JEDEC STANDARD

Definition of External Clearance and Creepage Distances of Discrete Semiconductor Packages for Thyristors and Rectifier Diodes

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JEDEC SOLID STATE TECHNOLOGY ASSOCIATION

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DEFINITION OF EXTERNAL CLEARANCE AND CREEPAGE DISTANCES OF DISCRETE SEMICONDUCTOR PACKAGES FOR THYRISTORS AND RECTIFIER DIODES

(From JEDEC Council Ballot JCB-90-02, formulated under the cognizance of JEDEC Committee JC-22.2 on Diodes.)

INTRODUCTION

This Standard defines reference distances for the external package. It specifically excludes transistors, non-hermetic devices (leak rate > 1 x 10^{-6} standard cubic centimeter/second) and assemblies of semiconductor devices such as thyristors and rectifier diodes.

The reader's attention is called to the fact that the voltages given in Table 1 are working voltages as seen by the semiconductors in the equipment and in all probability would be considerably less than the voltage ratings of the semiconductors themselves. Good industrial practice, particularly with respect to power semiconductor components, is to subject them to a working peak reverse voltage (PRV) in the order of only 40% - 50% of the component repetitive rating.

Additionally, it should be noted that low-current semiconductors, that generally are built in housings where the clearance and creepage distance are quite small, are in most cases connected only to control power sources having limited short circuit capability. In many cases less than 500 VA (volt amperes), and seldom, if ever, greater than 10 kVA.

Clearance and creepage distances given in Table 1 apply only to the external terminals of semiconductor devices. They do not apply to internal distances, nor do they pertain to creepage and clearance distances for electrical isolation that may be used to isolate all the active terminals of a power semiconductor from a metallic mounting surface. Other Standards dealing with internal distances and isolation in industrial equipment would apply in this case, see NEMA Standard ICS-1, "General Standard for Industrial Control and Systems", for more information.

The distances given in Table 1 do not apply between external terminals and the case of a semiconductor when the case is made of electrically conducting material and is not intentionally connected to any of the external terminals.

The creepage distances shown in Table 1 are for clean, dry surfaces and those conditions are to be maintained by the user. This Standard recognizes that properly applied protective coatings improve resistance to contamination and may be required under certain conditions. It is anticipated that, normally, insulator surfaces will be glass or glazed ceramic. However, this Standard does provide that other insulating materials (i.e., rubber or plastic, for example) having suitable insulation properties, may be molded or otherwise attached to the basic device housing and terminations to increase the creepage and clearance distances.

1. SCOPE

This document represents a resolution of existing practices and standards. It specifically excludes transistors, non-hermetic devices (leak rate > 1 x 10^{-6} standard cc/s) and assemblies of semiconductor devices such as thyristors and rectifier diodes.

2. PURPOSE

The purpose of this Standard is to provide external strike and creepage distances to be used in the design of the subject semiconductor devices in such a manner that insulation coordination in any given installation is possible.

3. RELATED DOCUMENTS

ICS-1 "General Standard for Industrial Control and Systems", 1978

NEMA
National Electrical Manufacturers Association
2101 L Street, N.W.
Washington, D.C. 20037

4. DEFINITIONS

4.1 Creepage Distance (NEMA ICS-1, Part 100)

The shortest path measured over the external insulator surface, from the anode terminal to the cathode terminal of a rectifier diode; or from the anode terminal to the cathode or gate terminal of a thyristor. See Notes 1, 2 and 3.

4.2 Clearance Distance (NEMA ICS-1, Part 100)

The shortest external distance measured through air from the anode terminal to the cathode terminal of a rectifier diode; or from the anode terminal to the cathode or gate terminal of a thyristor. See Notes 1 and 4.

NOTE 1: When the thyristor is a bidirectional type, the anode and cathode terminals become main terminal 2 and main terminal 1 respectively in the definition.

NOTE 2: If the anode-to-cathode or anode-to-gate insulation consists of two or more insulators with intervening conducting segments that are electrically isolated (floating), the creepage distance may be computed as the sum of the shortest paths over the external surface of each insulator.

NOTE 3: If the anode-to-cathode insulator surface is pierced by a conducting pin that is electrically isolated (floating) the dimension across the pin is not to be included in any creepage path that passes through the pin.

NOTE 4: Clearance distance for a disc type semiconductor device is to be measured between two flat parallel plates with the semiconductor device mounted between them and recommended mounting force applied. The method of measuring clearance distances pertains to the disc type device itself and is not intended to define clearance distances when the disc type device is built into an assembly. Clearance distances to isolated (floating) electrically conducting parts of the semiconductor device case are to be ignored.

5. GENERAL

5.1 Spacing (NEMA ICS-1, Part 111)

The publication applies to hermetically sealed rectifier diodes and thyristors for use in three (3) classes of service. Factors such as steady-state voltage waveform and frequency, transient over-voltage conditions, properties of insulating material, environmental pollution, moisture, available source power, service life expectancy, consequences of failure, altitude above sea level, etc., will determine which class of equipment the manufacturer will choose for his application.

The clearances and creepage distances given in Table 1 do not apply to internal distances of hermetically sealed rectifier diodes and thyristors; however, the external terminals (including electrically isolated, conducting members such as terminals, and/or device case) of such components shall have clearance and creepage distances specified in this document. This also does not pertain to clearance distances that may be used to isolate the terminals of power or enclosure walls, or other terminals of adjacent semiconductor devices.

The creepage distances shown in Table 1 are for clean, dry surfaces and these conditions shall be maintained. Properly applied protective coatings improve resistance to contamination and are required under certain conditions. Normally, insulator surfaces will be glass or ceramic. However, other materials (rubber or plastics for example) with suitable insulation properties may be molded or otherwise attached to the basic device housing and terminations to increase the creepage and clearance distances. Creepage distances shorter than 0.125 inch are especially susceptible to trouble because of contamination by dirt, moisture, conducting particles, etc.

The instantaneous peak (or crest) working voltage shown in Table 1 is normally somewhat less than the device (rectifier diode or thyristor) repetitive peak voltage rating. In no case should the instantaneous peak working voltage exceed the device repetitive peak voltage rating.

Table 1
Clearance and Creepage Distances for
Use Where Transient Voltages are Controlled and Known

	Instantaneous Working Voltage, Volts			Clearance Distance Through Air, Inches	Clearance Distance Through Air, mm (see Note 4)	Creep Distance Along Surface, Inches	Creep Distance Along Surface, mm
A. For general use where transient voltages are controlled and known	0	-	50	0.030	0.76	0.030	0.76
	51	-	225	0.075	1.90	0.075	1.90
	226	-	450	0.130	3.30	0.130	3.30
	451	-	900	0.130	3.30	0.130	3.30
	901	-	2100	0.185	4.70	0.185	4.70
	2101	-	2600	0.420	10.7	0.420	10.7
	2601	-	3500	0.600	15.2	0.600	15.2
B. For use where the power is limited to a short circuit of 10 kVA or less (See Note 1)	0	-	30	0.030	0.76	0.030	0.76
	31	-	50	0.030	0.76	0.030	0.76
	51	-	225	0.030	0.76	0.030	0.76
	226	-	450	0.040	1.02	0.040	1.02
	451	-	900	0.055	1.40	0.055	1.40
	910	-	2100	0.185	4.70	0.185	4.70
C. For use where the power is limited to a short circuit of 500 VA or less (See Note 1)	0	-	100	0.014	0.36	0.014	0.36
	101	-	225	0.014	0.36	0.014	0.36
	226	-	450	0.025	0.64	0.025	0.64
	451	-	900	0.050	1.27	0.050	1.27

NOTE 1: Maximum short-circuit VA is determined as the product of the open circuit voltage and the short-circuit amperes available at the supply terminal when protective devices are by-passed.

NOTE 2: This Table is primarily intended for use at altitudes of up to 1000 meters (approximately 3300 feet).

NOTE 3: This Table applies where provision is made to limit random non-repetitive surge and transient voltages to 150% of the instantaneous peak working voltage between the terminals of the device (rectifier diode or thyristor).

NOTE 4: Dimensions in inches are controlling. Equivalent metric (mm) values are shown for convenience only.

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