JABIL Technology Services **Regulatory Laboratory**

Jabil Circuit, Inc.
10800 Roosevelt Boulevard
St. Petersburg, FL 33716
USA
Telephone: (727) 803-5953

47 C.F.R. Part 15 FCC Rules
Digital Circuitry Radiated Emissions Test and Supplementary §15.203 and §15.247 Test Results

Zhone Technologies
SkyZhone-1224 WiFi Access Point

Equipment:	**SKYZHONE-1224, Wi-Fi Access Point**
Client:	**Zhone Technologies**
Address:	**8545 126th Avenue North**
	Largo, FL 33773
	USA

Test Report Number: FCCIR-ZHONE-04-18-07d
Date: May 22, 2007
Total Number of Pages: 47

Table of Contents

1 IDENTIFICATION SUMMARY

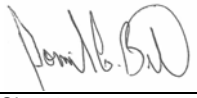
1.1 Test Report

Test Report Number: FCCIR-ZHONE-04-18-07d
Test Report Date: May 4, 2007

Report written and approved by:

Date	Name	Signature
May 22, 2007	Peter J. Walsh, NCE	

Reviewed by:

Date	Name	Signature
May 22, 2007	Dominick Bitume	

1.2 Testing Laboratory

Jabil Circuit
JTS Regulatory & Safety Lab
10800 Roosevelt Boulevard
St. Petersburg FL 33716
USA

Telephone: (727) 803-5953
Internet: www.jabil.com
Email: Peter_Walsh@jabil.com

1.3 Limits and Reservations

The test results in this report apply only to the particular Device Under Test (DUT) and component Implementations Under Test (IUTs) declared in this test report. The results and associated conclusions apply only to the DUT while operating in the configuration and modes described herein. The test data contained herein is intended to be used by a TCB for the purpose of achieving FCC Part 15 and Industry Canada RSS-210e certification of the DUT. The TCB may perform supplemental tests as required. This revision of the test report was made to incorporate editorial changes affirming that preliminary tests were performed in response to the TCB review of the test report.

1.4 Client Information

Name:	Zhone Technologies
Street:	8545 126th Avenue North
City:	Largo
State:	Florida
Country:	USA
Phone:	(727) 530-2000
Contact Person:	Chuck Coston
Phone:	(727) 530-8326
Email:	ccoston@zhone.com

1.5 Dates

Date of commission:	November 1, 2006
Date of receipt of DUT:	April 18, 2007
Date of test completion:	May 4, 2007

1.6 Device Under Test (DUT)

Name:	SKYZHONE-1224, Wi-Fi Access Point
Version:	4 Port SHDSL STU-R with IEEE 802.11 b/g
Serial Number:	None (Engineering Prototype)

2 GENERAL INFORMATION

2.1 Product Description

The SkyZhone access point is a line-powered carrier class outdoor Wi-Fi access point with 22 Mbps symmetric DSL backhaul to every unit. The SkyZhone supports a variety of applications including VoIP, internet access, mobile video, and enterprise VPNs optimized for citywide Wi-Fi deployments by telephone companies. SkyZhone enables telephone companies to deploy a more reliable, lower latency, higher speed and lower cost network than traditional mesh Wi-Fi solutions. The product includes three 5 dBi antennas, Comet Part Number CFA-245W. Antennas with lower gain may also be used.

2.2 Interface Cable Details

Interface cables used in the system are as follows:

Qty	Length	Cable Description
1	30’	Shielded CAT5 4 twisted pairs SHDSL cable
1	30’	Shielded CAT5 4 twisted pairs Ethernet cable

2.3 Peripheral Devices

The following test support devices were used in the test set-up.

Qty	Description	Manufacturer/Model	Serial Number
1	PC	Gateway GP6-400	0014300762

2.4 Test Methodology

A radiated emission testing was performed according to ANSI C63.4-2003, the procedure referenced by Part 15, FCC Rules. Radiated emissions tests were performed at an antenna to EUT distance of 3 meters. The measurement of digital transmission systems operating under Section 15.247 was performed in accordance with KDB Publication Number 558074 issued by the FCC’s OET.

2.5 Test Facility

The 3-meter semi-anechoic test chamber and measurement facility used to collect the radiated and conducted data is located at 8545 126th Avenue N., Largo FL 33773. This site is NVLAP Accredited (200125-0). The site has also been registered with Industry Canada, 2146A-1.

2.6 Deviations

No deviations were exercised during the course of the testing.

3 SYSTEM TEST CONFIGURATION

3.1 Justification

The DUT was tested using two specialized test modes used to stress the DUT maximizing its emissions.

One test mode enabled the DUT to output its maximum power spectral density and bandwidth on each of its 4 SHDSL lines without the need for companion STU-C equipment. These lines were terminated in a 135 Ω differential resistive load with lines 1 and 2 fed by the requisite dc line power. The SHDSL cable was routed down to the center of the turn table and beneath the ground plane on out to a dc supply source located outside the test chamber.

The Power over Ethernet (POE) cable was also routed down to the center of the turn table beneath the ground plane. Its 10/100 Base-T pairs were connected to a host PC located outside the test chamber. The PC was conditioned to ping the IP address of the DUT continuously. The cable's 48 V and return pair was terminated in a resistive load providing the maximum rated load of 5 watts.

The other test mode allowed the radio to transmit at its maximum duty cycle and allowed the mode (b/g), line rate, channel, and power level to be set. The tested power levels were as those to be set in production units with the intention of providing sufficient margin to account for unit-to-unit variability.

All measurements were performed with the DUT powered by a maximum line voltage of $\pm$140 VDC.

Although not required, the radiated emissions test for digital circuitry was performed with the radio on. Performing the test in this manner also confirmed that the radio did not cause excessive emissions levels in the restricted frequency bands below 1000 MHz.

The DUT has a console port used exclusively by service personnel for configuration. Since this is a temporary cable and not part of the user's installation, this cable was not connected for radiated emissions tests.

3.2 Special Accessories

None

3.3 Equipment Modifications

No modifications were needed to achieve compliance.

Signature:  Date: May 4, 2007

Typed/Printed Name: Peter J. Walsh

Position: Regulatory Lab Manager

If modifications were needed to achieve compliance, the client shall acknowledge these by signing below.

Signature: _____ Date: _____

Typed/Printed Name: _____

Position: _____

4 CONDUCTED EMISSIONS DATA

Reference: 47 C.F.R. § 15.207 (a)

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

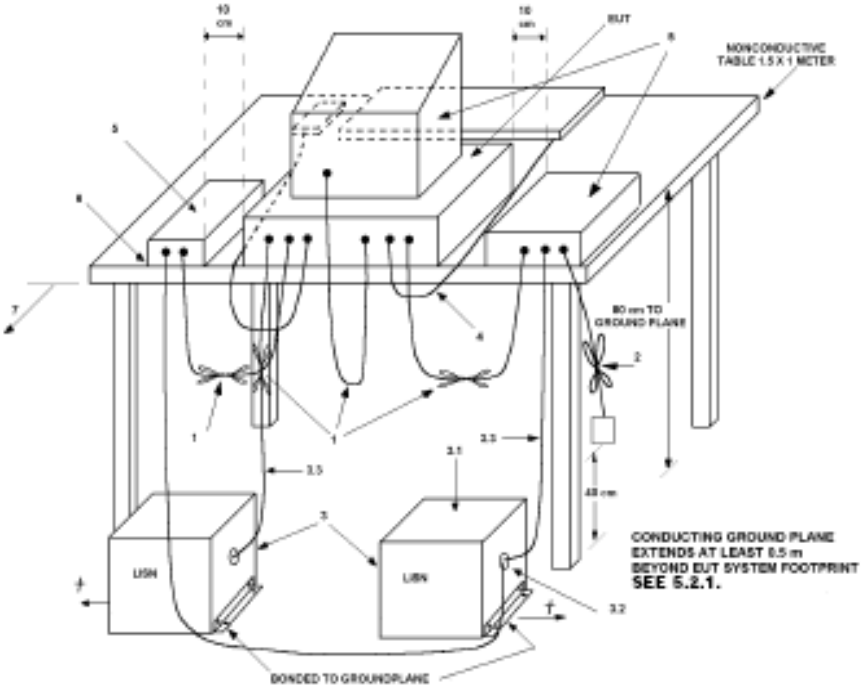
Table 4-1

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

4.1 Test Procedure

The test is performed in accordance with ANSI C63.4-2003 § 7. The test setup is consistent with ANSI C63.4-2003 Figure 10a below. The test was performed in a semi-anechoic chamber. As such, the optional vertical conducting plane is not used.



LEGEND:

1) Interconnecting cables that hang closer than 40 cm to the groundplane shall be folded back and forth in the center forming a bundle 30 to 40 cm long (see 6.1.4 and 11.2.4).
2) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m (see 6.1.4).
3) EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω. LISN can be placed on top of, or immediately beneath, reference groundplane (see 5.2.3 and 7.2.1).
   3.1) All other equipment powered from additional LISN(s).
   3.2) Multiple outlet strip can be used for multiple power cords of non-EUT equipment.
   3.3) LISN at least 80 cm from nearest part of EUT chassis.
4) Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use (See 6.2.1.3 and 11.2.4).
5) Non-EUT components of EUT system being tested (see also Figure 13).
6) Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (see 6.2.1.1 and 6.2.1.2).
7) Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the groundplane (see 5.2.2 for options).

Figure 10a—Test arrangement for conducted emissions

Conducted emissions measurements are first made using a peak detector and average detector simultaneously. The receiver then performs the final measurements using a quasi-peak detector for comparison with the quasi-peak limit and an average detector for comparison with the average limit.

4.2 Measured Data

Compliance Verdict: None

As the DUT was not ac powered, the conducted emissions test was not applicable. The DUT is dc (span) powered from the SHDSL telephone lines.

4.3 Conducted Emissions Test Instrumentation

Type	Manufacturer/ Model No.	Serial Number
EMI Receiver	Rohde & Schwarz ESCS 30	825788/002
LISN	Rohde & Schwarz ESH3-Z5	840730/005

Calibration and Traceability: All measuring and test equipment are calibrated every 12 months and are traceable to the National Institute for Standards and Technology (NIST) and Methods.

4.4 Conducted Emissions Photographs

No photos were taken as the test was not performed.

5 RADIATED EMISSIONS DATA

Reference: 47 C.F.R. § 15.209

(a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Table 5-1

Frequency of Emission (MHz)	Field Strength (3 m) (microvolts/meter)	Field Strength (3 m) (dBµV/m)
0.009 – 0.490	2400/F (kHz) @ 300 m	300
0.490 – 1.705	24000/F (kHz) @ 30 m	30
1.705 – 30.0	30 @ 30 m	30
30 - 88	100**	40.0
88 - 216	150**	43.5
216 - 960	200**	46.0
Above 960	500	54.0

*** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.*

Reference: 47 C.F.R. § 15.205

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

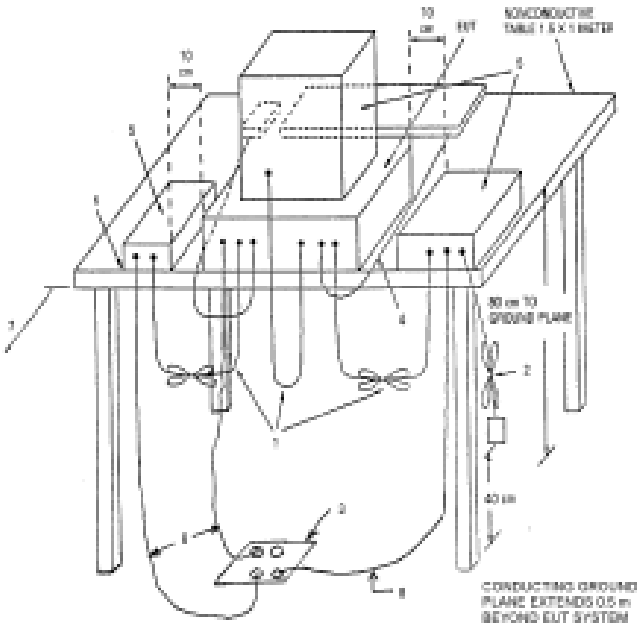
Table 5-2

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

5.1 Test Procedure

The test was performed in accordance with ANSI C63.4-2003 § 8. The test setup was consistent with ANSI C63.4-2003 Figure 11a below. The test was performed in a semi-anechoic chamber.



LEGEND:

1) Interconnecting cables that hang closer than 40 cm to the groundplane shall be folded back and forth in the center, forming a bundle 30 to 40 cm long (see 6.1.4 and 11.2.4).

2) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated if required using the correct terminating impedance. The total length shall not exceed 1 m (see 6.1.4).

3) If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the groundplane with the receptacle flush with the groundplane (see 6.1.4).

4) Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use (see 6.2.1.3 and 11.2.4).

5) Non-EUT components of EUT system being tested (see also Figure 13).

6) Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (see 6.2.1.1 and 6.2.1.2).

7) No vertical conducting plane used (see 5.2.2).

8) Power cords drape to the floor and are routed over to receptacle (see 6.1.4).

Figure 11a—Test arrangement for radiated emissions tabletop equipment

The following data lists the significant emission frequencies, amplitude levels (including cable correction and antenna factors), plus the limit. The frequency range investigated was 30 MHz to 1 GHz. The highest frequency to which the DUT must be measured for digital circuitry is 1 GHz as determined by the calculation of 5 times the highest frequency to which the DUT operates or tunes. The six highest emissions within 20 dB of the limit were recorded. Additional radiated emissions were performed from 1 to 10 GHz to examine the

DUT's spurious emissions in the restricted bands. This data was intended to provide the TCB test lab with data that would be supplemented by their data in the restricted bands from 1 GHz to 25 GHz.

5.2 Test Data

Compliance Verdict: PASS

Figure 5.2-1 below shows a composite graph of the radiated emissions levels from 30 to 1000 MHz measured with a peak detector in both vertical and horizontal antenna polarity at turntable angles of 0, 90, 180, and 270 degrees and an antenna height of 1, 2.5, and 4 meters. Rotating the turntable and adjusting the antenna elevation and polarity maximized the final quasi-peak measurements, denoted by the diamonds. In the 30 to 1000 MHz frequency range, the final measurement detector was quasi-peak; the measurement bandwidth was 120 kHz. Table 5.2-1 shows the six highest measured results within 20 dB of the limit for the 30 to 1000 MHz frequency range.

For measurements taken above 1 GHz, the final measurement detector was average; the measurement bandwidth was 1 MHz. Figures 5.2-2 and 5.2-5 show the maximum (peak hold) radiated emissions from 1 to 10 GHz. These plots include measurements at all turntable angles and an antenna height of 1, 2.5, and 4 meters showing the emissions relative to the restricted band limit. These measurements were made with the DUT transmitting in 802.11g mode (Channel 6) in the highest transmit power mode as determined by the conducted, peak power measurements. In the 4 to 10 GHz frequency range, a 2.4 to 2.5 GHz notch filter was used at the input of the preamplifier to prevent the preamplifier from being over driven. This improved measurement sensitivity.

Additional radiated emissions measurements were made in the restricted bands above and below the 2.4 to 2.4835 GHz operating band. See Figure 5.2-6 through 5.2-10. Preliminary measurements showed that the 802.11b and 802.11g lowest data rates resulted in the highest peak power and slightly greatly bandwidth relative to the higher data rates. For this reason, all measurements in this report were made with the DUT operating at its lowest data rate. Preliminary measurements were made in both 802.11b and 802.11g modes with the final data reported in 802.11g mode. Also, preliminary measurements were made using a peak detector in the restricted bands above 1 GHz however these emission levels were considerably below the peak limit.

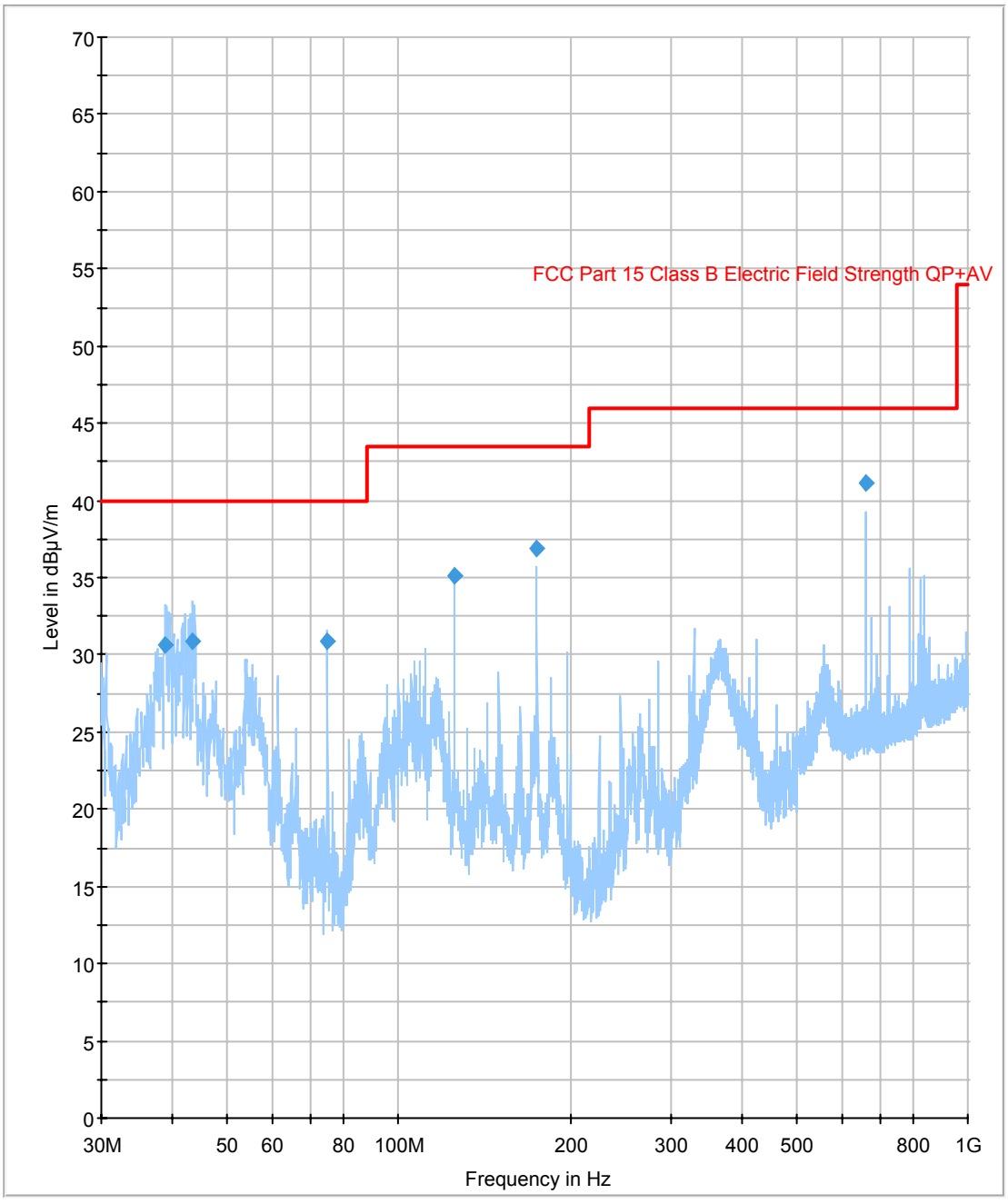

70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Level in dBµV/m
FCC Part 15 Class B Electric Field Strength QP+AV
30M
50
60
80
100M
200
300
400
500
800
1G
Frequency in Hz
FCC Part 15 Class B Electric Field Strength QP+AV
Preview Measurement Detector 1
Final Measurement Detector 1

Figure 5.2-1

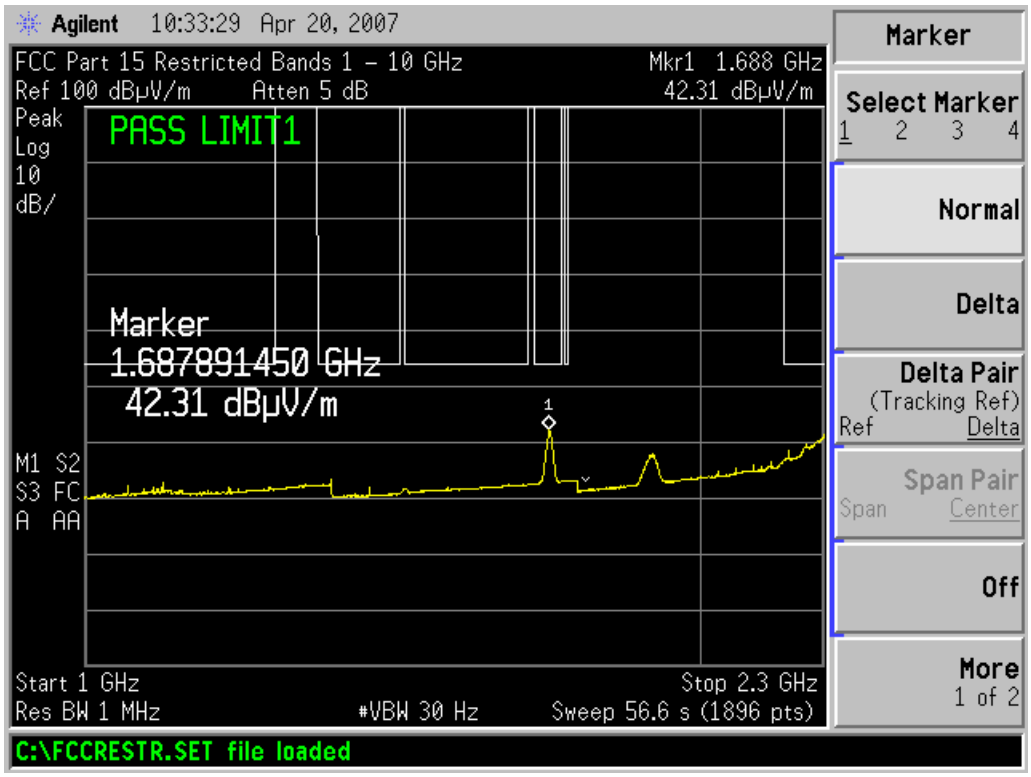


Figure 5.2-2 – Radiated Emissions 1 to 2.3 GHz

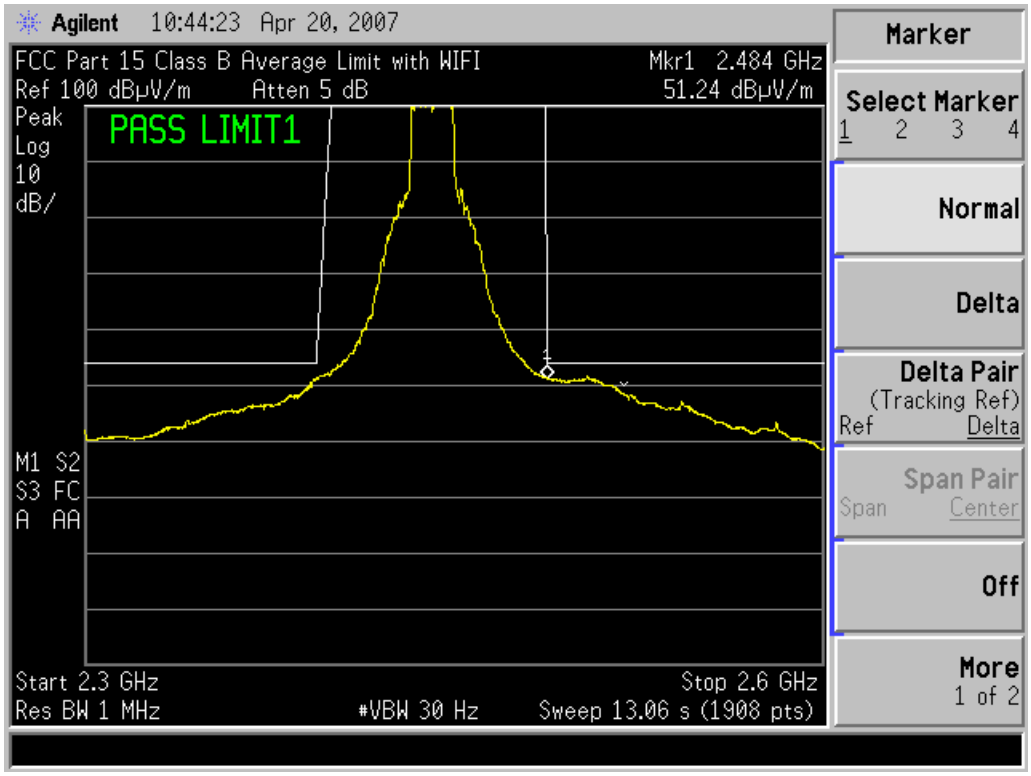


Figure 5.2-3 – Radiated Emissions 2.3 to 2.6 GHz

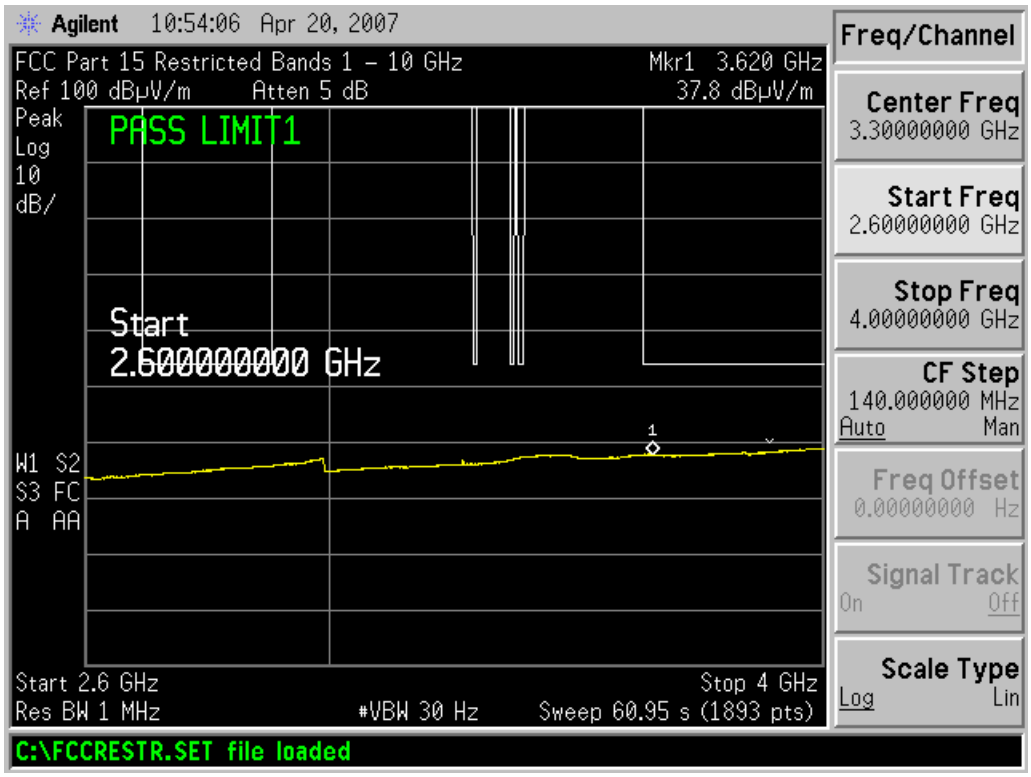


Figure 5.2-4 – Radiated Emissions 2.6 to 4 GHz

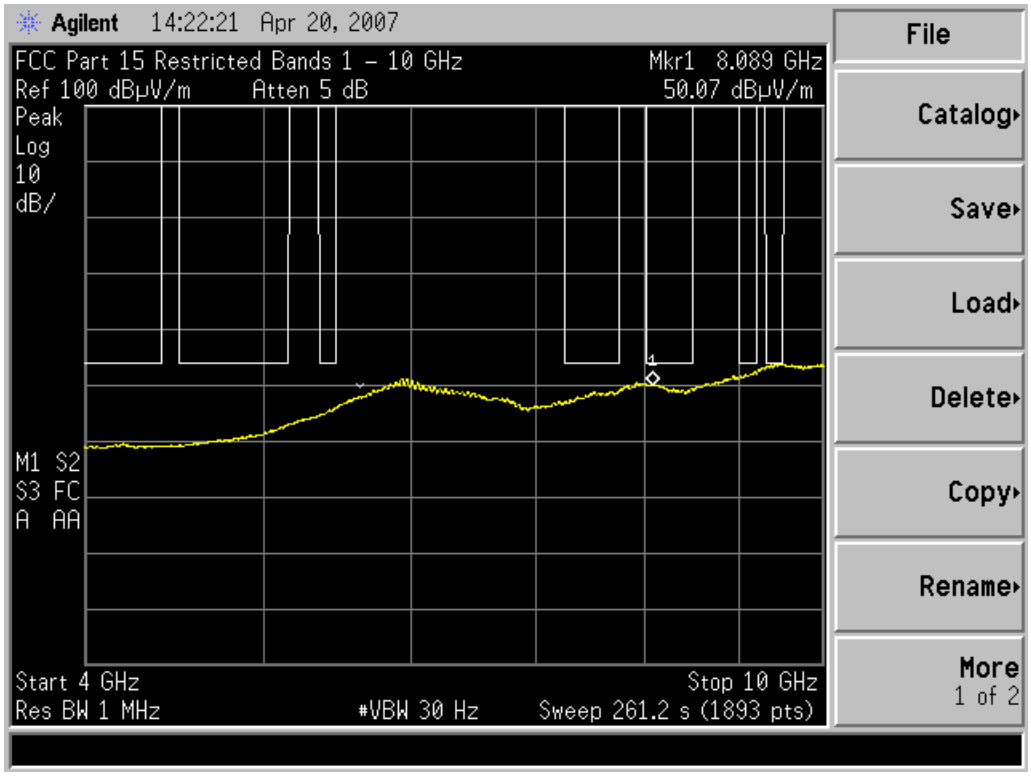


Figure 5.2-5 – Radiated Emissions 3 to 10 GHz

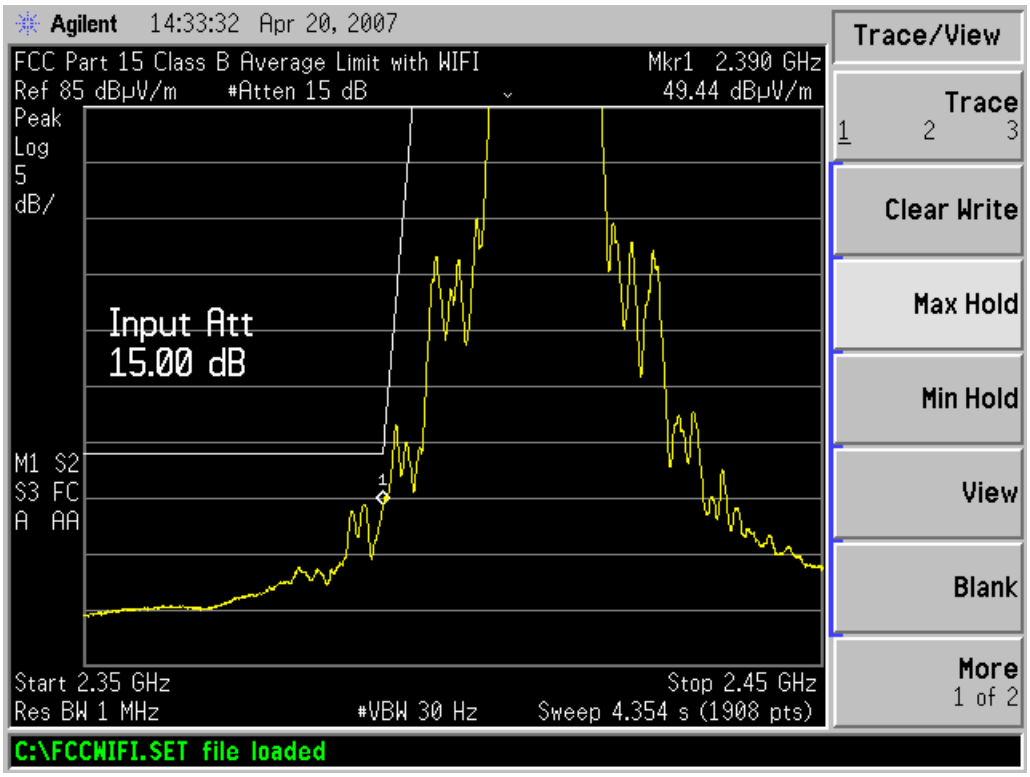


Figure 5.2-6 – Band Edge Radiated Emissions 802.11b Mode Channel 1

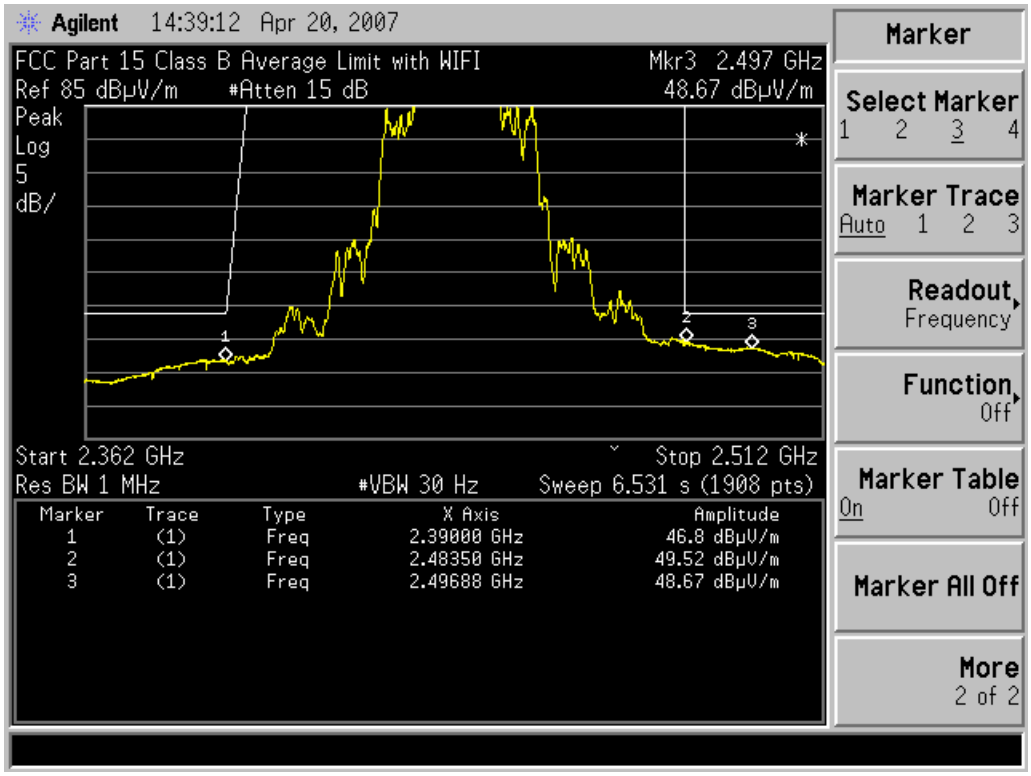


Figure 5.2-7 – Band Edge Radiated Emissions 802.11b Mode Channel 6

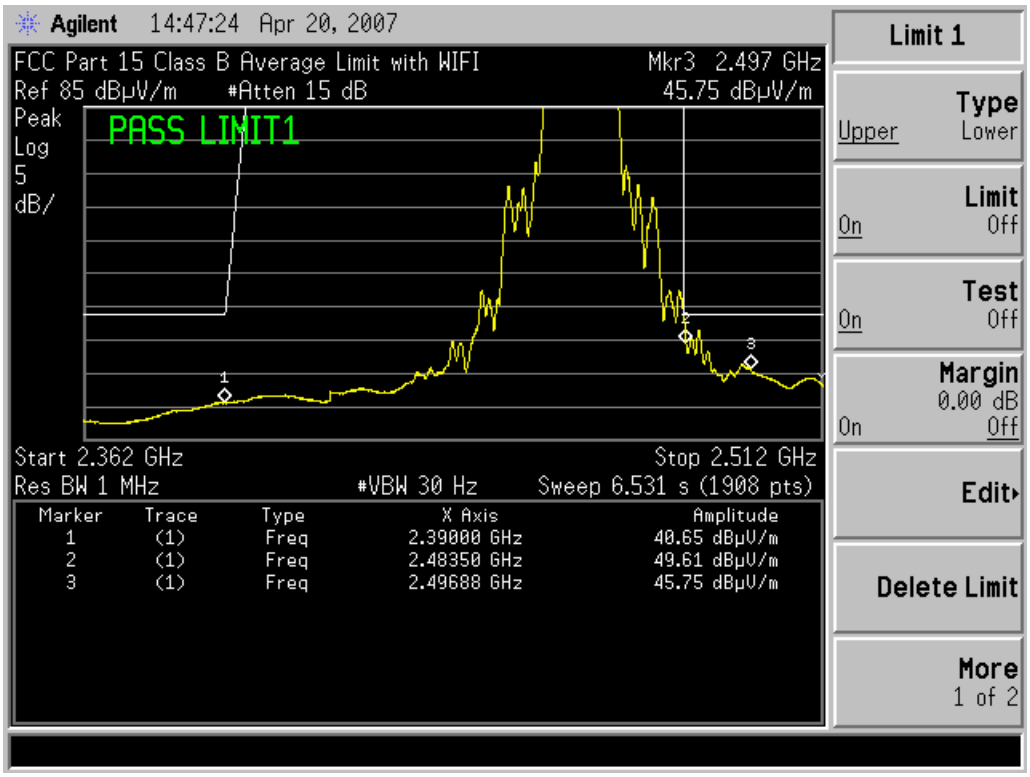


Figure 5.2-8 – Band Edge Radiated Emissions 802.11b Mode Channel 11

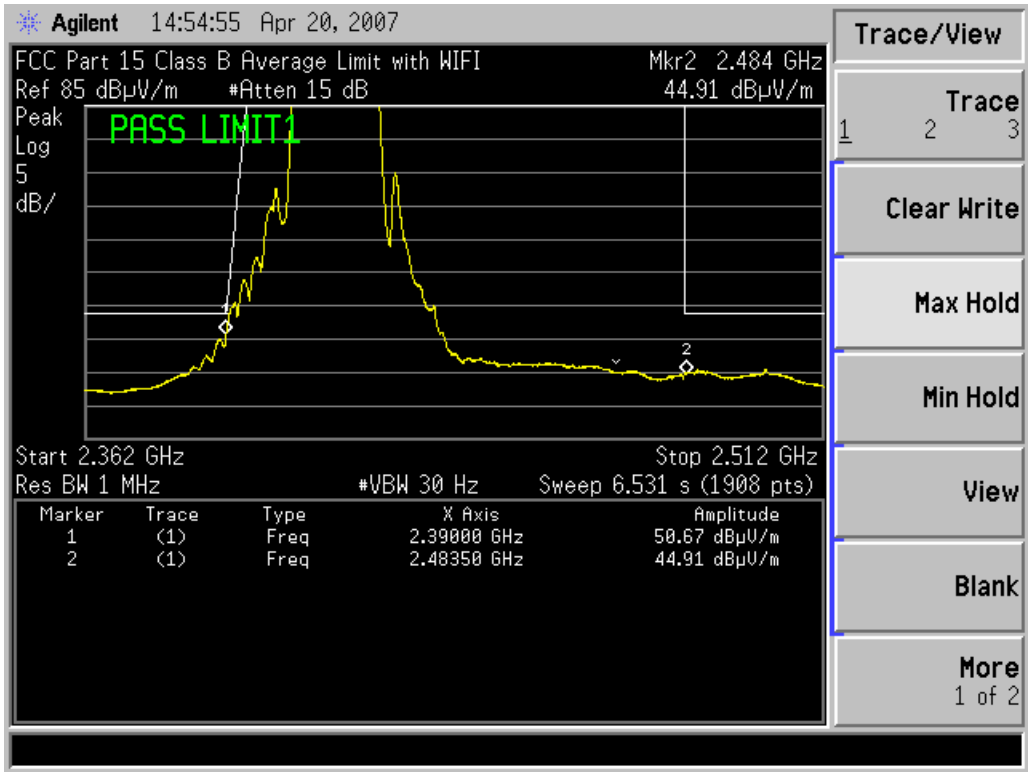


Figure 5.2-9 – Band Edge Radiated Emissions 802.11g Mode Channel 1

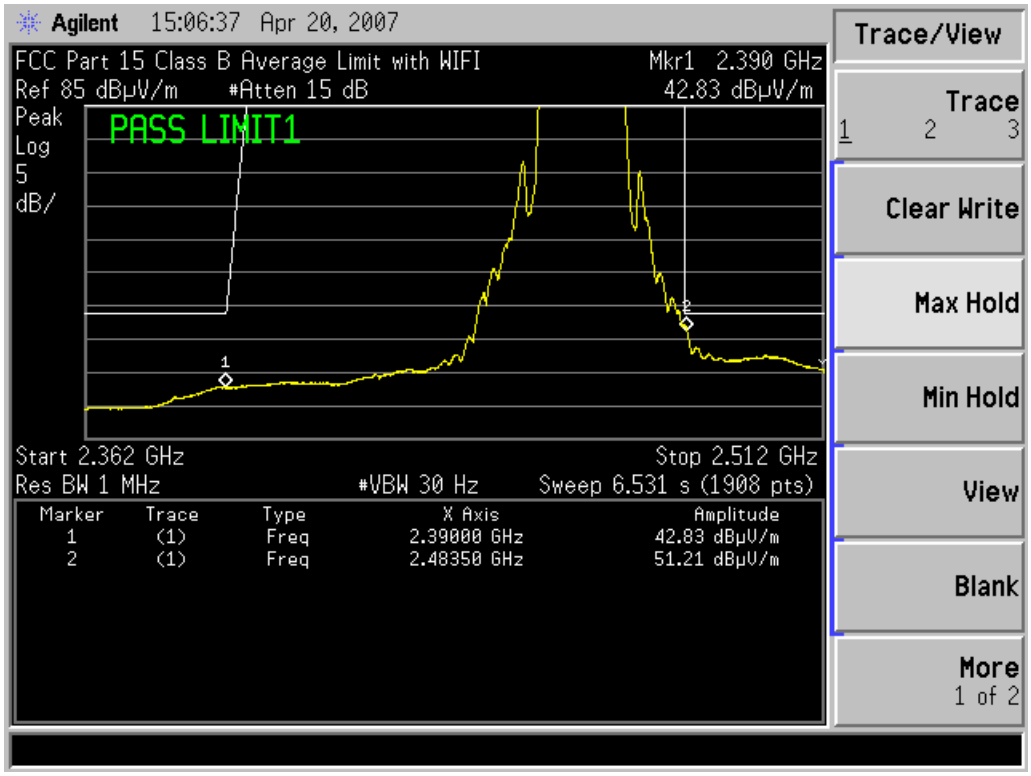


Figure 5.2-10 – Band Edge Radiated Emissions 802.11g Mode Channel 11

Table 5.2-1

Frequency (MHz)	QuasiPeak (dBµV/m)	Antenna height (cm)	Polarity	Turntable position (deg)	CF (dB)	Limit (dBµV/m)	Margin (dB)
38.940000	30.7	100.0	V	255.0	12.3	40.0	9.3
43.500000	30.9	100.0	V	300.0	10.0	40.0	9.1
75.000000	30.9	100.0	V	255.0	6.6	40.0	9.1
125.000000	36.5	100.0	V	282.0	14.1	43.5	7.0
175.020000	38.6	100.0	V	308.0	11.3	43.5	4.9
660.000000	41.5	100.0	V	334.0	21.5	46.0	4.5

* CF is the antenna correction factor and cable loss

Minimum Margin: 4.5 dBµV/m

Measurement Uncertainty: +4.8 dB, -5.2 dB

Test Personnel:

May 4, 2007	Peter J. Walsh, NCE	
Date	Name	Signature

5.3 Test Instrumentation Used, Radiated Measurement

Type	Manufacturer/ Model No.	Serial Number
EMI Receiver	Rohde & Schwarz ESCS 30	825788/002
Spectrum Analyzer	Agilent E7405A	MY42000055
Preamplifier	Com-Power PA-122	181925
Notch Filter	Micro-tronics BRM50702-01	023
Antenna	Chase EMCCBL6112B	2579
Antenna	EMCO Horn Model 3115	9002-3393

Calibration and Traceability: All measuring and test equipment are calibrated every 12 months and are traceable to the National Institute for Standards and Technology (NIST) and Methods.

5.4 Field Strength Calculation

The field strength is calculated by adding the antenna correction factor and cable loss and subtracting the amplifier gain (if any) from the measured reading.

The Rohde & Schwarz Model ESCS30 receiver and Agilent E7405A spectrum analyzer have the capability of automatically performing the field strength calculations. The amplitude level displayed on the receiver or analyzer represents the total measured field strength. This level is directly compared to the appropriate FCC limit to determine the actual margin of the DUT.

5.5 Radiated Emissions Photographs

Photo 5.5-1 Front View

Photo 5.5-1 Rear View

6 ANTENNA REQUIREMENT

Reference: 47 C.F.R. § 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

6.1 Test Procedure

Inspect the DUT.

6.2 Test Data

Compliance Verdict: PASS

This requirement is not applicable to the DUT as it must be professionally installed as detailed in the Installation Instructions. The Installation Instructions will clearly state that the supplied antennas must be used and the use of other antennas will invalidate the device's FCC Part 15 certification.

6.3 Antenna Photographs

Photo 6.3-1 below shows the DUT's antennas.

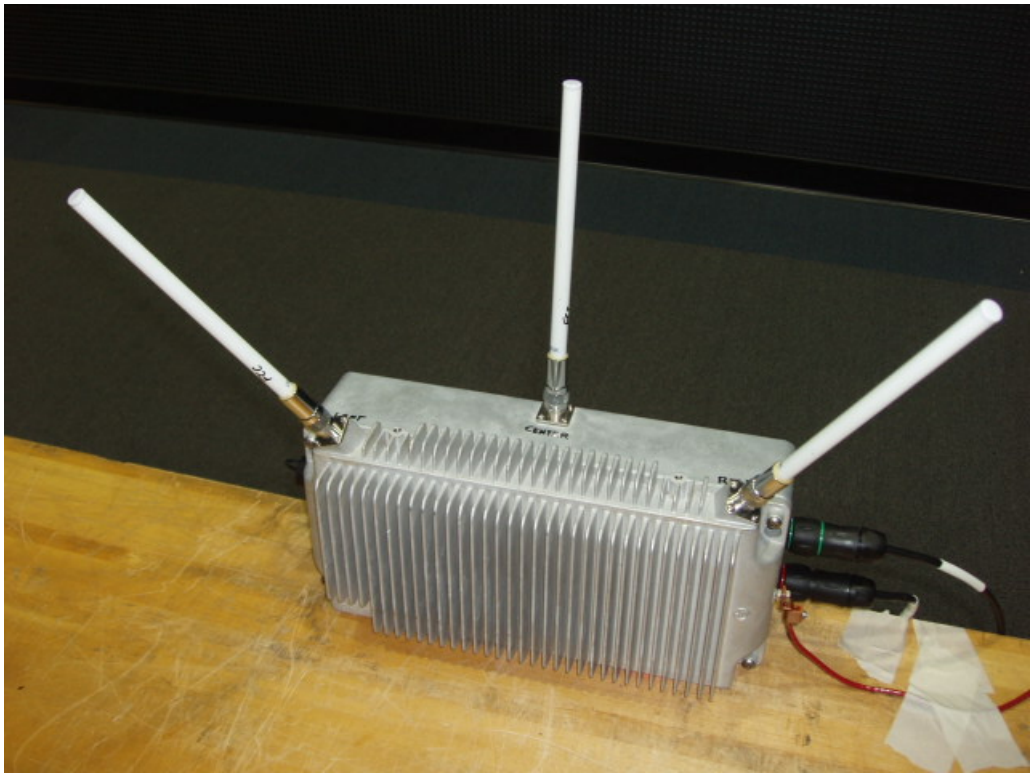


Photo 6.3-1

7 BANDWIDTH DATA

Reference: 47 C.F.R. § 15.247 (a) (2)

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(2) Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

7.1 Test Procedure

The measurement is made using a direct connection between the DUT's antenna connection and the spectrum analyzer. The spectrum analyzer's resolution bandwidth (RBW) is set to 100 kHz and its span set to encompass the full bandwidth of the emission. The DUT is conditioned to transmit at its maximum duty cycle.

7.2 Test Data

Compliance Verdict: PASS

Figure 7.2-1 shows the 6 dB bandwidth of the DUT on Channel 6 in 802.11b mode. Figure 7.2-2 shows the 6 dB bandwidth of the DUT on Channel 6 in 802.11g mode. The 802.11 standard assures that the 6 dB bandwidth will be much greater than the required 500 kHz. Preliminary measurements made on Channel 1 and Channel 11 showed similarly compliant results.

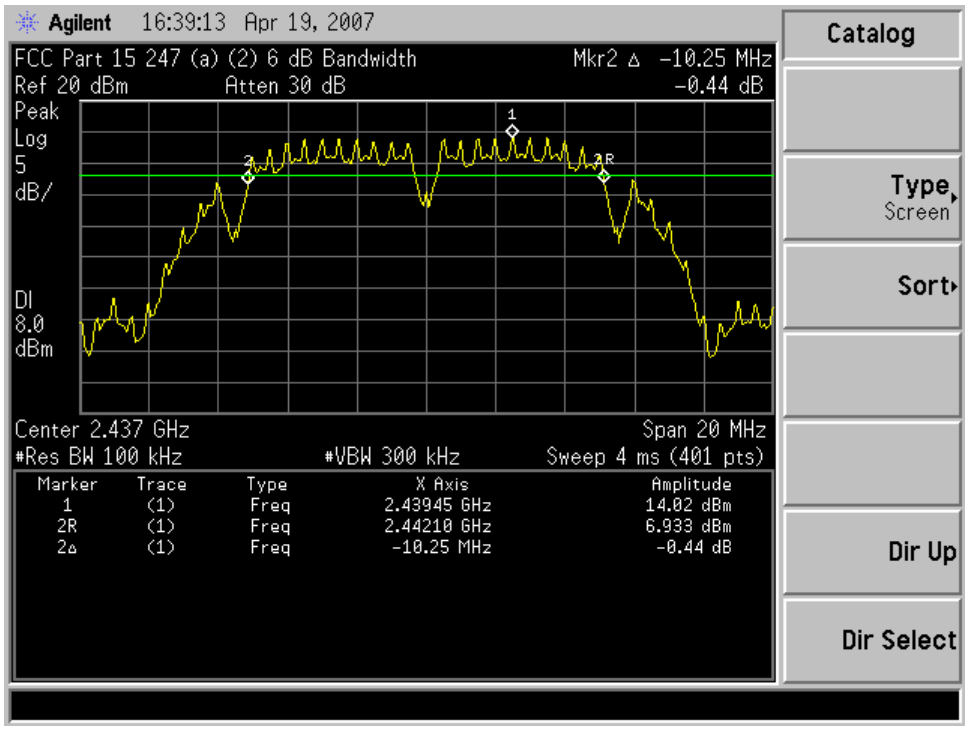


Figure 7.2-1 – 802.11b Mode Channel 6

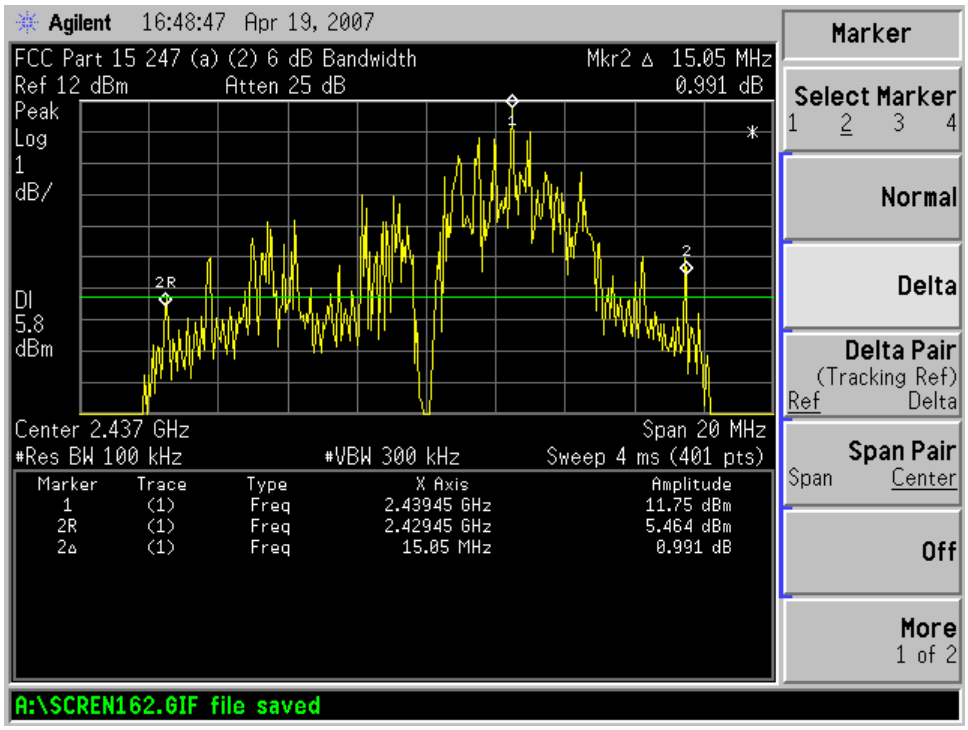


Figure 7.2-2 – 802.11g Mode Channel 6

7.3 Test Instrumentation Used, Bandwidth Measurement

Type	Manufacturer/ Model No.	Serial Number
Spectrum Analyzer	Agilent E7405A	MY42000055
10 dB Attenuator Pad	Agilent 8491A 10 dB	90077

Calibration and Traceability: All measuring and test equipment are calibrated every 12 months and are traceable to the National Institute for Standards and Technology (NIST) and Methods.

8 PEAK POWER DATA

Reference: 47 C.F.R. § 15.247 (b)

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Reference: 47 C.F.R. § 15.247 (c)

(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i)Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) and (c)(1)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

(2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that

comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of 10 log(number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

(B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beam forming.

(iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.

(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

8.1 Test Procedure

The measurement is made using a direct connection between the DUT's antenna connection and the spectrum analyzer. The spectrum analyzer's resolution bandwidth (RBW) is set to 1 MHz, video bandwidth set to 10 kHz and its span set to encompass the full bandwidth of the emission, approximately 5 times the 20 dB bandwidth of the channel. The DUT is conditioned to transmit at its maximum duty cycle. The trace should be set to max hold. Markers are placed at the lower and upper 20 dB points relative to the peak level. The spectrum analyzer's bandpower function is used to integrate the total power. The test method used was set out in KDB Publication No. 558074, Power Output Option 2, Method # 3.

8.2 Test Data

Compliance Verdict: PASS

First the total power limit must be determined. The system employed three antennas two of which could be active at one time under certain modes of operation. The antenna gain for each antenna was declared by the manufacturer to be 4.8 dBi. The additional gain associated with the second antenna was computed as follows:

$G_{dir} = G_{ant} + 10LOG(N)$ where N is the number of elements or staves

$G_{dir} = 4.8 + 10LOG(2) = 4.8 + 3 = 7.8$ dBi

Because the directional gain did not exceed 6.0 dBi by more than 3 dBi, it was not necessary to further reduce the DUT's output power. The 1 watt peak limit was applicable as the total power delivered to both antennas where the DUT's mode supported more than one antenna. In modes where just one antenna was supported, e.g. 802.11b the 1 watt limit applied to that one antenna port.

Table 8.2-1 below shows the measured power at the DUT's antenna terminals and calculated total power delivered to all antennas for the 802.11b mode.

Table 8.2-1

Antenna C Power (dBm)	Antenna L Power (dBm)	Antenna R Power (dBm)	Total Power (watts)	Total Power (dBm)	Mode	Channel
15.62	-	-	0.036	15.62	802.11b	1
23.79	-	-	0.239	23.79	802.11b	6
16.92	-	-	0.049	16.92	802.11b	11

Figure 8.2-1 shows the in-band spectral characteristics and the bandpower calculation performed by the spectrum analyzer for Channel 6.

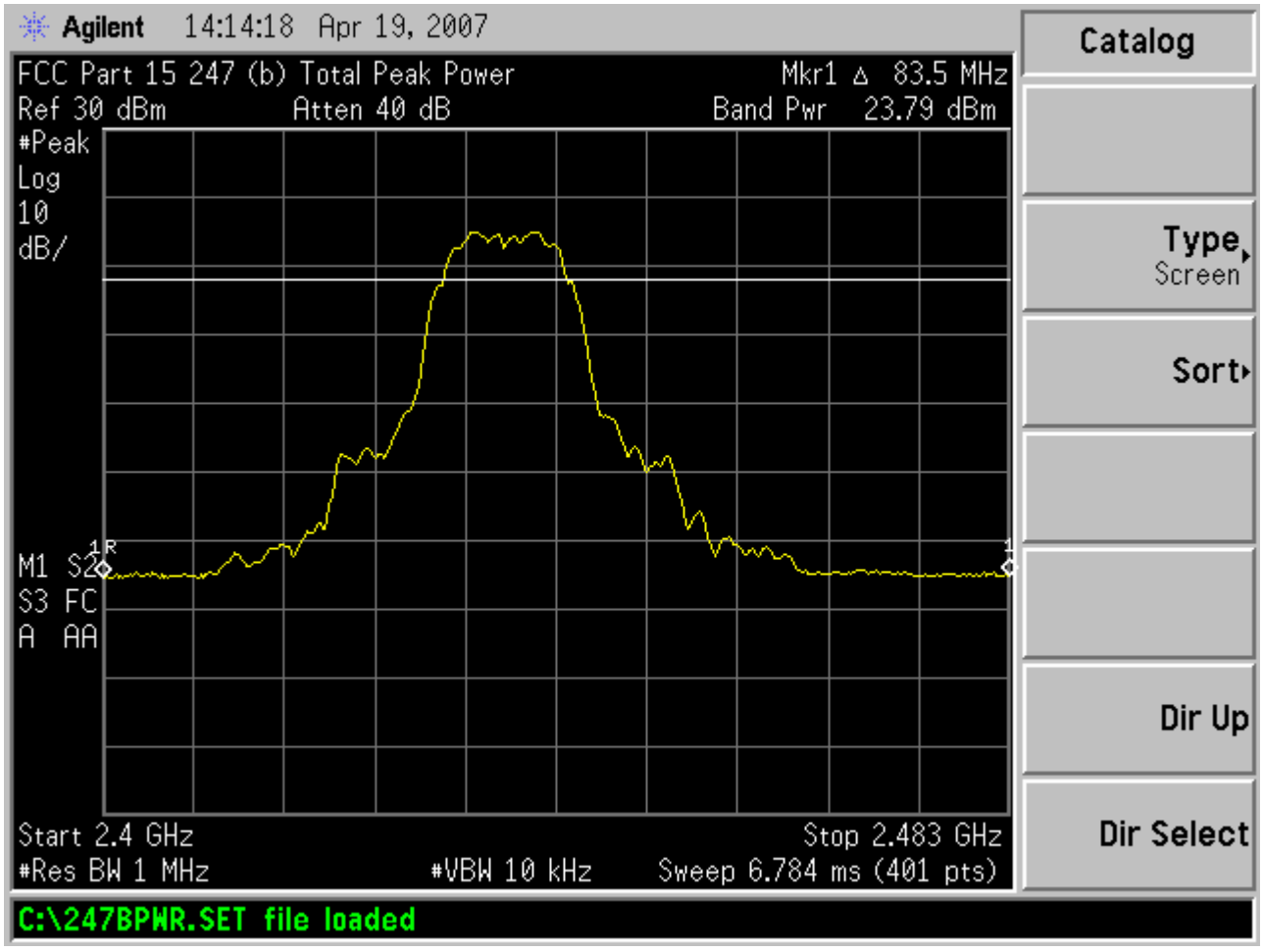


Figure 8.2-1 – 802.11b Mode Channel 6 Signal Power

Tables 8.2-2 through 8.2-10 show the measured power at the DUT's antenna terminals and calculated total power delivered to all antennas for various antenna and channel combinations in 802.11g mode.

Table 8.2-2

Antenna C Power (dBm)	Antenna L Power (dBm)	Antenna R Power (dBm)	Total Power (watts)	Total Power (dBm)	Mode	Channel
15.16	12.68	-	0.051	17.10	802.11g	1

Table 8.2-3

Antenna C Power (dBm)	Antenna L Power (dBm)	Antenna R Power (dBm)	Total Power (watts)	Total Power (dBm)	Mode	Channel
15.16	-	15.52	0.068	18.35	802.11g	1

Table 8.2-4

Antenna C Power (dBm)	Antenna L Power (dBm)	Antenna R Power (dBm)	Total Power (watts)	Total Power (dBm)	Mode	Channel
-	12.27	15.58	0.053	17.24	802.11g	1

Table 8.2-5

Antenna C Power (dBm)	Antenna L Power (dBm)	Antenna R Power (dBm)	Total Power (watts)	Total Power (dBm)	Mode	Channel
19.29	19.95	-	0.184	22.64	802.11g	6

Table 8.2-6

Antenna C Power (dBm)	Antenna L Power (dBm)	Antenna R Power (dBm)	Total Power (watts)	Total Power (dBm)	Mode	Channel
22.1	-	23.05	0.364	25.61	802.11g	6

Table 8.2-7

Antenna C Power (dBm)	Antenna L Power (dBm)	Antenna R Power (dBm)	Total Power (watts)	Total Power (dBm)	Mode	Channel
-	21.29	22.56	0.315	24.98	802.11g	6

Table 8.2-8

Antenna C Power (dBm)	Antenna L Power (dBm)	Antenna R Power (dBm)	Total Power (watts)	Total Power (dBm)	Mode	Channel
15.38	16.79	-	0.082	19.15	802.11g	11

Table 8.2-9

Antenna C Power (dBm)	Antenna L Power (dBm)	Antenna R Power (dBm)	Total Power (watts)	Total Power (dBm)	Mode	Channel
13.33	-	16.66	0.068	18.32	802.11g	11

Table 8.2-10

Antenna C Power (dBm)	Antenna L Power (dBm)	Antenna R Power (dBm)	Total Power (watts)	Total Power (dBm)	Mode	Channel
-	13.42	13.87	0.046	16.66	802.11g	11

Figures 8.2-2 shows the in-band spectral characteristics and the bandpower calculation performed by the spectrum analyzer for Channel 6.

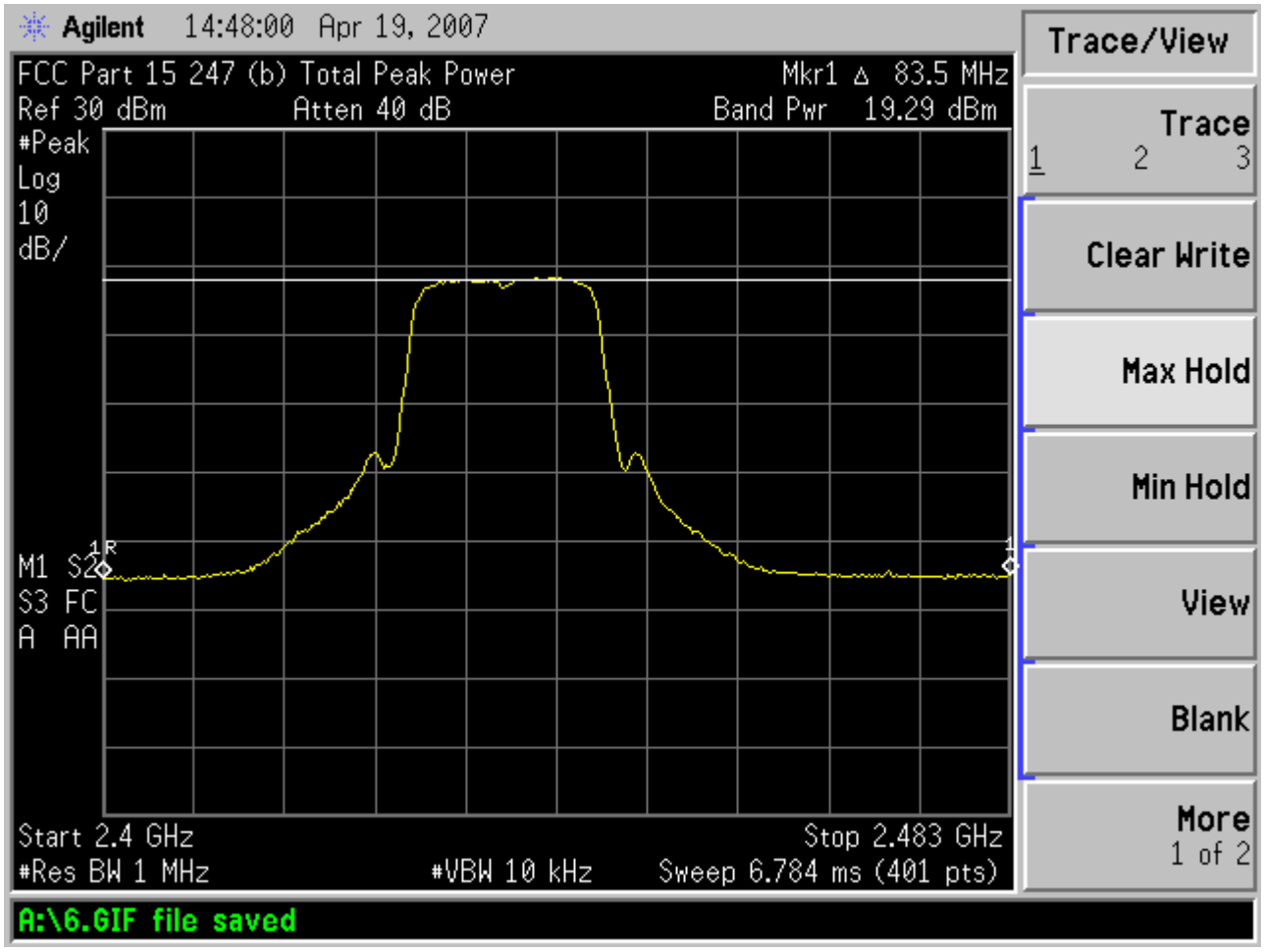


Figure 8.2-2 – 802.11g Mode Channel 6 Signal Power

8.3 Test Instrumentation Used, Peak Power Measurement

Type	Manufacturer/ Model No.	Serial Number
Spectrum Analyzer	Agilent E7405A	MY42000055
10 dB Attenuator Pad	Agilent 8491A 10 dB	90077

Calibration and Traceability: All measuring and test equipment are calibrated every 12 months and are traceable to the National Institute for Standards and Technology (NIST) and Methods.

9 OUT OF BAND POWER DATA

Reference: 47 C.F.R. § 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

9.1 Test Procedure

The measurement is made using a direct connection between the DUT's antenna connection and the spectrum analyzer. The spectrum analyzer's resolution bandwidth (RBW) is set to 100 kHz and its span set to encompass the full bandwidth of the emission. The DUT is conditioned to transmit at its maximum duty cycle. The maximum peak power level of the emission is measured first. Next, a limit line is programmed at a level 20 dB below the measured maximum peak power level outside the operating band. Spurious emissions are measured relative to that limit.

Radiated emissions in the restricted bands are measured using the test method referenced in Section 5.1.

9.2 Test Data

Compliance Verdict: PASS

Radiated emissions measurements in the restricted bands were documented in Section 5.2 of this report. Preliminary conducted emissions on Channels 1, 6 and 11 in both 802.11b and 802.11g mode showed that spurious emissions were down by greater than 20 dB from the in-band signals.

9.3 Test Instrumentation Used, Out of band Power Measurement

Type	Manufacturer/ Model No.	Serial Number
EMI Receiver	Rohde & Schwarz ESVS30	826006/014
Spectrum Analyzer	Agilent E7405A	MY42000055
Preamplifier	Com-Power PA-122	181925
Notch Filter	Micro-tronics BRM50702-01	023
Antenna	Chase EMCCBL6112B	2579
Antenna	EMCO Horn Model 3115	9002-3393
10 dB Attenuator Pad	Agilent 8491A 10 dB	90077

Calibration and Traceability: All measuring and test equipment are calibrated every 12 months and are traceable to the National Institute for Standards and Technology (NIST) and Methods.

10 POWER SPECTRAL DENSITY DATA

Reference: 47 C.F.R. § 15.247 (e)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

10.1 Test Procedure

The measurement is made using a direct connection between the DUT's antenna connection and the spectrum analyzer. The spectrum analyzer's resolution bandwidth (RBW) is set to 3 kHz and its span set to encompass the full bandwidth of the emission. The DUT is conditioned to transmit at its maximum duty cycle. The maximum peak power level of the emission measured.

10.2 Test Data

Compliance Verdict: PASS

Figure 10.2-1 shows the conducted power in a 3 kHz bandwidth of the DUT on Channel 6 in 802.11b mode. Figure 10.2-2 shows the conducted spurious emissions levels of the DUT on Channel 6 in 802.11g mode. Preliminary measurements were made on Channels 1 and 11 and showed similarly compliant test results. The PSD data in presented herein was the worst case since the power was set the highest for Channel 6. Power is intentionally set lower on these channels to meet the restricted band edge radiated emissions limit. As such, PSD is much lower on these channels.

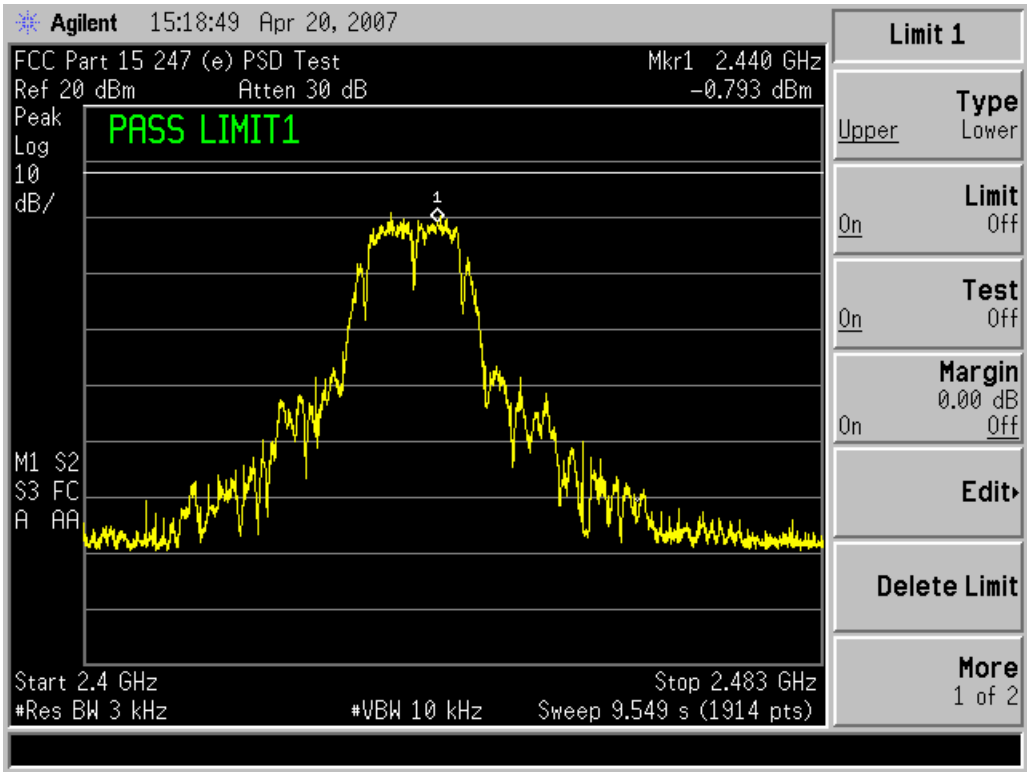


Figure 10.2-1 – 802.11b Mode Channel 6

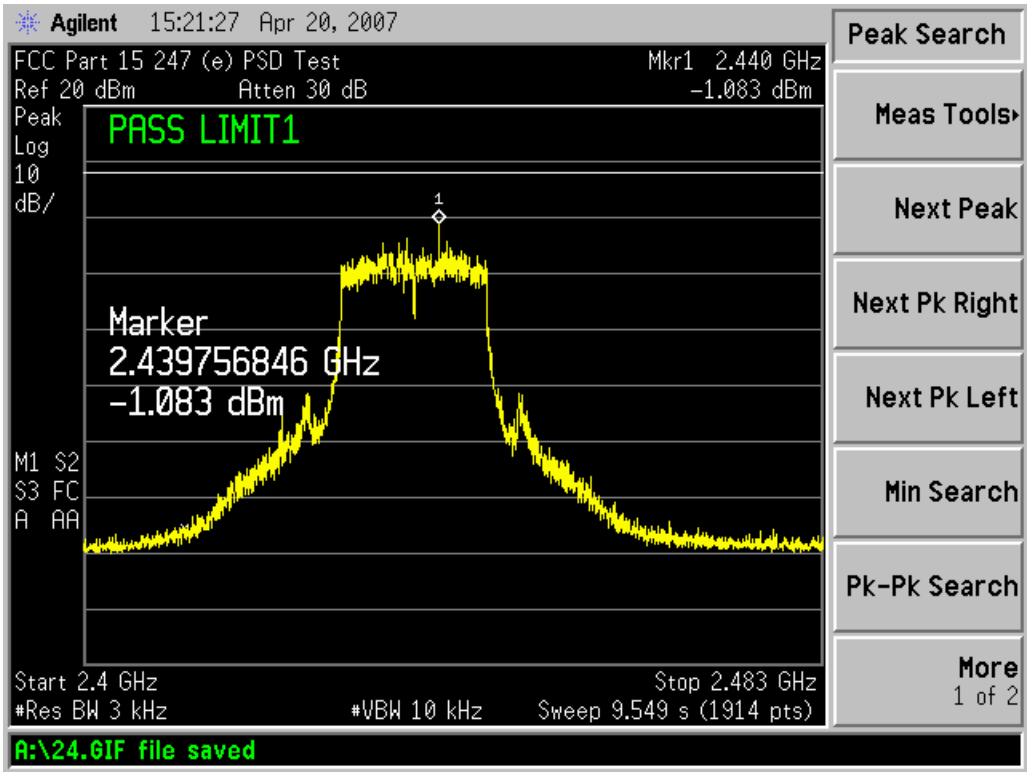


Figure 10.2-2 – 802.11g Mode Channel 6

10.3 Test Instrumentation Used, PSD Measurement

Type	Manufacturer/ Model No.	Serial Number
Spectrum Analyzer	Agilent E7405A	MY42000055
10 dB Attenuator Pad	Agilent 8491A 10 dB	90077

Calibration and Traceability: All measuring and test equipment are calibrated every 12 months and are traceable to the National Institute for Standards and Technology (NIST) and Methods.

11 LABELING AND USER'S GUIDE REQUIREMENTS

11.1 FCC Label Statement

The FCC compliance label shall include the following information:

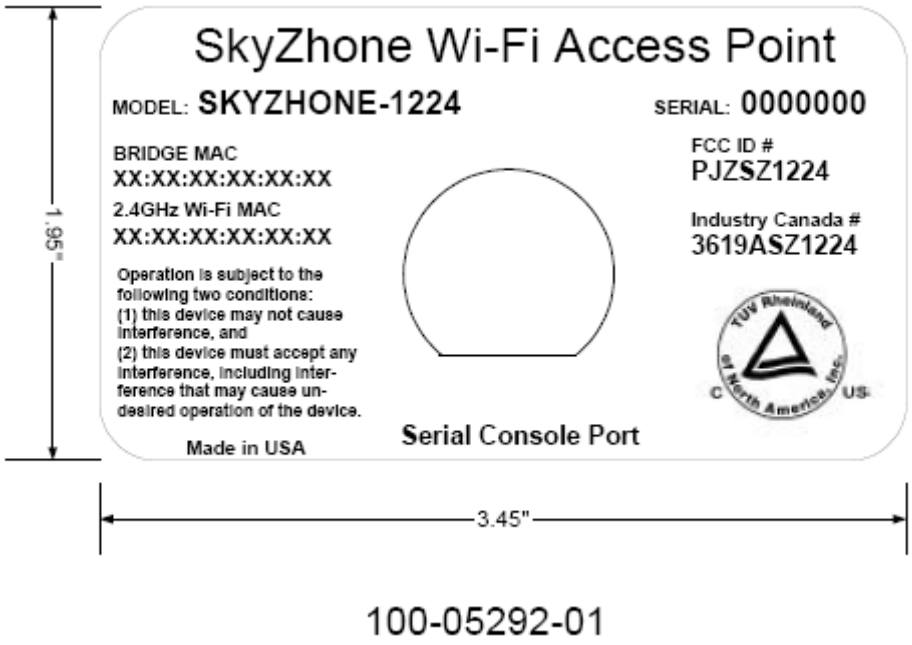
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

The FCC id number will be: PJZSZ1224.

The Industry Canada id number will be: 3619ASZ1224.

Figure 11.1-1 below shows a drawing of the label.



100-05292-01

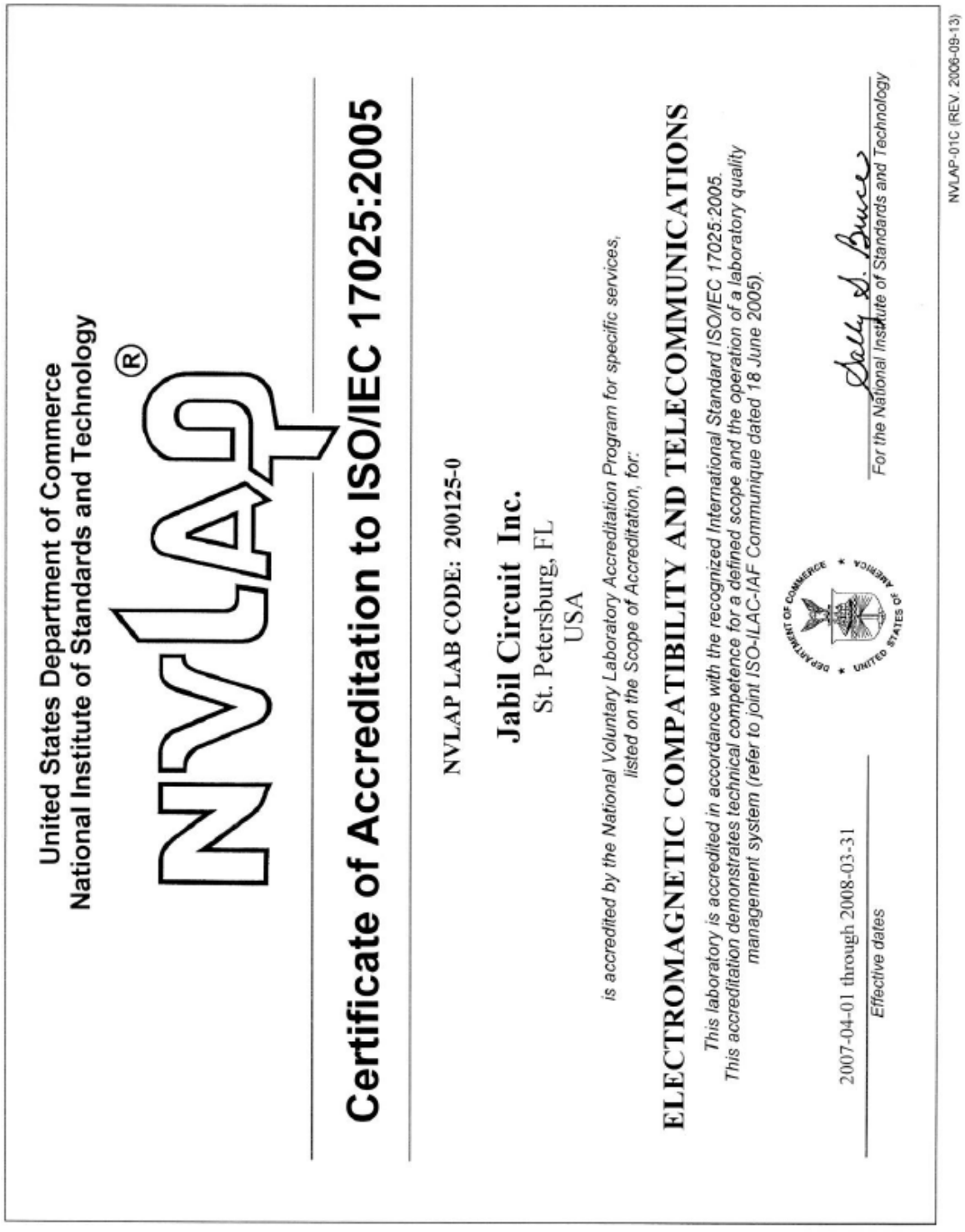
Figure 11.1-1 Sample Label

11.2 Instruction Manual Statements

The instruction manual must contain the following statements:

- Changes or modifications not expressly approved by the responsible party could void the user's authority to operate the equipment.
- The supplied shielded cables must be used to ensure compliance with Part 15, FCC Rules.
- This device may only be used with approved antennas that are shipped with the unit and installed per installation instructions. The use of any other antennas will invalidate the unit's FCC Part 15 certification.
- This device has been designed to operate with the antennas listed below, and having a maximum gain of 5 dBi. Antennas not included in this list (Comet Part Number CFA-245W) or having a gain greater than 5 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.
- To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication. Operating the device with the supplied antennas will ensure that this requirement is met.
- Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

ANNEX A NVLAP CERTIFICATE of ACCREDITATION



United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200125-0

Jabil Circuit Inc.
St. Petersburg, FL
USA

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated 18 June 2005).

2007-04-01 through 2008-03-31
Effective dates

For the National Institute of Standards and Technology

NVLAP-01C (REV. 2006-09-13)

ANNEX B NVLAP SCOPE of ACCREDITATION

NVLAP® National Voluntary Laboratory Accreditation Program

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

Jabil Circuit Inc.
10800 Roosevelt Boulevard
St. Petersburg, FL 33716
USA
Mr. Peter Walsh, NCE
Phone: 727-803-5953 Fax:
E-Mail: peter_walsh@jabil.com
URL: http://www.jabil.com

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS — **NVLAP LAB CODE 200125-0**

NVLAP Code	*Designation / Description*
Emissions Test Methods:	
12/CIS22	IEC/CISPR 22 (1997) & EN 55022 (1998) + A1(2000): Limits and methods of measurement of radio disturbance characteristics of information technology equipment
12/CIS22a	IEC/CISPR 22 (1993) and EN 55022 (1994): Limits and methods of measurement of radio disturbance characteristics of information technology equipment, Amendment 1 (1995) and Amendment 2 (1996)
12/CIS22b	CNS 13438 (1997): Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment
12/CIS22e1	IEC/CISPR 22, Edition 5 (2005) and EN 55022 (1998): Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
12/CIS22e3	IEC/CISPR 22, Edition 5 (2005) + A1(2005): Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
12/CIS22e4	EN 55022 (1998) + A1(2000) + A2(2003): Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement

2007-04-01 through 2008-03-31
Effective dates

Sally S. Bruce
For the National Institute of Standards and Technology

Page 1 of 3

NVLAP-01S (REV. 2005-05-19)

NVLAP® **National Voluntary Laboratory Accreditation Program**

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

NVLAP LAB CODE 200125-0

NVLAP Code	***Designation / Description***
12/FCC15b	ANSI C63.4 (2003) with FCC Method 47 CFR Part 15, Subpart B: Unintentional Radiators
12/FCC15c3	KDB Pub. No. 200433 Millimeter Wave Test Procedures: with FCC Method - 47 CFR Part 15, Subpart C: Intentional Radiators
12/T51a	AS/NZS CISPR 22 (2004): Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
12/VCCIb	Agreement of VCCI V-3 (2006.04): Agreement of Voluntary Control Council for Interference by Information Technology Equipment - Technical Requirements: V-3/2006.04

Radio Test Methods

12/BETS7a	Document AT-34-04-RT: Testing Procedures for Type Approval testing per BETS-7, Issue 1 (November 1, 1996)

Telecommunications Test Methods:

12/CS03a	Industry Canada CS-03, Issue 9, Amendment 1 (2005): Compliance Specification for Terminal Equipment, Terminal Systems, Network Protection Devices, Connection Arrangements and Hearing Aids Compatibility
12/T01	Terminal Equipment Network Protection Standards, FCC/ACTA Method - 47 CFR Part 68 - Analog and Digital
12/T01a	68.302 (Par. c,d,e,f) Environmental simulation; 68.304 Leakage current limit.; 68.306 Hazardous voltage limit.; 68.308 Signal power limit.; 68.310 Longitudinal balance limit.; 68.312 On-hook impedance limit.; 68.314 Billing protection
12/T01b	68.316 and 68.317 Hearing Aid Compatibility: technical standards
12/T01c	68.302 Environmental simulation (Par. a,b)
12/TIA968	ANSI/TIA-968-A (2003): Telephone Terminal Equipment, Technical Requirements for Connection of Terminal Equipment to the Telephone Network

2007-04-01 through 2008-03-31
Effective dates

Sally S. Bruce
For the National Institute of Standards and Technology

Page 2 of 3

NVLAP-01S (REV. 2005-05-19)

NVLAP® National Voluntary Laboratory Accreditation Program

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

NVLAP LAB CODE 200125-0

NVLAP Code	*Designation / Description*
12/TIA968a	ANSI/TIA-968-A-1 (2003): Telephone Terminal Equipment, Technical Requirements for Connection of Terminal Equipment to the Telephone Network - Addendum 1
12/TIA968b	ANSI/TIA-968-A-2 (2004): Telephone Terminal Equipment, Technical Requirements for Connection of Terminal Equipment to the Telephone Network - Addendum 2
12/TIA968c	ANSI/TIA-968-A-3 (2005): Telephone Terminal Equipment, Technical Requirements for Connection of Terminal Equipment to the Telephone Network - Addendum 3

2007-04-01 through 2008-03-31

Effective dates

Sally S. Bruce

For the National Institute of Standards and Technology

Page 3 of 3

NVLAP-01S (REV. 2005-05-19)

ANNEX C DISCLOSURE STATEMENT

Jabil Circuit Inc. represents to the client that testing was done in accordance with standard procedures as applicable and that reported test results are accurate within generally accepted commercial ranges of accuracy. Jabil Circuit Inc. test reports only apply to the specific sample(s) tested. This report is the property of the client. This report shall not be reproduced except in full without the expressed written approval of Jabil Circuit, Inc.

TERMS and CONDITIONS

ARTICLE 1 *- Services, Jabil Circuit will:*

1.1 Act for Client in a professional manner, using the degree of care and skill ordinarily exercised by and consistent with the standards of the profession.

1.2 Provide only those services that lie within the technical and professional area of expertise and capability of the Lab.

1.3 Perform all technical services in accordance with accepted laboratory test principles and practices.

1.4 Use test equipment which has been calibrated within a period not exceeding the manufacturer's recommendation and which is traceable to the NIST.

1.6 Consider all reports to be the confidential property of the client, and distribute reports only to those persons designated by the client.

ARTICLE 2 *- Client's Responsibilities, The Client will:*

2.1 Provide all information necessary for proper performance of technical services.

2.2 Designate a person who is authorized to transmit instructions, receive information and test data reports, interpret and define Client's policies, and make decisions regarding technical services, as may be required at Clients expense.

2.3 Deliver without cost, representative samples of product for technical evaluation, together with any relevant data.

2.4 Furnish such labor and equipment necessary to handle sample product and to facilitate the technical evaluation.

2.5 The Client shall provide prior to the start of evaluation testing a signed Purchase Order for the amount agreed to by both parties.

ARTICLE 3 *- General Requirements.*

3.1 The only warranty made by Jabil Circuit, in connection with services performed thereunder is that it will use that degree of care and skill as stated in Article 1.1 and 1.3 above. No other warranty, expressed or implied, is made or intended for services provided thereunder.

3.2 Jabil Circuit shall supply technical services and prepare reports based solely on product samples submitted. The Client understands that application of the data to other devices is highly speculative and should be applied with extreme caution.

3.3 Jabil Circuit agrees to exercise ordinary care in receiving, preserving, and shipping any test sample to be tested, but assumes no responsibility for damages, either direct or consequential, which arise or are alleged to arise from loss, damage or destruction of the sample due to the act of examination, modification or testing, or technical analysis, or circumstances beyond our control.

3.4 The Client recognizes that generally accepted error variances apply and agrees to consider such error variances in its use of test data.

3.5 It is agreed between Jabil Circuit and Client that no distribution of any test reports, etc. shall be made to any third party without the prior written consent of both parties.

3.6 Test Reports may not be used by the Client to claim product endorsement by NVLAP or any agency of the U.S. Government.

ARTICLE 4 *- Payment.*

4.1 The Client agrees to pay for services and expenses as covered in the Purchase order or modified by Article 2.2. Jabil Circuit will present an invoice at the completion of work and will be paid within 30 days of receipt by Client unless the testing services are included with development services covered under a different agreement.