

The influence of 200° C Junction Temperature Transients on *ZERO RECOVERY*® Schottky Diode Power Cycle Reliability

Objective

During operation of a power converter there may be instances where the switching components are expected to carry surge currents which are 2–3 times their continuous rated value. An example would be a power glitch restarting a line fed converter when operating at elevated temperature. Schottky diodes due to their positive temperature coefficient of forward voltage and lack of conductivity modulation have limited ability to endure high surge currents. By taking advantage of Silicon Carbides inherent high temperature operation ability we can increase the *ZERO RECOVERY*® Schottky diode surge current capability by allowing the diode junction temperature to transition as high as 200°C with out affecting device reliability.

Verification

Power cycle testing was performed on a sample of 5 CSD04060 (4 amp, 600 volt) diodes. The K factor was measured to be 0.778 °C/mV using a measurement current of 0.1 amp. The device under test (DUT) was mounted to a hot plate and the junction temperature brought to equilibrium at 100°C. A 12 amp heating pulse was applied to the diode for 60 ms to bring the junction temperature to 200°C. The repetition rate was set to 1 second to allow the DUT junction to return to 100°C. The 0.1 amp measurement current was present during the heating current off period, permitting the junction temperature to be determined from the diode forward voltage. The DUT was removed and the forward voltage measured at rated current (4amp) every 10,000 cycles.

Figure 1 is a plot of the diodes forward voltages at 4 amps over the test period. All devices failed between 50,000 and 60,000 cycles due to high forward voltage (greater than the 1.8 volt spec limit). ASM and de-encapsulation showed die attach failures due to solder fatigue.

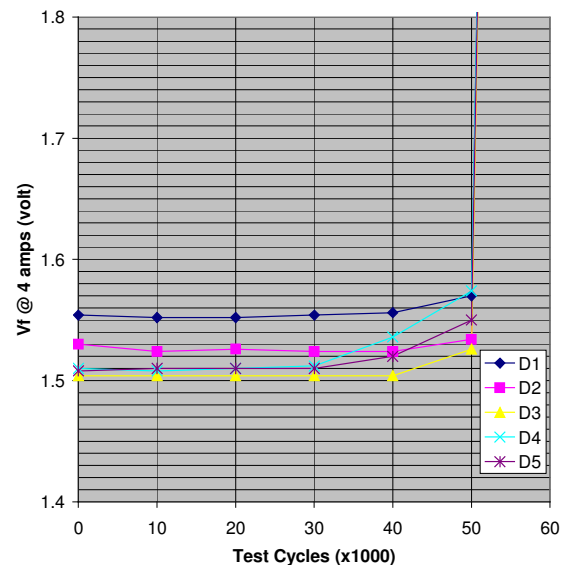


Figure 1: *ZERO RECOVERY*® Schottky diodes forward voltage at 4 amp, measured before testing and at 10,000 cycle intervals.

Conclusion

50,000 Cycles is at least an order of magnitude greater than these devices would see during normal operational life. Therefore the *ZERO RECOVERY*® Schottky diodes can tolerate increased surge currents by allowing the diode junction temperature to transition as high as 200°C with out affecting device reliability.

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.

Copyright © 2001-2005 Cree, Inc. All rights reserved. Permission is given to reproduce this document provided the entire document (including this copyright notice) is duplicated.

The information in this document is subject to change without notice.

Cree and the Cree logo are trademarks of Cree, Inc.

Cree, Inc.
Power Products
4600 Silicon Drive • Durham, NC 27703 • USA
Tel: 919-313-5300 • Fax: 919-313-5451
www.cree.com