An Improved Turn-on Switching Transient Model of 10 kV SiC MOSFET

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Background
- The emerging 10 kV SiC MOSFET brings great benefit for medium and high voltage applications. Accurate switching transient modeling of the 10 kV SiC MOSFETs is critical for successful application.
- Conventional models based on curve tracer results fail to consider transconductance and dynamic gate charge during actual high voltage turn-on switching transient, and shows obvious discrepancies compared to experiments.
- Transconductance varies under different drain-source voltage due to SiC MOSFET short channel effect and drain induced barrier lowering effect. Dynamic gate-drain charge under MOSFET channel turn-on condition is different from static gate-drain charge when MOSFET channel is off.

High Voltage Transconductance During Turn-on Transient

Dynamic Gate-drain Charge During Turn-on Transient

Improved Model and Experimental Results

Conclusions
- An improved turn-on switching transient model of the 10kV SiC MOSFET which considers the high voltage transconductance and dynamic gate-drain charge during turn-on transient is proposed and experimentally verified.
- With the proposed model, both current rise stage and voltage fall stage waveforms during turn-on transient match well with that in the experiment. The loss error is within 5% over wide load conditions.