

Team **FIRE** (Firebox and Iridium ReEntry)

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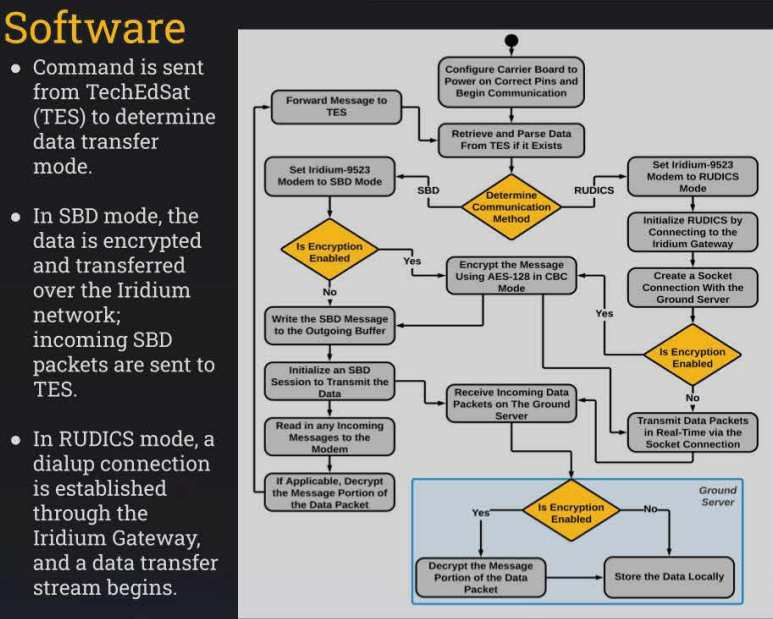
Background

The high cost of satellite to ground communication is a barrier to space research. Team FIRE developed software libraries and electronic hardware to leverage the existing Iridium Satellite network for cheap data streaming with cube satellites. The team also designed a battery containment unit to house the batteries powering these devices and contain a potentially explosive battery failure.

- ## Objective
- Develop software packages and libraries for a microcontroller to establish a live connection via the Iridium Network
 - Redesign the carrier board used to power the Iridium 9523 modem
 - Design a lightweight *firebox* capable of containing a fire due to batteries entering thermal runaway

Design Requirements

Criteria	Must	Should
Software	Handle all Iridium functionality from a microcontroller unit	---
	Toggle between SBD and Data Streaming modes	---
Size & Weight	Weigh under 500g	Weigh under 300g
	Fit the PC-104 form factor	Shortest z-axis
Batteries	Carry four BP-955 batteries	---
	Each battery needs to supply 5A	Use universal terminals
Insulation	Quench all flames	---
	Maintain temperature between 0°C & 40°C	---
	Vent hot gasses	---
Misc.	Burn up upon reentry	---

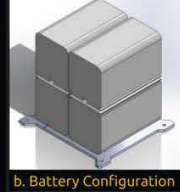


Battery Box

The integrated vent system (a) will be on the top of the battery configuration and consists of a metal foam and insulating fabric acting as a pressure release. Pyrogel insulation will maintain the desired operating temperature for the batteries, and the metal foam will act as a flame-quenching conductor to stop flames from escaping the box. The battery configuration on PCB 104 form factor (b) will allow for four monitoring thermocouples and an insulating aerogel blanket.



a. Vent Prototype

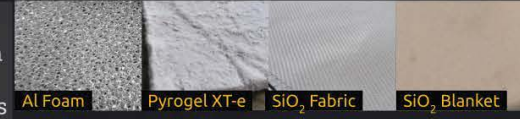


b. Battery Configuration

	Al/Al-Foam	Pyrogel XT-e	Silica Fabric	Aerogel Blanket
Insulation	--	Excellent	--	Excellent
Density	0.7 g/cm ³	0.7g/cm ³	0.93 g/cm ³	0.2 g/cm ³
Thermal conductivity	5.8 W/mK	0.022 W/mK	0.3 W/mK	0.033 W/mK
Maximum Operating Temperature	1200°C	650°C	1400°C	300°C
Ventilation	Excellent	--	--	Poor
Effective thickness	--	5 mm	.25 mm	--

Key Materials:

- 1100 H14 Aluminum
- Open-cell Al foam
- Insulation materials

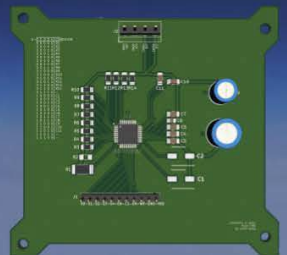


Al Foam Pyrogel XT-e SiO₂ Fabric SiO₂ Blanket

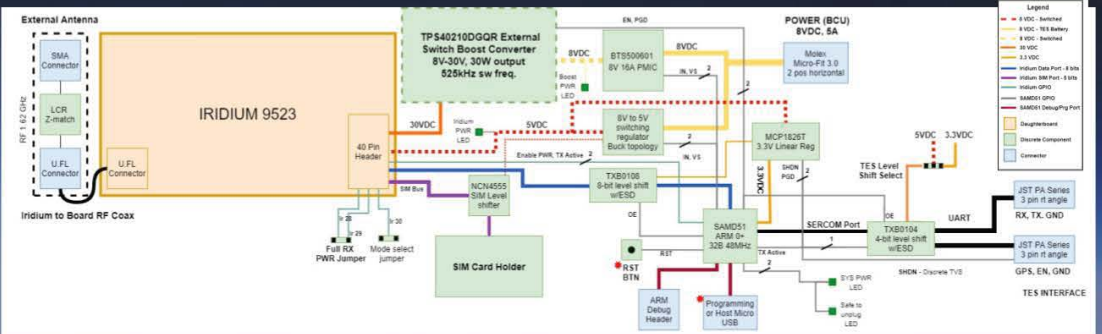
See table for properties Insulation, ventilation, & flame quenching properties are areas of interest for experimentation.

Hardware

The team designed a PCB to test passive component performance in near-space conditions. The board was sent to NASA for testing.



Below: The prototype carrier board designed by Team SCUBEE required a redesign to fit in the PC-104 form factor, and the board's power structure was improved for better reliability and efficiency.



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