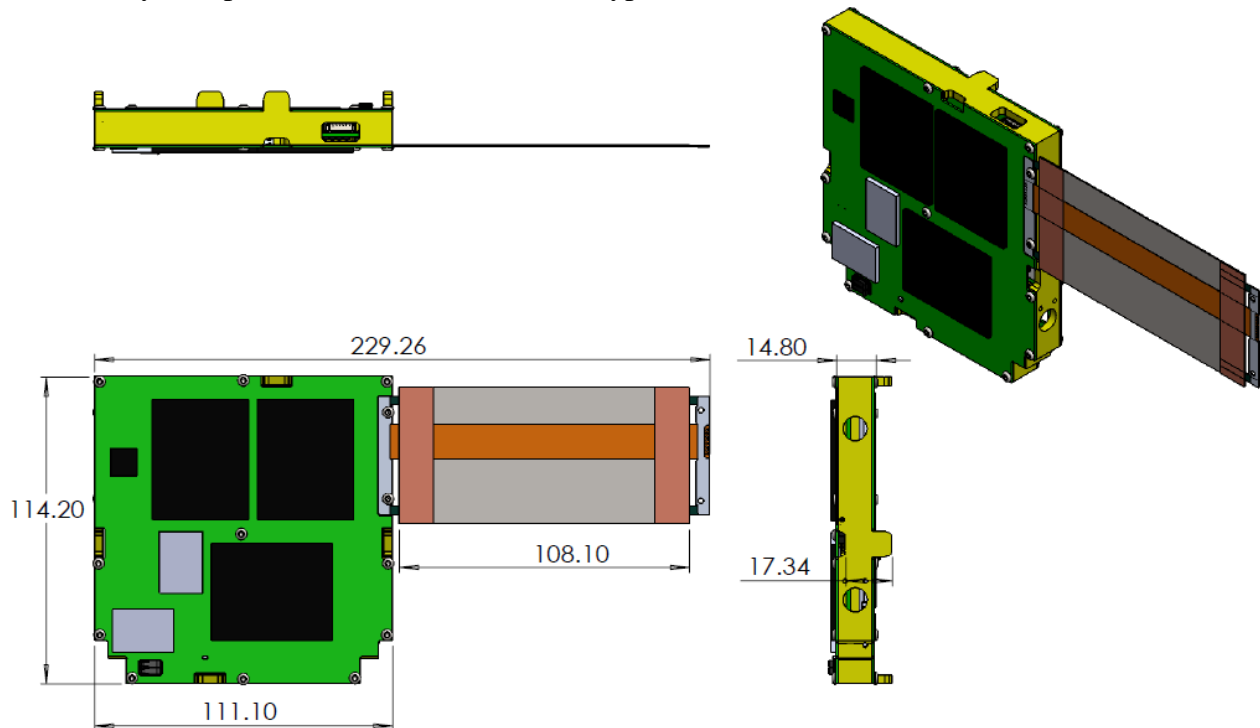# WVSAT Mission Technical Description

The overall goal of the WVSAT mission, is to deploy small satellites with two distinct form factors, to test ground station radar tracking, and in doing so, demonstrate rapid turnaround and deployment of these satellites.

The experiment will use a total of 4 satellites, 2 ThinSats and 2 1U CubeSats, launched as a secondary payload aboard NG16, from the mid-Atlantic Regional Spaceport, Wallops Island, Virginia, Q3 2021. The satellites will be inserted into Low Earth Orbit (LEO), at 260 km apogee and 180 km perigee, on an inclination from the equator of 51.6 degrees. They are deployed from a single Canisterized Satellite Dispenser (CSD) mounted on the Antares second stage of the launch vehicle. The ThinSats unfold accordion style as they exit the CSD; the two CubeSats are separate from the ThinSats. Transmission will begin upon deployment, and cease when de-orbiting occurs. See the Orbital Debris Assessment Report for details.

Each ThinSat spacecraft is comprised of multiple ThinSat units. Figure 1 shows a typical single unit. One unit in WVSAT A has two frames layered together containing a single payload, as in Figures 2. Figures 3, 4 and 5 show the composition and dimensions in mm of each spacecraft type, and identify the spacecraft associated with the type.

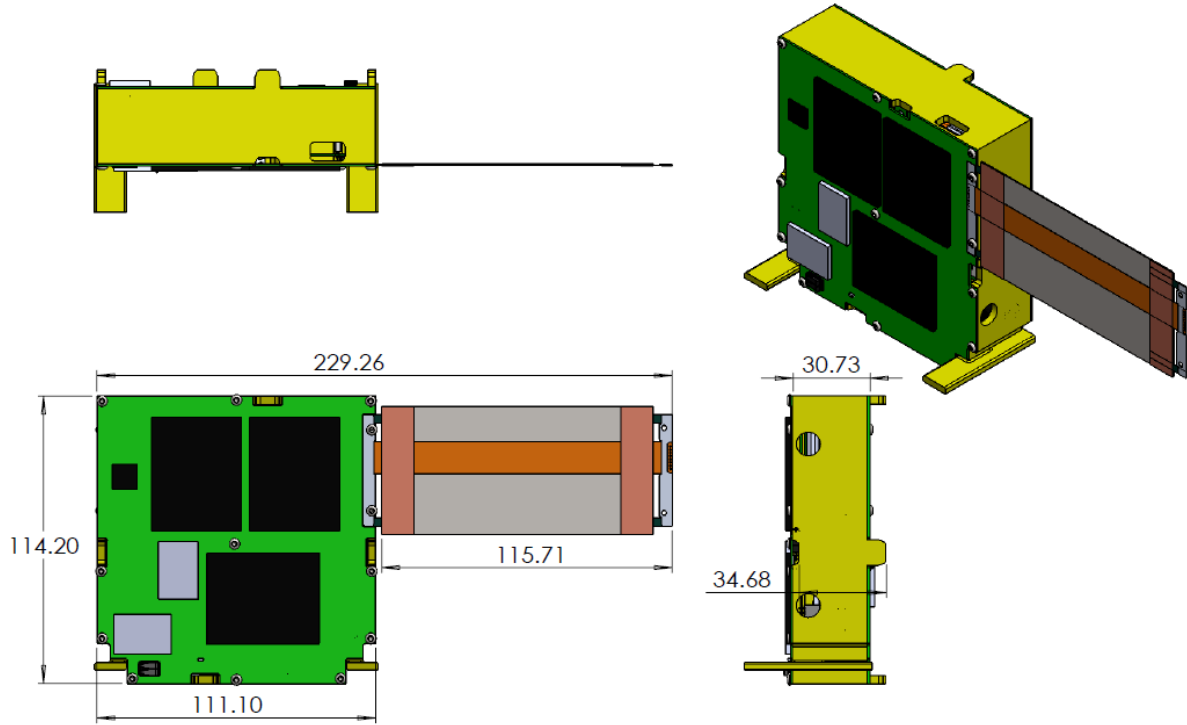**Figure 1 Single Frame ThinSat Unit Detail**

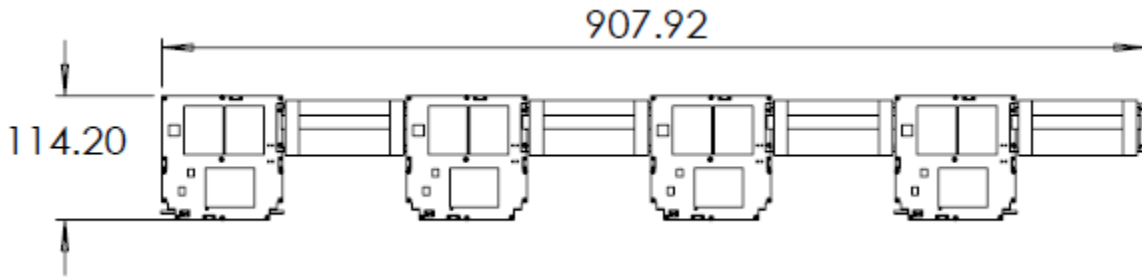**Figure 2 Double Frame ThinSat Unit Detail**

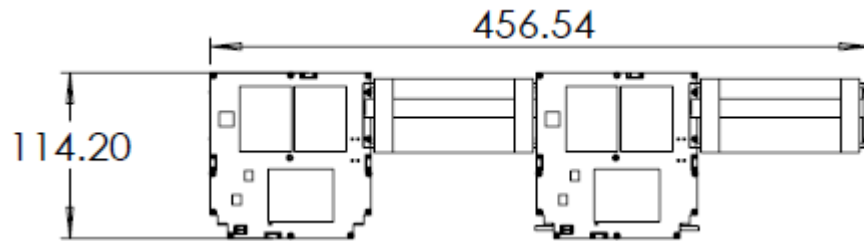**Figure 3 WVSAT A 1 x 2T and 3 x 1T**

Figure 4 WVSAT B 2 x 1T
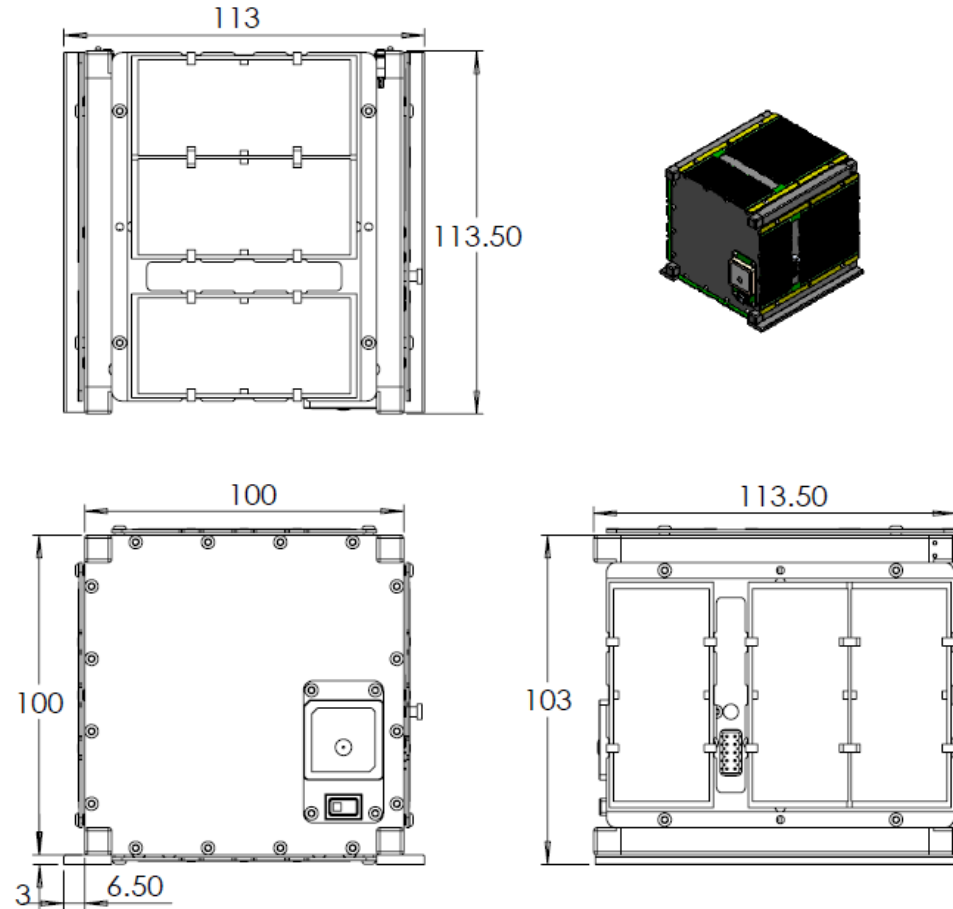
WVSAT Mission Technical Description

Figure 5 WVSAT C and D 1U

Subsystem Description:

Each spacecraft will carry the following subsystems.

Guidance, Navigation and Control (GNC) Subsystem: Navigation sensors consist of the VEML3328 Single Pixel IR Horizon sensor on each unit, a Grid IR 8x8 Pixel Sensor, a High Quality 32x24 Pixel, Infrared sensor, and a GPS unit.

- Mu metal plates will dampen the tumbling rate, and magnetorquers will be used for attitude control. The magnetorquer coil is capable of producing up to 0.2 A*m^2 of magnetic moment. These magnetorquers will act upon the earth's magnetic field to restrict the rotation of the spacecraft about the velocity vector, aligning the Simplex transmitter antenna to face in the zenith direction.

- A single axis reaction wheel will stabilize the tumble, and point normal to the orbit plane.

- The 1U CubeSats will have small fins on the -Z face, causing slight aerodynamic torques which will assist in keeping the CubeSats oriented with the +Z face in the RAM.

Command and Data Handling (CDH) Subsystem: Consists of two microprocessors which facilitate data transfer between the payload and the COMMS subsystem. The CDH can receive serial data packets, or sample dedicated analog and digital input lines.

Communications Subsystem (COMMS): Each module in each spacecraft, will contain one EyeStar-S3F transmitter, transmitting to the Globalstar constellation; an S3F antenna; and VEML3328 single pixel IR horizon sensor associated with the transmission enable logic. Each spacecraft will contain an S band receiver to support command and control, including command termination of transmission if necessary. Command and control is done through the NSL ground station.

Electrical Power Subsystem (EPS): Includes mechanical RBF switch, deployment switch, and solar detection circuit which inhibit power from the battery. Charging circuit supplies solar power to the battery and a regulator transfers battery power to the rest of the system. E-fuses limit current supplied to the payload to 100 mA per line.

Thermal Control Subsystem (TCS): ThinSats have Al 7075 unit body frame thermally shorts internal and external surfaces. Copper ground planes in external PCBs, including solar arrays, provides good radiation surfaces. The 1U CubeSats use an Al 6061 unit body frame to provide a similar thermal short for internal and external surfaces.

Structure Subsystem: The ThinSat external frame structures are fabricated of 7075 aluminum, while the 1U CubeSats are 6061 aluminum.

Propulsion Subsystem: No propulsion subsystem is included.

Payload Subsystem: Each spacecraft will report back position and orbit data to mission operations, to help ground radar stations locate them, and to validate the tracking data that is produced. Payloads will use sensors that include particle detectors, plasma probes, temperature sensors, and IMUs.