SVAD WSMR: Enhancing Testing Infrastructure for Aerospace and Defense Electronics

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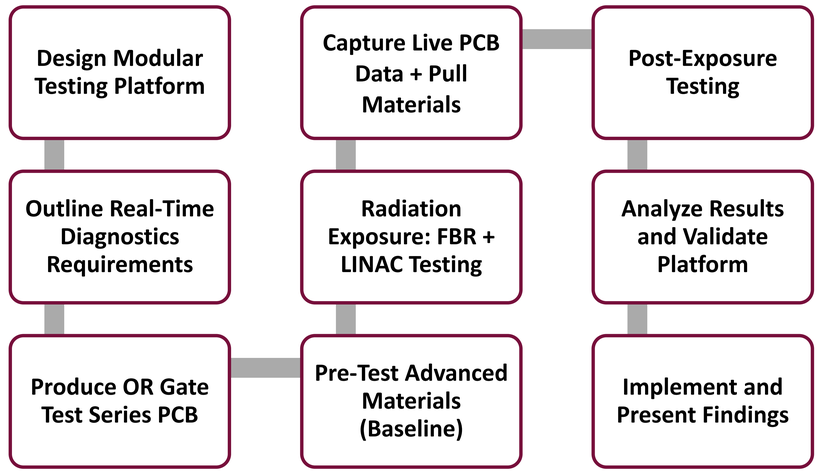
Mission

Ensuring the survival of mission-critical electronics in high-radiation environments is essential to defense and aerospace operations. The WSMR PCB Optimization Project supported SVAD at White Sands Missile Range by developing a modular testing platform, evaluating advanced materials for improved durability, and integrating real-time diagnostics to capture live performance data. These efforts modernized nuclear survivability testing workflows and improved the efficiency and reliability of component validation for national defense systems.

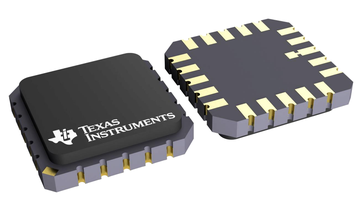
Research

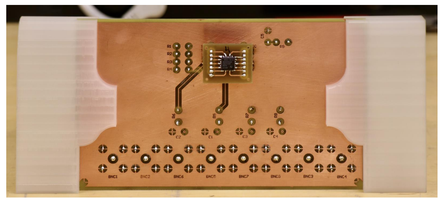
- **Validation Series for Testing:** A custom PCB featuring an OR gate chip was developed to establish a repeatable baseline for functional performance. This enabled verification of electrical behavior and ensured compatibility with the modular platform.
- **Modular Testing Architecture:** The platform supports swappable daughterboards and adaptable interfaces, allowing rapid reconfiguration for diverse test scenarios and improved throughput in hardware validation cycles.
- **Real-Time Diagnostics:** Integrated systems with fast data logging enabling fault detection, transient response tracking, and precision-driven performance analysis under stress.
- **Advanced Materials Integration:** High-performance materials to replace brittle components, ensuring durability in high-radiation and thermal environments.

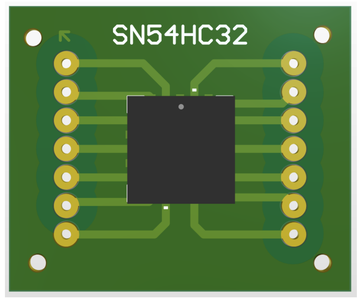
Methodology

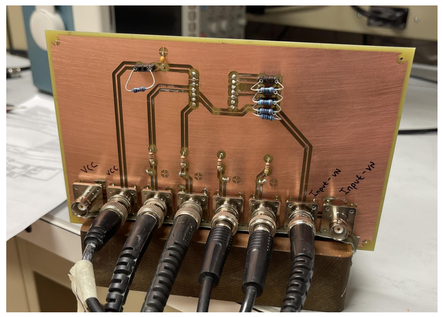


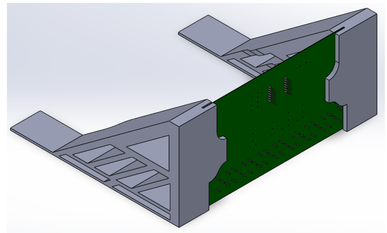
Design Solution

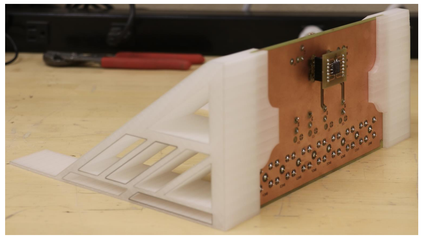




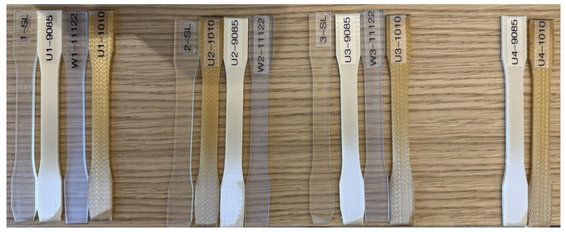


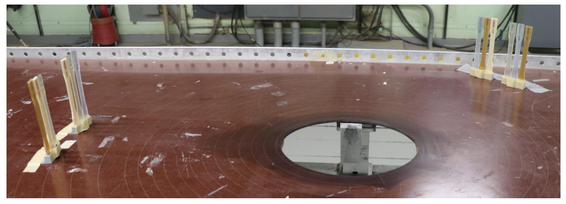


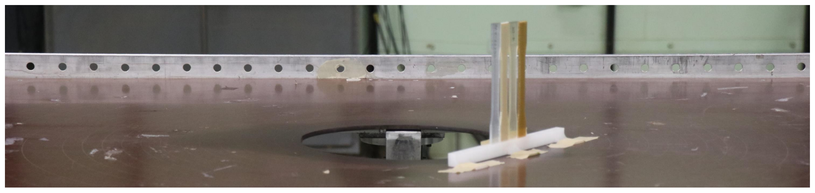




Materials Research







Results

- **Validation Testing Conducted in Radiation Environments:** The modular testing platform and custom PCB were exposed to controlled radiation conditions to assess performance in operational scenarios.
- **LINAC Tests:** Gamma Dose Rate (GDR) radiation pulse exposure testing was conducted. The Dose rate given met mission critical levels in which voltage and current measured during live testing provided insights into system responses and capabilities. The system demonstrated expected transient behavior and satisfactory tolerance to high radiation pulses.
- **Fast Burst Reactor (FBR) Tests:** Steady-state neutron fluence radiation exposure was simulated at various levels. Waveforms and voltage stability was recorded during live testing. The dose rate given met the mission critical level needed to certify the part. These results validate steady-state neutron fluence exposure.
- **Successful Signal Monitoring:** High-speed diagnostic tools were used to monitor electrical behavior during testing, confirming system responsiveness and data capture reliability.
- **Ongoing Material Evaluation:** Several advanced materials underwent mechanical stress and strain analysis.

References

[1] *Texas Instruments. SN74HC32 Quadruple 2-Input OR Gate Datasheet*, Rev. F, April 2021.
[2] Department of Defense. *MIL-STD-883: Test Method Standard for Microcircuits*, U.S. DoD, 2019
[3] *White Sands Test Center*. *Official Website*. U.S. Army, White Sands Missile Range. Available at: https://home.army.mil/wsmr/unitstenants/white-sands-test-center