



FCC 47 CFR PART 15 SUBPART C

TEST REPORT

For

LabQuest2

Model: LabQuest2

Trade Name: Vernier

Issued to

Vernier Software & Technology
13979 SW Millikan Way Beaverton, OR 97005

Issued by

Compliance Certification Services Inc.
No.11, Wu-Gong 6th Rd., Wugu Industrial Park,
New Taipei City 248, Taiwan (R.O.C.)
<http://www.ccsrf.com>
service@ccsrf.com

Issued Date: February 16, 2012



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Revision History

Rev.		Issue Date		Revisions	Effect Page	Revised By
00		February 16, 2012		Initial Issue	ALL	Sandy Lin



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1. TEST RESULT CERTIFICATION

Applicant: Vernier Software & Technology
13979 SW Millikan Way Beaverton, OR 97005

Equipment Under Test: LabQuest2

Trade Name: Vernier

Model: LabQuest2

Date of Test: February 9 ~ 14, 2012

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:

Jason Lin

Jason Lin
Section Manager
Compliance Certification Services Inc.

Reviewed by:

Gina Lo

Gina Lo
Section Manager
Compliance Certification Services Inc.



2. EUT DESCRIPTION

Product	LabQuest2
Trade Name	Vernier
Model Number	LabQuest2
Model Discrepancy	N/A
Received Date	February 5, 2012
Power Rating	1. Power Adapter CONDOR / 3A-154WP05 I/P: 100-240V, 50/60Hz, 0.6A O/P: 5V, 2.6A Vernier / SPS-12-002A I/P: 100-240V, 50/60Hz, 0.5A O/P: 5V, 1.5A 2. Battery Rating: 3.7V, 12.21Wh
Frequency Range	2412 ~ 2462 MHz
Transmit Power	IEEE 802.11b mode: 17.42 dBm (55.21 mW) IEEE 802.11g mode: 25.06 dBm (320.63 mW) IEEE 802.11n HT 20 MHz mode: 24.89 dBm (308.32 mW)
Modulation Technique	IEEE 802.11b mode: DSSS (1, 2, 5.5 and 11 Mbps) IEEE 802.11g mode: OFDM (6, 9, 12, 18, 24, 36, 48 and 54 Mbps) IEEE 802.11n HT 20 MHz mode: OFDM (6.5, 13, 19.5, 26, 39, 52, 58.5, 65.0Mbps)
Number of Channels	IEEE 802.11b/g mode: 11 Channels IEEE 802.11n HT 20 MHz mode: 11 Channels
Antenna Specification	PCB Antenna / Gain: 2.35615 dBi

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: **AUO-LABQUEST2** 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 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.

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 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.



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
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	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	(²)
13.36 - 13.41	322 - 335.4		

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² 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: LabQuest2) had been tested under operating condition.

Software used to control the EUT for staying in continuous transmitting mode was programmed.

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 802.11b mode:

Channel Low (2412MHz), Channel Mid (2442MHz) and Channel High (2462MHz) with 1Mbps data rate were chosen for full testing.

IEEE 802.11g mode:

Channel Low (2412MHz), Channel Mid (2442MHz) and Channel High (2462MHz) with 6Mbps data rate were chosen for full testing.

IEEE 802.11n HT 20 MHz mode:

Channel Low (2412MHz), Channel Mid (2442MHz) and Channel High (2462MHz) with 6.5Mbps data rate were chosen for full testing.

The field strength of spurious emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.



4. INSTRUMENT CALIBRATION

4.1 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.



4.2 MEASUREMENT EQUIPMENT USED

Equipment Used for Emissions Measurement

Remark: Each piece of equipment is scheduled for calibration once a year and Loop Antenna is scheduled for calibration once three years.

Conducted Emissions Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY43360131	03/17/2012
Power Meter	Anritsu	ML2495A	1012009	04/27/2012
Power Sensor	Anritsu	MA2411B	0917072	04/27/2012

Wugu 966 Chamber A				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510252	11/02/2012
EMI Test Receiver	R&S	ESCI	100064	02/17/2012
Pre-Amplifier	Mini-Circuits	ZFL-1000LN	SF350700823	01/12/2013
Pre-Amplifier	MITEQ	AFS44-00102650-42-10P-44	1415367	11/19/2012
Bilog Antenna	Sunol Sciences	JB3	A030105	10/03/2012
Horn Antenna	EMCO	3117	00055165	01/11/2013
Horn Antenna	EMCO	3116	00026370	10/12/2012
Loop Antenna	EMCO	6502	8905/2356	06/10/2013
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
Site NSA	CCS	N/A	N/A	12/25/2012
Test S/W	EZ-EMC (CCS-3A1RE)			

Conducted Emission room # A				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
EMI Test Receiver	R&S	ESHS10	843743/015	05/01/2012
LISN	SCHWARZBECK	NSLK 8127	8127-541	12/17/2012
LISN	SCHAFFNER	NNB 41	03/10013	N.C.R.
Test S/W	CCS-3A1-CE			



4.3 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
Powerline Conducted Emission	+/- 1.2159
3M Semi Anechoic Chamber / 30M~200M	+/- 4.0138
3M Semi Anechoic Chamber / 200M~1000M	+/- 3.9483
3M Semi Anechoic Chamber / 1G~8G	+/- 2.5975
3M Semi Anechoic Chamber / 8G~18G	+/- 2.6112
3M Semi Anechoic Chamber / 18G~26G	+/- 2.7389
3M Semi Anechoic Chamber / 26G~40G	+/- 2.9683

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



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, Wu-Gong 6th Rd., Wugu Industrial Park, New Taipei City 248, Taiwan (R.O.C.)

Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045

☐ No.81-1, Lane 210, Bade 2nd Rd., Lujhu Township, Taoyuan County 33841, 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 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.



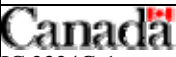
Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

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	FCC	3M Semi Anechoic Chamber (FCC MRA: TW1039) to perform FCC Part 15 measurements	 FCC MRA: TW1039
Taiwan	TAF	LP0002, RTTE01, FCC Method-47 CFR Part 15 Subpart C, D, E, RSS-210, RSS-310 IDA TS SRD, AS/NZS 4268, AS/NZS 4771, TS 12.1 & 12.2, ETSI EN 300 440-1, ETSI EN 300 440-2, ETSI EN 300 328, ETSI EN 300 220-1, ETSI EN 300 220-2, ETSI EN 301 893, ETSI EN 301 489-1/3/7/17 FCC OET Bulletin 65 + Supplement C, EN 50360, EN 50361, EN 50371, RSS 102, EN 50383, EN 50385, EN 50392, IEC 62209, CNS 14958-1, CNS 14959 FCC Method -47 CFR Part 15 Subpart B IEC / EN 61000-3-2, IEC / EN 61000-3-3, IEC / EN 61000-4-2/3/4/5/6/8/11	
Canada	Industry Canada	3M Semi Anechoic Chamber (IC 2324G-1 / IC 2324G-2) to perform	 IC 2324G-1 IC 2324G-2

** No part of this report may be used to claim or imply product endorsement by A2LA or any agency of the US Government.*



6. SETUP OF EQUIPMENT UNDER TEST

6.1 SETUP CONFIGURATION OF EUT

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

6.2 SUPPORT EQUIPMENT

No	Device Type	Brand	Model	Series No.	FCC ID	Data Cable	Power Cord
1.	Notebook PC	HP	dv6-1332TX	CNF9491GLJ	PD9112BNHU	N/A	AC I/P: Unshielded, 1.8m DC O/P: Unshielded, 1.8m with a core
2.	Stainless Steel Temperature Probe	TMP-BTA	N/A	N/A	Vernier	Unshielded, 1m	N/A
3.	Stainless Steel Temperature Probe	TMP-BTA	N/A	N/A	Vernier	Unshielded, 1m	N/A
4.	PH Sensor	PH-BTA	N/A	N/A	Vernier	Unshielded, 1m	N/A
5.	Motion Detector	MD-BTD	N/A	N/A	Vernier	Unshielded, 1m	N/A
6.	Motion Detector	MD-BTD	N/A	N/A	Vernier	Unshielded, 1m	N/A
7.	Earphone	Labtec	Axis-301	N/A	FCC DoC	Unshielded, 1.8m	N/A
8.	SD Card	SANDISK	N/A	N/A	N/A	N/A	N/A
9.	Notebook PC (Remote)	HP	dv6-1332TX	CNF9491GM9	PD9112BNHU	N/A	AC I/P: Unshielded, 1.8m DC O/P: Unshielded, 1.8m with a core
10.	GPS Simulator (Remote)	HWAJEAT	GPS-101	EN001	N/A	N/A	N/A
11.	Wireless Pre-N Router (MIMO) (Remote)	BELKIN	F5D8230-4	N/A	SA3-AGN0901AP0100	N/A	AC I/P: Unshielded, 1.8m DC O/P: Unshielded, 1.8m with a core

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.



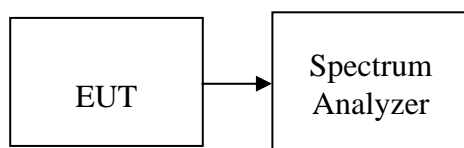
7. FCC PART 15.247 REQUIREMENTS

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 = 100 kHz, 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.

TEST RESULTS

No non-compliance noted

**Test Data****Test mode: IEEE 802.11b mode**

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (kHz)	Result
Low	2412	9.1666	>500	PASS
Mid	2442	9.1666		PASS
High	2462	9.1666		PASS

Test mode: IEEE 802.11g mode

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (kHz)	Result
Low	2412	15.5	>500	PASS
Mid	2442	15.3334		PASS
High	2462	15.8333		PASS

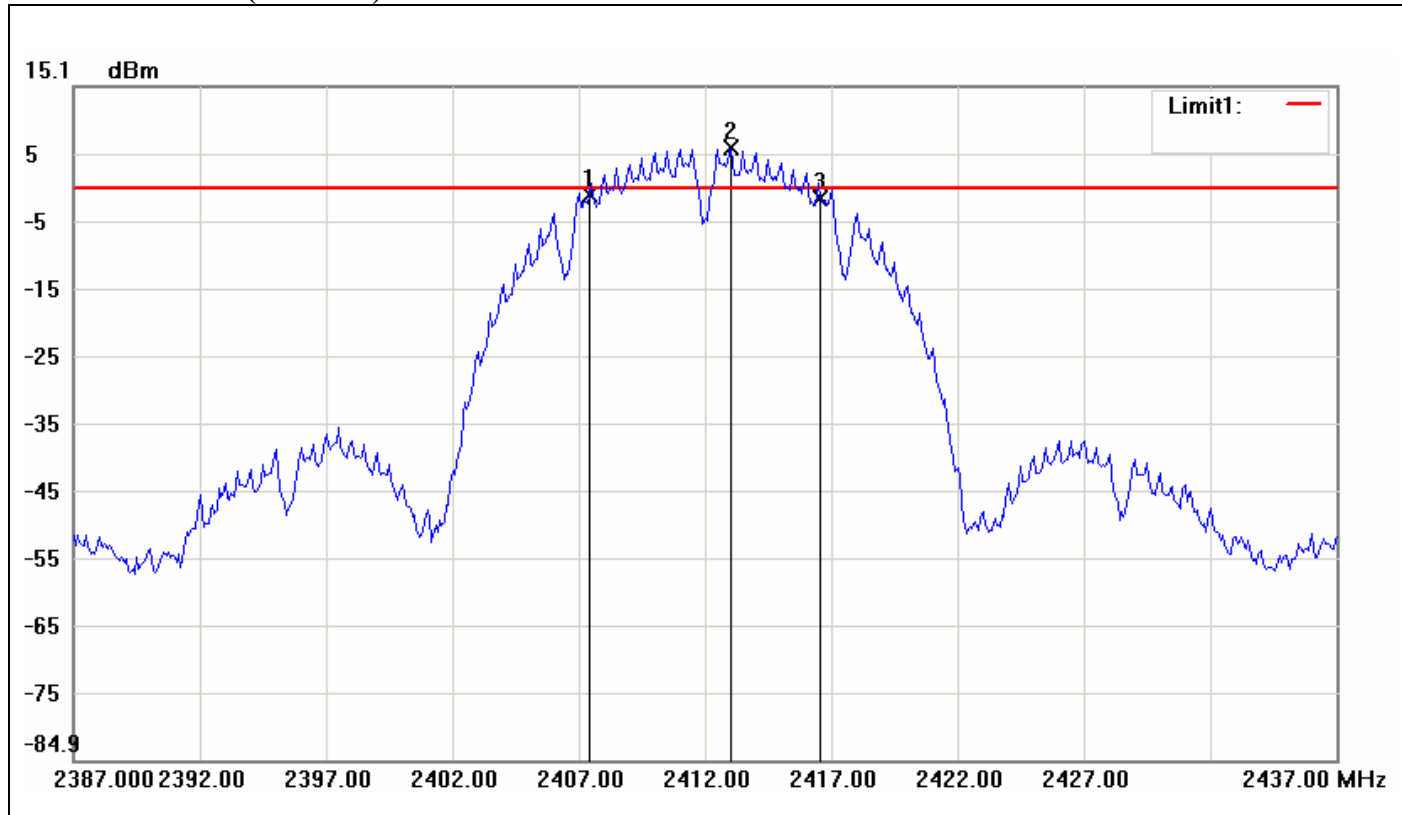
Test mode: IEEE 802.11n HT 20 MHz mode

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (kHz)	Result
Low	2412	15.8334	>500	PASS
Mid	2442	15.6666		PASS
High	2462	15.5		PASS



IEEE 802.11b mode

6dB Bandwidth (CH Low)

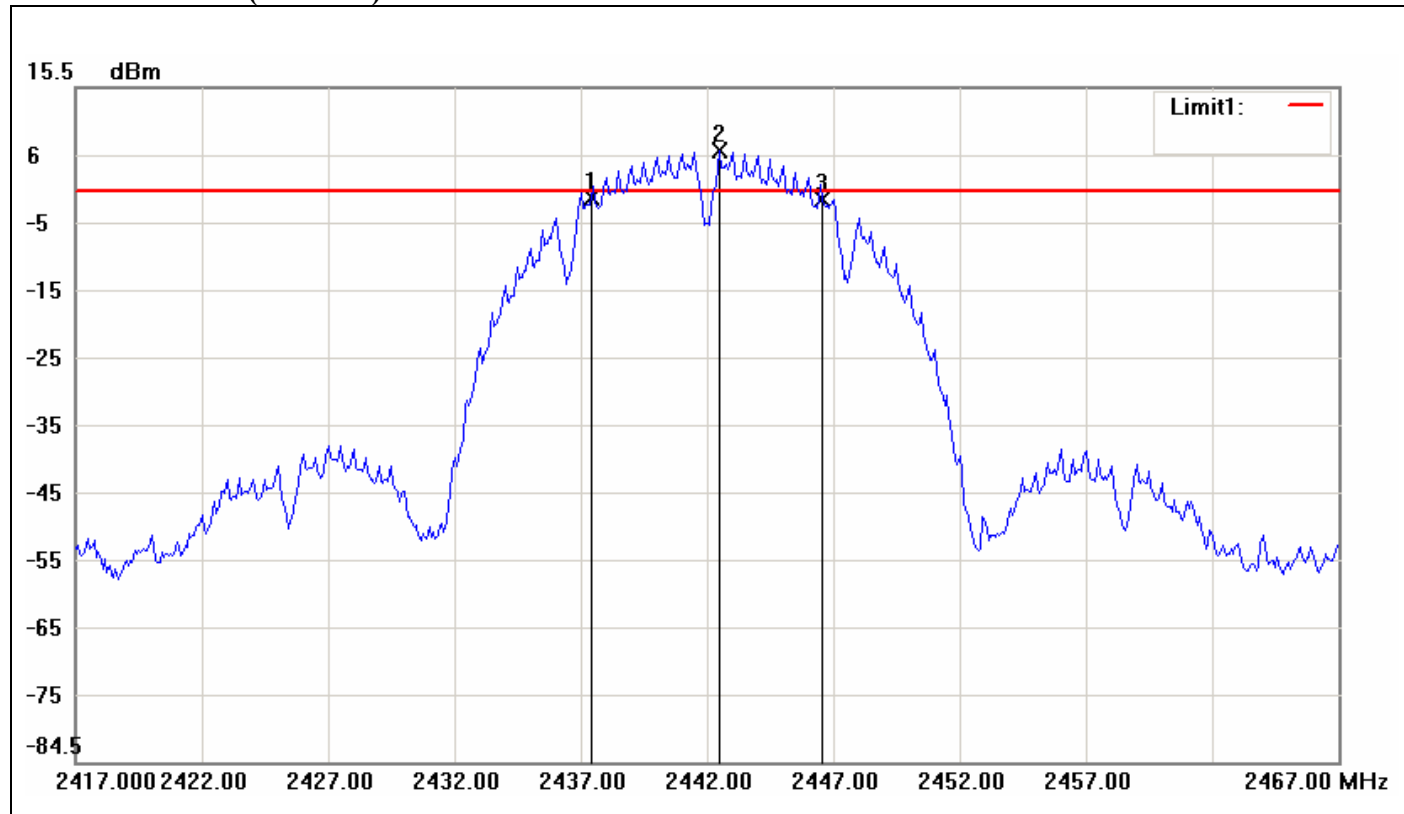


No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2407.4167	-1.15	-0.14	-1.01
2	2413.0000	5.86	-0.14	6.00
3	2416.5833	-1.46	-0.14	-1.32

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	9.1666	-0.31



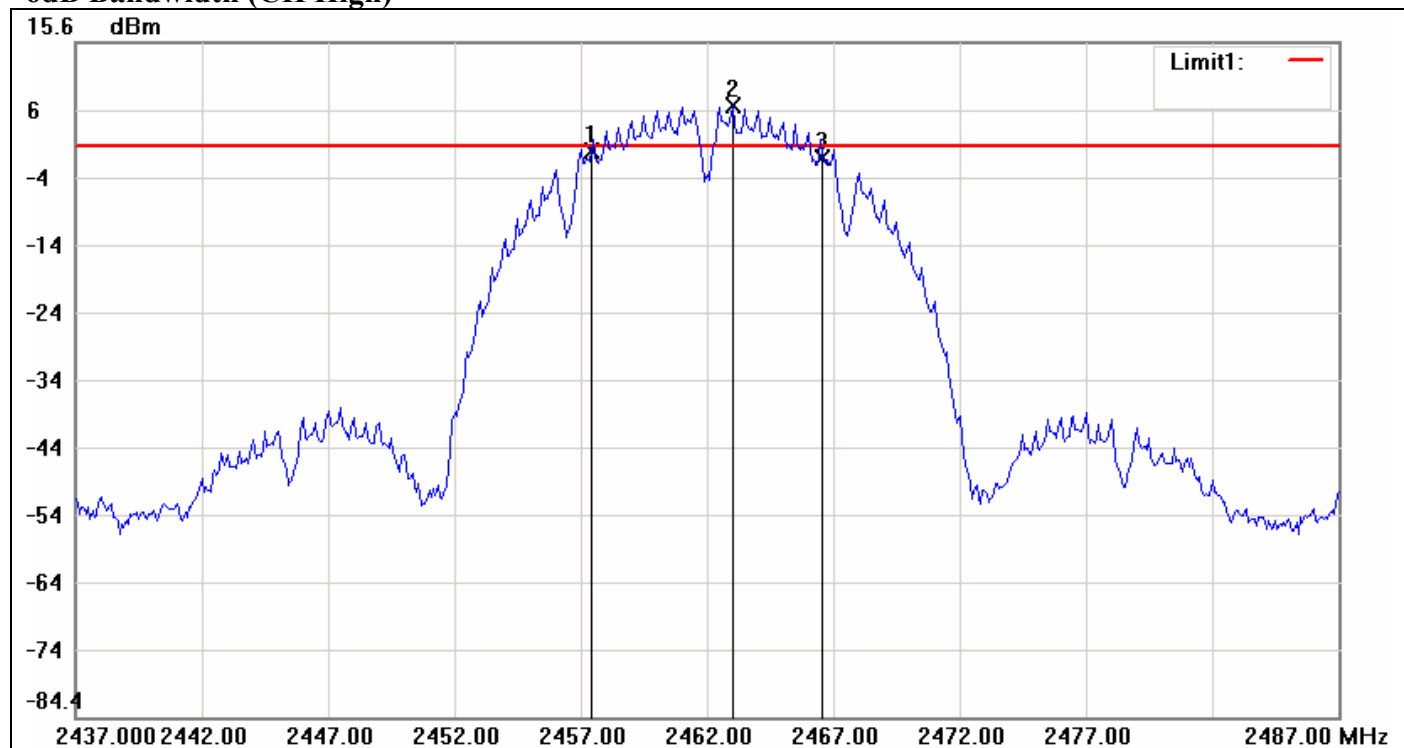
6dB Bandwidth (CH Mid)



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2437.4167	-0.95	0.05	-1.00
2	2442.5000	6.05	0.05	6.00
3	2446.5833	-1.08	0.05	-1.13

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	9.1666	-0.13

6dB Bandwidth (CH High)



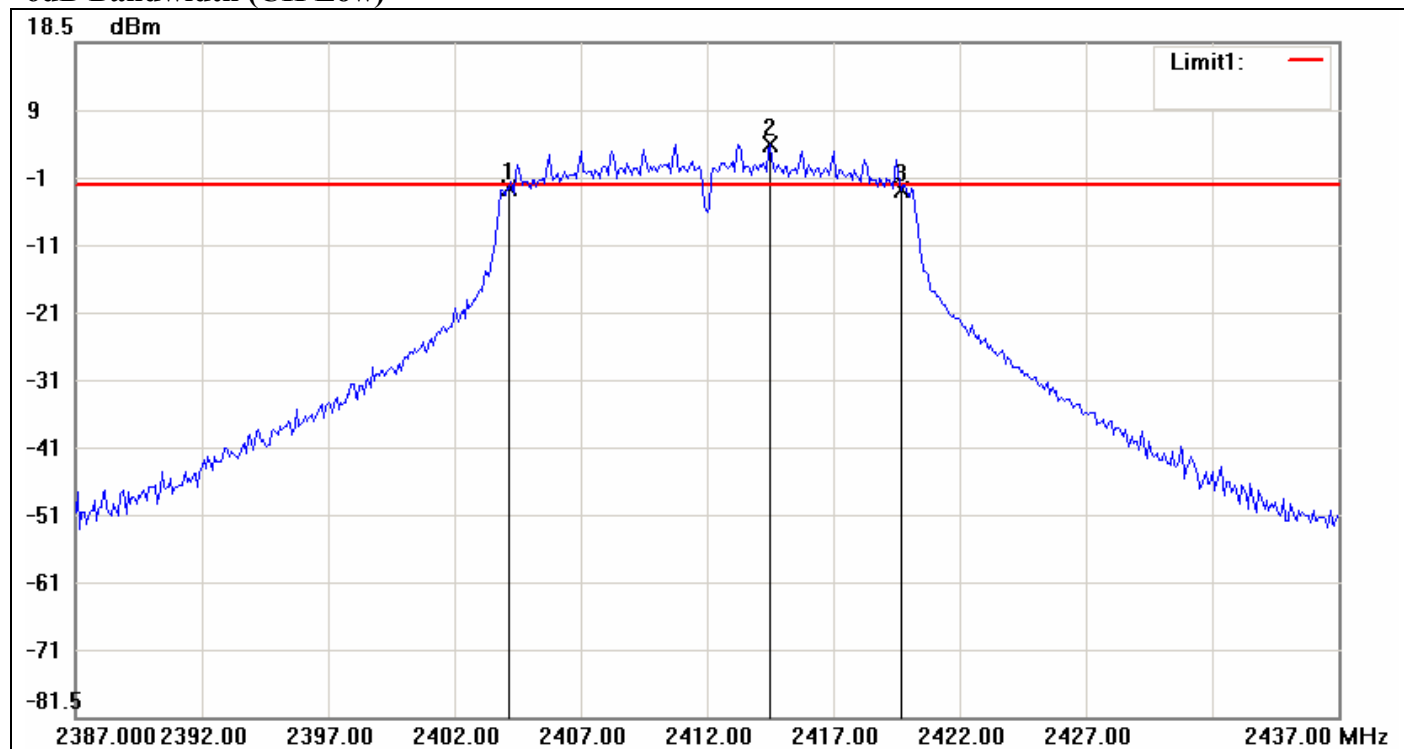
No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2457.4167	-0.45	0.18	-0.63
2	2463.0000	6.18	0.18	6.00
3	2466.5833	-1.52	0.18	-1.70

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	9.1666	-1.07



IEEE 802.11g mode

6dB Bandwidth (CH Low)

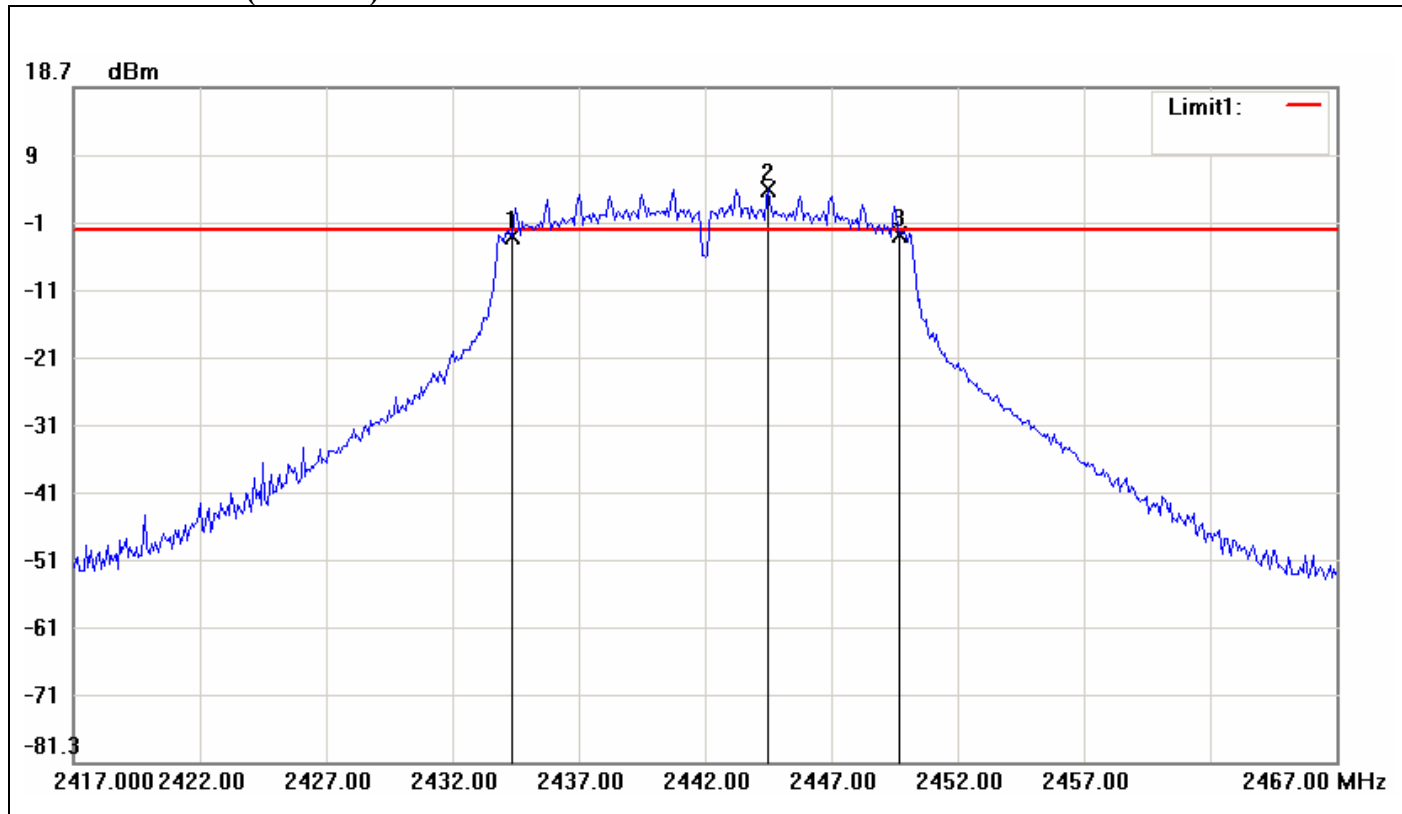


No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2404.1667	-3.00	-2.54	-0.46
2	2414.5000	3.46	-2.54	6.00
3	2419.6667	-3.43	-2.54	-0.89

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	15.5	-0.43



6dB Bandwidth (CH Mid)

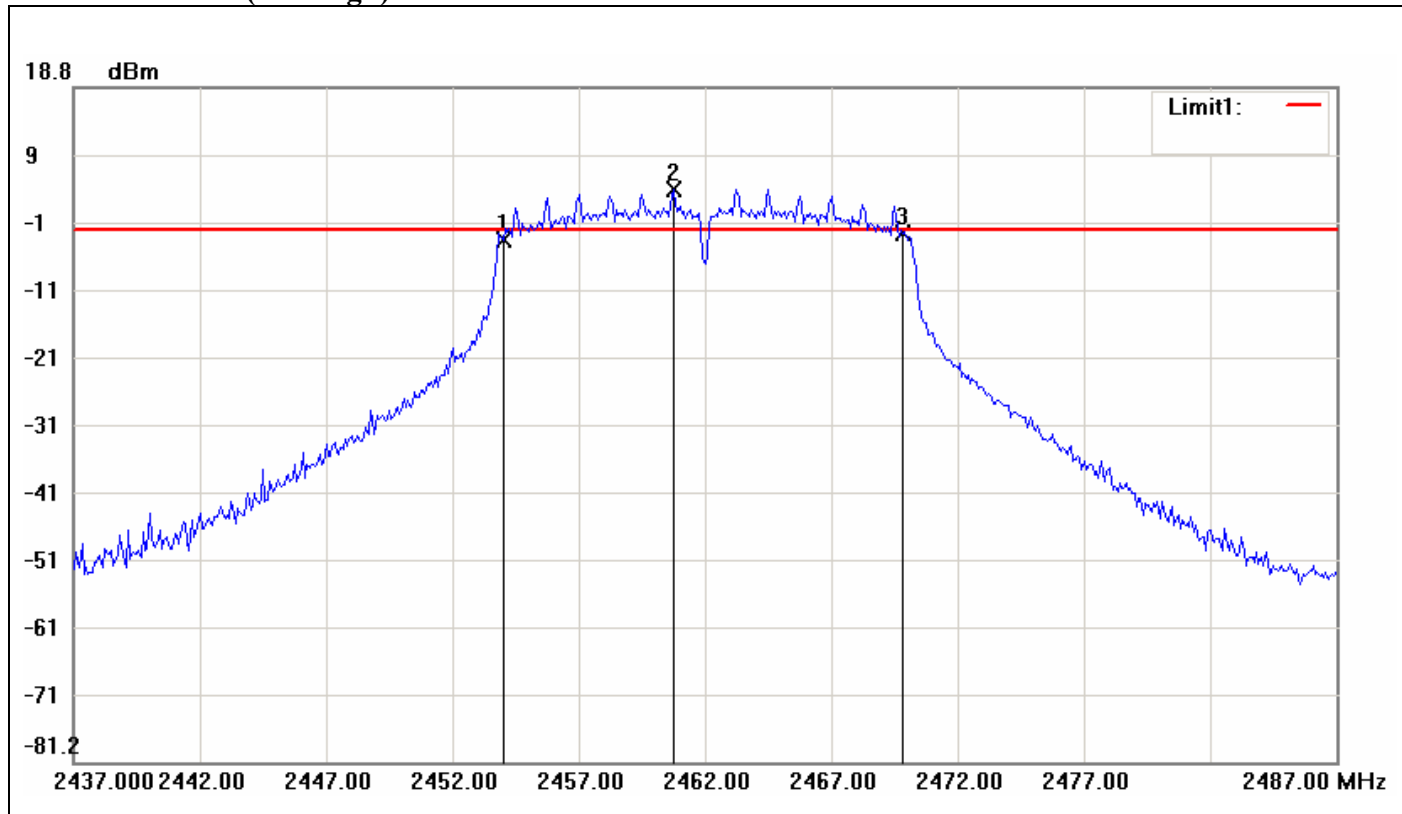


No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2434.3333	-3.37	-2.42	-0.95
2	2444.5000	3.58	-2.42	6.00
3	2449.6667	-3.22	-2.42	-0.80

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	15.3334	0.15



6dB Bandwidth (CH High)



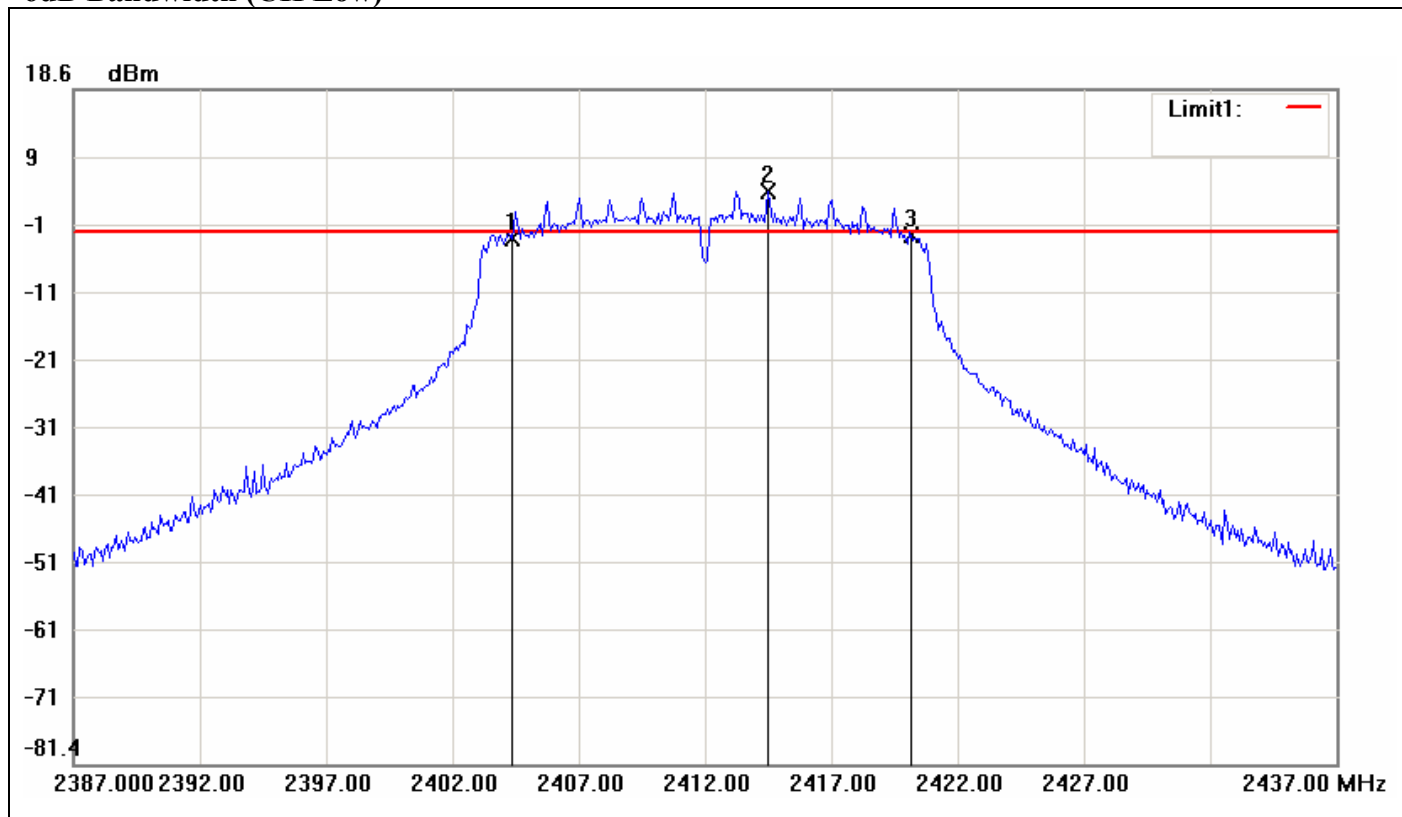
No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2454.0000	-3.83	-2.36	-1.47
2	2460.7500	3.64	-2.36	6.00
3	2469.8333	-2.81	-2.36	-0.45

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	15.8333	1.02



IEEE 802.11n HT 20 MHz mode

6dB Bandwidth (CH Low)

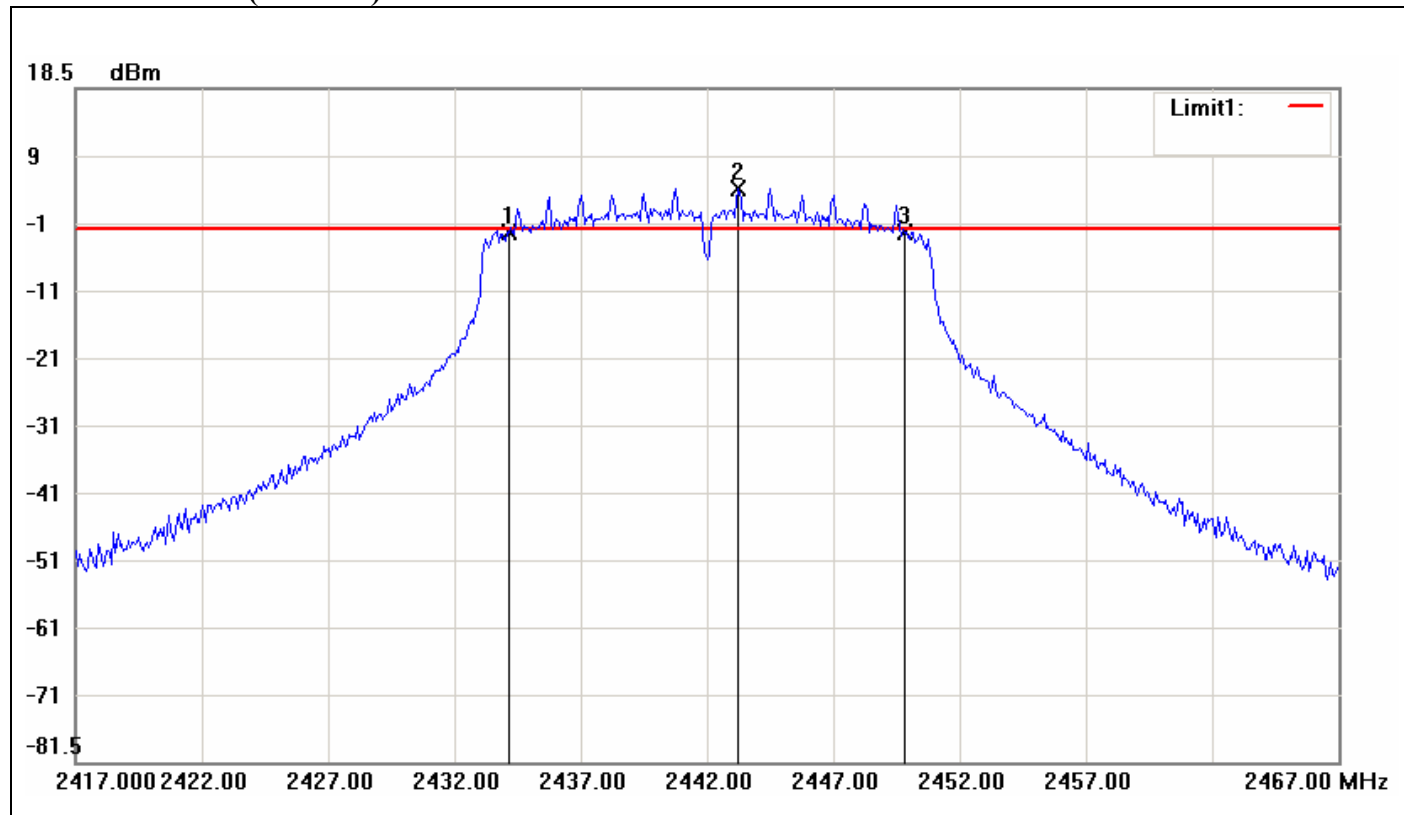


No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2404.3333	-3.40	-2.61	-0.79
2	2414.5000	3.39	-2.61	6.00
3	2420.1667	-3.00	-2.61	-0.39

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	15.8334	0.4



6dB Bandwidth (CH Mid)

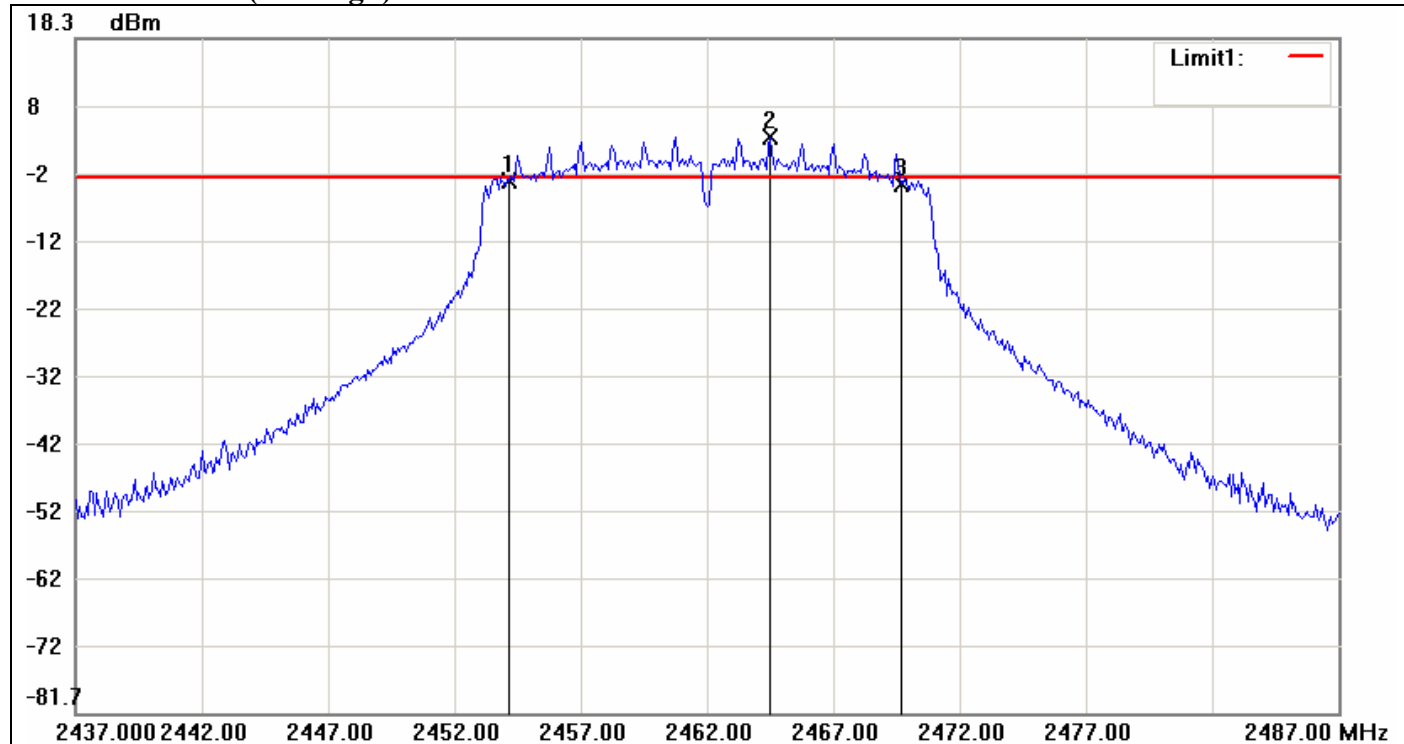


No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2434.1667	-2.73	-2.41	-0.32
2	2443.2500	3.59	-2.41	6.00
3	2449.8333	-2.85	-2.41	-0.44

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	15.6666	-0.12



6dB Bandwidth (CH High)



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2454.1667	-2.77	-2.36	-0.41
2	2464.5000	3.64	-2.36	6.00
3	2469.6667	-3.37	-2.36	-1.01

No.		Δ Frequency(MHz)	Δ Level(dB)
1	mk3-mk1	15.5	-0.6



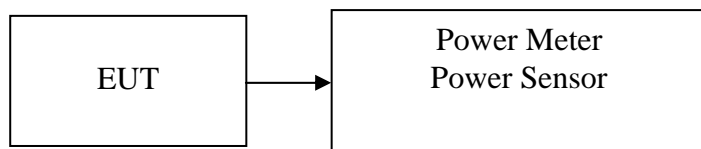
7.2 PEAK POWER

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

The transmitter output is connected to the Power Meter. The Power Meter is set to the peak power detection.

TEST RESULTS

No non-compliance noted

**Test Data****Test mode: IEEE 802.11b mode**

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	17.29	0.05358	1.00	PASS
Mid	2442	17.28	0.05346		PASS
High	2462	17.42	0.05521		PASS

Test mode: IEEE 802.11g mode

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	24.78	0.30061	1.00	PASS
Mid	2442	25.06	0.32063		PASS
High	2462	24.89	0.30832		PASS

Test mode: IEEE 802.11n HT 20 MHz mode

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	24.87	0.30690	1.00	PASS
Mid	2442	24.89	0.30832		PASS
High	2462	24.87	0.30690		PASS

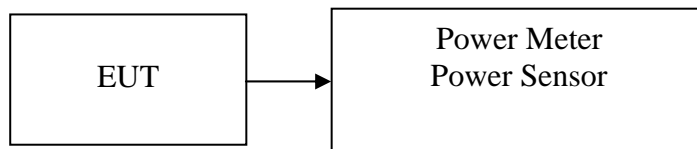


7.3 AVERAGE POWER

LIMIT

None; for reporting purposes only.

Test Configuration



TEST PROCEDURE

The transmitter output is connected to the Power Meter. The Power Meter is set to the peak power detection.

TEST RESULTS

No non-compliance noted



Test Data

Test mode: IEEE 802.11b mode

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	2412	14.88	0.03076
Mid	2442	15.04	0.03192
High	2462	15.05	0.03199

Test mode: IEEE 802.11g mode

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	2412	14.56	0.02858
Mid	2442	14.68	0.02938
High	2462	14.70	0.02951

Test mode: IEEE 802.11n HT 20 MHz mode

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	2412	14.52	0.02831
Mid	2442	14.51	0.02825
High	2462	14.62	0.02897

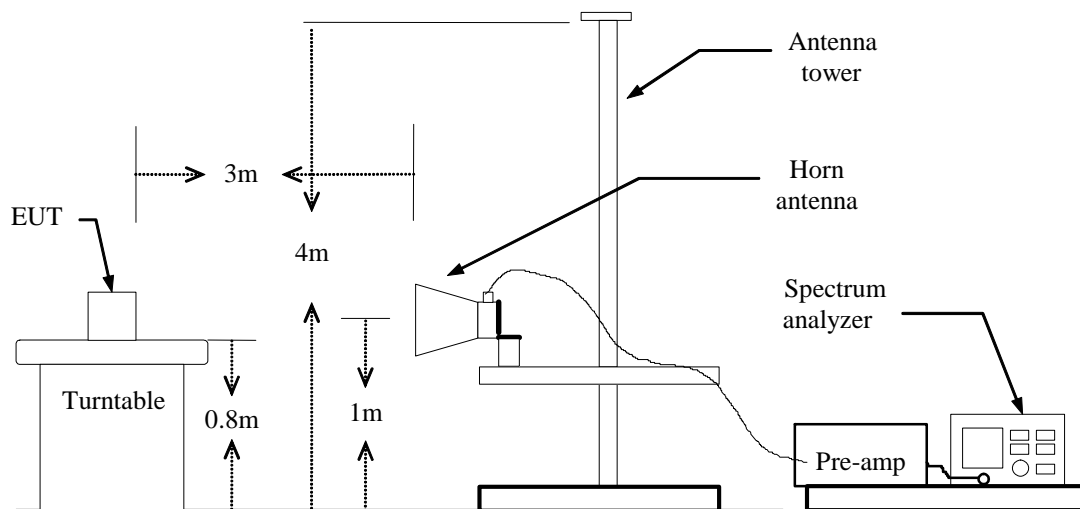


7.4 BAND EDGES MEASUREMENT

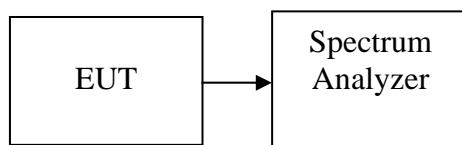
LIMIT

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 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=1MHz / VBW=3MHz / Sweep=AUTO
 - (b) AVERAGE: RBW=1MHz / VBW=10Hz / Sweep=AUTO

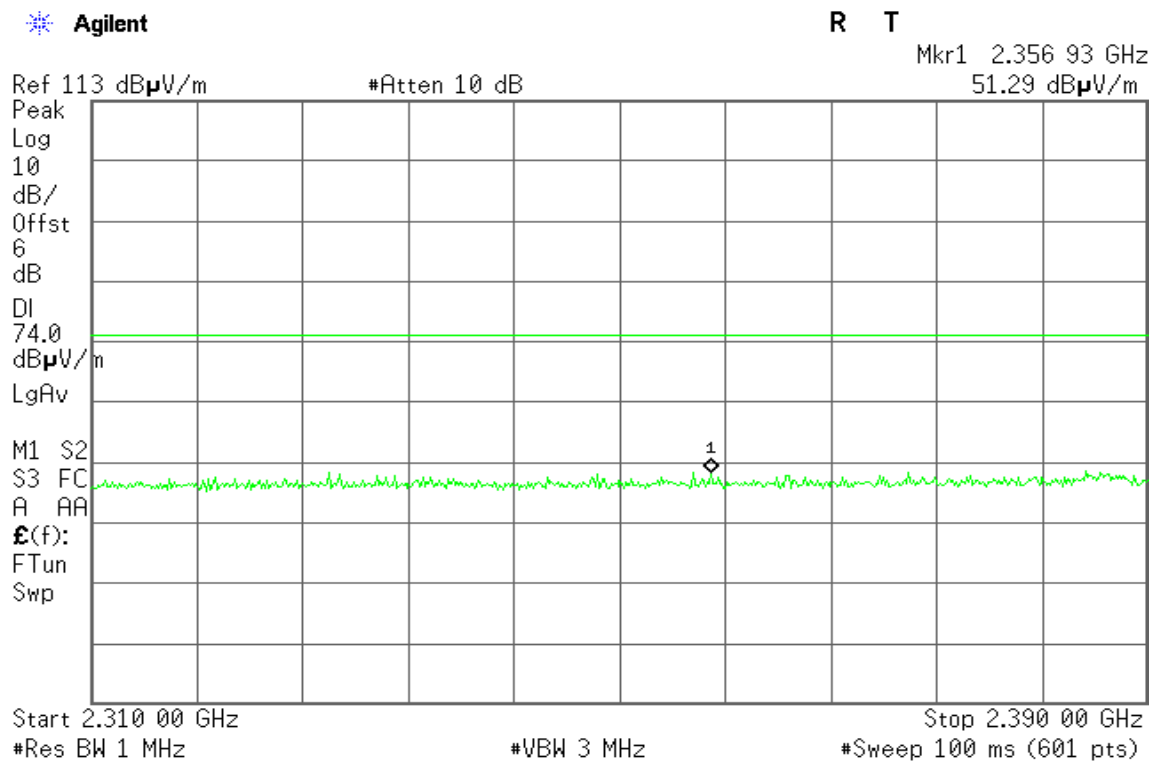
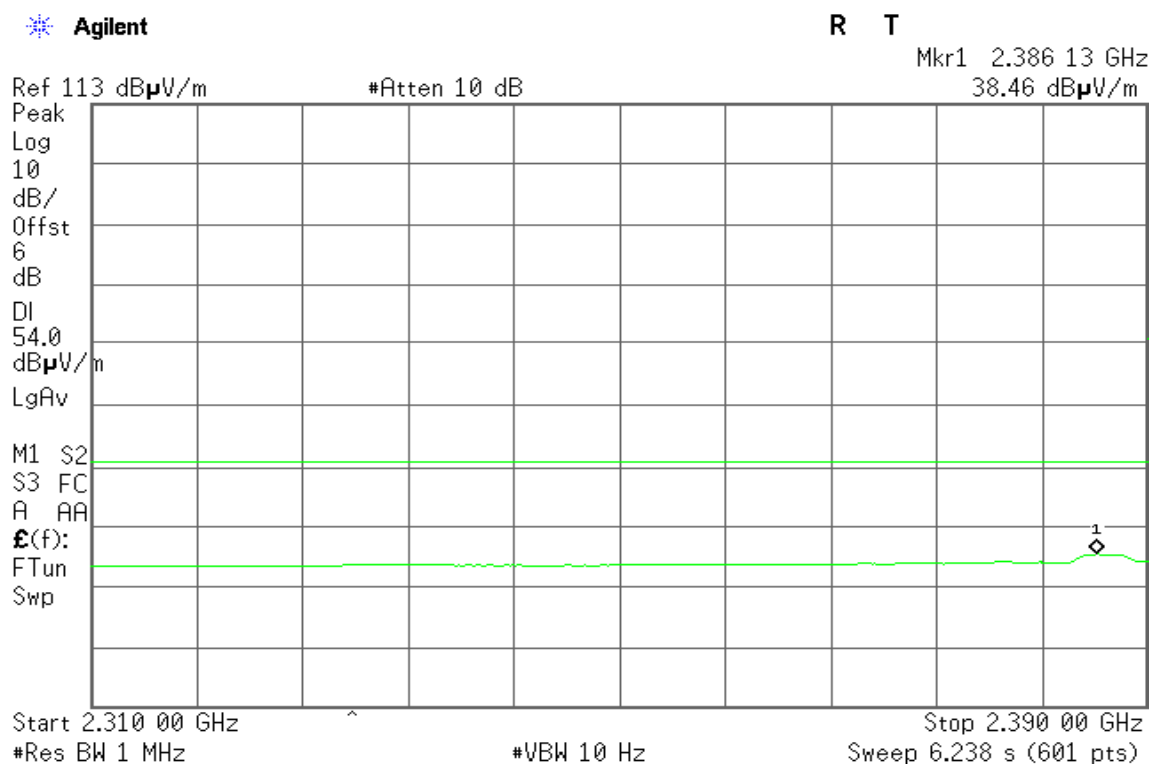
Band edge of the conducted emission

RBW: 100 kHz, VBW: 300Hz, sweep: AUTO

5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

TEST RESULTS

Refer to attach spectrum analyzer data chart.

**Band Edges (IEEE 802.11b mode / CH Low)****Detector mode: Peak****Polarity: Vertical****Detector mode: Average****Polarity: Vertical**



Detector mode: Peak

Polarity: Horizontal

Agilent

R T

Mkr1 2.373 47 GHz

51.36 dB μ V/mRef 113 dB μ V/m

#Atten 10 dB

Peak

Log

10

dB/

Offst

6

dB

DI

74.0

dB μ V/m

LgAv

M1 S2

S3 FC

A AA

E(f):

FTun

Swp

Start 2.310 00 GHz

#Res BW 1 MHz

#VBW 3 MHz

Stop 2.390 00 GHz

#Sweep 100 ms (601 pts)

Detector mode: Average

Polarity: Horizontal

Agilent

R T

Mkr1 2.386 40 GHz

37.02 dB μ V/mRef 113 dB μ V/m

#Atten 10 dB

Peak

Log

10

dB/

Offst

6

dB

DI

54.0

dB μ V/m

LgAv

M1 S2

S3 FC

A AA

E(f):

FTun

Swp

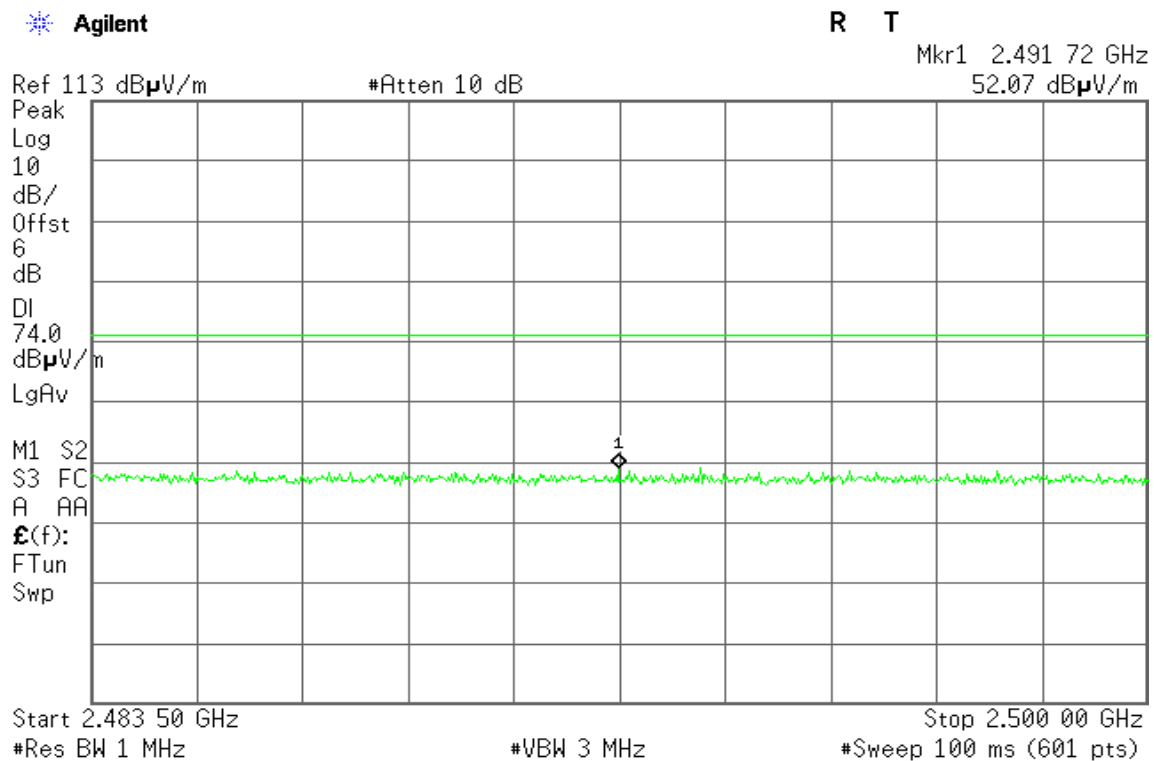
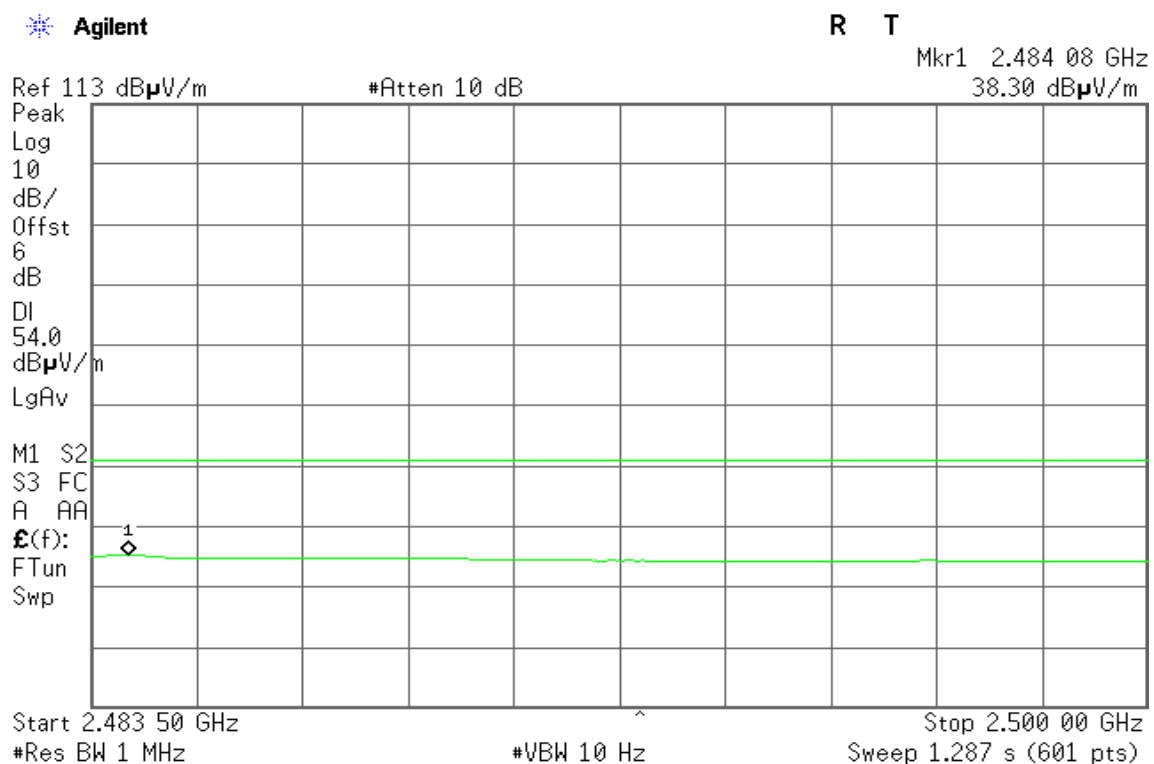
Start 2.310 00 GHz

#Res BW 1 MHz

#VBW 10 Hz

Stop 2.390 00 GHz

Sweep 6.238 s (601 pts)

**Band Edges (IEEE 802.11b mode / CH High)****Detector mode: Peak****Polarity: Vertical****Detector mode: Average****Polarity: Vertical**



Detector mode: Peak

Polarity: Horizontal

Agilent

R T

Mkr1 2.492 88 GHz

51.35 dB μ V/mRef 113 dB μ V/m

#Atten 10 dB

Peak

Log

10

dB/

Offst

6

dB

DI

74.0

dB μ V/m

LgAv

M1 S2

S3 FC

A AA

E(f):

FTun

Swp

Start 2.483 50 GHz

#Res BW 1 MHz

#VBW 3 MHz

Stop 2.500 00 GHz

#Sweep 100 ms (601 pts)

Detector mode: Average

Polarity: Horizontal

Agilent

R T

Mkr1 2.483 94 GHz

37.64 dB μ V/mRef 113 dB μ V/m

#Atten 10 dB

Peak

Log

10

dB/

Offst

6

dB

DI

54.0

dB μ V/m

LgAv

M1 S2

S3 FC

A AA

E(f):

FTun

Swp

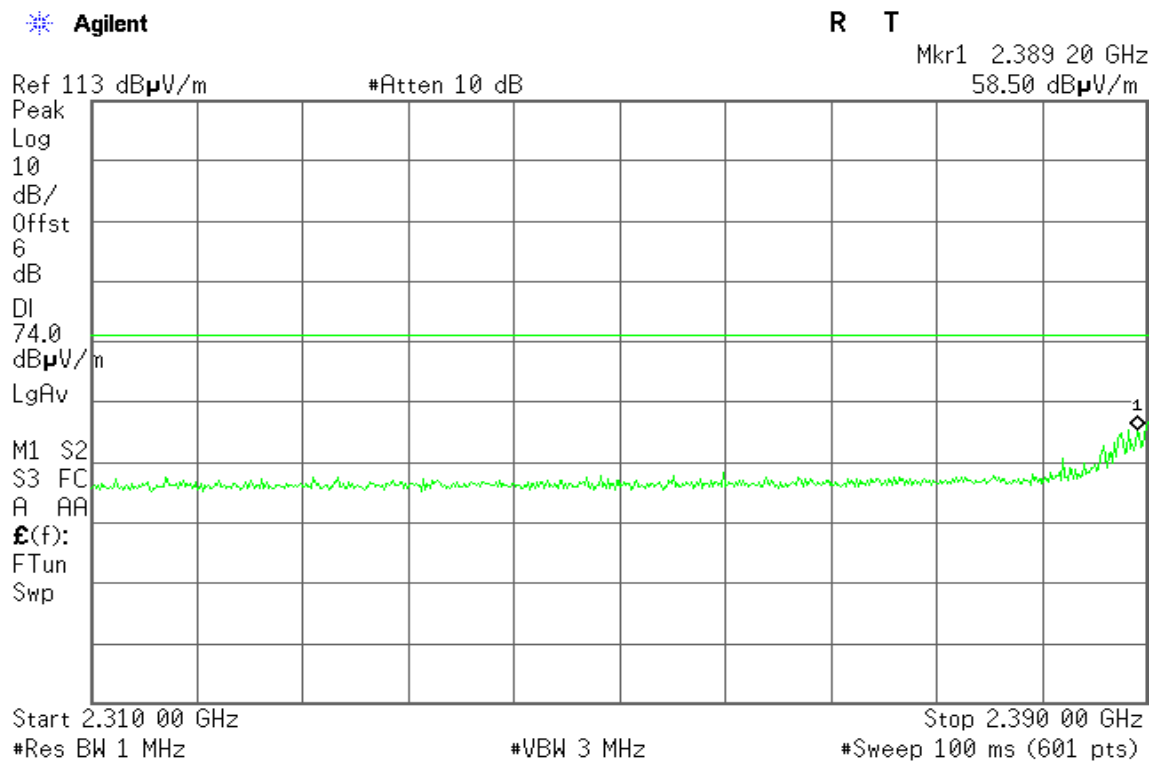
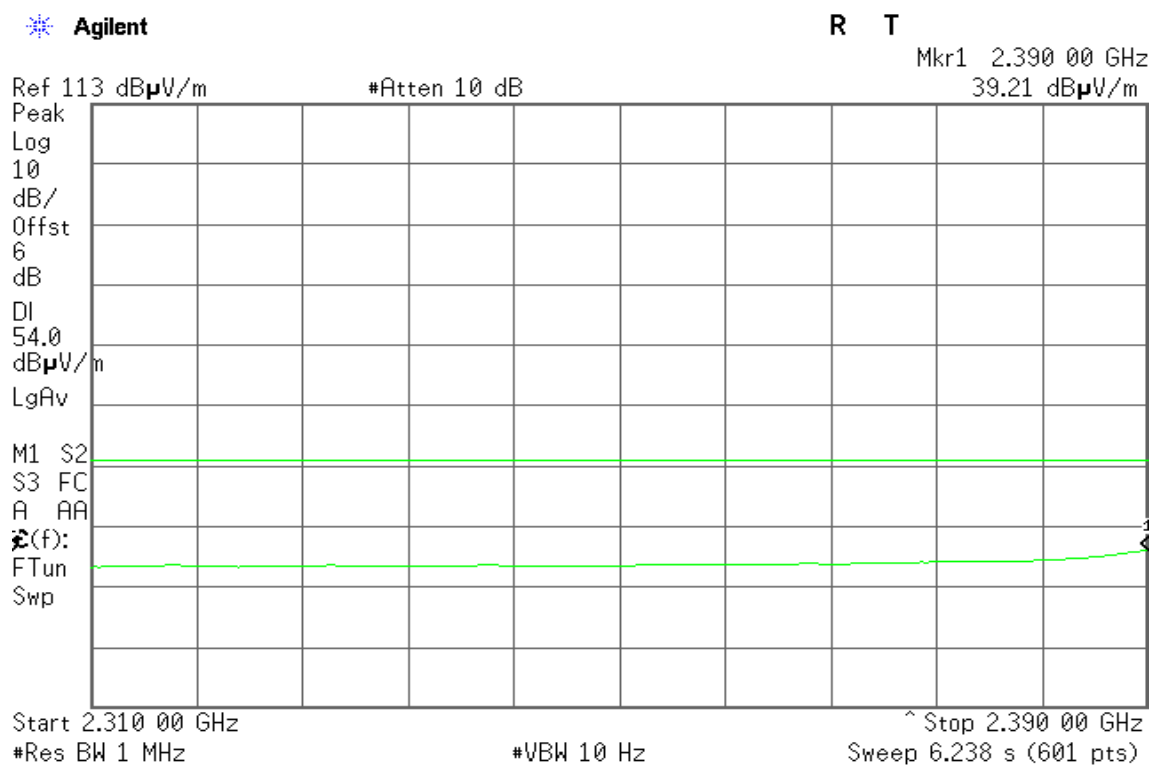
Start 2.483 50 GHz

#Res BW 1 MHz

#VBW 10 Hz

Stop 2.500 00 GHz

Sweep 1.287 s (601 pts)

**Band Edges (IEEE 802.11g mode / CH Low)****Detector mode: Peak****Polarity: Vertical****Detector mode: Average****Polarity: Vertical**



Detector mode: Peak

Polarity: Horizontal

Agilent

R T

Mkr1 2.389 73 GHz

58.44 dB μ V/mRef 113 dB μ V/m

#Atten 10 dB

Peak

Log

10

dB/

Offst

6

dB

DI

74.0

dB μ V/m

LgAv

.

M1 S2

S3 FC

A AA

E(f):

FTun

Swp

Start 2.310 00 GHz

#Res BW 1 MHz

#VBW 3 MHz

Stop 2.390 00 GHz

#Sweep 100 ms (601 pts)

Detector mode: Average

Polarity: Horizontal

Agilent

R T

Mkr1 2.390 00 GHz

38.29 dB μ V/mRef 113 dB μ V/m

#Atten 10 dB

Peak

Log

10

dB/

Offst

6

dB

DI

54.0

dB μ V/m

LgAv

.

M1 S2

S3 FC

A AA

E(f):

FTun

Swp

Start 2.310 00 GHz

#Res BW 1 MHz

#VBW 10 Hz

Stop 2.390 00 GHz

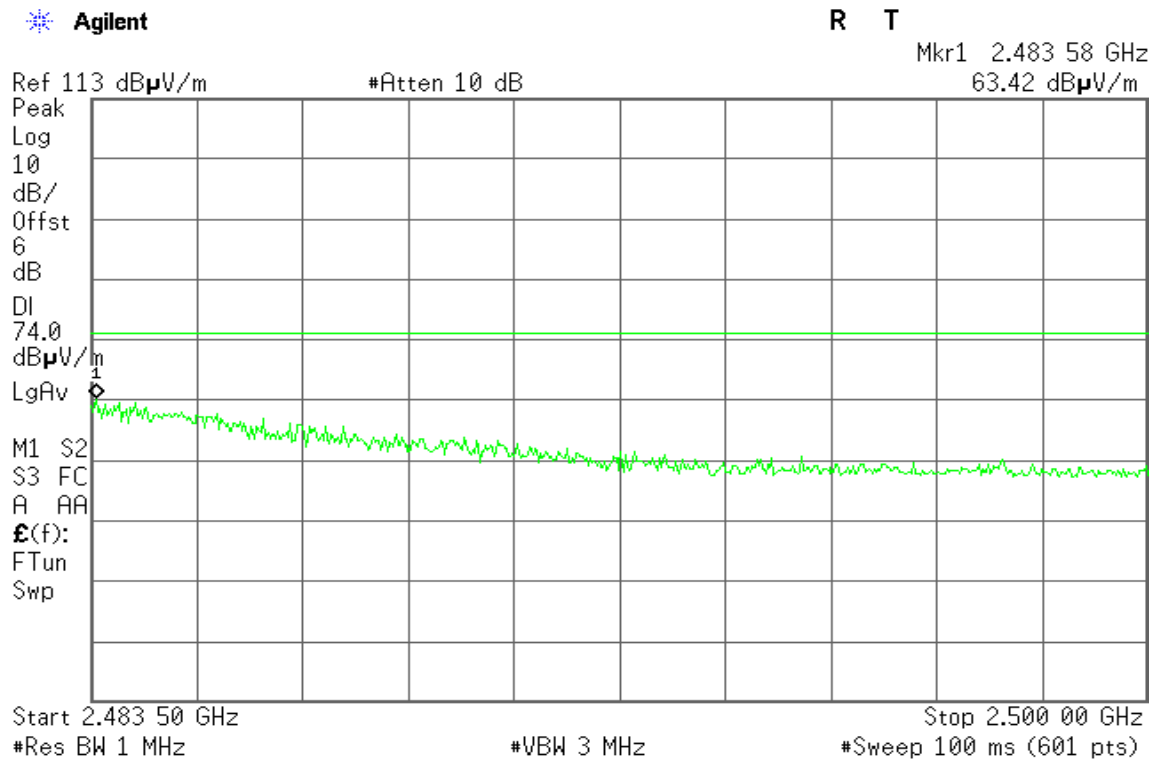
Sweep 6.238 s (601 pts)



Band Edges (IEEE 802.11g mode / CH High)

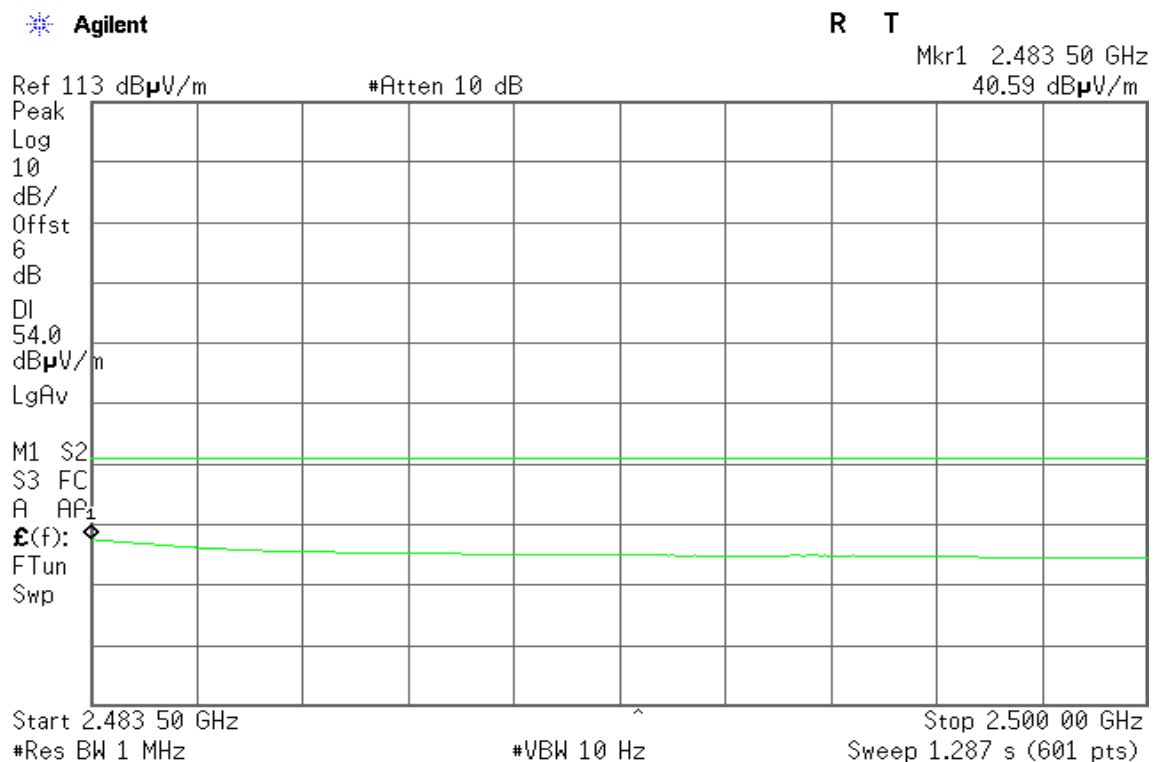
Detector mode: Peak

Polarity: Vertical



Detector mode: Average

Polarity: Vertical





Detector mode: Peak

Polarity: Horizontal

Agilent

R T

Mkr1 2.483 91 GHz

61.68 dB μ V/m

Ref 113 dB μ V/m

#Atten 10 dB

Peak

Log

10

dB/

Offst

6

dB

DI

74.0

dB μ V/m

LgAv

M1 S2

S3 FC

A AA

$\mathcal{E}(f)$:

FTun

Swp

Start 2.483 50 GHz

#Res BW 1 MHz

#VBW 3 MHz

Stop 2.500 00 GHz

#Sweep 100 ms (601 pts)

Detector mode: Average

Polarity: Horizontal

Agilent

R T

Mkr1 2.483 50 GHz

40.63 dB μ V/m

Ref 113 dB μ V/m

#Atten 10 dB

Peak

Log

10

dB/

Offst

6

dB

DI

54.0

dB μ V/m

LgAv

M1 S2

S3 FC

A AP1

$\mathcal{E}(f)$:

FTun

Swp

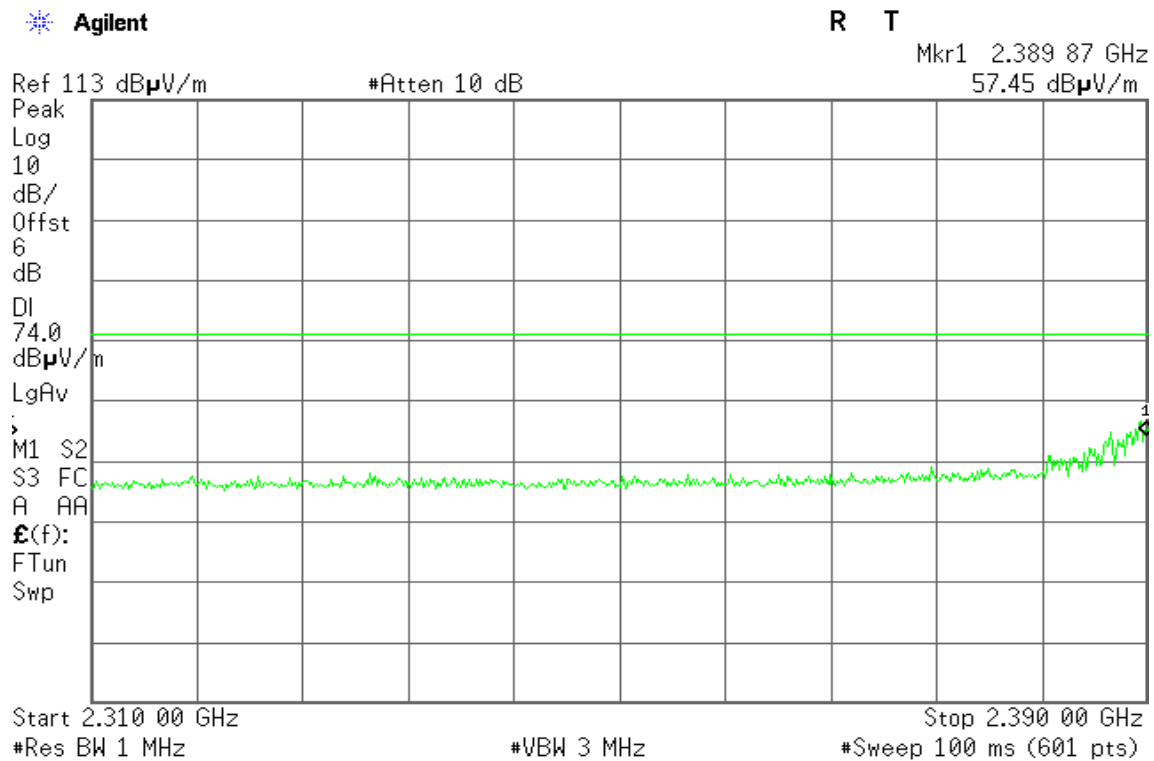
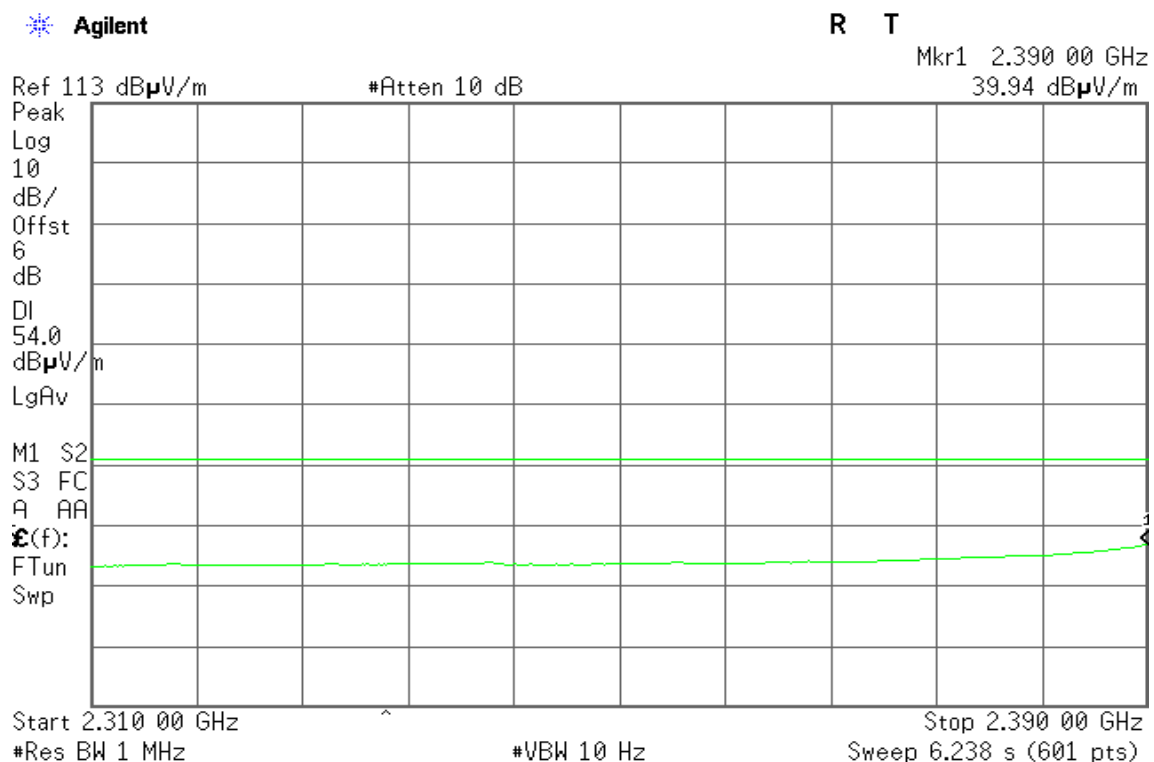
Start 2.483 50 GHz

#Res BW 1 MHz

#VBW 10 Hz

Stop 2.500 00 GHz

Sweep 1.287 s (601 pts)

**Band Edges (IEEE 802.11n HT 20 MHz mode / CH Low)****Detector mode: Peak****Polarity: Vertical****Detector mode: Average****Polarity: Vertical**



Detector mode: Peak

Polarity: Horizontal

Agilent

R T

Mkr1 2.388 13 GHz

53.50 dB μ V/mRef 113 dB μ V/m

#Atten 10 dB

Peak

Log

10

dB/

Offst

6

dB

DI

74.0

dB μ V/m

LgAv

M1 S2

S3 FC

A AA

E(f):

FTun

Swp

Start 2.310 00 GHz

#Res BW 1 MHz

#VBW 3 MHz

Stop 2.390 00 GHz

#Sweep 100 ms (601 pts)

Detector mode: Average

Polarity: Horizontal

Agilent

R T

Mkr1 2.390 00 GHz

38.01 dB μ V/mRef 113 dB μ V/m

#Atten 10 dB

Peak

Log

10

dB/

Offst

6

dB

DI

54.0

dB μ V/m

LgAv

M1 S2

S3 FC

A AA

E(f):

FTun

Swp

Start 2.310 00 GHz

#Res BW 1 MHz

#VBW 10 Hz

Stop 2.390 00 GHz

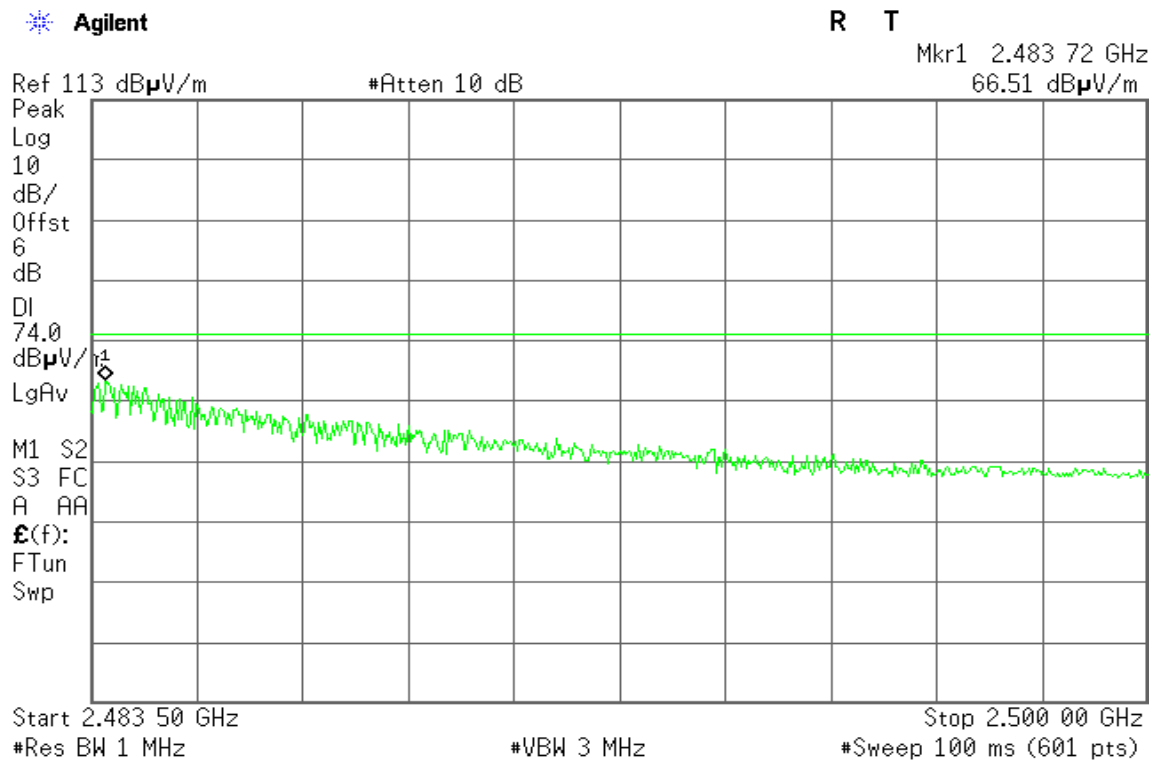
Sweep 6.238 s (601 pts)



Band Edges (IEEE 802.11n HT 20 MHz mode / CH High)

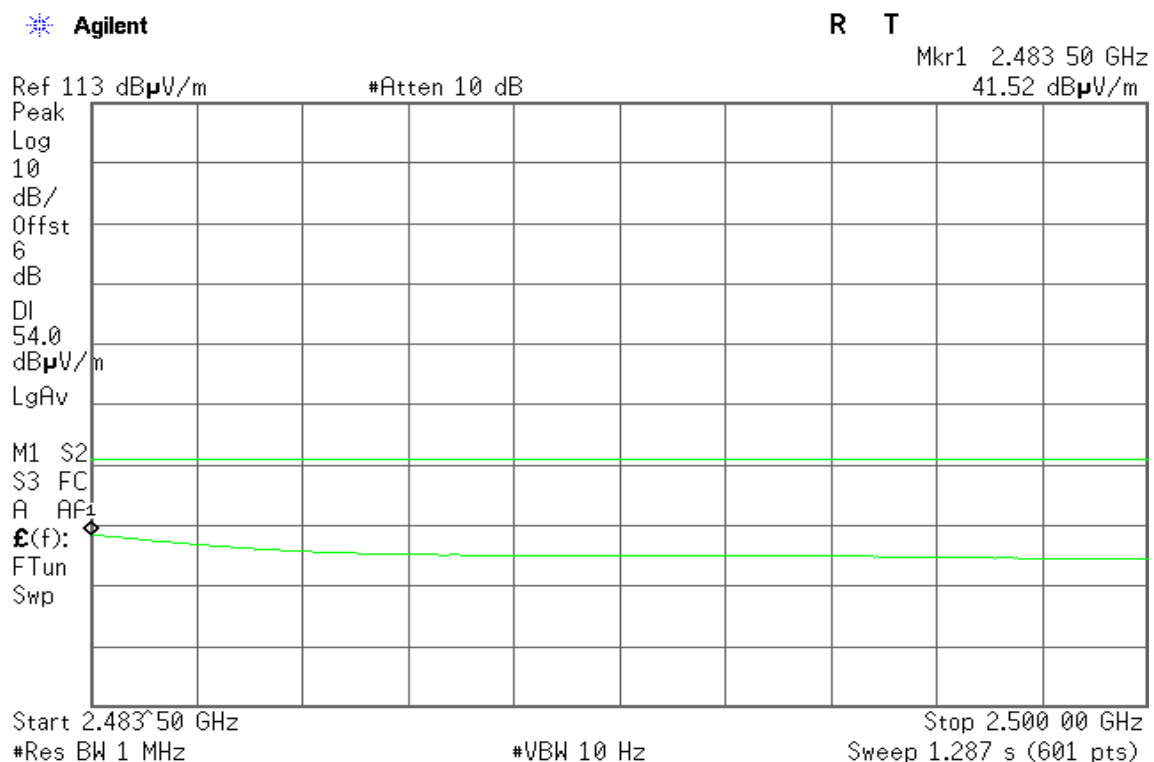
Detector mode: Peak

Polarity: Vertical



Detector mode: Average

Polarity: Vertical





Detector mode: Peak

Polarity: Horizontal

Agilent

R T

Mkr1 2.483 86 GHz

63.24 dB μ V/mRef 113 dB μ V/m

#Atten 10 dB

Peak

Log

10

dB/

Offst

6

dB

DI

74.0

dB μ V/m

LgAv

M1 S2

S3 FC

A AA

E(f):

FTun

Swp

Start 2.483 50 GHz

#Res BW 1 MHz

#VBW 3 MHz

Stop 2.500 00 GHz

#Sweep 100 ms (601 pts)

Detector mode: Average

Polarity: Horizontal

Agilent

R T

Mkr1 2.483 50 GHz

39.49 dB μ V/mRef 113 dB μ V/m

#Atten 10 dB

Peak

Log

10

dB/

Offst

6

dB

DI

54.0

dB μ V/m

LgAv

M1 S2

S3 FC

A AA

E(f):

FTun

Swp

Start 2.483 50 GHz

#Res BW 1 MHz

#VBW 10 Hz

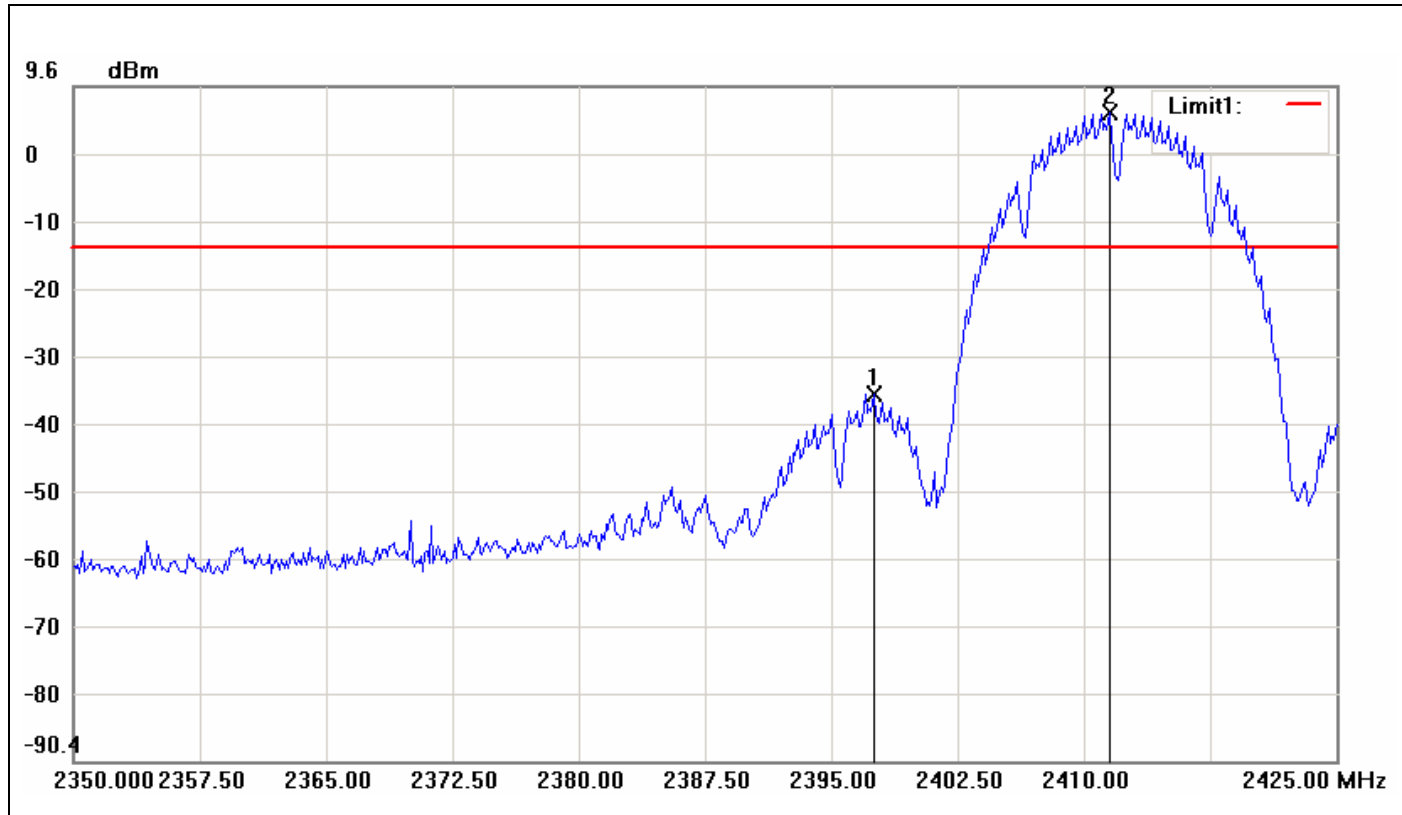
^ Stop 2.500 00 GHz

Sweep 1.287 s (601 pts)



Conducted Band Edge

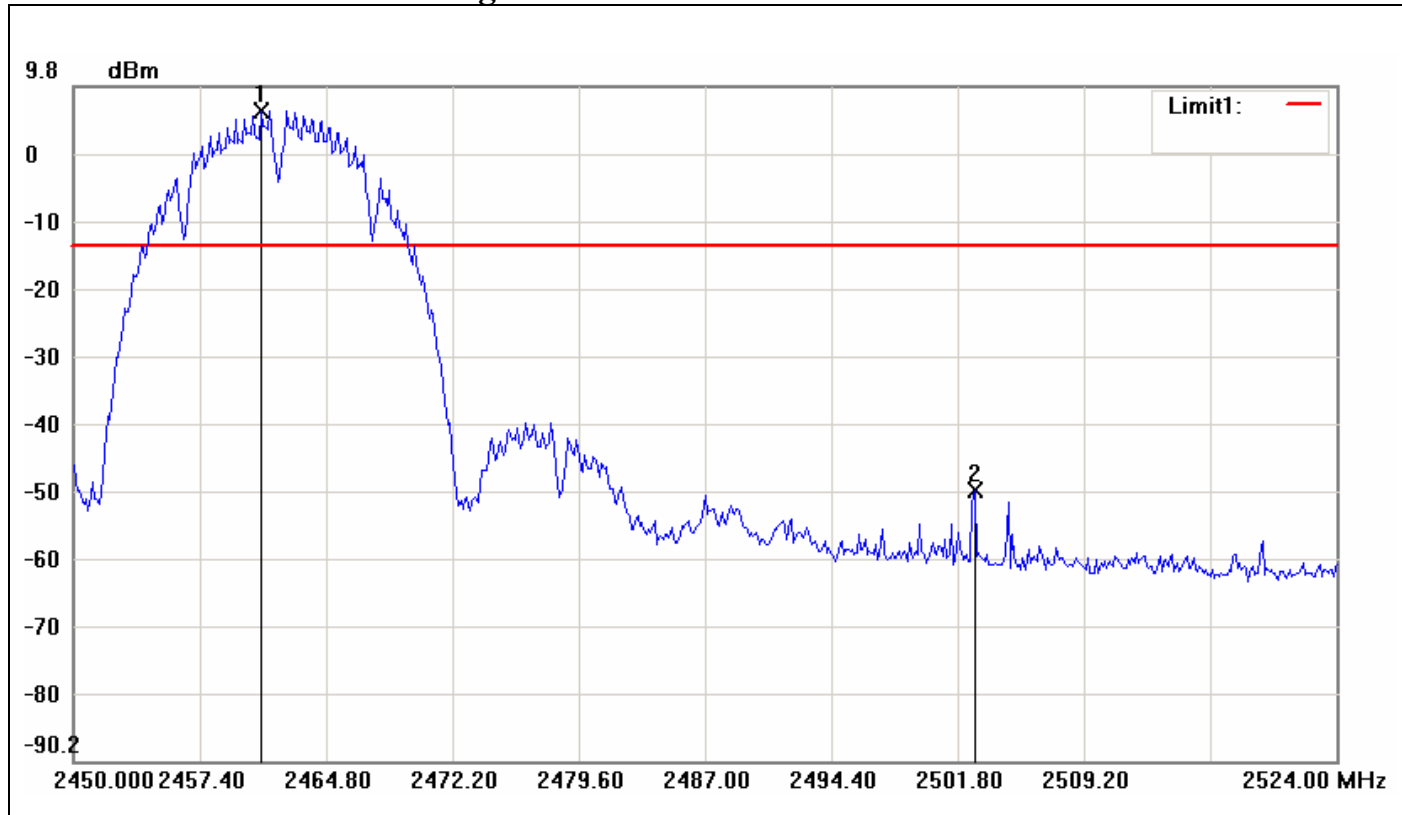
IEEE 802.11b Mode / CH Low



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2397.5000	-35.94	-14.33	-21.61
2	2411.5000	5.67	-14.33	20.00



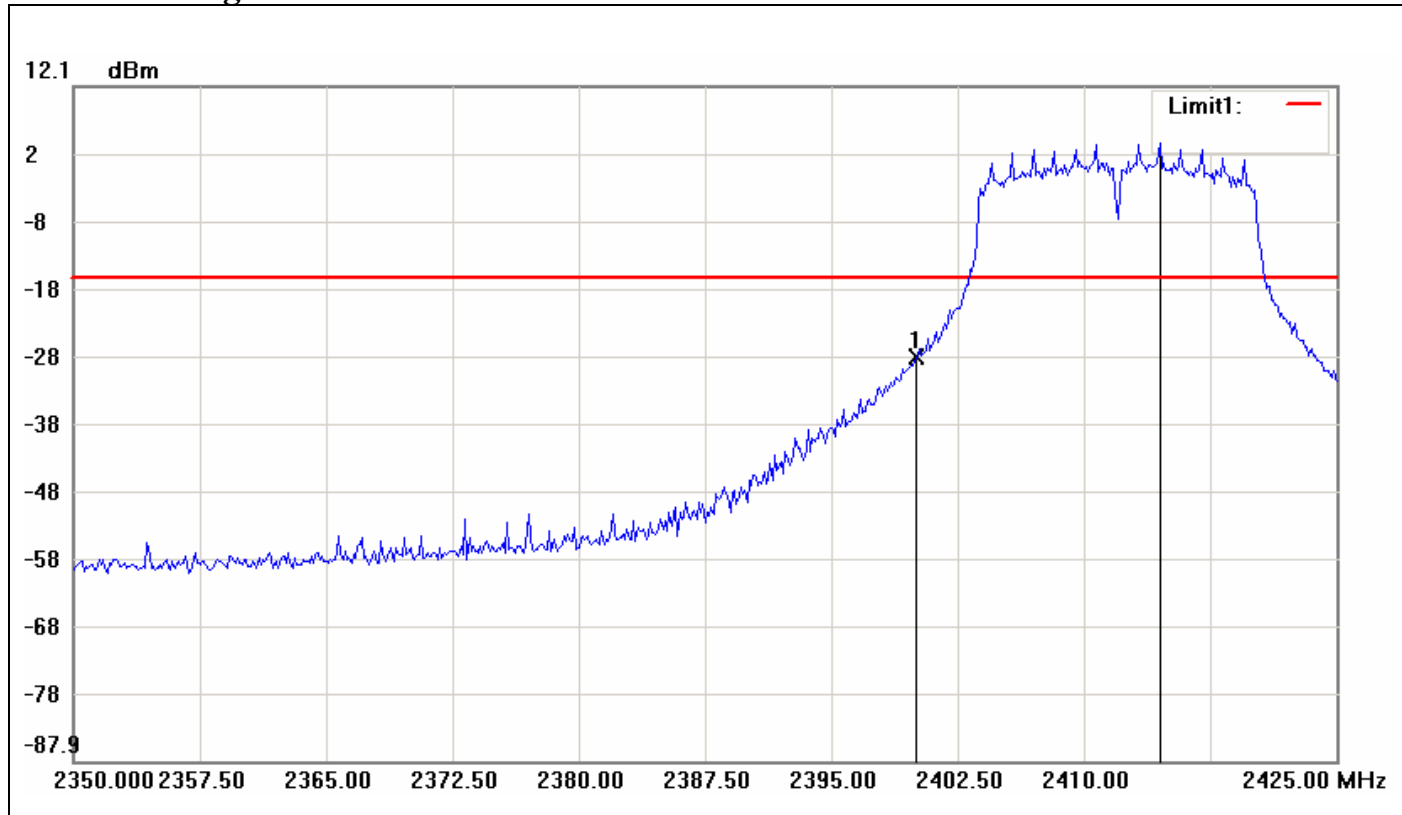
IEEE 802.11b Mode / CH High



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2460.9767	6.23	-13.77	20.00
2	2502.7867	-50.06	-13.77	-36.29



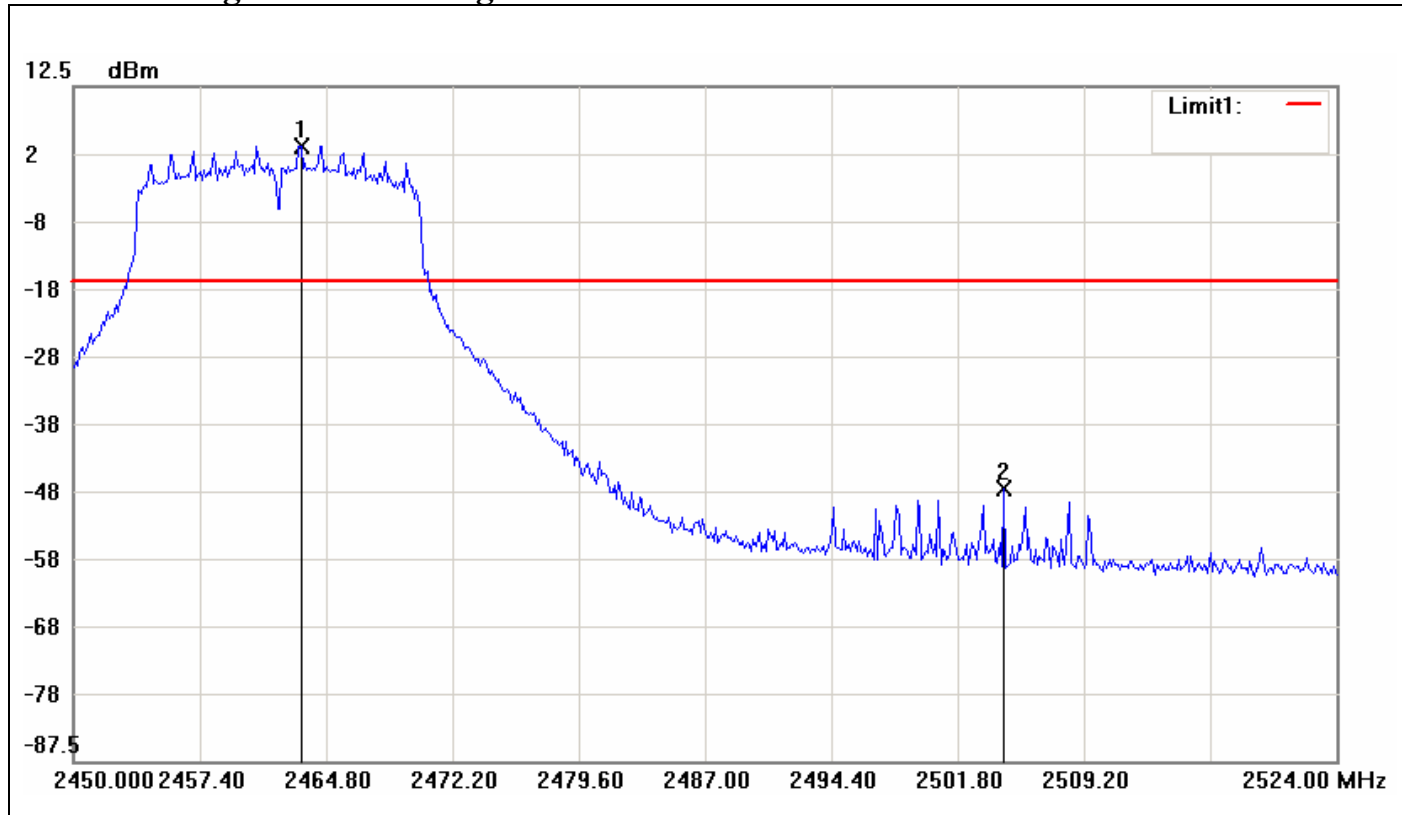
IEEE 802.11g Mode / CH Low



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2400.0000	-28.00	-16.41	-11.59
2	2414.5000	3.59	-16.41	20.00



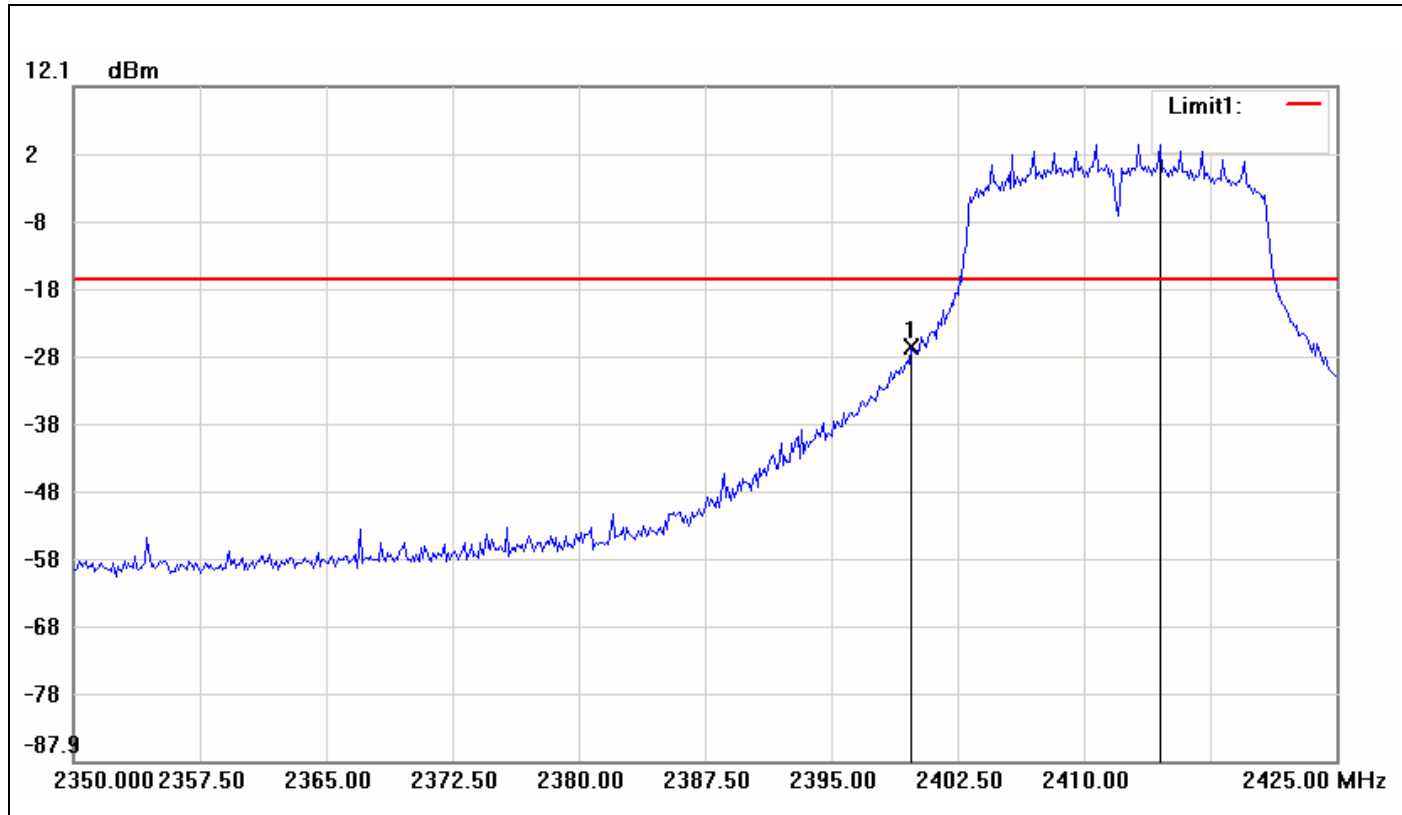
IEEE 802.11g Mode / CH High



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2463.3200	3.67	-16.33	20.00
2	2504.5133	-47.20	-16.33	-30.87



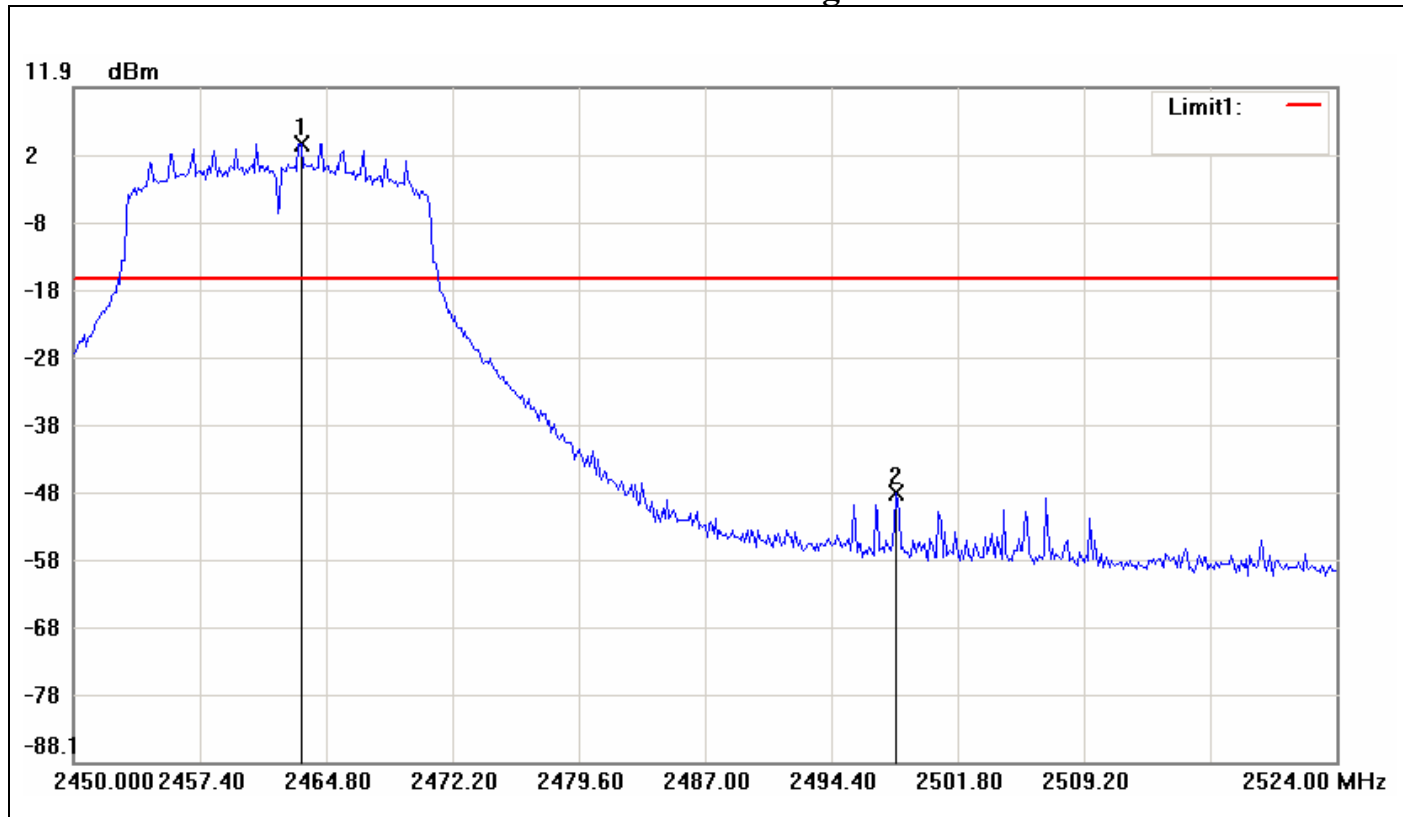
IEEE 802.11n HT 20 MHz Channel Mode / CH Low



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2399.7500	-26.61	-16.48	-10.13
2	2414.5000	3.52	-16.48	20.00



IEEE 802.11n HT 20 MHz Channel Mode / CH High



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2463.3200	3.53	-16.47	20.00
2	2498.2233	-48.23	-16.47	-31.76

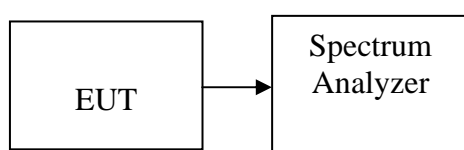


7.5 DENSITY

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 = 3 kHz, VBW = 10 kHz, Span = 300 kHz, Sweep time = 100 s
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

Test mode: IEEE 802.11b mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2412	-6.57	8.00	PASS
Mid	2442	-5.87		PASS
High	2462	-5.77		PASS

Test mode: IEEE 802.11g mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2412	-10.36	8.00	PASS
Mid	2442	-10.42		PASS
High	2462	-9.29		PASS

Test mode: IEEE 802.11n HT 20 MHz mode

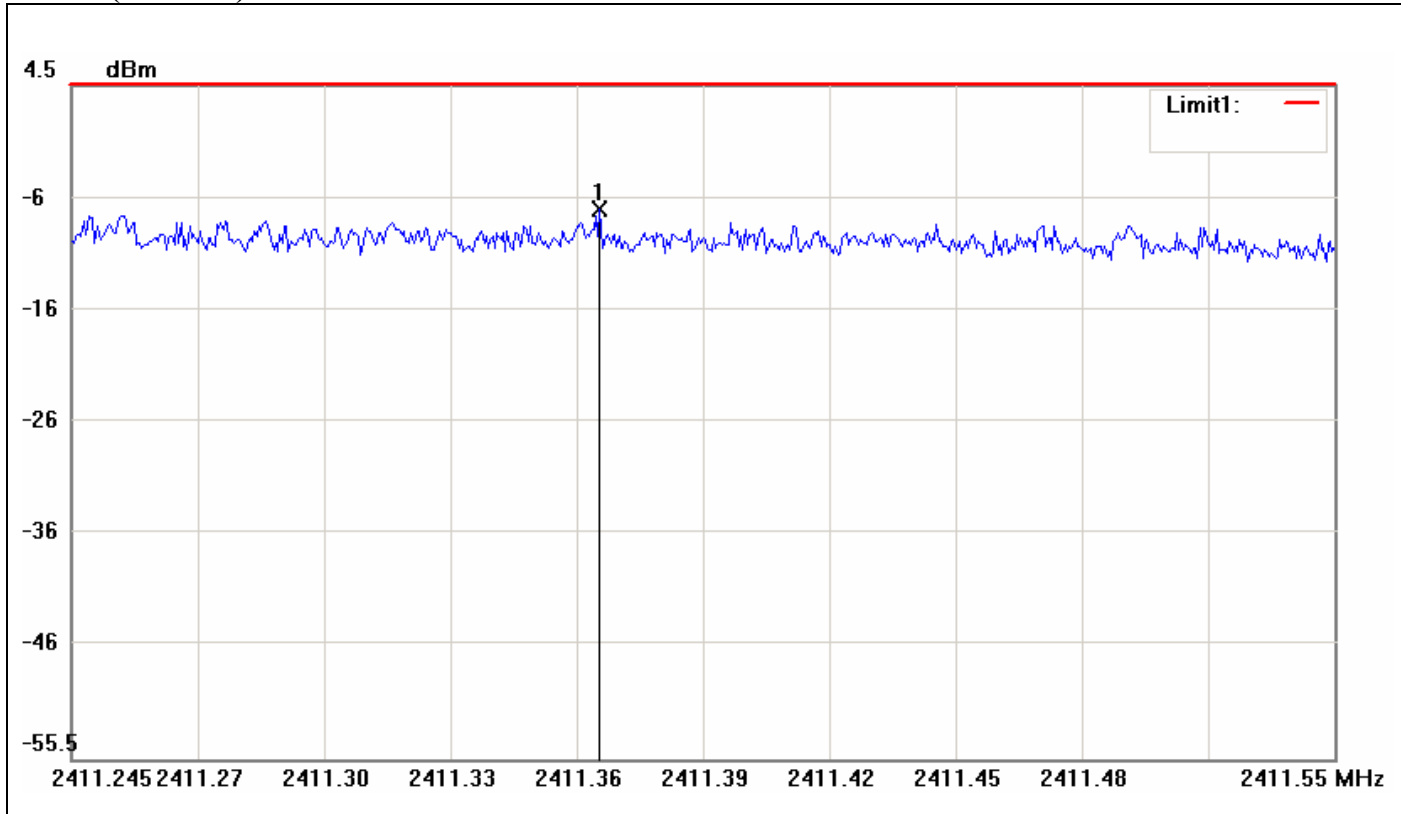
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2412	-10.81	8.00	PASS
Mid	2442	-10.07		PASS
High	2462	-10.54		PASS



Test Plot

IEEE 802.11b mode

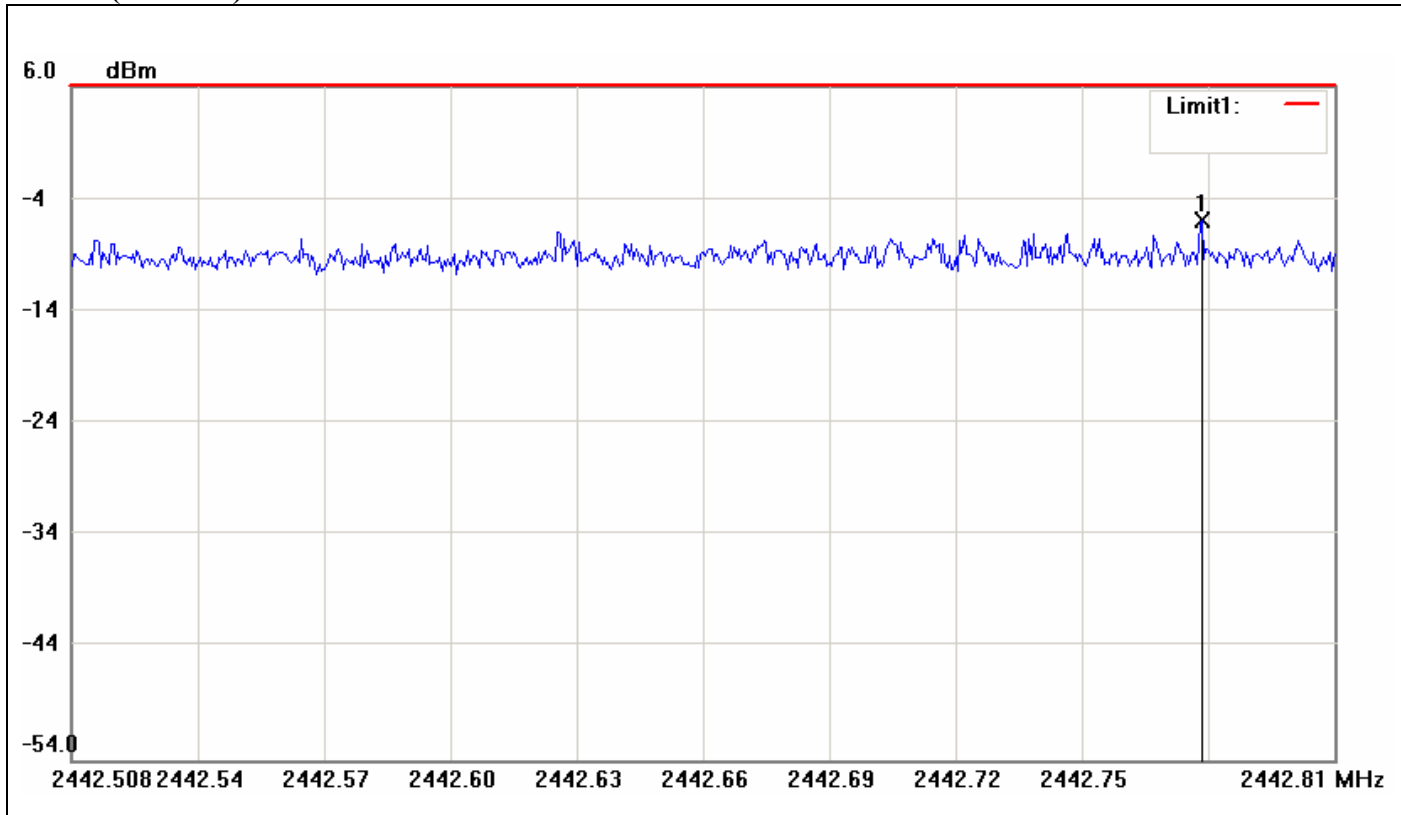
PPSD (CH Low)



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2411.3702	-6.57	8.00	-14.57



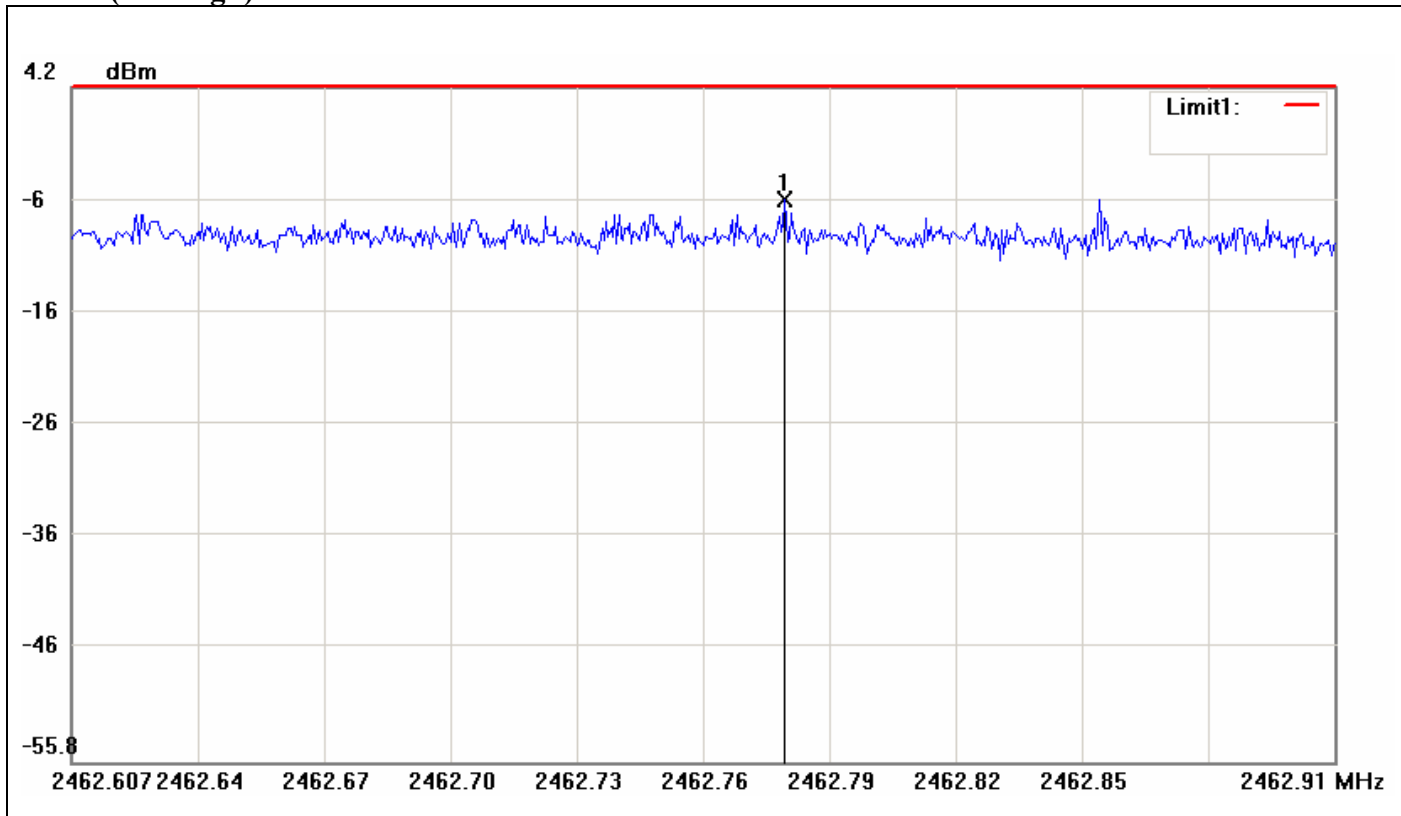
PPSD (CH Mid)



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2442.7762	-5.87	8.00	-13.87



PPSD (CH High)

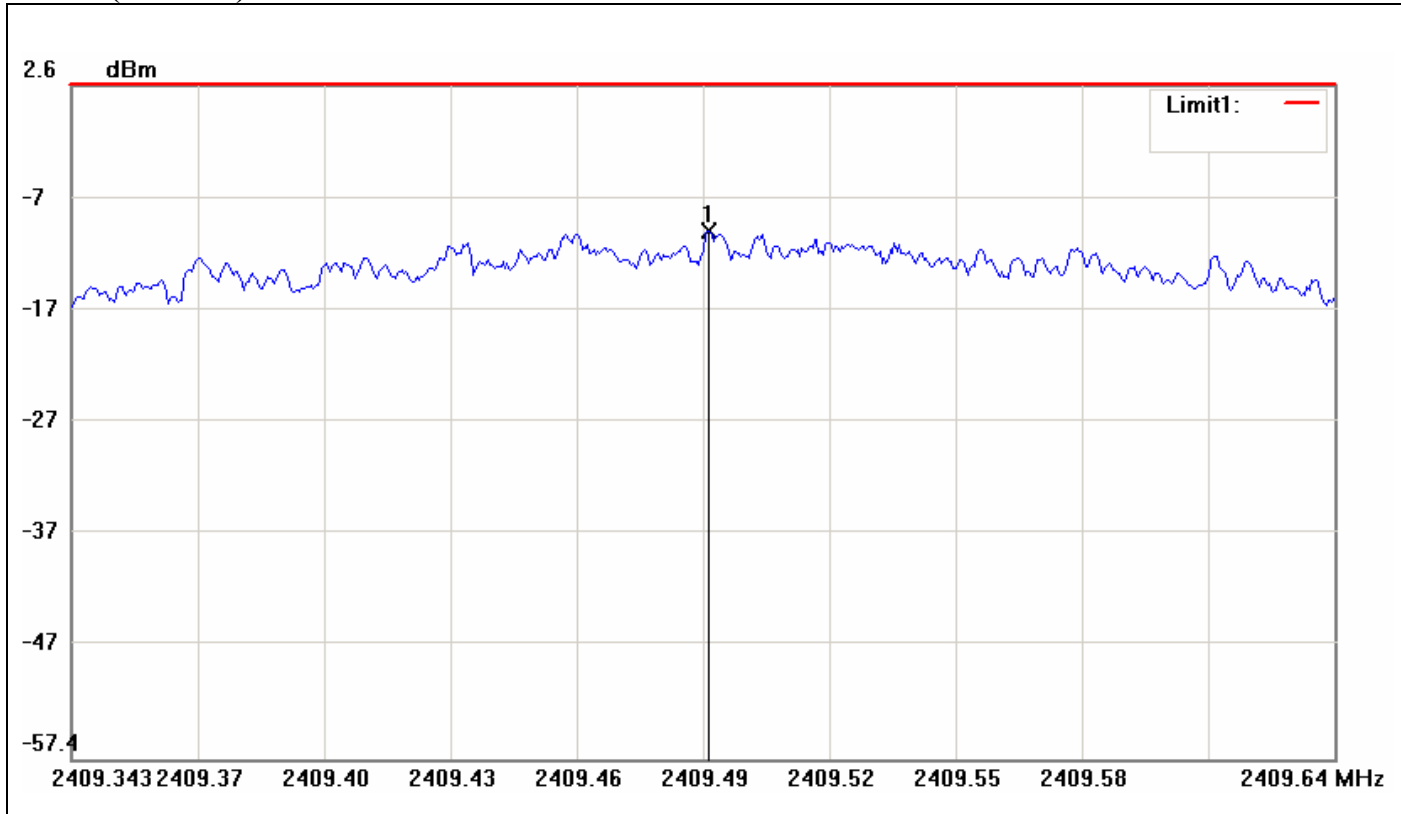


No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2462.7768	-5.77	8.00	-13.77



IEEE 802.11g mode

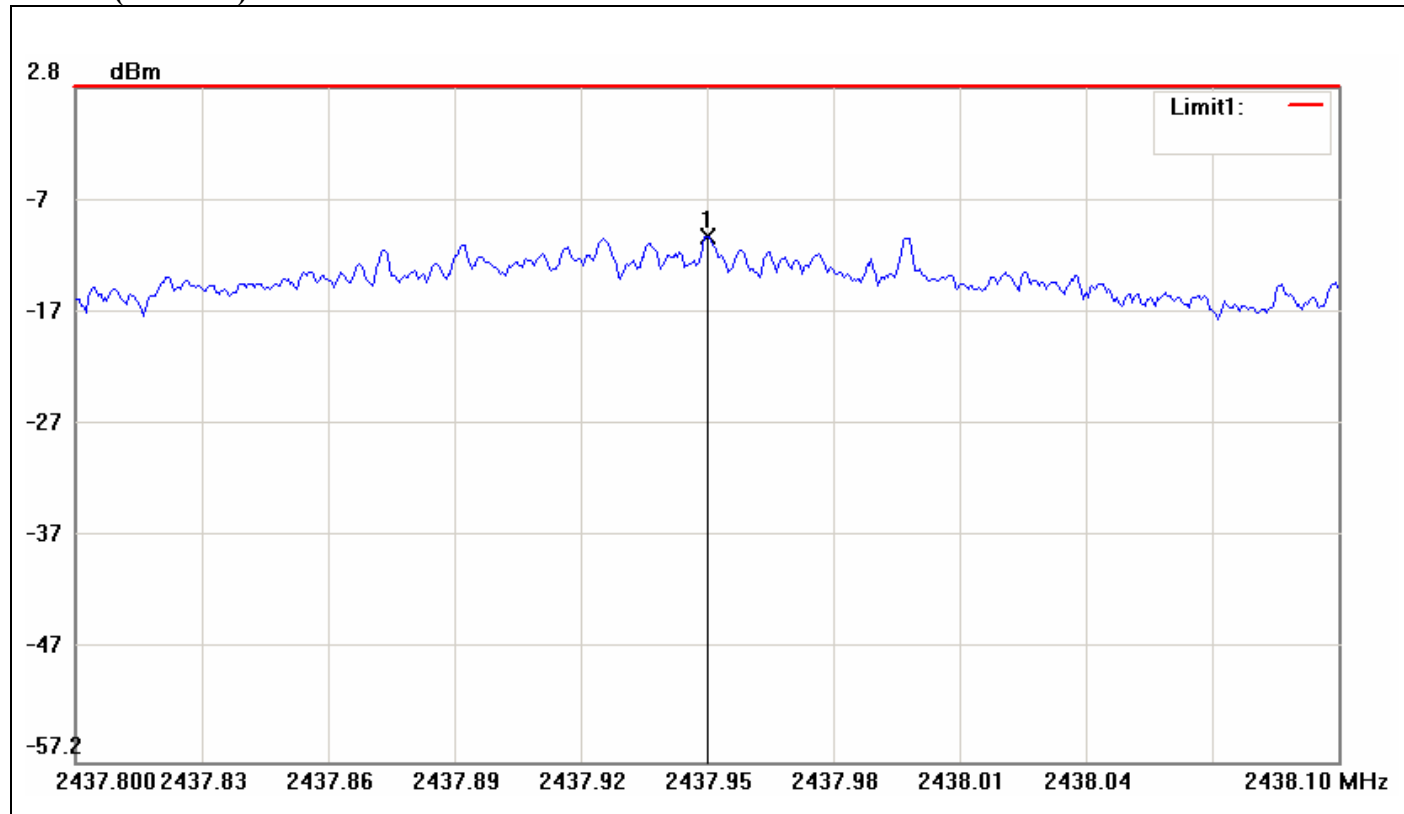
PPSD (CH Low)



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2409.4942	-10.36	8.00	-18.36



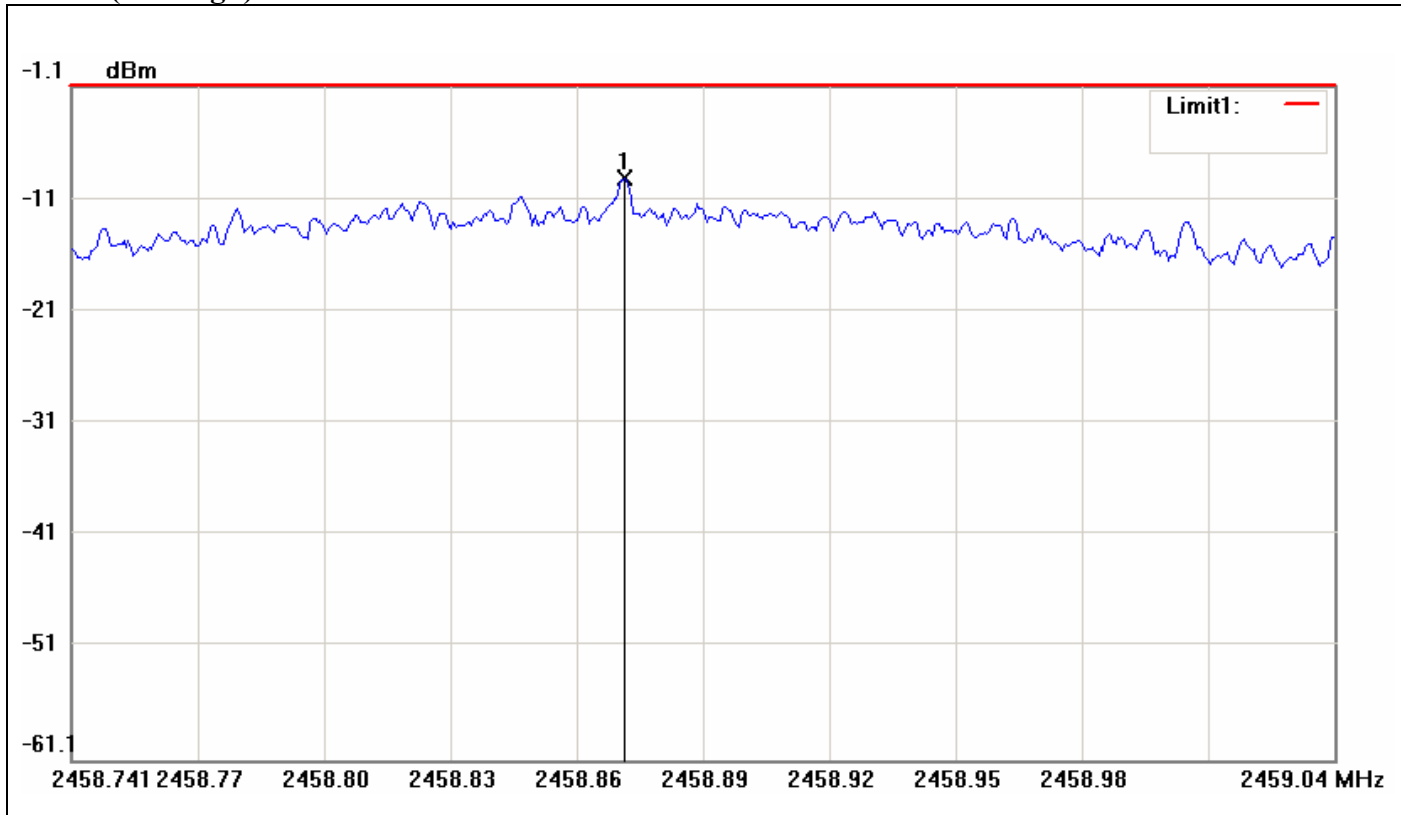
PPSD (CH Mid)



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2437.9495	-10.42	8.00	-18.42



PPSD (CH High)

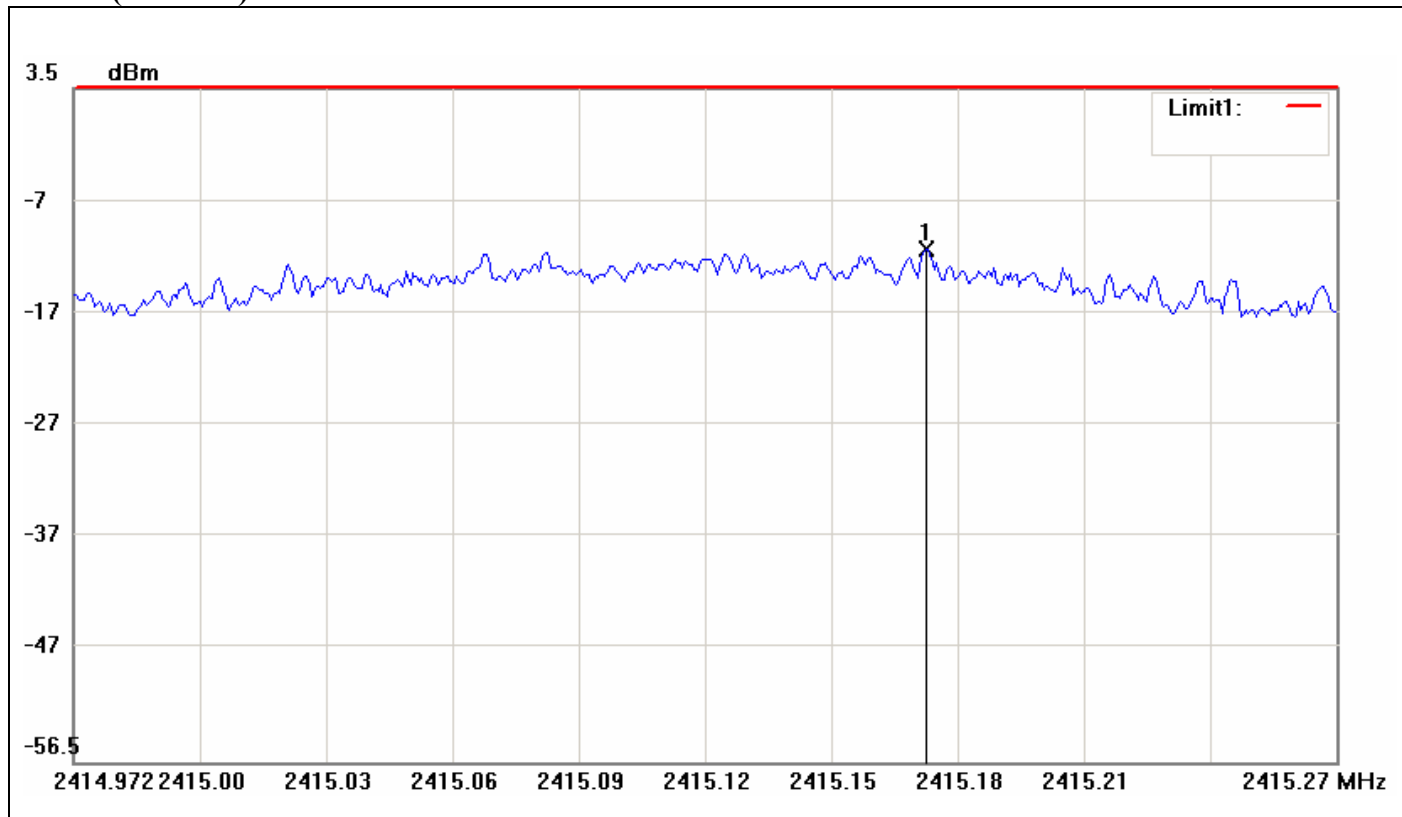


No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2458.8724	-9.29	8.00	-17.29



IEEE 802.11n HT 20 MHz mode

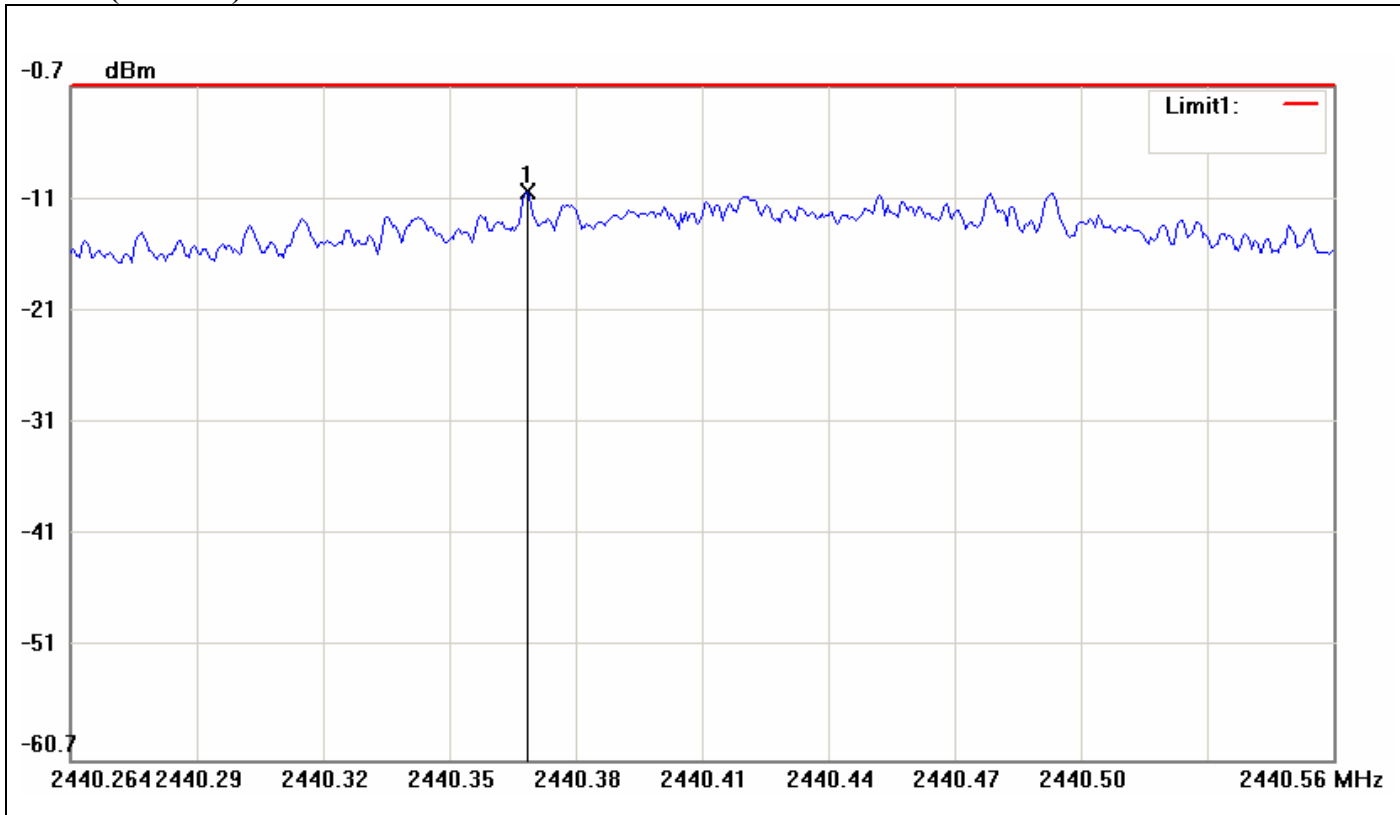
PPSD (CH Low)



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2415.1740	-10.81	8.00	-18.81



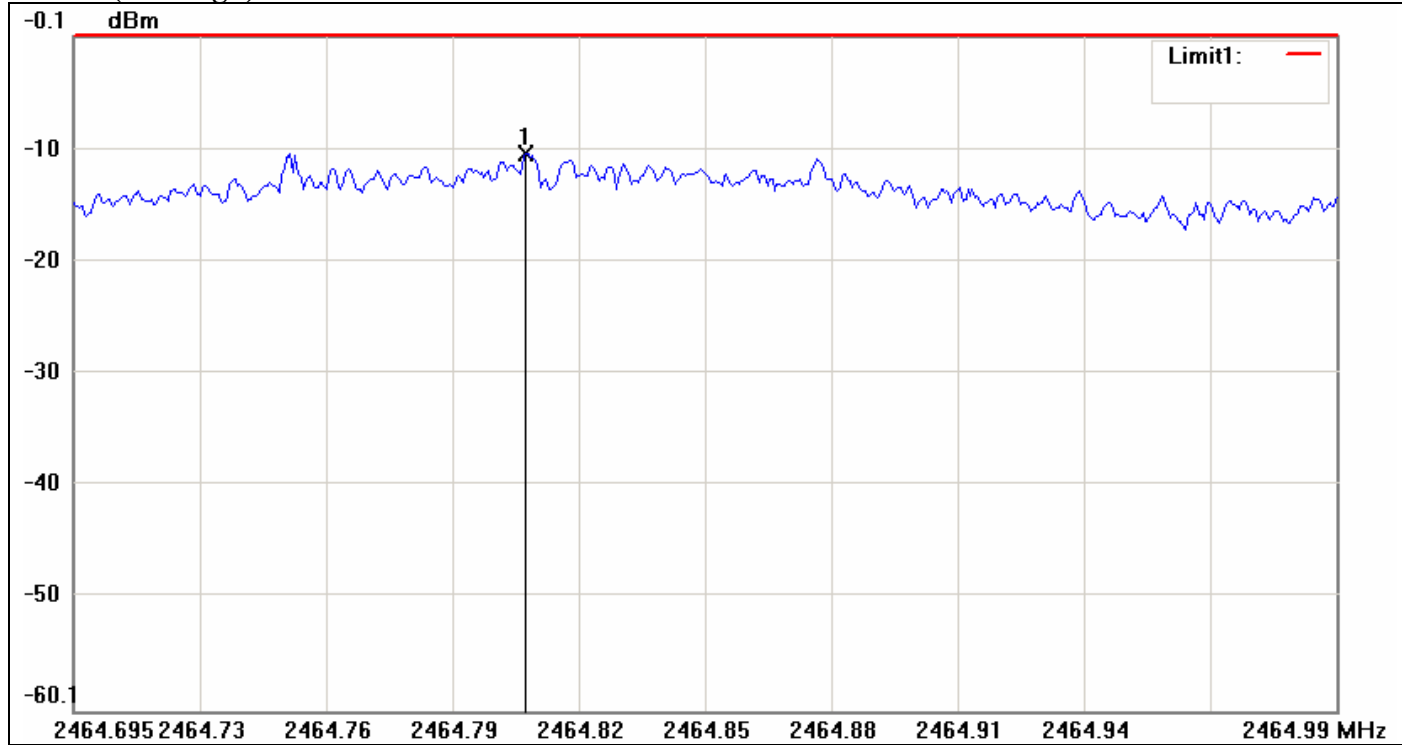
PPSD (CH Mid)



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2440.3726	-10.07	8.00	-18.07



PPSD (CH High)



No.	Frequency(MHz)	Level(dBm)	Limit(dBm)	Margin(dBm)
1	2464.8029	-10.54	8.00	-18.54



7.6 SPURIOUS EMISSIONS

7.7 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 (μ V/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.

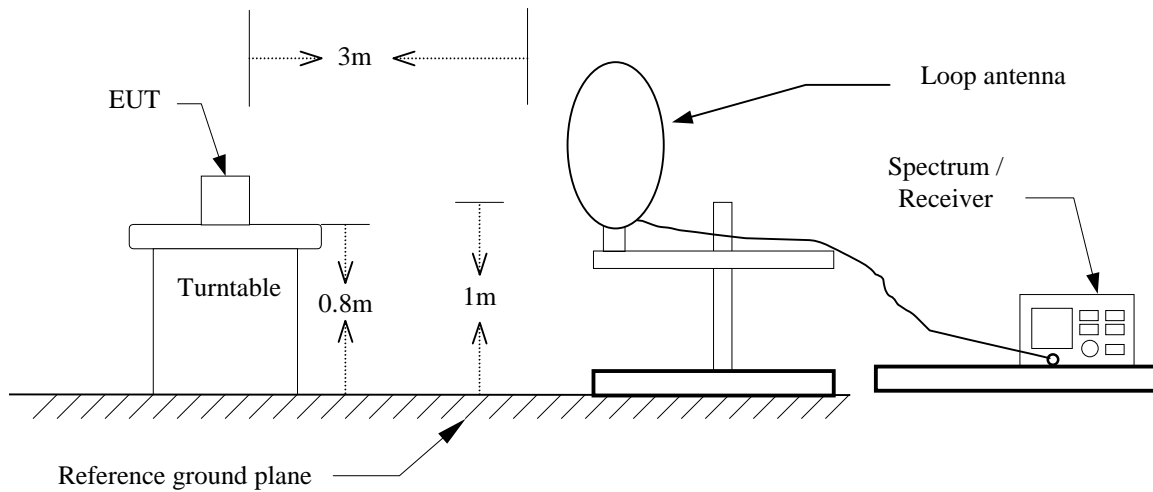
2. In the emission table above, the tighter limit applies at the band edges.

Frequency (MHz)	Field Strength (μ V/m at 3-meter)	Field Strength (dB μ V/m at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

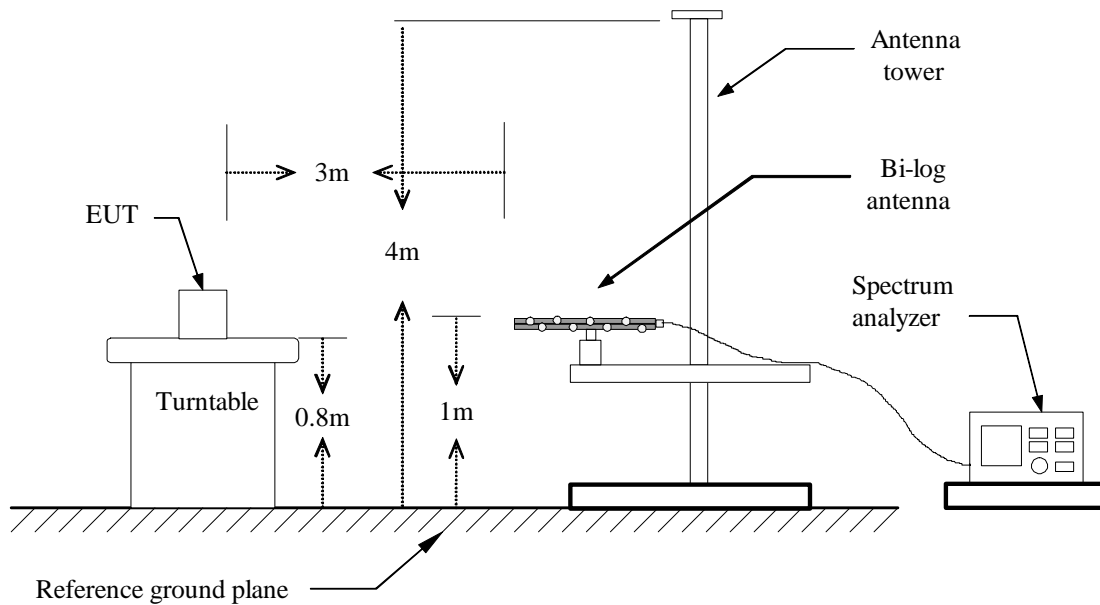


Test Configuration

9kHz ~ 30MHz

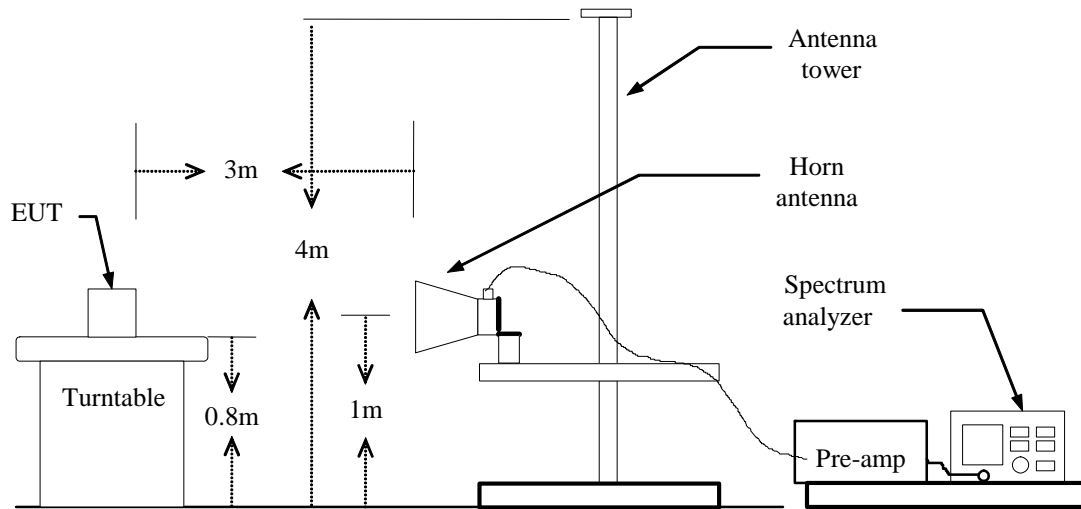


30MHz ~ 1GHz





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=300kHz / 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****Below 1GHz****Operation Mode:** Normal Link**Test Date:** February 9, 2012**Temperature:** 25°C**Tested by:** Ali Shu**Humidity:** 50% RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Pol. (H/V)
41.32	60.00	-28.19	31.80	40.00	-8.20	Peak	V
144.78	56.83	-28.15	28.68	43.50	-14.82	Peak	V
169.03	54.90	-29.18	25.72	43.50	-17.78	Peak	V
395.37	54.62	-23.97	30.66	46.00	-15.34	Peak	V
686.37	41.26	-19.12	22.15	46.00	-23.85	Peak	V
857.73	41.91	-16.84	25.07	46.00	-20.93	Peak	V
233.70	52.42	-29.03	23.39	46.00	-22.61	Peak	H
338.78	46.19	-25.47	20.73	46.00	-25.27	Peak	H
395.37	56.96	-23.97	33.00	46.00	-13.00	Peak	H
754.27	44.03	-18.05	25.98	46.00	-20.02	Peak	H
857.73	48.04	-16.84	31.20	46.00	-14.80	Peak	H
961.20	42.32	-15.93	26.39	54.00	-27.61	Peak	H

Remark:

- 1. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz)*
- 2. Radiated emissions measured in frequency range from 30 MHz to 1000MHz were made with an instrument using peak/quasi-peak detector mode.*
- 3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.*
- 4. 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.*
- 5. Margin (dB) = Result (dBuV/m) – Limit (dBuV/m).*

**Above 1 GHz****Operation Mode:** TX / IEEE 802.11b / CH Low**Test Date:** February 9, 2012**Temperature:** 25°C**Tested by:** Ali Shu**Humidity:** 50 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark	Ant. Pol. (H/V)
1673.33	55.75	---	-8.79	46.96	---	74.00	54.00	-7.04	Peak	V
4825.00	49.62	47.95	2.61	52.23	50.56	74.00	54.00	-3.44	AVG	V
5650.00	47.89	---	3.27	51.16	---	74.00	54.00	-2.84	Peak	V
N/A										
1653.33	55.64	---	-8.99	46.65	---	74.00	54.00	-7.35	Peak	H
4825.00	48.69	42.88	2.61	51.30	45.49	74.00	54.00	-8.51	AVG	H
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 / CH Mid

Test Date: February 9, 2012

Temperature: 25°C

Tested by: Ali Shu

Humidity: 50 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark	Ant. Pol. (H/V)
1783.33	55.73	---	-7.67	48.06	---	74.00	54.00	-5.94	Peak	V
4883.33	49.92	47.58	2.73	52.64	50.31	74.00	54.00	-3.69	AVG	V
N/A										
1766.67	55.43	---	-7.84	47.59	---	74.00	54.00	-6.41	Peak	H
4883.33	51.46	47.32	2.73	54.19	50.05	74.00	54.00	-3.95	AVG	H
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 / CH High

Test Date: February 9, 2012

Temperature: 25°C

Tested by: Ali Shu

Humidity: 50 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark	Ant. Pol. (H/V)
1916.67	55.84	---	-6.32	49.53	---	74.00	54.00	-4.47	Peak	V
6133.33	46.95	---	4.27	51.22	---	74.00	54.00	-2.78	Peak	V
6641.67	47.86	33.41	5.59	53.44	39.00	74.00	54.00	-15.00	AVG	V
N/A										
1663.33	55.53	---	-8.89	46.64	---	74.00	54.00	-7.36	Peak	H
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 / CH Low

Test Date: February 9, 2012

Temperature: 25°C

Tested by: Ali Shu

Humidity: 50 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark	Ant. Pol. (H/V)
1436.67	55.41	---	-10.62	44.80	---	74.00	54.00	-9.20	Peak	V
N/A										
1873.33	56.10	---	-6.76	49.34	---	74.00	54.00	-4.66	Peak	H
2550.00	54.96	---	-3.70	51.26	---	74.00	54.00	-2.74	Peak	H
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 / CH Mid

Test Date: February 9, 2012

Temperature: 25°C

Tested by: Ali Shu

Humidity: 50 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark	Ant. Pol. (H/V)
1663.33	55.03	---	-8.89	46.14	---	74.00	54.00	-7.86	Peak	V
N/A										
1760.00	55.71	---	-7.91	47.81	---	74.00	54.00	-6.19	Peak	H
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 / CH High

Test Date: February 9, 2012

Temperature: 25°C

Tested by: Ali Shu

Humidity: 50 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark	Ant. Pol. (H/V)
1696.67	55.65	---	-8.55	47.10	---	74.00	54.00	-6.90	Peak	V
7108.33	44.64	---	7.31	51.95	---	74.00	54.00	-2.05	Peak	V
N/A										
1776.67	53.97	---	-7.74	46.23	---	74.00	54.00	-7.77	Peak	H
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 802.11n HT 20 MHz mode / CH Low **Test Date:** February 9, 2012**Temperature:** 25°C**Tested by:** Ali Shu**Humidity:** 50 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark	Ant. Pol. (H/V)
1440.00	56.27	---	-10.61	45.66	---	74.00	54.00	-8.34	Peak	V
4825.00	48.22	---	2.61	50.83	---	74.00	54.00	-3.17	Peak	V
6641.67	48.13	33.48	5.59	53.71	39.07	74.00	54.00	-14.93	AVG	V
N/A										
1493.33	56.03	---	-10.56	45.47	---	74.00	54.00	-8.53	Peak	H
2160.00	55.81	---	-5.05	50.75	---	74.00	54.00	-3.25	Peak	H
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 802.11n HT 20 MHz mode / CH Mid **Test Date:** February 9, 2012**Temperature:** 25°C**Tested by:** Ali Shu**Humidity:** 50 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark	Ant. Pol. (H/V)
1586.67	55.68	---	-9.67	46.01	---	74.00	54.00	-7.99	Peak	V
N/A										
1653.33	56.03	---	-8.99	47.04	---	74.00	54.00	-6.96	Peak	H
5625.00	47.59	---	3.22	50.81	---	74.00	54.00	-3.19	Peak	H
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 802.11n HT 20 MHz mode / CH High **Test Date:** February 9, 2012**Temperature:** 25°C**Tested by:** Ali Shu**Humidity:** 50 % RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (Peak) (dBuV)	Reading (Average) (dBuV)	Correction Factor (dB/m)	Result (Peak) (dBuV/m)	Result (Average) (dBuV/m)	Limit (Peak) (dBuV/m)	Limit (Average) (dBuV/m)	Margin (dB)	Remark	Ant. Pol. (H/V)
1693.33	56.43	---	-8.59	47.84	---	74.00	54.00	-6.16	Peak	V
N/A										
1570.00	55.13	---	-9.84	45.29	---	74.00	54.00	-8.71	Peak	H
7716.67	45.41	33.76	7.72	53.13	41.48	74.00	54.00	-12.52	AVG	H
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).



7.8 POWERLINE CONDUCTED EMISSIONS

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 μ 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 μ 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 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 Data

Operation Mode: Normal Link **Test Date:** February 14, 2012
Temperature: 26°C **Tested by:** Ali Shu
Humidity: 60% RH

Freq. (MHz)	QP Reading (dBuV)	AV Reading (dBuV)	Corr. factor (dB/m)	QP Result (dBuV/m)	AV Result (dBuV/m)	QP Limit (dBuV)	AV Limit (dBuV)	QP Margin (dB)	AV Margin (dB)	Note
0.1942	40.22	27.56	0.09	40.31	27.65	63.85	53.85	-23.54	-26.20	L1
0.2236	35.62	20.40	0.09	35.71	20.49	62.68	52.68	-26.97	-32.19	L1
0.3920	36.64	24.93	0.10	36.74	25.03	58.02	48.02	-21.28	-22.99	L1
0.4712	42.60	31.09	0.10	42.70	31.19	56.49	46.49	-13.79	-15.30	L1
2.0091	46.64	34.96	0.14	46.78	35.10	56.00	46.00	-9.22	-10.90	L1
7.4095	30.92	22.14	0.32	31.24	22.46	60.00	50.00	-28.76	-27.54	L1
0.1900	40.18	31.83	0.09	40.27	31.92	64.04	54.04	-23.77	-22.12	L2
0.4590	46.63	37.95	0.09	46.72	38.04	56.71	46.71	-9.99	-8.67	L2
1.1579	41.53	27.44	0.10	41.63	27.54	56.00	46.00	-14.37	-18.46	L2
2.0220	50.04	39.81	0.12	50.16	39.93	56.00	46.00	-5.84	-6.07	L2
4.8517	37.65	28.19	0.19	37.84	28.38	56.00	46.00	-18.16	-17.62	L2
26.0324	29.69	21.00	0.67	30.36	21.67	60.00	50.00	-29.64	-28.33	L2

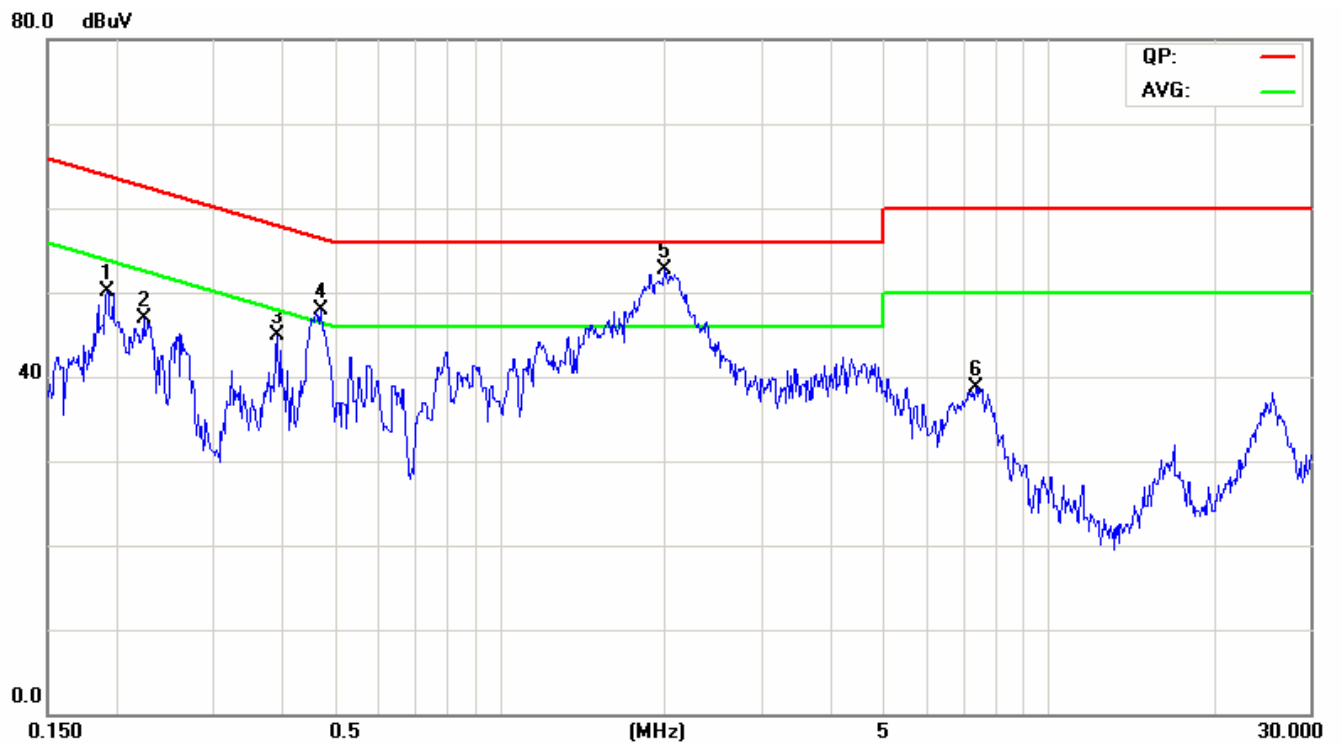
Remark:

1. Measuring frequencies from 0.15 MHz to 30MHz.
2. The emissions measured in frequency range from 0.15 MHz to 30MHz were made with an instrument using Quasi-peak detector and average detector.
3. The IF bandwidth of SPA between 0.15MHz and 30MHz was 10 kHz; the IF bandwidth of Test Receiver between 0.15MHz and 30MHz was 9 kHz;
4. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line)

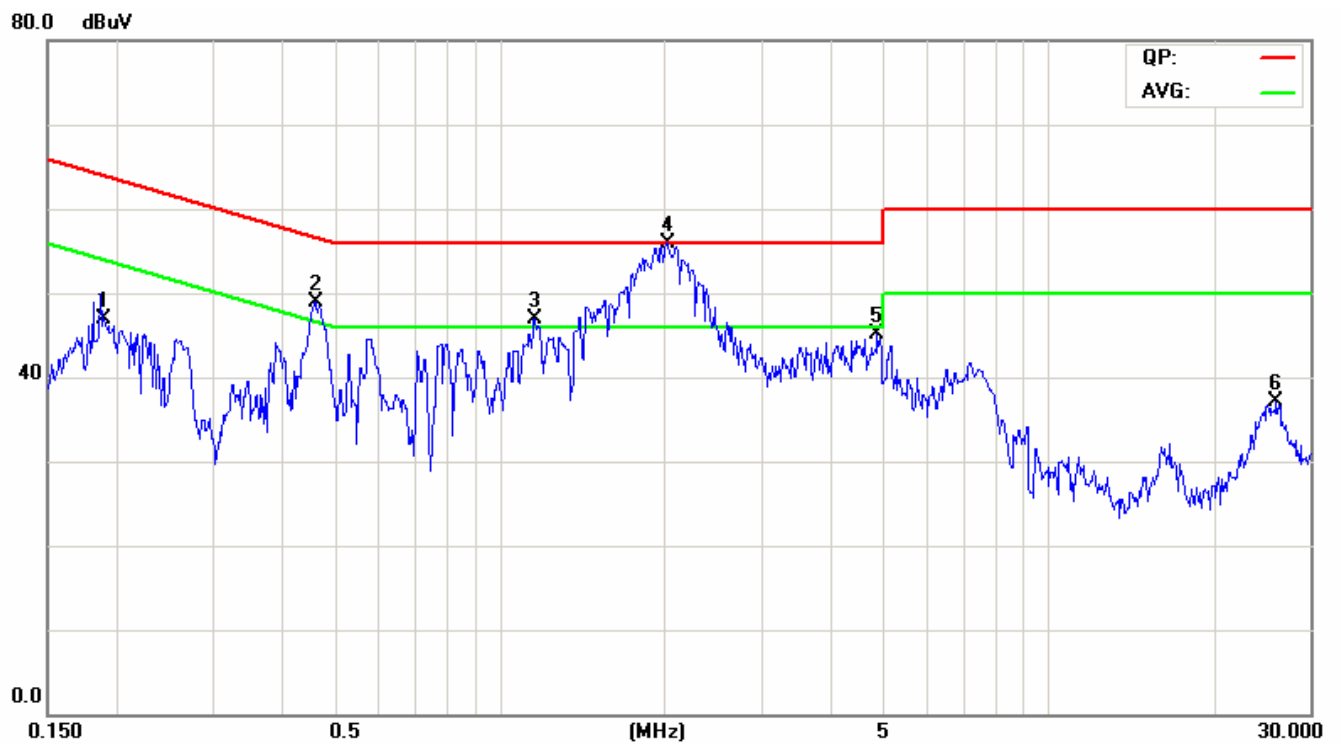


Test Plots

Conducted emissions (Line 1)



Conducted emissions (Line 2)





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

EUT	LabQuest2
Frequency band (Operating)	<input checked="" type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input type="checkbox"/> WLAN: 5.18GHz ~ 5.32GHz / 5.50GHz ~ 5.70GHz <input type="checkbox"/> WLAN: 5.745GHz ~ 5.825GHz <input type="checkbox"/> Others
Device category	<input checked="" type="checkbox"/> Portable (<20cm separation) <input type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others
Exposure classification	<input checked="" type="checkbox"/> Occupational/Controlled exposure ($S = 5\text{mW/cm}^2$) <input type="checkbox"/> General Population/Uncontrolled exposure ($S=1\text{mW/cm}^2$)
Antenna diversity	<input checked="" type="checkbox"/> Single antenna <input type="checkbox"/> Multiple antennas <input type="checkbox"/> Tx diversity <input type="checkbox"/> Rx diversity <input type="checkbox"/> Tx/Rx diversity
Max. output power	IEEE 802.11b mode: 17.42 dBm (55.21 mW) IEEE 802.11g mode: 25.06 dBm (320.63 mW) IEEE 802.11n HT 20 MHz mode: 24.89 dBm (308.32 mW)
Antenna gain (Max)	2.35615 dBi (Numeric gain: 1.72)
Evaluation applied	<input type="checkbox"/> MPE Evaluation <input checked="" type="checkbox"/> SAR Evaluation* <input type="checkbox"/> N/A

Remark:

The maximum output power is 25.06dBm (320.63 mW) at 2442MHz (with 1.72 numeric antenna gain.)

TEST RESULTS

No non-compliance noted.

Remark: Please refer to the separated SAR report.