

Design of a Reconfigurable (Software Defined) Radio

Senior Design II - Fall 2024

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Objective

Develop a modular, reconfigurable SDR platform to support future student projects.

Key Functionality

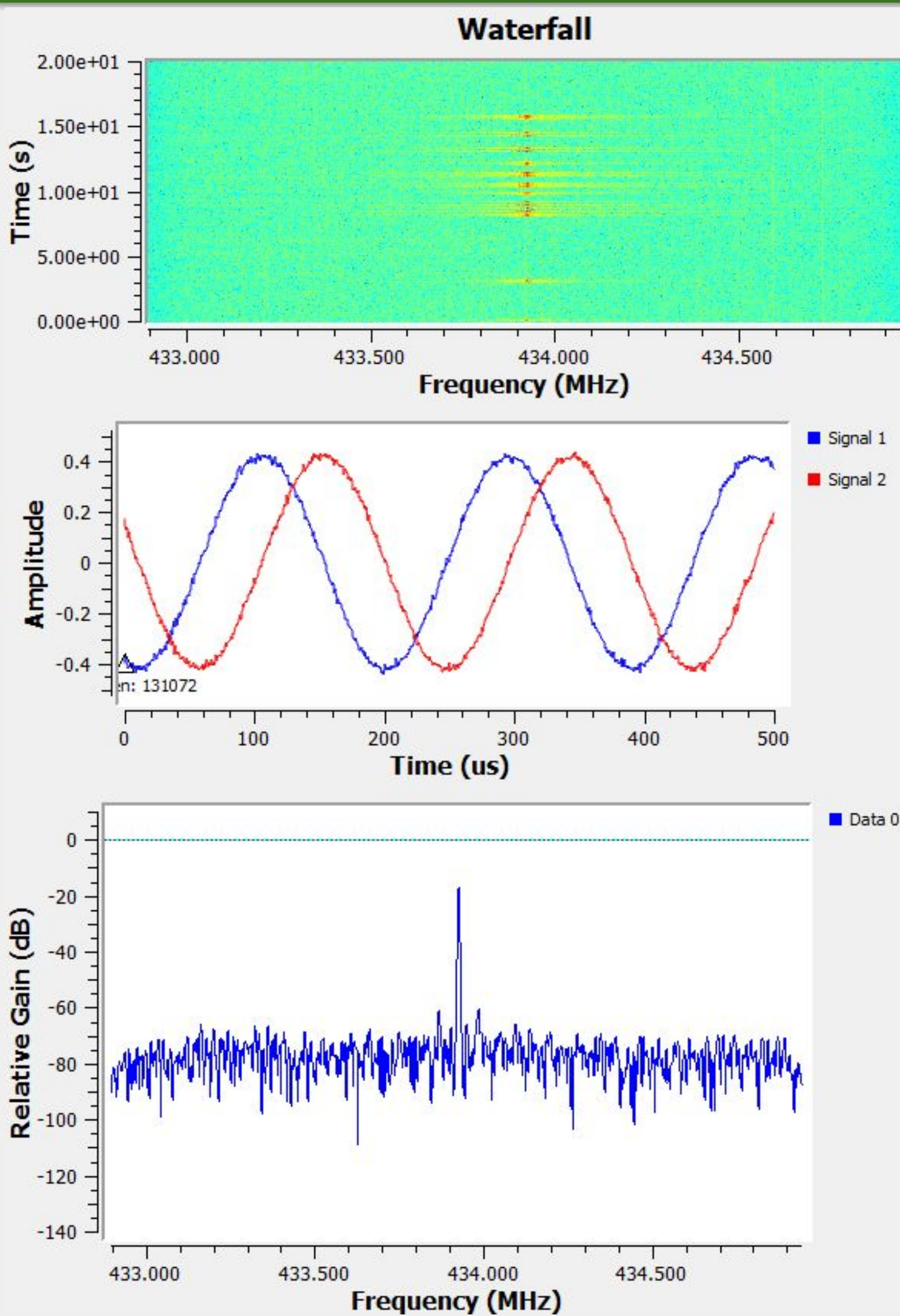
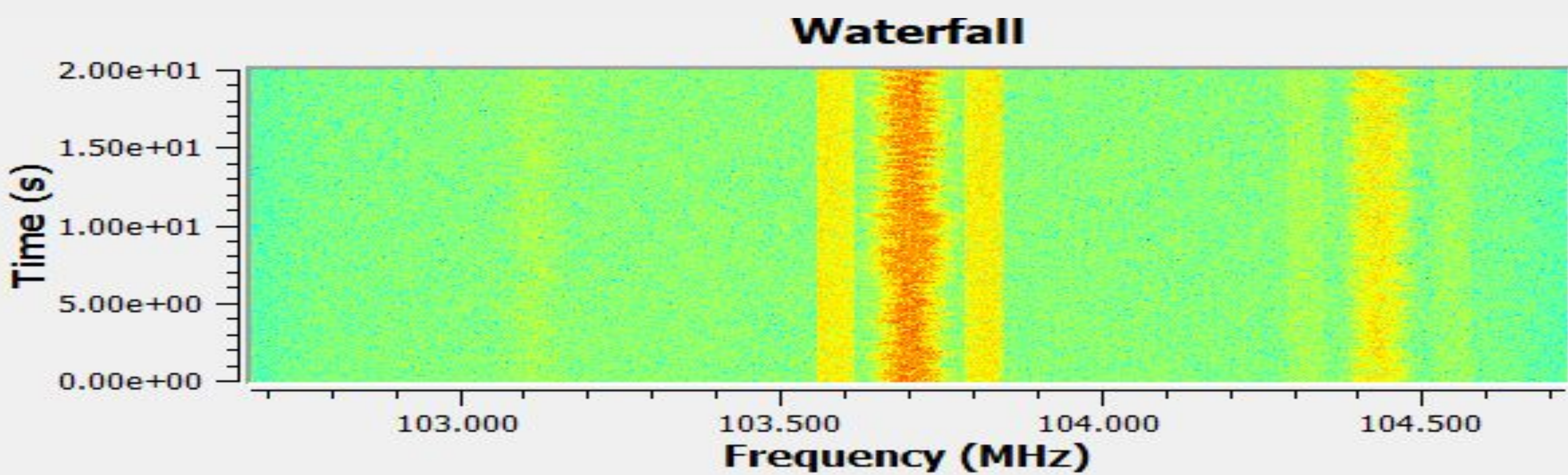
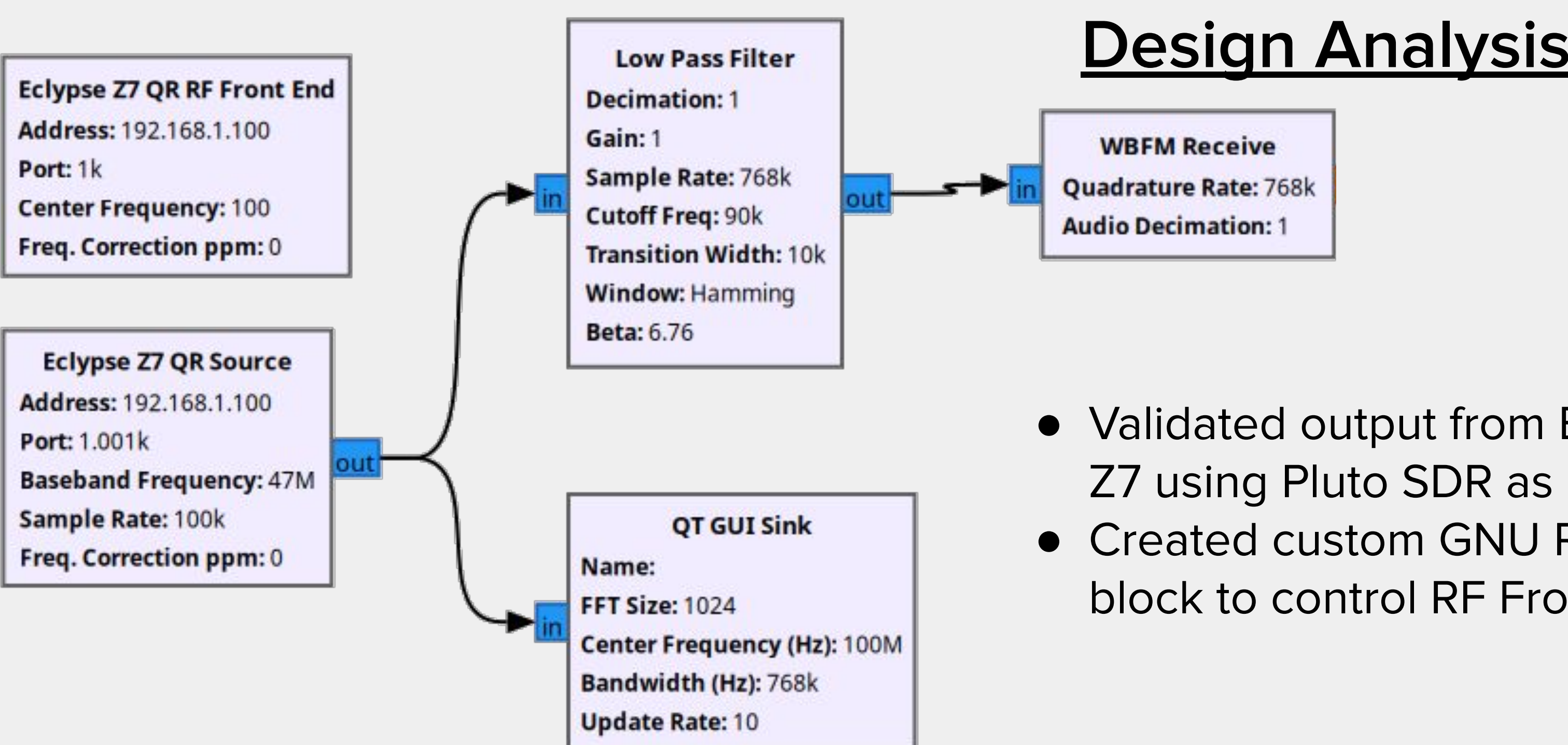
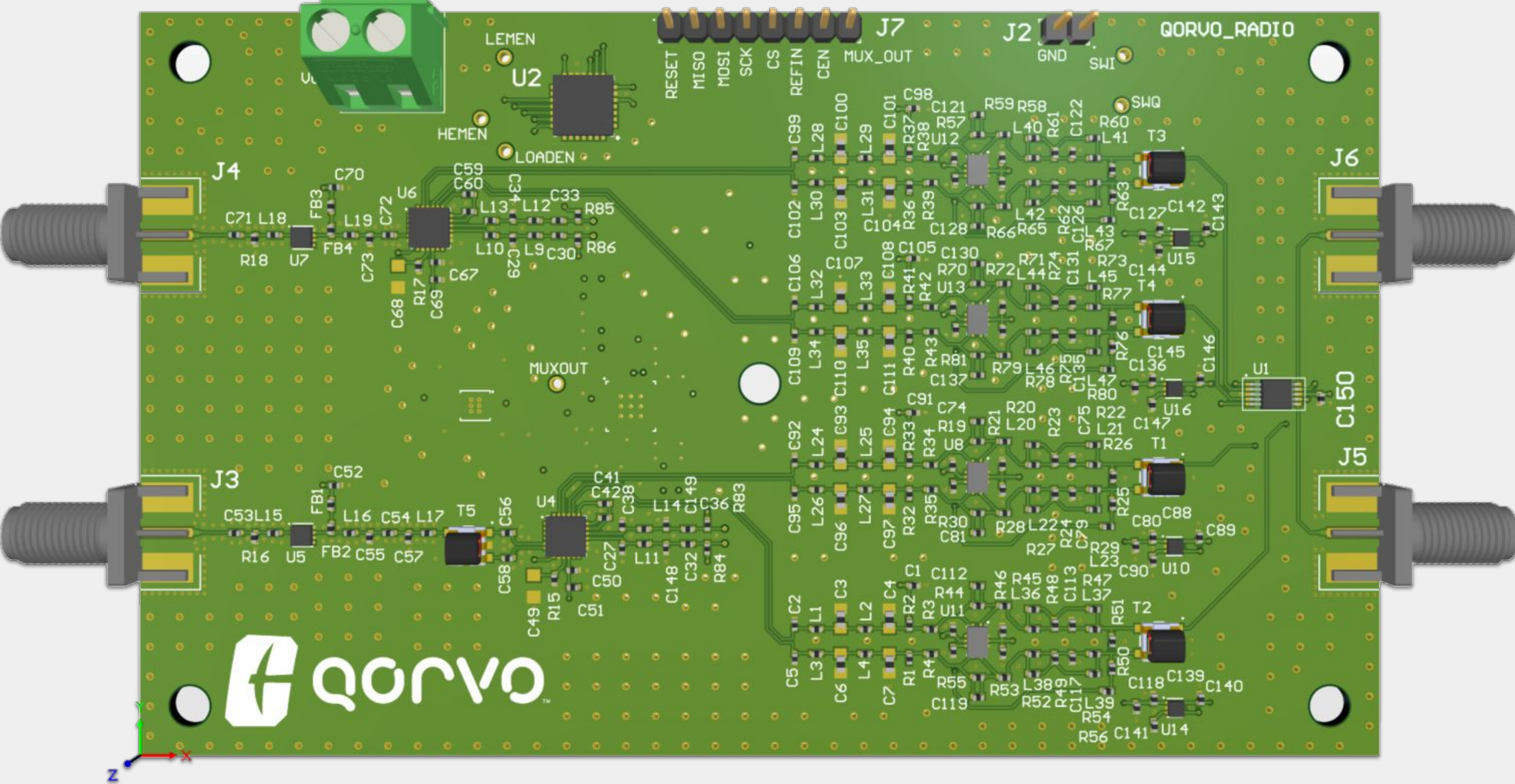
- Enable simultaneous testing of multiple RF modules
- 50-4000 MHz
- Dual Rx receive channels
- USB-based hardware-software interaction.

PCB Design Considerations

- **Layout:** Dual Rx paths for high and low frequency bands to optimize signal processing.
- **PCB:** Isolated RF paths reduce noise and signal attenuation.
- **Mixers and LO:** Direct conversion architecture with a single LO controlling both quadrature signal chains.
- **Filtering:** 50 MHz low-pass filters for differential amplifier.
- **Signal Chain:** Analysis ensures signal integrity and clarity before conversion.

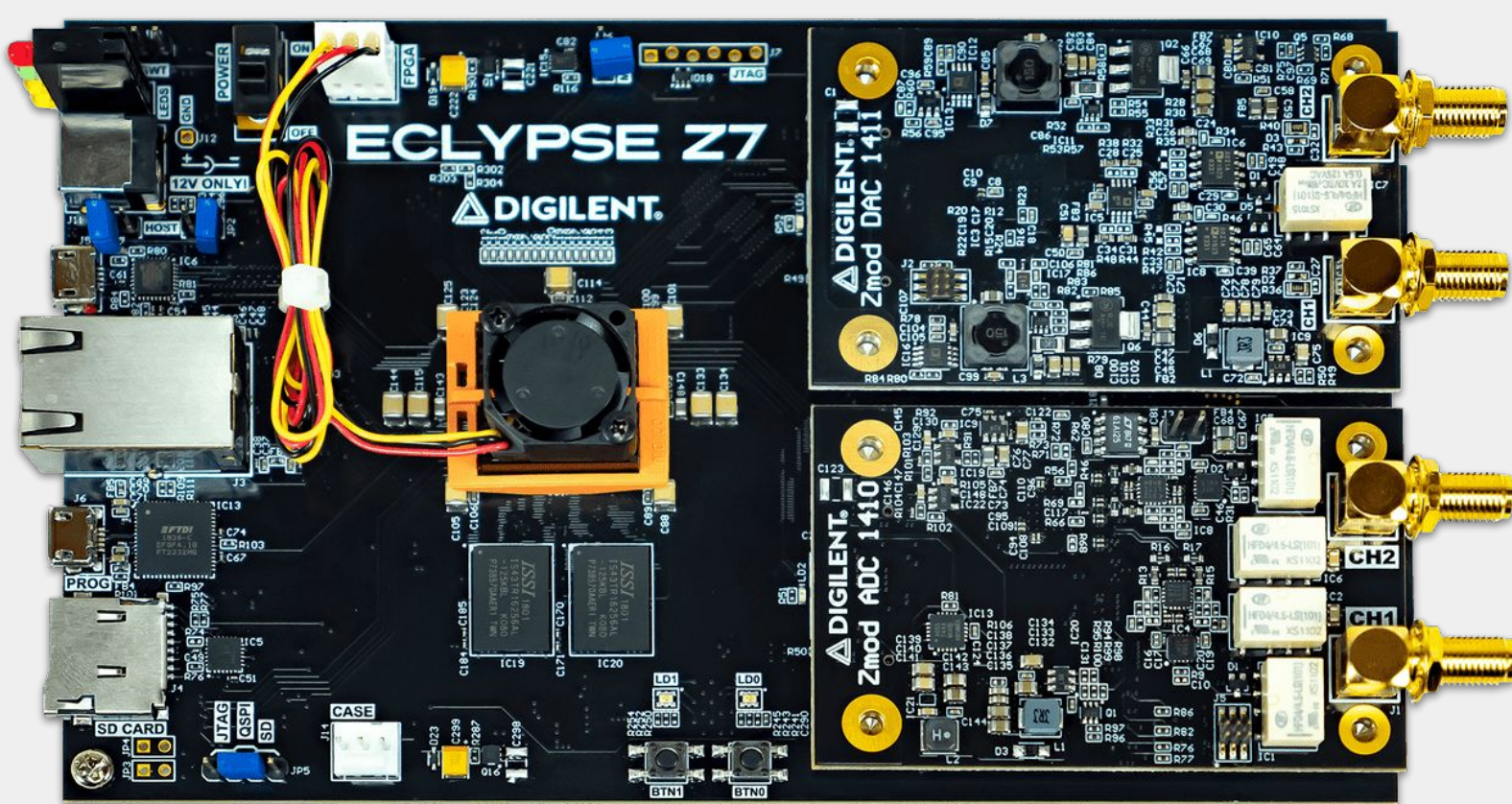
3D Model of Custom RF Front-End PCB

Built as a modular, student-driven SDR platform supporting dual-band RF reception and FPGA-based control.



FPGA and Control System Integration

- Dynamic reconfiguration support.
- GNU Radio for user-defined control.
- Stable high-quality RF performance.
- Low-latency communication.
- Modular design for hardware enhancement.
- 14-bit Resolution
- 125 MSPS sampling rate
- 70 MHz Bandwidth (per channel)



RPD-60A Power Supply

- Purchased RPD-60A medical-grade power supply (5V, 12V, 50W, 100 kHz).
- 12V will be used in the next phase for transceiving

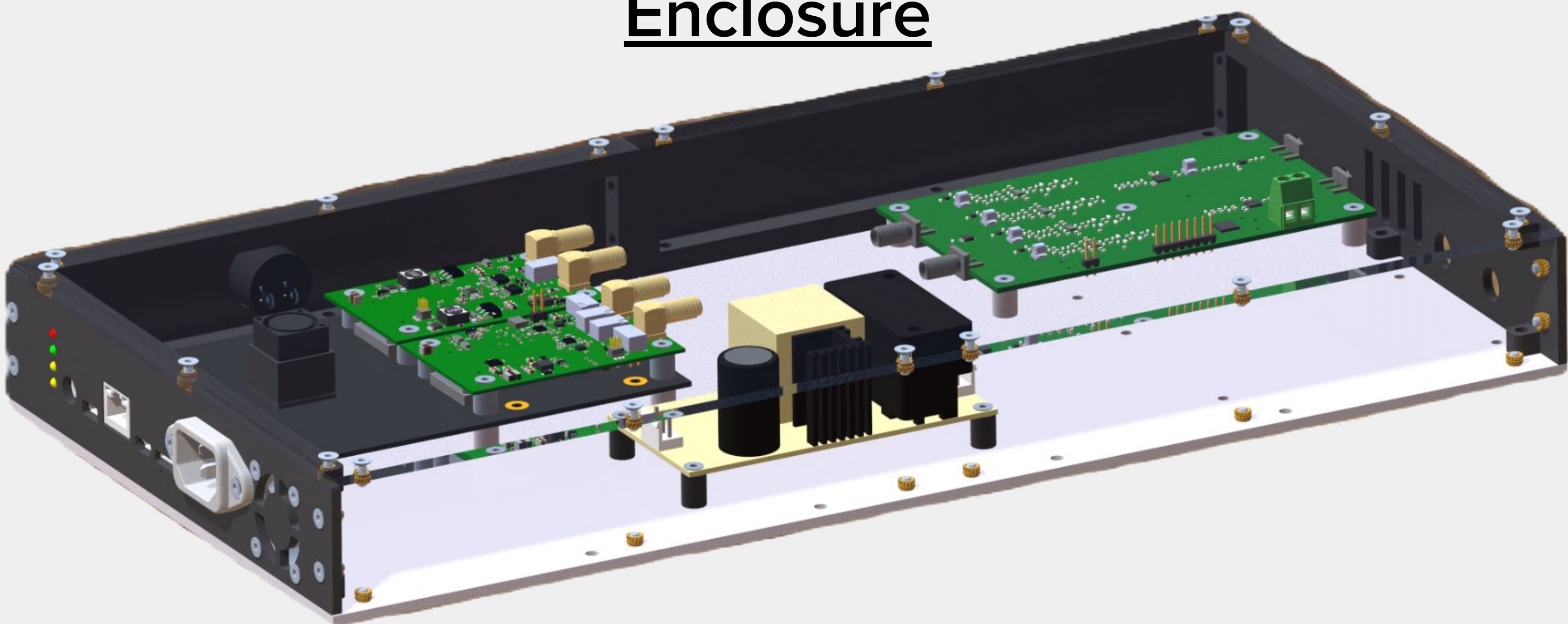


Contingency Plan

- Covers 70 MHz–6 GHz
- Operated using GNU Radio.
- Cost-effective, reliable, easy to integrate
- Passed FM radio stress test (1 hour)
- Single Rx Path

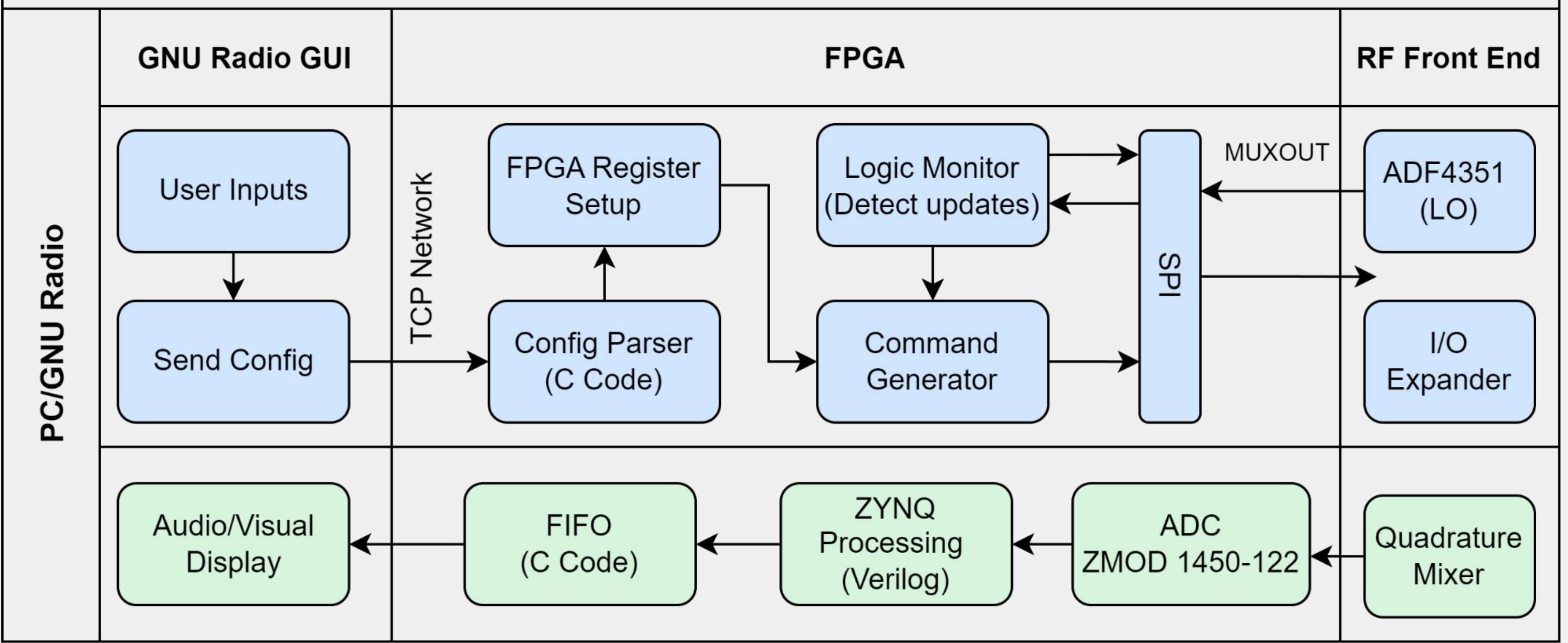


Enclosure



- Server rack size
- Aluminum base
- 3D Printed Walls
- Threaded inserts
- Integrated user interface
- Clear lid for observation

System Overview



Future Usage

- Function as an interactive platform for hands-on RF education.
- Enable easy customization for future student-led enhancements.
- Broaden RF research opportunities and experiential learning at UNC Charlotte.



GitHub