g GE Energy	**Functional Testing Specification**
Parts & Repair Services ***Louisville, KY***	**LOU-GED-IS2020LVPS**

Test Procedure for a Mark VI Power Supply

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Darren Johnson			Charlie Wade
DATE	**DATE**	**DATE**	**DATE**
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1. SCOPE

1.1 This is a functional testing procedure for a 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** Check board's electronic folder for more information
- **3.1.2** Grayhill schematic documentation
- **3.1.3** Grayhill material lists for "input" and "output" boards
- **3.1.4** Any documentation available on N:\Design Folders\IS2\IS2020\IS2020RKPS
- **3.1.5** Any documentation available on N:\Design Folders\IS2\IS2020\IS2020LVPS

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 site specific SRA's 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 or 2		24Vdc power supply
1		Wall mounted Mark VI simplex rack test station, with 400W load bank and network interface for GE Control Systems Toolbox software monitoring
1		Pace ST400 heat plate (optional)
1		H188739/H188738/H188737 any one of these will do for testing

Special Note 1: Be sure all older style Vicor power modules are removed during all incoming repairs. When replacing with newer style 24Vdc Vicor modules, look for the suffix letter "B", here is an example: VI-710622B, V24B15C150BL, V24B28C150BL, & VI-810421B. If a unit comes in with all new modules and one has failed, replace only the failed unit (warranties come to mind). We have extended this policy to cover both RKPS and LVPS units, for good measure.

Special Note 2: When replacing power modules replace power switch with new and be sure to add hardware to switch (washer and locking nut). Instructions pertaining to hardware installation are located in the RKPS folder under SW1 hardware.

6. Testing Process

6.1 Setup

6.1.1 Assess unit for any signs of physical damage. In particular watch for shipping damage, burns (once the cover is removed), and/or corrosion. Another thing you may run into is prior repair attempts, which may or may not have left the boards with eyelet damage. There are inner layer traces to be aware of while removing the power modules, and outside facilities have been known to damage these supplies by not properly removing the modules. If damage is too severe you may chose to exercise caution and simply RLR the unit, rather than try to give an 18-month warranty on an "iffy" repair. Consult a lead tech if you find yourself in this situation.

6.1.2 There are over 120 screws to remove to perform repairs to these units, so it's advisable to get a cordless screwdriver to use during disassembly and reassembly. Make sure it has an adjustable torque clutch for use when reassembling the unit, because the module-to-heat-sink torque specs call for a very light touch.

6.2 Testing Procedure

6.2.1 Powering up the Fixture: There are three identical test fixtures, so you should have an open slot to test your unit. Make sure the E-stop is turned on, or "pulled out" as some folks call it. This enables the cooling fan on the load bank to be turned on. **LEAVE THE E-STOP ON EVEN AFTER YOU'VE FINISHED TESTING THE UNIT.** The load resistors are small for the amount of wattage they are dissipating, and they need the cooling fan left on during and for a while after testing to prevent damage. LVPS units require 24vdc input voltage at connector J5 (+24 = pin3, common = pin2). Two

independent power supplies are located in the bottom of the power supplies rack underneath the bench where these units are tested. Removed the supplies from the cabinet and connect the black cord to pin 3 of connector J5 on the LVPS input board; now connect the white wire to pin 2 of J5. Connect the remaining power cables from the fixture to the unit under test. These will be the main RKPS output connector and the P28E load. The supplies have a 120vac cord so plug it into an outlet. With the E-stop on, turn the Master Power switch on, and you should see the meters come on along with a red LED to indicate Power On status. Make sure the LVPS itself is switched off before you switch on the UUT Power.

6.2.2 Powering up the LVPS: When power is applied with the LVPS's power switch "off" you should get a yellow led lamp illumination. Flipping the main power switch "on" will either give you a green led illumination (I'M OK or "all circuits good") or a red led illumination (problem detected somewhere). Don't trust a green led, check the outputs on the fixture panel door anyway. There could still be a bad output voltage that the LVPS's detection circuitry is missing or it could die under load testing.

6.2.3 Initial load testing: At this point, you can choose either to leave the Load Cycle Control's Auto Select switch set to AUTO and sit for a complete cycle, which will cycle heavy loading through the + & -15Vdc, P28A & C, and P28B & D outputs respectively for approximately 5 minutes each, giving you a 15 minute complete cycle time, *OR* you can choose to switch over to MANUAL and select each of the three pairs of outputs individually for as long as you like, perhaps for troubleshooting reasons. Testing requires that at least one complete auto cycle take place, so at some point you'll need to do this. It's a good idea to use this setting when burning a unit in so that the entire unit gets tested thoroughly.

6.2.4 Repair and troubleshooting 1: If at this point you find no dead or out of tolerance output voltages, you should allow the unit to burn in for a while to see if the problem will show up later (heat related). Since you'll need to replace all old Vicor modules anyway, you should still make sure you can identify any failing modules and document them for the Service Failure Report before replacement. If you find one or more dead or weak modules, go ahead and write down what you found, then shut down the unit, LVPS first, then UUT POWER, and then remove the LVPS connections. **REMEMBER TO LEAVE THE E-STOP ON FOR THE COOLING FAN.** It won't hurt to leave the Master Power switch on either way, as this pretty much leaves the meters powered up.

6.2.5 Repair and troubleshooting 2: If you found only one or two dead modules, but all others were working, and you have written down which ones were bad, go ahead with replacement of all modules, blown fuses, and outdated electrolytic caps. MAKE sure to replace any blown fuses, which will most certainly be associated with the bad modules you found. *Don't get fooled into thinking that the fuse was the reason the module quit*. 99% of the time the module is what took the fuse out. If you found that the entire unit was dead, then this most likely means a dead 5V module. This can be diagnosed either by checking the fuse for the 5V module (with the metal cover off and all NFPA/OSHA rules strictly observed), or by looking at the 5V control logic voltage (which is generated by the LVPS control circuitry, not the actual 5V module itself). If there is 5V control logic voltage present at the 5V module, but no 5V main output, it is likely the 5V module is bad. The other modules will not operate until they see the 5V module is up and running because the LVPS control circuitry cannot supply enough current to the 5V control logic to get the other modules up and running without the 5V module coming online and assisting it. You can also bench test by injecting 5Vdc at the 5V module's output pins while applying 24Vdc to the main power input and seeing if the other modules come up and run. *Since this requires the boards to be exposed with the steel cover off during bench testing, be sure to observe any NFPA rules for safety involving circuits over 50V.* If they do, measure their outputs and write down which ones are bad before replacing the modules.

6.2.6 Repair and troubleshooting 3: The process for replacement is as follows: Remove boards from heat sink. You must remove both boards together before unplugging them from each other. Throw away the heat sink dielectric foil pads. Clean up any and all dielectric grease from both the modules and the heat sink. Flux-Off 2000 and paper towels work best for this, though you may find it necessary to use a scraper (razor) to get the built-up grease off of the heat sink. You'll also need to spray the Flux-Off directly onto the little glue strips on the module's heat sinks where the foil pads went to soften them and scrape them off with a razor. Use the Pace ST400 heat plate to get each module pre-heated to approximately 210 degrees Fahrenheit, and while the module is hot use a large solder extractor tip heated to around 800 degrees and **PLENTY** of flux to suck out as much original solder as possible, and after re-fluxing, replacing that solder with Chip Quick, a lead-free alloy used for chip removal. By adding the Chip Quick, and keeping a steady heat to all the leads, the module should fall out on its own. Be sure to suck out all the Chip Quick once the module has been removed, and move on to the

next one. The idea behind all this is to remove the modules **WITHOUT** pulling eyelets. If you chose the heat plate method, be sure to keep plenty of solder filters handy (disc and cotton), and be ready to clean the traps and change out tips often. Also, replace any fuses that are blown and replace any caps that are out of date. Right now is a good time to give all the surface mount caps a good visual inspection and possibly reflow or replace any that need it. Make sure to remove any Chip Quick form the ones that sit adjacent to module pin eyelets and could have wicked up the alloy during the module removal process.

6.2.7 Repair and troubleshooting 4: It's a good idea to clean the board up at this point. Many of these cards have excess flux from the factory, usually a no-clean rosin type flux around many components. This may escape the QA process if left in there because it's hidden under a metal cover, but it is a best-practice to clean this stuff up since it's been found on a few occasions to attract moisture and start the corrosion process. There will be more instances of this occurring in the future as this product line ages, so be sure to nip it in the bud now while the unit is in for repair. It's easiest to clean up the mess before installing the new modules.

6.2.8 Repair and troubleshooting 5: Now that you have a clean heat sink and clean boards, you're ready for the new modules. Take a piece of copier/printer paper and cut it into squares approximately the size of a module (remember the 12V modules are smaller) to use as shims in between the modules and the heat sink. These modules normally have a thermal pad that goes between the sink and the module, and this affects the depth at which the pins will be set into the eyelets of the boards. You don't want to waste a set of pads for this step since you will still need to wash the boards once again, but if you don't shim the modules there is the remote possibility that once you tighten the modules and boards down to the heat sink for final assembly, you could put the boards, solder joints, and the inner layer traces in a bind, causing problems later on. **ALSO**: Be sure to use the same heat sink for this step that you plan to use for the final assembly. If you switch heat sinks, the height of the standoffs can be different, which will cause your depth to be wrong and cause the aforementioned binding problem to occur. We haven't seen this cause a problem with function *YET*, but when you can observe the screws cranking down and twisting the boards under very little torque you see where the concern comes in.

6.2.9 Repair and troubleshooting 6: There is a diagram at the end of this test that shows proper placement and orientation for all of the modules, along with the locations and

orientations of the electrolytic caps. Refer to it when placing the modules on the heat sink over your shims. Now that you've got things in place, set the boards, one at a time, over the modules. You may need to finagle everything a bit to get all the modules into their eyelets. Make sure ALL the modules for that board are set properly, and that the board sits flush with the standoffs, and make sure the screw holes for the boards are lined up properly. You may wish to start a few screws into some standoffs temporarily to ensure proper alignment. Using a liberal dose of flux for each pin, start soldering the pins to the board. The bigger the soldering tip you can use the better. These things can sink a lot of heat. **ALSO**: make sure to press down gently on the board above or all around the module to be sure the board is actually seated against the standoffs before you apply solder. Some warpage is to be expected with unsecured module-less boards, but mustn't be allowed to cause a problem while soldering in the new modules. Once all of the modules are soldered in, and assuming you've already changed out any fuses, caps, or other failed components, you can go ahead and wash the unit for the last time. **BE SURE TO GIVE IT A THOROUGH CLEANING.** A lot of flux will have been used on these cards, and in addition to other contaminants that may still be present, problems have arisen when normal cleaning has taken place.

6.2.10 Using the proper sized thermal pad for each module, install them carefully so that you don't crease them when removing the backing papers. Set the boards down on the heat sink, start all of the screws into their holes, but DON'T torque them down until ALL screws have been started. Now, you can tighten them down to the official specs-- Torque specs are as follows: #4-40 screws, qty 102 (incl. Vicor modules) -- 5.5 +/-0.5 in-lbs. #6-32 screws, qty 21(brackets, cover, etc.) -- 11.0 +/-0.5 in-lbs.

6.2.11 **Repair and troubleshooting 7:** Power the unit up and observe the meters to be sure all voltages are good, and check to make sure you have a green light on the unit under test. IF BY CHANCE you notice the red light glowing faintly while the green is on strong, this is an indicator of the floating grounds causing noise in the monitor circuit while the heat sink isn't there. You could verify this simply by laying the boards on the heatsink and inserting one screw in the hole nearest the P28E output connector. This should cause the slight glowing of the red led to go out.

6.2.12 **Repair and troubleshooting 8: Final Testing and Burn-in:** Install unit into the test station. Apply power, and observe the outputs on the load bank's voltmeters. Leave the supply here and "burn it in" for a while. Some units may require an hour, others more or less, depending on the nature of the repairs performed and the customer involved.

There is no set time limit, so use your best judgment unless otherwise instructed by a lead tech or MSO. If it still passes, it is then ready for shipment to the customer.

6.2.13 If the brackets for the main power output connector, one slotted and the other with a nut, have been loosened or disturbed, loosen them and install a main power output connector to align them, and then re-tighten their screws.

6.3 ***TEST COMPLETE ***

7. Notes

7.1 None at this time.

8. Attachments

8.1 SW1 assembly instructions:

Grayhill An ISO 9001 Company

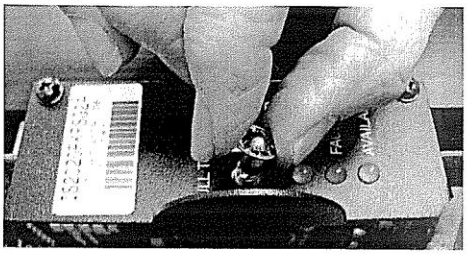
GEYY35001-2 Assembly Instructions

UNCONTROLLED COPY INFORMATIVE ONLY

Process ID Number	Rev	Process ID Description	Parent Product Description
GEYY17005	A	Assembly Instructions	GEYY17005

Assembly Instructions

Step 1

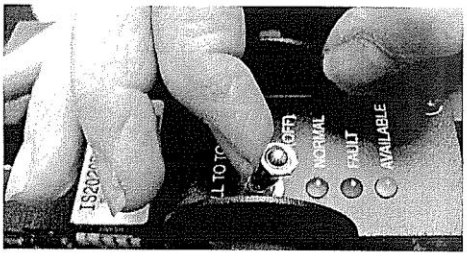


Place lock washer 08J1026 over the toggle switch as shown.

Step 2

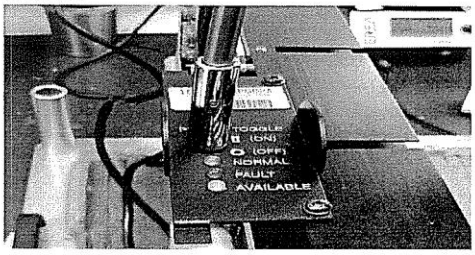
Next, place flat washer SHH690-19 over the toggle switch as shown.

Step 3



Next, place nut SHH3348-0021 over the toggle switch as shown. Begin tightening by hand to ensure the nut isn't cross-threaded.

Step 4



Using a calibrated torque driver, torque to 8 in. lbs.

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