

**Exhibit For
SATCOM Digital Networks
Cranberry Township, Pennsylvania
RSI Satcom 6.4 Meter Earth Station**

**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 proposed SATCOM Digital Network's satellite earth station, to be located in Cranberry Township, Pennsylvania, 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:

Table 1. Earth Station Characteristics

- Coordinates (NAD83): 40° 42' 25.0" N, 80° 05' 44.0" W
- Satellite Location for Earth Station: Amazonas 1 and 2 at 61.0° WL
- Frequency Band: 13.75-14.0 GHz for uplink
- Polarizations: Circular and Linear
- Emissions: 20M0G7W
23M0G7W
- Modulation: Digital
- Maximum Aggregate Uplink EIRP: 80.40 dBW for the 20 MHz Carriers
80.92 dBW for the 23 MHz Carriers
- Transmit Antenna Characteristics
 - Antenna Size: 6.4 meters in Diameter
 - Antenna Type/Model: RSI Satcom
 - Gain: 57.4 dBi
- RF power into Antenna Flange: 20 MHz
23.0 dBW or 10.0 dBW/MHz
or -14.0 dBW/4 kHz

23 MHz
 23.52 dBW or 9.9 dBW/ MHz
 or -14.1 dBW/4 kHz (Maximum)

- Minimum Elevation Angle:
 Cranberry Twp, Pa. 39.0° @ 152.0° Az. (Amazonas 1 & 2) at 61.0° W
- 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, (2) Data Relay Satellites.

Summary of Coordination Issues:

- 1) Potential Impact to Government Radiolocation (Shipboard Radar)
- 2) 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 Cranberry Township earth station is approximately 341 km Southeast toward the Chesapeake Bay. The calculation of the power spectral density at this distance is given by:

	<u>20 MHz</u>	<u>23 MHz</u>
1. Clear Sky EIRP:	80.40 dBW	80.92 dBW
2. Carrier Bandwidth:	20.0 MHz	23.0 MHz
3. PD at antenna input: (dBW/4 kHz)	-14.0	-14.1
4. Transmit Antenna Gain:	57.4 dBi	
5. Antenna Gain Horizon:	FCC Reference Pattern	
6. Antenna Elevation Angle:	39.0°	

The proposed earth station will radiate interference toward the Chesapeake Bay according to its off-axis side-lobe performance. A conservative analysis, using FCC standard reference pattern, results in off-axis antenna gains of -9.9 dBi towards the Chesapeake Bay.

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

20 MHz Carriers

PFD = Antenna Feed Power density (dBW/4 kHz) + Antenna Off-Axis Gain (dBi) – Spread Loss (dBw-m²).

$$\begin{aligned} &= -14.0 \text{ dBw/4 kHz} + (-9.9 \text{ dBi}) - 10*\log[4\pi*(341000\text{m})^2] \\ &= -145.5 \text{ dBW/m}^2/4 \text{ kHz} + \text{Additional Path Losses} (\sim 85.0 \text{ dB}) \\ &= -230.5 \text{ dBW/m}^2/4 \text{ kHz} \end{aligned}$$

23 MHz Carriers

PFD = Antenna Feed Power density (dBW/4 kHz) + Antenna Off-Axis Gain (dBi) – Spread Loss (dBw-m²).

$$\begin{aligned} &= -14.1 \text{ dBw/4 kHz} + (-9.9 \text{ dBi}) - 10*\log[4\pi*(341000\text{m})^2] \\ &= -145.6 \text{ dBW/m}^2/4 \text{ kHz} + \text{Additional Path Losses} (\sim 85.0 \text{ dB}) \\ &= -230.6 \text{ dBW/m}^2/4 \text{ kHz} \end{aligned}$$

Our calculations indicate additional path loss of approximately 85.0 dB including absorption loss and earth diffraction loss for the actual path profiles from the proposed earth station to the nearest shoreline.

For the 20 MHz carriers, the calculated PFD including additional path losses to the closest shoreline location is -230.5 dBW/m²/4 kHz. This is 63.5 dB below the -167 dBW/m²/4 kHz interference criteria of R&O 96-377. For the 23 MHz carriers, the calculated PFD including additional path losses to the closest shoreline location is -230.6 dBW/m²/4 kHz. This is 63.6 dB below the -167 dBW/m²/4 kHz interference criteria of R&O 96-377. Therefore, for the 20 and 23 MHz emissions there should be no interference to the US Navy RADAR from the Cranberry Township earth station due to the distance and the terrain blockage between the site and the shore.

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

The geographic location of the SATCOM Digital Networks' earth station in Cranberry Township, Pennsylvania 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 SATCOM Digital Networks earth station in Cranberry Township.

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 6.4 meter earth station antenna will have an EIRP greater than 71 dBW/6 MHz in this band. The total EIRP for all the 20 MHz carriers is 80.4 dBW, and the equivalent EIRP per 6 MHz segment will be 77.1 dBW/6 MHz. The total EIRP for the 23 MHz carriers is 80.92 dBW, and the equivalent EIRP per 6 MHz segment will be 77.1 dBW/6 MHz. Therefore, there could be interference to the TDRSS space-to-space link (Table 1) from both emissions.

For the 20 MHz emissions to meet the 71 dBW/6 MHz interference criteria, the earth station would have to be limited to an RF power density 6.2 dB lower than the maximum of -14.0 dBW/4kHz or -20.2 dBW/4kHz for an EIRP of 74.2 dBW. For the 23 MHz emissions to meet the 71 dBW/6 MHz interference criteria, the earth station would have to be limited to an RF power density 6.6 dB lower than the maximum of -14.1 dBW/4kHz or -20.7 dBW/4kHz for an EIRP of 74.3 dBW. If this operational condition cannot be met, then the Cranberry Township, Pennsylvania earth station may not be tuned to operate at the frequencies in the 13.770 to 13.780 GHz Band.

4. Coordination Issue Result Summary and Conclusions

The results of the analysis and calculations performed in this exhibit indicate that compatible operation between the earth station at the Cranberry Township facility and the US Navy and NASA systems space-to-earth link are possible. This analysis has been based on the assumption of 20 and 23 MHz bandwidth carriers.

Operations in NASA systems space-to-space link (13770.0 to 13780.0 MHz) will not be permitted.

Table 1

Excluded Frequency Range for SATCOM Digital Networks Earth Station

System	Frequency Restriction
TDRSS	13.770-13.780 GHz (see Note 1)

Note 1: In order to meet the 71 dBW/6 MHz interference criteria for the 20 MHz emissions, the earth station would have to be limited to a maximum total EIRP of 74.2 dBW.

In order to meet the 71 dBW/6 MHz interference criteria for the 23 MHz emissions, the earth station would have to be limited to a maximum total EIRP of 74.3 dBW.

No interference to US Navy RADAR operations from the Cranberry Township, Pennsylvania earth station will occur.