g GE Energy	**Functional Testing Specification**
Parts & Repair Operations ***Louisville, KY***	**LOU-GED-IS200TTURH2C**

Test Procedure for a Turbine Termination Board

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DATE	**DATE**	**DATE**	**DATE**
March 24, 2009	4/21/2010		3/24/2009

1. SCOPE

1.1 This is a functional testing procedure for a Mark VI Turbine Terminal Card, IS200TTURHxC.

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 K:\IS2\IS200T\TTUR\Marked up prints WITH IMPORTANT NOTES.pdf
3.1.2 K:\IS2\IS200T\TTUR\IS200TTUR TEST NOTES.pdf
3.1.3 K:\IS2\IS200T\TTUR\Failure notes.doc
3.1.4 K:\IS2\IS200T\TTUR\ECN's
3.1.5 K:\IS2\IS200T\TTUR\GEI-100639.pdf

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)
2 or more as needed		Tenma dual power supplies (or equivalent 125VDC, 28VDC, and 5VDC supplies)
1		Function Generator, 0-8Vrms output or greater
1		ID chip reader PC

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6. TESTING PROCESS

6.1 Setup

6.1.1 Each circuit shall be set up for testing individually for each test step. Some steps may share a setup between them, and this will be mentioned in those particular steps.

6.2 Testing Procedure

6.2.1 **Magnetic Pickup Circuits:** These are generally used to clamp AC signals for measurement by the VTUR card. You only need to apply 8VRMS sine-wave to TB2 as shown in the following chart and look for 1.1 to 1.2VRMS on the corresponding Px5 connector:

TB2 AC Input	1.2VRMS Output
TB2-25 & 26	PT3-37 & 16
TB2-27 & 28	PT3-38 & 17
TB2-29 & 30	PT3-39 & 18
TB2-31 & 32	PT3-40 & 19
TB2-33 & 34	PS3-37 & 16
TB2-35 & 36	PS3-38 & 17
TB2-37 & 38	PS3-39 & 16
TB2-39 & 40	PS3-40 & 19
TB2-41 & 42	PR3-37 & 16
TB2-43 & 44	PR3-38 & 17
TB2-45 & 46	PR3-39 & 18
TB2-47 & 48	PR3-40 & 19

6.2.2 **BUS & GENERATOR VOLTAGE INPUTS:** These two circuits are nothing more than 120VAC to 1.5Vac transformers with replicated (TMR) outputs. Simply connect a 120VAC power cord to TB1-19 & 20 but wait to apply power until you are set up to read output between pins PR3-5 & 47. Apply power and you should read 1.5VAC output. These readings should be repeated at PS3-5 & 47 and PT3-5 & 47. Now, with power disconnected, move your 120VAC cord over to TB1-17 & 18 and your meter leads over to PR3-4 & 26. Power circuit up, and once again you should read 1.5VAC. These readings should be repeated at PS3-4 & 26 and PT3-4 & 26. If you've been following along in the schematics this concludes SH3 & SH4 except for the Chip ID read, which will be covered at the end of this test.

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6.2.3 SHAFT VOLTAGE & CURRENT INPUTS, and VOLTAGE REGULATORS: These will be simple resistance and voltage checks. First, check for the following resistance values according to the chart below. Then power the board up with 28VDC via PR3-43\PS3-43\PT3-43 (P28) & PR3-1\PS3-1\PT3-1 (PCOM) and look for 5VDC output from U13 pin 1 and U14 pin 1, and look for 13VDC at U8 pin 2.

Point	To Point	Value @ 1% tolerance
TB1-21	PR3-3	118 OHM
TB1-21	PS3-3	118 OHM
TB1-21	PT3-3	118 OHM
TB1-22	PR3-25	118 OHM
TB1-22	PS3-25	118 OHM
TB1-22	PT3-25	118 OHM
TB1-23	PR3-2	8K OHM
TB1-23	PS3-2	8K OHM
TB1-23	PT3-2	8K OHM
TB1-24	PR3-24	8K OHM
TB1-24	PS3-24	8K OHM
TB1-24	PT3-24	8K OHM

6.2.4 SHAFT VOLTAGE & CURRENT INPUTS, and VOLTAGE REGULATORS Continued: This is the part that can get confusing. With 28VDC applied to card as it was in step 6.2.3, look for 5VDC out at PR3-44/PS3-44/PT3-44 and also at PR3-45/PS3-45/PT3-45. Next measure PR3-46/PS3-46/PT3-46 and you should see approximately 5VDC. Wire jumpers WJ2, 3, 4, & 5 may or may not be installed at the factory for whatever reason, and this is the only connection between the two grounds. For testing purposes we aren't worried so much about this measurement since we only are going to use it as a Hi/Low reference voltage. Now, we will be looking to toggle relays K4 & K5, which connect these same three circuits we just tested with pins on the TB1 connector. With your meter still measuring the app. 5VDC output at PR3-46\PS3-46\PT3-46, connect TB1-22 to ground. Toggle K4/K5 by grounding PR3-49, and you should see the meter reading drop to zero (Low, or <.1VDC). De-energize K4/K5 (remove the PR3-49 connection). Move your positive meter lead over to read PR3-45/PS3-45/PT3-45. It should be 5VDC. Connect TB1-21 to ground. Now, once again toggle K4/K5 and the meter should drop to <.1VDC. Now connect TB1-23 to ground. Move your positive meter lead over to PR3-

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44/PS3-44/PT3-44. It should be showing 5VDC. Once again, toggling K4/K5 should cause this reading to drop from Hi to Low. This completes the circuits shown on Sh.5 of the schematic. I have put a hand-drawn layout of the circuits in this step in the Design Folders under **K:\IS2\IS200T\TTUR\IS200TTUR TEST NOTES.pdf** to help you visualize what's going on here, since some of these circuits jump back and forth between Sh.5 and Sh.6. It may help you understand what you're doing in this step a little better.

6.2.5 RELAY DRIVER, RELAY FEEDBACK, AND RELAY CIRCUITS: Now that you've already tested K4 & K5, some of your work for Sh.6 is already done. For the other three relays, first you must know something about how the Mark VI TMR system works. The relays K1 & K2 operate by having at least two out of three possible inputs toggled in order for them to operate. This is because the TMR system is similar to a "voting" system where the "majority" rules. These inputs are tied to three separate VTUR cards, and if one fails, there should be two other functional VTUR cards left to "overrule" the malfunctioning card, hence the requirement that at least two of the three inputs agree for K1 or K2 to be engaged. Where this affects you and this test is simple: To fire K1, you must ground at least two of the three inputs PR3-28/PS3-28/PT3-28. Any two, or all three if you like, must be grounded for this circuit to fire. But there is a caveat: if JP1 is in the "SIMPLEX" position, then PR3-28 can be used alone to fire K1. Simplex operation does not require 2 out of 3 signals to work. You should test this circuit both ways just to ensure proper operation. You'll find the same thing with K2. It is also a TMR operated relay, via inputs PR3-51, PS3-51, & PT3-51, EXCEPT when JP2 is set to the "SIMPLEX" position, in which case PR3-6 is all that's needed to fire it. K3 is not a TMR operated relay. Only PR3-51\PS3-51\PT3-51, J8-1, or J8-2 is needed to fire it. Any one of these taken to ground by itself can fire K3. The easiest way to test these relays is all at once. To do this, connect your meter across TB1-1 and TB1-6. Make the necessary connections as stated above to fire all three relays (K1, K2, & K3). You should find continuity once the three relays are all engaged. Using the auditory tone setting on the meter works well for this step. Remember to test K1 & K2 in both TMR and Simplex modes (jumpers JP1 and JP2). With the three relays energized, take the lead connected to TB1-6 and move it down the line to TB1-5, then TB1-4, and finally TB1-3 and you should find continuity at all these points with TB1-1 (so long as K1, K2, & K3 are still energized). **Also:** there are two logic outputs that have to be observed when firing K1 or K2. Take a 10K ohm resistor and connect it in series with the regulated 5VDC output of the DC bench supply that is supplying the 28VDC power to the board to make it a pull-up

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resistor (for logic testing). Make sure the COM of the 5VDC logic supply is connected to the PCOM of the 28VDC supply. Connect your positive meter lead to PR3-7\PS3-7\PT3-7. Connect the other end of your pull-up resistor to the same point—or connect it straight to the positive input of your meter "daisy chained" with your meter lead, since both need to be connected together for the remainder of the test. While toggling K1, observe the output at the meter to make sure it's functioning as follows: with the relay de-energized, the logic output should be Low. It should transition to Hi as soon as the relay is energized. Move the positive meter lead to PR3-48\PS3-48\PT3-48 and repeat for K2 logic. This concludes Sh.6 and all the relay testing. Remove all leads except for the 28VDC board power and the 5VDC pull-up for the next step.

6.2.6 125VDC MONITOR CIRCUITS: If you find a problem in this part of testing, as you likely will since this is where the highest rate of failures happens amongst these cards, then you should remember to observe any applicable safety requirements when troubleshooting beyond what this test procedure lays out. Now, setup your remaining Tenma DC power supply(s) to produce 125VDC (120 to 125VDC is ok, just try to stay below 130 since that's what the MOV's are set to trip at) but don't apply this voltage yet. In fact once the voltage is set, shut the power off. Using the 5VDC logic pull-up constructed as in step 6.2.5, and your negative meter lead still connected to PCOM, connect your positive meter lead to PR3-8\PS3-8\PT3-8. Now, for the remainder of the test, **TB1-8** will remain the "COM" or N125, where the negative side of your 125VDC stays connected. If you use mini-grabber leads or other means of hands-free operation so you don't have to physically hold any leads. Now connect the positive side of your 125VDC to TB1-1. Turn on the supply and observe the meter transition from Hi to Low. All of these circuits were designed to give a logic Low when 125VDC is present on their inputs. Use the following chart to repeat this test on the other Monitor circuits:

P125	**N125**	**P5 LOGIC**	**PCOM**
TB1-1 or 3	TB1-8	PR3-8\PS3-8\PT3-8	PR3-2\PS3-2\PT3-2
TB1-2	TB1-8	PR3-9\PS3-9\PT3-9	PR3-2\PS3-2\PT3-2
TB1-6	TB1-8	PR3-29\PS3-29\PT3-29	PR3-2\PS3-2\PT3-2
TB1-4	TB1-8	PR3-30\PS3-30\PT3-30	PR3-2\PS3-2\PT3-2
TB1-5	TB1-8	PR3-50\PS3-50\PT3-50	PR3-2\PS3-2\PT3-2

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6.2.7 CHIP ID: As mentioned in step 6.2.2, the three ID chips need to be read to confirm that they have all been programmed properly. The instances or blank or mis-programmed ID chips leaving the factory and seeing service out in the field is higher than you might think. This can cause some problems with equipment, maybe even hard failures, even when nothing else is wrong with the card depending on how the customer's software is set up. Simply take the card over to the CHIP ID pc located in the MARK VI area of the shop and select the correct revision of IS200TTUR from the menu and follow the instructions given to you by the pc. When selecting which IS200TTUR to use, you may see a 5G or 7G next to the number. This refers to the serial number and whether it has 5 or 7 digits in it. Select the proper one, as you will be expected to type this number into the system at a given point. When entering this data, be sure to use all CAPITAL LETTERS as lower case might cause it not to agree with what's programmed in the chip. If the particular revision you need to select doesn't have a 5G or 7G next to it, get with Monte Starling to have it added before proceeding.

6.2.7.1 A trick to remember about chip ID serial numbers: If for some reason your serial number is a 6 digit one, like the R##### numbers given out to units that arrive in our Receiving Dept. without serial number labels, you'll only need to type in some sort of gibberish to get the system to spit out an error when it compares it to what's in the chip, at which point it will tell you what serial number it found, then it'll ask you if you want to change it to the one you typed in. Your answer will be NO, to let it fail the test and quit programming. Be sure to jot down what the number was that it found in the chip and print off this number in a barcode label to place on the card instead of the in-house serial number that Receiving stuck on it. Then go back and re-try the test with the correct serial number. This trick works for boards with un-readable or marred up serial number labels, too.

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6.2.8 Check continuity between these points.

PR\S\T3-10	**JR\S\T4-4**
PR\S\T3-11	**JR\S\T4-7**
PR\S\T3-12	**JR\S\T4-10**
PR\S\T3-13	**JR\S\T4-24**
PR\S\T3-14	**JR\S\T4-29**
PR\S\T3-15	**JR\S\T4-37**
PR\S\T3-31	**JR\S\T4-3**
PR\S\T3-32	**JR\S\T4-12**
PR\S\T3-33	**JR\S\T4-9**
PR\S\T3-34	**JR\S\T4-23**
PR\S\T3-35	**JR\S\T4-28**
PR\S\T3-36	**JR\S\T4-33**
PR\S\T3-52	**JR\S\T4-11**
PR\S\T3-53	**JR\S\T4-8**
PR\S\T3-54	**JR\S\T4-22**
PR\S\T3-55	**JR\S\T4-25**
PR\S\T3-56	**JR\S\T4-30**

6.3 ***TEST COMPLETE ***

7. NOTES

7.1 IS200TTUR FAILURES

7.1.1 The 125VDC monitor circuits seem to fail more than the rest. See sh.7 in the Marked up test prints (**K:\IS2\IS200T\TTUR\Marked up prints WITH IMPORTANT NOTES.pdf**). Common failures seem to be the dual opto-couplers (U9, 11, & 12), the FETs (Q1-5), the biasing diodes for the FETs (D138-139, & D141-143), and for some reason D140, which sits reverse-biased between TB1-6 & TB1-8. D153 is another one. It's fixed up just like D140. **REMEMBER**: U9, 10, 11, & 12 have **OPEN COLLECTOR OUTPUTS!** Keep this in mind when testing them. They **will not** give a 5V output… you have to provide that thru a pull-up resistor. If you don't, you will get a false failure.

8. ATTACHMENTS

8.1 None at this time.

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