



September 26, 2017

FCC Office of Engineering and Technology
445 12th Street SW
Washington, DC 20554

SUBJECT: TEMPEST-D cubesat mission (FCC application # 0573-EX-CN-2017)

Ms. Leann Nguyen,

Please find details on the TEMPEST-D cubesat mission included below.

Date license is required: **December 1st, 2017**

LV integration date: **February 1st, 2018**

Launch date: **CRS15 April 2018**

Date for initiation of on-orbit operations: **NET 1 month post launch**

Expected mission duration: **12 months**

Principle Investigator for the mission.

Point of Contact Name: Dr. Steve Reising
Organization Name: Colorado State University
Address: B113 Engineering Bldg, Fort Collins, CO 80521
E-Mail: steven.reising@colostate.edu
Telephone Number: 970-491-2228

Technical point of contact for the mission.

Point of Contact Name: Matt Pallas
Organization Name: Blue Canyon Technologies
Address: 2425 55th St. Suite A-200, Boulder, CO 80301
E-Mail: mpallas@bluecanyontech.com
Telephone Number: 720-458-0703

*please also include Steve Reising on any relevant communications.

Point of contact who can terminate ALL satellite transmissions if interference is detected.

Point of Contact Name: Scott Palo, PhD
Organization Name: Blue Canyon Technologies
Address: 2425 55th St. Suite A-200, Boulder, CO 80301
E-Mail: palo@bluecanyontech.com
Telephone Number: 720-458-0703

*please also include Matt Pallas and Steve Reising on any relevant communications.

Point of contact who can terminate ALL Boulder CO ground station transmissions if interference is detected.

Point of Contact Name: Scott Palo, PhD



Organization Name: Blue Canyon Technologies
Address: 2425 55th St. Suite A-200, Boulder, CO 80301
E-Mail: palo@bluecanyontech.com
Telephone Number: 720-458-0703

*please also include Matt Pallas and Steve Reising on any relevant communications.

Point of contact who can terminate ALL Wallops VA ground station transmissions if interference is detected.

Point of Contact Name: Thomas Johnson
Organization Name: NASA/GSFC Wallops Flight Facility
Address: Bldg U25, Wallops Is., VA, 23337
E-Mail: thomas.e.johnson@nasa.gov
Telephone Number: 757-824-2560

*please also include Matt Pallas, Steve Reising and Scott Palo on any relevant communications.

Point of contact who can terminate ALL Morehead KY ground station transmissions if interference is detected.

Point of Contact Name: Ben Malphrus
Organization Name: Morehead State University
Address: Space Science Center 235 Martindale Drive, Morehead, KY
40351
E-Mail: b.malphrus@moreheadstate.edu
Telephone Number: 606-783-9596

*please also include Matt Pallas, Steve Reising and Scott Palo on any relevant communications.

Point of contact for conjunction alerts.

Point of Contact Name: Matt Pallas
Organization Name: Blue Canyon Technologies
Address: 2425 55th St. Suite A-200, Boulder, CO 80301
E-Mail: mpallas@bluecanyontech.com
Telephone Number: 720-458-0703

*please also include Steve Reising on any relevant communications.

Project Description

The TEMPEST-D (Temporal Experiment for Storms and Tropical Systems - Demonstrator) is a 6U CubeSat mission to provide risk mitigation for the six-satellite TEMPEST mission that will provide the first temporal observations of cloud and precipitation processes on a global scale.

These observations are important to understand the linkages in and between Earth's water and energy balance, as well as to improve our understanding of cloud model microphysical processes that are vital to climate change prediction.



TEMPEST-D consists of one of the proposed TEMPEST 6U CubeSats, to raise the technology readiness level of the system to TRL 9 and to demonstrate its measurement capabilities.

The payload consists of a radiometer developed for the failed RACE mission and a High-frequency Airborne Microwave and Millimeter-wave Radiometer (HAMMR) IIP-10 radiometer.

TEMPEST-D is a science mission lead by Dr. Steve Reising at the Colorado State University. The CubeSat bus is built and operated by Blue Canyon Technologies.

License Details

The TEMPEST-D mission will utilize a Utah State University provided UHF Cadet radio that will operate at with a 15kHz uplink at 450MHz and a downlink at 467.5MHz with a bandwidth of 3MHz. We are requesting a 47 CFR Part 5 - EXPERIMENTAL RADIO SERVICE license for our uplink at 450MHz per footnote US87 in the NTIA MANUAL OF REGULATIONS AND PROCEDURES FOR FEDERAL RADIO FREQUENCY MANAGEMENT which states “US87 - The band 449.75-450.25 MHz may be used by Federal and non-Federal stations for space telecommand (Earth-to-space) at specific locations, subject to such conditions as may be applied on a case-by-case basis. Operators shall take all practical steps to keep the carrier frequency close to 450 MHz”. For the downlink, we are requesting operation between 465MHz and 470MHz which is a secondary allocation for the Meteorological-satellite service (space-to-EARTH) in the Federal Table and as such we expect coordination with NTIA is required. Additionally, per footnote 5.289 “Earth exploration-satellite service applications, other than the meteorological-satellite service, may also be used in the bands 460-470 MHz and 1690-1710 MHz for space-to-Earth transmissions subject to not causing harmful interference to stations operating in accordance with the Table”. BCT is aware of footnote US201 and will insure that the TEMPEST-D power flux-density produced at the Earth’s surface shall not exceed $-152 \text{ dBW/m}^2/4 \text{ kHz}$.

TEMPEST-D is also requesting to use the Globalstar GSP-1720 for space-to-space communication between the TEMPEST-D cubesat and the Globalstar satellite network. The onboard XACT attitude system will insure that the Globalstar antenna is pointed away from the earth and we will only be using GSP-1720 transmit channels 5 thru 7. Blue Canyon Technologies will coordinate with Globalstar to insure compliance with all regulations.

Additional data required for applications requesting use of federal or shared government frequencies.

Spacecraft: TEMPEST-D

Inclination: 52° [ISS]



Apogee: 400km
Perigee: 400km
Orbital period: 1.62h
Number of satellites in the system: 1
Number of transmitting satellites: 1
Number of transmitting satellites: 2

Transmitter #1 Cadet U/U

Center Frequency: 468MHz
Bandwidth: 3MHz
3dB beamwidth: 100°
Maximum Antenna Gain: 5dBi
Polarization: RCP
Maximum transmit power: 2W
Modulation: OQPSK
ITU emission designator: 3M00G2DAX

Receiver #1 Cadet U/U

Center Frequency: 450MHz
Bandwidth: 15kHz
3dB beamwidth: 100°
Maximum Antenna Gain: 5dBi
Polarization: RCP
Receiver Sensitivity: -97dBm
Modulation: FSK
ITU emission designator: 15K0G2DAX

Transmitter #2 Globalstar GSP-1720

Center Frequency: 1615.650MHz to 1618.110MHz
Bandwidth: 1.25MHz
3dB beamwidth: 100°
Maximum Antenna Gain: 0.5dBi
Polarization: LCP
Maximum transmit power: 2W
Modulation: OQPSK
ITU emission designator: 3M00G2DAX

Receiver #2 Globalstar GSP-1720



Center Frequency: 2483.5MHz to 2500MHz

Bandwidth: 1.23MHz

3dB beamwidth: 100°

Maximum Antenna Gain: 0.2dBi

Polarization: LCP

Receiver Sensitivity: -100dBm

Modulation: unknown

ITU emission designator: 15K0G2DAX

Ground Station #1:

Wallops Island, VA 23337

37 51' 21" N 75 30' 43" W

Altitude above MSL [m]: 4

Antenna height above ground [m] : 18

Elevation: 5-90°

Azimuth: 0-360°

Transmitter

Center Frequency: 450MHz

Bandwidth: 15kHz

3dB beamwidth: 2.9°

Maximum Antenna Gain: 35dBi

Polarization: RCP

Maximum transmit power: 20W

Modulation: FSK

ITU emission designator: 15K0G2DAX

Receiver

Center Frequency: 468MHz

Bandwidth: 3MHz

3dB beamwidth: 2.9°

Maximum Antenna Gain: 35dBi

Polarization: RCP

Receiver Sensitivity: -114dBm @ 1MHz BW

Modulation: OQPSK

ITU emission designator: 3M00G2DAX



Ground Station #2:

100 Satellite Drive Morehead, KY 40351

38° 11' 30.8" N 83° 26' 19.9" W

Altitude above MSL [m]: 350

Antenna height above ground [m] : 25.6

Elevation: 5-90°

Azimuth: 0-360°

Transmitter

Center Frequency: 450MHz

Bandwidth: 15kHz

3dB beamwidth: 2.6°

Maximum Antenna Gain: 32dBi

Polarization: RCP

Maximum transmit power: 50W

Modulation: FSK

ITU emission designator: 15K0G2DAX

Receiver

Center Frequency: 468MHz

Bandwidth: 3MHz

3dB beamwidth: 2.6°

Maximum Antenna Gain: 32dBi

Polarization: RCP

Receiver Sensitivity: -100dBm

Modulation: OQPSK

ITU emission designator: 3M00G2DAX

Ground Station #3:

2425 55th St, Boulder, CO 80301

40°01'23.8"N 105°13'34.7"W

Altitude above MSL [m]: 1600

Antenna height above ground [m] : 4

Elevation: 5-90°

Azimuth: 0-360°

Transmitter

Center Frequency: 450MHz



Blue Canyon Technologies

2425 55th St, STE 200 BLDG A

Boulder, CO 80301

www.bluecanyontech.com

Bandwidth: 15kHz

3dB beamwidth: 17°

Maximum Antenna Gain: 21dBi

Polarization: RCP

Maximum transmit power: 500W

Modulation: FSK

ITU emission designator: 15K0G2DAX

Receiver

None