

**Technical Support Bulletin: S3-FTLD-02**  
**Field Testing of the BVS-S3 Load Drive PCB**

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*This procedure outlines the steps required to test and verify control signals and functionality of the Load Drive PCB.*

**Troubleshooting Procedure #1:**

1. Check that the plug from the dual load board is firmly seated in the chassis and the screw terminals on the plug are properly tightened. If a loose connection was found, repeat the impedance measurement to see if the problem was corrected.
2. Check for voltage on the load current leads at the terminal strip. This terminal strip is located at the upper left-hand side of the load plate. For a BVS with a single string, the red lead is the positive most lead, the orange is located approximately at the middle of the first string, and the black lead is at the negative most end of the battery. There are a variety of configurations that use more than 3 load current leads. The voltages measured should match the voltages shown in the Load Wire Voltage sheet provided with the installation information.
3. If the voltage at the terminal strip is not what is expected, check the Load Current Lead fuses. One or more of the fuses could have failed. Replace any blown fuses and take an impedance measurement to see if the problem is corrected.

**Troubleshooting Procedure #2:**

1. Verify that the BVS is powered and the front panel display indicates battery voltage. The green "MONITOR NORMAL" LED and the yellow "VOLTAGE Vdc" LED should be lit. If the red "ALARM" LED is lit, press the # key to clear the alarm.
2. Open the cabinet door and locate the cover of the load drive board just above the center of the cabinet. This cover has a "WARNING!" label affixed. Just below the label are 2 (and sometimes 4) holes in the cover. Green LED lights behind 2 of the holes should flash once during this test.
3. Place the unit in Diagnostic Mode by pressing the following keys on the keypad: **B B A D C** (Note: Push keys firmly and slowly, briefly pausing between keys!). As each key is pressed a tone should be heard. If a mistake is made, press the # key to return the unit to normal mode and then start the key sequence over.
4. If the proper key sequence was entered, the display will flash a 4 digit number and may show **c 1** below "VALUE". Press the **A** key to select the first unit. The left side of the display should now show **1** under the "UNITS".
5. To test the left side of the circuit, observe the hole(s) on the left side of the load drive board cover and press the **2** key on the keypad. A tone will be heard and after a short delay (1 to 3 seconds) the green light under the load drive board cover will flash once. To verify that the proper keystrokes have been entered, observe the yellow "IMPEDANCE mΩ" should be lit. If not, press the # key and repeat step 3. This test can be repeated after a delay of 15 seconds. **CAUTION: Repeated pressing of the 2 key in this mode will damage the equipment! Always wait at least 15 seconds between tests!**

6. To test the right side of the circuit, repeat steps in step 5 but press the **7** key on the keypad and observe the hole(s) on the right side of the load drive board cover. The green light under the right side of the load drive board cover will flash once. This test can be repeated after a delay of 15 seconds. **CAUTION: Always wait at least 15 seconds between tests!**
7. To return the system to the normal mode, press the **#** key. A tone will be heard and the display will show the battery voltage.
8. If both LED's on the circuit flashed during this test, power and control signals are reaching the Load Drive PC board and it is functioning satisfactorily. Other tests can be performed to verify the function of the load plate.

#### **Troubleshooting Procedure – If the LED does not light and a Test Plug is available:**

1. Remove the plug for the control and power signals from the chassis to the dual load board and replace with a plug equipped with four LEDs. The status of these lamps will indicate the outputs of the motherboard to the Dual Load Board.
2. Verify that the BVS is powered and the front panel display indicates battery voltage. The green "MONITOR NORMAL" LED and the yellow "VOLTAGE Vdc" LED should be lit. If the red "ALARM" LED is lit, press the **#** key to clear the alarm.
3. Place the unit in Diagnostic Mode by pressing the following keys on the keypad: **B B A D C** (Note: Push keys firmly and slowly, briefly pausing between keys!). As each key is pressed a tone should be heard. If a mistake is made, press the **#** key to return the unit to normal mode and then start the key sequence over.
4. If the proper key sequence was entered, the display will flash a 4 digit number and may show **c 1** below "VALUE". Press the **A** key to select the first unit. The left side of the display should now show **1** under the "UNITS".
5. Press the **2** key on the keypad; see that the left LED in the plug lights. If you are using a meter, see that the voltage from the violet lead to the black lead drops when the key is pressed.
6. Press the **7** key on the keypad; see that the right LED in the plug lights. If you are using a meter, see that the voltage from the white lead to the black lead drops when the key is pressed.
7. If the voltage does not drop, the problem is not with the Dual Load Board. Troubleshooting procedures should be performed for the motherboard.

#### **Troubleshooting Procedure – If the LED does not light and a Test Plug is NOT available:**

**CAUTION - BEFORE REMOVING THE COVER TO THE DUAL LOAD BOARD, DISCONNECT THE HYPERTRONICS CONNECTOR(S) AT THE UPPER LEFT-HAND SIDE OF THE LOAD PLATE. ALL THE HYPERTRONICS CONNECTORS MUST BE REMOVED! NOTE: The button on the connector must be depressed to release the latch!**

1. Verify that there is no voltage on the terminal strips connected to the load current leads. This terminal strip is located at the upper left-hand side of the load plate. No voltage should be present between any 2 terminals.
2. Remove the cover from the dual load board.

3. Verify that all the wires to the input terminals on the dual load board are in place and the screw terminals are properly tightened. If not, reconnect/tighten and then replace the cover **BEFORE** proceeding with a re-test of the board.
4. With the Hypertronics connectors disconnected, verify that there is 5V dc between the black and red input leads to the dual load boards. If not, disconnect the red lead from the dual load board to isolate the problem to the dual load board or the motherboard. If the 5 volt power is present between the red lead and black leads when the red lead is lifted from the dual load board, the problem is on the dual load board. Otherwise there is a problem with the 5V power supply on the motherboard or the connection between the motherboard and the dual load board.
5. If the 5V is available to the dual load board verify that the control signals are reaching the dual load board. In the case of the 910018.02 board, only one signal is supplied to each side of the dual load board from the motherboard. When the right side FET is turned on, the signal is applied between the black and white terminals. When the left side FET is turned on, the signal is applied between the black and violet terminals. This is a 4.4V signal that gets pulled low during impedance measurements. To verify this signal, connect the scope between the black and white wires on the input to the dual load board. During impedance measurement on the first half of the string, the left side is turned on, a 50% duty cycle should be seen for 400 ms. Similarly, when the right side is turned on, a 50% duty cycle should be seen for 400 ms
6. In the case of the 910018.03 board, 2 signals are provided to the board. In addition to the signal verified in step 5 above, an “enable” signal is also provided on the blue wire to the dual load board. Normally there is no signal between the black and blue leads. However, during impedance measurements, a 5 volt signal is provided to the blue input wire for 400ms.
7. If these signals are not available, the leads to the dual load board should be lifted and the tests 5 and 6 performed to isolate the problem to the dual load or motherboard.

#### **Troubleshooting Procedure – If the LED does light:**

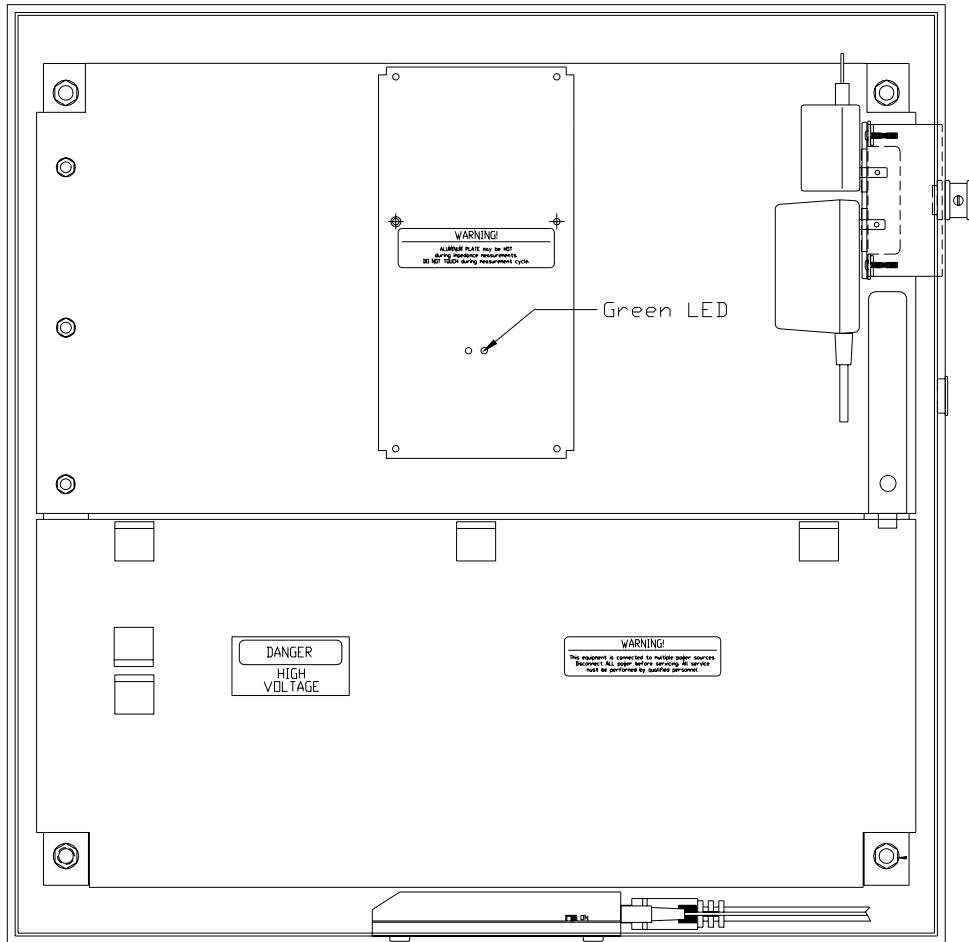
**CAUTION - BEFORE REMOVING THE COVER TO THE DUAL LOAD BOARD, DISCONNECT THE HYPERTRONICS CONNECTOR(S) AT THE UPPER LEFT-HAND SIDE OF THE LOAD PLATE. ALL THE HYPERTRONICS CONNECTORS MUST BE REMOVED! NOTE: The button on the connector must be depressed to release the latch!**

1. Verify that there is no voltage on the terminal strips connected to the load current leads. This terminal strip is located at the upper left-hand side of the load plate. No voltage should be present between any 2 terminals.
2. Remove the cover from the dual load board by removing the 6 phillips head screws.
3. Verify that all the wires and terminals on the dual load board are in place and the screw terminals are properly tightened. If not, reconnect/tighten and then replace the cover **BEFORE** proceeding with a re-test of the impedance measurement function in PROCEDURE 1 above.
4. Using a meter with a diode test function, verify “continuity” between the red load current lead and the middle terminal of the FET on the left-hand side of the plate in **BOTH DIRECTIONS**. In one direction a large reading (open) should be observed, and in the reverse about 0.5 V (continuity).
5. The same test should be done for the right-hand side of the load plate. Verify “continuity” between the Orange load current lead and the middle terminal of the FET on the right-hand side of the plate in **BOTH DIRECTIONS**. In one direction a large reading (open) should be observed, and in the reverse about 0.5 V (continuity).

6. If continuity is not observed, the plate should be removed and the resistors, diodes and connectors checked for continuity one at a time and the problem identified and corrected.
7. If continuity is observed in step 4, the next step is to verify the gate signal from the dual load board is reaching the FET's. This is done using a scope connected between the black and white terminals on the output of the dual load board where the leads are connected to the FETs. The ground of the scope should be connected to the black lead and the signal lead of the scope should be connected to the white lead. WITH THE HYPERTRONICS CONNECTORS REMOVED, perform the same test used to verify the function of the green LED lights in test 1 above. During the test, the signal to the FETS should rise to 12 V in a 50% duty cycle for 300 ms. Check both sides of the dual load board.
8. If the signal is not available, remove the leads connected to the FET and again check for the 50% duty cycle on the output terminals of the dual load board. Check the output of both sides of the board.
9. If the output is observed in either 5 or 6, check for damage to the FETs by checking continuity between the drain and source of the FETs. The drain and source are the top leads of the FET as mounted on the load plate. Resistance should be greater than 1 megohm in both directions. Also check for resistance between the Gate and Source of both FETs. The Source is the top lead of the FET and the Gate is the bottom lead of the FET. The resistance should be about 10k ohms in both directions since a 10k resistor is connected between the 2 leads of the FET.

Please call **BTECH Inc.** Technical Support if any questions arise.

## Inside View of BVS-S3



## Top view of Chassis (Location of Current Control Plug)

