FCC TEST REPORT

Test report
On Behalf of
Webee Corporation
For
Smartee G3
Model No.: SM3001, SM3001+, SM3001x, PCHQ1

FCC ID: 2AVI7-91DA3C

Prepared for :	**Webee Corporation**
	SUITE# W014. 440 N. Wolfe Road, Sunnyvale, CA 94085
Prepared By :	**Shenzhen HUAK Testing Technology Co., Ltd.**
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Date of Test:	**Oct. 06, 2019 ~Oct. 12, 2019**
Date of Report:	**Oct. 12, 2019**
Report Number:	**HK1910082514-9E**

TEST RESULT CERTIFICATION

Applicant's name.....: Webee Corporation

Address .....: SUITE# W014. 440 N. Wolfe Road, Sunnyvale, CA 94085

Manufacture's Name.....: Webee Corporation

Address .....: SUITE# W014. 440 N. Wolfe Road, Sunnyvale, CA 94085

Product description

Trade Mark: N/A

Product name.....: Smartee G3

Model and/or type reference .: SM3001, SM3001+, SM3001x, PCHQ1

Standards .....: FCC Rules and Regulations Part 15 Subpart C Section 15.407
ANSI C63.10: 2013

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Date of Test .....:

Date (s) of performance of tests .....: Oct. 06, 2019 ~Oct. 12, 2019

Date of Issue.....: Oct. 12, 2019

Test Result.....: Pass

Prepared by: Gary Qian

Project Engineer

Reviewed by: Leo Zhang

Project Supervisor

Approved by: James Zhou

Technical Director

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1. Test Result Summary

1.1. TEST PROCEDURES AND RESULTS

Requirement	CFR 47 Section	Result
Antenna requirement	§15.203	PASS
AC Power Line Conducted Emission	§15.207	PASS
Maximum Conducted Output Power	§15.407(a)	PASS
6dB Emission Bandwidth	§15.407(e)	PASS
26dB Emission Bandwidth& 99% Occupied Bandwidth	§15.407(a)	PASS
Power Spectral Density	§15.407(a)	PASS
Band edge	§15.407(a)	PASS
Radiated Emission	§15.407(a)	PASS
Frequency Stability	§15.407(g)	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	Smartee G3
Model Name	SM3001
Serial No.	SM3001+, SM3001x, PCHQ1
Trade Mark	N/A
Model Difference	All model's the function, software and electric circuit are the same, only with a product color and model named different. Test sample model: SM3001
FCC ID	2AVI7-91DA3C
Operation Frequency:	IEEE 802.11a/n/ac(HT20) 5.180GHz-5.240GHz IEEE 802.11n/ac(HT40) 5.190GHz-5.230GHz IEEE 802.11ac(HT80) 5.210GHz
Modulation Technology:	IEEE 802.11a/n/ac
Modulation Type	CCK/OFDM/DBPSK/DAPSK
Antenna Type	Internal Antenna
Antenna Gain	2dBi
Power Source	DC5V/3A From Adapter
Power Supply:	DC5V/3A From Adapter

2.2. Operation Frequency each of channel

802.11a/802.11n(HT20) 802.11ac(HT20)		802.11n(HT40)/ 802.11ac(HT40)		802.11ac(HT80)	
Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180	38	5190	42	5210
40	5200	46	5230		
44	5220				
48	5240				

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

For 802.11a/n (HT20)/ac(HT20)

Band I (5150 - 5250 MHz)		
Channel Number	Channel	Frequency (MHz）
36	Low	5180
40	Mid	5200
48	High	5240

For 802.11n (HT40)/ ac(HT40)

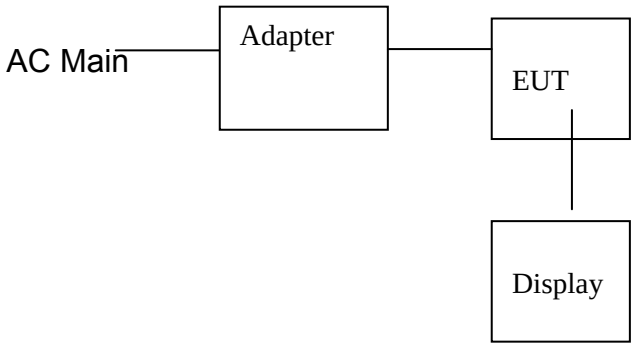
Band I (5150 - 5250 MHz)		
Channel Number	Channel	Frequency (MHz）
38	Low	5190
46	High	5230

For 802.11ac(HT80)

Band I (5150 - 5250 MHz)	
Channel Number	Frequency (MHz）
42	5210

2.4. DESCRIPTION OF TEST SETUP

Operation of EUT during Conducted, Radiation testing:



Operation of EUT during Above1GHz Radiation testing:

- Adapter information
  Model: TEKA018-0503000UK
  Input: 100-240V~ 50/60Hz, 0.5Amax
  Output: 5V, 3000mA

- Display information
  Model: 24PFF3661/T3
  Input: AC 120V/60Hz

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 Z 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 100%)
The sample was placed 0.8m/1.5m for blow/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.	

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
802.11a	6 Mbps
802.11n(HT20)	MCS0
802.11n(HT40)	MCS0
802.11ac(HT20)/ac(HT40)/ac(HT80)	/
Final Test Mode:	
Operation mode:	Keep the EUT in continuous transmitting with modulation

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
/	/	/	/	/

Note:

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

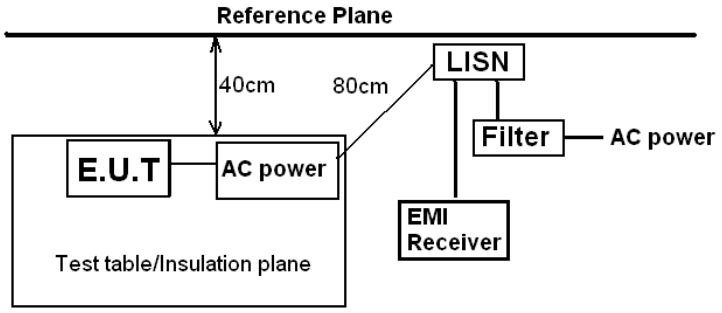
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

3. For conducted measurements (Output Power, 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>Tx Mode</td></tr>
<tr><td>Test Procedure:</td><td>1. The E.U.T and simulators are 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

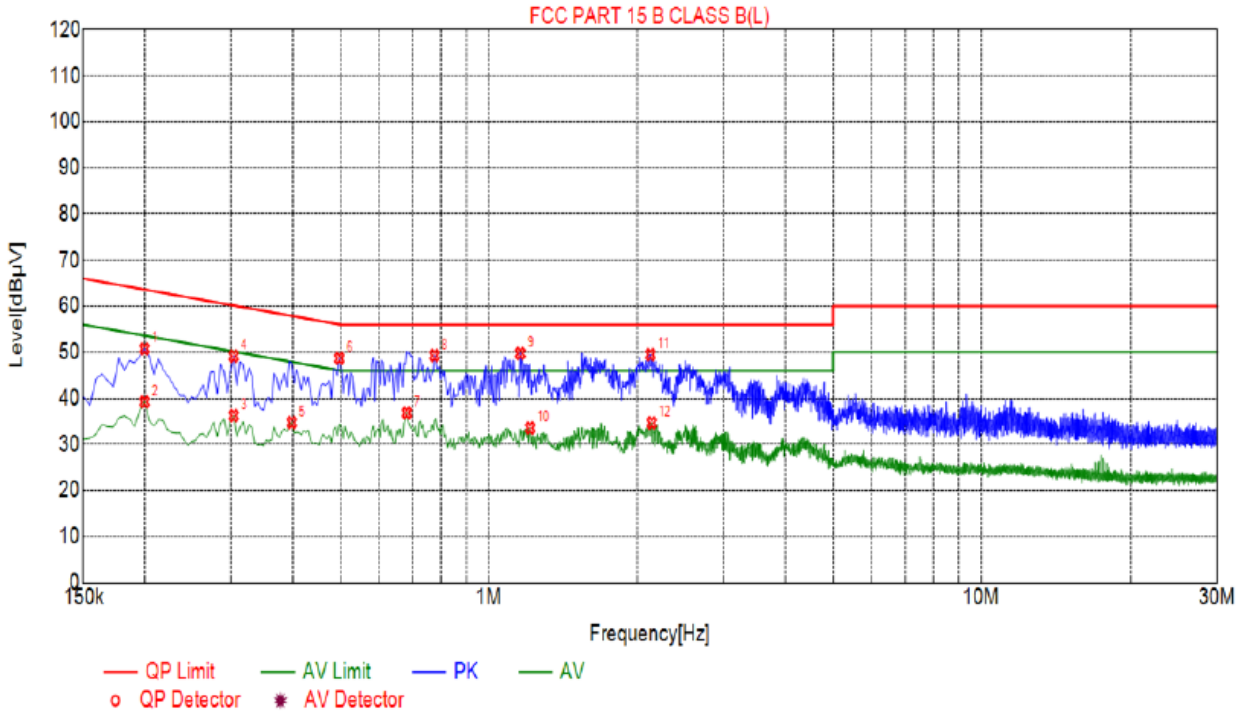
Conducted Emission Shielding Room Test Site (843)					
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Receiver	R&S	ESCI 7	HKE-010	Dec. 28, 2018	Dec. 27, 2019
LISN	R&S	ENV216	HKE-002	Dec. 28, 2018	Dec. 27, 2019
Coax cable (9KHz-30MHz)	Times	381806-002	N/A	Dec. 28, 2018	Dec. 27, 2019
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 AC 240V/60Hz (802.11a at 5180MHz) was reported

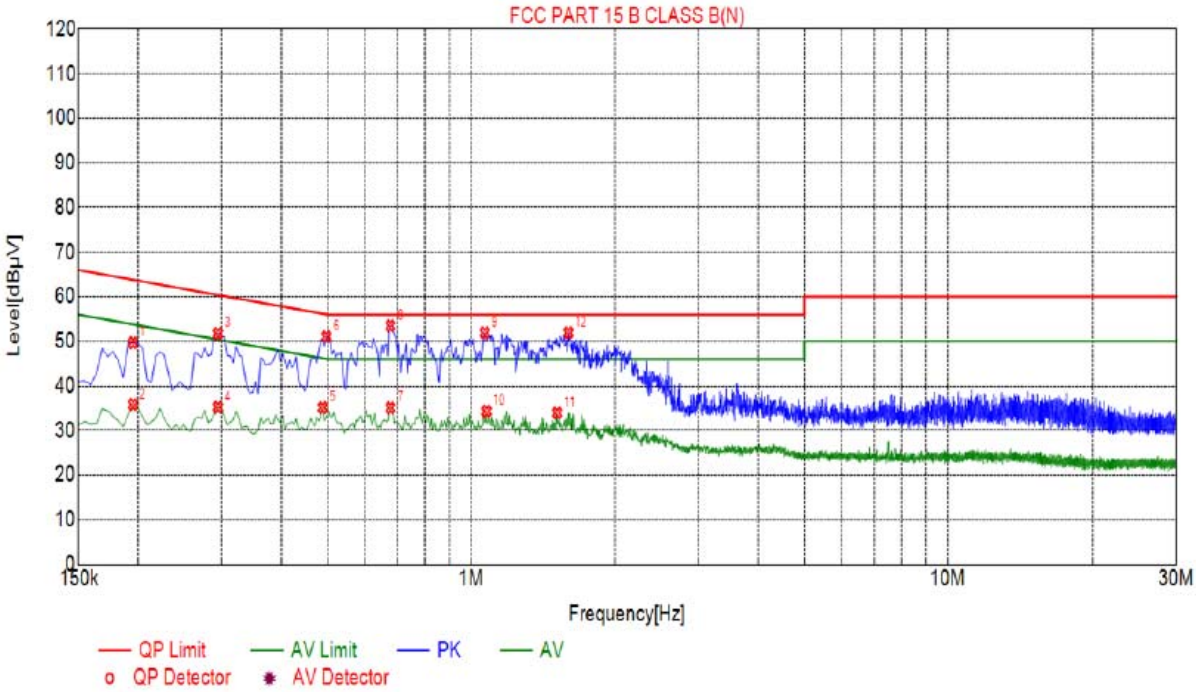
Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)



Suspected List								
NO.	Freq. [MHz]	Level [dBμV]	Factor [dB]	Limit [dBμV]	Margin [dB]	Reading [dBμV]	Detector	Type
1	0.1995	50.74	10.03	63.63	12.89	40.71	PK	L
2	0.1995	39.23	10.03	53.63	14.40	29.20	AV	L
3	0.3030	36.24	10.04	50.16	13.92	26.20	AV	L
4	0.3030	49.18	10.04	60.16	10.98	39.14	PK	L
5	0.3975	34.74	10.04	47.91	13.17	24.70	AV	L
6	0.4965	48.69	10.04	56.06	7.37	38.65	PK	L
7	0.6810	36.83	10.05	46.00	9.17	26.78	AV	L
8	0.7755	49.31	10.05	56.00	6.69	39.26	PK	L
9	1.1580	49.76	10.09	56.00	6.24	39.67	PK	L
10	1.2120	33.55	10.09	46.00	12.45	23.46	AV	L
11	2.1300	49.49	10.16	56.00	6.51	39.33	PK	L
12	2.1435	34.67	10.16	46.00	11.33	24.51	AV	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)

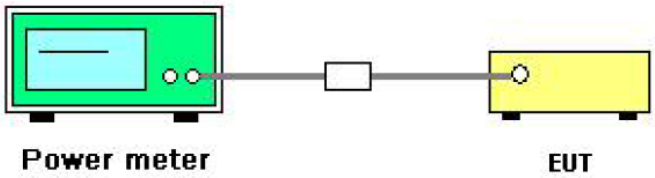


Suspected List								
NO.	Freq. [MHz]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Reading [dBµV]	Detector	Type
1	0.1950	49.71	10.03	63.82	14.11	39.68	PK	N
2	0.1950	35.84	10.03	53.82	17.98	25.81	AV	N
3	0.2940	51.76	10.03	60.41	8.65	41.73	PK	N
4	0.2940	35.24	10.03	50.41	15.17	25.21	AV	N
5	0.4875	35.14	10.04	46.21	11.07	25.10	AV	N
6	0.4965	51.07	10.04	56.06	4.99	41.03	PK	N
7	0.6765	35.09	10.05	46.00	10.91	25.04	AV	N
8	0.6765	53.51	10.05	56.00	2.49	43.46	PK	N
9	1.0680	51.93	10.07	56.00	4.07	41.86	PK	N
10	1.0770	34.33	10.07	46.00	11.67	24.26	AV	N
11	1.5135	33.96	10.11	46.00	12.04	23.85	AV	N
12	1.5990	51.97	10.11	56.00	4.03	41.86	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 E Section 15.407(a)
Test Method:	KDB789033 D02 General UNII Test Procedures New Rules v02.r01 Section E
Limit:	Frequency Band (MHz): Limit 5150-5250: 1W for indoor access points device
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The testing follows the Measurement Procedure of KDB789033 D02 General UNII Test Procedures New Rules v02r01 Section E, 3, a 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. 5. Measure the conducted output power and record the results in the test report.
Test Result:	PASS
Remark:	Conducted output power= measurement power +10log(1/x) X is duty cycle=1, so 10log(1/1)=0 Conducted output power= measurement power

4.2.2. Test Instruments

RF Test Room					
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 28, 2018	Dec. 27, 2019
Power meter	Agilent	E4419B	HKE-085	Dec. 28, 2018	Dec. 27, 2019
Power Sensor	Agilent	E9300A	HKE-086	Dec. 28, 2018	Dec. 27, 2019
RF cable	Times	1-40G	HKE-034	Dec. 28, 2018	Dec. 27, 2019
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 28, 2018	Dec. 27, 2019

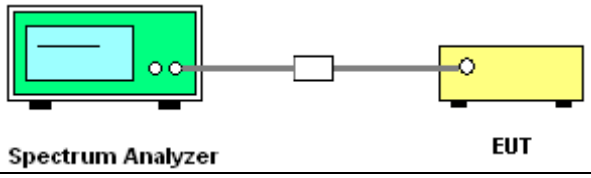
Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

4.2.3. Test Data

Configuration Band I (5150 - 5250 MHz)				
Mode	Test channel	Maximum Conducted Output Power (dBm)	FCC Limit (dBm)	Result
11a	CH36	13.86	30	PASS
11a	CH40	13.79	30	PASS
11a	CH48	13.62	30	PASS
11n(HT20)	CH36	13.73	30	PASS
11n(HT20)	CH40	13.51	30	PASS
11n(HT20)	CH48	13.62	30	PASS
11n(HT40)	CH38	12.54	30	PASS
11n(HT40)	CH46	12.33	30	PASS
11ac(HT20)	CH36	12.84	30	PASS
11ac(HT20)	CH40	12.76	30	PASS
11ac(HT20)	CH48	12.89	30	PASS
11ac(HT40)	CH38	11.22	30	PASS
11ac(HT40)	CH46	11.16	30	PASS
11ac(HT80)	CH42	10.41	30	PASS

4.3. 6dB Emission Bandwidth

4.3.1. Test Specification

Test Requirement:	FCC CFR47 Part 15 Section 15.407(e)
Test Method:	KDB789033 D02 General UNII Test Procedures New Rules v02r01 Section C
Limit:	>500kHz
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. KDB789033 D02 General UNII Test Procedures New Rules v02r01 Section C 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. 28, 2018	Dec. 27, 2019
RF cable	Times	1-40G	HKE-034	Dec. 28, 2018	Dec. 27, 2019
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 28, 2018	Dec. 27, 2019

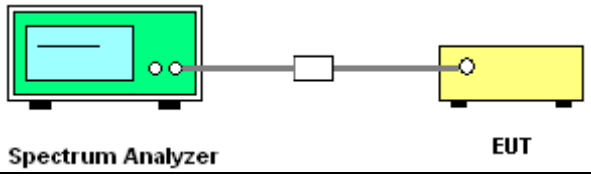
Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

4.3.3Test data

N/A

4.4. 26dB Bandwidth and 99% Occupied Bandwidth

4.4.1. Test Specification

Test Requirement:	47 CFR Part 15C Section 15.407
Test Method:	KDB789033 D02 General UNII Test Procedures New Rules v02r01 Section C
Limit:	No restriction limits
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. KDB789033 D02 General UNII Test Procedures New Rules v02r01 Section C 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 = 1% EBW, VBW≥3RBW, In order to make an accurate measurement. 4. 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. 28, 2018	Dec. 27, 2019
RF cable	Times	1-40G	HKE-034	Dec. 28, 2018	Dec. 27, 2019
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 28, 2018	Dec. 27, 2019

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

Band I

Mode	Test channel	Frequency (MHz)	26 dB Bandwidth (MHz)	Verdict
11a	CH36	5180	19.62	PASS
11a	CH40	5200	19.90	PASS
11a	CH48	5240	19.90	PASS
11n(HT20)	CH36	5180	20.00	PASS
11n(HT20)	CH40	5200	20.29	PASS
11n(HT20)	CH48	5240	20.11	PASS
11n(HT40)	CH38	5190	40.28	PASS
11n(HT40)	CH46	5230	40.08	PASS
11ac(HT20)	CH36	5180	20.13	PASS
11ac(HT20)	CH40	5200	20.02	PASS
11ac(HT20)	CH48	5240	20.07	PASS
11ac(HT40)	CH38	5190	40.25	PASS
11ac(HT40)	CH46	5230	40.35	PASS
11ac(HT80)	CH42	5210	80.87	PASS

Test plots as follows:

Band I （5150 – 5250 MHz）

802.11a

Low

Mid

High

802.11n(HT20)

Low

Mid

High

802.11n(HT40)
Low
High

802.11ac(HT20)

Low

Mid

High

802.11ac(HT40)

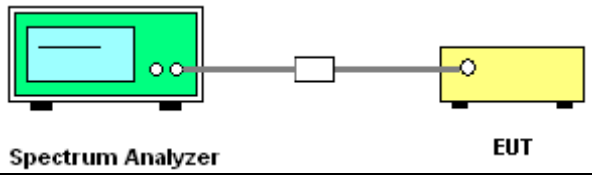
Low

High

802.11ac(HT80)

4.5. Power Spectral Density

4.5.1. Test Specification

Test Requirement:	FCC Part15 E Section 15.407 (a)
Test Method:	KDB789033 D02 General UNII Test Procedures New Rules v02r01 Section F
Limit:	≤11.00dBm/MHz for Band I 5150MHz-5250MHz ≤17dBm/MHz for indoor access device ≤30.00dBm/500KHz for Band IV 5725MHz-5850MHz The e.i,r,p spectral density for Band I 5150MHz – 5250 MHz should not exceed 10dBm/MHz
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. Set the spectrum analyzer or EMI receiver span to view the entire emission bandwidth. 1. Set RBW = 510 kHz/1 MHz, VBW ≥ 3*RBW, Sweep time = Auto, Detector = RMS. 2. Allow the sweeps to continue until the trace stabilizes. 3. Use the peak marker function to determine the maximum amplitude level. 4. The E.I.R.P spectral density used radiated test method. At a test site that has been validated using the procedures of ANSI C63.4 or the latest CISPR 16-1-4 for measurements above 1 GHz, so as to simulate a near free-space environment.
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. 28, 2018	Dec. 27, 2019
RF cable	Times	1-40G	HKE-034	Dec. 28, 2018	Dec. 27, 2019
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 28, 2018	Dec. 27, 2019

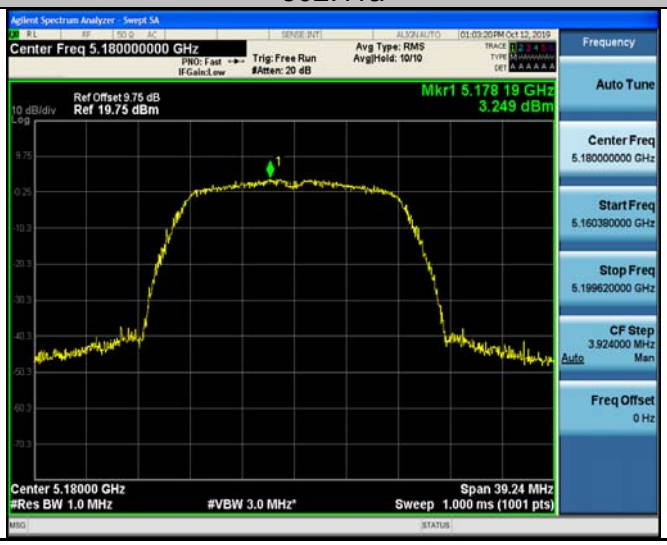
Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

4.5.3. Test data

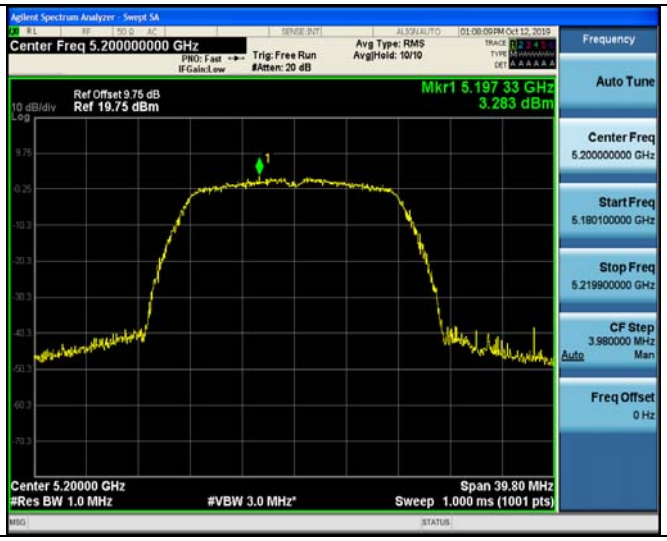
Configuration Band I (5150 - 5250 MHz)						
Mode	Test channel	Level [dBm/MHz]	10log(1/x) Factor [dB]	Power Spectral Density	Limit (dBm/MHz)	Result
11a	CH36	3.25	0	3.25	17	PASS
11a	CH40	3.28	0	3.28	17	PASS
11a	CH48	2.42	0	2.42	17	PASS
11n(HT20)	CH36	3.16	0	3.16	17	PASS
11n(HT20)	CH40	1.55	0	1.55	17	PASS
11n(HT20)	CH48	1.20	0	1.20	17	PASS
11n(HT40)	CH38	-1.72	0	-1.72	17	PASS
11n(HT40)	CH46	-1.92	0	-1.92	17	PASS
11ac(HT20)	CH36	2.15	0	2.15	17	PASS
11ac(HT20)	CH40	1.00	0	1.00	17	PASS
11ac(HT20)	CH48	0.96	0	0.96	17	PASS
11ac(HT40)	CH38	-0.55	0	-0.55	17	PASS
11ac(HT40)	CH46	-1.26	0	-1.26	17	PASS
11ac(HT80)	CH42	-4.74	0	-4.74	17	PASS

Band I （5150 – 5250 MHz）

802.11a



Low



Mid

High

802.11n(HT20)
 Low
 Mid
 High

802.11n(HT40)
 Low
 High

802.11ac(HT20)

Agilent Spectrum Analyzer - Swept SA
Center Freq 5.180000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold: 10/10
Ref Offset 9.75 dB
10 dB/div
Ref 19.75 dBm
Mkr1 5.178 67 GHz
2.145 dBm
Center 5.18000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Span 40.26 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
5.180000000 GHz
Start Freq
5.159970000 GHz
Stop Freq
5.200130000 GHz
CF Step
4.026000 MHz
Auto
Man
Freq Offset
0 Hz

Low

Agilent Spectrum Analyzer - Swept SA
Center Freq 5.200000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold: 10/10
Ref Offset 9.75 dB
10 dB/div
Ref 19.75 dBm
Mkr1 5.201 36 GHz
0.998 dBm
Center 5.20000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Span 40.04 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
5.200000000 GHz
Start Freq
5.179980000 GHz
Stop Freq
5.220020000 GHz
CF Step
4.004000 MHz
Auto
Man
Freq Offset
0 Hz

Mid

Agilent Spectrum Analyzer - Swept SA
Center Freq 5.240000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold: 10/10
Ref Offset 9.66 dB
10 dB/div
Ref 19.66 dBm
Mkr1 5.242 17 GHz
0.964 dBm
Center 5.24000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Span 40.14 MHz
Sweep 1.000 ms (1001 pts)
Frequency
Auto Tune
Center Freq
5.240000000 GHz
Start Freq
5.219930000 GHz
Stop Freq
5.260070000 GHz
CF Step
4.014000 MHz
Auto
Man
Freq Offset
0 Hz

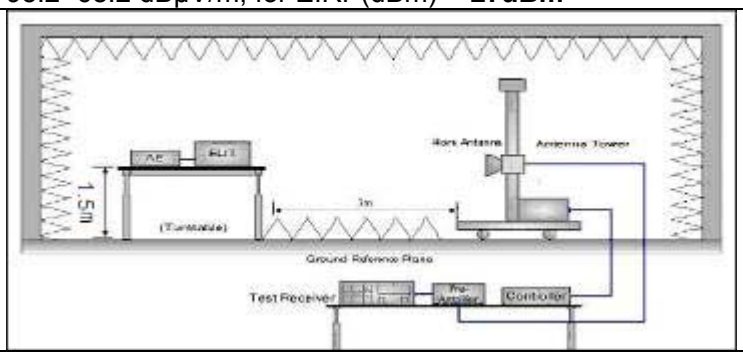
High

802.11ac(HT40)
Low
High

802.11ac(HT80)
Low

4.6. Band edge

4.6.1. Test Specification

Test Requirement:	FCC CFR47 Part 15E Section 15.407
Test Method:	ANSI C63.10 2013
Limit:	For band I&II&III: E[dBμV/m] = EIRP[dBm] + 95.2=68.2 dBμV/m, for EIRP(dBm)= **-27dBm** For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge. For band IV(5715-5725MHz&5850-5860MHz): E[dBμV/m] = EIRP[dBm] + 95.2=78.2 dBμV/m, for EIRP(dBm)= **-27dBm**; For band IV(other un-restricted band):E[dBμV/m] = EIRP[dBm] + 95.2=68.2 dBμV/m, for EIRP(dBm)= **-27dBm**
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the

	maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasipeak or average method as specified and then reported in a data sheet.
Test Result:	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	ESRP3	HKE-005	Dec. 28, 2018	Dec. 27, 2019
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 28, 2018	Dec. 27, 2019
Preamplifier	EMCI	EMC051845SE	HKE-015	Dec. 28, 2018	Dec. 27, 2019
Preamplifier	Agilent	83051A	HKE-016	Dec. 28, 2018	Dec. 27, 2019
Loop antenna	Schwarzbeck	FMZB 1519 B	HKE-014	Dec. 28, 2018	Dec. 27, 2019
Broadband antenna	Schwarzbeck	VULB 9163	HKE-012	Dec. 28, 2018	Dec. 27, 2019
Horn antenna	Schwarzbeck	9120D	HKE-013	Dec. 28, 2018	Dec. 27, 2019
Antenna Mast	Keleto	CC-A-4M	N/A	N/A	N/A
Position controller	Taiwan MF	MF7802	HKE-011	Dec. 28, 2018	Dec. 27, 2019
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
Hf antenna	Schwarzbeck	LB-180400-KF	HKE-031	Dec. 28, 2018	Dec. 27, 2019
RF cable	Tonscend	1-18G	HKE-099	Dec. 28, 2018	Dec. 27, 2019
RF cable	Times	1-40G	HKE-034	Dec. 28, 2018	Dec. 27, 2019

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

Radiated Band Edge Test:
Operation Mode: 802.11a Mode with 5.2G TX CH Low

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5150	52.67	-2.49	50.18	74	-23.82	peak
5150	/	-2.49	/	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)	
5150	51.15	-2.49	48.66	74	-25.34	peak
5150	/	-2.49	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Operation Mode: 802.11n20 Mode with 5.2G TX CH Low

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5150	54.14	-2.49	51.65	74	-22.35	peak
5150	/	-2.49	/	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)	
5150	51.49	-2.49	49	74	-25	peak
5150	/	-2.49	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Operation Mode: 802.11 n40 Mode with 5.2G TX CH Low

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5150	52.89	-2.49	50.4	74	-23.6	peak
5150	/	-2.49	/	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)	
5150	51.07	-2.49	48.58	74	-25.42	peak
5150	/	-2.49	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Operation Mode: 802.11 ac20 Mode with 5.2G TX CH Low

Horizontal

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
5150	54.56	-2.49	52.07	74	-21.93	peak
5150	/	-2.49	/	54	/	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
5150	52.03	-2.49	49.54	74	-24.46	peak
5150	/	-2.49	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Operation Mode: 802.11 ac40 Mode with 5.2G TX CH Low

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5150	53.45	-2.49	50.96	74	-23.04	peak
5150	/	-2.49	/	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)	
5150	51.79	-2.49	49.3	74	-24.7	peak
5150	/	-2.49	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Operation Mode: 802.11 ac80 Mode with 5.2G TX CH Low

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5150	53.58	-2.49	51.09	74	-22.91	peak
5150	/	-2.49	/	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)	
5150	51.06	-2.49	48.57	74	-25.43	peak
5150	/	-2.49	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

4.7. Spurious Emission

4.7.1.1. Test Specification

Test Requirement:	FCC CFR47 Part 15 Section 15.407 & 15.209 & 15.205
Test Method:	KDB 789033 D02 v02r01
Frequency Range:	9kHz to 40GHz
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:

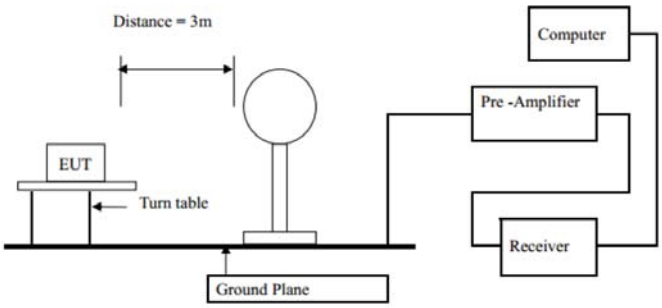
Unwanted spurious emissions fallen in restricted bands per FCC Part15.205 shall comply with the general field strength limits set forth in § 15.209 as below table,

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

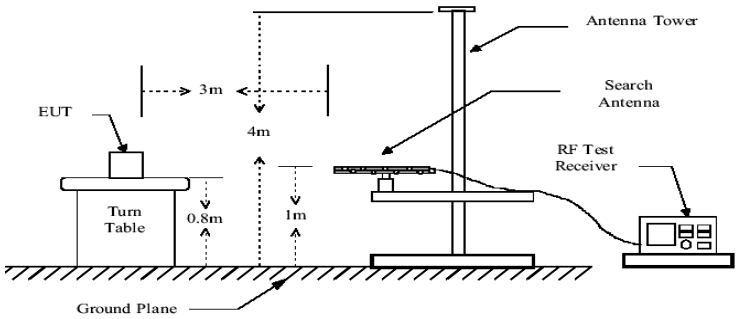
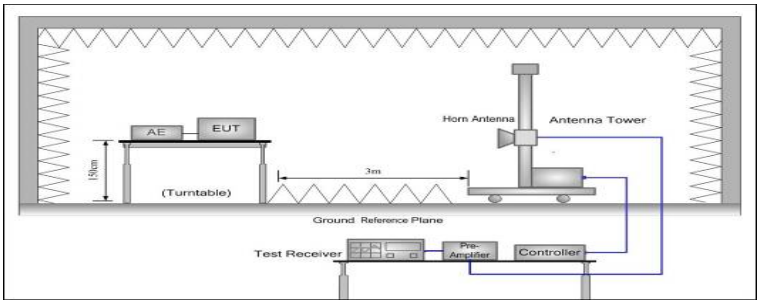
Frequency	Limit (dBuV/m @3m)	Detector
Above 1G	74.0	Peak
	54.0	Average

Test setup:

For radiated emissions below 30MHz



30MHz to 1GHz

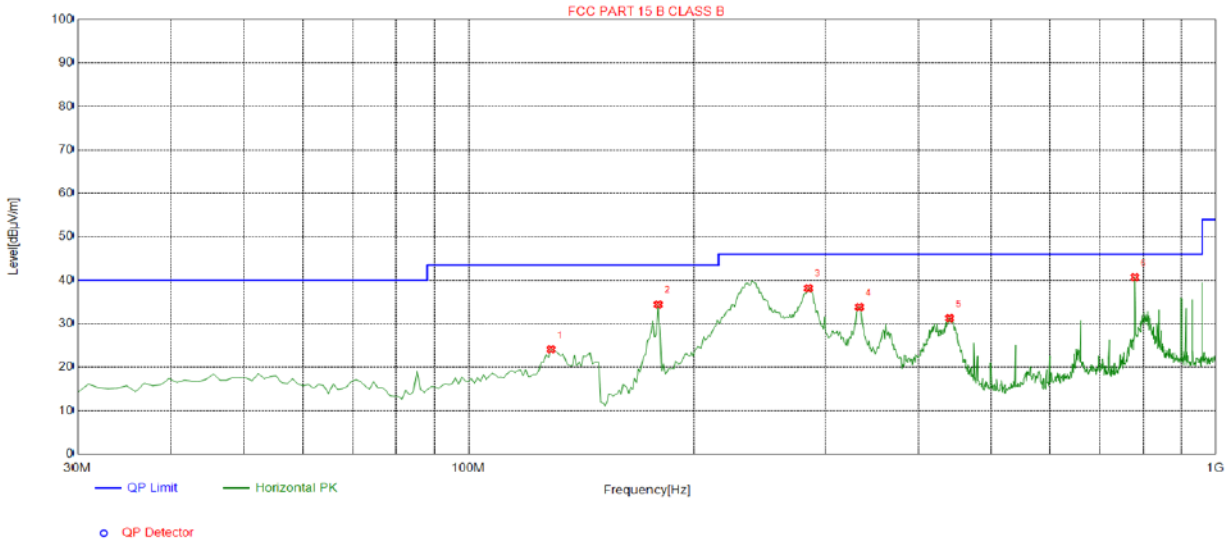
	 Above 1GHz 
Test Procedure:	1. The EUT was placed on the top of a rotating table 0.8 meters above the groundat a 3 meter camber. The table was rotated 360 degrees todetermine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, whichwas mounted on the top of a variable-height antenna tower. 3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. 4. For each suspected emission, the EUT was arranged to its worst case and thenthe antenna was tuned to heights from 1 meter to 4 meters and the rotatablewas turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and SpecifiedBandwidth with Maximum Hold Mode. 6. If the emission level of the EUT in peak mode was 10dB lower than the limitspecified, then testing could be stopped and the peak values of the EUT wouldbe reported. Otherwise the emissions that did not have 10dB margin would bere-tested one by one using peak, quasi-peak or average method as specified andthen reported in a data sheet.
Test results:	PASS

4.7.2. Test Data

All the test modes completed for test. only the worst result of AC 240V/60Hz (802.11a at 5180MHz) was reported

Below 1GHz

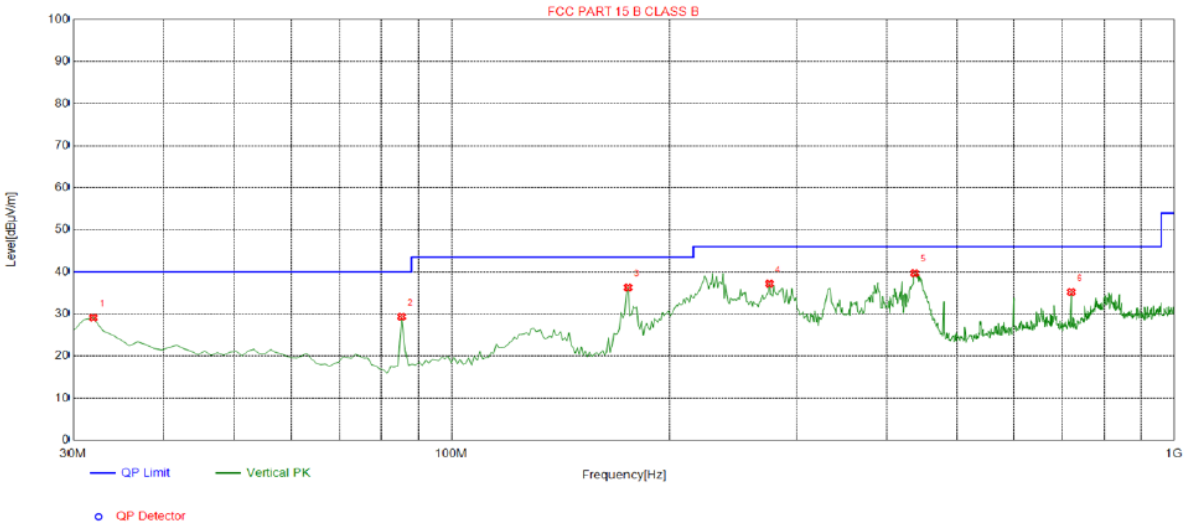
Horizontal



Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	128.9400	-18.41	42.49	24.08	43.50	19.42	100	345	Horizontal
2	179.3800	-16.88	51.28	34.40	43.50	9.10	100	226	Horizontal
3	285.1100	-13.04	51.22	38.18	46.00	7.82	100	322	Horizontal
4	333.6100	-11.61	45.46	33.85	46.00	12.15	100	169	Horizontal
5	440.3100	-9.41	40.68	31.27	46.00	14.73	100	319	Horizontal
6	779.8100	-3.26	43.95	40.69	46.00	5.31	100	348	Horizontal

Remark: Margin = Limit – Level
Correction factor = Cable lose + LISN insertion loss
Level=Test receiver reading + correction factor

Vertical



Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	31.9400	-16.26	45.38	29.12	40.00	10.88	100	38	Vertical
2	85.2900	-18.20	47.56	29.36	40.00	10.64	100	191	Vertical
3	175.5000	-17.06	53.34	36.28	43.50	7.22	100	286	Vertical
4	275.4100	-13.44	50.63	37.19	46.00	8.81	100	354	Vertical
5	437.4000	-9.53	49.25	39.72	46.00	6.28	100	325	Vertical
6	720.6400	-4.70	39.93	35.23	46.00	10.77	100	236	Vertical

Remark: Margin = Limit – Level
Correction factor = Cable lose + LISN insertion loss
Level=Test receiver reading + correction factor

Above 1GHz

LOW CH 36 (802.11 a Mode with 5.2G)/5180

Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
3647	61.11	-4.59	56.52	74	-17.48	peak
3647	48.52	-4.59	43.93	54	-10.07	AVG
10360	52.33	3.74	56.07	74	-17.93	peak
10360	42.76	3.74	46.5	54	-7.5	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
3647	62.07	-4.59	57.48	74	-16.52	peak
3647	48.32	-4.59	43.73	54	-10.27	AVG
10360	51.74	3.74	55.48	74	-18.52	peak
10360	41.09	3.74	44.83	54	-9.17	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

MID CH40 (802.11 a Mode with 5.2G)/5200
Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
3647	62.77	-4.59	58.18	74	-15.82	peak
3647	45.63	-4.59	41.04	54	-12.96	AVG
10400	54.85	3.74	58.59	74	-15.41	peak
10400	41.66	3.74	45.4	54	-8.6	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)	
3647	62.96	-4.59	58.37	74	-15.63	peak
3647	46.23	-4.59	41.64	54	-12.36	AVG
10400	53.61	3.74	57.35	74	-16.65	peak
10400	40.14	3.74	43.88	54	-10.12	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

HIGH CH 48 (802.11a Mode with 5.2G)/5240
Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
3647	62.88	-4.59	58.29	74	-15.71	peak
3647	47.52	-4.59	42.93	54	-11.07	AVG
10480	53.26	3.75	57.01	74	-16.99	peak
10480	41.34	3.75	45.09	54	-8.91	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

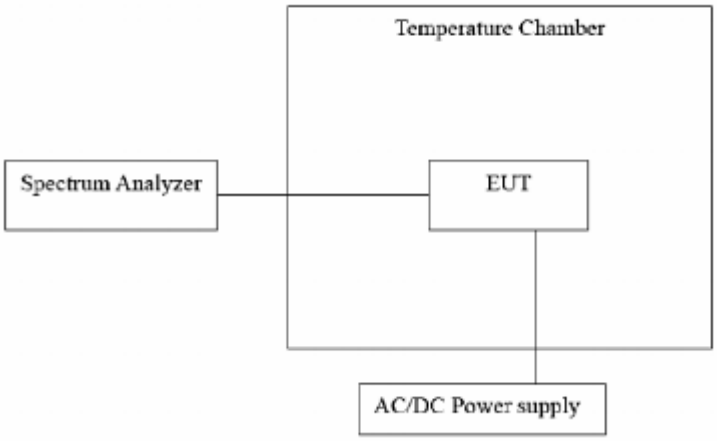
Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
3647	61.17	-4.59	56.58	74	-17.42	peak
3647	45.63	-4.59	41.04	54	-12.96	AVG
10480	52.78	3.75	56.53	74	-17.47	peak
10480	40.19	3.75	43.94	54	-10.06	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Remark：
(1) Measuring frequencies from 1 GHz to the 40 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.

4.8. Frequency Stability Measurement

4.8.1. Test Specification

Test Requirement:	FCC Part15 Section 15.407(g) &Part2 J Section 2.1055
Test Method:	ANSI C63.10: 2013
Limit:	The frequency tolerance shall be maintained within the band of operation frequency over a temperature variation of 0 degrees to 35 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.
Test Setup:	
Test Procedure:	The EUT was placed inside the environmental test chamber and powered by nominal AC/DC voltage. b. Turn the EUT on and couple its output to a spectrum analyzer. c. Turn the EUT off and set the chamber to the highest temperature specified. d. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize. e. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature. f. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.
Test Result:	PASS
Remark:	N/A

4.8.2. Test Instruments

RF Test Room				
Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Due**
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 27, 2019
Temperature and humidity meter	Boyang	HTC-1	HKE-077	Dec. 27, 2019
programmable power supply	Agilent	E3646A	HKE-092	Dec. 27, 2019

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

Test Result as follows:

Mode	Voltage (V)	FHL (5180MHz)	Deviation (KHz)	FHH (5240MHz)	Deviation (KHz)
5.2G Band	4.2V	5179.99	22	5239.975	25
	3.8V	5179.99	31	5239.978	22
	3.4V	5179.93	27	5239.966	37

Mode	Temperature (℃)	FHL (5180MHz)	Deviation (KHz)	FHH (5240MHz)	Deviation (KHz)
5.2G Band	-30	5180.00	18	5239.968	35
	-20	5179.85	29	5239.966	30
	-10	5180.06	22	5239.970	32
	0	5179.96	15	5239.973	27
	10	5180.03	34	5239.982	20
	20	5180.00	17	5239.980	23
	30	5179.90	25	5239.966	31
	40	5179.90	26	5239.960	37
	50	5180.00	31	5239.968	25

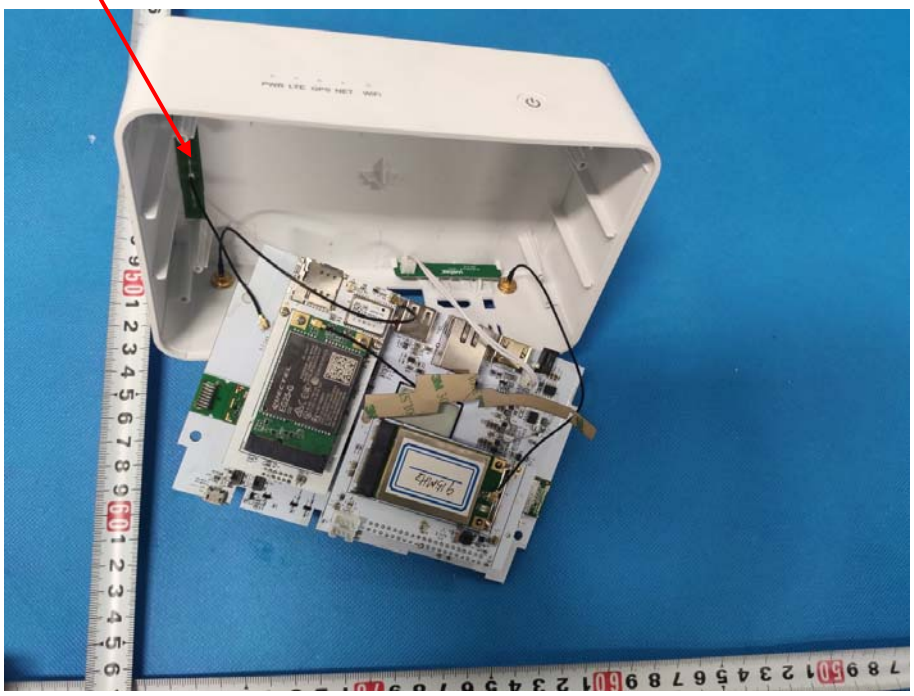
ANTENNA REQUIREMENT

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.

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.

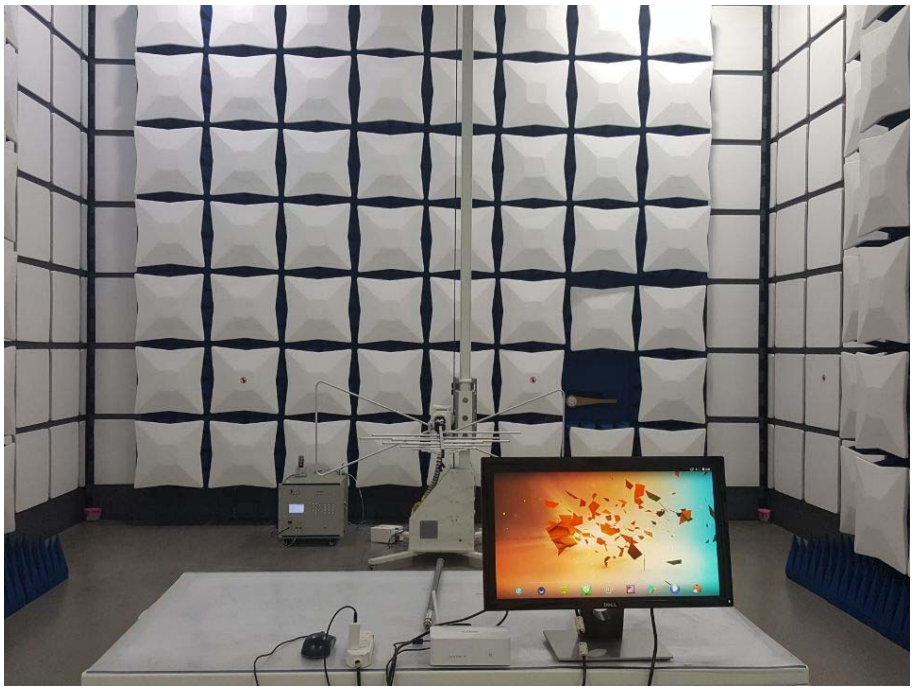
Antenna Connected Construction
The antenna used in this product is a Internal Antenna, The directional gains of antenna used for transmitting is 2dBi.

WIFI ANTENNA



4.9. Photographs of Test Setup

Radiated Emission



Conducted Emission