Portable User-Friendly Oscilloscope
Project Summary

Group 003-2
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For this project, we set out to design a feature-rich, yet easy to use two-channel oscilloscope. Our main goals were making the system compatible with standard oscilloscope probes, reaching a sampling rate over 1 MHz, and allowing users to adjust parameters commonly found on commercial units, such as trigger level, voltage scaling, and time scaling. We also wanted to incorporate AC and DC coupling modes and allow the system to operate safely when powered with input voltages between 10 and 30 volts. As our vision for the project evolved throughout the development process, we eventually added additional features such as a run/stop option and selectable trigger channel.

Initial phases of the design process focused on attaining the high sampling rate, as we determined this would likely be our most difficult task. The Teensy 4.1 development board proved to be an excellent choice because of its ADC sampling rate, processor clock speed, and high RAM capacity. By using direct memory access, we managed to achieve a sampling rate around 1.18 MHz on both input channels simultaneously.

To maintain accuracy in our oscilloscope, we invested significant time into designing the analog input circuitry and display output. Multiple circuit layouts were explored and simulated to find the best design for biasing and scaling input from the probes to the Teensy ADCs. The final design that we settled on allowed us to accept a wide range of input voltages and accurately convert readings from the ADC into millivolts. Developing the display programming was also time intensive but crucial to correctly showing the input across various divisions while the voltage and time axes were adjusted. The initial design achieved this, but the resulting voltage and time divisions were seemingly random values. We eventually adapted the code to display output with more proportional and even division values, which also made it easier to test the system accuracy against a laboratory oscilloscope.

Planning ahead to manage our time and foresee potential obstacles ended up being a key takeaway from this project. Identifying the sampling rate as a central challenge early on helped us avoid related issues later in the development process. Figuring out how to best divide the system into blocks also allowed us to meet our deadlines and easily combine our individual blocks for system integration. We managed to get the oscilloscope functioning on day one of system integration, which allowed us to focus our efforts on testing and improving the system during the final stages of the project.

Project Timeline

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
Team		Project Brainstorming	System Block Diagram	Block 1		Block 2		System Integration	Final System Check-Off
Cole Miller			Initial System Research	User Interface Control Processing Block		Graphical Output to Display Block		Enclosure Design & Assembly	
Connor Moyce			Input Circuitry Design & Simulations	Signal Processing Block (ADC Input)		Signal Bias & Scaling Block, PCB Design		Code Integration & System Testing	