Diode Temperature Sensor Calibration – Bath versus Oven Approaches
(cont'D)

The most common way to measure junction temperature when performing semiconductor thermal measurements is to use a diode intrinsic to the device under measurement as a temperature sensor. The relationship between the diode voltage and the diode junction temperature has to determined – i.e., calibrated – before the thermal measurements can begin. (Refer to TB-02 DIODE TEMPERATURE SENSING for more information.)

There are typically two ways to establish the temperature environment for the calibration process. One approach is to insert one or more devices into a temperature-controlled liquid bath – referred to as the "Bath" approach. The other is to insert one or more devices into a temperature-controlled laboratory oven – referred to as the "Oven" approach. Theoretically, both approaches are equally accurate. The difference lies in the practical implementation of each approach.

The "Bath" approach has the following limitations –

a) If the bath is relatively small, there is a limit to the number of units can be measured at one time. The more units stuffed into the bath, the greater the chance of a temperature differential between the units at a given bath set temperature. Further, this temperature differential will likely vary with bath set temperature. These two issues can easily affect the accuracy of the K Factor measurement. These kinds of problems are made worse if the bath size is increased to accommodate a larger number of units.

b) The bath liquid does not have a uniform temperature distribution. These could lead to accuracy and repeatability problems. Common practice is to stir the liquid in an attempt to reduce the temperature distribution but this usually makes the matter worse because the stirring makes the laminar flow issues worse.

c) When dealing with non-hermetic packages, the bath liquid becomes an issue if it leaks into the package. Depending on the specific liquid used, the package thermal characteristics could change enough to distort the thermal measurements.

d) The bath liquid has to be thoroughly cleaned off the package and the board before the thermal testing is started. This is both messy and time consuming. The bath liquid may cause other problems in the case of non-hermetic packages.

The "Oven" approach has the following limitations –

a) Depending on the oven, there may be some temperature differential between devices. However, if the right oven is used (such as the TEA CE-100), the oven chamber is large enough to insure that all thermal test boards inserted into TEA's TF-901 calibration fixture are at approxi-

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mately the same temperature at both low and high oven temperatures. The slight temperature differential between units (typically less than 1 degree C) is not an issue because the process requires differential measurements (i.e., T_{high} - T_{low}) which helps to minimize calibration errors.

b) The oven is larger, requiring more table space, than the bath apparatus and probably uses more electricity than the bath apparatus.