GE Energy *Parts & 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

PREPARED BY	REVIEWED BY	REVIEWED BY	QUALITY APPROVAL
John Madden	S. Cash		Charlie Wade
DATE	**DATE**	**DATE**	**DATE**
April 3, 2008	10/12/2012		4/14/2008

1. SCOPE

1.1 This is a functional testing procedure for a DS200DSFB or an IS200DSFCGxAxx 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 dual power supply, switchable to 50+Vdc operation
1		Oscilloscope, able to display 1MHz readings or better

6. TESTING PROCESS

6.1 Setup

6.1.1 There are four main sections to test on this card. For cards with two PPL connectors in the center of the card, three of these sections will be tested with the card installed in the fixture. For cards with only one PPL connection, you will not be installing the card in the fixture. See the bold-typed notes below for further explanation.

Note: The test fixture was originally built to accommodate both the early DS200 versions of these cards with the single PPL connector, and the later IS200 versions with 2 PPL connectors in the center of the board. Only the pigtail for the newer 2 PPL connections was ever finished due to time constraints.

Testing has revealed the partial capabilities of the incomplete fixture to work for powering up and running the gate voltage tests with the customer's card installed with both early and later versions of these cards. Where differences lie in testing of the two versions, these will be called out in each test step.

6.2 Testing Procedure

6.2.1 **DC Link Monitor Test:** For now, regardless of which type of card you have, we will setup for the DC Link monitor test. Set your Tenma Dual Power Supply to "Series" mode, so you can achieve over 50Vdc output. With output voltage set to Zero, connect the positive lead to UCB, and the negative lead to DCLN. Turn the voltage up slowly and observe the red DS1 LED, the one labeled "Link Above 50V". It should start to glow in proportion to how much voltage you apply, and as you approach 50Vdc it should be glowing quite visibly. Place a jumper across zener diode D22 and verify DS1 LED goes off.

6.2.2 If this is the case, then you may go on to the next section of the test. You're also done with the Tenma power supply **(except for the older DSFB cards)**. 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 610-D 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!)

6.2.3 **Continuity Test:** Verify < 1 ohm resistance between the following points.

From	To
PPL1-7	PPL2-1
PPL1-8	PPL2-2
PPL1-9	PPL2-3
PPL1-10	PPL2-4
PPL1-11	PPL2-5
PPL1-12	PPL2-6

6.2.4 **Gate Voltage Test:** **Special Note: HFPA card may require 220VAC input for it to operate correctly**. Connect card to fixture. Now turn the power on to the fixture. After a moment you should observe the green LED's UFF and LFF light up. Take voltage readings at the terminals with screws on them labeled **LGA-LEA**, **LGB-LEB**, **UEB-UGB**, & **UEA-UGA**. The official reading for these is supposed to be 15Vdc +/- .7Vdc (14.3 to 15.7). If these are present, then you're ready to move on. Most often you won't. 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.

6.2.5 **Special Note for DS200DSFB only**

6.2.5.1 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

6.2.6 <u>VCO Test:</u> Next, with power turned on, 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). It is recommended that you use a scope for this measurement because there is enough ringing in the waveform here that it can confuse most frequency counters and make them give erratic readings. *DS200DSFB cards: you will need to artificially inject approximately 4.7Vdc into PPL9 (+) and PPL10 (-) to make this test work properly. This is not necessary on the later IS200DSFC cards. You can trace these two wires over to the un-used secondary PPL2 connector intended for IS200DSFC cards and inject this voltage there. Once a proper DS200 connector harness is finished for this fixture there will be no need to do this.* With no voltage input to the SHPL connector jacks, and with unit powered up, you should observe a waveform on the scope that is square in nature, with ringing after each vertical rise and fall, and about 1 microsecond (1MHz) wavelength. As you increase the mVdc input value from the voltage source, you should see the wavelength get longer (frequency getting lower) in proportion to the increase in voltage. 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. The first step from 0V to 25mV is almost indiquingishable, 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)

6.2.7 Still using the same voltage input as in Step 6.2.4, connect your DVM 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 to meter should read **–4.73Vdc (more or less).** Increase input voltage to 250mV, and somewhere between 250mV and 260mV the polarity of the output should flip, giving you a reading of **+4.73Vdc.** The output voltages should be within +/- .1Vdc.

6.2.8 Apply a 2v p/p 6K Hz 50% duty cycle square wave signal between the white test jacks marked PPL2-15 and PPL2-16. Positive of the square wave to PPl2-16 and negative to PPL2-15.

6.2.9 Monitor with a scope, the output of the square wave generator on channel 1 and the output of the UUT (yellow jack marked UGA) on channel 2.

6.2.10 Verify the wave form on channel 2 closely resembles channel 1 with the exception of amplitude. Channel 2 amplitude should approx. 30vp/p. Also both the green and yellow LEDs DS2 and DS4on the upper circuit should be illuminated.

6.2.11 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.

6.2.12 Move channel 2 of the scope to the test jack marked UGB and verify it works the same as UGA.

6.2.13 Reverse the polarity of the of the square wave generator and verify the lower circuit performs the same as the upper circuit at test jacks LGA, LGB and LEDs DS3, DS5.

6.2.14 Remove the generator from the test fixture.

6.2.15 Monitor with a volt meter pin 5 of U12 with reference to the (-) side of capacitor C93. Verify approx. 0vdc. Place a jumper across resistor R38 and verify pin 5 of U12 switches to approx. +5vdc. Remove the jumper from R38.

6.2.16 Monitor with a volt meter pin 8 of U12 with reference to the (-) side of capacitor C93. Verify approx. +5vdc. Place a jumper across resistor R104 and verify pin 8 of U12 switches to approx. 0vdc. Remove the jumper from R104.

6.3 Post Testing Burn-in **Required ___ Yes _X_ No**

Note: Give the card a thorough visual inspection before completing, as has been stated before they take a pounding in the field, so 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. NOTES

7.1 Sometimes you may find the voltages in Step 6.2.3 are lower than expected, possibly in the 12 or 13-volt range. This is not acceptable and must be corrected. Make sure that the HFPA power supply in the fixture isn't being loaded down too much, either by a bad DSFx card or the HFPA being weak itself. The acceptable input voltage coming into T1 from the DPPL connector is 18.2Vac RMS. If this is low, determine why and fix it. This issue is likely to produce a warranty if the problem is in the DSFC card and not our test HPFA unit. One thing to look at is whether your 115Vac supply is up to snuff. Sometimes if you're powering up through an isolation transformer, it may not be set to a high enough voltage, or it may just not be outputting enough line voltage for the HFPA to supply a full 18Vac to the DSFC. Or your line voltage supply from the wall may be weak. Make sure this isn't the case before you start tearing into your unit under test to chase a non-problem.

8. ATTACHMENTS

8.1 None at this time.