

**Exhibit For
Vitacom Services Corporation
Miami, Florida
Andrew Corporation 4.6 Meter Earth Station
Call Sign: E090157**

**Compliance with FCC Report & Order (FCC96-377) for the 13.75 - 14.0 GHz Band
Analysis and Calculations**

1. Background

This Exhibit is presented to demonstrate the extent to which the Vitacom Services Corporation satellite earth station in Miami, Florida is in compliance with FCC REPORT & ORDER 96-377. The potential interference from the earth station to US Navy shipboard radiolocation operations (RADAR) and the NASA space research activities in the 13.75 - 14.0 GHz Band is addressed in this exhibit. The parameters for the earth station are as follows:

Table 1. Earth Station Characteristics

- Coordinates (NAD83): 25° 55' 25.7" North, 80° 13' 04.6" West
- Satellite Location for Earth Station: Telestar 11N at 37.5° W.
- Frequency Band: 13750.0 – 14000.0 GHz
- Polarizations: Linear and Circular
- Emissions: 5M00G7D
- Modulation: Digital
- Maximum Aggregate Uplink EIRP: 72.0 dBW
- Transmit Antenna Characteristics
 - Antenna Size: 4.6 meters in Diameter
 - Antenna Type/Model: Andrew Corporation ESA46-124
 - Gain: 55.0 dBi
- RF power into Antenna Flange: 17.0 dBW or 10.0 dBW/ MHz:
or -14.0 dBW/4 kHz (Maximum)
- Minimum Elevation Angle:
Miami, Florida 34.2° @ 115.3° Az. (Telestar 11N).
- Side Lobe Antenna Gain: 32 - 25*log(θ)

Because the above uplink spectrum is shared with the Federal Government, coordination in this band requires resolution data pertaining to potential interference between the earth station and both Navy Department and NASA systems. Potential interference from the earth station could impact with the Navy and/or NASA systems in two areas. These areas are noted in FCC Report and Order 96-377 dated September 1996, and consist of (1) Radiolocation and radio navigation and (2) Data Relay Satellites.

Summary of Coordination Issues:

- 2) Potential Impact to Government Radiolocation (Shipboard Radar)
- 3) Potential Impact to NASA Data Relay Satellite Systems (TDRSS)

2. Potential Impact to Government Radiolocation (Shipboard Radar)

Radiolocation operations (RADAR) may occur anywhere in the 13.4 - 14 GHz frequency band aboard ocean-going United States Navy ships. The Federal Communication Commission (FCC) order 96-377 allocates the top 250 MHz of this 600 MHz band to the Fixed Satellite Service (FSS) on a co-primary basis with the radiolocation operations and provides for an interference protection level of -167 dBW/m²/4 kHz.

The closest distance to the shoreline from the Miami, Florida earth station is approximately 9.70 km east toward the Atlantic Ocean. The calculation of the power spectral density at this distance is given by

- 1. Clear Sky EIRP: 72.0 dBW
- 2. Carrier Bandwidth: 5.0 MHz
- 3. Transmit Antenna Gain: -14.0 dBW/4 kHz
- 4. Antenna Gain Horizon: FCC Reference Pattern
- 3. Antenna Elevation Angle: 34.2°

The proposed earth station will radiate interference toward the ocean according to its off-axis side-lobe performance. A conservative analysis, using FCC standard reference pattern, results in off-axis antenna gains of -6.2 dBi towards the Atlantic Ocean.

The calculated signal density at the shoreline, through free space is:

$$\begin{aligned} \text{PFD} &= \text{Antenna Feed Power density (dBW/4 kHz)} + \text{Antenna Off-Axis Gain (dBi)} - \text{Spread Loss (dBw-} \\ &\text{m}^2\text{)}. \\ &= -14.0 \text{ dBw/4 kHz} + (-6.2 \text{ dBi}) - 10 \cdot \log[4\pi(9700\text{m})^2] \\ &= -110.9 \text{ dBW/m}^2\text{/4 kHz} + \text{Additional Path Losses (} \sim 25.3 \text{ dB)} \\ &= -136.2 \text{ dBW/ m}^2\text{/4 kHz} \end{aligned}$$

Our calculations show additional path losses of approximately 25.3 dB including absorption loss and earth diffraction loss for the actual path profiles from the proposed earth station to the nearest shoreline.

In an effort to analyze the effects of earth station transmissions on naval radar systems, power flux densities were calculated from the earth station to the shipboard radars in increments from 6.0 miles to 60 miles (See Table 2). The calculation of interference level to the RADAR sidelobes was made at the initial distance of 6.0 miles. A distance of 6.0 miles (9.7 Km.) was used as the initial increment because it is the distance from the earth station site to the shoreline. This is the worst case condition. If the interference level is below the criteria at this range, it will be below the criteria at all of the greater ranges. A power flux density was also calculated from the shipboard radars to the shoreline and the reflection of the radar transmissions back to the radar. Since this flux density concerns the transmission from the ship to shore and back to the ship the mileage number is doubled. The power flux densities are based on the following formulas:

Earth Station to Naval Radars

$$P_{FD} = P_{ES}G_{ES} / 4\pi r^2$$

Where: P_{FD} = Power Flux Density

P_{ES} = Power of Earth Station (-14.0 dBW/4 kHz)

G_{ES} = Worst Case Earth Station Gain Toward the Shipboard Radars
(-6.2 dB)

4π = $10\text{Log}(4\pi) = -11.0$

r = Distance from ES to radars in Meters [Used $20\text{Log}(r)$]

Naval Radars to Shore and Reflection back to the Radar Source

$$P_{FD} = P_T G_T / 4\pi (2r)^2 * (0.01 \text{ m}^2)$$

Where: P_{FD} = Power Flux Density

P_T = Power of Radar (Used 56.0 dBW for 1 MHz or 32 dBW for 4 kHz)

G_T = Gain of Radar (Used 44 dB)

4π = $10\text{Log}(4\pi) = -11.0$

$2r$ = Distance to Shoreline and Reflection back to Radar Source

0.01m^2 = Size of the Radar Sectional Area of Target

Based upon calculations from the above formulas, it was determined that reflections of the radar transmissions from the shoreline and back to the radar were 75.5 dB higher than the earth station transmissions into the radar.

These calculations are presented in the tables below. This being the case, it can be concluded that in the main beam, earth station operations should not be a problem for naval radar operations.

Table 2

Distance from ES to Radar (Miles)	Flux Density		<u>Radar Signal</u> ES Interference (dB)
	Interference From ES (dBW/4 kHz/m ²)	Desired Radar Return from (0.01m) ² Target (dBW/4 kHz/m ²)	
6.0	-136.2	-60.7	75.5
8.0	-138.7	-63.2	75.5
10.0	-140.6	-65.1	75.5
15.0	-144.2	-68.7	75.5
20.0	-146.7	-71.2	75.5
30.0	-150.2	-74.7	75.5
40.0	-152.7	-77.2	75.5
50.0	-154.6	-79.1	75.5
60.0	-156.2	-80.7	75.5

The calculated PFD for the 5 MHz emissions, which include 25.3 dB of additional path losses to the shoreline location is $-136.2 \text{ dBW/m}^2/4 \text{ kHz}$. If off axis, side lobe considerations are made, 44 dB was used as the gain of the radar and -10.0 dBi was the radar antenna side lobe gain toward the direction of the earth station. This additional -54.0 dB will create an equivalent PFD of $-190.2 \text{ dBW/m}^2/4 \text{ kHz}$, which is 23.2 dB lower than the $-167 \text{ dBW/m}^2/4 \text{ kHz}$ interference criteria of R&O 96-377.

Therefore, there should be no interference to the US Navy RADAR from the Miami earth station in both the main beam and side lobe of the radar.

3. Potential Impact to NASA's Data Relay Satellite System (TDRSS)

The geographic location of the Vitacom Services Corporation, Miami, Florida earth station is outside the 390 km radius coordination contour surrounding NASA's White Sands, New Mexico ground station complex. Therefore, the TDRSS space-to-earth link will not be impacted by the Vitacom Services Corporation earth station in Miami, Florida.

The TDRSS space-to-space link in the 13.772 to 13.778 GHz band is assumed to be protected if an earth station produces an EIRP less than 71 dBW/6 MHz in this band. The maximum EIRP for the 5 MHz carriers is 72.0 dBW, and the equivalent EIRP per 6 MHz segment for a 5 MHz carrier will remain at 72.0 dBW/6 MHz. Therefore, there will be interference to the TDRSS space-to-space link.

The applicant will need to avoid transmissions on frequencies 13.772 to 13.778 GHz in the transmit spectrum.

4. Coordination Issue Result Summary and Conclusions

The results of the analysis and calculations performed in this exhibit indicate that compatible operations between the earth station at the Miami, Florida facility, and the US Navy is likely.

However, potential interference into NASA's systems will preclude operations on frequencies 13772.0 to 13778.0 MHz.

Table 3

Excluded Frequency Range for Vitacom Services Corporation Earth Station

System	Frequency Restriction
TDRSS	13.772-13.778 GHz (see Note 1)

Note 1: In order to meet the 71 dBW/6 MHz interference criteria, the earth station would have to be limited to a maximum total EIRP of 71.0 dBW. Since the earth station does not meet that requirement, operations between frequencies 13772.0 and 13778.0 MHz will not be permitted.

No interference to US Navy RADAR operations from the Miami, Florida earth station will occur.