Viasat

Exhibit B

Analysis of Non-Ionizing Radiation for a Viasat Antenna System

Introduction

This report analyzes the non-ionizing radiation levels for a Viasat antenna system.

The FCC's Office of Engineering Technology's Bulletin No. 65 specifies that there are two separate tiers of exposure limits that are dependent upon the situation in which the exposure takes place and/or the status of the individuals who are subject to the exposure. The two tiers are General Population / Uncontrolled environment, and an Occupational / Controlled environment.

As described in the definitional section of this document, this report considers the maximum power density levels in the vicinity of an ES antenna in several regions: (1) the far field, (2) the near field, (3) the transition region between near field and far field, and (4) the surface of the radiating aperture. These radiation regions were analyzed using the definitions and formulas in Bulletin No. 65 for aperture antennas but replaces formula (13) of Bulletin No. 65 with the near field power density formula from Table D.5 of the IEEE C95.3-2021 Standard as indicated by FCC/OET staff in the context of other Viasat applications. The results of this analysis are summarized at the end of this document.

Analysis of Occupational/Controlled Environment

The applicable exposure limit for the General Population / Uncontrolled environment, i.e., areas that people may enter freely, at this frequency of operation is 1 mW/cm^2 average power density over a 30-minute period.

The applicable exposure limit for the Occupational / Controlled environment, i.e., areas that only authorized / trained personnel have access to, at this frequency of operation is 5 mW/cm^2 average power density over a 6-minute period.

The tables below summarize the expected radiation level in the main beam of the antenna for a controlled environment at the frequencies of operation.

Summary of expected radiation levels for the antenna at 30.0 GHz for a Controlled Environment

Region	Maximum Power Density	Hazard Assessment
Far field (R_{ff}) = 5.4 m	13.69 mW/cm^2	Does not satisfy FCC MPE
Near field (R_{nf}) = 2.25 m	289.55 mW/cm^2	Does not satisfy FCC MPE
Transition region (R_t) (Rt) = $R_{nf} < R_t < R_{ff}$	120.64/R_t mW/cm^2	Does not satisfy FCC MPE
Main Reflector Surface ($S_{surface}$)	96.20 mW/cm^2	Does not satisfy FCC MPE

Analysis

The analysis and calculations that follow in this report are performed in compliance with the methods described in the OET Bulletin No. 65, but replaces formula (13) of Bulletin No. 65 with the near field power density formula from Table D.5 of the IEEE C95.3-2021 Standard as indicated by FCC/OET staff in the context of other Viasat applications. Per OET Bulletin No. 65, In the near field and transition regions, power density is 100 times (20 dB) less than on axis power density once the point of interest is one antenna diameter away from the center of main beam. In the far field, off-axis power density is determined by the antenna's radiation pattern. The graph below shows the off-axis power density using the OET Bulletin No. 65 instructions.

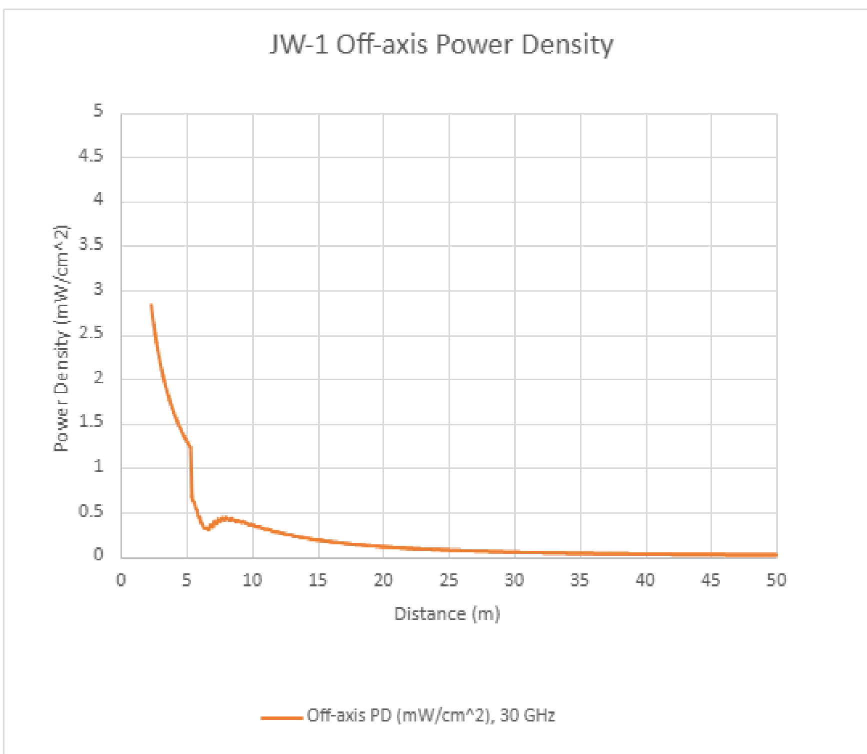

Figure 1: Off-axis power density as a function of distance from the antenna for operation at 30 GHz, calculated in accordance with FCC OET Bulletin No. 65

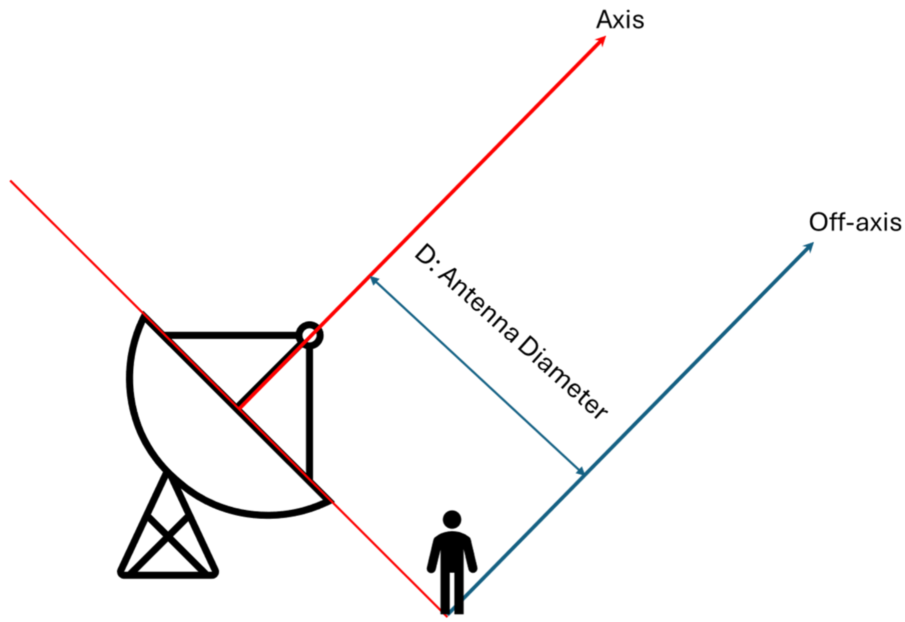

Figure 2: Illustration of personnel exposure relative to the antenna main beam, demonstrating that accessible areas remain outside regions exceeding FCC maximum permissible exposure (MPE) limits.

Conclusion

Given the antenna's installation on an aircraft, exposure of ground-level personnel to the main lobe of the radiated beam is not anticipated. Although the calculations below show that the proposed system exceeds FCC MPE limits in the main beam direction, personnel will not be in the boresight of the antenna due to high operational elevation angles. Assuming a minimum elevation angle of 10° for the HEO satellites, the gain towards personnel is approximately 8.2 dBi, corresponding to a calculated power density of less than 0.03 mW/cm² at the beginning of far field region. On the ground, a keep out distance equal to far field distance of the antenna (5.4 m) will be more than sufficient to meet the FCC MPE limits due to off-axis antenna gain reduction. Additionally, personnel will not be permitted in the near field region while the antenna is operational. Finally, the General public has no access to anywhere near the antenna and given the minimum operating elevation, any area of uncontrolled access where general population may travel are well removed from the cylinder of RF power projected by the antenna.

The proposed system will be in an environment with controlled access and will be serviced by trained personnel. Only trained personnel will operate the transmitting system during testing. Procedures will be established that will ensure that all transmitters are turned off before access by maintenance personnel to this area is possible. Based on the above analysis, it is concluded that no hazard exists for the public.

In the following section, the power density in the above regions, as well as other critically important areas will be calculated and evaluated using the parameters for the 0.3 m antenna at 30.0 GHz.

Definition of terms

The terms used in the formulas here are defined as follows:

S_{surf}	=	maximum power density at the antenna surface
S_{nf}	=	maximum near-field power density
S_t	=	power density in the transition region
S_{ff}	=	power density (on axis)
R_{nf}	=	extent of near-field
R_{ff}	=	distance to the beginning of the far-field
R_t	=	distance to point of interest
P	=	17.0 W power fed to the antenna in Watts
A	=	0.0707 m^2 physical area of the aperture antenna
G	=	2951.21 antenna gain relative to an isotropic radiator
D	=	0.3 m diameter of antenna in meters
F	=	30.0 GHz frequency in GHz
λ	=	0.01 m wavelength in meters
η	=	0.33 aperture efficiency
D_C	=	1.0 duty cycle of 100%

Antenna Surface. The maximum power density directly in front of an antenna (e.g., at the antenna surface) can be approximated by the following equation:

$S_{surface}$ = (DC * 4 * P) / A

= (1.0* 4 * 17 W) / 0.0707 m^2

= 96.20 mW/cm^2

Near Field Region. In the near-field or Fresnel region, of the main beam, the power density can reach a maximum before it begins to decreased with distance. The extent of the near field can be described by the following equation (**D** and λ in same units):

R_{nf} = D^2 / (4 * λ)

= $(0.3)^2$ / (4 * 0.01 m)

= 2.25 m

The magnitude of the on-axis (main beam) power density varies according to location in the near field. However, the maximum value of the near-field, on-axis, power density can be expressed by the following equation:

S_{nf} = (DC * 16 * P) / (η * π * D^2)

= (1.0 * 16 * 17 W) / (0.33 * π * $(0.3 \text{ m})^2$)

= (289.55 mW/cm^2)

Transition Region. Power density in the transition region decreased inversely with distance from the antenna, while power density in the far field (Fraunhofer region) of the antenna decreased inversely with the square of the distance. The transition region will then be the region extending from R_{nf} to R_{ff}. If the location of interest falls within this transition region, the on-axis power density can be determined from the following equation:

S_t $= (DC * S_{nf} * R_{nf}) / R_t$

$= (1.0 * 289.55\ mW/cm^2 * 2.25\ m) / R\ (cm)$

$= (120.64\ mW/cm) / R_t\ (cm)$ where R_t is the location of interest in centimeters

Far-Field Region. The power density in the far-field or Fraunhofer region of the antenna pattern decreased inversely as the square of the distance. The distance to the start of the far field can be calculated by the following equation:

R_{ff} $= (0.6 * D^2) / \lambda$

$= (0.6 * (0.3\ m)^2) / 0.0106\ m$

$= 5.40\ m$

The power density at the start of the far-field region of the radiation pattern can be estimated by the equation:

S_{ff} $= (DC * P * G) / (4 * \pi * R_{ff}^2)$

$= (1.0 * 17\ W * 2951.21) / (4 * \pi * (5.40\ m)^2)$

$= 13.69\ mW/cm^2$