ELECOMP CAPSTONE SUMMIT
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THE UNIVERSITY OF RHODE ISLAND

THINK BIG WE DO℠

Portable Waveform Generator

AstroNova®
Bright ideas. Realized.

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Project Motivation

AstroNova is committed to supplying their clients with the most innovative test and measurement equipment on the market. To demonstrate the capability of such equipment, a handheld Waveform Generator is used; however the original design has become obsolete due to rapid growth in system capabilities. AstroNova commissioned a Portable Waveform Generator to be designed as a replacement for the current model. This waveform generator is able to demonstrate the full capability of the data acquisition systems that are manufactured by AstroNova. There is also a possibility that this product will be of interest to future shareholders due to its uniqueness. This has been kept in mind during the design process to ease the transition from an in-house product, to a product sold on the market.

Key Accomplishments

- **Optimal Component Selection:** The major components of the WG800 were selected to meet or exceed the requested specifications. These components consist of a display, an output connector, Digital to Analog Converters, Op-Amps, an FPGA, a Serial Peripheral Interface (SPI) flash memory, push buttons, a power switch, a USB port, a power connector, a JTAG connector, a battery pack, a voltage reference, DC-DC converters, and LDO regulators.

- **Printed Circuit Board Fabrication:** After the components were chosen, a schematic was generated. This schematic was reviewed by the team and used to generate the required PCB documents. These documents were sent to a PCB fabrication house where revision A of the board was fabricated (Figure 2). After obtaining our custom PCB in early February, there was a slight error. The footprint for our USB to UART chip was too small. This will be fixed on the next revision of the board; however, we can get around this temporarily by soldering a couple wires where the chip was supposed to be on the board. After connecting a USB to UART cable to these wires, the board operates as expected. All other functionality of the PCB was tested and verified.

- **Eight Hour Battery Life:** The prototype has been stress tested and initial results indicate that therequested battery life is achievable with the current hardware. Further battery degradation and charge loss testing will be conducted.

- **Dynamic User Interface:** The heart of the WG800 User Interface (as seen in Figures 1 & 2) is the New Haven 20 by 4 character LCD display with LED Backlight. The LCD display is controlled by six tactile buttons. The back side of the device includes a “D-Shell” 25 pin connectors for the outputs, a toggle style on-off switch, USB connector, and a DC Barrel for charging. All components are seated in an angled enclosure produced by OKW Enclosures. Finally, an overlay was placed over the top of the display area to complete the product. The overlay features the product name, AstroNova logo, and button labels.

- **Customizable Waveform Generation:** The final hardware and software together support Sinusoidal, Square, and Arbitrary waveform synthesis. Arbitrary waveforms are created by software algorithms and user uploaded files. All waveforms are customizable. Many waveform parameters can be customized by the user and modified extensively. The operational system can be seen in Figure 1.

- **Responsive and Efficient Fabric Implementation:** The final FPGA hardware implementation handles all I/O interpretation, power management, and waveform generation. The custom RTL blocks use a fast, lightweight communication protocol which reduces output update lag from the user’s perspective, and speeds up usage, while minimizing overall size.

- **Embedded Software:** Software development was completed for the MicroBlaze (MB) using C. The software allows the user to easily navigate through the menus and control the device. The software also includes the interpretation of host commands and queries from a PC. These commands include fine frequency adjustment, fine amplitude adjustment, bank control, waveform ID adjustment, phase control, voltage offset control, high voltage control, low voltage control, and status requests. Lastly, the MB uses the onboard memory that is used to configure the FPGA to store data. Overall, the MB software is a success.

- **Intuitive PC Application:** This application is based on a Windows Form Application, and is being completed using Microsoft Visual Studios using visual C#. The PC application is responsible for fine tuning of parameters. The final UI of the PC App is shown to the right. (Figure 3) The PC App is near completion, with room for future development.

Anticipated Best Outcome

Team AstroNova developed a new portable waveform generator that can be used as a direct replacement for the older model. Our new and improved WG800 features a sleek updated design along with an easy to operate user interface. We set out to create a PC application that allows the user to have advanced control over the WG800 and the ability to program arbitrary waveforms into onboard memory to be recalled later. The updates and improvements to the product will offer new capabilities that will make it even more useful than the last.

Project Outcome

The Anticipated Best Outcome was achieved: A replacement Portable Waveform Generator with an updated design and a PC Application.

Figures

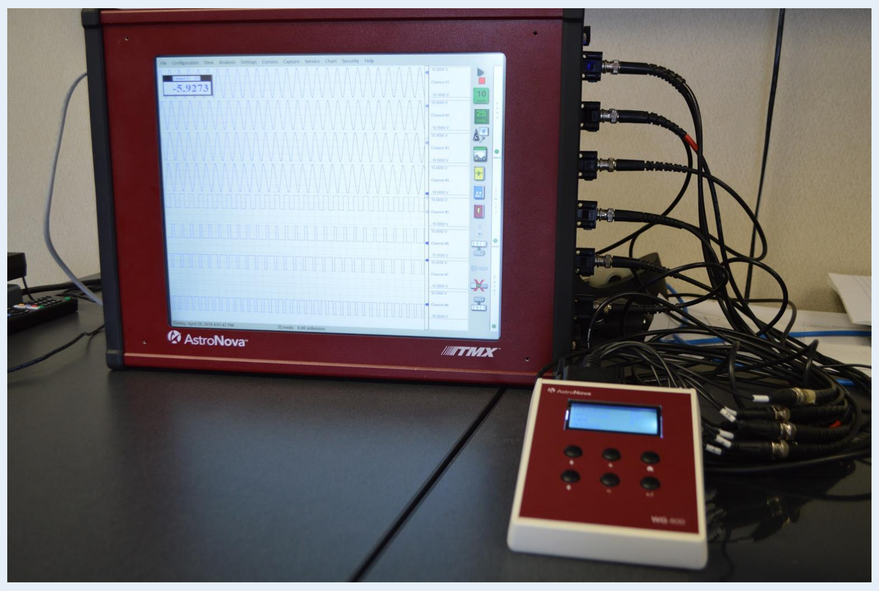

Figure 1: A Practical application of the WG-800; demonstrating the capabilities of the AstroNova’s TMX. This is how the WG800 will be used by AstroNova’s sales representatives at trade shows.

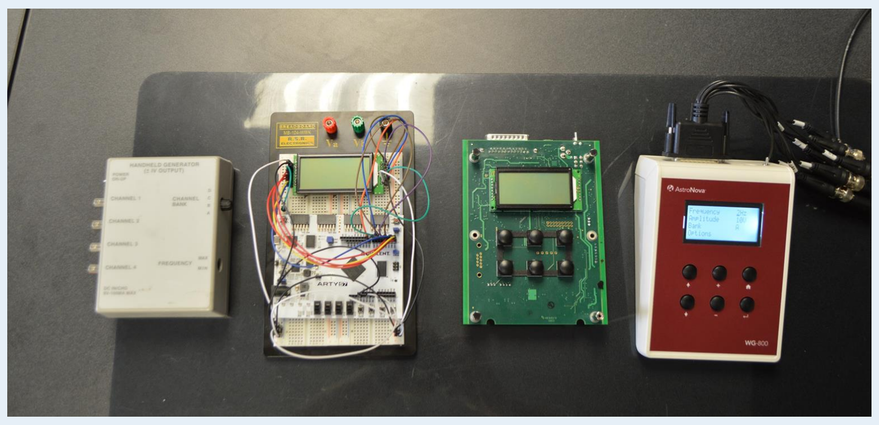

Figure 2: The progression of the Portable Waveform Generator. From left to right, the obsolete portable waveform generator, proof-of-concept board, WG800 rev A, and final prototype.

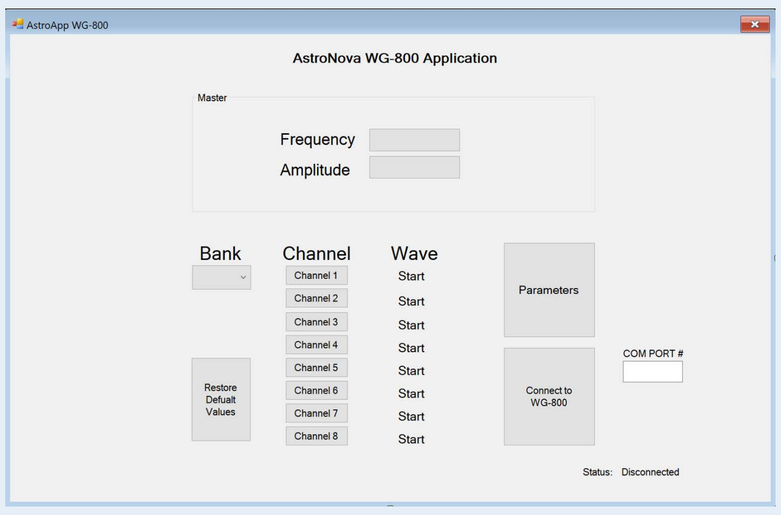

Figure 3: PC Application: Final User Interface

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