

VITA 50

Electronics Cooling

Best Practices

Proposed Approach:

- 1. Set Goals and Scope
- 2. Outline Desired Contents
- 3. Gather Public Information
 - Full credit to Authors and Author's Companies
- 4. Recruit Authors to fill in blanks
 - Full credit to Authors and Author's Companies
- 5. Arrange and Edit for Uniformity

Proposed Overall Goal:

- A Comparison and Description of available Methods of Cooling Electronics
- Others?

General Approach:

- “What can be done”

- *not*

- “How to do it”
- 

Scope of Vita 50

- Spectrum:
 - 1. Only air cooling (or any other method)
 - 2. Only well established cooling methods that are in production (air, conduction, liquid)?
 - 3. All demonstrated methods of cooling including those not yet in production?
 - 4. All cooling methods no matter how exotic or what their state of development?

First Section

- First Section will be to compare all the various Cooling methods in various criteria such as:
 - Capacity
 - Cost
 - Weight
 - Size
 - Complexity
 - Repairability
 - Reliability
 - Ruggedness
 - Maintenance
 - Consumables
 - Etc.
 - Etc.(as determined by the committee)

Detail Goal:

- Goal is to make it easy to compare the various methods of electronics cooling.
 - Charts
 - Keep apples compared to apples
 - Uniform Units (what type?)
 - Avoid outlandish Claims

Other Detail Goals

- Use Bookmarking to be able to easily drill down to subject of interest
- Use Pictures liberally
- Include Links to Suppliers
- Include Links to Supplier Engr. Tools
-
-
-

Background to Determine Organization of Vita 50 Spec.

- Cooling System Functions
- Food for Thought
- Methods of Organization

Primary Electronic Cooling System Functions:

- 1. Remove Heat (from immediate area of Source)
- 2. Move Heat (to where desired)
- 3. Dispose of Heat (ultimately to the environment)

(Real systems usually combine and blur the distinctions between the functions)

Famous old Cowboy Quote #1

- “There’s no such thang as coolin’, only movin’ heat around”

Famous old Cowboy Quote #2

- “Heat only moves downhill, and the steep’r the bett’r.”

Food for Thought:

- Heat will move through Static:
 - Solids
 - Liquids
 - Gases
- Only if there is a lower temperature at the other end of the material.
- Convection helps this process especially in the more mobile materials.
- But relatively little heat will move on its own.

Food for Thought:

- Heat will move better through Dynamic:
 - Solids
 - Liquids
 - Gases
- Much more heat can be removed when the heat moves into the material and then that material moves away from the heat source presenting new material.

Methods of Organization:

- Cooling can be organized by Material:
 - Solids (conduction plates, heat sinks, etc.)
 - Liquids (cold plates, etc.)
 - Gases (passive or forced air, etc.)

Methods of Organization:

- Cooling can be organized by Process:
 - Passive (conduction, passive air, liquid immersion etc.)
 - Active (forced air, liquid flow-thru cold plates, spray cooling, etc.)

Methods of Organization:

- Cooling can be organized by the Number of Stages required :
 - Single Stage (heatsink example: solid material takes heat from source, moves it to cooling fins, fins reject it to cooler ambient air)
(the common heatsink is a monolithic solid-state device that contains no moving parts)
(clever, but limited in heat capacity)

Methods of Organization:

- Cooling can be organized by the Number of Stages required :
 - Multiple Stages (server farm example:
 - Stage 1: heat moves by conduction from source to heat sink
 - Stage 2: forced convection air fan moves heat into room air
 - Stage 3: mechanical air conditioner moves heat from room air into outside air.
 - (advantage: heat can actually be rejected to temperatures higher than the device being cooled. (no, it doesn't defy thermodynamic laws)
 - (disadvantage: each system component needs considerable power and adds, not only that heat, but also it's own heat of inefficiency to the system, all of which ultimately has to be dumped to ambient.
 - (disadvantage: many moving pressurized fluids and high speed parts usually)
(clever, but costly in hardware, volume, weight, and power)

Methods of Organization:

- Cooling can be organized by Capacity to move Heat:
 - Spray Evaporative Cooling with Water
 - Spray Evaporative Cooling with Dielectric Fluids
 - Spray Jet Liquid Cooling
 - Submerged Jet Liquid Cooling
 - Liquid Flow Boiling
 - Liquid Pool Boiling
 - Spray Mist Cooling
 - Forced Air Cooling
 - Etc.