

JEDEC STANDARD

Thermal Resistance Measurements of Conduction Cooled Power Transistors

JESD313B

(Revision of EIA-313-B formerly RS-313-B)

OCTOBER 1975 (Reaffirmed: APRIL 1981, APRIL 2001)

JEDEC SOLID STATE TECHNOLOGY ASSOCIATION



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Published by
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FOREWORD

This standard describes a recommended test method for measuring the thermal resistance of conduction-cooled power transistors. This method is offered as a replacement for that contained in EIA/NEMA Standard RS-313-A (March 1968) which has been found deficient in its test method detail. The present method is the emitter-base forward voltage method with emitter-base switching and treats the detail circuitry, test instruments, calibration and precautions to assure reliable and reproducible measurement. It generally conforms to the principle of MIL-STD-750 Method 3131 and to IEC Publication 147-C2 Method 12.3.1. However, experience has shown that the test performed under this Standard is applicable to all power transistors regardless of thermal response times.

This material was prepared by JEDEC Committee JC-25 on Power Transistors and approved for publication by the JEDEC Solid State Products Council.

THERMAL RESISTANCE MEASUREMENTS OF CONDUCTION COOLED POWER TRANSISTORS

(From Standards Proposal No. 1179, formulated under the cognizance of the JC-25 JEDEC Committee on Power Transistors.)

1. THERMAL RESISTANCE, JUNCTION to SPECIFIED REFERENCE POINT ($R_{\theta JR}$).

1.1 General Considerations. Of the thermal characteristics of a semiconductor device, the most frequently specified parameter is the thermal resistance between the chip and a reference point such as the device case or ambient.

The thermal resistance of a semiconductor device is a measure of the ability of its mechanical structure (package) to provide for heat removal from the semiconductor junction. In most devices, the maximum junction temperature can't be measured directly since the area of interest is not accessible due to packaging considerations. Thus, indirect means are used to infer the temperature of a specific area on the chip. The thermal resistance of a semiconductor device is therefore determined by the measurement of a temperature-sensitive electrical parameter of a semiconductor junction within the device.

The measured thermal resistance of semiconductor elements (transistors) is not constant as frequently assumed, but depends on the device operating conditions, the junction and reference point temperatures, and the temperature-sensitive parameter chosen. When specifying thermal resistance, it is therefore important to indicate clearly the measuring conditions. The temperature sensitive device parameter is used as an indicator of an average (weighted) junction temperature of the semiconductor element for calculations of thermal resistance.

In measuring power transistor thermal resistance, either the emitter-base forward voltage or the collector-base forward voltage can be used as the temperature sensitive electrical parameter to indicate the junction temperature. Although equally precise, the Emitter-Base Voltage Technique has been found to be more accurate than the Collector-Base Voltage Technique, i.e., the Emitter-Base Voltage Technique gives a junction temperature closer to the actual peak temperature on the chip. The greater inaccuracy of the Collector-Base Voltage Technique is due to the greater deviation between the region of the collector junction traversed by the measuring current during calibration and the region traversed during test.

1.2 The Measurement of Thermal Resistance, Junction to Specified Reference Point ($R_{\theta JR}$), using the emitter-base voltage of a transistor in the emitter-only switching mode as the temperature sensitive parameter.

1.2.1 Purpose. The purpose of the test is to measure the junction to specified reference point thermal resistance of single element transistors by using the emitter-base junction to indicate the device junction temperature. This method is to be used as the standard