



Memorandum

Date: 05 Apr 2019

From: Christopher Timperio
Vector Launch, Inc.

FRN: 0026456863

Subject: Vector Launch, Inc. Experimental STA Application for
Vector-R Series B0.101 Launch Vehicle

Reference Documents:

REF1 FCC, DA-13-446, Guidance on Obtaining Experimental Authorizations for Commercial Space Launch Activities, 15 March 2013.

REF2 GN-0275-VSS-1001, Vector FCC Memo 1001 (this document)

REF3 GN-0276-VSS-1001, Vector Supporting Material Experimental STA Application 1001

REF4 87_Tform_Vector_1001, AFTRCC Experimental License Form

REF5 FCC Table of Frequency Allocations (Note US276)

This memorandum provides backup data for the Experimental STA Application for the Vector-R Block 1 series launch vehicle being developed by Vector Launch Inc. of Tucson AZ. This STA request follows the application guidelines DA-13-446 Guidance on Obtaining Experimental Authorizations for Commercial Space Launch Activities (REF1) and guidance from the FCC Table of Frequency Allocations Note US276 (REF5). Vector Launch Inc. is developing the Vector-R as a rapid and frequent launch vehicle with capabilities to serve the commercial small satellite market. A spreadsheet providing tabulated values of mission parameters is provided in REF3, also attached to this application.

Vector has completed an analysis of the nominal trajectory for a two-stage flight of the Vector-R. The timeline of mission events (Max Q, MECO, Stage Sep, etc..) is listed in the attached REF3. Max Q will occur roughly 22 seconds into flight, where MECO will occur roughly at the same time. Stage separation will occur roughly 7.5 seconds after MECO. Maximum downrange distance where communication is required is 1.58 km. The maximum vehicle altitude will be 3.6 km, and the maximum slant range (crossrange) will be 3.93 km from the ground station to the vehicle.

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Under nominal flight conditions, after Stage 1 burnout and separation, Stage 2 is expected to tumble and break up with an instantaneous impact point (IIP) similar to that of Stage 1. These IIP are as well listed in REF3.

This application will cover a **single flight** of the Vector-R B0.101 launch vehicle. This launch will demonstrate launch capability for the Vector-R B1 and B2 series. Separate STA applications will be submitted for the follow-on Vector-R series.

This application is for a single flight (**estimated 3 hours of frequency usage**) of the Vector launch vehicle. The launch vehicle maximum flight duration will be less than 10 minutes. Pre-flight transmitter operation is expected to be less than 90 minutes. The maximum operating time is expected to be less than 3 hours from the commencement of launch activities.

For this application we would like to submit approval for the following range of dates; May 1st, 2019 to October 1st, 2019. This application should cover the following launch sites;

- Mid-Atlantic Regional Spaceport (MARS), located at the southern top of NASA's Wallops Flight Facility on Wallops Island, VA. MARS is operated by the Virginia Commercial Space Flight Authority (VCSFA), also known as 'Virginia Space', and is located at 37°49'40.8" N, 75°29'38.04" W.
- Pacific Spaceport Complex Alaska (PSCA), located on Kodiak Island, Alaska at 57°26'6" N, 152°20'30.12" W.
- Vandenberg Air Force Base (VAFB), located in southern California at 34°34'34.68" N, 120°37'57" W.
- Cape Canaveral Air Force Station located in Cape Canaveral, FL at 28°35'0.24" N, 80°34'58.44" W.
- Friends of Amateur Rocketry (FAR) launch complex, located in Randsburg, CA at 35°20'51" N, 117°48'33.84" W.
- Vector Arizona Test Site (ATS), located in Pinal County, AZ at 32°30'43.92" N, 111°17'59.64" W.
- NASA's Kennedy Space Center (KSC), located in Cape Canaveral, FL at 28°27'29.88" N, 80°31'42.96" W.
- Spaceport Camden, located in Camden County, GA, near the city of Woodbine at 30°56'1.32" N, 81°31'5.88" W.

Vector will finalize the planned launch site and date with local area frequency managers 15-days prior to the flight. Communications will be by means of email and telephone. Vector will also provide an update 7-days prior to launch and at the day of launch prior to the flight. Vector has included a stop buzzer phone number in the data table attached to our FCC STA application (REF3). Vector will confirm the stop buzzer contact information prior to the flight.

The experimental STA application requests two telemetry downlinks in the 2360 to 2390 MHz Upper S-Band. This band is allocated for government use however the allocation is also authorized for use by commercial launch vehicles telemetering in accordance with the FCC Table of Frequency Allocations Note US276 (REF5). Vector requests use of this band on a non-interference basis.

The two downlink frequencies listed below are planned for the Vector-R B0.101 flight.

	Frequency	Modulation	Data Rate	Emission Designator	Use
Link 1	2370.5 MHz	SOQPSK-TG	2 Mbps	1M92G1D	2 nd Stage Telemetry

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Link 2	2382.5 MHz	SOQPSK-TG	10 Mbps	8M00G1D	Special Instrumentation
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Two S-Band transmitters (Quasonix nanoTX and Quasonix TIMTER) will be used as Commercial-Off-The-Shelf (COTS) telemetry transmitter radio components for the Vector-R B0.101 rocket. The Quasonix brand is used extensively throughout the aerospace and space industries. Both Quasonix units employ Shaped Offset Quadrature Phase Shift Key (SOQPSK-TG) modulation to provide highly efficient bandwidth utilization at higher data rates. For the Vector-R B0.101 application, two data rates are indicated: 2 Mbps and 10 Mbps. These are to be used for high-rate digital telemetry, and special instrumentation digital telemetry including NTFS digital video data.

The Quasonix transmitter radios will output a 10W (40dBm) 2370.5MHz RF signal of 2MHz bandwidth (nanoTX), and a 10W (40dBm) 2382.5MHz RF signal of 10MHz bandwidth (TIMTER).

Two omni-directional antennas with “hemi-spherical” patterns are used on opposite sides of the vehicles to provide full RF visibility during flight. The output power from the Quasonix transmitters will be combined and split equally and fed to these antennas. Given the full pattern coverage of the vehicle, we note the vehicle antennas to have a “total equivalent gain” of 0dBi. Therefore, the effective isotropic radiated power (EIRP) can be estimated as the equivalent power output from both transmitters; 20W (43dBm).

The TX S-Band antennas on the launch vehicle are of a single omnidirectional type; Haigh-Farr conformal panel antennas. The S-Band antennas are of the linear polarization type. The antenna height on the vehicle is 12.2 m off the ground.

Thank you for your consideration, and if additional information is required, please do not hesitate to contact me as soon as possible.

Thank you,

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