

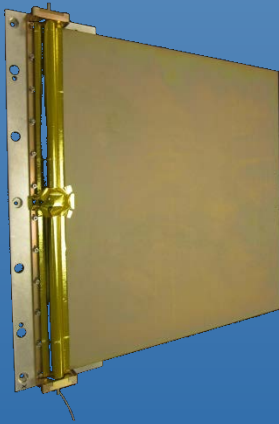


Thermal Management Technologies

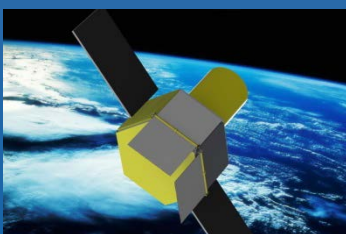
-Innovative Products and Engineering-

- Features-

- *Easily integrated*
- *Uniform temperature panel/ structure*
- *Low mass thermal/ structural solution*
- *Low thermal impedance panel-to-panel connections*
- *Operational temperature: -20 °C to +65 °C*
- *Multi-chambered to eliminate single point failures*



Prototype 100 W deployable radiator



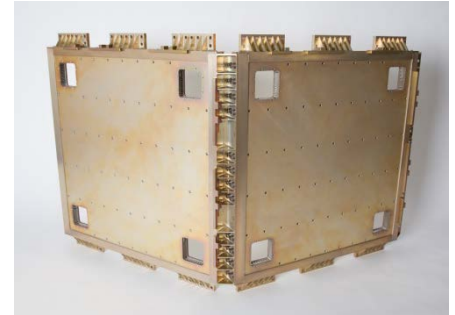
Spacecraft thermal radiator concept

Thermal Control Panels

- Scalable Multifunctional Structural-Thermal Solution

A straight-forward approach to efficient isothermal spacecraft structures, thermal radiators, and uniform heat spreading

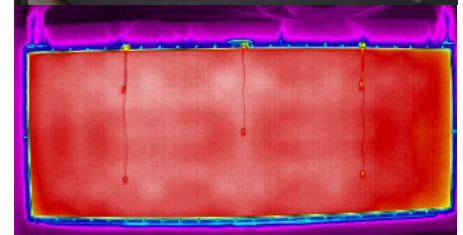
The basis for Thermal Control Panel technology is the matrix of thin, flat heat pipes embedded within a honeycomb panel structure which provides multi-directional heat spreading. Structures can be developed using a variety of materials including aluminum, metal matrix composites (MMC), and graphite composites. The multifunctional features of this technology make it an ideal structure for both small and large spacecraft as well as hosted payloads.



Prototype 56 cm square SBIR spacecraft panels

Isothermal Spacecraft Structures

For advanced structures, Thermal Control Panels provide the benefits of distributed heat pipes combined with the strength and stiffness of standard spacecraft panels into one cohesive structural panel. Developed under SBIR contracts to the Air Force, the isothermal panel technology shows significant application potential as low temperature difference heat spreading structures. A built-in fastener grid enhances the ease of component integration. The panel technology has been space qualification tested.



1000 W, 1 m x 2.5 m
Spacecraft Demonstration
Panel- (top);
IR picture of structure (bottom)

Thermal Radiators

Thermal Control Panels are configured for uniform temperature, light weight radiators. The thin, conductive panels spread heat over the entire surface resulting in a more efficient radiator surface. The technology is also applicable for backing solar arrays to provide a uniform mounting temperature and heat path to the radiating surfaces.

Uniform Heat Spreading

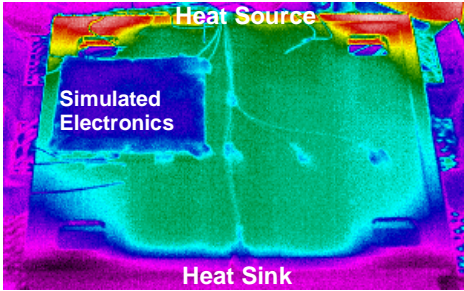
The technology can also be used to distribute heat from within the bus to external surfaces or to radiators providing more efficient use of bus volume.

Contact TMT to see how Thermal Control Panels can be implemented into your next design

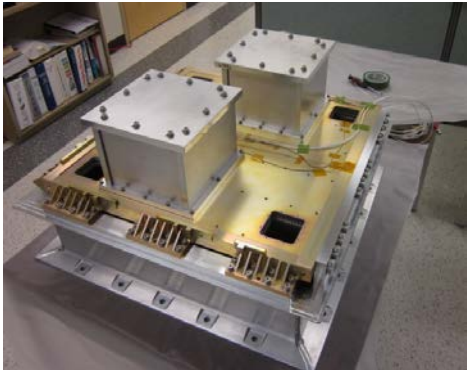
TMT Thermal Control Panels Can Be Configured for Your Application

Panel Interfaces

- Component interfaces can be adapted for each application.
 - Existing panels contain fastener grids on both 5 cm x 10 cm, or 4 in x 4 in grids



IR picture of 56 cm x 56 cm SBIR panel under test (~2C across active panel w/ 56 W input)



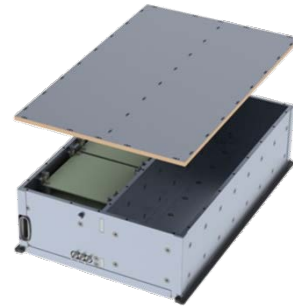
Typical small spacecraft application, panel with component simulators



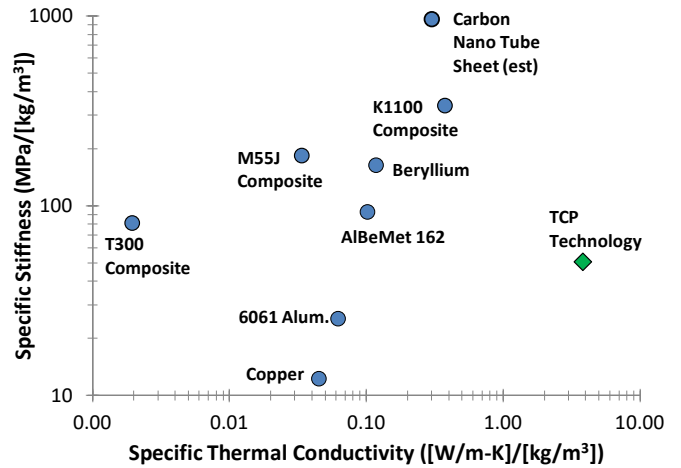
1m x 2.5 m, 1000 W Spacecraft Development panels showing 4"x4" fastener grid

Key Specifications

- Operating temperature: -20 to +65 °C
- Survival temperature -40 to +75 °C
- Typical structure materials
 - Aluminum
 - AlSiC metal matrix composites
 - Graphite composites



Isothermal Structural Panels can be constructed from CubeSat to ComSat Size



Graph illustrating spacecraft construction material comparison

* These values are for reference and should not be used for design

Product History

This technology was principally developed under SBIR funding managed by the Air Force Research Laboratory, Space Vehicles Directorate under FA9453-10-C-0053 and FA9453-12-C-0070

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