1.0 Fundamental Overview

The smart power supply test bench is an automated test fixture for a power supply and control board assembly. It will fully calibrate and test the functionality of the two boards serially and in parallel. The test fixture will also keep the technician isolated from exposure to any high voltages. This document provides instructions on how to properly test the design of the fixture to determine that all engineering and customer requirements have been met and verified.

Tools Needed:
- Measuring Tape
- PCB Schematic – PN:
- Assembly Schematic Diagrams – PN:
- High Voltage Procedure Document – PN:
- Digital Multimeter – Ranges between 50 V and 400 V
- SD Card – SanDisk 8GB Class 4 SDHC
- Stop Watch
- Thermometer

2.0 Enclosure Specification

This section of the Engineering Requirements Test Plan only needs to be performed once to validate the dimensions and other specifications for the enclosure and scatter shield.

The required dimensions of the enclosure are a length of 1.5” ± .25”, a width of 1.5” ± .25”, and a height of 1” ± .25”. Use a measuring tape to validate these requirements. The transparent Lexan cover used to protect the UUT (Unit Under Test) and the operator should be a height of 3” ± .25”, therefore requiring the height of the metal enclosure to be a height of 9” ± .5”.

The transparent Lexan cover protecting the operator from failure of the UUT is required to be transparent. Verify that the UUT and connections made to it are visible while the scatter shield is closed and locked.

3.0 Fixture Validation

The operator should utilize the PCB Schematic (PN:) and Assembly Schematic (PN:) Diagrams throughout the procedure.
The High Voltage Procedure Document (PN: ) should be read and taken into account throughout testing.

Although there will be leads to verify the proper disengaging of AC voltage, these will not be part of the final unit, but are used to test the AC voltage connection. These are simply to verify the desired functionality of the testing unit. They will be accessible from the transparent Lexan cover through small holes, smaller than the size of a finger.

### 3.1 AC Voltage Accessibility

**WARNING:** High voltage is present in this procedure. Remember the guidelines listed in the High Voltage Procedure Document (PN: ).

This is a crucial part of the enclosure design. The AC voltage leads used for further testing must not be accessible to the operator unless the test fixture is powered off.

Verify that all voltage lines are within the metal enclosure and cannot be shorted to the enclosure, Lexan cover, or any other surface of the fixture. *This can be accomplished through the use of electrical tape and clamps. Small, drilled holes in the Lexan cover will allow for access to the leads. After connection to alligator clips.*

Verify that the transparent Lexan cover and the enclosure top are both closed and locked prior to initiating the test, and that they stay locked throughout the test.

Verify that any leads used for initial testing are disconnected and removed from the unit before actual testing occurs. Prior to powering on, check around the outside of the enclosure and inside as well to make sure there are no unwanted and dangerous leads that don’t correlate to the schematic drawings.

### 3.2 AC Voltage Disengaging

**WARNING:** High voltage is present in this procedure. Remember the guidelines listed in the High Voltage Procedure Document (PN: ).

Required functionality of the enclosure includes the disengaging of the AC line once the lid has been opened and/or upon the pushing of the emergency stop button. The emergency stop button is included on the fixture in the event an emergency occurs and the operator is unable to open the scatter shield to stop the test and disengage the AC voltage.
• Look for the ‘ON LED’ (LED) indicator to be turned off once power has been shut off.
• Use a volt meter along with additional wires from the AC voltage line leading to the power supply board to verify that the power disengages when the lid is opened.
  o Use this to verify that the ‘ON LED’ (LED #) is turning off properly.
• Use a volt meter to be sure that voltage has dissipated. Once the voltage is below 60V, the enclosure is safe to open.

3.3 Fixture Functionality

There should be indications for the operator to know that the fixture is on and completing a test.

• Verify there is an LED indicator and a label saying ‘Test Bench Power On’ and verify that the LED is on once the fixture is powered on
  o Refer to the system schematic as well for any troubleshooting issues dealing with this LED
• Verify that there is an LED indicator that the UUT is powered on, and a label saying ‘UUT Power On’
  o With leads safe but outside of the enclosure and a volt meter, verify that power is engaged for the system once it is powered on and that the LED isn’t just turning on.

A simple LCD display will be utilized to help verify that proper communication is being made with the Arduino. The LCD GUI is also used to display a ‘Pass’ or ‘Fail’ message. If a test fails, it should display the reason for failure.

• Verify the GUI displays the message ‘Successful Communication’ indicating that communication has been made.
  o Perform manual test to determine if communication is working.
• Verify that the GUI displays a message of ‘Successful Calibration’ after the procedure has been completed.
  o Perform manual a calibration procedure to be sure that the Arduino is calibrating correctly. Try to use values that might trip up and confuse the system into calibrating incorrectly.
• Verify that the GUI lists pass/fail after a test is completed.
  o Perform a manual test to verify that what the GUI is listing is accurate through manual testing.
The purpose of this document is to validate that the Smart Power Supply Test Bench has met and properly tested the Engineering Requirements.

- Verify from GUI that data is being shared and received through the proper completion of the test.
  - Connect SD card to computer to see if proper test data is being stored and the proper naming and filing conventions are being followed as well.
    - Test Data
    - Date and time of test
    - Part number being tested
    - Pass/Fail for each series of tests
      - Step in test where failure occurred
    - Run same test via automated system and verify that the test fails at the same place as manual test, and that the LCD displays ‘FAILURE’ and a reason for failure is stored in the SD card.

### 3.4 Enclosure Safety

The scatter shield and enclosure should be able to withstand any type of failure of the test. It should be able to withstand intense heat and any accidental and rare explosion. The internal temperature must stay below 50°C as well to be sure that the electronics will not be damaged.

- Run simulated analysis to determine which material and thickness will be able to withstand the most force.
- Run tests to see how much heat the enclosure can withstand.
  - Use manufacturing requirements of the materials.
- Run stress tests and force tests on the base and the safety shield to see how much heat and force each can withstand
- Is the Internal Temperature ≤ 50 Celsius?
  - Activate temperature sensor via Arduino Control
  - Trigger the fans to turn on once a temperature threshold has been reached
  - Trigger the test to stop if temperature rises above the required maximum temperature
    - Verify that the testing stops if triggered due to overheating
    - Check if the ‘ON LED’ indicator turns off
    - Verify that the AC power disengages. With accessible, yet safe, leads outside of the enclosure from the AC voltage line
leading to the power supply board, use a volt meter to verify that upon temperature overload the power turns off.

4.0 Test Ergonomics

The automatic testing enclosure goal is to make the time required for testing shorter and the test easier to complete. The number of steps can affect the time and ease of use. This includes placing the controller board or power supply board, making the connections, initiating the test, validating collected data, and disconnecting leads. There are three tests to be completed; calibrating and testing the controller board, testing the power supply board, and testing the unit as a whole. There should be less than 5 steps per test.

- Place the Controller board, Power Supply board, or Assembled Unit in the test fixture.
- Make appropriate connections depending on which test is being completed.
  - This part of the setup should take less than 1 minute.
  - The connections should take less than 5 seconds each to make
- Close the transparent Lexan cover and initiate the test by pressing the start button located on the top of the fixture.
  - Time this section. It should take less than 4 minutes, accounting for the 1 minute of setup.
- Once the test is complete, insert the SD card into a computer to affirm that the SD card is correctly logging data. The file system saved on the card must be viewed. In order to do so, remove the SD card from the fixture and insert it into an SD card reader on a PC. View the contents of the card in File Explorer. There should be multiple text files following an 8.3 naming convention, 8 characters for the barcode and 3 for the file extension, in this case, .txt. Open any of the files and confirm that the results match with what was recorded previously in the excel spreadsheet. Also confirm that the name of the file matches the corresponding barcode that was used.
  - Test Data
  - Date and time of test
  - Part number being tested
  - Pass/Fail for each series of tests
    - Step in test where failure occurred
- Upon completion of the test, validate that connections take less than 5 seconds each to disconnect.
• Base on the previously stated steps the set up and ease of use can be determined on a relative scale.
  o Is the setup time fast, i.e. less than 1 minute?
  o Is the total number of steps for the test le