New Release

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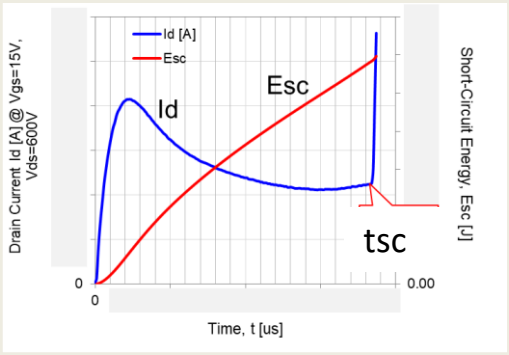
WOLFSPEED E3M0065090D AUTOMOTIVE CERTIFIED 900V SiC MOSFET SHORT CIRCUIT ROBUSTNESS ANALYSIS REPORT

February 2020. The short-circuit (SC) capability of power transistors, especially SiC power MOSFETs, is one of the most critical reliability-related specifications. Compared to Si-based IGBTs, the size of the SiC transistor is smaller. This leads to significant reduction in SC endurance time (tsc).

Package

Die image



Drain current waveform and short-circuit energy (Esc)

This is the first published short-circuit robustness analysis report that examines the correlation between short circuit robustness and the physical structure of the E3M006509d. This product is compliant to the AEC Q101 automotive certification standard.

The report includes:

- Identification of the mechanisms limiting short-circuit capability, measurements, physical analysis results, and extraction of the critical temperature (Tj(crit)) at the onset of failure.
- Comparison of short-circuit robustness with a 3rd generation 1200V process and a 900V transistor. Examination of the differences in semiconductor structure, process, and their effect on short circuit robustness.
- Comparison of electrical characteristics (off-state leakage current and its temperature dependence), and identification of differences and limitations.

Use value of the evaluation results in this report

- The minimum response time requirement of the short-circuit protection circuit can be estimated.
- The internal temperature of the transistor can be estimated by performing SPICE electrothermal simulation using the measured short-circuit drain current waveform and endurance time ($t_{sc,f}$).

Note: The report price may change over time. For current price contact **info@ltecusa.com**.

19G-0005-1

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Excerpts from the report

Fig.2: Die

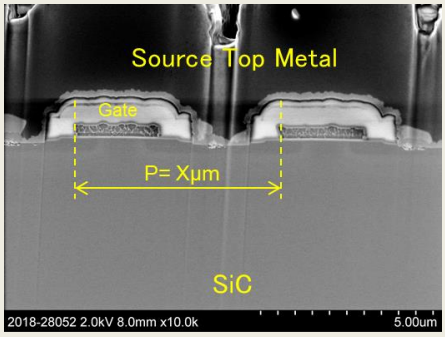

Fig.4: Cross-sectional image of SiC transistor

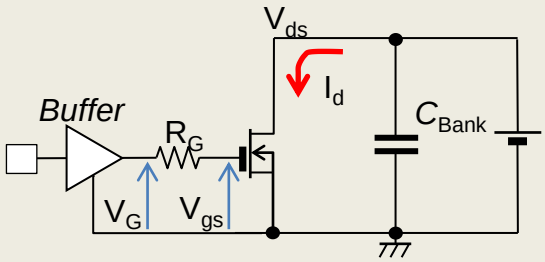

Table 2: Evaluated conditions

#	Vds [V]	Vgs [V]	Purpose
1	600	15	Basic SC characteristics
2	600	15	Check reproducibility
3	400	15	Drain voltage effect
4	800	15	"
5	800	15	Check reproducibility
6	600	12	Check Gate-Source voltage effect
7	600	18	"
8	600	20	"

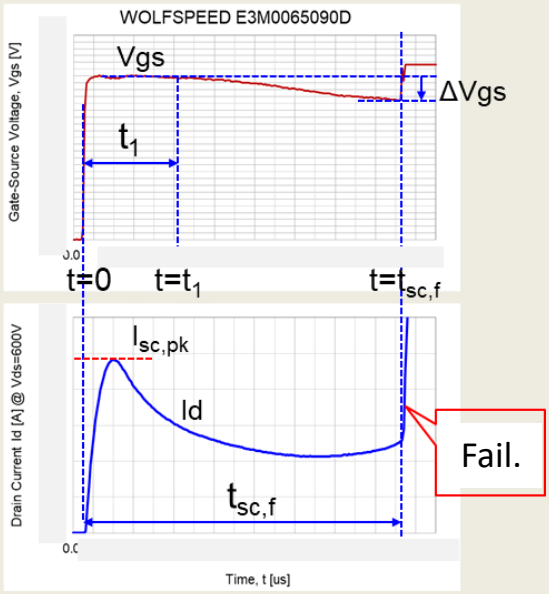

Fig. 17: Measured gate-source voltage and drain current waveforms during SC event.

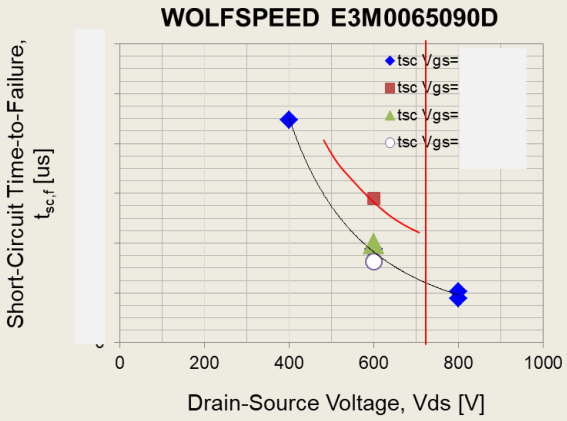

Fig. 20: Measured dependence of the SC time to failure $t_{sc,f}$ vs the drain voltage Vds.

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Excerpts from the report (cont.)

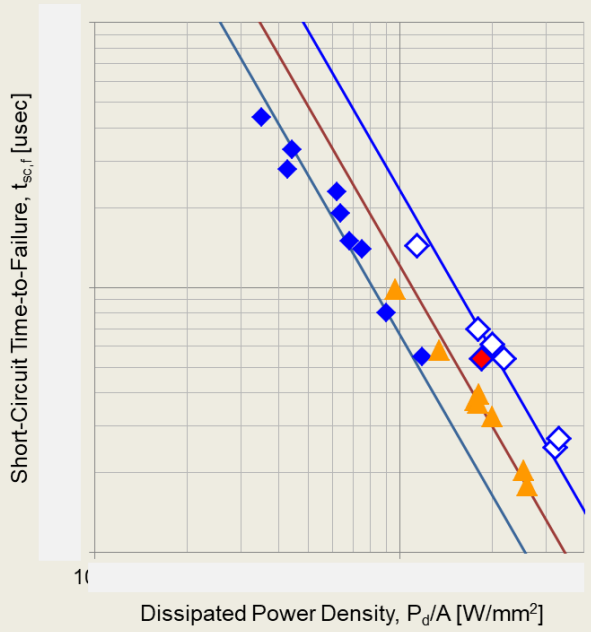

Fig. 28: Measured short circuit endurance time ($t_{sc,f}$) vs. Power dissipation density Pd/A＝(Vds x Id)/A.

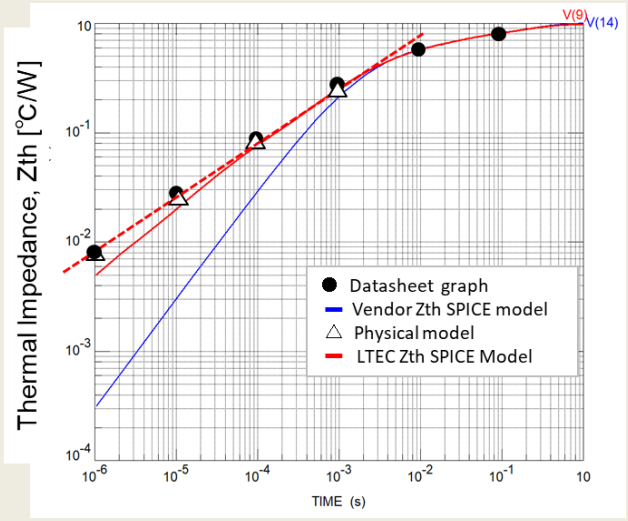

Fig. 30: E3M0065090D thermal impedance plot
●: Data from datasheet, (blue line) calculated using the SPICE model provided by the manufacturer, and
△: Calculated using the analysis result by LTEC

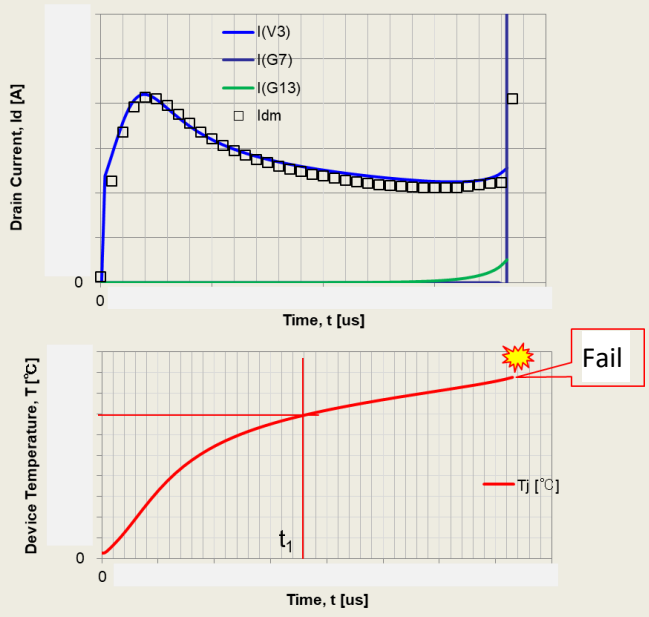

Fig. 31: Extracted transistor temperature rise using short circuit transient SPICE model

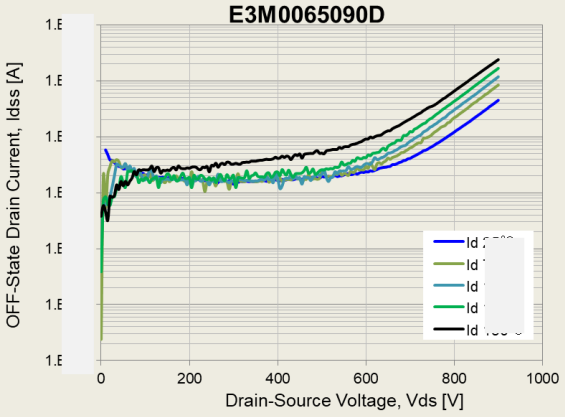

Fig. 38: Measured off –state drain current (@ Vgs = 0V)

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