GE Energy Management *Industrial Repair Services* *Louisville, KY*	**Functional Testing Specification** **LOU-GED-IS200DSFC**

Test Procedure for an Innovation Series Gate Driver/Shunt Feedback Card

DOCUMENT REVISION STATUS: Determined by the last entry in the "REV" and "DATE" column

REV.	DESCRIPTION	SIGNATURE	REV. DATE
A	Initial release	John Madden	7-21-06
B	Added more data to the last note (7.1) in the test	John Madden	7-28-06
C	Added a notes for testing older DSFB cards using the fixture	John Madden	4-03-08
D	Added special note for DS200DSFB to step 6.2.4	S. Cash	10-12-2012
E	Added steps; 6.2.3, 6.2.8 thru 6.2.16 to enhance test.	G. Chandler	7-05-2013
F	Rewrite of Procedure to Reflect New Test Fixture. Also Moved Theory of Operation to Notes Section	Steve Pharris	11-14-2014

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DATE	**DATE**	**DATE**	**DATE**
April 3, 2008	10/12/2012	11/14/2014	4/14/2008

1. SCOPE

1.1 This is a functional testing procedure for a DS200DSFB or an IS200DSFC Card.

2. STANDARDS OF QUALITY

2.1 Refer to the current revision of the IPC-A-610 standard for workmanship standards.

3. APPLICABLE DOCUMENTS

3.1 The following document(s) shall form part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue shall apply.

3.1.1 N:\Design Folders\DS\DS200\DS200D\DSFB

3.1.2 N:\Design Folders\IS2\IS200D\DSFC

4. ENGINEERING REQUIREMENTS

4.1 Equipment Cleaning

4.1.1 Equipment should be clean and free of debris prior to applying power unless performing an initial check. Refer to the local documented procedures for cleaning guidelines.

4.2 Equipment Inspection

4.2.1 Equipment should be visually inspected for any defects prior to applying power. This inspection should include the following as a minimum:

4.2.1.1 Wires - broken, cracked, or loosely connected

4.2.1.2 Terminal strips / connectors - broken or cracked

4.2.1.3 Components - visually damaged

4.2.1.4 Capacitors - bloated or leaking

4.2.1.5 Solder joints - damaged or cold

4.2.1.6 Circuit board - burned or de-laminated

4.2.1.7 Printed wire runs / Traces - burned or damaged

5. EQUIPMENT REQUIRED

5.1 The following equipment is required to perform the process requirements. Equipment may be substituted provided that all accuracy's and test ratios are equivalent or better.

Qty	Reference #	Description
1		Fluke 87 DMM (or Equivalent)
1	H188596	IS/DS200 DSFC/DSFB Test Fixture
1		Precision voltage source, 1mV-1V range
1		Tenma 72-5010 (or equivalent) Function Generator
1		Oscilloscope

6. TESTING PROCESS

6.1 Note

Note: Give the card a thorough visual inspection before completing, there may be hidden burn damage someplace that may or may not cause a failure during testing. Use your best judgment as to whether to try to repair a badly burned card or replace it with one from Legacy.

6.2 Setup

6.2.1 This fixture is designed to test both DS200DSFB and IS200DSFC Circuit Cards.

Differences in testing of the two versions will be called out in each test step.

6.3 Testing Procedure

6.3.1 Install Card into Test Fixture and Connect the Appropriate Test Cable to Card and Fixture. Do Not Apply Power Yet.

6.3.2 **Continuity Test:** There is a section for each model. Use the White test jacks for the model you have. Go down the column for your model

IS200DSFC

From	To	Reading
PPL1-7	PPL2-1	<5 ohms
PPL1-13	PPL2-13	<1 ohm
PPL1-14	PPL2-14	<1 ohm
PPL1-15	PPL2-15	<1 ohm
PPL1-16	PPL2-16	<1 ohm
THPL1	THPL2	<5 ohm

DS200DSFB

From	To	Reading
THPL1	PPL13	<1 ohm

6.3.3 Apply power to fixture. It takes a minute to power up. Look for green LED's on UUT

6.3.4 **Gate Voltage Test:** Verify the following points have approx. 13.5VDC **LGA to LEA**, **LGB to LEB**, **UEB to UGB**, & **UEA to UGA**. Maybe less on the DS200 version.

6.3.5 **DC Link Monitor Test:** Press the button on the fixture labeled "Above 50V Link Test" and verify DS1 is illuminated when the button is pressed.

6.3.6 **VCO Test:** Connect your precision voltage source to the red and black jacks labeled PHASE SHUNT FEEDBACK, DCmV INPUT, positive lead to SHPL-1 and negative lead to SHPL-2. Connect your oscilloscope leads to the next set of jacks labeled PPL-1/PPL1-1 (pos. scope lead) and PPL-2/PPL1-2 (neg. scope lead).

6.3.7 Follow the chart below and verify the frequency changes as the millivolt source is increased. The first step from 0V to 25mV is almost indistinguishable then you will see the changes better as you go. Refer to the following chart for details:

Input (mVDC)	Output (KHz)	Output (nSec)
0mV	1Mhz	1000nSec (1uSec)
25mV	900-920KHz	Appx. 1000nSec
50mV	815-830KHz	1250nSec (1.25uSec)
75mV	650-700KHz	1500nSec (1.5uSec)
100mV	570-600KHz	1750nSec (1.75uSec)

Note: The thing to remember isn't the exactness of the frequency reduction, but that it drops in noticeable blocks as you shift through the voltage range.

6.3.8 Still using the same voltage input as in Step 6.2.4, connect your DMM leads to the next pair of red & black jacks, labeled PPL-4/PPL1-4 (positive meter lead) and PPL-3/PPL1-3 (negative meter lead). Output should read **–4.73Vdc (more or less) on IS200 boards, on DS200 boards this voltage is typically -5.3VDC.**

6.3.9 Increase input voltage and somewhere between 230mV and 270mV the polarity of the output should flip, giving you a reading of **+4.73Vdc (or +5.3VDC on DS200 Boards).**

6.3.10 **Gate Driver Output:** Apply a 2v p/p 6K Hz square wave signal between the white test jacks that have a blue ring around the top marked PPL2-15 and PPL2-16. Positive of the square wave to PPL2-15 and negative to PPL2-16. **!!!SEE NOTE BELOW!!!**

6.3.11 Connect scope to one of the Yellow Jack on the fixture (UGA, UGB, LGA or LGB) and common of the scope to the COM

6.3.12 Turn the Apply Gate switch to ON and set the common switch in the direction of the jack you are reading from. (down if checking UGA or UGB and up if LGA or LGB)

6.3.13 Monitor with a scope the output of the function generator on channel 1 and the output of the UUT (yellow jacks) on channel 2.

6.3.14 Verify the wave form on channel 2 closely resembles channel 1 with the exception of amplitude. Channel 2 amplitude should be approx. 30vp/p. Also both the green and yellow LEDs DS2 and DS4 should be illuminated.

6.3.15 Vary the duty cycle on the square generator and verify that channel 2 wave form follows channel 1. The yellow LED should increase in intensity and the green decrease when the duty cycle is increased and the opposite when the duty cycle is decreased.

6.3.16 Test remaining Gate Pulses (Yellow Jacks) as described above. Be sure to set the Common switch to the correct direction.

6.3.17 Remove the generator from the test fixture.

Note: Give the card a thorough visual inspection before completing, there may be hidden burn damage someplace that may or may not cause a failure during testing. Use your best judgment as to whether to try to repair a badly burned card or replace it with one from Legacy.

*6.4 ***TEST COMPLETE ****

7. <u>NOTES</u>

7.1 SPECIAL NOTE CONCERNING GATE TEST STEP 6.3.10: If the DC offset is not correctly set you will not see an output on the Gate Driver Test. This is made more difficult because it varies slightly from Board to Board, Lower Gate to Upper Gate, and Model to Model. So then the question is how do we know if we are failing due to an error on the circuit card or if the settings on the function generator are wrong. We watch the signal we are applying and the signal we are checking for at the same time while very slowly changing the DC Offset. Once you hit the magic Offset you will see the output waveform lock in (May need to trigger your scope again). If after going through the entire range of DC Offset and there is no waveform on the output you have one of three possibilities. First the card is defective. Second, you have the common switch in the wrong direction. Finally, the gate signal switch is set to off.
Pay close attention to this or you could spend a lot of time troubleshooting a circuit that was never faulty to begin with.

7.2 Sometimes you may find the voltages in Step 6.3.4 are lower than expected, possibly in the 12 to 13-volt range. This is acceptable due to running the unit off of 120VAC instead of 240VAC.

7.3 If no voltage is present on points listed in step 6.3.4 make sure that the HFPA power supply in the fixture isn't being loaded down too much by a bad DSxx card. To check the circuit in the fixture to make sure it is outputting the correct voltage remove the DPPL connector and check for approx. 20VAC on the connector. The Low acceptable input voltage coming into T1 from the DPPL connector is 18.2Vac RMS. If this is low, Contact Test Development.

7.3.1 Take note that these cards are notorious for burning up the main resistor in the circuit, R82, along with occasionally shorting out the transistor Q16. If you replace R82 and have to repair burn damage to the substrate beneath it, be sure to follow IPC guidelines with respect to mounting of components over 1 watt in value (which basically means don't set the component directly against the card like the factory did!)

7.3.2 If no voltage in step 6.3.4 this is usually either due to shorted zener diodes right next to the affected test points, blown or open runs in the vicinity, blown or shorted two or three legged yellow polyester capacitors, blown/open 2.2 Ohm resistors, shorted or open FET transistors, etc. etc. These cards take a pounding whenever the drive gets spiked or IGBTs blow out, so many times it will be multiple components damaged. Many times the input transformer T1 is open or shorted, so watch for that, too. Be sure to pay attention to which yellow polyester caps are on the card. There were two types: the earlier two legged variety, mostly found on the DS200 cards, and the newer three-legged variety found on the IS200 cards. They **ARE NOT** interchangeable. We keep both kinds in stock, so refer to the Bill of Materials for whichever card you're working on to get the correct parts.

7.3.3 Special Note for DS200DSFB only

7.3.3.1 Output-phase current is monitored by deriving a VCO output signal from the voltage dropped across the phase shunt. This voltage is amplified, then passed on to the VCO circuitry. The VCO has a range of 0 – 500KHz and the circuit is biased so that at zero current, the nominal output is 250KHz. A +-200mV shunt voltage is converted into +- 200KHz change in the VCO output Frequency. The output of the VCO is optically coupled to a different driver interface to the control logic.

Measured Values

250KHz 0 shunt feedback

50KHz -200mV shunt feedback

450KHz +200mV shunt feedback

8. ATTACHMENTS

8.1 None at this time.