



FCC TEST REPORT

Test report
On Behalf of
EMBUX Technology Co. Ltd.
For
Security Gateway
Model No.: EBX-601-CG, EBX-601-CGXXXXXX(X is the wildcard
source)
FCC ID: 2AVW3-EBX601CG

Prepared for : **EMBUX Technology Co. Ltd.**
13F, No. 920, Chung-Cheng Rd. Zhonghe Dist., New Taipei City 23586 Taiwan

Prepared By : **Shenzhen HUAK Testing Technology Co., Ltd.**
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Date of Test: **Aug. 02, 2021 ~ Aug. 18, 2021**

Date of Report: **Aug. 18, 2021**

Report Number: **HK2108162914-3E**

**TEST RESULT CERTIFICATION**

Applicant's name: EMBUX Technology Co. Ltd.
Address: 13F, No. 920, Chung-Cheng Rd. Zhonghe Dist., New Taipei City
23586 Taiwan
Manufacture's Name: EMBUX Technology Co. Ltd.
Address: 13F, No. 920, Chung-Cheng Rd. Zhonghe Dist., New Taipei City
23586 Taiwan
Product description
Trade Mark: EMBUX TECHNOLOGY CO., LTD.
Product name: Security Gateway
Model and/or type reference ..: EBX-601-CG, EBX-601-CGXXXXXXX(X is the wildcard source)
Standards: FCC Rules and Regulations Part 15 Subpart E Section 15.407
ANSI C63.10: 2013

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Date of Test:
Date (s) of performance of tests: **Aug. 02, 2021 ~ Aug. 18, 2021**
Date of Issue: **Aug. 18, 2021**
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. Genera 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	22
4.5. POWER SPECTRAL DENSITY	23
4.6. BAND EDGE	27
4.7. SPURIOUS EMISSION	34
4.8. FREQUENCY STABILITY MEASUREMENT	42
4.9. ANTENNA REQUIREMENT	44
4.10. PHOTOGRAPHS OF TEST SETUP	45
5. PHOTOS OF THE EUT	47



**** Modified History ****

Revision	Description	Issued Data	Remark
Revision 1.0	Initial Test Report Release	Aug. 18, 2021	Jason Zhou



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 HUAKE 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 expanded 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	$\pm 2.2\text{dB}$
4	All emissions, radiated(<1G)	$\pm 3.90\text{dB}$
5	All emissions, radiated(>1G)	$\pm 4.28\text{dB}$



2. EUT DESCRIPTION

2.1. GENERAL DESCRIPTION OF EUT

Equipment	Security Gateway
Model No:	EBX-601-CG
Serial No:	EBX-601-CGXXXXXXXX(X is the wildcard source)
Model Difference:	All model's the function, software and electric circuit are the same, only with a product color, appearance and model named different. Test sample model: EBX-601-CG.
Trade Mark	EMBUX TECHNOLOGY CO., LTD.
FCC ID	2AVW3-EBX601CG
Operation Frequency	IEEE 802.11a/n(HT20)5.745GHz-5.825GHz
Modulation Technology	IEEE 802.11a/n
Modulation Type	OFDM
Antenna Type	External Antenna
Antenna Gain	2dBi
Power Source	DC 12V from Adapter with AC100-240V 50/60Hz, 1.7A
Power Supply	DC 12V from Adapter with AC100-240V 50/60Hz, 1.7A



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:

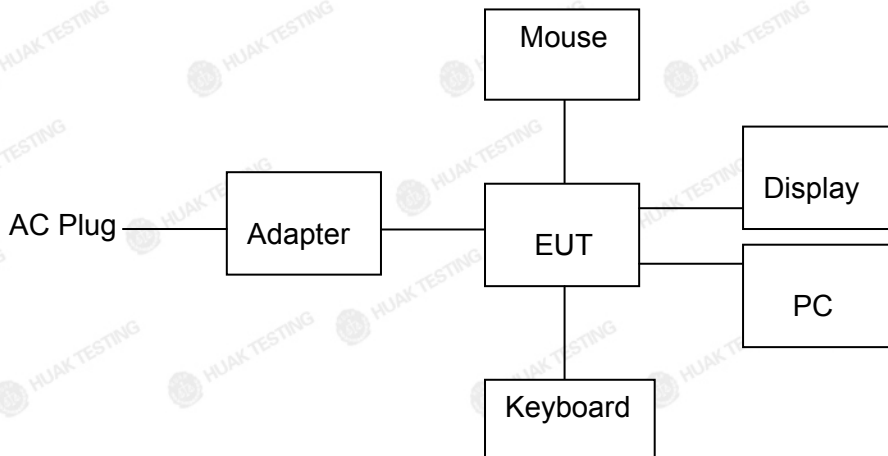
2.3. OPERATION OF EUT DURING TESTING

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

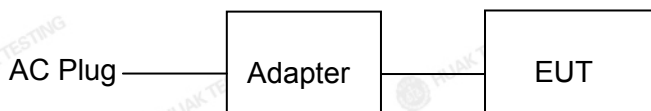


2.4. DESCRIPTION OF TEST SETUP

Operation of EUT during conducted and radiation below 1GHz testing:



Operation of EUT during radiation above 1GHz testing:



Adapter information

Model: KPL-060F-VI

Input: 100-240V, 50-60Hz, 1.7A

Output: 12VDC, 5A

PC information

Model: TP00067A

Input: DC20V, 2.25-3.25A

Output: 5VDC, 0.5A

Display information

Model: 24PFF3661/T3

Input: AC 120V/60Hz

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



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 below/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
-----------------	---



3.2. DESCRIPTION OF SUPPORT UNITS

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

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

Note:

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



4. TEST RESULTS AND MEASUREMENT DATA

4.1. CONDUCTED EMISSION

4.1.1. Test Specification

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><tr><th rowspan="2">Frequency range (MHz)</th><th colspan="2">Limit (dBuV)</th></tr><tr><th>Quasi-peak</th><th>Average</th></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>			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:	<div><p>Reference Plane</p><p>40cm 80cm</p><p>E.U.T AC power LISN Filter AC power EMI Receiver</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></div>																
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																



4.1.2. Test Instruments

Conducted Emission Shielding Room Test Site (843)					
Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Receiver	R&S	ESCI 7	HKE-010	Dec. 10, 2020	Dec. 09, 2021
LISN	R&S	ENV216	HKE-002	Dec. 10, 2020	Dec. 09, 2021
Coax cable (9KHz-30MHz)	Times	381806-002	N/A	Dec. 10, 2020	Dec. 09, 2021
Conducted test software	Tonscend	TS+ Rev 2.5.0.0	HKE-081	N/A	N/A

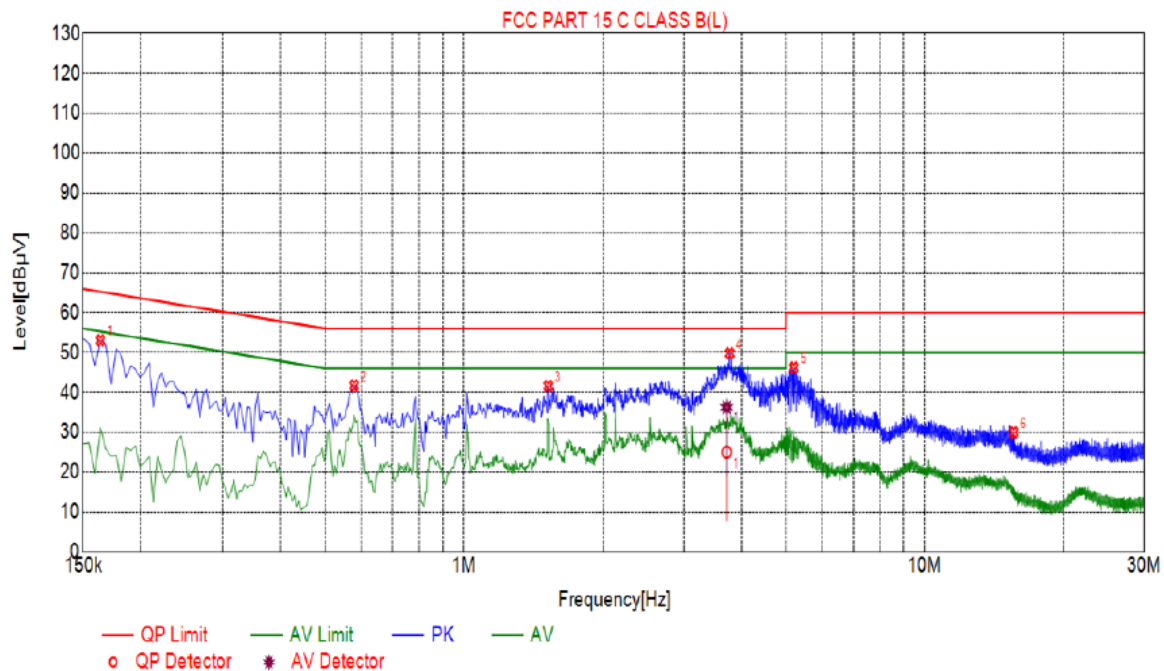
Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

**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	0.1635	53.06	19.98	65.28	12.22	33.08	PK	L
2	0.5775	41.74	20.05	56.00	14.26	21.69	PK	L
3	1.5225	41.62	20.11	56.00	14.38	21.51	PK	L
4	3.7725	49.83	20.25	56.00	6.17	29.58	PK	L
5	5.1990	46.20	20.26	60.00	13.80	25.94	PK	L
6	15.5985	30.00	19.97	60.00	30.00	10.03	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	3.7161	20.25	25.01	56.00	30.99	4.76	36.25	46.00	9.75	16.00	L

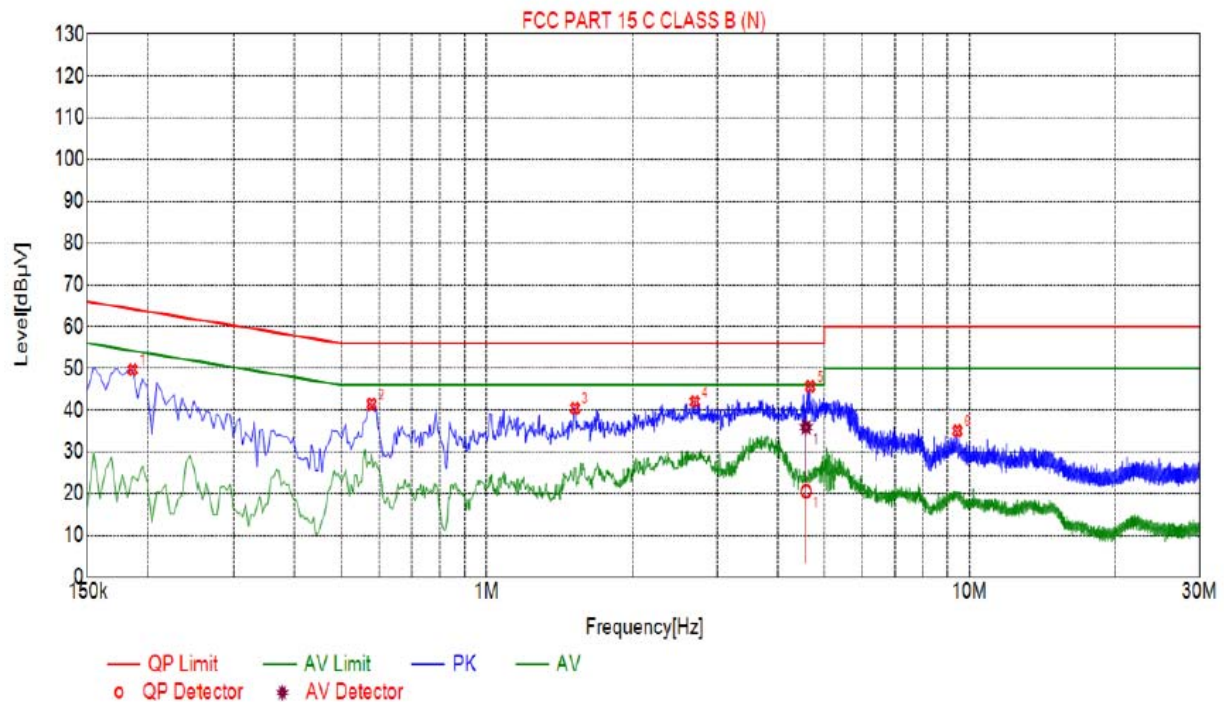
Remark: Margin = Limit – Level

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	0.1860	49.68	20.05	64.21	14.53	29.63	PK	N
2	0.5775	41.44	20.05	56.00	14.56	21.39	PK	N
3	1.5225	40.42	20.11	56.00	15.58	20.31	PK	N
4	2.6970	42.05	20.21	56.00	13.95	21.84	PK	N
5	4.6770	45.69	20.26	56.00	10.31	25.43	PK	N
6	9.4335	35.06	20.09	60.00	24.94	14.97	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	4.5860	20.25	20.56	56.00	35.44	0.31	35.89	46.00	10.11	15.64	N

Remark: Margin = Limit – Level

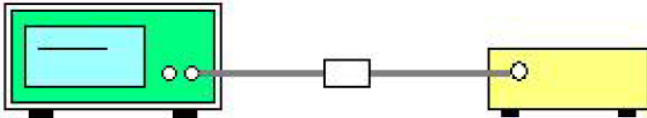
Correction factor = Cable lose + LISN insertion loss

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:	 <p style="text-align: center;">Power meter EUT</p>	
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 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	
Note: The test double antenna is simultaneously transmitted, and the transmitting module is the same.		



4.2.2. Test Instruments

RF Test Room					
Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 10, 2020	Dec. 09, 2021
Power meter	Agilent	E4419B	HKE-085	Dec. 10, 2020	Dec. 09, 2021
Power Sensor	Agilent	E9300A	HKE-086	Dec. 10, 2020	Dec. 09, 2021
RF cable	Times	1-40G	HKE-034	Dec. 10, 2020	Dec. 09, 2021
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 10, 2020	Dec. 09, 2021

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	11.04	30	PASS
11a	CH157	10.35	30	PASS
11a	CH165	9.89	30	PASS
11n HT20	CH149	10.63	30	PASS
11n HT20	CH157	10.16	30	PASS
11n HT20	CH165	10.18	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:	 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	Dec. 10, 2020	Dec. 09, 2021
RF cable	Times	1-40G	HKE-034	Dec. 10, 2020	Dec. 09, 2021
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 10, 2020	Dec. 09, 2021

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	15.200	0.5	PASS
11a	CH157	5785	13.920	0.5	PASS
11a	CH165	5825	12.800	0.5	PASS
11n HT20	CH149	5745	13.880	0.5	PASS
11n HT20	CH157	5785	13.920	0.5	PASS
11n HT20	CH165	5825	15.120	0.5	PASS

Test plots as follows:



Band IV (5725 – 5850 MHz)

802.11a



Low



Mid



High

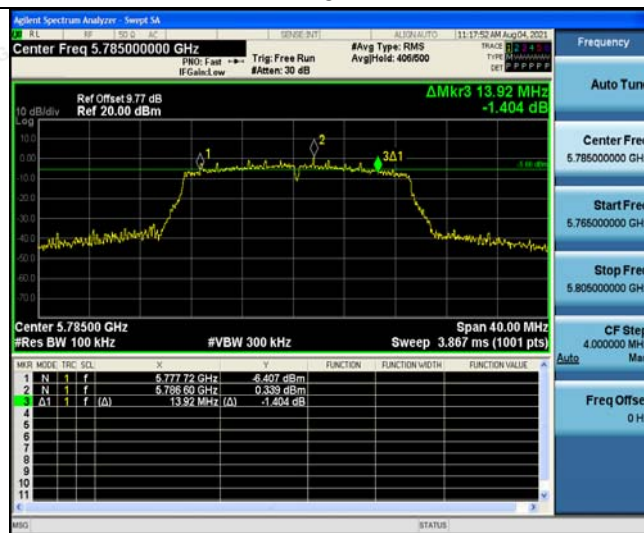
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802.11n HT20



Low



Mid




High

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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:	 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 $RBW = 1\% \text{ EBW}$, $VBW \geq 3RBW$, 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	Dec. 10, 2020	Dec. 09, 2021
RF cable	Times	1-40G	HKE-034	Dec. 10, 2020	Dec. 09, 2021
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 10, 2020	Dec. 09, 2021

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:	$\leq 11.00\text{dBm/MHz}$ for Band I 5150MHz-5250MHz $\leq 30.00\text{dBm/500KHz}$ 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 $\geq 3 \times$ 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	Dec. 10, 2020	Dec. 09, 2021
RF cable	Times	1-40G	HKE-034	Dec. 10, 2020	Dec. 09, 2021
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 10, 2020	Dec. 09, 2021

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	6.79	-0.086	6.70	30	PASS
11a	CH157	6.47	-0.086	6.38	30	PASS
11a	CH165	5.5	-0.086	5.41	30	PASS
11n HT20	CH149	5.99	-0.086	5.90	30	PASS
11n HT20	CH157	6.34	-0.086	6.25	30	PASS
11n HT20	CH165	5.37	-0.086	5.28	30	PASS

Test plots as follows:



Band IV (5725 – 5850 MHz)



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802.11n HT20



Low



Mid



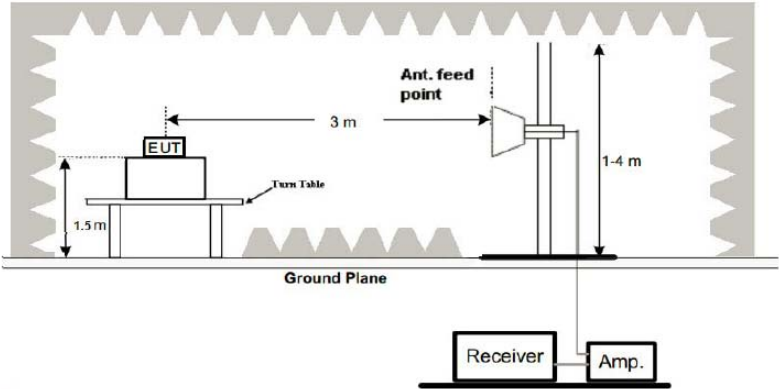
High

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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>(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 comply 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 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.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	Dec. 10, 2020	Dec. 09, 2021
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 10, 2020	Dec. 09, 2021
Preamplifier	EMCI	EMC051845S E	HKE-015	Dec. 10, 2020	Dec. 09, 2021
Preamplifier	Agilent	83051A	HKE-016	Dec. 10, 2020	Dec. 09, 2021
Loop antenna	Schwarzbeck	FMZB 1519 B	HKE-014	Dec. 10, 2020	Dec. 09, 2021
Broadband antenna	Schwarzbeck	VULB 9163	HKE-012	Dec. 10, 2020	Dec. 09, 2021
Horn antenna	Schwarzbeck	9120D	HKE-013	Dec. 10, 2020	Dec. 09, 2021
Antenna Mast	Keleto	CC-A-4M	N/A	N/A	N/A
Position controller	Taiwan MF	MF7802	HKE-011	Dec. 10, 2020	Dec. 09, 2021
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	Dec. 10, 2020	Dec. 09, 2021
RF cable	Tonscend	1-18G	HKE-099	Dec. 10, 2020	Dec. 09, 2021
RF cable	Times	1-40G	HKE-034	Dec. 10, 2020	Dec. 09, 2021

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	53.67	-2.06	51.61	68.2	-16.59	peak
5700	84.16	-1.96	82.2	105.2	-23	peak
5720	91.39	-2.87	88.52	110.8	-22.28	peak
5725	107.99	-2.14	105.85	122.2	-16.35	peak
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5650	53.77	-2.06	51.71	68.2	-16.49	peak
5700	84.18	-1.96	82.22	105.2	-22.98	peak
5720	90.53	-2.87	87.66	110.8	-23.14	peak
5725	107.91	-2.14	105.77	122.2	-16.43	peak
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						



Operation Mode: TX CH High with 5.8G

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5850	108.22	-1.97	106.25	122.2	-15.95	peak
5855	90.06	-2.13	87.93	110.8	-22.87	peak
5875	86.33	-2.65	83.68	105.2	-21.52	peak
5925	50.93	-2.28	48.65	68.2	-19.55	peak
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5850	112.82	-1.97	110.85	122.2	-11.35	peak
5855	88.87	-2.13	86.74	110.8	-24.06	peak
5875	87.79	-2.65	85.14	105.2	-20.06	peak
5925	50.14	-2.28	47.86	68.2	-20.34	peak
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						



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	53.56	-2.06	51.5	68.2	-16.7	peak
5700	90.34	-1.96	88.38	105.2	-16.82	peak
5720	95.68	-2.87	92.81	110.8	-17.99	peak
5725	111.68	-2.14	109.54	122.2	-12.66	peak
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5650	56.32	-2.06	54.26	68.2	-13.94	peak
5700	93.98	-1.96	92.02	105.2	-13.18	peak
5720	89.51	-2.87	86.64	110.8	-24.16	peak
5725	109.36	-2.14	107.22	122.2	-14.98	peak
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						



Operation Mode: TX CH High with 5.8G

Horizontal:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5850	108.81	-1.97	106.84	122.2	-15.36	peak
5855	94.51	-2.13	92.38	110.8	-18.42	peak
5875	86.7	-2.65	84.05	105.2	-21.15	peak
5925	50.69	-2.28	48.41	68.2	-19.79	peak
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5850	107.54	-1.97	105.57	122.2	-16.63	peak
5855	93.61	-2.13	91.48	110.8	-19.32	peak
5875	89.41	-2.65	86.76	105.2	-18.44	peak
5925	56.58	-2.28	54.3	68.2	-13.9	peak
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						



4.7. SPURIOUS EMISSION

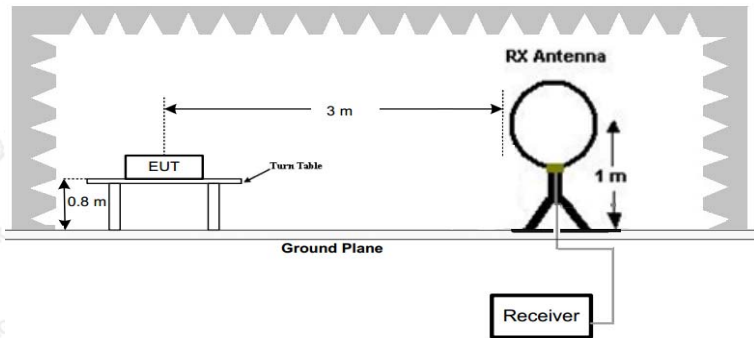
4.7.1.1. Test Specification

Test Requirement:	FCC CFR47 Part 15 Section 15.407 & 15.209 & 15.205				
Test Method:	KDB 789033 D02 v02r01				
Frequency Range:	9kHz to 40GHz				
Measurement Distance:	3 m				
Antenna Polarization:	Horizontal & Vertical				
Operation mode:	Transmitting mode with modulation				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	9kHz- 150kHz	Quasi-peak	200Hz	1kHz	Quasi-peak Value
	150kHz- 30MHz	Quasi-peak	9kHz	30kHz	Quasi-peak Value
	30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		Peak	1MHz	10Hz	Average Value
Limit:	<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>(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 comply 15.209.</p>				

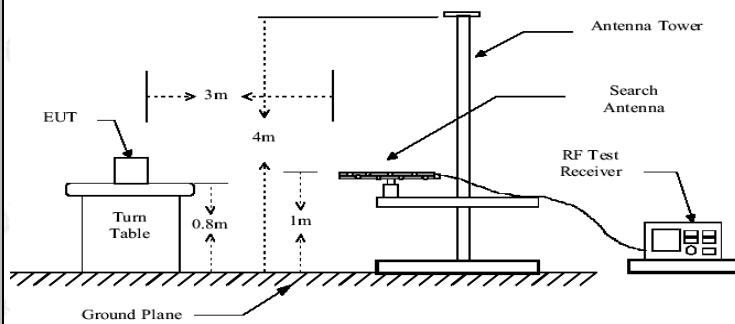


Test setup:

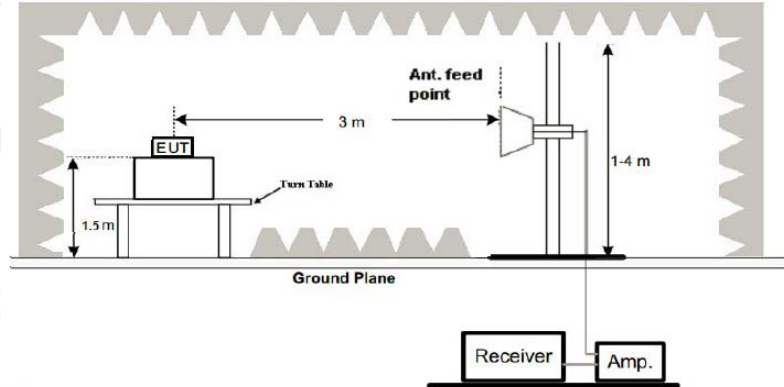
For radiated emissions below 30MHz



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.
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 be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Test results:**PASS**

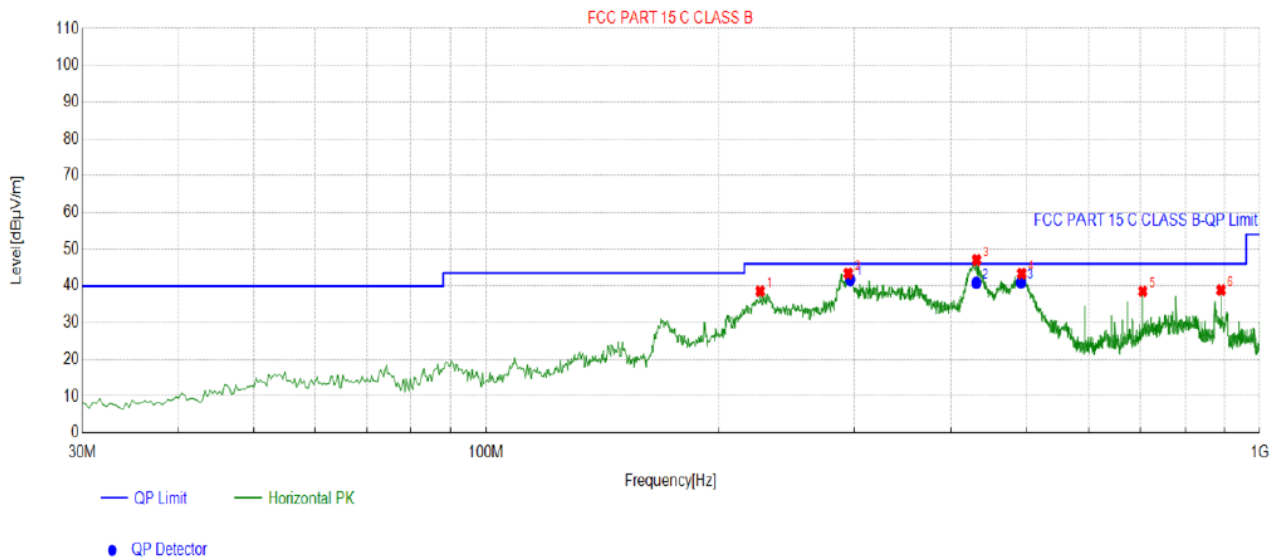


4.7.2. Test Data

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



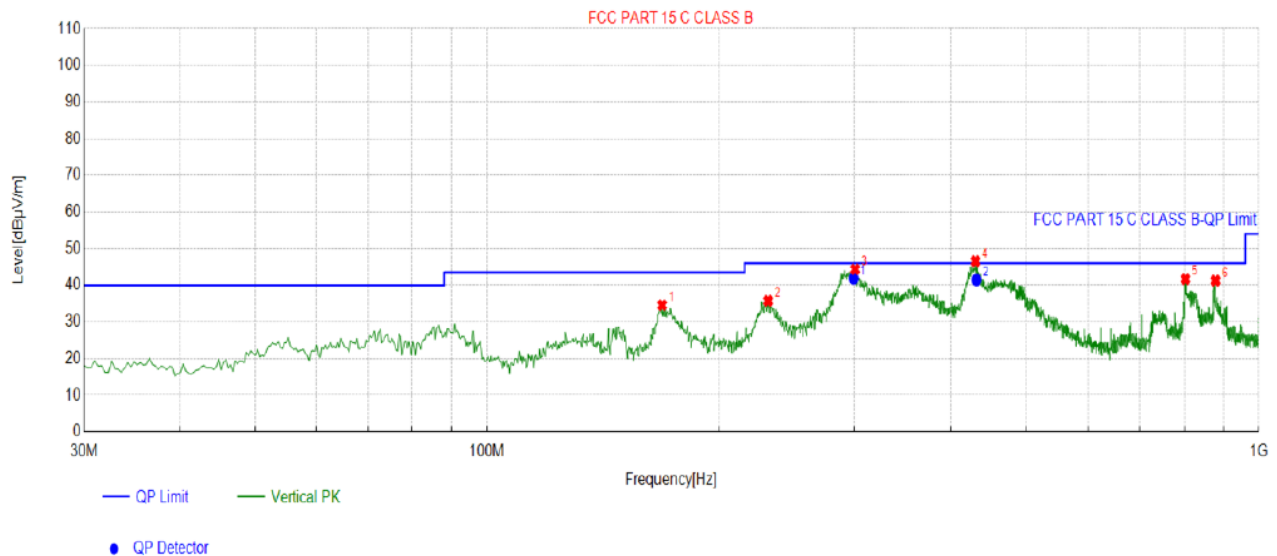
Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBμV/m]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	226.3288	-14.41	52.97	38.56	46.00	7.44	100	1	Horizontal
2	294.2514	-12.80	56.18	43.38	46.00	2.62	100	298	Horizontal
3	431.7139	-9.78	56.81	47.03	46.00	-1.03	100	171	Horizontal
4	493.4912	-8.46	51.79	43.33	46.00	2.67	100	226	Horizontal
5	705.3451	-4.96	43.49	38.53	46.00	7.47	100	9	Horizontal
6	891.0003	-1.87	40.70	38.83	46.00	7.17	100	322	Horizontal

Final Data List									
NO.	Freq. [MHz]	Factor [dB]	QP Reading [dBμV/m]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	296.0185	-12.78	54.48	41.70	46.00	4.30	130	10	Horizontal
2	431.2016	-9.77	50.58	40.81	46.00	5.19	190	320	Horizontal
3	492.4985	-8.46	49.38	40.92	46.00	5.08	180	310	Horizontal

Remark: Factor = Cable loss + Antenna factor – Pre-amplifier; 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	168.7563	-17.41	51.99	34.58	43.50	8.92	100	330	Vertical
2	231.5038	-14.25	49.99	35.74	46.00	10.26	100	0	Vertical
3	300.3968	-12.73	57.06	44.33	46.00	1.67	100	248	Vertical
4	430.4201	-9.83	56.36	46.53	46.00	-0.53	100	168	Vertical
5	803.0243	-3.07	44.73	41.66	46.00	4.34	100	2	Vertical
6	878.3861	-2.09	43.33	41.24	46.00	4.76	100	348	Vertical

Final Data List									
NO.	Freq. [MHz]	Factor [dB]	QP Reading [dBμV/m]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	299.1317	-12.73	54.58	41.85	46.00	4.15	170	350	Vertical
2	431.6908	-9.83	51.29	41.46	46.00	4.54	170	20	Vertical

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

Harmonics and Spurious Emissions

Frequency Range (9 kHz-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.

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**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	60.01	-4.59	55.42	74	-18.58	peak
3647	47.4	-4.59	42.81	54	-11.19	AVG
11570	49.64	4.21	53.85	74	-20.15	peak
11570	40.23	4.21	44.44	54	-9.56	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
3647	59.66	-4.59	55.07	74	-18.93	peak
3647	46.45	-4.59	41.86	54	-12.14	AVG
11570	51.71	4.21	55.92	74	-18.08	peak
11570	37.66	4.21	41.87	54	-12.13	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						



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	59.37	-4.59	54.78	74	-19.22	peak
3647	47.3	-4.59	42.71	54	-11.29	AVG
11570	51.62	4.21	55.83	74	-18.17	peak
11570	40.71	4.21	44.92	54	-9.08	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
3647	61.3	-4.59	56.71	74	-17.29	peak
3647	47.88	-4.59	43.29	54	-10.71	AVG
11570	48.51	4.21	52.72	74	-21.28	peak
11570	37.63	4.21	41.84	54	-12.16	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						



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	57.22	-4.59	52.63	74	-21.37	peak
3647	48.44	-4.59	43.85	54	-10.15	AVG
11650	50.8	4.84	55.64	74	-18.36	peak
11650	39.74	4.84	44.58	54	-9.42	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
3647	59.55	-4.59	54.96	74	-19.04	peak
3647	46.67	-4.59	42.08	54	-11.92	AVG
11650	51.96	4.84	56.8	74	-17.2	peak
11650	35.44	4.84	40.28	54	-13.72	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Remark:

- (1) Measuring frequencies from 1 GHz to the 40 GHz.
- (2) "F" denotes fundamental frequency; "H" denotes spurious frequency; "E" denotes band edge frequency.
- (3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
- (4) 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.
- (7) All modes of operation were investigated and the worst-case of 802.11a are reported.



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:	<pre>graph LR; SA[Spectrum Analyzer] --- EUT[EUT]; EUT --- P[AC/DC Power supply]; subgraph TC [Temperature Chamber]; EUT; end</pre>
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	10.2V	5744.979	-21	5824.987	-13
	12V	5745.013	13	5824.979	-21
	13.8V	5745.008	8	5824.982	-18

Mode	Temperature (°C)	FHL (5745MHz)	Deviation (KHz)	FHH (5825MHz)	Deviation (KHz)
5.8G Band	-30	5744.992	-8	5825.021	21
	-20	5744.976	-24	5824.985	-15
	-10	5745.013	13	5824.989	-11
	0	5744.985	-15	5824.978	-22
	10	5745.032	32	5825.016	16
	20	5745.019	19	5824.996	-4
	30	5744.984	-16	5824.986	-14
	40	5745.011	11	5825.018	18
	50	5744.993	-7	5825.013	13



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.

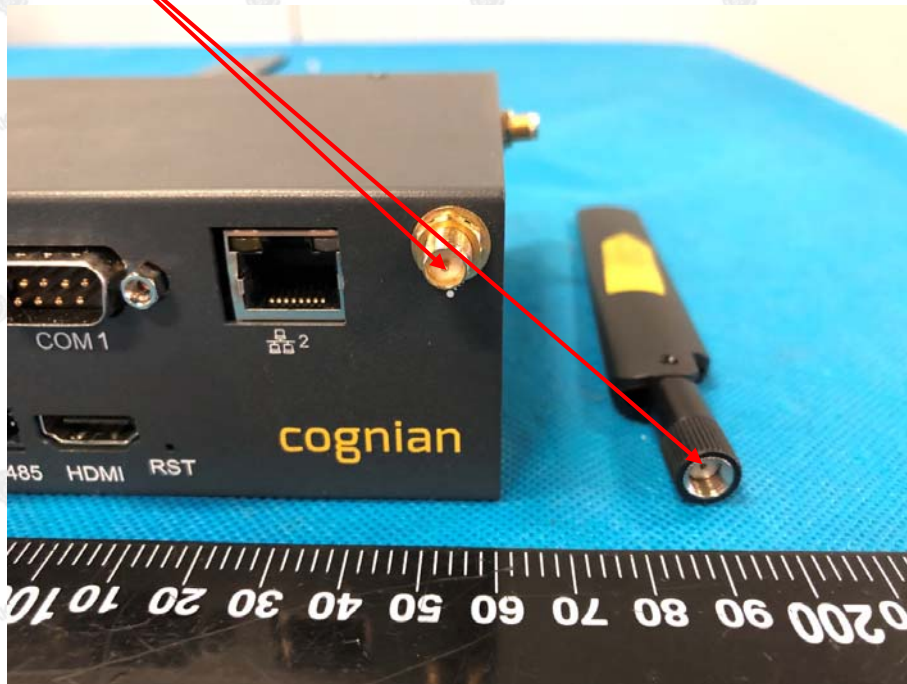
Refer to statement below for compliance.

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

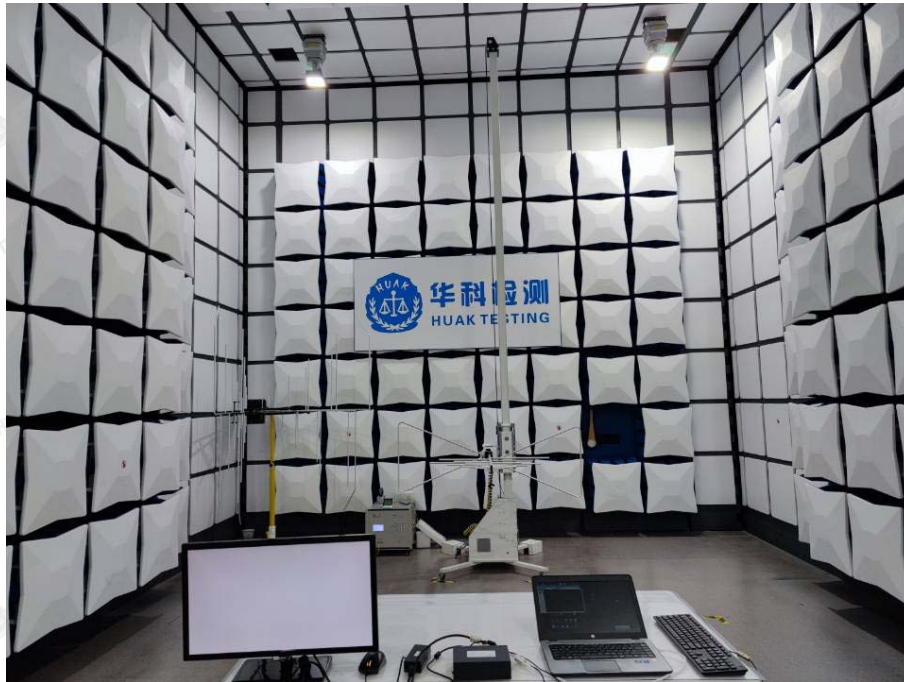
The antenna used in this product is a External Antenna, with non-standard SMA connector, need professional installation, not easy to remove. It conforms to the standard requirements. The directional gains of antenna used for transmitting is 2dBi.

WIFI ANTENNA





4.10. PHOTOGRAPHS OF TEST SETUP



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5. PHOTOS OF THE EUT

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

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

