PolarCube Satellite Technical Description

PolarCube is a 3U CubeSat carrying a small radiometer payload. The goal of the mission is to collect Earth surface and atmospheric temperature data, using a passive microwave radiometer operating at the 118.7503 GHz, which is the resonant frequency of molecular oxygen. The objective is to demonstrate a method for collecting brightness temperature spectra at high spatial resolution and low cost, to be evaluated for remote sensing science and technology applications.

The satellite will be launched, aboard Virgin Galactic's Launcher One, from Mohave Air and Space Port, June 2019. It will be inserted into a near circular orbit at 500 km altitude, on an inclination from the equator of 61 degrees. Transmission will begin 1 hour after insertion into orbit, and cease two years later. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs about 4.6 years after launch. See the Orbital Debris Assessment Report for details.

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 30 cm.) The total mass is approximately 3.9 kg.

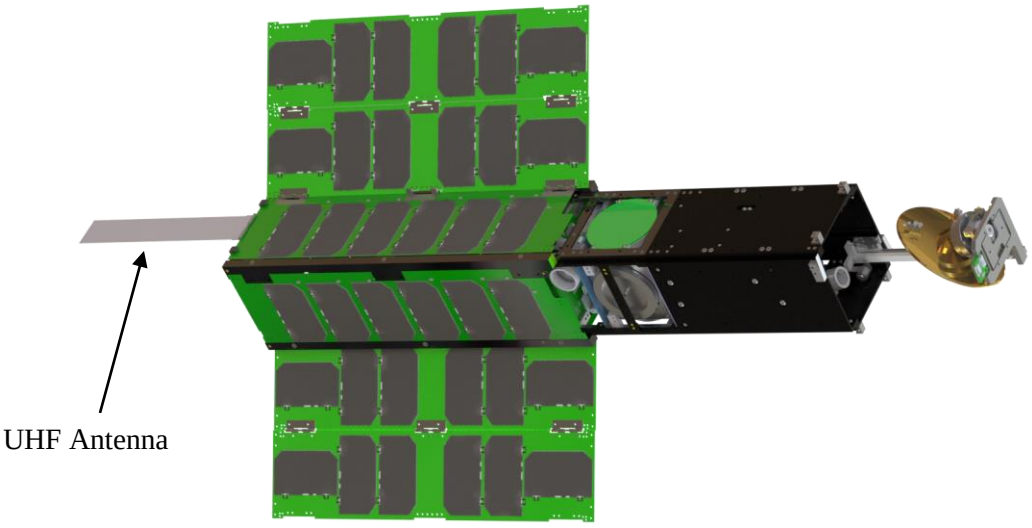

Figure 1: PolarCube Overview

The satellite contains the following systems:

Attitude Determination and Control (ADCS) Subsystem: The Attitude Determination and Control system is comprised of two actuator types - reaction wheels and magnetorquers; and three sensor types - three-axis gyroscopes, three-axis magnetometers, and a star camera. PolarCube will also be flying a GPS receiver for position knowledge for orbital propagation.

Command and Data Handling (CDH) Subsystem: PolarCube's CDH subsystem is comprised of a single PCB backplane. The subsystem provides the hardware interface for PolarCube flight

software. The subsystem monitors the current and voltage draws, and temperature, for each subsystem. It also provides the hardware connections and interfaces between each subsystem.

Electrical Power Subsystem (EPS): The PolarCube satellite contains an electrical power subsystem (EPS), which consists of: solar cells for energy conversion, lithium-ion MH48285 which include cell protection for energy storage, and control electronics for power switching and gathering data. PolarCube has body mounted solar panels on each of the 3U faces, and two sets of double fold solar panel wings. PolarCube will be powered off until deployed on orbit. The design of the PolarCube satellite incorporates two deployment switch (also referred to as separation foot switch to isolate the batteries from the rest of the subsystems.

Structure Subsystem: The PolarCube satellite is constructed using a custom 3U frame. The frame is constructed using Aluminum 6061 and is hard anodized with Teflon coating. The satellite has one UHF monopole antenna, ~17 cm in length. The stowed antenna is deployed after the dispenser ejects the satellite into orbit. PolarCube also has two double fold deployable solar panel wings along with a deployable payload extension zone and reflector boom. The reflector boom is required to achieve the proper focal length for the radiometer system.

Communications Subsystem: PolarCube's communications subsystem uses the Colordao Space Grant Cs-3 cubesat transceiver, for communication with the ground station at the CU Boulder campus, which uses the Ettus research's B200 radio.

The UHF transceiver on the spacecraft will operate half-duplex with GMSK modulation uplink and downlink, up to 115,200 bps. The system will use lower data rates to establish a solid communication link and then increase data rates with available margin.

Propulsion Subsystem: No propulsion subsystem is included.

Payload Subsystem: PolarCube's payload will be a miniaturized radiometer, MiniRad. MiniRad will receive 118.7503 GHz, the O2 Resonance frequency, to collect data on temperature brightness of the troposphere.