IEC 63275-2

Edition 1.0 2022-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Semiconductor devices – Reliability test method for silicon carbide discrete metal-oxide semiconductor field effect transistors –
Part 2: Test method for bipolar degradation due to body diode operation

Dispositifs à semiconducteurs – Méthode d'essai de fiabilité pour les transistors à effet de champ métal-oxyde-semiconducteurs discrets en carbure de silicium –
Partie 2: Méthode d'essai de la dégradation bipolaire due au fonctionnement de la diode intrinsèque

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Part 2: Test method for bipolar degradation due to body diode operation

FOREWORD

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The text of this International Standard is based on the following documents:

Draft	Report on voting
47/2756/FDIS	47/2765/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 63275 series, published under the general title *Semiconductor devices – Reliability test method for silicon carbide discrete metal-oxide semiconductor field effect transistors*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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 carrier generation rate, higher saturated electron drift velocity, and lower intrinsic carrier concentration. These attributes realize 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.

Possible reliability issues include on-state voltage drop change, on-state resistance increase and reverse drain voltage change of metal-oxide semiconductor field effect transistors due to a current flowing through the body diode. This occurs because the body diode current causes the formation of stacking faults that expand within the drift region of the MOSFET and impede current flow within the area that they occupy. This increases the on-state resistance and degrades the operation of the power electronics system. This effect will only occur if the active device volume contains basal plane dislocations (BPDs), and there is electron-hole pair (EHP) recombination such as occurs during forward biasing of the body diode of the SiC MOSFET. That means some of the devices may show parameter drift, others will not drift. Therefore, it is indispensable to establish an International Standard with regard to evaluation of on-state voltage drop change and on-state resistance change as reliability issues.

This document defines the evaluation method of on-state voltage drop change and on-state resistance change under body diode current stress on SiC metal-oxide semiconductor field effect transistors.

SEMICONDUCTOR DEVICES – RELIABILITY TEST METHOD FOR SILICON CARBIDE DISCRETE METAL-OXIDE SEMICONDUCTOR FIELD EFFECT TRANSISTORS –

Part 2: Test method for bipolar degradation due to body diode operation

1 Scope

This part of IEC 63275 gives the test method and a procedure using this method to evaluate the on-state voltage change, on-state resistance change and reverse drain voltage change of silicon carbide (SiC) power MOSFET devices due to body diode operation. This test is not generally requested for Si power transistors.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60747-8, *Semiconductor devices – Discrete devices – Part 8: Field-effect transistors*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60747-8 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
silicon carbide
compound semiconductor material composed of silicon and carbon

3.2
on-state voltage change
change in the on-state voltage ($V_{DS(on)}$) due to body diode current stress from the source terminal of the device to the drain terminal

3.3
on-state resistance change
change in the on-state resistance ($R_{DS(on)}$) due to body diode current stress from the source terminal of the device to the drain terminal

3.4
reverse drain voltage change
change in the reverse drain voltage (V_{SD}) due to body diode current stress from the source terminal of the device to the drain terminal