SSC23-WP1-23

Instrumentation design and placement for KRUPS re-entry capsules

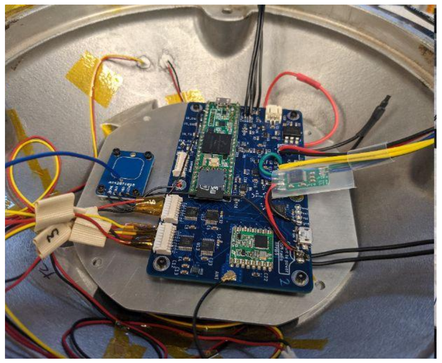
College of Engineering

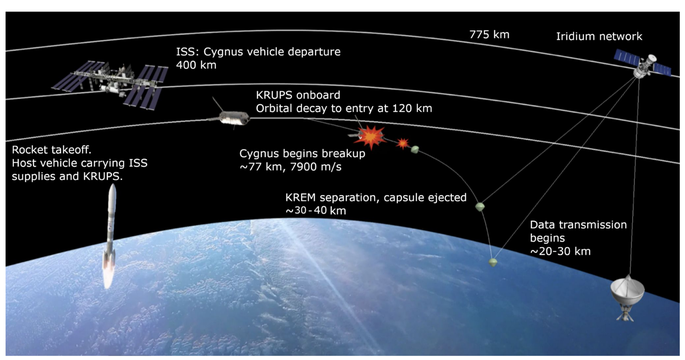
Matthew P. Ruffner (matthew.ruffner@uky.edu), Kirsten Ford, Logan Craig, Bruno Tacchi (brunodtacchi@uky.edu), William Smith, Savio J. Poovathingal, and Alexandre Martin

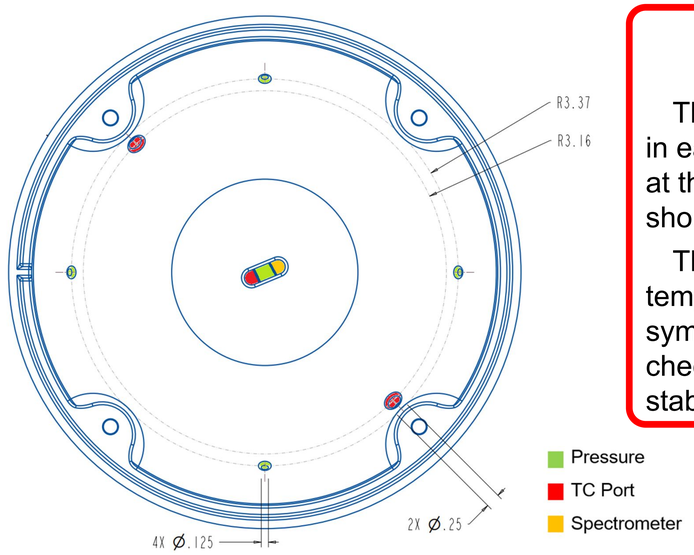
Background

Atmospheric re-entry flight tests are one of the best ways to evaluate the performance of new Thermal Protection System (TPS) materials. The flight proven Kentucky Re-Entry Payload System (KRUPS) project provides a low cost, quick turnaround platform for these evaluative missions.

Following the success of the first KREPE mission, the KRUPS Flight Computer (KFC) and the instrumentation suite were redesigned for the next mission, KREPE-2. The original suite contained only four thermocouples. The new design contains six thermocouples, five pressure sensors, a mini-spectrometer, an IMU and an accelerometer.



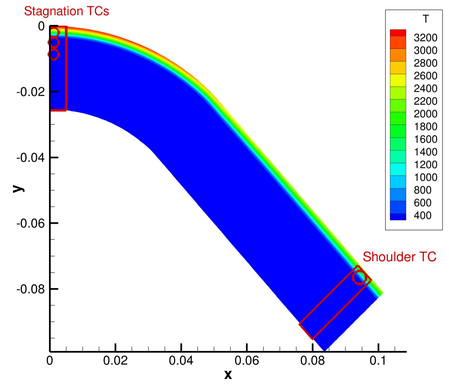




Thermocouples

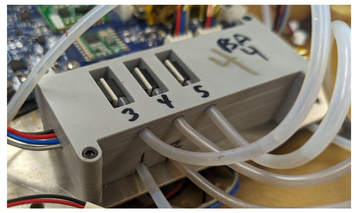
Thermocouples are placed inside a plug in each of the marked locations, with three at the stagnation, two and one in the shoulders.

The different depths capture the drop in temperature across the TPS. The symmetrical shoulder thermocouples checks if the capsule's orientation has stabilized.



Pressure Sensors

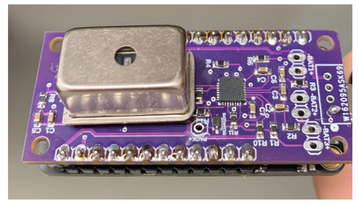
The main purpose of the pressure sensors is to provide data for a trajectory reconstruction. The stagnation pressure port measures the total pressure, whereas the remaining pairs measure the angle of attack and angle of sideslip.



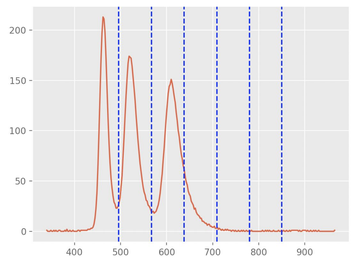
Spectrometer

A mini-spectrometer is placed at the stagnation line, and is connected to the outside of the capsule with a fiber optic cable.

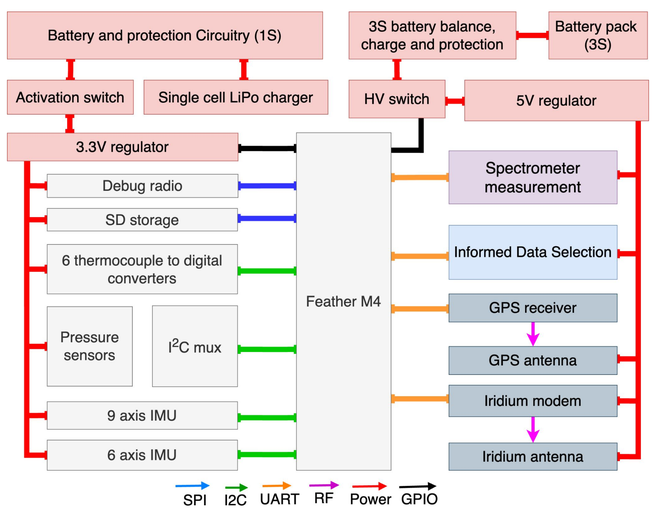
The C12880MA spectrometer captures light emittance in the 340-850 nm range. This range is split into 6 bins, and then the average and max emittance of each bin is obtained.



Spectrometer Data



Hardware Overview



Informed Data Selection Subsystem

Due to bandwidth limitations of the Iridium network, the transmitted data must be selected in an informed fashion. The IDS can build packets with varying bit width representations for all telemetry channels, allowing us to prioritize various sensor types.