# Application for Certification

Adtran Inc.
Tracer Rack Mount
Model: 4280TRACERT1L7

47 CFR, Part 15, Subpart C, §15.247

Spread Spectrum Transmitters

**FCC ID: HDCTRACERT1L7**

January 27, 1999

J98030625
RPT# AD30625c.CER
s:\emc\emissions\certs\1999\ad30625c.cer

TABLE OF CONTENTS

## List of Figures



## List of Tables

# 1.0 General Description

## *1.1 Product Description*

The ADTRAN TRACER is a digital microwave radio that uses spread spectrum technology for medium, and short-haul dual T1 communication link.

TRACER provides a digital communications link using Direct Sequence Spread Spectrum (DSSS) coding and Quadrature Phase Shift Keying (QPSK) modulation. TRACER is suited for Cellular/PCS T1 infrastructure, thin-route telco infrastructure, and fast turn-up construction of permanent or temporary applications. It is also ideal for applications such as emergency/disaster recovery, data/voice infrastructure for utility and public service companies, and building-to-building/campus-to-campus connectivity for voice, data and video.

TRACER is composed of two primary components, a Baseband Processor and a radio frequency converter (RFC). All signaling and power functions between the Baseband Processor and RFC are provided over this single coax connection. The Baseband Processor is housed in a 1U (1.75"), 19", 6 pound package that is suitable for rack or tabletop installation.

The TRACER transports two T1 digital signals in any format and provides two industry standard DS1 or DSX-1 digital signal interfaces. A separate maintenance channel is transported in addition to the T1 signal, and provides control for remote configuration and monitoring. The maintenance channel is supported over the link.

TRACER provides frequency agility by allowing one of two channel plans to be selected. Individual part numbers are assigned for the various channel configurations of the RFC for simplicity in factory ordering, but there is no difference in hardware components. Ten spreading codes are available for interference protection.

A list of all antennas for use with this transmitter is located in Appendix A.

## 1.2 Related Submittal(s) Grants

This is a single Application for Certification.

## 1.3 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.4 (1992). All measurements were performed in Open Area Test Sites. Preliminary scans were performed in the Open Area Test Sites only to determine worst case modes. For each scan, the procedures for maximizing emissions in Section 4.3 were followed. All radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

## 1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at 4317-A Park Drive NW, Norcross, Georgia. This test facility has been fully described in a report dated Jan. 8, 1993 submitted to your office. Please reference the site filing number: 31040/SIT 1300F2, dated April 26, 1996. The NVLAP program accredits this facility (NVLAP Code: 100409-0).

# 2.0 System Test Configuration

## *2.1 Justification*

The system was configured for testing in a typical fashion (as a customer would normally use it). The transmitter portion of the EUT was mounted in a metal rack, with appropriate antenna mounted on a non-metallic pole. The Baseband processor portion of the EUT was mounted in the metal rack along with the transmitter portion of the EUT. This configuration represents a typical installation of this system. During testing, all cables were manipulated to produce the worst case emissions.

For simplicity of testing, the EUT was configured to transmit continuously. The EUT was configured to transmit a typical maximum data stream during testing. Both frequency plans offered with this device were tested. The frequency plan was selected via the panel selection in the Baseband Processor and the appropriate cabling in the RF section.

## *2.2 EUT Exercising Software*

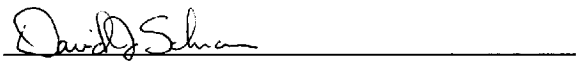
There was no special software to exercise the device. For simplicity of testing, the unit was configured to transmit continuously.

## 2.3 Special Accessories

There are no special accessories for compliance of this product.

*Confirmed by:*

*David J. Schramm*
*EMI Technical Supervisor*
*Intertek Testing Services*
*Agent for Adtran Inc.*



Signature

2/15/99

Date

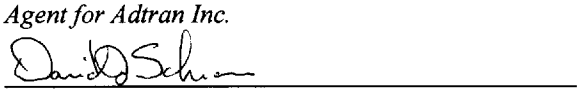
## 2.4 Equipment Modifications

Any modifications installed previous to testing by Adtran, Inc. will be incorporated in each production model sold/leased in United States.

Intertek Testing Services, Inc installed no modifications.

*Confirmed by:*

David J. Schramm
*EMI Technical Supervisor*
*Intertek Testing Services*
*Agent for Adtran Inc.*



Signature

2/15/99

Date

## 2.5 Support Equipment List and Description

The FCC ID's for all equipment, plus descriptions of all cables used in the tested system (including inserted cards, which have grants) are:

**Cables:**

AC Mains, 2 meters, unshielded
3 each single conductor wires, 1 meter, unshielded, (Alarm relay connection)
5 foot RG214 coaxial cable (Transmitter to Antenna), N-type connectors
25 foot RG214 coaxial cable (Baseband Processor to Transmitter), N-type connectors
1 meter unshielded twisted pairs cable (T1 connection), 2 each

## 2.6 Test Configuration Block Diagram

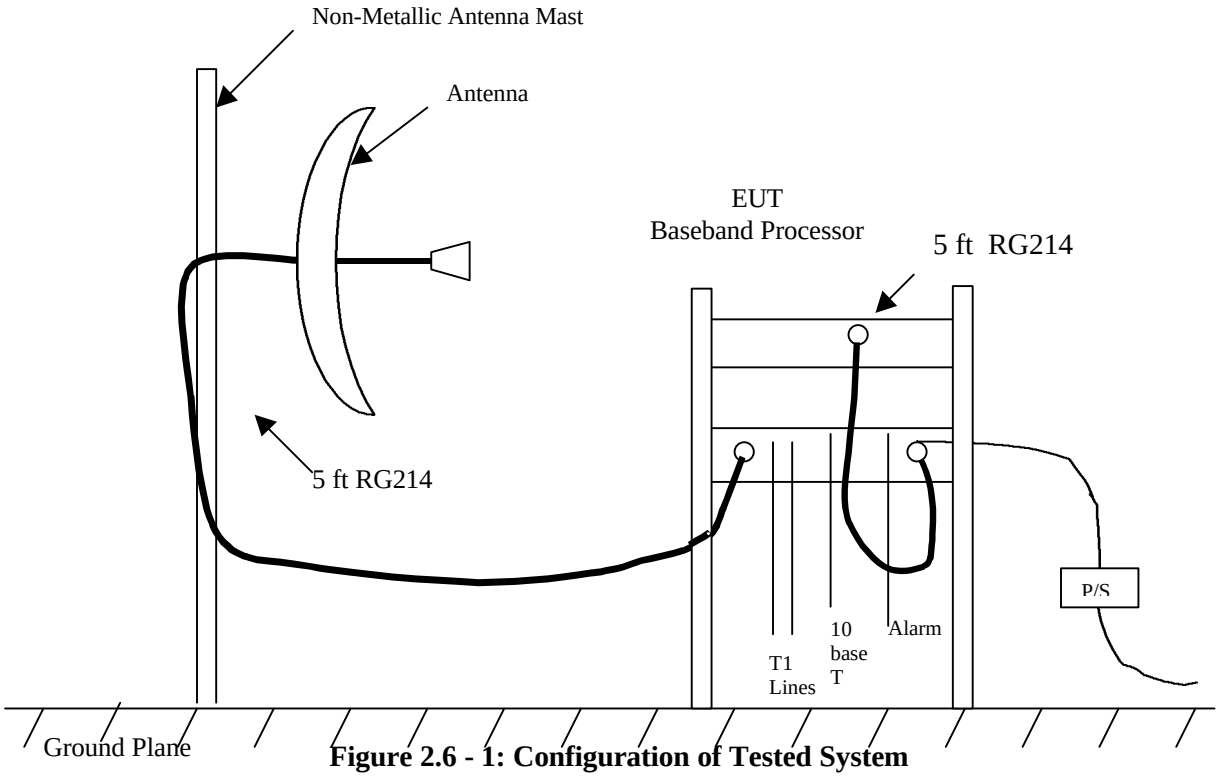



**Figure 2.6 - 1: Configuration of Tested System**

# 3.0 Test Results

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs, data tables and plots of the emissions are included.

## *3.1 Emission Bandwidth*

§15.247(a)(2) specifies that direct sequence systems shall have a 6 dB bandwidth of at least 500 kHz. The bandwidth was measured to be approximately 18.8 MHz. The following plot was taken with a resolution bandwidth (RBW) of 100 kHz and a video bandwidth (VBW) of 1 MHz. The maximum level of the emission was measured to be 10 dBm. Markers were displayed 6 dB down from the maximum peak of the fundamental.

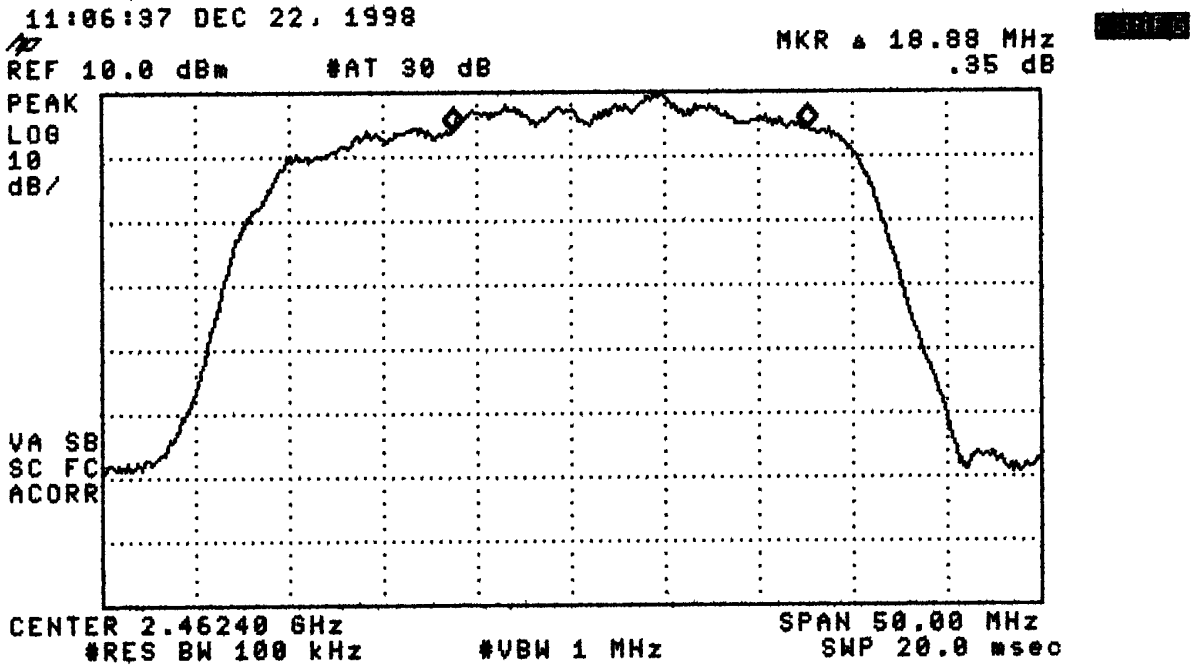



**Figure 3.1 - 1: Emission Bandwidth Plot**

## *3.2 Power Output*

§15.247(b)(1) specifies power output requirements for direct sequence spread spectrum transmitters. The maximum peak output power for these devices shall not exceed one watt. If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by one dB for every three dB that the directional gain of the antenna exceeds 6 dBi. The peak output power was measured to be **19.9 dBm** (97.7 mW) as measured at the end of a 5' coaxial cable installed on the transmitter section.

The power was determined by directly measuring the signal at the antenna terminal. The measurements were made with a HP power meter Model Number 436A.

### 3.2.1 Specific Absorption Rate and Maximum Permissible Exposure

The calculations for maximum transmitted power to be compared to the MPE limits are based on OET 65 (97-01). The Tracer is designed for a maximum transmit power of 20 dBm (100 mW). Assume the highest gain antenna of 35 dBi (3161) for the 10'parabolic dish is used

Using the equation for power density $S=PG/4BR^2$

Where S = power density in $mW/cm^2$
P = transmit power in milliwatts
G = numeric gain of transmit antenna
R = distance (cm)

$S = \{(100)(3163)\}/\{4B(100)^2\}$

$S = 2.5\ mW/cm^2$ at a distance of 1 meter.

This power density is for the worst case with maximum beam exposure. This level is below the 5 $mW/cm^2$ MPE for Occupational Controlled Access. This device is designed for telecommunications transmission for distances up to 20 miles. The design requires the use of relatively large antennas (10' dish) and the transmitter section is designed for mounting on an antenna mast. Only professionals install this device. The device is therefore limited by practice to installation in a rooftop to tower installation. Warnings are provided in the installation manual to limit exposure to the direct beam during installation and maintenance. These warnings to the installers insure the installation does not expose the general public to the RF energy.

## 3.3 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
where FS = Field Strength in dB(uV/m)
RA = Receiver Amplitude (including preamplifier) in dB(uV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB(1/m)
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows:

Assume a receiver reading of 52.0 dB(uV) is obtained. The antenna factor of 7.4 dB(1/m) and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB(uV/m). This value in dB(uV/m) was converted to its corresponding level in uV/m.

RA = 52.0 dB(uV)
AF = 7.4 dB
CF = 1.6 dB(1/m)
AG = 29.0 dB

FS = 52.0 + 7.4 + 1.6 - 29.0 = 32 dB(uV/m)

Level in uV/m = Common Antilogarithm [(32 dB(uV/m))/20] = 39.8 uV/m

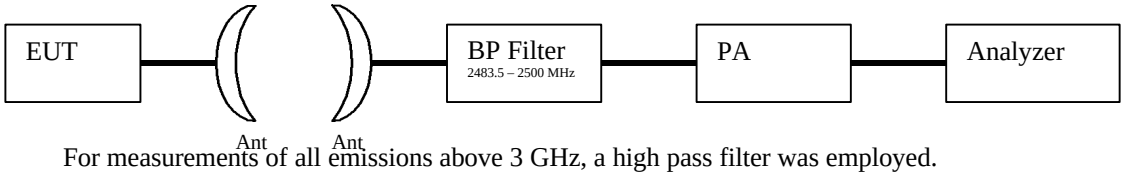
## 3.4 Transmitter Spurious Emissions

§15.247(c) specifies requirements for spurious emissions from direct sequence spread spectrum transmitters. In any 100 kHz bandwidth outside the frequency bands listed in §15.247, the radio frequency power that is produced by the modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that in any 100 kHz bandwidth within the band that contains the highest level of the desired power or shall not exceed the general levels specified in §15.209(a), whichever results in the lesser attenuation. All other emissions outside these bands shall not exceed the general radiated emission limits specified in §15.209(a).

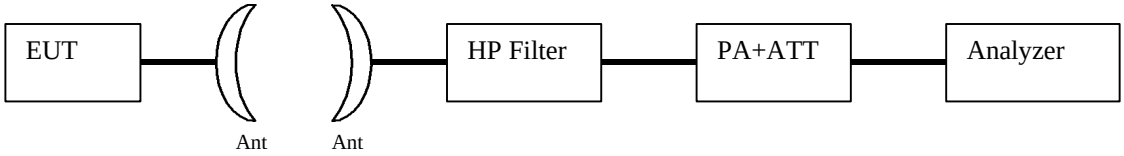
Two separate tests (described below) were performed to determine the spurious emissions from the device:

(1) The first test was performed using a direct connection between the antenna port of the transmitter and the spectrum analyzer. The resolution bandwidth was set to 100 kHz, and the video bandwidth was set greater than the resolution bandwidth. A scan was performed up to the tenth harmonic to ensure that all the harmonics/spurs were at least 20 dB down from the highest emission level within the authorized frequency bands. The results of this test are shown in Table 3.5-1.

(2) The second test was a radiated emission test to determine the amplitude of harmonics/spurs which fall within the restricted bands listed in §15.205(a). The limits for emissions in these restricted bands are listed in §15.209. For measurements above 1 GHz, a resolution bandwidth of 1 MHz and a video bandwidth of 1 MHz were used. The results of this test are shown in Table 3.5-2 and 3.5-3. This test was performed with a representative sample of each antenna type that is to be used with this device. For measurements in the restricted band of 2.4835 – 2.5 GHz, a notch filter was employed. The notch filter was designed to pass only frequencies in this restricted band.




For measurements of all emissions above 3 GHz, a high pass filter was employed.



## 3.5 Transmitter Spurious Emission Data: Plan A

The data shown below lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

**Table 3.5 - 1: Antenna Conducted Emissions**

ompany: Adtran
Model: Tracer
Rack Mount
Notes: Initial Results
Plan A
Standard: FCC Part 15
Class B

Date: 01/15/99
Tested by: Candy L. Campbell
Test Distance:
Job Number: J98030625

Average Readings

| | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | Distance Factor dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|
| | 611.120 | 33.3 | 0.0 | 0.0 | 0.0 | 0.0 | 33.3 | 46.0 | -12.8 |
| | 1824.000 | 39.8 | 0.0 | 0.7 | 0.0 | 0.0 | 40.5 | 54.0 | -13.5 |
| | 7164.000 | 37.2 | 0.0 | 1.5 | 0.0 | 0.0 | 38.7 | 54.0 | -15.3 |
| | 7548.000 | 38.6 | 0.0 | 1.7 | 0.0 | 0.0 | 40.3 | 54.0 | -13.7 |

Peak Readings

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 651.240 | 36.0 | 0.0 | 0.0 | 0.0 | 0.0 | 36.0 | 66.0 | -30.0 |
| | 1883.000 | 47.8 | 0.0 | 0.7 | 0.0 | 0.0 | 48.5 | 74.0 | -25.5 |
| | 7351.000 | 44.3 | 0.0 | 1.5 | 0.0 | 0.0 | 45.8 | 74.0 | -28.2 |
| | 12345.000 | 45.5 | 0.0 | 2.4 | 0.0 | 0.0 | 47.9 | 74.0 | -26.1 |

## 3.5 Transmitter Spurious Emission Data: Plan B

The data shown below lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

**Table 3.5 - 2: Antenna Conducted Emissions**

ompany: Adtran
Model: Tracer
Rack Mount
Notes: Initial Results
Plan B
Standard: FCC Part 15

Date: 01/15/99
Tested by: Candy L. Campbell
Test Distance:
Job Number: J98030625

Average Readings Class B

| | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | Distance Factor dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|
| | 651.240 | 32.2 | 0.0 | 0.0 | 0.0 | 0.0 | 32.2 | 46.0 | -13.8 |
| | 1883.000 | 36.1 | 0.0 | 0.7 | 0.0 | 0.0 | 36.8 | 54.0 | -17.2 |
| | 7351.000 | 41.5 | 0.0 | 1.5 | 0.0 | 0.0 | 43.0 | 54.0 | -11.0 |
| | 12345.000 | 33.9 | 0.0 | 2.4 | 0.0 | 0.0 | 36.3 | 54.0 | -17.7 |

Peak Readings

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 651.240 | 34.4 | 0.0 | 0.0 | 0.0 | 0.0 | 34.4 | 66.0 | -31.6 |
| | 1883.000 | 43.3 | 0.0 | 0.7 | 0.0 | 0.0 | 44.0 | 74.0 | -30.0 |
| | 7351.000 | 49.1 | 0.0 | 1.5 | 0.0 | 0.0 | 50.6 | 74.0 | -23.4 |
| | 12345.000 | 41.8 | 0.0 | 2.4 | 0.0 | 0.0 | 44.2 | 74.0 | -29.8 |

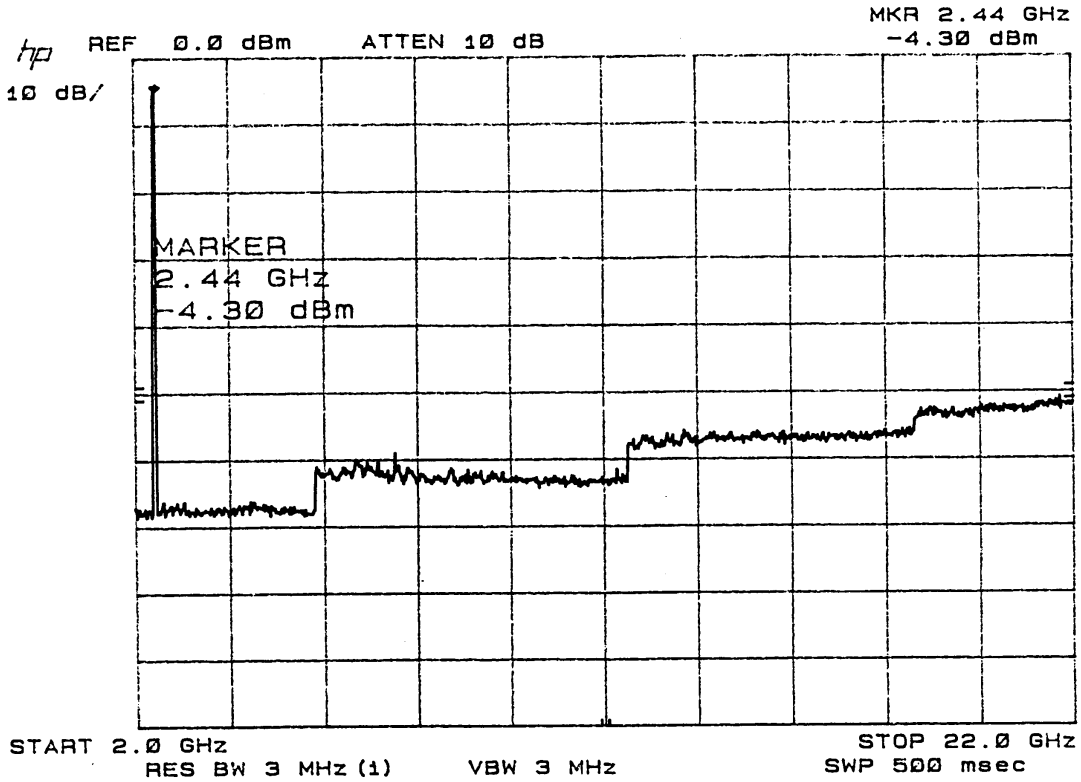



**Figure 3.5-1: Conducted Spurious - Frequency Plan A**

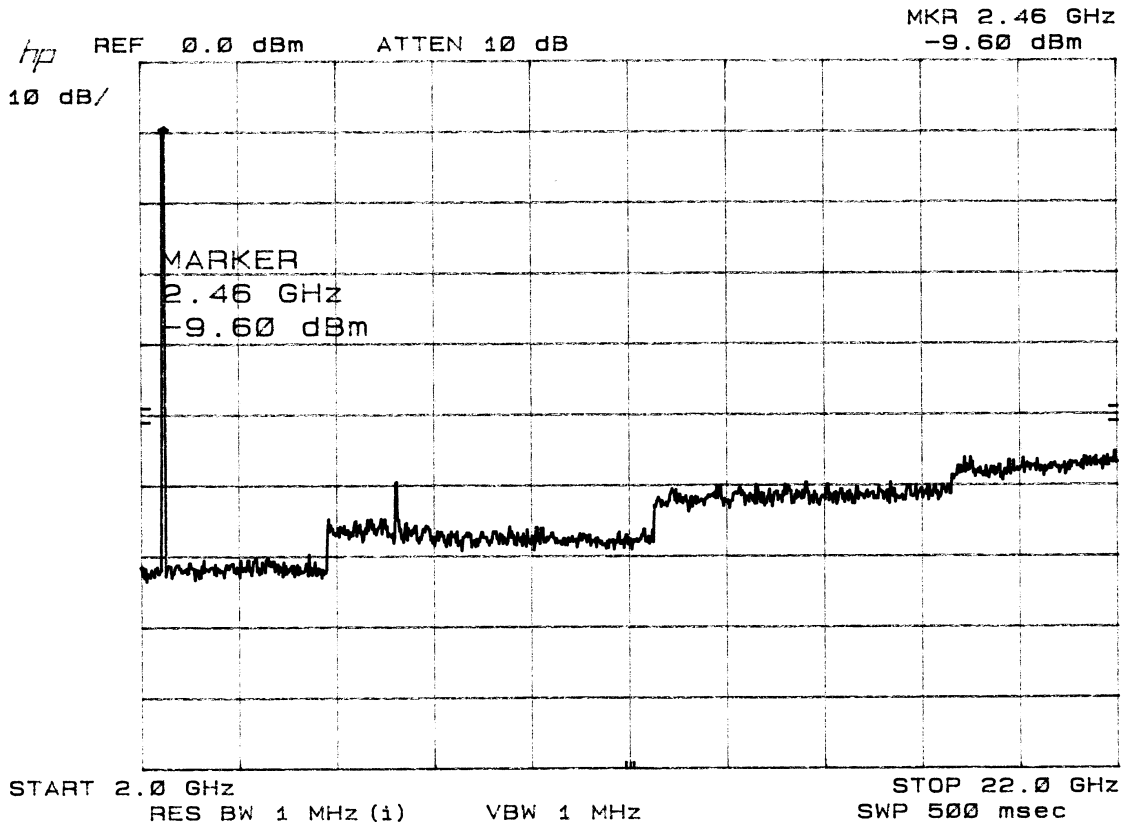



**Figure 3.5 - 2: Conducted Spurious - Frequency Plan B**

Parabolic Dish Antenna: Radiated Emission Test

The data shown below lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

The antenna used for this test was the Comsat RSI Grid Parabolic dish antenna (Model Number: P-24A36GN-U). This antenna was vertically polarized and had 24.8 dBi of gain. The largest antenna of the type listed for use with this device has a gain of 33.5 dBi.

**Table 3.5 - 3: Radiated Spurious Emissions, 1000 – 22000 MHz**

Company: Adtran
Model: Tracer Rack Mount

Date: 12/11/98
Tested by: Candy L. Campbell
Test Distance: 3
Job Number:

Notes: Initial Results
Parabolic Grid Vertically polarized
Standard: FCC Part 15

Average Readings Class B

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | External Atten. dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | |
|---|---|---|---|---|---|---|---|---|---|---|
| V | 4944.000 | 15.9 | 34.9 | 2.7 | 36.2 | 20.0 | 37.3 | 54.0 | -16.7 | * |
| V | 7418.000 | 20.4 | 36.5 | 3.3 | 36.3 | 20.0 | 43.9 | 54.0 | -10.1 | * |
| V | 9892.000 | 20.5 | 38.8 | 4.1 | 37.2 | 20.0 | 46.2 | 54.0 | -7.8 | * |
| V | 12366.000 | 19.4 | 41.1 | 5.2 | 36.8 | 20.0 | 48.9 | 54.0 | -5.1 | * |
| H | 4944.000 | 15.9 | 34.9 | 2.7 | 36.2 | 20.0 | 37.2 | 54.0 | -16.8 | * |
| H | 7418.000 | 20.4 | 36.5 | 3.3 | 36.3 | 20.0 | 43.9 | 54.0 | -10.1 | * |
| H | 9892.000 | 20.5 | 38.8 | 4.1 | 37.2 | 20.0 | 46.2 | 54.0 | -7.8 | * |
| H | 12366.000 | 19.5 | 41.1 | 5.2 | 36.8 | 20.0 | 49.0 | 54.0 | -5.0 | * |

Peak Readings

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | External Atten. dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | |
|---|---|---|---|---|---|---|---|---|---|---|
| V | 4944.000 | 22.9 | 34.9 | 2.7 | 36.2 | 20.0 | 44.3 | 74.0 | -29.7 | * |
| V | 7418.000 | 27.2 | 36.5 | 3.3 | 36.3 | 20.0 | 50.7 | 74.0 | -23.3 | * |
| V | 9892.000 | 27.4 | 38.8 | 4.1 | 37.2 | 20.0 | 53.1 | 74.0 | -20.9 | * |
| V | 12366.000 | 26.5 | 41.1 | 5.2 | 36.8 | 20.0 | 56.0 | 74.0 | -18.0 | * |
| H | 4944.000 | 23.1 | 34.9 | 2.7 | 36.2 | 20.0 | 44.5 | 74.0 | -29.5 | * |
| H | 7418.000 | 27.7 | 36.5 | 3.3 | 36.3 | 20.0 | 51.2 | 74.0 | -22.8 | * |
| H | 9892.000 | 27.1 | 38.8 | 4.1 | 37.2 | 20.0 | 52.8 | 74.0 | -21.2 | * |
| H | 12366.000 | 26.5 | 41.1 | 5.2 | 36.8 | 20.0 | 56.0 | 74.0 | -18.0 | * |

* Noise Floor

Parabolic Dish Antenna: Radiated Emission Test

The following plot contains the peak radiated output of the Comsat RSI Grid Parabolic dish antenna (Model Number: P-24A36GN-U). This antenna was vertically polarized and has 24.8 dBi gain. The plot shows peak carrier data for the antenna in vertical polarization. There was no external attenuation or pre-amplifier used for this plot. The measuring systems losses were 32.4 dB.

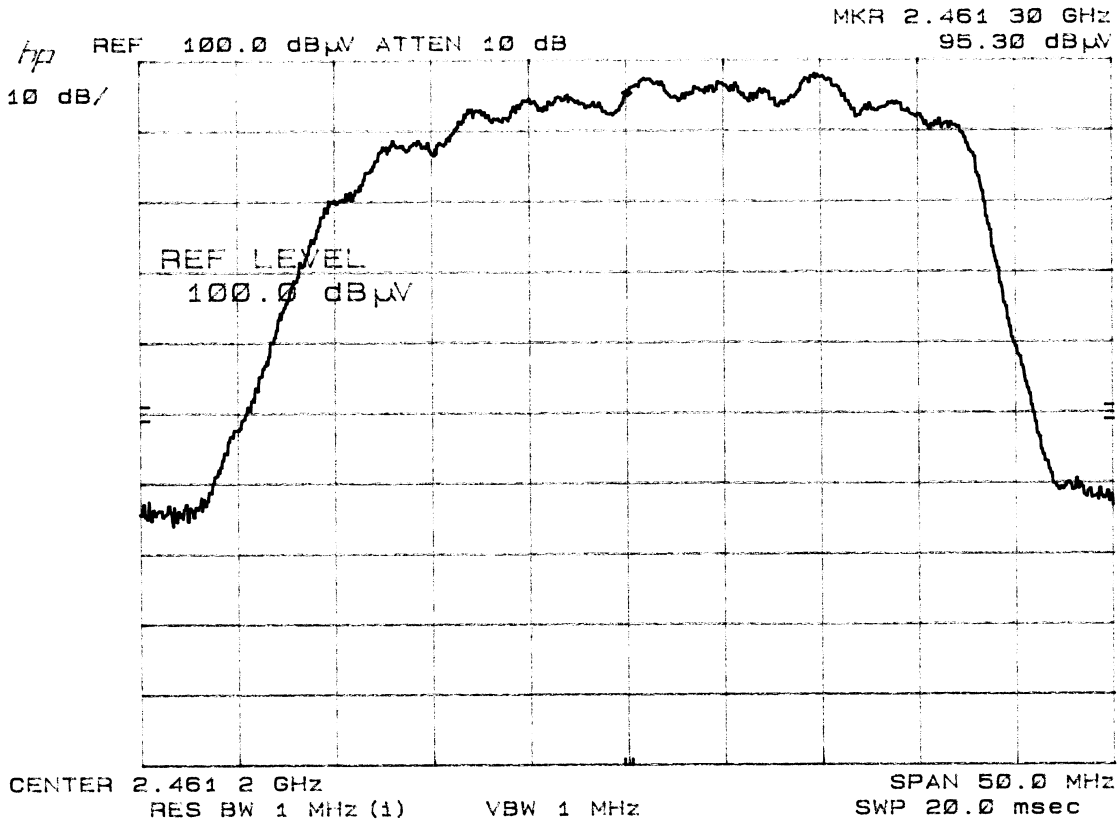



**Figure 3.5 - 3: Comsat RSI Grid Parabolic (M/N:P-24A36GN-U) 24.8 dBi - Peak Plot**

Parabolic Dish Antenna: Radiated Emission Test

The following plot contains the average radiated output of the Comsat Grid Parabolic dish antenna (Model Number: P-24A366N-U). This antenna was vertically polarized and has 24.8 dBi gain. The plot shows average carrier data for the antenna in vertical polarization. There was no external attenuation or pre-amplifier used for this plot. The measuring systems losses were 32.4 dB (this plot has been adjusted using a reference level offset of 32.4).

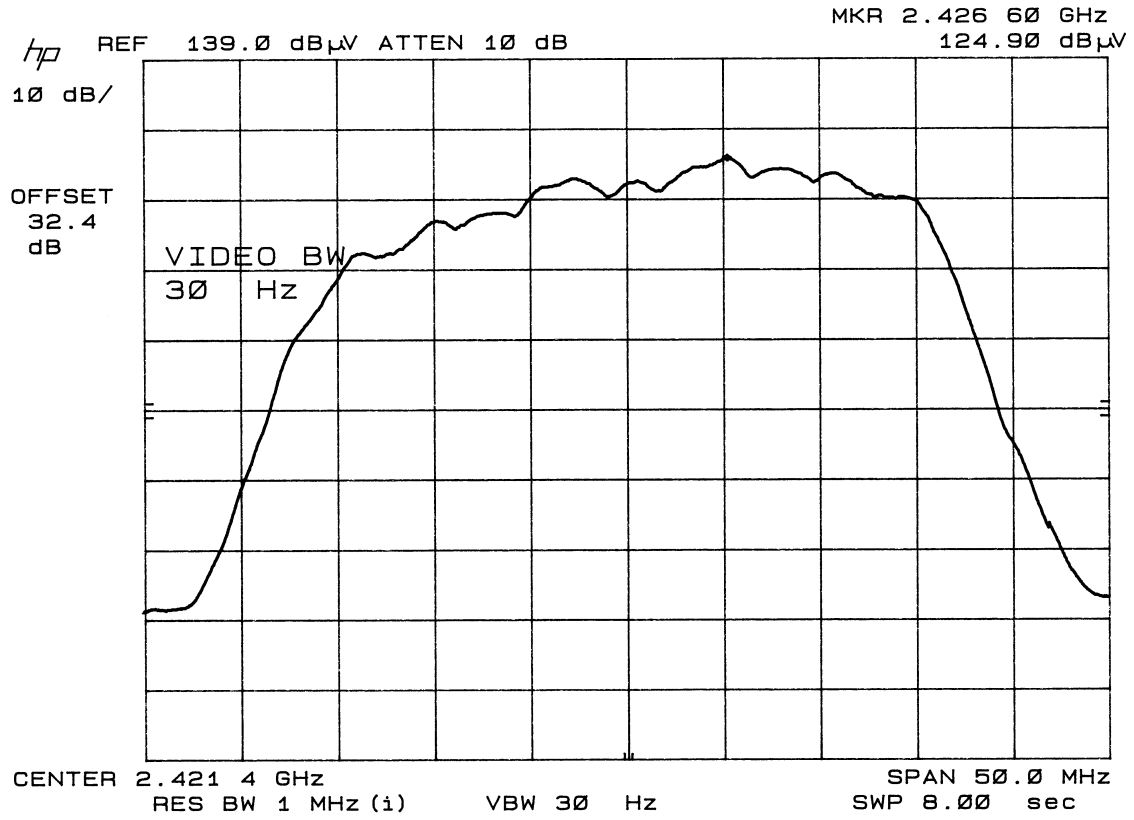



**Figure 3.5 - 4: Comsat RSI Grid Parabolic (M/N:P-24A36GN-U) 24.8 dBi - Average Plot**

Parabolic Dish Antenna: Radiated Emission Test

The following two plots show the horizontal and vertical emissions of the EUT within the restricted band 2.4835 – 2.5 GHz. The EUT was set for frequency plan B. The analyzer was set for average detection. A bandpass filter was used to pass 2.48 – 2.6 GHz allowing the measurements to be made without overloading the analyzer.

Calculation of field strength in restricted band:
FS = RR + CL + IL + AF – PA

Where: FS is the Field Strength in dB (μV/m)
RR is the receiver reading in dB (μV), 30.3
CL is the cable loss in dB, 2.0
IL is the insertion loss of the band pass filter in dB, 3.0

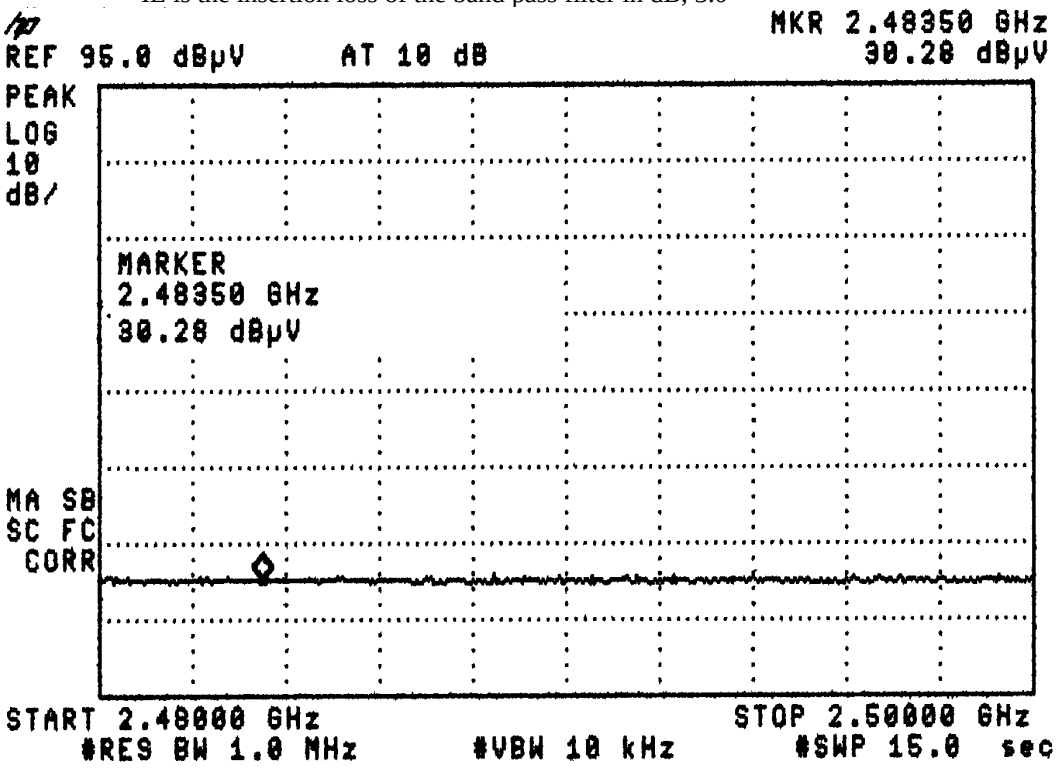



**Figure 3.5 - 5: Comsat RSI Grid Parabolic (M/N: P-24A36GN-U) 24.8 dBi – Restricted Band, Vertical**

Calculation of field strength in restricted band:

FS = RR + CL + IL + AF – PA

Where: FS is the Field Strength in dB (μV/m)
RR is the receiver reading in dB (μV), 30.1
CL is the cable loss in dB, 2.0
IL is the insertion loss of the band pass filter in dB, 3.0
AF is the antenna factor in dB (1/m), 30.9
PA is the gain of the preamplifier in dB, 36.6

FS = 30.1 + 2.0 + 3.0 + 30.9 – 36.6

FS = 29.4 dB (μV/m), which is 25.6 dB below the limit

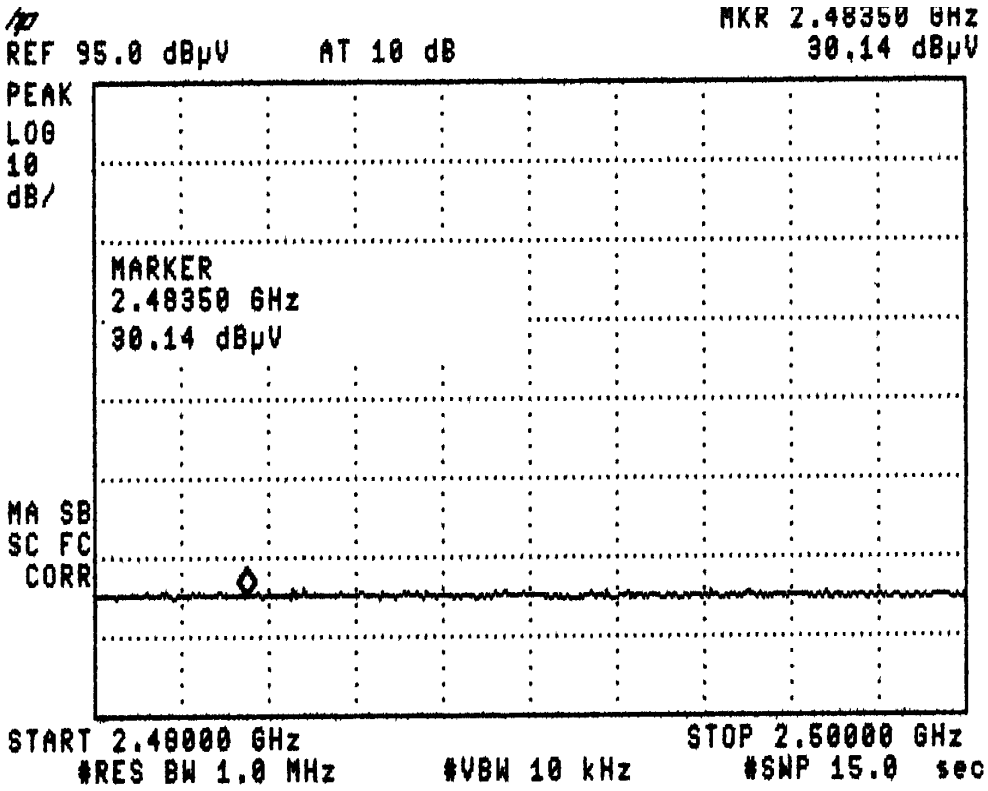



**Figure 3.5 - 6: Comsat RSI Grid Parabolic (M/N: P-24A36GN-U) 24.8 dBi – Restricted Band, Horizontal**

Parabolic Dish Antenna: Radiated Emission Test

The data shown below lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

The antenna used for this test was the Comsat RSI Grid Parabolic dish antenna (Model Number: P-24A36GN-U). This antenna was horizontally polarized and had 24.8 dBi of gain. The largest antenna of the type listed for use with this device has a gain of 33.5 dBi.

**Table 3.5 - 4: Radiated Spurious Emissions, 1000 – 22000 MHz**

Company: Adtran
Model: Tracer Rack Mount

Date: 12/11/98
Tested by: Candy L. Campbell
Test Distance: 3
Job Number:

Notes: Initial Results
Parabolic Grid Horizonal polarized
Standard: FCC Part 15

Average Readings Class B

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | External Atten. dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | |
|---|---|---|---|---|---|---|---|---|---|---|
| V | 4944.000 | 15.9 | 34.9 | 2.7 | 36.2 | 20.0 | 37.2 | 54.0 | -16.8 | * |
| V | 7418.000 | 20.4 | 36.5 | 3.3 | 36.3 | 20.0 | 43.9 | 54.0 | -10.1 | * |
| V | 9892.000 | 20.5 | 38.8 | 4.1 | 37.2 | 20.0 | 46.2 | 54.0 | -7.8 | * |
| V | 12366.000 | 19.5 | 41.1 | 5.2 | 36.8 | 20.0 | 49.0 | 54.0 | -5.0 | * |
| H | 4944.000 | 16.0 | 34.9 | 2.7 | 36.2 | 20.0 | 37.4 | 54.0 | -16.6 | * |
| H | 7418.000 | 20.4 | 36.5 | 3.3 | 36.3 | 20.0 | 43.9 | 54.0 | -10.1 | * |
| H | 9892.000 | 20.5 | 38.8 | 4.1 | 37.2 | 20.0 | 46.2 | 54.0 | -7.8 | * |
| H | 12366.000 | 19.4 | 41.1 | 5.2 | 36.8 | 20.0 | 48.9 | 54.0 | -5.1 | * |

Peak Readings

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | External Atten. dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | |
|---|---|---|---|---|---|---|---|---|---|---|
| V | 4944.000 | 23.2 | 34.9 | 2.7 | 36.2 | 20.0 | 44.6 | 74.0 | -29.4 | * |
| V | 7418.000 | 28.0 | 36.5 | 3.3 | 36.3 | 20.0 | 51.5 | 74.0 | -22.5 | * |
| V | 9892.000 | 27.7 | 38.8 | 4.1 | 37.2 | 20.0 | 53.4 | 74.0 | -20.6 | * |
| V | 12366.000 | 26.5 | 41.1 | 5.2 | 36.8 | 20.0 | 56.0 | 74.0 | -18.0 | * |
| H | 4944.000 | 22.8 | 34.9 | 2.7 | 36.2 | 20.0 | 44.2 | 74.0 | -29.8 | * |
| H | 7418.000 | 27.9 | 36.5 | 3.3 | 36.3 | 20.0 | 51.4 | 74.0 | -22.6 | * |
| H | 9892.000 | 27.8 | 38.8 | 4.1 | 37.2 | 20.0 | 53.5 | 74.0 | -20.5 | * |
| H | 12366.000 | 27.3 | 41.1 | 5.2 | 36.8 | 20.0 | 56.8 | 74.0 | -17.2 | * |

* Noise Floor

Parabolic Dish Antenna: Radiated Emission Test

The following plot contains the peak radiated output of the Comsat RSI Grid Parabolic dish antenna (Model Number:P-24A36GN-U). This antenna was horizontally polarized and has 24.8 dBi gain. The plot shows peak carrier data for the antenna in vertical polarization. There was no external attenuation or pre-amplifier used for this plot. The measuring systems losses were 32.4 dB.

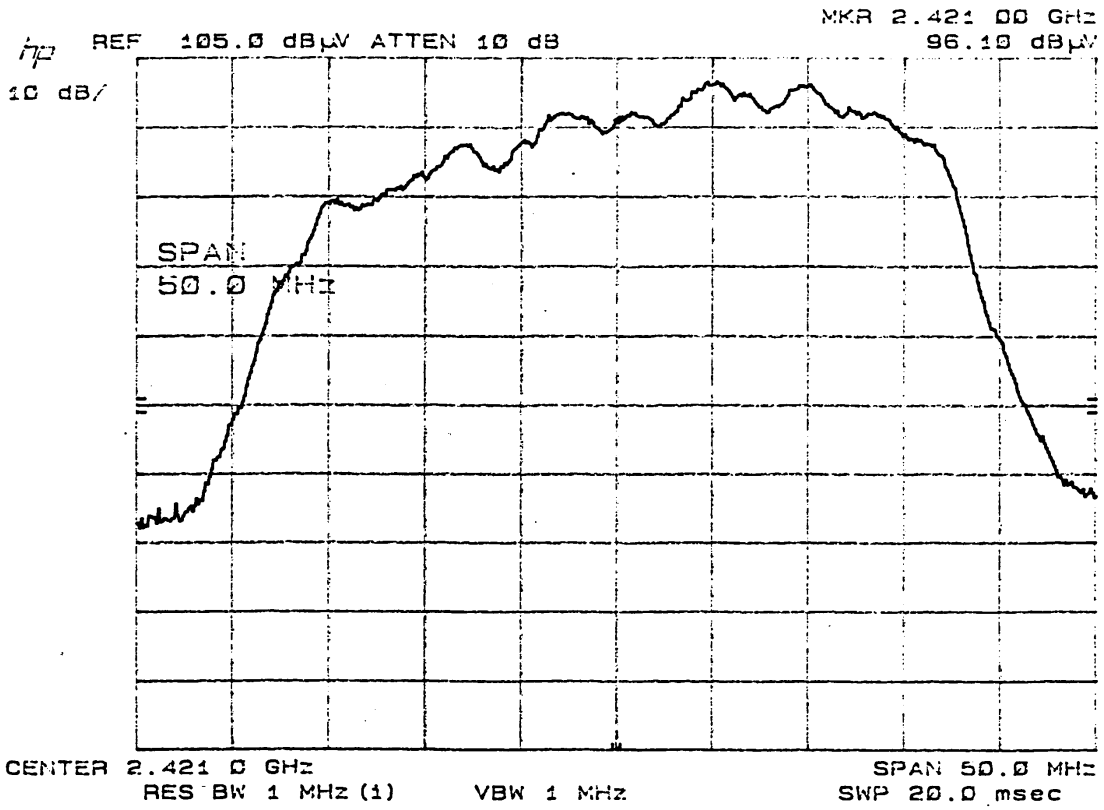



**Figure 3.5 - 7: Comsat RSI Grid Parabolic (M/N: P-24A36GN-U) 24.8 dBi - Peak Plot**

Parabolic Dish Antenna: Radiated Emission Test

The following plot contains the average radiated output of the Comsat RSI Grid Parabolic dish antenna (Model Number: P-24A36GN-U). This antenna was horizontally polarized and has 24.8 dBi gain. The plot shows average carrier data for the antenna in vertical polarization. There was no external attenuation or pre-amplifier used for this plot. The measuring systems losses were 32.4 dB (this plot has been adjusted using a reference level offset of 32.4).

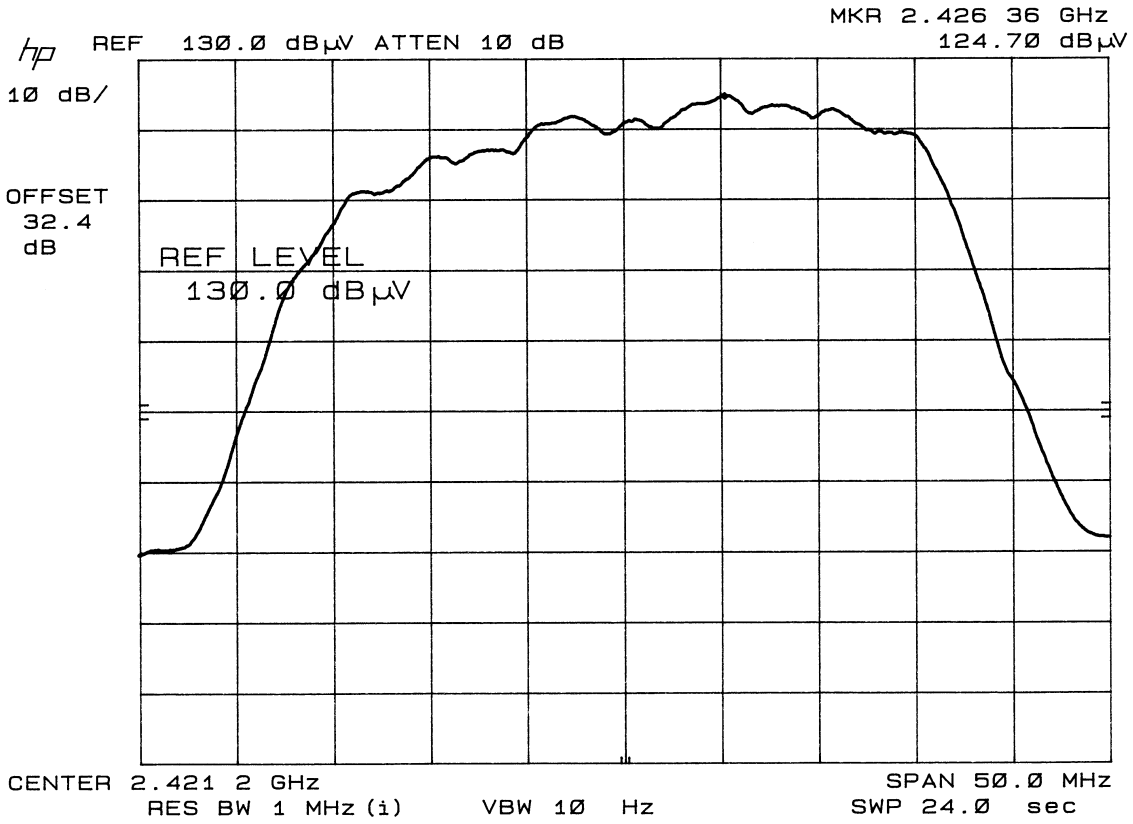



**Figure 3.5 - 8: Comsat RSI Grid Parabolic (M/N: P-24A36GN-U) 24.8 dBi - Average Plot**

Parabolic Dish Antenna: Radiated Emission Test

The following two plots show the horizontal and vertical emissions of the EUT within the restricted band 2.4835 – 2.5 GHz. The EUT was set for frequency plan B. The analyzer was set for average detection. A bandpass filter was used to pass 2.48 – 2.6 GHz allowing the measurements to be made without overloading the analyzer. The insertion loss of this filter is approximately 3 dB. The antenna factor in the restricted band is approximately 30 dB/m. The cable loss in this band is approximately 2 dB. The pre-amplifier factor in this band is approximately 37 dB. This yields a margin of approximately 15 dB throughout this restricted band.

Calculation of field strength in restricted band:
FS = RR + CL + IL + AF – PA
Where: FS is the Field Strength in dB (μV/m)
RR is the receiver reading in dB (μV), 32.4
CL is the cable loss in dB, 2.0
IL is the insertion loss of the band pass filter in dB, 3.0
AF is the antenna factor in dB (1/m), 30.9
PA is the gain of the preamplifier in dB, 36.6
FS = 32.4 + 2.0 + 3.0 + 30.9 – 36.6
FS = 31.7 dB (μV/m), which is 23.3 dB below the limit

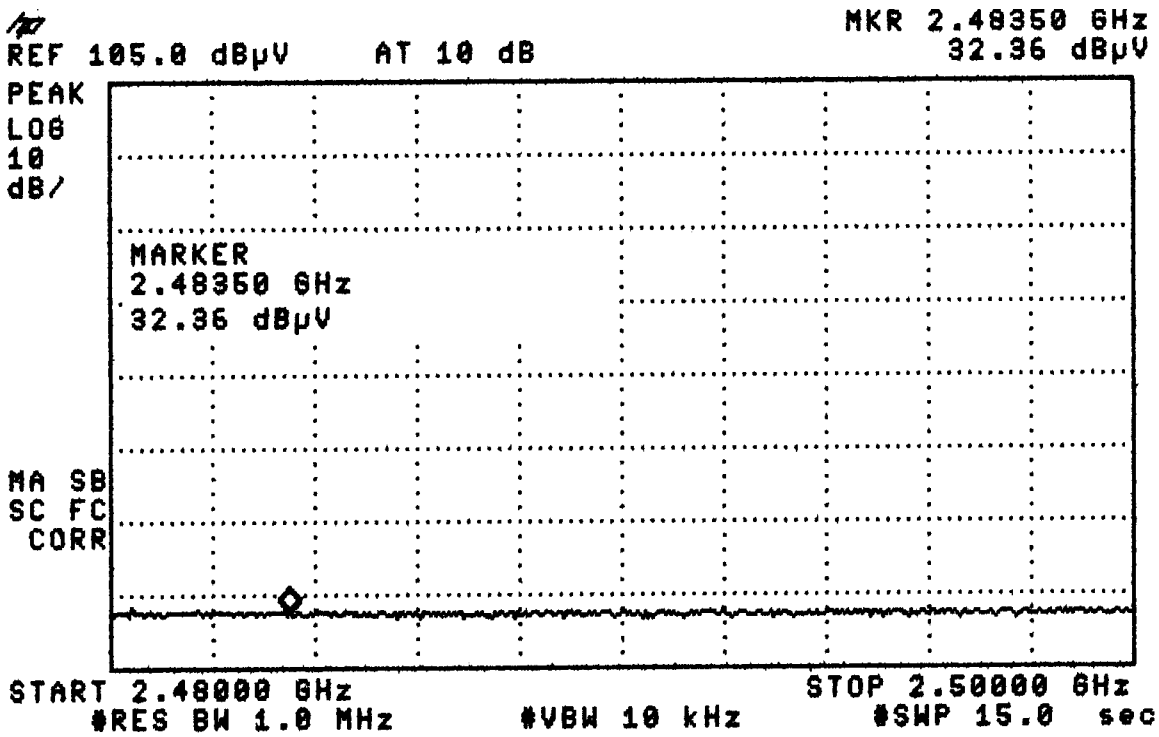



**Figure 3.5 - 9: Comsat RSI Grid Parabolic (M/N: P-24A36GN-U) 24.8 dBi – Restricted Band, Vertical**

Calculation of field strength in restricted band:

FS = RR + CL + IL + AF – PA

Where: FS is the Field Strength in dB (μV/m)
RR is the receiver reading in dB (μV), 32.4
CL is the cable loss in dB, 2.0
IL is the insertion loss of the band pass filter in dB, 3.0
AF is the antenna factor in dB (1/m), 30.9
PA is the gain of the preamplifier in dB, 36.6

FS = 32.4 + 2.0 + 3.0 + 30.9 – 36.6

FS = 31.7 dB (μV/m), which is 23.3 dB below the limit

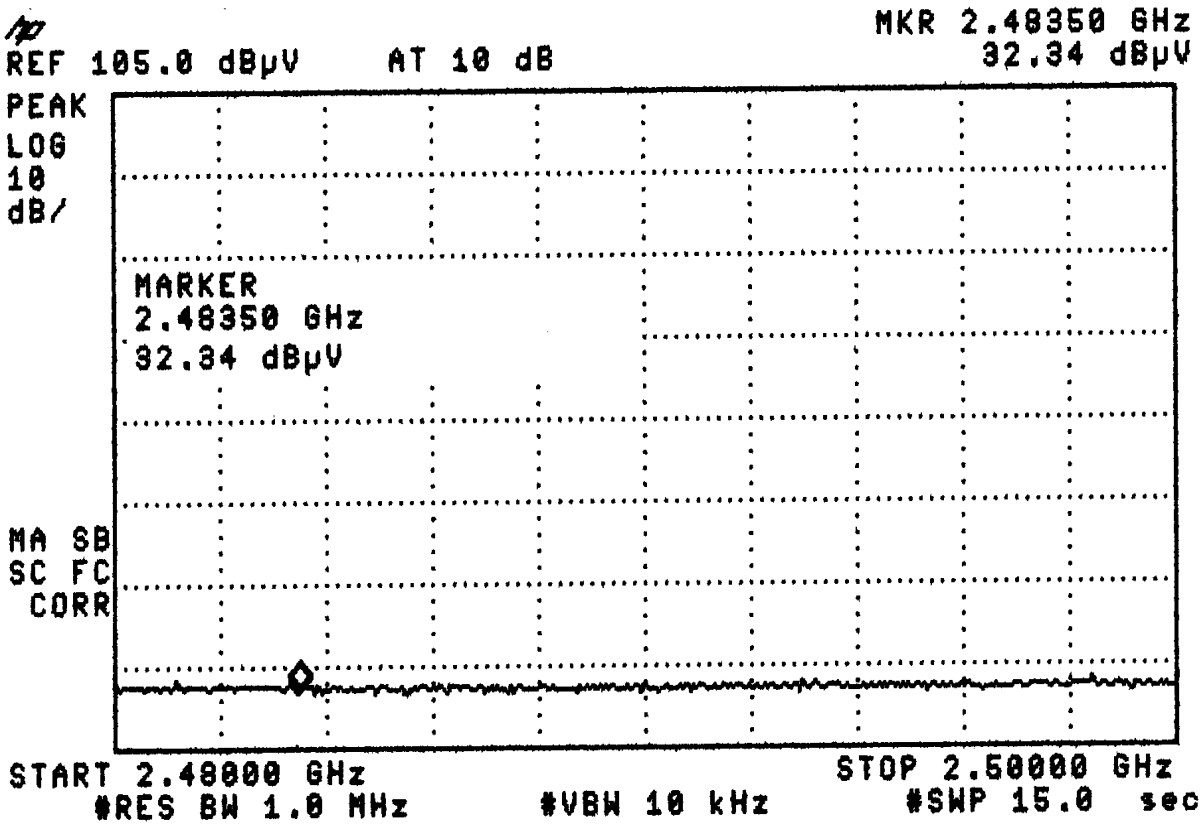



**Figure 3.5 - 10: Comsat RSI Grid Parabolic (M/N: P-24A36GN-U) 24.8 dBi – Restricted Band, Horizontal**

Yagi Antenna: Radiated Emission Test

The data shown below lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

The antenna used during testing of this type was the Cushcraft (Model number: PC2415N). This antenna has 13.9 dBi of gain and represents the highest gain for this type of antenna as listed.

**Table 3.5 – 5: Radiated Spurious Emissions, 1000 – 22000 MHz**

Company: Adtran
Model: Tracer Rack Mount

Notes: Initial Results
Yagi
Standard: FCC Part 15
Class B

Date: 12/11/98
Tested by: Candy L. Campbell
Test Distance: 3
Job Number:

Average Readings

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | External Atten. dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | |
|---|---|---|---|---|---|---|---|---|---|---|
| V | 4920.000 | 15.7 | 34.9 | 2.7 | 36.2 | 20.0 | 37.0 | 54.0 | -17.0 | * |
| V | 7380.000 | 20.5 | 36.5 | 3.3 | 36.3 | 20.0 | 44.0 | 54.0 | -10.0 | * |
| V | 9840.000 | 20.2 | 38.8 | 4.1 | 37.2 | 20.0 | 45.9 | 54.0 | -8.1 | * |
| V | 12300.000 | 19.4 | 41.1 | 5.2 | 36.8 | 20.0 | 48.9 | 54.0 | -5.1 | * |
| H | 4922.000 | 15.7 | 34.9 | 2.7 | 36.2 | 20.0 | 37.1 | 54.0 | -16.9 | * |
| H | 7380.000 | 20.3 | 36.5 | 3.3 | 36.3 | 20.0 | 43.8 | 54.0 | -10.2 | * |
| H | 9842.000 | 20.4 | 38.8 | 4.1 | 37.2 | 20.0 | 46.1 | 54.0 | -7.9 | * |
| H | 12302.000 | 19.5 | 41.1 | 5.2 | 36.8 | 20.0 | 49.0 | 54.0 | -5.0 | * |

Peak Readings

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | External Atten. dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | |
|---|---|---|---|---|---|---|---|---|---|---|
| V | 4920.000 | 23.2 | 34.9 | 2.7 | 36.2 | 20.0 | 44.6 | 74.0 | -29.4 | * |
| V | 7380.000 | 27.1 | 36.5 | 3.3 | 36.3 | 20.0 | 50.6 | 74.0 | -23.4 | * |
| V | 9840.000 | 27.8 | 38.8 | 4.1 | 37.2 | 20.0 | 53.5 | 74.0 | -20.5 | * |
| V | 12300.000 | 27.4 | 41.1 | 5.2 | 36.8 | 20.0 | 56.9 | 74.0 | -17.1 | * |
| H | 4922.000 | 23.6 | 34.9 | 2.7 | 36.2 | 20.0 | 45.0 | 74.0 | -29.0 | * |
| H | 7380.000 | 28.0 | 36.5 | 3.3 | 36.3 | 20.0 | 51.5 | 74.0 | -22.5 | * |
| H | 9842.000 | 27.8 | 38.8 | 4.1 | 37.2 | 20.0 | 53.5 | 74.0 | -20.5 | * |
| H | 12302.000 | 27.5 | 41.1 | 5.2 | 36.8 | 20.0 | 57.0 | 74.0 | -17.0 | * |

* Noise Floor

Yagi Antenna: Radiated Emission Test

The following plot contains the peak radiated output of the Cushcraft Yagi antenna (Model Number: PC2415N). This antenna has a 13.9 dBi gain. The plot shows peak carrier data for the antenna in vertical polarization. No pre-amplifier was used and no external attenuation was used for this plot. The measuring systems losses were 32.4 dB.

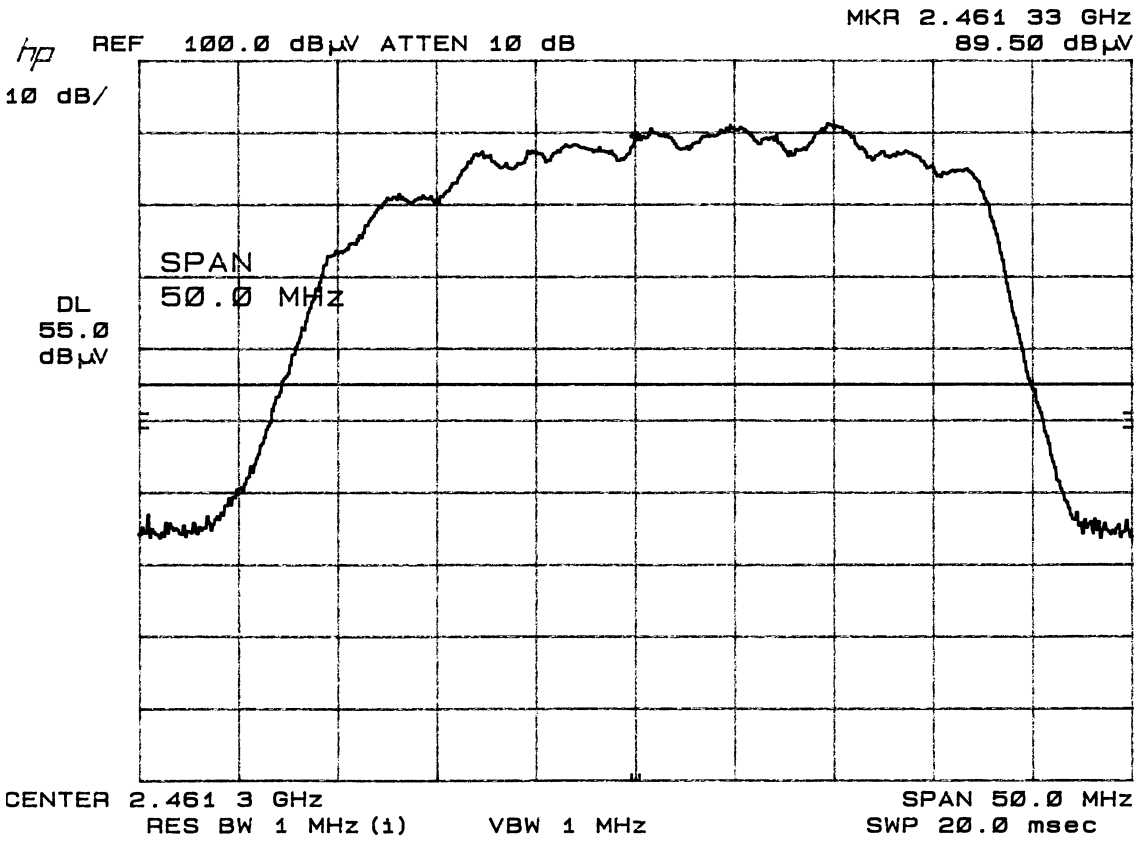



**Figure 3.5 - 11: Cushcraft Yagi (PC-2415N) 13.9 dBi - Peak Plot**

Yagi Antenna: Radiated Emission Test

The following plot contains the average radiated output of the Cushcraft Yagi antenna (Model Number: PC2415N). This antenna has a 13.9 dBi gain. The plot shows average carrier data for the antenna in vertical polarization. No pre-amplifier was used and no external attenuation was used for this plot. The measuring systems losses were 0 dB.

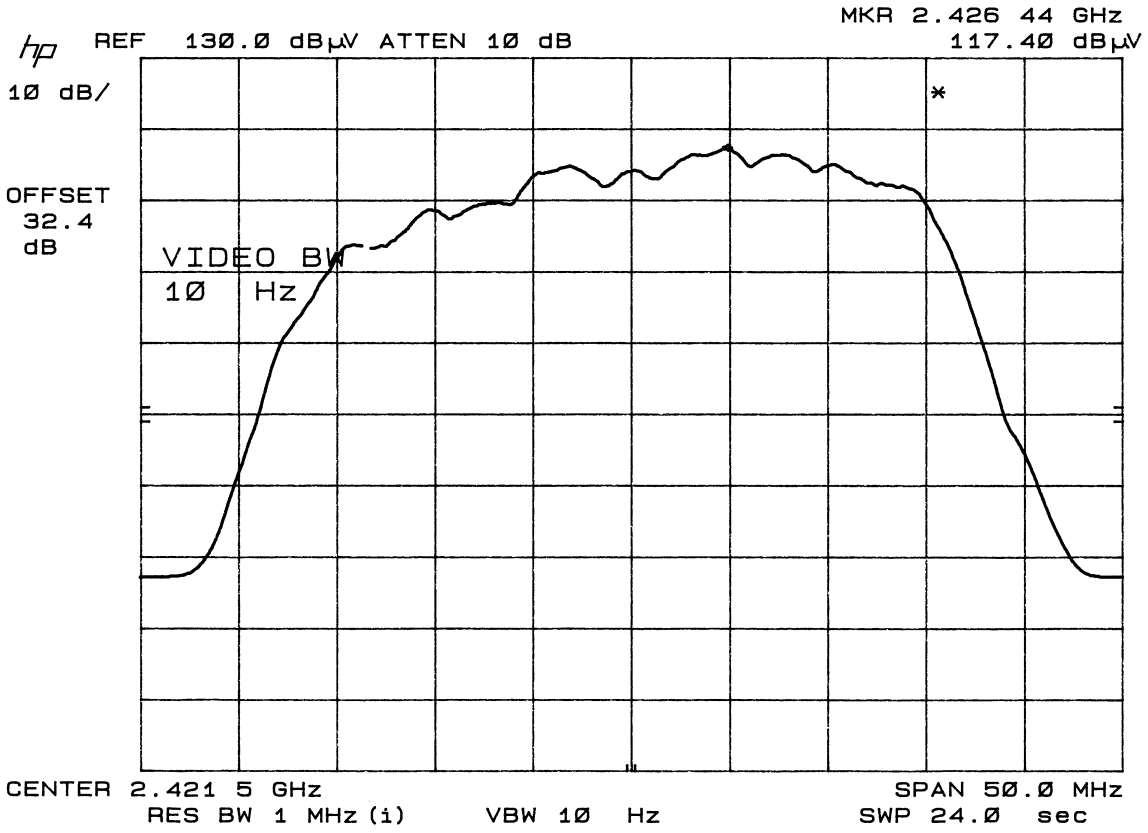



**Figure 3.5 - 12: Cushcraft Yagi (PC-2415N) 13.9 dBi - Average Plot**

Yagi Antenna: Radiated Emission Test

The following two plots show the horizontal and vertical emissions of the EUT within the restricted band 2.4835 – 2.5 GHz. The EUT was set for frequency plan B. The analyzer was set for average detection. A bandpass filter was used to pass 2.48 – 2.6 GHz allowing the measurements to be made without overloading the analyzer. The insertion loss of this filter is approximately 3 dB. The antenna factor in the restricted band is approximately 30 dB/m. The cable loss in this band is approximately 2 dB. The pre-amplifier factor in this band is approximately 37 dB. This yields a margin of approximately 25 dB throughout this restricted band.

Calculation of field strength in restricted band:

FS = RR + CL + IL + AF – PA

Where: FS is the Field Strength in dB (μV/m)
RR is the receiver reading in dB (μV), 30.5
CL is the cable loss in dB, 2.0
IL is the insertion loss of the band pass filter in dB, 3.0
AF is the antenna factor in dB (1/m), 30.9
PA is the gain of the preamplifier in dB, 36.6

FS = 30.5 + 2.0 + 3.0 + 30.9 – 36.6

FS = 29.8 dB (μV/m), which is 25.2 dB below the limit

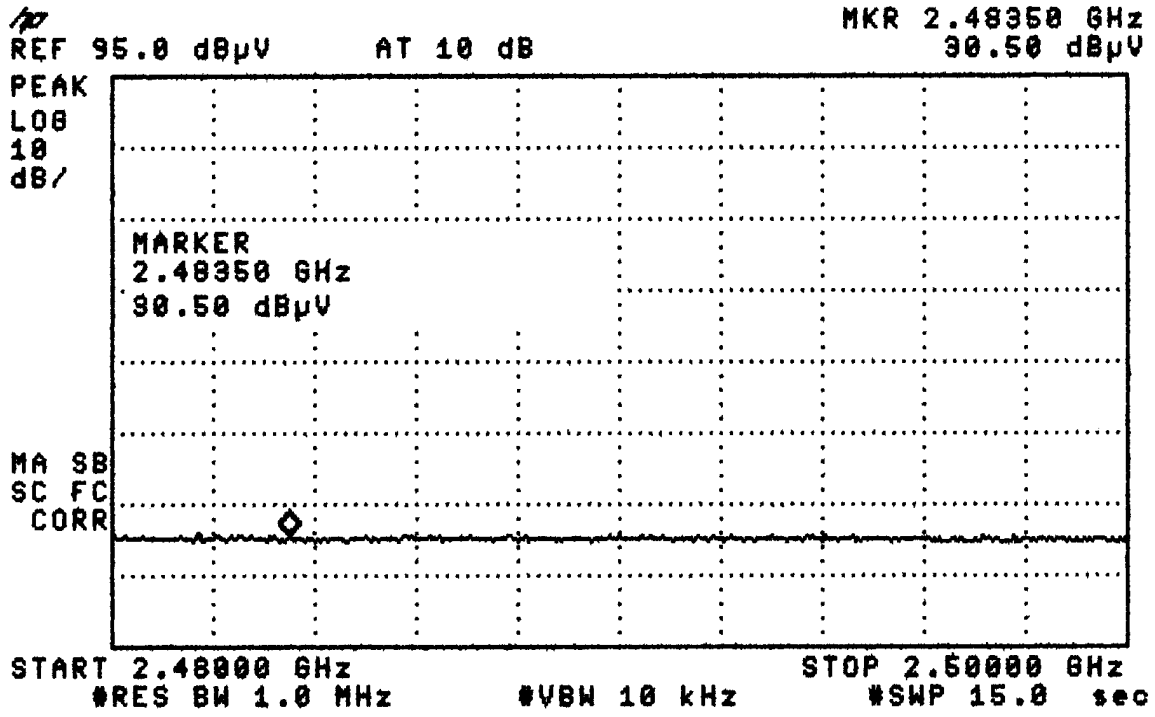



**Figure 3.5 - 13: Cushcraft Yagi (PC-2415N) 13.9 dBi - Restricted Band, Vertical**

Calculation of field strength in restricted band:

FS = RR + CL + IL + AF – PA

Where: FS is the Field Strength in dB (µV/m)
RR is the receiver reading in dB (µV), 29.9
CL is the cable loss in dB, 2.0
IL is the insertion loss of the band pass filter in dB, 3.0
AF is the antenna factor in dB (1/m), 30.9
PA is the gain of the preamplifier in dB, 36.6

FS = 29.9 + 2.0 + 3.0 + 30.9 – 36.6

FS = 29.2 dB (µV/m), which is 25.8 dB below the limit

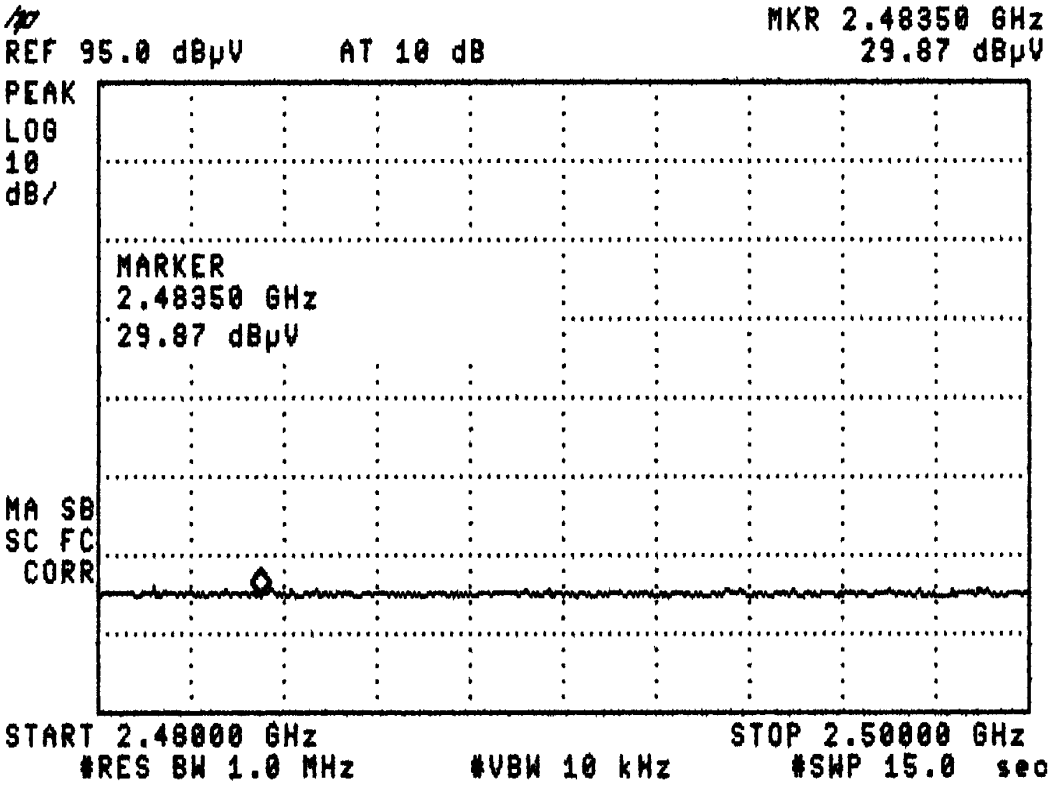



**Figure 3.5 - 14: Cushcraft Yagi (PC-2415N) 13.9 dBi - Restricted Band, Horizontal**

Flat Panel Array: Radiated Emission Test

The data shown below lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

The antenna used during this test was the Avitronics AVFP-18 with 18.0 dBi of gain. The highest gain antenna of this type listed for the EUT is 21.0 dBi.

**Table 3.5 - 6: Radiated Spurious Emissions, 1000 – 22000 MHz**

Company: Adtran
Model: Tracer Rack Mount

Date: 12/11/98
Tested by: Candy L. Campbell
Test Distance: 3
Job Number:

Notes: Initial Results
Flat Pannel
Standard: FCC Part 15

Average Readings Class B

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | External Atten. dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | |
|---|---|---|---|---|---|---|---|---|---|---|
| V | 4920.000 | 15.7 | 34.9 | 2.7 | 36.2 | 20.0 | 37.0 | 54.0 | -17.0 | * |
| V | 7380.000 | 20.5 | 36.5 | 3.3 | 36.3 | 20.0 | 44.0 | 54.0 | -10.0 | * |
| V | 9840.000 | 20.4 | 38.8 | 4.1 | 37.2 | 20.0 | 46.1 | 54.0 | -7.9 | * |
| V | 12300.000 | 19.9 | 41.1 | 5.2 | 36.8 | 20.0 | 49.4 | 54.0 | -4.6 | * |
| H | 4922.000 | 15.7 | 34.9 | 2.7 | 36.2 | 20.0 | 37.1 | 54.0 | -16.9 | * |
| H | 7380.000 | 20.4 | 36.5 | 3.3 | 36.3 | 20.0 | 43.9 | 54.0 | -10.1 | * |
| H | 9842.000 | 20.3 | 38.8 | 4.1 | 37.2 | 20.0 | 46.0 | 54.0 | -8.0 | * |
| H | 12302.000 | 19.4 | 41.1 | 5.2 | 36.8 | 20.0 | 48.9 | 54.0 | -5.1 | * |

Peak Readings

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | External Atten. dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | |
|---|---|---|---|---|---|---|---|---|---|---|
| V | 4920.000 | 23.6 | 34.9 | 2.7 | 36.2 | 20.0 | 45.0 | 74.0 | -29.0 | * |
| V | 7380.000 | 28.0 | 36.5 | 3.3 | 36.3 | 20.0 | 51.5 | 74.0 | -22.5 | * |
| V | 9840.000 | 28.2 | 38.8 | 4.1 | 37.2 | 20.0 | 53.9 | 74.0 | -20.1 | * |
| V | 12300.000 | 27.6 | 41.1 | 5.2 | 36.8 | 20.0 | 57.1 | 74.0 | -16.9 | * |
| H | 4922.000 | 23.2 | 34.9 | 2.7 | 36.2 | 20.0 | 44.6 | 74.0 | -29.4 | * |
| H | 7380.000 | 27.6 | 36.5 | 3.3 | 36.3 | 20.0 | 51.1 | 74.0 | -22.9 | * |
| H | 9842.000 | 27.3 | 38.8 | 4.1 | 37.2 | 20.0 | 53.0 | 74.0 | -21.0 | * |
| H | 12302.000 | 26.9 | 41.1 | 5.2 | 36.8 | 20.0 | 56.4 | 74.0 | -17.6 | * |

* Noise Floor

Flat Panel Antenna: Radiated Emission Test

The following plot contains the peak radiated output of the Avitronics Flat Panel antenna (Model Number: AVFP-18). This antenna has 18.0 dBi gain. The plot shows peak carrier data for the antenna in vertical polarization. No pre-amplifier was used and no external attenuation was used for this plot. The measuring systems losses were 32.4 dB.

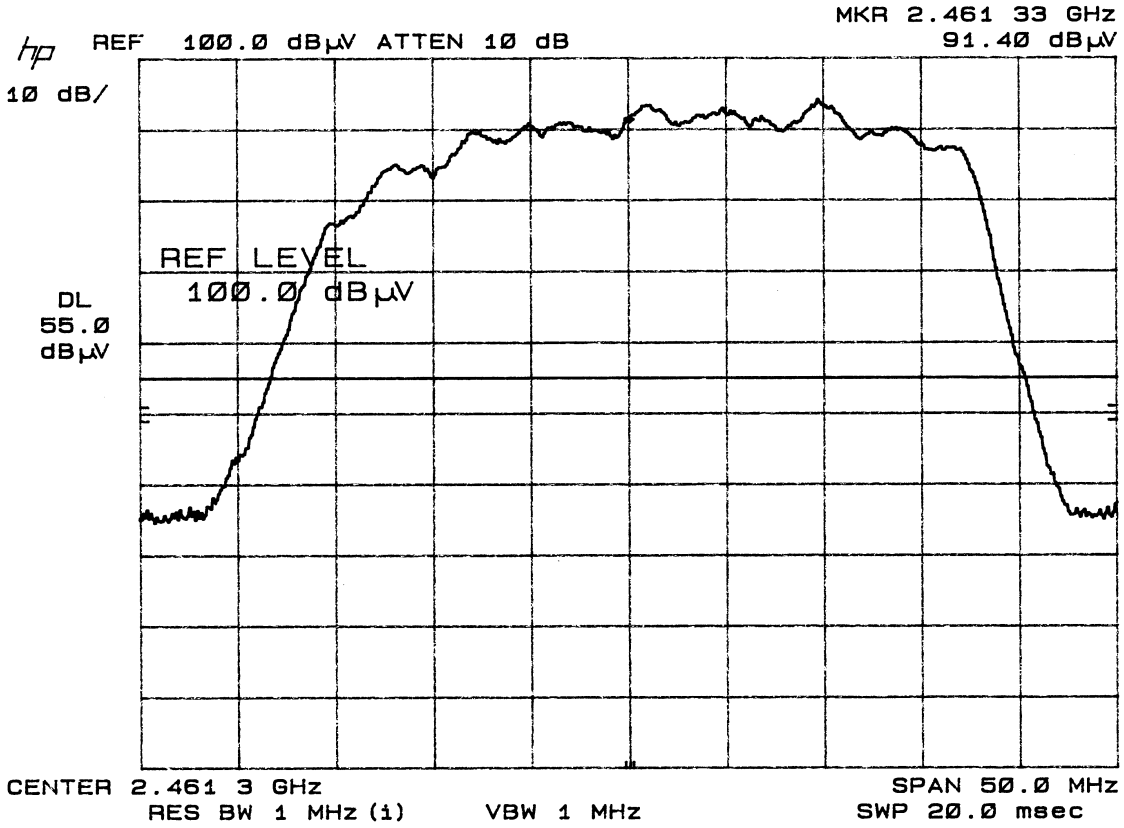



**Figure 3.5 - 15: Avitronics Flat Panel (AVFP-18) 18.0 dBi - Peak Plot**

Flat Panel Antenna: Radiated Emission Test

The following plot contains the average radiated output of the Avitronics Flat Panel antenna (Model Number: AVFP-18). This antenna has 18.0 dBi gain. The plot shows average carrier data for the antenna in vertical polarization. No pre-amplifier was used and no external attenuation was used for this plot. The measuring systems losses were 32.4 dB (this plot has been adjusted using a reference level offset of 32.4).

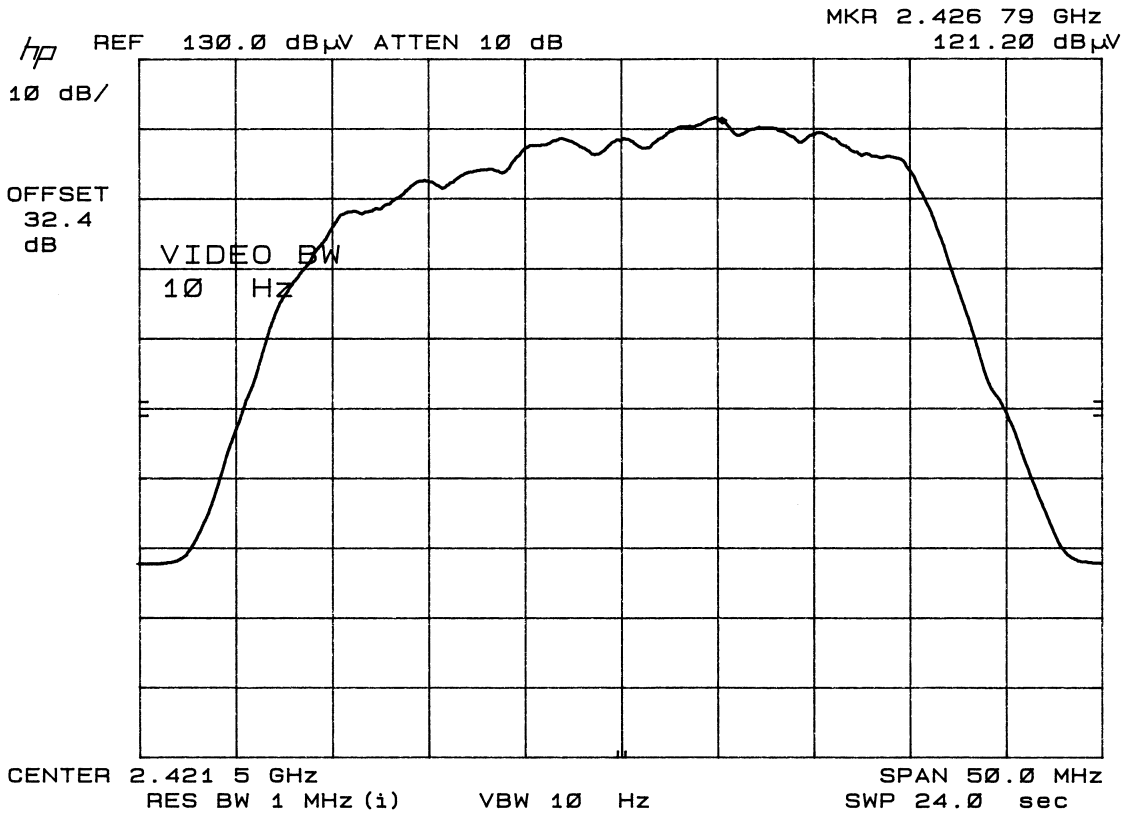



**Figure 3.5 - 16: Avitronics Flat Panel (AVFP-18) 18.0 dBi - Average Plot**

Flat Panel Antenna: Radiated Emission Test

The following two plots show the horizontal and vertical emissions of the EUT within the restricted band 2.4835 – 2.5 GHz. The EUT was set for frequency plan A. The analyzer was set for average detection. A bandpass filter was used to pass 2.48 – 2.6 GHz allowing the measurements to be made without overloading the analyzer.

Calculation of field strength in restricted band:

FS = RR + CL + IL + AF – PA

Where: FS is the Field Strength in dB (µV/m)
RR is the receiver reading in dB (µV), 30.1
CL is the cable loss in dB, 2.0
IL is the insertion loss of the band pass filter in dB, 3.0
AF is the antenna factor in dB (1/m), 30.9
PA is the gain of the preamplifier in dB, 36.6

FS = 30.1 + 2.0 + 3.0 + 30.9 – 36.6

FS = 29.4 dB (µV/m), which is 25.6 dB below the limit

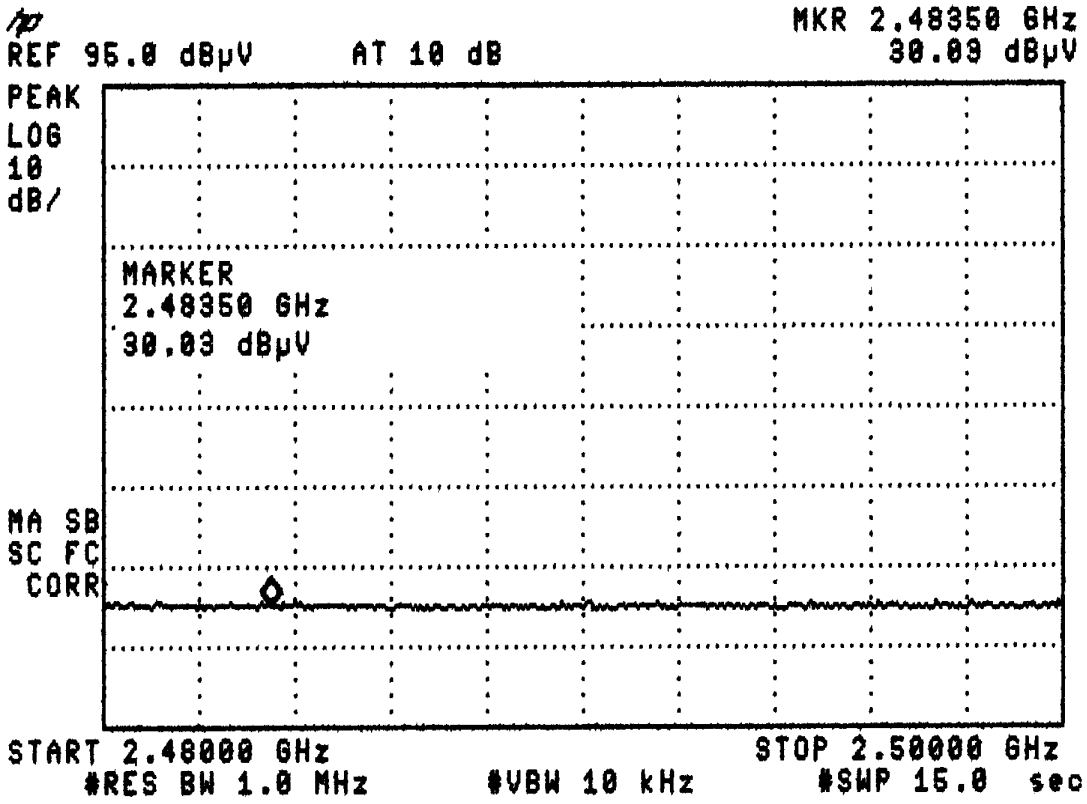



**Figure 3.5 - 17: Avitronics Flat Panel (AVFP-18) Restricted Band - Horizontal**

Calculation of field strength in restricted band:

FS = RR + CL + IL + AF – PA

Where: FS is the Field Strength in dB (μV/m)
RR is the receiver reading in dB (μV), 30.3
CL is the cable loss in dB, 2.0
IL is the insertion loss of the band pass filter in dB, 3.0
AF is the antenna factor in dB (1/m), 30.9
PA is the gain of the preamplifier in dB, 36.6

FS = 30.3 + 2.0 + 3.0 + 30.9 – 36.6

FS = 29.6 dB (μV/m), which is 25.4 dB below the limit

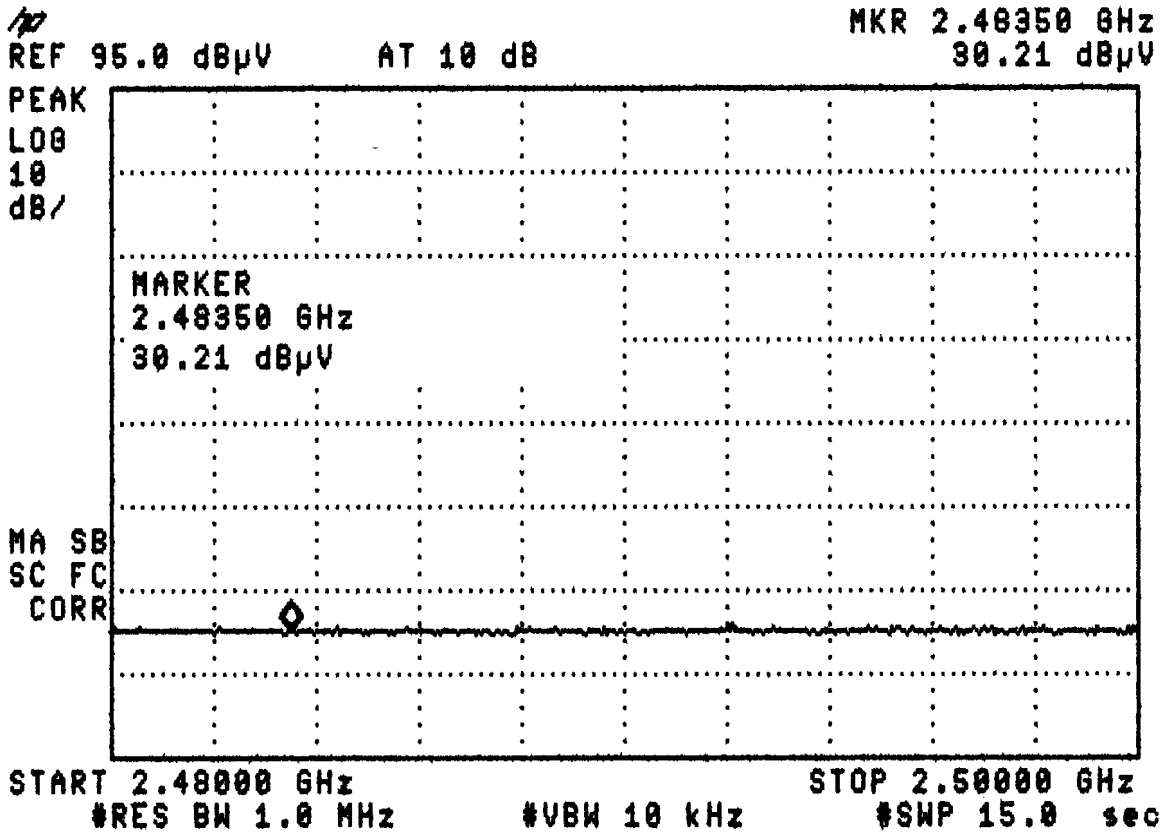



**Figure 3.5 - 18: Avitronics Flat Panel (AVFP-18) Restricted Band - Vertical**

Parabolic Dish Antenna: Radiated Emission Test

The data shown below lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

The antenna used for this test was the Telex Wireless Solid Parabolic (Model Number: 2440-24V) This antenna had 20.0 dBi of gain. The largest antenna of the type listed for use with this device has a gain of 24.0 dBi.

**Table 3.5 - 7: Radiated Spurious Emissions, 1000 – 22000 MHz**

Company: Adtran
Model: Tracer Rack Mount

Notes: Initial Results
Standard Parabolic Antenna
Standard: FCC Part 15

Date: 12/11/98
Tested by: Candy L. Campbell
Test Distance: 3
Job Number:

Average Readings Class B

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | External Atten. dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | |
|---|---|---|---|---|---|---|---|---|---|---|
| V | 4922.000 | 15.7 | 34.9 | 2.7 | 36.2 | 20.0 | 37.1 | 54.0 | -16.9 | * |
| V | 7383.000 | 20.5 | 36.5 | 3.3 | 36.3 | 20.0 | 44.0 | 54.0 | -10.0 | * |
| V | 9840.000 | 20.3 | 38.8 | 4.1 | 37.2 | 20.0 | 46.0 | 54.0 | -8.0 | * |
| V | 12300.000 | 19.5 | 41.1 | 5.2 | 36.8 | 20.0 | 49.0 | 54.0 | -5.0 | * |
| H | 4992.000 | 15.7 | 34.9 | 2.7 | 36.2 | 20.0 | 37.1 | 54.0 | -16.9 | * |
| H | 7383.000 | 20.5 | 36.5 | 3.3 | 36.3 | 20.0 | 44.0 | 54.0 | -10.0 | * |
| H | 9840.000 | 20.3 | 38.8 | 4.1 | 37.2 | 20.0 | 46.0 | 54.0 | -8.0 | * |
| H | 12300.000 | 19.5 | 41.1 | 5.2 | 36.8 | 20.0 | 49.0 | 54.0 | -5.0 | * |

Peak Readings

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | External Atten. dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB | |
|---|---|---|---|---|---|---|---|---|---|---|
| V | 4922.000 | 22.4 | 34.9 | 2.7 | 36.2 | 20.0 | 43.8 | 74.0 | -30.2 | * |
| V | 7383.000 | 27.3 | 36.5 | 3.3 | 36.3 | 20.0 | 50.8 | 74.0 | -23.2 | * |
| V | 9840.000 | 27.3 | 38.8 | 4.1 | 37.2 | 20.0 | 53.0 | 74.0 | -21.0 | * |
| V | 12300.000 | 27.6 | 41.1 | 5.2 | 36.8 | 20.0 | 57.1 | 74.0 | -16.9 | * |
| H | 4992.000 | 23.2 | 34.9 | 2.7 | 36.2 | 20.0 | 44.6 | 74.0 | -29.4 | * |
| H | 7383.000 | 27.4 | 36.5 | 3.3 | 36.3 | 20.0 | 50.9 | 74.0 | -23.1 | * |

Parabolic Dish Antenna: Radiated Emission Test

The following plot contains the peak radiated output of the Telex Wireless Solid Parabolic dish antenna (Model Number: 2440-24V ). This antenna has 20.0 dBi gain. The plot shows peak carrier data for the antenna in vertical polarization. There was no external attenuation or pre-amplifier used for this plot. The measuring systems losses were 32.4 dB.

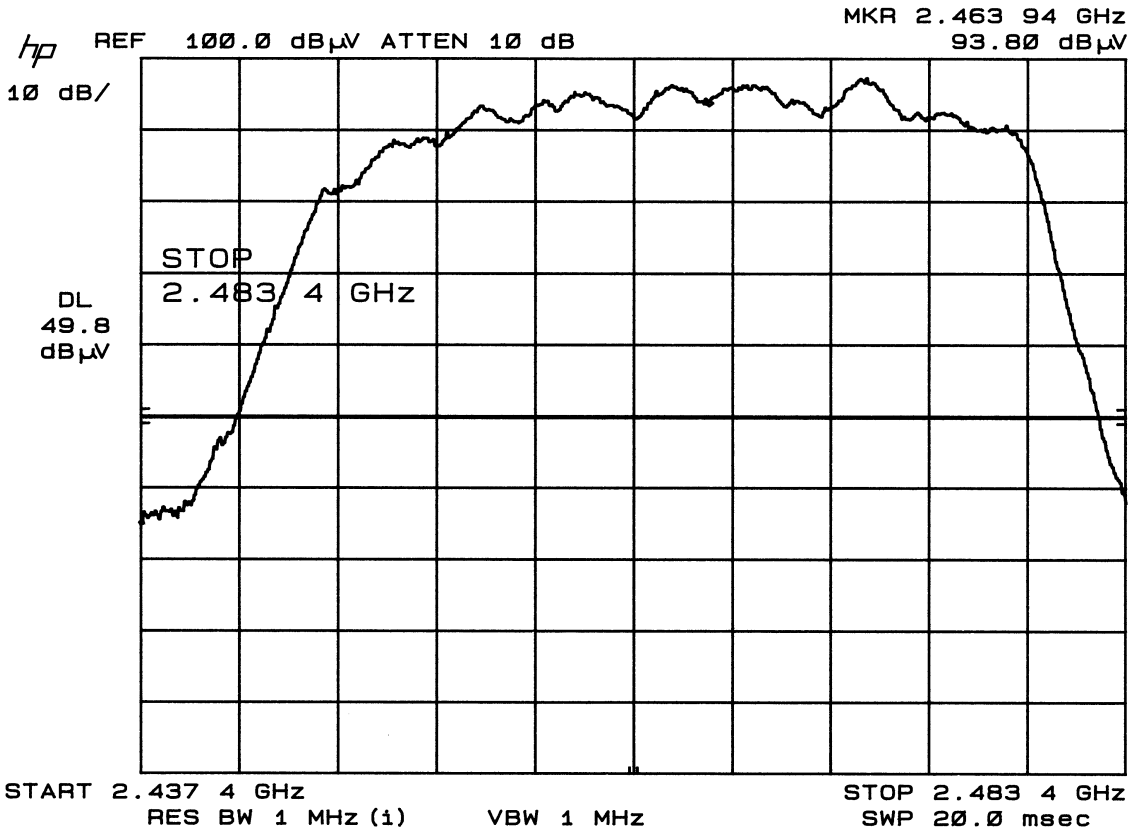



**Figure 3.5 - 19: Telex Wireless Solid Parabolic ( M/N:2440-24V) 20.0 dBi - Peak Plot**

Parabolic Dish Antenna: Radiated Emission Test

The following plot contains the average radiated output of the Telex Wireless Solid Parabolic dish antenna (Model Number: 2440-24V ). This antenna has a 20.0 dBi gain. The plot shows average carrier data for the antenna in vertical polarization. There was no external attenuation or pre-amplifier used for this plot. The measuring systems losses were 32.4 dB (this plot has been adjusted using a reference level offset of 32.4).

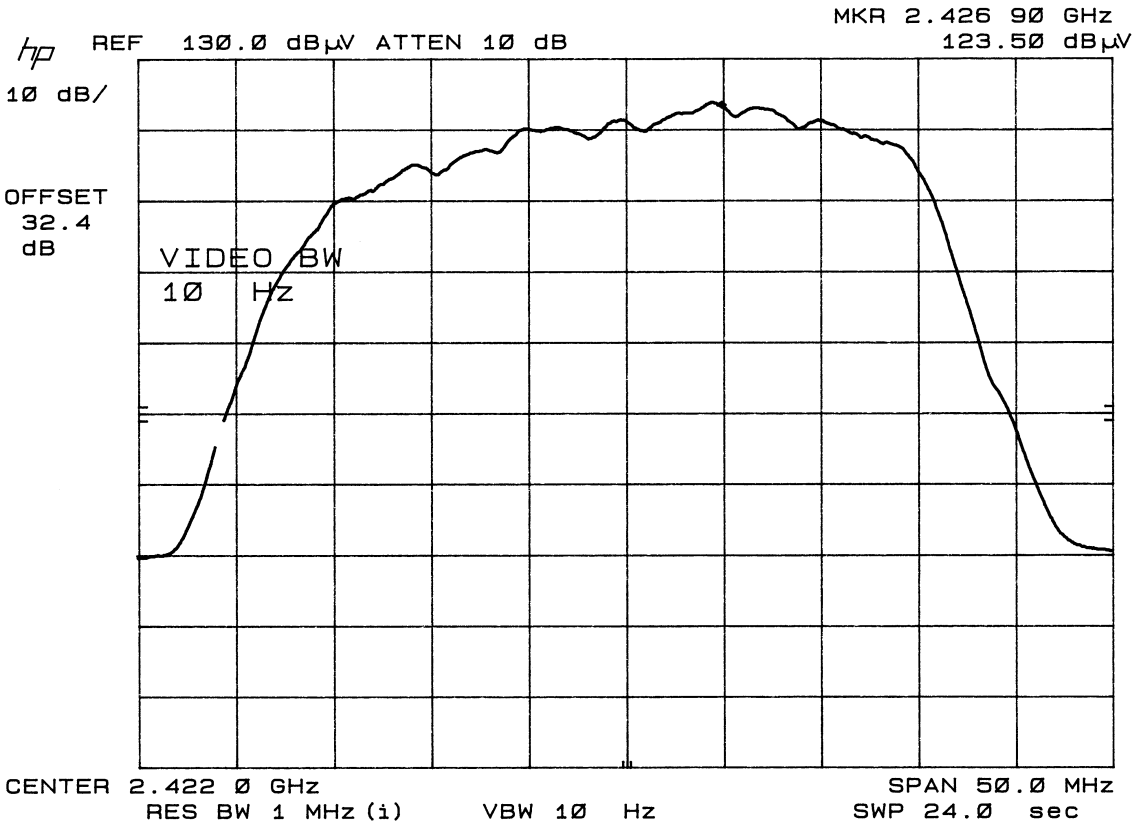



**Figure 3.5 - 20 Telex Wireless Solid Parabolic (M/N: 2440-24V) 20.0 dBi - Average Plot**

Parabolic Dish Antenna: Radiated Emission Test

The following two plots show the horizontal and vertical emissions of the EUT within the restricted band 2.4835 – 2.5 GHz. The EUT was set for frequency plan B. The analyzer was set for average detection. A bandpass filter was used to pass 2.48 – 2.6 GHz allowing the measurements to be made without overloading the analyzer.

Calculation of field strength in restricted band:
FS = RR + CL + IL + AF – PA
Where: FS is the Field Strength in dB (μV/m)
RR is the receiver reading in dB (μV), 25.0
CL is the cable loss in dB, 2.0
IL is the insertion loss of the band pass filter in dB, 3.0
AF is the antenna factor in dB (1/m), 30.9
PA is the gain of the preamplifier in dB, 36.6
FS = 25.0 + 2.0 + 3.0 + 30.9 – 36.6
FS = 24.3 dB (μV/m), which is 29.7 dB below the limit

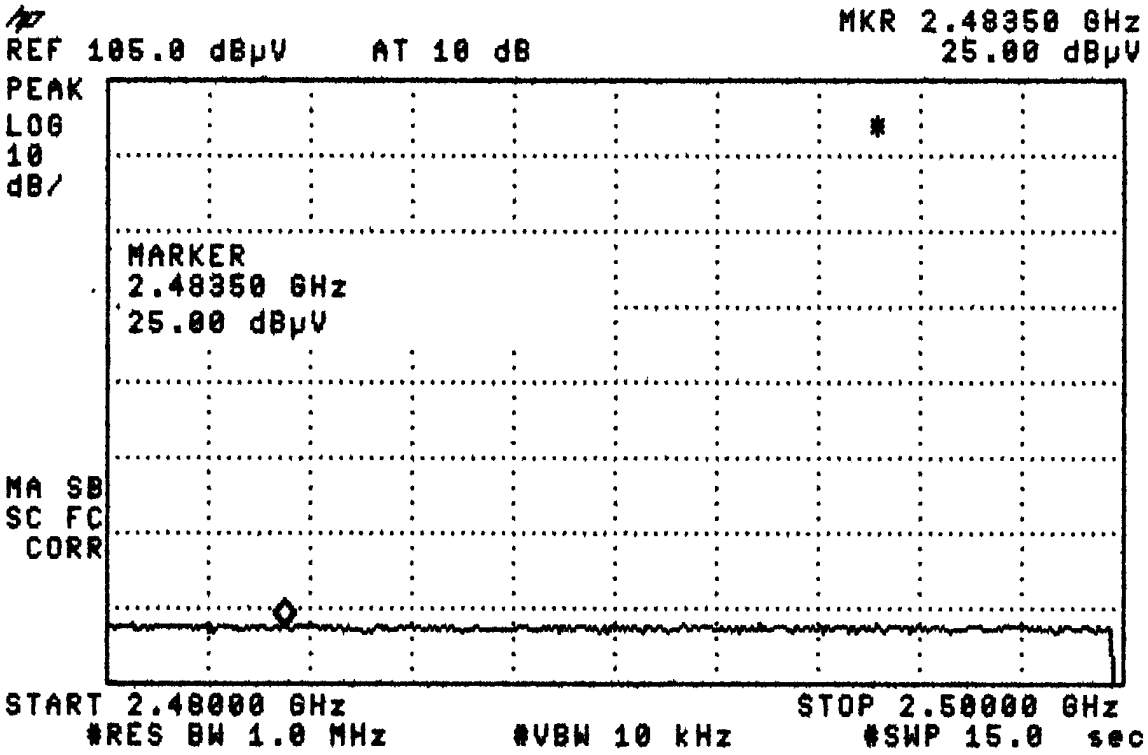



**Figure 3.5 - 21 Telex Wireless Solid Parabolic (M/N:2440-24V) 20.0-dBi- Restricted Band, Vertical**

Calculation of field strength in restricted band:

FS = RR + CL + IL + AF – PA

Where: FS is the Field Strength in dB (μV/m)
RR is the receiver reading in dB (μV), 32.4
CL is the cable loss in dB, 2.0
IL is the insertion loss of the band pass filter in dB, 3.0
AF is the antenna factor in dB (1/m), 30.9
PA is the gain of the preamplifier in dB, 36.6

FS = 32.4 + 2.0 + 3.0 + 30.9 – 36.6

FS = 31.7 dB (μV/m), which is 23.3 dB below the limit

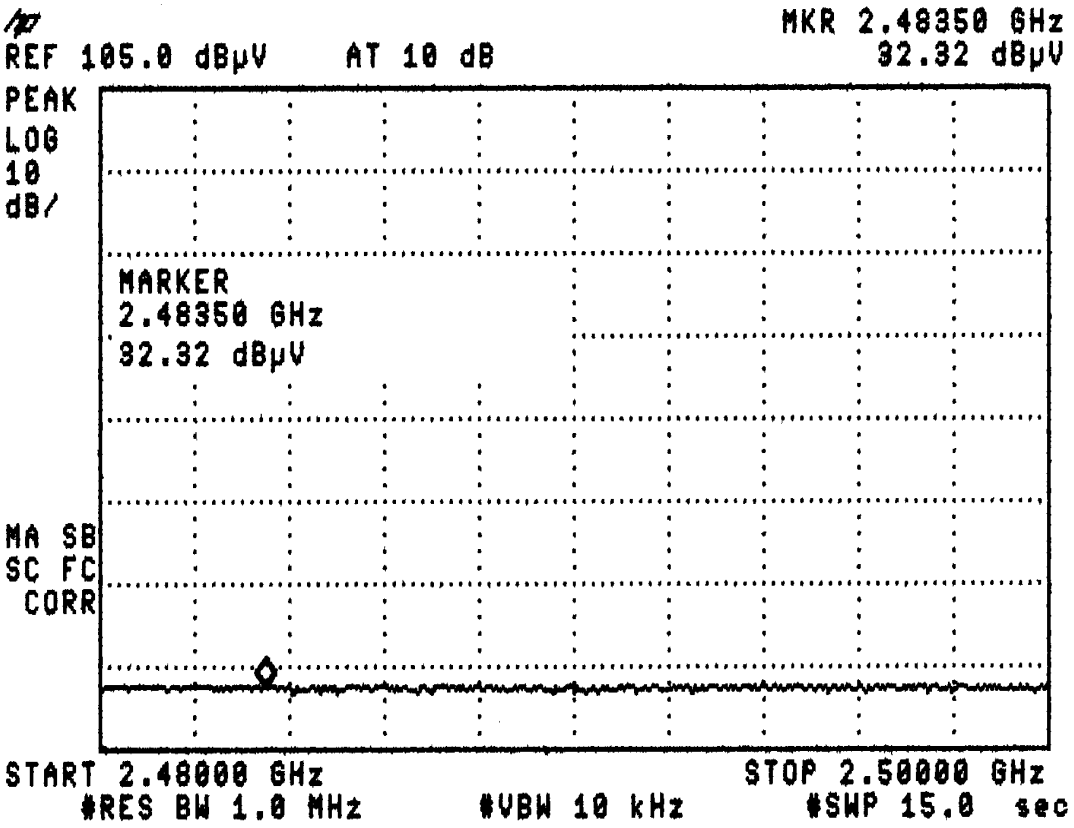



**Figure 3.5 - 22 Telex Wireless Solid Parabolic (M/N:2440-24V) 20.0-dBi – Restricted Band, Horizontal**

The data shown below lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

The Tracer was terminated into a 50 ohm load at the end of a 5' coaxial cable installed on the transmitter section.

**Table 3.5 - 8: Radiated Spurious Emissions, 30 - 1000 MHz**

Company: Adtran
Model: Tracer Rack Mount

Notes: Initial Results
Parabolic Grid Vertically Polarized Plan A
Standard: FCC Part 15

Date: 10/27/98
Tested by: Jeffrey D. Hiday
Test Distance: 3
Job Number: J98030625

Average Readings Class A

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | Distance Factor dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|
| V | 50.431 | 31.0 | 9.0 | 1.1 | 16.5 | 10.5 | 14.1 | 39.1 | -25.0 |
| V | 70.011 | 36.5 | 6.6 | 1.2 | 16.7 | 10.5 | 17.1 | 39.1 | -22.0 |
| V | 98.822 | 43.0 | 10.0 | 1.3 | 16.7 | 10.5 | 27.1 | 43.5 | -16.4 |
| V | 100.876 | 37.4 | 10.4 | 1.5 | 16.8 | 10.5 | 22.0 | 43.5 | -21.5 |
| V | 139.985 | 41.7 | 11.4 | 1.5 | 16.9 | 10.5 | 27.2 | 43.5 | -16.3 |
| V | 151.295 | 37.8 | 10.7 | 1.8 | 16.9 | 10.5 | 22.9 | 43.5 | -20.6 |
| V | 209.982 | 37.2 | 9.4 | 2.0 | 17.0 | 10.5 | 21.1 | 43.5 | -22.4 |
| V | 252.157 | 42.8 | 12.3 | 2.2 | 17.0 | 10.5 | 29.8 | 46.5 | -16.7 |
| V | 350.030 | 36.4 | 14.3 | 2.7 | 17.3 | 10.5 | 25.6 | 46.5 | -20.9 |
| V | 403.375 | 34.2 | 15.9 | 2.9 | 17.4 | 10.5 | 25.1 | 46.5 | -21.4 |
| V | 419.978 | 37.3 | 16.2 | 2.9 | 17.4 | 10.5 | 28.5 | 46.5 | -18.0 |
| V | 504.373 | 41.0 | 17.1 | 3.4 | 17.3 | 10.5 | 33.7 | 46.5 | -12.8 |
| V | 554.853 | 36.6 | 18.1 | 3.4 | 17.3 | 10.5 | 30.3 | 46.5 | -16.2 |
| V | 605.278 | 36.9 | 18.0 | 3.8 | 17.3 | 10.5 | 30.9 | 46.5 | -15.6 |
| V | 655.720 | 41.6 | 18.6 | 3.9 | 17.0 | 10.5 | 36.6 | 46.5 | -9.9 |
| V | 706.163 | 37.9 | 19.4 | 4.2 | 16.7 | 10.5 | 34.3 | 46.5 | -12.2 |
| V | 910.065 | 37.8 | 20.7 | 5.2 | 16.6 | 10.5 | 36.6 | 46.5 | -9.9 |
| H | 554.770 | 30.9 | 18.1 | 3.4 | 17.3 | 10.5 | 24.6 | 46.5 | -21.9 |
| H | 605.258 | 28.5 | 18.0 | 3.8 | 17.3 | 10.5 | 22.5 | 46.5 | -24.0 |
| H | 655.670 | 35.8 | 18.6 | 3.9 | 17.0 | 10.5 | 30.8 | 46.5 | -15.7 |
| H | 706.105 | 33.1 | 19.4 | 4.2 | 16.7 | 10.5 | 29.5 | 46.5 | -17.0 |
| H | 910.215 | 33.7 | 20.7 | 5.2 | 16.6 | 10.5 | 32.5 | 46.5 | -14.0 |

The data shown below lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

The Tracer was terminated into a 50 ohm load at the end of a 5' coaxial cable installed on the transmitter section.

**Table 3.5 - 9: Radiated Spurious Emissions, 1000 - 22000 MHz**

Company: Adtran
Model: Tracer Rack Mount

Date: 12/11/98
Tested by: Candy L. Campbell
Test Distance: 3
Job Number:

Notes: Initial Results
Tx into 50 ohm load
Standard: FCC Part 15

Average Readings Class B

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | External Atten. dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|
| V | 1050.000 | 36.7 | 25.9 | 1.3 | 38.1 | 20.0 | 45.8 | 54.0 | -8.2 |
| V | 1190.000 | 33.4 | 26.2 | 1.3 | 37.5 | 20.0 | 43.3 | 54.0 | -10.7 |
| V | 1260.000 | 29.0 | 26.3 | 1.3 | 37.4 | 20.0 | 39.2 | 54.0 | -14.8 |
| V | 2470.000 | 33.1 | 30.2 | 2.1 | 36.8 | 20.0 | 48.6 | 93.9 | -45.4 |
| H | 1050.000 | 25.7 | 25.9 | 1.3 | 38.1 | 20.0 | 34.8 | 54.0 | -19.2 |
| H | 1190.000 | 31.0 | 26.2 | 1.3 | 37.5 | 20.0 | 41.0 | 54.0 | -13.0 |
| H | 1260.000 | 27.6 | 26.3 | 1.3 | 37.4 | 20.0 | 37.8 | 54.0 | -16.2 |
| H | 2462.000 | 29.9 | 30.2 | 2.1 | 36.8 | 20.0 | 45.4 | 93.9 | -48.5 |

Peak Readings Class B

| Antenna Polarity | Frequency MHz | Receiver Amplitude dB(uV) | Antenna Factor dB(1/m) | Cable Loss dB | Pre-amp Factor dB | External Atten. dB | Net dB(uV/m) | Limit dB(uV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|
| V | 1050.000 | 38.5 | 25.9 | 1.3 | 38.1 | 20.0 | 47.6 | 74.0 | -26.4 |
| V | 1190.000 | 36.3 | 26.2 | 1.3 | 37.5 | 20.0 | 46.3 | 74.0 | -27.7 |
| V | 1260.000 | 32.7 | 26.3 | 1.3 | 37.4 | 20.0 | 42.9 | 74.0 | -31.1 |
| V | 2470.000 | 39.8 | 30.2 | 2.1 | 36.8 | 20.0 | 55.3 | 113.9 | -58.6 |
| H | 1050.000 | 29.4 | 25.9 | 1.3 | 38.1 | 20.0 | 38.5 | 74.0 | -35.5 |
| H | 1190.000 | 33.6 | 26.2 | 1.3 | 37.5 | 20.0 | 43.6 | 74.0 | -30.4 |
| H | 1260.000 | 30.8 | 26.3 | 1.3 | 37.4 | 20.0 | 41.0 | 74.0 | -33.0 |
| H | 2462.000 | 37.6 | 30.2 | 2.1 | 36.8 | 20.0 | 53.1 | 113.9 | -60.8 |

## 3.6 AC Power Line-Conducted Emissions

For AC powered devices, line-conducted emissions testing is performed based on the requirements in §15.207.

**Table 3.6 - 2: Power Line Conducted Emissions**

Company: Adtran Date: 10/29/98
Model: Tracer Rack Mount Tested by: Mark A. Severson
Umec brand Ac adapter Model UP0351A-24P SN: 9503 ›b Number: J98030625
Notes: Initial Results

Standard: FCC Part 15
Class B

Quasi-Peak Readings

| Frequency MHz | Reading Side A dB(uV) | Reading Side B dB(uV) | Attenuator Factor dB | Net dB(uV) | QP Limit dB(uV) | Margin dB |
|---|---|---|---|---|---|---|
| 0.493 | 23.5 | 21.9 | 10.0 | 33.5 | 48.0 | -14.5 |
| 4.093 | 29.6 | 29.0 | 10.0 | 39.6 | 48.0 | -8.4 |
| 4.911 | 27.1 | 29.2 | 10.0 | 39.2 | 48.0 | -8.8 |
| 6.221 | 28.4 | 29.4 | 10.0 | 39.4 | 48.0 | -8.6 |
| 6.384 | 28.7 | 28.9 | 10.0 | 38.9 | 48.0 | -9.1 |
| 29.034 | 21.0 | 21.4 | 10.0 | 31.4 | 48.0 | -16.6 |

For AC powered devices, line-conducted emissions testing is performed based on the requirements in §15.207.

**Table 3.6 - 3: Power Line Conducted Emissions**

Company: Adtran
Model: Tracer Rack Mount
El Pac brand Ac adapter Model W4024 SN: 0600
Notes: Initial Results

Date: 10/29/98
Tested by: Mark A. Severson
Job Number: J98030625

Standard: FCC Part 15
Class B

Quasi-Peak Readings

| Frequency MHz | Reading Side A dB(uV) | Reading Side B dB(uV) | Attenuator Factor dB | Net dB(uV) | QP Limit dB(uV) | Margin dB |
|---|---|---|---|---|---|---|
| 0.493 | 21.0 | 24.7 | 10.0 | 34.7 | 48.0 | -13.3 |
| 4.437 | 30.2 | 26.8 | 10.0 | 40.2 | 48.0 | -7.8 |
| 5.005 | 30.1 | 26.5 | 10.0 | 40.1 | 48.0 | -7.9 |
| 6.481 | 29.2 | 29.1 | 10.0 | 39.2 | 48.0 | -8.8 |
| 24.113 | 24.4 | 23.1 | 10.0 | 34.4 | 48.0 | -13.6 |
| 30.000 | 9.9 | 9.8 | 10.0 | 19.9 | 48.0 | -28.1 |

## *3.7 Power Spectral Density, §15.247(d)*

For direct sequence systems, the peak power spectral density conducted from the intentional radiator shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Attached is a plot that shows the power spectral density. This measurement was made with the antenna port of the transmitter directly connected to the spectrum analyzer.

The resolution bandwidth is set to 3 kHz, the span is set to 300 kHz, and the sweep time is 100 seconds. The highest peak measurement for plan A was –2.8 dBm. See Figure 3.7-1 for plot.

The resolution bandwidth is set to 3 kHz, the span is set to 300 kHz, and the sweep time is 100 seconds. The highest peak measurement for plan B was –4.62 dBm. See Figure 3.7-1 for plot.

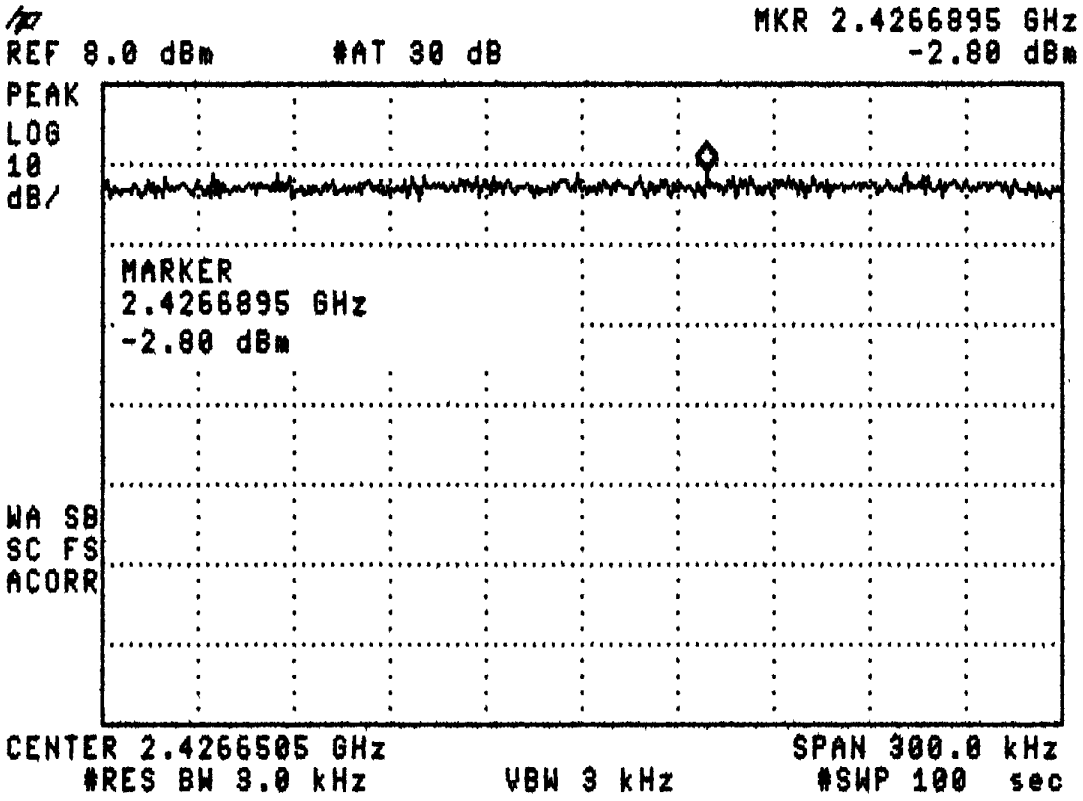



**Figure 3.7 - 1: Power Spectral Density - Plan A**

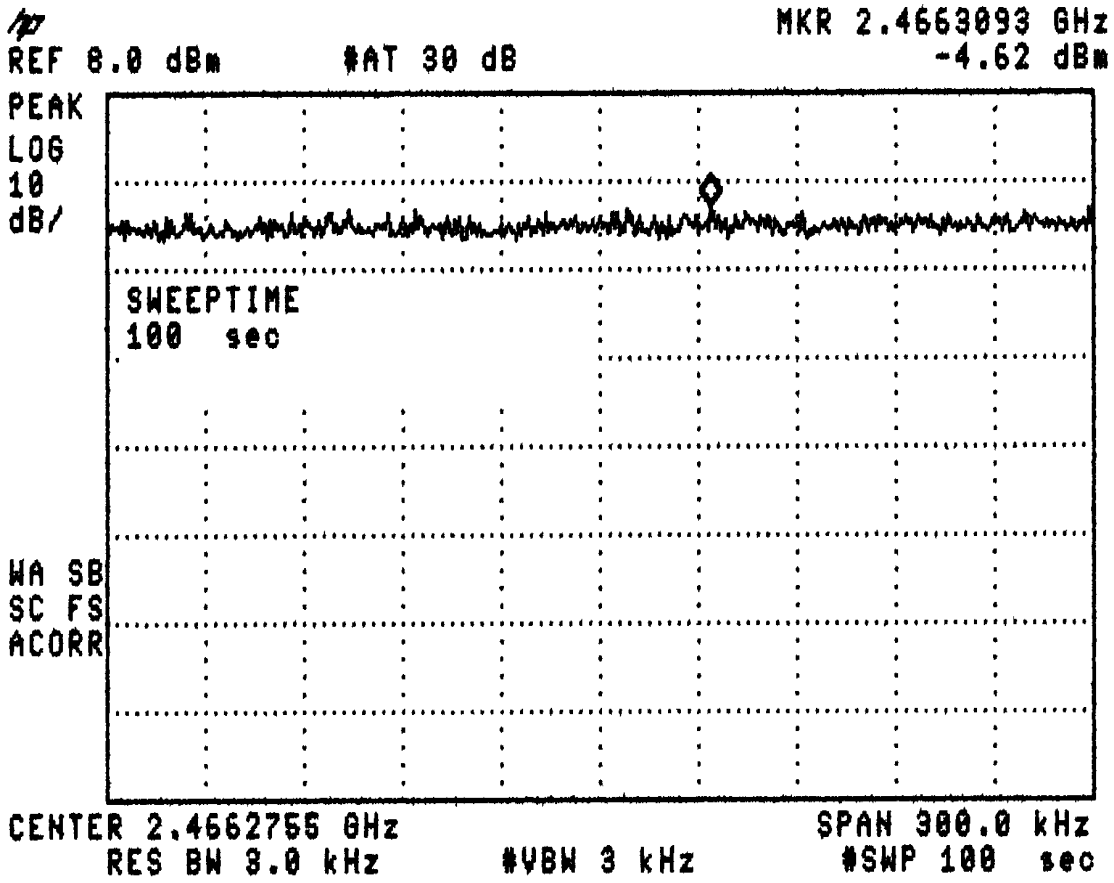



**Figure 3.7 - 1: Power Spectral Density – Plan B**

### *3.8 Radiated and Line-Conducted Emission Configuration Photographs*

**Figure 3.8 - 1: Worst Case Radiated Emission, Front View**

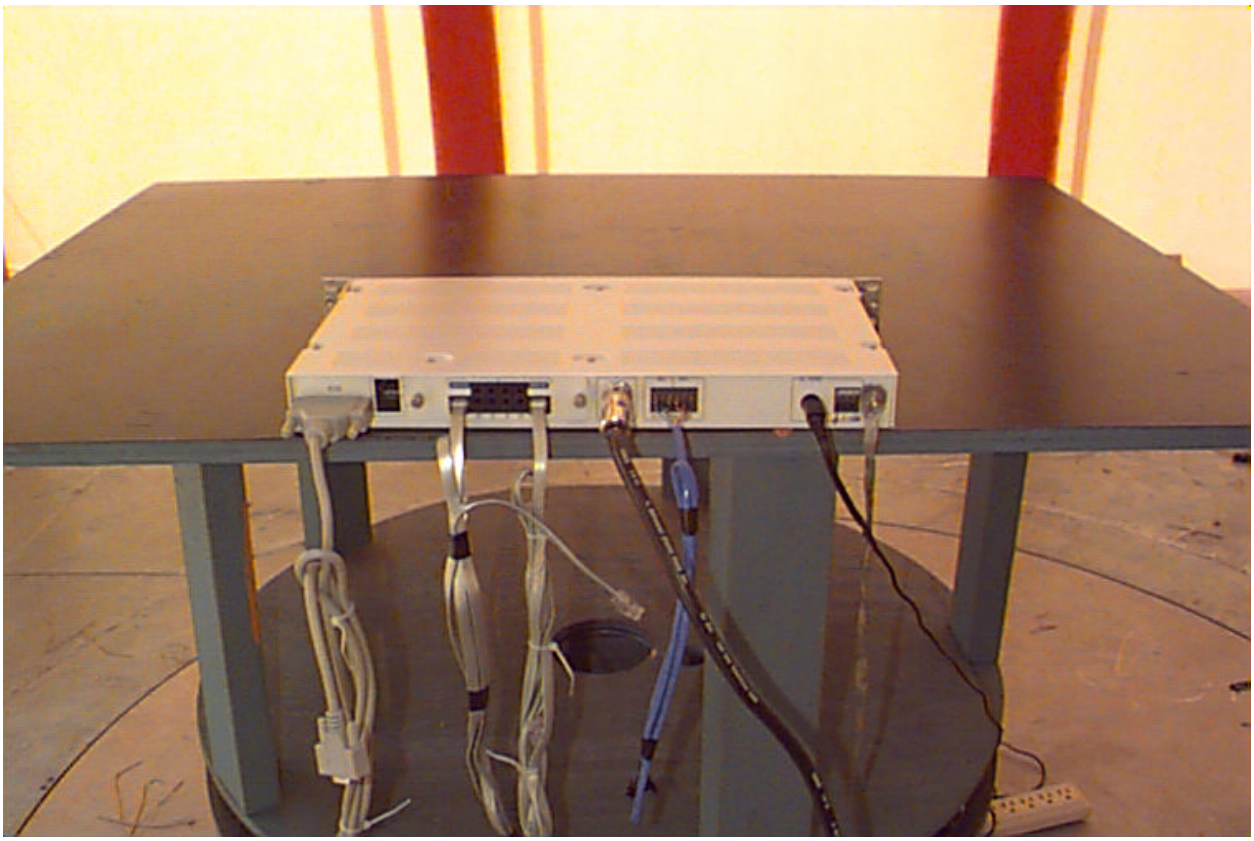


**Figure 3.8 - 2: Worst Case Radiated Emission, Rear View**

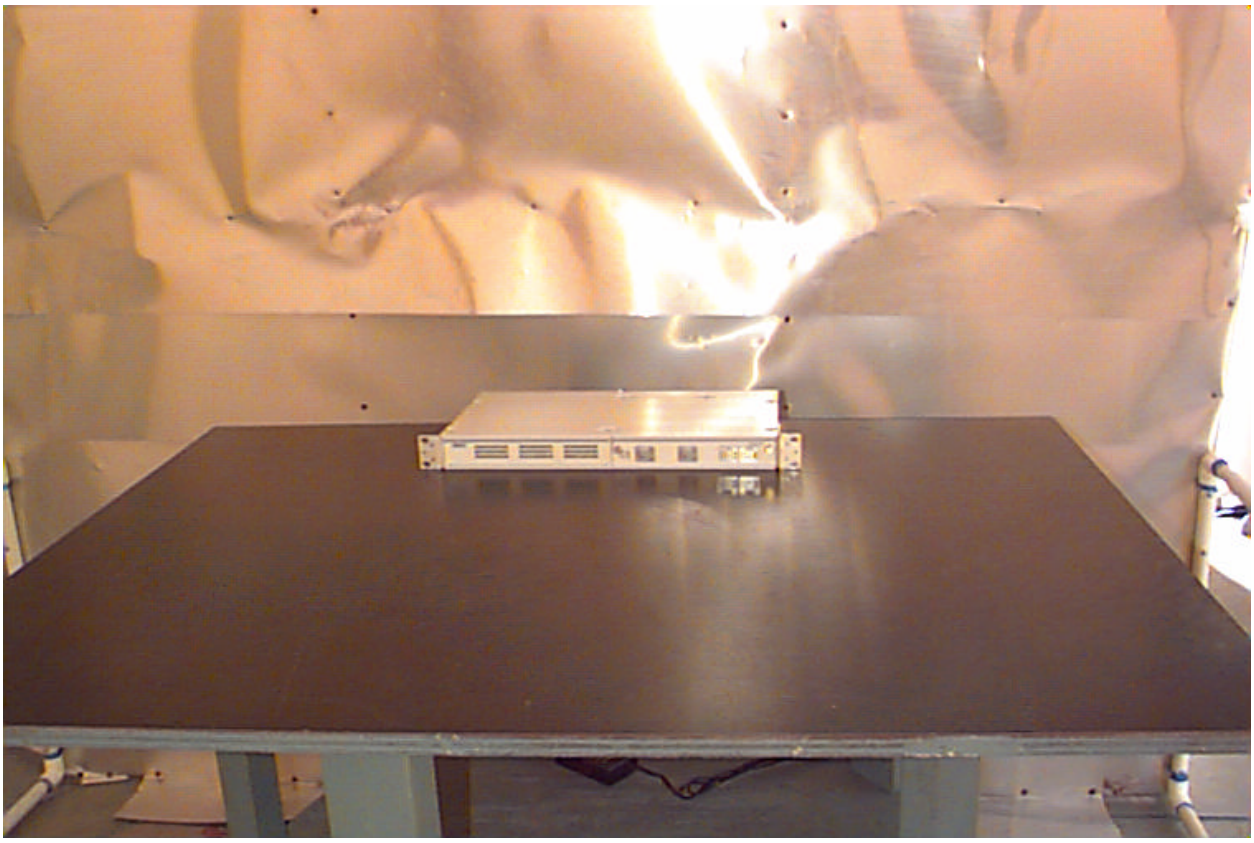


**Figure 3.8 - 3: Worst Case Line-Conducted Emission, Front View**

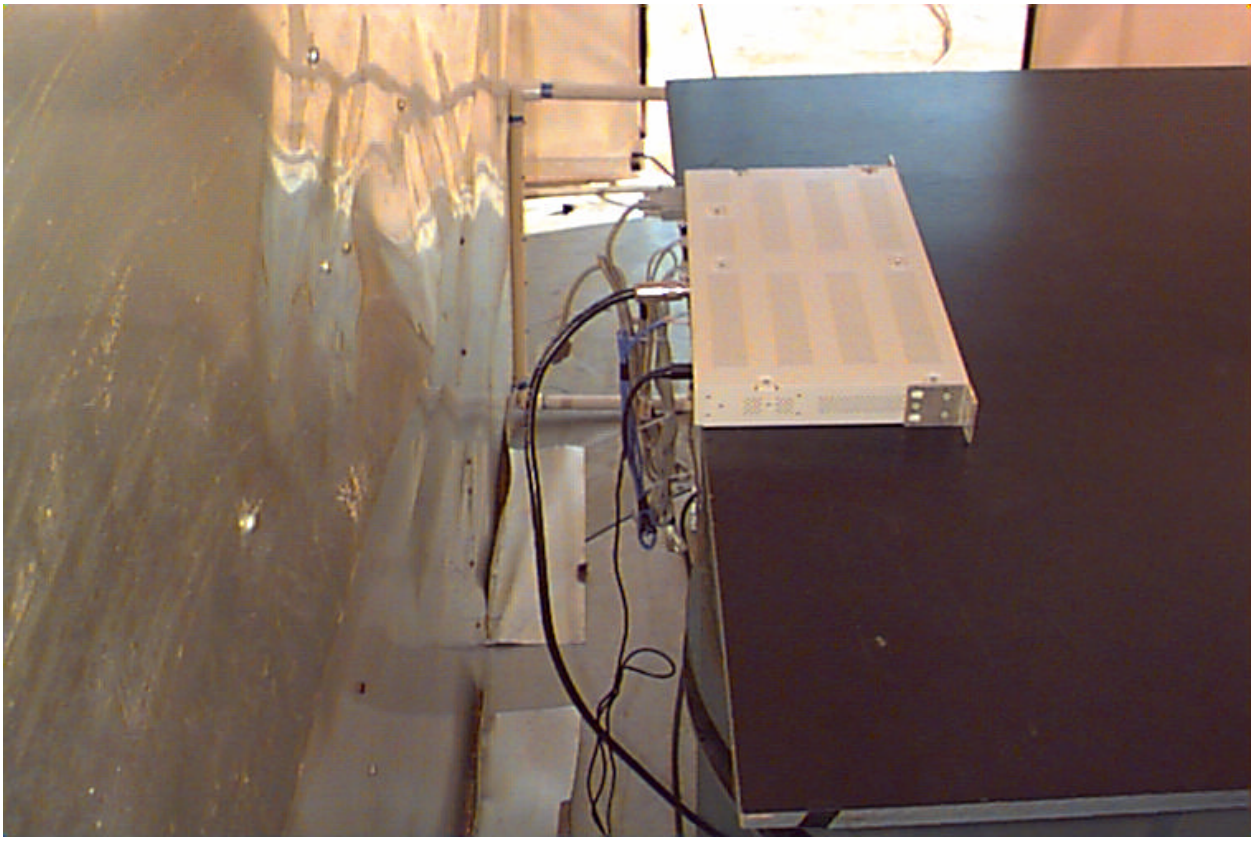


**Figure 3.8 - 4: Worst Case Line-Conducted Emission, Rear View**

4317-A Park Drive, NW
Norcross, GA 30093
Phone: 770-925-2444
FAX: 770-925-7294

# 4.0 Miscellaneous Information

This miscellaneous information includes details of the measured bandwidth, the test procedure and calculation of factors such as pulse desensitization and averaging factor.

## *4.1 Discussion of Pulse Desensitization*

The determination of pulse desensitivity was made in accordance with Hewlett Packard Application Note 150-2, *Spectrum Analysis ... Pulsed RF*.

## *4.2 Calculation of Average Factor*

Detector function for radiated emission measurements is peak or quasi-peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings according to the following formula:

Average Factor in dB = 20 LOG (duty cycle)

The time over which the duty cycle is measured is 100 msec. The worst-case (highest percentage on) duty cycle is used and described specifically in the calculation contained in this section. A plot of the worst case duty cycle, if applicable, is also provided in this report.

Note: This EUT has a 100% duty cycle, therefore no correction applies.

**Figure 4.2 - 1: Duty Cycle Plot**

4317-A Park Drive, NW
Norcross, GA 30093
Phone: 770-925-2444
FAX: 770-925-7294

## 4.3 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C rules. The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4:1992.

The transmitter portion of the EUT was mounted in a metal rack, with appropriate antenna mounted on a non-metallic pole. The Baseband processor portion of the EUT was mounted in the metal rack along with the transmitter portion of the EUT. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The antenna height and polarization are also varied during the testing to search for maximum signal levels. The height of the antenna is varied from one to four meters.

For small, battery powered transmitters, the transmitter is attached to a cardboard box and placed in each of it orthogonal axis during the procedure described above.

Detector function for radiated emissions is in quasi-peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in Exhibit 8.2. Alternatively, the average detector of the receiver may be used. The method of measurement is indicated in the data tables.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower. For line conducted emissions, the range scanned is 450 kHz to 30 MHz.

The EUT is warmed up for 15 minutes prior to the test. AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

Conducted measurements were made as described in ANSI C63.4:1992. An IF bandwidth of 9 kHz is used, and quasi-peak detection is employed.

The IF bandwidth used for measurement of radiated signal strength was 120 kHz or greater below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report (See Exhibit 8.1). Above 1000 MHz, a resolution bandwidth of 1 MHz is used.

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise-floor in the forbidden bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.