



FCC Certification Test Report
for
ADTRAN, Inc.
HDCTRC4103

October 11, 2001

Prepared for:

ADTRAN, Inc.
901 Explorer Blvd
Huntsville, AL 35806

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879



FCC Certification Test Report
for the
ADTRAN, Inc.
TRACER 4103 Spread Spectrum Transceiver
HDCTRC4103

WLL JOB# 6422

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Abstract

This report has been prepared on behalf of ADTRAN, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Spread Spectrum Transceiver under Part 15.247 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for an ADTRAN, Inc. TRACER 4103 Spread Spectrum Transceiver.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The ADTRAN, Inc. TRACER 4103 Spread Spectrum Transceiver complies with the limits for a Spread Spectrum Transceiver device under Part 15.247 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The ADTRAN, Inc. TRACER 4103 Spread Spectrum System complies with the limits for a Spread Spectrum Transceiver device under Part 15.247 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	ADTRAN, Inc. 901 Explorer Blvd Huntsville, AL 35806
Purchase Order Number:	414394
Quotation Number:	59077

1.4 Test Dates

Testing was performed from August 3, 2001 to August 28, 2001.

1.5 Test and Support Personnel

Washington Laboratories, LTD	John Lam, Mike Violette
Customer Representative	Derek Foster

1.6 Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
cm	centimeter
CW	Continuous Wave
dB	decibel
dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
k	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
m	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification & Description

The TRACER 4103 provides dual T1 transport by way of spread spectrum microwave link for distance up to 20 miles. TRACER 4103 operates in the 2.400 to 2.4835 ISM band using direct sequence spread spectrum transmission. Each end of the TRACER 4103 link is composed of a single TRACER 4103 unit. The single unit is composed of the baseband processor and the microwave receiver and transmitter. Two DS1/DSX-1 (T1) interfaces are provided on the rear of the TRACER 4103 unit. The TRACER 4103 is typically mounted in a standard 19 inch rack. The DS1/DSX-1 interface provides connections up to 6000 feet from the T1 equipment. There is also a type N connector that connects the antenna to the unit.

The TRACER 4103 can be used in data communications such as inter-networking, video conferencing and telemetry.

The ADTRAN Part Number is 1280TRC242T1R1A/B.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	ADTRAN, Inc.
FCC ID Number	HDCTRC4103
EUT Name:	Spread Spectrum Transceiver
Model:	TRACER 4103
FCC Rule Parts:	§15.247
Frequency Range:	2422 MHz and 2462 MHz
Maximum Output Power:	20 dBm
Modulation:	Direct Sequence Spread Spectrum
Necessary Bandwidth:	N/A
Keying:	Automatic
Type of Information:	Data
Number of Channels:	2
Power Output Level	Fixed
Antenna Type	Dish Yagi Omni "patch" antenna
Frequency Tolerance:	N/A ppm %
Emission Type(s):	N/A
Interface Cables:	None
Power Source & Voltage:	21 to 60 Vdc

The TRACER 4103 contains the following sources:

Frequency (MHz)	Description
12.0	TCXO, reference oscillator for VCOs
280.0	TCXO, reference oscillator for modulator and demodulator
2142	LO, TX Channel A
2182	LO, TX Channel B
2282	LO, RX Channel A
2322	LO, RX Channel B
280	TX IF
140	RX IF
2422	TX output, Channel A
2462	TX output, Channel B
14.7456	Microprocessor clock oscillator
50.4320	Data Clock

2.2 Test Configuration

The EUT was configured with an external power adapter, loopback connections on Channels A and B, unshielded wires connected to the alarm I/O, and a 50 Ohm coaxial cable connected to the antenna port.

The EUT firmware was set up to provide continuous random data for Direct Sequence modulation to the output connector.

Two channels are available: "A" and "B". The channels were changed by swapping an internal cable on the transmit module.

2.3 Testing Algorithm

The TRACER 4103 was operated continuously by firmware test sequence that provided a modulated RF data stream to the output port.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The measurement uncertainty of the data contained herein is ± 2.3 dB.

For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is $\pm$ dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, total uncertainty = $0.5 (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Results

3.1 Peak Power Output

For DSSS devices, the peak output power from the intentional radiator to the antenna shall not be greater than 1 watt.

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system.

The carrier was modulated internally via firmware that provided loop-back data to the rear-panel T1 connectors.

The peak power measured:

Channel A: 20.2dBm

Channel B: 19.9dBm

3.2 Power Spectral Density

For DSSS devices, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band.

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system.

The carrier was modulated internally via firmware that provided loop-back data to the rear-panel T1 connectors.

Table 2. Power Spectral Density

Frequency	Level	Limit	Pass/Fail
Channel A 2422 MHz	-3.0 dBm	8 dBm	Pass
Channel B 2462 MHz	-2.8 dBm	8 dBm	Pass

3.3 Occupied Bandwidth

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

For Direct Sequence Spread Spectrum Systems, FCC Part 15.247 requires that the minimum 6 dB bandwidth be at least 500 kHz.

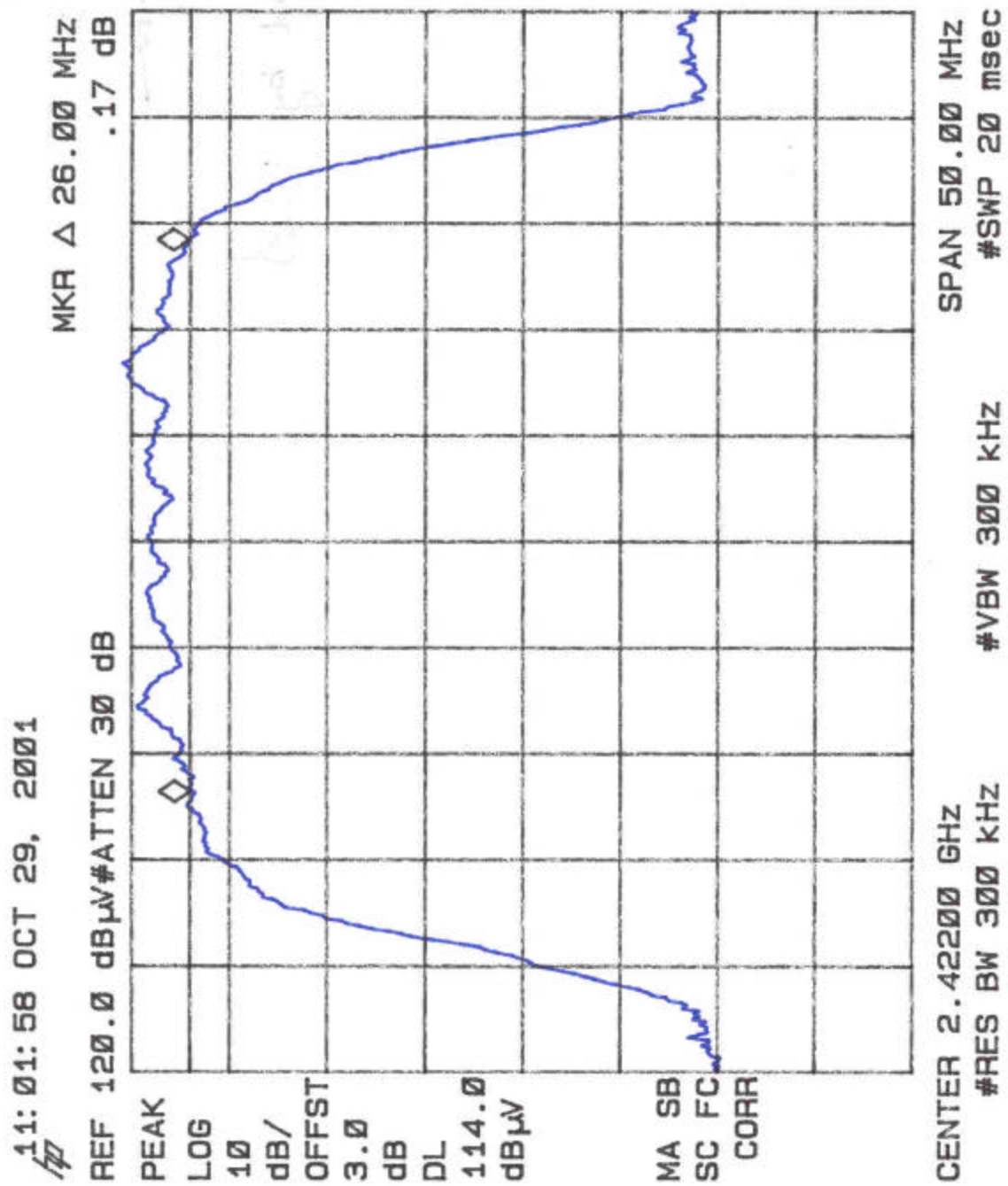


Figure 1. Occupied Bandwidth Channel A

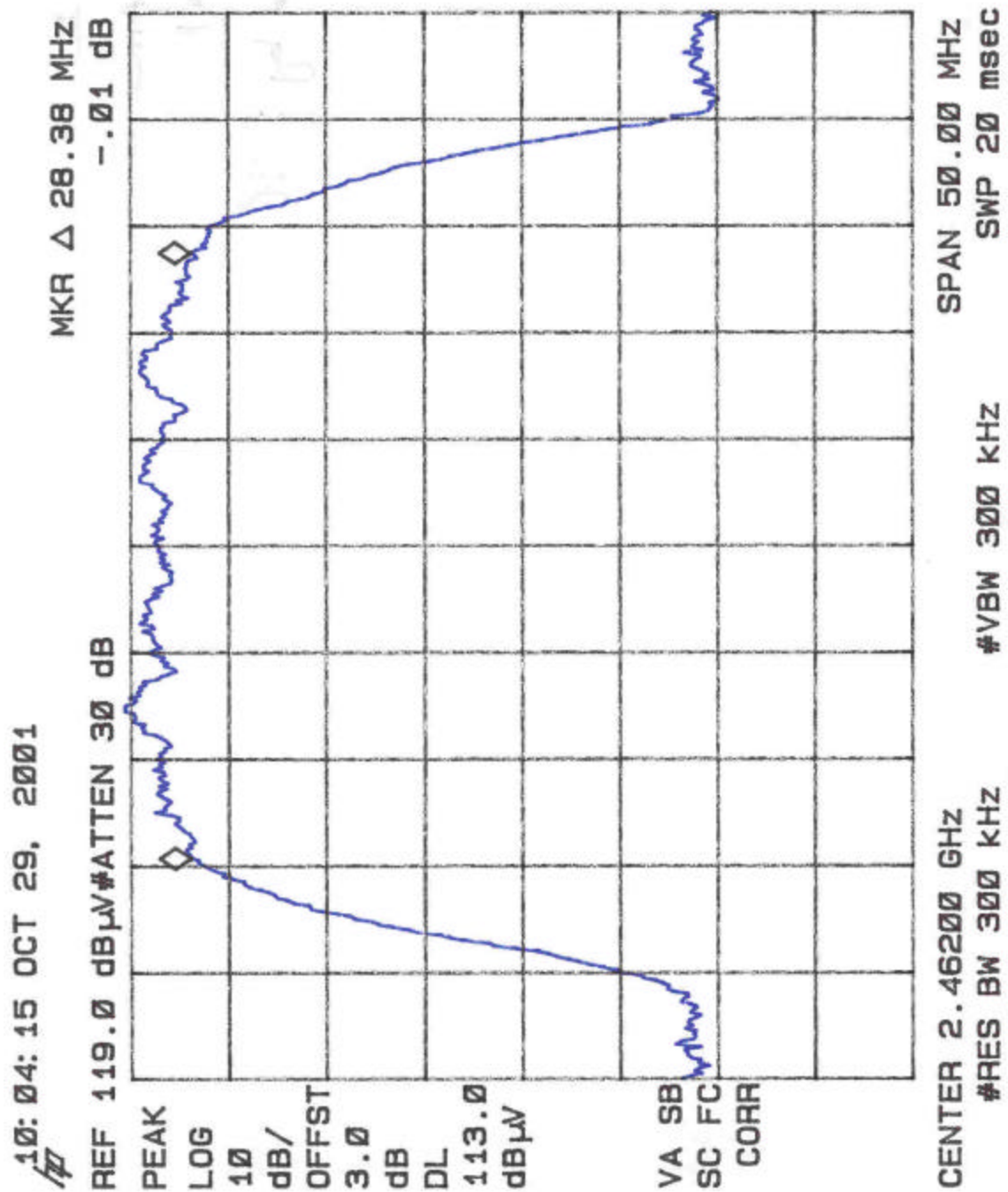


Figure 2. Occupied Bandwidth Channel B

Table 3 provides a summary of the Occupied Bandwidth Results.

Table 3. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Channel A 2422 MHz	25.7 MHz	> 500 kHz	Pass
Channel B 2462 MHz	29 MHz	> 500 kHz	Pass

3.4 Spurious Emissions at Antenna Terminals (FCC Part §15.247(b))

In any 100 kHz band outside the frequency band in which the system is operating, the RF power shall be at least 20dB below that in the 100 kHz bandwidth that contain the highest level of the desired power.

See the plots of conducted emissions plots below.

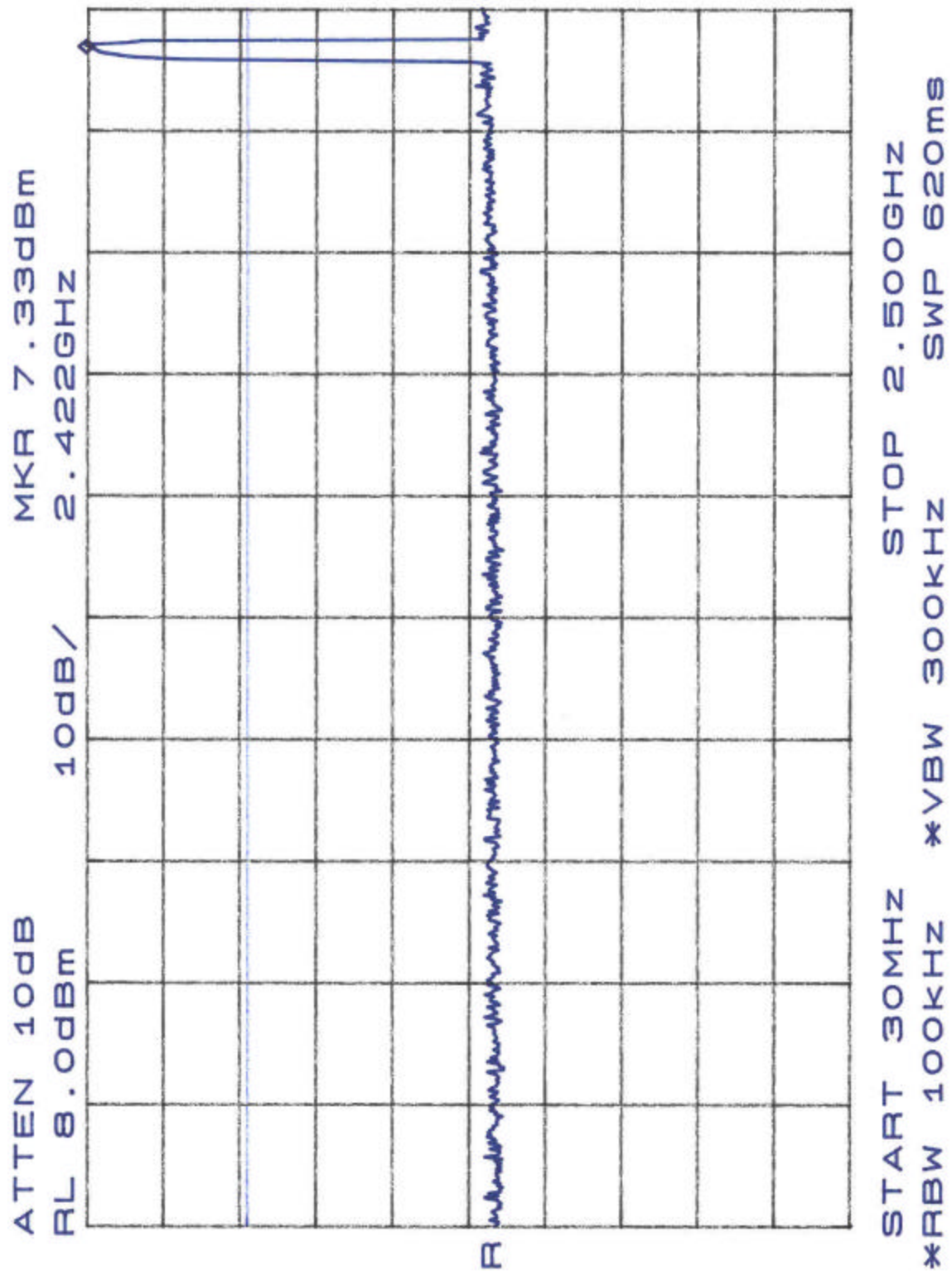


Figure 3. Conducted Spurious Emissions, Channel A, 30M – 2.5GHz

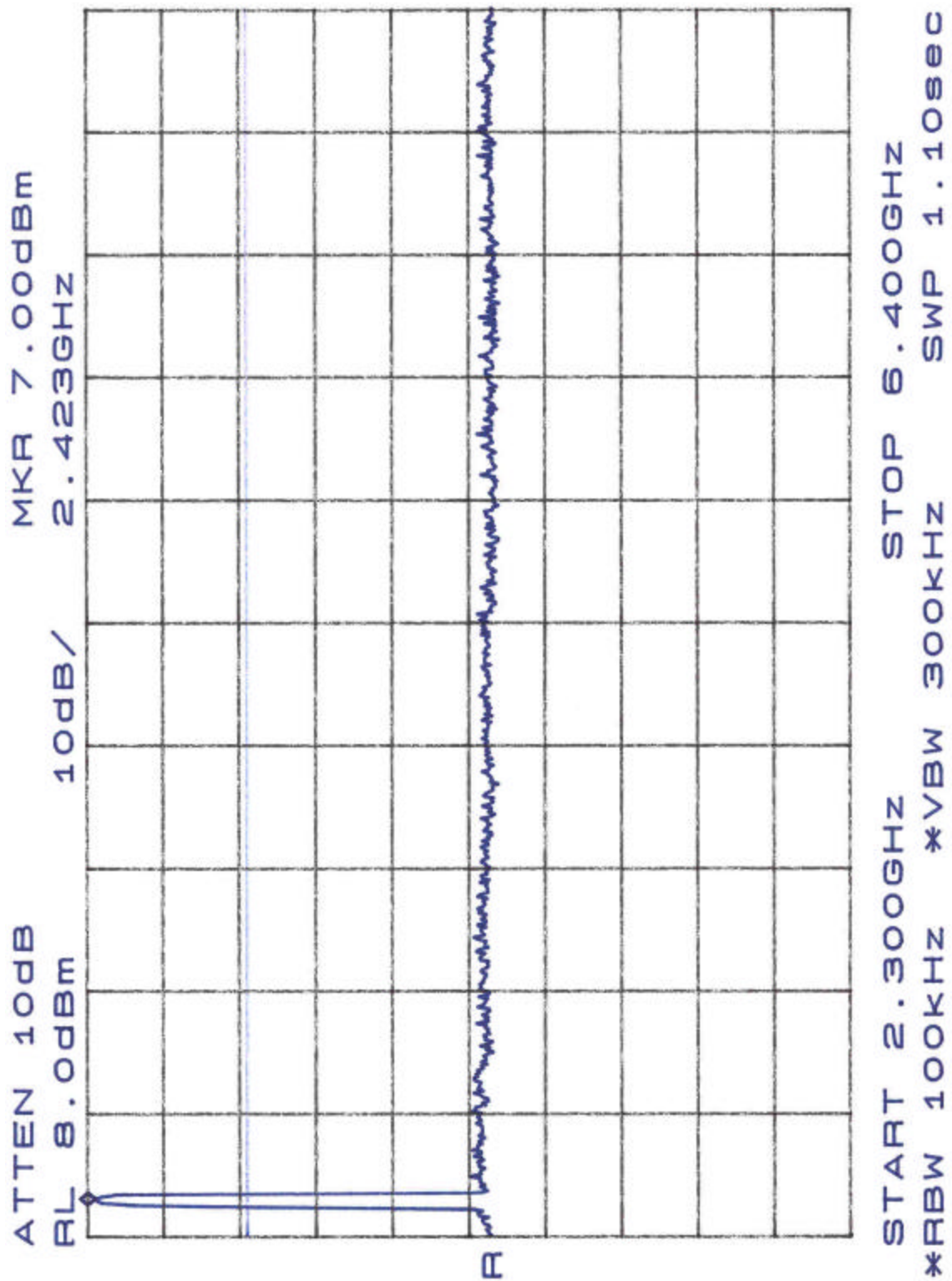


Figure 4. Conducted Spurious Emissions, Channel A, 2.5G – 6.4GHz

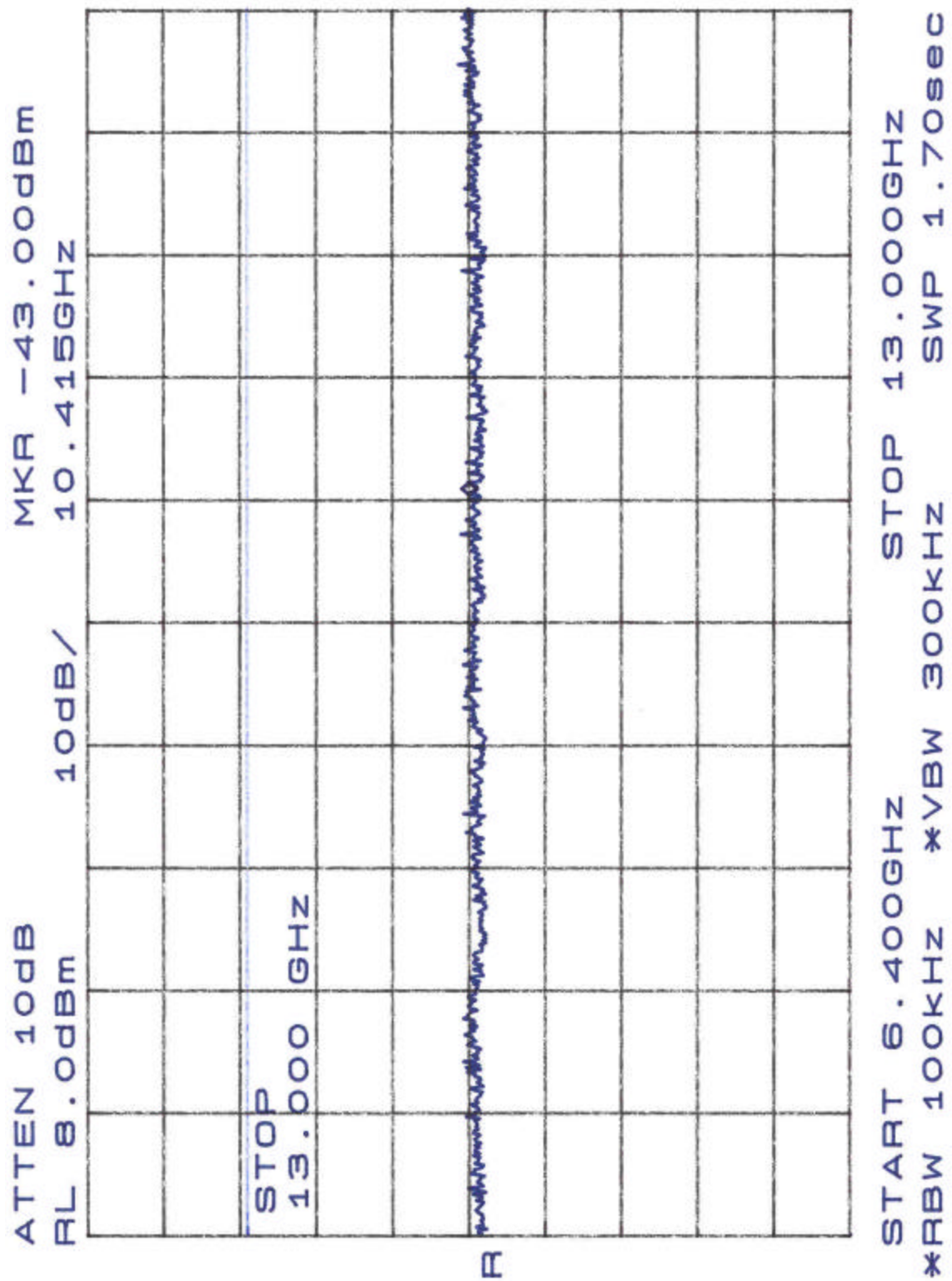


Figure 5. Conducted Spurious Emissions, Channel A, 6.4G – 13GHz

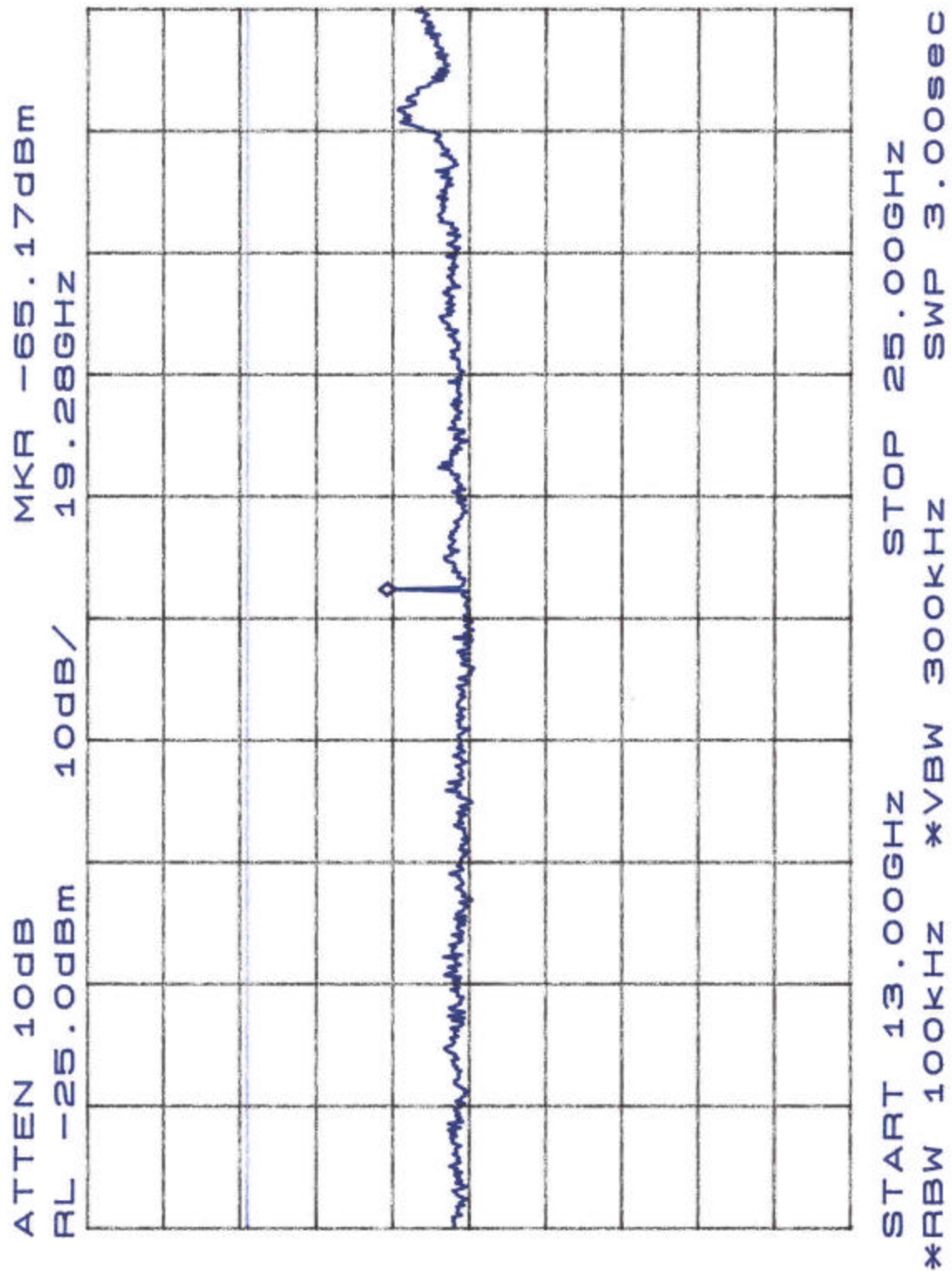


Figure 6. Conducted Spurious Emissions, Channel A, 13G – 25GHz

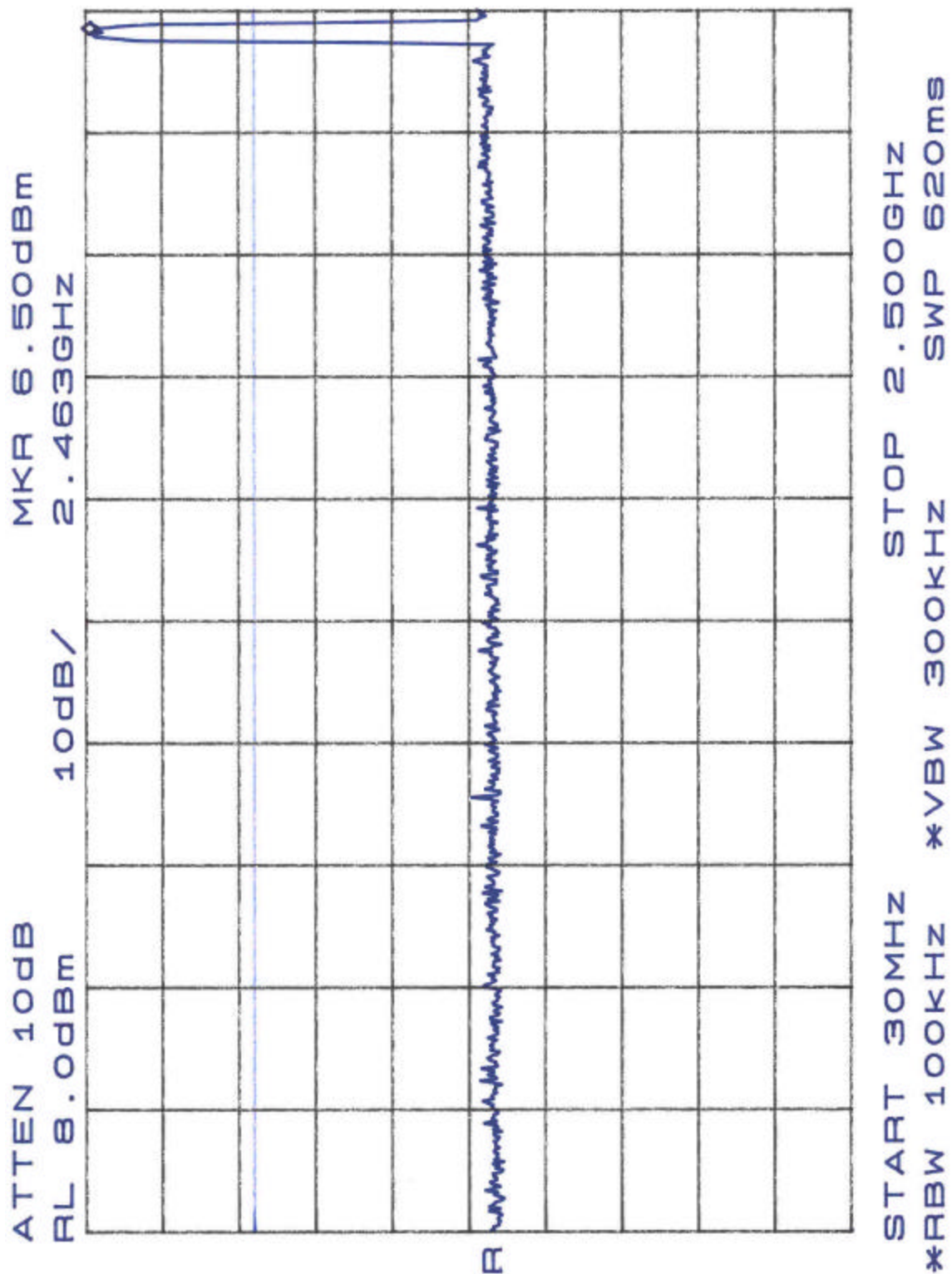


Figure 7. Conducted Spurious Emissions, Channel B, 30M – 2.5GHz

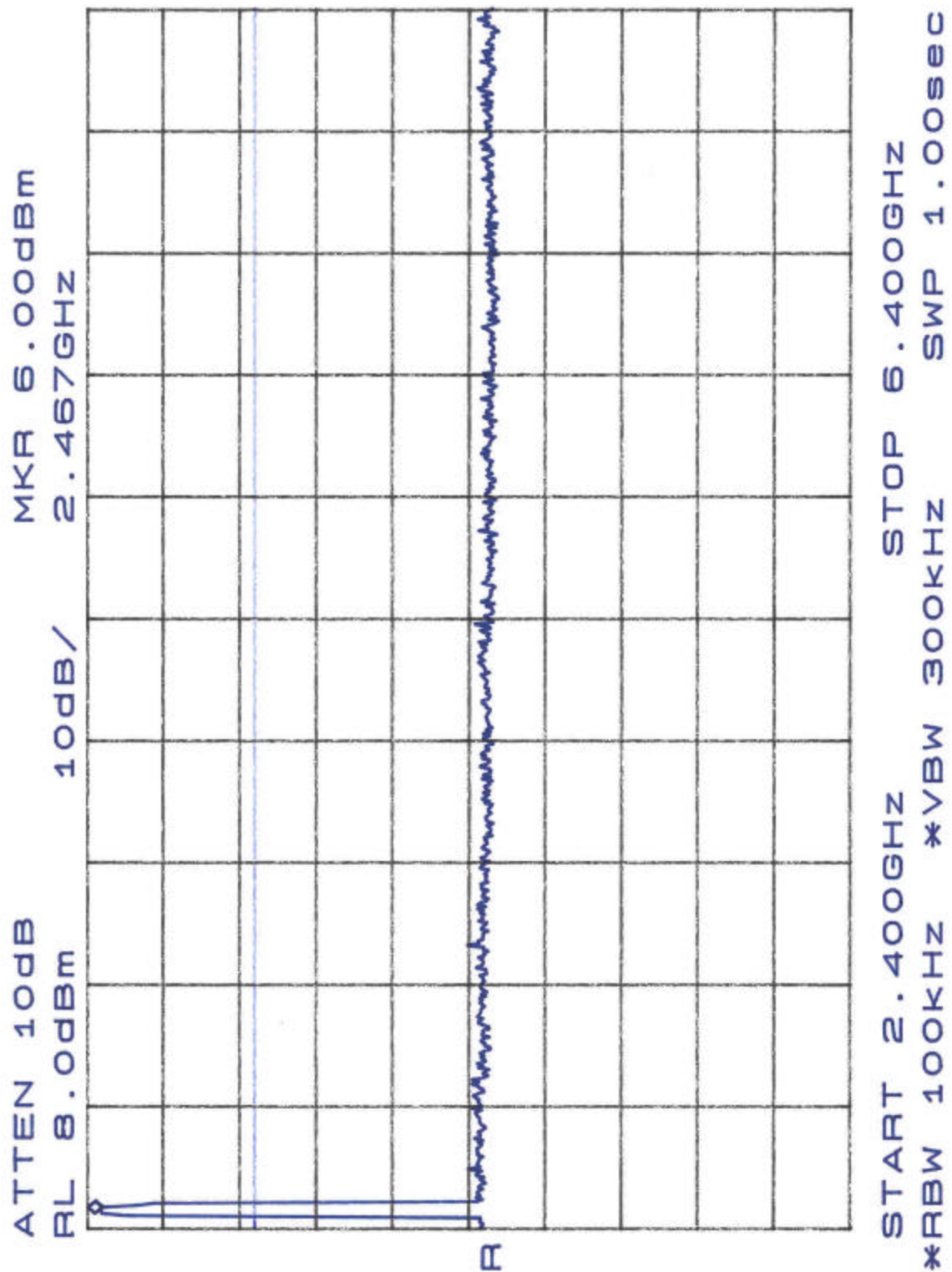


Figure 8. Conducted Spurious Emissions, Channel B, 2.4G – 6.4GHz

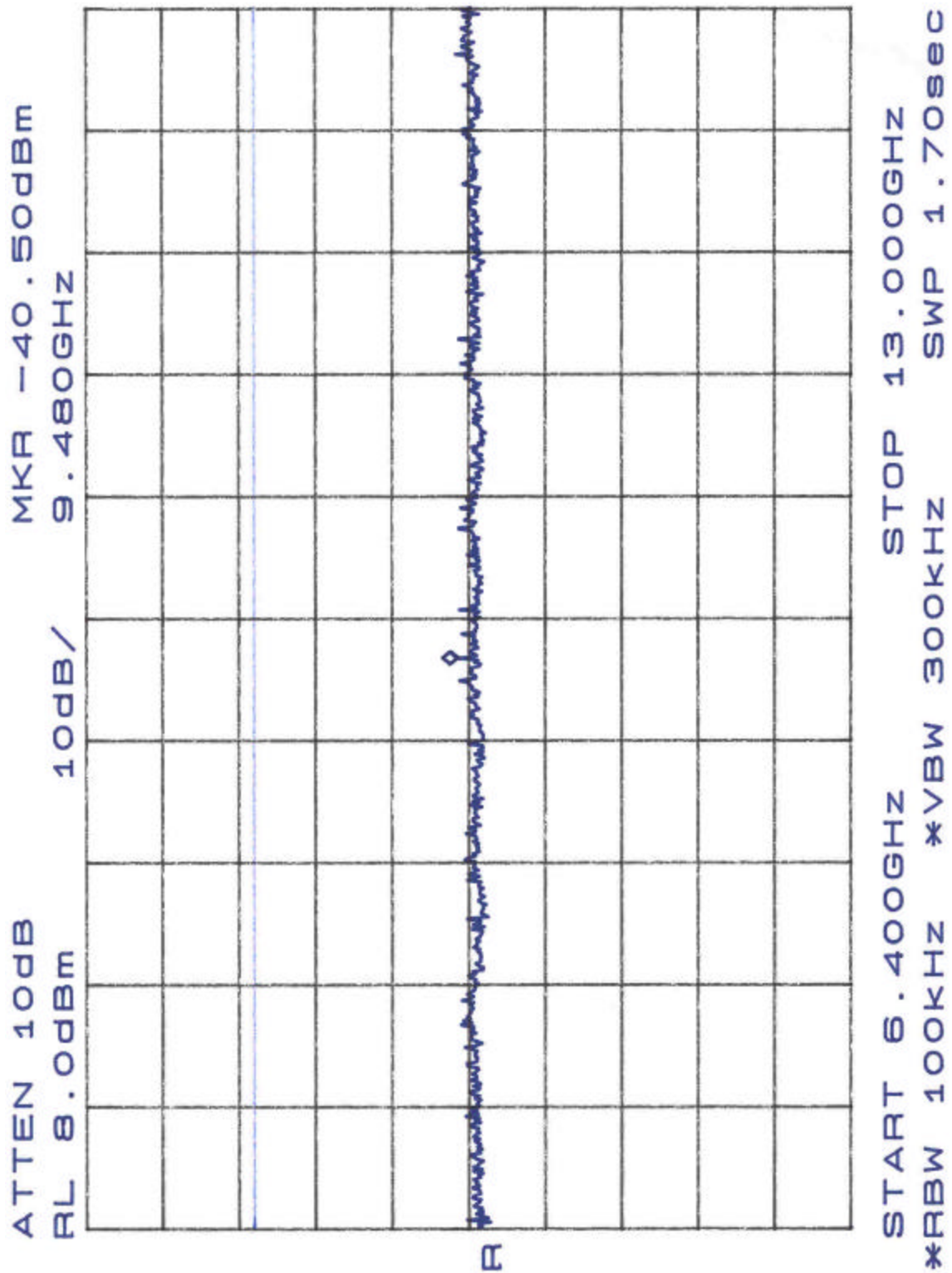


Figure 9. Conducted Spurious Emissions, Channel B, 6.4G – 13GHz

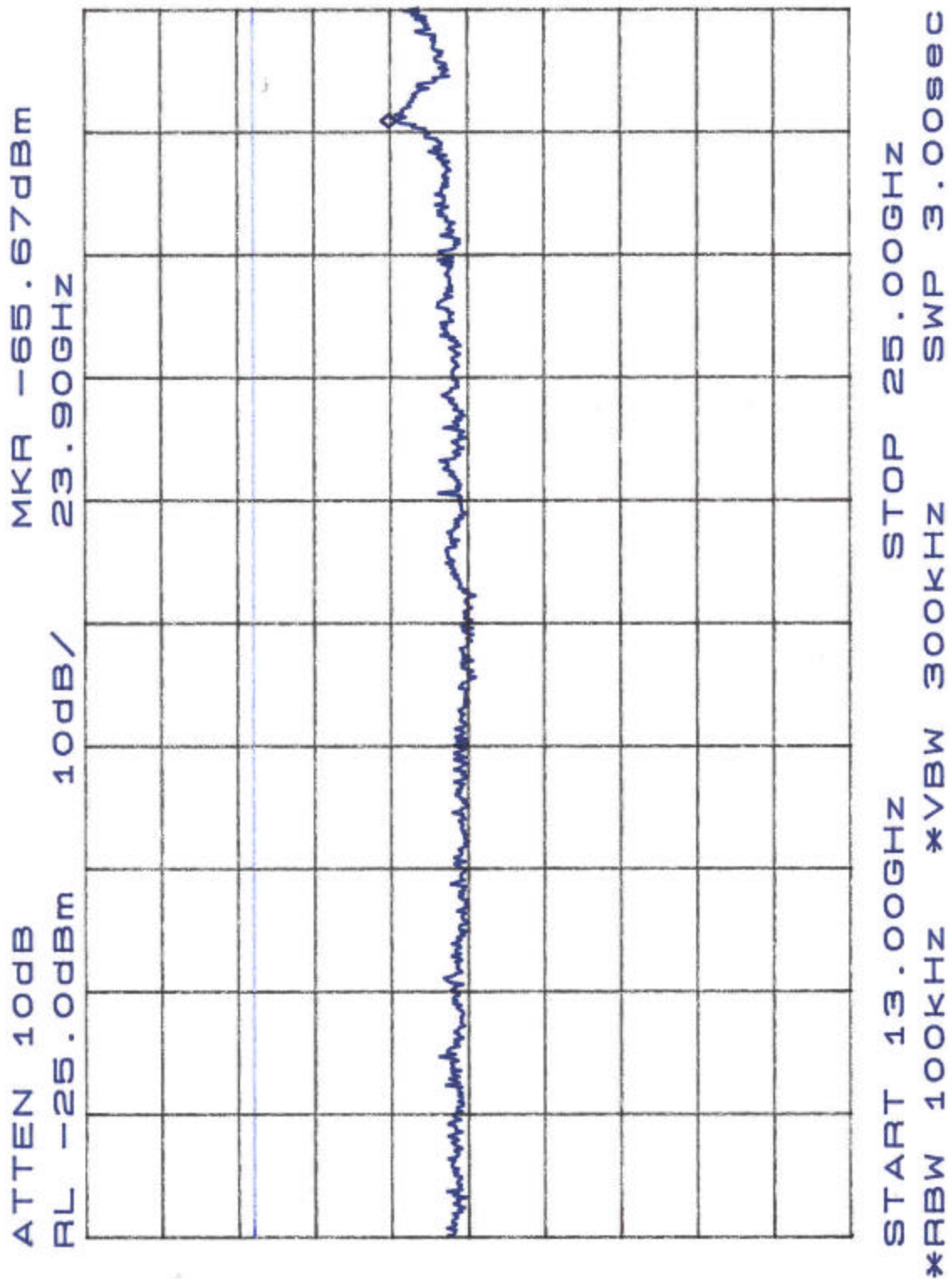


Figure 10. Conducted Spurious Emissions, Channel B, 13G – 25GHz

3.5 Radiated Spurious Emissions: (FCC Part §15.247(c))

Radiated emissions that fall in the restricted bands must comply with the general emissions limits in 15.209(a).

The emissions were measured using the following resolution bandwidths:

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>30 kHz
>1000 MHz	1 MHz	<30 Hz

Harmonic and Spurious emissions that were identified as coming from the EUT were checked in Peak and in Average Mode. It was verified that the peak-to-average ratio did not exceed 20dB for the restricted bands.

Peak measurements and average measurements are made. All emissions were determined to have a peak-to-average ratio of less than 20 dB.

Emissions were measured to the 10th harmonic of the transmit frequency.

3.5.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-1992. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The EUT was tested in the following configurations and modes:

Antenna	Channel
Dish	A&B
Yagi	A&B
Omni	A&B

These data are supplied in the following tables.

Table 4: Radiated Emission Test Data-Dish Antenna—Channel A

CLIENT: Adtran Inc.
MODEL NO: TRACER II
TYPE/PART: 1280TRC242T1R1A/B
DATE: 5/18/2001 & 8/13/01
BY: S. Lavorata & John Lam
JOB #: 6422
Tx Frequency: 2422 MHz
Channel: A
Antenna: Dish Antenna

Frequency	Polarity	Azimuth	Antenna	SA Level	AFC	E-Field	E-Field	Limit	Margin	
MHz	H/V	Deg	Height	(Peak)						
			m	dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
2491.5	V	0	1.0	50.0	-5.2	44.8	172.9	5000	-29.2	Amb
2715.0	V	0	1.0	49.0	-4.9	44.1	160.5	5000	-29.9	Amb
3264.0	V	0	1.0	51.0	-4.1	46.9	220.6	5000	-27.1	Amb
3334.5	V	0	1.0	47.0	-4.0	43.0	140.6	5000	-31.0	Amb
4260.1	V	0	1.0	50.5	-3.0	47.5	236.3	5000	-26.5	
4644.0	V	158	1.0	56.5	-2.7	53.8	491.2	5000	-20.2	
7738.4	V	0	1.0	49.3	2.2	51.5	375.8	5000	-22.5	Amb
8407.4	V	0	1.0	49.5	2.2	51.7	384.6	5000	-22.3	Amb
9375.0	V	0	1.0	49.3	2.7	52.0	398.1	5000	-22.0	Amb
11500.0	V	0	1.0	47.0	5.0	52.0	399.1	5000	-22.0	Amb
14104.0	V	0	1.0	45.0	7.1	52.1	404.8	5000	-21.8	Amb
15775.0	V	0	1.0	45.0	6.8	51.8	390.9	5000	-22.1	Amb
17850.0	V	0	1.0	39.0	12.9	51.9	391.8	5000	-22.1	Amb
2715.0	H	0	1.0	64.0	-4.9	59.1	902.7	5000	-14.9	Amb
3264.0	H	0	1.0	48.0	-4.1	43.9	156.2	5000	-30.1	Amb
3334.5	H	0	1.0	44.0	-4.0	40.0	99.5	5000	-34.0	Amb
4284.0	H	180	1.0	49.7	-3.0	46.7	215.3	5000	-27.3	
4644.0	H	158	1.0	53.7	-2.7	51.0	354.6	5000	-23.0	
7378.3	H	0	1.0	46.3	2.2	48.5	266.1	5000	-25.5	Amb
8407.4	H	0	1.0	46.0	2.2	48.2	257.0	5000	-25.8	Amb
9375.0	H	0	1.0	44.0	2.7	46.7	215.5	5000	-27.3	Amb
11500.0	H	0	1.0	44.0	5.0	49.0	282.5	5000	-25.0	Amb
14104.0	H	0	1.0	45.0	7.1	52.1	404.8	5000	-21.8	Amb
15775.0	H	0	1.0	44.9	6.8	51.7	386.4	5000	-22.2	Amb
17850.0	H	0	1.0	38.9	12.9	51.8	387.3	5000	-22.2	Amb

Average Measurements Above 1 GHz (Restricted Bands)

Frequency	Polarity	Azimuth	Antenna	SA Level	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Deg	Height m	(AVG) dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
4644.0	V	158	1.0	52.7	-2.7	50.0	317.2	500	-4.0	
19000.0	V	0	1.0	23.0	12.0	35.0	56.2	1500	-28.5	Amb
22500.0	V	0	1.0	25.0	15.0	40.0	100.0	1500	-23.5	Amb
23650.0	V	0	1.0	26.0	16.0	42.0	125.9	1500	-21.5	Amb
4644.0	H	158	1.0	46.7	-2.7	44.0	158.4	500	-10.0	
21000.0	H	0	1.0	27.0	13.0	40.0	100.0	1500	-23.5	Amb
22330.0	H	0	1.0	28.0	14.0	42.0	125.9	1500	-21.5	Amb
23700.0	H	0	1.0	29.0	15.0	44.0	158.5	1500	-19.5	Amb

Frequencies above 18 GHz: Interpolated 1 meter limit

Table 5: Radiated Emission Test Data-Yagi Antenna—Channel A

CLIENT: Adtran Inc
MODEL NO: TRACER II
TYPE/PART: 1280TRC242T1R1A/B
DATE: 5/18/2001 & 8/13/01
BY: S. Lavorata & John Lam
JOB #: 6422
Tx Frequency: 2422 MHz
Channel: A
Antenna: Yagi

Frequency	Polarity	Azimuth	Antenna	SA Level	AFC	E-Field	E-Field	Limit	Margin	
MHz	H/V	Deg	Height	(Peak)						
			m	dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
2491.5	V	0	1.0	66.2	-5.2	61.0	1116.4	5000	-13.0	Amb
2715.0	V	0	1.0	66.9	-4.9	62.0	1260.5	5000	-12.0	Amb
3264.0	V	0	1.0	65.0	-4.1	60.9	1105.5	5000	-13.1	Amb
3334.5	V	0	1.0	65.0	-4.0	61.0	1116.7	5000	-13.0	Amb
4260.1	V	0	1.0	47.0	-3.0	44.0	157.9	5000	-30.0	Amb
4644.0	V	0	1.0	55.0	-2.7	52.3	413.3	5000	-21.7	
7738.4	V	0	1.0	49.0	2.2	51.2	363.1	5000	-22.8	Amb
8407.4	V	0	1.0	49.9	2.2	52.1	402.7	5000	-21.9	Amb
9375.0	V	0	1.0	49.7	2.7	52.4	415.4	5000	-21.6	Amb
11500.0	V	0	1.0	50.0	5.0	55.0	563.7	5000	-19.0	Amb
14104.0	V	0	1.0	48.0	7.1	55.1	571.9	5000	-18.8	Amb
15775.0	V	0	1.0	53.2	6.8	60.0	1004.7	5000	-13.9	Amb
17850.0	V	0	1.0	50.0	12.9	62.9	1390.2	5000	-11.1	Amb
2491.5	H	0	1.0	67.0	-5.2	61.8	1224.1	5000	-12.2	Amb
2715.0	H	0	1.0	66.9	-4.9	62.0	1260.5	5000	-12.0	Amb
3264.0	H	0	1.0	65.0	-4.1	60.9	1105.5	5000	-13.1	Amb
3334.5	H	0	1.0	66.0	-4.0	62.0	1253.0	5000	-12.0	Amb
4284.0	H	180	1.0	52.0	-3.0	49.0	281.6	5000	-25.0	
4644.0	H	158	1.0	53.0	-2.7	50.3	328.3	5000	-23.7	
7378.3	H	0	1.0	48.0	2.2	50.2	323.6	5000	-23.8	Amb
8407.4	H	0	1.0	50.0	2.2	52.2	407.4	5000	-21.8	Amb
9375.0	H	0	1.0	53.0	2.7	55.7	607.4	5000	-18.3	Amb
11500.0	H	0	1.0	49.0	5.0	54.0	502.4	5000	-20.0	Amb
14104.0	H	0	1.0	50.0	7.1	57.1	716.6	5000	-16.9	Amb
15775.0	H	0	1.0	52.0	6.8	58.8	875.1	5000	-15.1	Amb
17850.0	H	0	1.0	50.5	12.9	63.4	1472.6	5000	-10.6	Amb

Average Measurements Above 1 GHz (Restricted Bands)

Frequency	Polarity	Azimuth	Antenna	SA Level	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Deg	Height m	(AVG) dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
4644.0	V	158	1.0	49.8	-2.7	47.2	227.9	500	-6.8	
19000.0	V	0	1.0	23.0	12.0	35.0	56.2	1500	-28.5	Amb
22500.0	V	0	1.0	25.0	15.0	40.0	100.0	1500	-23.5	Amb
23650.0	V	0	1.0	26.0	16.0	42.0	125.9	1500	-21.5	Amb
4644.0	H	158	1.0	45.0	-2.7	42.3	130.7	500	-11.7	
21000.0	H	0	1.0	25.0	13.0	38.0	79.4	1500	-25.5	Amb
22330.0	H	0	1.0	24.0	14.0	38.0	79.4	1500	-25.5	Amb
23220.0	H	0	1.0	23.0	15.0	38.0	79.4	1500	-25.5	Amb

Frequencies above 18 GHz: Interpolated 1 meter limit

Table 6: Radiated Emission Test Data—Omni Antenna—Channel A

CLIENT: Adtran Inc.
MODEL NO: TRACER II
TYPE/PART: 1280TRC242T1R1A/B
DATE: 5/18/2001 & 8/13/01
BY: S. Lavorata & John Lam
JOB #: 6422
Tx Frequency: 2422 MHz
Channel: A
Antenna: Omni

Frequency	Polarity	Azimuth	Antenna	SA Level	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Deg	Height	(Peak)						
			m	dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
2491.5	V	0	1.0	64.0	-5.2	58.8	866.6	5000	-15.2	Amb
2715.0	V	0	1.0	63.0	-4.9	58.1	804.5	5000	-15.9	Amb
3264.0	V	0	1.0	65.0	-4.1	60.9	1105.5	5000	-13.1	Amb
3334.5	V	0	1.0	64.0	-4.0	60.0	995.3	5000	-14.0	Amb
4260.1	V	225	1.0	53.8	-3.0	50.8	345.5	5000	-23.2	
4644.0	V	158	1.0	55.0	-2.7	52.3	413.3	5000	-21.7	
7738.4	V	0	1.0	47.9	2.2	50.1	319.9	5000	-23.9	Amb
8407.4	V	0	1.0	48.0	2.2	50.2	323.6	5000	-23.8	Amb
9375.0	V	0	1.0	49.0	2.7	51.7	383.3	5000	-22.3	Amb
11500.0	V	0	1.0	48.0	5.0	53.0	447.8	5000	-21.0	Amb
14104.0	V	0	1.0	49.0	7.1	56.1	641.6	5000	-17.8	Amb
15775.0	V	0	1.0	48.5	6.8	55.3	584.8	5000	-18.6	Amb
17850.0	V	0	1.0	48.0	12.9	60.9	1104.3	5000	-13.1	Amb
2491.5	H	0	1.0	64.0	-5.2	58.8	866.6	5000	-15.2	Amb
2715.0	H	0	1.0	64.5	-4.9	59.6	956.2	5000	-14.4	Amb
3264.0	H	0	1.0	65.0	-4.1	60.9	1105.5	5000	-13.1	Amb
3334.5	H	0	1.0	65.5	-4.0	61.5	1182.9	5000	-12.5	Amb
4284.0	H	180	1.0	52.0	-3.0	49.0	281.6	5000	-25.0	
4644.0	H	158	1.0	52.5	-2.7	49.8	309.9	5000	-24.2	
7378.3	H	0	1.0	47.0	2.2	49.2	288.4	5000	-24.8	Amb
8407.4	H	0	1.0	48.5	2.2	50.7	342.8	5000	-23.3	Amb
9375.0	H	0	1.0	48.3	2.7	51.0	353.6	5000	-23.0	Amb
11500.0	H	0	1.0	48.5	5.0	53.5	474.3	5000	-20.5	Amb
14104.0	H	0	1.0	49.0	7.1	56.1	641.6	5000	-17.8	Amb
15775.0	H	0	1.0	50.0	6.8	56.8	695.1	5000	-17.1	Amb
17850.0	H	0	1.0	48.0	12.9	60.9	1104.3	5000	-13.1	Amb

Average Measurements Above 1 GHz (Restricted Bands)

Frequency	Polarity	Azimuth	Antenna	SA Level	AFc	E-Field	E-Field	Limit	Margin
MHz	H/V	Deg	Height m	(AVG) dBuV	dB/m	dBuV/m	uV/m	uV/m	dB
4284.3	V	0	1.0	44.2	-3.0	41.2	114.7	500	-12.8
4644.0	V	0	1.0	52.0	-2.7	49.3	292.6	500	-4.7
19000.0	V	0	1.0	25.0	12.3	37.3	73.3	1500	-26.2 Amb
22500.0	V	0	1.0	23.0	12.3	35.3	58.2	1500	-28.2 Amb
23650.0	V	0	1.0	26.0	12.3	38.3	82.2	1500	-25.2 Amb
4644.0	H	0	1.0	46.5	-2.7	43.8	155.3	500	-10.2
21050.0	H	0	1.0	25.0	13.0	38.0	79.4	1500	-25.5 Amb
22330.0	H	0	1.0	24.0	14.0	38.0	79.4	1500	-25.5 Amb
23900.0	H	0	1.0	23.6	15.0	38.6	85.1	1500	-24.9 Amb

Frequencies above 18 GHz: Interpolated 1 meter limit

Frequency	Polarity	Azimuth	Antenna	SA Level	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Deg	Height m	(Peak) dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
7378.3	H	0	1.0	43.0	2.2	45.2	182.0	5000	-28.8	Amb
8407.4	H	0	1.0	42.5	2.2	44.7	171.8	5000	-29.3	Amb
9375.0	H	0	1.0	41.8	2.7	44.4	166.3	5000	-29.6	Amb
11500.0	H	0	1.0	43.2	5.0	48.2	257.7	5000	-25.8	Amb
14104.0	H	0	1.0	43.1	7.1	50.3	325.7	5000	-23.7	Amb
15775.0	H	0	1.0	44.5	6.8	51.3	369.0	5000	-22.6	Amb
17850.0	H	0	1.0	45.6	12.9	58.5	837.7	5000	-15.5	Amb

Average Measurements Above 1 GHz (Restricted Bands)

Frequency	Polarity	Azimuth	Antenna	SA Level	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Deg	Height m	(AVG) dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
1008.8	V	45	1.0	47.7	-12.7	35.0	56.1	500	-19.0	
1143.3	V	315	1.0	61.0	-11.5	49.4	296.5	500	-4.5	
1240.0	V	0	1.0	44.7	-10.7	34.0	49.9	500	-20.0	
1481.2	V	0	1.0	58.0	-9.0	49.0	280.3	500	-5.0	
1491.0	V	0	1.0	56.2	-9.0	47.2	228.2	500	-6.8	
4364.0	V	135	1.0	48.1	-2.9	45.1	180.9	500	-8.8	
4564.0	V	135	1.0	50.8	-2.7	48.1	253.6	500	-5.9	
19000.0	V	0	1.0	25.0	12.3	37.3	73.3	1500	-26.2	Amb
22500.0	V	0	1.0	23.0	12.3	35.3	58.2	1500	-28.2	Amb
23650.0	V	0	1.0	26.0	12.3	38.3	82.2	1500	-25.2	Amb
1008.8	H	45	1.0	59.0	-12.7	46.3	206.2	500	-7.7	
1143.3	H	315	1.0	51.8	-11.5	40.3	103.6	500	-13.7	
1160.2	H	315	1.0	45.7	-11.4	34.3	52.1	500	-19.6	
1240.0	H	0	1.0	46.0	-10.7	35.3	58.2	500	-18.7	
1494.0	H	0	1.0	48.0	-9.0	39.0	89.5	500	-14.9	
1597.5	H	0	1.0	47.8	-8.3	39.5	94.1	500	-14.5	
4364.0	H	135	1.0	44.1	-2.9	41.2	114.7	500	-12.8	
4564.0	H	90	1.0	53.7	-2.7	50.9	351.7	500	-3.1	
21050.0	H	0	1.0	25.0	13.0	38.0	79.4	1500	-25.5	Amb
22330.0	H	0	1.0	24.0	14.0	38.0	79.4	1500	-25.5	Amb
23900.0	H	0	1.0	23.6	15.0	38.6	85.1	1500	-24.9	Amb

Frequencies above 18 GHz: Interpolated 1 meter limit

Table 8: Radiated Emission Test Data-Yagi Antenna—Channel B

CLIENT: ADTRAN, INC.
MODEL NO: TRACER II
TYPE/PART: 1280TRC242T1R1A/B
DATE: July 16, 2001
BY: John Lam
JOB #: 6422
Tx Frequency: 2462 MHz
Channel: B
Antenna: YAGI

Frequency	Polarity	Azimuth	Antenna	SA Level	AFc	E-Field	E-Field	Limit	Margin
MHz	H/V	Deg	Height m	(Peak) dBuV	dB/m	dBuV/m	uV/m	uV/m	dB
1008.8	V	90	1.0	58.8	-12.7	46.1	202.2	5000	-27.9
1109.8	V	90	1.0	60.0	-11.8	48.2	256.9	5000	-25.8
1143.3	V	0	1.0	54.5	-11.5	43.0	140.9	5000	-31.0
1160.2	V	0	1.0	54.9	-11.4	43.5	149.1	5000	-30.5
1240.0	V	0	1.0	55.5	-10.7	44.8	172.9	5000	-29.2
1481.2	V	0	1.0	55.3	-9.0	46.3	206.1	5000	-27.7
1490.0	V	0	1.0	54.8	-9.0	45.8	195.9	5000	-28.1
2491.5	V	0	1.0	53.8	-5.2	48.6	268.7	5000	-25.4
2831.9	V	0	1.0	53.6	-4.7	48.9	278.1	5000	-25.1
4364.0	V	135	1.0	57.5	-2.9	54.6	535.1	5000	-19.4
4564.0	V	135	1.0	61.2	-2.7	58.4	834.1	5000	-15.6
7738.4	V	0	1.0	53.8	2.2	56.0	633.1	5000	-17.9
8407.4	V	0	1.0	55.8	2.2	58.0	797.1	5000	-15.9
9375.0	V	0	1.0	52.3	2.7	55.0	560.4	5000	-19.0
11500.0	V	0	1.0	54.3	5.0	59.3	924.8	5000	-14.7
14104.0	V	0	1.0	54.2	7.1	61.3	1163.6	5000	-12.7
15775.0	V	0	1.0	55.3	6.8	62.2	1283.9	5000	-11.8
17850.0	V	0	1.0	54.8	12.9	67.7	2424.3	5000	-6.3
1008.8	H	135	1.0	62.0	-12.7	49.3	291.2	5000	-24.7
1109.8	H	45	1.0	60.2	-11.8	48.4	262.9	5000	-25.6
1143.3	H	0	1.0	55.0	-11.5	43.5	149.3	5000	-30.5
1160.2	H	0	1.0	56.0	-11.4	44.6	170.2	5000	-29.4
1240.0	H	0	1.0	55.8	-10.7	45.1	179.6	5000	-28.9
1481.2	H	0	1.0	55.3	-9.0	46.3	206.1	5000	-27.7
1494.0	H	0	1.0	55.2	-9.0	46.2	204.3	5000	-27.8
1599.8	H	0	1.0	54.8	-8.3	46.5	211.8	5000	-27.5
2491.5	H	0	1.0	55.0	-5.2	49.8	307.5	5000	-24.2
2715.0	H	0	1.0	53.3	-4.9	48.4	264.3	5000	-25.5
3264.0	H	0	1.0	54.0	-4.1	49.9	311.6	5000	-24.1
3334.5	H	0	1.0	53.7	-4.0	49.6	303.0	5000	-24.4
4364.0	H	135	1.0	56.8	-2.9	53.9	495.4	5000	-20.1
4564.0	H	135	1.0	60.0	-2.7	57.3	729.0	5000	-16.7
7378.3	H	0	1.0	54.2	2.2	56.4	656.9	5000	-17.6

Frequency	Polarity	Azimuth	Antenna Height	SA Level (Peak)	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Deg	m	dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
8407.4	H	0	1.0	55.7	2.2	57.9	782.5	5000	-16.1	Amb
9375.0	H	0	1.0	54.5	2.7	57.2	721.9	5000	-16.8	Amb
11500.0	H	0	1.0	53.8	5.0	58.9	876.1	5000	-15.1	Amb
14104.0	H	0	1.0	53.5	7.1	60.6	1077.2	5000	-13.3	Amb
15775.0	H	0	1.0	54.3	6.8	61.2	1144.3	5000	-12.8	Amb
17850.0	H	0	1.0	54.8	12.9	67.7	2424.3	5000	-6.3	Amb

Average Measurements Above 1 GHz (Restricted Bands)

Frequency	Polarity	Azimuth	Antenna Height	SA Level (AVG)	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Deg	m	dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
1008.8	V	180	1.0	48.7	-12.7	36.0	62.8	500	-18.0	
1109.8	V	90	1.0	45.0	-11.8	33.2	45.7	500	-20.8	
4364.0	V	135	1.0	50.8	-2.9	47.9	248.3	500	-6.1	
4564.0	V	135	1.0	53.0	-2.7	50.3	325.6	500	-3.7	
19000.0	V	0	1.0	25.0	12.3	37.3	73.3	1500	-26.2	Amb
22500.0	V	0	1.0	26.0	12.3	38.3	82.2	1500	-25.2	Amb
23850.0	V	0	1.0	24.0	12.3	36.3	65.3	1500	-27.2	Amb
1008.8	H	90	1.0	56.2	-12.7	43.5	148.8	500	-10.5	
1198.0	H	315	1.0	48.0	-11.1	36.9	70.2	500	-17.1	
4364.0	H	135	1.0	46.2	-2.9	43.3	145.7	500	-10.7	
4564.0	H	135	1.0	50.1	-2.7	47.4	233.2	500	-6.6	
21200.0	H	0	1.0	23.0	13.0	36.0	63.1	1500	-27.5	Amb
22330.0	H	0	1.0	25.0	14.0	39.0	89.1	1500	-24.5	Amb
23800.0	H	0	1.0	24.0	15.0	39.0	89.1	1500	-24.5	Amb

Frequencies above 18 GHz: Interpolated 1 meter limit

Table 9: Radiated Emission Test Data-Omni Antenna—Channel B

CLIENT: ADTRAN, INC.
MODEL NO: TRACER II
TYPE/PART: 1280TRC242T1R1A/B
DATE: August 03, 2001
BY: John Lam
JOB #: 6422
Tx Frequency: 2462 MHz
Channel: B
Antenna: Omni

Frequency	Polarity	Azimuth	Antenna	SA Level	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Deg	Height m	(Peak) dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
1008.8	V	225	1.0	61.9	-12.7	49.2	287.9	5000	-24.8	
1210.0	V	135	1.0	63.3	-11.0	52.4	414.5	5000	-21.6	
1160.2	V	0	1.0	57.3	-11.4	45.9	198.4	5000	-28.0	Amb
1240.0	V	0	1.0	55.0	-10.7	44.3	163.2	5000	-29.7	Amb
1481.2	V	0	1.0	58.5	-9.0	49.5	296.9	5000	-24.5	Amb
1490.0	V	315	1.0	55.5	-9.0	46.5	211.6	5000	-27.5	Amb
1602.0	V	0	1.0	54.7	-8.3	46.4	208.3	5000	-27.6	Amb
2491.5	V	315	1.0	53.0	-5.2	47.8	244.2	5000	-26.2	Amb
2870.0	V	315	1.0	54.0	-4.7	49.3	293.1	5000	-24.6	Amb
4364.0	V	135	1.0	53.2	-2.9	50.2	325.1	5000	-23.7	
4564.0	V	180	1.0	54.8	-2.7	52.1	402.0	5000	-21.9	
7738.4	V	0	1.0	50.0	2.2	52.2	407.4	5000	-21.8	Amb
8407.4	V	0	1.0	51.2	2.2	53.4	467.7	5000	-20.6	Amb
9375.0	V	0	1.0	50.8	2.7	53.5	471.5	5000	-20.5	Amb
11500.0	V	0	1.0	50.5	5.0	55.5	597.1	5000	-18.5	Amb
14104.0	V	0	1.0	50.7	7.1	57.8	777.7	5000	-16.2	Amb
15775.0	V	0	1.0	50.9	6.8	57.7	767.4	5000	-16.3	Amb
17850.0	V	0	1.0	50.6	12.9	63.5	1489.6	5000	-10.5	Amb
1008.8	H	135	1.0	61.0	-12.7	48.3	259.5	5000	-25.7	
1210.0	H	45	1.0	60.0	-11.0	49.0	282.5	5000	-25.0	
1160.2	H	0	1.0	54.3	-11.4	42.9	139.9	5000	-31.1	Amb
1240.0	H	0	1.0	56.0	-10.7	45.3	183.1	5000	-28.7	Amb
1481.2	H	0	1.0	55.2	-9.0	46.1	202.4	5000	-27.9	Amb
1494.0	H	0	1.0	55.3	-9.0	46.4	208.1	5000	-27.6	Amb
1599.3	H	0	1.0	54.0	-8.3	45.7	192.5	5000	-28.3	Amb
2491.5	H	0	1.0	53.0	-5.2	47.8	244.2	5000	-26.2	Amb
2715.0	H	0	1.0	52.0	-4.9	47.1	226.8	5000	-26.9	Amb
3264.0	H	0	1.0	50.2	-4.1	46.0	200.5	5000	-27.9	Amb
3334.5	H	0	1.0	50.2	-4.0	46.2	203.2	5000	-27.8	Amb
4364.0	H	135	1.0	53.0	-2.9	50.1	318.8	5000	-23.9	
4564.0	H	90	1.0	57.2	-2.7	54.4	526.9	5000	-19.5	
7378.3	H	0	1.0	51.0	2.2	53.2	457.1	5000	-20.8	Amb
8407.4	H	0	1.0	50.6	2.2	52.8	436.5	5000	-21.2	Amb

Frequency	Polarity	Azimuth	Antenna	SA Level	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Deg	Height m	(Peak) dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
9375.0	H	0	1.0	50.3	2.7	53.0	446.7	5000	-21.0	Amb
11500.0	H	0	1.0	52.0	5.0	57.0	709.7	5000	-17.0	Amb
14104.0	H	0	1.0	50.0	7.1	57.1	719.9	5000	-16.8	Amb
15775.0	H	0	1.0	51.0	6.8	57.8	779.9	5000	-16.1	Amb
17850.0	H	0	1.0	51.8	12.9	64.7	1716.3	5000	-9.3	Amb

Average Measurements Above 1 GHz (Restricted Bands)

Frequency	Polarity	Azimuth	Antenna	SA Level	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Deg	Height m	(AVG) dBuV	dB/m	dBuV/m	uV/m	uV/m	dB	
1008.8	V	225	1.0	57.0	-12.7	44.3	163.8	500	-9.7	
1210.0	V	225	1.0	58.5	-11.0	47.5	237.7	500	-6.5	
4364.0	V	180	1.0	45.0	-2.9	42.1	126.9	500	-11.9	
4564.0	V	180	1.0	50.0	-2.7	47.3	230.5	500	-6.7	
19000.0	V	0	1.0	23.0	12.0	35.0	56.2	1500	-28.5	Amb
22500.0	V	0	1.0	25.0	15.0	40.0	100.0	1500	-23.5	Amb
23650.0	V	0	1.0	26.0	16.0	42.0	125.9	1500	-21.5	Amb
1008.8	H	90	1.0	56.5	-12.7	43.8	154.6	500	-10.2	
1210.0	H	90	1.0	54.3	-11.0	43.3	146.6	500	-10.7	
4364.0	H	135	1.0	42.0	-2.9	39.1	89.8	500	-14.9	
4564.0	H	135	1.0	51.5	-2.7	48.8	274.0	500	-5.2	
21000.0	H	0	1.0	27.0	13.0	40.0	100.0	1500	-23.5	Amb
22330.0	H	0	1.0	28.0	14.0	42.0	125.9	1500	-21.5	Amb
23700.0	H	0	1.0	29.0	15.0	44.0	158.5	1500	-19.5	Amb

Frequencies above 18 GHz: Interpolated 1 meter limit

4 Test Equipment

Table 10 shows a list of the test equipment used for measurements along with the calibration information.

Table 10: Test Equipment List

Manufacturer & Model	Description	Serial Number	Property Number	Date Calibrated	Calibration Due Date
Antenna Research Associates DRG-118/A	Horn Antenna	1010	00004	9/10/99	9/10/01
Antenna Research Associates LPB-2520	Biconilog Antenna	1044	00007	6/13/01	6/13/02
Hewlett Packard 11970W	Harmonic Mixer	2521A01455	00055	8/27/98	8/27/01
Hewlett Packard 11970U	Harmonic Mixer	3003A01626	00083	7/30/98	7/30/01
Hewlett Packard 11970V Harmonic Mixer	Harmonic Mixer	2521A01269	00054	9/10/98	9/10/01
Hewlett Packard 8449B	Pre-Amplifier	3008A00729	00066	12/7/00	12/7/01
Hewlett Packard 8564E	Spectrum Analyzer	3643A00657	00067	4/11/01	4/11/02
Hewlett Packard 85650A	Q.P. Adapter	2811A01283	00068	6/29/01	6/29/02
Hewlett Packard 85685A	RF Preselector	3221A01395	00071	6/28/01	6/28/02
Hewlett Packard 8568B	Spectrum Analyzer	2928A04750	00072	6/29/01	6/29/02