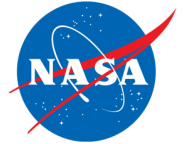


National Aeronautics and
Space Administration



TECHNOLOGY SOLUTION

Aerospace

CubeSat Form Factor Thermal Control Louvers

Passive thermal cooling for CubeSats

As small spacecraft become a part of NASA's repertoire of missions, one reoccurring theme is an increased need for thermal control as power budgets increase and tight instrument temperature tolerances are introduced on smaller platforms. Until now CubeSats have not needed thermal control outside of resistive heaters due to the low power and short lifespan of most CubeSat missions. However, in the past few years CubeSat solar panels have been developed by private companies which can produce up to 80W of power for a 3U (30X10X10 cm) spacecraft. Now, CubeSat and small satellite missions are being proposed which rise to meet this new technological envelope, with high power instruments and multiple months or years of mission life. Therefore it is critical that a thermal control system be designed for small spacecraft missions.

The CubeSat Form Factor Thermal Control Louvers use passive thermal control to significantly improve the internal thermal stability of small spacecraft, creating a difference of several watts in dissipated heat between open and closed louvers.

BENEFITS

- Provides passive actuation of flaps via bimetallic springs, requiring no power for thermal control
- Allows adaptability while still maintaining a standard form factor; the modular design can be produced in large quantities and swapped into various sized plates to tailor the thermal control to each spacecraft's needs
- Built in redundancy is inherent in the multiple bi-metallic spring design, so if one spring fails then only one pair of flaps will be inactive
- Implements additive manufacturing to create lightweight, easily reproduceable flaps



THE TECHNOLOGY

Thermal control of small spacecraft, including CubeSats, is a challenge for the next era of NASA spaceflight. Science objectives and components will still require strict thermal control while smaller volumes will inherently absorb and shed heat more quickly than a larger body. Thus, game-changing technologies must be developed to stabilize the thermal environment inside of small spacecraft.

The CubeSat louver assembly of the present invention is based upon the proven designs of full-sized louvers for large spacecraft. Internal spacecraft components are thermally coupled to the side of the spacecraft. Bimetallic springs serve as a passive control mechanism for opening and closing flaps. As the spacecraft heats up the springs expand due to the difference in thermal expansion rates of their two fused metals (hence bimetallic). This opens the flaps, changing the thermal radiation properties of the exterior surface. As the spacecraft cools the flaps close and return the exterior surface to the previous emissivity. These temperature-driven adjustments create a more stable thermal environment for components.

The power dissipated via the thermal louvers shows a substantial difference between fully closed and fully open louvers at the high temperatures significant for electrical components.



CubeSat Form Factor Thermal Control Louvers on a 6U CubeSat

APPLICATIONS

The technology has several potential applications:

- Designers and manufacturers of CubeSats / SmallSats in academia, government, and industry could benefit from this tool.

PUBLICATIONS

Patent No: 9862507