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Thermal Design of the Earth Surface Mineral Dust Source Investigation (EMIT)

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The Earth Surface Mineral Dust Source Investigation (EMIT) instrument, designed and built by the NASA Jet Propulsion Laboratory, will map the surface mineralogy of arid source regions in the visible and short-wave infrared (VSWIR) from the International Space Station. EMIT requires a long-life mechanical cooler that provides cooling at 150K and a heat rejection system (HRS) that can effectively absorb, transfer, and reject instrument waste heat to space. The Thermal Control System (TCS) consists of a combination of active and passive components to maintain components within the allowable flight temperature (AFT) limits. The active components include a mechanical cryocooler and variable conductance heat pipes. The focal plane detector and spectrometer are cooled to 155K and 235K, respectively, by a single-stage pulse tube cryocooler. High performance Pyrolytic Graphite Sheet (PGS) thermal links are used to transport operational and parasitic heat loads from the FPA and spectrometer to the cooler cold tip. The HRS absorbs, transfers, and rejects cryocooler and avionics waste heat to Space from ELC 1 FRAM 8 via two radiators. The passive TCS include multi-layer and single layer insulation, flexible thermal links, and coatings. This paper provides an overview of the EMIT instrument TCS architecture, cryocooler and instrument/ISS thermal requirements and key design drivers, and top-level thermal design and analysis approach.