FCC Form 312
Exhibit B
RF Hazard Assessment of the FT2225 Terminal

1. Introduction

This report analyzes the non-ionizing radiation levels for the FT2225 earth station. The FT2225 typically is a fixed device, typically mounted on the top of a pole or roof of a building at a commercial facility, but may also be installed on top of a shipping container or vehicle and could transmit while in motion. The device is designed in such a way that separation distance of much greater than 22 cm is normally maintained between the transmitter's radiating structure and the body of nearby persons.

2. Governing Limits

The FT2225 operates within the frequency range of 300 kHz and 6 GHz, evaluation of human exposure to RF radiation can be used as set forth in FCC's Section 47 CFR § 1.1307(b).

Table 1 of FCC's Section 47 CFR § 1.1310 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.

The applicable maximum exposure (MPE) limit for this antenna is 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 (Reference 1).

The formulae provided in FCC OET Bulletin 65 (Reference 2) are utilized to calculate near- and far-field ranges and power spectral densities.

3. Summary Results

As described in Exhibit A, the typical installation for these terminals will be on a pole or roof in a fixed installation, or on top of a shipping container or vehicle in a mobile installation. In these typical installation scenarios, the user likely will be greater than 0.22 m away from the unit during operation, and thus within the safe region. The analysis assumes maximum antenna gain and continuous transmission at maximum available power. The analysis also assumes a 100% duty cycle, while in actual operation the equipment transmits typically at a duty cycle of 50% or less. Further, the maximum gain (used in this analysis) occurs at a 90 degree elevation angle and is reduced by at least 50%

at an elevation angle of 15 degrees. The terminals typically will be installed pointed upward toward the satellite, and thus, the power density in areas to the side of the antenna will be significantly reduced. Based on the typical installation locations, individuals in the vicinity of the antenna will typically be below or behind the antenna.

Based on the above analysis it is concluded that no hazard exists for the public.

4. Radiation Hazard Assessment

4.1 Definition of Terms

The terms are used in the formulas here are defined as follows:
S = power density at the specified distance
Rff = distance to the beginning of the far-field
R = 0.022 m (8.66 in) distance to point of interest
P = 1.5 W power fed to the antenna in Watts
D = 0.121 m effective diameter of antenna array
G = 4 power gain relative to an isotropic radiator
F = 1675 frequency in MHz
λ = 0.181 m wavelength in meters ($300/F_{MHz}$)

4.2 Governing Parameters

The antenna parameters of Table 1 are used to calculate the power flux densities ("PFDs") for this terminal installation. Items 1 through 5 reflect the system design point. As indicated in Item 6, the system can provide 7.7 dBW. The assessment is conservative as the radome loss is excluded from the analysis. The antenna half-power beamwidth is approximately to 60°.

Table 1. System Parameters

Item	Parameter	Value
1	Frequency	1625 – 1675 MHz
2	Antenna maximum length, D	0.121 meter
3	Wavelength, λ, at 1675 MHz	0.181 meter
4	Boresight gain, G(dB)	6 dBic
5	Max power into antenna	1.48 W (1.7 dBW)
6	Max EIRP at 1675 MHz	7.7 dBW
7	Reactive Near field	0.009 m

4.2.1 Near-Field Region

The extent of the near-field region is described by Equation 1 (D and λ in same units), where "R_{nf}" signifies "range to the farthest edge of the near field":

$$R_{nf} = D^2 / (4\lambda) \quad \textbf{(1)}$$

= $(0.121\ m)^2 / (4 * 0.181m)$
= 0.020 m

Since user separation distance is much larger than farthest edge of the near field, far-field model is used to provide a conservative estimate.

4.2.2 Distance to far-field

From Reference 1, the distance to the beginning of the far field region is:

Range to far-field region, $R_{ff} = 0.6*D^2 / \lambda = 0.049$ meters **(2)**

4.2.3 Maximum Power Flux Density at evaluation distance of 4.9 cm

From Table 1, the maximum on-axis PFD at the nearest edge of the far field region is calculated, as follows:

PFD, far-field = $P * G / (4 * \pi * R^2)$
= $(1.5\ W * 4) / (4 * \pi * (0.049\ m)^2)$
= $19.8\ mW/(cm)^2$ **(3)**

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

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

= $(1.5\ W * 4) / (4 * \pi * (0.22\ m)^2) = 0.986\ mW/cm^2$ **(4)**

Calculations are based on maximum power and assumes that device may operate continuously, and thus are very conservative. At separation distance of 0.22 meters, power density drops below 1 $mW/(cm)^2$, MPE limit for general population/uncontrolled exposure.

The proposed earth station system will be mounted on the top of a pole or roof of a building at a commercial facility, or on top of a shipping container or vehicle. During operation, the user will be greater than 0.22 m away from the unit. The maximum gain (used in this analysis) occurs at a 90 degree elevation angle and is reduced by at least 50% at an elevation angle of 15 degrees.

Therefore, it is concluded that the device generates no RF hazards in the far field region for the public.

5.0 Owner/Operator Responsibility

It is the responsibility of the owner and operator of the terminal to adhere to the warnings provided by the manufacturer, whether provided on the labels on the unit or in the

supplied manuals. This includes keeping any labels of the mounting platform in good condition and within clear view of anyone within close proximity (within 0.22 meters).

It is also the responsibility of the owner/operator to appropriately cordon off the area surrounding the antenna when the antenna is operated on the ground or on the rooftop of a building. This distance is a minimum of 0.22 meters from the center of the antenna.

References

1. *Evaluating Compliance with FCC Guidelines for Human Exposure to Radio-frequency Electromagnetic Fields*, OET Bulletin No. 65, August 1997.

2. *47 CFR* § 1.1310 *Radio Frequency Exposure Limit.s*

3. *Reference Data for Radio Engineers*, ITT/ /Howard W. Sams & Co., Inc., 6th ed.,1982, pgs. 27-46 through 27-48,

Notes

1. Safety Limits from Ref. 2, Table 1:

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
(A) Limits for *Occupational/Controlled* Exposure (Note 2)				
1500-100,000	--	--	5	6
(B) Limits for *General Population/Uncontrolled* Exposure (Note 3)				
1500-100,000	--	--	1.0	30

2: ***Occupational/controlled*** limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when a person is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure. The phrase fully aware in the context of applying these exposure limits means that an exposed person has received written and/or verbal information fully explaining the potential for RF exposure resulting from his or her employment. With the exception of transient persons, this phrase also means that an exposed person has received appropriate training regarding work practices relating to controlling or mitigating his or her exposure. Such training is not required for transient persons, but they must receive written and/or verbal information and notification (for example, using signs) concerning their exposure potential and appropriate means available to mitigate their exposure. The phrase exercise control means that an exposed person is allowed to and knows how to reduce or avoid exposure by administrative or engineering controls and work practices, such as use of personal protective equipment or time averaging of exposure.

3: ***General population/uncontrolled*** exposures 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.