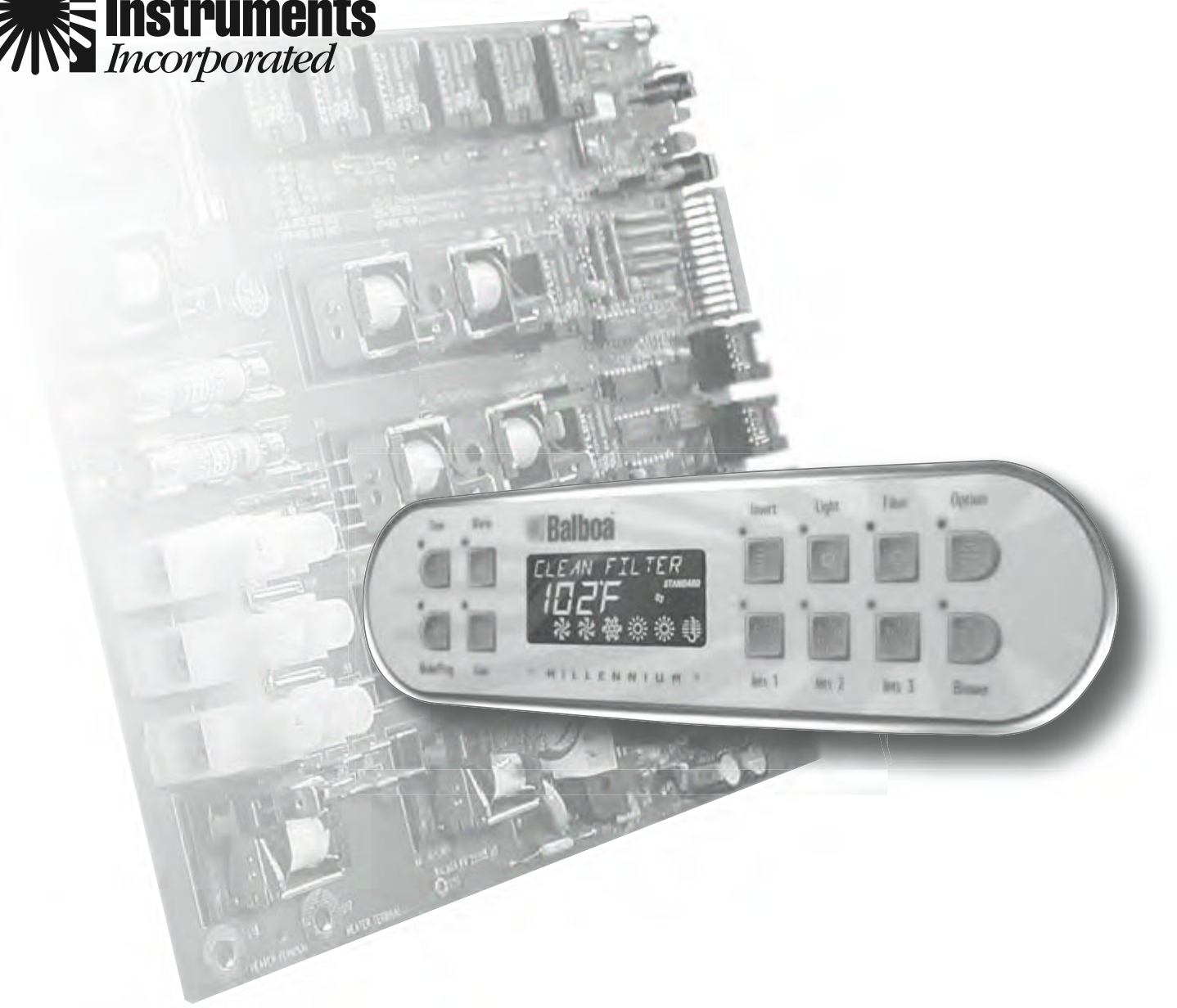
Balboa Instruments *Incorporated*



M-7 Technical Service Manual

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End User Warning

This Technical Service Manual is provided solely to aid qualified spa service technicians in troubleshooting and repairing spas with control systems manufactured by Balboa Instruments, Inc. Balboa controls have absolutely no end user serviceable parts. Balboa Instruments does not authorize attempts by the spa owner/user to repair or service any Balboa products. Non-qualified users should never open or remove covers, as this will expose dangerous voltage points and other dangerous risks. Please contact your dealer or authorized repair center for service.

Balboa Control Service Checklist

Preface

This manual is provided to aid the qualified service technician in troubleshooting and correcting problems found in spas with M-7 Technology and control systems manufactured by Balboa Instruments, Inc.

Tools Required

- Ammeter (50A)
- Digital Multi-meter
- Balboa Logic Jumper on a Stick
- Balboa Six-in-one Screwdriver, Includes:

  Two Phillips Head and Two Flathead Screwdrivers Along with a $^{1}/_{4}$" and $^{5}/_{16}$" Nut Driver
- $^{5}/_{16}$" Socket
- $^{1}/_{4}$" Open End Wrench
- Small Wire Cutters
- Pliers & Needlenose Pliers
- Quick Check™ Test Kit
- Precision Thermometer - Digital Fever Type
- Padlock (to lock electr disconnect during servi
- Plumber's Sealant

Quick Check™ Test Kit

System Components Required

- Fuses (30 and 20A time delay plus 20, 10 and 3A)
- System Transformers (120 V and 240 V plus a 120 V Duplex)
- System Sensors
- System Panel(s)
- System Circuit Board

Important

Due to the danger of severe electrical shock, locate all power disconnects before servicing a spa. Precautions must be taken whenever working with breaker boxes, G.F.C.I.'s, or service disconnects.

Always refer to the wiring diagram which is included with each system on the inside of the system box cover. Use this diagram for voltage measurement points, and for proper reconnection of wires.

Important

Be sure to bring the correct circuit board, topside control panel, components, and tools.

Safety Tips

- Keep children and pets away.
- Be aware of your surroundings. Standing in water while repairing a spa puts you at serious risk.
- Avoid working in cramped or crowded conditions.

Digital Fever Thermometer

Balboa Logic Jumper on a Stick

DANGER: SHOCK HAZARD.

DO NOT PROCEED IF UNQUALIFIED IN WORKING WITH HIGH VOLTAGE.

System Description

Highly advanced microprocessor technology has been combined with solid-state electronic switches to produce the world's finest, high quality state-of-the-art digital control systems. Balboa control systems are technologically sophisticated, yet easy to understand, use, and troubleshoot.

Topside Control Panel

The control panel activates functions at the touch of a button. Each function will echo from the circuit board to the LCD in a corresponding manner. The panel will also display diagnostic messages which enable the service technician to easily troubleshoot the system.

Circuit Board

A typical circuit board has the following output capabilities:

- 240 VAC System
- Two-speed pump
  240 VAC, 60 Hz, 2 HP
- Single-speed pump
  240 VAC, 60 Hz, 2 HP
- Blower
  240 VAC, 60 Hz, 2 HP
- Heater
  240 VAC, 60 Hz, 5.5 kW
- Light
  12 V, 12 W, 60 Hz, 1A or
  120 V, 100 W

In addition to these outputs, the board receives input from the two temperature sensors located within the heater housing.

Important

Do not remove and replace the circuit board unless you have tested all other components and proven that the circuit board is actually causing the problem.

M-7 Sensors

The two sensors located within the heater housing compare the inlet water temperature with the outlet water temperature (regardless of water flow direction) to determine the presence of water, low flow, temperature limits, and operating temperatures. The system will automatically select the sensor that is exposed to the lowest temperature as the spa water temp controlling sensor.

The sensors in combination with specific software allow the spa to be controlled without the use of external pressure switches, flow switches, or temperature sensors.

Wiring Checks

Safety is key when servicing any spa or spa control panel. Remember, safety comes first for you and your customer. Please take all necessary precautions before attempting any repairs. Wiring checks are the first step to ensure safety and proper function before beginning service on a unit.

Wiring Check Precautions

- When working in a system box always be aware that it may contain high voltage.
- Always keep your fingers and hand tools away from any wiring or circuit board when the power is on. Touching anything in these areas can result in serious injury.
- All service calls, no matter how minor, should include a complete wiring check, beginning with the house breaker.
- Keep in mind, Balboa equipped spas only run on single phase electrical service. Three phase power will not supply proper voltage to the system. Three phase power may overheat the pumps and cause the G.F.C.I. to trip.

Check for Loose Connections or Damaged Wires:

- Make sure the power is off before you touch any wiring.
- Once the power is off, carefully examine all wires for cuts or defects.

System Box Wire Gauge Check

When inspecting the wiring for any control system, note that connections for the incoming wires are clearly labeled at the main terminal block.

- 30A service – minimum ten gauge copper wire.
- 40A service – minimum eight gauge copper wire.
- 50A service – minimum six gauge copper wire.

These wires must connect the house breaker box, through the local disconnect, to the main terminal block. The wiring diagram inside the system box shows the main terminal block as TB1.

Important

Using non-copper wire can be dangerous, and also can be the cause of a spa's malfunction. If non-copper wire is used at any point, we do not recommend servicing the spa until an electrician replaces it with the proper gauge copper wire.

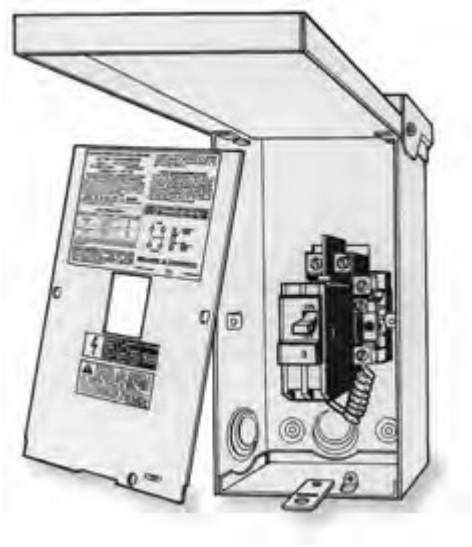
Important

This service must be single phase. Any abnormal voltage reading requires an electrician. Do not attempt to fix these types of problems yourself. High voltage can seriously injure or kill.

G.F.C.I. Wiring Check

If a Ground Fault Circuit Interrupter has recently been installed, a majority of tripping problems can be attributed to incorrect wiring of the G.F.C.I. A clear understanding of the correct configuration is essential. **Please refer to the figure on page 10 as needed.**

Wiring Check for G.F.C.I./Service Disconnect



Important

The National Electrical Code states that a service disconnect breaker box (a G.F.C.I. can be used for this purpose) must be located at least five feet away from the spa and should be conveniently located near the equipment bay. If it is not in plain sight, keep the disconnect padlocked when in the off position.

Precautions

Effective January 1994, G.F.C.I.'s are required for spa installations. Prior to that, G.F.C.I.'s had been recommended for spa installations, but were not mandatory.

If the spa you are servicing was not installed with a G.F.C.I., strongly urge your customer to improve safety and comply with current standards by installing one.

Note: A suitable G.F.C.I. may be acquired through your local distributor or Balboa Direct.

Important!

Remember, high voltage is still accessible in the house breaker box even though you have turned off the spa breaker.

G.F.C.I. Line-in Wiring Check

- Locate the proper circuit breaker and turn it off.
- Remove the cover from the house breaker box. Check the main service amperage rating to the breaker box.

Note: Typically, a house circuit will require at least a 100 Amp service when a spa is installed.

- From the circuit breaker, locate the red load wire and the black load wire.
- From the neutral bar, locate the white load neutral, and the green ground wire.
- Be sure there are no other appliances on the spa circuit. If there are, service must be re-wired to supply the spa only.
- Make sure all four wires exit the house breaker box via conduit, routed to the G.F.C.I. breaker box. The black should be connected to the G.F.C.I. line-in 1. The red should be connected to the line-in 2. The white load neutral connects to the neutral bar. The green ground wire should be attached securely to the ground lug inside the G.F.C.I. box.

G.F.C.I. Line-out Wiring Check for 240 V Dedicated System (3 wire system including ground wire)

The black wire should connect to load out 1, the red wire from load out 2, and the green ground wire should be attached securely to the ground lug inside the G.F.C.I. box. All wires will exit the box via conduit routed to the spa control system. The white pigtail should be connected to the G.F.C.I. neutral bar. All wires will exit the box via conduit routed to the spa control system. If the system does not operate a 120 V component (ozone, music equipment, etc.) then the white load neutral wire is not required.

G.F.C.I. Line-out Wiring Check for 120/240 V Convertible System (3/4 wire system including ground wire)

___If the spa is equipped with a 120/240 V control system, an additional white load neutral wire must connect to the load neutral out. This wire runs with the others to the system box. Proper placement of this neutral wire is essential. If miswired, the G.F.C.I. will trip when a 120 V device is activated.

Once you have found all wiring correctly installed, begin to check for proper voltage.

Voltage Checks - Breaker Box/G.F.C.I.

When checking for proper voltage, please keep in mind that the acceptable voltage range is ± 10% of the recommended voltage. Acceptable voltage when 120 V is specified as the desired voltage, is between 108 and 132 V. Acceptable voltage when 240 V is specified as the desired voltage, is between 216 and 264 V.

⚠ Important!

This service must be single phase. Any abnormal voltage reading requires an electrician. Do not attempt to fix problems yourself. High voltage can seriously injure or kill.

Breaker Box Voltage Check

- Set your multi-meter or voltmeter for AC Volts.
- Make sure the G.F.C.I. is off.
- Carefully turn on the spa circuit breaker.
- At the house breaker box, probe the spa circuit breaker between the black and red wires. Your meter should read 240 V.
- Probe the black wire and the green ground wire. You should see 120 V.
- Probe between the red wire and the green ground wire. You should also see 120 V.
- The voltage between the white load neutral and the green ground wire should be approximately 0 V.

G.F.C.I. Line-In Voltage Check

240 V Dedicated System:

- Be sure the spa circuit breaker (located in the house breaker box) is on.
- Make sure the G.F.C.I. is off.
- Probe the black and red wires. The meter should read 240 V.
- Probe the black wire and the green ground wire. The meter should read 120 V.
- Probe the red wire and the green ground wire. This should also read 120 V.
- Turn on the G.F.C.I. breaker before continuing to the system box.

Note: A white load neutral wire is not used in a 240 V dedicated system.

120/240 V Convertible System:

- Be sure the spa circuit breaker (located in the house breaker box) is on.
- Make sure the G.F.C.I. is off.
- Probe the black and red wires. The voltage should be 240 V.
- Probe the black wire and the white load neutral wire. The voltage should read 120 V.
- Probe the red wire and the white load neutral wire. The voltage should read 120 V.
- The voltage between the white load neutral and the G.F.C.I. box ground lug should read approximately 0 V.
- Turn on the G.F.C.I. breaker before continuing to the system box.

Voltage Checks - System Box

G.F.C.I. Load Out Voltage Check

240 V Dedicated System:

- Be sure the house breaker is on.
- Be sure the G.F.C.I. breaker is on.
- Probe the black and red wires at the G.F.C.I. load out 1 and 2. The voltage should be 240 V.
- Probe the black wire and the G.F.C.I. neutral bar. The meter should read 120 V.
- Probe the red wire and the G.F.C.I. neutral bar. The voltage should read 120 V.
- Probe the black load out wire and the box chassis ground lug. The voltage should read 120 V.
- Probe the red load out wire and the ground lug. The voltage should be 120 V.
- Recheck voltage under peak load conditions.*

120/240 V Convertible System:

- Be sure the G.F.C.I. breaker is on.
- Probe the black and red wires at G.F.C.I. load out 1 and 2. The voltage should be 240 V.
- Probe the black wire and the white load neutral wire. The meter should read 120 V.
- Probe the red wire and the white load neutral wire for 120 V.
- Probe the red load out wire and the box chassis ground lug. Your meter should read 120 V.
- Probe the black load out wire and the ground lug. The voltage should read 120 V.
- Recheck voltage under peak load conditions.*

Important!

If the voltage is not within the acceptable range, call an electrician or the local electric company to diagnose the problem.

System Box Check (at TB1)

240 V Dedicated System Check:

- Be sure the G.F.C.I. breaker is on.
- Probe the black and red wires. Look for 240 V.
- Probe the black wire and the green ground wire for 120 V.
- Probe the red wire and the green ground wire – also 120 V.
- Recheck voltage under peak load conditions.*

120/240 V Convertible System Check:

- Be sure the G.F.C.I. breaker is on.
- Begin the voltage check at TB1. Probe the black and red wires. Your meter should read 240 V.
- Probe the black and white wires. Look for 120 V.
- Probe the black wire and the green ground wire – also 120 V.
- Probe the red wire and the green ground wire – again 120 V.
- Probe the red wire and the white load neutral wire. This should read 120 V.
- Probe the white neutral wire and the green ground wire. This will show approximately 0 V.
- Recheck voltage under peak load conditions.*

*Peak Load Check

It is important to check the voltage again under **peak load conditions**. To reach peak load, turn on the blower, heater, light, and all pumps.

Peak Load Check for 240 V System:

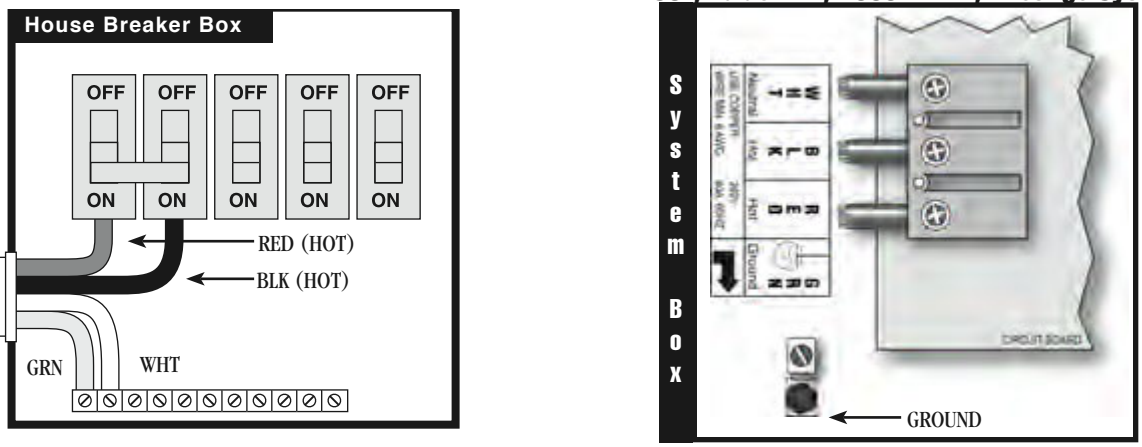
- Check the voltage between the black and red wires. The acceptable voltage range is between 216 and 264 V.
- Probe the black wire and the white neutral wire. This voltage must be between 108 and 132 V.

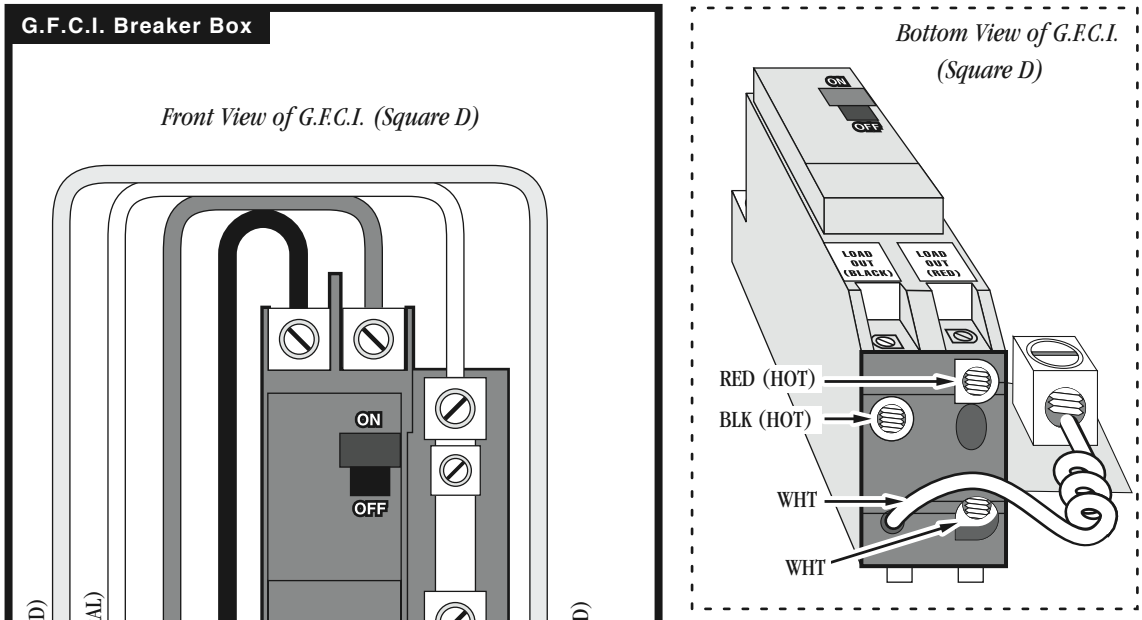
Peak Load Check for 120/240 V Convertible System:

- Check the voltage between the black and red wires. Acceptable range is between 216 and 264 V.
- Probe the black wire and the white load neutral wire. The voltage must be between 108 and 132 V.
- Probe the red wire and the white load neutral wire. The voltage must be between 108 and 132 V.

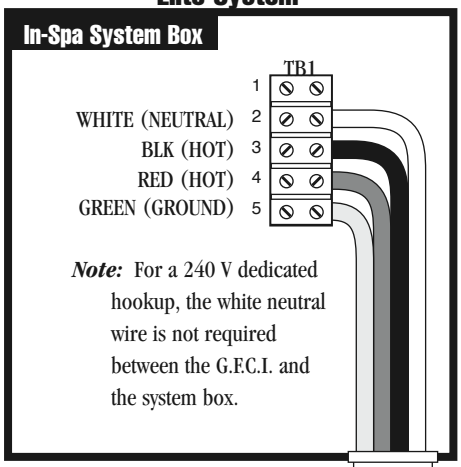
Wiring Schematic

SUV, Value M-7, 2000LE M-7, Prestige Systems





Elite System



Note: For a 240 V dedicated hookup, the white neutral wire is not required between the G.F.C.I. and the system box.

Low Voltage

At Balboa, it's been our experience that the majority of the problems associated with electronic control systems are due to low voltage.

Brown outs

"Brown outs" can have an effect on the spa's operation in a variety of ways. The control panel may go blank, have scrambled messages on the LCD, or only a few features will function.

- If the system is getting the proper voltage at TB1, but still does not operate, then test for a blown power input fuse. If the system you are troubleshooting is a Prestige, 2000LE M-7, Value M-7, or SUV System, the power input fuses snap directly to the circuit board.

Checking the System Power Input Fuse

Warning

These procedures are performed while the system is powered up and running under peak loads. **Be careful.**

SUV, Value M-7, 2000LE M-7, and Prestige Systems

If your system uses 120V peripheral devices:

- Measure between the white TB1 terminal and F5 power input fuse on the side farthest away from the circuit board edge (opposite the F5 silkscreen). You should see 120 volts.
- If the system is equipped with the additional F6 power input fuse, measure F6 in the same manner. You should also see 120 volts.

If your system uses 240V peripheral devices:

- Measure between the red TB1 terminal and F5 power input fuse on the side farthest away from the circuit board edge (opposite the F5 silkscreen). You should see 240 volts.
- If the system is equipped with the additional F6 power input fuse, measure F6 in the same manner. You should also see 240 volts.
- If you determine that there is no voltage at one or both locations, then the system power input fuse(s) need to be replaced. Both F5 and F6 use a 25A time delay fuse. Only use a fuse of the same type and amp rating when you replace any of these fuses.

Elite System

- Measure fingers 5 and 6 of the circuit board. You should see either 120V or 240V, depending upon the system configuration.
- If you determine that there is no voltage at fingers 5 and 6, then the system power input fuse needs to be replaced. This fuse is located in the large fuse block inside the system box. This configuration utilizes a 30A time delay fuse.

Note For All Systems: In each situation, the most likely reason for the system power input fuse to blow is a pump problem. However, on occasion, a blower problem may also cause this fuse to blow if a 10A blower fuse is not built in.

Once the power input fuse has been changed:

- Probe the red wire and the white neutral wire. Again, voltage must be between 108 and 132 V.
- Check the voltage between the black and red wires again. Acceptable voltage range is between 216 and 264 V.

These readings should be taken under peak load conditions.

Important

If the voltage is not in the acceptable range, call an electrician or the local electric company to diagnose the problem.

To Determine the Cause of a Blown Power Input Fuse:

Perform the following **sequence of tests**:

Test the System:

- Turn the power off.
- Be sure to replace the system power input fuse with the same type.
- Unplug the blower and all pumps.
- Restore the power and verify system operation.
- If the fuse blows, then re-check the internal system wires and connector for burns, cracks or cuts in insulation.
- If the fuse does not blow, turn the power off and plug in the pump.

Note: Be sure to test each device individually.

Test the Pump:

- Restore the power and activate the pump.
- If the fuse blows, there is a pump problem.
- If the fuse does not blow, turn off the power.

Test the Blower:

- Plug in the blower.
- Power up the system and activate the blower.
- If the fuse blows, then there is a blower problem.
- If the fuse does not blow, the combined pump and blower amperage may be excessive. To verify this, first check with your spa manufacturer for amperage draw limits on each device.
- Since the blower should now be running, you can check the amperage draw with an ammeter by measuring around the black blower wire and compare with manufacturer's specifications.

Test the Amperage Draw:

- Turn off the power, disconnect the blower, make sure the pump is plugged in, and restore power.
- Start the pump and switch to high speed (if available), this should draw the most current.
- Make sure all jets and valves are open.
- Check the amperage at the red pump wire. Compare your reading with manufacturer specifications. (If the other plug-in devices exist, they should be tested in the same way.)
- If the amperage draw for each device is within manufacturer's specifications, the problem could be a nuisance spike in the pump, or water in the blower.

Note: These slow-blow fuses are not always discolored when blown. **Always test continuity of a fuse with an ohmmeter.**

Note: Miswiring of the spa is the most common reason for this fuse to blow. However, a lightning strike in the area is a possible, though less likely, cause of the failure.

Test the Circuit Board Protection Fuse: SUV, Value M-7, 2000LE M-7, and Prestige Systems

If your system has a white neutral line coming in from either your service disconnect or GFCI installed into TB1:

- Probe from the white TB1 terminal and one side of the circuit board protection fuse. The voltage should read 120 volts.
- Probe from the white TB1 terminal and the other side of the circuit board protection fuse. The voltage should read 120 volts.

Elite System

- For a class 2 transformer circuit, UL requirements specify that a fuse must be permanently installed to protect the circuit board.
- If you have determined that the system is getting proper voltage through the power input fuse, then you must check to see if the circuit board protection fuse has blown.
- First, turn off the power. Next, unplug the transformer from the circuit board, then turn the power back on and probe from the red TB1 terminal to one side of the fuse.
- The voltage should read 120 V or 240 V depending on the system.
- Probe from finger 5 to the other side of the circuit board protection fuse. The voltage should read 120 V or 240 V depending on the system.
- If either side has 0 volts, then the fuse is blown. If so, turn off the power and replace the circuit board. (See page 26.)

Note: Another, less likely reason for the circuit board protection fuse to blow is that a 240 V transformer was replaced with a 120 V transformer by mistake.

- Make sure that the transformer is properly rated for the system. The voltage reading between fingers 5 and 6 on the circuit board will determine the proper transformer input voltage for Deluxe and Standard models.
- For a 120 V system, the transformer should have **two blue connectors**.
- A 240 V transformer should have **one blue connector**.
- If you determine that the circuit board protection fuse is not blown, this means that the transformer is receiving voltage.

Transformer Installation Requirement

*(Applies to **Elite and Prestige only**; other systems have the transformer as a permanent part of the circuit board.)*

Some symptoms of low voltage may be caused by the transformer.

When working on a 120 V Elite or Prestige system, double check to make sure the transformer has **two blue connectors**.

A 240 V transformer with **one blue connector** may be installed by mistake in a 120 V system causing low voltage.

Confirm Transformer Connections:

Intermittent problems may occur when transformer connections are loose. Make sure your fingers are away from exposed high voltage connections. Wiggle the transformer wires near the connector on the circuit board. This will determine if there is a loose transformer connection or bad pin on the circuit board.

- If the system intermittently turns on and off, turn the power off.
- Plug in the test transformer, restore the power, and wiggle the transformer wires again.
- If there is no intermittent failure, no further analysis is required.
- Turn off the power and replace the transformer.
- After installing your test transformer, intermittent symptoms may still occur during the test. If so, replace the circuit board (see page 26) and install the original transformer.

Important

Be sure to turn the power off before replacing any component, especially a circuit board.

Power-Up, Pump Priming and Software ID

Before applying voltage to the System, it is very important that you understand the sequence of events that occur when power is applied so that the pumps can be primed efficiently and faults created by no water flow can be prevented.

Please review the following procedures and power-up events before applying voltage to the System:

1. Check the voltage at the main power panel to be sure that you have the correct voltage for the System being used. Also, be sure that the voltage is within + or - 10% of the mean voltage. For 120V it should be between 108V and 132V. For 240V it should be between 216V and 264V.
2. Test and reset the GFCI. If it does not operate properly, do not apply voltage to the System until the problem has been corrected.
3. Fill the spa to its correct operating level. Be sure to open all valves in the plumbing system before filling to allow as much air as possible to escape from the plumbing and the heater during the filling process.
4. Vent air from the pump(s). Do this by loosening the union nuts on the discharge of all pumps. Allow a small amount of water and air to escape from the pump(s) and related plumbing. Retighten the union nuts.
5. Turn the power on at the main power panel. Depending on which top-side panel the System is configured for, the displays will go through specific sequences. During these sequences, you will need to prime the pump(s) as described in the following:

The following will occur:

- Display will show a series of numbers immediately following Power-Up. On M-7 software created or updated since May 2001, this will be a series of four numbers. **The first three numbers in combination are called the Software ID.** The three numbers in order are the Software Manufacturer ID, the Software Product Type ID, and the Software Version ID. Following the Software ID will be either 12 or 24, indicating the heater wattage the software is configured for. There are differences in freeze protection between units that display a Software Version ID of 00 (or that don't display a Software ID at all), versus units that display a Software Version ID of 01 or greater.
- Display will show "Pr" (or "Priming Mode" on Prestige Systems), indicating that the System is in a pump priming mode. During this mode the heater is disabled to allow the priming process to be completed without the possibility of energizing the heater under low flow or no flow conditions. Nothing comes on automatically, but the pump(s) can be energized by pushing all Jet buttons.

  This mode will automatically last for about 4 minutes or you can manually exit the priming mode after the pump(s) have primed. (Manually exiting the priming mode is described later in this text). Regardless of whether the priming mode is automatically terminated or you manually exit the priming mode, the system will automatically return to the normal heating and filtering mode at the end of the priming mode.
- **Pump Priming.** As soon as "Pr" is indicated on the top-side panel, push all Jet buttons to start the pumps. On models with a combined Jet button, push it until all pumps are on high speed. All pumps need to be running in the high speed mode to facilitate priming. If the pumps have not primed after 2 minutes, and water is not flowing from the jets in the spa, **do not allow the pumps to continue to run.** Turn the power off at the main power panel and repeat the process of venting the air from the pump(s). (See step 4 on this page). After venting air from the pump(s) a second time, turn the power back on at the main power panel. This will initiate a new pump priming mode. Sometimes momentarily turning the pump off and on will help it to prime. Do not do this more than 5 times.

<u>Important:</u> A pump should not be allowed to run without priming for more than 2 minutes. Under NO circumstances should a pump be allowed to run without priming beyond the end of the 4 minute priming mode. Doing so may cause damage to the pump and cause the system to go into an overheat condition.

- After pump priming, push all Jet buttons to turn off the pump(s).
- Next, manually exit the priming mode by pushing either the "Warm" or "Cool" button (the "Temp" button on smaller panels). Note that if you do not manually exit the priming mode as described above, the priming mode will be automatically terminated after 4 minutes. Be sure that the pump(s) have been primed by this time.

- After you have manually exited the priming mode or the system has automatically exited the priming mode, the top-side panel will momentarily display the set temperature and then dashes.

  Note that the display is not showing the temperature yet. This is because the system requires approximately 2 minutes of water flowing through the heater to determine the water temperature.
- After 2 minutes of water flowing through the heater the temperature will be displayed.
  Push the "Warm" or "Temp" button to adjust the temperature to the desired setting. If the water temperature in the spa is less than the set temperature, the heat indicator will turn on signifying that the heater has been energized.
- When the System is in the "Standard" operational mode it will automatically heat the spa and maintain it at the set temperature. All user buttons will be functional. If a higher temperature is desired, simply push the "Warm" or "Temp" button until the desired temperature is displayed. (The maximum temperature setting is 104°F). Other energy-saving operation modes are selectable by pushing "Mode" (or mode button sequence).

6. After the System has been powered-up and the pumps have been primed, make a final voltage check at the System terminal block.
   - Voltage Check
     1. Activate the low speed of the pump.
     2. Adjust the temperature to turn on the heater.
     3. Activate any other equipment that does not turn the heater off.
     4. Activate the light.
     5. Check the voltage.

   The voltage for 120V systems should be 108-132 between line and neutral..

   The voltage for 240V systems should be 216-264 between either line and 108-132 between either line and neutral.

Note:

If the voltage is not within tolerance while the System is operating as described above, turn off the power at the main power panel and correct the problem before continuing to operate the System.

Selecting Test Mode and Analysis Display Mode

- The software is in test mode when J43 is on 2 pins on the Elite, or when DIP switch 1 is ON on all models that have a DIP switch at the edge of the circuit board.
- Test mode may be entered and exited (by changing the jumper or switch setting) at any time (no need to cycle power).
- The software goes into analysis display mode when in test mode and the light is on (at any intensity, if light is dimmable).

  Note that on models where the light button is combined with the pump button, it is not possible to go into analysis display mode without the pump running.

Differences in the display when in test mode (but not in analysis display mode)

- In standard mode (circ or non-circ), temperature shimmers when not current.
- In economy mode (circ or non-circ), temperature shimmers when not current, and is always displayed with "E" instead of "F" or "C".
- In sleep mode (circ or non-circ), temperature shimmers when not current, and is always displayed with "P" instead of "F" or "C".

Differences in the display when in analysis display mode:

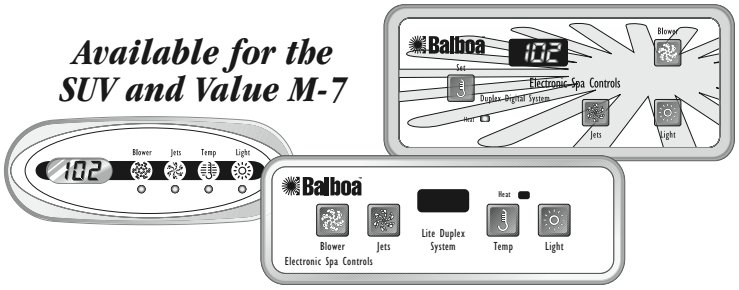
- On the Elite: Whether in standard, economy, or sleep mode (and circ or non-circ), temperature display alternates between displaying "temp" connector sensor temperature with "t" instead of "F" or "C" and "high limit" connector sensor temperature with "H" instead of "F" or "C". (These sensors are not actually serving different "temp" versus "high limit" functions; the labeling on the circuit board simply predates M7 nomenclature.)
- On all other models: Whether in standard, economy, or sleep mode (and circ or non-circ), temperature display alternates between displaying "A" connector sensor temperature with "A" instead of "F" or "C" and "b" connector sensor temperature with "b" instead of "F" or "C".
- Pressing Mode toggles pump/blower/light timeouts off (displays “toOF" or "tF") and back on (displays "toOn" or "tn"). When timeouts are off, ozone disabling on function button presses is suppressed (but not retroactively to function buttons pressed before timeouts were turned off; it's thus suggested that timeouts be turned off as the first action after powering up the spa). This setting is not saved upon power down. NOTE: Even though the main purpose of turning timeouts off is to disable timeouts on manual pump/blower/light turn ons – on some models, **leaving timeouts off can make a pump run "forever" once it's turned on automatically in certain situations. For this reason, it's imperative that the spa never be left in test mode for the user. And if you're unsure as to whether you turned timeouts off or not in test mode, it's safest to exit test mode and then cycle power on the spa.**

On panels which cannot display a letter such as F or C after the temperature:

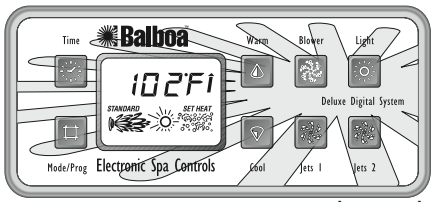
In test mode, the character that would be shown to the right of the temperature (A, b, F, C, E, or P) is instead shown for a split second before the temperature it's for, with an equal sign (=) to the right of it. For example, instead of 105A alternating with 104b, you'll see A= followed quickly by 105 alternating with b= followed quickly by 104.

Topside Control Panels

Available for the SUV and Value M-7

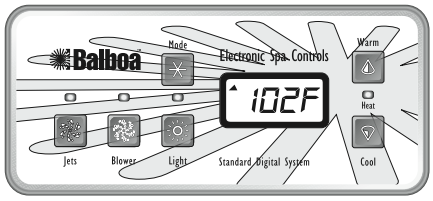


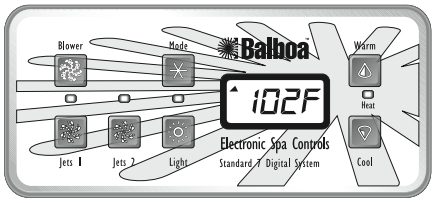
Available for the Elite



Deluxe Panel

Available for the Elite and 2000LE M-7





Preliminary Panel Check

- **If the problem is not obvious, look on the topside control panel for diagnostic messages.** If no messages are seen, run through all spa functions and note any inconsistent operation.
- If diagnostic messages appear on the topside control panel, see page 19 for troubleshooting tips.

Once you have determined that proper voltage is running through the circuit board and transformer, continue to the topside control panel. A panel that is not functioning properly may include the following symptoms: low voltage such as missing or scrambled segments, missing icons on the LCD, non-functional LED's, or nonfunctional buttons. If any of these symptoms are present, perform the following:

- Turn the power off and unplug the panel from the circuit board.
- Then, plug in your test panel and restore power. If everything functions normally, replace the topside panel.
- If you still see symptoms of low voltage, such as a sluggish, blank or partially blank panel, or if the display or the LED's do not function at all, turn the power off; reset the battery backup (if applicable); unplug the ozone generator (if equipped); then restore power to the system. If the problem persists, turn off the power and replace the circuit board.

Bulb Replacement

Another panel problem may be burned out backlighting bulbs. These bulbs can easily be replaced.

- With the power off, gently pry up the topside control panel with a screwdriver. Next, locate the gray bulb holes in the back of the panel. Use a screwdriver to twist the bulb approximately $^1/_4$ turn to remove and replace the bulb. (Needlenose pliers may also be useful.)

Remote Panel Troubleshooting

Remote panel applications need special consideration where the panels connect to the circuit board.

If You are Working on a Spa With a Remote Panel:

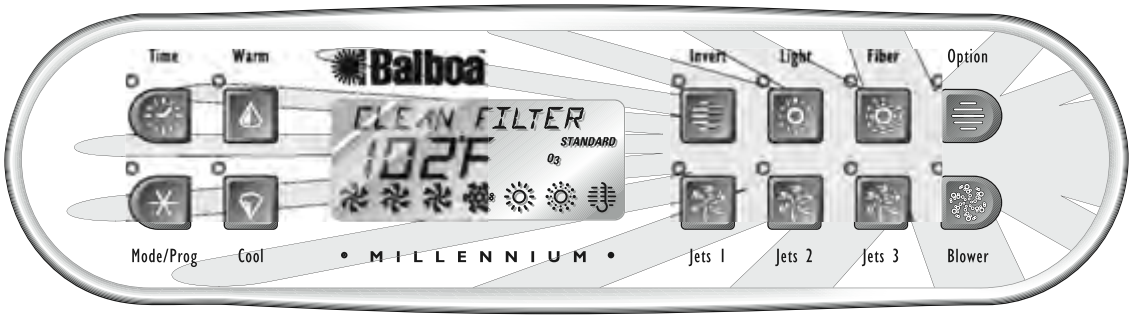
- Before replacing the circuit board or any panel, remove the gang connector from the system box and plug each panel into the circuit board directly and individually. Test all functions with each panel separately.

If a Remote Panel Doesn't Work:

- Remove the remote panel from its location.
- Be sure to secure the end of the panel cable.
- Plug the remote panel directly into the board. This removes the extension loom with its one-to-one connector from the circuit board and will help you determine whether you have one panel with a problem, a defective gang connector, a bad extension loom, a bad one-to-one connector, or a circuit board problem.

Topside Control Panels

Available for the Prestige



Preliminary Panel Check

- **If the problem is not obvious, look on the topside control panel for diagnostic messages.** If no messages are seen, run through all spa functions and note any inconsistent operation.
- If diagnostic messages appear on the topside control panel, see page 19 for troubleshooting tips.
- Most error messages are stored in the fault log. To view the fault log, the spa must be in test mode and the spa light must be turned on. (See page 22)

Once you have determined that proper voltage is running through the circuit board and transformer, continue to the topside control panel. A panel that is not functioning properly may include the following symptoms: low voltage such as missing or scrambled segments, missing icons on the LCD, non-functional LED's, or nonfunctional buttons. If any of these symptoms are present, perform the following:

- Turn the power off and unplug the panel from the circuit board.
- Then, plug in your test panel and restore power. If everything functions normally, replace the topside panel.
- Disconnect ozone generator (if applicable).
- If you still see symptoms of low voltage, such as a sluggish, blank or partially blank panel, or if the display or the LED's do not function at all, turn the power off; reset the battery backup (if applicable); unplug the ozone generator (if equipped); then restore power to the system. If the problem persists, turn off the power and replace the circuit board.
- Press "Warm" and "Cool" simultaneously to access the performance analysis mode. (See page 23)

Bulb Replacement

Another panel problem may be burned out back-lighting bulbs. These bulbs can easily be replaced.

- With the power off, gently pry up the topside control panel with a screwdriver. Next, locate the gray bulb holes in the back of the panel. Use a screwdriver to twist the bulb approximately $^1/_4$ turn to remove and replace the bulb. (Needlenose pliers may also be useful.)

Remote Panel Troubleshooting

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If a Remote Panel Doesn't Work:

- Remove the remote panel from its location.
- Be sure to secure the end of the panel cable.
- Plug the remote panel directly into the board. This removes the extension loom with its one-to-one connector from the circuit board and will help you determine whether you have one panel with a problem, a defective gang connector, a bad extension loom, a bad one-to-one connector, or a circuit board problem.
- Gang connectors cannot be used on the first three jacks (i.e., on Millennium panel jacks).
- The first three jacks are functionally identical. Try the panel in another one of these jacks.
- The two aux panel jacks are functionally identical.
- If multiple panels work in one jack but not another jack (of the same set), the problem is most likely with the controller board.

Panel Messages

Panel messages are a quick clue toward solving a variety of problems. Here are the most common messages and what they mean:

The Panel Displays:

HH, OHH, **or** HTR TEMP LMT

(At least one of the sensors has detected water temperatures of 118ºF inside the heater.)

or

The Panel Displays:

OH, OHS, **or** SPA TEMP LMT

(One of the sensors has detected the temperature of the water coming into the heater to be 110ºF, and so the water in the spa is likely to be that hot.)

These indicate that the spa has shut down due to an overheat situation:

Note: Overheating may occur if the low-speed pump is set to operate for extended periods of time, or if the incorrect pump is installed. In rare cases (usually warmer climates), the circulation pump may also cause overheating.

The following is a list of most probable causes of this message. Inspect these first:

- Check slice or ball valves. Make sure that they are open.
- Make sure the correct pump is installed.
- Clean the filter/skimmer if there is any blockage.
- Check heater element alignment.
- Check for debris on the heater element.
- In extremely hot weather, check for proper cabinet ventilation.
- Make sure the temperature sensor is fully inserted into the sensor fitting on the heater.
- Check for excessive filter duration.

Note: A common programming mistake is overlapping filter times that may cause the spa to filter continuously.

- Check the water level.
- Check the water temperature with an accurate temperature thermometer. Remove the spa cover and allow the water to cool to below 108° F. Adding cool water may be necessary. Touch any button to reset the system. If the water is still hotter than the set temperature, press the blower button (if applicable) to cool the spa.

If the Problem Recurs, test the Sensor Set. (See page 21)

The Panel Displays:

SA, SnA, SnH, **or**
SENSOR A
SERVICE RQD

or

The Panel Displays:

Sb, Snb, Snt, **or**
SENSOR B
SERVICE RQD

This indicates that the spa has shut down due to an open or faulty sensor:

If the problem recurs, test the sensor set. (See page 21)

Note: In rare cases, rapid system overheat causes sensor error messages. Be sure to rule out possible situations like no flow or no water.

The Panel Displays:

Sn, SnS, **or** SENSOR SYNC

This indicates that the sensors are out of balance.

If alternating with temperature, it may just be a temporary condition. If flashing by itself, spa is shut down.

If the panel also displays "Service Reqd," spa is shut down.

If the spa shuts down due to this error, one (or both) of the sensors are probably reading several degrees off. If the problem recurs, test the sensor set. (See page 21)

The Panel Displays:

cd, CLd, **or** COLD WATER

This indicates that a sensor detects a possible freeze condition.

Panel Messages (cont.)

This message does not appear on M-7 software showing a Software Version ID of 01 or greater.

This is a normal spa function; no further action is necessary.

When either sensor reads below 40° F, the system provides freeze protection. It automatically activates the pump (and the heater if necessary) to circulate the water and warm the plumbing. The equipment stays on until the sensors detect that the spa temperature has risen to within 15ºF of the set temperature. The other pumps and the blower will purge for 30 seconds to 2 minutes at the end of the freeze condition. If pump 1 was turned on due to this reason alone, this message will appear for up to two minutes right after very cold water is detected.

Note: Internal freeze protection only functions when there is proper power running to the spa, and the control system is operational. Using an optional freeze sensor may be necessary in extreme climates to prevent plumbing damage, but will only work properly if placed inside the spa skirt in the coldest area.

All spa models are different in shape and size and have different thermal characteristics; therefore, Balboa Instruments, Inc. cannot be held responsible for freeze damage to the spa's plumbing. Testing is the responsibility of the spa manufacturer and must be done to determine the best location for the freeze sensor.

The Panel Displays:

IC, ICE, **or** FREEZE COND

This indicates that the auxiliary sensor detects a possible freeze condition.

This is a normal spa function; no further action is necessary.

When the auxiliary sensor reads around 40°F (actual temperature dependent on specific auxiliary sensor used), the system provides freeze protection. It automatically activates all of the pumps and the blower to circulate water and warm the plumbing.

Note: This auxiliary freeze protection functions at all times, even when another fault condition has occurred and has otherwise shut the spa down.

This message can also indicate "simplified" sensor freeze protection in progress (on M-7 software showing a Software Version ID of 01 or greater), which behaves as follows:

Any time the lower of the two temperature sensors goes below 45°F, all pumps/blowers turn on. They continue to run for 4 minutes after the temperature reaches 45°F or above. As soon as the temperature falls below 45°F again, this process restarts. This "simplified" sensor freeze protection functions at all times, even when another fault condition (other than total sensor failure) has occurred and has otherwise shut the spa down.

The Panel Displays:

HL, HFL, **or** HTR FLOW LOW

This indicates that a substantial difference in temperature between sensors has been detected during heating.

This could indicate a flow problem. Check water level in spa. Refill, if necessary. If the water level is okay, make sure the pumps have been primed.

On the fifth occurrence of the above message the panel will display:

LF, **or** LOW FLOW

This indicates a persistent flow problem

The heater is shut down while all other spa functions continue to run normally. Power on the spa must be cycled before the heater will function again.

The Panel Displays:

dr, dr4, **or** HEATER MAY BE DRY-- WILL RETEST SHORTLY

This indicates that there is not enough water in the heater. Spa shuts down for 15 minutes.

This could indicate poor flow or air bubbles in the heater.

On the third consecutive occurrence of the above message (without a successful heating cycle in between) the panel will display:

dY, dr4, **or** HEATER DRY SERVICE ROD

Spa is shut down and will not reset in 15 minutes. Press any button to reset manually.

continued on page 22

Testing the Sensor Set

1. Check sensor wires for cracks or damage that may indicate the presence of a rodent.
2. Inspect the connections of both sensors on the circuit board. The plugs must be clean.
3. If the sensors are not totally failing but are showing excessive (2° F / 1.0 °C or more) difference between the two sensors when not heating (a possible cause of Sn/SnS/SENSOR SYNC, HL/HFL/HTR FLOW LOW, and LF/LOW FLOW messages), do the following:
   - Note which sensor is reading consistently higher (A vs B or t vs H).
4. Unplug the two sensors from the circuit board and interchange them (ie, plug the one that was in the A or t jack into the B or H jack and vice versa).
5. Press a panel button if any "stray" faults appeared during the process. (Stray fault are normal when sensors are unplugged then plugged back in while the system is running.)
6. Within a minute or so*, see if the same or other sensor is now reading consistently higher:
   - If the same sensor (A vs B or t vs H) is reading higher after the sensor interchange, the problem is on the circuit board. Replace the circuit board.
   - If the opposite sensor is now reading higher, the problem is with the sensor(s). Replace the sensor set.

   ** If you wait more than 2 minutes after plugging the sensors back in, heating may start (even outside a filter in Economy or Sleep mode) due to a stray Cd/CLd/COLD WATER condition usually detected when sensors are being plugged in while the system is running.*
7. If there is a message indicating an open or faulty sensor:
   - Unplug the sensor set (but leave the original sensors in the heater) and plug in the test sensor set. Put both sensors into the same cup of warm water (ideally above the set temperature, so the spa won't try to heat during this test, as there is no heater protection during this test) and verify that they read the same temperature (within 1°F/0.5°C).
   - If the problem is solved, replace the sensor set. If the problem is not solved, do not replace the sensor set.
   - Plug in the original sensor set to verify that there is not a connection problem.
   - If the problem continues after following the above steps, then replace the circuit board.
8. If you cannot get readings of the sensors on the topside panel even in M7 Test Mode / Analysis Display Mode (for example, because the system always indicates an Overheat condition when it shouldn't):
   - You can use an ohmmeter to evaluate the validity of each sensor independently (after unplugging the sensors from the circuit board).
   - You will need sharp tips on the meter probes(or a Balboa Logic Jumper on a Stick) to be able to make contact with the little bit of metal of each of the two sensor wires visible through a window on the connector.
   - The following chart shows what temperatures certain resistance values translate to:

1.5k	231F	110.5C	14.7k	108F	42.5C
3.0k	190F	88.0C	15.4k	106F	41.0C
5.0k	162F	72.0C	16.2k	104F	40.0C
7.0k	144F	62.5C	17.2k	101F	38.5C
9.0k	131F	55.0C	18.1k	99F	37.0C
10.0k	126F	52.5C	20.2k	94F	34.5C
11.1k	121F	49.5C	25.5k	84F	29.0C
11.7k	119F	48.5C	30.0k	77F	25.0C
12.1k	117F	47.5C	40.0k	65F	18.5C
12.7k	115F	46.0C	55.0k	53F	11.5C
13.2k	113F	45.0C	95.0k	32F	0.0C
13.6k	112F	44.5C	184.0k	9F	-13.0C
14.1k	110F	43.5C	320.0k	-9F	-23.0C

Panel Messages (cont.)

The Panel Displays:

--F, --C, -.-C *or* --

This indicates that the temperature is completely unknown because the pump has not yet run for 2 minutes after Priming Mode was exited. This is only displayed for 2 minutes at power-up.

The Panel Displays:

BACKUP FAIL

This indicates that the IC chip used to store battery backup information cannot be communicated with.

It may be a problem with the chip itself or a problem with the interconnections to that chip. Replace the circuit board.

Some Troubleshooting Scenarios

1. You find out the system is in "OHH." This alone doesn't explain a lot. What led up to the "OHH" is much more important. If it's a Prestige, review the fault log carefully. Otherwise, see if the user has any additional information (for example, how long before the "OHH" was the spa panel last checked, and how hot was the water then). If the spa has cooled, see whether the problem can happen again, this time watching carefully to see if there are additional clues leading to the "OHH" (for example, other messages that appear shortly before the "OHH" happens).

2. You find out the system keeps showing "HFL," or is now in "LF," or is shut down due to a "dry" fault. Put the spa in test mode with the light on, so that you see the two sensor temperatures. Are they normal (within 1°F / 0.5°C) when not heating? How far apart are they when heating? "HFL" happens when they are 6°F / 3°C apart (4°F / 2°C on 120V and other low-heater-wattage systems), see how quickly that happens after heating starts. If it's getting close to that right away, it's probably a consistent flow problem, but if it's nowhere close to the "HFL"-causing temperature difference, the flow problem may be intermittent or only occur in certain specific situations.

Prestige Fault Log

Every time the Prestige goes into a condition correlating to one of the following messages it records the message and information. The most recent 24 such conditions are stored (if a 25th such condition occurs, it is stored and the oldest of the previous 24 is forgotten).

Messages logged:

PRIMING MODE

STANDBY MODE

HTR TEMP LMT

SPA TEMP LMT

SENSOR A
SERVICE ROD

SENSOR B
SERVICE ROD

SENSOR SYNC

HTR FLOW LOW

LOW FLOW

HEATER MAY
BE DRY--
WILL RETEST
SHORTLY

HEATER DRY
SERVICE ROD

Information stored for each event:

Message displayed
"Days ago" count
Actual hour
Actual minute
Mode (Standard, Economy, Sleep)
Set temperature
Sensor A temperature
Sensor B temperature

To View the Fault Log:

- Make sure the system is in test mode with the spa light turned on.
- Press the "Up" button to cycle through the last 24 fault messages (oldest first).
  - The display reads Ft01 through Ft24 and the normal message for that fault.
  - Power cycling events will be indicated by a "PRIMING MODE" message.
  - The mode in effect at the time of the fault flashes while information for that fault is being displayed (not valid in the case of a power cycling event).
  - After the "Up" button has been pressed 24 times to show all the stored events, the display reverts back to normal test mode.
- Press the "Down" button to view information on each fault.
  - The first press will display "...DAYS AGO" and the time the fault started.
  - The second press will show "SET TEMP WAS" with the set temperature shown.
  - The next press of the "Down" button will display "SENSOR A WAS" with the Sensor A temperature displayed.
  - The next press will display "SENSOR B WAS" with the Sensor B temperature displayed.
  - Power cycling events show partly valid* "DAYS AGO" data but invalid time and temperature data.

**There is one day added to the fault log for each power cycling. The system does not keep track of how many days the power was actually out for.*

Note: *To avoid confusing the display, you cannot press "Time" or "Mode" buttons while in the middle of viewing the fault log. Pressing "Up" while programming time settings will not bring up a fault display log.*

Interpretation of fault messages is best done in context. It may be helpful to write down the information you see at each step while viewing the fault log. Information such as temperature at the time of the fault and what kind of fault may have come before and after is most helpful in diagnostic situations.

Performance Analysis Mode (Prestige Only)

The panel has a built-in ability to display information about the reliability of its communication with the motherboard.

Performance Analysis Mode is toggled by pressing the "Up" and "Down" buttons simultaneously.

(*It comes on automatically for the first 15 seconds after power up, then turns off, but can be turned on by the user at any time.)*

In the performance analysis mode, the top line doesn't display the normal text messages, but instead shows a constantly updated text line in a two hexadecimal digit format as follows:

```
00.00.00 99 45   (sample line)
BC.W1.W2 LW GC   (explained below)
```

BC = How many times the CRC on the received packet turned out bad

W1 = How many times the first byte of a packet was wrong

W2 = How many times the second byte of packet was wrong

LW = The last wrong first byte of a packet

GC = How many times the CRC was good

Summary: If communication between the panel and the motherboard is good, the rightmost value should be changing constantly and the other values should change only a few times a minute at most in bursts, and even less often in the long run.

G.F.C.I. Troubleshooting

Keep in mind that a majority of G.F.C.I. tripping problems can be attributed to incorrect wiring. G.F.C.I. troubleshooting usually finds the problem.

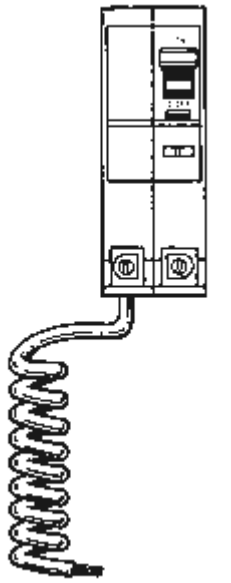
If Correct Wiring is Verified

- Check to see if the proper G.F.C.I. is installed.
- Check the label in the system box near TB1 to determine the maximum amperage draw for the system.
- Be sure the G.F.C.I. is rated for more amperage than the system will draw.
- For a 240 V dedicated system, a 2-pole G.F.C.I. with no load neutral is acceptable.
- For a 120/240 V system, the G.F.C.I. must include a load neutral out.
- If the white load neutral wire is routed from the G.F.C.I. neutral bar directly to TB1 in the system box, then the G.F.C.I. will trip when a 120 V device is activated.
- For a detailed wiring checklist, please review the previous segment of this manual on proper G.F.C.I. wiring or the G.F.C.I. manufacturer's instructions.
- If the wiring is correct and the G.F.C.I. will not reset, then unplug the pump and try to reset the G.F.C.I.

  If the G.F.C.I. trips again, then unplug the blower and reset the G.F.C.I.. If the G.F.C.I. continues to trip, then do the same procedure for the ozone generator.
- If the G.F.C.I. stops tripping after you unplugged one of the spa's components, turn off the power to the spa then plug in each component except the one that tripped the G.F.C.I.
- Power up the system. If the G.F.C.I. no longer trips, then you have correctly identified the problem. Repair or replace the component as instructed by the spa manufacturer.
- If you have unplugged all of the spa's components and the G.F.C.I. still doesn't reset, then the problem is most likely a ground fault in the heater.

To Disconnect the Heater

- First, turn off the main circuit breaker, then remove both heater straps or wires from the system heater output, not the heater itself.
- After restoring the power, try to reset the G.F.C.I. again. If it no longer trips after the system calls for heat, then replace the heater.
- If the G.F.C.I. still trips, look for pinched or shorted wires at the transformer. Make sure that the screws that attach the transformer to the system box have not pinched or damaged the insulation of the transformer wires.
- If the transformer wires are undamaged, check for any other pinched wires. Refer to the wiring diagram to verify the correct wiring of the control system.
- If everything looks to be in perfect working order, then the G.F.C.I. may be defective.



Ground-Fault Circuit Interrupter/Circuit Breaker (GFCI)

Testing the Circuit Board Output

If your topside control panel is working properly, but a pump, blower, or other device does not activate when its panel button is pressed, further diagnosis is easily accomplished with the Balboa Quick Check™.

Quick Check™ Test Kit

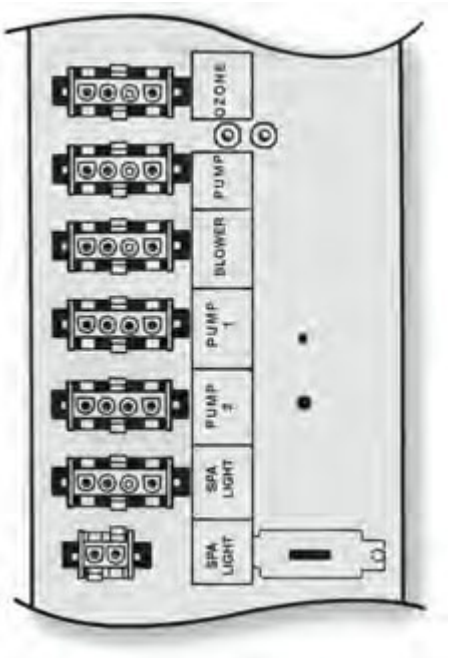
To use the Balboa Quick Check:

- Turn off the power at the house breaker box.
- Unplug the device in question, and plug the Quick Check in its place.
- Restore power to the spa and press the appropriate panel button again. If the Quick Check's light appears, the device in question is receiving voltage.
- An ordinary multi-meter can also be used to check for proper output voltage, except when working with a variable-speed blower or a dimmable spa light. In these cases, a component on the circuit board called a "triac" needs to be under a small load to test output voltage.

Note: If a small load is not applied to these systems, voltage indications of up to 240 volts AC can be seen when measuring output voltage, even if the component is not activated.

- Even if the system is not equipped with a blower triac, the best way to verify voltage output is with the Balboa Quick Check.
- If the Quick Check light does not appear after pressing the appropriate panel button, trace the wires from the corresponding connector in the system box back to the circuit board.
- Probe these connections at the circuit board after activating the function with the topside control panel.
- If you do not have correct voltage, double check the input voltage before you replace the circuit board.
- If you do have correct voltage at the circuit board, turn off the system power and check for a blown in-line fuse. Blowing the in-line fuse or the power input fuse is usually a symptom of a faulty pump, blower, or a short in the wiring to one of those devices.
- If the fuse is good, then replace the output connector.
- If the high-speed pump comes on when the system calls for heat or when the system goes into a filter cycle, the pump is most likely wired backwards. Verify that the black (low speed) and red (high speed) wires are not switched in the amp connector or the pump itself.
- Always check to make sure all devices are plugged into the proper location.

Note: If the spa light output is not detected with the Balboa Quick Check, be sure to check continuity of the light fuse on the circuit board.



Changing a System Circuit Board

Important!

Be sure to turn the power off before replacing any component, **especially a circuit board.**

Important!

Do not remove and replace the circuit board unless the fault has positively been determined to be the circuit board.

How to Remove a System Circuit Board:

- Shut OFF line power to the spa at the main circuit breaker panel. Do not attempt to service a spa without shutting off the power. Serious injury or damage may result.
- If present, remove the screw which mounts the blower triac (TRC2 on the Value M-7 and the 2000LE M-7 boards, and TRC6 on the Prestige boards). The SUV does not use a triac.
- Disconnect all wires and slip-on connectors as necessary to remove the board.

Note: Labeling these wires may help speed up reinstallation. The wiring diagram should always be used to ensure proper wire placement.

- Remove all the screws which mount the board to the system enclosure. The SUV has 9 screws across the center and bottom of the board. The Value M-7 and the 2000LE M-7 have 2 screws that are located at the upper left and lower right corners of the board. The Prestige board has 3 screws; one located at the upper left, one located at the lower right corner of the board, and one that is above and to the right of center. The Elite board uses mounting screws in the terminal block only.
- Remove the board from the plastic stand-offs by gently squeezing the locking flange on each stand-off with a pair of pliers. (The SUV does not use plastic stand-offs.) The board should now be free and can be removed from the system box. For the Value M-7, 2000LE M-7, and Prestige boards, use care to be sure the connectors on the right side of the board clear the enclosure as the board is removed.

How to Replace a System Circuit Board:

- Check all jumpers and dip switch positions on the new board. Make sure they are in the same position as the old board.
- Make sure the new board snaps in place on the plastic stand-offs. (The SUV does not use plastic stand-offs.) Use care to be sure the connectors on the right side of the board clear the enclosure openings as the board is installed.
- If present, carefully install the screw which mounts the blower triac (TRC2on the Value M-7 and the 2000LE M-7, and TRC6 on the Elite M-7 and the Prestige boards). The SUV does not use a triac.
  Caution: Do Not Overtighten this screw.
- Install all screws which mount the board to the system enclosure. The SUV has 9 screws across the center and bottom of the board. The Value M-7 and the 2000LE M-7 have 2 screws that are located at the upper left and lower right corners of the board. The Prestige board has 3 screws; one located at the upper left, one located at the lower right corner of the board, and one that is above and to the right of center. The Elite board uses mounting screws in the terminal block only.
- Reconnect all wires and slip-on connectors.
- Restore power to the spa at the main breaker.
- Test to make sure all functions work correctly.

See the photos on pages 31-35 for additional information about Balboa circuit boards.

Important

Do not remove and replace the circuit board unless you have tested all other components and proven that the circuit board is actually causing the problem.

Spa Behavior

See manufacturer's owners manual or reference card for general information on operating the spa, including programming filters and other settings that are changed from the topside control panel.

In Priming Mode, the “Mode” button toggles the ozone on/off (with a 15-second timeout). This can be useful if you want to verify ozone generator operation without waiting for a filter cycle. This feature is not available on smaller panels where Mode is a multi-button sequence, since such a sequence exits Priming Mode.

General Filter Information

- On the Prestige, and on any system with a Deluxe panel, the filter times and durations are completely programmable from the topside control panel, and the first filter may not run for many hours after power-up. If you want the filter to run sooner, you have to either reprogram the filter or advance the time to just before the filter start.
- On all other systems, the first filter starts 6 minutes after power-up and the duration can be chosen (either using button sequences on the topside control panel or via a DIP switch) between several preset choices. Note that if you let Priming Mode exit automatically after 4 minutes, you have 2 more minutes before the first filter runs after power-up. Exiting Priming Mode by pressing the “Temp,” Warm,” or “Cool” buttons, allows up to 6 minutes available before the first filter runs.

IMPORTANT INFORMATION: If the filter settings have just been changed, it may take up to 24 hours for the filter cycle to reflect the changes. This is especially likely when changing from a very long filter duration (such as Continuous), to a short one, or vice versa.

- The low-speed pump (on non-circ) and ozone generator (if installed) will run during the filter cycles.
- The blower runs for 30 seconds at the start of each filter cycle. This will maintain water quality in the air channel.
- The pumps (other than pump 1 in non-circ, including pump 1 in circ) will run for 5 minutes at the start of each filter cycle.

Heater Startup Information:

On M-7 systems, the heater goes through a testing phase every time it starts up to assure that there is adequate water flow. This provides sophisticated dry fire and low flow protection. It can be confusing if you don't know what to expect. Step by step, here is what happens (Note that the timing/temperature details may be slightly different on some older M7 systems):

- Prior to heating, the pump is run for at least two minutes, and then the temperature difference between the sensors is assessed. It must be 2°F / 1.0°C or less for heating to proceed, otherwise an error is issued.
- The heater turns on for 6.5 to 18 seconds (depending on heater voltage and wattage). At this point, the heat indicator on the panel is "solid." During this time the panel is not immediately responsive.
- The heater turns off for 90 seconds, making sure that the water flow keeps the temperature rise small and short. (Abnormal water flows, or lack of water, will produce a large and/or long temperature rise, and the system faults in that situation.) At this point, the heat indicator on the panel may appear to "shimmer" or "dim" (on some panels this may be less obvious from certain angles and more obvious from other angles, or in different lighting).
- If the dry fire test has passed, heating turns back on to heat the spa. The heat indicator on the panel returns to "solid".
- During spa heating, a difference between the sensors of 2°F / 1.0°C, or perhaps 3°F / 1.5°C (at least with 4-6kW 240V heaters), is considered normal. A significantly higher difference, however, is usually indicative of a flow problem, and will cause a fault which disables the heating for at least a minute (and then restarts the whole above process).

Dip Switch and Jumper Settings

SUV

S#	Mode of Operation	On	Off
S10	30/50 Amp	30A	50A
S9	N/A	N/A	N/A
S8	Deg C/F	C°	F°
S7	N/A	N/A	N/A
S6	50/60 HZ	50HZ	60HZ
S5	N/A	N/A	N/A
S4	Aux Freeze	- MUST BE OFF -	
S3	Panel Option	Mini	DigDup
S2	N/A	N/A	N/A
S1	Test Mode	On	Off

Jumper J43 is persistent memory reset. Reset persistent memory to default by putting J43 on 2 pins during power-up (until "Pr" is displayed). Must be on 1 pin otherwise for persistent memory to work.

Value M-7

S#	Mode of Operation	On	Off
S10	30/50 Amp	30A	50A
S9	N/A	N/A	N/A
S8	Deg C/F	C°	F°
S7	N/A	N/A	N/A
S6	50/60 HZ	50HZ	60HZ
S5	N/A	N/A	N/A
S4	N/A (Must be off)	N/A	N/A
S3	Panel Option	Mini	DigDup
S2	N/A	N/A	N/A
S1	Test Mode	On	Off

Jumper J43 is persistent memory reset. Reset persistent memory to default by putting J43 on 2 pins during power-up (until "Pr" is displayed). Must be on 1 pin otherwise for persistent memory to work.

2000LE M-7

S#	Mode of Operation	On	Off
S10	30/50 Amp	30A	50A
S9	1 or 2 Pumps	1 Pump	2 Pumps
S8	Deg C/F	C°	F°
S7	Pump 1spd/2spd	1spd	2spd
S6	50/60 HZ	50HZ	60HZ
S5	Pump1 1spd/2spd in Circ	1spd	2spd
S4	N/A (Must be off)	N/A	N/A
S3	Circ/Non-Circ	Circ	Non-Circ
S2	F.O. / Spa Light	F.O.	Spa Light
S1	Test Mode	On	Off

Jumper J43 is persistent memory reset. Reset persistent memory to default by putting J43 on 2 pins during power-up (until "Pr" is displayed). Must be on 1 pin otherwise for persistent memory to work.

Prestige

SW1 BANK

S#	Mode of Operation	On	Off
S12	Battery Reset	Reset	No
S11	Pump 3 Enable	On	Off
S10	Pump3 1spd/2spd	1spd	2spd
S9	Pump2 1spd/2spd	1spd	2spd
S8	Enable Ozone Disp*	On	Off
S7	Pump1 1spd/2spd in Circ	1spd	2spd
S6	Circ System	Yes	No
S5	Deg C/F	°C	°F
S4	Spa Light	On/Off	Dim
S3	Amperage Select		
S2	Amperage Select		
S1	Test Mode	On	Off

*Leave off if using ozone sensor jack

SW2 BANK

S#	Mode of Operation	On	Off
S6	N/A	N/A	N/A
S5	High/Low Wattage Heater	>3kw (greater than)	≤3kw (equal or less than)
S4	50/60HZ (°C/F on SW1; S5)	50HZ	60HZ
S3	Extended Time Outs	45 min	30 min
S2	Enable Fiber Optic	On	No
S1	Enable Blower	On	No

DETAILS SW1-2 & SW3 POSITION

# High Speed w/Htr	S1-2	S1-3
4	On	On
3	Off	On
2	On	Off
0	Off	Off

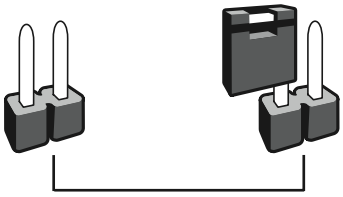
Important

Dip Switches must be pushed entirely to one side to register on or off.

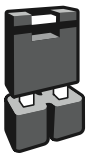
Dip Switch and Jumper Settings

Jumper orientation and configuration

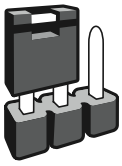
Logic Jumper



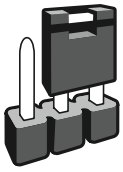
Open



Shorted



Feature " A " Enabled



Feature " B " Enabled

The printed circuit boards (especially of the Elite System) utilize jumpers that control the operation of the Power System depending upon the model of the system and the top-side control panel being used. The jumpers are identified on the board with the letter "J" followed by a number.

These jumpers are positioned at the time of manufacture for specific system configurations. For configurations other than described on page 30; call Balboa Instruments.

Important!

The illustrations at left indicate how the logic jumpers are used. If a jumper is installed on two pins, it is completing a circuit across the two pins. If it is installed on one pin, the circuit between the two pins is open. Sometimes a logic jumper will be used on a group of three pins and depending on which two pins have been connected by the jumper, feature "A" or "B" will be enabled.

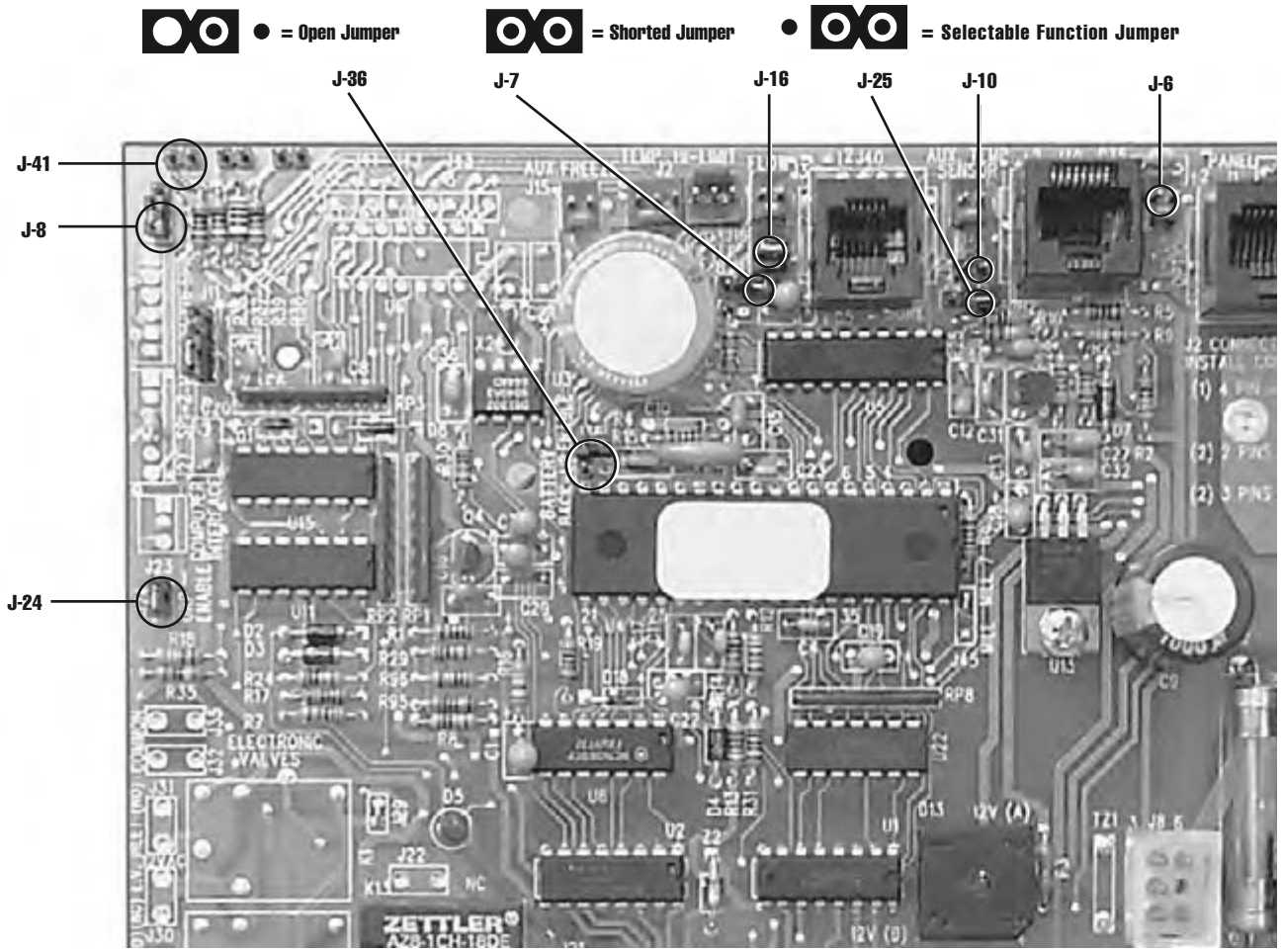
Dip Switch and Jumper Settings

Elite Chart

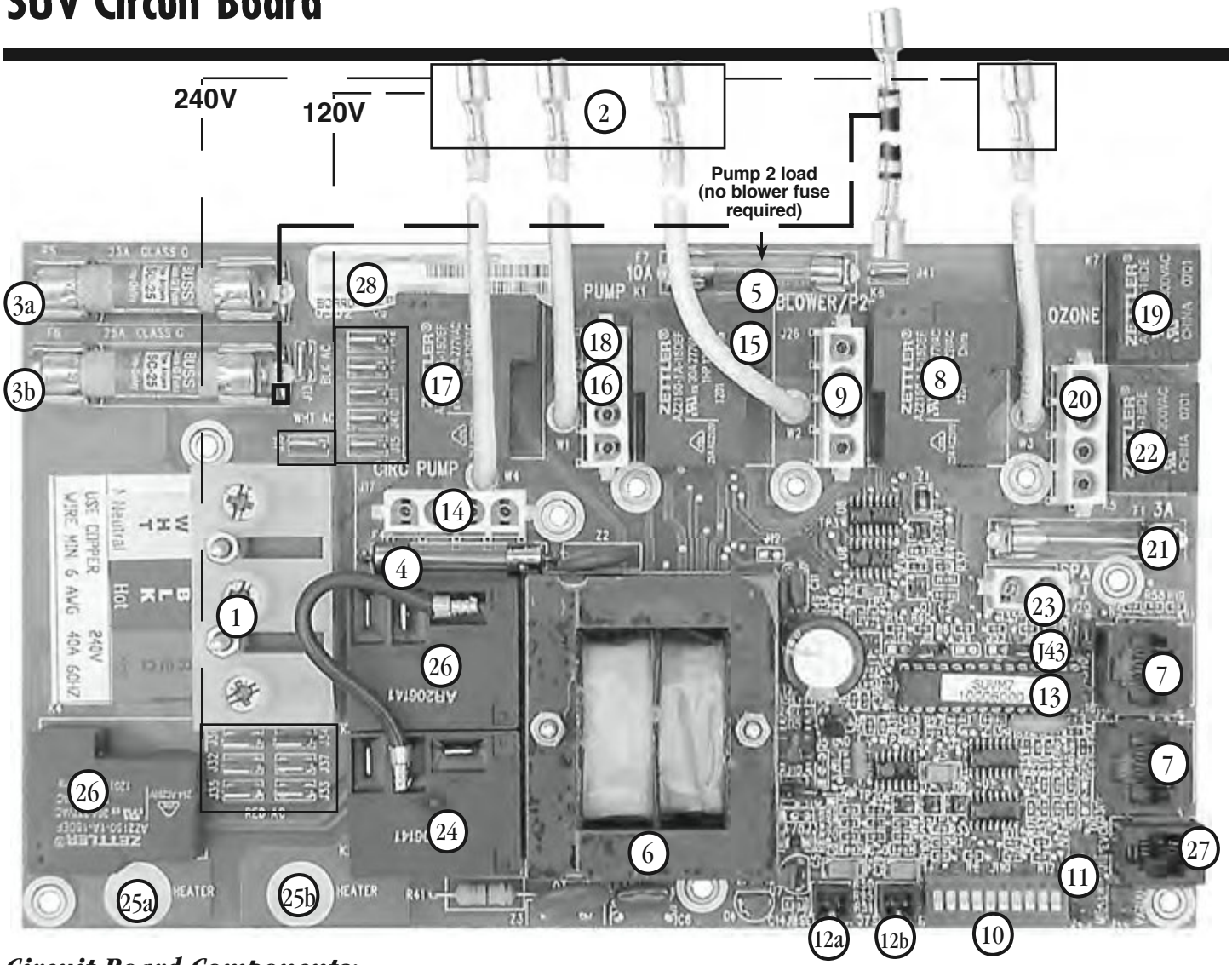
Jumper #	Function of Jumper	Position*
J-6	Selects circ/non-circ pump option	(Non-circ pump selected)
J-7	Selects top-side panel being used	(Deluxe panel selected)
J-9	Selects 120V/240V logic	(240V logic selected)
J-10	Selects 1 or 2 speed pump 2 operation	(1 speed operation selected)
J-16	Enables O_3 message	(O_3 message disabled)
J-24	Disables ORP	(ORP disabled)
J-25	Selects 50HZ, ºC / 60HZ, ºF operation	(60hz, ºF operation selected)
J-36	Allows memory storage and resets memory	(Memory storage allowed)
J-41	Disables pump 2	(Pump 2 enabled)

*** The Jumper symbols shown here are oriented to correspond to their actual positions on the printed circuit board.**

Portion of PC board for Elite showing location of jumpers.



SUV Circuit Board

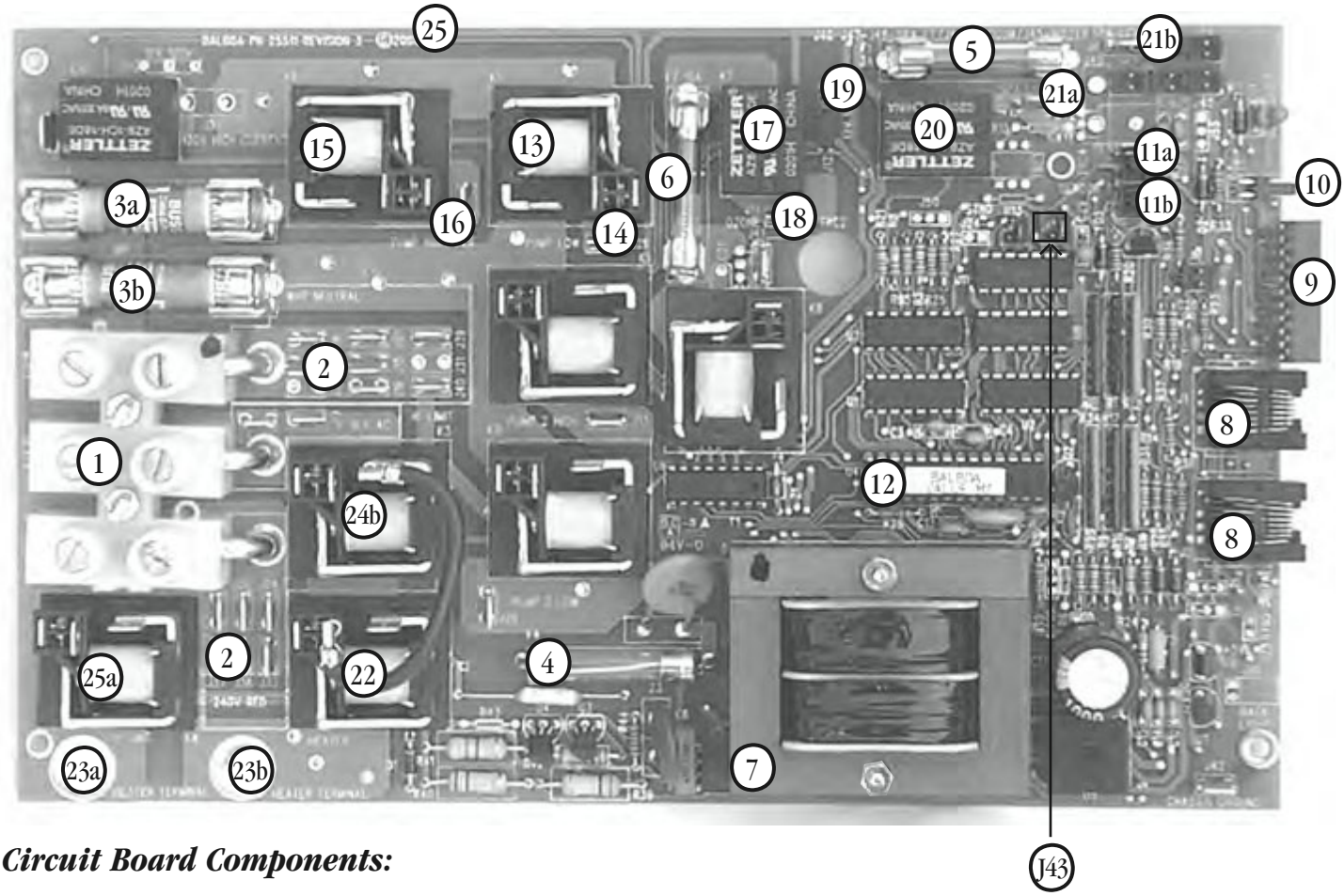


Circuit Board Components:

1. A/C Input
2. 120/240 VAC optional connectors for conversion of pumps, ozone and blower
3. Onboard load fuses
  a. F5 25A
  b. F6 25A
4. Circuit Board Protection Fuse (F4)
5. Onboard blower fuse (F7)
6. Onboard transformer
7. Control panel input, duplex or mini panel
8. Blower or Pump 2 Relay
9. Blower or Pump 2 Output
10. 10-position dip switch, modes of operation (see chart)
11. Aux freeze protection circuit (J22, optional)
12. **a.** Sensor A connection
  b. Sensor B connection
13. U4 main processor
14. Circ Pump Output (if applicable)
15. Pump 1 low relay (K1)
16. Pump 1 low output
17. Pump 1 hi relay (K6)
18. Pump 1 hi output
19. Ozone relay (K7)
20. Ozone output
21. Spa light fuse 3A 250V (F1)
22. Spa light relay (K5)
23. Spa light output only
24. Heater relay (K2)
25. Heater output A and B
26. High-limit relays A and B
27. A.D.C.M Connection
28. Serial Number/Model Number Designation

J43 Reset persistent memory to defaults by putting J43 on 2 pins during power-up (until "Pr" is displayed). Must be on 1 pin otherwise for persistent memory to work.

Value M-7 Circuit Board



Circuit Board Components:

1. A/C Input

2. 120/240 VAC optional connectors for conversion of pumps, ozone and blower

3. Onboard load fuses
a. F5 25A
b. F6 25A

4. Circuit Board Protection Fuse (F4)

5. Spa and fiber optic light fuse 3A 250V (F1)

6. Onboard blower fuse (F7)

7. Onboard transformer

8. Control panel input, duplex or mini panel

9. 10-position dip switch, modes of operation (see chart)

10. Aux freeze protection circuit (J22, optional)

11. **a.** Sensor A connection
b. Sensor B connection

12. U4 main processor

13. Pump 1 low relay (K1)

14. Pump 1 low output (J29)

15. Pump 1 hi relay (K6)

16. Pump 1 hi output (J28)

17. Ozone relay (K7)

18. Ozone output (J14)

19. 12/120 VAC jumper option for spa light or fiber optic light (J12)

20. Spa light and fiber optic light relay (K5)

21. Spa light output only
a. (J27)
b. (J4)

21. **a.** (J27) Fiber optic light and wheel output only option

22. Heater relay (K2)

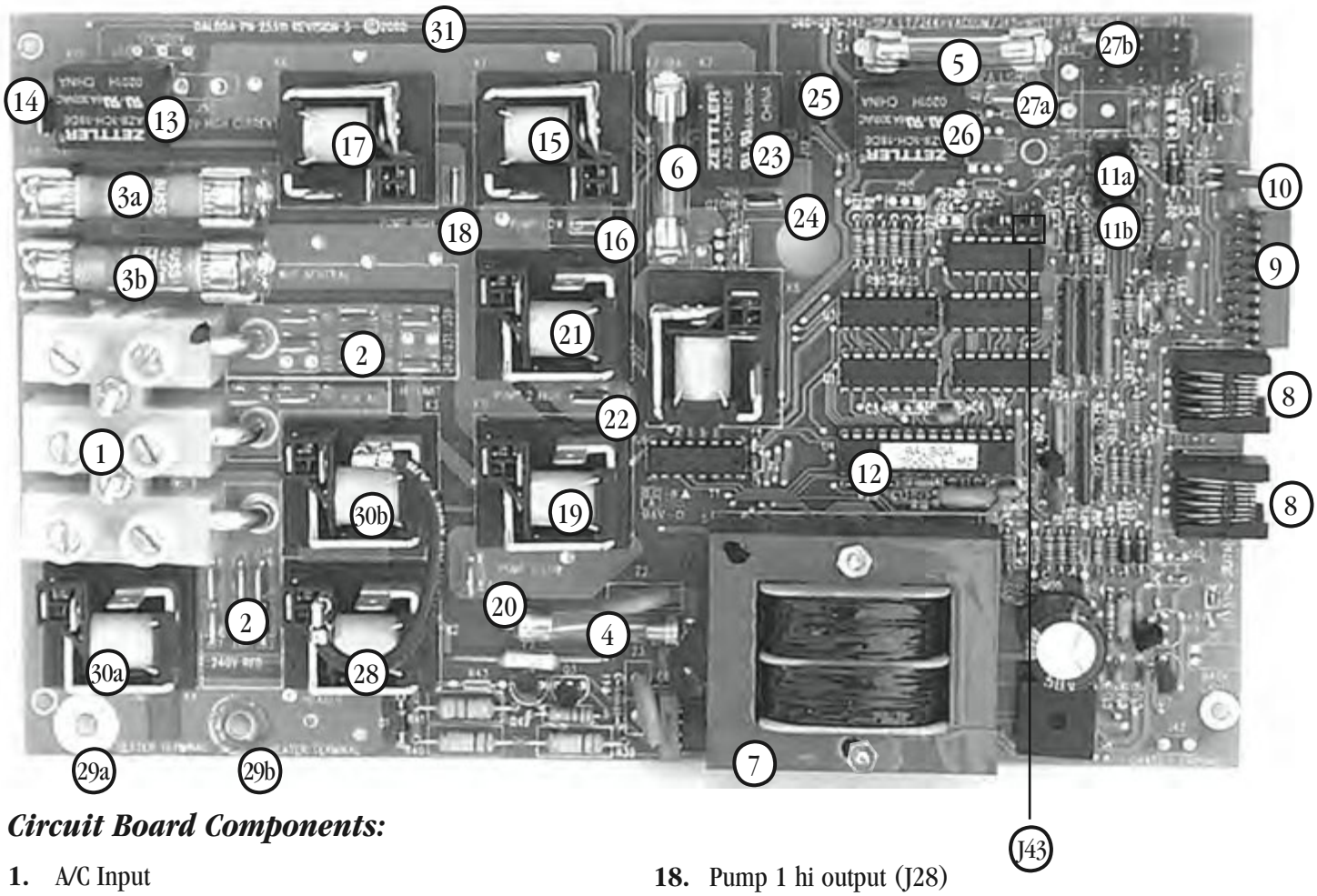
23. Heater output A and B

24. High-limit relays A and B

25. Serial Number/Model Number Designation

J43 Reset persistent memory to defaults by putting J43 on 2 pins during power-up (until "Pr" is displayed). Must be on 1 pin otherwise for persistent memory to work.

2000LE M-7 Circuit Board



Circuit Board Components:

1. A/C Input

2. 120/240 VAC optional connectors for conversion of pumps, ozone and blower

3. Onboard load fuses
a. F5 25A
b. F6 25A

4. Circuit Board Protection Fuse (F4)

5. Spa and fiber optic light fuse 3A 250V (F1)

6. Onboard blower fuse (F7)

7. Onboard transformer

8. Control panel input, Serial Standard and Deluxe panels

9. 10-position dip switch, modes of operation (see chart)

10. Aux freeze protection circuit (J22)

11. **a.** Sensor A connection
b. Sensor B connection

12. U4 main processor

13. Fiber optic wheel relay (K10)

14. Fiber optic wheel output (J26)

15. Pump 1 low relay (K1)

16. Pump 1 low output (J29)

17. Pump 1 hi relay (K6)

18. Pump 1 hi output (J28)

19. Pump 2 low relay (K11) (optional)

20. Pump 2 low output (J20)

21. Pump 2 hi relay (K9) (optional)

22. Pump 2 hi output (J13)

23. Ozone relay (K7)

24. Ozone output (J14)

25. 12/120 VAC option for spa light or fiber optic light (J12)

26. Spa light and fiber optic light relay (K5), optional 3-speed circuit for spa light only

27. Spa light and fiber optic output
a. (J27)
b. (J4) (for spa light only)

27. **a.** (J27) Fiber optic light and wheel output only option

28. Heater relay (K2)

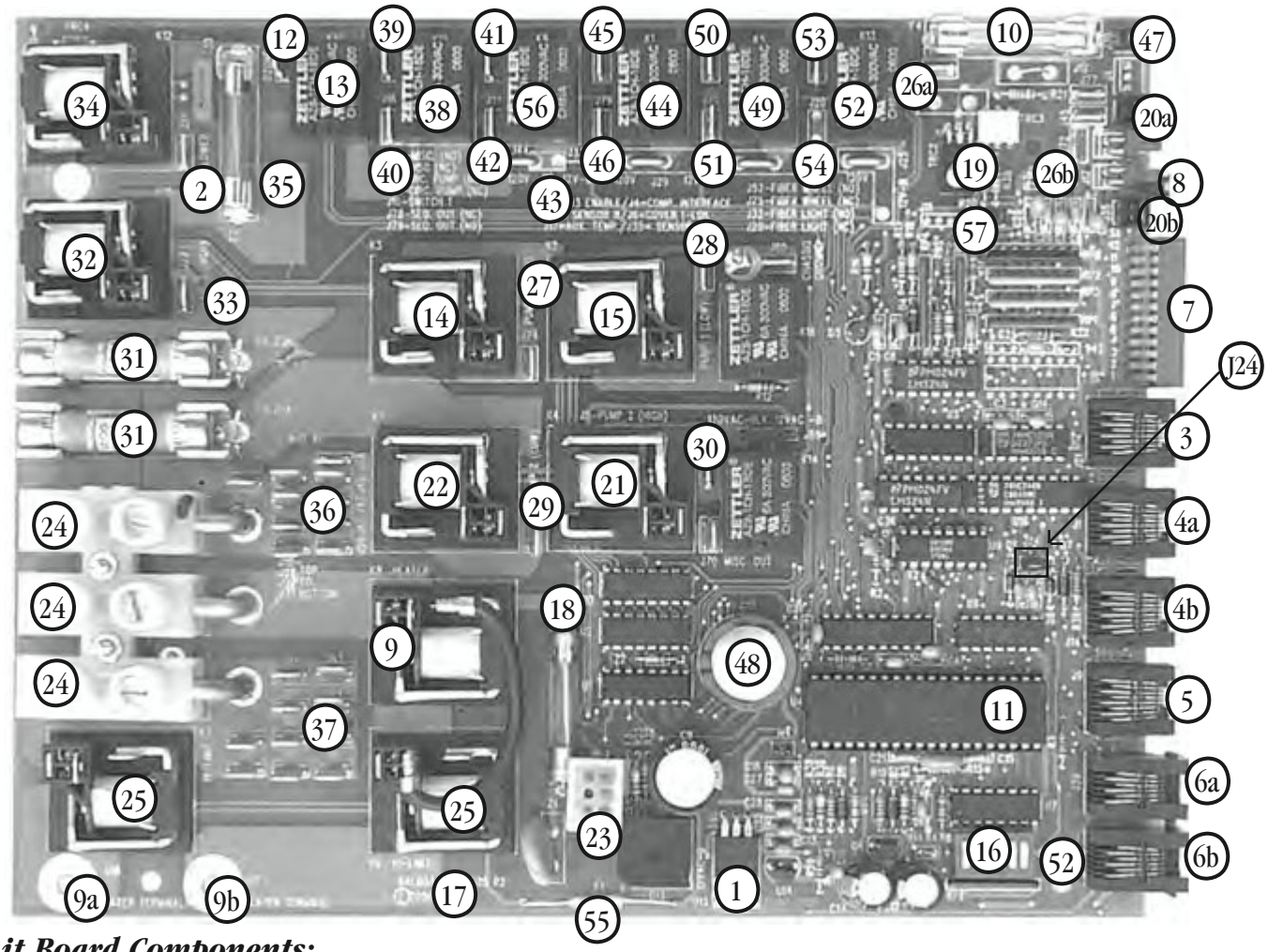
29. Heater output A and B

30. High-limit relays A and B

31. Serial Number/Model Number Designation

J43 Reset persistent memory to defaults by putting J43 on 2 pins during power-up (until "Pr" is displayed). Must be on 1 pin otherwise for persistent memory to work.

Prestige Circuit Board

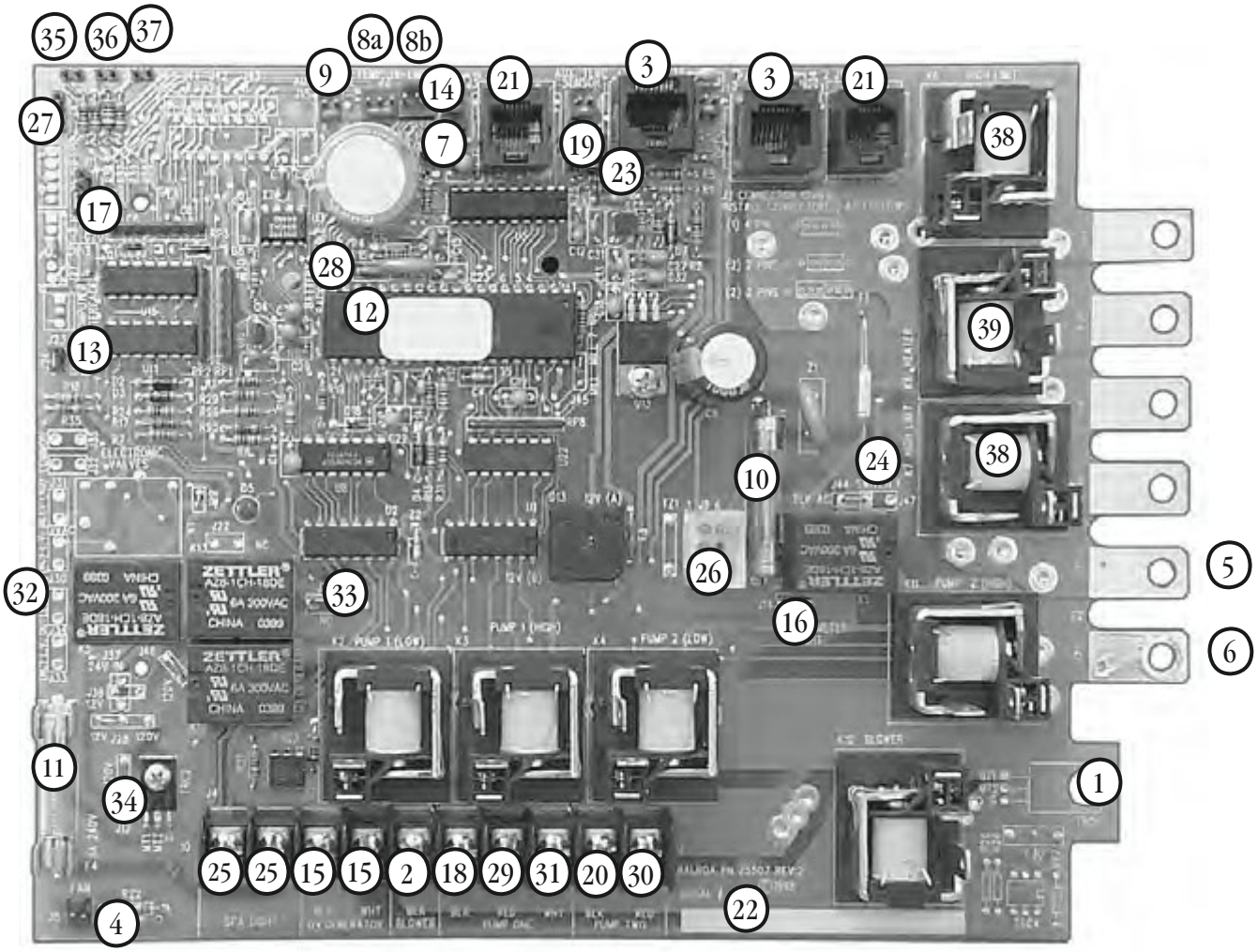


Circuit Board Components:

1. Voltage Regulator Triac (Option), Use Screw For Heat Sink Only. **Do Not Overtighten.**
2. Blower Hookup
3. Control Panel Input (21)
4a. Control Panel J1(*Option*), **4b**.=J14, 8 pin
5. Remote Control Input (J9) 8 pin
6. Aux Panel (*Option)* 6a.=J39, 6b.=J34, 6 pin
7. SW1 Bank of Dip Switches
8. Aux Freeze Control Sensor Input (J17)
9. Heater Relay; 9=K8, (9a, 9b=Heater Output)
10. Light Fuse (F4) 3A, 12W
11. Main Processor with Software Number (U4)
12. Ozone Connection (J16)
13. Ozone Generator Relay (K10)
14. Pump 1 High Relay (K3)
15. Pump 1 Low Relay (K2)
16. SW2 Bank of Dip Switches
17. Serial Number/Model Number Designations
18. Circuit Board Protection Fuse (F2)
19. Spa Light Triac Circuit
20a. M-7 Technology Sensor A; **20b**. Sensor B
21. Pump 2 Low Relay (K4)
22. Pump 2 High Relay (K11)
23. Transformer Input
24. Power Input
25. High Limit Relays (K6) (K7)
26a. 12W Spa Light output (J73); **26b**.=(J72)
27. Pump 1 High Connection (J74)
28. Pump 1 Low Connection (J76)
29. Pump 2 High Connection (J7)
30. Pump 2 Low Connection (J5)
31. Inboard Load Fuses (F6), (F5) 25 Amp each
32 . Pump 3 High (K15)
33. Pump 3 Connection (J22)
34. Blower Relay (K12) or optional 3-sp Triac Circuit
35. Blower Fuse (F7), 10A 250V
36. Wht AC "Common" Connectors for 120VAC Application
37. Red 120VAC Connection for 240VAC Application
38. Misc. Relay (K18)
39. Misc. (No) output (J48)
40. Misc. (Nc) output (J18)
41. Circ Pump (No) output (J2)
42. Circ Pump (Nc) output (J51)
43. (J10) Switch 120VAC (J44) - 12Vac (J33)
44. Sequencer Relay (K1)
45. Sequencer Output (No) (J78)
46. Sequencer Output (Nc) (J79)
47. O_3 Enable (J30)
48. Battery Backup
49. Fiber-optic Wheel (K5) Relay
50. Fiber-optic Wheel (J52) (No)
51. Fiber-optic Wheel (J75) (Nc)
52. Fiber-optic Light (K13) Relay
53. Fiber-optic Light (J32) (No)
54. Fiber-optic Light (J20) (Nc)
55. Thermal Cut-off Fuse (F1)
56. Circ Pump Relay (K9)
57. pH/Orp (J11)

J24 Orp disable

Elite Circuit Board



Circuit Board Components:

1. Blower Triac (TRC6) or optional 1-speed blower relay, Use Screw For Heat Sink Only. **Do Not Overtighten.**
2. Blower Hookup
3. Control Panel Input
4. Fan Input (J5)
5. Finger 5
6. Finger 6
7. Filter Select Jumper (Standard Only – J7)

8a. Sensor A 8b. Sensor B

9. Aux. Freeze Control Sensor Input (J15)
10. Circuit Board Protection Fuse (F2)
11. Light Fuse 3A 250V
12. Main Processor with software number
13. Orp Enable Jumper (J24)
14. Ozone Enable Jumper (J16)
15. Ozone Generator Hookup
16. Perimeter Light Hookup or Optional Circ Pump
17. pH/Orp Sensor Input (J11)
18. Pump 1 Hookup Low
19. Pump 2 Enable Jumper (J10)
20. Pump 2 Hookup Low
21. Auxiliary Panel Input
22. Serial Number/Model Number Designations
23. 50Hz/60Hz Jumper (J25)
24. Soldered-in Thermal Cut-Off Fuse
25. Spa Light Hookup
26. Transformer Input
27. 50A/20A Jumper (J9)
28. Battery Backup Enable Jumper (J36)
29. Pump 1 Hookup High
30. Pump 2 Hookup High
31. Pump 1 Common Hookup
32. Fiber Optic Wheel Hookup (J34)
33. Fiber Optic Light Hookup (J21)
34. 12V or 120V Spa Light Jumper (J12)
35. Misc 1 Jumper (J41)
36. Misc 2 Jumper (J42)
37. Misc 3 Jumper (J43) - M-7 Test Mode
38. High Limit Relay (K6) (K7)
39. Heater Relay (K8)