PenGUI

Vertical-Cavity Surface-Emitting Laser Development Kit

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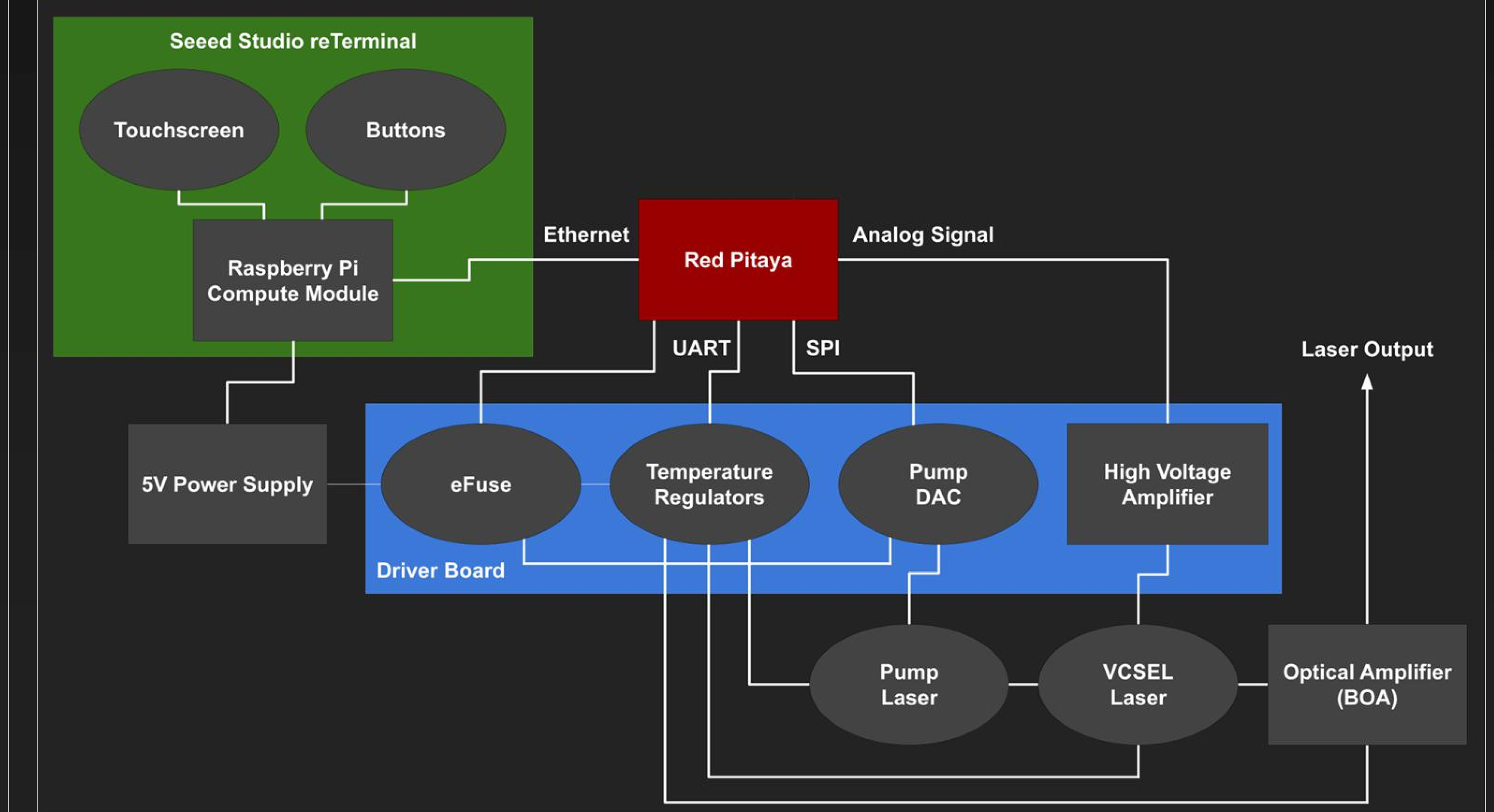
Overview

PenGUI's mission is to provide a user friendly, fully offline, and relatively affordable solution to fully tune and control Praevium Research, Inc.'s VCSEL Laser Development Kit.

The Praevium VCSEL Laser is driven by a Red Pitaya backend. Our Python based touch screen GUI runs on a Seeed Studio reTerminal, which contains a Rapsberry Pi Compute Module,, and delivers commands and data packets via an Ethernet cable directly to the Red Pitaya. Both the front and backend hardware modules are power efficient, requiring only a 5V power supply to maintain operation.

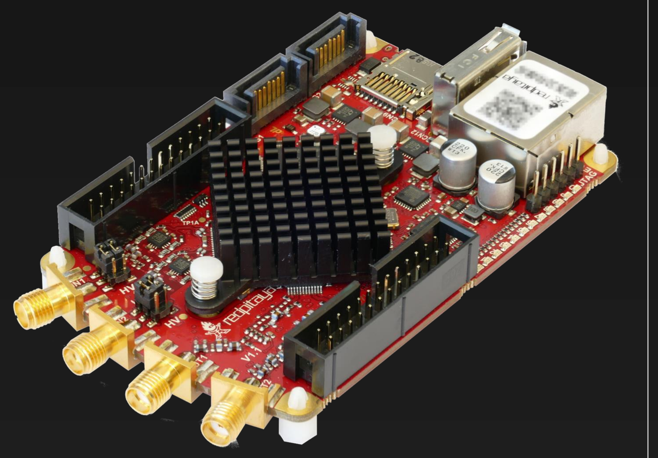
To demonstrate the Laser Development Kit's capabilities, we implemented several application demos, including basic laser tuning, gas spectroscopy, and fiber optic shape sensing.

Block Diagram

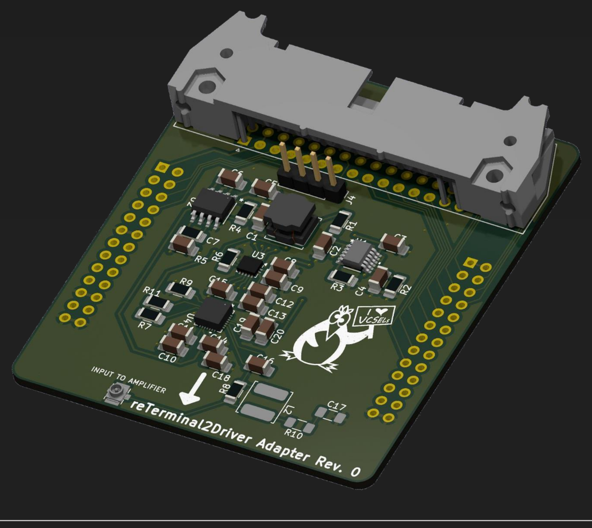


Key Components

Red Pitaya— Main backend module controlling Dev. Kit Laser. Contains an onboard FPGA to be replaced with a custom PCB.



Custom PCB – Replaces the Red Pitaya using GPIO from reTerminal and a DAC to generate low frequency input signals, saving $300+ from DevKit costs.



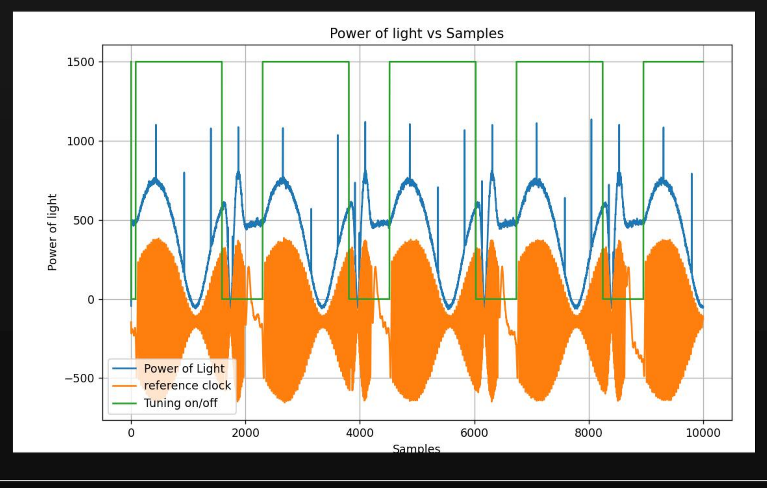
Application Demos

Laser Based Research

Praevium's tunable laser allows for wide varieties of research. The GUI allows for laser voltage and current tuning, waveform generation and temperature change.

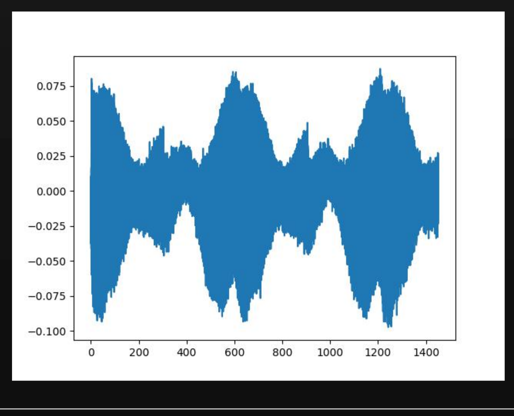
Gas Spectroscopy

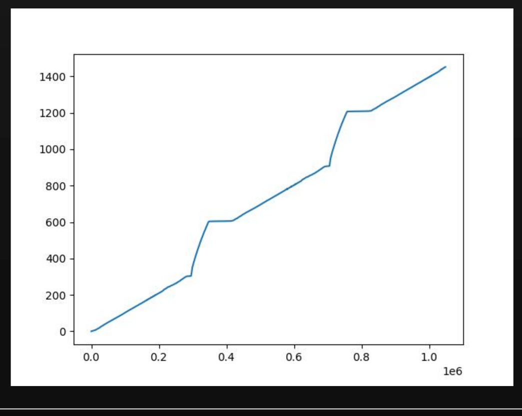
Detection of gas through monitoring wavelengths. By continuously varying the wavelength of the laser and firing it through a gas, we can observe which wavelengths were absorbed in the resulting data acquired on the Red Pitaya from a photodetector. The gas in the chamber can be identified using by comparing with a reference clock. The following image shows the absorbed frequencies as spikes in the blue signal.

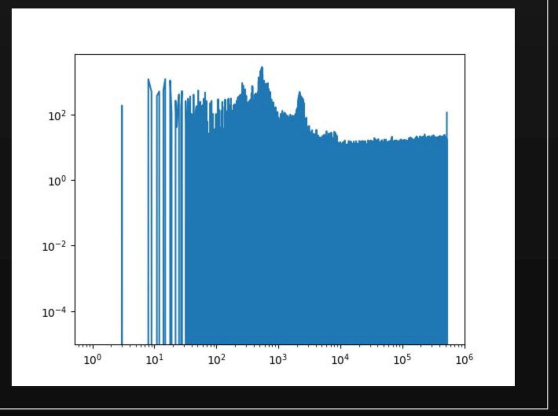


Fiber Optic Shape Sensing

A novel technology that utilizes FBGs (Fiber Bragg Gratings) to detect changes in the Bragg wavelength, and predict the changes in the shape of the fiber optic cable. Currently in active development for a NASA project that focuses on detecting the strain on a spacecraft shuttle wing. The 3 images below show the raw signal data, the unwrapped clock phase data, and the final processed FFT results. The raw data is resampled using the clock data as a reference, gaussian smoothed and then run through an FFT . We were able to perform all operations including a 1 million point FFTs in real time, and render the final FFT results on screen at a 60 FPS by utilizing the GPU.

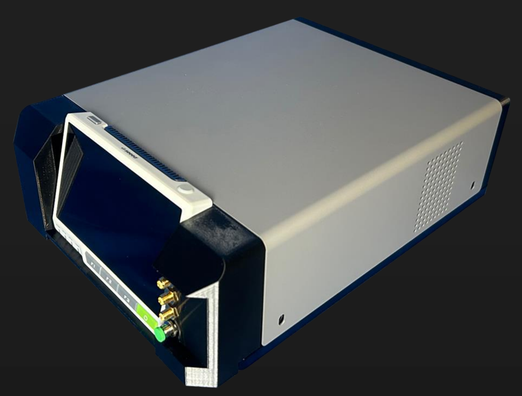






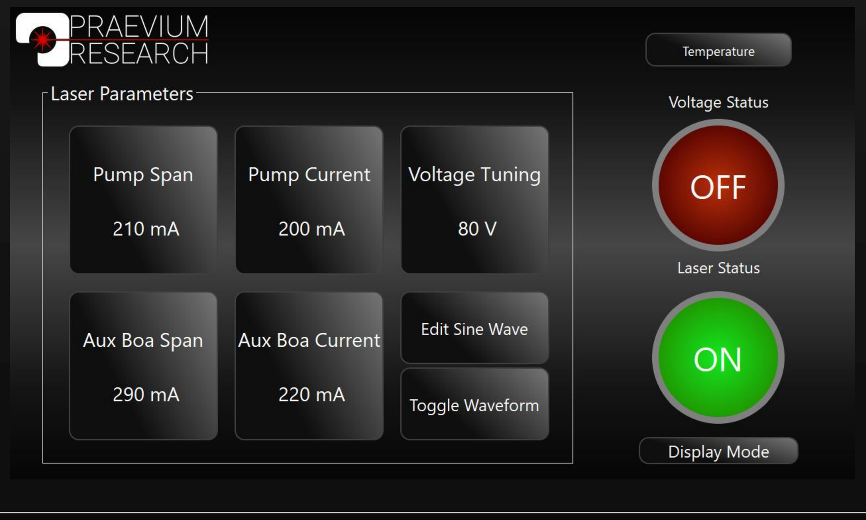
Final Product

Development Kit Exterior



Development Kit Interior

Main GUI Window



Waveform Generator Window

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