FCC Certification Test Report

FCC Certification Test Report
for
Hand Held Products, Inc.
FCC ID: HD588352

March 31, 2004

Prepared for:

Hand Held Products, Inc.
700 Visions Drive
Skaneateles Falls, NY 13153-0208

Prepared By:

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

FCC Certification Test Report
for the
Hand Held Products, Inc.
TT8870-352 Radio Card
FCC ID: HD588352

WLL JOB# 8001

Prepared by: Brian J. Dettling
Documentation Specialist

Reviewed by: Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of Hand Held Products, 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 a Hand Held Products, Inc. TT8870-352 Radio Card.

Hand Held Products wishes to have this device approved as a module. An Attestation letter and required consumer information are found in the exhibits related to this application.

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 Hand Held Products 8870 Radio Card is an IEEE 802.11/802.11b compliant device and complies with the limits for a Direct Sequence Spread Spectrum Transmitter device under Part 15.247 of the FCC Rules and Regulations.

The radio transmitter in this device is based on a Certified module listed under FCC ID: LDK102040.

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1 Introduction

1.1 Compliance Statement

The Hand Held Products, Inc. TT8870-352 Radio Card complies with the limits for a Spread Spectrum Transceiver device under Part 15.247 of the FCC Rules and Regulations.

The product is a mobile device designed for wireless access application and use.

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2001 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:	Hand Held Products, Inc. 700 Visions Drive Skaneateles Falls, NY 13153-0208
Purchase Order Number:	3162
Quotation Number:	61383-A

1.4 Test Dates

Testing was performed from March 1 to March 4, 2004.

1.5 Test and Support Personnel

Washington Laboratories, LTD	Ken Gemmell

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 Hand Held Products, Inc. TT8870-352 Radio Card is an unlicensed Direct Sequence Spread Spectrum Transceiver for 802.11b wireless LAN applications.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Hand Held Products, Inc.
FCC ID Number	HD588352
EUT Name:	Spread Spectrum Transceiver
Model:	TT8870-352 Radio Card
FCC Rule Parts:	§15.247
Frequency Range:	2412 - 2462
Maximum Output Power:	100 mW
Modulation:	Direct Sequence Spread Spectrum
Necessary Bandwidth:	N/A
Keying:	Automatic
Type of Information:	Data
Number of Channels:	11
Power Output Level	57 mW
Antenna Type	MMCX Male connector, circuit board antenna
Frequency Tolerance:	N/A
Emission Type(s):	N/A
Interface Cables:	None
Power Source & Voltage:	5 VDC from 120VAC

2.2 Test Configuration

The EUT was configured with a PCBD power supply, an antenna, a support PC with PCMCIA extender card. The EUT firmware/software was set up to control power, bit rate, and channel selection.

N channels are available: 11

2.3 Testing Algorithm

The TT8870-352 Radio Card was operated using DOS drivers.

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 ± 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:

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 = $0.5\ (2^2 + 1^2 + 4^2)^{1/2}$ = ±2.3 dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Equipment	Serial Number	Calibration Due
Sunol JB1 Biconilog Antenna	A090501	10/21/04
ARA DRG118/A Microwave Horn Antenna	1236	4/17/04
Hewlett-Packard Spectrum Analyzer: HP 8568B (Site 1)	2928A04750	7/02/04
Hewlett-Packard Quasi-Peak Adapter: HP 85650A (Site 1)	3303A01786	7/08/04
Hewlett-Packard RF Preselector: HP 85685A (Site 1)	3146A01296	7/02/04
Hewlett-Packard Spectrum Analyzer: HP 8564E	3643A00657	5/22/04
Hewlett-Packard Microwave Preamp: 8449B	3008A00385	9/29/05
Solar Electronics LISN 8012-50-R-24-BNC	8379493	6/30/04
Narda Horn Antenna M/N: 638	Asset 00210	7/22/04
Tektronix Digital Oscilloscope	B010043	9/5/04
Hewlett-Packard Diode Detector 8474B	2905A04196	12/19/04
Amplifier Research Power Meter PM 2002	26679	2/3/05
Amplifier Research Power Head PM 2002	26852	2/3/05
Hewlett-Packard Signal Generator, 8648C	3347A00242	4/30/04

4 Test Results

4.1 RF Power Output:

To measure the output power the unit was set to transmit on a low, high and middle channel. The output from the transmitter was connected to an attenuator and then to the input of a detector diode. The output of the detector diode was displayed on an oscilloscope. The trace deflection was recorded and the transmitter was replaced with a signal generator at the same frequency. The output of the signal generator was increased until the trace deflection was the same as it was with the transmitter. The signal from the generator was then connected to a power meter and the level was taken.

Table 3. RF Power Output

Frequency	Level	Limit	Pass/Fail
Channel 1: 2412 MHz	17.6 dBm	20 dBm	Pass
Channel 5: 2432 MHz	16.64 dBm	20 dBm	Pass
Channel 11: 2462 MHz	16.73 dBm	20 dBm	Pass

4.2 RF 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.

Table 4. RF Power Spectral Density

Frequency	**Level**	**Limit**	**Pass/Fail**
Channel 1: 2412 MHz	-1.67 dBm	8 dBm	Pass
Channel 5: 2432 MHz	-2.83 dBm	8 dBm	Pass
Channel 11: 2462 MHz	-3.17	8dBm	Pass

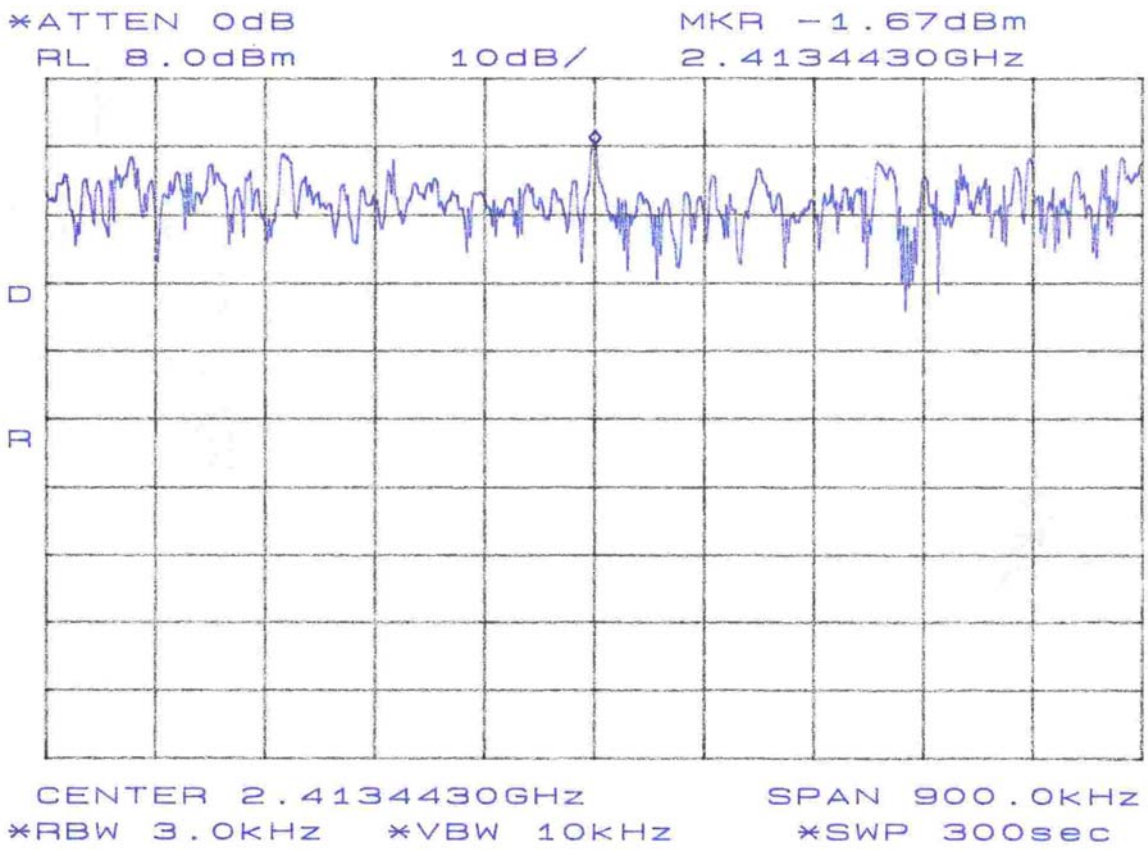

Figure 1: Power Spectral Density Plot, Channel 1

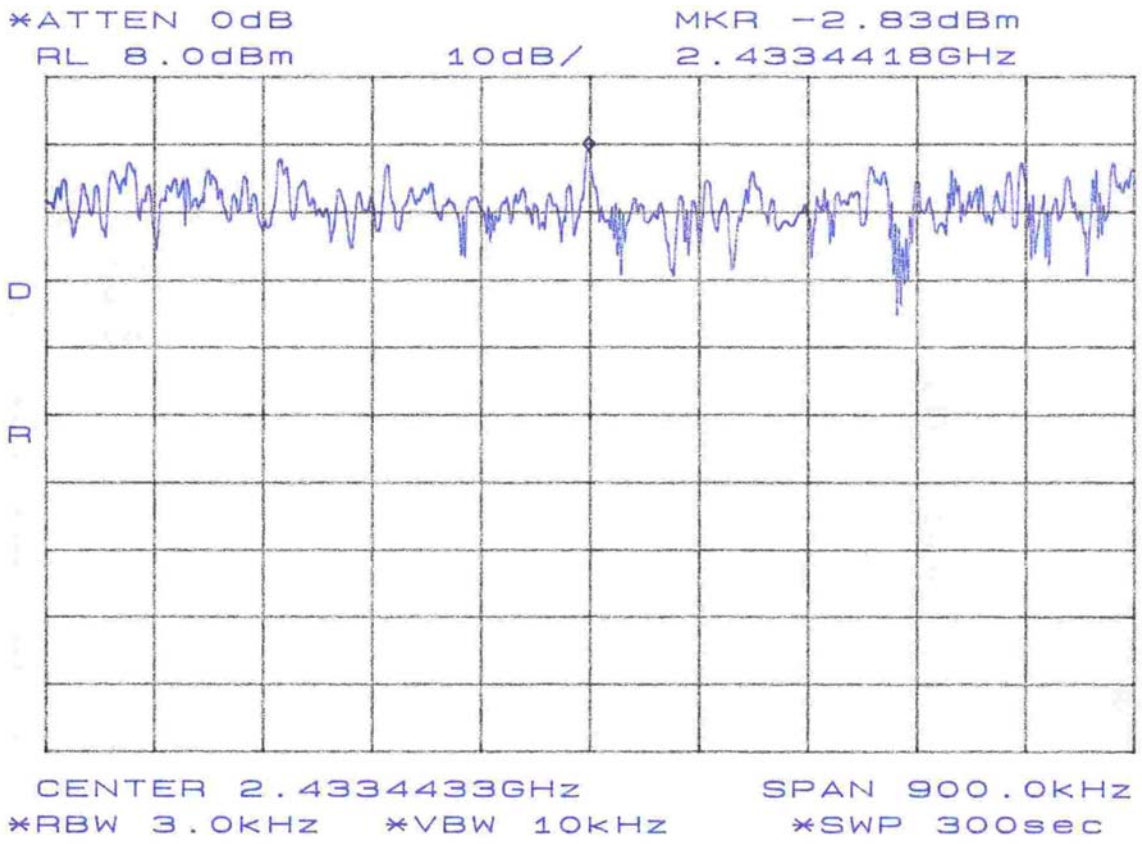

Figure 2: Power Spectral Density Plot, Channel 5

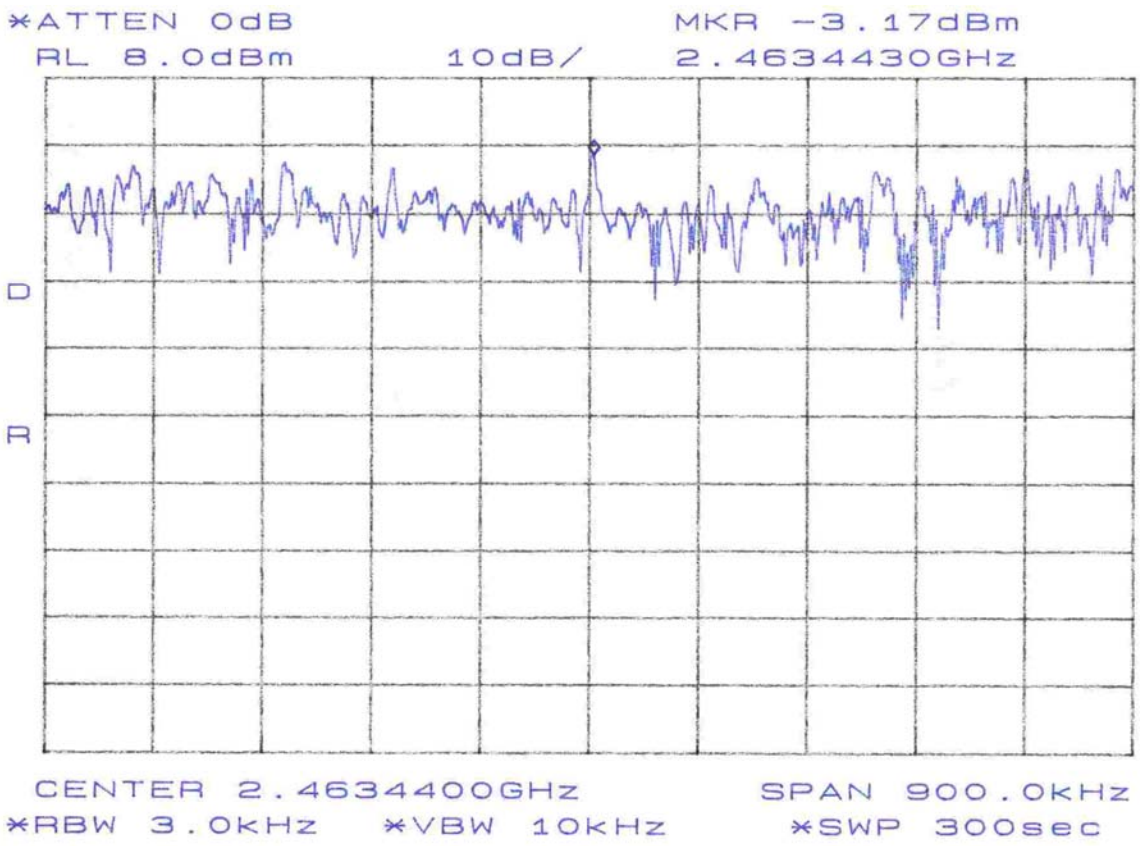

Figure 3: Power Spectral Density Plot, Channel 11

4.3 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.

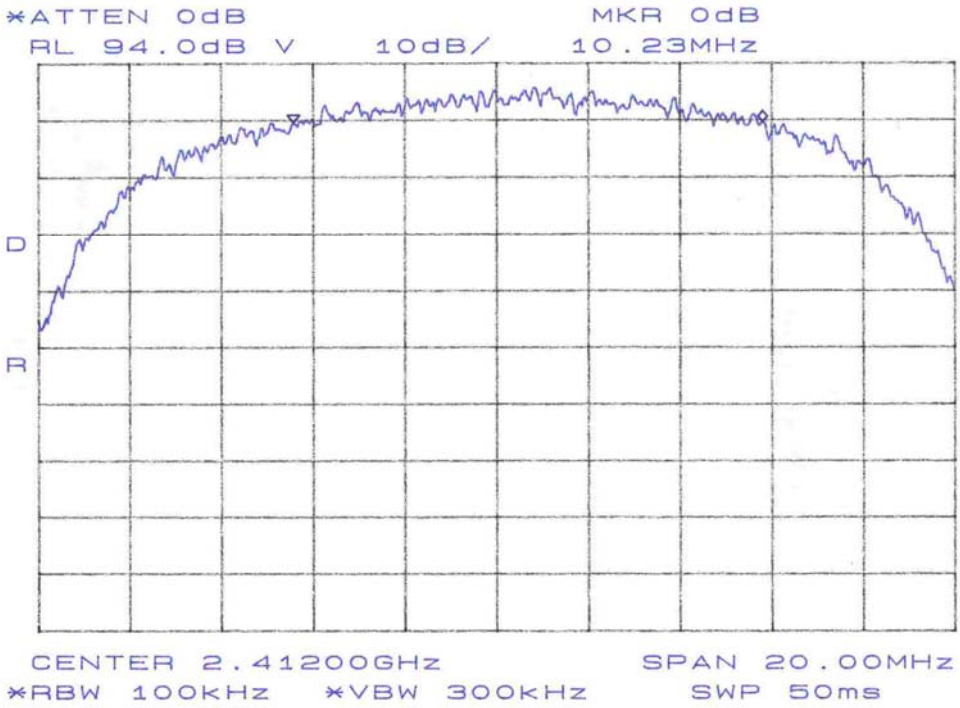

Figure 4. Occupied Bandwidth, Channel 1

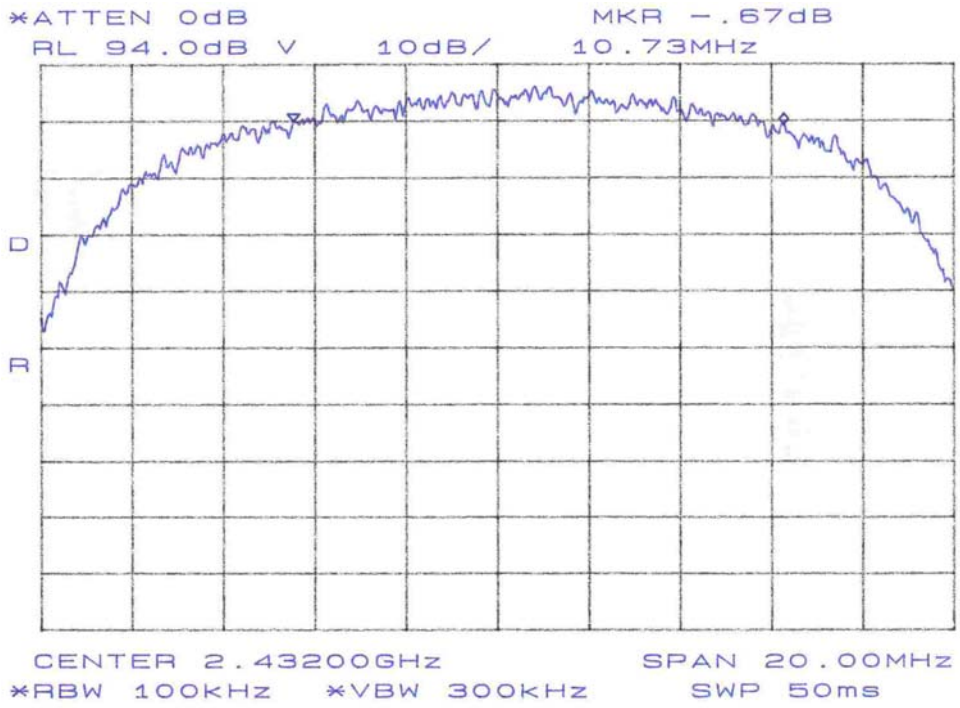

Figure 5. Occupied Bandwidth, Channel 5

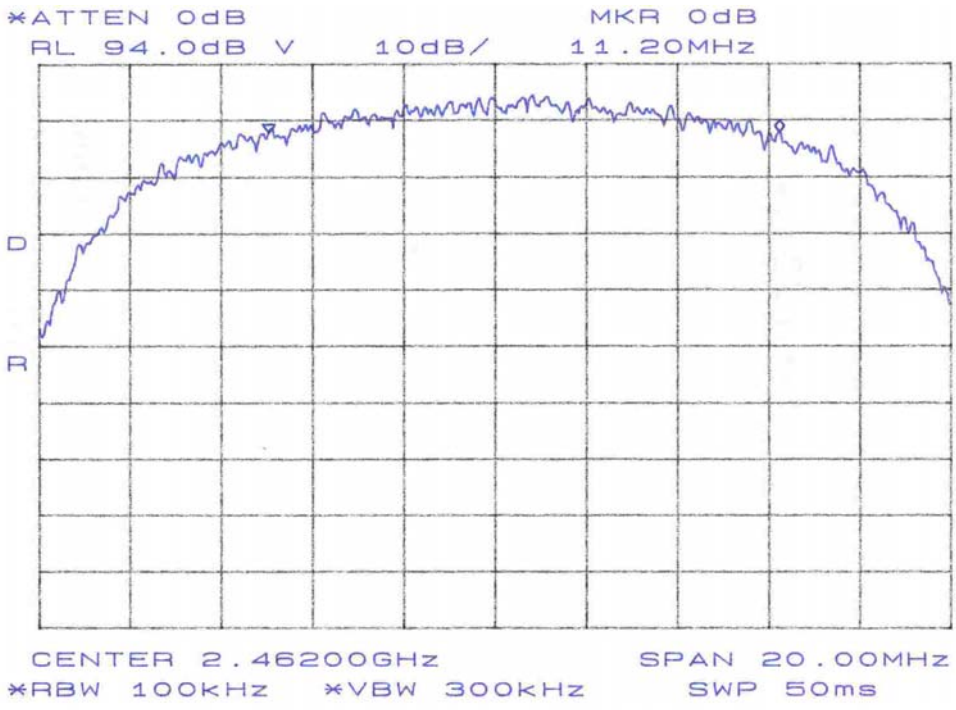

Figure 6. Occupied Bandwidth, Channel 11

Table 5 provides a summary of the Occupied Bandwidth Results.

Table 5. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Channel 1: 2412 MHz	10.23MHz	> 500 kHz	Pass
Channel 5: 2432 MHz	10.73MHz	> 500 kHz	Pass
Channel 11: 2462 MHz	11.20MHz	> 500 kHz	Pass

4.4 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.

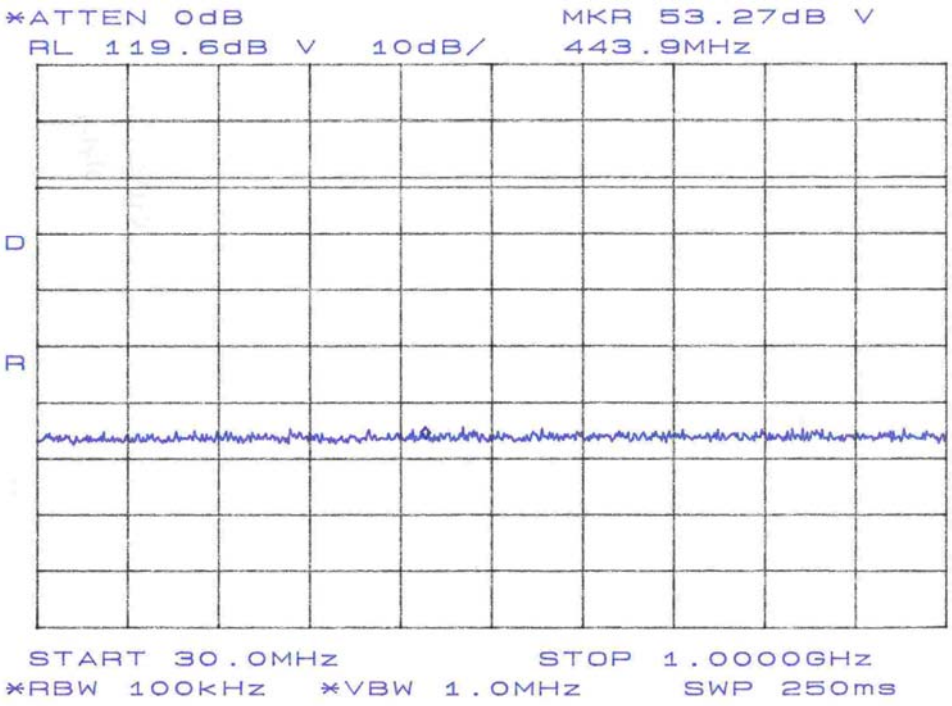

Figure 7. Conducted Spurious Emissions; Ch 1, 30MHz - 1GHz

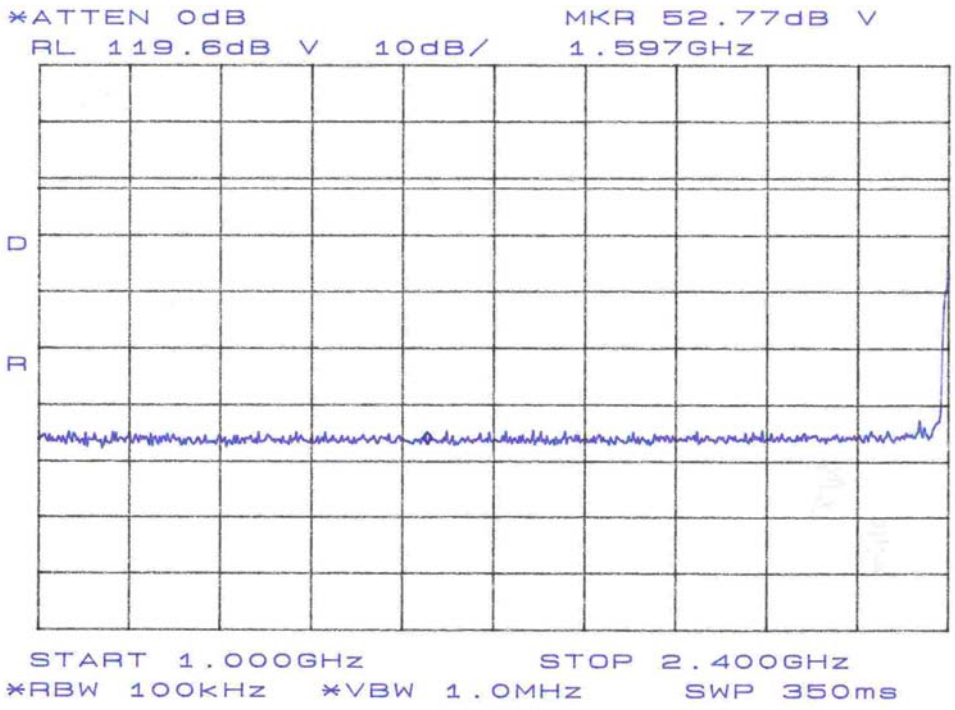

Figure 8. Conducted Spurious Emissions; Ch 1, 1GHz – 2.4GHz

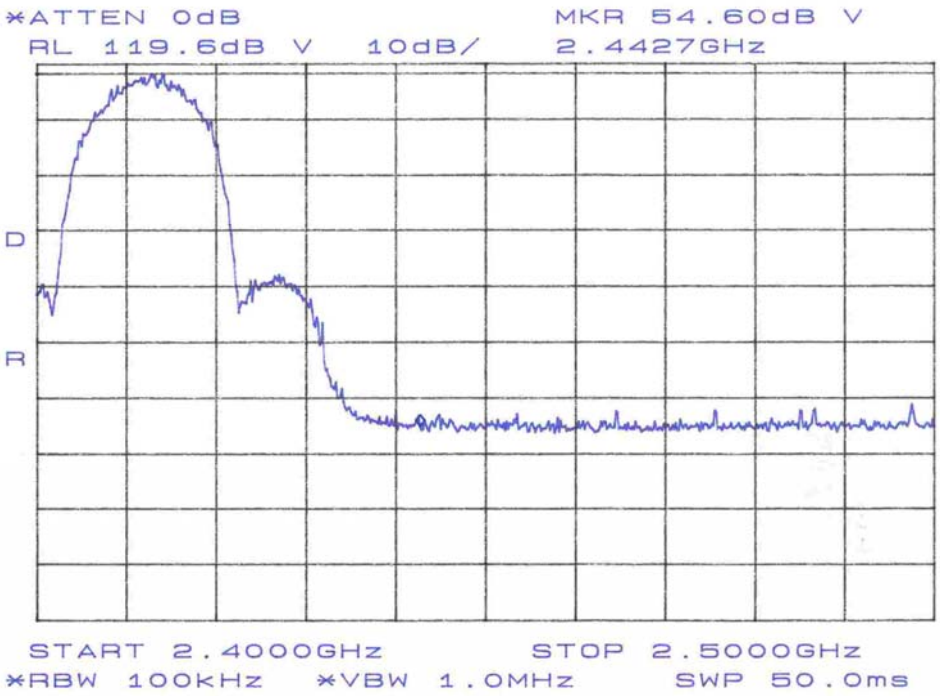

Figure 9. Conducted Spurious Emissions; Ch 1, 2.4GHz – 2.5GHz

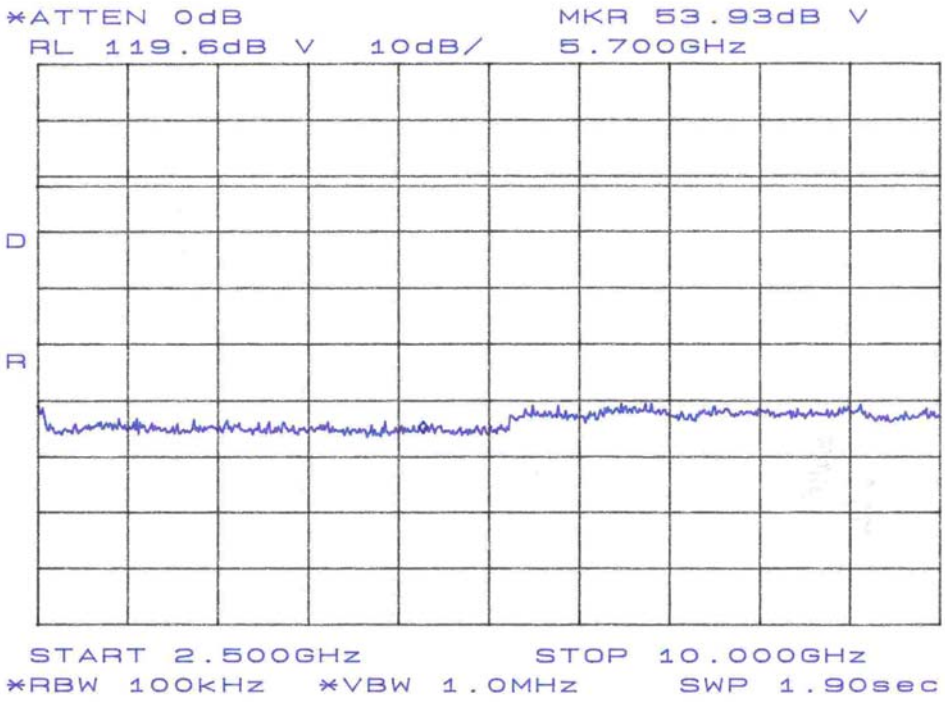

Figure 10. Conducted Spurious Emissions; Ch 1, 2.5GHz – 10GHz

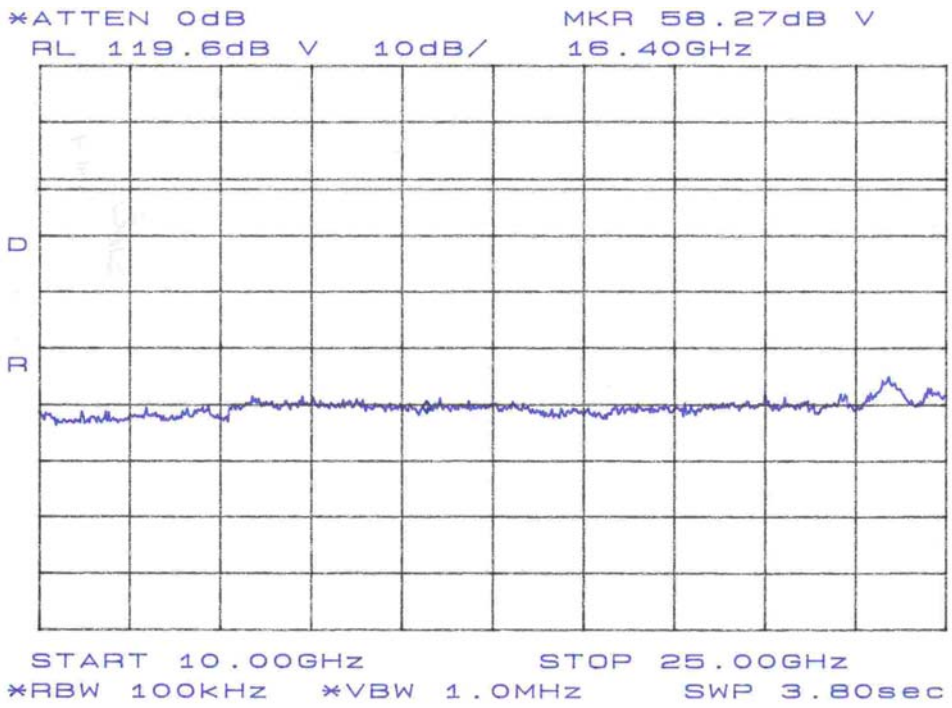

Figure 11. Conducted Spurious Emissions; Ch 1, 10GHz – 25GHz

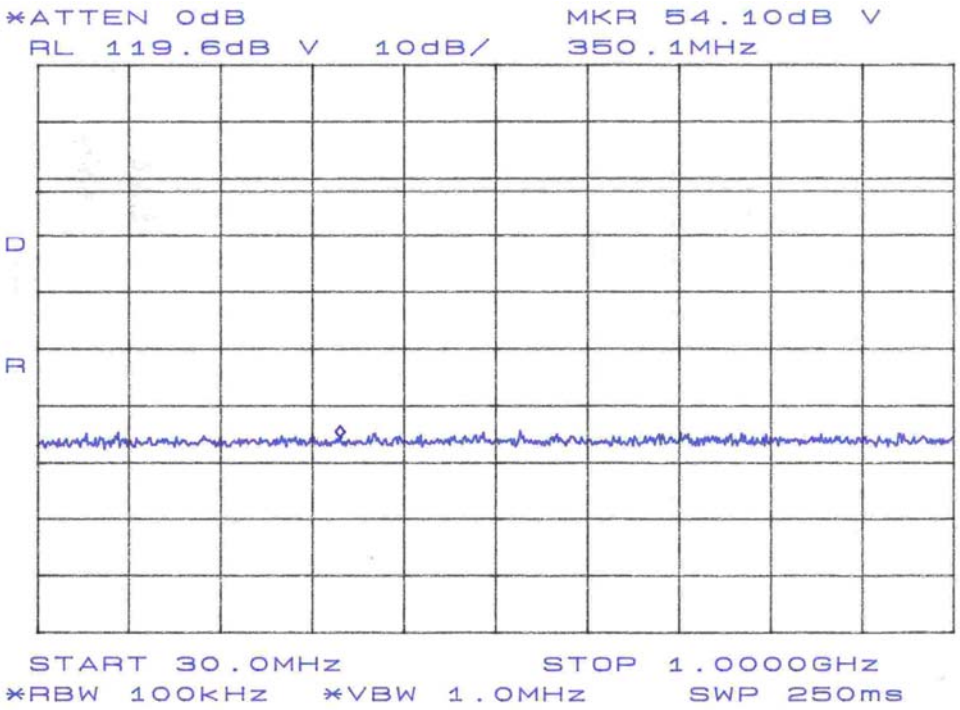

Figure 12. Conducted Spurious Emissions; Ch 5, 30MHz - 1GHz

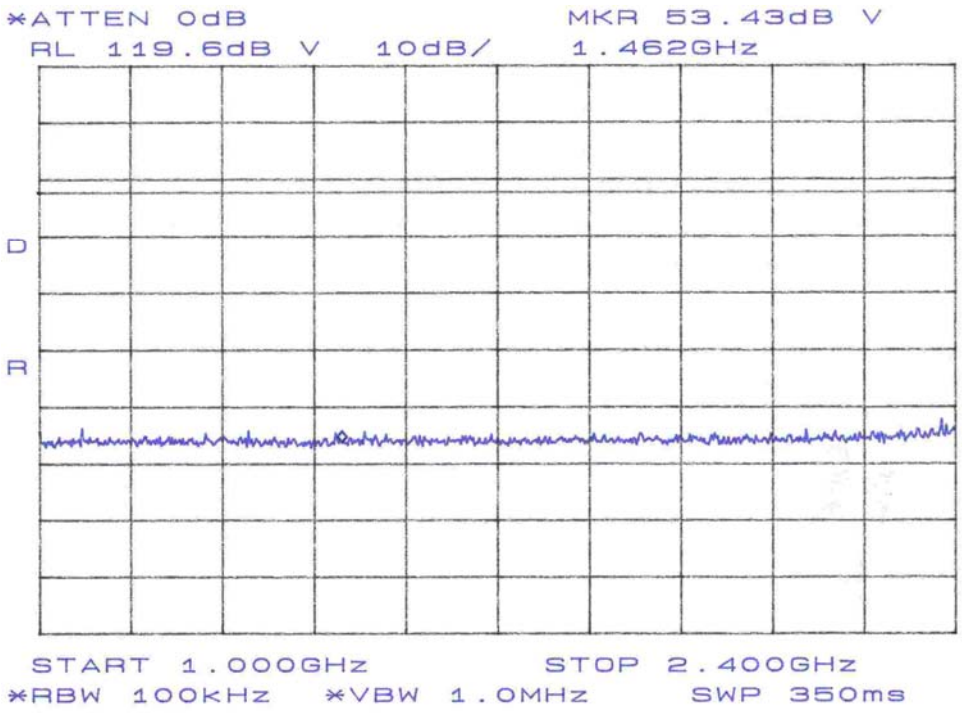

Figure 13. Conducted Spurious Emissions; Ch 5, 1GHz – 2.4GHz

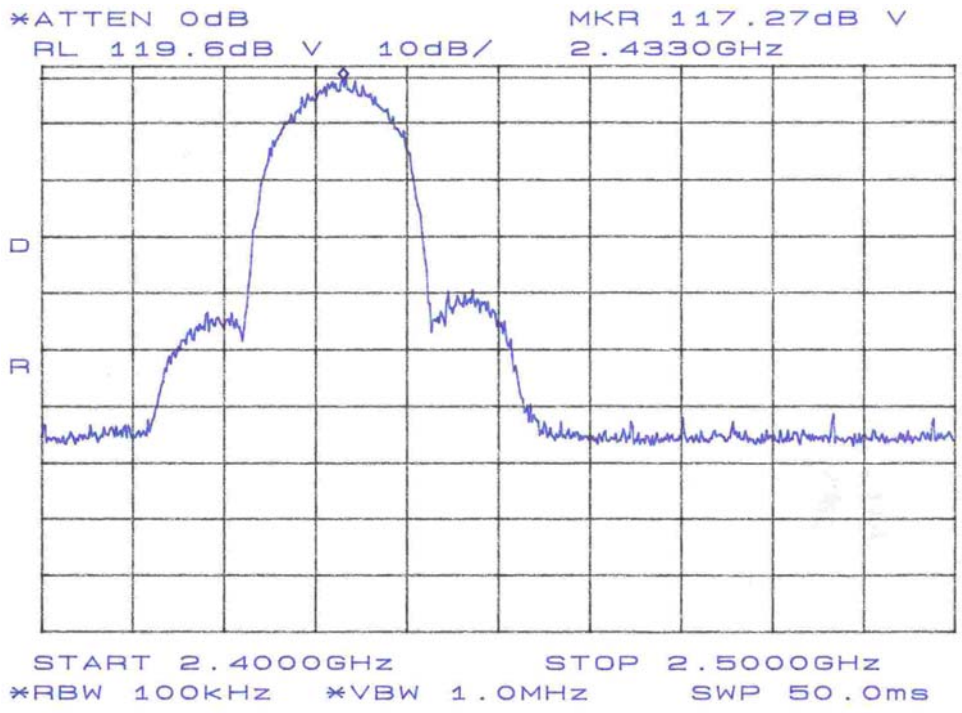

Figure 14. Conducted Spurious Emissions; Ch 5, 2.4GHz – 2.5GHz

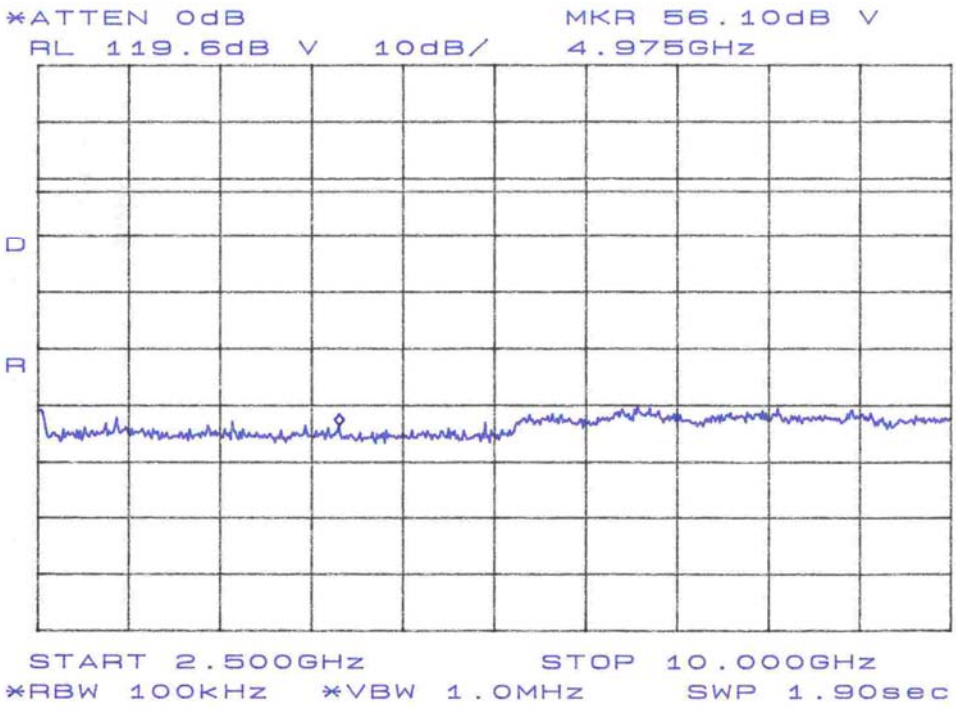

Figure 15. Conducted Spurious Emissions; Ch 5, 2.5GHz – 10GHz

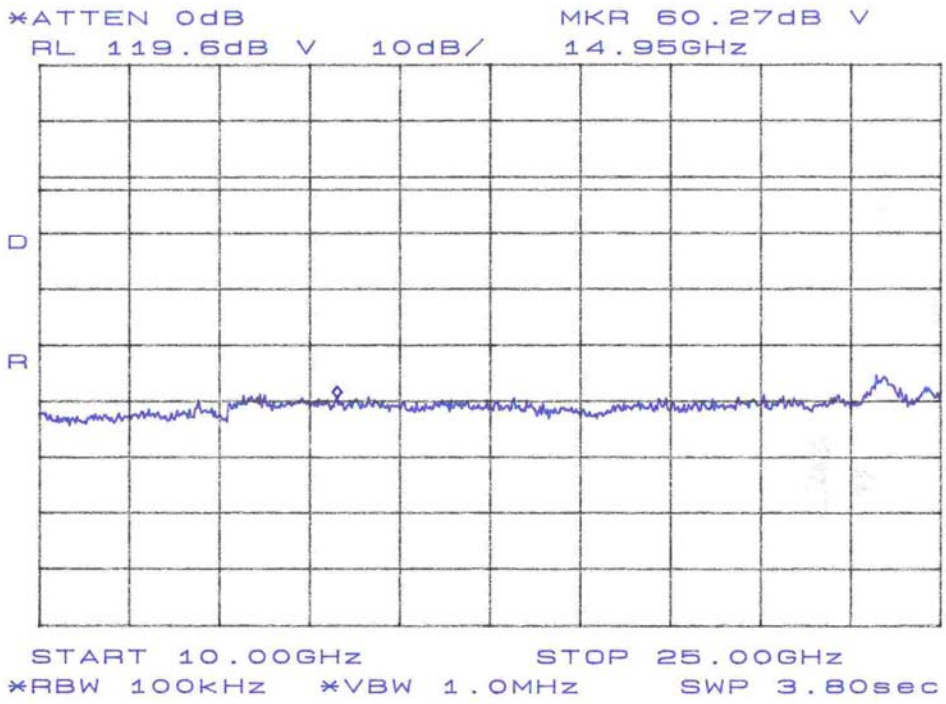

Figure 16. Conducted Spurious Emissions; Ch 5, 10GHz – 25GHz

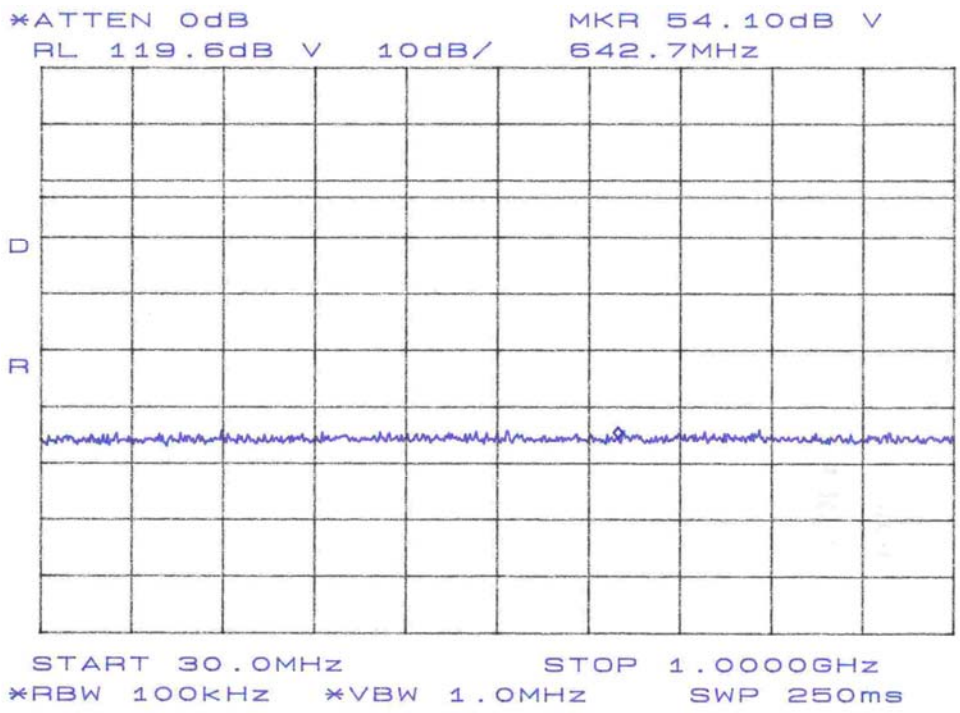

Figure 17. Conducted Spurious Emissions; Ch 11, 30MHz - 1GHz

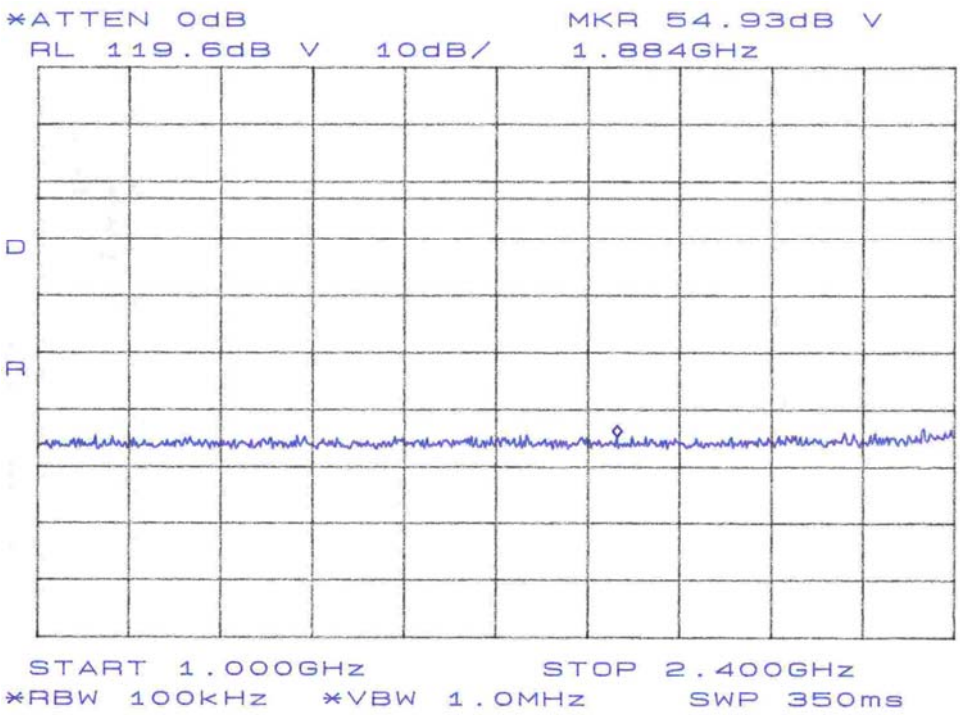

Figure 18. Conducted Spurious Emissions; Ch 11, 1GHz – 2.4GHz

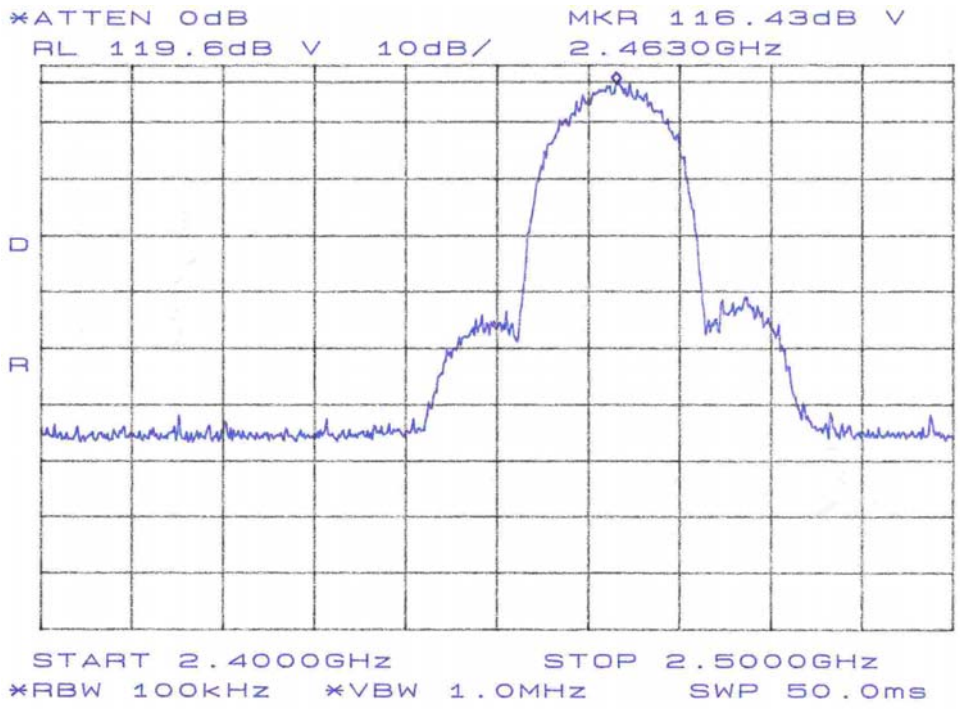

Figure 19. Conducted Spurious Emissions; Ch 11, 2.4GHz – 2.5GHz

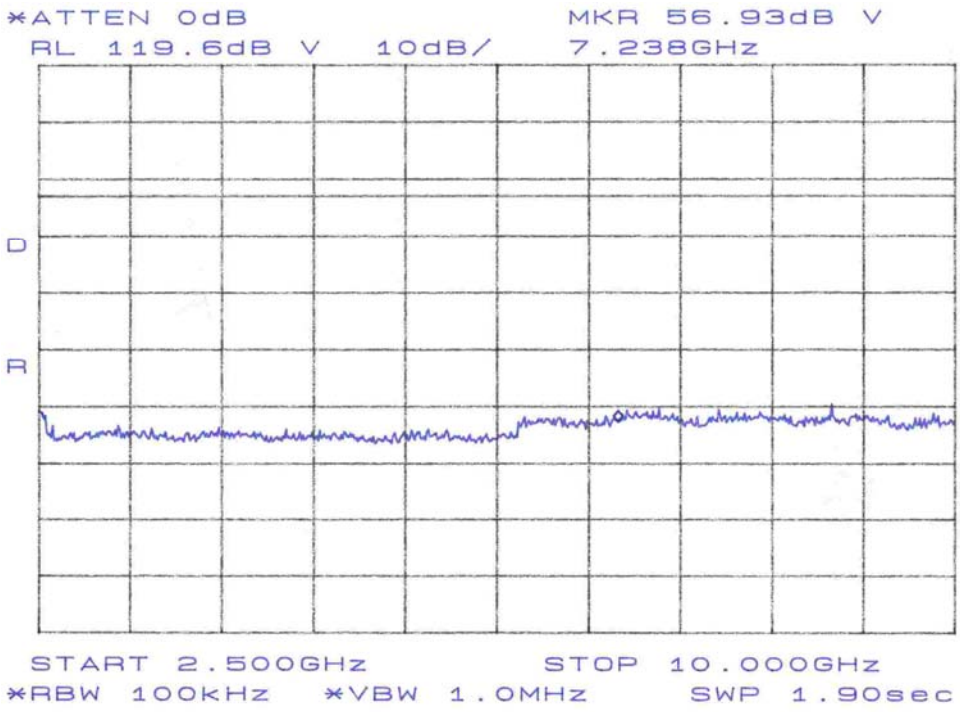

Figure 20. Conducted Spurious Emissions; Ch 11, 2.5GHz – 10GHz

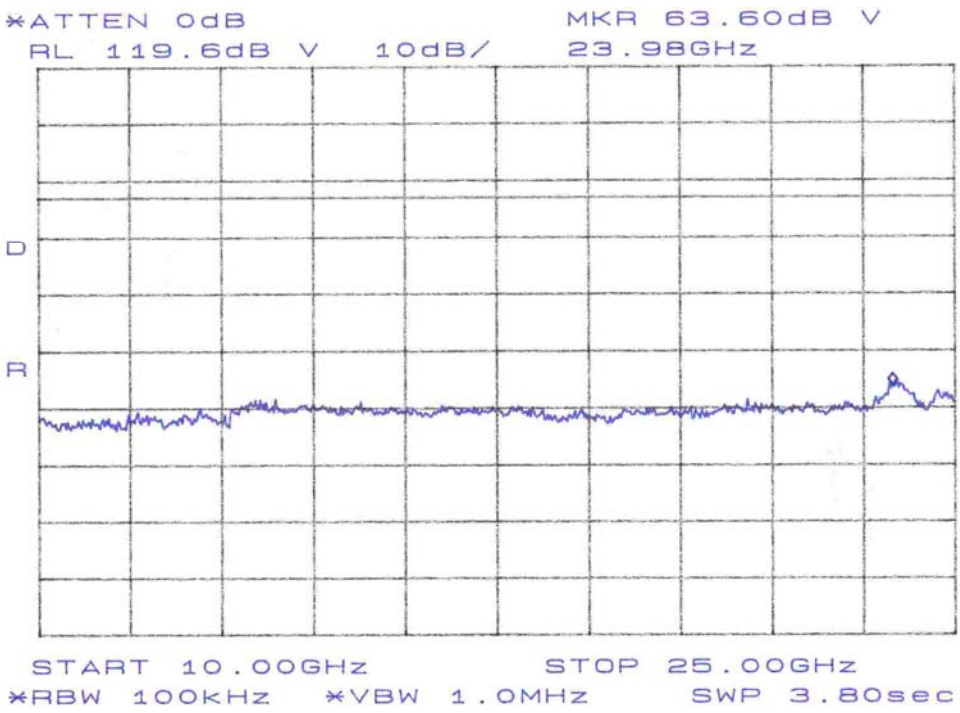

Figure 21. Conducted Spurious Emissions; Ch 11, 10GHz – 25GHz

4.5 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.

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

4.5.1 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 C63.4-2001. 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
Centurion internal antenna	1
Centurion internal antenna	5
Centurion internal antenna	11

These data are supplied in the following tables.

Table 6: Radiated Emission Test Data, Low Frequency

CLIENT:	HHP	DATE:	3/4/2004
TESTER:	Ken Gemmell	JOB #:	8001
EUT Information:		**Test Requirements:**	
EUT:	TT 8870 Radio Card	TEST STANDARD:	FCC Part 15
CONFIGURATION:	Channel 1	DISTANCE:	3m
		CLASS:	B
Test Equipment/Limit:			
ANTENNA:	A_00382	CABLE:	CSITE1_3m
LIMIT:	LFCC_3m_Class_B	AMPLIFIER (dB)	None

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
114.50	V	0.0	1.0	2.7	13.6	1.6	17.9	7.8	150.0	-25.7 **a**
133.54	V	0.0	1.0	8.1	14.0	1.6	23.7	15.4	150.0	-19.8
167.00	V	180.0	1.0	7.6	12.2	1.8	21.5	11.9	150.0	-22.0
239.58	V	270.0	1.0	11.0	11.6	2.0	24.6	17.0	200.0	-21.4
266.00	V	270.0	1.0	8.4	12.8	2.2	23.4	14.7	200.0	-22.7
400.00	V	180.0	1.0	15.9	15.5	2.5	33.9	49.8	200.0	-12.1
114.50	V	0.0	3.8	3.5	13.6	1.6	18.7	8.6	150.0	-24.9 **a**
133.54	V	45.0	3.8	12.2	14.0	1.6	27.8	24.6	150.0	-15.7
167.00	V	180.0	3.5	14.9	12.2	1.8	28.8	27.6	150.0	-14.7
239.58	V	90.0	2.0	15.8	11.6	2.0	29.4	29.5	200.0	-16.6
266.00	V	270.0	2.0	15.6	12.8	2.2	30.6	33.7	200.0	-15.5
400.00	V	270.0	1.0	18.5	15.5	2.5	36.5	67.1	200.0	-9.5

a = ambient level reading

Table 7. Radiated Emission Test Data, High Frequency

CLIENT:	HHP	DATE:	3/3/2004
TESTER:	Ken Gemmell	JOB #:	8001
EUT Information:		Test Requirements:	
EUT:	TT 8870 Radio Card	TEST STANDARD:	FCC Part 15
CONFIGURATION:	Channel 11	DISTANCE:	3m
CLASS:	B		
Test Equipment/Limit:			
ANTENNA:	A_00425	CABLE:	CSITE1_HF
LIMIT:	LFCC_3m_Class_B	AMPLIFIER (dB)	A_00066

Peak Data

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
1012.03	V	180.0	1.0	51.2	25.2	2.2	36.5	42.1	127.2	5000.0	-31.9
1056.07	V	180.0	1.0	50.5	25.4	2.2	36.4	41.7	122.3	5000.0	-32.2
1552.00	V	180.0	1.0	49.0	27.7	2.3	35.8	43.2	144.7	5000.0	-30.8
4924.00	V	180.0	1.0	49.7	33.5	4.1	36.0	51.3	366.6	5000.0	-22.7
7386.00	V	0.0	1.0	44.8	37.8	5.1	35.9	51.7	385.0	5000.0	-22.3
12310.00	V	0.0	1.0	46.2	41.1	6.7	35.5	58.5	838.5	5000.0	-15.5
1012.03	H	180.0	1.0	54.2	25.2	2.2	36.5	45.1	179.7	5000.0	-28.9
1056.07	H	180.0	1.0	53.0	25.4	2.2	36.4	44.2	163.1	5000.0	-29.7
1552.00	H	180.0	1.0	47.2	27.7	2.3	35.8	41.4	117.2	5000.0	-32.6
4924.00	H	180.0	1.0	50.0	33.5	4.1	36.0	51.6	380.8	5000.0	-22.4
7386.00	H	0.0	1.0	45.8	37.8	5.1	35.9	52.7	431.9	5000.0	-21.3
12310.00	H	0.0	1.0	45.5	41.1	6.7	35.5	57.8	776.2	5000.0	-16.2

Table 7. Radiated Emission Test Data, High Frequency (continued)

Average Data

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Hght (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amp Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
1012.03	V	180.0	1.0	41.8	25.2	2.2	36.5	32.8	43.4	500.0	-21.2
1056.07	V	180.0	1.0	40.3	25.4	2.2	36.4	31.6	37.9	500.0	-22.4
1552.00	V	180.0	1.0	37.0	27.7	2.3	35.8	31.2	36.4	500.0	-22.8
4924.00	V	180.0	1.0	36.3	33.5	4.1	36.0	37.9	78.9	500.0	-16.0
7386.00	V	0.0	1.0	33.2	37.8	5.1	35.9	40.0	100.6	500.0	-13.9
12310.00	V	0.0	1.0	33.8	41.1	6.7	35.5	46.1	202.5	500.0	-7.8
1012.03	H	180.0	1.0	48.8	25.2	2.2	36.5	39.8	97.2	500.0	-14.2
1056.07	H	180.0	1.0	48.3	25.4	2.2	36.4	39.6	95.3	500.0	-14.4
1552.00	H	180.0	1.0	36.2	27.7	2.3	35.8	30.4	33.0	500.0	-23.6
4924.00	H	180.0	1.0	37.0	33.5	4.1	36.0	38.6	85.3	500.0	-15.4
7386.00	H	0.0	1.0	33.7	37.8	5.1	35.9	40.5	106.5	500.0	-13.4
12310.00	H	0.0	1.0	34.0	41.1	6.7	35.5	46.3	206.5	500.0	-7.7

4.6 Band Edge Measurements

Band edge measurements at 2390MHz and 2483MHz were made with the unit transmitting in the low end of the channel range and the high end closest to the restricted bands respectively. The emissions were made on the OATS and the table lists the corrected levels of the emissions at the band edge for comparison to the limit. Table 8 shows the band edge emissions.

Both Peak and Average measurements were made at the band edge.

Table 8. Band Edge Measurements

CLIENT: *Hand Held Products* DATE: *3/31/2004*
TESTER: *Steve Koster* JOB #: *8001*

EUT Information:
EUT: *Model*
CONFIGURATION: *Transmitting*
CLOCKS: *2.412, and 2.463 GHz*
S/N:

Test Requirements:
TEST STANDARD: *FCC Part 15*
DISTANCE: *3m*
CLASS: *B*

Test Equipment/Limit:
ANTENNA A_00425
CABLE: CSITE1_HF
LIMIT: LFCC_3m_Class_B
AMPLIFIER (dB) A_00066

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amplifier Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
2390.00	H	180.0	1.0	46.0	29.9	2.9	35.6	43.2	144.6	5000.0	-30.8
2390.00	H	180.0	1.0	35.1	29.9	2.9	35.6	32.3	41.2	500.0	-21.7
2390.00	V	270.0	1.0	68.6	29.9	2.9	35.6	65.8	1939.3	5000.0	-8.2
2390.00	V	270.0	1.0	52.3	29.9	2.9	35.6	49.5	298.6	500.0	-4.5
2483.50	H	225.0	1.0	49.0	30.0	3.0	35.6	46.4	209.6	500.0	-7.6
2483.50	H	225.0	1.0	37.4	30.0	3.0	35.6	34.8	54.9	500.0	-19.2
2483.50	V	225.0	1.0	68.5	30.0	3.0	35.6	65.9	1971.5	5000.0	-8.1
2483.50	V	225.0	1.0	50.8	30.0	3.0	35.6	48.2	256.9	500.0	-5.8

4.7 AC Powerline Conducted Emissions: (FCC Part §15.207)

The EUT was placed on an 80 cm high 1 x 1.5 m non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω/50 μH Line Impedance Stabilization Network bonded to a 3 x 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 450 kHz to 30 MHz were measured. The detector function was set to quasi-peak or peak, as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth.

Data is recorded in Table 7.

Table 9: Conducted Emissions Test Data; 15.207

CLIENT:	HHP	DATE:	3/4/2004
JOB #:	8001	TEST SITE:	CSITE1_CE
MODEL:	TT 8870 Radio Card	CLASS:	FCC_B
TESTER:	Ken Gemmell	TEST STANDARD:	FCC Part 15
TEST VOLTAGE:	120 VAC		

LINE 1 - NEUTRAL

Frequency MHz	Level QP dBuV	Cable Loss dB	Limit QP dBuV	Margin QP dB	Level AVG dBuV	Cable Loss dB	Limit AVG dBuV	Margin AVG dB
0.17	34.8	10.6	64.9	-19.5	17.4	10.6	54.9	-26.9
0.35	25.0	10.8	59.1	-23.3	19.6	10.8	49.1	-18.7
1.18	13.8	10.9	56.0	-31.3	13.8	10.9	46.0	-21.3
9.53	22.0	11.4	60.0	-26.6	22.0	11.4	50.0	-16.6
13.98	21.2	11.6	60.0	-27.2	21.2	11.6	50.0	-17.2
20.26	20.4	11.9	60.0	-27.7	20.4	11.9	50.0	-17.7

LINE 2 - PHASE

Frequency MHz	Level QP dBuV	Cable Loss dB	Limit QP dBuV	Margin QP dB	Level AVG dBuV	Cable Loss dB	Limit AVG dBuV	Margin AVG dB
0.17	32.4	10.6	64.9	-21.9	19.6	10.6	54.9	-24.7
0.35	31.8	10.8	59.1	-16.5	20.2	10.8	49.1	-18.1
1.18	16.5	10.9	56.0	-28.6	16.5	10.9	46.0	-18.6
9.53	22.8	11.4	60.0	-25.8	22.8	11.4	50.0	-15.8
13.98	20.9	11.6	60.0	-27.5	20.9	11.6	50.0	-17.5
20.26	19.8	11.9	60.0	-28.3	19.8	11.9	50.0	-18.3