

Northrop Grumman Innovation Systems
Alliant Techsystems Operations LLC.
4700 Nathan Lane
Plymouth, MN 55442

Nimesh Sangani
Federal Communications Commission
Experimental Radio Services
P.O.Box 358320
Pittsburg, PA 15251-5320

Mr. Sangani,

Below is Northrop Grumman Innovation Systems' Alliant Techsystems Operations response to your questions dated April 16, 2019.

- 1) What is the size of the proposed antenna(s)? If there is no call sign and IBFS file no. for the proposed antenna(s), please submit antenna's pattern performances

Two antennas are used in our testing. One mounted on the projectile (mobile station) and one at the fixed station to receive data from the projectile.

Mobile antenna has a peak gain of 5.4dB and the pattern is shown in figures 3 and 4, fixed antenna has a peak gain of 34dB and the pattern is shown in figures 1 and 2.

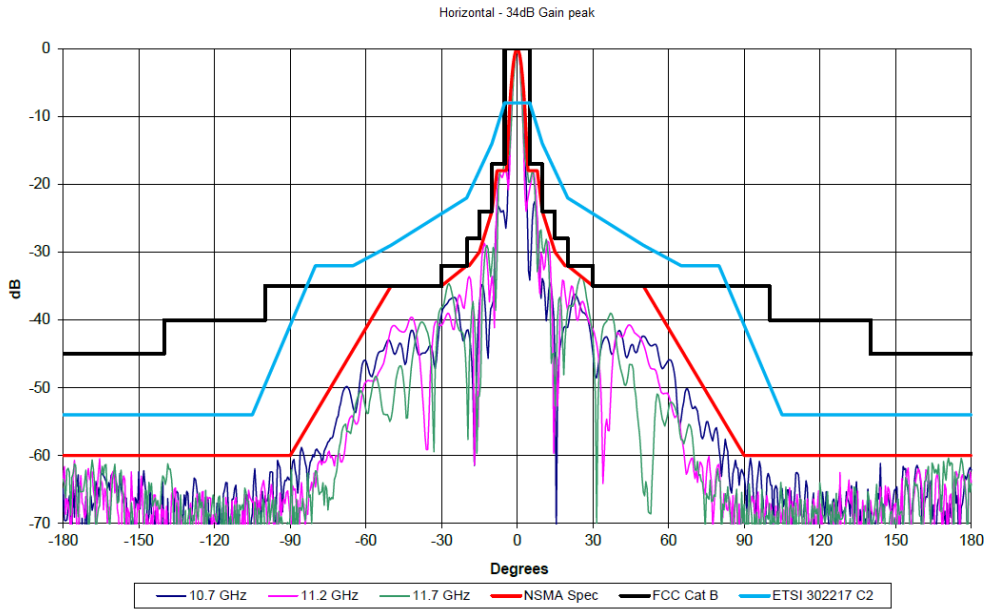


Figure 1 - Fixed Antenna Horizontal Pattern

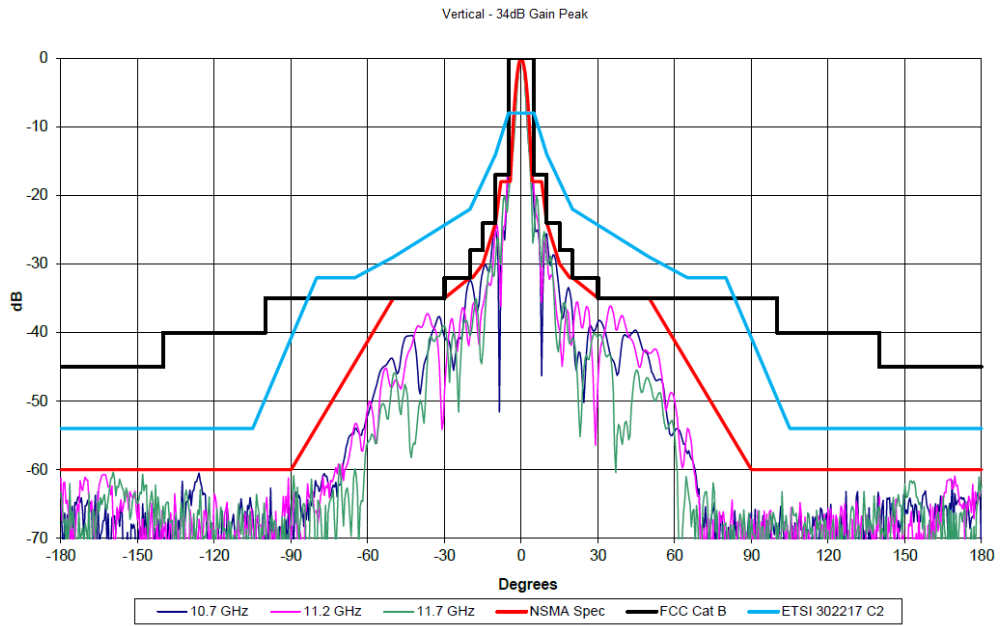


Figure 2 - Fixed Antenna Vertical Pattern

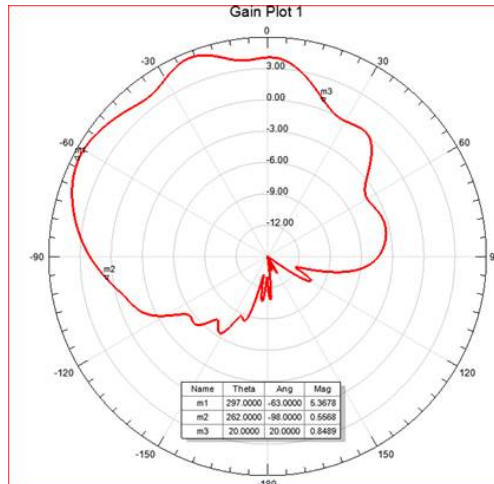


Figure 3 - Mobile Antenna (E Plane)

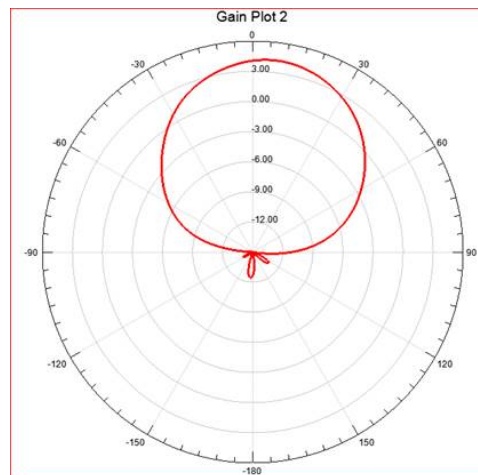


Figure 4 - Mobile Antenna (H Plane)

- 2) Please submit a radiation hazard of the proposed antennas if there is no call sign and IBFS file no.

Radiation hazard calculations were performed using an online “Amateur Radio RF Safety Calculator” (http://hintlink.com/power_density.htm) and shown in figure 5. Only the Fixed Station was analyzed, as the mobile station is very low power and is only active for a very short period of time.

Existing safety zones for this experiment (several thousand meters) are considerably larger than the calculated RF hazard zone.

Calculation Results

Average Power at the Antenna	1.995 watts
Antenna Gain in dBi	34 dBi
Distance to the Area of Interest	40 feet 12.192 metres
Frequency of Operation	11750 MHz
Are Ground Reflections Calculated?	Yes
Estimated RF Power Density	0.6868 mW/cm ²

	Controlled Environment	Uncontrolled Environment
Maximum Permissible Exposure (MPE)	5.005 mW/cm ²	1.005 mW/cm ²
Distance to Compliance From Centre of Antenna	14.8747 feet 4.5338 metres	33.1991 feet 10.1191 metres
Does the Area of Interest Appear to be in Compliance?	yes	yes

Figure 5 - RF Safety Hazard Results

- 3) Please provide Point of communication: (i.e. specify an authorized GSO Ku-band or NGSO Ku-band satellites or both, and then provide call sign for each satellite)

No satellite communications are part of this experiment. Communications are exclusively between the fixed and mobile (projectile / bullet) stations described in the experimental license request.

This experiment is testing communications between a bullet in flight (mobile station) and a fixed receiver station.

Communications are only active for the time of flight of the projectile (under 1 second) during each test.

Target area and firing position are at similar elevations. Antenna will be pointed directly at the target position (due west, 270 degrees) with zero incline from horizontal.

- 4) If the proposed satellite is NGSO satellite, please demonstrate that your proposed operations in the 11.7-11.8 GHz band will meet the power Flux-density limits in Article 21 of the ITU Radio Regulations and the equivalent power Flux-density limits in Article 22 of the ITU Radio Regulations.

No satellite communications are part of this experiment. See response for question number three (3).

- 5) Please certify that your proposed operations and communication between earth stations and satellites are in compliance with all existing or future coordination agreements between the proposed satellite operators and other administrations, GSO and NGSO satellite operators.

No satellite communications are part of this experiment. See response for question number three (3).

Northrop Grumman Innovation Systems' Armament Systems strives to minimize any interference from our testing and will accept a lower power limit if deemed necessary by the FCC for issuance of this license.

Sincerely,

Mark Turpin, Sr. Principal Electrical Engineer
Northrop Grumman Innovation Systems
Armament Systems