



# TEST REPORT

No.I23N00436-WLAN 2.4GHz

for

TCL Communication Ltd.

LINKHUB

Model Name: HH40L2

with

Hardware Version: TZ7.823.397

Software Version: HH40L2.1.01

FCC ID: 2ACCJB202

Issued Date: 2023-04-20

**Designation Number: CN1210**

**Note:**

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of SAICT.

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## **REPORT HISTORY**

<b>Report Number</b>	<b>Revision</b>	<b>Description</b>	<b>Issue Date</b>
I23N00436-WLAN 2.4GHz	Rev.0	1st edition	2023-04-20

Note: the latest revision of the test report supersedes all previous versions.



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## 1. Summary of Test Report

### 1.1. Test Items

Description	LINKHUB
Model Name	HH40L2
Applicant's name	TCL Communication Ltd.
Manufacturer's Name	TCL Communication Ltd.

### 1.2. Test Standards

FCC Part15-2021; ANSI C63.10-2013; KDB 662911 D01-V02r01.

### 1.3. Test Result

#### **Pass**

Please refer to "5.2. Test Results"

### 1.4. Testing Location

Address: Building G, Shenzhen International Innovation Center, No.1006 Shennan Road,  
Futian District, Shenzhen, Guangdong, P. R. China 51800

### 1.5. Project data

Testing Start Date:	2023-03-30
Testing End Date:	2023-04-18

### 1.6. Signature

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Lin Zechuang

(Prepared this test report)

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An Ran

(Reviewed this test report)

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Zhang Bojun

(Approved this test report)



## **2. Client Information**

### **2.1. Applicant Information**

Company Name: TCL Communication Ltd.  
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### **2.2. Manufacturer Information**

Company Name: TCL Communication Ltd.  
Address: 5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong  
Contact Person: Annie Jiang  
E-Mail: nianxiang.jiang@tcl.com  
Telephone: 0086-755-3661 1621  
Fax: 0086-755-36612000-81722



### **3. Equipment Under Test (EUT) and Ancillary Equipment (AE)**

#### **3.1. About EUT**

Description	LINKHUB
Model Name	HH40L2
RF Protocol	IEEE 802.11b/g/n-HT20/n-HT40
Operating Frequency	ISM 2412MHz~2462MHz
Type of Modulation	DSSS/CCK/OFDM
Antenna Type	Integrated antenna
Antenna Gain	SISO: Antenna 0:3.88dBi; Antenna 1:3.74dBi. Directional Gain: 3.81dBi (see Note1)
Power Supply	12V DC by External Power Supply
FCC ID	2ACCJB202
Condition of EUT as received	No abnormality in appearance

Note1: After confirmation with the customer, the DUT uses STBC technology, and the antennas are completely uncorrelated. Directional gain =  $10\log [(10^{G1/10} + 10^{G2/10} + \dots + 10^{GN/10})/NANT]$  dBi =  $10\log [(10^{3.88/10} + 10^{3.74/10})/2]$  dBi  $\approx 3.81$  dBi.

Note2: Components list, please refer to documents of the manufacturer; it is also included in the original test record of Shenzhen Academy of Information and Communications Technology.

#### **3.2. Internal Identification of EUT used during the test**

<b>EUT ID*</b>	<b>SN or IMEI</b>	<b>HW Version</b>	<b>SW Version</b>	<b>Date of Receipt</b>
UT02aa	355197410026723	TZ7.823.397	HH40L2.1.01	2022-03-29
UT06aa	355197410026814	TZ7.823.397	HH40L2.1.01	2023-03-27

\*EUT ID: is used to identify the test sample in the lab internally.

UT02aa is used for conduction test, UT06aa is used for radiation test and AC Power line Conducted Emission test.

#### **3.3. Internal Identification of AE used during the test**

<b>AE No.</b>	<b>Description</b>	<b>AE ID*</b>
AE1	Battery	/
AE2	Charger	/

##### AE1

Model	Z2000
Manufacturer	ShenzhenAerospaceElectronic Co.,Ltd
Capacity	2000mAh
Nominal Voltage	7.4 V

##### AE2

Model	1-CHUSB102-131
Manufacturer	Huizhou Puan electronics Co.,Ltd



\*AE ID: is used to identify the test sample in the lab internally.

### **3.4. General Description**

The Equipment under Test (EUT) is a model of LINKHUB with Integrated antenna.

It consists of normal options: Lithium Battery, Charger and USB Cable.

Manual and specifications of the EUT were provided to fulfil the test.

Samples undergoing test were selected by the client.



## **4. Reference Documents**

### **4.1. Documents supplied by applicant**

EUT feature information is supplied by the applicant or manufacturer, which is the basis of testing.

### **4.2. Reference Documents for testing**

The following documents listed in this section are referred for testing.

<b>Reference</b>	<b>Title</b>	<b>Version</b>
FCC Part15	FCC CFR 47, Part 15, Subpart C: 15.205 Restricted bands of operation; 15.209 Radiated emission limits, general requirements; 15.247 Operation within the bands 902–928MHz, 2400–2483.5 MHz, and 5725–5850 MHz	2021
ANSI C63.10	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	2013
KDB 662911 D01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band (e.g., MIMO, Smart Antenna, etc)	V02r01





## 5. Test Results

### 5.1. Testing Environment

Normal Temperature: 15~35°C

Relative Humidity: 20~75%

### 5.2. Test Results

No	Test cases	Sub-clause of Part 15C	Verdict
0	Antenna Requirement	15.203	P
1	Maximum Output Power	15.247 (b)	P
2	Peak Power Spectral Density	15.247 (e)	P
3	6dB Bandwidth	15.247 (a)	P
4	Band Edges Compliance	15.247 (d)	P
5	Conducted Emission	15.247 (d)	P
6	Radiated Emission	15.247, 15.205, 15.209	P
7	AC Power line Conducted	15.207	P

See **ANNEX A** for details.

### 5.3. Statements

SAICT has evaluated the test cases requested by the applicant/manufacture as listed in section 5.2 of this report, for the EUT specified in section 3, according to the standards or reference documents listed in section 4.2.

Disclaimer:

A. After confirmation with the customer, the sample information provided by the customer may affect the validity of the measurement results in this report, and the impact and consequences arising therefrom shall be borne by the customer.

B. The samples in this report are provided by the customer, and the test results are only applicable to the samples received.



## 6. Test Equipments Utilized

### Conducted test system

No.	Equipment	Model	Serial Number	Manufacturer	Calibration Due date	Calibration Period
1	Vector Signal Analyzer	FSV40	100903	Rohde & Schwarz	2023-12-28	1 year
2	Power Sensor	U2021XA	MY55430013	Keysight	2023-12-28	1 year
3	Data Acquisition	U2531A	TW55443507	Keysight	/	/

### Radiated test system

No.	Equipment	Model	Serial Number	Manufacturer	Calibration Due date	Calibration Period
1	Test Receiver	ESR7	101676	Rohde & Schwarz	2023-11-23	1 year
2	BiLog Antenna	3142E	0224831	ETS-Lindgren	2024-05-27	3 years
3	Horn Antenna	3117	00066577	ETS-Lindgren	2025-04-17	3 years
4	Anechoic Chamber	FACT3-2.0	1285	ETS-Lindgren	2023-05-29	2 years
5	Spectrum Analyzer	FSV40	101192	Rohde & Schwarz	2024-01-11	1 year
6	Loop Antenna	HLA6120	35779	TESEQ	2025-05-10	3 years
7	Horn Antenna	QSH-SL-1 8-26-S-20	17013	Q-par	2026-01-30	3 years
8	Test Receiver	ESCI	100702	Rohde & Schwarz	2024-01-11	1 year
9	LISN	ENV216	102067	Rohde & Schwarz	2023-07-14	1 year

### Test software

No.	Equipment	Manufacturer	Version
1	TechMgr Software	CAICT	2.1.1
2	EMC32	Rohde & Schwarz	10.50.40

EUT is engineering software provided by the customer to control the transmitting signal. The EUT was programmed to be in continuously transmitting mode.



## 7. Laboratory Environment

### Shielded room

Temperature	Min. = 15 °C, Max. = 35 °C
Relative humidity	Min. = 20 %, Max. = 75 %
Shielding effectiveness	0.014MHz-1MHz> 60 dB; 1MHz-18000MHz>90 dB
Electrical insulation	> 2M $\Omega$
Ground system resistance	< 4 $\Omega$

### Anechoic chamber

Temperature	Min. = 15 °C, Max. = 35 °C
Relative humidity	Min. = 20 %, Max. = 75 %
Shielding effectiveness	0.014MHz-1MHz> 60 dB; 1MHz-18000MHz>90 dB
Electrical insulation	> 2M $\Omega$
Ground system resistance	< 4 $\Omega$
Normalised site attenuation (NSA)	< $\pm 4$ dB, 3 m distance, from 30 to 1000 MHz
Voltage Standing Wave Ratio (VSWR)	$\leq 6$ dB, from 1 to 18 GHz, 3m distance
Uniformity of field strength	Between 0 and 6 dB, from 80 to 6000 MHz



### 8. Measurement Uncertainty

Test Name	Uncertainty (k=2)	
1. Maximum Peak Output Power	1.32dB	
2. Peak Power Spectral Density	1.32dB	
3. 6dB Bandwidth	4.56kHz	
4. Band Edges Compliance	1.92dB	
5. Transmitter Spurious Emission - Conducted	30MHz≤f<1GHz	1.41dB
	1GHz≤f<7GHz	1.92dB
	7GHz≤f<13GHz	2.31dB
	13GHz≤f≤26GHz	2.61dB
6. Transmitter Spurious Emission - Radiated	9kHz≤f<30MHz	1.79dB
	30MHz≤f<1GHz	4.86dB
	1GHz≤f<18GHz	4.82dB
	18GHz≤f≤40GHz	2.90dB
7. AC Power line Conducted Emission	150kHz≤f≤30MHz	2.62dB

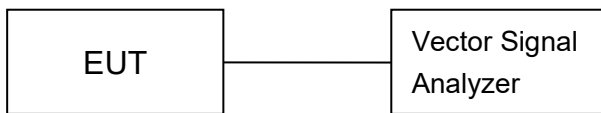
## **ANNEX A: Detailed Test Results**

### **Test Configuration**

The measurement is made according to ANSI C63.10.

#### **1) Conducted Measurements**

1. Connect the EUT to the test system correctly.
2. Set the EUT to the required work mode.
3. Set the EUT to the required channel.
4. Set the spectrum analyzer to start measurement.
5. Record the values.



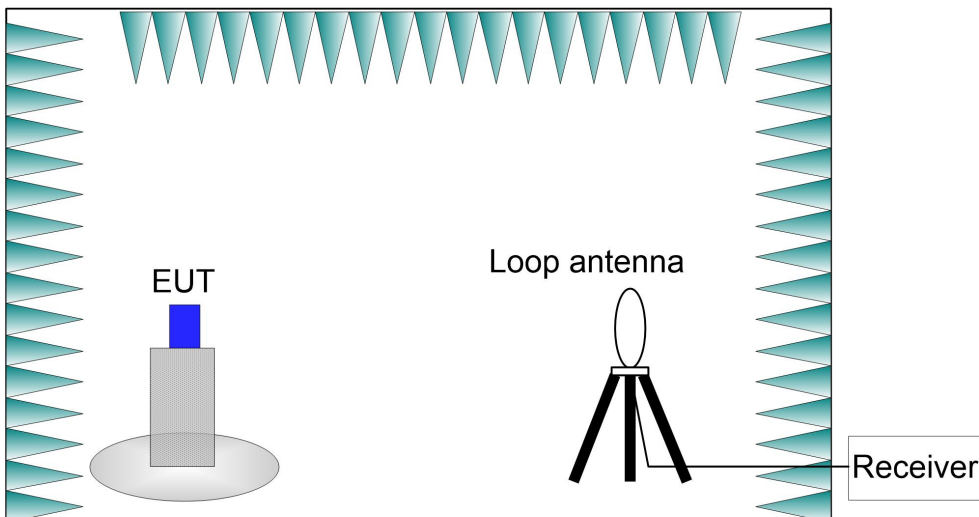
#### **2) Radiated Measurements**

**Test setup:**

**9kHz-30MHz:**

The EUT are measured in a anechoic chamber. The EUT is placed on a non-conductive stand of 80cm high, and at a measurement distance of 3m from the receiving antenna. The center of the receiving loop antenna is 1.0 meter above the ground. The test setup refers to figure below.

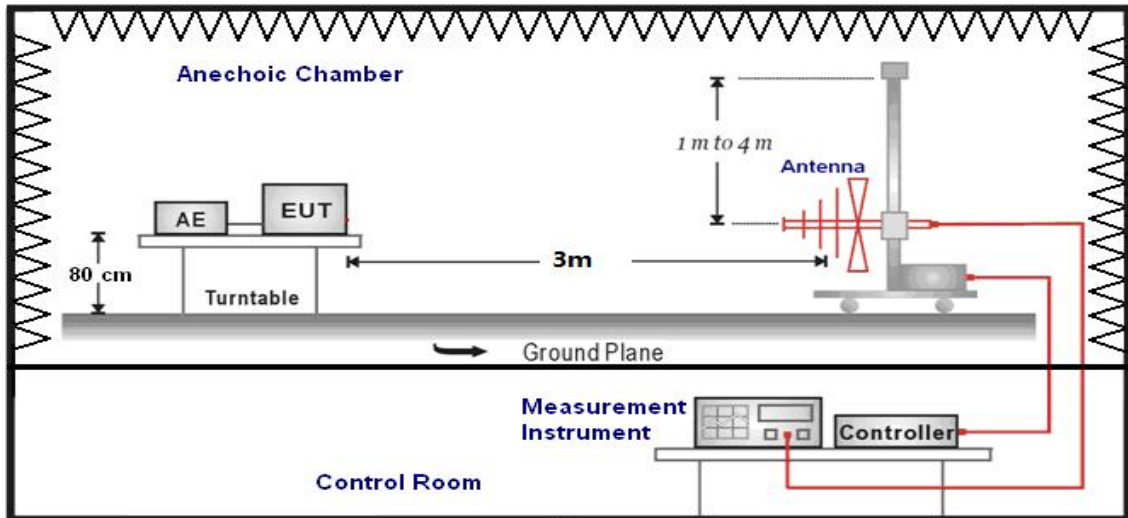
Detected emissions were maximized at each frequency by rotating the EUT and adjusting the receiver antenna polarization.



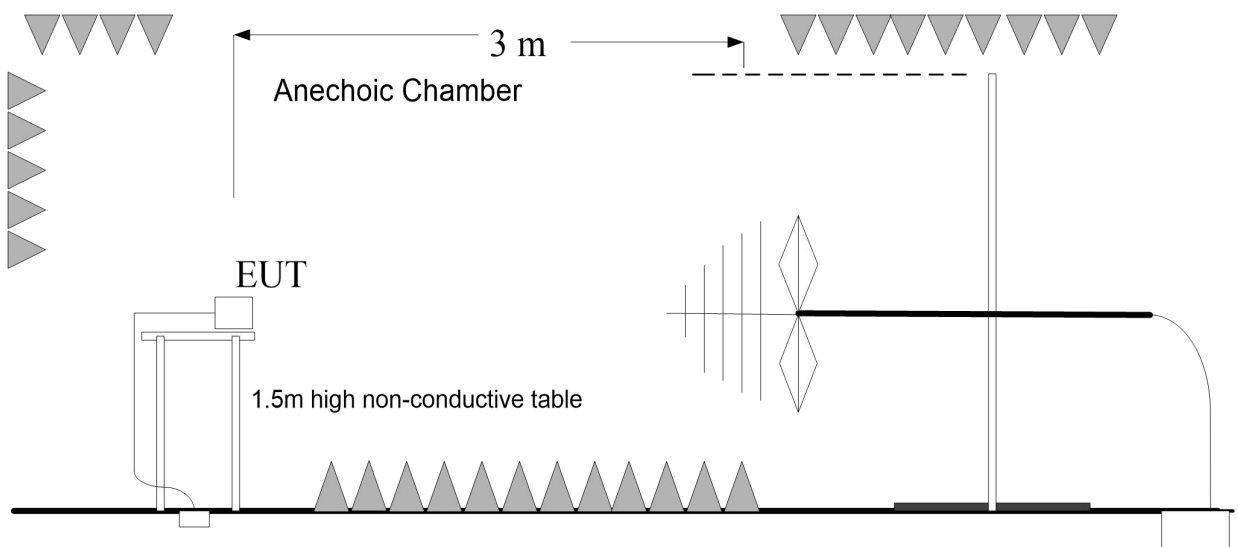
**30MHz-26.5GHz:**

The EUT are measured in an anechoic chamber. The EUT is placed on a non-conductive stand of 80cm high, and at a measurement distance of 3m from the receiving antenna. The center of the receiving antenna is 1.0 meter to 4.0 meter above the ground. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the EUT and adjusting the receiver antenna polarization.

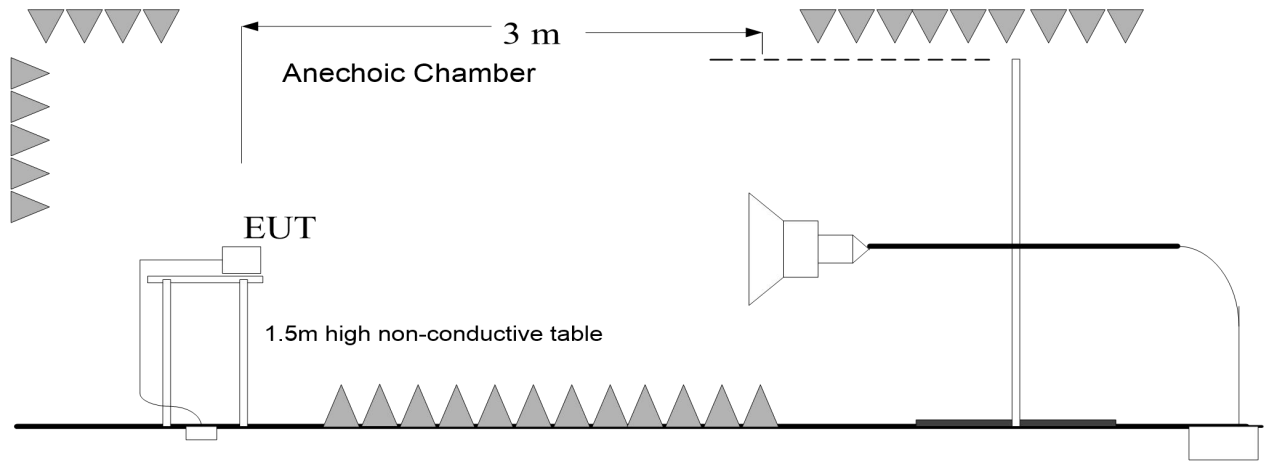
**30MHz-1GHz:**



**1GHz-3GHz:**

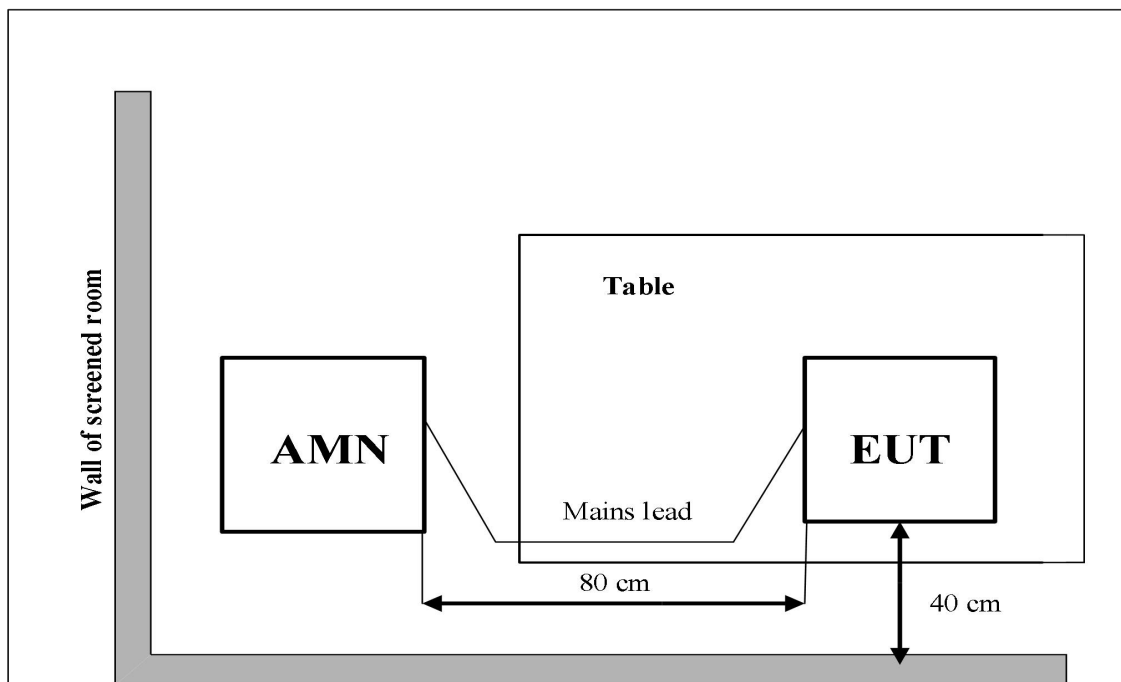


**3GHz-26.5GHz:**



**3) AC Power line Conducted Emission Measurement**

For WLAN, the EUT is working under test mode. The EUT is commanded to operate at maximum transmitting power.





### A.0 Antenna requirement

**Measurement Limit:**

Standard	Requirement
FCC CRF Part 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

**Conclusion: The Directional gains of antenna used for transmitting:**

**SISO: Antenna 0:3.88dBi; Antenna 1:3.74dBi.**

**Directional Gain: 3.81dBi**

**The RF transmitter uses an integrate antenna without connector.**





### A.1 Maximum Output Power

**Measurement of method: See ANSI C63.10-2013-Clause 11.9.2.3.2.**

Method AVGPM-G is a measurement using a gated RF average power meter.

Alternatively, measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Because the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

**Measurement Limit:**

Standard	Limit (dBm)
FCC CRF Part 15.247(b)	< 30

**Measurement Results:**

**SISO:**

**Antenna 0:**

Mode	RF output power (dBm)		
	2412MHz(CH1)	2437MHz(CH6)	2462MHz(CH11)
802.11b	19.58	19.47	19.62
802.11g	15.36	15.75	15.41
802.11n-HT20	15.42	15.79	15.36
/	2422MHz(CH3)	2437MHz(CH6)	2452MHz(CH9)
802.11n-HT40	15.53	15.81	15.34

**Antenna 1:**

Mode	RF output power (dBm)		
	2412MHz(CH1)	2437MHz(CH6)	2462MHz(CH11)
802.11b	18.94	19.33	19.09
802.11g	15.03	15.29	15.37
802.11n-HT20	14.91	15.37	15.02
/	2422MHz(CH3)	2437MHz(CH6)	2452MHz(CH9)
802.11n-HT40	15.27	15.23	15.03

**MIMO:**

Mode	RF output power (dBm)								
	2412MHz (Ch1)			2437MHz (Ch6)			2462MHz (Ch11)		
	Ant0	Ant1	Sum	Ant0	Ant1	Sum	Ant0	Ant1	Sum
802.11n-HT20	12.50	12.30	15.41	12.73	12.55	15.65	12.43	12.13	15.29
	2422MHz (Ch3)			2437MHz (Ch6)			2452MHz (Ch9)		
	Ant0	Ant1	Sum	Ant0	Ant1	Sum	Ant0	Ant1	Sum
802.11n-HT40	12.50	12.26	15.39	12.55	12.27	15.42	12.02	11.96	15.00

**Note:** The data rate 1Mbps (11b mode), 6Mbps (11g mode) and MCS0 (11n mode) are tested and selected as the Worst-Case. Antenna 0 is selected as the worst condition (SISO). The following cases and test graphs are performed with this condition.



The EUT was programmed to be in continuously transmitting mode and the transmit duty cycle is not less than 98%.

**Conclusion: PASS**

The test method is provided by the customer, which is to enter the test mode through Telnet, and then use the command to test. The power Settings are as follows:

<b>Mode</b>	<b>Type</b>	<b>2412MHz(CH1)</b>	<b>2437MHz(CH6)</b>	<b>2462MHz(CH11)</b>
802.11b	SISO(Ant0)	45	49	47
	SISO(Ant1)	45	47	47
802.11g	SISO(Ant0)	45	49	47
	SISO(Ant1)	45	45	46
802.11n-HT20	SISO(Ant0)	45	49	47
	SISO(Ant1)	45	45	46
	MIMO	41	43	42
/	/	<b>2422MHz(CH3)</b>	<b>2437MHz(CH6)</b>	<b>2452MHz(CH9)</b>
802.11n-HT40	SISO(Ant0)	47	49	48
	SISO(Ant1)	46	46	46
	MIMO	42	43	42



**A.2 Peak Power Spectral Density**

**Method of Measurement: See ANSI C63.10-clause 11.10.2.**

**Measurement Limit:**

Standard	Limit (dBm/10 kHz)
FCC CRF Part 15.247(e)	< 8

**Measurement Results:**

**SISO:**

Mode	Frequency (MHz)	Test Results(dBm/10 kHz)		Conclusion
		Fig.	Value	
802.11b	2412(CH1)	Fig.1	1.46	P
	2437(CH6)	Fig.2	1.60	P
	2462(CH11)	Fig.3	1.57	P
802.11g	2412(CH1)	Fig.4	-13.68	P
	2437(CH6)	Fig.5	-13.31	P
	2462(CH11)	Fig.6	-13.25	P
802.11n-HT20	2412(CH1)	Fig.7	-12.60	P
	2437(CH6)	Fig.8	-12.12	P
	2462(CH11)	Fig.9	-12.34	P
802.11n-HT40	2422(CH3)	Fig.10	-15.01	P
	2437(CH6)	Fig.11	-15.38	P
	2452(CH9)	Fig.12	-15.53	P

**MIMO:**

Mode	Frequency (MHz)	Test Results(dBm/10 kHz)			Conclusion
		Ant 0	Ant 1	Sum	
802.11n-HT20	2412(CH1)	-15.72	-15.84	-12.77	P
	2437(CH6)	-15.39	-15.42	-12.39	P
	2462(CH11)	-15.61	-16.04	-12.81	P
802.11n-HT40	2422(CH3)	-18.08	-18.59	-15.32	P
	2437(CH6)	-18.36	-18.56	-15.45	P
	2452(CH9)	-18.87	-19.10	-15.97	P

**See below for test graphs.**

**Conclusion: PASS**

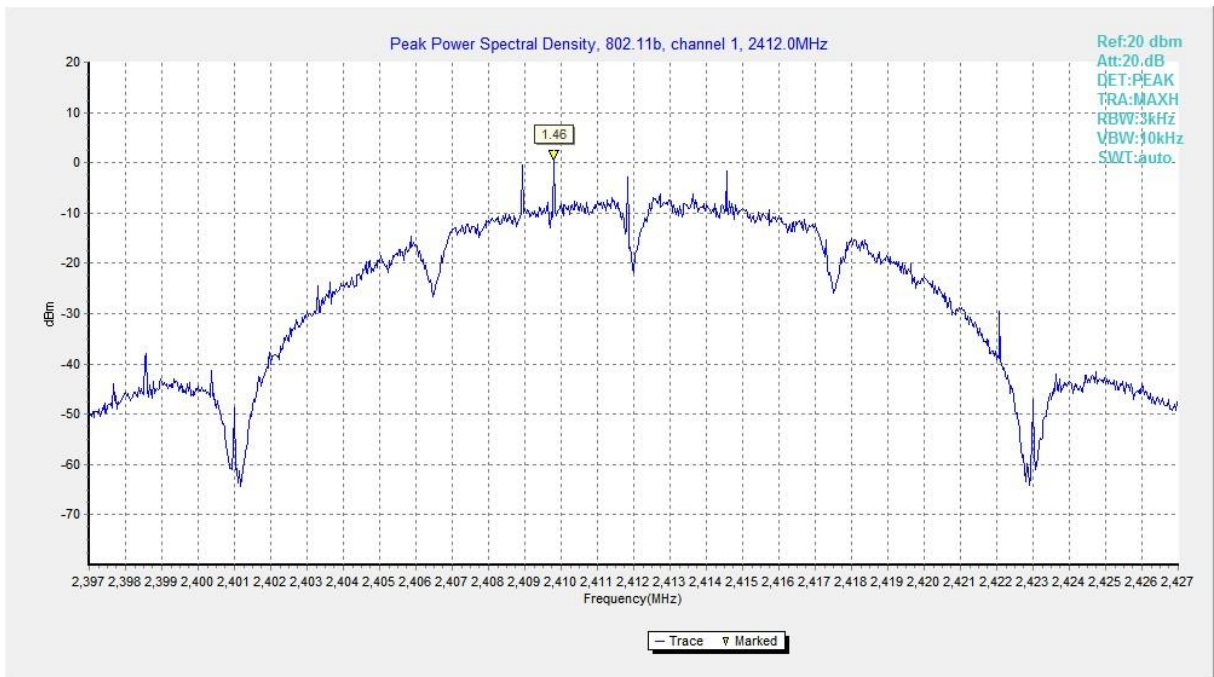


Fig.1 Power Spectral Density (802.11b, CH1)

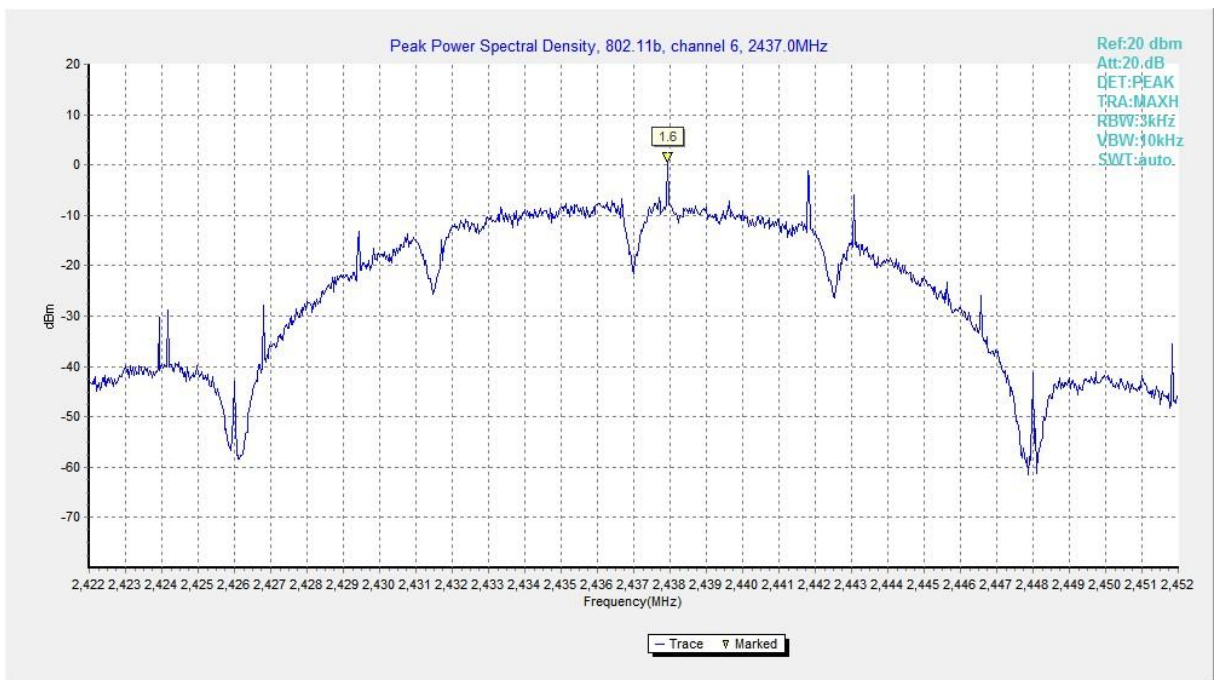
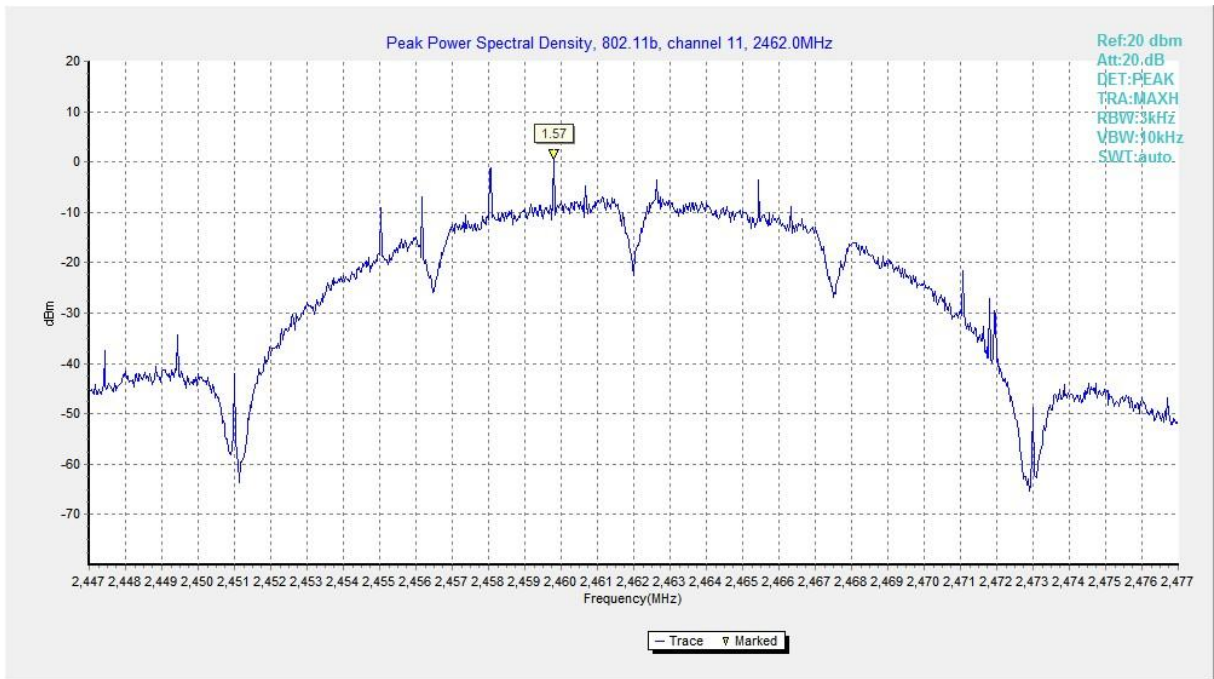
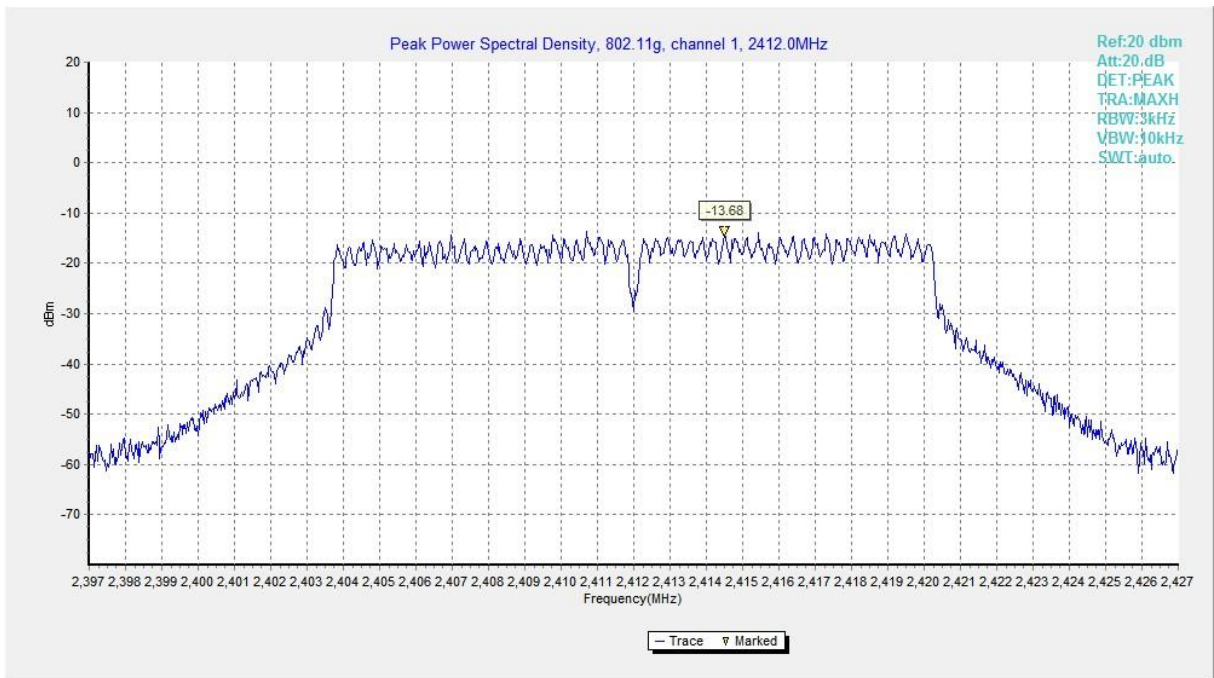


Fig.2 Power Spectral Density (802.11b, CH6)



**Fig.3 Power Spectral Density (802.11b, CH11)**



**Fig.4 Power Spectral Density (802.11g, CH1)**

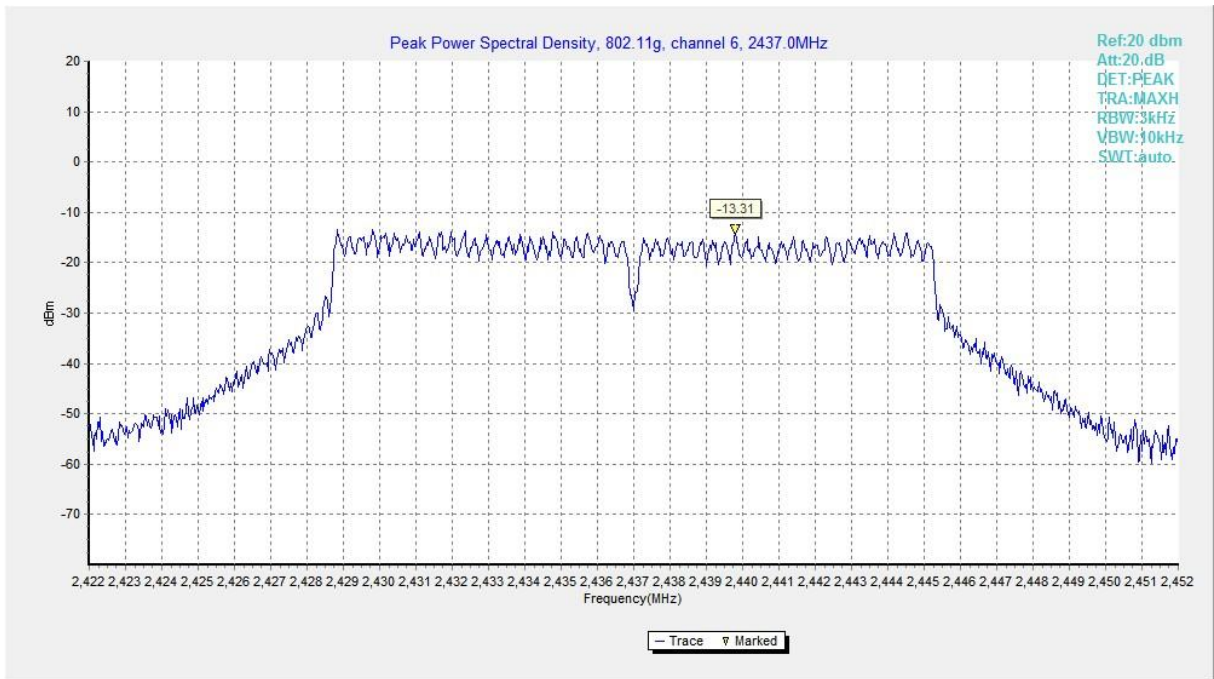


Fig.5 Power Spectral Density (802.11g, CH6)

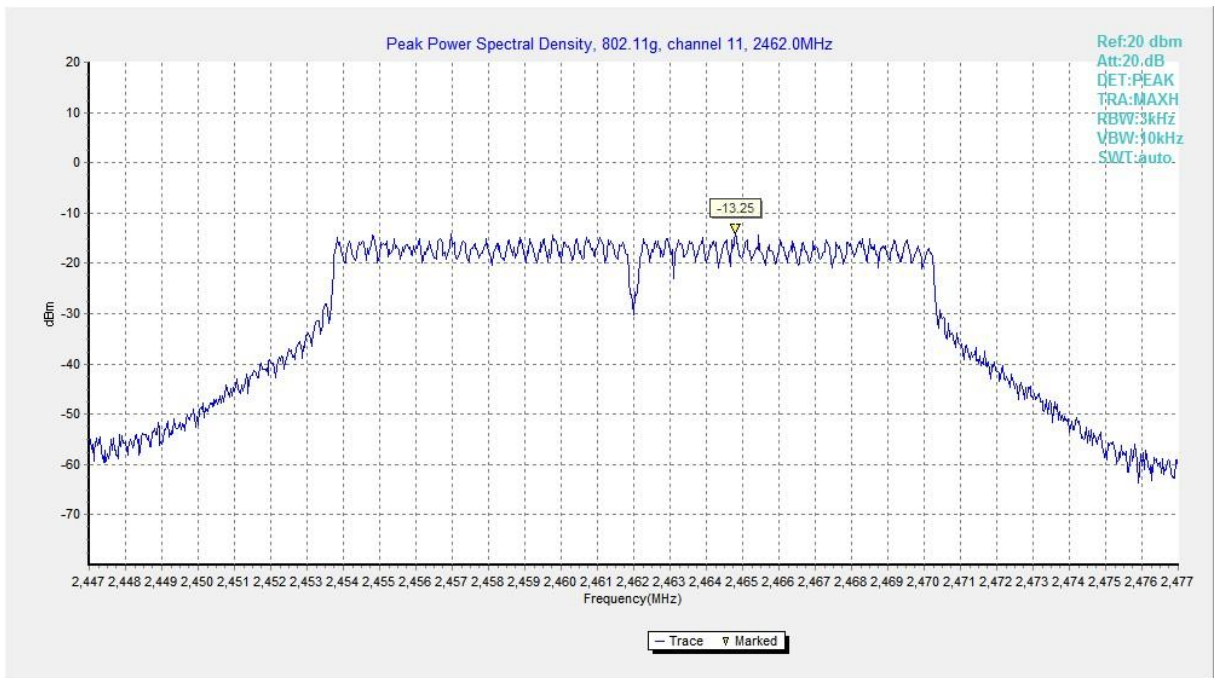


Fig.6 Power Spectral Density (802.11g, CH11)

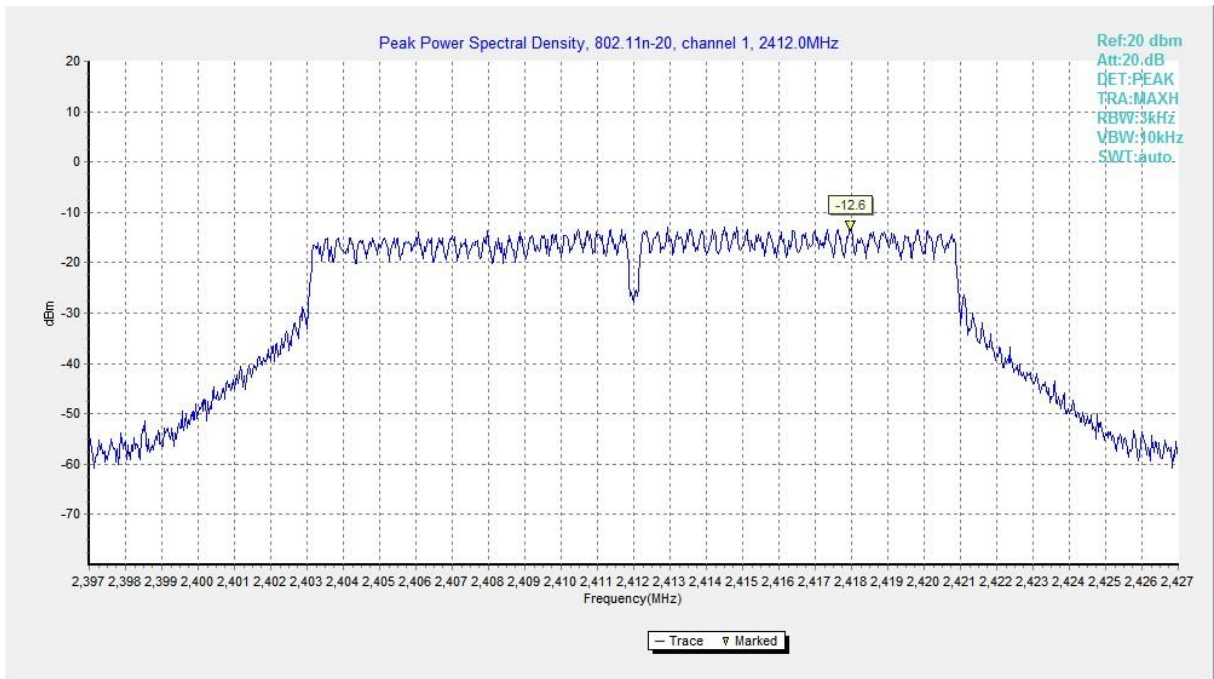


Fig.7 Power Spectral Density (802.11n-HT20, CH1)

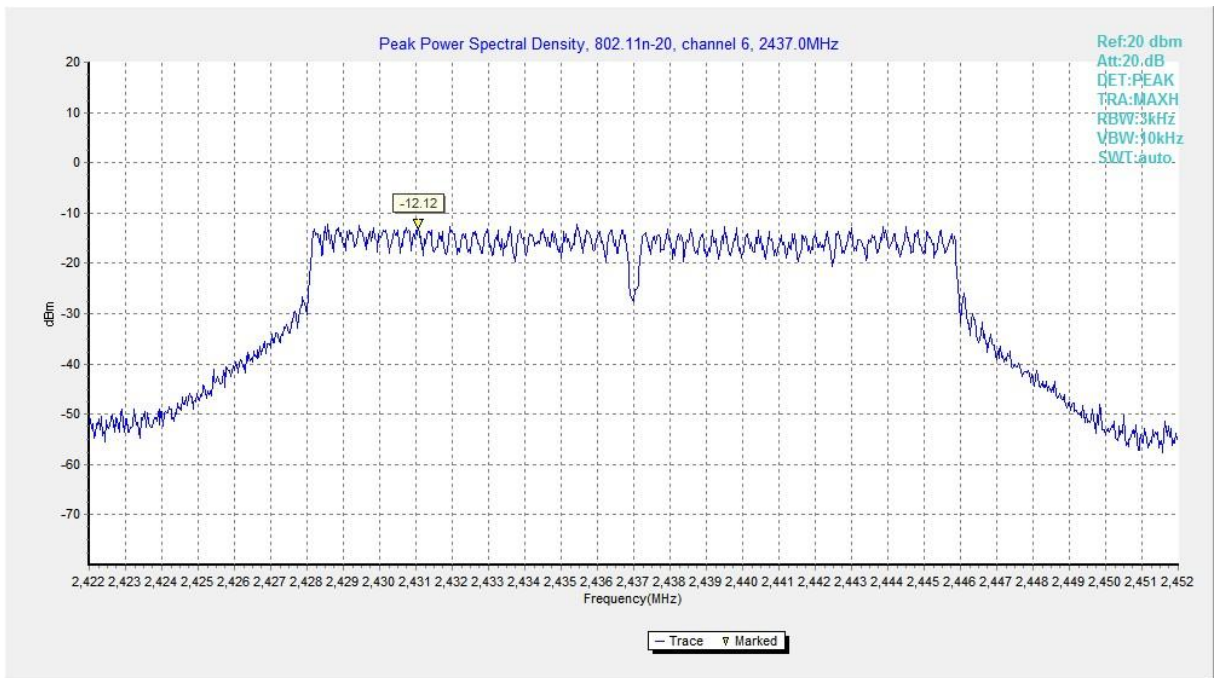
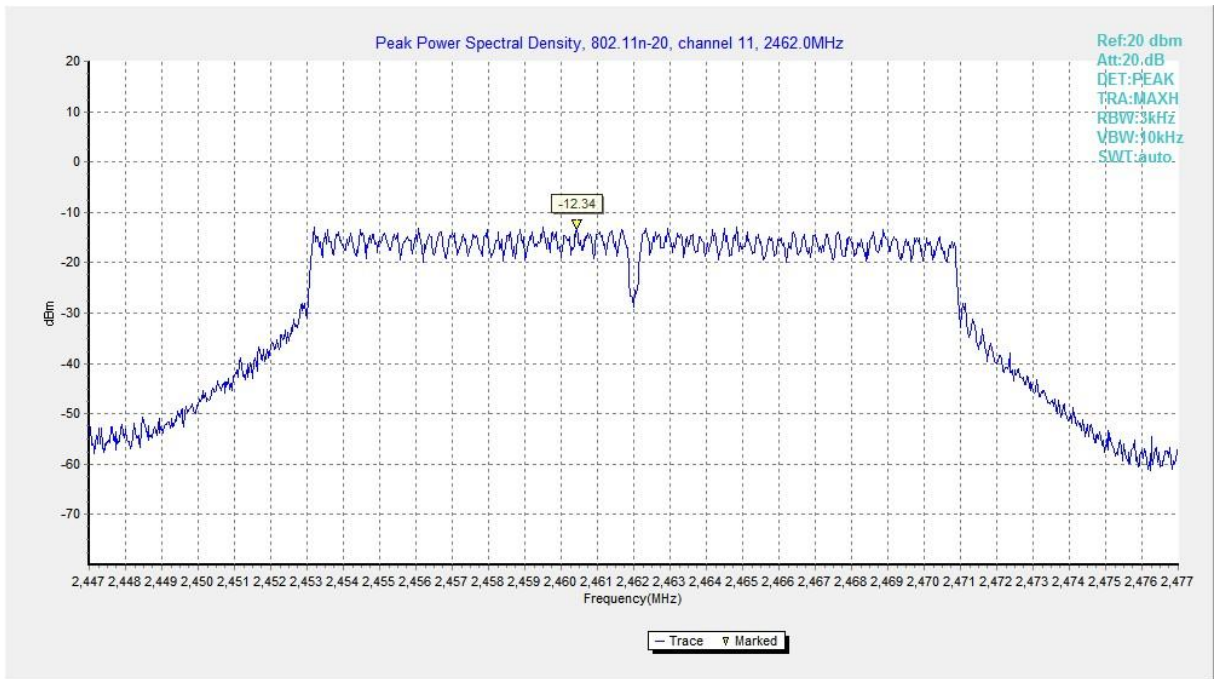
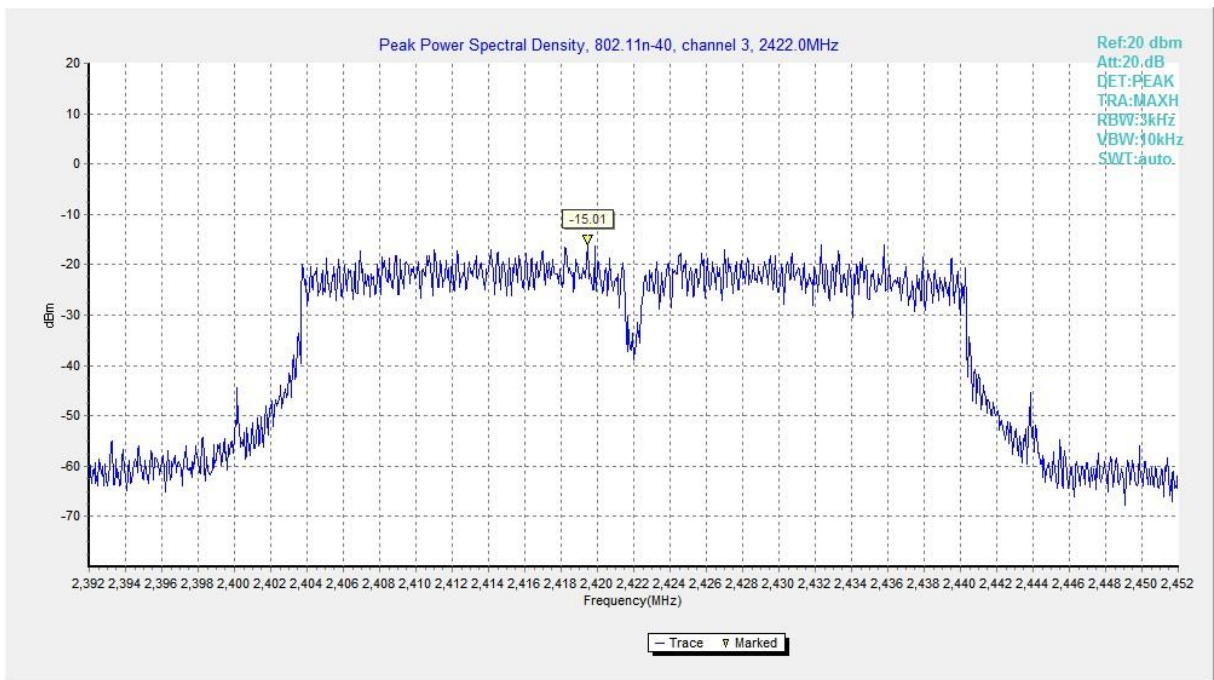


Fig.8 Power Spectral Density (802.11n-HT20, CH6)



**Fig.9 Power Spectral Density (802.11n-HT20, CH11)**



**Fig.10 Power Spectral Density (802.11n-HT40, CH3)**



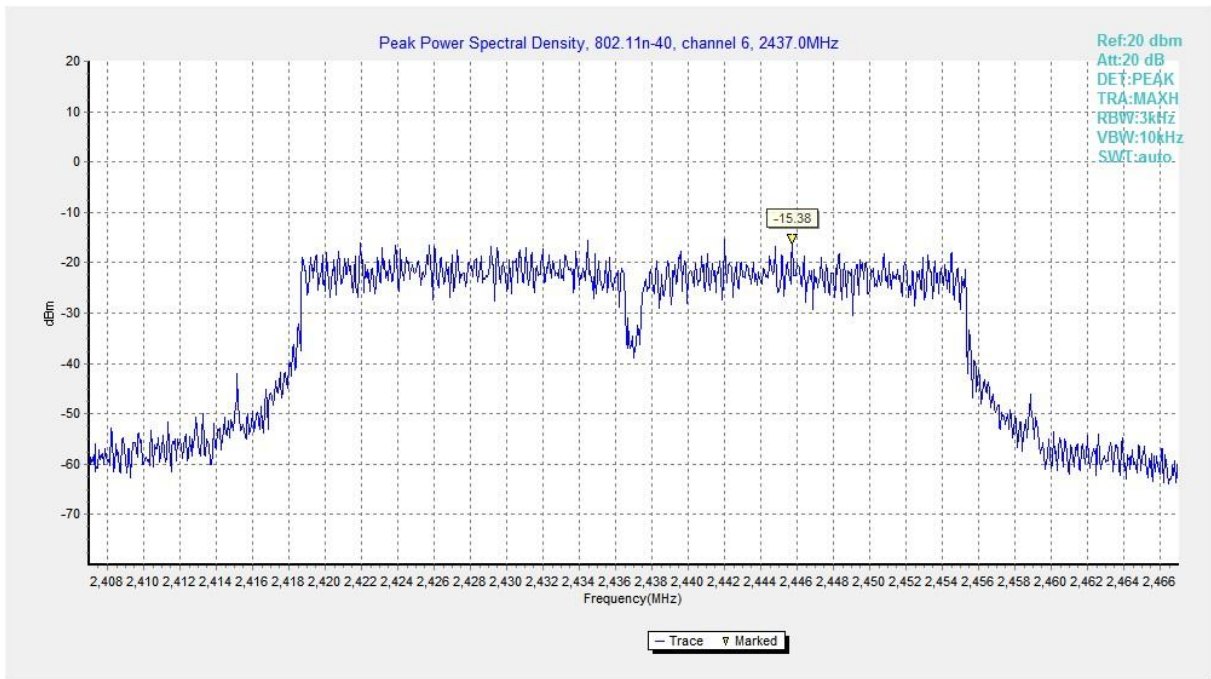


Fig.11 Power Spectral Density (802.11n-HT40, CH6)

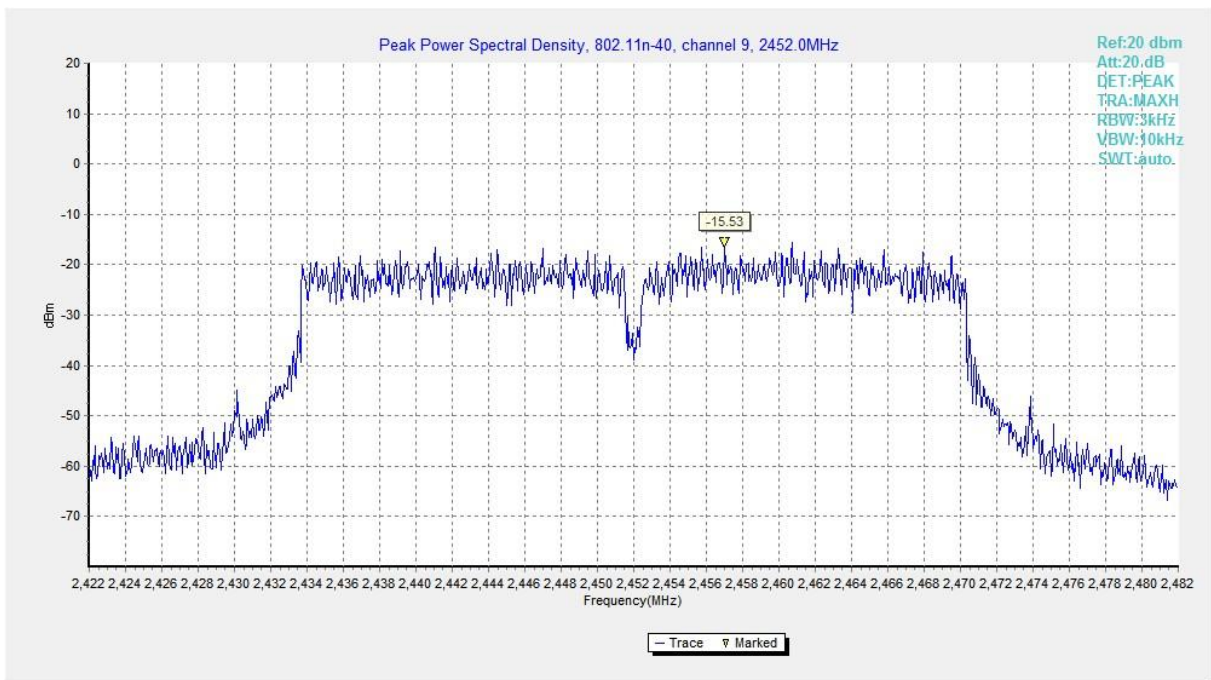


Fig.12 Power Spectral Density (802.11n-HT40, CH9)



### A.3 6dB Bandwidth

Method of Measurement: See ANSI C63.10-clause 11.8.

Measurement Limit:

Standard	Limit (MHz)
FCC 47 CFR Part 15.247 (a)	≥ 0.5

Measurement Result:

Mode	Frequency (MHz)	Test Results (MHz)		Conclusion
802.11b	2412(CH1)	Fig.13	9.55	P
	2437(CH6)	Fig.14	10.05	P
	2462(CH11)	Fig.15	9.55	P
802.11g	2412(CH1)	Fig.16	16.30	P
	2437(CH6)	Fig.17	16.35	P
	2462(CH11)	Fig.18	16.30	P
802.11n-HT20	2412(CH1)	Fig.19	17.30	P
	2437(CH6)	Fig.20	17.60	P
	2462(CH11)	Fig.21	17.30	P
802.11n-HT40	2422(CH3)	Fig.22	35.20	P
	2437(CH6)	Fig.23	36.08	P
	2452(CH9)	Fig.24	36.00	P

See below for test graphs.

Conclusion: PASS



Fig.13 6dB Bandwidth (802.11b, CH1)

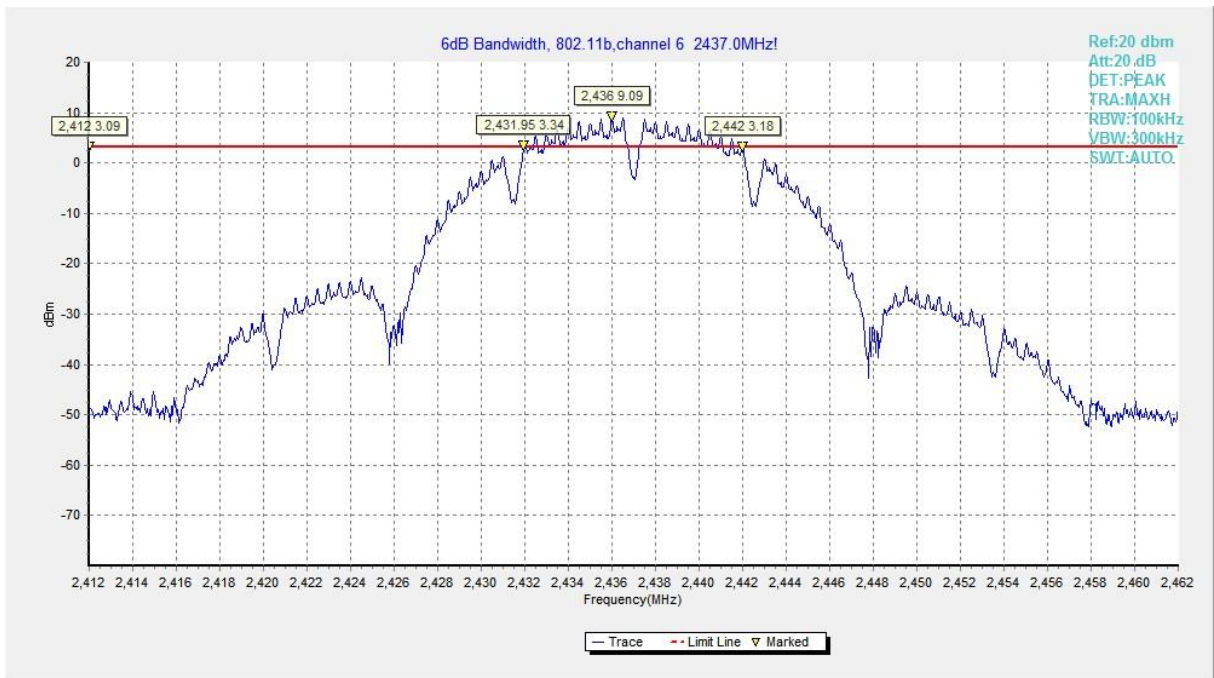


Fig.14 6dB Bandwidth (802.11b, CH6)

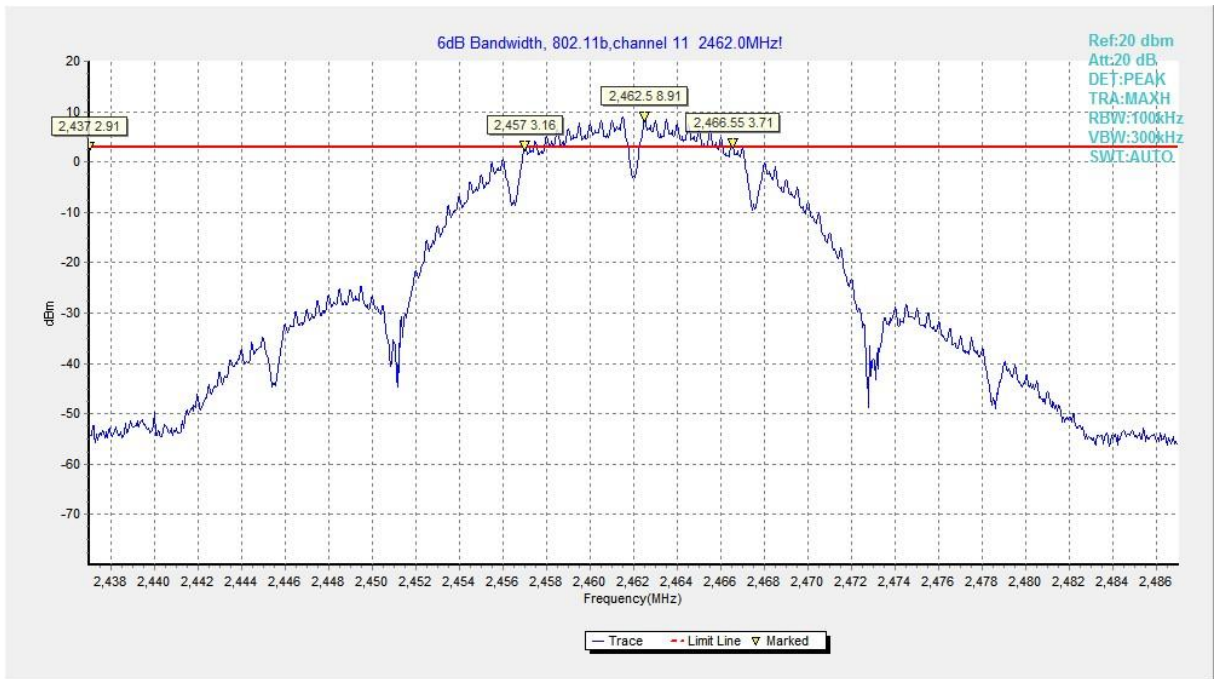


Fig.15 6dB Bandwidth (802.11b, CH11)

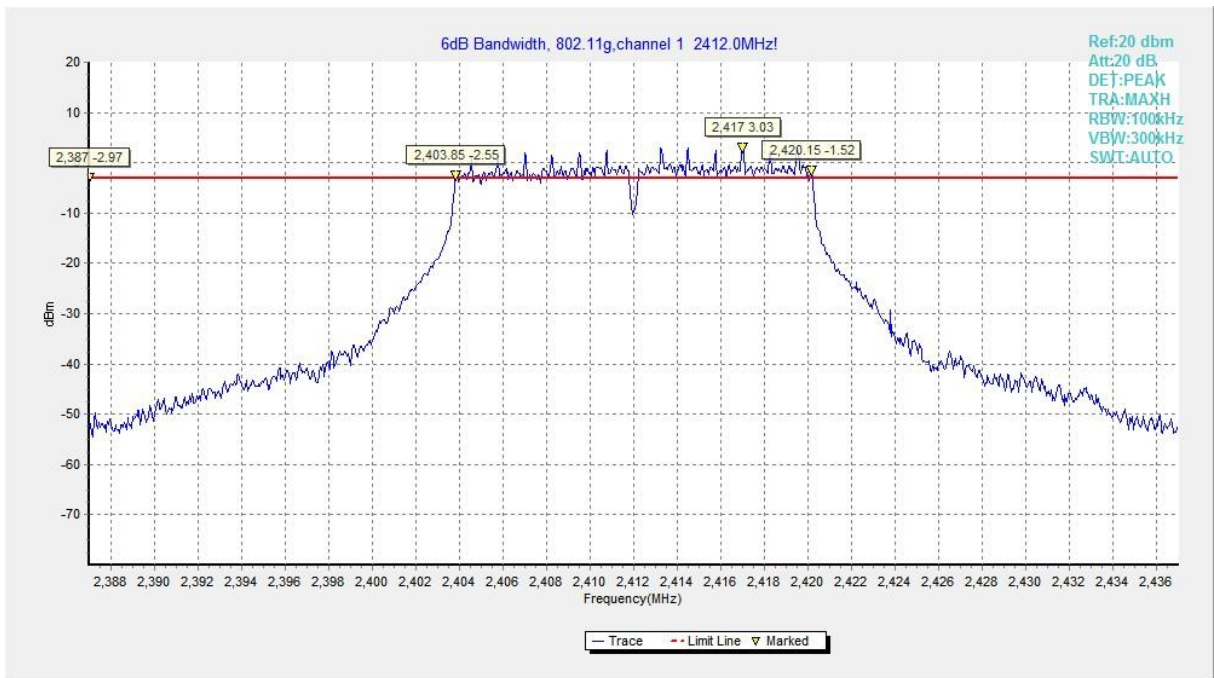


Fig.16 6dB Bandwidth (802.11g, CH1)

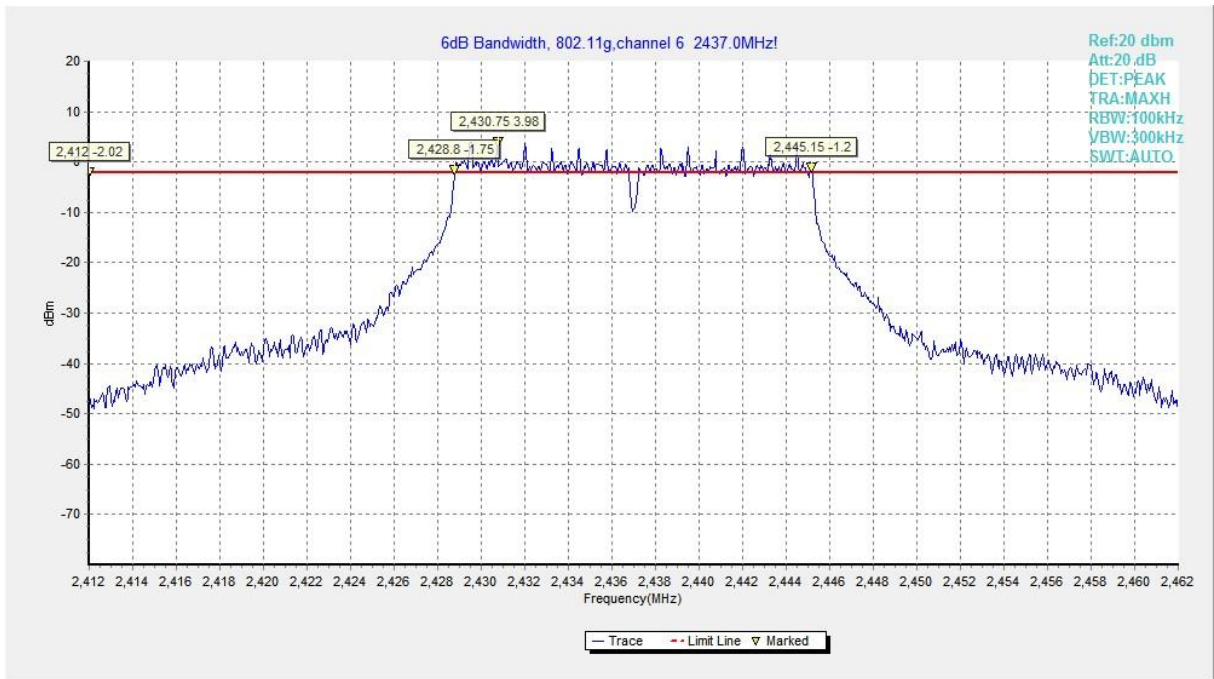


Fig.17 6dB Bandwidth (802.11g, CH6)

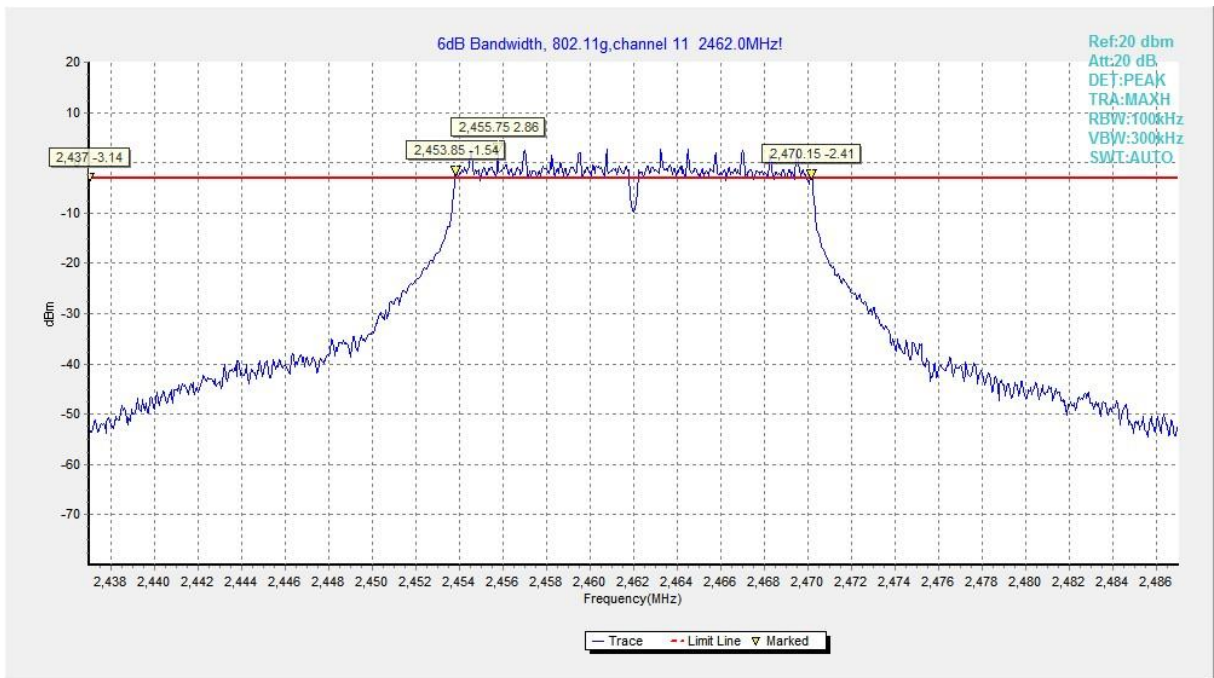


Fig.18 6dB Bandwidth (802.11g, CH11)

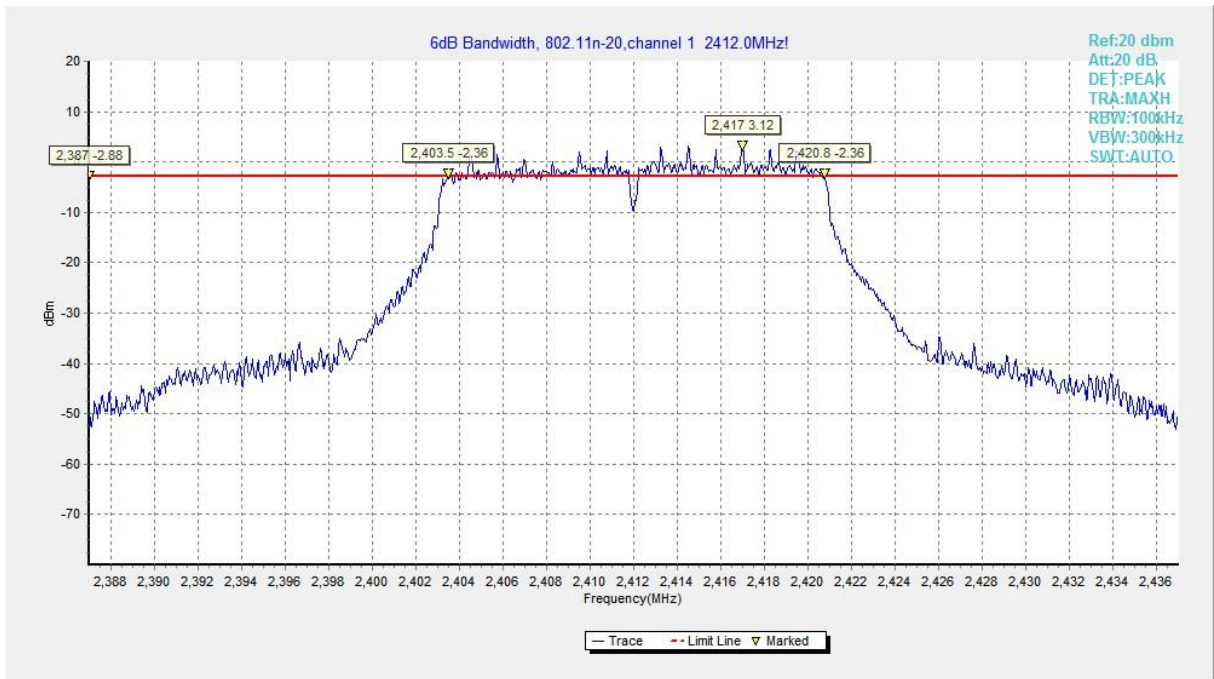


Fig.19 6dB Bandwidth (802.11n-HT20, CH1)

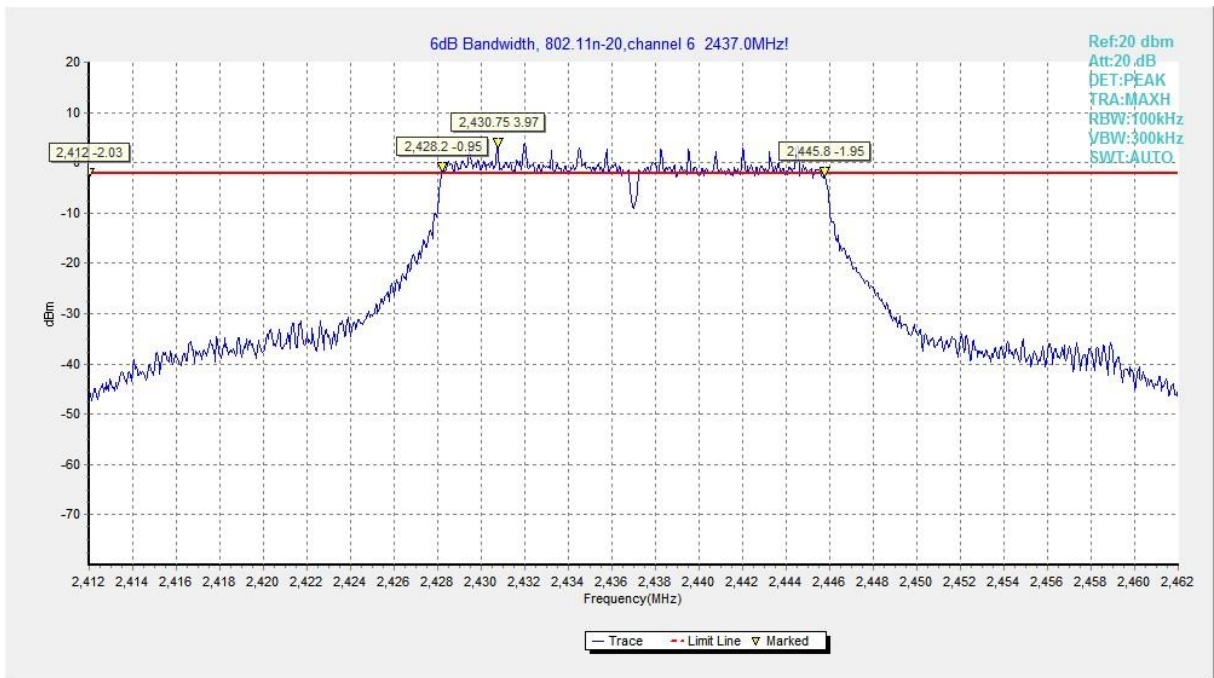


Fig.20 6dB Bandwidth (802.11n-HT20, CH6)

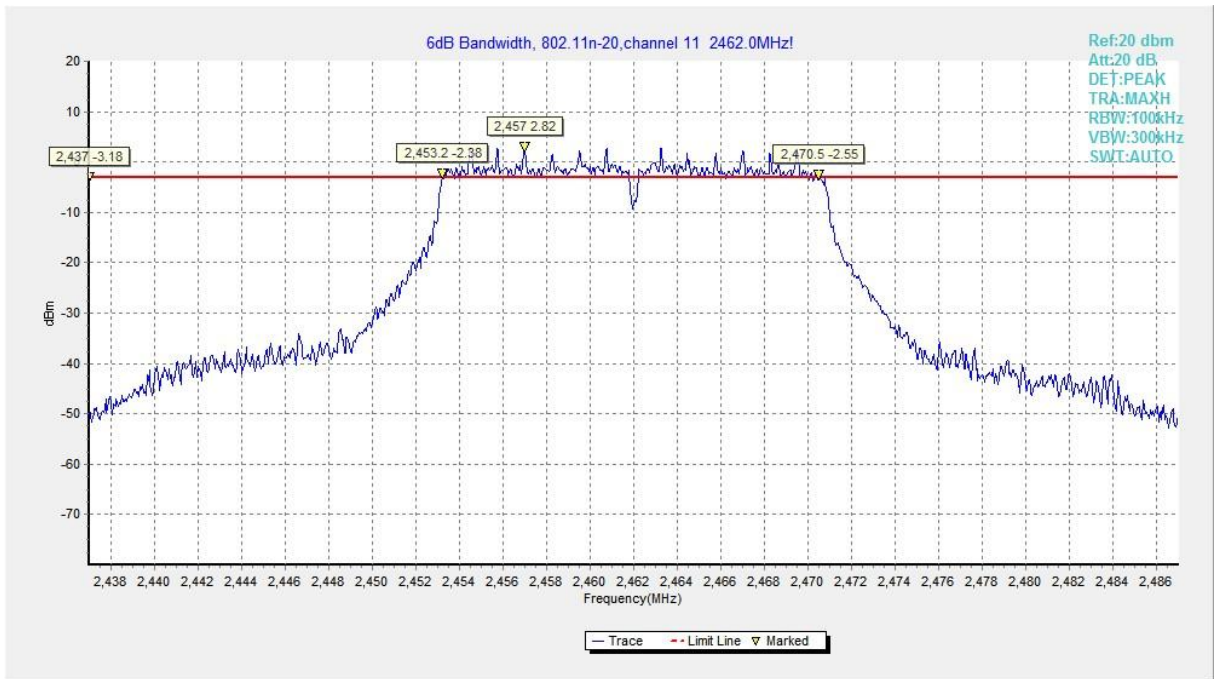


Fig.21 6dB Bandwidth (802.11n-HT20, CH11)

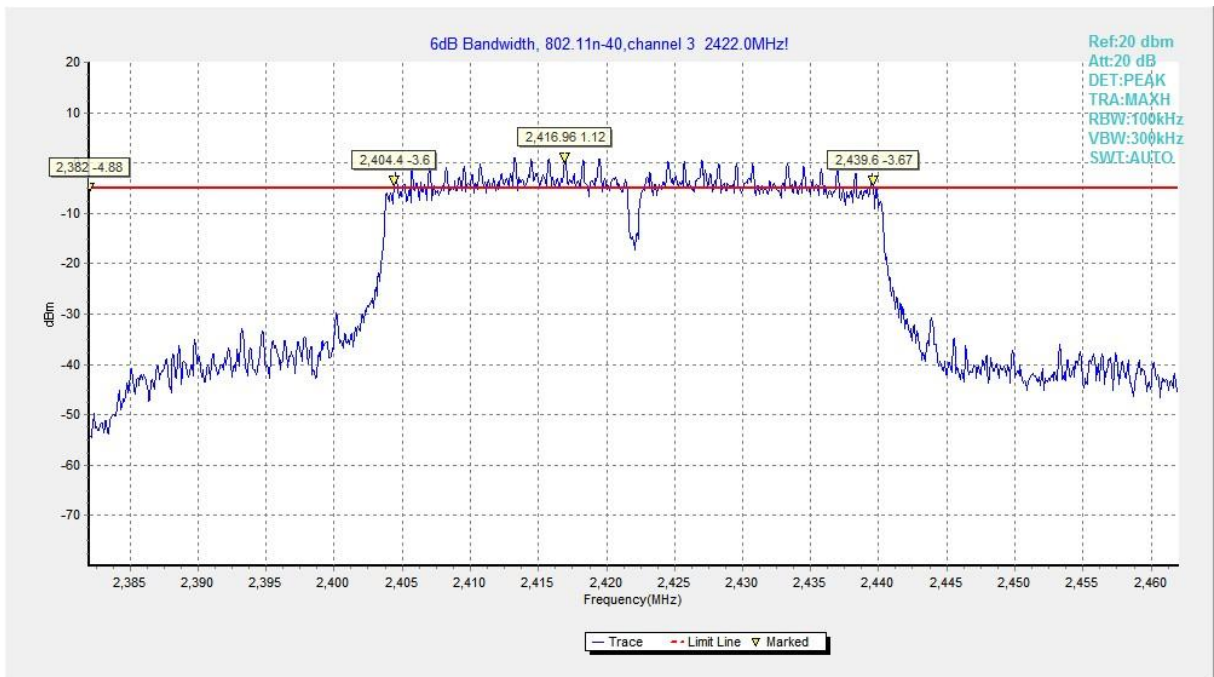


Fig.22 6dB Bandwidth (802.11n-HT40, CH3)

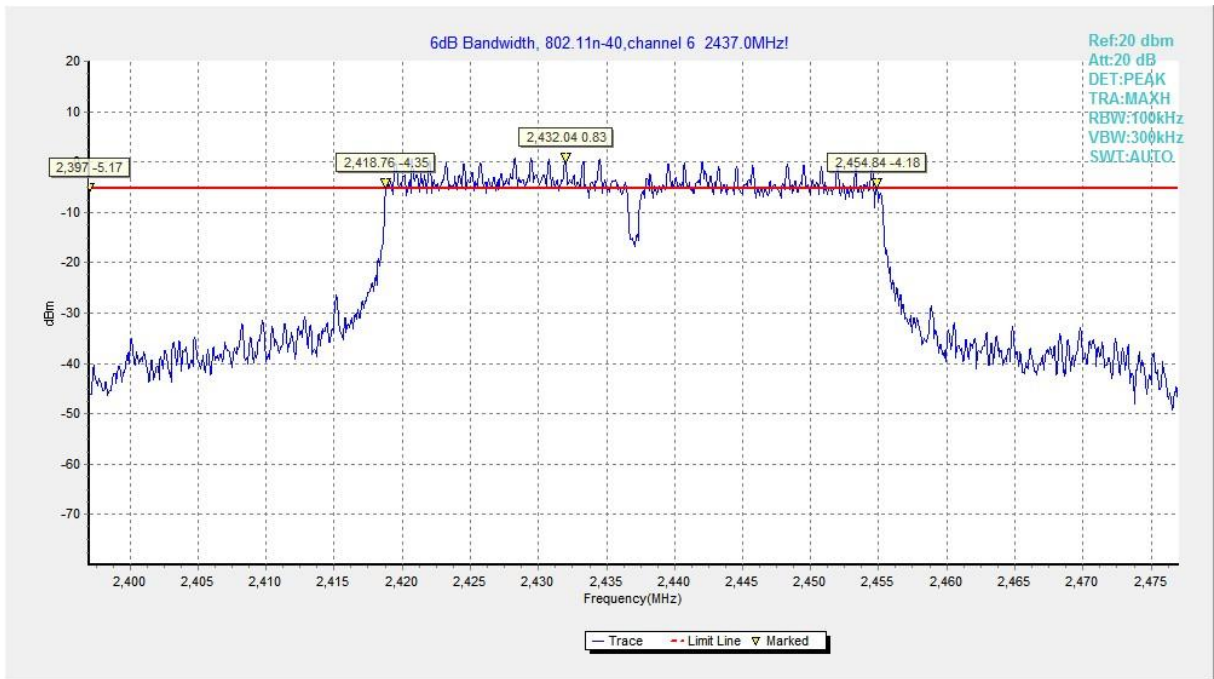


Fig.23 6dB Bandwidth (802.11n-HT40, CH6)

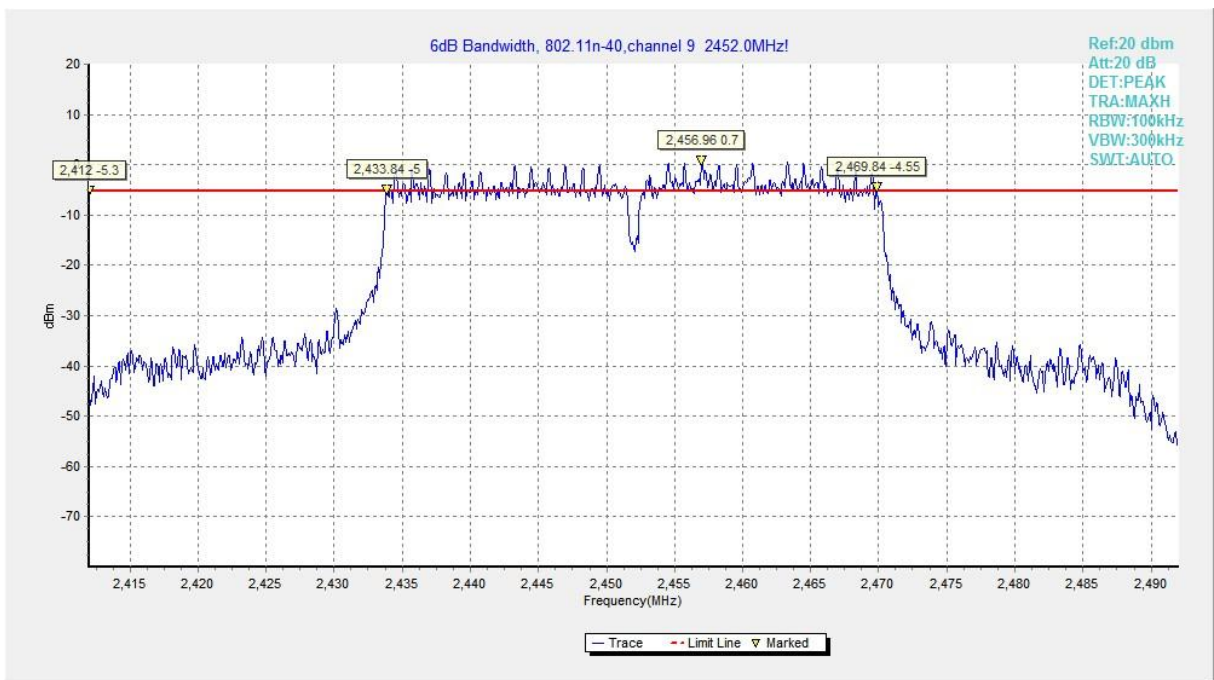


Fig.24 6dB Bandwidth (802.11n-HT40, CH9)





### A.4 Band Edges Compliance

**Method of Measurement: See ANSI C63.10-clause 11.13.3.**

**Measurement Limit:**

Standard	Limit (dBc)
FCC 47 CFR Part 15.247 (d)	> 30

**Measurement Result:**

Mode	Frequency (MHz)	Test Results (dBc)		Conclusion
802.11b	2412(CH1)	Fig.25	37.87	P
	2462(CH11)	Fig.26	63.33	P
802.11g	2412(CH1)	Fig.27	38.22	P
	2462(CH11)	Fig.28	51.37	P
802.11n-HT20	2412(CH1)	Fig.29	37.09	P
	2462(CH11)	Fig.30	47.99	P
802.11n-HT40	2422(CH3)	Fig.31	37.35	P
	2452(CH9)	Fig.32	44.16	P

**See below for test graphs.**

**Conclusion: PASS**

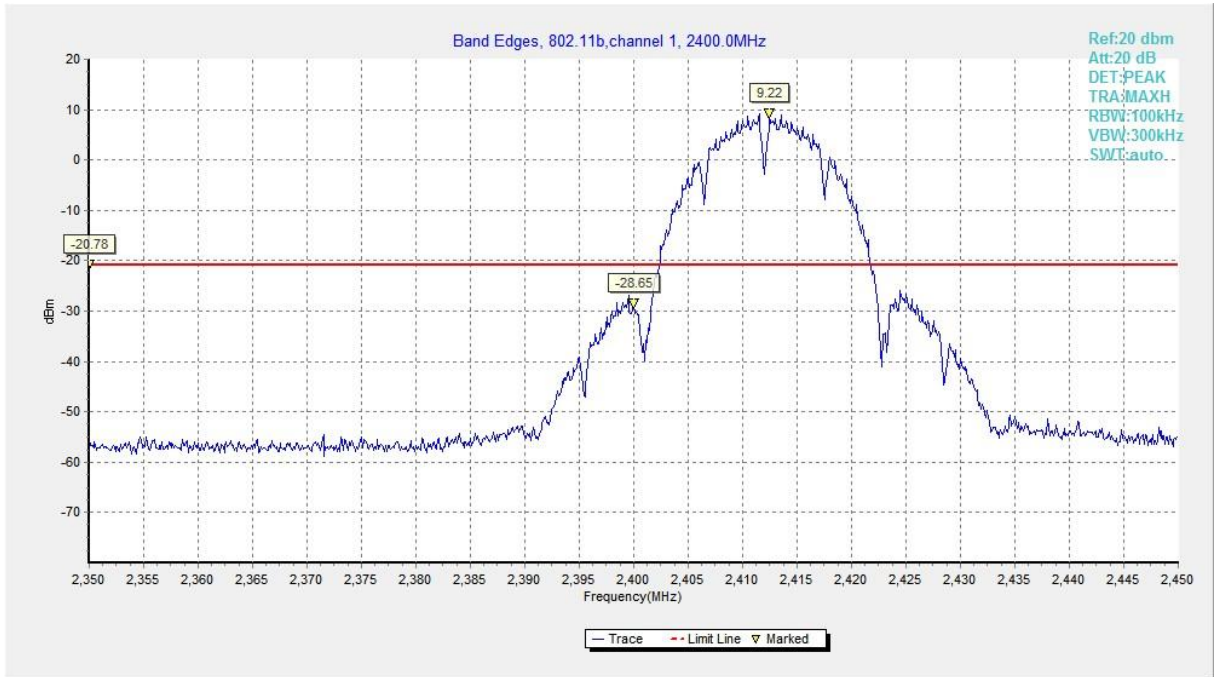


Fig.25 Band Edges (802.11b, CH1)

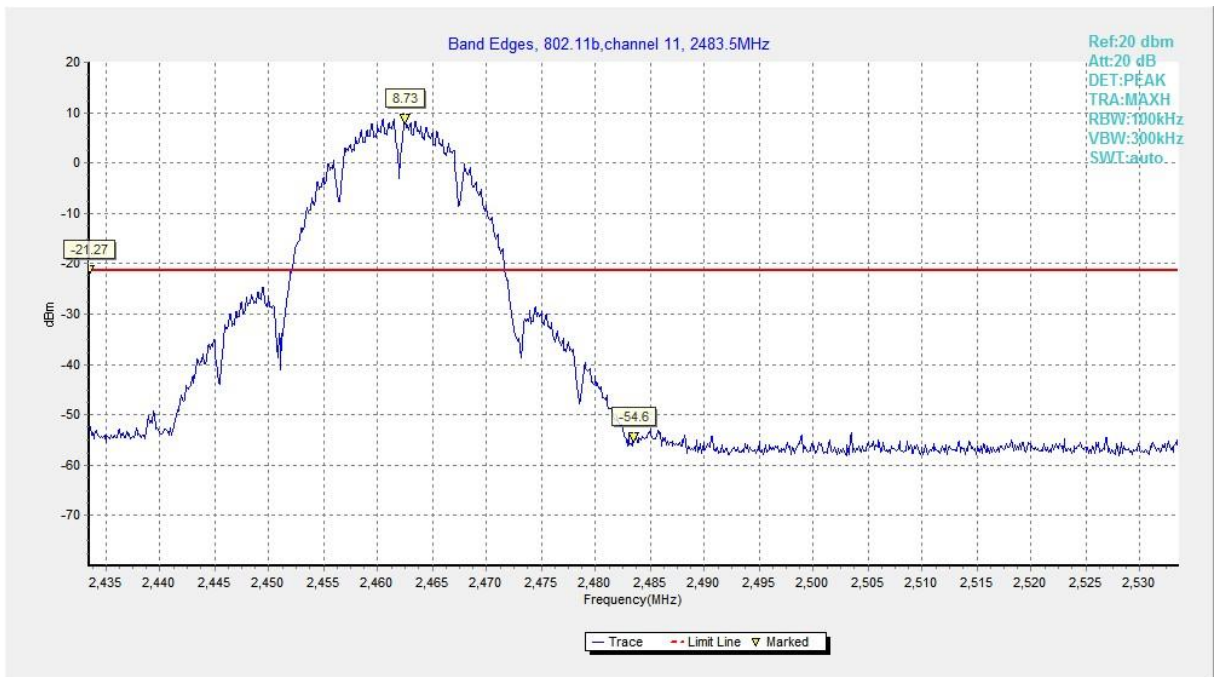


Fig.26 Band Edges (802.11b, CH11)



Fig.27 Band Edges (802.11g, CH1)

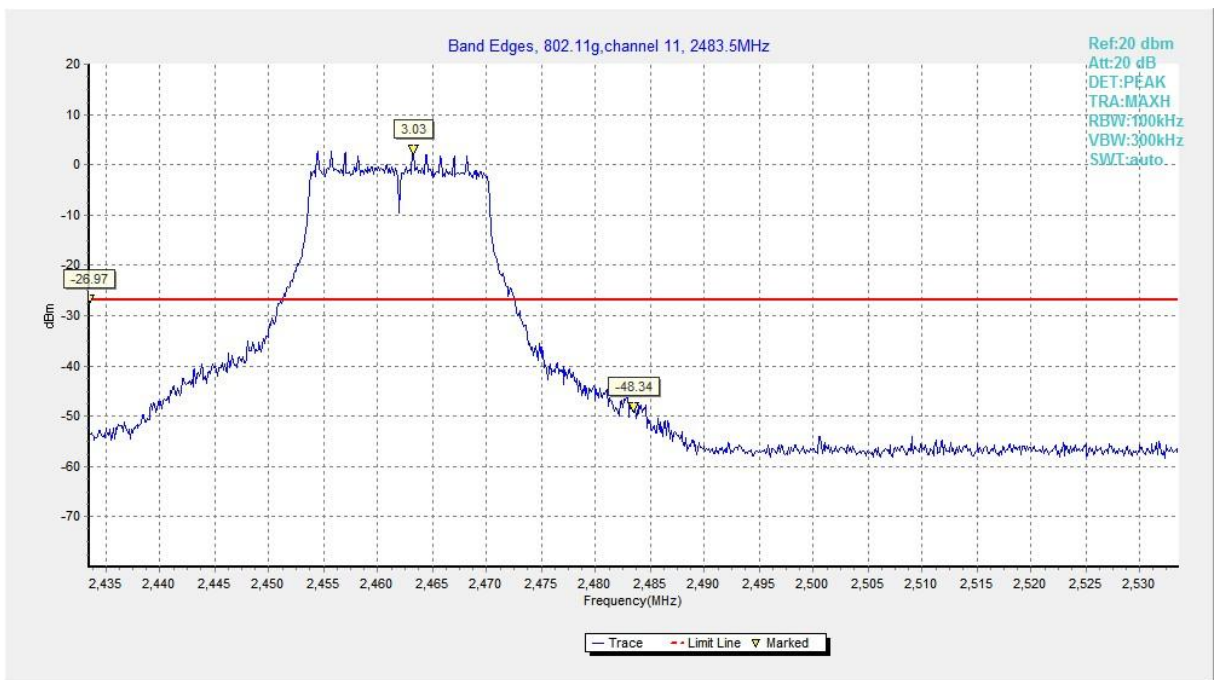


Fig.28 Band Edges (802.11g, CH11)

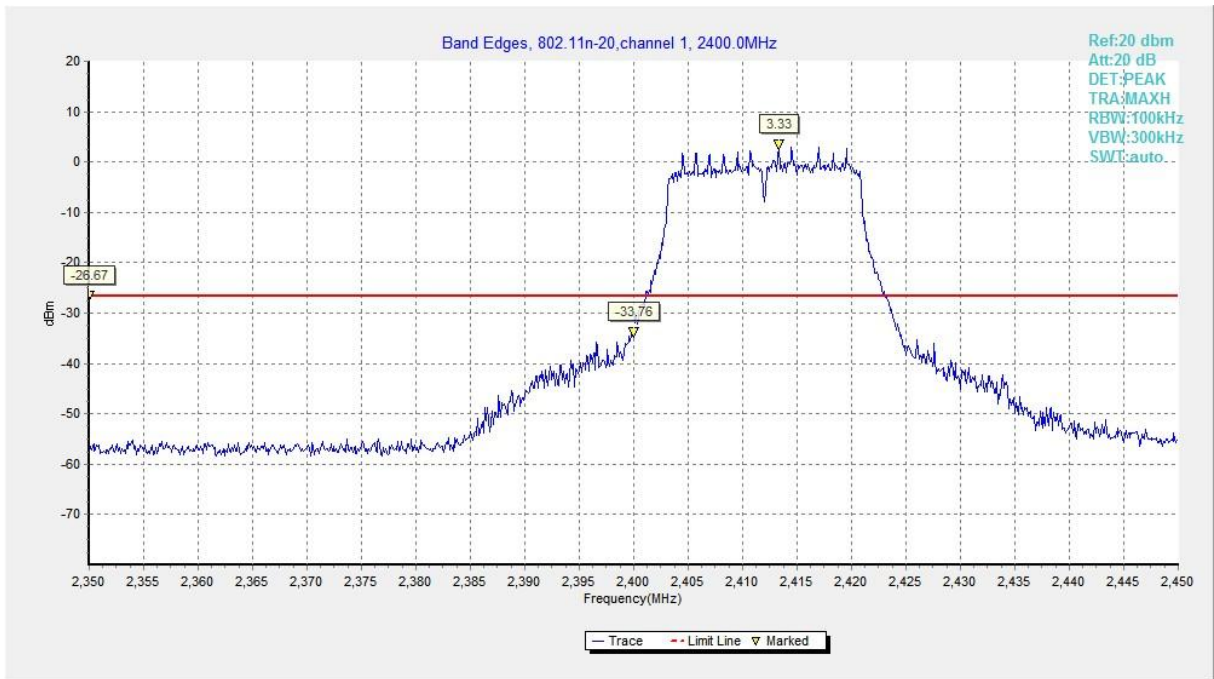


Fig.29 Band Edges (802.11n-HT20, CH1)

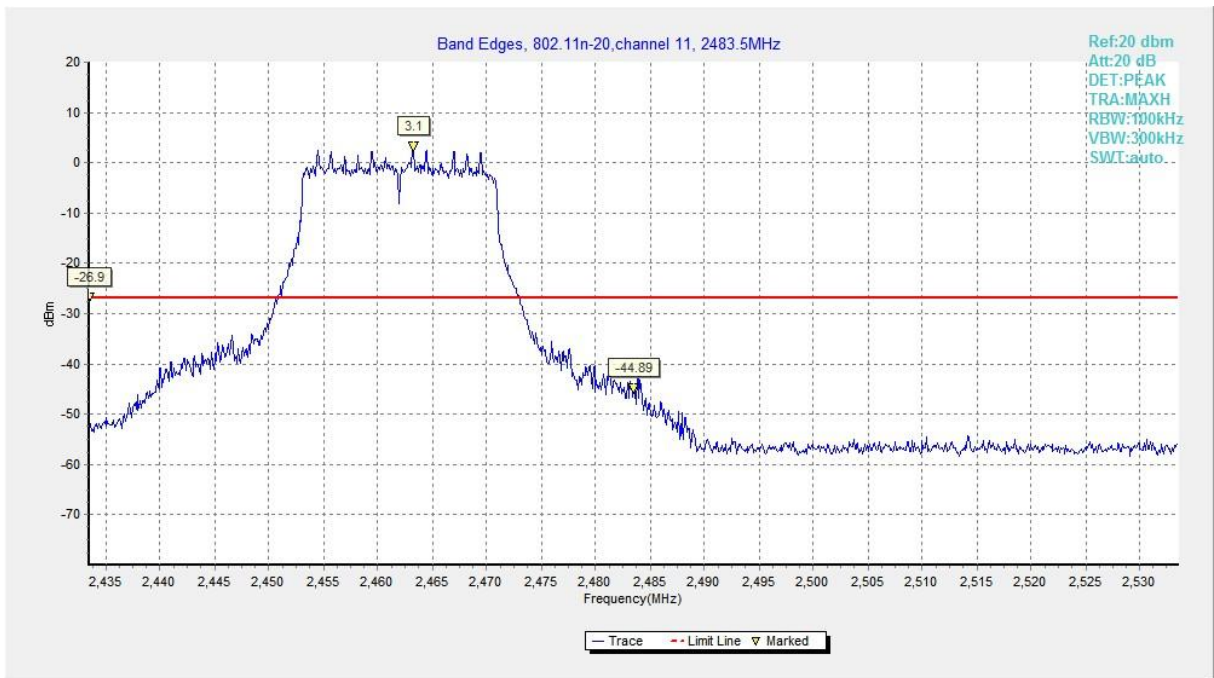


Fig.30 Band Edges (802.11n-HT20, CH11)

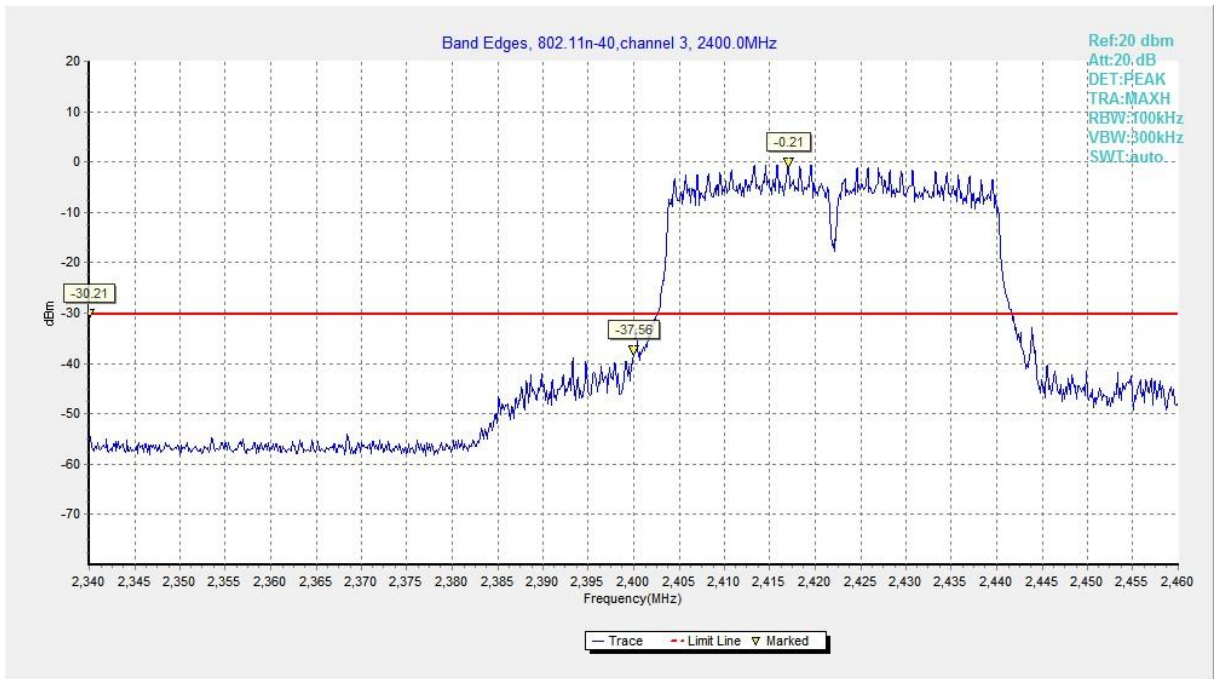


Fig.31 Band Edges (802.11n-HT40, CH3)

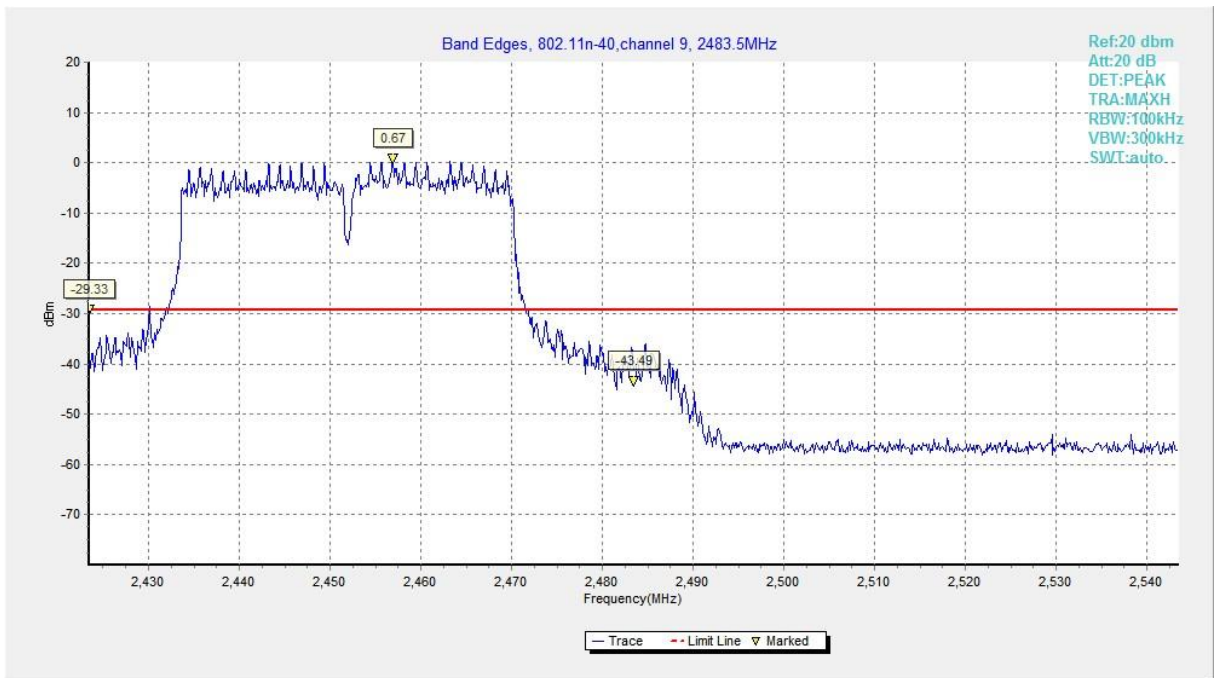


Fig.32 Band Edges (802.11n-HT40, CH9)



### A.5 Conducted Emission

**Method of Measurement: See ANSI C63.10-clause 11.11.**

**Measurement Limit:**

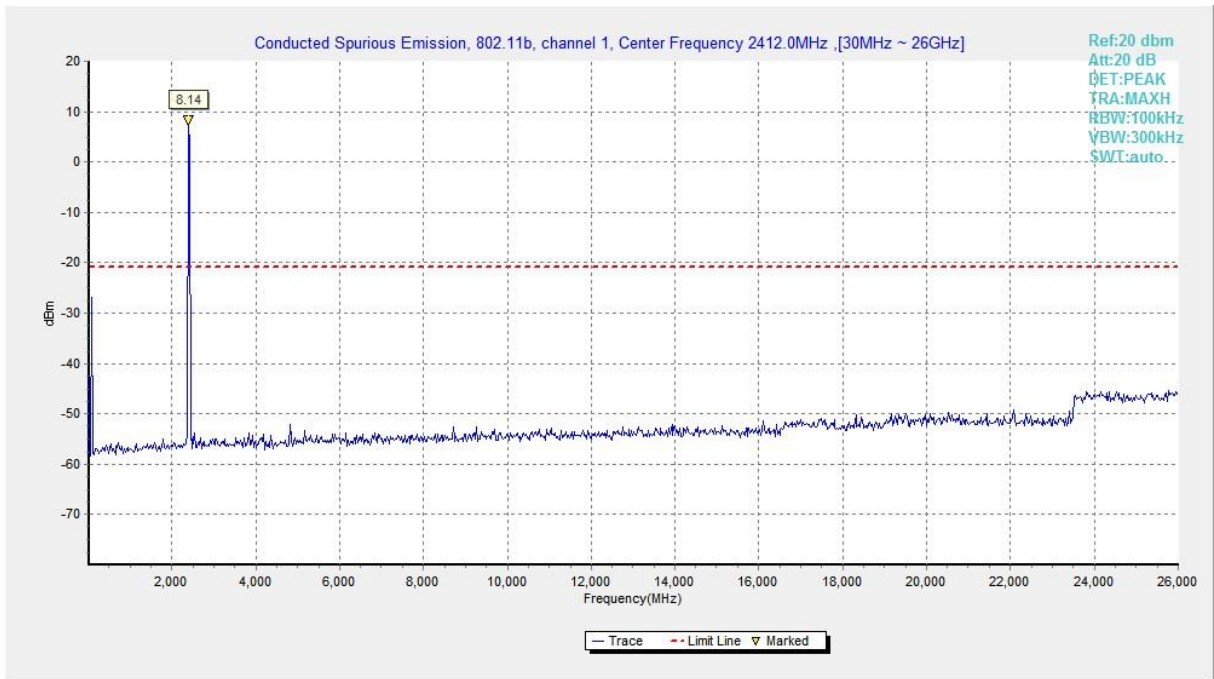
Standard	Limit (dBm)
FCC 47 CFR Part 15.247 (d)	30dBm below peak output power in 100kHz bandwidth

**Measurement Results:**

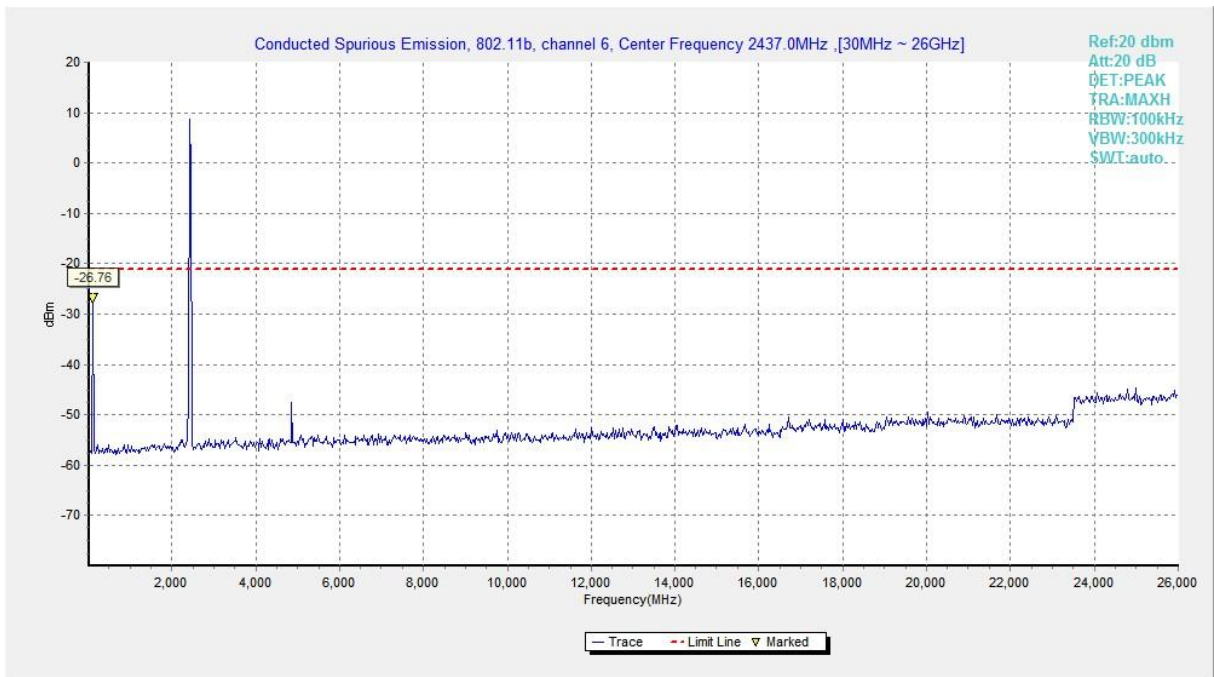
Mode	Frequency (MHz)	Frequency Range	Test Results	Conclusion
802.11b	2412(CH1)	30MHz-26GHz	Fig.33	<b>P</b>
	2437(CH6)	30MHz-26GHz	Fig.34	<b>P</b>
	2462(CH11)	30MHz-26GHz	Fig.35	<b>P</b>
802.11g	2412(CH1)	30MHz-26GHz	Fig.36	<b>P</b>
	2437(CH6)	30MHz-26GHz	Fig.37	<b>P</b>
	2462(CH11)	30MHz-26GHz	Fig.38	<b>P</b>
802.11n-HT20	2412(CH1)	30MHz-26GHz	Fig.39	<b>P</b>
	2437(CH6)	30MHz-26GHz	Fig.40	<b>P</b>
	2462(CH11)	30MHz-26GHz	Fig.41	<b>P</b>
802.11n-HT40	2422(CH3)	30MHz-26GHz	Fig.42	<b>P</b>
	2437(CH6)	30MHz-26GHz	Fig.43	<b>P</b>
	2452(CH9)	30MHz-26GHz	Fig.44	<b>P</b>

**See below for test graphs.**

**Conclusion: PASS**



**Fig.33 Conducted Spurious Emission (802.11b, CH1)**



**Fig.34 Conducted Spurious Emission (802.11b, CH6)**

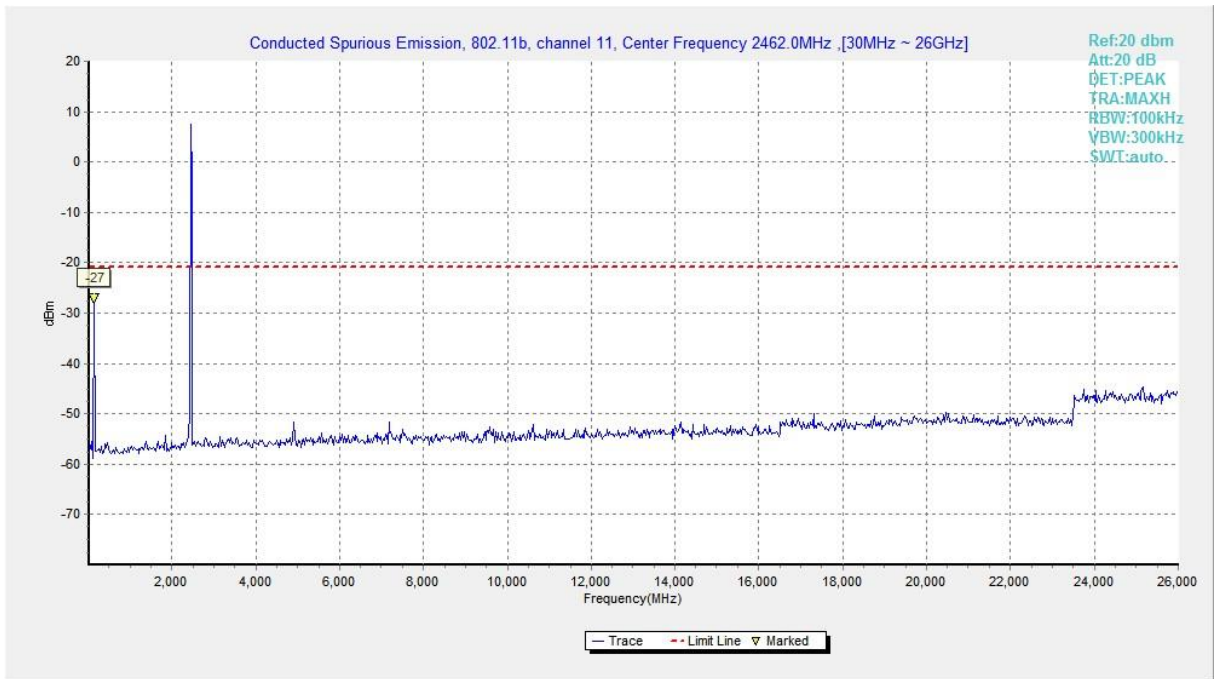


Fig.35 Conducted Spurious Emission (802.11b, CH11)

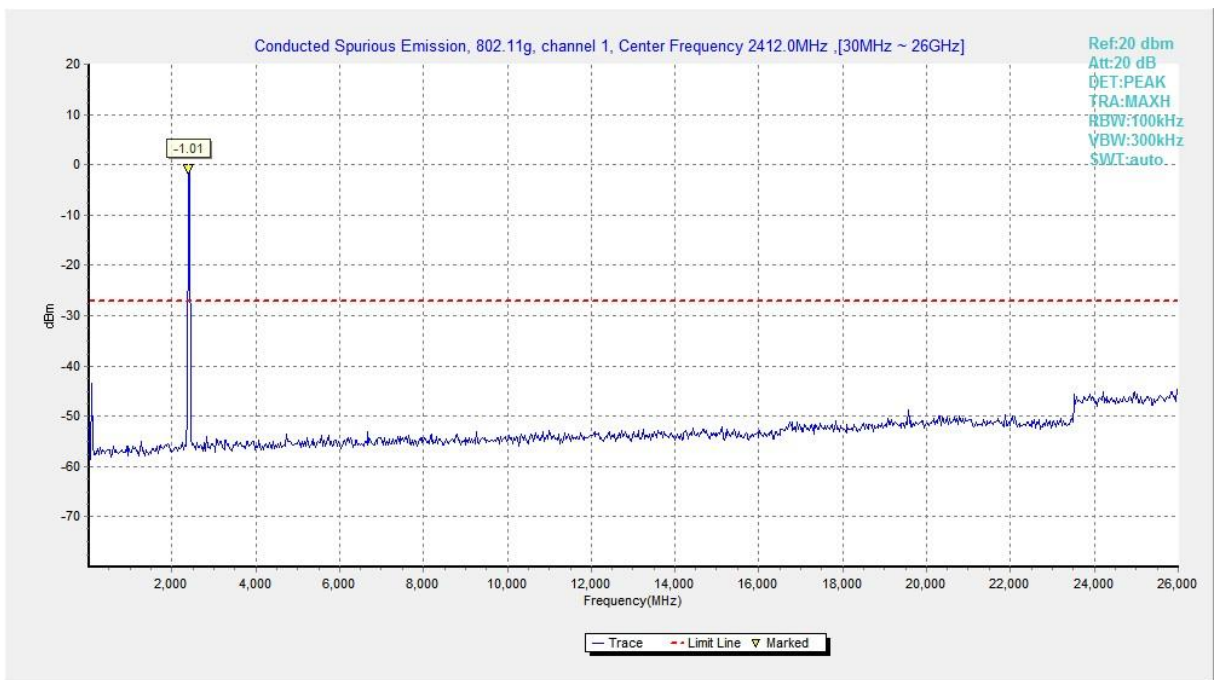


Fig.36 Conducted Spurious Emission (802.11g, CH1)



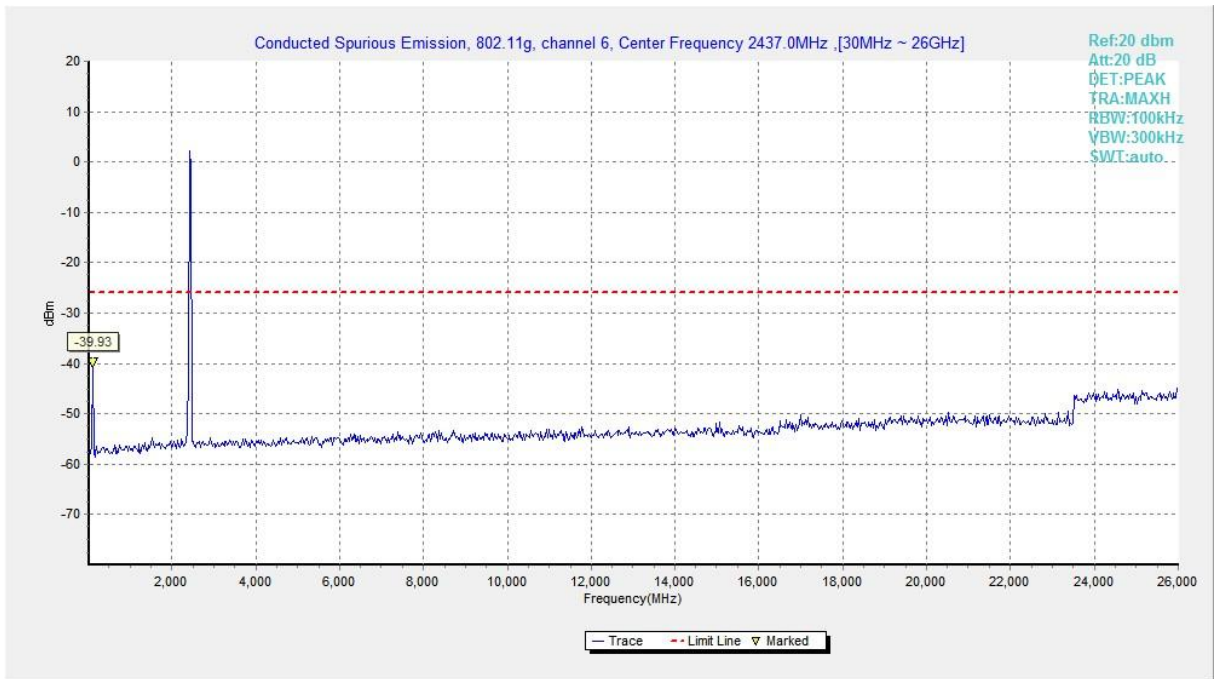


Fig.37 Conducted Spurious Emission (802.11g, CH6)

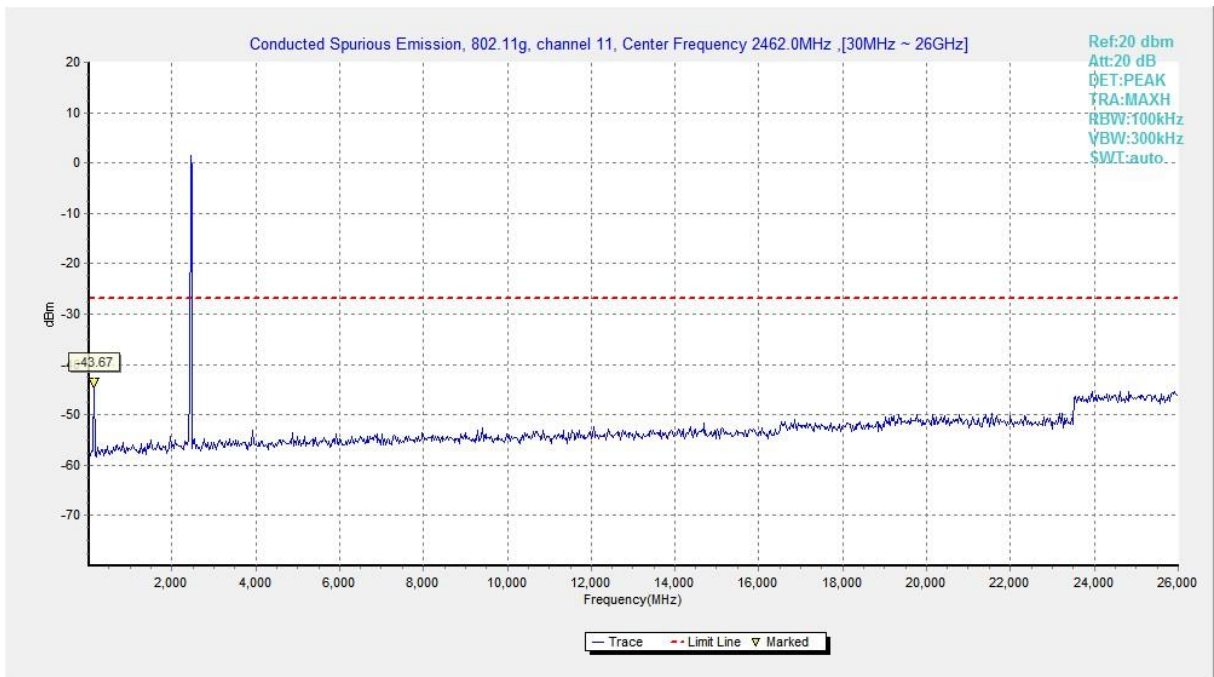


Fig.38 Conducted Spurious Emission (802.11g, CH11)

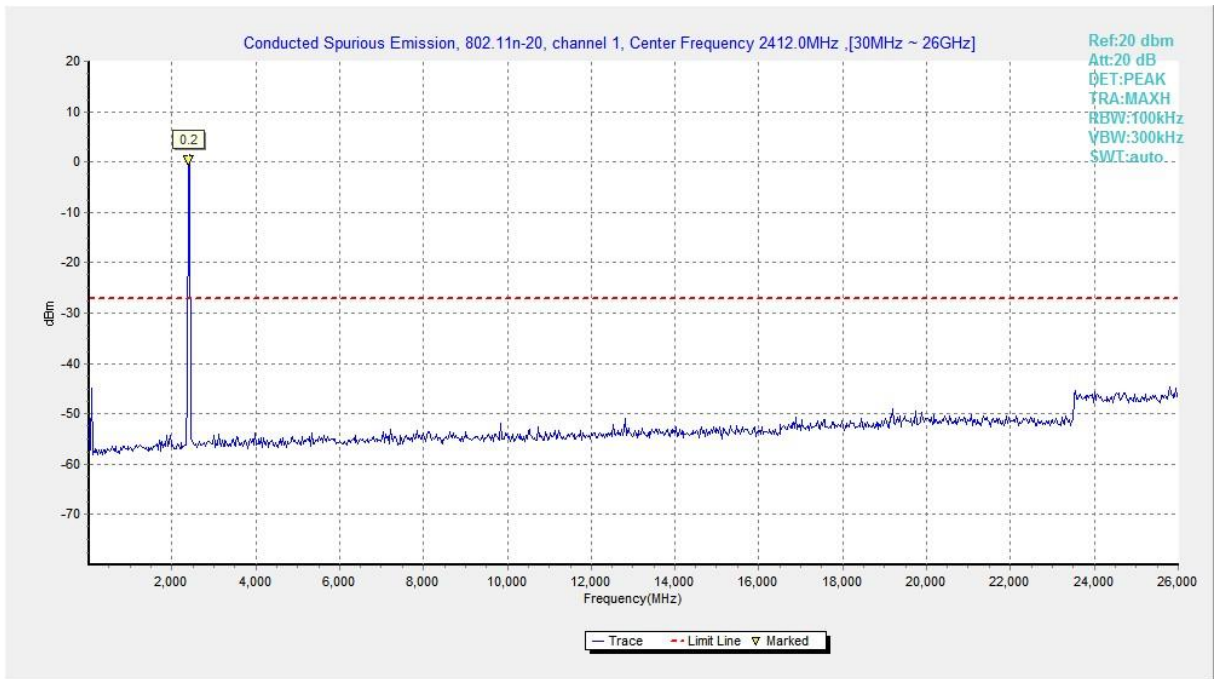


Fig.39 Conducted Spurious Emission (802.11n-HT20, CH1)

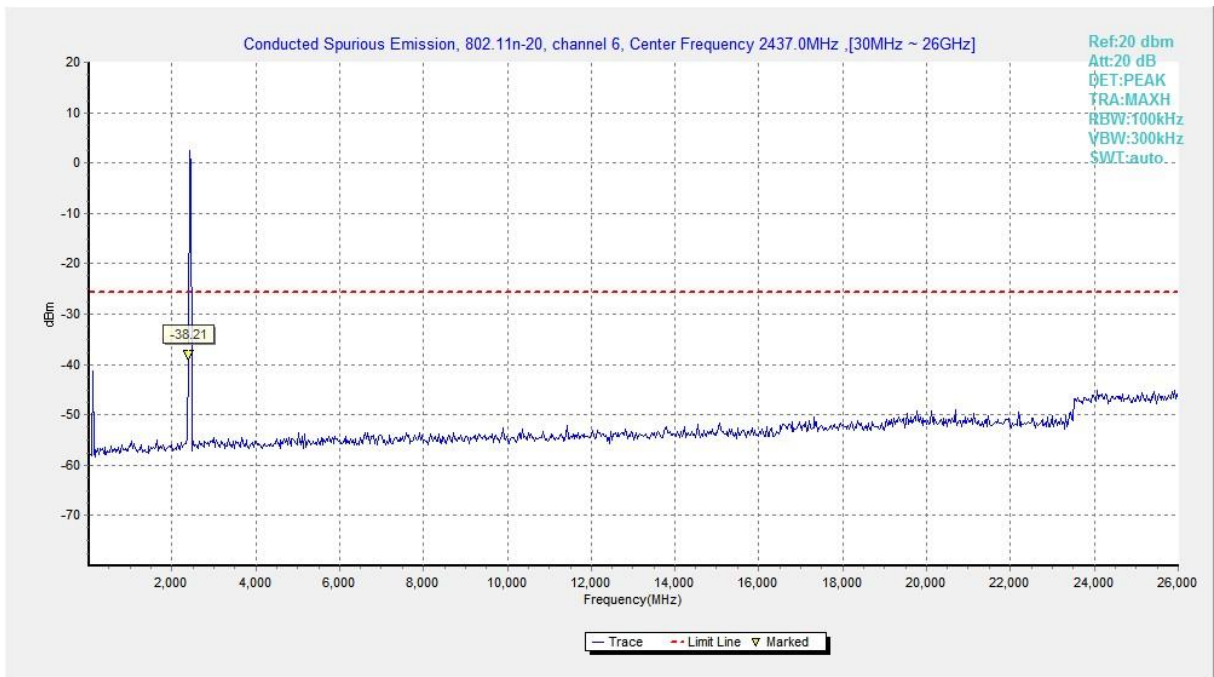


Fig.40 Conducted Spurious Emission (802.11n-HT20, CH6)

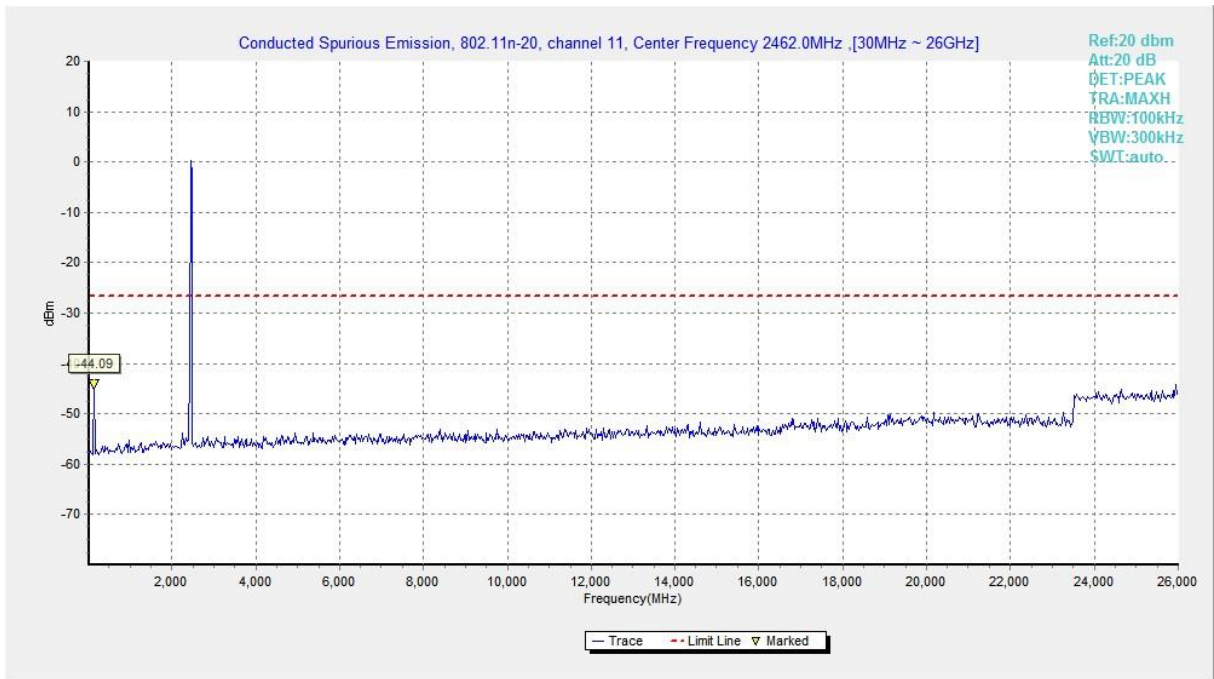


Fig.41 Conducted Spurious Emission (802.11n-HT20, CH11)

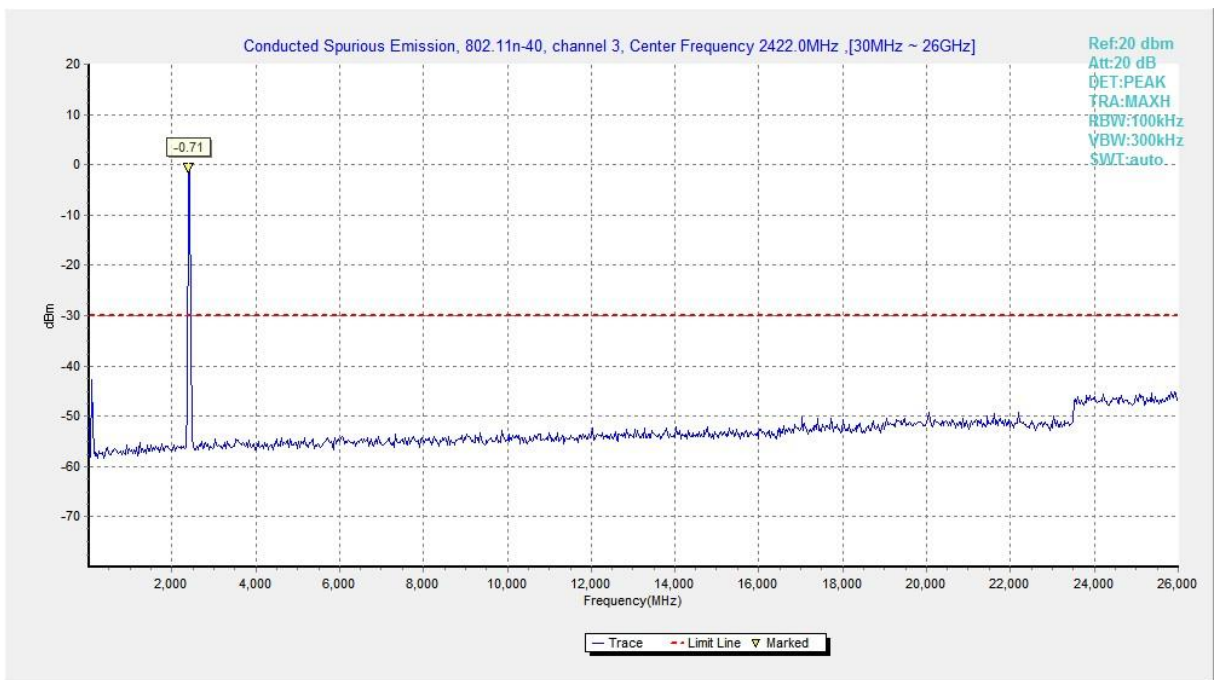


Fig.42 Conducted Spurious Emission (802.11n-HT40, CH3)

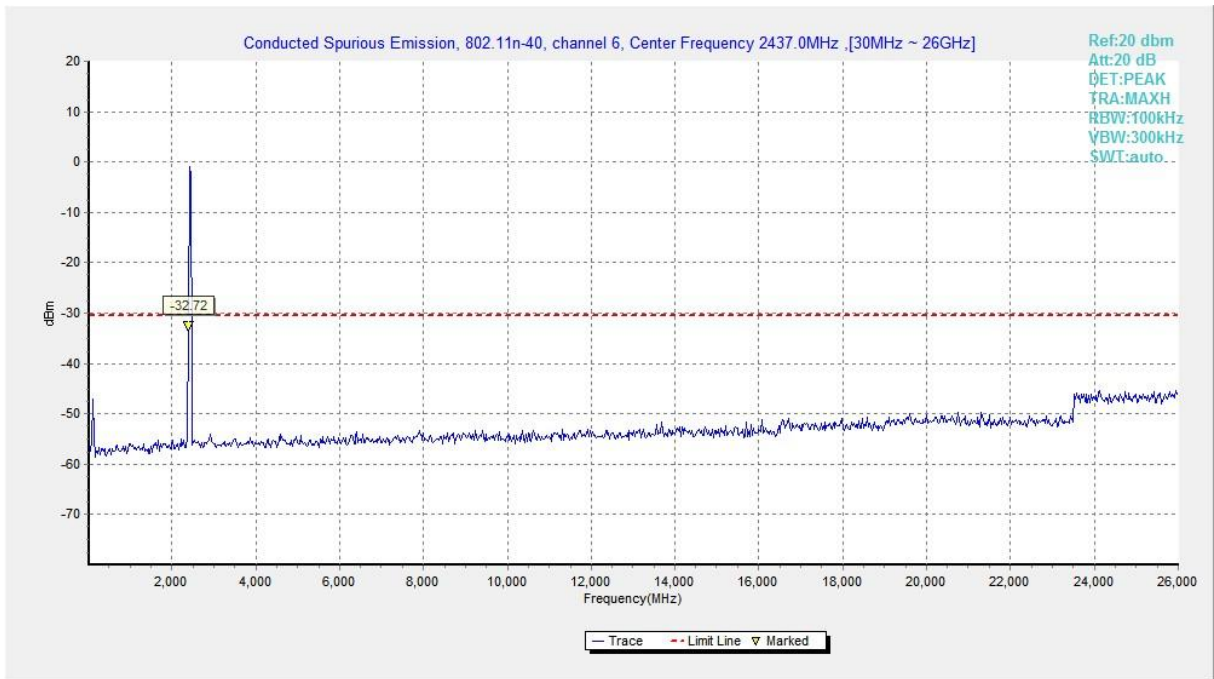


Fig.43 Conducted Spurious Emission (802.11n-HT40, CH6)

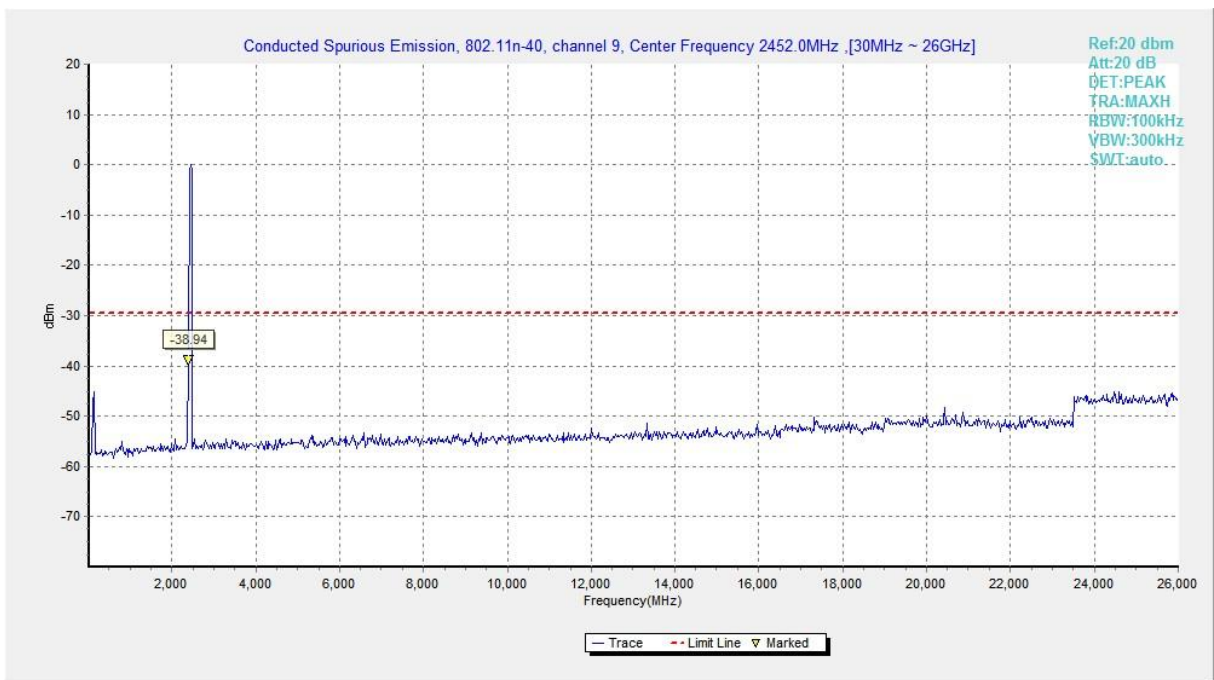


Fig.44 Conducted Spurious Emission (802.11n-HT40, CH9)



## A.6 Radiated Emission

**Method of Measurement: See ANSI C63.10-clause 11.11&11.12.**

**Measurement Limit:**

Standard	Limit (dBm)
FCC 47 CFR Part 15.247, 15.205, 15.209	20dBm below peak output power

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)).

**Limit in restricted band:**

Frequency of emission (MHz)	Field strength( $\mu$ V/m)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

**Test Condition:**

The EUT was placed on a non-conductive table. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

Frequency of emission (MHz)	RBW/VBW	Sweep Time(s)
30-1000	120kHz/300kHz	5
1000-4000	1MHz/3MHz	15
4000-18000	1MHz/3MHz	40
18000-26500	1MHz/3MHz	20

**Note:** According to the performance evaluation, the radiated emission margin of EUT is over 20dB in the band from 9kHz to 30MHz. Therefore, the measurement starts from 30MHz to tenth harmonic. The measurement results include the horizontal polarization and vertical polarization measurements. For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Y plane) were recorded in this report.



**Measurement Results:**

**SISO:**

Mode	Frequency (MHz)	Frequency Range	Test Results	Conclusion
802.11b	2412(CH1)	1 GHz ~18 GHz	Fig.45	P
	2437(CH6)	1 GHz ~18 GHz	Fig.46	P
	2462(CH11)	1 GHz ~18 GHz	Fig.47	P
	Restricted Band (CH1)	2.38 GHz ~ 2.45 GHz	Fig.48	P
	Restricted Band (CH11)	2.45 GHz ~ 2.5 GHz	Fig.49	P
802.11g	2412(CH1)	1 GHz ~18 GHz	Fig.50	P
	2437(CH6)	1 GHz ~18 GHz	Fig.51	P
	2462(CH11)	1 GHz ~18 GHz	Fig.52	P
	Restricted Band (CH1)	2.38 GHz ~ 2.45 GHz	Fig.53	P
	Restricted Band (CH11)	2.45 GHz ~ 2.5 GHz	Fig.54	P
802.11n- HT20	2412(CH1)	1 GHz ~18 GHz	Fig.55	P
	2437(CH6)	1 GHz ~18 GHz	Fig.56	P
	2462(CH11)	1 GHz ~18 GHz	Fig.57	P
	Restricted Band (CH1)	2.38 GHz ~ 2.45 GHz	Fig.58	P
	Restricted Band (CH11)	2.45 GHz ~ 2.5 GHz	Fig.59	P
802.11n- HT40	2422(CH3)	1 GHz ~18 GHz	Fig.60	P
	2437(CH6)	1 GHz ~18 GHz	Fig.61	P
	2452(CH9)	1 GHz ~18 GHz	Fig.62	P
	Restricted Band (CH3)	2.38 GHz ~ 2.45 GHz	Fig.63	P
	Restricted Band (CH9)	2.45 GHz ~ 2.5 GHz	Fig.64	P
/	All Channels	9 kHz ~30 MHz	Fig.65	P
		30 MHz ~1 GHz	Fig.66	P
		18 GHz ~26.5 GHz	Fig.67	P

**MIMO:**

Mode	Frequency (MHz)	Frequency Range	Test Results	Conclusion
802.11n- HT20	2412(CH1)	1 GHz ~18 GHz	Fig.68	P
	2437(CH6)	1 GHz ~18 GHz	Fig.69	P
	2462(CH11)	1 GHz ~18 GHz	Fig.70	P
	Restricted Band (CH1)	2.38 GHz ~ 2.45 GHz	Fig.71	P
	Restricted Band (CH11)	2.45 GHz ~ 2.5 GHz	Fig.72	P
802.11n- HT40	2422(CH3)	1 GHz ~18 GHz	Fig.73	P
	2437(CH6)	1 GHz ~18 GHz	Fig.74	P
	2452(CH9)	1 GHz ~18 GHz	Fig.75	P
	Restricted Band (CH3)	2.38 GHz ~ 2.45 GHz	Fig.76	P
	Restricted Band (CH9)	2.45 GHz ~ 2.5 GHz	Fig.77	P
/	All Channels	9 kHz ~30 MHz	Fig.78	P
		30 MHz ~1 GHz	Fig.79	P
		18 GHz ~26.5 GHz	Fig.80	P



**Worst-Case Result:**

**SISO:**

**802.11b CH11 (1-18GHz)**

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB/m)
4924.500000	48.05	74.00	25.95	H	3.7
8241.000000	45.62	74.00	28.38	H	5.9
9847.714286	51.34	74.00	22.66	H	7.7
14869.285714	50.41	74.00	23.59	V	13.0
16836.428571	54.76	74.00	19.24	H	17.9
17919.428571	54.96	74.00	19.04	H	18.9

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB/m)
4924.500000	38.05	54.00	15.95	H	3.7
8241.000000	35.01	54.00	18.99	H	5.9
9847.714286	46.61	54.00	7.39	H	7.7
14869.285714	38.15	54.00	15.85	V	13.0
16836.428571	41.82	54.00	12.18	H	17.9
17919.428571	42.61	54.00	11.39	H	18.9

**802.11g CH6 (1GHz-18GHz)**

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB/m)
9747.857143	51.95	74.00	22.05	H	7.5
11495.571429	47.81	74.00	26.19	H	10.1
13068.857143	47.36	74.00	26.64	H	10.8
14898.857143	51.78	74.00	22.22	V	13.0
16610.142857	53.73	74.00	20.27	H	16.9
17952.857143	54.57	74.00	19.43	H	19.0

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB/m)
9747.857143	48.17	54.00	5.83	H	7.5
11495.571429	37.41	54.00	16.59	H	10.1
13068.857143	36.82	54.00	17.18	H	10.8
14898.857143	38.25	54.00	15.75	V	13.0
16610.142857	41.36	54.00	12.64	H	16.9
17952.857143	42.50	54.00	11.50	H	19.0



**802.11n-HT20 CH6 (1GHz-18GHz)**

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB/m)
5753.100000	47.38	74.00	26.62	V	4.0
7032.428572	44.64	74.00	29.36	H	5.1
9747.857143	53.18	74.00	20.82	H	7.5
14840.142857	51.10	74.00	22.90	H	13.0
17091.428571	54.62	74.00	19.38	H	18.5
17987.571429	55.63	74.00	18.37	H	19.2

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB/m)
5753.100000	37.11	54.00	16.89	V	4.0
7032.428572	34.54	54.00	19.46	H	5.1
9747.857143	49.42	54.00	4.58	H	7.5
14840.142857	37.66	54.00	16.34	H	13.0
17091.428571	42.10	54.00	11.90	H	18.5
17987.571429	42.77	54.00	11.23	H	19.2

**802.11n-HT40 CH6 (1GHz-18GHz)**

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB/m)
5454.000000	47.59	74.00	26.41	V	3.8
7823.142857	44.30	74.00	29.70	V	5.9
10442.571429	47.40	74.00	26.60	H	9.0
13255.714286	47.68	74.00	26.32	H	11.1
16948.285714	54.62	74.00	19.38	H	18.2
17917.714286	55.33	74.00	18.67	V	18.9

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pol	Corr. (dB/m)
5454.000000	34.79	54.00	19.21	V	3.8
7823.142857	31.95	54.00	22.05	V	5.9
10442.571429	34.91	54.00	19.09	H	9.0
13255.714286	35.51	54.00	18.49	H	11.1
16948.285714	42.14	54.00	11.86	H	18.2
17917.714286	42.66	54.00	11.34	V	18.9





**MIMO:**

**802.11n-HT20 CH6 (1GHz-18GHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB/m)
5763.000000	49.08	74.00	24.92	V	4.1
7080.857143	45.21	74.00	28.79	H	5.3
9747.857143	50.00	74.00	24.00	V	7.5
12460.714286	49.47	74.00	24.53	V	11.4
16968.857143	54.13	74.00	19.87	H	18.3
17969.142857	54.68	74.00	19.32	V	19.1

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB/m)
5763.000000	36.06	54.00	17.94	V	4.1
7080.857143	32.92	54.00	21.08	H	5.3
9747.857143	43.75	54.00	10.25	V	7.5
12460.714286	36.11	54.00	17.89	V	11.4
16968.857143	41.84	54.00	12.16	H	18.3
17969.142857	42.40	54.00	11.60	V	19.1

**802.11n-HT40 CH6 (1GHz-18GHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB/m)
5811.900000	48.81	74.00	25.19	V	4.5
7628.571429	45.20	74.00	28.80	V	5.7
9747.857143	50.35	74.00	23.65	H	7.5
12895.285714	48.50	74.00	25.50	V	11.0
17004.000000	54.09	74.00	19.91	H	18.4
17934.428571	55.05	74.00	18.95	H	19.0

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Pol	Corr. (dB/m)
5811.900000	36.21	54.00	17.79	V	4.5
7628.571429	32.77	54.00	21.23	V	5.7
9747.857143	44.91	54.00	9.09	H	7.5
12895.285714	36.35	54.00	17.65	V	11.0
17004.000000	41.74	54.00	12.26	H	18.4
17934.428571	42.54	54.00	11.46	H	19.0

**Note:**

A "reference path loss" is established and the  $A_{Rpl}$  is the attenuation of "reference path loss", and Antenna Factor, the gain of the preamplifier, the cable loss.  $P_{Mea}$  is the field strength recorded from the instrument. The measurement results are obtained as described below:

Result=  $P_{Mea}$  +Cable Loss +Antenna Factor-Gain of the preamplifier.



See below for test graphs.  
Conclusion: PASS

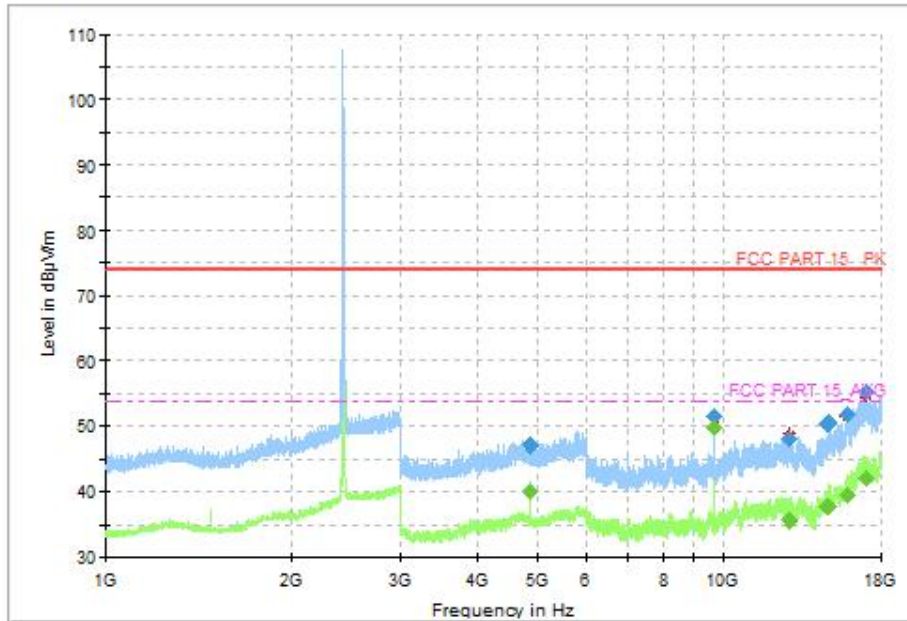


Fig.45 Radiated Spurious Emission (802.11b, CH1, 1GHz-18GHz)

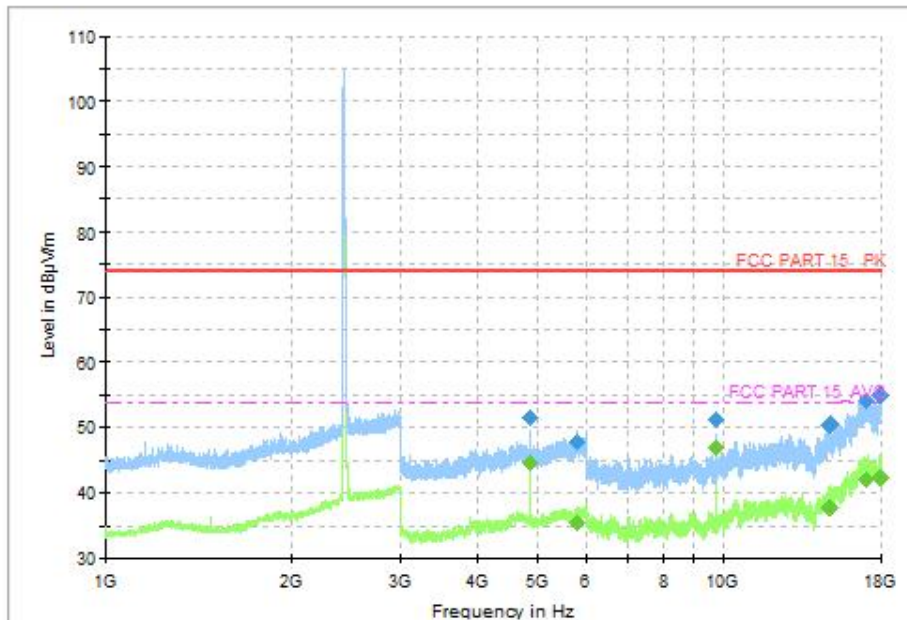


Fig.46 Radiated Spurious Emission (802.11b, CH6, 1GHz-18GHz)

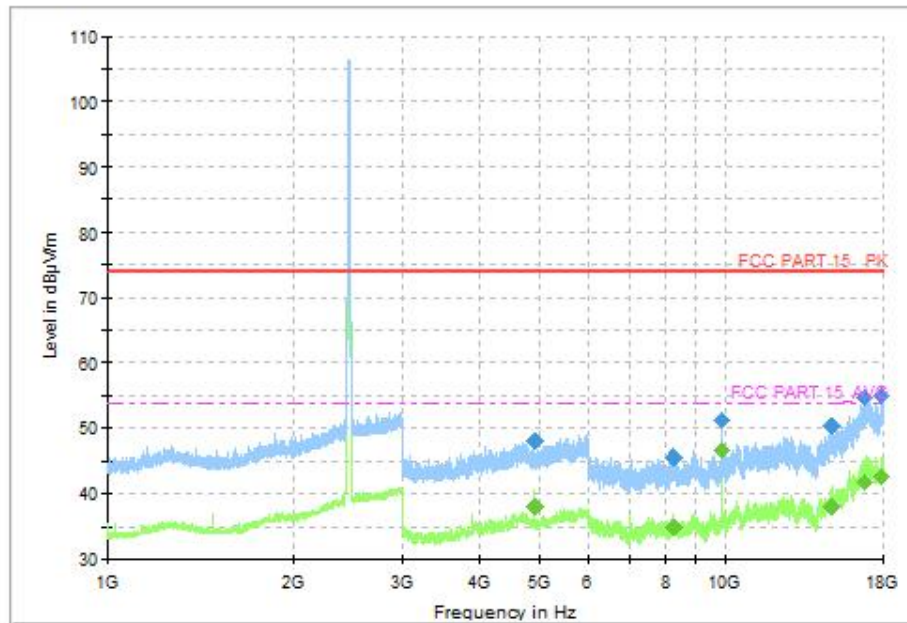


Fig.47 Radiated Spurious Emission (802.11b, CH11, 1GHz-18GHz)

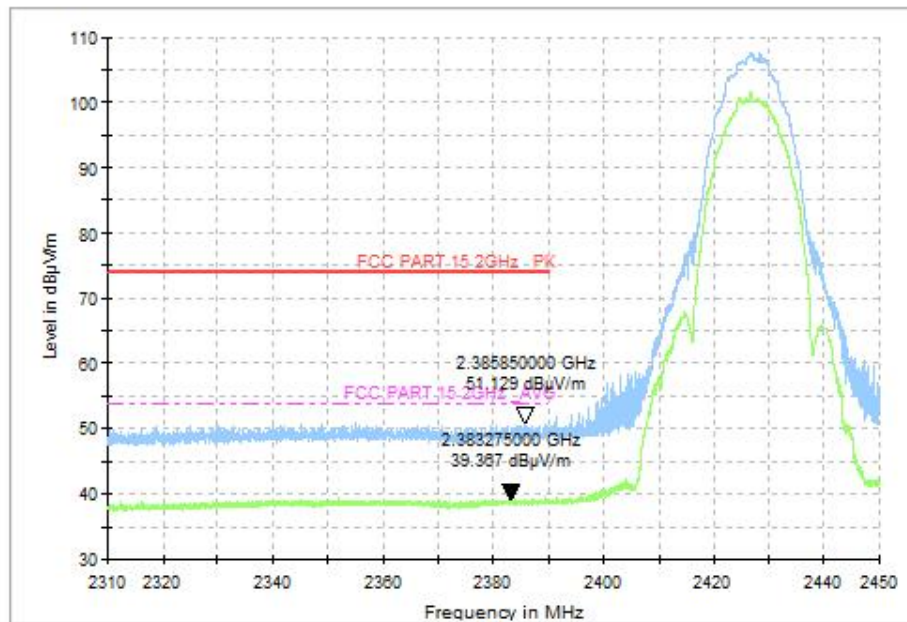


Fig.48 Radiated Restricted Band (802.11b, CH1, 2.38GHz~2.45GHz)

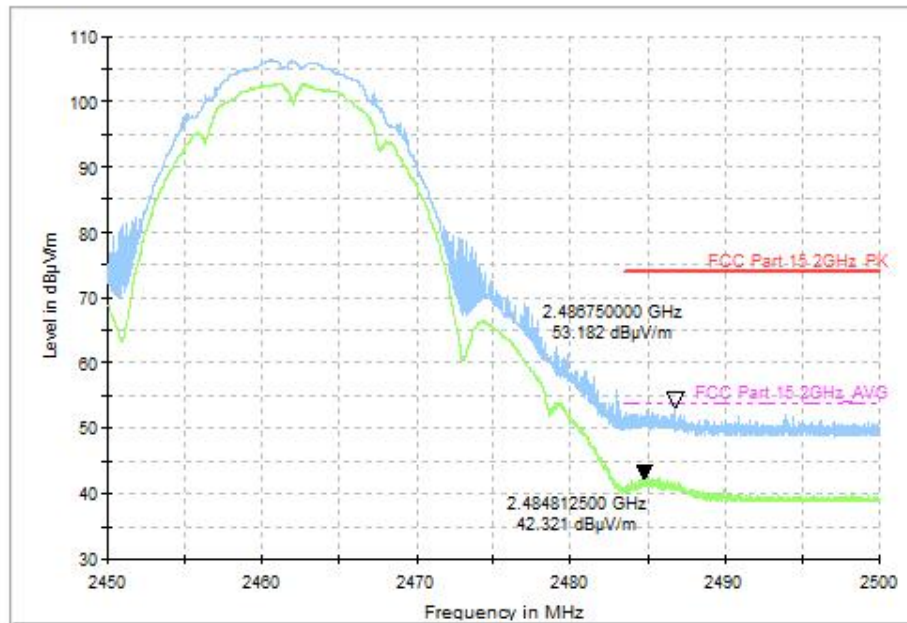


Fig.49 Radiated Restricted Band (802.11b, CH11, 2.45GHz~2.50GHz)

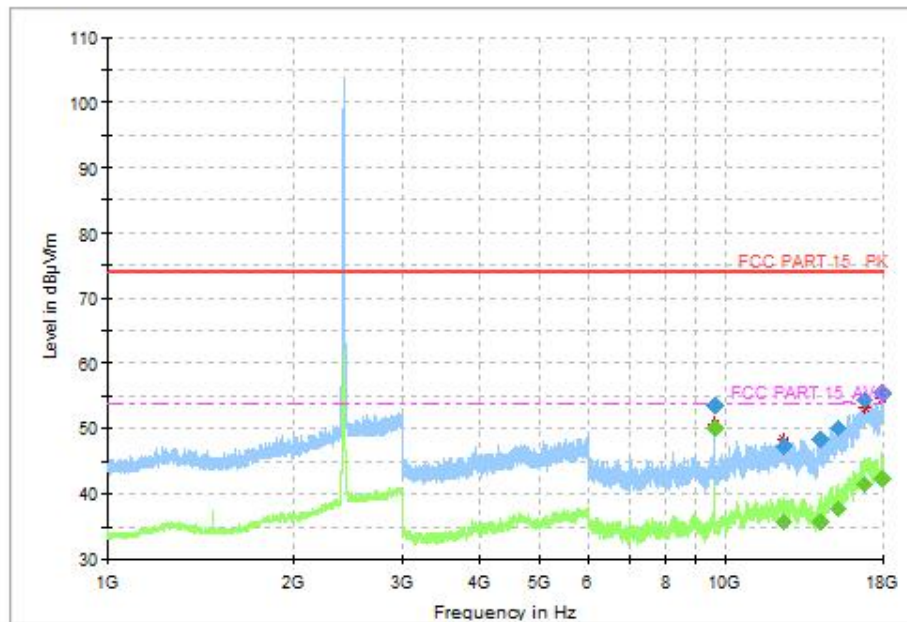


Fig.50 Radiated Spurious Emission (802.11g, CH1, 1GHz-18GHz)

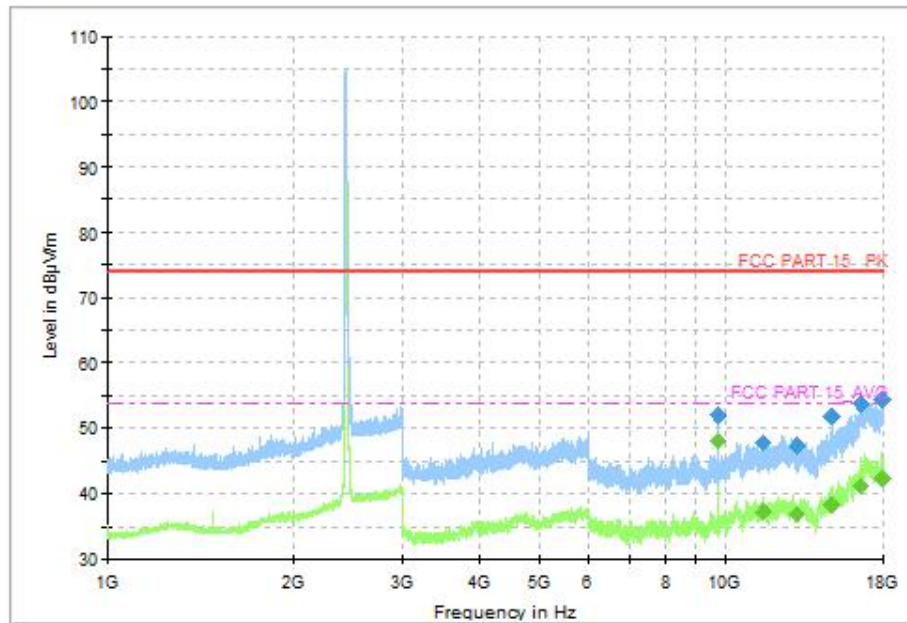


Fig.51 Radiated Spurious Emission (802.11g, CH6, 1GHz-18GHz)

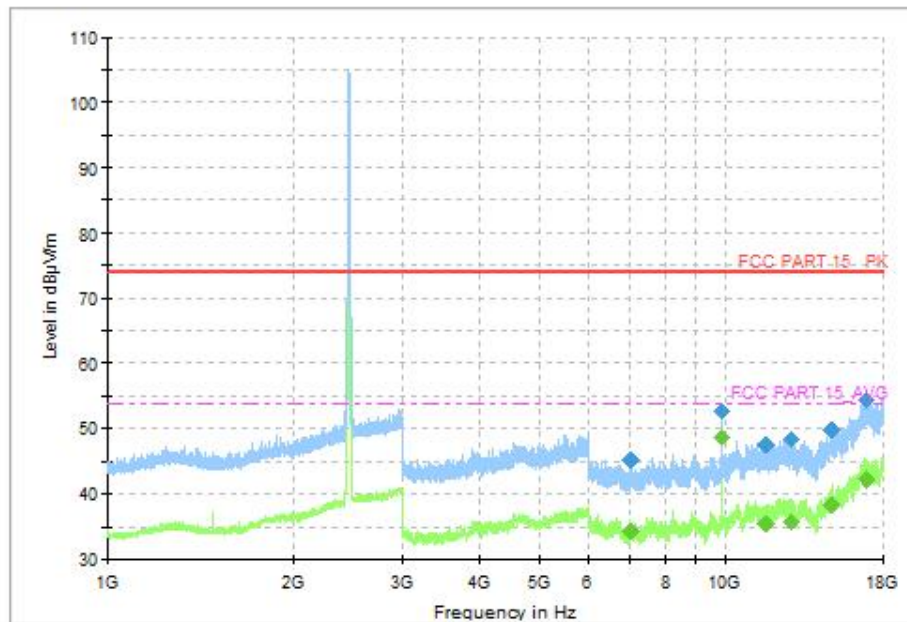


Fig.52 Radiated Spurious Emission (802.11g, CH11, 1GHz-18GHz)

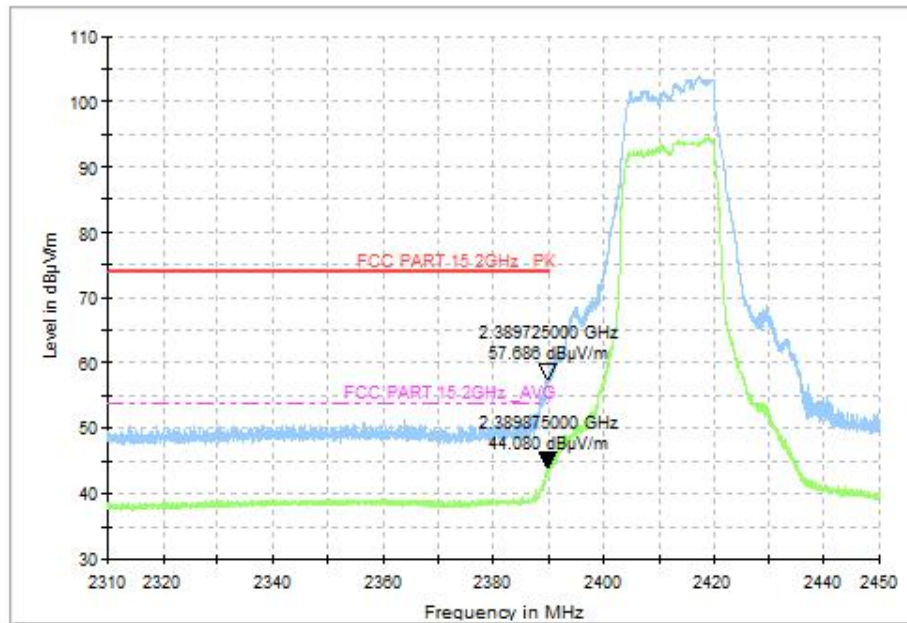


Fig.53 Radiated Restricted Band (802.11g, CH1, 2.38GHz~2.45GHz)

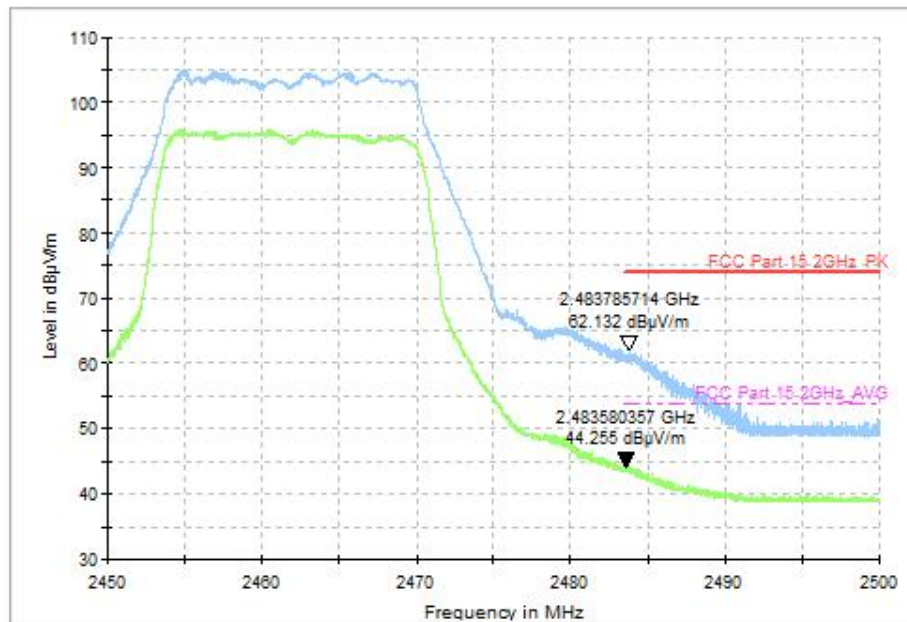


Fig.54 Radiated Restricted Band (802.11g, CH11, 2.45GHz~2.50GHz)

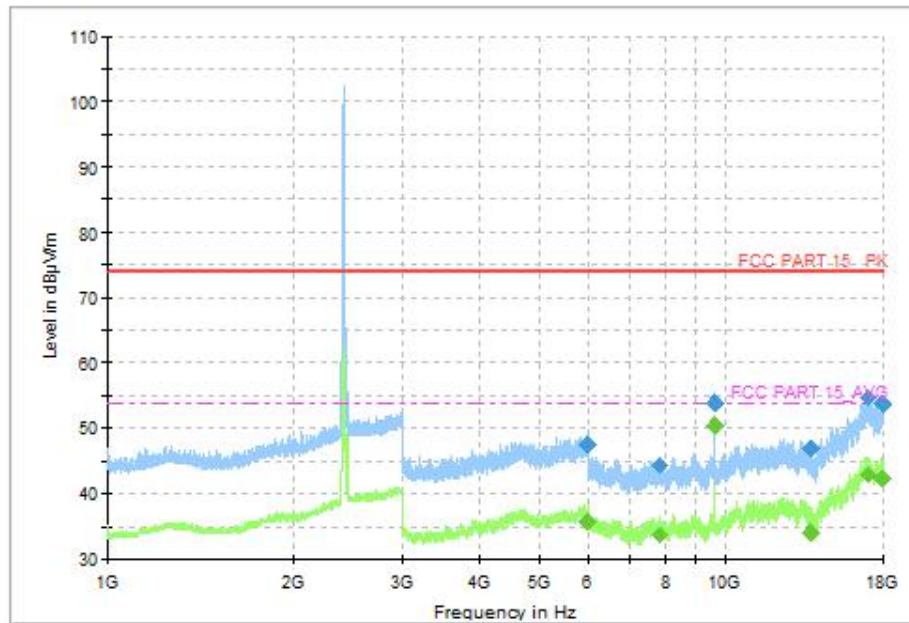


Fig.55 Radiated Spurious Emission (802.11n-HT20, CH1, 1GHz-18GHz)

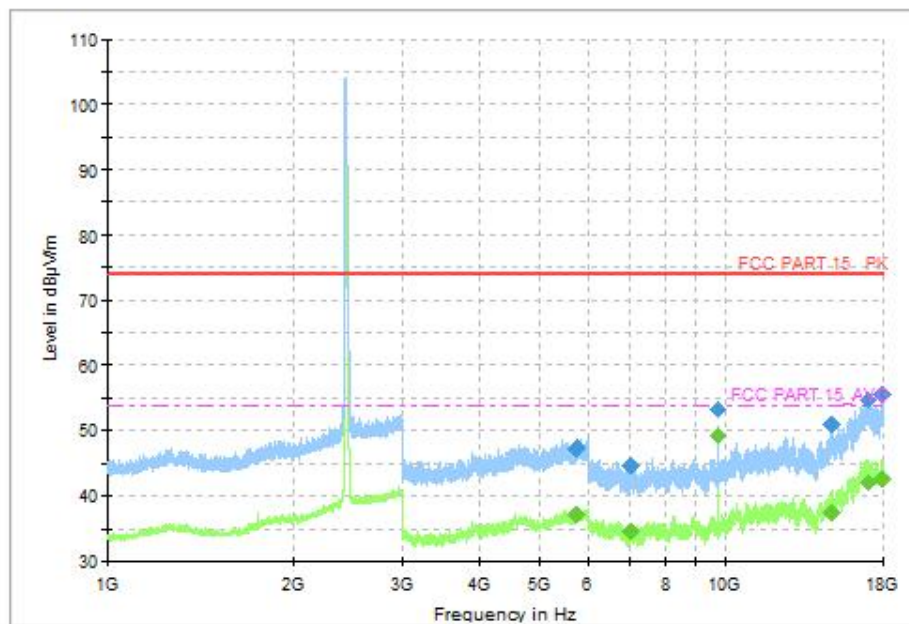


Fig.56 Radiated Spurious Emission (802.11n-HT20, CH6, 1GHz-18GHz)

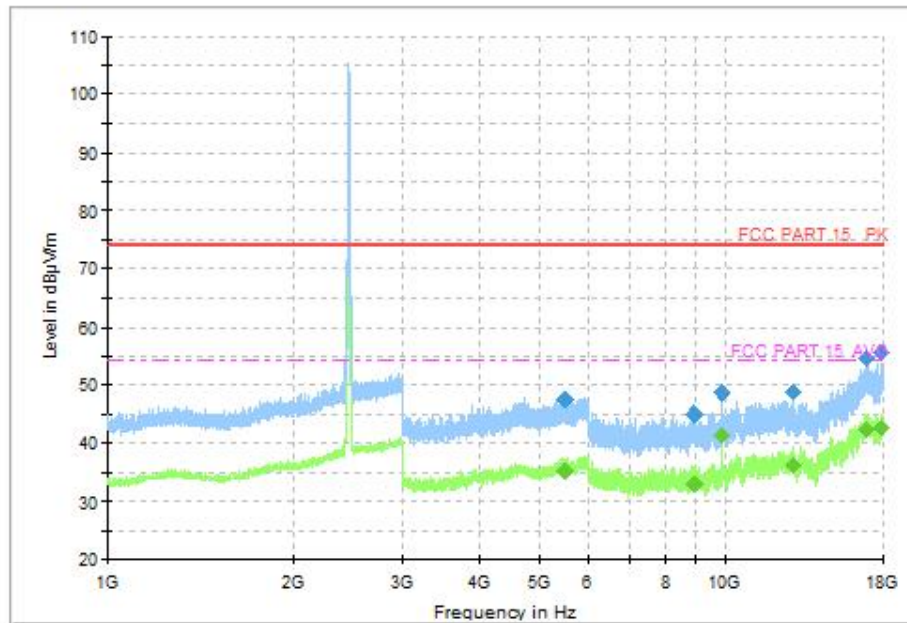


Fig.57 Radiated Spurious Emission (802.11n-HT20, CH11, 1GHz-18GHz)

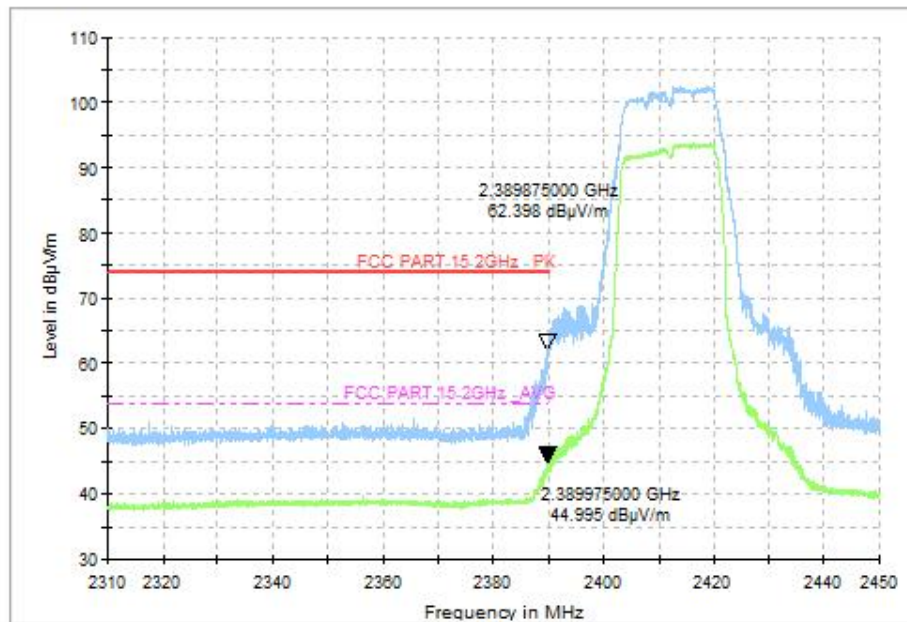


Fig.58 Radiated Restricted Band (802.11n-HT20, CH1, 2.38GHz~2.45GHz)



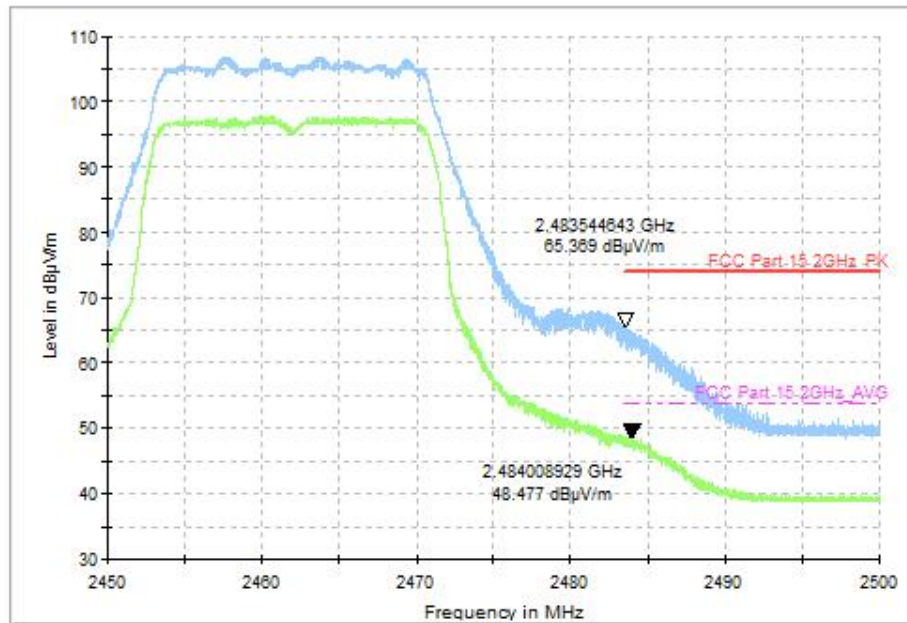


Fig.59 Radiated Restricted Band (802.11n-HT20, CH11, 2.45GHz~2.5GHz)

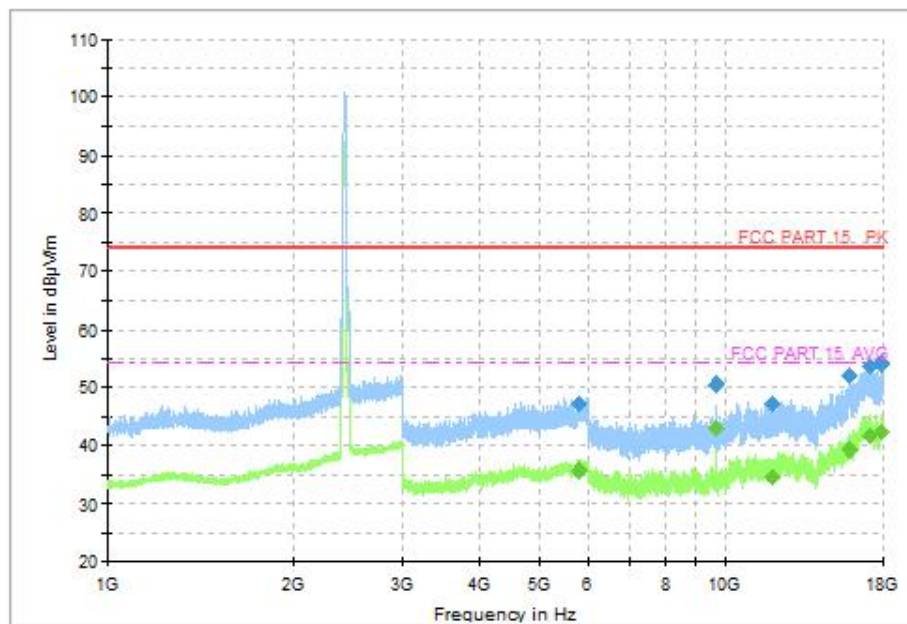


Fig.60 Radiated Spurious Emission (802.11n-HT40, CH3, 1GHz-18GHz)

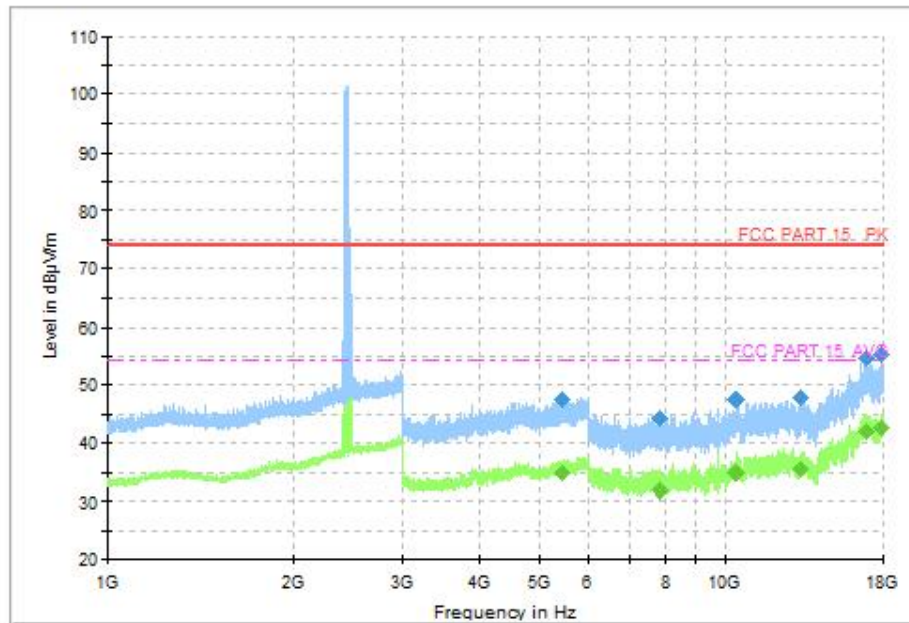


Fig.61 Radiated Spurious Emission (802.11n-HT40, CH6, 1GHz-18GHz)

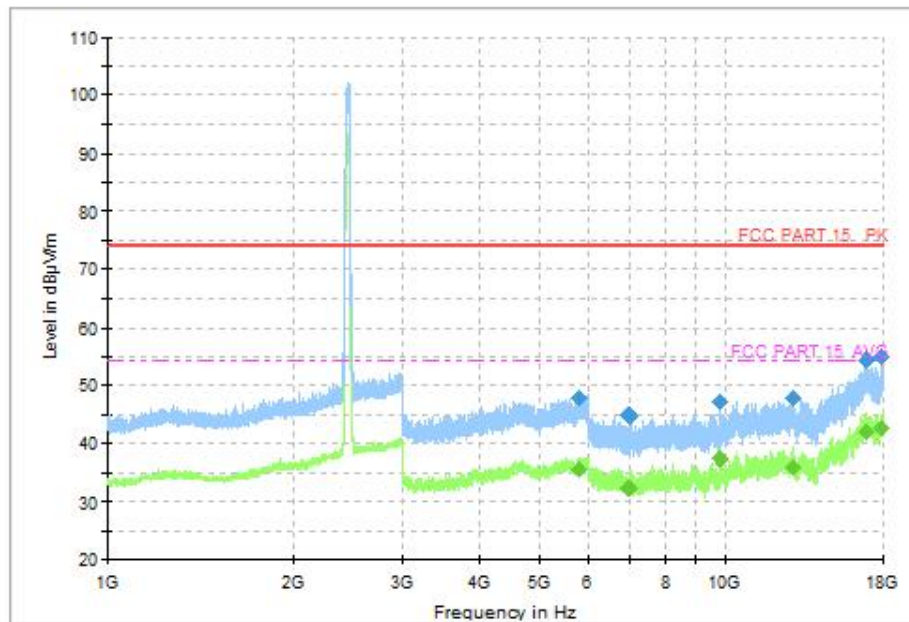


Fig.62 Radiated Spurious Emission (802.11n-HT40, CH9, 1GHz-18GHz)

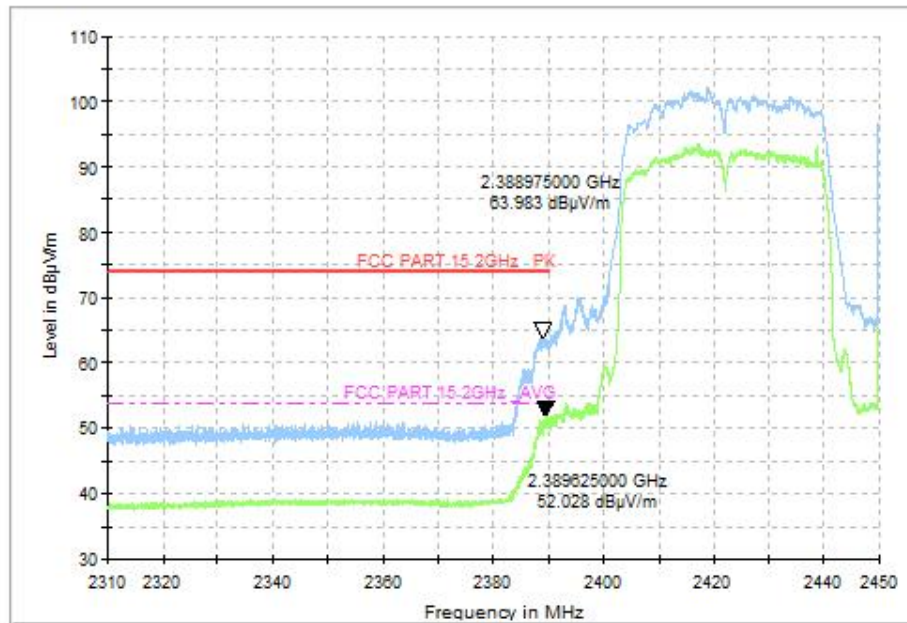


Fig.63 Radiated Restricted Band (802.11n-HT40, CH3, 2.38GHz~2.45GHz)

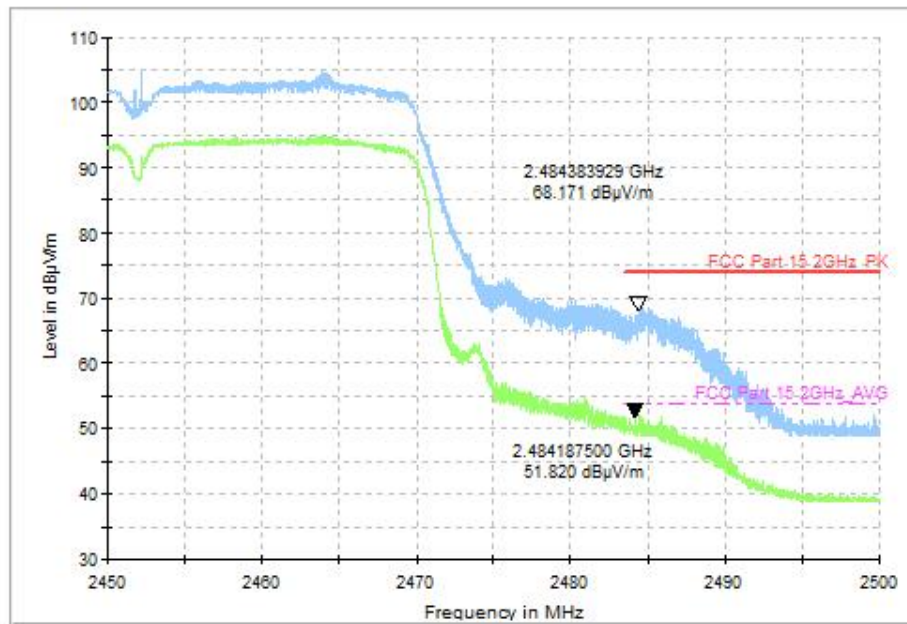
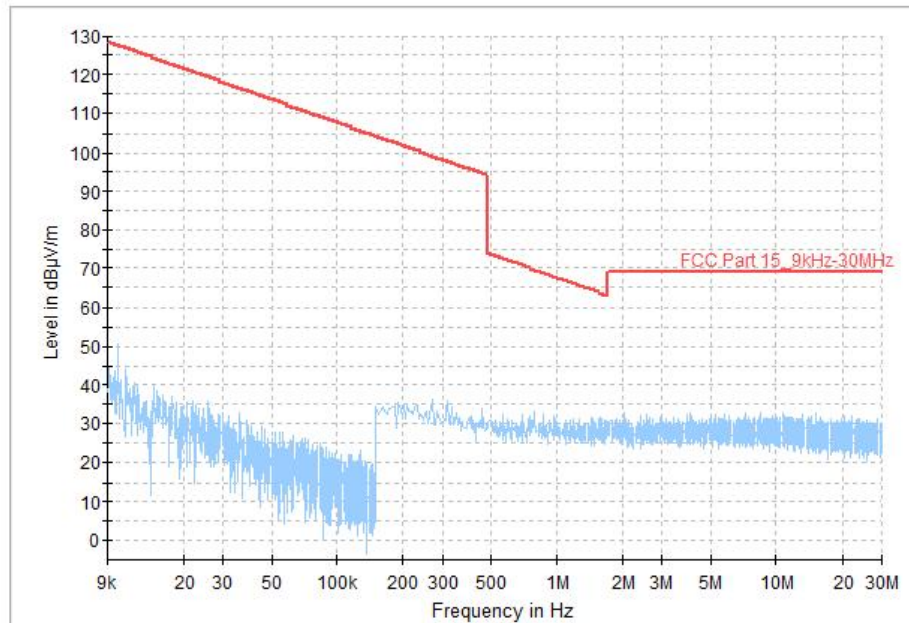
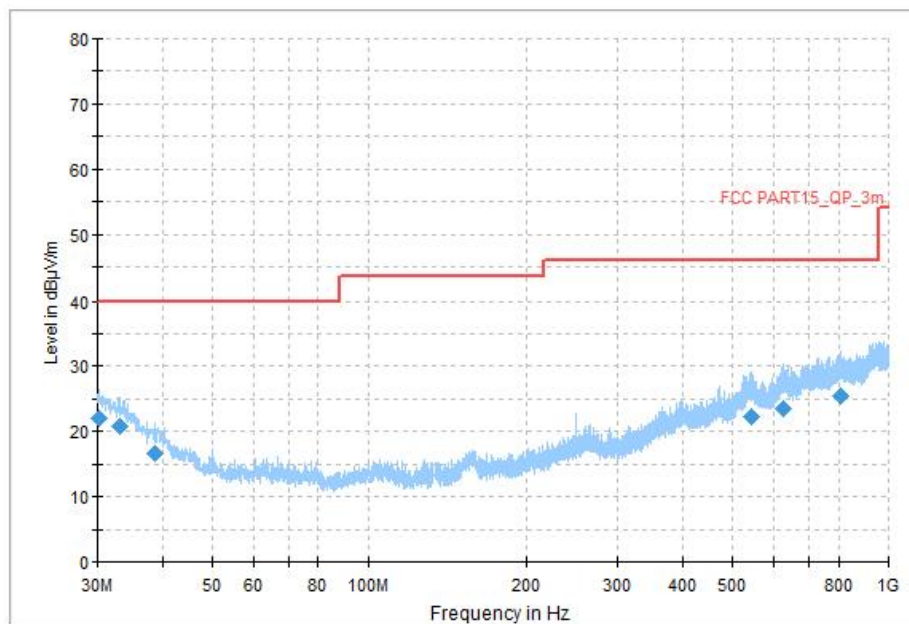


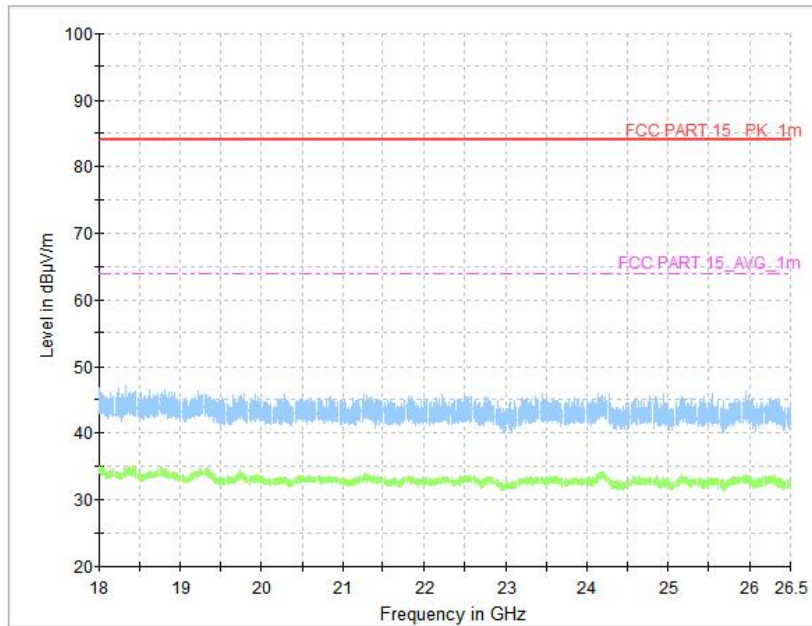
Fig.64 Radiated Restricted Band (802.11n-HT40, CH9, 2.45GHz~2.50GHz)



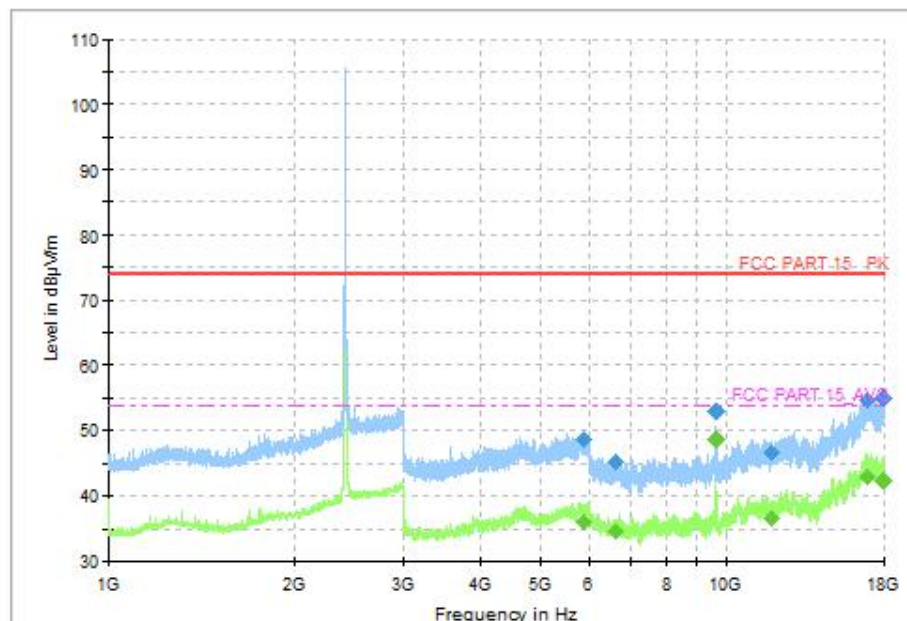
**Fig.65 Radiated Spurious Emission (All Channels, 9kHz-30MHz)**



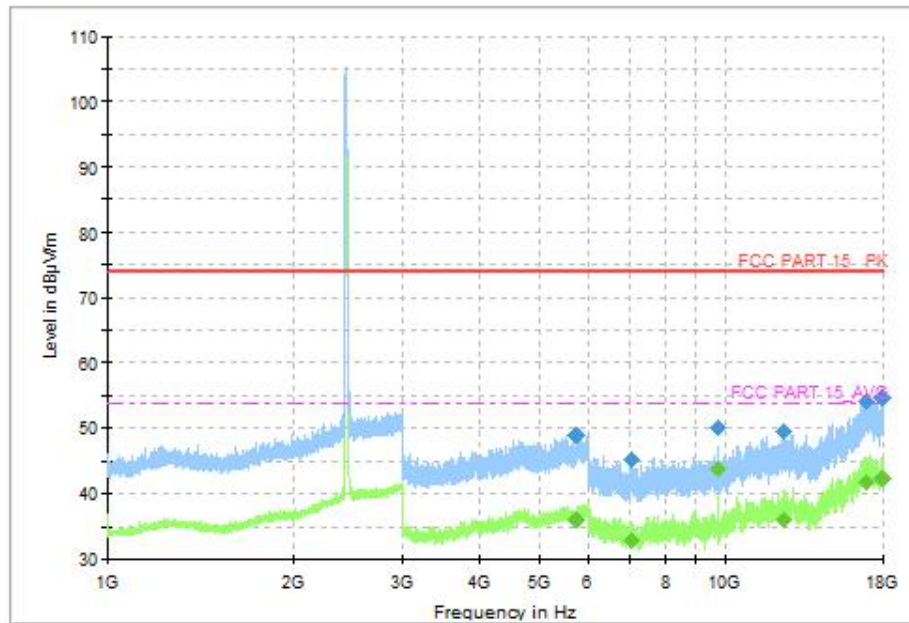
**Fig.66 Radiated Spurious Emission (All Channels, 30MHz-1GHz)**



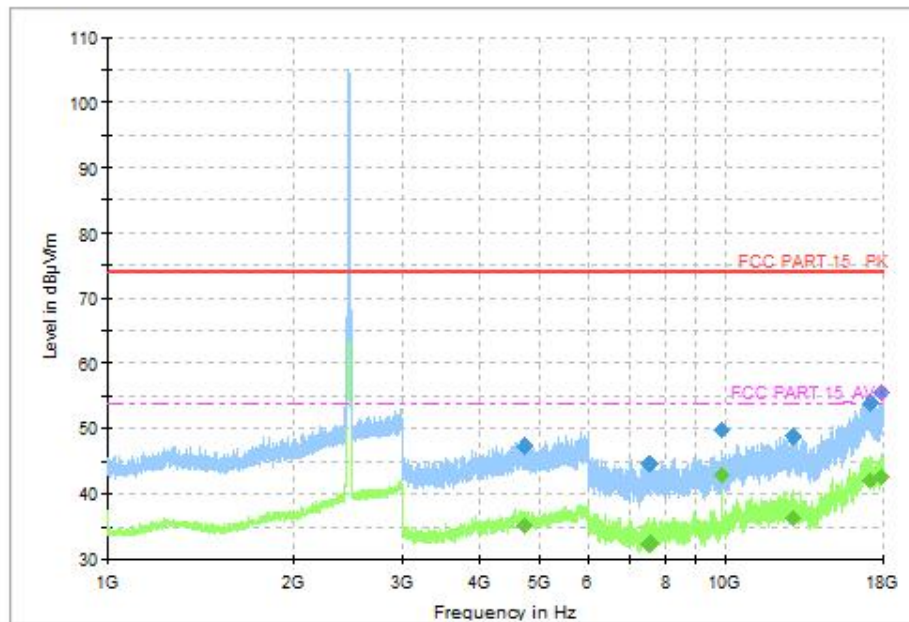
**Fig.67 Radiated Spurious Emission (All Channels, 18GHz-26.5GHz)**



**Fig.68 Radiated Spurious Emission (802.11n-HT20, CH1, 1GHz-18GHz, MIMO)**



**Fig.69 Radiated Spurious Emission (802.11n-HT20, CH6, 1GHz-18GHz, MIMO)**



**Fig.70 Radiated Spurious Emission (802.11n-HT20, CH11, 1GHz-18GHz, MIMO)**

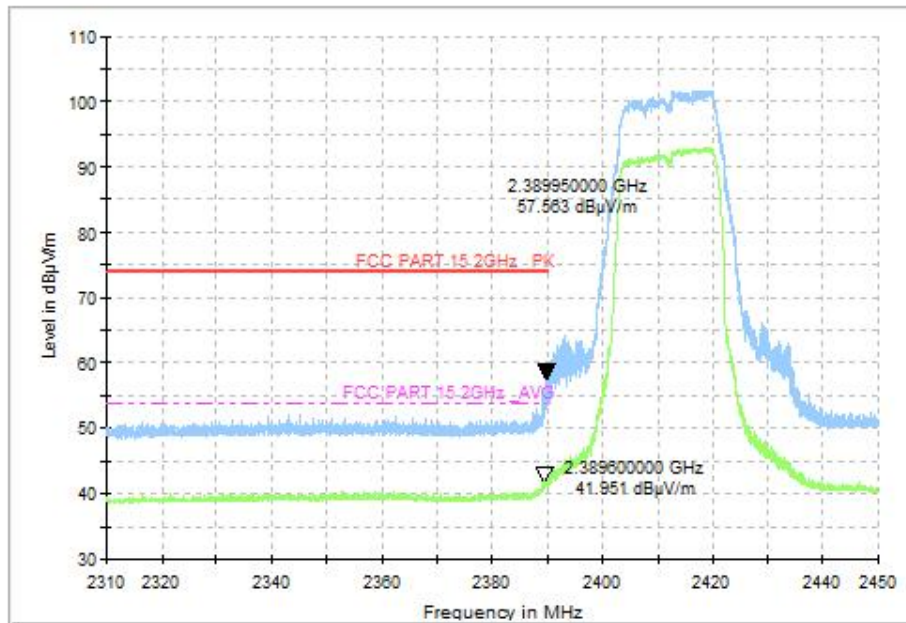


Fig.71 Radiated Restricted Band (802.11n-HT20, CH1, 2.38GHz~2.45GHz, MIMO)

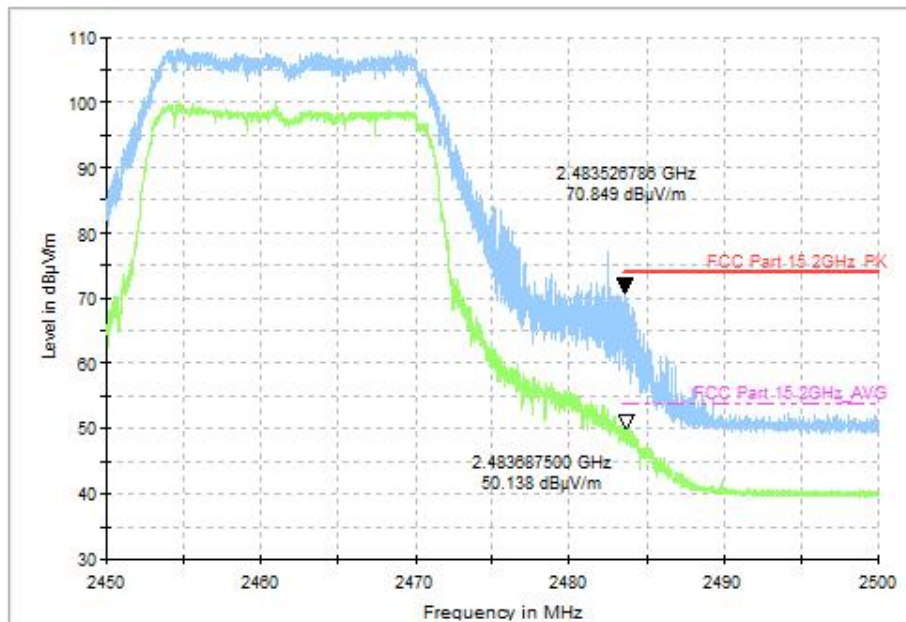
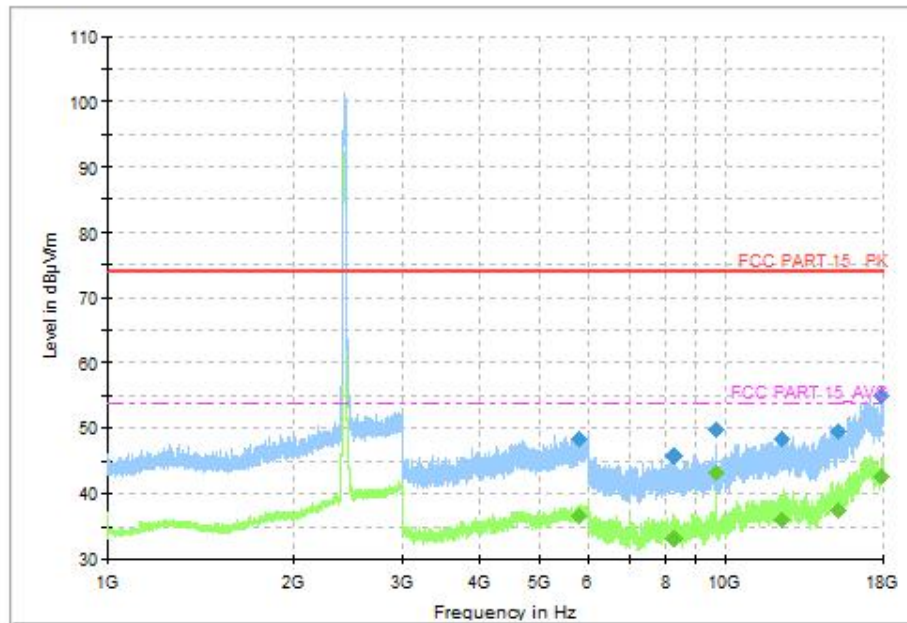
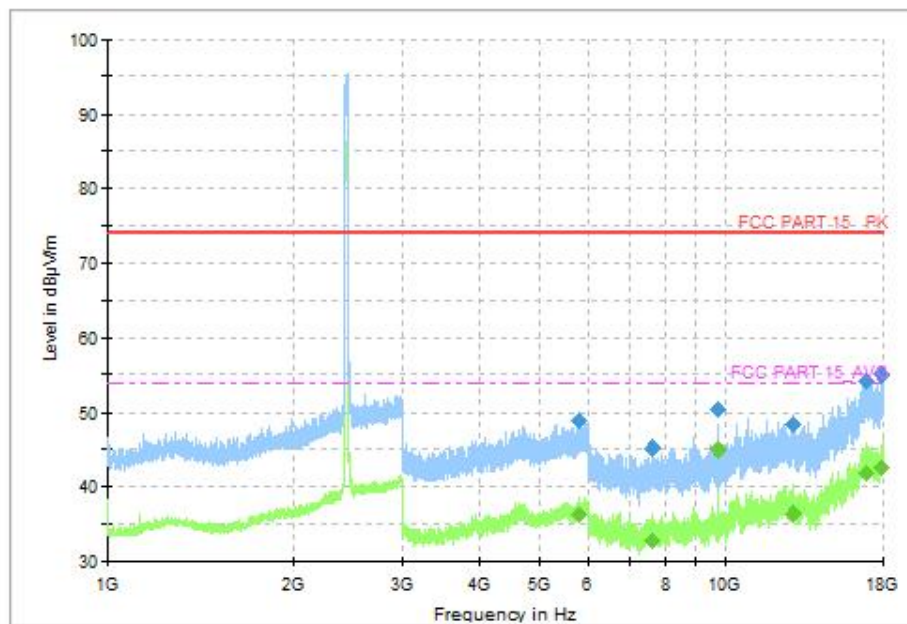


Fig.72 Radiated Restricted Band (802.11n-HT20, CH11, 2.45GHz~2.50GHz, MIMO)

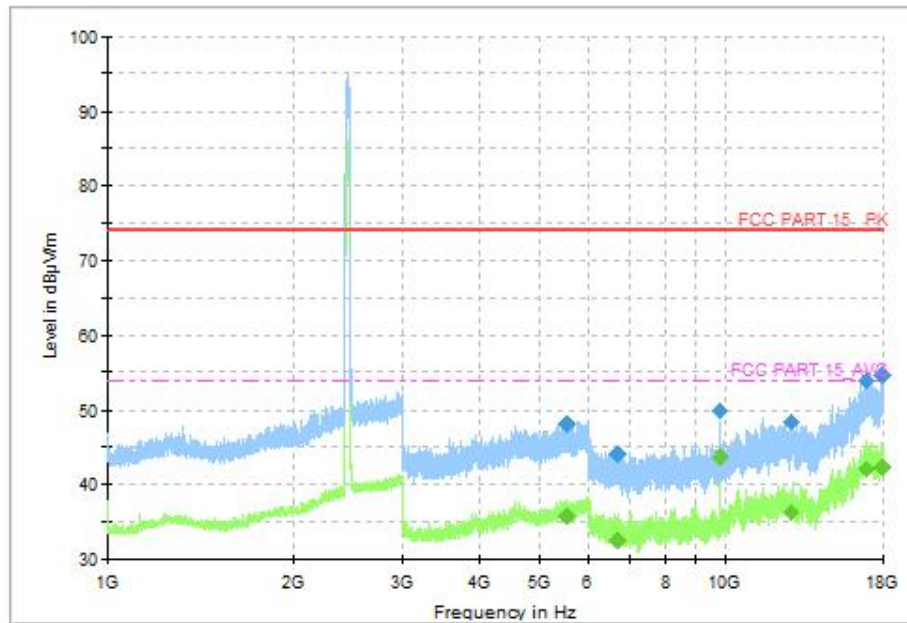


**Fig.73 Radiated Spurious Emission (802.11n-HT40, CH3, 1GHz-18GHz, MIMO)**

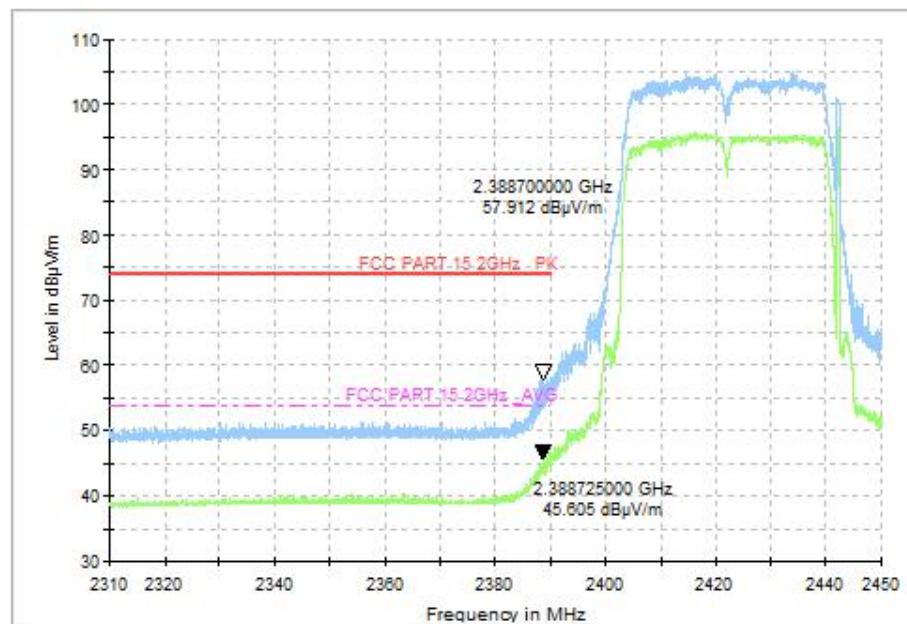


**Fig.74 Radiated Spurious Emission (802.11n-HT40, CH6, 1GHz-18GHz, MIMO)**





**Fig.75 Radiated Spurious Emission (802.11n-HT40, CH9, 1GHz-18GHz, MIMO)**



**Fig.76 Radiated Restricted Band (802.11n-HT40, CH3, 2.38GHz~2.45GHz, MIMO)**

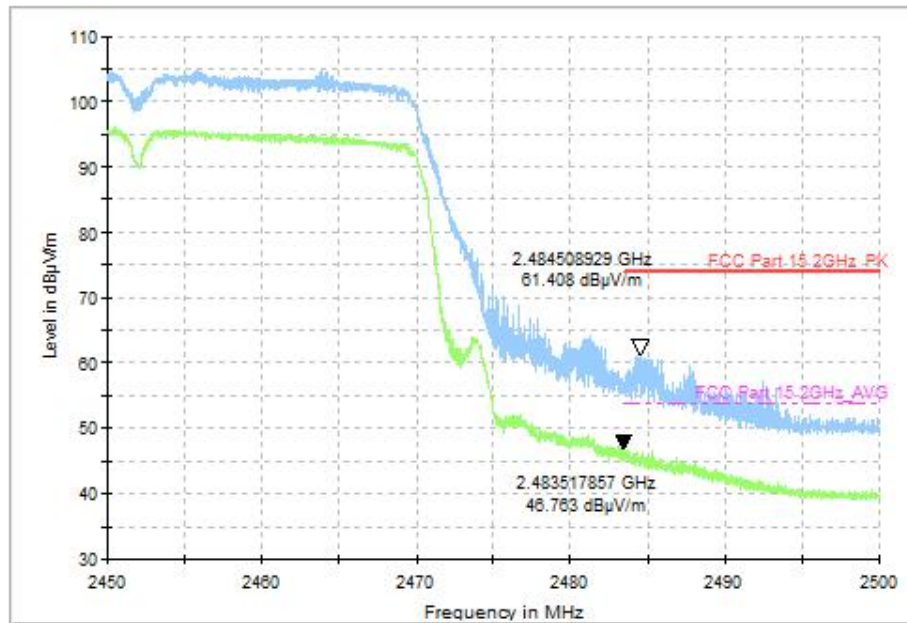


Fig.77 Radiated Restricted Band (802.11n-HT40, CH9, 2.45GHz~2.50GHz, MIMO)

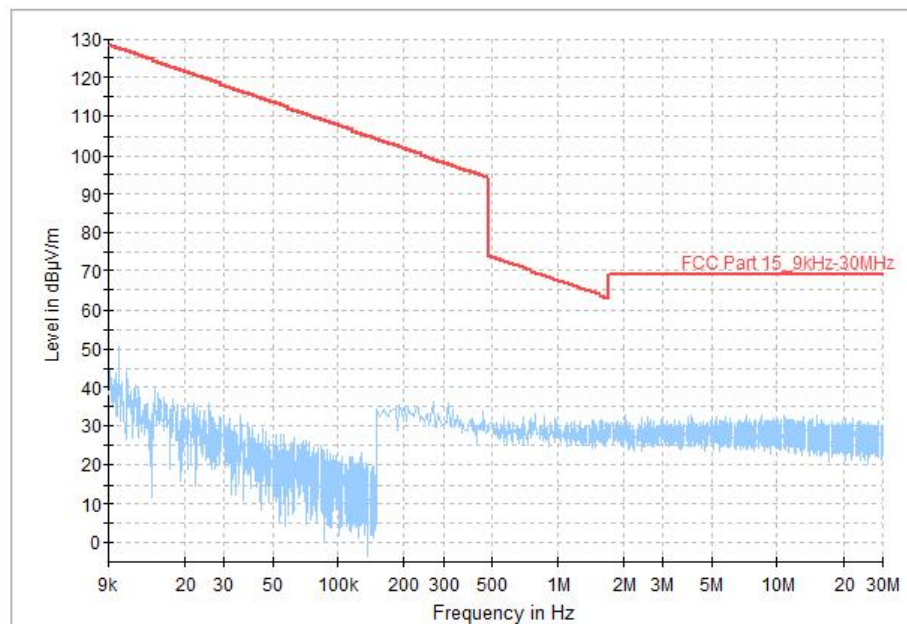
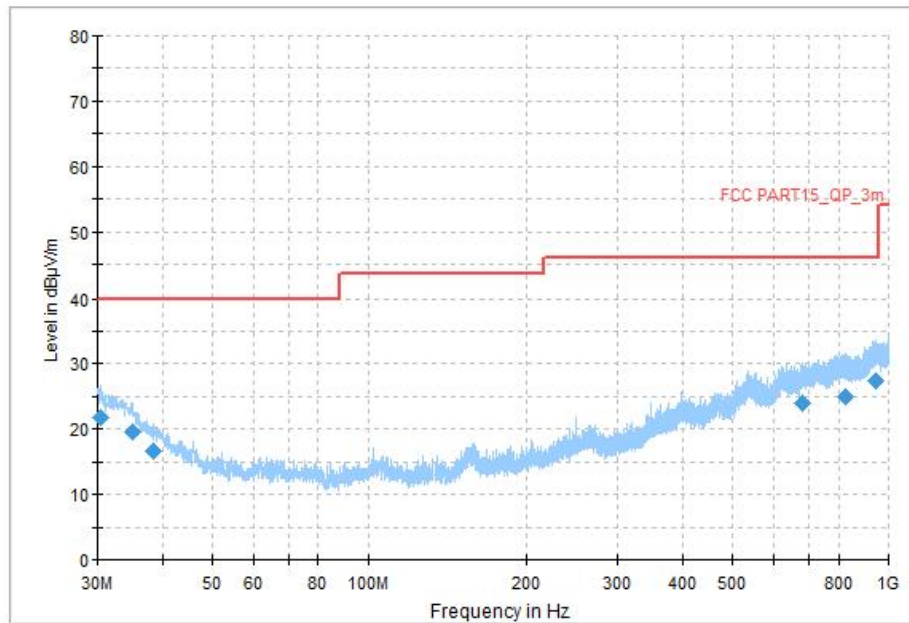
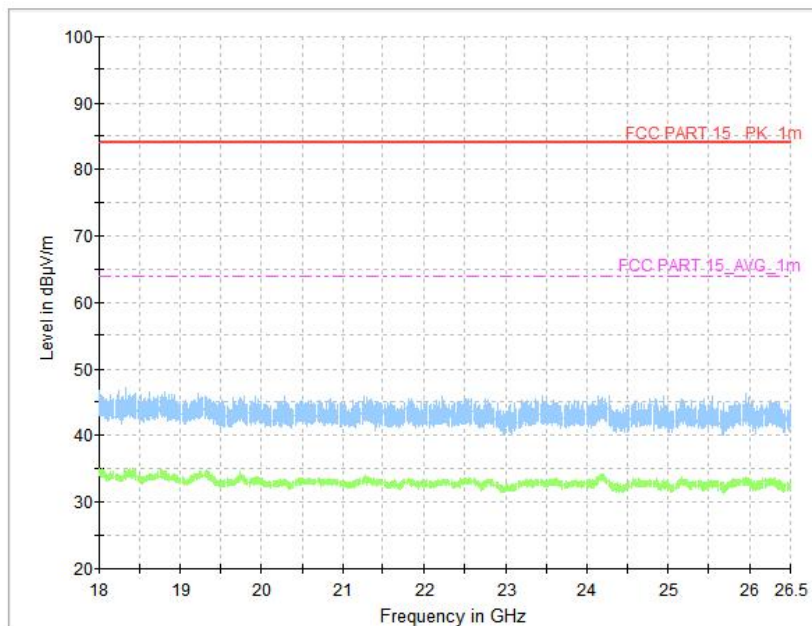


Fig.78 Radiated Spurious Emission (All Channels, 9kHz-30MHz, MIMO)



**Fig.79 Radiated Spurious Emission (All Channels, 30MHz-1GHz, MIMO)**



**Fig.80 Radiated Spurious Emission (All Channels, 18GHz-26.5GHz, MIMO)**



### A.7 AC Power line Conducted Emission

Method of Measurement: See ANSI C63.10-clause 6.2.

Test Condition:

Voltage (V)	Frequency (Hz)
120	60

Measurement Result and limit:

Frequency range (MHz)	Quasi-peak Limit (dB $\mu$ V)	Average-peak Limit (dB $\mu$ V)	Result (dB $\mu$ V)		Conclusion
			Traffic	Idle	
0.15 to 0.5	66 to 56	56 to 46	Fig.81	Fig.82	<b>P</b>
0.5 to 5	56	46			
5 to 30	60	50			

NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

**Note:** The measurement results include the L1 and N measurements.

See below for test graphs.

**Conclusion: PASS**

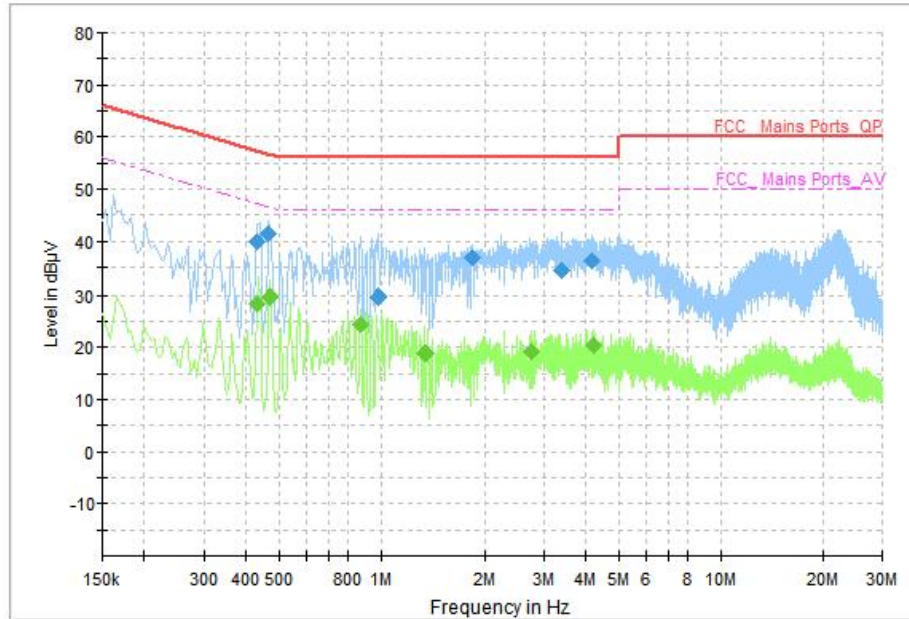


Fig.81 AC Power line Conducted Emission (Traffic)

Measurement Results: Quasi Peak

Frequency (MHz)	Quasi Peak (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.430000	40.08	57.25	17.17	L1	ON	10
0.466000	41.60	56.59	14.98	L1	ON	10
0.986000	29.44	56.00	26.56	L1	ON	10
1.850000	36.92	56.00	19.08	N	ON	10
3.370000	34.53	56.00	21.47	N	ON	10
4.170000	36.21	56.00	19.79	N	ON	10

Measurement Results: Average

Frequency (MHz)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.430000	28.23	47.25	19.03	L1	ON	10
0.470000	29.61	46.51	16.90	N	ON	10
0.874000	24.24	46.00	21.76	L1	ON	10
1.346000	18.98	46.00	27.02	N	ON	10
2.758000	19.25	46.00	26.75	N	ON	10
4.202000	20.44	46.00	25.56	N	ON	10

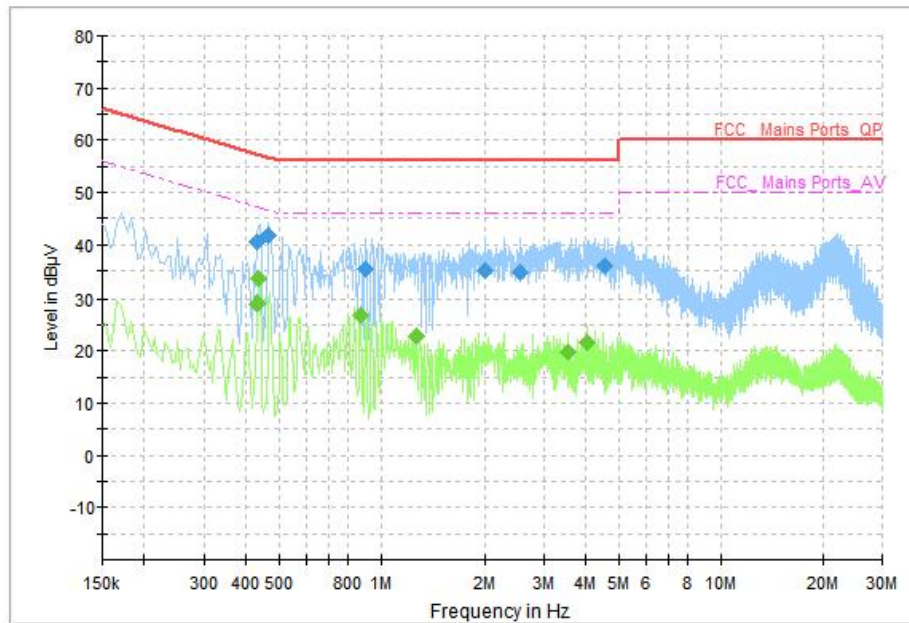


Fig.82 AC Power line Conducted Emission (Idle)

**Measurement Results: Quasi Peak**

Frequency (MHz)	Quasi Peak (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.430000	40.42	57.25	16.83	L1	ON	10
0.466000	41.70	56.59	14.89	L1	ON	10
0.902000	35.38	56.00	20.62	L1	ON	10
2.018000	34.93	56.00	21.07	N	ON	10
2.554000	34.85	56.00	21.15	N	ON	10
4.534000	36.11	56.00	19.89	N	ON	10

**Measurement Results: Average**

Frequency (MHz)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr. (dB)
0.430000	28.80	47.25	18.46	L1	ON	10
0.434000	33.44	47.18	13.74	L1	ON	10
0.870000	26.66	46.00	19.34	L1	ON	10
1.270000	22.70	46.00	23.30	L1	ON	10
3.526000	19.63	46.00	26.37	N	ON	10
4.030000	21.46	46.00	24.54	N	ON	10

\*\*\*END OF REPORT\*\*\*