

Executive Summary

The Problem:

Benchtop oscilloscopes are bulky, lack multiple channel inputs, and are limited in portability.

The Solution:

Design a portable 4-channel, 8-hour battery life oscilloscope capable of testing various electronic devices.

Design Specifications:

The project must be able to **input $\pm 30V$** , last **8 hours**, and **store data** in an **SD card**.

Background

- The UTA EE lab oscilloscopes require you to be present in the lab to test your device. There are times when you may need to test a device which cannot be brought into the lab for various reasons such as size, weight, hazards, etc. However, this should not limit you from being able to test your device.



Figure 1. Comparison between Handheld Oscilloscope (Left) and a Benchtop Oscilloscope (Right)

Experimental Setup

The project aims to achieve a 4-channel oscilloscope with an 8-hour battery life capable of measuring at least $\pm 10V$. Currently our main systems consist of an analog front end (AFE), controller unit (MCU/FPGA), and a display output for the user.

The AFE has been custom designed to fit the requirements of the project listed in Table 1. All the parameters listed in the table are decided by the AFE, therefore extreme care must be taken to achieve and keep these specifications. Alternatively, if the user wishes to tweak values it can be done so through the AFE.

Table 1. Oscilloscope Design Parameters

Header	Header	Header
1	Bandwidth	25 MHz
2	Sampling Rate	125 MSPS
3	Vertical Resolution	12 bits
4	Input Impedance	1M Ω

Experimental Test Plan

- Our project samples at a rate of 125MSPS, allowing for a bandwidth of up to 25 MHz, just half of the bandwidth of the bench top oscilloscopes found in UTA EE labs. Additionally, the resolution is greater in our design which gives the user 12-bit ADCs to capture data with greater detail than the standard 10-bit lab oscilloscope. Furthermore, the two attenuation stages allow for the user to increase attenuation in 1-2-5 steps, granting a wide input range.
- To process the inputs, a Microcontroller Unit (MCU) or Field-Programmable Gate Array (FPGA) must be used. Our design makes use of the STM32F407G-DISC1 MCU and DE10-Lite Pro FPGA to handle the streams of data produced by the AFE. These devices work together to distribute workload such as the FPGA primarily handling the ADC outputs while the MCU controls the electronic switching, and UI.
- This data is then displayed as an output through a screen. Additionally, an arbitrary waveform generator (AWG) is integrated into the project that allows the user to probe devices and measure their response to the generated waveform if needed.

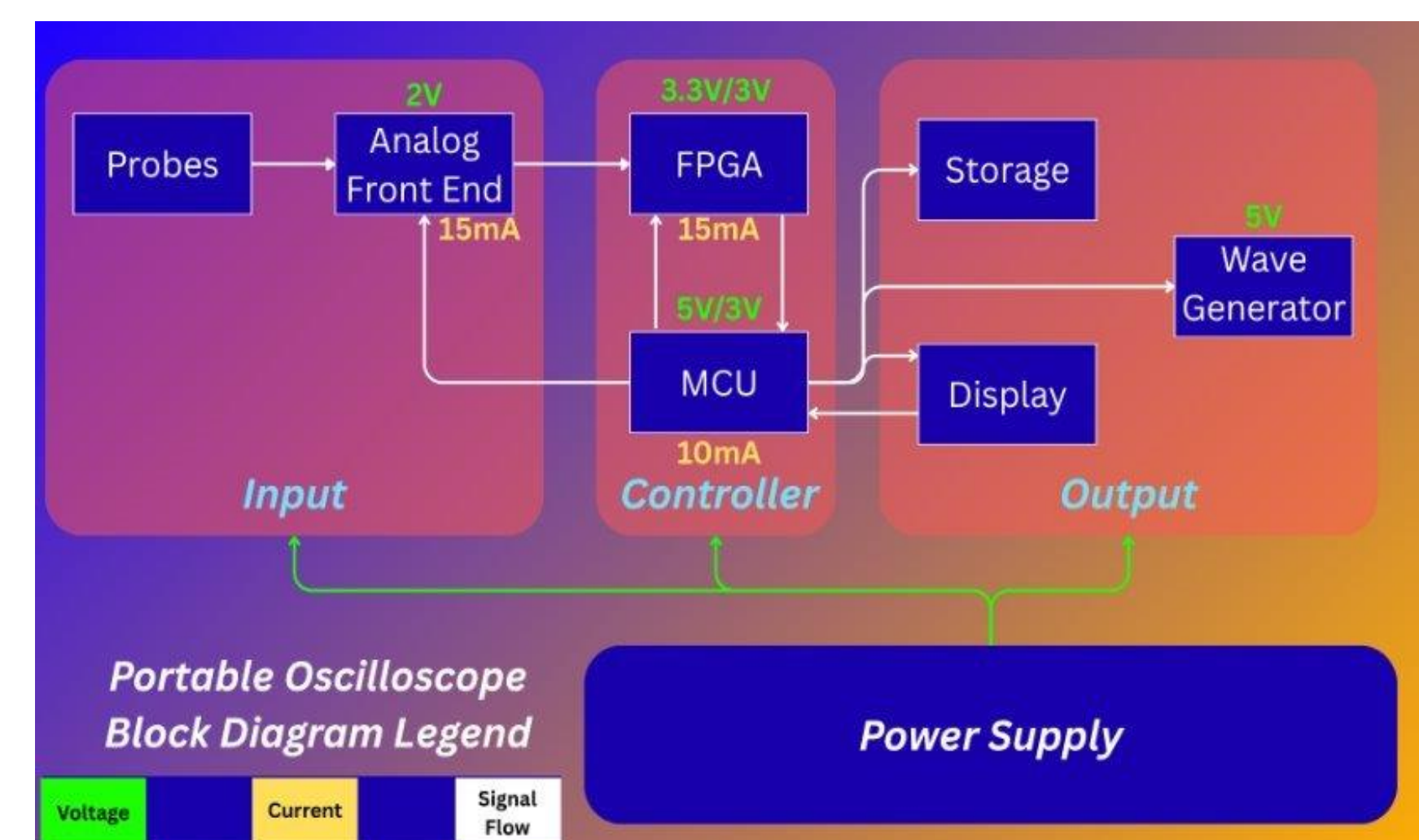


Figure 3. Oscilloscope Block Diagram

Experimental Results

- Simulations and schematics have been drawn up to tackle the design goals. In Figure 2, a Fusion schematic of the AFE is shown which displays the approach taken to reach Hi-Z impedance and withstand over a $\pm 30V$ input.

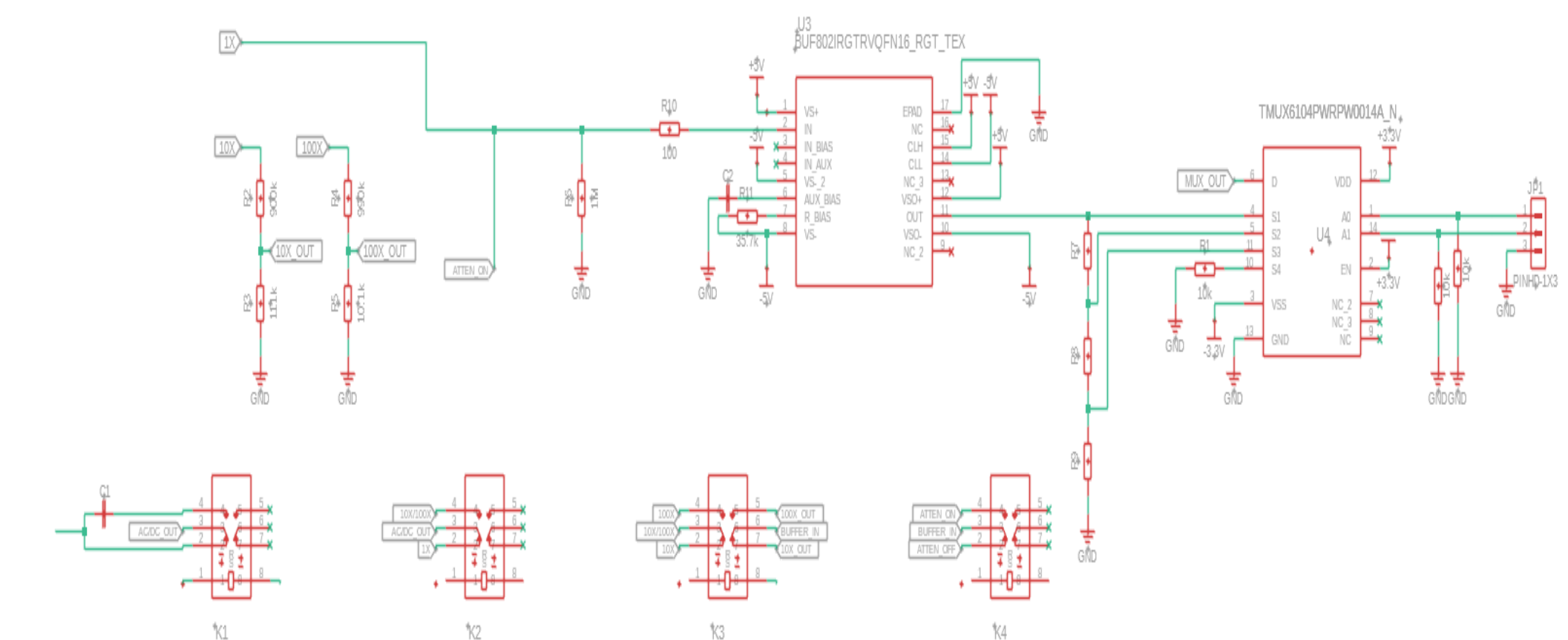


Figure 2. AFE Fusion Schematic

Conclusions

- Thus far, certain parameters such as the input range and the data storage have been achieved. The AFE takes care of the input range due to the set up shown in Figure 2 while the data storage is handled by a built-in SD card receptacle found in the display under possession by one of our members.
- Progress has to be made on the 8-hour benchmark as this device can prove to be very power hungry given the electronically controlled nature of this device. Despite this, efforts are being made to improve battery capacity by utilizing the power efficiently and expanding our storage through additionally battery cells.

References

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- Texas Instruments, "50-Ohm 2-GHz Oscilloscope Front-end Reference Design," https://www.ti.com/lit/ug/tiduba4/tiduba4.pdf?ts=1775089925753&ref_url=https%253A%252F%252Feducduckgo.com%252F
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