

Method and system for calculating a lifetime of gallium nitride (gan) based converter

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ABSTRACT

A method (400) and a system (300) for calculating a lifetime of Gallium Nitride (GaN) based converter. A mission profile is translated (404) in at least a current mode and a voltage mode. The GaN based converter is subjected (406) to the mission profile to obtain a current response and a voltage response. Curve fitting is performed (408) on the current response and the voltage response, and a peak current expression and a peak voltage expression is identified under each mode of the mission profile. Values of peak currents and peak voltages are discretized (410) with a sampling period equal to a switching frequency for the GaN based converter. A damage accumulation per switching cycle is calculated (412) based on the discretized values of the peak currents and the peak voltages.

KEY APPLICATION AREAS

- 1.Power electronics reliability and lifetime prediction.
- 2.Electric vehicle (EV) onboard chargers.
- 3.Gallium Nitride (GaN)-based power converters.
- 4.Semiconductor health monitoring and predictive maintenance.
- 5.Wide-bandgap semiconductor reliability assessment.
- 6.Electronic Design Automation (EDA) and converter design validation.

POTENTIAL USE

- 1.Lifetime estimation of GaN-based converters under real-world mission profiles with reduced simulation time.
- 2.Predictive maintenance of power converters by estimating remaining useful life before failure.

3. Reliability assessment of EV onboard chargers (OBCs) using Constant Current–Constant Voltage (CC–CV) charging profiles.
4. Health monitoring of GaN power devices by modeling damage accumulation per switching cycle.
5. Design optimization and validation of GaN-based power converter topologies using mission-profile-based lifetime analysis.
6. Reliability evaluation for high-performance electronics in automotive, medical, communication, and computing systems using GaN converters.