Enhancing 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.