New Release

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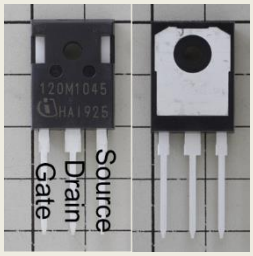
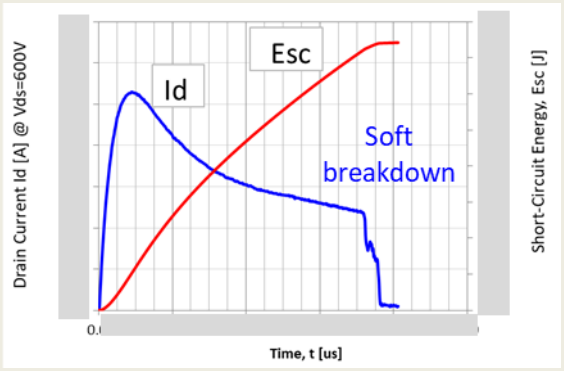
INFINEON IMW120R045M1 CoolSiC 1,200V SiC MOSFET SHORT CIRCUIT ROBUSTNESS ANALYSIS REPORTS

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

Abstract

This report evaluates short-circuit capability and the behavior under fault condition when the device is brought to damage-causing overstress. **Compared with other SiC MOSFETs, INFINEON's CoolSiC MOSFETs exhibits a "soft" failure without exploding**. Other SiC MOSFETs explode at the moment of the onset of short-circuit fault.

The report includes:

- Identification of the mechanisms limiting short-circuit capability, measurement, physical analysis results, and extraction of the critical temperature (Tj(crit)) at the onset of failure.
- Comparison of short circuit robustness with other makers' 1,200V SiC MOSFETs. Examination of the differences in semiconductor structure, process, and their effect on short circuit robustness.
- Comparison of the electrical characteristics (off-leakage current and temperature dependence) and identification of differences and limitations.

Use value of the evaluation results in this report

- The minimum response time of the short-circuit protection circuit can be estimated.
- The internal device temperature can be estimated by performing electrothermal SPICE simulation using 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**.

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Fig.2: Die

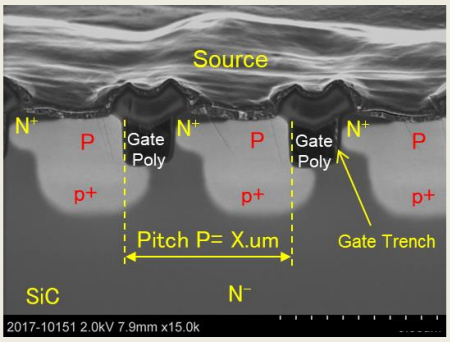

Fig.4: Cross-sectional image of SiC transistor

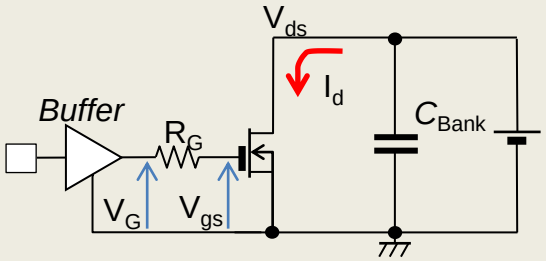

Table 2 : SC evaluation conditions

#	Vds [V]	Vgs [V]	Purpose
1	600	15	Basic SC characteristics
2	600	15	Reproducibility check
3	400	15	Drain voltage effect
4	800	15	“
5	600	12	Gate-Source voltage effect
6	600	18	“
7	600	21	“

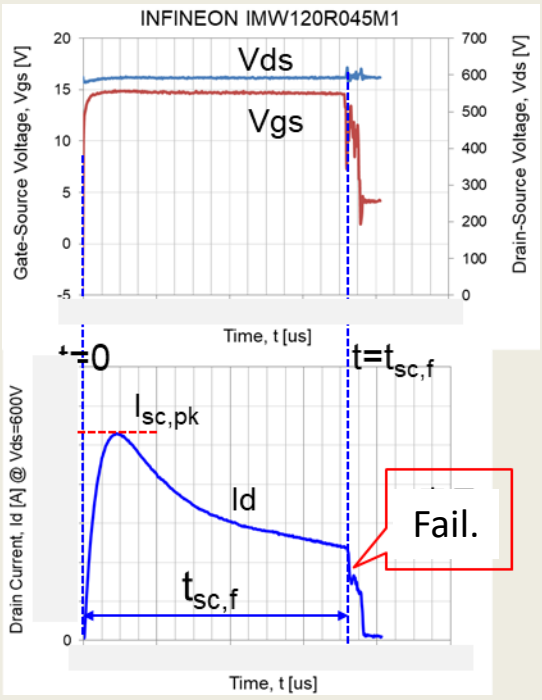

Fig.17: Measured gate-source voltage and drain current waveforms during SC event.

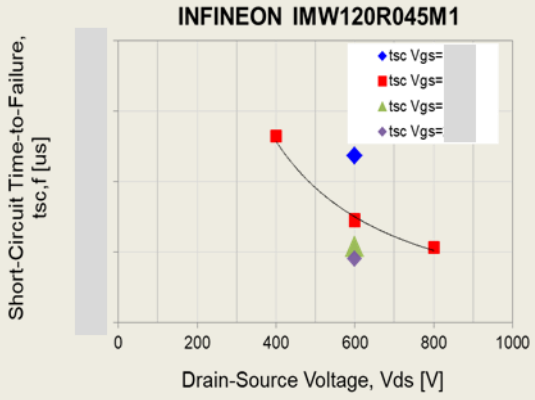

Fig.18:Measured short circuit durable time ($t_{sc,f}$) vs. Drain voltage (Vds)

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Excerpts from the report (cont.)

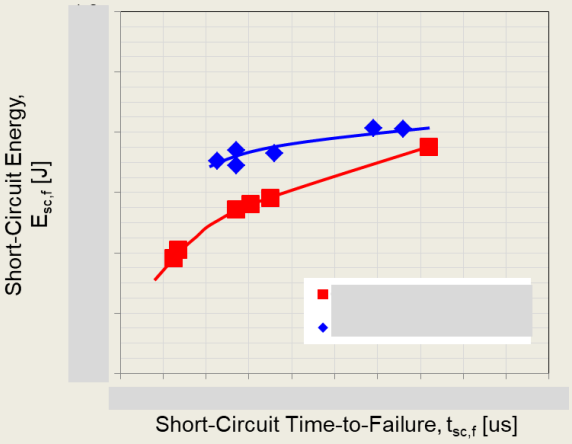

Fig.28:Measured short circuit critical energy-to-failure $E_{sc,f}$ vs endurance time ($t_{sc,f}$).

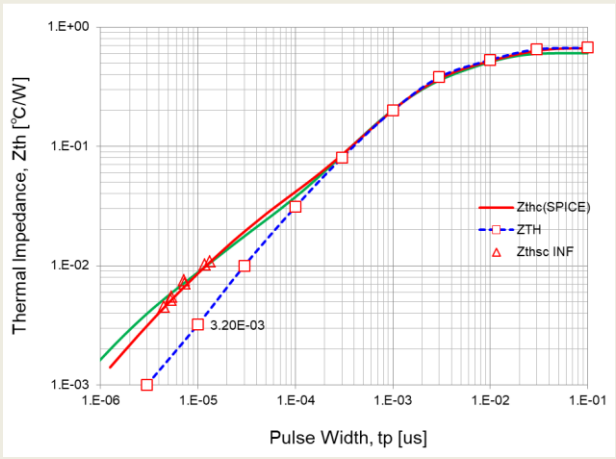

Fig.29: IMW120R045M1 Thermal impedance plot:
□: Data from datasheet,
Blue dash line: Calculated using the SPICE model provided by manufacturer, and
△: Calculated using the analysis result by LTEC

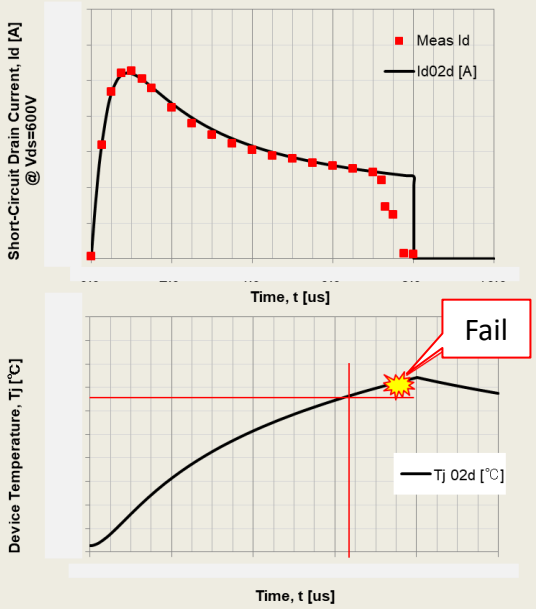

Fig.30: Extracted transistor temperature rise using short circuit transient SPICE model

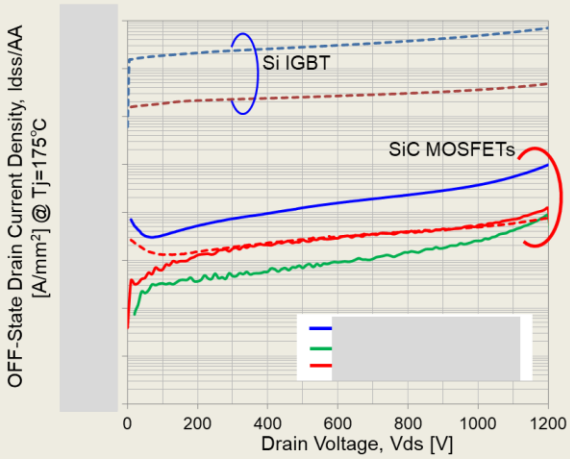

Fig.33: Measured off-state drain current (@ Vgs = 0V）

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