New Release

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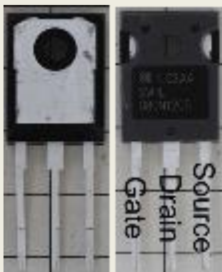
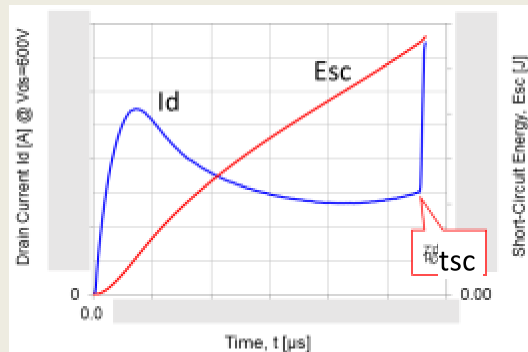
ON SEMICONDUCTOR NVHL080N120SC1 AUTOMOTIVE CERTIFIED 1,200V SiC MOSFET SHORT CIRCUIT ROBUSTNESS ANALYSIS REPORT

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)

Abstract

This is the first published short-circuit robustness analysis report that examines the correlation between short circuit robustness and the physical structure of the NVHL080N120SC1 device. This device is compliant with the AEC Q101 automotive 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 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-state leakage current and temperature dependence) with other makers, 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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LTEC Corporation US Representative Office
No.203 2880 Zanker Road San Jose, CA 95034
Phone: (408) 489-1994
www.ltecusa.com Contact: info@ltecusa.com

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Excerpts from the report

Fig.2: Die

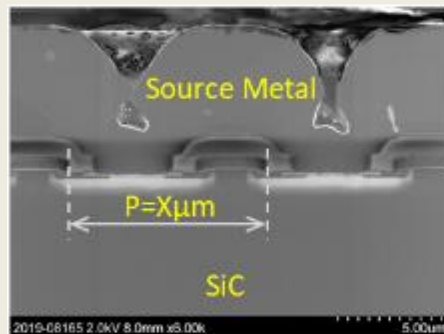

Fig.4: Cross-sectional image of SiC transistor

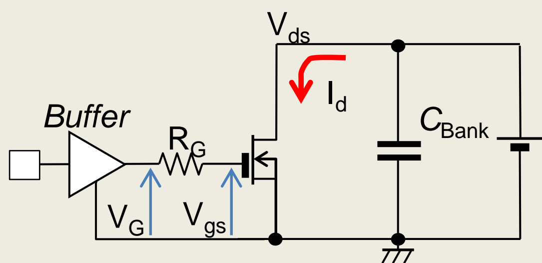

Table 2 : Evaluation Conditions

#	Vds [V]	Vgs [V]	Purpose
1	600	20	Basic SC characteristics
2	600	20	Check reproducibility
3	400	20	Drain voltage effect
4	800	20	"
5	600	16	Gate-Source voltage effect
6	600	24	"

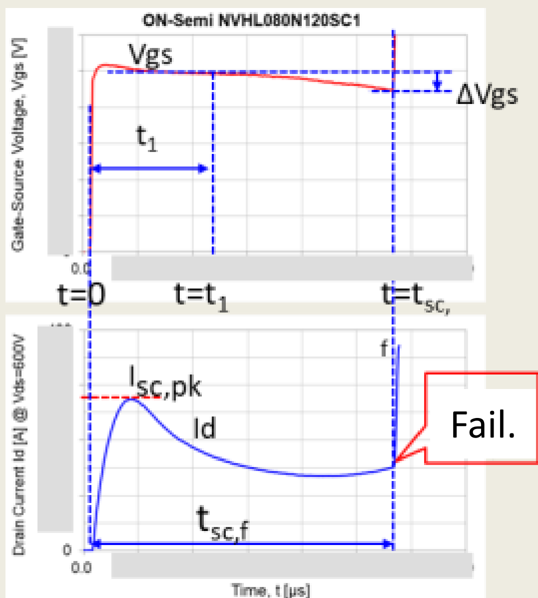

Fig.17: Measured gate-source voltage and drain current waveforms during SC event.

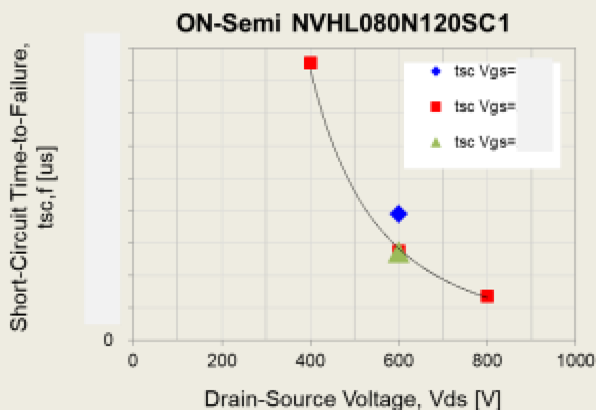

Fig.18: Measured dependence of the SC time to failure $t_{sc,f}$ vs the drain voltage Vds.

Excerpts from the report (cont.)

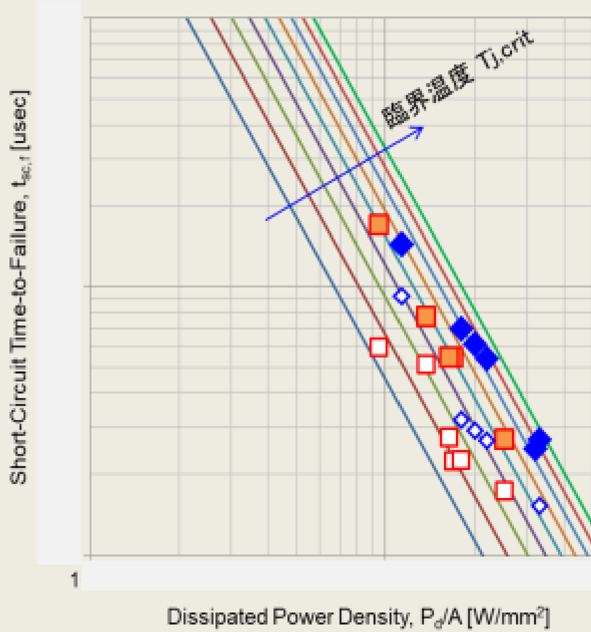

Fig.28:Measured short circuit durable time (tsc, f) vs. Power dissipation density Pd/A＝(Vds x Id)/A.

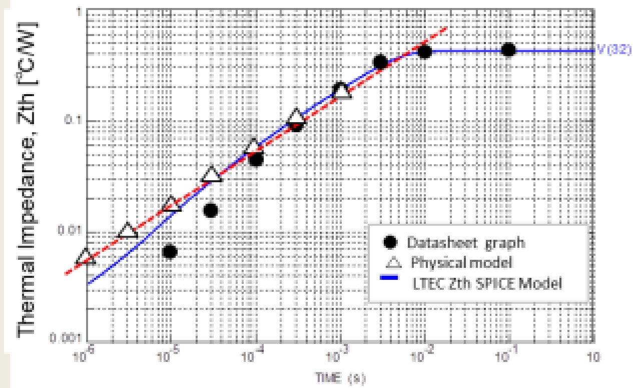

Fig.29: NVHL080N120SC1 Thermal impedance plot
●: Data from datasheet,
(Blue line) Calculated using the SPICE model provided by manufacturer, and
(△) Calculated using the analysis result by LTEC

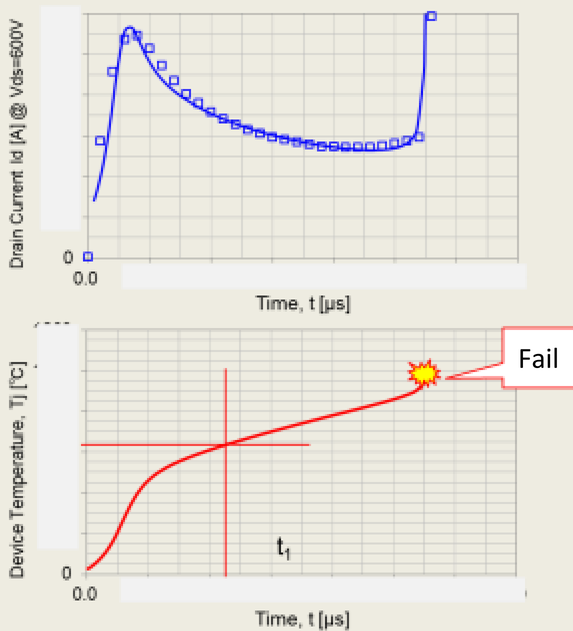

Fig. 30: Extracted transistor temperature rise using short circuit transient SPICE model

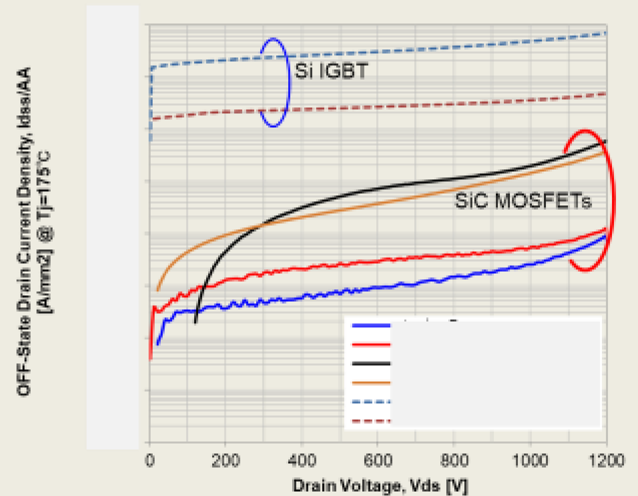

Fig. 33: Measured off-state drain current (@ Vgs = 0V）