

**OPERATING AND MAINTENANCE MANUAL FOR
T1000 CONTROLLER**



CONTROLLER DESCRIPTION

CONTROL BOARD AND DISPLAY

The control board supplies all the necessary functions for heater operation. These include control temperature, hi-limit cut-out, low water detection, and leak detection.



OPTIONAL EQUIPMENT

XB1 Expansion Board

An optional expansion board to the control board can be used to for additional circuit firing when more than two circuits are required and/or as an auxiliary high or low temperature alarm/relay. On models with three contactors the XB1 is supplied as standard.

Remote Alarm Plug Adapter

An optional plug adapter is available to provide a remote fault alarm signal through the J4 connector on the control board.



24-Volt Heater Interlock Adapter

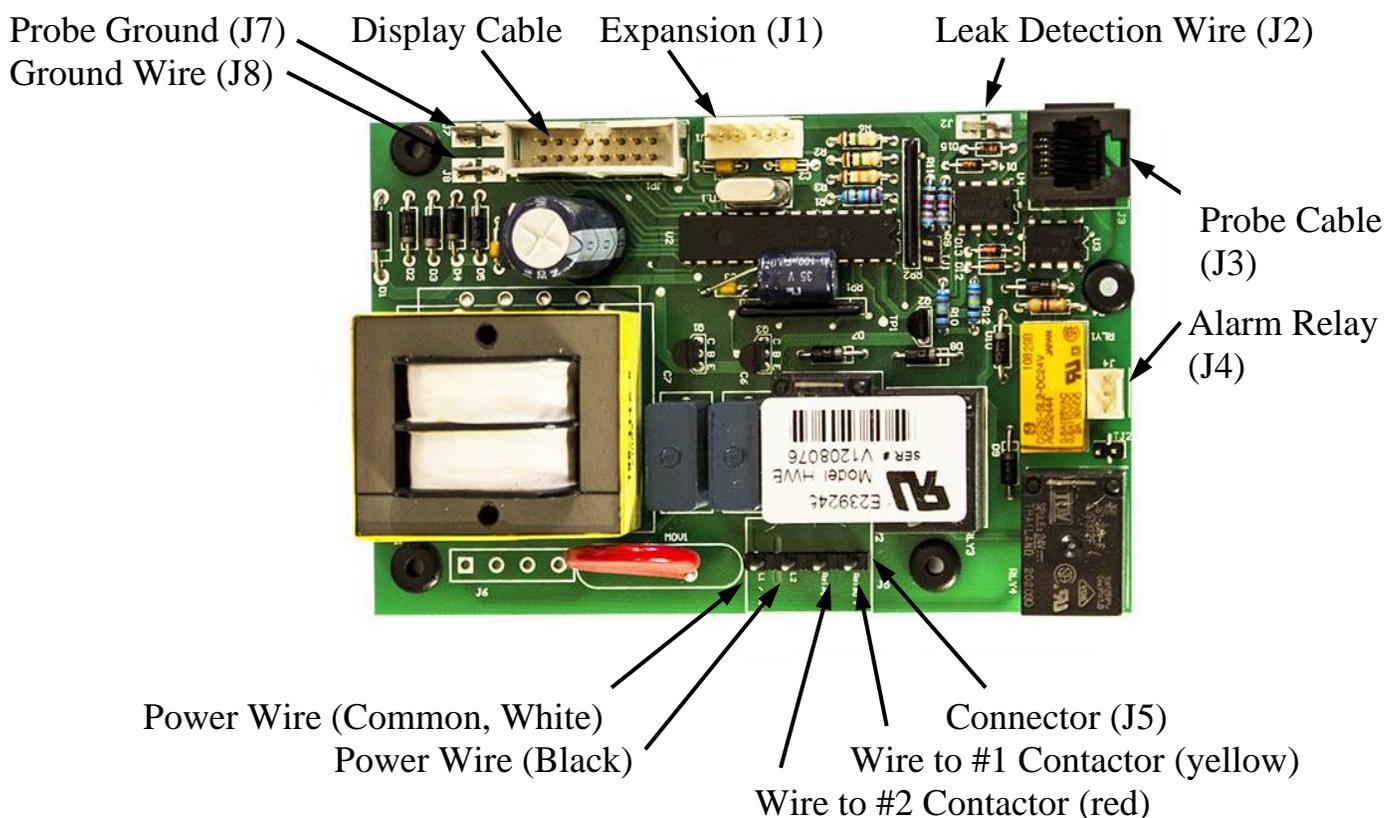
An optional plug adapter is available to interlock the heater via a 24-volt signal through the J1 connector on the control board. The 24-volt heater interlock adapter is supplied standard on the J3 model. (Only available with r23 or later software).



CONTROLLER INSTALLATION AND WIRING OPTIONS

CONTROLLER (T1000) / DISPLAY (TD1000)

Shown below is the controller connection layout.



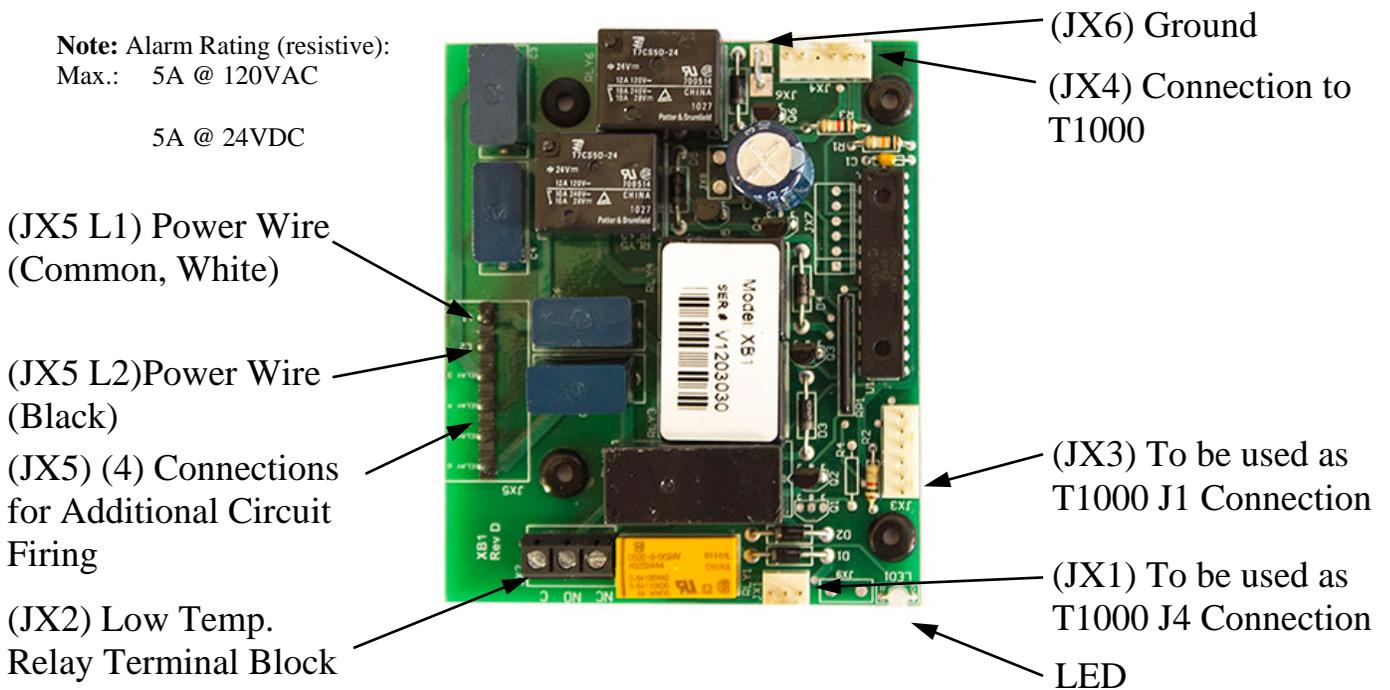
Note: Probe connector J3 comes filled with a dielectric gel.

OPTIONAL XB1 EXPANSION BOARD (used for temperature alarm / interlock)

1. If desired, the XB1 can be used as an alarm relay or a temperature interlock at a setpoint other than the water temperature setpoint on the booster heater.
2. If the XB1 is not factory installed, mount the XB1 to the control panel and connect the XB1 to the T1000 control board with the factory supplied cable between JX4 on the XB1 and J1 and J4 on the T1000 and connect the ground between JX6 on the XB1 and J8 on the T1000.
3. Make connections as required to the relay terminal block. When the temperature drops below the XB1 setpoint the relay is open between Normally Open (NO) and Common (C) and the LED will flash green. When the temperature is above the XB1 setpoint the relay is closed between NO and C and the LED will be solid green. Use NO and C for low temperature interlock or high temperature alarm. Use Normally Closed (NC) and C for low temperature alarm. A red LED indicates an error.

Note: Alarm Rating (resistive):
Max.: 5A @ 120VAC

5A @ 24VDC



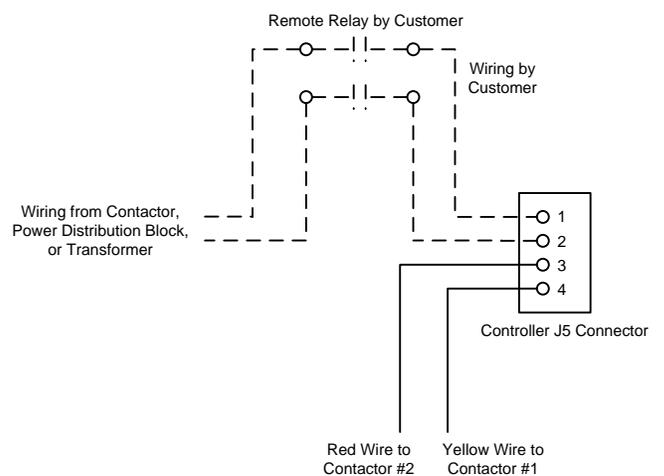
Note: Once the XB1 is connected to the T1000 control board, an additional menu option will be available to set the low temperature setpoint. See Section III.

FOR REMOTE ON/OFF CONTROL

To remotely control the On / Off operation of the heater, it is recommended that a DPST switch or relay (by others) be used to break both power legs (white and black wires) connected to the top two terminals of the J5 connector on the control board. See diagram at right.

Use a NC (Normally Closed) relay to turn the booster ON when energizing the relay coil or to turn the booster OFF when de-energizing the relay coil.

Use a NO (Normally Open) relay to turn the booster OFF when energizing the relay coil or to turn the booster ON when de-energizing the relay coil.



OPTIONAL REMOTE ALARM CONTACTS

1. If desired, the control board can be wired to a remote alarm to indicate a reset fault condition. These fault conditions include over-temperature, no probe, and low water (when the configuration is set to manual reset).

- This alarm can be wired to the J4 connector on the control board as shown below. To facilitate this installation, an optional adapter, Hubbell P/N PLUG ADAPTER J4, can be purchased to provide wire connections.



J4 Connector



PLUG ADAPTER J4



Note: Rating (resistive)
 Max. Switching Power:
 60W, 62.5VA
 Max. Switching Voltage:
 220VDC, 250VAC
 Max. Switching Current: 2A
 Max. Carrying Current: 3A

Common

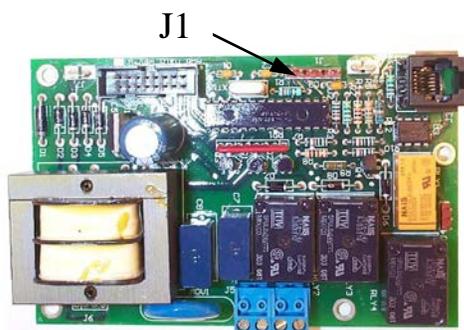
(NO)

(NC)

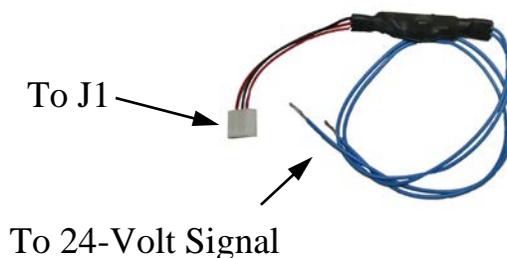
Note: That when the XB1 expansion board is used, the J4 PLUG ADAPTER should plug into the JX1 connection on the XB1.

OPTIONAL 24-VOLT HEATER INTERLOCK ADAPTER

- If desired, the heater can be wired to operate only when supplied with a 24-volt signal through the heater interlock adapter. When no 24-volt signal is supplied through the heater interlock adapter the heater is interlocked and will not energize. When interlocked the display will show “HLd”. The heater will resume normal operation when a 24-volt signal is re-applied through the heater interlock adapter.
- To utilize this feature, plug the 24-volt heater interlock adapter into terminal J1 of the T1000 control board (note: if the XB1 expansion board is used, plug the adapter into terminal JX3 of the XB1) and verify that the configuration is set to “Hon”, see the controller operation section for further detail. The signal can be either AC or DC. However, if a DC signal is utilized and the interlock feature does not operate, switch the two 24-volt supply wires at the heater interlock adapter.



J1



To J1

To 24-Volt Signal

CONTROLLER OPERATION

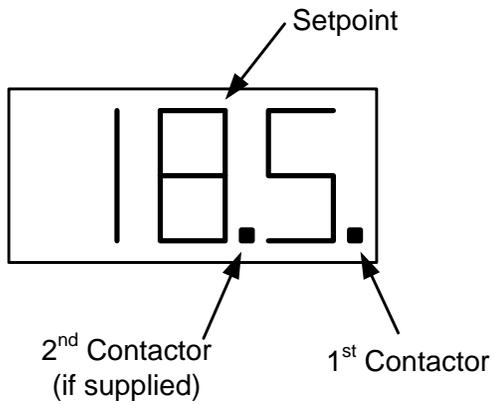
CONTROLLER OPERATION

NOTE: All controller variables come preset from the factory to include a preset temperature of 185°F.

- To turn unit on or off:
 - Press the ON/OFF button on the display module.
 - Note that the controller will resume its last mode of operation if power is disconnected.
- To change setpoint temperature (the temperature is fully adjustable from 32° to 194°F (0°-90°C):
 - Press the UP and DOWN arrows simultaneously to enter setpoint change mode.
 - Press the UP or DOWN button to change the setpoint temperature.
 - Pressing and holding the UP or DOWN button will scroll through the setpoint temperature.
 - To leave setpoint change mode
 - Wait 5 seconds without pushing any buttons or press the UP and DOWN buttons simultaneously.

3. To view the number of operational hours (the number of hours when a contactor is pulled in) and software version:
 - a. Press the UP and DOWN arrows simultaneously to enter setpoint change mode.
 - b. Press the ON/OFF button.
 - c. Display will flash the software version (e.g. R14), HRS, followed by the hours in thousands of hours, followed by the hours.
 - i. Example: r 14, H r S, 12 3, 4 5 6; indicates software version R1.4 and 123,456 hours.
 - d. To leave operational hours mode
 - i. Wait 5 seconds without pushing any buttons or press the UP and DOWN buttons simultaneously.
4. Configuration Menu. (NOTE: Configuration menu change should only be made by qualified personnel).
 - a. With the controller turned OFF, to enter the configuration menu, press and hold the UP, DOWN, and ON/OFF buttons simultaneously for 5 seconds.
 - b. To scroll through menu settings, press the ON/OFF button.
 - c. To make a change to a menu setting use either the UP or DOWN arrow.
 - d. Settings:
 - i. Relays – sets the number of magnetic contactors used in the heater.
 1. r ##, where ## is the number of magnetic contactors (01 or 02).
With XB1 installed ## can be 01 through 06.
 - ii. Low water detection – sets the low water detection on or off.
 1. LOn, for low water on. (Factory Default)
 2. LOF, for low water off.
 - iii. Low water reset – sets the low water reset for either automatic or manual
 1. LAU, for low water automatic reset. (Factory Default)
 2. LAn, for low water manual reset.
 - iv. Temperature units – sets the temperature units to either degrees Fahrenheit or Celsius.
 1. DEF, for degrees Fahrenheit. (Factory Default)
 2. DEC, for degrees Celsius.
 - v. Differential – sets the number of degrees below setpoint that the heater will resume heating after it has achieved setpoint.
 1. d##, where ## is the differential in degrees (1 to 20). (Factory set at 02)
 - vi. Display – sets the display to either setpoint or actual temperature.
 1. dSS, for display setpoint temperature. (Factory Default)
 2. dSt, for display actual temperature.
 - vii. Heater Interlock – sets the heater interlock mode to on or off. (Only available with r23 or later software).
 1. HoF, to disable the 24-volt interlock feature. (Factory Default)
 2. Hon, to enable the 24-volt interlock feature.
 - viii. XB1 Temperature Setpoint – sets the setpoint for the operation of the XB1 relay operation.
 - e. To leave the configuration menu, wait 5 seconds without pushing any buttons or press the UP and DOWN buttons simultaneously.
5. To reset any high-limit, no probe, or low water (when in manual reset mode) fault condition, press the RESET button.
6. Display
 - a. By default the display will show the setpoint of the booster heater.
 - b. The decimal points on the display, as shown below, indicate that the controller is calling for a contactor to pull in. If three or more contactors are installed, the

third decimal point is used for all remaining contactors.



TROUBLESHOOTING

ERROR MESSAGES

1. `Err, No, Prb` - This message will flash when the controller does not detect that the probe is connected to the control board. To clear this error reinsert the probe connector and press RESET.
2. `Err, too, hot, ###` (where `###` is the actual temperature of the water.) - This message will display if the temperature of the water exceeds the high limit temperature setpoint. To clear this error, wait until the temperature is below the operating setpoint and press RESET. Note that the unit will not reset until the indicated temperature is below 195°F. If this message continually occurs, follow the troubleshooting flow chart for continuous over-temperature condition.
3. `Err, No, H2O` - This message will display when the water level in the tank has dropped below the sensor probe. To clear this message, refill the tank. If the low water reset is set for automatic, the error will clear. If the low water reset is set for manual, when the tank is full press RESET. Check the heater and the piping for leaks. Check for mineral buildup on the probe and clean as required. Check for continuity between the yellow wire and ground. See diagram 2 on the following page.
4. `Err, H2O, LEA` - This message displays if the leak detection sensor determines there is water in the base of the heater shell. To clear this message, remove the water from the leak detection sensor. Check the unit and piping for leaks.
5. `CC` - This message displays if the display cable is installed into the control board backwards. To clear this message, remove and correctly install the display cable.
6. `255` - This message indicates that the probe is likely out of calibration. To clear this message, it is recommended that the probe be removed and replaced.
7. `HLd` - This message indicates that the 24-volt interlock feature is enabled, there is no 24-volt signal present, and the heater is in standby mode. If it is not the intention to operate the heater with the 24-volt interlock feature, this feature should be disabled as shown in the controller operation section. (Only available with r23 or later software).

MISCELLANEOUS

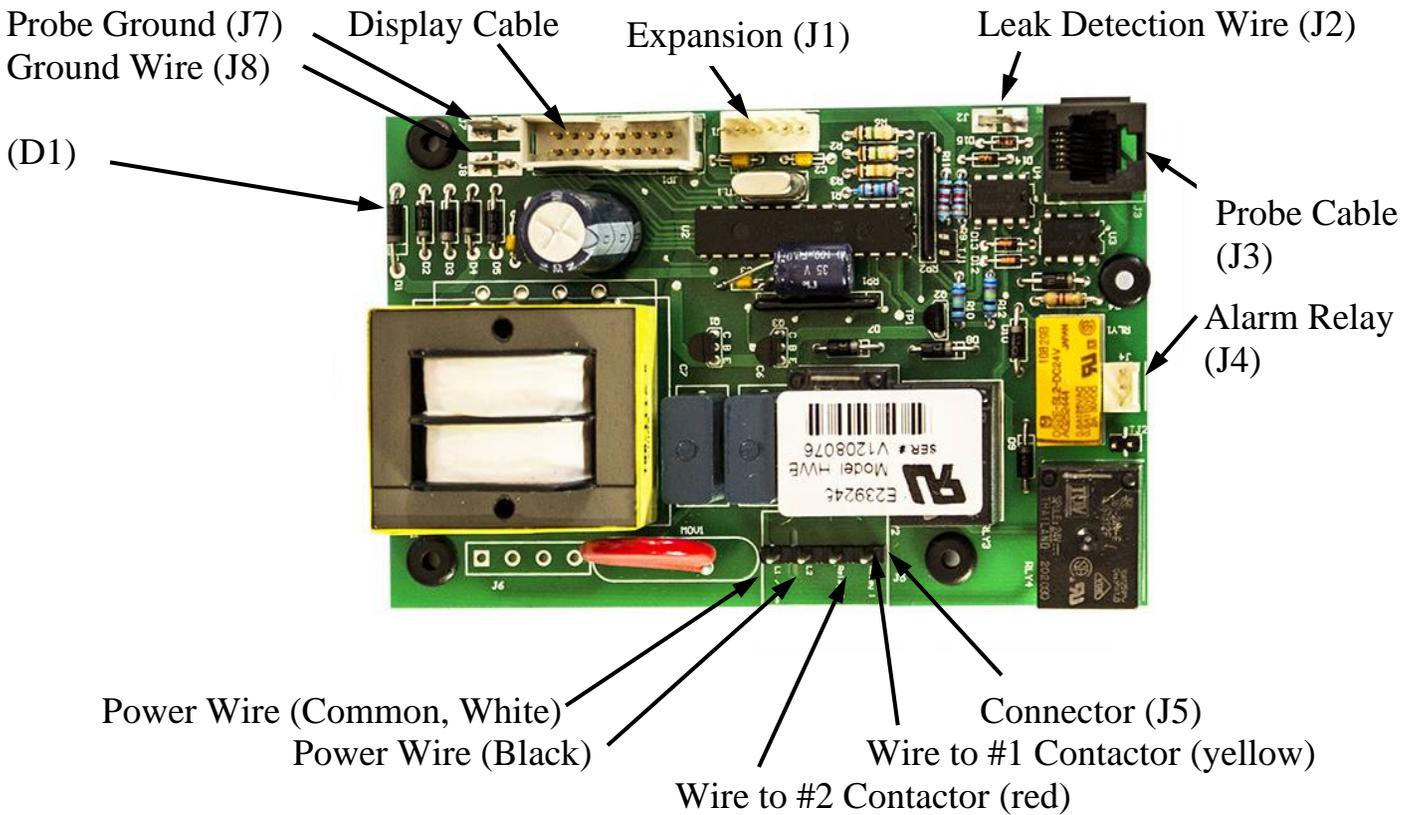
1. If the display flashes when the unit is first turned on or turned on after maintenance, check that the J5 terminal on the controller is engaging all four pins on the board.
2. Note that before replacing the control board, display, or probe, it is recommended that the power supply to the booster heater be turned off at the main circuit breaker disconnect to the booster heater to reset and clear the electronic controller.

GENERAL TROUBLESHOOTING

Symptom	Probable Cause	Corrective Action
Water reaches setpoint temperature but does not last through the entire process cycle.	Low incoming water temperature.	Incoming water temperature must be adequate for the heater size. Increase the incoming water temperature.
	Incoming water temperature is dropping.	Primary water supply is not adequate to continually provide correct temperature in sufficient quantities. Increase the supply of primary cold water.
	Heater may be undersized.	The heater must be properly sized for the incoming water and rinse requirements of the process. If required, replace with a properly sized unit.
	Incorrect voltage.	Voltage available at the heater must be correct for unit. Verify voltage on all phases matches nameplate on the heater.
	If two magnetic contactors are utilized, one is not energizing.	Verify that both magnetic contactors are operating. If not, see the 'Magnetic Contactor Troubleshooting' section.
	One or more elements are not energizing.	Verify that each element is drawing the correct amperage. Replace elements as required.
Water at the outlet is not the proper temperature.	Temperature setpoint too low.	Adjust the temperature setpoint.
	Water heater piping to point of use is not insulated.	If there is more than 5 linear feet of piping between the heater and the process, the piping should be wrapped in insulation or a recirculating system should be installed.
	Bypass valve (if installed) is open or allowing water to pass when closed.	Verify that the bypass valve between the hot and cold water lines is closed. If condition continues, replace the bypass valve.
Water heater does not heat at all.	Main supply circuit breaker tripped.	Check and/or reset the circuit breaker.
	Water heater circuit breaker tripped.	If unit is supplied with a circuit breaker, check and/or reset the circuit breaker.
	Heater in high limit.	If a high limit error occurs, allow water to cool and press the reset button.
	Low water error.	Verify that the heater is full of water. If error is still present see the 'P65 Probe Troubleshooting' section.
	Magnetic contactor does not energize.	See the 'Magnetic Contactor Troubleshooting' section.
	No power to control board (T1000) or display (TD1000) not lit.	Reseat the display (TD1000) ribbon cable in the control board (T1000) connector. If the display is still not lit, see the 'Control Board (T1000) / Display (TD1000) Troubleshooting' section.
	Element Failure	Disconnect the wires from each element and verify that the resistance (ohms) value for each element is correct. Replace elements as required.
	Incorrect Configuration Settings	Verify and correct configuration settings as required.

CONTROL BOARD (T1000) / DISPLAY (TD1000) TROUBLESHOOTING

1. Verify proper power supply voltage between each phase (L1 to L2, L2 to L3, and L1 to L3). The power supply voltage should match the voltage listed on the heater nameplate. If voltage is incorrect, check main supply wiring or replace unit with proper heater.
2. Check for 208/240VAC between pin 1 (white wire) and pin 2 (black wire) of the J5 connector on the T1000 control board. If no voltage is present, skip to step 4.
3. If 240VAC is present, check for 24VDC between D1 and ground. If 24VDC is present replace the display (TD1000). If 24VDC is not present replace the control board (T1000).



4. If a transformer is installed, verify proper power supply voltage to the primary side of the transformer and verify approximately 240VAC on the secondary side of the transformer. If voltage is present on the primary side but not on the secondary side, replace the transformer.
5. If circuit breakers are installed, verify that the circuit breaker is ON. Verify proper power supply voltage between each phase (L1 to L2, L2 to L3, and L1 to L3) to the line side of each circuit breaker and to the load side of each circuit breaker. If voltage is present on the line side but not on the load side, replace the circuit breaker.
6. Verify that the heater is wired according to the proper wiring schematic for the unit. Correct as required. If unit still does not operate, contact the factory.

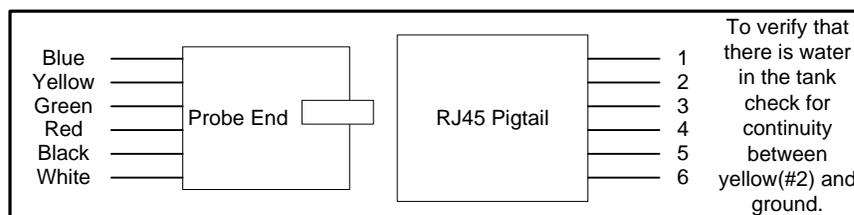
MAGNETIC CONTACTOR TROUBLESHOOTING

1. With the unit ON and calling for heat, check for lit decimal points on the display. If the unit has a single contactor, the first decimal to the right of the display should be lit. If two decimals are lit, verify that the configuration is set for one contactor. If the unit has two contactors, verify that two decimals are lit. If only one decimal is lit, verify that the configuration is set for two contactors. If no decimals are lit, continue to the 'P65 Probe Troubleshooting' section.
2. With the unit ON and calling for heat and one decimal lit, check for 240VAC between pin 1 (white wire) and pin 4 (yellow wire) of the J5 connector on the T1000 control board. If no voltage is present, replace the control board (T1000). If voltage is present, check for voltage across the contactor coil. If voltage is present at the contactor coil, replace the magnetic contactor. If no voltage is present, verify that the heater is wired according to the proper wiring schematic for the unit.

3. If the unit has two contactors, with the unit ON and calling for heat and two decimals lit, check for 240VAC between pin 1 (white wire) and pin 3 (red wire) of the J5 connector on the T1000 control board. If no voltage is present, replace the control board (T1000). If voltage is present, check for voltage across the contactor coil. If voltage is present at the contactor coil, replace the magnetic contactor. If no voltage is present, verify that the heater is wired according to the proper wiring schematic for the unit.

P65 PROBE TROUBLESHOOTING

1. Unplug and reseal the P65 probe wire in the jack on the T1000 control board. Note that the error message “Err, No, Prb” will be displayed and the reset button must be pressed to clear the message.
2. If problem persists, unplug the P65 probe from the control board and plug into the RJ45 pigtail (not supplied).
3. If the problem is with temperature control or high limit:
 - a. Change the configuration to ‘d S t’ to display the actual water temperature.
 - b. Check the temperature of the water with a thermometer and compare that with the temperature on the display. If the two temperatures coincide, replace the T1000 control board. If the two temperatures do not coincide, continue to the next step.
 - c. Unplug the P65 probe from the control board and plug into the RJ45 pigtail (not supplied). Check the resistance value (ohms) between the blue wire of the pigtail (#1) and the red wire of the pigtail (#4). Compare the resistance value measure with the chart below at the measured temperature of the water. If the two values coincide, replace the T1000 control board. If the two values do not coincide, replace the P65 sensor
4. If the problem is with low water:
 - a. Verify that the unit is filled with water.
 - b. Check for continuity between the yellow wire of the pigtail (#2) and ground. If continuity exists, replace the T1000 control board. If no continuity exists, replace the P65 sensor probe.

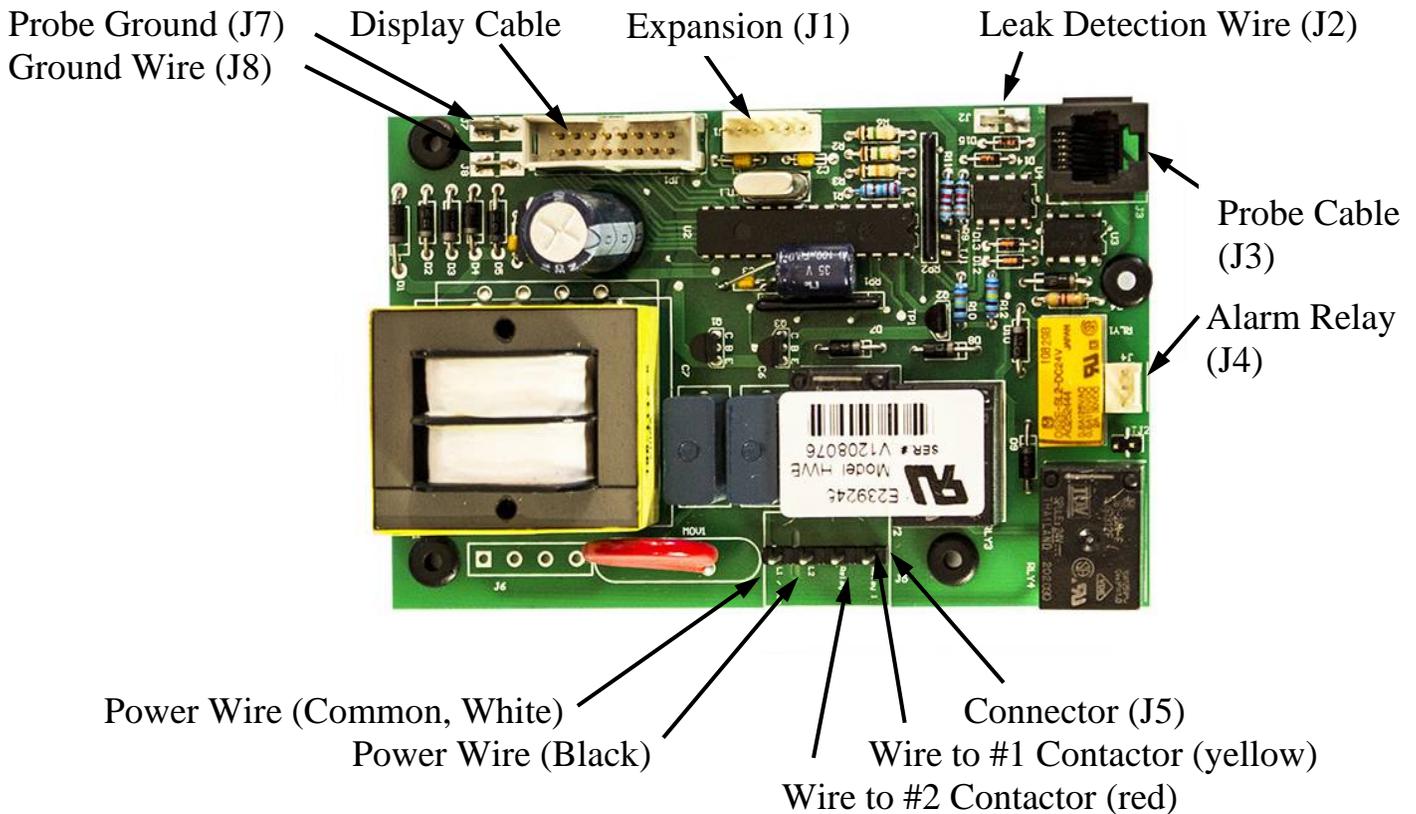


Thermistor Resistance vs. Temperature	
Water Temperature	Resistance ($\pm 3\%$)
70°F	11883Ω
80°F	9299Ω
90°F	7334Ω
100°F	5828Ω
110°F	4664Ω
120°F	3758Ω
130°F	3048Ω
140°F	2488Ω
150°F	2043Ω
160°F	1687Ω
170°F	1400Ω
180°F	1169Ω
190°F	980Ω

SERVICING AND REPLACEMENT

CONTROL BOARD

1. Disconnect power from unit.
2. Disconnect display cable, probe cable (J3) and probe ground (J7), leak detection wire (J2), ground wire (J8), and terminal block (J5) from the control board. NOTE: The terminal block (J5) is removable from the control board. Grasp the terminal block on the ends and pull straight away from the board.



Note: Probe connector J3 comes filled with a dielectric gel that should remain in the connector.

3. Remove four (4) screws securing control board to panel.
4. Remove and replace control board.
5. Reconnect wires disconnected in step 2. NOTE: When reconnecting the ribbon cable, be sure to have the key on the cable align with the slot in the connector.
6. Connect power to unit.

P65 SENSOR PROBE

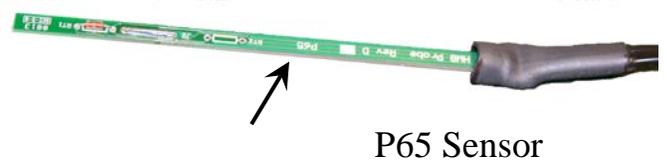
1. Disconnect power from the unit.
2. Unplug the P65 probe connector from J3 and the probe ground from J7 on the T1000 control board.



3. Twist the cord and shrink-wrap end of the P65 probe (or cut the shrink-wrap with a sharp knife) to loosen the P65 sensor assembly from the P65 thermowell.

- Remove the old P65 sensor assembly by pulling on the cord coming out of the P65 thermowell.

Note: It is unnecessary to unscrew the thermowell from the vessel to replace the P65 sensor.



- Insert the new P65 sensor assembly into the P65 thermowell. Be sure to insert the sensor until the shrink-wrap cap engages the threads on the end of the thermowell.

Note: The new sensor and cord assembly is push-fit onto the end of the thermowell threads. Do not twist the new sensor and cord assembly into the thermowell. The thermal conductive heat transfer paste inside the thermowell is sufficient for replacement sensors. Adding additional paste is not required.

- Plug P65 probe connector into the T1000 control board.
- Turn on power to the unit. If display shows “Err, No, Prb”, press the reset button.

P65 THERMOWELL

- Follow steps 1-4 for removing the P65 Sensor Probe above.
- Shut off incoming water supply.
- Attach hose to drain connection.
- Lift manual release lever on relief valve to let air into system or break union on outgoing water line.
- Drain water from tank.
- Remove the thermowell from tank using a 13/16” socket.
- Install new #115 Buna-N o-ring gasket and install new thermowell. **NOTE:** Hubbell recommends lubricating the o-ring with Parker O-Lube prior to installation. **WARNING:** Do not remove the jam nut.



Thermowell

- Reinstall or install a replacement P65 sensor probe in accordance with steps 5 and 6 above.
- Refill tank.
- Check for leaks. Retighten as required.
- Turn on power to the unit.
- Note that to resume operation the controller will need to be reset by pressing the ‘RESET’ button on the display.



CAUTION: Do not use plumber’s tape/Teflon tape/pipe dope when installing the P65 Thermowell. Tape will prevent the low water detection system from operating properly and will cause false low water errors. Lubricate O-ring prior to installation. Tighten probe at the brass hex flats only.



STRATFORD, CT 06615-0288

PHONE: (203) 378-2659

FAX: (203) 378-3593

INTERNET: <http://www.hubbellheaters.com/>