

MemSat—Technical Narratives

MemSat is a 1U CubeSat to fly in 2Q 2018 with its primary mission to evaluate the behavior of emergent memristor memory technology.

Memristors are a new class of fundamental electronic devices exhibiting multi-state impedances, which can be used to create basic electronic elements and systems to implement a diverse range of functions including—but not limited to—computer systems, memory elements, and sensors. MemSat’s memristor evaluation payload aims at characterizing and comparing the behavior of memristor memory devices against standard, silicon-based memory technologies to determine potential advantages—and/or disadvantages—of memristors for space applications. The key figure of merit to be quantified between technologies for this mission experiment is comparisons of single event upset (SEU) rate. This figure of merit is important, because it measures the susceptibility of a device to state changes caused by energetic particles—a reduced SEU rate can offer many advantages that directly improve mission capabilities, expand capabilities for long-term missions, and can potentially reduce costs for spacecraft reliability by minimizing the numbers of bit changes incurred by a systems, which can cause anomalous behaviors.

MemSat will be composed of the following physical subsystems:

- Payload (Experiment Subsystem): The memristor evaluation payload is to characterize and compare the single event upset (SEU) rates of memristor memory devices against standard, silicon-based memory technologies to determine potential advantages—and/or disadvantages—of memristors for space applications.
- C&DH (Command & Data Handling Subsystem): The C&DH subsystem contains the satellite’s main processor and is connected to all other subsystems. It monitors/controls the satellite health condition, provides mission software, and processes experiments/communication.
- EPS (Electrical Power Subsystem): The electrical power system is the subsystem that generates, stores, distributes, and controls power for the entire CubeSat. The EPS is comprised of six exterior PCB planes (each with two CiC solar panels and a MPPC chip), four Li-ion battery cells, battery management circuits, and output voltage regulators.
- COMMS (Communication Subsystem): The communications subsystem performs the function of communicating the scientific data of SEU rates for memristor and conventional silicon-based memory to the ground station. The communication subsystem has the following characteristics:
 - Half duplex with 9600 baud GMSK;
 - 70 cm (435–438 MHz) band for downlink, 2 m (144–148 MHz) band for uplink;
 - Adjustable output power (1.5–3 W), and deployable monopole antenna
- ADCS (Attitude Determination and Control Subsystem): The ADCS of MemSat aims to detumble and maintain the CubeSat orientation as required by the antenna radiation pattern to maximize the earth-satellite communication capability. Passive magnetic attitude control has been chosen for its simplicity.