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Memorandum

Date: **06 Sept 2018**

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 small, low cost, launch vehicle 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 41 seconds after launch, where MECO will occur roughly 2 minutes and 7 seconds into the launch. Stage separation will occur roughly 5 seconds after MECO. Maximum downrange distance where communication is required is 316 km. The maximum vehicle altitude will be 64 km, and the maximum slant range (crossrange) will be 242 km from the ground station to the vehicle.

Under nominal flight conditions, after Stage 1 burnout and separation, Stage 2 is expected to tumble and break up with an instantaneous impact point similar to that of Stage 1. These points will be off the coast of Kodiak Island, approximately 316 km downrange into the Pacific Ocean; located at 54° 9' 8.28''N, 149° 50' 14.64'' W.

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. This is an absolute worst-case estimate as operating longer than 30 to 60 minutes may require shut down of the transmitters due to thermal concerns.

The proposed launch site is Launch Pad C at Pacific Spaceport Complex - Alaska, located on Kodiak Island, Alaska at 57°25'50.57141" N, 152°21'10.93786" W. For this application we would like to submit approval for the following range of dates; October 8th, 2018 to April 1st, 2019. However, the planned launch date for Vector-R B0.101 is targeted for October 31st, 2018 from Kodiak Island, AK (PSCA).

Launch processing and integration will be performed at the Integration and Processing Facility (IPF) located at 57°26'04.6" N, 152°20'33.2" W. Launch operations will be controlled from the Launch Operations Control Center (LOCC) located at 57°27'12.9" N, 152°22'46.3" W. The launch site is operated by Alaska Aerospace Corporation (AAC).

Vector will finalize the planned launch date with local area frequency managers 7-days prior to the test flight. Communications will be email and telephone. Vector will also provide an update 2-days prior to launch and 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. Vector will confirm the stop buzzer contact information prior to the flight.

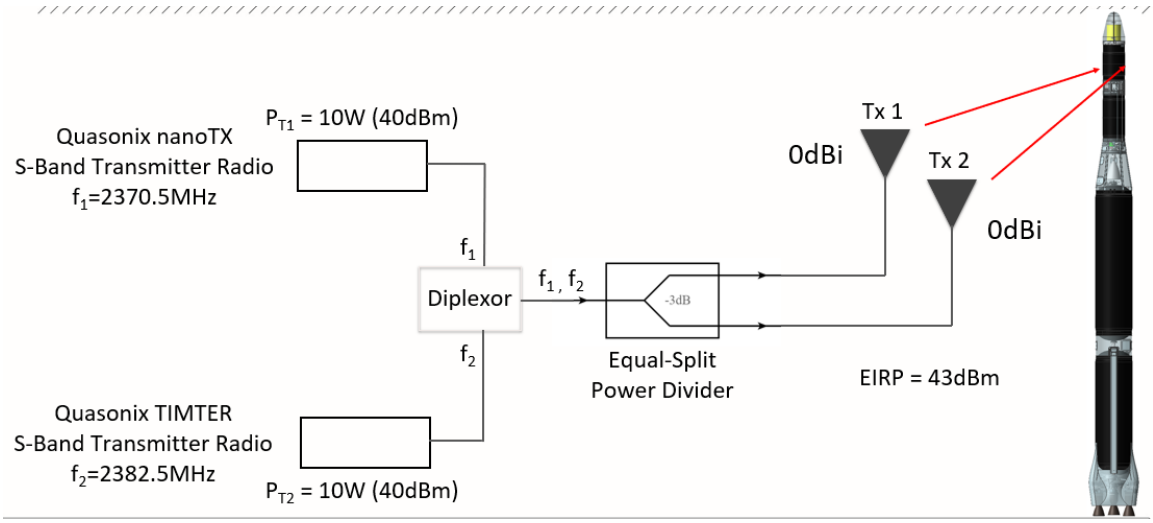
The experimental STA application requests two telemetry downlinks in the 2360 to 2390 MHz S-Band. This band is allocated for government use however the allocation is also authorized for use by commercial launch vehicles telemetering in accordance with the FCC Table of Frequency Allocations Note US276 (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	2nd Stage Telemetry
Link 2	2382.5 MHz	SOQPSK-TG	10 Mbps	9M10G1D	Special Instrumentation

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, 2 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). The RF chain of TX components which follow the Quasonix transmitter radios are shown below;



Two 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 split equally and fed to these antennas. Given the full pattern coverage of the vehicle, we note the antennas to have a 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; P/N: 13315. 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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