

# Installation and Operation Instructions

## Balboa **VS501Z PN54356-03 (or HC3)** Spa Pak

### *Using Software Rev 43 or later*

## Retrofitted into an Older Spa or Hot Tub

*Prepared by:  
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Winnipeg, MB, Canada*

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To be supplied with eBay and other Direct Sales

### Supports:

*one 2-spd Pump 1 + one 1-speed Pump 2 OR a Blower  
+ one circulating pump + one ozonator  
+ one Audio/Video power receptacle + one 12 V light*

**Warning:** THIS IS NOT A PRODUCT INTENDED TO BE INSTALLED BY A NON-QUALIFIED OR NON-TRAINED (IN BALBOA M7 PRODUCTS) INDIVIDUAL. THIS MANUAL IS NOT A SUBSTITUTE FOR SUCH QUALIFICATION AND TRAINING. The VS501Z was factory tested and was shipped in good order (test report is attached to back of unit). The unit equipped with a 5.5 kW heater requires a minimum flow of 23 USGPM to operate properly, or 12.6 USGPM if equipped with a 3 kW heater. If your system uses a **small circulation pump** with 1" or less piping, you may not have sufficient flow and must do some further testing before you proceed to install the spa pak. If the unit is installed and then returned, because of irresolvable low flow error codes, Northern Lights Cedar Tubs Inc. will at best only partially (50% or less) refund monies, the amount depending on the condition of the returned parts. **Northern Lights Cedar Tubs Inc. takes no responsibility for lack of understanding or ignorance on behalf of the VS501Z buyer and consequently the buyer carrying out an improper retrofit installation, including but not limited to: connecting faulty components to the VS501Z unit (such as a faulty pump), wiring or plumbing the unit or components improperly, setting switches or jumper wires improperly or using or operating the hot tub improperly (such as turning on the service breaker with no water in the heater tube or having isolation valves closed). If in our opinion, the VS501Z was damaged as a result of any of these conditions (whether or not admitted by the buyer), manufacturer's warranty on the spa pack (2 years from the date of manufacture) is cancelled and no refund will be provided. This applies regardless of whether such improper situations were created by the buyer directly or by trade persons (plumber, spa technologist, electrician, etc.) hired by the buyer, whether they deem themselves to be qualified or not.**

**Important NOTE:** These instructions are intended for VS501Z spa packs, manufactured after Jan 31/2008 that utilizes software revision 43 or later. The difference in these spa packs, over previous versions, is in the setting of the A5 & A9 DIP switch. You can verify that you have this software version, if the Serial Number on the circuit board starts with 54357-03.... The serial number is found on the side of the transformer. The software revision number will be the third number to come up during the power up sequence.

### Wiring Information

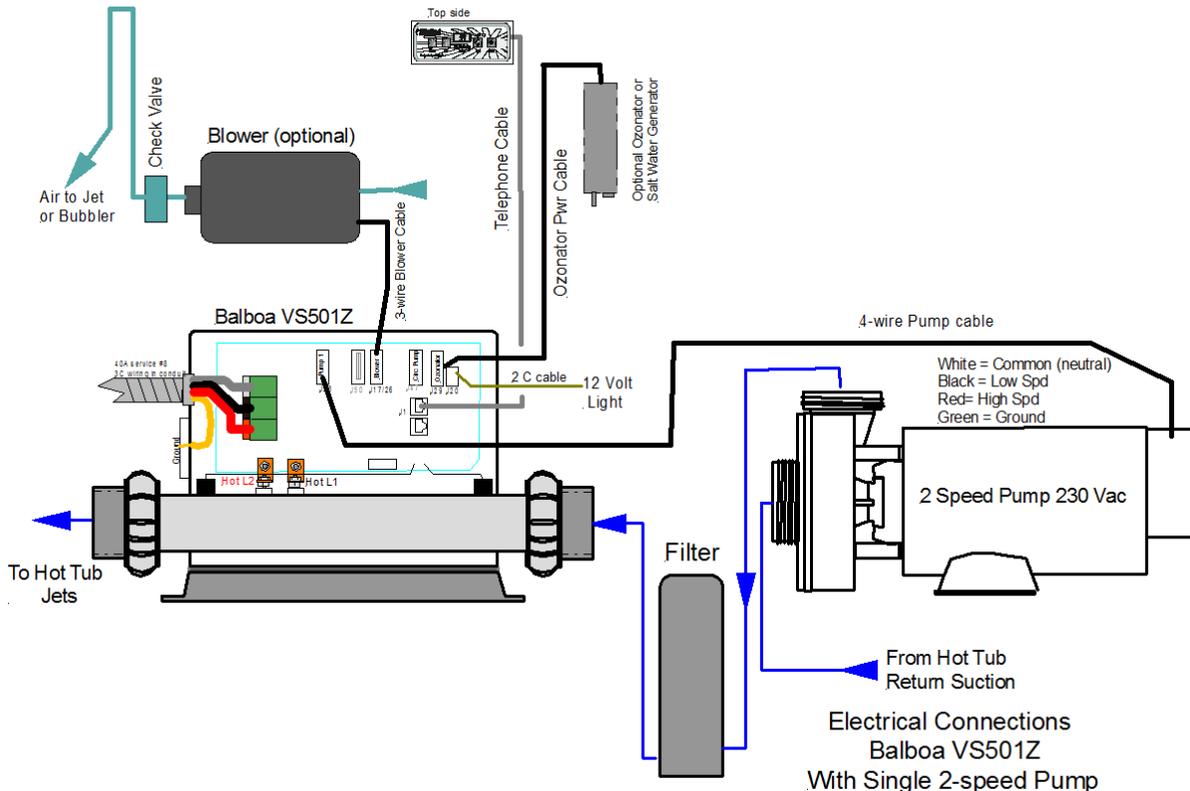
The Balboa VS501Z is a flexible digital spa controller with a built-in 5.5kW (or 3 kW) heater (common known as a “spa pak”). If used as a replacement unit for older spa paks, this unit supports a 2-speed Pump 1, a Blower or 1-speed Pump 2, an ozonator or other electronic sanitizer, a circulating pump, and a 12 volt standard or LED light. It also has an always-on receptacle for audio/video equipment. The retrofit package comes with the VS501Z spa pak, the 4 button Light Duplex Panel, plasticized instructions for the panel and a set of four cables (1 x 4-wire cable for 2-speed pump, 2x 3-wire cable for 1 speed pump or blower and circulating pump, and 12 volt light connection set). A spare 4-pin AMP plug with loose pins is also provided such you need to connect a non-Balboa Ozonator. The unit is flexible in that it can be operated from either a 2-Pole 230 VAC service or from a 1-Pole 120 VAC service. In the latter case the heating element power is reduced to 1/4 and all devices attached to it must be 120 VAC devices. When supplied with the normal 230VAC 2-Pole service, the heater produces the full 5500 watts

and the devices attached can be either 230 VAC devices (typical for the 2-speed pump) or 120 VAC.

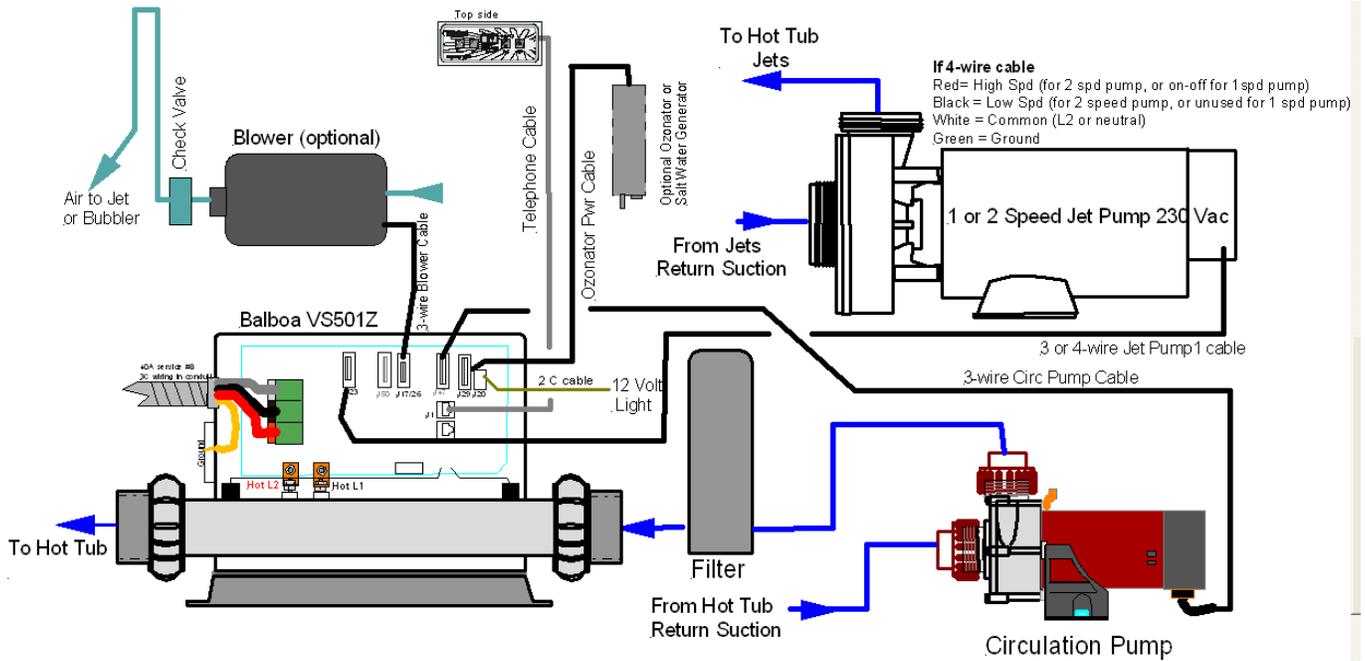
The 1<sup>st</sup> diagram (Figure1 below) shows how the spa pak will typically be wired when there is no circulation pump and only a 2-speed 230 VAC pump 1, a 120 or 230 VAC blower, a 120 or 230 VAC ozonator and a 12 VAC light. Instead of the blower, a second 1-speed 230 VAC Pump 2 could be substituted. The blower/pump2, ozonator or light may or may not exist. Be aware that the voltage, the corresponding device receptacle will provide, is determined by the white wire jumpers (shown magenta in Figure 8). Attached to a WHT AC terminals the voltage will be 120 and attached to RED AC it will be 230 VAC. The ozonator and circ pump receptacles will always both provide the same voltage as determined by the W2 jumper wire.

The 2nd diagram (Figure2 overleaf) shows how the spa pak will typically be wired when there is a circulation pump 120 or 230 VAC, a 1-speed or 2 speed 230 volt Jet supply pump 1, a 120 or 230 VAC blower, a 120 or 230 VAC ozonator and a 12 VAC light. The blower, ozonator or light may or may not exist. Again be aware that the voltage the corresponding device receptacle will provide is determined by the white wire jumpers (shown magenta in Figure 8). In this case the ozonator must have the same voltage rating as the circulation pump. Also note that if you have the dip switches A5 and A9 set for 24 hour circulation pump operation and pump1 to be 1-speed, then the top pin of J23 is the pin that is switched on and off. If you use a 3-wire cable for pump 1 the black wire will be the switched wire, but if you use a 4-wire cable the red wire will be the switched wire and the black wire is inactive.

**Figure 1 - Wiring to VS501Z Using 2-speed Pump Only (No Circulation Pump)**



**Figure 2 - Wiring to VS501Z Using a Circulation Pump and a 1 or 2 speed Jet Supply Pump 1**



**Electrical Connections  
 Balboa VS501Z  
 With Circulation Pump**

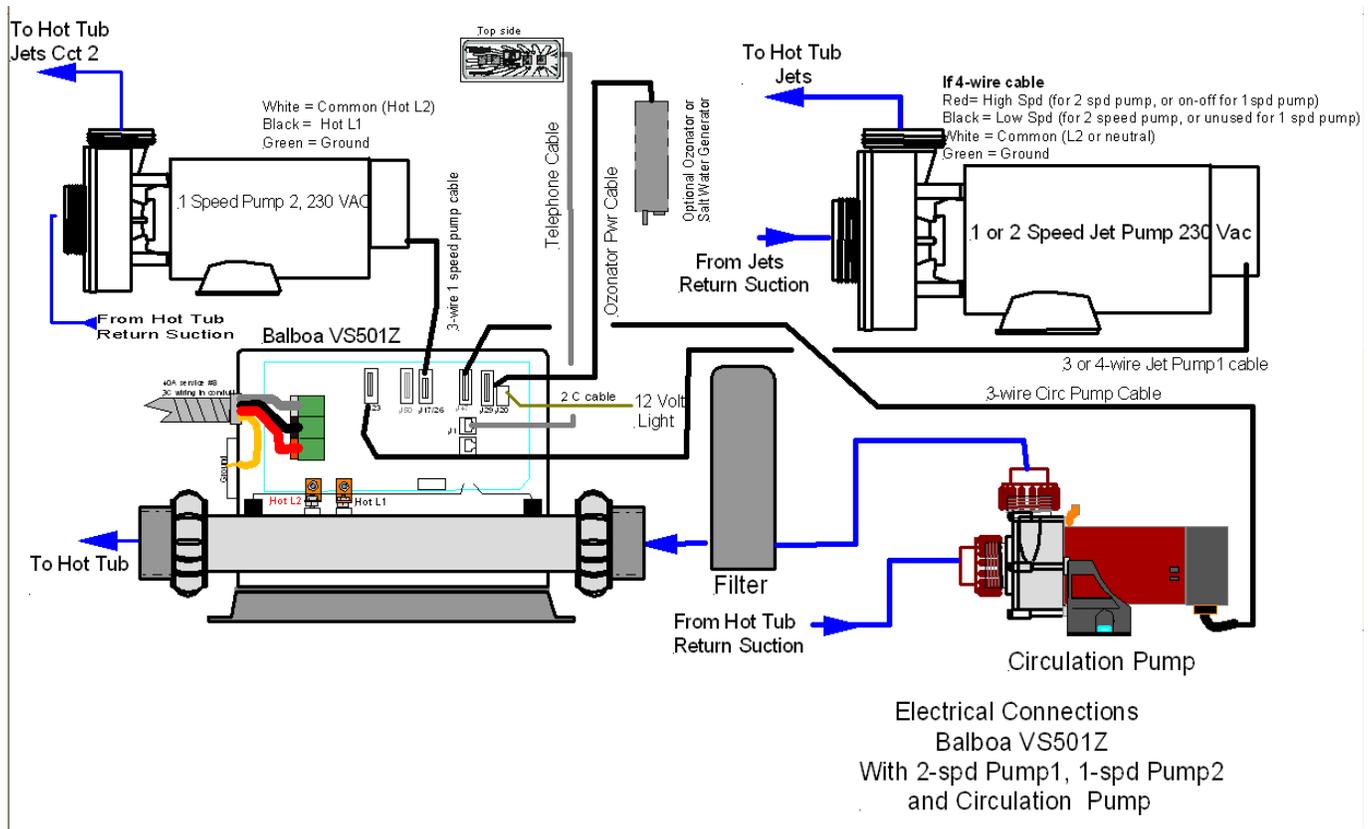
The 3rd diagram (Figure3 overleaf) shows how the spa pak will typically be wired when there is a circulation pump 120 or 230 VAC, a 1-speed or 2-speed 230 VAC Jet pump 1, and another 1-speed 230 VAC Jet pump 2, a 120 or 230 VAC ozonator (must be same voltage as circ pump) and a 12 VAC light. The pump 2, ozonator or light may or may not exist. Again, be aware that the voltage the corresponding device receptacle will provide is determined by the white wire jumpers (shown magenta in Figure 8). In this case the ozonator must have the same voltage rating as the circulation pump. Also note that if you have the dip switches A5 and A9 set for 24 hour circulation pump operation and pump1 to be 1-speed, then the top pin of J23 is the pin that is switched on and off. If you use a 3-wire cable for pump 1 the black wire will be the switched wire, but if you use a 4-wire cable the red wire will be the switched wire and the black wire is inactive.

There are **other configurations possibilities**, such as a circulation pump and a 1-speed jet pump1, or 1-speed pump1 and a 1-speed pump 2. In this case the wiring of the 1-speed pump1 needs to be given some attention. J23

is designed to switch a 2-speed pump, with the top pin intended for the high speed (red) wire and the 2<sup>nd</sup> from the top pin is intended for the low speed (black) wire. With a 1-speed pump1 and a circulation pump you can use a 3-wire cable (like Figure 5) and have A5 ON and A9 OFF, or if you use a 4-wire cable, be sure the red wire is used at the pump end.

If you have a 1-speed pump1 that supplies flow through the heater and may or may not also supply some jets, and you have a 2<sup>nd</sup> pump that supplies flow through the other jets, then the 1<sup>st</sup> pump plugs into J23 and the 2<sup>nd</sup> into J17/J26. A5 needs to be OFF; A9 OFF and you should use a 4-wire cable for Pump1. At the pump wire both the red and the black wire to the pump's hot terminal, using a yellow spade connector. Alternatively you can connect only the black wire, but then you must also ensure A10 is set to be ON. Since you don't have a low and high speed for the jets the jets button will need to be pushed twice in certain situations.

**Figure 3 - to VS501Z Using a Circulation Pump and a 1 or 2 spd Jet Supply Pump 1 and 1-spd Jet Supply Pump 2**



The Balboa VS501Z requires 3-conductor 2-pole service (+ground) and can be sized at 40/50 Amps (#8 AWG wire size), or if current capacity is limited, can be downsized to 30 Amps and #10 AWG copper wire size, provided the unit is set to low current mode. The connections of the ex-

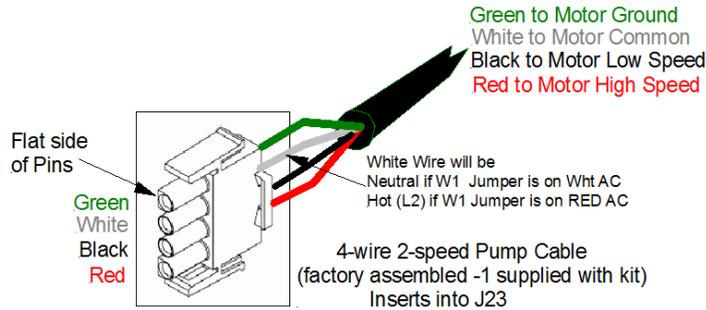
ternal devices to the circuit board, within the VS501Z, are detailed in Figure 8.

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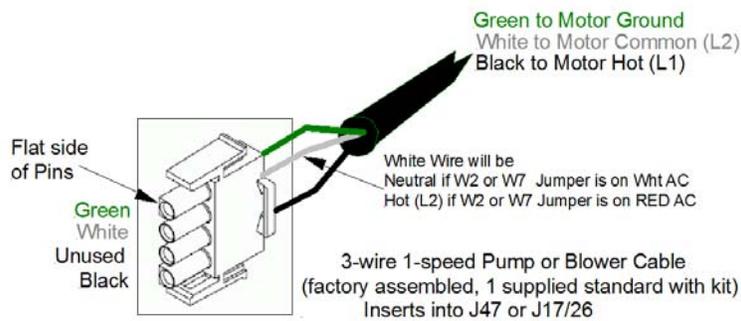
## Cable & Receptacle information

The VS501Z is not warranted for failures cause by incorrect wiring to pumps. Therefore be sure you ensure these devices are wired according to the diagrams below.

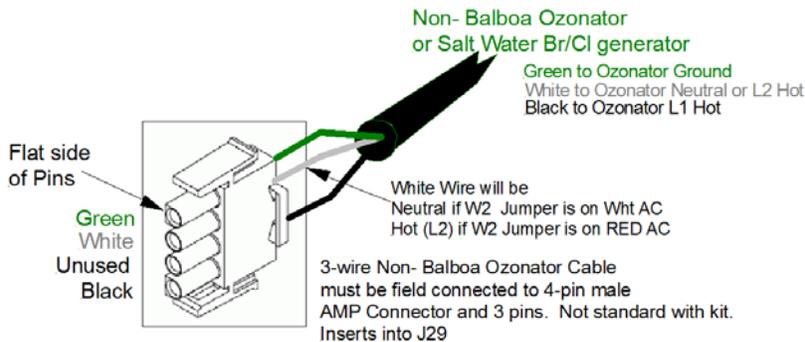
**Figure 4 – 2-speed Pump Connector Arrangement**



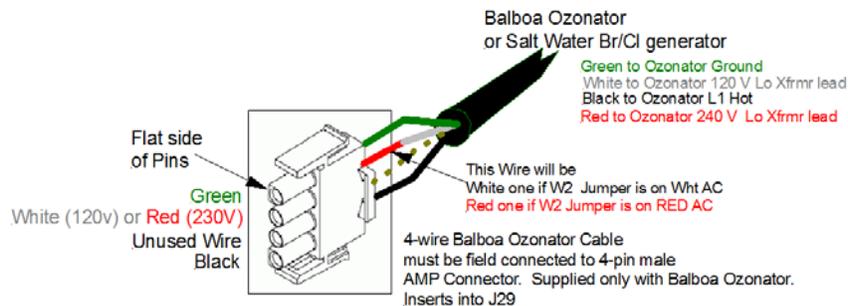
**Figure 5 - 1-speed Pump or Blower or A/V Connector Arrangement**



**Figure 6 - non-Balboa Brand Ozonator Connector Arrangement**



**Figure 7 - Balboa Brand Ozonator Connector Arrangement**



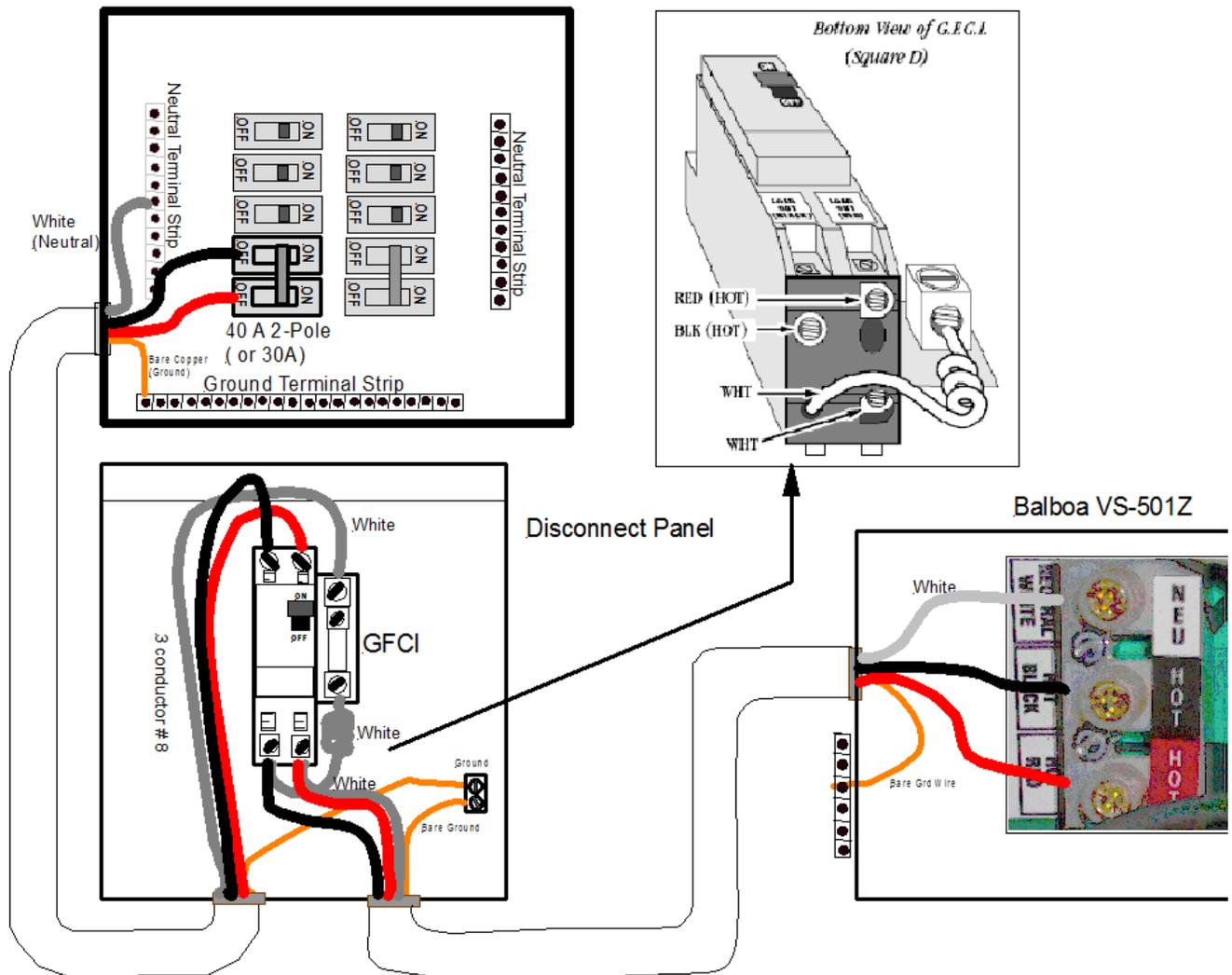


## Other Electric Service Considerations

The national electrical codes require a Ground Fault Current Interrupter (GFCI) to be used. This can be complied with by using the wiring scheme illustrated in Figure 4.

For new installations, the codes also usually call for a disconnect means within sight near the equipment but further than 5 ft (1.5 m) away from the hot tub. This can be accomplished by installing the GFCI in a disconnect panel as shown in Figure 9. Here the GFCI also serves as the disconnect switch. There are other means to achieve the same functionality. To ensure your installation is properly installed be sure to use qualified electrician

Figure 9 - Typical Service Connection



## How it Works

The Balboa VS501Z Digital Spa Pak uses Balboa Millennium 7 (M7) technology. This technology is unique to Balboa and uses a differential temperature measurement method to detect flow. Other Spa Paks use a pressure switch to try to ascertain whether a save flow exists. But pressure is not always a good way to establish whether adequate flow exists. Differential temperature will be directly related to flow, given a fixed amount of heating kilowatts is produced by the electric heater.

The VS501Z digital spa pak thus has a temperature sensor on either end of the heater tube. The electronics has a means of determining which way the water is flowing through the heater tube. This eliminates the need to have an in and an out end. The Spa Pak orientation or location wrt pump or filter does not matter.

When the spa pak is first turned on, it goes through a power up sequence. It will first flash a series of numbers that provide model and software revision information. For example this might be a sequence such as *100 63 43*. The last of these numbers is the software revision and this manual applies if the number is 43 or higher. Then a number of either *24* or *12* will appear which indicates whether you have connected the unit to 240 volt supply or a 120 volt supply. Then the indicator panel will display “Pr” standing for “prime”. This is the end of the power up sequence.

The “Pr” indication will last for 4 minutes. During this time the pump can be primed to get rid of air. This is not automatic however. If, during this 4 minute interval, the “jets” button is depressed, the pump will go into high speed and remain there until either the 4 minutes has elapsed or the “jets” button is depressed again. Then the motor will switch to low speed to begin the temperature determination sequence indicated by two dashed “--”

Since the temperature sensors are in the heater tube, they will read the temperature of the water coming in and coming out of the heater tube. This temperature is not necessarily a reflection of the hot tub water temperature, especially if the pump is not circulating water, as may be the case if a filtration cycle has been set to be non-continuous. With no flow the water in the piping cools down much more quickly than the water in the tub. The Balboa Spa Pak will turn the pump on at least every 30 minutes. The pump will run for 2 minutes before a decision is made whether the heater needs to be energized. During this 2 minutes the “--” will appear. This insures the hot tub temperature is being sensed.

Beyond this the Spa Pak has the usual features of a modern digital Spa Pak including the mentioned ability to set a filtration cycle, the ability to operate in high current or low current mode, +/-1°F temperature regulation, fault code display, freeze protection (at 44°F) and power saving modes.

## Setting of Options

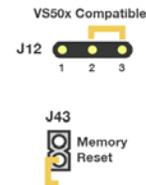
The VS501Z Spa Pak has options that are set once and then are left alone. These are set by a bank of dip switches and Jumpers on the circuit board. Options that the owner may wish to change once in a while, like the filtration cycle time is set via the digital top-side panel.

## J12 & J43 Jumpers

Northern Lights uses the VS501Z in VS501 compatibility mode. In this mode Balboa duplex or light duplex top side panels must be used (plugged into J1). This mode is selected by jumpering pins 2 & 3 of J12. This is the factory default.

J43 located above and to the right of the DIP switches, is left open (jumper on one pin only), to enable persistent memory. For example, this will recall the last temperature setting, after a power failure. To reset the memory to factory default, turn off power, set jumper across both pins, turn power on until “Pr” appears, power off and reset jumper to be on one pin only.

Figure 10 - J12 and J43 Jumpers



## Dip Switch Options

Figure 11 - Dip Switch Setting with NO Circulation Pump (Corresponds with Figure 1)

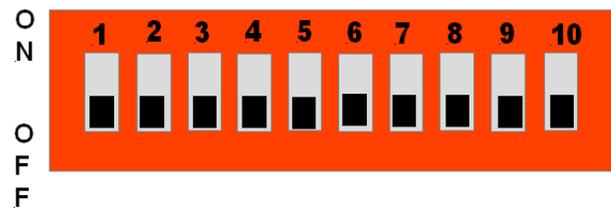


Figure 11 depicts the Dip Switches in its most common setting if there is no circulation pump (corresponding to Figure 1).

Figure 12 - Dip Switch Setting with Circulation Pump and 2-speed Jet Supply Pump 1

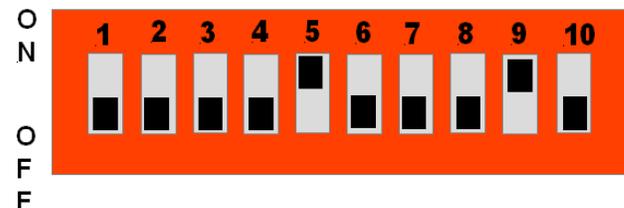


Figure 12 depicts the Dip if there is a 24 hr circulation pump and a 2-speed Jets pump1 (corresponding to Figure 2).

Rules for A5 & A9 settings need to follow the rules in table overleaf:

A5	A9	Circulation Pump Behaviour	Pump 1 Speeds
OFF	OFF	No Circ Pump Utilized	2-speed (circ & jets)
ON	OFF	Circ Pump used and acts like "PUMP1 low" above (ie., filter cycle/polls, etc.)	1-speed (jets)
OFF	ON	Circ pumps runs 24/7 with 3°F shut-off	1-speed (jets)
ON	ON	Circ pumps runs 24/7 with 3°F shut-off	2-speed (jets)

An explanation, of what the various switches do, follows (Default or recommended setting is indicated in green):

- A 1 . . . Test Mode (normally Off)
- A 2 . . . In "ON" position, unit will always be in "Standard" mode. In "Off" position mode change ( standard, economy, sleep) via digital panel will be allowed .
- A 3 . . . In "OFF" position, use Light Duplex (rectangular) Panel. In "ON" position, use mini-Oval panel.
- A 4 . . . Aux Freeze (must be OFF if no aux freeze sensor is used). If ON Aux freeze sensor needs to be used. Otherwise IC message will flash and unit will run in freeze protection mode.
- A 5 & A9 set to correspond with speed of Pump 1 ( 1 or 2 spd) and behavior of circulation pump, if used. The following table applies:

A5	A9	Circulation Pump Behaviour	Pump 1 Speeds
OFF	OFF	No Circ Pump Utilized	2-speed (circ & jets)
ON	OFF	Circ Pump used and acts like "PUMP1 low" above (ie., filter cycle/polls, etc.)	1-speed (jets)
OFF	ON	Circ pumps runs 24/7 with 3°F shut-off	1-speed (jets)
ON	ON	Circ pumps runs 24/7 with 3°F shut-off	2-speed (jets)

- A 6 . . . In "ON" position, 50Hz operation. In "OFF" position, 60Hz operation
- A 7 . . . In "OFF" position, Blower/PUMP2 function is available and 4 button panel functions are (left to right) Blower, Jets, Temp, Light.



In "ON" position no blower function is available from the 4 button panel. Button function changes to (left to right) Jets, Light, Temp Down (cool), Temp Up (warm).



Note that in this case blower/pump2 can only be used if a separated 1-button Aux panel is plugged into J2.

- A 8 . . . In "ON" position, temperature is displayed in degrees Celsius. In "OFF" position, temperature is displayed in degrees Fahrenheit
- A 9 . . . See Table for A5 above.
- A 10 . . . In "ON" Position, Heater and Pump1 Hi-speed or Blower-On are interlocked resulting in lower maximum current draw. In "OFF" position, both heater element and Pump1 hi-speed or Blower can both be on simultaneously resulting in higher maximum current requires 40 or 50A service.

## Digital Top Side Set Options

### Mode

Mode is changed by pressing the "Temp" (Warm or Cool) button, releasing it and immediately pressing the "Light" button. Each time you do this it will switch to and display the next mode.

**Standard Mode** is programmed to maintain the desired temperature. Note that the last measured spa temperature displayed is current only when the pump has been running for at least 2 minutes. "St" will be displayed momentarily when you switch into Standard Mode.

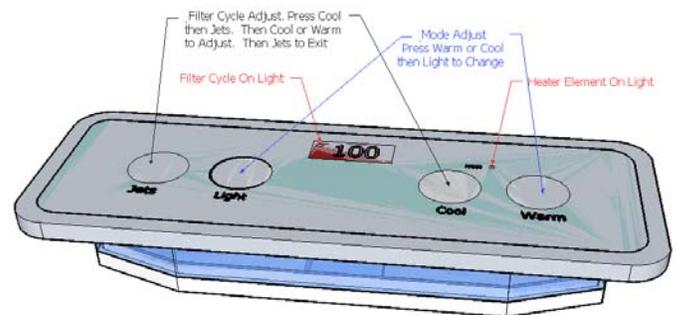
**Economy Mode** heats the spa to the set temperature only during filter cycles. "Ec" will display solid when temperature is not current, and will alternate with temperature when temperature is current.

**Sleep Mode** heats the spa to within 20°F/10°C of the set temperature only during filter cycles. "Sl" will display solid when temperature is not current, and will alternate with temperature when temperature is current.

### Preset Filter Cycles

The first filter cycle begins 6 minutes after the spa is energized. The filter cycle repeats 12 hours later. Filter duration is programmable for 2, 4, 6, 8 hours or for continuous filtration (indicated by "FC"). The default filter time is 2 hours.

To program, press "Temp" (Warm or Cool), release and then immediately press "Jets." Now press "Temp" (Warm or Cool) to adjust. Press "Jets" to exit programming. The blower purges for 30 seconds at the beginning of each filter cycle. The ozonator receptacle will be enabled during the filtration cycle.



Note: The filter cycle on indicator light does not exist in some top side panels or circuit board models.

## Most Common Initial Problems

- 1) *Low flow errors are occurring, such as dr, dy and 230 volt Pump 1 motor runs weakly or not at all. Receptacle voltage jumper wire, W1 has not been moved to RED AC. See page 2 and Figure 8.*
- 2) *Pump does not properly respond to jet button, Pump cable is plugged into the wrong receptacle (see Figure 8) or A7 is not set to the correct position according to the overlay supplied for the top side panel (see page 9)*
- 3) *Pump 1 starts up in high speed after the initial prime (Pr) indication, instead of low speed. Pump Hi-Lo wires wired need to be reversed at the motor.*
- 4) *Pump1 does not come on in low speed, but turns on in high speed if Jets1 button is depressed. Check A5 & A9 switch setting. See table on page 9*
- 5) *Unit is in sleep mode (SL indicated alternating with temperature and temperature is 20°F (11°C) below setting). Change to “St” mode. See page 9.*
- 6) *dr, dy and/or HL or LF error indications. This could be due to incorrect A5 & A9 settings. Check that you have software revision 43 or higher (third number to flash on start up). Use previous table on page to determine A5 and A9 settings, if software revision is 43 or higher. If less than 43, then you need different instructions. Contact us.  
If this is not the problem, then these are typical indications when there is insufficient flow going through the heater. Check that proper voltage has been provided to the pump receptacle (i.e., that the W1 wire is set to RED AC if pump 1 is a 230 volt pump). If this is not the problem, check that there are no air locks or flow blockages. If you have a small circulation pump (one with 1” Unions for example (such as a Laing or Waterway Tiny Might), it may not be delivering the prerequisite 23/12.6 USGPM (5.5kW element requires 23 USGPM 3 kW element requires 12.6 USGPM). The flow either needs to be increased or the wattage of the heater element needs to be decreased. If you have a 2-speed jet pump, in addition to the circulation pump, the spa pack can be re positioned to the jets circuit. Contact us.*
- 7) *Display indicates IC. This will be due to a sensor reading a temperature below 44°F (6.6°C) and the spa pak will be in freeze protection mode. The pump will be running in low speed and the heater should be on (if A10 switch is down). IC will not clear until water temperature at the sensor has risen above 7.2°C or 45°F. IC will also indicate if A4 switch has been inadvertently switched to ON (up). NOTE: If A10 is up, heater element will not come on because Blower/pump2 receptacle will be switched on in an IC condition which locks out the heater. In that case you must use other techniques to raise the water temperature to above 45°F before heater element will function.*
- 8) *Hot tub overheats. Temperature will not hold around the setting, but continues to creep upwards until 108°F is reached and OH then displays and pump shuts down. This is typical of a pump heat problem. If a pump is rated at 2 HP, for example, and it is running continuous in high speed it is producing approximately 1.5 kW of heat, which causes the temperature of the water to keep rising. Check that the pump motor wiring is correct (i.e., that you do not have the low and high speed wires reversed). If this is not the problem, reduce the filter cycle time setting.*

## Diagnostic Messages

Explanations for Diagnostic Messages are provided on the Control Reference Card that Balboa supplies. They are repeated on the next page. If any of the flow or water level messages (HL, FL, dr or dy) occur after the unit has been operational successfully, 1<sup>st</sup> check your suction screens and your filter for blockage.

## Diagnostic Messages

Message	Meaning	Action Required
	No message on display. Power has been cut off to the spa.	The control panel will be disabled until power returns. Spa settings will be preserved until next power up.
--	Temperature unknown.	After the pump has been running for 2 minutes, the temperature will be displayed.
HH	"Overheat" - The spa has shut down. One of the sensors has detected 118°F/48°C at the heater.	DO NOT ENTER THE WATER. Remove the spa cover and allow water to cool. Once the heater has cooled, reset by pushing any button. If spa does not reset, shut off the power to the spa and call your dealer or service organization.
OH	"Overheat" - The spa has shut down. One of the sensors has detected that the spa water is 110°F/43°C.	DO NOT ENTER THE WATER. Remove the spa cover and allow water to cool. At 107°F/42°C, the spa should automatically reset. If spa does not reset, shut off the power to the spa and call your dealer or service organization.
IC	"Ice" - Potential freeze condition detected.	No action required. The pump and blower will automatically activate regardless of spa status.
SA	Spa is shut down. The sensor that is plugged into the Sensor "A" jack is not working.	If the problem persists, contact your dealer or service organization. (May appear temporarily in an overheat situation and disappear when the heater cools.)
Sb	Spa is shut down. The sensor that is plugged into the Sensor "B" jack is not working.	If the problem persists, contact your dealer or service organization. (May appear temporarily in an overheat situation and disappear when the heater cools.)
Sn	Sensors are out of balance. If alternating with spa temperature, it may just be a temporary condition. If flashing by itself, spa is shut down.	If the problem persists, contact your dealer or service organization.
HL	A significant difference between temperature sensors has been detected. 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. If problem persists, contact your dealer or service organization.
LF	Persistent low flow problems. (Displays on the fifth occurrence of "HL" message within 24 hours.) Heater is shut down, but other spa functions continue to run normally.	Follow action required for "HL" message. Heating capability of the spa will not reset automatically; you may press any button to reset.
dr	Possible inadequate water, poor flow, or air bubbles in detected in the heater. Spa is shut down for 15 minutes.	Check water level in spa. Refill if necessary. If water level is okay, make sure the pumps have been primed. Press any button to reset, or this message will automatically reset within 15 minutes. If problem persists, contact your dealer or service organization.
dy	Inadequate water detected in heater. (Displays on third occurrence of "dr" message.) Spa is shut down.	Follow action required for "dr" message. Spa will not automatically reset. Press any button to reset.

## **Warranty**

Manufacturer's Warranty (Balboa) applies, which is **2 years for the spa pack** and **1 year for the top side panel**. Spa pack warranty involves replacement of faulty component only (heater tube, temperature sensor, circuit board), not the entire spa pack.

If you need to make a warranty claim, contact Northern Lights Cedar Tub's technical support (dieter@cedartubs.com) , along with a description of fault. You will be required to supply the purchase Invoice number and you will need to supply the serial number of the faulty component. The serial number of circuit board is found on the transformer.

Once technical support has agreed the warranty claim is legitimate a replacement component will be sent by UPS ground to the customer at NLCT expense. The customer will be required to send the faulty component to Balboa at the customer's expense and instructions for this will be provided.