

Radiation Hazard Analysis for ThinKom KA2517 0.433 meter Ka-band

Introduction

A radiation hazard analysis is presented for a 0.433 meter Ka band aperture antenna. This Radiation Analysis calculates the non-ionizing radiation levels expected to be emitted from the earth station on a worse case basis and is performed in accordance with the Federal Communications Commissions Office of Engineering and Technology (OET) Bulletin, No. 65.

Requirements

OET 65 outlines the maximum permissible exposure limits in two cases for operation in this frequency range.

1. The first case is the maximum level that a person may be exposed to in the general population. The exposure limit is defined as a non-ionizing power level equal to 1 milliwatt per centimeter squared averaged over a thirty minute period.
2. The second case is a controlled environment where the maximum permissible exposure limit must not exceed 5 milliwatts per centimeter squared averaged over any six minute period.

Summary

The results indicate that no significant hazard will be presented to the general population and will be fully mitigated in the controlled area by the use of procedures that require the removal of transmit power before accessing the area around the main reflector.

Analysis

This analysis was performed on seven zones. The results of this is shown in Radiation Hazard Zones. The Table labelled Input Values provides the input data used to perform the analysis. The table labelled OET 65 Calculated Values provides the intermediate calculation used to perform the assessment in accordance with OET 65. The Analysis is performed for each of the seven radiation zones as shown in Figure 1 – Analysis Zones. These zones are:

1. Point between the feed and the sub-reflector
2. The power at the surface of the antenna
3. The power level between the main reflector and ground
4. The near-field or Fresnel region in which the maxima can be reached before the field starts to diminish with distance
5. The Transition region where power begins to decrease inversely with distance from the antenna
6. The Far Field or Fraunhofer region where power decreases inversely with the square of the distance. This is the point at which the antenna beam is fully collimated
7. The off-axis level in the near field. This is defined as the area outside of the main beam removed and at least one antenna diameter removed from the main beam

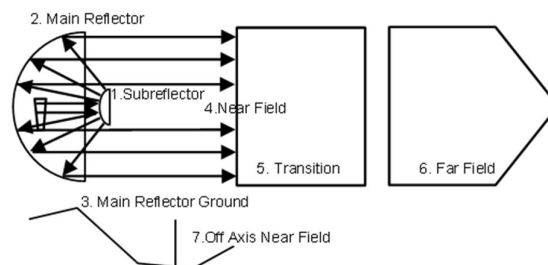


Figure 1 - Analysis Zones

Radiation Hazard Analysis

Operator: **SES**
Antenna: **ThinKom KA2517**

Input Values	Value	Unit
D = Aperture Diameter	0.433	meters
Antenna Gain	38.2	dBi
FCC Designation	Ka	Band
F = Frequency	29500	MHz
P = Transmitter Power	18.1	Watts

Band	Frequency MHz
L	1000-2000
S	2000-4000
C	4000-8000
X	8000-12500
Ku	12500-18000
K	18000-25500
Ka	26500-40000
O	40000-50000
V	50000-75000

OET 65 Calculated Values	Formula	Value	Unit
λ = Wavelength	c / F	0.0102	meters
G = Antenna Gain	$10^{(G/10)}$	6606.9	linear
η = Antenna Efficiency	$\frac{G\lambda^2}{4\pi A}$	37%	percentage
A = Area of reflector	$\pi \left(\frac{D}{2}\right)^2$	0.15	meters ²
R_{nf} = Near-Field Region	$\frac{D^2}{4\lambda}$	4.61	meters
R_t = Transition Region	$R_{nf} < R_t < R_{ff}$	4.61 11.1	>meters <meters
R_{ff} = Far Field Region	$\frac{0.6D^2}{\lambda}$	11.1 2	meters meters AGL

Radiation Analysis Zone		Formula	Level	Value	Exposure Limits	
					General Public <1mW/cm ²	Occupational <5mW/cm ²
1	Antenna Surface	$\frac{4P_t}{A}$	49.19	mW/cm ²	>FCC MPE See Note 1	>FCC MPE See Note 2
2	Main Reflector Ground	$\frac{P_t}{A}$	12.30	mW/cm ²	>FCC MPE See Note 1	>FCC MPE See Note 2
3	S_{nf} = Near-Field Power Density	$\frac{16P_t}{\pi\eta D^2} = \frac{4}{\eta} \left(\frac{P_t}{A}\right)$	133.15	mW/cm ²	>FCC MPE See Note 3	>FCC MPE See Note 2
4	S_t = Max Transition Power Density	$\frac{S_{nf}R_{nf}}{R_t}$	133.15	mW/cm ²	>FCC MPE See Note 3	>FCC MPE See Note 2
5	S_{ff} = Max Far field Power Density	$\frac{P_t G}{4\pi R^2}$	7.73	mW/cm ²	>FCC MPE See Note 4	>FCC MPE See Note 2
6	S_{oa} = Off Axis Level Near Field	$S_{nf} - 20\text{dB}$	1.33	mW/cm ²	>FCC MPE See Note 1	<FCC MPE

- The antenna is installed in a controlled location, access is restricted to authorized personnel only. The area is marked with RF Radiation Hazard signage. Area not accessible to the general public.
- Inside the controlled area, MPE levels exceed the MPE exposure for occupational levels. The levels will be reduced to safe MPE by removing power to the transmitters when work is performed on or around the antenna. This area can only be accessed by qualified personnel.
- The applicant will ensure that the main beam of the antenna will be pointed at least one diameter away from any points of interest accessible to the general public. Since one diameter removed from the center of the main beam, the MPE levels are down at least 20 dB or by a factor of 100, and public safety will be ensured.
- The far field develops 11.1 meters from the antenna at 2 meters above ground level when operating at the minimum elevation angle which is not accessible to the general public. The distance at which the far field power density decreases to below the FCC public limit is 30.8 meters from the antenna at 5 meters above ground level which is also not accessible to the general public.