# Diagnosis of Power Electronic Systems (DOPES)

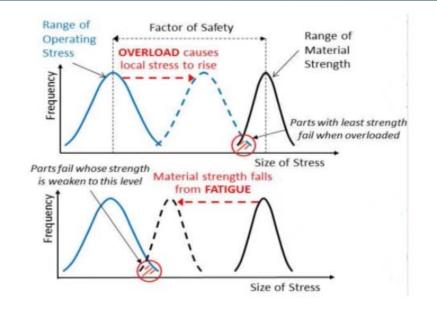
#### **Shamar Christian**

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2<sup>nd</sup> EECS Day April 20, 2018

#### Background

- Electronic overload and fatigue have been known to degrade component health.
- This jeopardizes overall system operation and consumer safety.
- A Diagnostic method and tool are needed in order to define and correct the occurrences of failure.



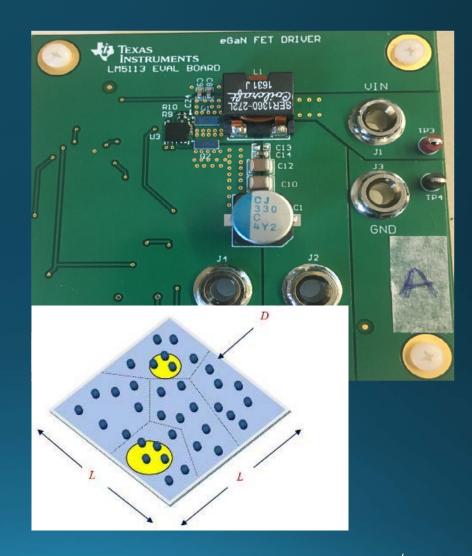


#### Problem Definition and Objectives

- Developing a real-time embedded sensory network coupled with a recovery system, to characterize electronic failure in order to diagnose and "heal" power electronics in their operation as they cope with electronic stress.
- Intended Users: Power Electronic manufacturers
- Focus: Development of sensory network and failure model

#### Approach Overview

- Texas Instruments LM5113
- GaN Transistor
- Simultaneous readings of temperature and magnetic field through IR and GMW Magnetic sensors.



#### Design Requirements

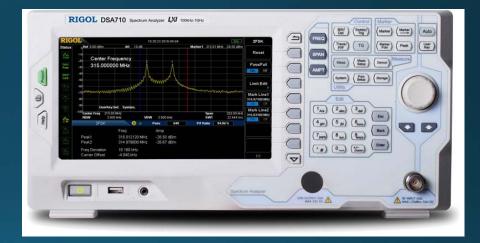
- Economics
- Pinging data within 1% accuracy
- Operating conditions (65-300°C)
- Sampling Rate (1-100 reading /ms)
- FCC Part 15 Compliance
- IEC 61000-4-2 Compliance





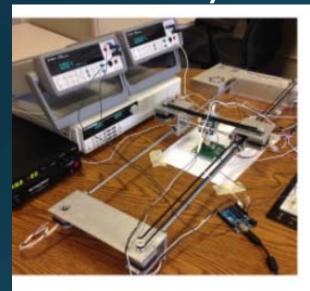
#### Current State of Art

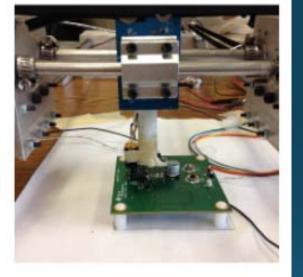
- Spectrum Analyzer
  - \$4-5000.00
- Weaknesses:
  - Intrusive (interferes with circuit behavior)
  - Large
  - Expensive

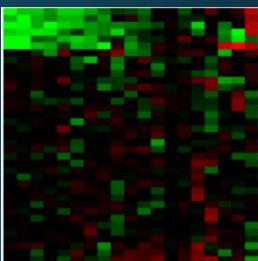


#### Solution Designs

## Design 1.0 - w/ scanning arm and intensity map



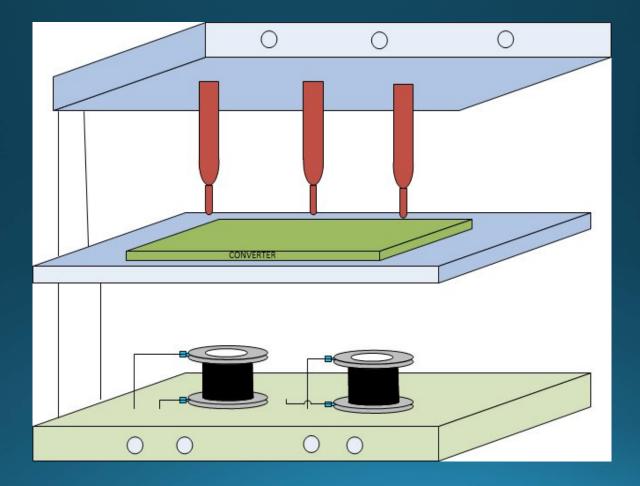




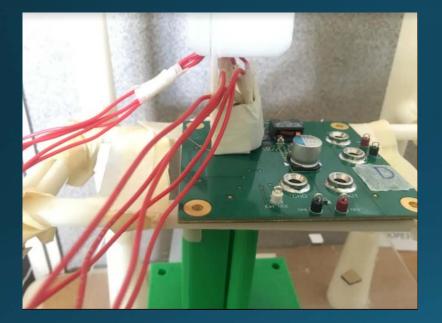
Low Points

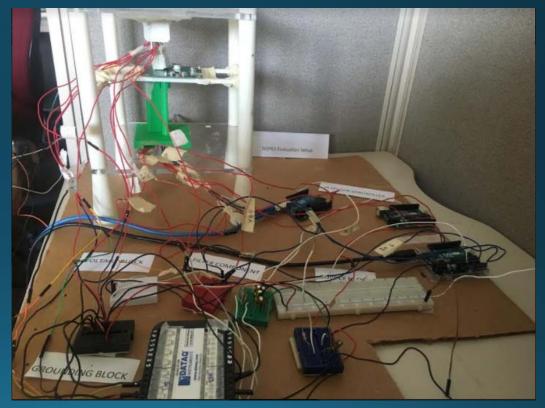
- Inconsistencies in data
- Time

#### Design – 1.1a stationary sensor network



#### Design 1.1a Implementation



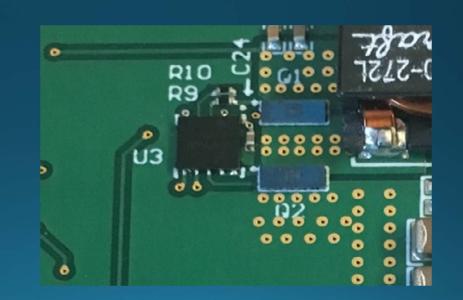


#### Sample Data from Design 1.1a

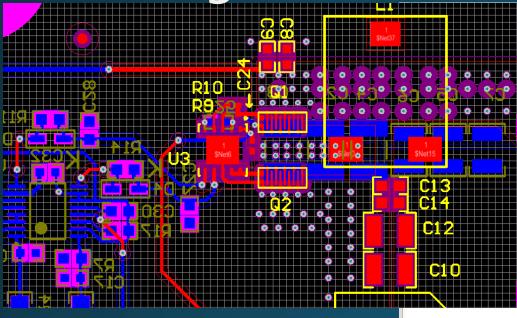
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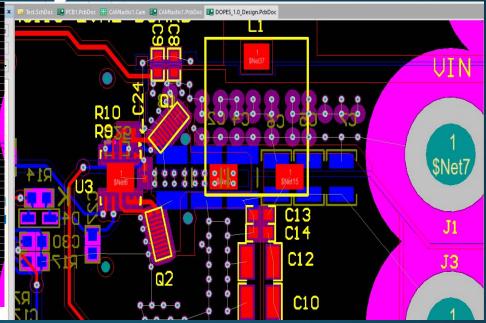
### Design 1.1b - PCB Modification





#### Design 1.1b PCB Adjustment





- Capacity for sensor self mount
- Modified transistor placement

Low Points

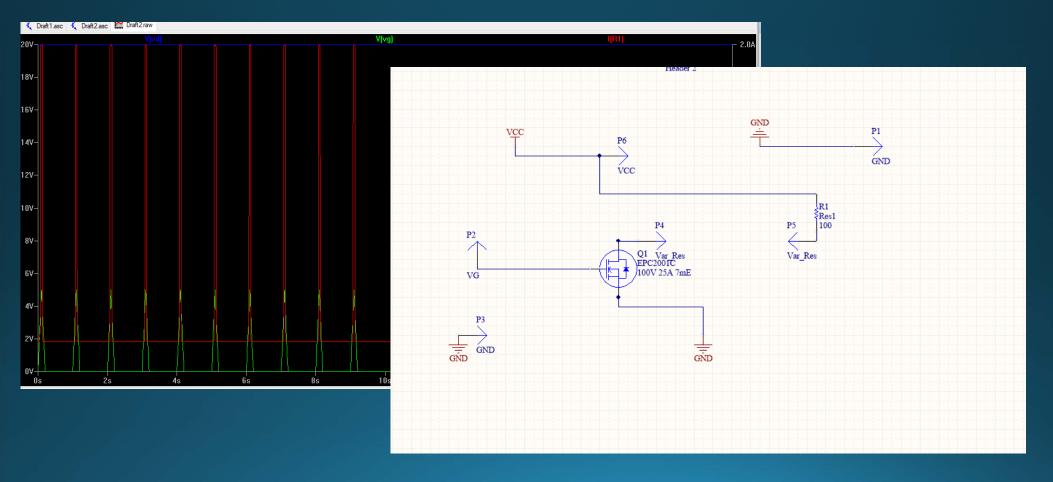
- Expensive to fabricate
- Time

#### Design 1.1c - Isolated Transistor

- Transistor Isolation
- Simple Set Up



#### Schematic and Simulation for verification



#### Conclusion

- The movement forward
  - Implementation of Design 1.1c
  - Further refinement of mathematical model
- Impact
  - Window into physical phenomena at GaN level
  - Commencement of diagnosis methodologies

