



**FCC 47 CFR PART 15 SUBPART C**

**TEST REPORT**

**For**

**WLAN 802.11a/b/g mini-PCI Module**

**Model: CM9**

**Trade Name: ADVANTECH**

*Issued to*

**Advantech Co., Ltd.**

**No. 1, Alley 20, Lane 26, Rueiguang Road, Neihu District,  
Taipei 114, Taiwan, R.O.C.**

*Issued by*

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**Revision History**

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	July 22, 2010	Initial Issue	ALL	Celine Chou



## TABLE OF CONTENTS

<b>1</b>	<b>TEST RESULT CERTIFICATION</b> .....	<b>4</b>
<b>2</b>	<b>EUT DESCRIPTION</b> .....	<b>5</b>
<b>3</b>	<b>TEST METHODOLOGY</b> .....	<b>6</b>
3.1.	EUT CONFIGURATION .....	6
3.2.	EUT EXERCISE .....	6
3.3.	GENERAL TEST PROCEDURES .....	6
3.4.	FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS .....	7
3.5.	DESCRIPTION OF TEST MODES .....	8
<b>4</b>	<b>INSTRUMENT CALIBRATION</b> .....	<b>9</b>
4.1.	MEASUREMENT EQUIPMENT USED .....	9
4.2.	MEASUREMENT UNCERTAINTY .....	10
4.3.	MEASUREMENT UNCERTAINTY .....	10
<b>5</b>	<b>FACILITIES AND ACCREDITATIONS</b> .....	<b>11</b>
5.1.	FACILITIES.....	11
5.2.	EQUIPMENT .....	11
5.3.	TABLE OF ACCREDITATIONS AND LISTINGS.....	12
<b>6</b>	<b>SETUP OF EQUIPMENT UNDER TEST</b> .....	<b>13</b>
6.1.	SETUP CONFIGURATION OF EUT .....	13
6.2.	SUPPORT EQUIPMENT .....	13
<b>7</b>	<b>FCC PART 15.247 REQUIREMENTS</b> .....	<b>14</b>
7.1.	6DB BANDWIDTH.....	14
7.2.	PEAK POWER.....	21
7.3.	AVERAGE POWER.....	28
7.4.	BAND EDGES MEASUREMENT .....	34
7.5.	PEAK POWER SPECTRAL DENSITY .....	44
7.6.	SPURIOUS EMISSIONS .....	51
7.7.	POWERLINE CONDUCTED EMISSIONS .....	70
<b>8</b>	<b>APPENDIX I RADIO FREQUENCY EXPOSURE</b> .....	<b>73</b>
<b>9</b>	<b>APPENDIX II PHOTOGRAPHS OF TEST SETUP</b> .....	<b>75</b>



## 1 TEST RESULT CERTIFICATION

**Applicant:** **Advantech Co., Ltd.**  
No. 1, Alley 20, Lane 26, Rueiguang Road, Neihu District,  
Taipei 114, Taiwan, R.O.C.

**Equipment Under Test:** WLAN 802.11a/b/g mini-PCI Module

**Trade Name:** ADVANTECH

**Model:** CM9

**Date of Test:** July 14 ~ 16, 2010

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 15 Subpart C	No non-compliance noted

### 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:**

Stan Lin  
Supervisor

**Reviewed by:**

Alonso Lu  
Engineer



## 2 EUT DESCRIPTION

<b>Product</b>	WLAN 802.11a/b/g mini-PCI Module
<b>Trade Name</b>	ADVANTECH
<b>Model Number</b>	CM9
<b>Model Name Discrepancy</b>	N/A
<b>EUT Power Rating</b>	Power by Notebook
<b>Operating Frequency Range</b>	IEEE 802.11a: 5.745~5.825 GHz IEEE 802.11b/g: 2.412~2.462 GHz
<b>Transmit Power</b>	IEEE 802.11a: 19.67 dBm (92.68mW) IEEE 802.11b: 21.41 dBm (138.36mW) IEEE 802.11g: 20.25 dBm (105.93mW)
<b>Modulation Technique</b>	IEEE 802.11a: OFDM (QPSK, BPSK, 16-QAM, 64-QAM) IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (QPSK, BPSK, 16-QAM, 64-QAM)
<b>Number of Channels</b>	IEEE 802.11a: 5 Channels IEEE 802.11b/g: 11 Channels
<b>Antenna Specification</b>	IEEE 802.11a: 2 dBi IEEE 802.11b/g: 2 dBi
<b>Antenna Designation</b>	IEEE 802.11a/b/g: Dipole Antenna

**Remark:**

1. The sample selected for test was production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: **M82-EKI6323AG** filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.



### **3 TEST METHODOLOGY**

The tests documented in this report were performed in accordance with ANSI C63.4 (2003) and FCC CFR 47 15.207, 15.209 and 15.247.

#### **3.1. 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.

#### **3.2. 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.

#### **3.3. 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 (2003) 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 (2003).



### 3.4. 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 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	( <sup>2</sup> )
13.36 - 13.41	322 - 335.4		

<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.



### **3.5. DESCRIPTION OF TEST MODES**

The EUT (model: CM9) had been tested under operating condition.

Software used to control the EUT for staying in continuous transmitting mode was programmed. The worst case data rate is determined as the data rate with highest output power.

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz and power line conducted emissions below 30MHz, which worst case was in normal link mode only.

**IEEE 802.11a mode:**

Channel Low(5745MHz), Channel Mid(5785MHz) and Channel High(5825MHz) with 6Mbps data rate were chosen for full testing.

**IEEE 802.11b mode:**

Channel Low(2412MHz), Channel Mid(2437MHz) and Channel High(2462MHz) with 1Mbps data rate were chosen for full testing.

**IEEE 802.11g mode:**

Channel Low(2412MHz), Channel Mid(2437MHz) and Channel High(2462MHz) with 6Mbps data rate were chosen for full testing.





### 4 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.

#### 4.1. MEASUREMENT EQUIPMENT USED

##### Equipment Used for Emissions Measurement

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

3M Semi Anechoic Chamber				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY48250064	11/05/2010
Spectrum Analyzer	R&S	FSEB	825829/011	11/02/2010
Pre-Amplifier	HP	8447D	2944A06530	01/02/2011
Pre-Amplifier	HP	8449B	3008A01738	04/17/2011
EMI Test Receiver	SCHAFFNER	SCR 3501	436	01/26/2011
Loop Antenna	EMCO	6502	2356	06/11/2013
Bilog Antenna	SCHWAZBECK	VULB9160	3084	09/11/2010
Horn Antenna	EMCO	3115	00022250	05/09/2011
Turn Table	CCS	CC-T-1F	N/A	N.C.R
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R
Test S/W	LabVIEW 6.1 (Wugu Chamber EMI Teat V1_4.5.3)			

Conducted Emission Test site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY48250064	11/05/2010
Spectrum Analyzer	R&S	FSEB	825829/011	11/02/2010
USB Power Sensor	BOONTON	52012	2061194	06/22/2011



Powerline Conduction Emission Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EMI Test Receiver	R&S	ESCS30	845552/030	05/18/2011
LISN	R&S	ENV216	100069	01/19/2011
LISN	FCC	FCC-LISN-50/25 0-16-2-07	06013	10/13/2010
Test S/W	LabVIEW 6.1 (CCS Conduction Test SW Version_01)			

## 4.2. MEASUREMENT UNCERTAINTY

Parameter	Uncertainty
Powerline Conducted Emission	$\pm 1.7806$
3M Semi Anechoic Chamber / 30MHz ~ 1GHz	$\pm 4.0235$
3M Semi Anechoic Chamber / Above 1GHz	$\pm 3.8718$

**Remark:** This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

## 4.3. MEASUREMENT UNCERTAINTY

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR 100 028-1 [2] and shall correspond to an expansion factor (coverage factor)  $k = 1,96$  or  $k = 2$  (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Table 6 is based on such expansion factors.

**Table 6: Maximum measurement uncertainty**

Parameter	Uncertainty
RF frequency	$\pm 1 \cdot 10^{-5}$
Total RF power conducted	$\pm 1,5$ dB
RF power density, conducted	$\pm 3$ dB
Spurious emissions, conducted	$\pm 3$ dB
All emissions, radiated	$\pm 6$ dB
Humidity	$\pm 5$ %
Temperature	$\pm 1$ °C
DC and low frequency voltages	$\pm 3$ %



## **5 FACILITIES AND ACCREDITATIONS**

### **5.1. FACILITIES**

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

- No.199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.  
Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029
  
- No.11, Wugong 6th Rd., Wugu Industrial Park, Taipei Hsien 248, Taiwan  
Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045
  
- No. 81-1, Lane 210, Pa-De 2nd Rd., Luchu Hsiang, Taoyuan Shien, (338) Taiwan,  
R.O.C.  
Tel: 886-3-324-0332 / Fax: 886-3-324-5235

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 (2003) and CISPR Publication 22.

### **5.2. 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."



5.3. TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	A2LA	CFR 47, FCC Part15/18, CISPR 22, EN 55022, ICES-003, AS/NZS CISPR 22, VCCI V-3, EN 55011, CISPR 11, IEC/EN 61000-4-2/3/4/5/6/8/11, EN 61000-6-1/2/3/4, EN 55024, CISPR 24, AS/NZS CISPR 24, AS/NZS 61000.6.2, EN 55014-1/-2, ETSI EN 300 386 v1.3.2/v1.3.3, IEC/EN 61000-3-2, AS/NZS 61000.3.2, IEC/EN 61000-3-3, AS/NZS 61000.3.3	
USA	FCC MRA	3/10 meter Open Area Test Sites to perform FCC Part 15/18 measurements	
Japan	VCCI	3/10 meter Open Area Test Sites and conducted test sites to perform radiated/conducted measurements	
Taiwan	TAF	EN 55014-1, CISPR 14, CNS 13781-1, EN 55013, CISPR 13, CNS 13439, EN 55011, CISPR 11, CNS 13803, PLMN09, IS2045-0, LP0002 FCC Part 27/90, Part 15B/C/D/E, RSS-192/193/210/310 ETSI EN 300 328/ 300 220-1/ 300 220-2/ 301 893/ 301 489-01/ 301 489-03/ 301 489-07 / 301 489-17/ 300 440-1/ 300 440-2 AS/NZS 4268, AS/NZS 4771 CISPR 22, EN 55022, CNS 13438, AS/NZS CISPR 22, VCCI, IEC/EN 61000-4-2/3/4/5/6/8/11, CNS 14676-2/3/4/5/6/8, CNS 14934-2/3, CNS 13783-1, CNS 13439, CNS 13803	
Taiwan	BSMI	CNS 13438, CNS 13783-1, CNS 13439, CNS 14115	SL2-IS-E-0014 / IN-E-0014 /A1-E-0014 /R1-E-0014 /R2-E-0014 /L1-E-0014
Canada	Industry Canada	RSS212, Issue 1	

Note: No part of this report may be used to claim or imply product endorsement by A2LA, TAF or other government agency.



## 6 SETUP OF EQUIPMENT UNDER TEST

### 6.1. SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

### 6.2. SUPPORT EQUIPMENT

For Conducted Emission and Radiated Emission above 1 GHz test only							
No.	Device Type	Brand	Model	Series No.	FCC ID	Data Cable	Power Cord
1.	Notebook PC	DELL	D400	0932RY	E2K24GBRL	N/A	AC I/P: Unshielded, 1.8m DC O/P: Unshielded, 1.8m with a core
2.	LCD Monitor	DELL	2407WFPb	CN-0FC255-466 33-660-045S	FCC DoC	D-SUB Cable Shielded, 1.8m with two core	Unshielded, 1.8m
3.	Printer	EPSON	STYLUS C60	DR3K041511	FCC DoC	Unshielded, 1.8m	Unshielded, 1.8m
4.	USB Mouse	HP	MO19UCA	020509272	FCC DoC	Unshielded, 1.8m	N/A

For Radiated Emission Below 1 GHz and Power Line Conducted Emissions test only							
No.	Device Type	Brand	Model	Series No.	FCC ID	Data Cable	Power Cord
5.	Notebook PC	DELL	D400	0932RY	E2K24GBRL	N/A	AC I/P: Unshielded, 1.8m DC O/P: Unshielded, 1.8m with a core
6.	LCD Monitor	DELL	2407WFPb	CN-0FC255-466 33-660-045S	FCC DoC	D-SUB Cable Shielded, 1.8m with two core	Unshielded, 1.8m
7.	Printer	EPSON	STYLUS C60	DR3K041511	FCC DoC	Unshielded, 1.8m	Unshielded, 1.8m
8.	USB Mouse	HP	MO19UCA	020509272	FCC DoC	Unshielded, 1.8m	N/A

**Remark:** Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.



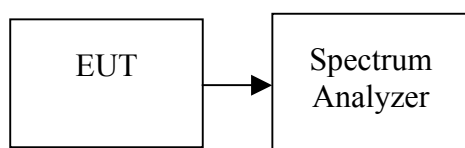
## **7 FCC PART 15.247 REQUIREMENTS**

### **7.1. 6Db bandwidth**

#### **LIMIT**

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

#### **Test Configuration**



#### **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 = 300kHz, Span = mode: 30MHz, Sweep = auto.
4. Mark the peak frequency and -6dB (upper and lower) frequency.
5. Repeat until all the rest channels are investigated.

#### **TEST RESULTS**

*No non-compliance noted*



**TEST DATA**

**IEEE 802.11b**

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Test Result
Low	2412	12192	>500	PASS
Mid	2437	12150		PASS
High	2462	12210		PASS

**IEEE 802.11g**

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Test Result
Low	2412	16533	>500	PASS
Mid	2437	16479		PASS
High	2462	16479		PASS

**IEEE 802.11a**

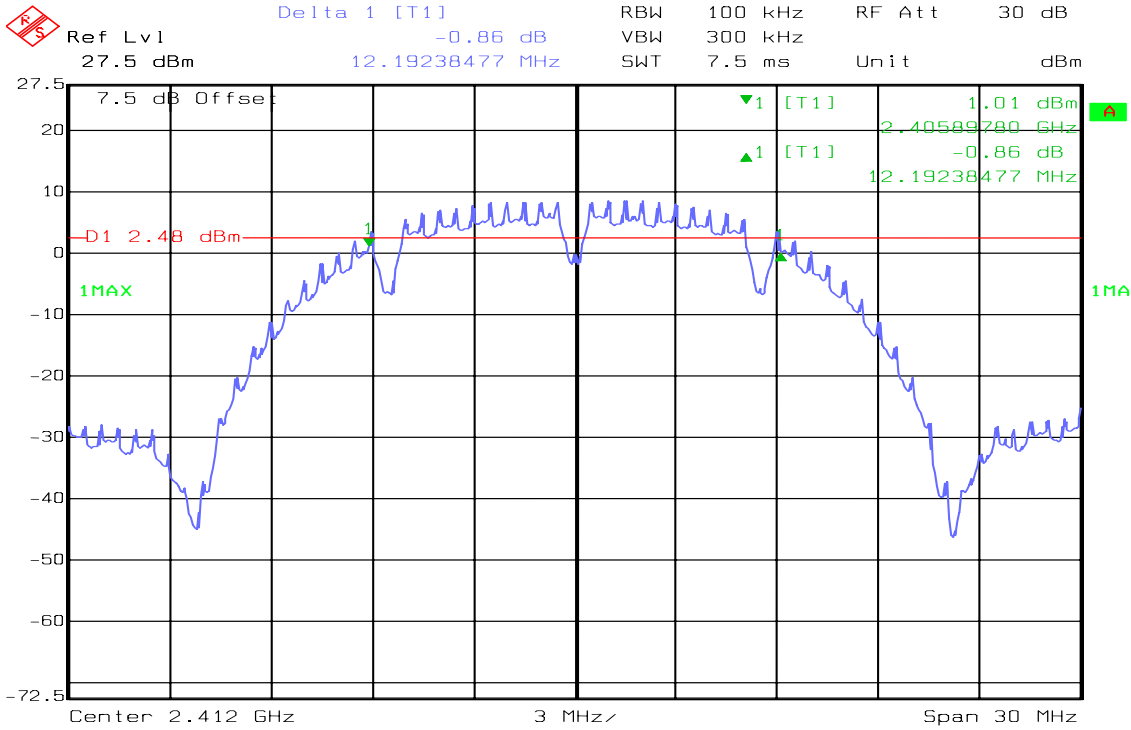
Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Test Result
Low	5745	16587	>500	PASS
Mid	5785	16527		PASS
High	5825	16599		PASS



Test Plot

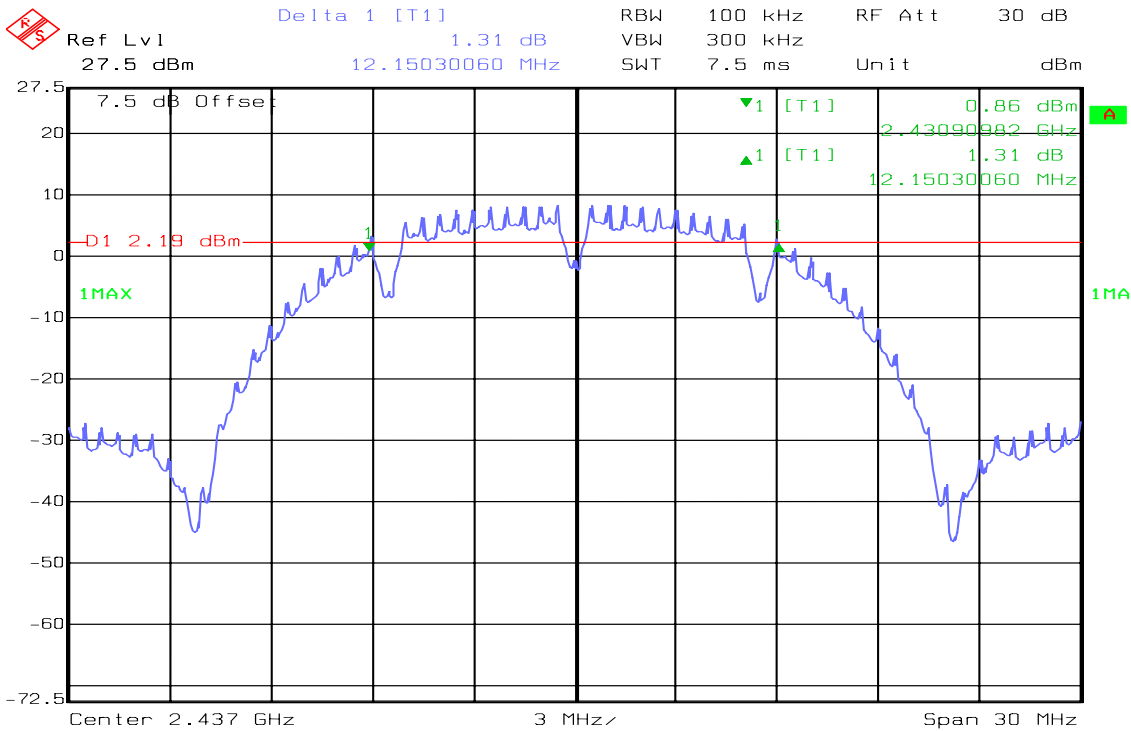
IEEE 802.11b mode

CH Low



Date: 15.JUL.2010 19:59:26

CH Mid

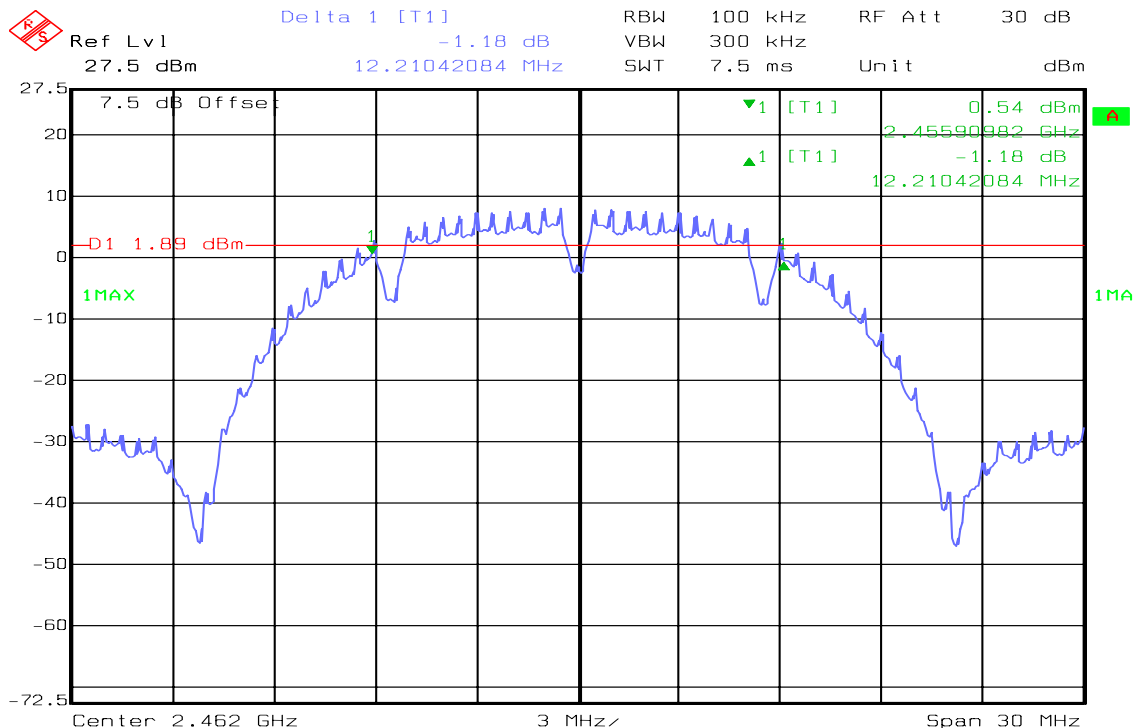


Date: 15.JUL.2010 20:01:24





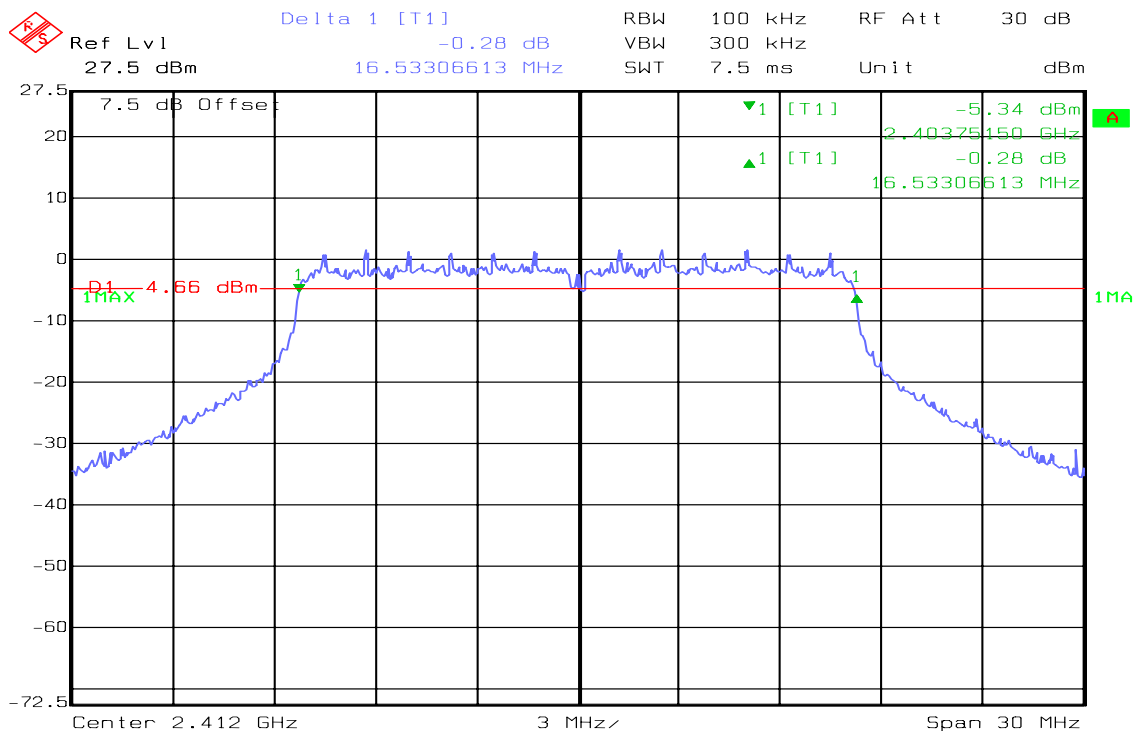
### CH High



Date: 15.JUL.2010 20:02:59

### IEEE 802.11g mode

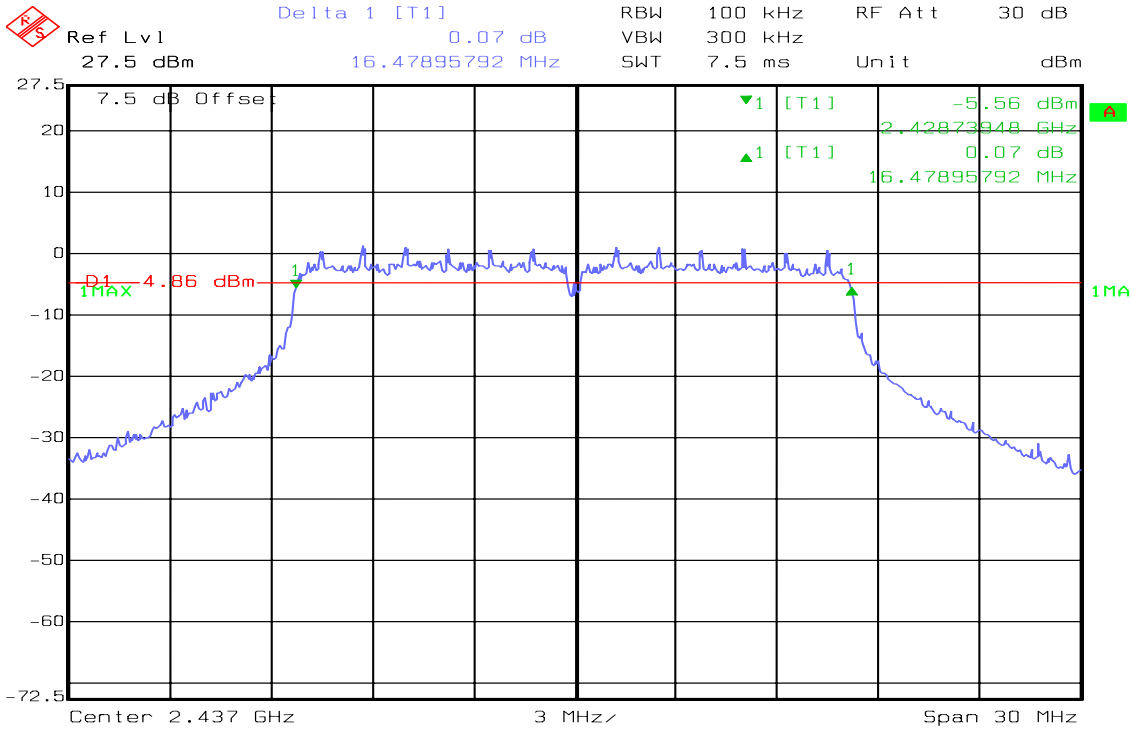
### CH Low



Date: 15.JUL.2010 20:09:04

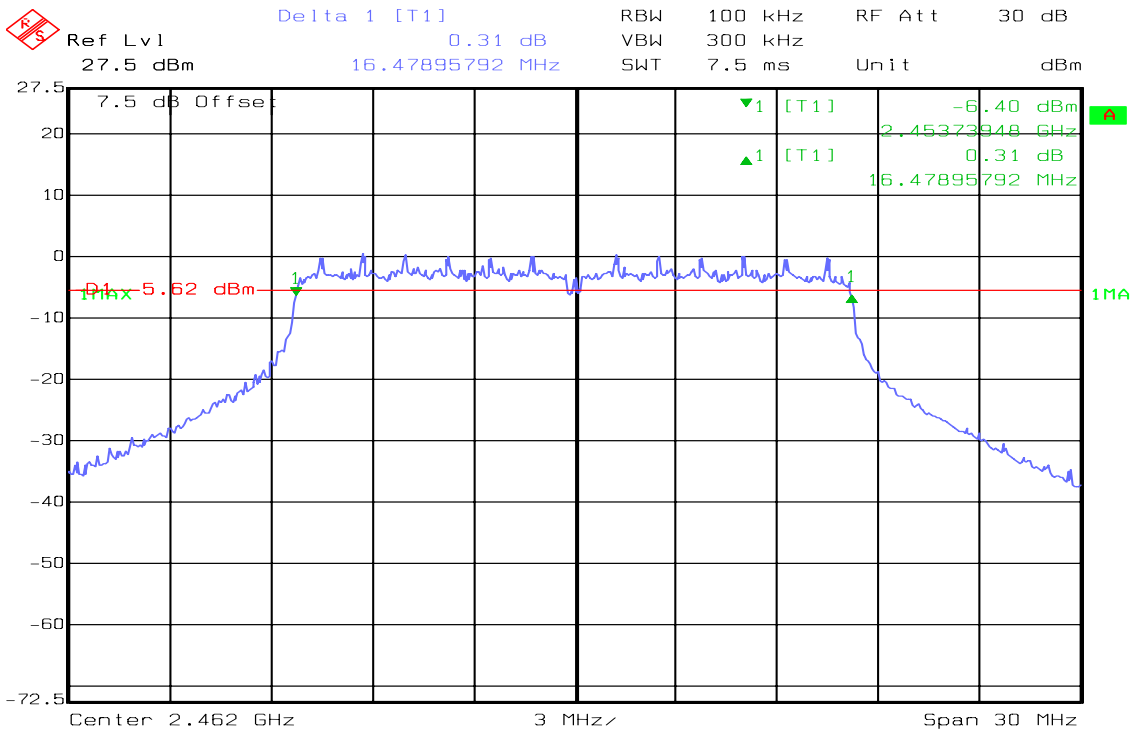


### CH Mid



Date: 15.JUL.2010 20:07:48

### CH High

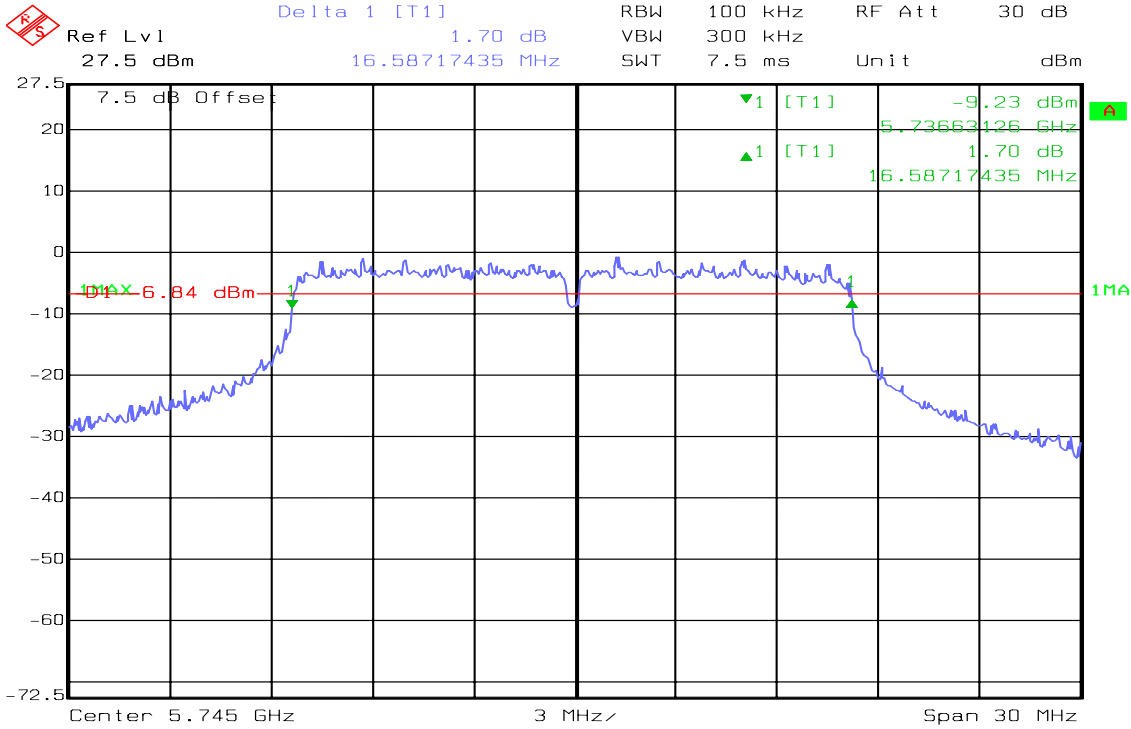


Date: 15.JUL.2010 20:05:55



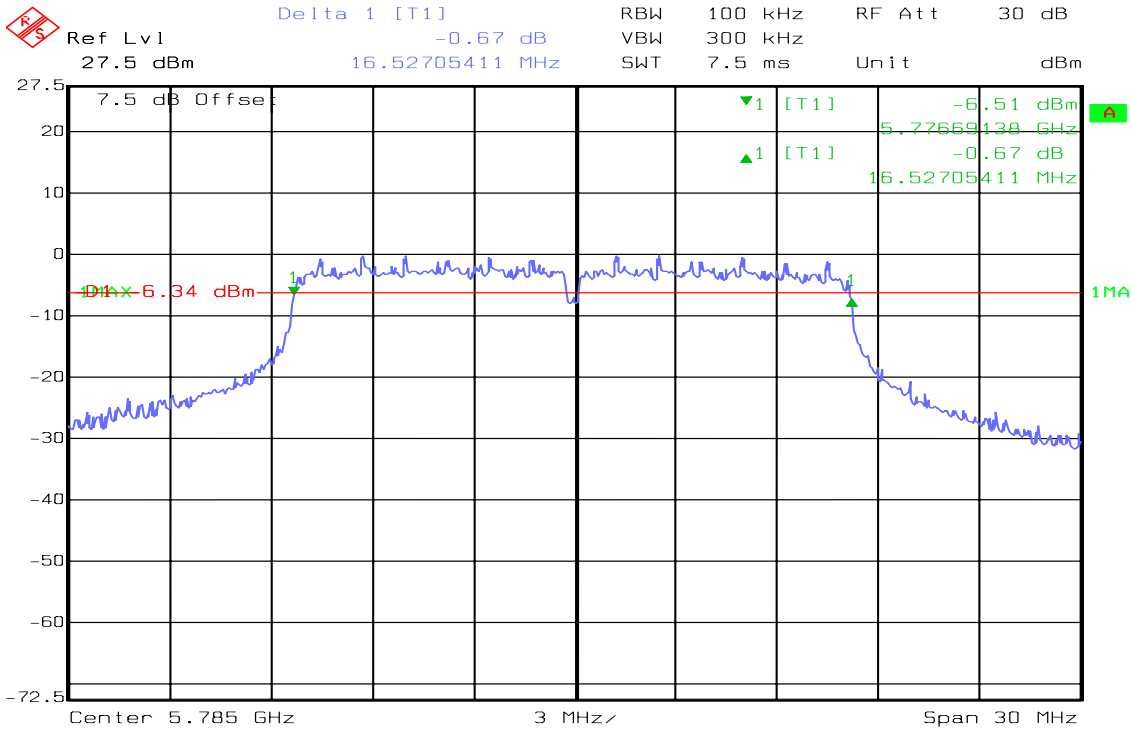
IEEE 802.11a mode

CH Low



Date: 15.JUL.2010 20:19:21

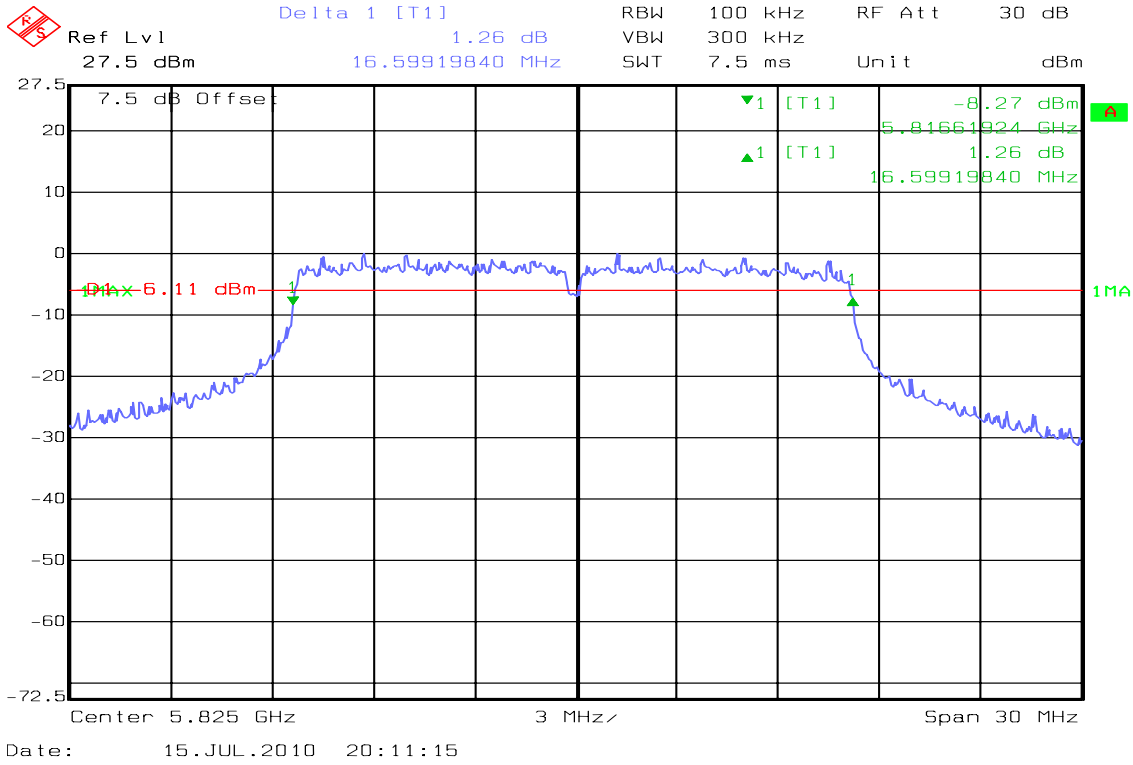
CH Mid



Date: 15.JUL.2010 20:17:42



### CH High





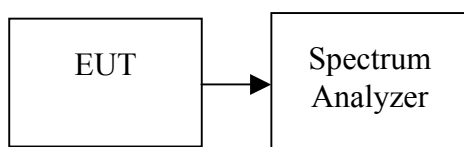
## **7.2. PEAK POWER**

### **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 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 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**



### **TEST PROCEDURE**

1. Peak power is measured using the spectrum analyzer's internal channel power integration function.
2. Power is integrated over a bandwidth greater than or equal to the 99% bandwidth.

### **TEST RESULTS**

*No non-compliance noted.*



**TEST DATA**

**IEEE 802.11b**

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Test Result
Low	2412	21.41	0.13836	1	PASS
Mid	2437	21.09	0.12853		PASS
High	2462	20.39	0.10940		PASS

**IEEE 802.11g**

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Test Result
Low	2412	20.25	0.10593	1	PASS
Mid	2437	19.71	0.09354		PASS
High	2462	19.02	0.07980		PASS

**IEEE 802.11a**

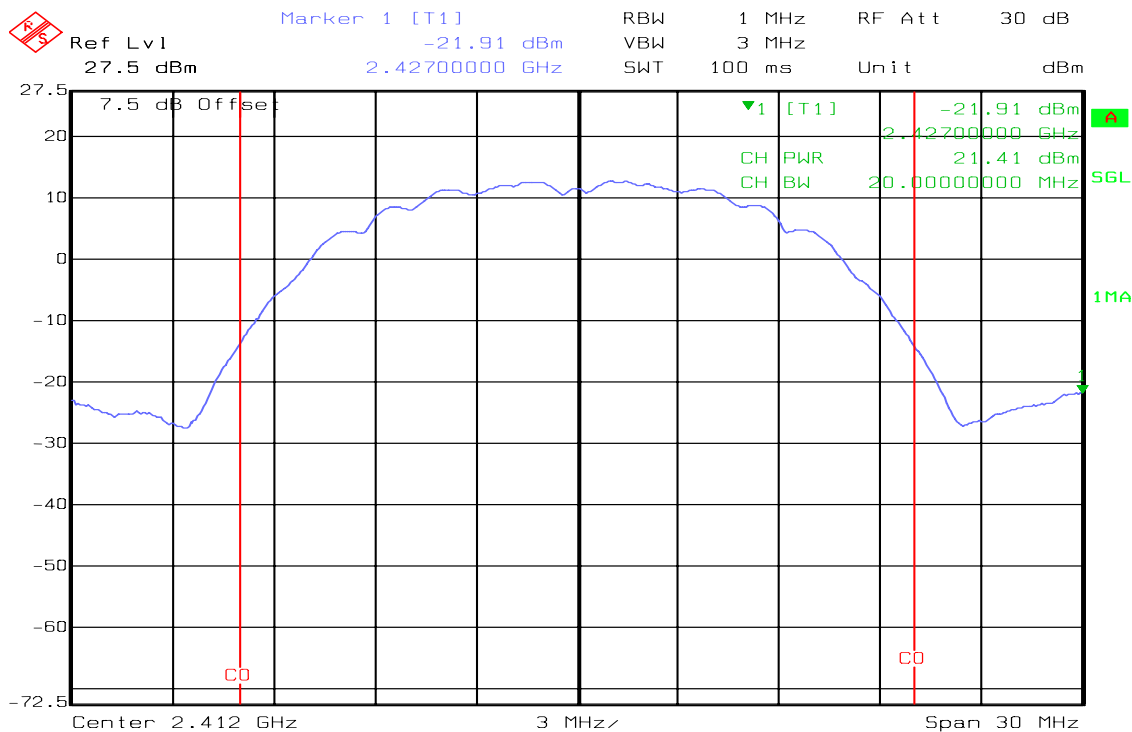
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Test Result
Low	5745	19.02	0.07980	1	PASS
Mid	5785	19.03	0.07998		PASS
High	5825	19.67	0.09268		PASS



Test Plot

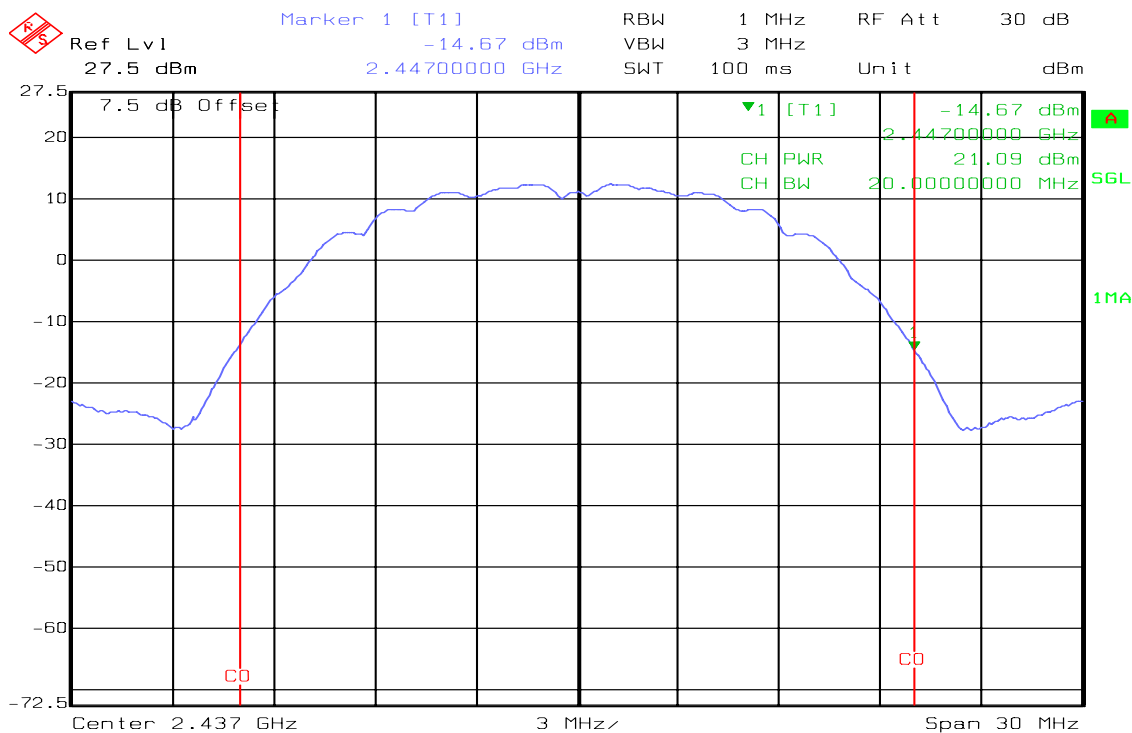
IEEE 802.11b mode

CH Low



Date: 15.JUL.2010 19:55:46

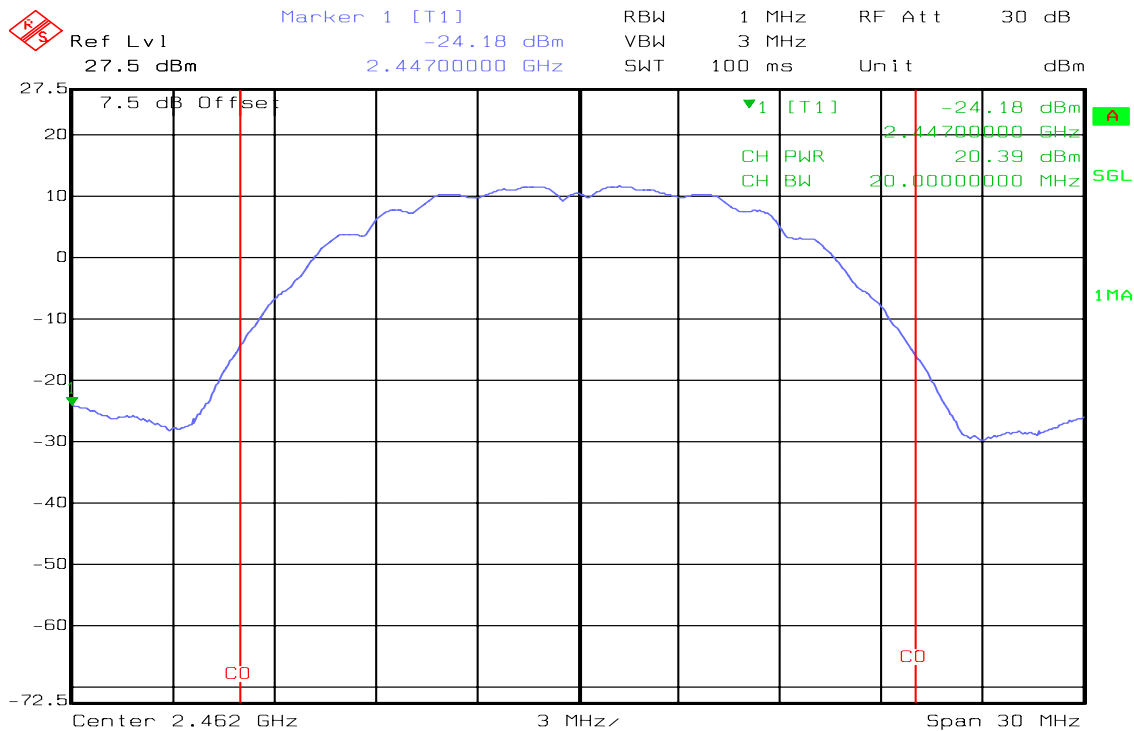
CH Mid



Date: 15.JUL.2010 19:53:37



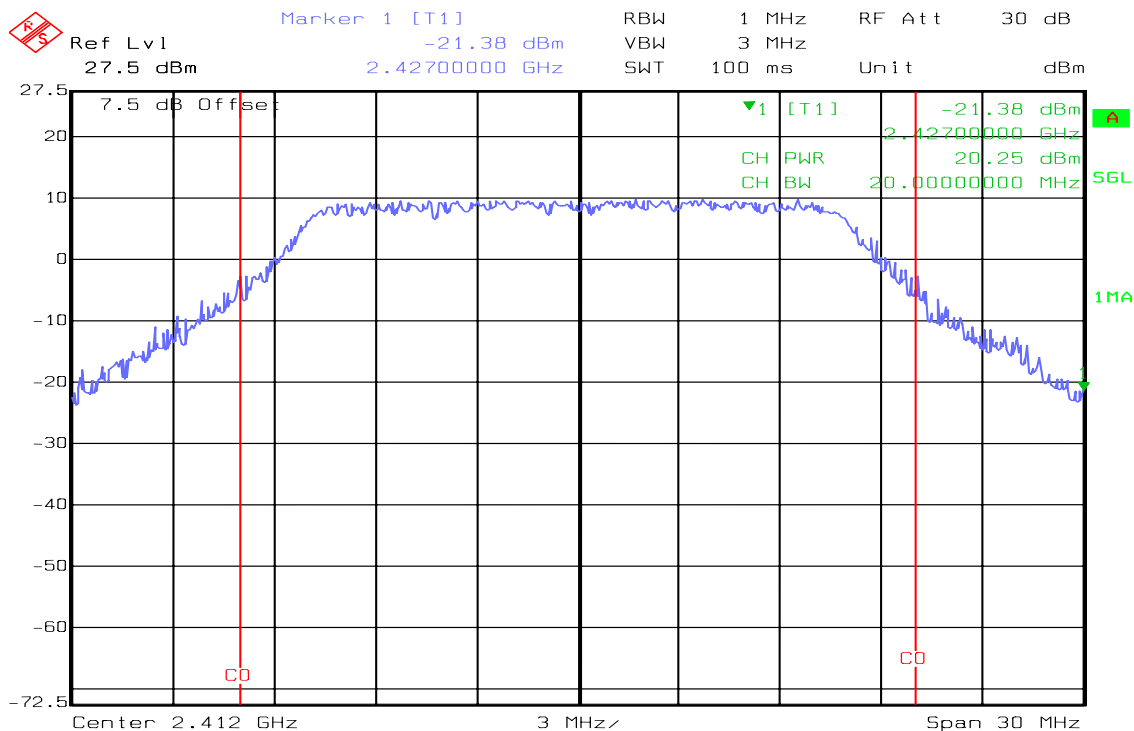
### CH High



Date: 15.JUL.2010 19:51:48

### IEEE 802.11g mode

#### CH Low

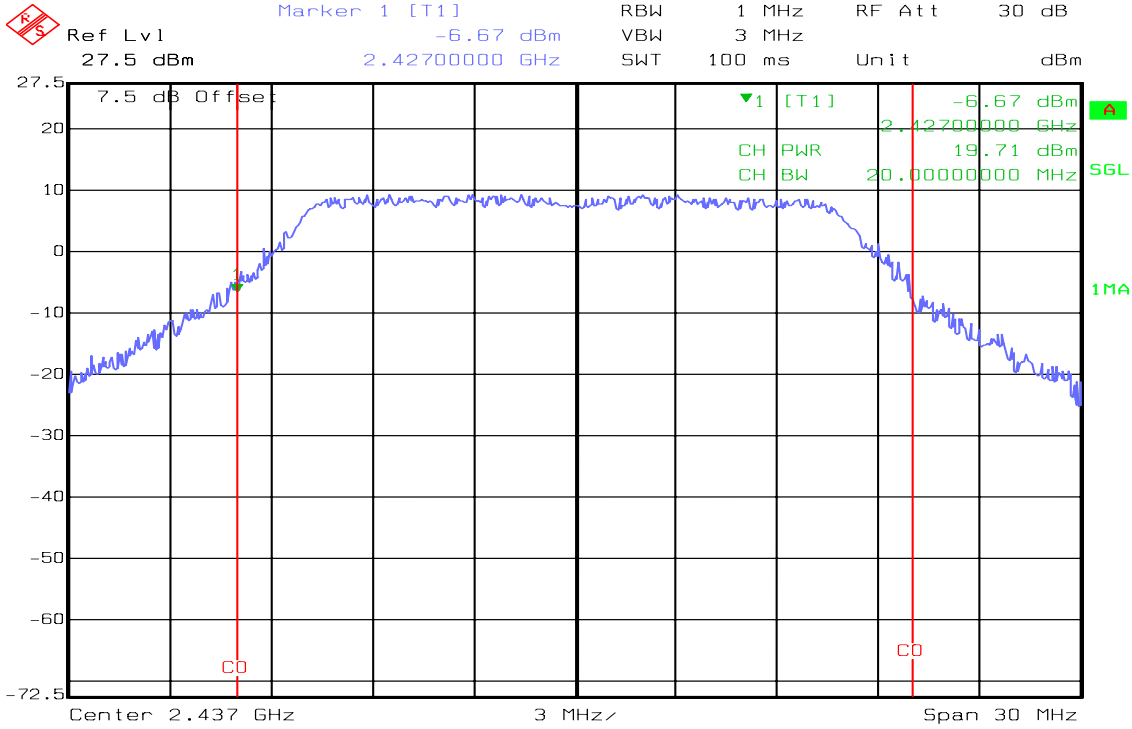


Date: 15.JUL.2010 19:44:53



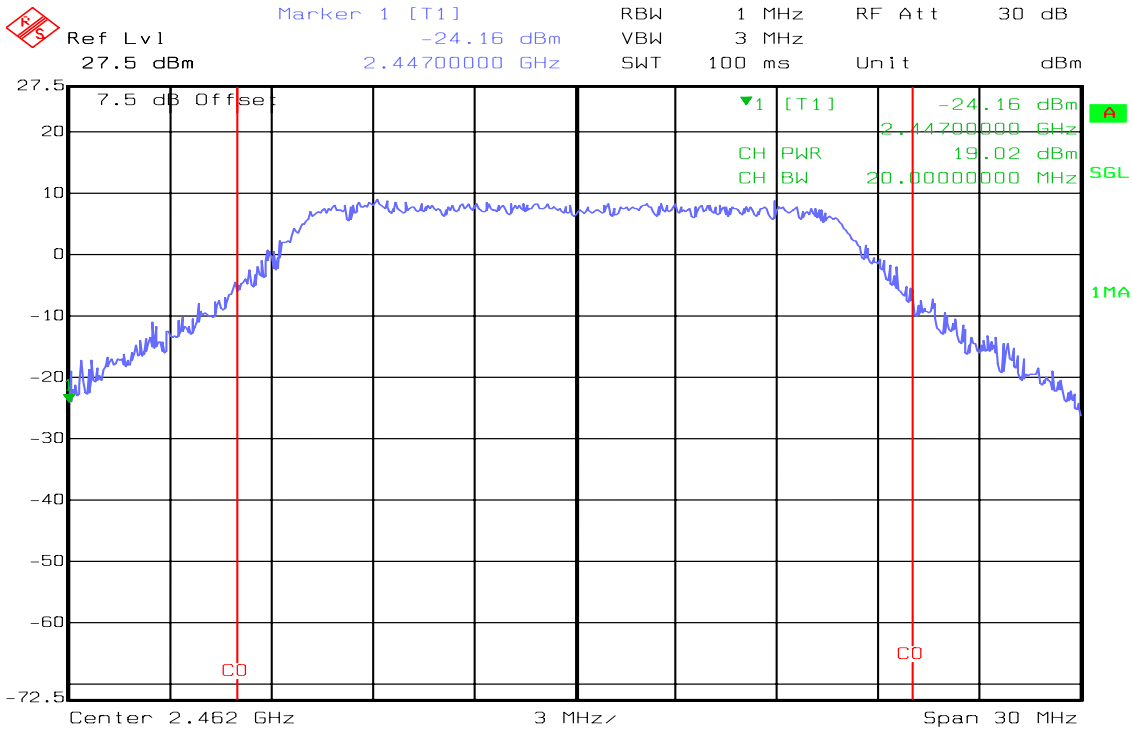


### CH Mid



Date: 15.JUL.2010 19:47:11

### CH High

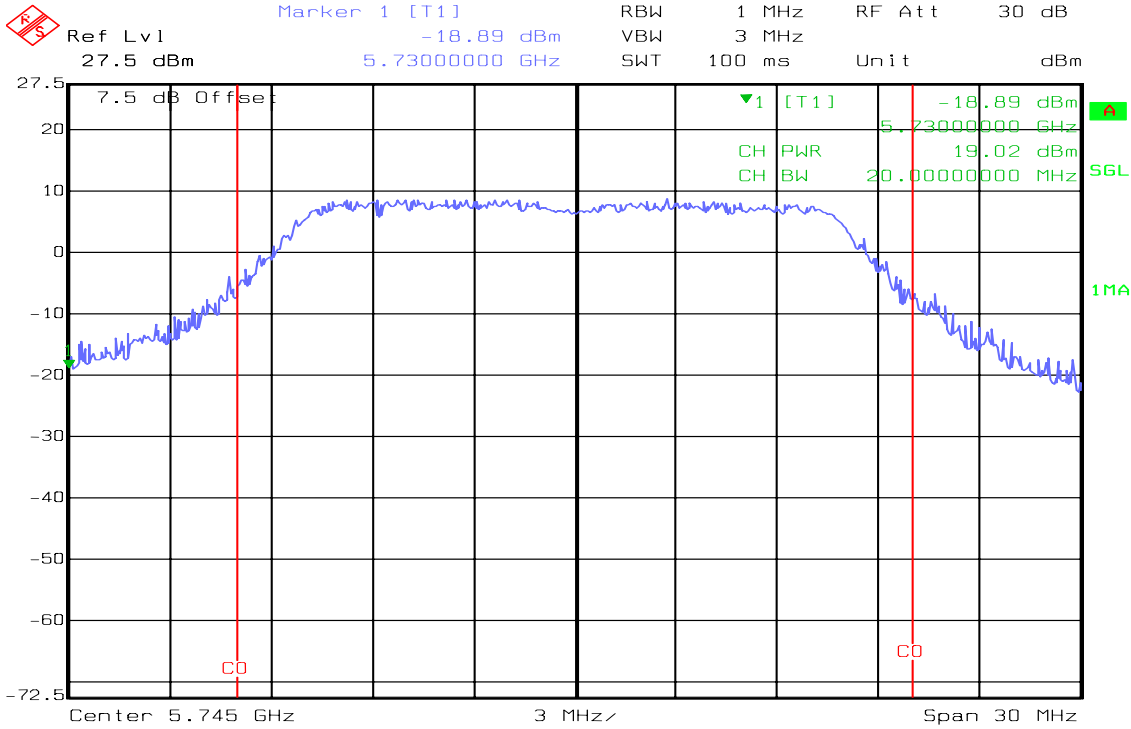


Date: 15.JUL.2010 19:49:05



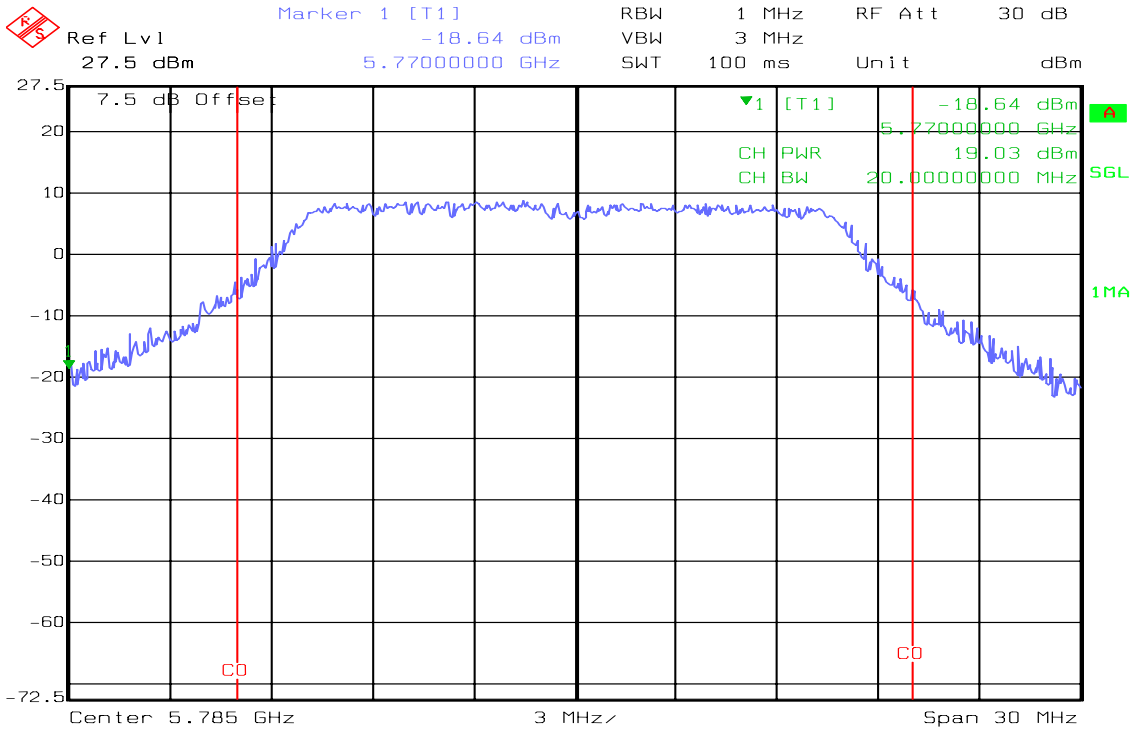
IEEE 802.11a mode

CH Low



Date: 15.JUL.2010 19:40:26

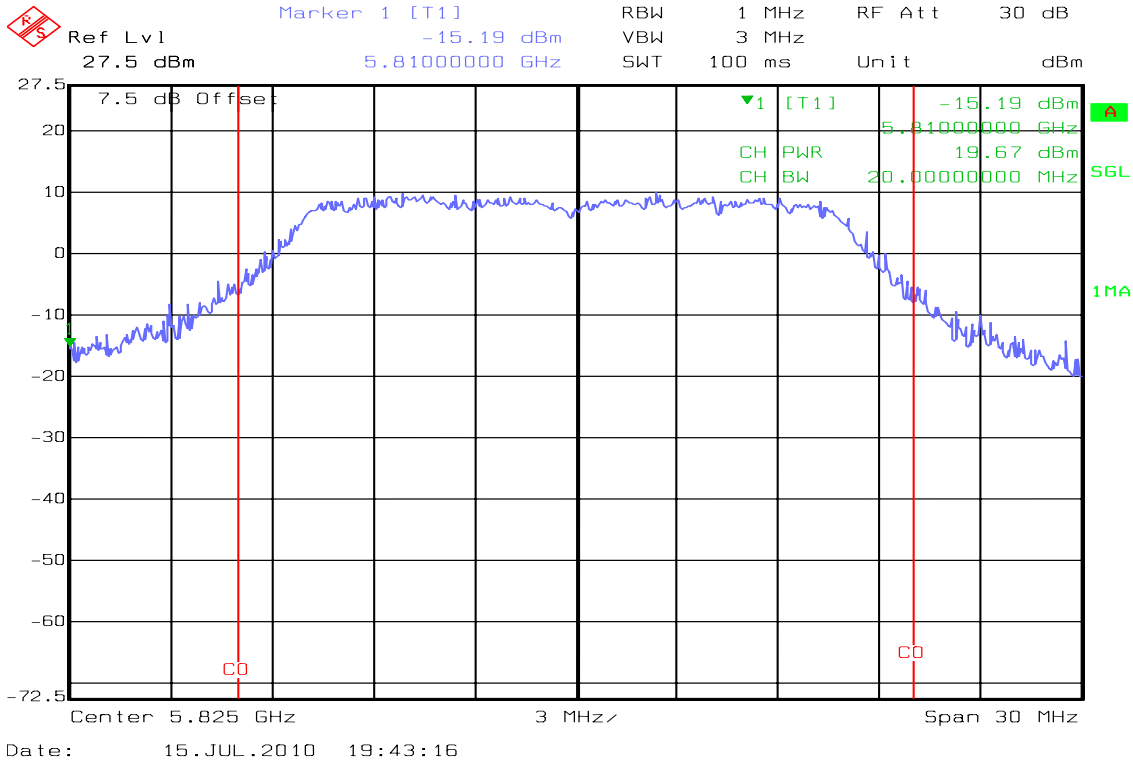
CH Mid



Date: 15.JUL.2010 19:42:29



### CH High



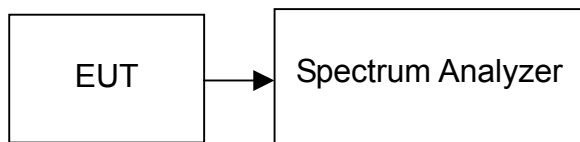


### 7.3. AVERAGE POWER

#### LIMIT

None; for reporting purposes only.

#### TEST CONFIGURATION



#### TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. The Spectrum Analyzer is set to the average power detection.

#### TEST RESULTS

*No non-compliance noted*

#### TEST DATA

##### Test mode: IEEE 802.11b

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	2412	18.40	0.06918
Mid	2437	18.02	0.06339
High	2462	17.21	0.05260

##### Test mode: IEEE 802.11g

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	2412	12.80	0.01905
Mid	2437	12.31	0.01702
High	2462	11.65	0.01462

##### Test mode: IEEE 802.11a

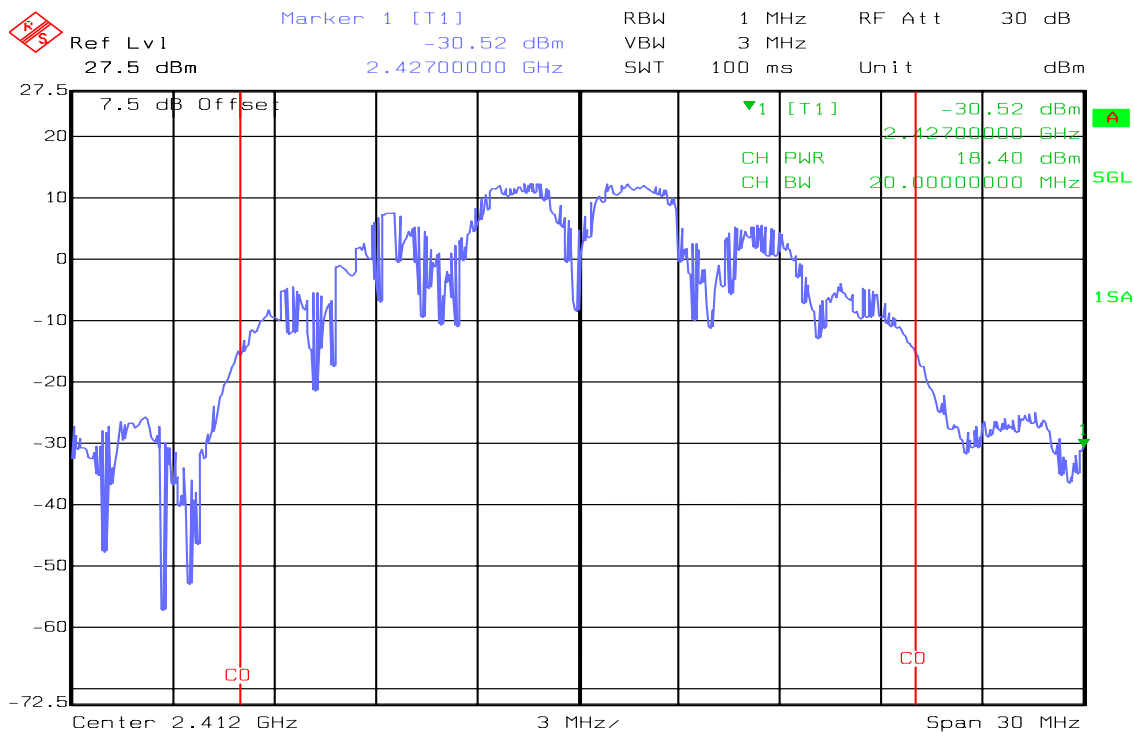
Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	5745	11.54	0.01426
Mid	5785	11.51	0.01416
High	5825	11.73	0.01489



Test Plot

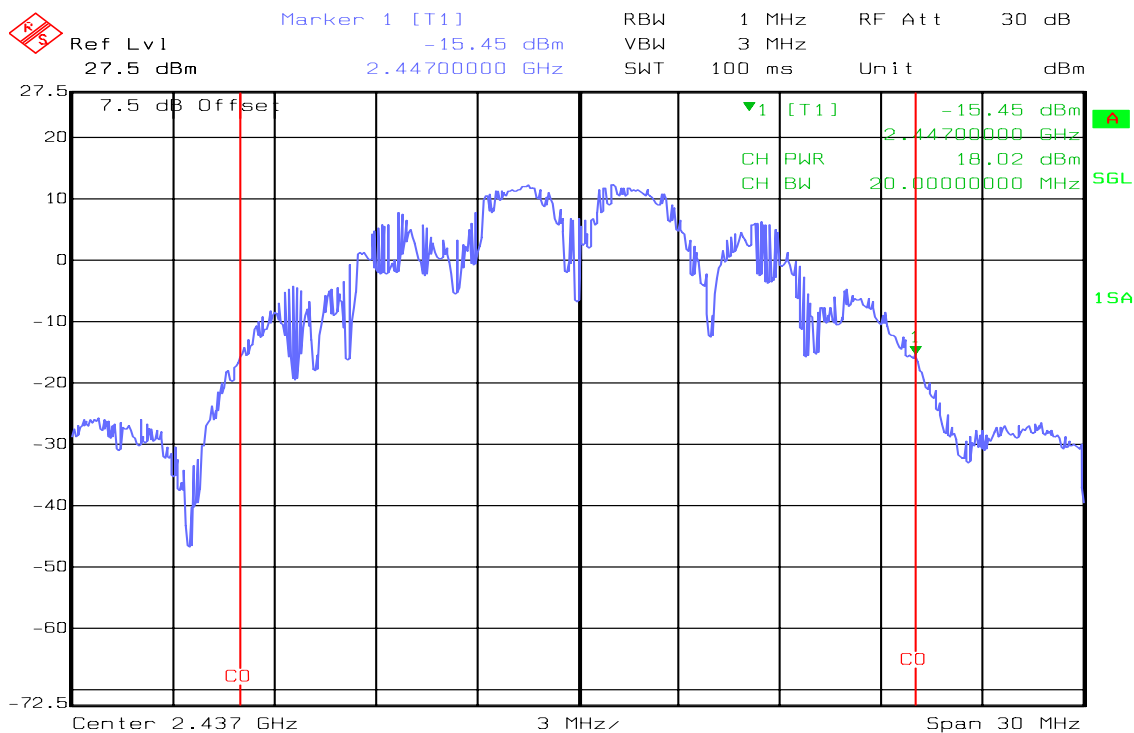
IEEE 802.11b mode

CH Low



Date: 15.JUL.2010 19:56:35

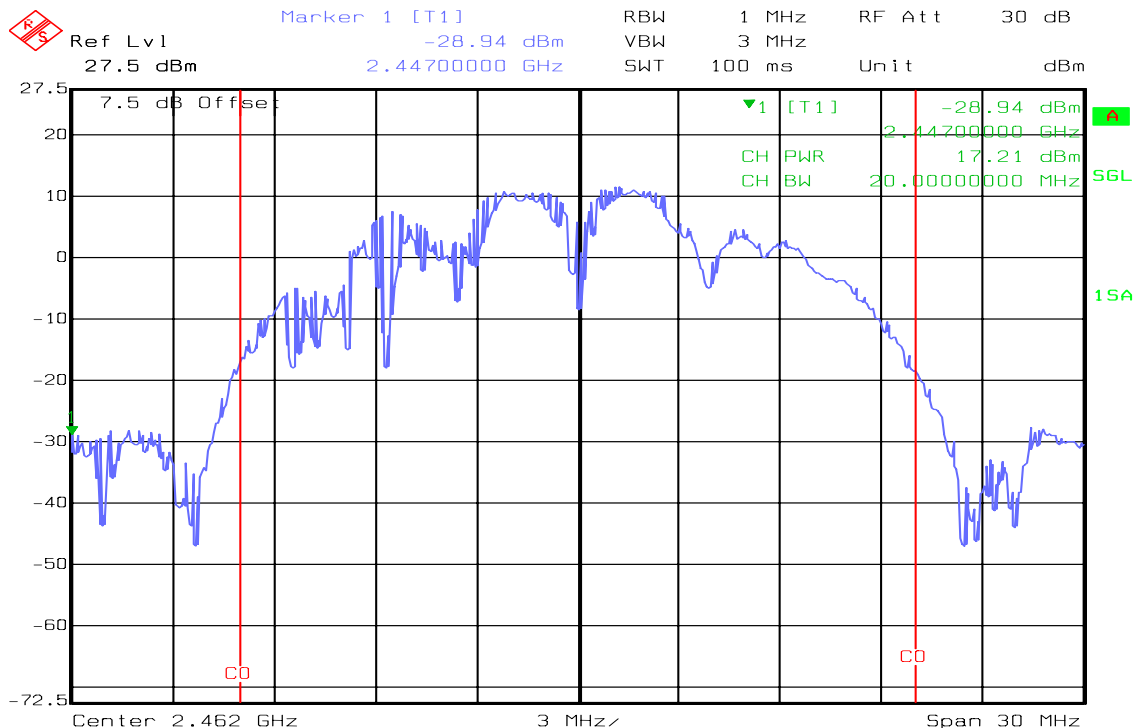
CH Mid



Date: 15.JUL.2010 19:54:12



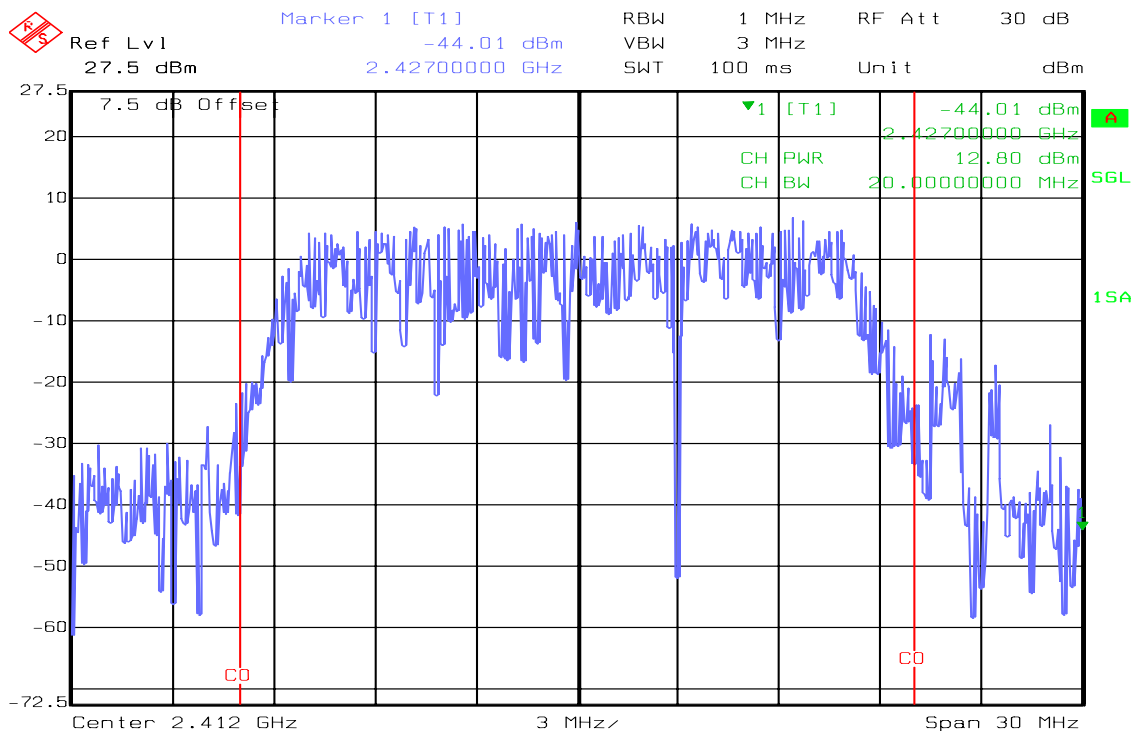
### CH High



Date: 15.JUL.2010 19:52:30

### IEEE 802.11g mode

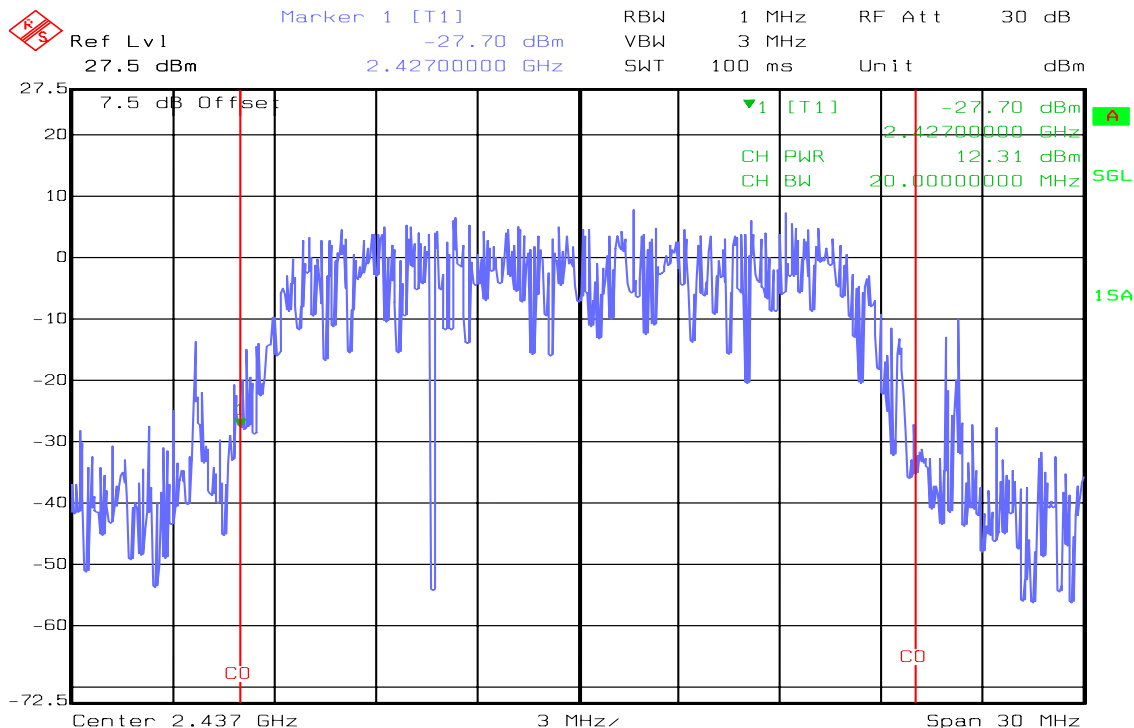
### CH Low



Date: 15.JUL.2010 19:45:21

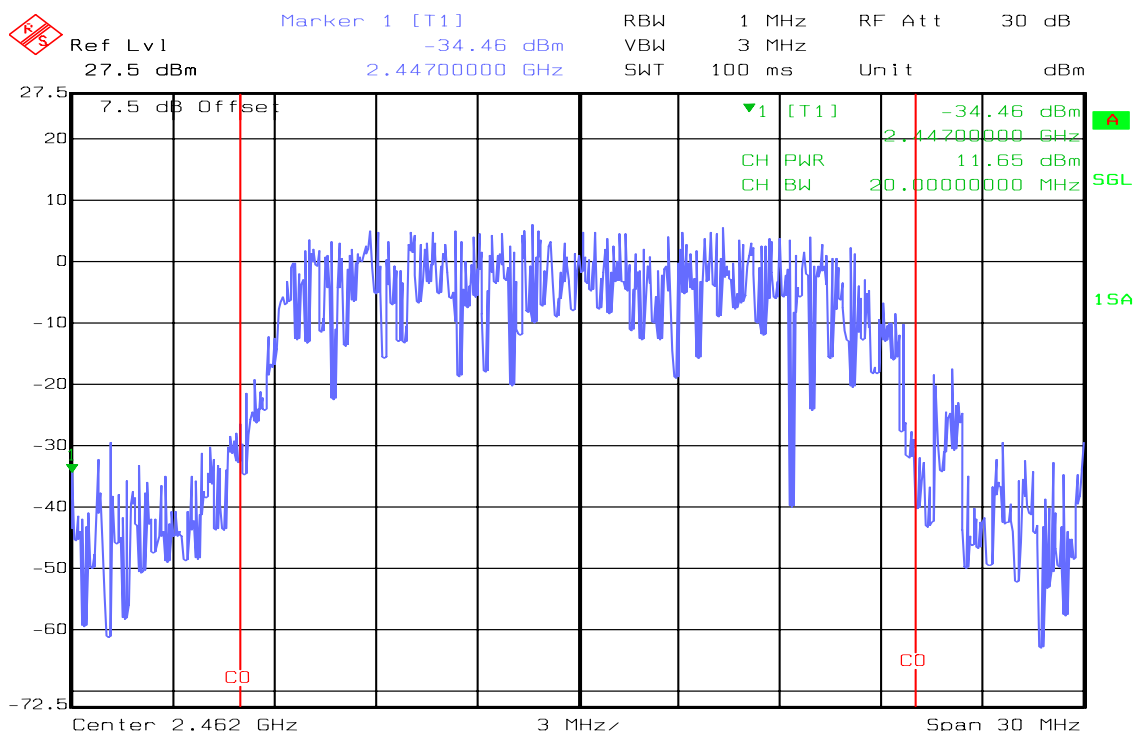


### CH Mid



Date: 15.JUL.2010 19:47:47

### CH High

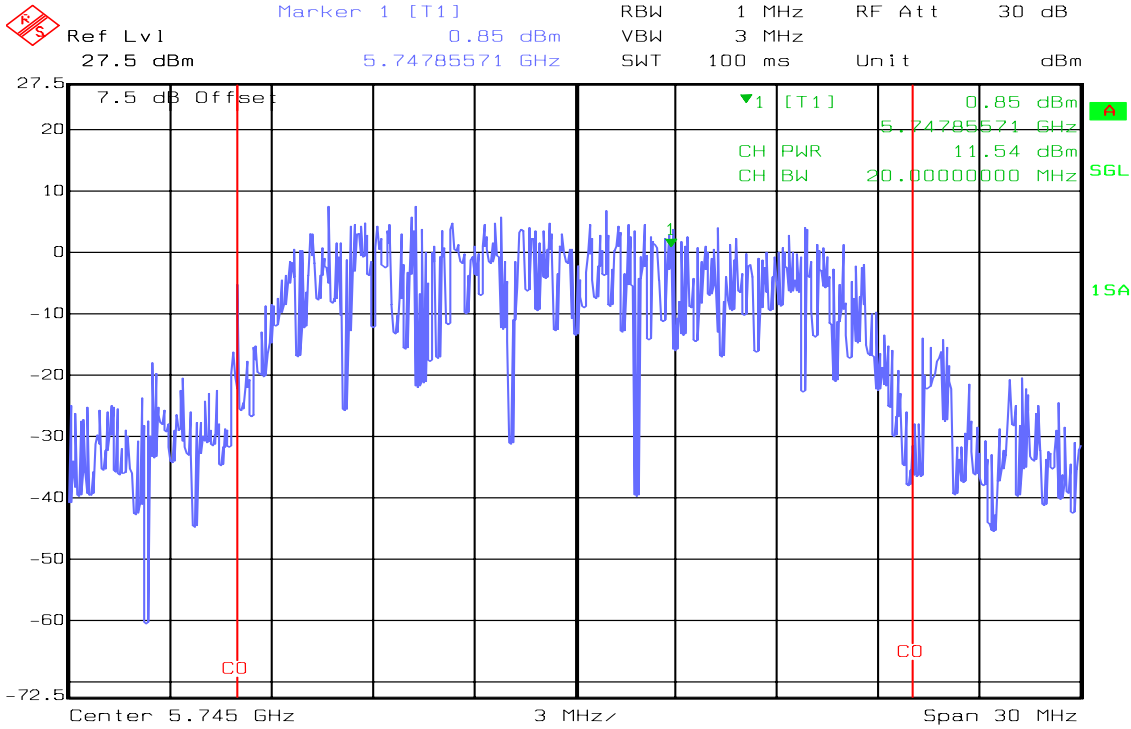


Date: 15.JUL.2010 19:49:25



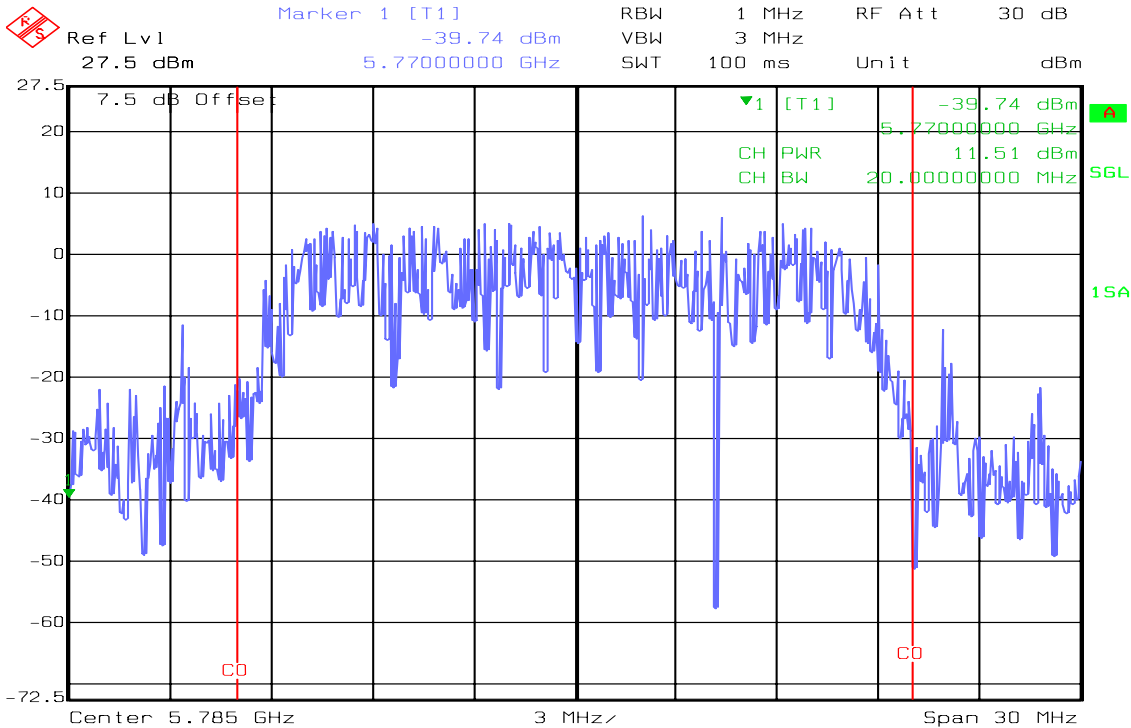
IEEE 802.11a mode

CH Low



Date: 15.JUL.2010 19:25:47

CH Mid

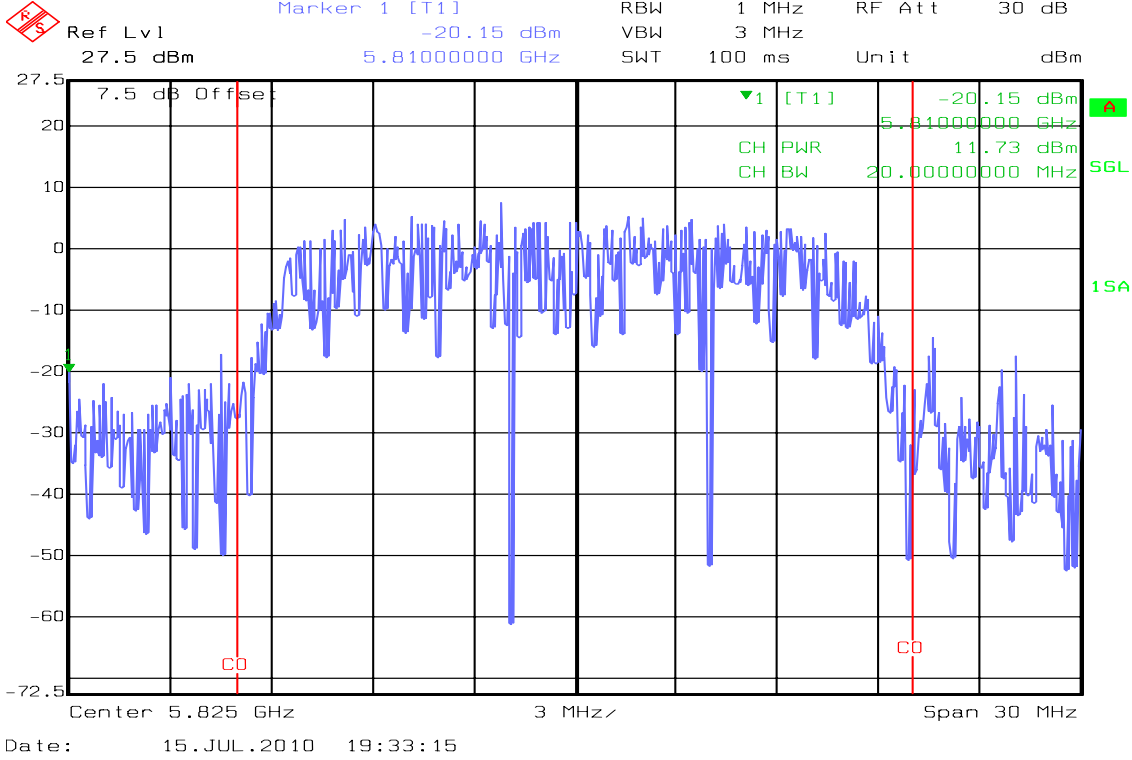


Date: 15.JUL.2010 19:28:01





CH High



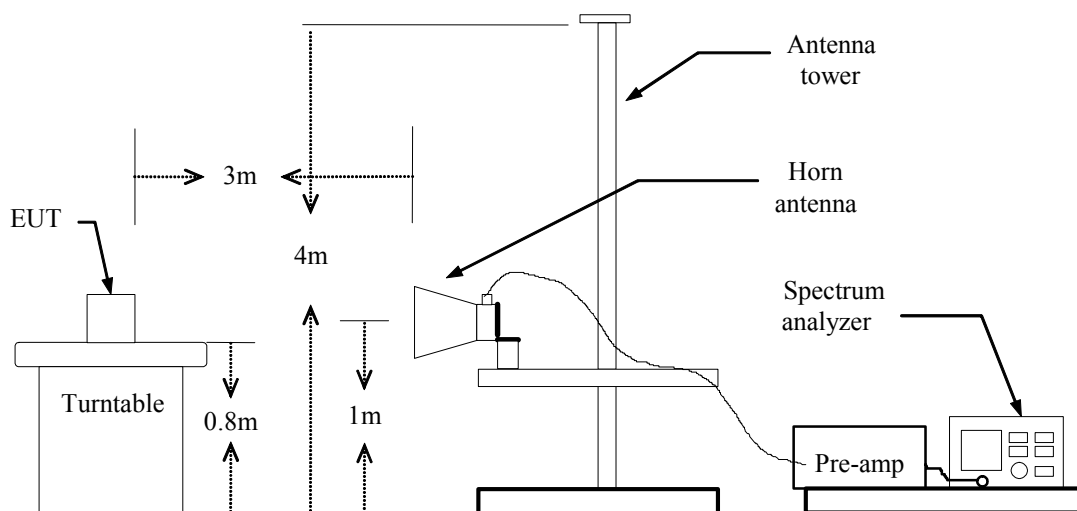


## 7.4. BAND EDGES MEASUREMENT

### LIMIT

According to §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 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)).

### TEST CONFIGURATION



### 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=100ms
  - (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

### TEST RESULTS

*No non-compliance noted*

### TEST DATA

Refer to attach spectrum analyzer data chart.



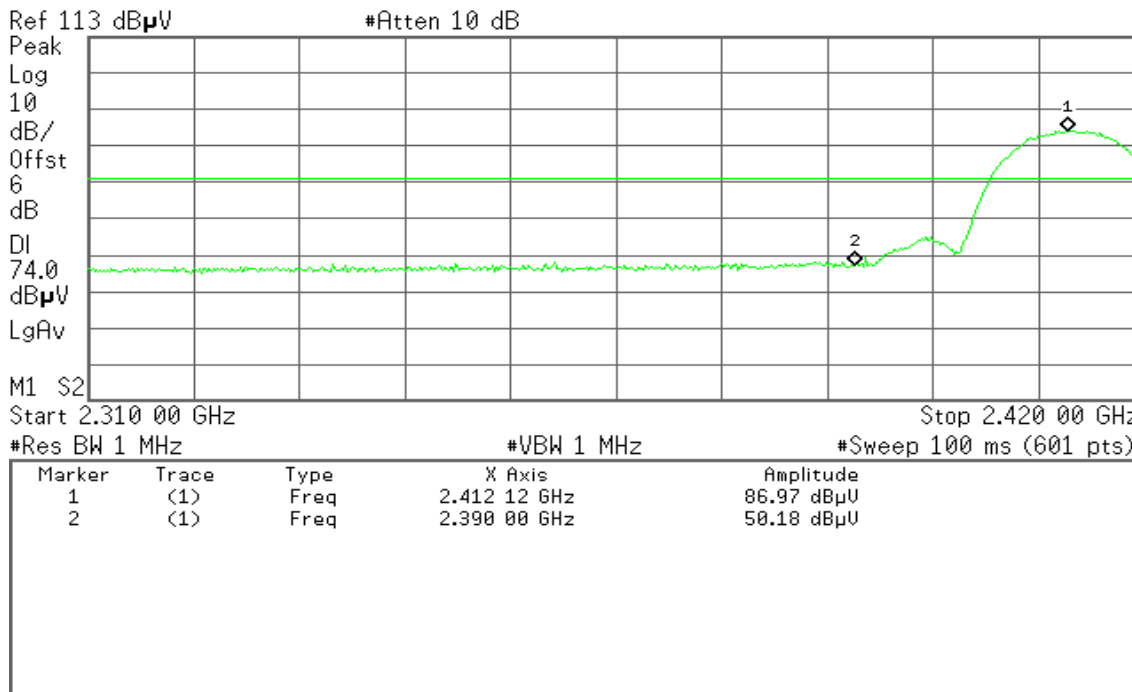
Band Edges (IEEE 802.11b mode / CH Low)

Detector mode: Peak

Polarity: Vertical

\* Agilent 15:15:45 Jul 14, 2010

R T

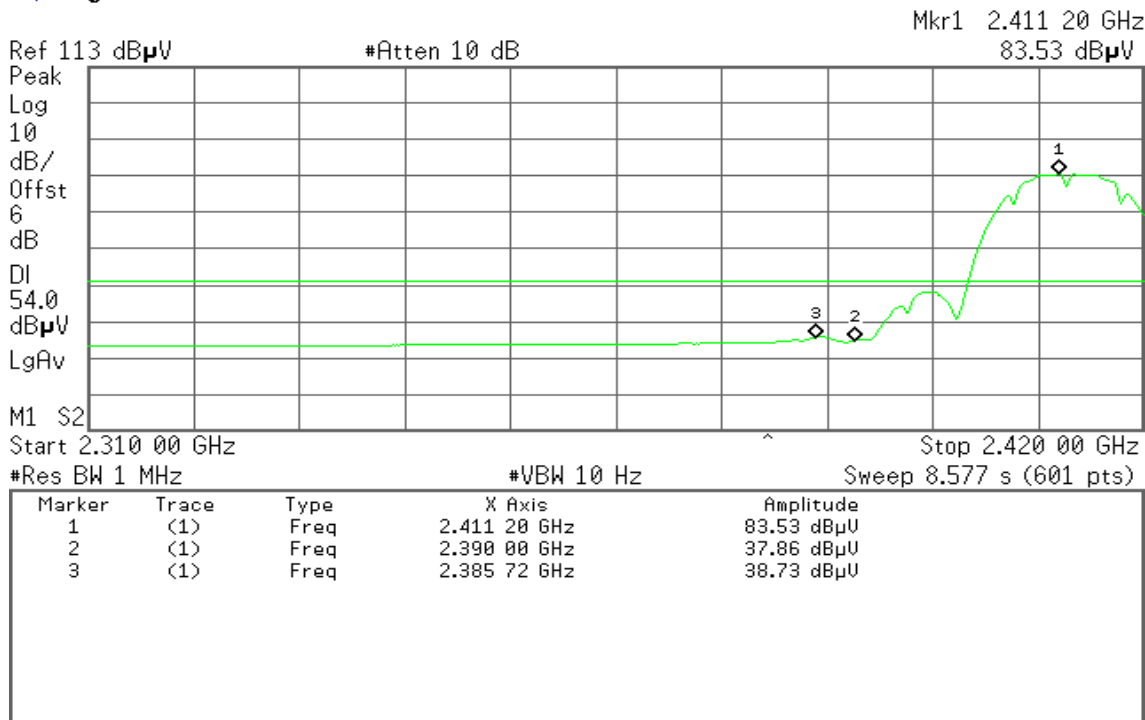


Detector mode: Average

Polarity: Vertical

\* Agilent 15:16:32 Jul 14, 2010

R T





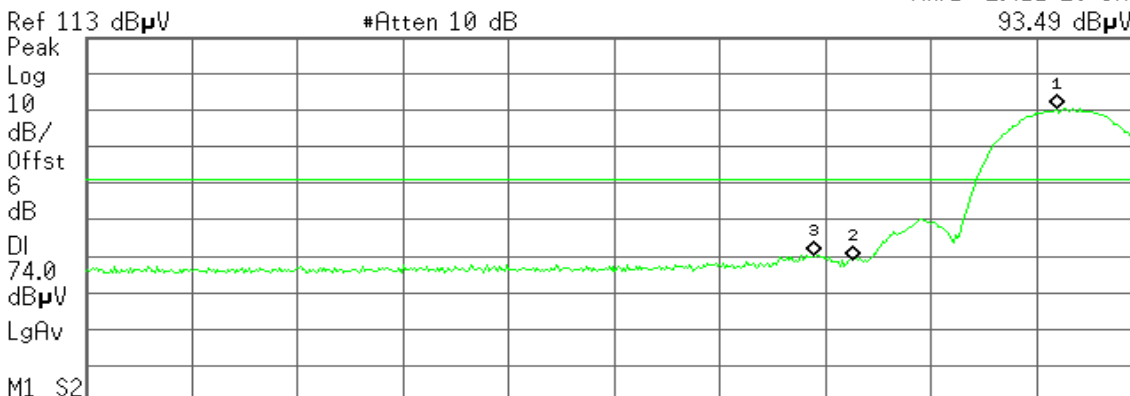
Detector mode: Peak

Polarity: Horizontal

Agilent 15:18:27 Jul 14, 2010

R T

Mkr1 2.411 20 GHz  
93.49 dBµV



Start 2.310 00 GHz Stop 2.420 00 GHz  
#Res BW 1 MHz #VBW 1 MHz #Sweep 100 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.411 20 GHz	93.49 dBµV
2	(1)	Freq	2.390 00 GHz	51.81 dBµV
3	(1)	Freq	2.385 72 GHz	53.36 dBµV

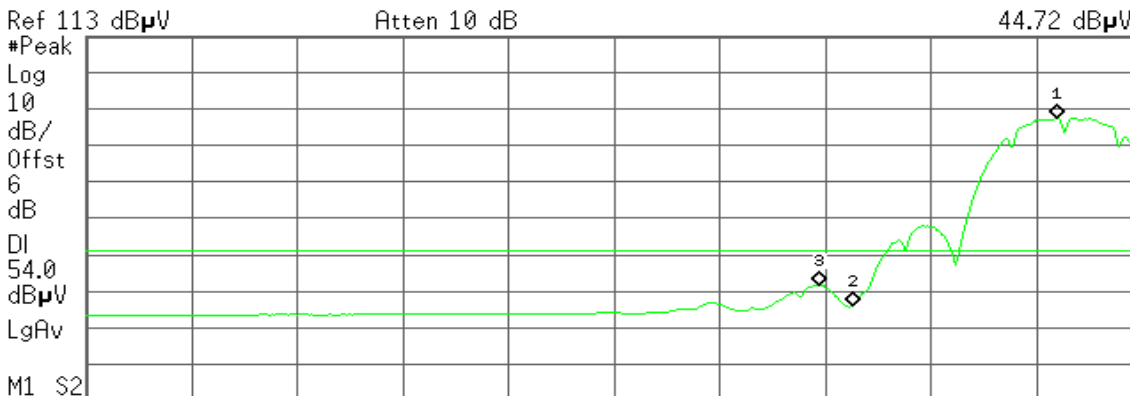
Detector mode: Average

Polarity: Horizontal

Agilent 15:25:07 Jul 14, 2010

R T

Mkr3 2.386 27 GHz  
44.72 dBµV



Start 2.310 00 GHz Stop 2.420 00 GHz  
Res BW 1 MHz #VBW 10 Hz Sweep 8.577 s (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.411 20 GHz	90.48 dBµV
2	(1)	Freq	2.390 00 GHz	39.09 dBµV
3	(1)	Freq	2.386 27 GHz	44.72 dBµV



Band Edges (IEEE 802.11b mode / CH High)

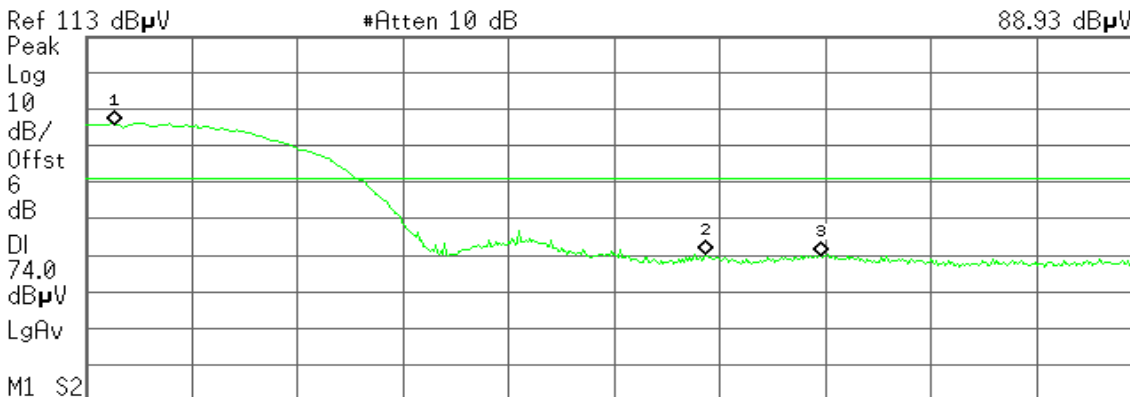
Detector mode: Peak

Polarity: Vertical

Agilent 15:09:29 Jul 14, 2010

R T

Mkr1 2.461 07 GHz  
88.93 dBµV



Start 2.460 00 GHz #Res BW 1 MHz #VBW 1 MHz #Sweep 100 ms (601 pts) Stop 2.500 00 GHz

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.461 07 GHz	88.93 dBµU
2	(1)	Freq	2.483 50 GHz	53.17 dBµU
3	(1)	Freq	2.487 80 GHz	52.79 dBµU

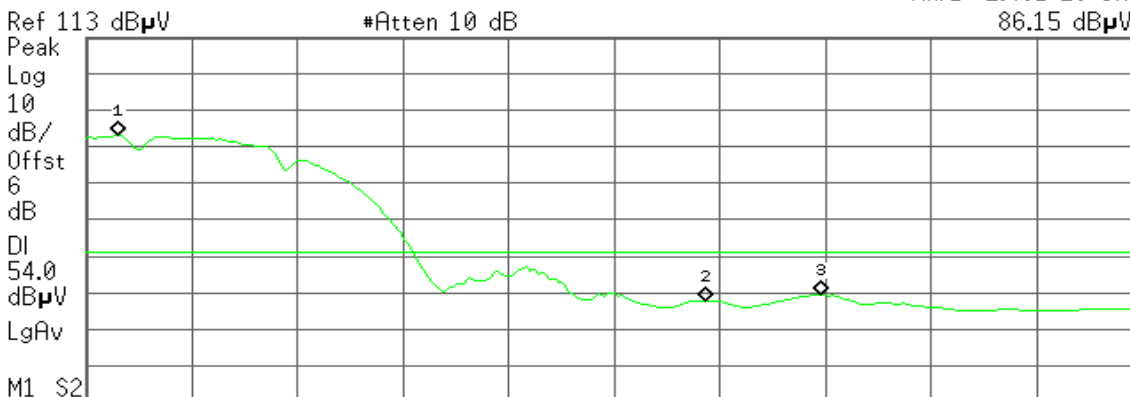
Detector mode: Average

Polarity: Vertical

Agilent 15:10:09 Jul 14, 2010

R T

Mkr1 2.461 20 GHz  
86.15 dBµV



Start 2.460 00 GHz #Res BW 1 MHz #VBW 10 Hz Sweep 3.119 s (601 pts) Stop 2.500 00 GHz

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.461 20 GHz	86.15 dBµU
2	(1)	Freq	2.483 50 GHz	40.86 dBµU
3	(1)	Freq	2.487 80 GHz	42.64 dBµU



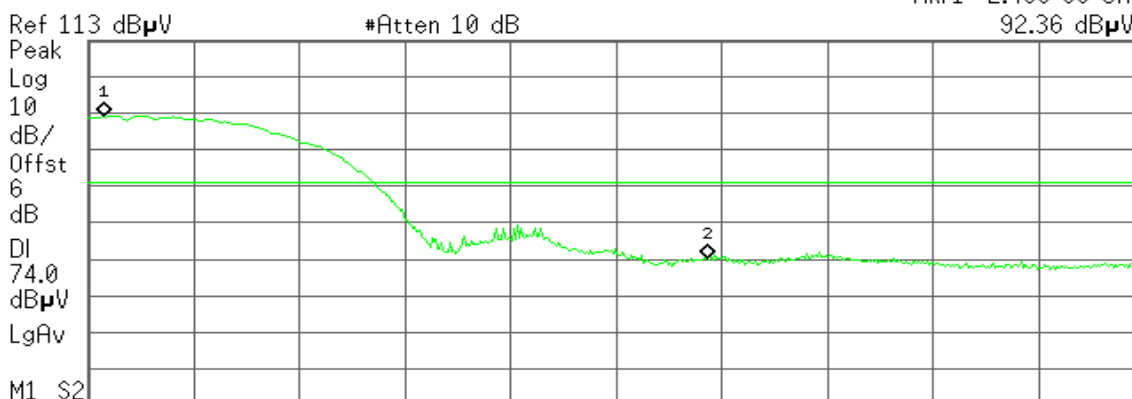
Detector mode: Peak

Polarity: Horizontal

Agilent 15:04:19 Jul 14, 2010

R T

Mkr1 2.460 60 GHz  
92.36 dBµV



Start 2.460 00 GHz Stop 2.500 00 GHz  
#Res BW 1 MHz #VBW 1 MHz #Sweep 100 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.460 60 GHz	92.36 dBµU
2	(1)	Freq	2.483 50 GHz	53.11 dBµU

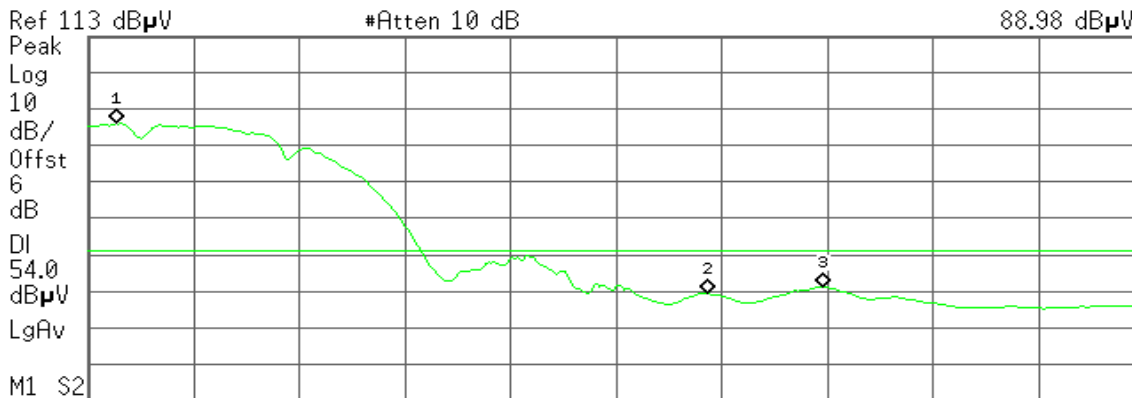
Detector mode: Average

Polarity: Horizontal

Agilent 15:05:17 Jul 14, 2010

R T

Mkr1 2.461 07 GHz  
88.98 dBµV



Start 2.460 00 GHz Stop 2.500 00 GHz  
#Res BW 1 MHz #VBW 10 Hz Sweep 3.119 s (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.461 07 GHz	88.98 dBµU
2	(1)	Freq	2.483 50 GHz	42.31 dBµU
3	(1)	Freq	2.487 80 GHz	44.07 dBµU



Band Edges (IEEE 802.11g mode / CH Low)

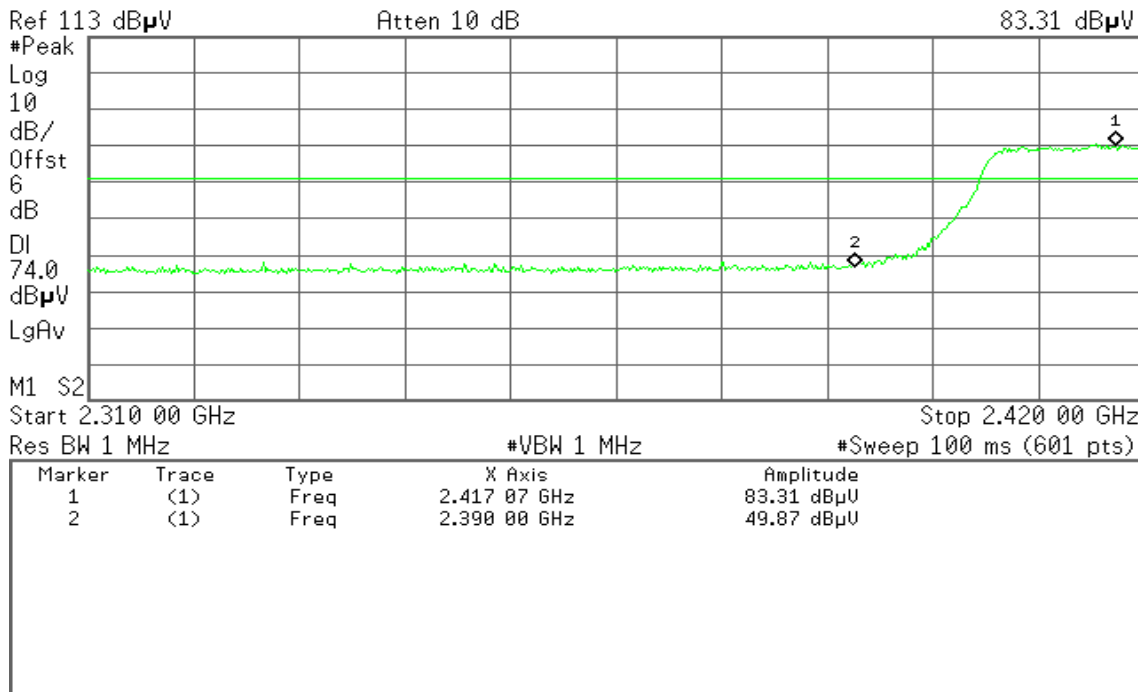
Detector mode: Peak

Polarity: Vertical

Agilent 15:31:37 Jul 14, 2010

R T

Mkr1 2.417 07 GHz  
83.31 dBµV



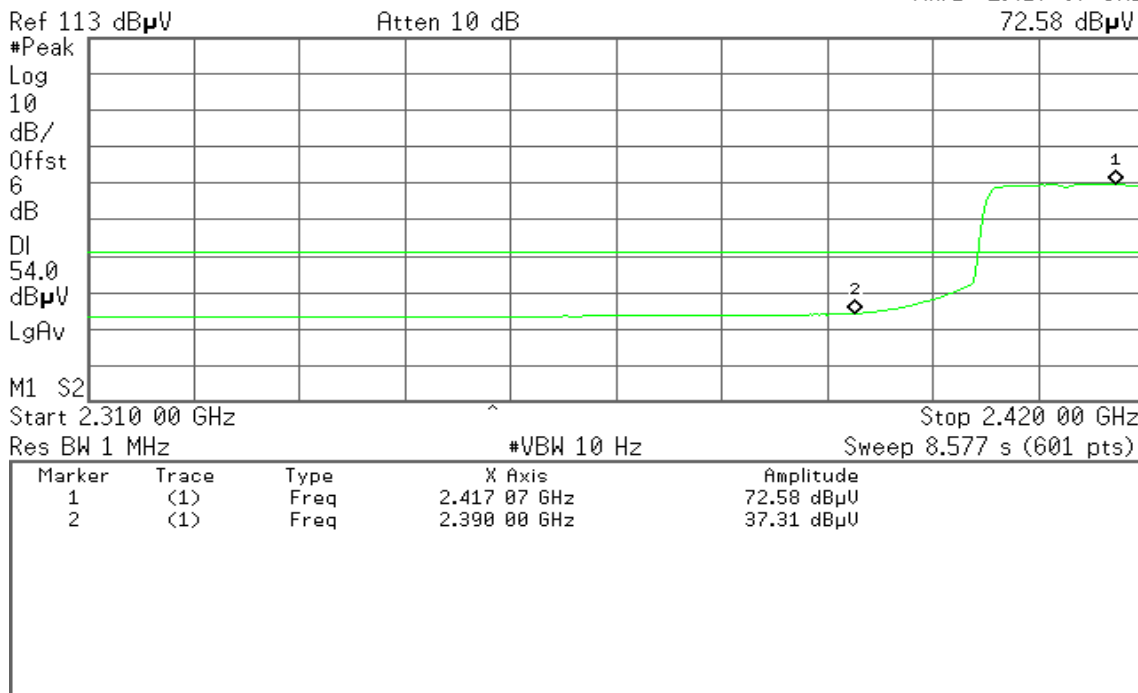
Detector mode: Average

Polarity: Vertical

Agilent 15:32:10 Jul 14, 2010

R T

Mkr1 2.417 07 GHz  
72.58 dBµV





Detector mode: Peak

Polarity: Horizontal

Agilent 15:29:19 Jul 14, 2010

R T

Mkr1 2.414 50 GHz  
90.10 dBµV



Start 2.310 00 GHz Stop 2.420 00 GHz  
Res BW 1 MHz #VBW 1 MHz #Sweep 100 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.414 50 GHz	90.10 dBµU
2	(1)	Freq	2.390 00 GHz	54.42 dBµU

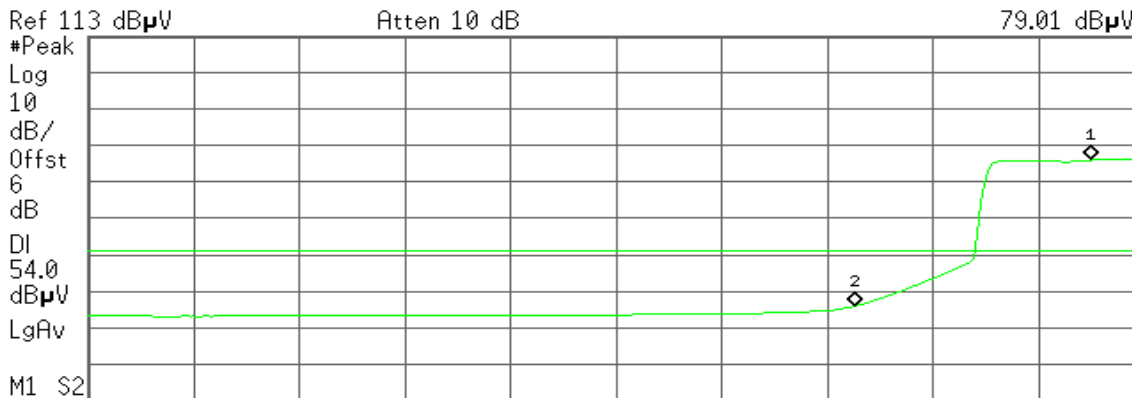
Detector mode: Average

Polarity: Horizontal

Agilent 15:30:01 Jul 14, 2010

R T

Mkr1 2.414 50 GHz  
79.01 dBµV



Start 2.310 00 GHz Stop 2.420 00 GHz  
Res BW 1 MHz #VBW 10 Hz Sweep 8.577 s (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.414 50 GHz	79.01 dBµU
2	(1)	Freq	2.390 00 GHz	38.92 dBµU





Band Edges (IEEE 802.11g mode / CH High)

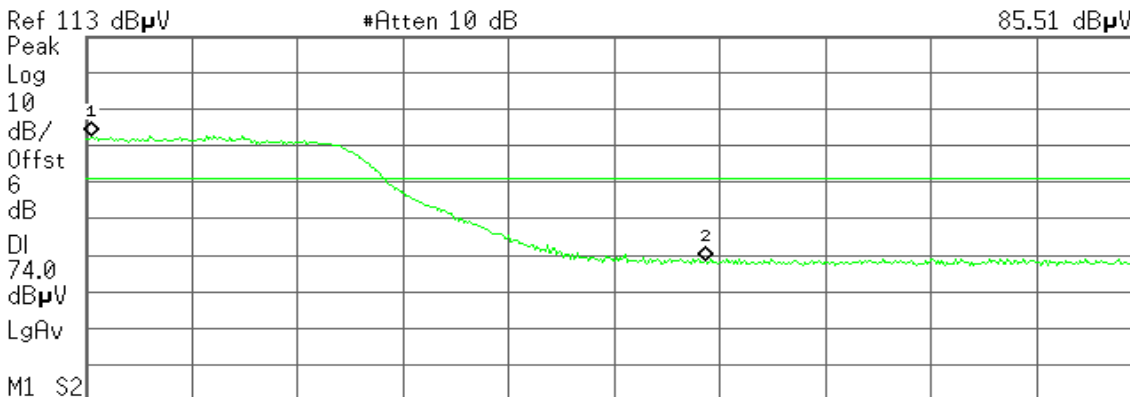
Detector mode: Peak

Polarity: Vertical

Agilent 14:56:47 Jul 14, 2010

R T

Mkr1 2.460 20 GHz  
85.51 dBμV



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.460 20 GHz	85.51 dBμU
2	(1)	Freq	2.483 50 GHz	51.68 dBμU

Detector mode: Average

Polarity: Vertical

Agilent 14:57:19 Jul 14, 2010

R T

Mkr1 2.460 00 GHz  
74.97 dBμV



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.460 00 GHz	74.97 dBμU
2	(1)	Freq	2.483 50 GHz	38.49 dBμU



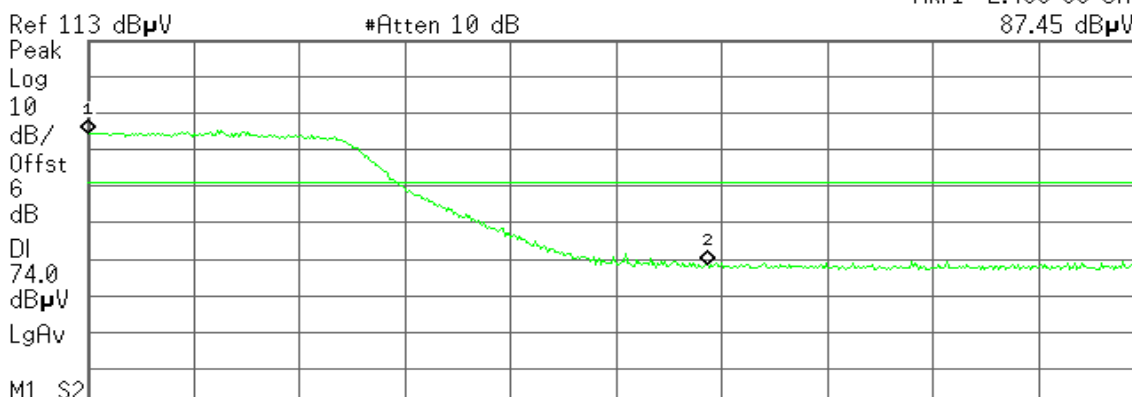
Detector mode: Peak

Polarity: Horizontal

Agilent 14:59:56 Jul 14, 2010

R T

Mkr1 2.460 00 GHz  
87.45 dBµV



#Res BW 1 MHz #VBW 1 MHz #Sweep 100 ms (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.460 00 GHz	87.45 dBµU
2	(1)	Freq	2.483 50 GHz	51.44 dBµU

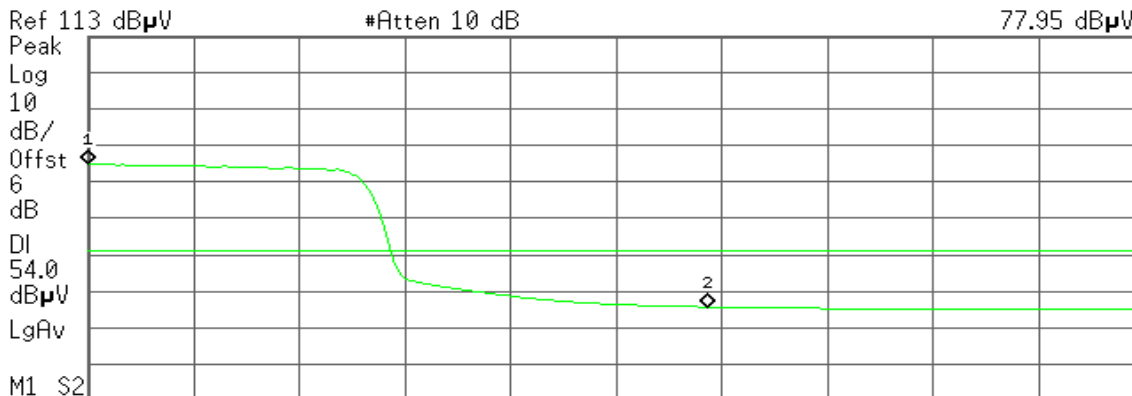
Detector mode: Average

Polarity: Horizontal

Agilent 15:00:29 Jul 14, 2010

R T

Mkr1 2.460 00 GHz  
77.95 dBµV



#Res BW 1 MHz #VBW 10 Hz Sweep 3.119 s (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.460 00 GHz	77.95 dBµU
2	(1)	Freq	2.483 50 GHz	38.69 dBµU



**Band Edges (802.11a Mode)**

1. Operating Frequency: 5725-5875MHz
2. CH Low: 5745MHz, CH High: 5825MHz
3. 6dB bandwidth: CH Low: 16.59MHz, CH High: 16.60MHz

Because the mentioned conditions, the operating frequency is in frequency bands 5725-5875MHz, the test is not applicable.

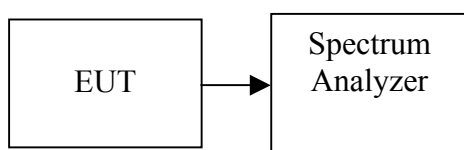


## **7.5. PEAK POWER SPECTRAL DENSITY**

### **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**



### **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.

### **TEST RESULTS**

*No non-compliance noted*

**TEST DATA****IEEE 802.11b**

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Test Result
Low	2412	-4.99	8.00	PASS
Mid	2437	-4.94		PASS
High	2462	-6.25		PASS

**IEEE 802.11g**

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Test Result
Low	2412	-6.52	8.00	PASS
Mid	2437	-6.22		PASS
High	2462	-6.81		PASS

**IEEE 802.11a**

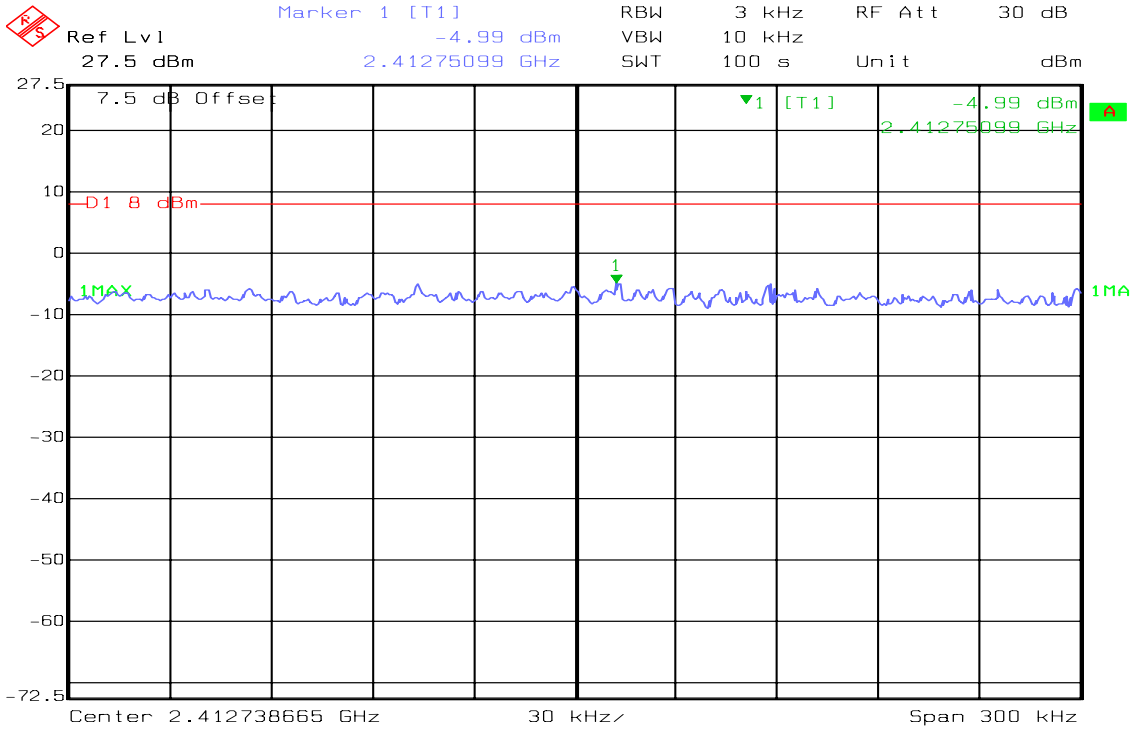
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Test Result
Low	5745	-12.47	8.00	PASS
Mid	5785	-12.90		PASS
High	5825	-11.61		PASS



Test Plot

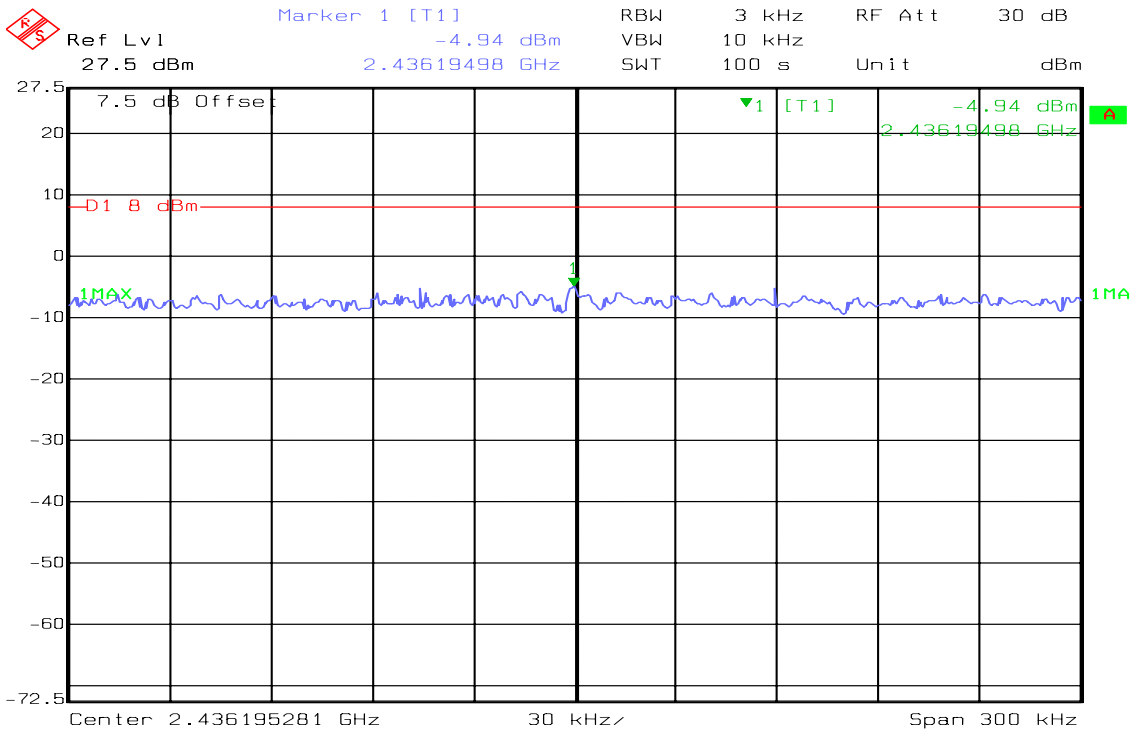
IEEE 802.11b mode

CH Low



Date: 15.JUL.2010 20:42:56

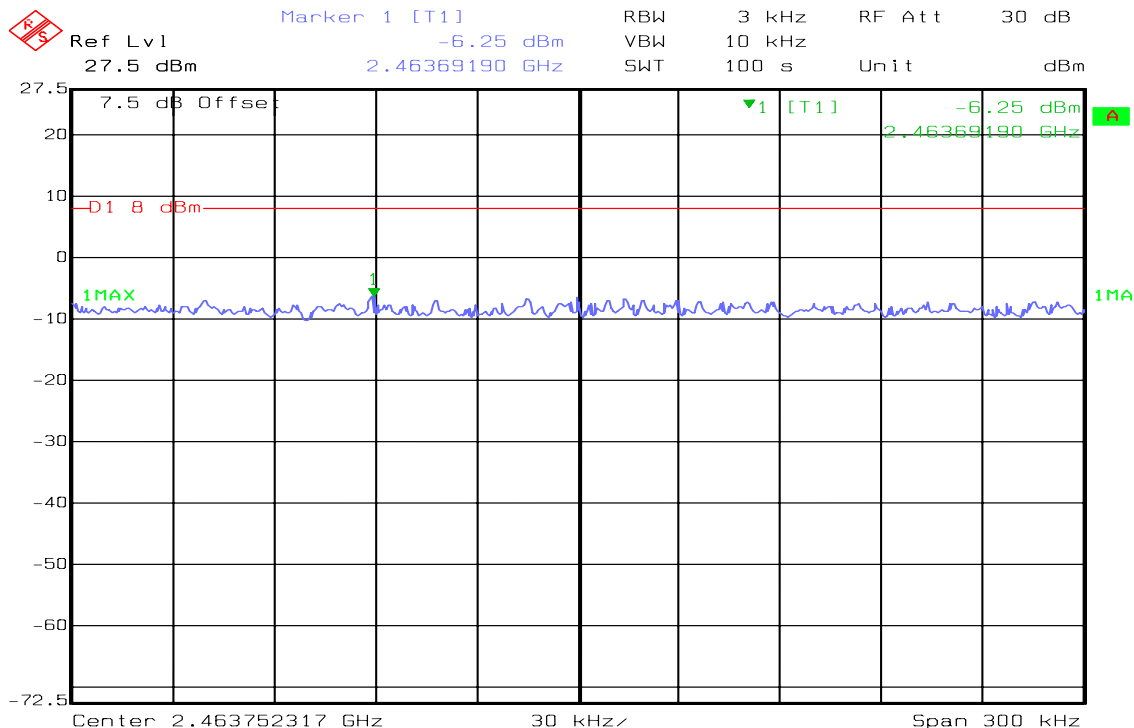
CH Mid



Date: 15.JUL.2010 20:50:28



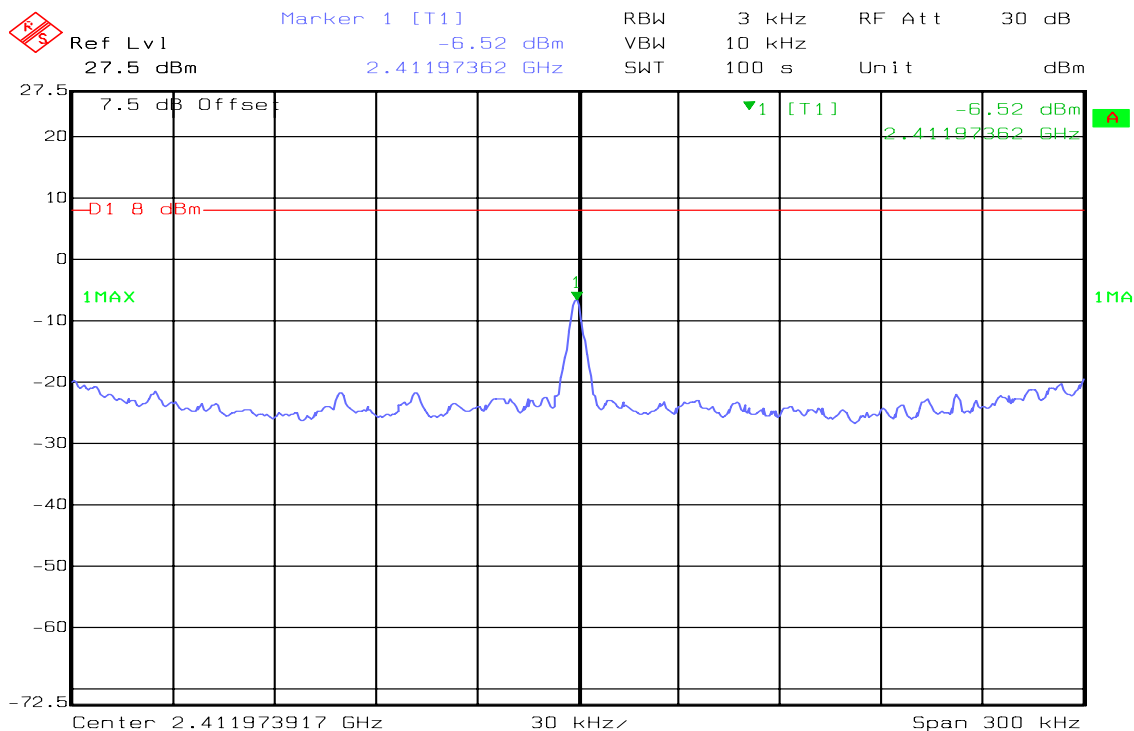
### CH High



Date: 15.JUL.2010 20:57:33

### IEEE 802.11g mode

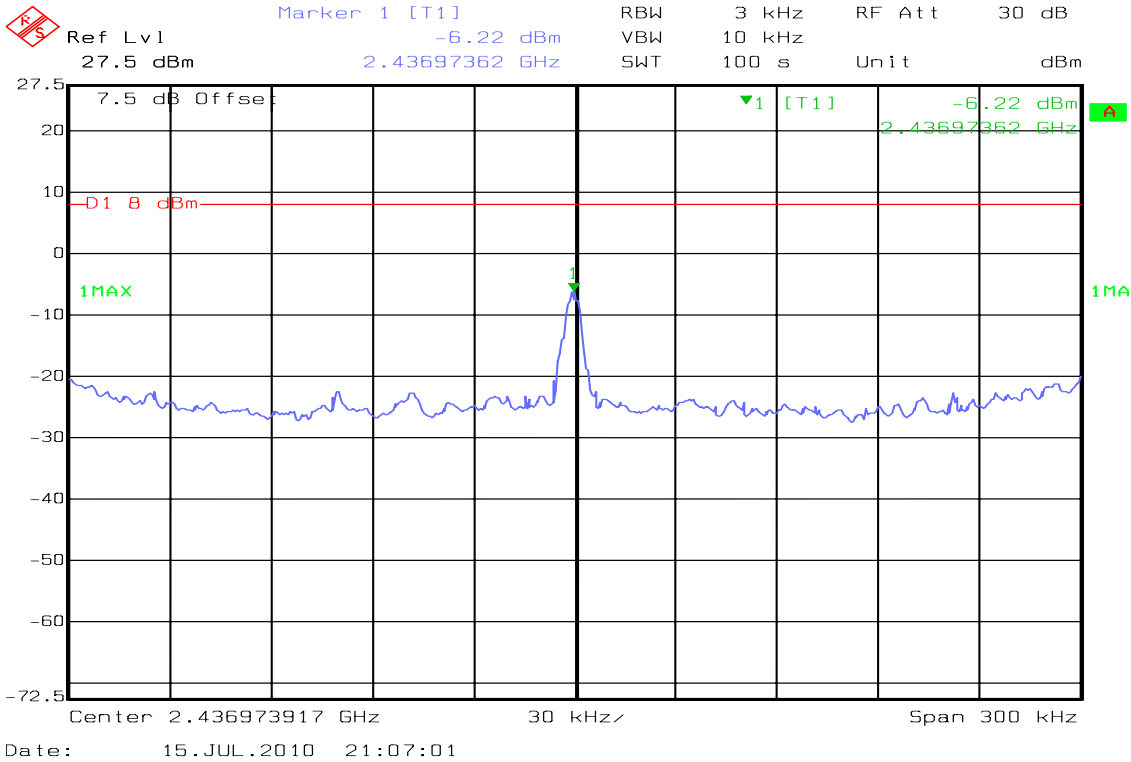
### CH Low



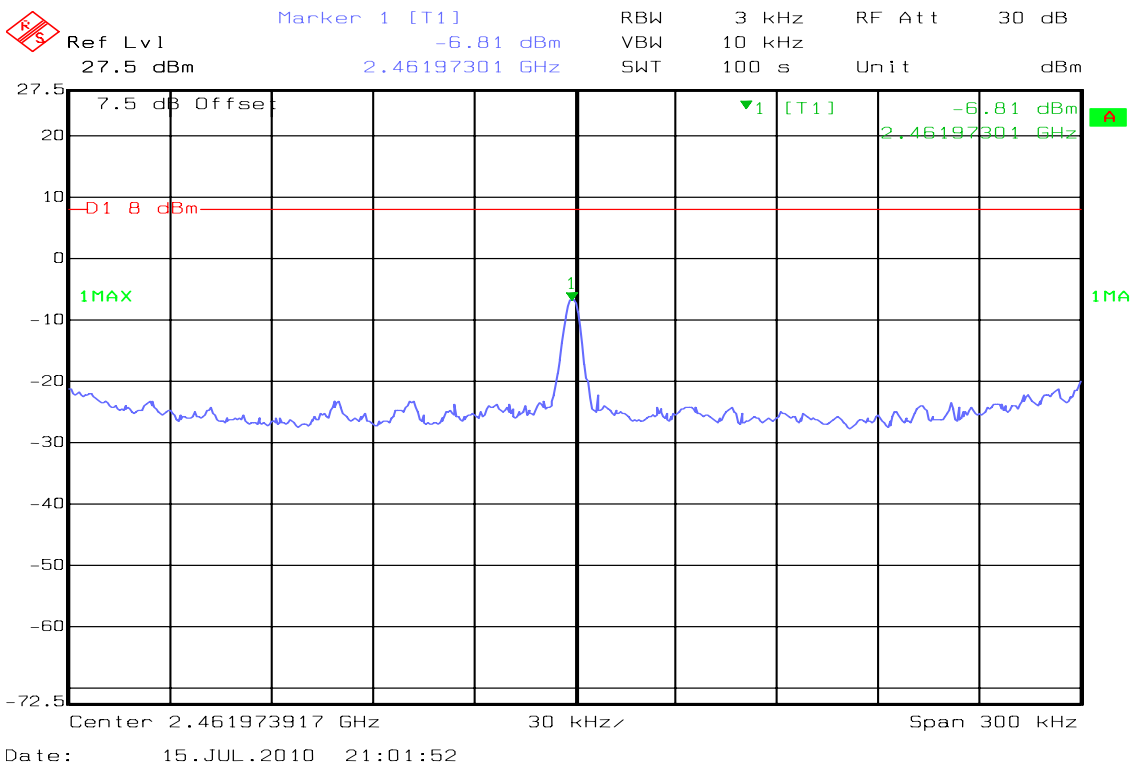
Date: 15.JUL.2010 21:16:09



### CH Mid



### CH High

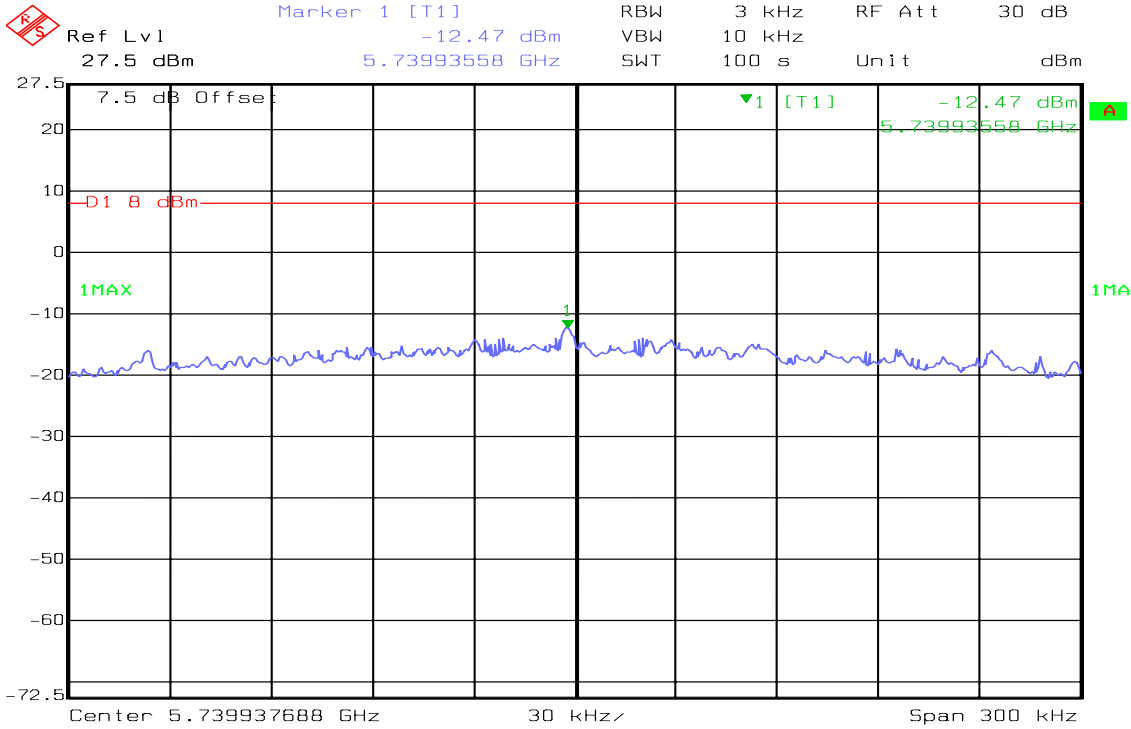






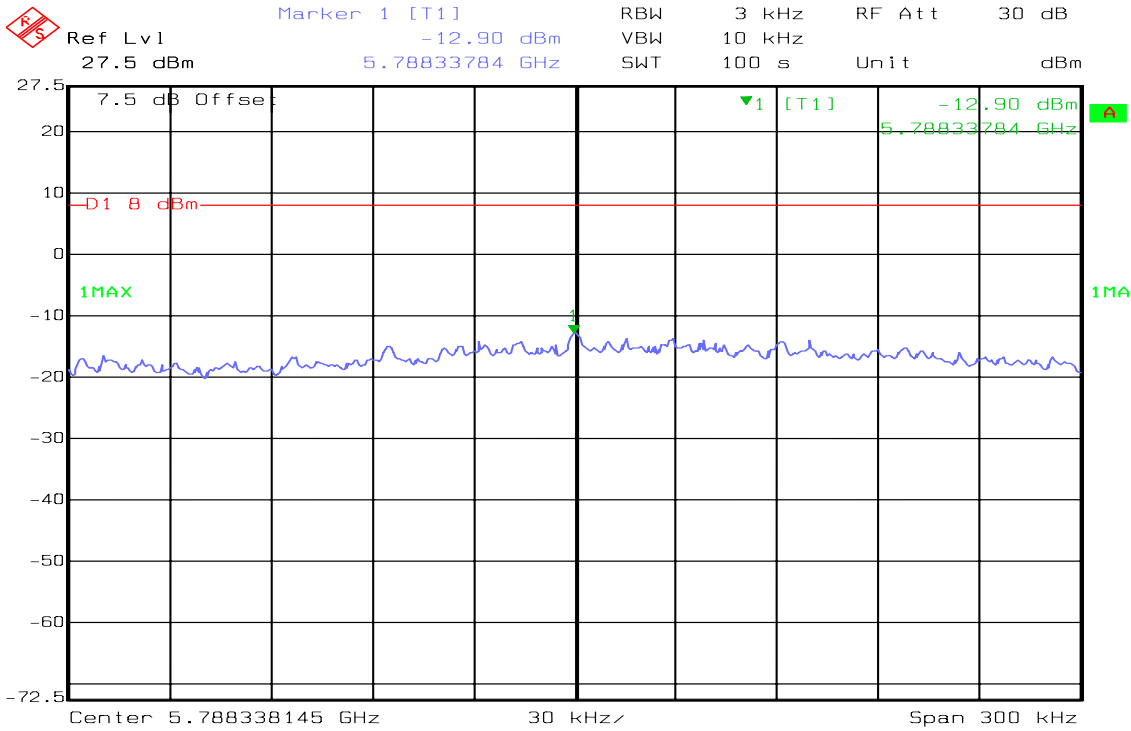
IEEE 802.11a mode

CH Low



Date: 15.JUL.2010 21:34:29

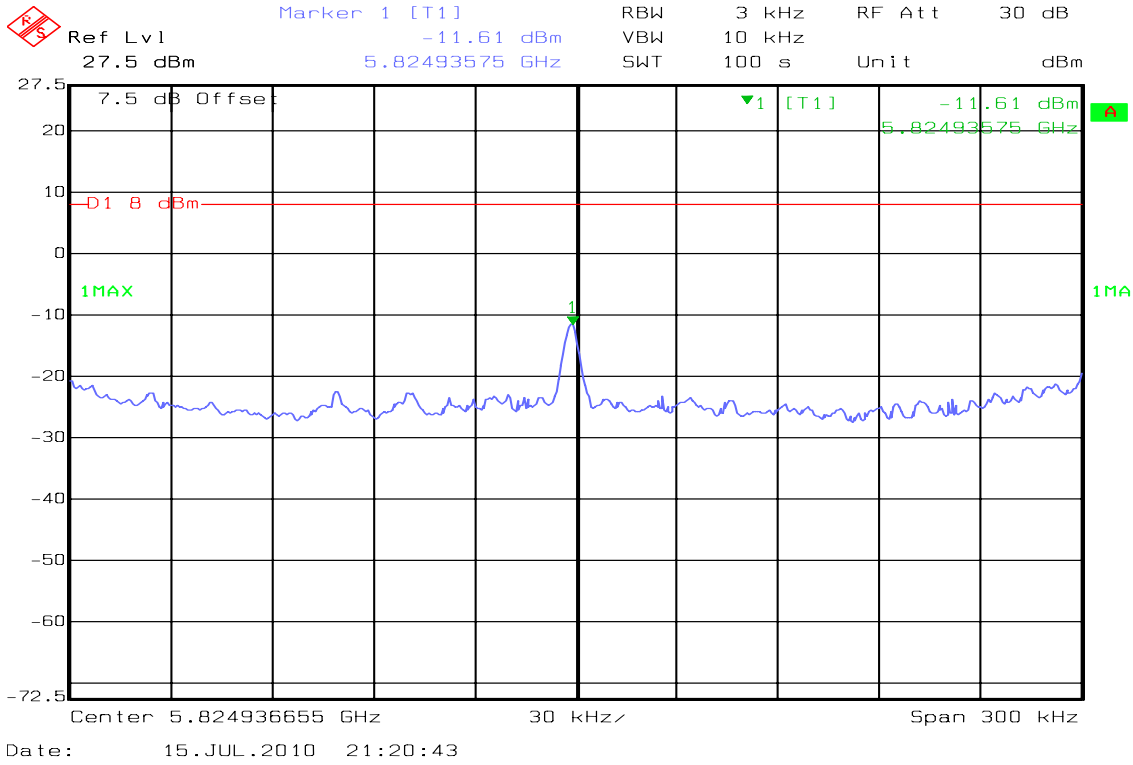
CH Mid



Date: 15.JUL.2010 21:28:38



CH High





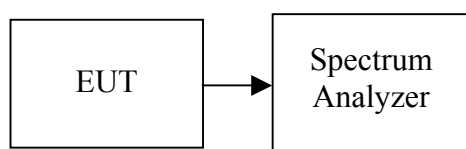
## **7.6. SPURIOUS EMISSIONS**

### **7.6.1 CONDUCTED MEASUREMENT**

#### **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**



#### **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 kHz.

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.

#### **TEST RESULTS**

*No non-compliance noted.*



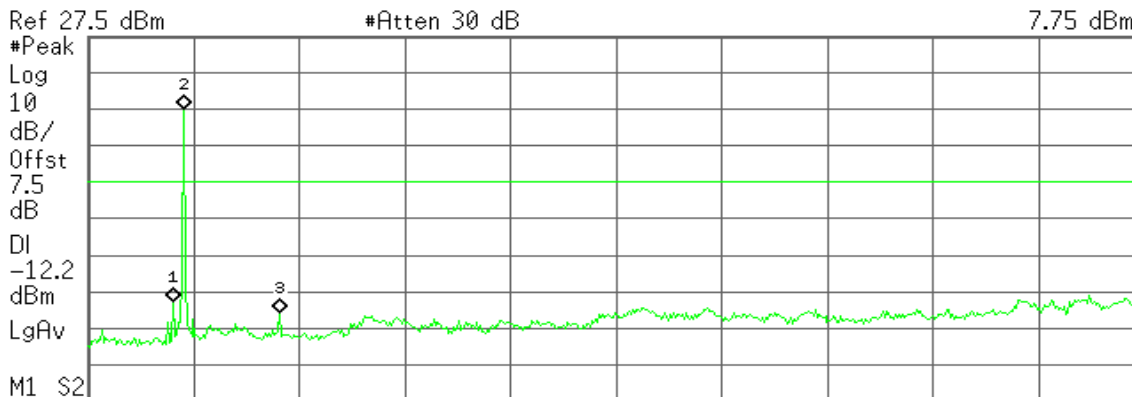
Test Plot

IEEE 802.11b / CH Low

Agilent 21:50:38 Jul 15, 2010

R L

Mkr2 2.41 GHz  
7.75 dBm



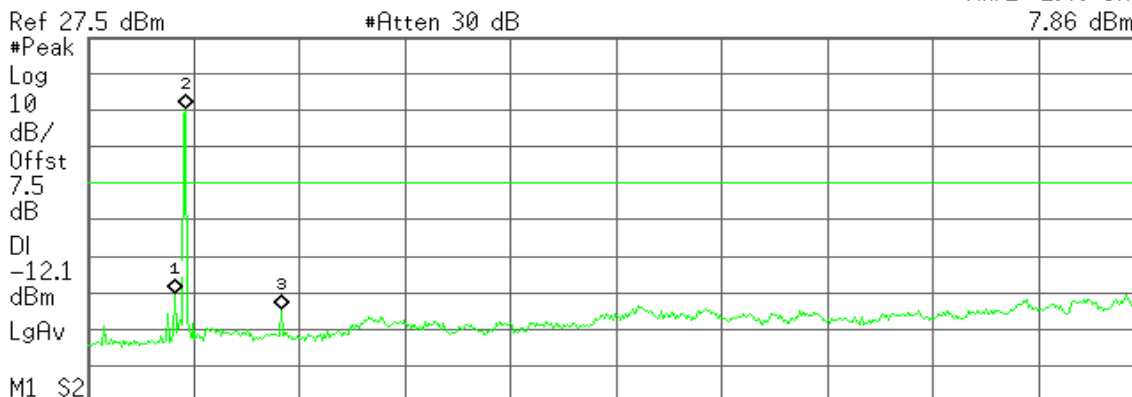
Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.15 GHz	-45.26 dBm
2	(1)	Freq	2.41 GHz	7.75 dBm
3	(1)	Freq	4.84 GHz	-48.40 dBm

IEEE 802.11b / CH Mid

Agilent 21:49:49 Jul 15, 2010

R L

Mkr2 2.46 GHz  
7.86 dBm



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.19 GHz	-42.78 dBm
2	(1)	Freq	2.46 GHz	7.86 dBm
3	(1)	Freq	4.88 GHz	-46.92 dBm

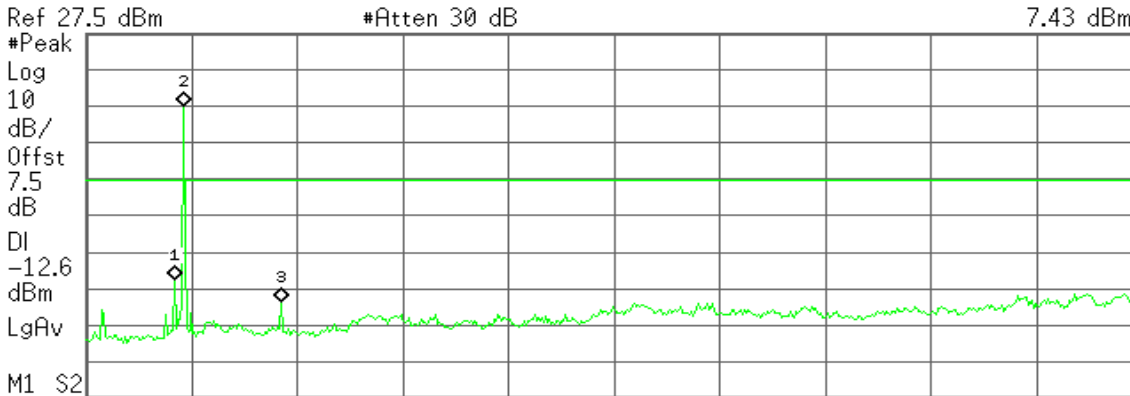


IEEE 802.11b / CH High

Agilent 21:48:43 Jul 15, 2010

R L

Mkr2 2.46 GHz  
7.43 dBm



Start 30 MHz Stop 26.50 GHz #Res BW 100 kHz #VBW 100 kHz Sweep 3.192 s (601 pts)

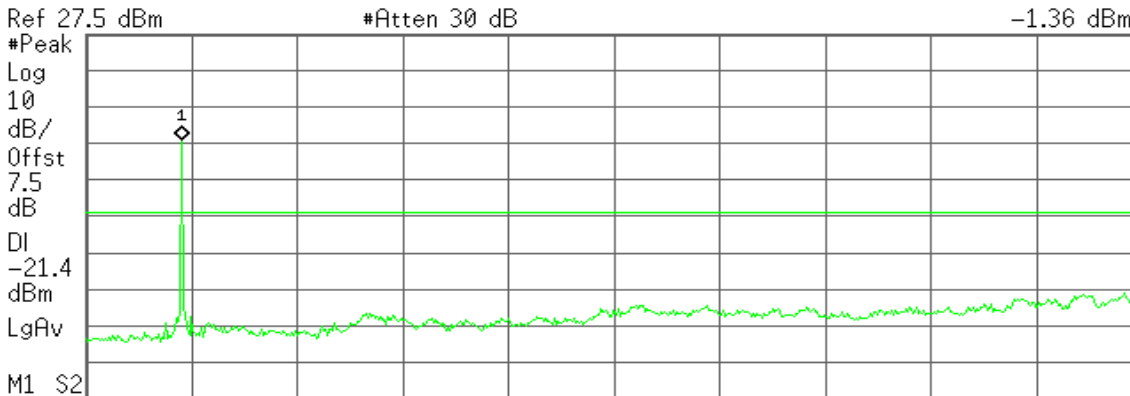
Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.24 GHz	-39.86 dBm
2	(1)	Freq	2.46 GHz	7.43 dBm
3	(1)	Freq	4.93 GHz	-46.04 dBm

IEEE 802.11g / CH Low

Agilent 21:43:04 Jul 15, 2010

R L

Mkr1 2.41 GHz  
-1.36 dBm



Start 30 MHz Stop 26.50 GHz #Res BW 100 kHz #VBW 100 kHz Sweep 3.192 s (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.41 GHz	-1.36 dBm

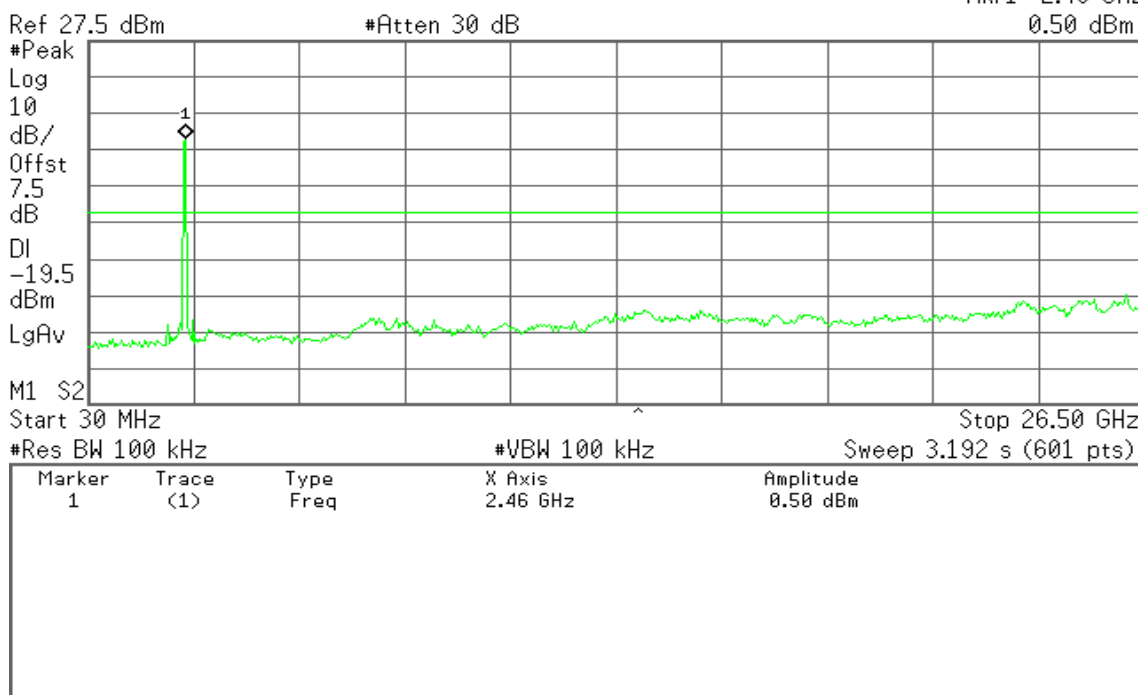


IEEE 802.11g / CH Mid

Agilent 21:44:57 Jul 15, 2010

R L

Mkr1 2.46 GHz  
0.50 dBm

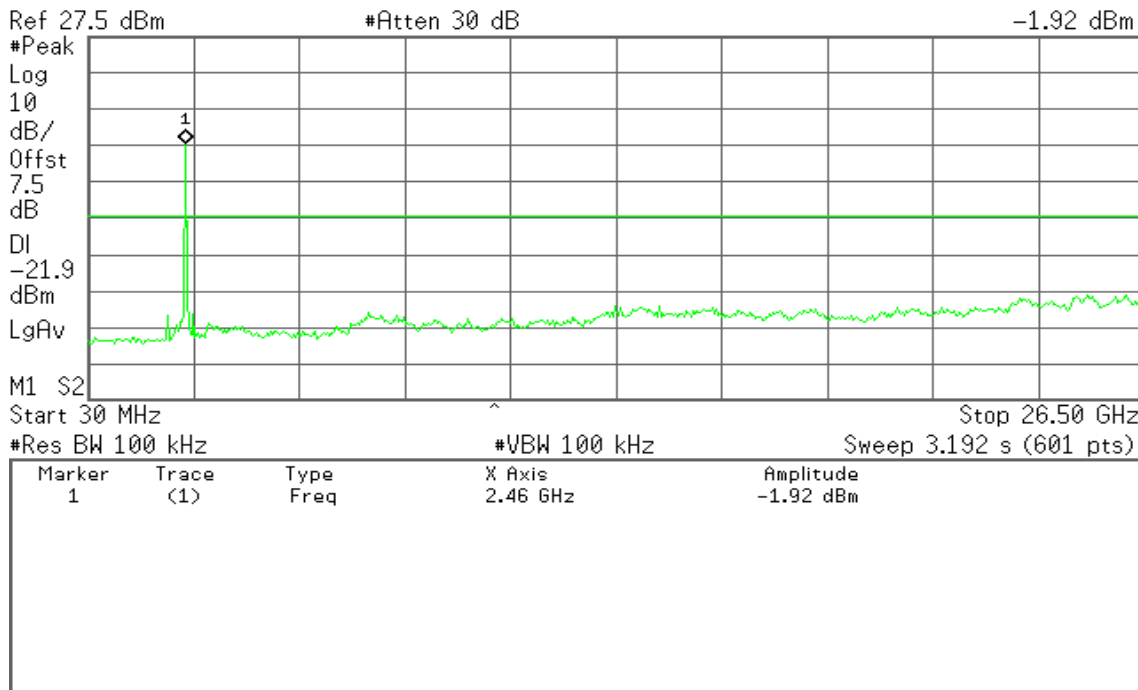


IEEE 802.11g / CH High

Agilent 21:46:49 Jul 15, 2010

R L

Mkr1 2.46 GHz  
-1.92 dBm



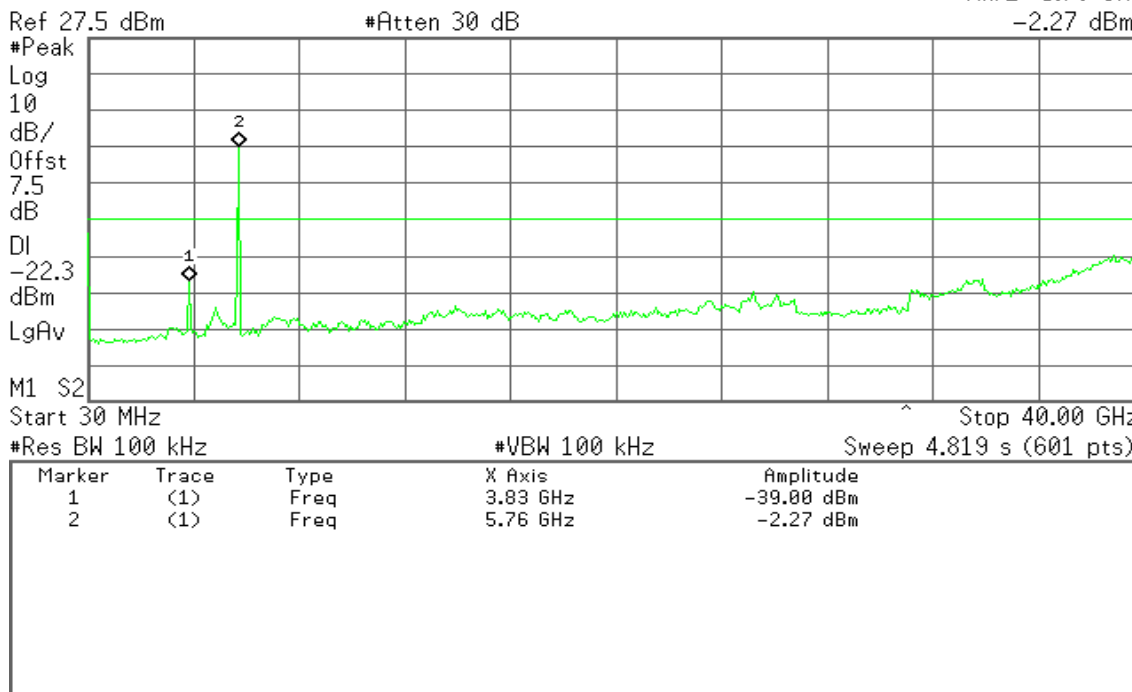


IEEE 802.11a / CH Low

Agilent 21:38:33 Jul 15, 2010

R L

Mkr2 5.76 GHz  
-2.27 dBm

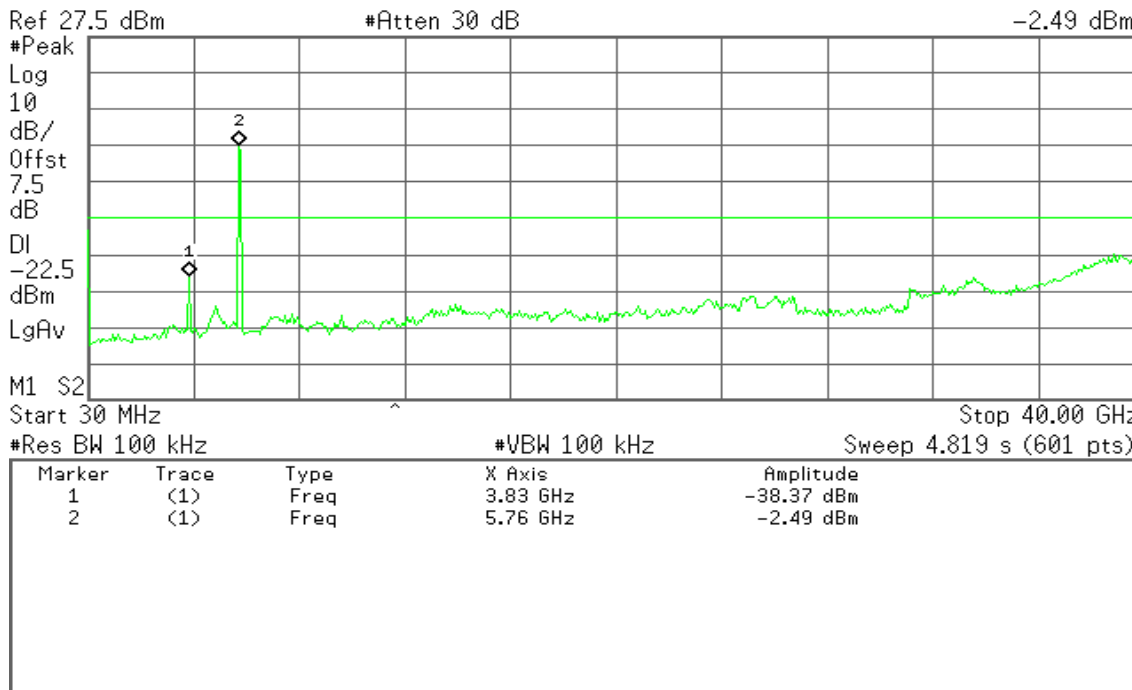


IEEE 802.11a / CH Mid

Agilent 21:40:05 Jul 15, 2010

R L

Mkr2 5.76 GHz  
-2.49 dBm



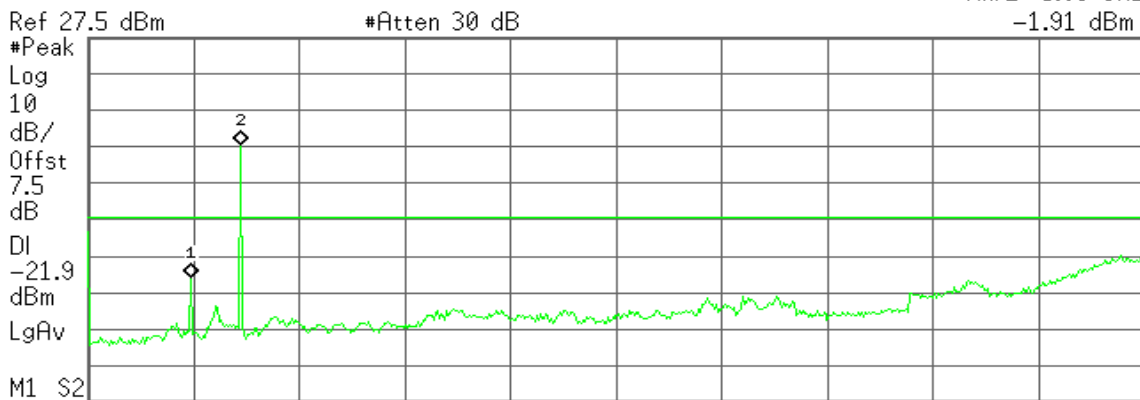


IEEE 802.11a / CH High

Agilent 21:41:17 Jul 15, 2010

R L

Mkr2 5.83 GHz  
-1.91 dBm



Start 30 MHz Stop 40.00 GHz  
#Res BW 100 kHz #VBW 100 kHz Sweep 4.819 s (601 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	3.89 GHz	-38.52 dBm
2	(1)	Freq	5.83 GHz	-1.91 dBm





### 7.6.2 RADIATED EMISSIONS

#### LIMIT

1. According to §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:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
30-88	100*	3
88-216	150*	3
216-960	200*	3
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.

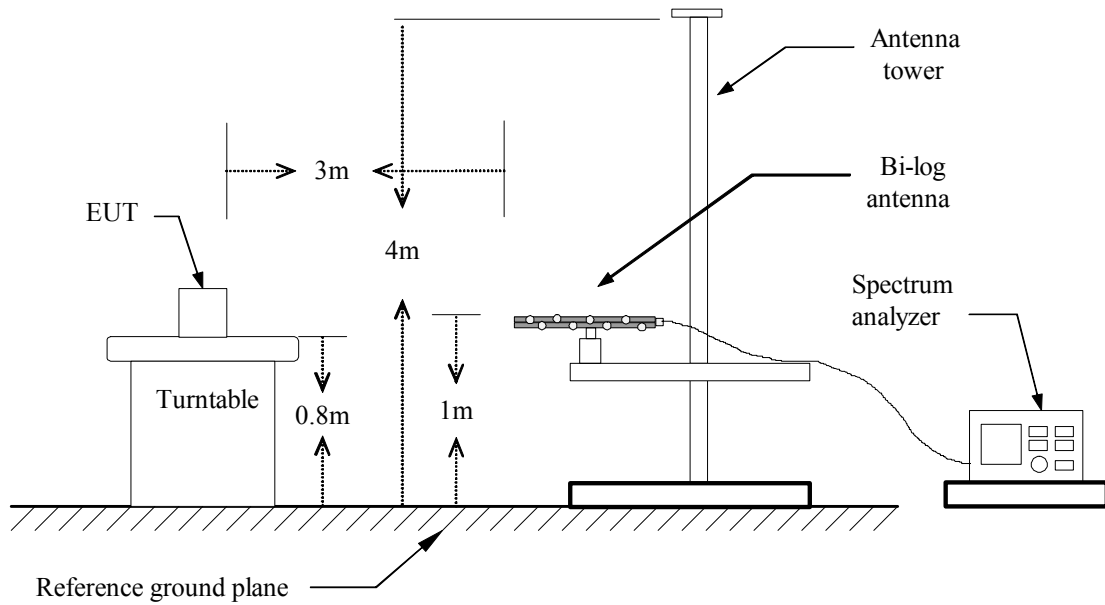
2. In the emission table above, the tighter limit applies at the band edges.

Frequency (Hz)	Field Strength (μV/m at 3-meter)	Field Strength (dBμV/m at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

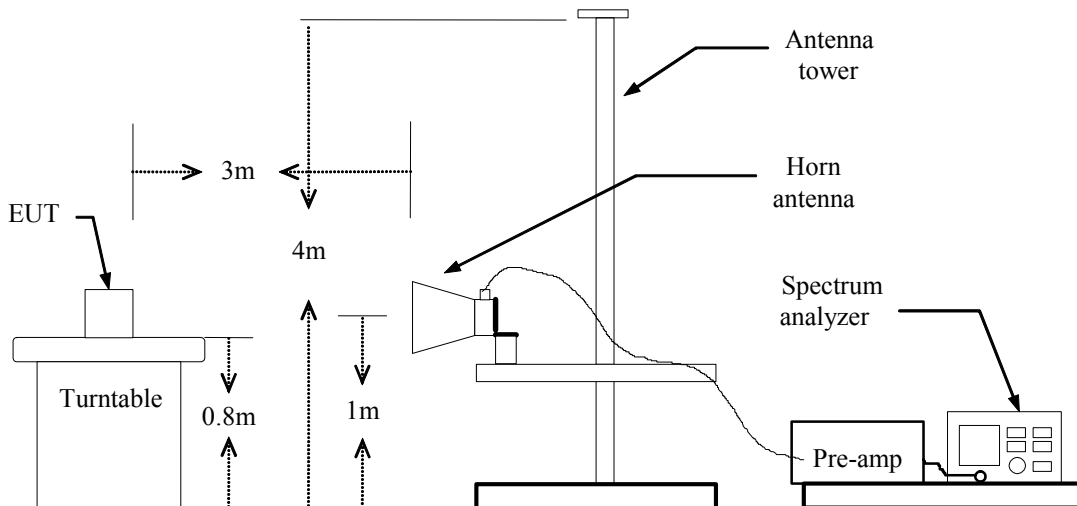


## TEST CONFIGURATION

### Below 1 GHz



### Above 1 GHz





## **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 1GHz:  
                    RBW=100kHz / VBW=100kHz / Sweep=AUTO  
Above 1GHz:  
          (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.

## **TEST RESULTS**

*No non-compliance noted*



**TEST DATA**

**Below 1 GHz**

Operation Mode: Normal Link

Test Date: July 14, 2010

Temperature: 18°C

Tested by: Stan Lin

Humidity: 60 % RH

Polarity: Ver. / Hor.

Freq. (MHz)	Ant.Pol. H/V	Detector Mode (PK/QP)	Reading (dBUV)	Factor (dB)	Actual FS (dBUV/m)	Limit 3m (dBUV/m)	Safe Margin (dB)
41.6400	V	QP	47.21	-13.57	33.64	40.00	-6.36
165.8000	V	QP	51.26	-13.41	37.85	43.50	-5.65
191.0200	V	QP	53.06	-15.02	38.04	43.50	-5.46
198.7800	V	QP	56.81	-15.36	41.45	43.50	-2.05
231.7600	V	QP	56.37	-14.17	42.20	46.00	-3.80
398.6000	V	QP	45.38	-9.48	35.90	46.00	-10.10
563.5000	V	QP	40.15	-5.61	34.54	46.00	-11.46
662.4400	V	QP	48.08	-4.48	43.60	46.00	-2.40
99.8399	H	QP	51.28	-17.57	33.71	43.50	-9.79
165.8000	H	QP	52.03	-13.41	38.62	43.50	-4.88
198.7800	H	QP	56.54	-15.36	41.18	43.50	-2.32
231.7600	H	QP	58.12	-14.17	43.95	46.00	-2.05
299.6600	H	QP	51.21	-11.13	40.08	46.00	-5.92
363.6800	H	QP	50.81	-9.62	41.19	46.00	-4.81
396.6600	H	QP	46.40	-9.48	36.92	46.00	-9.08
431.5800	H	QP	47.49	-8.72	38.77	46.00	-7.23
666.3200	H	QP	48.00	-4.35	43.65	46.00	-2.35
906.8800	H	QP	42.93	0.45	43.38	46.00	-2.62

**Remark:**

1. No emission found between lowest internal used / generated frequency to 30 MHz. (9kHz ~ 30MHz)
2. Measuring frequencies from 30 MHz to the 1GHz.
3. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using Peak detector mode.
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. The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz.

**Above 1 GHz****Operation Mode:** Tx / IEEE 802.11b mode / CH Low    **Test Date:** July 14, 2010**Temperature:** 20°C    **Tested by:** Alonso Lu**Humidity:** 50 % RH    **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
2313.33	V	49.68	---	0.54	50.23	---	74.00	54.00	-3.77	Peak
2493.33	V	48.68	---	2.35	51.03	---	74.00	54.00	-2.97	Peak
2533.33	V	49.36	---	2.01	51.37	---	74.00	54.00	-2.63	Peak
4825.00	V	49.50	47.02	6.51	56.01	53.53	74.00	54.00	-0.47	AV
7241.67	V	45.07	39.30	13.59	58.67	52.89	74.00	54.00	-1.11	AV
N/A										
1686.67	H	50.37	---	-4.01	46.36	---	74.00	54.00	-7.64	Peak
2306.67	H	49.01	---	-1.33	47.68	---	74.00	54.00	-6.32	Peak
2670.00	H	48.40	---	-0.28	48.12	---	74.00	54.00	-5.88	Peak
4825.00	H	45.48	44.31	7.74	53.22	52.05	74.00	54.00	-1.95	AV
7233.33	H	40.61	33.99	12.43	53.04	46.42	74.00	54.00	-7.58	AV
N/A										

**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) = Remark result (dBuV/m) – Average limit (dBuV/m).



**Operation Mode:** Tx / IEEE 802.11b mode / CH Mid      **Test Date:** July 14, 2010  
**Temperature:** 20°C      **Tested by:** Alonso Lu  
**Humidity:** 50 % RH      **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
2153.33	V	50.04	---	-0.61	49.43	---	74.00	54.00	-4.57	Peak
2606.67	V	49.92	---	1.19	51.12	---	74.00	54.00	-2.88	Peak
2763.33	V	48.76	---	1.28	50.04	---	74.00	54.00	-3.96	Peak
4875.00	V	48.55	46.13	7.30	55.85	53.43	74.00	54.00	-0.57	AV
7308.33	V	44.21	37.67	13.01	57.22	50.68	74.00	54.00	-3.32	AV
N/A										
2113.33	H	48.76	---	-1.64	47.12	---	74.00	54.00	-6.88	Peak
2550.00	H	49.21	---	-0.64	48.57	---	74.00	54.00	-5.43	Peak
2600.00	H	48.77	---	0.23	49.00	---	74.00	54.00	-5.00	Peak
4875.00	H	44.04	---	7.74	51.78	---	74.00	54.00	-2.22	Peak
7308.33	H	40.90	34.76	12.48	53.39	47.24	74.00	54.00	-6.76	AV
N/A										

**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) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** Tx / IEEE 802.11b mode / CH High    **Test Date:** July 14, 2010**Temperature:** 20°C    **Tested by:** Alonso Lu**Humidity:** 50 % RH    **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
2306.67	V	49.21	---	0.49	49.70	---	74.00	54.00	-4.30	Peak
2536.67	V	49.14	---	1.97	51.11	---	74.00	54.00	-2.89	Peak
2656.67	V	49.09	---	1.36	50.45	---	74.00	54.00	-3.55	Peak
4925.00	V	49.35	46.45	7.38	56.73	53.83	74.00	54.00	-0.17	AV
7383.33	V	44.80	36.52	12.76	57.55	49.28	74.00	54.00	-4.72	AV
N/A										
2093.33	H	49.41	---	-1.71	47.70	---	74.00	54.00	-6.30	Peak
2293.33	H	49.44	---	-1.38	48.06	---	74.00	54.00	-5.94	Peak
2716.67	H	48.99	---	-0.55	48.44	---	74.00	54.00	-5.56	Peak
4925.00	H	42.95	---	8.18	51.13	---	74.00	54.00	-2.87	Peak
7383.33	H	41.21	35.91	11.52	52.73	47.43	74.00	54.00	-6.57	AV
N/A										

**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) = Remark result (dBuV/m) – Average limit (dBuV/m).



Operation Mode: Tx / IEEE 802.11g mode / CH Low Test Date: July 14, 2010

Temperature: 20°C Tested by: Alonso Lu

Humidity: 50 % RH Polarity: Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
1576.67	V	50.77	---	-3.71	47.06	---	74.00	54.00	-6.94	Peak
2203.33	V	49.42	---	0.79	50.20	---	74.00	54.00	-3.80	Peak
2693.33	V	49.24	---	1.49	50.73	---	74.00	54.00	-3.27	Peak
7233.33	V	40.44	31.09	13.67	54.11	44.76	74.00	54.00	-9.24	AV
N/A										
2196.67	H	49.74	---	-2.18	47.56	---	74.00	54.00	-6.44	Peak
2590.00	H	48.89	---	0.06	48.95	---	74.00	54.00	-5.05	Peak
4616.67	H	38.95	---	9.41	48.36	---	74.00	54.00	-5.64	Peak
6175.00	H	38.50	---	9.95	48.45	---	74.00	54.00	-5.55	Peak
N/A										

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) = Remark result (dBuV/m) – Average limit (dBuV/m).



**Operation Mode:** Tx / IEEE 802.11g mode / CH Mid    **Test Date:** July 14, 2010**Temperature:** 20°C    **Tested by:** Alonso Lu**Humidity:** 50 % RH    **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
1603.33	V	50.84	---	-3.31	47.54	---	74.00	54.00	-6.46	Peak
2183.33	V	48.98	---	0.30	49.28	---	74.00	54.00	-4.72	Peak
2540.00	V	49.01	---	1.93	50.93	---	74.00	54.00	-3.07	Peak
6208.33	V	38.34	---	10.02	48.36	---	74.00	54.00	-5.64	Peak
7308.33	V	39.40	32.14	13.01	52.41	45.15	74.00	54.00	-8.85	AV
N/A										
2143.33	H	48.85	---	-1.83	47.02	---	74.00	54.00	-6.98	Peak
2250.00	H	49.99	---	-1.76	48.23	---	74.00	54.00	-5.77	Peak
2616.67	H	48.30	---	0.11	48.41	---	74.00	54.00	-5.59	Peak
4233.33	H	40.12	---	8.81	48.93	---	74.00	54.00	-5.07	Peak
6066.67	H	39.03	---	10.01	49.04	---	74.00	54.00	-4.96	Peak
N/A										

**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) = Remark result (dBuV/m) – Average limit (dBuV/m).



**Operation Mode:** Tx / IEEE 802.11g mode / CH High    **Test Date:** July 14, 2010

**Temperature:** 20°C    **Tested by:** Alonso Lu

**Humidity:** 50 % RH    **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
1830.00	V	49.75	---	-0.96	48.79	---	74.00	54.00	-5.21	Peak
2183.33	V	49.02	---	0.30	49.32	---	74.00	54.00	-4.68	Peak
2350.00	V	49.48	---	0.85	50.33	---	74.00	54.00	-3.67	Peak
2520.00	V	49.61	---	2.18	51.79	---	74.00	54.00	-2.21	Peak
4883.33	V	38.24	---	7.44	45.68	---	74.00	54.00	-8.32	Peak
6283.33	V	37.74	---	10.54	48.28	---	74.00	54.00	-5.72	Peak
2193.33	H	50.12	---	-2.16	47.97	---	74.00	54.00	-6.03	Peak
2883.33	H	48.94	---	0.85	49.79	---	74.00	54.00	-4.21	Peak
4433.33	H	39.20	---	8.75	47.94	---	74.00	54.00	-6.06	Peak
6400.00	H	39.29	---	9.35	48.64	---	74.00	54.00	-5.36	Peak
N/A										

**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) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** Tx / IEEE 802.11a mode / CH Low    **Test Date:** July 14, 2010**Temperature:** 20°C    **Tested by:** Alonso Lu**Humidity:** 50 % RH    **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
1193.33	V	48.14	---	-5.78	42.36	---	74.00	54.00	-11.64	Peak
1303.33	V	47.97	---	-5.40	42.57	---	74.00	54.00	-11.43	Peak
1733.33	V	47.27	---	-2.07	45.20	---	74.00	54.00	-8.80	Peak
2260.00	V	42.96	---	0.58	43.53	---	74.00	54.00	-10.47	Peak
3833.33	V	41.24	---	5.71	46.95	---	74.00	54.00	-7.05	Peak
3900.00	V	39.29	---	7.36	46.65	---	74.00	54.00	-7.35	Peak
6200.00	V	38.78	---	9.96	48.74	---	74.00	54.00	-5.26	Peak
11483.33	V	38.88	---	10.59	49.47	---	74.00	54.00	-4.53	Peak
1696.67	H	43.22	---	-3.77	39.45	---	74.00	54.00	-14.55	Peak
2066.67	H	42.54	---	-2.36	40.18	---	74.00	54.00	-13.82	Peak
5333.33	H	39.51	---	10.26	49.77	---	74.00	54.00	-4.23	Peak
5400.00	H	39.15	---	10.71	49.86	---	74.00	54.00	-4.14	Peak
6191.67	H	38.61	---	9.97	48.58	---	74.00	54.00	-5.42	Peak
11483.33	H	37.84	---	10.59	48.43	---	74.00	54.00	-5.57	Peak

**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) = Remark result (dBuV/m) – Average limit (dBuV/m).



**Operation Mode:** Tx / IEEE 802.11a mode / CH Mid    **Test Date:** July 14, 2010  
**Temperature:** 20°C    **Tested by:** Alonso Lu  
**Humidity:** 50 % RH    **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
1196.67	V	51.01	---	-5.74	45.27	---	74.00	54.00	-8.73	Peak
1503.33	V	45.85	---	-4.92	40.93	---	74.00	54.00	-13.07	Peak
1726.67	V	45.98	---	-2.18	43.80	---	74.00	54.00	-10.20	Peak
2503.33	V	43.30	---	2.39	45.69	---	74.00	54.00	-8.31	Peak
3858.33	V	40.59	---	6.33	46.92	---	74.00	54.00	-7.08	Peak
4883.33	V	38.38	---	7.44	45.82	---	74.00	54.00	-8.18	Peak
6316.67	V	38.53	---	10.54	49.07	---	74.00	54.00	-4.93	Peak
11583.33	V	46.60	37.84	10.63	57.23	48.47	74.00	54.00	-5.53	AV
1700.00	H	42.23	---	-3.69	38.54	---	74.00	54.00	-15.46	Peak
2630.00	H	42.17	---	0.01	42.18	---	74.00	54.00	-11.82	Peak
3858.33	H	43.84	---	7.65	51.49	---	74.00	54.00	-2.51	Peak
4950.00	H	40.45	---	8.61	49.06	---	74.00	54.00	-4.94	Peak
11566.67	H	41.86	34.38	10.62	52.48	45.00	74.00	54.00	-9.00	Peak
N/A										

**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) = Remark result (dBuV/m) – Average limit (dBuV/m).

**Operation Mode:** Tx / IEEE 802.11a mode / CH High    **Test Date:** July 14, 2010**Temperature:** 20°C    **Tested by:** Alonso Lu**Humidity:** 50 % RH    **Polarity:** Ver. / Hor.

Freq. (MHz)	Ant. Pol H/V	Peak Reading (dBuV)	AV Reading (dBuV)	Ant. / CL CF (dB)	Actual Fs		Peak Limit (dBuV/m)	AV Limit (dBuV/m)	Margin (dB)	Remark
					Peak (dBuV/m)	AV (dBuV/m)				
1063.33	V	48.33	---	-6.80	41.52	---	74.00	54.00	-12.48	Peak
1193.33	V	47.95	---	-5.78	42.17	---	74.00	54.00	-11.83	Peak
1726.67	V	45.50	---	-2.18	43.31	---	74.00	54.00	-10.69	Peak
2176.67	V	42.80	---	0.09	42.89	---	74.00	54.00	-11.11	Peak
3883.33	V	41.09	---	6.95	48.03	---	74.00	54.00	-5.97	Peak
6325.00	V	37.72	---	10.48	48.20	---	74.00	54.00	-5.80	Peak
11650.00	V	52.17	41.96	10.65	62.82	52.61	74.00	54.00	-1.39	AV
1753.33	H	43.11	---	-4.05	39.07	---	74.00	54.00	-14.93	Peak
2503.33	H	42.33	---	-1.45	40.88	---	74.00	54.00	-13.12	Peak
2570.00	H	41.66	---	-0.29	41.37	---	74.00	54.00	-12.63	Peak
3883.33	H	47.48	45.34	7.70	55.18	53.04	74.00	54.00	-0.96	AV
4716.67	H	39.81	---	9.20	49.00	---	74.00	54.00	-5.00	Peak
6200.00	H	38.42	---	9.98	48.40	---	74.00	54.00	-5.60	Peak
11650.00	H	43.66	35.08	10.65	54.31	45.73	74.00	54.00	-8.27	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) = Remark result (dBuV/m) – Average limit (dBuV/m).



## **7.7. POWERLINE CONDUCTED EMISSIONS**

### **LIMIT**

For an intentional radiator which 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 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

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

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

### **TEST CONFIGURATION**

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

### **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.

### **TEST RESULTS**

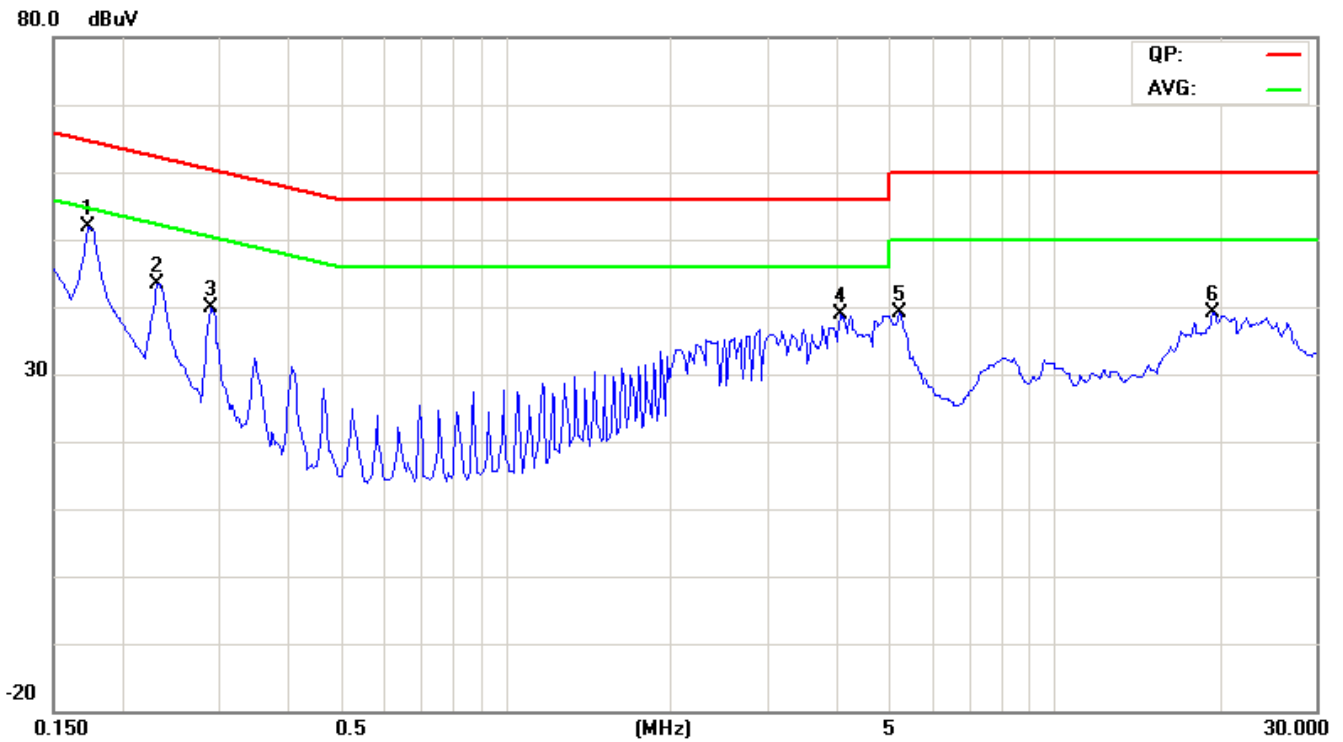
The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.



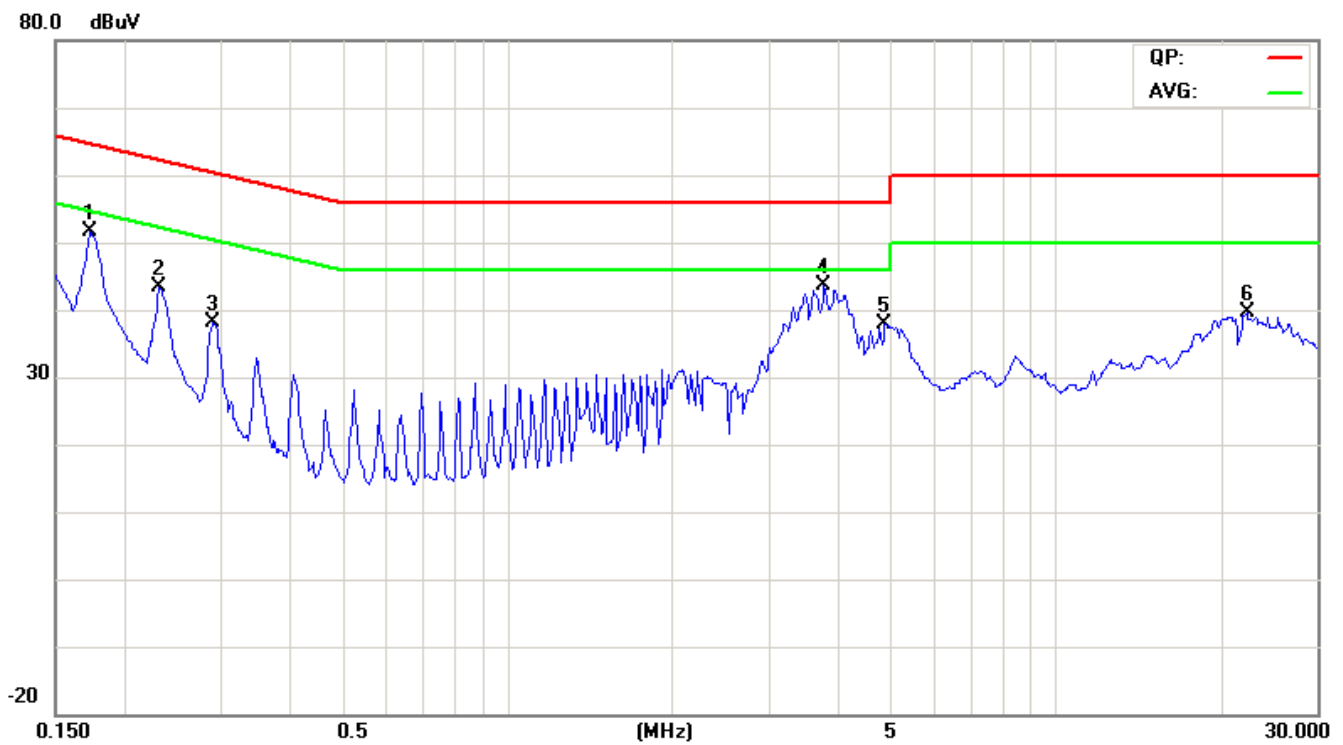


**Test Plots**

**Conducted emissions (Line 1)**



**Conducted emissions (Line 2)**







# 8 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>	WLAN 802.11a/b/g mini-PCI Module
<b>Frequency band (Operating)</b>	<input checked="" type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input type="checkbox"/> WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz <input checked="" 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 ( $S = 5mW/cm^2$ ) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure ( $S=1mW/cm^2$ )
<b>Antenna diversity</b>	<input checked="" type="checkbox"/> Single antenna <input 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 802.11a: 19.67 dBm (92.68mW) IEEE 802.11b: 21.41 dBm (138.36mW) IEEE 802.11g: 20.25 dBm (105.93mW)
<b>Antenna gain (Max)</b>	IEEE 802.11a: 2 dBi (Numeric gain: 1.58) IEEE 802.11b/g: 2 dBi (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 21.41dBm (138.36mW) at 2412MHz (with 1.58 numeric antenna gain.)
2. 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:

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

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 = 138.36mW

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>

→ Power density = 0.04350 mW / cm<sup>2</sup>

(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.)