

# **1 INTRODUCTION**

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Thermal management becomes most focused and important area in various fields due to requirement of heating and cooling which are integral part of all universal systems, like military research applications, cooling of materials during heat treatment, machine structure cooling, very large scale electronics cooling, lightning source cooling, turbine components cooling, engine / reciprocating devices cooling, cooling during metal machining, space cooling, high speed plane cooling, recirculating coolant cooling, process industry cooling applications, LED lighting cooling, mobile cooling, data center cooling, etc. These applications of cooling need are having due importance as the overheating may cause the entire system to collapse with major damage. Electronics cooling is one of the area which helps in improving processing speed, life and reliability of systems used in household appliances to military applications. The hard failure of systems will result in damaging components and may even lead to burning by creating serious effects on entire plant and operations.

In electronic systems only active components are not generating heat, but all other surrounding subsystems are also to be carefully kept under observation. Sometimes wires, power sources are also generating heat. The position of heat generation and quantity, both are equally significant.

## **1.2 Need of electronics cooling**

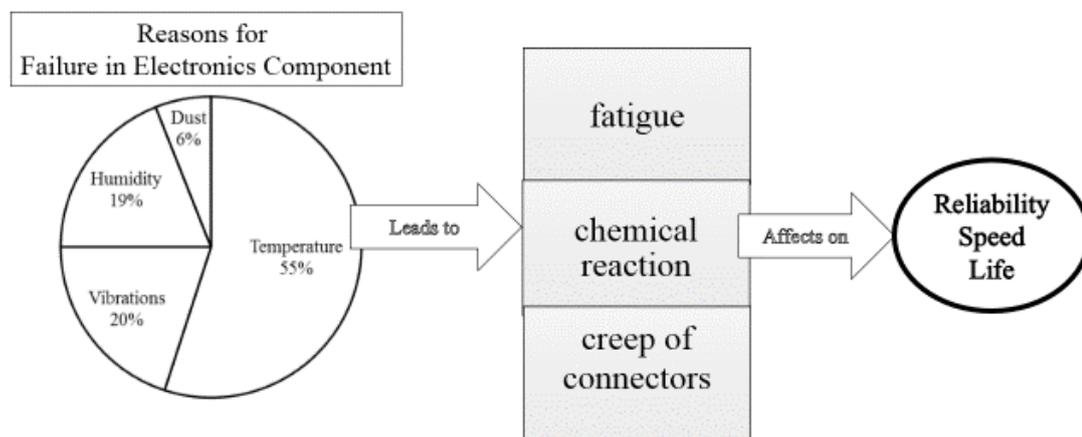
Higher temperatures of semiconductors are giving low performance reliability and lower life. Larger electronic components density, compact system needs, importance of operational reliability, exceeding limits of simple conventional cooling system are compelling to think thermal designers to work on thermal management. Designers are challenged by heat load which is increasing from 800 to 8000 W/m<sup>2</sup> during 1992 to 2010 for workstations. The challenge became tough with 20000 W/m<sup>2</sup> for servers and communication equipment in 2010. [1]

Thermal design is considered a secondary issue at the initial electronics circuit design stage, which often seriously affects the reliability, consistency and life cycle of the

product. The excessive heating leads to fatigue, chemical reaction and creep of connecting material of component. To develop decent and feasible solutions, the thermal management of electronics systems can be broadly classified as:

1. Chip level cooling : Using high thermal conductive material control of junction temperature, good conductive adhesives, thermal pastes, use of better materials
2. Array level: in which PCBs and combination and placements of components are important and addressed for cooling solution.
3. Component level: Entire component can be addressed w. r. t. availability of space by using air cooling, liquid cooling, use of fins, heat pipe, etc.
4. Packaging level : In which entire systems and power supply in combination with casing, exit ways will be solved by considering flow, volume, fluid rate, heat dissipation, etc.

Failure in electronics components are found highest due to excessive temperature (55%), followed by component and system vibrations (20%), humidified area (19%) and dust particles (6%). [2]. (Fig. 1.1) As junction temperature of a component increases, the failure rate increases exponentially. Failure rate increases by two times for temperature rise of 10°C for the electronic component.



**Fig. 1.1 : Electronics components failure analysis**

With reference to heat conditions, the electronics components are tested for High temperature shelf test, high temperature load test, high temperature and high humidity test, thermal shock test.

Packaging engineers which are not related to functional framework, but are concerned with small and smaller versions of systems which are better heat dissipater. Also they have to analyze hot spot, cold spot, flow path, component layout, heat dissipation, material properties. The developments in packaging are continued till date.

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