FCC Test Report

Test report

On Behalf of

Shenzhen CTV Int Cloud Technology Co., Ltd

For

Security Camera

Model No.: ZS-D1, ZY-D1, ZY-D2, ZY-D3, ZY-D4, ZY-D5, ZY-D6, ZY-D7, ZY-D8, ZY-D9, ZS-GX1S, ZS-GX2S, ZS-GX3S, ZS-GX4S, ZS-GX5S, ZS-GX6S, ZS-GX7S, ZS-GX8S, ZS-GQ1, ZS-GQ2, ZS-GQ3, ZS-GQ4, ZS-GQ5, ZY-C1, ZY-C2, ZY-C3, ZY-C4, ZY-C5, ZY-C7, ZY-C8, ZY-C9, ZY-Q1, ZY-Q2, ZY-Q3, ZY-Q4, ZY-Q5, ZY-Q6, ZY-Q7, ZY-Q8, ZY-Q9, ZY-E1, ZY-E2, ZY-E4, ZY-E5, ZY-E6, ZY-E7, ZY-E8, ZY-E9, ZY-F1, ZY-F2, ZY-F3, ZY-F4, ZY-F5, ZY-F6, ZY-F7, ZY-F8, ZY-F9, ZY-G1, ZY-G2, ZY-G3, ZY-G4, ZY-G5, ZY-G6, ZY-G7, ZY-G8, ZY-G9

FCC ID: 2AZL7-ZS-D1

Prepared For :	**Shenzhen CTV Int Cloud Technology Co., Ltd** **501, Building A, Debaoli Industrial Park, Shangxue Technology City, Xinxue Community, Bantian Street, Longgang District, Shenzhen, China**
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:	**Jul. 20, 2023 ~ Aug. 25, 2023**
Date of Report:	**Aug. 25, 2023**
Report Number:	**HK230713002-3E**

Test Result Certification

Applicant's name.....:	Shenzhen CTV Int Cloud Technology Co., Ltd
Address .....:	501, Building A, Debaoli Industrial Park, Shangxue Technology City, Xinxue Community, Bantian Street, Longgang District, Shenzhen, China
Manufacture's Name.....:	Shenzhen CTV Int Cloud Technology Co., Ltd
Address .....:	501, Building A, Debaoli Industrial Park, Shangxue Technology City, Xinxue Community, Bantian Street, Longgang District, Shenzhen, China

Product description

Trade Mark:	N/A
Product name.....:	Security Camera
Model and/or type reference .:	ZS-D1, ZY-D1, ZY-D2, ZY-D3, ZY-D4, ZY-D5, ZY-D6, ZY-D7, ZY-D8, ZY-D9, ZS-GX1S, ZS-GX2S, ZS-GX3S, ZS-GX4S, ZS-GX5S, ZS-GX6S, ZS-GX7S, ZS-GX8S, ZS-GQ1, ZS-GQ2, ZS-GQ3, ZS-GQ4, ZS-GQ5, ZY-C1, ZY-C2, ZY-C3, ZY-C4, ZY-C5, ZY-C7, ZY-C8, ZY-C9, ZY-Q1, ZY-Q2, ZY-Q3, ZY-Q4, ZY-Q5, ZY-Q6, ZY-Q7, ZY-Q8, ZY-Q9, ZY-E1, ZY-E2, ZY-E4, ZY-E5, ZY-E6, ZY-E7, ZY-E8, ZY-E9, ZY-F1, ZY-F2, ZY-F3, ZY-F4, ZY-F5, ZY-F6, ZY-F7, ZY-F8, ZY-F9, ZY-G1, ZY-G2, ZY-G3, ZY-G4, ZY-G5, ZY-G6, ZY-G7, ZY-G8, ZY-G9
Standards.....:	FCC Rules and Regulations Part 15 Subpart E Section 15.407 ANSI C63.10: 2013

Date of Test.....:

Date (s) of performance of tests .....:	Jul. 20, 2023 ~ Aug. 25, 2023
Date of Issue.....:	Aug. 25, 2023
Test Result.....:	Pass

Testing Engineer : Gary Qian

(Gary Qian)

Technical Manager : Eden Hu

(Eden Hu)

Authorized Signatory : Jason Zhou

(Jason Zhou)

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** Modified History **

Revision	Description	Issued Data	Remark
Revision 1.0	Initial Test Report Release	Aug. 25, 2023	Jason Zhou

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.

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 ± 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	±2.71dB
2	RF power, conducted	±0.37dB
3	Spurious emissions, conducted	±0.11dB
4	All emissions, radiated(<1G)	±3.90dB
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:	Security Camera
Model Name:	ZS-D1
Series Model:	ZY-D1, ZY-D2, ZY-D3, ZY-D4, ZY-D5, ZY-D6, ZY-D7, ZY-D8, ZY-D9, ZS-GX1S, ZS-GX2S, ZS-GX3S, ZS-GX4S, ZS-GX5S, ZS-GX6S, ZS-GX7S, ZS-GX8S, ZS-GQ1, ZS-GQ2, ZS-GQ3, ZS-GQ4, ZS-GQ5, ZY-C1, ZY-C2, ZY-C3, ZY-C4, ZY-C5, ZY-C7, ZY-C8, ZY-C9, ZY-Q1, ZY-Q2, ZY-Q3, ZY-Q4, ZY-Q5, ZY-Q6, ZY-Q7, ZY-Q8, ZY-Q9, ZY-E1, ZY-E2, ZY-E4, ZY-E5, ZY-E6, ZY-E7, ZY-E8, ZY-E9, ZY-F1, ZY-F2, ZY-F3, ZY-F4, ZY-F5, ZY-F6, ZY-F7, ZY-F8, ZY-F9, ZY-G1, ZY-G2, ZY-G3, ZY-G4, ZY-G5, ZY-G6, ZY-G7, ZY-G8, ZY-G9
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: ZS-D1.
FCC ID:	2AZL7-ZS-D1
Operation Frequency:	IEEE 802.11a/n (HT20)5.745GHz-5.825GHz
Modulation Technology:	IEEE 802.11a/n
Modulation Type:	OFDM
Antenna Type:	Internal Antenna
Antenna Gain:	4.94dBi
Power Source:	AC 120V
Power Supply:	AC 120V

2.2. Operation Frequency Each of Channel

802.11a/802.11n(HT20)	
Channel	Frequency
149	5745
153	5765
157	5785
161	5805
165	5825

Note:

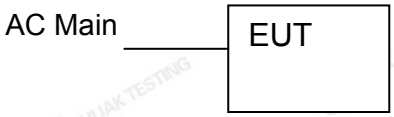
In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

2.3. Operation of EUT During Testing

Band IV (5725 - 5850 MHz)		
For 802.11a/ n HT20		
Channel Number	Channel	Frequency (MHz)
149	Low	5745
157	Mid	5785
165	High	5825

2.4. Description of Test Setup

Operation of EUT during testing:



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.

2.5. 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.

Item	Equipment	Trade Mark	Model/Type No.	Specification	Remark
1	Security Camera	N/A	ZS-D1	N/A	EUT
2	Power Cable	N/A	N/A	1.5m	Peripheral
3	RF Cable	N/A	N/A	0.1m	Peripheral
4					

Note:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.
3. For conducted measurements (Output Power, 6dB Emission Bandwidth, Power Spectral Density, Spurious Emissions), the antenna of EUT is connected to the test equipment via temporary antenna connector, the antenna connector is soldered on the antenna port of EUT, and the temporary antenna connector is listed in the Test Instruments.

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

Final Test Mode:

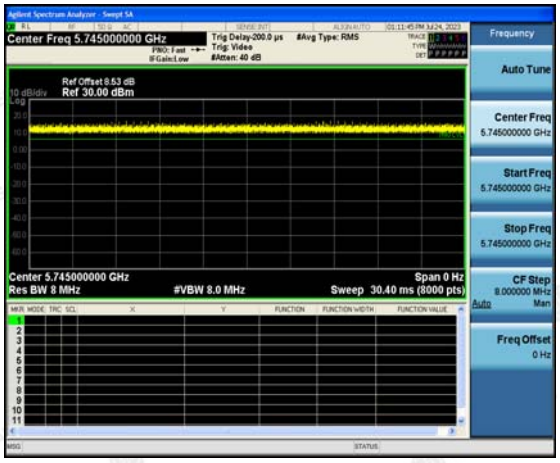
Operation mode:	Keep the EUT in continuous transmitting with modulation

Mode Test Duty Cycle:

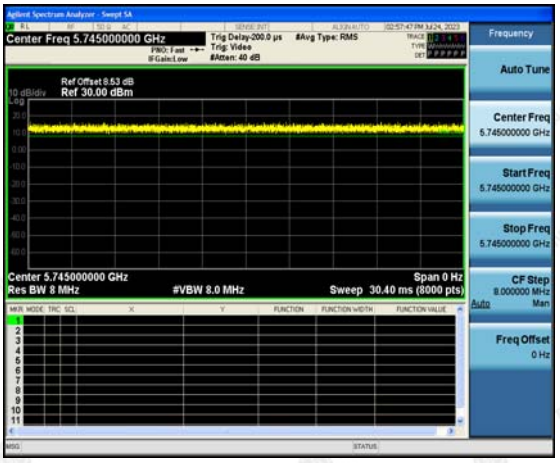
Mode	Duty Cycle	Duty Cycle Factor (dB)
802.11a	100%	0
802.11n(HT20)	100%	0

Test plots as follows:

802.11a



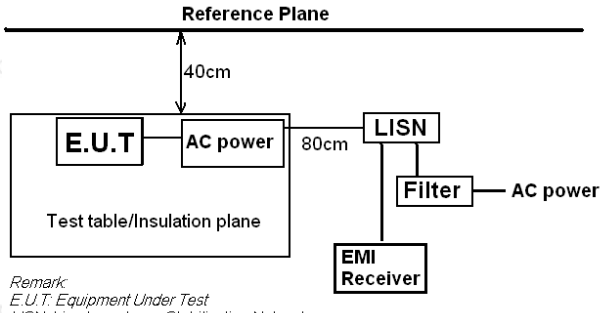
802.11n(HT20)



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	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
10dB Attenuator	Schwarzbeck	VTSD9561F	HKE-153	Feb. 17, 2023	Feb. 16, 2024
Conducted test software	Tonscend	TS+ Rev 2.5.0.0	HKE-081	N/A	N/A

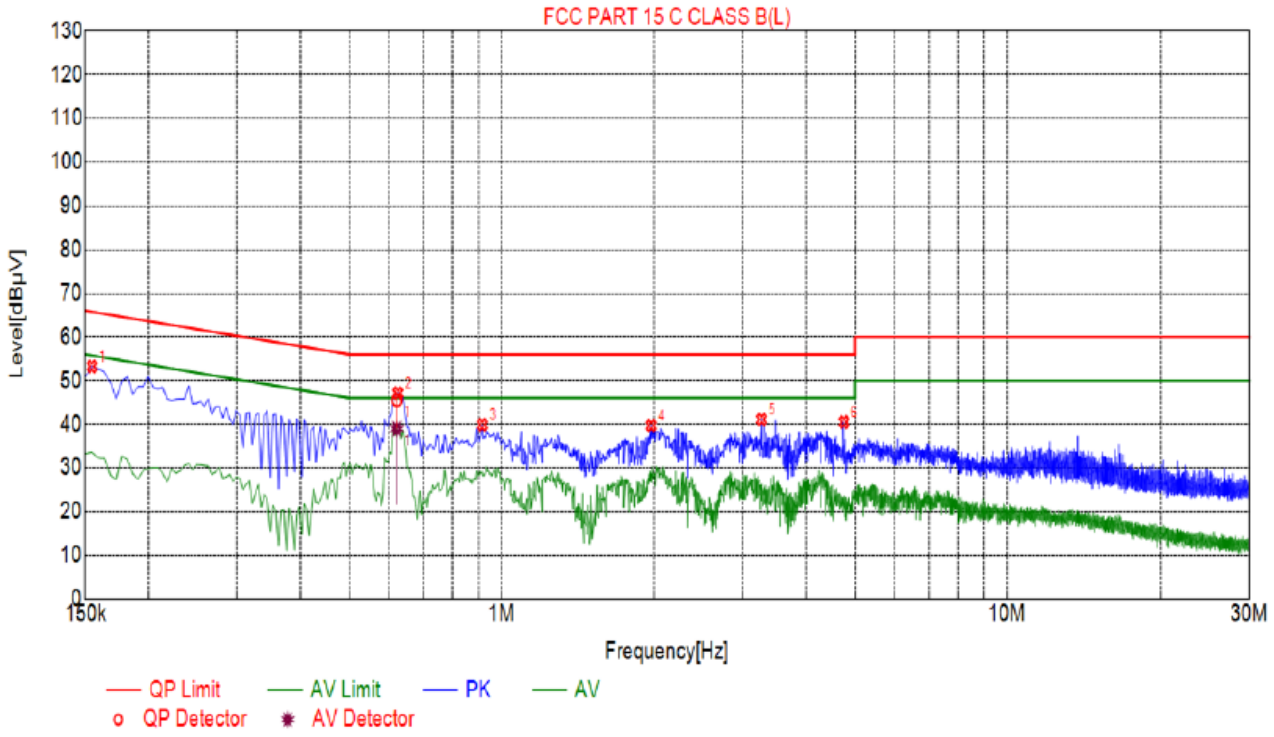
Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

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

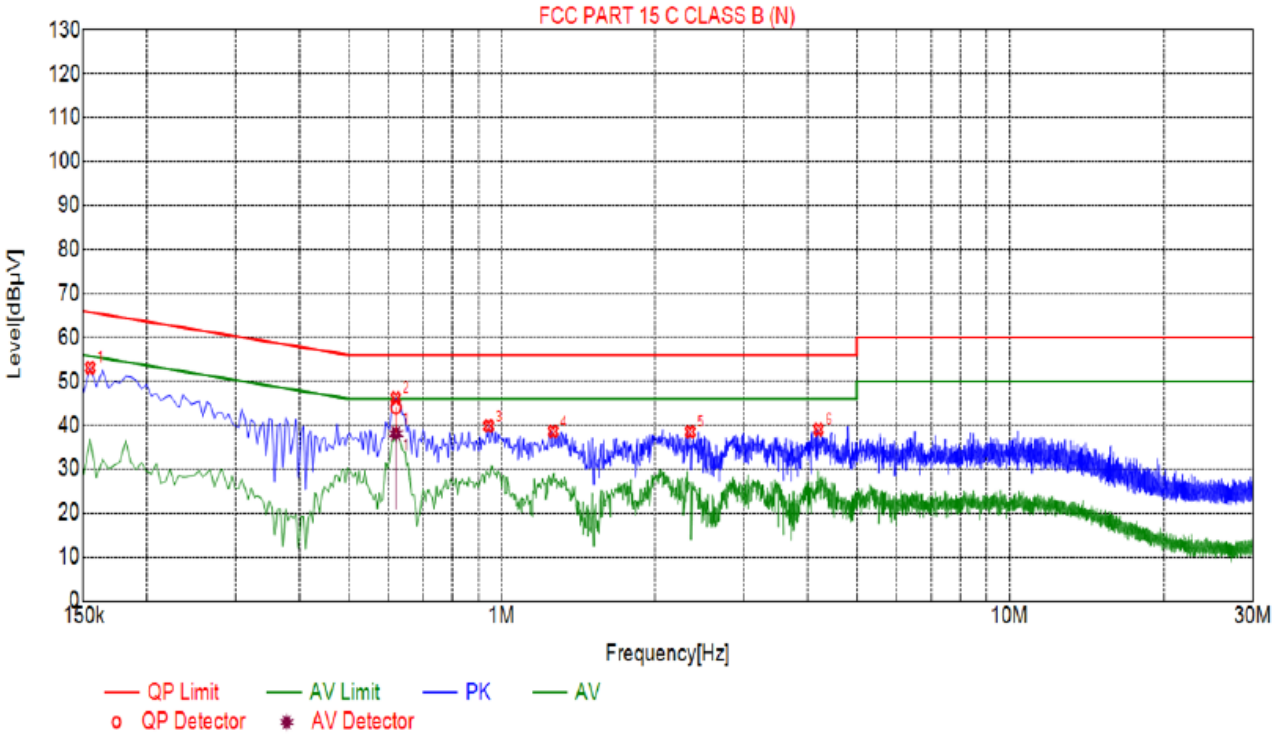
NO.	Freq. [MHz]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Reading [dBµV]	Detector	Type
1	0.1545	53.24	20.03	65.75	12.51	33.21	PK	L
2	0.6225	47.13	20.05	56.00	8.87	27.08	PK	L
3	0.9150	39.86	20.06	56.00	16.14	19.80	PK	L
4	1.9770	39.68	20.14	56.00	16.32	19.54	PK	L
5	3.2685	41.10	20.23	56.00	14.90	20.87	PK	L
6	4.7535	40.50	20.26	56.00	15.50	20.24	PK	L

Final Data List

NO.	Freq. [MHz]	Correction factor[dB]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	QP Reading [dBµV]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]	AV Reading [dBµV]	Type
1	0.6198	20.05	45.54	56.00	10.46	25.49	38.96	46.00	7.04	18.91	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	0.1545	53.10	20.03	65.75	12.65	33.07	PK	N
2	0.6180	46.20	20.05	56.00	9.80	26.15	PK	N
3	0.9420	39.82	20.06	56.00	16.18	19.76	PK	N
4	1.2615	38.60	20.09	56.00	17.40	18.51	PK	N
5	2.3505	38.49	20.18	56.00	17.51	18.31	PK	N
6	4.2045	39.03	20.25	56.00	16.97	18.78	PK	N

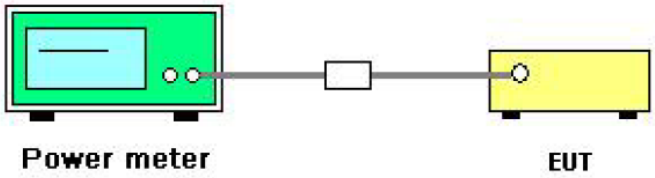
Final Data List

NO.	Freq. [MHz]	Correction factor[dB]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	QP Reading [dBµV]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]	AV Reading [dBµV]	Type
1	0.6184	20.05	44.09	56.00	11.91	24.04	38.11	46.00	7.89	18.06	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:	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. 4. 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	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

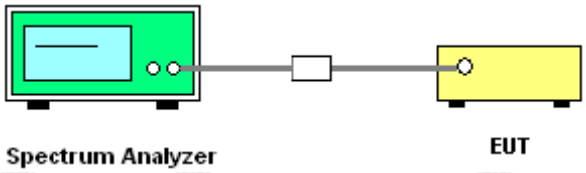
Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

Test Data

Configuration Band IV (5725 - 5850 MHz)				
Mode	Test channel	Maximum Conducted Output Power (dBm)	FCC Limit (dBm)	Result
11a	CH149	18.21	30	PASS
11a	CH157	19.01	30	PASS
11a	CH165	19.07	30	PASS
11n HT20	CH149	18.36	30	PASS
11n HT20	CH157	16.74	30	PASS
11n HT20	CH165	17.28	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	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).*

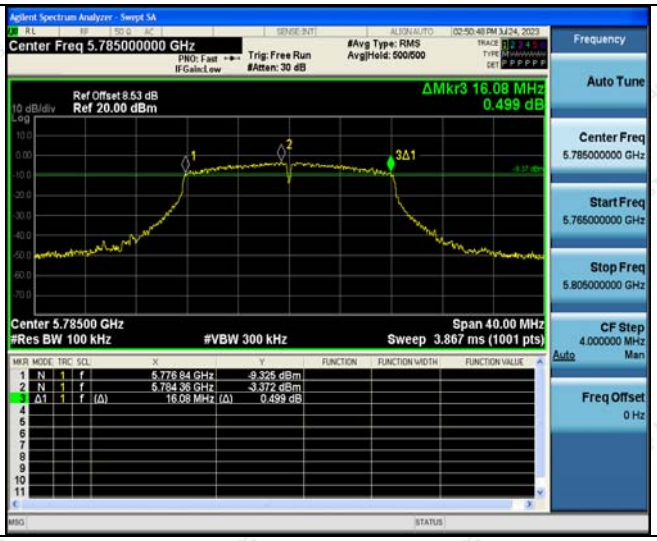
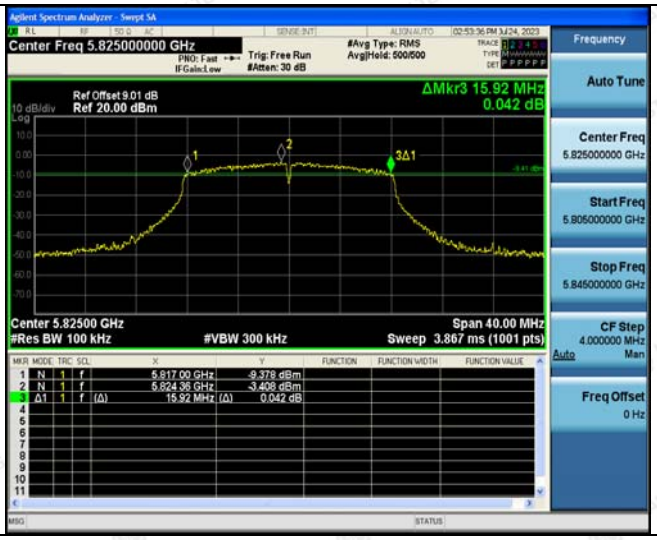
Test data

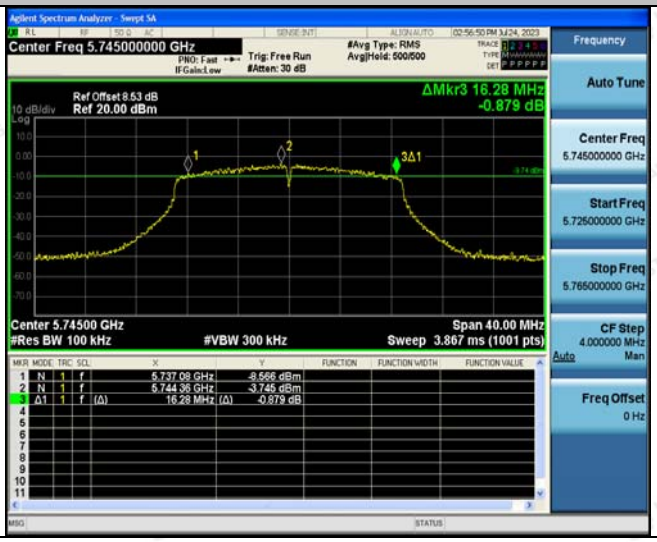
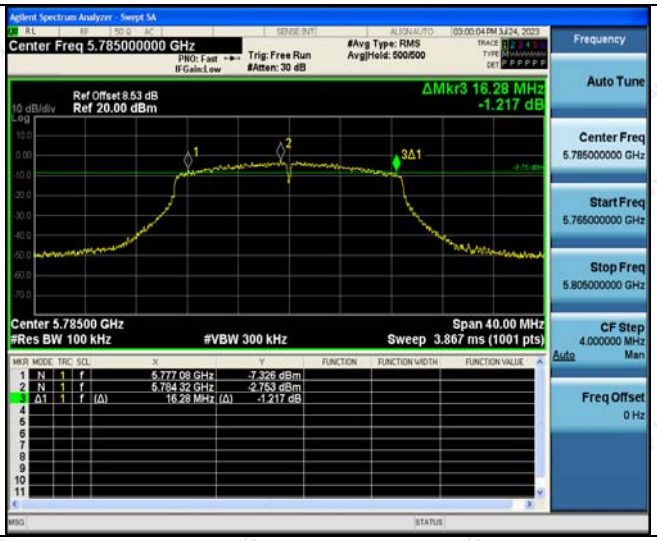
Band IV (5725 - 5850 MHz)					
Mode	Test channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)	Result
11a	CH149	5745	16.08	0.5	PASS
11a	CH157	5785	16.08	0.5	PASS
11a	CH165	5825	15.92	0.5	PASS
11n HT20	CH149	5745	16.28	0.5	PASS
11n HT20	CH157	5785	16.28	0.5	PASS
11n HT20	CH165	5825	16.28	0.5	PASS

Test plots as follows:

Band IV (5725 – 5850 MHz)

802.11a

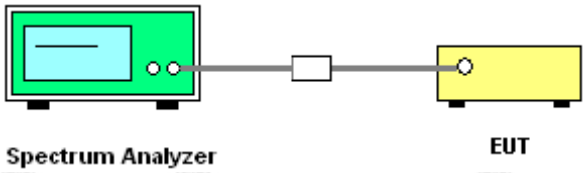
Low

Mid

High

802.11n HT20

Low

Mid

High

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:	
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:	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

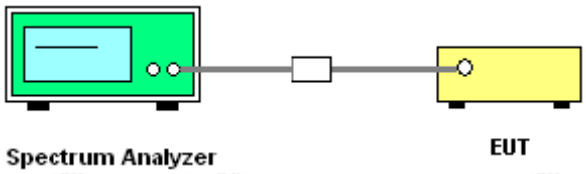
Note: *The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).*

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:	≤30.00dBm/500KHz for Band IV 5725MHz-5850MHz
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. 2. Set RBW = 510 kHz/1 MHz, VBW ≥ 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	Level [dBm/510kHz]	10log(500/510)	Power Spectral Density	Limit (dBm/500kHz)	Result
11a	CH149	4.19	-0.086	4.104	30	PASS
11a	CH157	5.24	-0.086	5.154	30	PASS
11a	CH165	4.31	-0.086	4.224	30	PASS
11n HT20	CH149	4.36	-0.086	4.274	30	PASS
11n HT20	CH157	4.48	-0.086	4.394	30	PASS
11n HT20	CH165	4.14	-0.086	4.054	30	PASS

Note: 1. Power Spectral Density= Level [dBm/510kHz]+（10log(Limit RBW/Test RBW)）
2. Note: Instrument attenuation and cable loss See test diagram

Test plots as follows:

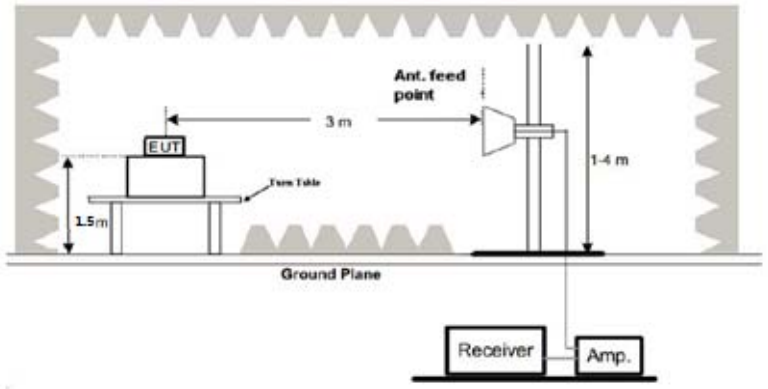
Band IV (5725 – 5850 MHz)

802.11a
 Low
 Mid
 High

802.11n HT20
 Low
 Mid
 High

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:	(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. (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. (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. (4) For transmitters operating in the 5.725-5.85 GHz band: (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. The limit of frequency below 1GHz and which fall in restricted ba nds should complies 15.209.
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.

Test Procedure:	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, quasi peak 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	Feb. 17, 2023	Feb. 16, 2024
Spectrum analyzer	Agilent	N9020A	HKE-048	Feb. 17, 2023	Feb. 16, 2024
Preamplifier	EMCI	EMC051845SE	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-KF	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	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5650	54.45	-2.06	52.39	68.2	-15.81	peak
5700	84.75	-1.96	82.79	105.2	-22.41	peak
5720	89.69	-2.87	86.82	110.8	-23.98	peak
5725	104.95	-2.14	102.81	122.2	-19.39	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)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5650	52.84	-2.06	50.78	68.2	-17.42	peak
5700	85.09	-1.96	83.13	105.2	-22.07	peak
5720	88.81	-2.87	85.94	110.8	-24.86	peak
5725	108.09	-2.14	105.95	122.2	-16.25	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 (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
5850	104.88	-1.97	102.91	122.2	-19.29	peak
5855	90.86	-2.13	88.73	110.8	-22.07	peak
5875	86.31	-2.65	83.66	105.2	-21.54	peak
5925	53.19	-2.28	50.91	68.2	-17.29	peak
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
5850	110.99	-1.97	109.02	122.2	-13.18	peak
5855	89.17	-2.13	87.04	110.8	-23.76	peak
5875	86.17	-2.65	83.52	105.2	-21.68	peak
5925	49.08	-2.28	46.8	68.2	-21.4	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	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5650	53.38	-2.06	51.32	68.2	-16.88	peak
5700	85.06	-1.96	83.1	105.2	-22.1	peak
5720	91.76	-2.87	88.89	110.8	-21.91	peak
5725	108.73	-2.14	106.59	122.2	-15.61	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)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5650	60.79	-2.06	58.73	68.2	-9.47	peak
5700	95.52	-1.96	93.56	105.2	-11.64	peak
5720	93.47	-2.87	90.6	110.8	-20.2	peak
5725	105.22	-2.14	103.08	122.2	-19.12	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 (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
5850	108.99	-1.97	107.02	122.2	-15.18	peak
5855	90.99	-2.13	88.86	110.8	-21.94	peak
5875	86.21	-2.65	83.56	105.2	-21.64	peak
5925	51.63	-2.28	49.35	68.2	-18.85	peak
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.						

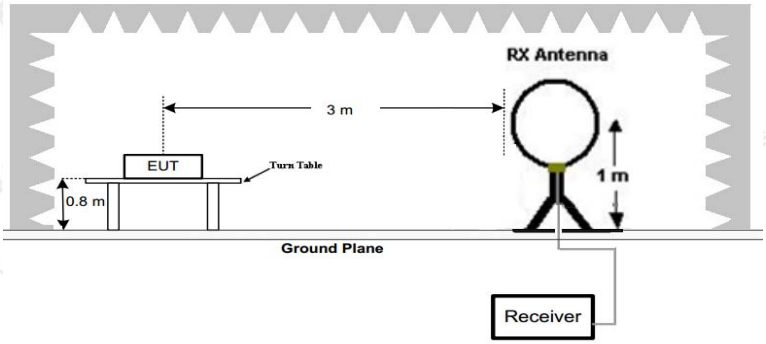
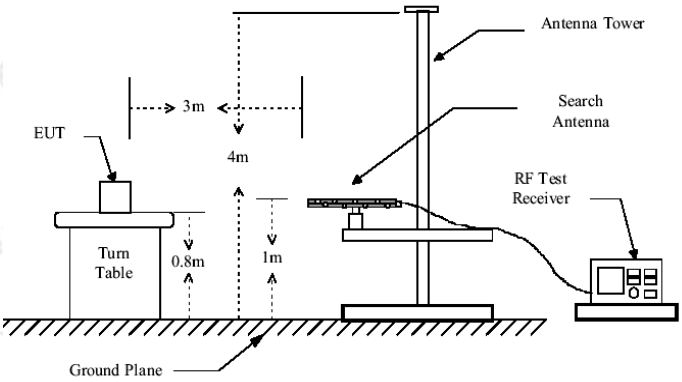
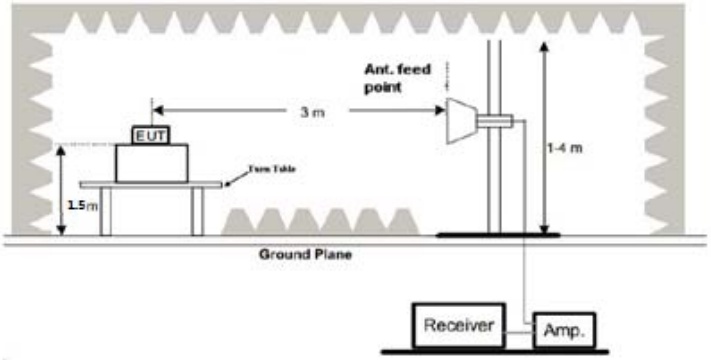
Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
5850	108.13	-1.97	106.16	122.2	-16.04	peak
5855	90.56	-2.13	88.43	110.8	-22.37	peak
5875	81.44	-2.65	78.79	105.2	-26.41	peak
5925	53.24	-2.28	50.96	68.2	-17.24	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

<table>
<tr><td>Test Requirement:</td><td>FCC CFR47 Part 15 Section 15.407 & 15.209 & 15.205</td></tr>
<tr><td>Test Method:</td><td>KDB 789033 D02 v02r01</td></tr>
<tr><td>Frequency Range:</td><td>9kHz to 40GHz</td></tr>
<tr><td>Measurement Distance:</td><td>3 m</td></tr>
<tr><td>Antenna Polarization:</td><td>Horizontal & Vertical</td></tr>
<tr><td>Operation mode:</td><td>Transmitting mode with modulation</td></tr>
<tr><td>Receiver Setup:</td><td>
<table>
<tr><td>Frequency</td><td>Detector</td><td>RBW</td><td>VBW</td><td>Remark</td></tr>
<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>
</table>
</td></tr>
<tr><td>Limit:</td><td>(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.
(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.
(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.
(4) For transmitters operating in the 5.725-5.85 GHz band:
(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.
The limit of frequency below 1GHz and which fall in rest ricted bands should complies 15.209.</td></tr>
</table>

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 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.

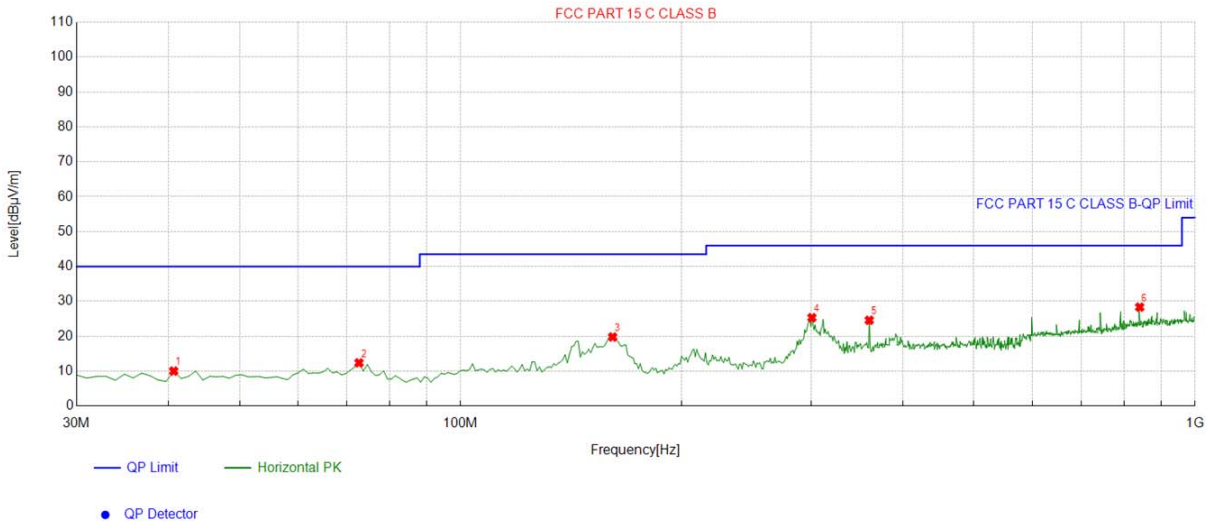
Test Procedure:	4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function 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 bere-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
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

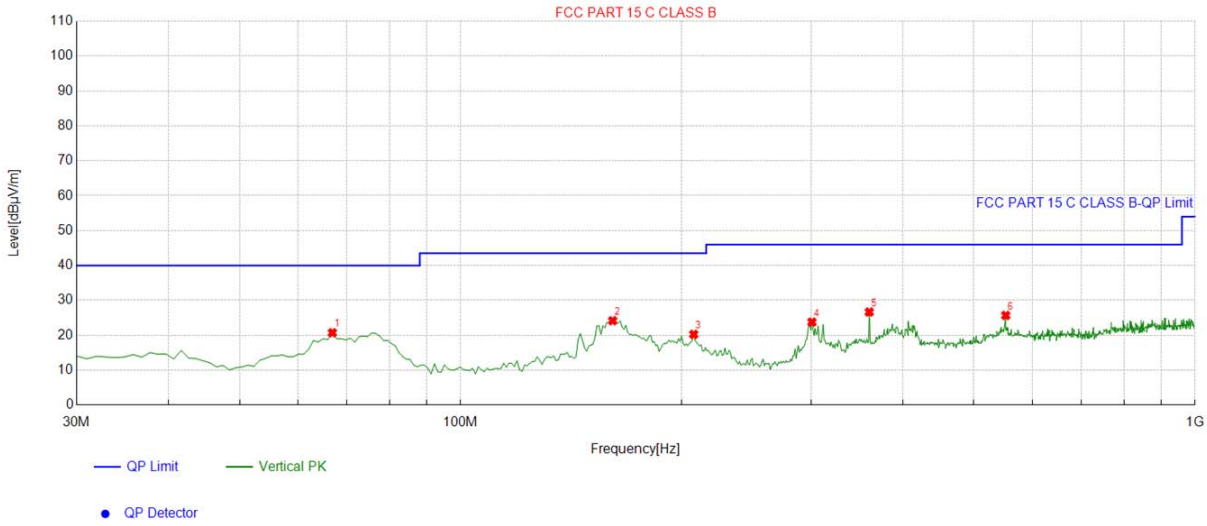
Horizontal



Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	40.680681	-15.30	25.32	10.02	40.00	29.98	100	242	Horizontal
2	72.722723	-16.35	28.74	12.39	40.00	27.61	100	6	Horizontal
3	161.08108	-17.19	36.99	19.80	43.50	23.70	100	80	Horizontal
4	300.90090	-11.91	37.24	25.33	46.00	20.67	100	97	Horizontal
5	360.13013	-10.97	35.57	24.60	46.00	21.40	100	223	Horizontal
6	840.76076	-1.42	29.77	28.35	46.00	17.65	100	176	Horizontal

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

Vertical



Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	66.896897	-15.28	36.00	20.72	40.00	19.28	100	99	Vertical
2	161.08108	-17.19	41.36	24.17	43.50	19.33	100	69	Vertical
3	207.68768	-14.61	34.87	20.26	43.50	23.24	100	236	Vertical
4	300.90090	-11.91	35.68	23.77	46.00	22.23	100	61	Vertical
5	360.13013	-10.97	37.63	26.66	46.00	19.34	100	154	Vertical
6	552.38238	-6.06	31.75	25.69	46.00	20.31	100	44	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 (dBµV/m)	Limit@3m (dBµV/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	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
3647	59.25	-4.59	54.66	74	-19.34	peak
3647	44.97	-4.59	40.38	54	-13.62	AVG
11570	47.58	4.21	51.79	74	-22.21	peak
11570	41.09	4.21	45.3	54	-8.7	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)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
3647	61.37	-4.59	56.78	74	-17.22	peak
3647	44.97	-4.59	40.38	54	-13.62	AVG
11570	56.25	4.21	60.46	74	-13.54	peak
11570	40.52	4.21	44.73	54	-9.27	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	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
3647	58.91	-4.59	54.32	74	-19.68	peak
3647	43.19	-4.59	38.6	54	-15.4	AVG
11570	55.03	4.21	59.24	74	-14.76	peak
11570	40.49	4.21	44.7	54	-9.3	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)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
3647	59.41	-4.59	54.82	74	-19.18	peak
3647	46.66	-4.59	42.07	54	-11.93	AVG
11570	50.72	4.21	54.93	74	-19.07	peak
11570	40.86	4.21	45.07	54	-8.93	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)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
3647	58.42	-4.59	53.83	74	-20.17	peak
3647	42.52	-4.59	37.93	54	-16.07	AVG
11650	51.66	4.84	56.5	74	-17.5	peak
11650	39.16	4.84	44	54	-10	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier; Level = Reading + Factor; Margin = Level-Limit.						

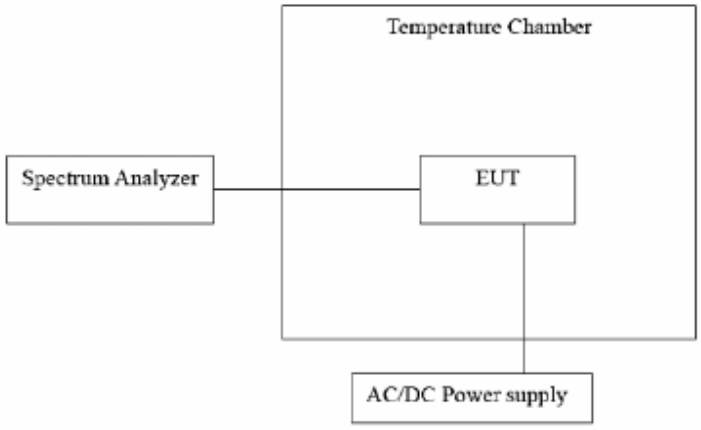
Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
3647	54.91	-4.59	50.32	74	-23.68	peak
3647	45.15	-4.59	40.56	54	-13.44	AVG
11650	50.29	4.84	55.13	74	-18.87	peak
11650	42.66	4.84	47.5	54	-6.5	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 73.16dBuV/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)
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

Test Result as follows:

Mode	Voltage (V)	FHL (5745MHz)	Deviation (KHz)	FHH (5825MHz)	Deviation (KHz)
5.8G Band	102V	5744.982	-18	5824.981	-19
	120V	5745.046	46	5825.016	16
	138V	5745.039	39	5824.977	-23

Mode	Temperature (℃)	FHL (5745MHz)	Deviation (KHz)	FHH (5825MHz)	Deviation (KHz)
5.8G Band	-30	5744.971	-29	5824.980	-20
	-20	5744.989	-11	5824.963	-37
	-10	5744.981	-19	5825.025	25
	0	5745.013	13	5825.031	31
	10	5744.982	-18	5825.009	9
	20	5745.022	22	5824.981	-19
	30	5744.976	-24	5825.041	41
	40	5744.969	-31	5825.028	28
	50	5745.018	18	5825.011	11

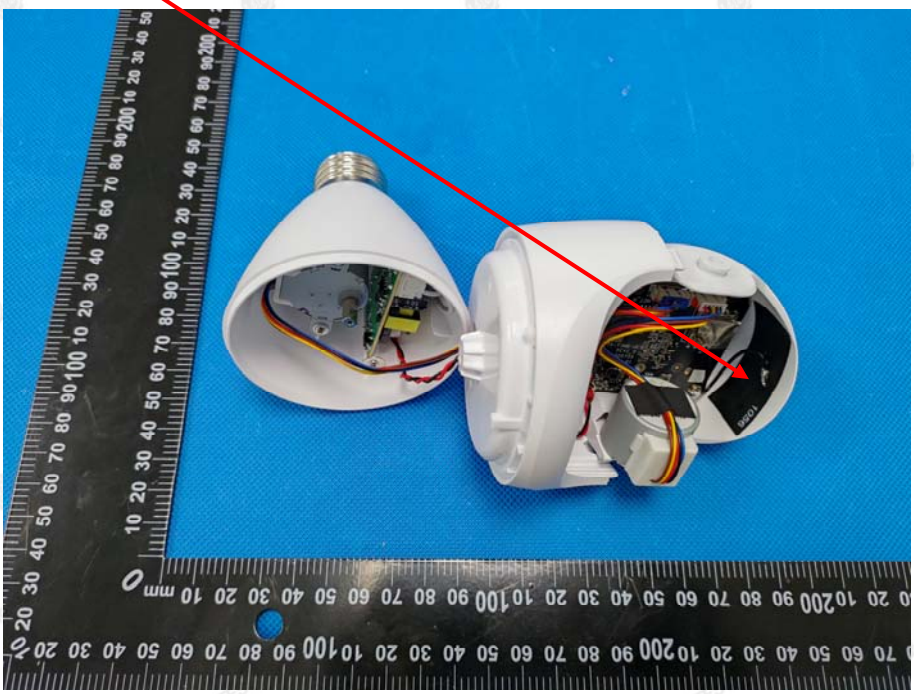
4.9. Antenna Requirement

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.

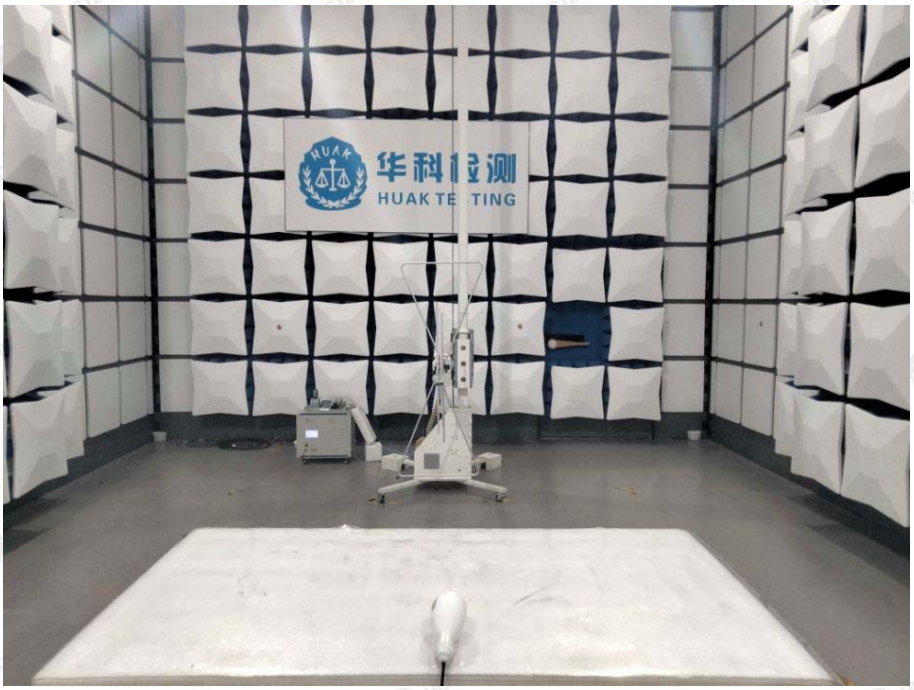
Antenna Connected Construction
The antenna used in this product is a Internal Antenna, need professional installation, not easy to remove. It conforms to the standard requirements. The directional gains of antenna used for transmitting is 4.94dBi.

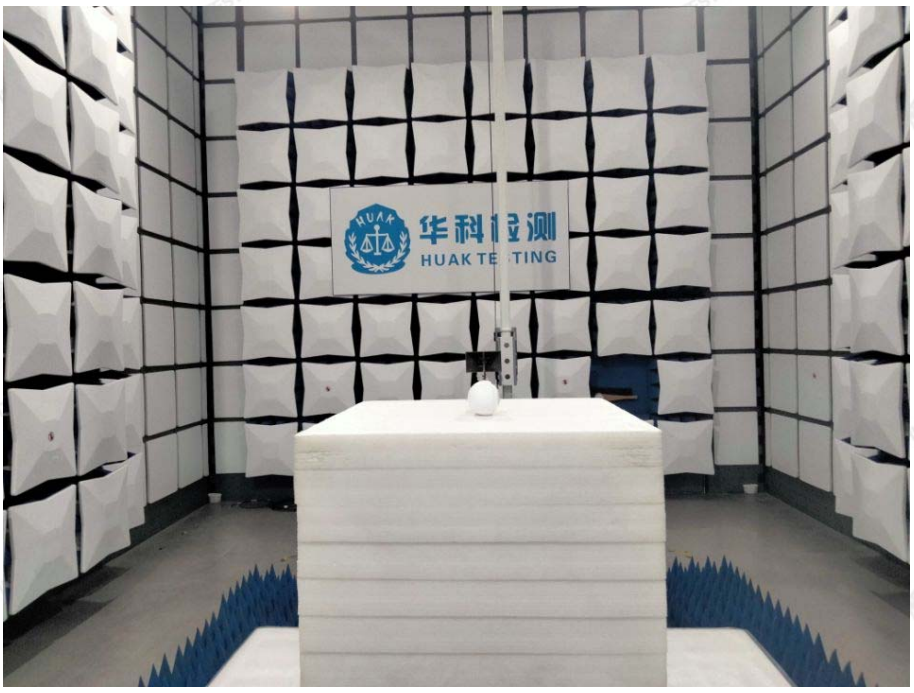
WIFI ANTENNA



5. Photographs of Test Setup

Radiated Emissions





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Conducted Emission

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6. Photos of the EUT

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

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

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