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ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT
INTENTIONAL RADIATOR CERTIFICATION TO
FCC PART 15 SUBPART C REQUIREMENT

OF

150Mbps Wireless N SDIO Module

Model No.: BL-R8188EU1

FCC ID: S8J-R8188EU1

Trademark: LB-LINK

Report No.: KAD150421102E

Issue Date: June 25, 2015

Prepared for

Shenzhen Bilian Electronic Co., Ltd.
Building B1, Zhongxing Industrial Zone, Juling Jutang Community,
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Prepared by

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VERIFICATION OF COMPLIANCE

Applicant:	Shenzhen Bilian Electronic Co., Ltd. Building B1, Zhongxing Industrial Zone, Juling Jutang Community, Guanlan street, Bao'an, Shenzhen China
Manufacturer:	Shenzhen Bilian Electronic Co., Ltd. Building B1, Zhongxing Industrial Zone, Juling Jutang Community, Guanlan street, Bao'an, Shenzhen China
Product Description:	150Mbps Wireless N SDIO Module
Model Number:	BL-R8188EU1
Trade Mark:	LB-LINK
Date of Test:	April 21, 2015 to June 03, 2015

We hereby certify that:

The above equipment was tested by DONGGUAN EMTEK CO., LTD. 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 conducted and radiated emission limits of FCC Rules Part 15.247(2014).

Approved By

Sam Lv / Q.A. Manager
DONGGUAN EMTEK CO., LTD.

Modified Information

Version	Summary	Revision Date	Report No.
Ver.1.0	Original Report	/	KAD150421102E

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APPENDIX I (PHOTOS OF EUT)(2PAGES)

1. General Information

1.1 Product Description

A major technical descriptions of EUT is described as following:

A). Operation Frequency: 2412-2462MHz for 802.11b/g/n(HT20) ;
2422-2452MHz for 802.11n(HT40)
B). Modulation: OFDM with BPSK/QPSK/16QAM/64QAM for 802.11g/n,
DSSS with DBPSK/DQPSK/CCK for 802.11b;
C). Number of Channel: 11 Channels for 802.11b/g/n(HT20)
7 Channels for 802.11n(HT40)
D). Antenna Type: External antenna
E). Antenna Gain:2dBi
F). Power Supply: DC from PC

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

Note:
1. This device is included 802.11b, 802.11g and 802.11n(HT20), 802.11n(HT40) 2.4GHz transceiver function.
2. Channel 1-11 for 802.11b, 802.11g, 802.11n(HT20); Channel 3-9 for 802.11n(HT40)
3. Test of channel was included the lowest middle and highest frequency in lowest data rate and to perform the test, then record on this report.

1.2 Related Submittal(s) / Grant(s)

This submittal(s) (test report) is intended for filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules. The composite system is compliance with Subpart B is authorized under a DOC procedure.

1.3 Test Methodology

All the test program has follow FCC new test procedure KDB558074 D01 v03r03, Both conducted and radiated testing was performed according to the procedures in ANSI C63.10-2013. Radiated testing was performed at an antenna to EUT distance 3 meters.

1.4 Special Accessories

Not available for this EUT intended for grant.

1.5 Equipment Modifications

Not available for this EUT intended for grant.

1.6 Test Facility

Site Description

EMC Lab :

Accredited by FCC,June 18, 2014
The Certificate Number is 247565

Accredited by Industry Canada, February 19, 2014
The Certificate Number is 9444A

Name of Firm : DONGGUAN EMTEK CO., LTD.
Site Location : No.281, Guantai Road, Nancheng District, Dongguan, Guangdong, China

2. System Test Configuration

2.1 EUT Configuration

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

2.2 EUT Exercise

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-Peak and average detector mode.

2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table 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 max. Emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013.

2.4 Configuration of Tested System

Fig. 2-1 Configuration of Tested System

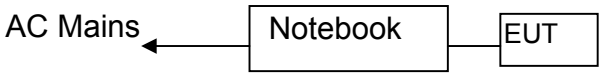


Table 2-1 Equipment Used in Tested System

Item	Equipment	Trademark	Model No.	FCC ID	Note
1.	150Mbps Wireless N USB Module	LB-LINK	BL-R8188EU1	S8J-R8188EU1	EUT
2	Notebook	DELL	Inspiron 14R-N4110	N/A	Support Equipment

Note:

(1) Unless otherwise denoted as EUT in『Remark』column, device(s) used in tested system is a support equipment.

3. Description of Test Modes

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

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

Test of channel included the lowest and middle and highest frequency to perform the test, then record on this report.

Those data rates (802.11b: 1 Mbps; 802.11g: 6 Mbps; 802.11n (HT20): MCS0; 802.11n (HT40): MCS8) were used for all test.

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Frequency and Channel list for 802.11 b/g/n (HT20):

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

Frequency and Channel list for 802.11 n (HT40):

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
3	2422	5	2432	8	2447
4	2427	6	2437	9	2452
		7	2442		

Test Frequency and Channel for 802.11 b/g/n (HT20):

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	6	2437	11	2462

Test Frequency and channel for 802.11 n (HT40):

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
3	2422	6	2437	9	2452

4. Summary of Test Results

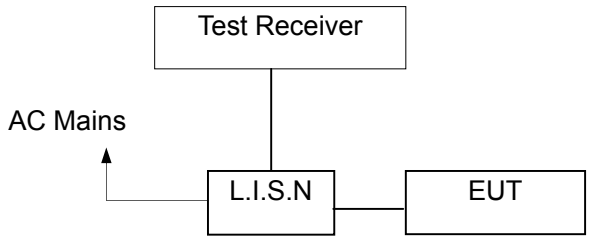
FCC Rules	Description Of Test	Result
§15.247(a)(2)	6dB bandwidth	Pass
§15.247(b)(3)	Max Peak output Power test	Pass
§15.247(e)	Power density	Pass
§15.247(d)	Band edge test	Pass
§15.207	AC Power Conducted Emission	Pass
§15.247(d), §15.209	Radiated Emission	Pass
§15.247(d)	Antenna Port Emission	Pass
§15.247(b)&§15.203	Antenna Application	Pass

5. Conducted Emissions Test

5.1 Measurement 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.

5.2 Test SET-UP (Block Diagram of Configuration)



5.3 Measurement Equipment Used

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde&Schwarz	ESCS30	100018	03/16/2015	1 Year
2.	L.I.S.N.	Rohde&Schwarz	ENV216	100017	03/16/2015	1Year
3.	RF Switching Unit	CDS	RSU-M2	38401	03/16/2015	1Year

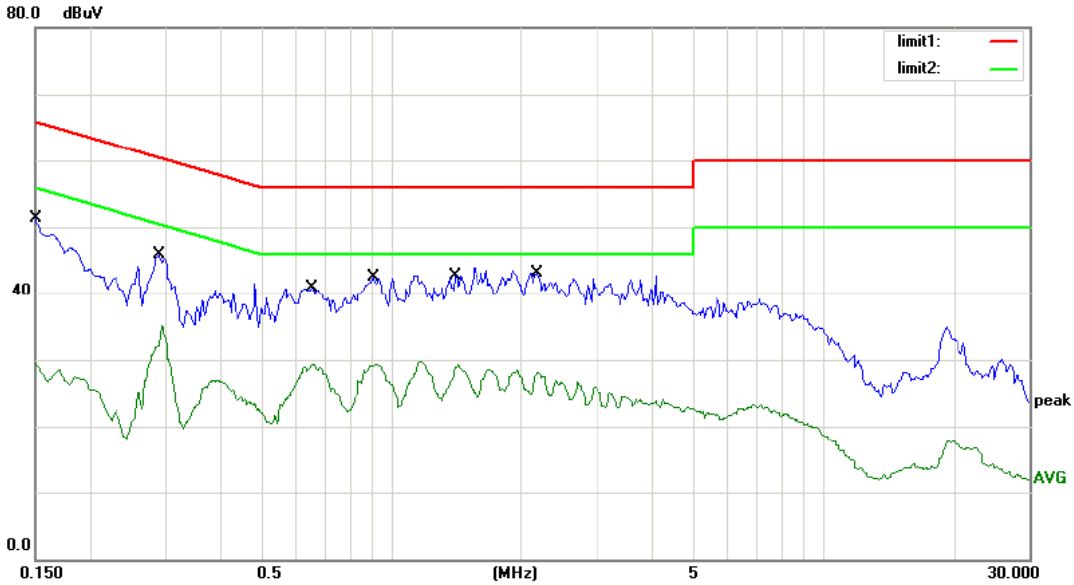
5.4 Conducted Emission Limit

Conducted Emission

Frequency(MHz)	**Quasi-peak**	**Average**
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

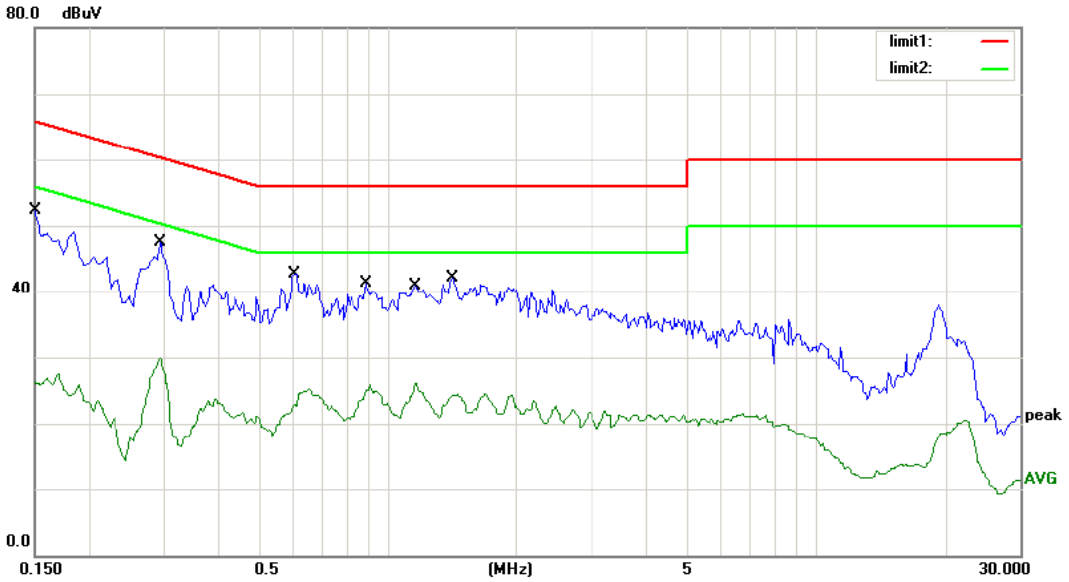
5.5 Measurement Result



Site site #1	Phase:	*L1*	Temperature: 26
Limit: (CE)FCC PART 15B_QP	Power:	AC 120V/60Hz	Humidity: 60 %
Mode: TX			
Note:			

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1500	51.35	0.00	51.35	66.00	-14.65	QP	
2		0.1500	29.41	0.00	29.41	56.00	-26.59	AVG	
3		0.2900	45.89	0.00	45.89	60.52	-14.63	QP	
4		0.2900	35.04	0.00	35.04	50.52	-15.48	AVG	
5		0.6550	40.88	0.00	40.88	56.00	-15.12	QP	
6		0.6550	29.37	0.00	29.37	46.00	-16.63	AVG	
7		0.9100	42.46	0.00	42.46	56.00	-13.54	QP	
8		0.9100	29.30	0.00	29.30	46.00	-16.70	AVG	
9		1.4100	42.79	0.00	42.79	56.00	-13.21	QP	
10		1.4100	29.21	0.00	29.21	46.00	-16.79	AVG	
11	*	2.1800	43.15	0.00	43.15	56.00	-12.85	QP	
12		2.1800	28.17	0.00	28.17	46.00	-17.83	AVG	

*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver.



Site site #1 Phase: N Temperature: 26
Limit: (CE)FCC PART 15B_QP Power: AC 120V/60Hz Humidity: 60 %
Mode: TX
Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1500	52.27	0.00	52.27	66.00	-13.73	QP	
2		0.1500	26.90	0.00	26.90	56.00	-29.10	AVG	
3	*	0.2950	47.51	0.00	47.51	60.38	-12.87	QP	
4		0.2950	29.96	0.00	29.96	50.38	-20.42	AVG	
5		0.6050	42.69	0.00	42.69	56.00	-13.31	QP	
6		0.6050	25.29	0.00	25.29	46.00	-20.71	AVG	
7		0.8900	41.39	0.00	41.39	56.00	-14.61	QP	
8		0.8900	25.97	0.00	25.97	46.00	-20.03	AVG	
9		1.1650	40.82	0.00	40.82	56.00	-15.18	QP	
10		1.1650	26.16	0.00	26.16	46.00	-19.84	AVG	
11		1.4150	42.14	0.00	42.14	56.00	-13.86	QP	
12		1.4150	24.44	0.00	24.44	46.00	-21.56	AVG	

*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver.

6. Radiated Emission Test

6.1 Measurement Procedure

1. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured was complete.

When spectrum scanned from 30MHz to 1GHz setting resolution bandwidth 120KHz and video bandwidth 300KHz:

EMI Test Receiver	Setting
Attenuation	Auto
RB	120KHz
VB	300KHz
Detector	QP
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

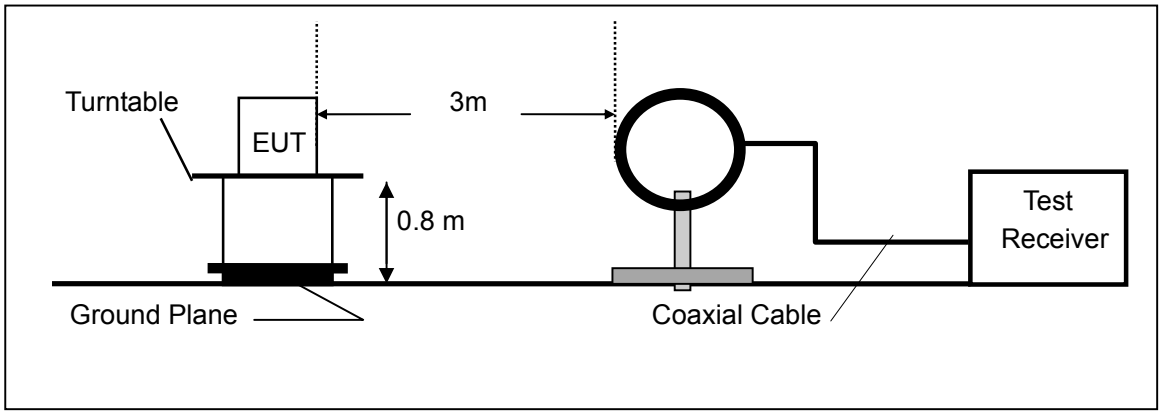
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 10Hz:

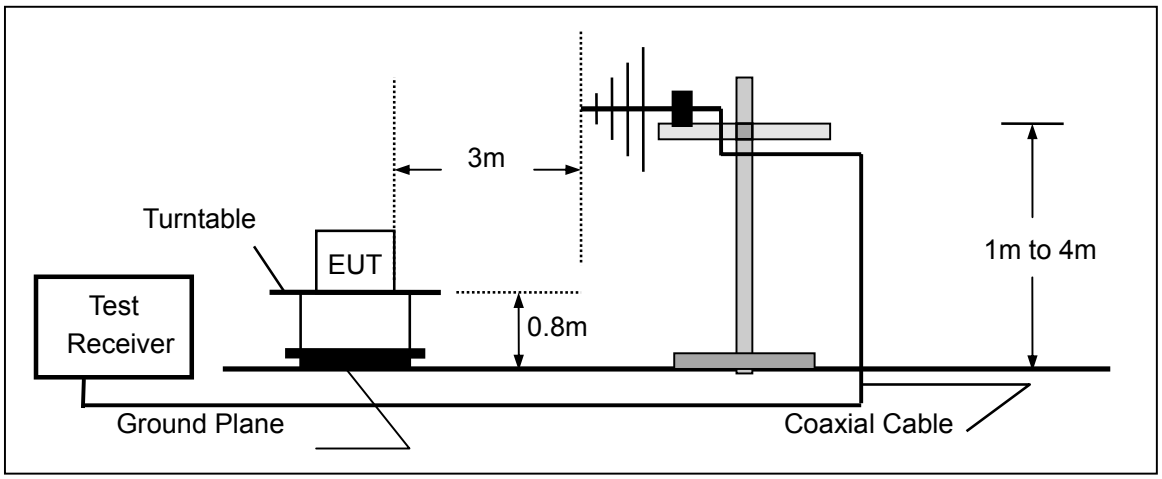
EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Peak
Trace	Max hold

6.2 Test SET-UP (Block Diagram of Configuration)

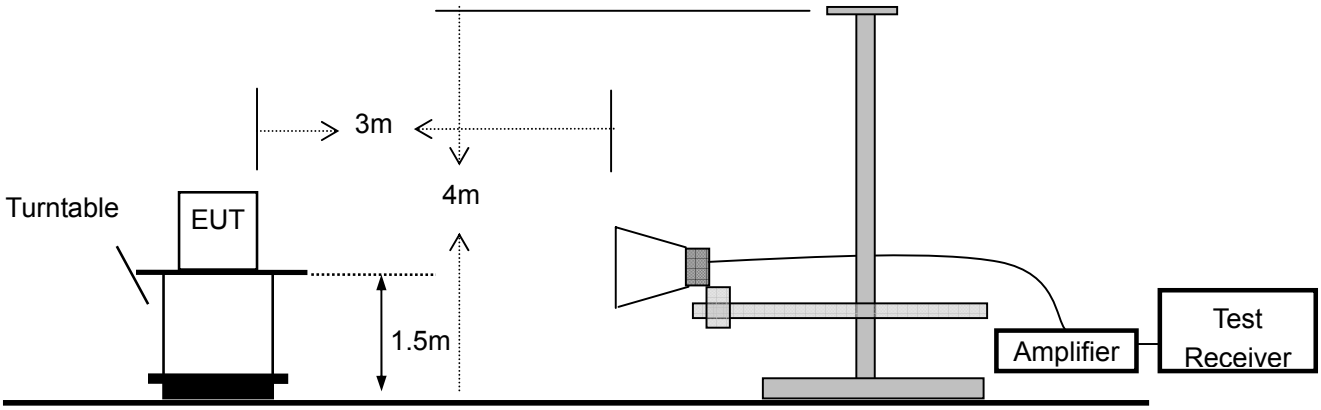
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



6.3 Measurement Equipment Used

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI	1166.5950.03	03/16/2015	1 Year
2.	Bilog Antenna	Schwarzbeck	VULB9163	000141	03/16/2015	1 Year
3.	Power Amplifier	CDS	RSU-M352	818	03/16/2015	1 Year
4.	Power Amplifier	HP	8447F	OPT H64	03/16/2015	1 Year
5.	Color Monitor	SUNSPO	SP-140A	N/A	03/16/2015	1 Year
6.	Single Line Filter	JIANLI	XL-3	N/A	03/16/2015	1 Year
7.	Single Phase Power Line Filter	JIANLI	DL-2X100B	N/A	03/16/2015	1 Year
8.	3 Phase Power Line Filter	JIANLI	DL-4X100B	N/A	03/16/2015	1 Year
9.	DC Power Filter	JIANLI	DL-2X50B	N/A	03/16/2015	1 Year
10.	Cable	Schwarzbeck	PLF-100	549489	03/16/2015	1 Year
11.	Cable	Rosenberger	CIL02	A0783566	03/16/2015	1 Year
12.	Cable	Rosenberger	RG 233/U	525178	03/16/2015	1 Year
13.	Signal Analyzer	Rohde & Schwarz	FSV30	103040	12/29/2014	1 Year
14.	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1272	12/29/2014	1 Year
15.	Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	12/29/2014	1 Year
16.	Cable	H+S	CBL-26	N/A	12/29/2014	1 Year
17.	Cable	H+S	CBL-26	N/A	12/29/2014	1 Year
18.	Cable	H+S	CBL-26	N/A	12/29/2014	1 Year

6.4 Radiated Emission Limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table15.209(a):

Frequencies (MHz)	Field Strength (micorvolts/meter)	Measurement Distance (meters)
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

Restricted bands of operation

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

Remark : 1. Emission level in dBuV/m=20 log (uV/m)
2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of ξ 15.205, and the emissions located in restricted bands also comply with 15.209 limit.

6.5 Measurement Result

Below 30MHz:

All the modulation modes were tested the data of the test mode are recorded in the following pages.

Operation Mode:	TX Mode	Test Date :	April 30, 2015
Frequency Range:	9KHz~30MHz	Temperature :	28℃
Test Result:	PASS	Humidity :	60 %
Measured Distance:	3m	Test By:	WOLF

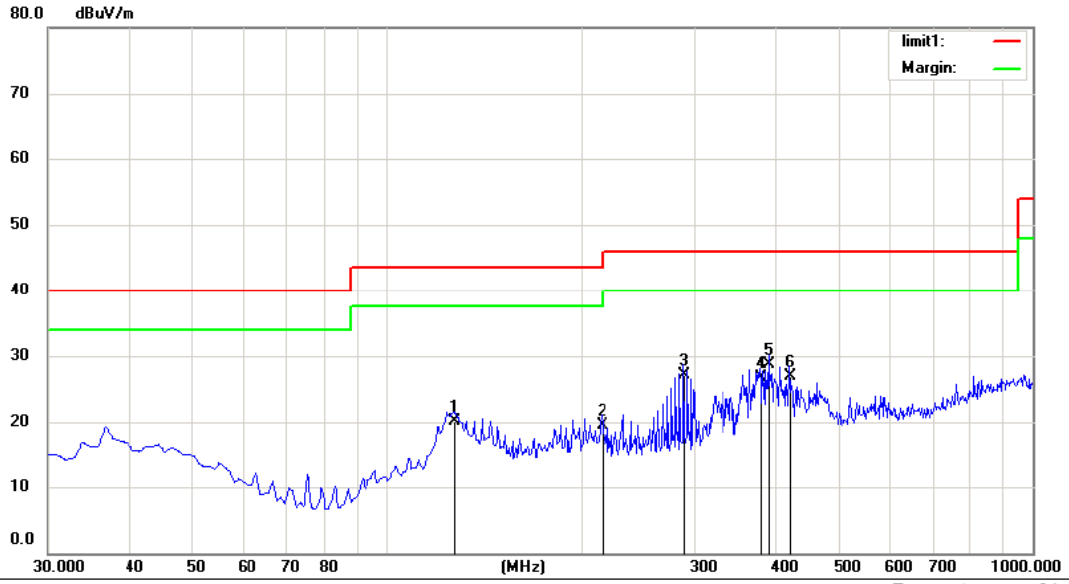
Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)
--	--	--	--	--

Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.
Distance extrapolation factor =40log(Specific distance/ test distance)(dB);
Limit line=Specific limits(dBuV) + distance extrapolation factor.

Below 1000MHz:

All the modulation modes were tested the data of the worst mode (TX 802.11g) are recorded in the following pages and the others modulation methods do not exceed the limits.

Please refer to the following test plots:



Site Chamber #1 Polarization: **Horizontal** Temperature: 24

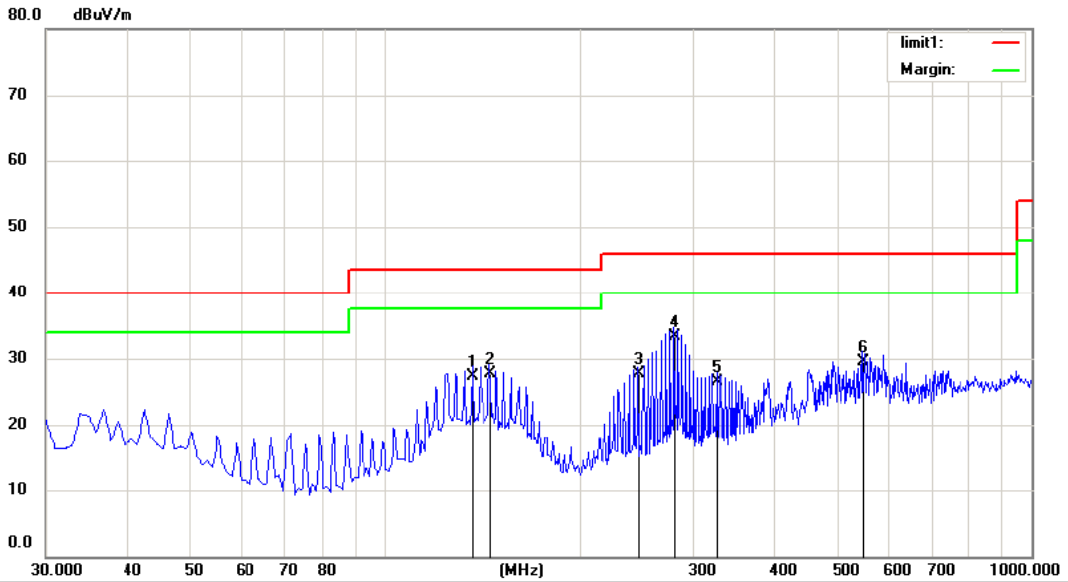
Limit: (RE)FCC PART 15 class B 3m Power: PC INPUT Humidity: 55 %

Mode: TX2412

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		127.0000	36.40	-16.34	20.06	43.50	-23.44	QP			
2		215.2700	36.02	-16.46	19.56	43.50	-23.94	QP			
3		288.9900	41.93	-14.74	27.19	46.00	-18.81	QP			
4		379.2000	38.82	-12.16	26.66	46.00	-19.34	QP			
5	*	390.8400	40.29	-11.67	28.62	46.00	-17.38	QP			
6		420.9100	38.37	-11.37	27.00	46.00	-19.00	QP			

*:Maximum data x:Over limit !:over margin Operator: Snake



Site Chamber #1 Polarization: **Vertical** Temperature: 24

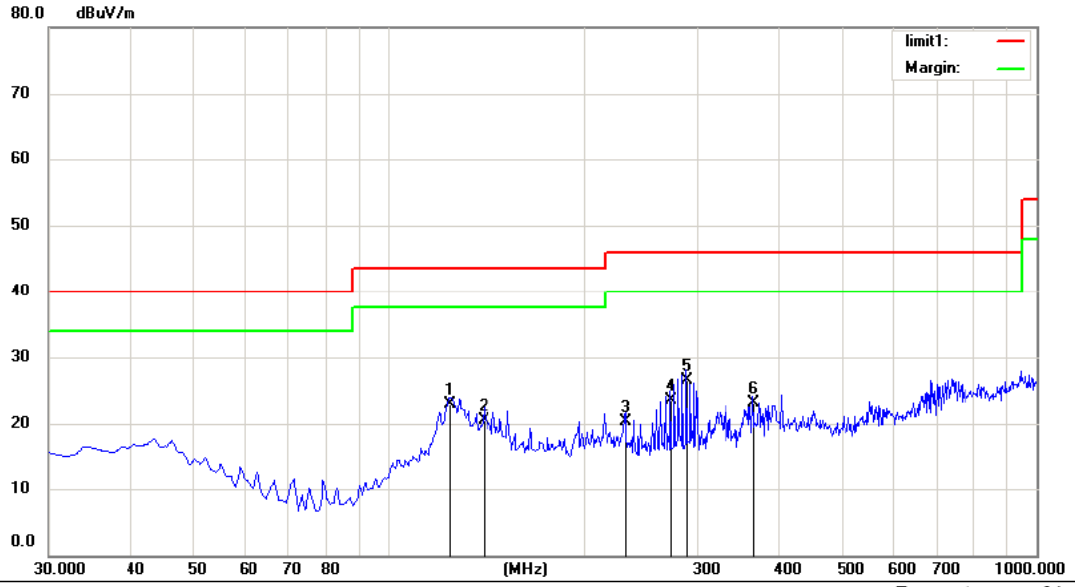
Limit: (RE)FCC PART 15 class B 3m Power: PC INPUT Humidity: 55 %

Mode: TX2412

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		136.7000	44.03	-16.68	27.35	43.50	-16.15	QP			
2		145.4300	45.05	-17.42	27.63	43.50	-15.87	QP			
3		247.2800	43.18	-15.54	27.64	46.00	-18.36	QP			
4	*	280.2600	48.11	-14.90	33.21	46.00	-12.79	QP			
5		325.8500	39.66	-13.24	26.42	46.00	-19.58	QP			
6		550.8900	38.95	-9.36	29.59	46.00	-16.41	QP			

*:Maximum data x:Over limit !:over margin Operator: Snake



Site Chamber #1 Polarization: **Horizontal** Temperature: 24

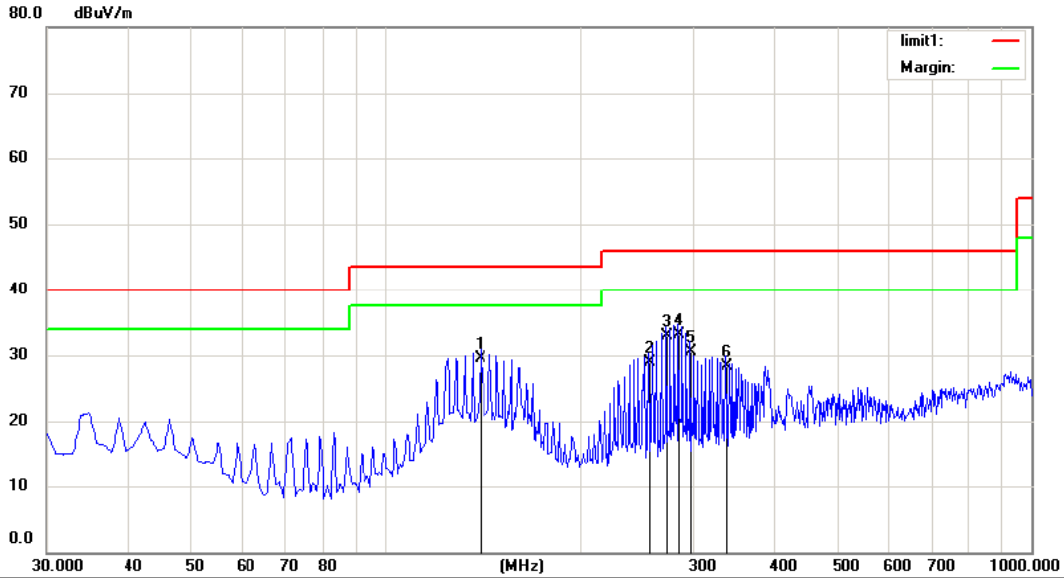
Limit: (RE)FCC PART 15 class B 3m Power: PC INPUT Humidity: 55 %

Mode: TX2437

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		124.5690	39.36	-16.44	22.92	43.50	-20.58	QP			
2		140.5800	37.55	-17.09	20.46	43.50	-23.04	QP			
3		232.7300	36.19	-15.93	20.26	46.00	-25.74	QP			
4		272.5000	38.56	-15.12	23.44	46.00	-22.56	QP			
5	*	288.9900	41.31	-14.74	26.57	46.00	-19.43	QP			
6		365.6200	35.70	-12.54	23.16	46.00	-22.84	QP			

*:Maximum data x:Over limit !:over margin Operator: Snake



Site Chamber #1 Polarization: **Vertical** Temperature: 24

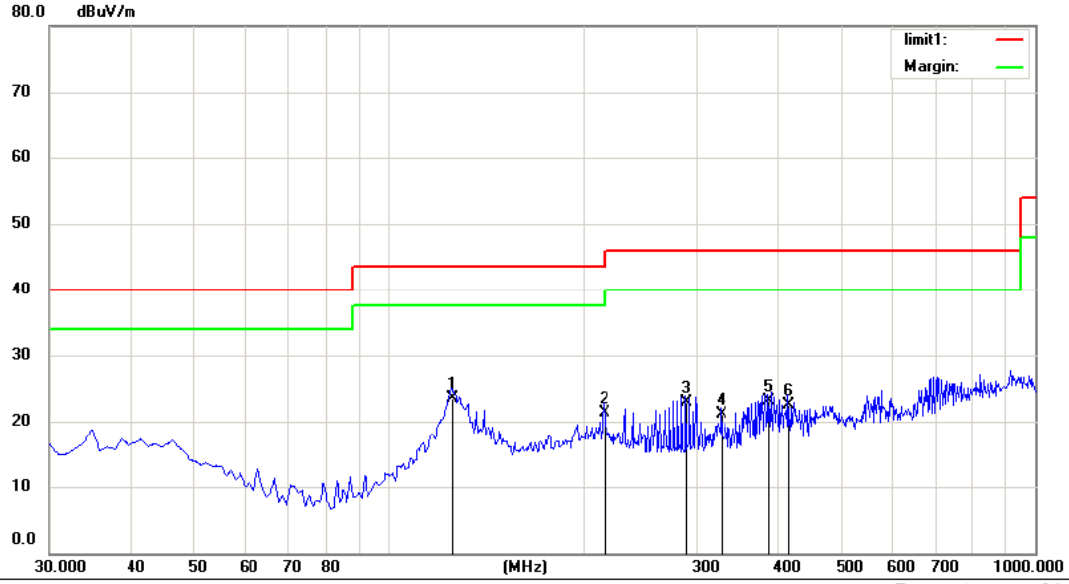
Limit: (RE)FCC PART 15 class B 3m Power: PC INPUT Humidity: 55 %

Mode: TX2437

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		140.5800	46.59	-17.09	29.50	43.50	-14.00	QP			
2		256.0100	44.46	-15.58	28.88	46.00	-17.12	QP			
3		272.5000	47.98	-15.12	32.86	46.00	-13.14	QP			
4	*	284.1400	47.99	-14.86	33.13	46.00	-12.87	QP			
5		296.7500	45.13	-14.54	30.59	46.00	-15.41	QP			
6		337.4900	41.50	-13.18	28.32	46.00	-17.68	QP			

*:Maximum data x:Over limit !:over margin Operator: Snake



Site Chamber #1 Polarization: **Horizontal** Temperature: 24

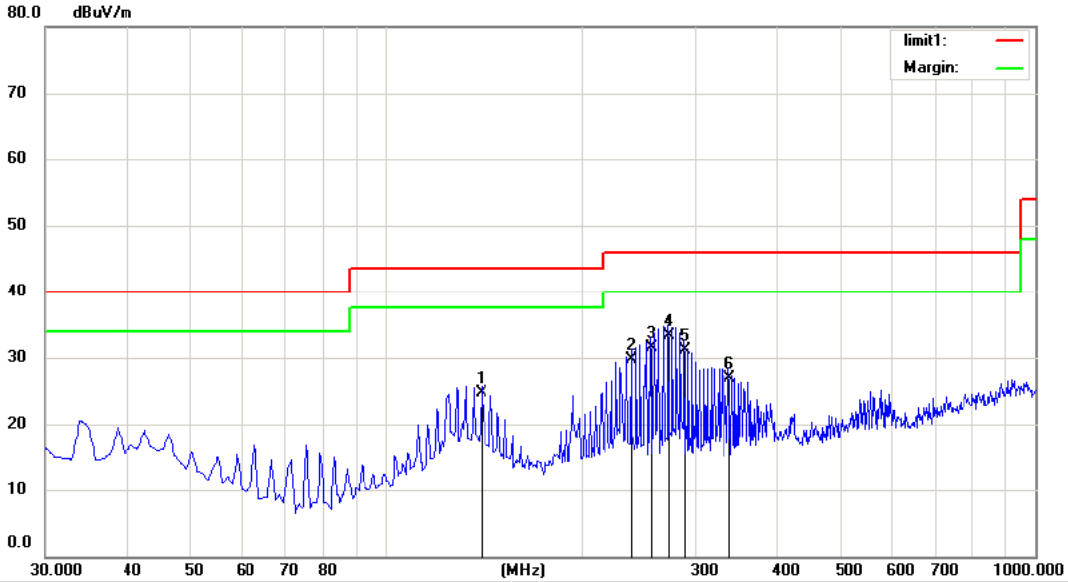
Limit: (RE)FCC PART 15 class B 3m Power: PC INPUT Humidity: 55 %

Mode: TX2462

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	125.0600	39.96	-16.40	23.56	43.50	-19.94	QP			
2		215.2700	37.78	-16.46	21.32	43.50	-22.18	QP			
3		288.9900	37.72	-14.74	22.98	46.00	-23.02	QP			
4		326.8200	34.23	-13.09	21.14	46.00	-24.86	QP			
5		386.9600	35.02	-11.84	23.18	46.00	-22.82	QP			
6		416.0600	33.92	-11.36	22.56	46.00	-23.44	QP			

*:Maximum data x:Over limit !:over margin Operator: Snake



Site Chamber #1 Polarization: **Vertical** Temperature: 24

Limit: (RE)FCC PART 15 class B 3m Power: PC INPUT Humidity: 55 %

Mode: TX2462

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		140.5800	41.83	-17.09	24.74	43.50	-18.76	QP			
2		239.5200	45.41	-15.68	29.73	46.00	-16.27	QP			
3		256.0100	47.07	-15.58	31.49	46.00	-14.51	QP			
4	*	272.5000	48.44	-15.12	33.32	46.00	-12.68	QP			
5		288.9900	45.82	-14.74	31.08	46.00	-14.92	QP			
6		337.4900	40.09	-13.18	26.91	46.00	-19.09	QP			

*:Maximum data x:Over limit !:over margin Operator: Snake

Above 1000MHz:

Operation Mode: 802.11g Lowest Test Date : April 30, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4824	V	66.02	46.35	74	54	-7.98	-7.65
7236	V	65.13	45.15	74	54	-8.87	-8.85
9648	V	64.35	44.05	74	54	-9.65	-9.95
12060	V	63.26	43.2	74	54	-10.74	-10.8
14472	V	62.1	42.62	74	54	-11.9	-11.38
16884	V	59.36	41.1	74	54	-14.64	-12.9
4824	H	65.34	46.35	74	54	-8.66	-7.65
7236	H	64.01	45.13	74	54	-9.99	-8.87
9648	H	63.95	44.25	74	54	-10.05	-9.75
12060	H	62.5	43.62	74	54	-11.5	-10.38
14472	H	61.36	42.85	74	54	-12.64	-11.15
16884	H	59.48	41.62	74	54	-14.52	-12.38

Operation Mode: 802.11g Middle Test Date : April 30, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4874	V	65.33	44.1	74	54	-8.67	-9.9
7311	V	64.72	43.62	74	54	-9.28	-10.38
9688	V	63.62	42.92	74	54	-10.38	-11.08
12185	V	62.92	41.58	74	54	-11.08	-12.42
14622	V	61.05	40.35	74	54	-12.95	-13.65
17059	V	60.36	39.72	74	54	-13.64	-14.28
4874	H	64.72	45.62	74	54	-9.28	-8.38
7311	H	63.92	44.15	74	54	-10.08	-9.85
9688	H	62.59	43.96	74	54	-11.41	-10.04
12185	H	61.35	42.11	74	54	-12.65	-11.89
14622	H	60.59	41.92	74	54	-13.41	-12.08
17059	H	59.54	40.25	74	54	-14.46	-13.75

Operation Mode: 802.11g Highest Test Date : April 30, 2015

Freq.	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
(MHz)	H/V	PK	AV	PK	AV	PK	AV
4924	V	66.05	44.15	74	54	-7.95	-9.85
7386	V	65.13	43.62	74	54	-8.87	-10.38
9848	V	64.22	42.01	74	54	-9.78	-11.99
12310	V	63.92	41.92	74	54	-10.08	-12.08
14772	V	62.18	40.35	74	54	-11.82	-13.65
17234	V	61.42	39.52	74	54	-12.58	-14.48
4924	H	65.03	45.62	74	54	-8.97	-8.38
7386	H	64.25	44.15	74	54	-9.75	-9.85
9848	H	63.92	43.92	74	54	-10.08	-10.08
12310	H	62.15	42.01	74	54	-11.85	-11.99
14772	H	60.2	41.92	74	54	-13.8	-12.08
17234	H	58.79	40.35	74	54	-15.21	-13.65

All emissions not reported were more than 20dB below the specified limit or in the noise floor.

Note: (1) All Readings are Peak Value and AV.
(2) Emission Level= Reading Level+Probe Factor +Cable Loss.
(3) 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.

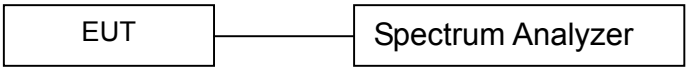
7. 6dB Bandwidth Test

7.1 Measurement Procedure

The EUT was operating in IEEE 802.11b, 802.11g, 802.11n(HT20), 802.11n(HT40) mode or could be controlled its channel. Printed out the test result from the spectrum by hard copy function.

1. Set resolution bandwidth (RBW) = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequency) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

7.2 Test SET-UP (Block Diagram of Configuration)



7.3 Measurement Equipment Used

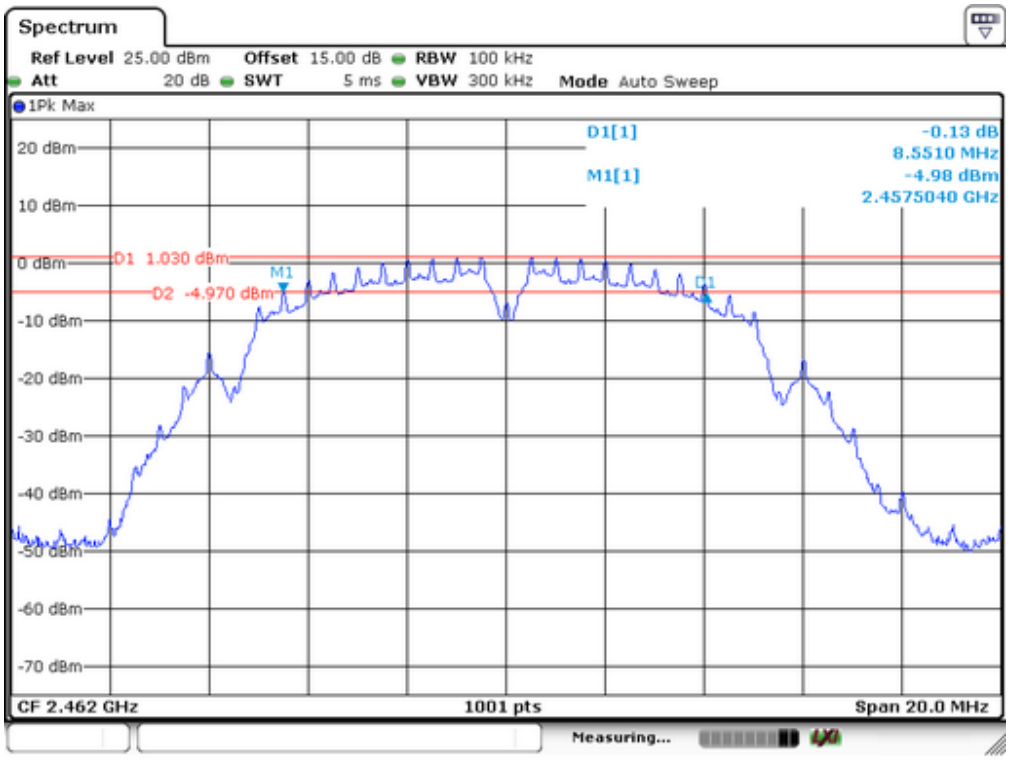
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	FSV30	1321.3008K	03/16/2015	03/15/2016

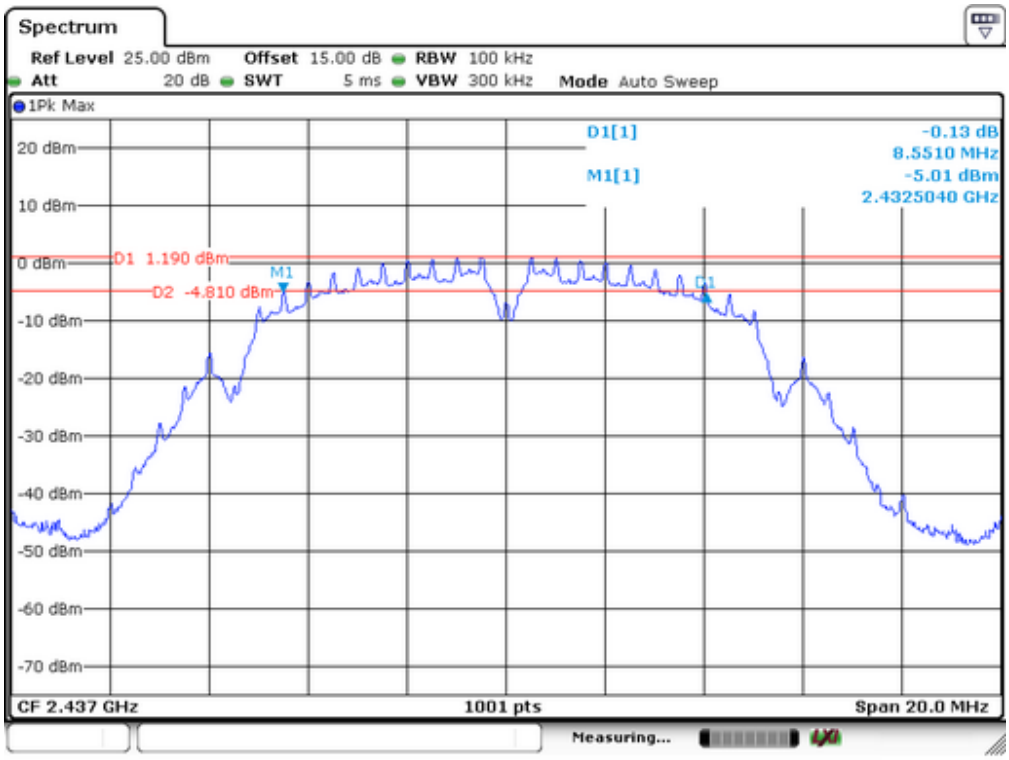
7.4 Measurement Results

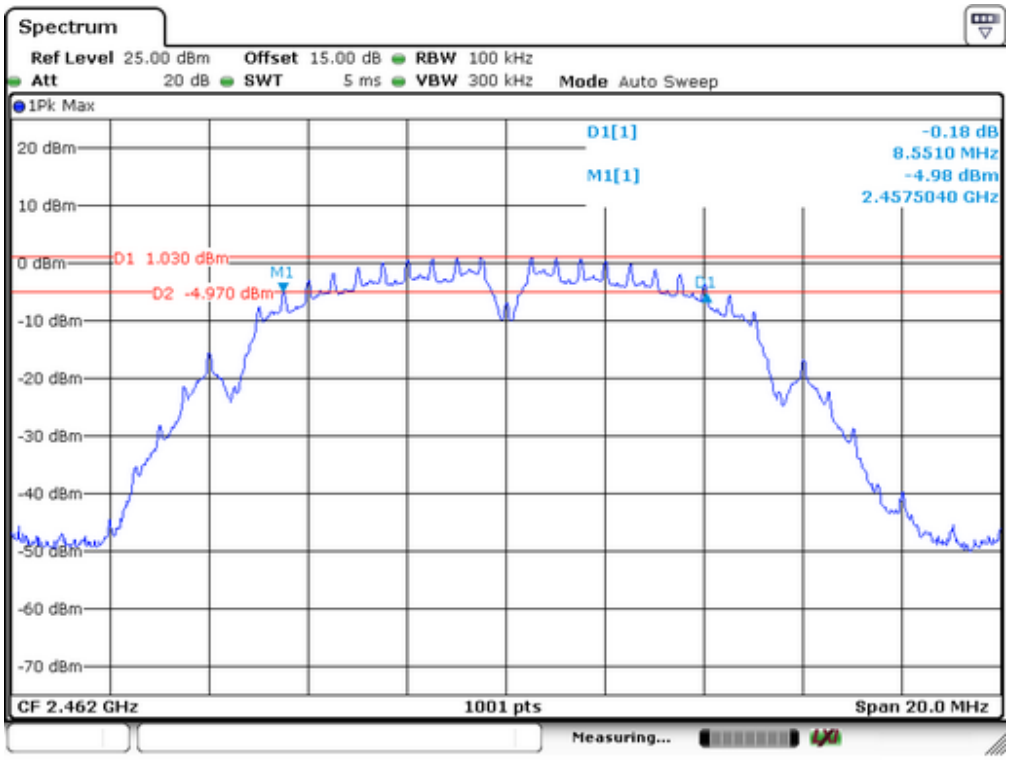
6 Bandwidth Test Data Chart:

Refer to attached data chart.

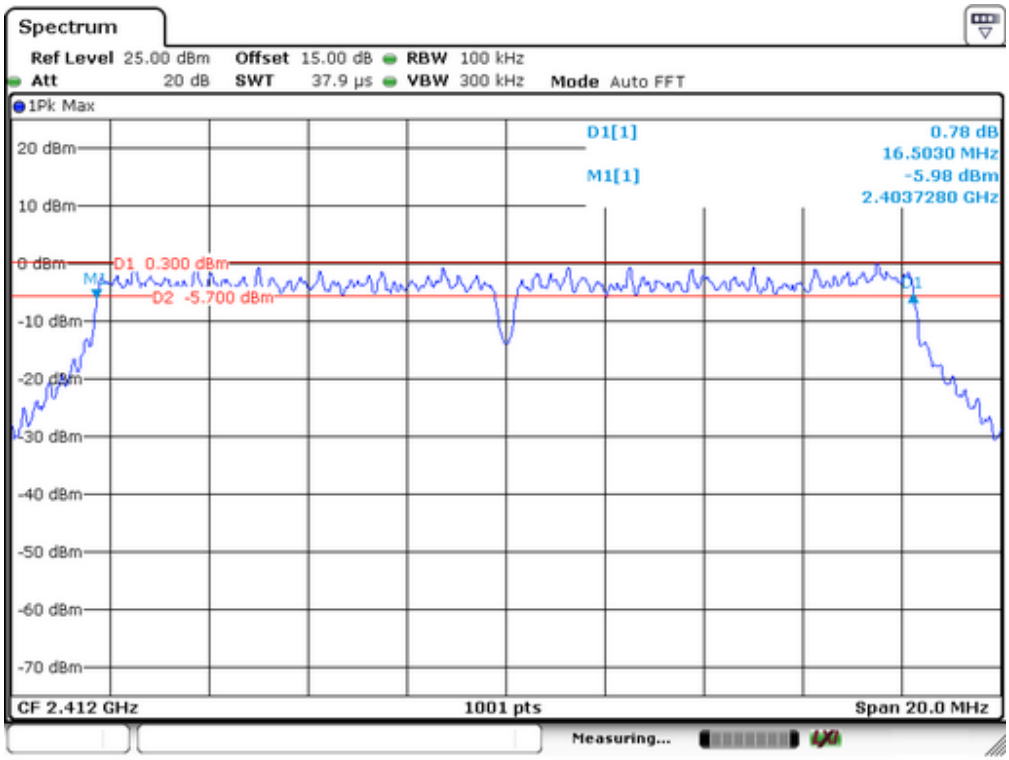
IEEE 802.11b			
Channel frequency (MHz)	Measurement level (KHz)	Required Limit (KHz)	Result
2412	8551	>500	Pass
2437	8551	>500	
2462	8551	>500	

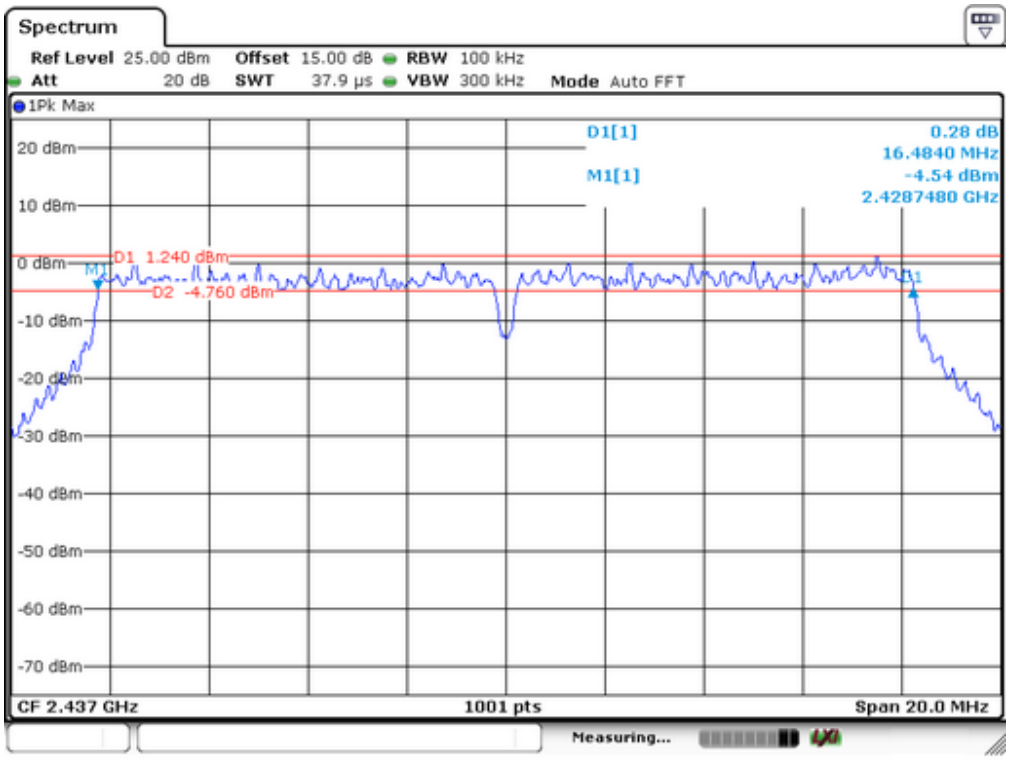


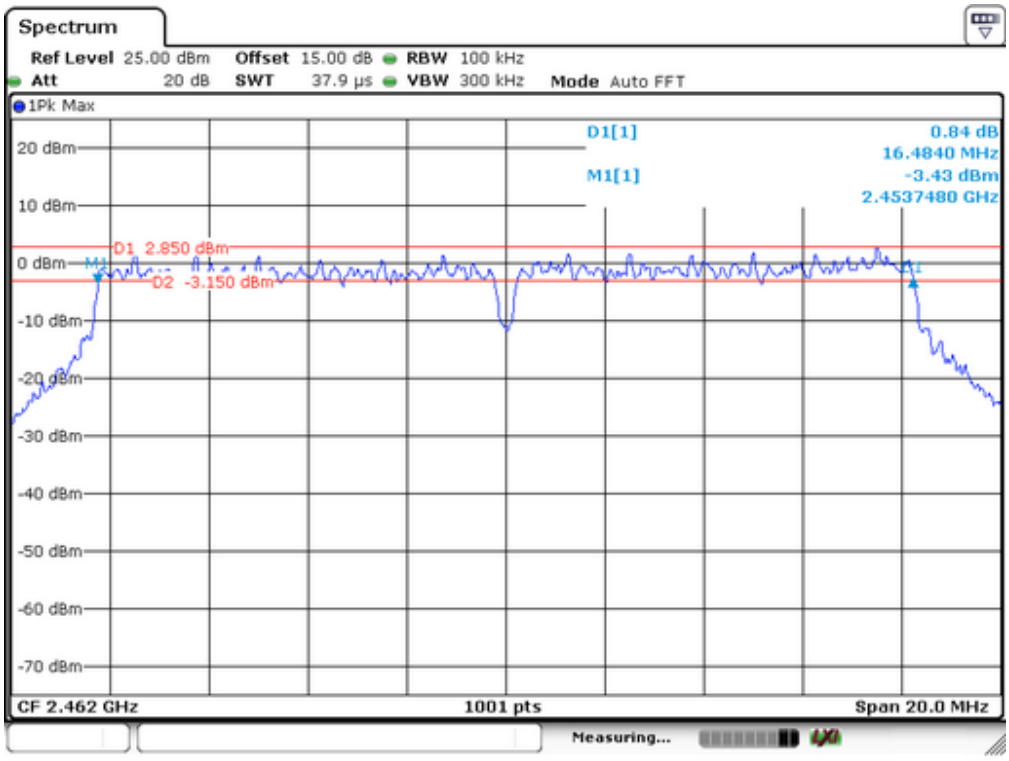

Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 100 kHz
Att 20 dB SWT 5 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D1[1] -0.13 dB
8.5510 MHz
M1[1] -5.01 dBm
2.4325040 GHz
D1 1.190 dBm
D2 -4.810 dBm
M1
D1
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.437 GHz
1001 pts
Span 20.0 MHz
Measuring...


Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 100 kHz
Att 20 dB SWT 5 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D1[1] -0.18 dB
8.5510 MHz
M1[1] -4.98 dBm
2.4575040 GHz
D1 1.030 dBm
D2 -4.970 dBm
M1
D1
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.462 GHz
1001 pts
Span 20.0 MHz
Measuring...

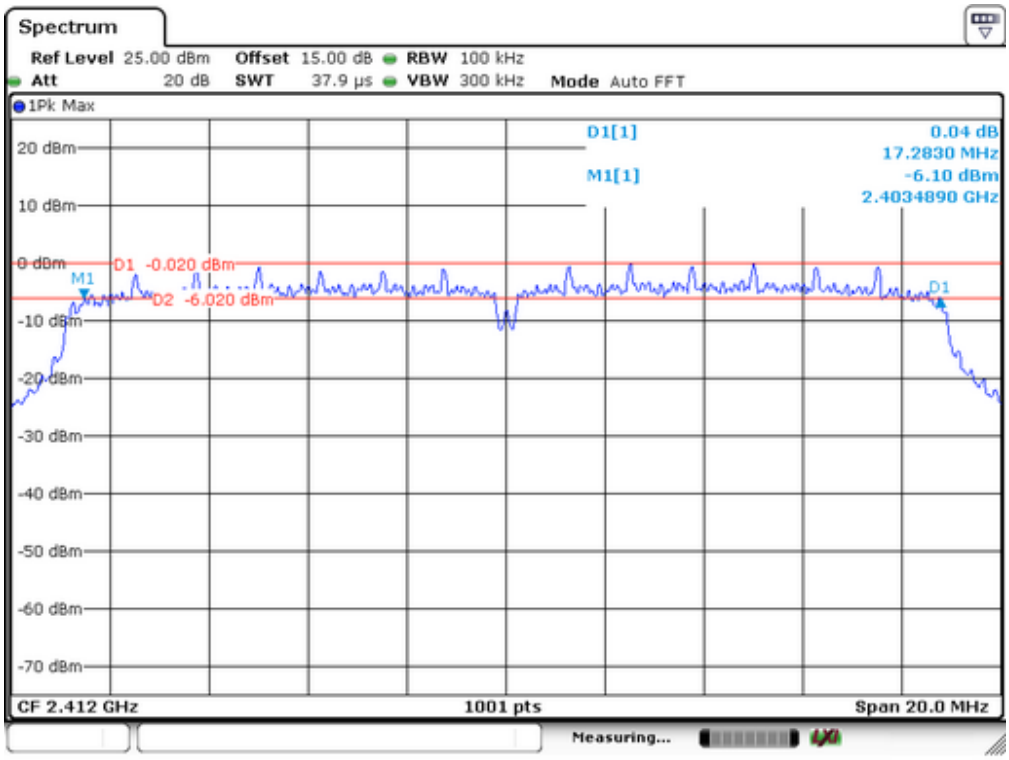
IEEE 802.11g			
Channel frequency (MHz)	Measurement level (KHz)	Required Limit (KHz)	Result
2412	16503	>500	Pass
2437	16484	>500	
2462	16484	>500	

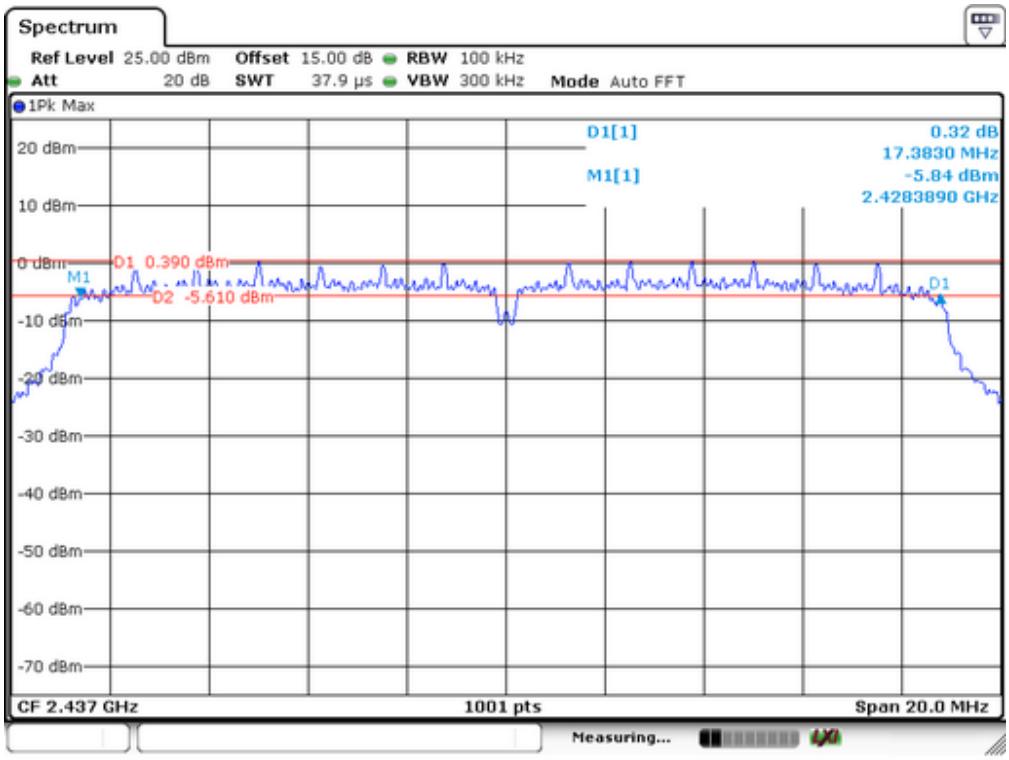


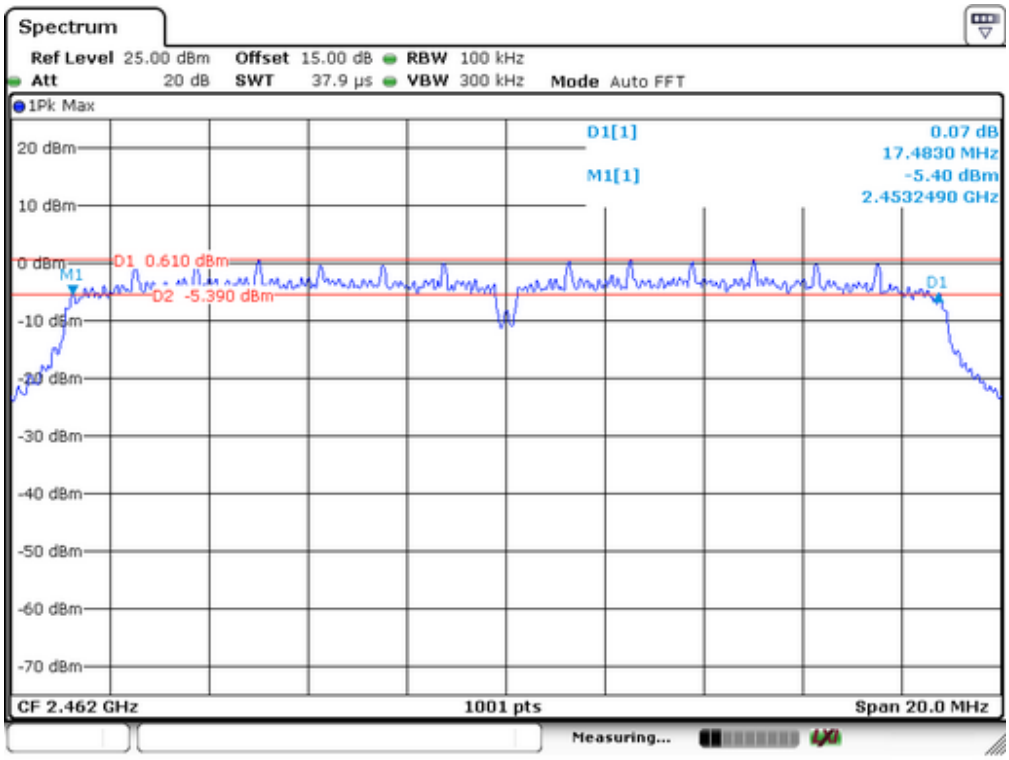

Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 100 kHz
Att 20 dB SWT 37.9 µs VBW 300 kHz Mode Auto FFT
1Pk Max
D1[1] 0.28 dB
16.4840 MHz
M1[1] -4.54 dBm
2.4287480 GHz
D1 1.240 dBm
D2 -4.760 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.437 GHz
1001 pts
Span 20.0 MHz
Measuring...


Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 100 kHz
Att 20 dB SWT 37.9 µs VBW 300 kHz Mode Auto FFT
1Pk Max
D1[1] 0.84 dB
16.4840 MHz
M1[1] -3.43 dBm
2.4537480 GHz
D1 2.850 dBm
D2 -3.150 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.462 GHz
1001 pts
Span 20.0 MHz
Measuring...

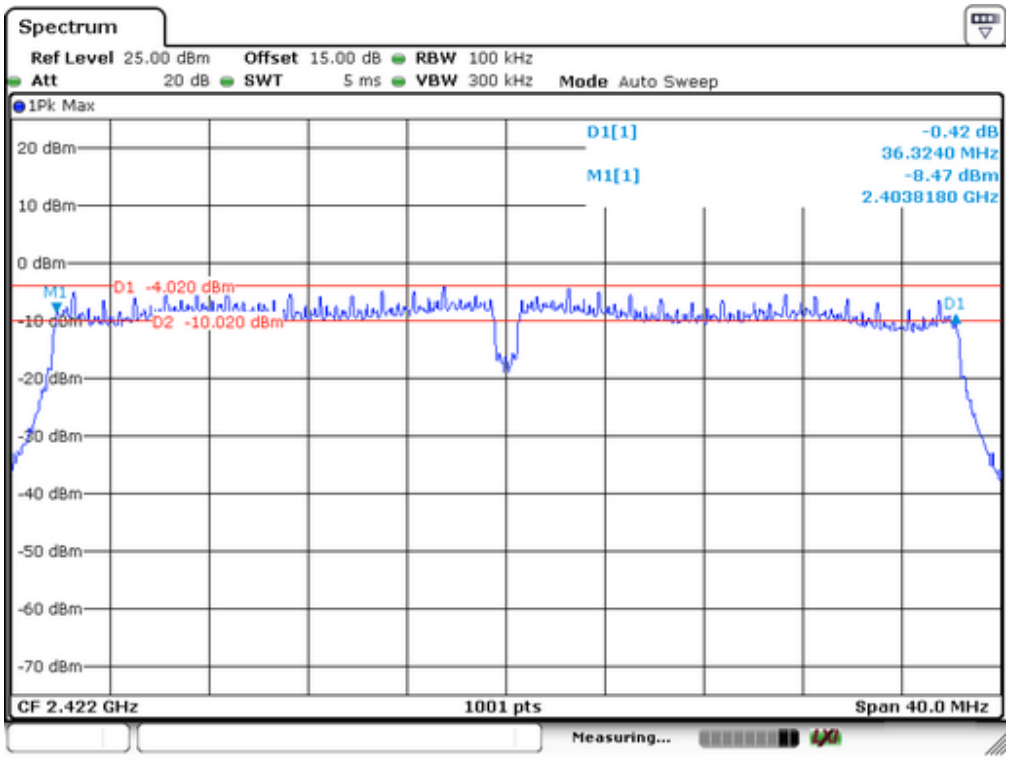
IEEE 802.11n(HT20)			
Channel frequency (MHz)	Measurement level (KHz)	Required Limit (KHz)	Result
2412	17283	>500	Pass
2437	17383	>500	
2462	17483	>500	

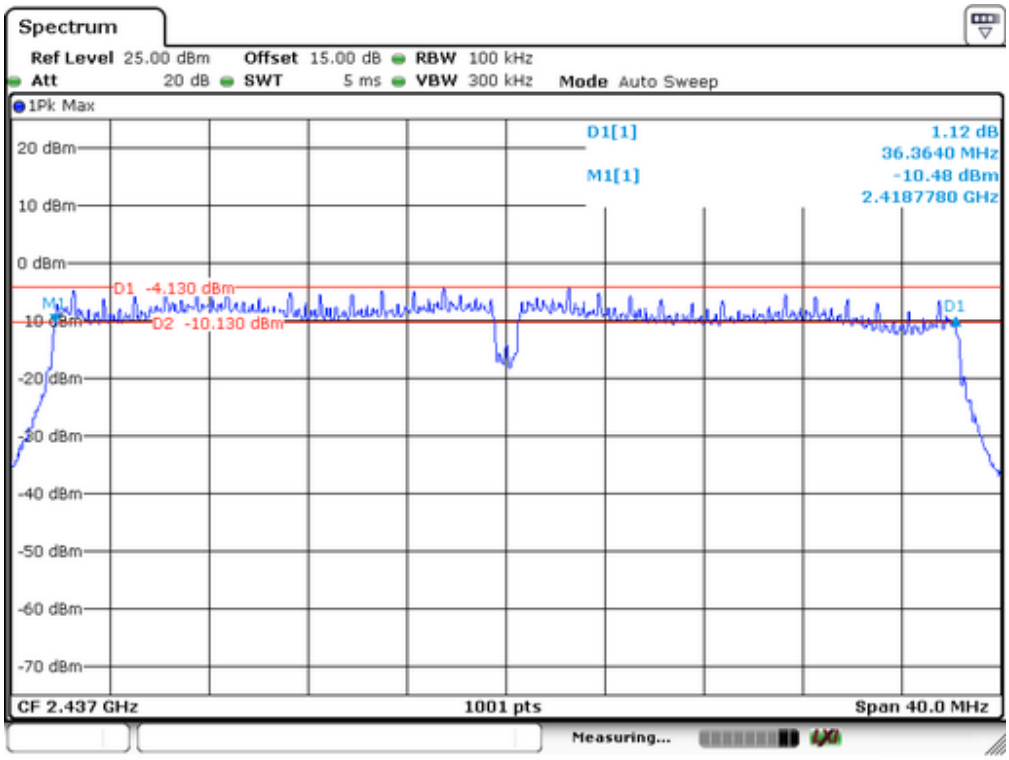


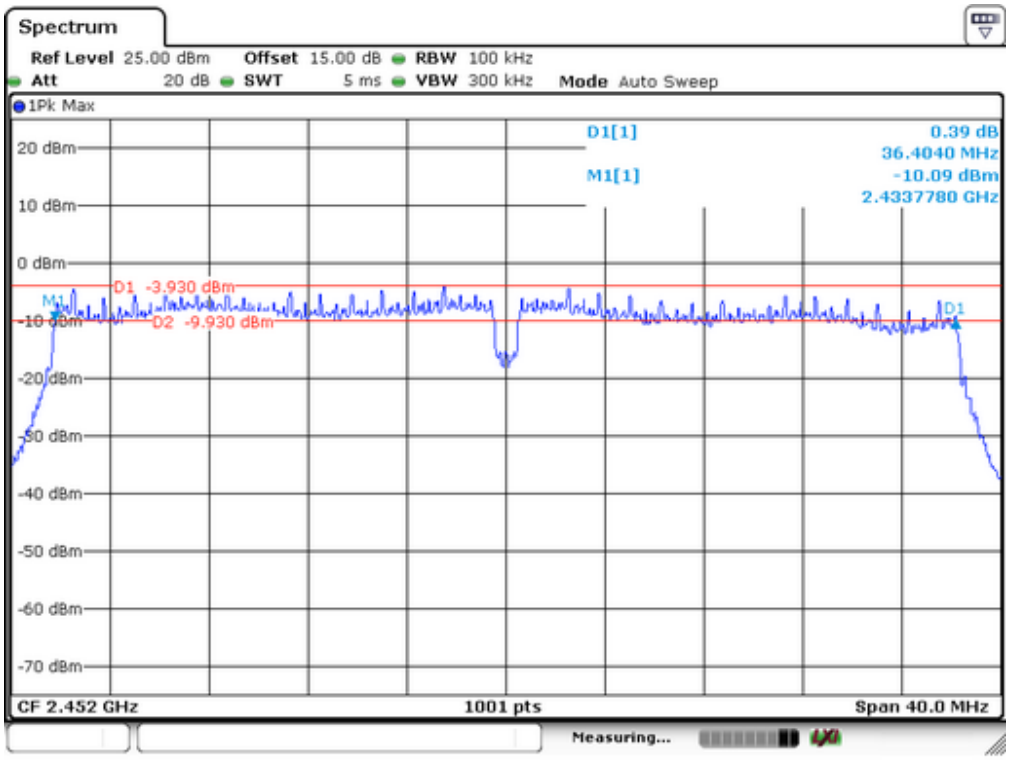

Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 100 kHz
Att 20 dB SWT 37.9 µs VBW 300 kHz Mode Auto FFT
1Pk Max
D1[1] 0.32 dB
17.3830 MHz
M1[1] -5.84 dBm
2.4283890 GHz
D1 0.390 dBm
D2 -5.610 dBm
M1
D1
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.437 GHz
1001 pts
Span 20.0 MHz
Measuring...


Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 100 kHz
Att 20 dB SWT 37.9 µs VBW 300 kHz Mode Auto FFT
1Pk Max
D1[1] 0.07 dB
17.4830 MHz
M1[1] -5.40 dBm
2.4532490 GHz
D1 0.610 dBm
D2 -5.390 dBm
M1
D1
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.462 GHz
1001 pts
Span 20.0 MHz
Measuring...

IEEE 802.11n(HT40)			
Channel frequency (MHz)	Measurement level (KHz)	Required Limit (KHz)	Result
2422	36324	>500	Pass
2437	36364	>500	
2452	36404	>500	




Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 100 kHz
Att 20 dB SWT 5 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D1[1] 1.12 dB
36.3640 MHz
M1[1] -10.48 dBm
2.4187780 GHz
D1 -4.130 dBm
D2 -10.130 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.437 GHz
1001 pts
Span 40.0 MHz
Measuring...


Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 100 kHz
Att 20 dB SWT 5 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
D1[1] 0.39 dB
36.4040 MHz
M1[1] -10.09 dBm
2.4337780 GHz
D1 -3.930 dBm
D2 -9.930 dBm
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.452 GHz
1001 pts
Span 40.0 MHz
Measuring...

8. Maximum Peak Output Power Test

8.1 Measurement Procedure

The maximum peak conducted output power can be measured using a broadband peak RF power meter. The power meter must have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast, average-responding diode type sensor.

a. The Transmitter output (antenna port) was connected to the power meter.
b. Turn on the EUT and power meter and then record the peak power value.
c. Repeat above procedures on all channels needed to be tested.

8.2 Test SET-UP (Block Diagram of Configuration)

8.3 Measurement Equipment Used

EQUIPMENT TYPE	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power meter	ML2495A	0824006	03/16/2015	03/15/2016
Power sensor	MA2411B	0738172	03/16/2015	03/15/2016

8.4 Peak Power output limit

The maximum peak power shall be less 1Watt.

8.5 Measurement Results

Spectrum Detector:	PK	Test Date :	April 30, 2015
Test By:	Jack	Temperature :	28℃
Test Result:	PASS	Humidity :	60%

Test Channel	Max Output Power (dBm)				Limit(dBm)	Result
	802.11b	802.11g	802.11n(HT20)	802.11n(HT40)		
Lowest	13.25	12.40	11.22	9.52	30	Pass
Middle	14.46	13.05	12.62	10.46		
Highest	15.66	14.35	13.44	11.05		

9. Band Edge Test

9.1 Measurement Procedure

For Conducted Test

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r03.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. Measure and record the results in the test report.
5. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

For Radiated emission Test

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r03.
2. The EUT was placed on a styrofoam table which is 1.5m above ground plane.
3. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
4. The EUT was placed on a turntable with 0.8 meter above ground.
5. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
6. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.
7. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
8. Repeat above procedures until all frequency measured were complete.

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz.

EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	3MHz
Detector	Peak
Trace	Max hold

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 10Hz.

EMI Test Receiver	Setting
Attenuation	Auto
RB	1MHz
VB	10Hz
Detector	Peak
Trace	Max hold

9.2 Test SET-UP (Block Diagram of Configuration)

EUT —— Spectrum Analyzer

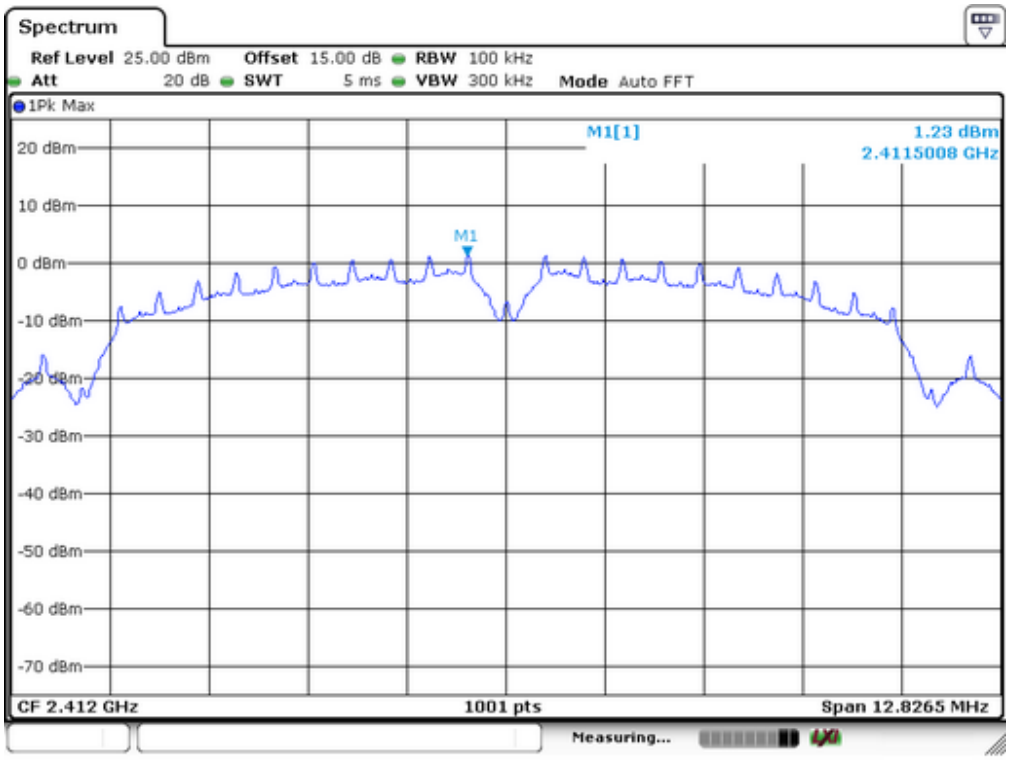
9.3 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	FSV30	1321.3008K	03/16/2015	03/15/2016

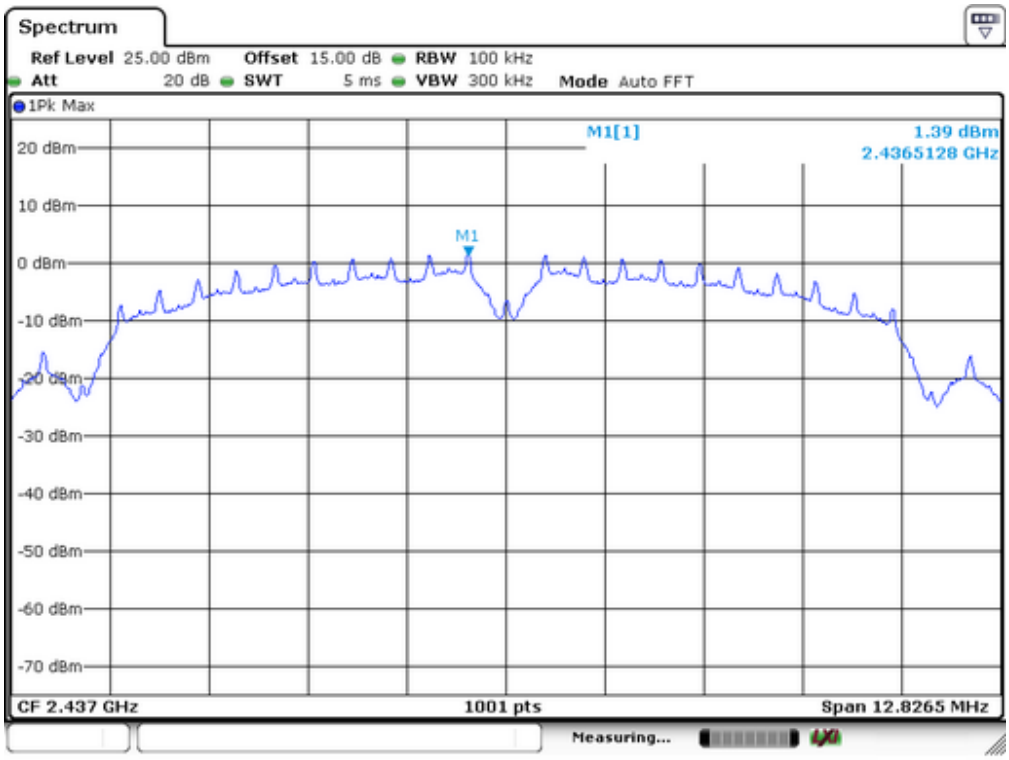
9.4 Measurement Results

1. Conducted Test

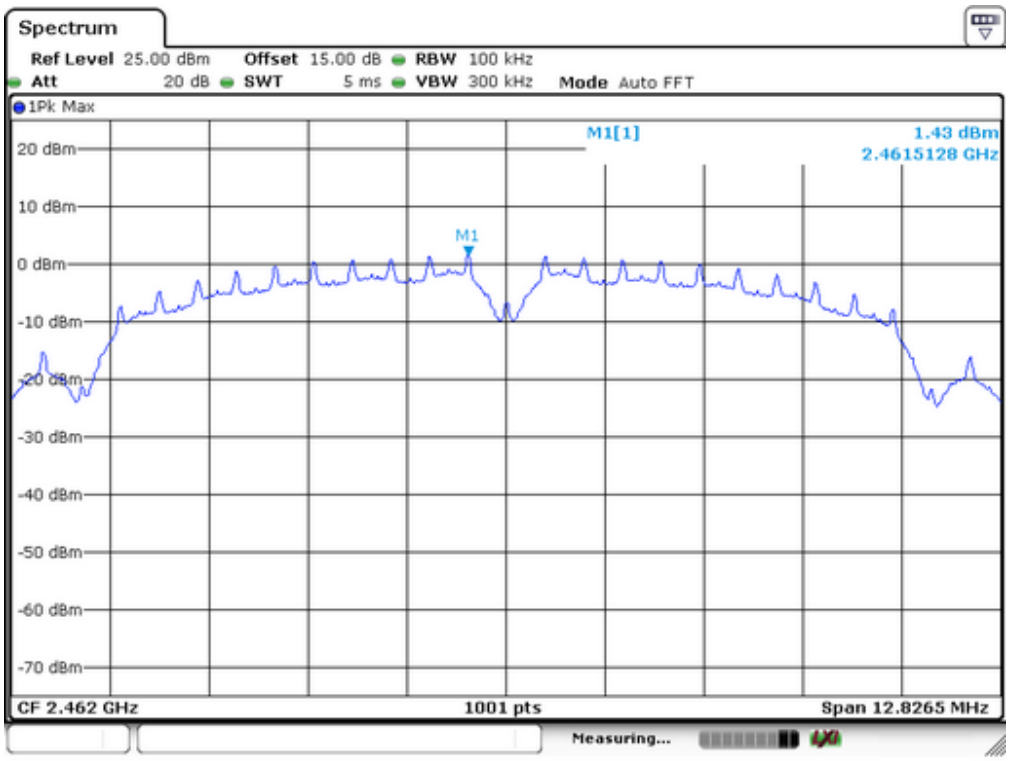
Test Mode: 802.11b



Lowest Channel

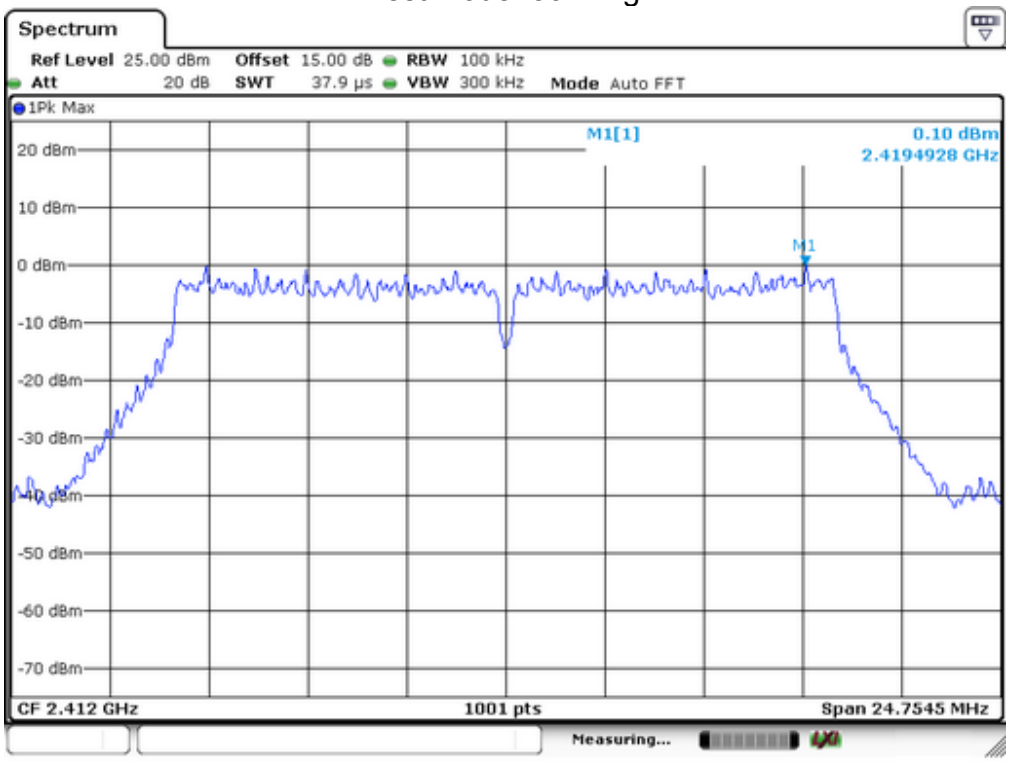


Middle Channel

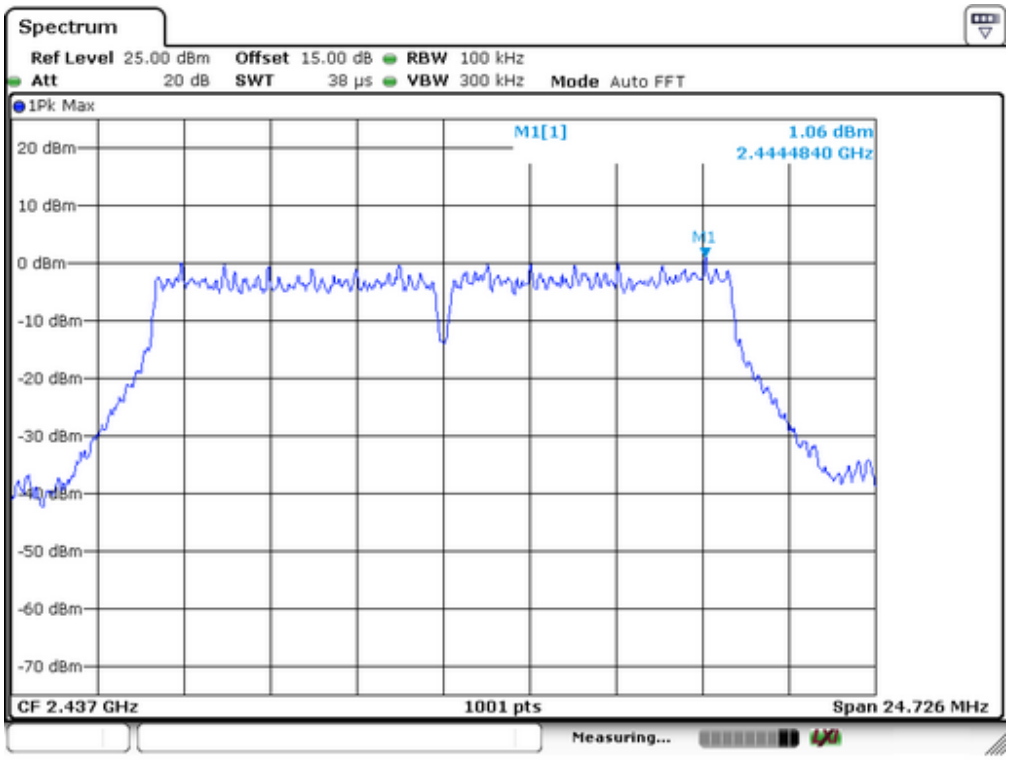


Highest Channel

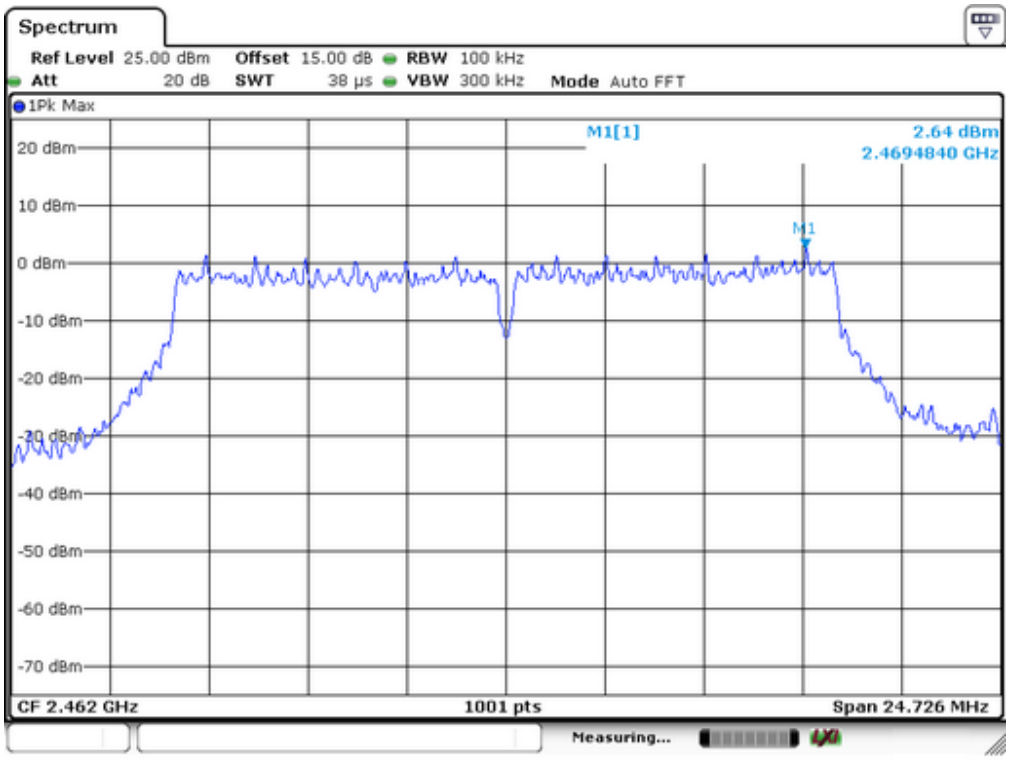
Test Mode: 802.11g



Lowest Channel

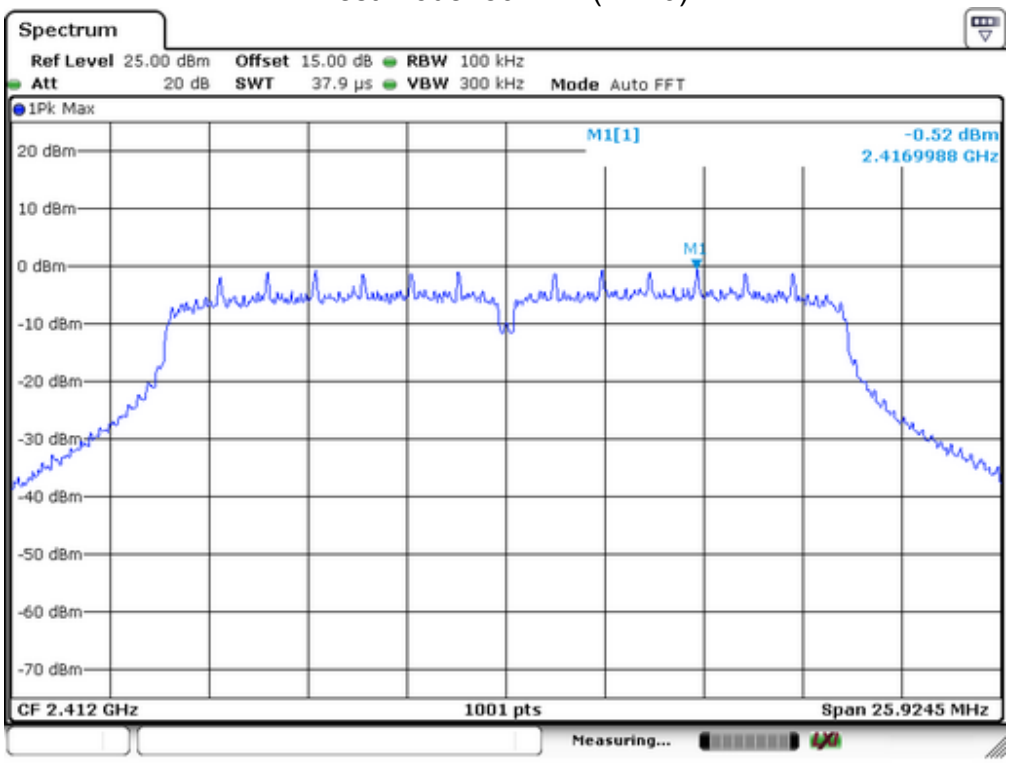


Middle Channel

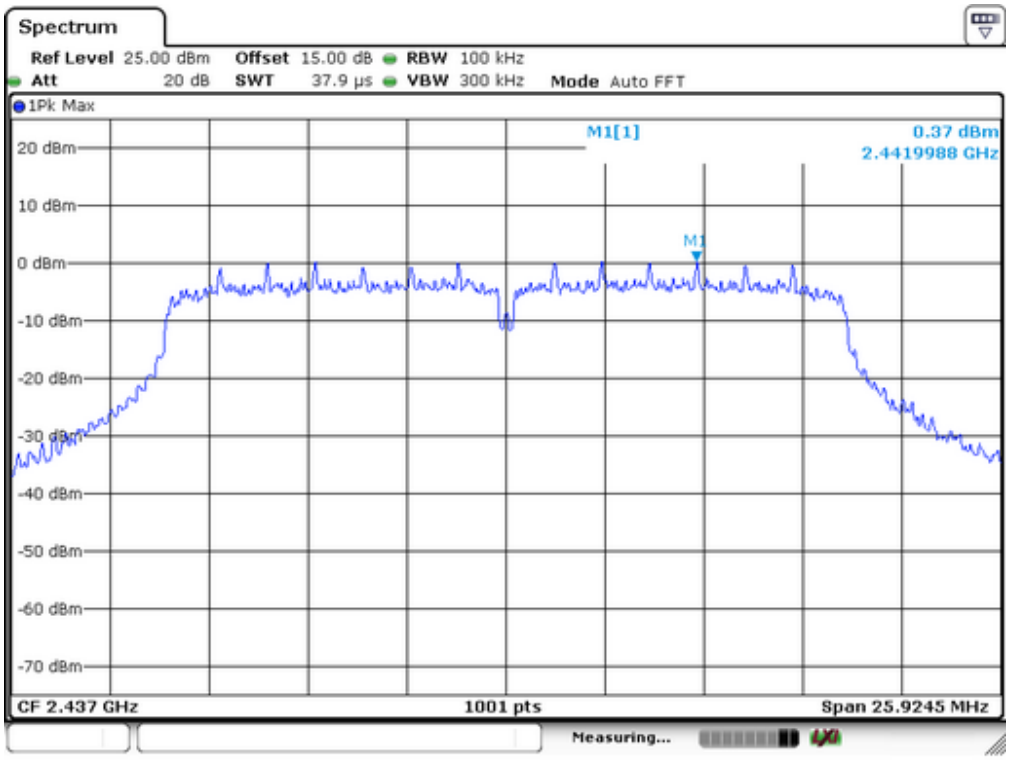


Highest Channel

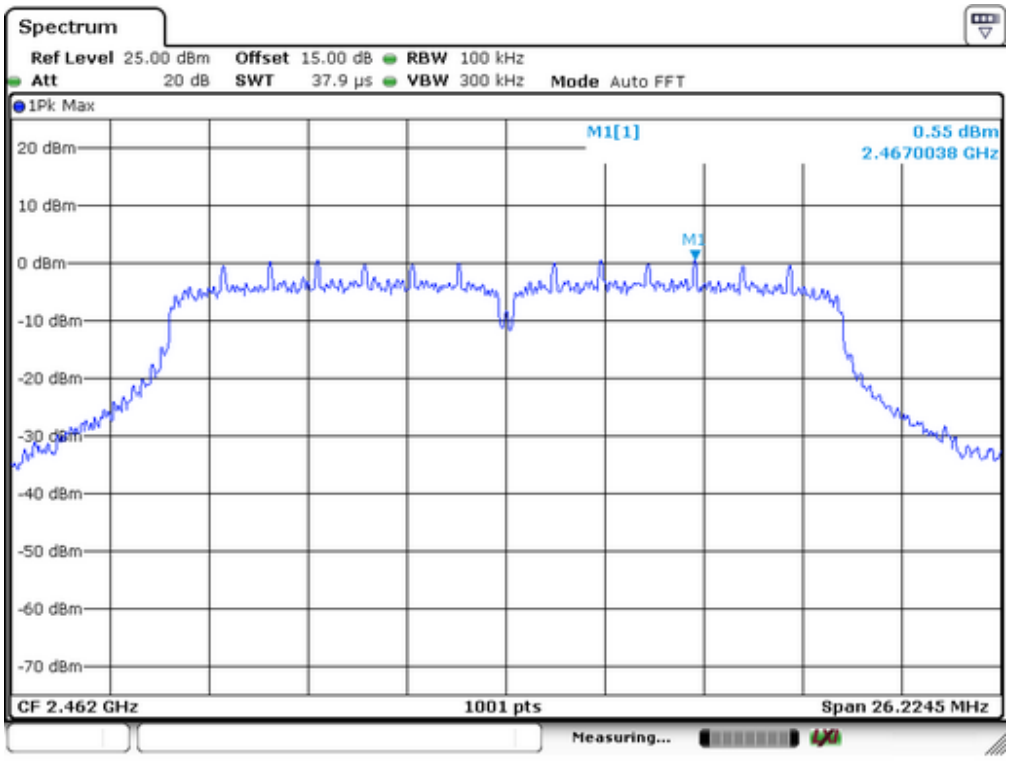
Test Mode: 802.11n(HT20)



Lowest Channel

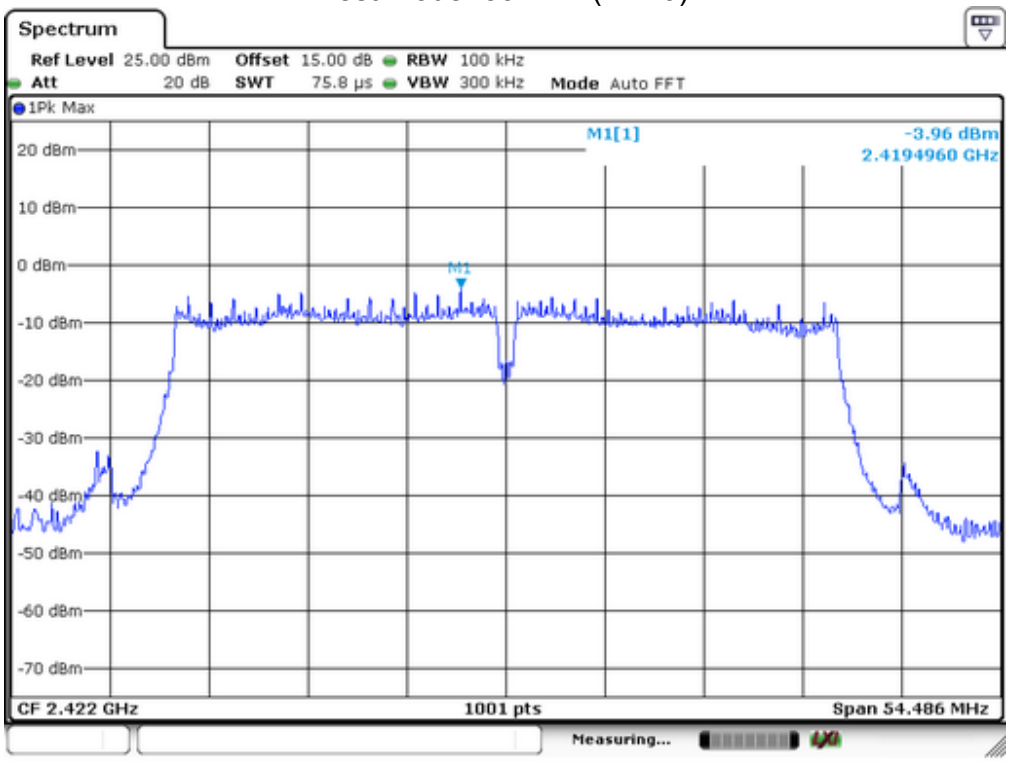


Middle Channel

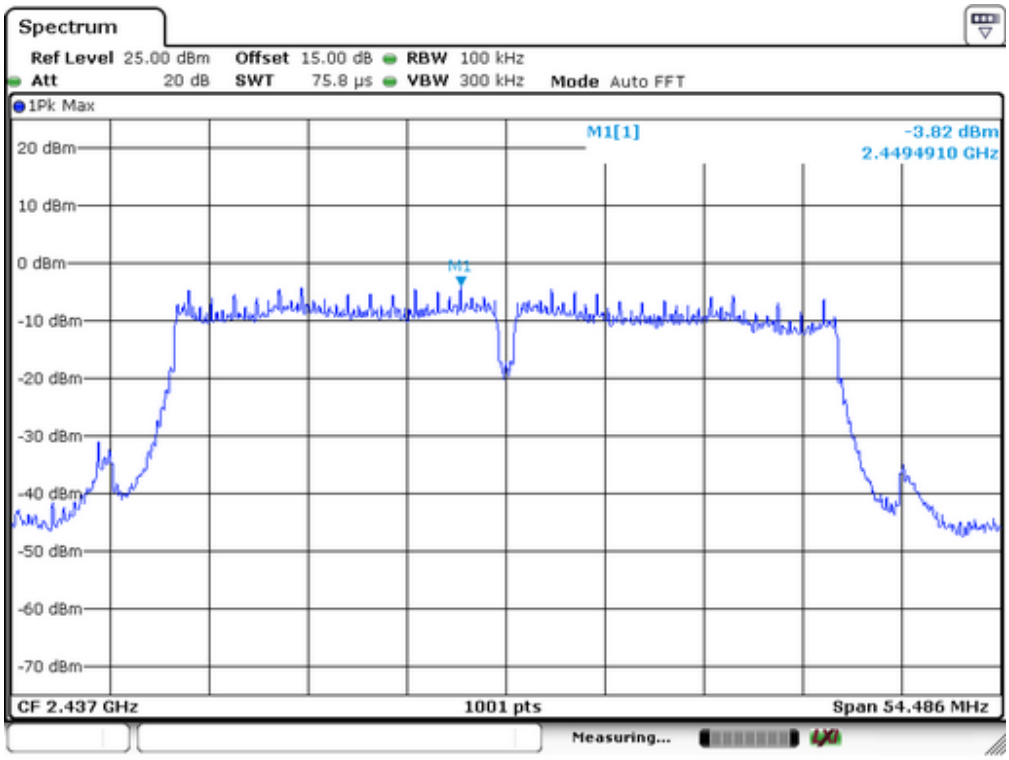


Highest Channel

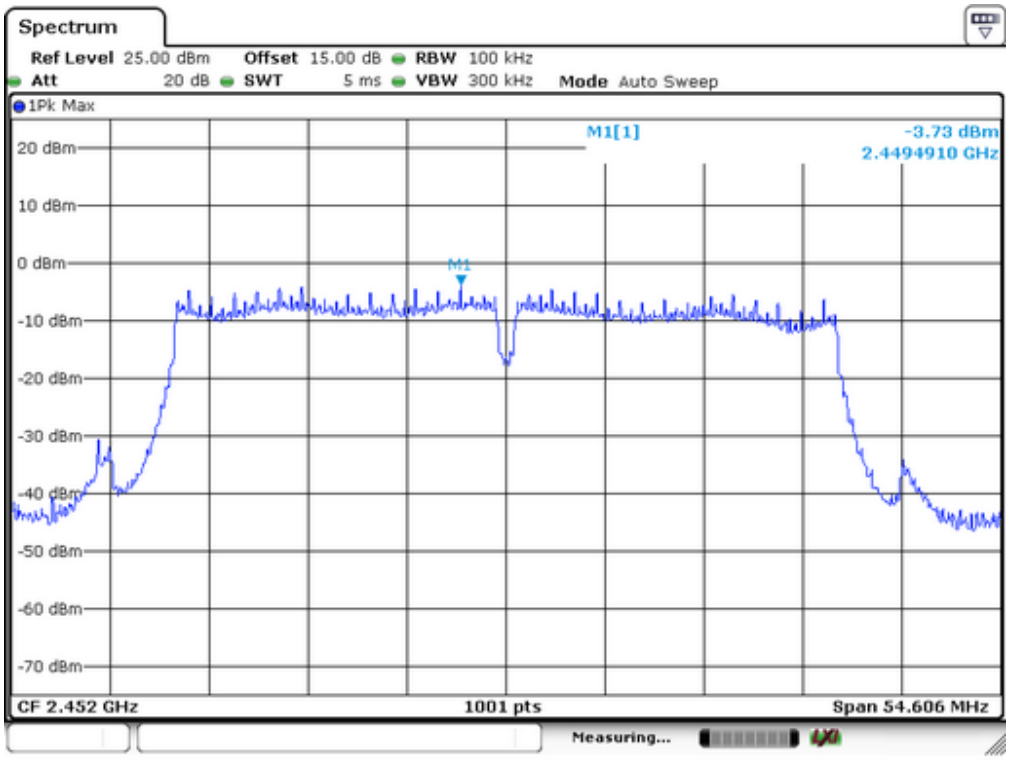
Test Mode: 802.11n(HT40)



Lowest Channel

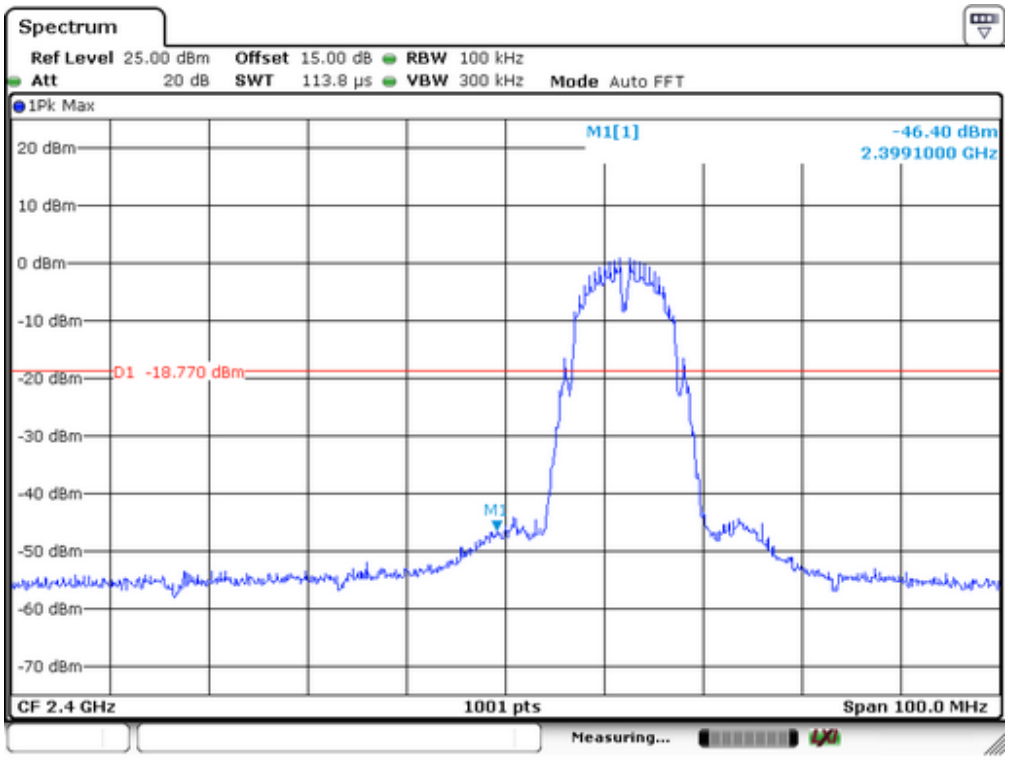


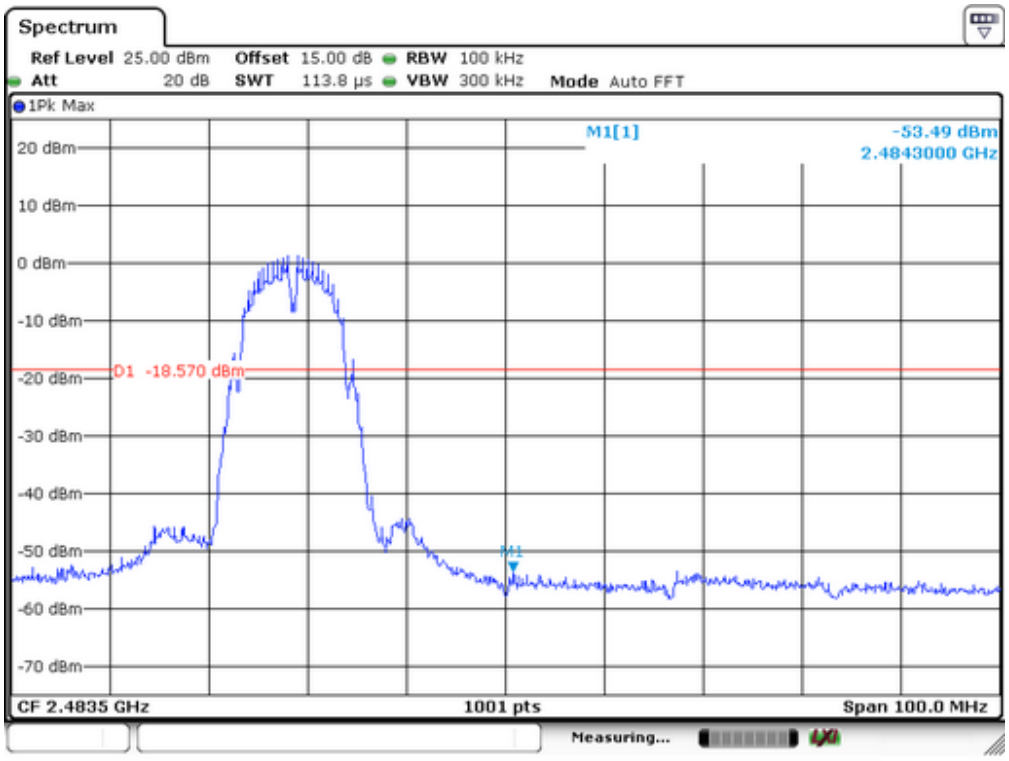
Middle Channel



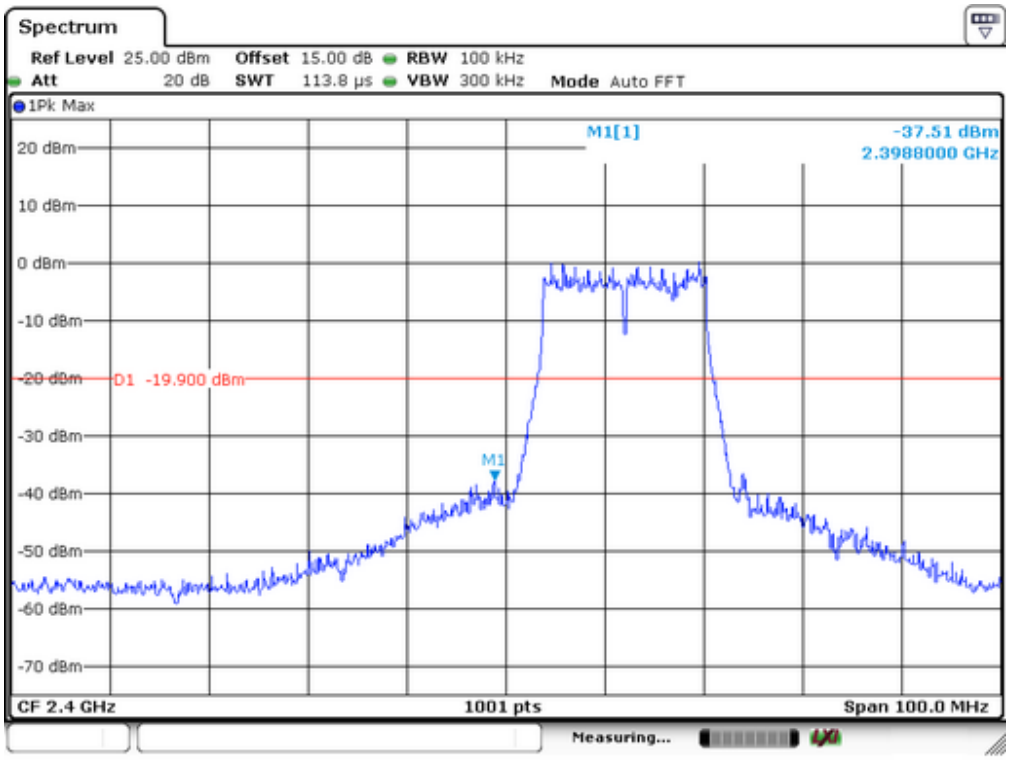
Highest Channel

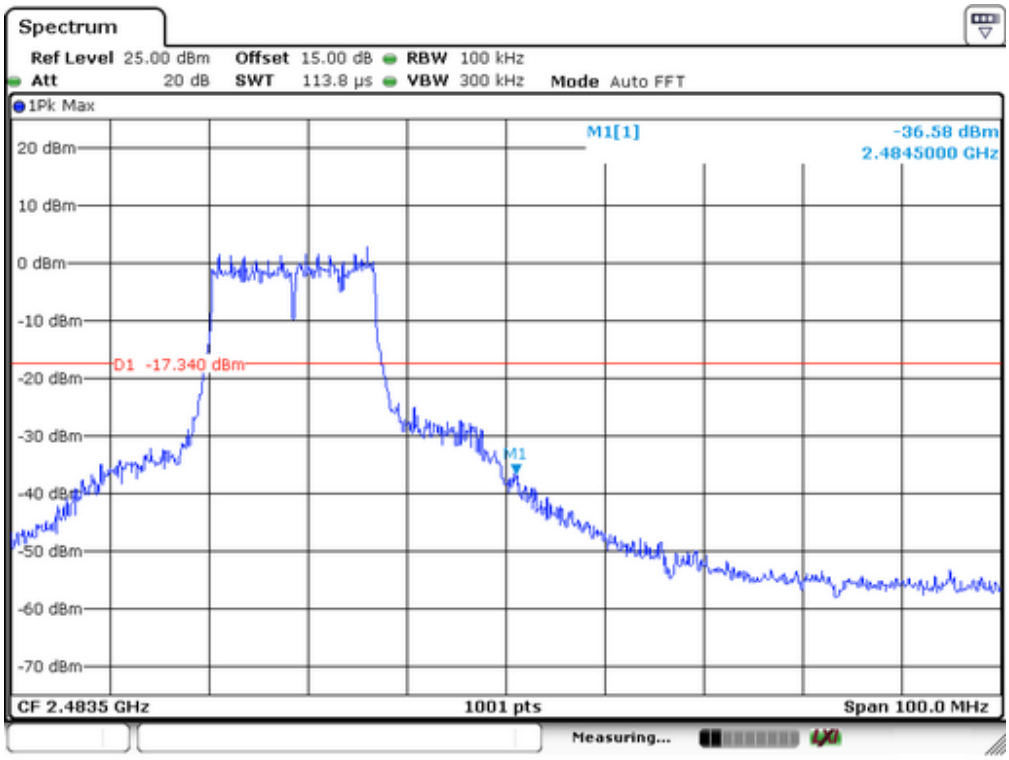
Test mode: 802.11b



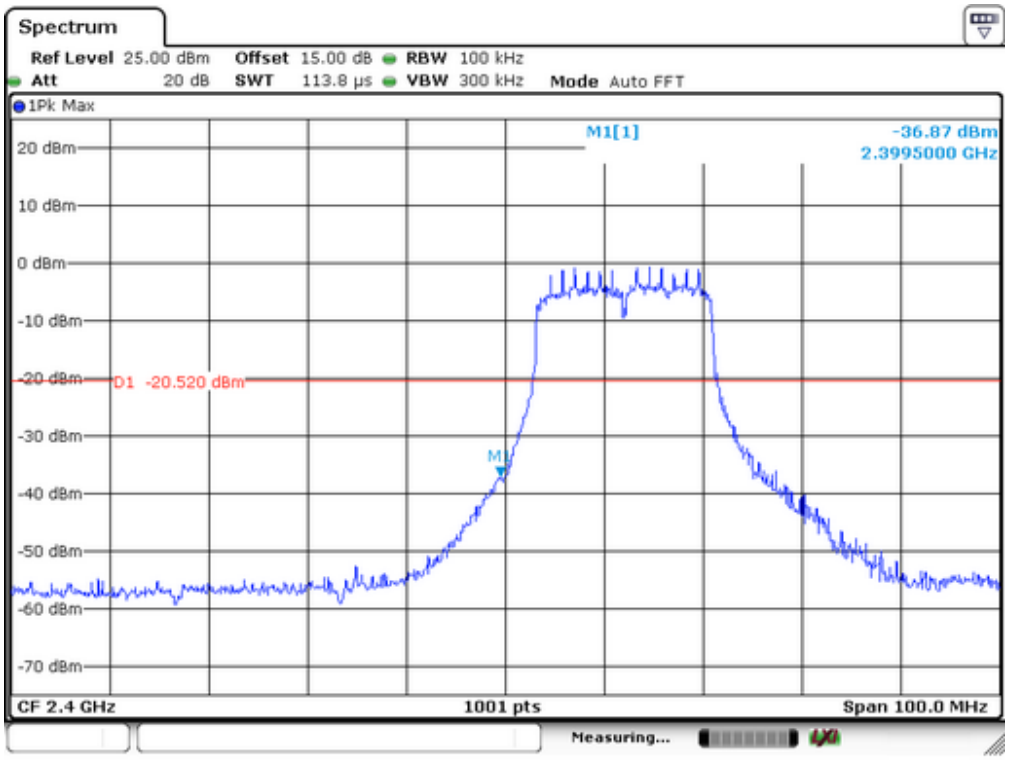


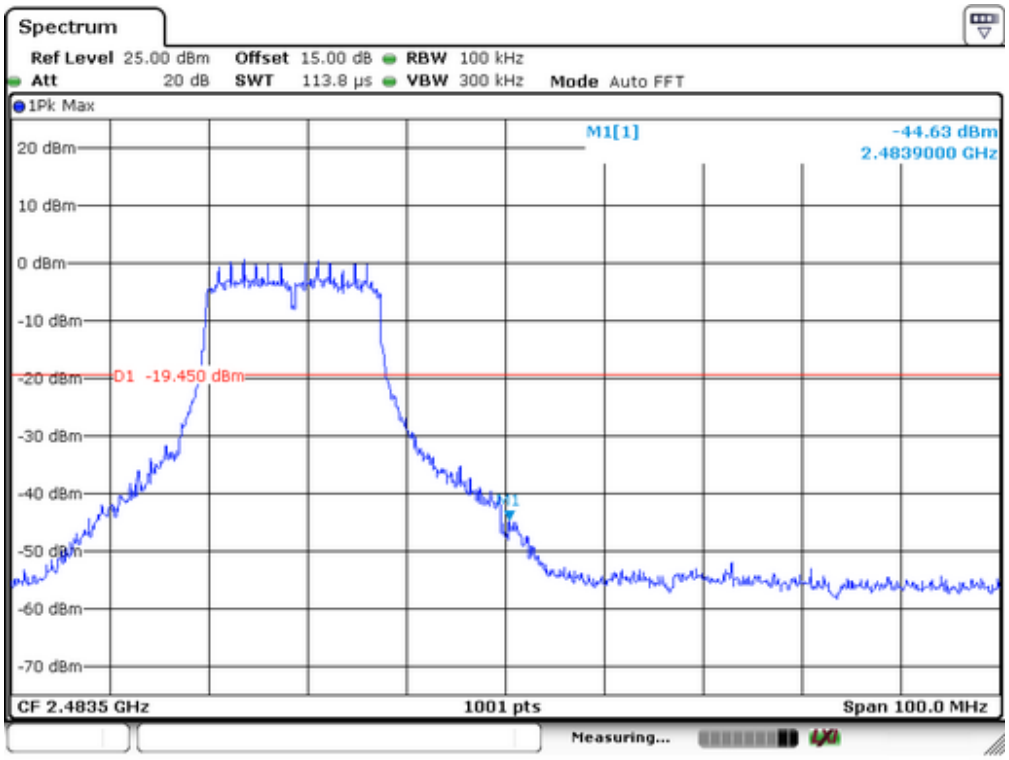
Test mode: 802.11g



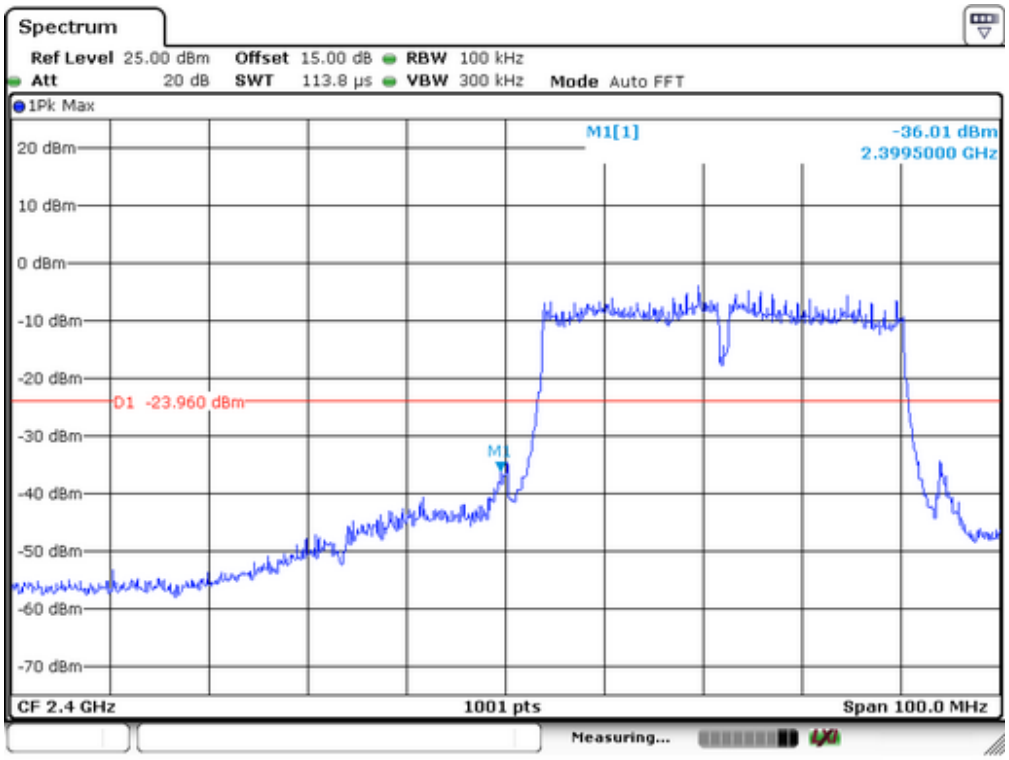


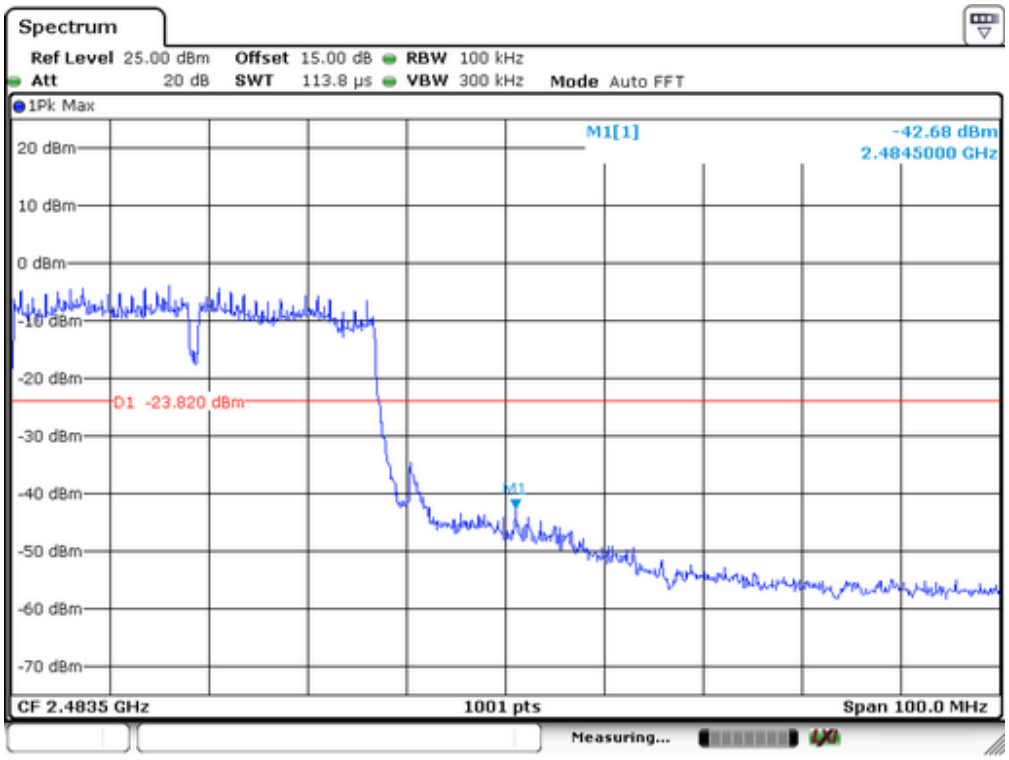
Test mode: 802.11n(HT20)





Test mode: 802.11n(HT40)





2. Radiated emission Test

Spectrum Detector:	PK/AV	Test Date :	April 30, 2015
Test By:	Andy	Temperature :	28 ℃
		Humidity :	65 %

IEEE 802.11b							
Frequency (MHz)	Antenna polarization	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Margin (dB)	
	(H/V)	PK	AV	PK	AV	PK	AV
<2400	H	64.03	45.13	74	54	-9.97	-8.87
<2400	V	60.72	40.85	74	54	-13.28	-13.15
>2483.5	H	65.13	44.31	74	54	-8.87	-9.69
>2483.5	V	59.55	38.49	74	54	-14.45	-15.51

IEEE 802.11g							
Frequency (MHz)	Antenna polarization	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Margin (dB)	
	(H/V)	PK	AV	PK	AV	PK	AV
<2400	H	65.01	44.15	74	54	-8.99	-9.85
<2400	V	60.48	40.35	74	54	-13.52	-13.65
>2483.5	H	64.33	43.92	74	54	-9.67	-10.08
>2483.5	V	59.85	38.54	74	54	-14.15	-15.46

IEEE 802.11n(HT20)							
Frequency (MHz)	Antenna polarization	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Margin (dB)	
	(H/V)	PK	AV	PK	AV	PK	AV
<2400	H	64.02	44.05	74	54	-9.98	-9.95
<2400	V	60.35	43.92	74	54	-13.65	-10.08
>2483.5	H	63.55	45.13	74	54	-10.45	-8.87
>2483.5	V	58.18	39.85	74	54	-15.82	-14.15

IEEE 802.11n(HT40)							
Frequency (MHz)	Antenna polarization	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Margin (dB)	
	(H/V)	PK	AV	PK	AV	PK	AV
<2400	H	65.15	45.13	74	54	-8.85	-8.87
<2400	V	60.35	40.25	74	54	-13.65	-13.75
>2483.5	H	64.82	44.33	74	54	-9.18	-9.67
>2483.5	V	59.85	39.58	74	54	-14.15	-14.42

10. Power Density

10.1 Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	FSV30	1321.3008K	03/16/2015	03/15/2016

10.2 Measuring Instruments and Setting

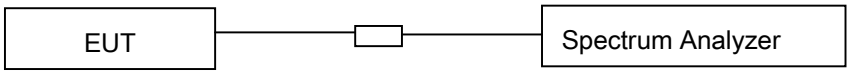
The following table is the setting of spectrum analyzer.

Spectrum analyzer	Setting
Attenuation	Auto
Span Frequency	Set the span to 1.5 times the DTS bandwidth.
RB	100KHz
VB	300KHz
Detector	Peak
Trace	Max hold
Sweep Time	Automatic

10.3 Test Procedures

a. The transmitter output (antenna port) was connected to the spectrum analyzer.
b. Set analyzer center frequency to DTS channel center frequency.
c. Set the analyzer span to a minimum of 1.5 times the DTS bandwidth.
d. Set the RBW=100KHz. Set the VBW=300KHz
e. Detector = peak.
f. Sweep time = auto couple.
g. Trace mode = max hold.
h. Allow trace to fully stabilize.
i. Use the peak marker function to determine the maximum amplitude level.

10.4 Block Diagram of Test Setup



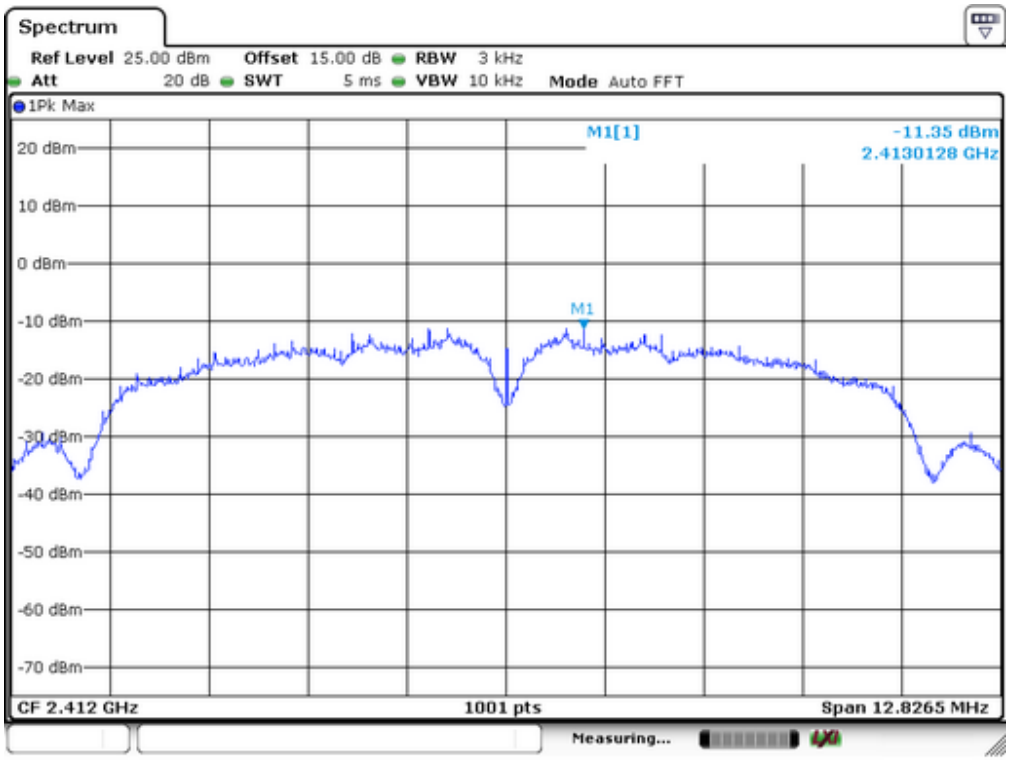
10.5 Limit

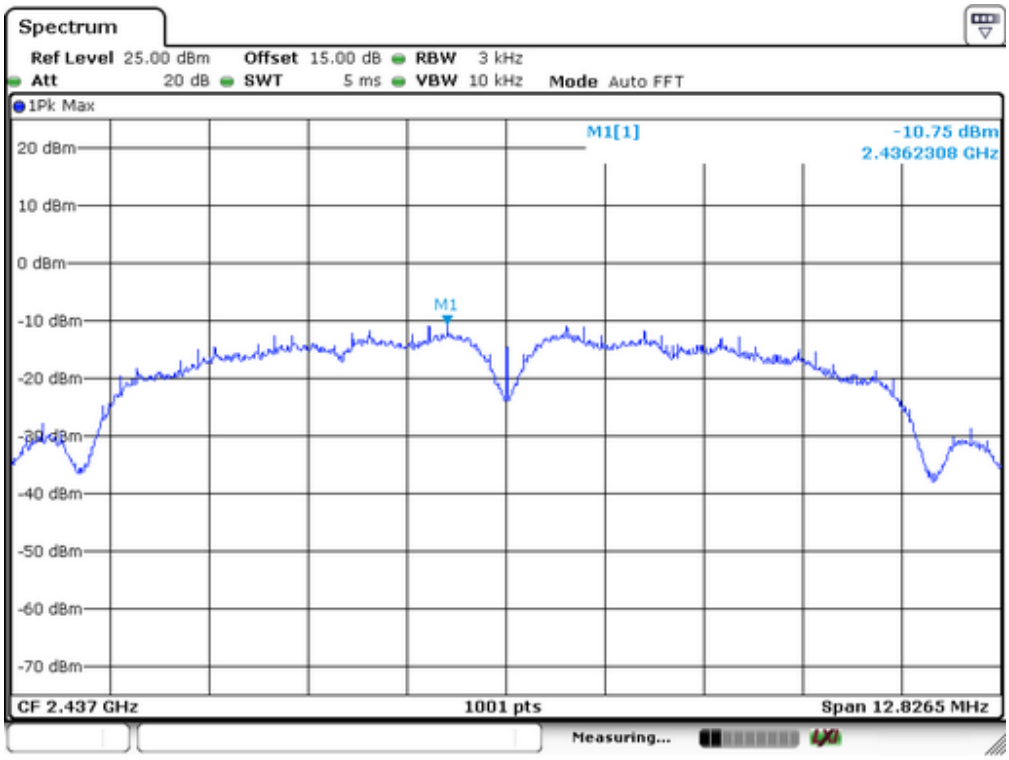
The transmitted power density averaged over any 1 second interval shall not be greater +8dBm in any 3 kHz bandwidth.

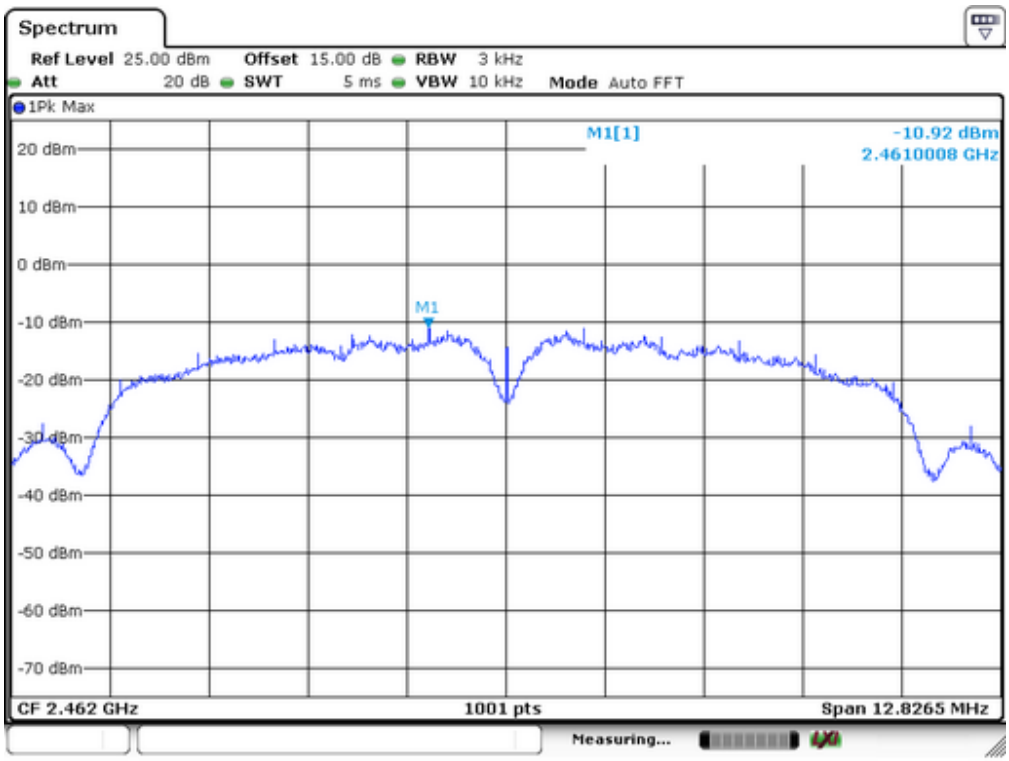
10.6 Test Result

Spectrum Detector:	PK	Test Date :	April 30, 2015
Test By:	Andy	Temperature :	28℃
		Humidity :	60%

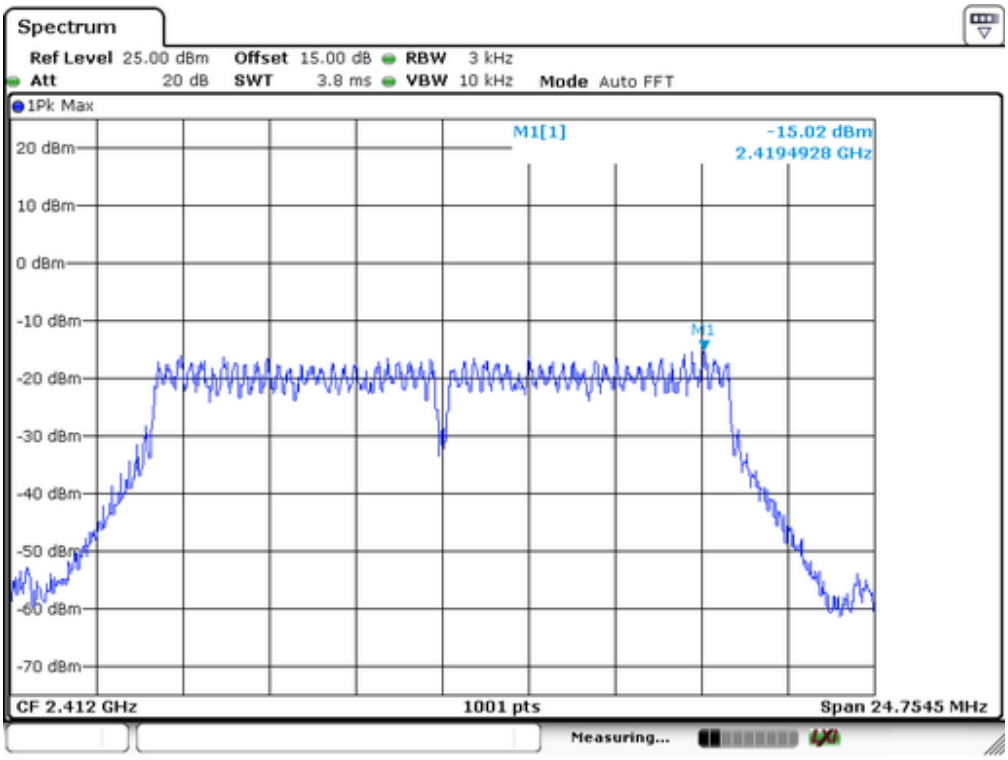
IEEE 802.11b			
Channel frequency (MHz)	Measurement level (dBm)	Limit(dBm)	Result
2412	-11.35	8	Pass
2437	-10.75		
2462	-10.92		

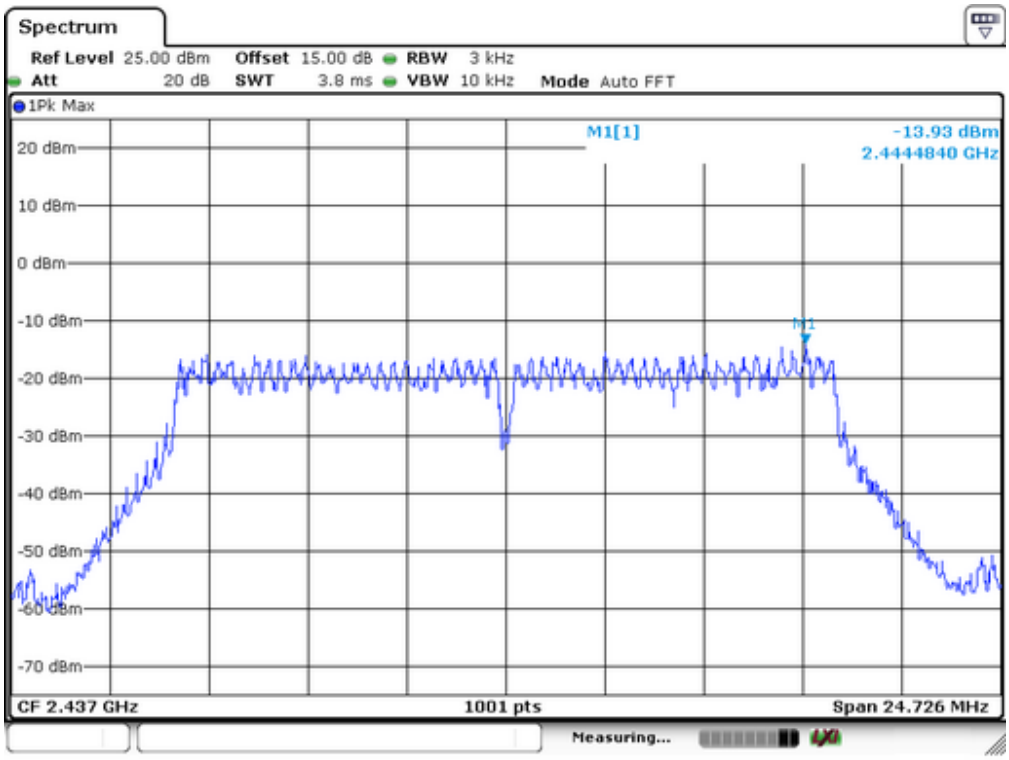


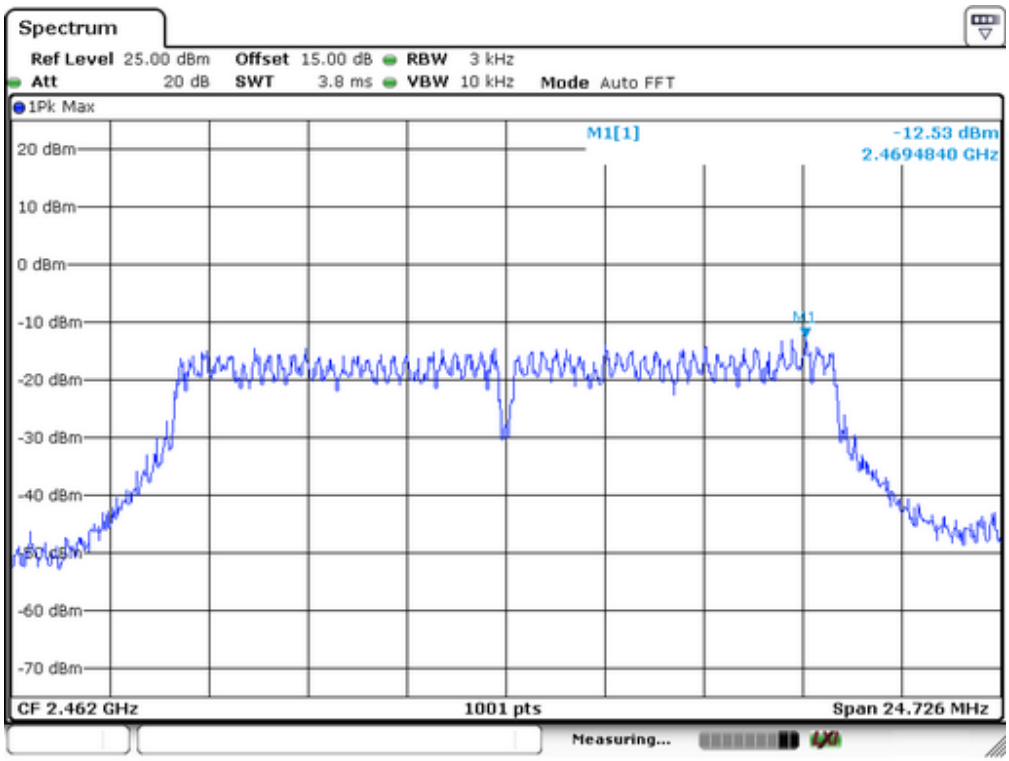

Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 3 kHz
Att 20 dB SWT 5 ms VBW 10 kHz Mode Auto FFT
1Pk Max
M1[1] -10.75 dBm
2.4362308 GHz
M1
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.437 GHz
1001 pts
Span 12.8265 MHz
Measuring...


Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 3 kHz
Att 20 dB SWT 5 ms VBW 10 kHz Mode Auto FFT
1Pk Max
M1[1] -10.92 dBm
2.4610008 GHz
M1
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.462 GHz
1001 pts
Span 12.8265 MHz
Measuring...

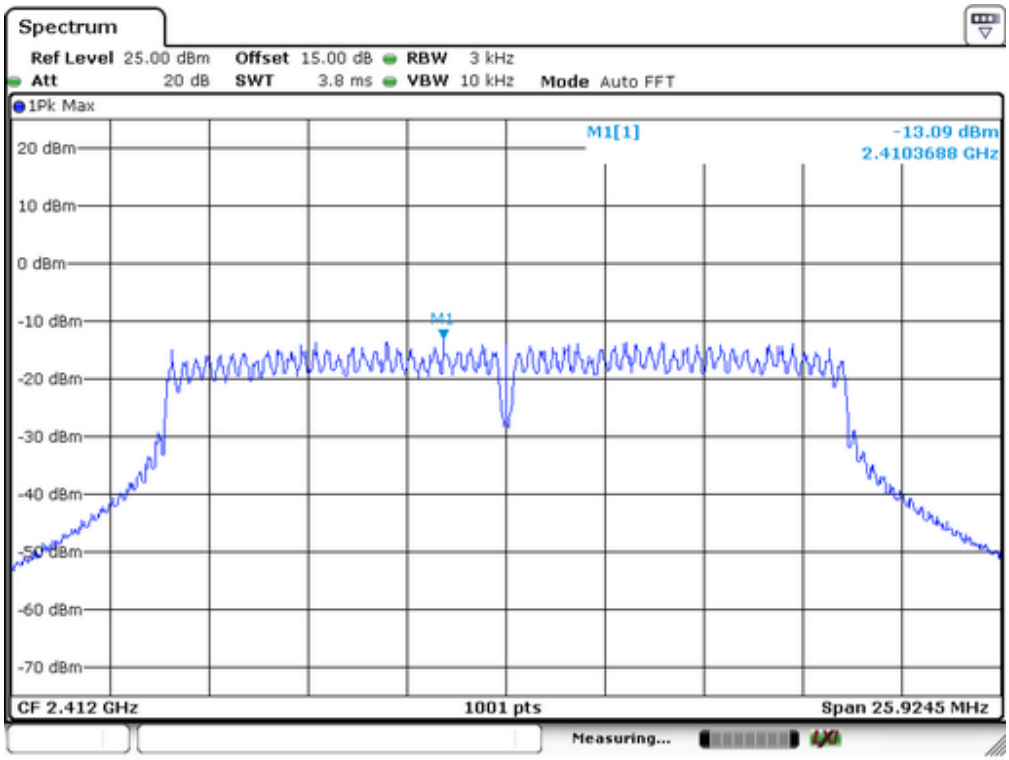
IEEE 802.11g			
Channel frequency (MHz)	Measurement level (dBm)	Limit(dBm)	Result
2412	-15.02	8	Pass
2437	-13.93		
2462	-12.53		

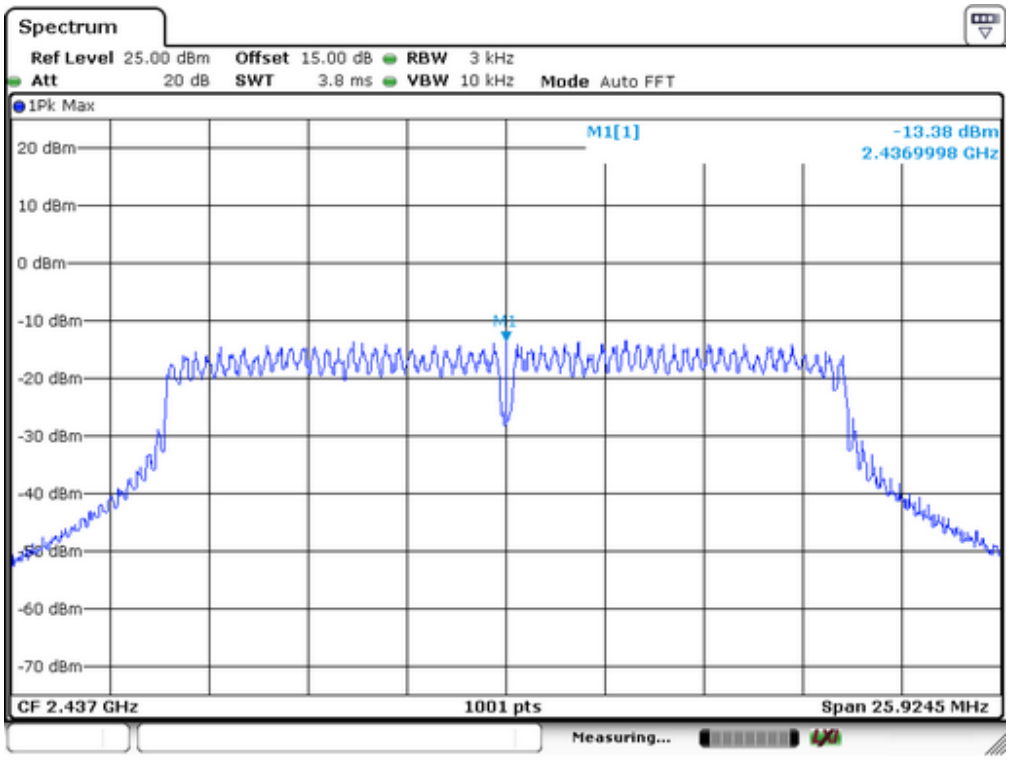


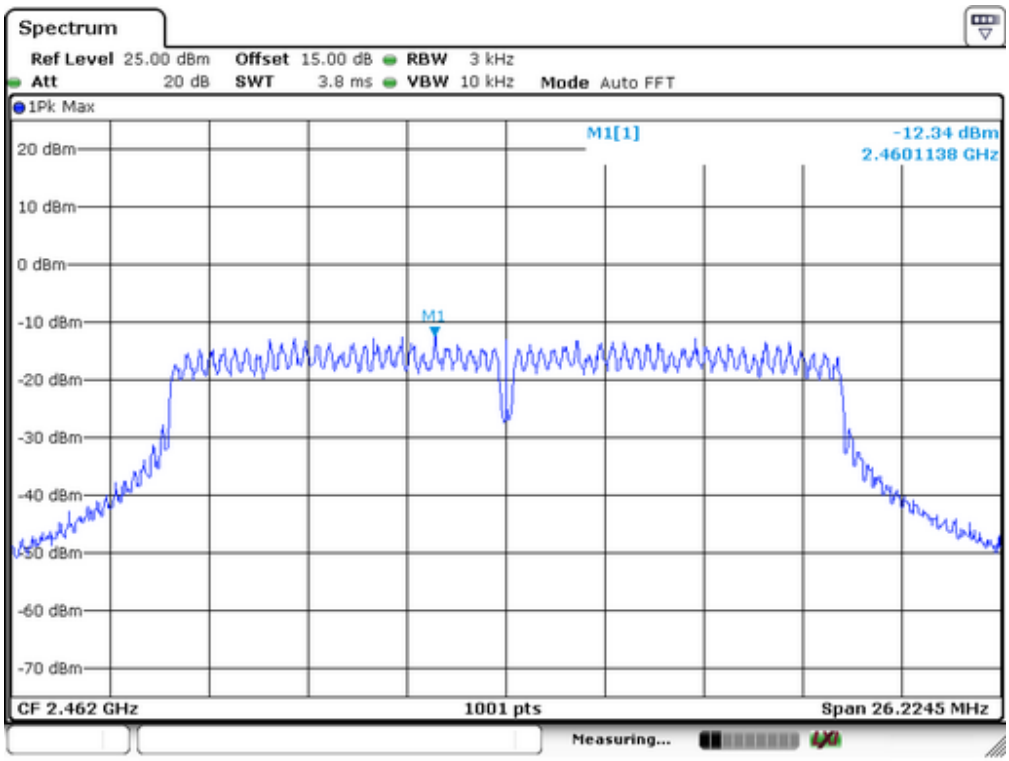

Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 3 kHz
Att 20 dB SWT 3.8 ms VBW 10 kHz Mode Auto FFT
1Pk Max
M1[1]
-13.93 dBm
2.4444840 GHz
M1
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.437 GHz
1001 pts
Span 24.726 MHz
Measuring...


Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 3 kHz
Att 20 dB SWT 3.8 ms VBW 10 kHz Mode Auto FFT
1Pk Max
M1[1]
-12.53 dBm
2.4694840 GHz
M1
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.462 GHz
1001 pts
Span 24.726 MHz
Measuring...

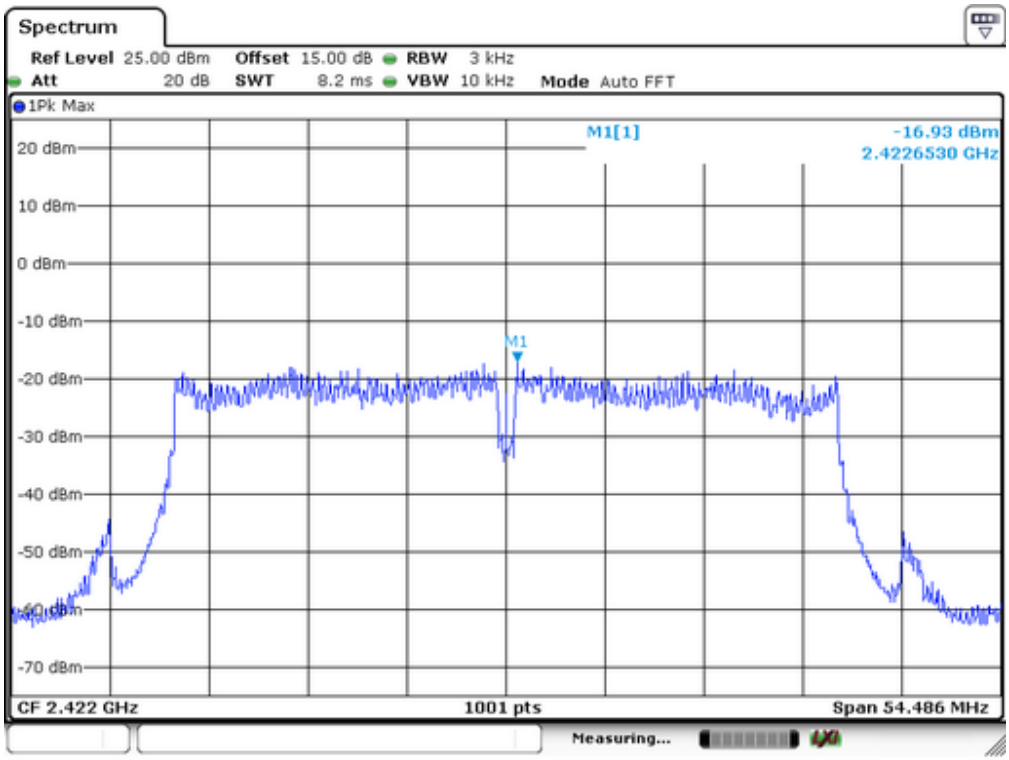
IEEE 802.11n(HT20)			
Channel frequency (MHz)	Measurement level (dBm)	Limit(dBm)	Result
2412	-13.09	8	Pass
2437	-13.38		
2462	-12.34		

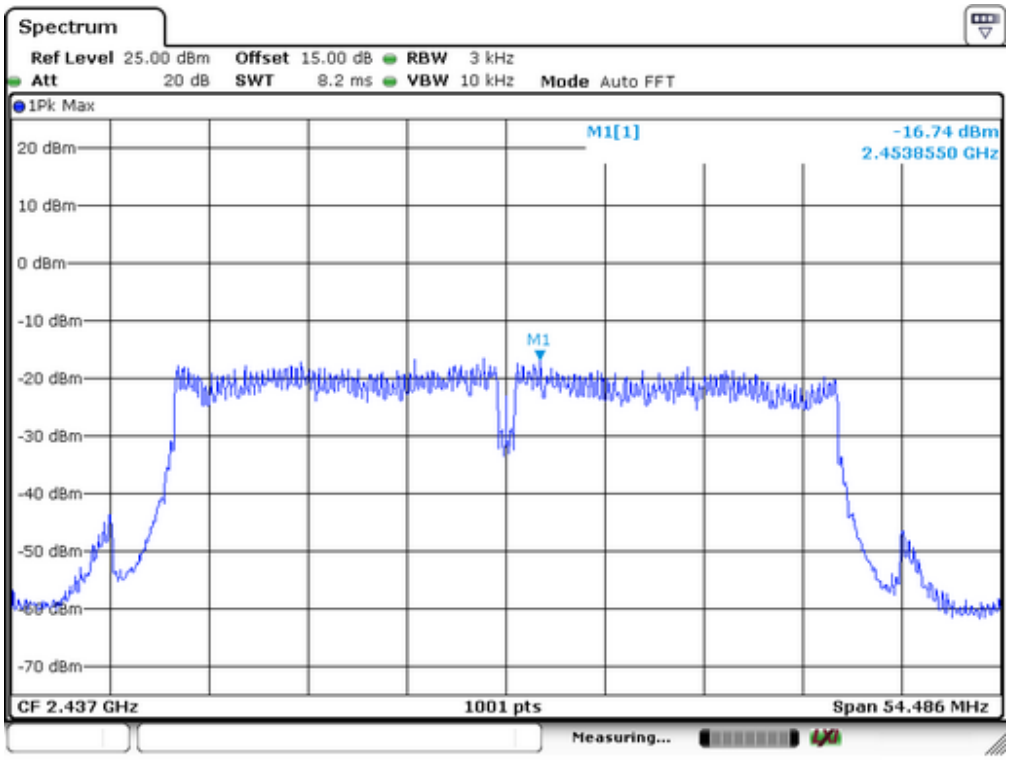


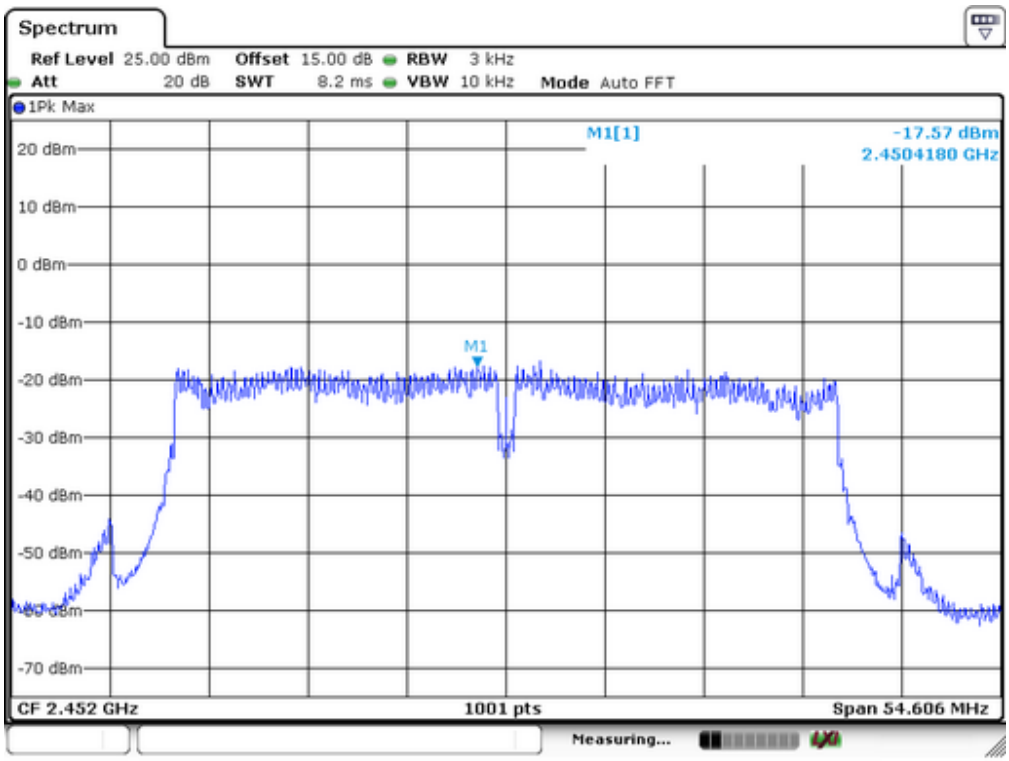

Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 3 kHz
Att 20 dB SWT 3.8 ms VBW 10 kHz Mode Auto FFT
1Pk Max
M1[1] -13.38 dBm
2.4369998 GHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
CF 2.437 GHz
1001 pts
Span 25.9245 MHz
Measuring...


Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 3 kHz
Att 20 dB SWT 3.8 ms VBW 10 kHz Mode Auto FFT
1Pk Max
M1[1] -12.34 dBm
2.4601138 GHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
CF 2.462 GHz
1001 pts
Span 26.2245 MHz
Measuring...

IEEE 802.11n(HT40)			
Channel frequency (MHz)	Measurement level (dBm)	Limit(dBm)	Result
2422	-16.93	8	Pass
2437	-16.74		
2452	-17.57		




Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 3 kHz
Att 20 dB SWT 8.2 ms VBW 10 kHz Mode Auto FFT
1Pk Max
M1[1] -16.74 dBm
2.4538550 GHz
M1
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.437 GHz
1001 pts
Span 54.486 MHz
Measuring...


Spectrum
Ref Level 25.00 dBm Offset 15.00 dB RBW 3 kHz
Att 20 dB SWT 8.2 ms VBW 10 kHz Mode Auto FFT
1Pk Max
M1[1] -17.57 dBm
2.4504180 GHz
M1
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.452 GHz
1001 pts
Span 54.606 MHz
Measuring...

11. Antenna Port Emission

11.1 Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Spectrum Analyzer	Agilent	FSV30	1321.3008K	03/16/2015	03/15/2016

11.2 Measuring Instruments and Setting

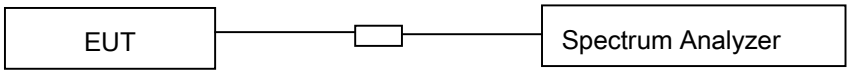
The following table is the setting of spectrum analyzer.

Spectrum analyzer	Setting
Attenuation	Auto
RB	100kHz
VB	300kHz
Detector	Peak
Trace	Max hold

11.3 Test Procedures

The conducted spurious emissions were measured conducted using a spectrum analyzer at low, Middle, and high channels, the limit was determined by attenuation 20dB of the RF peak power output.

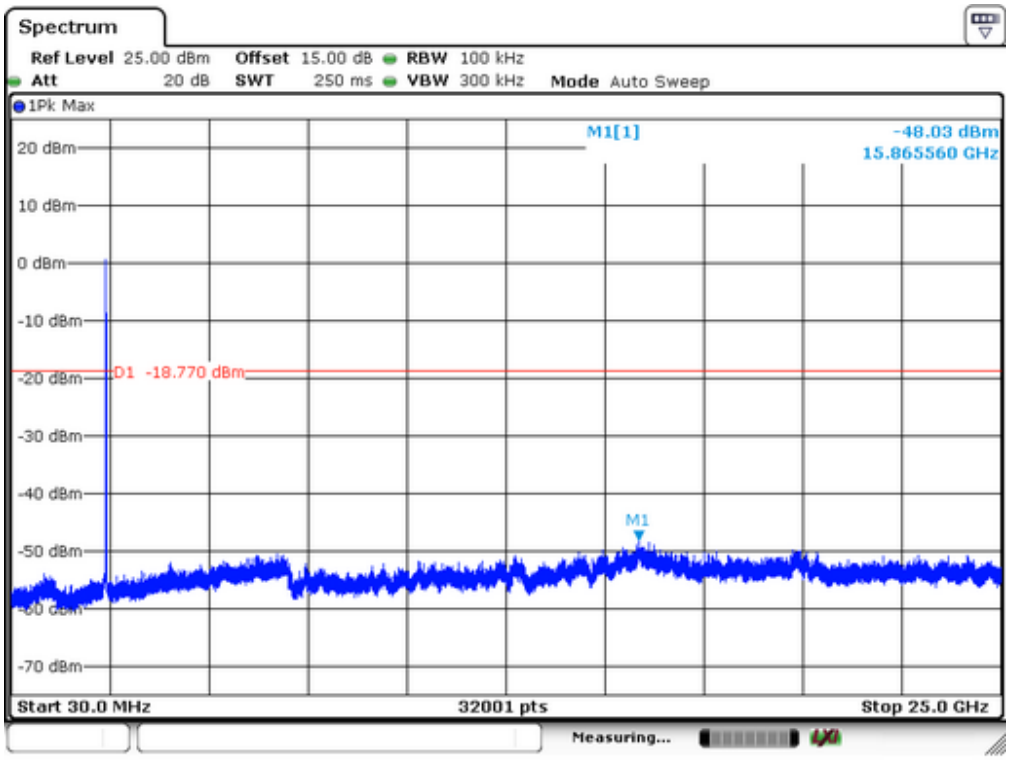
11.4 Block Diagram of Test setup



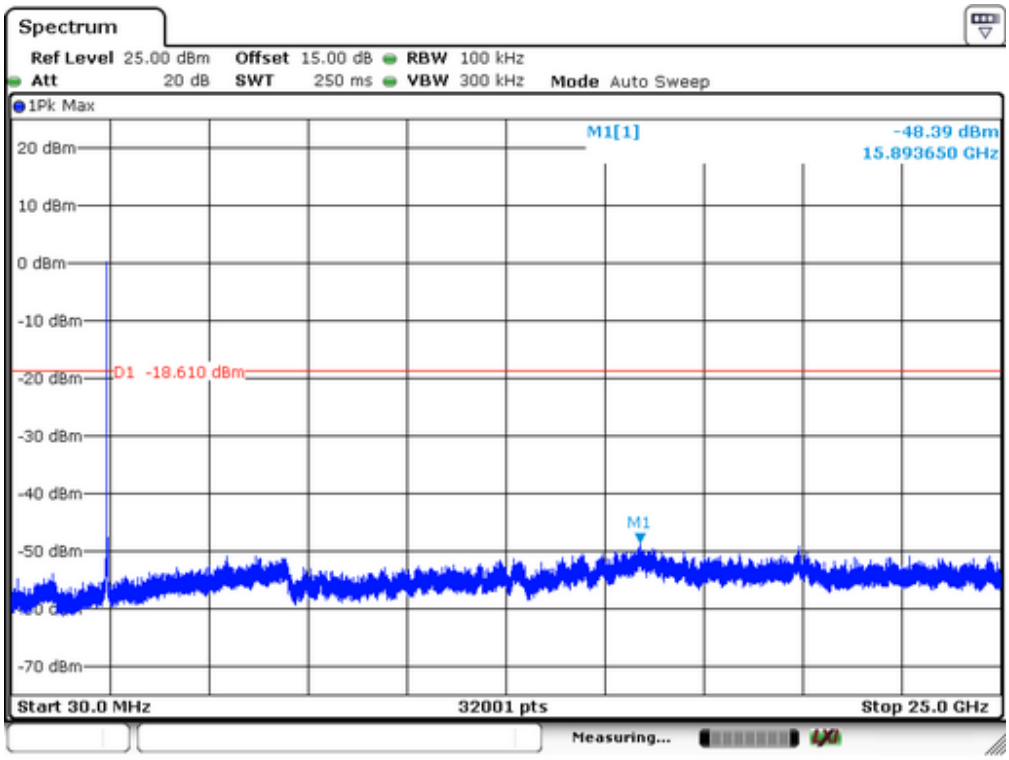
11.5 Test Result

PASS.

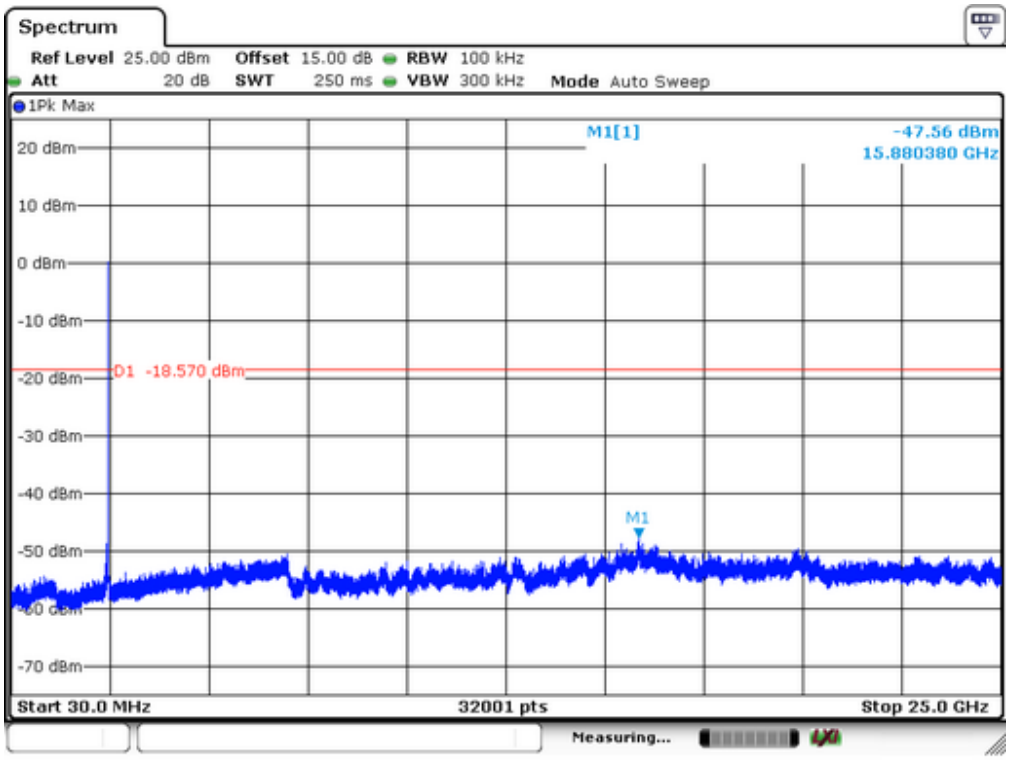
Test Mode: 802.11b



Lowest Channel

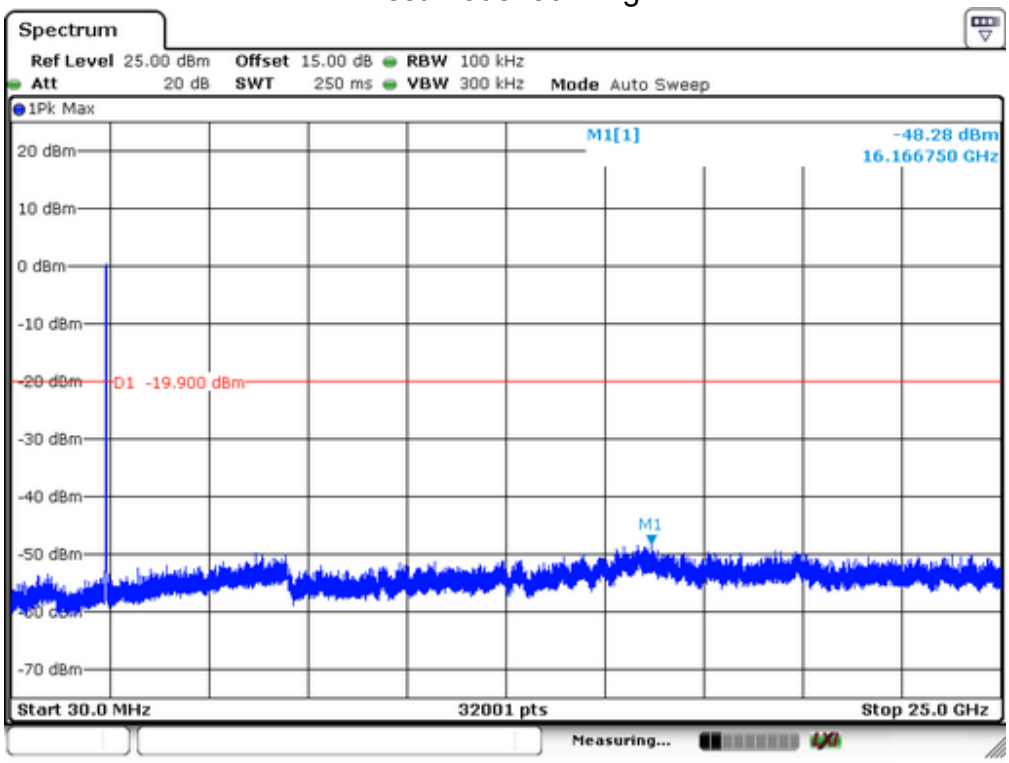


Middel Channel

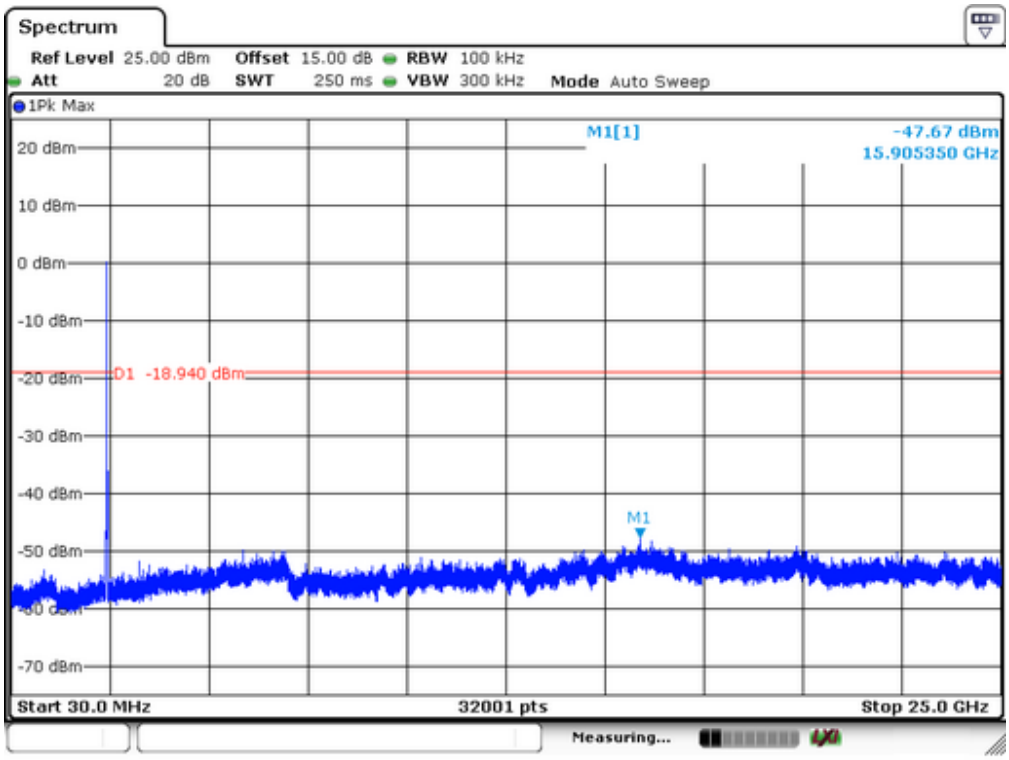


Highest Channel

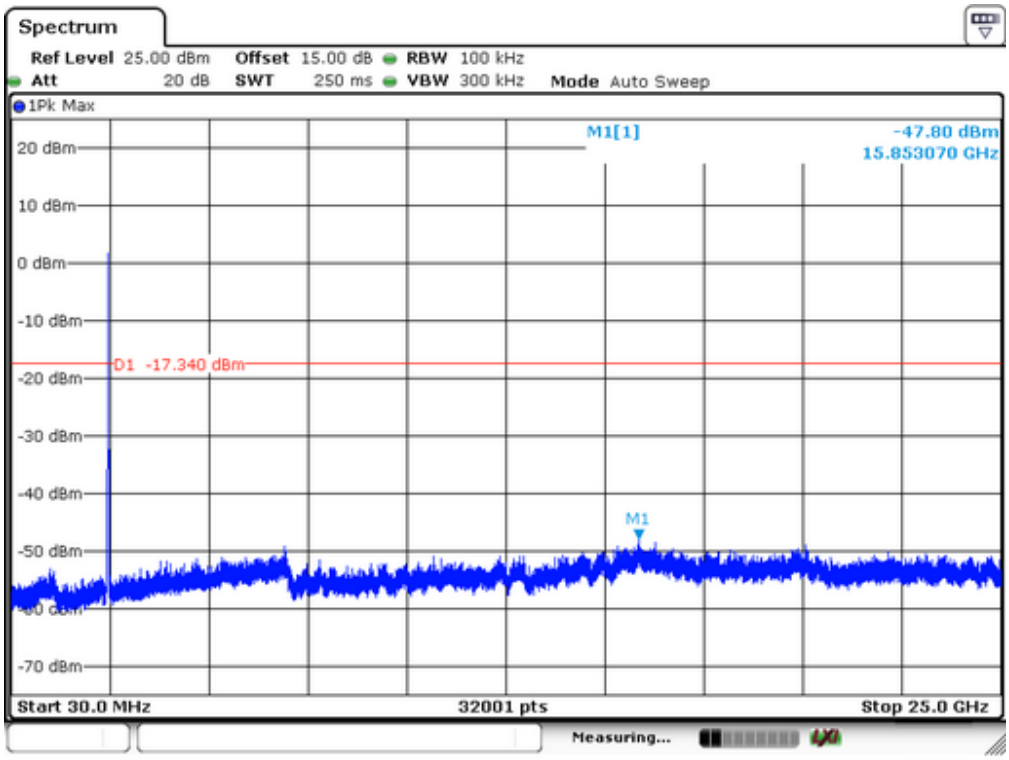
Test Mode: 802.11g



Lowest Channel

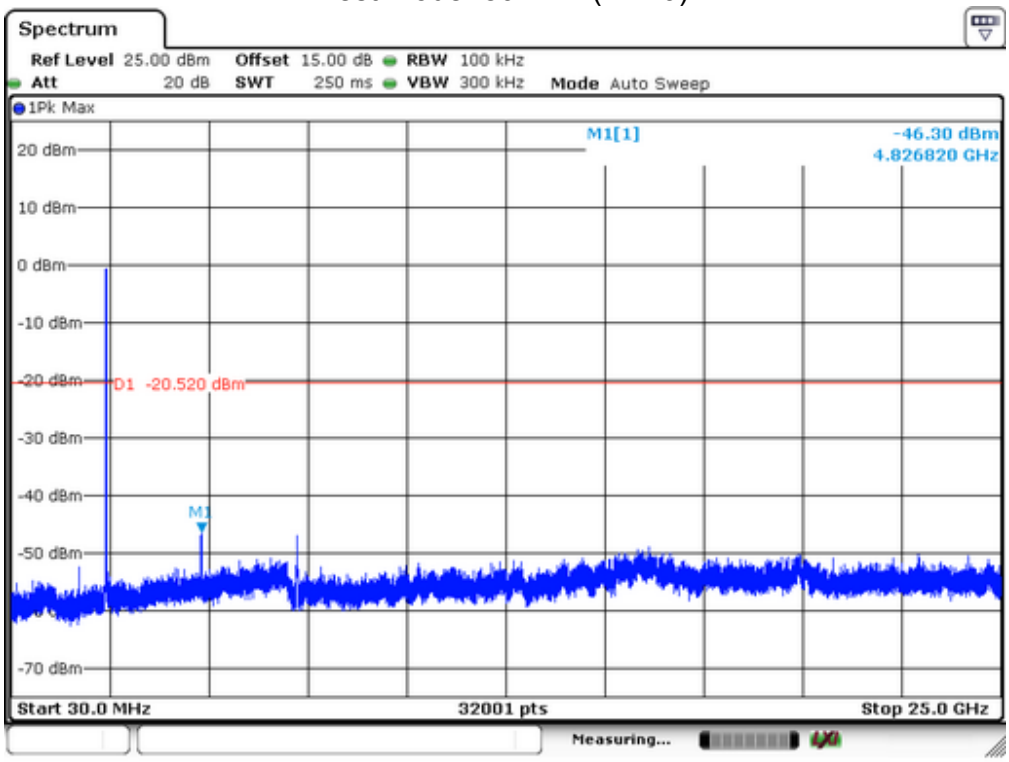


Middle Channel

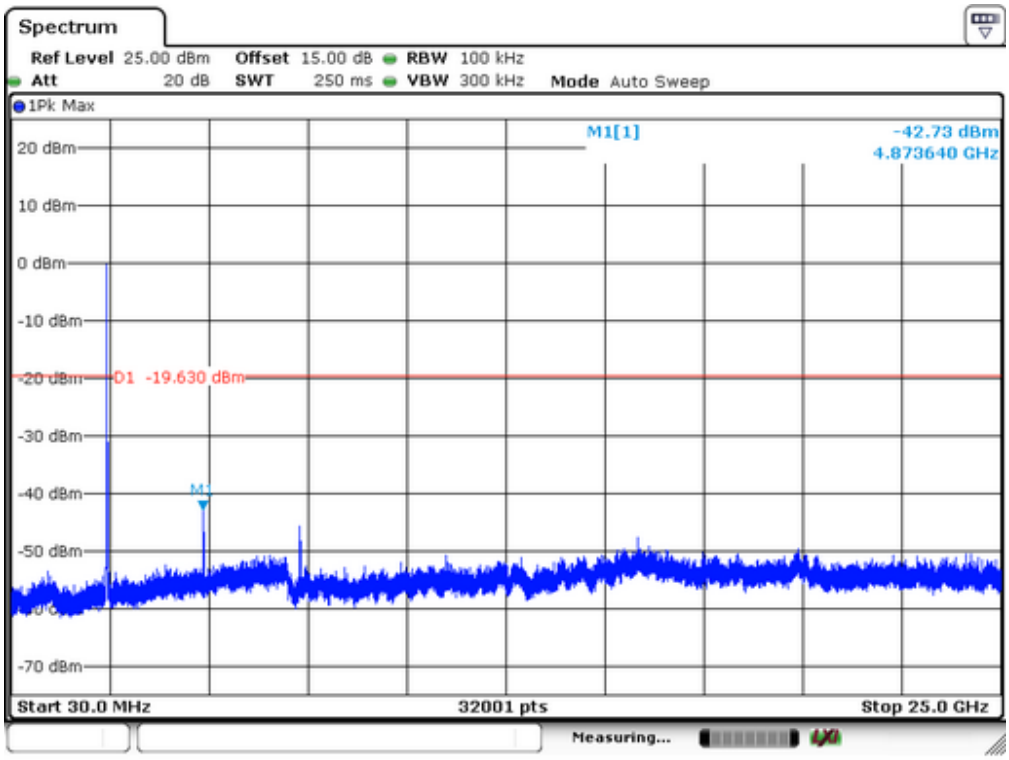


Highest Channel

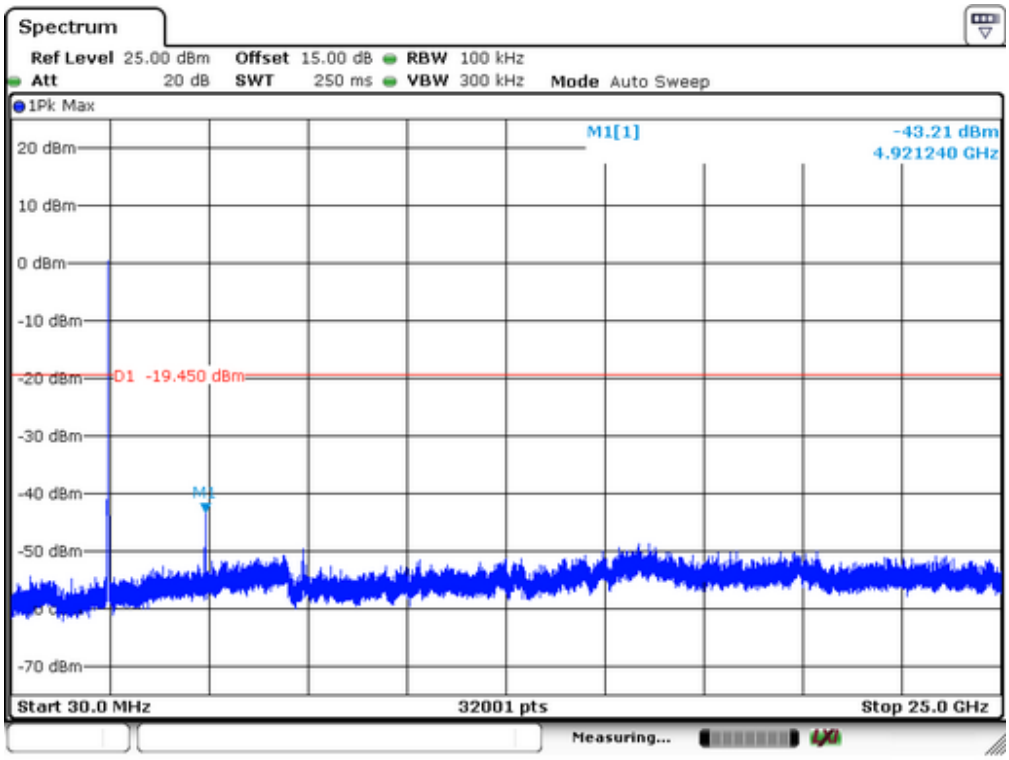
Test Mode: 802.11n(HT20)



Lowest Channel

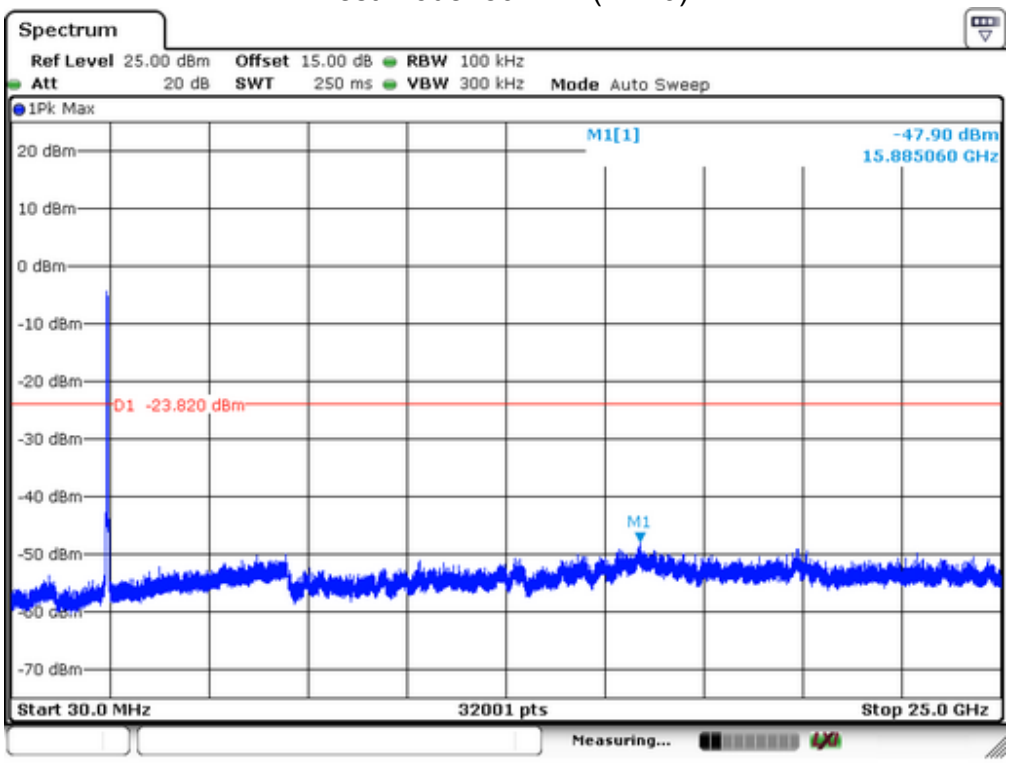


Middle Channel

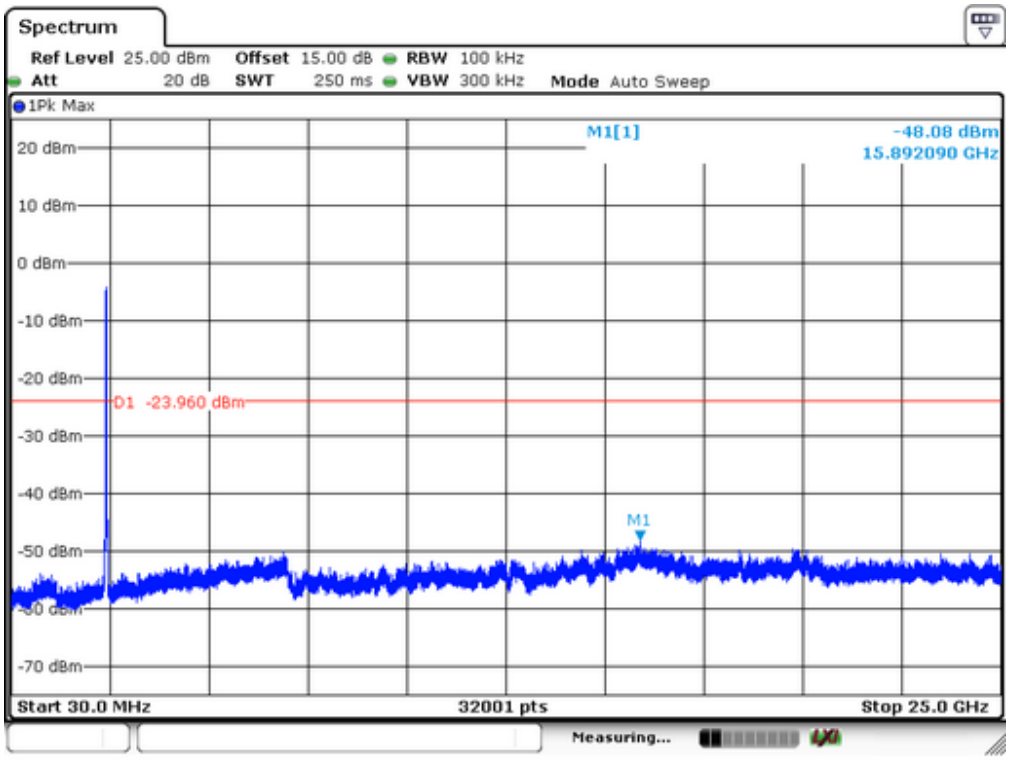


Highest Channel

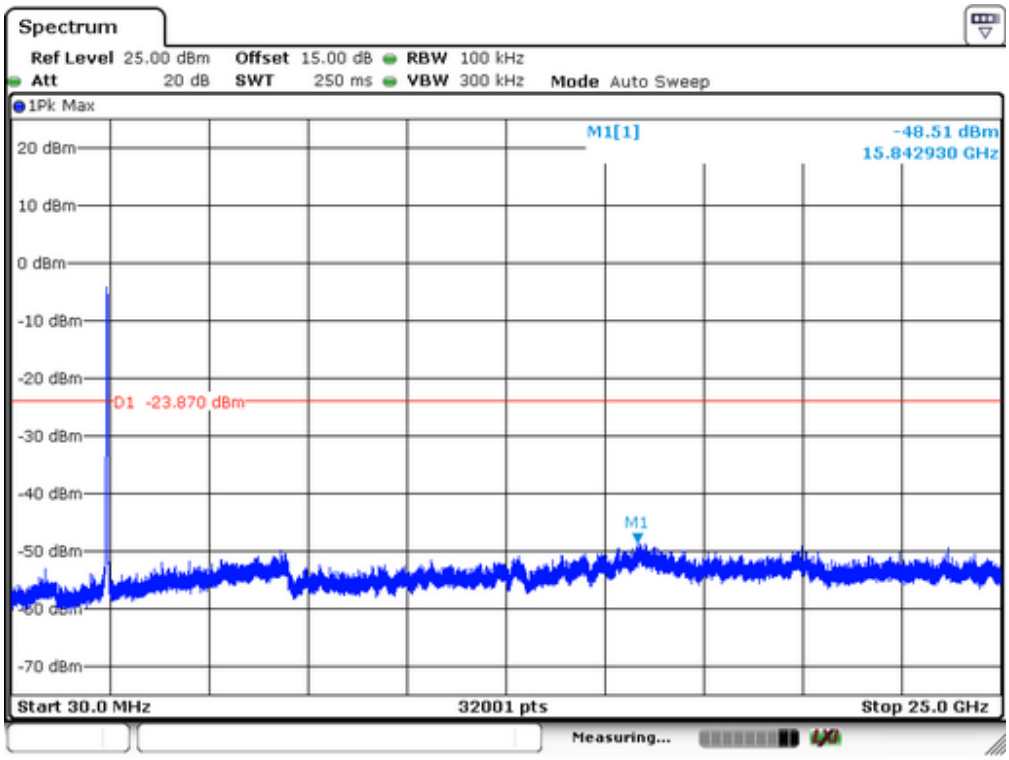
Test Mode: 802.11n(HT40)



Lowest Channel



Middle Channel



Highest Channel

12. Antenna Application

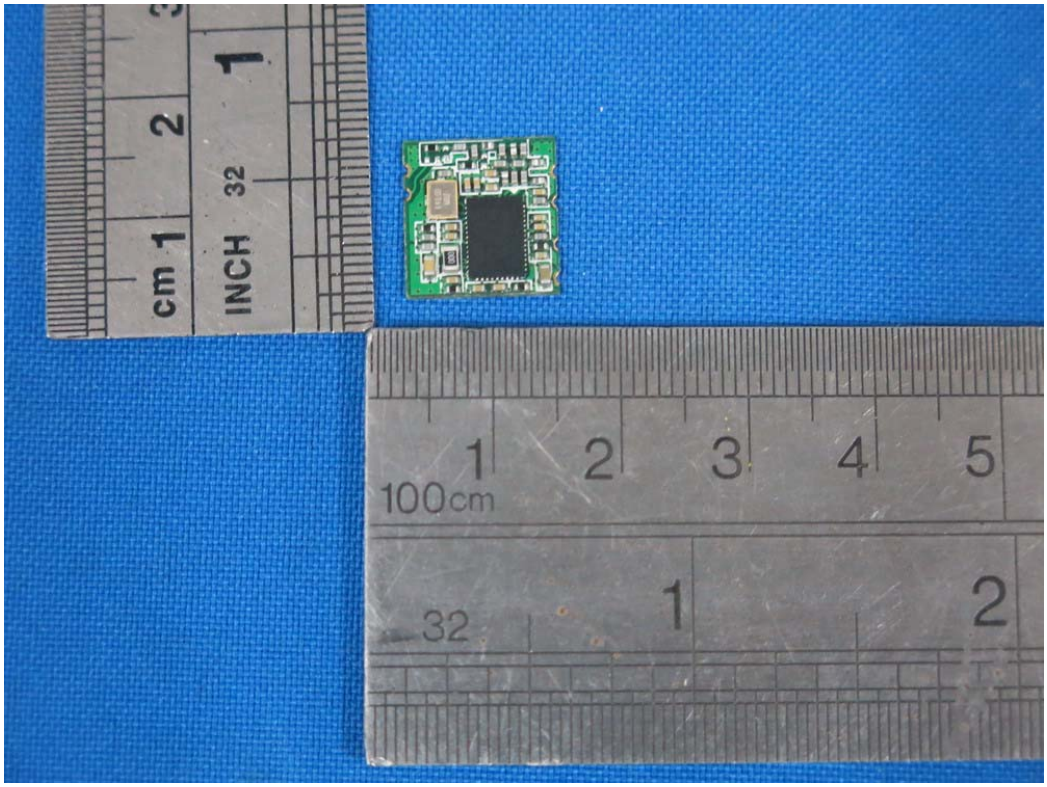
12.1 Antenna Requirement

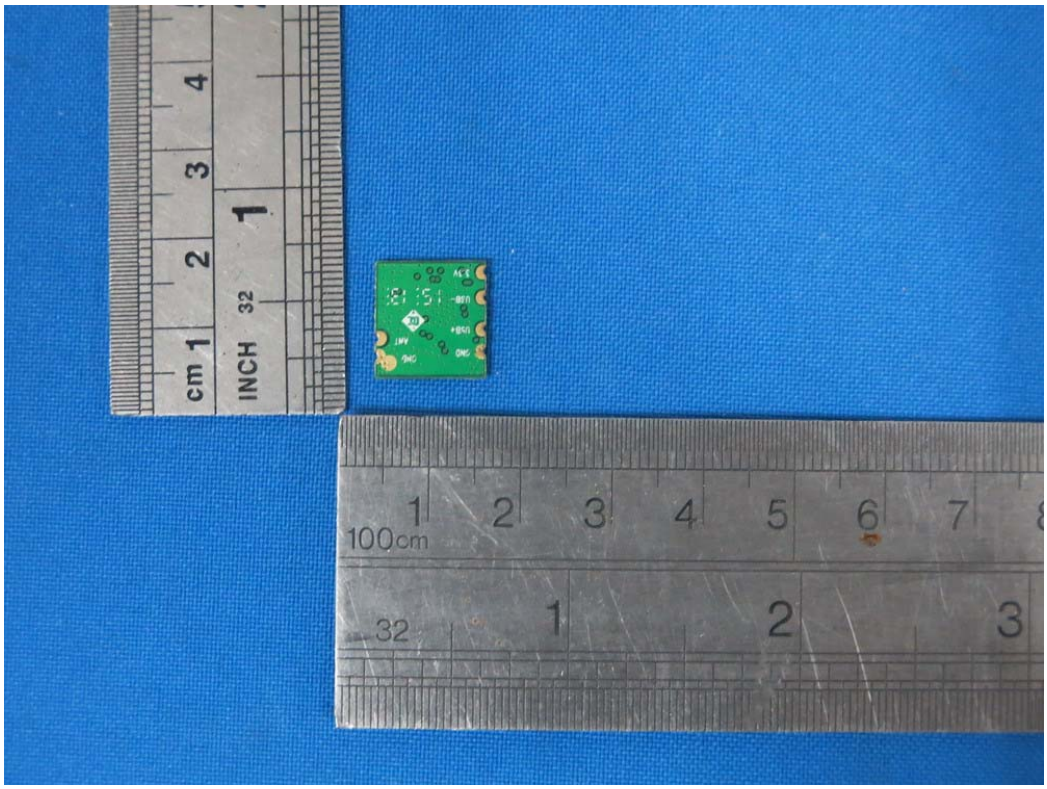
For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

12.2 Result

The EUT'S antenna, permanent attached antenna, is an external antenna. The antenna's gain is 2dBi and meets the requirement.

APPENDIX I
(PHOTOS OF EUT)


cm 1 2 3
INCH 32 1
100cm 1 2 3 4 5
32 1 2


cm 1 2 3 4
INCH 32 1
100cm 1 2 3 4 5 6 7
32 1 2 3