

JEDEC STANDARD

Temperature Cycling

JESD22-A104F.01

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JEDEC SOLID STATE TECHNOLOGY ASSOCIATION



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TEST METHOD A104F.01 TEMPERATURE CYCLING

(From Board Ballot JCB-00-16, JCB-05-82, JCB-09-20, JCB-14-45, and JCB-20-31, formulated under the cognizance of the JC-14.1 Committee on Reliability Test Methods for Packaged Devices.)

1 Scope

This standard applies to single-, dual- and triple-chamber temperature cycling in an air or other gaseous medium and covers component and solder interconnection testing. In single chamber cycling, the load is placed in a stationary chamber and is heated or cooled by introducing hot or cold air into the chamber. In dual-chamber cycling, the load is placed on a moving platform that shuttles between stationary chambers maintained at fixed temperatures. In triple-chamber temperature cycling there are three chambers and the load is moved between them. (This standard does not cover thermal shock conditions that leverage fast ramp rates commonly associated with thermal energy liquid coupling media used by thermal shock chambers.)

This test is conducted to determine the ability of components and solder interconnects to withstand mechanical stresses induced by alternating high- and low-temperature extremes. Permanent changes in electrical and/or physical characteristics can result from these mechanical stresses.

2 Terms and definitions

2.1 load: The sample(s) and associated fixtures (trays, racks, etc.) in the chamber during the test.

2.2 working zone: The volume in the chamber(s) in which the temperature of the load is controlled within the specified conditions.

2.3 sample temperature (T_s): The temperature of the samples during temperature cycling, as measured by thermocouples or equivalent temperature measurement apparatus affixed to, or imbedded in, their bodies.

NOTE The thermocouple, or equivalent temperature measurement apparatus, attachment method used should ensure that the entire mass of the sample(s) is reaching the temperature extremes and the soak requirements.

2.4 maximum sample temperature: ($T_{s(max)}$): The maximum temperature experienced by the sample(s) as measured by thermocouples, per 3.3.

2.5 minimum sample temperature: ($T_{s(min)}$): The minimum temperature experienced by the sample(s) as measured by thermocouples, per 3.3.

2 Terms and definitions (cont'd)

2.6 load transfer time: The time it takes to physically transfer the load from one temperature chamber and introduce it into the other. Load transfer applies to dual and triple chamber cycling.

2.7 maximum load: The largest load that can be placed in the chamber and still meet the specified temperature cycling requirements as verified by thermocouples, per 3.3.

2.8 nominal ΔT : The difference between nominal $T_{s(max)}$ and nominal $T_{s(min)}$ for the Temperature Cycling Test Condition; see Table 1.

2.9 soak time: The total time the sample temperature is within a specified range of each nominal $T_{s(max)}$ and nominal $T_{s(min)}$. This range is defined as the time T_s is at $-5\text{ }^{\circ}\text{C}$ to $+10\text{ }^{\circ}\text{C}$ $\pm 15\text{ }^{\circ}\text{C}$ (dependent on the Test Condition tolerance) of $T_{s(max)}$ nominal for the upper end of the cycle and the time T_s is $+5\text{ }^{\circ}\text{C}$ to $-10\text{ }^{\circ}\text{C}$ of $T_{s(min)}$ nominal for the lower end of the cycle.

2.10 soak temperature: The temperature range that is $-5\text{ }^{\circ}\text{C}$ to $+10/+15\text{ }^{\circ}\text{C}$ (dependent on the Test Condition tolerance) of $T_{s(max)}$ nominal and $+5\text{ }^{\circ}\text{C}$ to $-10\text{ }^{\circ}\text{C}$ of $T_{s(min)}$ nominal.

2.11 (temperature) cycle time: The time interval between one high-temperature extreme to the next, or from one low-temperature extreme to the next, for a given sample; see Figure 1.

2.12 ramp rate: The rate of temperature increase or decrease per unit of time for the sample(s).

NOTE 1 Ramp rate should be measured for the linear portion of the profile curve, which is generally the range between 10% and 90% of the test condition temperature range; see points **a** and **b** in Figure 1.

NOTE 2 Ramp rate can be load dependent and should be verified for the load being tested.

2.13 test conditions: The various temperature cycle range options listed in Table 1.

2.14 soak mode: The categorization nomenclature that defines minimum soak time at soak temperature (max) & soak temperature (min) in minutes.

NOTE 1 Each Test Condition will have four possible Soak Modes. These Soak Modes are listed in Table 2.

NOTE 2 The soak mode selected is dependent on the failure mechanism of interest.

2.15 nominal $T_{s(max)}$: The temperature of the sample required to meet the maximum nominal temperature for a specific test condition; see Table 1.

2.16 nominal $T_{s(min)}$: The temperature of the sample required to meet the minimum nominal temperature for a specific test condition; see Table 1.