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THE UNIVERSITY OF RHODE ISLAND

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Automated Variable Load Testing of HV DC Output Boards

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Acumentrics
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Project Motivation

Acumentrics is known for designing and building uninterruptible power supplies (UPS), which have the ability to support a wide array of input sources while providing clean and reliable output power. The motivation in creating an automated testing system comes from the 1U Blade Series UPS being a complex piece of power equipment. The 1U Blade has high power density and allows users to chain multiple units together. It is composed of over a dozen different circuit boards with numerous responsibilities. With an automated testing system, the testing process becomes more efficient, thus saving Acumentrics time and money. If a faulty board is discovered, the system would normally have to be disassembled before replacing the board. The end goal is to eliminate that step by testing a small selection of boards separate from the unit to see if it can accept any input source, condition and clean the signal, and convert the signal to the required output signal.

Key Accomplishments

Safe Testing Environment: We spent time integrating safety equipment into our testing with LabVIEW. In addition to personal protective equipment, a DUT enclosure, grounding rod, safety barriers, and warning signs were purchased to create a safe testing environment in accordance with OSHA and NFPA regulations. The DUT enclosure **(Fig. 2)** ensures that power is cut when the container is opened. The programmable test equipment in **(Fig. 1)** that was decided upon was a Preen single-phase power supply, a Keysight data acquisition system with a 20 channel multiplexer, and a 20 channel switch module, a BK Precision DC electronic load, and a Tekpower DC power supply.

Constructed Cables: We spent time at the Acumentrics facility constructing cables to connect the boards to devices for testing. An important part of this was to make sure the wire gauge was appropriate to handle the amount of current flowing through. We wanted the system to be as organized, compact, and universal as possible. We labeled all of the wires and added quick disconnects to them to make our system compatible with testing other boards and to make sure it is easy to transition from one board to the next.

Manual Testing: Manual testing is required before using the LabVIEW program. Beginning with the DC/DC Output and Charger boards we were able to determine how we wanted the LabVIEW program to work. We spent a large amount of time collecting data and studying the boards when running manual tests. There were many times we had to troubleshoot to determine if the board was broken or if there was an issue with our cables/hardware.

LabVIEW Testing: After manually collecting data, we were able to achieve programs that run through automated tests for each board. This consists of the DC board, Charger board, and preliminary programs for the DC Front End board. The LabVIEW programs initialize the testing equipment **(Fig. 3)** and runs through a current loop that constantly raises depending on the board being tested.

LabVIEW Convenience: Along with automation, a User Interface (UI) was designed to enhance the test engineer's ability to monitor data as well as the state of tests. LEDs can be witnessed in the UI to signify the user whether the current test is running, passed or failed. In addition to this, work was done on each individual VI to condense the block diagrams using sub-VIs, allowing for an easier flow of information and editing. A master VI was created to call to other VIs depending on the board being tested, so the test engineer only needs to go to one place to access all testable boards.

AC and DC solid-state relays: The relays are powered by 5V from the benchtop voltage source. The positive voltage is connected to the switch channels within the DAQ to control which relay is being used. The positive end of the high voltage power supply is connected to each of the relays and then to the DUT enclosure interlock. From the interlock, each board can be connected to their matching cables for testing. We performed a manual test on the DC/DC Output board to verify the enclosure works as designed. When the lid is opened, the circuit is not complete, and the power is cut. Two relays **(Fig. 2)** were required because only one can be used at a time and is only AC or DC. Since AC and DC boards are being tested, two different relays were required for complete compatibility.

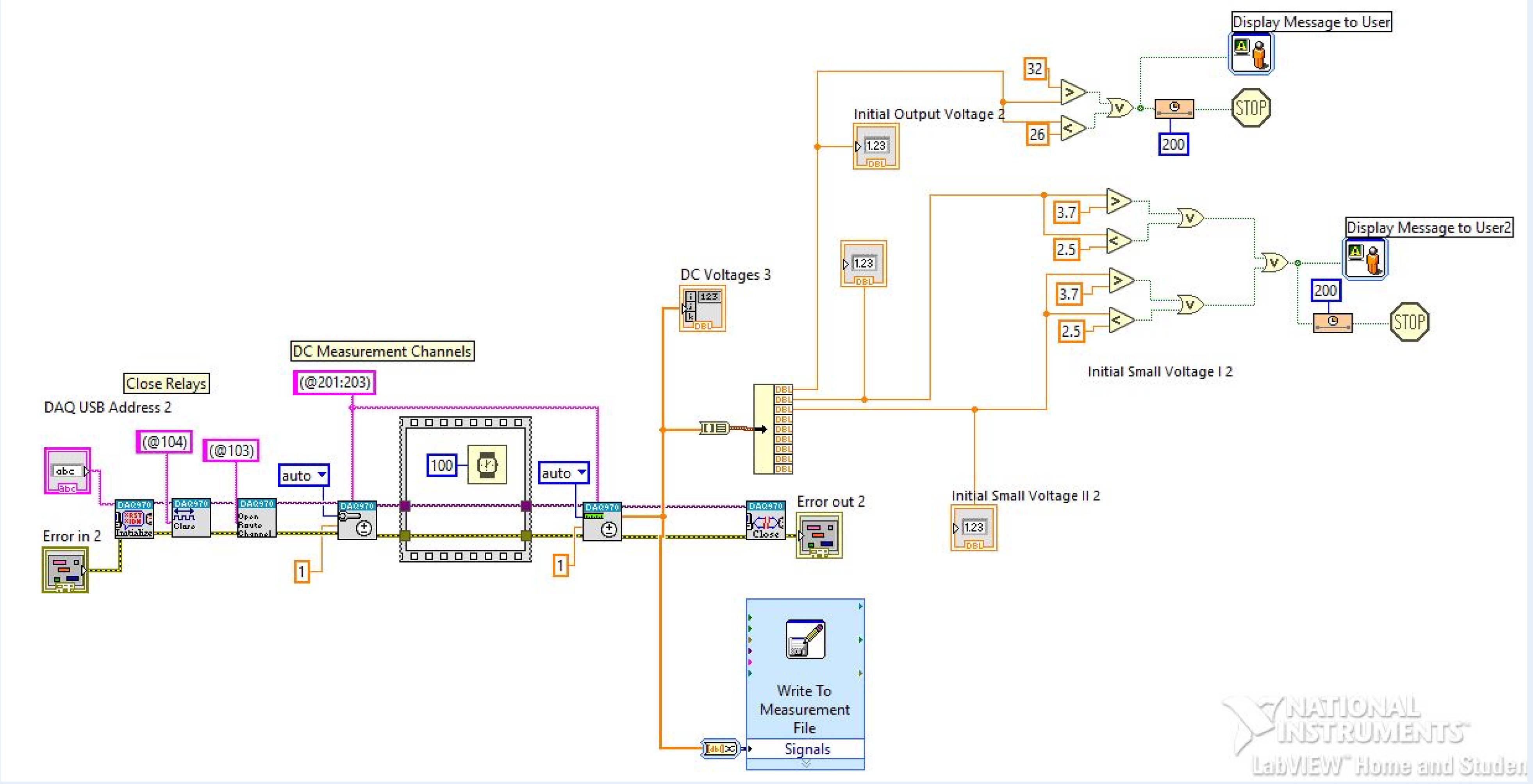

Fig.3: DAQ Initialization

Anticipated Best Outcome

The Anticipated Best Outcome (ABO) and Extended Best Outcome was to create a functional prototype system that is capable of performing automated load tests of the DC/DC Output board, Charger board, DC Front End board, and PFC module. The system must compare the characteristics of each board to values sensed by the testing system. This is done by using a data logging function in LabVIEW. These values are then used to determine whether the board is acting as it should or not. This system will not rely on the 1U Blade and will visually indicate to the operator the results of the test.

Project Outcome

The Anticipated Best Outcome was achieved.

Figures

Fig.1: Automated Testing Equipment

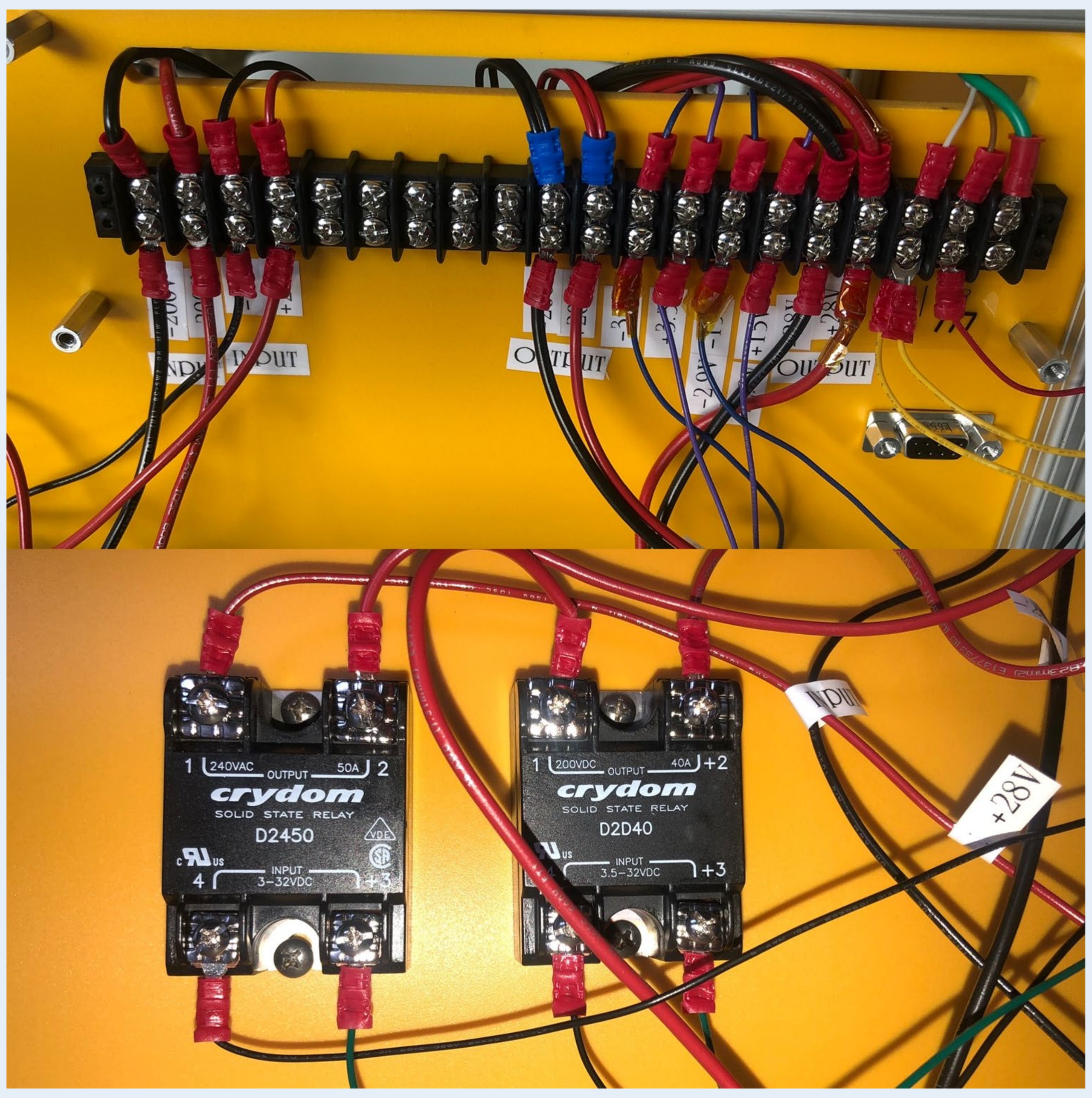

Fig.2: Wiring on DUT Enclosure