1.0 Overview

Tools Needed:
- Digital Multimeter
- Oscilloscope
- Power Supply
- Schematics
  - Controller Board (PN: )
  - Load Board (PN: )
  - Relay Board (PN: )
  - System Wiring Diagram (PN: )
  - UML Diagram (PN: )

The Smart Power Supply Test Bench is composed of connections between several subsystems. The trouble shooting guide is divided into sections corresponding to each subsystem. Each section contains problems encountered during the assembly/design process and their resolutions, along with issues that can be encountered during the lifetime of the test fixture. Error messages generated from the software also serve as indicators to the operator as to what the problem(s) could be.

Figure 1: System Wiring Diagram
2.0 Controller Board

The controller board contains the Arduino Mega microcontroller and enables the automated calibration and testing process for the UUT. Many issues that can occur might stem from an issue with the controller board as it is responsible for the vast majority of the performance of the test fixture. The current should always be limited to 0.5 A when powering the controller board separately from the test fixture to prevent damages. Refer to document _______.

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1. Arduino won’t turn on
   a. Check the linear regulator’s (U19) I/O pins. Check to see if the 12 V volt power rail is reaching the input of the linear regulator, and then check the output pin of the linear regulator to see if it is sourcing 5 V.
   b. Verify the \( V_{in} \) pin is receiving 5 V and make sure the GND pin is nearly equipotential with the ground rail on the controller board.

3.0 Load Board

The load board primarily contains Op-Amps that emulate varying resistive loads to be used to calibrate and test and the UUT against the calibration and test procedure for said UUT. The active load design operates in both constant current and constant voltage mode. Refer to document ________.

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1. Issue

Possible Causes and Solutions
4.0 Relay Board

The Relay Board contains the two autotransformers and the relays that enable the selection of 85 VAC or 264 VAC to be used by the UUT and to power the rest of the test fixture. So, following High Voltage Safety Protocol is necessary for troubleshooting this portion of the test fixture. Refer to document _____.

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1. Either the 264 V or the 85 V transformers won’t source voltage properly
   a. Inspect the SPDT relay to see if it is receiving a 12 V signal from the appropriate FET.
   b. Inspect the 120 V (U1) relay to see if it is receiving a 12 V signal from the appropriate FET.
   c. Inspect the switching FETs to see if they are receiving a 5 V enable signal from the Arduino I/O pin. D15 (Pin 15) controls the 120 V SPDT relay and D16 (Pin 14) controls the switching relay for the step down and step up transformer.
   d. Inspect the AC lines. Check for frayed cables and loose connections.
   e. Observe the AC monitor display to see how much the AC voltage is varying.
   f. Inspect the relays for any signs of damage from a power surge.

5.0 Safety Enclosure

The safety enclosure contains the least amount of electrical components; however it does contain several fans which are controlled by the Arduino Mega Microcontroller as well as the “START”, “Emergency Stop Switch” and the LCD.

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1. Fans not rotating
a. PWM signal from Arduino MEGA not reaching fans
b. Use the oscilloscope to inspect the analog pins with the oscilloscope to see if the PWM signal is leaving the Arduino MEGA.
c. Use the Oscilloscope to check the power lines of the fans (red wire) to see if the PWM signal is not being corrupted by the wire at some point.
d. Check for frayed cables that are connected to the fans.

2. LCD not turning on
a. Open the enclosure, and check to see if the power and GND wires are connected to correct pins on the bottom of the LCD and the controller board’s connector for the LCD.
b. Check all wires on the LCD to see if any of them have been frayed and are shorting with any other wires
c. Additionally, check to make sure connector (J3) is still firmly soldered onto the controller board.

3. Start Switch Not Responsive
a. Open the enclosure, and check to see if the switch’s wire is still grounded to the controller board and that the input wire is connected to the controller board.
b. Check the voltage at pin 26 (D48 on pin layout) to see if the enable signal is from the switch is high when the start switch is pressed.
c. Check for any shorts on the underneath the switch or on the controller board (check along the trace for that leads to D48)

4. Emergency Stop Switch Not Responsive
a. Open the enclosure, and check to see if the switch’s wire is still grounded to the relay board and that the input wire is connected to the relay board as well.
b. Check for frayed power and ground wire and see if they are shorting with anything
   c. Connect test fixture to a standard 120 V outlet and check to see if a 120 V RMS signal passes through SPDT relay (reference designator U1) when the emergency stop switch is enabled. The switch will need to be replaced if a 120 V RMS signal is enabled.
6.0 Software Overview

The power supply operates in two distinct modes, constant current and constant voltage mode and has to be calibrated in both operating modes. A brief overview of the calibration procedure in terms of a UML diagram is provided for both modes. Further study of the source code and official specifications for the calibration of the power supply may be needed to trouble shoot issues with the test fixture. Refer to the UML diagram, document ______.

Figure 2: Arduino Mega I/O Pin Layout