Enabling CubeSat and small satellite reliability through improved thermal management

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Overview

One major challenge in CubeSat system design is heat dissipation and thermal management. To meet the high power density demands of CubeSat systems, a flat, lightweight and conformable heat strap was developed called FlexCool. Thermal analysis of a CubeSat system was performed to show the effect of a high conductance thermal strap. Additionally, a reliability study was used to demonstrate the increase in lifetime of on-board electronics.

FlexCool Heat Strap

- All copper construction
- Bonded layers and case
- >135 psi internal gauge pressure
- <1 mm total thickness
- Lightweight and conformable

Orbital Analysis

- Thermal Desktop analysis
- 1U and 3U CubeSat systems
- Orbital-averaged temperatures

Testing & Modeling

- Working fluid: Acetone
- One-dimensional measurements
- Single, uniform heat source
- 2.83 in effective length

Conclusions

The FlexCool heat strap developed at Roccor demonstrated an effective thermal conductivity up to 2.149 W/m·K (5x higher than copper) with a total thickness of 0.86 mm. Use of a FlexCool strap in a CubeSat system can greatly decrease the average orbital temperature, resulting in an exponential increase in MTTF of the on-board electronics.