cycle Description

Controls ON (Standby)

The vent valve is open when the unit is in standby mode. The heater is turned on to warm up the chamber.

Fill Phase

When CYCLE START is pressed, a 30 second delay begins, during which time the chamber temperature is allowed to stabilize. For the duration of this delay the display will read “Cooling Chamber” and the current chamber temperature. The sterilizer will wait up to 60 minutes for the chamber to drop below 70% before the Fill Phase. When the chamber has cooled, there is a 15 second delay and then the fill valve is open for timed period. Water from the reservoir enters the chamber.

Air Removal Phase

The fill valve is closed and the heater is turned on. The water boils, producing pressure that forces air out of the chamber through the vent valve.

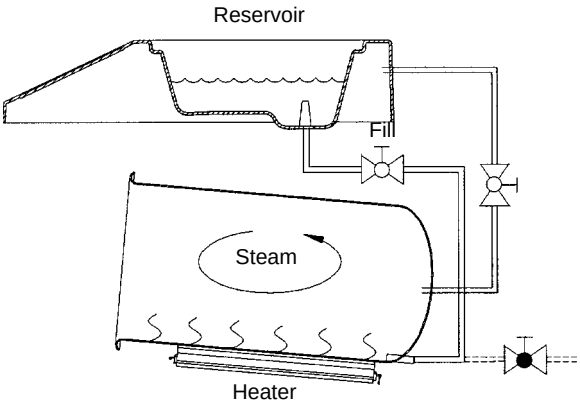


Figure 4
Exposure Phase

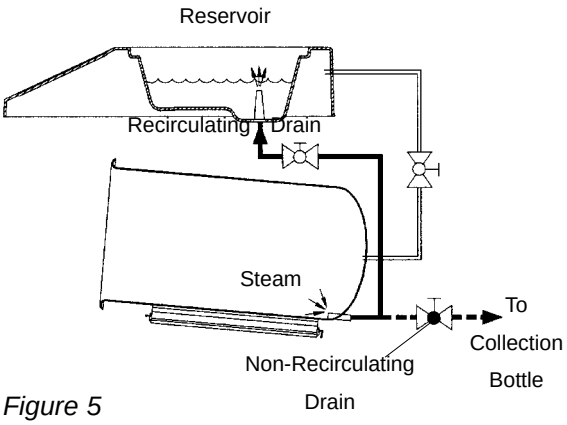


Figure 5
Exhaust Phase

Heatup Phase

The vent valve is closed and the chamber pressure increases until the exposure set point is reached.

Exposure Phase

The exposure set point is maintained for a timed period. The heater is controlled to maintain the chamber temperature and pressure.

Exhaust Phase

Dry Goods (Recirculating Unit)

The heater is turned off and the fill (exhaust) valve is opened. Steam exhausts back into the reservoir. Near the end of the phase, the fill valve is closed and the vent valve is opened to relieve the remaining pressure.

Dry Goods (Non-Recirculating Unit)

The heater is turned off and the drain valve is opened. Steam exhausts into the external collection bottle. Near the end of the phase, the drain valve is closed and the vent valve is opened to relieve the remaining pressure.

Liquids (Recirculating Unit)

The heater is turned off and the fill (exhaust) valve is opened and closed in small increments to slowly bleed off the chamber pressure. Steam exhausts back into the reservoir. Near the end of the phase, the fill valve is closed and the vent is opened to relieve the remaining pressure.

Liquids (Non-Recirculating Unit)

The heater is turned off and the drain valve is opened and closed in small increments to slowly bleed off the chamber pressure. Steam exhausts into the external collection bottle. Near the end of

the phase, the drain valve is closed and the vent valve is opened to relieve the remaining pressure.

Drying Phase (Optional)

Open Door

The operator opens the door and leaves it ajar. The heater is controlled to provide a heated chamber for drying goods. The vent valve remains open.

Closed Door

The drying phase, if selected, starts automatically at the end of the cycle. The heater is controlled to provide a heated chamber for drying goods. The vent valve remains open.

Controls Description

The electronic controls include the following assemblies:

- Power I/O PC Board 2A
- Control PC Board 3A
- Control Panel 4A
- Printer 5A (optional)
- Transformer PC Board 6A (optional MC10 printer)

Power Input

The customer supply input (115 or 230 VAC) is routed to the EMI filter, Power I/O PC Board, and Transformer PC Board. The filtered input is applied to the Power I/O Board, which produces the required operating voltages for the controls.

Power I/O Board

The Power I/O PC Board produces +24 VDC for the solenoid valves and +5 VDC for the control circuits. The unfiltered supply voltage is routed to the heater circuit.

The Power I/O PC Board communicates with the Control PC Board via a serial data interface. In response to commands from the Control PC Board, the Power I/O PC Board controls solenoid valves 1SOL through 3SOL and heater 1HTR/2HTR. The solenoid valves are activated by the solenoid driver on the Power I/O PC Board. The heater is activated by solid-state relay 1SSR, mounted on the chassis.

If an over temperature condition should occur, thermal switch 2SW will open to remove power from the heaters.

Control PC Board

The Control PC Board contains a microprocessor that controls the sterilization cycle. The microprocessor monitors temperature, pressure and switch inputs, and controls the solenoid valves and heaters via the Power I/O PC Board.

The input from temperature sensor 1RT is an analog voltage that is applied to a conditioning circuit which produces coarse and fine control voltages. These voltages are applied to the microprocessor for precise control of the chamber temperature.

The pressure input from 1PT is an analog voltage that is applied directly to the microprocessor. The amplitude of the voltage is proportional to the pressure.

The Control PC Board communicates with the printer over a serial data interface.

Control Panel

The control panel is a membrane switch panel connected to the Control PC Board by a ribbon cable.

Printer

The MC8 printer connects to the printer receptacle on the back of the sterilizer. Power for the printer is provided by a transformer-type wall plug.

The MC10 printer is mounted next to the Control Panel.

Transformer PC Board

The Transformer PC Board steps down the input voltage to the level required by the MC10 printer.

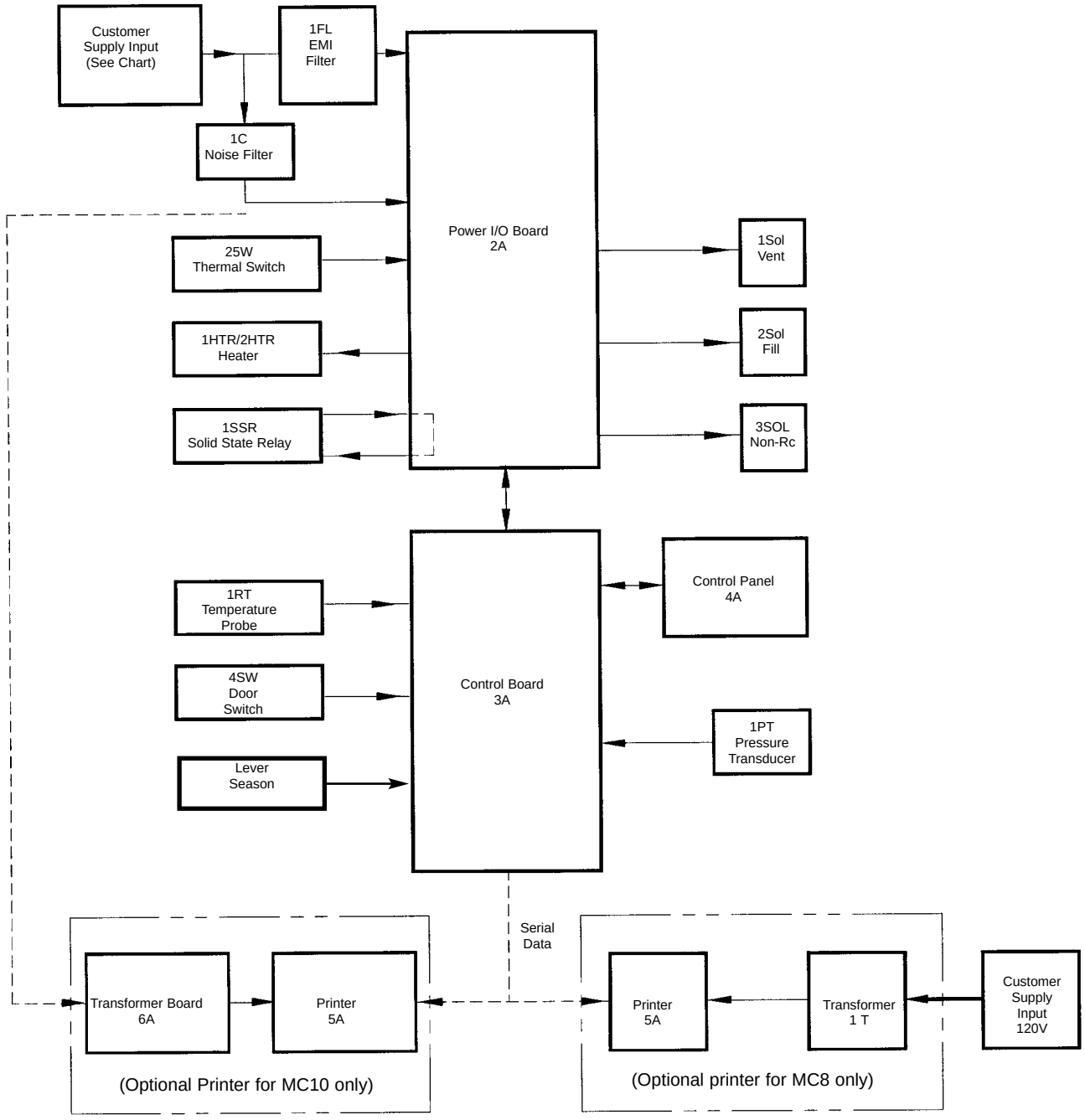


Figure 6
MC8/MC10 Block Diagram

Trouble Analysis

Caution
Factory setup mode should only be used by authorized service personnel.

Fuse Replacement

Main Fuses
The main fuses are located on the back panel of the sterilizer. 115 VAC units have one or two 15A fuse. 230 VAC units have two 8A fuses.

Transformer Board (MC10 Printer Option)
Fuses 1F and 2F (100 mA) are soldered on the Transformer PC Board.

Diagnostic Messages
When a malfunction occurs, the Control Panel will display a message describing the nature of the problem. Some malfunctions will be due to out of tolerance conditions during the processing cycle.

The last five malfunctions will be listed in the error log. The error log can be viewed by entering factory setup mode:

1. Press CONTROLS ON.
2. Press and hold the CONTROLS OFF switch.
3. Press and hold the PROGRAM/SET switch.
4. Release the CONTROLS OFF switch
5. Release the PROGRAM/SET switch.
6. The error log will be displayed. Use the up and down arrows to view the last five entries.

Error log entries include the following information:

- ER number. Use this number to determine the specific malfunction (see diagnostic message tables, pp. 17-18).
- Cycle count during which malfunction occurred.
- Date and time at which malfunction occurred.
- Press CYCLE STOP when finished viewing the error log.

Diagnostic Messages

Message	Fault Condition	Corrective Action
Self Test Failed	ER1: EEPROM failure during self test.	Replace Control PC Board.
Pressure Too High	ER2: Chamber pressure exceeded 40 psig.	Check heater circuit. Check solenoid valves.
Controls Error	ER3: RTD shorted or open.	Check RTD connection at J12 on Control PC Board. Replace RTD.
	ER4: Pressure tranducer voltage out of range.	Check pressure transducer connection at J14 on Control PC Board. Check voltage at J14-2. Replace pressure transducer.
	ER5: Fault indication from solenoid driver.	Check cable connection at J1 on Control PC Board. Check solenoid control circuits. Replace Power I/O PC Board. Replace Control PC Board.
Heatup Too Long	ER6: One of the following has occurred: Chamber temperature did not reach 90° C within 15 minutes of cycle start. Air removal phase was not completed within 30 minutes. Chamber temperature did not reach exposure temperature within 40 minutes of initial heater activation. During the exposure phase, timer was suspended for more than 10 minutes.	Check heater circuit.
Overheat	ER7: Chamber temperature exceeded 145° C.	Check heater circuit. Check fill solenoid valve.
Vent Too Long	ER8: Chamber pressure did not fall below 1.0 psig within 10 minutes during vent phase.	Check for debris in chamber. Clean filter screen. Check non-recirculating valve if using the Non-Recirculating feature. Check vent solenoid valve.

Diagnostic Messages

Message	Fault Condition	Corrective Action
Door Open	ER9: Door open during cycle.	Check door switch. Check door lock mechanism.
Pressure Too Low	ER10: Chamber pressure fell 10 psig below exposure pressure setpoint during exposure.	Check solenoid valves. Check door gasket. Check piping for leaks.
Temperature Too Low	ER11: Chamber temperature fell 10° C below exposure temperature setpoint during exposure.	Check heater circuit.
Unit Error	ER12: Watchdog timer reset occurred during power-up.	Press OFF to clear error. If fault condition is still present when controls are turned back on; Unplug the unit. Press and hold the OFF button after "PERFORMING SELF-TEST" is displayed. If fault condition is still present after restart, replace the Control PC Board.
Temperature Too High	ER13: Chamber temperature was above 70° C for more than 60 minutes when cycle started.	Check heater circuit. Allow chamber to cool longer between cycles.

Caution
Factory setup mode should only be used by authorized service personnel.

Note
To enable the automatic cycle start feature, RECYCLE must be selected at the DIAGNOSTICS prompt in factory setup mode.

To stop a cycle from repeating, open the door or press CYCLE STOP during the 30 second delay between cycles.

Caution
If the user advances through an un-timed phase and the temperature/pressure conditions are not met for the Enhanced Data Display phase, an error may occur.

Diagnostics Mode

When diagnostics mode has been enabled in the factory setup mode, the following features will be available:

- Automatic Cycle Start. If the door is not opened within 30 seconds after a cycle is completed, the software will automatically start another cycle.
- Cycle Phase Advance. If the down arrow is pressed during a timed phase (fill, air removal, exposure, or drying), the timer will be zeroed and the cycle will advance to the next phase.
- Enhanced Data Display. During a cycle, additional information is displayed on the LCD: the cycle phase and timer in minutes and seconds.
- Enhanced Data Printout. The message DIAGNOSTICS MODE will be added to the standard printout. If any malfunctions occur, a detailed message will be printed.

Testing for Leaks

If the sterilizer cannot reach or maintain chamber pressure, inspect door gasket and replace it if worn or damaged. Check piping connections for leaks by applying soapy water and looking for steam bubbles.

Power Supply Circuits

Step	Procedure	Corrective Action
1	Plug in power cord.	If clock is not on: Check fuses—replace if blown. Check DS10 on Power I/O PC Board. If DS10 is not lit, see step 2. Check DS10 on Control PC Board. If DS10 is not lit, see step 3.
2	Check power supply voltages on Power I/O PC Board.	If power supply voltages are not present: Check ac input connection at J3 and J6. Check tightness of power transistor heatsink mounting screws. Replace power I/O PC Board.
3	Check power supply voltages on Control PC Board.	If power supply voltages are not present: Check cable connection between control PC Board and Power I/O PC Board. Replace Control PC Board.
4	Press CONTROLS ON switch.	If controls do not function, replace control PC Board.

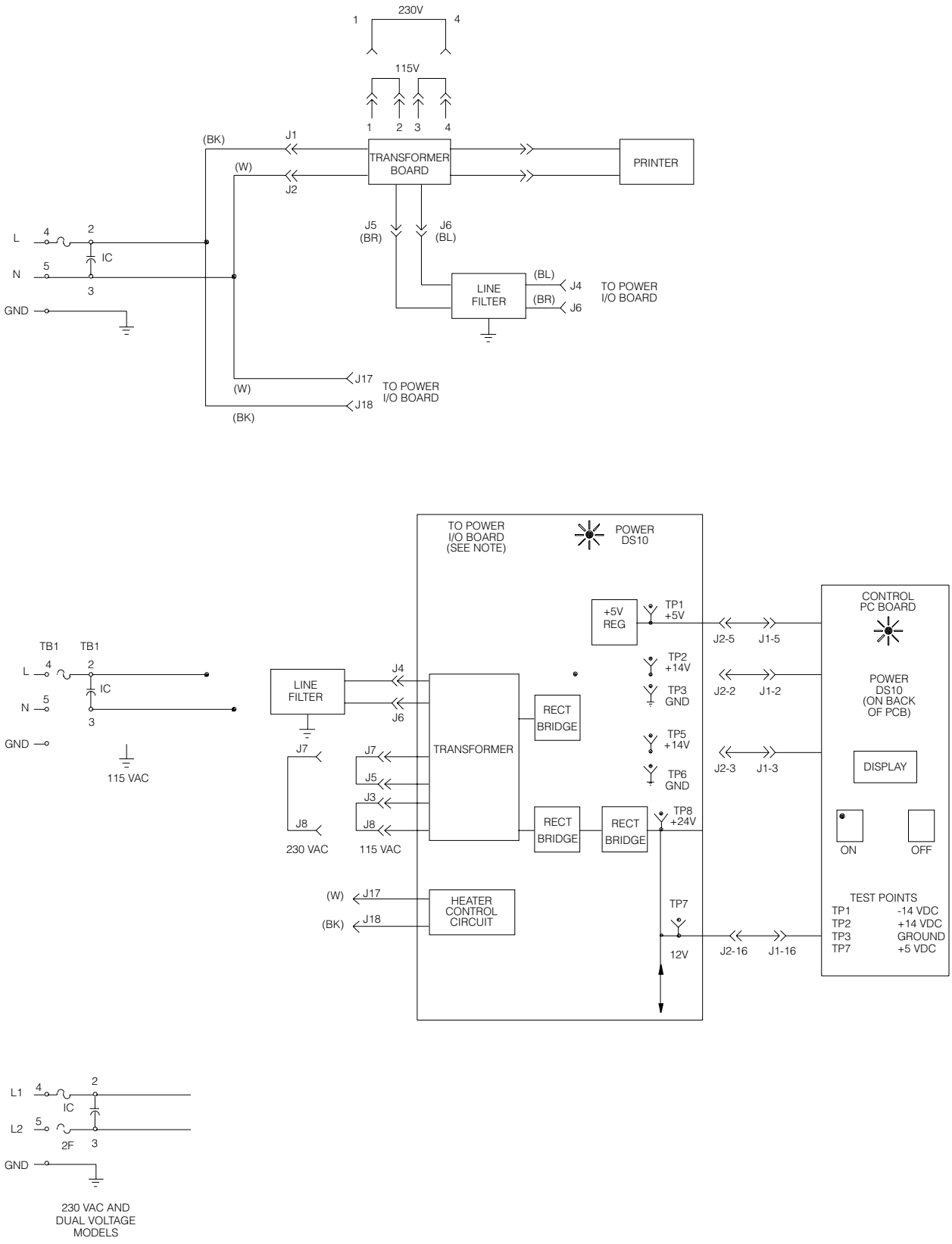


Figure 7
Power Supply Circuits

Heater Control Unit

Step	Procedure	Corrective Action
1	Allow the chamber to cool to room temperature. Enter the factory setup menus. Press the program button until the "HEATER TEST," "HEAT OFF 0" is displayed. Press the start button to power the heater for a fixed 10 second duration. When the display shows "HEAT ON" check DS1 (Heater) on Power I/O PC Board.	If DS1 is OFF: Check ribbon cable connection between Power I/O PC Board and Control PC Board. Replace Control PC Board. Replace Power I/O PC Board.
2	Check for ac input at J17 and J18 on Power I/O PC Board.	Check connections.
3	Check continuity of thermal cut-off switch.	Replace if open circuit at room temperature.
4	Check continuity of heater.	Replace heater if open circuit.
5	Check heater SSR.	

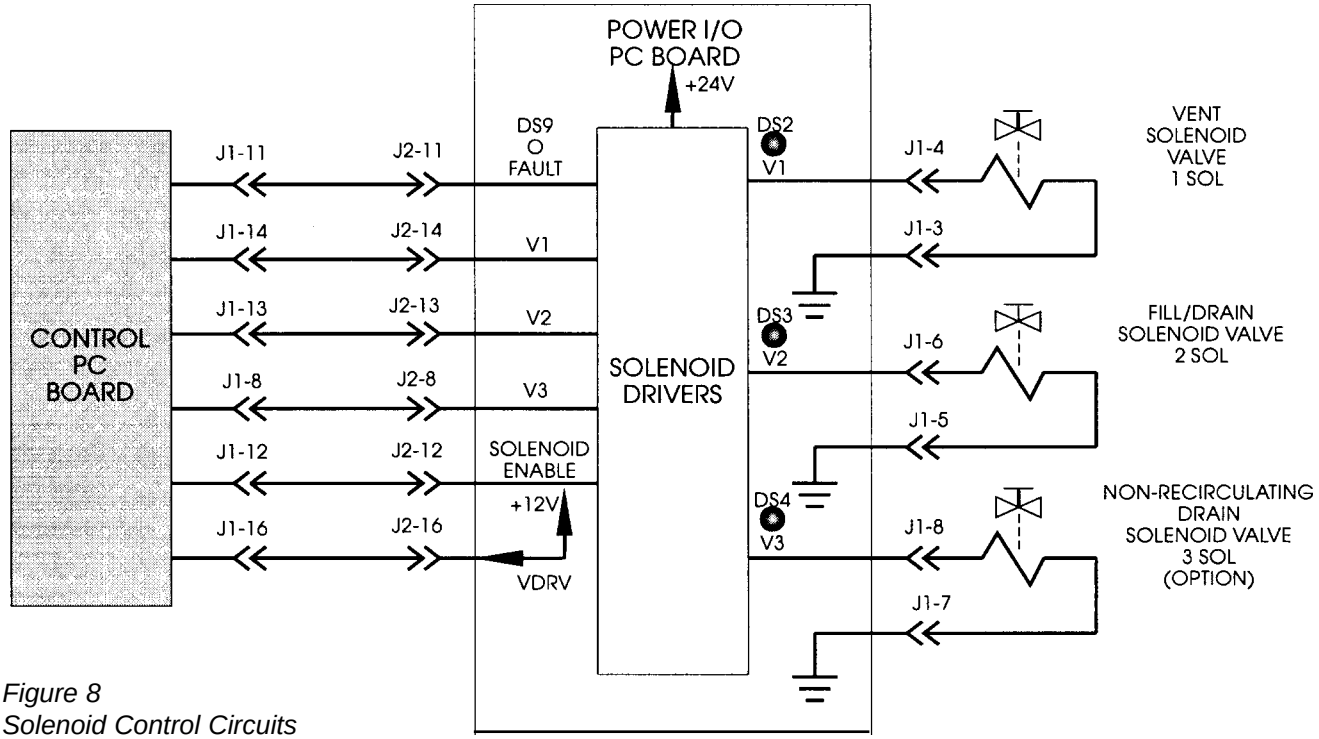


Figure 8
Solenoid Control Circuits

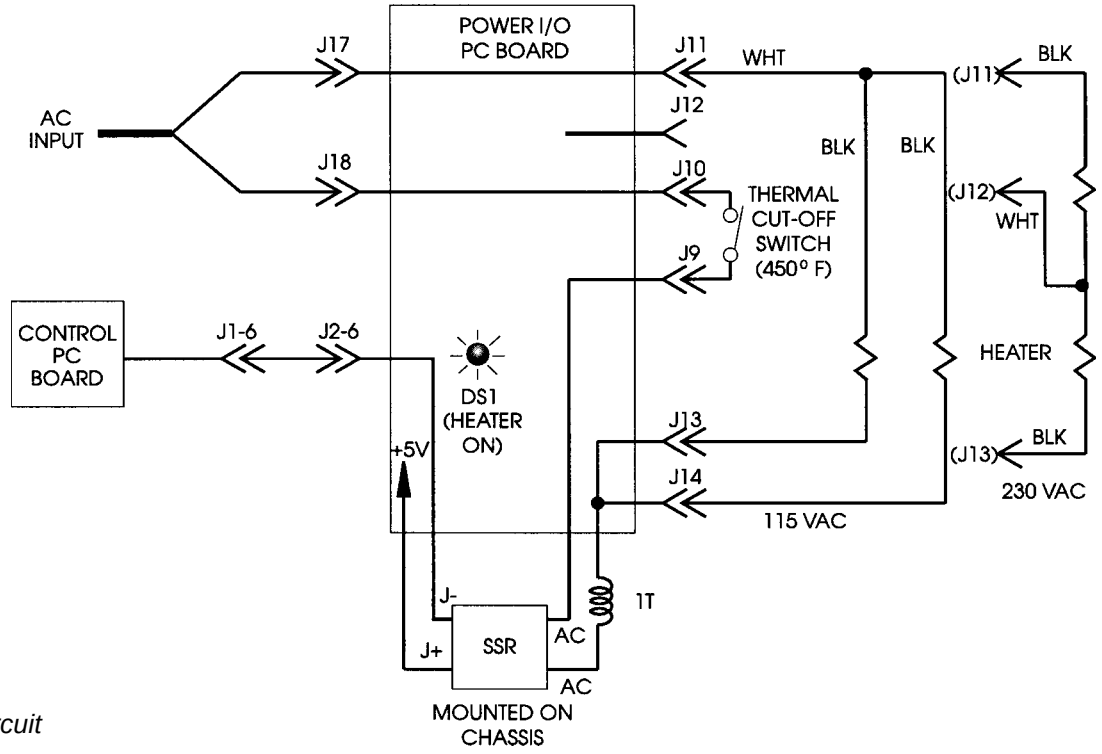


Figure 9
Heater Control Circuit

Solenoid Control Circuits

Step	Procedure	Corrective Action
1	Press CONTROLS ON.	
2	Check DS9 on Power I/O PC Board.	If DS9 is ON, unplug the cable (J1) between Power I/O PC Board and solenoid valves: If DS9 goes out, a solenoid is shorted—replace the solenoid valve. If DS9 remains ON after J1 is unplugged, unplug cable (J2) between Power I/O PC Board and Control PC Board. If DS9 goes out when J2 is unplugged, replace the Control PC Board. If DS9 remains on when J2 is unplugged, replace the Power I/O PC Board.
3	Press CONTROLS OFF and enter the factory setup menus.	
4	Press program button until the “SOLENOID TEST”, “VENT OFF/ON” menu appears. Verify DS2 on the Power I/O PC Board toggled on/off coinciding with the display.	If DS2 is OFF: Check ribbon cable connection between Power I/O PC Board and Control PC Board. Replace Control PC Board. Replace Power I/O PC Board. If DS9 (Fault) is ON: Replace Power I/O PC Board.
5	Verify the vent solenoid 1SOL toggles on/off coinciding with display.	If solenoid coil is not energized: Check cable connection at J1 on Power I/O PC Board. Replace solenoid valve.
6	Press program button.	
7	The “SOLENOID TEST”, “FILL OFF/ ON” should now be present. Verify DS3 on the Power I/O PC Board toggled on and off coinciding with the display.	If DS3 does not toggle on or DS9 (FAULT) is on SEE STEP 4.
8	Verify the fill solenoid 2SOL toggles on/off coinciding with display.	If solenoid coil is not energized SEE STEP 5.
9	Press program button.	
10	The “SOLENOID TEST”, “DRAIN OFF/ON” menu should now be displayed. Verify DS4 on the Power I/O Board toggled on/off coinciding with the display.	If DS4 does not toggle on or DS9 (FAULT) is on SEE STEP 4.
11	Verify the non-recirculating drain solenoid 3SOL toggles on/off coinciding with display.	If solenoid coil is not energized SEE STEP 5.

Component Check Procedures

Component	Check Procedure
Power I/O PC Board	Verify DS10 (Power) is ON. Measure power supply voltages. The +5 VDC supply provides power to the Control PC Board and SSR1 (heater). The +14 VDC and -14 VDC supplies provide power to the temperature sensing circuit on the Control PC Board. The +24 VDC supply provides power to the solenoid driver circuit on the Power I/O PC Board. If +5 VDC is low, check U3 heatsink mounting hardware for tightness. Torque to 10 in/lbs. If +24 VDC is low, check U2 heatsink mounting hardware for tightness. Torque to 10 in/lbs. Observe LEDs during cycle.When an output device (heater, solenoid valve) is on, the associated LED should be lit (see **Cycle Phase Diagram**).
Control PC Board	Measure power supply voltages. Check the calibration of the temperature sensing circuit. Check display contrast.
Switch Panel	If one or several switches do not function, replace the switch panel. Before replacing the switch panel, verify that the Control Board is functioning properly: Remove side panel. Remove shield to gain access to the back of the Control Board. Disconnect switch panel cable from J2 on the Control Board. Check individual switch inputs by momentarily placing a jumper between the associated pins of J2. Observe LEDs or display window on display panel while checking individual switch inputs. If asociated LED or display function does not occur, the problem is on the Control Board. If associated LED lights, the Control Board is functional and the problem is at the Switch Panel.

Component Check Procedures

Component	Check procedure
Printer (Option)	If the printer power LED is off, check the printer power connector for approx. 9 VAC. If the printer power LED is on, check the cable connection between the Control PC Board and the printer.
Transformer PC Board (MC10 Printer Option)	Check fuses. Check transformer configuration.
Heater	Unplug the sterilizer. Unplug the heater. Using an ohmmeter, check the resistance between each black lead and white lead. The resistance should be approx. 16 to 20 ohms. Be sure to reinstall heater connections as shown in electrical schematic.
Heater SSR	Enter the factory setup menus. Press program button until the "HEATER TEST", "HEAT OFF 0" is displayed. Press the start button to power the heater for a fixed 10 second duration. When the display shows "HEAT ON" measure the DC voltage across control terminals (J+ and J-). If +5vdc is measured across control terminal, then check wiring from Power I/O PC Board. If wiring appears sound, then replace the Power I/O PC Board. If 0vdc is measured across the control terminals and 115-230 vac is measured across the SSR AC terminals then replace the SSR. If 0vdc is measured across the control terminals and 0 VAC is measured across the SSR AC terminals then check the heater wiring and return to heater test.

Note

When +5VDC is measured across the control terminals (J+ and J-) of the SSR, there should be 0 VAC across the SSR AC terminals. This is the heat "on" condition.

When approximately 0 VDC is measured across the control terminals, there should be approximately 115/230 VAC across the SSR AC terminals. This is the heat "off" condition.

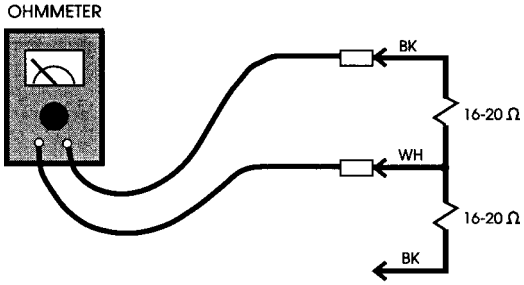


Figure 10
Testing Heater Leads

Component Check Procedures

Component	Check procedure
Thermal cut-Off Switch	Unplug the sterilizer. Disconnect J9 and J10 from Power I/O PC Board. Check the continuity of switch with ohmmeter. Switch should be closed at room temperature. The thermal cut-off switch opens at 450°F(232°C)
Solenoid Valve Cell	Touch the coil with a small flat screwdriver blade. A magnetic attraction, while the coil is energized, indicates coil operation. See SOLENOID TEST page 24.
Temperature Probe	Disconnect P12 from Control PC Board. Measure resistance of temperature probe. Resistance should be approx. 1100 ohms with the chamber at room temperature.
Pressure Transducer	At atmospheric pressure, the pressure transducer output, measured at J14-2 on the Control PC Board, should be between 0.08 and 0.50 VDC. The transducer excitation voltage at J14-1 should be +5 VDC. Before replacing transducer, check that the door gasket and door switch are OK, as some problems relating to pressure can be caused by a leaky door gasket or faulty door switch. Be sure pressure in the chamber is 0 psig before opening the door.
Door Switch	Disconnect P10 from Control PC Board. Check continuity between terminals P10-2 and P10-3. Switch should be closed when door is closed, open when door is open.

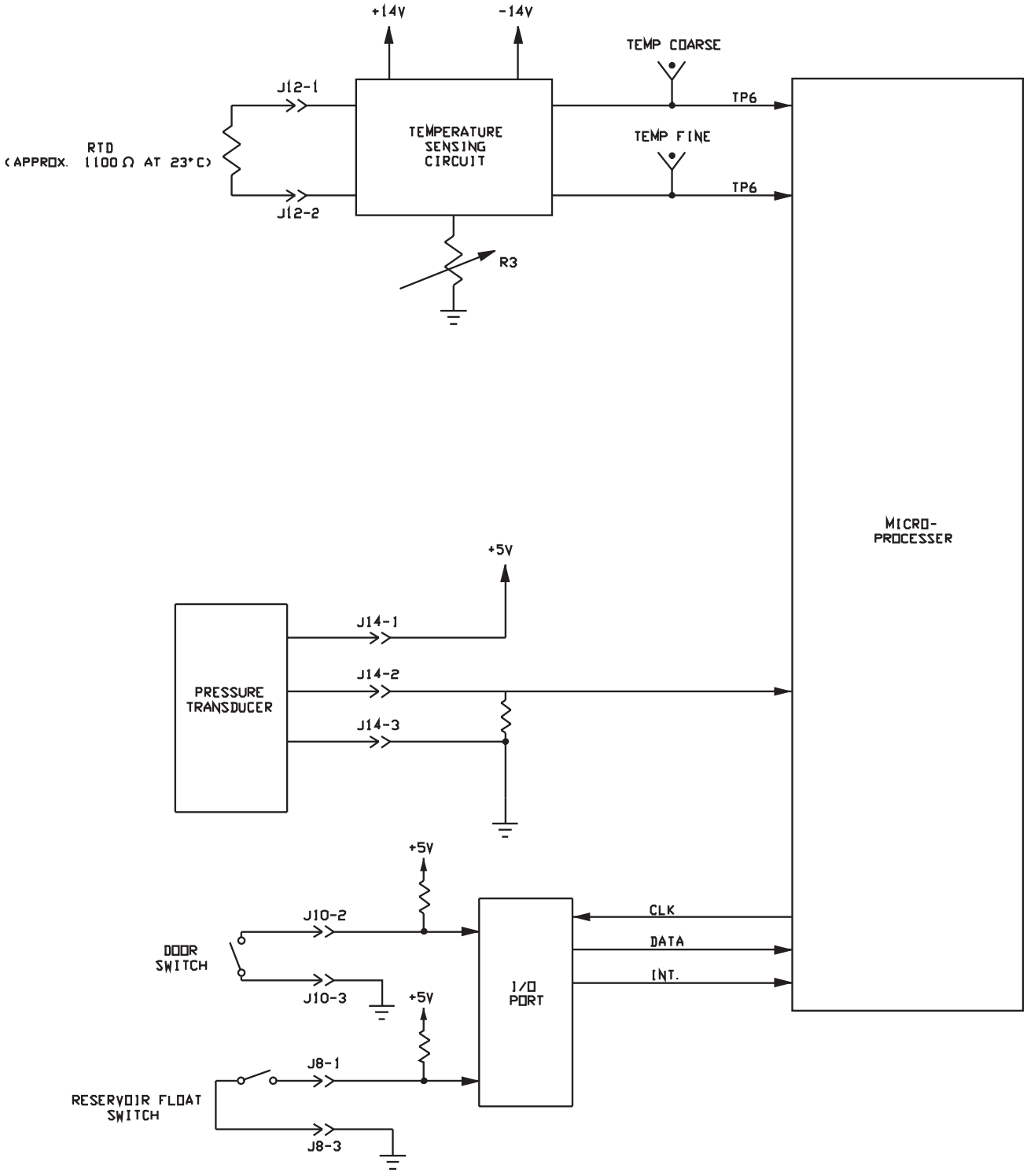


Figure 11
Transducer and Switch Input Circuits

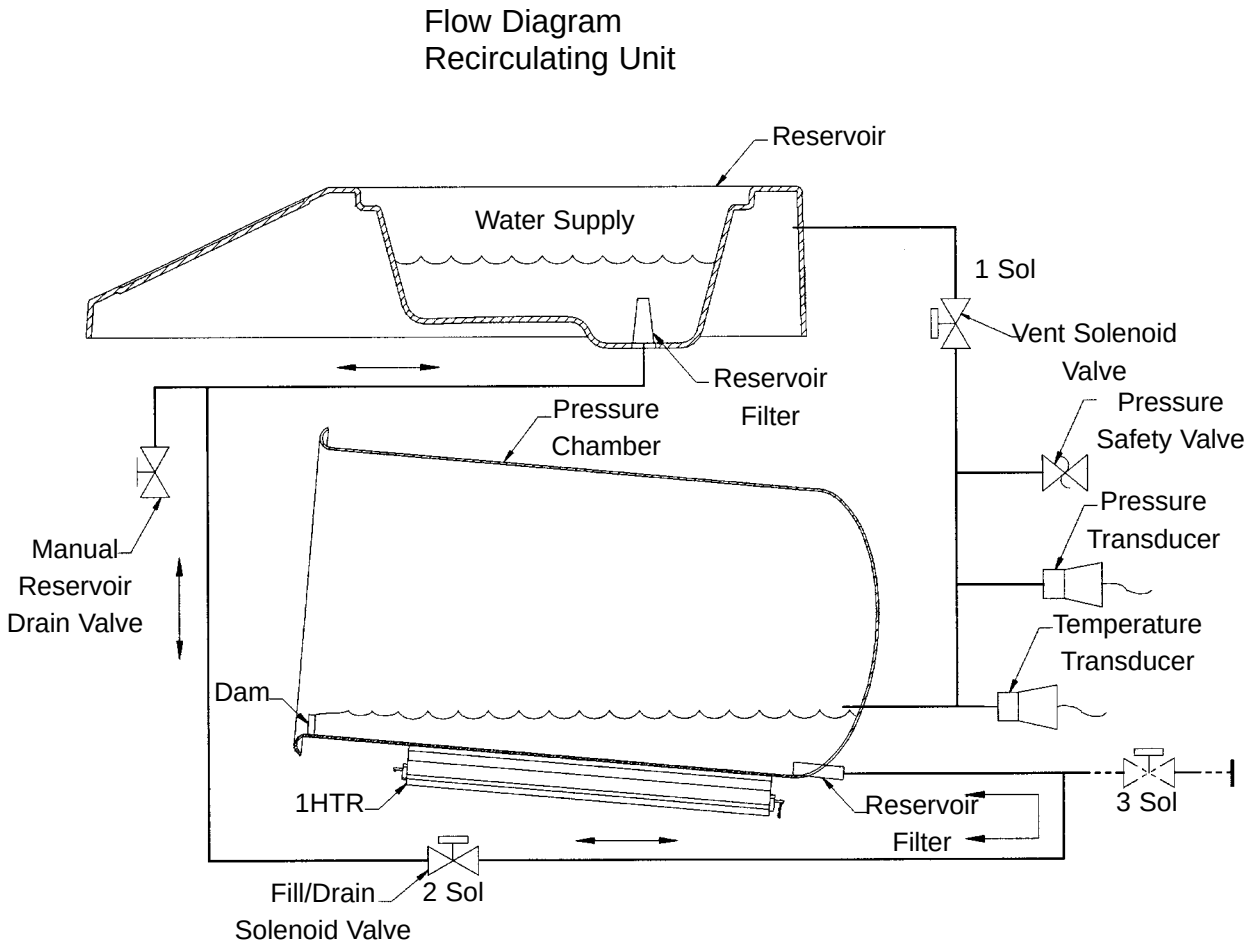


Figure 12
Piping Schematic - Recirculating Unit

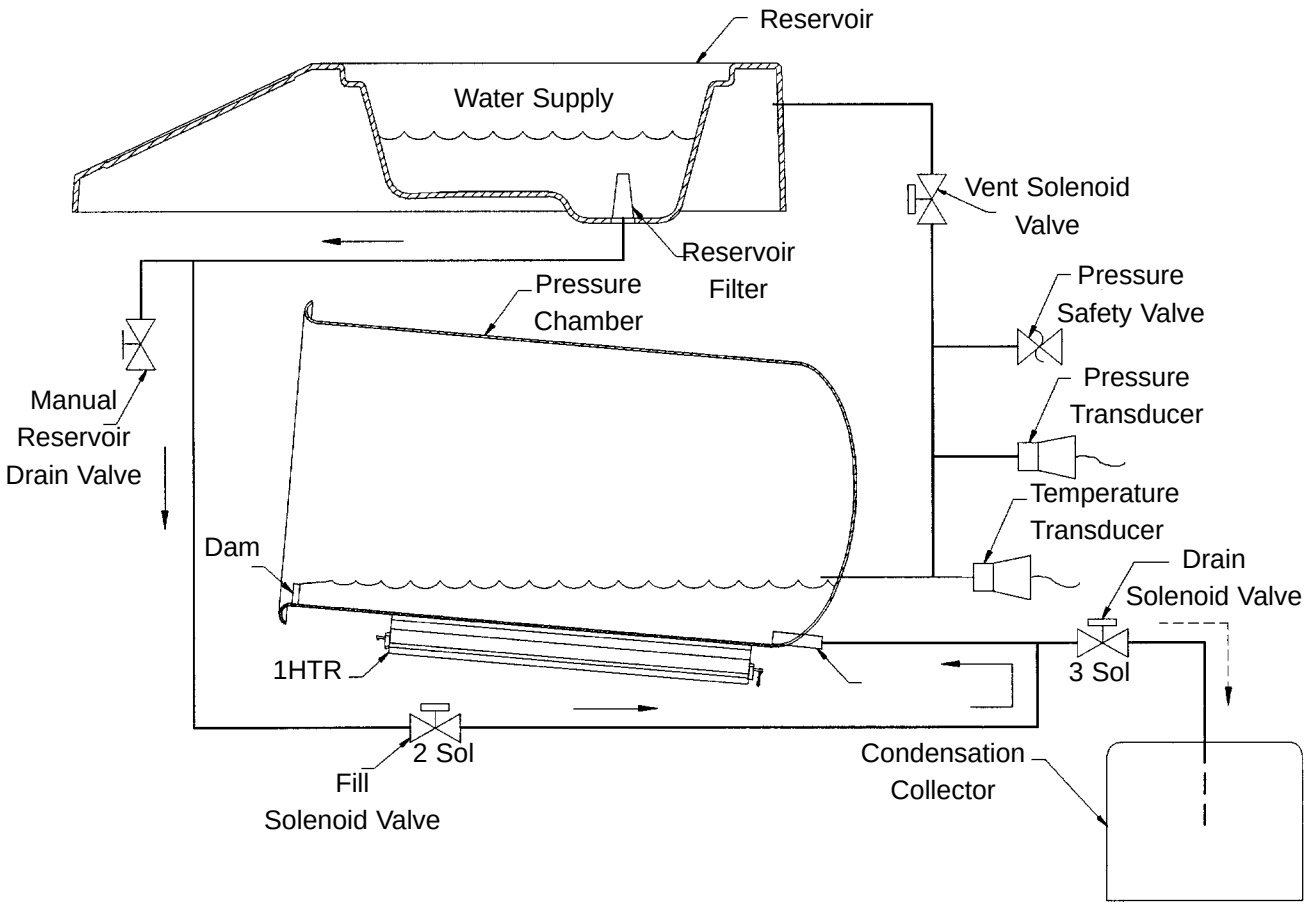


Figure 13
Non-Recirculating Unit

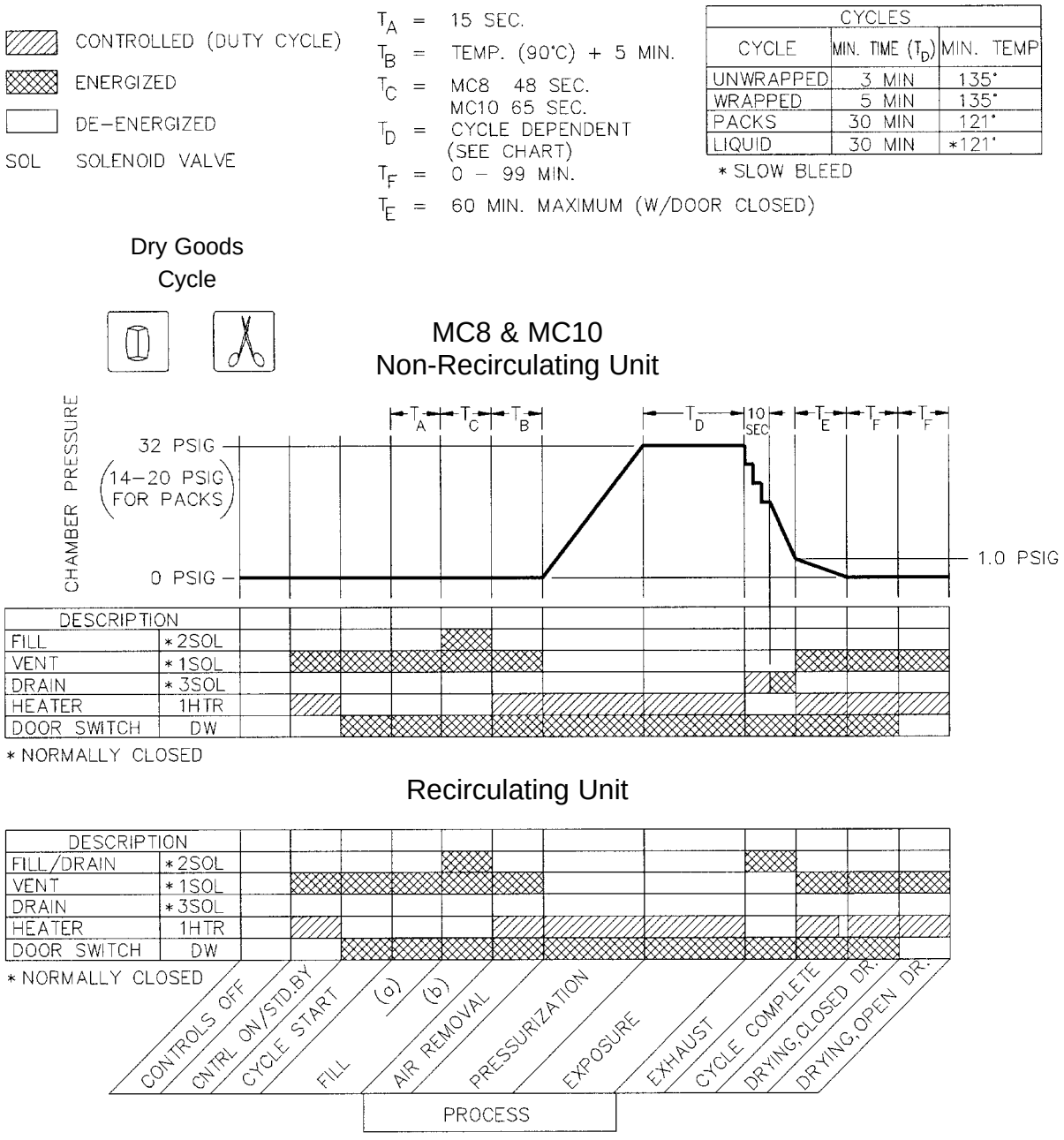


Figure 14
Cycle Phase Diagram - Dry Goods Cycle

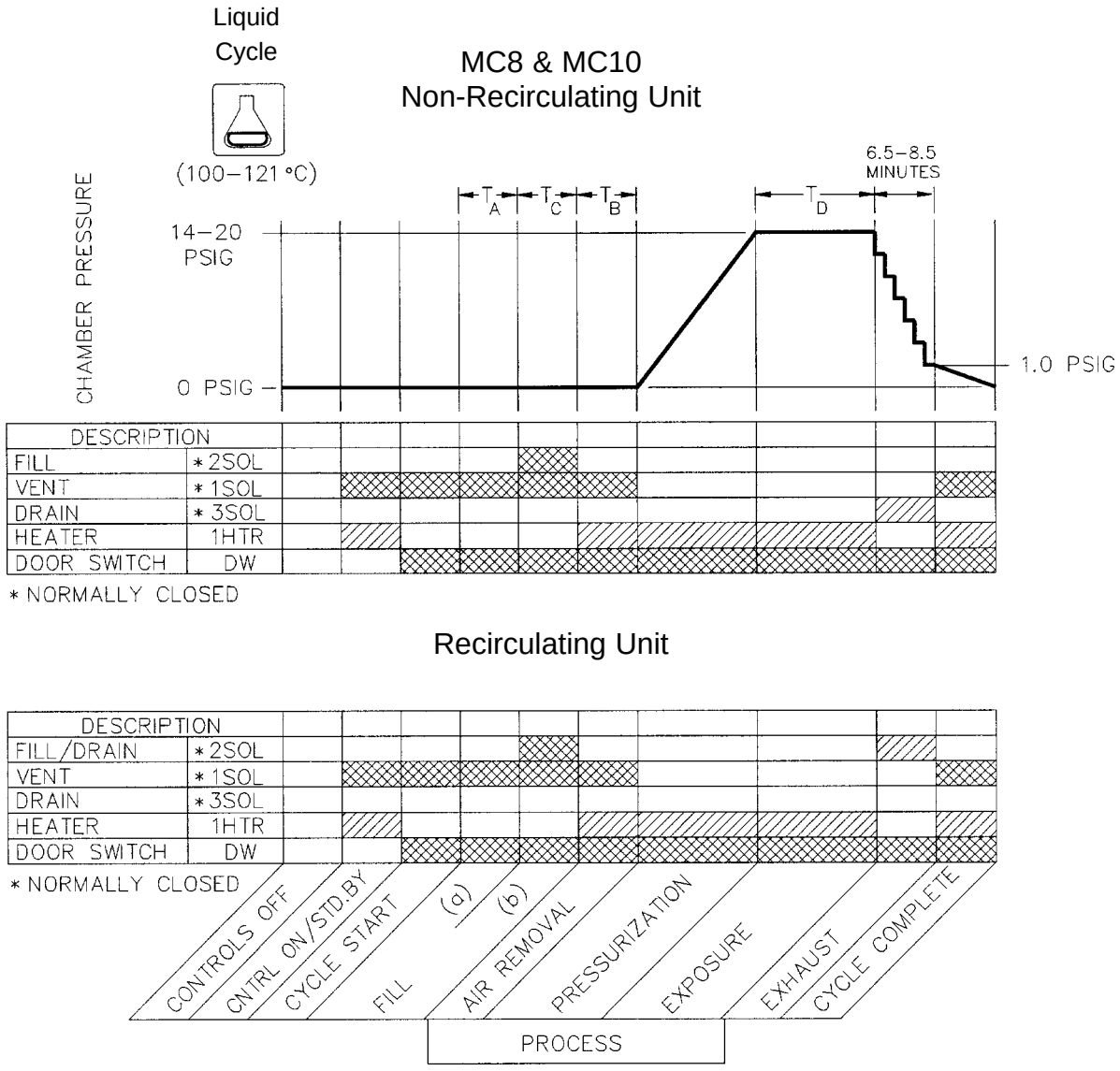


Figure 15
Cycle Phase Diagram - Liquids Cycle

Note

Thermal Switch 2S is mounted on the left side of the chamber as views from the front of the sterilizer. The leads from the Power I/O Board to the thermal switch are orange.

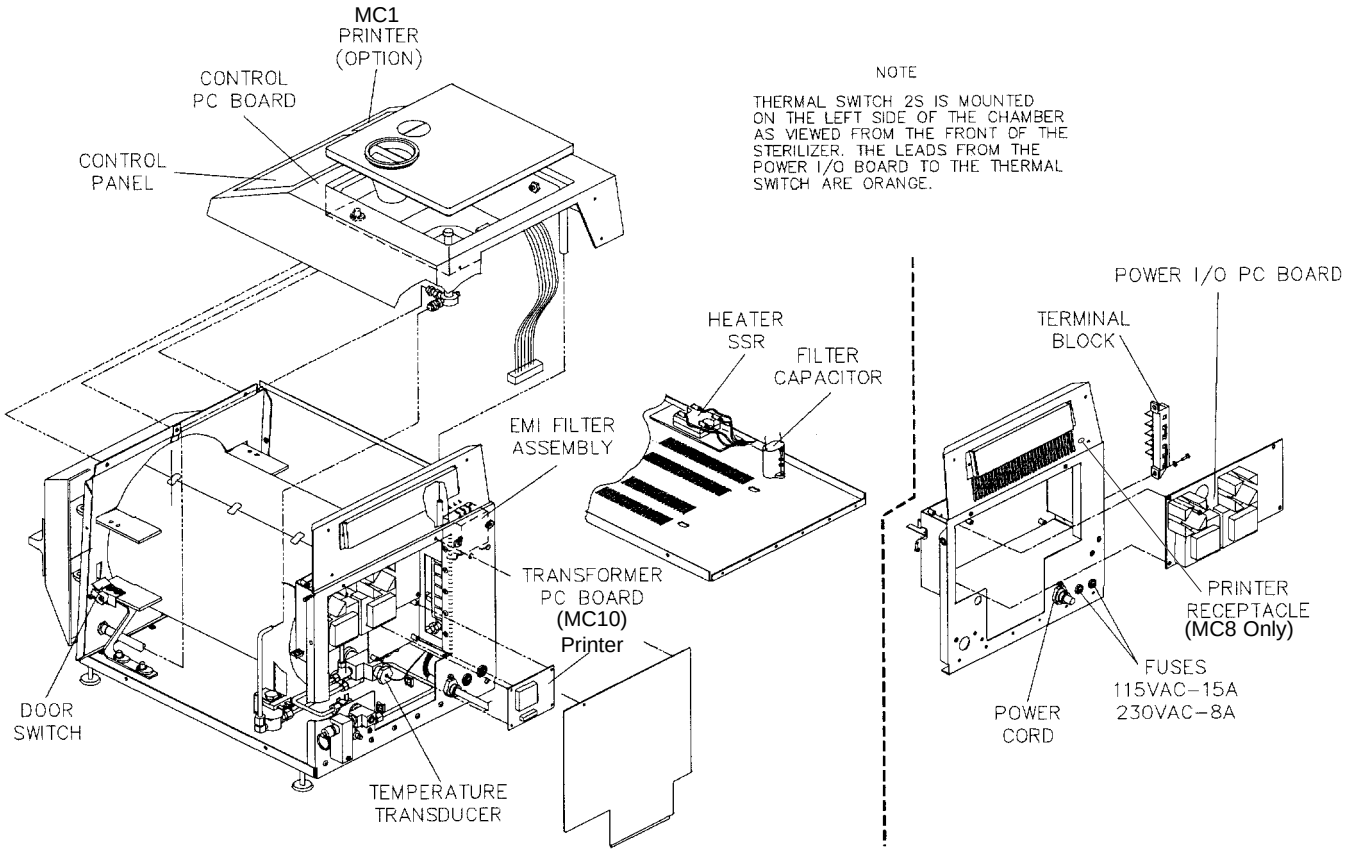


Figure 16
Electrical Components

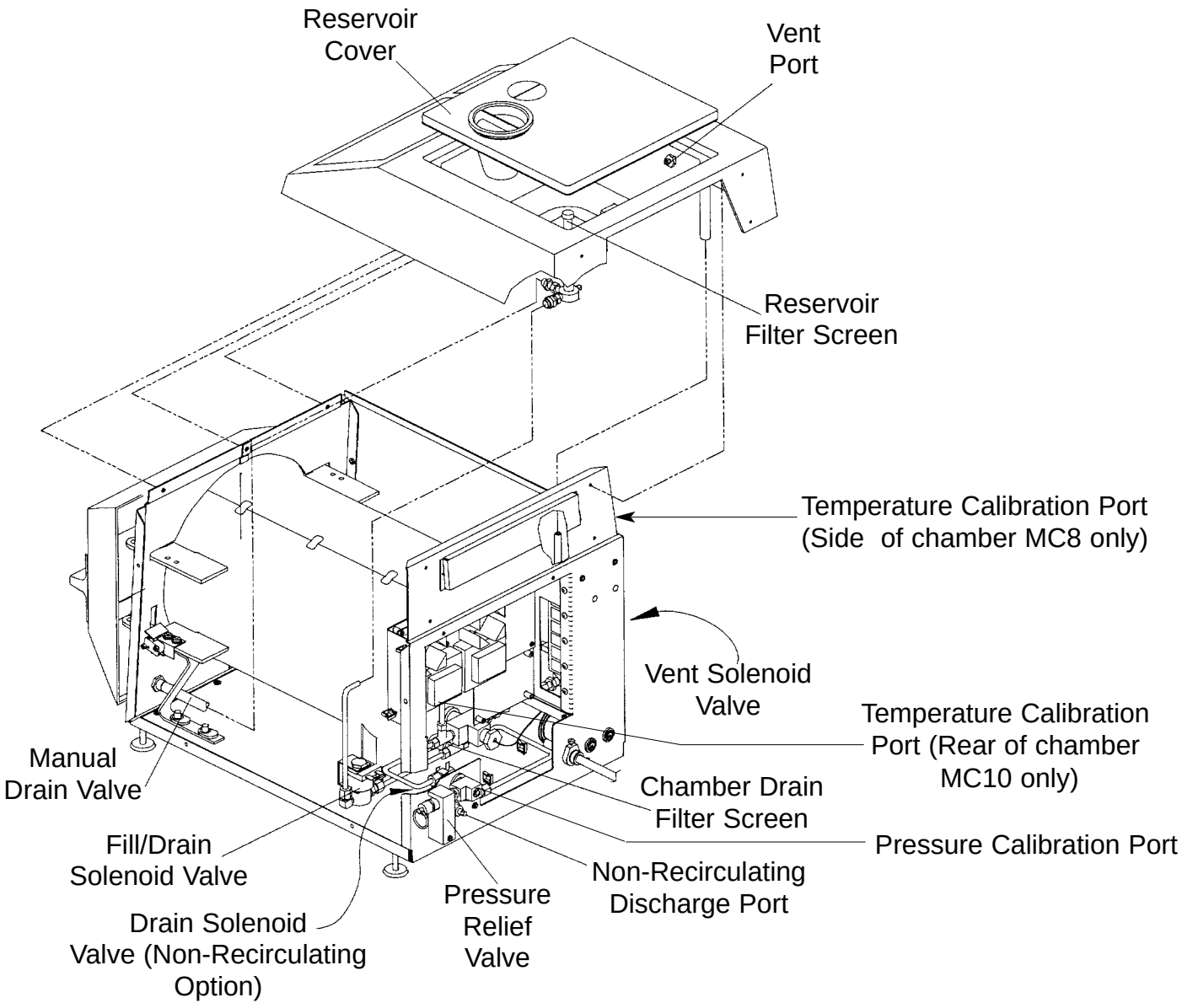
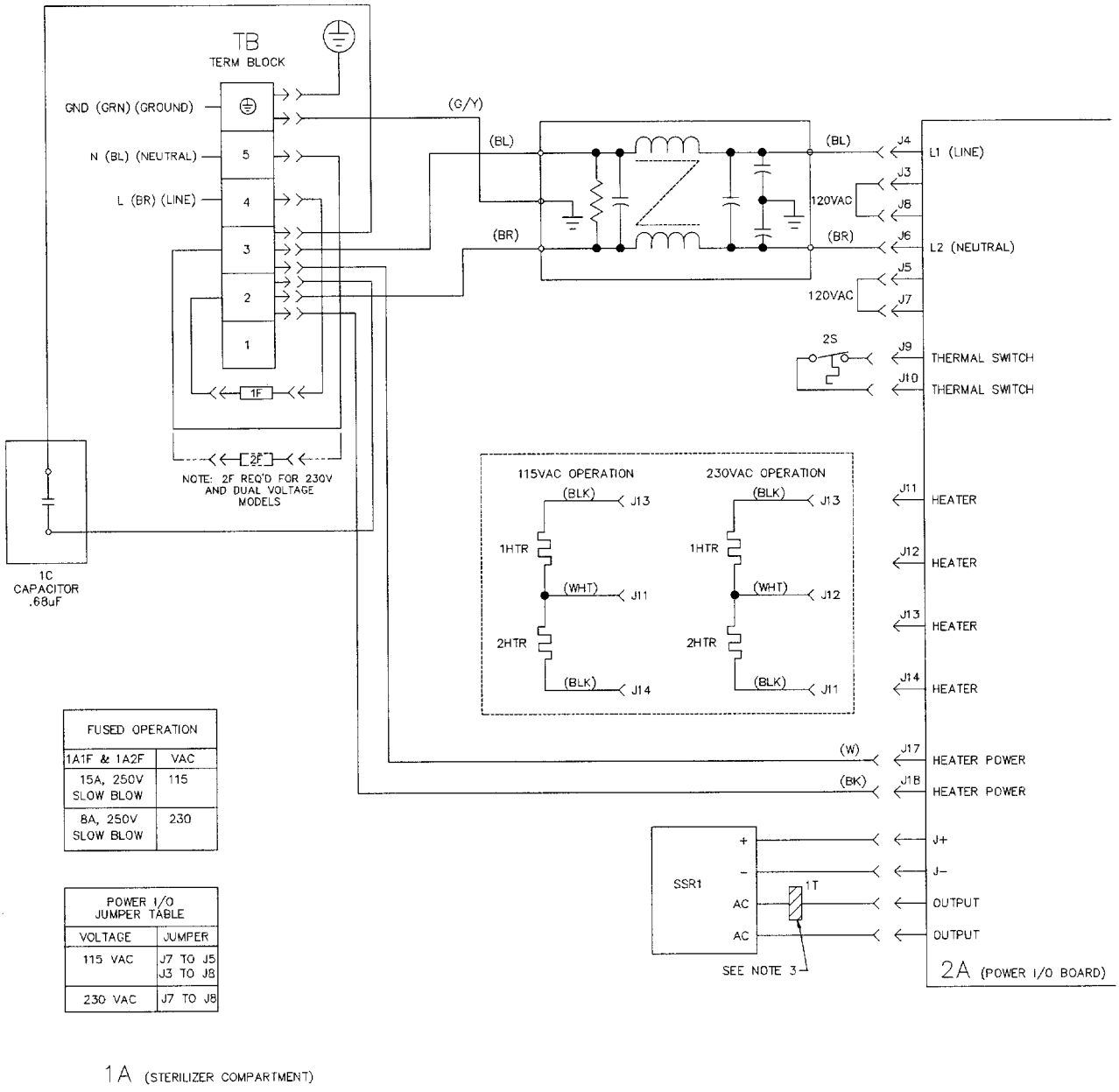


Figure 17
Piping Components



FUSED OPERATION	
1A1F & 1A2F	VAC
15A, 250V SLOW BLOW	115
8A, 250V SLOW BLOW	230

POWER I/O JUMPER TABLE	
VOLTAGE	JUMPER
115 VAC	J7 TO J5 J3 TO J8
230 VAC	J7 TO J8

Figure 18
Electrical Schematic

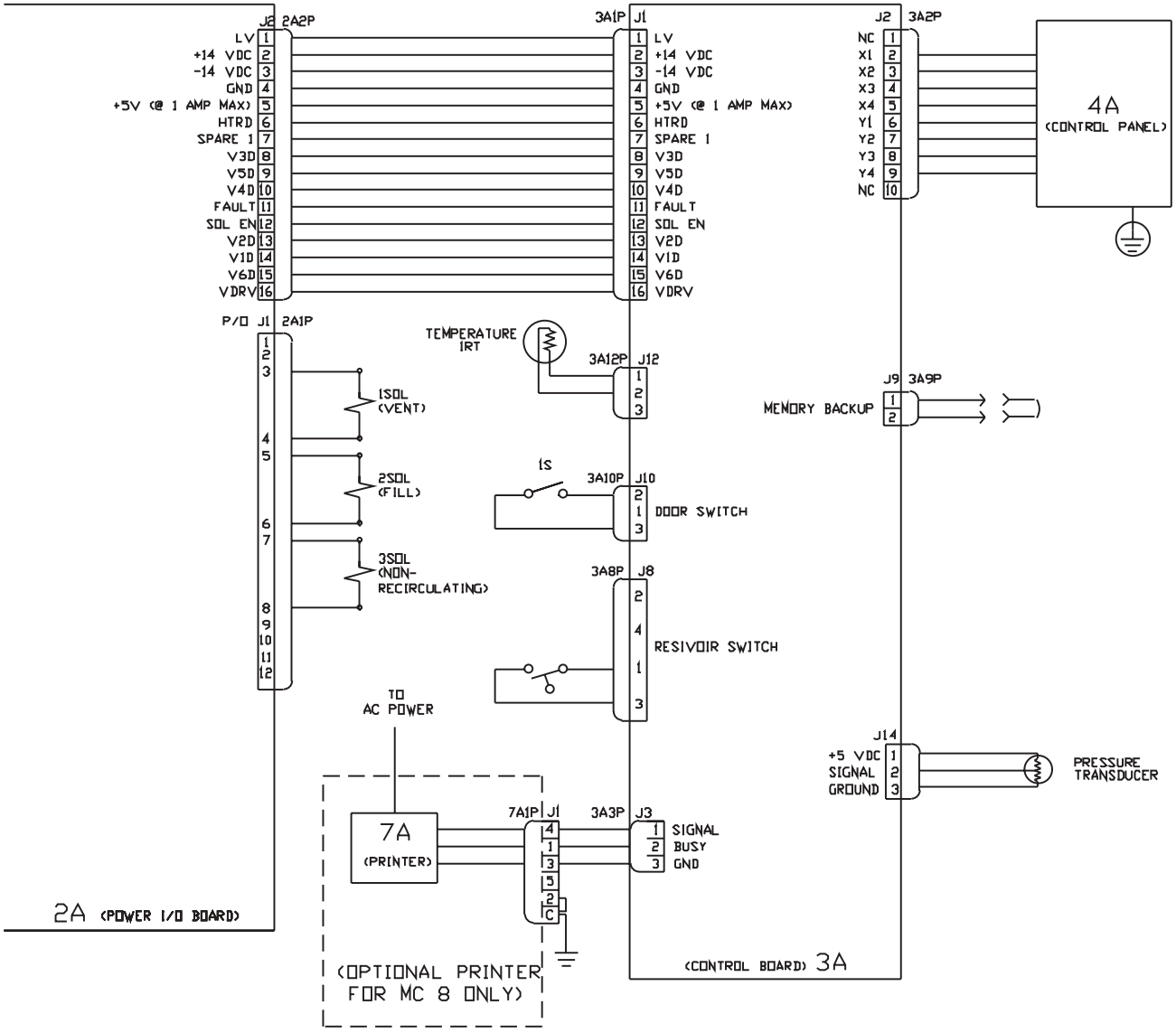


Figure 19
MC8 Electrical Schematic

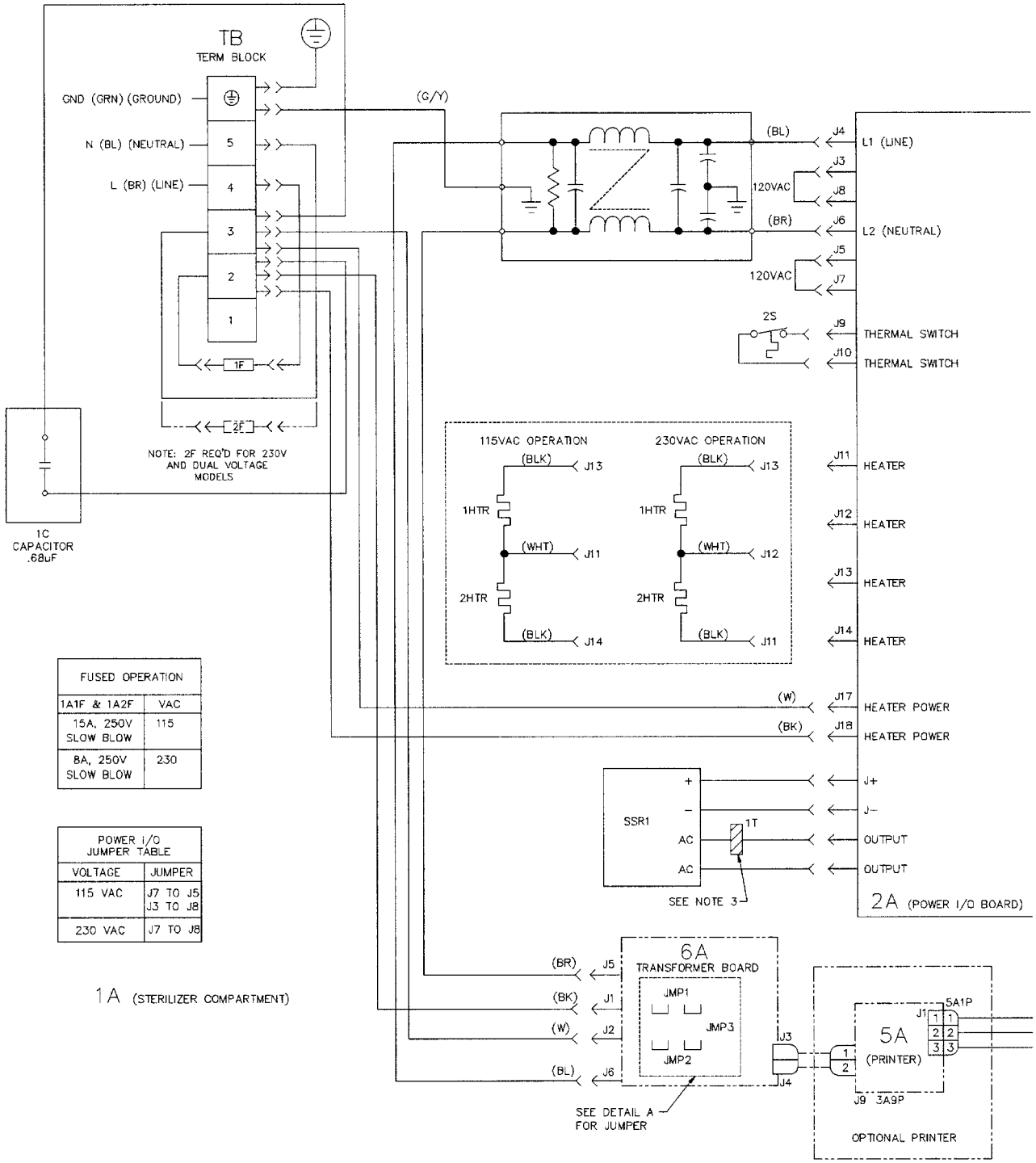


Figure 20
MC8 Electrical Schematic

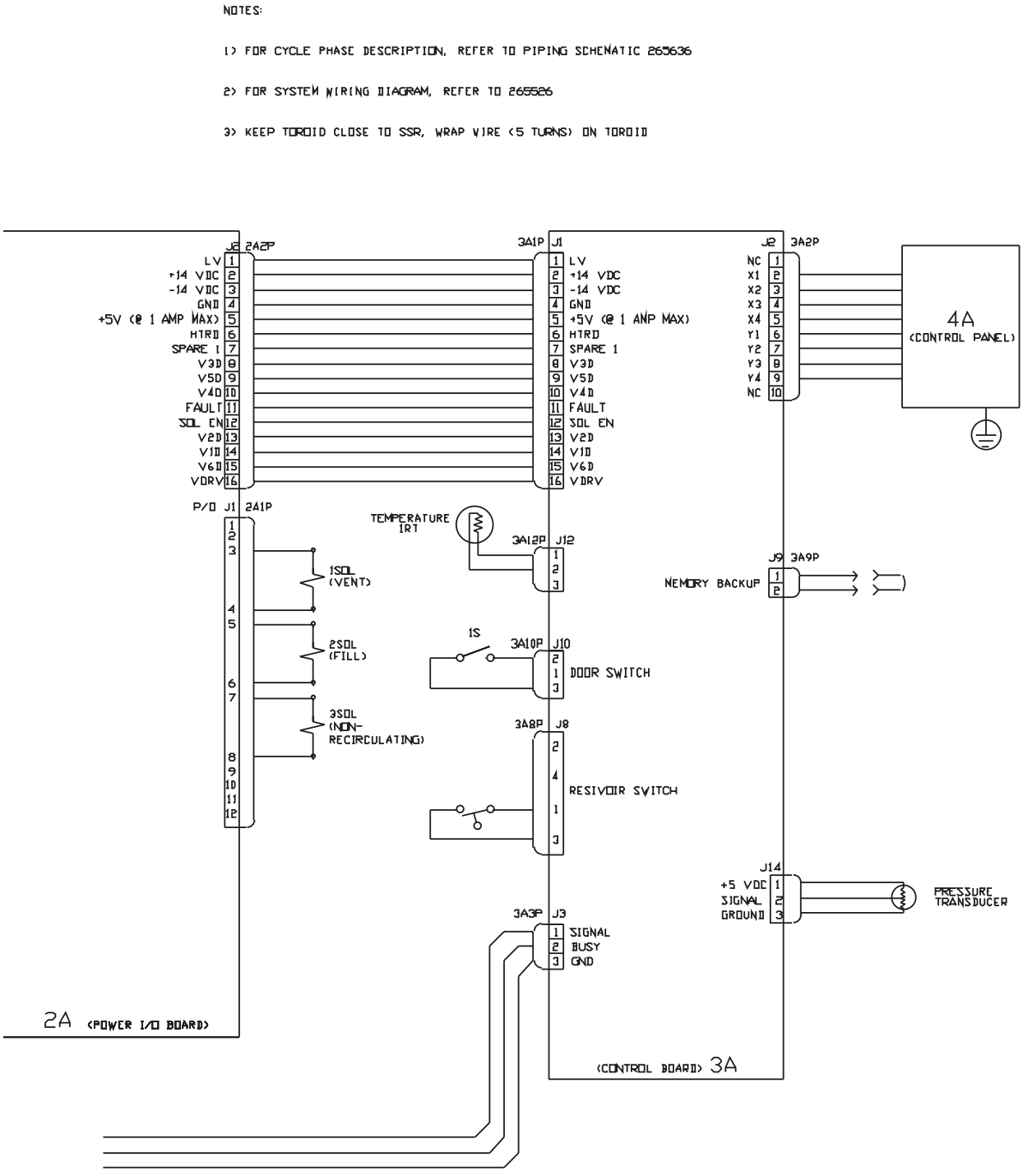


Figure 21
Electrical Schematic

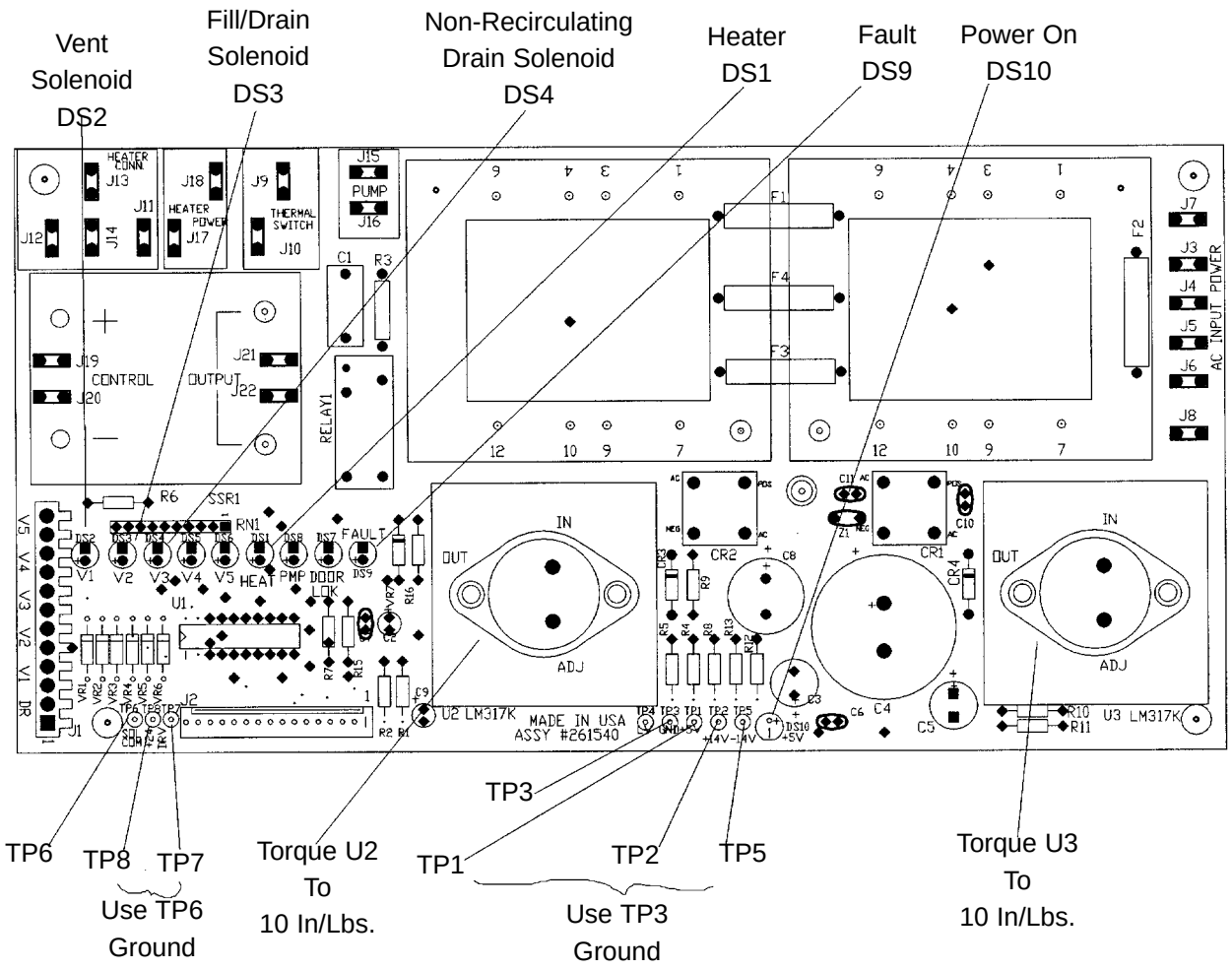


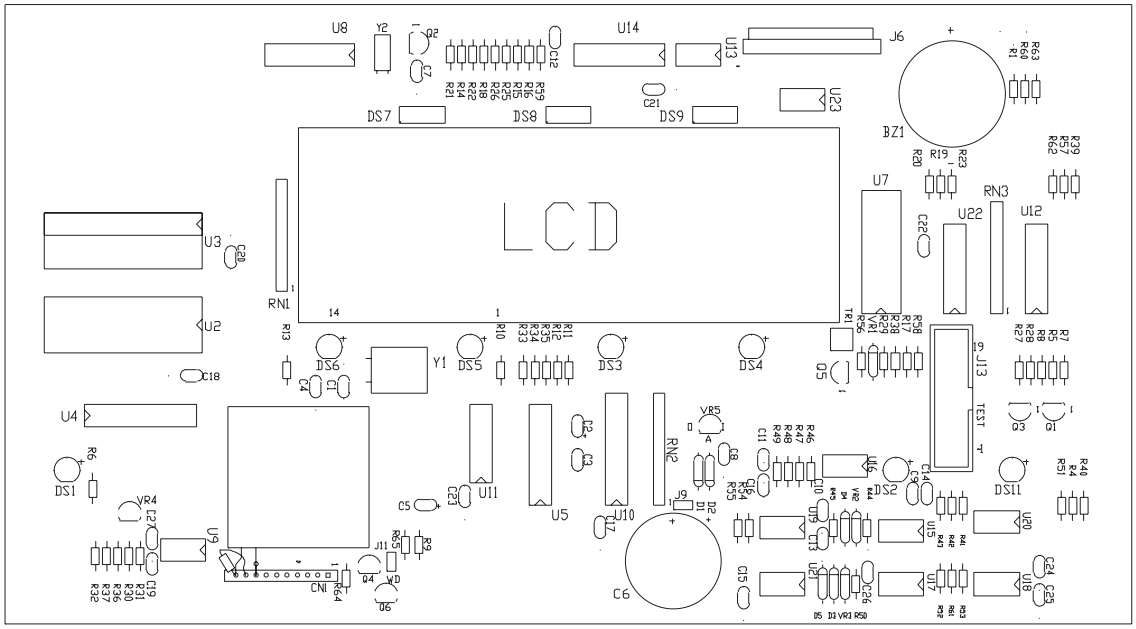
Figure 22
Power I/O PC Board Component Locations

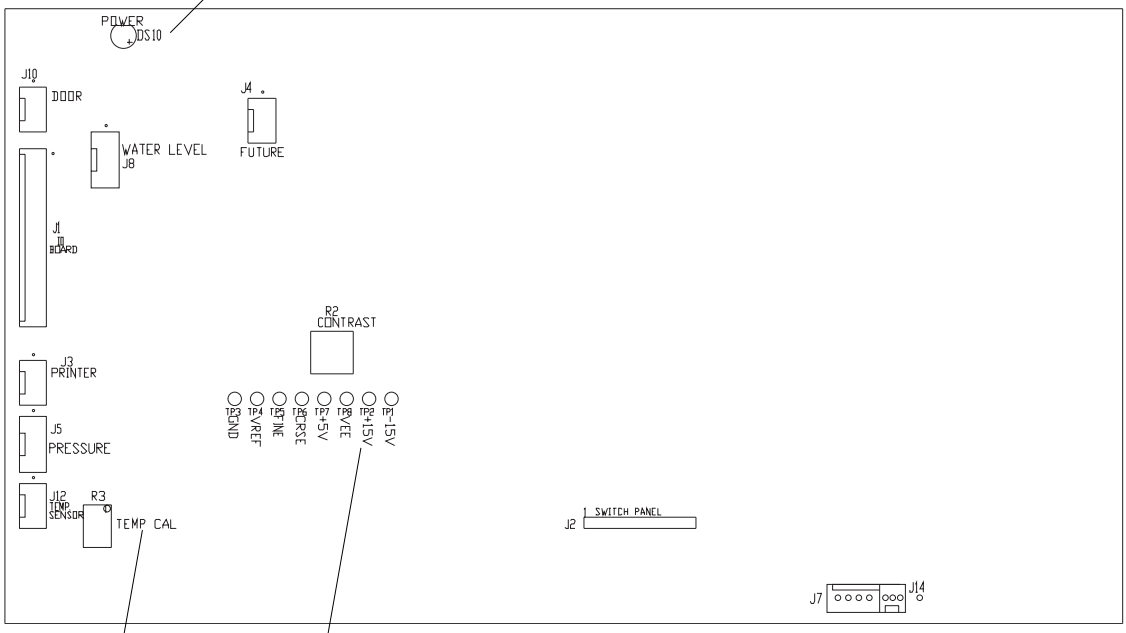
LED Indicators

Indicator	Input/Output
DS1	Heater 1HTR/2HTR
DS2	Vent Solenoid Valve 1SOL
DS3	Fill Solenoid Valve 2SOL
DS4	Drain Valve 3SOL (Non-Recirculating Units)
DS5	Not Used
DS6	Not Used
DS7	Not Used
DS8	Not Used
DS9	Fault
DS10	Power

Test Points

Test Point	Function	Voltage Range	Notes
TP1	+5 VDC	+4.8 to +5.2 VDC	Use TP3 ground
TP2	+14 VDC	+12 to +16 VDC	Use TP3 ground
TP3	Ground		
TP4	Not Used		
TP5	-14 VDC	-12 to -16 VDC	Use TP3 ground
TP6	Solenoid Power Common		
TP7	Driver Input Voltage (+12 VDC)	+12 ± 1.2 VDC	Use TP6 ground
TP8	+24 VDC	+24 ± 0.75 VDC	Use TP6 ground





Power On
DS10

Temperature
Sensing Circuit
Adjustment R3
(See Page 4-8)

Test Points

Figure 23
Control PC Board Component Locations

Test Points

Test Point	Function	Voltage Range
TP1	-14 VDC	-12 to -16 VDC
TP2	+14 VDC	+12 to +16 VDC
TP3	Ground	
TP4	V_{REF}	+5.000 ± 0.010 VDC
TP5	Temp Fine	Refer to RTD Voltage Table (Appendix)
TP6	Temp Coarse	Refer to RTD Voltage Table (Appendix)
TP7	+5 VDC	+4.80 to +5.30 VDC
TP8	V_{EE} (Contrast)	-9.200 ± 0.200 VDC (Adjust R2)

Adjustments

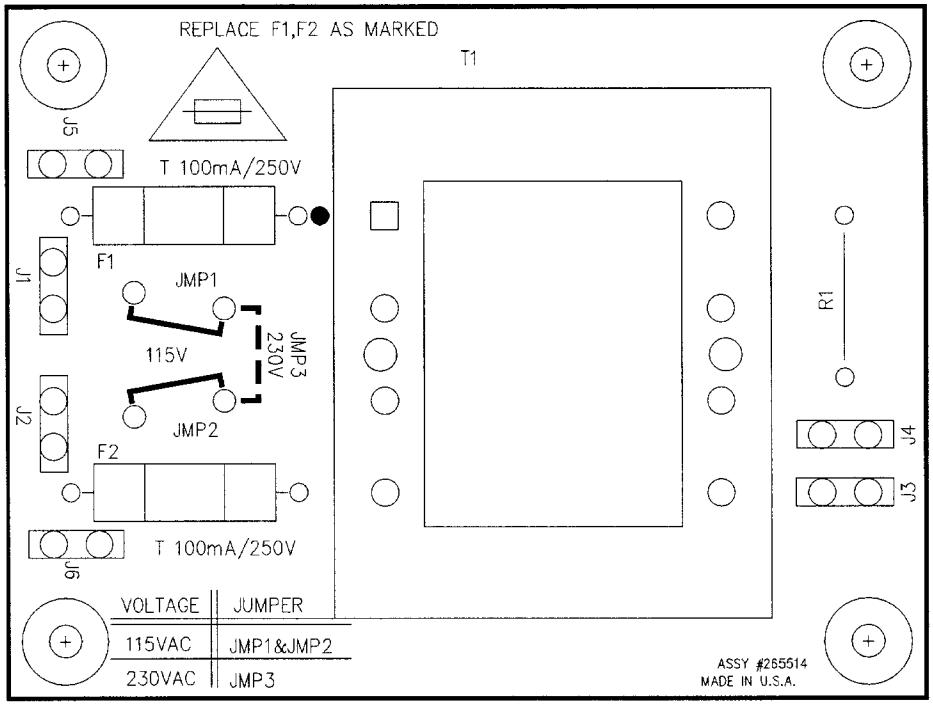
Adjustment	Function	Procedure
R2 R3	Display Contrast Temperature Circuit	See **Adjustments** section

LED Indicators

LED	Function
DS1	CONTROLS ON
DS2	CYCLE START
DS3	PACKS
DS4	LIQUIDS
DS5	WRAPPED INSTRUMENTS
DS6	UNWRAPPED INSTRUMENTS
DS7	PROCESSING
DS8	COMPLETE
DS9	DRYING
DS10	POWER ON
DS11	CYCLE STOP

Switch Panel Functions

Function	Pins at J2
ON	5 and 9
OFF	5 and 8
UNWRAPPED INSTRUMENTS	4 and 9
WRAPPED INSTRUMENTS	4 and 8
PACKS	4 and 7
LIQUIDS	4 and 6
START	5 and 7
STOP	5 and 6
PROGRAM/SET	3 and 6
UP ARROW	3 and 8
DOWN ARROW	3 and 7



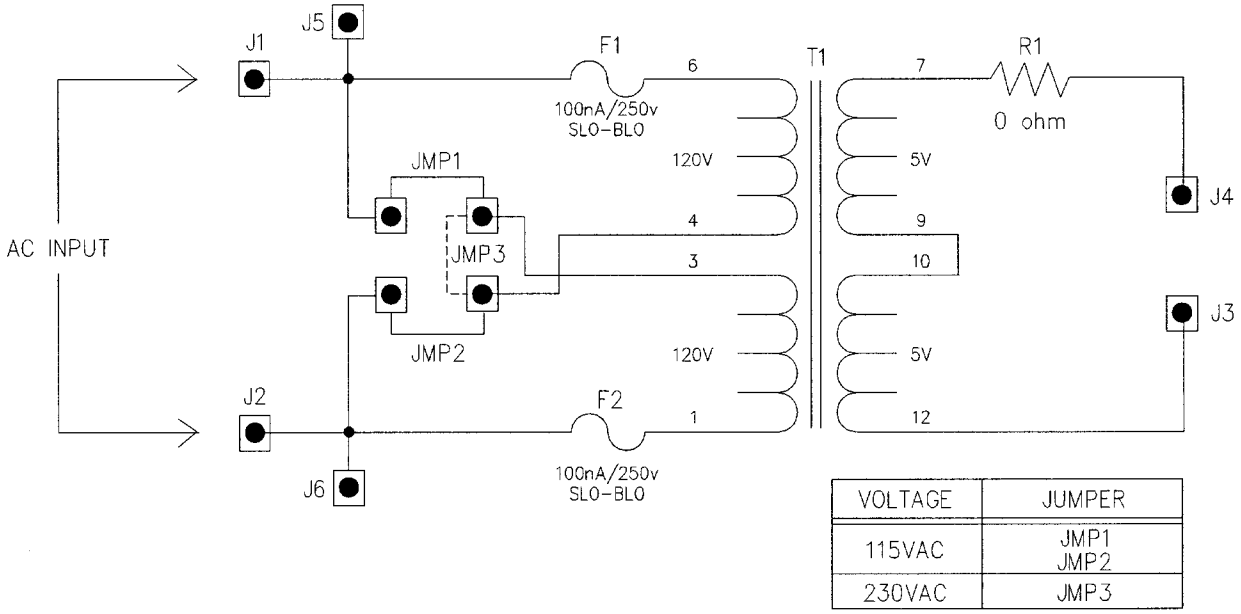


Figure 24
Transformer Board Component Locations

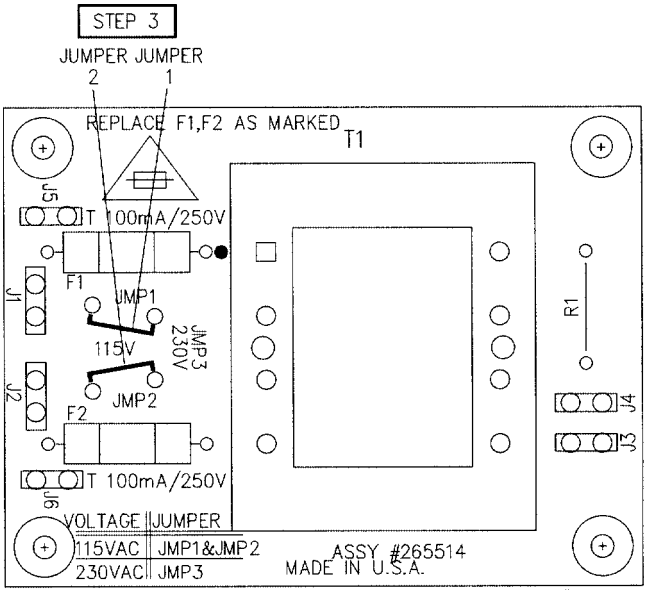


Figure 25
Transformer PC Board (115 VAC)

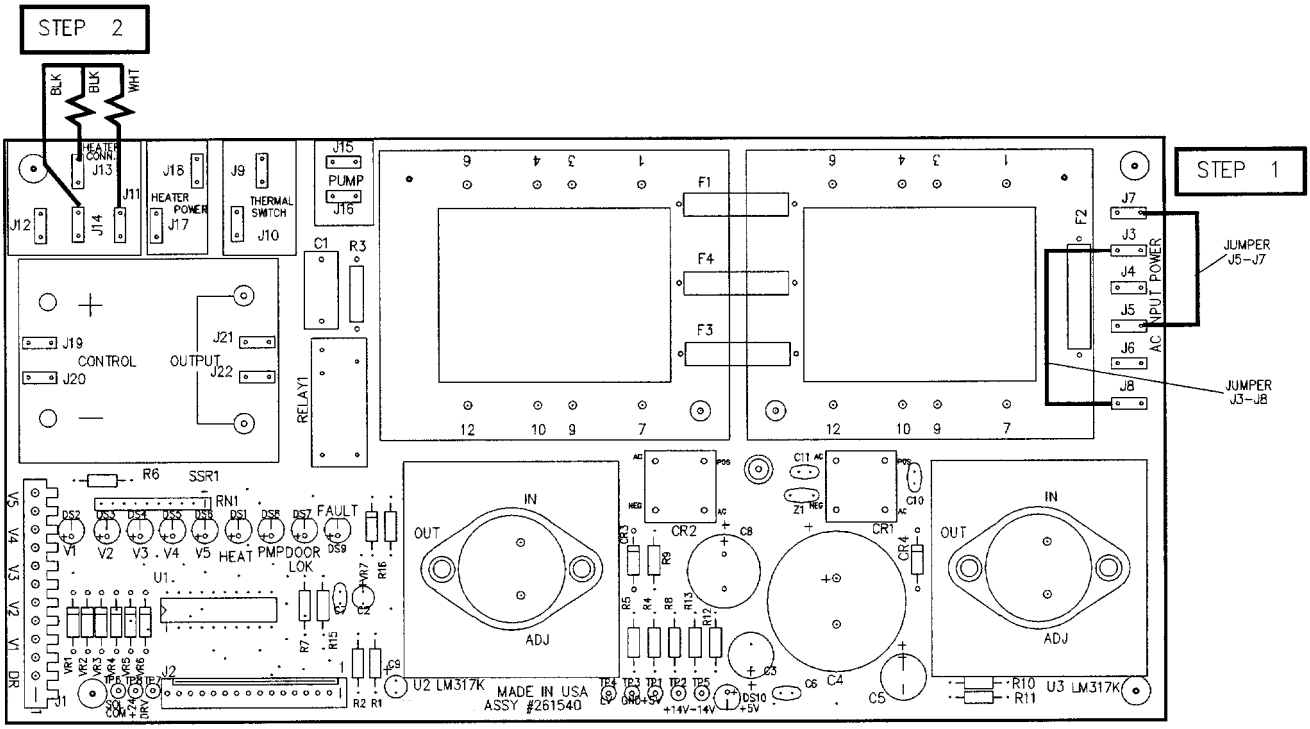


Figure 26
Power I/O PC Board (115 VAC)

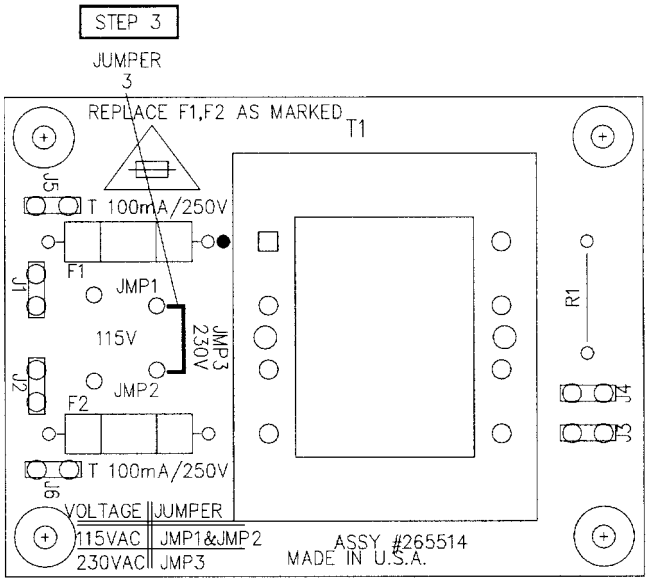


Figure 27
Transformer PC Board (230 Vac)

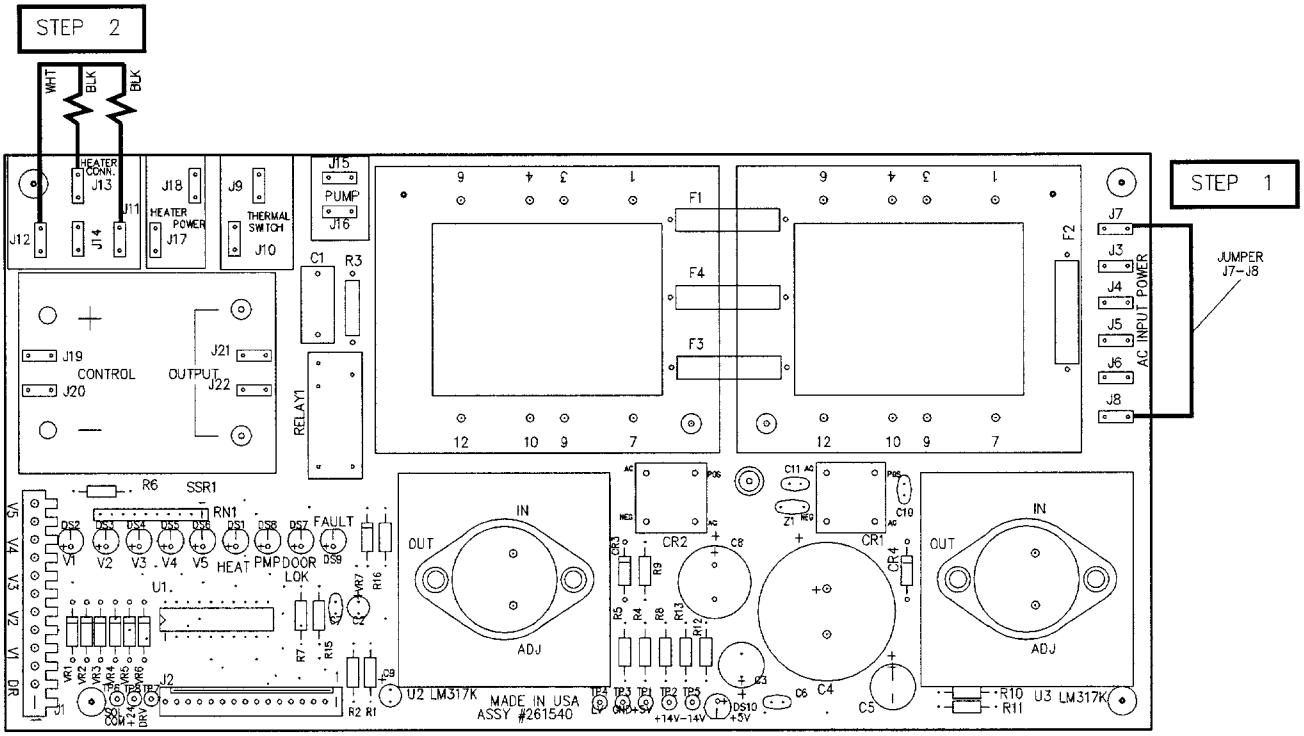


Figure 28
Power I/O PC Board (230 Vac)

Setup and Adjustments

Warning
Shock Hazard: Unplug the power cord before moving jumpers.

Caution
Dual voltage models have both voltages listed on the rating plate. Do not attempt to convert a unit that does not have two fuseholders or is not listed as a 115V/230V model.

Voltage Conversion

To configure the unit for 115 VAC operation:

1. On the Power I/O PC Board connect jumper from J7 to J5 and from J3 to J8.
2. Connect heater common (white) to J11, heater (black) 1 to J13 and heater (black) 2 to J14.
3. On the Transformer PC Board (MC10 with printer), connect jumpers JMP1 and JMP2.
4. Install 15A fuses in fuseholders on rear panel.
5. Install appropriate plug on power cord (or use adapter).

To configure the unit for 230 VAC operation:

1. On the Power I/O PC Board, connect jumper from J7 to J8.
2. Connect heater common (white) to J12, heater (black) 1 to J11, and heater (black) 2 to J13.
3. On the Transformer PC Board (MC10 with printer), connect jumper JMP3.
4. Install 8 A fuses in fuseholders on rear panel.
5. Install appropriate plug on power cord (or use adapter).

Software Configuration

There are three programming modes:

- clock set mode
- cycle parameter mode
- factory setup mode

Clock set and cycle parameter mode may be used by the operator. Factory setup mode should only be accessed by qualified service technicians.

Clock Set Sequence

1. Set the hour by pressing the up or down arrow. Press PROGRAM/SET to stir the value in the memory.

12:00 AM JAN 01 1998

2. Set the minute, then press PROGRAM/SET.

12:**00** AM JAN 01 1998

3. Set AM or PM, then press PROGRAM/SET.

12:00 **AM** JAN 01 1998

4. Set the month, then press PROGRAM/SET.

12:00 AM **JAN** 01 1998

5. Set the day, then press PROGRAM/SET.

12:00 AM JAN **01** 1998

6. Set the year. Press PROGRAM/SET to store the value in memory and exit clock set mode.

12:00 AM JAN 01 **1998**

Clock Set Mode

Clock set mode is used to set the time and date.

- To enter clock set mode, press PROGRAM/SET in CONTROLS OFF mode.

- To exit clock set mode at any time, press CYCLE STOP.

Cycle Parameter Mode

Cycle parameter mode is used to program the exposure and drying times (if desired).

To enter a cycle parameter mode:

a. Press CONTROLS ON.

b. Select desired cycle (UNWRAPPED INSTRUMENTS, WRAPPED INSTRUMENTS, PACKS, or LIQUIDS.

c. Press PROGRAM/SET.

To exit cycle parameter mode at any time, press CYCLE STOP.

Note
Minimum exposure times are: UNWRAPPED INSTRUMENTS—3 minutes, WRAPPED INSTRUMENTS—5 minutes, PACKS—30 minutes, and LIQUIDS—30 minutes.

Note
Drying time for LIQUIDS is 0 minutes and cannot be changed.

Warning
Select STANDARD UNIT when setting up a VWR brand sterilizer. If LAB UNIT is selected, it will be possible to program cycle parameters that will not result in sterilization.

Caution
Factory setup mode should only be used by authorized service personnel.

Cycle Parameter Setup Sequence

1. Set the exposure time (up to 99 minutes) by pressing up or down arrow, Press PROGRAM/SET to store selection.

TEMP	TIME	DRY
135C	**03**	15

2. Set the drying time (0 to 99 minutes) by pressing up or down arrows. Press PROGRAM/SET to store selection and end cycle programming.

TEMP	TIME	DRY
135C	03	**15**

Factory Setup Mode

Factory setup mode is used to:

- view the error log
- enable or disable diagnostics mode
- select the display format (temperature units, pressure units, language, 12 or 24 hour clock and date.
- set the cycle count
- configure the software (MC8 or MC10; standard or lab unit; non-recirculating option, and VWR brand)

To enter factory setup mode:

a. Press and release the CONTROLS OFF switch.

b. Press and hold the CONTROLS OFF

switch.

c. Press and hold the PROGRAM/SET switch.

d. Release the CONTROLS OFF switch.

e. Release the PROGRAM/SET switch.

To exit factory setup mode at any time, press CYCLE STOP.

Note
See **Trouble Analysis** section for a description of diagnostic mode features.

1. **Error Log:** The error log includes the error code, and cycle number, date and time of the cycle in which the malfunction occurred.

   LOG [error code] [cycle count]
   date] [time]

   Use either arrow to view the last five malfunctions. Press PROGRAM/SET to continue with setup.

2. **Diagnostic Mode:** Select YES (diagnostics mode). NO (normal operation) or RECYCLE (automatic cycle start). Press PROGRAM/SET.

   DIAGNOSTICS
   YES

3. **Time Format:** Select 12 HOUR CLOCK or 24 HOUR CLOCK. Press PROGRAM/SET.

   12 HOUR CLOCK

4. **Temperature Units:** Select CELSIUS (°C) or FAHRENHEIT (°F). Press PROGRAM/SET.

   TEMPERATURE
   CELSIUS

5. **Pressure Units:** Select PSI (pounds per square inch), kPa (kilopascals) or BAR (bars). Press PROGRAM/SET.

PRESSURE UNITS PSI

6. **Language:** Select ENGLISH, SPANISH, FRENCH, or GERMAN. Press PROGRAM/SET.

LANGUAGE ENGLISH

7. **Model Configuration:** Select VWR brand.

CONFIGURATION VWR BRAND

8. **Unit Size:** Select MC8 (8” diameter) or MC10 (10” diameter). Press PROGRAM/SET.

MODEL MC8 OR MC10

9. **Unit type:** Select STANDARD UNIT (fixed temperature) or LAB UNIT (selectable 102 to 135°C) unit. Press PROGRAM/SET.

STANDARD UNIT

10. **Recirculating Status:** Select RECIRCULATE or NON-RECIRCULATE. Press PROGRAM/SET.

RECIRCULATE

Warning
Select STANDARD UNIT when setting up a VWR brand sterilizer. If LAB UNIT is selected, it will be possible to program cycle parameters that will not result in sterilization.

Caution
Be sure non-recirculating option has been installed before selecting NON-RECIRCULATE.

11. **Sterilization Mode:** Select STERILIZE for normal operation. Select CALIBRATE to calibrate sterilizer temperature and pressure. Press PROGRAM/SET.

STERILIZE

12. **Solenoid Test:** This menu is used to test operation of the vent solenoid. The vent solenoid will toggle on/off at a 2 second rate coinciding with the display. Press PROGRAM/SET.

SOLENOID TEST VENT **ON**

13. **Solenoid Test:** This menu is used to test operation of the fill solenoid. The fill solenoid will toggle on/off at a 2 second rate coinciding with the display. Press PROGRAM/SET.

SOLENOID TEST FILL **ON**

14. **Solenoid Test:** This menu is used to test operation of the drain solenoid. The drain solenoid will toggle on/off at a 2 second rate coinciding with the display. Press PROGRAM/SET.

SOLENOID TEST DRAIN **ON**

15. **Solenoid Test:** This menu is used to trigger a recording device used during factory calibration. Press PROGRAM/SET.

SOLENOID TEST TRIGGER **ON**

16. **Heater Test:** By pressing start the heater will be turned on (100% duty cycle) for a period of 10 seconds. Press PROGRAM/SET.

HEATER TEST	
HEAT **OFF**	**0**

17. **Cycle Count:** This menu displays the number of cycles your sterilizer has run during the life of the unit. Press PROGRAM/SET.

CYCLE COUNT
00000

18. **Serial Number:** This menu displays the serial number of the unit. Press PROGRAM/SET.

19. Factory setup is now complete.

Unit Calibration

1) • Remove Pressure Calibration Port plug located by the pressure relief valve.
   • Attach the pressure meter to the calibration port, sealing the threads with thread tape.
   • Remove the Chamber Temperature plug from the rear of the chamber on MC10/AS10 models and the left side of the chamber on the MC8/AS8.
   • Wrap the threads of the temperature probe and thread into the Temperature Calibration Port.
   • Connect the Test Printer to the J3 Printer Port on the back of the Display Board in the unit being tested (MC10/AS10 units without the printer option only). Connect the Test Printer to the Printer Port on the rear of the unit (MC8/AS8 units only).
   • Close the door and latch.

2) • Hold the **CONTROLS OFF** button down and plug the unit in, release the button when the lights illuminate. The unit should go through a power up self test.

3) • Set the time and date by pressing the **PROGRAM SET** button to select the digit, and the **UP Arrow** or **DOWN Arrow** to change the value. This operation is complete when all the settings are correct and none of the digits are flashing.

4) • Press and hold **CONTROLS OFF**, then press and hold **PROGRAM SET**.
   • Release **CONTROLS OFF**, wait a second and release the **PROGRAM SET** button. The unit should display the *LOG* in the upper left corner of the display.
   • Step through the selections by pressing **PROGRAM SET**. Use the **UP Arrow** or **DOWN Arrow** to change the selection.

- Set the parameters as follows:
  DIAGNOSTICS to *YES*
  12 HOUR CLOCK
  TEMPERATURE to *CELSIUS*
  PRESSURE UNITS to *PSI*
  LANGUAGE to *ENGLISH*
  CONFIGURATION to (*VWR* or *HARVEY*)
  MODEL to (*MC8, AS8, MC10* or *AS10*)
  STANDARD UNIT
  RECIRCULATE
  CALIBRATE

5) • Fill the Reservoir with clean DI or distilled water up to the Fill Line, on the cover.
   • Open the door and press **CONTROLS ON**.
   • Press **CYCLE START**, the display should show *DOOR OPEN*.
   • Close the door.

6) • Press **CYCLE START** again, the Test Printer should start printing and the unit should display *COOLING CHAMBER*.
   • Review the Printout to verify an exposure temperature of 114°C.
   • When the unit has completed the first stage of calibration the display will show *SET PRESSURE*, use the **UP Arrow** or **DOWN Arrow** to change the displayed value of the unit to match the measured value shown on the Calibration Unit. (Each press is approximately 0.05 PSI, ±4 PSI range).
   • Press **PROGRAM SET** and the display should show *SET TEMPERATURE*. Use the **UP Arrow** or **DOWN Arrow** button to change the displayed value of the unit to match the measured value shown on the Calibration Unit. (Each press is approximately 0.1 degree, ±4°C Range).
   • Press **PROGRAM SET** and the unit should now heat to 135°C.

Caution
The Reservoir Cover should remain on the unit during all the calibration and test procedures. The unit can exhaust HOT steam and HOT water through the vent inside the reservoir. the unit will beep short beeps followed by a long beep before venting the reservoir.

- When the unit has completed this stage of calibration, the display will show *SET PRESSURE*. Use the **UP Arrow** or **DOWN Arrow** to change the displayed value of the unit to match the measured value shown on the Calibration Unit. (Each press is approximately 0.05 PSI, ±4 PSI Range).
- Press **PROGRAM SET** and the display should read *SET TEMPERATURE*. Use the **UP Arrow** or **DOWN Arrow** to change the displayed value of the unit to match the measured value shown on the Calibration Unit. (Each press is approximately 0.1 degree, ±4°C Range).
- Press **PROGRAM SET** and the unit should begin venting pressure.
- When the unit has completed venting and the dry cycle is complete, open the door.
- Unplug the unit, wait for 10 seconds, then plug the unit back in.
- Press **CONTROLS ON**.

Unit Verification

1)
- Close the door when the Calibration Unit's display is indicating 40°C or less.
- Press **UNWRAPPED INSTRUMENTS**, the display should read *TEMP* = *135°C,* *TIME* = *3,* and *DRY* = *1*.
- Press **CYCLE START** and the display should read *COOLING CHAMBER*.
- When the chamber has cooled below 70°C, the display should read the Temperature, Status, Pressure, and Time.
- Open the door when the cycle is complete.
- Advance the printer in the calibration unit until the latest printed readings are visible.

Note

- The pressure and temperature readings which are printed by the sterilizer must all be within ±0.5 of the measured readings. If any cycle ends abnormally or the criteria is not met, the problem needs to be resolved before continuing to the next step in the procedure. Once the problem is resolved testing must be restarted at the beginning of the Calibration section.
- The temperature and pressure readings from the Test Printer should be recorded from the second line printed with the same Time-Stamp, and above the *VENT* phase indicator line.

Example Test Printer Printout

EXPOSURE		
028	32.9	135.8
029	32.8	135.5
030	32.8	135.5
031	33.3	136.1
031	***33.0***	***136.3***
VENT		
032	18.6	125.2

Record information from this line.

- Record the latest temperature and pressure readings from the calibration unit's printout and the test printer's printout onto the checklist.
- Subtract the unit readings from the test fixture readings and record onto the checklist.

2) • Close the door when the calibration unit's display is indicating 40°C or less.
- Press **PACKS** and the display should read *TEMP* = *121°C,* *TIME* = *30* and *DRY* = *30*.
- Press **CYCLE START** and the display should read *COOLING CHAMBER*.
- When the chamber has cooled below 70°C, the display should read the Temperature, Status, Pressure, and Time.
- Open the door when the cycle ends.
- Advance the printer in the calibration unit until the latest printed readings are visible.
- Record the latest temperature and pressure readings from the calibration unit's printout and the test printer's printout on the checklist.
- Subtract the unit readings from the test fixture readings and record on the checklist.

3) • Press **CONTROLS OFF**.
- Press and hold **CONTROLS OFF**, then press and hold **PROGRAM SET**.
- Release **CONTROLS OFF**, wait a second and release **PROGRAM SET**. The unit should display the *LOG* in the upper left corner of the display.
- Press **CYCLE START**, then press the **UNWRAPPED INSTRUMENTS**.

Note
If satisfactory calibration cannot be achieved, attempt coarse temperature circuit calibration. Retesting will be necessary if coarse temperature circuit calibration is done.

- Wait 5 seconds, the display should read *LOG ER00*.
- Press **UP Arrow**, the display should still read *LOG ER00*.
- Step through the following selections by pressing **PROGRAM SET**. Use **UP Arrow** or **DOWN Arrow** to change the selection if needed.
- Set the following parameters, if necessary:
  DIAGNOSTICS = NO
  12 HOUR CLOCK
  TEMPERATURE = CELSIUS
  PRESSURE UNITS = PSI
  LANGUAGE = ENGLISH
  CONFIGURATION = (VWR or *HARVEY)*
  MODEL = (MC8 or *MC10)*
  STANDARD UNIT
  RECIRCULATE
  STERILIZE

4)
- Unplug the unit.
- Disconnect the Test Printer (if used).
- Drain the main reservoir and discard the water in the unit.

Control PC Board Adjustments

Temperature Sensing

Circuit Calibration

Equipment Required:

- digital voltmeter (dvm), 4-1/2 digit, 0.03% accuracy
- five-decade resistance box, 0.1 to 1000 ohms decades, 0.025% accuracy

  or

  0.03% precision resistor, 1500.5 ohms

Calibration Check

Note
Allow the chamber to cool down to room temperature before performing a calibration check.

1. Unplug RTD from J12 on Control PC Board.
2. Measure RTD resistance.
3. From the RTD voltage table (see Appendix), determine the coarse voltage that corresponds to the RTD resistance.
4. Plug RTD into J12.
5. Measure coarse voltage at TP6. Use TP3 ground.
6. If coarse voltage is not within 10 mV of calculated value, calibrate the Control PC Board.

Calibration Procedure

1. Measure reference voltage at TP4. Use TP3 ground. Reference voltage should be +5.000 ±0.010 VDC. Replace Control PC Board if reference voltage is out of tolerance.

2. Connect resistance box to J12-1 and J12-2. Set box to 1500.5 ohms.

3. Measure coarse voltage at TP6. Use TP3 ground.

4. Adjust R3 for +4.332 ±0.001 VDC.

5. Measure fine voltage at TP5. Use TP3 ground. Fine voltage should be +3.047 ±0.050 VDC.

6. This completes calibration of the temperature sensing circuit.

Display Contrast Adjustment

Note
The optimum value for the voltage level may vary depending on the LCD.

Equipment Required:

- digital voltmeter (dvm), 4-1/2 digit, 0.03% accuracy

Adjustment Procedure

1. Measure voltage at TP8. Use TP3 ground.

2. Adjust R2 on Control PC Board for -9.200 ±0.200 VDC.

3. This completes the display contrast adjustment.

Repair and Replacement

Warning
Shock Hazard: Disconnect power cord from power source before removing panels or servicing internal parts.

Cabinet Removal

Side Panels

1. Remove two screws at the lower edge of the side panel.
2. Pull the panel down and outward at the bottom until upper edge disengages from the top cover.

Top Cover and Reservoir Assembly

1. Remove reservoir cover.
2. Remove paper roll to prevent dropping if top is tipped.
3. Drain reservoir.
4. Disconnect the tubing from the fill/drain and vent solenoid valves.
5. Unplug connectors from the Control PC Board (behind the Control Panel).
6. Remove three (3) screws at the front and four (4) fasteners at the back of the top cover and lift the top from the sterilizer.

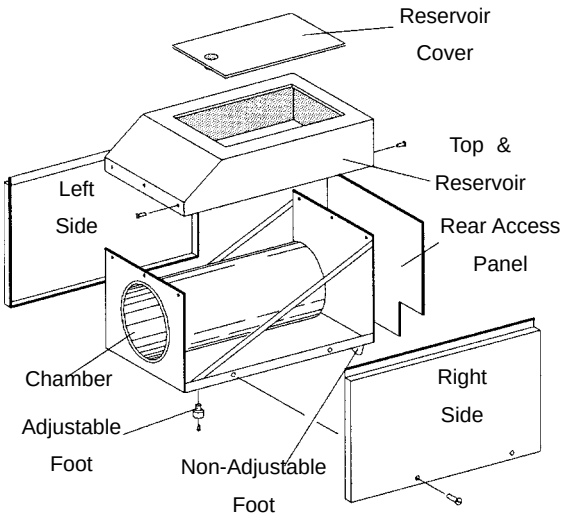


Figure 29
Cabinet Assembly

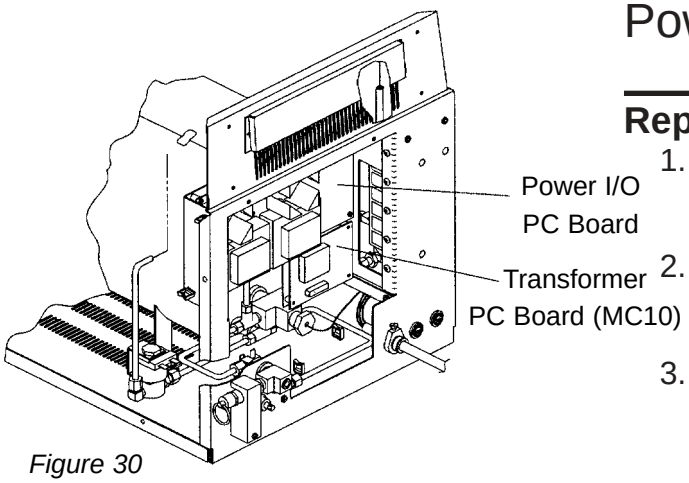


Figure 30
Replacing Power I/O PC Board

Note
Be sure replacement board is configured for correct voltage.

Power I/O PC Board

Replacement

1. Unplug power cord from the power source.
2. Remove the side and back panels from the sterilizer.
3. Unplug all wires and cables from Power I/O PC Board. Tag wires for identification.
4. Remove the five (5) screws that secure the Power I/O PC Board to the standoffs.
5. Install replacement Power I/O PC Board.

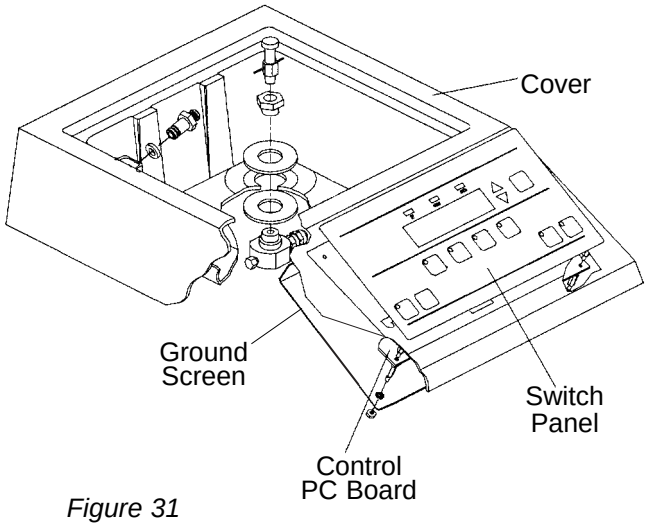


Figure 31
Replacing Control PC Board

Control PC Board

Replacement

1. Remove the side panels from the sterilizer.
2. Remove the four (4) screws that secure the cover shield. Disconnect ground screw.
3. Unplug connectors from wire side of Control PC Board.
4. Remove the four (4) spacers that secure the Control PC Board to the standoffs.
5. Install replacement Control PC Board.

Note
Be sure all connectors are plugged in and the LEDs on the PC board are aligned with the openings in the Control Panel.

6. Check temperature circuit calibration and display contrast before reinstalling cover shield.
7. Reinstall cover shield. Be sure to reinstall ground screen.
8. Perform Unit Calibration.

Switch Panel

Replacement

Warning
When control PC Board is replaced, the sterilizer must be recalibrated to insure sterilization, see “Unit Calibration.”

1. Remove side panels from sterilizer.
2. Remove cover shield from Control PC Board.
3. Disconnect ribbon cable from J2 on Control PC Board.
4. Remove Control PC Board.
5. Remove Switch Panel.
6. Route ribbon cable of replacement Switch Panel through slot.
7. Peel off adhesive backing and attach Switch Panel to sterilizer.
8. Reinstall Control PC Board.
9. Connect ribbon cable to J2.
10. Reinstall cover shield.

Warning
Do not wrench or apply stress to the plastic body of the transducer.

Warning
When the pressure transducer is replaced, the sterilizer must be recalibrated to ensure that sterilization occurs. See Unit Calibration.

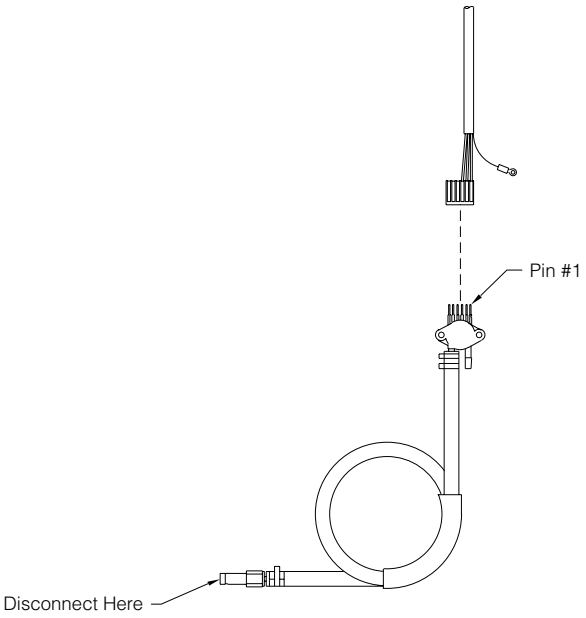


Figure 32
Pressure Transducer Cable Removal

Transformer PC Board (MC10)

Replacement

1. Unplug power cord.
2. Remove back access panel.
3. Unplug AC input terminals from J1 and J2, J5 and J6.
4. Unplug printer connector from J3 and J4.

Pressure Transducer

Replacement

1. Unplug power cord.
2. Remove right side access panel.
3. Using two wrenches, disconnect pressure transducer from fitting. Apply one wrench to fitting and the other wrench to the transducer connector.
4. Disconnect cable from transducer:
5. Reinstall
6. Perform “Unit Calibration.”

Warning
When temperature probe is required, the sterilizer must be recalibrated to insure sterilization occurs. See Unit Calibration.

Temperature Probe

Removal

1. Remove right side panel and access panel from back of cabinet.
2. Unplug connector from J12 on the Control Panel PC Board.
3. Unscrew the probe assembly from the cross fitting.

Replacement

4. Apply pipe thread sealant and install replacement probe assembly.
5. Plug connector into J12 on Control PC Board and replace panels.
6. Perform Unit Calibration.

Thermal Cut-Off Switch

Replacement

1. Unplug power cord.
2. Disconnect switch from Power I/O PC Board.
3. Carefully remove insulation around thermal switch.
4. Remove switch from heater extrusion.
5. Install replacement switch.
6. Reinstall insulation.

Heater

The heater is not replaceable in the field. Return the sterilizer to the factory for repair.

Solenoid Valves

Replacement solenoid valves are available as assemblies with fittings installed.

- Vent - Part No. 265691 (MC10 Only)

  Part No. 265834 (MC8 Only)

- Fill/Drain - Part No. 265690

- Non-Recirculating Drain - Part No. 265757.

Caution
Water in reservoir and piping may be HOT. Care should be taken to prevent burns.

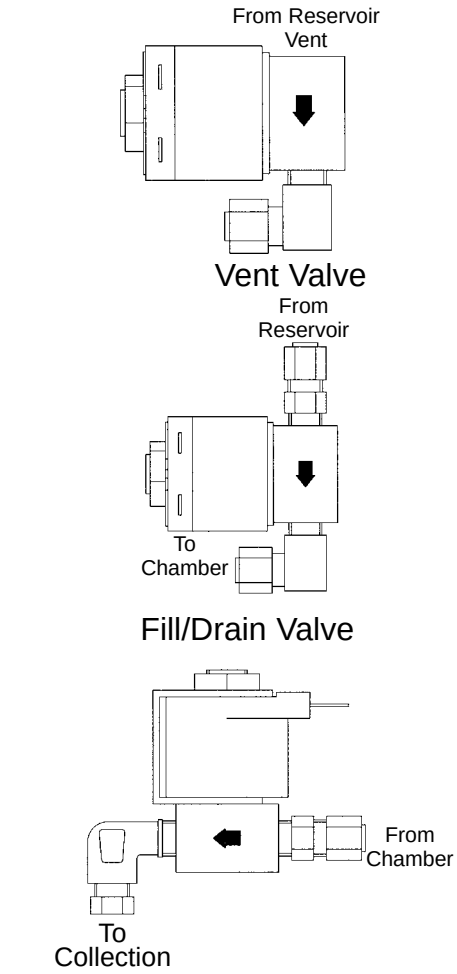


Figure 33
Non-Recirculating Valve

Note
Gasket will be adhered to doorplate.

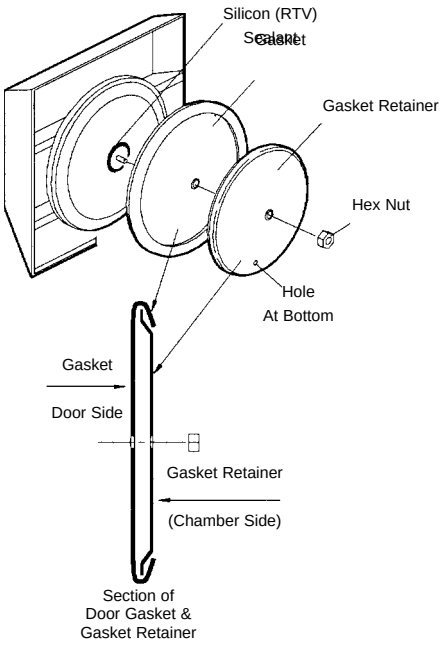


Figure 34
Door Gasket Replacement

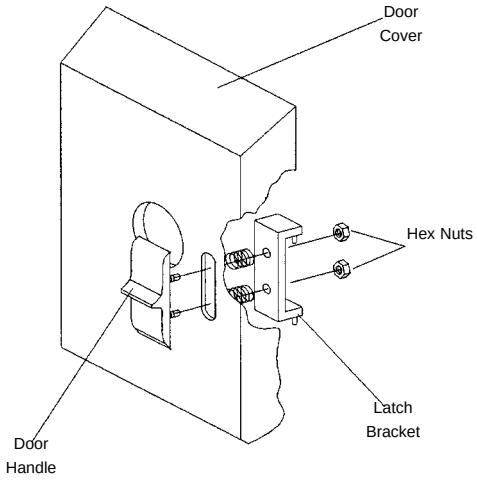


Figure 35
Door Handle Replacement

Note
The gasket is adhered to the door plate. Do not remove gasket.

Chamber Door

Door Gasket Replacement

1. Remove the hex nut in the center of the gasket retainer and remove the gasket and gasket retainer.

2. Clean surface of the door plate, new gasket and gasket retainer of any dirt, adhesives or deposits.

3. Apply a generous amount of silicone sealant in a 2” diameter area around the center fitting on the door plate.

4. Assemble the gasket retainer (formed lip toward gasket) and gasket with narrow flap on gasket over lip on retainer.

5. Place the gasket and retainer assembly on the center fitting of the door plate as shown and secure with hex nut, finger tight (firm) then 1/2 turn.

6. Allow a half hour or so for the silicone sealant to set, then run a sterilize cycle (no load) to seat the new gasket.

Door Handle and Latch Replacement

1. Open the door and remove the two screws from the latch bracket.

To remove the latch bracket, it will be necessary to remove the door cover.

Door Cover Replacement

1. Remove the door handle as described in **Door Handle and Latch Removal.**

2. Remove the hex nut in the center of the door gasket retainer and remove the GASKET RETAINER ONLY.

3. Carefully fold sides of gasket back to expose two mounting screws on each side of door plate. Removing the four mounting screws will dismount the outer door cover.

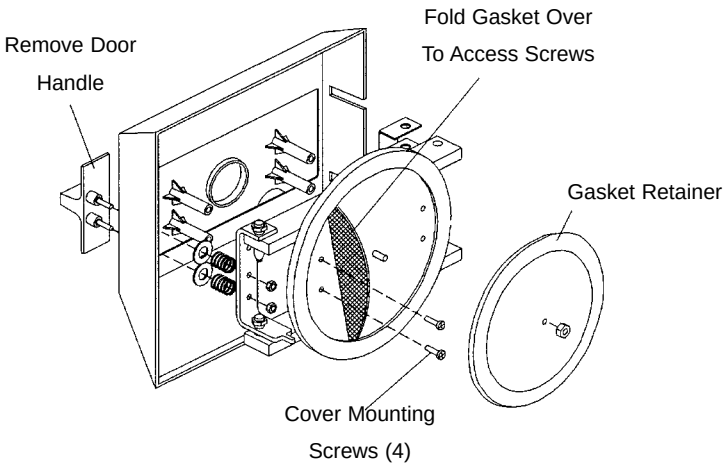


Figure 36
Outer Door Cover Replacement

Appendix

RTD Voltage Table			
Temp (°C)	**RTD (Ohms)**	**Coarse (Volts)**	**Fine (Volts)**
10	1038.50	0.333	0.000
11	1042.35	0.367	
12	1046.20	0.400	
13	1050.05	0.433	
14	1053.90	0.467	
15	1057.15	0.500	
16	1061.60	0.533	
17	1065.45	0.567	
18	1069.30	0.600	
19	1073.15	0.633	
20	1077.00	0.667	
21	1080.85	0.700	
22	1084.70	0.733	
23	**1088.55**	**0.766**	
24	**1092.40**	**0.800**	
25	1096.25	0.833	
26	1100.10	0.866	
27	1103.95	0.900	
28	1107.80	0.933	
29	1111.65	0.966	
30	1115.50	1.000	
31	1119.35	1.033	
32	1123.20	1.066	
33	1127.05	1.100	
34	1130.90	1.133	
35	1134.75	1.166	
36	1138.60	1.200	
37	1142.45	1.233	
38	1146.30	1.266	
39	1150.15	1.300	
40	1154.00	1.333	

How to Use This Table

1. Find the measured RTD resistance in the RTD (Ohms) column.

2. If the measured resistance is between two values, note the upper and lower value.

3. Note the coarse voltage that corresponds to the lower resistance value.

4. Calculate the offset voltage:

V offset = (R-R1) / (R2 - R1) x (V2 - V1)

where R = measured resistance

R1 = lower resistance value V1 = lower voltage value

R2 = upper resistance value V2 = upper voltage value

5. Add the offset voltage to the voltage in step 3 to determine the coarse voltage.

Example:

1. The measured resistance is 1090 (between 23°C and 24°C).

2. Resistance at 23°C = 10.88.55

   Resistance at 24°C = 1092.40

3. Coarse voltage at 23°C = 766 mV

4. V offset = (1090.00 - 1088.55) / (1092.40 - 1088.55) x (0.800 - 0766)

   V offset = 12mV

5. Coarse voltage = 766 mV + 12 mV = 778 mV