

## Powermax65 and 85 System Service Tests

This reference document is intended for experienced Powermax service partners. It addresses only the tests and fault codes introduced with the Powermax65 and 85 systems.

For more information about Powermax testing in general refer to any of the Powermax Service Manuals for the Powermax1650, 1250, 1000, or 45. IGBT testing General testing procedures that are not included in this document include: work lead continuity checks,

Test #	Description	Associated fault codes
1	Voltage input	0-60-All
2	DC power buss	3-43-0
3	Output diode bridge	General
4	Temperature out of range	0-40-ALL, 2-10-ALL, 3-11-ALL
5	Flyback (DC to DC) circuit	3-00-0, 3-43-ALL
6	Torch stuck open	0-30-ALL
7	Start signal	General, 0-51-0
8	Torch cap-sensor switch	0-50-0
9	Electronic regulator	0-21-0, 3-20-ALL
10	Pressure sensor	0-12-0, 0-20-0, 2-11-ALL
11	Fan	3-10-ALL
12	Power switch auxiliary	Unreported interlock at START

Before performing any tests do the *Internal inspection* and the *Resistance check* in Test #2 below. These tests should only be performed by a qualified service technician. Wear the proper personal protective equipment and use approved tools and measurement equipment.

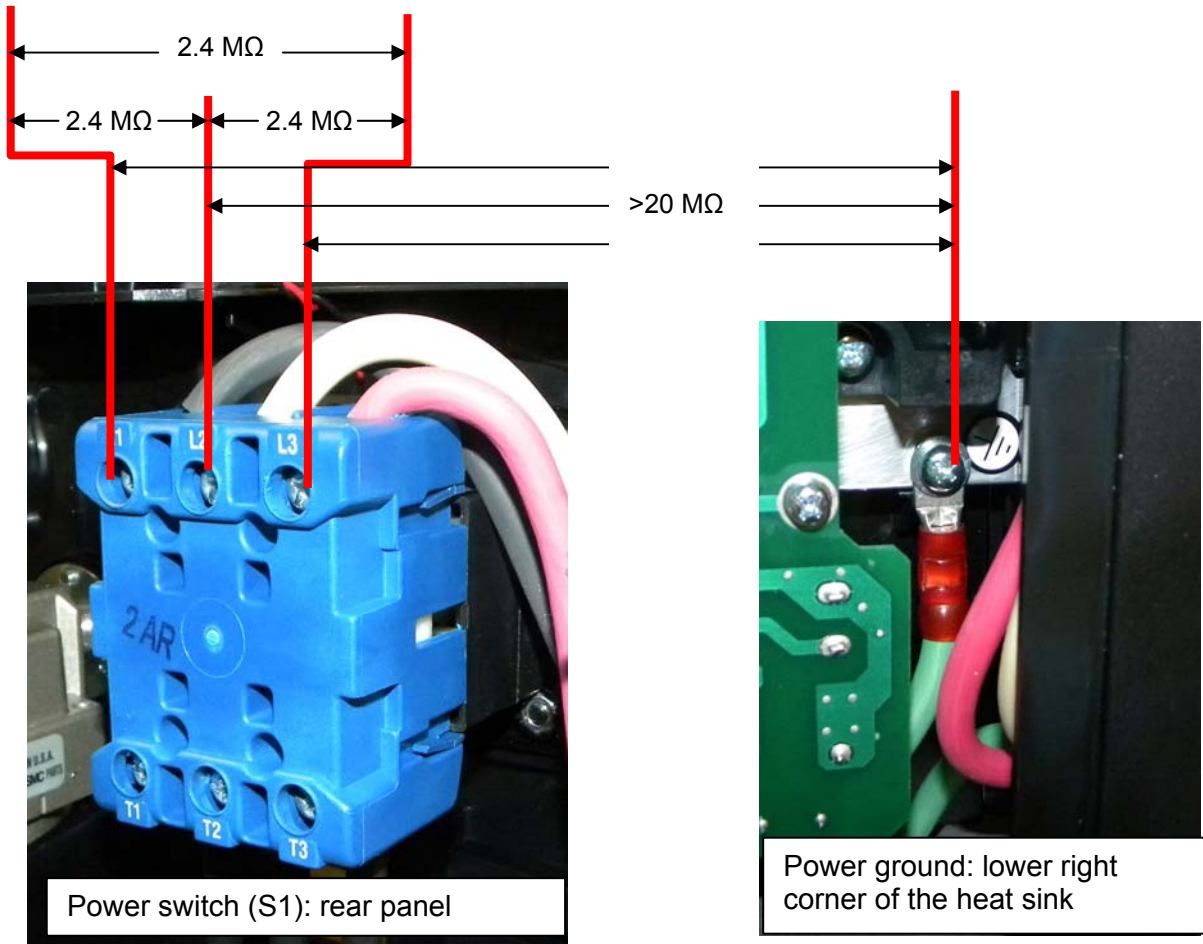
Before purchasing a major replacement component, verify the problem with Hypertherm Technical Service (1-800-643-9878) or the nearest Hypertherm repair facility.

### **Internal inspection**

- Set the ON/OFF switch (S1) to O (OFF), unplug the power cord and disconnect the gas supply.
- Remove the power supply's cover by removing the 16 securing screws. (8 #15 and 8 #20 Torx drive machine screws)
- Remove the Mylar barrier from the power board side of the power supply. Be certain to replace the barrier when you are finished working on the power supply.
- Inspect the inside of the power supply, especially the power board. Look for broken or loose wiring connections, burn and char marks, damaged components, etc.. Repair or replace as necessary.

## Power switch resistance check

- Disconnect power and set the ON/OFF switch (S1) to ON (I).
- Check the resistance across the input leads and from the input leads to ground. Values are  $\pm 25\%$



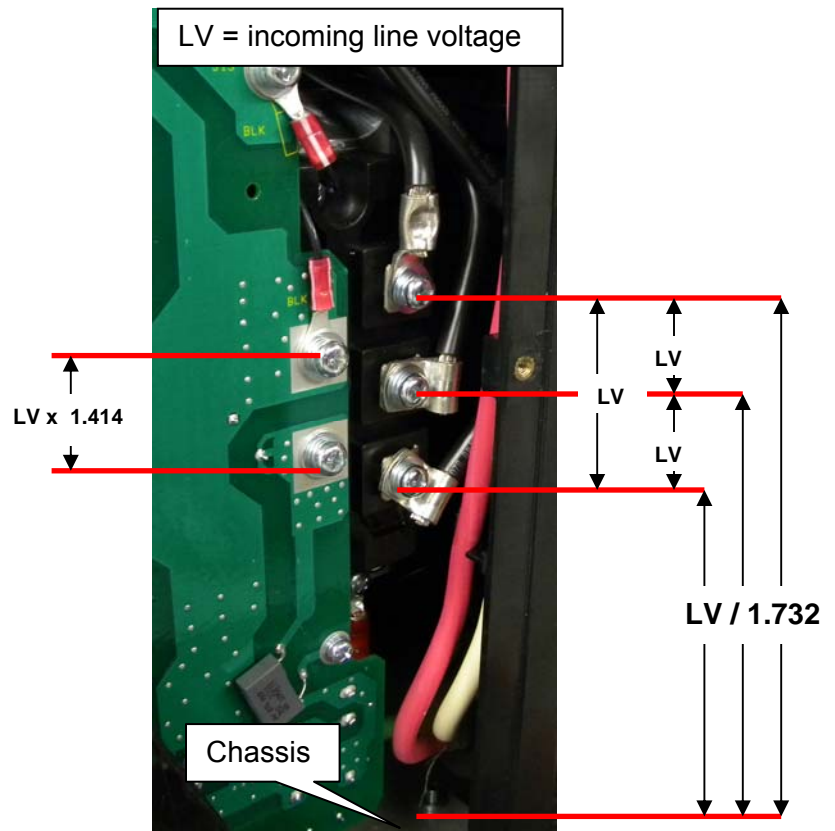
### Test 1 – voltage input

Symptom: There is a voltage fault (0-60-0, -1 or -2)

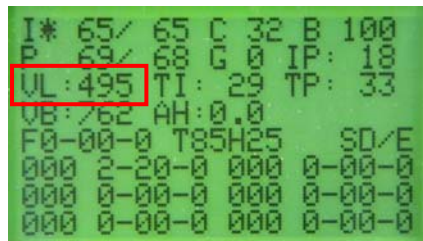
- Check the line voltage at the power switch (S1).
- Check the input voltage to the input diode bridge.
  - The AC voltage between any 2 input wires should equal the line voltage.
- If there is proper voltage to the power switch, and low voltage to the input diode, replace the power switch.
- Check the output voltage of the input diode bridge.
  - Output VDC = Line Voltage x 1.414 VDC.

	CSA unit	CE unit
L1	Black	Black (U)
L2	White	Gray (V)
L3	Red	Brown (W)
PE	Green	Green/Yellow

**Note: All values ±15%.**



- If there is a fault and the diode bridge output value is correct:
  - Go to service screen and confirm that the value “VL” is ±15% of AC line voltage



- If there is a fault and the “VL” value is correct:
  - Verify the DSP board by replacing it with a known good board.
  - If DSP board is not the problem, replace the power board and the PFC IGBT (CSA units only).

## Test 2 – DC Power Buss

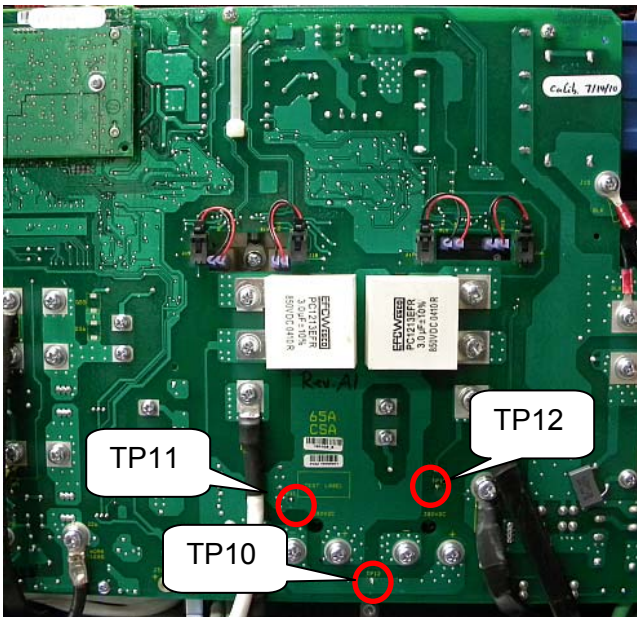
### Resistance check

**NOTE:** All resistance values must be taken with the power cord disconnected and all internal power supply wires attached.

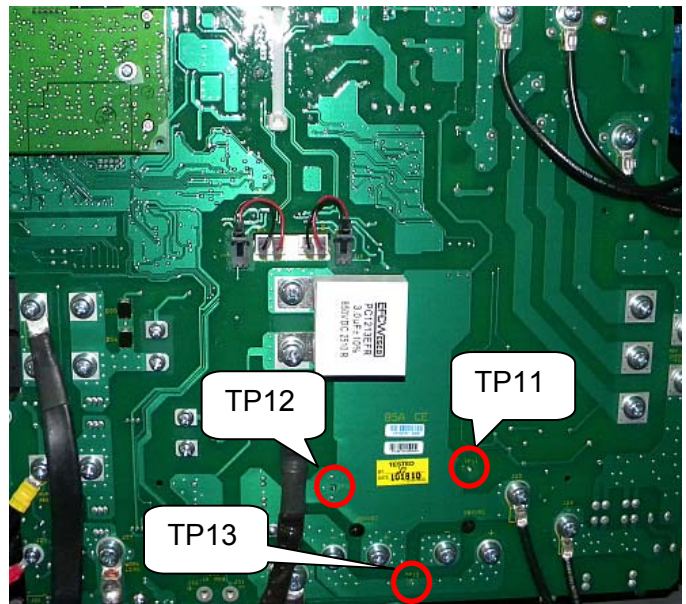
- Remove the mounting screws from the bulk capacitors.
- Measure resistances described in the following table.

CSA unit		CE unit	
Test points	Value	Test points	Value
TP 10 and 12	25K $\Omega$	TP 11 and 13	18K $\Omega$
TP11 and 12	25K $\Omega$	TP12 and 13	18K $\Omega$

CSA power board



CE power board

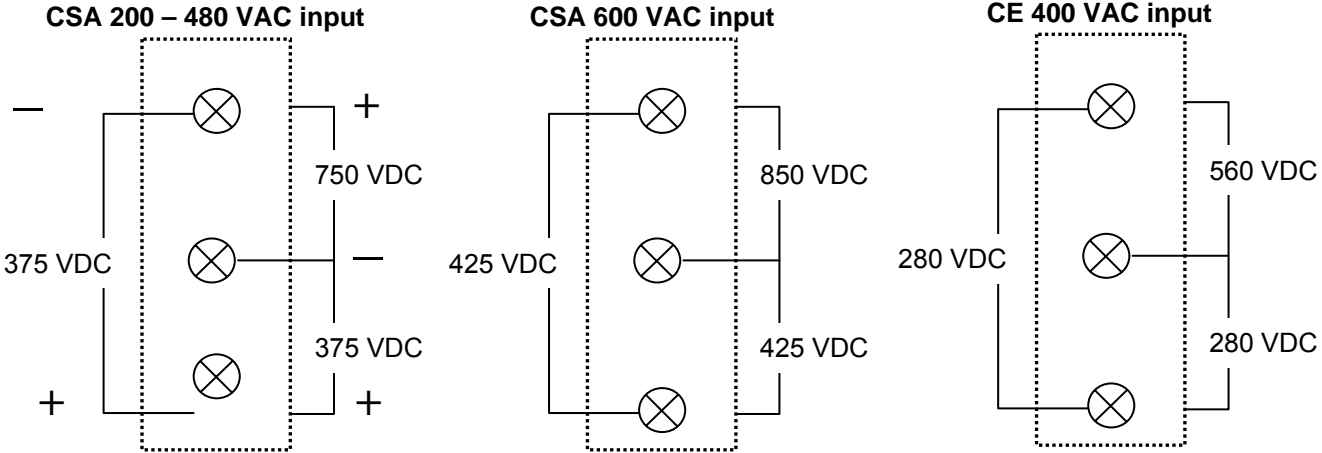


- Replace the bulk capacitor mounting screws before power-up.

**Voltage check**

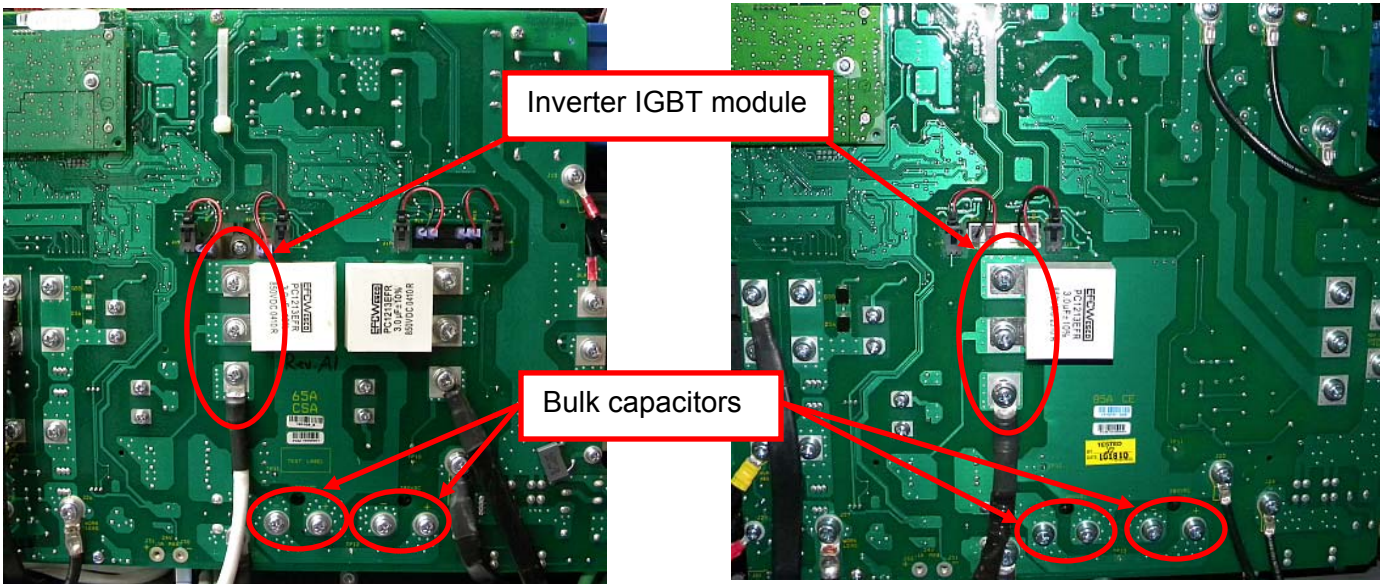
**NOTE:** All voltages must be measured with the input power connected and the machine on. Use proper safety precautions and PPE

- Check the inverter IGBT voltages across the as described below:

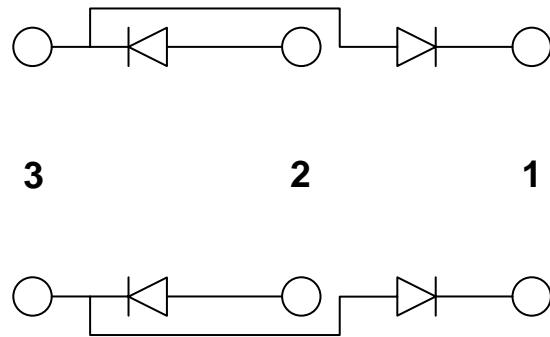
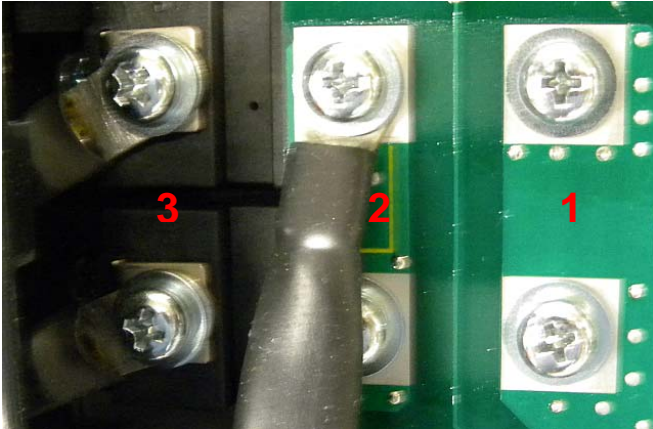


- The voltage measured across the bulk capacitors (half the buss voltage or the smaller values above) should be the same before and during torch operation.

**Note: All values are ±15%.**



### Test 3 – output diodes



- Check the four diodes in the bridge with an ohmmeter in diode test mode.
- For each diode, the value should be “open” (very high resistance) with the meter leads in one direction and 0.1V to 1.0V with the meter leads reversed.
  - A diode is shorted if the value is less than 0.1V. Replace the bridge.
  - A diode is open if the value is greater than 1.0V in both directions. Replace the bridge.

### Test 4 – Inverter and PFC temperature sensor test

Symptom: Fault code 0-40 appears in the operator screen of the display.

NOTE: Remove power and allow the system to come to room temperature. (at least 60 min after use)

If the system has a temperature interlock either an 0-40 or an 0-99 fault code will appear on the operator screen. Go to the service screen and check the “F” field for the live (most recent) fault code. 0-40 will appear on the operator screen but there are four 0-40 fault code variations:

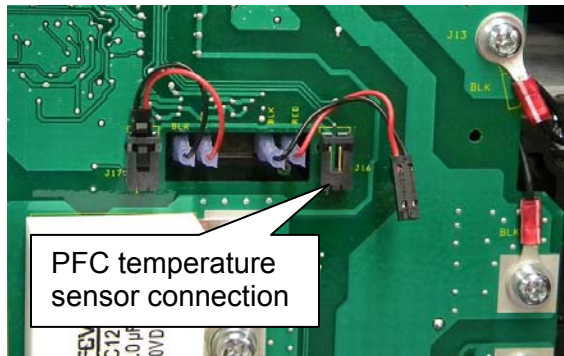
- 0-40-0 PFC module under temperature.
- 0-40-1 PFC module over temperature.
- 0-40-2 Inverter module under temperature.
- 0-40-3 Inverter module over temperature.

If there is an 0-99 fault code on the operator screen, check the “F” field on the service screen for:

- 2-10-0 Inverter module temperature sensor open.
- 2-10-1 Inverter module temperature sensor shorted.
- 3-11-0 PFC module temperature sensor open.
- 3-11-1 PFC module temperature sensor shorted.

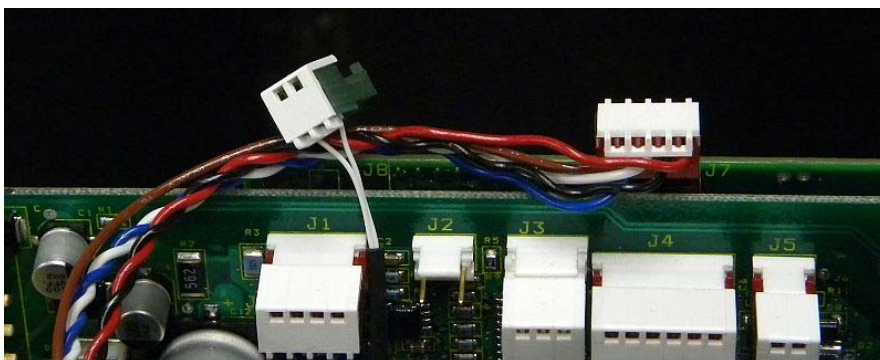
**For operational fault codes 0-40-0 and 0-40-1 or power board faults 3-11-0 and 3-11-1 (CSA only)**

- Remove PFC temperature sensor connector (J16) from power board.
- Check the resistance between pins 1 and 2 on the plug. Resistance should be 5.5k $\Omega$ .
- If resistance is incorrect, replace the PFC IGBT and gate drive cables.
- If value is correct, measure resistance between pins 1 and 2 on the power board with the temperature sensor disconnected. Resistance should be 4.7k $\Omega$ .
- If value is correct, replace DSP board.
- If value is incorrect, replace power board.



**For operational fault codes 0-40-2 and 0-40-3 or board faults 2-10-0 and 2-10-1**

- Remove the inverter temperature sensor connector from the power board (J2 on CSA units or J4 on CE units).
- Measure the resistance between pins 1 and 3 on the plug.
- If the resistance is not within  $\pm 15\%$  of 10k $\Omega$  replace the temperature sensor.
- If the value is correct, remove the DSP board and measure the resistance between pins 1 and 3 on the power board with the temperature switch disconnected. Resistance should be 57.6k $\Omega$ .
- If value is correct, replace DSP board.
- If value is incorrect, replace power board.



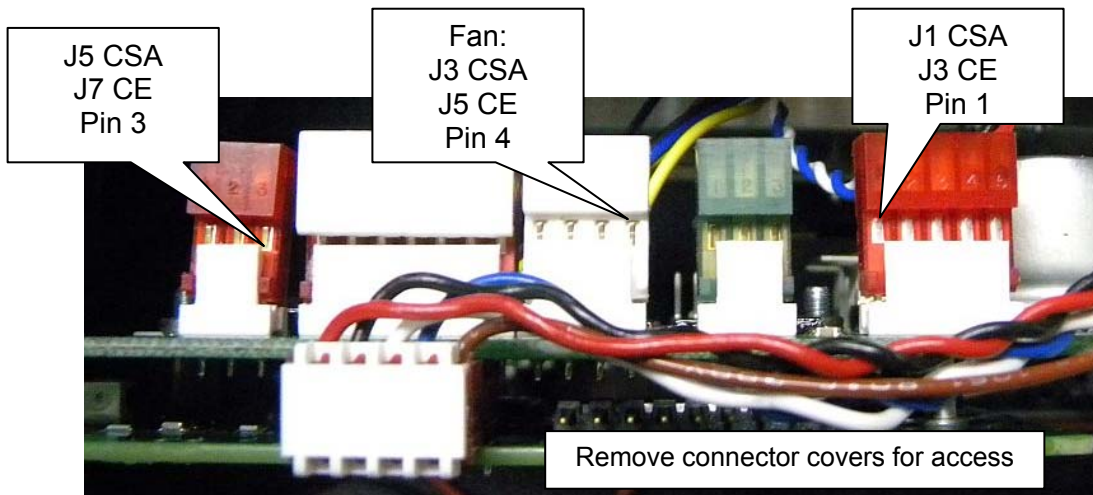
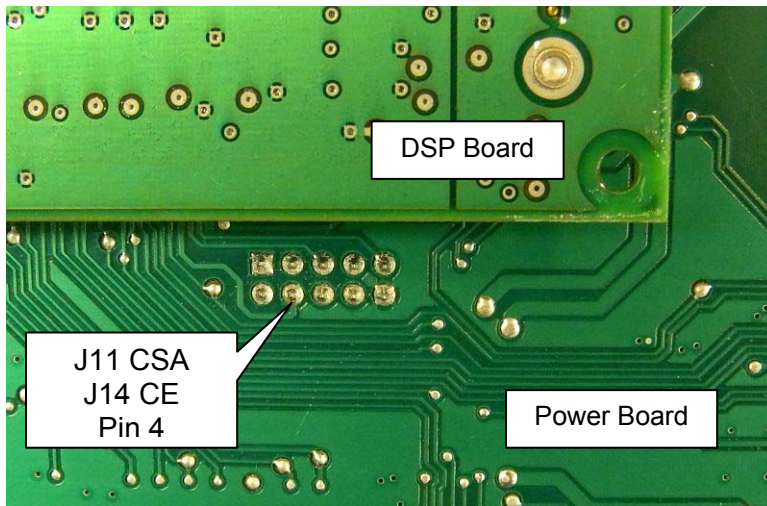
**Test 5 – Flyback circuit (DC minor voltages)**

Symptom: Minor voltages are not present.

**NOTE: Wear the proper PPE for testing powered equipment**

The flyback circuit is the source of the minor DC voltages in the power supply. It provides +3.3 VDC, +5 VDC, +24 VDC, and +48 VDC.

Check voltages as described in the table below. If the value is not within  $\pm 15\%$ , perform the appropriate test(s) in this section.



Volts DC	Test points (use chassis for negative)	
	CSA units	CE units
+3.3	J11 – Pin 4	J14 – Pin 4
+5.0	J5 – Pin 3	J7 – Pin 3
+24	J1 – Pin 1	J3 – Pin 3
+48	J3 – Pin 1	J5 – Pin 1



If the +48 VDC value is incorrect:

- Remove fan connector (J3 for standard units or J5 for CE units) and repeat test.
- If value is now correct, replace the fan.
- If value is still incorrect, replace power board.

If the +3.3 VDC value is incorrect:

- Remove the fan connector (J3 CSA or J5 for CE units) and repeat the test.
- If the value is now correct, replace the fan.
- If value is still incorrect, remove the DSP board and repeat the test.
- If the value is now correct, replace the DSP board.
- If the value is still incorrect, replace the power board.

If the +5 VDC value is incorrect:

- Remove the pressure sensor connector (J5 CSA or J7 for CE units) and repeat the test.
- If the value is now correct, replace the pressure sensor.
- If the value is still incorrect, remove the DSP board and repeat the test.
- If the value is now correct, replace the DSP board.
- If the value is still incorrect, replace the power board.

If the +24 VDC value is incorrect:

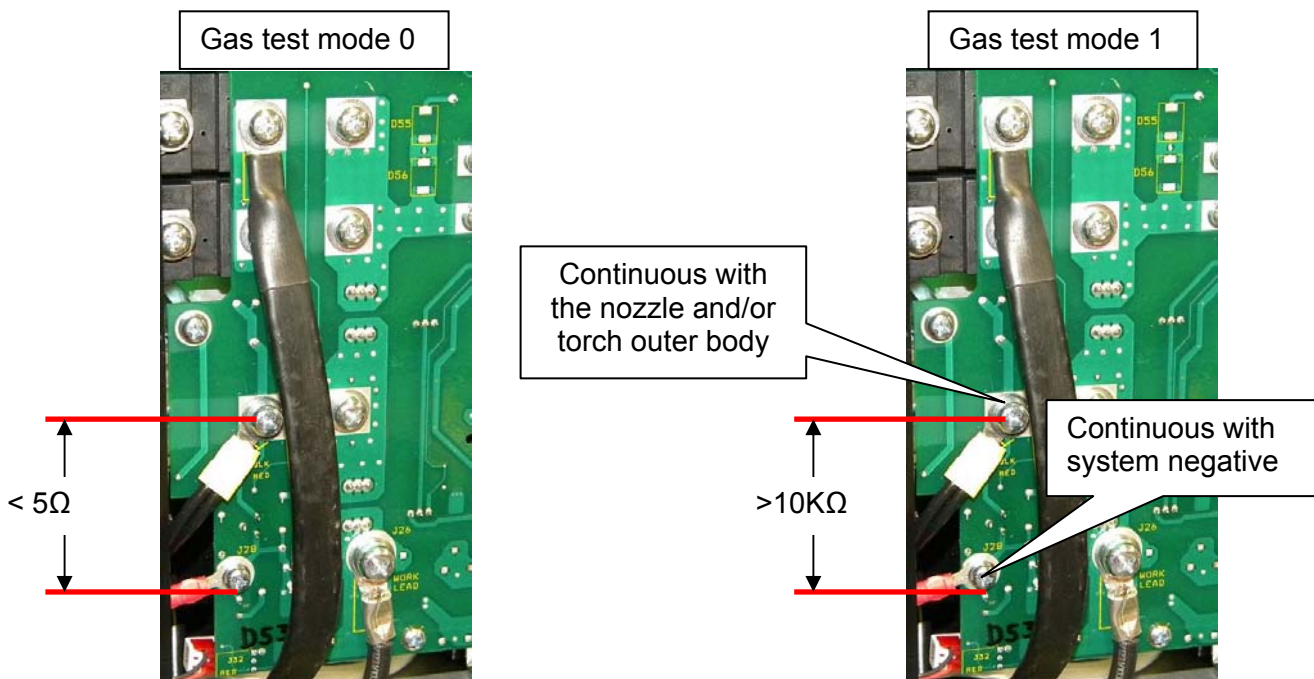
- Remove the pressure switch connector (J1 CSA or J3 for CE units) and repeat the test.
- If the value is now correct, replace the pressure switch.
- If the value is still incorrect, replace the pressure switch connector and remove solenoid valve connector (J4 CSA and J6 for CE units) and repeat the test. If the value is now correct, replace the solenoid valve. If the value is still incorrect, replace the power board.

### **Test 6 – Torch stuck open (TSO)**

Symptom: No fault at power up but an 0-30 fault on the operator screen when attempting to fire the torch.

Confirm that all of the proper consumables are installed in the torch.

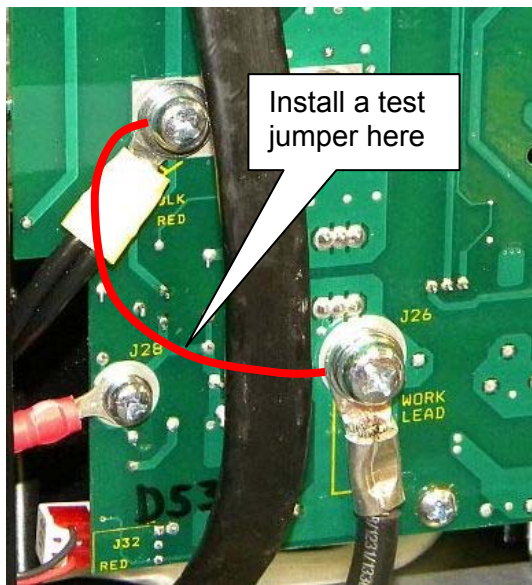
In an idle (no start signal) working system with the torch and consumables installed, there will be continuity between the dual black wires connected to the center post of the pilot arc IGBT and the red wire connecting to J28. With gas flowing through the torch (gas test mode 1 or with an arc established) there will be very high resistance between those two points.



- If the resistance value is always less than 100Ω remove the torch and re-check the resistance. If the value is still less than 100Ω:
  - Use an IGBT tester to check for a shorted pilot arc IGBT.
  - Replace the pilot arc IGBT if it is shorted.
- If the resistance is always greater than 100Ω:
  - Replace all consumables and recheck.
  - If the resistance is correct (< 100 Ω) replace the consumables.
  - If the resistance is still greater than 100Ω, measure the resistance in the torch between the pilot arc wires (Pin 1 or 2) and negative arc power (the center connection).
  - If the resistance is still too high replace the torch and lead.

**Note: The retaining cap should be snug but not over-tightened.  
All values are ±15%**

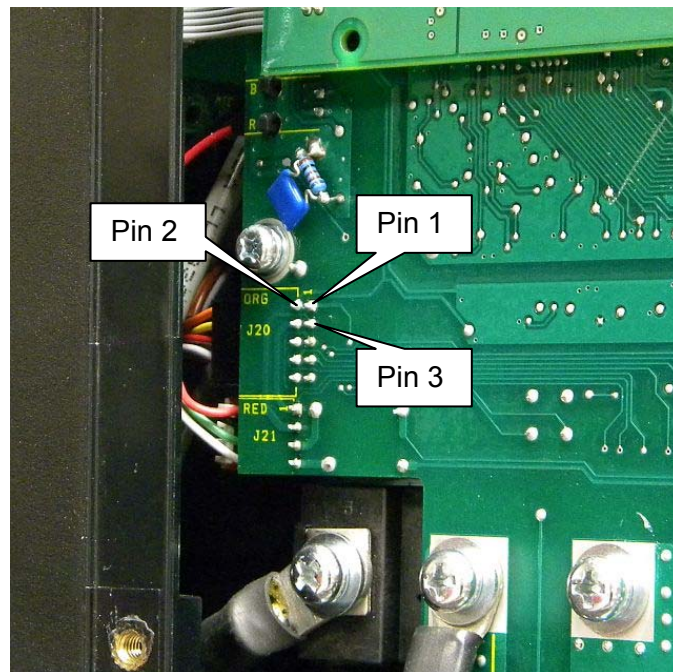
- Check the function of the pilot arc IGBT
  - Turn the machine off and disconnect power.
  - Put a jumper wire from work lead (J26 for CSA units and J27 for CE units) to the Pilot Arc IGBT (dual black wires).
  - Reconnect power and turn the machine on.
  - Attempt to fire the torch.
  - If the torch fires, replace the Pilot Arc IGBT.



## Test 7 – Start signal


Symptom: There is no arc when the torch trigger is closed:

- If the start icon (⚡) is displayed and there is a fault code 0-51 at power up:
  - Remove the torch from the system.
  - Check the resistance between Pin 6 and Pin 7 In the lead plug, with the torch trigger open (not pulled).
  - If there is very low resistance, inspect the lead set and trigger switch for shorts and replace or repair as necessary.
- If the icon (⚡) is not displayed at power up and does not appear when the torch trigger is closed:
  - Remove the torch from the system.
  - Close the trigger switch and check the resistance between Pin 6 and Pin 7.
  - If there is very high resistance, inspect the lead and trigger switch for opens and replace or repair as necessary.
- If there is no problem found with the torch wiring or trigger switch and there is still no arc or start icon (⚡):
  - Turn the machine off and disconnect power.
  - Remove the nozzle and electrode from the torch and re-install the retaining cap.
  - Reconnect power and turn the machine on.
  - Temporarily connect J20 Pin 1 to Pin 3. A small screwdriver works well for this. (**CAUTION:** Gas will flow to the torch)



- If gas does not flow and there is no start icon on the display:
  - Verify the DSP board is working by replacing it with a known good DSP board.
  - If DSP board is not the problem, replace the power board.

## **Test 8 – Torch cap switch**

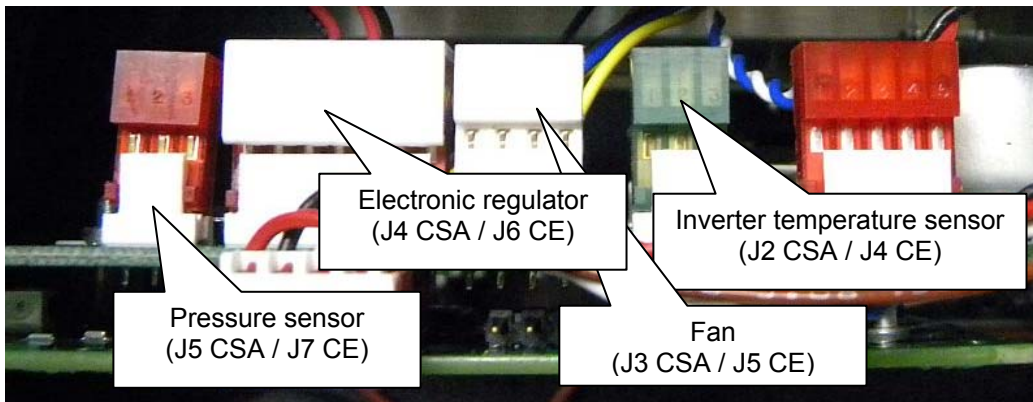
Symptom: Fault code 0-50 and the cap-sensor switch icon  appear on the operator screen.

- Confirm that the retaining cap is in place.
- Remove the torch from the power supply and check the resistance between Pin 5 and Pin 7 in the torch lead plug.
  - If the resistance is very high, check for opens in the torch leads and cap sensor switch.
  - If there is no problem with the leads or switch test the circuit boards.
    - Turn off the machine and disconnect power.
    - Put a jumper wire between J20 pins 1 and 2.
    - Reconnect power and turn on the machine.
    - If the cap-sensor switch icon is not displayed.
      - Verify the DSP board by replacing it with a known working board.
      - If the DSP is not the problem replace the power board.

## **Test 9 – Electronic regulator**

Symptom: Air flows continuously through the torch.

- Turn off the machine and disconnect power.
- Disconnect the electronic regulator control cable (J4 for CSA units and J6 for CE units) from the power board.
- If air continues to flow:
  - Replace the electronic regulator.
- If the air stops flowing
  - Verify the DSP board by replacing it with a known good one.
  - If the DSP board is not the problem, replace the power board.



### **Test 10 – Pressure sensor**

Symptom: Pressure sensor reading doesn't agree with known pressures.

**NOTE: Wear proper PPE**

- Remove the white cover on the plug at J5 for CSA units or J7 for CE units.
- Turn the machine on.
- Measure power to the sensor between Pin 2 and Pin 3.
  - If not 5.0 (±5%) perform the Flyback Circuit test above.
- From the service screen enable gas test.
- Note the flowing gas pressure in the "P" field to the right of the slash.
- Measure DCV between Pin 2 (-) and Pin 3 (+)
  - The value should be 0.0463 times the pressure.
  - For example (68PSI \* .0463VDC/PSI = 3.148 VDC)
- If the voltage measurement is within ±10% of the correct value:
  - And you have a pressure warning or fault:
  - Test with a known working DSP board.
  - If the measured voltage is correct, replace the DSP board.
- If the measured voltage is not correct:
  - Replace the pressure sensor.

### **Test 11 – Fan**

Symptom: Fan is not operating properly.

**NOTE: Wear proper PPE**

- Remove the inverter temperature sensor plug from J2 in CSA units or J4 in CE units.
- Place a jumper between Pin 1 and Pin 3 of the connector(J2/J4) on the power board.
- Remove the white cover from the fan control cable at J3 for CSA units and J5 for CE units.
- Turn the machine on.
- With the fan control cable connected to J3 for CSA units and J5 for CE, measure the DC voltage between Pin 1 and Pin 4 in the plug.
  - If the voltage is 48 VDC (±5%) replace the fan.
  - If the voltage is not correct:
    - Remove the fan control cable and re-measure the DC voltage on the power board connector between Pin 1 and Pin 4 of J3 / J5.
    - If the voltage is 48 VDC, replace the fan.
    - If not perform Test 6 – flyback circuit.
  - If the system passes the flyback circuit test:
    - If the voltage between Pin 1 and Pin 3 (J3 / J5) is 0 VDC replace the DSP board.
    - If that voltage is greater than 0, replace the power board.

### **Test 12 – AUX switch**

Symptom: Display goes blank after the HYP logo appears. (CSA units only)

- Turn the machine off and disconnect power.
- Disconnect the auxiliary switch cable from J1 on the power board.
- Measure resistance on the cable plug between Pin 4 and Pin 5.
- If the power switch is closed (ON) there should be very low resistance.
- If the power switch is open (OFF) there should be very high resistance.
- If the resistance measurement doesn't agree check the cable, plug and switch for opens or shorts.