

Subject 1557

September 7, 2018

SUMMARY OF TOPICS

The following changes in requirements to the Standard for Electrically Isolated Semiconductor Devices, UL 1557, are being proposed:

- 1. Define Requirements for Series End Test as Minimum Values for Compliance to IEC***
- 2. Power Electronic Modules with Ceramic Insulation***

STP BALLOTS AND ALL COMMENTS DUE: October 8, 2018

UL's goal is to have no interest category comprise more than one-third of the STP membership balance. To improve the current balance for STP 1557, UL is looking for participants in all interest categories. Definitions for these interest categories are available on the Standards STP Internet site:

<http://ulstandards.ul.com/develop-standards/participation/interest-categories/>

If you are interested in applying for STP 1557 membership or are aware of potential candidates for this STP, please contact the STP Project Manager at Mitchell.Gold@ul.com.

For your convenience in review, proposed additions to existing requirements are shown underlined and proposed deletions are shown ~~lined-out~~.

1. Define Requirements for Series End Test as Minimum Values for Compliance to IEC

RATIONALE

Proposal submitted by: Daniel Hoffmann, Infineon Technologies AG

UL 1557 determines a production-line test of the dielectric strength by testing the 'rated isolation voltage' for 60 seconds or 120 percent of the rated isolation voltage for one second.

There is no explicit definition of 'rated isolation voltage'. The 'rated isolation voltage' is implicitly defined in the standard, in paragraph 12.1. The isolation voltage is defined as the dielectric strength, which the component can withstand for 60 seconds. It is not determined whether this condition can be applied only once, or for each insulation test during maintenance.

For semiconductor devices with a rated blocking voltage exceeding 4500 V, the test with a duration of 1 second is difficult to implement.

There are several IEC standards that have to be considered for international market access as well. The IEC 61287, for example, limits the duration of the dielectric strength test to 10 seconds. In combination with IEC 62497, semiconductors have to be pre-tested with a 25% higher voltage in their initial production line test. This is to enable rated isolation voltage testing at the converter level.

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We are compelled to define the rated isolation voltage as the voltage the customer may use for repetitive device testing.

The IEC and UL standards are not compatible here. The IEC 61287 requires a test of 125% of the rated isolation voltage for 10 seconds.

The application aims to define the UL 1557 specifications for test duration and test voltage as minimum values. The change of definition of a rated isolation voltage is out of scope.

PROPOSAL

14.2 The production-line test potential shall be at least the rated isolation rms voltage for 60 seconds or at least 120 percent of the rated isolation rms voltage for a minimum of one second.

Exception: For a dc test potential:

- a) At least 1.414 times the rated isolation rms voltage for one minute, or*
- b) At least 1.414 X 1.2 times the rated isolation rms voltage for at least one second.*

2. Power Electronic Modules with Ceramic Insulation

RATIONALE

Proposal submitted by: Thomas Harder, ECPE - European Center for Power Electronics e.V.

The applicable test conditions for the insulation stability of power electronic modules according to the "UL Standard for Safety for Electrically Isolated Semiconductor Devices, UL 1557" has been a source of discussion in several instances in the past. The problem of applicable test conditions is related to special operation conditions of power electronic modules.

UL 1557 (12/2011) states in Section 7 that insulating materials shall have a thermal index at least equal to the insulating material operating temperature. If the thermal index (RTI value specified in the material yellow card) is lower than the insulating material operating temperature, a Limited Thermal Ageing test (LTA) as specified in UL 1557 Section 13 must be performed. During the LTA, 3 samples are stored in an oven for typically 1000 hours at a temperature defined by the temperature index lines defined in Figure 13.1. All three samples of the device shall be capable of withstanding the rated isolation rms voltage when tested as described in 12.1 and 12.2.

The discussion on material RTI ratings and LTA test condition is related to the definition of the insulating material operating temperature, which is defined in section 5.4:

5.4 INSULATING MATERIAL OPERATING TEMPERATURE – The maximum temperature of the insulating material for either the semiconductor device or module when operating in accordance with the manufacturer's specifications, usually the maximum junction temperature.

The major source of discussion, however, is the definition of the insulating material operating temperature in relation to power modules. Power module data sheets specify two absolute maximum ratings: the maximum junction temperature $T_{j,op,max}$ and the maximum case temperature $T_{c,max}$. The maximum case temperature $T_{c,max}$ limits the maximum value measured at any surface position of a power semiconductor package. Both values shall not be exceeded during operation. These limits