

SiC *ZERO RECOVERY*[®] Schottky Diode Reliability at Extremely High Voltage Slew Rates

Summary

Testing was performed to determine if a failure mechanism was present in the Cree Silicon Carbide (SiC) *ZERO RECOVERY*[®] Schottky diode when operated at extremely high voltage slew rates (dV/dt). 600 volt *ZERO RECOVERY*[®] Schottky diodes with current ratings of 6 and 10 amp were tested with a turn-on dV/dt of 75 V/ns and a turn-off dV/dt of 100 V/ns. After 5000 test cycles per device, with ten of each type tested, no failures were observed.

Background

A paper by Acharya, et al. [1] showed SiC Schottky diode failures at dV/dt values of 55 – 60 V/ns. While the diodes tested in this paper were not Cree devices the failures have led to questions about the dV/dt performance of SiC Schottky diodes in general. Without additional details of the transmission line test setup used and full test waveforms, it can not be ruled out that the failures were not induced by the testing method described in the paper.

Verification

A pulsed inductive test setup was used to demonstrate the dV/dt capability of the Cree *ZERO RECOVERY*[®] Schottky diodes. This test method allows the highest dV/dt obtainable while stressing the *ZERO RECOVERY*[®] diodes in a manner similar to Switched Mode Power Supply (SMPS) applications. Figure 1 shows the two-pulse inductive test set and waveforms used for the diode dV/dt testing. The pulse width was adjusted to set the diode current to 6 amps for the 6 amp devices and 10 amps for the 10 amp devices. The voltage was set to 480 volts in both cases. Figure 2 is the pulse generated during 10 amp device testing. This voltage waveform is expanded in Figure 3 and Figure 4 showing a turn-on voltage slew rate of 75 V/ns and a turn-

off dV/dt of 100V/ns. The test sequence for each *ZERO RECOVERY*[®] diode consisted of 5000 pulses with a 1-second repetition rate. Ten of the 10 amp diode and ten of the 6 amp diode were tested.

Conclusion

A total of 20 Cree SiC *ZERO RECOVERY*[®] Schottky diodes were tested at a voltage slew rate greater than what was shown in the Acharya paper. The devices were tested for a total of 100,000 cycles with a method approximating a SMPS application. There were no failures of the Cree SiC *ZERO RECOVERY*[®] Schottky diodes.

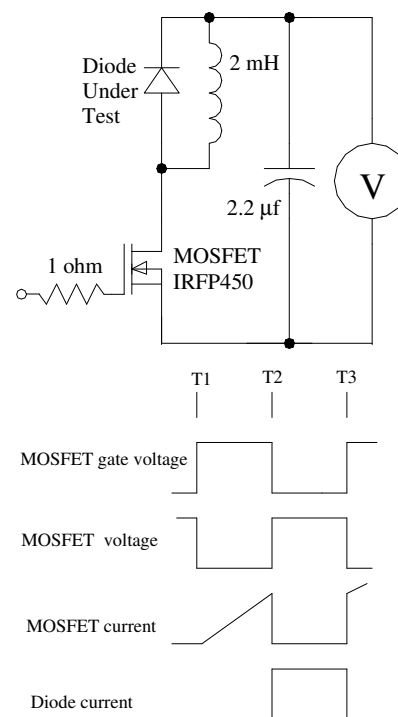


Figure 1: Two-pulse diode inductive switching test setup used for dV/dt testing.

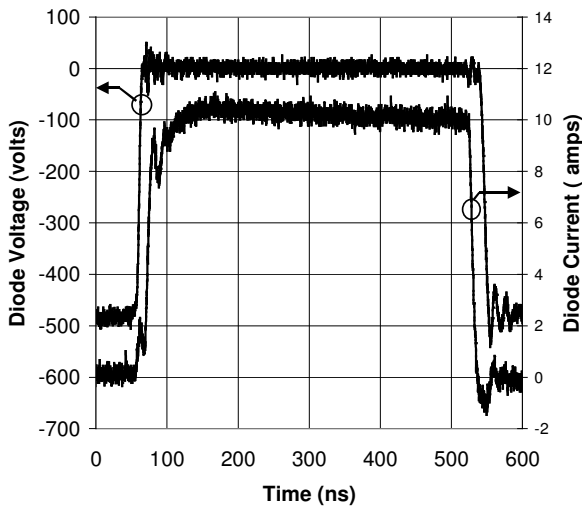


Figure 2: 10 amp SiC ZERO RECOVERY[®] diode current and voltage waveform measured during dV/dt testing.

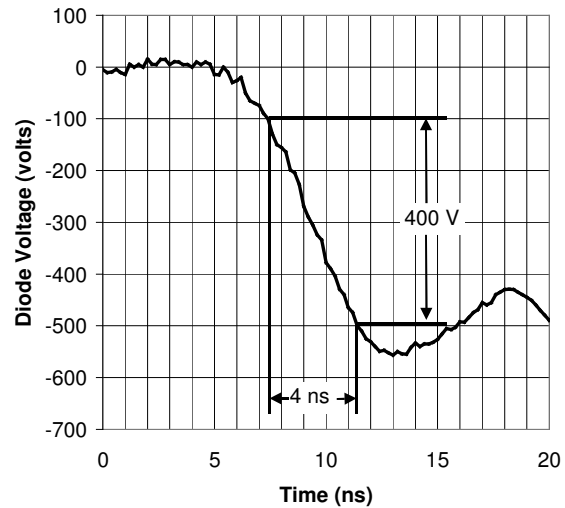


Figure 4: Expanded waveform of the 10 amp SiC ZERO RECOVERY[®] diode turn-off voltage showing a dV/dt of 100 V/ns.

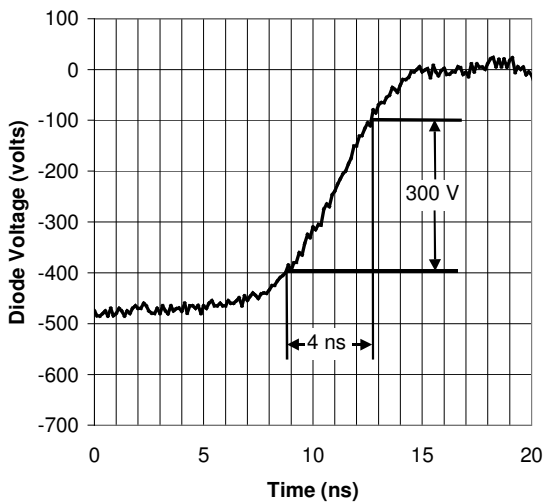


Figure 3: Expanded waveform of the 10 amp SiC ZERO RECOVERY[®] diode turn-on voltage showing a dV/dt of 75 V/ns.

This product has not been designed or tested for use in, and is not intended for use in, applications implanted into the human body nor in applications in which failure of the product could lead to death, personal injury or property damage, including but not limited to equipment used in the operation of nuclear facilities, life-support machines, cardiac defibrillators or similar emergency medical equipment, aircraft navigation or communication or control systems, air traffic control systems, or weapons systems.

Reference:

[1] "On the dV/dt Rating of SiC Schottky Power Rectifiers", Acharya, K.; Shenai, K. Proceedings Power Electronics Technology Conference, October 2002. Pages: 672-677

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