

Time Domain Reflectometry (TDR) Based Cable Fault Analyzer



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Background: Rescue 21 is the U.S. Coast Guard's (USCG) system for maritime search and rescue maintained by General Dynamics Mission Systems (GDMS). The program consists of coastal radio towers that locate vessels in distress by intercepting emergency radio transmissions. In 2025, Rescue 21 assisted with the rescue of 14,711 lives.

Problem: Damage occurs to tower communication cables connecting radio equipment to ground facilities. Technicians lack a portable device capable of identifying and locating faults.

Results: The cable fault analyzer is capable of resolving cable fault distance to a resolution of 22 feet and classifying known good and faulty cable/equipment conditions correctly 85% of the time. The prototype features custom-designed cable multiplexing, pulse generation, waveform capture/analysis software, and a graphical user interface (GUI).

Objective: Implement a portable TDR based fault analyzer capable of accurately classifying & determining distance to faults along cables up to 2,000 ft in length.

Approach:



Fig 1. Cable Damage

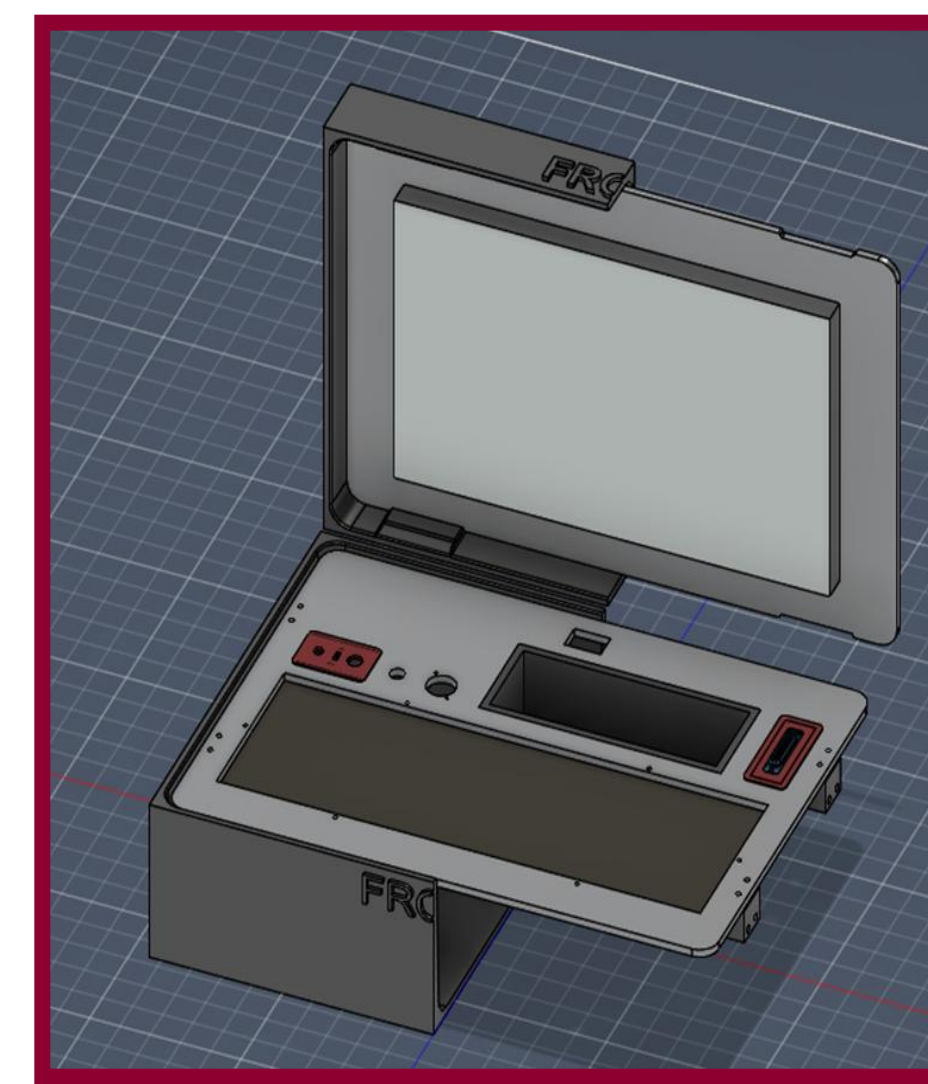


Fig 2. Prototype CAD Model

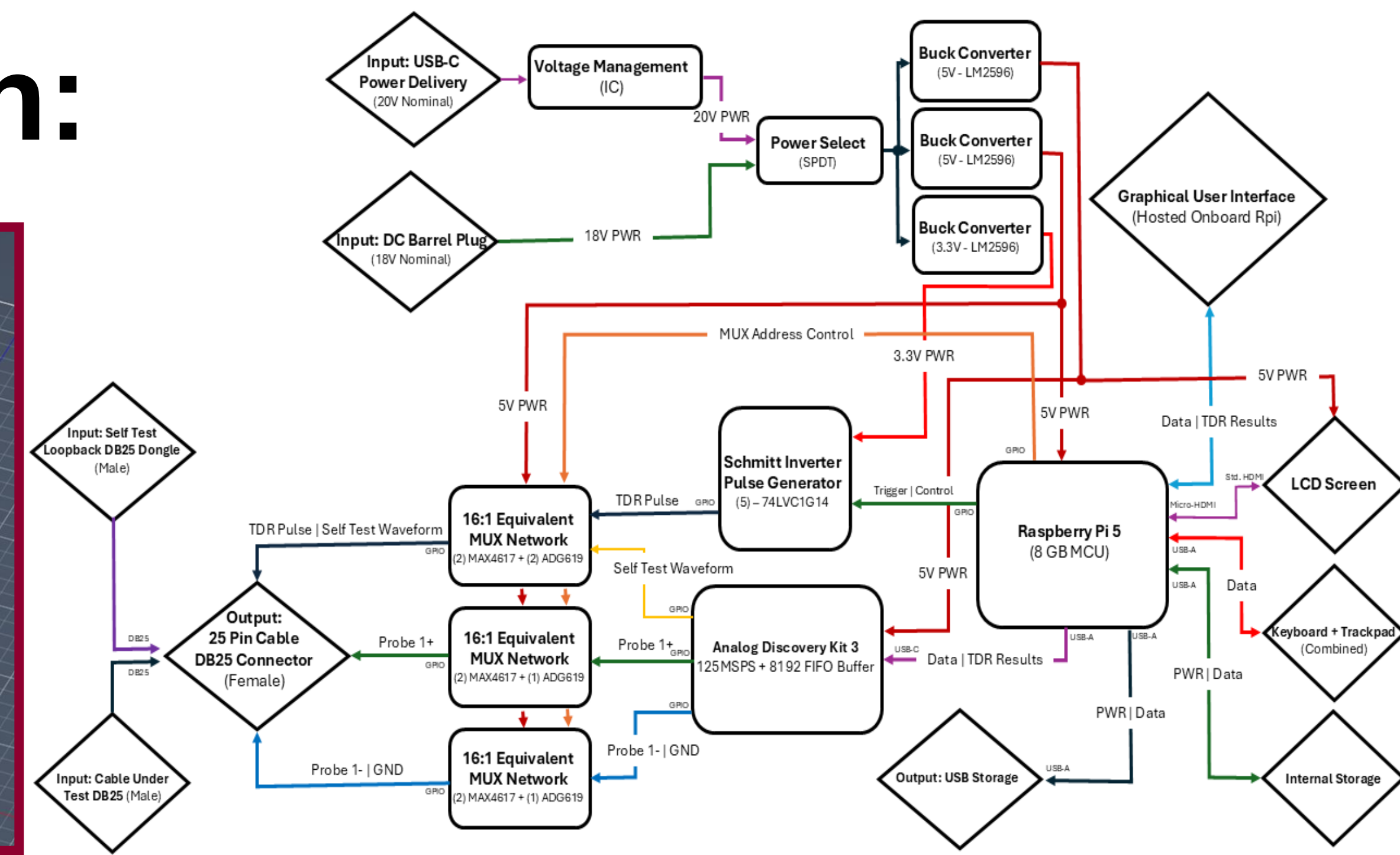


Fig 3. System Flowchart

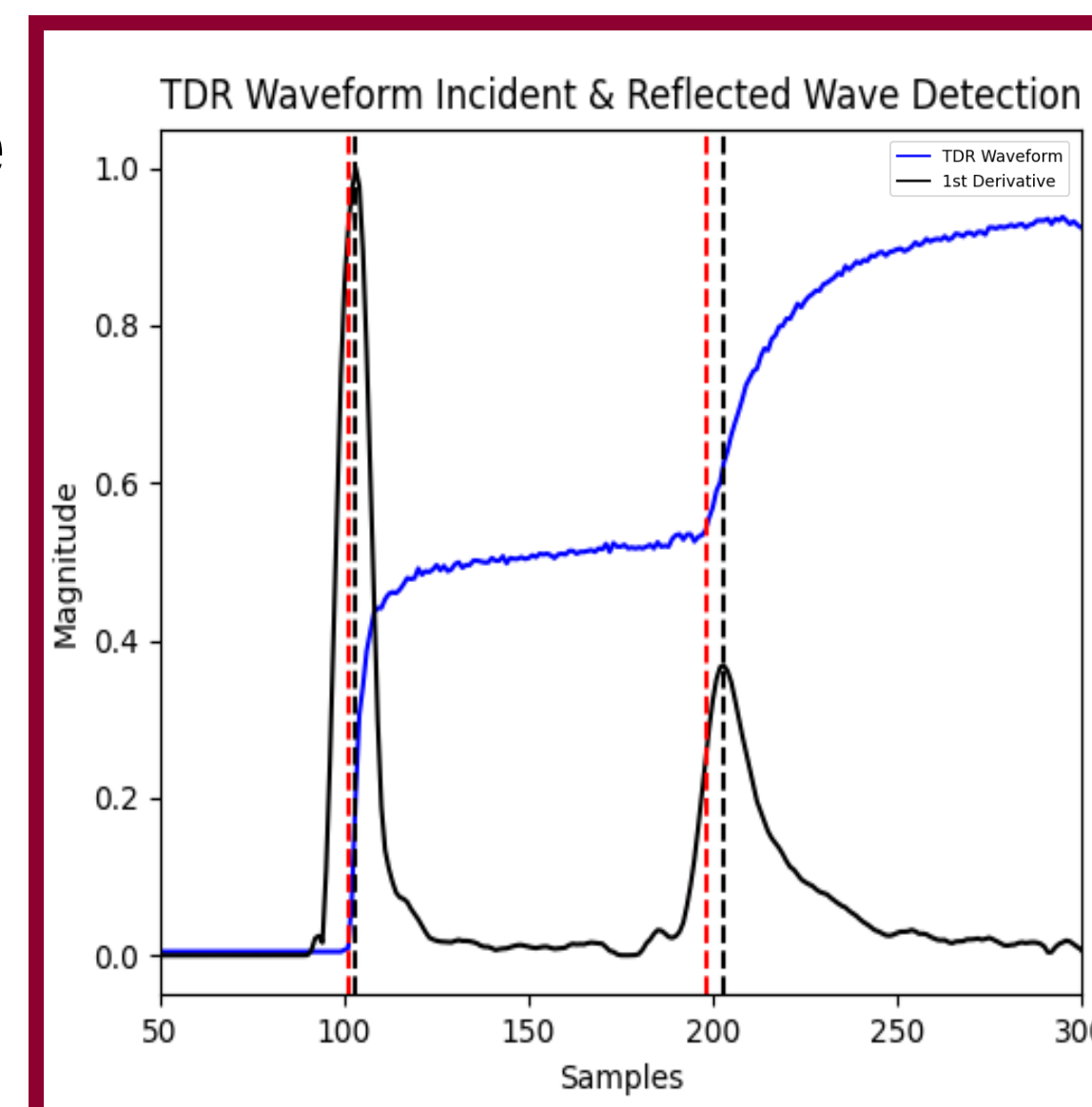


Fig 4. Incident & Reflected Wave Detection

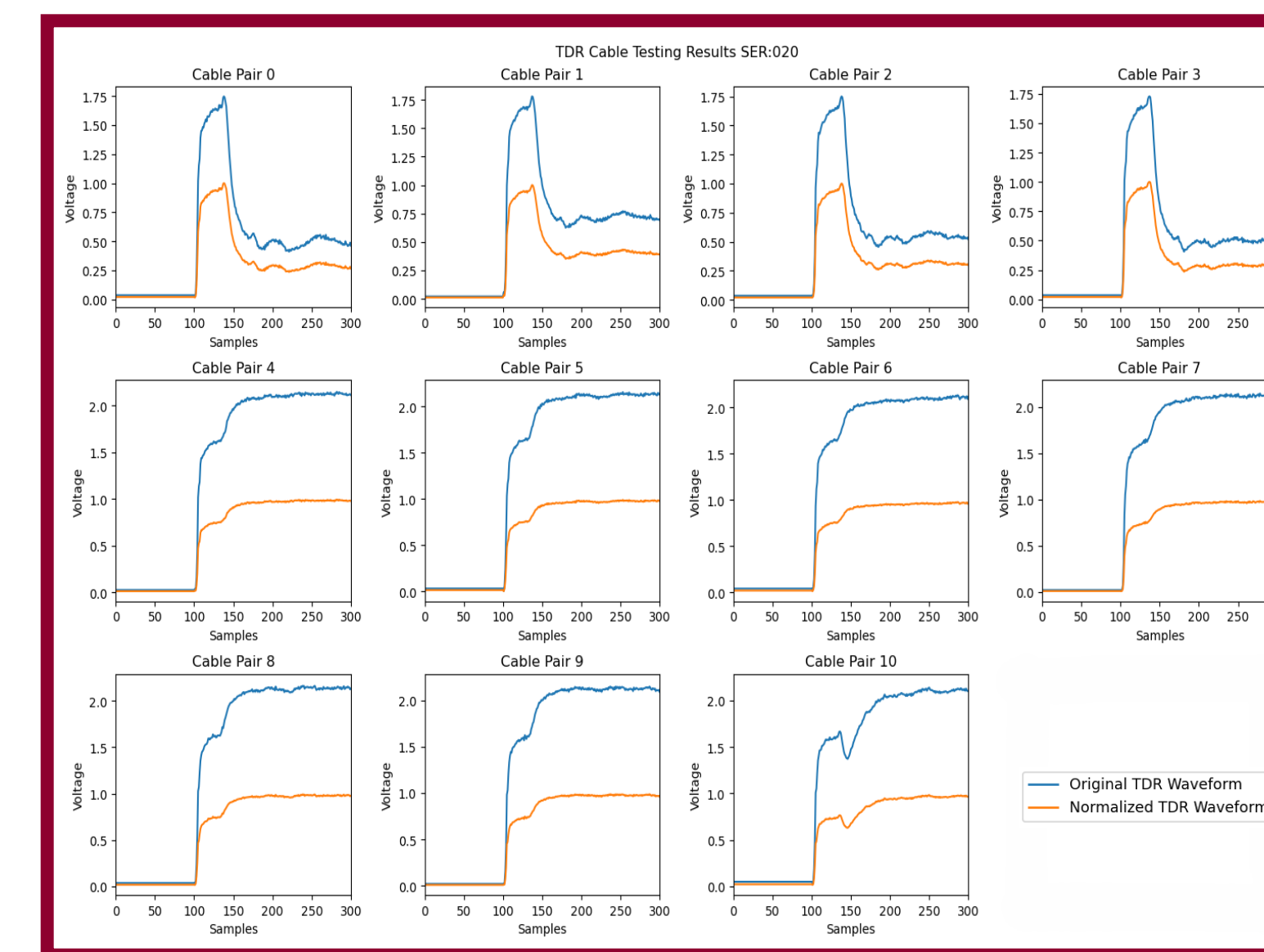


Fig 5. Twisted Pair Known Good Condition Capture

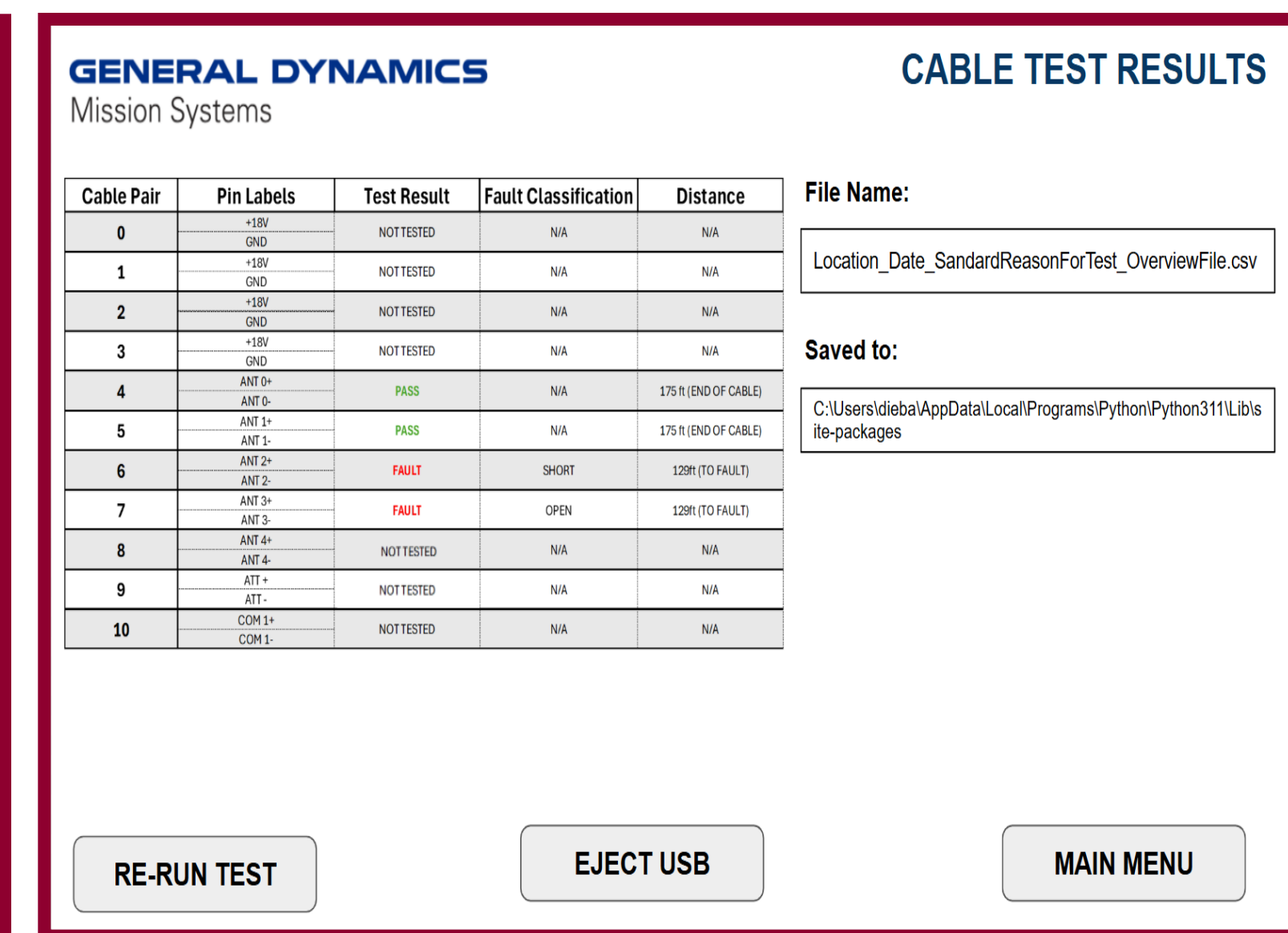


Fig 6. Graphical User Interface (GUI)