FCC TEST REPORT

FCC ID: 2AR6UR2

Product	:	Wireless Router
Model Name	:	Netduma R2
Brand	:	Netduma
Report No.	:	PTC18112601001E-FC01

Prepared for

Netduma Limited

20-22 Wenlock Road, London, N1 7GU, United Kingdom

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	:	Netduma Limited
Address	:	20-22 Wenlock Road, London, N1 7GU, United Kingdom
Manufacture's name	:	Visonicom Technology Corporation Limited
Address	:	Block B2, No. 14 Jian'an Road, Shajing Subdistrict, Baoan District, Shenzhen, 518104 China
Product name	:	Wireless Router
Model name	:	Netduma R2
Standards	:	FCC CFR47 Part 15 Section 15.247
Test procedure	:	ANSI C63.10:2013
Test Date	:	January 10, 2019 to February 28, 2019
Date of Issue	:	February 28, 2019
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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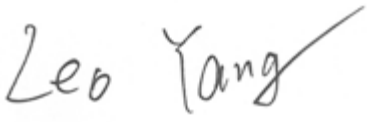
Test Engineer:



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
Conducted Spurious Emission	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: N/A: Not Applicable		

3 General Information

3.1 General Description of E.U.T.

Product Name	:	Wireless Router
Model Name	:	Netduma R2
Specification	:	802.11b/g/n HT20/HT40
Operation Frequency	:	2412-2462MHz for 802.11b/g/n(HT20) 2422-2452MHz for 802.11n(HT40)
Number of Channel	:	11 channels for 802.11b/g/n(HT20) 7 channels for 802.11b/g/n(HT20)
Type of Modulation	:	DSSS with DBPSK/DQPSK/CCK for 802.11b; OFDM with BPSK/QPSK/16QAM/64QAM for 802.11g/n;
Antenna installation	:	External Antenna
Antenna Type		2TX2RX
Antenna Port	:	☒Ant1; ☒Ant2; ☐Ant3; ☐Ant4
Smart system		☒SISO for 802.11b/g ☒MIMO for 802.11n
Smart system	:	5.0dBi (for per antenna port Max) 8.01dBi for MIMO(Ant1+Ant2 Directional Gain)
Power supply	:	For Adapter: Model: JZB-1201000E Input: AC 100-240V, 50/60Hz, 0.35A Max Output: DC 12V, 1000mA
Hardware Version	:	V1.2
Software Version	:	N/A

3.2 Channel List

The EUT has been tested under its typical operating condition.

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.

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 :

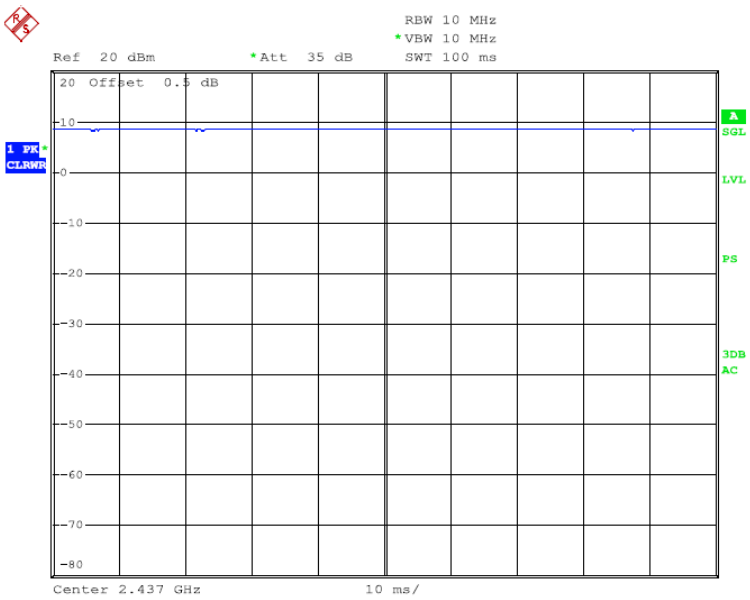
802.11b/g/n(HT20)		802.11n(HT40)	
Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	**2412**	1	--
2	2417	2	--
3	2422	**3**	**2422**
4	2427	4	2427
5	2432	5	2432
6	**2437**	**6**	**2437**
7	2442	7	2442
8	2447	8	2447
9	2452	**9**	**2452**
10	2457	10	--
11	**2462**	11	--

The maximum duty cycle as following table:

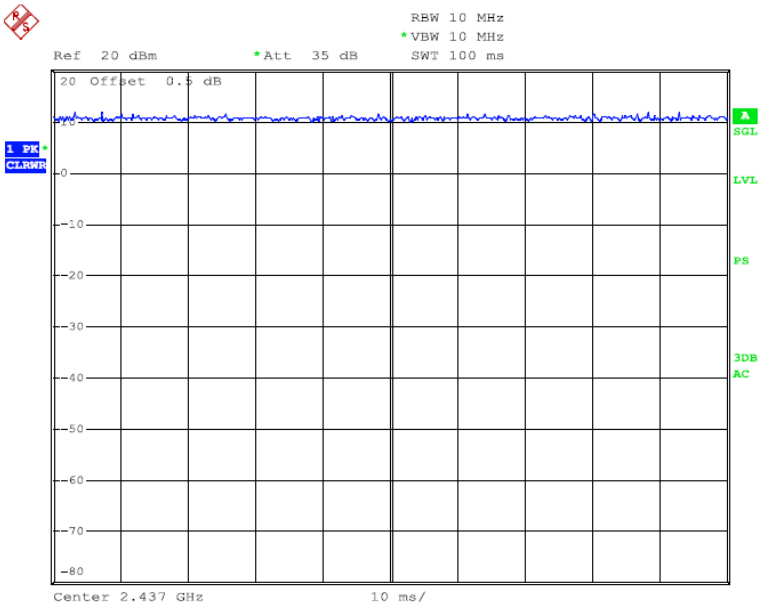
Test Mode	T_{on}(ms)	T_{on+off}(ms)	Duty Cycle(%)
802.11b	100	100	100%
802.11g	100	100	100%
802.11n(HT20)	100	100	100%
802.11n(HT40)	100	100	100%

Test Plots:

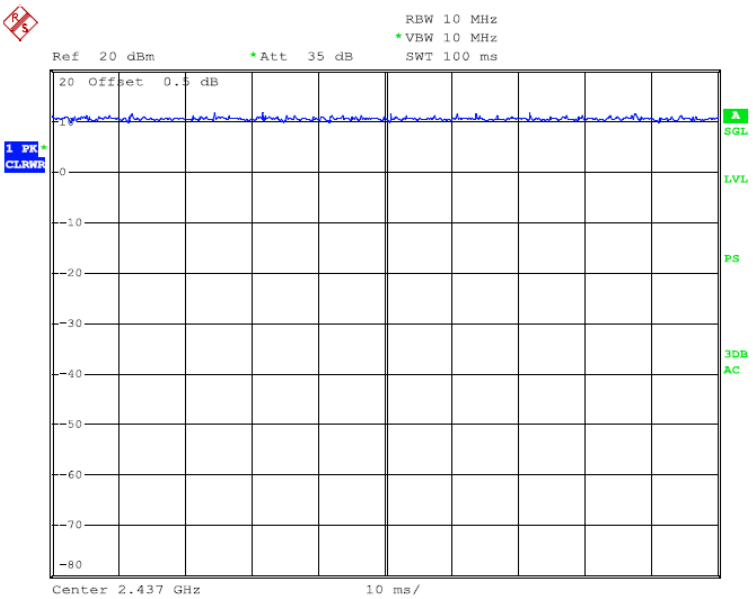
802.11b



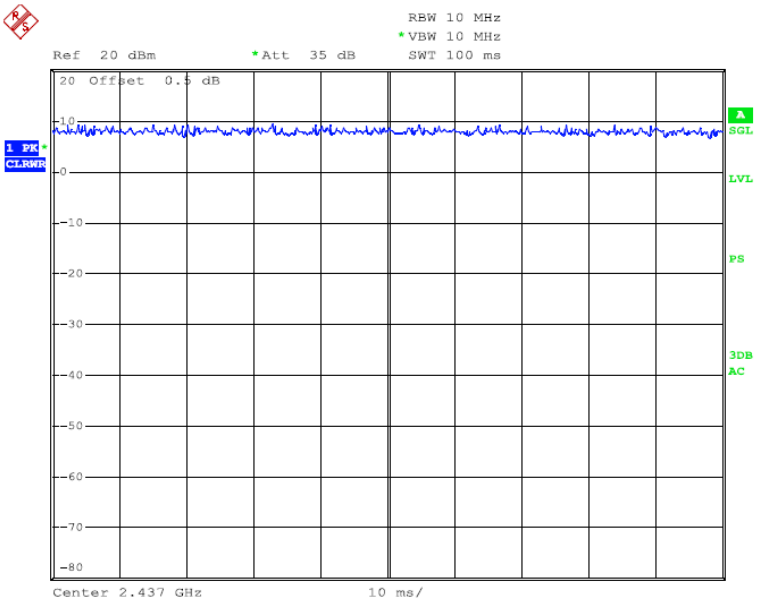
802.11g



802.11n(HT20)



802.11n(HT40)


RBW 10 MHz
*VBW 10 MHz
Ref 20 dBm
*Att 35 dB
SWT 100 ms
20 Offset 0.5 dB
1 PK
CLRWR
A
SGL
LVL
PS
3DB
AC
10
0
-10
-20
-30
-40
-50
-60
-70
-80
Center 2.437 GHz
10 ms/

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	VULB9160	9160-3355	25MHz-2GHz	Sep.19, 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.19, 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)

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
Spectrum Analyzer	Agilent	E4407B	MY45109572	9KHz-26.5GHz	Sep.19, 2019
Test Receiver	R&S	ESPI	101396	9KHz-7GHz	Sep.19, 2019
Horn Antenna	SCHWARZBECK	BBHA 9170	9170-181	14GHz-40GHz	Sep.19, 2019
Amplifier	SCHWARZBECK	BBV 9721	9721-205	18GHz-40GHz	Sep.19, 2019
RF Cable	R&S	R204	R21X	1GHz-40GHz	Sep.19, 2019
Antenna Connector	Florida RF Labs	N/A	RF01#	N/A	Sep.19, 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

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

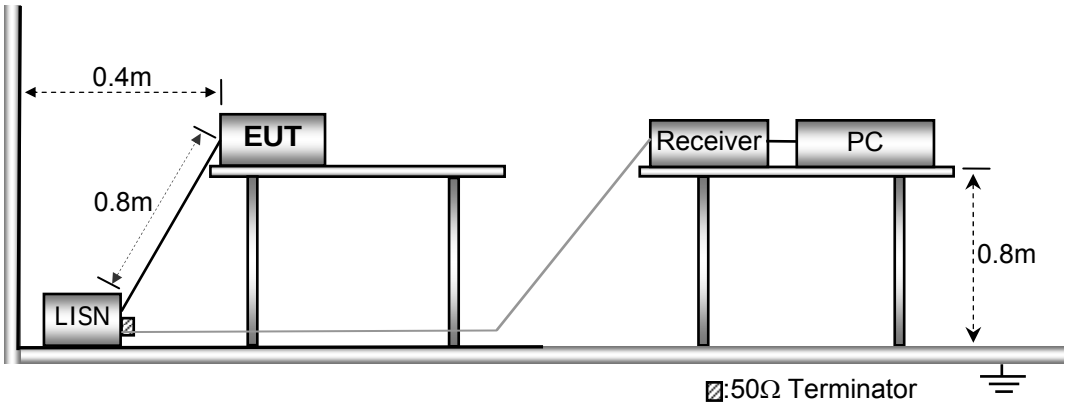
5.1 E.U.T. Operation

Operating Environment **:**

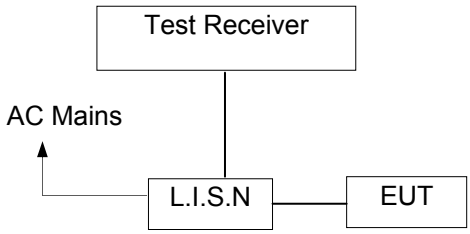
Temperature	:	25.5 °C
Humidity	:	51 % RH
Atmospheric Pressure	:	101.2kPa

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.

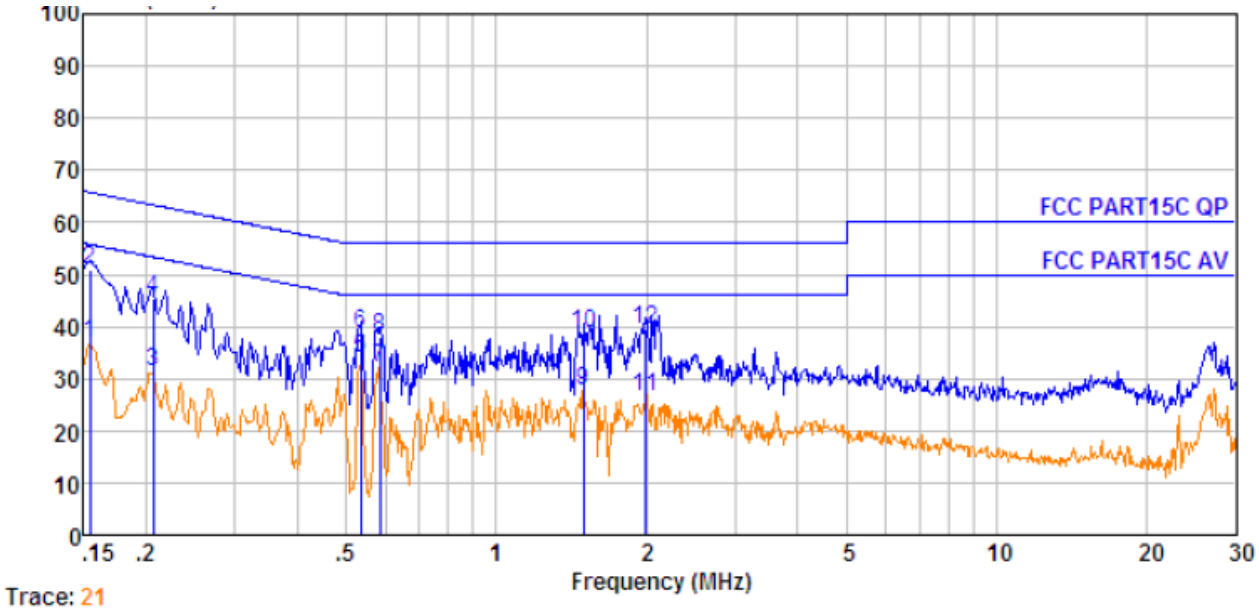
5.7 Conducted Emission Test Result

Pass.

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

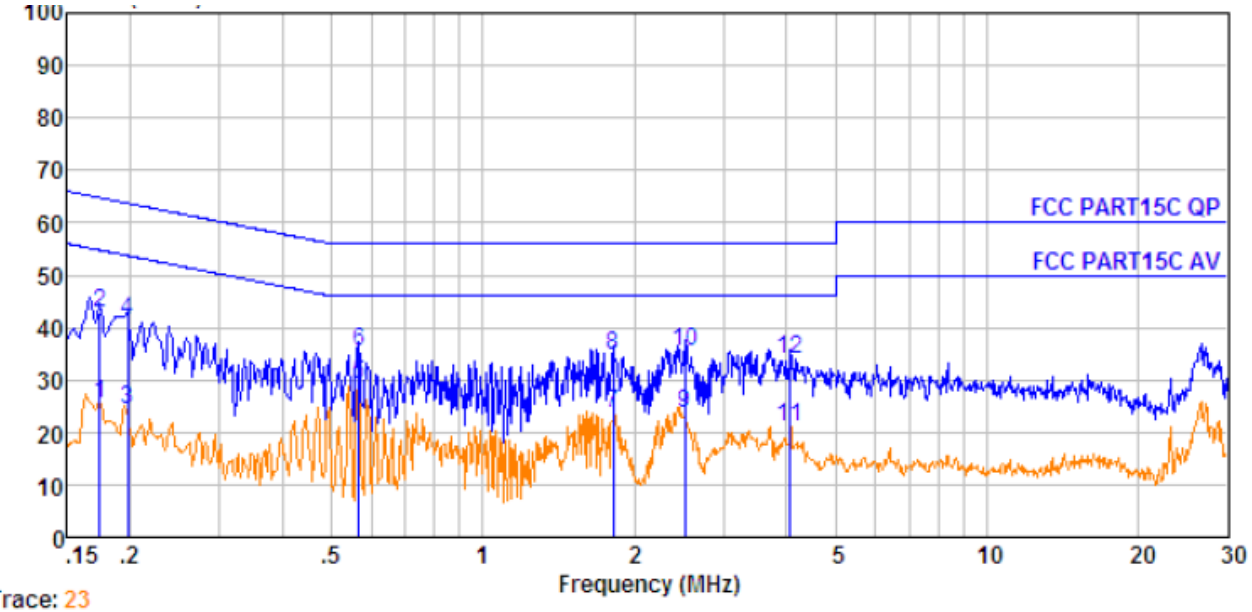
Please refer to the following test plots:

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.	0.154	0.21	9.50	27.10	36.81	55.78	-18.97	Average
2.	0.154	0.21	9.50	41.10	50.81	65.78	-14.97	QP
3.	0.206	0.29	9.60	21.63	31.52	53.36	-21.84	Average
4.	0.206	0.29	9.60	35.63	45.52	63.36	-17.84	QP
5.	0.535	0.43	9.78	23.67	33.88	46.00	-12.12	Average
6.	0.535	0.43	9.78	28.67	38.88	56.00	-17.12	QP
7.	0.585	0.43	9.79	21.75	31.97	46.00	-14.03	Average
8.	0.585	0.43	9.79	27.75	37.97	56.00	-18.03	QP
9.	1.495	0.47	9.84	17.27	27.58	46.00	-18.42	Average
10.	1.495	0.47	9.84	28.27	38.58	56.00	-17.42	QP
11.	1.991	0.47	9.85	16.20	26.52	46.00	-19.48	Average
12.	1.991	0.47	9.85	29.20	39.52	56.00	-16.48	QP

Neutral-AC 120V/60Hz



Trace: 23

No.	Freq MHz	Cable Loss dB	AMN Factor dB	Receiver Reading dBuV	Emission Level dBuV	Limit dBuV	Over Limit dB	Remark
1.	0.174	0.24	9.57	15.79	25.60	54.77	-29.17	Average
2.	0.174	0.24	9.57	32.83	42.64	64.77	-22.13	QP
3.	0.198	0.28	9.62	14.30	24.20	53.71	-29.51	Average
4.	0.198	0.28	9.62	31.35	41.25	63.71	-22.46	QP
5.	0.567	0.43	9.82	18.88	29.13	46.00	-16.87	Average
6.	0.567	0.43	9.82	25.00	35.25	56.00	-20.75	QP
7.	1.810	0.47	9.88	13.26	23.61	46.00	-22.39	Average
8.	1.810	0.47	9.88	24.29	34.64	56.00	-21.36	QP
9.	2.513	0.47	9.90	13.13	23.50	46.00	-22.50	Average
10.	2.513	0.47	9.90	25.20	35.57	56.00	-20.43	QP
11.	4.070	0.47	9.94	10.49	20.90	46.00	-25.10	Average
12.	4.070	0.47	9.94	23.60	34.01	56.00	-21.99	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

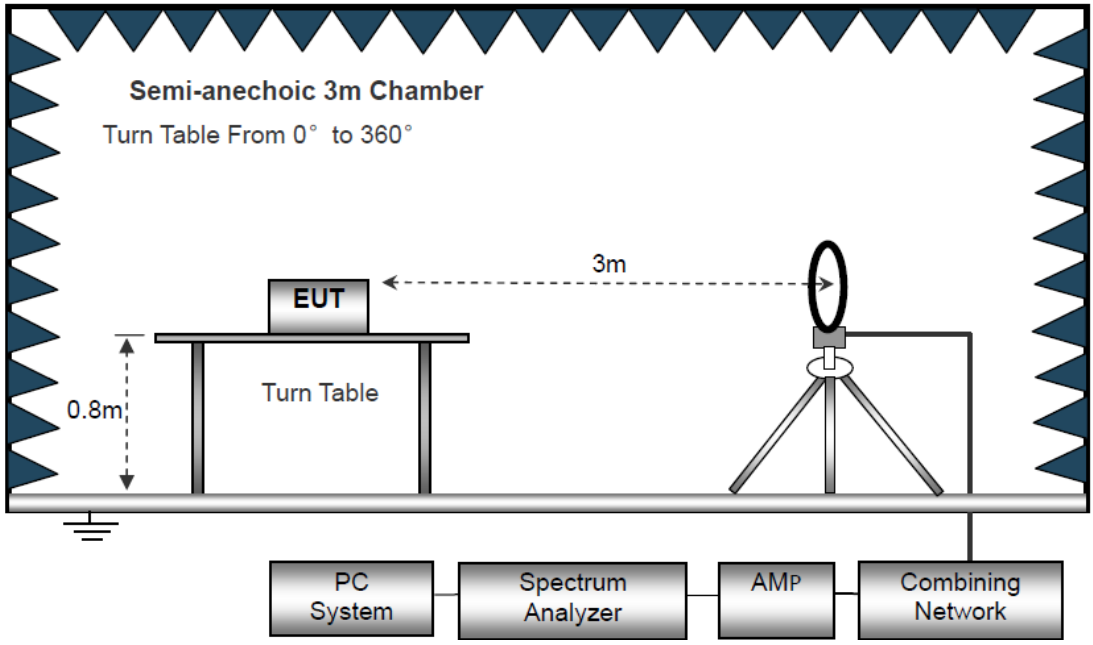
Humidity: : 51.1 % RH

Atmospheric Pressure: : 101.2kPa

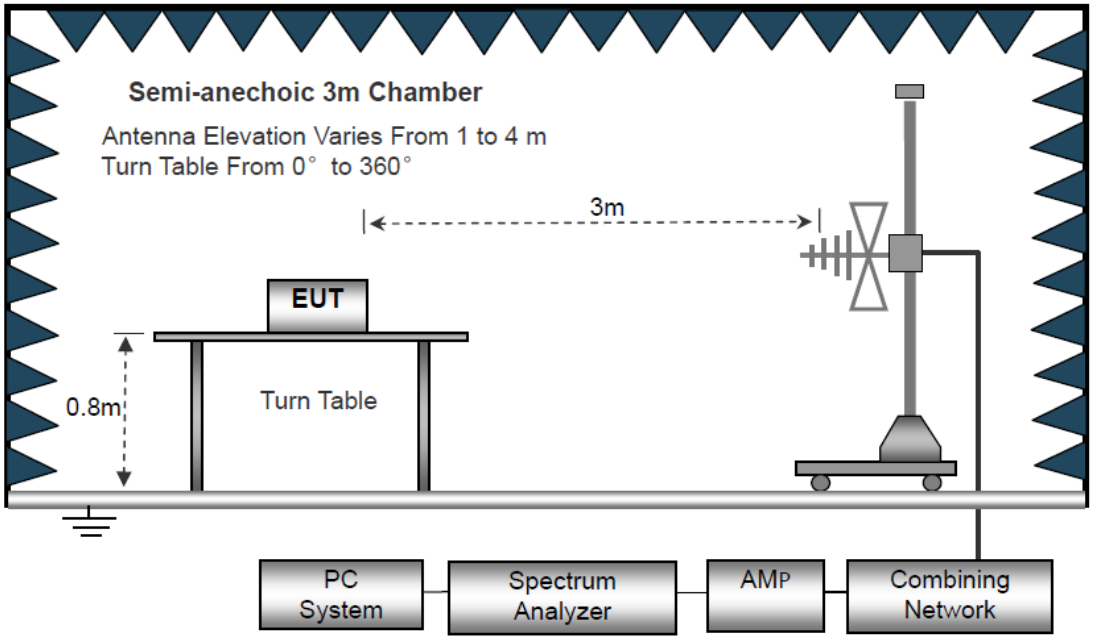
6.2 Test Setup

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

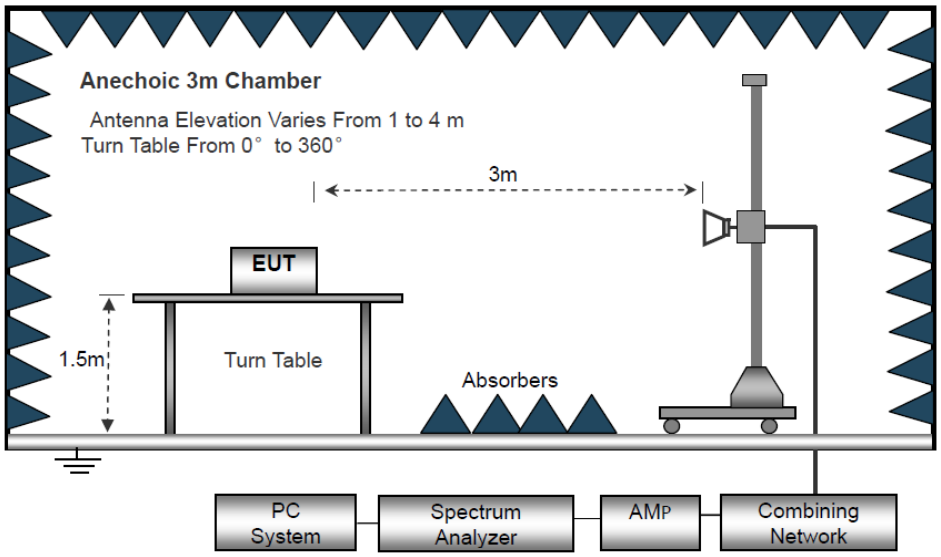
The test setup for emission measurement below 30MHz



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

	Frequency	Detector	RBW	VBW	Remark
Receiver Setup	Below 30MHz	--	10kHz	10kHz	--
	30MHz ~ 1GHz	Quasi-peak	120kHz	300kHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		RMS	1MHz	3MHz	Average Value

6.4 Test 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. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.

3. EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.

5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

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

7. The test above 1GHz must be use the fully anechoic room, and the test below 1GHz use the half anechoic room

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.

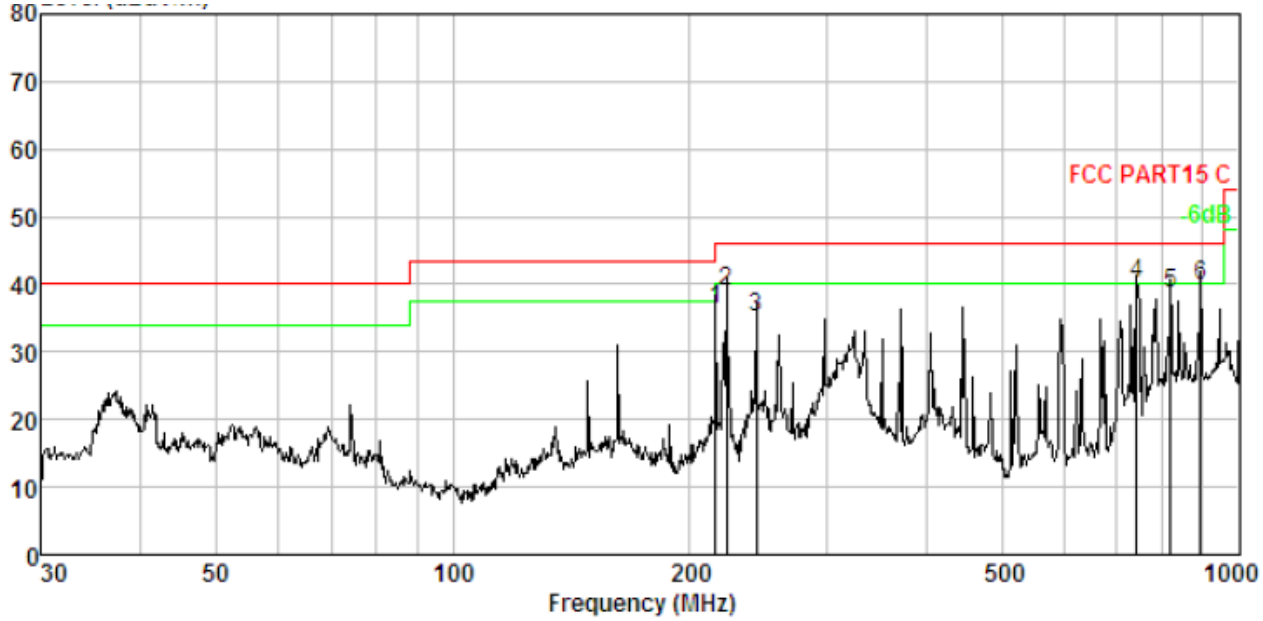
Distance extrapolation factor =40log(Specific distance/ test distance)(dB);
Limit line=Specific limits(dBuV) + distance extrapolation factor.

Test Frequency: 30MHz ~ 1GHz

All the modulation modes were tested the data of the worst mode (TX 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:

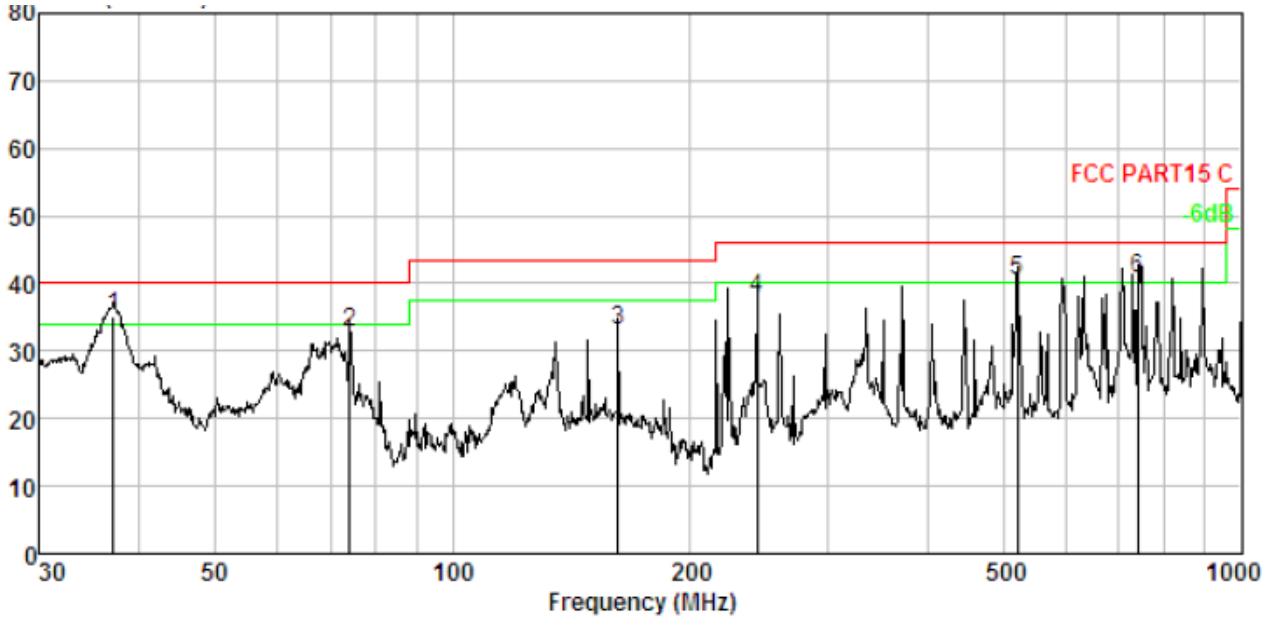
Antenna Polarization: Horizontal



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.	216.024	2.84	10.69	53.48	30.66	36.35	46.00	-9.65	QP
2.	222.950	2.87	10.91	56.00	30.67	39.11	46.00	-6.89	QP
3.	243.377	2.95	11.78	51.24	30.70	35.27	46.00	-10.73	QP
4.	742.259	3.96	21.12	46.27	31.09	40.26	46.00	-5.74	QP
5.	818.834	4.05	21.89	43.96	31.12	38.78	46.00	-7.22	QP
6.	893.857	4.13	22.45	44.48	31.15	39.91	46.00	-6.09	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.	37.155	1.25	13.50	50.51	30.04	35.22	40.00	-4.78	QP
2.	74.135	1.87	9.89	51.19	30.28	32.67	40.00	-7.33	QP
3.	162.041	2.58	13.76	47.19	30.56	32.97	43.50	-10.53	QP
4.	243.377	2.95	11.78	53.78	30.70	37.81	46.00	-8.19	QP
5.	520.888	3.64	17.35	50.48	30.96	40.51	46.00	-5.49	QP
6.	739.661	3.96	21.04	46.78	31.09	40.69	46.00	-5.31	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	35.69	AV	V	35.16	10.55	40.05	41.35	54	-12.65
4824	36.15	AV	H	35.16	10.55	40.05	41.81	54	-12.19
4824	41.45	PK	V	35.16	10.55	40.05	47.11	74	-26.89
4824	46.22	PK	H	35.16	10.55	40.05	51.88	74	-22.12
16884	34.28	AV	V	35.39	10.58	39.42	40.83	54	-13.17
16884	35.02	AV	H	35.39	10.58	39.42	41.57	54	-12.43
16884	46.82	PK	V	35.39	10.58	39.42	53.37	74	-20.63
16884	48.12	PK	H	35.39	10.58	39.42	54.67	74	-19.33

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	36.15	AV	V	35.18	10.58	40.07	41.84	54	-12.16
4874	37.22	AV	H	35.18	10.58	40.07	42.91	54	-11.09
4874	45.92	PK	V	35.18	10.58	40.07	51.61	74	-22.39
4874	48.17	PK	H	35.18	10.58	40.07	53.86	74	-20.14
17059	35.04	AV	V	35.42	10.62	39.16	41.92	54	-12.08
17059	36.62	AV	H	35.42	10.62	39.16	43.5	54	-10.5
17059	46.92	PK	V	35.42	10.62	39.16	53.8	74	-20.2
17059	47.15	PK	H	35.42	10.62	39.16	54.03	74	-19.97

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	36.32	AV	V	35.26	10.54	40.01	42.11	54	-11.89
4924	37.12	AV	H	35.26	10.54	40.01	42.91	54	-11.09
4924	46.58	PK	V	35.26	10.54	40.01	52.37	74	-21.63
4924	49.67	PK	H	35.26	10.54	40.01	55.46	74	-18.54
17234	35.24	AV	V	35.67	10.66	39.04	42.53	54	-11.47
17234	36.72	AV	H	35.67	10.66	39.04	44.01	54	-9.99
17234	47.12	PK	V	35.67	10.66	39.04	54.41	74	-19.59
17234	48.67	PK	H	35.67	10.66	39.04	55.96	74	-18.04

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(802.11g) was report as below

Test Mode: 802.11g 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	26.76	27.27	6.62	0	60.65	74	-13.35	V	Peak
2390.00	27.29	27.53	6.75	0	61.57	74	-12.43	V	
2310.00	26.37	27.27	6.62	0	60.26	74	-13.74	H	
2390.00	26.77	27.53	6.75	0	61.05	74	-12.95	H	
2310.00	12.91	27.27	6.62	0	46.8	54	-7.2	V	Average
2390.00	13.21	27.53	6.75	0	47.49	54	-6.51	V	
2310.00	12.93	27.27	6.62	0	46.82	54	-7.18	H	
2390.00	14.16	27.53	6.75	0	48.44	54	-5.56	H	

Test Mode: 802.11g 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	25.69	27.85	6.83	0	60.37	74	-13.63	V	Peak
2500.00	25.68	27.9	6.84	0	60.42	74	-13.58	V	
2483.50	26.12	27.85	6.83	0	60.8	74	-13.2	H	
2500.00	26.17	27.9	6.84	0	60.91	74	-13.09	H	
2483.50	13.03	27.85	6.83	0	47.71	54	-6.29	V	Average
2500.00	12.7	27.9	6.84	0	47.44	54	-6.56	V	
2483.50	14.11	27.85	6.83	0	48.79	54	-5.21	H	
2500.00	12.94	27.9	6.84	0	47.68	54	-6.32	H	

Test Frequency: From 18GHz to 25GHz

The measurements were more than 20dB below the limit and not reported.

7 Conducted Spurious Emission

Test Requirement	:	FCC CFR47 Part 15 Section 15.247
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)).

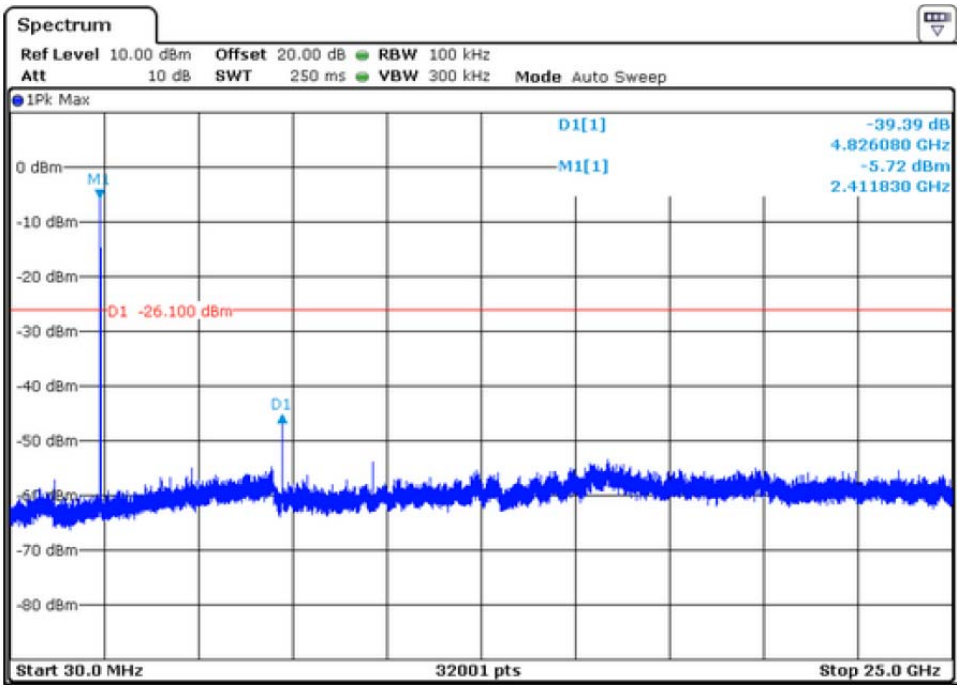
7.1 Test Procedure

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 = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold

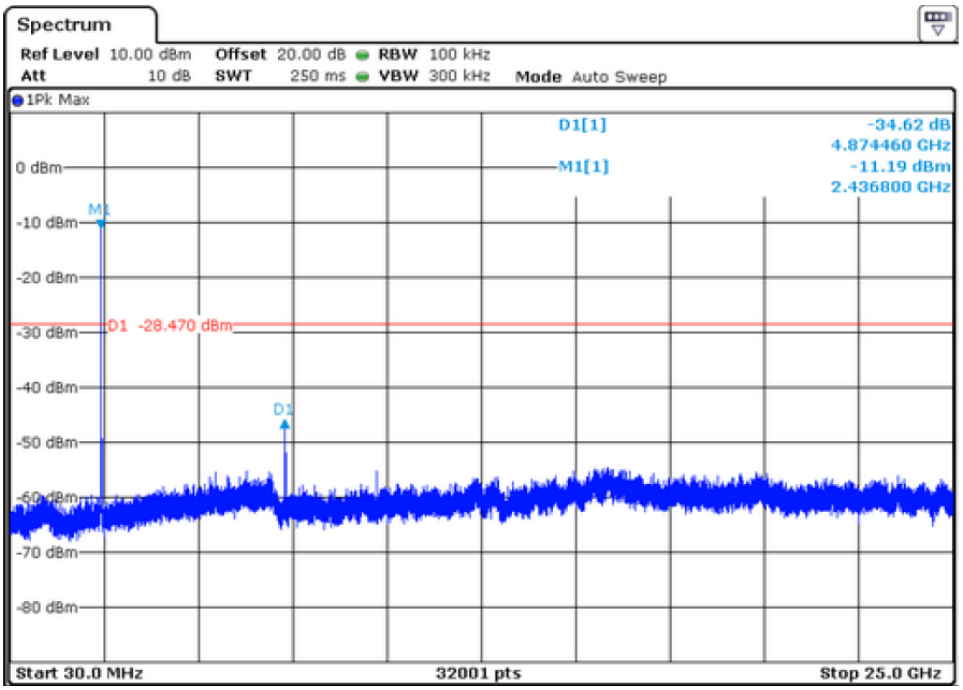
7.2 Test Result

ANT 1 802.11 b

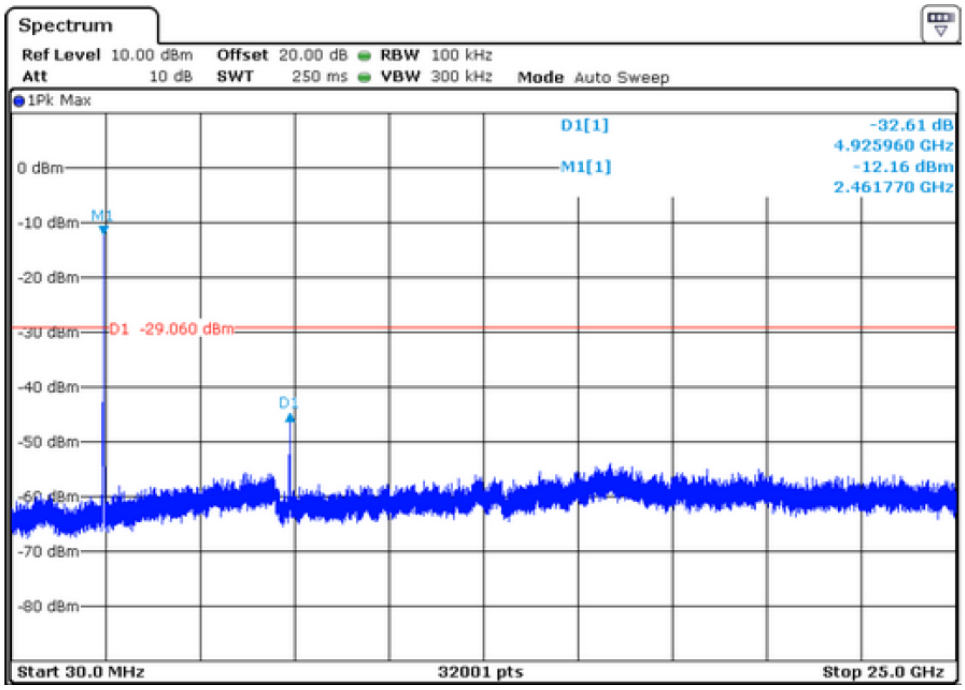
Low Channel



Middle Channel

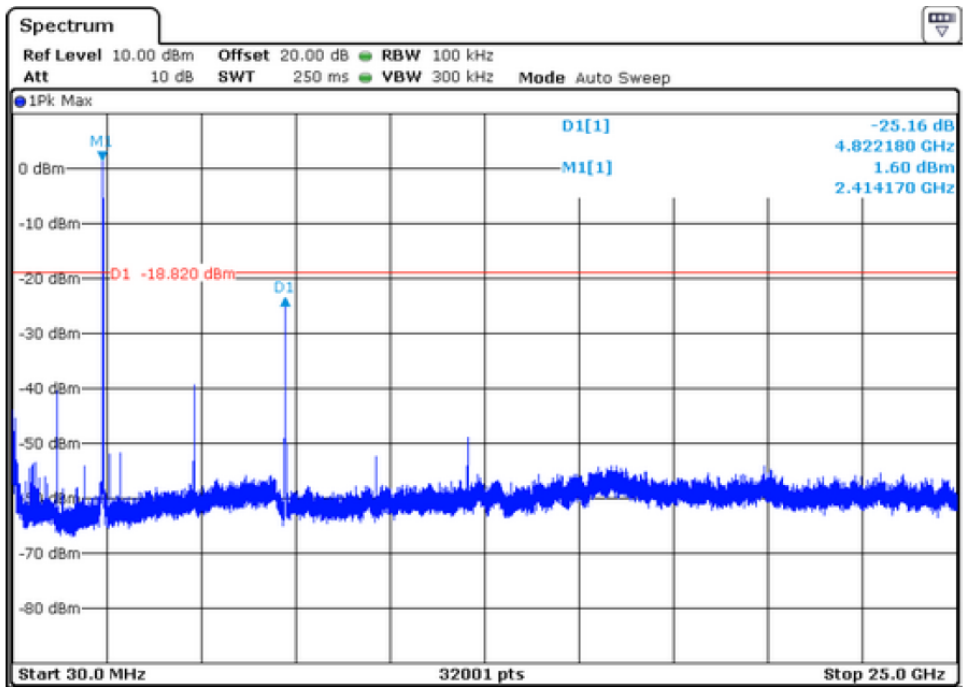


High Channel

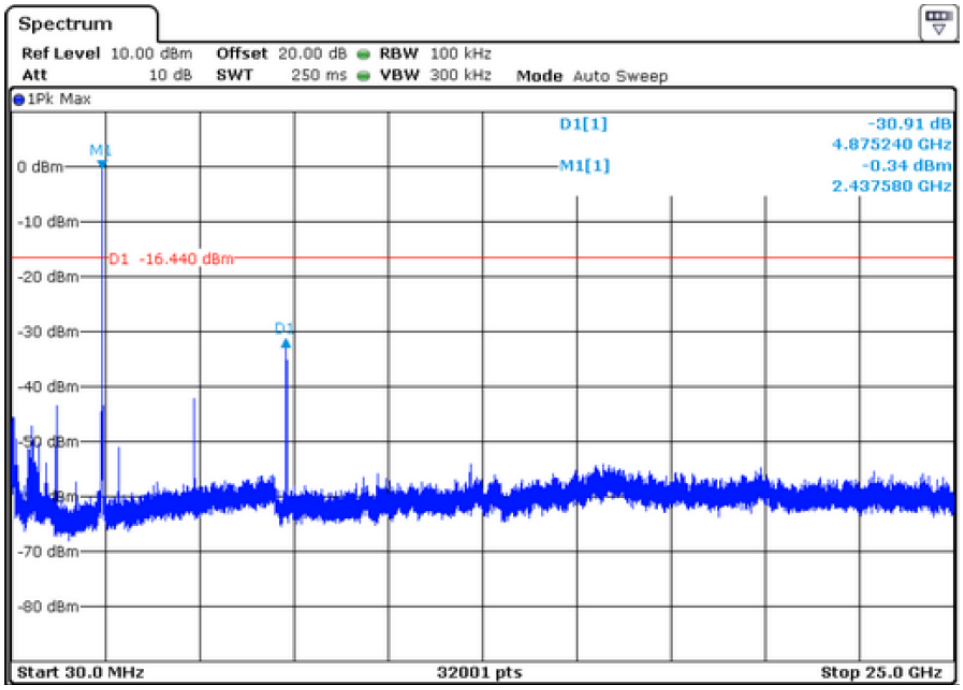


ANT 2 802.11 b

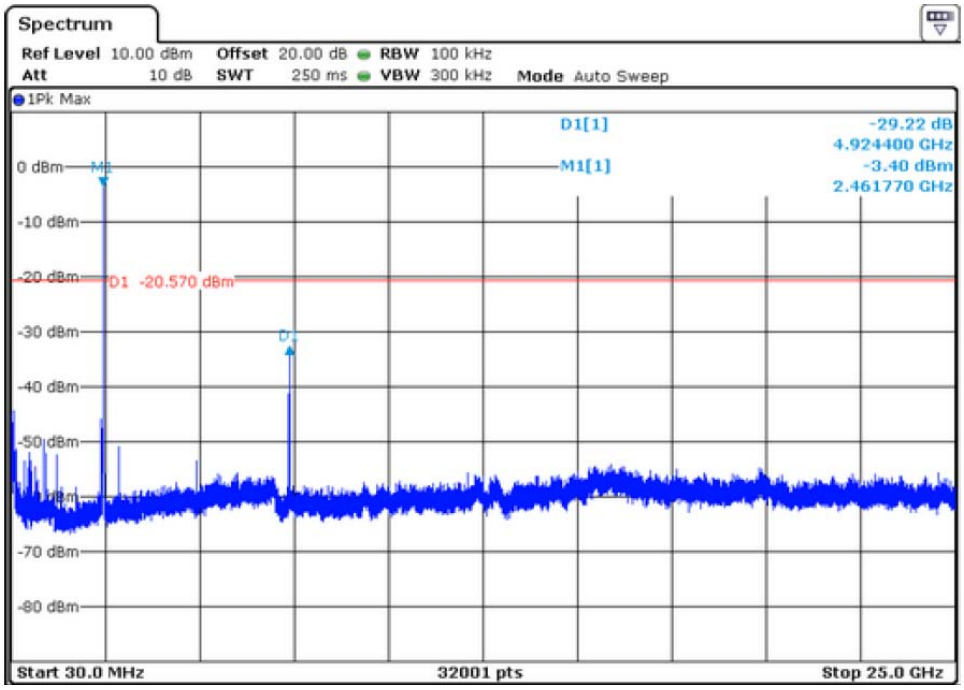
Low Channel



Middle Channel

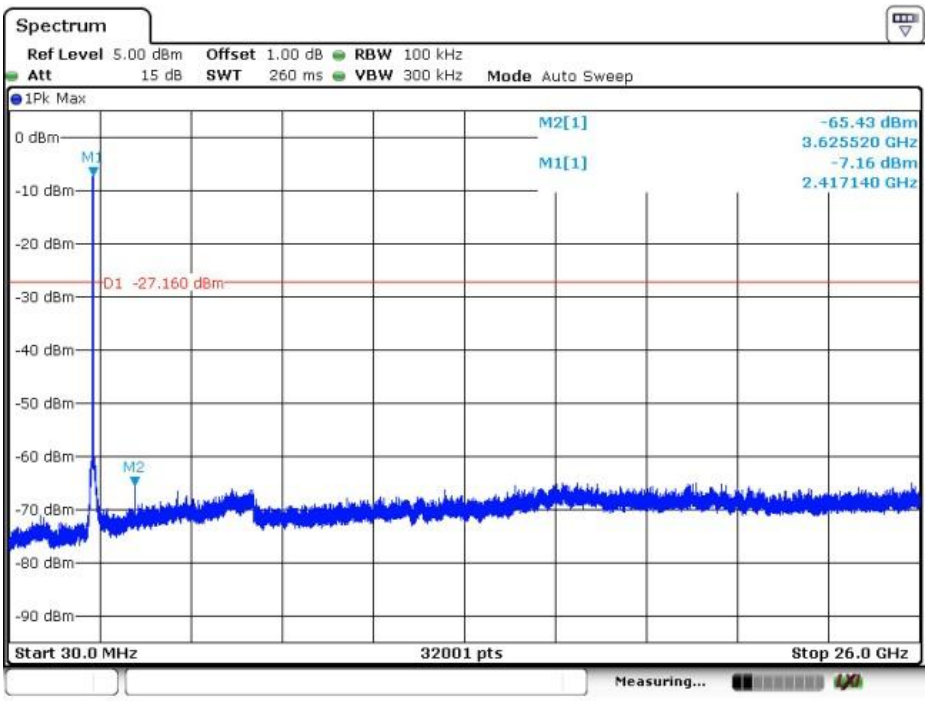


High Channel

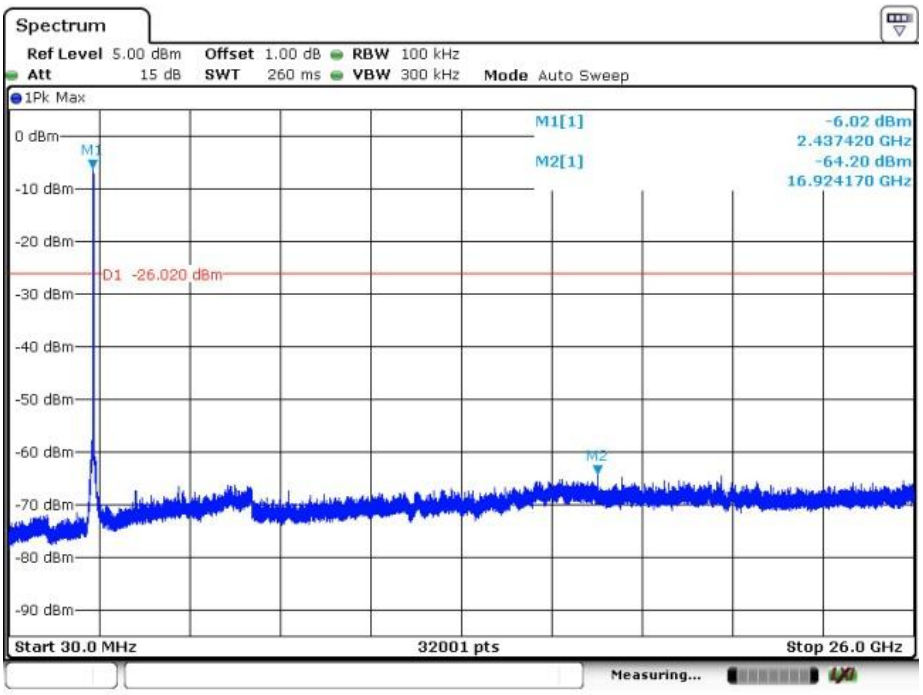


ANT 1 802.11g

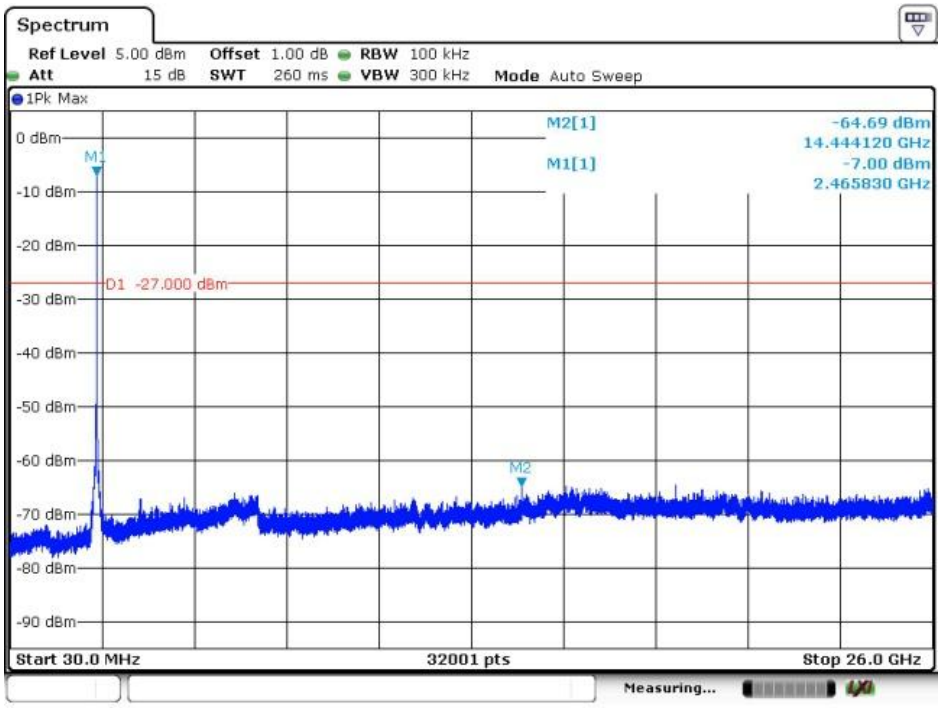
Low Channel



Middle Channel

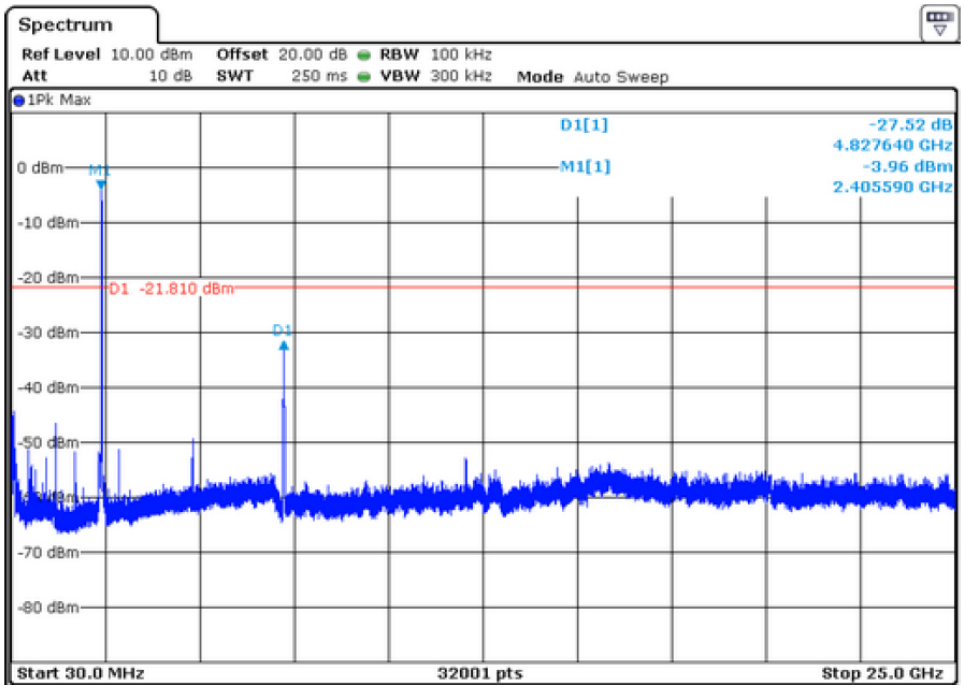


High Channel

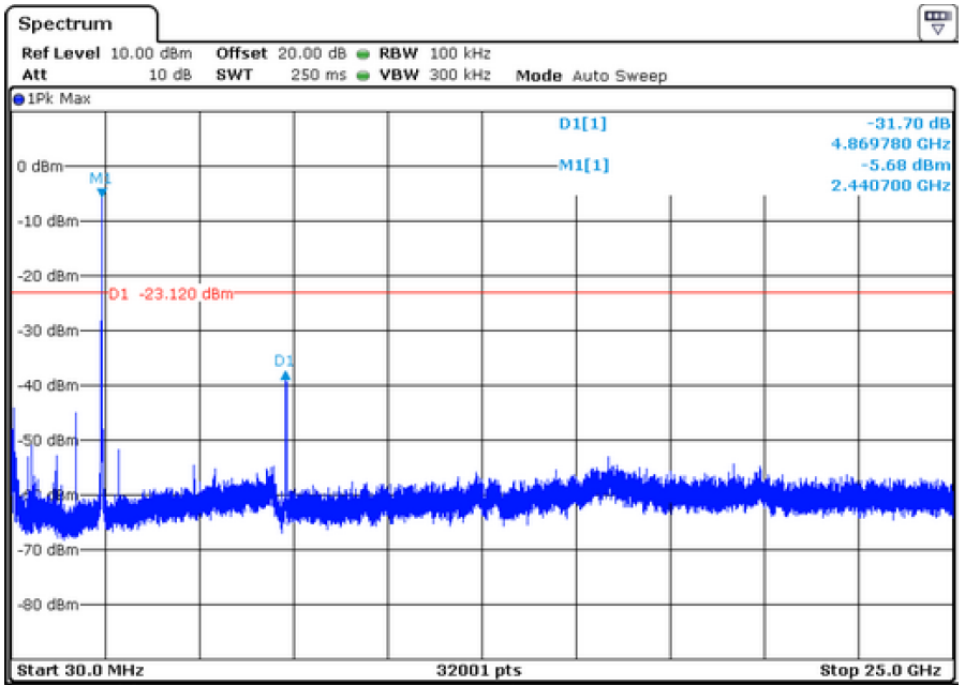


ANT 2 802.11g

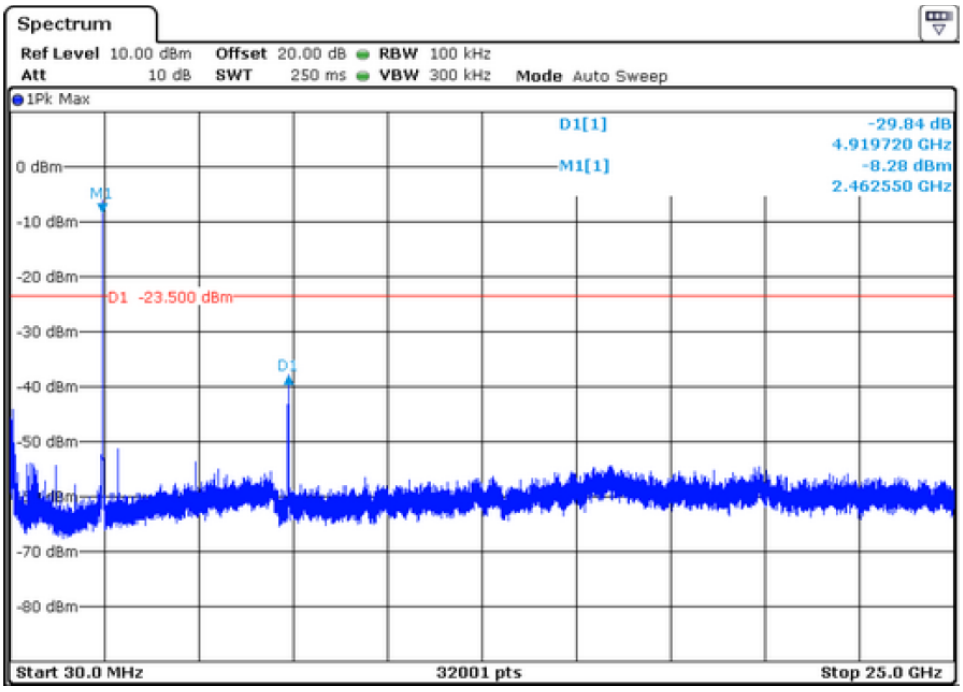
Low Channel



Middle Channel

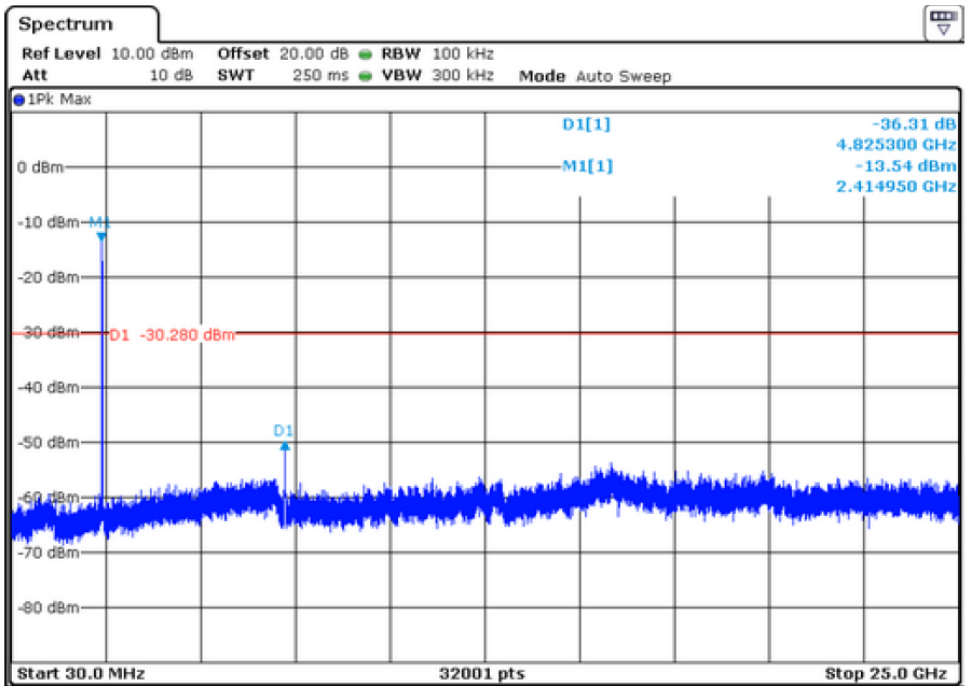


High Channel

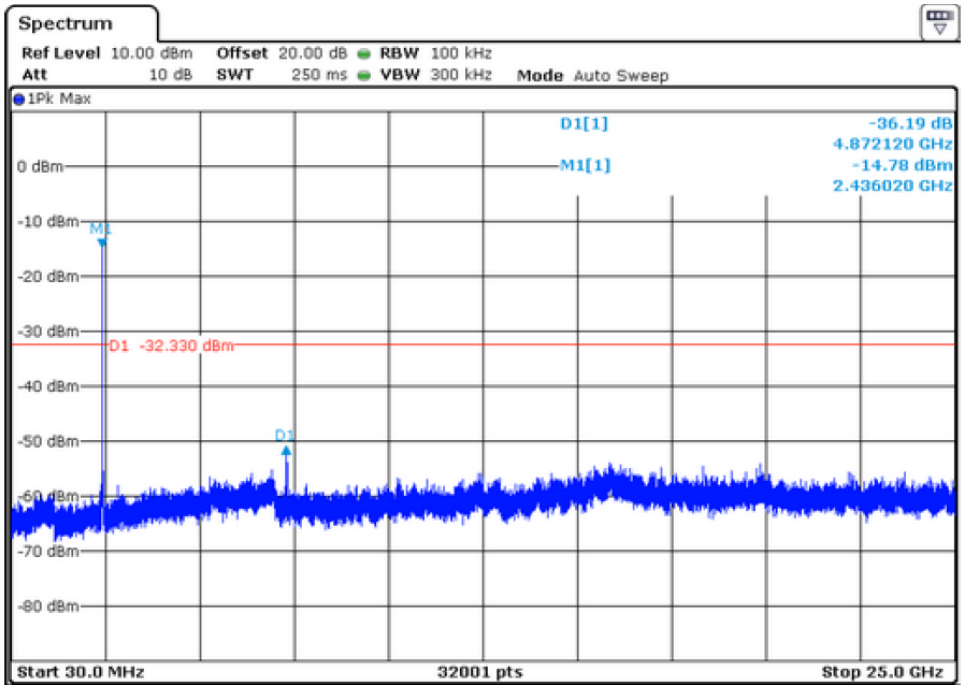


802.11n-HT20 MIMO

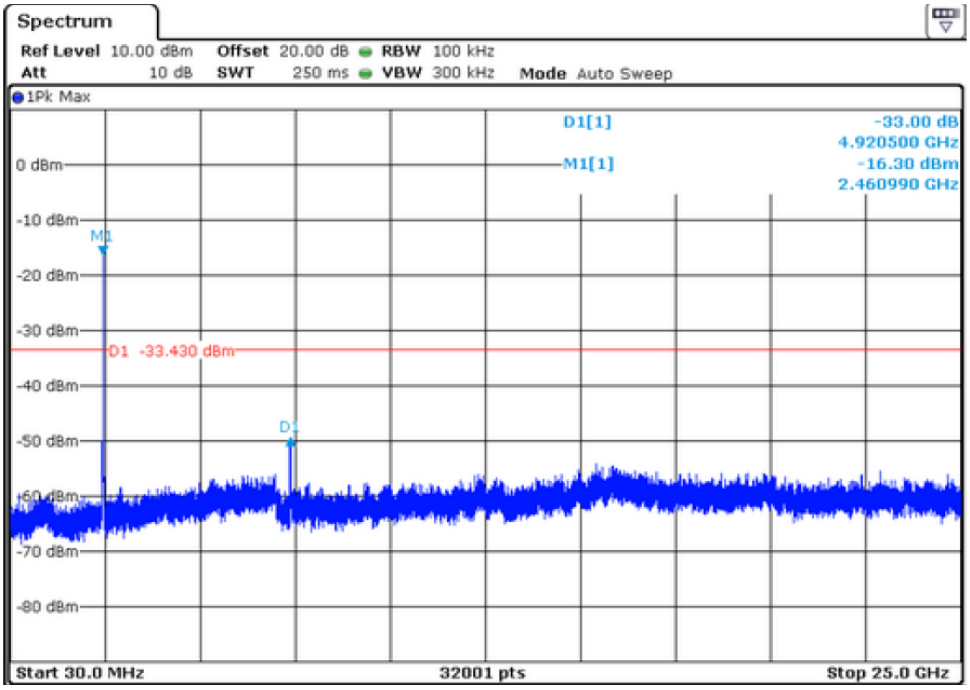
Low Channel



Middle Channel

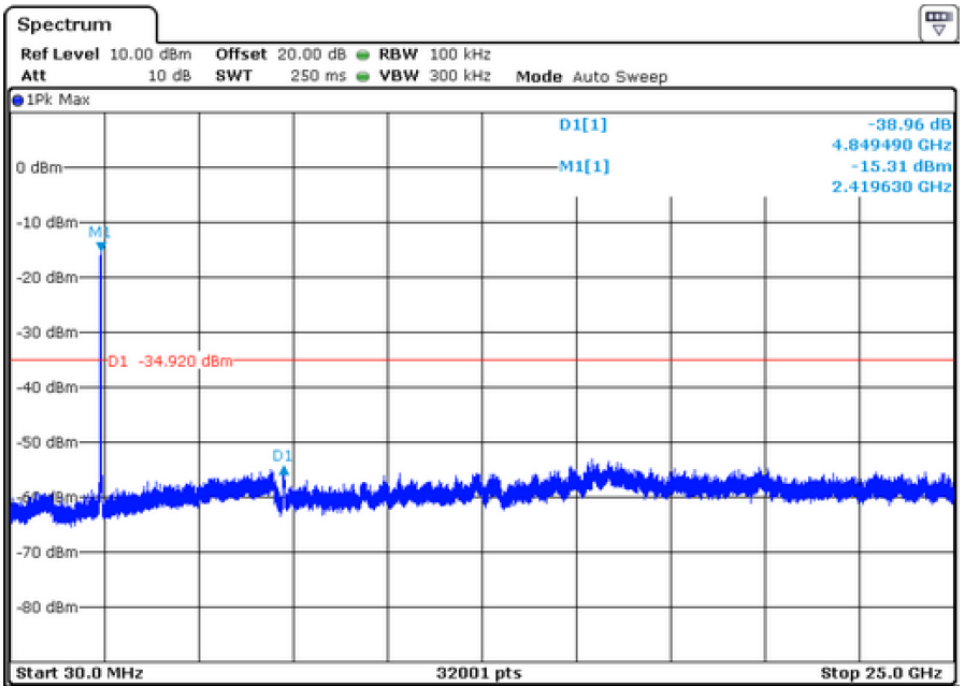


High Channel

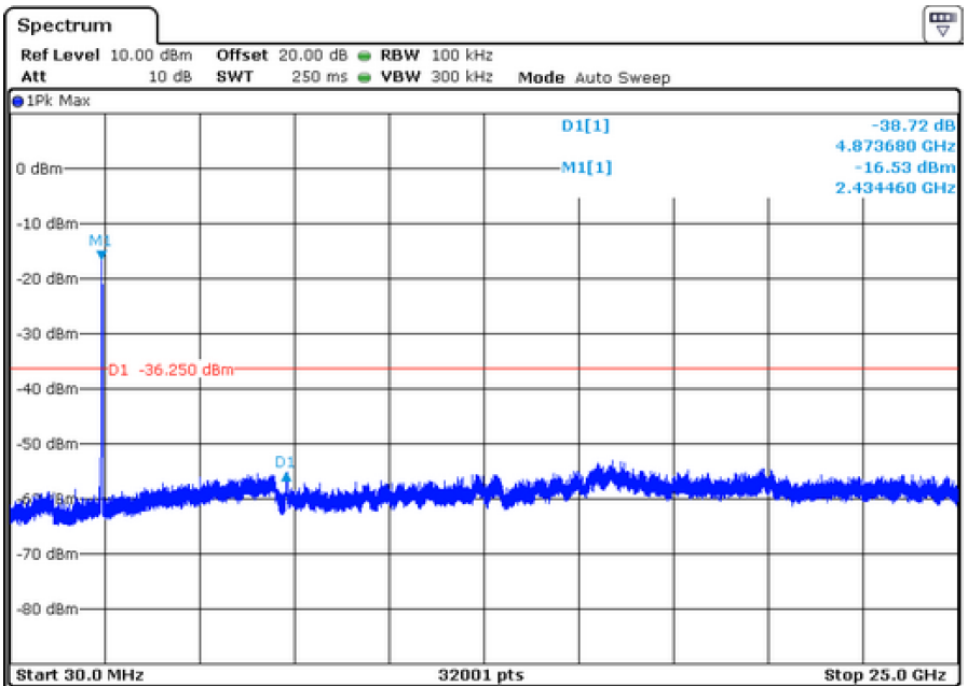


802.11n-HT40 MIMO

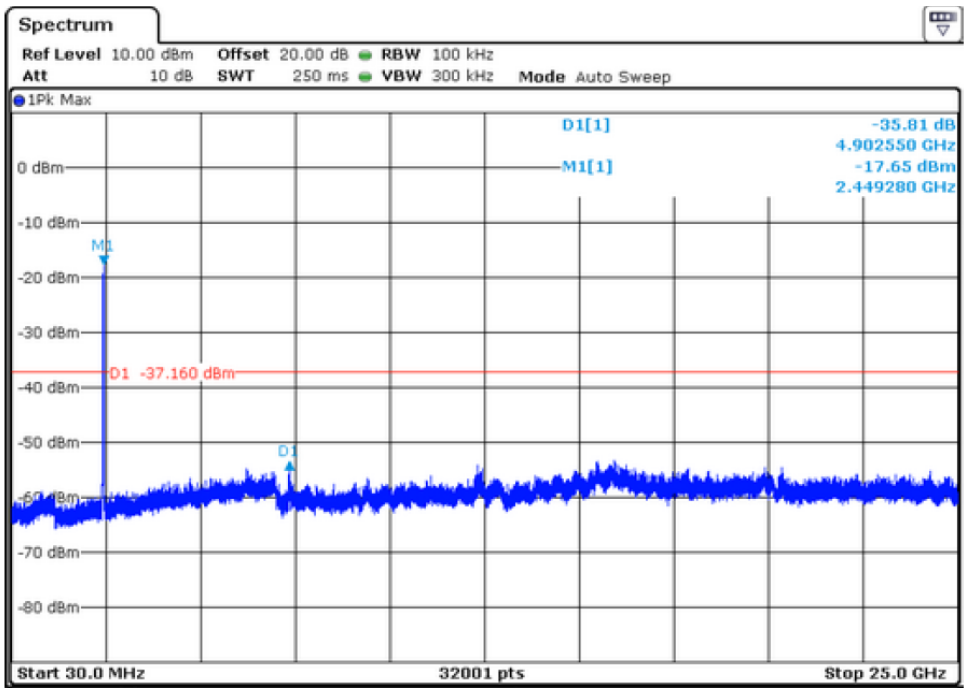
Low Channel



Middle Channel



High Channel



8 Band Edge Measurement

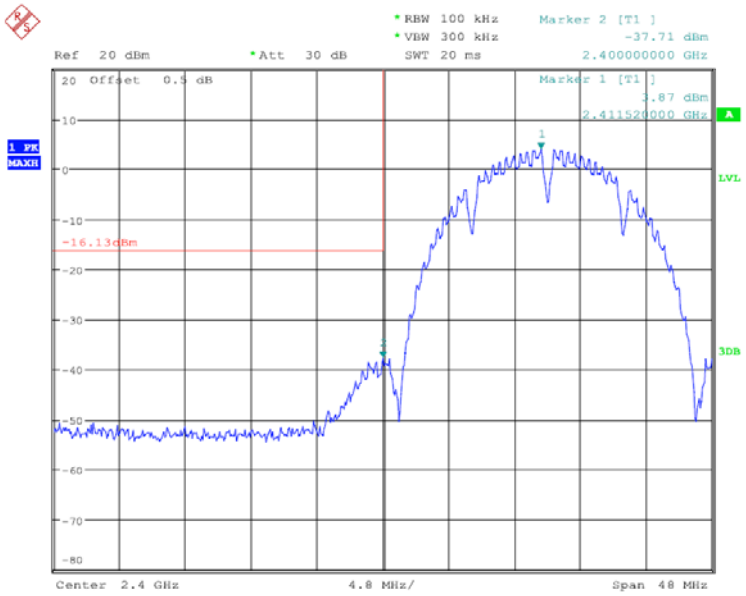
Test Requirement	:	Section 15.247(d) In addition, radiated emissions which fall in the restricted bands. as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).
Test Method	:	ANSI C63.10:2013
Test Limit	:	Regulation 15.247 (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)).

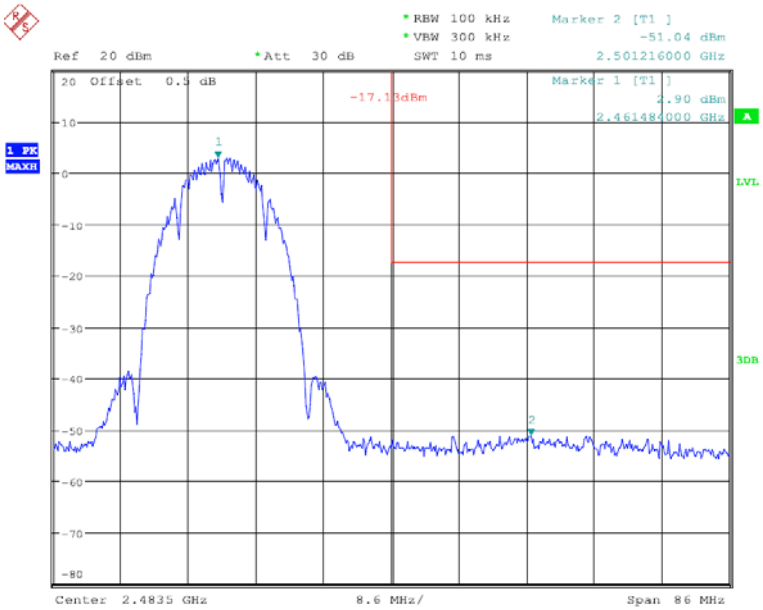
8.1 Test Procedure

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, Sweep = auto
Detector function = peak, Trace = max hold

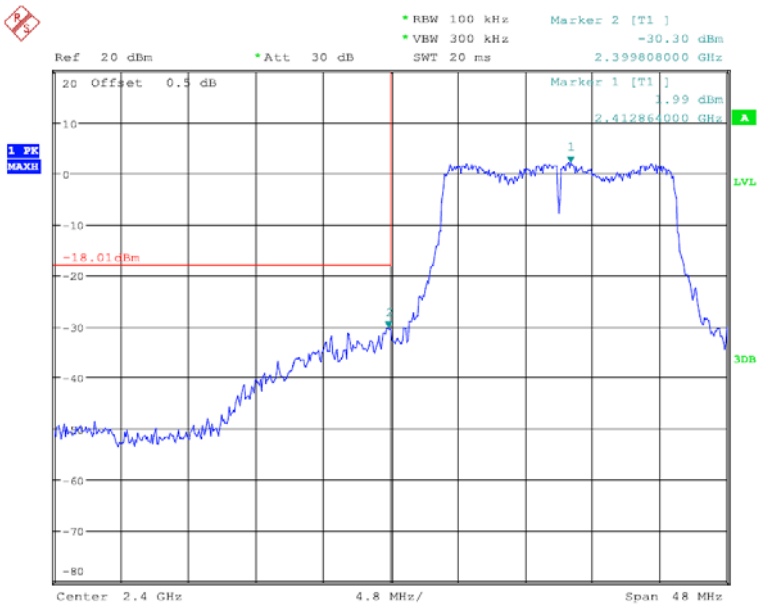
8.2 Test Result

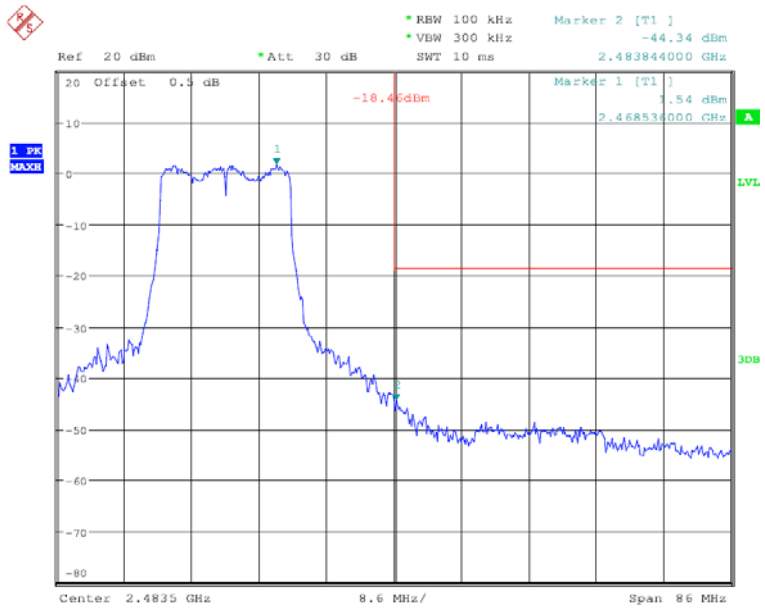
ANT 1 802.11b



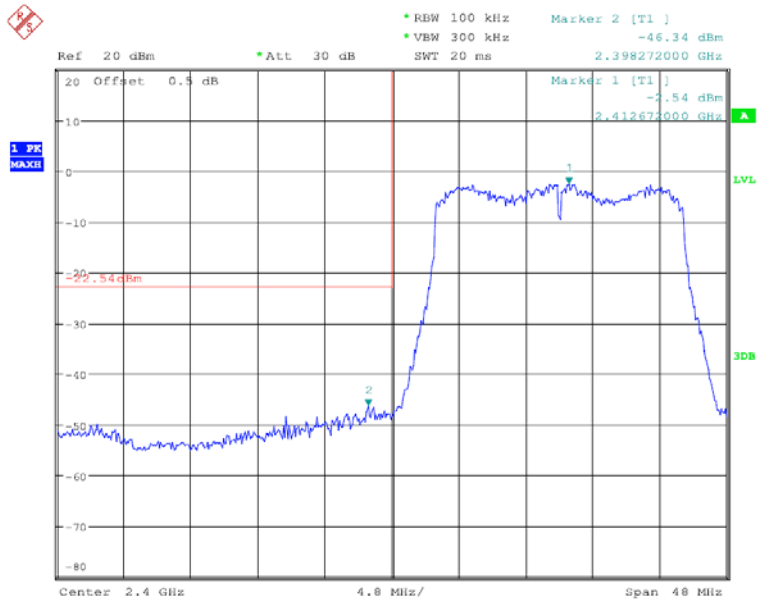


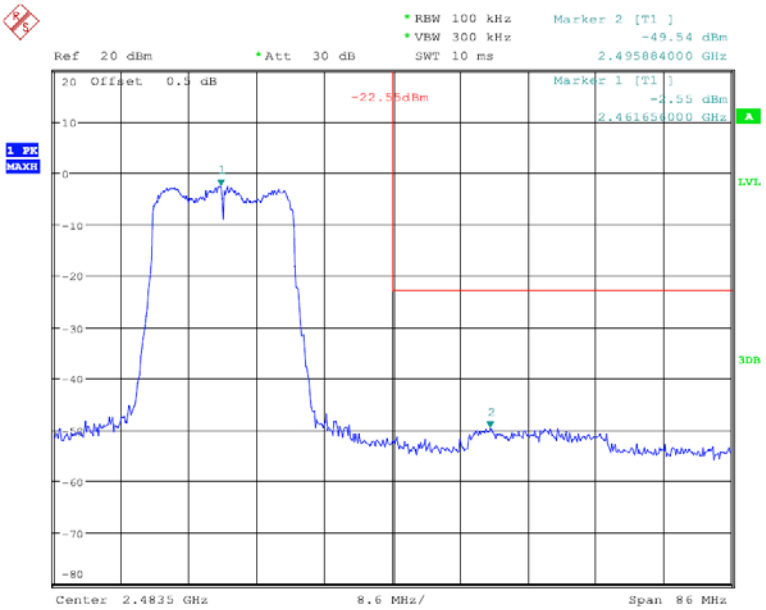
ANT 1 802.11g


RBW 100 kHz
VBW 300 kHz
SWT 20 ms
Marker 2 [T1]
-30.30 dBm
2.399808000 GHz
Ref 20 dBm
Att 30 dB
20 Offset 0.5 dB
Marker 1 [T1]
1.99 dBm
2.412864000 GHz
1 PK MAXH
A
LVL
-18.01dBm
3DB
Center 2.4 GHz
4.8 MHz/
Span 48 MHz

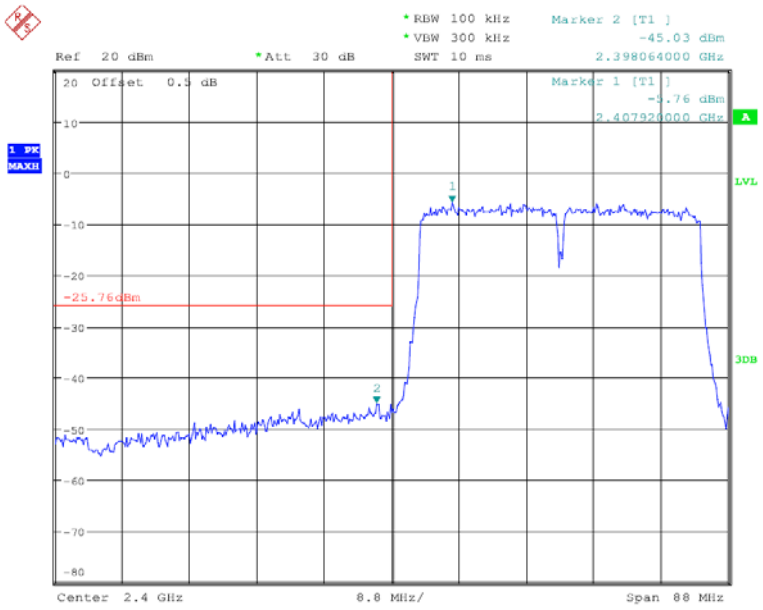

RBW 100 kHz
VBW 300 kHz
SWT 10 ms
Marker 2 [T1]
-44.34 dBm
2.483844000 GHz
Ref 20 dBm
Att 30 dB
20 Offset 0.5 dB
-18.46dBm
Marker 1 [T1]
1.54 dBm
2.468536000 GHz
1 PK MAXH
A
LVL
3DB
Center 2.4835 GHz
8.6 MHz/
Span 86 MHz

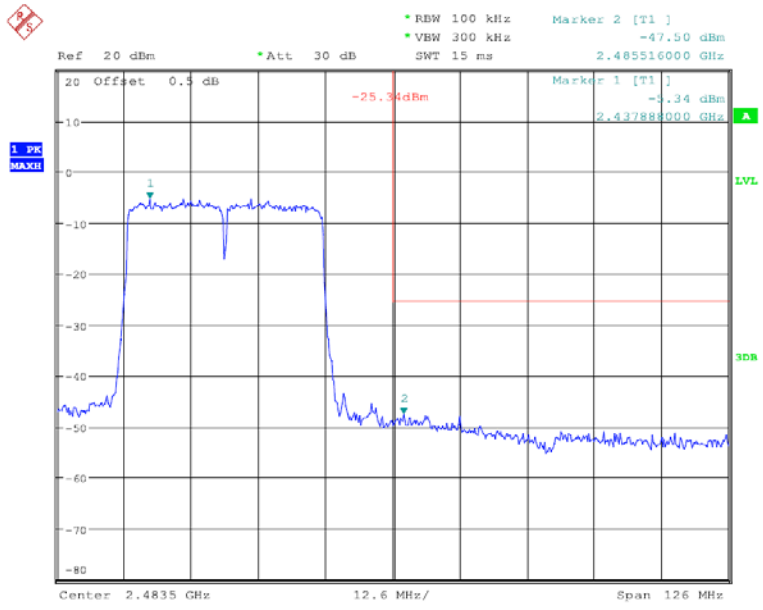
ANT 1 802.11n-HT20



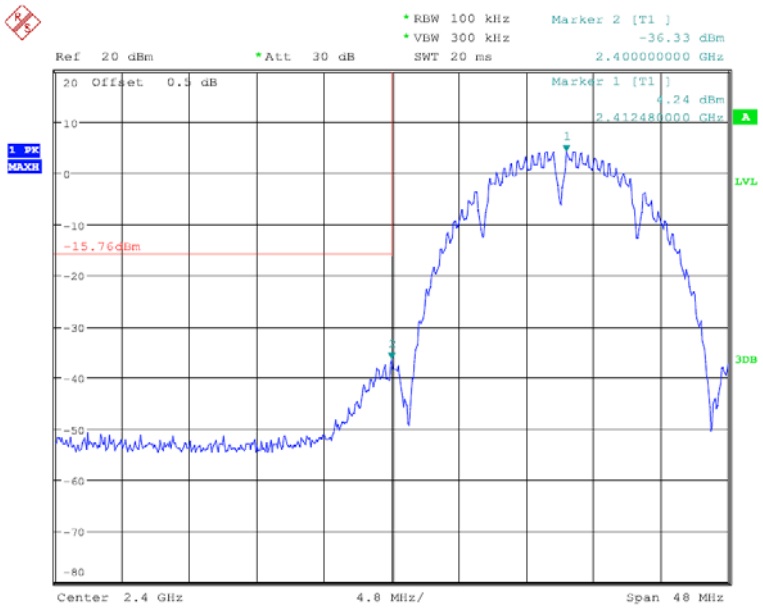


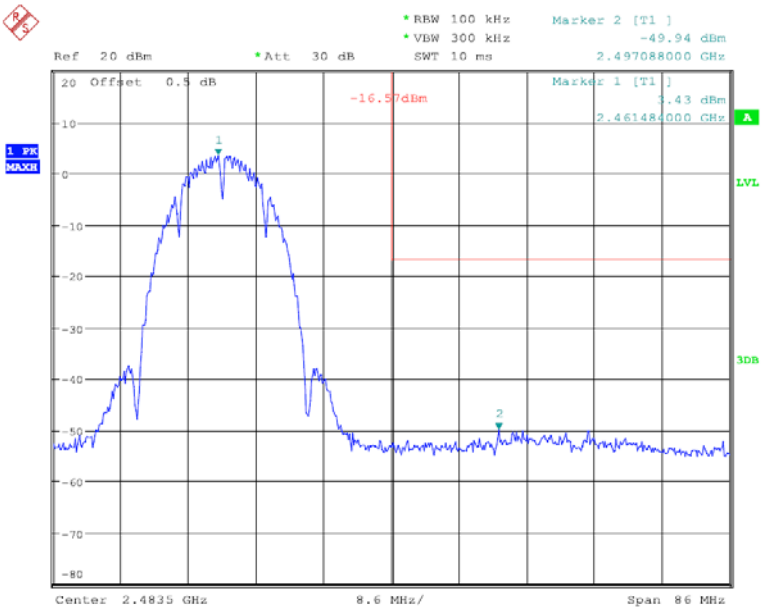
ANT 1 802.11n-HT40



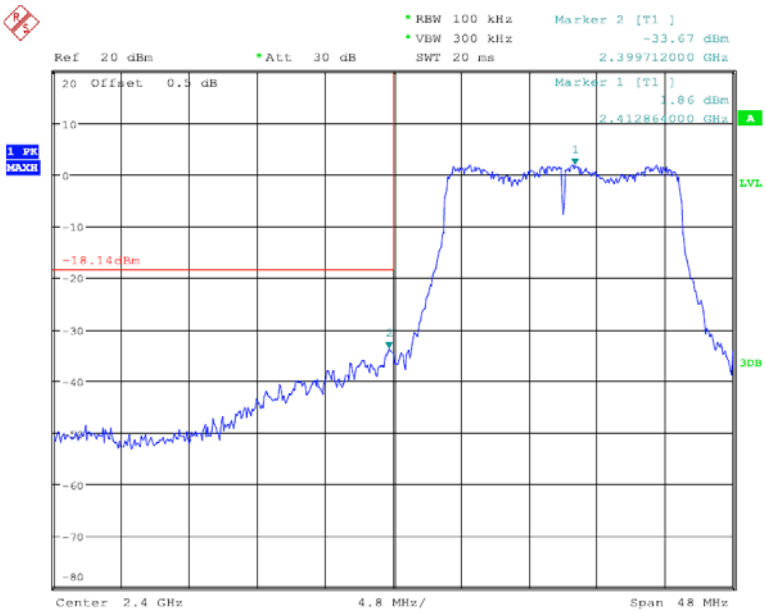


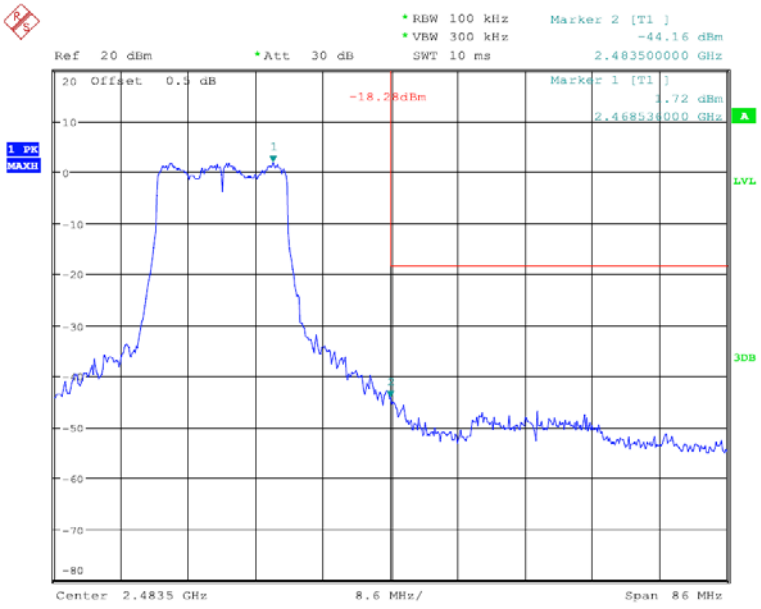
ANT 2 802.11b


RBW 100 kHz
VBW 300 kHz
SWT 20 ms
Marker 2 [T1]
-36.33 dBm
2.400000000 GHz
Ref 20 dBm
Att 30 dB
20 Offset 0.5 dB
Marker 1 [T1]
4.24 dBm
2.412480000 GHz
1 PK MAXH
A
LVL
3DB
-15.76dBm
Center 2.4 GHz
4.8 MHz/
Span 48 MHz

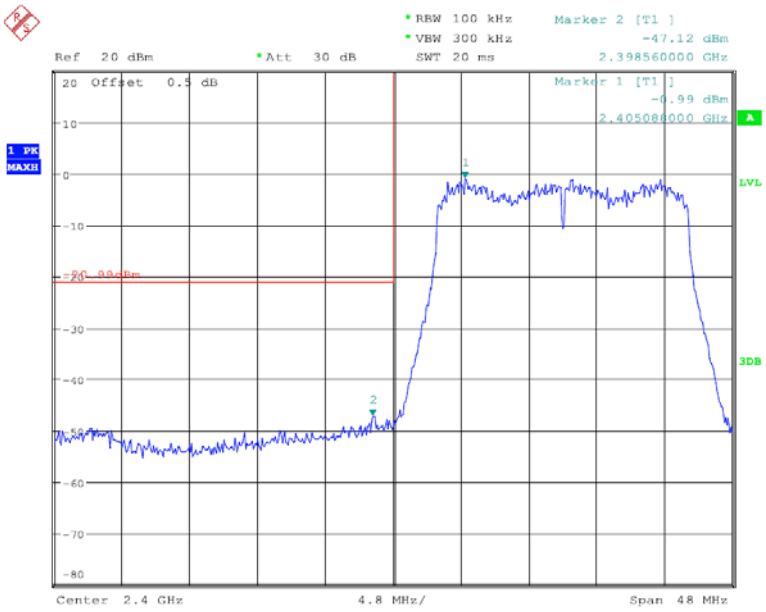

RBW 100 kHz
VBW 300 kHz
SWT 10 ms
Marker 2 [T1]
-49.94 dBm
2.497088000 GHz
Ref 20 dBm
Att 30 dB
20 Offset 0.5 dB
Marker 1 [T1]
3.43 dBm
2.461484000 GHz
-16.57dBm
1 PK MAXH
A
LVL
3DB
Center 2.4835 GHz
8.6 MHz/
Span 86 MHz

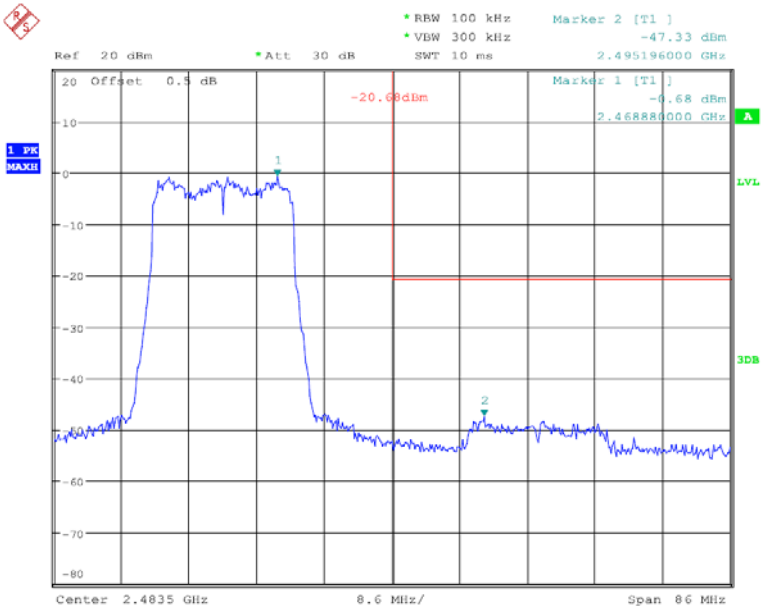
ANT 2 802.11g


RBW 100 kHz
VBW 300 kHz
SWT 20 ms
Marker 2 [T1]
-33.67 dBm
2.399712000 GHz
Ref 20 dBm
Att 30 dB
Offset 0.5 dB
Marker 1 [T1]
1.86 dBm
2.412864000 GHz
1 PK MAXH
-18.14dBm
LVL
3DB
Center 2.4 GHz
4.8 MHz/
Span 48 MHz

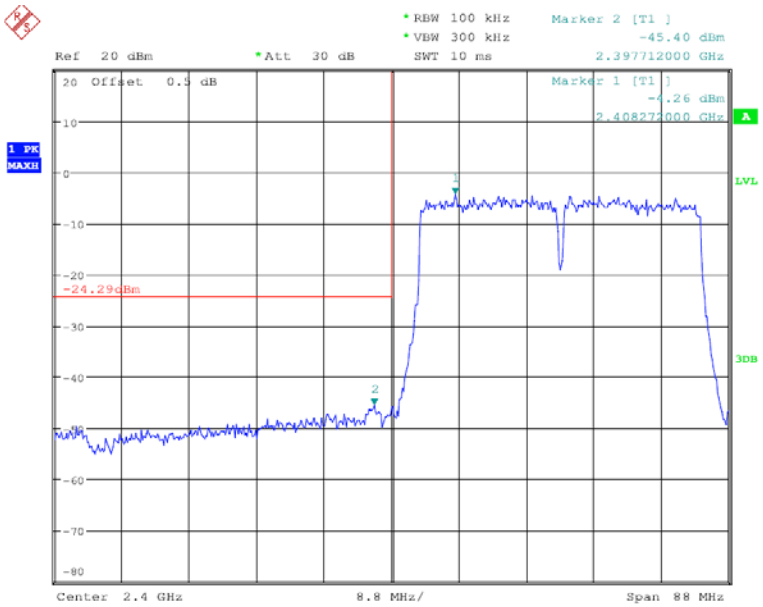

RBW 100 kHz
VBW 300 kHz
SWT 10 ms
Marker 2 [T1]
-44.16 dBm
2.483500000 GHz
Ref 20 dBm
Att 30 dB
Offset 0.5 dB
Marker 1 [T1]
1.72 dBm
2.468536000 GHz
-18.28dBm
1 PK MAXH
LVL
3DB
Center 2.4835 GHz
8.6 MHz/
Span 86 MHz

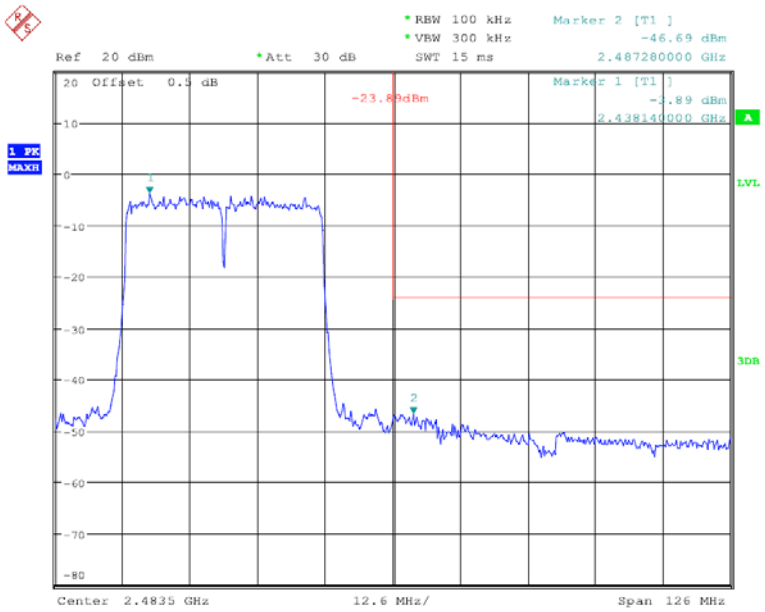
ANT 2 802.11n-HT20





ANT 2 802.11n-HT40





9 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.

9.1 Test Procedure

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

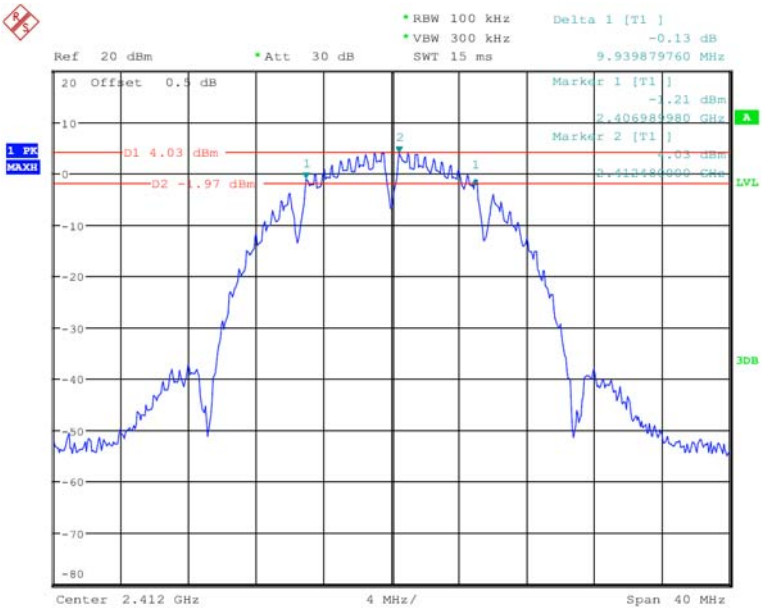
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

9.2 Test Result

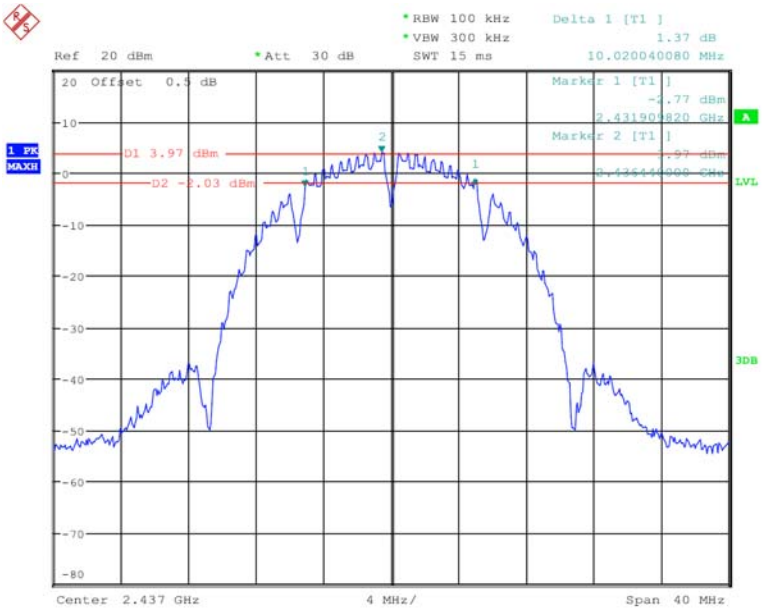
Test performed at ANT 1, Please refer to the following table and plots.

Modulation	Bandwidth(MHz)			Limit
	Low Channel	Middle Channel	High Channel	
802.11b	9.94	10.02	9.94	≥500kHz
802.11g	16.35	16.35	16.35	≥500kHz
802.11n-HT20	17.47	17.47	17.47	≥500kHz
802.11n-HT40	36.23	36.23	36.23	≥500kHz

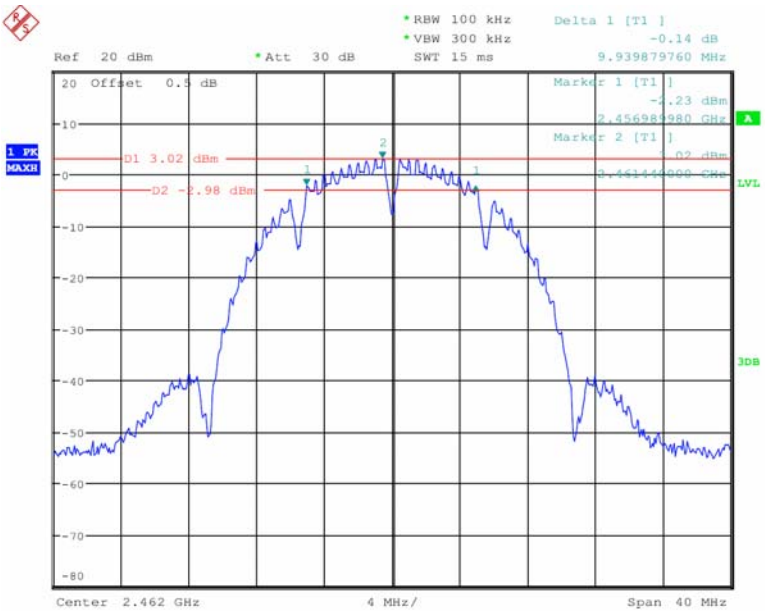
802.11b Low Channel



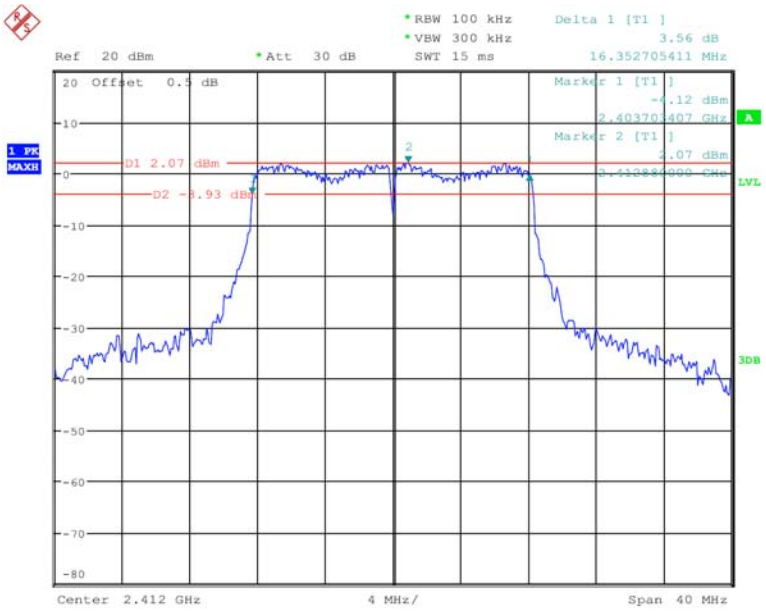
802.11b Middle Channel



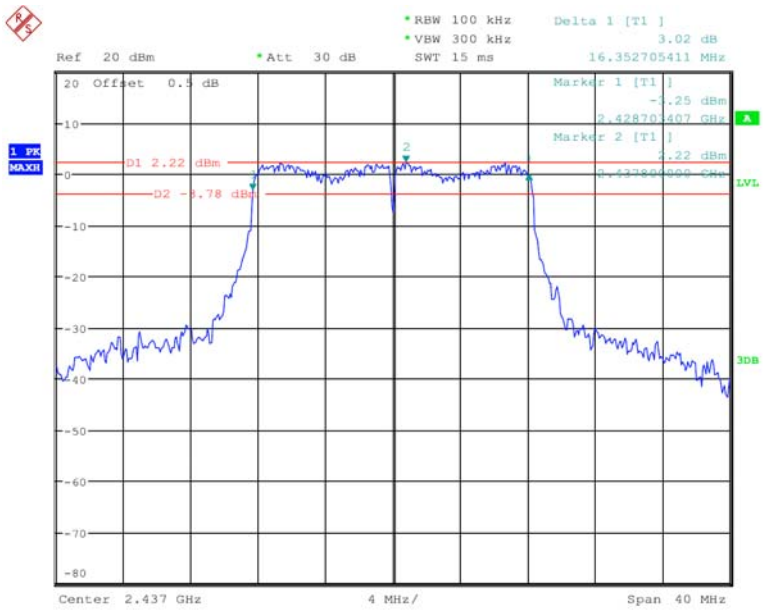
802.11b High Channel



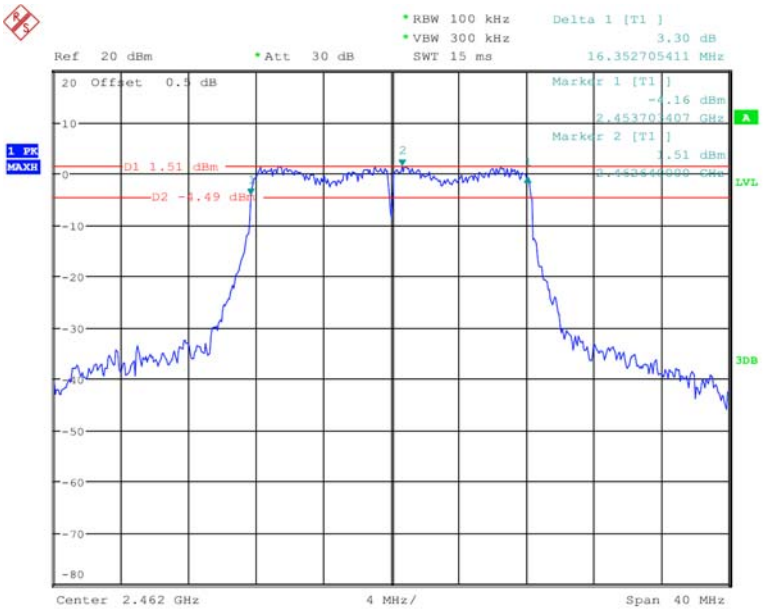
802.11g Low Channel



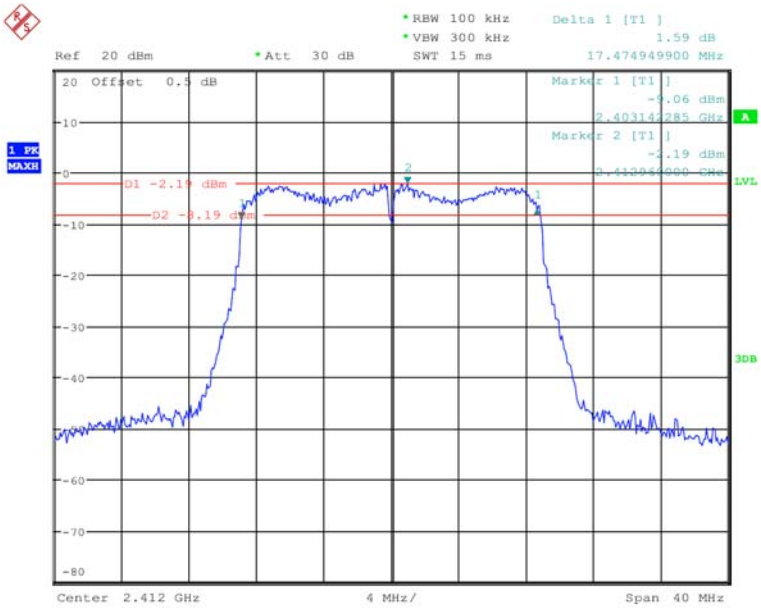
802.11g Middle Channel



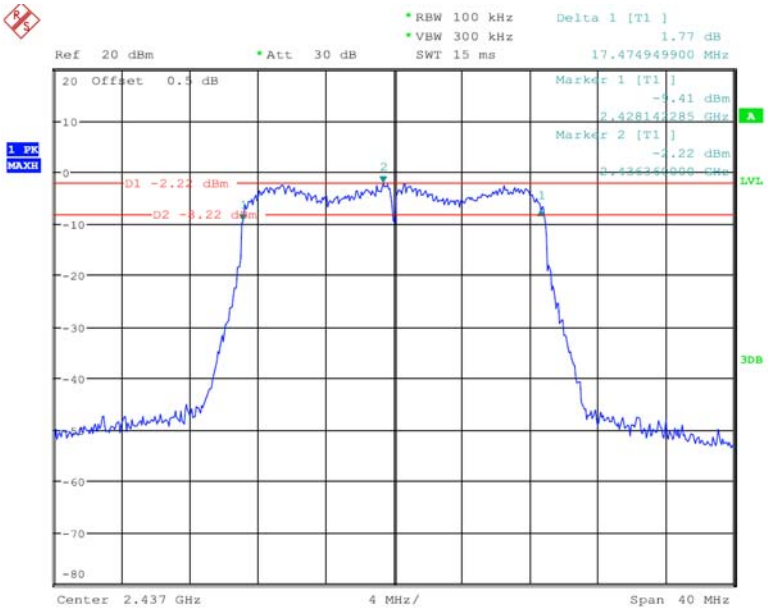
802.11g High Channel



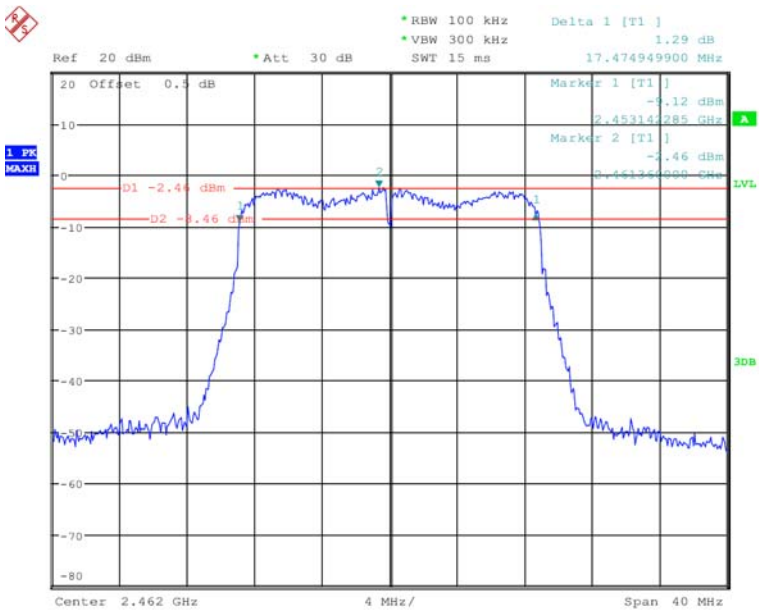
802.11n-HT20 Low Channel



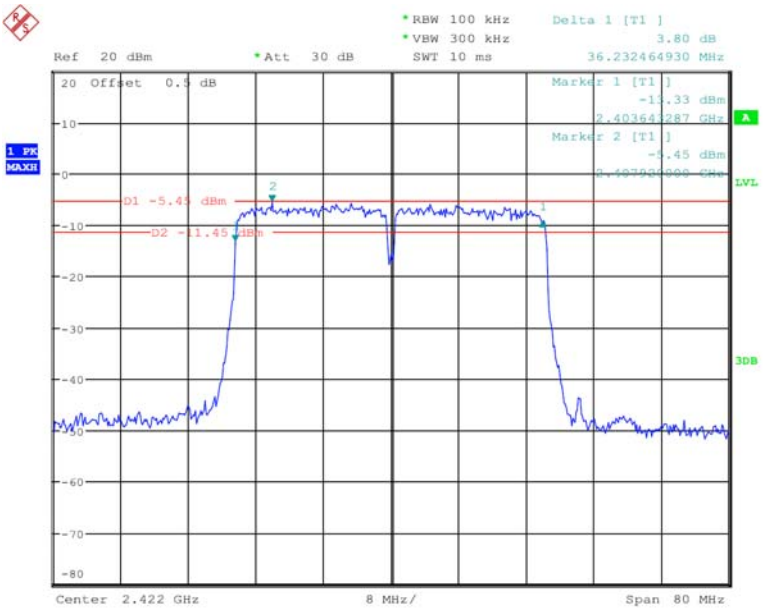
802.11n-HT20 Middle Channel



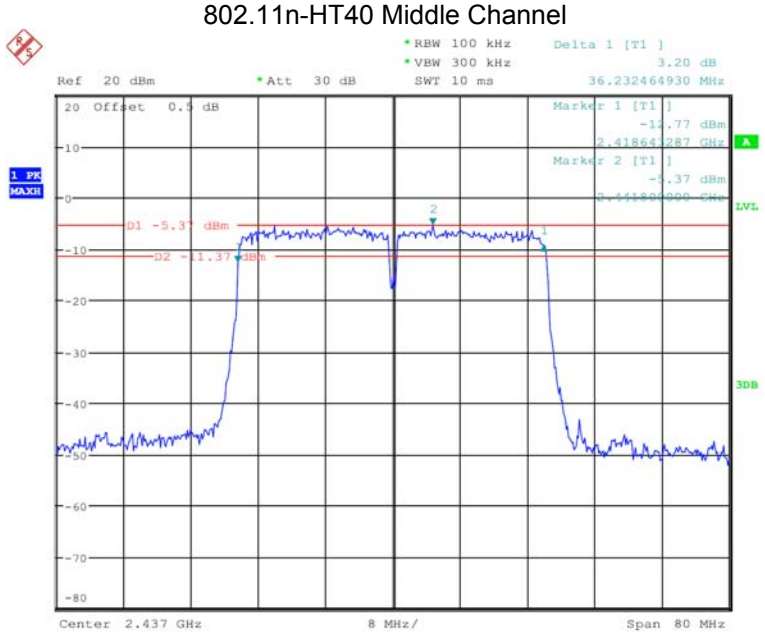
802.11n-HT20 High Channel



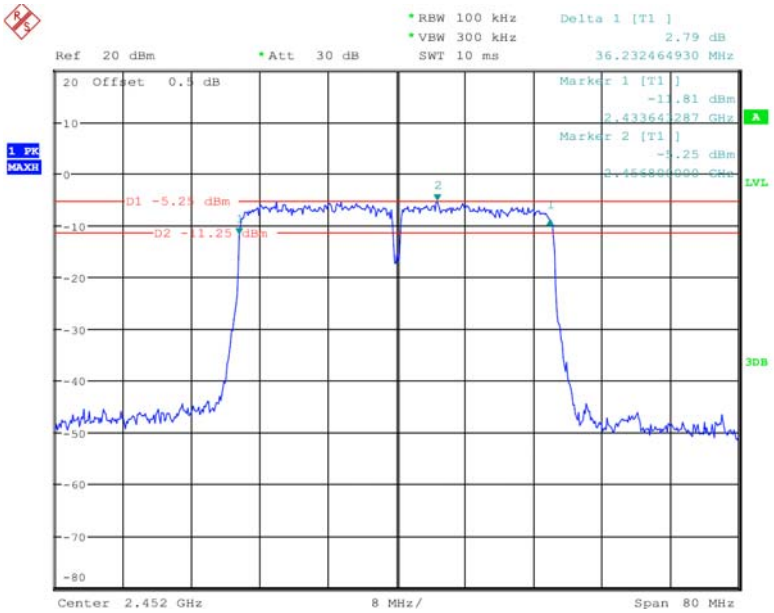
802.11n-HT40 Low Channel



802.11n-HT40 Middle Channel



802.11n-HT40 High Channel



10 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.

10.1 Test Procedure

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.

10.2 Test Result

Operation Mode	Channel Number	Channel Frequency (MHz)	Measurement Level (dBm)			Limit (dBm)	Verdict
			Ant1	Ant2	Sum		
802.11b	1	2412	17.19	16.89	--	30	PASS
	6	2437	17.17	16.75	--	30	PASS
	11	2462	16.25	16.14	--	30	PASS
802.11g	1	2412	15.34	14.22	--	30	PASS
	6	2437	15.08	14.05	--	30	PASS
	11	2462	14.68	13.62	--	30	PASS
802.11n (HT20)	1	2412	13.48	13.24	14.65	28	PASS
	6	2437	13.24	12.08	13.28	28	PASS
	11	2462	12.04	12.48	11.58	28	PASS
802.11n (HT40)	3	2422	12.62	11.36	8.94	28	PASS
	6	2437	11.48	11.08	6.49	28	PASS
	9	2452	11.85	10.69	9.34	28	PASS

Note:
For MIMO System of 802.11n(HT20) and 802.11n(HT40), total power is calculated by combining the output power of each antenna according to KDB662911.
Antenna 1 Gain: 5dBi, Antenna 2 Gain: 5dBi. For antennas with gains of 6dBi or less, maximum allowed Transmitter output watt(+30dBm)
In MIMO, Ant1+Ant2 Directional Gain=G_{ANT}+10Log(N)dBi=5+10log(2)=8.01dBi.

11 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.

11.1 Test Procedure

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

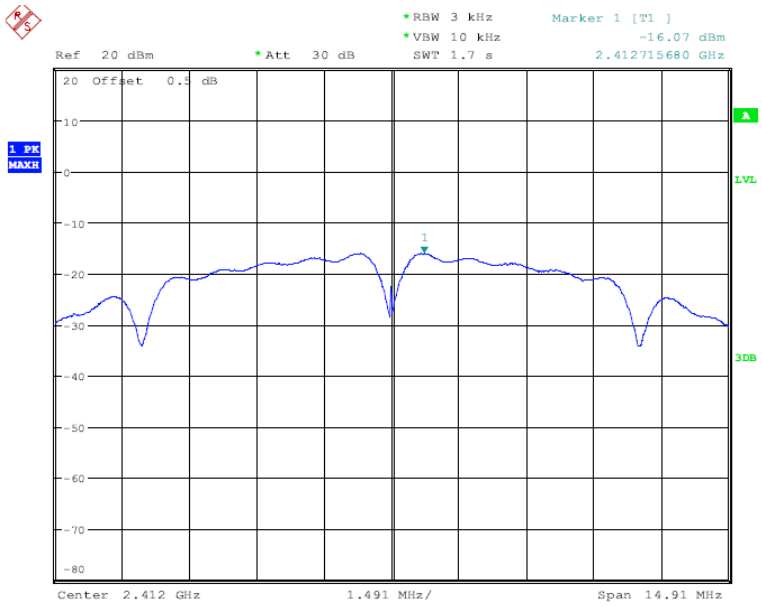
2. Set the spectrum analyzer: RBW = 3kHz. VBW = 10kHz, Span = 1.5 times the DTS channel bandwidth(6 dB bandwidth). Sweep = auto; Detector Function = Peak. Trace = Max hold.

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.

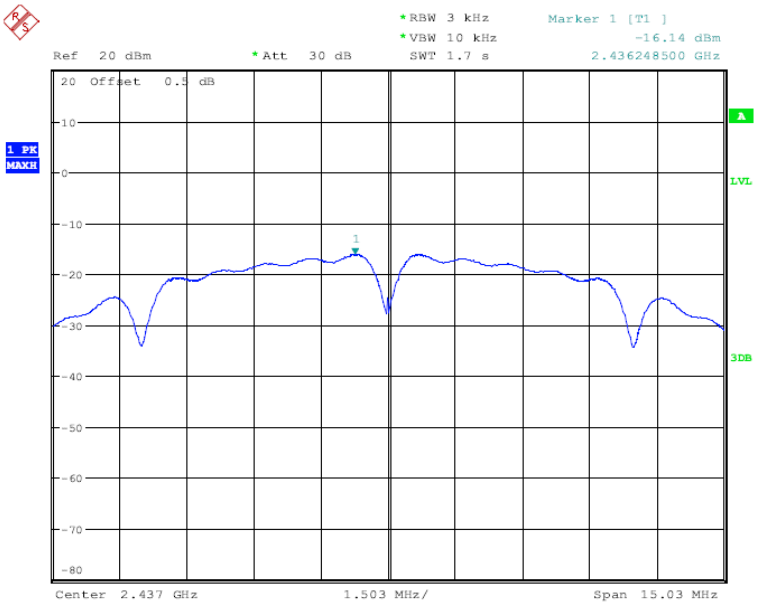
11.2 Test Result

Test Mode	Channel	Frequency (MHz)	Power Spectral density (dBm/3kHz)		Total (dBm/3kHz)	Limit (dBm/3kHz)
			Ant 1	Ant 2		
802.11b	Low	2412	-16.07	-15.74	/	≤8
	Middle	2437	-16.14	-15.74	/	≤8
	High	2462	-17.01	-16.50	/	≤8
802.11g	Low	2412	-11.96	-12.28	/	≤8
	Middle	2437	-11.55	-12.05	/	≤8
	High	2462	-12.12	-12.35	/	≤8
802.11n(HT20)	Low	2412	-15.06	-15.51	-12.27	≤6
	Middle	2437	-15.33	-14.05	-11.63	≤6
	High	2462	-15.94	-14.18	-11.96	≤6
802.11n(HT40)	Low	2422	-19.23	-18.84	-16.02	≤6
	Middle	2437	-17.54	-18.96	-15.18	≤6
	High	2452	-17.28	-18.92	-15.01	≤6

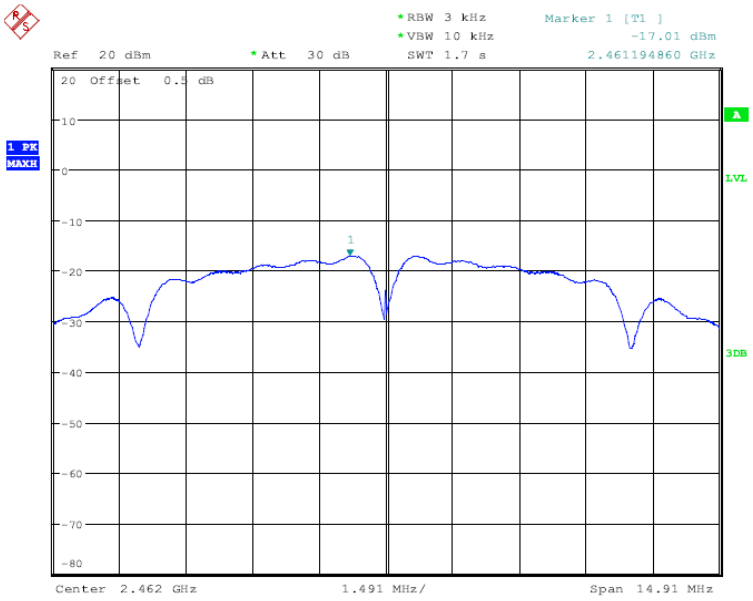
ANT 1 802.11b Low Channel



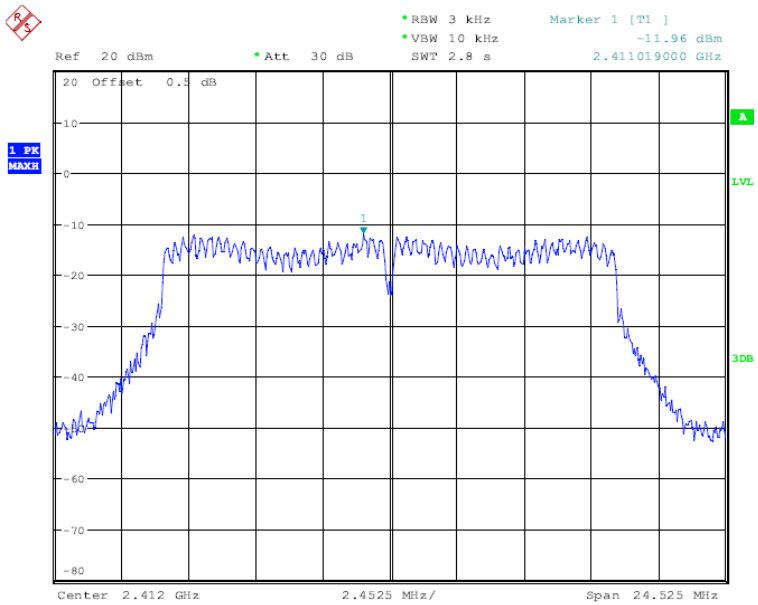
ANT 1 802.11b Middle Channel



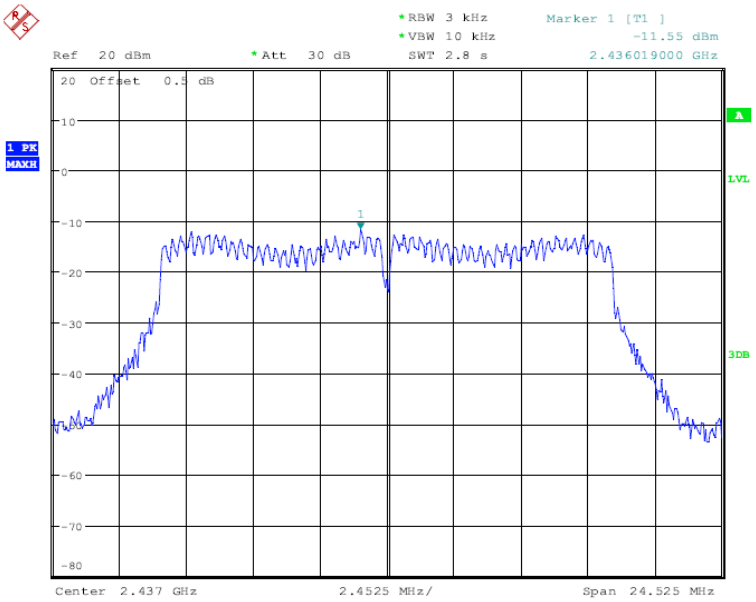
ANT 1 802.11b High Channel



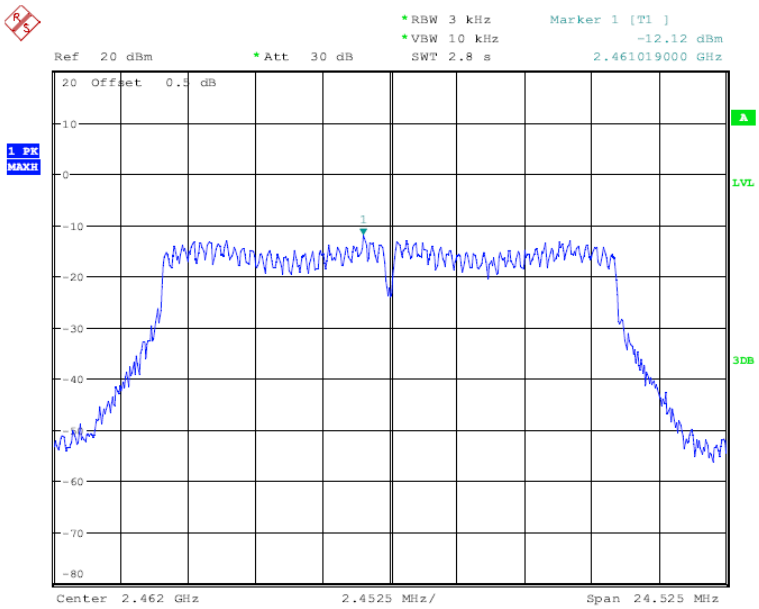
ANT 1 802.11g Low Channel



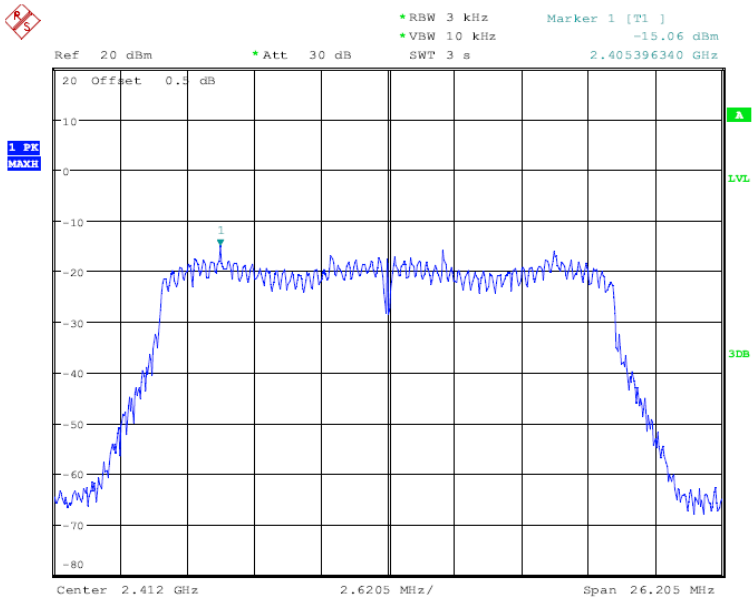
ANT 1 802.11g Middle Channel



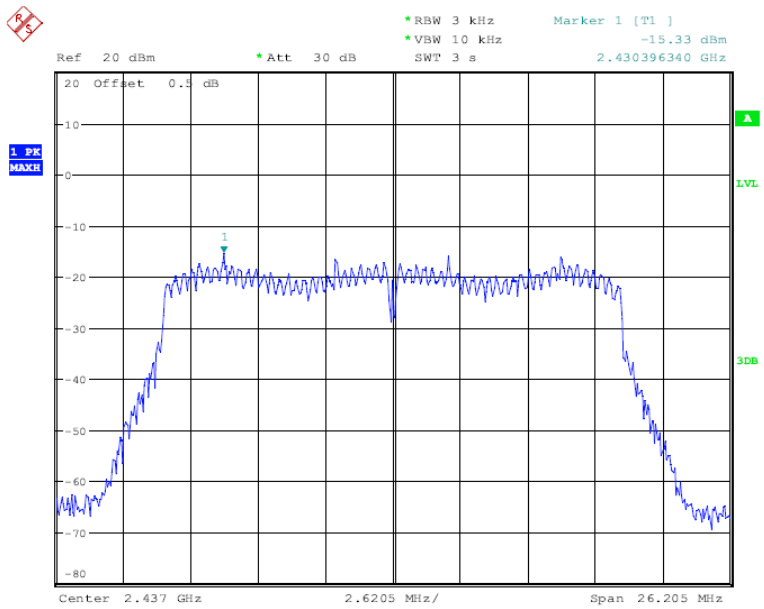
ANT 1 802.11g High Channel



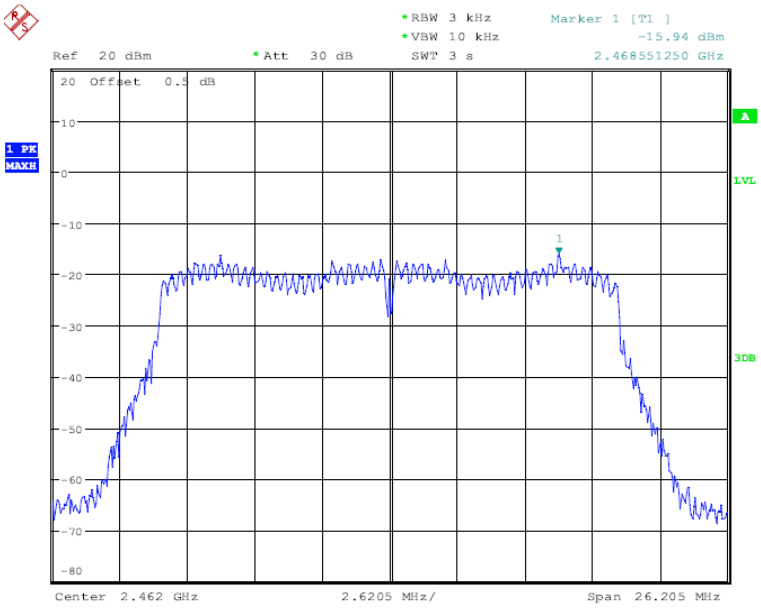
ANT 1 802.11n-HT20 Low Channel



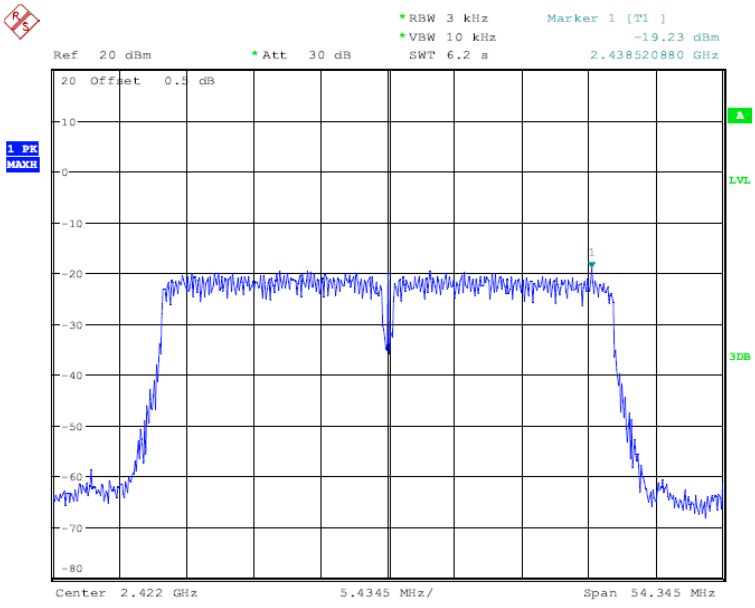
ANT 1 802.11n-HT20 Middle Channel



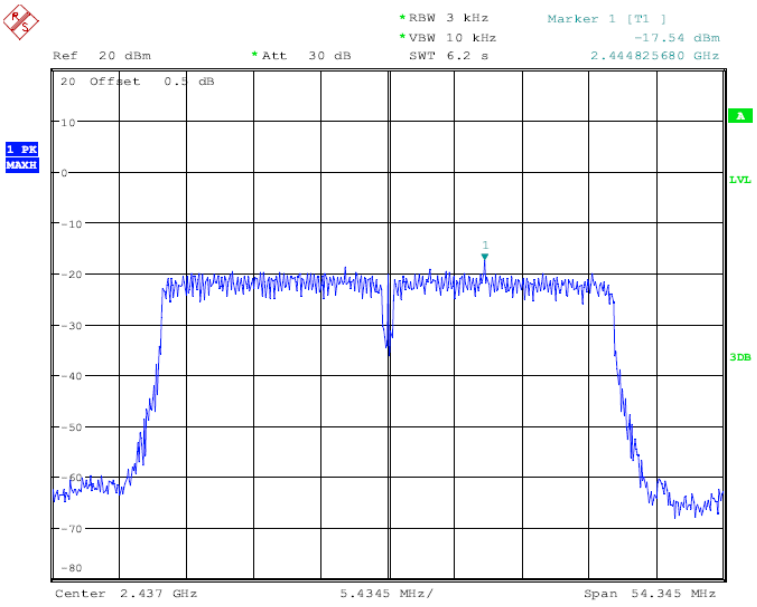
ANT 1 802.11n-HT20 High Channel



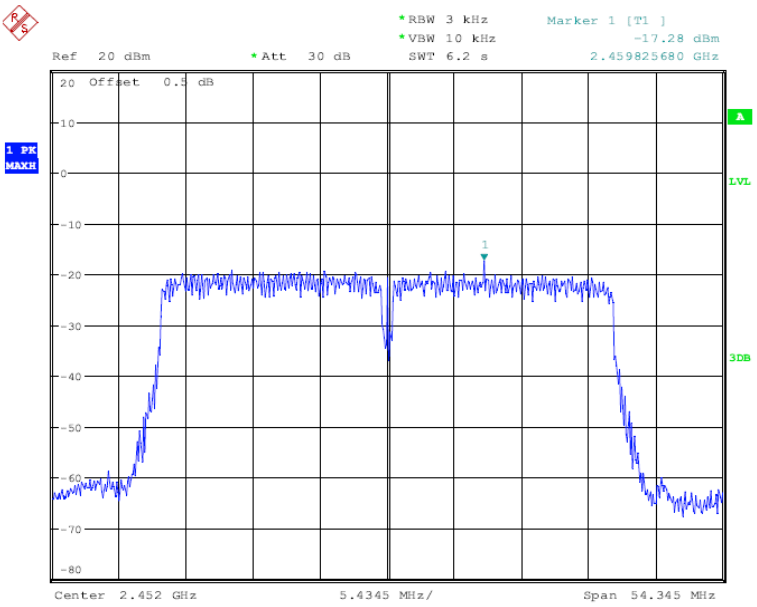
ANT 1 802.11n-HT40 Low Channel



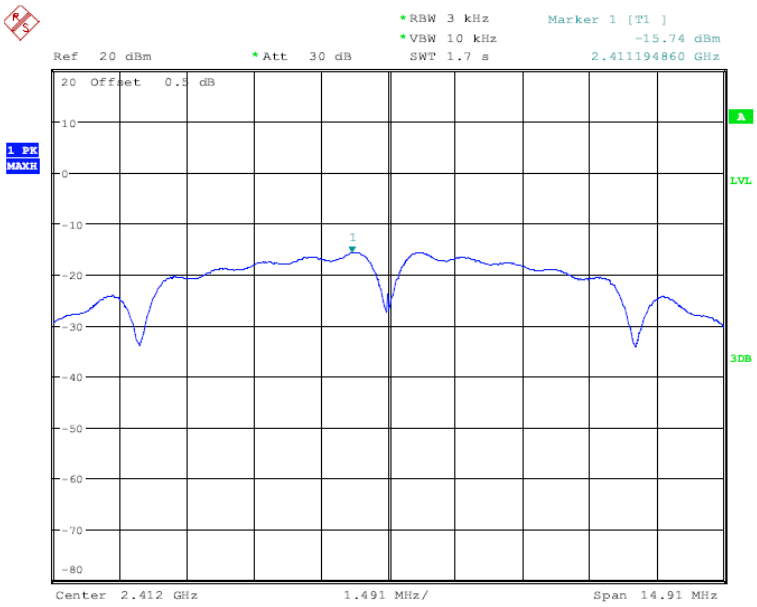
ANT 1 802.11n-HT40 Middle Channel



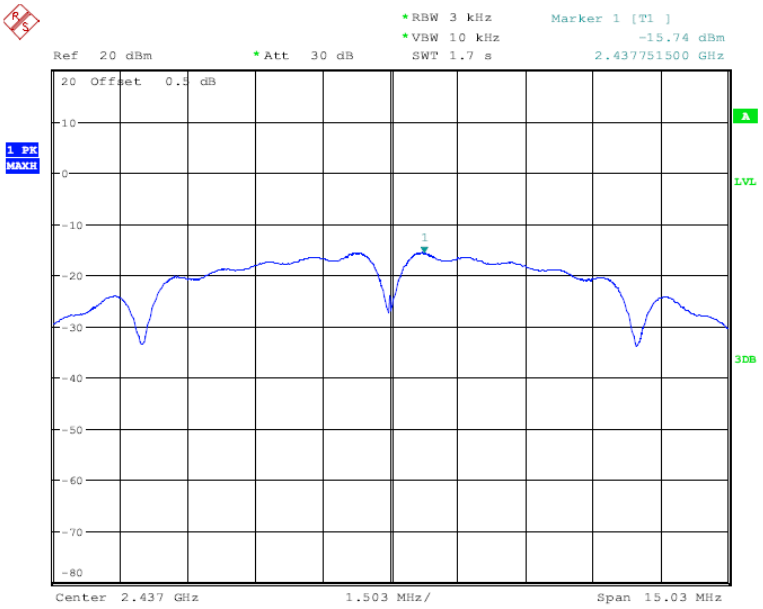
ANT 1 802.11n-HT40 High Channel



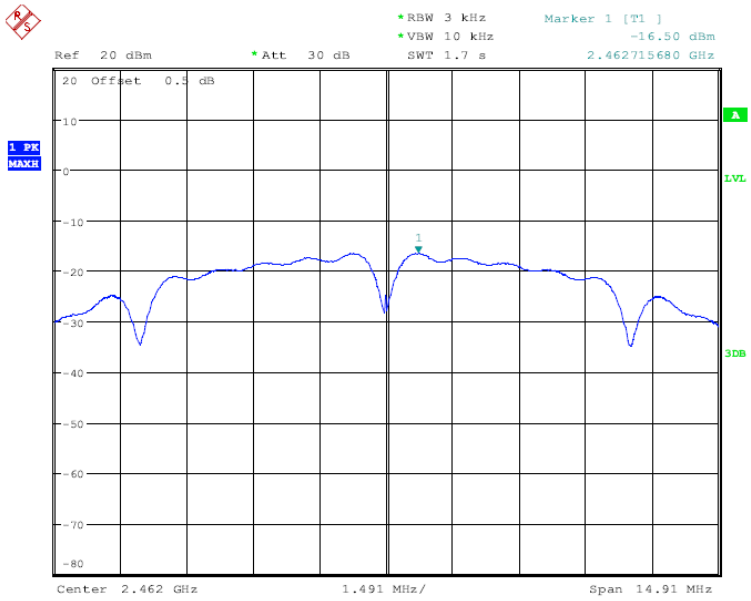
ANT 2 802.11b Low Channel



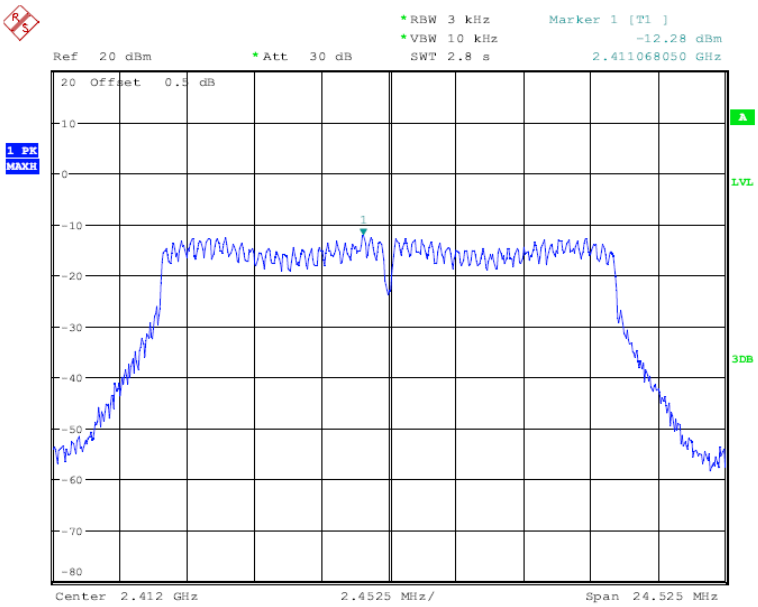
ANT 2 802.11b Middle Channel



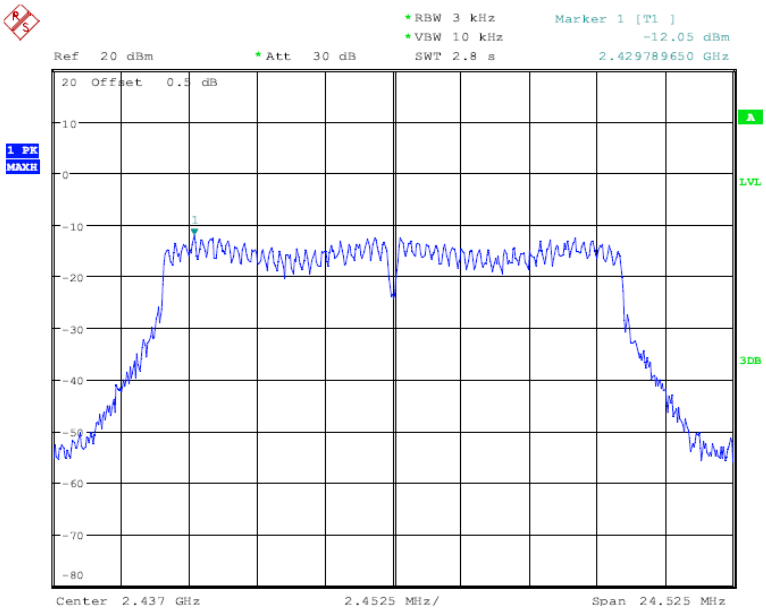
ANT 2 802.11b High Channel



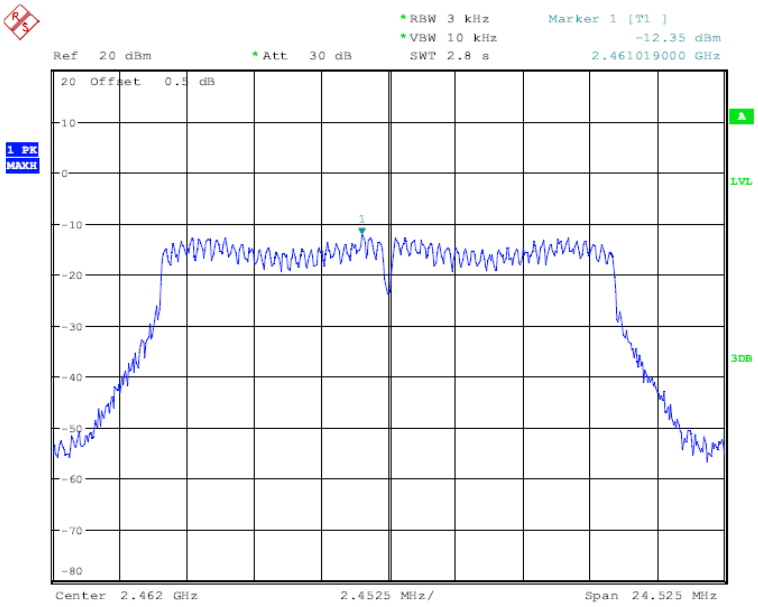
ANT 2 802.11g Low Channel



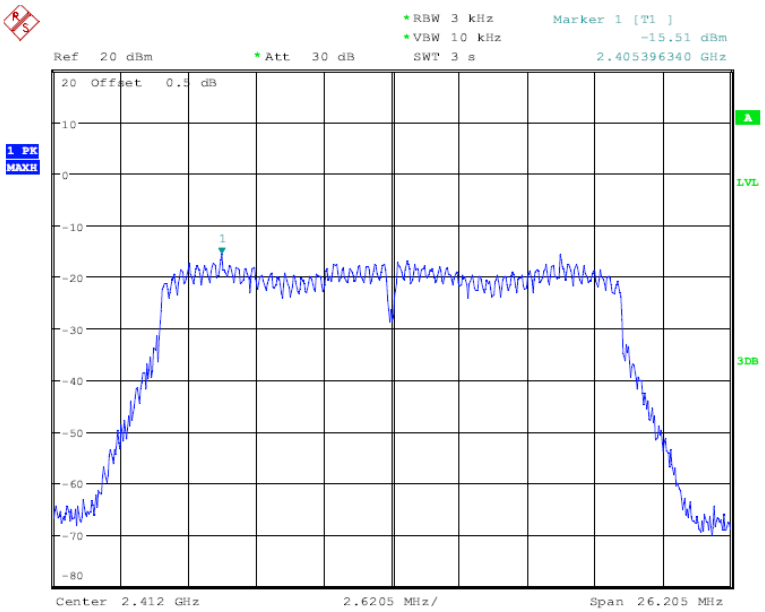
ANT 2 802.11g Middle Channel



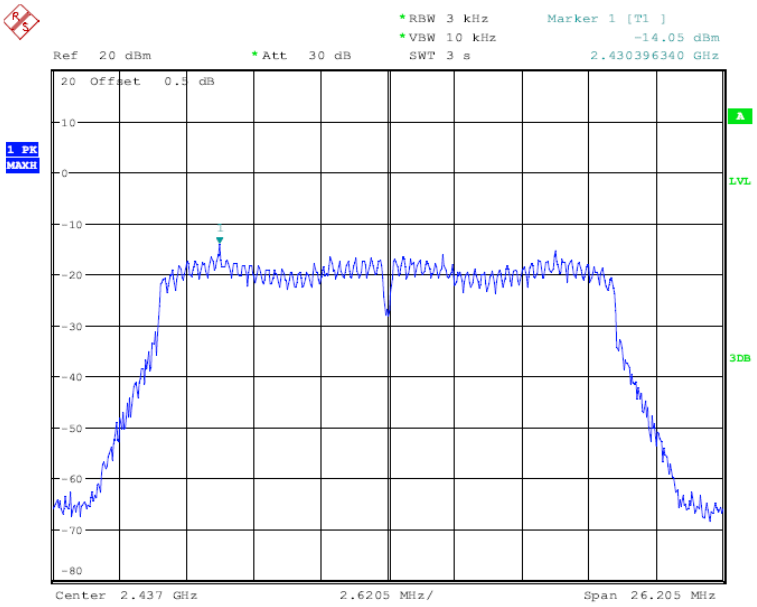
ANT 2 802.11g High Channel



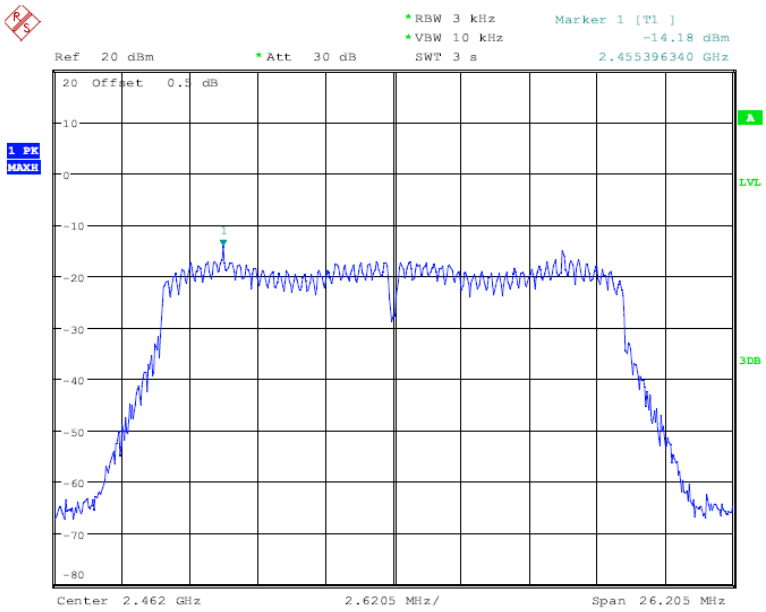
ANT 2 802.11n-HT20 Low Channel



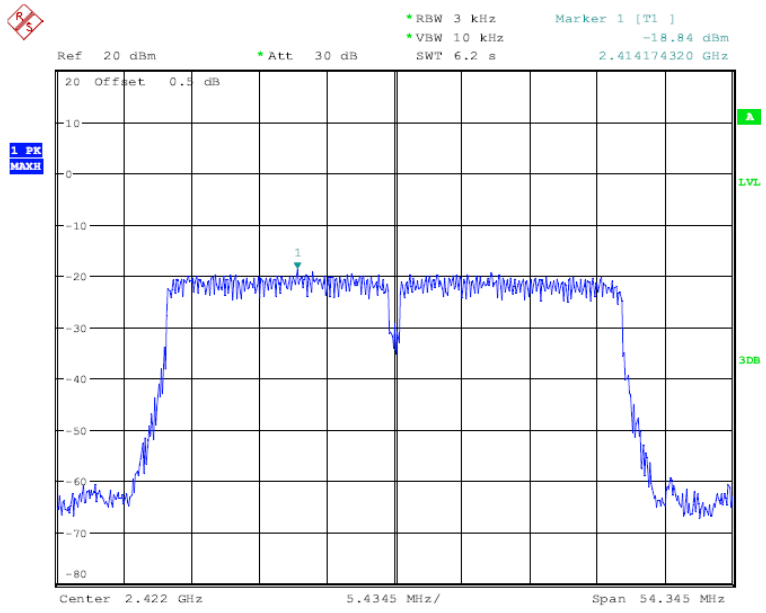
ANT 2 802.11n-HT20 Middle Channel



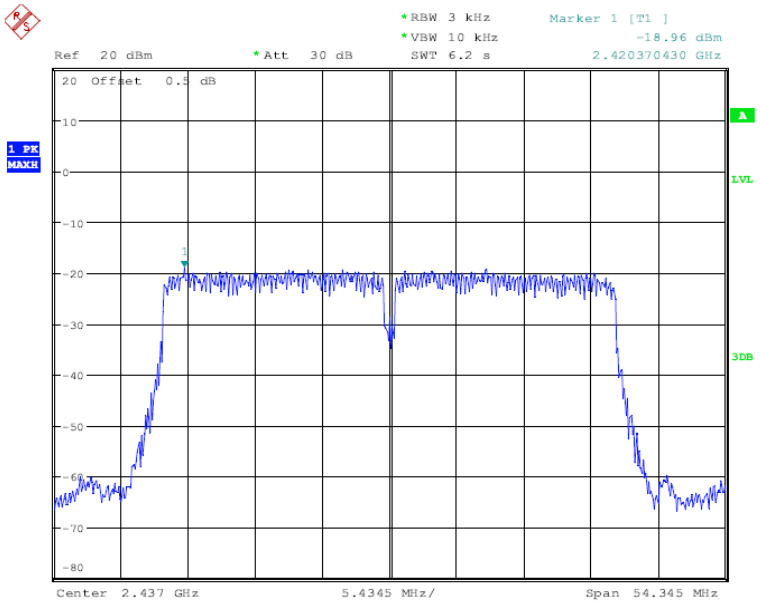
ANT 2 802.11n-HT20 High Channel



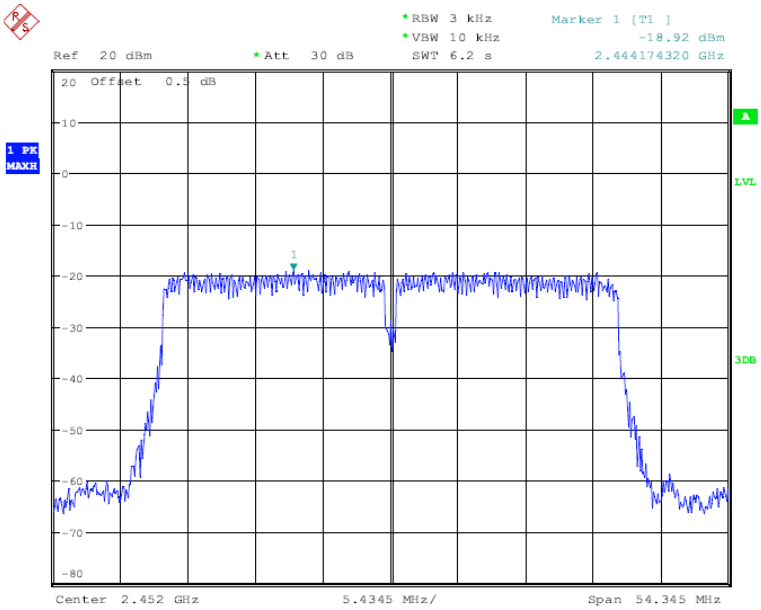
ANT 2 802.11n-HT40 Low Channel



ANT 2 802.11n-HT40 Middle Channel



ANT 2 802.11n-HT40 High 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

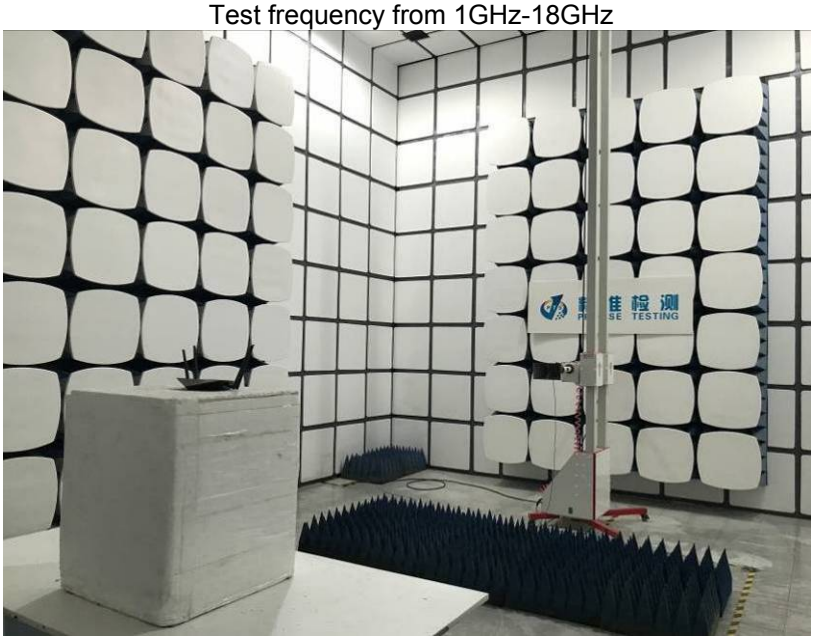
The EUT'S antenna, permanent attached antenna, is external antenna. The antenna's gain is 5dBi and meets the requirement.

13 Test Setup

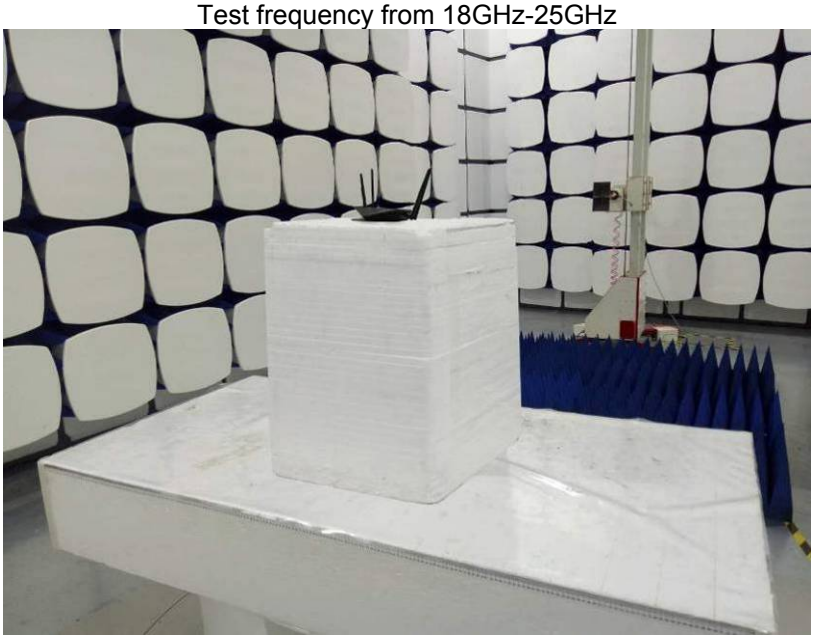
Conducted Emissions

Radiated Spurious Emissions
From 30MHz-1000MHz

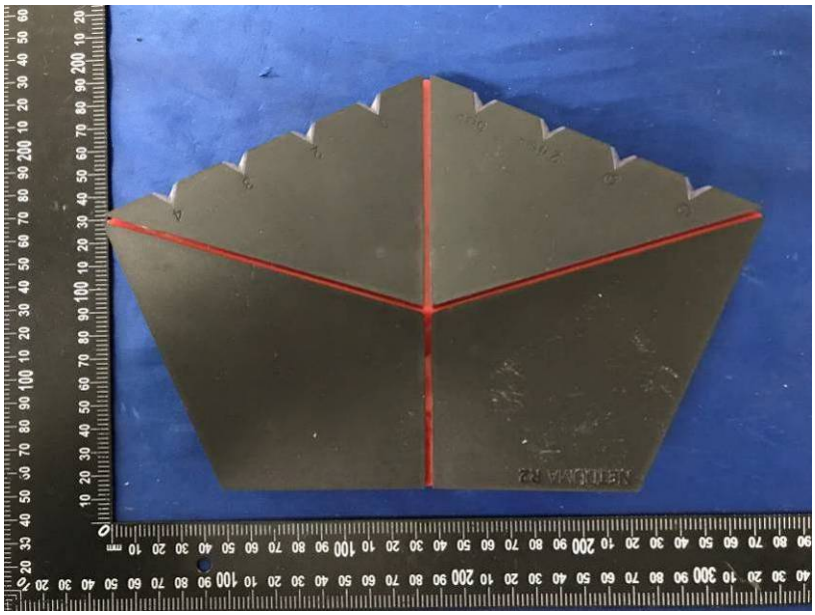
Test frequency from 1GHz-18GHz

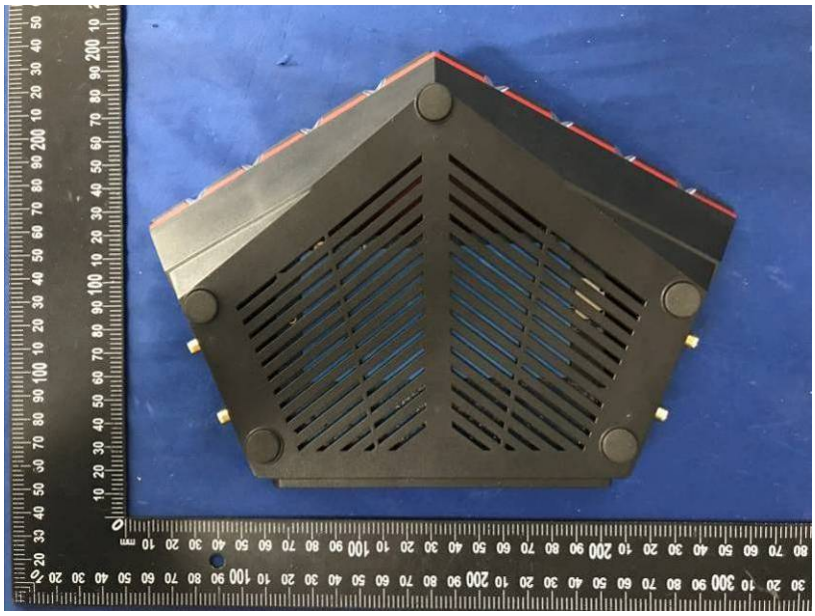


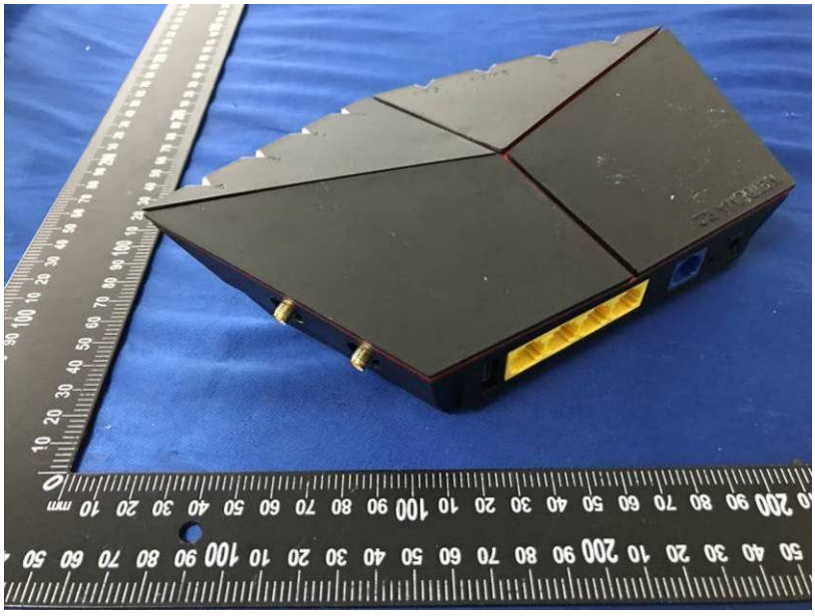
Test frequency from 18GHz-25GHz

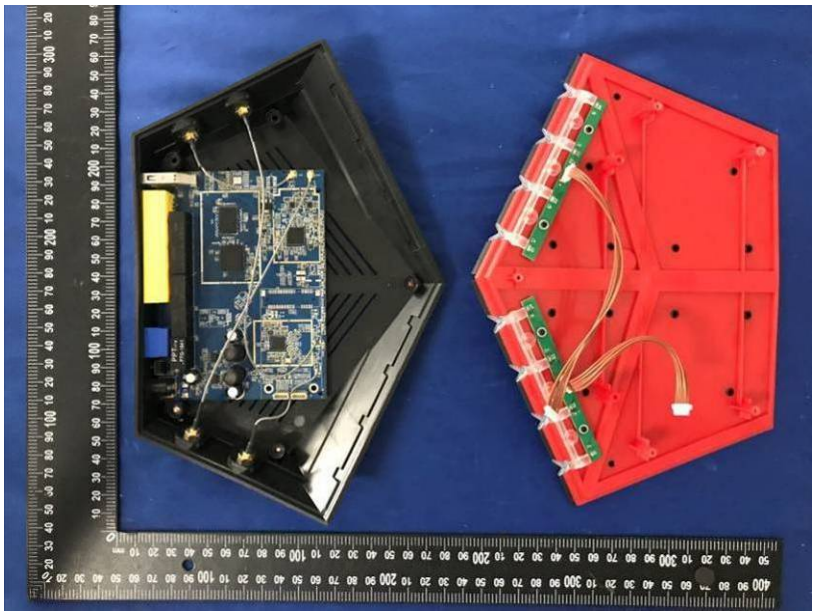


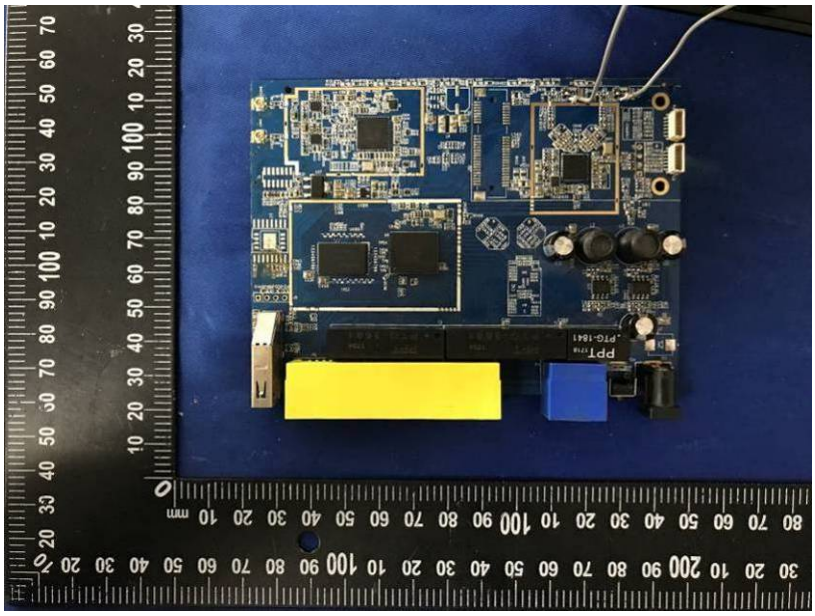
14 EUT Photos

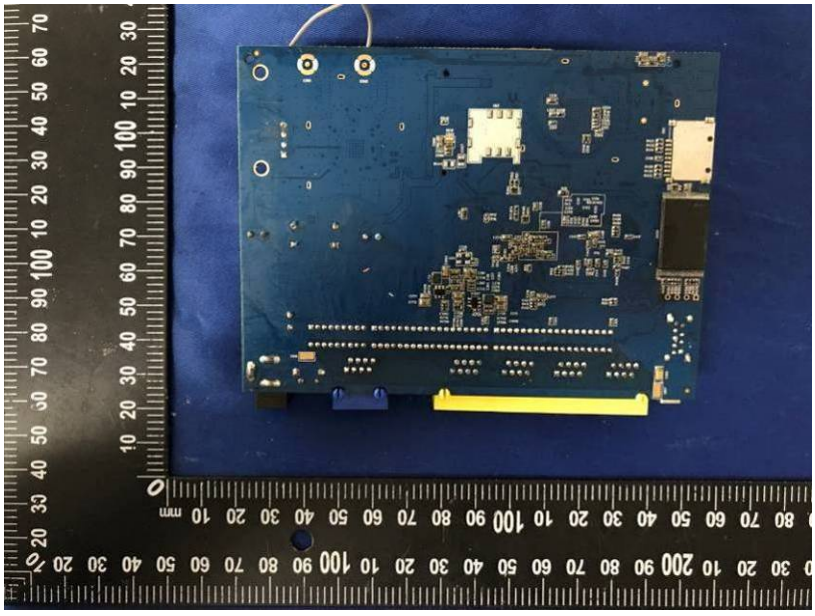


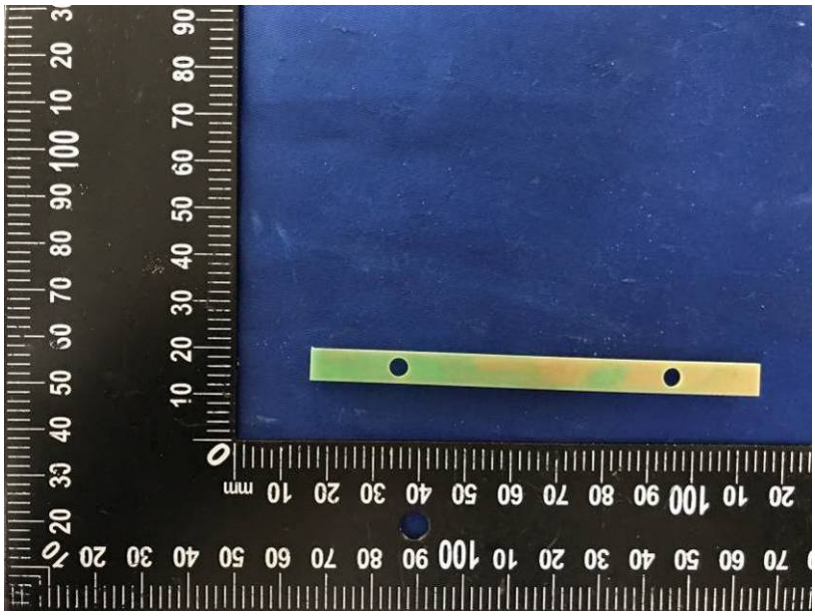


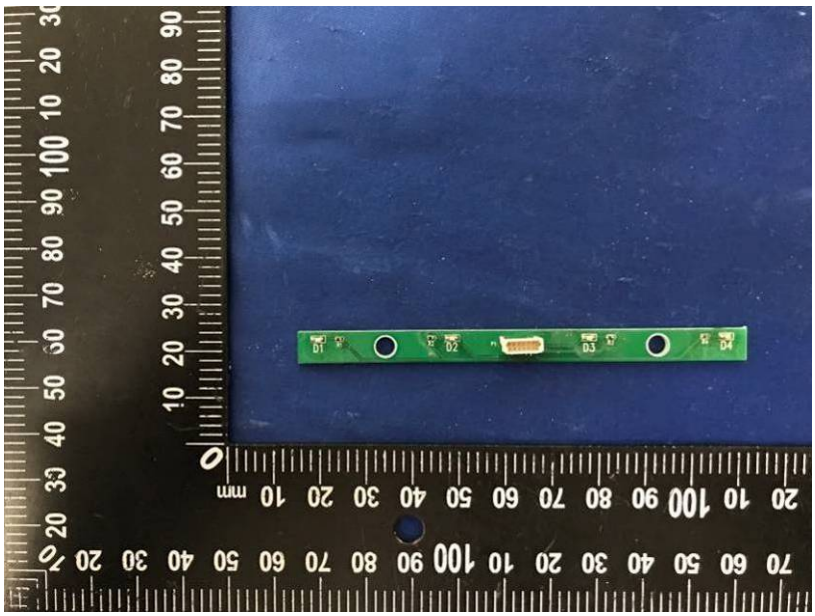


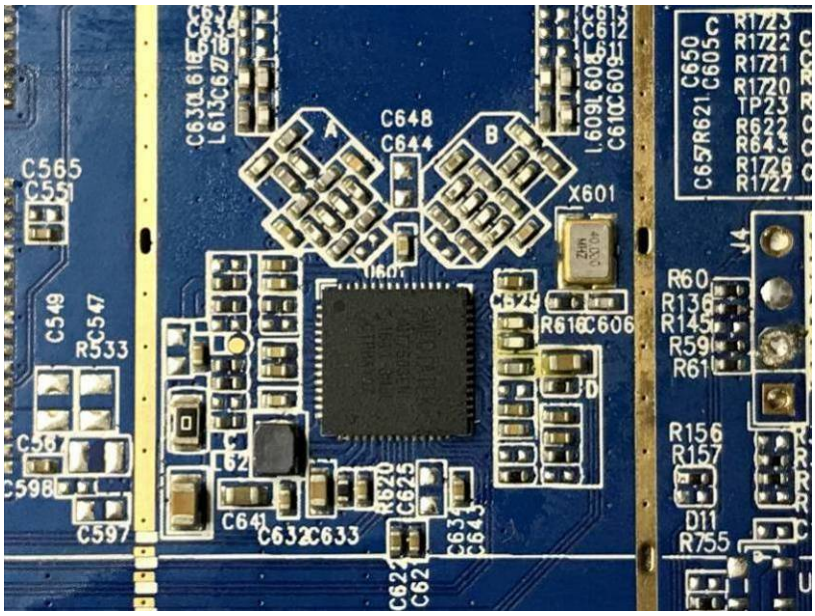












******THE END REPORT******