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Guideline for Evaluating Bipolar Degradation of Silicon Carbide Power Devices

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GUIDELINE FOR EVALUATING BIPOLAR DEGRADATION OF SILICON CARBIDE POWER DEVICES

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Foreword

This document has been drafted by the JEDEC JC-70.2 SiC Power Electronics Conversion Semiconductor Standards subcommittee consisting of recognized industry experts from various research centers, universities and power semiconductor companies.

The intent is to provide guidance to SiC product suppliers and related power electronic industries in their evaluation of bipolar degradation mechanism in SiC power devices.

Introduction

Silicon carbide (SiC) is widely used as a semiconductor material for next-generation power semiconductor devices. SiC, as compared with silicon (Si), has superior physical properties such as a higher breakdown electric field, higher thermal conductivity, lower thermal generation rate, higher saturated electron drift velocity, and lower intrinsic carrier concentration. With these attributes, it is possible to fabricate SiC-based power semiconductor devices with faster switching speeds, lower losses, higher blocking voltages, and higher temperature operation relative to standard Si based power semiconductor devices. With these advantages SiC-based power semiconductor devices have captured a small and growing share of the power electronics market. To continue this market share growth, reliability concerns of SiC devices must be thoroughly addressed.

One of the reliability issues is body diode degradation that results in on-state resistance increase of metal-oxide semiconductor field effect transistors (MOSFETs) that can be triggered by current flowing through the body diode when it is forward biased. In some reports, this degradation also increases the off-state leakage. Therefore, it is indispensable to establish an international guideline with regard to evaluation of parametric stability under bipolar conduction stress as a reliability issue. This guideline defines the evaluation method of on-state resistance increase due to source-drain body diode current stress in SiC MOSFETs.