FCC TEST REPORT

FCC ID: 2ARM8-LBPWVNA1

Product	:	LAMBOT Robotic Vacuum Cleaner
Model Name	:	LBPWVNA1, LBPBVNA1, LBPPVNA1, LBPCVNA1, LBPAVNA1, LBPRVNA1, LBPGVNA1, LBPYVNA1, LBPOVNA1, LBPTVNA1, LBPVVNA1, LBPSVNA1,LBPNVNA1, LBPLVNA1, LBPDVNA1, LBPFVNA1, LBPHVNA1, LBPIVNA1, IHPPWNA1, IHPPBNA1, IHPPPNA1, IHPPCNA1, IHPPANA1, IHPPRNA1, IHPPGNA1, IHPPYNA1, IHPPONA1, IHPPTNA1, IHPPVNA1, IHPPSNA1, IHPPNNA1, IHPPLNA1, IHPPDNA1, IHPPFNA1, IHPPHNA1
Brand	:	LAMBOT
Report No.	:	PTC18091919601E-FC02

Prepared for

Shanghai Lambot Intelligent Co., Ltd.

Building C, NO 888, West 2nd Huanhu Road, Nanhui New Town, Pudong New District, Shanghai, China

Prepared by

Dongguan Precise Testing & Certification Corp., Ltd.

Building D, Baoding Technology Park, Guangming Road 2, Guangming Community, Dongcheng District, Dongguan, Guangdong, China

1 TEST RESULT CERTIFICATION

Applicant's name	:	Shanghai Lambot Intelligent Co., Ltd.
Address	:	Building C, NO 888, West 2nd Huanhu Road, Nanhui New Town, Pudong New District, Shanghai, China
Manufacture's name	:	Shanghai Lambot Intelligent Co., Ltd.
Address	:	Building C, NO 888, West 2nd Huanhu Road, Nanhui New Town, Pudong New District, Shanghai, China
Product name	:	LAMBOT Robotic Vacuum Cleaner
Model name	:	LBPWVNA1, LBPBVNA1, LBPPVNA1, LBPCVNA1, LBPAVNA1, LBPRVNA1, LBPGVNA1, LBPYVNA1, LBPOVNA1, LBPTVNA1, LBPVVNA1, LBPSVNA1, LBPNVNA1, LBPLVNA1, LBPDVNA1, LBPFVNA1, LBPHVNA1, LBPIVNA1, IHPPWNA1, IHPPBNA1, IHPPPNA1, IHPPCNA1, IHPPANA1, IHPPRNA1, IHPPGNA1, IHPPYNA1, IHPPONA1, IHPPTNA1, IHPPVNA1, IHPPSNA1, IHPPNNA1, IHPPLNA1, IHPPDNA1, IHPPFNA1, IHPPHNA1
Standards	:	FCC CFR47 Part 15 Section 15.247
Test procedure	:	ANSI C63.10:2013
Test Date	:	October 10, 2018 to November 09, 2018
Date of Issue	:	November 09, 2018
Test Result	:	Pass

This device described above has been tested by PTC, and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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Test Engineer:

Leo Yang / Engineer

Technical Manager:

Chris Du / Manager

Contents

2 Test Summary

Test Items	Test Requirement	Result
Conduct Emission	15.207	PASS
Radiated Spurious Emissions	15.205(a) 15.209 15.247(d)	PASS
Band edge	15.247(d) 15.205(a)	PASS
6dB Bandwidth	15.247(a)(2)	PASS
Maximum Peak Output Power	15.247(b)(1)	PASS
Power Spectral Density	15.247(e)	PASS
Antenna Requirement	15.203	PASS

Remark:

1. The EUT is powered by full-charged battery during the test.

3 General Information

3.1 General Description of E.U.T.

Product Name	:	LAMBOT Robotic Vacuum Cleaner
Model Name	:	LBPWVNA1, LBPBVNA1, LBPPVNA1, LBPCVNA1, LBPAVNA1, LBPRVNA1, LBPGVNA1, LBPYVNA1, LBPOVNA1, LBPTVNA1, LBPVVNA1, LBPSVNA1, LBPNVNA1, LBPLVNA1, LBPDVNA1, LBPFVNA1, LBPHVNA1, LBPIVNA1, IHPPWNA1, IHPPBNA1, IHPPPNA1, IHPPCNA1, IHPPANA1, IHPPRNA1, IHPPGNA1, IHPPYNA1, IHPPONA1, IHPPTNA1, IHPPVNA1, IHPPSNA1, IHPPNNA1, IHPPLNA1, IHPPDNA1, IHPPFNA1, IHPPHNA1 (Note: The samples are the same except appearance and model number. So LBPWVNA1 was selected for full tested.)
Equipment Type	:	DTS
Specification	:	802.11b/g/n (HT20)/n (HT40) BLE
Operation Frequency	:	2.4G Wi-Fi: 2412-2462MHz for 802.11b/g/n (HT20) 2422-2452MHz for 802.11n (HT40) BLE: 2402-2480MHz
Number of Channel	:	802.11b/g/n(HT20): 11 Channels 802.11n(HT40): 7 Channels BLE: 40 Channels
Type of Modulation	:	802.11b/g/n: DSSS, OFDM BLE: GFSK
Antenna installation	:	Internal Antenna
Antenna Gain	:	3 dBi
Power supply	:	AC 100-240V,50/60Hz
Hardware Version	:	STC-B0254-R05
Software Version	:	2.6.0_599_dev-sdp_vre-20180923

3.2 Channel List

The system was configured for testing in testing mode, which was provided by manufacturer.

Wi-Fi, Frequency and Channel list :

802.11b/g/n(HT20)		802.11n(HT40)	
Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	**2412**	1	--
2	2417	2	--
3	2422	**3**	**2422**
4	2427	4	2427
5	2432	5	2432
6	**2437**	**6**	**2437**
7	2442	7	2442
8	2447	8	2447
9	2452	**9**	**2452**
10	2457	10	--
11	**2462**	11	--

For Bluetooth LE mode, 40 channels are provided for testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	**2402**	14	2430	28	2458
01	2404	15	2432	29	2460
02	2406	16	2434	30	2462
03	2408	17	2436	31	2464
04	2410	18	2438	32	2466
05	2412	**19**	**2440**	33	2468
06	2414	20	2442	34	2470
07	2416	21	2444	35	2472
08	2418	22	2446	36	2474
09	2420	23	2448	37	2476
10	2422	24	2450	38	2478
11	2424	25	2452	39	**2480**
12	2426	26	2454		
13	2428	27	2456		

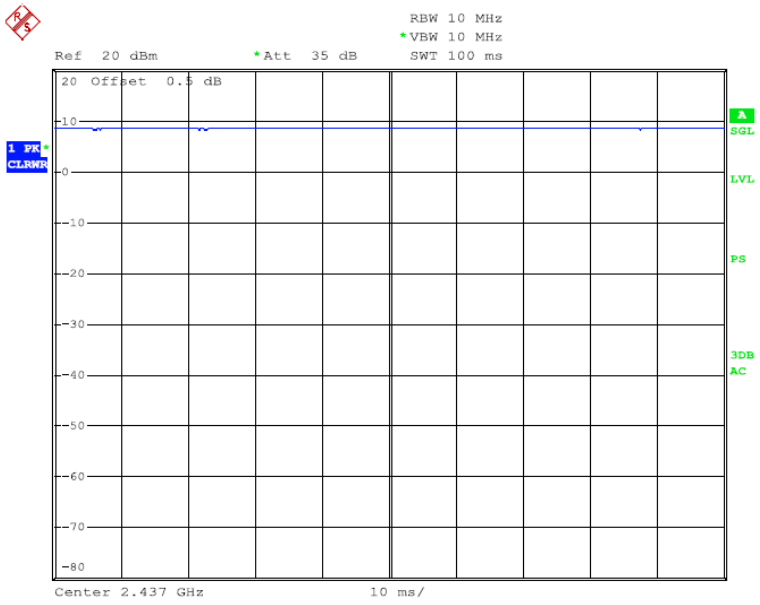
EUT was tested with channel 0, 19 and 39.

The maximum duty cycle as following table:

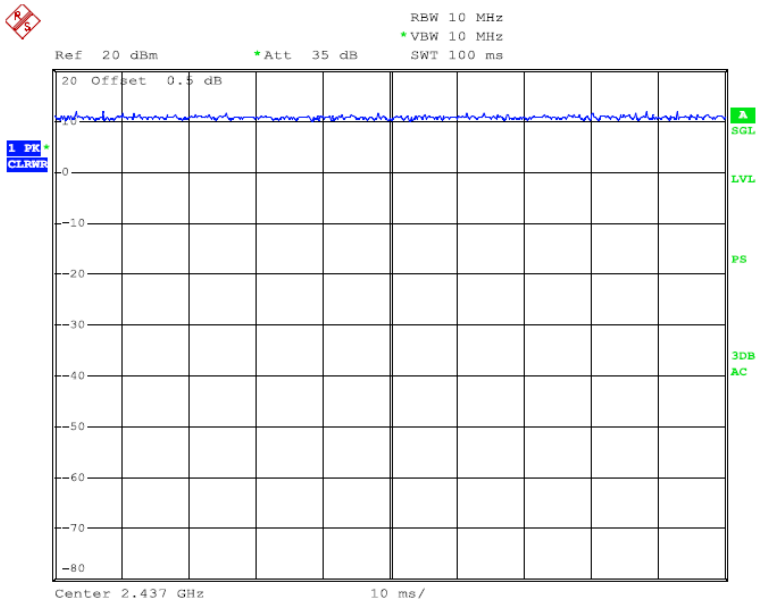
Test Mode	T_{on}(ms)	T_{on+off}(ms)	Duty Cycle(%)
802.11b	100	100	100%
802.11g	100	100	100%
802.11n(HT20)	100	100	100%
BLE	5.0	5.0	100%

Test Plots:

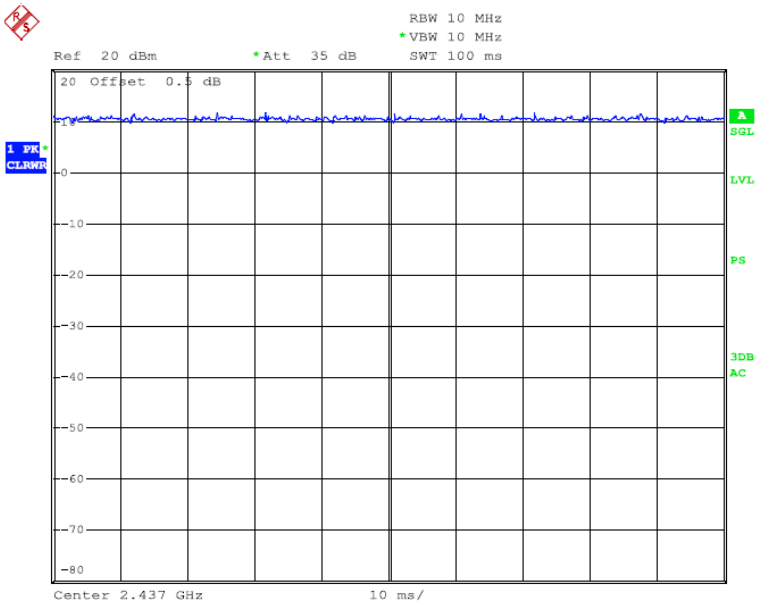
802.11b



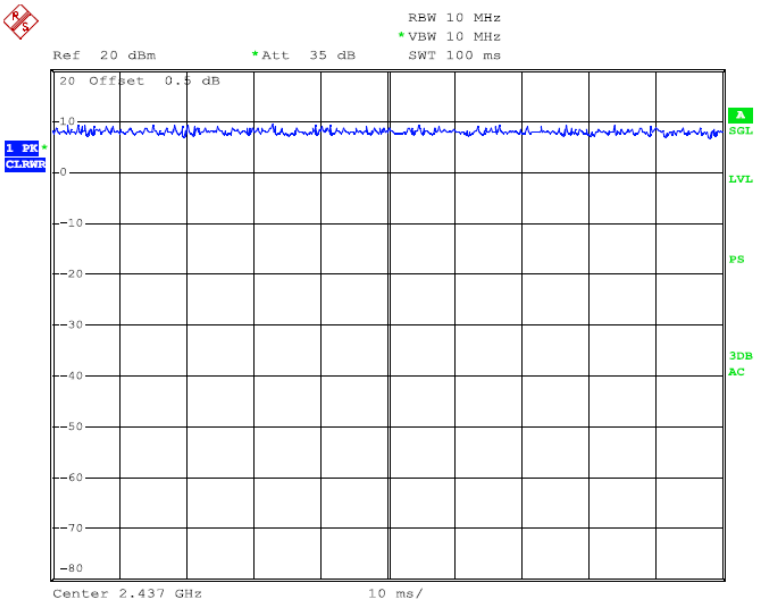
802.11g



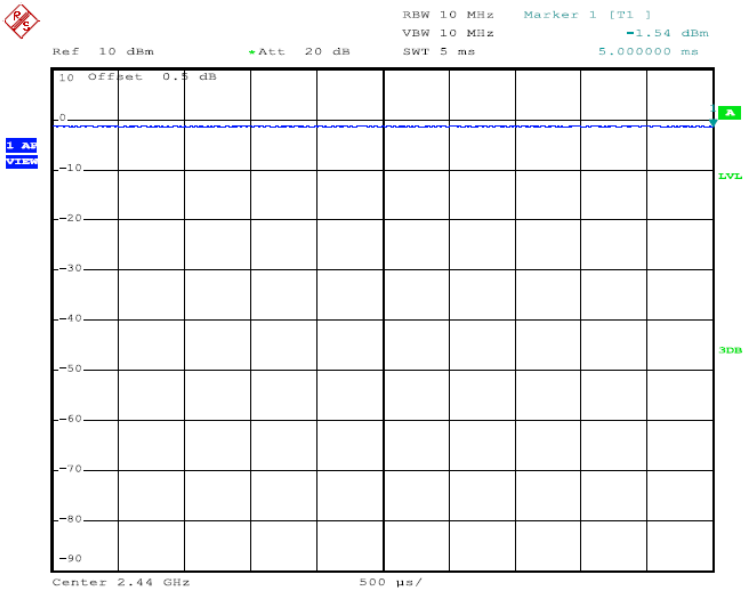
802.11n(HT20)



802.11n(HT40)



BLE



3.3 Test Site

Dongguan Precise Testing & Certification Corp., Ltd.

Building D, Baoding Technology Park, Guangming Road2, Dongcheng District, Dongguan, Guangdong, China

FCC Registration Number: 790290

A2LA Certificate No.: 4408.01

IC Registration Number: 12191A-1

Test Lab: Shenzhen BCTC Testing Co., Ltd.

Address: BCTC Building & 1-2F, East of B Building, Pengzhou Industrial, Fuyuan 1st Road, Qiaotou Community, Fuyong Street, Bao'an District, Shenzhen, China

FCC Registered No.: 712850

Test items: Radiated Spurious Emission(18GHz to 25GHz)

4 Equipment During Test

4.1 Equipments List

RF Conducted Test

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
MXG Signal Analyzer	Agilent	N9020A	MY56070279	10Hz-30GHz	Sep. 19, 2019
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	Sep. 19, 2019
Power Meter	Anritsu	ML2495A	0949003	300MHz-40GHz	Sep. 19, 2019
Power Sensor	Anritsu	MA2411B	0917017	300MHz-40GHz	Sep. 19, 2019

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

Radiated Emissions(Test Frequency from 9KHz-18GHz)

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Sep. 19, 2019
Loop Antenna	Schwarzbeck	FMZB 1519	012	9 KHz -30MHz	Sep. 19, 2019
Bilog Antenna	SCHWARZBECK	VULB 9168	9168-572	25MHz-2GHz	Sep. 21, 2019
Preamplifier (low frequency)	SCHWARZBECK	BBV 9475	9745-0013	1MHz-1GHz	Sep. 19, 2019
Cable	Schwarzbeck	PLF-100	549489	9KHz-3GHz	Sep. 19, 2019
Spectrum Analyzer	Agilent	E4407B	MY45109572	9KHz-40GHz	Sep. 19, 2019
Horn Antenna	SCHWARZBECK	9120D	9120D-1246	1GHz-18GHz	Sep. 26, 2019
Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	1GHz-26.5GHz	Sep. 19, 2019
Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	Sep. 19, 2019

Radiated Emission (Test Frequency from 18GHz-25GHz) (For Shenzhen BCTC Testing Co., Ltd.)

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
Spectrum Analyzer	Agilent	E4407B	MY45109572	9KHz-26.5GHz	Aug. 25, 2019
Test Receiver	R&S	ESPI	101396	9KHz-7GHz	Aug. 25, 2019
Horn Antenna	SCHWARZBECK	BBHA 9170	9170-181	14GHz-40GHz	Aug. 25, 2019
Amplifier	SCHWARZBECK	BBV 9721	9721-205	18GHz-40GHz	Aug. 25, 2019
RF Cable	R&S	R204	R21X	1GHz-40GHz	Aug. 25, 2019
Antenna Connector	Florida RF Labs	N/A	RF01#	N/A	Aug. 25, 2019

Conducted Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Sep. 19, 2019
Artificial Mains Network	Rohde&Schwarz	L2-16B	000WX31025	9KHz-300MHz	Sep. 19, 2019
Artificial Mains Network	Rohde&Schwarz	ENV216	101342	9KHz-300MHz	Sep. 19, 2019

4.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	±1.0dB
Power Spectral Density, conducted	±2.2dB
Radio Frequency	± 1 x 10^{-6}
Bandwidth	± 1.5 x 10^{-6}
Time	±2%
Duty Cycle	±2%
Temperature	±1°C
Humidity	±5%
DC and low frequency voltages	±3%
Conducted Emissions (150kHz~30MHz)	±3.64dB
Radiated Emission(30MHz~1GHz)	±5.03dB
Radiated Emission(1GHz~25GHz)	±4.74dB

Note 1: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

4.3 Description of Support Units

Equipment	Model No.	Series No.
N/A	N/A	N/A

5 Conducted Emission

Test Requirement:	:	FCC CFR 47 Part 15 Section 15.207
Test Method	:	ANSI C63.10: 2013
Test Result	:	PASS
Frequency Range	:	150kHz to 30MHz
Class/Severity	:	Class B

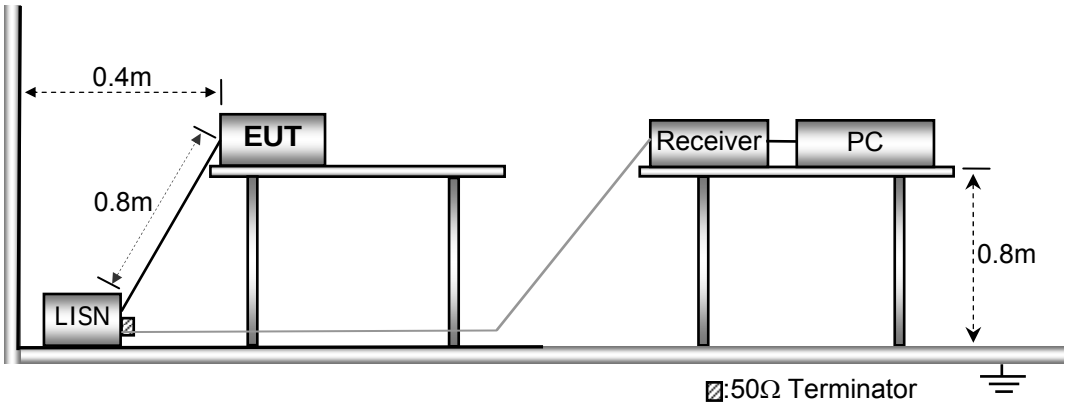
5.1 E.U.T. Operation

Operating Environment **:**

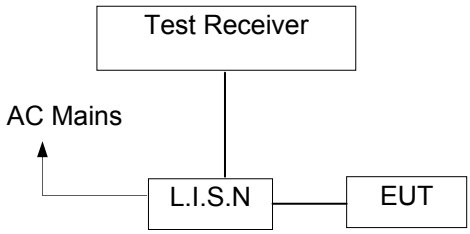
Temperature	:	25.5 °C
Humidity	:	51 % RH
Atmospheric Pressure	:	101.2kPa

5.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.



5.3 Test SET-UP (Block Diagram of Configuration)



5.4 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 was complete.

5.5 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.

5.6 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

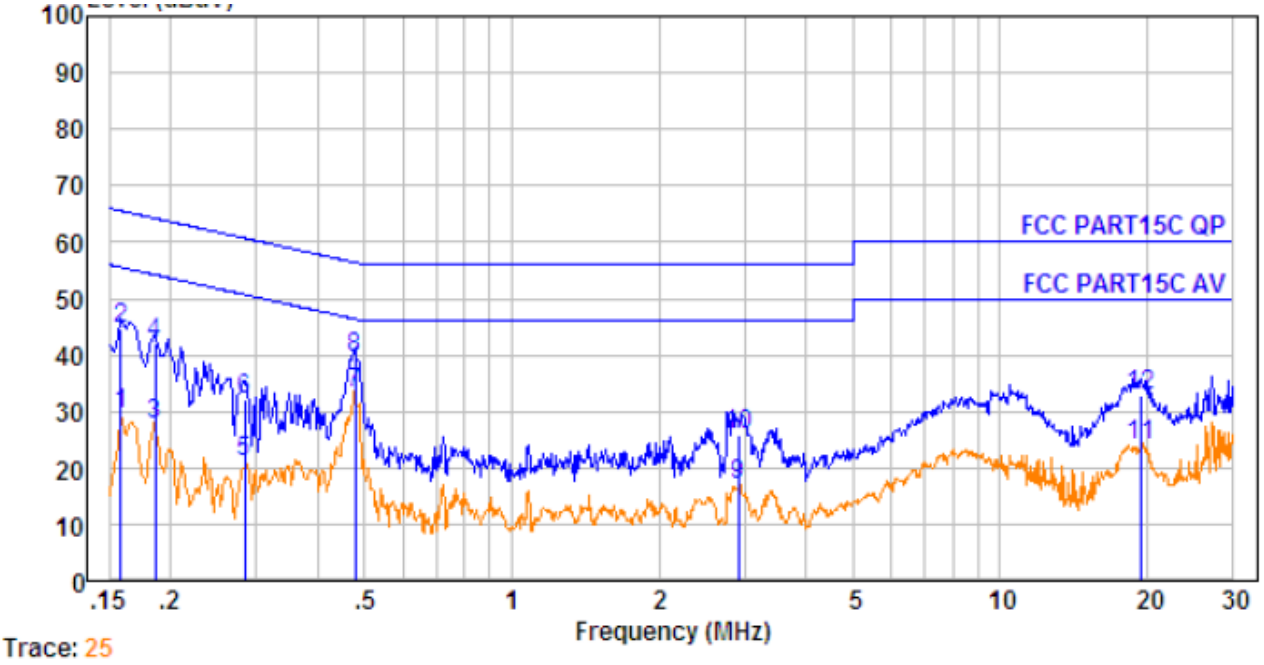
5.7 Conducted Emission Test Result

Pass.

Please refer to the following pages.

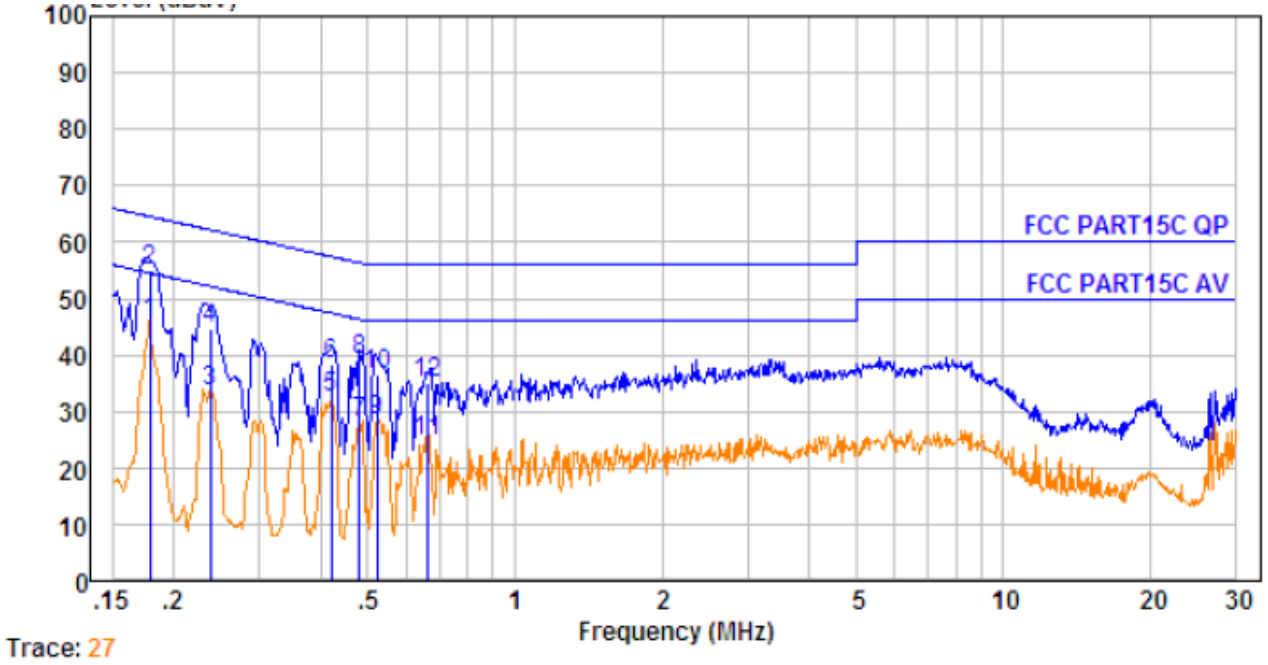
Test Mode: Keep TX Transmitting

Line-AC 120V/60Hz



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBuV	Emission Level dBuV	Limit dBuV	Over Limit dB	Remark
1.	0.158	0.22	9.51	19.93	29.66	55.56	-25.90	Average
2.	0.158	0.22	9.51	35.00	44.73	65.56	-20.83	QP
3.	0.186	0.26	9.57	18.00	27.83	54.20	-26.37	Average
4.	0.186	0.26	9.57	32.14	41.97	64.20	-22.23	QP
5.	0.283	0.36	9.66	10.92	20.94	50.72	-29.78	Average
6.	0.283	0.36	9.66	21.96	31.98	60.72	-28.74	QP
7.	0.479	0.42	9.77	23.20	33.39	46.36	-12.97	Average
8.	0.479	0.42	9.77	29.25	39.44	56.36	-16.92	QP
9.	2.915	0.47	9.88	6.45	16.80	46.00	-29.20	Average
10.	2.915	0.47	9.88	15.50	25.85	56.00	-30.15	QP
11.	19.428	0.41	9.86	13.62	23.89	50.00	-26.11	Average
12.	19.428	0.41	9.86	22.69	32.96	60.00	-27.04	QP

Neutral-AC 120V/60Hz



No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBuV	Emission Level dBuV	Limit dBuV	Over Limit dB	Remark
1.	0.179	0.25	9.58	36.10	45.93	54.55	-8.62	Average
2.	0.179	0.25	9.58	45.08	54.91	64.55	-9.64	QP
3.	0.238	0.32	9.66	23.69	33.67	52.17	-18.50	Average
4.	0.238	0.32	9.66	34.76	44.74	62.17	-17.43	QP
5.	0.421	0.41	9.77	22.13	32.31	47.42	-15.11	Average
6.	0.421	0.41	9.77	28.20	38.38	57.42	-19.04	QP
7.	0.481	0.43	9.80	17.72	27.95	46.32	-18.37	Average
8.	0.481	0.43	9.80	28.80	39.03	56.32	-17.29	QP
9.	0.521	0.43	9.81	18.30	28.54	46.00	-17.46	Average
10.	0.521	0.43	9.81	26.33	36.57	56.00	-19.43	QP
11.	0.661	0.44	9.83	14.61	24.88	46.00	-21.12	Average
12.	0.661	0.44	9.83	24.66	34.93	56.00	-21.07	QP

6 Radiated Spurious Emissions

Test Requirement : FCC CFR47 Part 15 Section 15.209 & 15.247

Test Method : ANSI C63.10:2013

Test Result : PASS

Measurement Distance : 3m

Limit : See the follow table

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	$20\log^{(2400/F(kHz))} + 80$
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	$20\log^{(24000/F(kHz))} + 40$
1.705 ~ 30	30	30	100 * 30	$20\log^{(30)} + 40$
30 ~ 88	100	3	100	$20\log^{(100)}$
88 ~ 216	150	3	150	$20\log^{(150)}$
216 ~ 960	200	3	200	$20\log^{(200)}$
Above 960	500	3	500	$20\log^{(500)}$

6.1 EUT Operation

Operating Environment :

Temperature: : 23.5 °C

Humidity: : 51.1 % RH

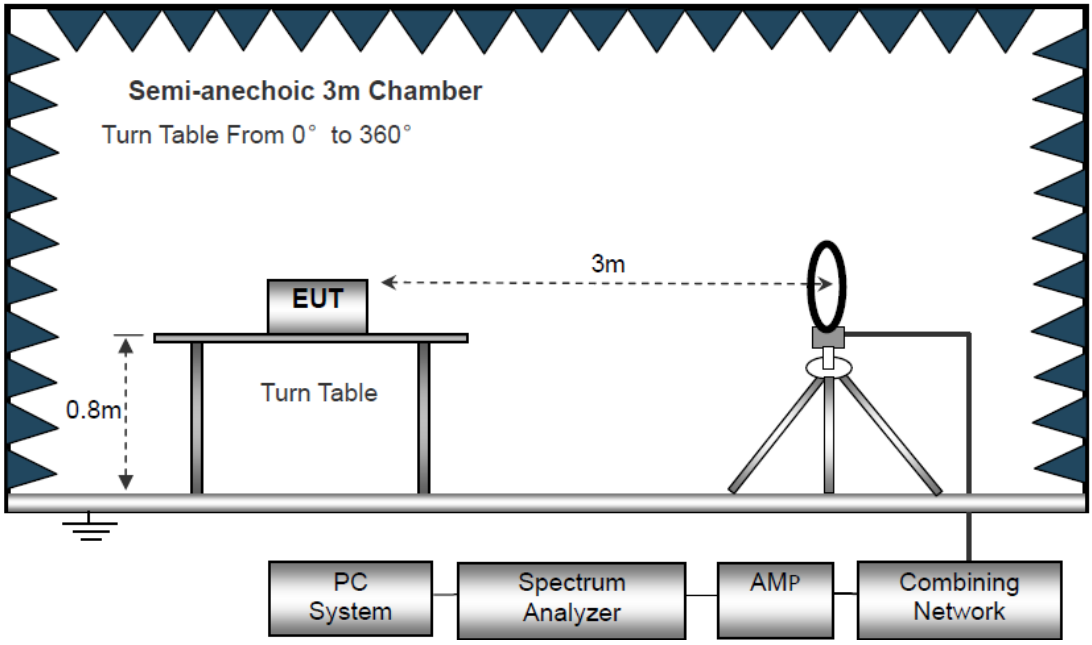
Atmospheric Pressure: : 101.2kPa

Test Voltage : DC 14.4V Battery

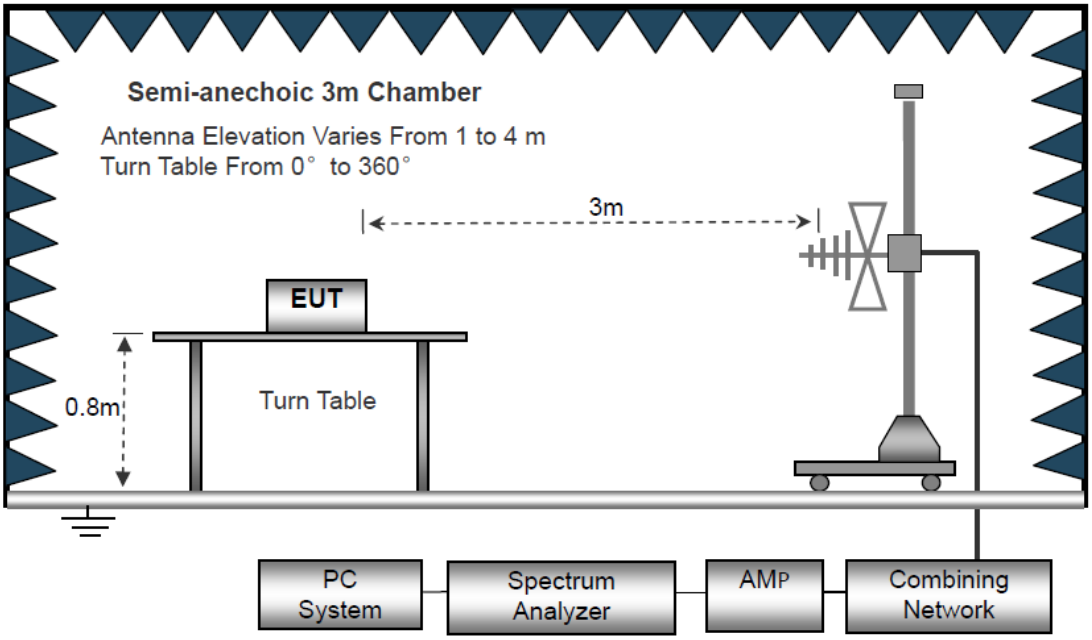
6.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

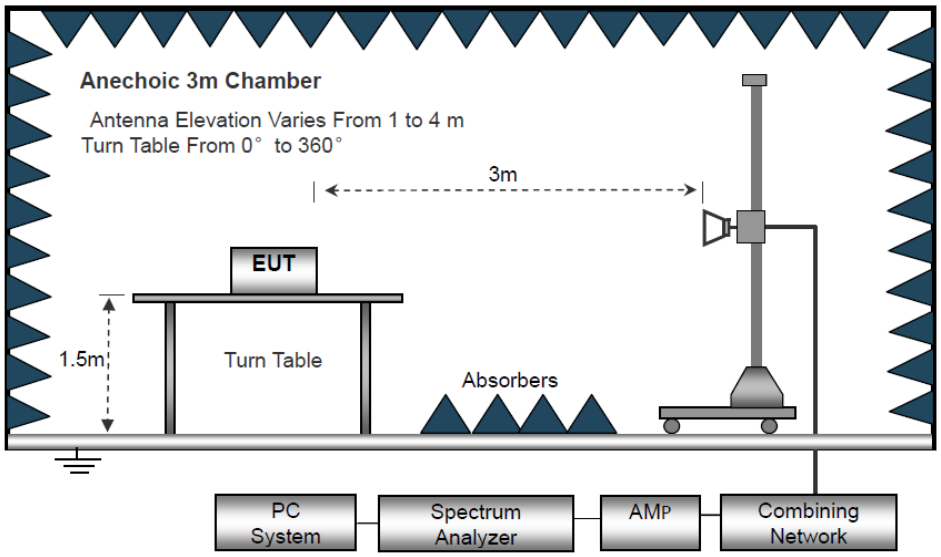
The test setup for emission measurement below 30MHz



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz



6.3 Spectrum Analyzer Setup

Below 30MHz			
IF Bandwidth	:	10kHz	
Resolution Bandwidth	:	10kHz	
Video Bandwidth	:	10kHz	
30MHz ~ 1GHz			
Detector	:	PK	QP
Resolution Bandwidth	:	100kHz	120kHz
Video Bandwidth	:	300kHz	300kHz
Above 1GHz			
Detector	:	PK	AV
Resolution Bandwidth	:	1MHz	1MHz
Video Bandwidth	:	3MHz	10Hz

6.4 Test Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.

2. 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.

3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.

4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) 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 to comply with the guidelines.

5. Set to the maximum power setting and enable the EUT transmit continuously.

6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.

7. Test Procedure of measurement (For Above 1GHz):

1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).

2) Change the antenna polarization and repeat 1) with vertical polarization.

3) Make a hardcopy of the spectrum.

4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.

5) Change the analyser mode to Clear/ Write and found the cone of emission.

6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.

7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.

8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.

6.5 Summary of Test Results

Test Frequency: 9KHz-30MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level (dBuV/m)	Limit 3m (dBuV/m)	Over (dB)
--	--	--	--	>20

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.

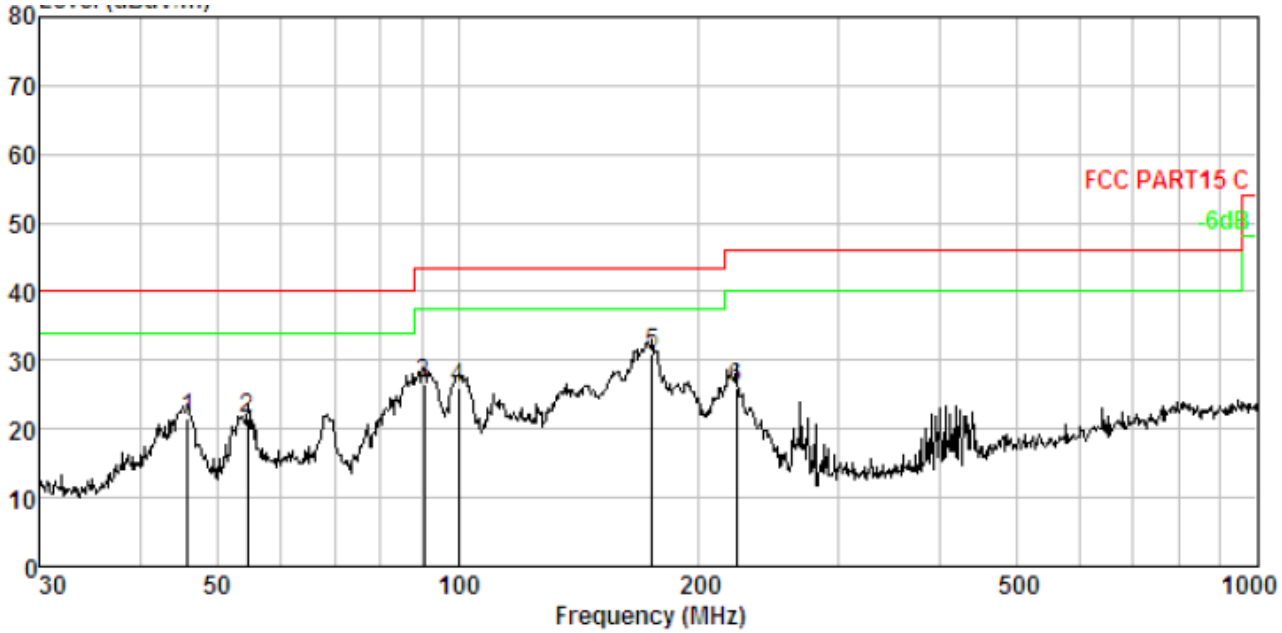
Test Frequency: 30MHz ~ 1GHz

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

Please refer to the following test plots:

Test Mode: 802.11b (2412MHz)

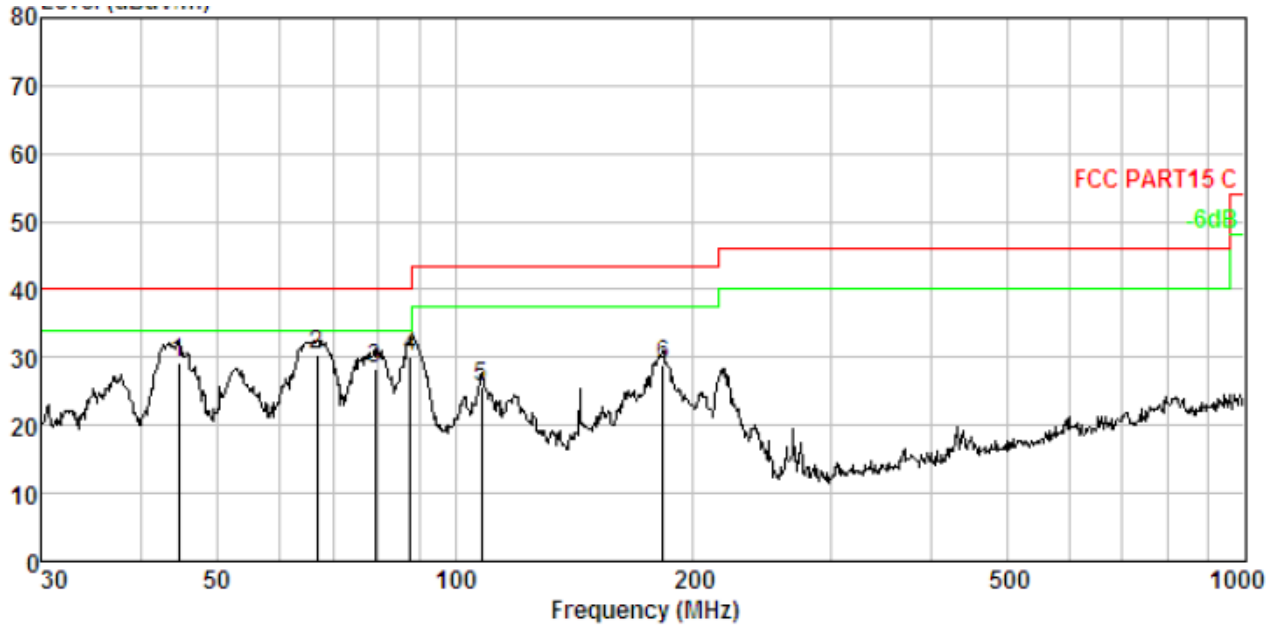
Antenna Polarization: Horizontal



No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBuV	Preamp Factor dB	Emission Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark
1.	45.855	1.44	13.07	37.24	30.12	21.63	40.00	-18.37	QP
2.	54.452	1.59	11.94	38.22	30.18	21.57	40.00	-18.43	QP
3.	90.537	2.06	9.35	45.56	30.35	26.62	43.50	-16.88	QP
4.	100.229	2.15	10.26	44.10	30.39	26.12	43.50	-17.38	QP
5.	175.037	2.65	12.88	46.16	30.58	31.11	43.50	-12.39	QP
6.	222.950	2.87	10.91	42.97	30.67	26.08	46.00	-19.92	QP

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor

Antenna Polarization: Vertical



No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBuV	Preamp Factor dB	Emission Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark
1.	44.743	1.42	13.27	44.56	30.11	29.14	40.00	-10.86	QP
2.	66.967	1.78	11.10	47.81	30.25	30.44	40.00	-9.56	QP
3.	79.243	1.93	8.93	47.72	30.31	28.27	40.00	-11.73	QP
4.	87.725	2.03	9.02	49.42	30.34	30.13	40.00	-9.87	QP
5.	107.888	2.21	10.90	43.09	30.42	25.78	43.50	-17.72	QP
6.	183.201	2.69	12.00	44.86	30.60	28.95	43.50	-14.55	QP

Remark:Emission Level=Reading+Cable Loss+ANT Factor-AMP Factor

Test Frequency: From 1GHz to 18GHz

Low Channel (2412MHz) Worst case 802.11g

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4824	38.47	AV	V	33.06	3.94	35.04	40.43	54	-13.57
4824	42.21	AV	H	33.06	3.94	35.04	44.17	54	-9.83
4824	50.11	PK	V	33.06	3.94	35.04	52.07	74	-21.93
4824	51.26	PK	H	33.06	3.94	35.04	53.22	74	-20.78
7236	39.24	AV	V	34.11	3.96	35.12	42.19	54	-11.81
7236	40.15	AV	H	34.11	3.96	35.12	43.1	54	-10.9
7236	52.49	PK	V	34.11	3.96	35.12	55.44	74	-18.56
7236	53.66	PK	H	34.11	3.96	35.12	56.61	74	-17.39

Middle Channel (2437MHz) Worst case 802.11n (HT20)

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4874	38.12	AV	V	33.16	3.96	35.15	40.09	54	-13.91
4874	39.06	AV	H	33.16	3.96	35.15	41.03	54	-12.97
4874	48.29	PK	V	33.16	3.96	35.15	50.26	74	-23.74
4874	50.17	PK	H	33.16	3.96	35.15	52.14	74	-21.86
7311	40.12	AV	V	34.02	3.41	35.26	42.29	54	-11.71
7311	41.62	AV	H	34.02	3.41	35.26	43.79	54	-10.21
7311	53.29	PK	V	34.02	3.41	35.26	55.46	74	-18.54
7311	52.84	PK	H	34.02	3.41	35.26	55.01	74	-18.99

High Channel (2462MHz) Worst case 802.11b

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4924	39.22	AV	V	33.19	3.42	35.28	40.55	54	-13.45
4924	39.15	AV	H	33.19	3.42	35.28	40.48	54	-13.52
4924	49.26	PK	V	33.19	3.42	35.28	50.59	74	-23.41
4924	51.42	PK	H	33.19	3.42	35.28	52.75	74	-21.25
7386	40.28	AV	V	33.53	3.49	35.62	41.68	54	-12.32
7386	39.58	AV	H	33.53	3.49	35.62	40.98	54	-13.02
7386	52.11	PK	V	33.53	3.49	35.62	53.51	74	-20.49
7386	53.06	PK	H	33.53	3.49	35.62	54.46	74	-19.54

High Channel (2480MHz) BLE

Frequency (MHz)	S.A Reading (dBuV)	Detector (PK/AV)	Polarity (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Pre-Amp. Gain (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4960	34.15	AV	V	31.22	5.10	36.51	33.96	54	-20.04
4960	35.29	AV	H	31.22	5.10	36.51	35.1	54	-18.9
4960	41.02	PK	V	31.22	5.10	36.51	40.83	74	-33.17
4960	42.16	PK	H	31.22	5.10	36.51	41.97	74	-32.03
7440	33.28	AV	V	31.53	5.22	35.16	34.87	54	-19.13
7440	34.35	AV	H	31.53	5.22	35.16	35.94	54	-18.06
7440	42.55	PK	V	31.53	5.22	35.16	44.14	74	-29.86
7440	43.69	PK	H	31.53	5.22	35.16	45.28	74	-28.72

Note:

1. The testing has been conformed to 10*2462MHz=24620MHz.
2. All other emissions more than 30dB below the limit.
3. Factor = Antenna Factor + Cable Loss – Pre-amplifier.
   Emission Level = Reading + Factor
   Margin=Emission Level-Limit
4. X-Axis, Y-Axis and Z-Axis were investigated. The results above show only the worst case.

Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

2.4G WiFi (802.11b/g/n)mode have been tested, and the worst result(802.11b) was report as below

Test Mode: 802.11b Low Channel 2412MHz									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Polarity H/V	Test Value
2310.00	13.85	28.05	6.62	0.00	48.52	74.00	-25.48	V	Peak
2390.00	13.86	27.65	6.75	0.00	48.26	74.00	-25.74	V	
2310.00	13.41	28.05	6.62	0.00	48.08	54.00	-25.92	V	
2390.00	12.72	27.65	6.75	0.00	47.12	54.00	-26.88	V	
2310.00	11.12	28.05	6.62	0.00	45.79	74.00	-8.21	H	Average
2390.00	10.73	27.65	6.75	0.00	45.13	74.00	-8.87	H	
2310.00	11.15	28.05	6.62	0.00	45.82	54.00	-8.18	H	
2390.00	10.63	27.65	6.75	0.00	45.03	54.00	-8.97	H	

Test Mode: 802.11b High Channel 2462MHz									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Polarity H/V	Test Value
2483.50	12.90	27.26	6.83	0.00	46.99	74.00	-27.01	V	Peak
2500.00	13.93	27.20	6.84	0.00	47.97	74.00	-26.03	V	
2483.50	13.40	27.26	6.83	0.00	47.49	54.00	-26.51	V	
2500.00	12.08	27.20	6.84	0.00	46.12	54.00	-27.88	V	
2483.50	10.77	27.26	6.83	0.00	44.88	74.00	-9.12	H	Average
2500.00	10.67	27.20	6.84	0.00	44.71	74.00	-9.29	H	
2483.50	10.72	27.26	6.83	0.00	44.81	54.00	-9.19	H	
2500.00	10.66	27.20	6.84	0.00	44.70	54.00	-9.30	H	

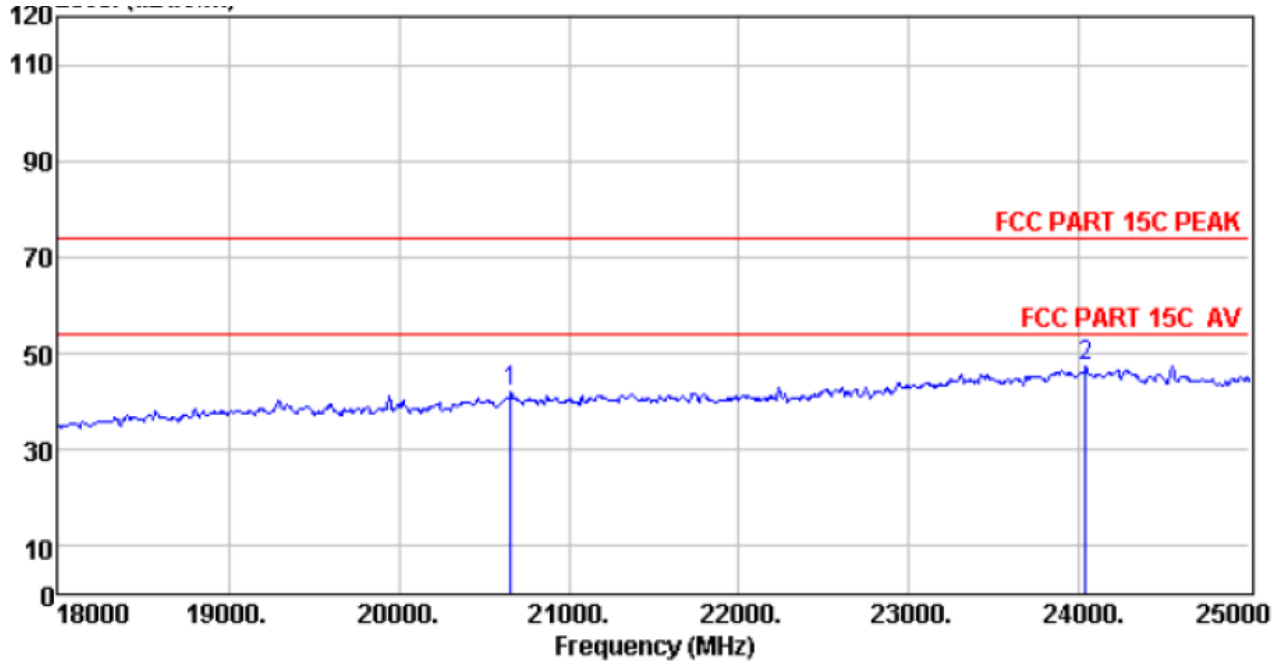
Test Mode: BLE Low Channel 2402MHz									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Polarity H/V	Test Value
2310.00	34.07	28.05	6.62	37.65	31.09	74.00	-42.91	V	Peak
2390.00	33.92	27.65	6.75	37.87	30.45	74.00	-43.55	V	
2310.00	26.95	28.05	6.62	37.65	23.97	54.00	-30.03	V	
2390.00	26.13	27.65	6.75	37.65	22.66	54.00	-31.34	V	
2310.00	33.79	28.05	6.62	37.87	30.81	74.00	-43.19	H	Average
2390.00	34.96	27.65	6.75	37.65	31.49	74.00	-42.51	H	
2310.00	26.64	28.05	6.62	37.65	23.66	54.00	-30.34	H	
2390.00	25.94	27.65	6.75	37.87	22.47	54.00	-31.53	H	

Test Mode: BLE High Channel 2480MHz									
Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Level (dBuV/m)	Limit (dBuV/m)	Over (dB)	Polarity H/V	Test Value
2483.50	41.62	27.26	6.83	37.87	37.84	74.00	-36.16	V	Peak
2500.00	33.79	27.20	6.84	37.87	29.96	74.00	-44.04	V	
2483.50	44.67	27.26	6.83	37.87	40.89	54.00	-13.11	V	
2500.00	26.16	27.20	6.84	37.87	22.33	54.00	-31.67	V	
2483.50	47.03	27.26	6.83	37.87	43.25	74.00	-30.75	H	Average
2500.00	33.34	27.20	6.84	37.87	29.51	74.00	-44.49	H	
2483.50	45.59	27.26	6.83	37.87	41.81	54.00	-12.19	H	
2500.00	26.06	27.20	6.84	37.87	22.23	54.00	-31.77	H	

Test Frequency: From 18GHz to 25GHz

Worst Test mode: BLE (2480MHz)

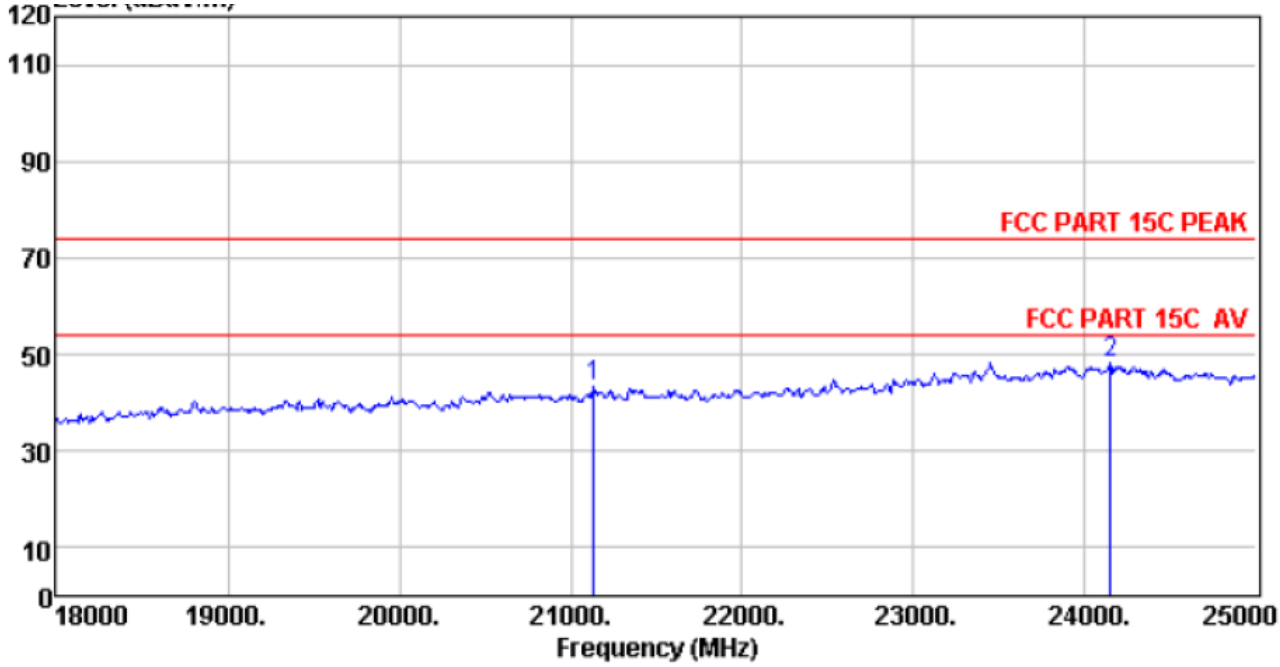
Vertical:



	Freq. (MHz)	ANT Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	20660.00	46.10	19.98	12.11	42.07	74.00	31.93	Peak
2	24034.00	45.60	22.06	12.43	47.25	74.00	26.75	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
2. The emission levels that are 20dB below the official limit are not reported.

Horizontal:



	Freq. (MHz)	ANT Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	21136.00	46.21	20.19	12.62	43.33	74.00	30.67	Peak
2	24146.00	45.63	22.13	13.47	48.20	74.00	25.80	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
2. The emission levels that are 20dB below the official limit are not reported.

7 Band Edge Measurement & Unwanted Emissions into Restricted Frequency Bands

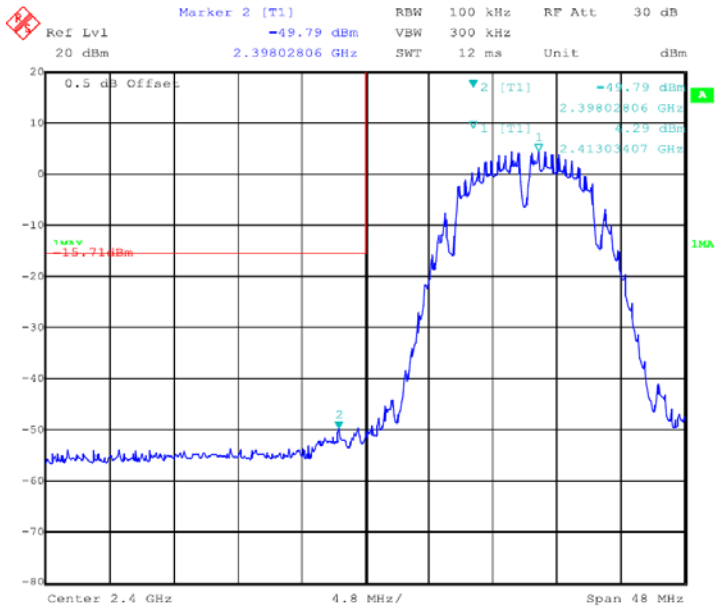
Test Requirement	:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 15.247 (d),In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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 §15.205(c)).

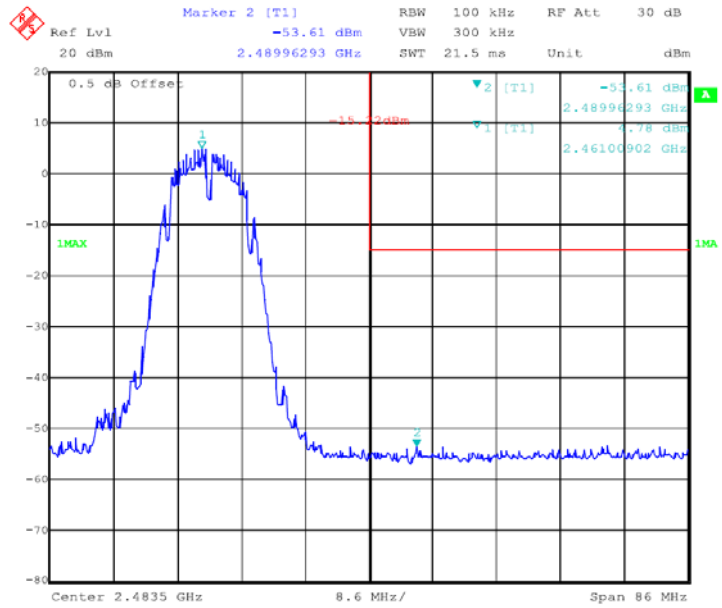
7.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 1MHz, VBW = 3MHz, Sweep = auto
Detector function = peak, Trace = max hold

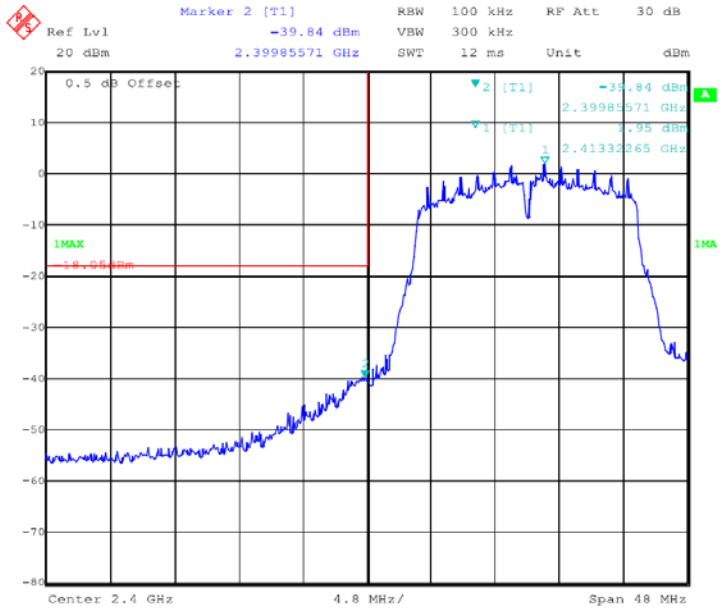
7.2 Test Result

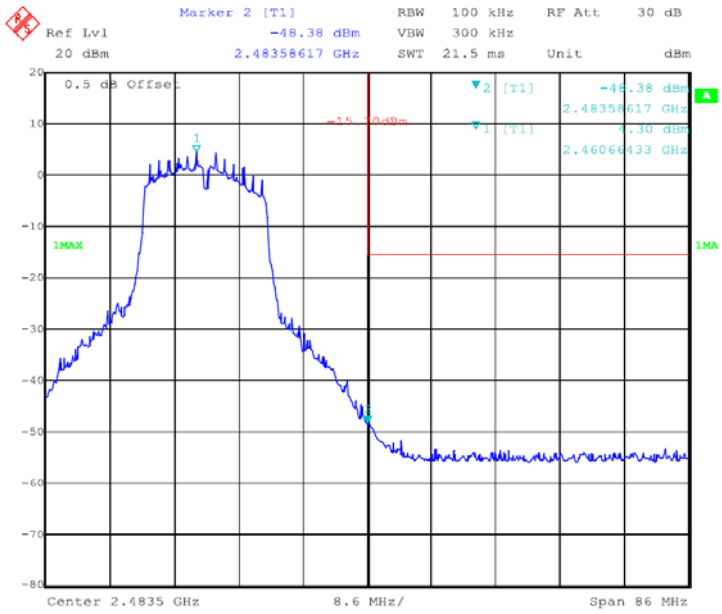
802.11b



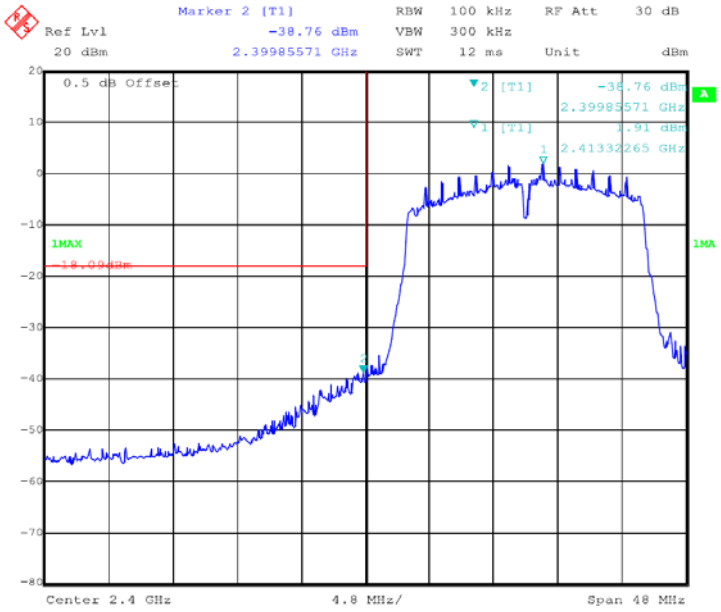


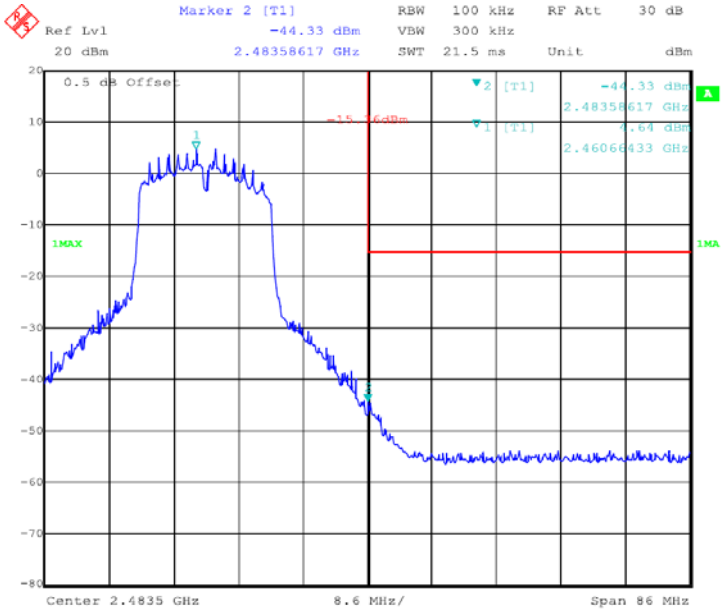
802.11g


Marker 2 [T1]
RBW 100 kHz
RF Att 30 dB
Ref Lvl
-39.84 dBm
VBW 300 kHz
20 dBm
2.39985571 GHz
SWT 12 ms
Unit dBm
0.5 dB Offset
2 [T1] -35.84 dBm
2.39985571 GHz
1 [T1] 1.95 dBm
2.41332265 GHz
1MAX
1MA
Center 2.4 GHz
4.8 MHz/
Span 48 MHz

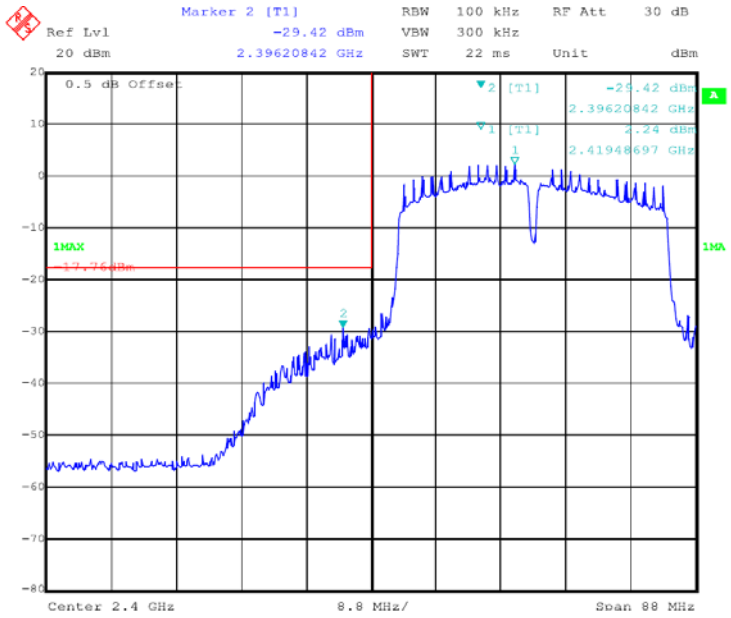

Marker 2 [T1]
RBW 100 kHz
RF Att 30 dB
Ref Lvl
-48.38 dBm
VBW 300 kHz
20 dBm
2.48358617 GHz
SWT 21.5 ms
Unit dBm
0.5 dB Offset
2 [T1] -48.38 dBm
2.48358617 GHz
1 [T1] 4.30 dBm
2.46066433 GHz
1MAX
1MA
Center 2.4835 GHz
8.6 MHz/
Span 86 MHz

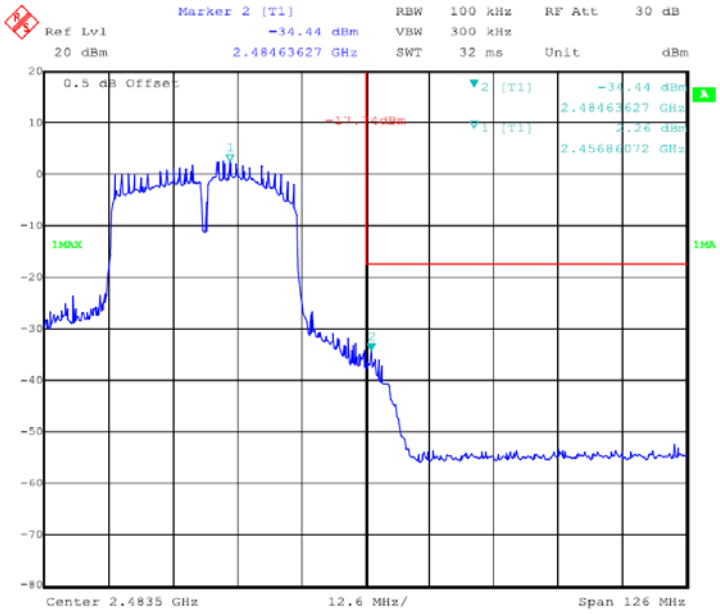
802.11n-HT20


Marker 2 [T1]
Ref Lvl
20 dBm
-38.76 dBm
2.39985571 GHz
RBW 100 kHz
VBW 300 kHz
SWT 12 ms
RF Att 30 dB
Unit dBm
0.5 dB Offset
2 [T1] -38.76 dBm
2.39985571 GHz
1 [T1] 1.91 dBm
2.41332265 GHz
1MAX
1MA
Center 2.4 GHz
4.8 MHz/
Span 48 MHz

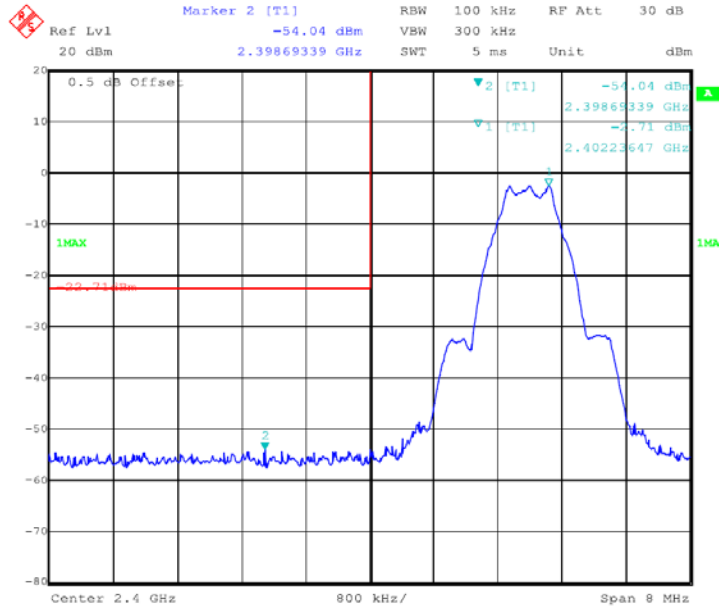

Marker 2 [T1]
Ref Lvl
20 dBm
-44.33 dBm
2.48358617 GHz
RBW 100 kHz
VBW 300 kHz
SWT 21.5 ms
RF Att 30 dB
Unit dBm
0.5 dB Offset
2 [T1] -44.33 dBm
2.48358617 GHz
1 [T1] 4.64 dBm
2.46066433 GHz
1MAX
1MA
Center 2.4835 GHz
8.6 MHz/
Span 86 MHz

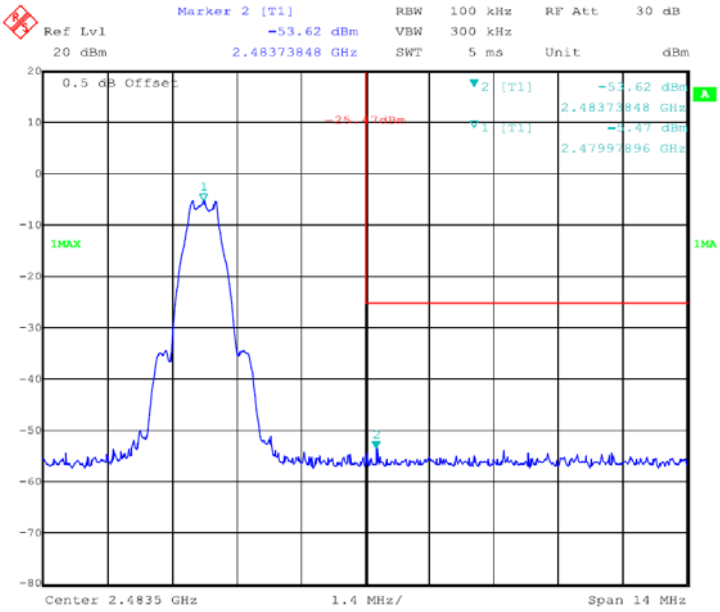
802.11n-HT40


Marker 2 [T1]
RBW 100 kHz
RF Att 30 dB
Ref Lvl
-29.42 dBm
VBW 300 kHz
20 dBm
2.39620842 GHz
SWT 22 ms
Unit dBm
0.5 dB Offset
2 [T1]
-29.42 dBm
2.39620842 GHz
1 [T1]
2.24 dBm
2.41948697 GHz
1MAX
-17.76 dBm
1MA
Center 2.4 GHz
8.8 MHz/
Span 88 MHz


Marker 2 [T1]
RBW 100 kHz
RF Att 30 dB
Ref Lvl
-34.44 dBm
VBW 300 kHz
20 dBm
2.48463627 GHz
SWT 32 ms
Unit dBm
0.5 dB Offset
2 [T1]
-34.44 dBm
2.48463627 GHz
1 [T1]
2.26 dBm
2.45686072 GHz
1MAX
1MA
Center 2.4835 GHz
12.6 MHz/
Span 126 MHz

BLE

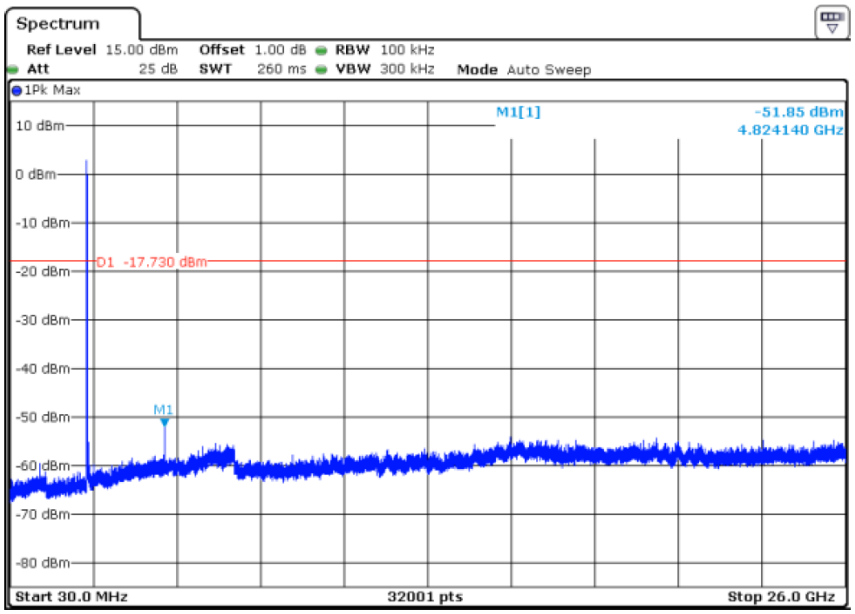

Marker 2 [T1]
Ref Lvl
-54.04 dBm
20 dBm
2.39869339 GHz
RBW 100 kHz
VBW 300 kHz
SWT 5 ms
RF Att 30 dB
Unit dBm
0.5 dB Offset
2 [T1] -54.04 dBm
2.39869339 GHz
1 [T1] -2.71 dBm
2.40223647 GHz
1MAX
1MA
-22.71dBm
Center 2.4 GHz
800 kHz/
Span 8 MHz


Marker 2 [T1]
Ref Lvl
-53.62 dBm
20 dBm
2.48373848 GHz
RBW 100 kHz
VBW 300 kHz
SWT 5 ms
RF Att 30 dB
Unit dBm
0.5 dB Offset
2 [T1] -53.62 dBm
2.48373848 GHz
1 [T1] -2.47 dBm
2.47997896 GHz
1MAX
1MA
-25.47dBm
Center 2.4835 GHz
1.4 MHz/
Span 14 MHz

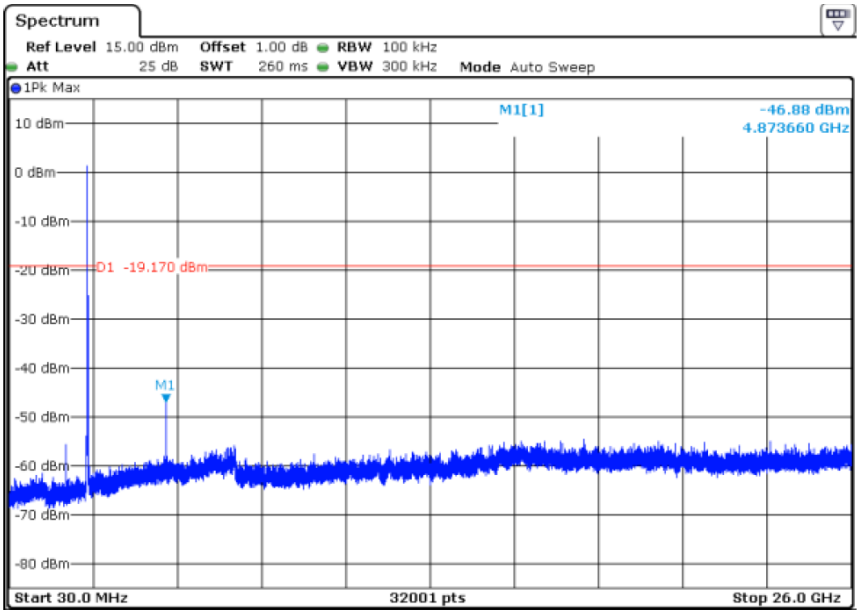
For conducted spurious emission

802.11b

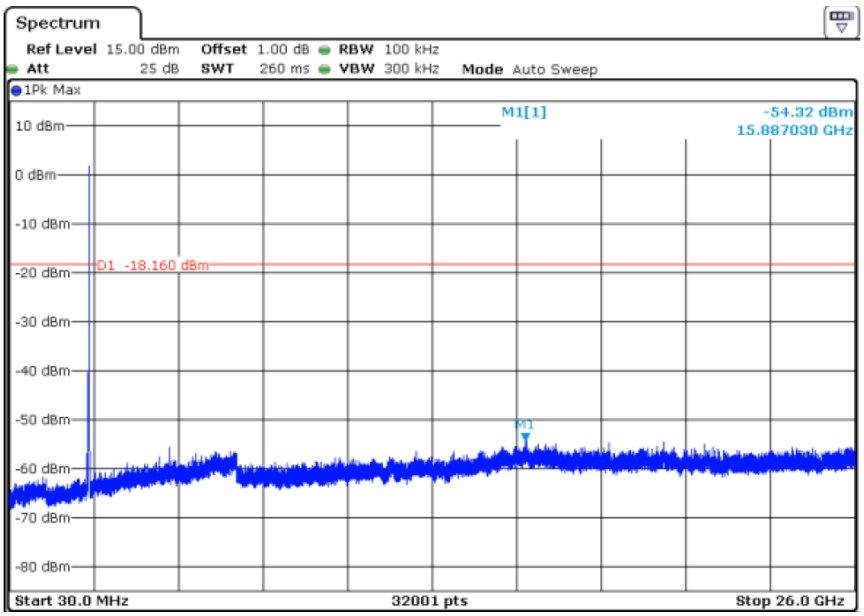
Low Channel



Middle Channel

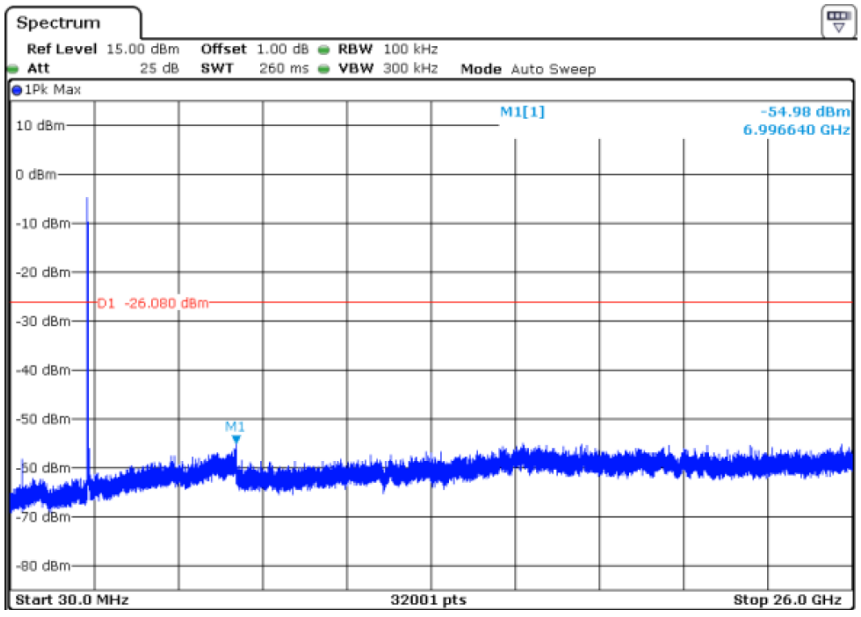


High Channel

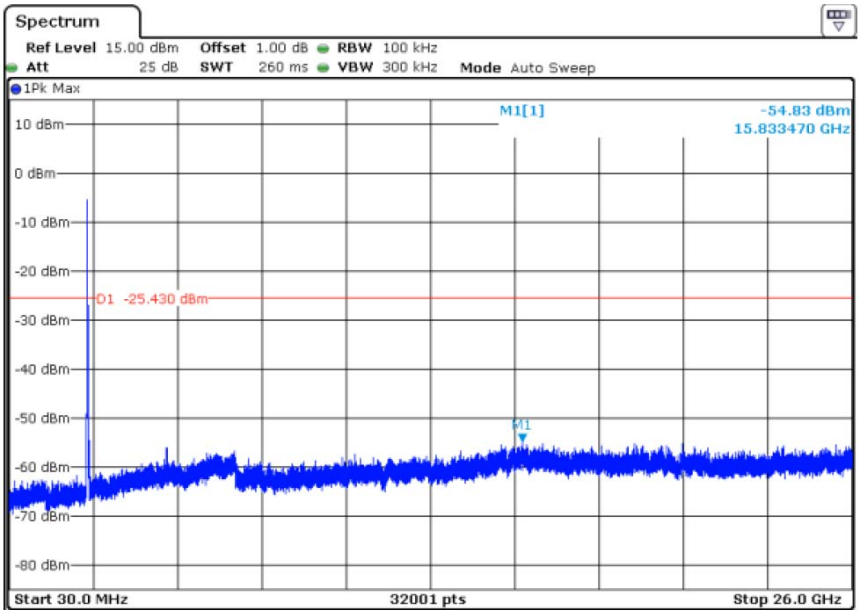


802.11g

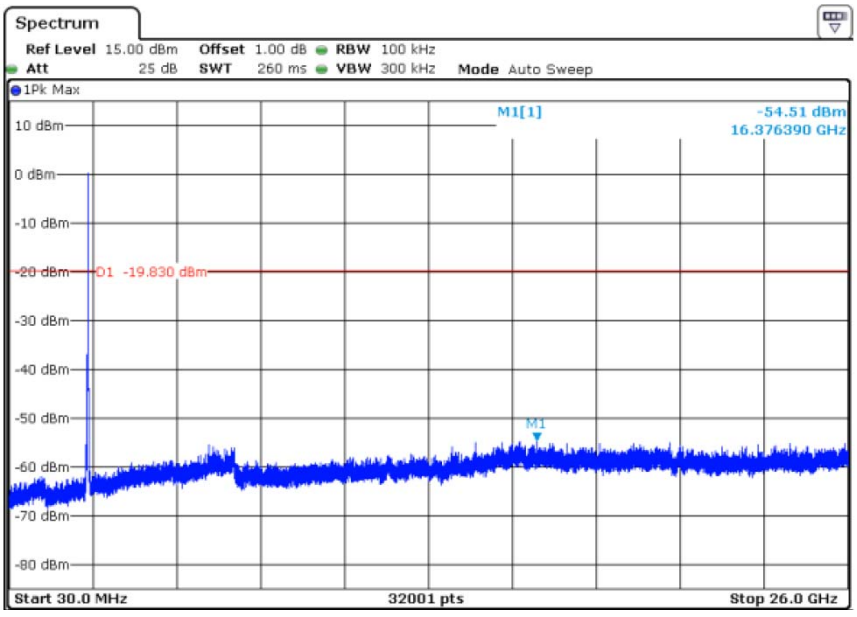
Low Channel



Middle Channel

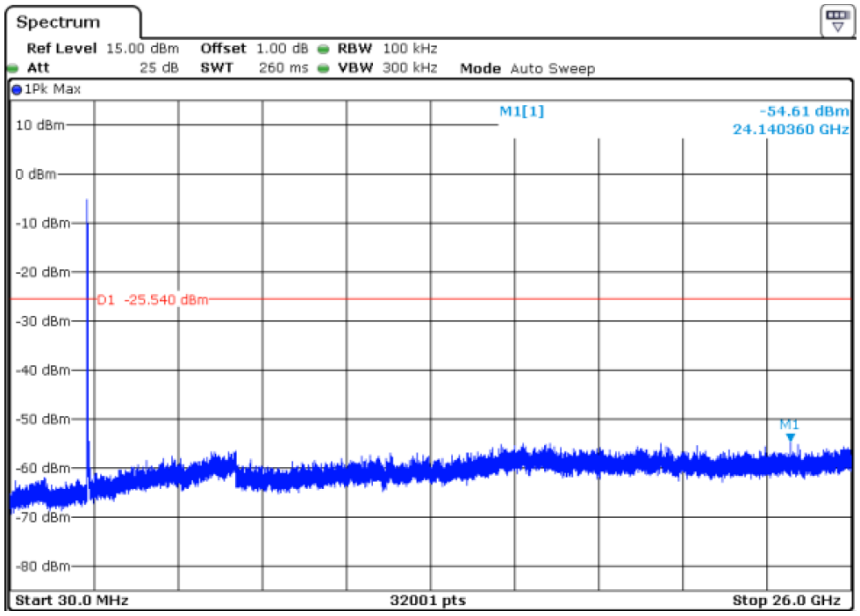


High Channel

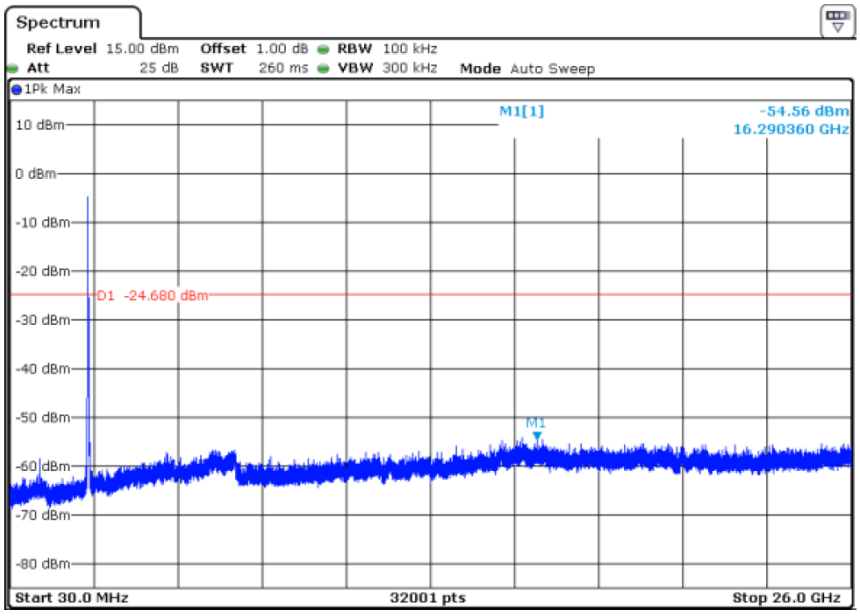


802.11n(HT20)

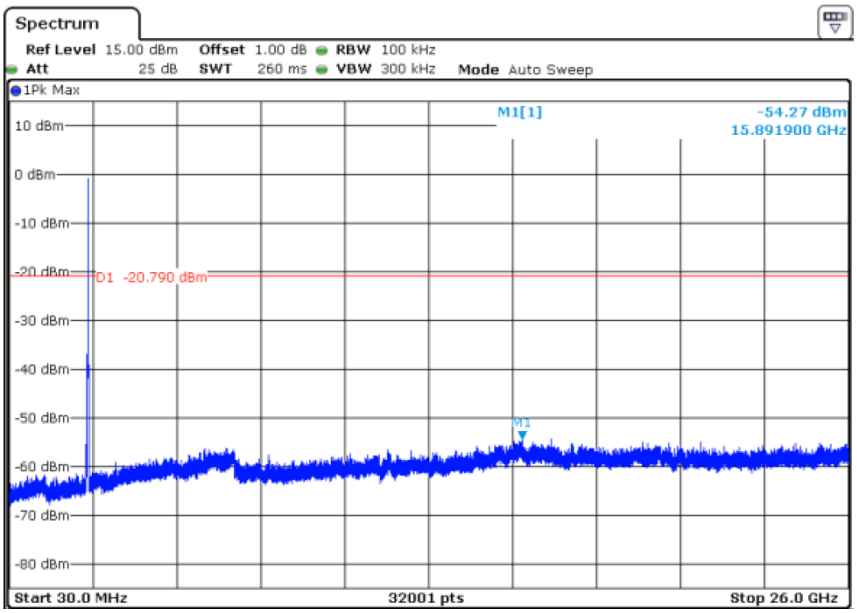
Low Channel



Middle Channel

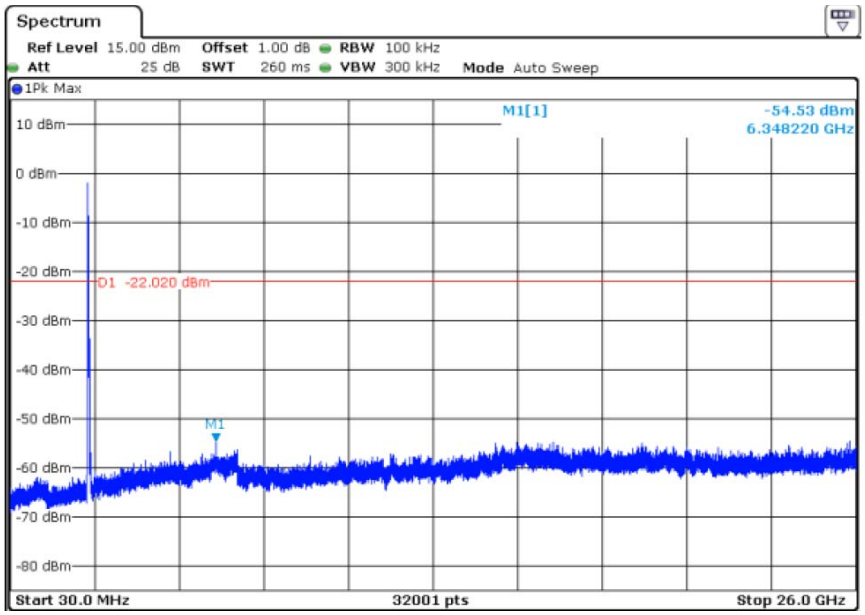


High Channel

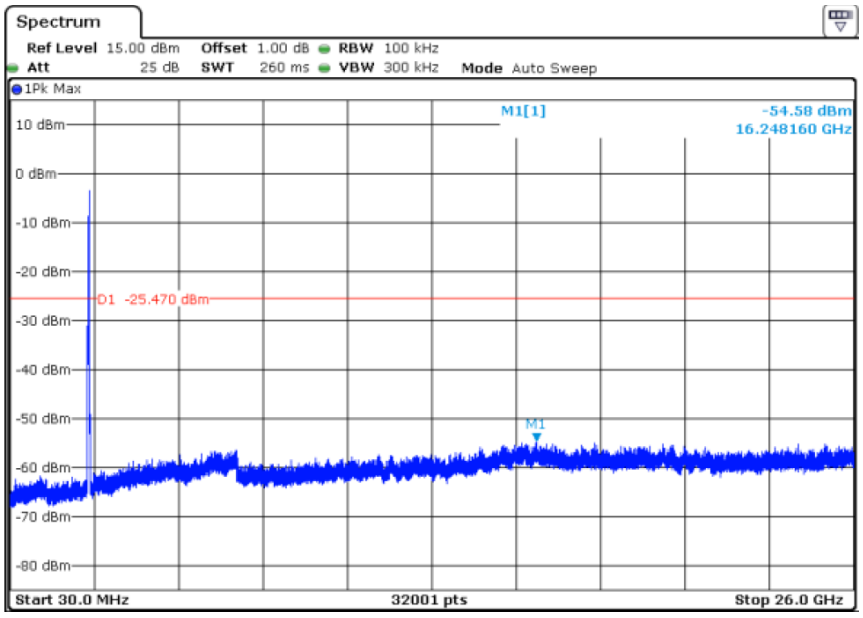


802.11n(HT40)

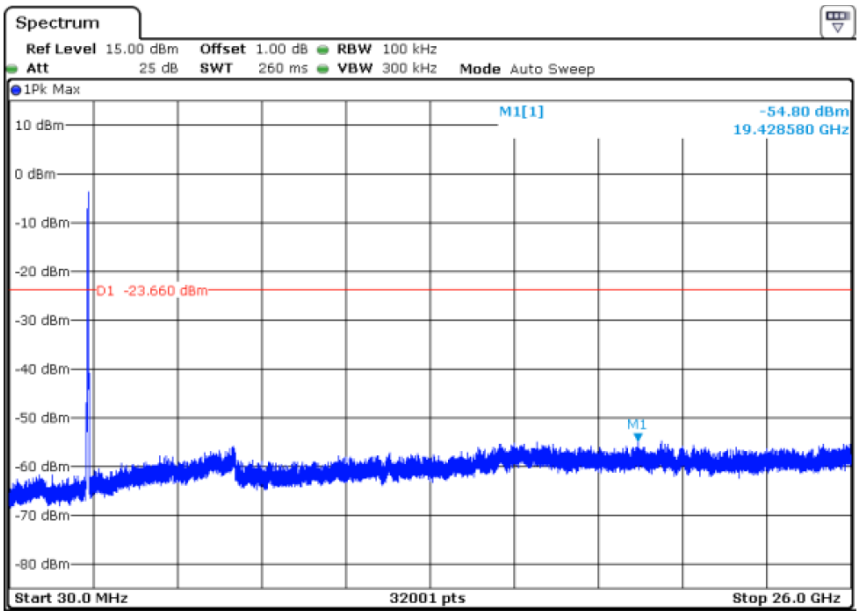
Low Channel



Middle Channel

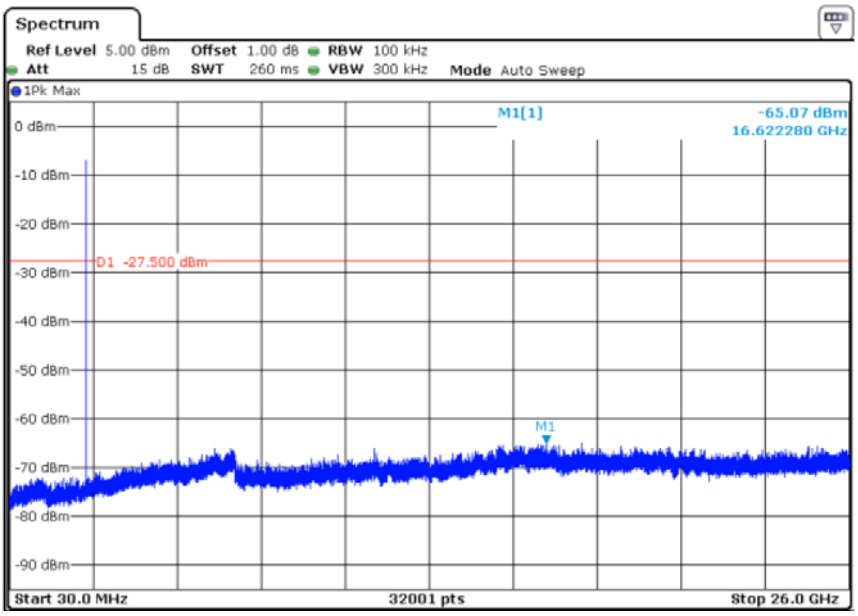


High Channel

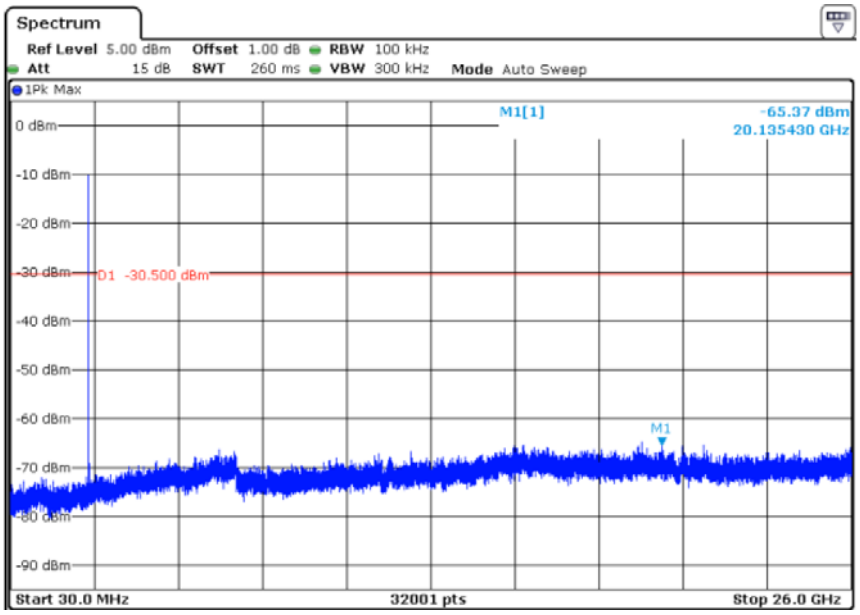


BLE

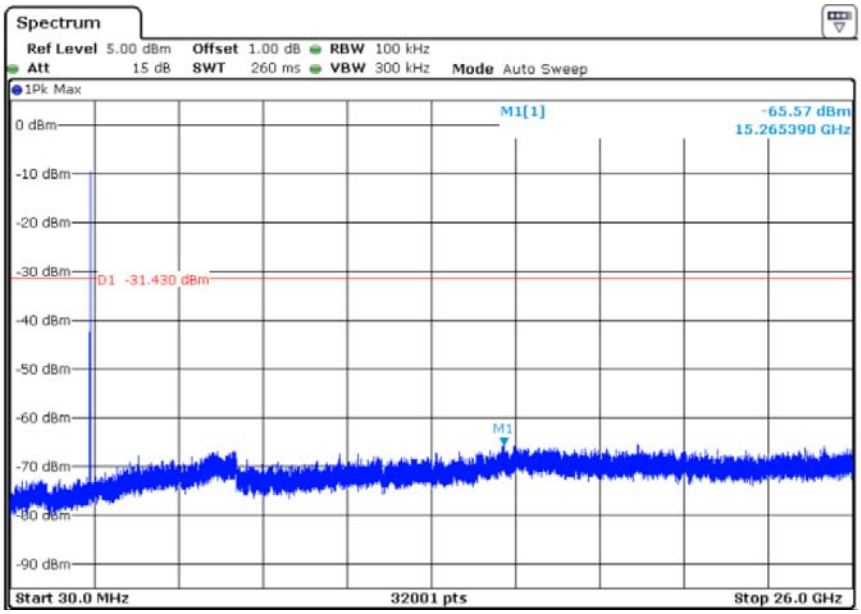
Low Channel



Middle Channel



High Channel



8 6dB Bandwidth Measurement

Test Requirement	:	FCC CFR47 Part 15 Section 15.247
Test Method	:	ANSI C63.10:2013
Test Limit		Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.1 Test Procedure

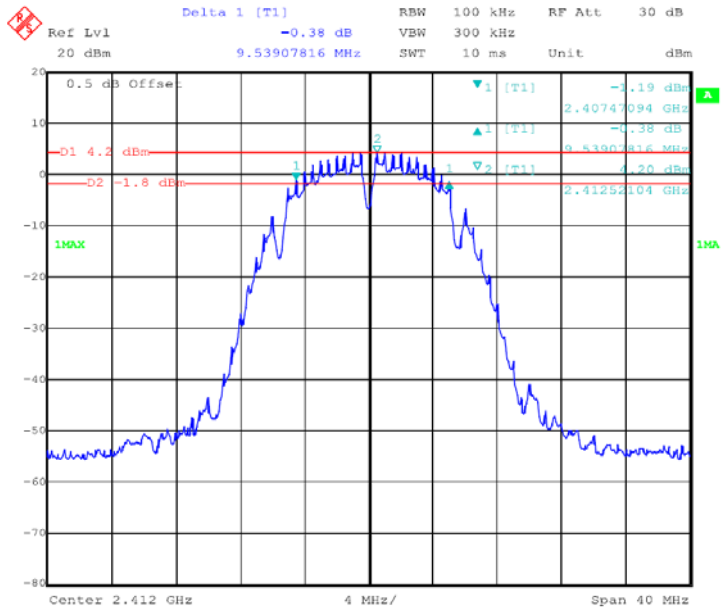
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;

2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

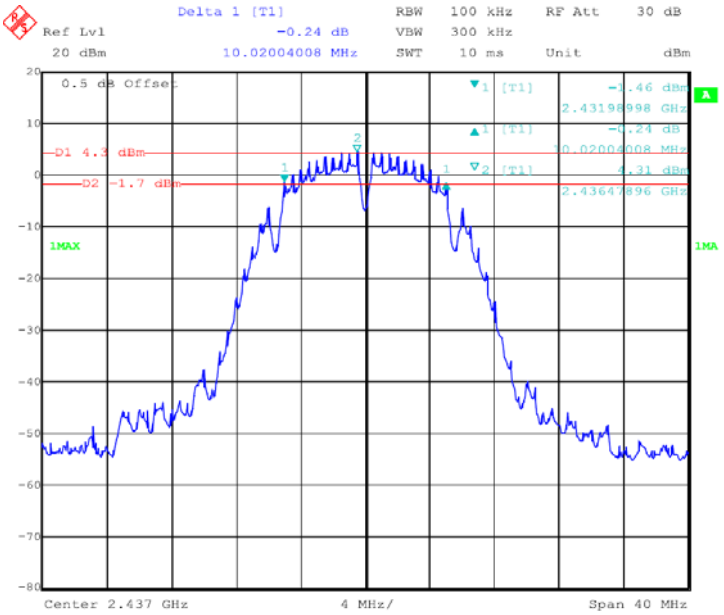
8.2 Test Result

Modulation	Bandwidth(MHz)			Limit
	Low Channel	Middle Channel	High Channel	
802.11b	9.54	10.02	9.54	≥500kHz
802.11g	15.31	15.47	15.31	≥500kHz
802.11n-HT20	16.03	16.91	16.11	≥500kHz
802.11n-HT40	35.11	35.75	35.27	≥500kHz
BLE	0.72	0.73	0.73	≥500kHz

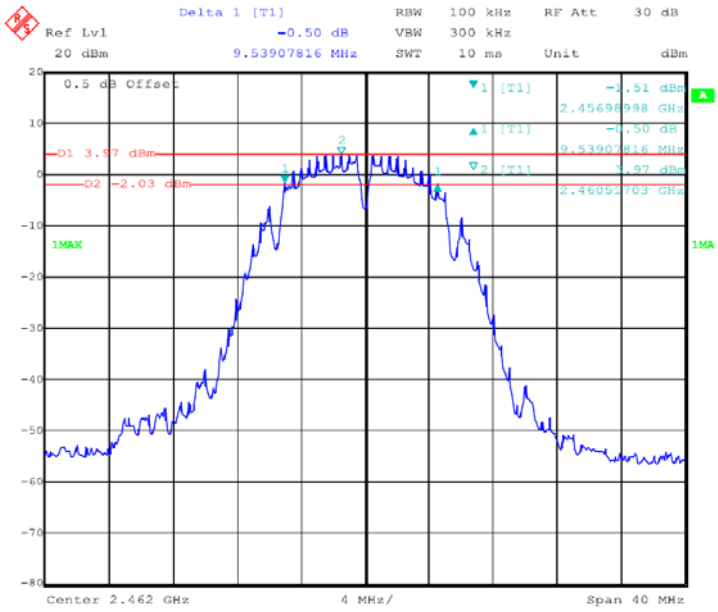
802.11b Low Channel



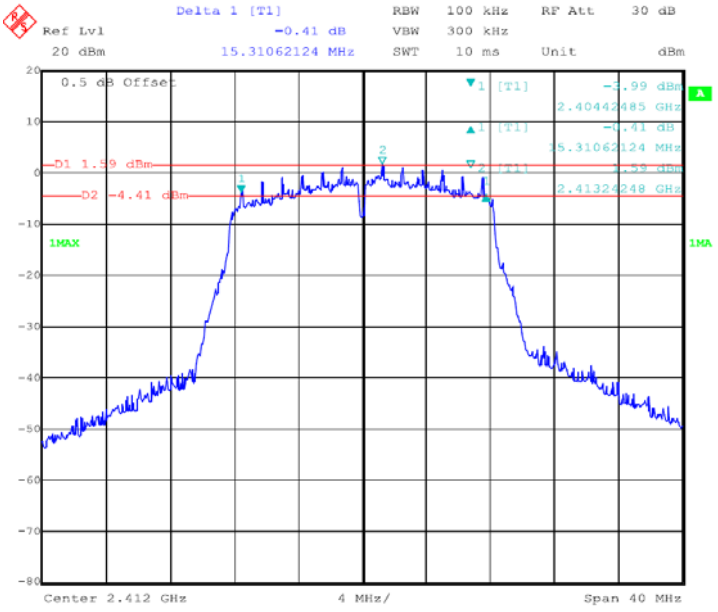
802.11b Middle Channel



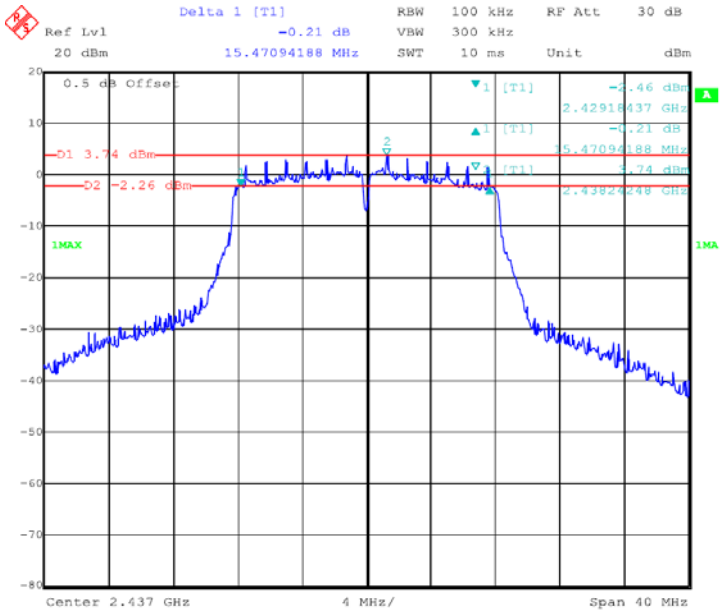
802.11b High Channel



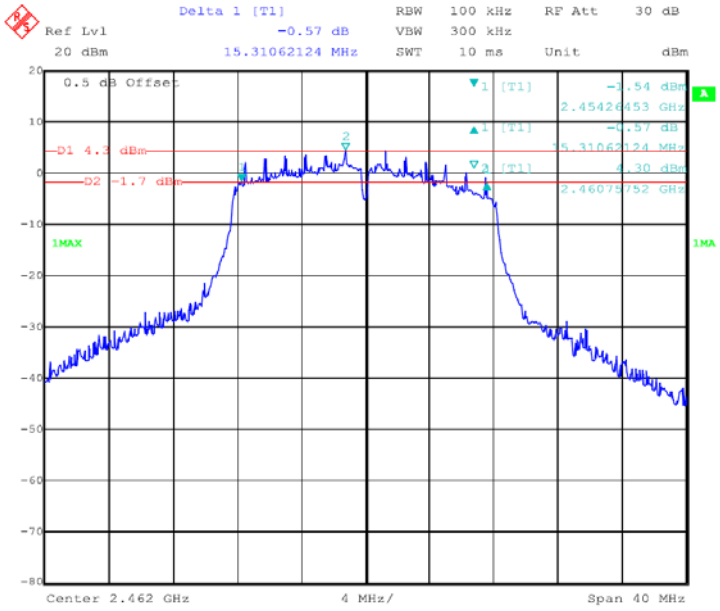
802.11g Low Channel



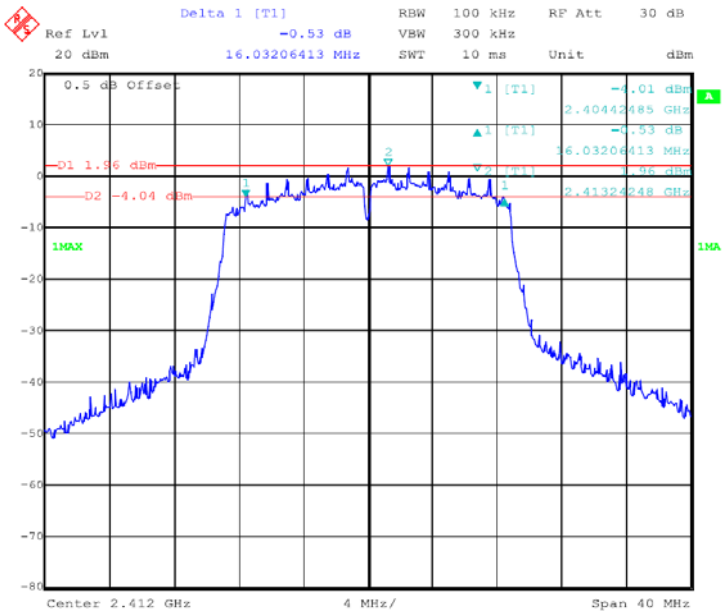
802.11g Middle Channel



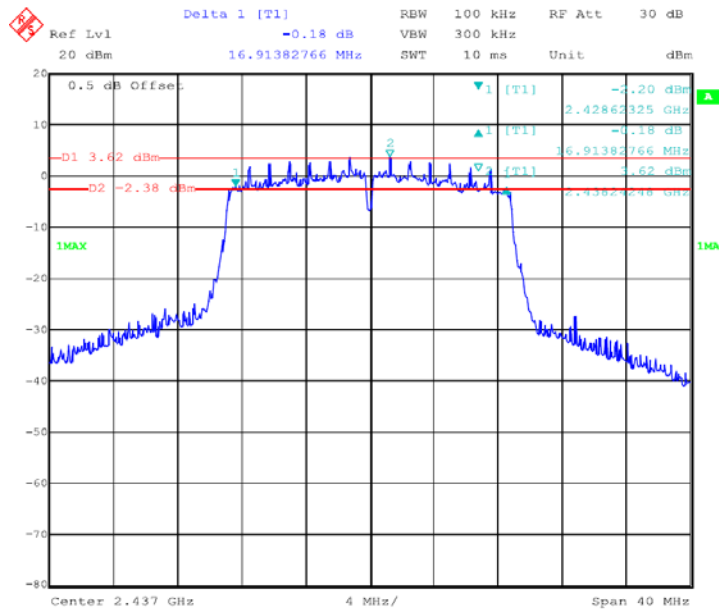
802.11g High Channel



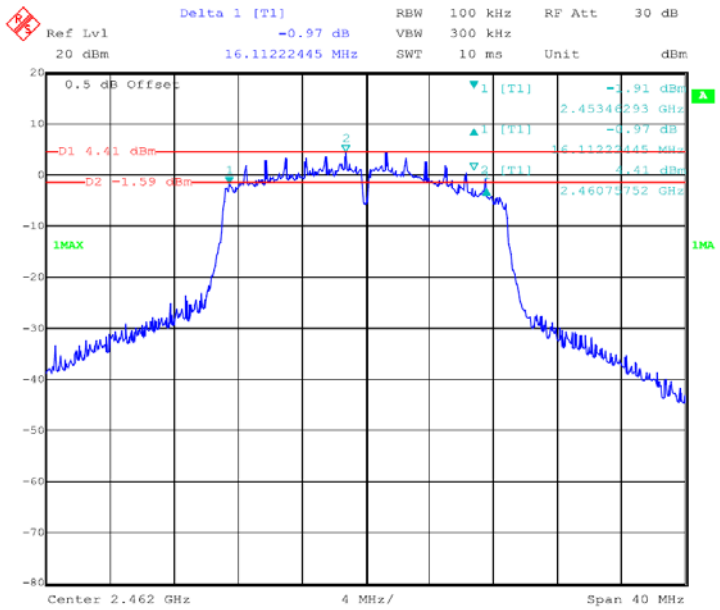
802.11n-HT20 Low Channel



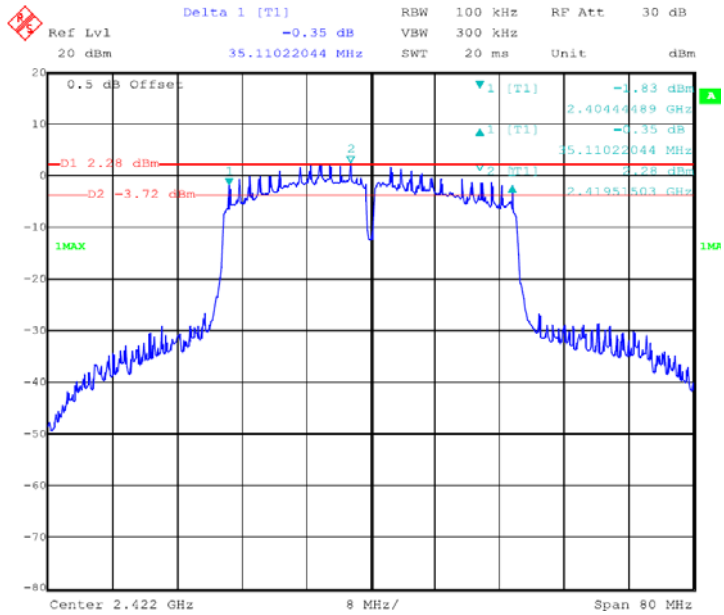
802.11n-HT20 Middle Channel



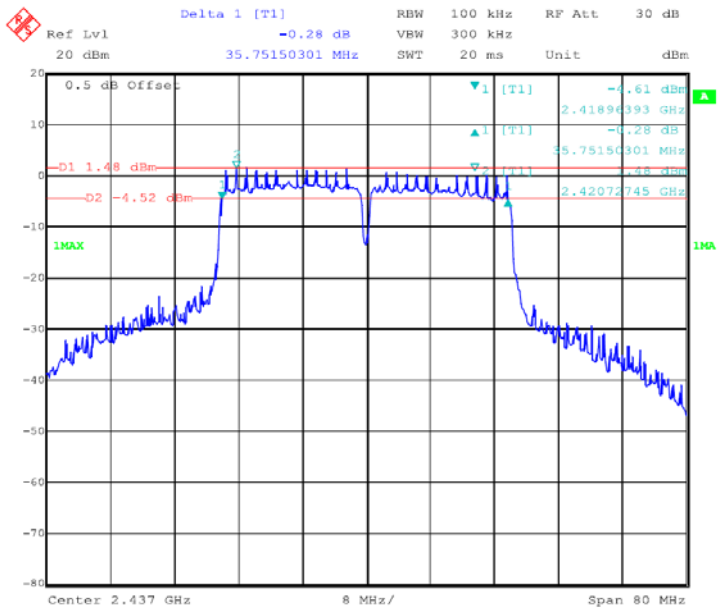
802.11n-HT20 High Channel



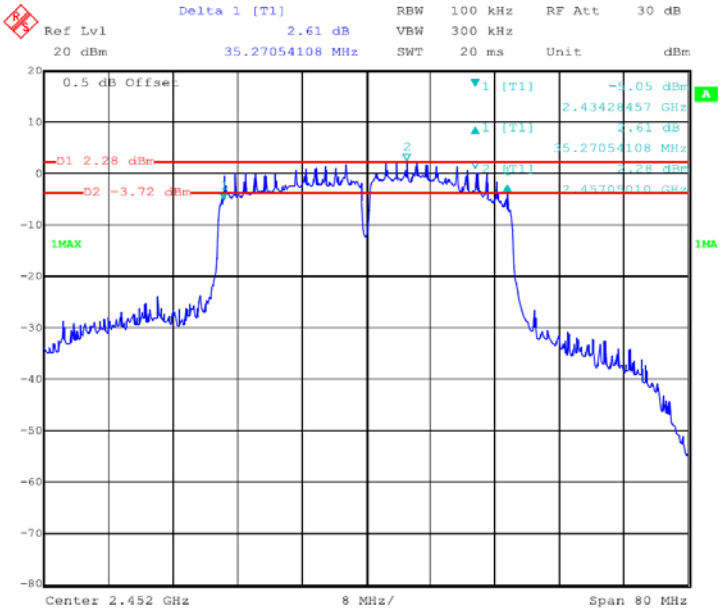
802.11n-HT40 Low Channel



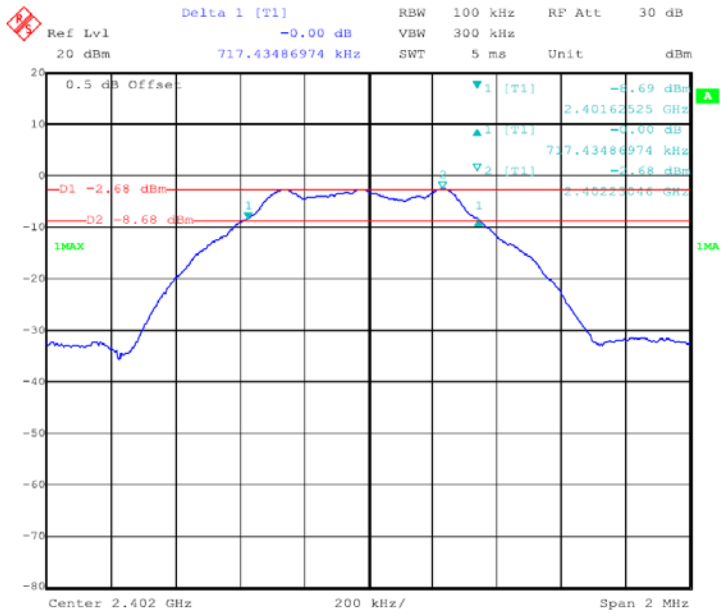
802.11n-HT40 Middle Channel



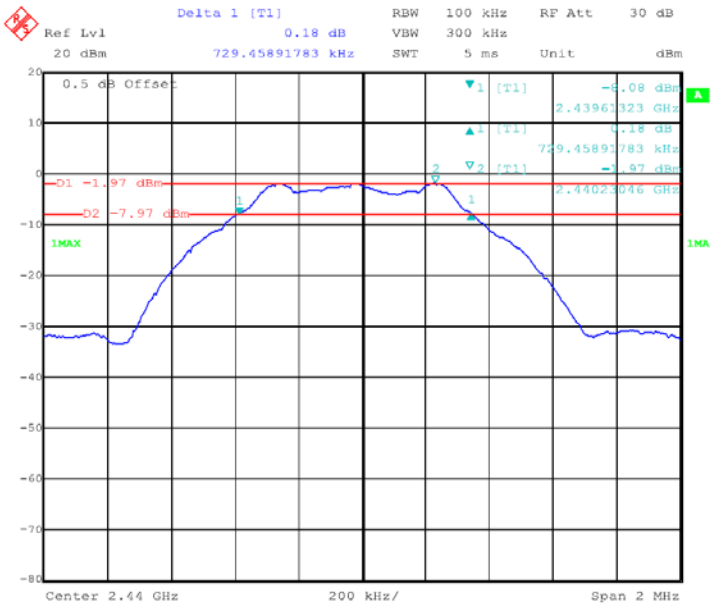
802.11n-HT40 High Channel



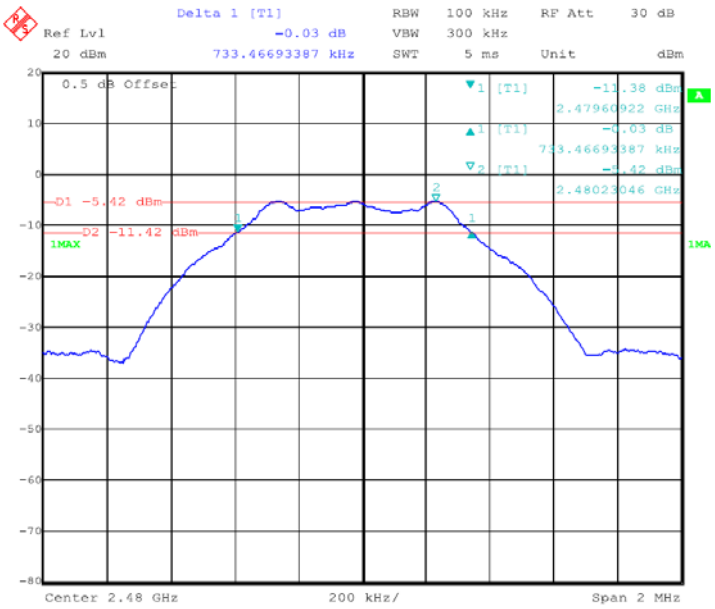
BLE Low Channel



BLE Middle Channel



BLE High Channel



9 Maximum Peak Output Power

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

Test Limit : Regulation 15.247 (b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.

9.1 Test Procedure

For 2.4G Wi-Fi

1. The testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance v04 section 9.1.2 PKPM1 Peak Power meter method.
2. The RF output of EUT was connected to the power meter 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. Measure the conducted output power and record the results in the test report.

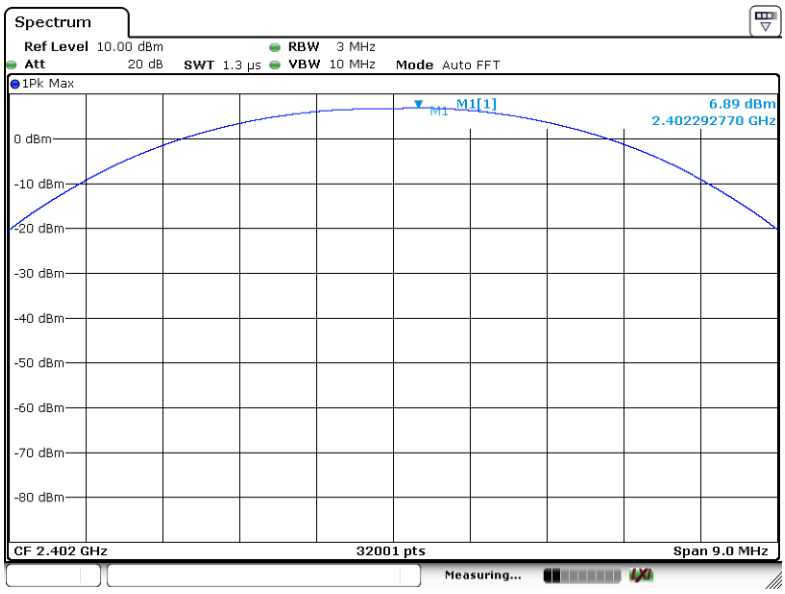
For BLE

1. The Transmitter output (antenna port) was connected to the spectrum Analyzer.
2. Turn on the EUT and then record the peak power value.
3. Repeat above procedures on all channels needed to be tested.

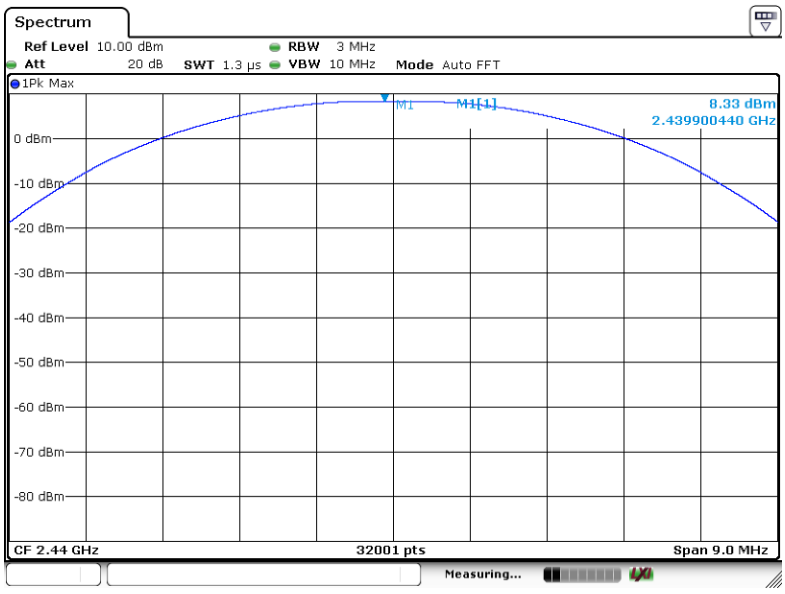
9.2 Test Result

Modulation	Maximum Peak Output Power (dBm)			Limit
	Low Channel	Middle Channel	High Channel	
802.11b	14.49	14.18	14.51	1W(30dBm)
802.11g	13.99	14.05	13.44	1W(30dBm)
802.11n-HT20	13.58	13.29	13.33	1W(30dBm)
802.11n-HT40	12.17	12.11	11.05	1W(30dBm)
BLE	6.89	8.33	8.61	1W(30dBm)

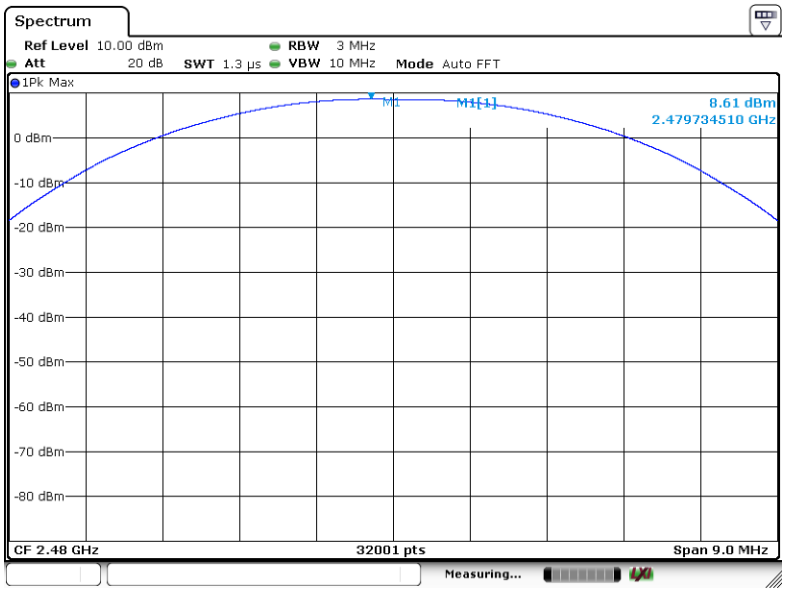
BLE Low Channel



BLE Middle Channel



BLE High Channel



10 Power Spectral density

Test Requirement : FCC CFR47 Part 15 Section 15.247

Test Method : ANSI C63.10:2013

Test Limit : Regulation 15.247(f) The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

10.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

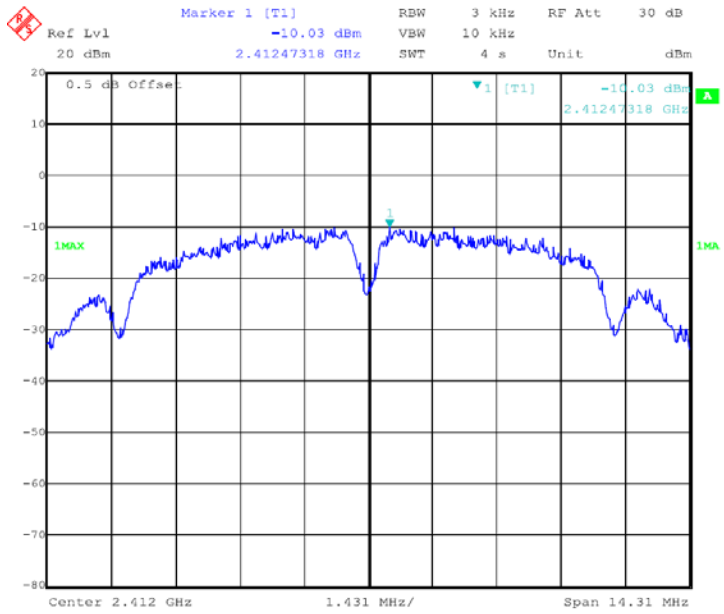
2. Set the spectrum analyzer: RBW = 3kHz. VBW = 10kHz, Span = 1.5 times the DTS channel bandwidth(6 dB bandwidth). Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

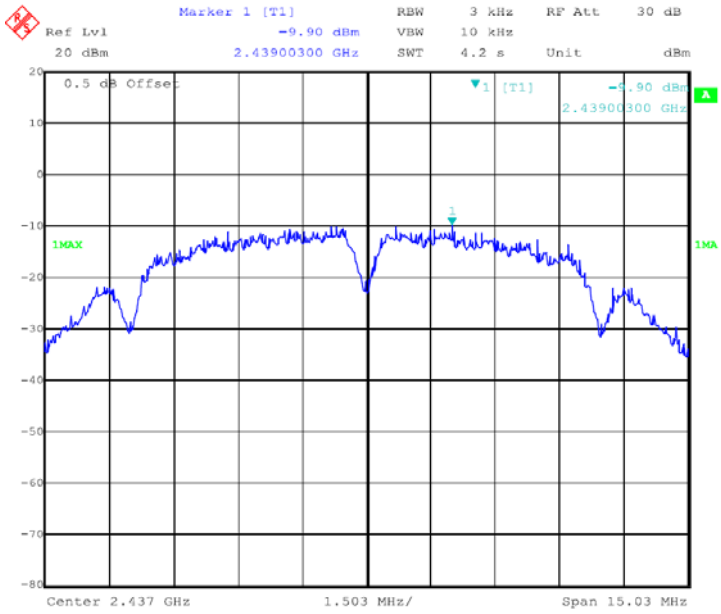
10.2 Test Result

Modulation	Power Spectral density (dBm/3kHz)			Limit
	Low Channel	Middle Channel	High Channel	
802.11b	-10.03	-9.90	-9.90	8dBm/3kHz
802.11g	-12.66	-10.53	-10.20	8dBm/3kHz
802.11n-HT20	-12.87	-10.97	-10.62	8dBm/3kHz
802.11n-HT40	-12.69	-12.84	-12.25	8dBm/3kHz
BLE	-17.35	-16.79	-20.26	8dBm/3kHz

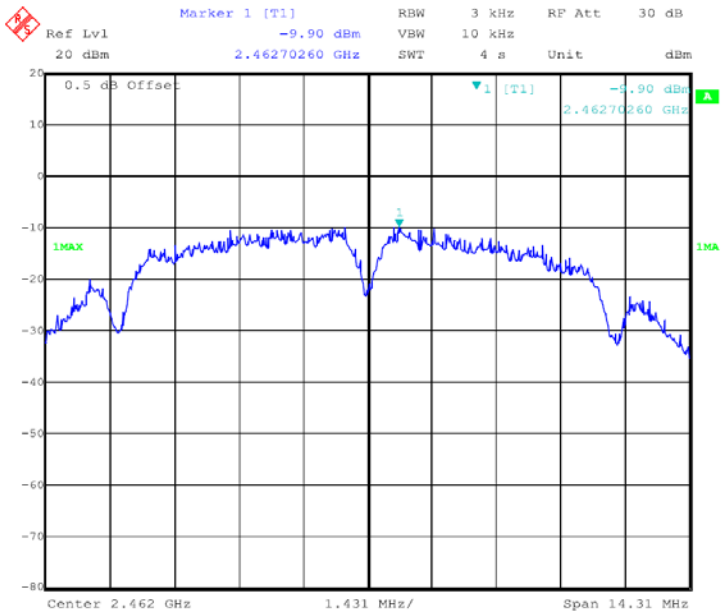
802.11b Low Channel



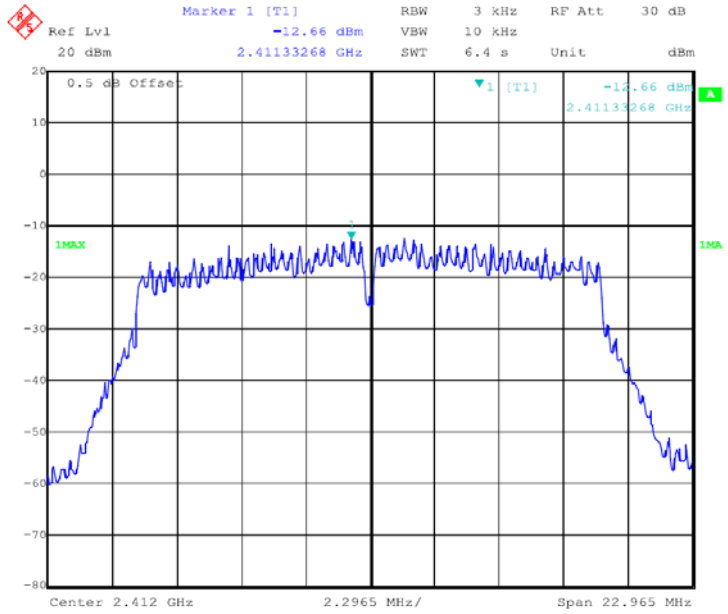
802.11b Middle Channel



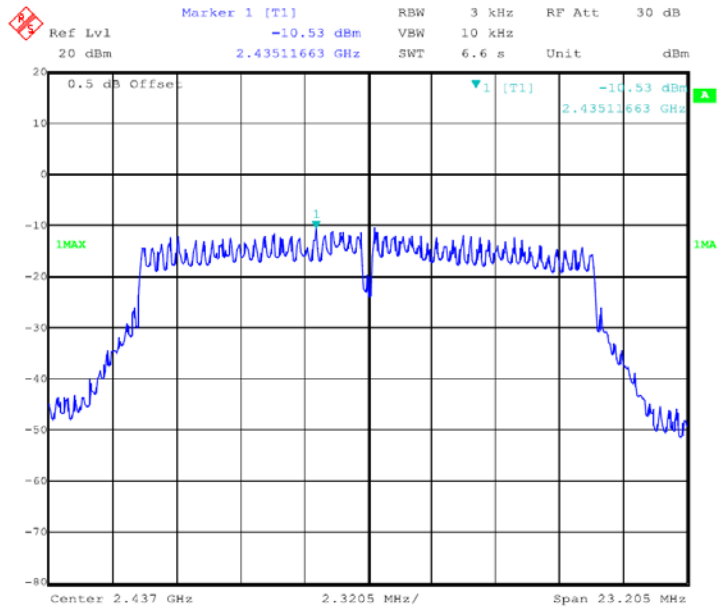
802.11b High Channel



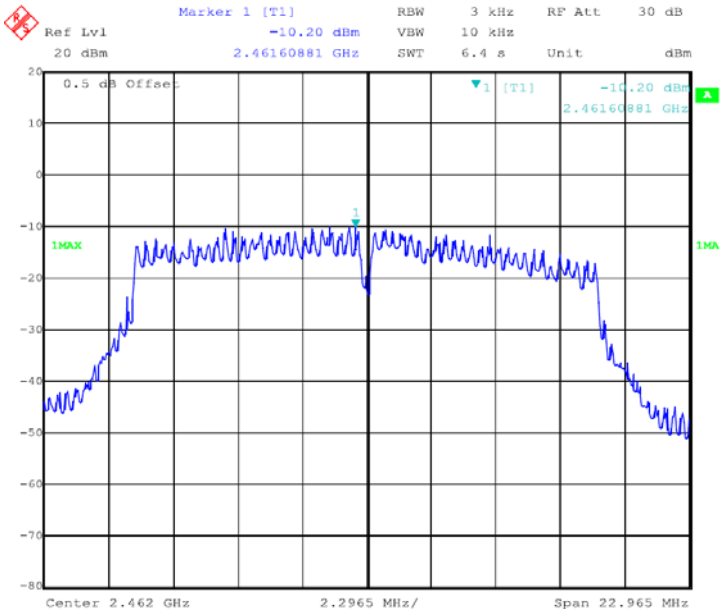
802.11g Low Channel



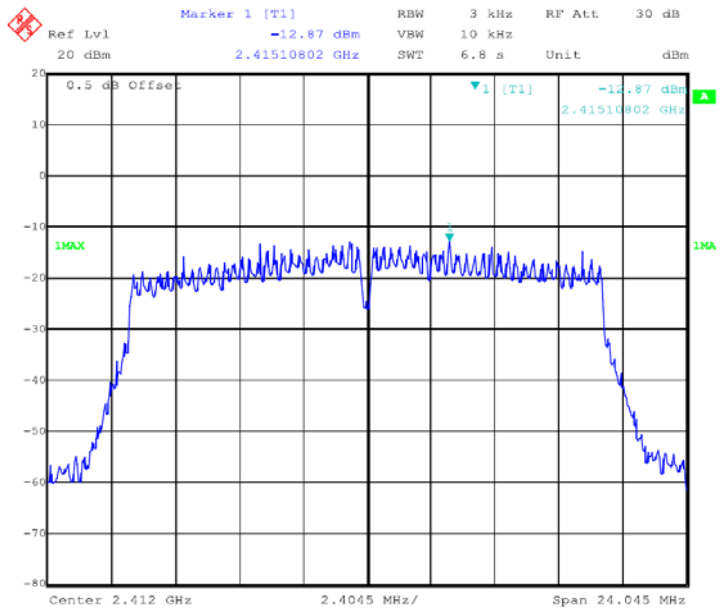
802.11g Middle Channel



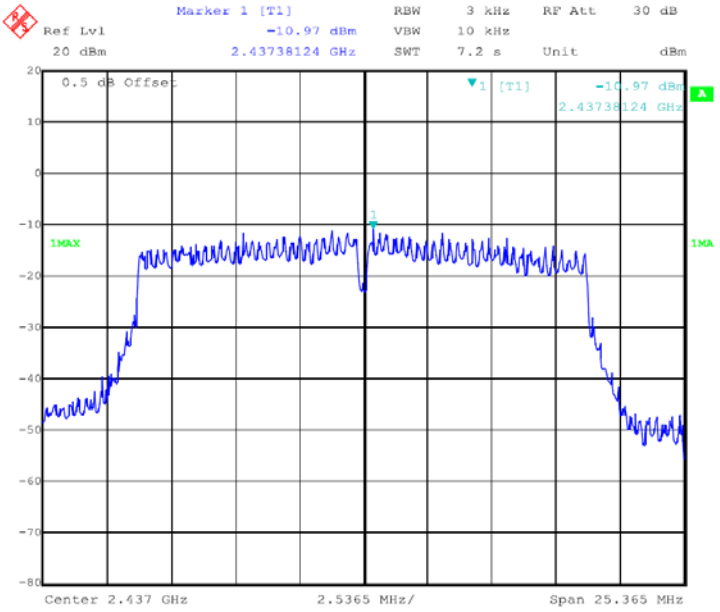
802.11g High Channel



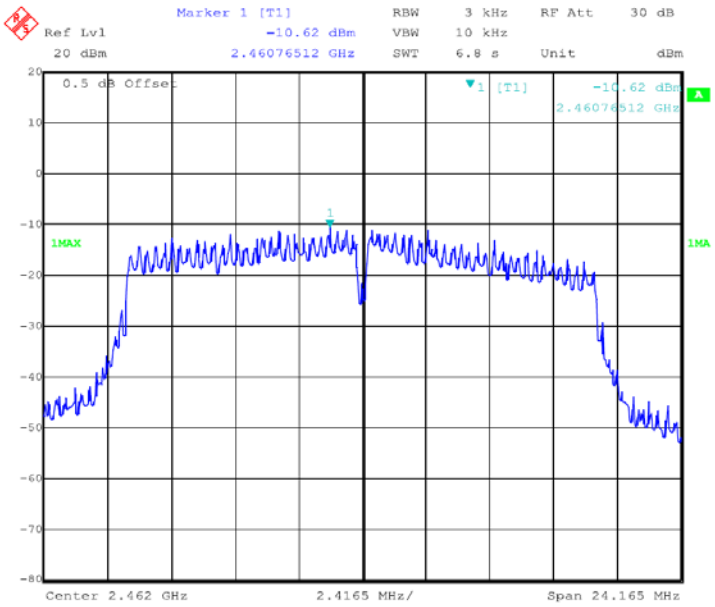
802.11n-HT20 Low Channel



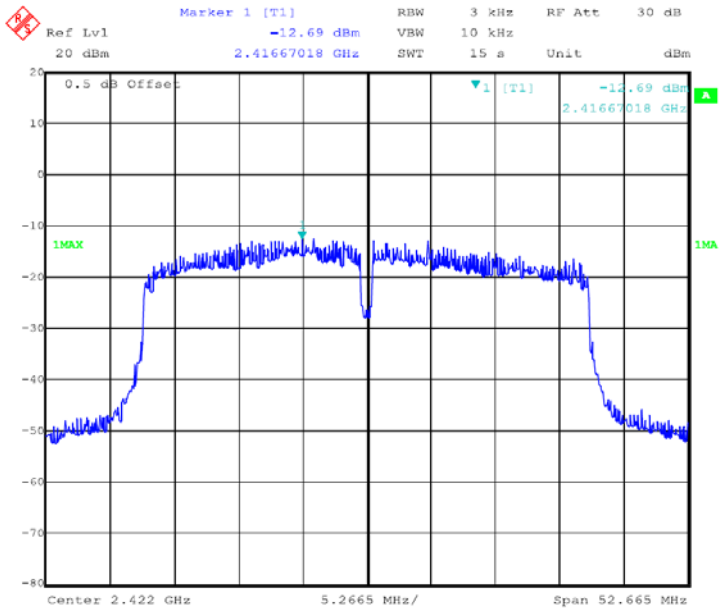
802.11n-HT20 Middle Channel



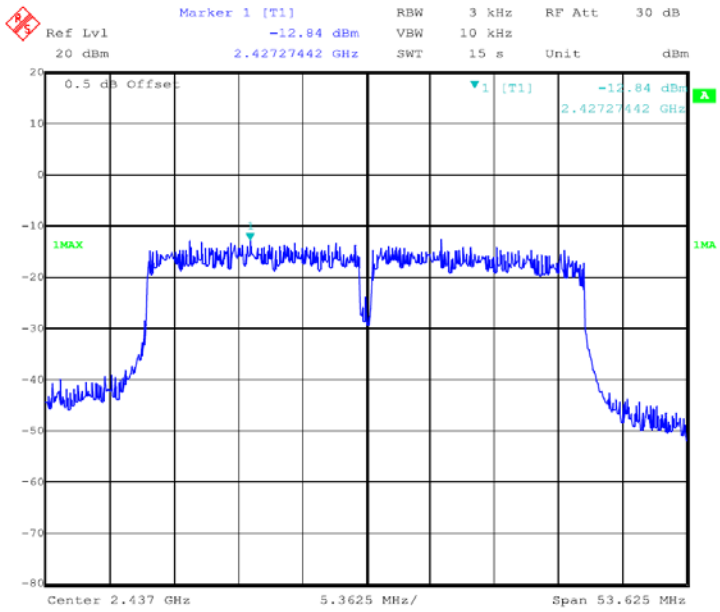
802.11n-HT20 High Channel



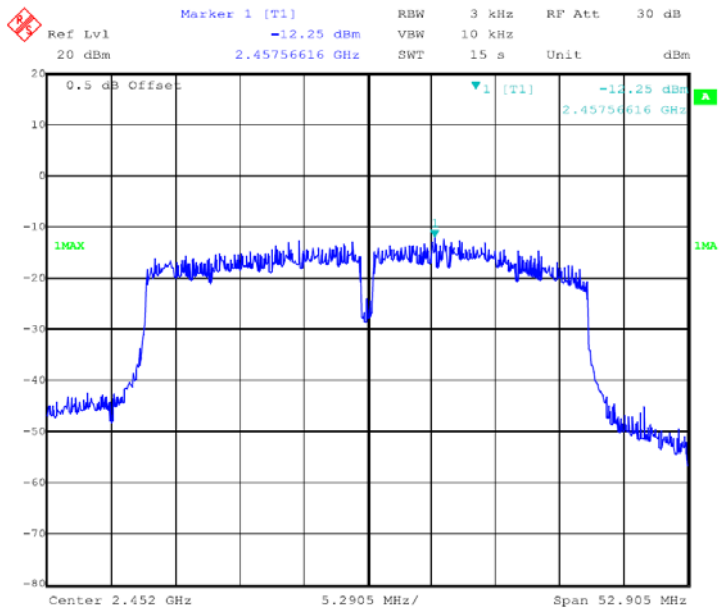
802.11n-HT40 Low Channel



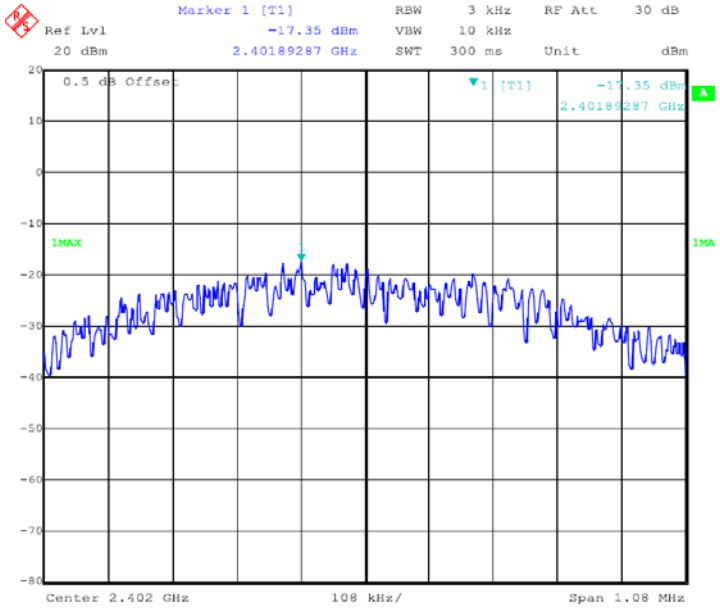
802.11n-HT40 Middle Channel



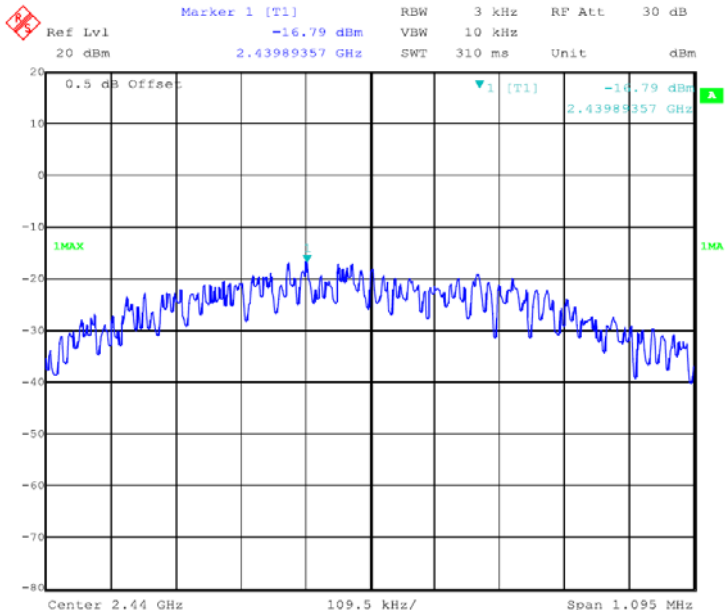
802.11n-HT40 High Channel



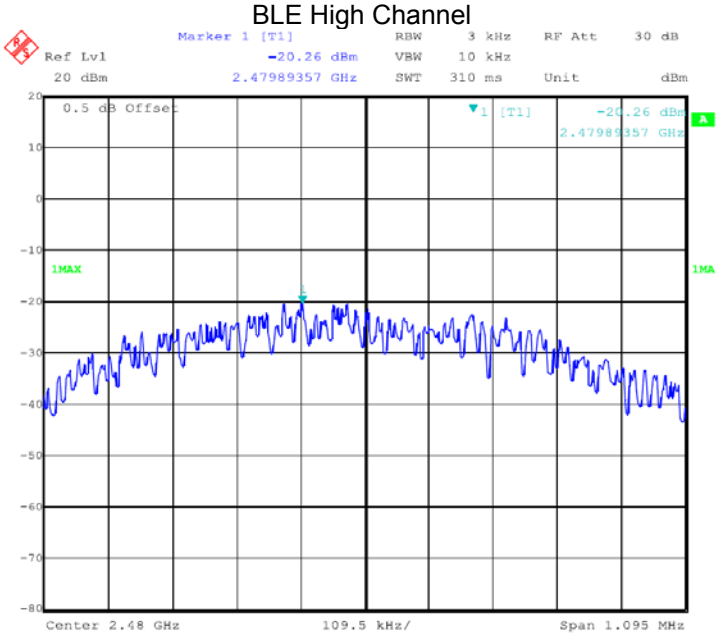
BLE Low Channel



BLE Middle Channel



BLE High Channel



11 Antenna Application

11.1 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.

11.2 Result

The EUT'S antenna, permanent attached antenna, is internal antenna. The antenna's gain is 3dBi and meets the requirement.

********THE END REPORT********