Tyvak-0261 Technical Description

The overall goal of the **Pony Express 2** mission is a technology demonstration involving two 12U CubeSats using Lockheed Martin RF technology for signal characterization in a LEO orbit. The Tyvak-0261 and Tyvak-0262 satellites will operate in identical orbits with an approximate three to five kilometer separation distance and will carry RF payloads developed by Lockheed Martin for receiving, crosslink, and ranging communication to facilitate demonstration capabilities.

The satellite will be launched aboard The SpaceX Transporter 7 in February 2023. It will be inserted into an orbit at 525 km apogee and 525 km perigee +/-25km, on an inclination from the equator of 97.5 (+/- 0.1) degrees. Transmission will begin no earlier than 15 minutes after spacecraft deployment and cease after 3 years. Atmospheric friction will slow the satellite and reduce the altitude of the orbit, until de-orbiting occurs nominally 10 years after launch. See the Orbital Debris Assessment Report for details.

The satellite contains the following subsystems:

Guidance, Navigation and Control (GNC) Subsystem:
For each spacecraft, the 3-axis inertial pointing system is the Tyvak MKII Avionics Platform, which contains four reaction wheel assemblies, three torque rods, two star-trackers, two coarse sensor modules, two STIM-320 IMUs, two Novatel GPS receivers, and two flight computers.

Command and Data Handling (CDH) Subsystem:
The CDH subsystem is the Tyvak MKII dual-string platform. This system performs basic spacecraft state of health maintenance, and interfaces to the payload and GNC system to store data and send commands. A custom interface board provides communication interfaces between the processor board, the UHF transceiver, the S-band transmitter, S-band receiver, and X-band transmitter.

Communications Subsystem (COMMS):
Tyvak-0261 and Tyvak-0262 use a UHF uplink and downlink for spacecraft operations, including termination of transmission if necessary. The UHF ground stations are in San Diego and Fairbanks, Alaska. The spacecrafts' main TT&C link will be handled by the Tyvak Low Data Rate Radio module which has a UHF Transceiver and S-band receiver. In addition to the TT&C radios, both spacecraft have a mission radio for larger file transfer speeds. This mission radio is an Innoflight SCR-106. The X-band downlink is also operated at the Petaluma California location. This beam uses the Innoflight SCR-106 radio for transmission of payload data.

Electrical Power Subsystem (EPS): The EPS includes all internally developed Tyvak MKII Platform avionics. The Maximum Power Point Tracking module is redundant and can provide up to 100W power OAP from two solar array assemblies. The battery stores up to 120W-Hrs of

energy. All significant power loads (ie. Payload) are fuse protected in the Tyvak MKII Load controller module.

Thermal Control Subsystem (TCS): Thermal control is primarily passive, making use of carefully chosen surface coatings, except for the flight battery which includes 3 internal heaters.

Structure Subsystem: The structure is fabricated of Aluminum 6061.

Propulsion Subsystem: The propulsion system for each spacecraft contains a ThrustMe NPT-30-I2 which weighs 1.2 kg.

Payload Subsystem: The spacecrafts' payload system will use space-to-space communications for a technology demonstration involving crosslink, RF communications, ranging and timing. The three payload systems are listed below:

Ranging & Timing System: The transmitted waveform originates from the Rincon Astro SDR.
The antenna is Lockheed-developed RHCP, 5dBi (9dBi at boresight); peak power <0.4W
Transmits and receives at 5.80041 GHz
Modulation uses a 1.024 Mbps rate with BPSK
Transmit/Receive front end is Lockheed Martin developed using commercially available C-band components.
Emission Designator: 05M0F3D
No Station Identification information is transmitted (space-to-space)
Transmissions are planned to automatically occur on the vehicle at pre-determined times. These experiment plans are developed and uplinked to the vehicle to execute autonomously at a given time.

Crosslink System: The transmitted waveform originates from the Rincon Astro SDR.
Uses DVB-S2 modulation originating from a Viasat modem within the Astro SDR
Frequencies/antenna = (22.60224, 24.5376) GHz
Utilizes 0.5-1.5 Mbps rate
Transmit/receive front end is Lockheed Martin developed using commercially available components.
Emission Designator: 2M0F3D
No Station Identification information is transmitted (space-to-space)
Transmissions are planned to automatically occur on the vehicle at pre-determined times. These experiment plans are developed and uplinked to the vehicle to execute autonomously at a given time.

Payload Transmitter: The transmitted waveform originates from the Rincon Astro SDR and uses a Lockheed Martin developed antenna with 5 dB of gain at boresight.

Frequency = 2492 MHz (space-to-Earth)
No Station Identification information is transmitted
Transmissions are planned to automatically occur on the vehicle at pre-determined times. These

experiment plans are developed and uplinked to the vehicle to execute autonomously at a given time.
The payload transmitter will only downlink to Lockheed Martin Earth stations located as noted in the Narrative.
Emission Designator: 2M0F3D