

CORRECTLY MEASURING CASE AND BOARD TEMPERATURE

In the management of electronics, it is of critical importance to understand the operating conditions of components. In order to understand the characteristics of a component, almost all vendors provide JEDEC determined thermal parameters Θ_{JC} (junction to case resistance) and Θ_{JB} (junction to board resistance) as functions from which the operating conditions can be determined. These functions allow silicon temperature (junction) to be monitored, and thermal performance of similar devices to be contrasted.

Many lower complexity devices do not offer the luxury of a silicon thermal diode, and so the external package must be measured in situ to determine life, creep or performance. The incorrect application of measurement techniques can alter these figures dramatically and provide a false impression of operating conditions.

CASE TEMPERATURE:

Defined as the hottest temperature on top of the device. It is recommended that a thermocouple (type J or K) of 36 gauge wire or less is utilised, with the wire dressed along its length, to avoid heatsinking of the thermocouple against the device case [1].

If the case is exposed, the thermocouple should:

1. be attached to the centre of the package ($\pm 1\text{mm}$) with a bead of thermally conductive epoxy no larger than $2\text{mm} \times 2\text{mm}$
2. be routed along the diagonal of the package, down to the PCB surface over a minimum of 25mm before lifting from PCB

If the case has a heatsink applied:

1. Drill a hole of less than 1mm in the heatsink at the centre of the device. The hole should be chamfered to accommodate the thermal epoxy
2. Thread the thermocouple through the hole from the top of the heatsink
3. Attach the thermocouple to the device with thermally conductive epoxy, oriented perpendicular to the package top surface
4. Once the epoxy has cured, slide the heatsink on top of the package without damaging the thermocouple

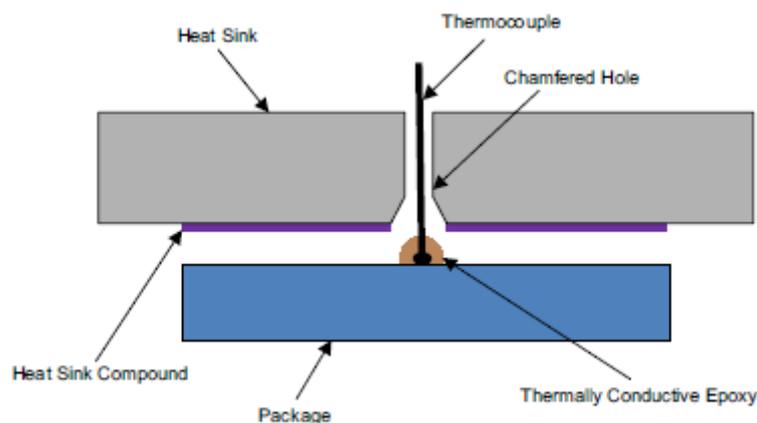


FIGURE 1 - MEASURING THE CASE TEMPERATURE OF A DEVICE THROUGH A HEATSINK [1]

BOARD TEMPERATURE:

The board temperature is typically the hottest area directly underneath the component. However as it is generally impossible to access this area, nearby conductive elements can be utilised as an alternative.

It is recommended a 40 gauge thermocouple is utilised, which is type T as these are more easily soldered.

For a leaded package, the thermocouple should be soldered to the foot of a package lead halfway along the side.

For an area array surface mount, the thermocouple should be attached directly to the board trace halfway along one side of the package. This should be within 1mm of the package body, solder mask may need to be removed to allow direct attachment.

Direct contact should be made to a board trace or package foot, and verified by testing the electrical conductivity. A thermally conductive epoxy bead no larger than 3mm should be applied over the joint to reduce temperature gradients to the wire and support the joint.

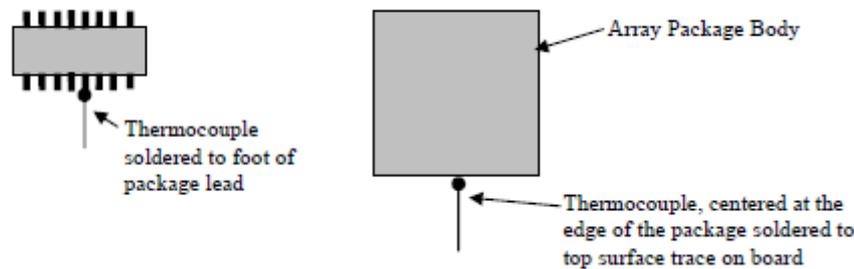


FIGURE 2 - MEASURING THE BOARD TEMPERATURE OF A DEVICE [2]

REFERENCES

- [1] H. N. D Edwards, "Texas Instruments," Texas Instruments, April 2016. [Online]. Available: <https://www.ti.com/lit/an/spra953c/spra953c.pdf>.
- [2] JEDEC, "Integrated Circuits Thermal Test Method Environmental Conditions - Natural Convection (Still Air)," JEDEC Solid State Technology Association, Arlington, 2008.