EXHIBIT C

Viasat, Inc.

Radiation Hazard Analysis

Mantarray M40 and GM40 Earth Stations

January 2018

Contents

1 Introduction

This analysis calculates the non-ionizing radiation levels for the Mantarray M40 and GM40 earth station terminal (“ES”). The calculations performed in this analysis comply with the methods described in FCC Office of Engineering and Technology Bulletin, Number 65 (Edition 97-01) (“Bulletin 65"). This analysis demonstrates that Viasat ES terminals are compliant and will not result in exposure levels exceeding the applicable radiation exposure limits.

Bulletin 65 and section 1.1310 of the Commission's rules specify two separate tiers of exposure limits: one for Occupational/Controlled Exposures and one for General Population/Uncontrolled Exposures. Limits for Occupational/Controlled Exposures apply in situations when persons are exposed as a consequence of their employment and are fully aware of and can control their exposure. These limits also apply in situations when a person is transient through a location where such limits would otherwise apply provided the person is made aware of the potential for exposure. The limits for General Population/Uncontrolled Exposure apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

Viasat will typically deploy these ES terminals on commercial aircraft, such as the Boeing 737 – 787 and Airbus A320 – 380, but deployments may also occur on certain government aircraft of similar size. Access to the operating environment of these aircraft is tightly controlled and only authorized individuals are allowed access to the areas of the aircraft where the earth station is installed. The earth station antenna is mounted on top of the fuselage of these aircraft under a protective radome which is clearly marked with RF warnings. Due to its location on top of the aircraft, the antenna is inaccessible to ground crew during normal gate operations when the antenna is active. The antenna will be turned off during maintenance windows where personnel may have access to areas near the antenna. Additionally, as discussed below, when maintenance occurs inside a hanger, the system will not transmit because receive communications (a precursor to transmit operations) with the satellite will be blocked.

Because the environment is controlled and any potential exposure of a transitory nature, the limits for Occupational/Controlled Exposures are assumed to apply. Accordingly, this analysis discusses only the Maximum Permissible Exposure (MPE) limit for those types of exposures, which is a power density equal to five milliwatts per centimeter squared averaged over a six minute period.

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 65 for aperture antennas. The results of this analysis are summarized in Table 1 and

Table 2, which identify the potential exposure under nominal operating conditions and worst-case conditions, respectively.

2 ES Terminal Description

The ES terminal transmits bursts of information at designated times that are assigned to the terminal by the network. The length and carrier frequency of each transmission burst depend on the ES terminal's traffic requirements. In normal operation, the ES terminal transmits burst traffic to the network with a nominal duty cycle of less than 6.25%.

The ES terminal incorporates two “fail safe" features that limit the potential for human exposure. First, the transmitter is not enabled until the receive down link connection to the satellite has been established and an acceptable down link bit error rate has been achieved. The transmitter is disabled very quickly, in less than 40 milliseconds, if a loss of down connectivity occurs. This includes the case where human interference causes degradation in the link. Transmissions will not resume until approximately 10 seconds after downlink communications have been reestablished. Secondly, the terminal's transmitter is not capable of operating in a continuous transmit mode of operation. The ES terminal's outdoor unit prevents the transmitter from remaining in a continuous transmit state for more than a few seconds. Under these conditions, the transmitter will be turned off briefly then resume normal operation after an internal reset has occurred.

3 Explanation of the Analysis

The “Calculated Values" in Tables 1 and 2 show the exposure rates calculated using the formulae from the Office of Engineering and Technology Bulletin Number 65 (Edition 97-01) for the peak RF power output during transmission. However, the Viasat network is based on a Time Division Multiple Access (TDMA) scheme using so-called “shared pipes". Viasat terminals transmit short bursts of data periodically as instructed by the network and are neither designed for nor capable of continuous transmission. Therefore, in order to compute the effective radiated energy of a Viasat ES terminal, the terminal’s transmitter duty cycle has been used to adjust the values calculated in accordance with Bulletin Number 65. To do this, the average power during the averaging period is calculated as the maximum transmitter peak transmit power output adjusted by the nominal duty cycle of 6.25%.

An important aspect of the Viasat ES terminal is the “fail safe" feature. When the receive signal is lost due to signal blockage, the transmitter is shut down until the receive downlink is restored. The transmitter is shutdown in less than 40 milliseconds of the loss of the downlink. Since the areas of high field strength near the antenna aperture are very sensitive to blockage of the down link, this “fail safe" feature minimizes the potential for human exposure in the area between the feed and reflector. If the blockage due to human exposure occurs in these areas, the down link will be interrupted causing the transmitter to turn off almost immediately and it will remain off until the blockage is removed. After the blockage is removed, the ES terminal will have to reacquire the receive downlink and wait to be invited back into the network before the transmitter will be enabled. The complete downlink recovery time is 10 seconds. Accordingly, the average power value would be multiplied by 0.004 because the transmitter cannot transmit more than 0.4% of any rolling six minute period (the period over which the power density is averaged) with significant blockage near the aperture.

4 Results of Analysis

This analysis demonstrates that the Viasat ES terminals satisfy Commission requirements because neither terminal would exceed the MPE limit of five milliwatt per centimeter squared averaged over a six minute period when operated in the network as designed. In particular, a fail-safe feature greatly reduces the chance of human exposure close to the aperture surface: a small blockage in this area is sufficient to cause transmissions to cease. If the down link (receive signal) is interrupted by an object in this area, the uplink (transmit signal) is shut down in less than 40 milliseconds and the receiver down link recovery time is 10 seconds. The uplink will remain off until the blockage is removed and the downlink recovery is complete. Additionally, the antenna is covered with a protective radome which is appropriately marked with RF warning labels. These features, coupled with the terminal's use of uplink power control and the non-continuous operation, ensures that personnel will not be exposed to levels of radiation that exceed Commission standards.

5 Conclusion

This radiation hazard analysis demonstrates that Viasat ES terminals will not result in exposure levels exceeding the applicable radiation exposure limits.

6 Analysis

Definitions

Near Field Region

The near field region is a rectangular volume co-incident with the boresight of the main beam extending outward from the aperture radiator. The length of the near field is $D_{maj}^2/(4\lambda)$ meters. The larger dimension (D_{maj}) of the rectangular antenna is used in place of the diameter of a circular antenna to calculate the worst case length of the near field.

Transition Region

The transition region is located between the near field region and the far field region. This region has a power density that decreases inversely with increasing distance. Therefore, the power density in the transition region will be less than the power density in the near field for the purpose of evaluating potential exposure.

Far Field Region

The far field region extends outward from the main reflector, beginning at a distance of $(0.6 \cdot D_{maj}^2)/\lambda$ meters where the larger diameter of the elliptical antenna is D_{maj}. The maximum power density is calculated using the equation recommended in Bulletin 65.

Power Density on the Antenna Surface.

The maximum power density directly in front of an antenna (e.g., at the antenna surface) can be approximated as four times the transmit power divided by the area of the antenna surface. Note: as described above, the antenna is covered with a protective radome which prevents direct access, and automatic transmit inhibit will activate when blockage between the antenna and satellite occurs.

Table 1
Radiation from M40 ES Terminal

Input Parameters

Antenna Aperture Major Axis:	D_{maj} := 76.7 cm
Antenna Aperture Minor Axis:	D_{min} := 15.3 cm
Frequency of Operation:	F := 30 GHz
Max Power into Antenna:	P := 4 W
Aperture Efficiency:	η := 0.75

Calculated Values

Wavelength:	$\lambda \coloneqq \frac{c}{F}$	$\lambda = 0.999\ cm$
Area of Reflector:	$A_{ref} \coloneqq D_{maj} D_{min}$	$A_{ref} = 0.118\ m^2$
Antenna Gain:	$G \coloneqq \frac{4\eta\pi A_{ref}}{\lambda^2} x \frac{1}{2}$	$G = 5.55 \times 10^3$ $G = 37.5\ dBi$
Length of Near Field:	$R_{nf} \coloneqq \frac{D_{maj}^2}{4\lambda}$	$R_{nf} = 14.7\ m$
EIRP:	$EIRP \coloneqq PG$	$EIRP = 43.5\ dBW$
Beginning of Far Field:	$R_{ff} \coloneqq 0.6 \left(\frac{D_{maj}^2}{\lambda}\right)$	$R_{ff} = 35.3\ m$

Power Density Calculations

Far Field:

$S_{ff} \coloneqq \frac{PG}{4\pi R_{ff}^2}$ $\quad 6.25\% S_{ff} = 0.009 \ \frac{mW}{cm^2}$

Near Field:

$S_{nf} \coloneqq \frac{16\eta P}{\pi D_{maj}^2}$ $\quad 6.25\% S_{nf} = 0.16 \ \frac{mW}{cm^2}$

Transition Region: Power density is less than the maximum near field region power density and greater than the minimum far field region power density.

Aperture:

$S_{apr} \coloneqq \frac{4P}{A_{apr}}$ $\quad 6.25\% S_{apr} x 0.004 = 0.003 \ \frac{mW}{cm^2}$

Table 2
Radiation from GM40 ES Terminal

Input Parameters

Antenna Aperture Major Axis:	D_{maj} := 76.7 cm
Antenna Aperture Minor Axis:	D_{min} := 15.3 cm
Frequency of Operation:	F := 30 GHz
Max Power into Antenna:	P := 31.6 W
Aperture Efficiency:	η := 0.75

Calculated Values

Wavelength:	$\lambda \coloneqq \frac{c}{F}$	$\lambda = 0.999\ cm$
Area of Reflector:	$A_{ref} \coloneqq D_{maj} D_{min}$	$A_{ref} = 0.118\ m^2$
Antenna Gain:	$G \coloneqq \frac{4\eta\pi A_{ref}}{\lambda^2}$	$G = 1.029 \times 10^4$ $G = 40.5\ dBi$
Length of Near Field:	$R_{nf} \coloneqq \frac{D_{maj}^2}{4\lambda}$	$R_{nf} = 14.7\ m$
EIRP:	$EIRP \coloneqq PG$	$EIRP = 58.0\ dBW$
Beginning of Far Field:	$R_{ff} \coloneqq 0.6\left(\frac{D_{maj}^2}{\lambda}\right)$	$R_{ff} = 35.3\ m$

Power Density Calculations

Far Field:

$S_{ff} \coloneqq \frac{PG}{4\pi R_{ff}^2}$ $6.25\% S_{ff} = 0.13 \ \frac{mW}{cm^2}$

Near Field:

$S_{nf} \coloneqq \frac{16\eta P}{\pi D_{maj}^2}$ $6.25\% S_{nf} = 1.3 \ \frac{mW}{cm^2}$

Transition Region: Power density is less than the maximum near field region power density and greater than the minimum far field region power density.

Aperture:

$S_{apr} \coloneqq \frac{4P}{A_{apr}}$ $6.25\% S_{apr} x 0.004 = 0.03 \ \frac{mW}{cm^2}$