New Release

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1200V SiC MOSFETs (Rohm, Wolfspeed, ON-Semi, Infineon) Short-Circuit Robustness Benchmark Report

Feb. 2020: LTEC releases a report with analysis and comparison-benchmark of evaluated short-circuit withstand capabilities of state-of-the-art 1200V-rated SiC MOSFETs from ROHM, WOLFSPEED, ON-Semiconductor and INFINEON (CoolSiC) transistors. This is the world's first assessment report with detailed comparison on short-circuit endurance.

The report provides data useful for system/circuit design, transistor modeling, and quality assurance (QA) considerations, as no short-circuit robustness limits for SiC power transistors are specified in the datasheets.

Background

There is a lack of information in the datasheet related to short-circuit robustness limits and modeling

- Not all transistor manufacturers provide short-circuit endurance data such as short-circuit withstand time (SCWT, $t_{sc,f}$) and critical energy ($E_{sc,f}$) to failure.
- Short-circuit benchmark data is insufficient among available SiC transistors.
- Transistor short-circuit limitation depends not only on the physical properties of semiconductors, but also on transistor structural design and processing technology.
- Lack of accuracy in thermal impedance Z_{th} data (and SPICE models) for power pulses with short pulse durations (1us-10us), within the range of short-circuit events. This fact prevents accurate simulations under short-circuit conditions.

◆ In this report, we conduct actual short-circuit test measurements, transistor structure analysis, physical modeling and simulations are applied to evaluate, analyze and compare the short-circuit tolerance of SiC MOSFETs

Report Survey Contents

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Main analysis and survey results

• For all SiC MOSFETs evaluated, device failure/destruction due to short circuit is a thermally-driven phenomenon. The transistor fails when it reaches a critical temperature ($T_{j,crit}$) instead of a critical energy. The critical temperature for transistor failure is a technology-related parameter and depends on (a) transistor design /structure, (b) material and manufacturing technology.

• The "universal plot" of short-circuit withstand time and power dissipation until failure enables fair comparison of different transistors. Criteria for using gate leakage current as a precursor to transistor degradation due to short circuit are considered. Based on this criterion, robust transistors can withstand up to 5us, while other transistors start to degrade (not destruct) at 2us.The influence of transistor scaling and the trade-off between short-circuit tolerance and on-resistance (performance) are considered.

Use of the evaluation results in this report

・The minimum response time of the short-circuit protection circuit can be estimated.

・The measured short-circuit drain current waveform and withstand time ($t_{sc,f}$) can be used in SPICE electrothermal simulation to estimate the internal temperature and critical failure energy ($E_{sc,f}$) of the transistor.

Report price: $9,500

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