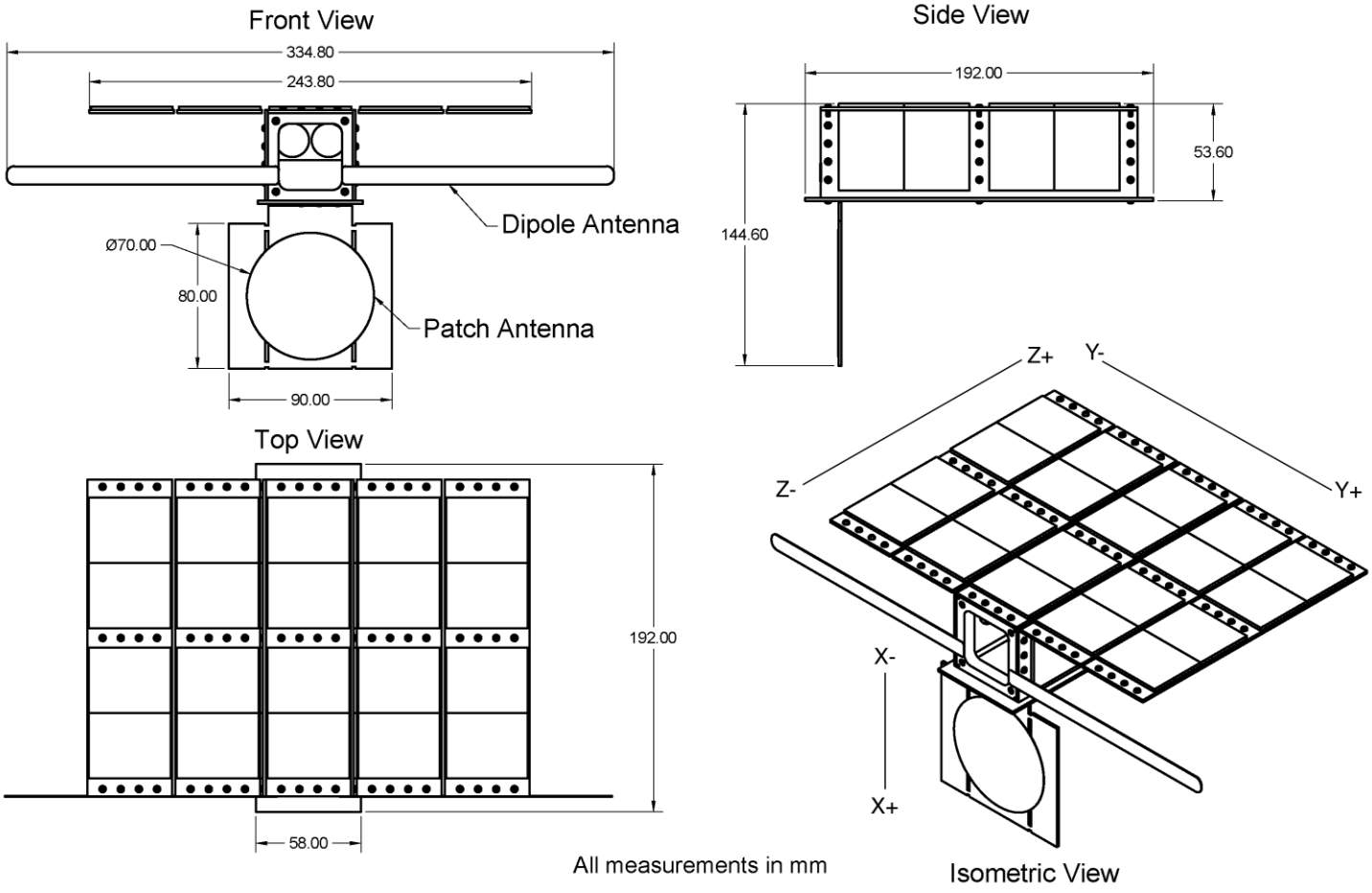
Challenger Satellite Technical Description

Mini-Cubes, LLC overall goal for the Challenger mission, is to develop a space based method to distribute secure system keys (SSH keys) for Internet of Things devices.

The satellite will be launched as a secondary payload carried by the Momentus Vigoride vehicle aboard SpaceX Falcon 9, from Vandenburg AFB, currently scheduled for June 2021. It will be deployed from the Momentus Vigoride into a Sun-synchronous orbit with a roughly circular orbit, altitude between 450km and 550 km. Orbital inclination from the equator is about 97 degrees. Transmission will begin upon deploy into orbit, and cease 2 years later. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs much less than 25 years after launch. See the Orbital Debris Assessment Report for details.

The spacecraft is a 3p pocketqube with deployable elements. Measurements after deployment of the solar panels and antennas are 19.2 cm X 14.5 cm X 24.4 cm. The total mass is about 0.75 Kg.

Figure 1 Challenger Overview



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The satellite contains the following systems:

Guidance, Navigation and Control (GNC) Subsystem:

Orientation of the spacecraft is maintained passively by a rare earth magnet and a gravity based system i.e. the mass of the spacecraft is biased to the front (Ram Direction) of the craft. This forces the antennas into an Earth facing orientation. Spin of the spacecraft is stabilized by the magnets and a tri-axis torque coil. Attitude is sensed by a solar tracker. The spacecraft will also experience aerodynamic effects that will aid in the desired orientation. A GPS receiver is on board, but is not used for attitude control, only position determination.

Command and Data Handling (CDH) Subsystem: The On Board Computer (OBC) is a Commercial off the shelf (COTS) Raspberry PI Computer Module 4.

Communications Subsystem (COMMS): The COMMS system is based on the Dorji DRA818U UHF transceiver, using a dipole antenna. It will communicate with the Mini-Cibes ground station located in Akron, PA. The same radio will also communicate with receiving stations to support the payload experiment.

The spacecraft also carries an experimental UHF patch antenna.

Electrical Power Subsystem (EPS): The EPS is a direct energy transfer system using a solar array producing approximately 10 W of orbit average power to charge the Two (2) 18560 Lithium Ion batteries matted in tandem to a thermal plate. This plate is connected to the OBC to provide heat dissipation from the CPU to the warm the batteries. The charging control system is based on an SP-1050 charging circuit, mounted to the main board.

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 OBC, which hosts thermal control algorithms to control the heaters.

Structure Subsystem: The structure is fabricated of Windform XT 2.0, the printed circuit boards are FR-4 fiberglass.

Propulsion Subsystem: No propulsion subsystem is provided.

Payload Subsystems: The primary payload is the Secure System Key software, supporting the experiment. Several experimental receiving stations will receive the Secure Keys at regular intervals as part of this experiment. The receiving stations are small handheld transportable units that can be used in the field to update Internet of Things devices such as PLC controllers. Locations will be within 100 miles of Akron, PA.

A secondary payload is the experimental patch antenna, which will be tested communicating with the Mini Cubes ground station.