

High-Reliability Uninterruptible Power Supply

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Approved for Public Release
Does Not Contain CUI.



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High Reliability Power Supply

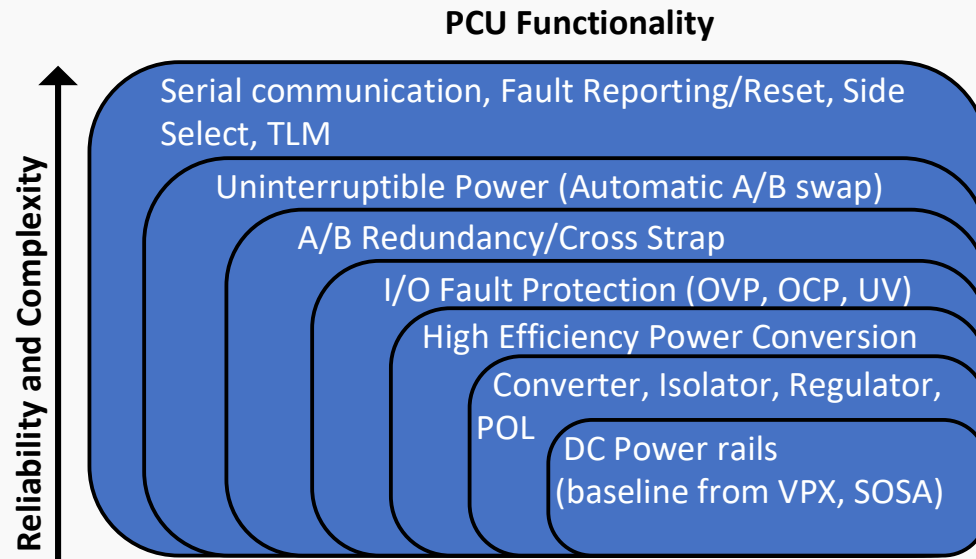
Agenda

- 1** Background
- 2** Block Diagrams
- 3** Results
- 4** Future Work

Does Not Contain CUI.

Background

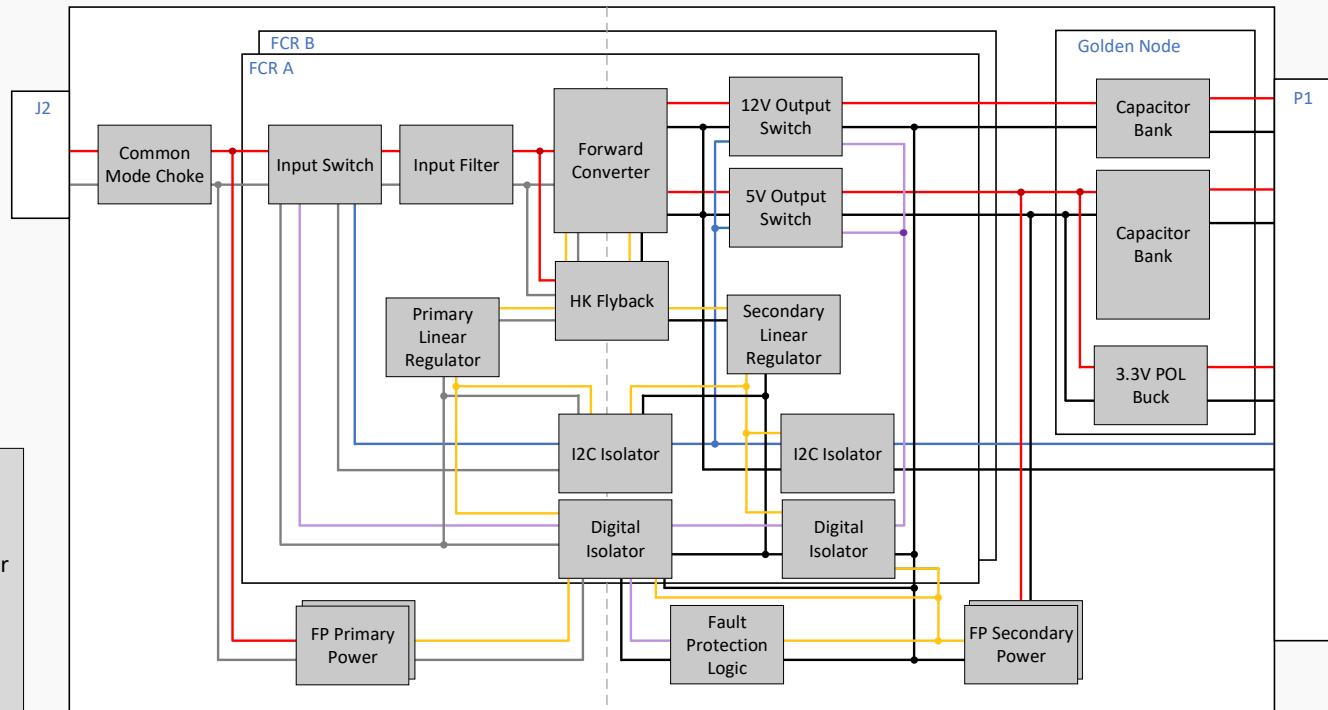
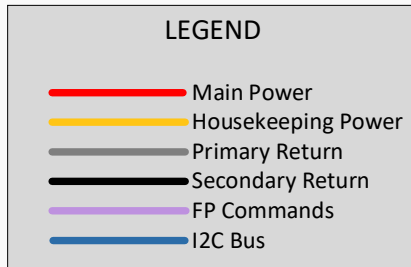
- Implementing standard interfaces can significantly reduce design NRE
- Fault protection and uninterruptible power is key for critical mission events



Block Diagram

Key Features

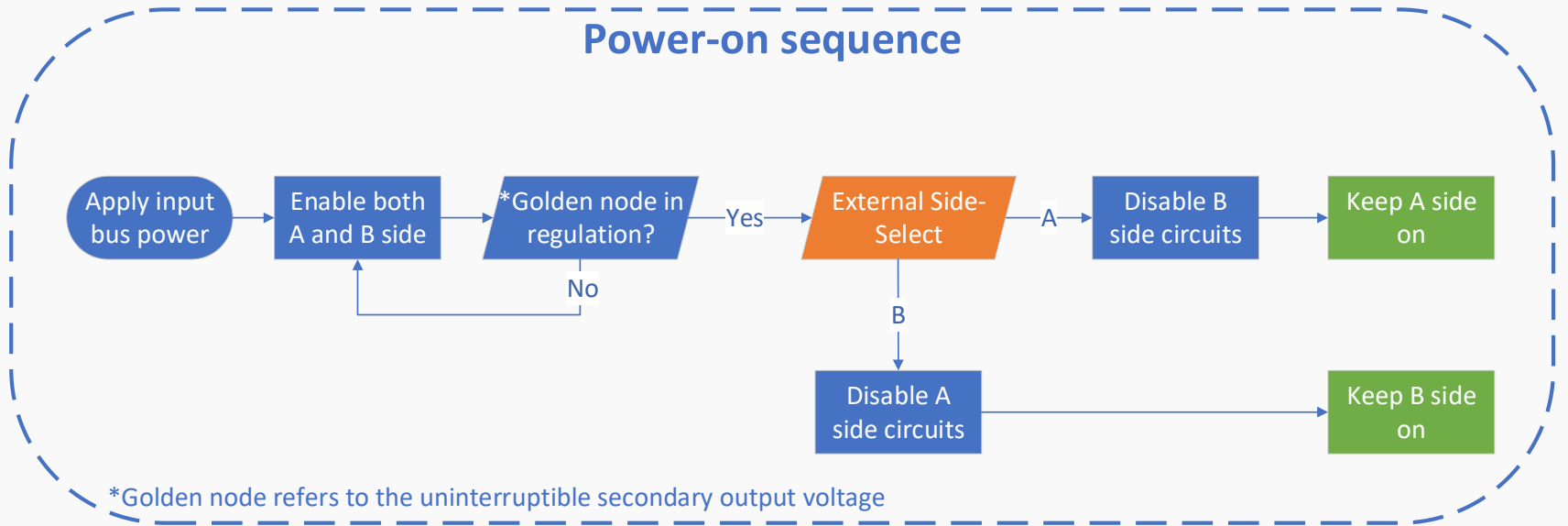
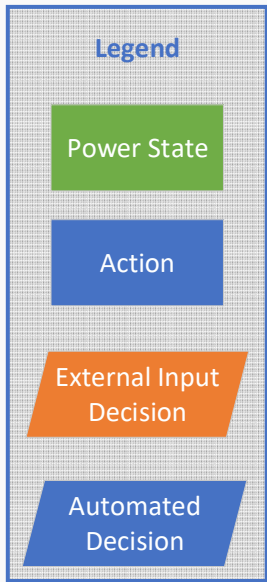
- Uninterruptible 12V and 5V outputs (referred to as golden node)
- A/B redundant converters and protection switches
- Fault protection logic to arbitrate which side is enabled to the output
- 6U form-factor with VITA78/SOSA interfaces



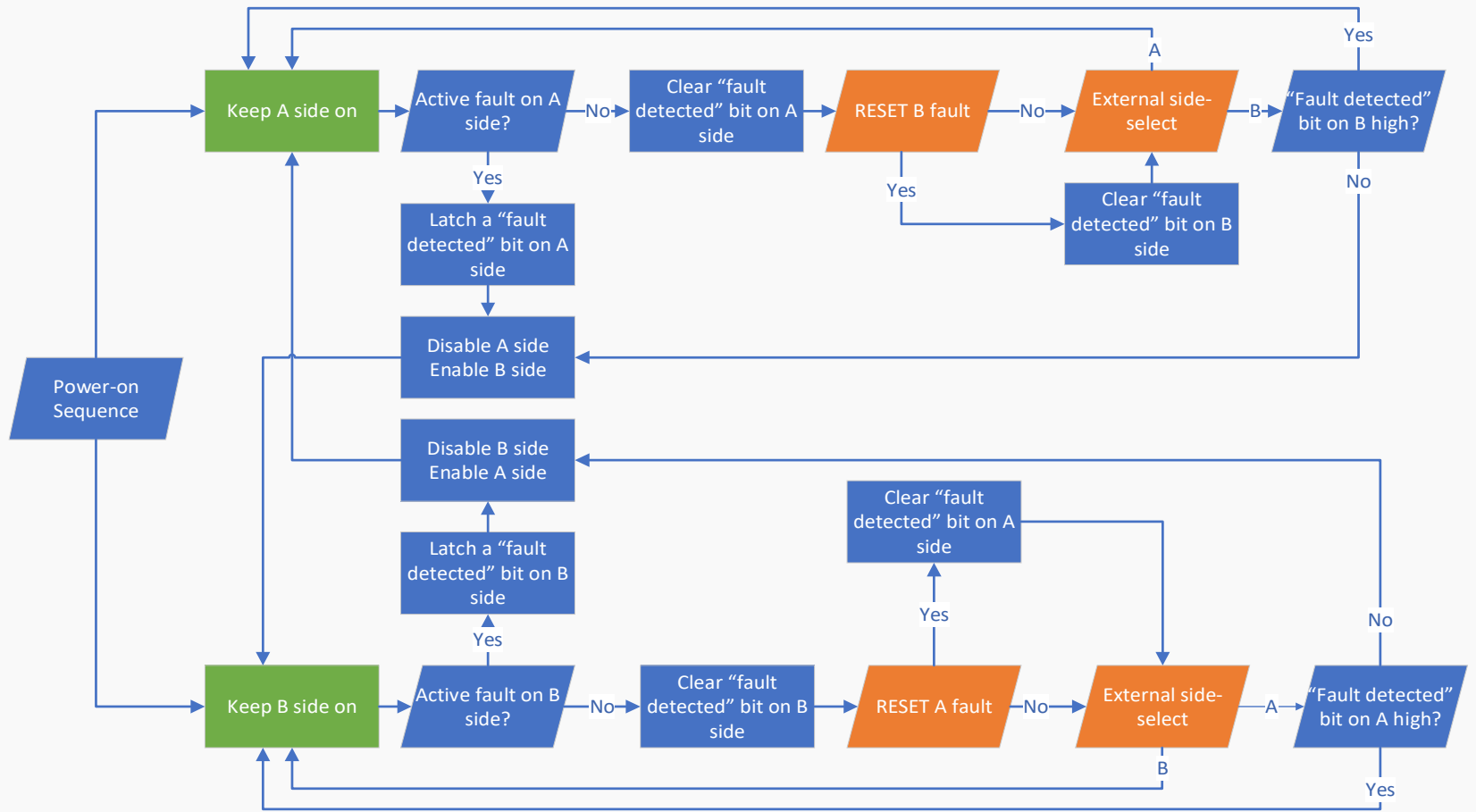
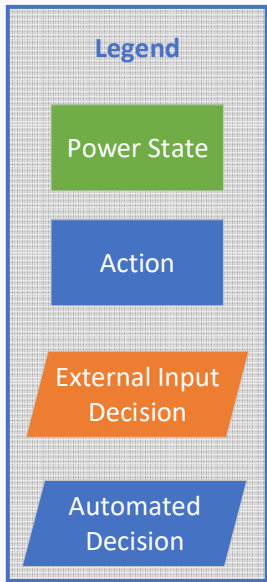
Fault Protection Behavioral Overview

- Enable both A and B sides to ensure golden node voltage is up
- Select which A/B side is enabled using external side-select signals
- Observe converter health using input and output protection switches' voltage and current telemetry
- Autonomously swap sides if fault been observed
- Latch "fault detected" bits to prevent swapping to a faulted side
- Use external reset signals to clear if any faults were previously detected on a side

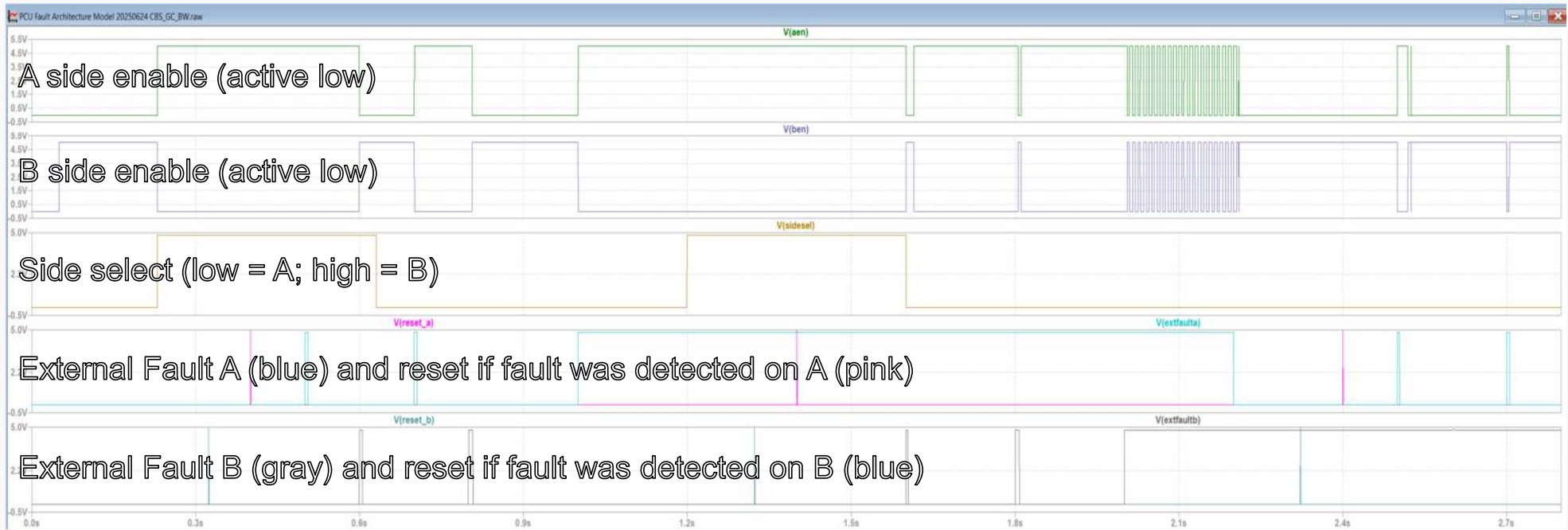
Fault Protection Flow Diagram – Initial power-on



Fault Protection Flow Diagram – side selection



Sim results



A side enable (active low)

B side enable (active low)

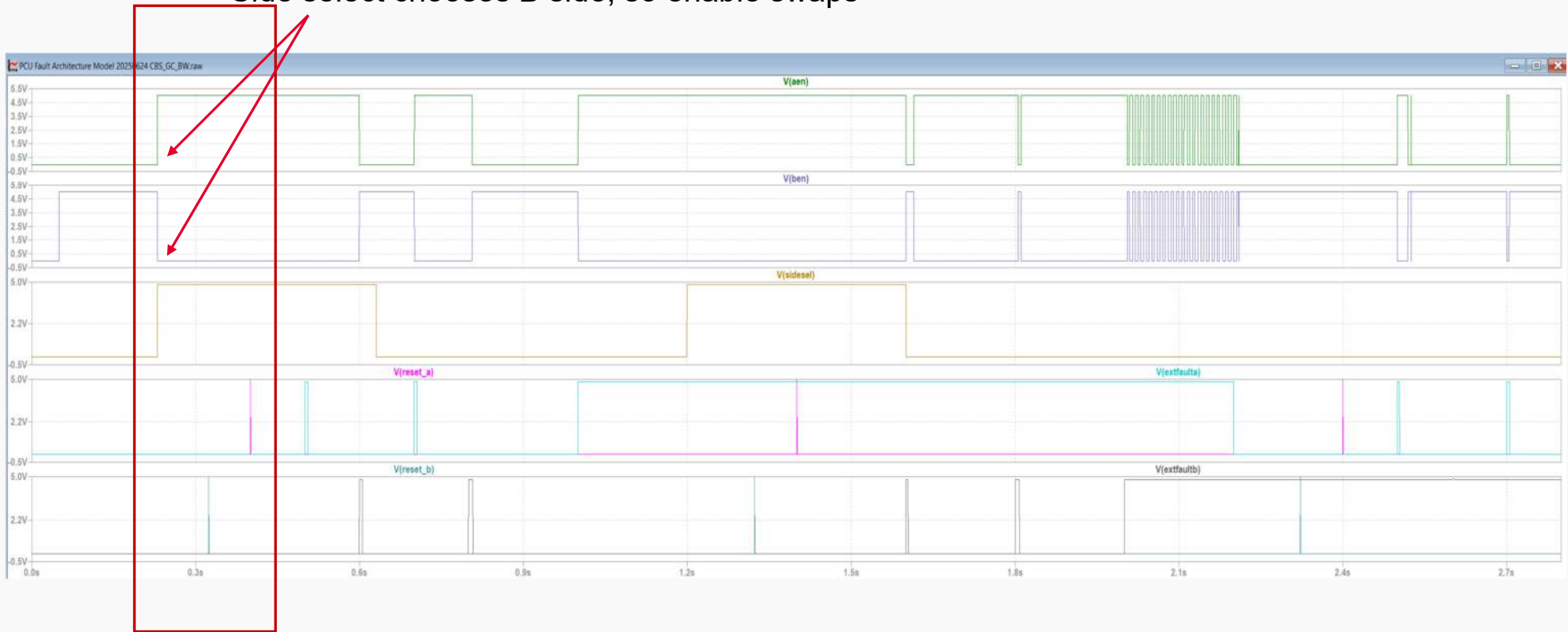
Side select (low = A; high = B)

External Fault A (blue) and reset if fault was detected on A (pink)

External Fault B (gray) and reset if fault was detected on B (blue)

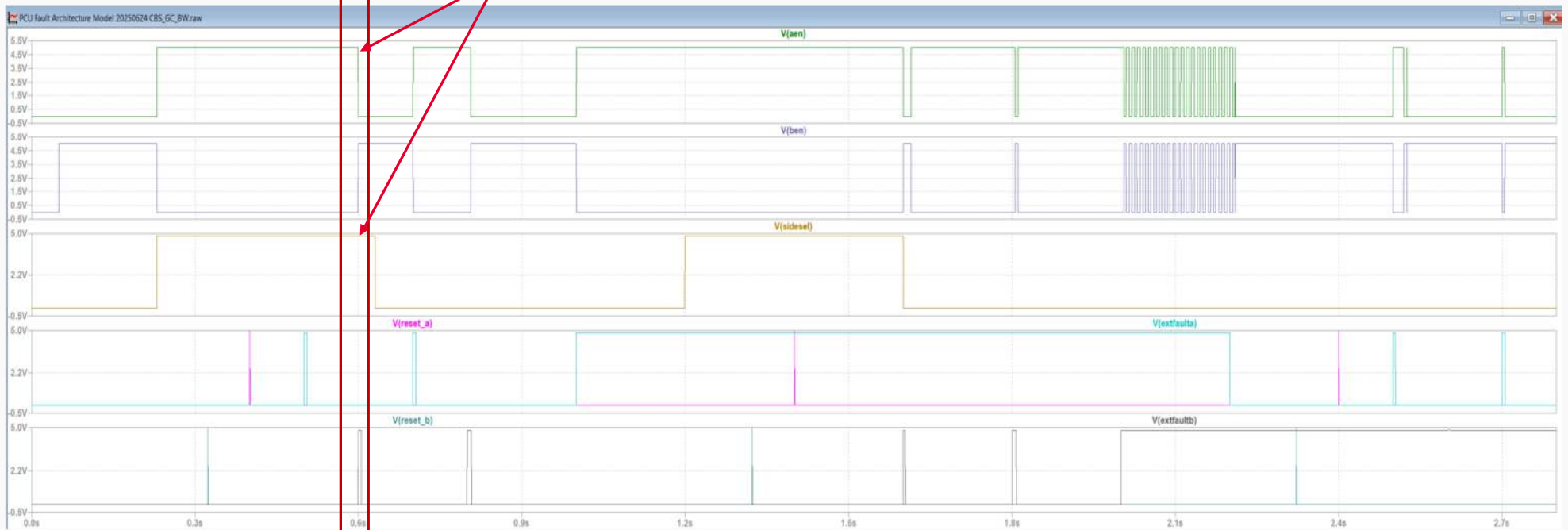
Sim results

Side select chooses B side, so enable swaps



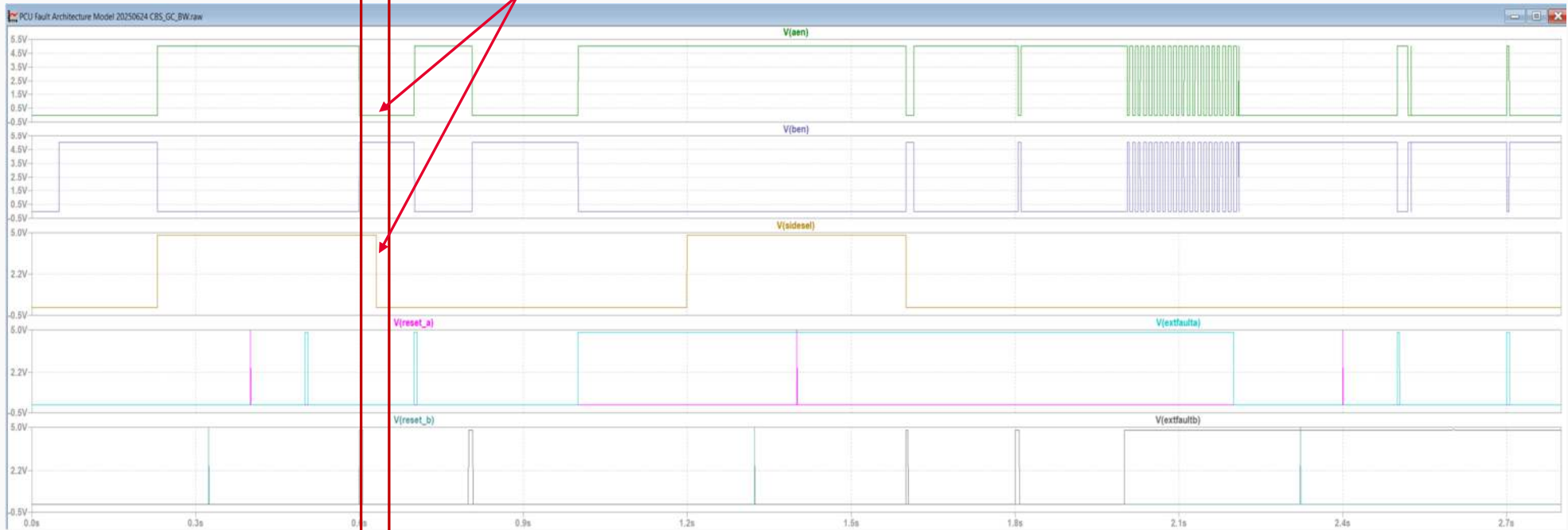
Sim results

Fault injected on B side, so change to A-side and ignore side select



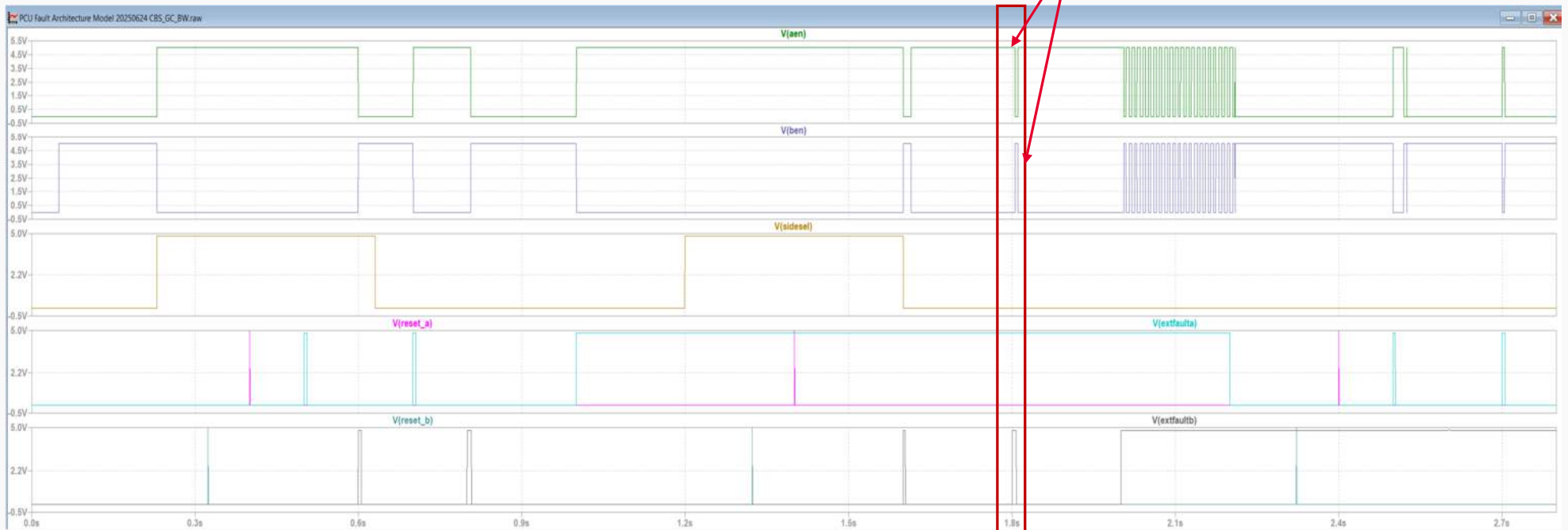
Sim results

Side select changed from A to B while already on B due to fault. No enable behavior change



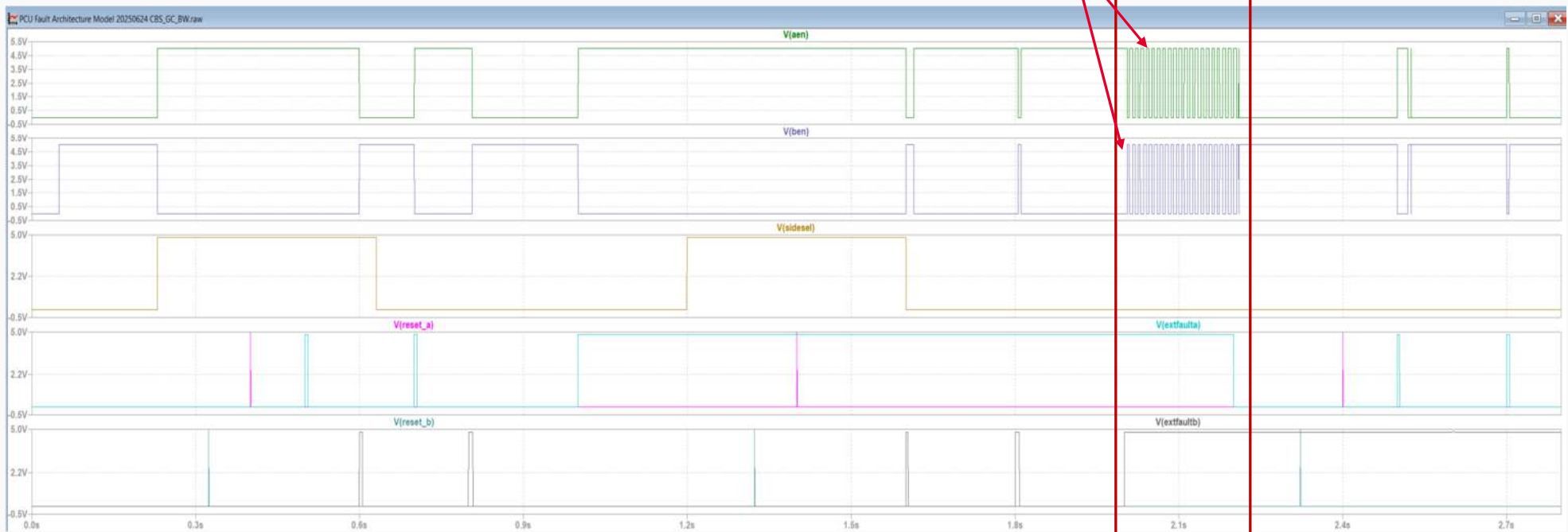
Sim results

Transient fault on B side while A side has a continued fault. Swaps to A side, then B side and stays on B since fault was cleared

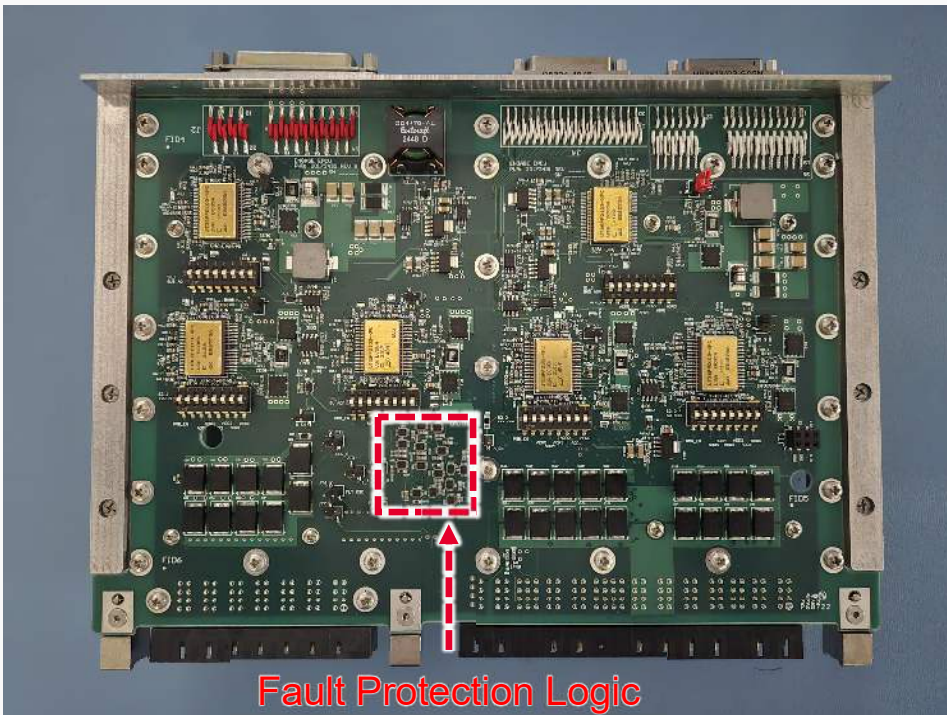


Sim results

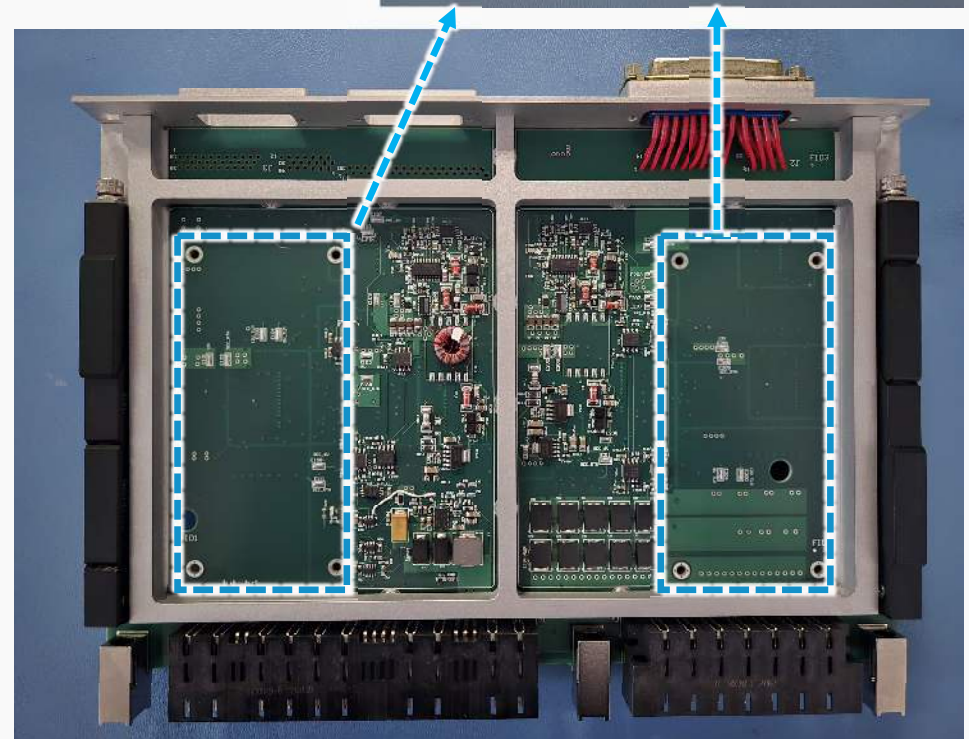
Persistent fault on both sides. Persistent side toggling until A side fault is removed



Hardware Photos

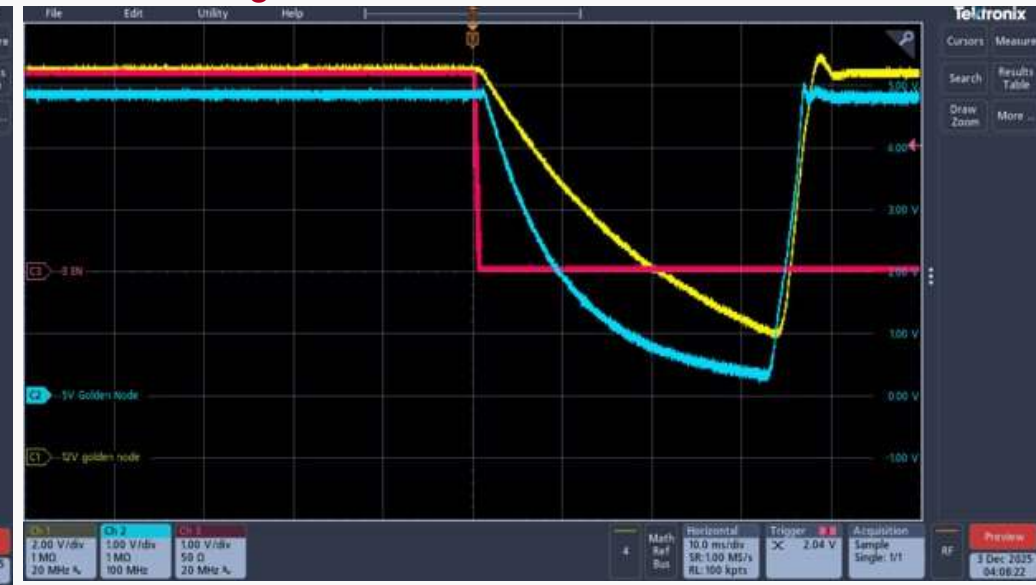
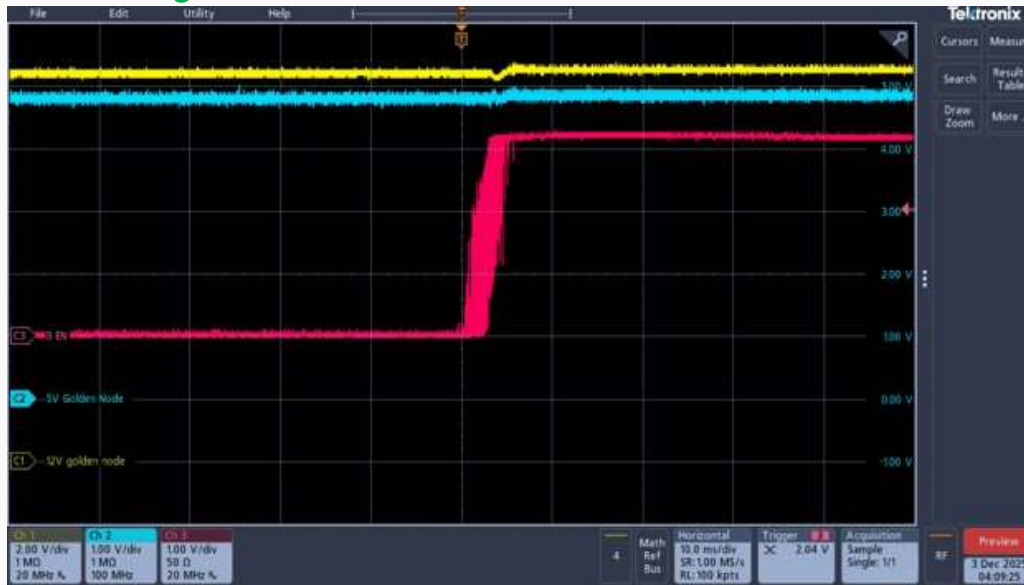


Power Converter Card



Test Results: Warm Spare vs Cold Spare

- Side swapping at 1A loads on both 12V and 5V output (17W total)
- Warm spare result – negligible change in output voltage
- Cold spare result – output voltage drops before recovering



Future Work

- Update timing to allow for uninterrupted output during cold-spare operation
- Update fault protection circuitry TMR digital logic parts
- Tune converter design and performance

Special thanks to the PCU team!

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