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Photovoltaic modules – Bypass diode – Thermal runaway test

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PHOTOVOLTAIC MODULES – BYPASS DIODE –
THERMAL RUNAWAY TEST**

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Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

During the normal operation of PV modules the bypass diodes are reverse biased. When the PV module is partially shaded (for example by utility poles, buildings, or leaves), some of the cells in the PV module may not be able to produce the current being produced by the other cells in the series string. The shaded cells are then driven into reverse bias so the bypass diode of the shaded cell-string becomes forward bias protecting the shaded cells.

Under these circumstances, the temperature of the bypass diode increases due to the forward current flowing through the diode. It is in this condition that the diodes are tested in accordance with IEC 61215-2:2016, 4.18.1: Bypass diode thermal test. When the shade is removed, operating conditions return to normal and the bypass diode is again reversed biased.

Some of the diodes utilized as bypass diodes in PV modules have characteristics where the reverse bias leakage current increases with the diode temperature. So if the diode is already at an elevated temperature when reverse biased, there will be a substantial leakage current and the diode junction temperature can increase considerably. The worst case occurs when this heating exceeds the cooling capability of the junction box in which the diode is installed. As a result of this increasing temperature and leakage current, the diode can break down. These phenomena are called “thermal runaway”. The thermal design of the bypass diode in the junction box shall be verified to ensure that thermal runaway does not occur.

PHOTOVOLTAIC MODULES – BYPASS DIODE – THERMAL RUNAWAY TEST

1 Scope

This document provides a method for evaluating whether a bypass diode as mounted in the module is susceptible to thermal runaway or if there is sufficient cooling for it to survive the transition from forward bias operation to reverse bias operation without overheating.

This test methodology is particularly suited for testing of Schottky barrier diodes, which have the characteristic of increasing leakage current as a function of reverse bias voltage at high temperature, making them more susceptible to thermal runaway.

The test specimens which employ P/N diodes as bypass diodes are exempted from the thermal runaway test required herein, because the capability of P/N diodes to withstand the reverse bias is sufficiently high.

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 TS 61836, *Solar photovoltaic energy systems – Terms, definitions and symbols*