

Responses to FCC Questions

Applicant hereby submits the following responses to the Commission's questions and certifications regarding this Amendment.

FCC Question 1: "The 17.8-18.3 GHz and 19.3-19.7 GHz frequency bands are shared with Fixed users. Section § 25.203 (Choice of sites and frequencies) required applicant to coordinate with Fixed users and submitted frequency report for each FIXED sites [sic] operated by 1.2m AVL 1270 auto-deploy antennas mounted on top of the mobile trailers. If the proposed operations will not comply with Section § 25.203, please submit a request of waiver of Section § 25.203 and provide demonstration and justification of 1) how the proposed operations can be shared without causing interference to Fixed users/facilities, and 2) why applicant will not [sic] submitted frequency report for each FIXED sites [sic]."

Applicant Reply 1: Since these are space-to-Earth FSS frequencies (an earth station receive band), it is our understanding that such a showing is covered at the space station authorization. Additionally, we request use of these frequencies on a non-interference, unprotected basis with respect to fixed service stations. As such, no coordination with fixed sites is necessary.

FCC Question 2: "The 17.8-18.6 GHz, 19.3-19.7 GHz, and 19.7-20.2 frequency bands are shared with Federal. To expedite the process, please provide a letter from O3b NGSO satellite operators showing the coordination had been completed between NTIA/Federal operators and O3b NGSO satellite operators for the proposed operation of 100 unites of 1.2m AVL 1270 auto-deploy antennas mounted on top of the mobile trailers with Area of operation CONUS, PR, VI for disaster recovery or immediately emergency."

Applicant Reply 2: As with Question #1 above, these are space-to-Earth frequencies for which coordination will be obtained, as conditioned in the space station authorization, prior to operation.¹ Additionally, we request use of these frequencies on a non-interference, unprotected basis with respect to Federal fixed service stations. As such, no coordination with Federal fixed sites should be necessary.

FCC Question 3: "The 28.35-28.6 GHz and 29.25-30.0 GHz (Earth-to-space) frequency bands are primary allocation for GSO FSS systems and secondary allocation for NGSO FSS systems. In addition, the 29.5-30.0 GHz (Earth-to-space) frequency band is for MOBILE-SATELLITE service. Therefore, NGSO FSS operations must not cause harmful interference to GSO FSS networks and MOBILE-SATELLITE service. Please provide demonstration on how the proposed "operation of 100 unites of 1.2m AVL 1270 auto-deploy antennas mounted on top of the mobile trailers with Area of operation CONUS, PR, VI, for disaster recovery or

¹ O3b Limited, Call Sign S2935, File No. SAT-AMD20171109-00154, ¶ 47 (granted June 4, 2018) ("O3b Market Access Grant") (requiring completion of coordination prior to operation).

immediately emergency” will not cause acceptable [sic] interference into GSO FSS networks and MOBILE-SATELLITE service facilities.”

Applicant Reply 3: Section 25.146 requires NGSO FSS applicants proposing operations in the 10.7-30 GHz frequency range to "certify" that they "will comply with . . . [a]ny applicable equivalent power flux-density levels in Article 22, Section II, and Resolution 76 of the ITU Radio Regulations." Consistent with this rule, we state the following: Pursuant to Sections 25.115(f)(1) and 25.146(a)(2) of the Commission's rules, applicant hereby certifies that the earth station operations proposed herein will comply with the applicable equivalent power flux-density ("EPFD") levels in Article 22, Section II, and Resolution 76 of the ITU Radio Regulations. In an abundance of caution, Applicant submits the Annex and accompanying data to demonstrate compliance with EPFD levels in Article 22, Section II, and Resolution 76 of the ITU Radio Regulations.

The Commission has recognized that any NGSO system that complies with these international EPFD limits "is considered as having fulfilled its obligation . . . not to cause unacceptable interference to any GSO network." Applicant will not claim protection from interference from U.S.-licensed GSO FSS networks in the 27.5-28.6 GHz and 29.5-30 GHz bands. Considering that MSS assignments must be accompanied with FSS assignments, MSS assignments will likewise be protected. As such, this language would appear to satisfy the Commission's requirements. In an abundance of caution, Applicant has submitted the Annex and accompanying data to demonstrate compliance with EPFD limits.

FCC Question 4: "For operations in the 28.35-28.6 GHz and 29.25-30.0 GHz (Earth-to-space) frequency bands, Please provide an Interference Analyses with Respect to GSO Satellite Networks to demonstrate how the proposed "operation of 100 unites of 1.2m AVL 1270 auto-deploy antennas mounted on top of the mobile trailers with Area of operation CONUS, PR, VI for disaster recovery or immediately emergency" and the 100 AVL 1270 1.2 antenna 's proposed operation will mee [sic] the EPFD limits in Article 22 of the ITU Radio Regulations. In the demonstration, please also provide the following uplink information in the 28.35-28.6 GHz and 29.5-30 GHz frequency bands:

- a. a maximum input power spectral density (dBW/40kHz and dBW/4kHz) for earth station,*
- b. the minimum separation angle between the O3b orbit and the GSO arc (degrees),*
- c. the off-axis gain (dBi) $(32 - 25\log(\theta))$ transmitting from earth station),*
- d. the off-axis EIRP density towards the GSO (dBW/40kHz and dBW/4kHz),*
- e. the minimum elevation angle from earth station FIXED site/location to the GSO orbit/ satellite,*
- f. the spreading loss"*

Applicant Reply 4: Section 25.146 requires NGSO FSS applicants proposing operations in the 10.7-30 GHz frequency range to "certify" that they "will comply with . . . [a]ny applicable equivalent power flux-density levels in Article 22, Section II, and Resolution 76 of the ITU

Radio Regulations.” Consistent with this rule, we state the following: Pursuant to Sections 25.115(f)(1) and 25.146(a)(2) of the Commission’s rules, applicant hereby certifies that the earth station operations proposed herein will comply with the applicable equivalent power flux-density EPFD levels in Article 22, Section II, and Resolution 76 of the ITU Radio Regulations. In an abundance of caution, Applicant submits the Annex and accompanying data to demonstrate compliance with EPFD limits.

The Commission has recognized that any NGSO system that complies with these international EPFD limits “is considered as having fulfilled its obligation . . . not to cause unacceptable interference to any GSO network.” Applicant will not claim protection from interference from U.S.-licensed GSO FSS networks in the 27.5-28.6 GHz and 29.5-30 GHz bands. As such, this language would appear to satisfy the Commission's requirements.

FCC Question 5: “The proposed operation (EIRP and EIRP density) exceeded the power levels authorized to Ka-band GSO FSS licensee operated at COUNUS [sic] or Various. Please provide letters showing the coordination had been completed between applicant and GSO FSS licensees.”

Commented [zach1]: Typo

Applicant Reply 5: Per the FCC’s band plan,² coordination is not required in bands where GSO FSS operations are primary and protected by EPFD limits from NGSO FSS operations. Likewise, primary NGSO FSS operations are not required to protect secondary GSO FSS operations in bands where NGSO systems are primary relative to GSO.

² See *Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters*, Report and Order and Further Notice of Proposed Rulemaking, 32 FCC Rcd 7809, 7850-51 (2017).

Annex: AVL 1.2m compliance with EPFD↑ limits

Figure 1 illustrates the 1.2-meter AVL antenna pattern in azimuth and elevation coordinates (left plot). The GSO arc and O3b arc are superimposed in az/el coordinates when the antenna boresight is pointing toward an O3b satellite located at 100°W (for example). The AVL antenna is located at 38°N, 95°W (for example). The colormap and associated scale shows the antenna gain (units in dBi) as a function of azimuth and elevation angles. The antenna gain data that intersects with the GSO arc is used to determine the gain in the direction of the GSO arc. The EPFD↑ limit is -162 dBW/m²/40 kHz. The spreading loss determined by the equation

$$spreading\ loss\ (dB) = 10\log_{10}(4\pi d^2)$$

where *d* is the distance to a point on the GSO arc from the location on the Earth of the transmitting earth station. With the spreading loss, input power spectral density and antenna gain in the direction of the GSO arc, the EPFD↑ can be determined. The plot of the right side of Figure 1 illustrates the EPFD↑ produced at the GSO arc from the 1.2-meter AVL antenna.

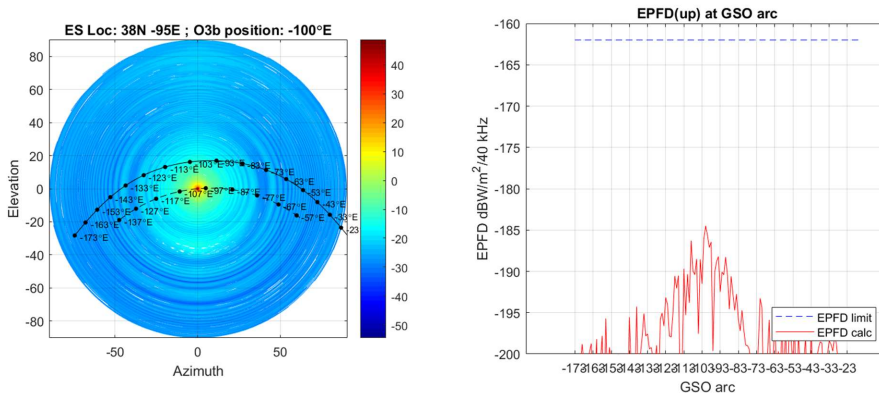


Figure 1. 1.2-meter AVL antenna gain and EPFD↑ at the GSO arc

As seen in Figure 1, the 1.2-meter AVL operations are compliant with the EPFD↑ limits with a margin of about 23 dB. Since this is a tracking antenna following an O3b satellite, the EPFD↑ limits are confirmed in the same way as demonstrated above for all pointing directions of an eligible O3b satellite.

Extending the above analysis to a set of test points distributed over the United States is shown in Figure 2. This plot illustrates a heatmap of the EPFD↑ margin for the 1.2-meter AVL antenna operating from anywhere in the United States. The margin varies between approximately 19 dB and slightly above 24 dB which confirms the antenna can be operated from anywhere in the United States and comply with the EPFD↑ limits.

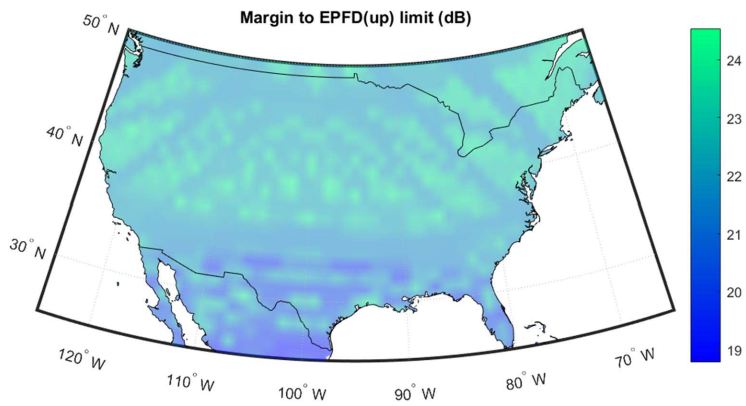


Figure 2. Margin to the EPFD \uparrow limits for the 1.2-meter AVL antenna operating anywhere in the US

Data Used for EPFD Analysis

		At minimum Elevation		At center of pass	
		4 kHz	40 kHz	4 kHz	40 kHz
a.	a maximum input power spectral density (dBW/40kHz and dBW/4kHz) for earth station,	-26.99	-16.99	-26.99	-16.99
b.	the minimum separation angle between the O3b orbit and the GSO arc (degrees),	8.5	8.5	12.2	12.2
c.	the off-axis gain (dBi) ($32-25\log(\theta)$) transmitting from earth station),	8.764526857	8.764526857	4.841004233	4.841004233
d.	the off-axis EIRP density towards the GSO (dBW/40kHz and dBW/4kHz),	- 18.22547314	- 8.225473143	- 22.14899577	- 12.14899577
e.	the minimum elevation angle from earth station FIXED site/location to the GSO orbit/satellite,	10	10	50	50
f.	the spreading loss	163.1	163.1	162.2	162.2