

# OPERATION MANUAL



LAB-LINE

ULTRA-CLEAN OVENS

*Model #*

3450M 3450M-1 -3450M-3

3455M-1 3455M-3 3459M-1 3459M-3

*+ take <sup>off</sup> - control panel*

*Serial #  
0982-116*

*Kim or Service*

*Sandy in Service*

*Mick Murray  
Electronics  
Engineer*

**LAB-LINE® INSTRUMENTS, Inc.**

Designers and Manufacturers

Lab-Line Plaza

Melrose Park, Illinois 60160

U.S.A.

82-77437

Phone: (312) 450-2600 TWX: 910-225-0402

LAB-LINE

ULTRA-CLEAN OVENS

3450M 3450M-1 3450M-3

3455M-1 3455M-3 3459M-1 3459M-3

# DESCRIPTION

## LAB-LINE

### ULTRA-CLEAN OVENS

3450M 3450M-1 3450M-3

3455M-1 3455M-3 3459M-1 3459M-3

For an environment of highly precise temperature stability as well as uniformity that meets the criteria of the semiconductor industry, among others, Lab-Line has created the Ultra-Clean Oven. With an operating range from slightly above ambient to 300 degrees C, the Ultra-Clean Oven has a temperature uniformity of +/- 1 degree C at 200 degrees.

Featured in the Ultra-Clean Oven are radiant warm wall heating (a Lab-Line exclusive), horizontal air flow, and a sophisticated solid-state circuit--the primary reasons for the Oven's precise control.

**RADIANT WARM WALL HEATING:** Special strip heaters fastened flat to the chamber's exterior wall are arranged for the most uniform heating possible. Circulating air in the chamber is heated by contact with the walls and helps toward uniform heat distribution.

**AIR FLOW:** Air in the Oven is circulated at the gentle rate of 30 cu ft/min by a blower beneath the chamber, is driven through a 5-micron filter (optional) in the right wall, passes horizontally over the shelves and through the perforated left wall, then is recycled. In making contact with the chamber, the air is heated and thus aids in the uniform distribution of heat. An adjustable vent at the rear of the Oven allows removal of any byproduct fumes or inert gas such as nitrogen used to purge the chamber.

**ELECTRONIC CONTROL:** Once the Oven's controls are set, its temperature is regulated electronically by proportioning, a process in which power to the heaters is applied intermittently to slow the temperature rise when the chamber is within 10 degrees of set point. In this way overshoots are virtually eliminated. A jack on the control panel permits easy connection to a remote programmable timer such as Lab-Line's 3460.

# SPECIFICATIONS

## ELECTRICAL REQUIREMENTS\*

3450M	120 V, 2400 W
3450M-1	240 V, 2400 W
3450M-3	208 V, 2400 W
3455M-1	240 V, 3000 W
3455M-3	208 V, 3000 W
3459M-1	240 V, 3000 W
3459M-3	208 V, 3000 W

\*50/60 Hz for all models.

## DIMENSIONS

### 3450M/M-1/M-3

Interior: 18"D x 11-1/2"H x 11"W  
(46D x 29.2H x 28W cm)

Exterior: 25"D x 27-1/2"H x 20-5/8"W  
(64D x 71H x 52W cm)

### 3455M-1/M-3

Interior: 18"D x 18-1/2"H x 16"W  
(46D x 47H x 41W cm)

Exterior: 25"D x 34-1/2"H x 25-5/8"W  
(64D x 87H x 65W cm)

### 3459M-1/M-1

Interior: 18"D x 18-1/2"H x 23"W  
(46D x 47H x 58W cm)

Exterior: 25"D x 34-1/2"H x 32-5/8"W  
(64D x 87H x 83W cm)

## WEIGHT

3450M/M-1/M-3	140 lbs (63 kgs)
3455M-1/M-3	195 lbs (87.7 kgs)
3459 M-1/M-3	235 lbs (105.7 kgs)

## TEMPERATURE RANGE

Slightly above Ambient to 300 Degrees C

## TEMPERATURE CONTROL ACCURACY

+/- .25 Degrees C

## TEMPERATURE UNIFORMITY

+/- 1 Degrees C

## AIR MOVEMENT IN CHAMBER (All Models)

Horizontal at 30 cu ft/min

## AIR FILTER (Optional All Models)

5-Micron, 10" x 10", Stainless Steel

## WIRING

High-Temperature Fiberglass-Insulated Nickel Wire

## THERMAL INSULATION

Semi-Rigid Silica Base, Three-Inches Thick

# FEATURES

## POWER SWITCH

A two-position switch that breaks all ungrounded electrical supply connections.

## CIRCUIT BREAKER RESET BUTTON

Located directly over the power switch; normally in, but protrudes when the circuit breaker, responding to excessive current draw by the Oven, disconnects electric power; permits resetting of the breaker--just push in the button until a click is heard. If the circuit breaker trips repeatedly, have the Oven serviced.

## TEMPERATURE SET CONTROL

A three-digit thumbwheel switch with a resolution of 1 degree C; sets the Oven from 0 to 300 degrees C. For proper control, however, the ambient temperature must be at least 10 degrees below the temperature selected.

## HEAT INDICATOR LAMP

Neon lamp; on when power is being delivered to the heaters, flashing at 10 cps when the temperature is within approximately 5 degrees C of the set temperature. Flashing indicates the heaters are being proportionally controlled, i.e., switched on and off, to bring the Oven to the set temperature with minimum overshoot. At low temperatures the Heat lamp will go out completely for short periods of time; at high temperatures the lamp will continue flashing even after the temperature has stabilized.

## HI-SAFETY THERMOSTAT CONTROL

Guards against overheating should temperature control circuit malfunction; should be set slightly above operating temperature.

## HI-SAFETY LAMP

Neon lamp; when on, indicates that the Hi-Safety Thermostat has disconnected power to the heaters. The Heat Lamp should always be out when the Safety Lamp is on.

**RECORDER OUTPUT**

Three-conductor 1/4-inch jack. Connects to Lab-Line 6206 Single-Pen Recorder or equivalent, to record temperature.

**REMOTE PROGRAM INPUT**

A five-pin female connector which, when the mating plug is inserted, transfers temperature control to a timer (provided the digital temperature set control is set at 500).

**TEMPERATURE LED**

A three-digit LED (light-emitting diode); reads with one-degree resolution the temperature of the Oven air flow; accurate to +/-1.5 degrees C.

**GAS INLET**

One-eighth-inch (schedule 40) pipe with a 1/8-inch 27 NPT thread on the back of the Oven; connects through polyethylene hose to the gas supply. Only nitrogen or other inert gas is to be used in the Oven.

**AIR VENT**

On the back of the Oven, a two-inch diameter vent controlled with a butterfly valve; permits purging of the Oven.

# INSTALLATION

## LOCATION

Place the Oven where it is to be operated, in an area protected from drafts but with space enough to allow free air movement around the Oven. Leave clearance at the rear for gas connection and adjustment of the air vent.

## STACKING

No Lab-Line Ultra-Clean Oven should be placed directly on top of another. To arrange the Ovens vertically, use Lab-Line's Space-Saver Stacking Racks.

## GAS CONNECTION

Gas--nitrogen or some other inert gas--can be injected into the chamber to flush out impurities. The gas inlet, located on the back of the Oven, is a 1/8-inch N.P.T. pipe. Connect a fitting to this pipe for a hose from a dual regulator of a gas source. Leave the gas turned off until the Oven is being operated.

If the Oven is to be operated without gas, keep the inlet capped.

CAUTION: Inject only an inert gas into the Oven.

## LEVELING

The Oven should be level, though its operation does not depend on this. Do not remove the Oven's rubber feet. They are necessary for proper ventilation, without which the result may be erratic temperature control and possible damage to delicate electronic components.

## SHELF INSTALLATION

Install the shelves. First insert rack clips into the rear slots in the chamber wall, taking care that corresponding clips are at equal heights. Hook one end of a rack into a rear clip, slide a free clip onto the other end, then insert this clip into front slots. Proceed in this fashion with the remaining racks. Finally, slide the shelves into place, flange down.



## ELECTRICAL POWER

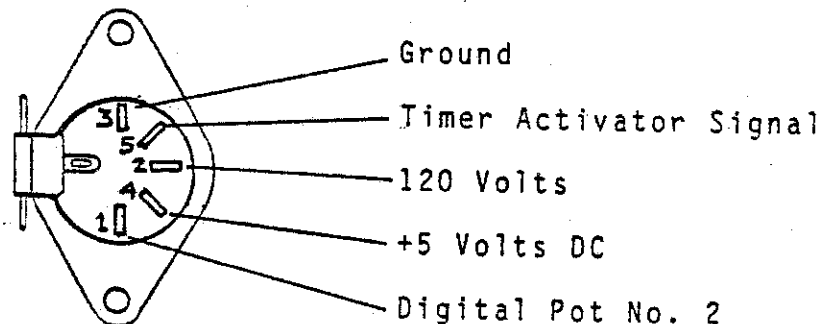
Turn the Power switch, located on the front panel, off. The bottom half of this rocker-type switch should be in.

## REMOTE PROGRAM INPUT

For greater flexibility of operation, the Lab-Line Ultra-Clean Oven may be controlled by a programmable timer through the Remote Program Input. Insertion of the mating plug causes temperature control to be transferred from the Temperature Set control to two pins on the input receptacle.

NOTE: When a remote programmer is used, the Oven's digital Temperature Set control should be set at 500.

## REMOTE PROGRAM INPUT RECEPTACLE VIEWED FROM FRONT LAB-LINE ULTRA-CLEAN OVENS



Input impedance is 40,000 ohms or more. The scale is approximately 6 mv/degree C (the actual scale may vary +/-10 per cent and should be calibrated to the individual timer).

TIMER: Lab-Line's Model 3460 Timer (for 60 Hz, 3460-1 for 50 Hz), designed especially for Ultra-Clean Ovens, can be set for up to 999.9 minutes. The timer begins when the Oven has reached its preset temperature. An alarm, which sounds at the end of the period, can be silenced by pushing the reset button.

## RECORDER

To record Oven temperature, plug a recorder into the standard 1/4-inch phone jack labeled "Recorder." The output circuit has a voltage output of 1 mv/degree C (with an accuracy of +/-1 degree C) and an impedance of 10,000 ohms. The recorder should have an input impedance of one megohm or greater and a one-volt full-scale sensitivity. Lab-Line's Model 6206 Single-Pen Recorder is recommended. Use a two-conductor shielded cable and terminate the shield at the output jack only. NOTE: Noise pickup may become a problem if more than 20 feet of cable is used.

# OPERATION

NOTE: The following instructions are for operation of the Oven minus timer, programmer and recorder. If such accessories are to be used, see their respective operation manuals.

1. Load the Oven evenly, keeping the load at least one inch from the side walls so that air may circulate properly. Close the door.
2. Turn on the Power switch.
3. Set the Temperature Set switch to the desired Oven temperature, then turn the Hi-Safety knob fully clockwise.

The Heat lamp will be on while the Oven is heating; it will blink on and off as the temperature set point is neared--within 10 degrees or so; it will be off and the Hi-Safety lamp on when the Oven temporarily removes electrical power to the heaters to maintain the temperature set point.

4. Allow the Oven temperature to reach the set point and to stabilize, i.e., the LED readout will no longer be increasing. (The readout, incidentally, may differ from the temperature set point by two or three degrees, depending on the circuit's tolerance.)

Turn the Hi-Safety control counterclockwise until the Safety lamp lights, slowly rotate the control clockwise again, then continue a couple of gradations further on the dial.

5. If you wish, the safety thermostat may be calibrated in order to gauge more accurately the upper limit setting.
  - A. Set Safety thermostat fully clockwise.
  - B. Set temperature set switch to desired safety temperature and let Oven stabilize.
  - C. Turn Safety thermostat counterclockwise until Safety lamp lights, then turn Safety thermostat clockwise just to the point where lamp goes out.
  - D. Reset Temperature set switch to desired operating temperature.

# MAINTENANCE

Make no attempt to service or repair a Lab-Line product under warranty before consulting your Lab-Line distributor. After the warranty period, such consultation is still advised, especially when the repair may be technically sophisticated or difficult.

If assistance is needed beyond what the distributor can provide, please call the Lab-Line Customer Relations Department at 312-450-2600.

No merchandise, however, should be returned directly to Lab-Line without prior written approval.

## RECALIBRATION

Recalibration of the control panel circuit may be needed as components age or are replaced. Normally, however, recalibration will have to be no more frequent than once a year. A fully calibrated assembly, which includes the PCB and front panel temperature set control, is available as a replacement part from Lab-Line.

Before the circuit is calibrated, it is essential that all its parts be functioning properly.

1. Disconnect electrical power from the Oven.
2. Remove the two screws in the top of the cover above the control panel. Remove the screws along the bottom of the panel (under the Oven).
3. Slide the panel assembly outward until access to the screws holding the back cover is gained. Remove the three screws in the back of the back cover and three in the top of the back cover.
4. Slide the back cover back or remove it to gain access to the circuit board.

**CAUTION:** When performing the rest of this procedure, use all nonconducting tools. Do not allow contact between any part of the PCB components and the chassis. The potential is 120 volts.

### TEMPERATURE SENSOR AMP--ZERO ADJUST

Remove the wires on the PCB terminals marked "RTD." Connect a precision 100 +/- .01 ohm resistor to the terminals marked "RTD." Connect a precision voltmeter (1 megohm input, 1 mv resolution) to test point 5 (the recorder output can be used, with reduced accuracy). The voltmeter should read +/- .5 mv. Adjust P1 for this value at TP5.

### LED READOUT ZERO ADJUST

Remove the LED bezel by carefully prying it outward. On the LED PCB, on the side nearest the recorder output jack, is a potentiometer. Adjust this pot to make the LED read zero.

### TEMPERATURE SENSOR AMP OUTPUT CALIBRATION

Remove the 100-ohm resistor used in zero adjusting the temperature sensor amp. Replace it with a 212.03 +/- .01 ohm resistor. Connect the voltmeter to the recorder output or the terminal marked analog output. Adjust P4 for 300 +/- .2 mv.

### LED READOUT CALIBRATION

Adjust the gain control on the LED readout for a reading of 300. Replace the bezel on the LED.

### TEMPERATURE CONTROL CALIBRATION

1. Set the digital set control to 297.

NOTE: This setting will compensate for the 3 degree difference between set point and chamber temperature caused by proportioning at maximum temperature. Under certain conditions (room ambient, load), this may not allow for optimum operation; therefore, another setting may be more desirable.

2. Set P3 (100K) maximum clockwise and P2 maximum counterclockwise.
3. Connect the voltmeter to IC2 pin 1 (TP6). Voltage should be +8 volts minimum.
4. Adjust P2 clockwise until voltage goes negative. Adjust P2 counterclockwise slowly until the TP6 voltage just starts to go positive--approximately +.5 volts. The heat lamp should go out at this point.

5. Adjust P3 maximum counterclockwise. Set the digital temperature control to 302. The heat lamp should be flashing. Turn P3 clockwise until the heat lamp just stops flashing. Set the temperature control to 292. The heat lamp should be out.
6. Remove the voltmeter and the resistor and reconnect the blue RTD wires to the RTD terminals. Replace the back cover and reinstall the control panel.

#### BLOWER MOTOR LUBRICATION & CLEANING

The blower motor should be lubricated every six months when the Oven is under continuous use. Turn the Oven upside down, remove the bottom plate and lubricate the motor with 30W SAE oil. Remove any dirt that has accumulated around the motor's ventilation holes.

#### BLOWER SERVICING & REPLACEMENT

A rattling or grinding noise during Oven operation may be caused by a loose or defective blower scroll. To gain access to the blower, carefully raise the front of the chamber floor with a screwdriver and pull forward on it. Remove the cover completely to expose the blower and sensor area of the Oven. If the blower needs to be removed, remove the three screws holding the scroll ring to the scroll. Remove the blower wheel by loosening the set screw on the motor shaft. Tighten the screws in the bottom of the scroll if they are loose. Reassemble the blower unit and replace the chamber floor.

#### CONTROL PANEL REMOVAL & ADJUSTMENT

When repairs or adjustments are indicated for the components on the control panel, proceed as follows: Remove the inside bottom cover, as described under "Blower Servicing & Replacement." Next, remove the sensors from the sensor clamp. Remove the sealant from around the sensor wire and tubing in the floor. Remove the two screws in the top of the panel shroud directly under the door. Remove the wires going to the 12-terminal strip at the rear of the Oven. (Noting the color coding at this point will aid in replacing the wires later.) Remove the panel completely by carefully threading the sensor bulbs, leads and tubing through their access ports as the panel is removed. CAUTION: Do not bend the hydraulic sensor's tubing sharply.

## DOOR GASKET REPLACEMENT

Loosen the screws holding the gasket retainer strips. Do not remove the screws or retainers. Remove the gasket by pulling it out from under the retainers. Find the center of the new gasket and insert it at the door latch position by slipping it under the retainer strip. Continue until the ends of the gasket meet. Trim the ends for a flush fit. Tighten the screws holding the retainers--but only enough to hold the gasket in place.

## HEATER REPLACEMENT

To get to the heaters, first remove the Oven's inner bottom cover, as described under "Blower Servicing & Replacement." Remove the perforated inner walls by pulling them straight out. Remove the back outer panel. Remove the insulation carefully, protecting the hands and arms against skin irritation. The heaters and wiring may now be inspected visually.

To remove a heater, remove the screws holding it by using a screwdriver from inside the Oven and a box wrench to hold the nuts on the heater retainers. After being loosened, the heater may be moved to the rear of the Oven and the wires removed.

All wiring to the heaters has a high nickel content and should not be replaced with regular copper wire. Replace the heat insulation and back cover by reversing the steps above.

## DOOR REMOVAL

With the door closed, remove the bolt in the upper hinge. Pull the door away from the hinges.

## FILTER REPLACEMENT/CLEANING

When the (optional) filter becomes clogged (as may be indicated by slower than usual heatups), it should be cleaned or replaced. Remove the shelves and the pan covering the inner bottom. Pull out the filter wall, located on the right side of the Oven chamber. The filter may be cleaned by reverse flushing, i.e., injecting a high-pressure solvent from the pilaster side to the other side.

# TROUBLESHOOTING

Only a qualified technician should troubleshoot the Ultra-Clean Oven circuits.

If any of the following tests do not produce the values given, replace the circuit with a new one. This must include the temperature set control, or recalibration will be necessary.

## ROUTINE TESTING

Equipment required: 0-15 mc oscilloscope and a digital voltmeter.

All voltages refer to ground terminal on the connector.

1. Check the voltage at TP1- (-C9): -13.5 V to -19.5 VDC. Check D2, D5, T1, main circuit breaker, power switch, and wiring to AC supply.
2. Check voltage at TP2 (+C10): +13.5 VDC to +19.5 VDC. Check D3, D4, T1, etc. (same as above).
3. Check IC5 pin 3 or TP3: +9 VDC to +11 VDC and AC component less than 5 mv peak. Otherwise, replace IC5 (CA723C). Check R32, R33, R34, C12, R35.
4. Check IC4 pin 7 or TP4: -9 VDC to -11 VDC and AC component less than 5 mv peak. Otherwise, replace IC4 (CA723C) and/or Q3 (2N4030). Check R36, R37, R38, R39, R40, C7.
5. Check voltage at IC5 pin 6: +7.0 VDC to +7.13 VDC. Replace IC5 if correct voltages are not present.
6. Check voltage across R3: 200 mv to 300 mv. Replace IC8 (LM308N) and/or Q1 (MPSD54) if correct voltages are not present. Check P1, R2, R3, R5, R6.
7. Check voltage across R4: +3.5 VDC to +3.7 VDC. If correct voltages are not present, replace IC8 (LM308N) and/or Q1 (MPSD54). Check R4, RTD sensor, R5, R6.
8. Set digital temperature control to 300. Check terminal marked "Dig. Pot 2": +1.8 VDC. Check P5 (temperature set), P2, wiring from PCB to P5.



9. Check the waveform at Q5 (2N3565) base. The triangular waveform should rise to -2.0 and fall to -8.2 V. Otherwise, replace IC2 (LM324N) and/or Q5 (2N3565). Check R18, R19, P3, C5, R22, R23, R24, R25, R26.
10. Check +C8: 6 VDC to 7 VDC. Replace IC7. Check C8 and R31.
11. Check TP6 for +9 VDC with digital temperature control set at 000. Check for 10 Hz pulses +9 to -.5 V with temperature set at 3 degrees C above sensor temperature; with temperature set at 20 degrees above sensor temperature the voltage should be -.5 VDC. Check the heat lamp: TP6 should read -.5 VDC when the lamp is on, +9 VDC when the lamp is off, and have pulsating voltage when the lamp is flashing. If not, replace IC2 (LM324) and/or IC3 (4N37), IC7 (CA3079), Q4 (T6401D or 2N6344A). Check C8, R21, R28, R29, R30, R31, D1, C6, R27, heaters, heat lamp.
12. Check +5 V terminal: the voltage should be 4.8 to 5.2 VDC. Check IC6 and IC11. Check for a short in the wiring to the LED display.

## SYMPTOMATIC TROUBLESHOOTING

### HEAT LAMP ON AT ALL TIMES--NO CONTROL

Test 1: Turn off the power. Remove IC7 (CA3079).  
Result: Turn the power on. If the lamp is still on, replace Q4 (T6401D). Check C6, R27, shorts.

If the lamp is out, replace IC7 (CA3079).

Test 2: Disconnect one lead of the RTD sensor.  
Result: If the lamp is still on, replace IC3 (4N37) and/or IC2 (LM324), IC1 (LM308).

If the lamp is out, replace the sensor.  
Check for shorts in sensor wires.

### HEAT LAMP OFF AT ALL TIMES--NO CONTROL

Set controls so that the heat lamp would normally be on.

Test 1: Short the RTD terminals.  
Result: If the heat lamp is on, replace the RTD sensor.

Test 2: Remove IC1 (LM308N).

Result: If the heat lamp is on, replace IC1.

Test 3: Remove IC2 (LM324).

Result: If the heat lamp is on, replace IC2.

Test 4: Check the output of IC7 pin 4 with an oscilloscope: 2 V pulse at 120 Hz or 100 Hz.

Result: If a pulse is not present, replace IC7 (CA3079).

If a pulse is present, replace Q4 (T6401D).

Check heaters, heater wiring, heat lamp.

Check C8 (100  $\mu$ fd) for 6 to 7 VDC. Check R31.

Check for AC line voltage on terminals marked "AC-L1" and "AC-L2."

# REPLACEMENT PARTS

PART	PART NUMBER
Blower Wheel	160-116-00
Clip, Pilaster	170-001-00
Control Panel Assemblies	
For Model 3450	012-119-00
For All Other Models	012-120-00
Cordset	470-105-00
Filter Assembly	
3450M/M-1/M-3	013-679-00
3455M-1/M-3	013-680-00
3459M-1/M-3	013-680-00
Foot	790-225-00
Gasket	
3450M/M-1/M-3	530-081-00
3455M-1/M-3	530-081-00
3459M-1/M-3	530-081-00
Heater	
400 W, 120 V	340-171-00
500 W, 120 V	340-183-00
Magnet, Door	
3450M/M-1/M-3	620-028-00
3455M-1/M-3	620-019-00
3459M-1/M-3	620-019-00
Motor, Blower	370-111-00
Shelf	
3450M/M-1/M-3	587-130-00
3455M-1/M-3	587-062-00
3459M-1/M-3	587-148-00
Wiring Diagram, Control Panel Assemblies*	
012-119-00 (120 V)	227-409-00
012-120-00 (208/240 V)	227-409-00

---

### \*CONTROL PANEL

### MODEL NUMBER

012-119-00	for	3450M	(120 V)
012-120-00	for	3450M-1	(240 V)
012-120-00	for	3450M-3	(208 V)
012-120-00	for	3455M-1	(240 V)
012-120-00	for	3455M-3	(208 V)
012-120-00	for	3459M-1	(240 V)
012-120-00	for	3459M-3	(208 V)

## Wiring Diagram, Heater

Hookup	
3450 M	227-542-00
3450M-1	227-543-00
3450M-3	227-477-00
3455M-1	227-521-00
3455M-3	227-498-00
3459M-1	227-544-00
3459M-3	227-545-00
PCB Schematic (All Models)	227-119-00

## CONTROL PANEL--ALL MODELS

Breaker, Circuit	
20 A	330-128-00
25 A	330-224-00
Capacitor	
1600 Mf	310-078-00
100 Mf Tantalum	310-084-00
Diode, IN5060	495-104-00
Integrated Circuit	
CA723CE	227-067-00
CA723E	227-068-00
CA3079	227-064-00
LM325	227-070-00
LM308	227-069-00
LM325	227-070-00
LM340-5	227-072-00
4N37	227-071-00
Knob, Hi-Safety Control	560-181-00
Lamp, Pilot	
Red, 120 V	360-146-00
Amber, 120 V	360-164-00
Amber, 208 V, 240 V	360-147-00**
PCB, Final Assembly	
120 V	012-019-00
208 V, 240 V	012-020-00
Meter, Led	560-077-00
Sensor, RTD	410-628-00
Switch, Power	440-098-00
Transformer	460-187-00
Transistor	
MPSD54	495-105-00
2N3565	495-110-00
2N4030	495-106-00

\*\*Only amber pilot lamps are used on 208 V and 240 V units.

Thermostat	920-223-00
Triac, T6401D, 20 A	495-248-00
Varistor, Mov, V3321A6GE	410-407-00
Voltage Divider, Incremental	660-078-00