



FCC Test Report

**Test Report
On Behalf of
Gemstone Lights Canada LTD
For
Hub2 Controller
Model No.: GM03**

FCC ID: 2BBFC-GM03

Prepared For: Gemstone Lights Canada LTD
#170 11080 50 ST SE, Calgary, Alberta, T2C 5T4, Canada

Prepared By: Shenzhen HUAK Testing Technology Co., Ltd.
1-2/F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping,
Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

Date of Test: Apr. 18, 2023 ~ Jun. 07, 2023
Date of Report: Jun. 07, 2023
Report Number: HK2304181489-7E

The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>.

TEL : +86-755 2302 9901 FAX : +86-755 2302 9901 E-mail : service@cer-mark.com

Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China



Test Result Certification

Applicant's Name.....: Gemstone Lights Canada LTD

Address: #170 11080 50 ST SE, Calgary, Alberta, T2C 5T4, Canada

Manufacture's Name.....: Gemstone Lights Canada LTD

Address: #170 11080 50 ST SE, Calgary, Alberta, T2C 5T4, Canada

Product Description

Trade Mark: Gemstone Lights

Product Name.....: Hub2 Controller

Model and/or Type Reference: GM03

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

This publication may be reproduced in whole or in part for non-commercial purposes as long as the Shenzhen HUAK Testing Technology Co., Ltd. is acknowledged as copyright owner and source of the material. Shenzhen HUAK Testing Technology Co., Ltd. takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.

Date of Test.....:

Date (s) of Performance of Tests: **Apr. 18, 2023 ~ Jun. 07, 2023**

Date of Issue.....: **Jun. 07, 2023**

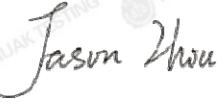
Test Result.....: **Pass**

Testing Engineer : 

(Gary Qian)

Technical Manager : 

(Eden Hu)

Authorized Signatory : 

(Jason Zhou)



Table of Contents

1. Test Result Summary	5
1.1. Test Procedures and Results.....	5
1.2. Information of the Test Laboratory	5
1.3. Measurement Uncertainty	6
2. EUT Description	7
2.1. General Description of EUT	7
2.2. Operation Frequency Each of Channel.....	8
2.3. Operation of EUT during Testing.....	8
2.4. Description of Test Setup.....	9
3. General Information.....	10
3.1. Test Environment and Mode	10
3.2. Description of Support Units	11
4. Test Results and Measurement Data	12
4.1. Conducted Emission.....	12
4.2. Maximum Conducted Output Power	16
4.3. 6dB Emission Bandwidth	18
4.4. 26dB Bandwidth and 99% Occupied Bandwidth	23
4.5. Power Spectral Density	24
4.6. Band Edge.....	29
4.7. Spurious Emission.....	44
4.8. Frequency Stability Measurement.....	52
4.9. Antenna Requirement.....	54
5. Photographs of Test Setup	55
6. Photos of the EUT.....	57

The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>.

**** Modified History ****

Revision	Description	Issued Data	Remark
Revision 1.0	Initial Test Report Release	Jun. 07, 2023	Jason Zhou

The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>.

TEL : +86-755 2302 9901 FAX : +86-755 2302 9901 E-mail : service@cer-mark.com

Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China



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)	N/A
Power Spectral Density	§15.407(a)	PASS
Band Edge	§15.407(b)/15.209/15.205	PASS
Radiated Emission	§15.407(b)/15.209/15.205	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.
5. the "Compliance" Test data refers to FCC ID: 2AMWOFSC-BW236, and report number is: HK201 0293163-3E.

1.2. Information of the Test Laboratory

Shenzhen HUAK Testing Technology Co., Ltd.

Add.: 1-2/F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

Testing Laboratory Authorization:

A2LA Accreditation Code is 4781.01.

FCC Designation Number is CN1229.

Canada IC CAB identifier is CN0045.

CNAS Registration Number is L9589.



1.3. Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, 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	$\pm 2.71\text{dB}$
2	RF power, conducted	$\pm 0.37\text{dB}$
3	Spurious emissions, conducted	$\pm 0.11\text{dB}$
4	All emissions, radiated(<1G)	$\pm 3.90\text{dB}$
5	All emissions, radiated(>1G)	$\pm 4.28\text{dB}$
6	Temperature	$\pm 0.1^\circ\text{C}$
7	Humidity	$\pm 1.0\%$



2. EUT Description

2.1. General Description of EUT

Equipment:	Hub2 Controller
Model Name:	GM03
Series Model:	N/A
Trade Mark:	Gemstone Lights
Model Difference:	N/A
FCC ID:	2BBFC-GM03
Operation Frequency:	IEEE 802.11a/ac(HT20)5.745GHz-5.825GHz IEEE 802.11ac(HT40)5.755GHz-5.795GHz
Modulation Technology:	IEEE 802.11a/ac
Modulation Type:	OFDM
Antenna Type:	Internal Antenna
Antenna Gain:	4.54dBi
Power Source:	DC 5V-24V
Power Supply:	DC 5V-24V

The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>.

TEL : +86-755 2302 9901 FAX : +86-755 2302 9901 E-mail : service@cer-mark.com

Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China



2.2. Operation Frequency Each of Channel

802.11a/ 802.11ac(HT20)		802.11ac(HT40)	
Channel	Frequency	Channel	Frequency
149	5745	151	5755
153	5765	159	5790
157	5785		
161	5805		
165	5825		

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

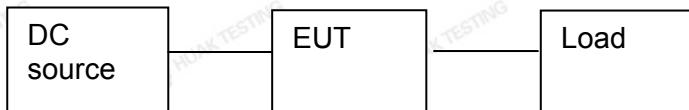
Band IV (5725 - 5850 MHz)		
For 802.11a/ac HT 20		
Channel Number	Channel	Frequency (MHz)
149	Low	5745
157	Mid	5785
165	High	5825

For 802.11ac HT 40		
Channel Number	Channel	Frequency (MHz)
151	Low	5755
159	High	5795

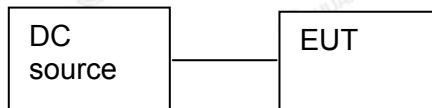


2.4. Description of Test Setup

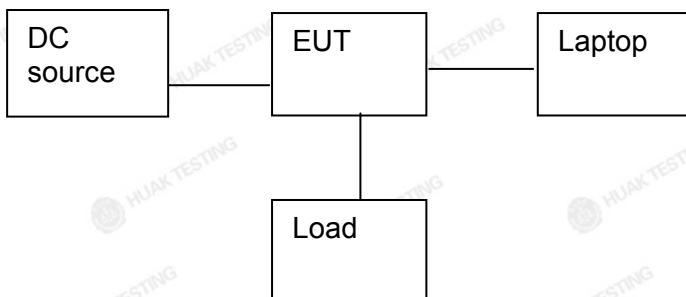
Operation of EUT during radiation below 1GHz testing:



Operation of EUT during radiation above 1GHz testing:



Operation of EUT during Conducted testing



Laptop information

Model: TP00018A

Input: 20V, 3.25~4.5A



3. General 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)	MCS0

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
Laptop	TP00096A	/	/	Lenovo

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

Test Requirement:	FCC Part15 C Section 15.207														
Test Method:	ANSI C63.10:2013														
Frequency Range:	150 kHz to 30 MHz														
Receiver Setup:	RBW=9 kHz, VBW=30 kHz, Sweep time=auto														
Limits:	<table border="1"> <thead> <tr> <th rowspan="2">Frequency range (MHz)</th> <th colspan="2">Limit (dBuV)</th> </tr> <tr> <th>Quasi-peak</th> <th>Average</th> </tr> </thead> <tbody> <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> </tbody> </table>	Frequency range (MHz)	Limit (dBuV)		Quasi-peak	Average	0.15-0.5	66 to 56*	56 to 46*	0.5-5	56	46	5-30	60	50
Frequency range (MHz)	Limit (dBuV)														
	Quasi-peak	Average													
0.15-0.5	66 to 56*	56 to 46*													
0.5-5	56	46													
5-30	60	50													
Test Setup:	<p>Reference Plane</p> <p>40cm</p> <p>E.U.T AC power LISN Filter AC power</p> <p>Test table/Insulation plane</p> <p>Remark E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</p>														
Test Mode:	TX Mode														
Test Procedure:	<ol style="list-style-type: none"> 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. 														
Test Result:	PASS														

The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>

**4.1.2. Test Instruments**

Conducted Emission Shielding Room Test Site (843)					
Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Receiver	R&S	ESR-7	HKE-005	Feb. 17, 2023	Feb. 16, 2024
LISN	R&S	ENV216	HKE-002	Feb. 17, 2023	Feb. 16, 2024
Coax cable (9KHz-30MHz)	Times	381806-002	N/A	Feb. 17, 2023	Feb. 16, 2024
Conducted test software	Tonscend	TS+ Rev 2.5.0.0	HKE-081	N/A	N/A

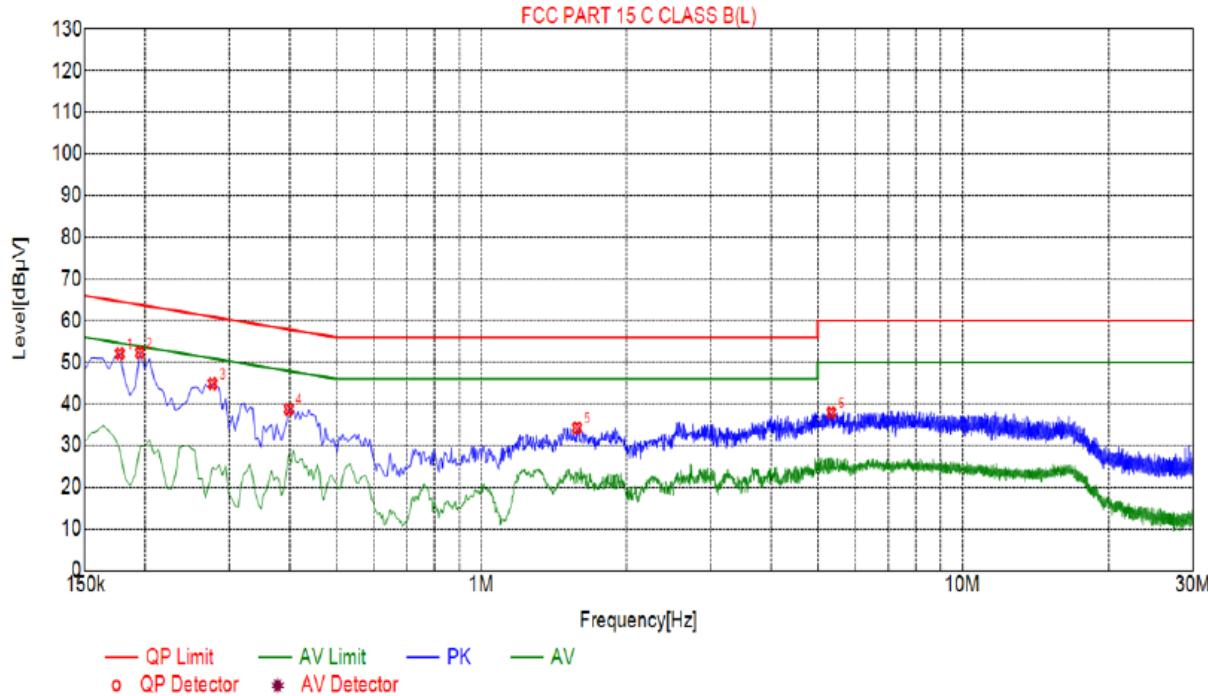
Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

**TEST RESULTS**

PASS

All the test modes completed for test. only the worst result of (802.11a at 5745MHz) was reported as below:

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

**Suspected List**

NO.	Freq. [MHz]	Level [dB μ V]	Factor [dB]	Limit [dB μ V]	Margin [dB]	Reading [dB μ V]	Detector	Type
1	0.1770	52.07	20.05	64.63	12.56	32.02	PK	L
2	0.1950	52.31	20.03	63.82	11.51	32.28	PK	L
3	0.2760	44.86	20.04	60.94	16.08	24.82	PK	L
4	0.3975	38.73	20.04	57.91	19.18	18.69	PK	L
5	1.5810	34.22	20.11	56.00	21.78	14.11	PK	L
6	5.3385	37.88	20.26	60.00	22.12	17.62	PK	L

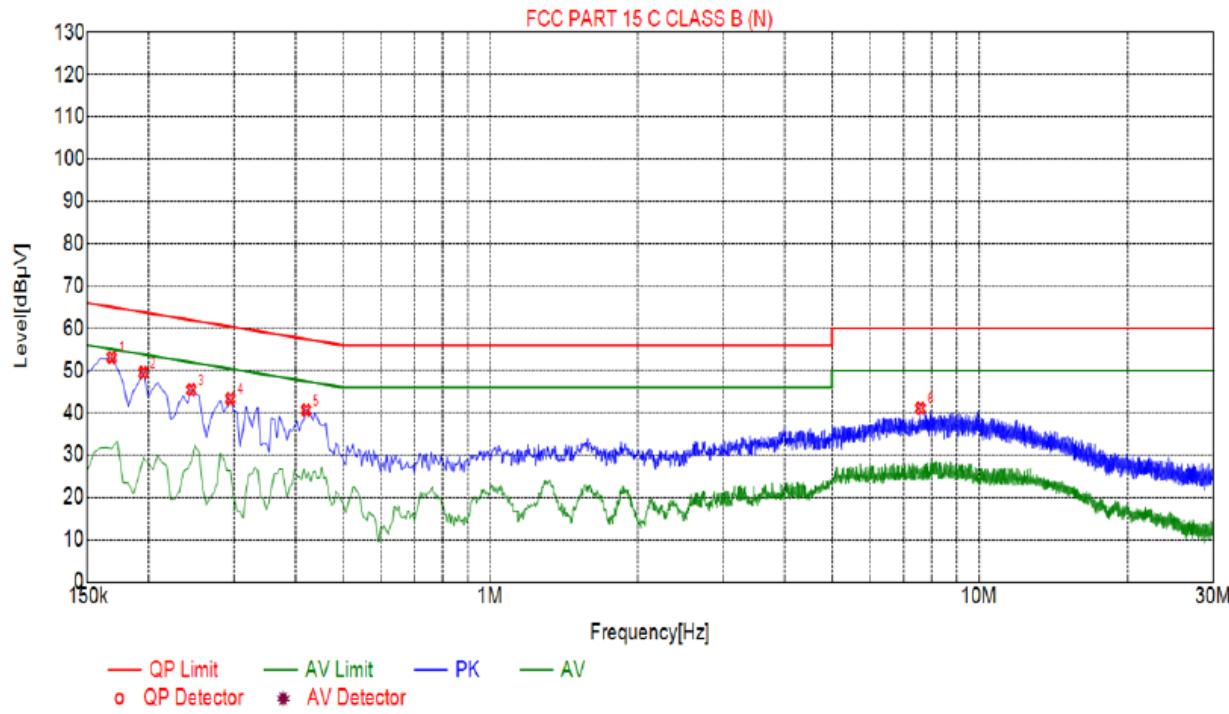
Remark: Margin = Limit – Level

Correction factor = Cable loss + 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 [dB μ V]	Factor [dB]	Limit [dB μ V]	Margin [dB]	Reading [dB μ V]	Detector	Type
1	0.1680	53.11	20.01	65.06	11.95	33.10	PK	N
2	0.1950	49.51	20.03	63.82	14.31	29.48	PK	N
3	0.2445	45.44	20.03	61.94	16.50	25.41	PK	N
4	0.2940	43.33	20.03	60.41	17.08	23.30	PK	N
5	0.4200	40.62	20.04	57.45	16.83	20.58	PK	N
6	7.5930	41.05	20.17	60.00	18.95	20.88	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
	5725-5850	1 W
Test Setup:		
Test Mode:	Transmitting mode with modulation	
Test Procedure:	<ol style="list-style-type: none">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 RF automatic control unit by RF cable and attenuator. The path loss was compensated to the results for each measurement.3. Set to the maximum power setting and enable the EUT transmit continuously.4. Measure the conducted output power and record the results in the test report.	
Test Result:	PASS	
Remark:	Conducted output power= measurement power + $10\log(1/x)$ X is duty cycle=1, so $10\log(1/1)=0$ Conducted output power= measurement power	

The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>.



4.2.2. Test Instruments

RF Test Room					
Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Spectrum analyzer	Agilent	N9020A	HKE-048	Feb. 17, 2023	Feb. 16, 2024
Power meter	Agilent	E4419B	HKE-085	Feb. 17, 2023	Feb. 16, 2024
Power Sensor	Agilent	E9300A	HKE-086	Feb. 17, 2023	Feb. 16, 2024
RF cable	Times	1-40G	HKE-034	Feb. 17, 2023	Feb. 16, 2024
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Feb. 17, 2023	Feb. 16, 2024

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

Test Data

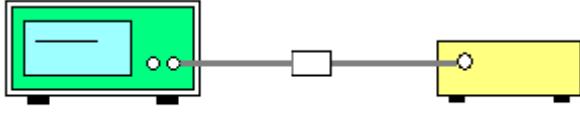
Configuration Band IV (5725 - 5850 MHz)						
Mode	Test channel	Reading Conducted Output Power(dBm)	Cable loss	Maximum Conducted Output Power (dBm)	FCC Limit (dBm)	Result
11a	CH149	10.02	0.8	10.82	30	PASS
11a	CH157	10.19	0.8	10.99	30	PASS
11a	CH165	10.11	0.8	10.91	30	PASS
11ac HT20	CH149	9.99	0.8	10.79	30	PASS
11ac HT20	CH157	10.28	0.8	11.08	30	PASS
11ac HT20	CH165	10.08	0.8	10.88	30	PASS
11ac HT40	CH151	11.01	0.8	11.81	30	PASS
11ac HT40	CH159	11.28	0.8	12.08	30	PASS

Note: Maximum Peak Conducted Output Power(dBm)= Reading Conducted Output Power(dBm)+ Cable loss



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:	 Spectrum Analyzer EUT
Test Mode:	Transmitting mode with modulation
Test Procedure:	<ol style="list-style-type: none"> 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	Feb. 17, 2023	Feb. 16, 2024
RF cable	Times	1-40G	HKE-034	Feb. 17, 2023	Feb. 16, 2024
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Feb. 17, 2023	Feb. 16, 2024

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

**Test data**

Band IV (5725 - 5850 MHz)					
Mode	Test channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)	Result
11a	CH149	5745	16.320	0.5	PASS
11a	CH157	5785	16.280	0.5	PASS
11a	CH165	5825	16.320	0.5	PASS
11ac(HT20)	CH149	5745	17.080	0.5	PASS
11ac(HT20)	CH157	5785	17.040	0.5	PASS
11ac(HT20)	CH165	5825	17.040	0.5	PASS
11ac(HT40)	CH151	5755	35.440	0.5	PASS
11ac(HT40)	CH159	5795	35.760	0.5	PASS

Test plots as follows:

The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>

TEL : +86-755 2302 9901 FAX : +86-755 2302 9901 E-mail : service@cer-mark.com

Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

Band IV (5725 – 5850 MHz)

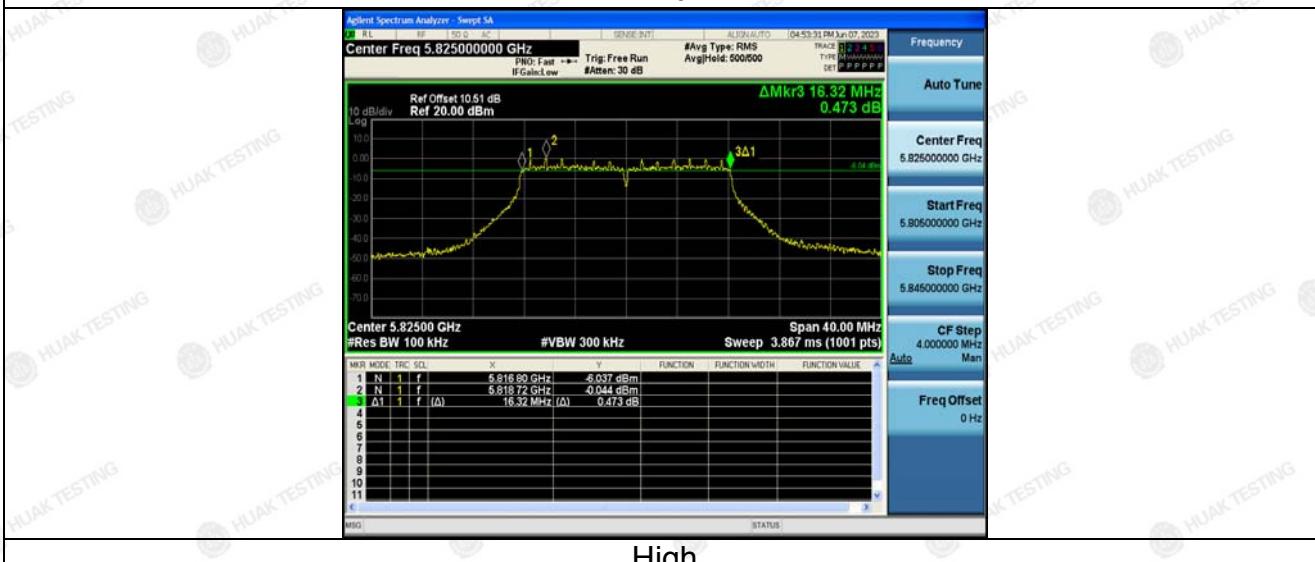
802.11a



Low



Mid



High

The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>.

TEL: +86-755 2302 9901 FAX : +86-755 2302 9901 E-mail: service@cer-mark.com

Add: 1-2F, Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China



802.11ac HT20



The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>.



802.11ac HT40



The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>.

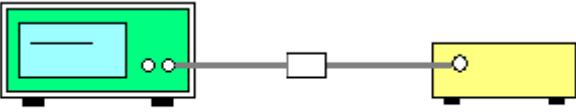
TEL : +86-755 2302 9901 FAX : +86-755 2302 9901 E-mail : service@cer-mark.com

Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China



4.4. 26dB Bandwidth and 99% Occupied Bandwidth

4.4.1. Test Specification

Test Requirement:	47 CFR Part 15C Section 15.407 (a)
Test Method:	KDB789033 D02 General UNII Test Procedures New Rules v02r01 Section C
Limit:	No restriction limits
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>
Test Mode:	Transmitting mode with modulation
Test Procedure:	<ol style="list-style-type: none"> 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\geq3RBW, In order to make an accurate measurement. 4. Measure and record the results in the test report.
Test Result:	N/A

4.4.2. Test Instruments

RF Test Room					
Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Spectrum analyzer	Agilent	N9020A	HKE-048	Feb. 17, 2023	Feb. 16, 2024
RF cable	Times	1-40G	HKE-034	Feb. 17, 2023	Feb. 16, 2024
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Feb. 17, 2023	Feb. 16, 2024

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

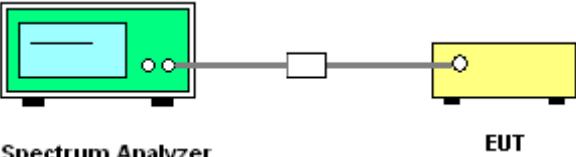
4.4.3. Test Result

N/A



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 ≤30.00dBm/500KHz for Band IV 5725MHz-5850MHz
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>
Test Mode:	Transmitting mode with modulation
Test Procedure:	<ol style="list-style-type: none"> 1. Set the spectrum analyzer or EMI receiver span to view the entire emission bandwidth. 2. Set RBW = 510 kHz/1 MHz, VBW \geq 3*RBW, Sweep time = Auto, Detector = RMS. 3. Allow the sweeps to continue until the trace stabilizes. 4. Use the peak marker function to determine the maximum amplitude level. 5. 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	Feb. 17, 2023	Feb. 16, 2024
RF cable	Times	1-40G	HKE-034	Feb. 17, 2023	Feb. 16, 2024
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Feb. 17, 2023	Feb. 16, 2024

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 IV (5725 - 5850 MHz)								
Mode	Test channel	Result [dBm/510kHz]	Offset	Test Result [dBm/510 kHz]	10log(500 /510)	Power Spectral Density	Limit (dBm/500 kHz)	Result
11a	CH149	-4.62	9.44	4.82	-0.086	4.73	30	PASS
11a	CH157	-4.83	9.44	4.61	-0.086	4.52	30	PASS
11a	CH165	-4.19	9.44	5.25	-0.086	5.16	30	PASS
11ac HT20	CH149	-4.98	9.44	4.46	-0.086	4.37	30	PASS
11ac HT20	CH157	-4.42	9.44	5.02	-0.086	4.93	30	PASS
11ac HT20	CH165	-4.92	9.44	4.52	-0.086	4.43	30	PASS
11ac HT40	CH151	-5.42	9.44	4.02	-0.086	3.93	30	PASS
11ac HT40	CH159	-4.67	9.44	4.77	-0.086	4.68	30	PASS

Note: Power Spectral Density= Level [dBm/510kHz]+ (10log(Limit RBW/Test RBW))

PSD Test Result (dBm/510kHz)= Result +Offset

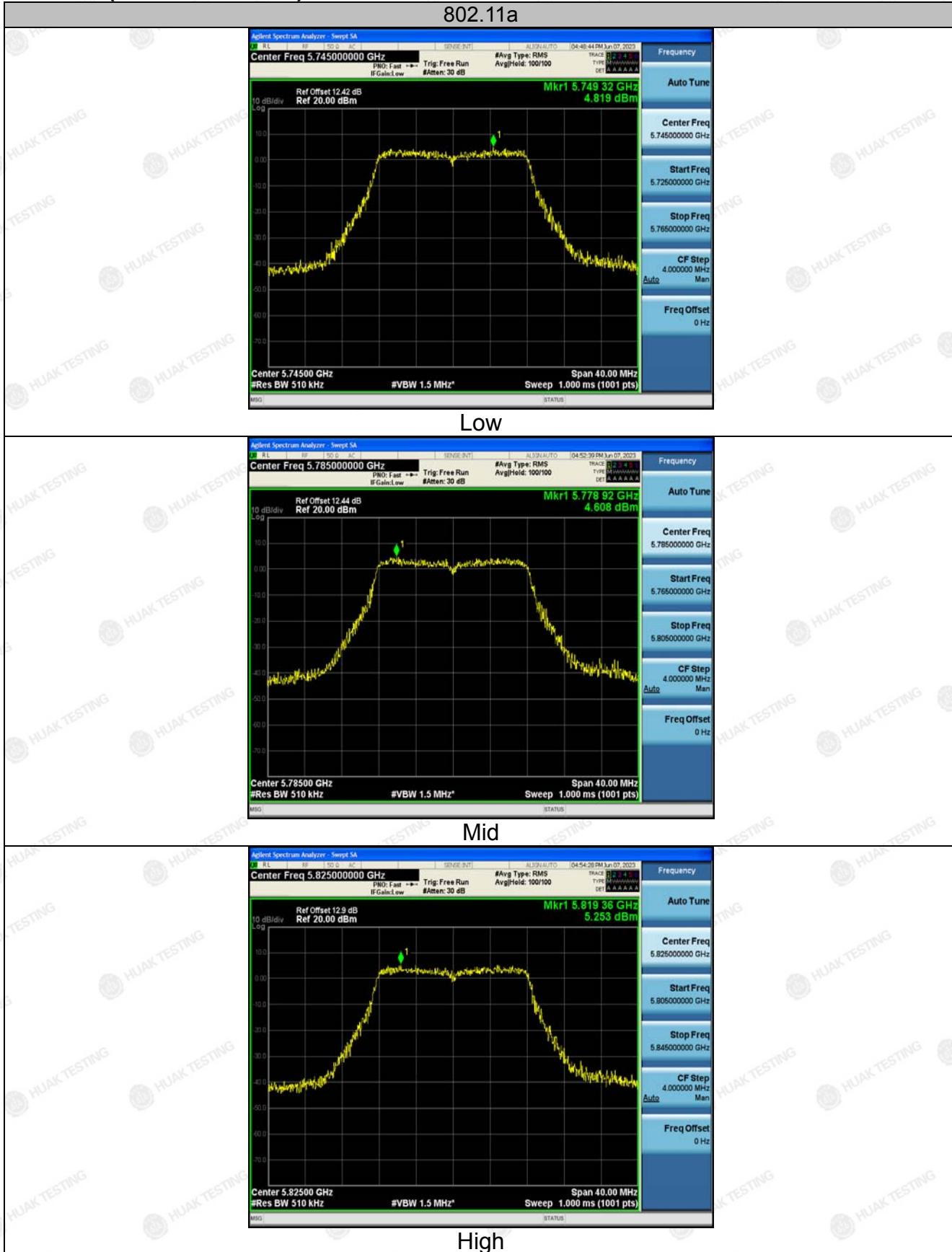
Offset= Instrument attenuation +cable loss=8.64 dB +0.8 dB =9.44dB

Test plots as follows:



Band IV (5725 – 5850 MHz)

802.11a



The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>.

TEL : +86-755 2302 9901 FAX : +86-755 2302 9901 E-mail : service@cer-mark.com

Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China



802.11ac HT20



Low



Mid



High

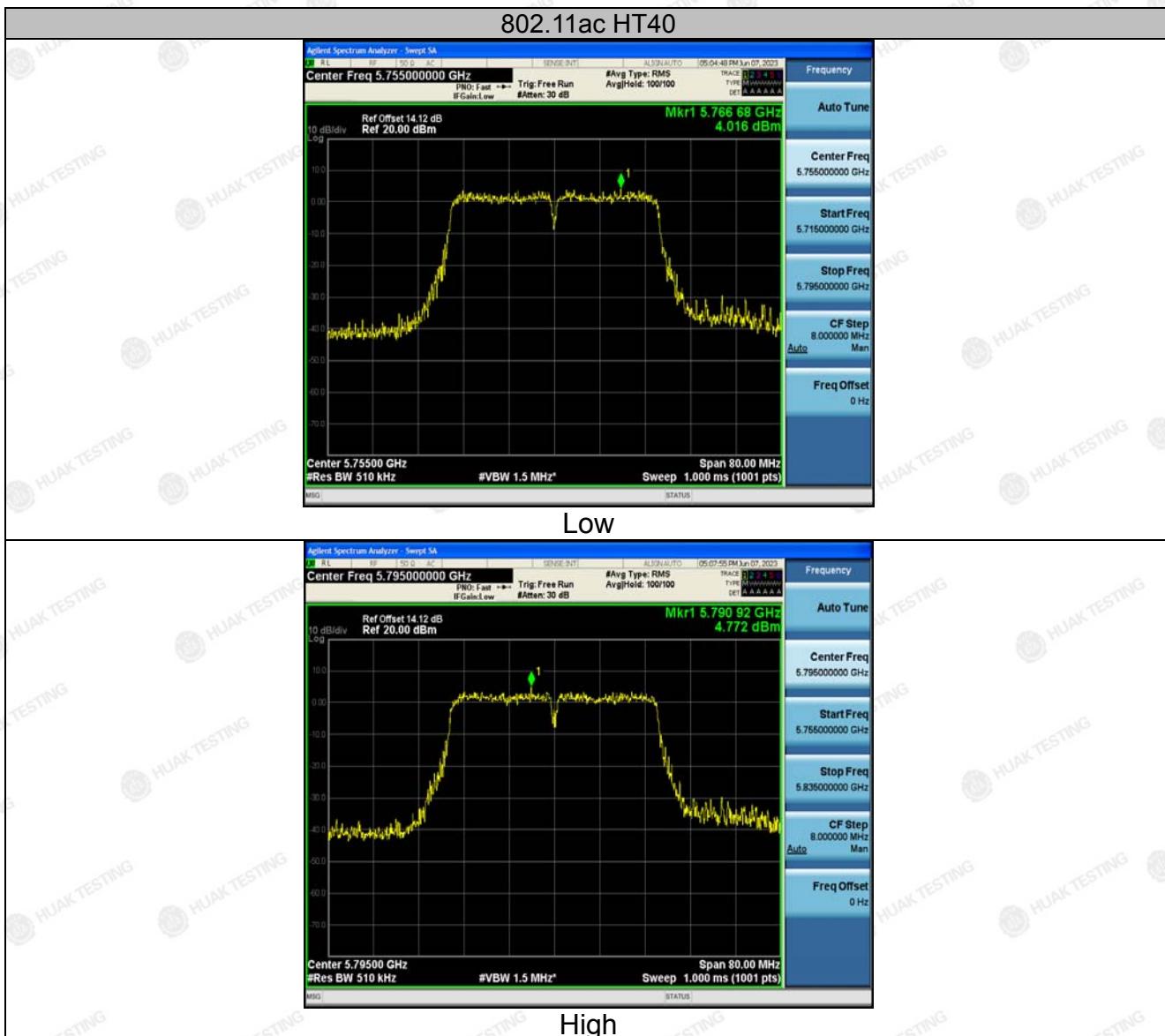
The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>.

TEL : +86-755 2302 9901 FAX : +86-755 2302 9901 E-mail : service@cer-mark.com

Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China



802.11ac HT40



The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>.

TEL : +86-755 2302 9901 FAX : +86-755 2302 9901 E-mail : service@cer-mark.com

Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China



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:	<p>(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.</p> <p>(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.</p> <p>(3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.</p> <p>(4) For transmitters operating in the 5.725-5.85 GHz band:</p> <p>(i) 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.</p> <p>The limit of frequency below 1GHz and which fall in restricted bands should complies 15.209.</p>
Test Setup:	
Test Mode:	Transmitting mode with modulation
Test Procedure:	<ol style="list-style-type: none"> 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.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>



Test Procedure:	<p>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.</p> <p>5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</p> <p>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, quasi peak or average method as specified and then reported in a data sheet.</p>
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	ESR-7	HKE-010	Feb. 17, 2023	Feb. 16, 2024
Spectrum analyzer	Agilent	N9020A	HKE-048	Feb. 17, 2023	Feb. 16, 2024
Preamplifier	EMCI	EMC051845S E	HKE-015	Feb. 17, 2023	Feb. 16, 2024
Preamplifier	Agilent	83051A	HKE-016	Feb. 17, 2023	Feb. 16, 2024
Loop antenna	Schwarzbeck	FMZB 1519 B	HKE-014	Feb. 17, 2023	Feb. 16, 2024
Broadband antenna	Schwarzbeck	VULB 9163	HKE-012	Feb. 17, 2023	Feb. 16, 2024
Horn antenna	Schwarzbeck	9120D	HKE-013	Feb. 17, 2023	Feb. 16, 2024
Antenna Mast	Keleto	CC-A-4M	N/A	N/A	N/A
Position controller	Taiwan MF	MF7802	HKE-011	Feb. 17, 2023	Feb. 16, 2024
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-K F	HKE-031	Feb. 17, 2023	Feb. 16, 2024
RF cable	Tonscend	1-18G	HKE-099	Feb. 17, 2023	Feb. 16, 2024
RF cable	Times	1-40G	HKE-034	Feb. 17, 2023	Feb. 16, 2024

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

Operation Mode: 802.11a Mode with 5.8G TX CH Low

Horizontal

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5650	51.75	-2.06	49.69	68.2	-18.51	
5700	83.65	-1.96	81.69	105.2	-23.51	peak
5720	91.34	-2.87	88.47	110.8	-22.33	peak
5725	105.81	-2.14	103.67	122.2	-18.53	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5650	50.17	-2.06	48.11	68.2	-20.09	
5700	81.99	-1.96	80.03	105.2	-25.17	peak
5720	86.54	-2.87	83.67	110.8	-27.13	peak
5725	106.31	-2.14	104.17	122.2	-18.03	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



Operation Mode: TX CH High with 5.8G

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
5850	53.62	-1.97	51.65	122.2	-70.55	peak
5855	82.12	-2.13	79.99	110.8	-30.81	peak
5875	90.7	-2.65	88.05	105.2	-17.15	peak
5925	104.44	-2.28	102.16	68.2	33.96	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
5850	50.85	-1.97	48.88	122.2	-73.32	peak
5855	82.9	-2.13	80.77	110.8	-30.03	peak
5875	88.71	-2.65	86.06	105.2	-19.14	peak
5925	106.24	-2.28	103.96	68.2	35.76	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



Operation Mode: 802.11n20 Mode with 5.8G TX CH Low

Horizontal

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5650	52.66	-2.06	50.6	68.2	-17.6	peak
5700	83.94	-1.96	81.98	105.2	-23.22	peak
5720	91.56	-2.87	88.69	110.8	-22.11	peak
5725	104.06	-2.14	101.92	122.2	-20.28	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5650	50.99	-2.06	48.93	68.2	-19.27	peak
5700	84.55	-1.96	82.59	105.2	-22.61	peak
5720	88.99	-2.87	86.12	110.8	-24.68	peak
5725	107.41	-2.14	105.27	122.2	-16.93	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



Operation Mode: TX CH High with 5.8G

Horizontal

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5850	110.12	-1.97	108.15	122.2	-14.05	
5855	90.49	-2.13	88.36	110.8	-22.44	peak
5875	85.38	-2.65	82.73	105.2	-22.47	peak
5925	52.52	-2.28	50.24	68.2	-17.96	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5850	106.46	-1.97	104.49	122.2	-17.71	
5855	91.07	-2.13	88.94	110.8	-21.86	peak
5875	81.18	-2.65	78.53	105.2	-26.67	peak
5925	52.49	-2.28	50.21	68.2	-17.99	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



Operation Mode: 802.11n40 Mode with 5.8G TX CH Low

Horizontal

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5650	51.71	-2.06	49.65	68.2	-18.55	peak
5700	83.64	-1.96	81.68	105.2	-23.52	peak
5720	90.17	-2.87	87.3	110.8	-23.5	peak
5725	105.69	-2.14	103.55	122.2	-18.65	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5650	51.03	-2.06	48.97	68.2	-19.23	peak
5700	83.03	-1.96	81.07	105.2	-24.13	peak
5720	87.66	-2.87	84.79	110.8	-26.01	peak
5725	108.25	-2.14	106.11	122.2	-16.09	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



Operation Mode: TX CH High with 5.8G

Horizontal

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5850	107.51	-1.97	105.54	122.2	-16.66	peak
5855	91.64	-2.13	89.51	110.8	-21.29	peak
5875	80.03	-2.65	77.38	105.2	-27.82	peak
5925	49.76	-2.28	47.48	68.2	-20.72	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5850	106.63	-1.97	104.66	122.2	-17.54	peak
5855	89.96	-2.13	87.83	110.8	-22.97	peak
5875	81.25	-2.65	78.6	105.2	-26.6	peak
5925	49.69	-2.28	47.41	68.2	-20.79	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



Operation Mode: 802.11ac20 Mode with 5.8G TX CH Low

Horizontal

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5650	50.07	-2.06	48.01	68.2	-20.19	peak
5700	85.05	-1.96	83.09	105.2	-22.11	peak
5720	91.49	-2.87	88.62	110.8	-22.18	peak
5725	107.67	-2.14	105.53	122.2	-16.67	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5650	52.46	-2.06	50.4	68.2	-17.8	peak
5700	85.09	-1.96	83.13	105.2	-22.07	peak
5720	89.95	-2.87	87.08	110.8	-23.72	peak
5725	107.15	-2.14	105.01	122.2	-17.19	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



Operation Mode: TX CH High with 5.8G

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
5850	104.37	-1.97	102.4	122.2	-19.8	peak
5855	92.35	-2.13	90.22	110.8	-20.58	peak
5875	84.33	-2.65	81.68	105.2	-23.52	peak
5925	45.84	-2.28	43.56	68.2	-24.64	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
5850	105.3	-1.97	103.33	122.2	-18.87	peak
5855	91.77	-2.13	89.64	110.8	-21.16	peak
5875	85.55	-2.65	82.9	105.2	-22.3	peak
5925	45.95	-2.28	43.67	68.2	-24.53	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



Operation Mode: 802.11ac40 Mode with 5.8G TX CH Low

Horizontal

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5650	52.89	-2.06	50.83	68.2	-17.37	peak
5700	83.19	-1.96	81.23	105.2	-23.97	peak
5720	90.33	-2.87	87.46	110.8	-23.34	peak
5725	106.32	-2.14	104.18	122.2	-18.02	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5650	53.82	-2.06	51.76	68.2	-16.44	peak
5700	83.16	-1.96	81.2	105.2	-24	peak
5720	89.3	-2.87	86.43	110.8	-24.37	peak
5725	107.42	-2.14	105.28	122.2	-16.92	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



Operation Mode: TX CH High with 5.8G

Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
5850	106.55	-1.97	104.58	122.2	-17.62	peak
5855	90.91	-2.13	88.78	110.8	-22.02	peak
5875	81.96	-2.65	79.31	105.2	-25.89	peak
5925	48.2	-2.28	45.92	68.2	-22.28	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
5850	107.56	-1.97	105.59	122.2	-16.61	peak
5855	91.33	-2.13	89.2	110.8	-21.6	peak
5875	82.71	-2.65	80.06	105.2	-25.14	peak
5925	46.93	-2.28	44.65	68.2	-23.55	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



Operation Mode: 802.11ac80 Mode with 5.8G TX CH Low

Horizontal

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5650	53.5	-2.06	51.44	68.2	-16.76	peak
5700	82.73	-1.96	80.77	105.2	-24.43	peak
5720	89.51	-2.87	86.64	110.8	-24.16	peak
5725	104.49	-2.14	102.35	122.2	-19.85	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5650	52.11	-2.06	50.05	68.2	-18.15	peak
5700	83.06	-1.96	81.1	105.2	-24.1	peak
5720	88.93	-2.87	86.06	110.8	-24.74	peak
5725	103.7	-2.14	101.56	122.2	-20.64	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



Operation Mode: TX CH High with 5.8G

Horizontal

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5850	106.49	-1.97	104.52	122.2	-17.68	peak
5855	86.3	-2.13	84.17	110.8	-26.63	peak
5875	82.92	-2.65	80.27	105.2	-24.93	peak
5925	52.89	-2.28	50.61	68.2	-17.59	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
5850	108.08	-1.97	106.11	122.2	-16.09	peak
5855	88.79	-2.13	86.66	110.8	-24.14	peak
5875	82.54	-2.65	79.89	105.2	-25.31	peak
5925	51.69	-2.28	49.41	68.2	-18.79	peak

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

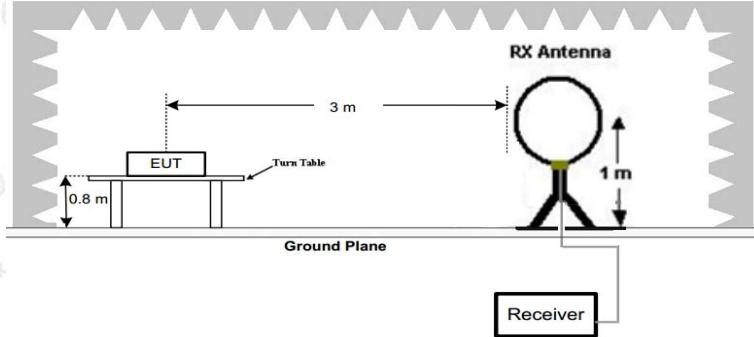
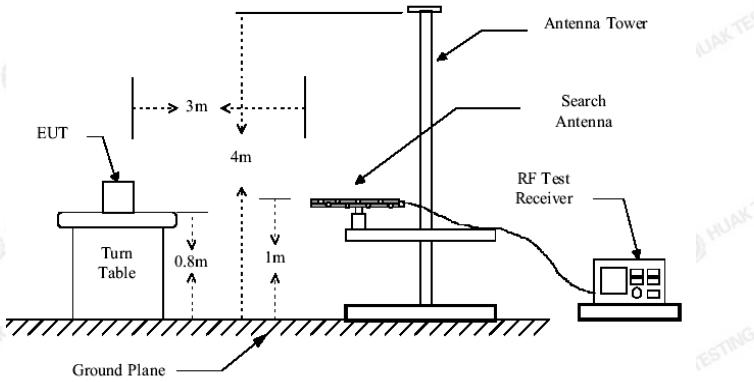
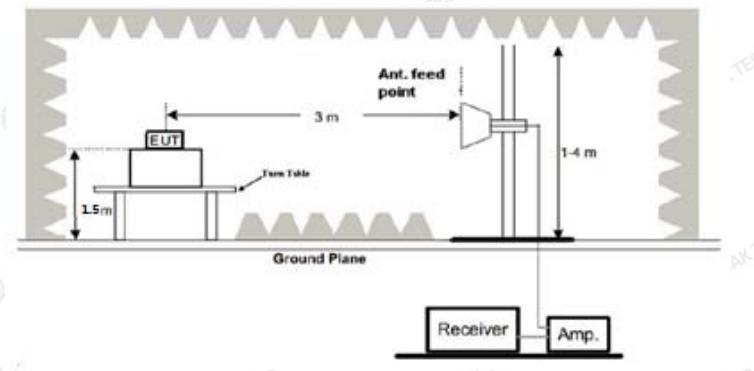


4.7. Spurious Emission

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:	<table border="1"> <thead> <tr> <th>Frequency</th> <th>Detector</th> <th>RBW</th> <th>VBW</th> <th>Remark</th> </tr> </thead> <tbody> <tr> <td>9kHz- 150kHz</td> <td>Quasi-peak</td> <td>200Hz</td> <td>1kHz</td> <td>Quasi-peak Value</td> </tr> <tr> <td>150kHz- 30MHz</td> <td>Quasi-peak</td> <td>9kHz</td> <td>30kHz</td> <td>Quasi-peak Value</td> </tr> <tr> <td>30MHz-1GHz</td> <td>Quasi-peak</td> <td>120KHz</td> <td>300KHz</td> <td>Quasi-peak Value</td> </tr> <tr> <td rowspan="2">Above 1GHz</td><td>Peak</td> <td>1MHz</td> <td>3MHz</td> <td>Peak Value</td> </tr> <tr> <td>Peak</td> <td>1MHz</td> <td>10Hz</td> <td>Average Value</td> </tr> </tbody> </table>					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
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:	<p>(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.</p> <p>(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.</p> <p>(3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.</p> <p>(4) For transmitters operating in the 5.725-5.85 GHz band:</p> <p>(i) 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.</p> <p>The limit of frequency below 1GHz and which fall in restricted bands should complies 15.209.</p>																																	



Test setup:	<p>For radiated emissions below 30MHz</p>  <p>30MHz to 1GHz</p>  <p>Above 1GHz</p> 
Test Procedure:	<ol style="list-style-type: none">1. The EUT was placed on the top of a rotating table 0.8 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.



Test Procedure:	<p>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 rotatable was turned from 0 degrees to 360 degrees to find the maximum reading.</p> <p>5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</p> <p>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, quasi-peak or average method as specified and then reported in a data sheet.</p>
Test Results:	PASS

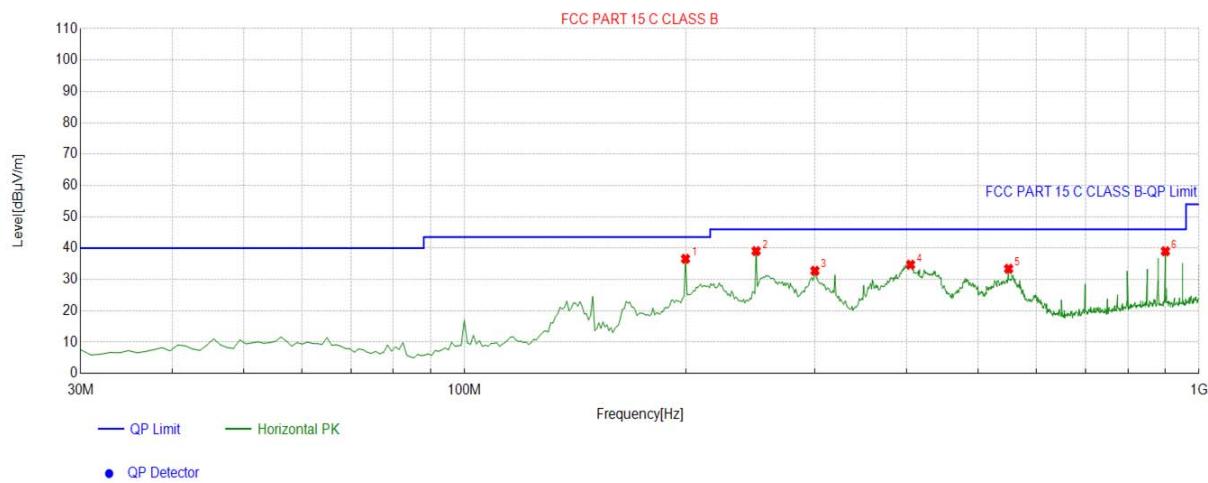


4.7.2. Test Data

Remark: All the test modes completed for test. The worst case of Radiated Emission is CH 149; the test data of this mode was reported.

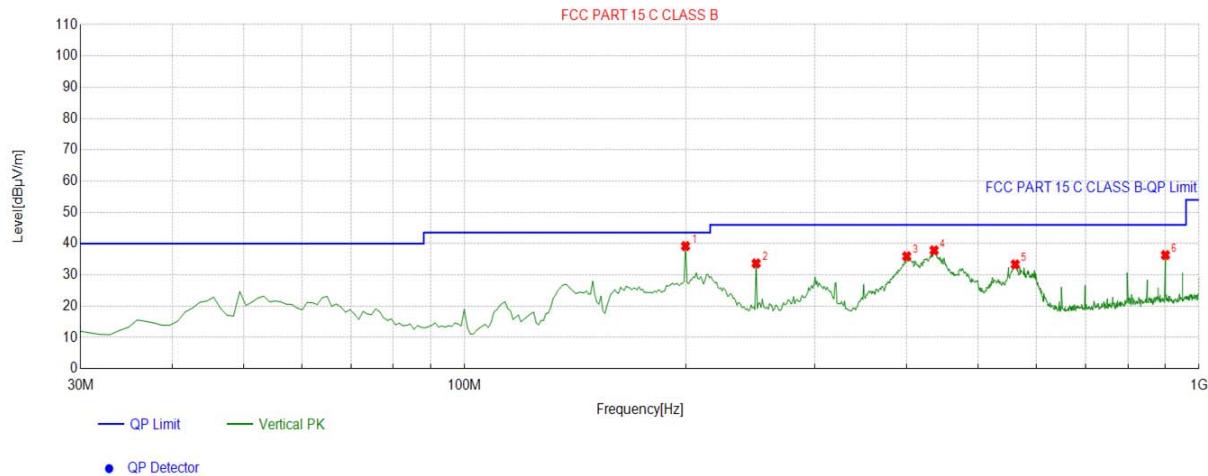
Below 1GHz

Horizontal



Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	199.9199	-15.27	51.85	36.58	43.50	6.92	100	10	Horizontal
2	249.4394	-13.15	52.20	39.05	46.00	6.95	100	165	Horizontal
3	299.9299	-11.91	44.66	32.75	46.00	13.25	100	117	Horizontal
4	404.7948	-9.33	44.02	34.69	46.00	11.31	100	359	Horizontal
5	550.4404	-6.08	39.47	33.39	46.00	12.61	100	168	Horizontal
6	899.9900	-0.51	39.50	38.99	46.00	7.01	100	50	Horizontal

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

**Vertical**

Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	199.9199	-15.27	54.48	39.21	43.50	4.29	100	286	Vertical
2	249.4394	-13.15	46.81	33.66	46.00	12.34	100	3	Vertical
3	399.9399	-9.45	45.40	35.95	46.00	10.05	100	51	Vertical
4	435.8659	-8.21	46.05	37.84	46.00	8.16	100	8	Vertical
5	562.0921	-5.93	39.27	33.34	46.00	12.66	100	62	Vertical
6	899.9900	-0.51	36.84	36.33	46.00	9.67	100	118	Vertical

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

Harmonics and Spurious Emissions**Frequency Range (9kHz-30MHz)**

Frequency (MHz)	Level@3m (dB μ V/m)	Limit@3m (dB μ V/m)
--	--	--
--	--	--
--	--	--
--	--	--

Note: 1. Emission Level=Reading+ Cable loss-Antenna factor-Amp factor.

2. The emission levels are 20 dB below the limit value, which are not reported. It is deemed to comply with the requirement.

**Above 1GHz**

LOW CH 149 (802.11 a Mode with 5.8G)/5745

Horizontal:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
3647	60.94	-4.59	56.35	74	-17.65	peak
3647	42.01	-4.59	37.42	54	-16.58	AVG
11570	55.02	4.21	59.23	74	-14.77	peak
11570	42.87	4.21	47.08	54	-6.92	AVG

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
3647	61.87	-4.59	57.28	74	-16.72	peak
3647	43.57	-4.59	38.98	54	-15.02	AVG
11570	54.46	4.21	58.67	74	-15.33	peak
11570	42.19	4.21	46.4	54	-7.6	AVG

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



MID CH157 (802.11 a Mode with 5.8G)/5785

Horizontal:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
3647	60.53	-4.59	55.94	74	-18.06	peak
3647	44.66	-4.59	40.07	54	-13.93	AVG
11570	56.07	4.21	60.28	74	-13.72	peak
11570	40.8	4.21	45.01	54	-8.99	AVG

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency (MHz)	Meter Reading (dB μ V)	Factor (dB)	Emission Level (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Detector Type
3647	59.7	-4.59	55.11	74	-18.89	peak
3647	42.5	-4.59	37.91	54	-16.09	AVG
11570	55.04	4.21	59.25	74	-14.75	peak
11570	40.69	4.21	44.9	54	-9.1	AVG

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.



HIGH CH 165 (802.11a Mode with 5.8G)/5825

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
3647	60.15	-4.59	55.56	74	-18.44	peak
3647	43.42	-4.59	38.83	54	-15.17	AVG
11650	54.54	4.84	59.38	74	-14.62	peak
11650	42.53	4.84	47.37	54	-6.63	AVG

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dB μ V)	(dB)	(dB μ V/m)	(dB μ V/m)	(dB)	
3647	60.56	-4.59	55.97	74	-18.03	peak
3647	44.33	-4.59	39.74	54	-14.26	AVG
11650	54.61	4.84	59.45	74	-14.55	peak
11650	42.42	4.84	47.26	54	-6.74	AVG

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.

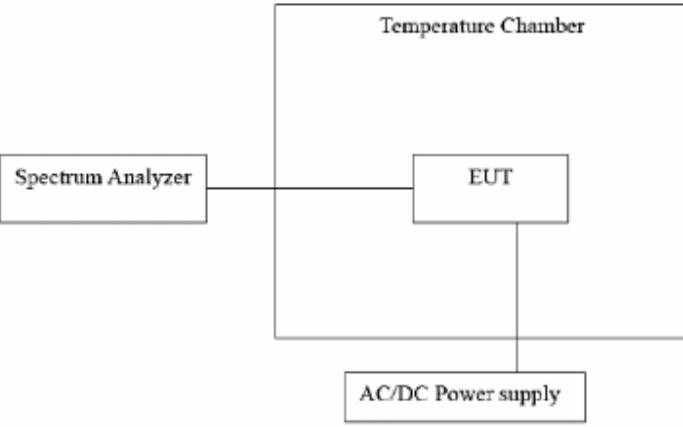
Remark:

- (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) The emissions are attenuated more than 20dB below the permissible limits are not recorded in the report.
- (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 73.16dB μ V/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dB μ V/m(PK Value) <54 dB μ V/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)
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

The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>

**Test Result as follows:**

Mode	Voltage (V)	FHL (5745MHz)	Deviation (KHz)	FHH (5825MHz)	Deviation (KHz)
5.8G Band	4.25V	5745.016	16	5825.045	45
	5V	5744.982	-18	5824.991	-9
	5.75V	5745.030	30	5824.970	-30

Mode	Temperature (°C)	FHL (5745MHz)	Deviation (KHz)	FHH (5825MHz)	Deviation (KHz)
5.8G Band	-30	5745.021	21	5825.026	26
	-20	5745.012	12	5824.980	-20
	-10	5745.030	30	5824.960	-40
	0	5745.043	43	5824.971	-29
	10	5744.974	-26	5824.995	-5
	20	5744.982	-18	5824.956	-44
	30	5744.978	-22	5825.015	15
	40	5745.001	1	5824.990	-10
	50	5745.012	12	5825.025	25



4.9. 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.

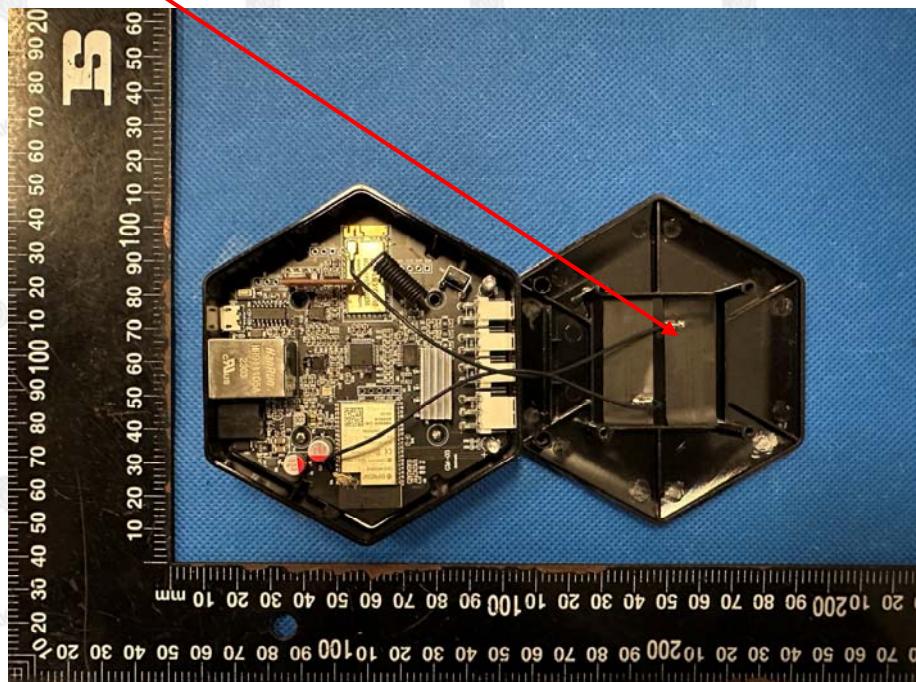
Refer to statement below for compliance.

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, need professional installation, not easy to remove. It conforms to the standard requirements. The directional gains of antenna used for transmitting is 4.54dBi.

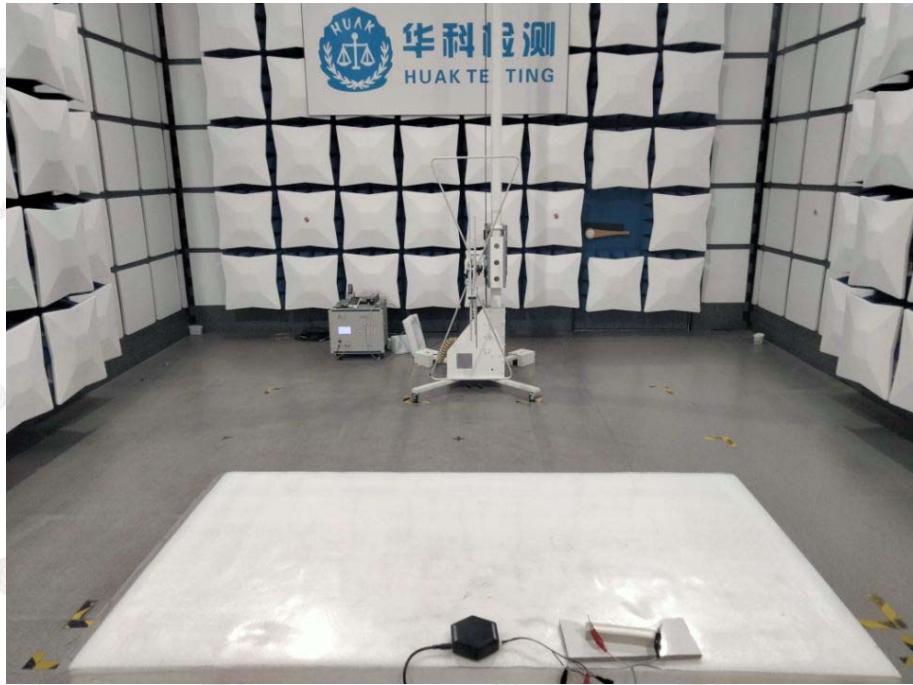
WIFI Antenna





5. Photographs of Test Setup

Radiated Emission



The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>

TEL : +86-755 2302 9901 FAX : +86-755 2302 9901 E-mail : service@cer-mark.com

Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

**Conducted Emission**

The results shown in this test report refer only to the sample(s) tested unless otherwise stated and the sample(s) are retained for 30 days only. The document is issued by HUAK, this document cannot be reproduced except in full with our prior written permission. The more details and the authenticity of the report will be confirmed at <http://www.cer-mark.com>

TEL : +86-755 2302 9901 FAX : +86-755 2302 9901 E-mail : service@cer-mark.com

Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China



6. Photos of the EUT

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

-----End of test report-----