VariSat-1 Satellite Technical Description

This document has been modified from the Technical Description in the current license, to include a third identical satellite, having a different launch arrangement and orbit. See the Purpose of Modification exhibit. Nothing else is changed from the current license 0293-EX-CM-2021.

The overall goal of the VariSat-1A/B/C mission, operated by VariSat LLC, is to experiment and gain flight heritage with a satellite designed to support HF marine data communications. Three satellites will be launched.

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.

VariSat-1A and -1B will continue to have the same launch plan as for the previous license. They will be launched aboard the ABL launch vehicle Demonstration Mission-1, from the Pacific Spaceport complex, Kodiak Island AK, NET May 30, 2022. This will be the initial launch for the ABL launch vehicle.   The satellites will be inserted into an orbit at 350 km apogee and 200 km perigee, on an inclination from the equator of 87.3 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 less than 2 months after launch, as per the ODAR. All this is as currently licensed.

The added satellite, VariSat-1C, will be launched aboard the SpaceX TR-5 launch vehicle, from Cape Canaveral, FL, NET June 1, 2022. It will be inserted into a circular SSO orbit at 525 km, on an inclination from the equator of 97.5 degrees. Transmission will begin 30 minutes after deploy from the launch vehicle, and cease 2 years later. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs. See the VariSat-1C Orbital Debris Assessment Report for details.

Each of the 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.

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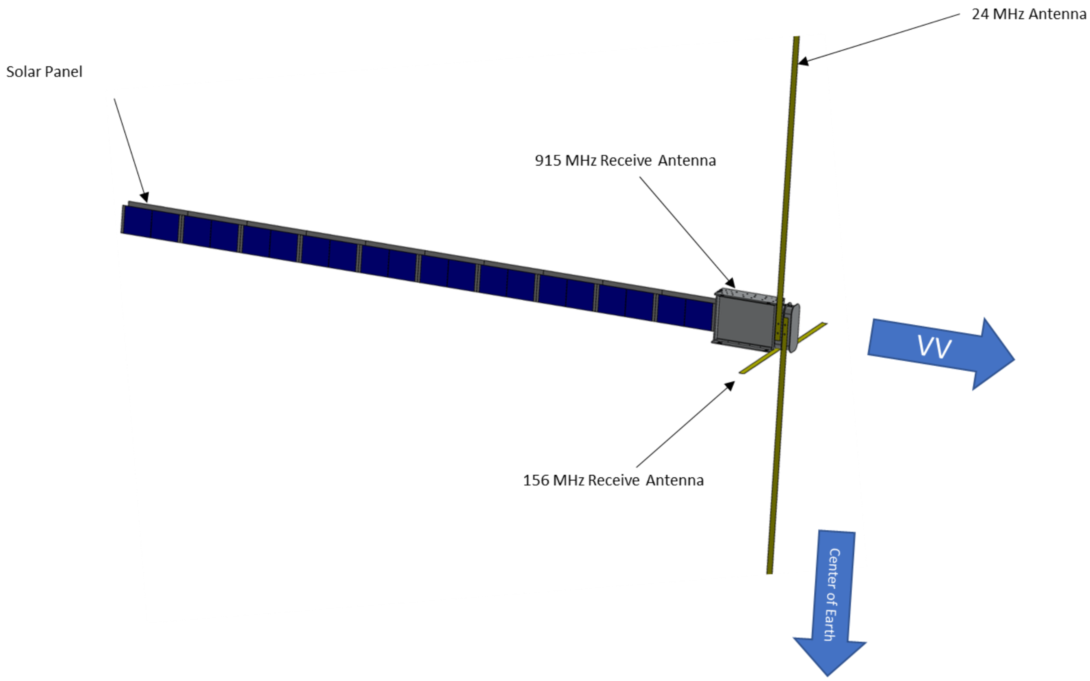

Figure 1 VariSat-1 Overview

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.

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 band 24 MHz Marine Band uplink and downlink.

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 will be supported by HF transceivers located in Hillsboro, West Virginia; Bastrop, Texas; and Palm Bay, Florida.

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 array utilizes 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 these signals will be attempted; the experiment only measures the aggregate power spectral density from all sources at a given frequency.