REAL Satellite Technical Description

The overall goal of the REAL mission is to collect scientific data on the physical mechanisms responsible for scattering radiation belt electrons into the Earth's atmosphere and to validate a particle instrument design. The results from REAL will improve predictive models of Earth's radiation belts, and will advance our understanding of space weather.

The satellite was launched July 23, 2025, into a circular orbit at 510 km, on an inclination from the equator of 97.4 degrees. Early communications challenges were eventually resolved and communications continue. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs about 2 years after launch. See the Orbital Debris Assessment Report for details.

The current STA, File 0003-EX-ST-2026, runs through July 19, 2026. This STA application requests an additional 6 months of operation so that despite delays from communications system fixes and sensor tuning, we can complete our mission to develop space heritage and technology readiness for the instrumentation, and also collect a sufficient volume of space weather data to fulfill the scientific objectives. See the Reason for Request document for more specifics on the challenges and opportunities that are presented.

The technical data following, are unchanged from the current STA.

The spacecraft is a single unit with the dimensions of 3 stacked 10 cm X 10 cm X 10 cm CubeSat modules (giving an overall dimension of 10 cm X 10 cm X 34.05 cm.) The total mass is about 3.9 kg.

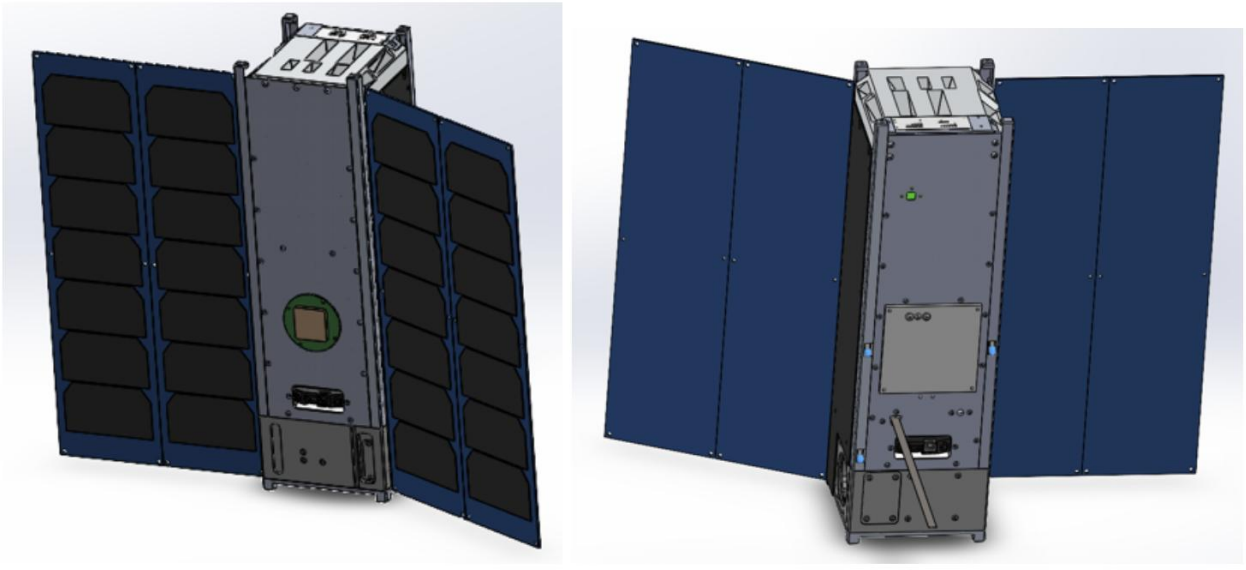

Figure 1 REAL Overview

The satellite contains the following subsystems:

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Guidance, Navigation and Control (GNC) Subsystem:

The 3-axis inertial pointing system is the XACT model ACDS provided by Blue Canyon Technologies, which contains three reaction wheel assemblies, three torque rods, a single miniaturized star tracker, two sun sensors and a processor board. Also included but not required for flight is a Novatel GPS receiver.

Command and Data Handling (CDH) Subsystem:

The CDH subsystem is A COTS Clyde 01-02930 (Kryten M3). This system performs basic spacecraft state of health maintenance, and interfaces to the payload and GNC system to store data and send commands. A custom interface board provides communication interfaces between the processor board and the UHF transceiver and S-band transmitter.

Communications Subsystem (COMMS):

REAL uses a UHF uplink and downlink for spacecraft operations, including termination of transmission if necessary. UHF ground stations are located is at Montana State University in Bozeman, Montana, and at the Dartmouth College campus in Hanover, New Hampshire. The spacecraft UHF transceiver is a COTS AstroDev Lithium 2. The UHF antenna when deployed, extends approximately 17 cm.

For science data downlink, REAL uses an S-band transmitter, a Quasonix NanoTx, with a fixed S-band patch antenna. The receive only ground is located at the Johns Hopkins Applied Physics Lab in Laurel, Maryland.

Electrical Power Subsystem (EPS): The EPS is maximum power point tracking and Battery Charge Regulator system from ClydeSpace (model 01-07384 XUA) using a solar array producing approximately 27W of orbit average power to charge the 40 Watt-hr battery system and generate secondary payload voltages. The REAL bus battery is a 335-gram, 40 Watt-hr Clyde Space Optimus 2S4P lithium polymer battery assembly with over-charge/current protection circuitry. The solar arrays were procured from DHV and utilize standard photovoltaic cells. Each of the two panels uses 14 cells and can produce a maximum of 15 watts. The two deployed solar arrays have a structural dimension of 16.6 cm x 31.05 cm each.

Thermal Control Subsystem (TCS): Thermal control is primarily passive, making use of carefully chosen surface coatings, except for the flight battery which includes an internal heater.

Structure Subsystem: The structure is fabricated of Aluminum 6061.

Propulsion Subsystem: No propulsion subsystem is included.

Payload Subsystem: The REAL payload is a scientific instrument that includes Si solid state detectors and an electrostatic analyzer to measure energetic charged particles, with an aluminum particle collimator. All sensors on REAL are passive. The instrument was fabricated at JHU Applied Physics Lab.