Thermal Infrared Earth Resource Monitoring Instrument (THERMI) for Future Landsat Missions

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Future Landsat missions are expected to host a thermal infrared instrument to monitor terrestrial environmental conditions including water resources use for agricultural irrigation in the United States and elsewhere around the globe. A detailed instrument design with radiometric accuracy and spatial resolution capable of measuring and monitoring evapotranspiration from a satellite remote sensing platform is described in detail. The instrument design includes two spectral bands in the thermal infrared, enabling use of the split-window atmospheric correction technique. The wide-field thermal infrared sensor will achieve a noise equivalent temperature difference of better than 0.4 K and a spatial resolution of better than 120 meters from the Landsat 8 705 km orbital altitude.

This paper describes the optical design, detector module design, electrical system block diagram, mechanical layout, and thermal design of the THERMI instrument. The instrument design incorporates flight-proven detectors and readout integrated circuits (ROICs) for the focal plane array module, an available mini-pulse tube cryocooler, flight-qualified on-board blackbody calibrators, and standard electrical and data interfaces. Design practices for engineering a thermal infrared space payload capable of achieving a radiometric calibration with an NEDT of less than 0.4 K will be explained. A summary of the radiometric calibration plan is discussed. The radiometric calibration of the instrument takes advantage of the unique thermal infrared calibration capabilities at the Utah State University Space Dynamics Lab, such as end-to-end relative spectral response measurements, stray light testing, and NIST traceable sources. The spacecraft resources of volume, mass, and power required to host the thermal infrared instrument will also be discussed.

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