FCC TEST REPORT

Test report
On Behalf of
EMBUX Technology Co. Ltd.
For
Industrial dual band Wi-Fi radio module
Model No.: MWF220HDB

FCC ID: 2AVW3-MWF220HDB

Prepared for :	**EMBUX Technology Co. Ltd.** **13F, No. 920, Chung-Cheng Rd. Zhonghe Dist., New Taipei City 23586, Taiwan**
Prepared By :	**Shenzhen HUAK Testing Technology Co., Ltd.** **1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park, Fuhai Street, Bao'an District, Shenzhen City, China**

Date of Test:	**Jan. 11, 2020 ~ Mar. 03, 2020**
Date of Report:	**Mar. 03, 2020**
Report Number:	**HK2002260224-1E**

TEST RESULT CERTIFICATION

Applicant's name.....:	EMBUX Technology Co. Ltd.
Address .....:	13F, No. 920, Chung-Cheng Rd. Zhonghe Dist., New Taipei City 23586, Taiwan
Manufacture's Name.....:	EMBUX Technology Co. Ltd.
Address .....:	13F, No. 920, Chung-Cheng Rd. Zhonghe Dist., New Taipei City 23586, Taiwan

Product description

Trade Mark:	EMBUX
Product name.....:	Industrial dual band Wi-Fi radio module
Model and/or type reference .:	MWF220HDB
Standards .....:	FCC Rules and Regulations Part 15 Subpart C Section 15.247 ANSI C63.10: 2013

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Date of Test .....:

Date (s) of performance of tests .....:	Jan. 11, 2020 ~ Mar. 03, 2020
Date of Issue.....:	Mar. 03, 2020
Test Result.....:	**Pass**

Testing Engineer : Gary Qian

(Gary Qian)

Technical Manager : Eden Hu

(Eden Hu)

Authorized Signatory : Jason Zhou

(Jason Zhou)

TABLE OF CONTENTS

1. Test Result Summary 4
   1.1. TEST PROCEDURES AND RESULTS 4
   1.2. TEST FACILITY 4
   1.3. MEASUREMENT UNCERTAINTY 5
2. EUT Description 6
   2.1. GENERAL DESCRIPTION OF EUT 6
   2.2. CARRIER FREQUENCY OF CHANNELS 7
   2.3. OPERATION OF EUT DURING TESTING 7
   2.4. DESCRIPTION OF TEST SETUP 8
3. Genera Information 9
   3.1. TEST ENVIRONMENT AND MODE 9
   3.2. DESCRIPTION OF SUPPORT UNITS 10
4. Test Results and Measurement Data 11
   4.1. CONDUCTED EMISSION 11
   4.2. MAXIMUM CONDUCTED OUTPUT POWER 15
   4.3. EMISSION BANDWIDTH 17
   4.4. POWER SPECTRAL DENSITY 28
   4.5. CONDUCTED BAND EDGE AND SPURIOUS EMISSION MEASUREMENT 40
   4.6. RADIATED SPURIOUS EMISSION MEASUREMENT 50
   4.7. ANTENNA REQUIREMENT 76
   4.8. PHOTOS OF THE EUT 79

1. Test Result Summary

1.1. TEST PROCEDURES AND RESULTS

Requirement	CFR 47 Section	Result
Antenna requirement	§15.203/§15.247 (c)	PASS
AC Power Line Conducted Emission	§15.207	PASS
Conducted Peak Output Power	§15.247 (b)(3)	PASS
6dB Emission Bandwidth	§15.247 (a)(2)	PASS
Power Spectral Density	§15.247 (e)	PASS
Band Edge	1§5.247(d)	PASS
Spurious Emission	§15.205/§15.209	PASS

Note:

1. PASS: Test item meets the requirement.

2. Fail: Test item does not meet the requirement.

3. N/A: Test case does not apply to the test object.

4. The test result judgment is decided by the limit of test standard.

1.2. TEST FACILITY

Test Firm : Shenzhen HUAK Testing Technology Co., Ltd.

Address 1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park, Fuhai Street, Bao'an District, Shenzhen City, China

1.3. Measurement Uncertainty

The reported uncertainty of measurement y ± U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95 %.

No.	Item	MU
1	Conducted Emission	±2.56dB
2	RF power, conducted	±0.12dB
3	Spurious emissions, conducted	±0.11dB
4	All emissions, radiated(<1G)	±3.92dB
5	All emissions, radiated(>1G)	±4.28dB
6	Temperature	±0.1°C
7	Humidity	±1.0%

2. EUT Description

2.1. GENERAL DESCRIPTION OF EUT

Equipment	Industrial dual band Wi-Fi radio module
Model Name	MWF220HDB
Serial Model	N/A
Model Difference	N/A
Trade Mark	EMBUX
FCC ID	**2AVW3-MWF220HDB**
Antenna Type	Internal Antenna
Antenna Gain	Antenna 1:4.5dBi Antenna 2: 4.5dBi MIMO: 7.510dBi
Operation frequency	802.11b/g/n 20:2412~2462 MHz 802.11n 40: 2422~2452MHz
Number of Channels	802.11b/g/n20: 11CH 802.11n 40: 7CH
Modulation Type	CCK/OFDM/DBPSK/DAPSK
Power Source	DC3.3V
Power Rating	DC3.3V
Note: The EUT incorporates a MIMO function. Physically, it provides two completed transmitte rs and receivers(2T2R), two transmit signals are completely correlated, then, Direction g ain=GANT+10*log(2)dBi.	

2.2. Carrier Frequency of Channels

Channel List for 802.11b/802.11g/802.11n (HT20)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
01	2412	04	2427	07	2442	10	2457
02	2417	05	2432	08	2447	11	2462
03	2422	06	2437	09	2452		

Channel List For 802.11n (HT40)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
--	--	04	2427	07	2442	--	--
--	--	05	2432	08	2447	--	--
03	2422	06	2437	09	2452		

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

2.3. Operation of EUT during testing

Operating Mode

The mode is used: **Transmitting mode for 802.11b/802.11g/802.11n (HT20)**

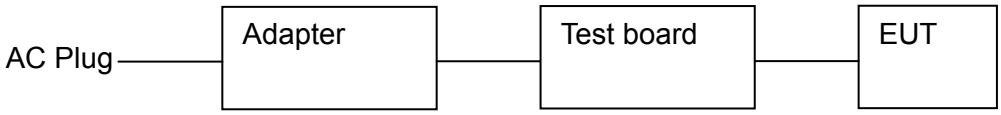
Low Channel: 2412MHz
Middle Channel: 2437MHz
High Channel: 2462MHz

The mode is used: Transmitting mode for 802.11n (HT40)

Low Channel: 2422MHz
Middle Channel: 2437MHz
High Channel: 2452MHz

2.4. DESCRIPTION OF TEST SETUP

Operation of EUT during testing:



- Adapter information
  Model: FSP010-DWDA1
  Input: AC100-240V, 50-60Hz, 0.4A
  Output: DC5V, 2A

- Test board information
  Model: 012
  Input: DC5V
  Output: DC3.3V

The sample was placed (0.8m below 1GHz, 1.5m above 1GHz) above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages. The worst case is X position

3. Genera Information

3.1. Test environment and mode

Operating Environment:	
Temperature:	25.0 °C
Humidity:	56 % RH
Atmospheric Pressure:	1010 mbar
Test Mode:	
Engineering mode:	Keep the EUT in continuous transmitting by select channel and modulations(The value of duty cycle is 98.46%)
The sample was placed (0.8m below 1GHz, 1.5m above 1GHz) above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages. For the full battery state and The output power to the maximum state.	

We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:	
Per-scan all kind of data rate in lowest channel, and found the follow list which it was worst case.	
Mode	Data rate
802.11b	1Mbps
802.11g	6Mbps
802.11n(H20)	6.5Mbps
802.11n(H40)	13.5Mbps
Final Test Mode:	
Operation mode:	Keep the EUT in continuous transmitting with modulation
1. For WIFI function, the engineering test program was provided and enabled to make EUT continuous transmit/receive. 2.According to ANSI C63.10 standards, the test results are both the “worst case” and “worst setup” 1Mbps for 802.11b, 6Mbps for 802.11g, 6.5Mbps for 802.11n(H20), 13.5Mbps for 802.11(H40). Duty cycle setting during the transmission is 98.5% with maximum power setting for all modulations.	

3.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
Antenna	19110505	/	/	/

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.

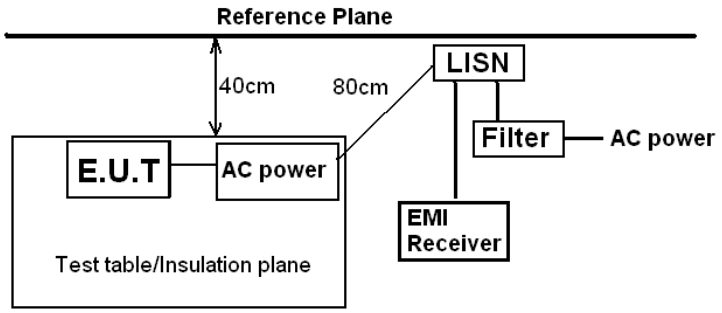
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

3. For conducted measurements (Output Power, 6dB Emission Bandwidth, Power Spectral Density, Spurious Emissions), the antenna of EUT is connected to the test equipment via temporary antenna connector, the antenna connector is soldered on the antenna port of EUT, and the temporary antenna connector is listed in the Test Instruments.

4. Test Results and Measurement Data

4.1. Conducted Emission

4.1.1. Test Specification

<table>
<tr><td>Test Requirement:</td><td>FCC Part15 C Section 15.207</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.10:2013</td></tr>
<tr><td>Frequency Range:</td><td>150 kHz to 30 MHz</td></tr>
<tr><td>Receiver setup:</td><td>RBW=9 kHz, VBW=30 kHz, Sweep time=auto</td></tr>
<tr><td>Limits:</td><td>
<table>
<tr><td rowspan="2">Frequency range (MHz)</td><td colspan="2">Limit (dBuV)</td></tr>
<tr><td>Quasi-peak</td><td>Average</td></tr>
<tr><td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr>
<tr><td>0.5-5</td><td>56</td><td>46</td></tr>
<tr><td>5-30</td><td>60</td><td>50</td></tr>
</table>
</td></tr>
<tr><td>Test Setup:</td><td>


Remark:
E.U.T: Equipment Under Test
LISN: Line Impedence Stabilization Network
Test table height=0.8m
</td></tr>
<tr><td>Test Mode:</td><td>Charging + transmitting with modulation</td></tr>
<tr><td>Test Procedure:</td><td>1. The E.U.T is connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment.
2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs).
3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.</td></tr>
<tr><td>Test Result:</td><td>PASS</td></tr>
</table>

4.1.2. Test Instruments

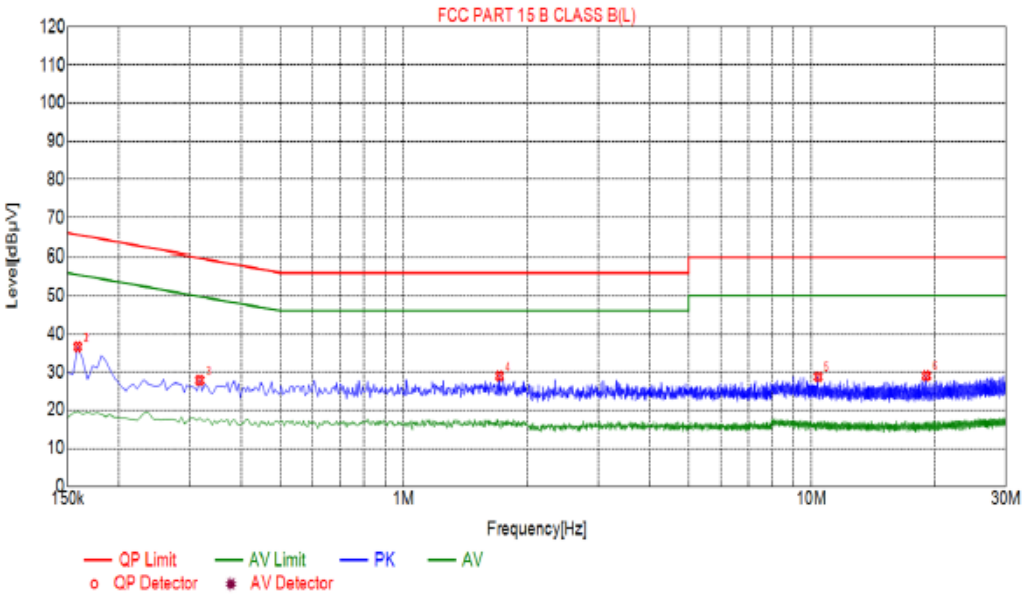
Conducted Emission Shielding Room Test Site (843)					
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Receiver	R&S	ESCI 7	HKE-010	Dec. 26, 2019	Dec. 25, 2020
LISN	R&S	ENV216	HKE-002	Dec. 26, 2019	Dec. 25, 2020
Conducted test software	Tonscend	TS+ Rev 2.5.0.0	HKE-081	N/A	N/A

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

4.1.3. Test data

All the test modes completed for test. only the worst result of AC240V/60Hz(802.11b at 2412MHz) was reported as below:

Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)



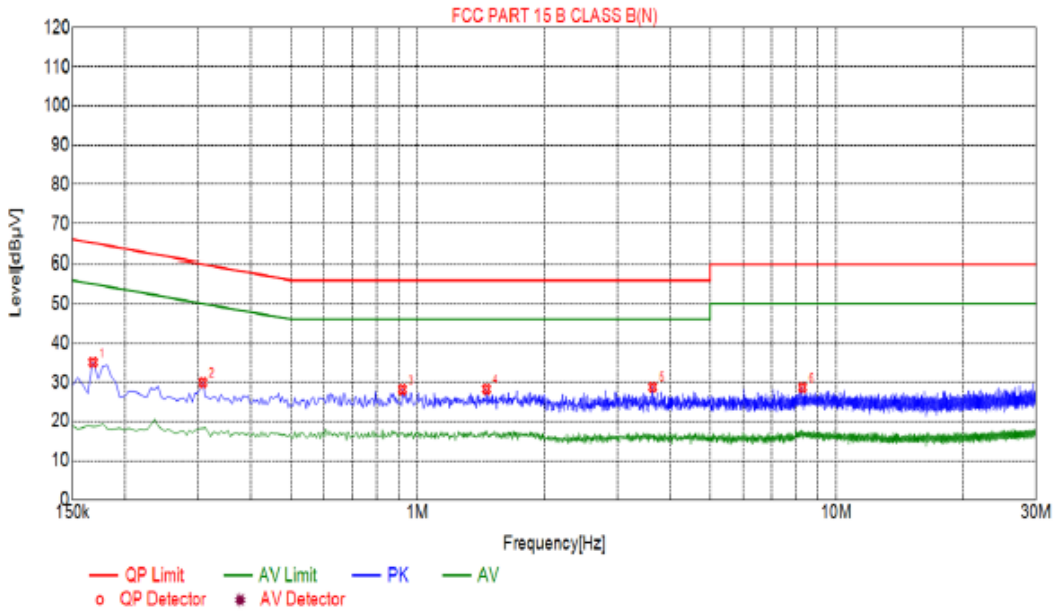
Suspected List								
NO.	Freq. [MHz]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Reading [dBµV]	Detector	Type
1	0.1590	36.64	10.01	65.52	28.88	26.63	PK	L
2	0.1590	36.64	10.01	65.52	28.88	26.63	PK	L
3	0.3165	27.84	10.05	59.80	31.96	17.79	PK	L
4	1.7160	28.97	10.13	56.00	27.03	18.84	PK	L
5	10.3785	28.76	10.05	60.00	31.24	18.71	PK	L
6	19.1265	29.02	10.07	60.00	30.98	18.95	PK	L

Remark: Margin = Limit – Level

Correction factor = Cable lose + LISN insertion loss

Level=Test receiver reading + correction factor

Conducted Emission on Neutral Terminal of the power line (150 kHz to 30MHz)



Suspected List								
NO.	Freq. [MHz]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Reading [dBµV]	Detector	Type
1	0.1680	35.05	10.01	65.06	30.01	25.04	PK	N
2	0.3075	29.90	10.05	60.04	30.14	19.85	PK	N
3	0.9195	28.16	10.06	56.00	27.84	18.10	PK	N
4	1.4595	28.24	10.10	56.00	27.76	18.14	PK	N
5	3.6465	28.74	10.25	56.00	27.26	18.49	PK	N
6	8.3130	28.65	10.13	60.00	31.35	18.52	PK	N

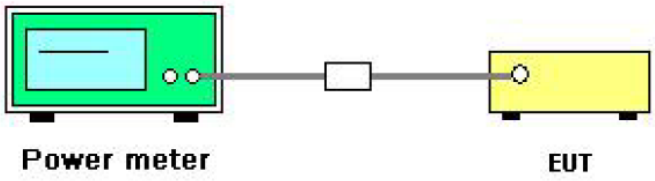
Remark: Margin = Limit – Level

Correction factor = Cable lose + LISN insertion loss

Level=Test receiver reading + correction factor

4.2. Maximum Conducted Output Power

4.2.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (b)(3)
Test Method:	KDB 558074
Limit:	30dBm
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance v05r02. 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 Peak output power and record the results in the test report.
Test Result:	PASS

4.2.2. Test Instruments

RF Test Room					
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Power meter	Agilent	E4419B	HKE-085	Dec. 26, 2019	Dec. 25, 2020
Power Sensor	Agilent	E9300A	HKE-086	Dec. 26, 2019	Dec. 25, 2020
RF cable	Times	1-40G	HKE-034	Dec. 26, 2019	Dec. 25, 2020
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 26, 2019	Dec. 25, 2020

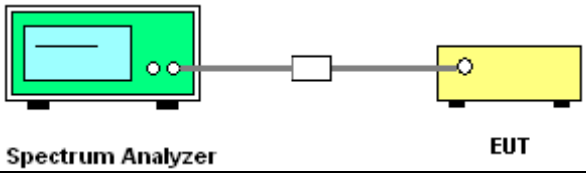
Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

4.2.3. Test Data

Test Channel	Frequency	Maximum Peak Conducted Output Power (dBm)			LIMIT
	(MHz)	Antenna port 1	Antenna port 2	MIMO	dBm
TX 802.11b Mode					
CH01	2412	18.87	17.51	/	30
CH06	2437	18.38	17.32	/	30
CH11	2462	18.93	18.54	/	30
TX 802.11g Mode					
CH01	2412	18.42	17.39	/	30
CH06	2437	18.24	18.87	/	30
CH11	2462	18.84	17.61	/	30
TX 802.11n20 Mode					
CH01	2412	18.41	18.75	21.59	28.49(MIMO)
CH06	2437	18.28	17.31	20.83	28.49(MIMO)
CH11	2462	18.76	18.77	21.78	28.49(MIMO)
TX 802.11n40 Mode					
CH03	2422	18.32	18.55	21.45	28.49(MIMO)
CH06	2437	17.57	17.79	20.69	28.49(MIMO)
CH09	2452	17.72	18.02	20.88	28.49(MIMO)
Note: This product supports antenna 1 and antenna 2 launch, but only support 802.11 n for MIMO mode, not support 802.11 b and 802.11 g for MIMO mode.					

4.3. Emission Bandwidth

4.3.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (a)(2)
Test Method:	KDB 558074
Limit:	>500kHz
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows FCC KDB Publication No. 558074 DTS D01 Meas. Guidance v05r02. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz. 4. Measure and record the results in the test report.
Test Result:	PASS

4.3.2. Test Instruments

RF Test Room					
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 26, 2019	Dec. 25, 2020
RF Cable (9KHz-26.5GHz)	Tonscend	170660	N/A	Dec. 26, 2019	Dec. 25, 2020
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 26, 2019	Dec. 25, 2020

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

4.3.3. Test data

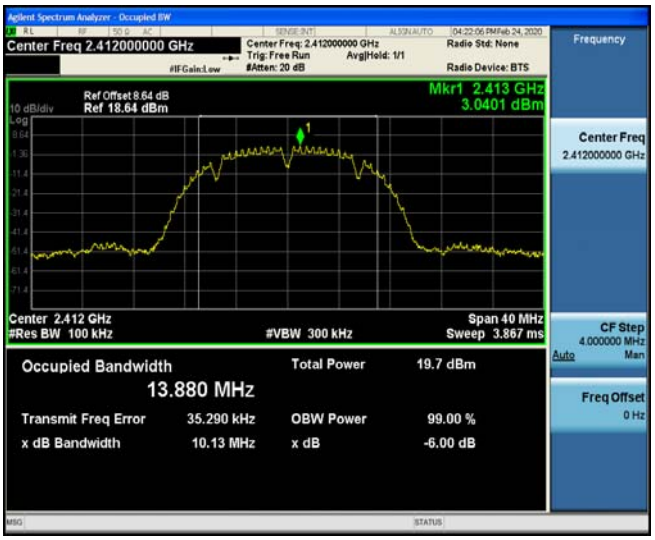
For antenna port 1

Test channel	6dB Emission Bandwidth (MHz)			
	802.11b	802.11g	802.11n(H20)	802.11n(H40)
Lowest	10.13	16.58	17.82	36.59
Middle	10.10	16.58	17.81	36.63
Highest	10.09	16.59	17.82	36.66
Limit:	>500k			
Test Result:	PASS			

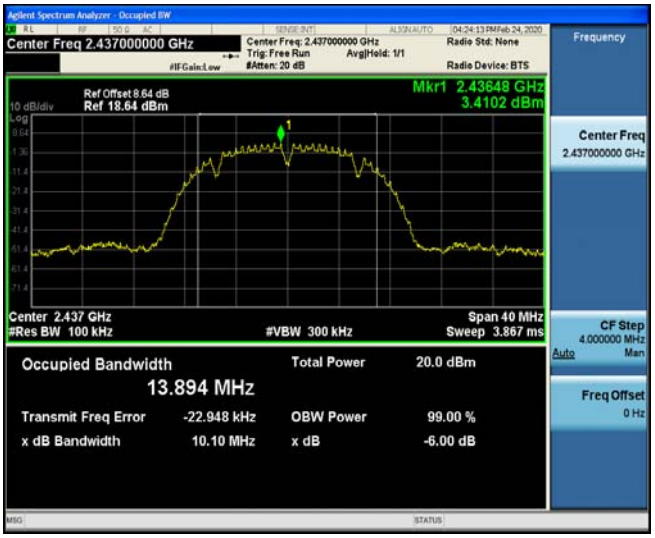
Test plots as follows:

802.11b Modulation

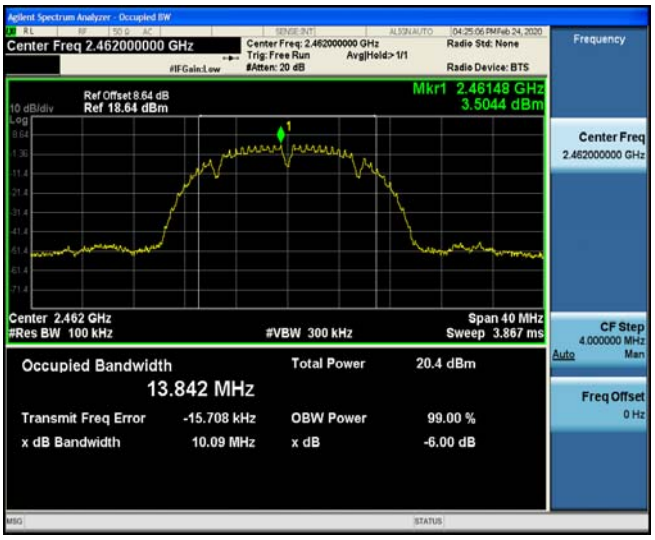
Lowest channel



Middle channel

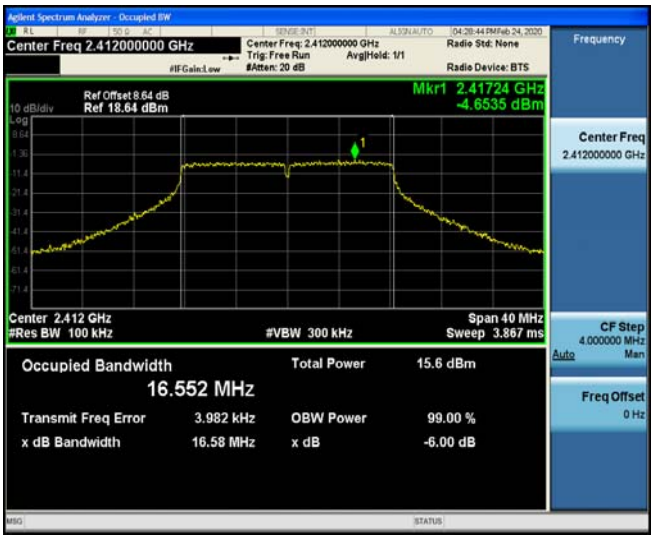


Highest channel

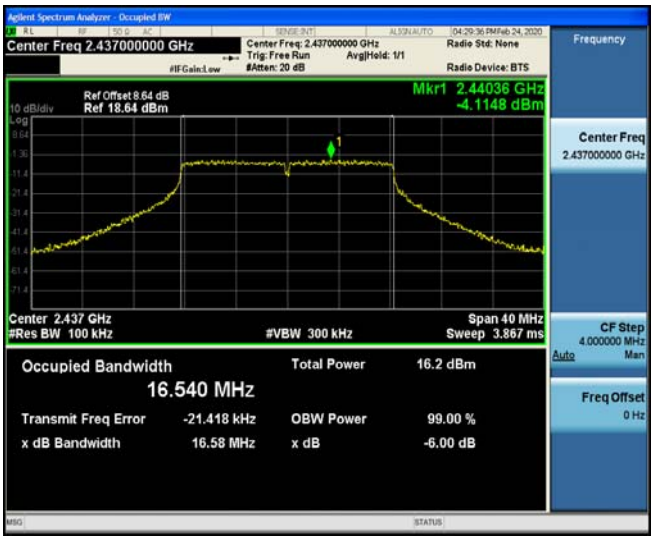


802.11g Modulation

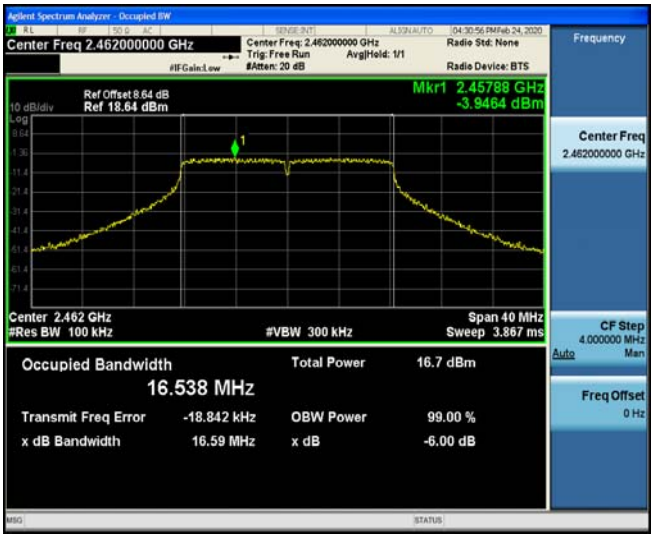
Lowest channel



Middle channel

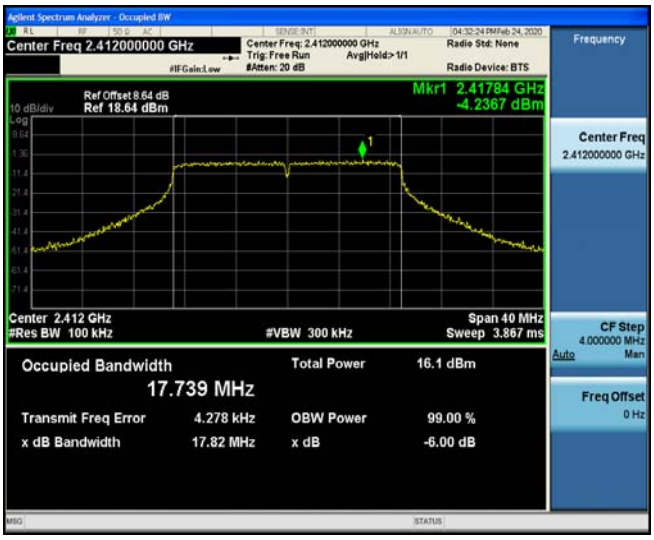


Highest channel

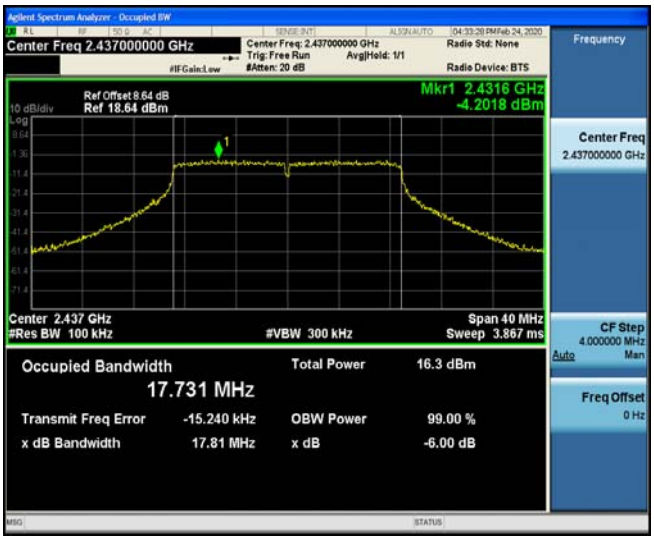


802.11n (HT20) Modulation

Lowest channel



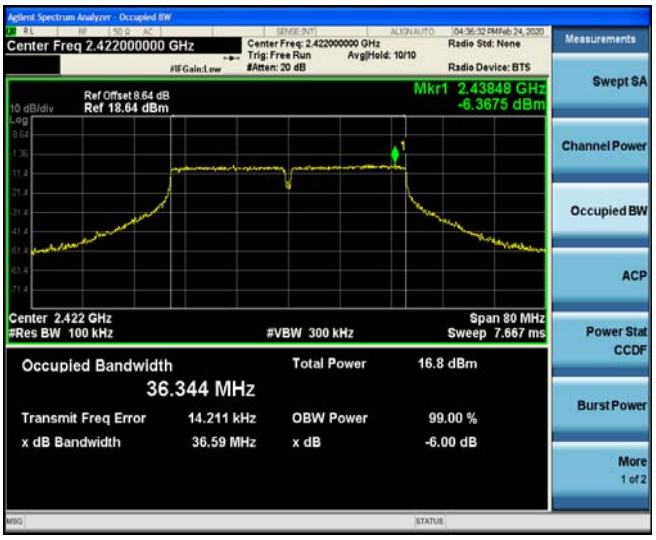
Middle channel



Highest channel

802.11n (HT40) Modulation

Lowest channel



Middle channel

Highest channel

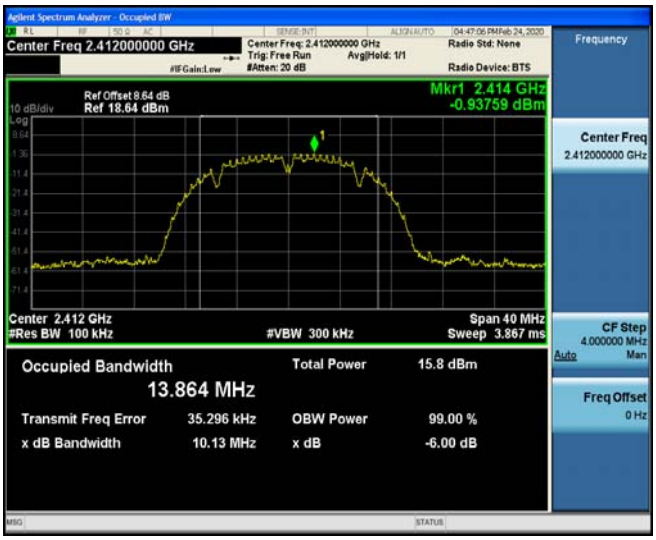
For antenna port 2

Test channel	6dB Emission Bandwidth (MHz)			
	802.11b	802.11g	802.11n(H20)	802.11n(H40)
Lowest	10.13	16.60	17.82	36.62
Middle	10.13	16.59	17.83	36.64
Highest	10.13	16.59	17.83	36.66
Limit:	≥500 (kHz)			
Test Result:	PASS			

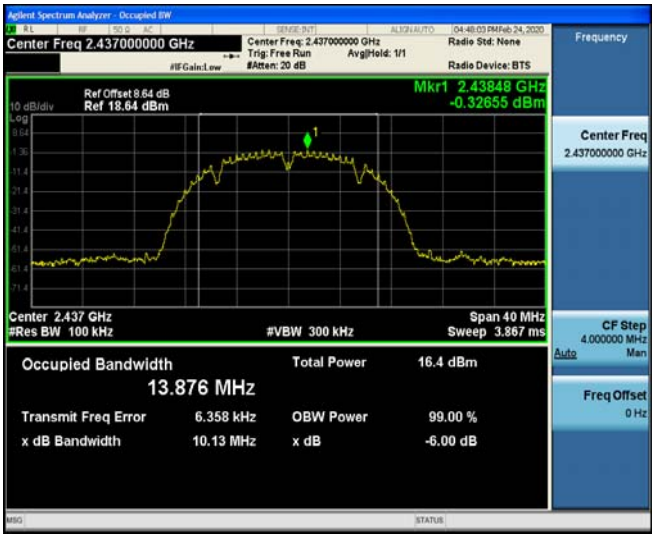
Test plots as follows:

802.11b Modulation

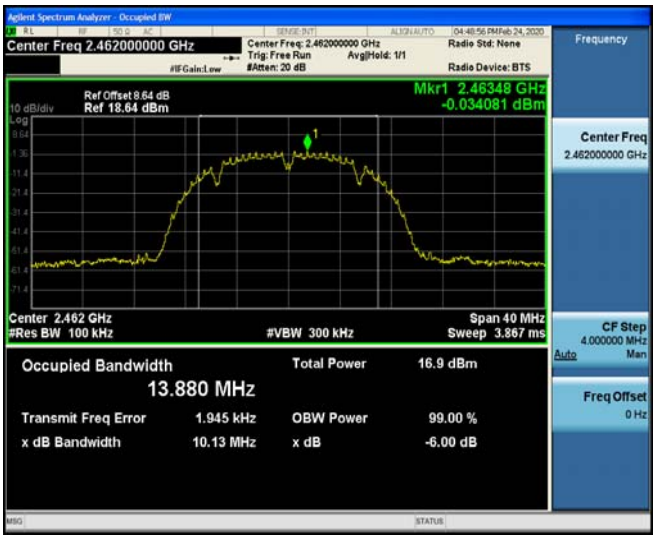
Lowest channel



Middle channel



Highest channel



802.11g Modulation

Lowest channel

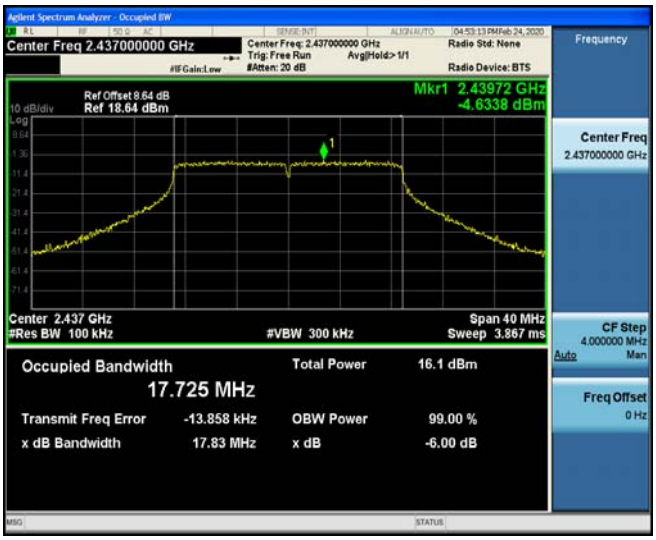
Middle channel

Highest channel

802.11n (HT20) Modulation

Lowest channel

Middle channel

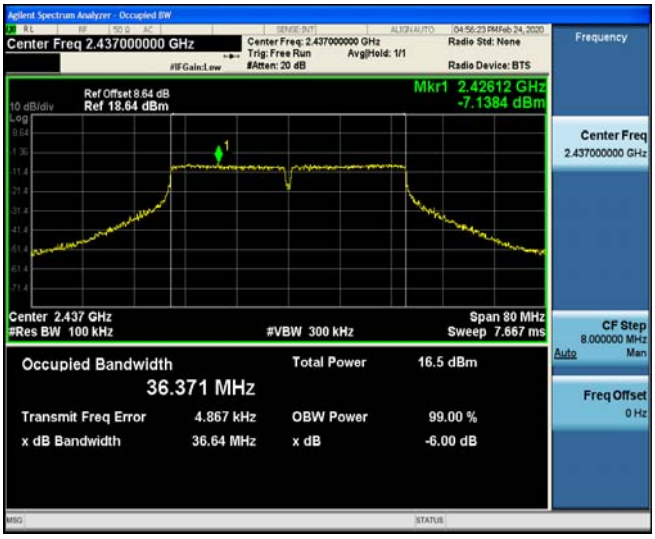


Highest channel

802.11n (HT40) Modulation

Lowest channel

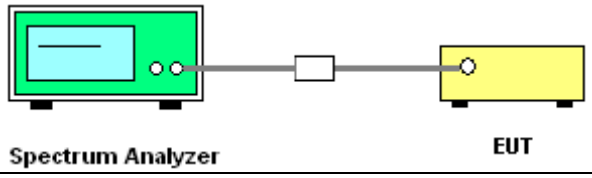
Middle channel



Highest channel

4.4. Power Spectral Density

4.4.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (e)
Test Method:	KDB 558074
Limit:	The average power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows Measurement procedure 10.2 method PKPSD of FCC KDB Publication No. 558074 DTS D01 Meas. Guidance v05r02 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW): 3 kHz ≤ RBW ≤ 100 kHz. Video bandwidth VBW ≥ 3 x RBW. Set the span to at least 1.5 times the OBW. 5. Detector = Peak, Sweep time = auto couple. 6. Employ trace averaging (Peak) mode over a minimum of 100 traces. Use the peak marker function to determine the maximum power level. 6. Measure and record the results in the test report.
Test Result:	PASS

4.4.2. Test Instruments

RF Test Room					
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 26, 2019	Dec. 25, 2020
RF Cable (9KHz-26.5GHz)	Tonscend	170660	N/A	Dec. 26, 2019	Dec. 25, 2020
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 26, 2019	Dec. 25, 2020

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

4.4.3. Test data

For antenna port 1

EUT Set Mode	Channel	Result (dBm/30kHz)	Result (dBm/3kHz)
802.11b	Lowest	-5.73	-15.73
	Middle	-5.48	-15.48
	Highest	-4.46	-14.46
802.11g	Lowest	-11.28	-21.28
	Middle	-13.16	-23.16
	Highest	-12.15	-22.15
802.11n(H20)	Lowest	-11.21	-21.21
	Middle	-11.21	-21.21
	Highest	-10.27	-20.27
802.11n(H40)	Lowest	-16.15	-26.15
	Middle	-16.16	-26.16
	Highest	-16.26	-26.26
PSD test result (dBm/3kHz)= PSD test result (dBm/30kHz)-10			
Limit: 8dBm/3kHz			
Test Result:	PASS		

Test plots as follows:

802.11b Modulation

Lowest channel

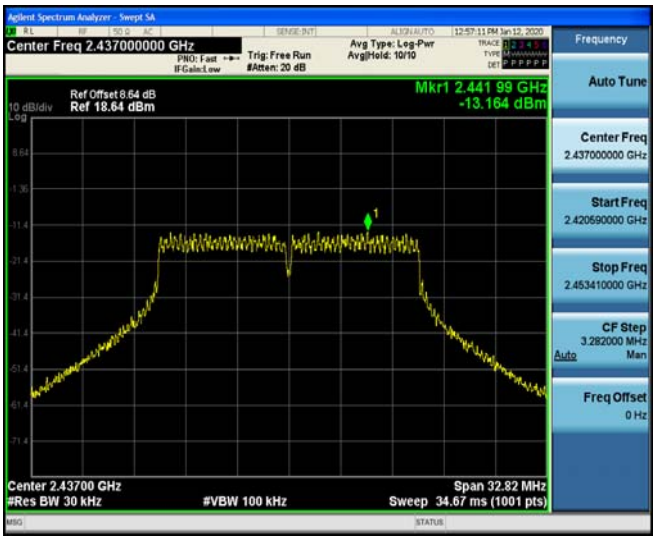
Middle channel

Highest channel

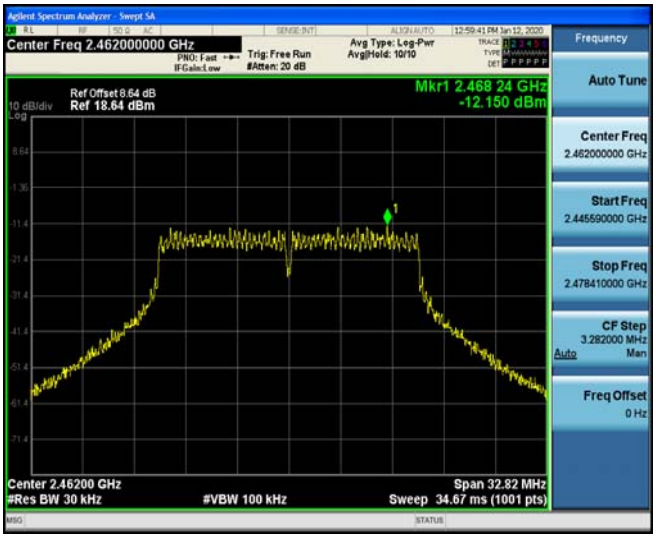
802.11g Modulation

Lowest channel

Middle channel



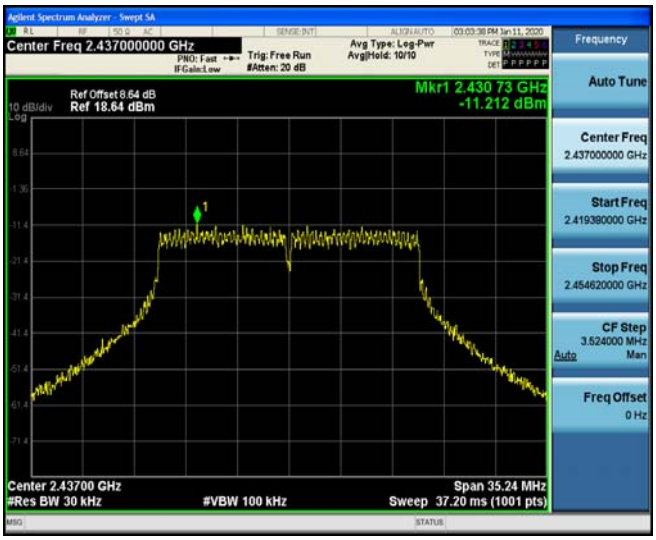
Highest channel



802.11n (HT20) Modulation

Lowest channel

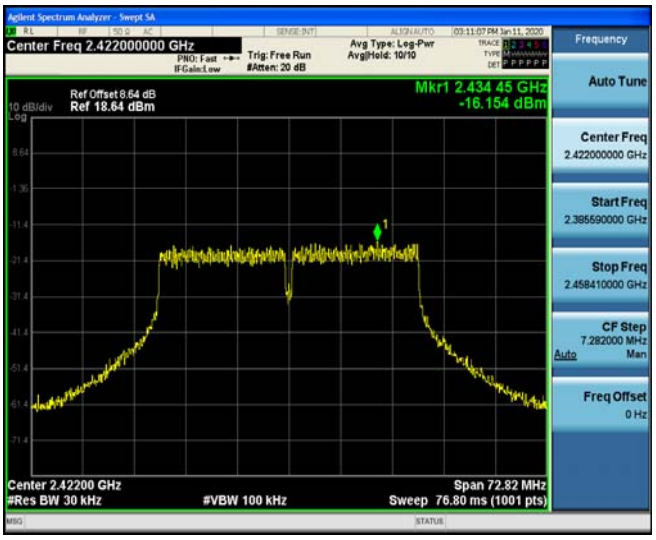
Middle channel



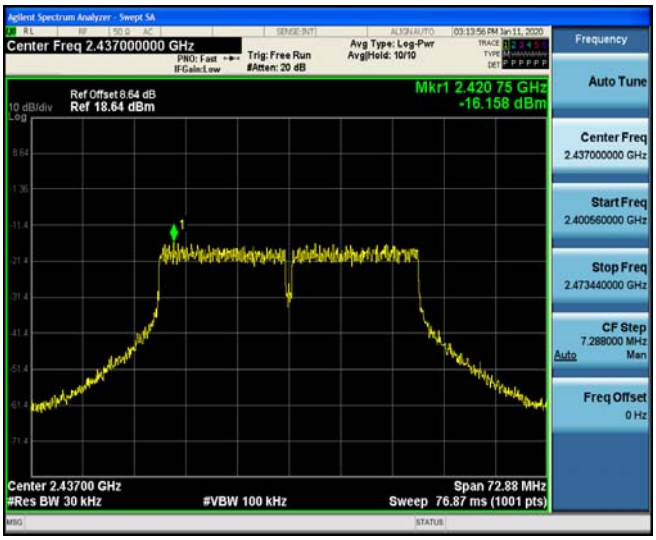
Highest channel

802.11n (HT40) Modulation

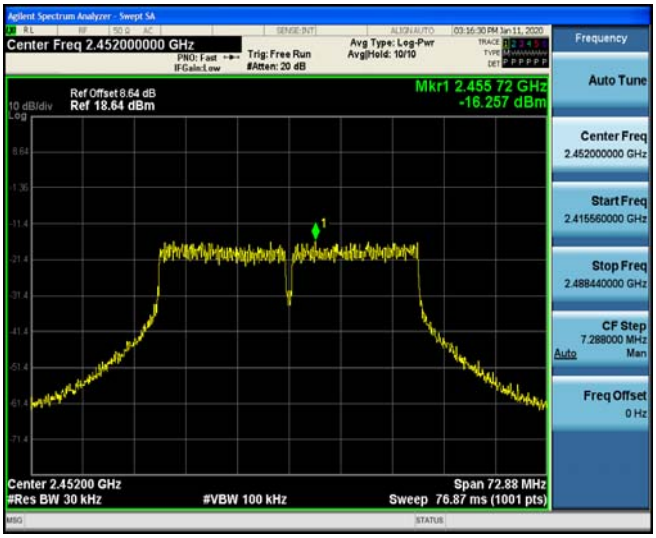
Lowest channel



Middle channel



Highest channel



For antenna port 2

EUT Set Mode	Channel	Result (dBm/30kHz)	Result (dBm/3kHz)
802.11b	Lowest	-5.62	-15.62
	Middle	-5.19	-15.19
	Highest	-5.05	-15.05
802.11g	Lowest	-11.68	-21.68
	Middle	-11.17	-21.17
	Highest	-11.18	-21.18
802.11n(H20)	Lowest	-12.46	-22.46
	Middle	-12.12	-22.12
	Highest	-11.54	-21.54
802.11n(H40)	Lowest	-15.01	-25.01
	Middle	-15.63	-25.63
	Highest	-15.97	-25.97
PSD test result (dBm/3kHz)= PSD test result (dBm/30kHz)-10			
Limit: 8dBm/3kHz			
Test Result:	PASS		

Test plots as follows:

802.11b Modulation

Lowest channel

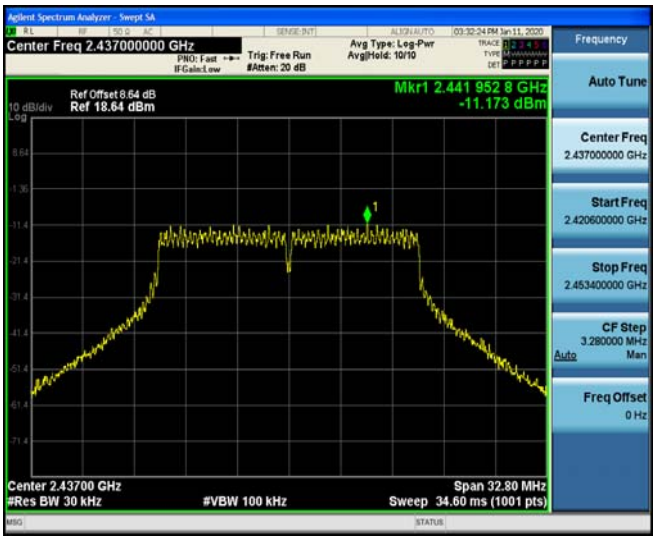
Middle channel

Highest channel

802.11g Modulation

Lowest channel

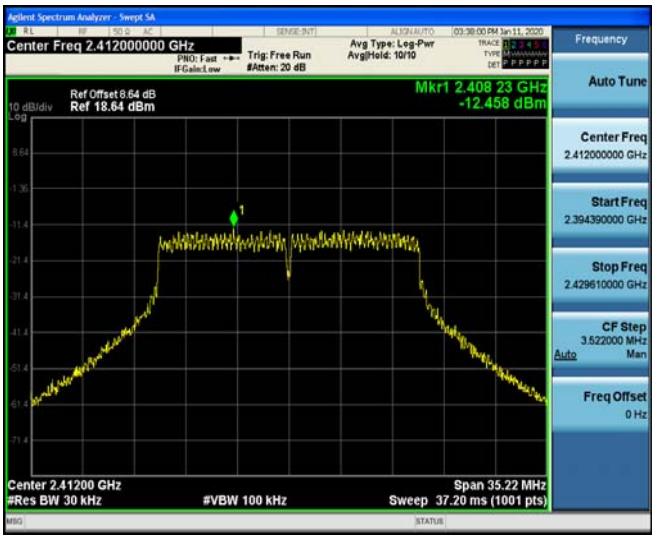
Middle channel



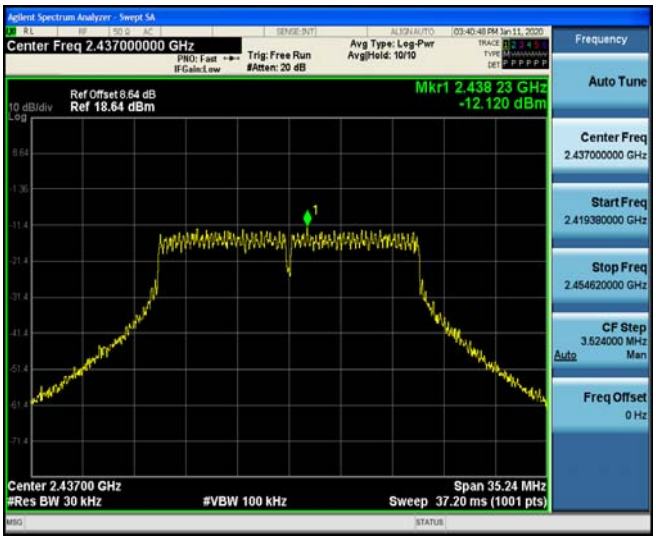
Highest channel

802.11n (HT20) Modulation

Lowest channel



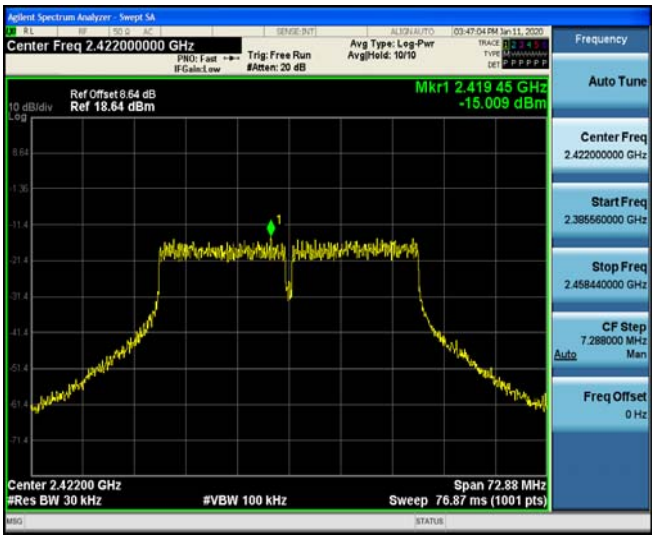
Middle channel



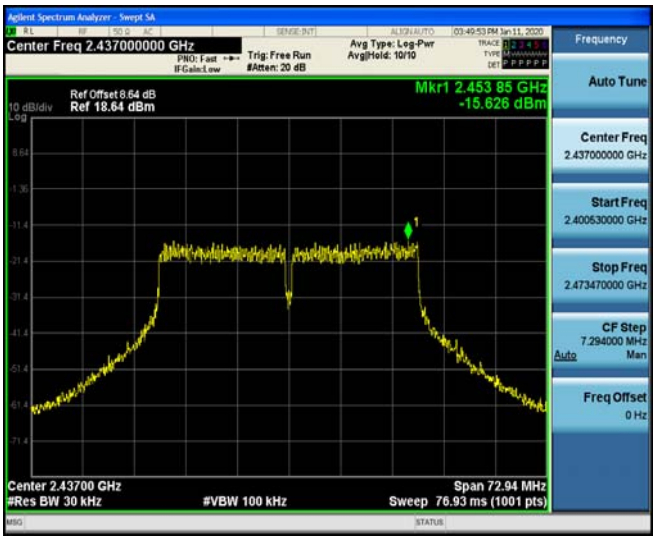
Highest channel

802.11n (HT40) Modulation

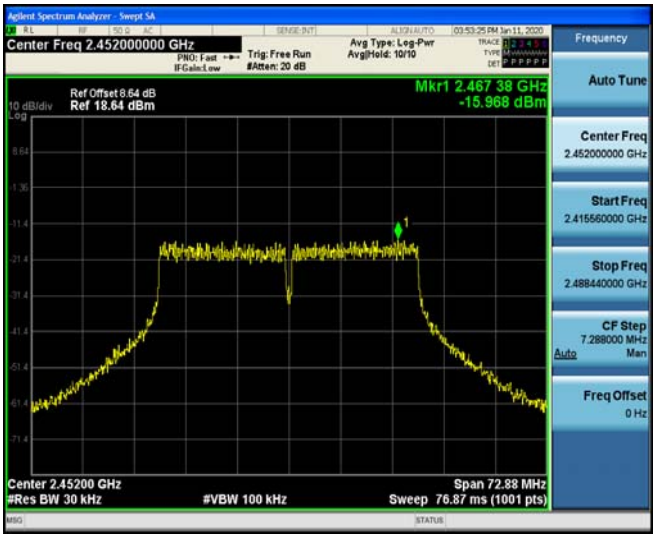
Lowest channel



Middle channel



Highest channel



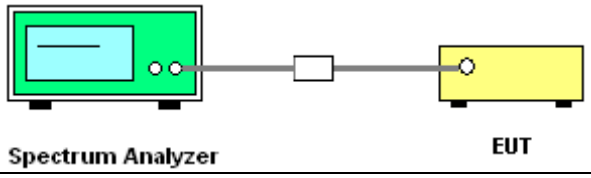
For MIMO antenna port 1+antenna port 2

Frequency	Power Density (dBm)	Limit (dBm)	Result
TX 802.11n/HT20 Mode			
2412 MHz	-8.78	6.49	**PASS**
2437 MHz	-8.63	6.49	**PASS**
2462 MHz	-7.85	6.49	**PASS**
TX 802.11n/HT40 Mode			
2422 MHz	-12.53	6.49	**PASS**
2437 MHz	-12.88	6.49	**PASS**
2452 MHz	-13.10	6.49	**PASS**
Note: 1 According to KDB 662911, Result power = $10\log(10^{(ant1/10}+10^{(ant2/10)})$. 2 Result unit: W, The end result is converted to units of dBm.			

Note: This product supports antenna 1 and antenna 2 launch, but only support 802.11 n for MIMO mode, not support 802.11 b and 802.11 g for MIMO mode.

4.5. Conducted Band Edge and Spurious Emission Measurement

4.5.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.247 (d)
Test Method:	KDB558074
Limit:	In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 20 dB / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement and 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).
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows FCC KDB Publication No. 558074 DTS D01 Meas. Guidance v05r02. 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement. 3. Set to the maximum power setting and enable the EUT transmit continuously. 4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d). 5. Measure and record the results in the test report. 6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
Test Result:	PASS

4.5.2. Test Instruments

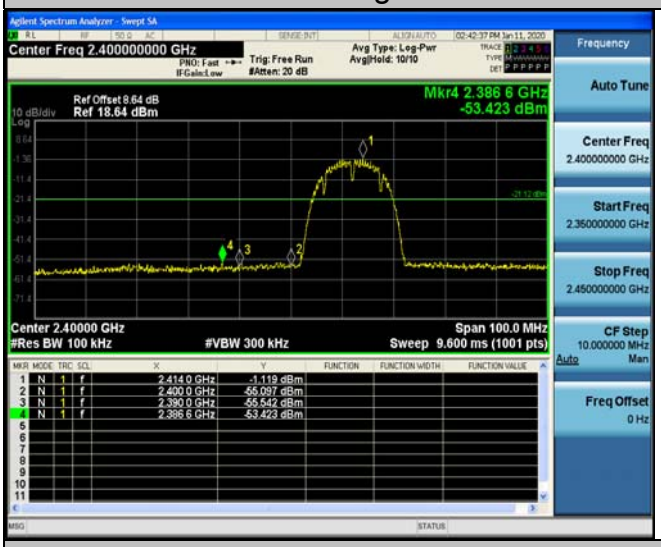
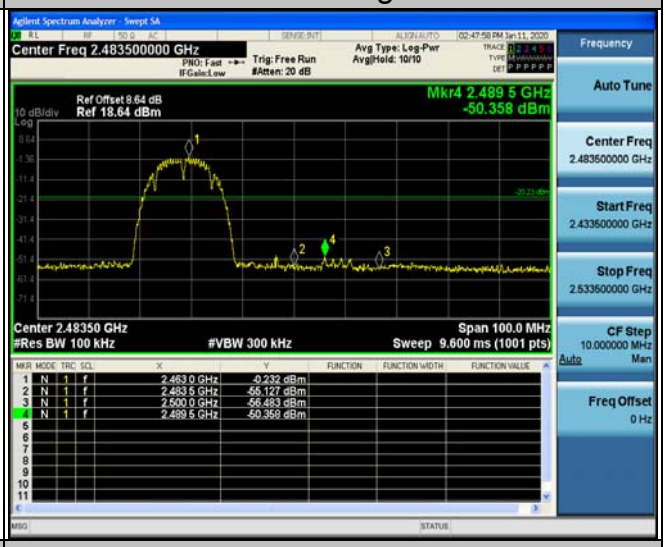
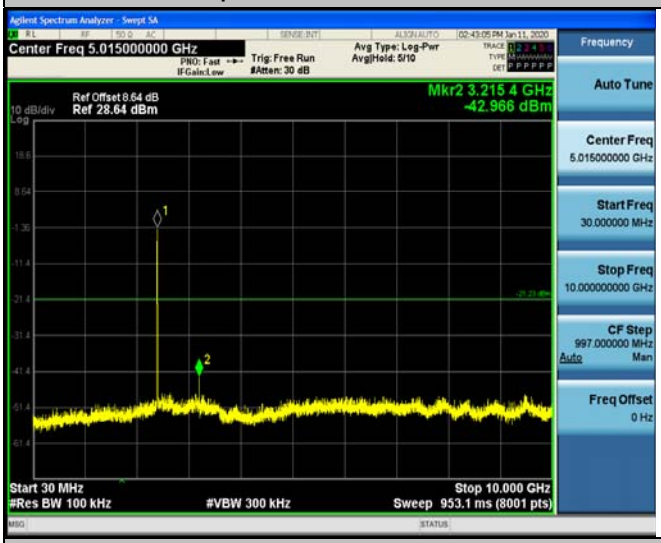
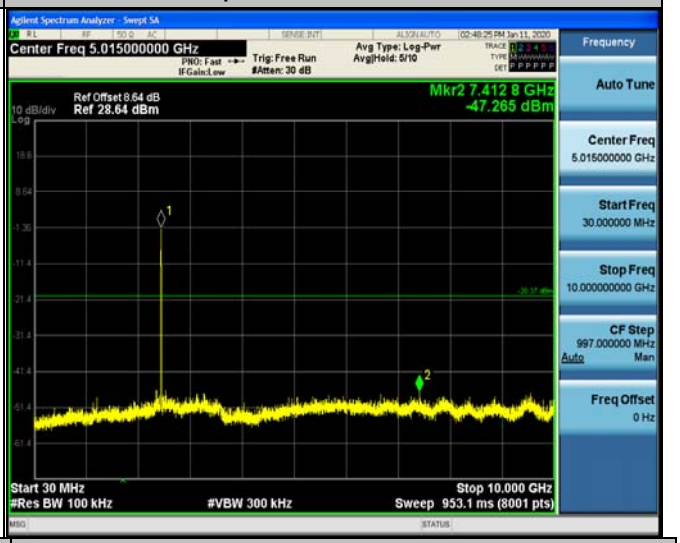
RF Test Room					
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 26, 2019	Dec. 25, 2020
Signal generator	Agilent	N5183A	HKE-071	Dec. 26, 2019	Dec. 25, 2020
RF Cable (9KHz-26.5GHz)	Tonscend	170660	N/A	Dec. 26, 2019	Dec. 25, 2020
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 26, 2019	Dec. 25, 2020

Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

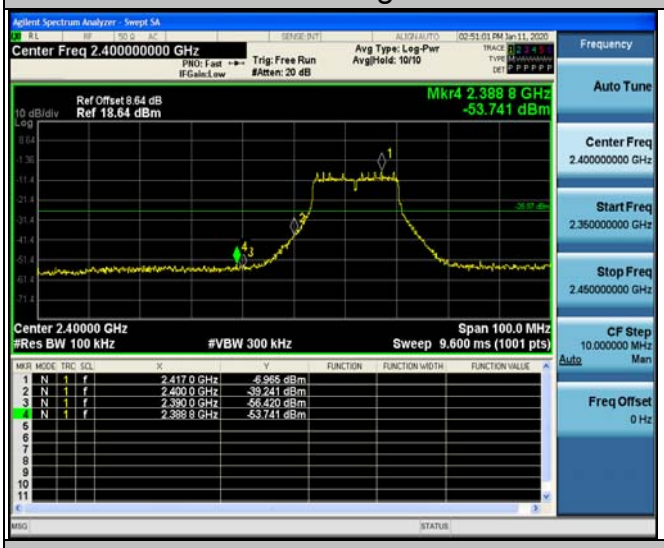
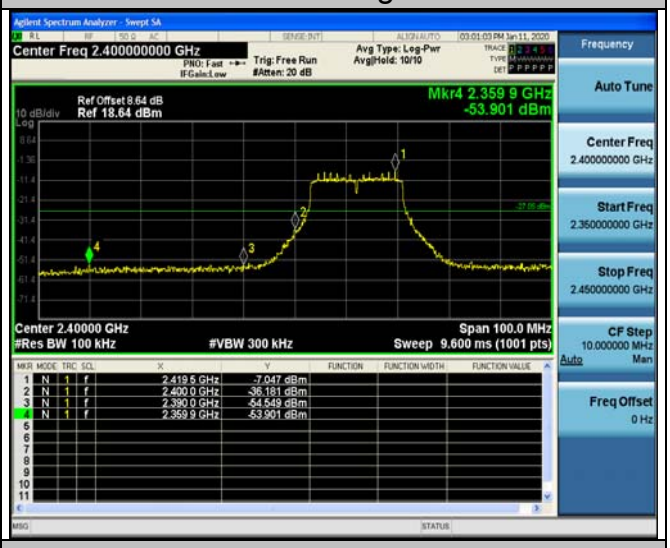
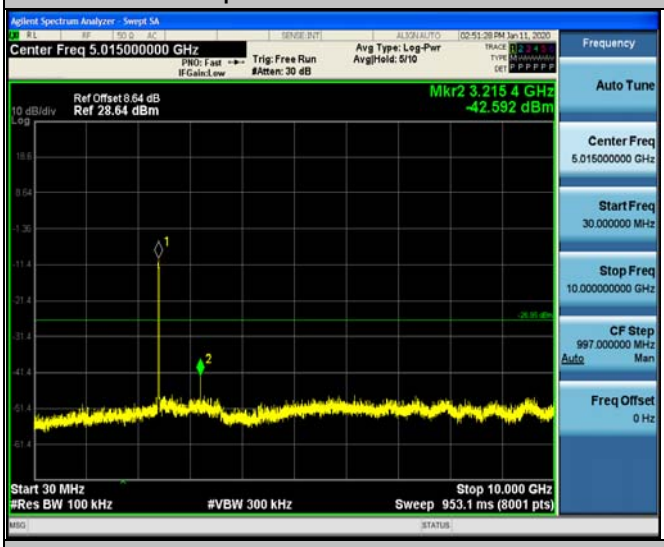
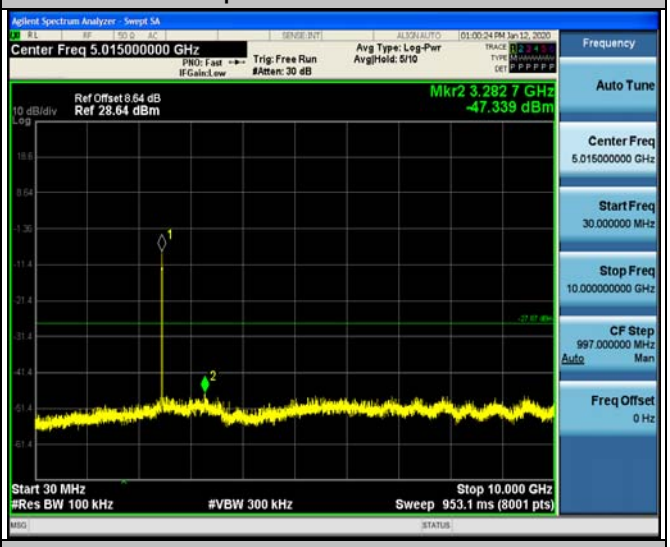
4.5.3. Test Data

Chain 1

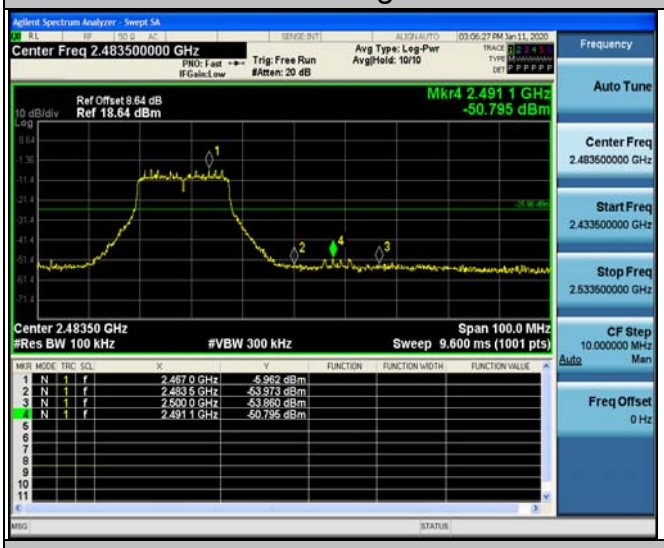
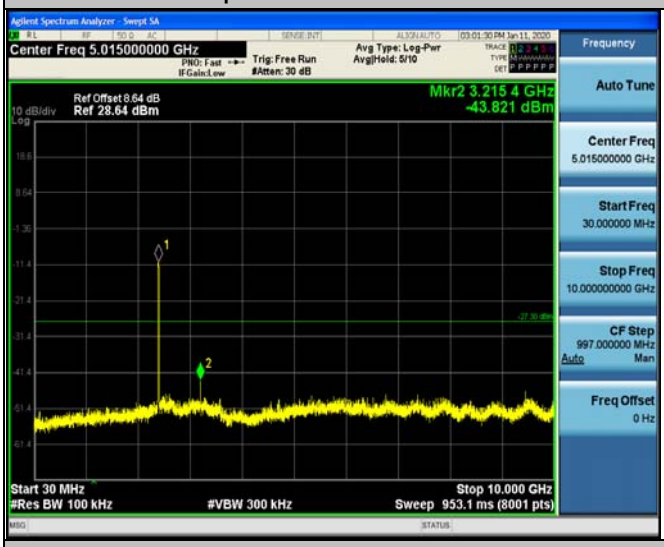
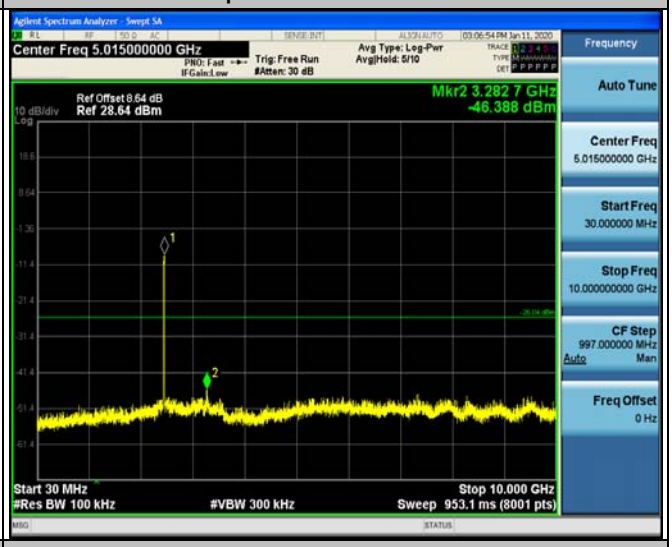
802.11b Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious emission	Spurious emission
	

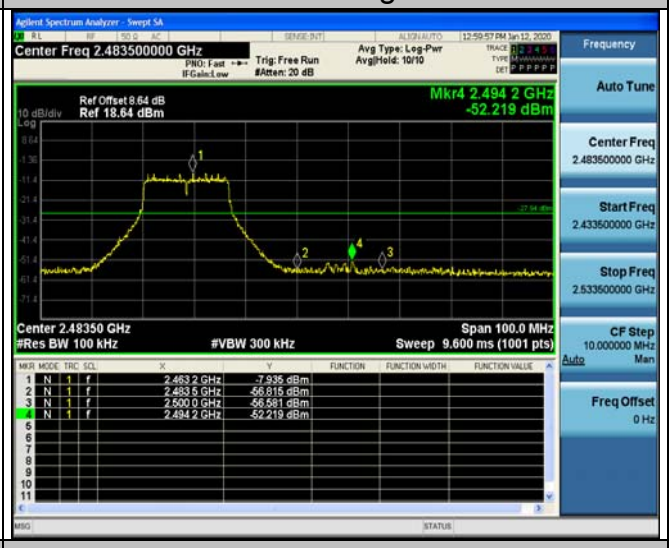
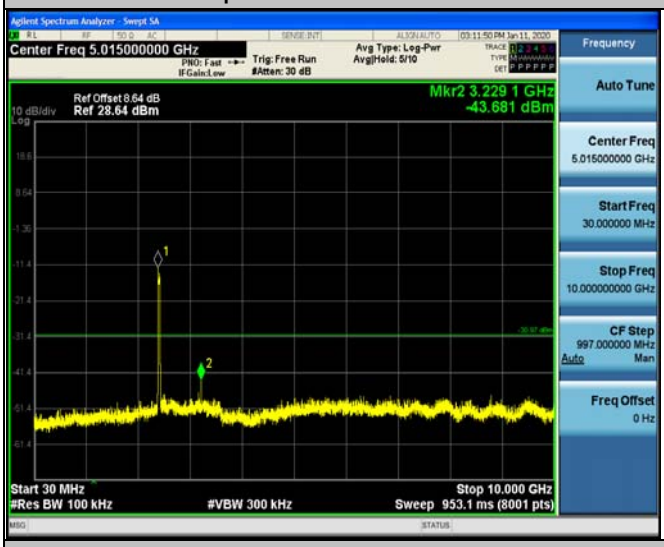
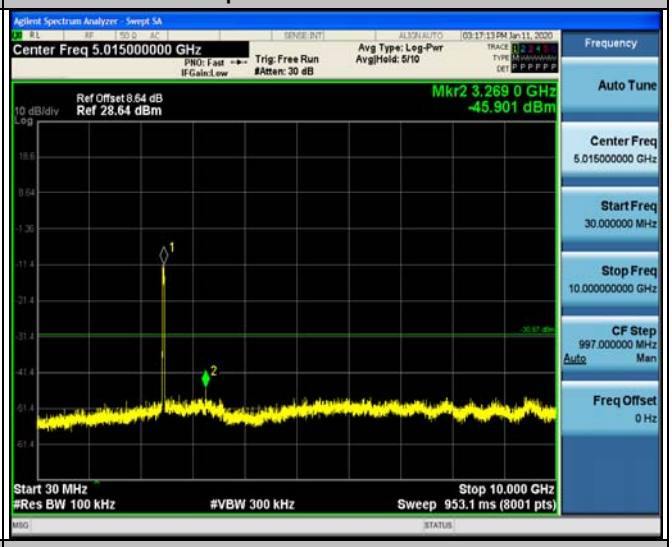
802.11g Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious emission	Spurious emission
	

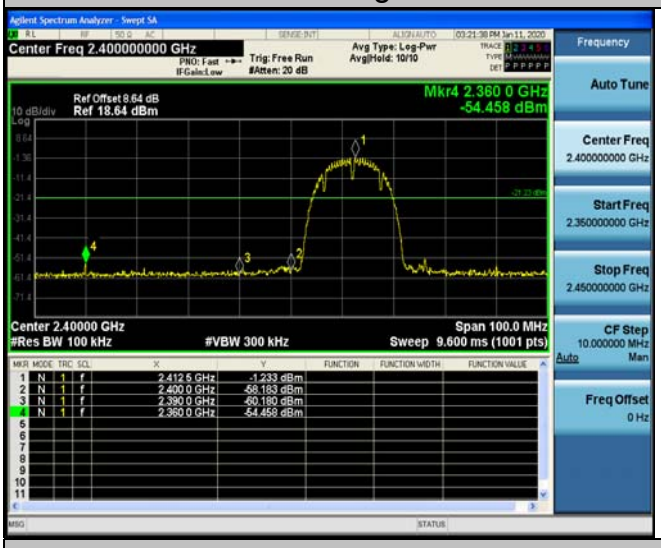
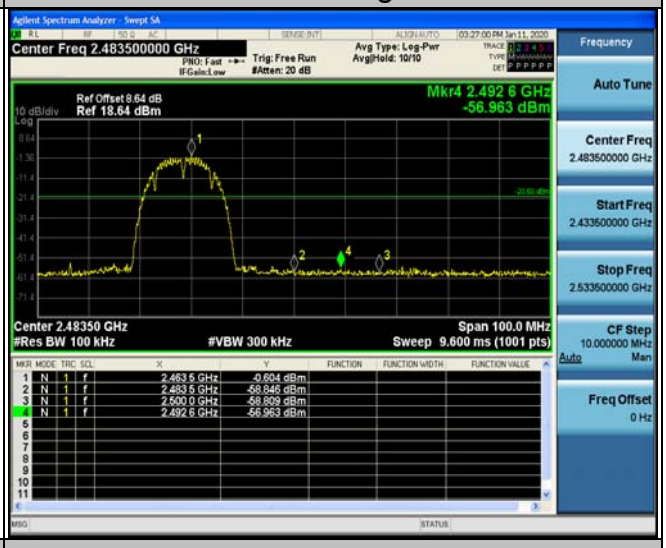
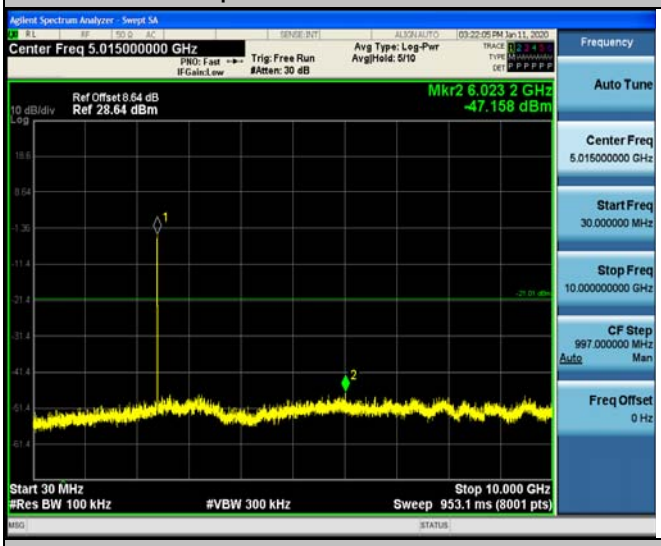
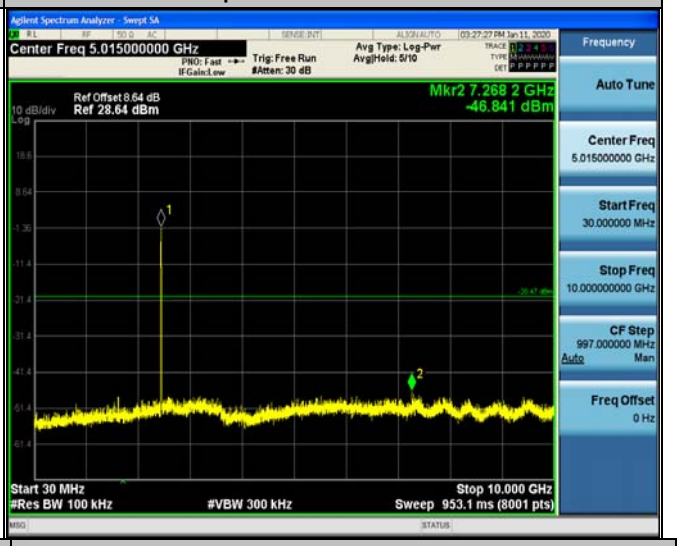
802.11n (HT20) Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious emission	Spurious emission
	

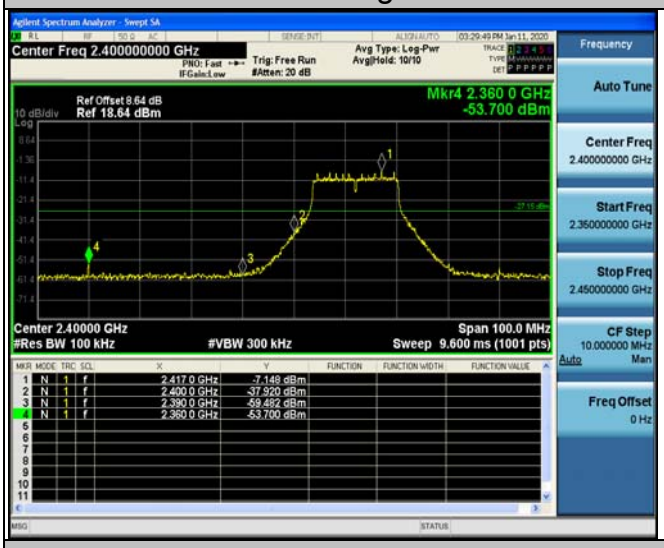
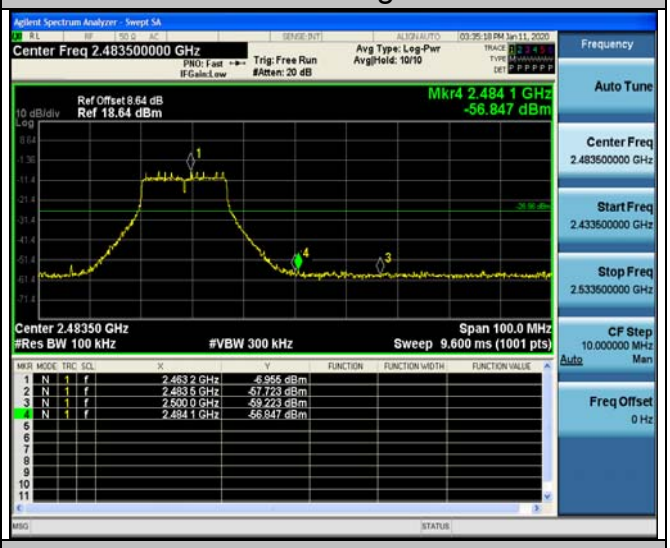
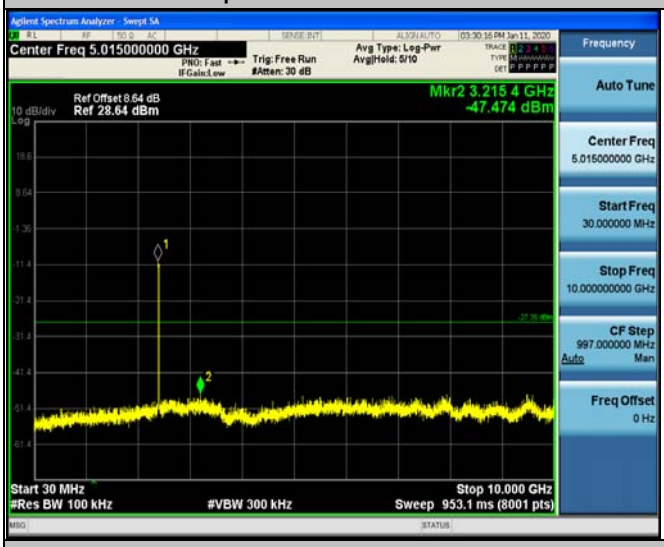
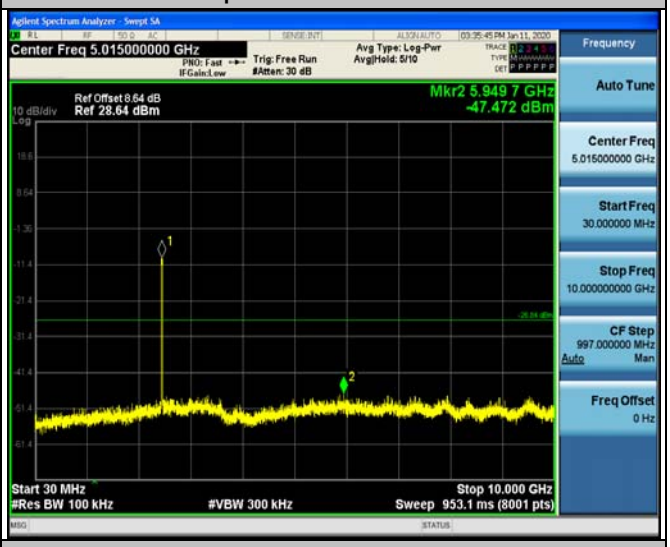
802.11n (HT40) Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious emission	Spurious emission
	

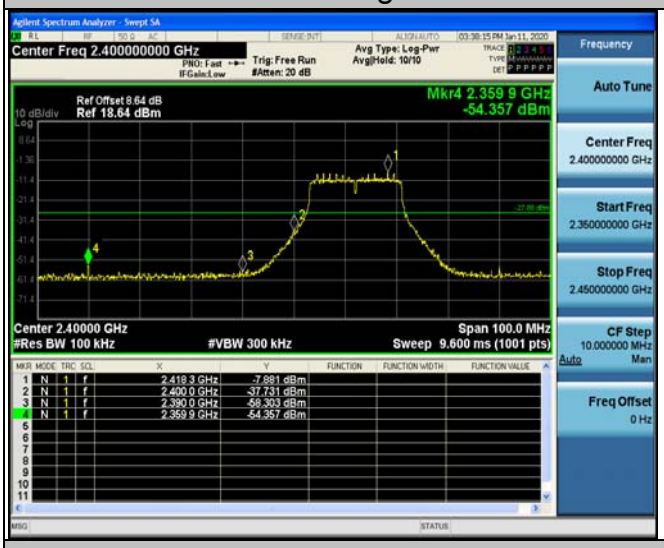
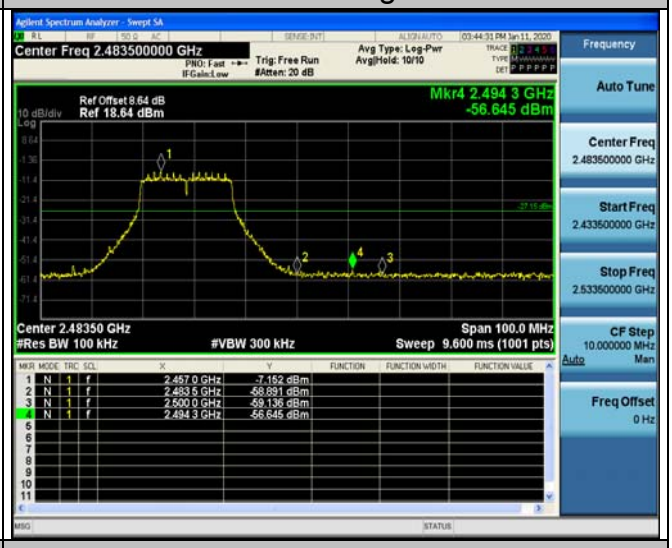
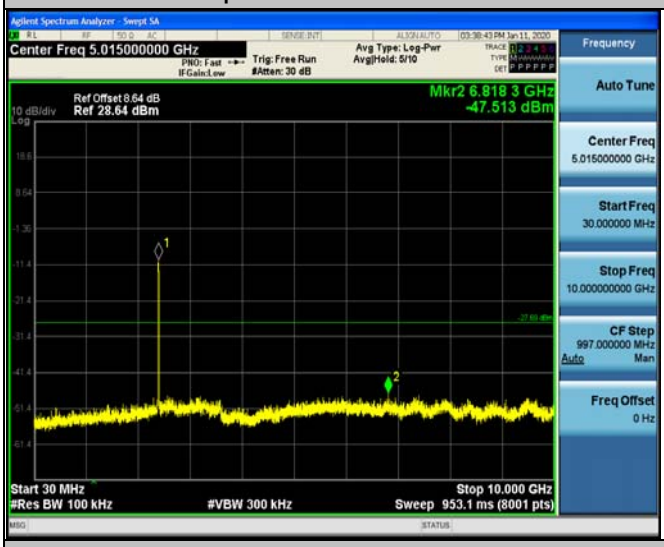
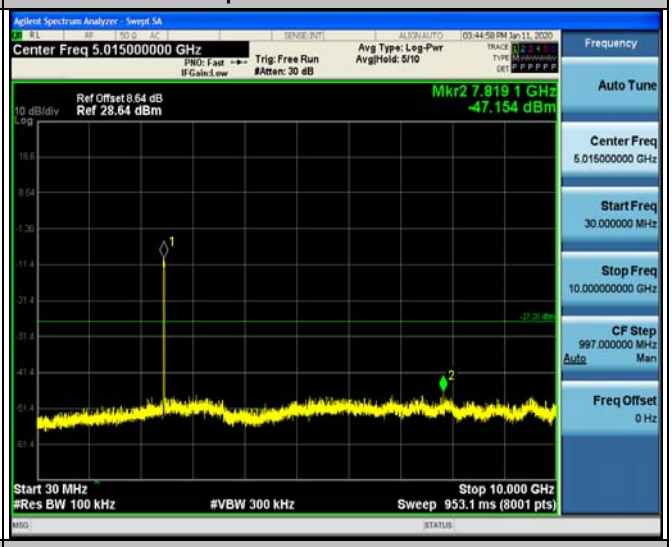
Chain 2
802.11b Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious emission	Spurious emission
	

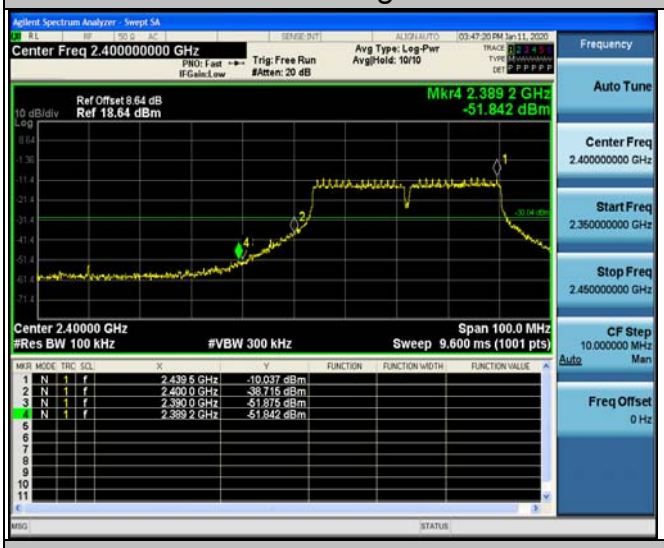
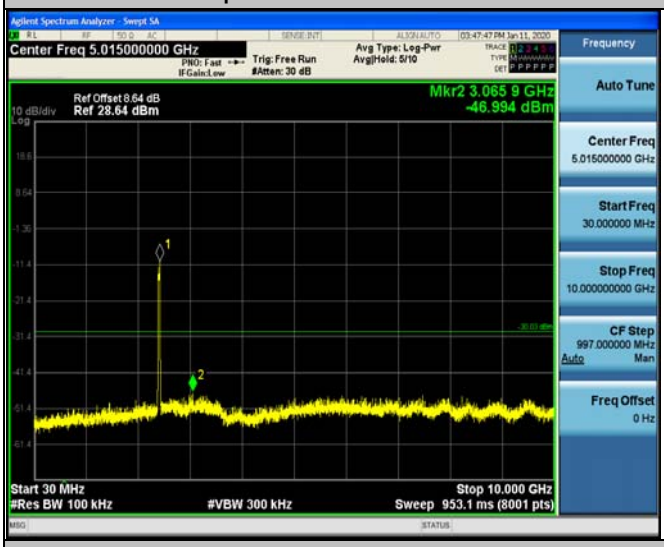
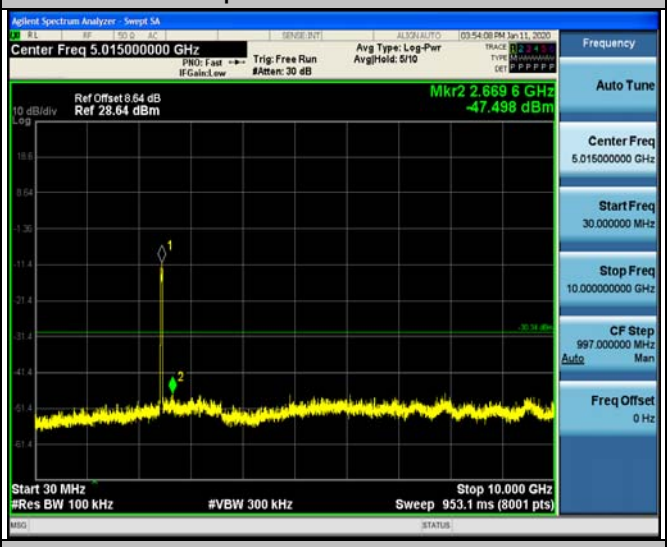
802.11g Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious emission	Spurious emission
	

802.11n (HT20) Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious emission	Spurious emission
	

802.11n (HT40) Modulation

Lowest Channel	Highest Channel
Band Edge	Band Edge
	
Spurious emission	Spurious emission
	

4.6. Radiated Spurious Emission Measurement

4.6.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.209
Test Method:	ANSI C63.10: 2013
Frequency Range:	9 kHz to 25 GHz
Measurement Distance:	3 m
Antenna Polarization:	Horizontal & Vertical
Operation mode:	Transmitting mode with modulation

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
9kHz- 150kHz	Quasi-peak	200Hz	1kHz	Quasi-peak Value
150kHz-30MHz	Quasi-peak	9kHz	30kHz	Quasi-peak Value
30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak Value
Above 1GHz	Peak	1MHz	3MHz	Peak Value
	Peak	1MHz	10Hz	Average Value

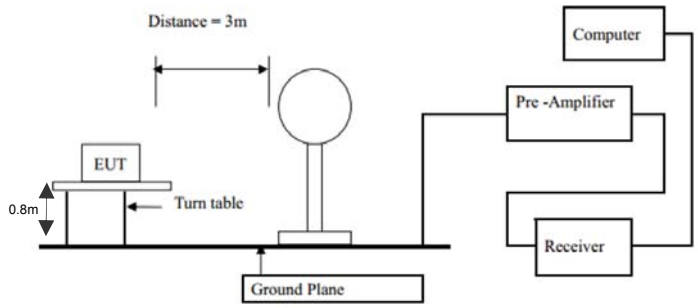
Limit:

Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009-0.490	2400/F(KHz)	300
0.490-1.705	24000/F(KHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Frequency	Field Strength (microvolts/meter)	Measurement Distance (meters)	Detector
Above 1GHz	500	3	Average
	5000	3	Peak

Test setup:

For radiated emissions below 30MHz



30MHz to 1GHz

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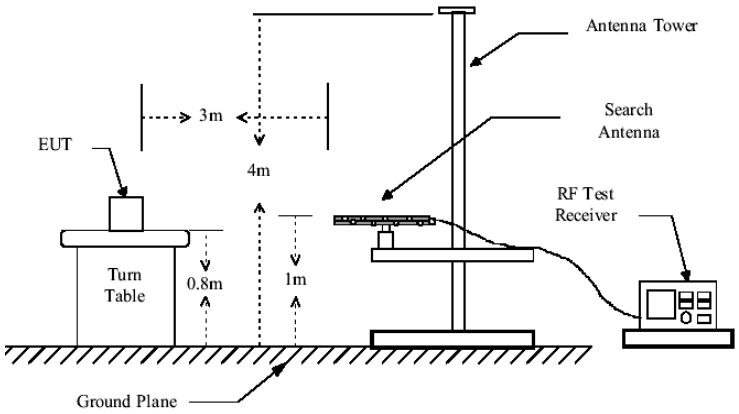
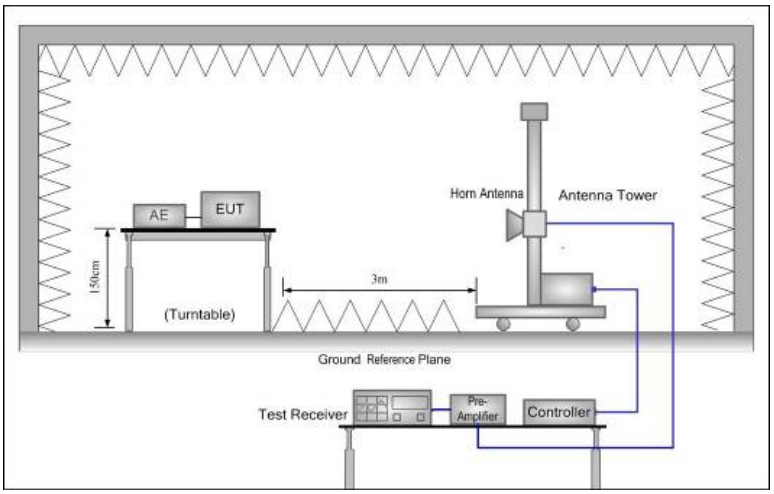


Above 1GHz


</td>
</tr>
<tr>
<td>Test Procedure:</td>
<td>1. For the radiated emission test below 1GHz:
The EUT was placed on a turntable with 0.8 meter above ground. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high PASS filter are used for the test in order to get better signal level.
For the radiated emission test above 1GHz:
Place the measurement antenna on a turntable with 1.5 meter above ground, which is away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which</td>
</tr>
</table>

	maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. 3. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level 4. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported. 5. Use the following spectrum analyzer settings: (1) Span shall wide enough to fully capture the emission being measured; (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥RBW; Sweep = auto; Detector function = peak; Trace = max hold; (3) Set RBW = 1 MHz, VBW= 3MHz for f 1 GHz for peak measurement. For average measurement: VBW = 10 Hz, when duty cycle is no less than 98 percent. VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
Test results:	PASS

4.6.2. Test Instruments

Radiated Emission Test Site (966)					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Receiver	R&S	ESCI-7	HKE-010	Dec. 26, 2019	Dec. 25, 2020
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 26, 2019	Dec. 25, 2020
Preamplifier	EMCI	EMC051845 SE	HKE-015	Dec. 26, 2019	Dec. 25, 2020
Preamplifier	Agilent	83051A	HKE-016	Dec. 26, 2019	Dec. 25, 2020
Loop antenna	Schwarzbeck	FMZB 1519 B	HKE-014	Dec. 26, 2019	Dec. 25, 2020
Broadband antenna	Schwarzbeck	VULB 9163	HKE-012	Dec. 26, 2019	Dec. 25, 2020
Horn antenna	Schwarzbeck	9120D	HKE-013	Dec. 26, 2019	Dec. 25, 2020
Antenna Mast	Keleto	CC-A-4M	N/A	N/A	N/A
Position controller	Taiwan MF	MF7802	HKE-011	Dec. 26, 2019	Dec. 25, 2020
Radiated test software	Tonscend	TS+ Rev 2.5.0.0	HKE-082	N/A	N/A
RF cable (9KHz-1GHz)	Times	381806-001	N/A	N/A	N/A
RF cable	Times	1-40G	HKE-034	Dec. 26, 2019	Dec. 25, 2020

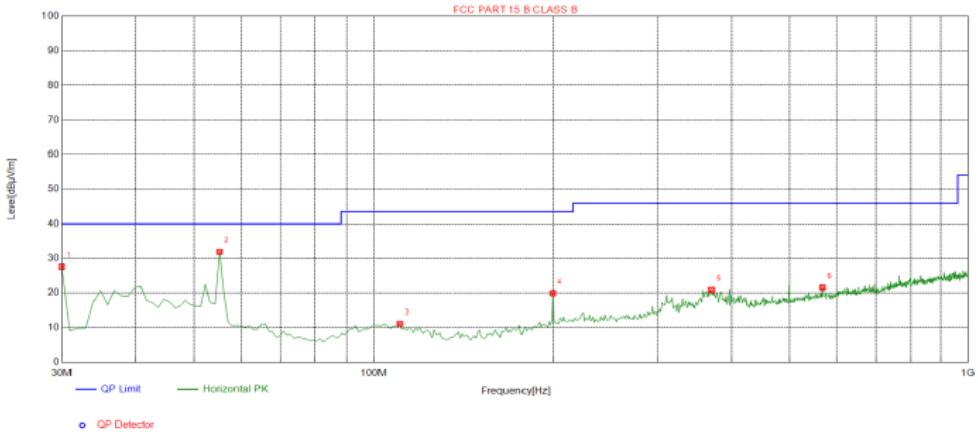
Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

4.6.3. Test Data

Please refer to following diagram for individual
Below 1GHz

test mode: TX 802.11b 2412MHz
All the test modes completed for test. The worst case of Radiated Emission; the test data of this mode was reported.

Horizontal

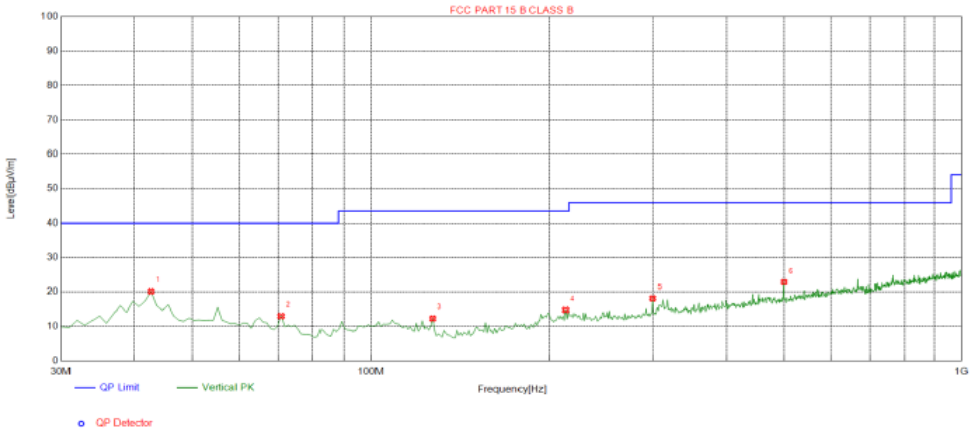


Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	30.0000	-16.34	43.93	27.59	40.00	12.41	100	188	Horizontal
2	55.2452	-14.44	46.35	31.91	40.00	8.09	100	233	Horizontal
3	110.5906	-15.53	26.58	11.05	43.50	32.45	100	79	Horizontal
4	199.9199	-15.07	35.02	19.95	43.50	23.55	100	312	Horizontal
5	369.8398	-11.01	31.85	20.84	46.00	25.16	100	136	Horizontal
6	568.8889	-6.43	28.03	21.60	46.00	24.40	100	172	Horizontal

Final Data List

Remark: Factor = Cable loss + Antenna factor – Preamplifier; Level = Reading + Factor; Margin = Limit – Level;

Vertical



Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	42.6226	-14.07	34.22	20.15	40.00	19.85	100	74	Vertical
2	70.7808	-17.81	30.78	12.97	40.00	27.03	100	267	Vertical
3	127.0971	-18.14	30.40	12.26	43.50	31.24	100	80	Vertical
4	213.5135	-14.72	29.47	14.75	43.50	28.75	100	348	Vertical
5	299.9299	-12.74	30.85	18.11	46.00	27.89	100	3	Vertical
6	499.9500	-8.30	31.17	22.87	46.00	23.13	100	251	Vertical

Final Data List

Remark: Factor = Cable loss + Antenna factor – Preamplifier; Level = Reading + Factor; Margin = Limit – Level;

Remark：
(1) Measuring frequencies from 9 KHz to the 1 GHz, Radiated emission test from 9KHz to 30MHz was verified, and no any emission was found except system noise floor.
(2) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(3) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.

Above 1GHz

RADIATED EMISSION TEST

LOW CH1 (802.11b Mode)/2412

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	61.66	-3.64	58.02	74	-15.98	peak
4824	47.23	-3.64	43.59	54	-10.41	AVG
7236	57.16	-0.95	56.21	74	-17.79	peak
7236	43.03	-0.95	42.08	54	-11.92	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4824	62.45	-3.64	58.81	74	-15.19	peak
4824	47.28	-3.64	43.64	54	-10.36	AVG
7236	57.12	-0.95	56.17	74	-17.83	peak
7236	43.98	-0.95	43.03	54	-10.97	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

MID CH6 (802.11b Mode)/2437

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	65.45	-3.51	61.94	74	-12.06	peak
4874	45.78	-3.51	42.27	54	-11.73	AVG
7311	57.69	-0.82	56.87	74	-17.13	peak
7311	38.52	-0.82	37.7	54	-16.3	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4874	62.26	-3.51	58.75	74	-15.25	peak
4874	44.03	-3.51	40.52	54	-13.48	AVG
7311	56.87	-0.82	56.05	74	-17.95	peak
7311	41.08	-0.82	40.26	54	-13.74	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

HIGH CH11 (802.11b Mode)/2462

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4924	61.89	-3.43	58.46	74	-15.54	peak
4924	42.08	-3.43	38.65	54	-15.35	AVG
7386	55.34	-0.75	54.59	74	-19.41	peak
7386	40.75	-0.75	40	54	-14	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4924	61.63	-3.43	58.2	74	-15.8	peak
4924	44.15	-3.43	40.72	54	-13.28	AVG
7386	53.27	-0.75	52.52	74	-21.48	peak
7386	38.74	-0.75	37.99	54	-16.01	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz。
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency. “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4) Data of measurement within this frequency range shown “--- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.

LOW CH1 (802.11g Mode)/2412

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4824	64.46	-3.64	60.82	74	-13.18	peak
4824	43.62	-3.64	39.98	54	-14.02	AVG
7236	54.74	-0.95	53.79	74	-20.21	peak
7236	43.68	-0.95	42.73	54	-11.27	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4824	61.63	-3.64	57.99	74	-16.01	peak
4824	44.05	-3.64	40.41	54	-13.59	AVG
7236	58.13	-0.95	57.18	74	-16.82	peak
7236	43.75	-0.95	42.8	54	-11.2	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

MID CH6 (802.11g Mode)/2437

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4874	61.77	-3.51	58.26	74	-15.74	peak
4874	48.25	-3.51	44.74	54	-9.26	AVG
7311	54.39	-0.82	53.57	74	-20.43	peak
7311	42.17	-0.82	41.35	54	-12.65	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4874	63.48	-3.51	59.97	74	-14.03	peak
4874	44.73	-3.51	41.22	54	-12.78	AVG
7311	52.24	-0.82	51.42	74	-22.58	peak
7311	41.69	-0.82	40.87	54	-13.13	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

HIGH CH11 (802.11g Mode)/2462

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4924	60.68	-3.43	57.25	74	-16.75	peak
4924	44.93	-3.43	41.5	54	-12.5	AVG
7386	54.81	-0.75	54.06	74	-19.94	peak
7386	38.78	-0.75	38.03	54	-15.97	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4924	61.45	-3.43	58.02	74	-15.98	peak
4924	46.22	-3.43	42.79	54	-11.21	AVG
7386	53.86	-0.75	53.11	74	-20.89	peak
7386	41.89	-0.75	41.14	54	-12.86	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz。
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency. “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4) Data of measurement within this frequency range shown “--- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.

LOW CH1 (802.11n/H20 Mode)/2412

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4824	61.11	-3.64	57.47	74	-16.53	peak
4824	47.56	-3.64	43.92	54	-10.08	AVG
7236	58.34	-0.95	57.39	74	-16.61	peak
7236	42.05	-0.95	41.1	54	-12.9	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4824	62.48	-3.64	58.84	74	-15.16	peak
4824	47.69	-3.64	44.05	54	-9.95	AVG
7236	57.74	-0.95	56.79	74	-17.21	peak
7236	41.46	-0.95	40.51	54	-13.49	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

MID CH6 (802.11n/H20 Mode)/2437

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4874.00	63.56	-3.51	60.05	74.00	-13.95	peak
4874.00	43.57	-3.51	40.06	54.00	-13.94	AVG
7311.00	55.26	-0.82	54.44	74.00	-19.56	peak
7311.00	44.01	-0.82	43.19	54.00	-10.81	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4874.00	60.74	-3.51	57.23	74.00	-16.77	peak
4874.00	45.32	-3.51	41.81	54.00	-12.19	AVG
7311.00	55.68	-0.82	54.86	74.00	-19.14	peak
7311.00	42.08	-0.82	41.26	54.00	-12.74	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

HIGH CH11 (802.11n/H20 Mode)/2462

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4924	58.14	-3.43	54.71	74	-19.29	peak
4924	44.88	-3.43	41.45	54	-12.55	AVG
7386	54.32	-0.75	53.57	74	-20.43	peak
7386	42.69	-0.75	41.94	54	-12.06	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4924	64.14	-3.43	60.71	74	-13.29	peak
4924	44.52	-3.43	41.09	54	-12.91	AVG
7386	54.39	-0.75	53.64	74	-20.36	peak
7386	38.15	-0.75	37.4	54	-16.6	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

LOW CH3 (802.11n/H40 Mode)/2422

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4844	60.77	-3.63	57.14	74	-16.86	peak
4844	46.35	-3.63	42.72	54	-11.28	AVG
7266	56.89	-0.94	55.95	74	-18.05	peak
7266	44.02	-0.94	43.08	54	-10.92	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4844	62.15	-3.63	58.52	74	-15.48	peak
4844	46.35	-3.63	42.72	54	-11.28	AVG
7266	3.02	-0.94	2.08	74	-71.92	peak
7266	41.51	-0.94	40.57	54	-13.43	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

MID CH6 (802.11n/H40 Mode)/2437

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4874	62.45	-3.51	58.94	74	-15.06	peak
4874	47.61	-3.51	44.1	54	-9.9	AVG
7311	52.58	-0.82	51.76	74	-22.24	peak
7311	44.67	-0.82	43.85	54	-10.15	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4874	62.77	-3.51	59.26	74	-14.74	peak
4874	43.56	-3.51	40.05	54	-13.95	AVG
7311	55.22	-0.82	54.4	74	-19.6	peak
7311	38.69	-0.82	37.87	54	-16.13	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

HIGH CH9 (802.11n/H40 Mode)/2452
Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4904	62.14	-3.43	58.71	74	-15.29	peak
4904	43.25	-3.43	39.82	54	-14.18	AVG
7356	54.69	-0.75	53.94	74	-20.06	peak
7356	42.35	-0.75	41.6	54	-12.4	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
4904	61.74	-3.43	58.31	74	-15.69	peak
4904	48.35	-3.43	44.92	54	-9.08	AVG
7356	55.16	-0.75	54.41	74	-19.59	peak
7356	42.88	-0.75	42.13	54	-11.87	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Remark：
(1) Measuring frequencies from 1 GHz to the 25 GHz。
(2) “F” denotes fundamental frequency; “H” denotes spurious frequency. “E” denotes band edge frequency.
(3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
(4) Data of measurement within this frequency range shown “--- ” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
(5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.
(6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.

Test Result of Radiated Spurious at Band edges

Operation Mode:
802.11b Mode TX CH Low (2412MHz)

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2310	62.57	-5.81	56.76	74	-17.24	peak
2310	/	-5.81	/	54	/	AVG
2390	62.31	-5.84	56.47	74	-17.53	peak
2390	52.24	-5.84	46.4	54	-7.6	AVG
2400	62.36	-5.84	56.52	74	-17.48	peak
2400	48.38	-5.84	42.54	54	-11.46	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2310	55.34	-5.81	49.53	74	-24.47	peak
2310	/	-5.81	/	54	/	AVG
2390	61.32	-5.84	55.48	74	-18.52	peak
2390	48.76	-5.84	42.92	54	-11.08	AVG
2400	62.69	-5.84	56.85	74	-17.15	peak
2400	45.26	-5.84	39.42	54	-14.58	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Operation Mode: TX CH High (2462MHz)

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	58.14	-5.65	52.49	74	-21.51	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	53.68	-5.65	48.03	74	-25.97	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	56.34	-5.65	50.69	74	-23.31	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	55.16	-5.65	49.51	74	-24.49	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

Operation Mode: 802.11g Mode TX CH Low (2412MHz)

Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	56.47	-5.81	50.66	74	-23.34	peak
2310	/	-5.81	/	54	/	AVG
2390	61.25	-5.84	55.41	74	-18.59	peak
2390	46.39	-5.84	40.55	54	-13.45	AVG
2400	62.88	-5.84	57.04	74	-16.96	peak
2400	49.48	-5.84	43.64	54	-10.36	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	56.49	-5.81	50.68	74	-23.32	peak
2310	/	-5.81	/	54	/	AVG
2390	62.24	-5.84	56.4	74	-17.6	peak
2390	48.52	-5.84	42.68	54	-11.32	AVG
2400	61.45	-5.84	55.61	74	-18.39	peak
2400	47.23	-5.84	41.39	54	-12.61	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Operation Mode: TX CH High (2462MHz)

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	59.15	-5.65	53.5	74	-20.5	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	53.28	-5.65	47.63	74	-26.37	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	51.69	-5.65	46.04	74	-27.96	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	52.78	-5.65	47.13	74	-26.87	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

Operation Mode: 802.11n/H20 Mode TX CH Low (2412MHz)

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2310	56.74	-5.81	50.93	74	-23.07	peak
2310	/	-5.81	/	54	/	AVG
2390	61.28	-5.84	55.44	74	-18.56	peak
2390	48.69	-5.84	42.85	54	-11.15	AVG
2400	60.03	-5.84	54.19	74	-19.81	peak
2400	48.66	-5.84	42.82	54	-11.18	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2310	54.62	-5.81	48.81	74	-25.19	peak
2310	/	-5.81	/	54	/	AVG
2390	63.68	-5.84	57.84	74	-16.16	peak
2390	47.95	-5.84	42.11	54	-11.89	AVG
2400	64.94	-5.84	59.1	74	-14.9	peak
2400	48.86	-5.84	43.02	54	-10.98	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Operation Mode: TX CH High (2462MHz)

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	55.45	-5.65	49.8	74	-24.2	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	54.12	-5.65	48.47	74	-25.53	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	56.17	-5.65	50.52	74	-23.48	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	54.66	-5.65	49.01	74	-24.99	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

Operation Mode: 802.11n/H40 Mode TX CH Low (2422MHz)

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2310	60.52	-5.81	54.71	74	-19.29	peak
2310	/	-5.81	/	54	/	AVG
2390	62.38	-5.84	56.54	74	-17.46	peak
2390	45.28	-5.84	39.44	54	-14.56	AVG
2400	62.33	-5.84	56.49	74	-17.51	peak
2400	45.07	-5.84	39.23	54	-14.77	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2310	58.14	-5.81	52.33	74	-21.67	peak
2310	/	-5.81	/	54	/	AVG
2390	61.35	-5.84	55.51	74	-18.49	peak
2390	45.22	-5.84	39.38	54	-14.62	AVG
2400	61.86	-5.84	56.02	74	-17.98	peak
2400	47.05	-5.84	41.21	54	-12.79	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Operation Mode: TX CH High (2452MHz)

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	56.63	-5.65	50.98	74	-23.02	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	53.08	-5.65	47.43	74	-26.57	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2483.50	54.75	-5.65	49.1	74	-24.9	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	53.24	-5.65	47.59	74	-26.41	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

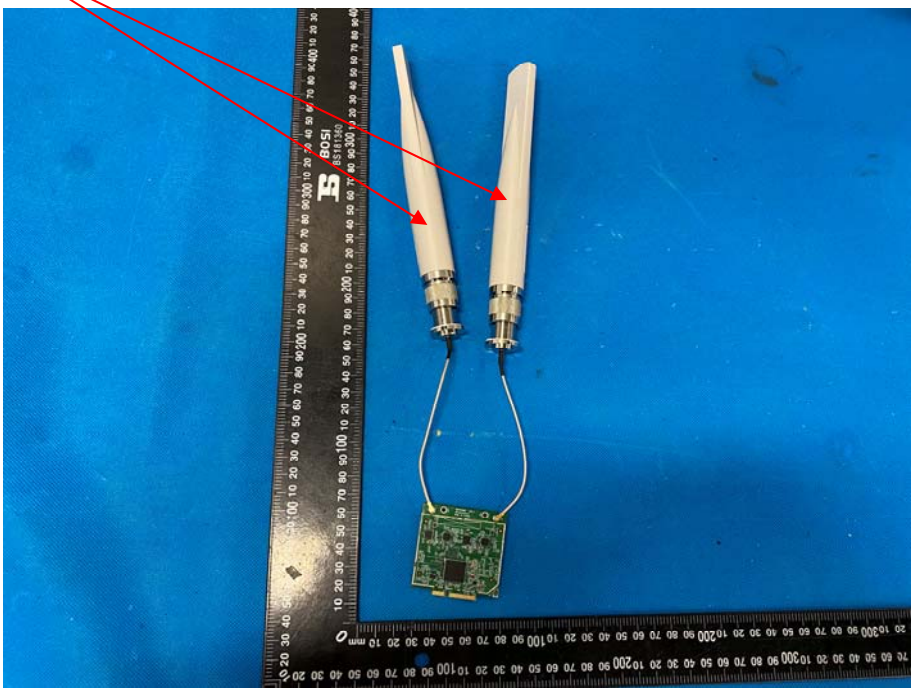
4.7. ANTENNA REQUIREMENT

Standard Applicable
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, 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.

Refer to statement below for compliance.
The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

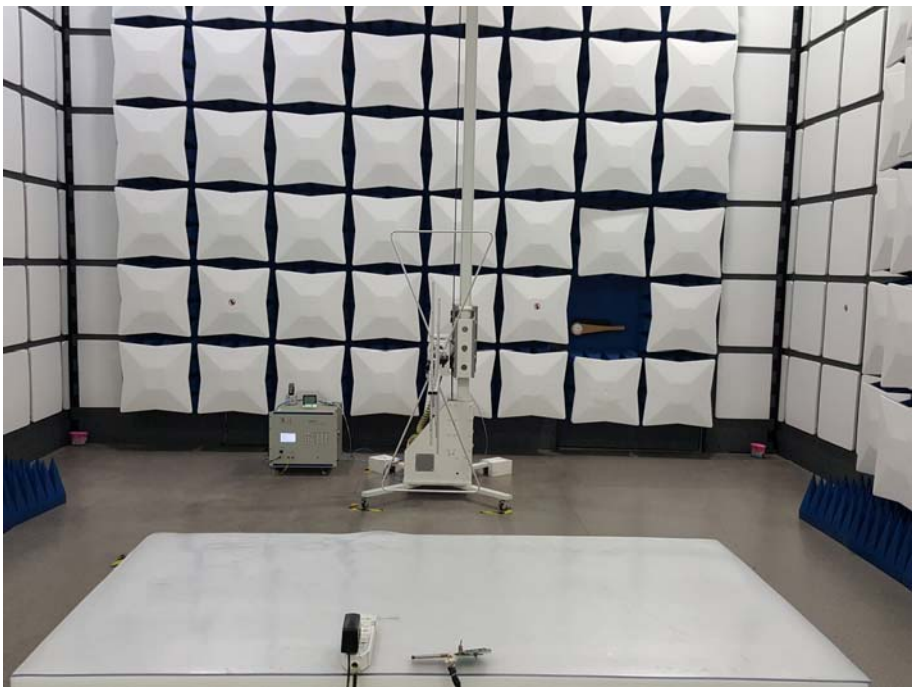
Antenna Connected Construction
The antenna used in this product is a Integral Antenna, and the best case gain of the antenna is Antenna port 1:4.5dBi and Antenna port 2:4.5dBi.

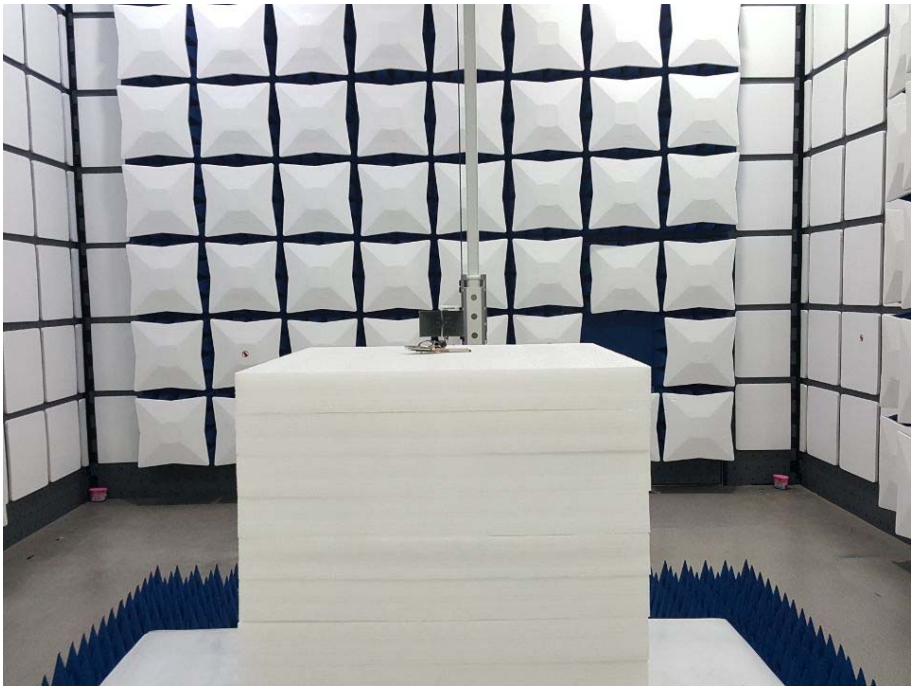
WIFI ANTENNA



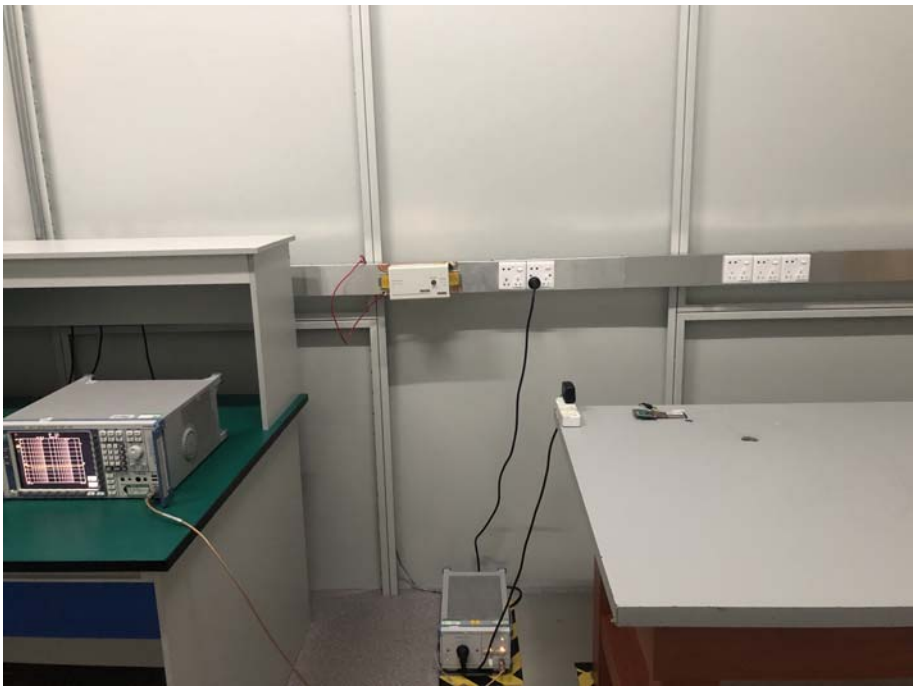
PHOTOGRAPH OF TEST

Radiated Emission





Conducted Emission



4.8. PHOTOS OF THE EUT

Reference to the reporter : ANNEX A of external photos and ANNEX B of internal photos

*******End of Report*******