

Space Studies of the Earth-Moon System, Planets, and Small Bodies of the Solar System (B)
Technologies and Instrumentations for Solar System Exploration (B0.4)

HIRIME - MAPPING MARS IN HIGH RESOLUTION. FOCAL PLANE AND DETECTOR READOUT PHASE A DESIGN.

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The High-Resolution Imager for Mars Exploration (HiRIME) is an instrument concept for the next-generation high-resolution scientific imaging of Mars and a core payload for ESA's SpotLight mission concept. Designed to deliver 25 cm/pixel panchromatic and 50 cm/pixel multispectral imagery over a 5 km × 24 km swath, HiRIME will provide essential capabilities for future landing site selections. Being built around the Teledyne CIS125 TDI detector, the design leverages heritage from HiRISE while incorporating European detector and processing technologies.

During a Phase A study conducted for ESA, a comprehensive subsystem design was developed for the Focal Plane Module (FPM) and the Front-end Electronics Unit (FEU), addressing the challenges associated with fast readout and large data volume resulting from the CIS125 detector. The FPM integrates the CIS125 detector with its proximity electronics on a rigid-flex PCB, providing precision power delivery, power sequencing, and high-fidelity housekeeping across 32 channels. It transmits 20 differential CML lanes at 2 Gbps/lane to the FEU. The FEU - built around a radiation-tolerant Xilinx Kintex UltraScale FPGA - performs real-time de-serialization, DDR4 buffering and CCSDS 122.0.B-2 wavelet compression, enabling efficient downlink of compressed imagery over a SpaceFibre interface. This architecture supports dual-detector operation with independent data paths, enhancing reliability and enabling flexible imaging modes (e.g., super-resolution).

We present the Phase A study design, key subsystem trades, and preliminary specifications of the FPM and FEU, and outline the critical tasks and challenges identified for Phase B1 - highlighting how their execution is essential to advance the Technology Readiness Level (TRL) in preparation for flight development.