



## FCC 47 CFR PART 15 SUBPART C

### TEST REPORT

**For**

**802.11n, 2.4G 1T1R Wireless LAN USB Module**

**Model: WN4615L**

**Trade Name: Lite-On**

*Issued to*

**Lite-On Technology Corp.**

**4F, 90, Chien 1 Road, Chung Ho, New Taipei City 23585, Taiwan, R.O.C.**

*Issued by*

**Compliance Certification Services Inc.**

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**Issued Date: April 27, 2015**



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**Revision History**

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	April 27, 2015	Initial Issue	ALL	Becca Chen



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# 1. TEST RESULT CERTIFICATION

**Applicant:** Lite-On Technology Corp.  
4F, 90, Chien 1 Road, Chung Ho, New Taipei City 23585, Taiwan,  
R.O.C.

**Equipment Under Test:** 802.11n, 2.4G 1T1R Wireless LAN USB Module

**Trade Name:** Lite-On

**Model:** WN4615L

**Date of Test:** April 25, 2015

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 C63.10: 2013 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:

Reviewed by:

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Miller Lee  
Section Manager  
Compliance Certification Services Inc.

\_\_\_\_\_  
Angel Cheng  
Section Manager  
Compliance Certification Services Inc.



## 2. EUT DESCRIPTION

<b>Product</b>	802.11n, 2.4G 1T1R Wireless LAN USB Module		
<b>Trade Name</b>	Lite-On		
<b>Model Number</b>	WN4615L		
<b>Model Discrepancy</b>	N/A		
<b>RF Module</b>	Realtek	<b>Model:</b>	RTL8188ETV
<b>Received Date</b>	April 17, 2015		
<b>Power Rating</b>	Powered from host device		
<b>Frequency Range</b>	IEEE 802.11b/g mode: 2412 ~ 2462 MHz IEEE 802.11n HT 20 MHz mode 2412 ~ 2462 MHz IEEE 802.11n HT 40 MHz mode: 2422 ~ 2452 MHz		
<b>Transmit Power</b>	IEEE 802.11b mode: 25.24 dBm IEEE 802.11g mode: 25.87 dBm IEEE 802.11n HT 20 MHz mode: 25.14 dBm IEEE 802.11n HT 40 MHz mode: 25.22 dBm		
<b>Modulation Technique</b>	IEEE 802.11b mode: DSSS IEEE 802.11g mode: OFDM IEEE 802.11n HT 20 MHz mode: OFDM IEEE 802.11n HT 40 MHz mode: OFDM		
<b>Number of Channels</b>	IEEE 802.11b/g mode: 11 Channels IEEE 802.11n HT 20 MHz mode: 11 Channels IEEE 802.11n HT 40 MHz mode: 7 Channels		
<b>Antenna Specification</b>	PIFA Antenna LITE-ON / WN4615L: 2.43dBi		

**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: PPQ-WN4615L** 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 C63.10: 2013 and FCC CFR 47 Part 15.207, 15.209, 15.247, KDB558074.

#### **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 C63.10 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 1.5 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 C63.10.



### 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: Satellite L4-C) 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 (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.

**IEEE 802.11n HT 20 mode:**

Channel Low (2412MHz), Channel Mid (2437MHz) and Channel High (2462MHz) with 6.5Mbps data rate were chosen for full testing.

**IEEE 802.11n HT 40 MHz mode:**

Channel Low (2422MHz), Channel Mid (2437MHz) and Channel High (2452MHz) with 13.5Mbps data rate were chosen for full testing.





## 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.*

Conducted Emissions Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510252	11/23/2015
Thermostatic/Hrgrosatic Chamber	TAICHY	MHG-150LF	930619	10/07/2015
AC Power Source	EXTECH	6205	1140845	N.C.R
DC Power Supply	ABM	8301HD	D011531	N.C.R
Power Meter	Anritsu	ML2495A	1012009	06/03/2015
Power Sensor	Anritsu	MA2411A	0917072	06/03/2015
Spectrum Analyzer	ROHDE&SCHWARZ	FSV40	101073	07/09/2015

3M Chamber Test Site				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	E4446A	US42510268	09/18/2015
EMI Test Receiver	R&S	ESCI	100064	05/30/2015
Bilog Antenna	Sunol Sciences	JB3	A030105	08/19/2015
Horn Antenna	EMCO	3117	00055165	01/26/2016
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	EZ-EMC (CCS-3A1RE)			

Conducted Emission room				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
N/A				

**NOTE:** 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

2. N.C.R = No Calibration Request.



### 4.3 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
Powerline Conducted Emission	N/A
3M Semi Anechoic Chamber / <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, Chungshen 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 Dist., New Taipei City 24891, 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 C63.10 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	

\* 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	TOSHIBA	Satellite M840	N/A	PPD-AR5B225	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.



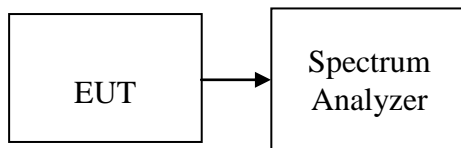
## 7. FCC PART 15.247 REQUIREMENTS

### 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

The transmitter output is connected to the spectrum analyzer. Set the RBW=100kHz the emission bandwidth, VBW  $\geq 3 \times$  RBW, Detector = Peak, Trace mode = max hold, Sweep = auto couple. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6dB relative to the maximum level measured in the fundamental emission.

#### 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	10.25	>500	PASS
Mid	2437	10.25		PASS
High	2462	10.3334		PASS

**Test mode: IEEE 802.11g mode**

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (kHz)	Result
Low	2412	16.6666	>500	PASS
Mid	2437	16.6666		PASS
High	2462	16.6666		PASS

**Test mode: IEEE 802.11n HT 20 mode**

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (kHz)	Result
Low	2412	17.8334	>500	PASS
Mid	2437	17.8334		PASS
High	2462	17.8334		PASS

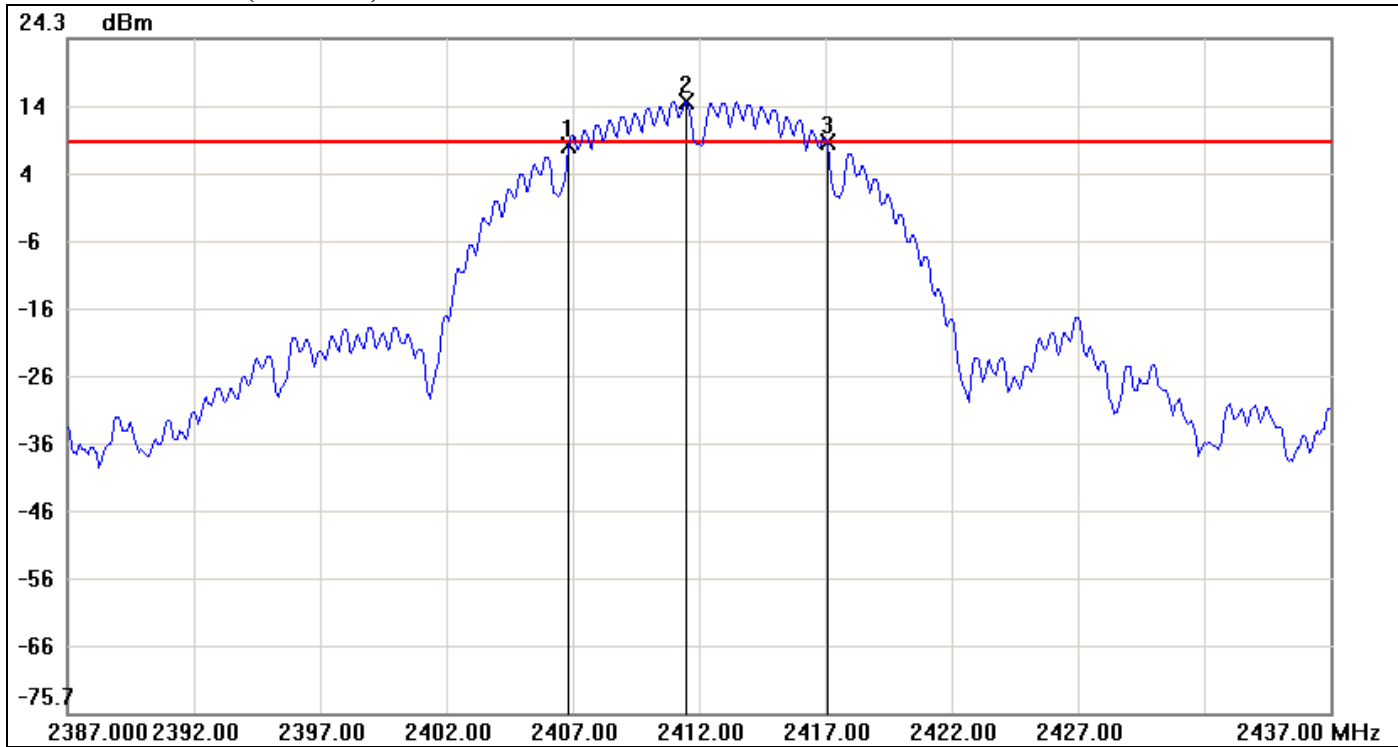
**Test mode: IEEE 802.11n HT 40 mode**

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (kHz)	Result
Low	2422	36.3333	>500	PASS
Mid	2437	36.3333		PASS
High	2452	36.3333		PASS



IEEE 802.11b mode

6dB Bandwidth (CH Low)



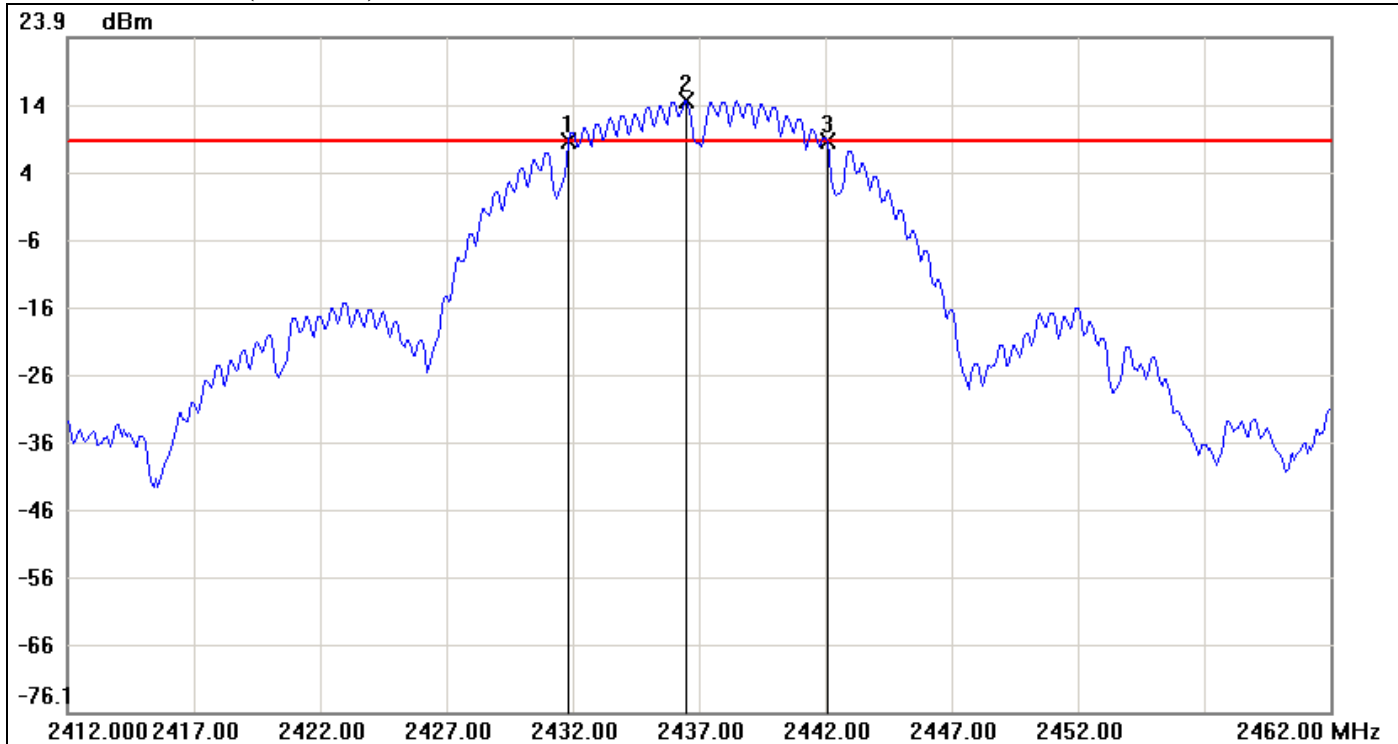
No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2406.8333	8.39	8.98	-0.59
2	2411.5000	14.98	8.98	6.00
3	2417.0833	8.88	8.98	-0.10

No.		$\Delta$ Frequency(MHz)	$\Delta$ Level(dB)
1	mk3-mk1	10.25	0.49





**6dB Bandwidth (CH Mid)**

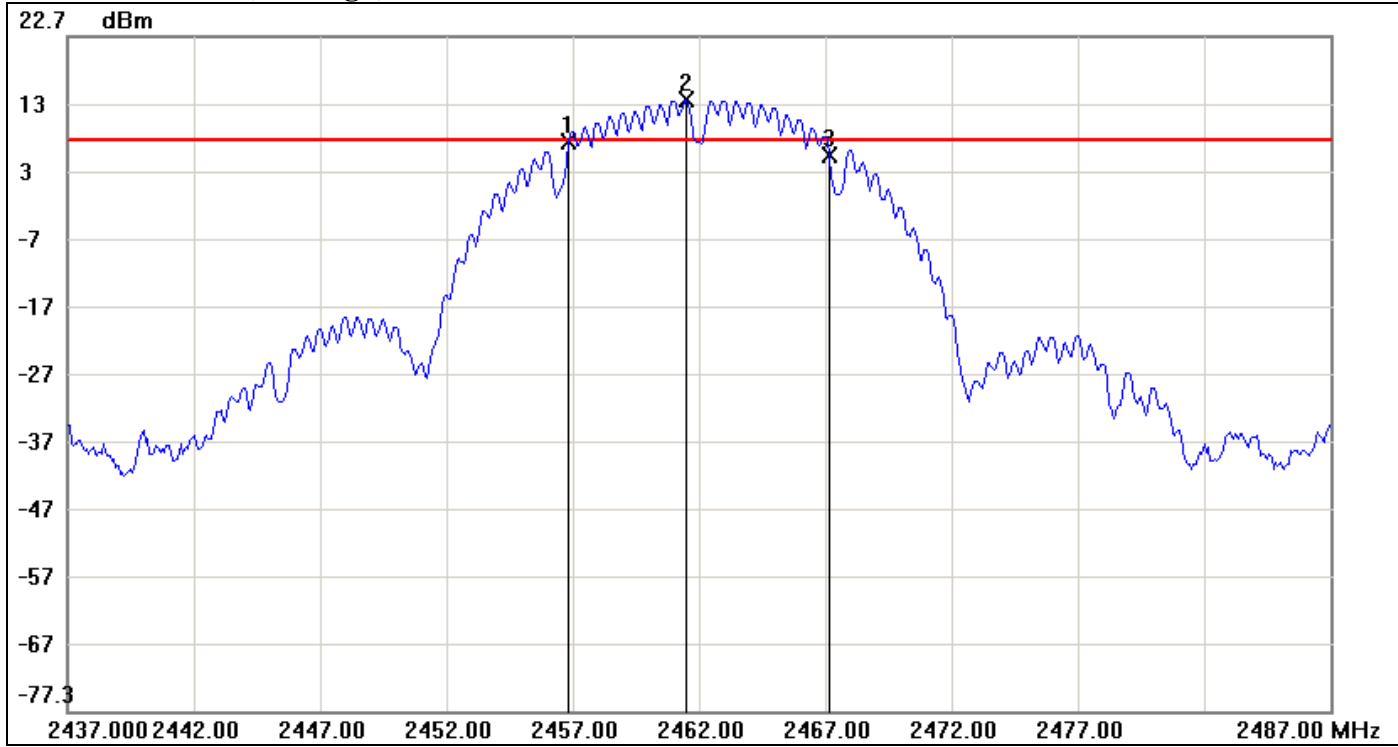


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2431.8333	8.45	8.61	-0.16
2	2436.5000	14.61	8.61	6.00
3	2442.0833	8.55	8.61	-0.06

No.		$\Delta$ Frequency(MHz)	$\Delta$ Level(dB)
1	mk3-mk1	10.25	0.1



**6dB Bandwidth (CH High)**



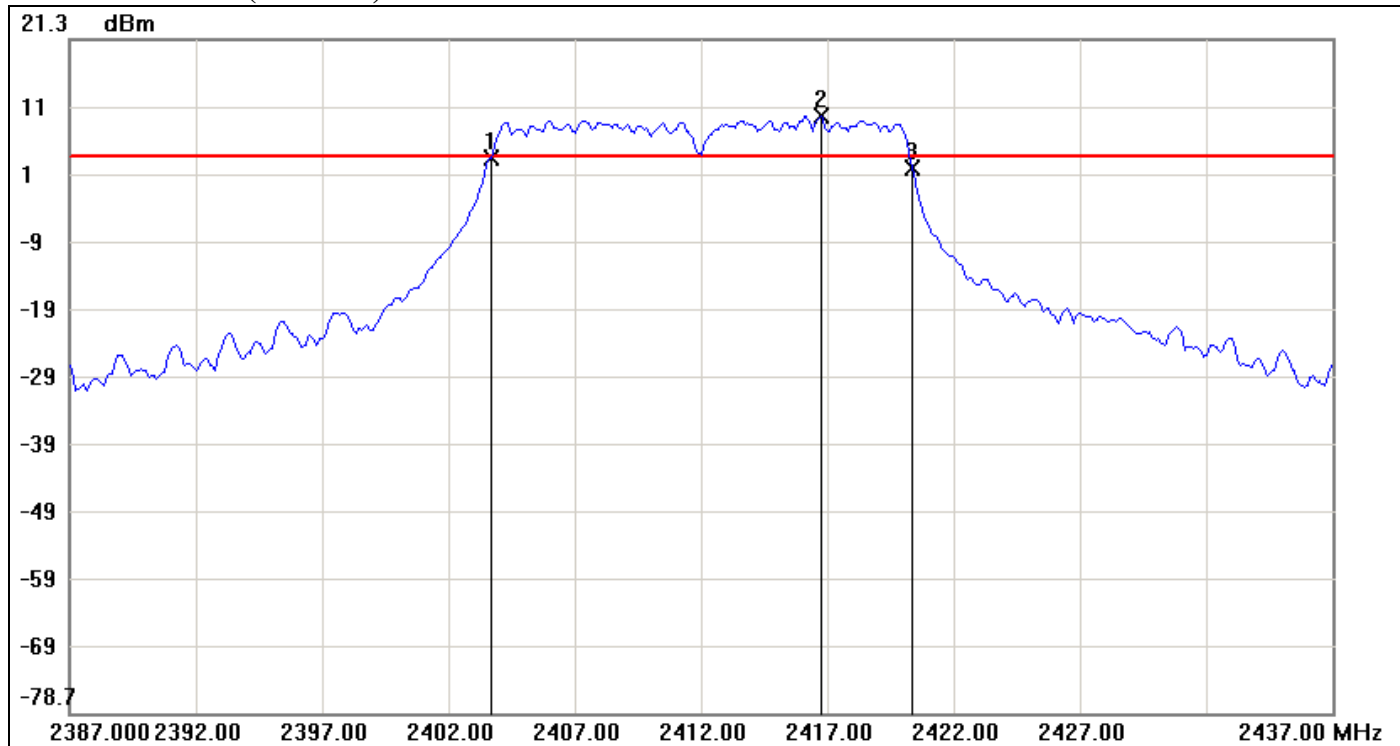
No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2456.8333	7.01	7.35	-0.34
2	2461.5000	13.35	7.35	6.00
3	2467.1667	5.09	7.35	-2.26

No.		$\Delta$ Frequency(MHz)	$\Delta$ Level(dB)
1	mk3-mk1	10.3334	-1.92



IEEE 802.11g mode

6dB Bandwidth (CH Low)

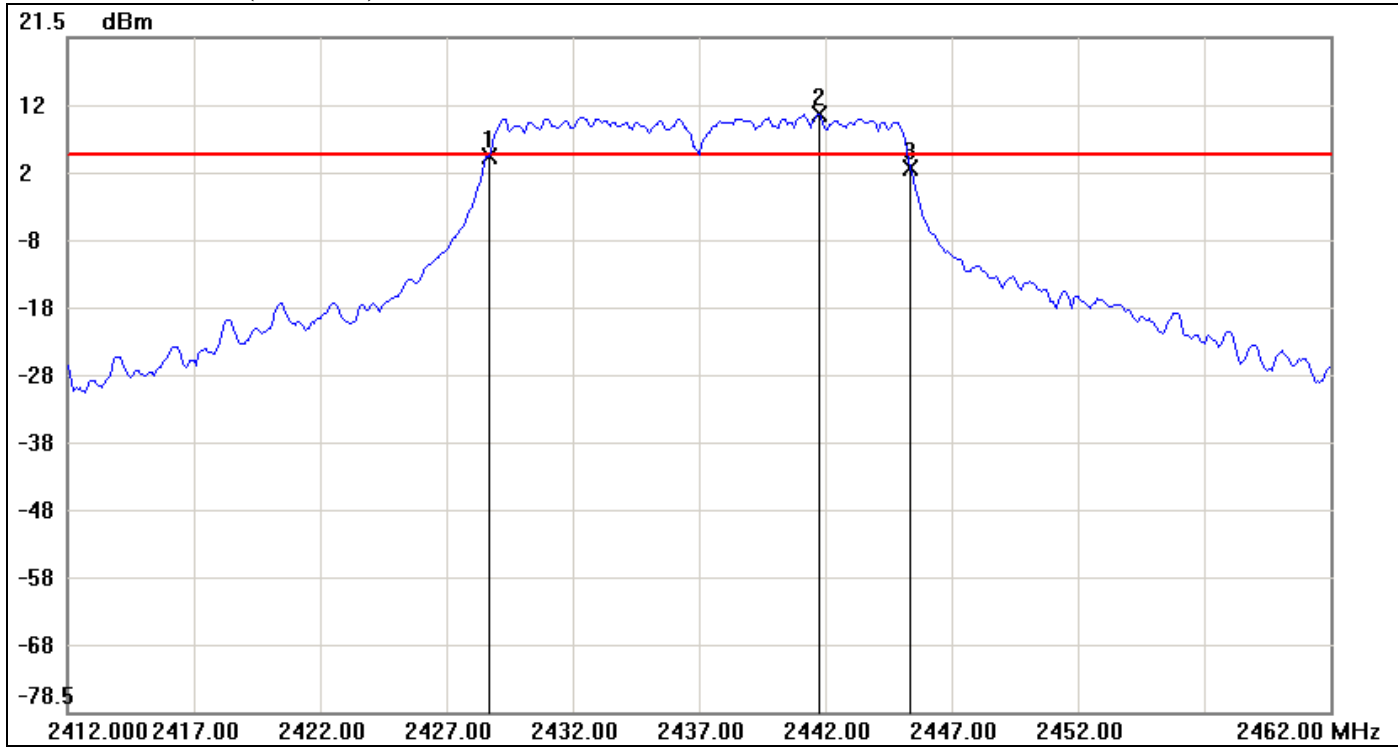


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2403.6667	3.54	3.82	-0.28
2	2416.7500	9.82	3.82	6.00
3	2420.3333	2.17	3.82	-1.65

No.		$\Delta$ Frequency(MHz)	$\Delta$ Level(dB)
1	mk3-mk1	16.6666	-1.37



**6dB Bandwidth (CH Mid)**

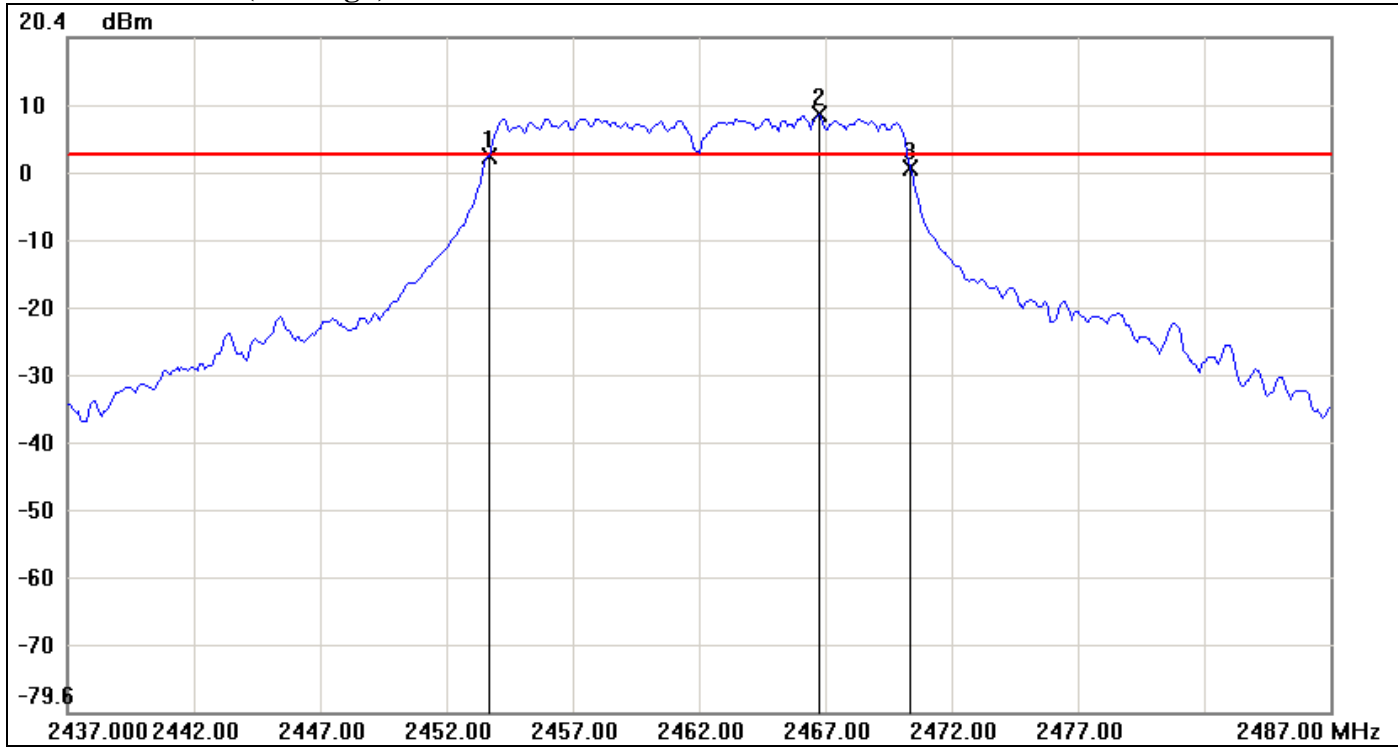


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2428.6667	3.98	4.21	-0.23
2	2441.7500	10.21	4.21	6.00
3	2445.3333	2.26	4.21	-1.95

No.		$\Delta$ Frequency(MHz)	$\Delta$ Level(dB)
1	mk3-mk1	16.6666	-1.72



**6dB Bandwidth (CH High)**



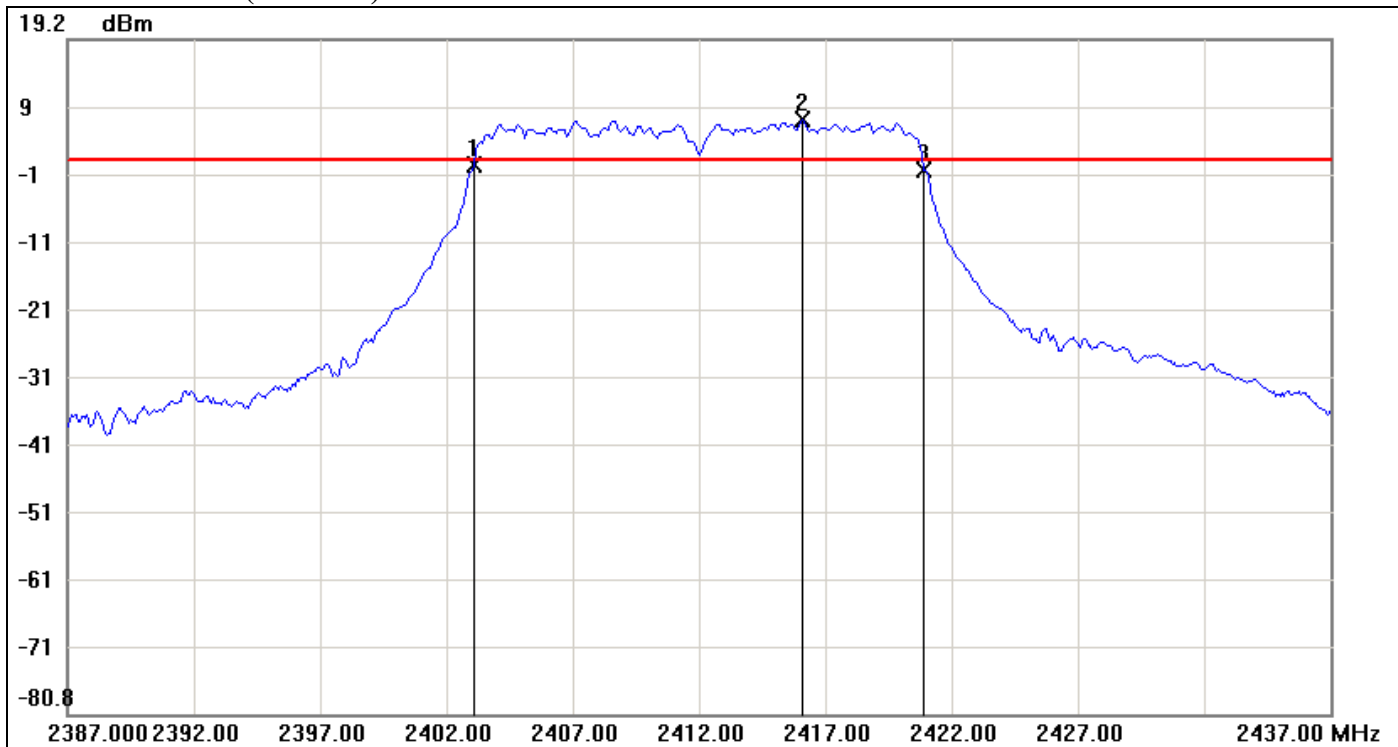
No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2453.6667	2.79	2.92	-0.13
2	2466.7500	8.92	2.92	6.00
3	2470.3333	1.10	2.92	-1.82

No.		$\Delta$ Frequency(MHz)	$\Delta$ Level(dB)
1	mk3-mk1	16.6666	-1.69



IEEE 802.11n HT 20 MHz mode

6dB Bandwidth (CH Low)

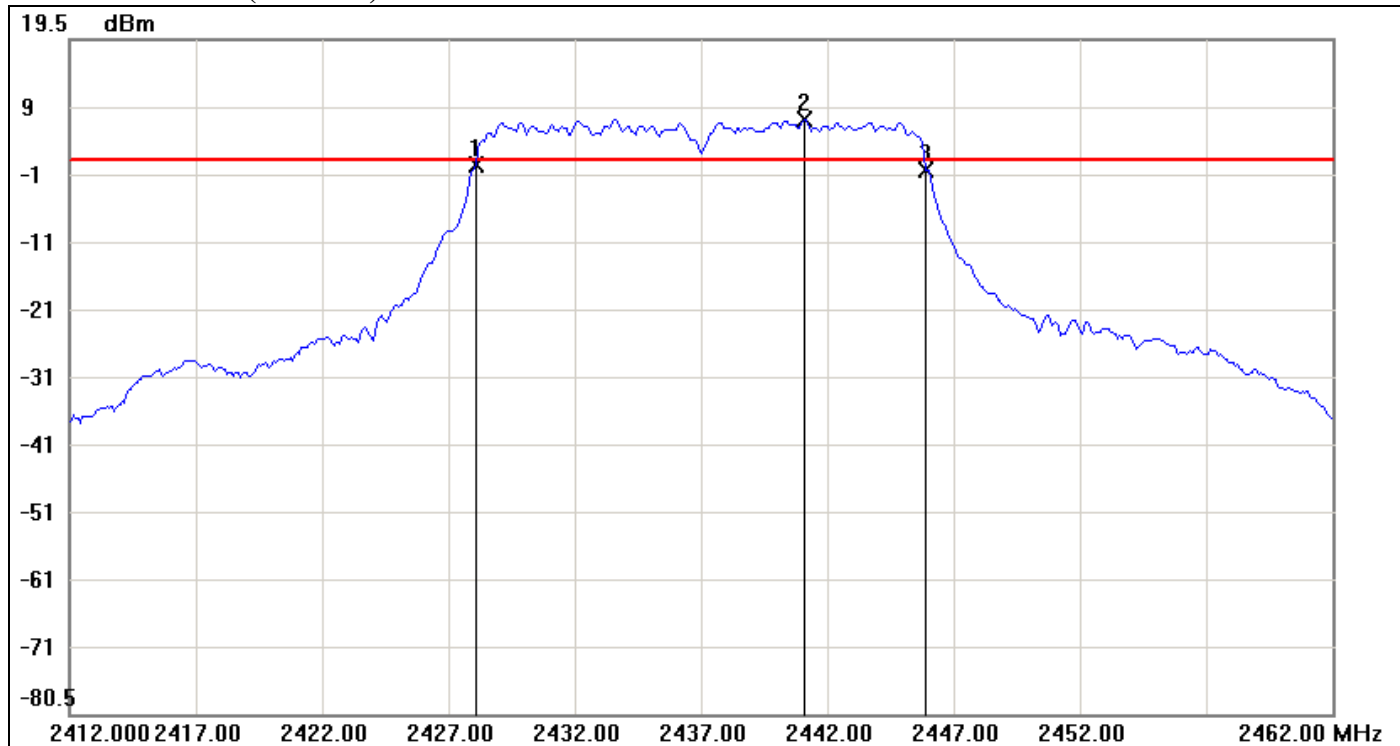


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2403.0833	0.61	1.20	-0.59
2	2416.0833	7.20	1.20	6.00
3	2420.9167	-0.23	1.20	-1.43

No.		$\Delta$ Frequency(MHz)	$\Delta$ Level(dB)
1	mk3-mk1	17.8334	-0.84



**6dB Bandwidth (CH Mid)**

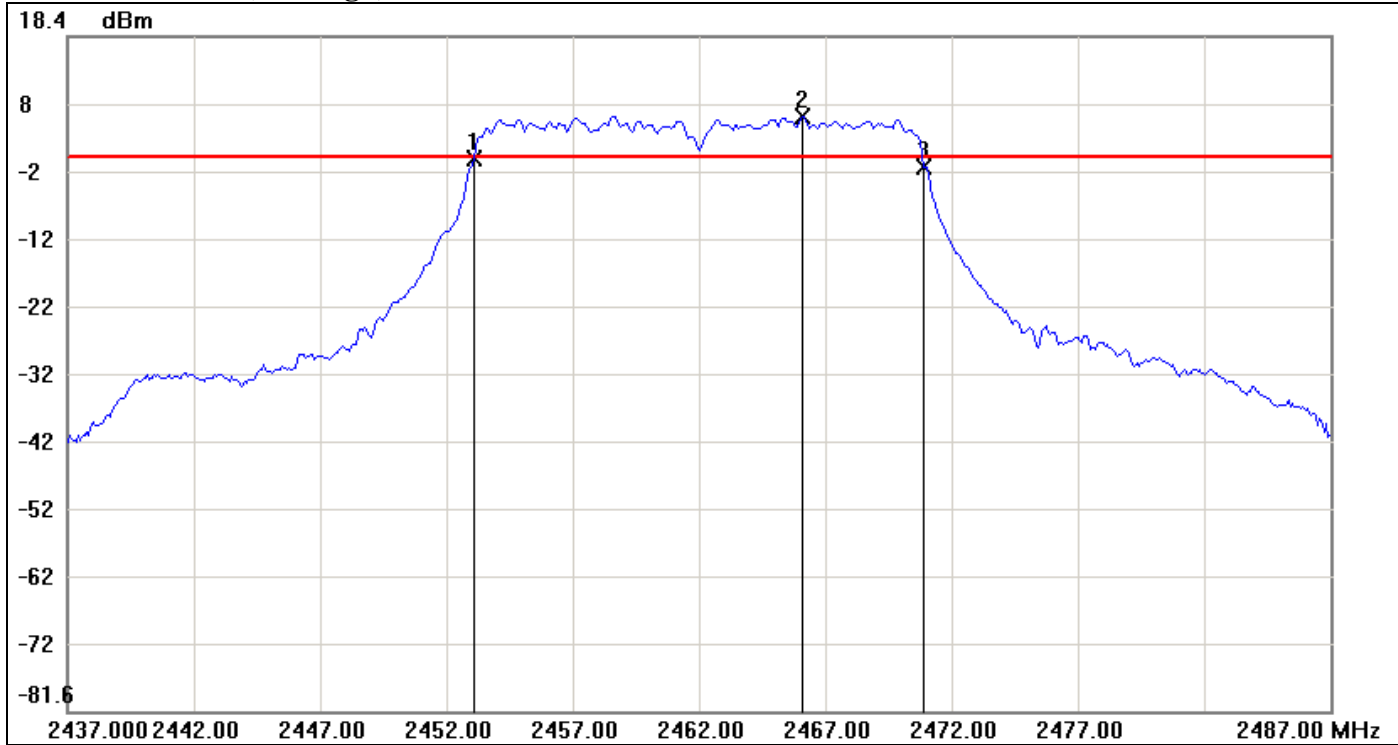


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2428.0833	0.97	1.71	-0.74
2	2441.0833	7.71	1.71	6.00
3	2445.9167	0.17	1.71	-1.54

No.		$\Delta$ Frequency(MHz)	$\Delta$ Level(dB)
1	mk3-mk1	17.8334	-0.8



**6dB Bandwidth (CH High)**



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2453.0833	0.19	0.56	-0.37
2	2466.0833	6.56	0.56	6.00
3	2470.9167	-0.98	0.56	-1.54

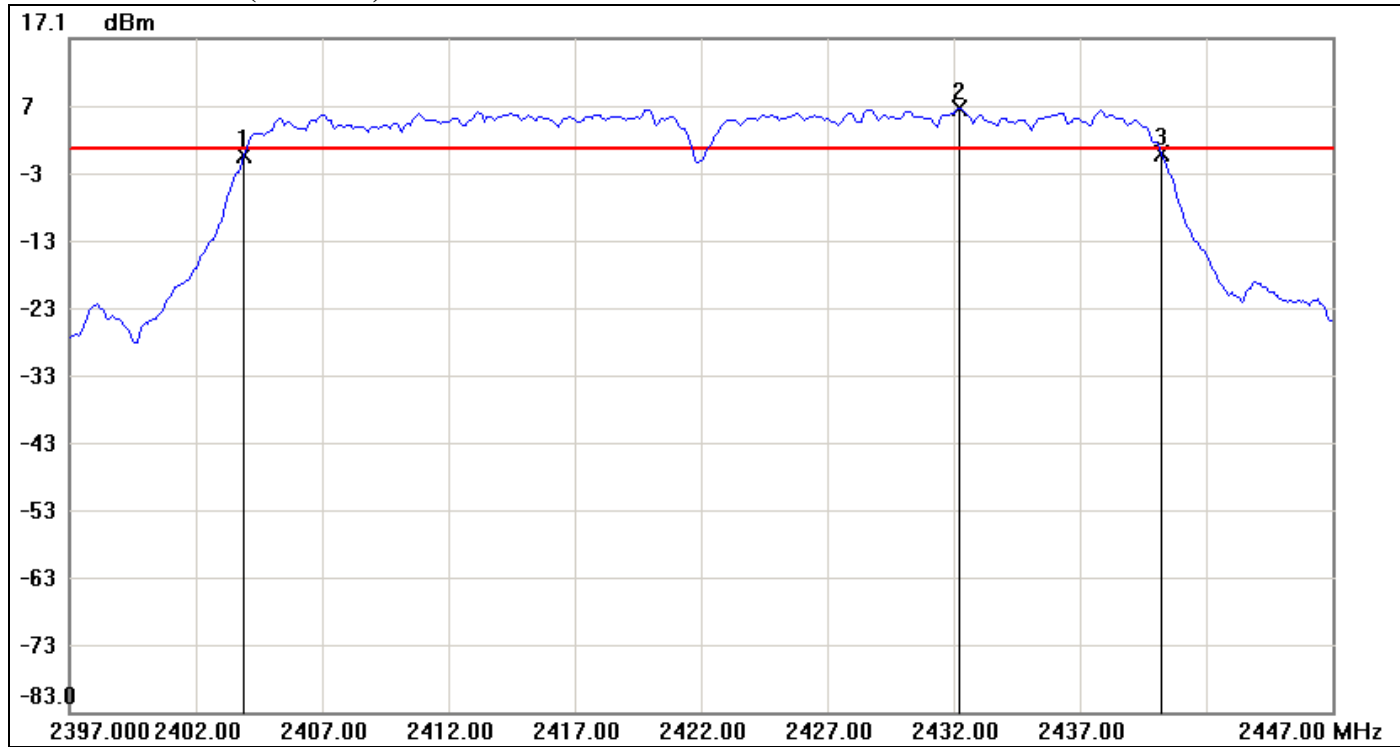
No.		$\Delta$ Frequency(MHz)	$\Delta$ Level(dB)
1	mk3-mk1	17.8334	-1.17





### IEEE 802.11n HT 40 MHz mode

#### 6dB Bandwidth (CH Low)

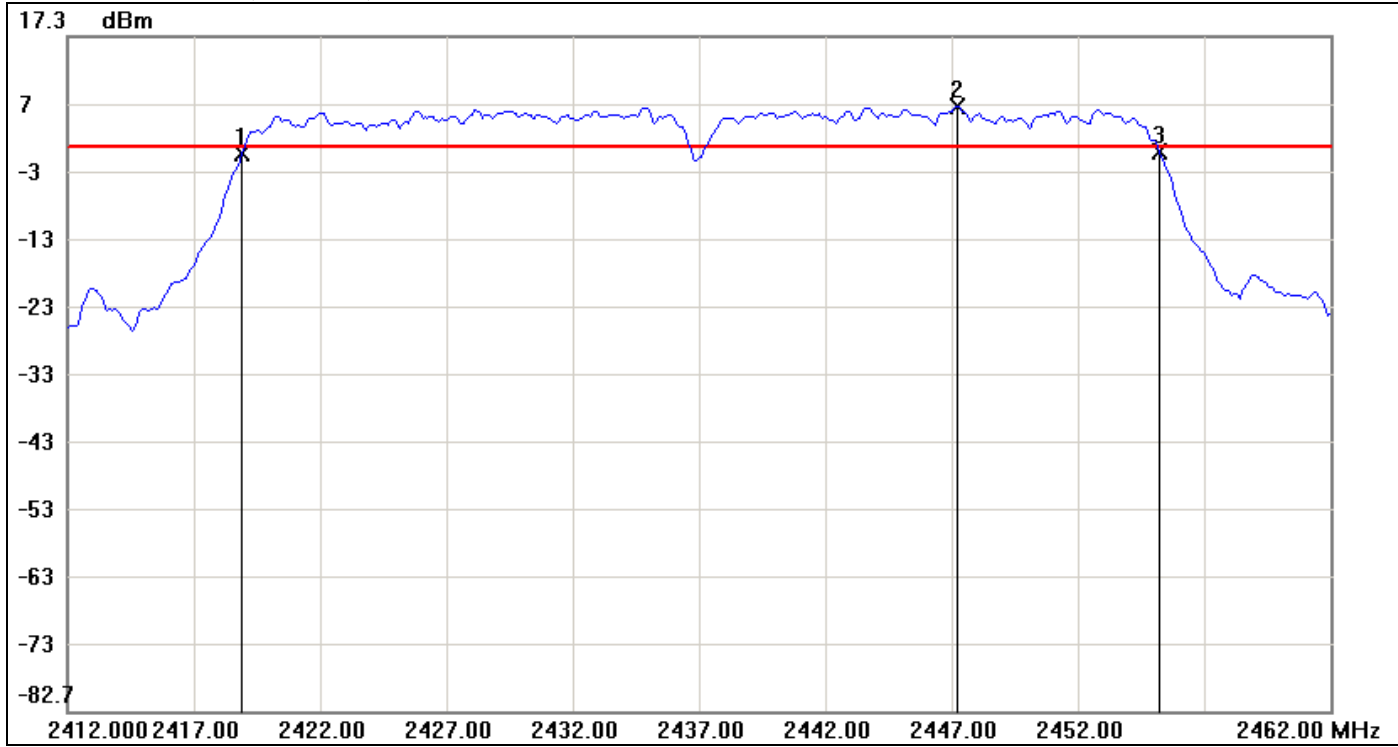


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2403.9167	-0.33	0.69	-1.02
2	2432.2500	6.69	0.69	6.00
3	2440.2500	-0.11	0.69	-0.80

No.		$\Delta$ Frequency(MHz)	$\Delta$ Level(dB)
1	mk3-mk1	36.3333	0.22



**6dB Bandwidth (CH Mid)**

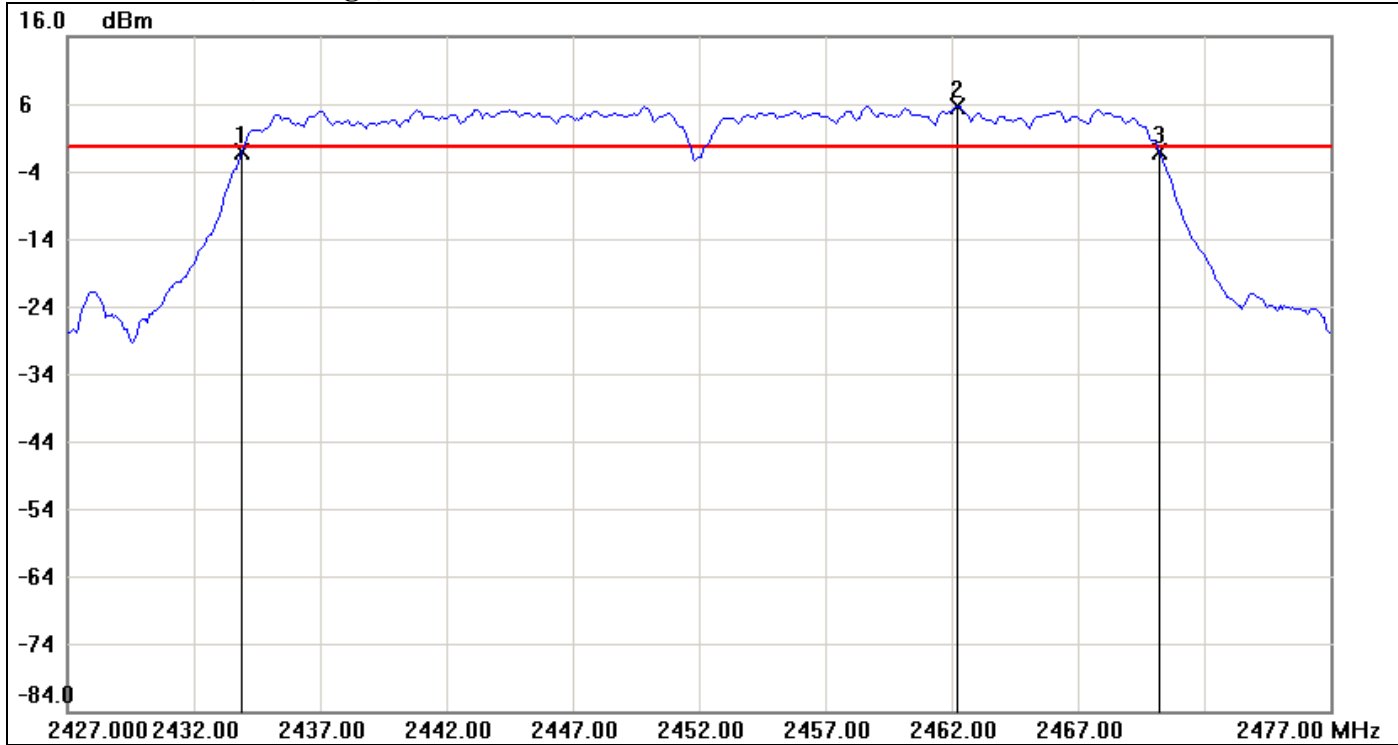


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2418.9167	-0.13	0.87	-1.00
2	2447.2500	6.87	0.87	6.00
3	2455.2500	0.20	0.87	-0.67

No.		$\Delta$ Frequency(MHz)	$\Delta$ Level(dB)
1	mk3-mk1	36.3333	0.33



**6dB Bandwidth (CH High)**



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2433.9167	-1.15	-0.36	-0.79
2	2462.2500	5.64	-0.36	6.00
3	2470.2500	-1.12	-0.36	-0.76

No.		$\Delta$ Frequency(MHz)	$\Delta$ Level(dB)
1	mk3-mk1	36.3333	0.03



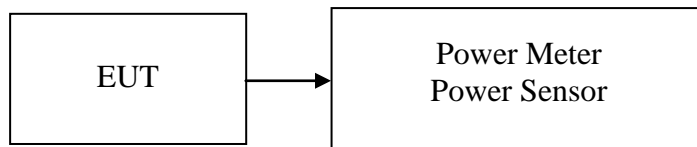
## 7.2 PEAK POWER

### 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	25.24	0.3342	1.00	PASS
Mid	2437	25.21	0.3319		PASS
High	2462	24.02	0.2523		PASS

**Test mode: IEEE 802.11g mode**

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	25.87	0.3864	1.00	PASS
Mid	2437	25.75	0.3758		PASS
High	2462	25.37	0.3443		PASS

**Test mode: IEEE 802.11n HT 20 mode**

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2412	25.12	0.3251	1.00	PASS
Mid	2437	25.14	0.3266		PASS
High	2462	24.25	0.2661		PASS

**Test mode: IEEE 802.11n HT 40 mode**

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)	Result
Low	2422	25.22	0.3327	1.00	PASS
Mid	2437	25.16	0.3281		PASS
High	2452	24.25	0.2661		PASS

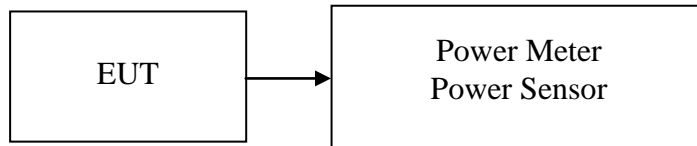


### **7.3 AVERAGE POWER**

#### **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 average 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	23.23	0.2104
Mid	2437	23.29	0.2133
High	2462	22.04	0.1600

#### **Test mode: IEEE 802.11g mode**

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	2412	18.67	0.0736
Mid	2437	19.12	0.0817
High	2462	18.05	0.0638

#### **Test mode: IEEE 802.11n HT 20 mode**

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	2412	16.60	0.0457
Mid	2437	17.08	0.0511
High	2462	16.01	0.0399

#### **Test mode: IEEE 802.11n HT 40 mode**

Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)
Low	2422	16.26	0.0423
Mid	2437	16.61	0.0458
High	2452	15.47	0.0352



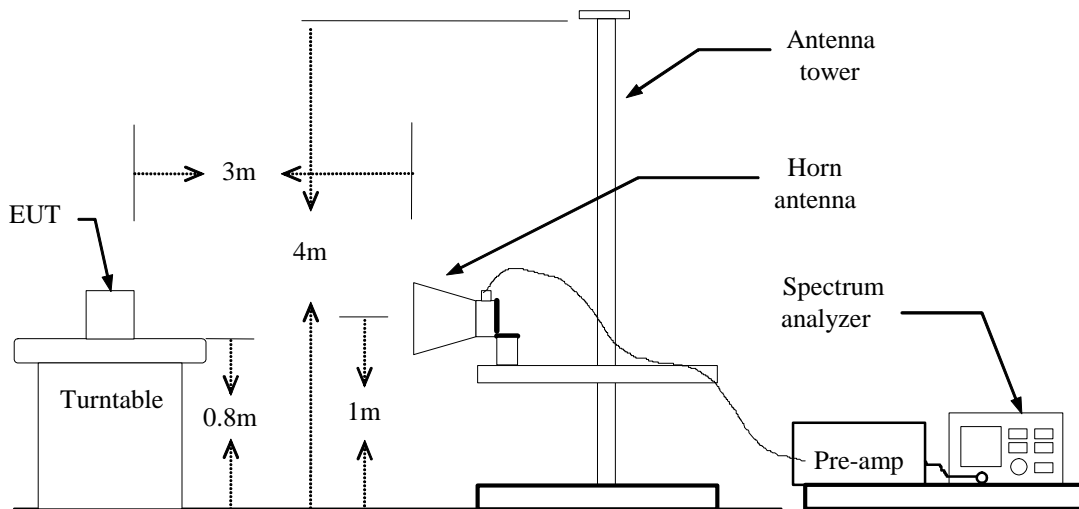
## 7.4 BAND EDGES MEASUREMENT

### LIMIT

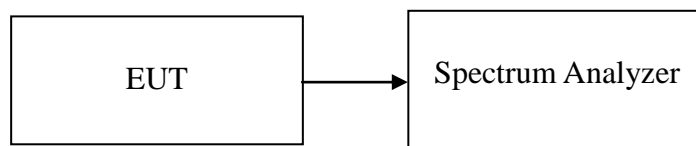
According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains 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

#### For Radiated



#### For Conducted







## **TEST PROCEDURE**

### **For Radiated**

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=3MHz / Sweep=AUTO
  - (b) AVERAGE: RBW=1MHz,  
if duty cycle  $\geq 98\%$ , VBW=10Hz.  
if duty cycle  $< 98\%$  VBW=1/T.  
**IEEE 802.11b mode:  $\geq 98\%$ , VBW=10Hz**  
**IEEE 802.11g mode:  $\geq 98\%$ , VBW=10Hz**  
**IEEE 802.11n HT 20 MHz mode:  $\geq 98\%$ , VBW=10Hz**  
**IEEE 802.11n HT 40 MHz mode:  $\geq 98\%$ , VBW=10Hz**
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

### **For Conducted**

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.

## **TEST RESULTS**

Refer to attach spectrum analyzer data chart.



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

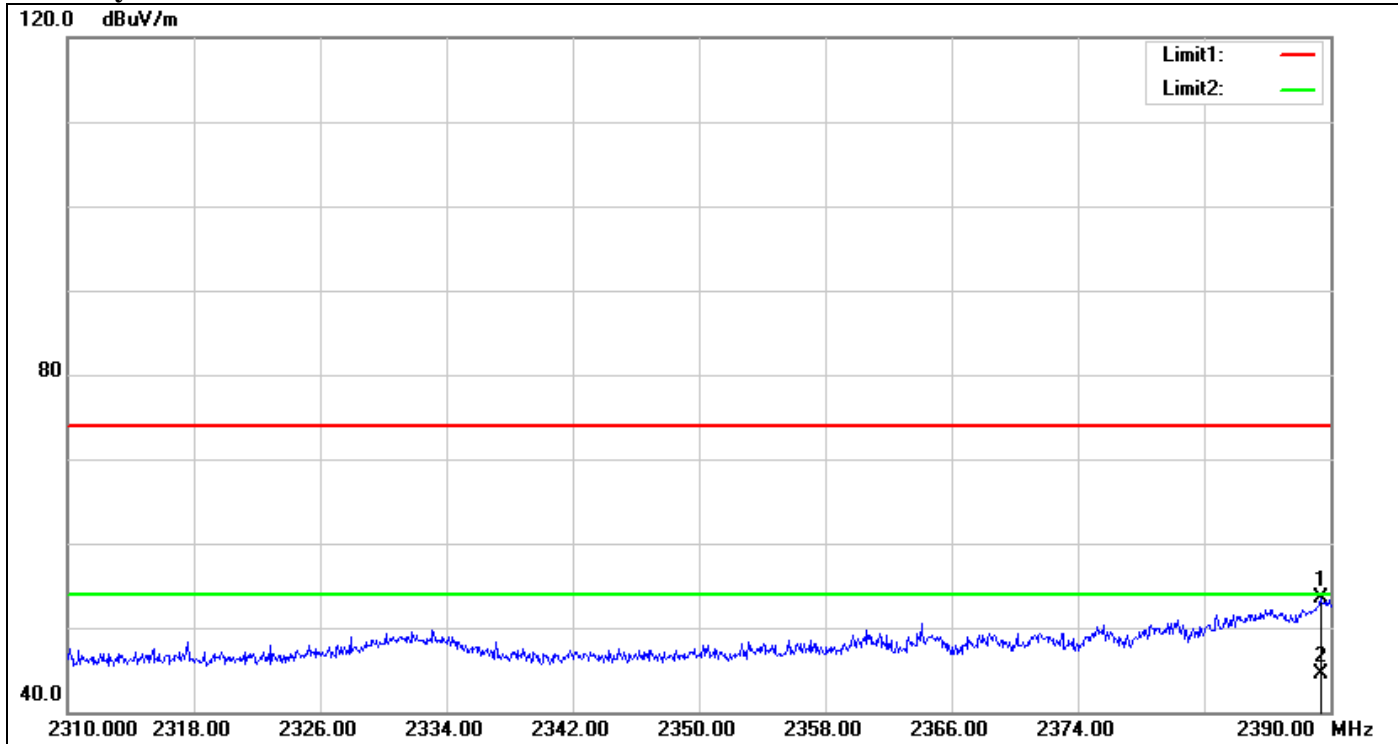
Polarity: Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
1	2389.840	63.15	-3.77	59.38	74.00	-14.62	100	192	peak
2	2389.840	55.40	-3.77	51.63	54.00	-2.37	100	192	AVG



**Polarity: Horizontal**

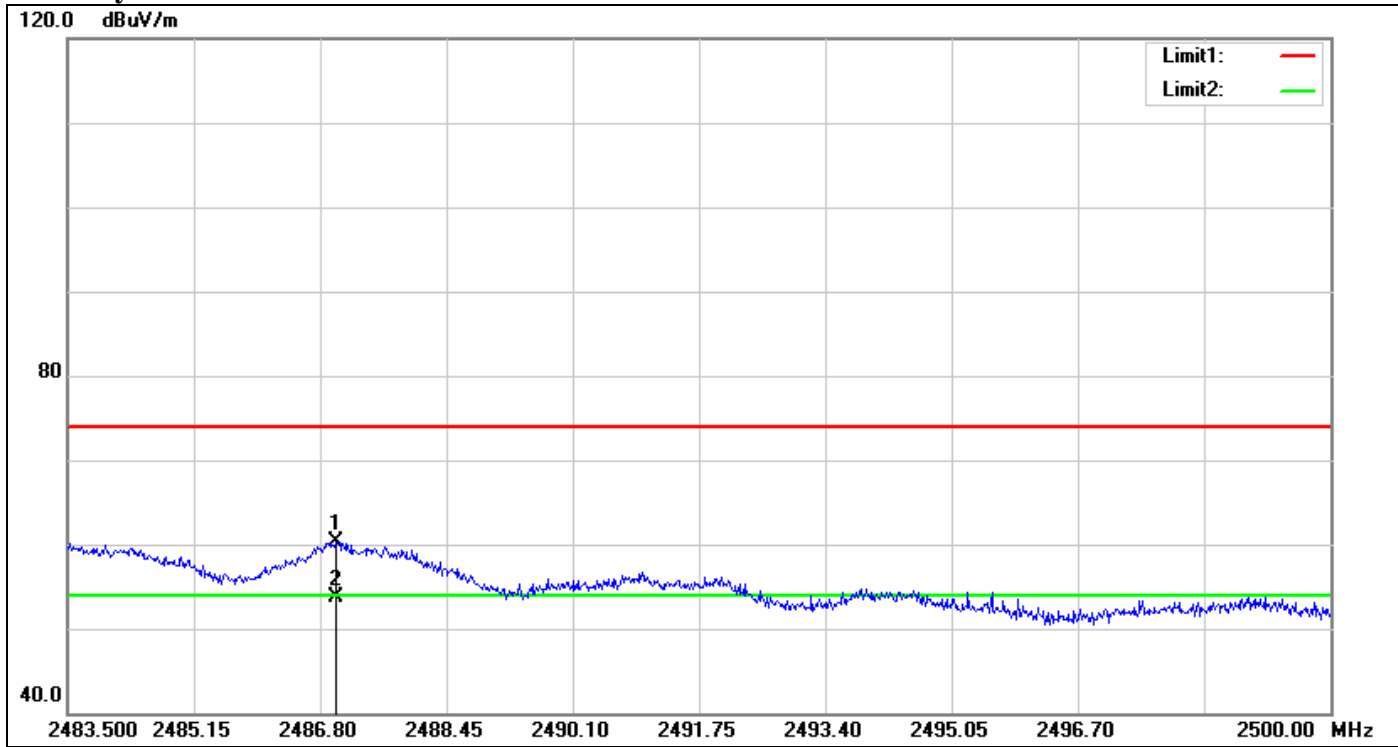


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree ( ° )	Remark
1	2389.360	57.20	-3.78	53.42	74.00	-20.58	100	8	peak
2	2389.360	48.27	-3.78	44.49	54.00	-9.51	100	8	AVG



**Band Edges (IEEE 802.11b mode / CH High)**

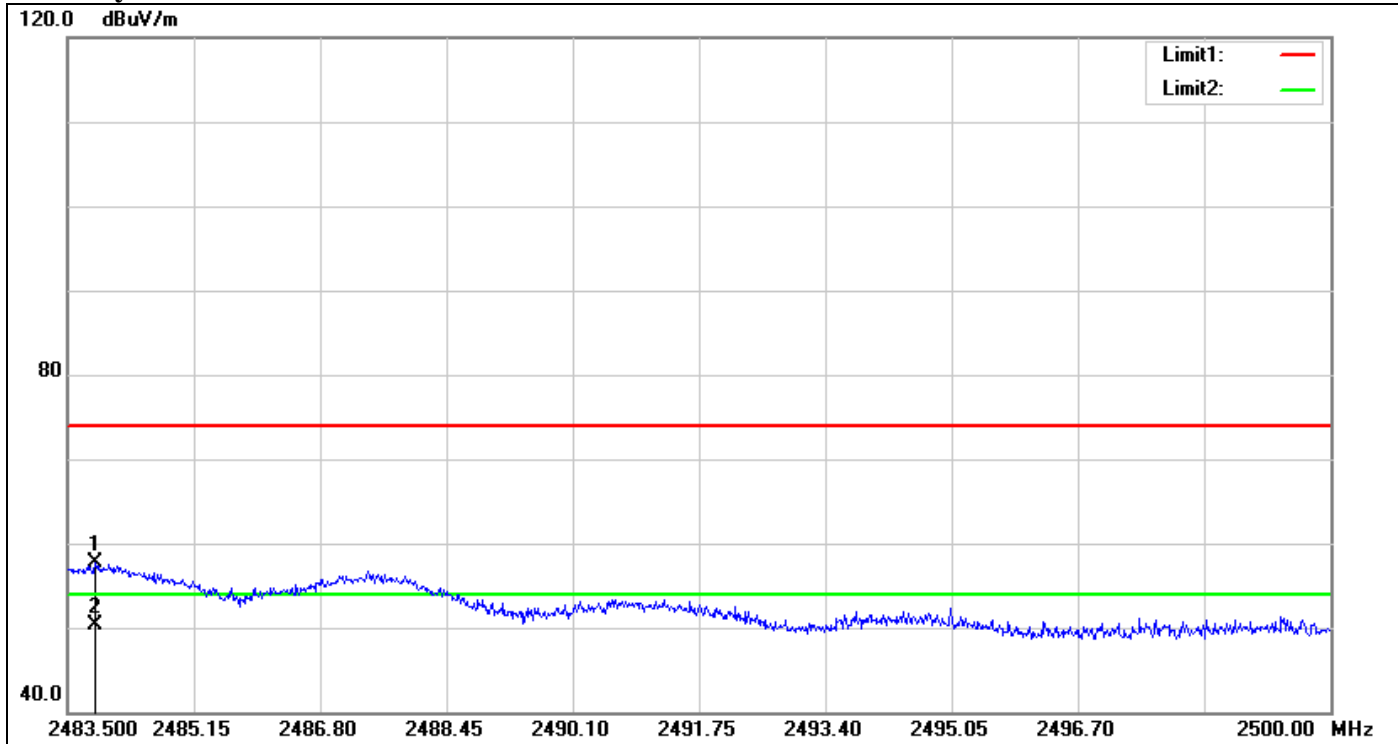
**Polarity: Vertical**



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree ( ° )	Remark
1	2486.998	63.54	-3.24	60.30	74.00	-13.70	100	359	peak
2	2486.998	56.98	-3.24	53.74	54.00	-0.26	100	359	AVG



**Polarity: Horizontal**



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree ( ° )	Remark
1	2483.863	61.01	-3.27	57.74	74.00	-16.26	100	45	peak
2	2483.863	53.51	-3.27	50.24	54.00	-3.76	100	45	AVG



**Band Edges (IEEE 802.11g mode / CH Low)**

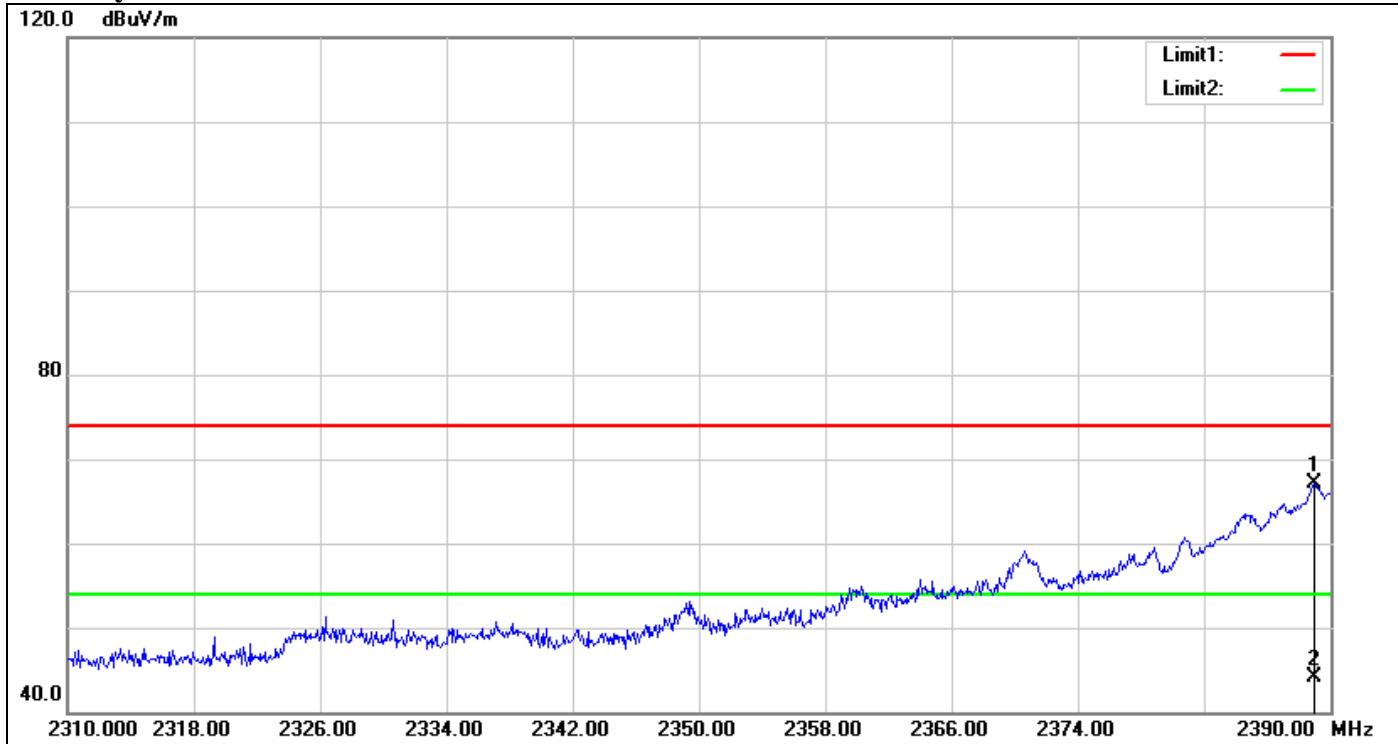
**Polarity: Vertical**



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
1	2390.000	77.29	-3.77	73.52	74.00	-0.48	100	224	peak
2	2390.000	57.68	-3.77	53.91	54.00	-0.09	100	224	AVG



**Polarity: Horizontal**

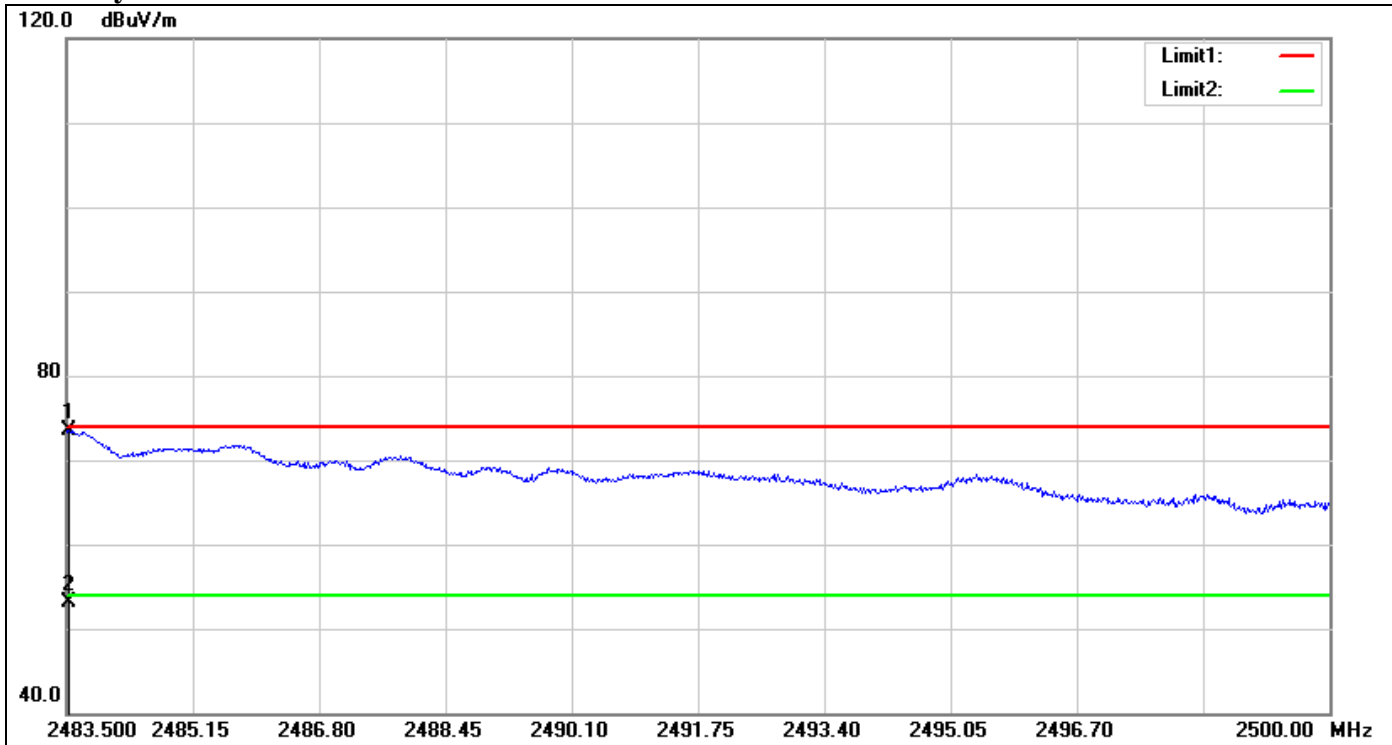


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree ( ° )	Remark
1	2388.960	70.79	-3.78	67.01	74.00	-6.99	100	359	peak
2	2388.960	47.80	-3.78	44.02	54.00	-9.98	100	359	AVG



**Band Edges (IEEE 802.11g mode / CH High)**

**Polarity: Vertical**

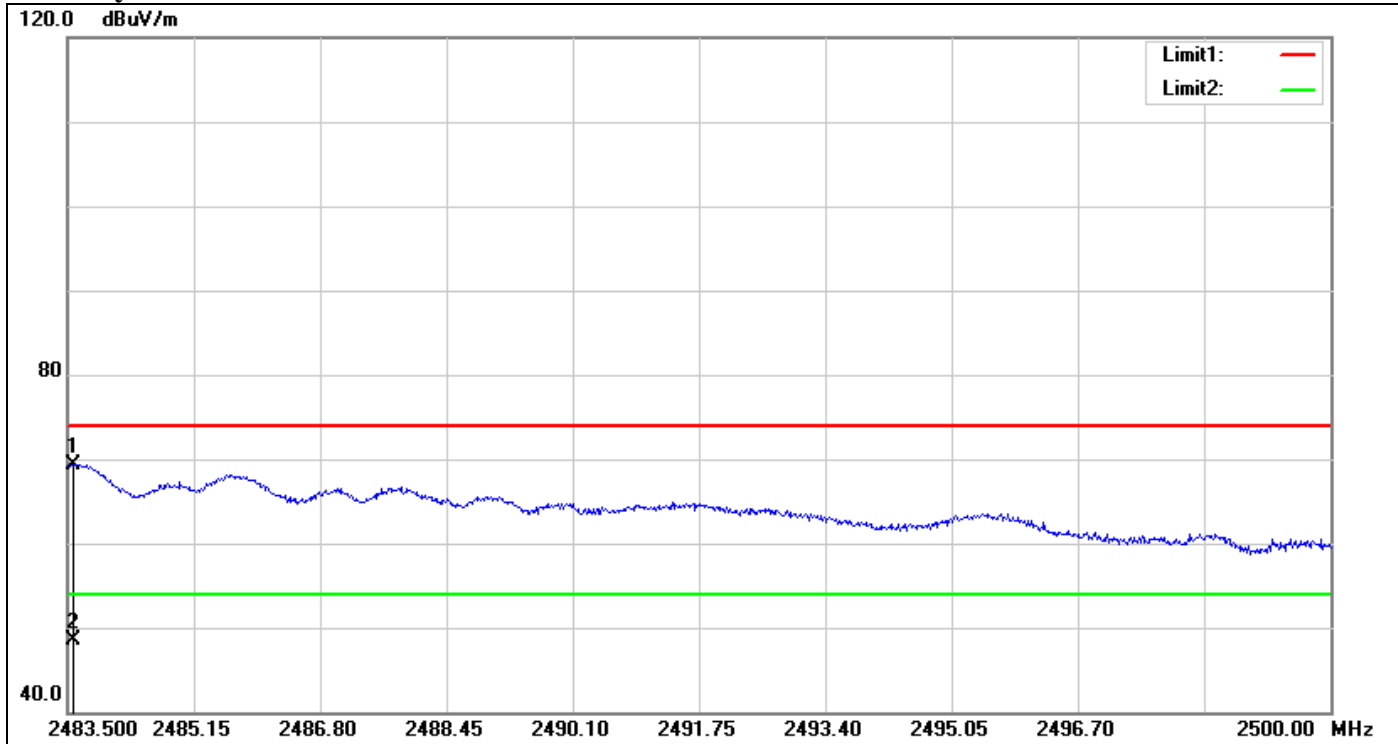


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
1	2483.533	76.79	-3.27	73.52	74.00	-0.48	100	182	peak
2	2483.533	56.37	-3.27	53.10	54.00	-0.90	100	182	AVG





**Polarity: Horizontal**

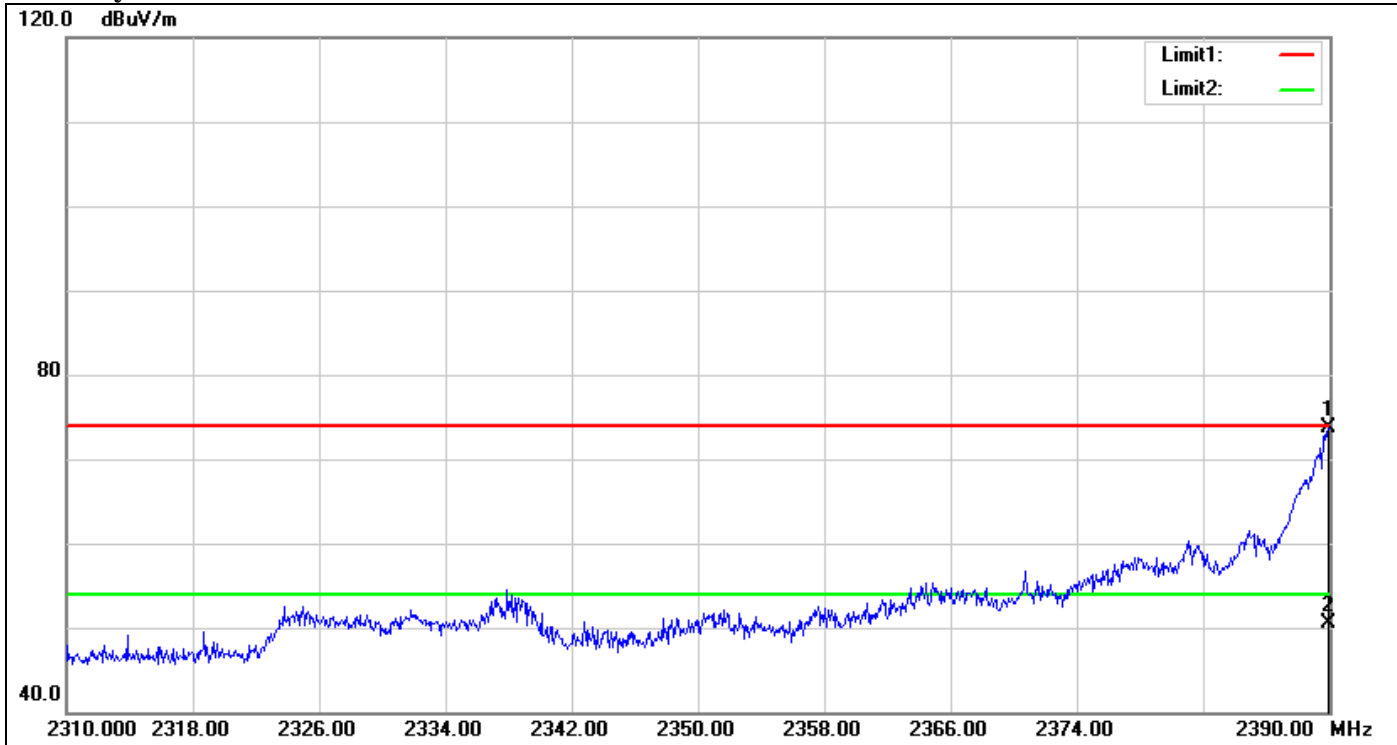


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree ( ° )	Remark
1	2483.582	72.66	-3.27	69.39	74.00	-4.61	100	356	peak
2	2483.582	51.81	-3.27	48.54	54.00	-5.46	100	356	AVG



**Band Edges (IEEE 802.11n HT 20 mode / CH Low)**

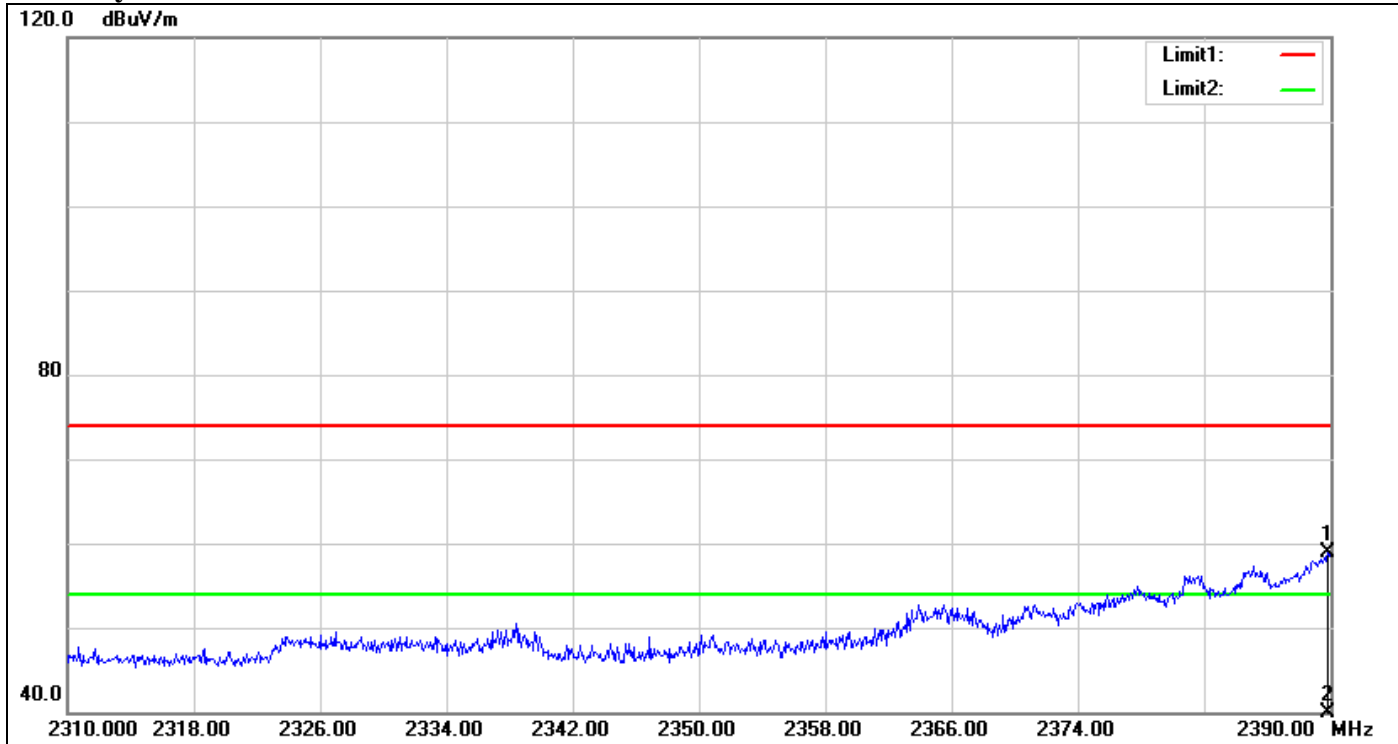
**Polarity: Vertical**



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
1	2389.920	77.41	-3.77	73.64	74.00	-0.36	100	252	peak
2	2389.920	54.20	-3.77	50.43	54.00	-3.57	100	252	AVG



**Polarity: Horizontal**

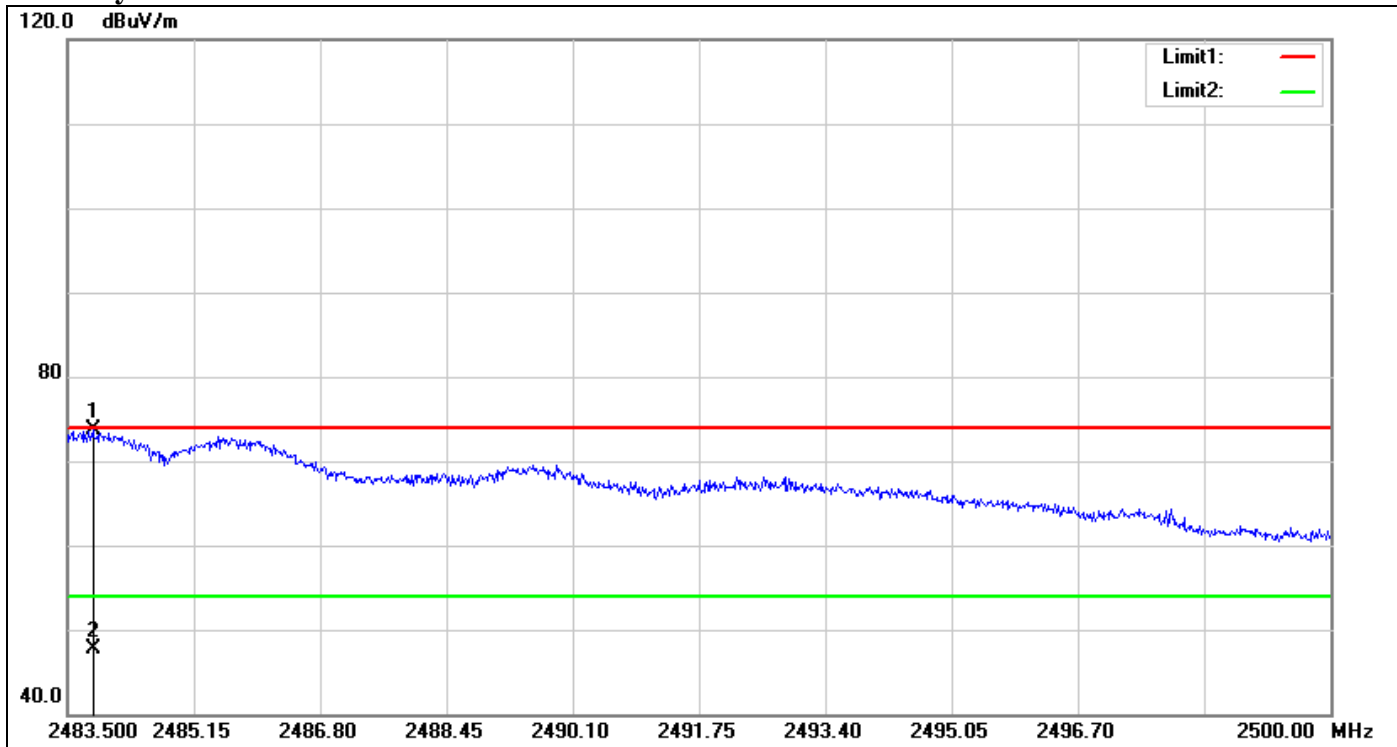


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree ( ° )	Remark
1	2389.840	62.65	-3.77	58.88	74.00	-15.12	100	195	peak
2	2389.840	41.73	-3.77	37.96	54.00	-16.04	100	195	AVG



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

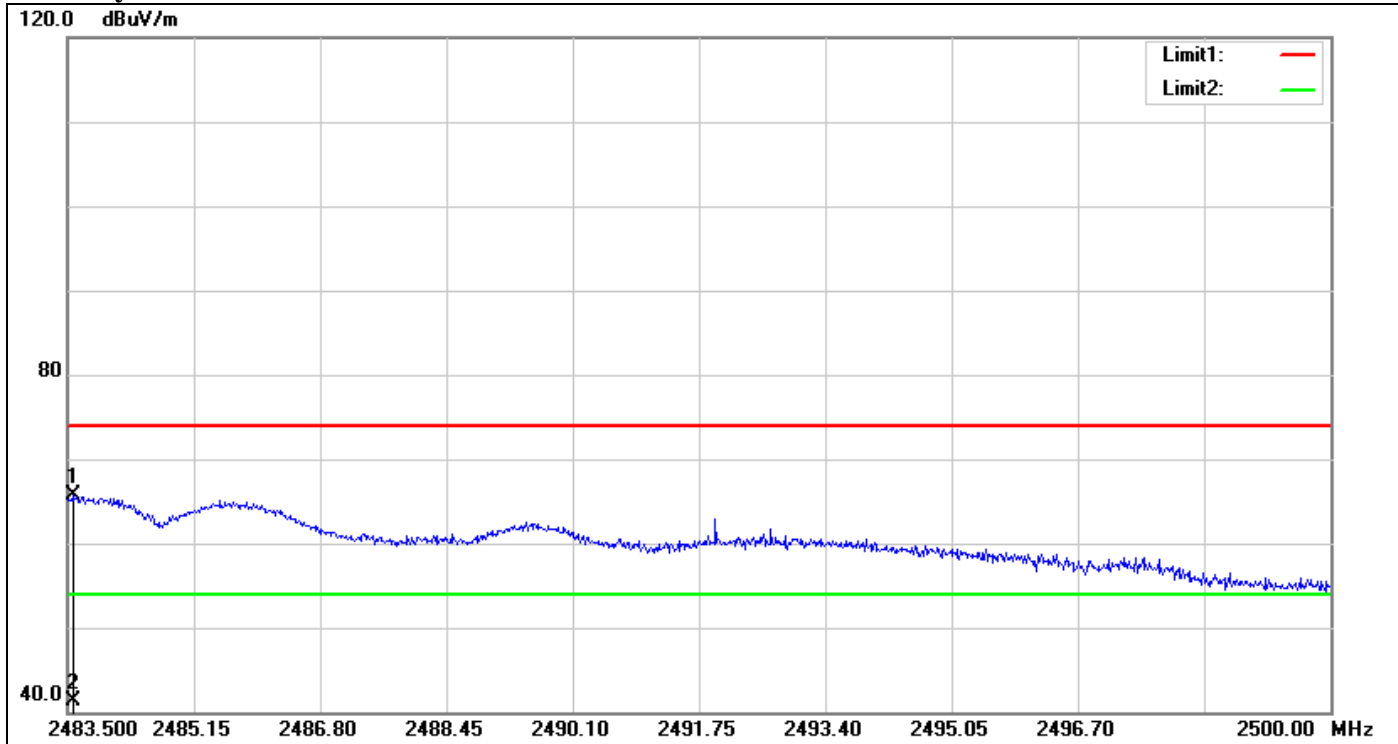
**Polarity: Vertical**



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
1	2483.830	76.88	-3.27	73.61	74.00	-0.39	100	329	peak
2	2483.830	50.90	-3.27	47.63	54.00	-6.37	100	329	AVG



**Polarity: Horizontal**



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree ( ° )	Remark
1	2483.566	68.95	-3.27	65.68	74.00	-8.32	100	41	peak
2	2483.566	44.67	-3.27	41.40	54.00	-12.60	100	41	AVG



**Band Edges (IEEE 802.11n HT 40 mode / CH Low)**

**Polarity: Vertical**



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
1	2388.640	76.79	-3.78	73.01	74.00	-0.99	100	208	peak
2	2388.640	57.59	-3.78	53.81	54.00	-0.19	100	208	AVG



**Polarity: Horizontal**

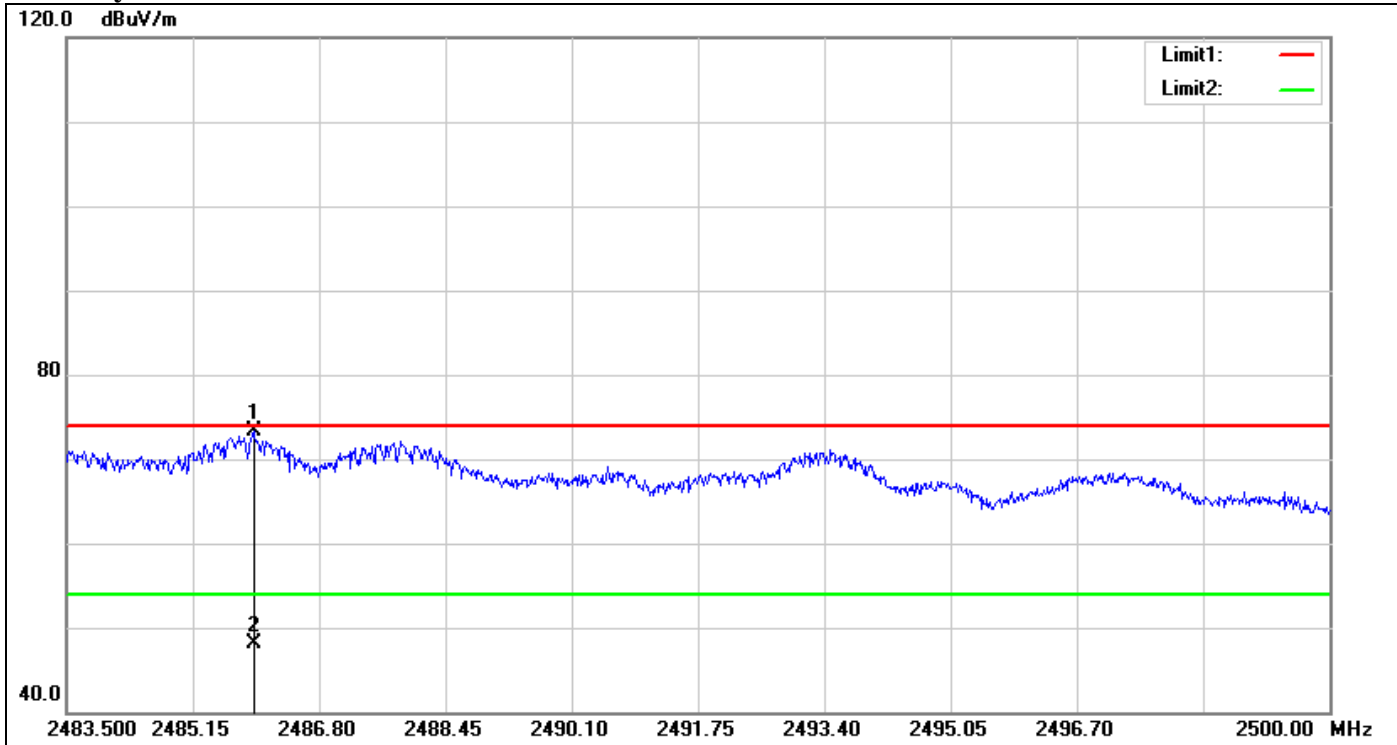


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree ( ° )	Remark
1	2383.120	64.65	-3.83	60.82	74.00	-13.18	100	359	peak
2	2383.120	44.70	-3.83	40.87	54.00	-13.13	100	359	AVG



**Band Edges (IEEE 802.11n HT 40 mode / CH High)**

**Polarity: Vertical**

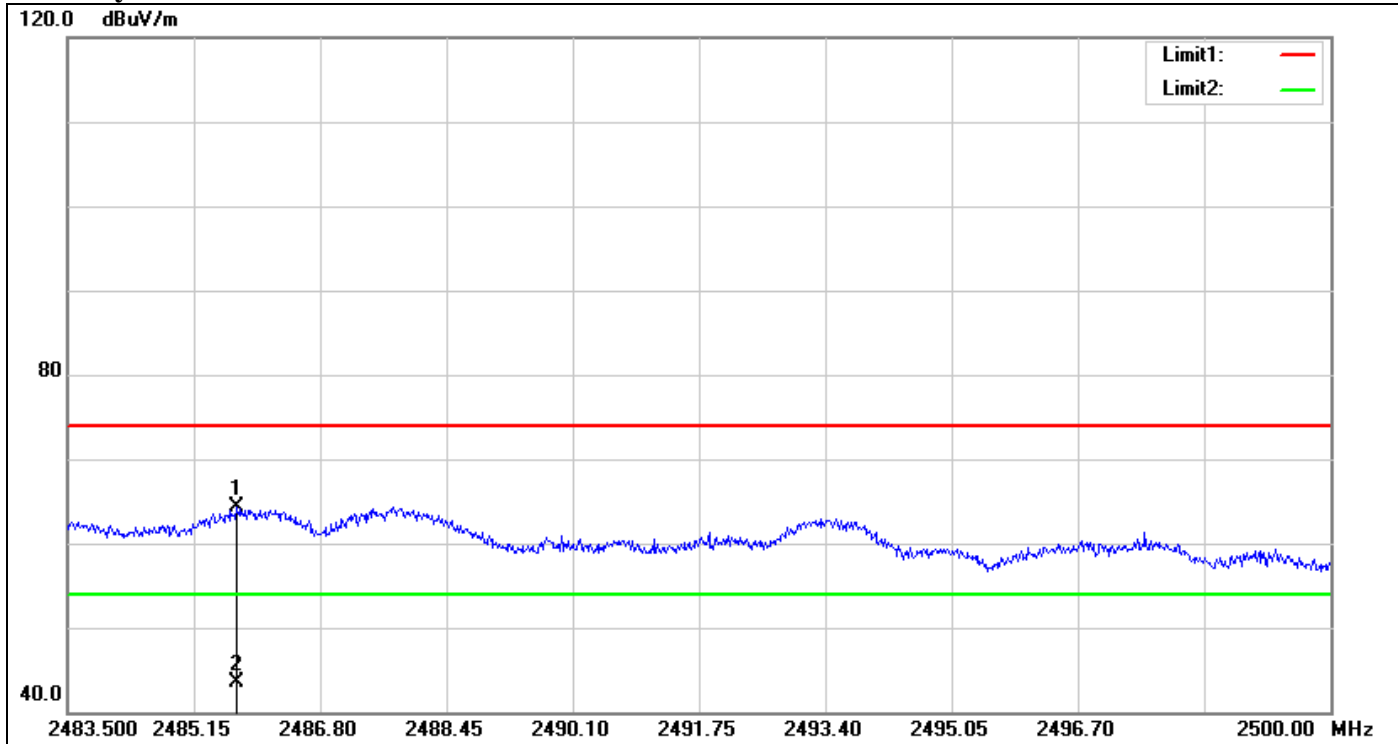


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (°)	Remark
1	2485.942	76.53	-3.25	73.28	74.00	-0.72	100	358	peak
2	2485.942	51.26	-3.25	48.01	54.00	-5.99	100	358	AVG





**Polarity: Horizontal**



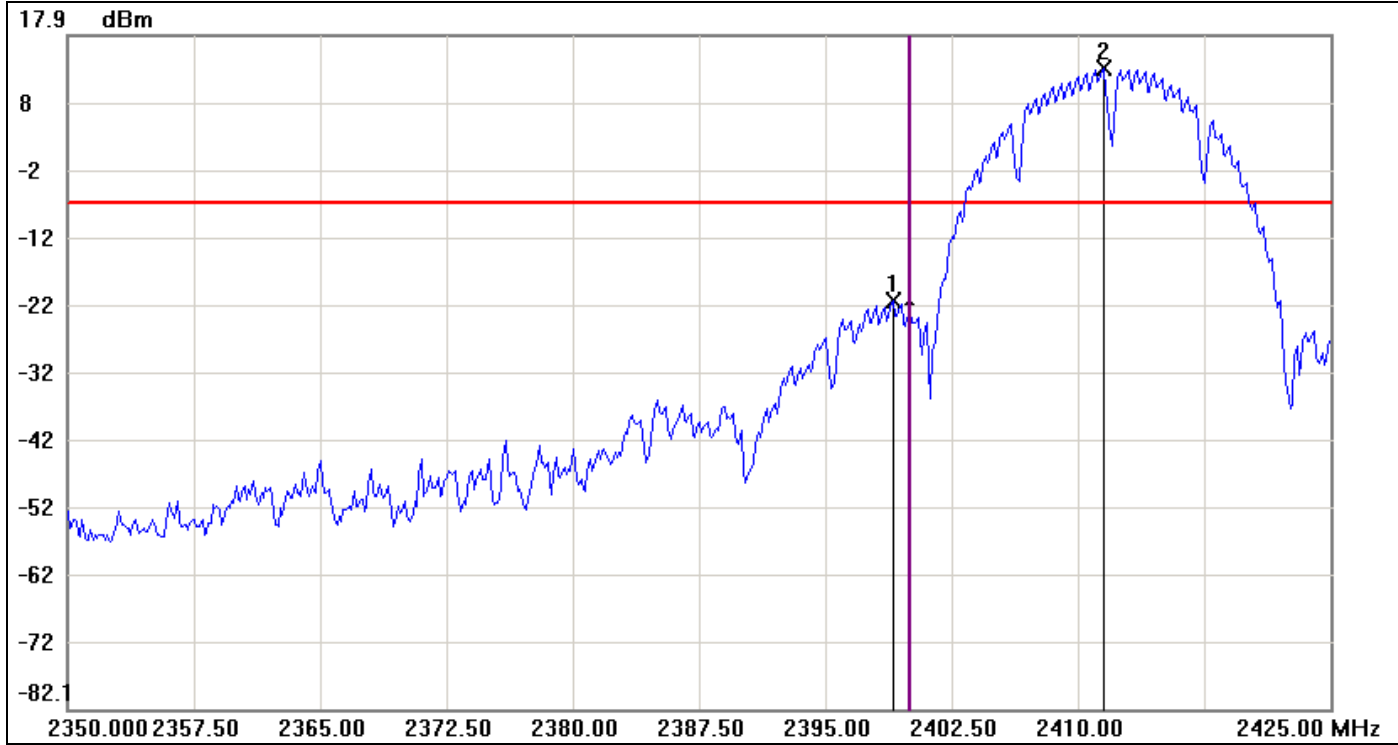
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree ( ° )	Remark
1	2485.711	67.61	-3.25	64.36	74.00	-9.64	100	107	peak
2	2485.711	46.74	-3.25	43.49	54.00	-10.51	100	107	AVG



### Conducted Band Edge

IEEE 802.11b

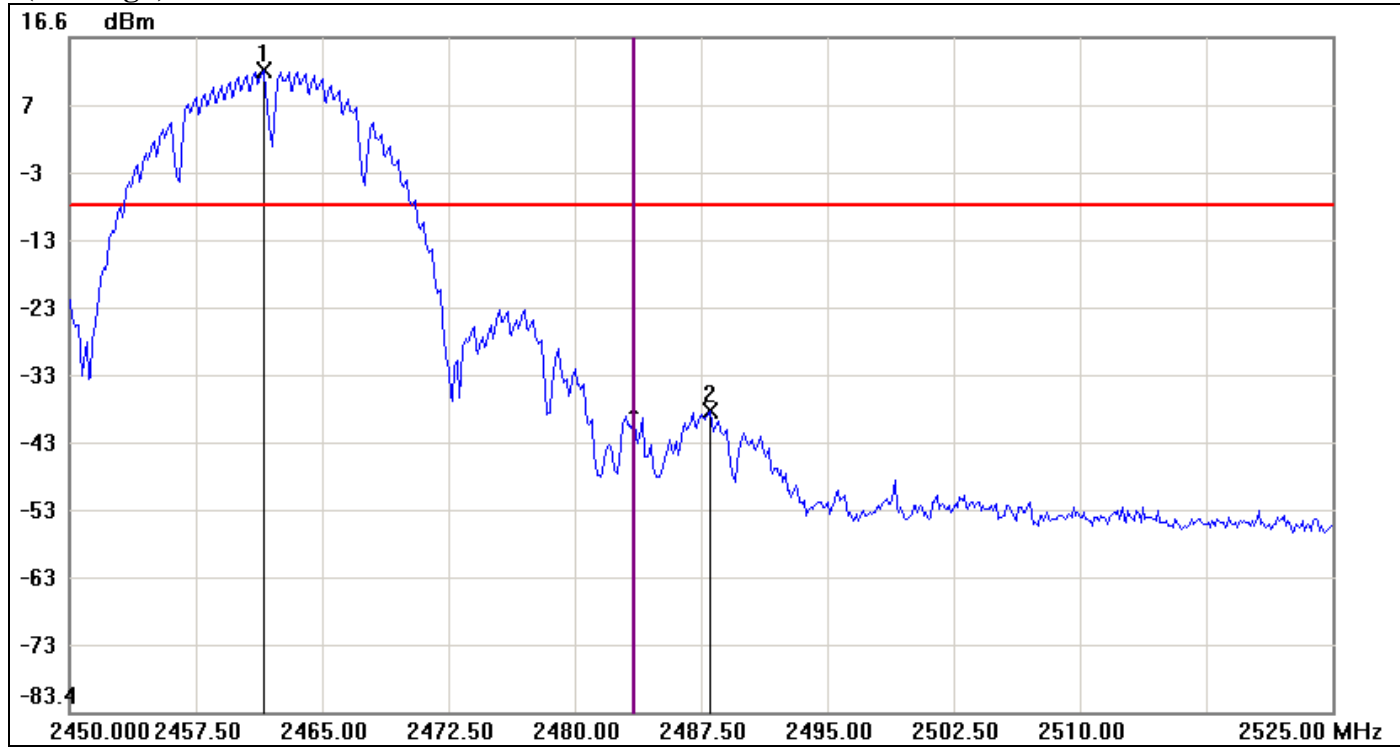
(CH Low)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2399.0000	-21.52	-7.11	-14.41
2	2411.5000	12.89	-7.11	20.00



(CH High)

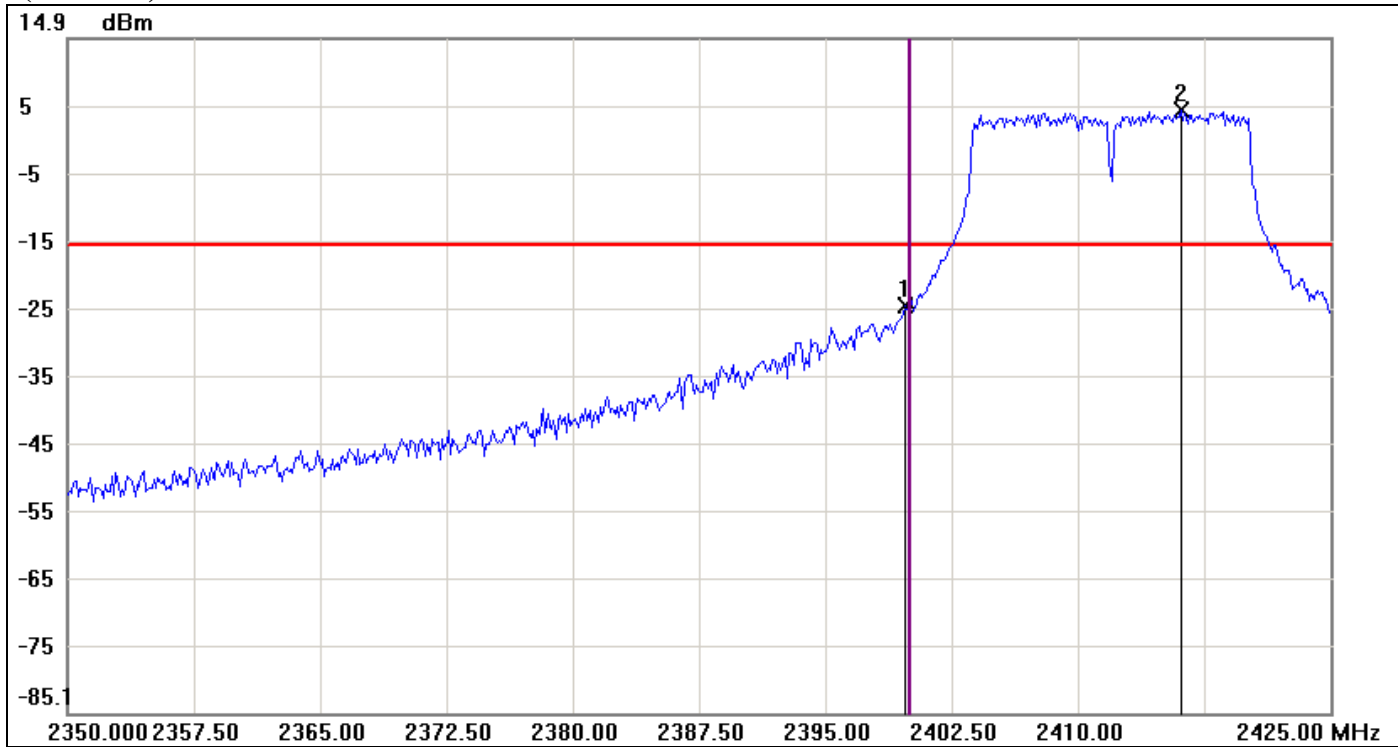


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2461.5000	11.71	-8.29	20.00
2	2488.0000	-38.76	-8.29	-30.47



IEEE 802.11g

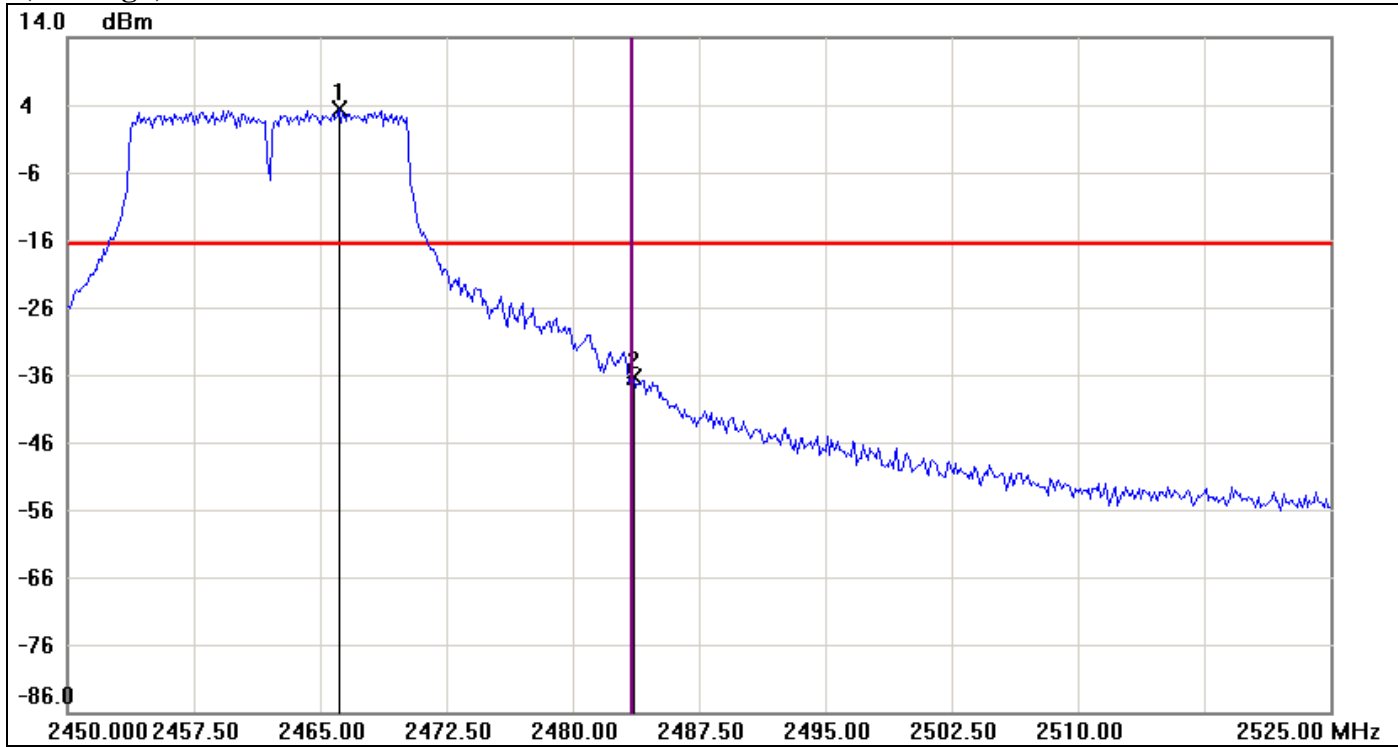
(CH Low)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2399.7500	-24.73	-15.78	-8.95
2	2416.1250	4.22	-15.78	20.00



(CH High)

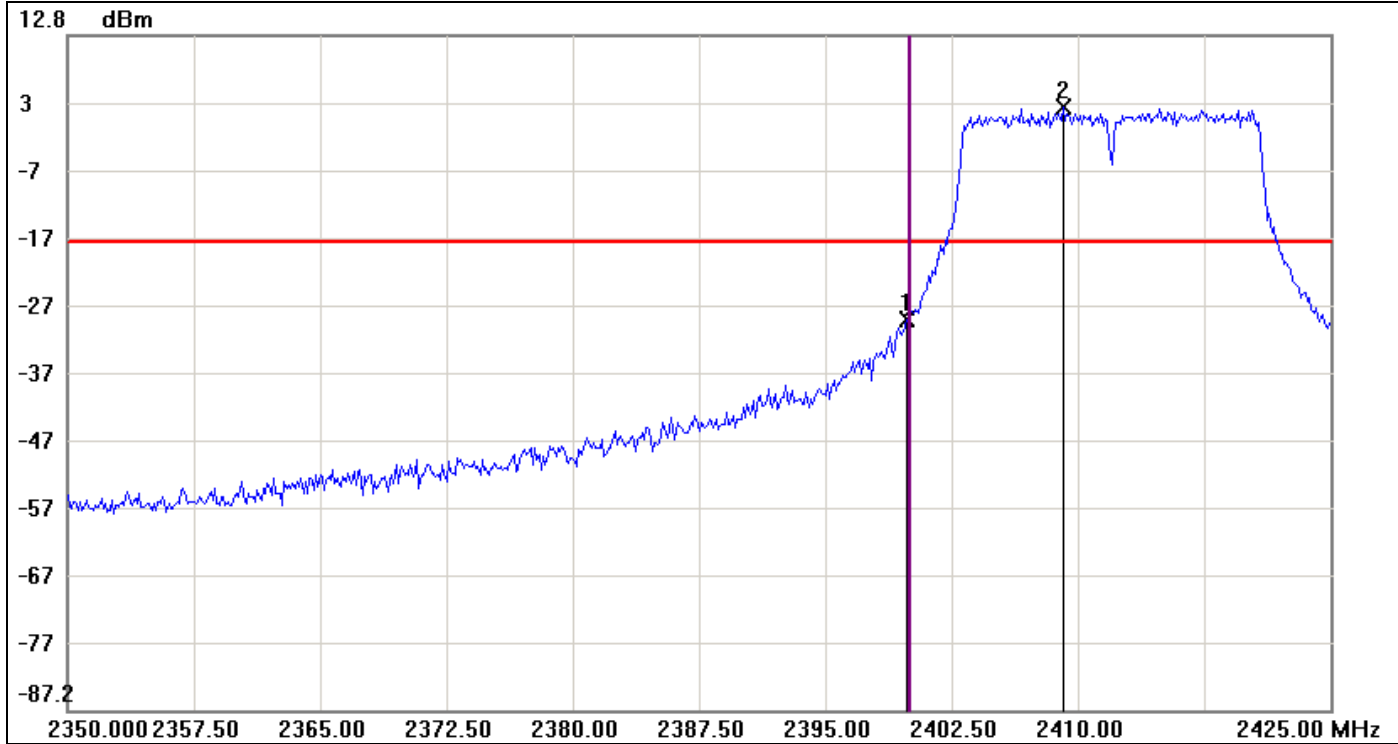


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2466.1250	3.31	-16.69	20.00
2	2483.6250	-36.36	-16.69	-19.67



IEEE 802.11n HT 20 mode

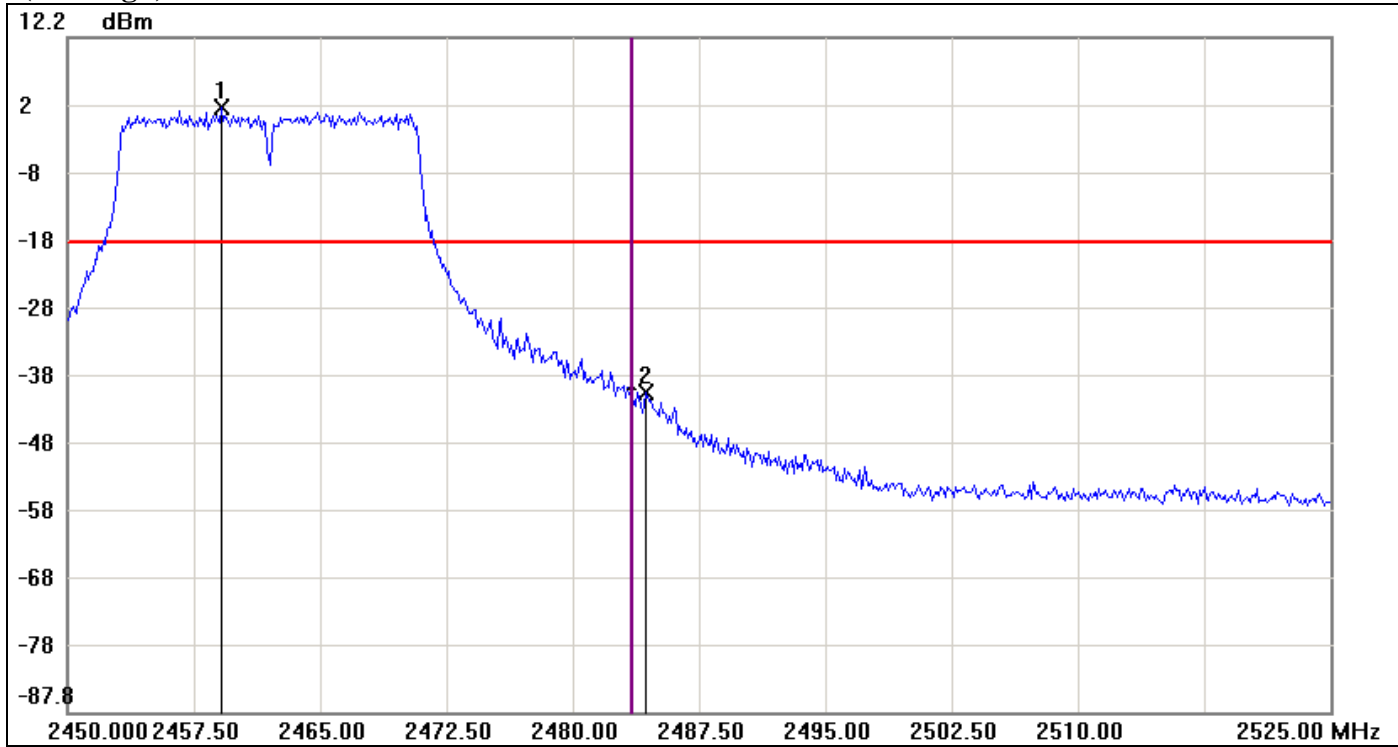
(CH Low)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2399.8750	-29.28	-17.79	-11.49
2	2409.1250	2.21	-17.79	20.00



(CH High)

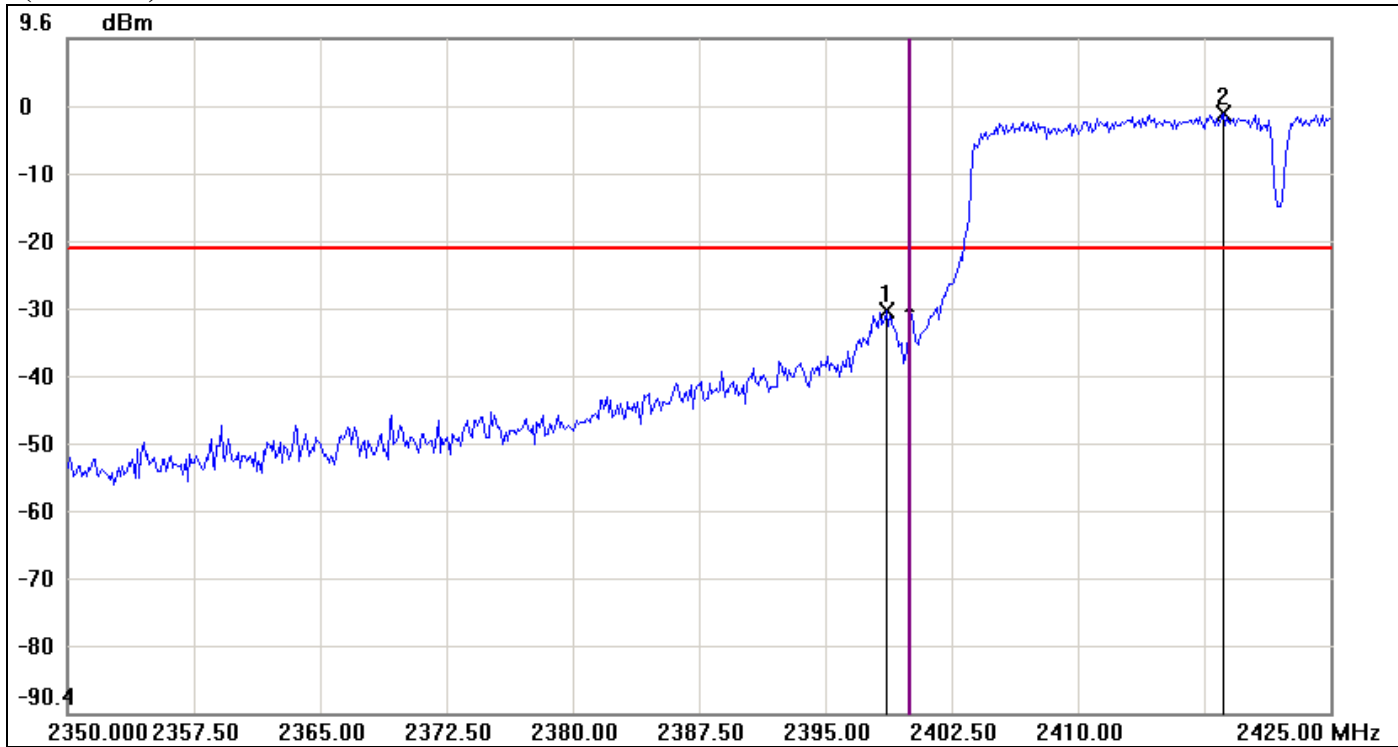


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2459.1250	1.74	-18.26	20.00
2	2484.3750	-40.38	-18.26	-22.12



IEEE 802.11n HT 40 mode

(CH Low)

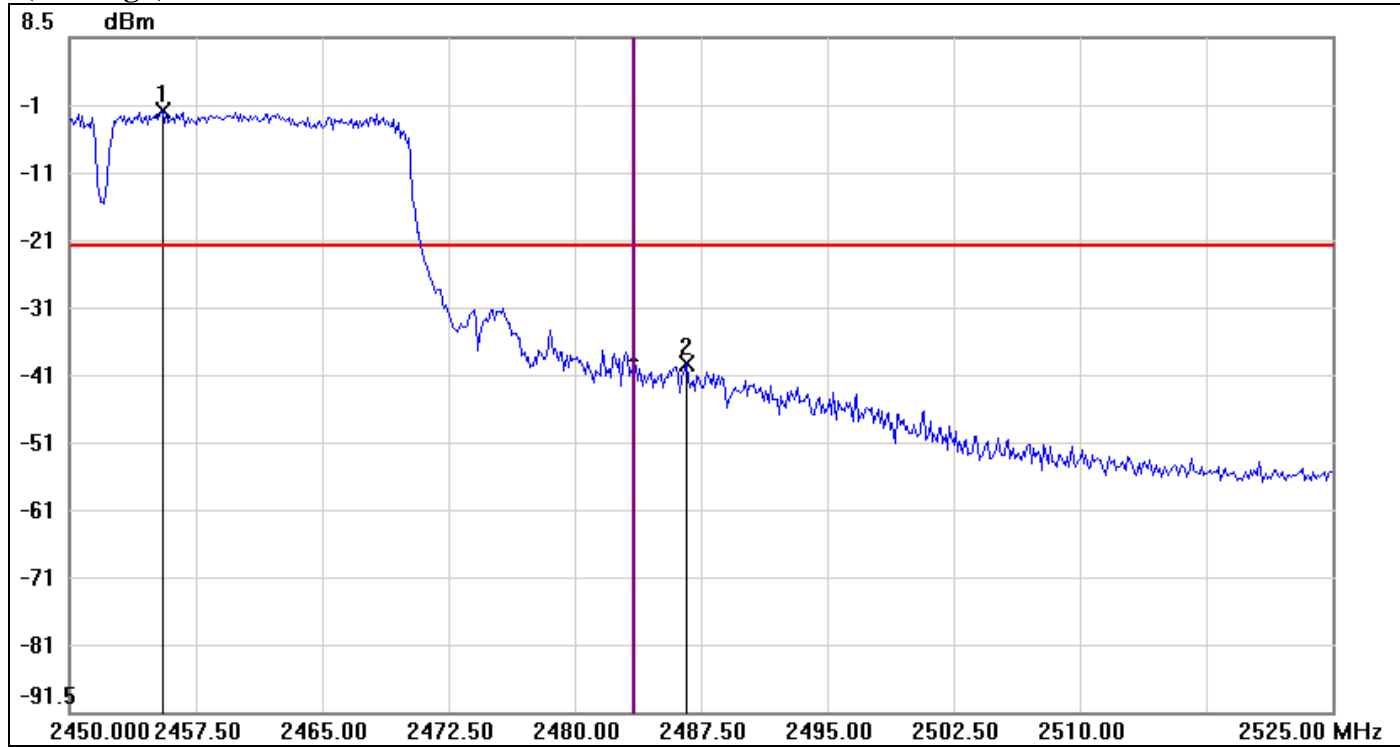


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2398.6250	-30.74	-21.46	-9.28
2	2418.6250	-1.46	-21.46	20.00





(CH High)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2455.5000	-2.42	-22.42	20.00
2	2486.6250	-39.94	-22.42	-17.52

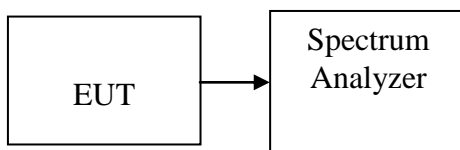


## 7.5 PEAK POWER SPECTRAL DENSITY

### 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

The transmitter output is connected to a spectrum analyzer. Set the RBW = 100 kHz, VBW  $\geq$  300 kHz, span to 1.5 times the DTS bandwidth, Detector = peak, Trace mode = max hold, Sweep = auto couple. Use the peak marker function to determine the maximum amplitude level within the RBW. If measured value exceeds limit, reduce RBW (no less than 3 kHz).



## **TEST RESULTS**

*No non-compliance noted*

### **Test Data**

#### **Test mode: IEEE 802.11b mode**

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2412	3.35	8.00	PASS
Mid	2437	3.21		PASS
High	2462	2.00		PASS

#### **Test mode: IEEE 802.11g mode**

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2412	-3.40	8.00	PASS
Mid	2437	-3.16		PASS
High	2462	-4.45		PASS

#### **Test mode: IEEE 802.11n HT 20 mode**

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2412	-4.75	8.00	PASS
Mid	2437	-4.22		PASS
High	2462	-5.34		PASS

#### **Test mode: IEEE 802.11n HT 40 mode**

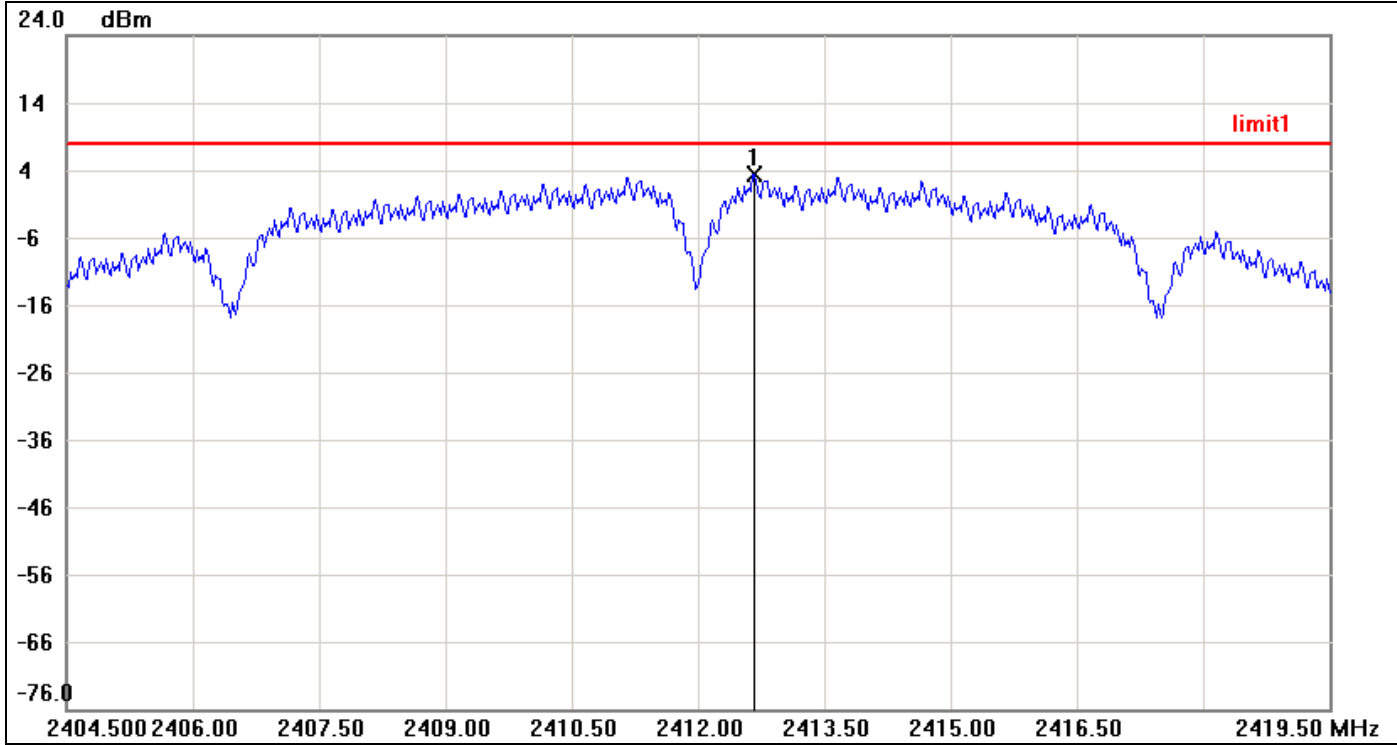
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Result
Low	2422	-7.58	8.00	PASS
Mid	2437	-7.28		PASS
High	2452	-9.29		PASS



**Test Plot**

IEEE 802.11b mode

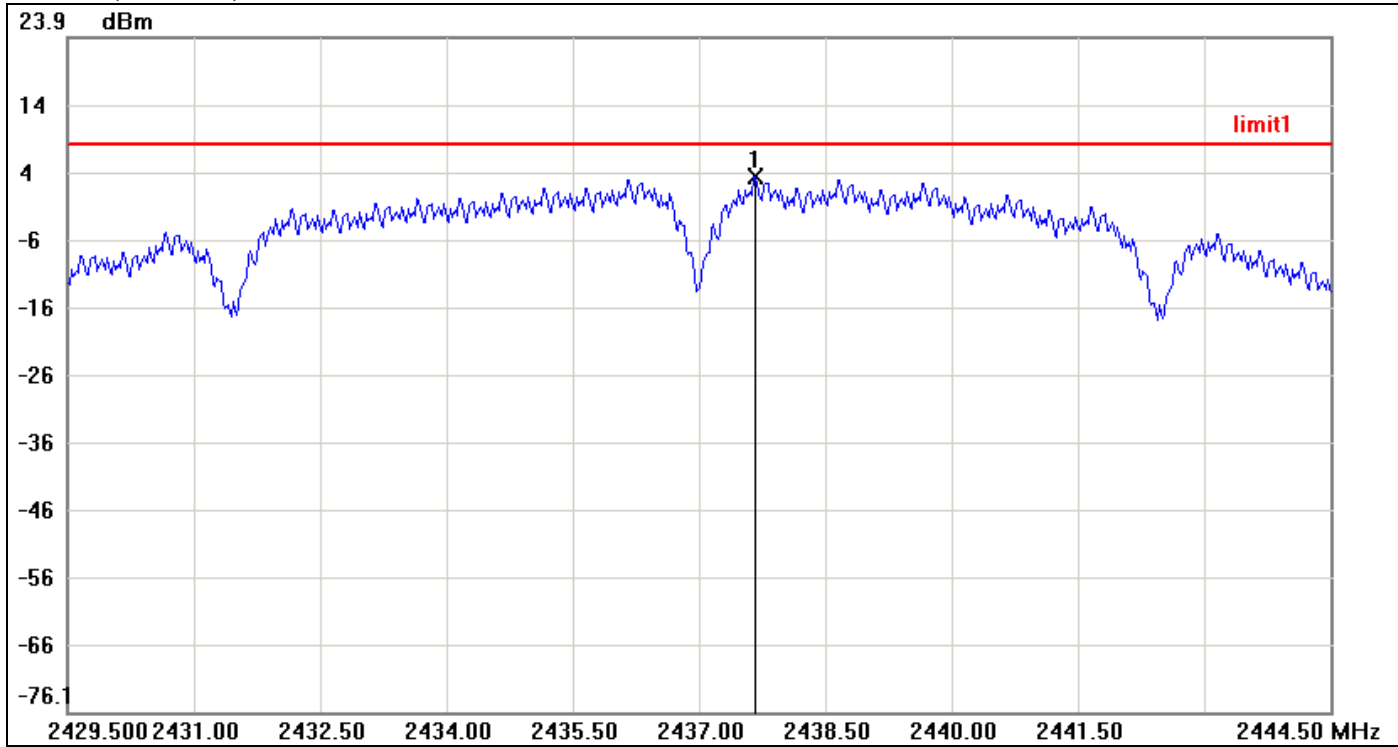
PPSD (CH Low)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2412.6750	3.35	8.00	-4.65



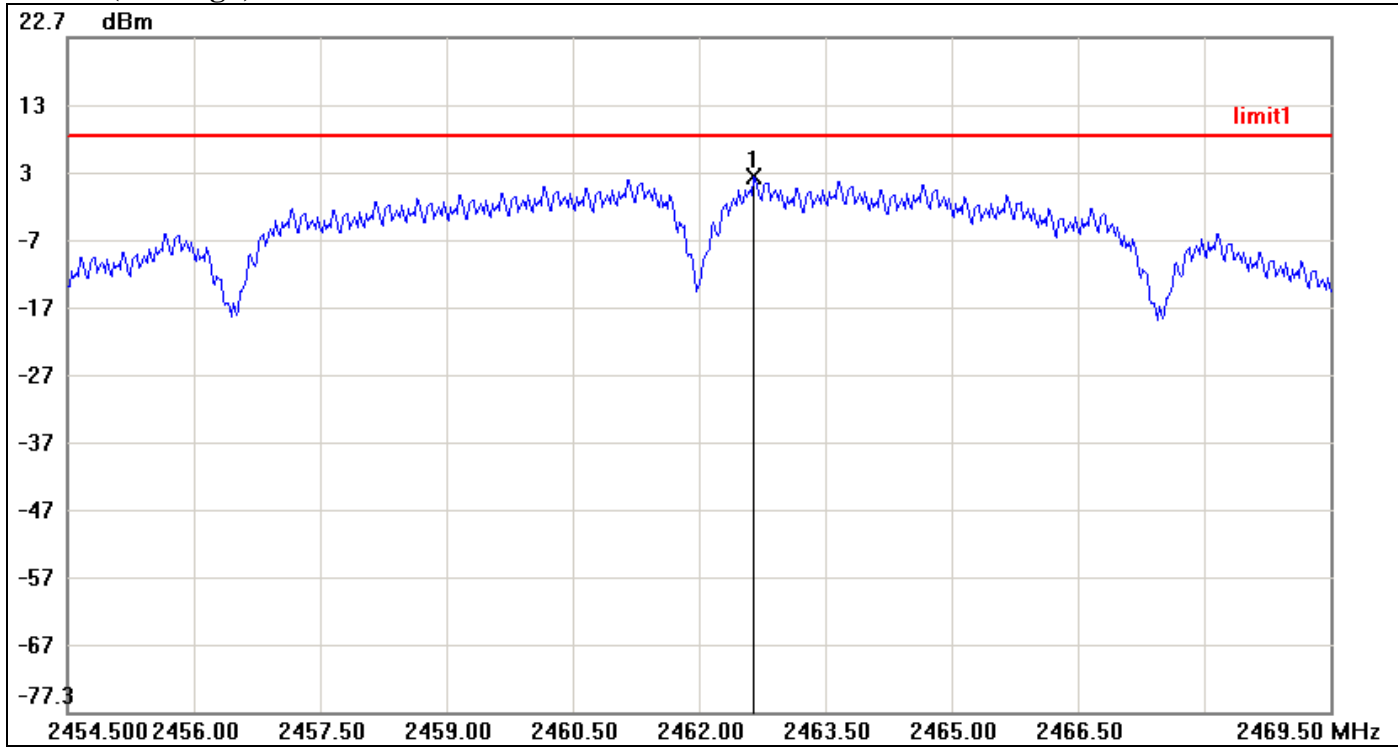
PPSD (CH Mid)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2437.6750	3.21	8.00	-4.79



**PPSD (CH High)**

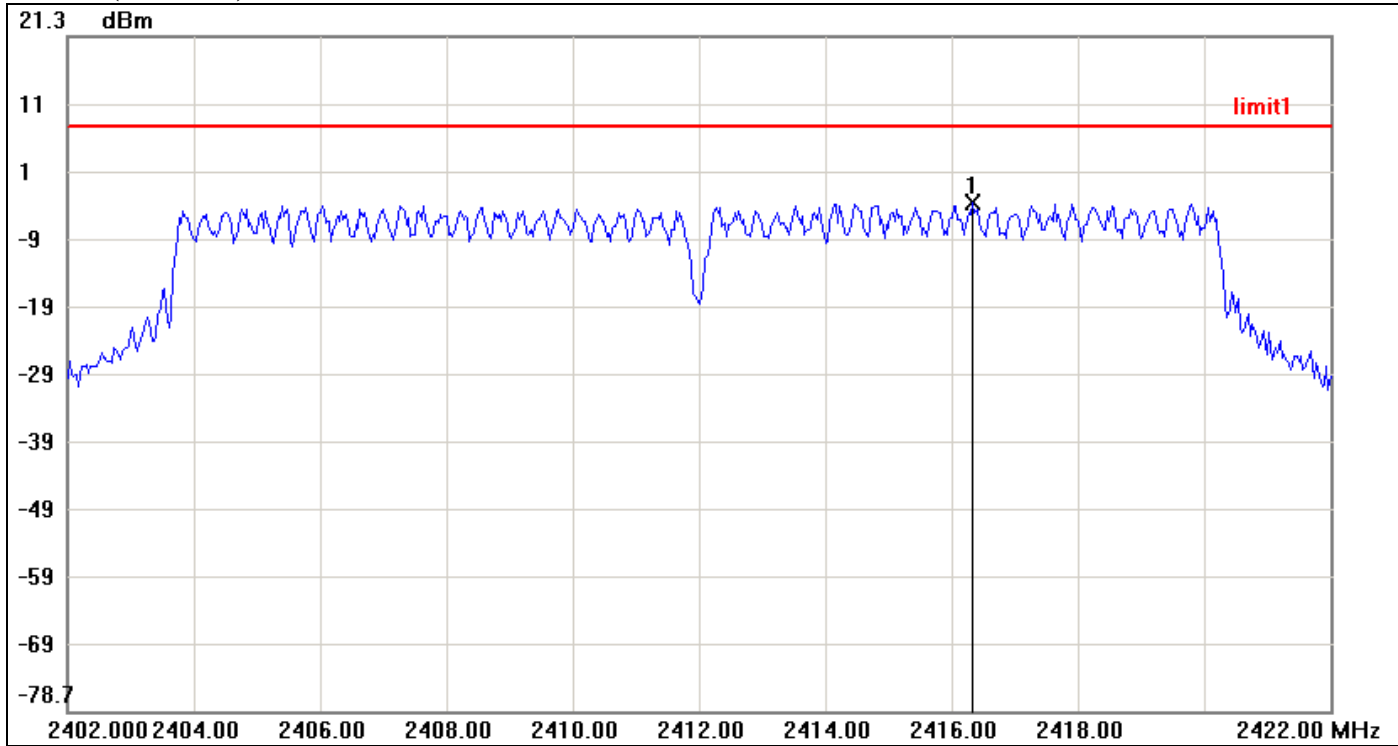


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2462.6500	2.00	8.00	-6.00



IEEE 802.11g mode

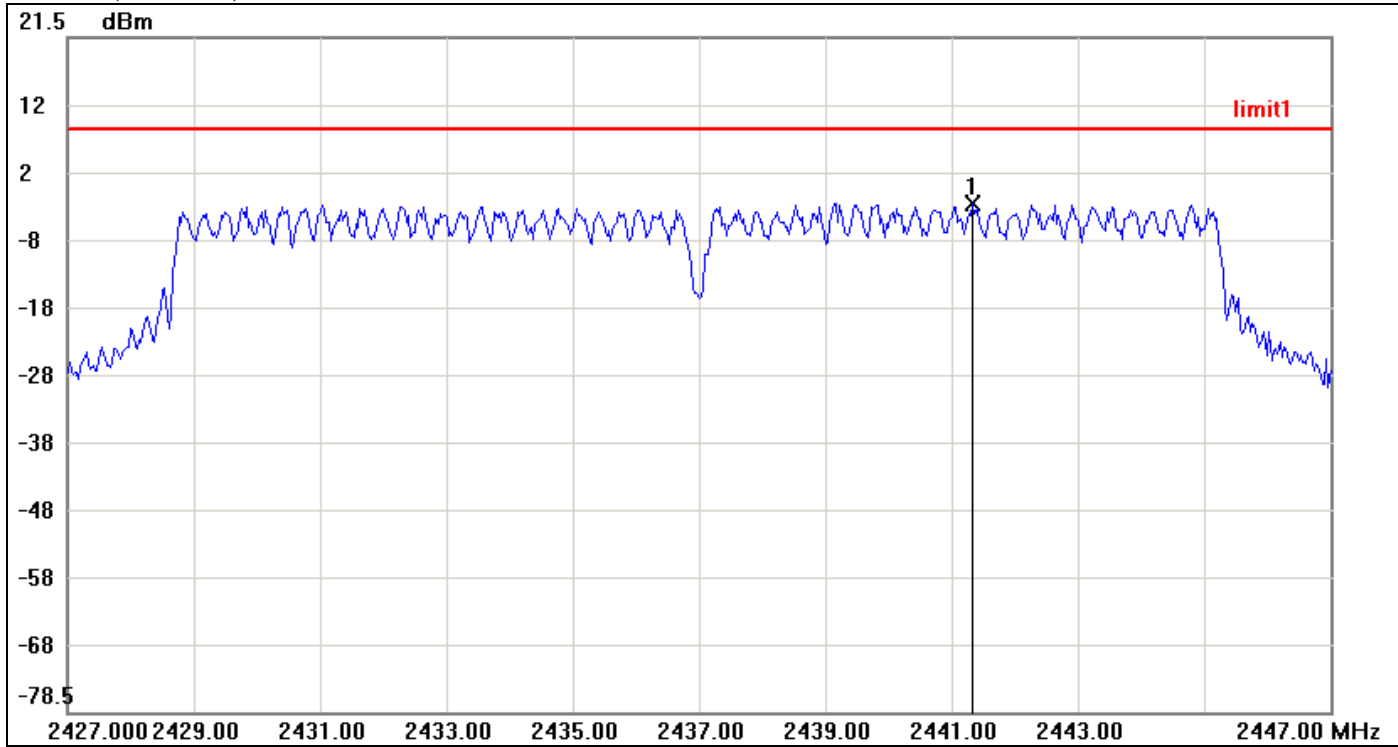
PPSD (CH Low)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2416.3333	-3.40	8.00	-11.40



PPSD (CH Mid)

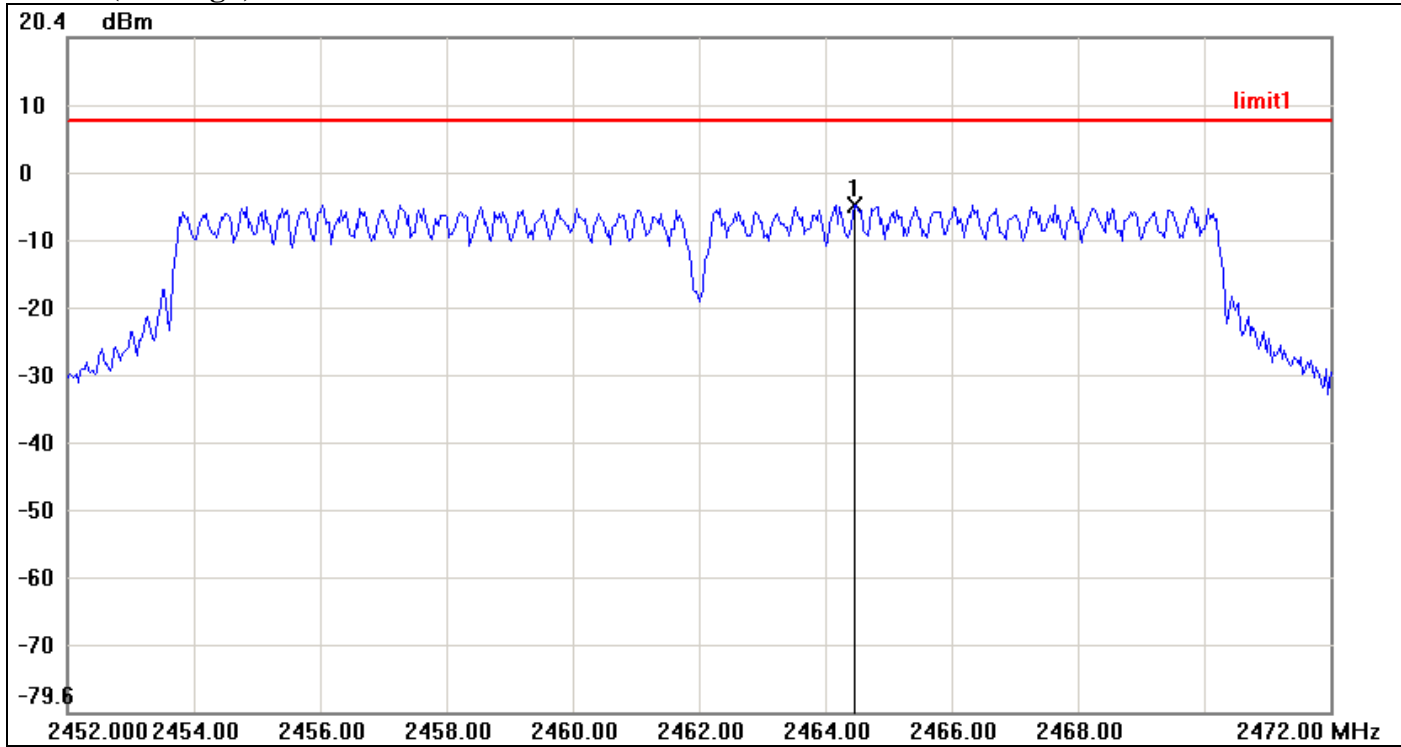


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2441.3333	-3.16	8.00	-11.16





**PPSD (CH High)**

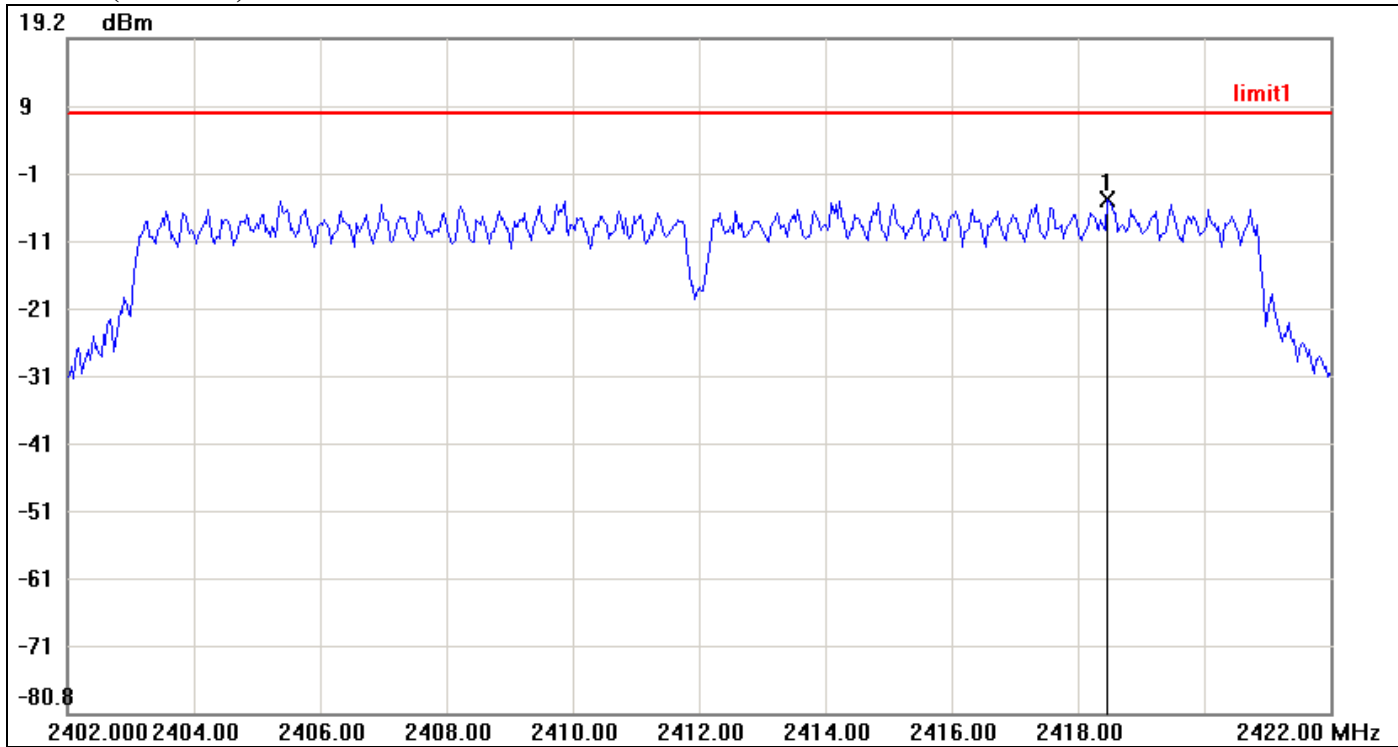


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2464.4667	-4.45	8.00	-12.45



IEEE 802.11n HT 20 mode

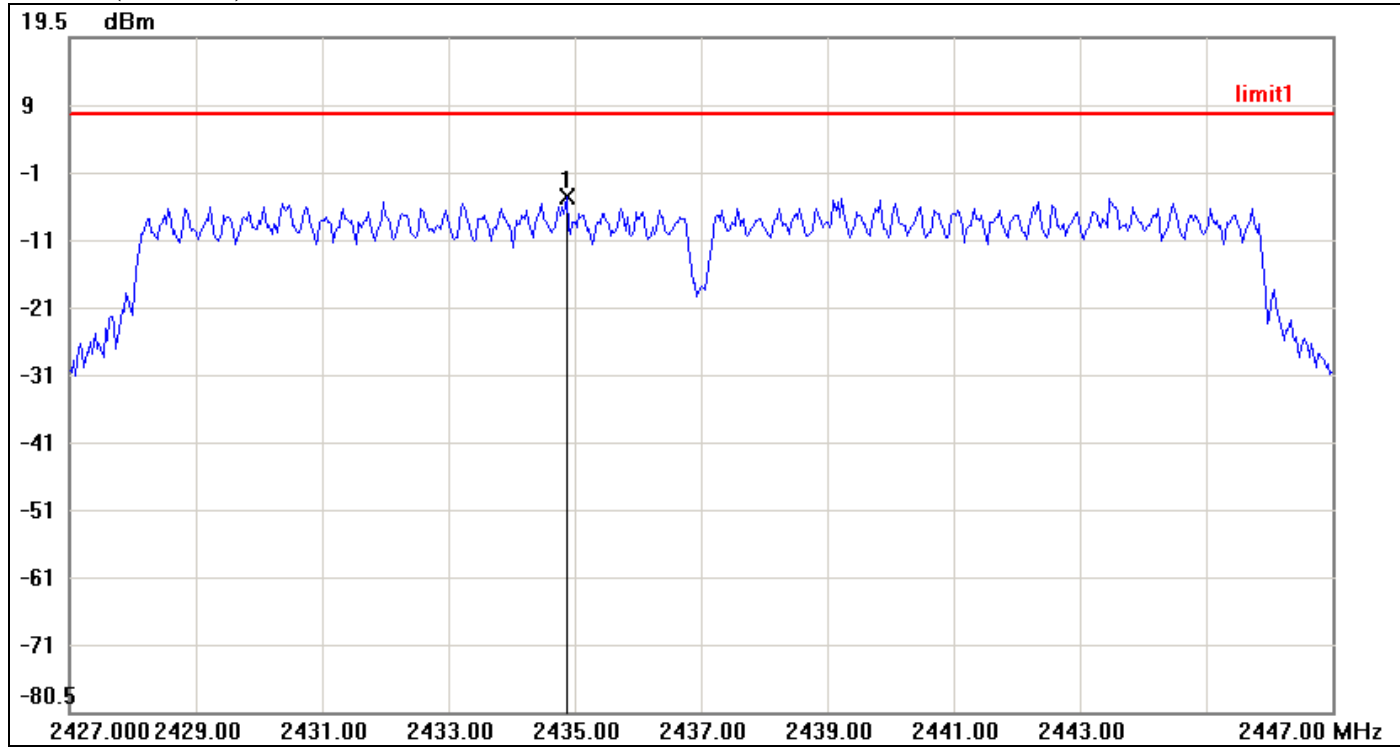
PPSD (CH Low)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2418.4667	-4.75	8.00	-12.75



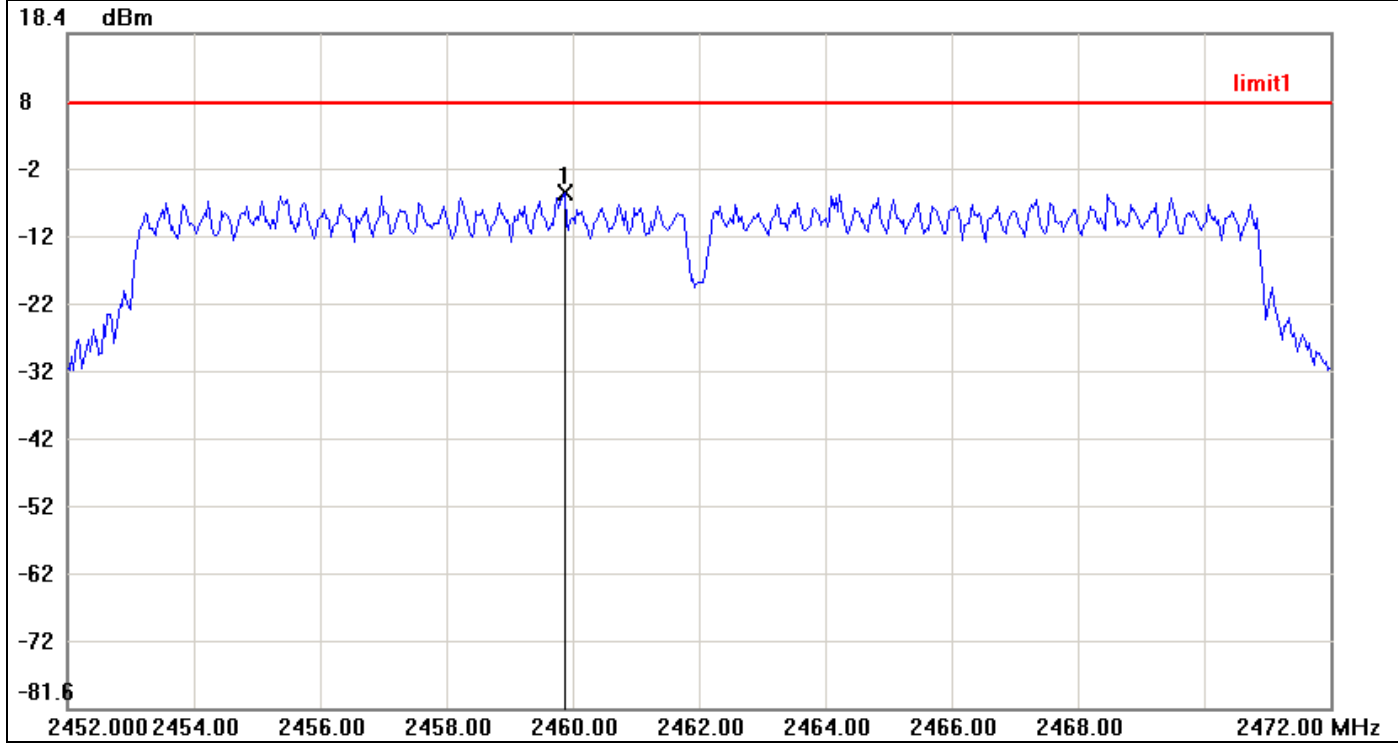
PPSD (CH Mid)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2434.8667	-4.22	8.00	-12.22



PPSD (CH High)

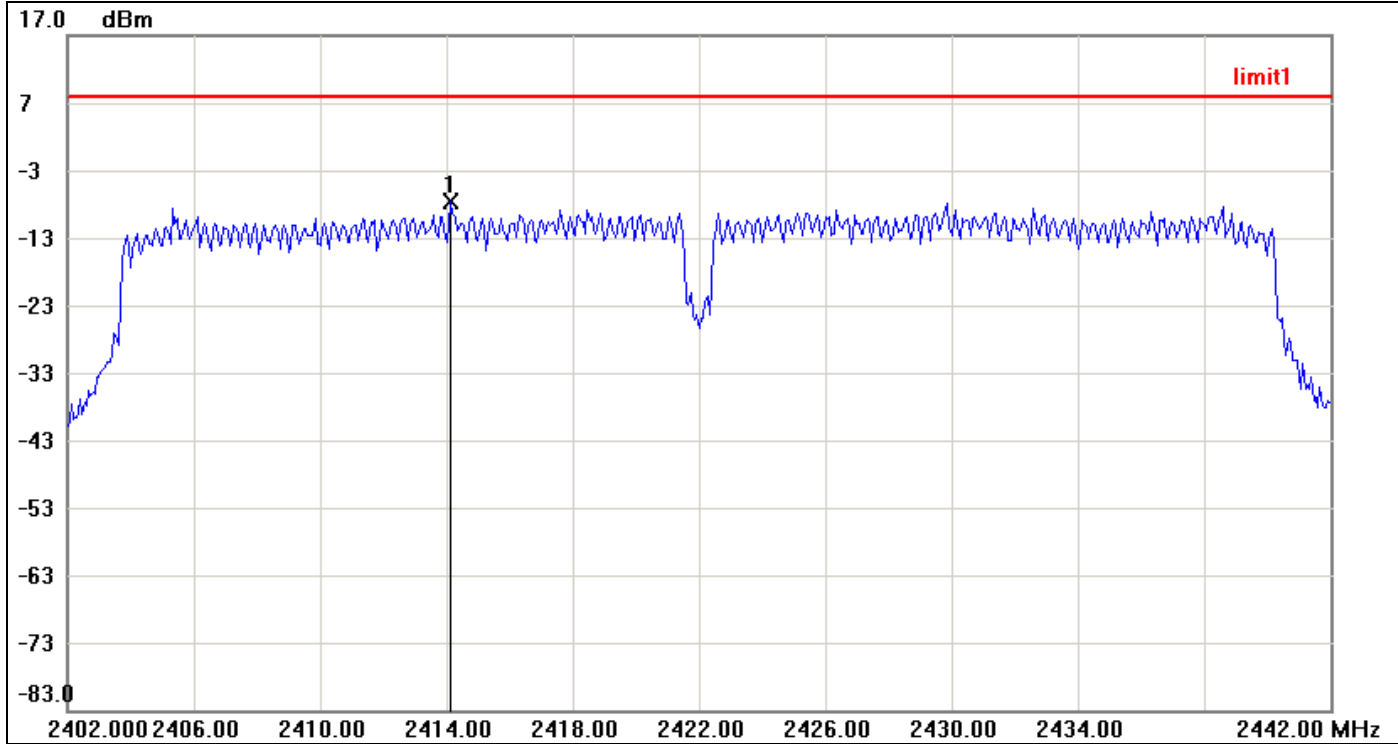


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2459.8667	-5.34	8.00	-13.34



IEEE 802.11n HT 40 mode

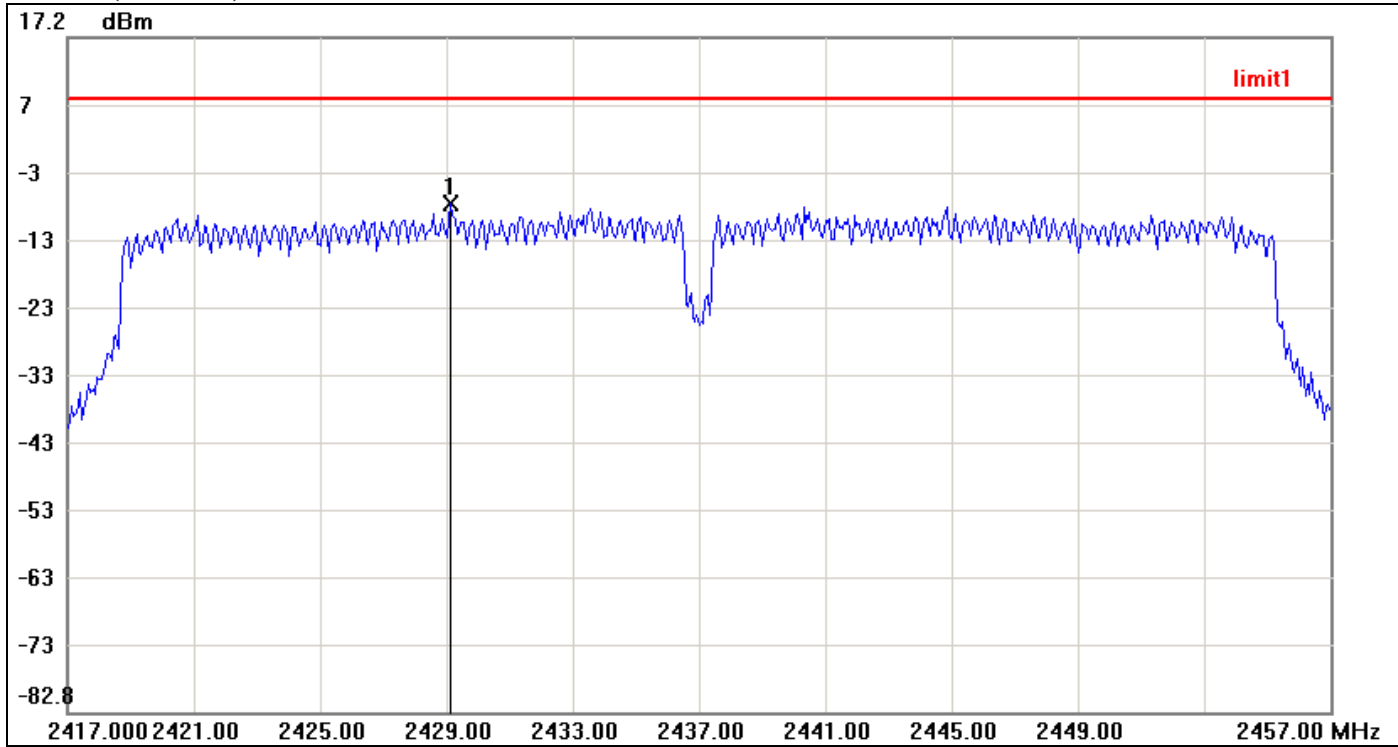
PPSD (CH Low)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2414.1333	-7.58	8.00	-15.58



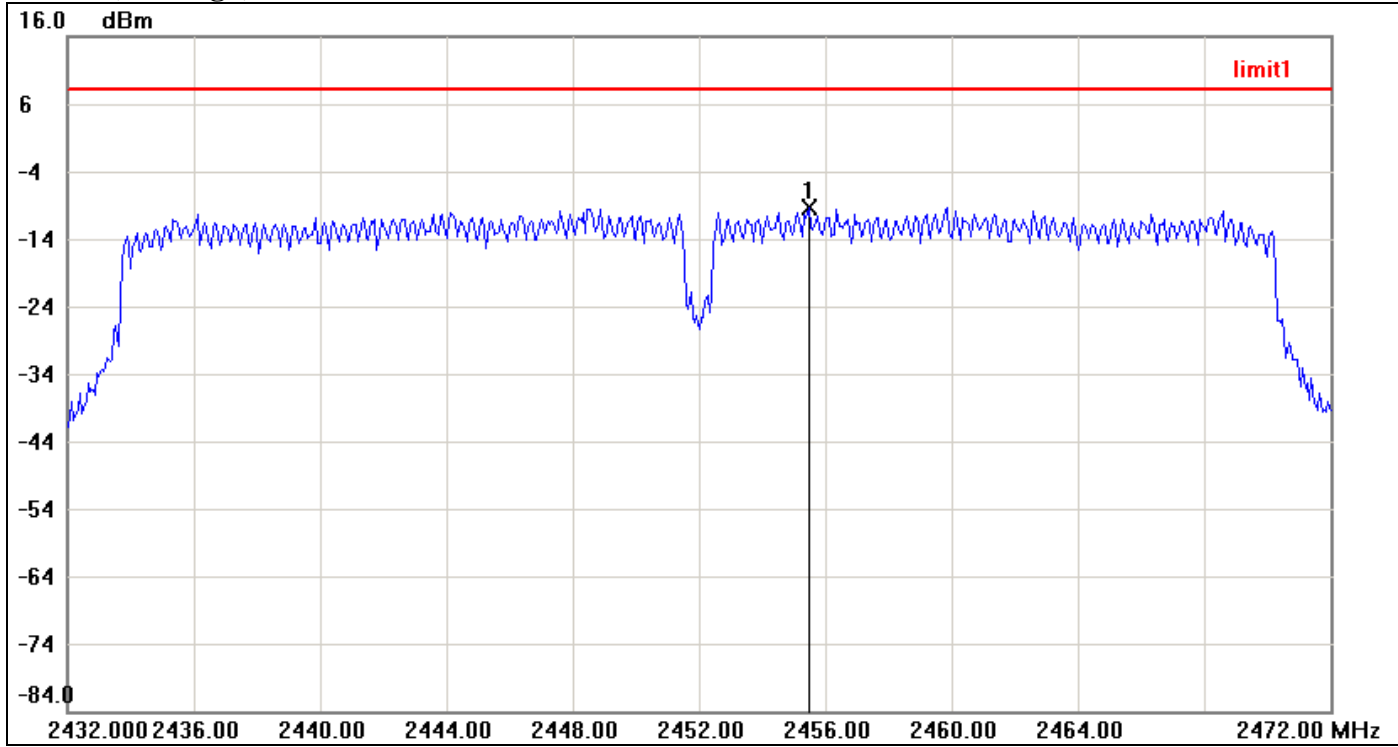
PPSD (CH Mid)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2429.1333	-7.28	8.00	-15.28



PPSD (CH High)



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2455.4667	-9.29	8.00	-17.29



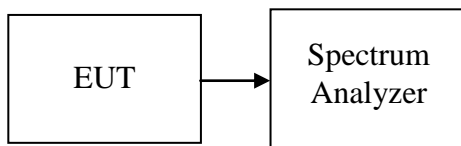
## 7.6 SPURIOUS EMISSIONS

### 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 300 kHz.

Measurements are made over the 30MHz to 26GHz range with the transmitter set to the lowest, middle, and highest channels.

#### TEST RESULTS

*No non-compliance noted*

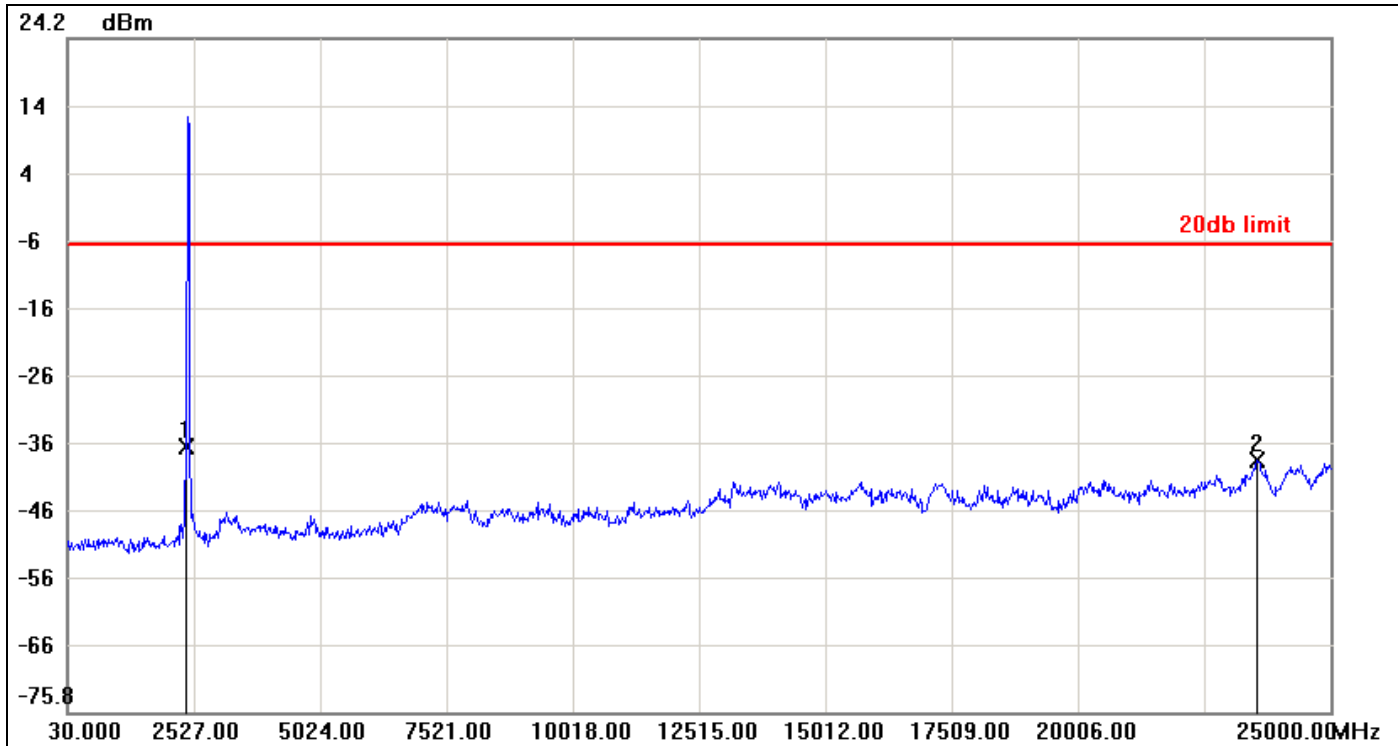




**Test Plot**

IEEE 802.11b mode

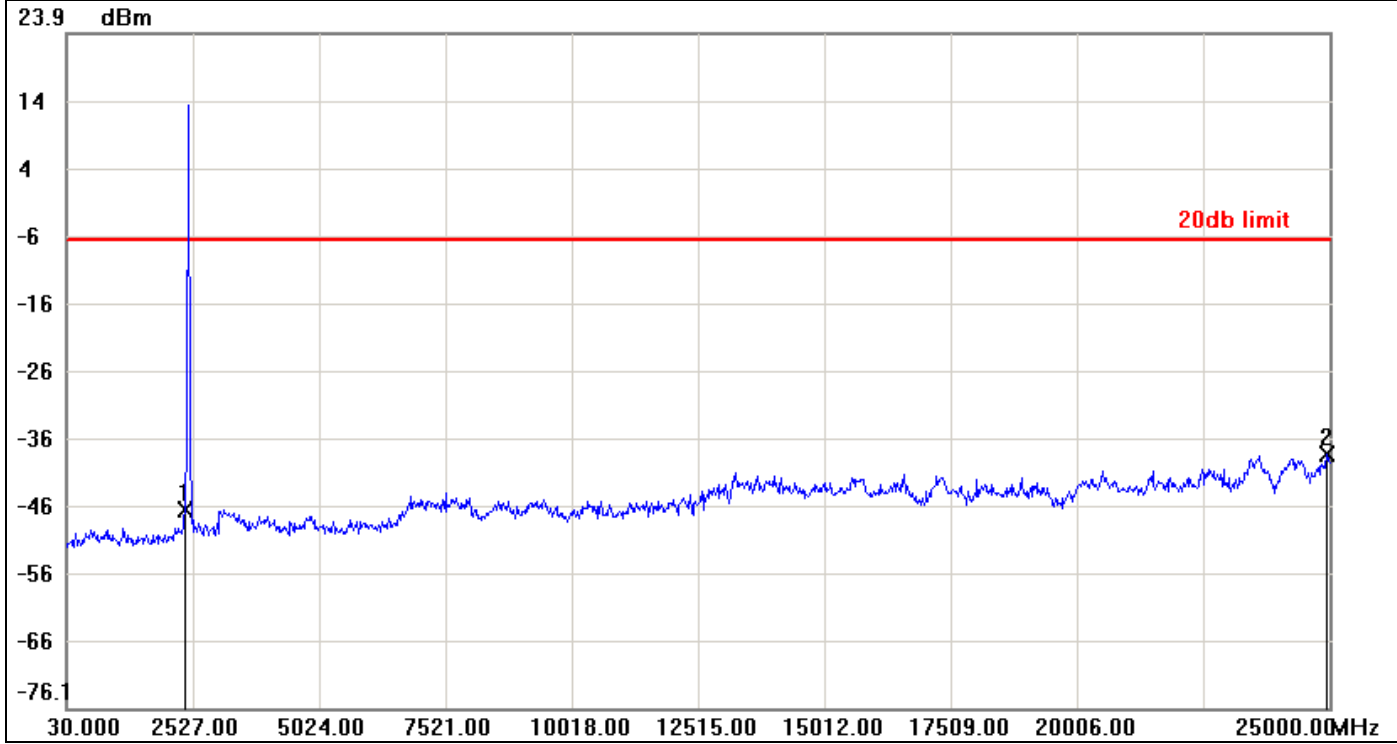
CH Low



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2377.1800	-36.39	-6.38	-30.01
2	23551.7400	-38.38	-6.38	-32.00



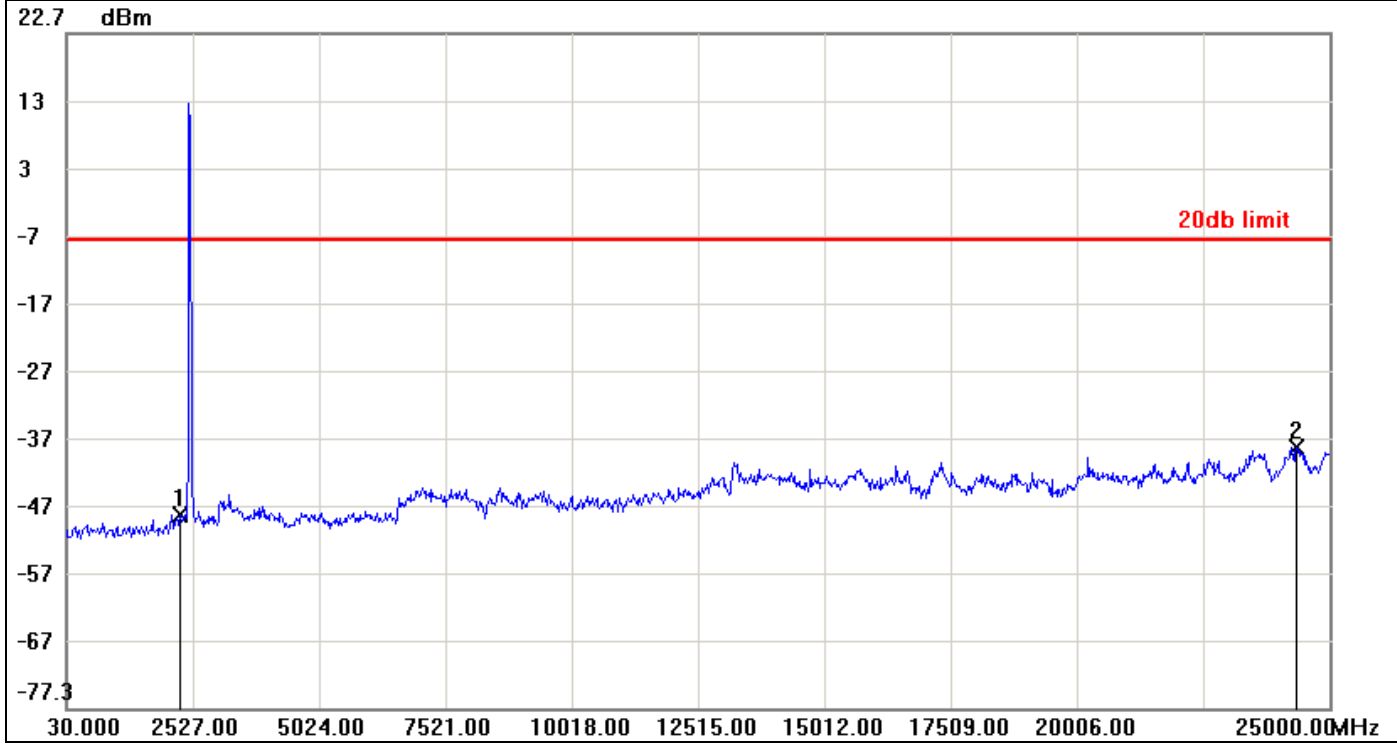
CH Mid



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2377.1800	-46.67	-6.58	-40.09
2	24950.0600	-38.37	-6.58	-31.79



CH High

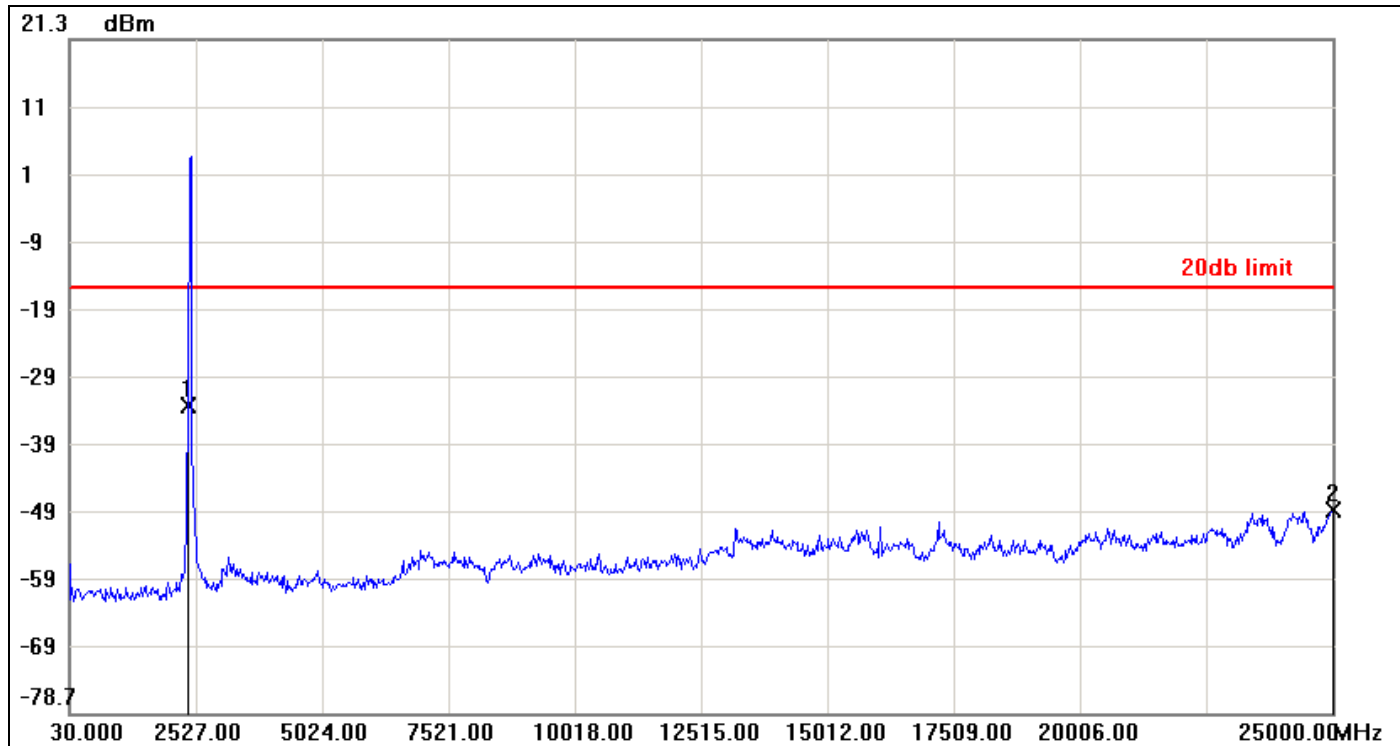


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2277.3000	-48.61	-7.86	-40.75
2	24350.7800	-38.59	-7.86	-30.73



IEEE 802.11g mode

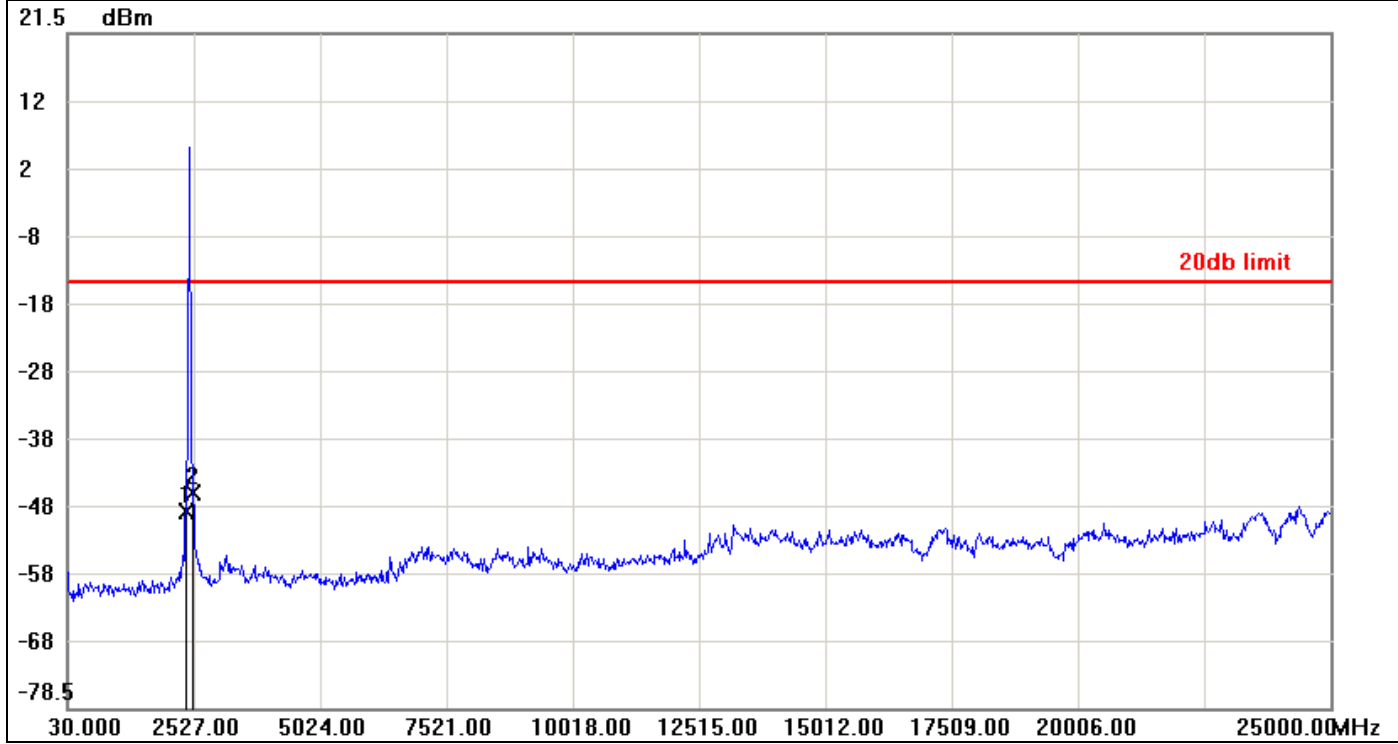
CH Low



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2377.1800	-33.12	-15.67	-17.45
2	25000.0000	-48.58	-15.67	-32.91



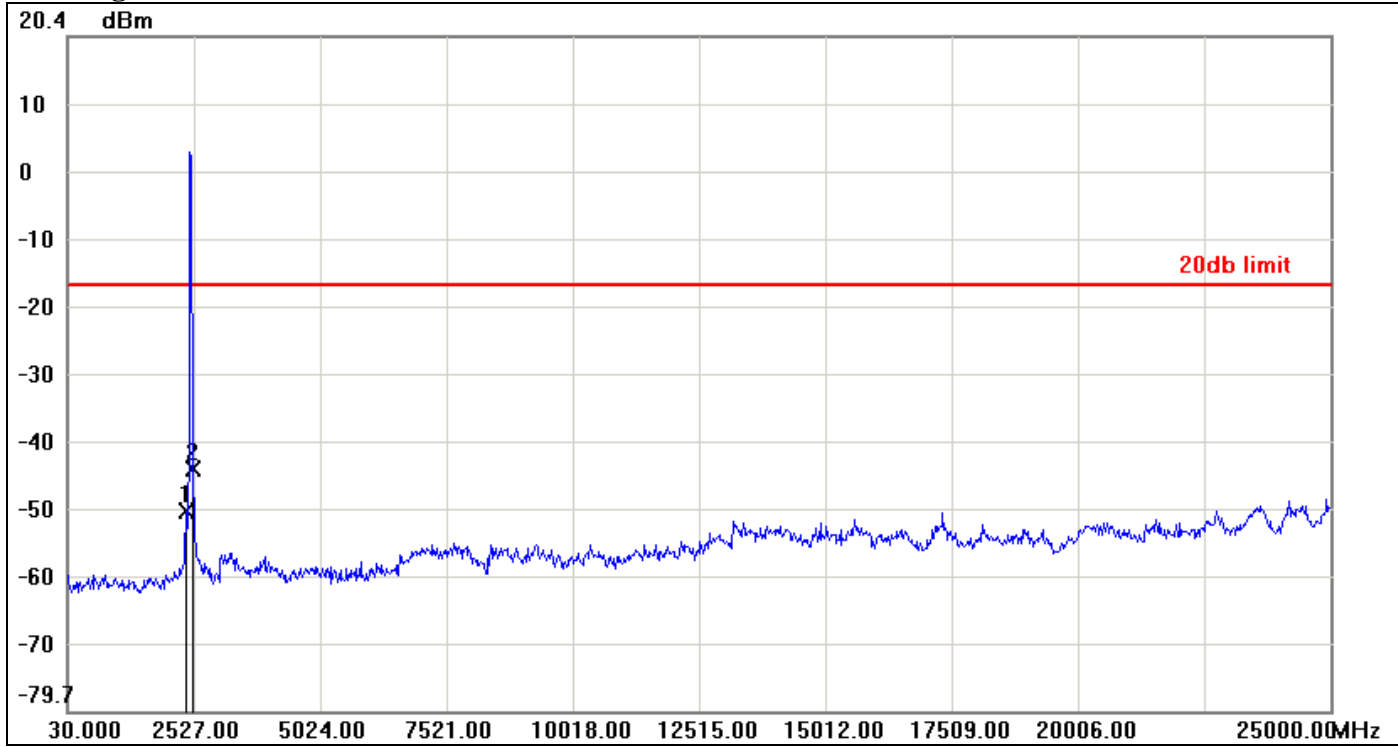
CH Mid



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2377.1800	-49.35	-15.26	-34.09
2	2502.0300	-46.73	-15.26	-31.47



CH High

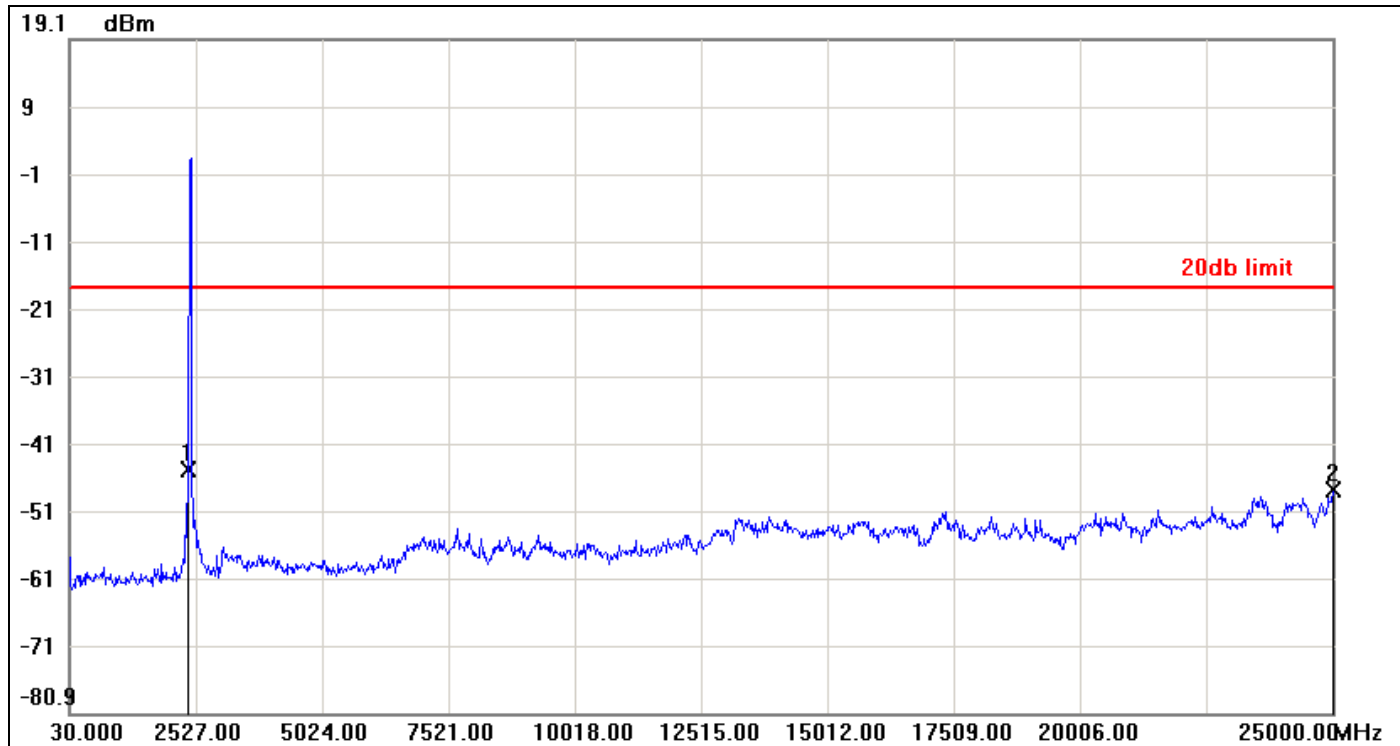


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2377.1800	-50.11	-16.48	-33.63
2	2502.0300	-43.89	-16.48	-27.41



IEEE 802.11n HT 20 mode

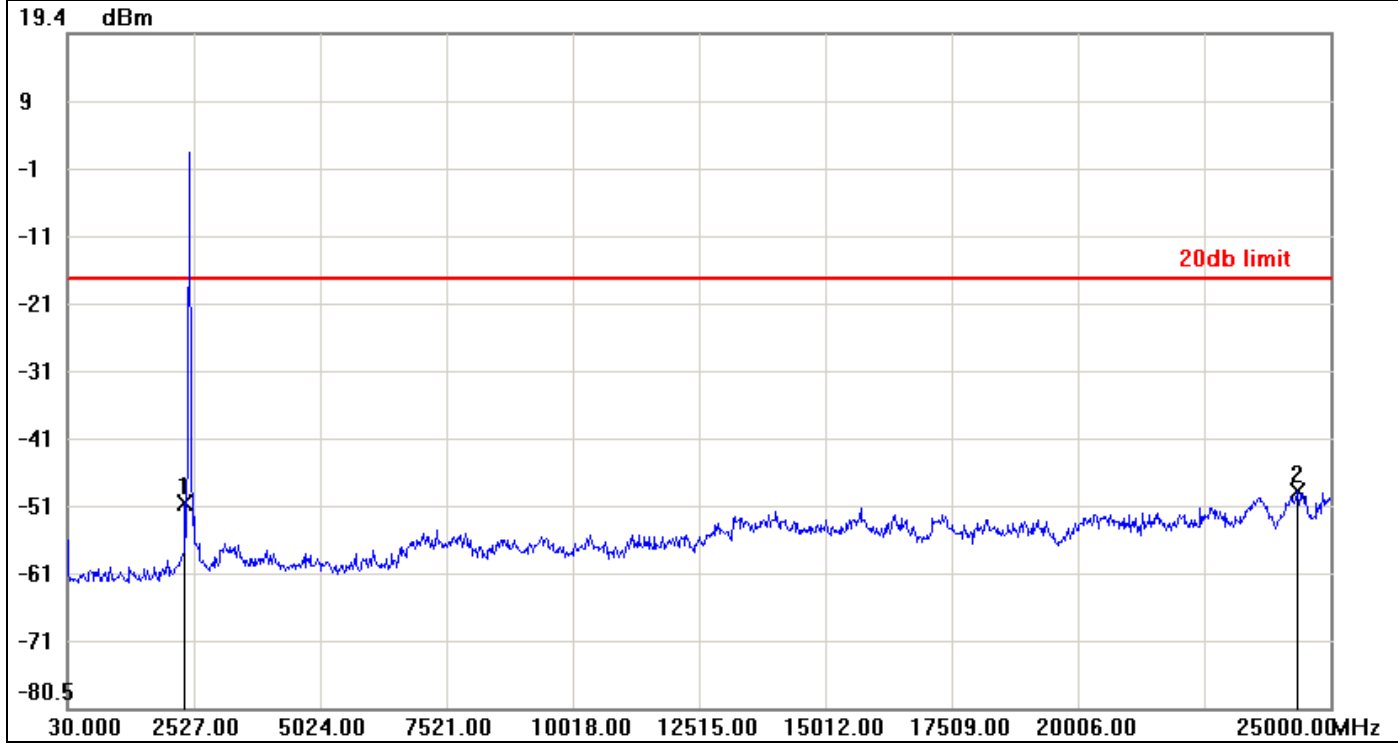
CH Low



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2377.1800	-44.74	-17.69	-27.05
2	25000.0000	-47.69	-17.69	-30.00



CH Mid



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2352.2100	-50.05	-17.02	-33.03
2	24350.7800	-48.53	-17.02	-31.51





CH High

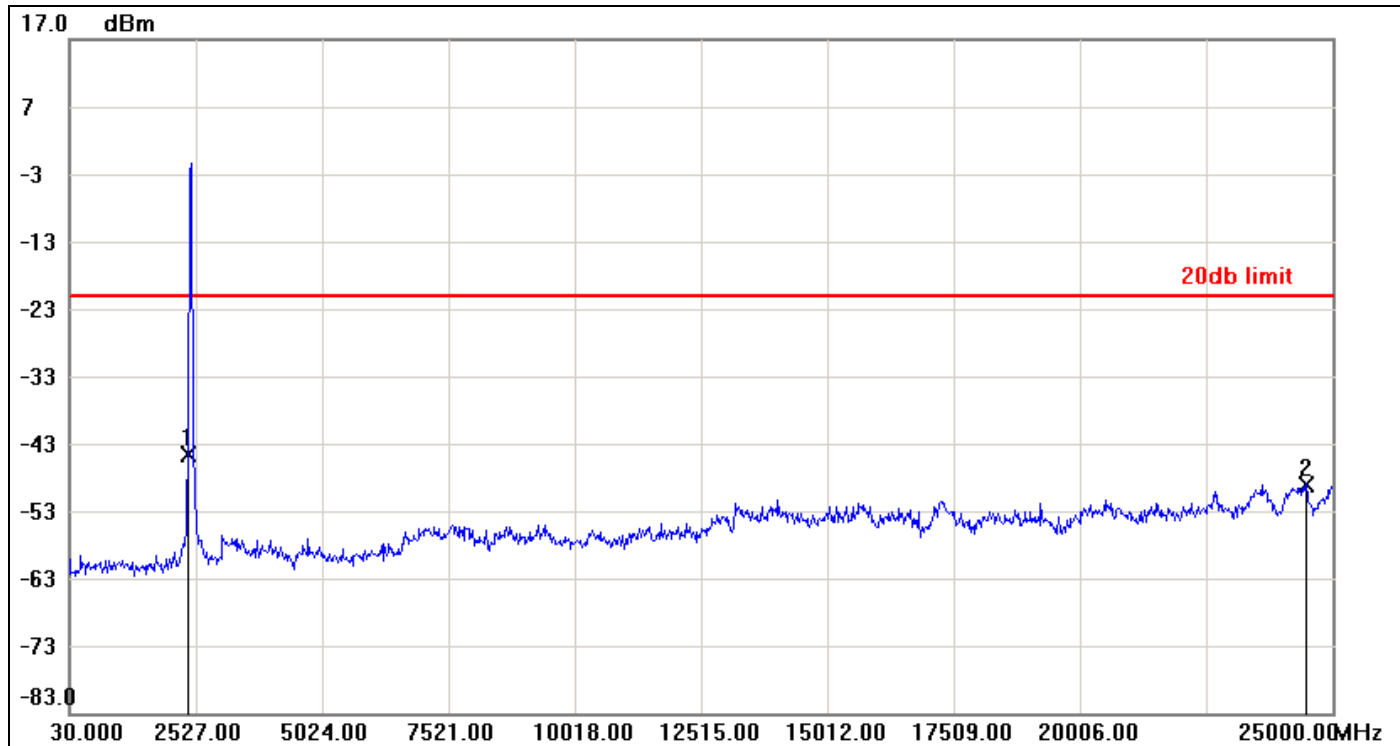


No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2377.1800	-50.89	-18.07	-32.82
2	2502.0300	-48.75	-18.07	-30.68



### IEEE 802.11n HT 40 mode

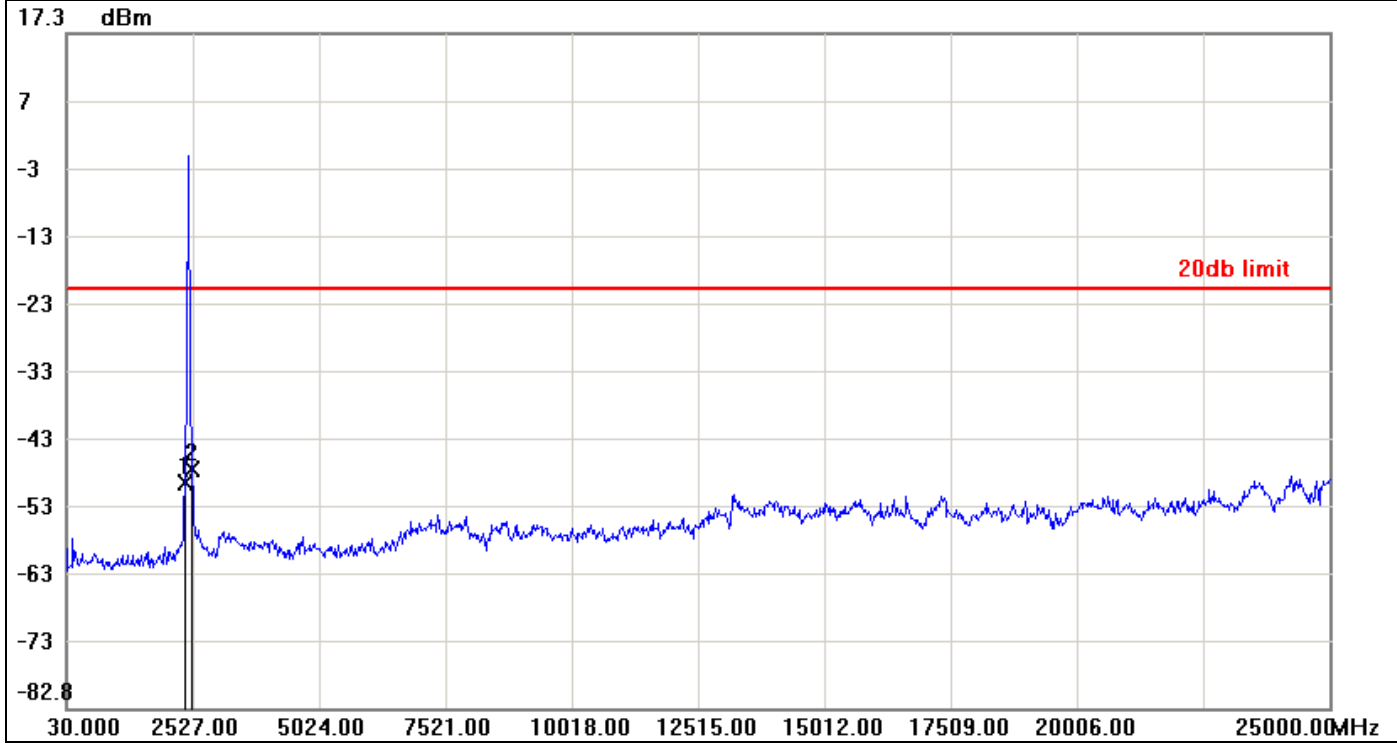
#### CH Low



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2377.1800	-44.53	-21.09	-23.44
2	24475.6300	-48.97	-21.09	-27.88



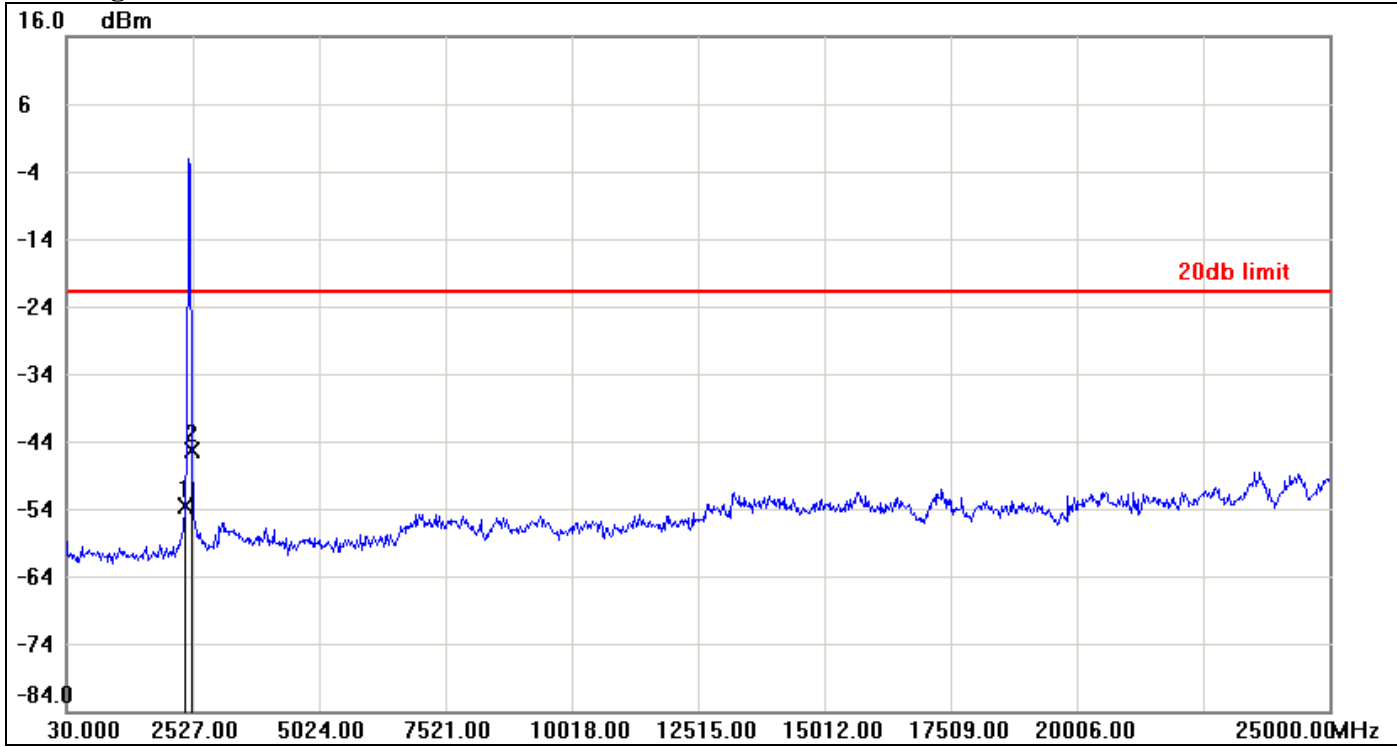
CH Mid



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2377.1800	-49.40	-20.69	-28.71
2	2502.0300	-47.38	-20.69	-26.69



CH High



No.	Frequency(MHz)	Result(dBm)	Limit(dBm)	Margin(dBm)
1	2377.1800	-53.66	-21.97	-31.69
2	2502.0300	-45.47	-21.97	-23.50



## 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 ( $\mu\text{V/m}$ )	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
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.

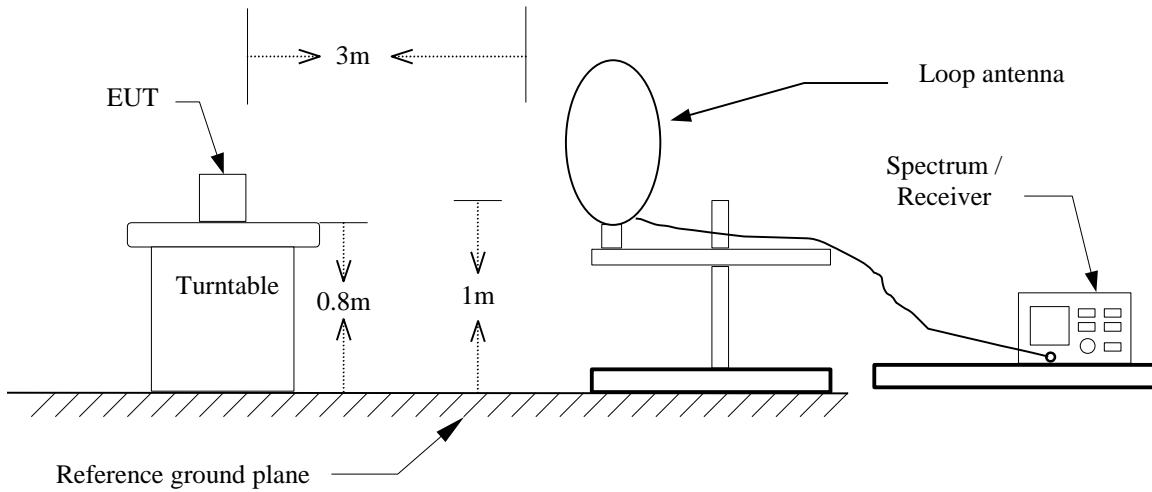
2. In the emission table above, the tighter limit applies at the band edges.

Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ at 3-meter)	Field Strength (dB $\mu\text{V/m}$ at 3-meter)
0.009 - 0.490	2400/F(kHz) +80	20LOG((2400/F(kHz))+80)
0.490 - 1.705	24000/F(kHz) +40	20LOG((24000/F(kHz))+40)
1.705 – 30.0	30	69.54
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

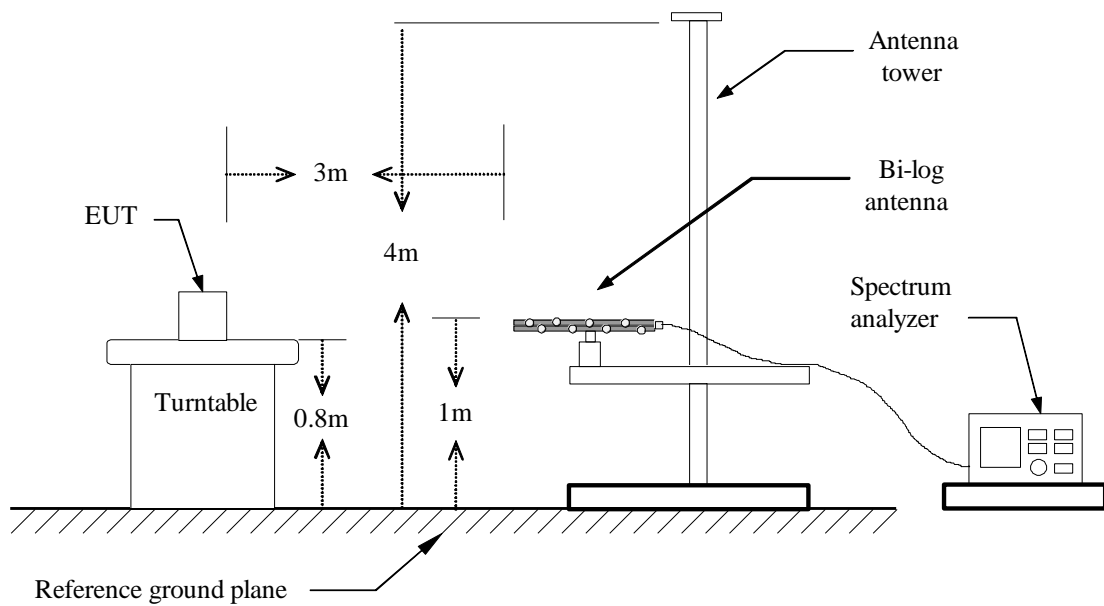


### Test Configuration

#### 9kHz ~ 30MHz

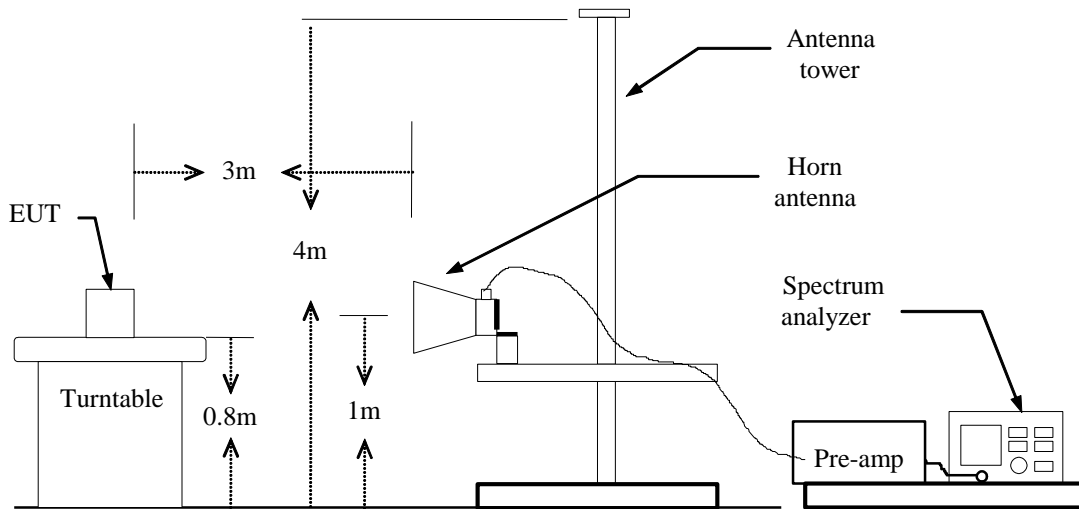


#### 30MHz ~ 1GHz





Above 1 GHz





## **TEST PROCEDURE**

1. The EUT is placed on a turntable, which is 1.5m 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=1MHz / VBW=3MHz / Sweep=AUTO

(b) AVERAGE: RBW=1MHz,  
if duty cycle  $\geq 98\%$ , VBW=10Hz.  
if duty cycle  $< 98\%$  VBW=1/T.

**IEEE 802.11b mode:  $\geq 98\%$ , VBW=10Hz**

**IEEE 802.11g mode:  $\geq 98\%$ , VBW=10Hz**

**IEEE 802.11n HT 20 MHz mode:  $\geq 98\%$ , VBW=10Hz**

**IEEE 802.11n HT 40 MHz mode:  $\geq 98\%$ , VBW=10Hz**

7. Repeat above procedures until the measurements for all frequencies are complete.



**TEST RESULTS****Below 1GHz****Operation Mode:** Normal Link**Test Date:** April 25, 2015**Temperature:** 27°C**Tested by:** Andy Shi**Humidity:** 53% 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)
34.8500	42.69	-13.43	29.26	40.00	-10.74	peak	V
167.7400	45.25	-18.69	26.56	43.50	-16.94	peak	V
223.0300	52.53	-18.94	33.59	46.00	-12.41	peak	V
392.7800	35.02	-14.19	20.83	46.00	-25.17	peak	V
532.4600	33.47	-11.29	22.18	46.00	-23.82	peak	V
665.3500	36.96	-9.15	27.81	46.00	-18.19	peak	V
223.0300	51.39	-18.94	32.45	46.00	-13.55	peak	H
394.7200	30.59	-14.14	16.45	46.00	-29.55	peak	H
532.4600	38.09	-11.29	26.80	46.00	-19.20	peak	H
665.3500	33.73	-9.15	24.58	46.00	-21.42	peak	H
798.2400	37.78	-7.40	30.38	46.00	-15.62	peak	H
960.2300	33.22	-5.32	27.90	54.00	-26.10	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:** April 25, 2015

**Temperature:** 27°C

**Tested by:** Andy Shi

**Humidity:** 53 % RH

**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
2000.000	50.22	-4.88	45.34	74.00	-28.66	peak	V
4175.000	41.94	1.89	43.83	74.00	-30.17	peak	V
N/A							
1952.000	51.53	-5.13	46.40	74.00	-27.60	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) = Result (dBuV/m) – limit (dBuV/m).



Operation Mode: TX / IEEE 802.11b / CH Mid

Test Date: April 25, 2015

Temperature: 27°C

Tested by: Andy Shi

Humidity: 53 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
1966.000	50.15	-5.06	45.09	74.00	-28.91	peak	V
N/A							
1782.000	51.76	-6.04	45.72	74.00	-28.28	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) = Result (dBuV/m) – limit (dBuV/m).



Operation Mode: TX / IEEE 802.11b / CH High

Test Date: April 25, 2015

Temperature: 27°C

Tested by: Andy Shi

Humidity: 53 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
1678.000	50.27	-6.59	43.68	74.00	-30.32	peak	V
N/A							
1796.000	52.23	-5.96	46.27	74.00	-27.73	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) = Result (dBuV/m) – limit (dBuV/m).



Operation Mode: TX / IEEE 802.11g / CH Low

Test Date: April 25, 2015

Temperature: 27°C

Tested by: Andy Shi

Humidity: 53 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
1674.000	51.41	-6.61	44.80	74.00	-29.20	peak	V
N/A							
1948.000	51.25	-5.16	46.09	74.00	-27.91	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) = Result (dBuV/m) – limit (dBuV/m).



Operation Mode: TX / IEEE 802.11g / CH Mid

Test Date: April 25, 2015

Temperature: 27°C

Tested by: Andy Shi

Humidity: 53 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
1678.000	50.33	-6.59	43.74	74.00	-30.26	peak	V
N/A							
1954.000	52.47	-5.12	47.35	74.00	-26.65	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) = Result (dBuV/m) – limit (dBuV/m).



Operation Mode: TX / IEEE 802.11g / CH High

Test Date: April 25, 2015

Temperature: 27°C

Tested by: Andy Shi

Humidity: 53 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
1952.000	50.94	-5.13	45.81	74.00	-28.19	peak	V
4170.000	42.24	1.87	44.11	74.00	-29.89	peak	V
N/A							
1952.000	50.18	-5.13	45.05	74.00	-28.95	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) = Result (dBuV/m) – limit (dBuV/m).



Operation Mode: TX / IEEE 802.11n HT 20 mode / CH Low

Test Date: April 25, 2015

Temperature: 27°C

Tested by: Andy Shi

Humidity: 53 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
1726.000	51.54	-6.33	45.21	74.00	-28.79	peak	V
4170.000	42.37	1.87	44.24	74.00	-29.76	peak	V
N/A							
1528.000	50.57	-7.38	43.19	74.00	-30.81	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) = Result (dBuV/m) – limit (dBuV/m).





Operation Mode: TX / IEEE 802.11n HT 20 mode / CH Mid

Test Date: April 25, 2015

Temperature: 27°C

Tested by: Andy Shi

Humidity: 53 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
1666.000	49.27	-6.65	42.62	74.00	-31.38	peak	V
N/A							
1952.000	50.64	-5.13	45.51	74.00	-28.49	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. Peak Margin (dB) = Peak result (dBuV/m) –Peak limit (dBuV/m).  
Average Margin (dB) = Peak result (dBuV/m) – Average limit (dBuV/m).



Operation Mode: TX / IEEE 802.11n HT 20 mode / CH High

Test Date: April 25, 2015

Temperature: 27°C

Tested by: Andy Shi

Humidity: 53 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
1642.000	50.29	-6.78	43.51	74.00	-30.49	peak	V
N/A							
1200.000	51.66	-8.85	42.81	74.00	-31.19	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) = Result (dBuV/m) – limit (dBuV/m).



Operation Mode: TX / IEEE 802.11n HT 40 mode / CH Low

Test Date: April 25, 2015

Temperature: 27°C

Tested by: Andy Shi

Humidity: 53 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
1862.000	51.33	-5.61	45.72	74.00	-28.28	peak	V
N/A							
1952.000	50.88	-5.13	45.75	74.00	-28.25	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) = Result (dBuV/m) – limit (dBuV/m).



Operation Mode: TX / IEEE 802.11n HT 40 mode / CH Mid

Test Date: April 25, 2015

Temperature: 27°C

Tested by: Andy Shi

Humidity: 53 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
1952.000	51.45	-5.13	46.32	74.00	-27.68	peak	V
N/A							
1954.000	51.30	-5.12	46.18	74.00	-27.82	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) = Result (dBuV/m) – limit (dBuV/m).



Operation Mode: TX / IEEE 802.11n HT 40 mode / CH High

Test Date: April 25, 2015

Temperature: 27°C

Tested by: Andy Shi

Humidity: 53 % RH

Polarity: Ver. / Hor.

Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
1680.000	51.73	-6.58	45.15	74.00	-28.85	peak	V
N/A							
1650.000	52.78	-6.74	46.04	74.00	-27.96	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) = Result (dBuV/m) – 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  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

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

\* Decreases with the logarithm of the frequency.

### Test Configuration

See test photographs attached in Appendix 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**

*Not applicable, because EUT does not connect to AC Main Source direct.*