FEASIBILITY DEMONSTRATION OF A THERMAL SWITCH FOR DUAL TEMPERATURE IR FOCAL PLANE COOLING

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A feasibility demonstration was performed examining the potential of a thermal switch to provide thermal isolation between two independent cooling systems providing different cooling temperatures to an infrared sensor focal plane assembly. Dual IR focal plane arrays (FPAs) are considered in this payload configuration, with the primary FPA being cooled by 60-K mechanical cryocoolers. The co- located second FPA would be passively cooled by a cryoradiator to ensure continuous, albeit different, infrared sensing capabilities when the mechanical cryocoolers are not operating. The dual focal planes are directly coupled to the cryocoolers, and indirectly coupled to the cryogenic radiator through the thermal switch.

A conical gas-gap thermal switch using a metal hydride sorption bed to control the hydrogen gas supply was designed to provide the thermal isolation link between the cryocooler and the passive cryoradiator cooling system, Test results of the thermal switch show a nominal 1 K/W thermal resistance in the on-state conduction mode for heat flows to 8 W, and a temperature dependent 600-900 K/W thermal resistance in the off-state conduction mode. The switching time to convert to the on-state or off-state mode was on the order of 1 minute and 12 minutes, respective y.

The thermal switch was integrated with a Matra Marconi Space Systems 80K cooler, a G-M cooler simulating the cryoradiator, and a simulated focal plane heat source for the feasibility demonstration. Heat flows to either cooling system were quantified in the two cases of the operating and non-operating cryocooler; as well, the cooling performance of the cryocooler in the integrated configuration was determined. The test results show the successful operation of the thermal switch as the isolation link between the cryocooler and the passive cryoradiator.

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