S4 CROSSOVER Technical Description

The goal of the S4 CROSSOVER mission, is to obtain flight heritage testing for a prototype payload host platform. Features that will be tested for use in supporting future payloads, include a Globalstar transmitter and an Iridium transceiver, as well space environmental instruments to characterize the radiation and plasma densities to which the payloads will be exposed. S4 CROSSOVER is self powered and operates independently of the larger Astra launch vehicle second stage to which it is permanently attached. It demonstrates a platform that may in the future be used to host payloads; it is an experimental activity.

The Astra rocket, LV009, will be launched from the Pacific Spaceport on Kodiak Island Alaska, No Earlier Than January 15, 2022, into a circular sun synch orbit at 525 km altitude, 97.5 inclination. Transmission from the S4 CROSSOVER will begin after second stage engine cutoff, activated by relays on the launch vehicle, and will operate until demise, which is expected to occur within a few weeks after launch.

S4 CROSSOVER is a single unit attached to the launch vehicle, see Figure 1.

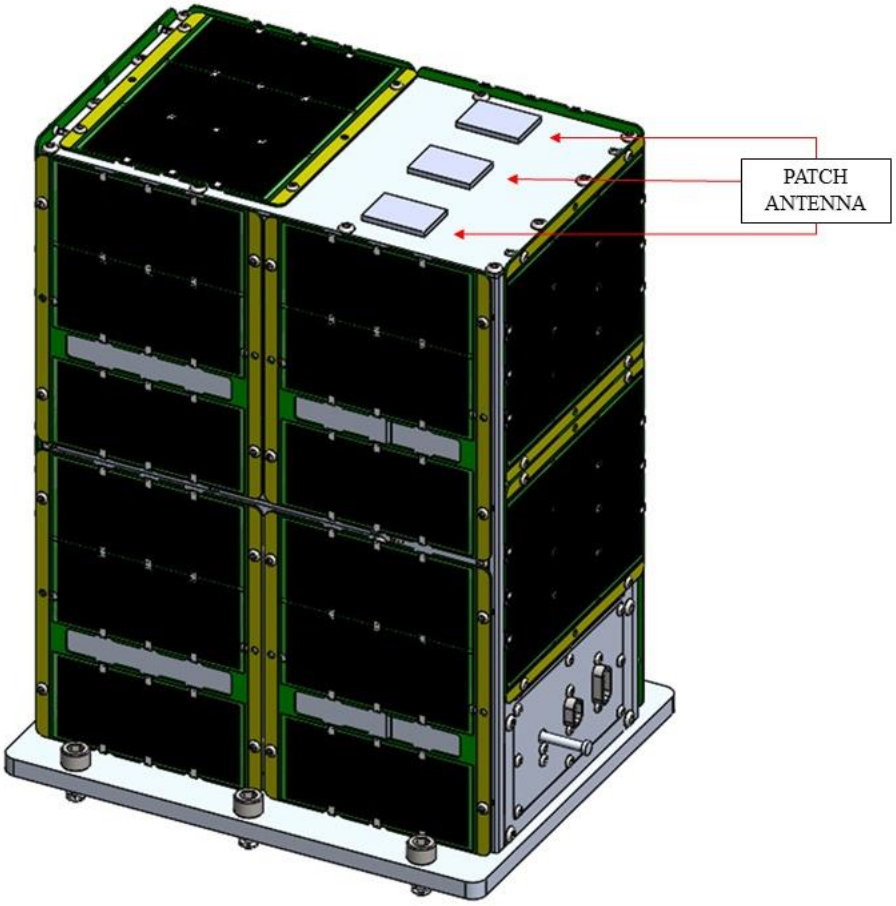

Figure 1 S4 CROSSOVER Overview

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S4 CROSSOVER contains the following systems:

Navigation and Attitude Subsystem: Attitude determination is made using a GridEye infrared horizon sensor. A GPS receiver is also included. From the GPS inputs, the CDH determines position and velocity, and orbit parameters are derived. These can be transmitted to Earth to provide accurate orbital TLEs. This will support accurate ground station antenna pointing, as well as updating of the SpaceTrack database to allow CSPOC to catalog and maintain the location of the spacecraft.

Command and Data Handling (CDH) Subsystem: The CDH function shares hardware with the EPS function. The hardware includes dual processors with onboard diagnostics supporting both the EPS and CDH functions. Commands from NSL mission operations, transmitted via the Iridium constellation, are received via the Iridium 9603 transceiver.

Communications System:

1) An EyeStar S3 Simplex module manufactured by NSL, using a patch antenna, and transmitting to the Globalstar constellation on the established Globalstar channel 1616.25 MHz. A GridEye Horizon Sensor on the patch antennas, allows transmitting only when the antenna is pointing away from the earth.
2) An Iridium 9603 transceiver using a patch antenna, communicating with the Iridium constellation on the established Iridium channels in the range of from 1618.75 MHz to 1625.5 MHz. This radio can only receive a signal from the Iridium constellation when the antenna is pointed away from Earth. And, the signal from the constellation must be received to enable it to transmit.
3) All transmission can be terminated on command from NSL mission operations via the Iridium constellation.

Electrical Power Subsystem (EPS): The EPS is a direct energy transfer system using 2 1U NSL solar arrays, producing approximately 1.6 W of orbit average power to charge the 5.6A-hr battery system. The total energy storage capacity is 41.44 W-hrs. The solar arrays utilize standard Alta Devices flexible photovoltaic cells; the batteries are COTS Tenergy 925050 Li-Polymer cells. The Advanced EPS board controls the charging through four MPPT modules and load switching of the system.

Thermal Monitoring Subsystem (TMS): The TMS consists of (4) thermocouples located throughout the electronics boards and on each solar array. There are no active heating mechanisms. The thermocouples are wired to the Advanced EPS board, which hosts algorithms to monitor and record the temperatures, and the EPS can shut down modules based on temperature.

Structure Subsystem: The structure is fabricated of 6061 Aluminum alloy. There are no extensible antennas, solar panels, or other items.

Propulsion Subsystem: No propulsion subsystem is included.

Payload Subsystem: The payloads are the radiation detector and the plasma detector. The mission will demonstrate use of the Globalstar Simplex transmitter and the Iridium transceiver, as a communications suite that will allow future systems to become hosting platforms, as well as space environmental monitors.