National Aeronautics and Space Administration

Mini Imaging Spectrometer for Mars Helicopter and Small Spacecraft Missions

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Program: FY22 R&TD Strategic Initiative
Strategic Focus Area: Micro Instruments for Mars Helicopter and Small Spacecraft Missions -
Strategic Initiative Leader: Yonggyu Gim

Objectives:

Imaging spectrometers require specialized electronics to perform the following:

- Supply the detector with low-noise power, commands, and clock signals
- Receive, buffer, and transmit the detector data to the host vehicle
- Acquire telemetry and detect faults

Our primary objective is to demonstrate these capabilities within a mass envelope of 0.8 kg while meeting the requirements for a multi-year, Class-C Mars Science Helicopter mission proposal. A secondary objective is to minimize the power consumption of the electronics.

Approach and Results:

Our technical approach integrates a digital-output detector array, a high-performance and low-power FPGA, radiation-tolerant flash memory, and host vehicle processing resources in order to implement the functions needed for an imaging spectrometer within the resource constraints of the Mars Science Helicopter (MSH) platform. This architecture will be demonstrated by designing and building the detector interface electronics and perform the analyses and tests to show that they will survive the launch, cruise, and operational phases of a Mars mission. The circuit boards were fabricated in FY22 and will be assembled and tested in FY23.

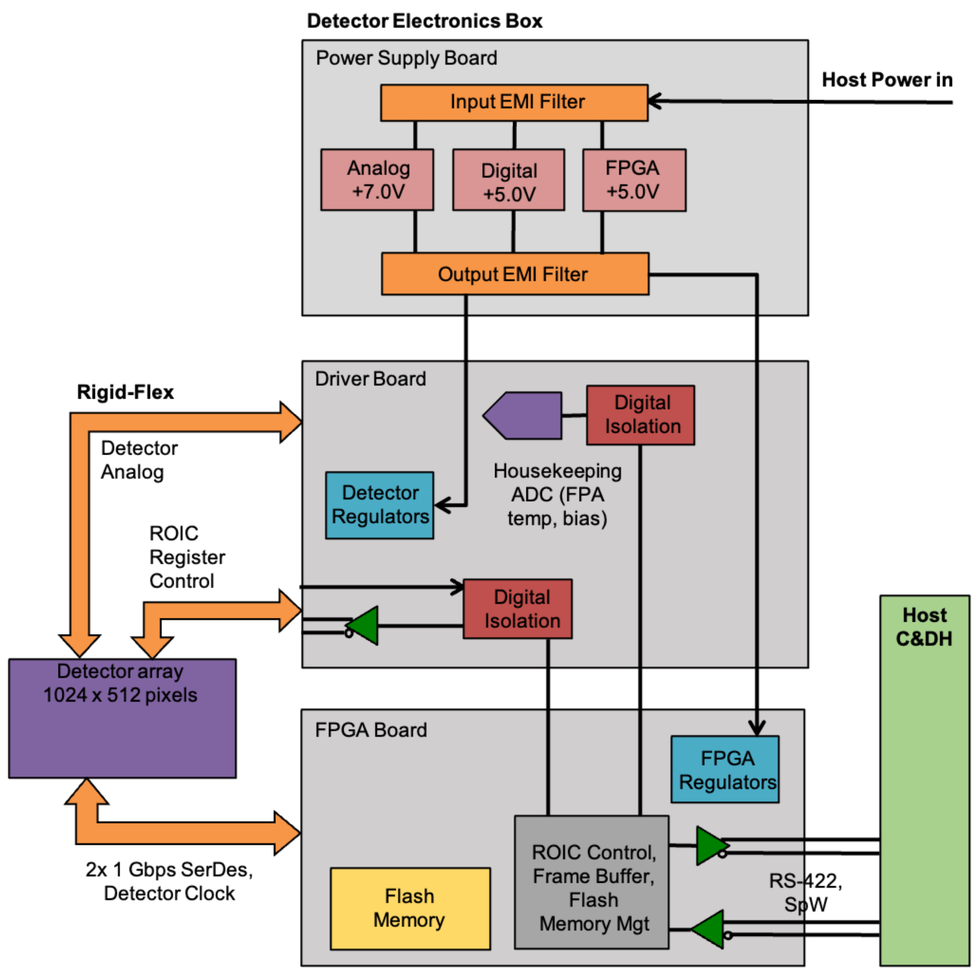

Figure 1. Block diagram of the micro-spectrometer electronics architecture.

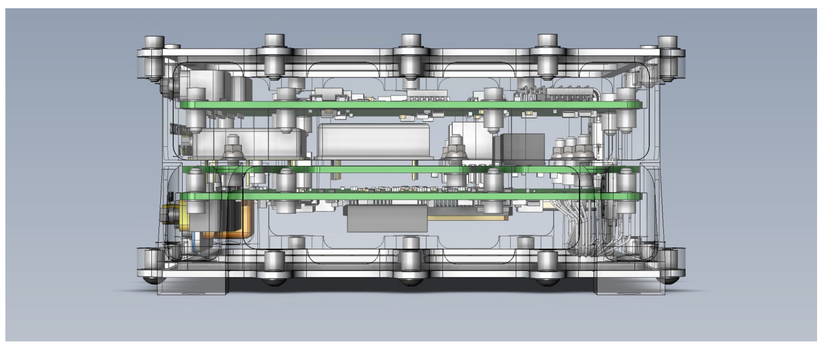

Figure 2. Side view showing, from top to bottom, the detector driver, power supply, and FPGA boards packaged in an custom chassis.

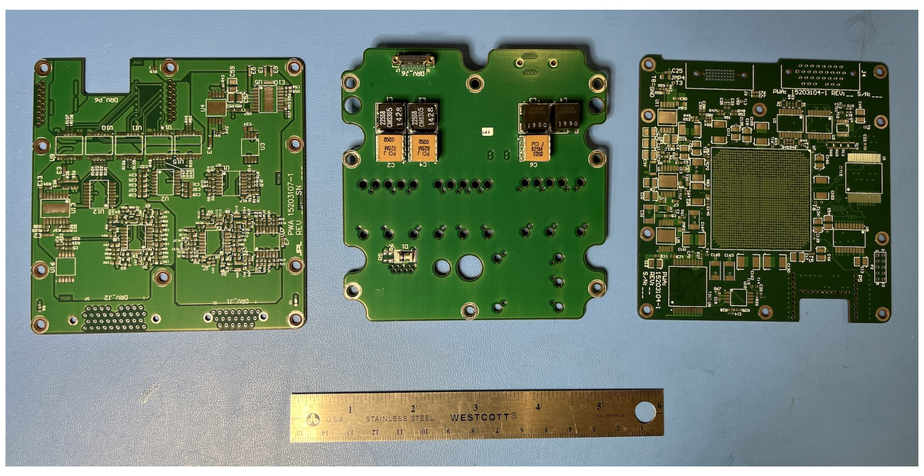

Figure 3. From left to right, the delivered detector driver, power supply, and FPGA boards. These will be assembled into the chassis in FY23.

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Publications:

P. Sullivan et. al, “A Comparison of Imaging Subsystems for Analog- versus Digital-Output Detector Arrays,” in 2023 IEEE Aerospace Conference (forthcoming)

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