Malibu Networks, Inc.
1107 Investment Blvd.
Suite 250
El Dorado Hills, CA 95762

FCC Part 15 Certification Application

Industrie Canada RSS210 Certification

EMI Test Report
and
Technical Documentation
on
Malibu Networks, Inc.
Models: AirMAX™ 240 / 2400

FCC ID: QGQ-AM241

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General Information

Unit(s) Under Test: AirMAX 240 and AirMAX 2400

FCC ID: QGQ-AM241

Tested For: Malibu Networks, Inc.
1107 Investment Blvd.
Suite 250
El Dorado Hills, CA 95762

Tested At: Elliott Laboratories
684 West Maude Ave
Sunnyvale, CA 94086

Tested By: Chris Byleckie, Sr. Test Engineer, Elliott Laboratories
Juan Martinez, Sr. Test Engineer, Elliott Laboratories
David Waitt, (Independent Consultant)

Test Specifications: FCC CFR 47, Part 15.247, 2400MHz Spread Spectrum Intentional Radiator
Industrie Canada RSS 210 - 6.2.2(O)

Test Date: June 2002

Requested Certification: 2400MHz, Part 15.247 DSSS Radio Approval

Company Background Malibu Networks is a venture backed startup supplying Broadband Wireless Access (BWA) systems to service providers. The systems are powered by Malibu Networks' patented MAXimum IP™ technology. MAXimum IP is a unique Quality of Service (QoS) and provisioning management technology that may be implemented in a BWA system. The devices that make up this infrastructure are the AirMAX 240 and the AirMAX 2400.

Malibu Networks distributes AirMAX through Value Added Resellers (VARs), stocking distributors, and network system integrators. Malibu Networks' has engaged distributors in North America to market and distribute the AirMAX product family in areas where wire-line technology does not exist and demand for broadband access is high.

Detailed Product Information

The Malibu AirMAX™ System is made up of “Base Station Equipment” (BSE) radios and “Customer Premises Equipment” (CPE) radios. The BSE stations are considered point-to-multipoint systems because they communicate with several different CPE stations on a regular basis. The CPE stations are considered point-to-point because they only communicate back to a particular BSE station. Both the BSE and the CPE stations operate on the 2.4 GHz ISM band utilizing IEEE 802.11 protocol. Both the BSE and the CPE radio are identical. The only difference between the two stations, if any at all, will be the antenna that is used at the installation.

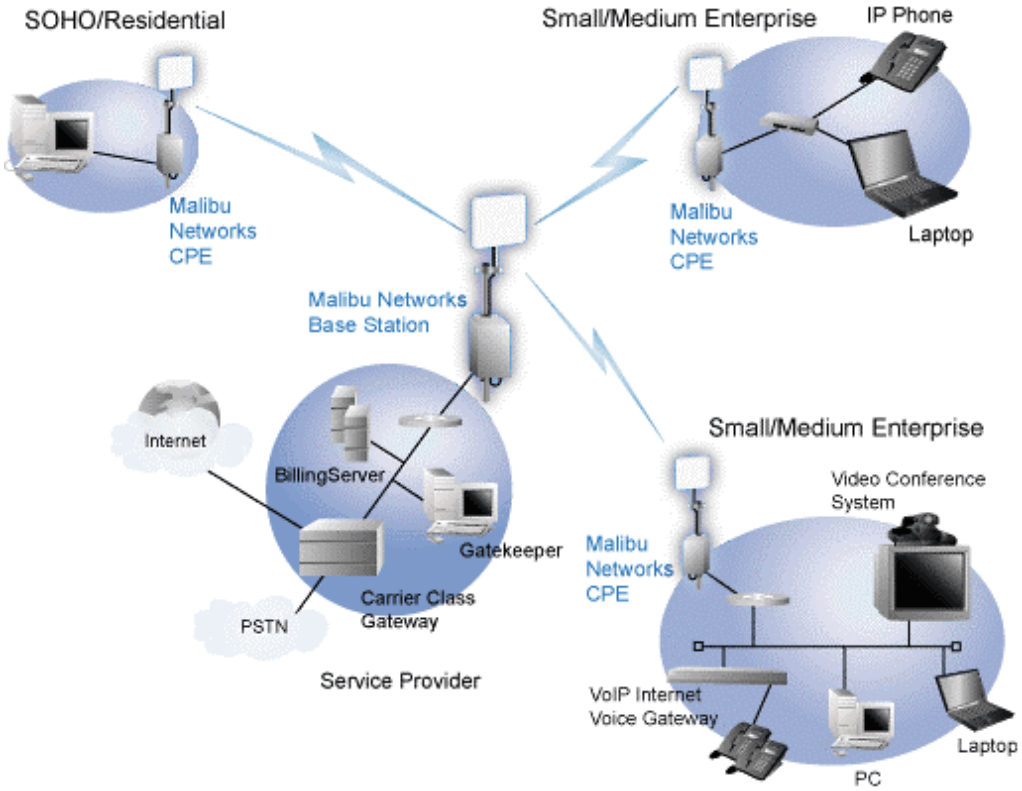
The BSE and CPE may utilize two types of high gain antennas up to and including, a 12 dBi Omni and a 19-dBi panel antenna. It is expected that in some cases, antennas with lower gains will be used, however the units were tested with these higher gain antennas to allow use of lower gain antennas.

Malibu Networks customers for the AirMAX system will typically be an ISP or a business who wishes to provide wireless Internet connectivity for their customers / employees. Malibu Networks will not be selling the products to the end user of the system. This being the case, both the BSE and the CPE radios are professionally installed and configured.

The transmitter in the AirMAX radio is a previously certified Cisco 802.11 PCMCIA card (FCC ID: LDK102040. The Unit is powered by a generic wall plug AC adapter and Power over Ethernet.

A functional diagram of the Malibu Networks wireless system is shown in the diagram to the right.

The diagram shows a AirMAX BSE station supporting 3 AirMAX CPE stations.



Results Summary

The following test were performed to demonstrate compliance with FCC Part 15.247 and RSS-210 6.2.2.(o). Compliance with the following Part 15 regulations was verified:

Part 15 Paragraph	RSS-210 Paragraph	Test	Results
15.247(b)	6.2.2(o)(a) 3	Maximum Power Output at Antenna Terminal 17 dBm Setting 20 dBm Setting	 17.00 dBm Max 20.70 dBm Max
15.247(a)(2)	6.2.2(o)(e1)	6dB Bandwidth	11.1 MHz Min
15.247(d)	6.2.2(o)(d1)	Power Spectral Density	-4.8dBm/3kHz
15.247(c)	6.2.2(o)(a) 4	Out of Band Spurious Emissions	Spurs <<-20 dBc
15.205	6.3(c)	Radiated Emissions in Restricted bands	4.1 dB in spec min @17.233.54GHz (7th * 2462MHz)

Test Facilities

Radiated emissions tests in accordance with FCC Part 15.205 and IC RSS210 6.2.2(O)(a)(5) were conducted at:

Elliott Labs
684 West Maude Ave
Sunnyvale, CA 94086

General:

Final radiated test measurements were taken in June 2002 at the Elliott Laboratories Open Area Test Site #4.

The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

OATS:

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated emissions are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 Guidelines.

Antenna, Antenna Mast and Turntable

The Horn antennas that are use to measure radiated emissions above 1000MHz are amounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

ANSI C63.4 specifies that the test height above the ground plane shall be 80cm unless the equipment is intended to be floor mounted. During the radiated emissions tests the equipment is positioned on a motorized turntable in conformance with the ANSI requirement.

Instrument Calibration

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

All remaining “Conducted RF” tests (with the exception of Out of Band Emissions) were performed at by David Waitt in an Engineering Lab utilizing calibrated HP test equipment. – See equipment list

Test Equipment

The following test equipment was used to perform the testing

Item	Desc.	Manufacturer	Model	S/N	Cal due date
1.	Spectrum Analyzer	HP	83563E	Elliott 00284	31 Mar 03
2.	Spectrum Analyzer	Agilent	4404B	US39440486	25 Feb 03
3.	3.5 GHz HPF	HP	NA	84300-80038	1 Mar 03
4.	Pre Amp	Miteq	ASF 44	805817	30 Oct 02
5.	Antenna	EMCO	3116	9711-5359	2 Mar 03

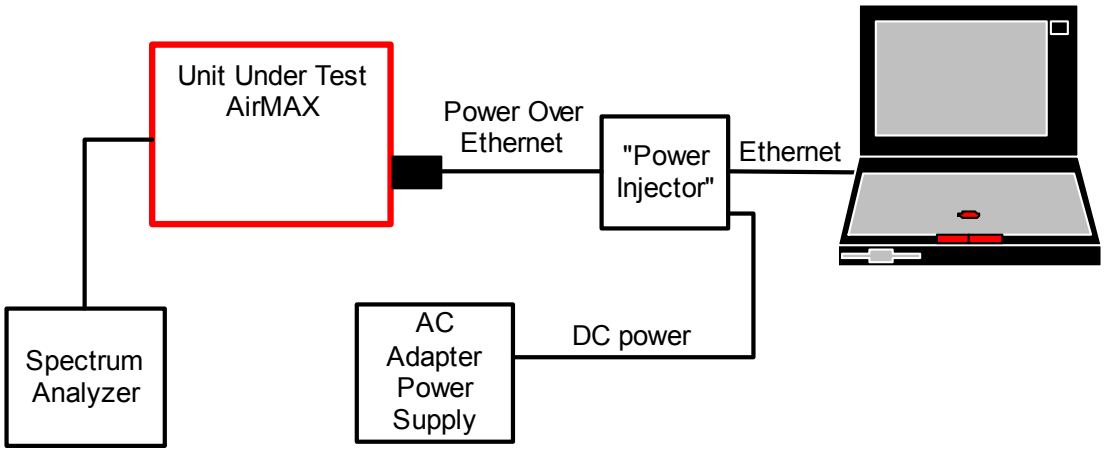
Test Methods

Many of the tests are performed at the low, middle and the high portion of the 2400 – 2483.5 MHz band. These tests are typically performed on the following channels / frequencies:

Channel	Frequency (MHz)
1	2412
6	2437
11	2462

The tests below are performed using the basic test setup shown below. In the case of measuring the power out, the spectrum was replaced with a power meter. In several cases it is required that the EUT have the hopping function disabled in order to make the required measurement, because of this necessity, the EUT was running special diagnostic firmware to allow this functionality

Part 15	RSS210	Test
15.247(a)(1)	6.2.2(O)(a)	6dB Bandwidth
15.247(c)	6.2.2(O)(a) 4	Out of Band Conducted Emissions
15.247(a)(1)(i)	6.2.2.(O)(a)1	Power Spectral Density
15.247(b)	6.2.2(o)(a)3	Transmit Power



Basic Conducted RF Bench Test Setup

Unless otherwise noted, the support equipment for the bench tests is listed below.

Support Equipment				
Description	**Model number**	**FCC ID or SN**	**Manufacturer**	**Power Cable**
Laptop	T21	78-0FX2F	IBM	Laptop PS
Power Injector	2310533-000A	NA	Malibu Networks	CAT 5
Power Supply	PCGA-AC16V2	S/N 0038 B 0038897		“Zip” cord

Test Results

Detailed test procedures and test results are contained in the following sections. In cases where the test setup differs from the Conducted RF test setup shown earlier, the test setup is also presented.

Test Conditions			
Temperature	24 C	**Humidity:**	52%
ATM pressure	1017 mBar	**Grounding:**	None
Tested By	David Waitt	**Date of Test:**	June 2002
Test Reference	Refer to individual test results		
Tested Range	Test Dependent		
Test Voltage	5 VDC to the module		
Modifications	No modifications were made to the unit during the tests		

Maximum RF Power Output at Antenna Terminals

Specifications:

FCC Specification: Paragraph: 15.247(b)
Industrie Canada Specification: Paragraph RSS210, 6.2.2(o)(a) 3

Procedure:

The test was configured as shown in the conducted RF test setup. The unit was tuned to the test channels and configured to transmit random data packets.

Because the unit will be operated at two different power levels in the field (+17 and +20 dBm depending on the antenna used) the power was measured low, middle and high channels for both the +17dBm and the +20 dBm power setting.

Power reduction calculation:

Point-To-Point with 19 dBi antenna

The specification requires a power reduction down from +30dBm by 1 dB for every 3dBi that the antenna gain exceeds 6dBi, This dictates that the highest transmit power for the AirMAX when used with the 19dBi panel antenna is:

(19dBi – 6dBi) / 3 = 4 dB

(30dBm – 4dB) + 19 dBi = 45 dBm EIRP

In reality, because of the restricted band at 2483.5, whenever the AirMAX radio is configured with the 19dBi antenna, the power will be set to +17dBm. Thus the actual maximum EIRP with the 19 dBi antenna is:

17dBm + 19 dBi = 36 dBm EIRP

This is 9 dB below the allowed EIRP for this antenna and a Point-to-Point system.

Point-To-Multipoint with 12 dBi antenna

The specification requires a power reduction down from +30dBm by 1 dB for every 1dBi that the antenna gain exceeds 6dBi to yield a EIRP limit of 36 dBm. When configured with the 12dBi antenna, the RF power will be set to +20 dBm, Therefore the EIRP of this configuration is:

20.7dBm + 12 dBi = 32.7 dBm EIRP

This is below the Point-to-Multipoint system EIRP requirement by 3.3 dB.

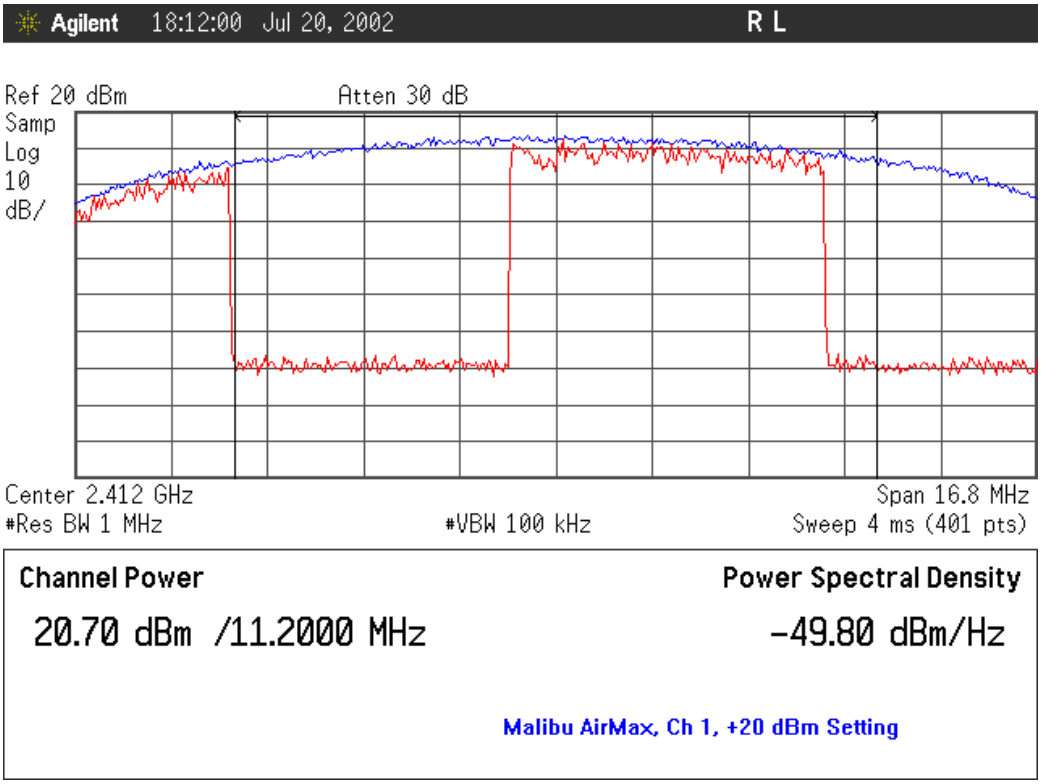
RF Transmit Power Result:

The following power levels were measured on low, mid and high channels integrated over an 11.2 MHz (6 dB) BW

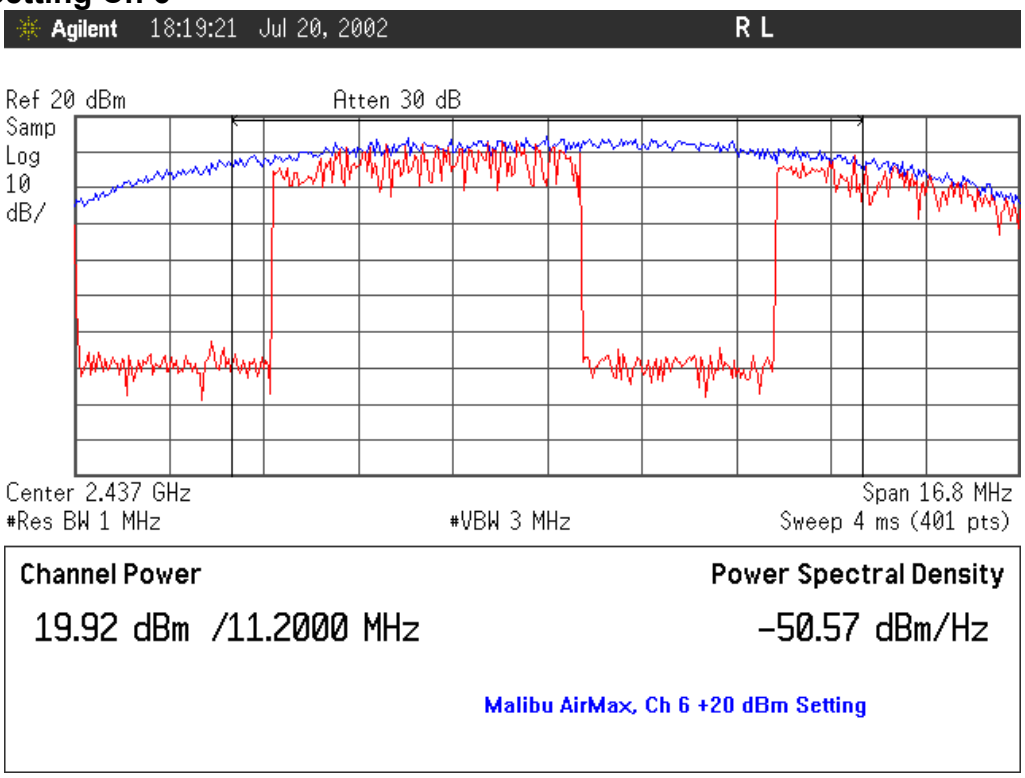
Chan	Pwr Setting	Freq. (MHz)	Level (dBm)	Level (Watts)
1	+20	2412	20.70	.1175
6	+20	2437	19.92	.0982
11	+20	2462	19.78	.0950
1	+17	2412	17.00	.0500
6	+17	2437	16.51	.0447
11	+17	2462	16.84	.0483

RF Power Output Plots

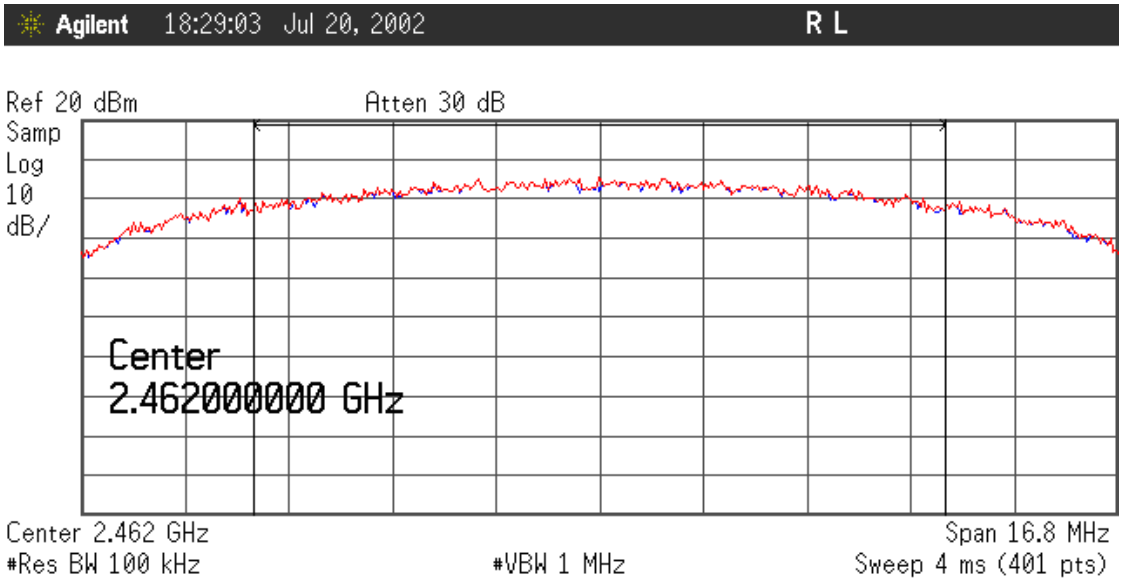
+20 dBm Setting Ch1



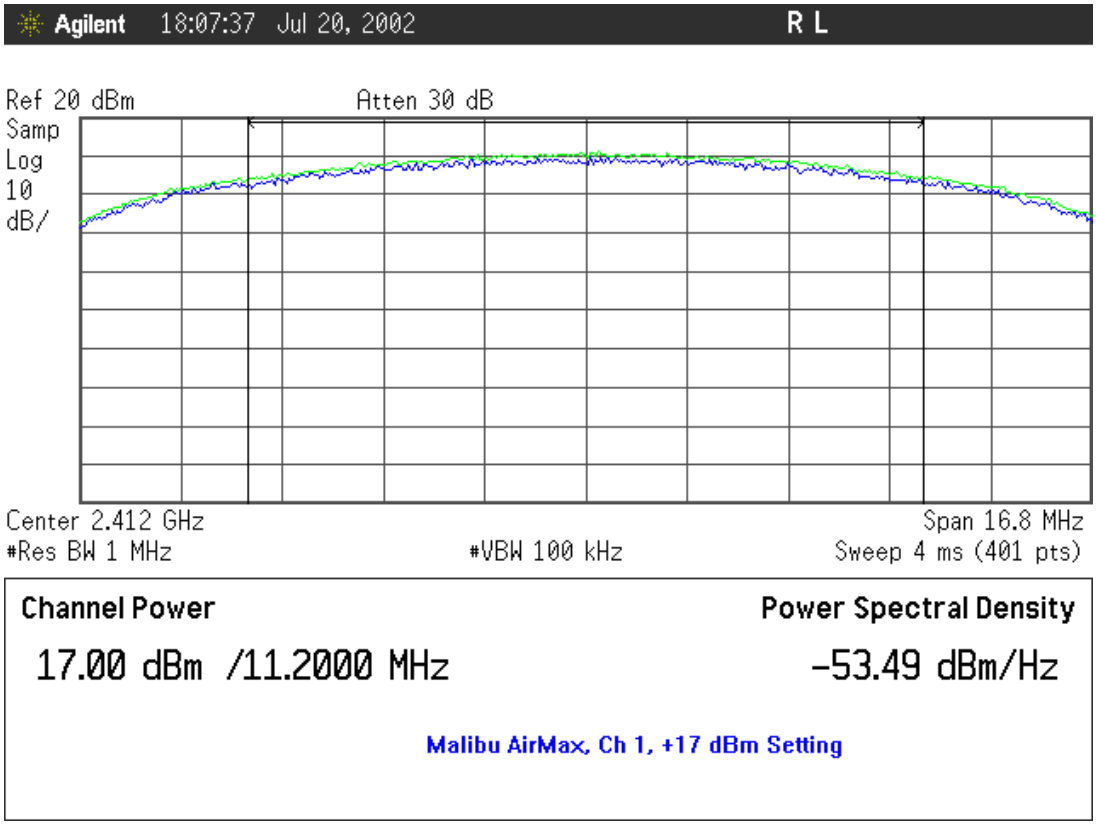
+20 dBm Setting Ch 6



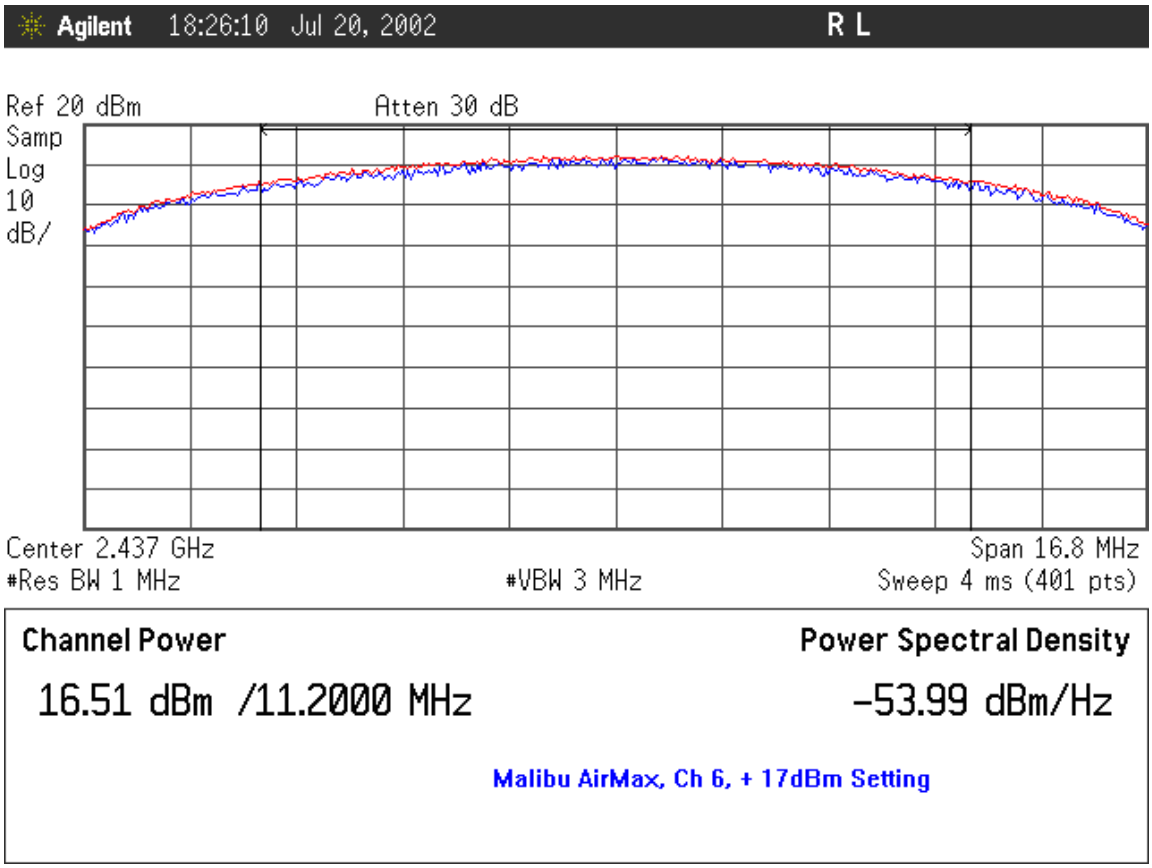
+20 dBm Setting Ch 11



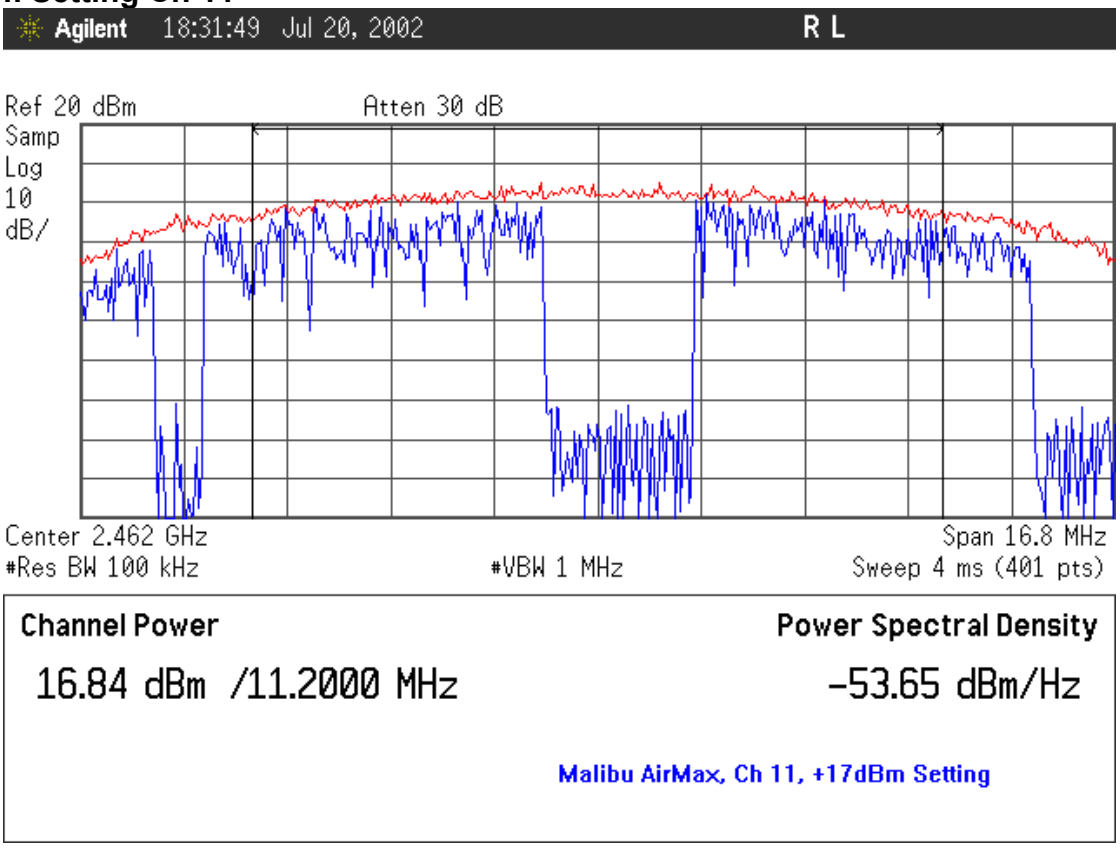
+17 dBm Setting Ch 1



+17 dBm Setting Ch 6



+17 dBm Setting Ch 11



6 dB bandwidth

Specifications

FCC Specification: Paragraph 15.247(a)(2)
Industrie Canada Specification: Paragraph RSS210, 6.2.2(o)(e1)

Procedure:

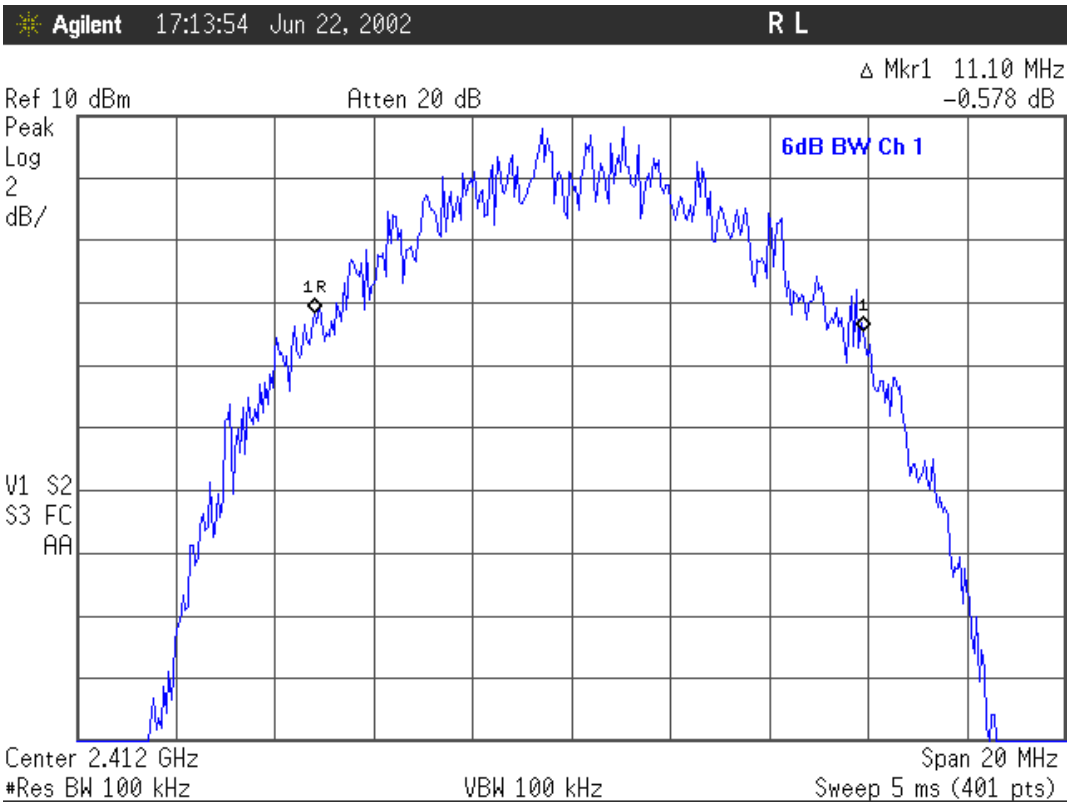
The Malibu AirMAX operates one the standard IEEE 802.11 channels. The 6dB bandwidth was measured on the low middle and high channel using the conducted RF test setup. The bandwidth test was performed only at the high of the two power settings that will be used in the system(+20 dBm) since it is unlikely that the bandwidth would change significantly when the unit is operating at +17 dBm.

Results:

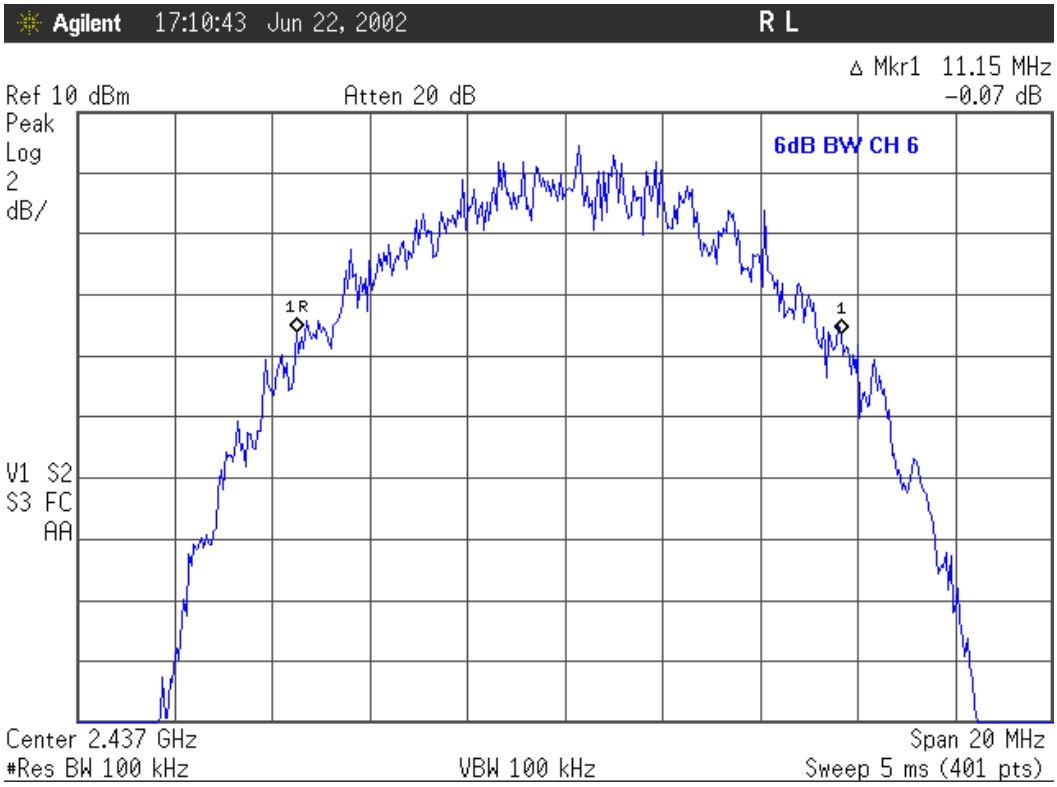
Channel	Freq (MHz)	Measured 6dB BW (MHz)	Spec(MHz)
1	2412	11.1	.500
6	2437	11.15	.500
11	2462	11.2	.500

6dB BW Plots

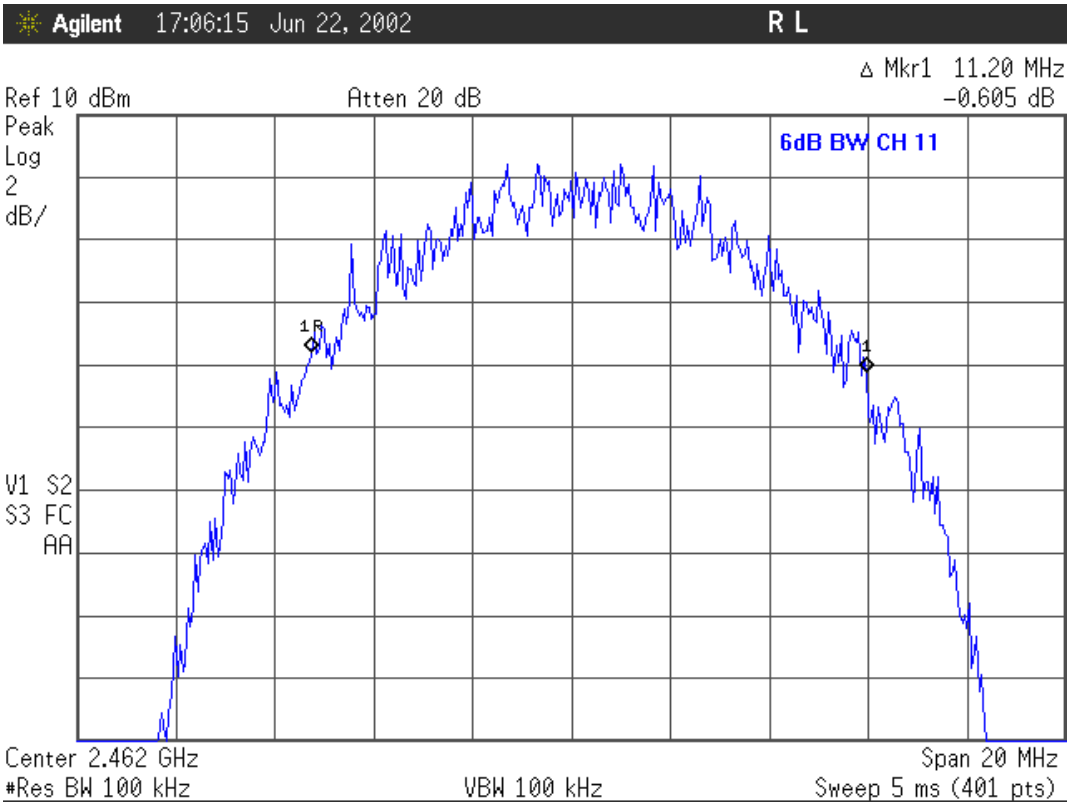
Channel 1



Channel 6



Channel 11



Power Spectral Density

FCC Specification: Paragraph: 15.247(4)(d)

Industrie Canada Specification: Paragraph 6.2.2(o)(d1)

Procedure:

The test setup was configured as shown in the conducted test setup. The UUT was configured to continuously transmit random data packets. Initially the bandwidth of the entire channel was examined. Using MAX HOLD and peak search, the frequency with the maximum power was determined.

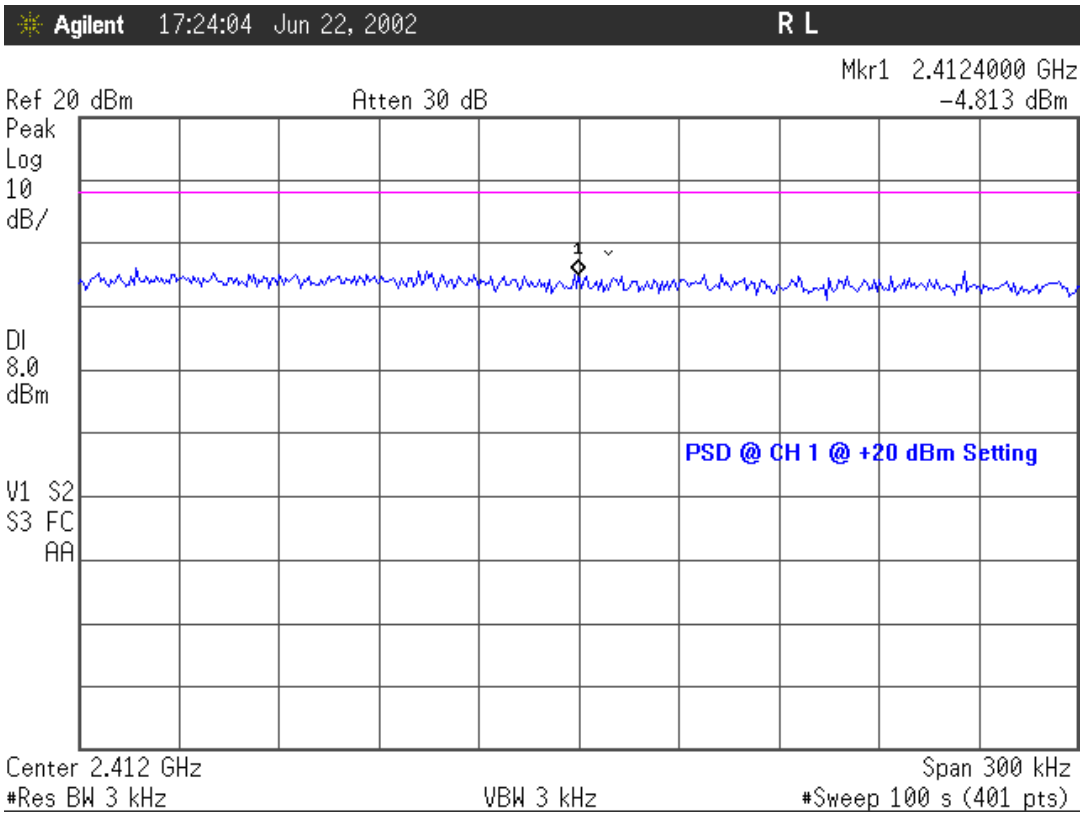
The measurement span was then narrowed to 300kHz and centered on this frequency and the RBW set to 3 kHz with a 100 second sweep. The analyzer was then set to MAX HOLD and a display line placed at +8dBm.

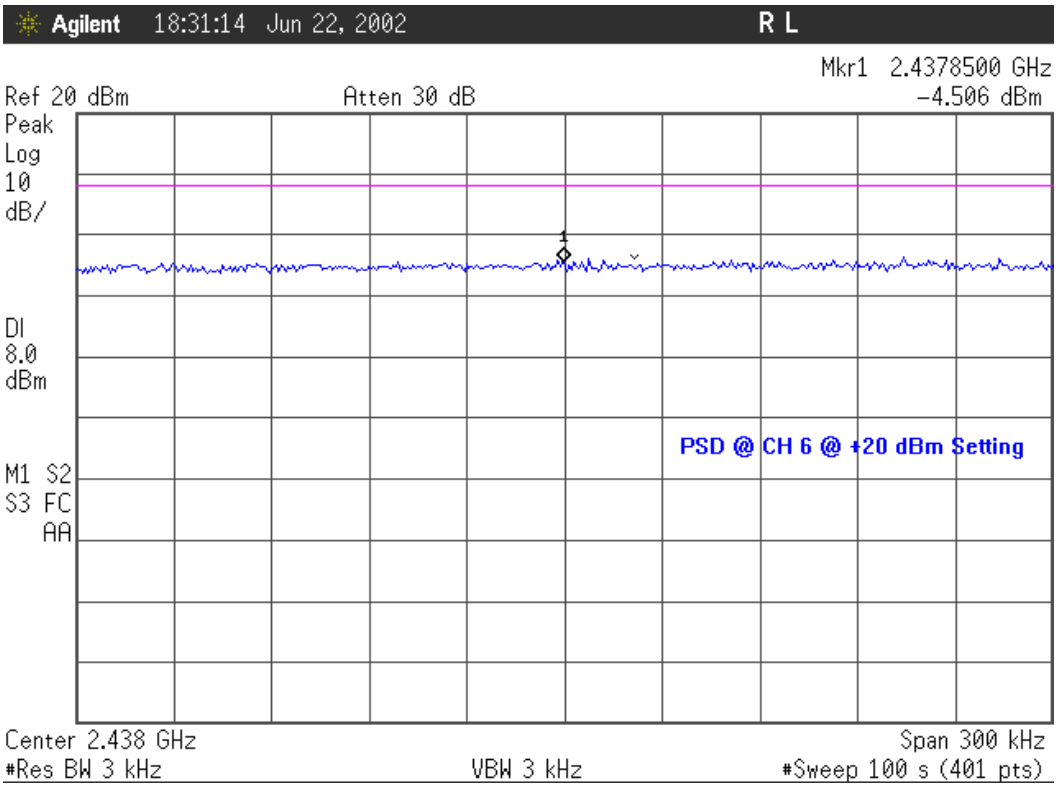
The power spectral density was measured at the low, middle and high test channels with the unit set to a power level of +20 dBm.

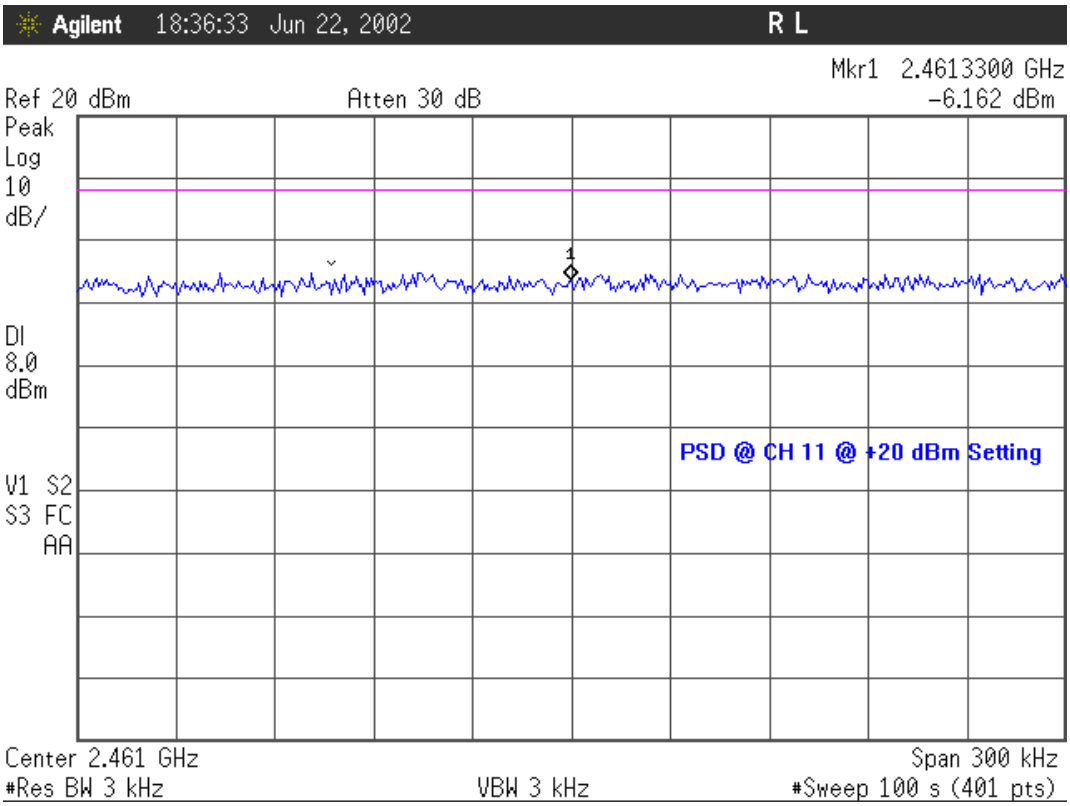
Results:

Channel	Freq (MHz)	Measured (PSD)	Spec
1	2412	-4.813	8dBm/3kHz
6	2437	-4.506	8dBm/3kHz
11	2462	-6.162	8dBm/3kHz

Power Spectral Density Plots




Agilent 18:31:14 Jun 22, 2002
R L
Mkr1 2.4378500 GHz
-4.506 dBm
Ref 20 dBm
Atten 30 dB
Peak
Log
10
dB/
DI
8.0
dBm
PSD @ CH 6 @ +20 dBm Setting
M1 S2
S3 FC
AA
Center 2.438 GHz
#Res BW 3 kHz
VBW 3 kHz
Span 300 kHz
#Sweep 100 s (401 pts)


Agilent 18:36:33 Jun 22, 2002
R L
Mkr1 2.4613300 GHz
-6.162 dBm
Ref 20 dBm
Atten 30 dB
Peak
Log
10
dB/
DI
8.0
dBm
PSD @ CH 11 @ +20 dBm Setting
V1 S2
S3 FC
AA
Center 2.461 GHz
#Res BW 3 kHz
VBW 3 kHz
Span 300 kHz
#Sweep 100 s (401 pts)

Out of band Spurious Emissions

Specifications:

FCC Part 15 Paragraph 15.247(c)
Industrie Canada: Paragraph RSS210, 6.2.2.(o)(b)4

Procedure:

The test was configured as shown in the Conducted RF test setup. The UUT was configured to transmit random data packets. The band from 1 GHz to 25GHz was examined spurious emissions. This test was conducted on the low middle and high channels with the UUT configured to transmit +20 dBm.

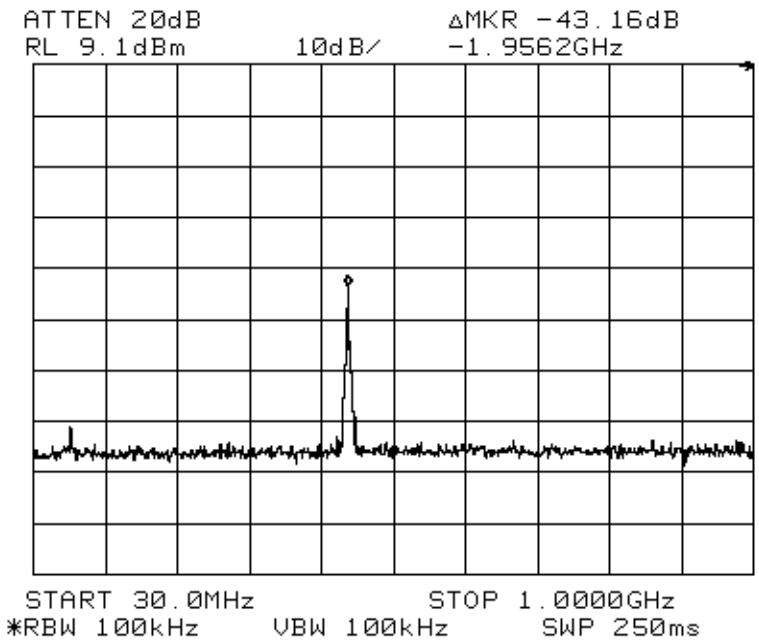
A reference level was first established by measuring the power level of the fundamental in a 100kHz BW. A display line was then placed at this level. The rest of the band was then examined to ensure that any visible spurs are greater then –20dBc.

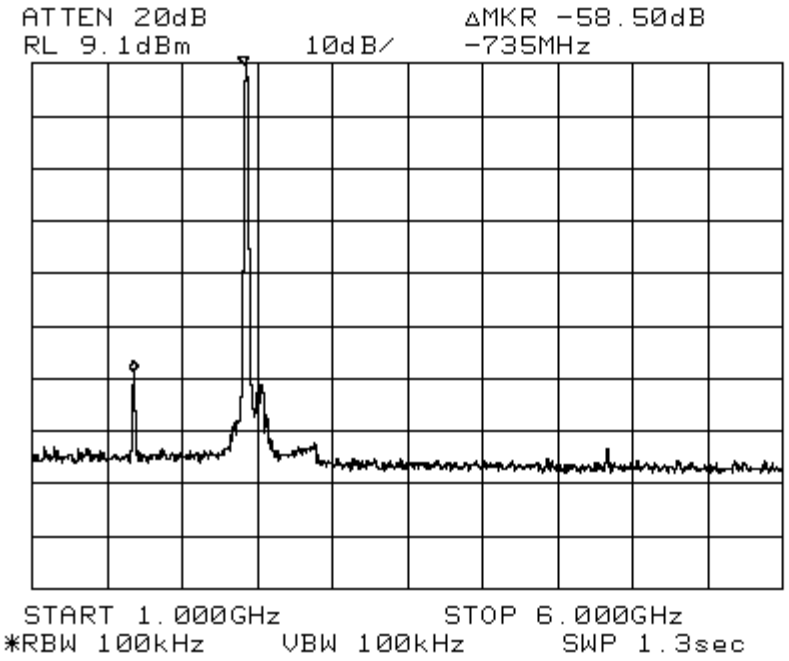
Results:

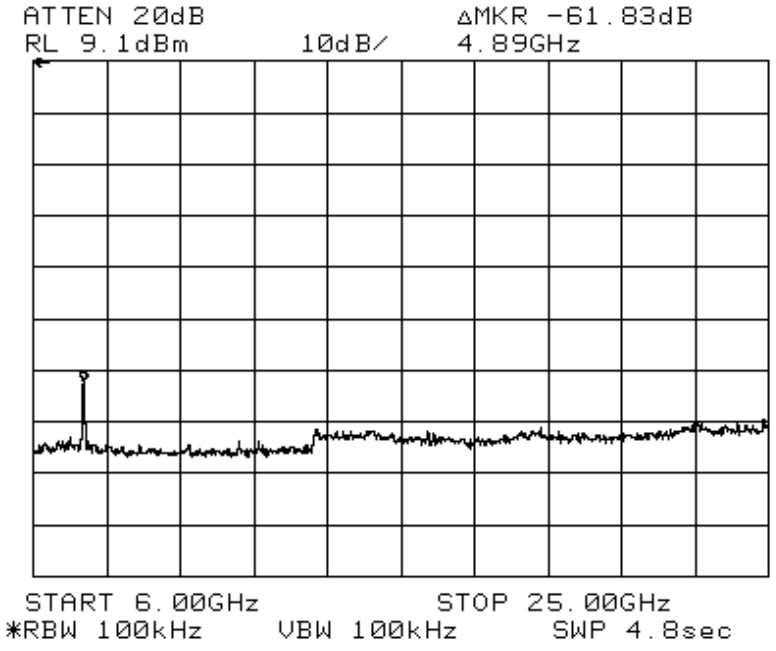
There were no visible spurs above the noise floor of the test setup.

Out of Band Emissions Plots

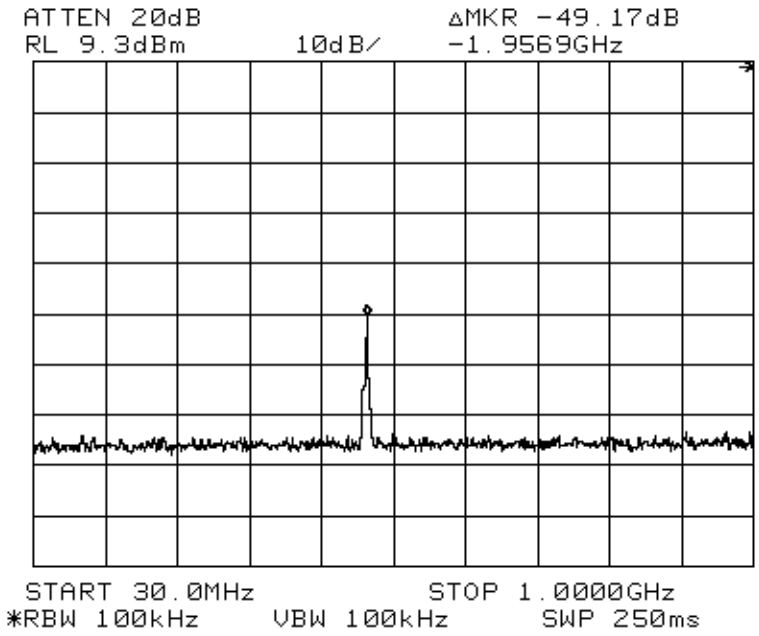
UUT Set to xmit on Channel 1

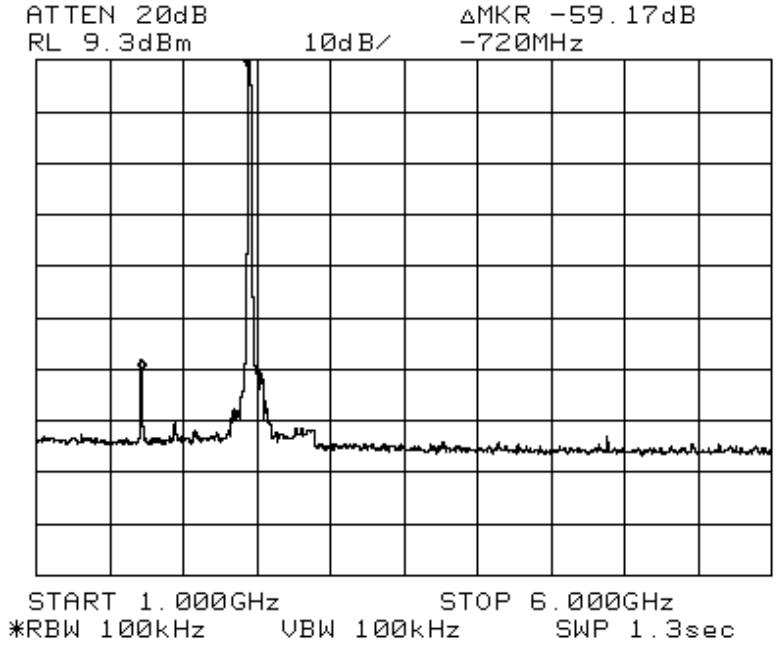


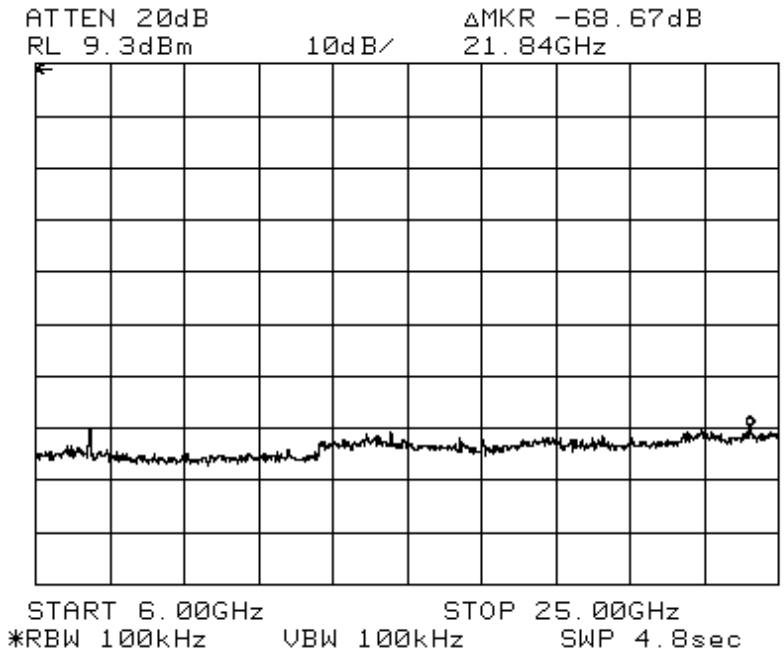

ATTEN 20dB
RL 9.1dBm
10dB/
ΔMKR -58.50dB
-735MHz
START 1.000GHz
STOP 6.000GHz
*RBW 100kHz
VBW 100kHz
SWP 1.3sec


ATTEN 20dB
RL 9.1dBm
10dB/
ΔMKR -61.83dB
4.89GHz
START 6.00GHz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
SWP 4.8sec

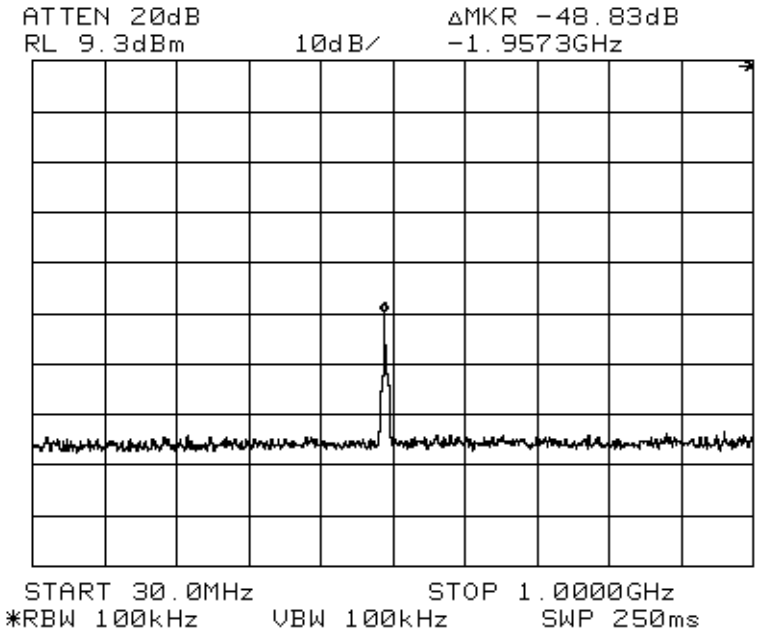
UUT Set to Xmit on channel 6

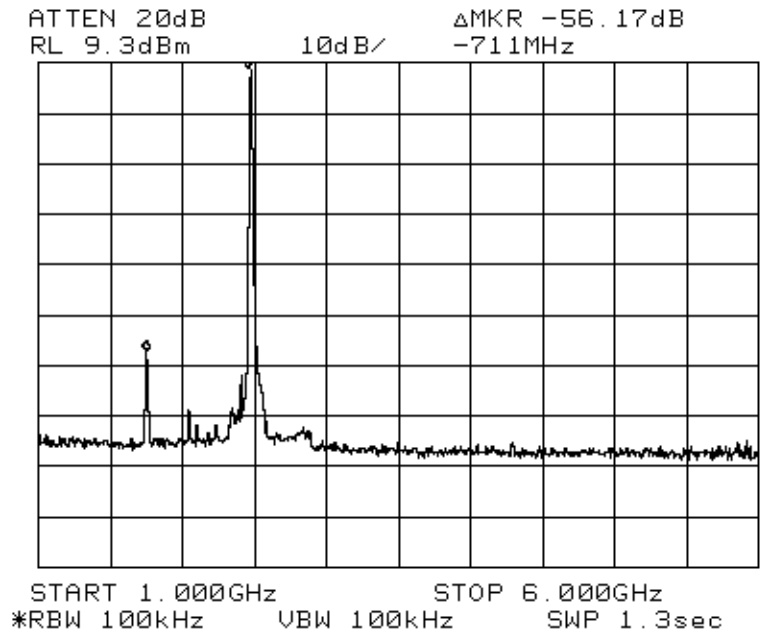


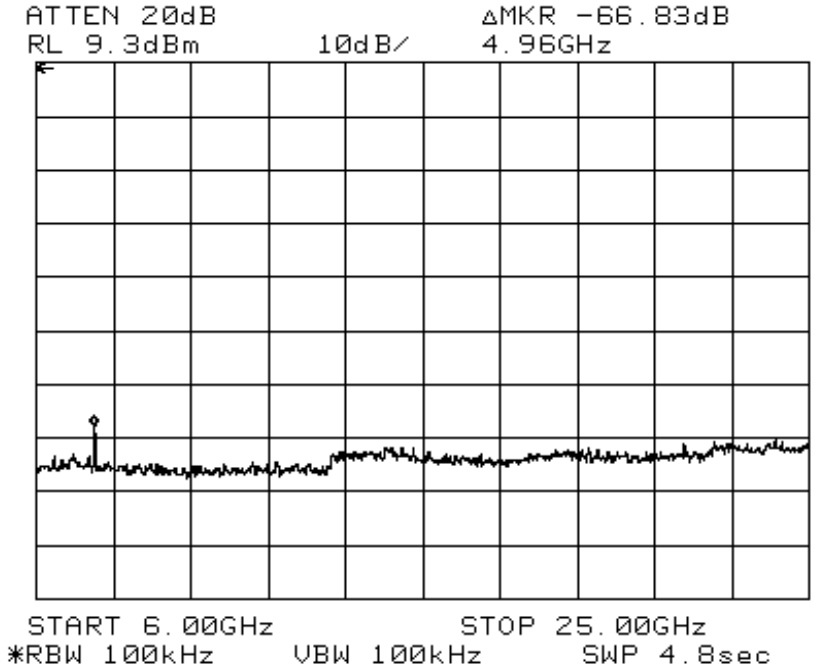




UUT Set to Xmit on channel 11




ATTEN 20dB
RL 9.3dBm
10dB/
ΔMKR -56.17dB
-711MHz
START 1.000GHz
STOP 6.000GHz
*RBW 100kHz
VBW 100kHz
SWP 1.3sec


ATTEN 20dB
RL 9.3dBm
10dB/
ΔMKR -66.83dB
4.96GHz
START 6.00GHz
STOP 25.00GHz
*RBW 100kHz
VBW 100kHz
SWP 4.8sec

Radiated Emissions in Restricted bands

Specification:

FCC Specification: Paragraph 15.205

Industrie Canada Specification: Paragraph RSS210, 6.2.3 (c)

Procedure:

This test was conducted on a 3-meter open-air test site at Elliott Laboratories The unit was placed on a rotating wooden table 80cm above the ground plane. A 1 - 18 GHz Horn antenna was secured to a mast 3 meters away. The unit was tested at each of the Low, Mid and High channels. The UUT was running in the diagnostic mode and set to transmit CW at maximum power on each of the channels. The test equipment was configured as shown below.

The harmonics of the fundamental that fell within restricted bands (up to the tenth) were measured (See table 1 below). A high pass filter prior to the pre-amplifier was required to prevent the large signal level of the fundamental frequency from overloading the front end of the spectrum analyzer and creating harmonics within the analyzer.

The EUT was rotated 360 degrees and the height of the antenna adjusted from 1 to 4 meters above the ground plane to determine the maximum level of the emission. The level of the harmonic emission was measured in two modes, “Peak” and “Average” .

The spectrum analyzer reading was entered into a spreadsheet where correction factors (antenna factor, cable loss, pre-amplifier gain, HPF loss...) were then applied by Elliott Lab’s Software to obtain a final corrected measurement.

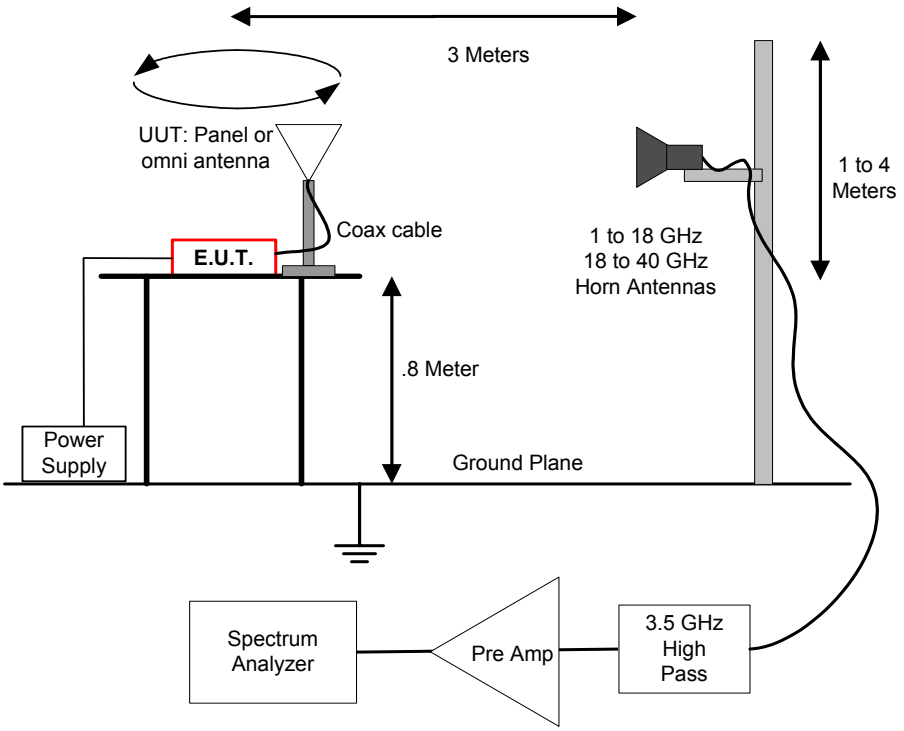
This procedure was repeated for the low mid and high channels within the 2400-2485.5 MHz band. The table below indicates the harmonics that fall within restricted bands.

FUND	Harmonic (MHz)								
	2	3	4	5	6	7	8	9	10
2412	**4824**	7236	9648	**12060**	**14472**	16884	**19296**	21708	24120
2437	**4874**	**7311**	9748	**12185**	14622	17059	**19496**	21933	24370
2462	**4924**	**7386**	9848	**12310**	14772	17234	**19696**	**22158**	24620

15.205 Harmonic test table

*NOTE: **RED** indicates a harmonic that falls within a restricted band and is subject to 15.205. The harmonics in **black** are NOT in restricted bands and are subject to 15.209*

Test Setup



Radiated Emissions in Restricted Bands Test Setup

Support Equipment				
Description	**Model number**	**FCC ID or SN**	**Manufacturer**	**Power Cable**
Power Supply	PCGA-AC16V2	S/N 0038 B 0038897		"Zip" Cord
Power Injector	2310533-000A	None	Malibu Networks	

Test Conditions			
Temperature	25 C	**Humidity:**	49%
ATM pressure	1020 mBar	**Grounding:**	None
Tested By	J Martinez / C Byleckie	**Date of Test:**	June 2002
Test Reference	FCC Part 15.205 IC Paragraph RSS210, 6.2.3 (c)		
Setup Method	ANSI C63.4		
Tested Range	1 GHz to 24 GHz		
Test Voltage	120 VAC / 60 Hz		
Modifications	No modifications were made to the unit		

Results:

There were some harmonic emissions detected during the test. In many cases the resolution bandwidth and the video bandwidth were reduced well below what is required of the specifications in an attempt to find the actual level of the emission.

In the case of the “PEAK” measurement the RBW and VBW were always set to 1 MHz. The “AVG” test was conducted with the RBW = 1MHz and VBW = 10Hz.

There were some cases where an emission was not visible using these bandwidth settings and narrower bandwidths were used in an effort to determine if an emission was present. In most cases, even with these lower bandwidths, there was no emission detected.

Elliott

EMC Test Data

Client:		Job Number:	J47530
Model:	Malibu Project	T-Log Number:	T47221
		Proj Eng:	Chris Byleckie
Contact:	David Waitt Consulting		
Spec:	802.11b	Class:	N/A

Radiated Emissions

Test Specifics

Objective:

Date of Test: 6/18/2002
Test Engineer: Juan Matrinez
Test Location: SVOATS #3

Config. Used: 1
Config Change:
EUT Voltage: 120V / 60 Hz

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing. All remote support equipment was located approximately 30 meters from the EUT with all I/O connections running on top of the groundplane or rou

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected

Ambient Conditions:

Temperature: 54°C
Rel. Humidity: 49%

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, 30 - 24000 MHz - Spurious Emissions In Restricted Bands	FCC Part 15.209 / 15.247(c)	Pass	See individual runs
2	RE, 30 - 24000 MHz - Spurious Emissions In Restricted Bands	FCC Part 15.209 / 15.247(c)	Pass	See individual runs

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Run #1a: Radiated Spurious Emissions, 30-24000 MHz. Low Channel @ 2412 MHz (Patch antenna)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4824.138	49.0	V	74.0	-25.0	Pk	305	1.2	
4823.895	36.2	V	54.0	-17.8	Avg	305	1.2	
7232.191	76.2	V	116.3	-40.1	Note 1	342	1.2	
9645.455	49.5	V	54.0	-17.8	Pk	358	1.2	
12055.98	48.4	V	54.0	-5.6	Pk	210	1.2	
14473.34	58.3	V	74.0	-15.7	Pk	0	1.2	Noise Floor measurement
14474.03	45.9	V	54.0	-8.1	Avg	0	1.2	Noise Floor measurement
16885.73	60.4	V	74.0	-13.6	Pk	0	0.0	Noise Floor measurement
16885.83	48.1	V	54.0	-5.9	Avg	0	0.0	Noise Floor measurement
4824.141	46.0	H	74.0	-28.0	Pk	67	1.2	
4824.136	33.2	H	54.0	-20.8	Avg	67	1.2	
7235.967	68.0	H	116.3	-48.3	Note 1	18	1.2	
9647.382	54.4	H	74.0	-19.6	Pk	0	1.2	
9647.204	40.7	H	54.0	-13.3	Avg	0	1.2	
12059.68	54.0	H	74.0	-20.0	Pk	313	1.3	Noise Floor measurement
12059.46	41.2	H	54.0	-12.8	Avg	313	1.3	Noise Floor measurement
14472.08	58.3	H	74.0	-15.7	Pk	350	1.3	Noise Floor measurement
14471.15	46.1	H	54.0	-7.9	Avg	350	1.3	Noise Floor measurement
16884.64	61.3	H	74.0	-12.7	Pk	317	1.3	Noise Floor measurement
16883.79	48.2	H	54.0	-5.8	Avg	317	1.3	Noise Floor measurement

Note 1: No emissions were visible above the noise floor above 17GHz

Run #1b: Radiated Spurious Emissions, 30-24000 MHz. Center Channel @ 2437 MHz (Patch antenna)+A99

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4873.933	49.1	H	74.0	-24.9	Pk	0	0.0	
4874.150	34.6	H	54.0	-19.4	Avg	0	0.0	
7311.558	55.4	H	74.0	-18.6	Pk	0	0.0	
7310.599	40.7	H	54.0	-13.3	Avg	0	0.0	
9748.268	56.2	H	74.0	-17.8	Pk	0	0.0	
9748.505	40.8	H	54.0	-13.2	Avg	0	0.0	
9749.000	55.7	V	74.0	-18.3	Pk	0	0.0	
9748.479	40.7	V	54.0	-13.3	Avg	0	0.0	
7311.085	54.9	V	74.0	-19.1	Pk	0	0.0	
7311.752	41.0	V	54.0	-13.0	Avg	0	0.0	
4874.095	49.4	V	74.0	-24.6	Pk	15	1.3	
4873.768	40.6	V	54.0	-13.4	Avg	15	1.3	

Note 1: No emissions were visible above the noise floor above 17GHz

Run #1c: Radiated Spurious Emissions, 30-24000 MHz. High Channel @ 2462 MHz (Patch antenna)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4923.938	47.3	V	74.0	-26.7	Pk	329	1.4	
4923.303	32.5	V	54.0	-21.5	Avg	329	1.4	
9848.122	56.1	V	74.0	-17.9	Pk	57	1.4	
9847.844	40.6	V	54.0	-13.4	Avg	57	1.4	
12310.44	56.4	V	74.0	-17.6	Pk	0	0.0	
12309.67	41.6	V	54.0	-12.4	Avg	0	0.0	
14771.53	61.1	V	74.0	-12.9	Pk	0	0.0	
14772.02	48.0	V	54.0	-6.0	Avg	0	0.0	
17234.59	64.3	V	74.0	-9.7	Pk	0	0.0	
17233.99	49.9	V	54.0	-4.1	Avg	0	0.0	
17233.54	64.1	H	74.0	-9.9	Pk	0	0.0	
17233.54	49.9	H	54.0	-4.1	Avg	0	0.0	
14771.32	61.2	H	74.0	-12.8	Pk	0	0.0	
14771.02	48.0	H	54.0	-6.0	Avg	0	0.0	
12310.57	56.6	H	74.0	-17.4	Pk	0	0.0	
12309.50	41.5	H	54.0	-12.5	Avg	0	0.0	
9848.673	55.8	H	74.0	-18.2	Pk	0	0.0	
9847.799	40.6	H	54.0	-13.4	Avg	0	0.0	
7386.095	55.3	H	74.0	-18.7	Pk	275	1.4	
7385.766	40.5	H	54.0	-13.5	Avg	275	1.4	
4924.100	47.5	H	74.0	-26.5	Pk	0	0.0	
4923.167	32.5	H	54.0	-21.5	Avg	0	0.0	

Note 1: No emissions were visible above the noise floor above 17GHz

Run #2a: Radiated Spurious Emissions, 30-24000 MHz. Low Channel @ 2412 MHz (Omni Antenna)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4823.781	48.3	V	74.0	-25.7	Pk	0	0.0	
4824.057	34.0	V	54.0	-20.0	Avg	0	0.0	
7235.203	54.8	V	74.0	-19.2	Pk	0	0.0	
7234.521	41.0	V	54.0	-13.0	Avg	0	0.0	
9646.985	55.9	V	74.0	-18.1	Pk	0	0.0	
9646.871	41.0	V	54.0	-13.0	Avg	0	0.0	
9647.796	56.8	H	74.0	-17.2	Pk	0	0.0	
9647.662	40.9	H	54.0	-13.1	Avg	0	0.0	
7235.936	54.7	H	74.0	-19.3	Pk	0	0.0	
7234.862	40.7	H	54.0	-13.3	Avg	0	0.0	
4823.354	46.5	H	74.0	-27.5	Pk	0	0.0	
4823.588	32.5	H	54.0	-21.5	Avg	0	0.0	

Note 1: No spurious emsisions were observed above the noise floor above 10GHz

Run #2b: Radiated Spurious Emissions, 30-24000 MHz. Center Channel @ 2437 MHz (Omni Antenna)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4874.013	48.6	V	74.0	-25.4	Pk	22	1.5	
4873.940	34.7	V	54.0	-19.3	Avg	22	1.5	
7310.766	55.2	V	74.0	-18.8	Pk	149	1.5	
7310.252	40.8	V	54.0	-13.2	Avg	149	1.5	
9748.653	55.8	V	74.0	-18.2	Pk	360	1.5	
9747.118	40.8	V	54.0	-13.2	Avg	360	1.5	
9748.202	56.7	H	74.0	-17.3	Pk	0	1.5	
9746.715	40.9	H	54.0	-13.1	Avg	0	1.5	
7311.049	55.4	H	74.0	-18.6	Pk	84	1.5	
7310.267	40.8	H	54.0	-13.2	Avg	84	1.5	
4874.012	48.1	H	74.0	-25.9	Pk	0	0.0	
4873.075	32.8	H	54.0	-21.2	Avg	0	0.0	

Note 1: No spurious emsisions were observed above the noise floor above 10GHz

Run #2c: Radiated Spurious Emissions, 30-24000 MHz. High Channel @ 2462 MHz (Omni Antenna)

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4923.339	47.2	V	74.0	-26.8	Pk	0	0.0	Noise Floor
4923.209	32.8	V	54.0	-21.2	Avg	0	0.0	Noise Floor
7384.892	55.1	V	74.0	-18.9	Pk	0	0.0	Noise Floor
7384.716	40.6	V	54.0	-13.4	Avg	0	0.0	Noise Floor
9847.329	55.6	V	74.0	-18.4	Pk	0	0.0	Noise Floor
9846.418	40.7	V	54.0	-13.3	Avg	0	0.0	Noise Floor
9847.241	55.6	H	74.0	-18.4	Pk	0	0.0	
9846.836	40.7	H	54.0	-13.3	Avg	0	0.0	
7384.702	55.3	H	74.0	-18.7	Pk	0	0.0	
7384.776	40.6	H	54.0	-13.4	Avg	0	0.0	
4923.211	47.3	H	74.0	-26.7	Pk	0	0.0	
4924.106	32.7	H	54.0	-21.3	Avg	0	0.0	

Note 1: No spurious emissions were observed above the noise floor above 10GHz

Radiated Emissions in the Restricted band beginning at 2483.5 MHz and below 2390.0MHz

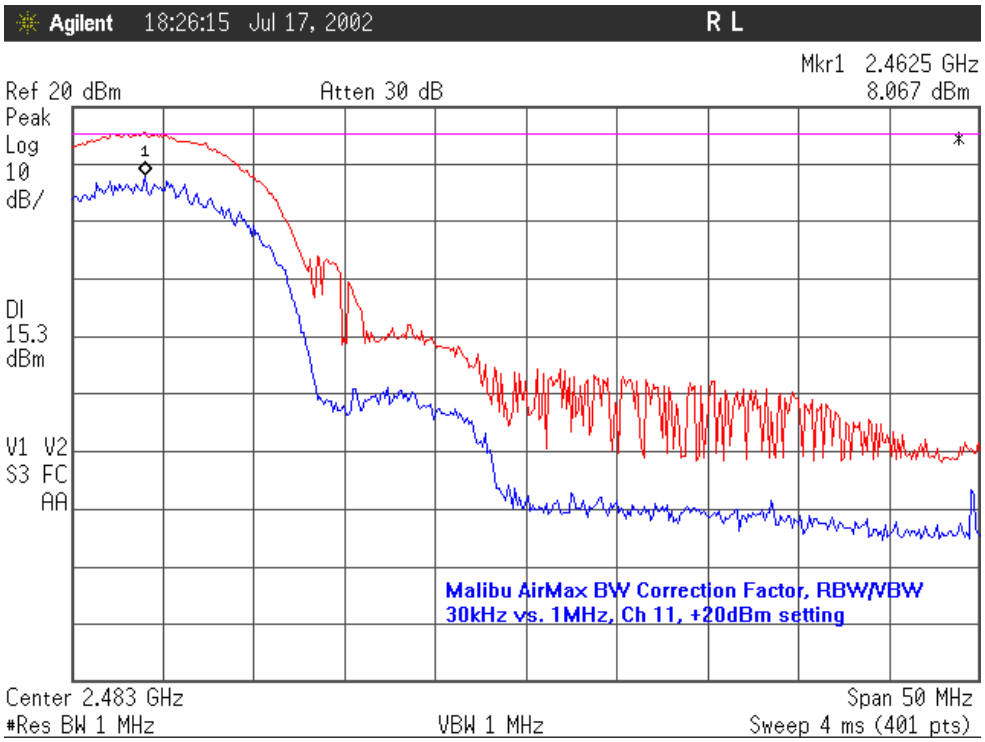
Procedure

There are two steps to performing this test. The first involves making a radiated measurement of the fundamental signal with the UUT on the highest channel. This measurement is used using the peak and average RBW and VBW of 1Mhz/1MHz and 1MHz/10Hz. This measured radiated level is then used as a reference.

Then a conducted measurement is made using narrower bandwidths (30 kHz) to determine a –dBc level between the fundamental reference level and the actual level at the band edge. This delta dB is then subtracted from the radiated field strength reference measurement made earlier.

This procedure is outline in FCC Public Notice DA 00-705, released on 30 March 2000 and is referred to as the “Marker-Delta Method”

A Bandwidth correction factor was then applied to the delta measurement. Restricted bands are to be measured in a 1MHz RBW, Since the delta measurement was made in a much narrower bandwidth than this (30 kHz) an additional measurement was made to correct the “Delta” measurement for the smaller bandwidth. This correction was measured top be a minimum of 7.233 dB. This correction is then added to the delta measurement to arrive at a delta in a 1 MHz BW. Note that this correction is not applied to the very narrow band out of band emissions since the BW of the emission was less than the RBW used in the initial delta measurement.



Because the Malibu Networks AirMAX unit will be operated at two different power levels due to the different high gain antenna types that will be used, this test was performed at each of the two power levels and a reference field strength measurement for each of the two high gain antennas (12 dBi omni and 19 dBi panel) was made.

A summary of the test results for each antenna at its applicable setting is presented on the next page.

19 dBi Panel (Vertical)

Chan	Pwr Stg	Vertical Ref Msmt		Delta Msmt	Radiated Level at Band Edge		Specification		Delta	
		Peak	Avg	1MHz	Peak	Avg	Peak	Avg	Peak	Avg
	dBm	dbuv/m	dbuv/m	dBc	dBuv/m	dBuv/m	dBuv/m	dBuv/m	dBuv/m	dBuv/m
11	17	128.8	117.3	72.0	56.8	45.3	74.0	54.0	-17.2	-8.7
1	17	129.8	118.6	72.2	57.6	46.4	74.0	54.0	-16.4	-7.6

19 dBi Panel (Horizontal)

Chan	Pwr Stg	Horz Ref Msmt		Delta Msmt	Radiated Level at Band Edge		Specification		Delta	
		Peak	Avg	1MHz	Peak	Avg	Peak	Avg	Peak	Avg
	dBm	dbuv/m	dbuv/m	dBc	dBuv/m	dBuv/m	dBuv/m	dBuv/m	dBuv/m	dBuv/m
11	17	112.3	101.3	72.0	40.3	29.3	74.0	54.0	-33.7	-24.7
1	17	113.8	103.0	72.2	41.6	30.8	74.0	54.0	-32.4	-23.2

12 dBi Omni (Vertical)

Chan	Pwr Stg	Vertical Ref Msmt		Delta Msmt	Radiated Level at Band Edge		Specification		Delta	
		Peak	Avg	1MHz	Peak	Avg	Peak	Avg	Peak	Avg
	dBm	dbuv/m	dbuv/m	dBc	dBuv/m	dBuv/m	dBuv/m	dBuv/m	dBuv/m	dBuv/m
11	20	122.9	111.6	68.3	54.6	43.3	74.0	54.0	-19.4	-10.7
1	20	124.3	112.2	67.2	57.1	45.0	74.0	54.0	-16.9	-9.0

12 dBi Omni (Horizontal)

Chan	Pwr Stg	Horz Ref Msmt		Delta Msmt	Radiated Level at Band Edge		Specification		Delta	
		Peak	Avg	1MHz	Peak	Avg	Peak	Avg	Peak	Avg
	dBm	dbuv/m	dbuv/m	dBc	dBuv/m	dBuv/m	dBuv/m	dBuv/m	dBuv/m	dBuv/m
11	20	105.6	93.3	68.3	37.3	25.0	74.0	54.0	-36.7	-29.0
1	20	103.9	93.8	67.2	36.7	26.6	74.0	54.0	-37.3	-27.4

Radiated Emissions Sample Calculations

Receiver readings are compared directly to the specification limit. The receiver internally corrects for cable loss, preamp gain and antenna factor. The calculations are in reverse from the signal flow, meaning that cable loss is actually added to the reading and amplification is subtracted. Antenna factor is a measure of the conversion of the voltage at the coaxial connector to the field strength at the antenna elements. A distance factor, for the electric field is calculated using the following formula

$$F_d = 20 \text{ Log}_{10} (D_m/D_s)$$

Where:
F_d = Distance Factor
D_m = Measurement distance in meters
D_s = specification distance in meters

Measurement distance is the distance at which the measurements were taken and the specification distance is the distance at which the specification limit is based.

The margin of a given emissions peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

Where :
R_r = Relative reading in dBuV/m
F_d = Distance Factor
R_c = Corrected reading in dBuV/m
L_s = specification Limit in dBuV/m
M = Margin in dB relative to the spec.