	THIS DOCUMENT CONSISTS OF THE FOLLOWING SHEETS AT THE REVISION SHOWN									
SHEET	REVISION									
1 DOCUMENT	A									
2	A									
3	A									
4	A									
5	A									
6	A									
7	A									
8	A									
9	A									
10	A									
11	A									
12	A									
APPROVAL SIGNATURES	AE									
	DC									
	EH									
CHANGE	N/A									
REVISION DATE	09/11/03									

APPROVAL SIGNATURES: JOB TITLES	ORIGINATING DEPT: ENGINEERING/DRAFTING
PROJECT ENGINEER TEST MANAGER QA MANAGER	CONTROLLING DEPT: ENGINEERING/DRAFTING
	CONTROL SHEET
	SETUP PROCEDURE AND TEST DATA SHEET FOR THE 2KW - 5KW ESS VARIAN - 1560B POWER SUPPLY
	DOCUMENT NUMBER: 07-510-009

1 SCOPE

This test procedure is for the setup of the standard ESS power supply.

2 APPLICATION

This test procedure applies to the ESS power supply built by Lambda EMI.

3 REFERENCE DOCUMENTS

Power Supply Specification #08-510-002

4 GENERAL PROCEDURE ASPECTS

5 TEST EQUIPMENT

All equipment must be within its calibration cycle.

- Decade Box
- Dual Trace Oscilloscope (Tektronix 465 or equivalent).
- Digital Voltmeter (Fluke 8062A or equivalent).
- Three Phase 15KW Variac Powerstat variable autotransformer or equivalent.
- AC Current Probe (Tektronix AC Current Probe 02-0105 or equivalent.
- Clamp Ammeter (F.W. Bell Current Gun “CG-100D” or equivalent).
- (2) 1x/10x scope probes
- Remove Prog. Plug 88-510-008.
- Hipot tester
- External bias supply ± 15VDC.
- Precision bench power source for programming (Variable 0-10VDC in 1 mV steps).

6 TEST PROCEDURE

6.1 HIPOT

Preparation – Read and understand each step completely before proceeding, otherwise, unit may be damaged. Any faults must be located and repaired.

6.1.1 Remove the output MOV/ Filter Board from the output terminals.

6.1.2 Remove input AC wires from circuit breaker upper terminals. Short the terminals together.

6.1.3 Turn the circuit breaker on.

6.1.4 Short both output terminals to chassis.

6.1.5 Apply 2500VDC between the upper ckt. Breaker terminals and the output terminals for one minute. The leakage current must not exceed IµA. Record on data sheet.

6.1.6 Turn down the high voltage and discharge the unit by applying a short between the input and output terminals.

6.1.7 Maintain the output terminal short and remove their connection to the chassis.

6.1.8 Apply 1500VDC between the output terminals and chassis for one minute. The leakage current must not exceed 1µA. Record on data sheet.

6.1.9 Turn down the high voltage and discharge the unit by applying a short between the output terminals and chassis.

6.1.10 Replace all removed wires and transient protection devices.

6.1.11 Output to chassis transient protection with the output terminals shorted together, check the resistance to chassis. It must be $\geq$ 10 MΩ in either polarity of the meter.

6.1.12 Attach the negative lead of the hipot tester to the output terminals. Attach the positive lead to chassis.

6.1.13 Hipot output to chassis for one minute at 850VDC. Leakage current must not exceed 500µA. Record reading on data sheet.

6.1.14 Keeping HV probe on unit, decrease test voltage to zero.

6.1.15 Reverse polarity of the hipot tester leads and perform steps 6.1.13 and 6.1.14.

6.1.16 With satisfactory results from all hipot tests, check off data sheet verification line.

6.2 INTIAL TEST

6.2.1 Units with Control Bd. (A100) 200321XX require setting S1 as follows: S1-A DWN, S1-B DWN, S1-C UP, S1-D DWN, S1-E DWN, S1-F UP, S1-G UP, S1-H UP.

6.2.1.1 Install Remote Cont. Plug 88-510-008 and apply 5V to Remote ENA. Remove J1 from A300 board and install jumper, shorting out the cable plug. Turn R9 fully clockwise. Remove the plug to A100-J10 and J13.

6.2.2 Connect external bias supply to J10 on A100 board (+15VDC and -15VDC). Also supply power to J13 on A100 board (+15VDC) for Remote turn on ckt. power.

Soft start relay should energize approximately 3 to 4 seconds later.

Power LED (green) should be lit only when line AC is applied.

With 15V on the REM. ENA J2-2(+) and J2-3(-) verify that J2-4 is 0 Volts when enabled. (J2 is DB25M on rear pan). The REM. ENA. LED is “OFF” when the REM. ENA. is 5-15VDC and “ON” when REM. ENA. is @ 0VDC.

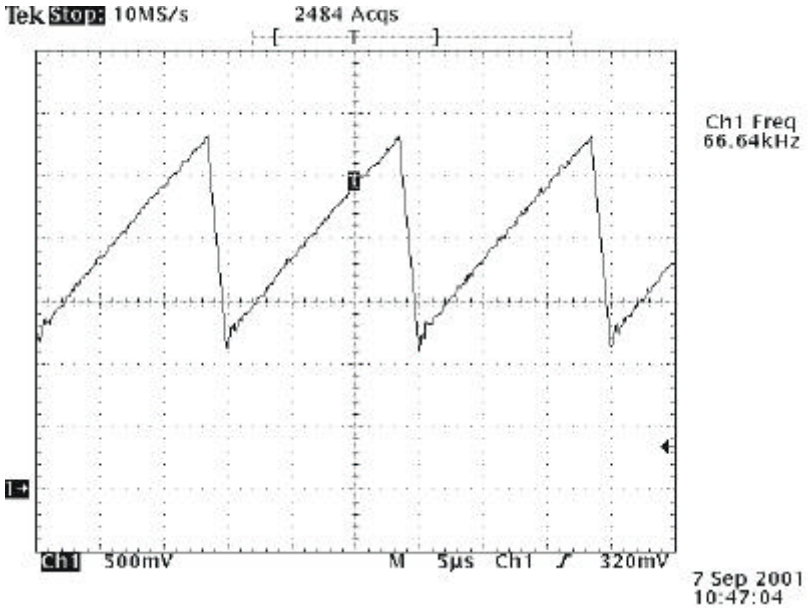
6.2.3 Check regulator voltages. Connect Negative (-) of meter to + side of C2.

Nominal	+12V	=	CR4 Anode
Nominal	-12V	=	CR5 Cathode
Nominal	+12V	=	CR10 Anode
Nominal	+5	=	CR48 Cathode

6.2.4 Set and check pulse width modulator frequency as follows.

6.2.4.1 Place scope probe from ground TP8 to TP3.

6.2.4.2 Adjust PWM rate R88, for a pulse width of 15 microseconds. Verify waveform shape resembles Figure 6.2.4.



PWM Ramp Waveform

Figure 6.2.4

6.2.5 Set nulls of U7, U8, U9 and U10 on the A100 Board as follows.

6.2.5.1 Either short output bus bars or connect unit to the proper load. Ext. current pot is half turn CW.

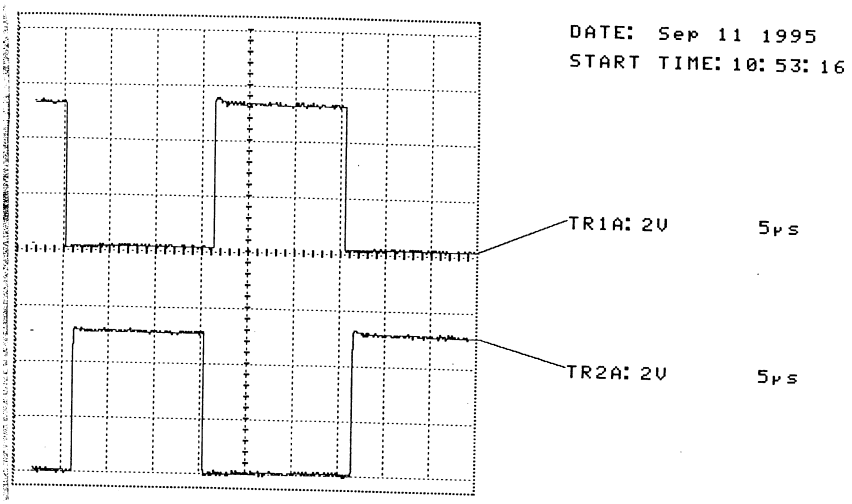
6.2.5.2 Monitor TP1 with scope. Connect meter from ground (TP8) to cathode side of CR30. JMP across C10. Adjust R15 until voltmeter reading switches from approximately +4.9V to approximately -0.8 volts. TP1 waveform should stop when in null mode. Remove JMPR immediately after adjustment is made.

6.2.5.3 Connect voltmeter negative to ground (TP8) and positive to the side of R28 nearest TP11. Adjust R21 to 0.000V ± 0.001V.

6.2.5.4 Connect voltmeter from ground (TP8) to cathode of CR40. Turn EXT Iprog fully counterclockwise. JMPR across C33 and adjust R30 until voltmeter reading switches from approximately +4.9V to approximately -0.8volts. TP1 Sq. wave should stop. If unit will not null @ FCCW position, check voltage @ TP11 or 12, it should be 0.000V. Any reading may cause null to not work. Check the associated pot, it may need changing.

6.2.5.5 Connect voltmeter negative ground (TP8) and positive to (TP13). Adjust R37 for a meter reading of zero volts.

6.2.6 Using TP8 on the A100 board to provide a ground for the probes, attach scope probe 1 to TP1, and probe 2 to TP2. Adjust R104 full CW for this test. Turn Iprog potentiometers on test fixture half turn clockwise. Verify waveforms resemble those of Figure 6.2.6. The edge dead time from TP1 to TP2 should be approximately 1.5 µsec. Turn Ext. Iprog potentiometer fully counterclockwise. Verify both waveforms collapse. Return Ext. Iprog potentiometer a half turn clockwise.



PWM Outputs
Figure 6.2.6

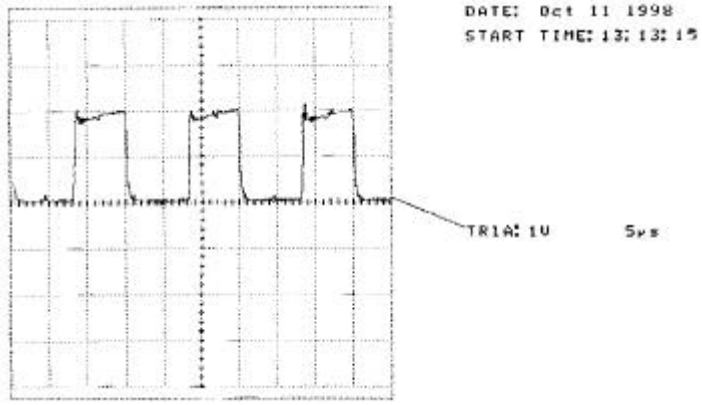
6.3 FINAL TEST

Note: When using an ext. bias supply it is necessary to provide an external AC input to the Top Switch Board fro the fans to operate. After the input cap bank, voltage and current channels are operationally checked. The unit should be configured for normal operation.

6.3.1 Set the load for full output. Connect the variac (Probe gnd to TP8). Connect probe to R76 (Nearest U15). Set scope to 50mV setting.

6.3.2 Ensure Ext. Iprog potentiometer fully counterclockwise and the circuit breaker is closed. Attach dedicated voltmeter to output terminals.

6.3.3 Turn on variac. Raise variac to 20 volts input. Turn Ext. current potentiometer as necessary to see waveform. Verify current control by varying the potentiometer up and down. Waveform seen should be similar in shape to drawing figure 6.3.3, although pulse height and pulse width will vary in accordance with input voltage and potentiometer setting.



I Sense Waveform
Figure 6.3.3

6.3.4 Slowly raise variac to full input voltage while monitoring the I sense waveform of the inverter.

6.3.5 There are two different types of Bias Boards in use. The U/L approved supply is 20-019-400. A universal bias supply 20-025-9XX may be used in non-U/L applications. The tester must determine which supply checkout procedure to use.

6.3.5.1 20-019-400 bias supply testing using bias board test fixture 88-510-003, install the board under test and connect the fan loads and AC input. Set the pot on test fixture to 26 ohms and connect into R1 position on the board under test.

Turn on variac, slowly bring variac to proper input voltage. The unit should be in operation.

Verify that the A600 bias & fan power board fan voltage is 26.6Vdc ± 0.1Vdc at nominal line voltage for the set. If adjustment is necessary, the value of R1 on the bias board needs to be changed. To lower the fan voltage, lower the value of R1. Typically R1 values range from 5 to 30 ohms. Twenty-two (22) ohms is a good starting value.

6.3.5.2 20-025-9XX Bias Supply Testing

This board is powered from the cap bank DC bus voltage. At high line for a 480VAC unit this bus voltage is 750VDC. Faults on the board are usually “spectacularly” catastrophic and cannot be repaired. Protect your eyes and face.

1. Connect all terminals. The supply must be tested under full load conditions. If any of the voltages fail to obtain their proper level, assume that there is a problem and STOP. Inspect the board for correct components and mechanical problems.
2. The A line voltage is connected to J1-5 and J1-7. If the AC line is not connected, C2 must be shorted out to bypass the dropout circuit. As C2 is a surface mount part, use a ½“ long #26AWG insulated jumper soldered across C2.
3. It is recommended that the bias supply be first tested on the bench with a current limited 450VDC supply. Limit the current to a couple amperes. C2 should be shorted as in Step 2.
4. R16 (1T) pot must be at full CCW for initial testing.
5. Connect the 450VDC supply to J1-1 and J1-3. Monitor the output voltage with a DVM. Note the polarity as J1-1 must be Positive (+) and J1-3 must be Negative (-). Monitor the supply under test output voltages with a DVM. Initially, the fan voltage will be checked first. Multiple meters are the preferred test method.
6. Check that the 450VDC supply has its voltage and current controls full CCW (zero output). Install a blast shield over the supply under test. Turn on the 450VDC supply and slowly increase the supply output voltage to about 300VDC.

The bias supply under test should start working at about 260-270VDC. With the supply set at 300VDC adjust R16 for 26.4VDC Fan voltage.

J2-1 (+) to J2-4 (-) must be set to 26.4VDC

J3-1 (+) to J3-2 (-) must be >= +15VDC

J3-2 (+) to J3-3 (-) must be >= -15VDC

J6-1 (+) to J6-2 (-) must be +5VDC

6.3.6 Turn off unit under test. Turn off variac. Disconnect bias supply. Remove jumper by passing the phase loss circuit @ P301. Connect P301. Connect the internal bias supply to A100, J10. Also return plug to A100 J13 for the REM. Turn on circuit power.

6.3.6.1 Turn Ext. Iprog potentiometer completely counterclockwise.

6.3.6.2 Turn the Circuit Breaker on.

6.3.6.3 Turn on variac, slowly bring variac to proper input voltage. The unit should be in operation.

6.3.7 Install Bias Supply in unit and verify correct wiring.

6.3.7.1 After powering up unit verify correct airflow. Standard flow is front to rear or see Spec. sheet.

6.4 CALIBRATION

6.4.1 Place external load into an open configuration.

1. Adjust R104 to mid position. Ext. Iprog to FCCW Pos.
2. Move Ext. Iprog CW ¼turn.
3. Adjust 1mA source (R6) for 500V and fine tune with R104 for correct output voltage. Record O/P volt on data sheet.
4. Adjust R110 for 8.33V @ Vmon (J2-13).

Turn Ext. current potentiometer fully counterclockwise. Verify voltage drops to zero. Turn off unit.

6.4.2 Put external load into a short full current condition.

1. Adjust R34 full CW (Lowest O/P current).
2. Adjust Ext. current pot CW, but not >10.00V (watch O/P current).
3. With Ext. current pot @ 10.000V, adjust R34 for correct output current as measured across the internal 100mV shunt (May be other than 100mV on some units). Record on data sheet.

4. Adjust R114 for 10.000V @ Imon (J2-15).

6.4.3 Connect the unit to the proper full load. Turn the unit on and advance the Ext. current control pot to 10.000V. Throw the unit in and out of a short and load a couple of times to ensure that the current stays stable while monitoring the scope and meters. Units should be within ±0.1% of full current output. Example: Output I (20 Amps x .001 = .02 Amps), Shunt V @ F.S.I. (100MV x .001 = ± 0.1MV).

6.4.4 Place unit in full load condition. Turn Ext. Iprog potentiometer clockwise until unit is between ¾and full output power. Lower variac voltage to 100VAC. Adjust R9 on the A300, filter/phase loss board, until the unit output shuts down. Raise the input voltage and verify that when the unit output turns on and is operational at 5-7 volts lower than the low line spec. Check the shutdown/turn-on point several times to verify correct adjustment. Readjust R9 as needed. Raise input line voltage to nominal value. Turn unit off.

6.4.5 Voltage Channel Regulation and Ripple Verification

Configure load for full voltage and nearly full (95% - 98%) current. Place DVM and scope across output terminals. Turn on unit. Turn Ext. current potentiometer to 10.000V. Adjust variac to provide low line input voltage Verify Hi, Low, and nominal Line Reg. and ripple requirements per spec. When complete adjust variac to provide nominal input voltage and measure line current. Record on data sheet. Turn off unit.

1. V .01% Line Reg.
2. .01% Load reg.
3. ≤400 mV Ripple pk-pk (Switching Ripple).

6.4.6 Current Channel regulation and ripple verification.

1. Configure load for full current and nearly full (95% - 98%) voltage.
2. Select an external shunt for the maximum output current of the power supply under test. Connect the external shunt to the negative output terminal in series with the load bank.
3. Verify the current channel accuracy with a (DVM) meter across on the external shunt to be within ±1%.

Place scope across the output terminals. Turn on unit. Adjust variac to provide low line input voltage then high line input then nominal input voltage. Verify ripple and regulation are per spec. Turn off unit.

1. .06% Line Regulation.
2. .15% Load Regulation
3. ≤ 10mA Ripple (10mA = 0.25mV on 100mV Shunt).

6.5 Thermostat Check

With power supply running, short (TS1-1 to TS1-2) thermostat terminals together on inverter, then the thermostat on output diode heatsink when applicable. Set should shut down (only control failure). Verify J2-5 goes to 0V @ Over Temp. The O.T. LED is normally “ON” and is “OFF” when thermal faults occur.

6.6 Proceed to test data sheet and record test data as required.

6.7 Burn-In

The burn in is a continuous duty for 30 minutes on and 30 minutes off @ 90-100% Load. Run for 3 cycles (3 hours). Monitor the output voltage, output current at start of burn in and end of burn in. Record the front panel meter voltage and current readings and that the test was completed on data sheet.

_____	_____	_____	_____
SALES ORDER NO.	MODEL	SERIAL NO.	JOB NO.
DATE_____	_____	_____	_____
PRE-FINAL INSPECTION	INSPECTOR	PRE-ELECT. TEST	TESTER
DATE_____	_____	_____	_____
FINAL INSPECTION	INSPECTOR	FINAL ELECT. TEST	TESTER
DATE_____	_____	BURN IN	
PRE-SHIPPING	INSPECTOR	10.1 _____ 3 CYCLES (3 HRS) Start Vout _____ Iout _____ End Vout _____ Iout _____	

6.1 HIPOT _____ 1 MINUTE DURATION EACH TEST

1500VDC-OUTPUT TO CHASSIS _____ 850VDC HIPOT (1MIN) _____≤ 500µA

2500VDC-INPUT TO OUTPUT _____ 850VDC HIPOT (1MIN REV.) _____ ≤ 500µA

6.4.1 OUTPUT VOLT. _____VDC (Open Ckt) Vmon Out _____VDC (8.333 ± 0.008VDC)

6.4.2 OUTPUT CURRENT _____A (Short Ckt) Imon Out _____VDC (10.000 ± 0.010VDC)

6.4.7 CURRENT MODE LINE REGULAITON

	FULL LOAD	½ CURRENT	SPEC
VAC LOW LINE	_____mVDC	_____mVDC	MAX CHANGE
VAC NOM. LINE	_____mVDC	_____mVDC	IN V0 = ± 100UV
VAC HIGH LINE	_____mVDC	_____mVDC	
MAX – MIN	_____mVDC	_____mVDC	

CURRENT MODE LOAD REGULATION

	FULL LOAD	½ CURRENT	MAX CHANGE
SHORT SWITCH A	_____mVDC	_____mVDC	IN V0 = ± 100UV
Full Load SWITCH B	_____mVDC	_____mVDC	
MAX-MIN	_____mVDC	_____mVDC	

REV	A																SETUP PROCEDURE AND TEST DATA SHEET FOR THE 2KW - 5KW ESS VARIAN -1560B POWER SUPPLY
DATE	09/11/03																DOCUMENT NUMBER: 07-510-009

SERIAL NO. _____

CURRENT MODE RIPLE

WITH SCOPE P-P _____ FULL LOAD ESS SPEC. 08-510-002

_____ ½ CURRENT

6.4.6 LINE CURRENT PHASE A _____AAC

PHASE B _____ AAC

PHASE C _____ AAC

6.4.5 LINE BREAK _____VAC

LOW LINE SHUT OFF _____VAC

6.5 THERMOSTAT _____OK

6.3.7.1 FANS B1 _____ ALL DIRECTION TO THE REAR

B2 _____

B3 _____

1560B Prog _____OK

VERIFY ALL OUTPUT SIGNALS TO REAR PANEL CONT. CONN (J2)

P.S. ON SIG @ J2-4 (ON = 0V, +5 = UNIT INHIBIT) _____OK

O.T. SIG @ J2-5 (~ +5V = OK, O.T. = 0V) _____OK

REV	A																SETUP PROCEDURE AND TEST DATA SHEET FOR THE 2KW - 5KW ESS VARIAN -1560B POWER SUPPLY
DATE	09/11/03																DOCUMENT NUMBER: 07-510-009

invensys LAMBDA