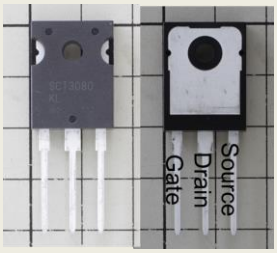
New Release

LTEC Corporation

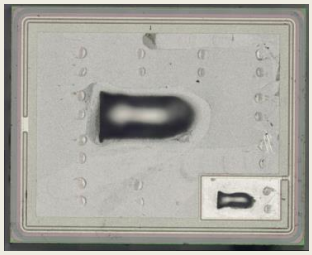
Your most experienced partner in IP protection

RHOM SCT3080HLHR AUTOMOTIVE CERTIFIED 1200V SiC MOSFET SHORT CIRCUIT ROBUSTNESS ANALYSIS REPORT

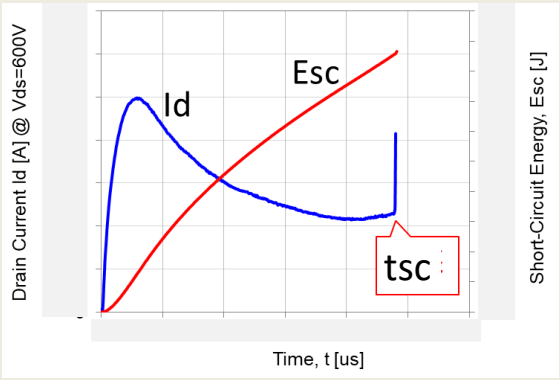
February 2020. The short-circuit (SC) capability of power transistors, especially SiC power MOSFETs, is one of the most critical reliability-related specifications. Compared to Si-based IGBTs, the size of the SiC transistor is smaller. This leads to significant reduction in SC endurance time (tsc).



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 SCT3080HLHR device. This device is compliant to the AEC Q101 automotive standard.

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' 1200V 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 ($t_{sc,\,f}$).

Contact LTEC Corporation for the current price as it decreases over time

19G-0019-1

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

Table of Contents

	Page
Summary	
Background, purpose and executive Summary	3
Physical analysis results	
Device structure and material analysis	5
Table 1. Summary of each parameter	6
Short circuit robustness evaluation	
Evaluation circuit	7
Evaluation conditions	9
Short circuit robustness evaluation results	
Voltage and current waveform	10
Table 3. Summary of measurement results	17
Discussion for evaluation results	
Peak drain current (Isc,pk) vs. drain voltage (Vds)	19
Short circuit endurance time (tsc) vs. drain voltage (Vds)	20
Short circuit energy (Esc,f) against drain voltage (Vds)	21
Short circuit endurance time (tsc) vs. power dissipation (Pd = Id x Vds)	22
Gate leakage current considerations during SC	23
Estimation of junction temperature (ΔTj) rise	27
Thermal impedance	30
Comparison of transistor structure and electrical characteristics	33
Comparison of the 1,200V ROHM and Wolfspeed transistors	
Electrical characteristics	35
Drain current at short circuit mode	37
Conclusion	39
Appendix	
References	40

Excerpts from the report

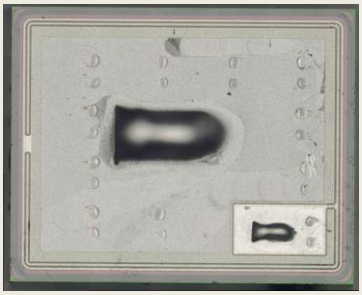


Fig.2: Die

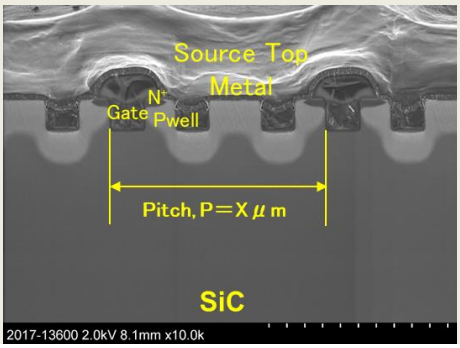
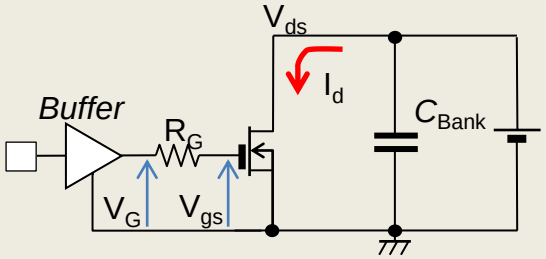


Fig.4: Cross-sectional image of SiC transistor

Table 2: Evaluation conditions

#	Vds [V]	Vgs [V]	Purpose
1	600	18	Basic SC characteristics
2	600	18	Reproducibility check
3	400	18	Drain voltage effect
4	800	18	"
5	600	15	Gate-Source voltage effect
6	600	20	"
7	600	24	"



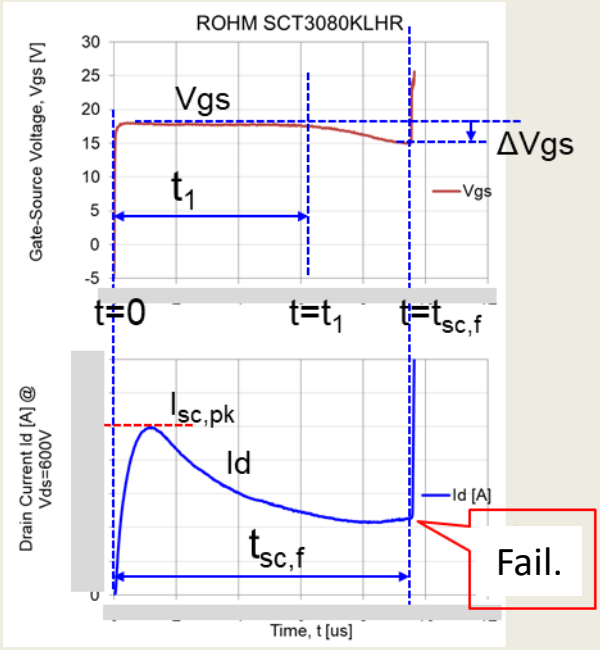


Fig.17: Measured gate-source voltage and drain current waveforms during SC event.

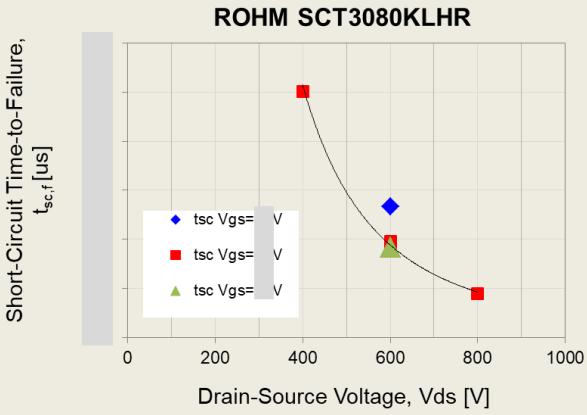


Fig.18: Measured dependence of the SC time to failure $t_{sc,f}$ vs the drain voltage Vds.

Excerpts from the report (cont.)

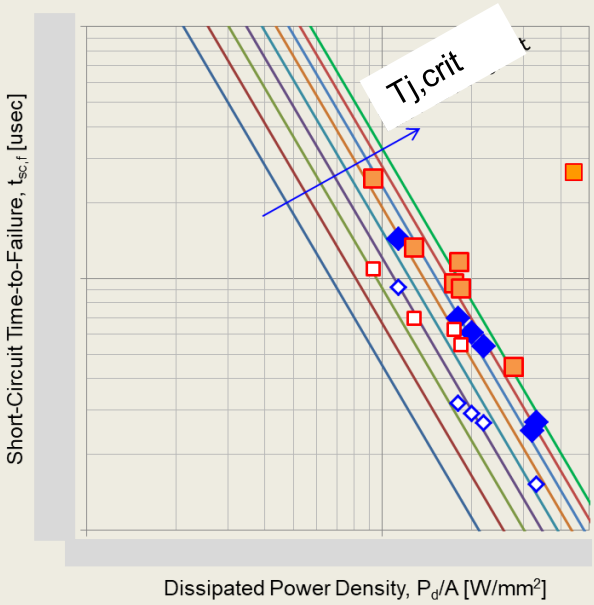


Fig.28:Measured short circuit durable time ($t_{sc,f}$) vs. Power dissipation density Pd/A＝(Vds x Id)/A.

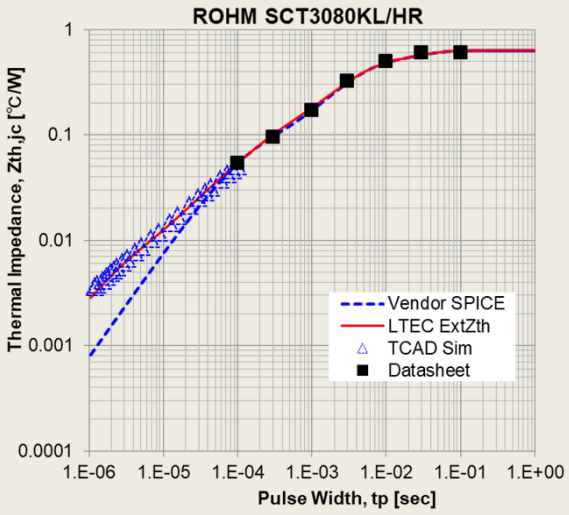


Fig.29: SCT3080KLHRThermal impedance plot
▪: Data from the datasheet,
Blue dash line): Calculated using the SPICE model provided by manufacturer, and
△ Calculated using the analysis result by LTEC
Red line: LTEC synthesized SPICE model

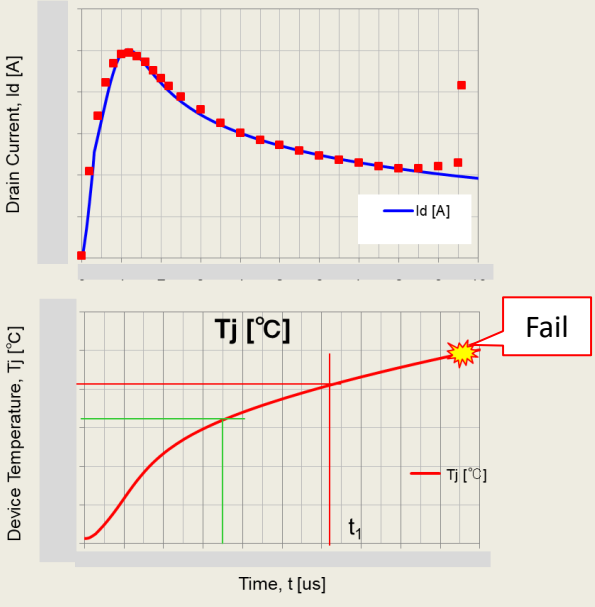


Fig.30: Extracted transistor temperature rise using short circuit transient SPICE model

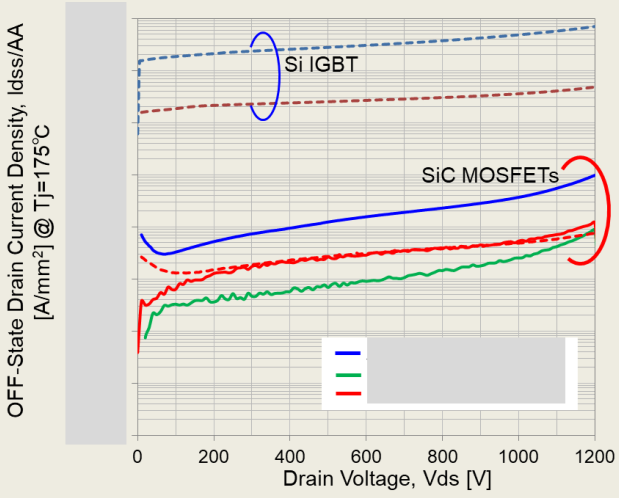


Fig.33: Measured off-state drain current (@ Vgs = 0V）

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