



Locus Inc.

Application
For Certification

**Locus 802.11b MiniPCI Radio Module with
2400LX-500mW Bi-Directional Amplifier**

FCC ID: OQ70S2401

June 2003



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1.0 GENERAL DESCRIPTION

1.1 Related Submittals Grants

This is single application of the *Locus 802.11b MiniPCI Radio Module with Bi-Directional Amplifier Model: 2400LX-500mW* for Certification under FCC Part 15, Subpart C.

There are no other simultaneous applications.

The Receiver portion will be verified under Declaration of Conformity.

1.2 Product Description

The *Locus 802.11b MiniPCI Radio Module* (Further: *MiniPCI Radio*) is an industrial radio provides a wireless Ethernet communication. The *MiniPCI Radio* is a Digitally Modulated Intentional Radiator operating at 11 channels within 2400 - 2483.5MHz frequency band under **CFR 47:2002**, Section 15.247. The intended use of the *MiniPCI Radio* unit is to generate a RF signal, deliver the signal directly or through external amplifier to the antenna in order to communicate with the *remote OS2400* series radios. The system includes *MiniPCI Radio* and *Bi-Directional Amplifier Model # 2400LX-500mW with DC Injector* manufactured by RF Linx Corp. The *MiniPCI Radio* is connected to the computer via Ethernet, or Serial cable; the *MiniPCI Radio* RF Output port connected to *DC Injector* input port and *DC Injector* output port connected to the RF Input port of the *Amplifier*, and the antenna connected to the RF Output port of the *Amplifier*; both *MiniPCI Radio* and *DC Injector* are powered at 120VAC/60Hz through Power Adapters. The *MiniPCI Radio* could operate without *Amplifier*. In order to demonstrate compliance with FCC regulations the *MiniPCI Radio* has been tested stand alone and with *Amplifier*.

Antennas:

Five Antennas have been tested with *MiniPCI Radio* (without *Amplifier*) in order to demonstrate compliance with FCC requirements. Measurements were performed on the highest gain antenna of each type.

Type	Pattern	Manufacturer	Manufacturer's p/n	Gain (dBi)	Connector	Locus p/n
½ Wave art.	Omni	Nearson	S181AH-2450S	2	SMA-RP	540-0002
Collinear Array	Omni	Mobile Mark	OD12-2400	12	N-RP	540-0038
Collinear Array	Omni	Mobile Mark	OD9-2400	9	N-RP	540-0037
Patch	Directional	Arc Wireless	AAI-000-84	19	N-RP	540-0035
Yagi	Directional	Maxrad	MYP24013PTR PNF	13.5	N-RP	540-0009
Parabolic	Directional	Pacific Wireless	PMANT25 PRN	24	N-RP	540-0008
Parabolic	Directional	Pacific Wireless	PMANT15-HD-PF1 PRN	15	N-RP	540-0017

Three Antennas have been tested with *MiniPCI Radio* and *Bi-Directional Amplifier Model # 2400LX-500mW* configuration. Measurements were performed on the highest gain antenna of each type.

Type	Pattern	Manufacturer	Manufacturer's p/n	Gain (dBi)	Connector	Locus p/n
½ Wave art.	Omni	Nearson	S181AH-2450S	2	SMA-RP	540-0002
Collinear Array	Omni	Mobile Mark	OD9-2400	9	N-RP	540-0037
Yagi	Directional	Maxrad	MYP24013PTR PNF	13.5	N-RP	540-0009



1.3 Test Methodology

Emission measurements were performed according to the procedures specified in **ANSI C63.4-1992** and FCC Public Notice DA 00-705: March 30, 2000. All field strength radiated emissions measurements were performed in the semi-anechoic chamber, and for each scan, the procedure for maximizing emissions in Appendices D and E were followed. All field strength 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 test site facility used to collect the radiated and conducted measurement data is located at 7250 Hudson Blvd., Suite 100, Oakdale, Minnesota. This test facility has been fully described in a report dated on March 2003 submitted to the FCC. Please reference the site registration number: 90706, dated April 18, 2003.



2.0 SYSTEM TEST CONFIGURATION

2.1 Justification

None

2.2 EUT Exercising Software

The *MiniPCI Radio* was operated during testing in continuous transmission mode at Channel 1, 5, and 11. The Remote Computer used HSE Finder V. 3, 2, 1, 0 software by Locus Inc. dated April 23, 2003 and WLAN Access Point utility controlled modes of operation.

2.3 Special Accessories

The system *MiniPCI Radio* and *Bi-Directional Amplifier Model # 2400LX-500mW* was tested with RF cable between *Amplifier itself and DC Injector*. Cable LMR400 with cable length of 94ft was used. The minimum insertion loss of the cable is 6.5dB.

2.4 Equipment Modification

No modifications were installed during the testing.

2.5 Support Equipment List and Description

Local Computer: OS2400-HSE, p/n 020-005705

Remote Computer: Gateway Laptop Computer

2.6 Test Configuration Block Diagrams

The *MiniPCI Radio* was installed in the *OS2400-HSE Local Computer* and setup as tabletop equipment. The *OS2400-HSE Local Computer* was connected to the *Remote Computer* via the *Ethernet Cable*. Non-terminated Serial Cable was connected to the *Local Computer* also. For configuration with the *Amplifier*, the *MiniPCI Radio* was connected to the *DC Injector* and the *DC Injector* was connected via RF Cable to the *Amplifier*, the *DC Injector* was powered at 120VAC/60Hz through the Power Adapter CUI INC DSA-0151F-12A 100-240VAC-50-60Hz/12VDC. Two figures below show the EUT configuration with no *Amplifier* (Fig. 2.6.1) and with *Amplifier* (Fig. 2.6.2).

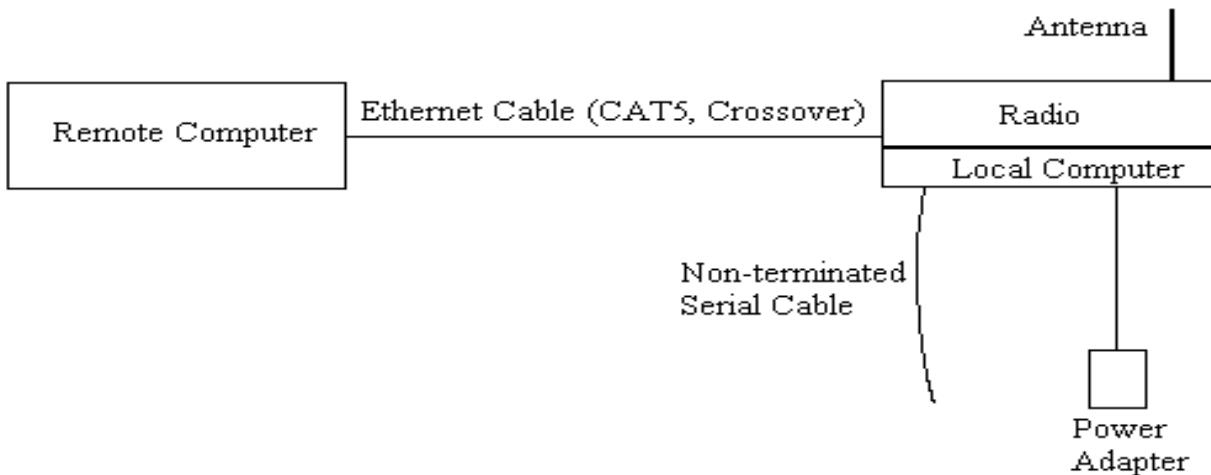


Fig. 2.6.1 EUT Configuration with no Amplifier

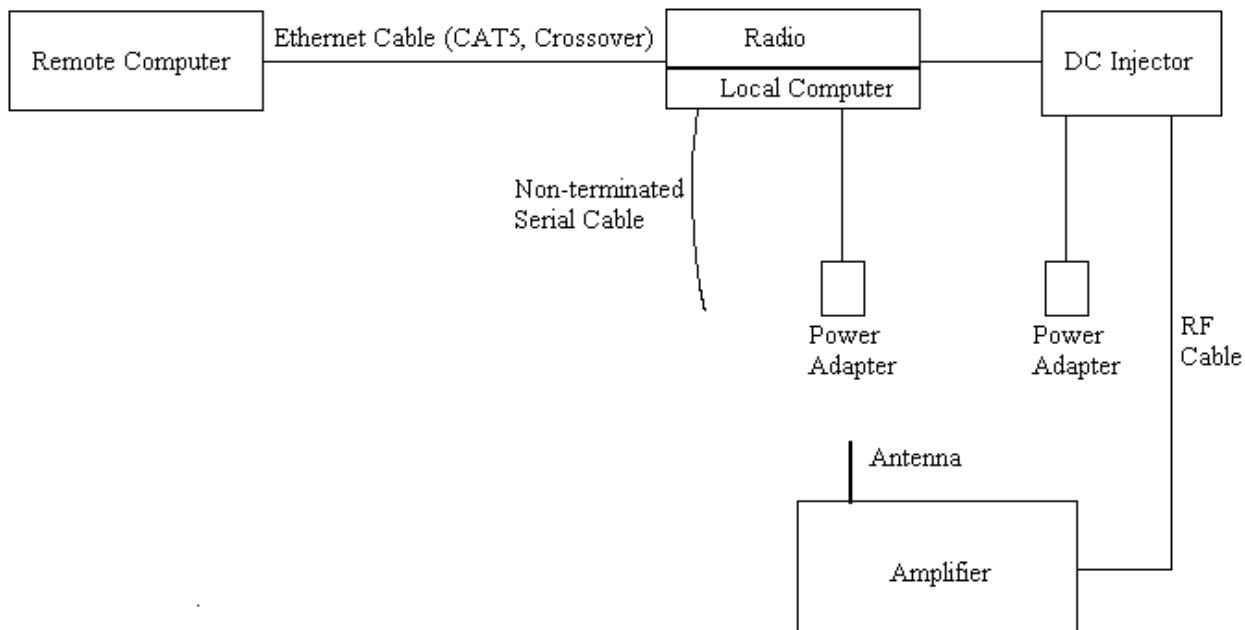


Fig. 2.6.2 EUT Configuration with Amplifier

Measurements at Antenna Terminal

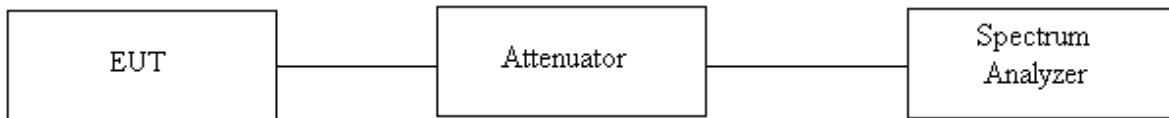


Fig. 2.6.3 Configuration with measurements at the EUT Antenna Terminal

Field Strength Measurements

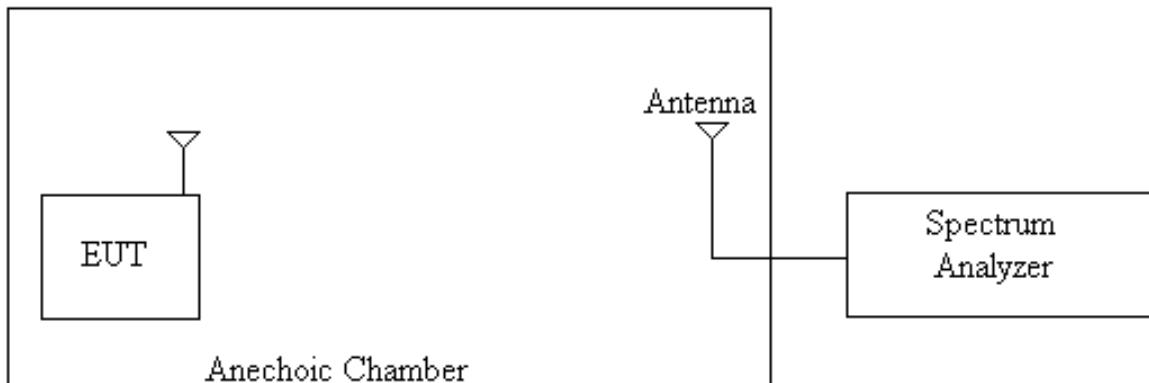


Fig. 2.6.4 Configuration with Field Strength Measurements

3.0 TEST RESULTS

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

The EUT is intended for operation under the requirements of Part 15 Subpart C. Specific test requirements include the following:

47 CFR 15.247(b)(3)	Maximum Peak Output Power
47 CFR 15.247(a)(2)	6dB Bandwidth
47 CFR 15.247(c)	Band Edge Compliance
47 CFR 15.247(c)	Spurious RF Conducted Emissions
47 CFR 15.247(d)	Peak Power Spectral Density
47 CFR 15.247(c) 15.205, 15.209	Radiated Spurious Emissions
47 CFR 15.207	Conducted Emissions

3.1 Maximum Peak Output Power, FCC 15.247(b)(3)

Maximum Peak Output Power measurements were made at the low, center, and high frequency channels (channels 1, 5, and 11), and for both the EUT configurations (with no Amplifier and with Amplifier and RF Cable with 6.5dB attenuation between DC Injector and Amplifier).

Test Procedure

The Peak Power Output for the device was measured at the maximum power transmission condition. The transmitter antenna port was connected to the Spectrum analyzer.

Total Power was calculated from Measured Power adding cable loss between the EUT Antenna Terminal and the Analyzer input.

Table 3-1-1 and Graphs from 3-1-1 to 3-1-6 below show the Maximum Peak Output Power.

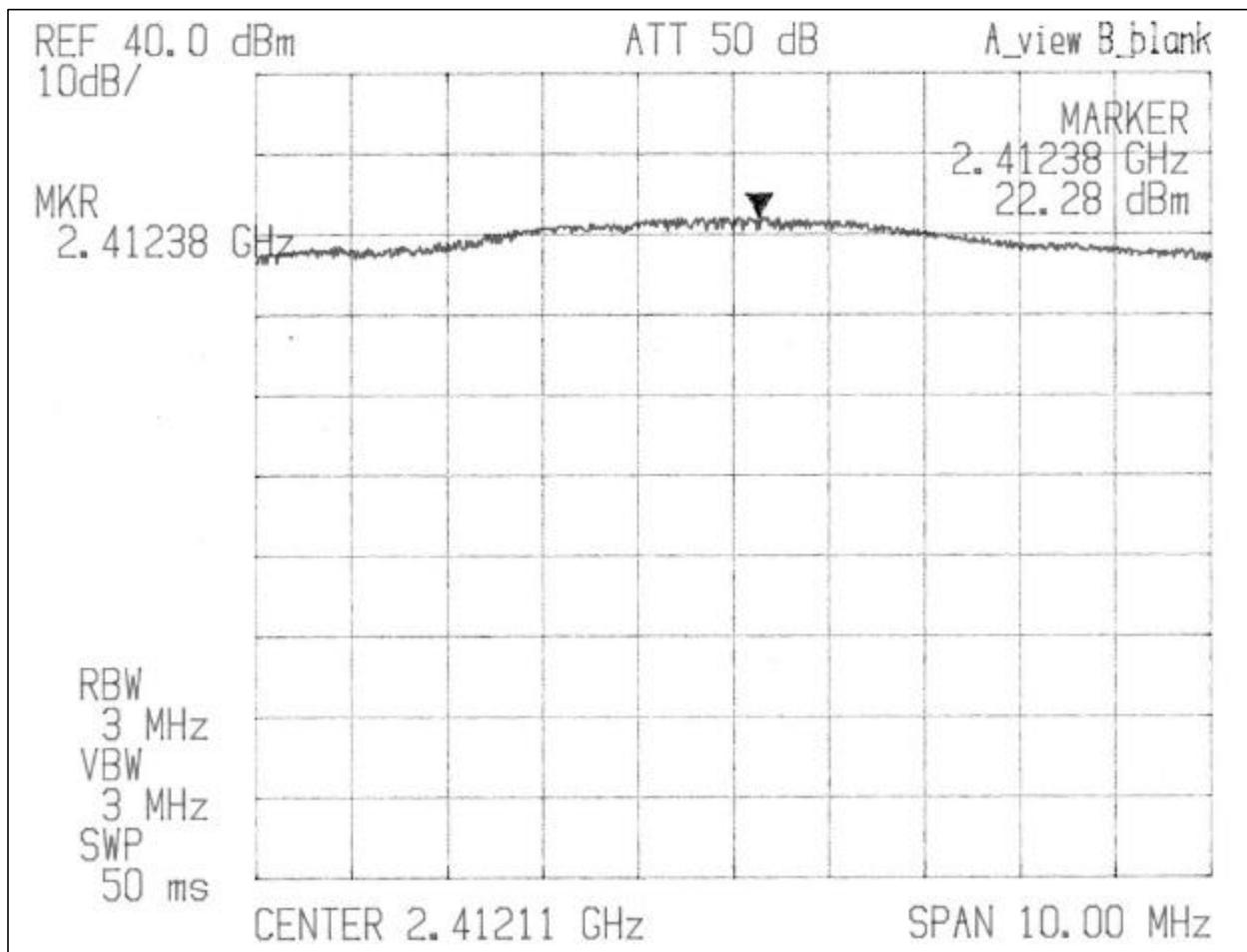
Maximum Peak Output Power

Company: Locus Inc.
Model: MiniPCI Radio
Test Engineer: Norman Shpilsher
Special Info.: The EUT antenna terminal was connected to the Spectrum Analyzer
Standard: FCC Part 15.247(b)(3)

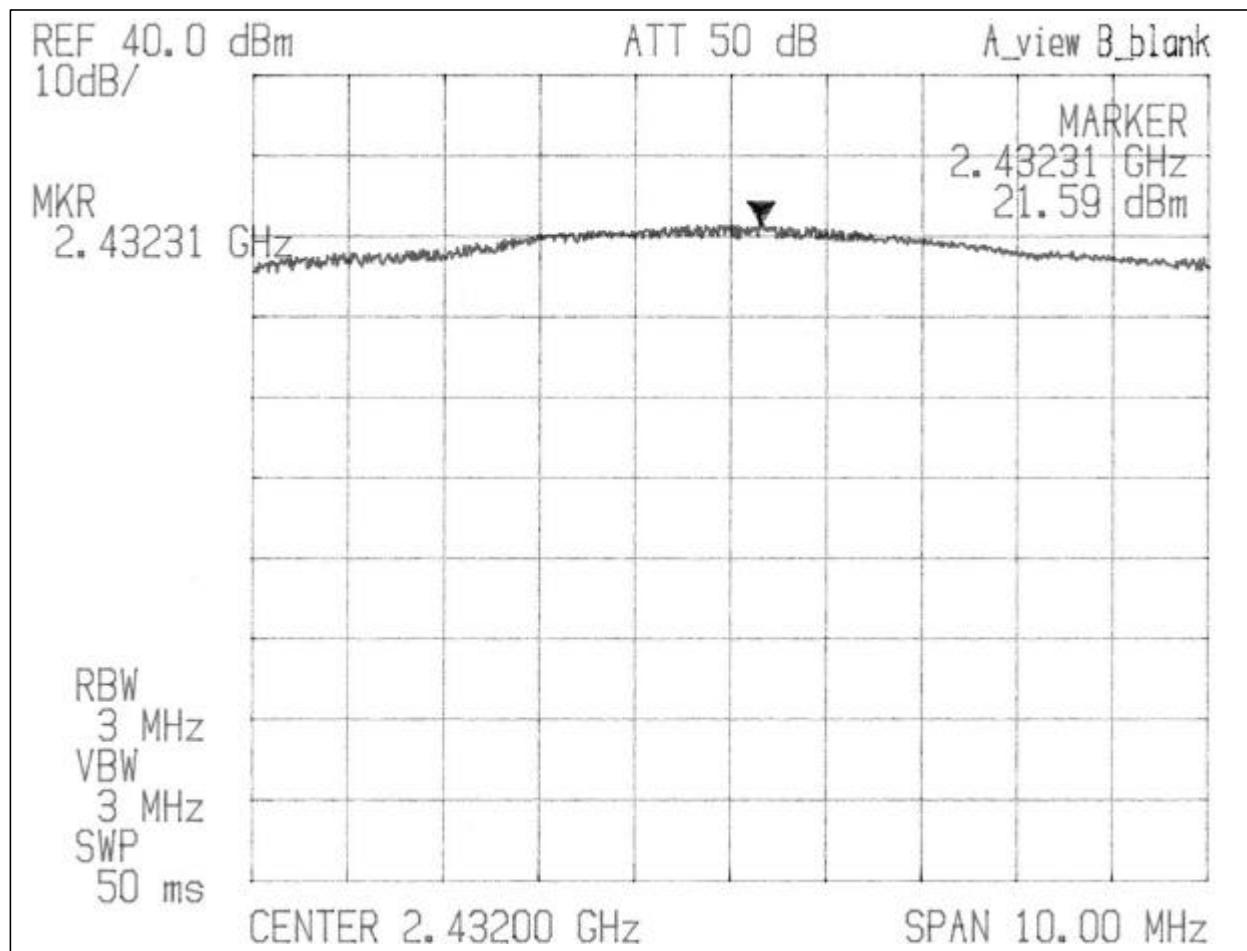
Table # 3-1-1

Output Freq. MHz	Measured Power dBm	Out-of-Analyzer Cable loss dB	Maximum Peak Output Power dBm	Maximum Peak Output Power mW
No Amplifier				
Channel 1	22.28	0.35	22.63	183.23
Channel 5	21.59	0.35	21.94	156.31
Channel 11	19.84	0.35	20.19	104.47
With Amplifier				
Channel 1	25.25	0.50	25.75	375.84
Channel 5	25.78	0.50	26.28	424.62
Channel 11	24.56	0.50	25.06	320.63

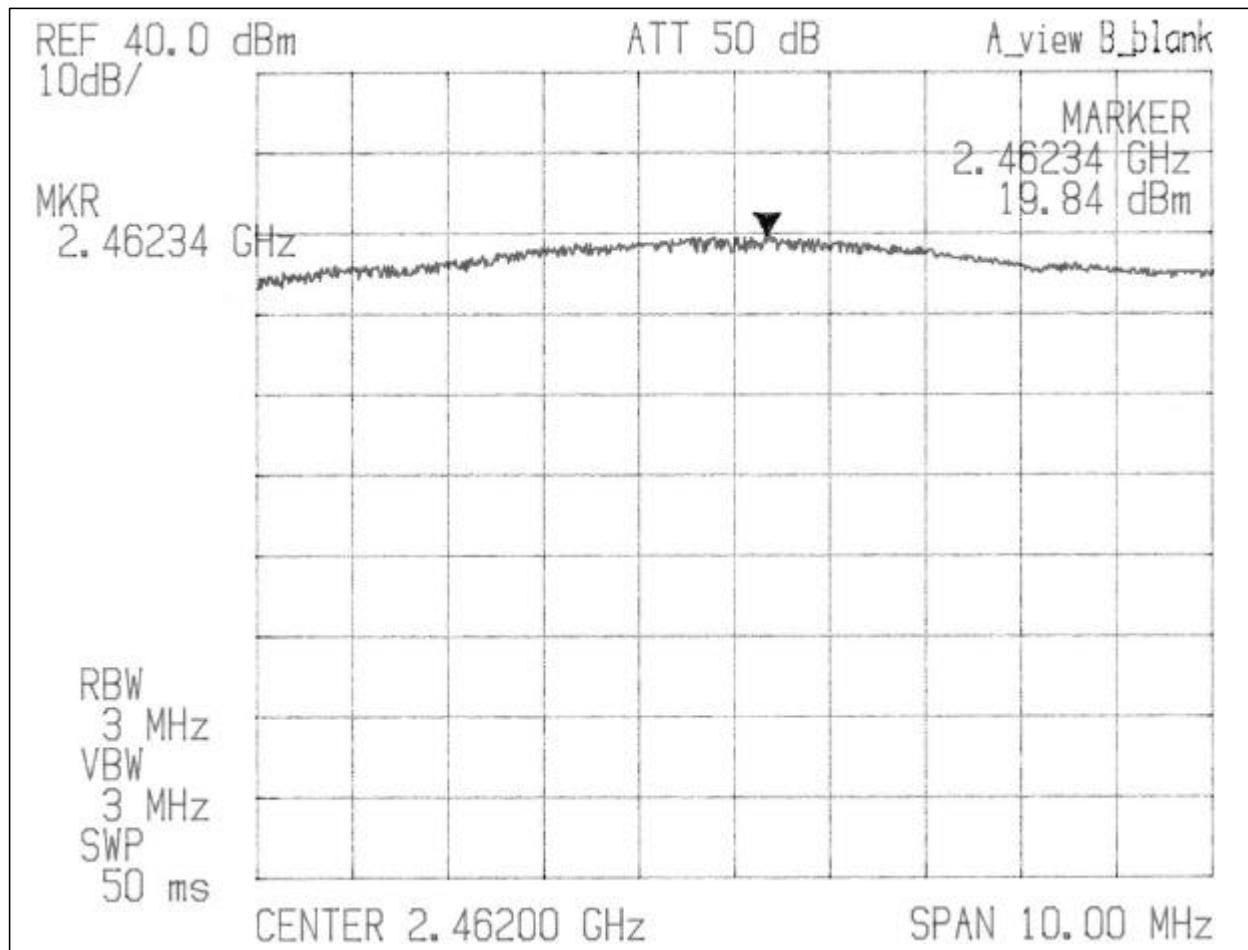
Graph # 3-1-1
Maximum Peak Output Power, Channel 1, No Amplifier



Graph # 3-1-2
Maximum Peak Output Power, Channel 5, No Amplifier

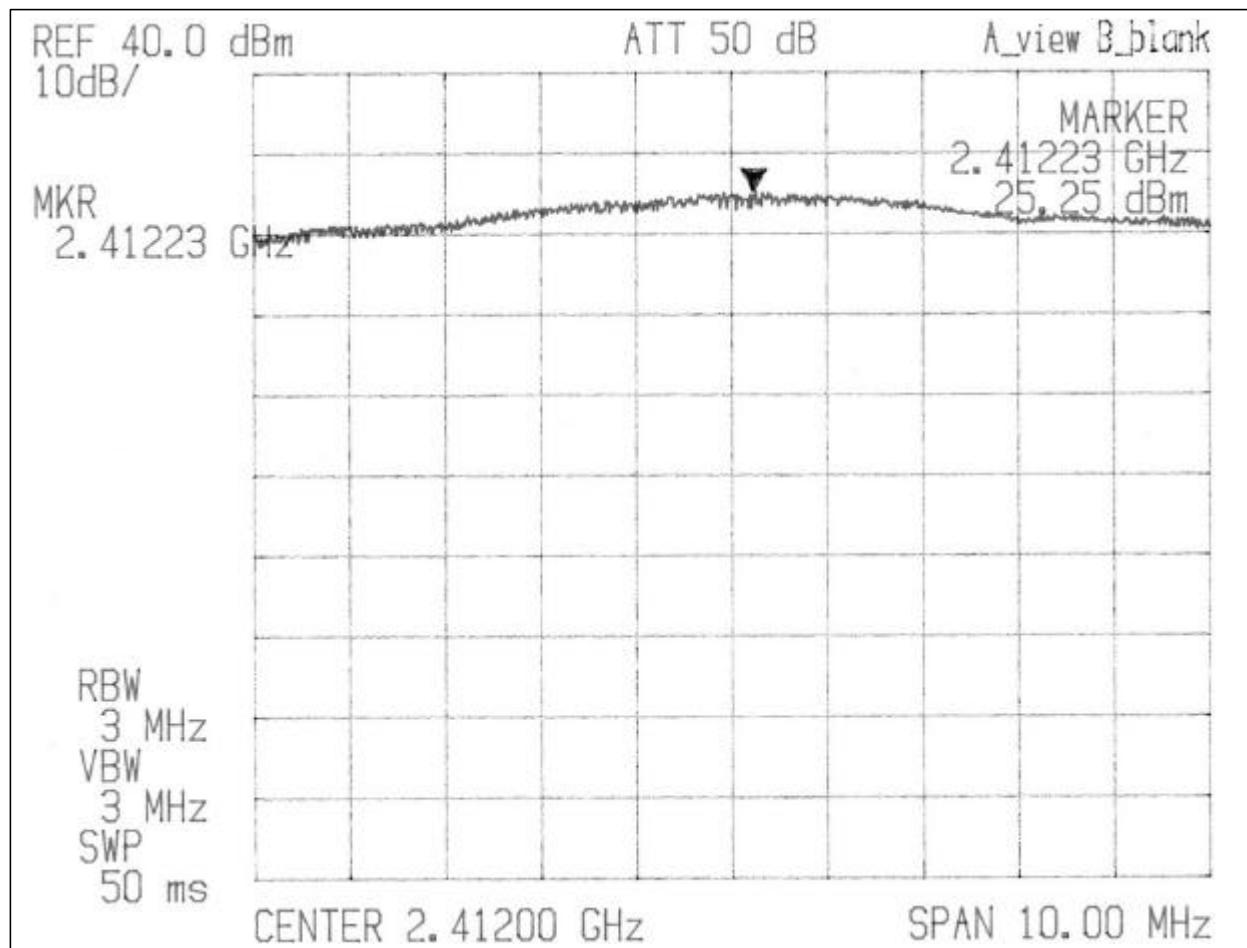


Graph # 3-1-3
Maximum Peak Output Power, Channel 11, No Amplifier



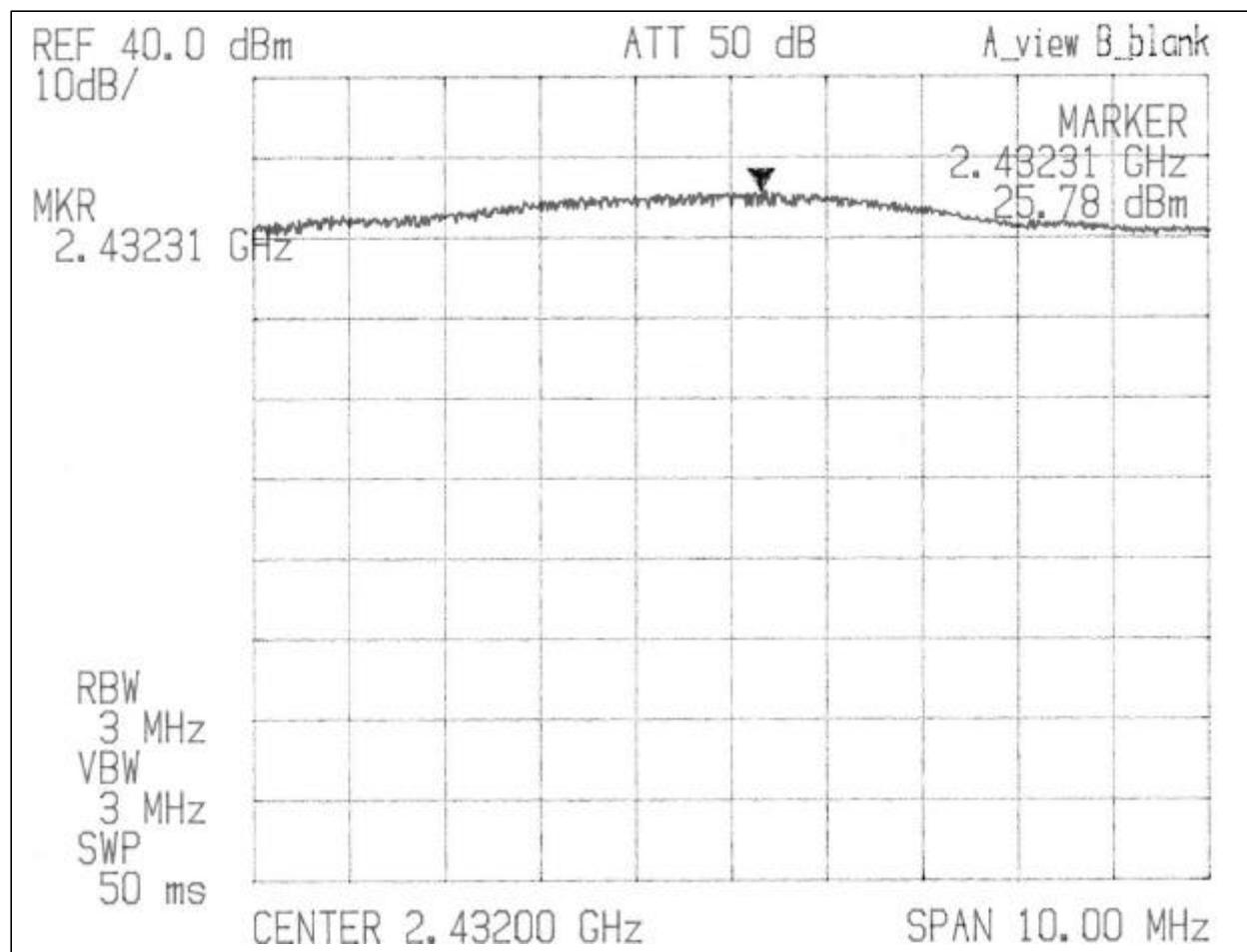
Graph # 3-1-4

Maximum Peak Output Power, Channel 1, With Amplifier

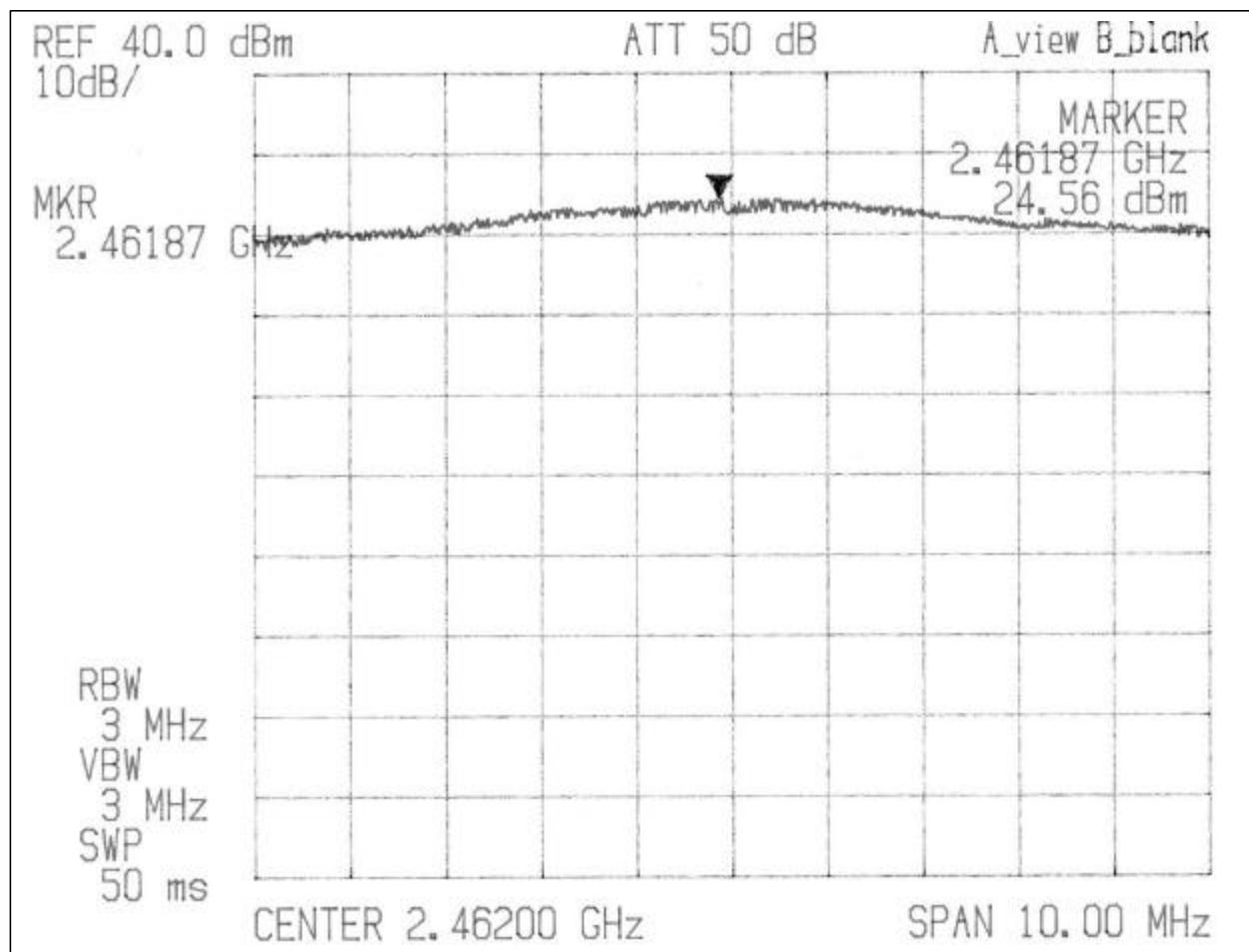


Graph # 3-1-5

Maximum Peak Output Power, Channel 5, With Amplifier



Graph # 3-1-6
Maximum Peak Output Power, Channel 11, With Amplifier



3.1.1 Antennas Compliance with Output Power, FCC 15.247(b)(4), 15.247(b)(4)(i)

The compliance of the EIRP limits for all tested antennas with the measured Maximum Peak Output Power (see Table 3-1-1) was calculated for both Mobile Operation and Fixed, Point-to-Point Operation and for both *MiniPCI Radio* without the Amplifier and *MiniPCI Radio* with the Amplifier configurations (see Tables 3-1-2 and 3-1-3).

Table # 3-1-2

MiniPCI Radio, Without an Amplifier

Antenna Type	Antenna Part No.	Antenna Gain dBi	Power at Antenna Antenna dBm	Max. Power for Fixed, Point-to Point Operation dBm	Margin for Fixed, Point-to Point Operation dB	EIRP Power dBm	Max. Power for Mobile Operation dBm	Margin for Mobile Operation dB	Comments
1/2 Wave	540-0002	2	22.63	30.0	-7.4	24.6	30.0	-5.4	Mobile
Collinear Array	540-0038	12	22.63	28.0	-5.4	34.6	36.0	-1.4	Mobile
Collinear Array	540-0037	9	22.63	29.0	-6.4	31.6	36.0	-4.4	Mobile
Patch	540-0035	19	22.63	25.7	-3.0	41.6	36.0	+5.6	Fixed
Yagi	540-0009	13.5	22.63	27.5	-4.9	36.0	36.0	0.0	Mobile
Parabolic	540-0008	24	22.63	24.0	-1.4	46.6	36.0	+10.6	Fixed
Parabolic	540-0017	15	22.63	27.0	-4.4	37.6	36.0	+1.6	Fixed

Table # 3-1-3

MiniPCI Radio with 2400LX-500mW Amplifier

Antenna Type	Antenna Part No.	Antenna Gain dBi	Power at Antenna Antenna dBm	Max. Power for Fixed, Point-to Point Operation dBm	Margin for Fixed, Point-to Point Operation dB	EIRP Power dBm	Max. Power for Mobile Operation dBm	Margin for Mobile Operation dB	Comments
1/2 Wave	540-0002	2	26.28	30.0	-3.7	28.3	30.0	-1.7	Mobile
Collinear Array	540-0037	9	26.28	29.0	-2.7	35.3	36.0	-0.7	Mobile
Yagi	540-0009	13.5	26.28	27.5	-1.2	39.8	36.0	+3.8	Fixed

3.2 6dB Bandwidth, FCC 15.247(a)(2)

6dB Bandwidth measurements were made at the low, center, and high frequency channels (channels 1, 5, and 11), and for both the EUT configurations (with no Amplifier and with Amplifier and RF Cable with 6.5dB attenuation between DC Injector and Amplifier).

Test Procedure

The 6dB Bandwidth was measured at the maximum power transmission condition. The transmitter antenna port was connected to the Spectrum analyzer.

Table 3-2-1 and Graphs from 3-2-1 to 3-2-6 show the 6dB Bandwidth

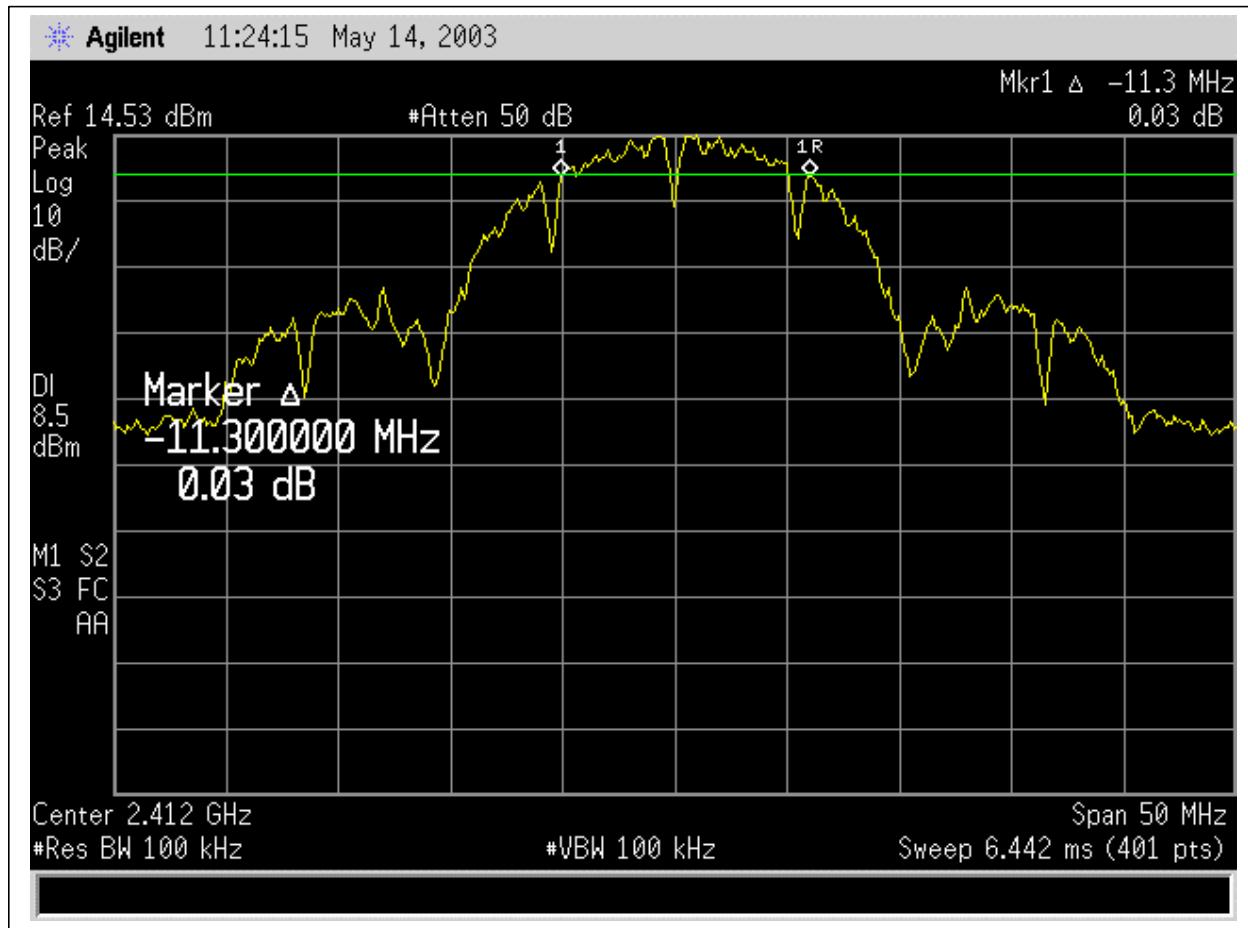
6dB Bandwidth

Company: Locus Inc.
Model: MiniPCI Radio
Test Engineer: Norman Shpilsher
Special Info.: The EUT antenna terminal was connected to the Spectrum Analyzer
Standard: FCC Part 15.247(a)(2)

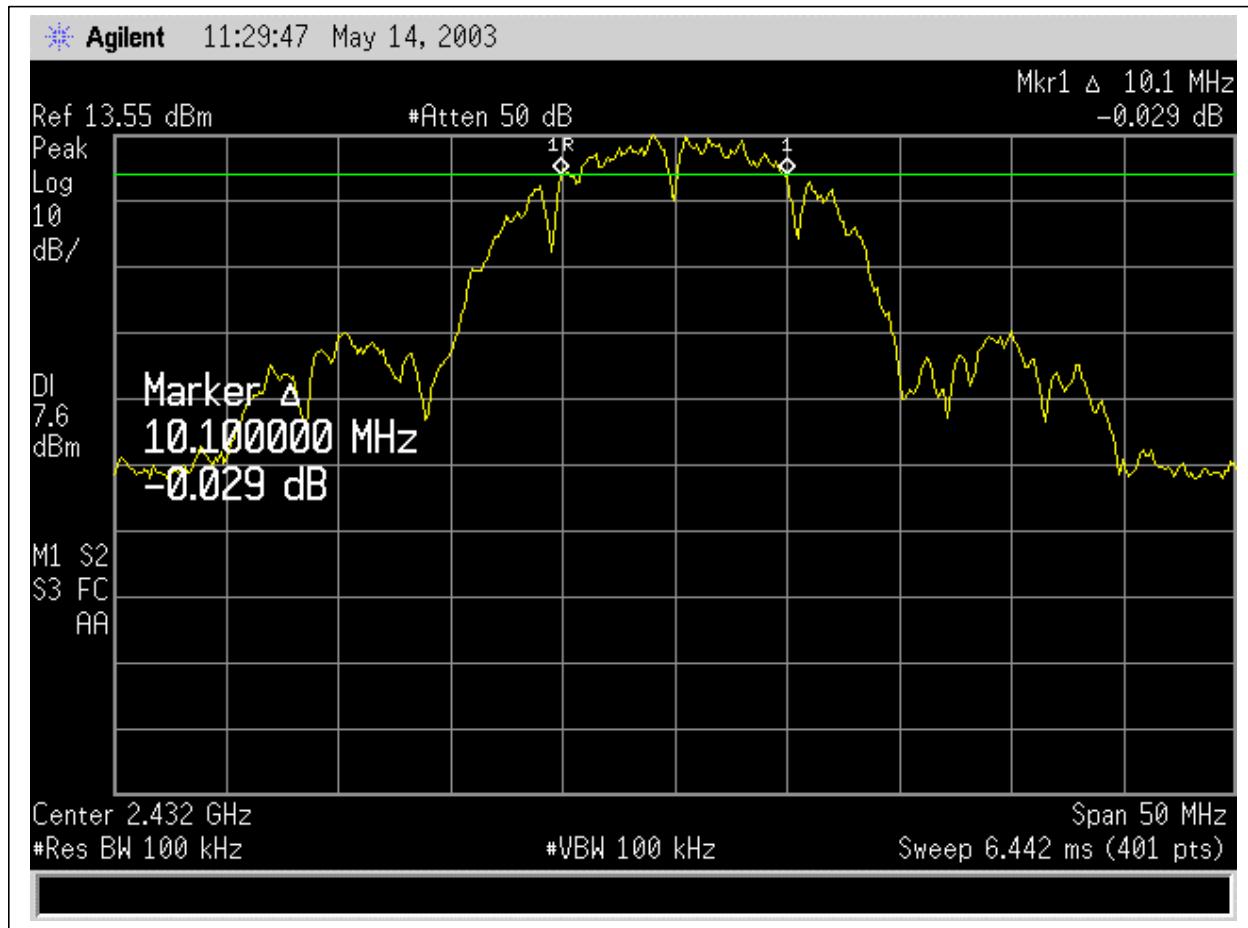
Table # 3-2-1

Output Freq. MHz	Measured 6dB Bandwidth MHz	Minimum 6dB Bandwidth MHz	Result	Comments
No Amplifier				
Channel 1	11.30	0.50	Pass	
Channel 5	10.10	0.50	Pass	
Channel 11	10.30	0.50	Pass	
With Amplifier				
Channel 1	9.90	0.50	Pass	
Channel 5	10.40	0.50	Pass	
Channel 11	10.40	0.50	Pass	

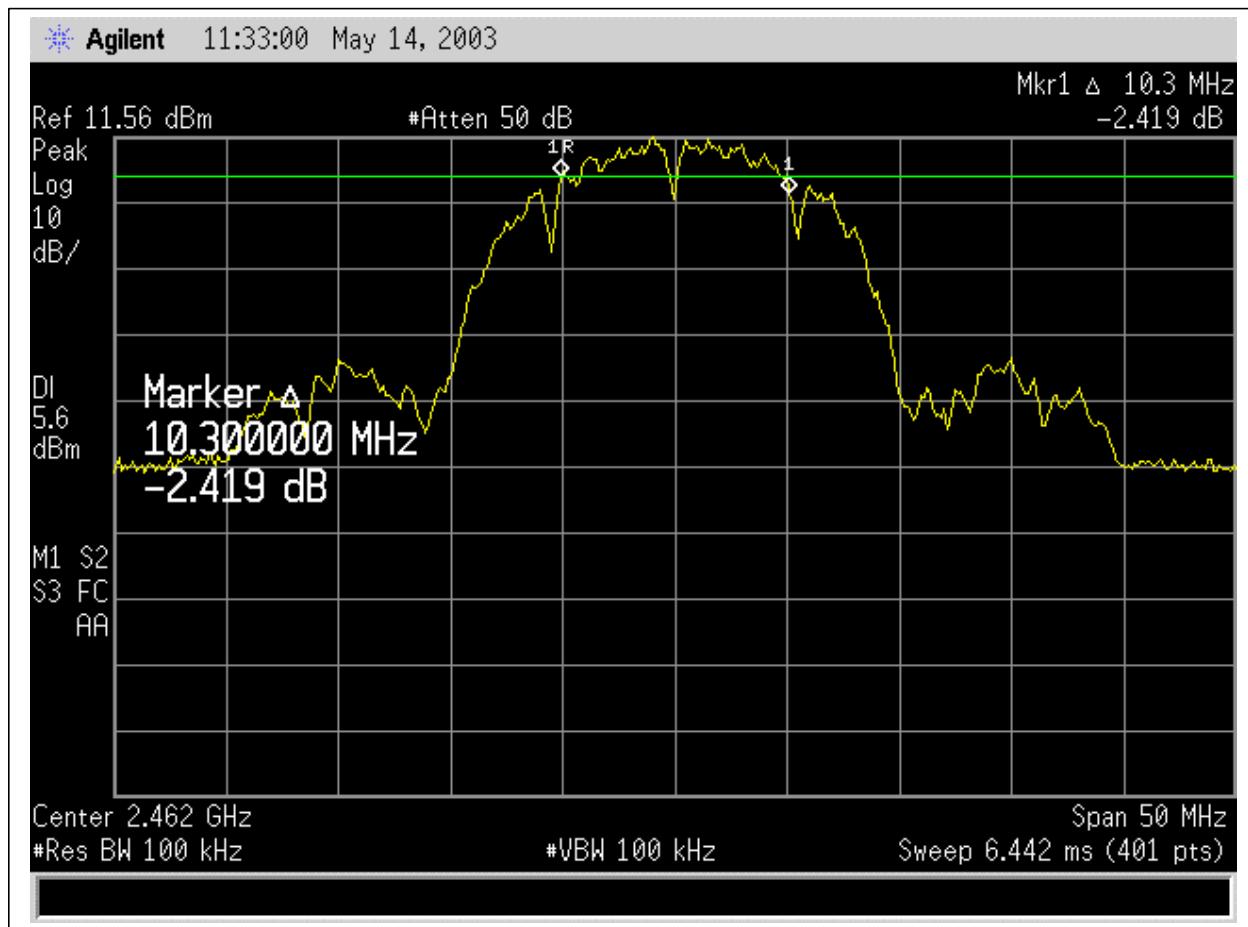
Graph # 3-2-1
6dB Bandwidth, Channel 1, No Amplifier



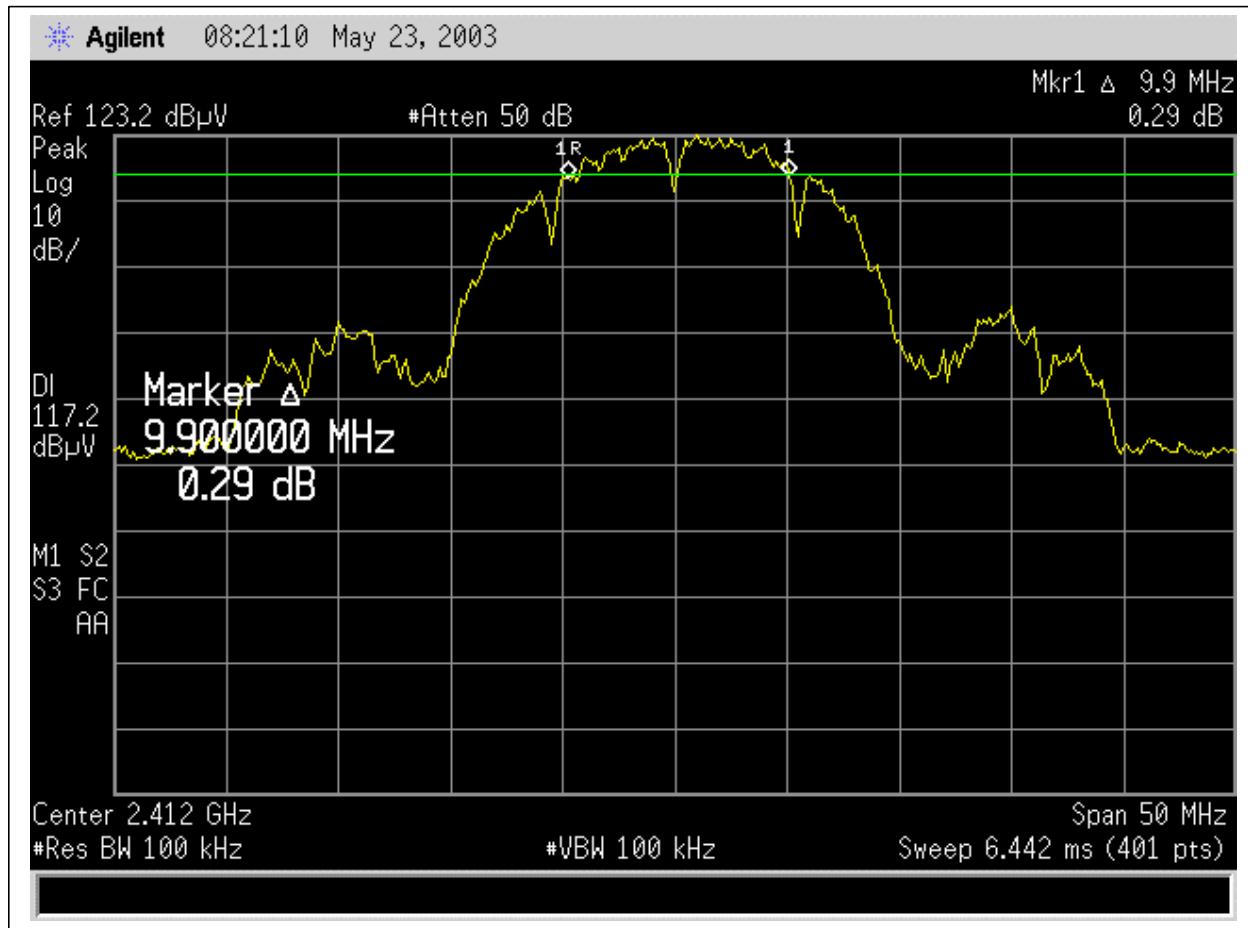
Graph # 3-2-2
6dB Bandwidth, Channel 5, No Amplifier



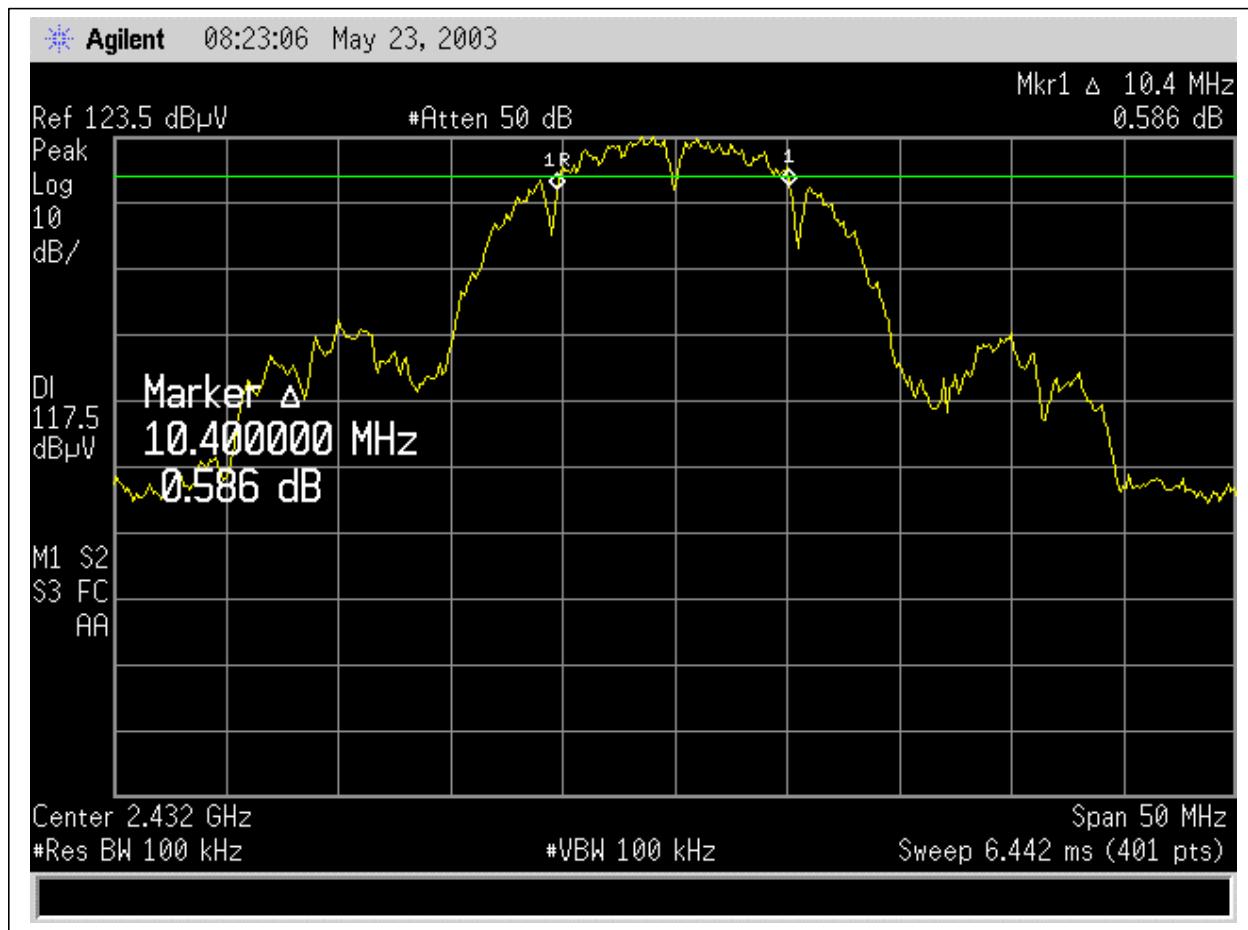
Graph # 3-2-3
6dB Bandwidth, Channel 11, No Amplifier



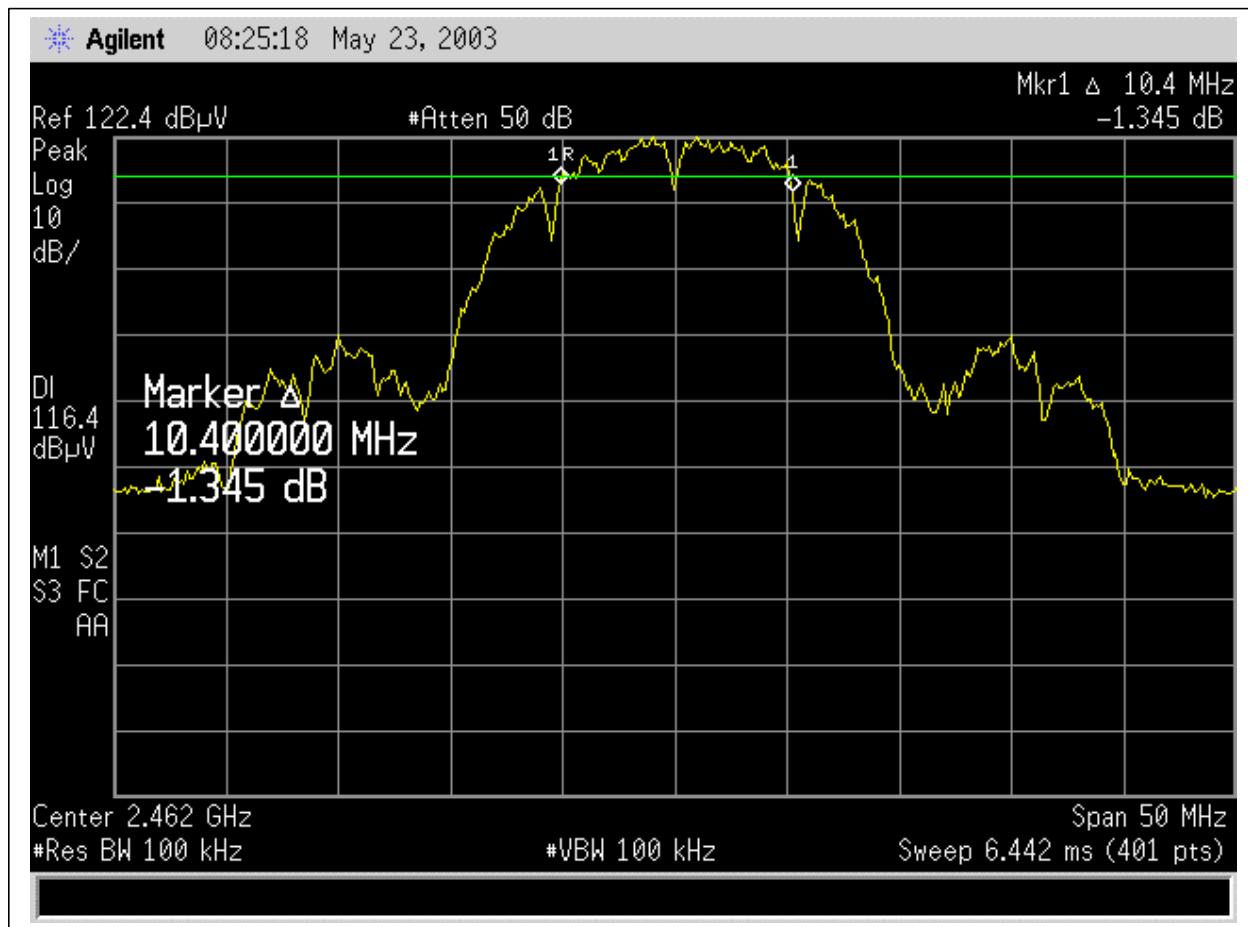
Graph # 3-2-4
6dB Bandwidth, Channel 1, With Amplifier



Graph # 3-2-5
6dB Bandwidth, Channel 5, With Amplifier



Graph # 3-2-6
6dB Bandwidth, Channel 11, With Amplifier



3.3 Band Edge Compliance, FCC 15.247(c)

Left and right band-edge compliance measurements were made at Channels 1, 5, and 11 and for both the EUT configurations (with no Amplifier and with Amplifier and RF Cable with 6.5dB attenuation between DC Injector and Amplifier) for band-edge frequencies of 2400.0 and 2483.5MHz respectively.

Test Procedure

The Spurious Emissions at the Antenna Terminal of the EUT were measured at the maximum power. The transmitter antenna port was connected to the Spectrum Analyzer.

The Band-Edge Emissions Attenuation calculation

The Band-Edge Emissions Attenuation was calculated using the Channel output power and spurious emissions at band-edges of 2400.0 and 2483.5MHz respectively.

Table 3-3-1 and Graphs from 3-3-1 to 3-3-12 show the band-edge emissions attenuation at the antenna terminal.

Band Edge Spurious Emissions at Antenna Terminal

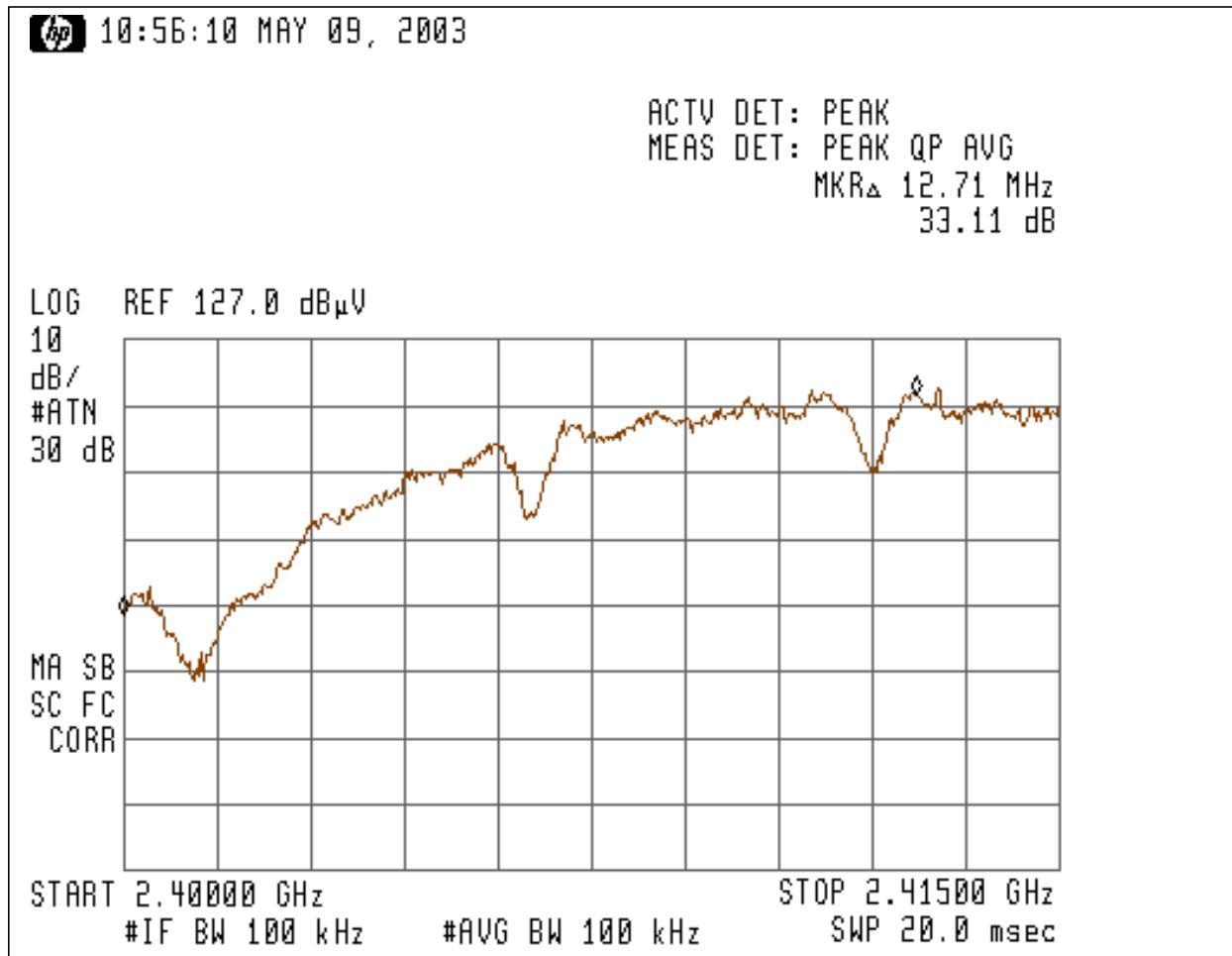
Company: Locus Inc.
Model: MiniPCI Radio
Test Engineer: Norman Shpilsher
Special Info: The EUT antenna terminal was connected to the Spectrum Analyzer
Standard: FCC Part 15.247(c)

Table # 3-3-1

Channel	Edge Freq. MHz	Channel Max. Power dBuV	Measured Atten. dB	Minimum Atten. dB	Margin
No Amplifier					
Channel 1	2400.00	119.4	33.1	20.0	-13.1
Channel 1	2483.50	119.4	63.9	20.0	-43.9
Channel 5	2400.00	118.8	58.5	20.0	-38.5
Channel 5	2483.50	118.8	61.0	20.0	-41.0
Channel 11	2400.00	119.2	60.8	20.0	-40.8
Channel 11	2483.50	119.2	44.8	20.0	-24.8
With Amplifier					
Channel 1	2400.00	123.1	27.5	20.0	-7.5
Channel 1	2483.50	123.1	55.6	20.0	-35.6
Channel 5	2400.00	123.9	56.0	20.0	-36.0
Channel 5	2483.50	123.9	56.6	20.0	-36.6
Channel 11	2400.00	122.8	53.9	20.0	-33.9
Channel 11	2483.50	122.8	51.9	20.0	-31.9

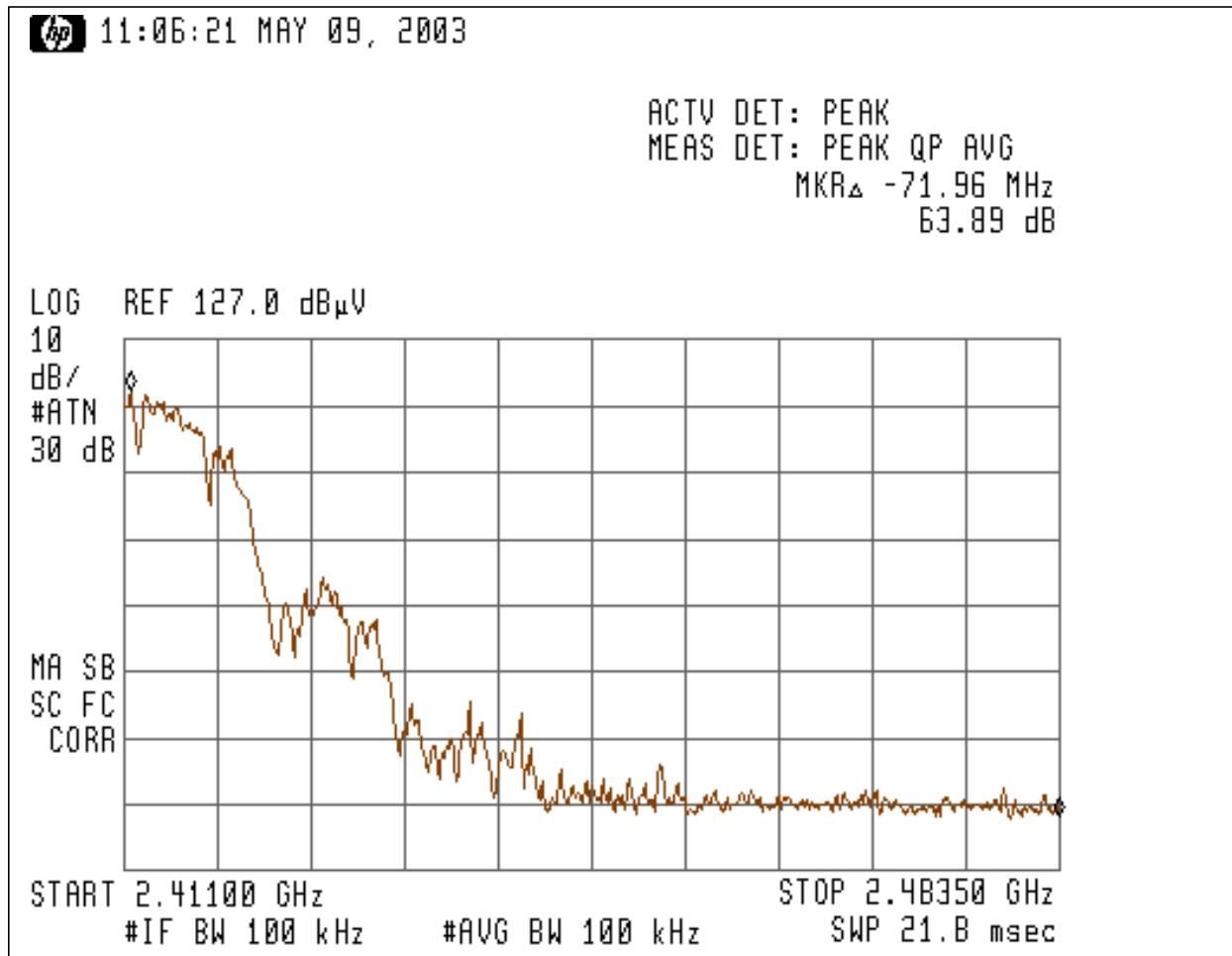
Graph # 3-3-1

Band Edge Emissions at 2400MHz, Channel 1, No Amplifier



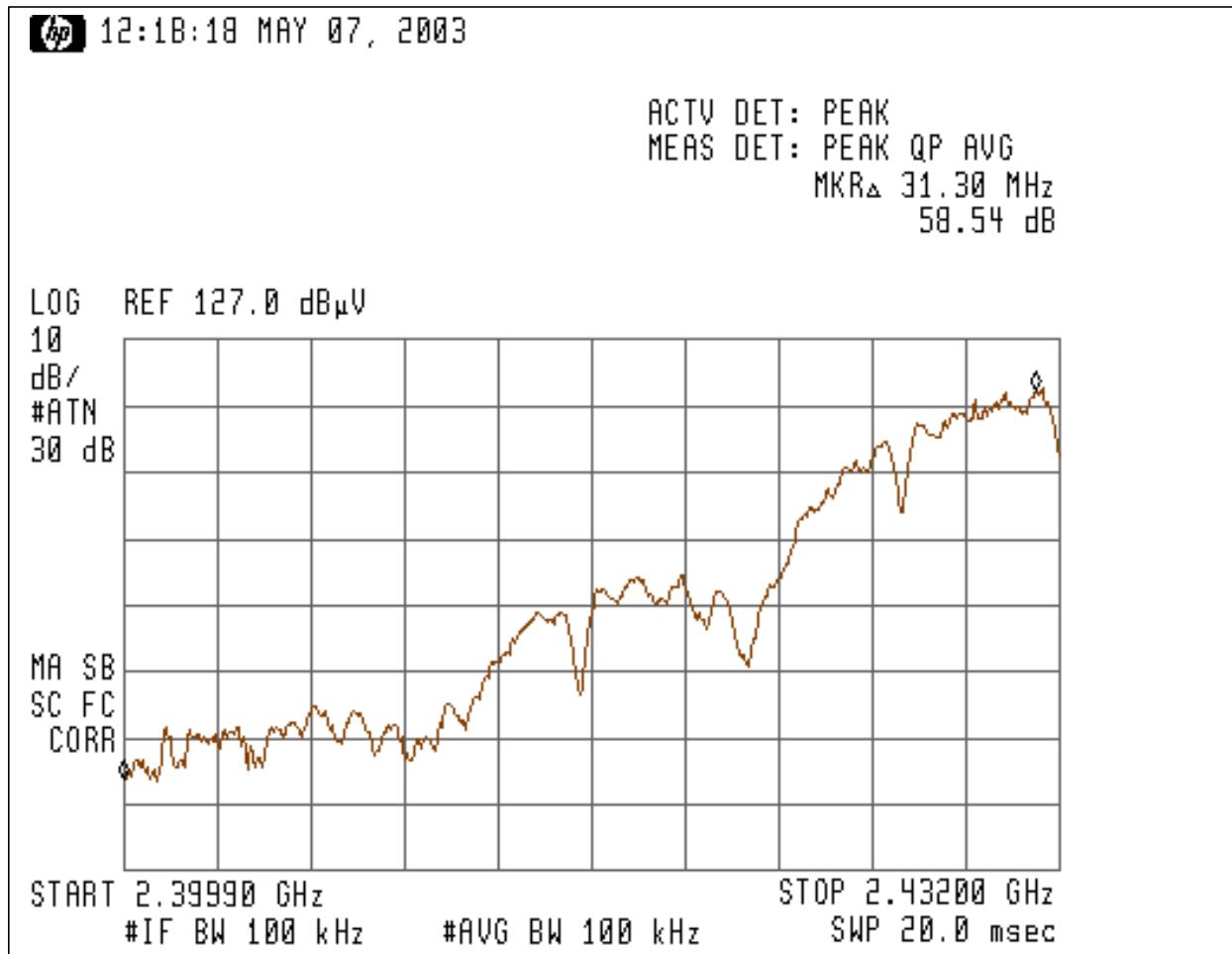
Graph # 3-3-2

Band Edge Emissions at 2483.5MHz, Channel 1, No Amplifier



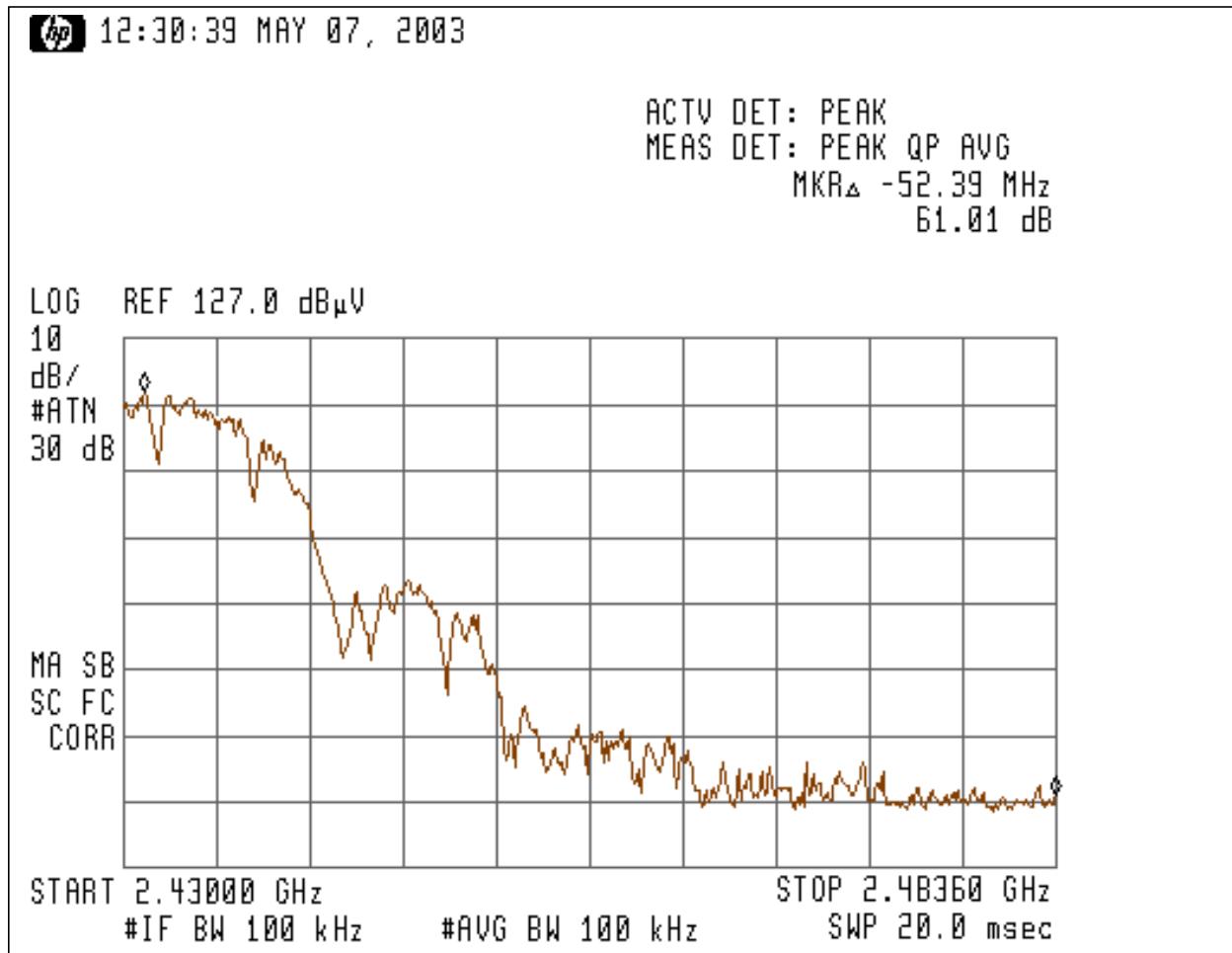
Graph # 3-3-3

Band Edge Emissions at 2400MHz, Channel 5, No Amplifier



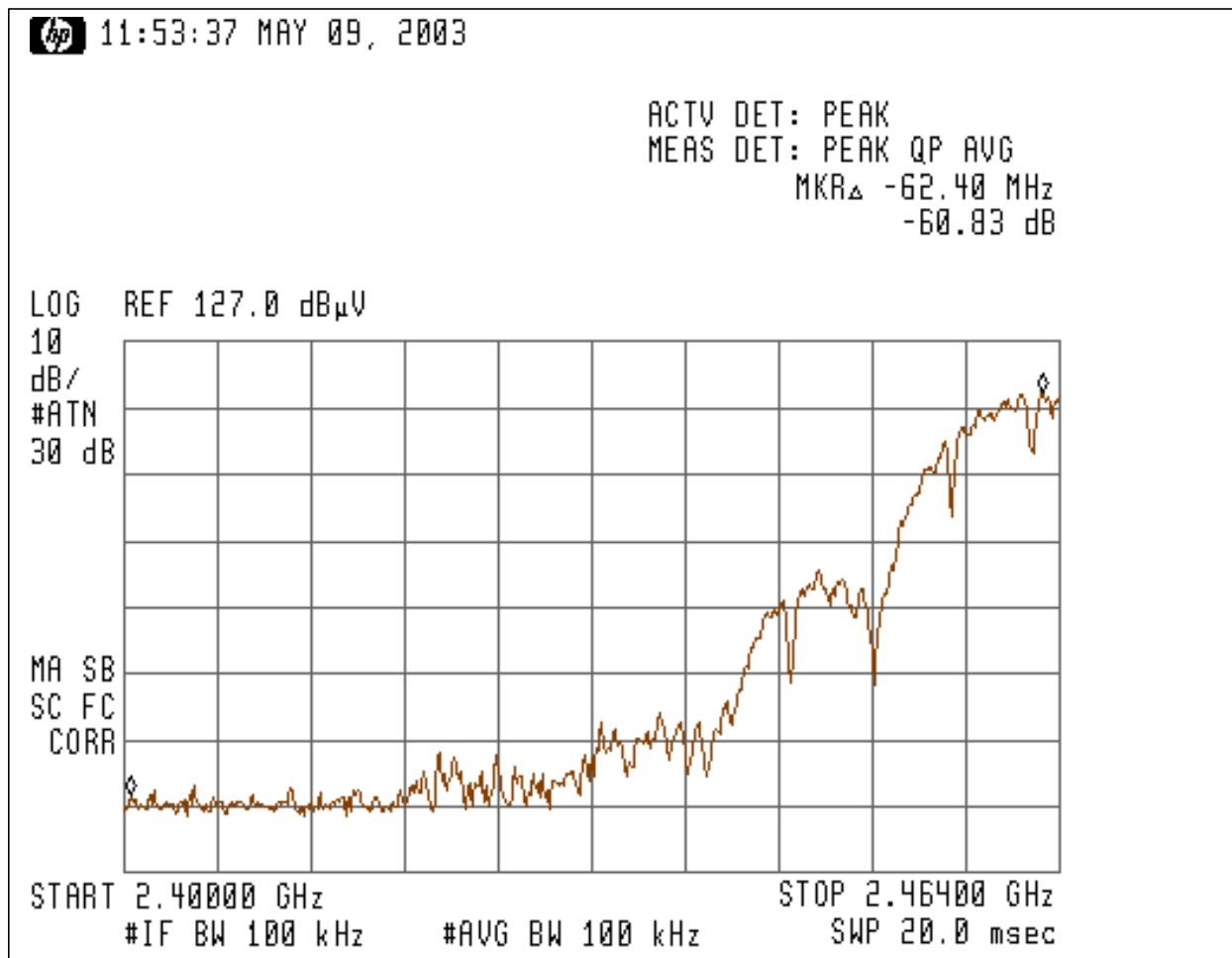
Graph # 3-3-4

Band Edge Emissions at 2483.5MHz, Channel 5, No Amplifier



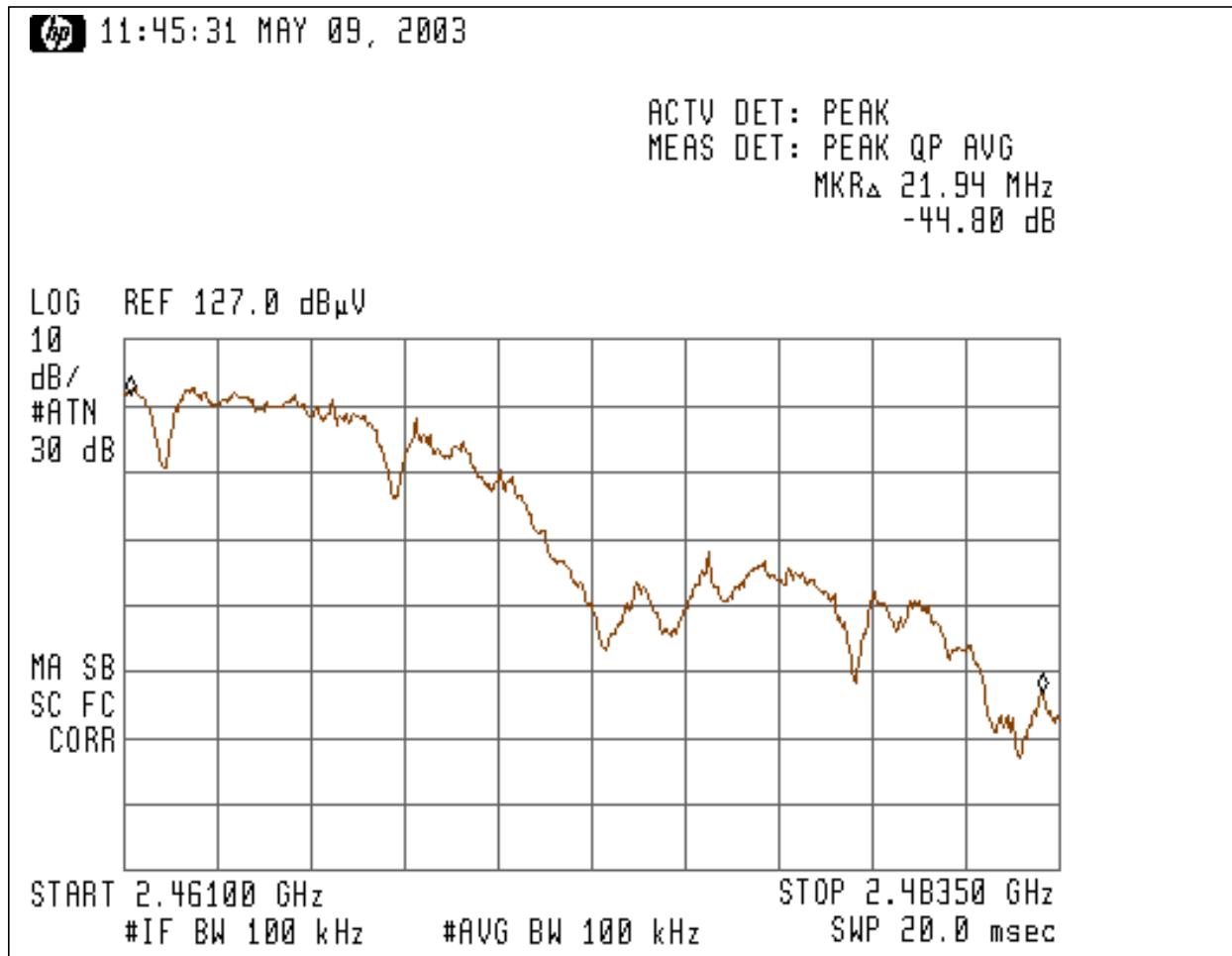
Graph # 3-3-5

Band Edge Emissions at 2400MHz, Channel 11, No Amplifier



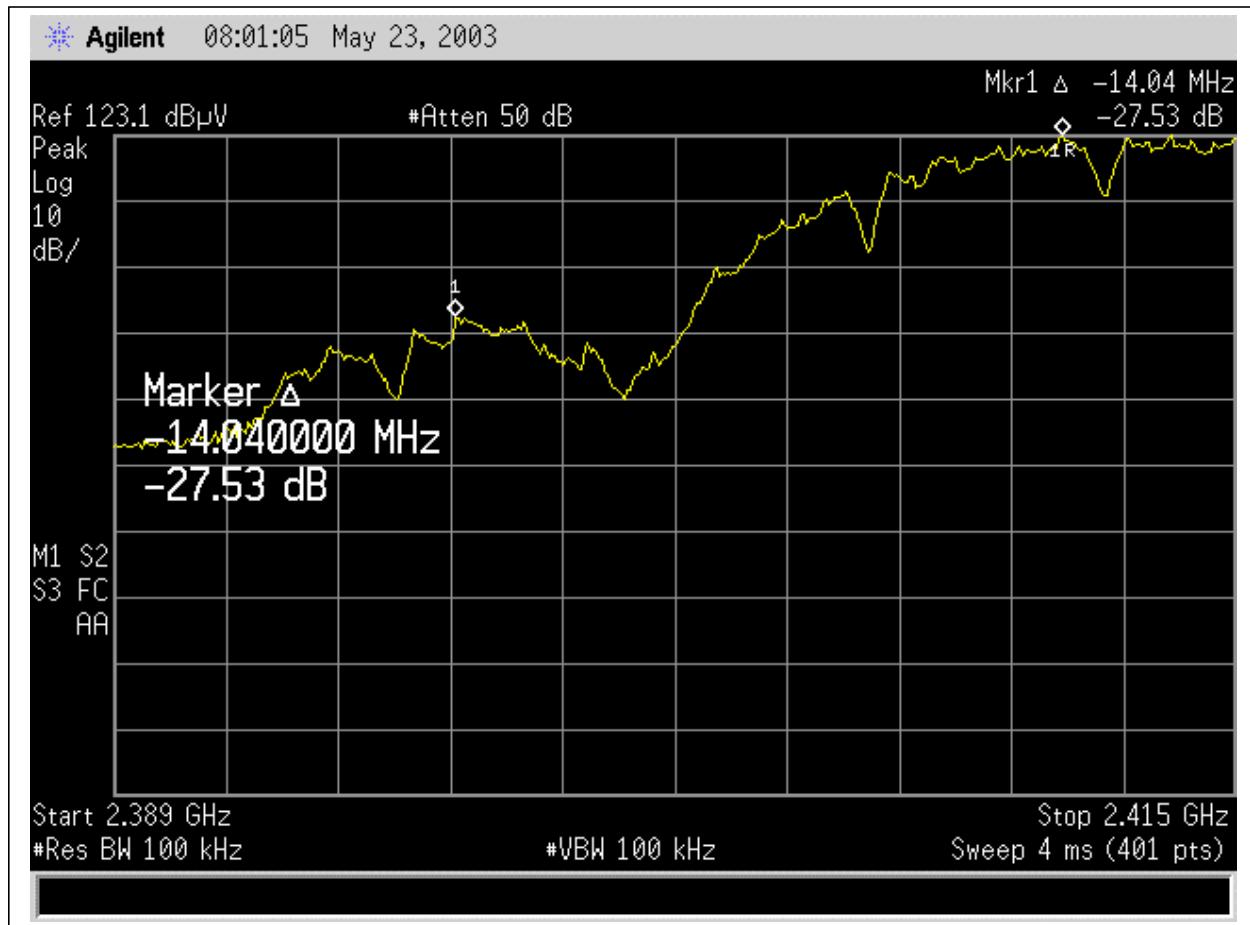
Graph # 3-3-6

Band Edge Emissions at 2483.5MHz, Channel 11, No Amplifier



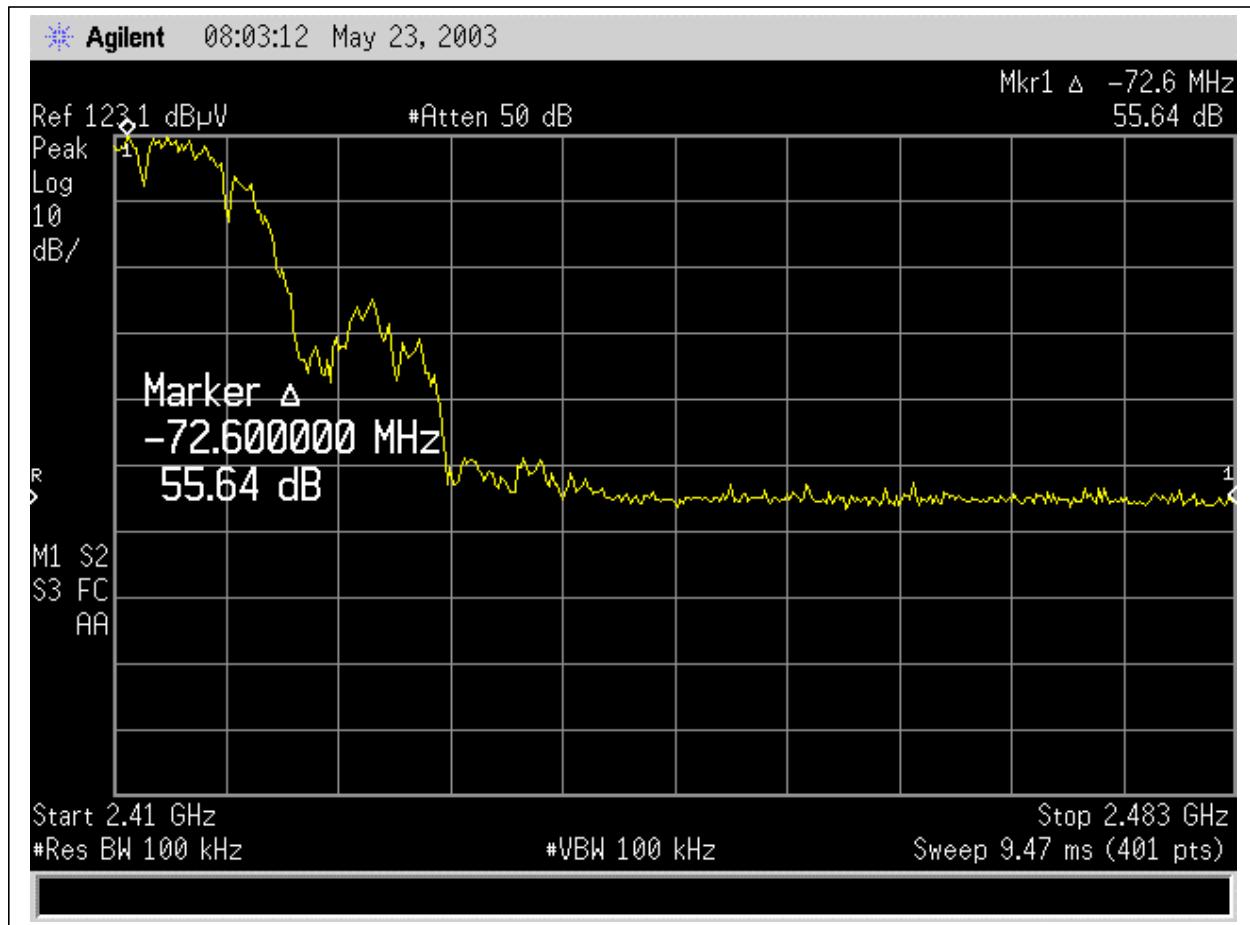
Graph # 3-3-7

Band Edge Emissions at 2400MHz, Channel 1, With Amplifier



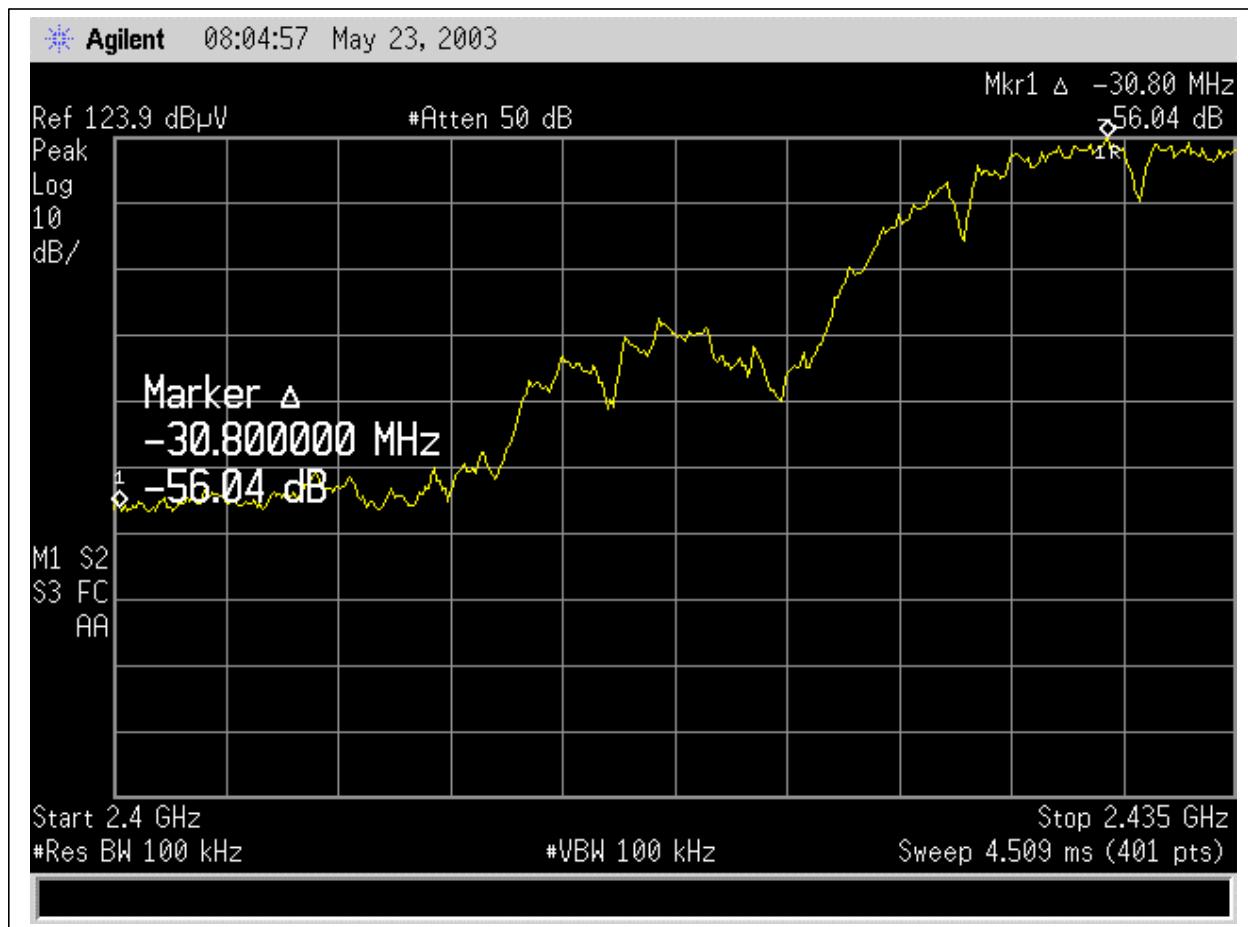
Graph # 3-3-8

Band Edge Emissions at 2483.5MHz, Channel 1, With Amplifier



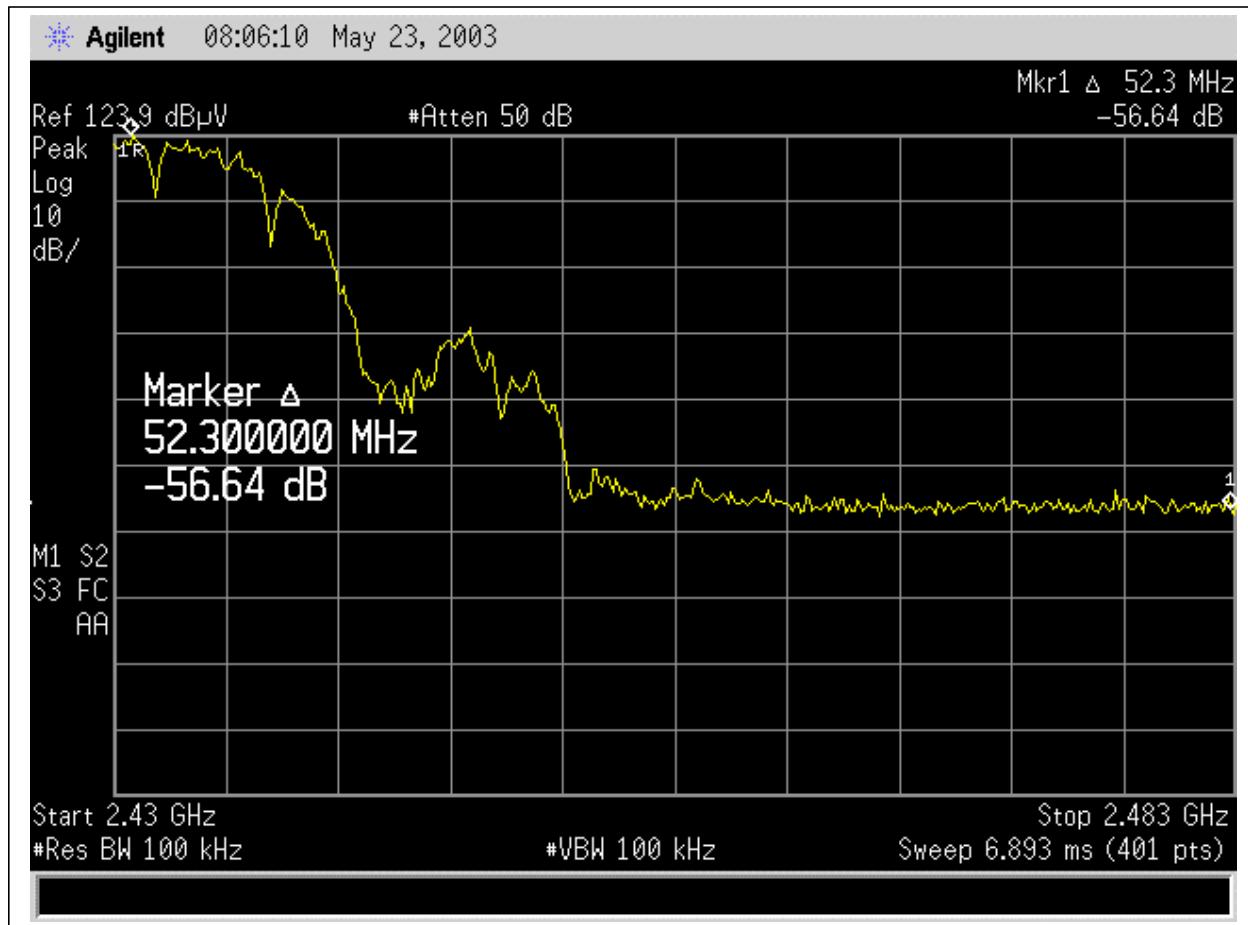
Graph # 3-3-9

Band Edge Emissions at 2400MHz, Channel 5, With Amplifier



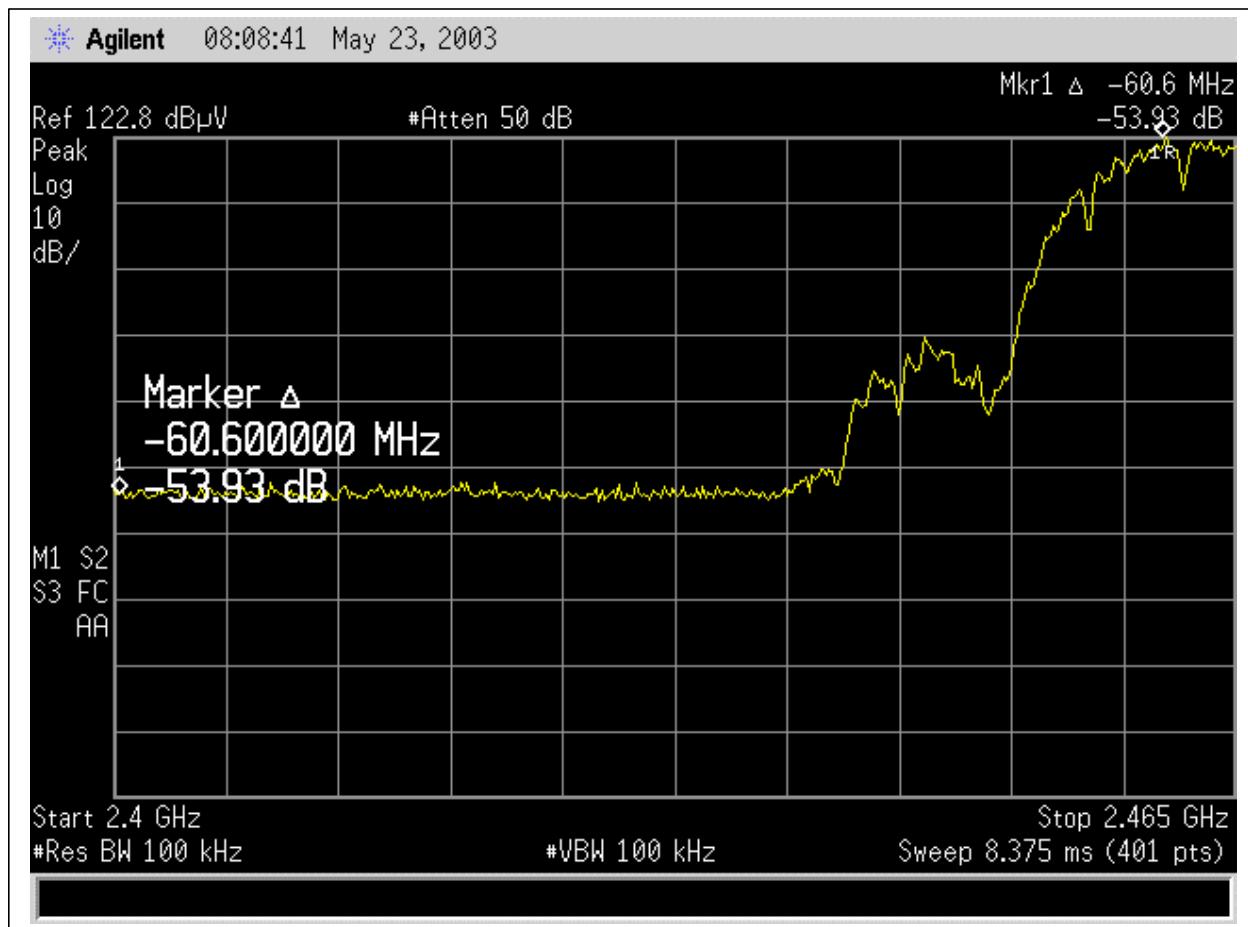
Graph # 3-3-10

Band Edge Emissions at 2483.5MHz, Channel 5, With Amplifier



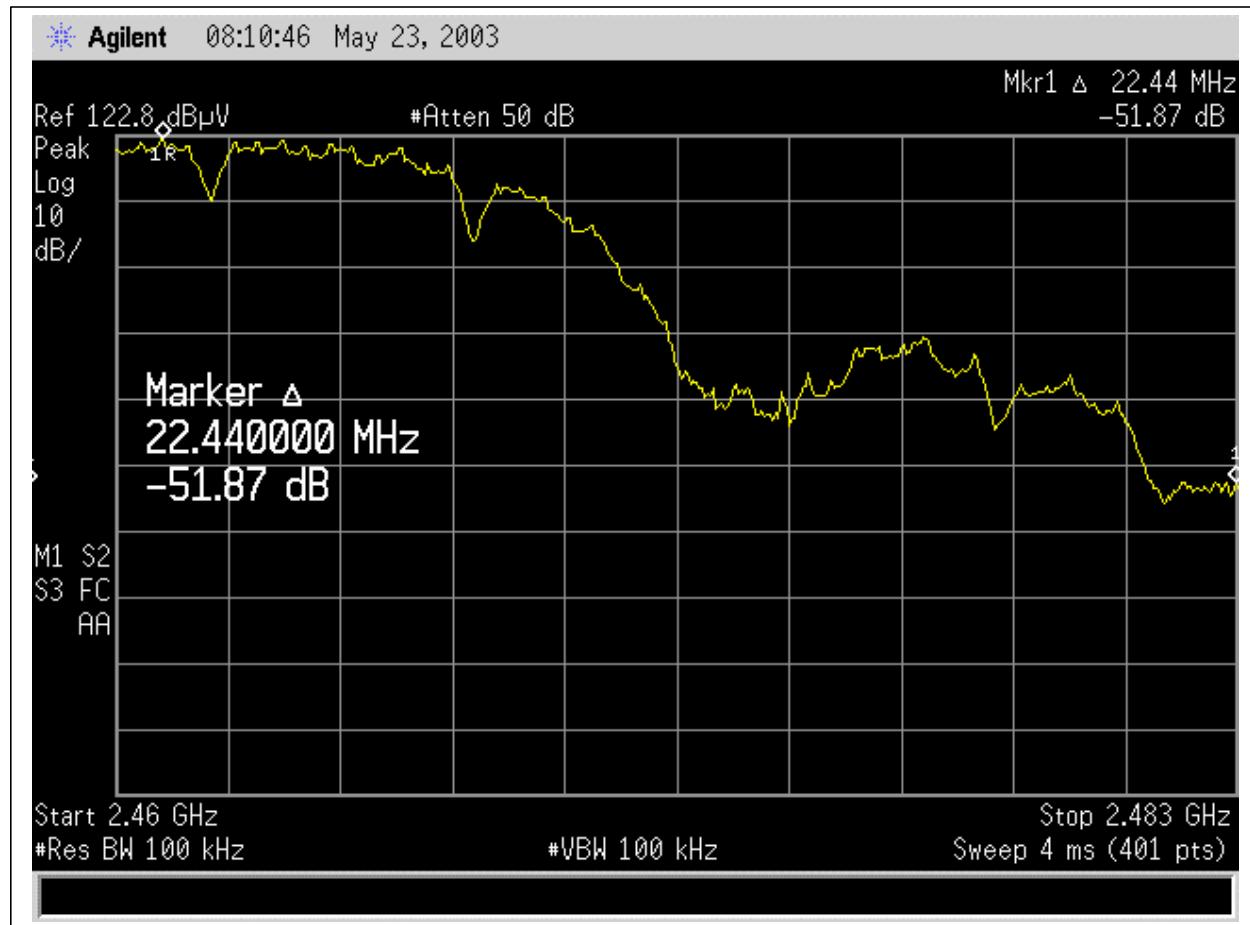
Graph # 3-3-11

Band Edge Emissions at 2400MHz, Channel 11, With Amplifier



Graph # 3-3-12

Band Edge Emissions at 2483.5MHz, Channel 11, With Amplifier



3.4 Spurious RF Conducted Emissions, FCC 15.247(c)

Spurious RF Conducted Emissions was measured for Channel 5 and for both the EUT configurations (with no Amplifier and with Amplifier and RF Cable with 6.5dB attenuation between DC Injector and Amplifier) to determine compliance with Standard requirements.

Test Procedure

The Spurious RF Conducted Emissions was measured at the EUT antenna terminal at the maximum power in frequency range from 30MHz to 25GHz. The transmitter antenna port was connected to the Spectrum analyzer.

Limits Calculation

Spurious Emissions limits should be 20dB below of the levels are shown in the Table 3-3-1.

Spurious Emissions Limits for configuration with no Amplifier = $118.8\text{dB}\mu\text{V} - 20\text{dB} = 98.8\text{dB}\mu\text{V}$

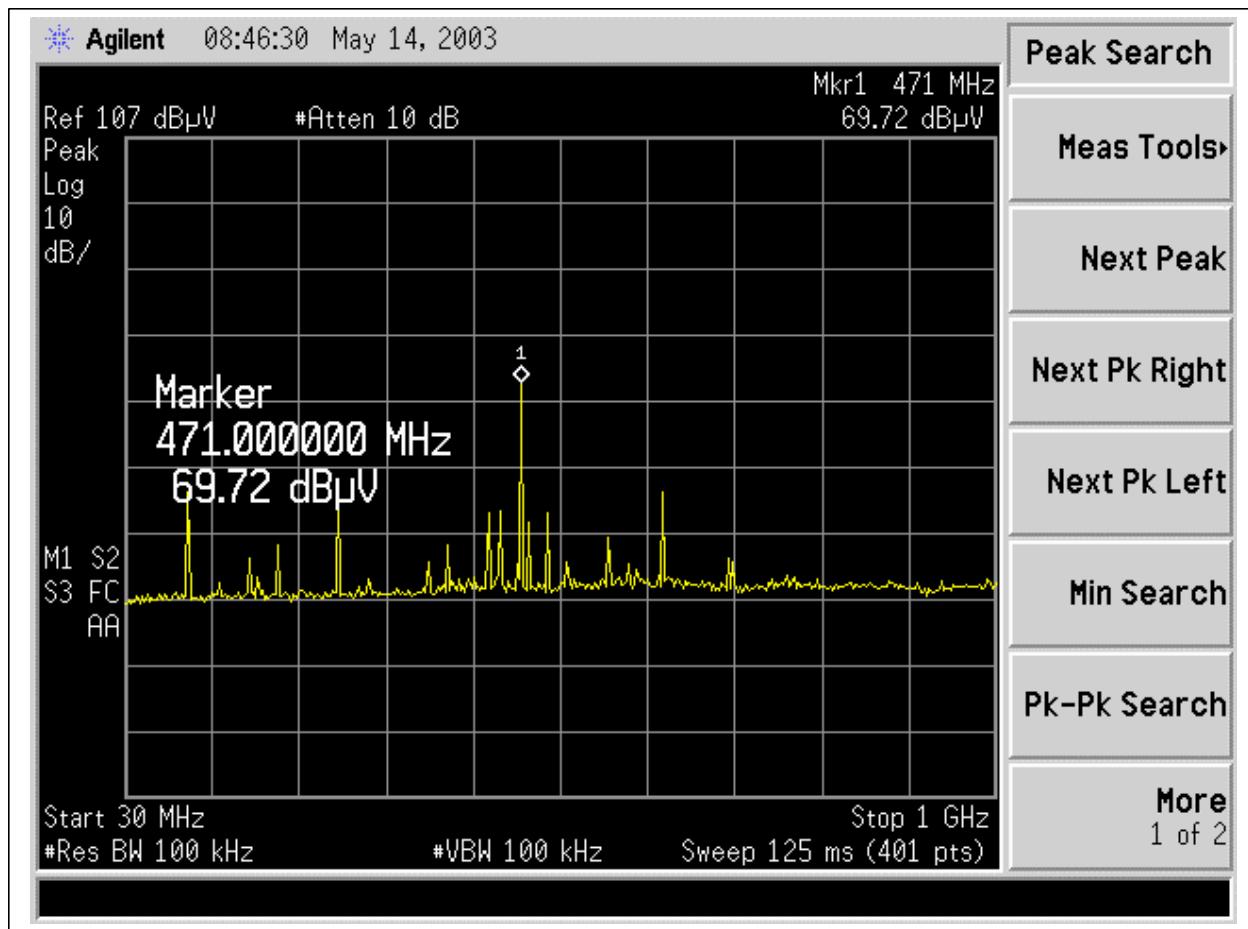
Spurious Emissions Limits for configuration with Amplifier = $122.8\text{dB}\mu\text{V} - 20\text{dB} = 102.8\text{dB}\mu\text{V}$

No Spurious Emissions above assigned limits.

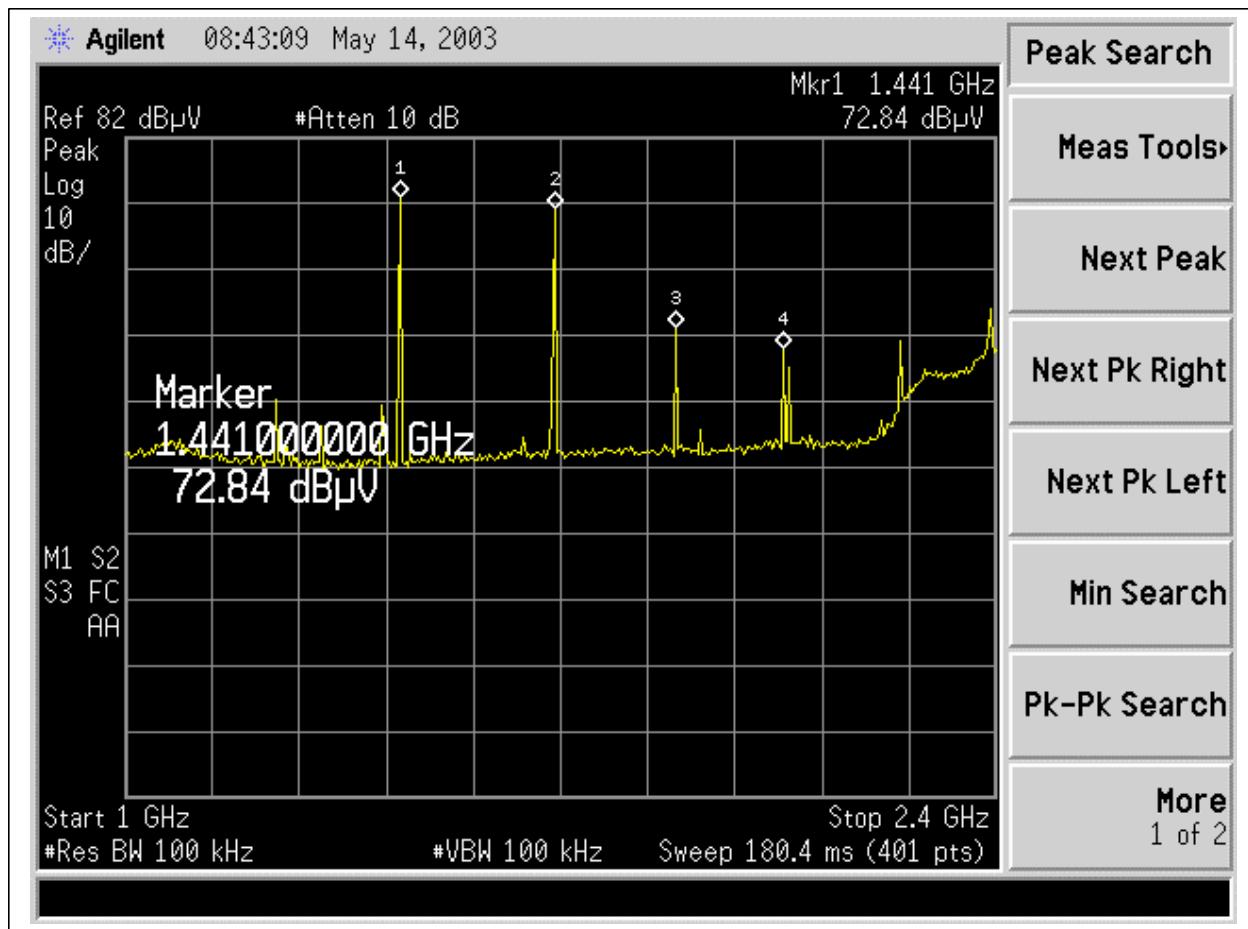
Graphs from 3-4-1 to 3-4-4 show the Spurious RF Conducted Emissions for EUT configuration without Amplifier.

Graphs from 3-4-5 to 3-4-8 show the Spurious RF Conducted Emissions for EUT configuration with Amplifier.

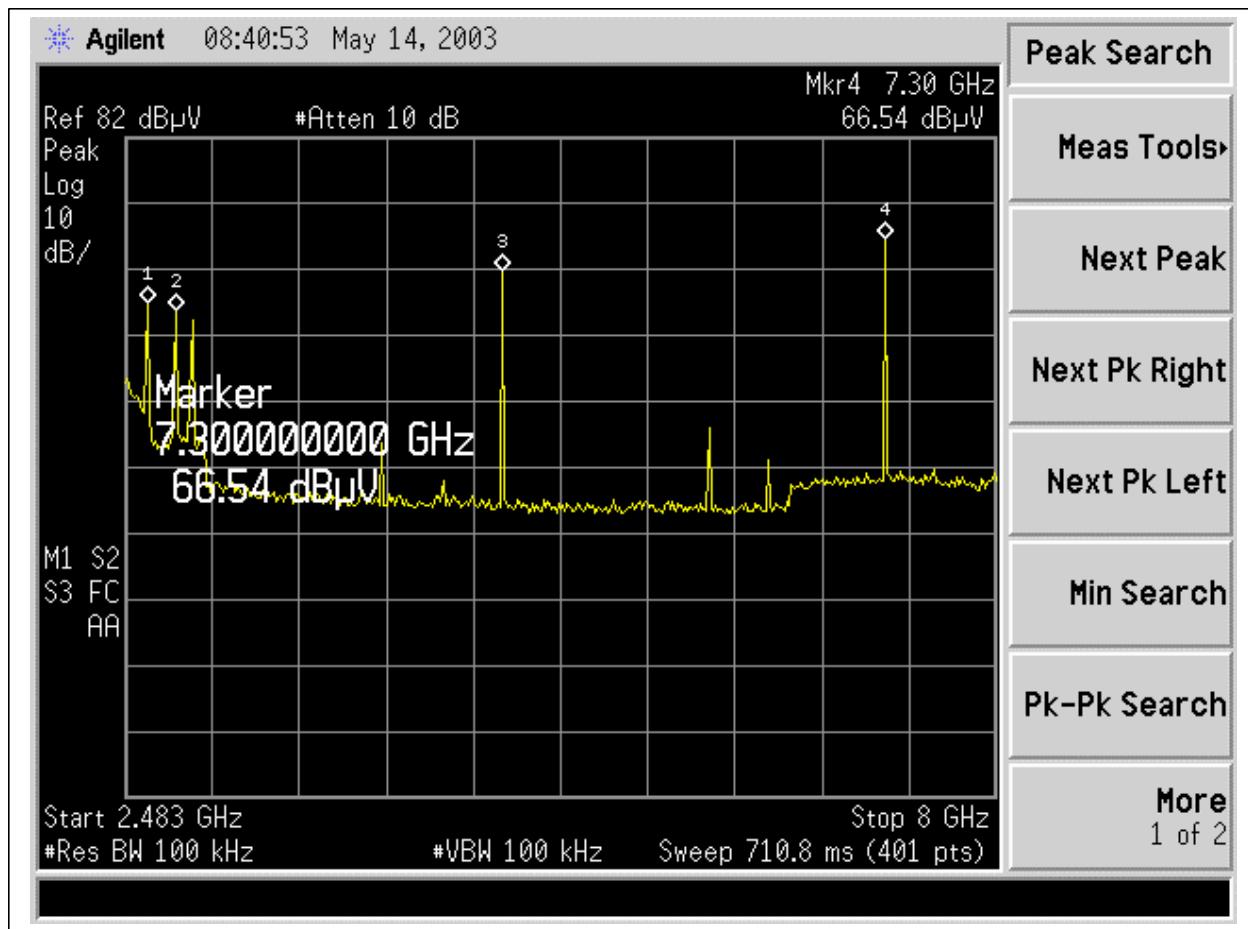
Graph # 3-4-1
Spurious Emissions at Antenna Terminal from 30MHz to 1 GHz
No Amplifier, Limits: 98.8dB μ V

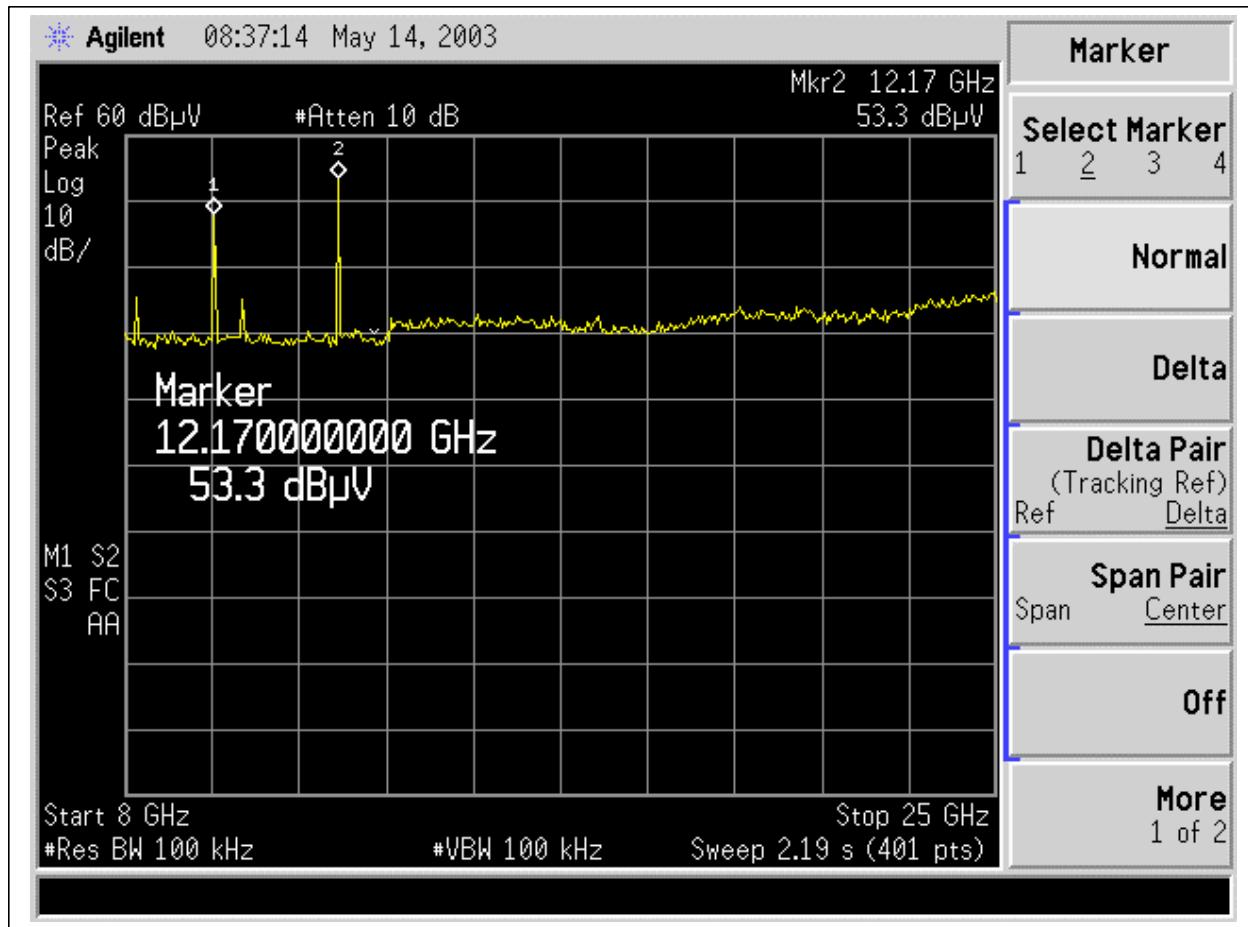


Graph # 3-4-2
Spurious Emissions at Antenna Terminal from 1 to 2.4GHz
No Amplifier, Limits: 98.8dB μ V

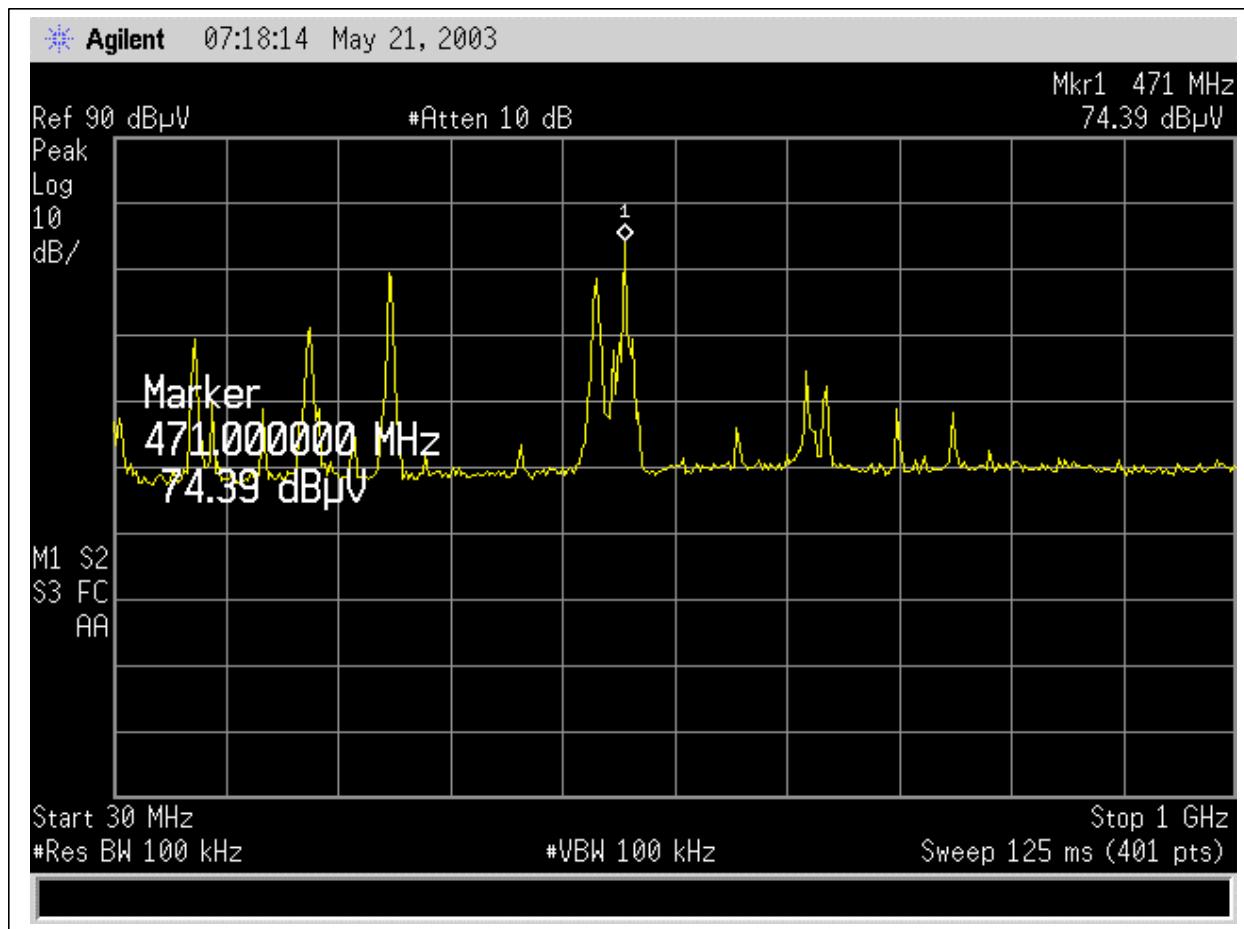


Graph # 3-4-3
Spurious Emissions at Antenna Terminal from 2.5 to 8 GHz
No Amplifier, Limits: 98.8dB μ V

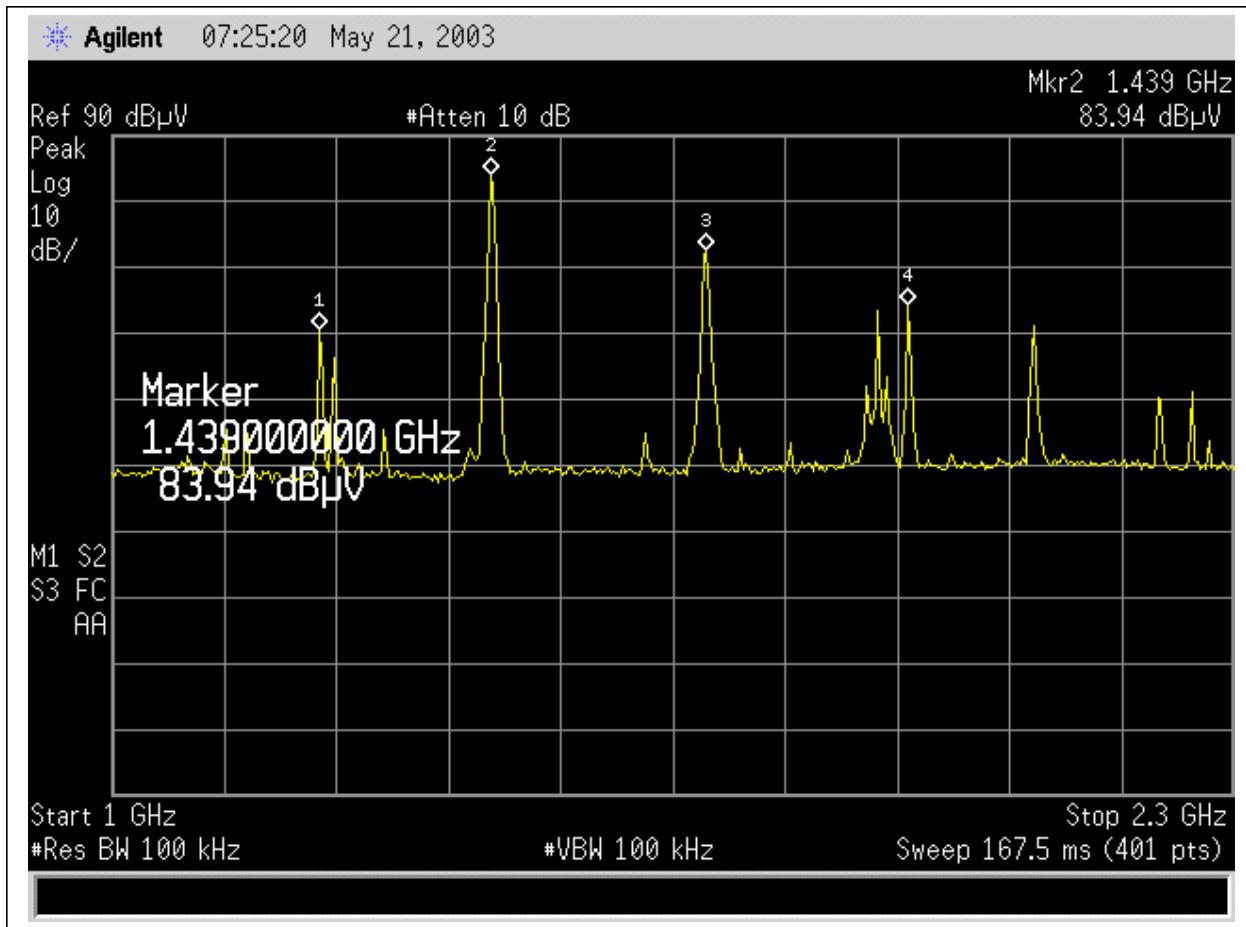


Graph # 3-4-4**Spurious Emissions at Antenna Terminal from 8 to 25GHz
No Amplifier, Limits: 98.8dB μ V**

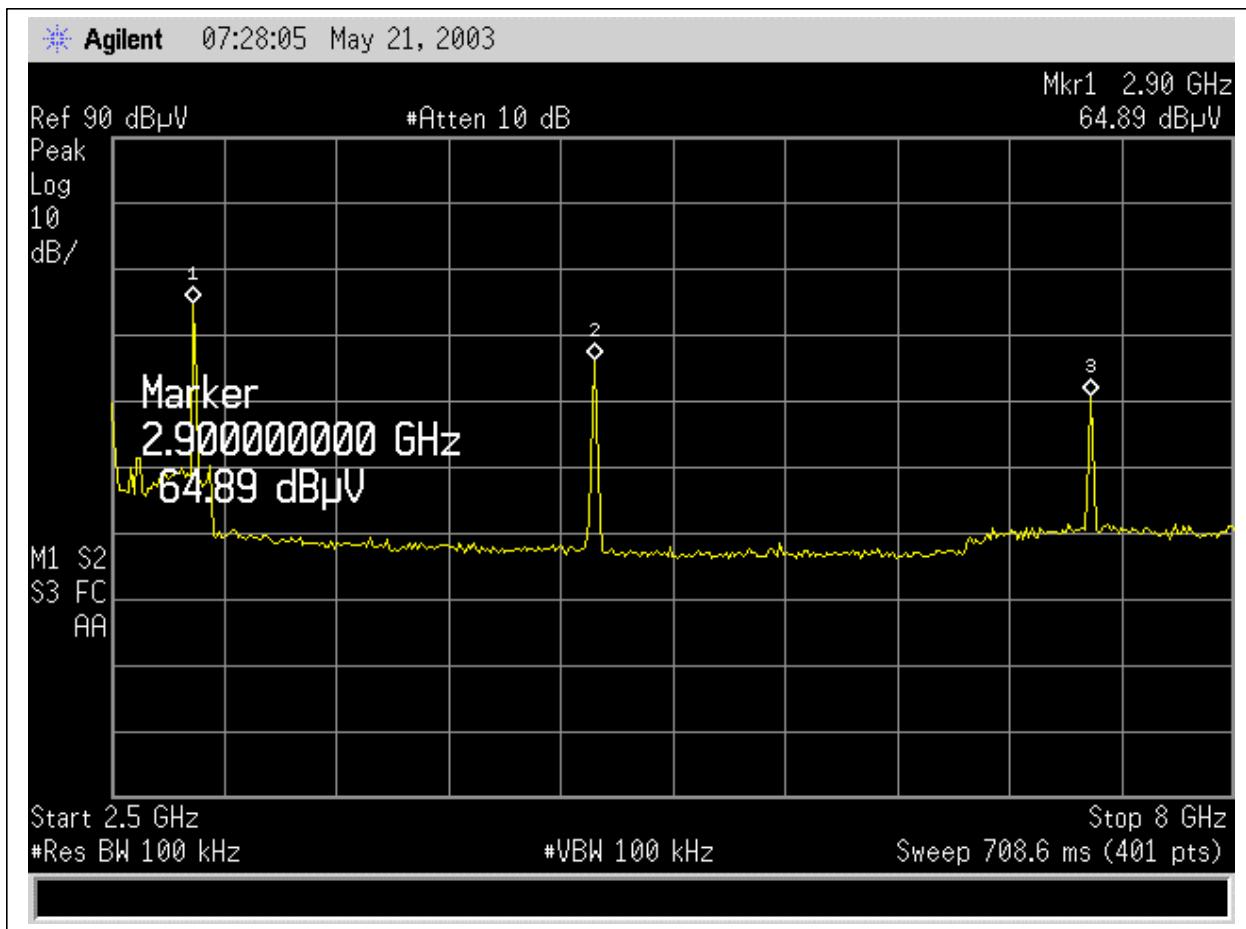
Graph # 3-4-5
Spurious Emissions at Antenna Terminal from 30MHz to 1 GHz
With Amplifier, Limits: 102.8dB μ V

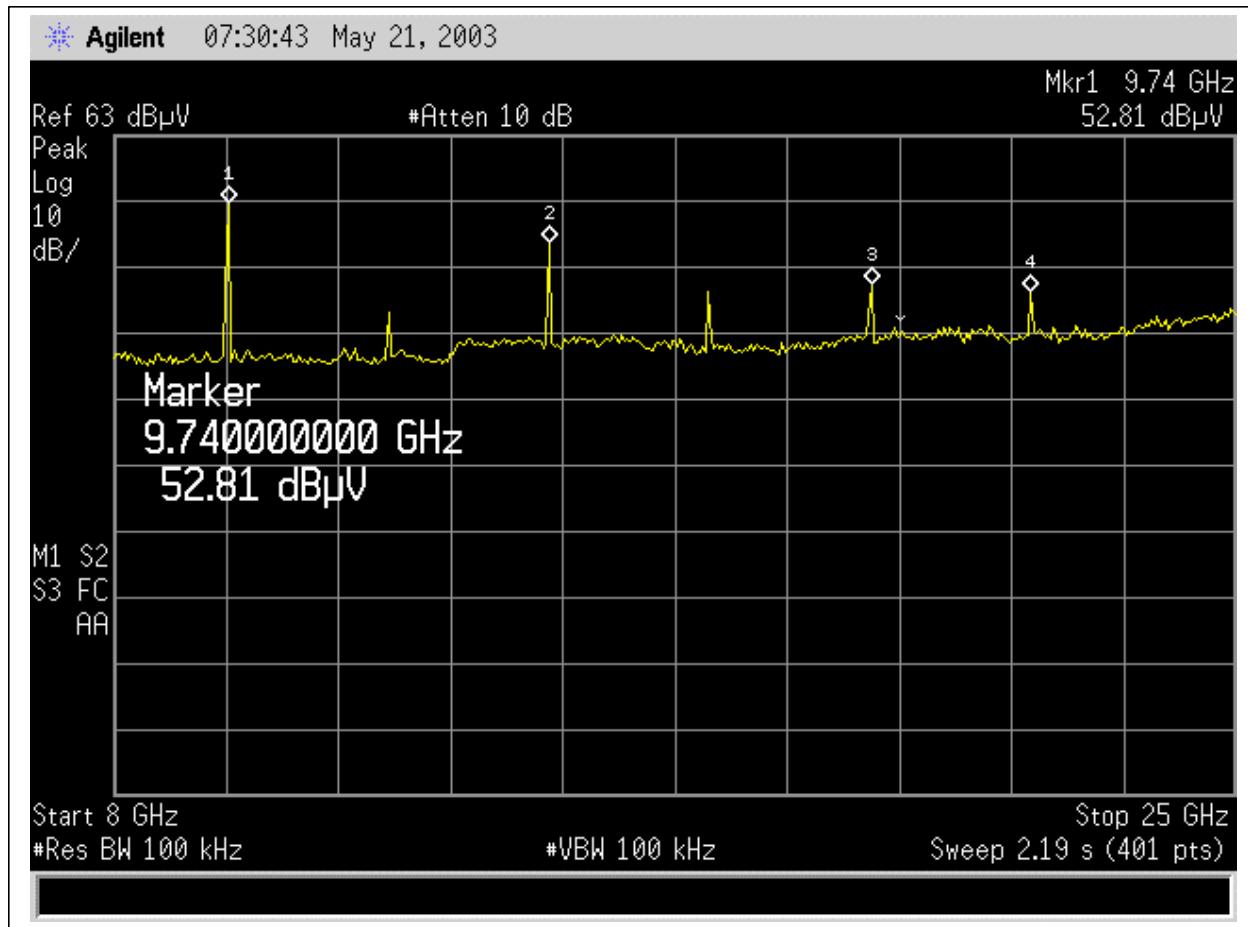


Graph # 3-4-6

Spurious Emissions at Antenna Terminal from 1 to 2.3GHz
With Amplifier, Limits: 102.8dB μ V

Graph # 3-4-7

**Spurious Emissions at Antenna Terminal from 2.5 to 8GHz
With Amplifier, Limits: 102.8dB μ V**

Graph # 3-4-8**Spurious Emissions at Antenna Terminal from 8 to 25GHz
With Amplifier, Limits: 102.8dB μ V**

3.4 Peak Power Spectral Density, FCC 15.247(d)

Peak Power Spectral Density measurements were made at the low, center, and high frequency channels (channels 1, 5, and 11), and for both the EUT configurations (with no Amplifier and with Amplifier and RF Cable with 6.5dB attenuation between DC Injector and Amplifier).

Test Procedure

The Peak Power Spectral Density for the device was measured at the maximum power transmission condition. The transmitter antenna port was connected to the Spectrum analyzer.

Total Peak Power Spectral Density was calculated from Measured Power adding cable loss between the EUT Antenna Terminal and the Analyzer input.

Peak Power Spectral Density limits calculation

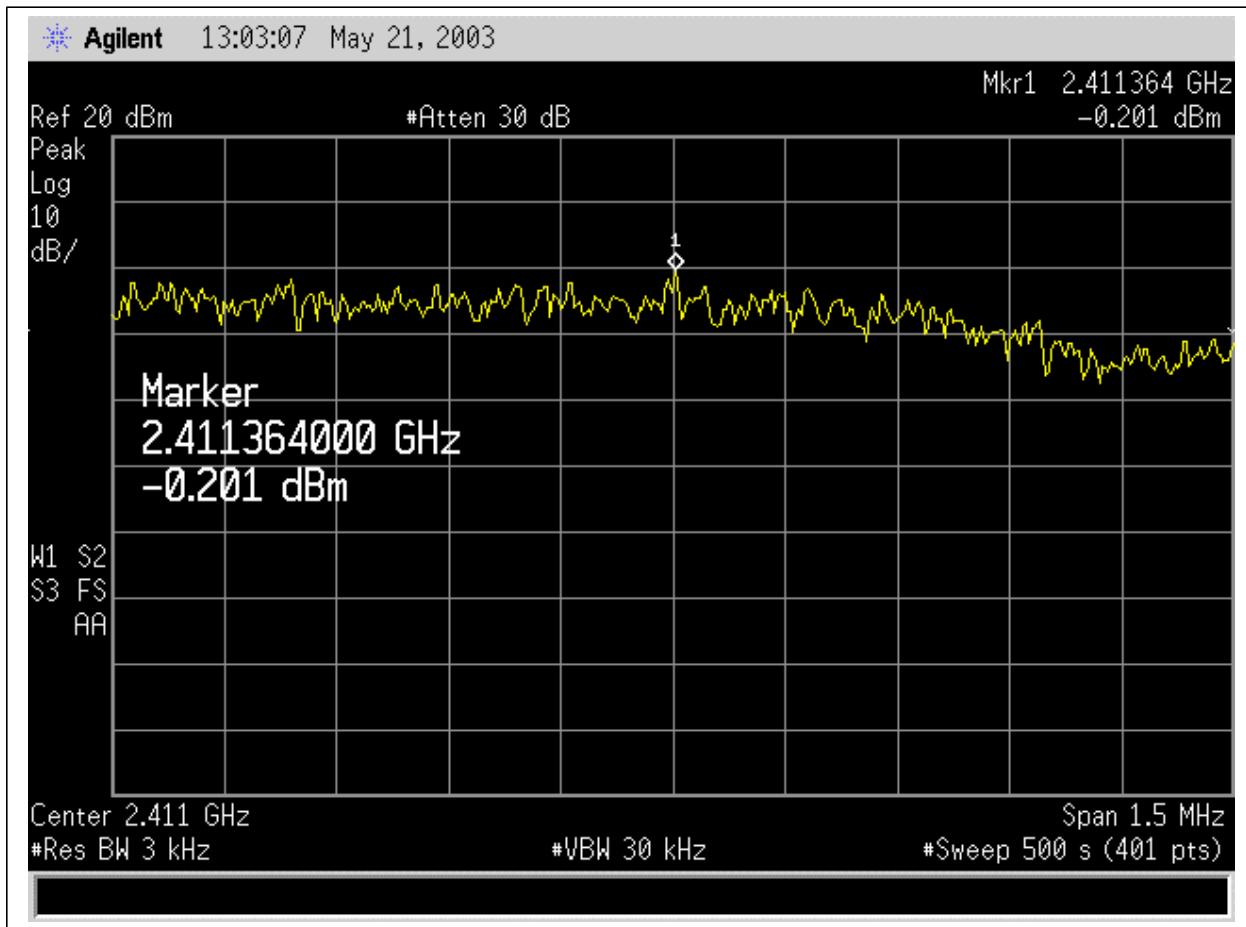
According to the FCC 15.247(d), the Maximum Peak Power Spectral Density is 8dBm in any 3kHz band.

Limits for the EUT configuration with no Amplifier = 8dBm – Cable Loss = 8dBm – 0.35dB = 7.65dBm
Limits for the EUT configuration with Amplifier = 8dBm – Cable Loss = 8dBm – 0.5dB = 7.5dBm

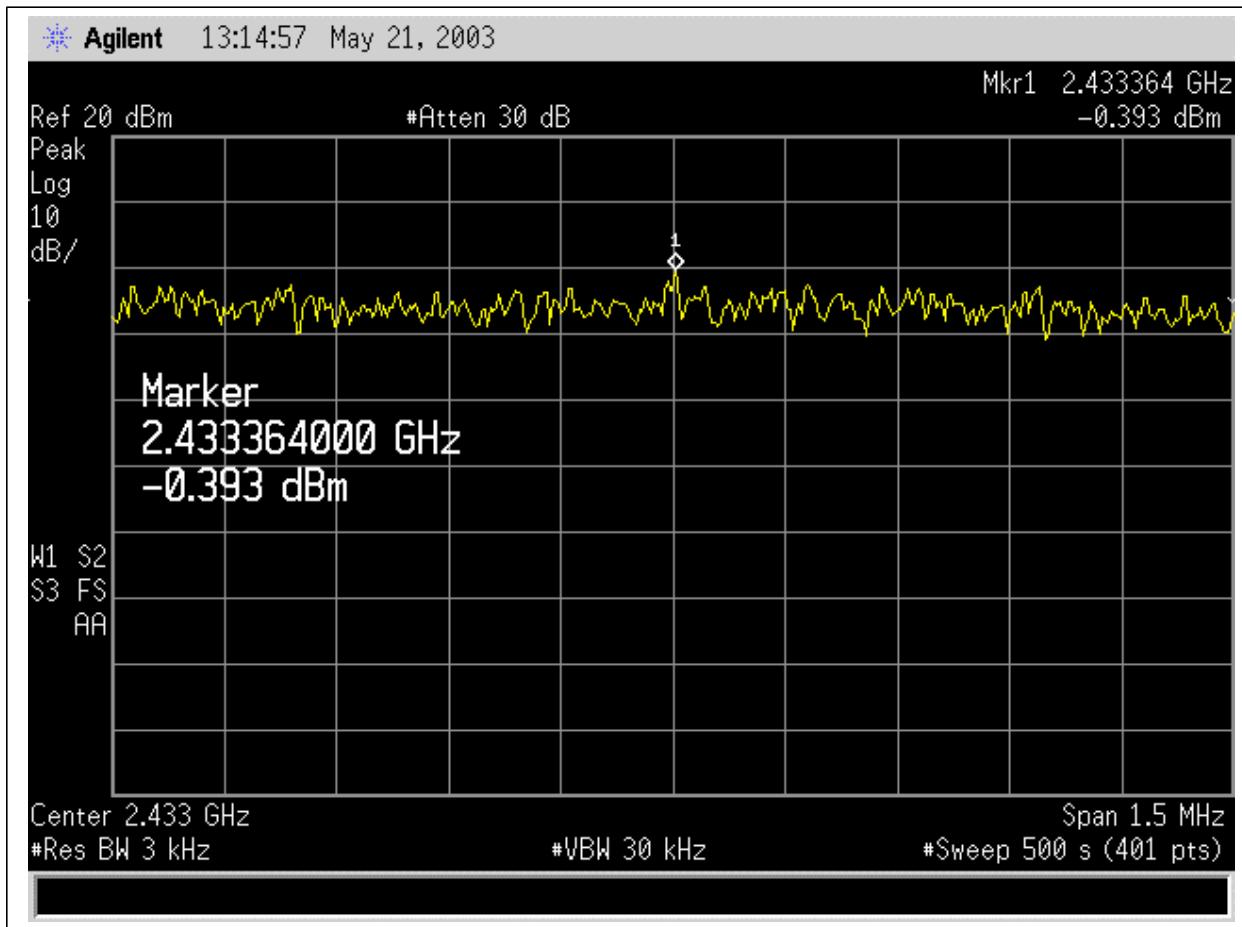
Measured Peak Power Spectral Density is within assigned limits.

Graphs from 3-5-1 to 3-5-6 show the Peak Power Spectral Density.

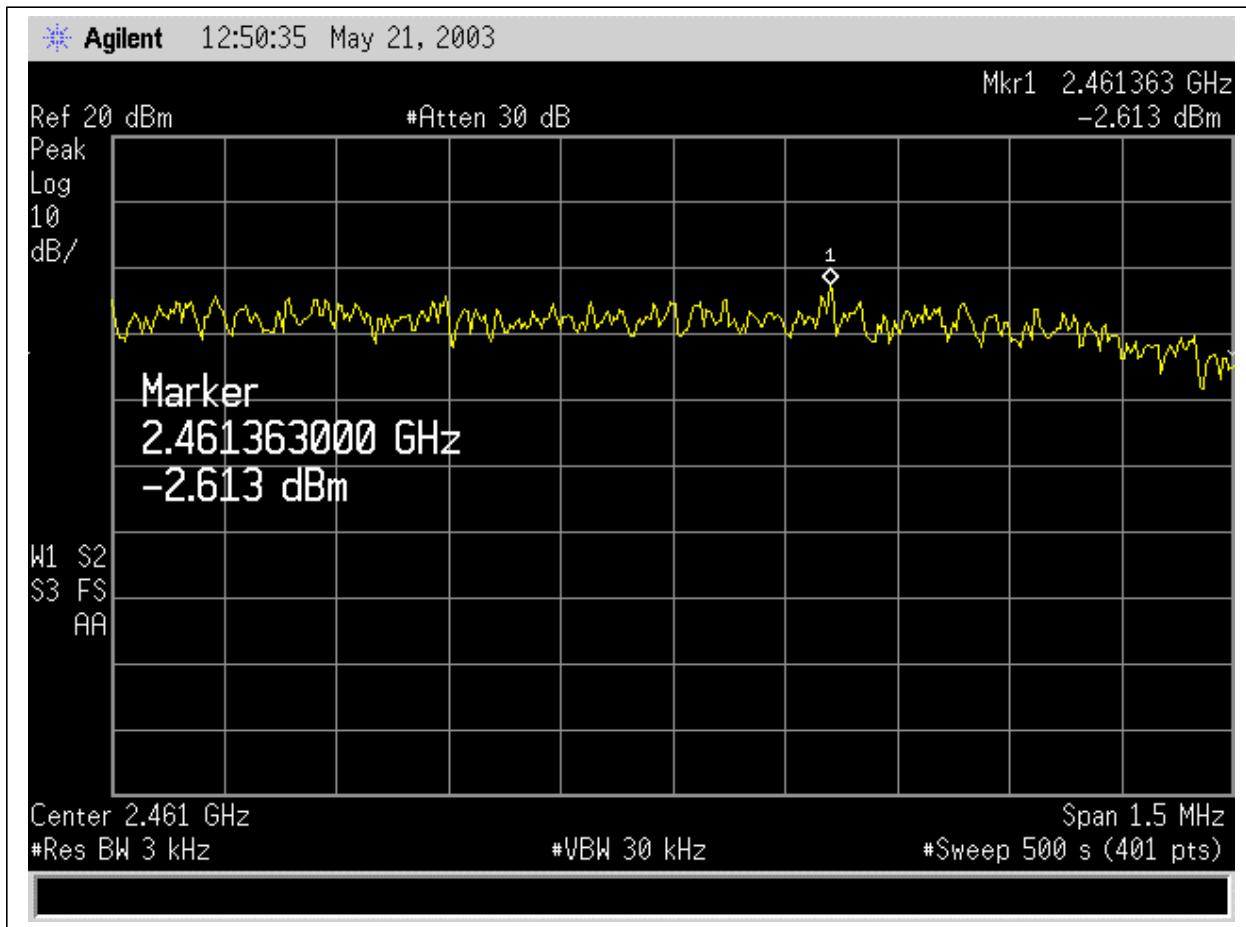
Graph # 3-5-1
Peak Power Spectral Density, Channel 1, No Amplifier
Limits: 7.65dBm



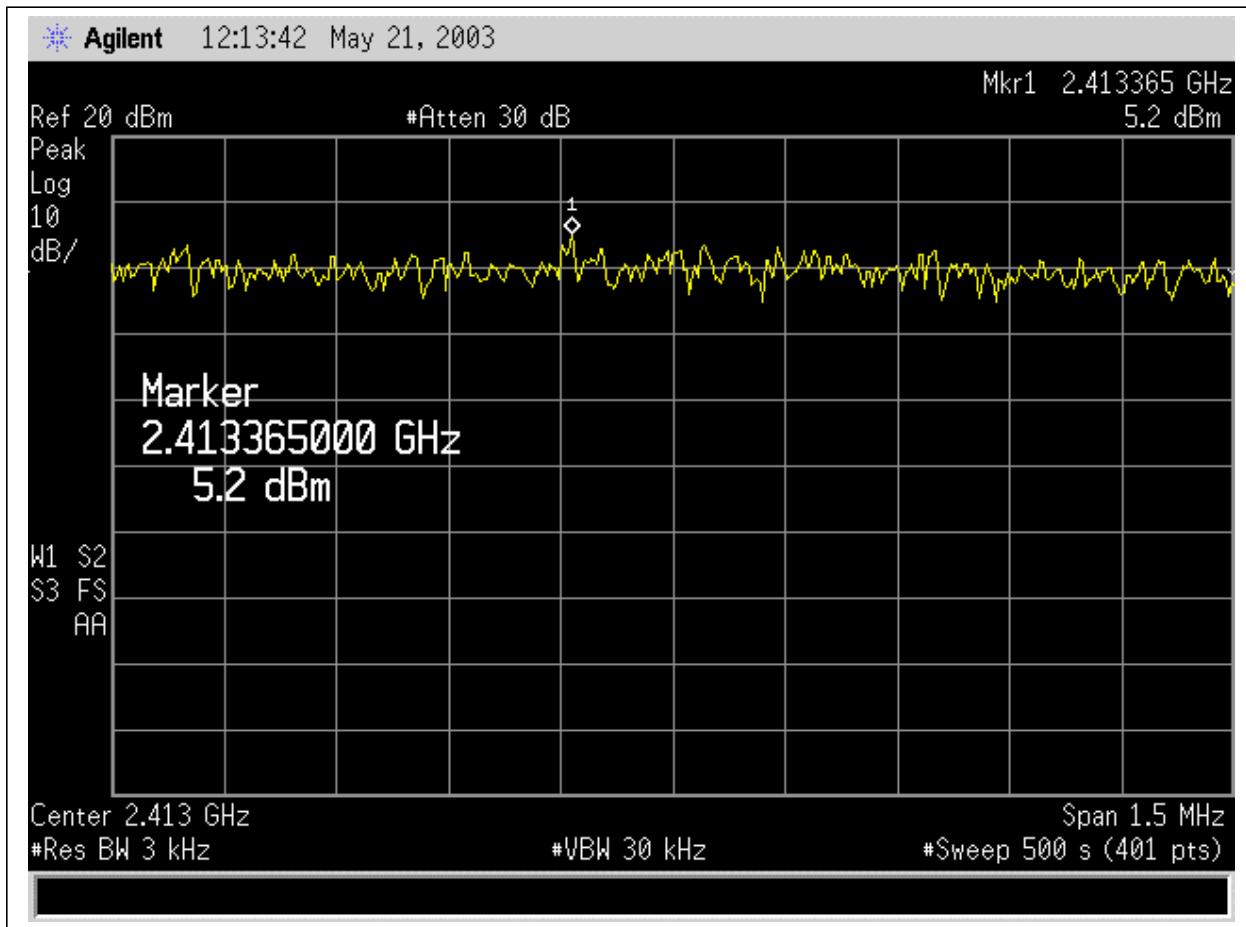
Graph # 3-5-2
Peak Power Spectral Density, Channel 5, No Amplifier
Limits: 7.65dBm



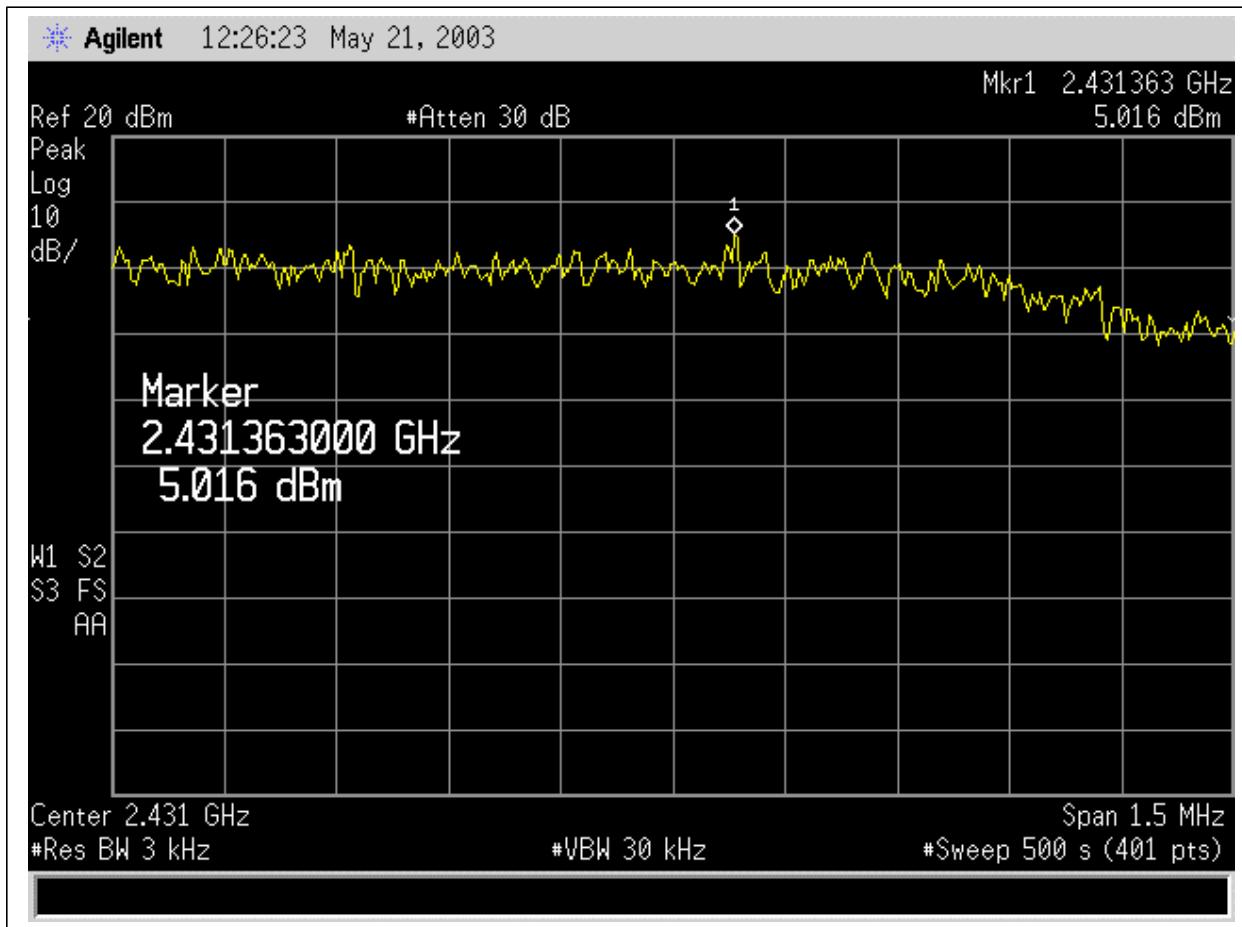
Graph # 3-5-3
Peak Power Spectral Density, Channel 11, No Amplifier
Limits: 7.65dBm



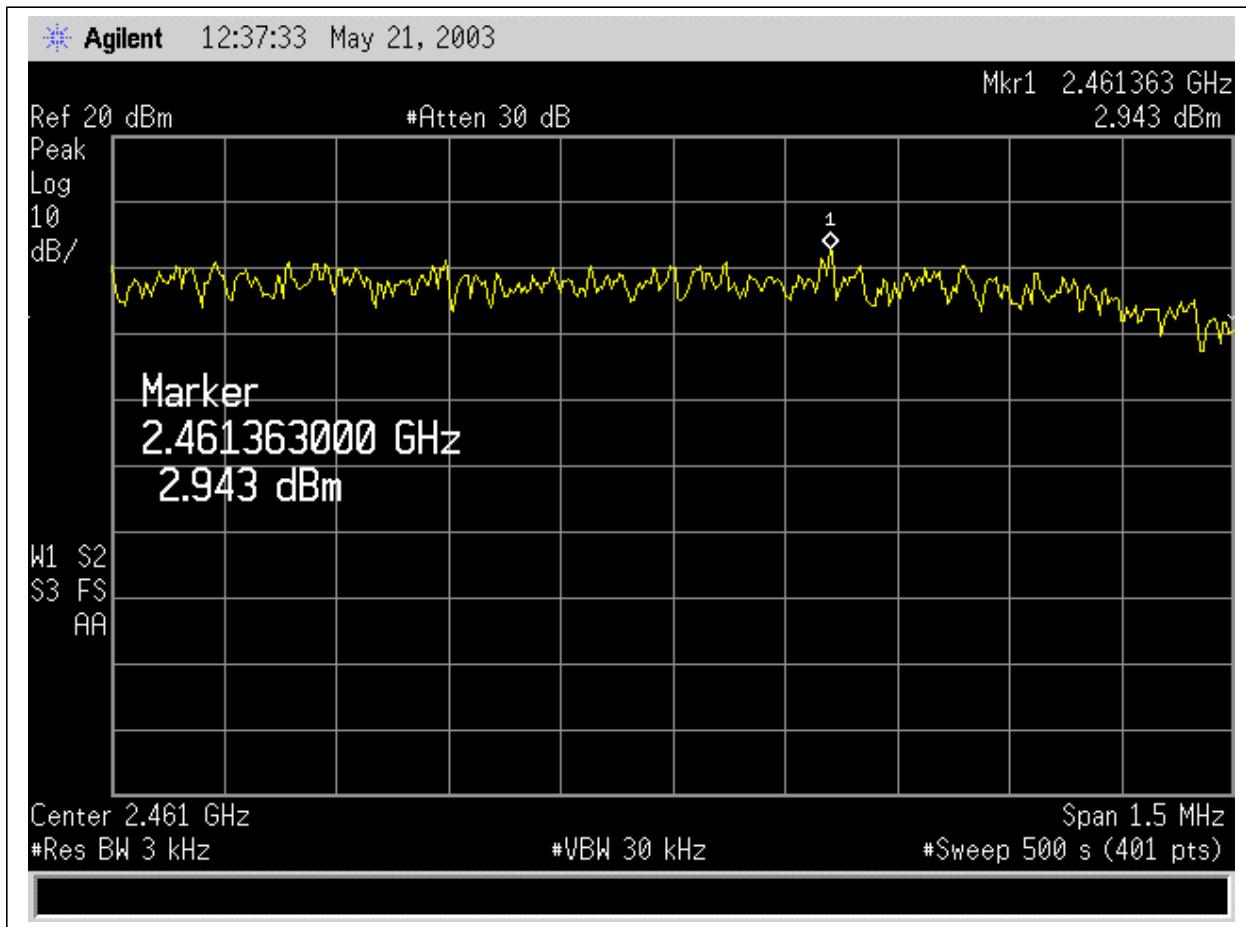
Graph # 3-5-4
Peak Power Spectral Density, Channel 1, With Amplifier
Limits: 7.5dBm



Graph # 3-5-5
Peak Power Spectral Density, Channel 5, With Amplifier
Limits: 7.5dBm



Graph # 3-5-6
Peak Power Spectral Density, Channel 11, No Amplifier
Limits: 7.65dBm



3.6 Spurious Radiated Emissions, FCC 15.247(c), 15.205, 15.209

Field Strength of Spurious Emissions measurements were measured in the frequency range up to 25GHz (10th harmonic) at the low, center, and high frequency channels (channels 1, 5, and 11), and for both the EUT configurations: with no Amplifier for five types of antenna with highest gain, and with Amplifier and RF Cable with 6.5dB attenuation between DC Injector and Amplifier for four types of antenna with highest gain.

Test Procedure

The EUT was placed on a non-conductive table 0.8m above the ground plane inside the Anechoic Chamber. The table was centered on a motorized turntable, which allows 360-degree rotation. The measurement antenna was positioned at a distance of 3m. The radiated emissions were maximized by configuring the EUT, by rotating the EUT, by changing antenna polarization, and by changing antenna height from 1 to 4m. Field strength was measured and calculated (See Section 3.8).

The Tables from 3-6-1 to 3-6-9 show the Field Strength of Spurious Emissions in the Restricted Bands of Operation according to FCC 15.205, therefore emissions at 2057.73MHz and at 4th Harmonic are not shown in these Tables.

Radiated Emissions**Date:** 05-19-2003**Company:**

Locus Inc.

EUT:

MiniPCI Radio without Amplifier

Antenna:

1/2 wave art Omni Antenna (Part # 540-0002)

Test Engineer:

Norman Shpilsher

Special Info:

Total Factor includes Antenna Factor, Cable Loss, Pre-Amp Gain, RF Filter Factor

Standard:

FCC Part 15.247(c), 15.205, 15.209

Test Site:

Anechoic Chamber, 3m measurement distance

Note:

The table shows the worst case radiated emissions (Average readings, RBW 1MHz)

No emissions above the floor noise were detected in restricted frequency
ranges (per FCC 15.205) at 5th and higher harmonics.**Table # 3-6-1**

Frequency MHz	Antenna		Total Factor(dB/m)	Avg. Reading dBuV	Total Emissions dBuV/m	Limit dBuV/m	Margin dB
	Polarity	Hts(cm)					
Channel 1							
4824.01	V	148	8.8	38.5	47.3	54.0	-6.7
4824.01	H	142	8.8	36.1	44.9	54.0	-9.1
7236.03	V	114	12.1	38.5	50.6	54.0	-3.4
7236.03	H	109	12.1	34.8	46.9	54.0	-7.1
Channel 5							
4863.96	V	148	8.8	38.4	47.2	54.0	-6.8
4863.96	H	142	8.8	36.1	44.9	54.0	-9.1
7296.00	V	114	12.2	38.5	50.7	54.0	-3.3
7296.00	H	109	12.2	34.7	46.9	54.0	-7.1
Channel 11							
4924.04	V	148	8.8	38.3	47.1	54.0	-6.9
4924.04	H	142	8.8	36.0	44.8	54.0	-9.2
7385.45	V	114	12.4	38.4	50.8	54.0	-3.2
7385.45	H	109	12.4	34.7	47.1	54.0	-6.9

Radiated Emissions**Date:** 05-19-2003**Company:**

Locus Inc.

EUT:

MiniPCI Radio without Amplifier

Antenna:

12dBi Collinear Array Omni Antenna (Part # 540-0038)

Test Engineer:

Norman Shpilsher

Special Info:

Total Factor includes Antenna Factor, Cable Loss, Pre-Amp Gain, RF Filter Factor

Standard:

FCC Part 15.247(c), 15.205, 15.209

Test Site:

Anechoic Chamber, 3m measurement distance

Note:

The table shows the worst case radiated emissions (Average readingds, RBW 1MHz)

No emissions above the floor noise were detected in restricted frequency ranges (per FCC 15.205) at 5th and higher harmonics.

Table # 3-6-2

Frequency MHz	Antenna		Total Factor(dB/m)	Avg. Reading dBuV	Total Emissions dBuV/m	Limit dBuV/m	Margin dB
	Polarity	Hts(cm)					
Channel 1							
4824.01	V	142	8.8	38.8	47.6	54.0	-6.4
4824.01	H	155	8.8	33.1	41.9	54.0	-12.1
7236.03	V	179	12.1	39.8	51.9	54.0	-2.1
7236.03	H	210	12.1	35.0	47.1	54.0	-6.9
Channel 5							
4863.96	V	142	8.8	38.9	47.7	54.0	-6.3
4863.96	H	155	8.8	33.2	42.0	54.0	-12.0
7296.00	V	179	12.2	39.6	51.8	54.0	-2.2
7296.00	H	210	12.2	34.9	47.1	54.0	-6.9
Channel 11							
4924.04	V	142	8.8	38.7	47.5	54.0	-6.5
4924.04	H	155	8.8	33.1	41.9	54.0	-12.1
7385.45	V	179	12.4	39.4	51.8	54.0	-2.2
7385.45	H	210	12.4	34.8	47.2	54.0	-6.8

Radiated Emissions**Date:** 05-20-2003**Company:**

Locus Inc.

EUT:

MiniPCI Radio without Amplifier

Antenna:

19dBi Patch Antenna (Part # 540-0035)

Test Engineer:

Norman Shpilsher

Special Info:

Total Factor includes Antenna Factor, Cable Loss, Pre-Amp Gain, RF Filter Factor

Standard:

FCC Part 15.247(c), 15.205, 15.209

Test Site:

Anechoic Chamber, 3m measurement distance

Note:

The table shows the worst case radiated emissions (Average readings, RBW 1MHz)

No emissions above the floor noise were detected in restricted frequency ranges (per FCC 15.205) at 5th and higher harmonics.

Table # 3-6-3

Frequency MHz	Antenna		Total Factor(dB/m)	Avg. Reading dBuV	Total Emissions dBuV/m	Limit dBuV/m	Margin dB
	Polarity	Hts(cm)					
Channel 1							
4824.01	V	157	8.8	39.3	48.1	54.0	-5.9
4824.01	H	169	8.8	33.9	42.7	54.0	-11.3
7236.03	V	144	12.1	34.5	46.6	54.0	-7.4
7236.03	H	149	12.1	33.1	45.2	54.0	-8.8
Channel 5							
4863.96	V	157	8.8	39.2	48.0	54.0	-6.0
4863.96	H	169	8.8	33.8	42.6	54.0	-11.4
7296.00	V	144	12.2	34.1	46.3	54.0	-7.7
7296.00	H	149	12.2	32.8	45.0	54.0	-9.0
Channel 11							
4924.04	V	157	8.8	39.1	47.9	54.0	-6.1
4924.04	H	169	8.8	33.7	42.5	54.0	-11.5
7385.45	V	144	12.4	34.0	46.4	54.0	-7.6
7385.45	H	149	12.4	32.8	45.2	54.0	-8.8

Radiated Emissions**Date:** 05-19-2003**Company:**

Locus Inc.

EUT:

MiniPCI Radio without Amplifier

Antenna:

13.5dBi Yagi Antenna (Part # 540-0009)

Test Engineer:

Norman Shpilsher

Special Info:

Total Factor includes Antenna Factor, Cable Loss, Pre-Amp Gain, RF Filter Factor

Standard:

FCC Part 15.247(c), 15.205, 15.209

Test Site:

Anechoic Chamber, 3m measurement distance

Note:

The table shows the worst case radiated emissions (Average readings, RBW 1MHz)

No emissions above the floor noise were detected in restricted frequency ranges (per FCC 15.205) at 5th and higher harmonics.

Table # 3-6-4

Frequency MHz	Antenna		Total Factor(dB/m)	Avg. Reading dBuV	Total Emissions dBuV/m	Limit dBuV/m	Margin dB
	Polarity	Hts(cm)					
Channel 1							
4824.01	V	104	8.8	40.2	49.0	54.0	-5.0
4824.01	H	169	8.8	36.2	45.0	54.0	-9.0
7236.03	V	144	12.1	38.4	50.5	54.0	-3.5
7236.03	H	149	12.1	35.3	47.4	54.0	-6.6
Channel 5							
4863.96	V	104	8.8	40.1	48.9	54.0	-5.1
4863.96	H	169	8.8	36.2	45.0	54.0	-9.0
7296.00	V	144	12.2	38.3	50.5	54.0	-3.5
7296.00	H	149	12.2	35.4	47.6	54.0	-6.4
Channel 11							
4924.04	V	104	8.8	39.8	48.6	54.0	-5.4
4924.04	H	169	8.8	36.1	44.9	54.0	-9.1
7385.45	V	144	12.4	38.1	50.5	54.0	-3.5
7385.45	H	149	12.4	35.2	47.6	54.0	-6.4

Radiated Emissions**Date:** 05-20-2003**Company:**

Locus Inc.

EUT:

MiniPCI Radio without Amplifier

Antenna:

24dBi Parabolic Dish Antenna (Part # 540-0008)

Test Engineer:

Norman Shpilsher

Special Info:

Total Factor includes Antenna Factor, Cable Loss, Pre-Amp Gain, RF Filter Factor

Standard:

FCC Part 15.247(c), 15.205, 15.209

Test Site:

Anechoic Chamber, 3m measurement distance

Note:

The table shows the worst case radiated emissions (Average readings, RBW 1MHz)

No emissions above the floor noise were detected in restricted frequency ranges (per FCC 15.205) at 5th and higher harmonics.

Table # 3-6-5

Frequency MHz	Antenna		Total Factor(dB/m)	Avg. Reading dBuV	Total Emissions dBuV/m	Limit dBuV/m	Margin dB
Channel 1							
4824.01	V	123	8.8	40.3	49.1	54.0	-4.9
4824.01	H	108	8.8	39.0	47.8	54.0	-6.2
7236.03	V	109	12.1	38.5	50.6	54.0	-3.4
7236.03	H	121	12.1	35.1	47.2	54.0	-6.8
Channel 5							
4863.96	V	123	8.8	40.4	49.2	54.0	-4.8
4863.96	H	108	8.8	38.9	47.7	54.0	-6.3
7296.00	V	109	12.2	38.6	50.8	54.0	-3.2
7296.00	H	121	12.2	35.1	47.3	54.0	-6.7
Channel 11							
4924.04	V	123	8.8	40.2	49.0	54.0	-5.0
4924.04	H	108	8.8	38.8	47.6	54.0	-6.4
7385.45	V	109	12.4	38.5	50.9	54.0	-3.1
7385.45	H	121	12.4	35.1	47.5	54.0	-6.5

Radiated Emissions**Date:** 05-27-2003**Company:**

Locus Inc.

EUT:

MiniPCI Radio with Bi-directional Amplifier 2400LX-500mW, s/n 2188

Antenna:

1/2 wave art Omni Antenna (Part # 540-0002)

Test Engineer:

Norman Shpilsher

Special Info:

Total Factor includes Antenna Factor, Cable Loss, Pre-Amp Gain, RF Filter Factor

Standard:

FCC Part 15.247(c), 15.205, 15.209

Test Site:

Anechoic Chamber, 3m measurement distance

Note:

The table shows the worst case radiated emissions (Average readings, RBW 1MHz)

No emissions above the floor noise were detected in restricted frequency ranges (per FCC 15.205) at 5th and higher harmonics.

Table # 3-6-6

Frequency MHz	Antenna		Total Factor(dB/m)	Avg. Reading dBuV	Total Emissions dBuV/m	Limit dBuV/m	Margin dB
	Polarity	Hts(cm)					
Channel 1							
4824.01	V	124	8.8	40.8	49.6	54.0	-4.4
4824.01	H	158	8.8	37.0	45.8	54.0	-8.2
7236.03	V	159	12.1	38.8	50.9	54.0	-3.1
7236.03	H	161	12.1	35.3	47.4	54.0	-6.6
Channel 5							
4863.96	V	124	8.8	40.9	49.7	54.0	-4.3
4863.96	H	158	8.8	37.1	45.9	54.0	-8.1
7296.00	V	159	12.2	38.9	51.1	54.0	-2.9
7296.00	H	161	12.2	35.2	47.4	54.0	-6.6
Channel 11							
4924.04	V	124	8.8	40.7	49.5	54.0	-4.5
4924.04	H	158	8.8	37.0	45.8	54.0	-8.2
7385.45	V	159	12.4	38.8	51.2	54.0	-2.8
7385.45	H	161	12.4	35.2	47.6	54.0	-6.4

Radiated Emissions**Date:** 05-27-2003**Company:**

Locus Inc.

EUT:

MiniPCI Radio with Bi-directional Amplifier 2400LX-500mW, s/n 2188

Antenna:

9dBi Collinear Array Omni Antenna (Part # 540-0037)

Test Engineer:

Norman Shpilsher

Special Info:

Total Factor includes Antenna Factor, Cable Loss, Pre-Amp Gain, RF Filter Factor

Standard:

FCC Part 15.247(c), 15.205, 15.209

Test Site:

Anechoic Chamber, 3m measurement distance

Note:

The table shows the worst case radiated emissions (Average readings, RBW 1MHz)

No emissions above the floor noise were detected in restricted frequency ranges (per FCC 15.205) at 5th and higher harmonics.

Table # 3-6-7

Frequency MHz	Antenna		Total Factor(dB/m)	Avg. Reading dBuV	Total Emissions dBuV/m	Limit dBuV/m	Margin dB
Channel 1							
4824.01	V	119	8.8	39.0	47.8	54.0	-6.2
4824.01	H	109	8.8	35.6	44.4	54.0	-9.6
7236.03	V	144	12.1	38.3	50.4	54.0	-3.6
7236.03	H	203	12.1	36.3	48.4	54.0	-5.6
Channel 5							
4863.96	V	119	8.8	38.9	47.7	54.0	-6.3
4863.96	H	109	8.8	35.4	44.2	54.0	-9.8
7296.00	V	144	12.2	38.4	50.6	54.0	-3.4
7296.00	H	203	12.2	36.2	48.4	54.0	-5.6
Channel 11							
4924.04	V	119	8.8	38.7	47.5	54.0	-6.5
4924.04	H	109	8.8	35.3	44.1	54.0	-9.9
7385.45	V	144	12.4	38.2	50.6	54.0	-3.4
7385.45	H	203	12.4	36.1	48.5	54.0	-5.5

Radiated Emissions **Date:** 05-23-2003
Company: Locus Inc.
EUT: MiniPCI Radio with Bi-directional Amplifier 2400LX-500mW, s/n 2188
Antenna: 13.5dBi Yagi Antenna (Part # 540-0009)
Test Engineer: Norman Shpilsher
Special Info: Total Factor includes Antenna Factor, Cable Loss, Pre-Amp Gain, RF Filter Factor
Standard: FCC Part 15.247(c), 15.205, 15.209
Test Site: Anechoic Chamber, 3m measurement distance
Note: The table shows the worst case radiated emissions (Average readingds, RBW 1MHz)
 No emissions above the floor noise were detected in restricted frequency
 ranges (per FCC 15.205) at 5th and higher harmonics.

Table # 3-6-8

Frequency MHz	Antenna		Total Factor(dB/m)	Avg. Reading dBuV	Total Emissions dBuV/m	Limit dBuV/m	Margin dB
	Polarity	Hts(cm)					
Channel 1							
4824.01	V	177	8.8	39.9	48.7	54.0	-5.3
4824.01	H	155	8.8	36.0	44.8	54.0	-9.2
7236.03	V	125	12.1	39.2	51.3	54.0	-2.7
7236.03	H	115	12.1	35.5	47.6	54.0	-6.4
12059.15	V	144	19.2	27.6	46.8	54.0	-7.2
12059.15	H	133	19.2	25.8	45.0	54.0	-9.0
Channel 5							
4863.96	V	177	8.8	39.8	48.6	54.0	-5.4
4863.96	H	155	8.8	36.1	44.9	54.0	-9.1
7296.00	V	125	12.2	39.3	51.5	54.0	-2.5
7296.00	H	115	12.2	35.5	47.7	54.0	-6.3
12158.49	V	144	19.1	27.7	46.8	54.0	-7.2
12158.49	H	133	19.1	25.8	44.9	54.0	-9.1
Channel 11							
4924.04	V	177	8.8	39.8	48.6	54.0	-5.4
4924.04	H	155	8.8	36.1	44.9	54.0	-9.1
7385.45	V	125	12.4	39.3	51.7	54.0	-2.3
7385.45	H	115	12.4	35.5	47.9	54.0	-6.1
12309.87	V	144	19.0	27.5	46.5	54.0	-7.5
12309.87	H	133	19.0	25.7	44.7	54.0	-9.3



3.7 Conducted Emissions, FCC 15.207

Conducted Emissions was measured at mains input in frequency range from 150kHz to 30MHz for Transmitter unit (Transmitter Power Adapter) and Amplifier unit (Amplifier Power Adapter).

Test Procedure

The Conducted Emissions was measured at the maximum power. Both Transmitter and Amplifier Power Adapters were powered via two separate Line Impedance Stabilization Networks (LISN's), and the Computer was powered from the internal batteries.

Tables 3-7-1 and 3-7-2 and Graphs 3-7-1 and 3-7-2 show the Conducted Emissions test result

TILE Instrument Control System EMI Measurement Software

Conducted Emissions **Date:** 05-23-2003
Company: Locus Inc.
EUT: OS2400-HSE Local Computer / MiniPCI Radio
Test Engineer: Norman Shpilsher
Special Config. Info:
Standard: FCC Part 15.207
Note: The table shows the worst case conducted emissions
 All measurements were taken using a CISPR Quasi-peak detector

Table # 3-7-1

Line 1

Frequency	QP dBuV	AVG dBuV	QP Limit dBuV	AVG Limit dBuV	QP Margin dB	AVG Margin dB
151.26 KHz	52.3	20.2	66.0	56.0	-13.6	-35.8
157.36 KHz	52.2	20.2	65.8	55.8	-13.6	-35.6
159.43 KHz	52.1	20.2	65.7	55.7	-13.7	-35.5
166.3 KHz	51.9	25.5	65.5	55.5	-13.7	-30.1
170.01 KHz	51.7	29.2	65.4	55.4	-13.7	-26.3
176.44 KHz	51.5	28.8	65.2	55.2	-13.8	-26.4
177.45 KHz	51.5	28.2	65.2	55.2	-13.8	-27.0
181.27 KHz	51.4	28.3	65.1	55.1	-13.8	-26.8
188.33 KHz	50.9	22.2	64.9	54.9	-14.0	-32.7
191.63 KHz	50.9	19.1	64.8	54.8	-13.9	-35.7
199.59 KHz	50.8	18.7	64.6	54.6	-13.8	-35.9
217.36 KHz	50.2	18.2	64.1	54.1	-13.9	-35.9

Line 2

Frequency	QP dBuV	AVG dBuV	QP Limit dBuV	AVG Limit dBuV	QP Margin dB	AVG Margin dB
151.68 KHz	52.3	19.8	66.0	56.0	-13.7	-36.2
155.79 KHz	52.1	20.1	65.8	55.8	-13.7	-35.8
159.95 KHz	52.0	21.1	65.7	55.7	-13.8	-34.6
164.12 KHz	51.9	25.0	65.6	55.6	-13.7	-30.6
168.23 KHz	51.7	29.7	65.5	55.5	-13.8	-25.8
175.98 KHz	51.5	29.6	65.3	55.3	-13.8	-25.6
185.62 KHz	51.0	25.1	65.0	55.0	-14.0	-29.9
195.34 KHz	50.6	18.3	64.7	54.7	-14.1	-36.4
200.42 KHz	50.7	18.3	64.6	54.6	-13.8	-36.2
212.53 KHz	50.4	18.1	64.2	54.2	-13.8	-36.1
223.78 KHz	50.1	18.3	63.9	53.9	-13.8	-35.6
235.11 KHz	49.8	17.6	63.6	53.6	-13.8	-36.0

TILE Instrument Control System EMI Measurement Software

Conducted Emissions **Date:** 05-23-2003
Company: Locus Inc.
EUT: 2400LX-500mW Amplifier
Test Engineer: Norman Shpilsher
Special Config. Info:
Standard: FCC Part 15.207
Note: The table shows the worst case conducted emissions
 All measurements were taken using a CISPR Quasi-peak detector

Table # 3-7-2

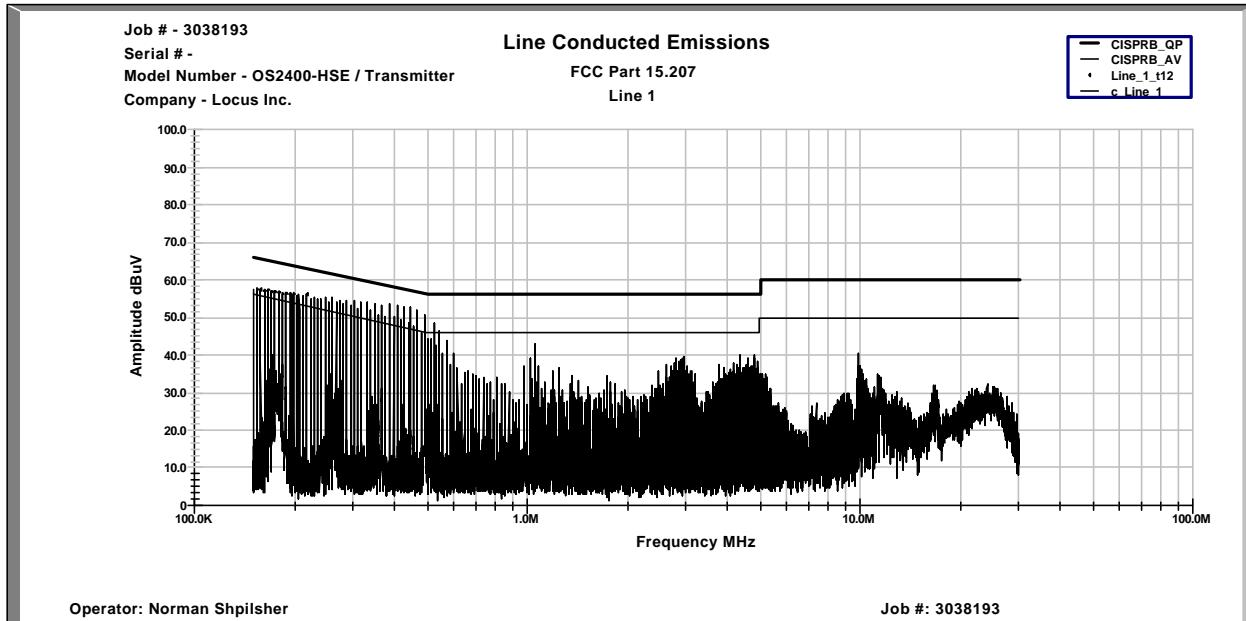
Line 1

Frequency	QP dBuV	AVG dBuV	QP Limit dBuV	AVG Limit dBuV	QP Margin dB	AVG Margin dB
166.3 KHz	48.3	33.6	65.5	55.5	-17.3	-21.9
168.54 KHz	49.9	36.4	65.5	55.5	-15.6	-19.1
169.21 KHz	49.9	37.0	65.5	55.5	-15.6	-18.4
2.5134 MHz	40.0	23.3	56.0	46.0	-16.0	-22.7
2.5829 MHz	40.3	21.2	56.0	46.0	-15.7	-24.8
2.6522 MHz	44.4	26.9	56.0	46.0	-11.7	-19.1
2.7428 MHz	45.0	28.2	56.0	46.0	-11.0	-17.8
2.7708 MHz	44.4	26.7	56.0	46.0	-11.6	-19.3
2.9152 MHz	44.9	29.0	56.0	46.0	-11.1	-17.0
2.9377 MHz	46.7	31.1	56.0	46.0	-9.3	-14.9
2.9388 MHz	46.6	31.0	56.0	46.0	-9.4	-15.0
4.715 MHz	39.2	23.7	56.0	46.0	-16.8	-22.3

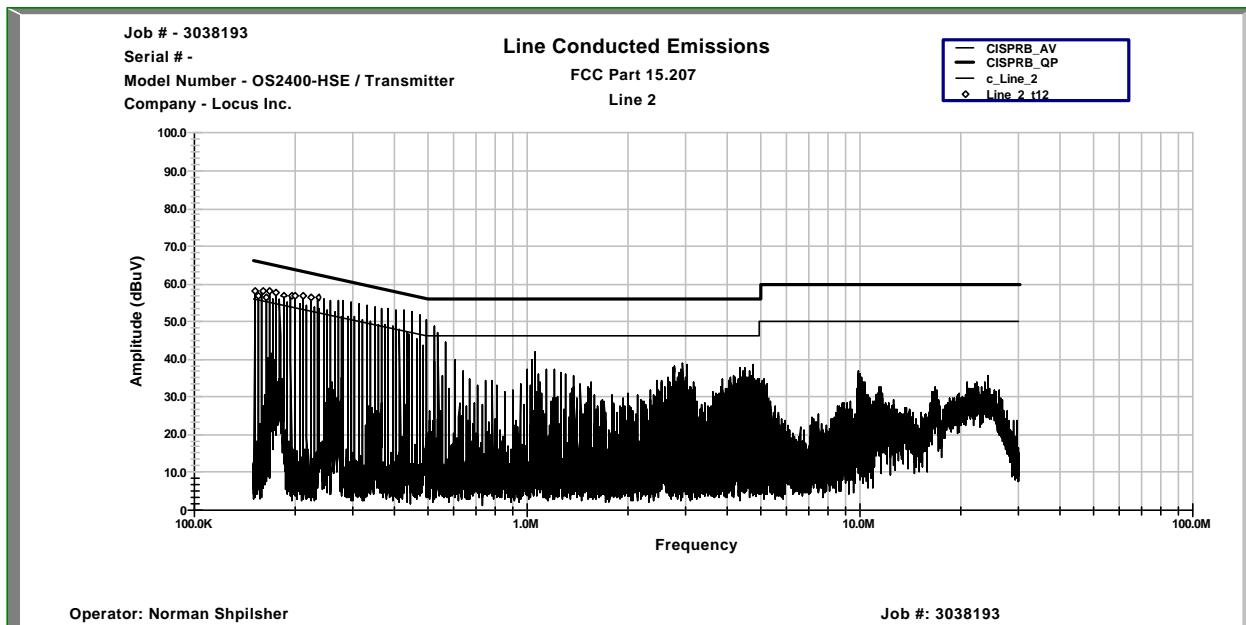
Line 2

Frequency	QP dBuV	AVG dBuV	QP Limit dBuV	AVG Limit dBuV	QP Margin dB	AVG Margin dB
172.09 KHz	49.0	37.3	65.4	55.4	-16.4	-18.1
2.6377 MHz	45.5	29.2	56.0	46.0	-10.6	-16.9
2.6909 MHz	47.2	29.3	56.0	46.0	-8.8	-16.7
2.7718 MHz	48.6	32.3	56.0	46.0	-7.4	-13.7
2.8488 MHz	47.6	32.5	56.0	46.0	-8.4	-13.5
2.8729 MHz	50.7	32.7	56.0	46.0	-5.4	-13.3
2.8925 MHz	47.1	30.7	56.0	46.0	-8.9	-15.3
2.9281 MHz	47.6	31.2	56.0	46.0	-8.4	-14.8
2.9477 MHz	48.9	33.2	56.0	46.0	-7.1	-12.9
2.9534 MHz	48.7	32.8	56.0	46.0	-7.4	-13.2
3.0236 MHz	47.6	32.3	56.0	46.0	-8.4	-13.7
3.0339 MHz	48.3	32.7	56.0	46.0	-7.7	-13.4

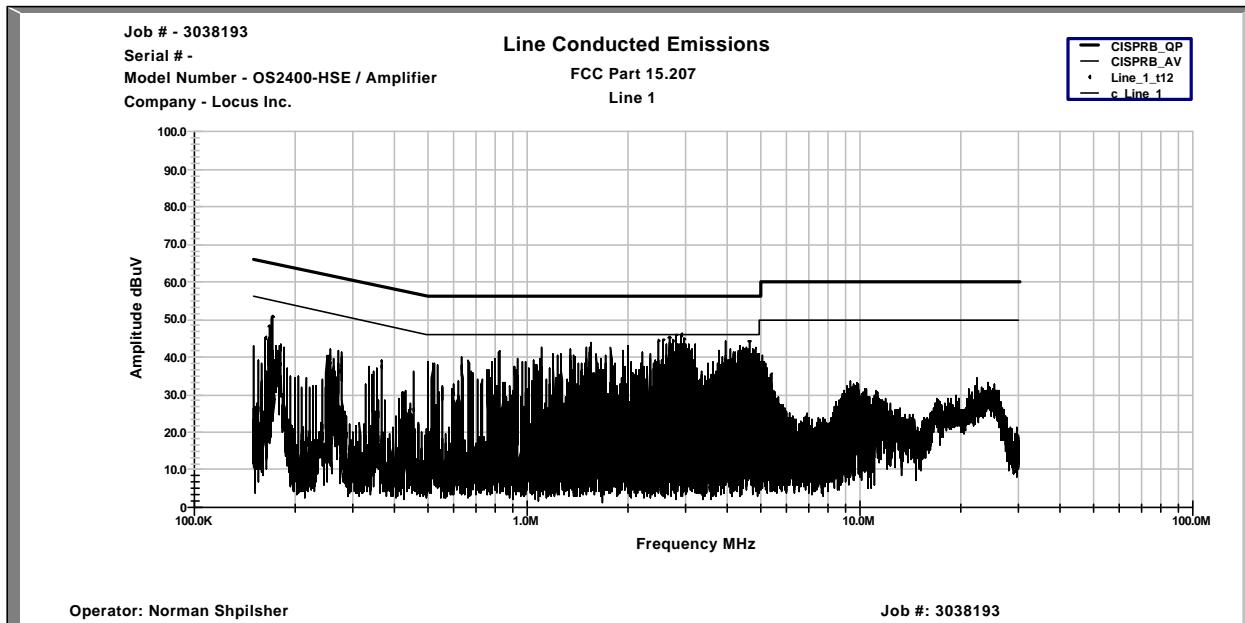
Graph # 3-7-1
Conducted Emissions, Transmitter Unit
Line 1



Line 2



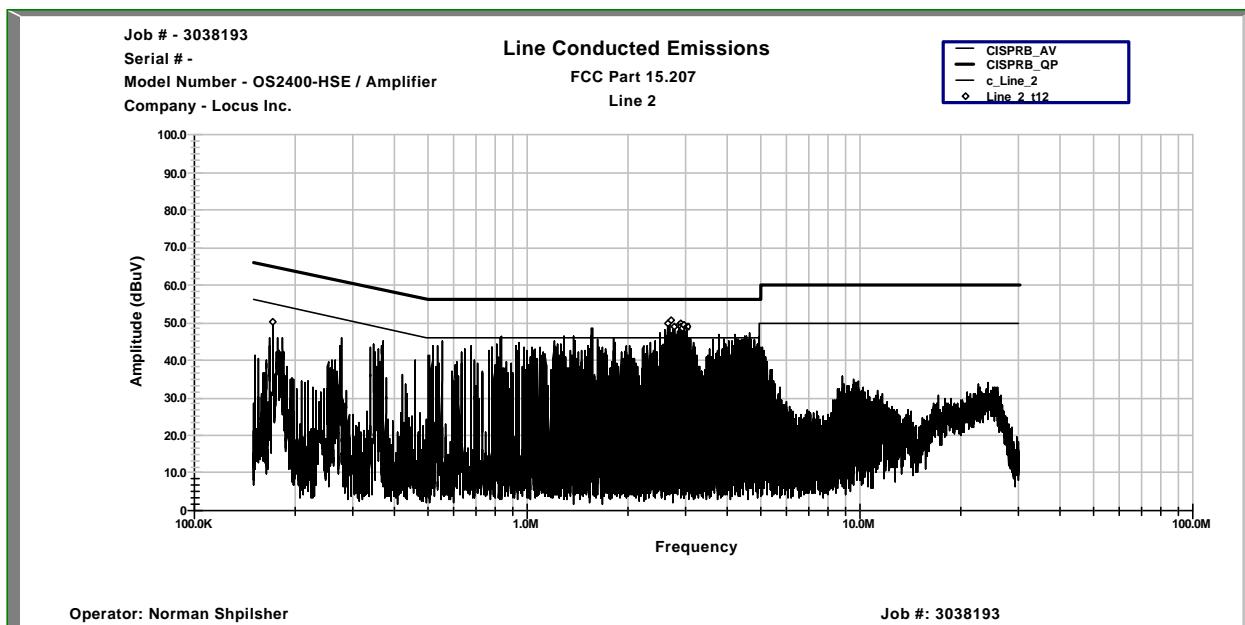
Graph # 3-7-2
Conducted Emissions, Amplifier Unit
Line 1



Operator: Norman Shpilsher

Job #: 3038193

Line 2



Operator: Norman Shpilsher

Job #: 3038193

3.8 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 emissions reading on the EMI Receiver.

The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where: FS = Field Strength in dB(?V/m)

RA = Receiver Amplitude in dB(?V)

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB(m⁻¹)

AG = Amplifier Gain in dBi

Assume a receiver reading of 48.1 dB(?V) is obtained. The antenna factor of 7.4 dB(m⁻¹) and cable factor of 1.6 dB is added and amplifier gain of 16.0 dBi is subtracted giving field strength of 41.1 dB(?V/m).

$$RA = 48.1 \text{ dB(?V)}$$

$$AF = 7.4 \text{ dB(m}^{-1}\text{)}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 16.0 \text{ dBi}$$

$$FS = RF + AF + CF - AG$$

$$FS = 48.1 + 7.4 + 1.6 - 16.0$$

$$FS = 41.1 \text{ dB(?V/m)}$$

In the tables the Cable correction factors are included to the Antenna Factors.

Tested by:

Norman Shpilsher
EMC Project Engineer
Intertek

Norman Shpilsher

Signature

Date: June 16, 2003

4.0 TEST EQUIPMENT

Receivers/Spectrum Analyzers

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
HP85462A Receiver RF Section	3325A00106	08/02	08/03	X
HP85460A RF Filter Section	3330A00109	08/02	08/03	X
HP85462A Receiver RF Section	3549A00306	12/02	12/03	
HP85460A RF Filter Section	3448A00276	12/02	12/03	
Agilent Spectrum Analyzer E7405A	US40240235	10/02	10/03	X
Advantest Spectrum Analyzer R3271A	55050084	05/02	05/03	

Antennas/Pre-Amplifiers

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
Schaffner-Chase Bicono-Log Antenna	2468	12/02	12/03	X
Schaffner-Chase Bicono-Log Antenna	2630	05/02	05/03	
HP 83017A Pre-Amplifier	3123A00475	05/24/02	05/24/03	X
EMCO Horn Antenna 3115	9507-4513	09/02	09/03	X
EMCO Horn Antenna 3116	9904-2423	05/05/03	05/04	X

Artificial Mains Networks/Absorbing Clamps

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
FCC LISN-2	316	01/03	01/04	X
FCC-LISN-50-25-2	2014	04/03	04/04	X
Farnell 1EXLSN930A	136	04/03	04/04	