

# DEPENDABLE POWER SYSTEMS, Inc.

## INVERTER TROUBLE SHOOTING

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### 1.0 SYSTEM

Notes:

1. Do not replace any of the semiconductor fuses in this unit with Gould/Shawmut form 101 fuses. The Gould/Shawmut fuses do not have a comparable  $I^2t$  rating and may cause damage or fire in the unit.
2. The charger equalize voltage should be set at no more than 29V, 56V, 140V or 280V when the inverter is running. Operation at higher voltages may blow an inverter fuse.

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### 3.0 INVERTER FAILURES

Note: Inverters with auto restart will not start if battery breaker is not closed. Bypass is not available. The front display panel must be functioning for inverter to start. The Inverter also will not start if RL1 on motherboard is not plugged in properly or the battery voltage is lower than 25V for 24V battery (12 cells), 50V for 48V battery (24 cells), 125V for 120V battery (60 cells), or 250V for 240V battery (120cells) or 234V for 197 to 261V battery.

PROBLEM: Inverter will not start.

CHECK: FU4 (FU5), battery voltage, SCR4 & 5 (SCR6 & 7) gate signals, voltage between wire #1 and wire #14 (#18), on inverter board voltage from TP9 to board ground. Note above.

SOLUTIONS or EXPLANATIONS: If Fuses are blown, check associated SCR's and Diodes before replacing fuse. Then perform a "BUZZ DOWN". If no gates, check the inverter board.

For inverter to run the following must exist on the inverter board:

- a. The inverter board 12V is between 11.5 and 12.5 volts.
- b. C15 voltage on inverter board should be at the DC input level or 150V, whichever is lower.
- c. Inverter board test point TP9 is low (0 to 1.2V).
- d. The voltage on bottom end of R73 must be low (0 to 1.2V).
- e. The signal at TP2 must be 60HZ(50) 12V square wave.
- f. The signal across D11 and D13 (D7 and D9) is a square wave going between 0 and twice the battery voltage.

a & b. No 12V and No C15 voltage, check wire connections to mother board at J2-2,3 and J2-7,9

- a. If no +12V on control board when DC input is available, check for voltage across ZD6 on the Inverter board. If greater than 18V, then replace the Board. If zero, check ZD6 and motherboard R16 to 27.
- b. C15 voltage zero or low and 12V ok, check R30, 31, 32 and 35, and ZD2 on motherboard, then replace Mother board.

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- c. If TP9 is high, make sure the DC bus voltage is above the minimum start voltage (25, 49, 124, or 258). This voltage should appear on R93. If not, check R40 on the mother board. Otherwise, adjust DC trip potentiometer ccw.
- d. If the conditions for a to c are okay and R73 is not zero, then replace the board.
- e. If the conditions for a to d are okay and TP2 is not a square wave, then replace the board.
- f. If the conditions for a to e are okay and D11 and D13 is not a square wave, then replace the inverter board and check the continuity of T2 (& T1) on the mother board.

On inverters with auto-start, if there are gates on SCR4 and 5, but no voltage at wire #14 (18), check RL1 on the mother board and check the gate wires to SCR8 (9). If the voltage across D7 on the mother board is equal to the DC bus, check R42 to R45, D8, D9 and continuity of RL1 socket on the mother board. Replace RL1. Replace the mother board.

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**PROBLEM:** NO Output but Inverter runs.

**CHECK:** CB6 or FU6(7, 8) , Check C10(C11) for shorted capacitor.

**SOLUTIONS or EXPLANATIONS:** If the fuses are blown, check the associated SCR's in the static switch before replacing. Replace static switch gate board (20060000). Replace Static Switch Board (200300X). Replace shorted capacitor.

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**PROBLEM:** Inverter Output low.

**CHECK:** CB6 or FU6(7, 8) , Check for bulged C10 (C11) or bad connections to C10 (C11). Check the voltage with True IRMS DVM. If a 3 phase unit, check FU4 and FU5.

**SOLUTIONS or EXPLANATIONS:** If the fuses are blown, check the associated SCR's in the static switch or inverter bridge before replacing. Replace bulged C10 (C11).

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**PROBLEM:** Inverter output normal but not in sync.

**CHECK:** Check for Bypass input (voltage and frequency) at static switch SCR's, Check Bypass input breaker, with meter measure difference voltage from Inverter to bypass on static switch SCR's.

**SOLUTIONS or EXPLANATIONS:** If Bypass is available, but not within +/- 10% in voltage and/or +/- 0.6 Hz, or the frequency is changing faster than 1Hz/second, the unit is not going to transfer. Correct the bypass. If Bypass is available and the different voltage is continuously <35V, but Static Switch will not transfer to inverter, replace "Static Switch Control board". If unit will transfer but "IN SYNC" LED does not light, check and replace LED. If Bypass is within the limits and difference voltage

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>35v or changing, check the motherboard connector J11 and reconnect. Check the phase rotation of bypass and reconnect bypass input for same rotation as inverter (3 phase only). Check the frequency of the inverter board oscillator TP8, adjust it with the oscillator potentiometer on board. Replace the "Inverter Control Board".

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**PROBLEM:** Inverter output is normal but will not synchronize and varies up and down in frequency without a bypass being available.

**CHECK:** Static switch SCR's (SCR10 - SCR13, SCR14 - SCR17, and SCR18 - SCR21) for shorted device. Check the static switch gate boards for damaged components.

**SOLUTIONS or EXPLANATIONS:** A shorted SCR or a bad gate board will tie the Bypass terminals of the static switch to the inverter. This causes the inverter to chase it's tail when the sync circuit tries to sync to itself.

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### 4.0 STATIC SWITCH FAILURES

**NOTES:**

1. On the Static switch control board the dip switches should be set as follows: SW1 - 120 position closed (on) all others open, SW2 - positions 1 to 4 closed and position 5, open for 120 or 240, closed for 208.

2. In order for a transfer to occur, the Inverter and bypass must be "IN SYNC" (less than 25V difference voltage), the inverter voltage must be within 90% (95%) of nominal, the system output must not be overloaded and the battery breaker must be closed. The front panel "IN SYNC" LED must be on and when provided the "Inverter Failure", "System Overload", and "Battery Breaker Open" LED's must be off. On the static switch board the same conditions are shown as follows:

1. TP4 continuously high (11.5 to 12V) indicates an "IN SYNC" condition.
  2. TP5 continuously high (11.5 to 12V) indicates an "Inverter Normal" condition.
  3. TP1 continuously high (11.5 to 12V) indicates a "System load normal" condition.
  4. TP6 continuously high (11.5 to 12V) indicates a "Bypass available" condition.
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**PROBLEM:** Will not transfer to inverter while "IN SYNC" is lit.

**CHECK:** Check inverter output Voltages, check output current.

**SOLUTIONS or EXPLANATIONS:** If the inverter output is low, see the appropriate Inverter failure above. If the current on any one phase is too high, correct the problem at the load. If the inverter output voltage is normal and IN SYNC, check J4 and reconnect. Then on the Static Switch Control board, measure from the board ground test point to TP1, TP5 and to board +12V. If +12V is not available or low replace the board. If TP4 is not above 11.5V, the static switch board is detecting an over current on

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the output. If no over current is present, replace the board or check for high crest factor loads. If TB5 is not high, the board is detecting an inverter under voltage. If the inverter voltage is normal, adjust potentiometers R53, R120, and R121 one at a time. Adjust only one turn in each direction. If this has no effect on TP5, return the potentiometer to the original position and adjust the next potentiometer. If this fails to correct the problem, replace the Static Switch board.

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**PROBLEM:** Will not transfer to Bypass while "IN SYNC".

**CHECK:** Check static switch board TP6 if low check the bypass voltages. Check the wires and connector J11 on the motherboard. Check the items in previous problem.

**SOLUTIONS or EXPLANATIONS:** Reconnect J11. Correct the bypass up stream from the UPS. On the Static Switch Control board, measure from the board ground test point to TP6. If TB6 is not above 11V, the static switch board will detect a bypass failure. If the bypass is available and the normal voltage is present, replace the board.

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**PROBLEM:** "IN SYNC" will not light

**CHECK:** The Voltage between the inverter (SCR11) wire #46 and bypass wire #40, and inverter (SCR15) wire #54 and bypass wire #48.

**SOLUTIONS or EXPLANATIONS:** If the voltage is less than 25VAC and constant between 40 and 46 and between 48 and 54, the unit is IN SYNC. On the Static switch board, check TP4 with the unit in sync, TP4 should be 11VDC or higher. Replace the Static switch board if not. If voltage is greater than 25VAC and/or changes high than low, the Inverter is not coming into sync or the inverter output is connected to the bypass. Replace the inverter board. If that fails to fix the problem, then check the static switch gate boards and SCR's 10 to 17.

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**PROBLEM:** FU6, 7, or 8 or CB6 keeps blowing.

**CHECK:** Before replacing fuses or closing breaker, check the Static Switch SCR's (10-13,14-17,18-21) for a shorted device. Check the small static switch gate boards for damaged components.

**SOLUTIONS or EXPLANATIONS:** Replace the Shorted SCR and replace the gate board associated with the fuse that is blowing. Once in a while, a static switch SCR will partially fail and the bad device cannot be located. Therefore, if no shorted device is found and the gate board does not help, replace all the SCR's in the leg that is blowing the fuse or breaker.

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### 5.0 ADDITIONAL HELP

If the above guide has failed to correct the problem, Dependable Power Systems can supply additional trouble shooting assistance by phone. In most cases, the problem can be analyzed and the solution determined by phone with the help of the customer and a DVM. Before calling the factory please check and measure the following:

1. Battery Voltage: Check across the large DC capacitors with bus bars.
2. Bypass Voltage: Check from ground to the horizontal bus bars with wire numbers 40 and 48 and between the bus bars.
3. Record what red LED's are on and what green LED's are off on front panel.
4. Record all meter readings.
5. Check FUSES FU1,2, 4 and CB6.
6. Unplug and plug in RL1 on motherboard if Auto-Start is provided.

With the above information we can isolate the problem to at least a section of the UPS and can either tell what is wrong or what else needs to be checked.