



## **FCC 47 CFR PART 15 SUBPART C**

### **TEST REPORT**

**For**

**Wireless-G Broadband Router With SpeedBooster**

**Model: WRT54GS V7.2**

**Trade Name: Linksys**

*Issued to*

**Cisco-Linksys LLC**

**121 Theory Drive  
Irvine, CA 92617(USA)**

*Issued by*

**Compliance Certification Services Inc.**

**Hsinchu Lab.**

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## **TABLE OF CONTENTS**

1.	TEST RESULT CERTIFICATION .....	4
2.	SUMMARY OF TEST RESULTS .....	5
3.	EUT DESCRIPTION .....	6
4.	TEST METHODOLOGY .....	7
4.1	EUT CONFIGURATION .....	7
4.2	EUT EXERCISE .....	7
4.3	GENERAL TEST PROCEDURES.....	7
4.4	FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS .....	8
4.5	DESCRIPTION OF TEST MODES .....	8
5.	INSTRUMENT CALIBRATION .....	9
5.1	MEASURING INSTRUMENT CALIBRATION .....	9
5.2	MEASUREMENT EQUIPMENT USED .....	9
6.	FACILITIES AND ACCREDITATIONS .....	10
6.1	FACILITIES.....	10
6.2	EQUIPMENT.....	10
6.3	TABLE OF ACCREDITATIONS AND LISTINGS .....	11
7.	SETUP OF EQUIPMENT UNDER TEST .....	12
7.1	SETUP CONFIGURATION OF EUT .....	12
7.2	SUPPORT EQUIPMENT .....	12
8.	FCC PART 15.247 REQUIREMENTS .....	13
8.1	6DB BANDWIDTH.....	13
8.1.1	LIMIT.....	13
8.1.2	TEST PROCEDURE.....	13
8.1.3	TEST RESULTS .....	14
8.2	PEAK POWER .....	18
8.2.1	LIMIT.....	18
8.2.2	TEST PROCEDURE.....	18
8.2.3	TEST RESULTS .....	19
8.3	BAND EDGES MEASUREMENT .....	20
8.3.1	LIMIT.....	20
8.3.2	TEST PROCEDURE.....	20
8.3.3	TEST RESULTS .....	20



8.4	PEAK POWER SPECTRAL DENSITY .....	29
8.4.1	LIMIT.....	29
8.4.2	TEST PROCEDURE.....	29
8.4.3	TEST RESULTS .....	30
8.5	SPURIOUS EMISSIONS .....	34
8.5.1	CONDUCTED MEASUREMENT .....	34
8.5.1.1	LIMIT.....	34
8.5.1.2	TEST PROCEDURE.....	34
8.5.1.3	TEST RESULTS .....	34
8.5.2	RADIATED EMISSIONS .....	38
8.5.2.1	LIMIT - ABOVE 1000 MHZ.....	38
8.5.2.2	TEST PROCEDURE.....	39
8.5.2.3	TEST RESULTS .....	40
8.5.2.4	LIMIT - BELOW 1000 MHZ .....	46
8.5.2.5	TEST PROCEDURE.....	47
8.5.2.6	TEST RESULTS .....	48
8.6	POWERLINE CONDUCTED EMISSIONS .....	49
8.6.1	LIMIT.....	49
8.6.2	TEST PROCEDURE.....	49
8.6.3	TEST RESULTS .....	50
APPENDIX I RADIO FREQUENCY EXPOSURE .....		66
APPENDIX II PHOTOGRAPHS OF TEST SETUP .....		69



## 1. TEST RESULT CERTIFICATION

**Applicant:** Cisco-Linksys LLC  
121 Theory Drive  
Irvine, CA 92617(USA)

**Equipment Under Test:** Wireless-G Broadband Router With SpeedBooster

**Trade Name:** Linksys

**Model:** WRT54GS V7.2

**Date of Test:** September 28 ~ October 26, 2007

APPLICABLE STANDARDS
FCC 47 CFR Part 15 Subpart C
Deviation from Applicable Standard
N/A

### We hereby certify that:

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4: 2003 and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247.

The test results of this report relate only to the tested sample EUT identified in this report.

**Approved by:**

S. B. Lu

S. B. Lu  
Manager of Hsinchu Laboratory  
Compliance Certification Services Inc.

**Reviewed by:**

Jerry Chang



Jerry Chang  
Test Engineer of Hsinchu Laboratory  
Compliance Certification Services Inc.



## 2. SUMMARY OF TEST RESULTS

THE EUT has been tested according to the following specifications:

<b>Applied Standard: FCC Part 15, Subpart C</b>			
<b>Standard Paragraph</b>	<b>Test Parameter</b>	<b>Result</b>	<b>Remark</b>
8.1 15.247(a)(2)	6dB Bandwidth	Pass	Meet the requirement of limit.
8.2 15.247(b)	Peak Power	Pass	Meet the requirement of limit.
8.3 15.247(d)	Band Edges Measurement	Pass	Meet the requirement of limit.
8.4 15.247(e)	Peak Power Spectral Density	Pass	Meet the requirement of limit.
8.5.1 15.247(d)	Conducted Measurement	Pass	Meet the requirement of limit.
8.5.2.1 15.247(d)	Radiated Emissions (Above 1 GHz)	Pass	Above 1 GHz: Minimum passing margin is – 0.46dB at 4875.00 MHz
8.5.2.4 15.247(d)	Radiated Emissions (Below 1 GHz)	Pass	Below 1 GHz: Minimum passing margin is – 5.29dB at 359.80 MHz
8.6 15.207	Powerline Conducted Emissions	Pass	Meet the requirement of limit. Minimum passing margin is – 5.07dB at 2.345MHz.



### 3. EUT DESCRIPTION

<b>Product</b>	Wireless-G Broadband Router With SpeedBooster
<b>Trade Name</b>	Linksys
<b>Model Number</b>	WRT54GS V7.2
<b>FCC ID</b>	Q87-WRT54GSV72
<b>Power Supply</b>	DC 12V (from Power Adapter)
<b>Frequency Range</b>	2.4GHz: 2400 ~ 2483.5MHz
<b>Number of Channels</b>	IEEE 802.11b/g mode: 11 Channels
<b>Modulation Technique</b>	IEEE 802.11b mode: DSSS IEEE 802.11g mode: OFDM
<b>Data Rate</b>	IEEE 802.11b mode: 1, 2, 5.5, 11 Mbps IEEE 802.11g mode: 6, 9, 12, 18, 24, 36, 48, 54 Mbps
<b>Transmit Power</b>	IEEE 802.11b mode: 20.20 dBm IEEE 802.11g mode: 22.00 dBm
<b>Antenna Specification</b>	Dipole Antenna, Antenna Gain : 2dBi (with Reversed-TNC connector)
<b>I/O Port</b>	LAN Port × 4; WAN Port × 1

#### Power Adapter

No.	Brand (Manufacturer)	Model No.	Power Input	Power Output
1	LINKSYS	LS120V05AE	100V-240V ~ 0.5A 50-60 Hz	12VDC 0.5A MAX
2	LINKSYS (ENERTRONIX)	AD12V/0.5A-SW	100V-240V ~ 0.5A 50-60 Hz	12VDC 0.5A MAX
3	LINKSYS	ADA12050UA05	100V-240V ~ 0.5A 50-60 Hz	12VDC 0.5A MAX
4	LINKSYS	LS120V05A	100V-240V ~ 0.5A 50-60 Hz	12VDC 0.5A MAX
5	LINKSYS (ENG)	AD12V/0.5A-SW	100V-240V ~ 0.5A 50-60 Hz	12VDC 0.5A MAX
6	LINKSYS (ENG)	AD12V/0.5A-SW (special version)	100V-240V ~ 0.5A 50-60 Hz	12VDC 0.5A MAX
7	LINKSYS	HK-X106-A12	100V-240V ~ 0.22A 50-60 Hz	12VDC 0.5A MAX
8	LINKSYS	AMS1-1200500FU	100V-240V ~ 0.2A 50-60 Hz	12VDC 0.5A MAX

**Remark:**

1. The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: Q87-WRT54GSV72 filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.



## **4. TEST METHODOLOGY**

The tests documented in this report were performed in accordance with ANSI C63.4 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 and 15.247.

### **4.1 EUT CONFIGURATION**

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

### **4.2 EUT EXERCISE**

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

### **4.3 GENERAL TEST PROCEDURES**

#### **Conducted Emissions**

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.4 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

#### **Radiated Emissions**

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 13.1.4.1 of ANSI C63.4.



#### 4.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

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

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
<sup>1</sup> 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	2655 - 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	( <sup>2</sup> )
13.36 - 13.41			

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

- (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.

#### 4.5 DESCRIPTION OF TEST MODES

Channel	Frequency	Channel	Frequency (MHz)
1	2412MHz	7	2442MHz
2	2417MHz	8	2447MHz
3	2422MHz	9	2452MHz
4	2427MHz	10	2457MHz
5	2432MHz	11	2462MHz
6	2437MHz		

There are three channels have been tested as following 2412MHz (CH1), 2437MHz(CH6) and 2462MHz(CH11).

IEEE 802.11b : 1Mbps data rate (worst case) were chosen for full testing.

IEEE 802.11g : 6Mbps data rate (worst case) were chosen for full testing.



## 5. INSTRUMENT CALIBRATION

### 5.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

### 5.2 MEASUREMENT EQUIPMENT USED

#### Equipment Used for Emissions Measurement

**Remark:** Each piece of equipment is scheduled for calibration once a year.

Conducted Emissions Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY433601.32	06/06/2008
Oscilloscope	Agilent	54642A	MY42001367 JH	06/04/2008

3m OATS				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
BILOG ANTENNA	CHASE	CBL6112B	2817	10/18/2008
SPECTRUM ANALYZER	Rohde & Schwarz	FSEK30	835253/002	10/18/2008
SPECTRUM ANALYZER	AGILENT	E4446A	MY433601.32	06/06/2008
EMI TEST RECEIVER	Rohde & Schwarz	ESCS30	835418/008	10/16/2008
OPEN SITE	-----	-----	No.2	05/07/2008
N TYPE COAXIAL CABLE	MIYAZAKI	8D-FB	02	05/16/2008
Horn-Antenna	-----	AH-118	10089	10/18/2008
Horn-Antenna	-----	AH-840	03077	02/25/2008
Pre-amplifier	Agilent	8449B	3008A01471	12/25/2007
Amplifier	HP	8447D	1937A02748	12/25/2007
High pass filter	HP	84300/80038	002	N.C.R.
High pass filter	HP	84300/80039	003	N.C.R.
Loop Antenna	ETS-LINDGREN	6502	2356	06/15/2008
Test S/W	LABVIEW (V 6.1)			

**Remark:** The measurement uncertainty is less than  $\pm 3.2\text{dB}$  (30MHz ~ 1GHz),  $\pm 3.2\text{dB}$  (Above 1GHz) which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.

Powerline Conducted Emissions Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
L.I.S.N.	SCHWARZBECK	NNLK 8121	8121-446	10/31/2007 For Insertion loss
	Rohde & Schwarz	ESH 3-Z5	840062/021	
TEST RECEIVER	Rohde & Schwarz	ESCS 30	100348	06/28/2008
TYPE N COAXIAL CABLE	SUHNER	-----	-----	02/26/2008
Test S/W	e-3 (5.04211c) R&S (2.27)			

**Remark:** The measurement uncertainty is less than  $\pm 2.05\text{dB}$ , which is evaluated as per the NAMAS NIS 81 and CISPR/A/291/CDV.



## **6. FACILITIES AND ACCREDITATIONS**

### **6.1 FACILITIES**

All measurement facilities used to collect the measurement data are located at

Rm.258, Bldg.17, NO.195 , Sec. 4, Chung Hsing Rd., Chu-Tung Chen. Hsin-Chu, Taiwan 310 R.O.C.

Tel: 886-3-591-0068 / Fax: 886-3-582-55720

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

### **6.2 EQUIPMENT**






Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

### 6.3 TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	NVLAP	EN 55014-1, AS/NZS 1044, CNS 13783-1, IEC/CISPR 14-1, IEC/CISPR 22, EN 55022, EN 61000-3-2, EN 61000-3-3, ANSI C63.4, AS/NZS CISPR 22, AS/NZS 3548, IEC 61000-4-2/3/4/5/6/8/11	 200118-0
USA	FCC	3/10 meter Open Area Test Sites to perform FCC Part 15/18 measurements	 90585, 90584
Japan	VCCI	3/10 meter Open Area Test Sites to perform conducted/radiated measurements	<b>VCCI</b> R-1229/1189 C-1250/1294
Taiwan	TAF	FCC Method-47 CFR Part 15 Subpart C,D,E CISPR 11, FCC METHOD-47 CFR Part 18, EN 55011, CNS 13803, CISPR 13, CNS 13439, FCC Method-47 CFR Part 15 Subpart B, CISPR 14-1, EN 55014-1, CNS 13783-1, EN 55015, CNS 14115, CISPR 22, EN 55022, VCCI CNS 13438, EN 61000-4-2/3/4/5/6/8/11	 Testing Laboratory 0240
Taiwan	BSMI	CNS 13803, CNS 13438, CNS 13439, CNS 13783-1, CNS 14115	 SL2-IS-E-0002 SL2-IN-E-0002 SL2-A1-E-0002 SL2-R1-E-0002 SL2-R2-E-0002 SL2-L1-E-0002
Canada	Industry Canada	RSS-GEN Issue 2	 IC 4417-1

\* No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government.



## 7. SETUP OF EQUIPMENT UNDER TEST

### 7.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix II for the actual connections between EUT and support equipment.

### 7.2 SUPPORT EQUIPMENT

No.	Product	Manufacturer	Model No.	Serial No.	FCC ID
1	Notebook PC	DELL	Latitude D610	CN-0XD762-48643-63 7-1743	E2K24BNHM
2	Notebook PC	DELL	Latitude D610	CN-0C4708-48643-625 -5565	E2K24BNHM
3	Notebook PC	HP	nx6130	CNU543274R	CNTWM3B2200BGA

**Remark:**

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.



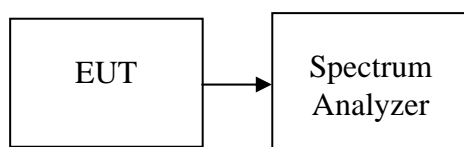
## 8. FCC PART 15.247 REQUIREMENTS

### 8.1 6dB BANDWIDTH

#### 8.1.1 LIMIT

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 2400 - 2483.5 MHz. The minimum 6dB bandwidth shall be at least 500 kHz.

#### Test Configuration



#### 8.1.2 TEST PROCEDURE

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW = 100kHz, VBW = RBW, Span = 50 MHz, Sweep = auto.
4. Mark the peak frequency and -6dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.



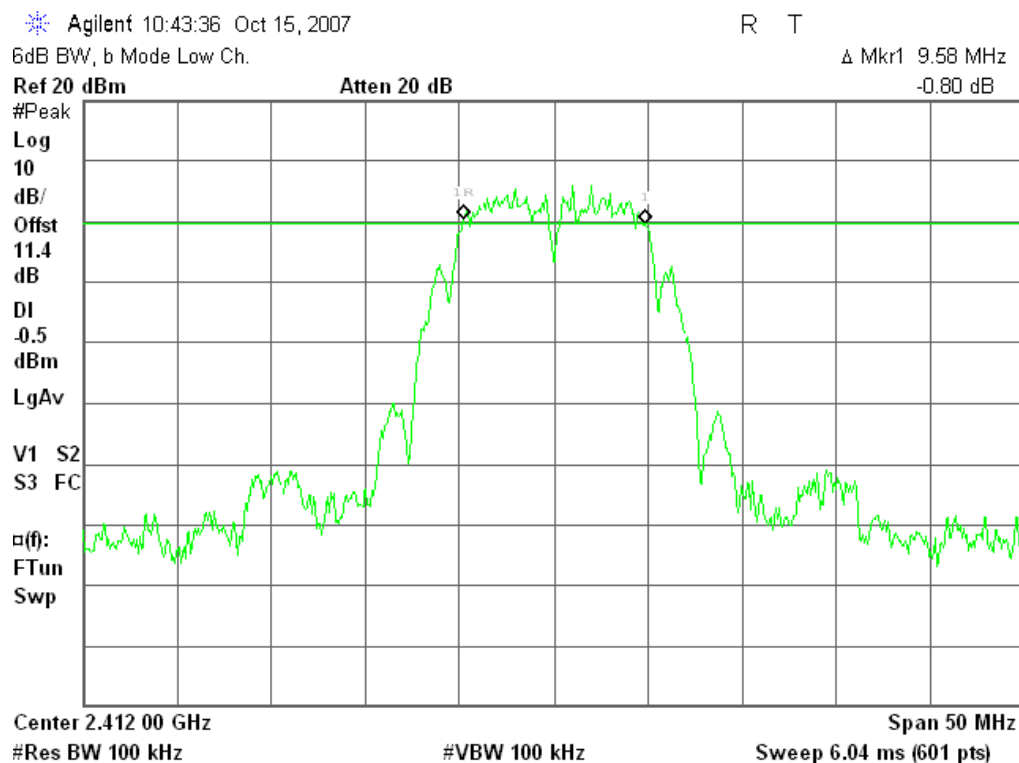
## 8.1.3 TEST RESULTS

*No non-compliance noted*

### Test Data

Test mode: IEEE 802.11b mode				
Channel	Frequency (MHz)	Bandwidth (MHz)	Limit (MHz)	Result
1	2412	9.58	>0.5	PASS
6	2437	9.58		PASS
11	2462	10.00		PASS

### 6dB Bandwidth (CH 1)





## 6dB Bandwidth (CH 6)

Agilent 10:57:07 Oct 15, 2007

R T

6dB BW, b Mode Mid Ch.

$\Delta$  Mkr1 9.58 MHz

Ref 20 dBm

Atten 20 dB

0.14 dB

#Peak

Log

10

dB/

Offst

11.4

dB

DI

1.2

dBm

LgAv

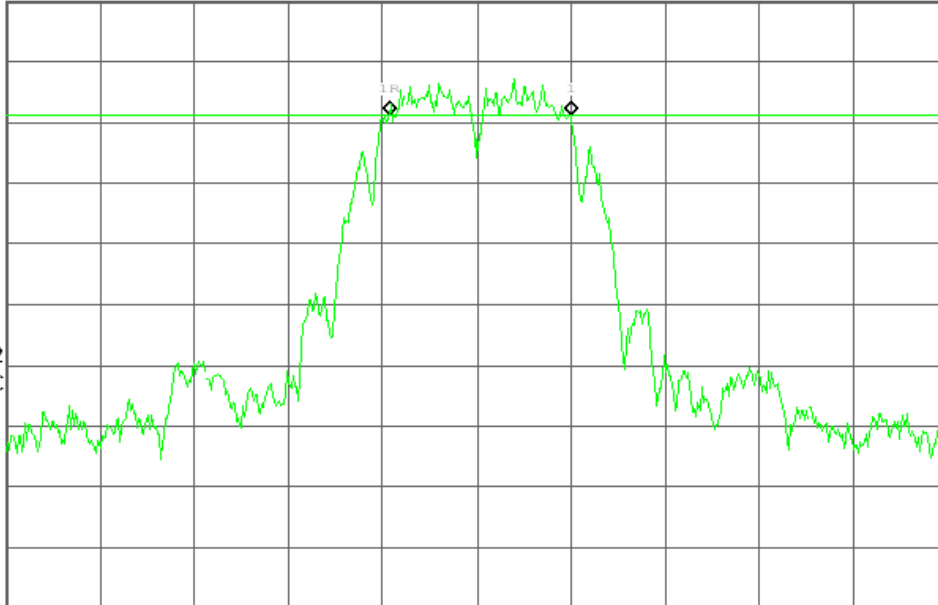
V1 S2

S3 FC

$\alpha(f)$ :

FTun

Swp



Center 2.437 00 GHz

Span 50 MHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 6.04 ms (601 pts)

## 6dB Bandwidth (CH 11)

Agilent 11:08:55 Oct 15, 2007

R T

6dB BW, b Mode High Ch.

$\Delta$  Mkr1 10.00 MHz

Ref 20 dBm

Atten 20 dB

1.26 dB

#Peak

Log

10

dB/

Offst

11.4

dB

DI

0.8

dBm

LgAv

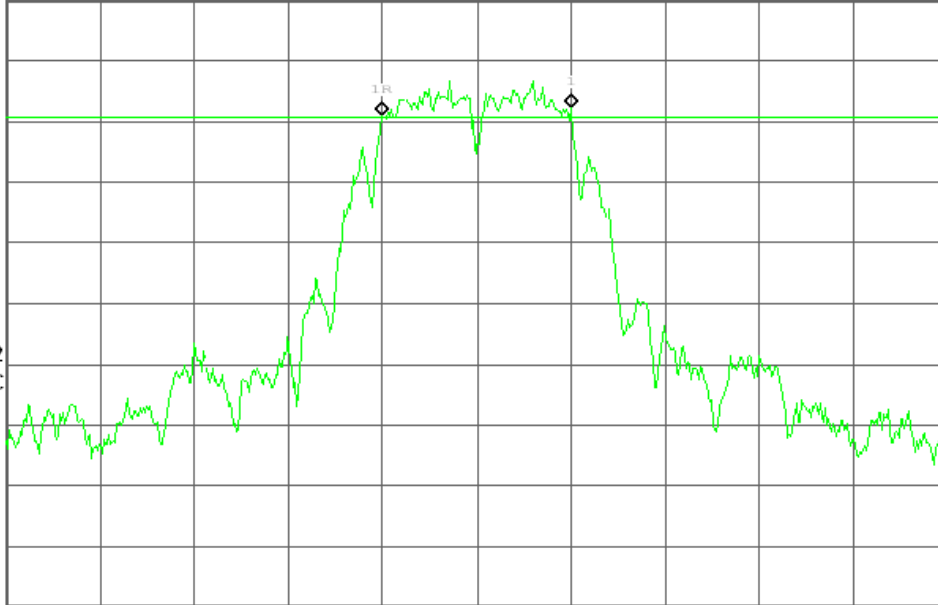
V1 S2

S3 FC

$\alpha(f)$ :

FTun

Swp



Center 2.462 00 GHz

Span 50 MHz

#Res BW 100 kHz

#VBW 100 kHz

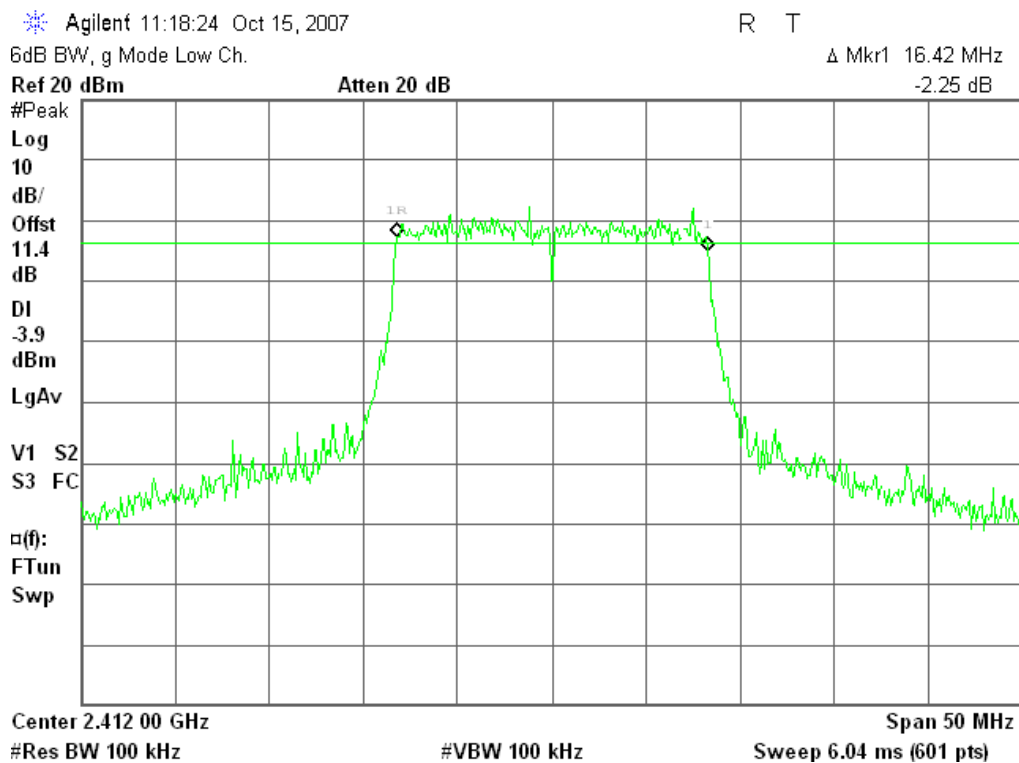
Sweep 6.04 ms (601 pts)



### Test Data

Test mode: IEEE 802.11g mode				
Channel	Frequency (MHz)	Bandwidth (MHz)	Limit (MHz)	Result
1	2412	16.42	>0.5	PASS
6	2437	16.50		PASS
11	2462	16.50		PASS

### 6dB Bandwidth (CH 1)





## 6dB Bandwidth (CH 6)

Agilent 11:25:45 Oct 15, 2007

R T

6dB BW, g Mode Mid Ch.

$\Delta$  Mkr1 16.50 MHz

Ref 20 dBm

Atten 20 dB

-1.18 dB

#Peak

Log

10

dB/

Offst

11.4

dB

DI

-3.8

dBm

LgAv

V1 S2

S3 FC

$\alpha(f)$ :

FTun

Swp

Center 2.437 00 GHz

Span 50 MHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 6.04 ms (601 pts)

## 6dB Bandwidth (CH 11)

Agilent 11:33:30 Oct 15, 2007

R T

6dB BW, g Mode High Ch.

$\Delta$  Mkr1 16.50 MHz

Ref 20 dBm

Atten 20 dB

0.74 dB

#Peak

Log

10

dB/

Offst

11.4

dB

DI

-4.3

dBm

LgAv

V1 S2

S3 FC

$\alpha(f)$ :

FTun

Swp

Center 2.462 00 GHz

Span 50 MHz

#Res BW 100 kHz

#VBW 100 kHz

Sweep 6.04 ms (601 pts)

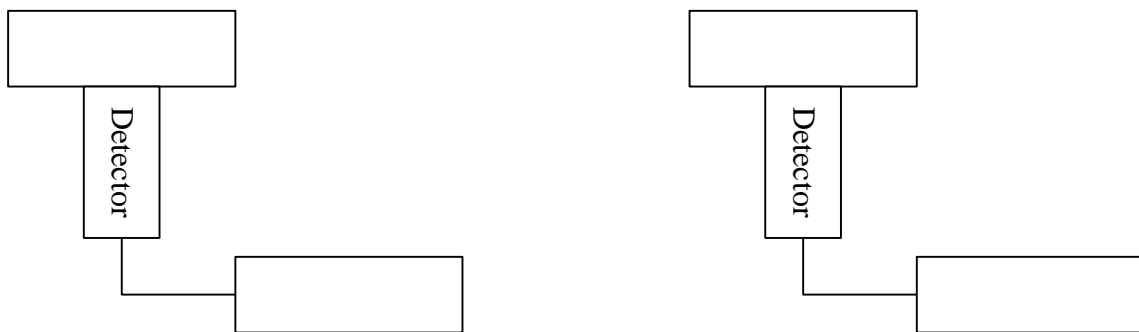
## 8.2 PEAK POWER

### 8.2.1 LIMIT

The maximum peak output power of the intentional radiator shall not exceed the following:

1. According to §15.247(b)(3), for systems using digital modulation in the bands of 2400-2483.5 MHz: 1 Watt.
2. According to §15.247(b)(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.

### Test Configuration



### 8.2.2 TEST PROCEDURE

The measurement set up as above setup diagram shall be used to determine on the oscilloscope the peak of the envelope of the output signal of the transmitter, the maximum deviation of the Y-trace of the oscilloscope shall be recorded as "B".

The transmitter shall be replaced by a signal generator. The output frequency of the signal shall be made equal to the centre of the frequency range occupied by the transmitter, The output power of the signal generator shall be raised to a level such that the deviation of the Y-trace of the oscilloscope reaches level B, this output power level "C" (in dBm) of the signal generator is the peak power.

Oscilloscope



### 8.2.3 TEST RESULTS

*No non-compliance noted.*

#### Test Data

Test mode: IEEE 802.11b mode					
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (dBm)	Result
1	2412	20.20	0.1047	30	PASS
6	2437	20.20	0.1047		PASS
11	2462	20.10	0.1023		PASS

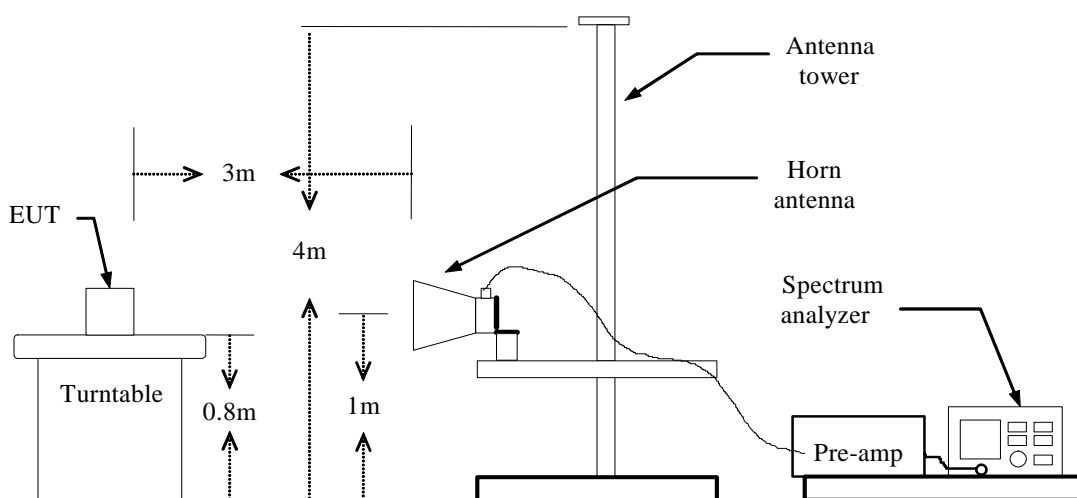
Test mode: IEEE 802.11g mode					
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (dBm)	Result
1	2412	22.00	0.1585	30	PASS
6	2437	21.50	0.1413		PASS
11	2462	20.30	0.1072		PASS

## 8.3 BAND EDGES MEASUREMENT

### 8.3.1 LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)).

#### Test Configuration



### 8.3.2 TEST PROCEDURE

1. The EUT is placed on a turntable, which is 0.8m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
  - (a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
  - (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

### 8.3.3 TEST RESULTS

Refer to attach spectrum analyzer data chart.



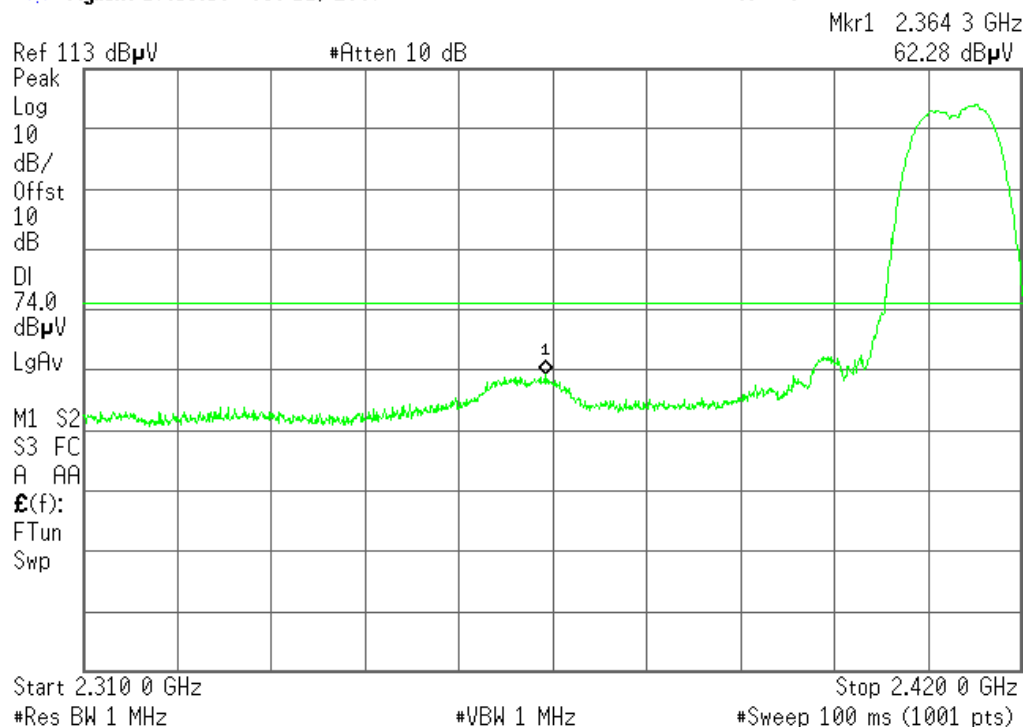
## Band Edges (IEEE 802.11b mode/ CH 1)

Detector mode: Peak

Polarity: Vertical

Agilent 17:53:56 Oct 11, 2007

R T

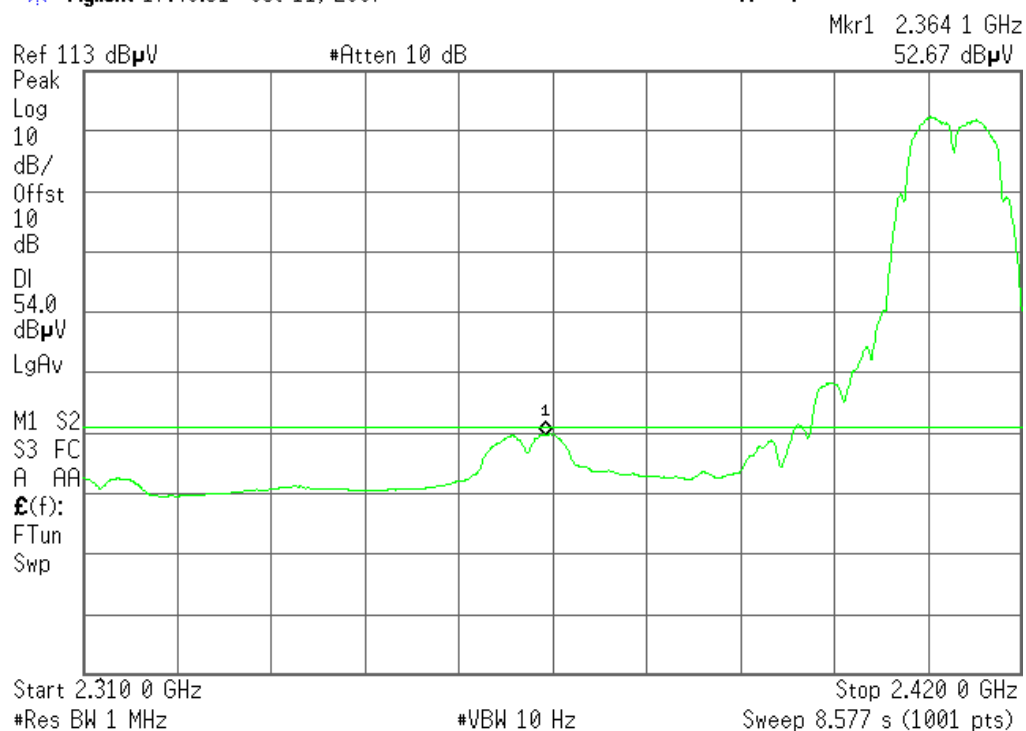


Detector mode: Average

Polarity: Vertical

Agilent 17:40:31 Oct 11, 2007

R T





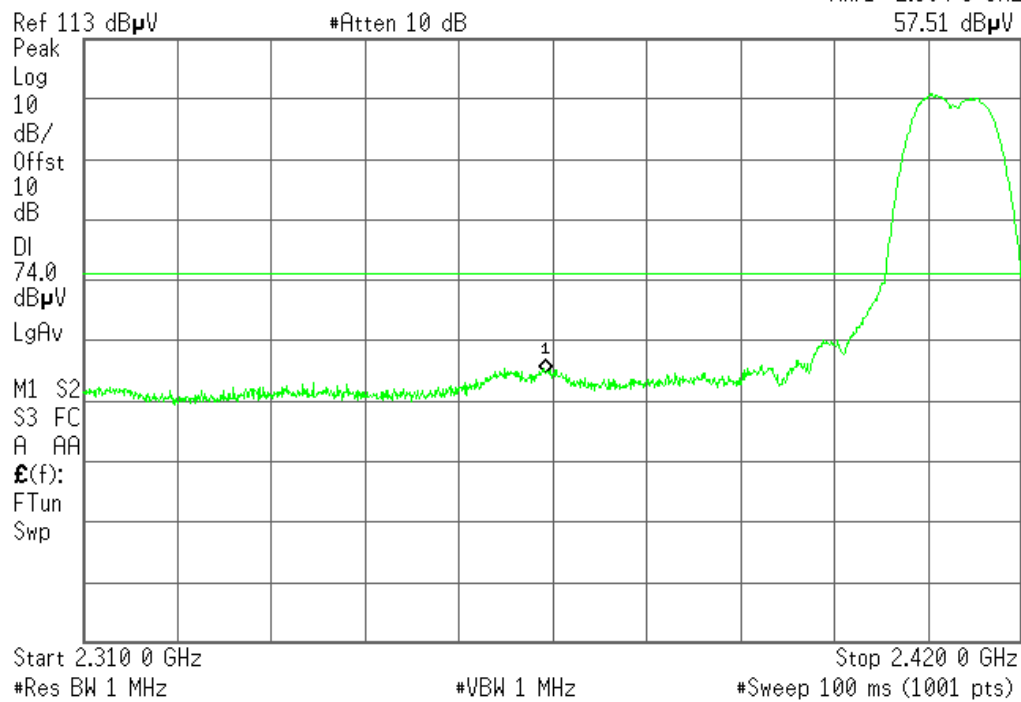
**Detector mode: Peak**

**Polarity: Horizontal**

Agilent 17:49:23 Oct 11, 2007

R T

Mkr1 2.364 3 GHz  
57.51 dB $\mu$ V



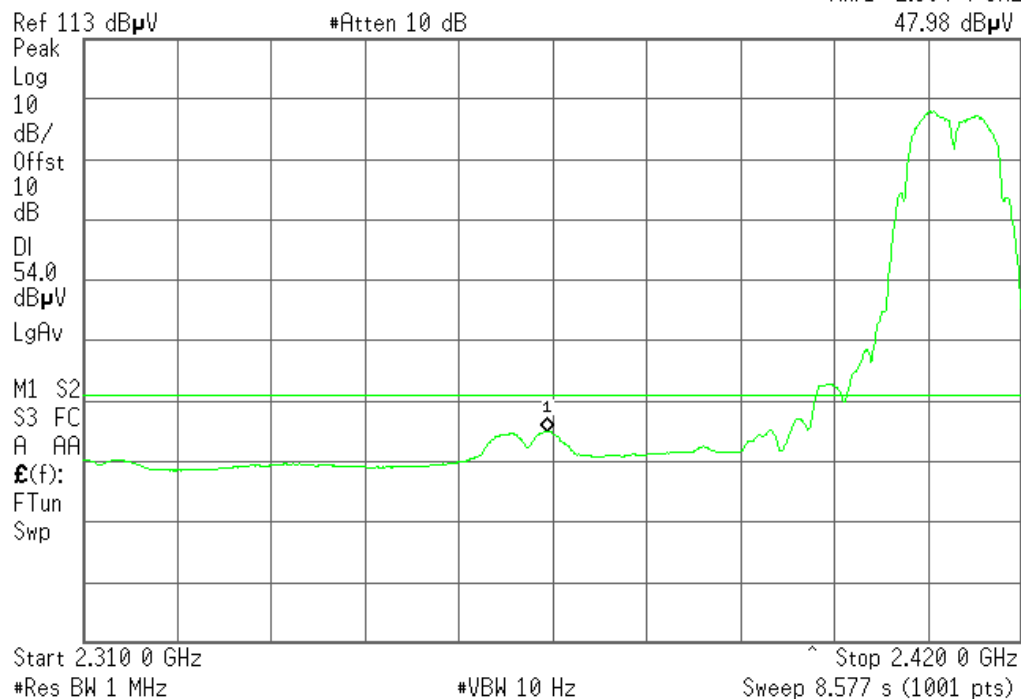
**Detector mode: Average**

**Polarity: Horizontal**

Agilent 17:48:54 Oct 11, 2007

R T

Mkr1 2.364 4 GHz  
47.98 dB $\mu$ V





## Band Edges (IEEE 802.11b mode/ CH 11)

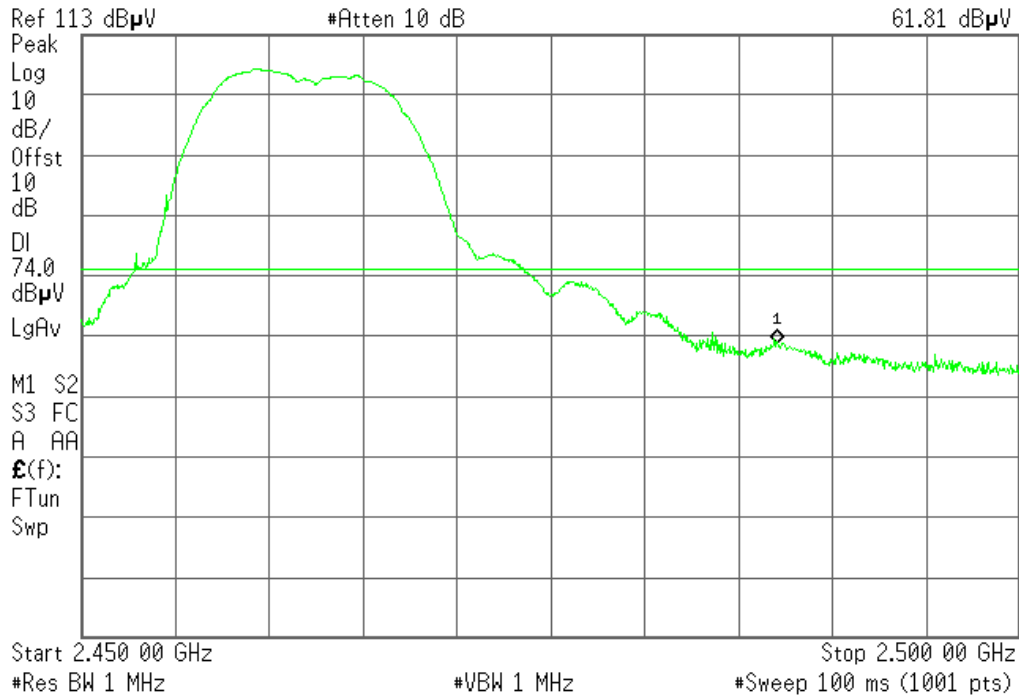
Detector mode: Peak

Polarity: Vertical

Agilent 18:38:33 Oct 11, 2007

R T

Mkr1 2.487 10 GHz  
61.81 dB $\mu$ V



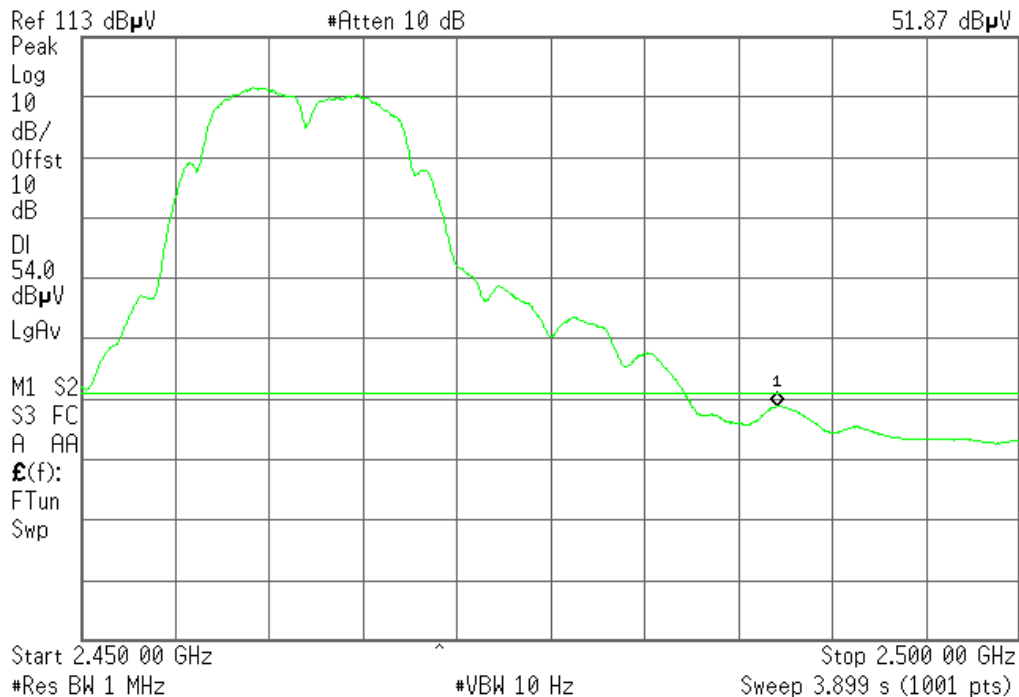
Detector mode: Average

Polarity: Vertical

Agilent 18:38:03 Oct 11, 2007

R T

Mkr1 2.487 10 GHz  
51.87 dB $\mu$ V





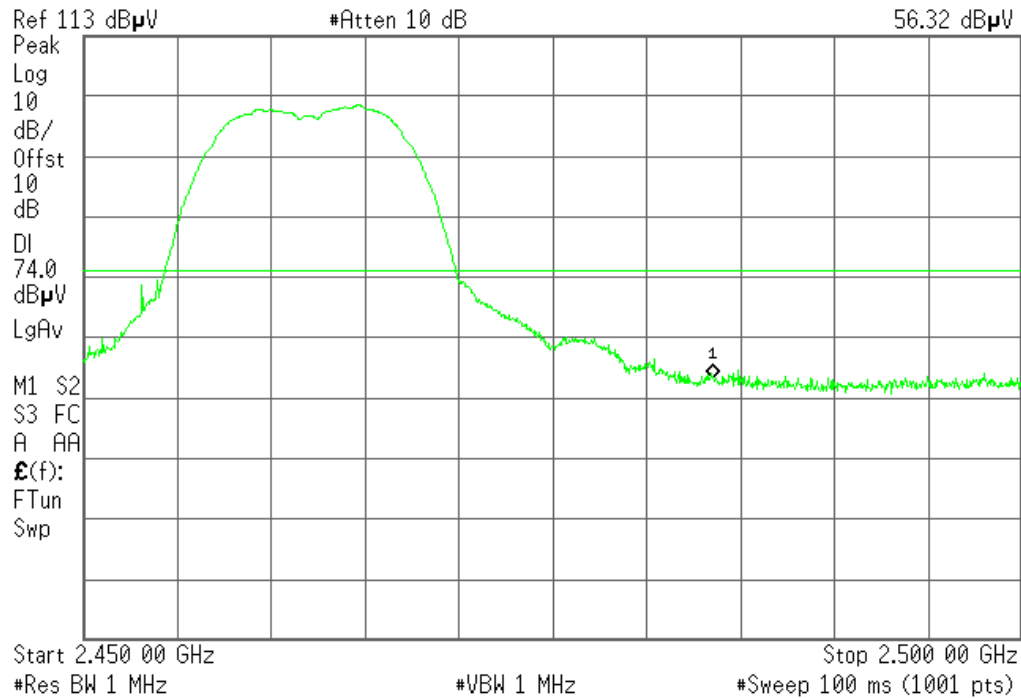
**Detector mode: Peak**

**Polarity: Horizontal**

Agilent 18:43:02 Oct 11, 2007

R T

Mkr1 2.483 50 GHz  
56.32 dB $\mu$ V



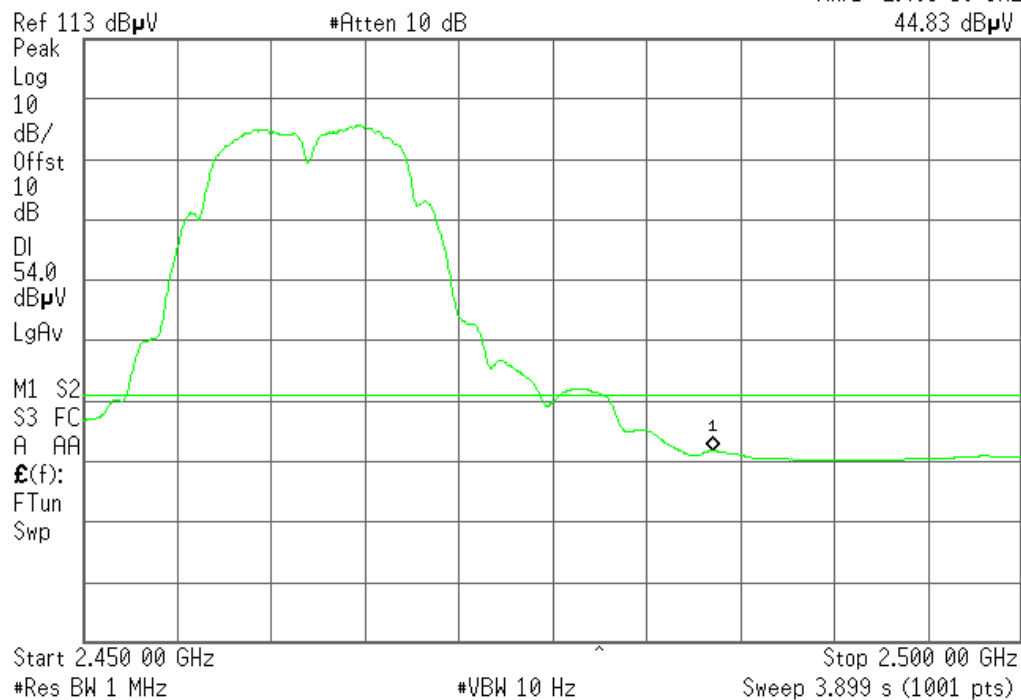
**Detector mode: Average**

**Polarity: Horizontal**

Agilent 18:43:26 Oct 11, 2007

R T

Mkr1 2.483 50 GHz  
44.83 dB $\mu$ V





## Band Edges (IEEE 802.11g mode / CH 1)

Detector mode: Peak

Polarity: Vertical

Agilent 19:52:04 Oct 11, 2007

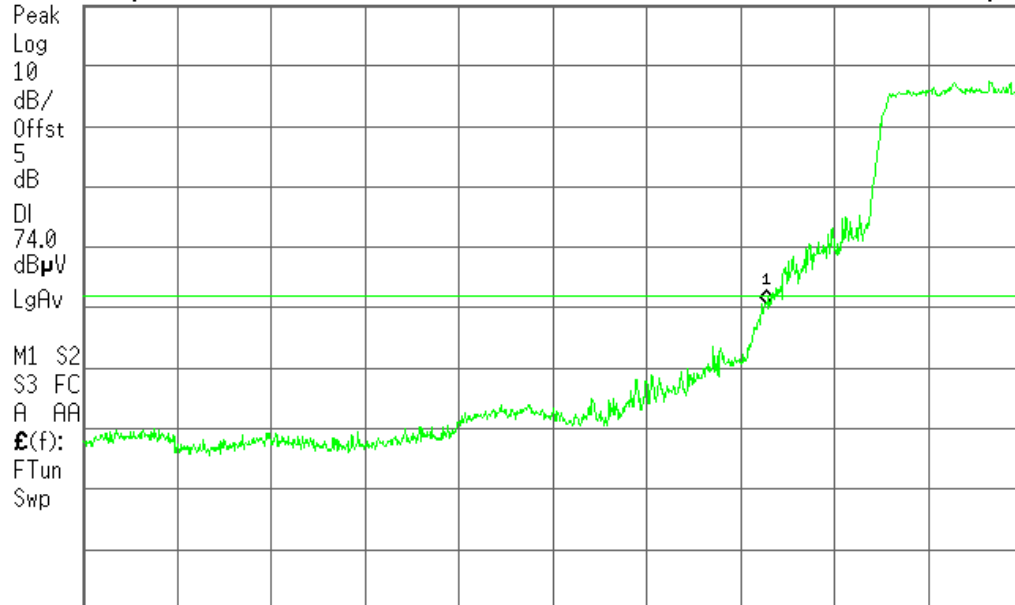
R T

Mkr1 2.390 0 GHz

72.57 dBμV

Ref 122 dBμV

#Atten 20 dB



Center 2.365 0 GHz

#Res BW 1 MHz

#VBW 1 MHz

Span 110 MHz

Sweep 1 ms (1001 pts)

Detector mode: Average

Polarity: Vertical

Agilent 19:51:08 Oct 11, 2007

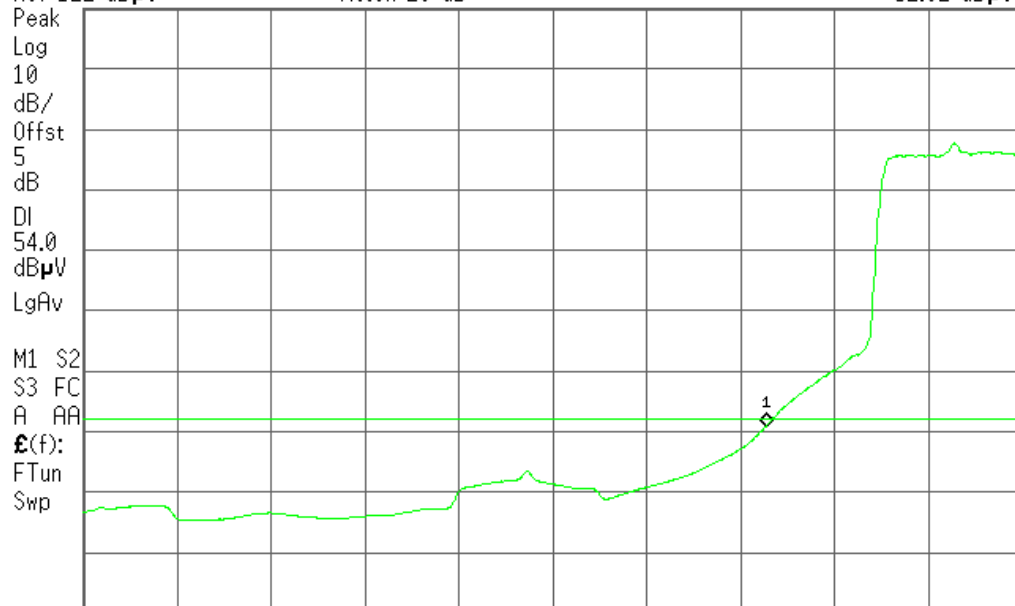
R T

Mkr1 2.390 0 GHz

52.82 dBμV

Ref 122 dBμV

#Atten 20 dB



Center 2.365 0 GHz ^

#Res BW 1 MHz

#VBW 10 Hz

Span 110 MHz

Sweep 8.577 s (1001 pts)



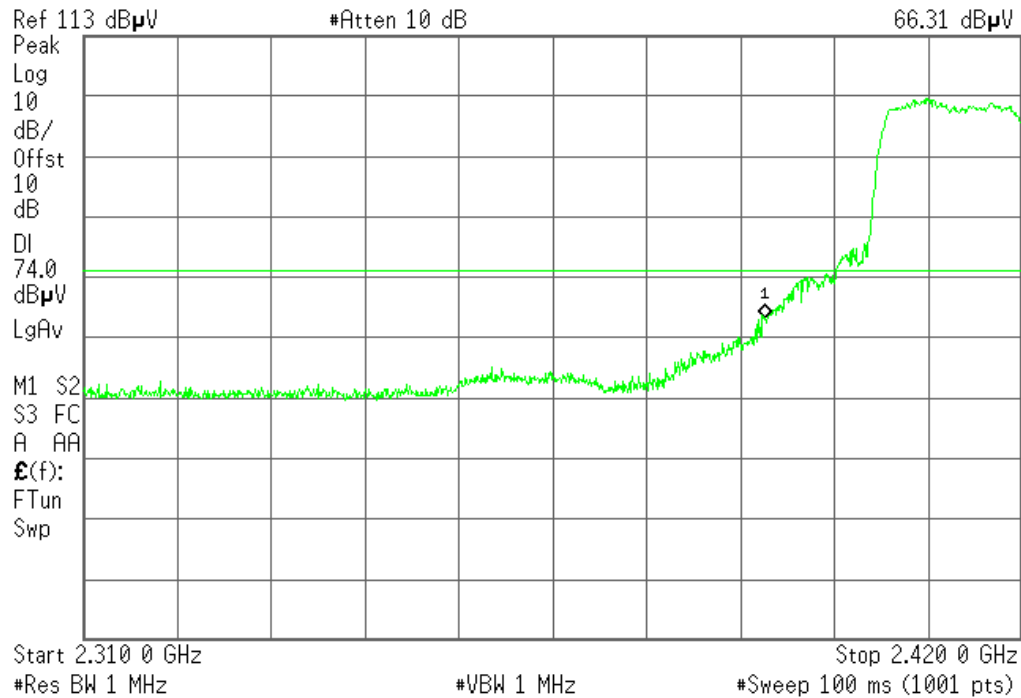
**Detector mode: Peak**

**Polarity: Horizontal**

Agilent 19:42:02 Oct 11, 2007

R T

Mkr1 2.389 9 GHz  
66.31 dB $\mu$ V



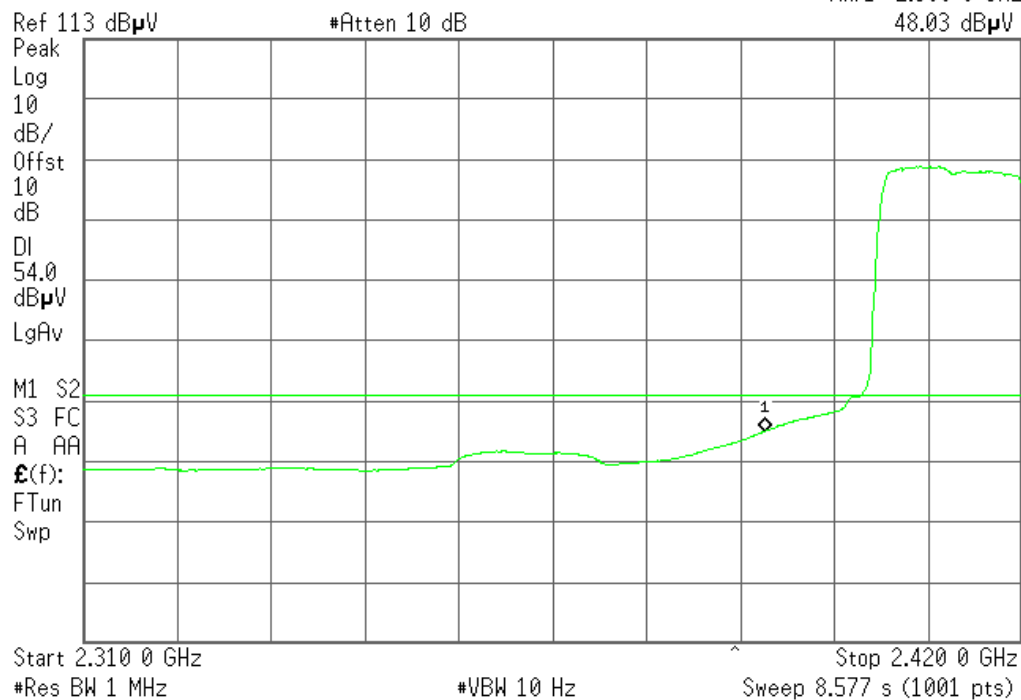
**Detector mode: Average**

**Polarity: Horizontal**

Agilent 19:45:07 Oct 11, 2007

R T

Mkr1 2.389 9 GHz  
48.03 dB $\mu$ V





## Band Edges (IEEE 802.11g mode / CH 11)

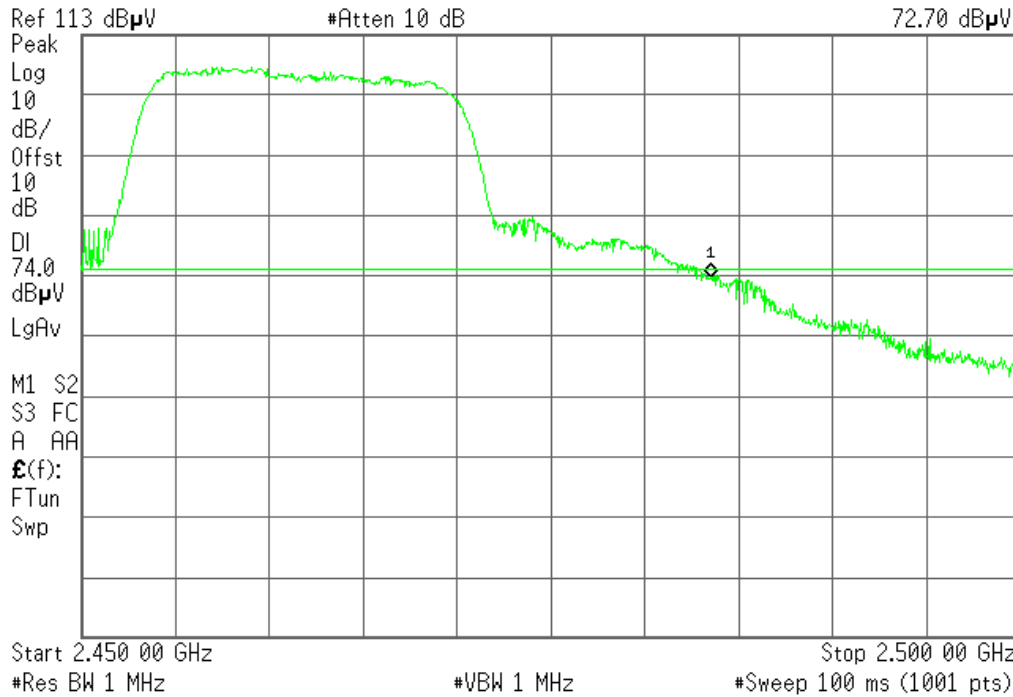
Detector mode: Peak

Polarity: Vertical

Agilent 18:51:48 Oct 11, 2007

R T

Mkr1 2.483 50 GHz  
72.70 dB $\mu$ V



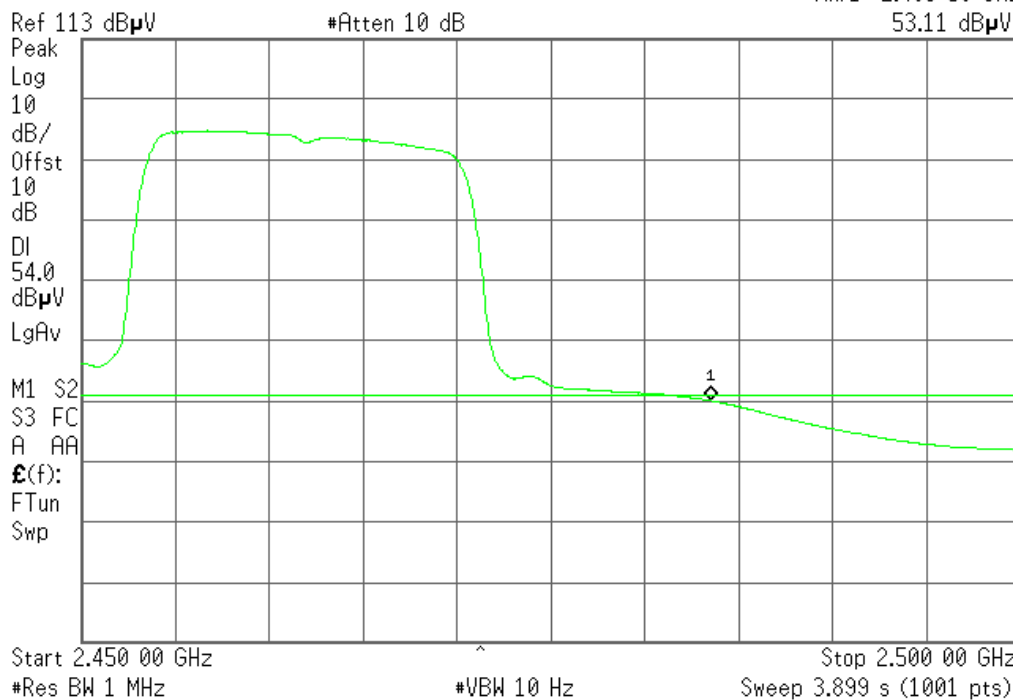
Detector mode: Average

Polarity: Vertical

Agilent 19:19:30 Oct 11, 2007

R T

Mkr1 2.483 50 GHz  
53.11 dB $\mu$ V





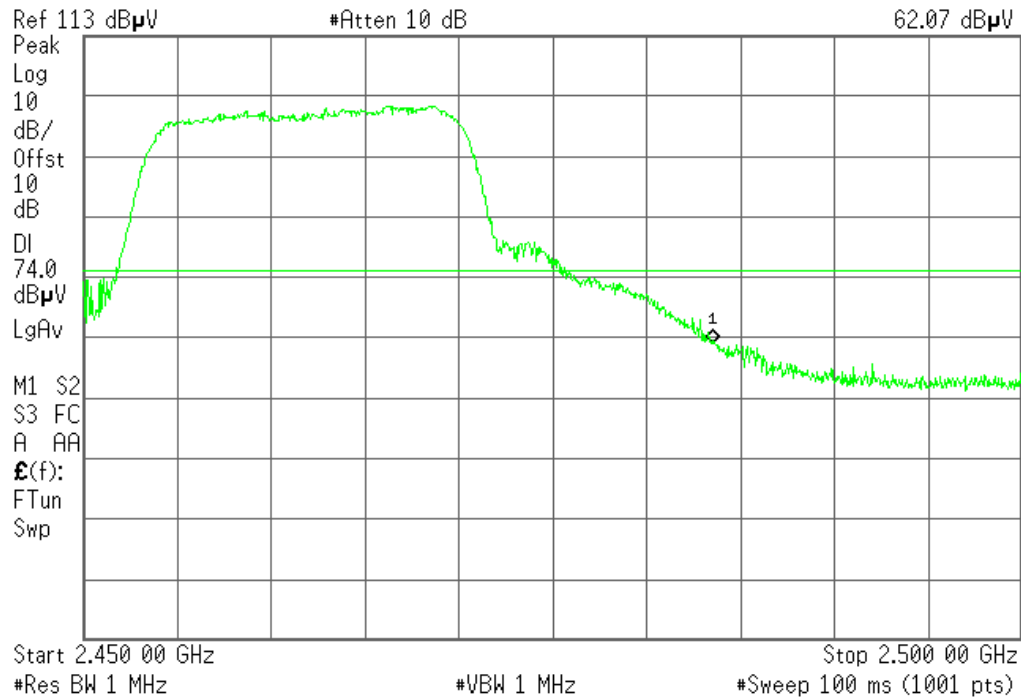
**Detector mode: Peak**

**Polarity: Horizontal**

Agilent 19:27:58 Oct 11, 2007

R T

Mkr1 2.483 50 GHz  
62.07 dB $\mu$ V



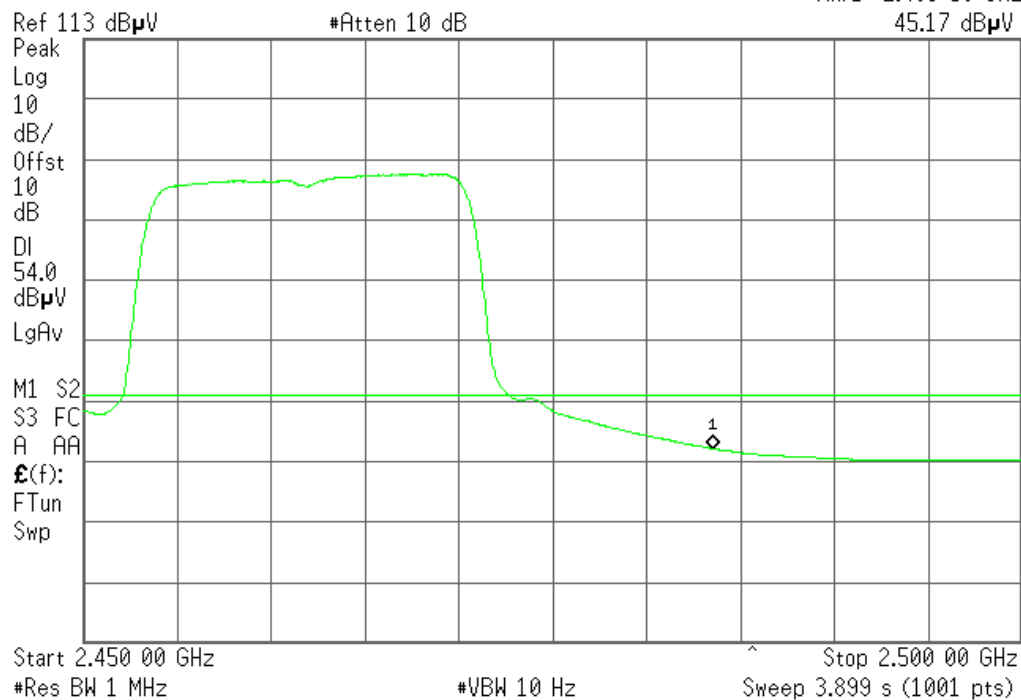
**Detector mode: Average**

**Polarity: Horizontal**

Agilent 19:28:22 Oct 11, 2007

R T

Mkr1 2.483 50 GHz  
45.17 dB $\mu$ V



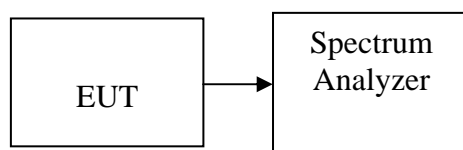


## **8.4 PEAK POWER SPECTRAL DENSITY**

### **8.4.1 LIMIT**

1. According to §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.
2. According to §15.247(f), the digital modulation operation of the hybrid system, with the frequency hopping turned off, shall comply with the power density requirements of paragraph (d) of this section.

### **Test Configuration**



### **8.4.2 TEST PROCEDURE**

1. Place the EUT on the table and set it in transmitting mode.  
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set the spectrum analyzer as RBW = 3kHz, VBW = 10kHz, Span = 300kHz, Sweep=100s.
3. Record the max. reading.
4. Repeat the above procedure until the measurements for all frequencies are completed.



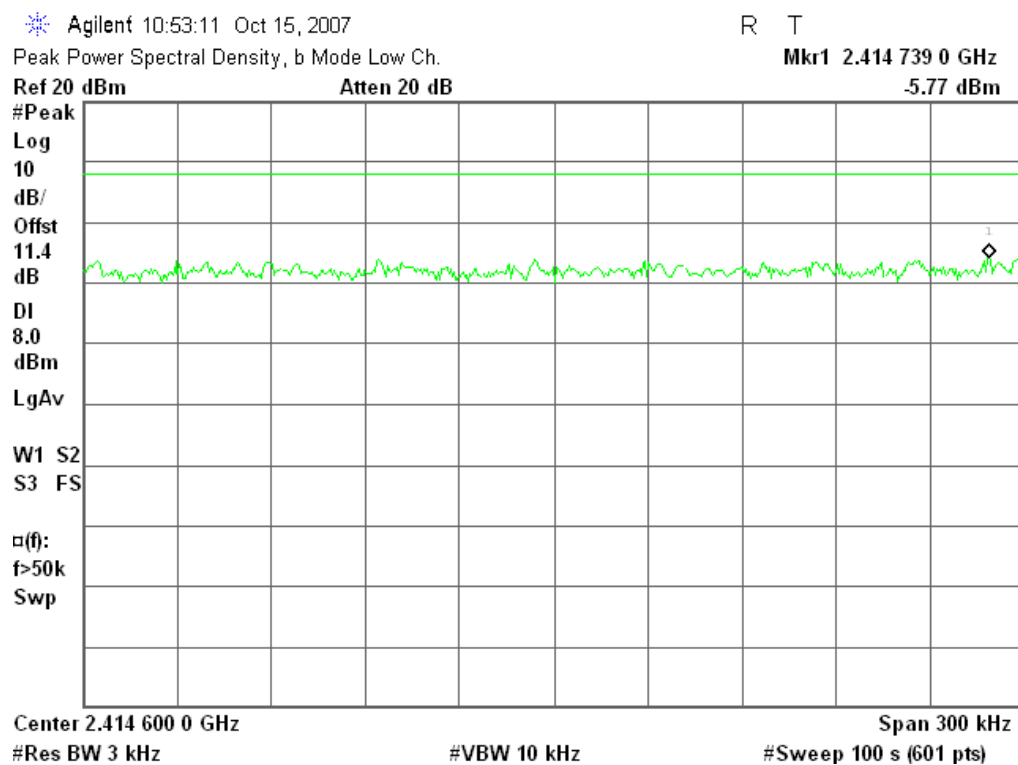
## 8.4.3 TEST RESULTS

*No non-compliance noted*

### Test Data

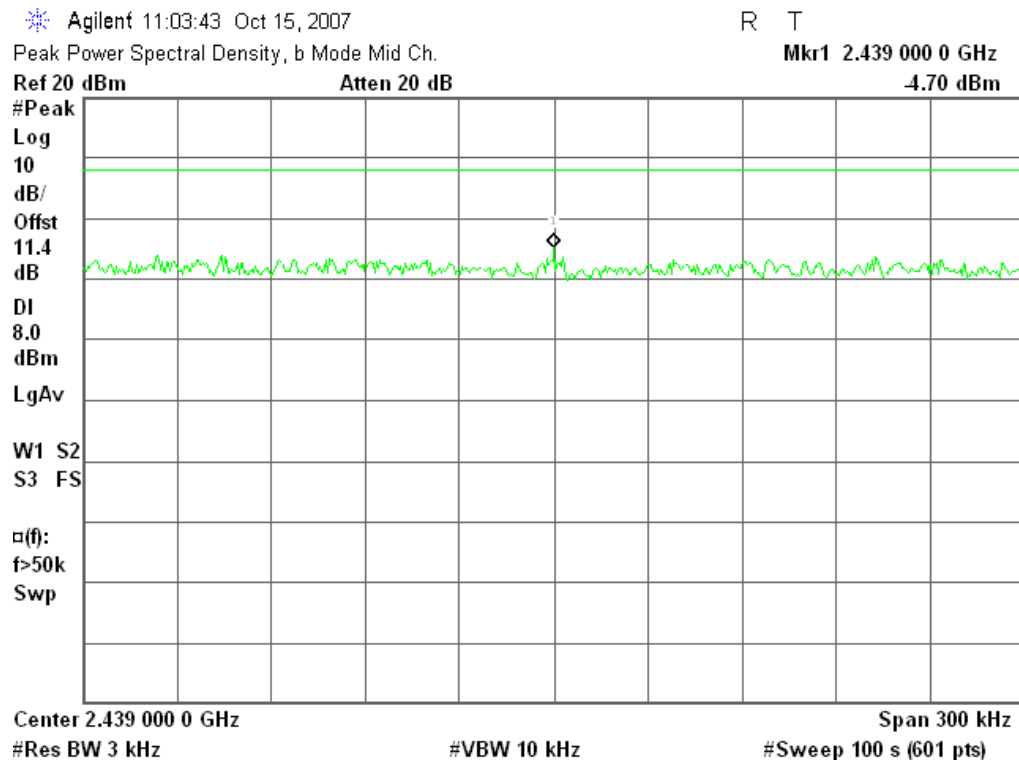
Test mode: IEEE 802.11b mode				
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
1	2412	-5.77	8.00	PASS
6	2437	-4.70		PASS
11	2462	-5.74		PASS

### PPSD (CH 1)

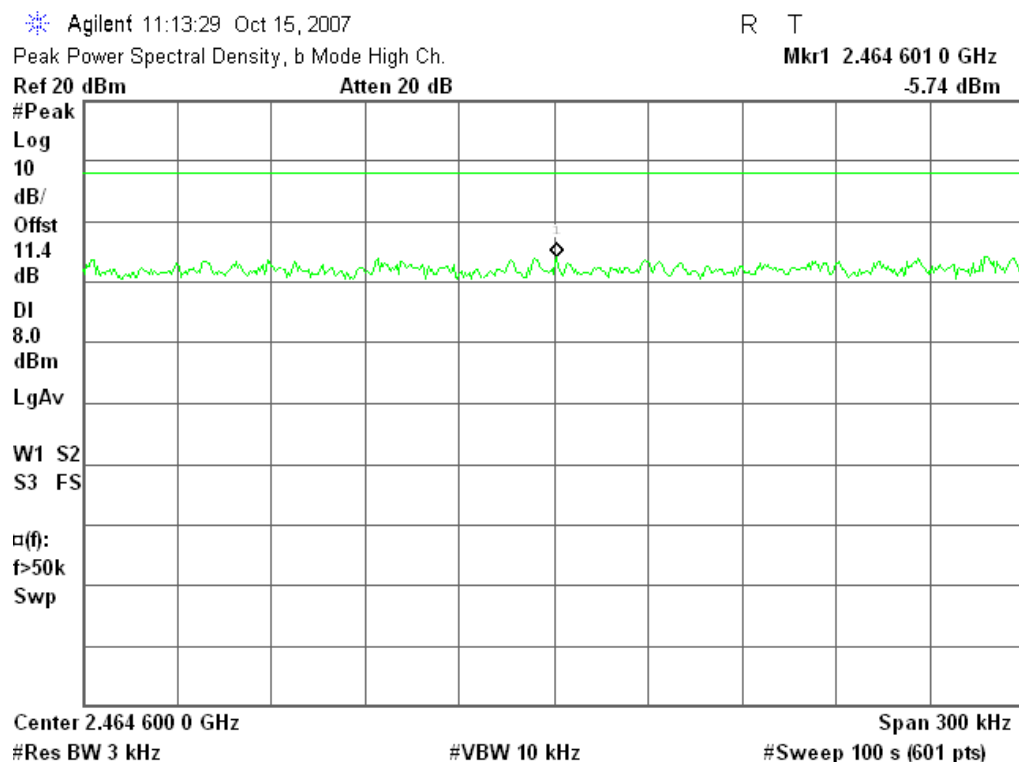




## PPSD (CH 6)



## PPSD (CH 11)

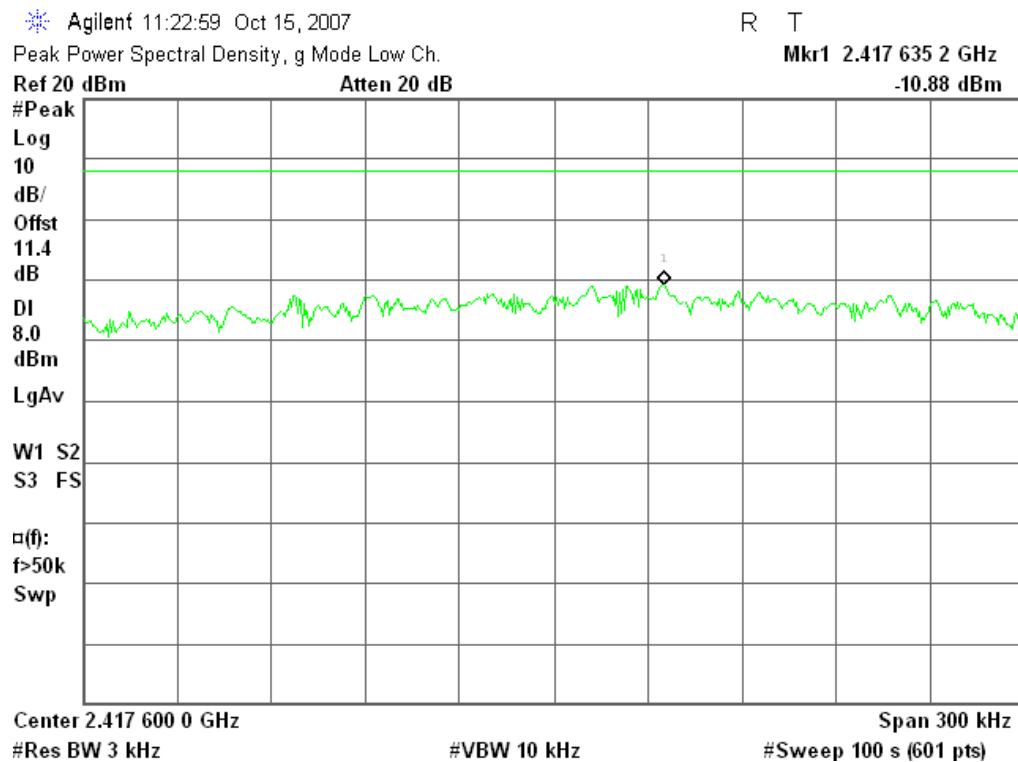




## Test Data

Test mode: IEEE 802.11g mode				
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
1	2412	-10.88	8.00	PASS
6	2437	-9.85		PASS
11	2462	-5.44		PASS

## PPSD (CH 1)





## PPSD (CH 6)

Agilent 11:30:08 Oct 15, 2007

R T

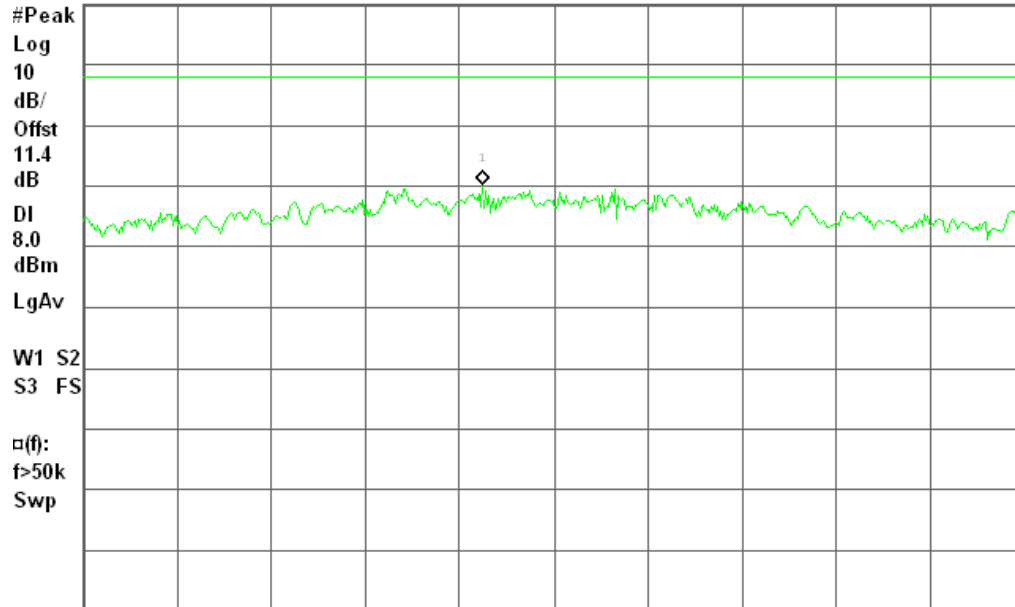
Peak Power Spectral Density, g Mode Mid Ch.

Mkr1 2.441 977 4 GHz

Ref 20 dBm

Atten 20 dB

-9.85 dBm



Center 2.442 000 0 GHz

Span 300 kHz

#Res BW 3 kHz

#VBW 10 kHz

#Sweep 100 s (601 pts)

## PPSD (CH 11)

Agilent 11:42:34 Oct 15, 2007

R T

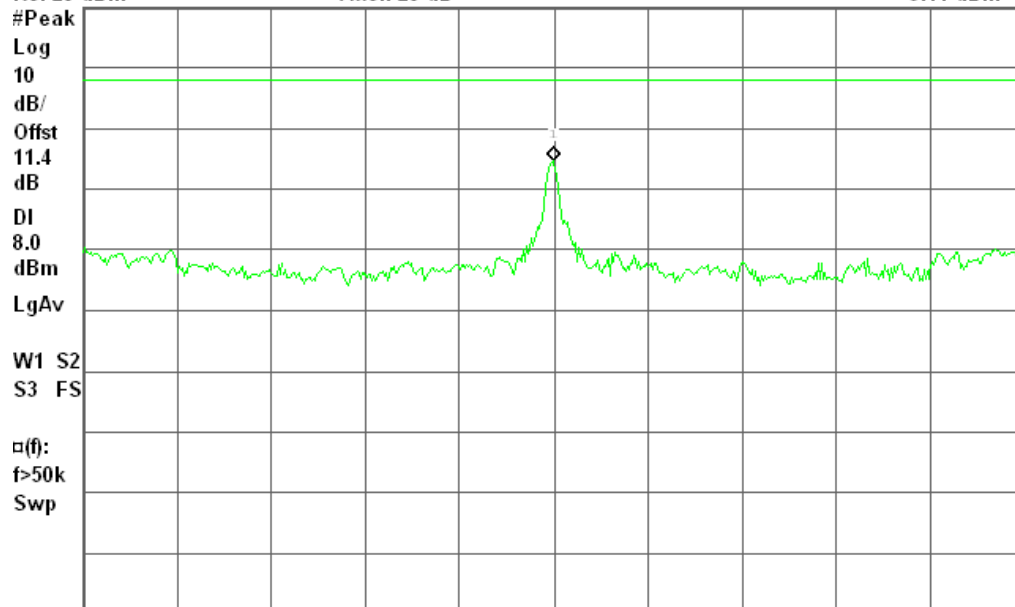
Peak Power Spectral Density, g Mode High Ch.

Mkr1 2.461 999 5 GHz

Ref 20 dBm

Atten 20 dB

-5.44 dBm



Center 2.462 000 0 GHz

Span 300 kHz

#Res BW 3 kHz

#VBW 10 kHz

#Sweep 100 s (601 pts)



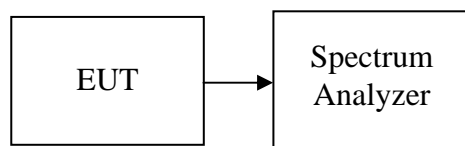
## 8.5 SPURIOUS EMISSIONS

### 8.5.1 CONDUCTED MEASUREMENT

#### 8.5.1.1 LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)).

#### Test Configuration



#### 8.5.1.2 TEST PROCEDURE

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 100 & 300kHz.

Measurements are made over the 30MHz to 26GHz range for IEEE 802.11b/g, 30MHz to 40GHz range for IEEE 802.11a with the transmitter set to the lowest, middle, and highest channels.

#### 8.5.1.3 TEST RESULTS

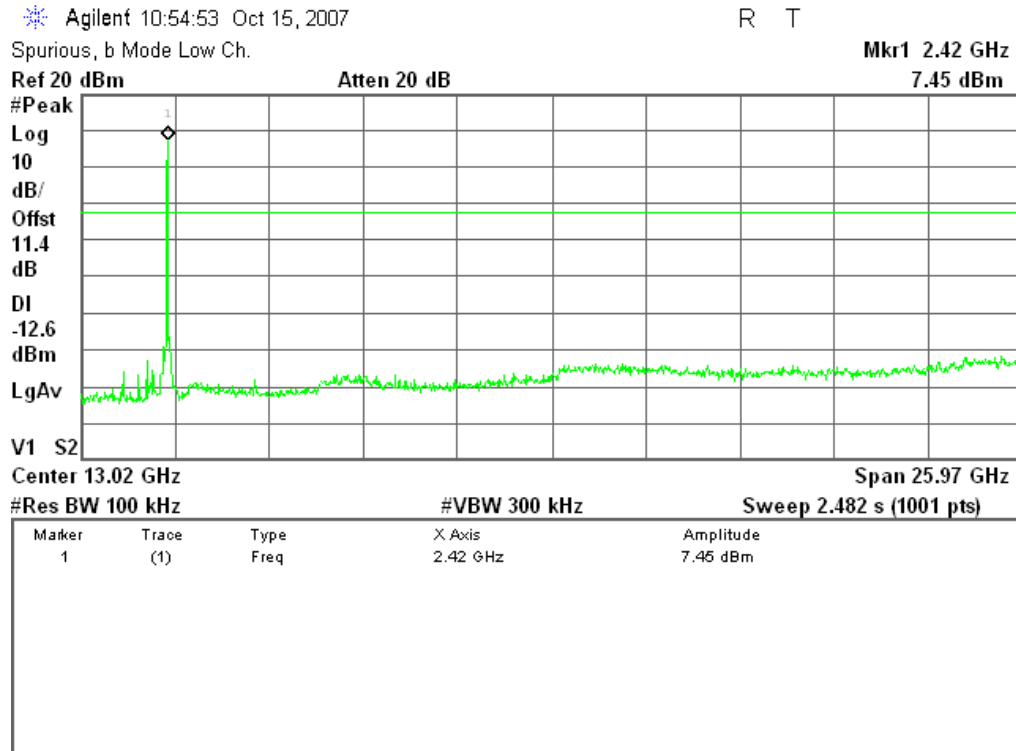
*No non-compliance noted.*



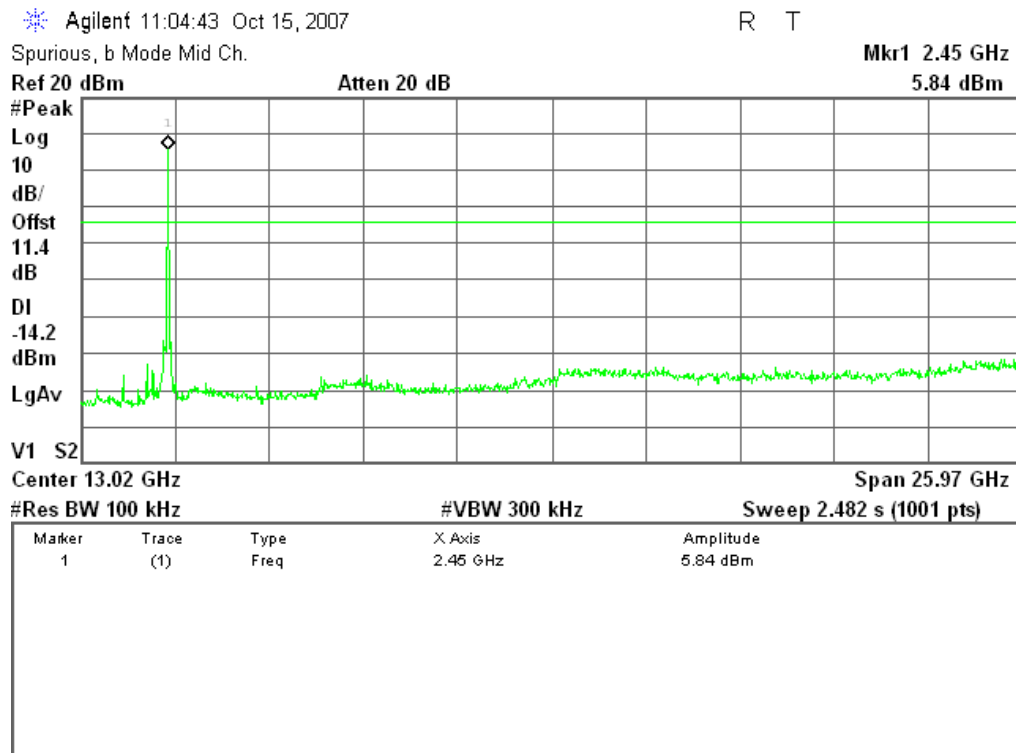
## Test Plot

### IEEE 802.11b mode

### SPURIOUS EMISSIONS (CH 1)



### SPURIOUS EMISSIONS (CH 6)



**SPURIOUS EMISSIONS (CH 11)**

Agilent 10:44:55 Oct 5, 2007

R T

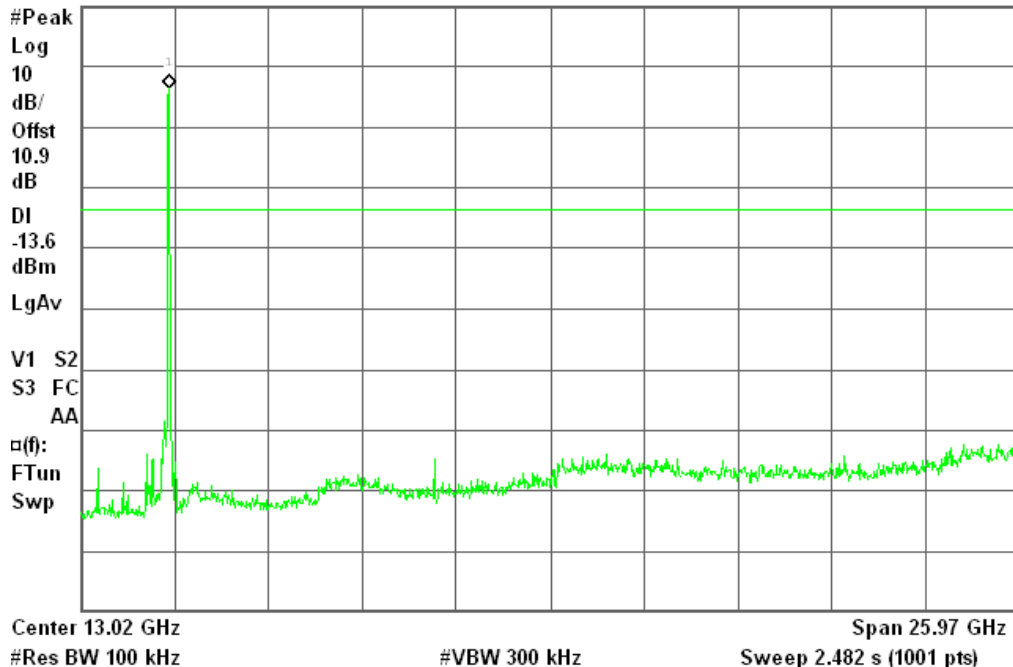
Spurious, b Mode High Ch.

Mkr1 2.47 GHz

Ref 20 dBm

Atten 20 dB

6.24 dBm

**IEEE 802.11g mode****SPURIOUS EMISSIONS (CH 1)**

Agilent 11:25:02 Oct 15, 2007

R T

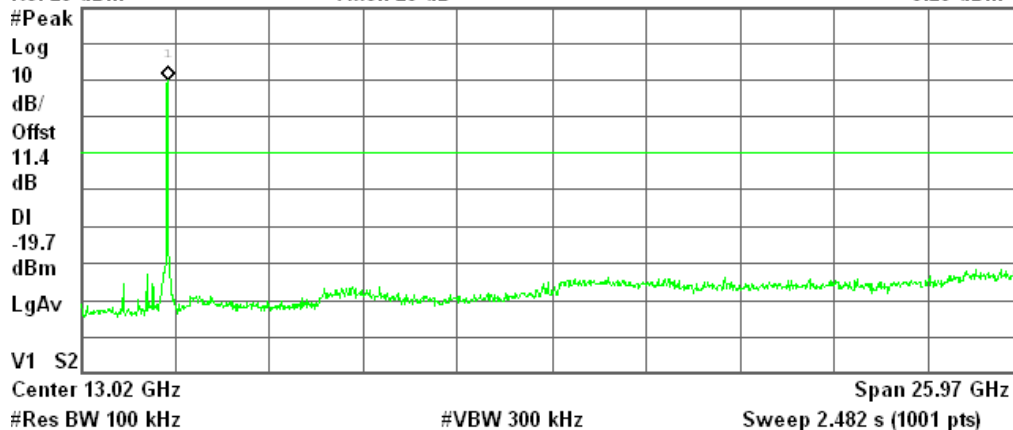
Spurious, g Mode Low Ch.

Mkr1 2.42 GHz

Ref 20 dBm

Atten 20 dB

0.28 dBm



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.42 GHz	0.28 dBm

**SPURIOUS EMISSIONS (CH 6)**

Agilent 11:31:21 Oct 15, 2007

R T

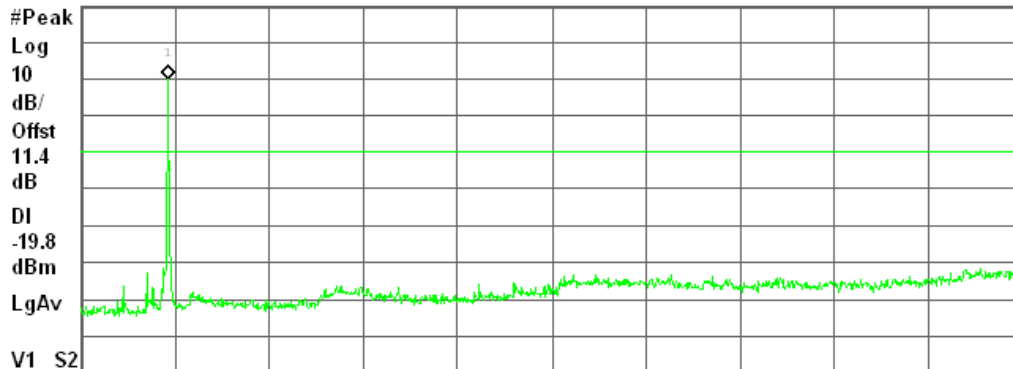
Spurious, g Mode Mid Ch.

Mkr1 2.45 GHz

Ref 20 dBm

Atten 20 dB

0.23 dBm



Center 13.02 GHz

Span 25.97 GHz

#Res BW 100 kHz

#VBW 300 kHz

Sweep 2.482 s (1001 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.45 GHz	0.23 dBm

**SPURIOUS EMISSIONS (CH 11)**

Agilent 11:43:29 Oct 15, 2007

R T

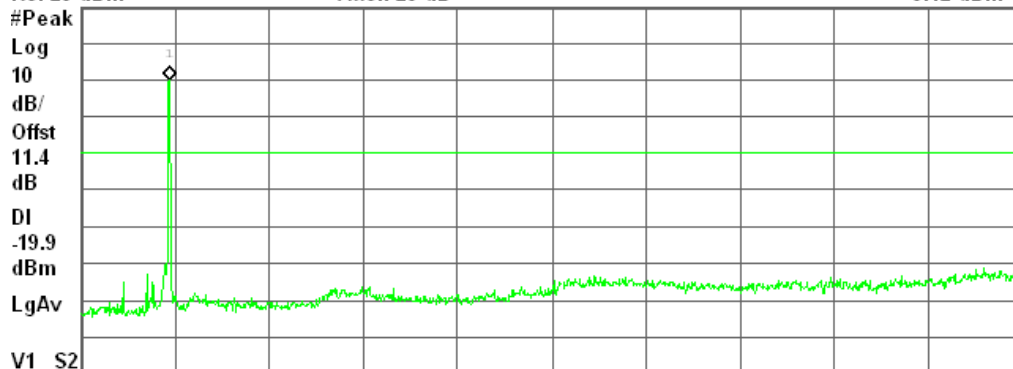
Spurious, g Mode High Ch.

Mkr1 2.47 GHz

Ref 20 dBm

Atten 20 dB

0.12 dBm



Center 13.02 GHz

Span 25.97 GHz

#Res BW 100 kHz

#VBW 300 kHz

Sweep 2.482 s (1001 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.47 GHz	0.12 dBm

## 8.5.2 RADIATED EMISSIONS

### 8.5.2.1 LIMIT - ABOVE 1000 MHZ

1. 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:

Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ )	Measurement Distance (m)
Above 960	500	3

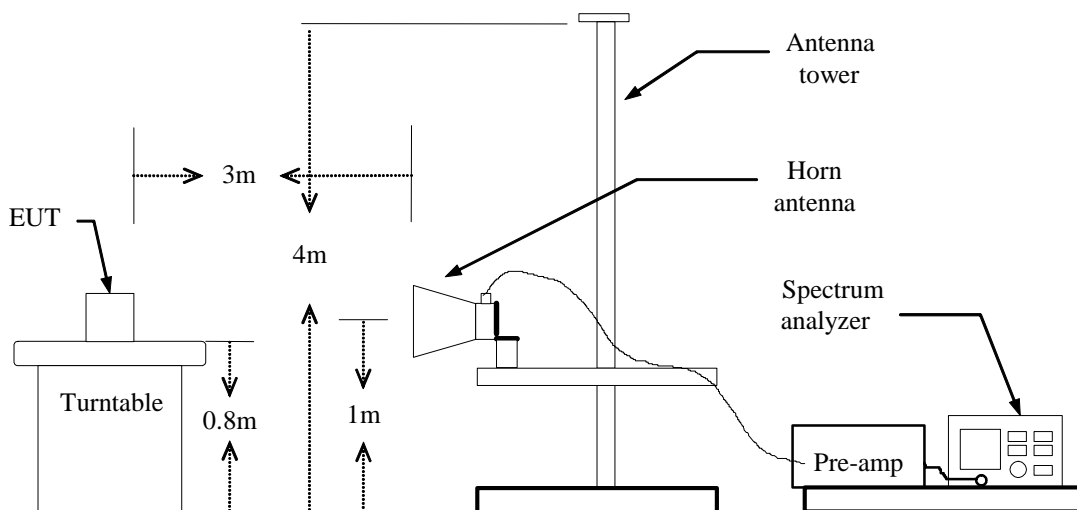
**Remark:** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections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

2. In the above emission table, the tighter limit applies at the band edges.

Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ at 3-meter)	Field Strength (dB $\mu\text{V/m}$ at 3-meter)
Above 960	500	54

### Test Configuration

#### Above 1000 MHz





### **8.5.2.2 TEST PROCEDURE**

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:  
Above 1000 MHz:
  - (a) PEAK: RBW=VBW=1MHz / Sweep=AUTO
  - (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
7. Repeat above procedures until the measurements for all frequencies are complete.



### 8.5.2.3 TEST RESULTS

*No non-compliance noted*

#### Above 1000 MHz

**Operation Mode:** Tx / IEEE 802.11b mode / CH 1

**Temperature:** 23°C

**Humidity:** 51% RH

**Test Mode:** Worst case / Power Adapter (1)

**Test Date:** October 12, 2007

**Tested by:** Jerry Chang

**Polarity:** Ver. / Hor.

Vertical polarity									
Freq. (MHz)	Reading-PK (dBuV)	Reading-AV (dBuV)	Correction Factor (dB/m)	Result-PK (dBuV/m)	Result-AV (dBuV/m)	Limit-PK (dBuV/m)	Limit-AV (dBuV/m)	Margin (dB)	Mark (PK/QP/AV)
3210.00	45.87	38.37	4.70	50.57	43.07	74.00	54.00	-10.93	AV
4830.00	49.40	45.17	8.30	57.70	53.47	74.00	54.00	-0.53	AV
Horizontal polarity									
Freq. (MHz)	Reading-PK (dBuV)	Reading-AV (dBuV)	Correction Factor (dB/m)	Result-PK (dBuV/m)	Result-AV (dBuV/m)	Limit-PK (dBuV/m)	Limit-AV (dBuV/m)	Margin (dB)	Mark (PK/QP/AV)
4830.00	44.97	38.38	8.30	53.27	46.68	74.00	54.00	-7.32	AV

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Peak Remark result (dBuV/m) – Peak limit (dBuV/m) or Average Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** Tx / IEEE 802.11b mode / CH 6**Temperature:** 23°C**Humidity:** 51% RH**Test Mode:** Worst case / Power Adapter (1)**Test Date:** October 12, 2007**Tested by:** Jerry Chang**Polarity:** Ver. / Hor.

Vertical polarity									
Freq. (MHz)	Reading-PK (dBuV)	Reading-AV (dBuV)	Correction Factor (dB/m)	Result-PK (dBuV/m)	Result-AV (dBuV/m)	Limit-PK (dBuV/m)	Limit-AV (dBuV/m)	Margin (dB)	Mark (PK/QP/ AV)
3255.00	44.50	37.47	4.82	49.32	42.29	74.00	54.00	-11.71	AV
4875.00	48.36	45.12	8.42	56.78	53.54	74.00	54.00	-0.46	AV
Horizontal polarity									
Freq. (MHz)	Reading-PK (dBuV)	Reading-AV (dBuV)	Correction Factor (dB/m)	Result-PK (dBuV/m)	Result-AV (dBuV/m)	Limit-PK (dBuV/m)	Limit-AV (dBuV/m)	Margin (dB)	Mark (PK/QP/ AV)
4875.00	43.87	37.85	8.42	52.29	46.27	74.00	54.00	-7.73	AV

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Peak Remark result (dBuV/m) – Peak limit (dBuV/m) or  
Average Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** Tx / IEEE 802.11b mode / CH 11**Test Date:** October 12, 2007**Temperature:** 23°C**Tested by:** Jerry Chang**Humidity:** 51% RH**Polarity:** Ver. / Hor.**Test Mode:** Worst case / Power Adapter (1)

Vertical polarity									
Freq. (MHz)	Reading-PK (dBuV)	Reading-AV (dBuV)	Correction Factor (dB/m)	Result-PK (dBuV/m)	Result-AV (dBuV/m)	Limit-PK (dBuV/m)	Limit-AV (dBuV/m)	Margin (dB)	Mark (PK/QP/ AV)
3285.00	45.86	40.52	4.91	50.77	45.43	74.00	54.00	-8.57	AV
4920.00	47.43	43.89	8.53	55.96	52.42	74.00	54.00	-1.58	AV
Horizontal polarity									
Freq. (MHz)	Reading-PK (dBuV)	Reading-AV (dBuV)	Correction Factor (dB/m)	Result-PK (dBuV/m)	Result-AV (dBuV/m)	Limit-PK (dBuV/m)	Limit-AV (dBuV/m)	Margin (dB)	Mark (PK/QP/ AV)
4920.00	44.38	39.63	8.53	52.91	48.16	74.00	54.00	-5.84	AV

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Peak Remark result (dBuV/m) – Peak limit (dBuV/m) or  
Average Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** Tx / IEEE 802.11g mode / CH 1**Test Date:** October 12, 2007**Temperature:** 23°C**Tested by:** Jerry Chang**Humidity:** 51% RH**Polarity:** Ver. / Hor.**Test Mode:** Worst case / Power Adapter (1)

Vertical polarity									
Freq. (MHz)	Reading-PK (dBuV)	Reading-AV (dBuV)	Correction Factor (dB/m)	Result-PK (dBuV/m)	Result-AV (dBuV/m)	Limit-PK (dBuV/m)	Limit-AV (dBuV/m)	Margin (dB)	Mark (PK/QP/AV)
3210.00	42.58	37.66	4.70	47.28	42.36	74.00	54.00	-11.64	AV
4815.00	41.22	29.71	8.26	49.48	37.97	74.00	54.00	-16.03	AV
Horizontal polarity									
Freq. (MHz)	Reading-PK (dBuV)	Reading-AV (dBuV)	Correction Factor (dB/m)	Result-PK (dBuV/m)	Result-AV (dBuV/m)	Limit-PK (dBuV/m)	Limit-AV (dBuV/m)	Margin (dB)	Mark (PK/QP/AV)
3210.00	41.38	36.85	4.70	46.08	41.55	74.00	54.00	-12.45	AV

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Peak Remark result (dBuV/m) – Peak limit (dBuV/m) or Average Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** Tx / IEEE 802.11g mode/ CH 6**Test Date:** October 12, 2007**Temperature:** 23°C**Tested by:** Jerry Chang**Humidity:** 51% RH**Polarity:** Ver. / Hor.**Test Mode:** Worst case / Power Adapter (1)

Vertical polarity									
Freq. (MHz)	Reading-PK (dBuV)	Reading-AV (dBuV)	Correction Factor (dB/m)	Result-PK (dBuV/m)	Result-AV (dBuV/m)	Limit-PK (dBuV/m)	Limit-AV (dBuV/m)	Margin (dB)	Mark (PK/QP/ AV)
3255.00	42.38	34.88	4.82	47.20	39.70	74.00	54.00	-14.30	AV
4875.00	41.87	33.25	8.42	50.29	41.67	74.00	54.00	-12.33	AV
Horizontal polarity									
Freq. (MHz)	Reading-PK (dBuV)	Reading-AV (dBuV)	Correction Factor (dB/m)	Result-PK (dBuV/m)	Result-AV (dBuV/m)	Limit-PK (dBuV/m)	Limit-AV (dBuV/m)	Margin (dB)	Mark (PK/QP/ AV)
3255.00	41.22	34.68	4.82	46.04	39.50	74.00	54.00	-14.50	AV

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Peak Remark result (dBuV/m) – Peak limit (dBuV/m) or  
Average Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** Tx / IEEE 802.11g mode/ CH 11**Test Date:** October 12, 2007**Temperature:** 23°C**Tested by:** Jerry Chang**Humidity:** 51% RH**Polarity:** Ver. / Hor.**Test Mode:** Worst case / Power Adapter (1)

Vertical polarity									
Freq. (MHz)	Reading-PK (dBuV)	Reading-AV (dBuV)	Correction Factor (dB/m)	Result-PK (dBuV/m)	Result-AV (dBuV/m)	Limit-PK (dBuV/m)	Limit-AV (dBuV/m)	Margin (dB)	Mark (PK/QP/ AV)
3285.00	43.68	36.52	4.91	48.59	41.43	74.00	54.00	-12.57	AV
Horizontal polarity									
Freq. (MHz)	Reading-PK (dBuV)	Reading-AV (dBuV)	Correction Factor (dB/m)	Result-PK (dBuV/m)	Result-AV (dBuV/m)	Limit-PK (dBuV/m)	Limit-AV (dBuV/m)	Margin (dB)	Mark (PK/QP/ AV)
3285.00	42.11	35.21	4.91	47.02	40.12	74.00	54.00	-13.88	AV

**Remark:**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Peak Remark result (dBuV/m) – Peak limit (dBuV/m) or  
Average Remark result (dBuV/m) – Average limit (dBuV/m).

### 8.5.2.4 LIMIT - BELOW 1000 MHZ

- 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:

Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ )	Measurement Distance (m)
0.009 – 0.490	2400/F (kHz)	300
0.490 – 1.706	24000/F (kHz)	30
1.705 – 30.0	30	30
30-88	100*	3
88-216	150*	3
216-960	200*	3

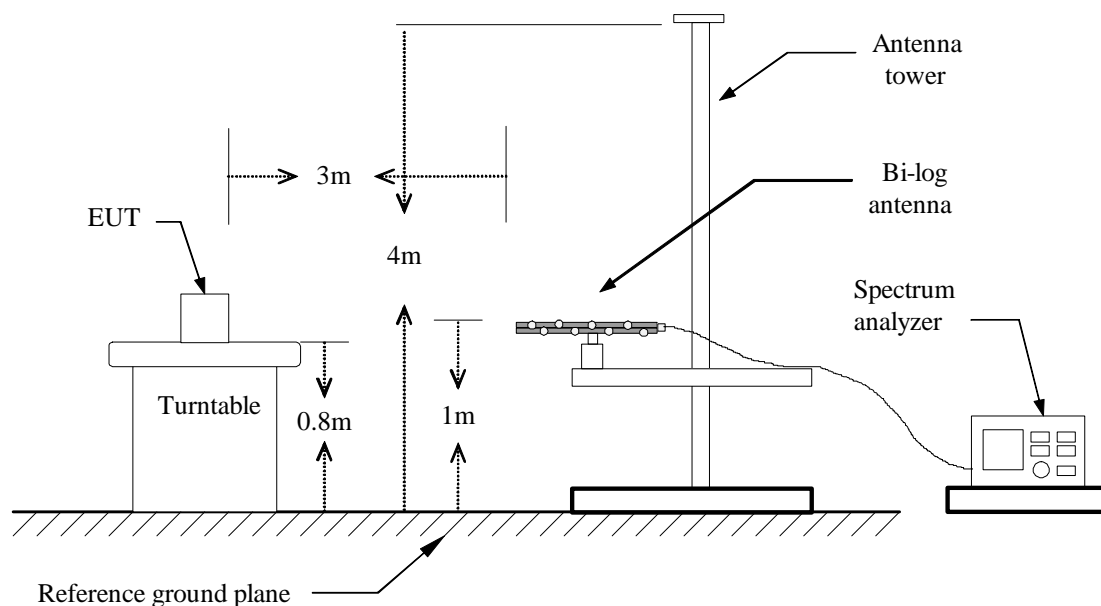
**Remark:** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections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

- In the above emission table, the tighter limit applies at the band edges.

Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ at 3-meter)	Field Strength (dB $\mu\text{V/m}$ at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46

### Test Configuration

#### Below 1000 MHz





### **8.5.2.5 TEST PROCEDURE**

1. The EUT is placed on a turntable, which is 0.8m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:  
Below 1000 MHz:  
RBW=100kHz / VBW=300kHz / Sweep=AUTO
7. Repeat above procedures until the measurements for all frequencies are complete.



## 8.5.2.6 TEST RESULTS

### Below 1000 MHz

**Operation Mode:** Worst case / Power Adapter (1)**Temperature:** 22°C**Humidity:** 51% RH**Test Date:** October 05, 2007**Tested by:** Jerry Chang**Polarity:** Ver. / Hor.

Vertical polarity						
Frequency (MHz)	Reading (dBμV)	Correction Factor (dB/m)	Result (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Mark (PK/QP/AV)
101.78	54.17	-17.52	36.65	43.50	-6.85	PK
143.49	51.62	-13.63	37.99	43.50	-5.51	PK
239.52	55.00	-14.84	40.16	46.00	-5.84	PK
359.80	52.64	-11.93	40.71	46.00	-5.29	PK
480.08	45.04	-10.18	34.87	46.00	-11.13	PK
719.67	41.00	-5.47	35.53	46.00	-10.47	PK
Horizontal polarity						
Frequency (MHz)	Reading (dBμV)	Correction Factor (dB/m)	Result (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Mark (PK/QP/AV)
165.80	50.87	-13.56	37.31	43.50	-6.19	PK
239.52	51.14	-14.84	36.30	46.00	-9.70	PK
359.80	50.35	-11.93	38.42	46.00	-7.58	PK
418.00	48.94	-11.12	37.82	46.00	-8.18	PK
480.08	45.98	-10.18	35.81	46.00	-10.19	PK
719.67	40.76	-5.47	35.28	46.00	-10.72	PK

**Remark:**

1. Measuring frequencies from 30 MHz to the 1GHz.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. Margin (dB) = Remark result (dBuV/m) – Quasi-peak limit (dBuV/m).



## 8.6 POWERLINE CONDUCTED EMISSIONS

### 8.6.1 LIMIT

According to §15.207(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  $\mu$ H/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.

Frequency Range (MHz)	Limits (dB $\mu$ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

\* Decreases with the logarithm of the frequency.

### Test Configuration

See test photographs attached in Appendix II for the actual connections between EUT and support equipment.

### 8.6.2 TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.



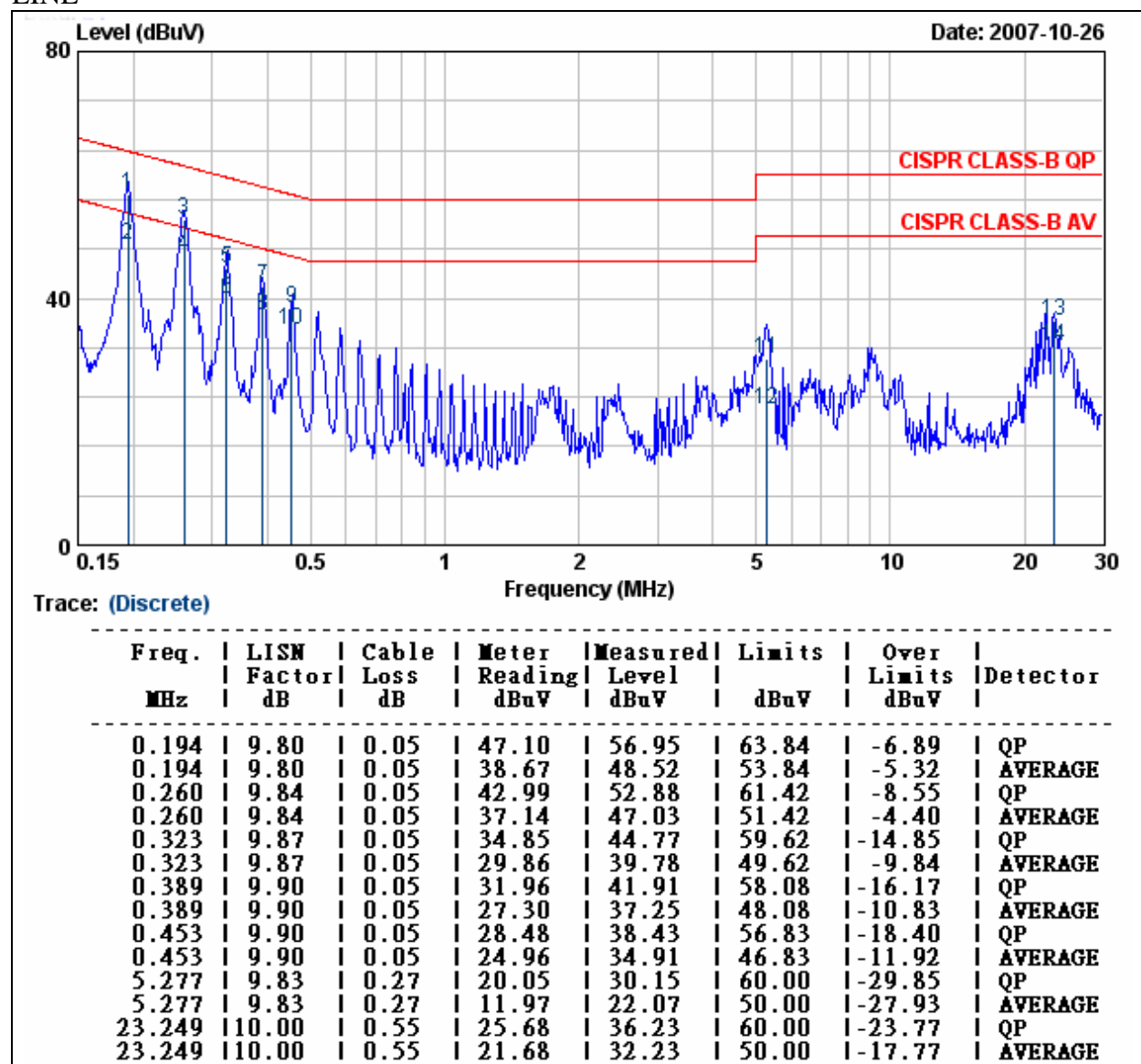
### 8.6.3 TEST RESULTS

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

#### Test Data

**Operation Mode:** Power Adapter (1)      **Test Date:** October 26, 2007  
**Temperature:** 23.5°C      **Tested by:** Jerry Chang  
**Humidity:** 58% RH

#### LINE



#### Remark:

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)
2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (1)

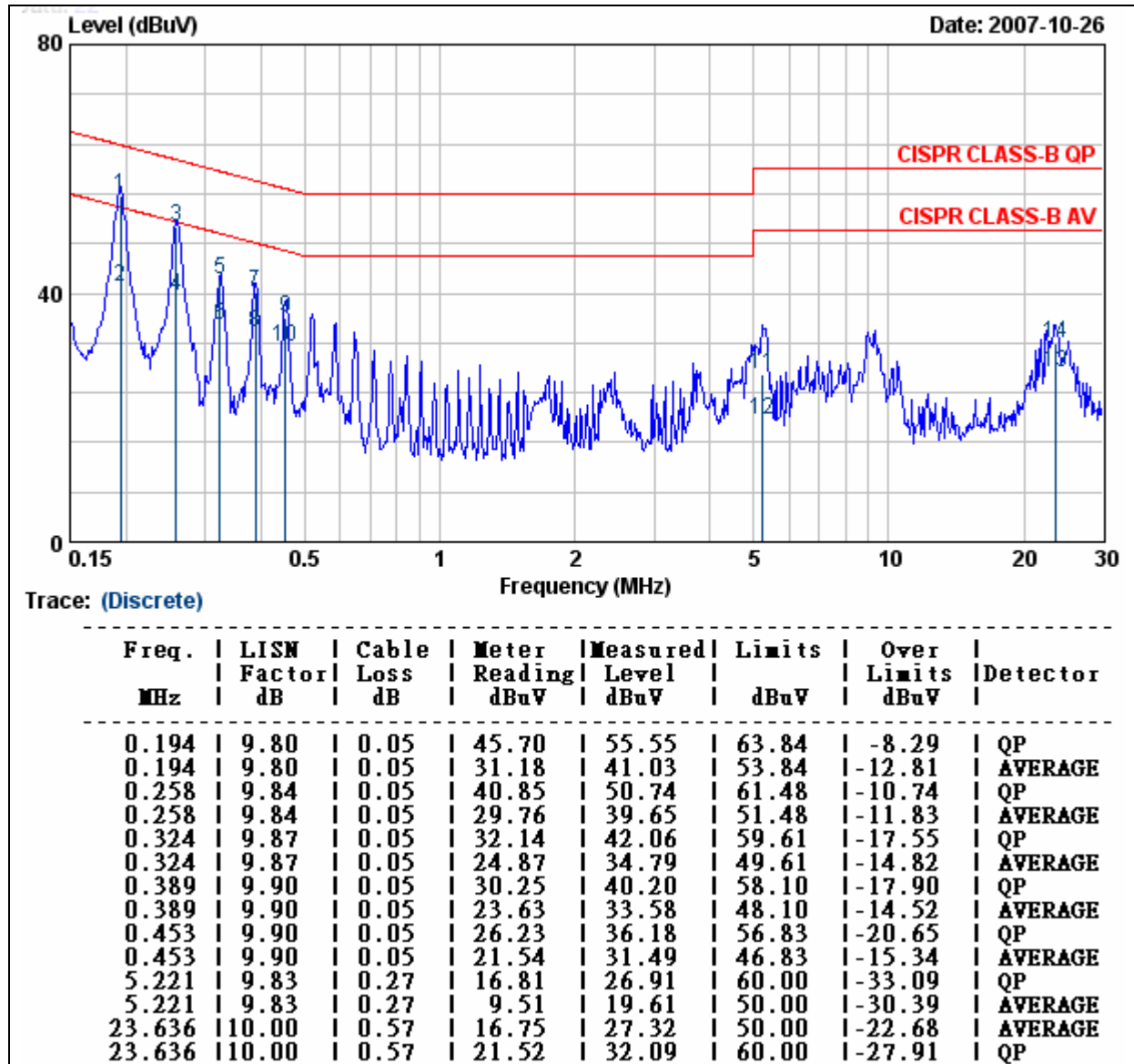
Test Date: October 26, 2007

Temperature: 23.5°C

Tested by: Jerry Chang

Humidity: 58% RH

NEUTRAL



Remark:

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)

2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (2)

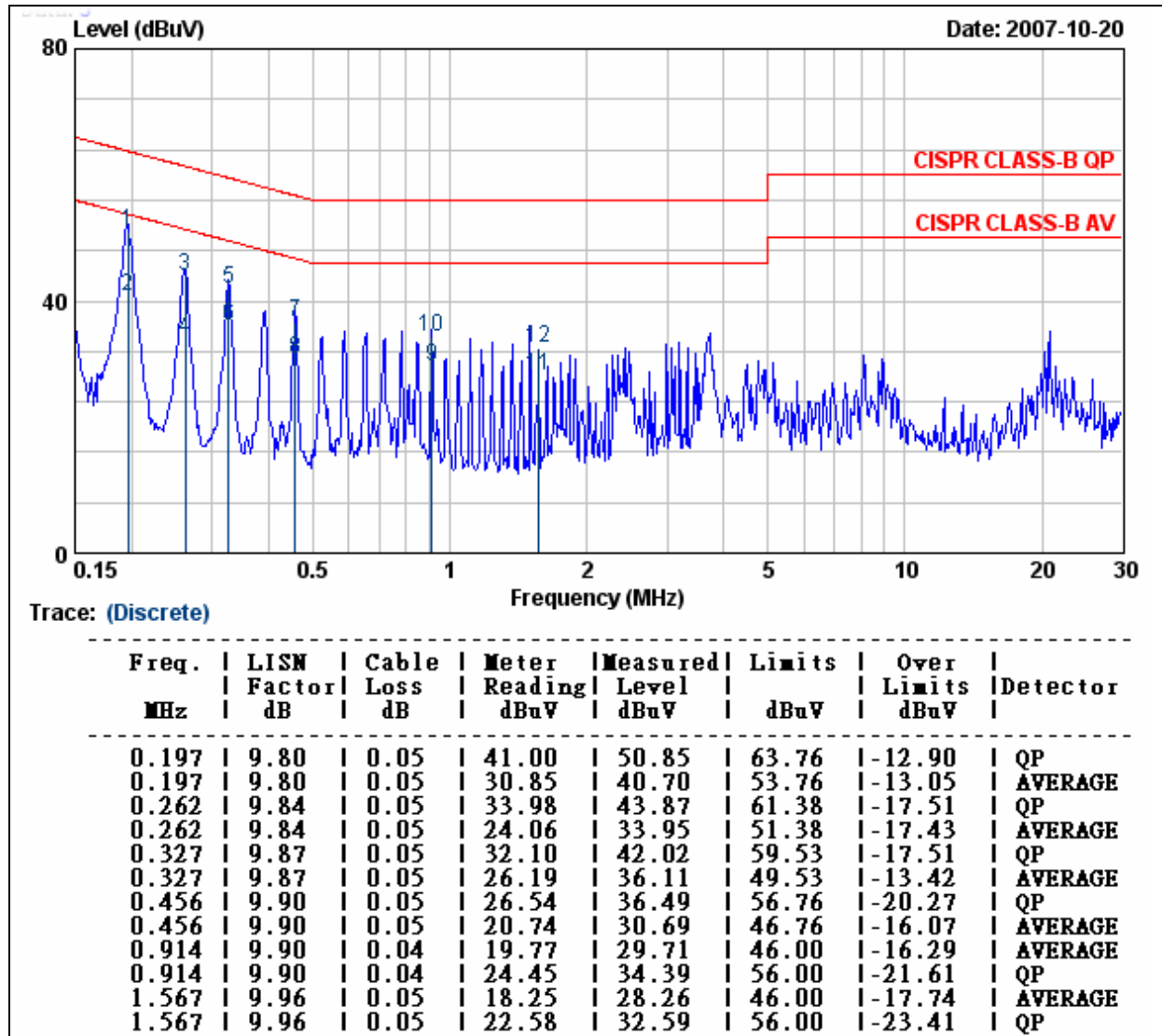
Test Date: October 20, 2007

Temperature: 23.8°C

Tested by: Jerry Chang

Humidity: 55% RH

## LINE



## Remark:

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)

2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (2)

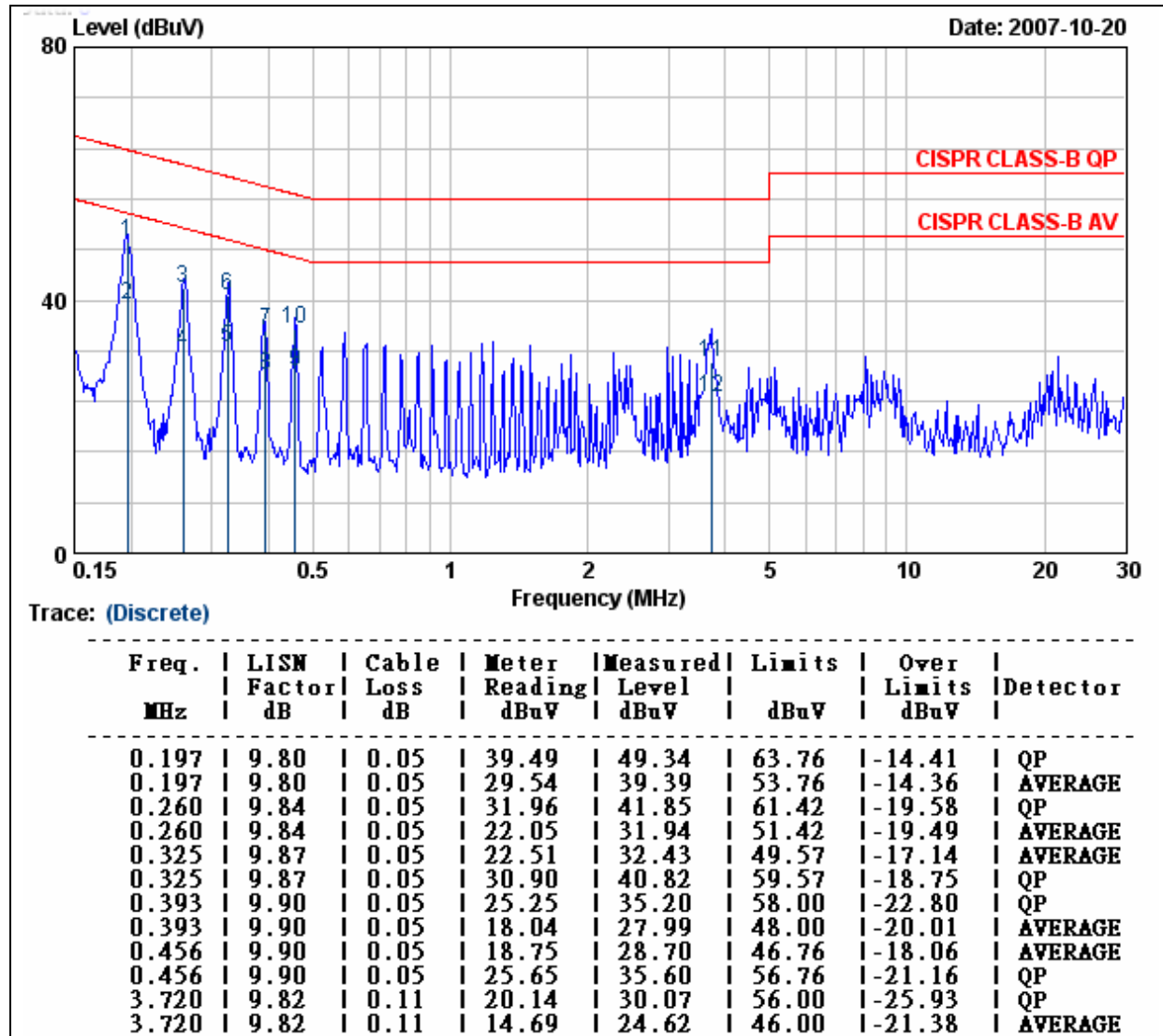
Test Date: October 20, 2007

Temperature: 23.8°C

Tested by: Jerry Chang

Humidity: 55% RH

## NEUTRAL



## Remark:

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)

2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (3)

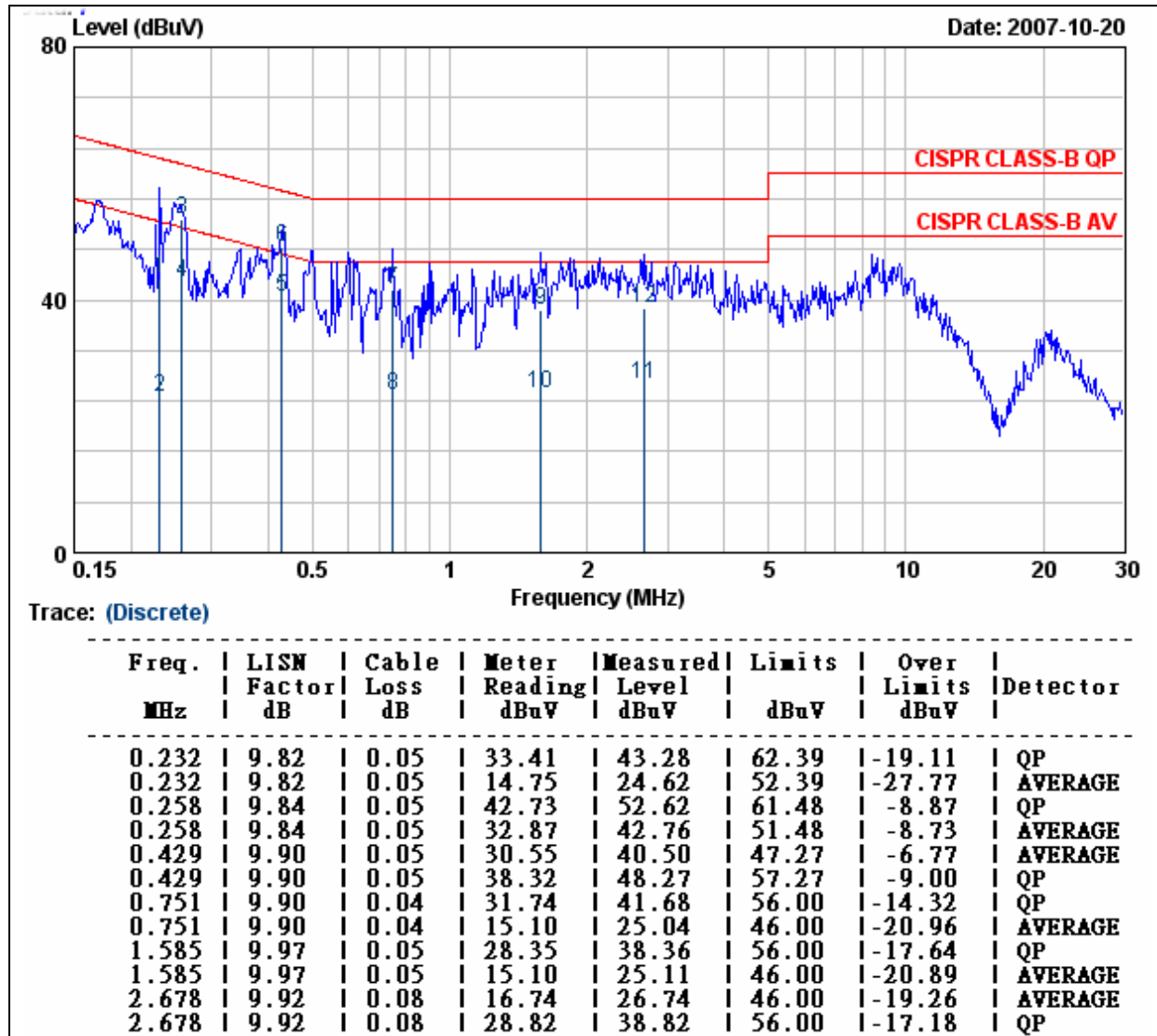
Test Date: October 20, 2007

Temperature: 23.8°C

Tested by: Jerry Chang

Humidity: 55% RH

## LINE



## Remark:

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)
2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (3)

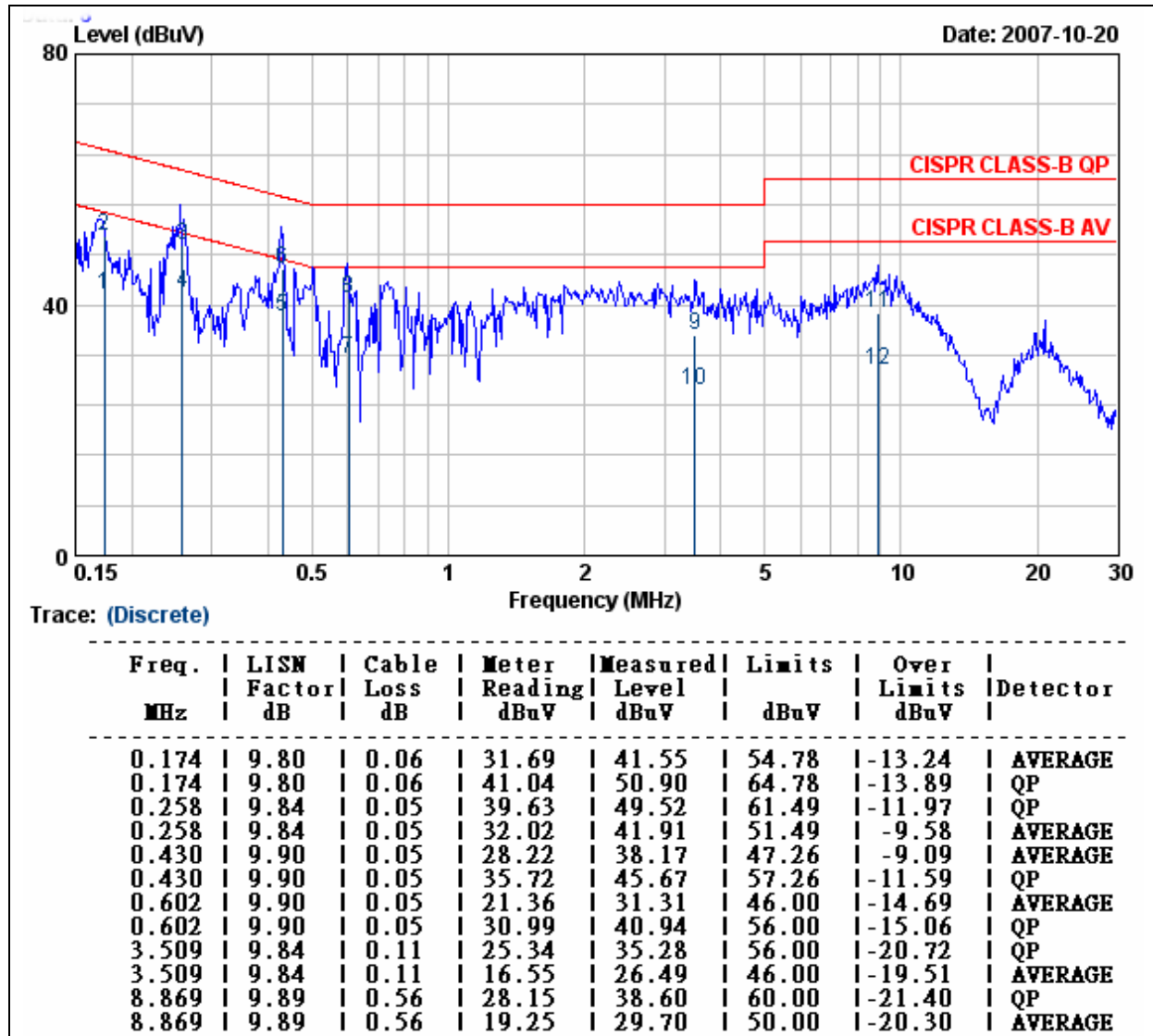
Test Date: October 20, 2007

Temperature: 23.8°C

Tested by: Jerry Chang

Humidity: 55% RH

NEUTRAL

**Remark:**

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)
2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (4)

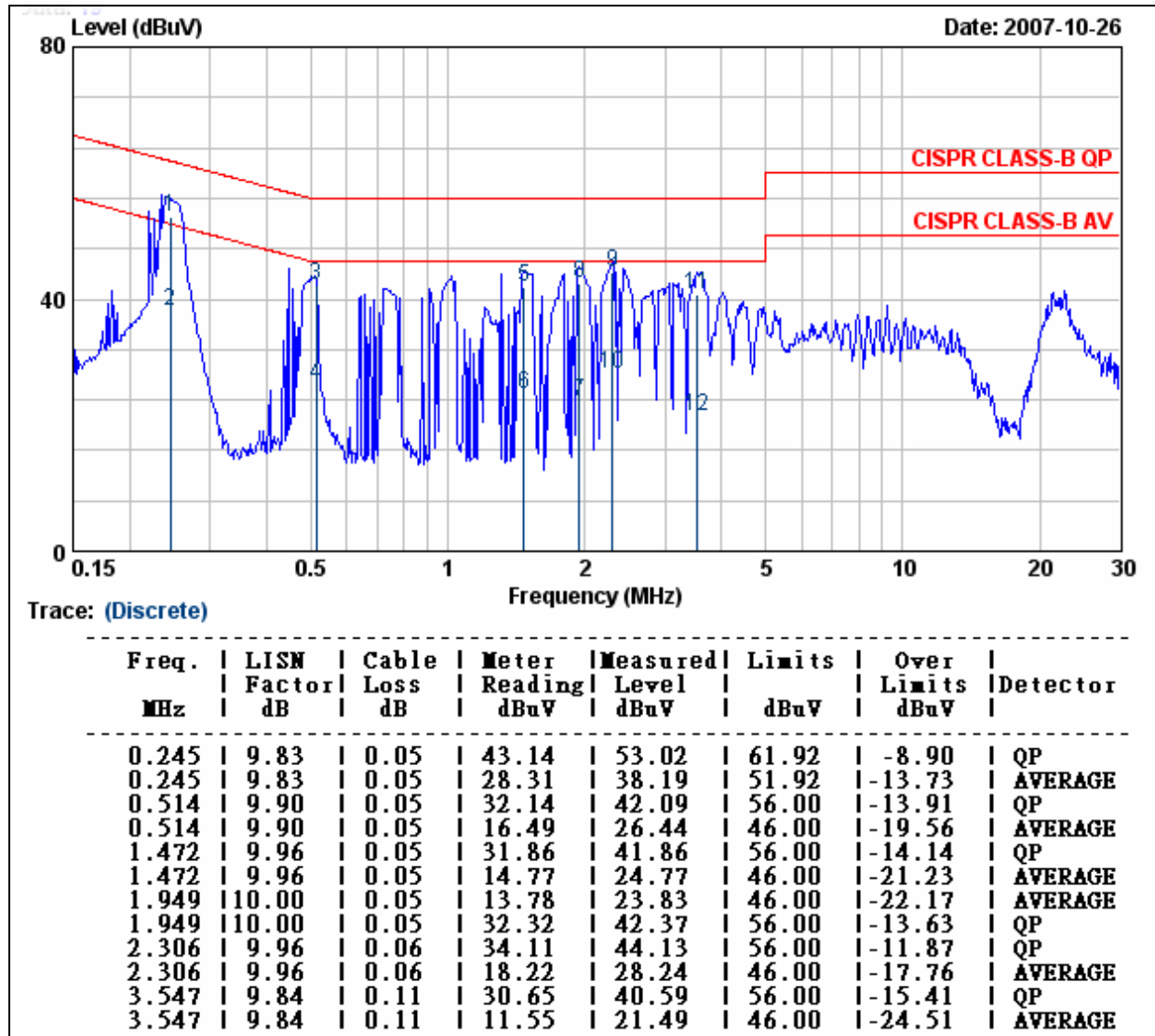
Test Date: October 26, 2007

Temperature: 23.5°C

Tested by: Jerry Chang

Humidity: 58% RH

## LINE



## Remark:

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)

2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (4)

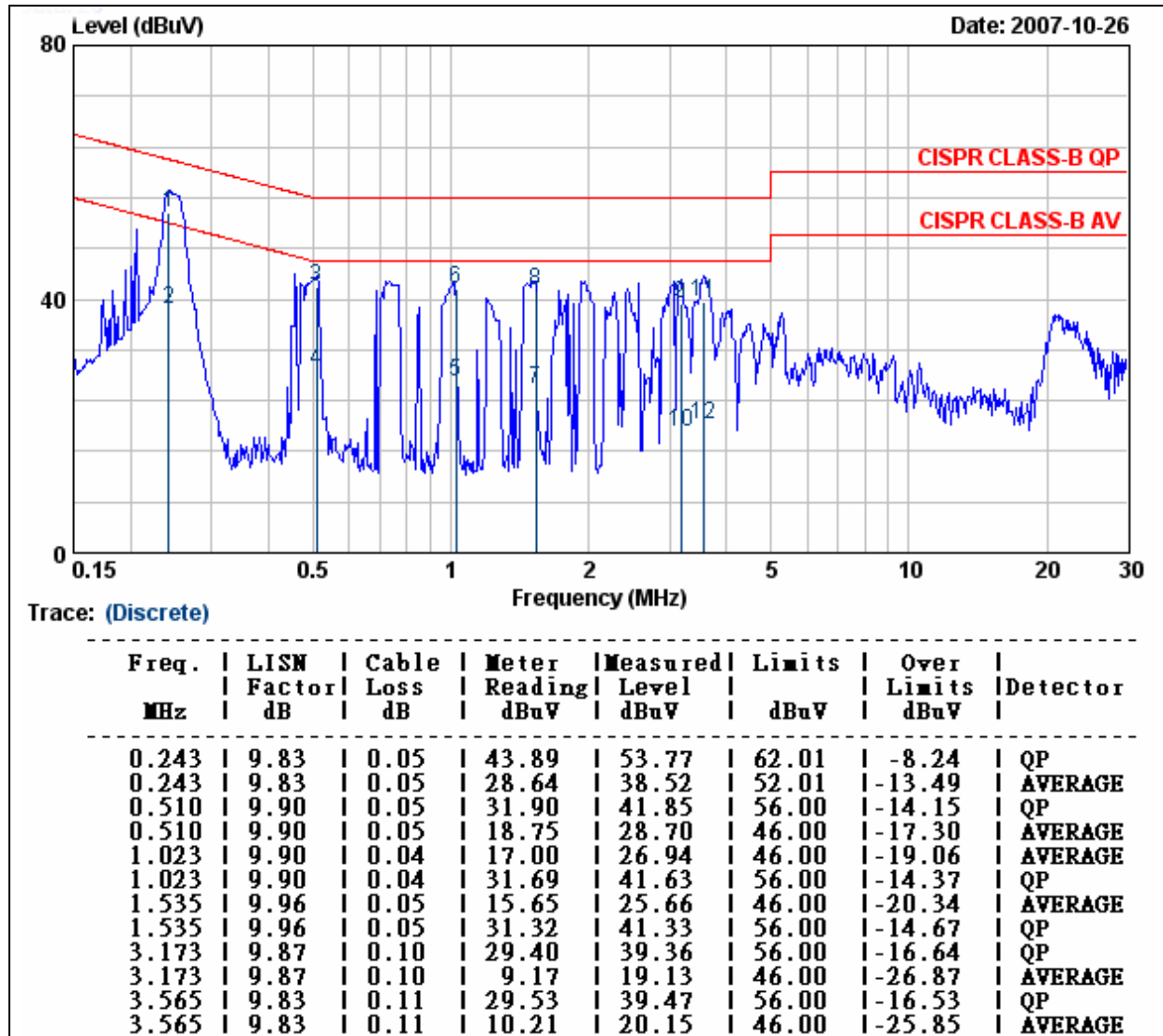
Test Date: October 26, 2007

Temperature: 23.5°C

Tested by: Jerry Chang

Humidity: 58% RH

NEUTRAL



Remark:

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)

2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (5)

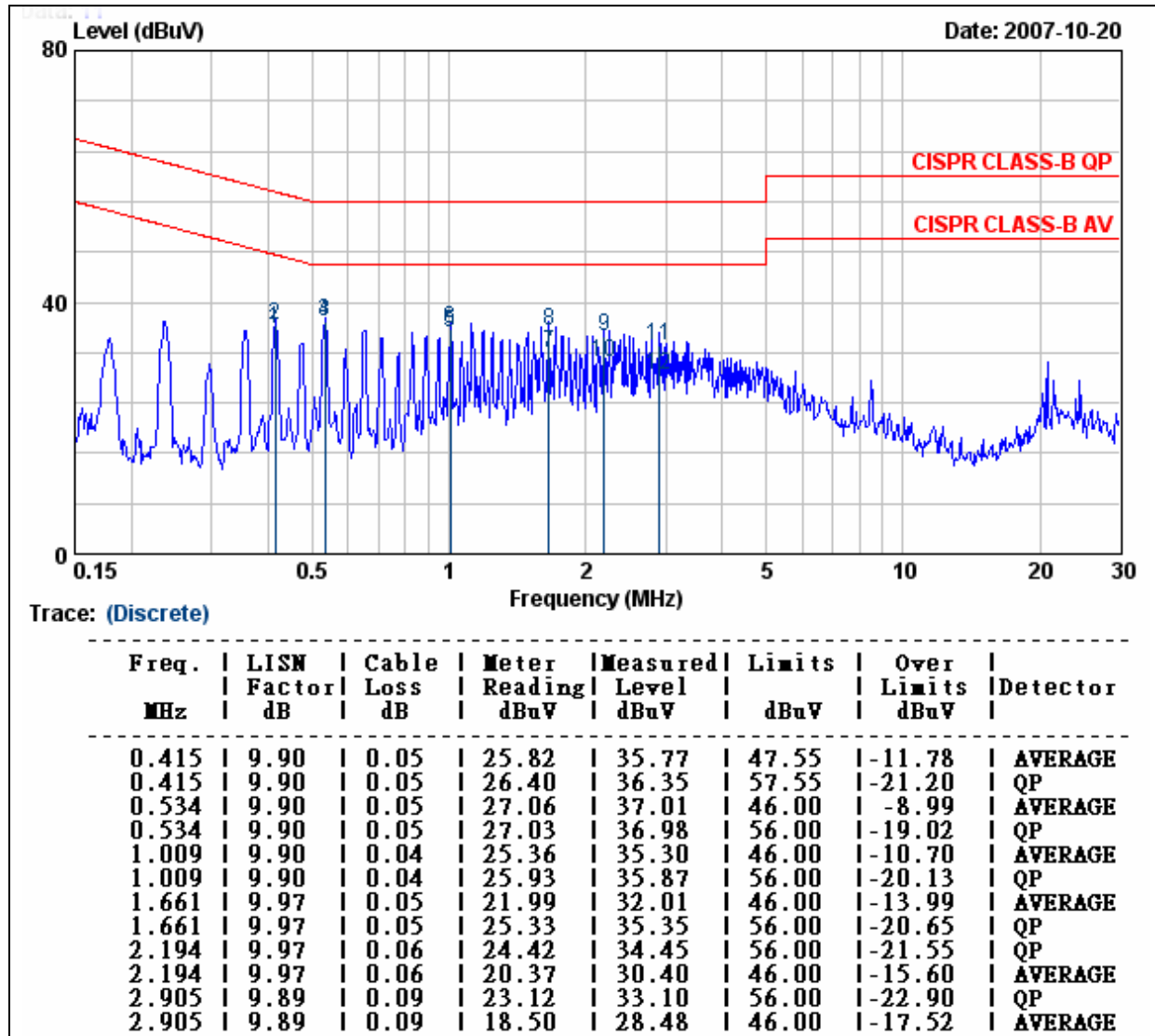
Test Date: October 20, 2007

Temperature: 23.8°C

Tested by: Jerry Chang

Humidity: 55% RH

## LINE



## Remark:

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)

2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (5)

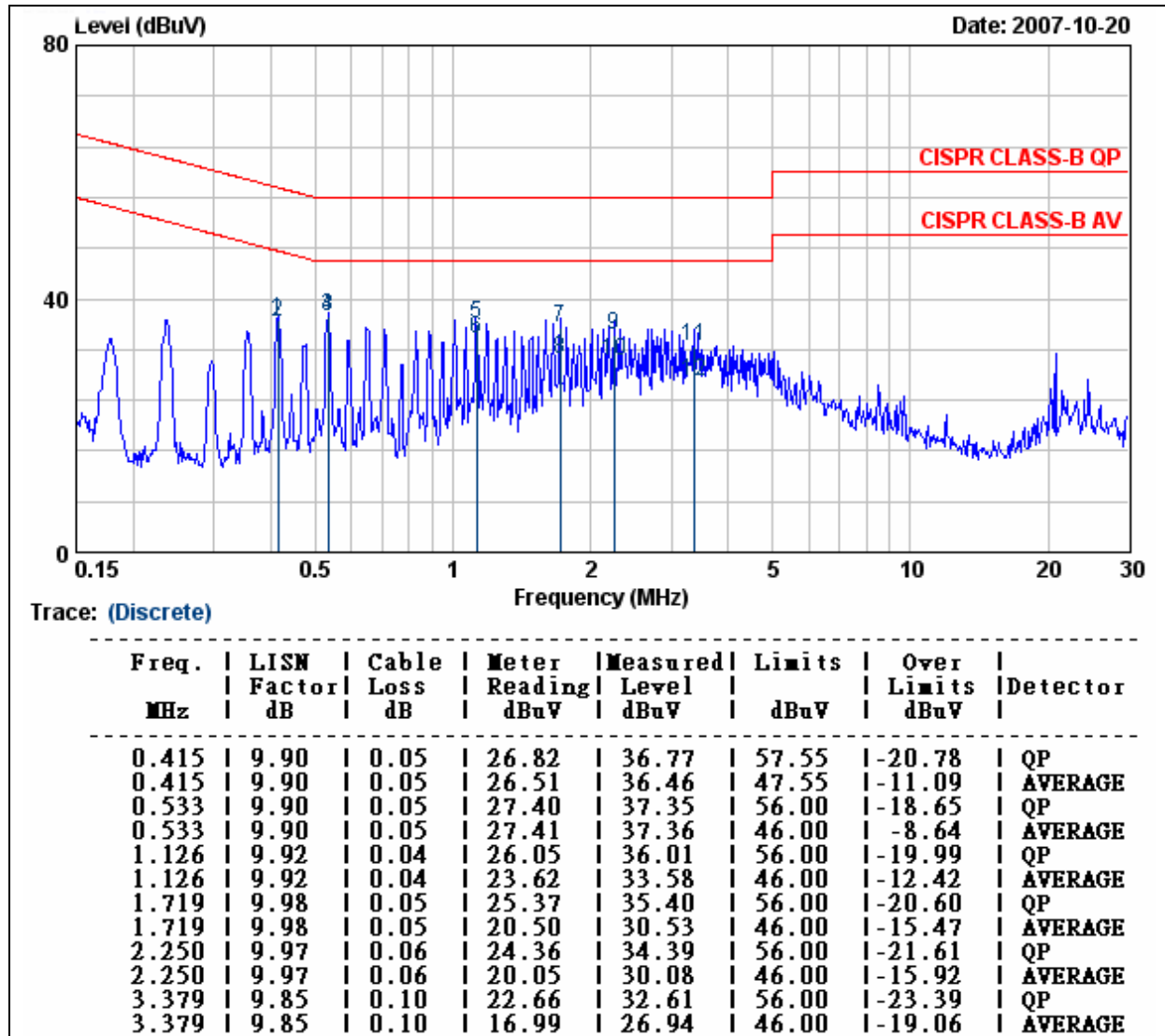
Test Date: October 20, 2007

Temperature: 23.8°C

Tested by: Jerry Chang

Humidity: 55% RH

## NEUTRAL



## Remark:

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)

2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (6)

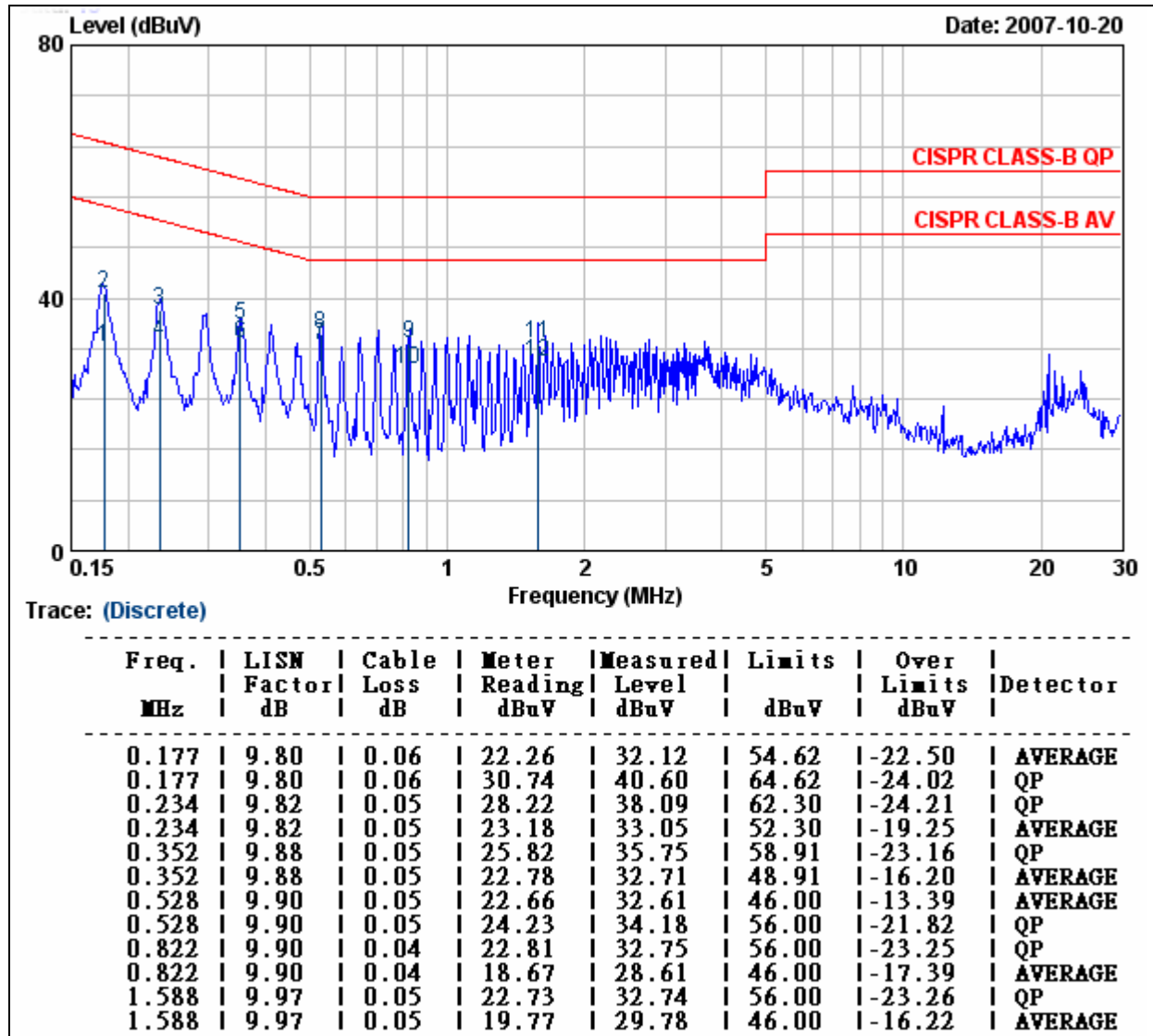
Test Date: October 20, 2007

Temperature: 23.8°C

Tested by: Jerry Chang

Humidity: 55% RH

## LINE



## Remark:

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)

2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (6)

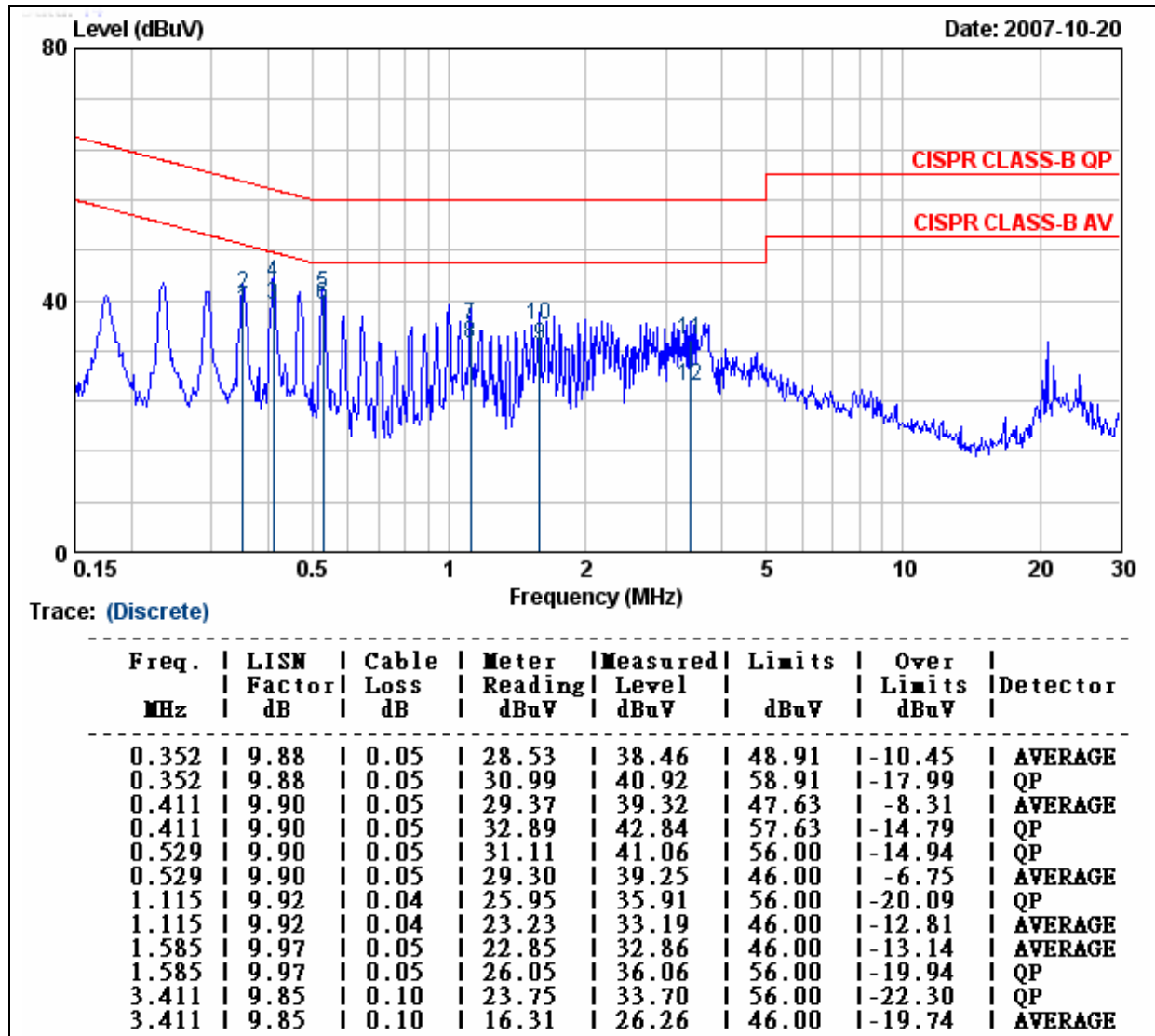
Test Date: October 20, 2007

Temperature: 23.8°C

Tested by: Jerry Chang

Humidity: 55% RH

NEUTRAL

**Remark:**

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)

2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (7)

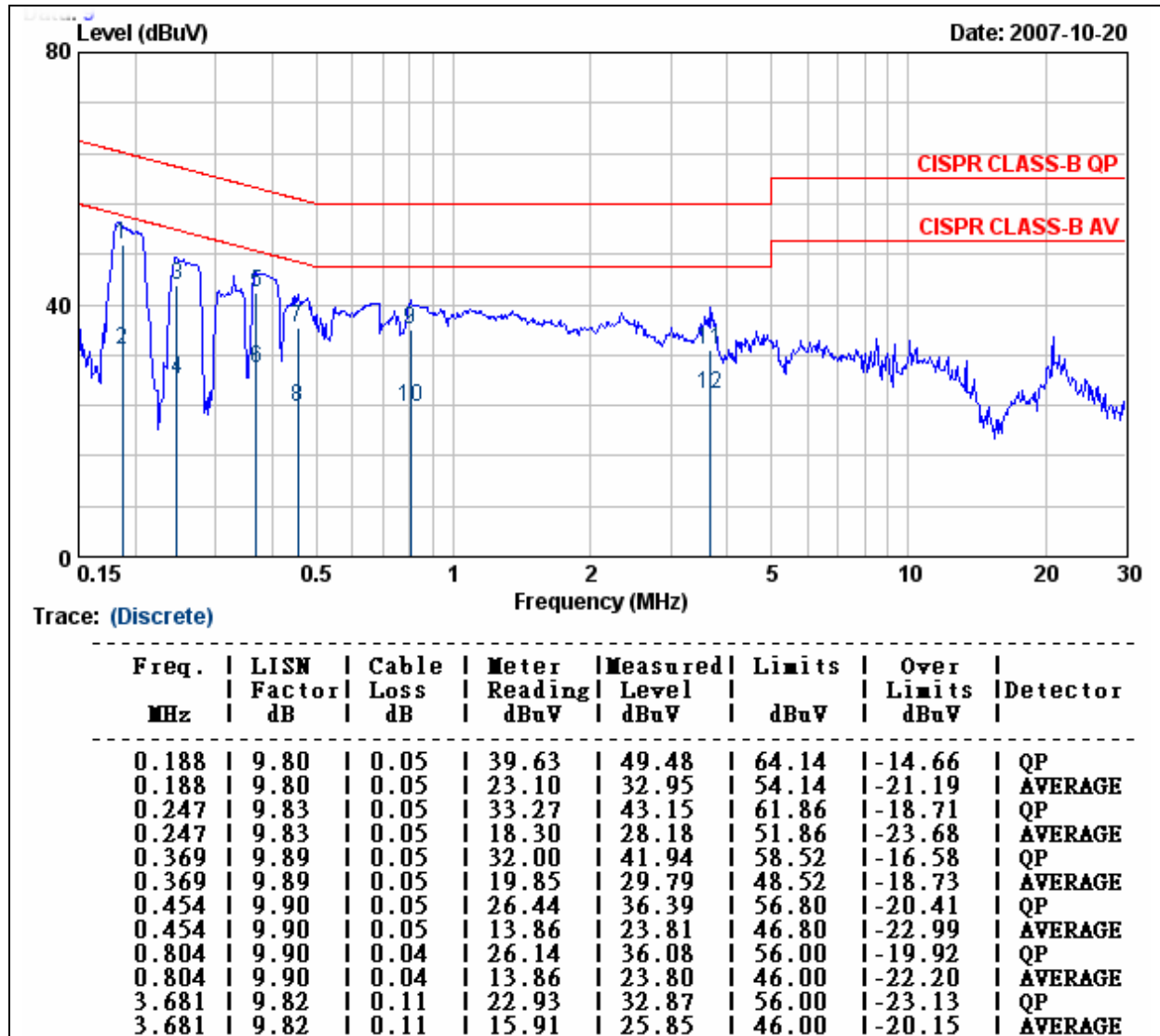
Test Date: October 20, 2007

Temperature: 23.8°C

Tested by: Jerry Chang

Humidity: 55% RH

## LINE



## Remark:

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)

2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (7)

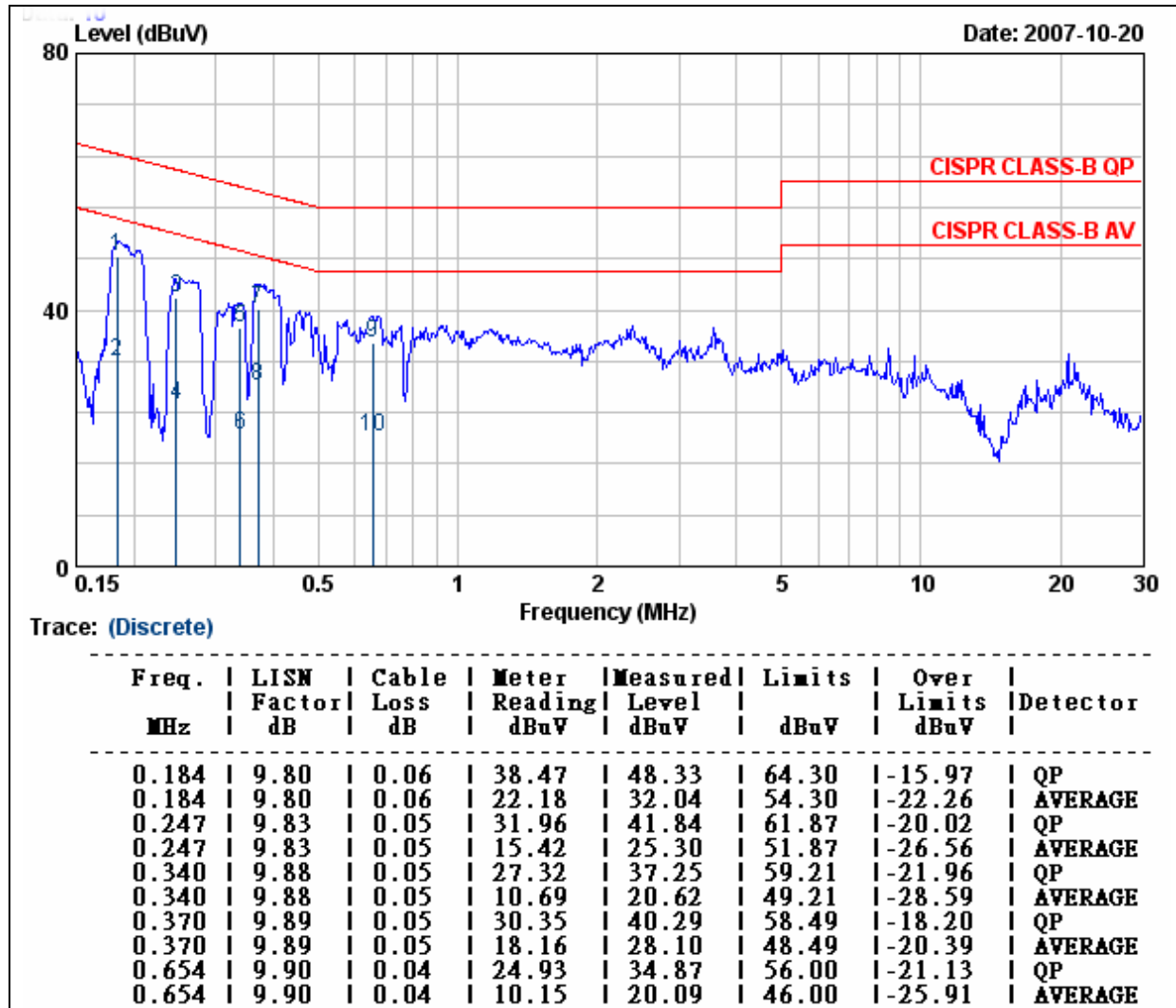
Test Date: October 20, 2007

Temperature: 23.8°C

Tested by: Jerry Chang

Humidity: 55% RH

NEUTRAL

**Remark:**

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)
2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (8)

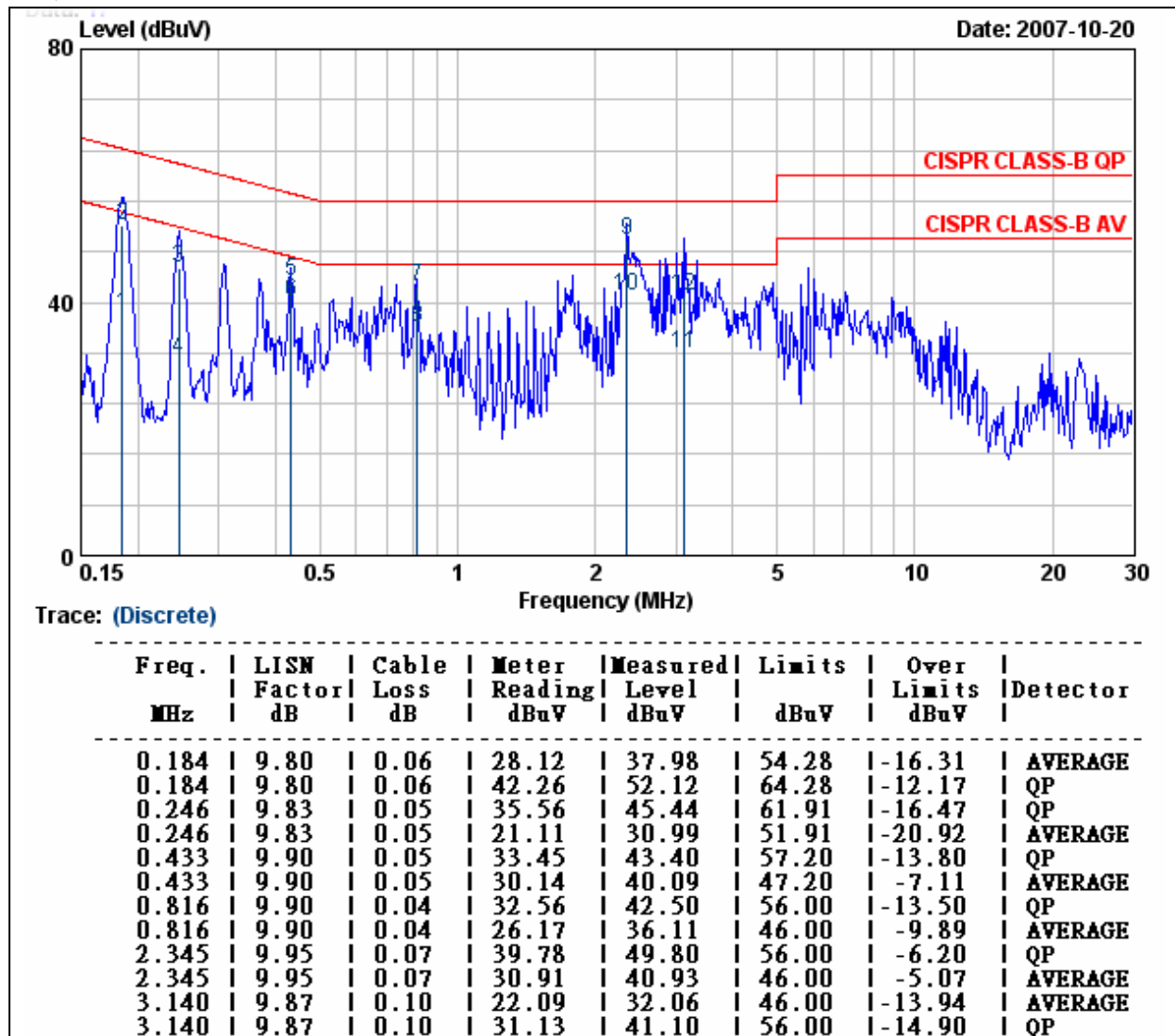
Test Date: October 20, 2007

Temperature: 23.8°C

Tested by: Jerry Chang

Humidity: 55% RH

## LINE



## Remark:

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)
2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



Operation Mode: Power Adapter (8)

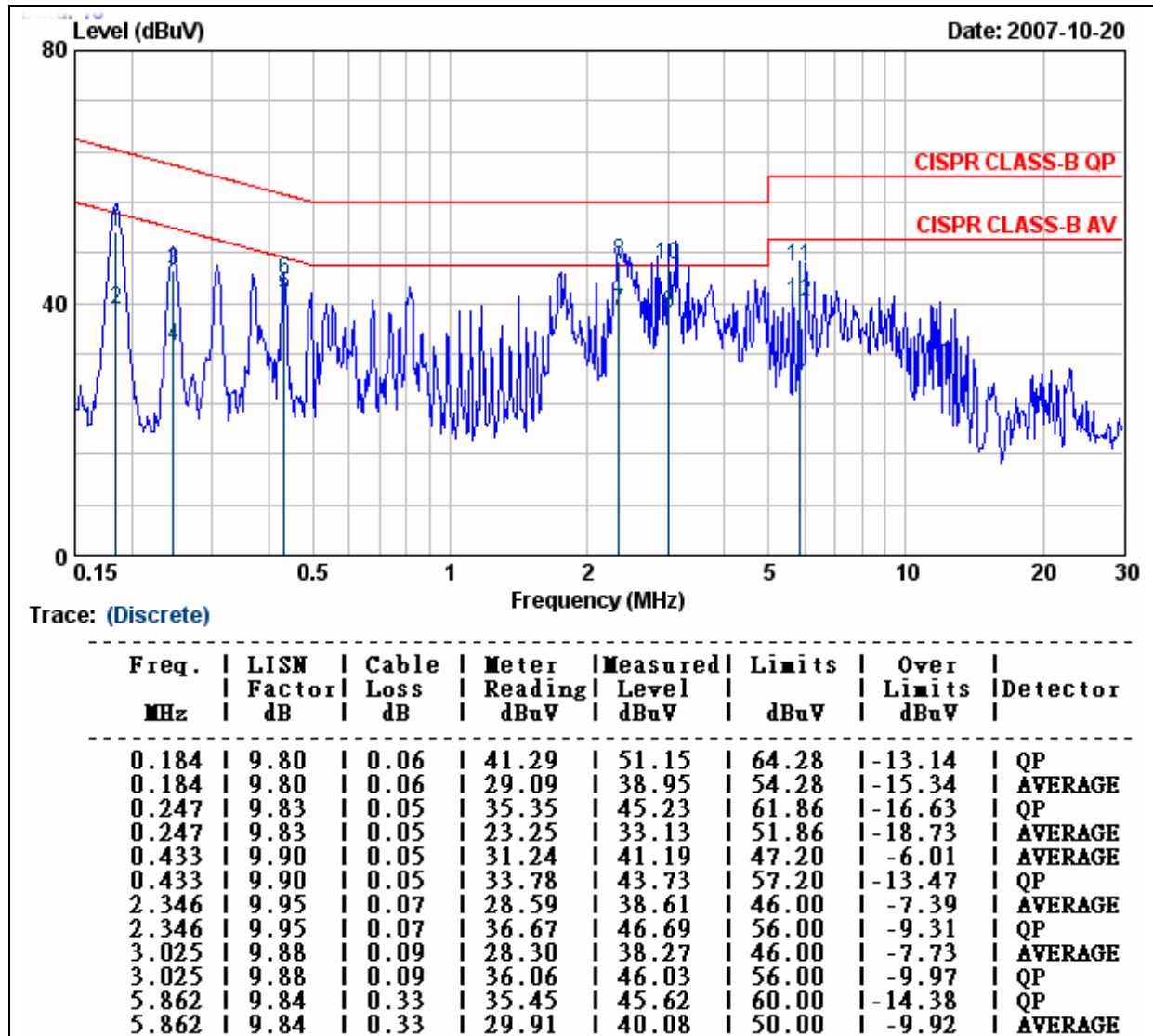
Test Date: October 20, 2007

Temperature: 23.8°C

Tested by: Jerry Chang

Humidity: 55% RH

NEUTRAL

**Remark:**

1. Level (dBuV) = Read Level (dBuV) + LISN Factor (dB) + Cable Loss (dB)
2. Over Limit value (dB) = Level (dBuV) - Limit Line (dBuV)



## APPENDIX I

### RADIO FREQUENCY EXPOSURE

#### LIMIT

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

#### EUT SPECIFICATION

<b>EUT</b>	Wireless-G Broadband Router With SpeedBooster
<b>Frequency band (Operating)</b>	<input checked="" type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input type="checkbox"/> WLAN: 5.745GHz ~ 5.825GHz <input type="checkbox"/> Others: Bluetooth: 2.402GHz ~ 2.480GHz
<b>Device category</b>	<input type="checkbox"/> Portable (<20cm separation) <input checked="" type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others
<b>Exposure classification</b>	<input type="checkbox"/> Occupational/Controlled exposure (S = 5mW/cm <sup>2</sup> ) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure (S=1mW/cm <sup>2</sup> )
<b>Antenna diversity</b>	<input type="checkbox"/> Single antenna <input checked="" type="checkbox"/> Multiple antennas <input type="checkbox"/> Tx diversity <input type="checkbox"/> Rx diversity <input checked="" type="checkbox"/> Tx/Rx diversity
<b>Max. output power</b>	IEEE 802.11b mode: 20.20 dBm (104.71mW) IEEE 802.11g mode: 22.00 dBm (158.49mW)
<b>Antenna gain (Max)</b>	Dipole Antenna, Antenna Gain : 2dBi (Numeric gain: 1.58)
<b>Evaluation applied</b>	<input checked="" type="checkbox"/> MPE Evaluation* <input type="checkbox"/> SAR Evaluation <input type="checkbox"/> N/A

**Remark:**

1. The maximum output power is 22.00dBm (158.494mW) at 2412MHz (with 1.58 numeric antenna gain.)
2. DTS device is not subject to routine RF evaluation; MPE estimate is used to justify the compliance.
3. For mobile or fixed location transmitters, no SAR consideration applied. The maximum power density is 1.0 mW/cm<sup>2</sup> even if the calculation indicates that the power density would be larger.

#### TEST RESULTS

No non-compliance noted.



### **Calculation**

Given  $E = \frac{\sqrt{30 \times P \times G}}{d}$  &  $S = \frac{E^2}{3770}$

Where  $E$  = Field strength in Volts / meter

$P$  = Power in Watts

$G$  = Numeric antenna gain

$d$  = Distance in meters

$S$  = Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{3770 d^2}$$

Changing to units of mW and cm, using:

$$P (mW) = P (W) / 1000 \text{ and}$$

$$d (cm) = d(m) / 100$$

Yields

$$S = \frac{30 \times (P/1000) \times G}{3770 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \text{Equation 1}$$

Where  $d$  = Distance in cm

$P$  = Power in mW

$G$  = Numeric antenna gain

$S$  = Power density in mW / cm<sup>2</sup>

### **Maximum Permissible Exposure**

EUT output power = 158.49mW

Numeric Antenna gain = 1.58

Substituting the MPE safe distance using  $d = 20$  cm into Equation 1:

Yields

$$S = 0.000199 \times P \times G$$

Where  $P$  = Power in mW

$G$  = Numeric antenna gain

$S$  = Power density in mW / cm<sup>2</sup>



IEEE 802.11b DSSS MODULATION				
Channel	Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/ cm <sup>2</sup> )
1	2412	104.71	0.03292	1.0
6	2437	104.71	0.03292	1.0
11	2462	102.33	0.03217	1.0

IEEE 802.11g OFDM MODULATION				
Channel	Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/ cm <sup>2</sup> )
1	2412	158.49	0.04983	1.0
6	2437	141.25	0.04441	1.0
11	2462	107.15	0.03369	1.0

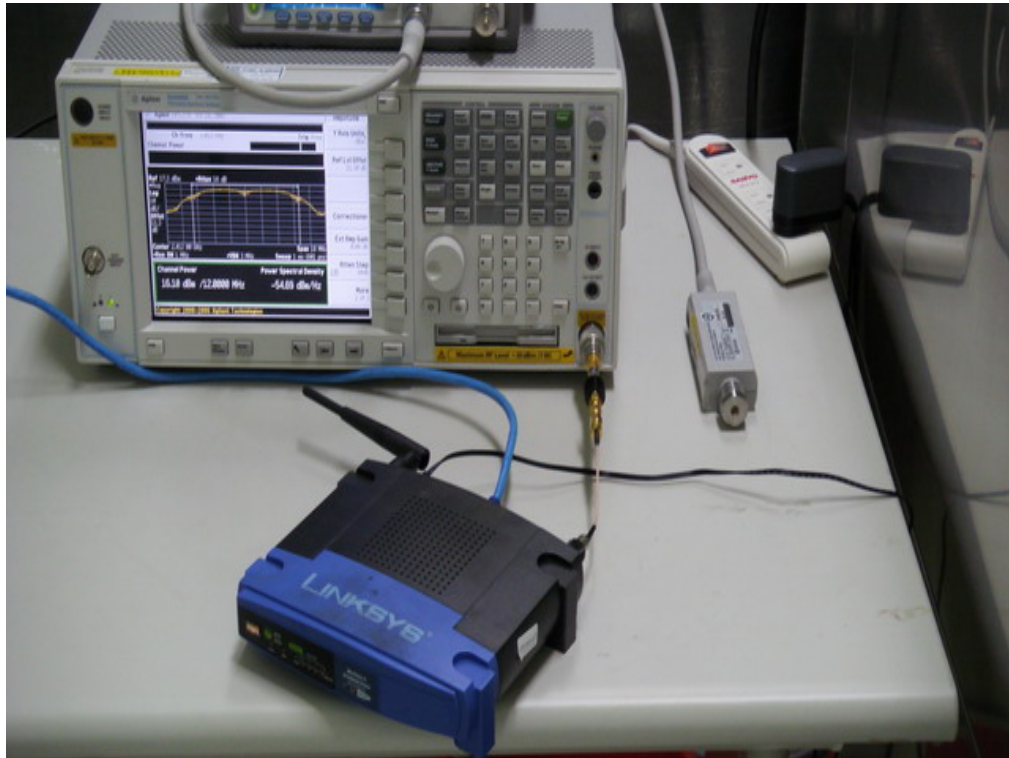
**Remark:** For mobile or fixed location transmitters, the maximum power density is 1.0 mW/cm<sup>2</sup> even if the calculation indicates that the power density would be larger.



## **APPENDIX II**

### **PHOTOGRAPHS OF TEST SETUP**

#### **CONDUCTED EMISSION SETUP PHOTOS**





## **RADIATED MEASUREMENT SETUP**







## **RADIATED RF MEASUREMENT SETUP**





## POWERLINE CONDUCTED EMISSIONS SETUP PHOTOS

