VariSat-1 Satellite Technical Description

The overall goal of the VariSat-1A/B mission, operated by VariSat LLC, is to experiment and gain flight heritage with a satellite designed to support HF marine data communications. A pair of satellites will be launched, to test the inter satellite link aspect of the system that is envisioned, as well as test ship to satellite and satellite to surface stations.

Also, experimental measurements will be made of on orbit spectral power density vs. frequency, in the 156 MHz and 900 MHz ranges, to help characterize channel congestion and noise floor in these ranges. This will help understand the suitability of these ranges for back up command and control, for future satellites.

The satellites, VariSat-1A and VariSat-1B, will be launched aboard the ABL launch vehicle Demonstration Mission-1, from Vandenberg, AFB, between April and August 2021. This will be the initial launch for the ABL launch vehicle. The satellites will be inserted into an orbit at 500 km apogee and 200 km perigee, on an inclination from the equator of 114 degrees. Transmission will begin 30 minutes after deploy from the launch vehicle, and cease upon reentry. 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.

Each of the two spacecraft is an identical unit with the dimensions of 6 stacked 10 cm X 10 cm X 10 cm CubeSat modules (giving an overall stowed dimension of 12 cm X 25.4 cm X 36.6 cm.) The total mass of each satellite is about 11 Kg.

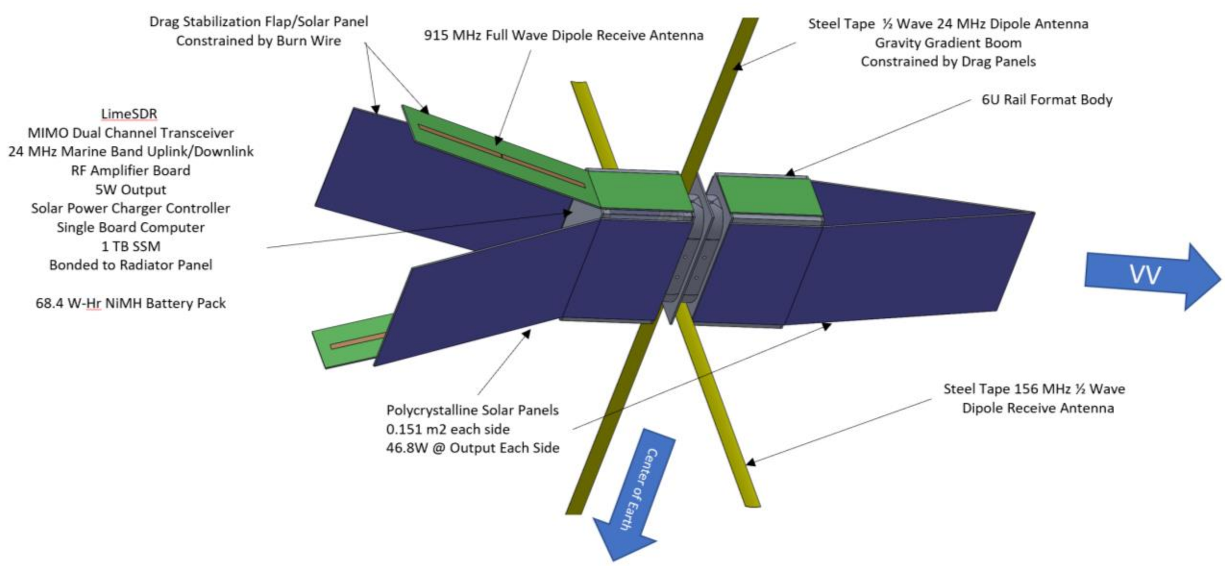

Figure 1 VariSat-1 Overview

The satellite contains the following systems:

Guidance, Navigation and Control (GNC) Subsystem: The satellite is gravity gradient stabilized (via ½ wavelength tape antenna), as well as aerodynamic drag stabilized.

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Command and Data Handling (CDH) Subsystem: The two critical printed circuit boards in the CDH subsystem are the Level Zero (L0) and the Flight Computer (FC) boards. The L0 board is the most critical spacecraft control hardware, and operates regardless of flight computer operating state. The L0 includes all communications interfaces to the transceiver and the FC and performs basic spacecraft state of health maintenance.

Communications Subsystem (COMMS): On each satellite, two redundant Lime Microsystems software defined transceivers are used. These will support HF 24 MHz Marine Band uplink and downlink, and intersatellite link.

The satellite uses a 24 MHz antenna ½ wavelength dipole/gravity gradient stabilized LVLH (i.e. dipole axis pointed to the center of the Earth). The mission operations HF transceiver will be located in Hillsboro, West Virginia.

Electrical Power Subsystem (EPS): The EPS is a direct energy transfer system, using a solar array producing approximately 23.4W of orbit average power to charge the 68.4 W-hr battery system. The solar arrays utilize standard silicon photovoltaic cells; the batteries are COTS NiMH AA cells. The L0 board sends signals to the Power Switch Boards to control charging and load switching.

Thermal Control Subsystem (TCS): The TCS controls hardware temperature through cold biasing of the thermal design, utilizing heaters to stabilize temperatures. Sensors are wired to the L0 board, which hosts thermal control algorithms to control the heaters.

Structure Subsystem: The body of the satellite is a 6U aluminum frame with six deployable solar array panels that double as aerodynamic stabilizing panels.

Propulsion Subsystem: There is no propulsion on the satellite.

Experiment Payload: The 156 MHz and 900 MHz frequency ranges will be measured for spectral density vs. frequency, to help understand channel congestion and noise floor in these ranges. Measurements will be made using a dedicated LoRa receiver, as well as the VHF and ISM receiver sections of the two Lime transceivers. The 900 MHz receive antenna is a full wave printed circuit dipole, and the 156MHz receive antenna is a half wave dipole tape antenna. No demodulation of signals will be attempted; the experiment only measures the aggregate power spectral density from all sources at a given frequency.