

C02-16 Thermal Management Solutions for Low Volume Complex Electronic Systems (LVCES)

Project Champions: Boeing, Honeywell, Raytheon, Rockwell-Collins

CALCE Team: M. Ohadi, C. Wilkinson

Objectives:

- To identify thermal management requirements and solutions that are currently available for electronic designers.
- To identify emerging technologies in electronic cooling
- To illustrate the application of these techniques to a typical avionics application

Background:

Over the past few years, CALCE researchers have been investigating a number of cooling systems that can be applied to electronic systems. These include liquid cooled metal matrix composite heat exchangers, solid liquid phase change materials (PCM), and compact thermosyphons using a microchannel evaporator. This work has generated interest in a number of members in the viability of novel cooling solutions for actual working designs.

There has been a general trend for suppliers of severe environment electronics to use 0°C-70°C parts as the availability of -55°C -125°C military parts is continuing to decline almost to the point of invisibility. Since the operating environment requirements have not moved, there is a difficult thermal management problem to solve. There has been one attempt at spray cooling (AAAV) but this may not be a practical approach for the majority of systems. Thermal management requirements tend to be 'boilerplated' from one generation to the next without any real thought as to what is reasonable and affordable. Current specifications try to cover the extremes of the distribution without attempting to constrain the limits to cover 'most' of the range. Limitations on traditionally accepted operating procedures and mission profiles may need to be accepted in order to constrain costs.

Approach:

This project will involve a compilation and review of current cooling solutions being used and/or marketed for low volume electronic systems, for example avionics. The study will provide a document with guidelines for electronics cooling, using an avionics application as an example of how these techniques might be applied to a typical system and an outline roadmap for future studies. This will include a study of innovative new cooling techniques that have potential application to electronics cooling. This project may be leveraged with work being conducted through the University of Maryland's Miniaturized and Intelligent Thermal Systems (MITS) Laboratory.

Deliverables:

- A survey of the current equipment level thermal management methodologies and their limitations.
- A document with guidelines for thermal management of electronics and a road map for future work
- Identify innovative technologies including source-integrated micro cooling devices.

Project Timeline

| | Q1 | Q2 | Q3 | Q4 |
|------------------------------|----------------------|----------|------------------------|----------|
| Task | | | | |
| Survey of current techniques | ████████████████████ | | | |
| Interim Report | | ██████ ▽ | | |
| Guidelines Document | | | ████████████████████ ▽ | |
| Cooling Roadmap | | | | ██████ ▽ |