



FCC TEST REPORT

Test report
On Behalf of
Ningbo Pelican Smart Fishing Tackle Co., Ltd.
For
MOBULA Remote Controller
Model No.: MR-0000W1AP01, M
FCC ID: 2ASTR-MR

Prepared for : Ningbo Pelican Smart Fishing Tackle Co., Ltd.
No.16, Yongchang Road, Chengdong Industrial Park, Xiangshan County,
Ningbo City, Zhejiang Province, China

Prepared By : Shenzhen HUAKE Testing Technology Co., Ltd.
1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park, Fuhai Street,
Bao'an District, Shenzhen City, China

Date of Test: Feb. 23, 2019 ~ Mar. 13, 2019
Date of Report: Mar. 13, 2019
Report Number: HK1903050374-2ER



TEST RESULT CERTIFICATION

Applicant's name: Ningbo Pelican Smart Fishing Tackle Co., Ltd.
Address: No.16, Yongchang Road, Chengdong Industrial Park,
Xiangshan County, Ningbo City, Zhejiang Province, China
Manufacture's Name.....: Ningbo Pelican Smart Fishing Tackle Co., Ltd.
Address: No.16, Yongchang Road, Chengdong Industrial Park,
Xiangshan County, Ningbo City, Zhejiang Province, China

Product description

Trade Mark: RIPPTON, MOBULA
Product name.....: MOBULA Remote Controller
Model and/or type reference : MR-0000W1AP01, M
Standards: FCC Rules and Regulations Part 15 Subpart C 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 HUAKE Testing Technology Co., Ltd. is acknowledged as copyright owner and source of the material. Shenzhen HUAKE 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: Feb. 23, 2019 ~ Mar. 13, 2019
Date of Issue.....: Mar. 13, 2019
Test Result.....: Pass

Testing Engineer :

(Gary Qian)

Technical Manager :

(Eden Hu)

Authorized Signatory :

(Jason Zhou)



TABLE OF CONTENTS

1. Test Result Summary	4
1.1. TEST PROCEDURES AND RESULTS.....	4
1.2. TEST FACILITY	4
1.3. MEASUREMENT UNCERTAINTY	5
2. EUT Description	6
2.1. GENERAL DESCRIPTION OF EUT	6
2.2. OPERATION FREQUENCY EACH OF CHANNEL.....	7
2.3. OPERATION OF EUT DURING TESTING	7
2.4. DESCRIPTION OF TEST SETUP	8
3. Genera Information	9
3.1. TEST ENVIRONMENT AND MODE	9
3.2. DESCRIPTION OF SUPPORT UNITS	10
4. Test Results and Measurement Data	11
4.1. CONDUCTED EMISSION	11
4.2. MAXIMUM CONDUCTED OUTPUT POWER	15
4.3. 6dB EMISSION BANDWIDTH	18
4.4. 26dB BANDWIDTH AND 99% OCCUPIED BANDWIDTH.....	24
4.5. POWER SPECTRAL DENSITY	25
4.6. BAND EDGE.....	31
4.7. SPURIOUS EMISSION	36
4.8. FREQUENCY STABILITY MEASUREMENT.....	45
4.9. ANTENNA REQUIREMENT	47
4.10. PHOTOGRAPHS OF TEST SETUP	48



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) §2.1046	PASS
6dB Emission Bandwidth	§15.407(e)	PASS
26dB Emission Bandwidth & 99% Occupied Bandwidth	§15.407(a) §2.1049	N/A
Power Spectral Density	§15.407(a)	PASS
Band edge	§15.407(a)	PASS
Radiated Emission	§15.407(a) §2.1053	PASS
Frequency Stability	§15.407(g) §2.1055	PASS

Note:

1. PASS: Test item meets the requirement.
2. Fail: Test item does not meet the requirement.
3. N/A: Test case does not apply to the test object.
4. The test result judgment is decided by the limit of test standard.

1.2. TEST FACILITY

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

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



1.3. Measurement Uncertainty

The reported uncertainty of measurement $y \pm U$, 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	$\pm 2.56\text{dB}$
2	RF power, conducted	$\pm 0.12\text{dB}$
3	Spurious emissions, conducted	$\pm 0.11\text{dB}$
4	All emissions, radiated(<1G)	$\pm 3.92\text{dB}$
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	MOBULA Remote Controller
Model Name	MR-0000W1AP01
Serial No.	M
Trade Mark	RIPPTON, MOBULA
Model Difference	All model's the function, software and electric circuit are the same, only with brand named and model named different. Test sample model: MR-0000W1AP01.
FCC ID	2ASTR-MR
Operation Frequency:	IEEE 802.11a
Modulation Technology:	IEEE 802.11a
Modulation Type	CCK/OFDM/DBPSK/DAPSK
Antenna Type	Internal Antenna
Antenna Gain	Antenna 1:1dBi Antenna 2:1dBi
Power Source	DC 5V From Adapter or DC 7.4V From Battery
Power Supply:	DC 5V From Adapter or DC 7.4V From Battery



2.2. Operation Frequency each of channel

802.11a	
Channel	Frequency(MHz)
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:

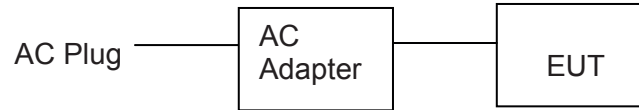
2.3. Operation of EUT during testing

Band IV (5725 - 5850 MHz)		
For 802.11a		
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 during Radiation testing and Above1GHz Radiation testing:



- Adapter information
Input: 100-240V, 50/60Hz
Output: DC 5V/1A



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%)
<p>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.</p>	

<p>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:</p>	
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
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:	<div><div>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.</div><div>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).</div><div>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.</div></div>														
Test Result:	PASS														



4.1.2. Test Instruments

Conducted Emission Shielding Room Test Site (843)				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Receiver	R&S	ESCI 7	HKE-010	Dec. 27, 2019
LISN	R&S	ENV216	HKE-002	Dec. 27, 2019
Coax cable (9KHz-30MHz)	Times	381806-002	N/A	Dec. 27, 2019
Conducted test software	Tonscend	TS+ Rev 2.5.0.0	HKE-081	N/A

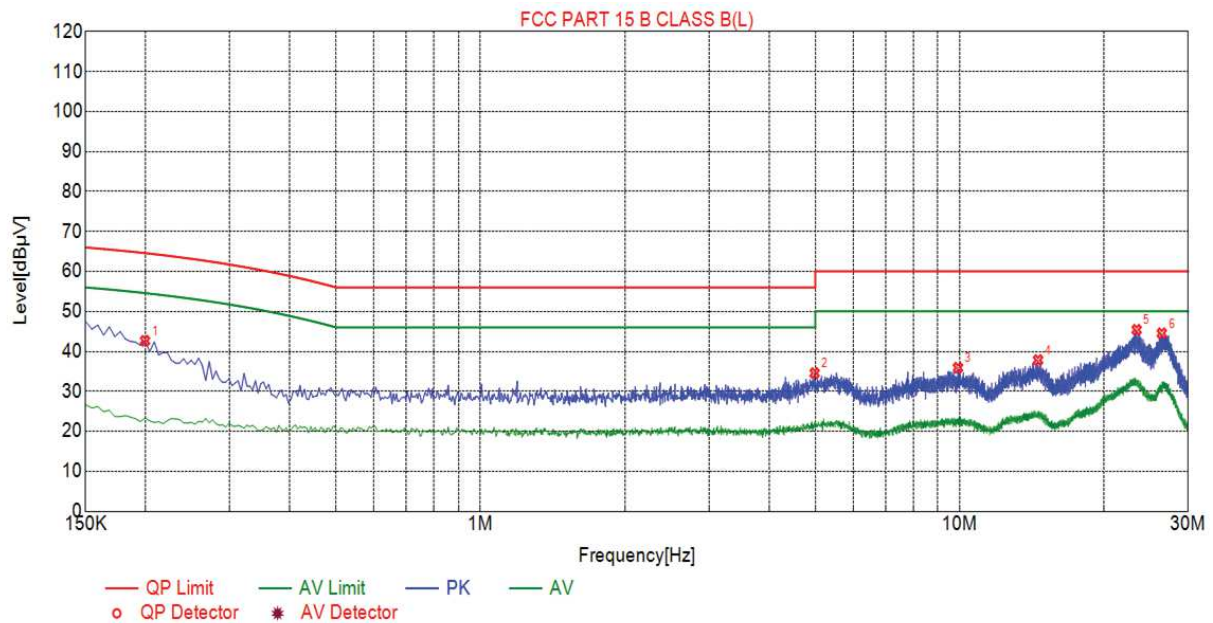
Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).



4.1.3. Test data

Remark: We tested three Channels in AC 120V/60Hz and AC 230V/50Hz, only the worst result of 802.11a High Channel was reported as below

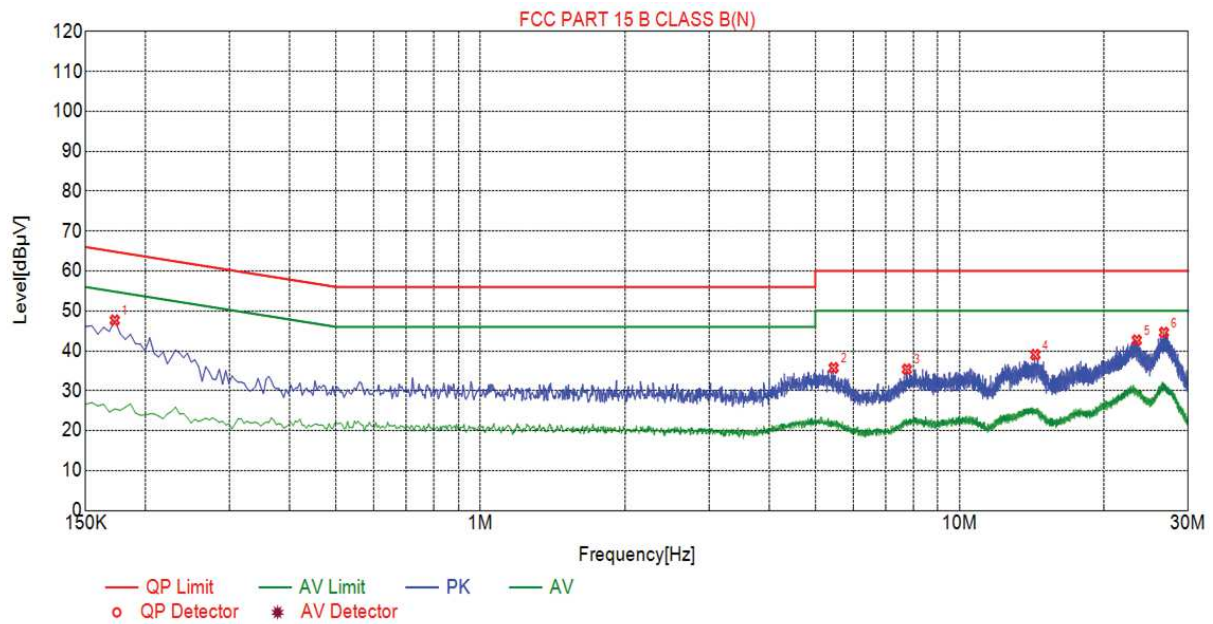
Conducted Emission on Line Terminal of the power line (150 kHz to 30MHz)



Suspected List						
NO.	Freq. [MHz]	Level [dBμV]	Factor [dB]	Limit [dBμV]	Margin [dB]	Detector
1	0.1995	42.65	10.03	63.65	21.00	PK
2	4.9830	34.56	10.26	56.00	21.44	PK
3	9.9240	35.92	10.07	60.00	24.08	PK
4	14.5815	37.83	9.95	60.00	22.17	PK
5	23.4195	45.42	10.20	60.00	14.58	PK
6	26.4255	44.52	10.26	60.00	15.48	PK

Notes:

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level = Receiver Read level + LISN Factor + Cable Loss
4. If the average limit is met when using a quasi-peak detector receiver, the EUT shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.

**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]	Detector
1	0.1725	47.66	10.04	64.84	17.18	PK
2	5.4600	35.73	10.26	60.00	24.27	PK
3	7.7640	35.38	10.16	60.00	24.62	PK
4	14.3925	39.03	9.95	60.00	20.97	PK
5	23.4375	42.66	10.20	60.00	17.34	PK
6	26.7090	44.60	10.26	60.00	15.40	PK

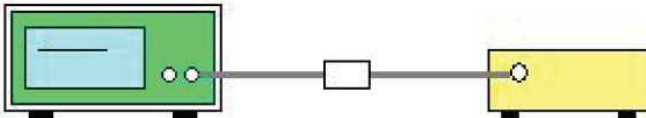
Notes:

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level = Receiver Read level + LISN Factor + Cable Loss.
4. If the average limit is met when using a quasi-peak detector receiver, the EUT shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.



4.2. Maximum Conducted Output Power

4.2.1. Test Specification

Test Requirement:	FCC Part15 E Section 15.407(a)& Part 2 J Section 2.1046	
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:	<div><p>Power meter EUT</p></div>	
Test Mode:	Transmitting mode with modulation	
Test Procedure:	<div>1. The testing follows the Measurement Procedure of KDB789033 D02 General UNII Test Procedures New Rules v02r01 Section E, 3, a</div> <div>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.</div> <div>3. Set to the maximum power setting and enable the EUT transmit continuously.</div> <div>5. Measure the conducted output power and record the results in the test report.</div>	
Test Result:	PASS	
Remark:	<div>Conducted output power= measurement power +10log(1/x) X is duty cycle=1, so 10log(1/1)=0</div> <div>Conducted output power= measurement power</div>	
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 Due
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 27, 2019
Power meter	Agilent	E4419B	HKE-085	Dec. 27, 2019
Power Sensor	Agilent	E9300A	HKE-086	Dec. 27, 2019
RF cable	Times	1-40G	HKE-034	Dec. 27, 2019
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 27, 2019

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


**Test Data**

Configuration Band IV (5725 - 5850 MHz)						
Mode	Test channel	Maximum Conducted Output Power (dBm)			FCC Limit (dBm)	Result
		Antenna port 1	Antenna port 2	MIMO		
11a	CH149	3.03	5.41	/	30	PASS
11a	CH157	5.26	5.52	/	30	PASS
11a	CH165	5.13	5.76	/	30	PASS



4.3. 6dB Emission Bandwidth

4.3.1. Test Specification

Test Requirement:	FCC CFR47 Part 15 Section 15.407(e)& Part 2 J Section 2.1049
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 C2. 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 Due
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 27, 2019
RF cable	Times	1-40G	HKE-034	Dec. 27, 2019
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 27, 2019

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



4.3.3. Test data

Antenna 1

Band IV (5725 - 5850 MHz)					
Mode	Test channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)	Result
11a	CH149	5745	16.36	0.5	PASS
11a	CH157	5785	16.33	0.5	PASS
11a	CH165	5825	16.31	0.5	PASS

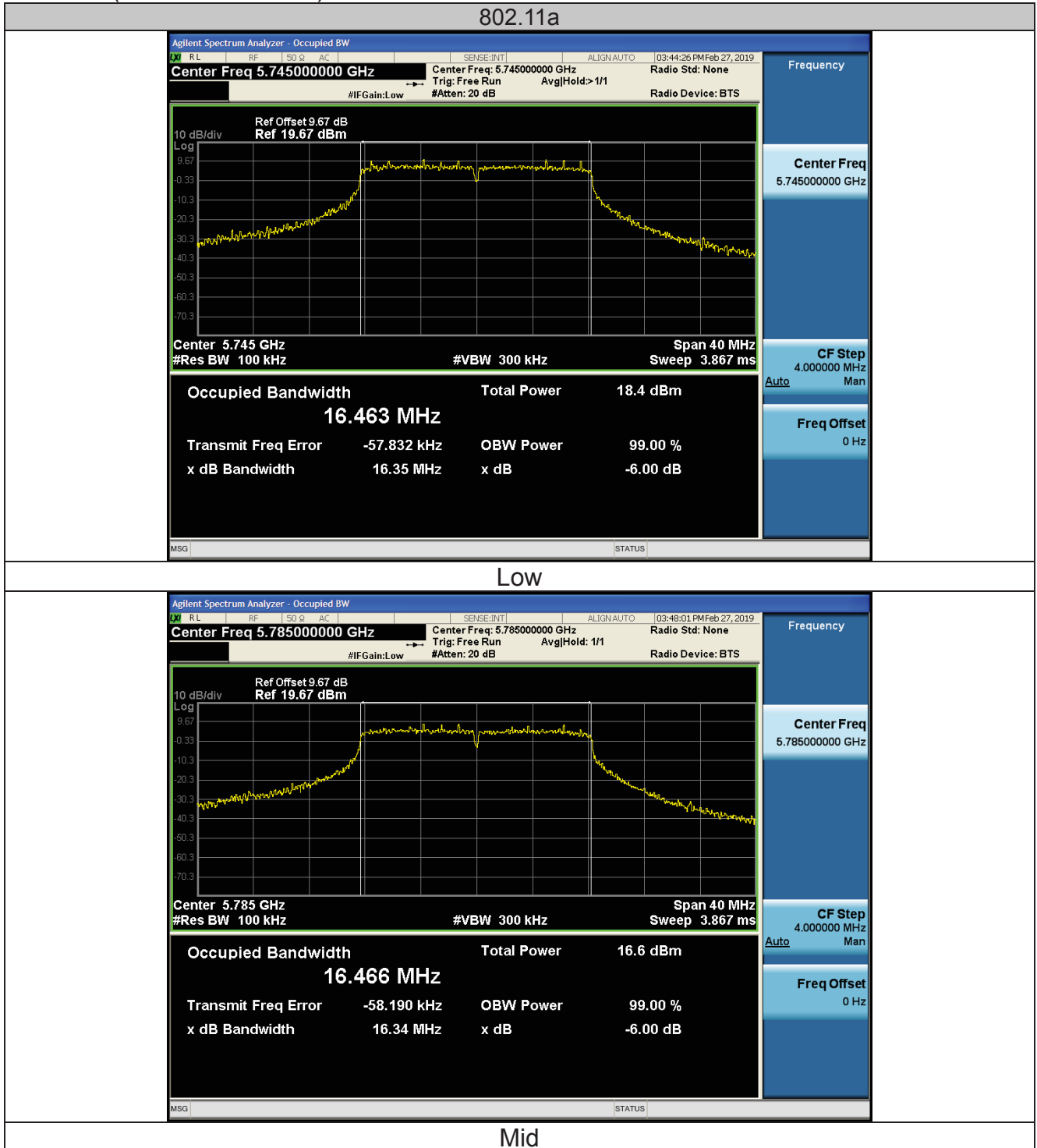
Antenna 2

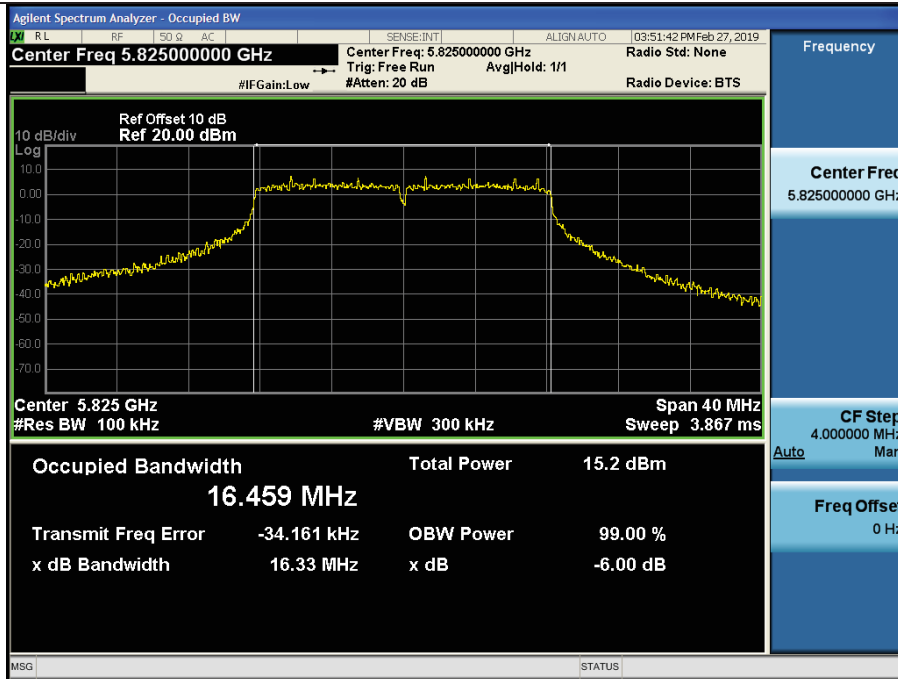
Band IV (5725 - 5850 MHz)					
Mode	Test channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)	Result
11a	CH149	5745	16.35	0.5	PASS
11a	CH157	5785	16.11	0.5	PASS
11a	CH165	5825	16.35	0.5	PASS

Test plots as follows:



Antenna 1
Band IV (5725 – 5850 MHz)

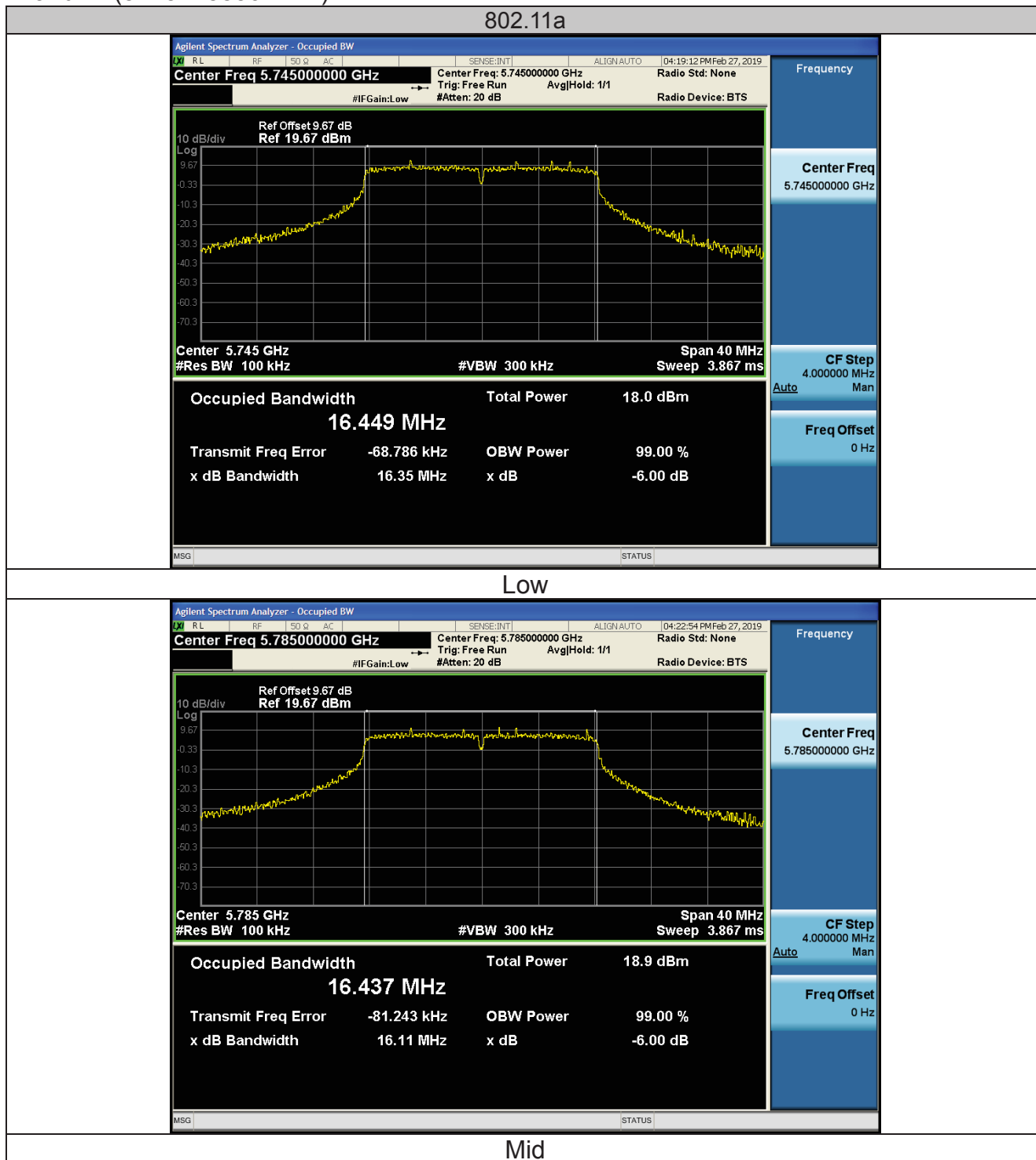


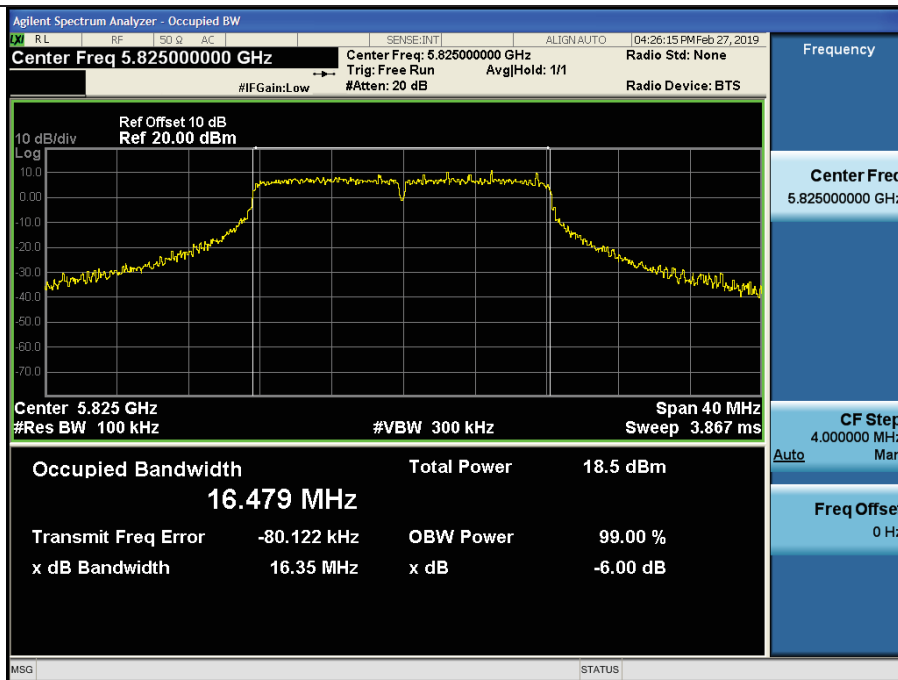


High



Antenna 2
Band IV (5725 – 5850 MHz)






High



4.4. 26dB Bandwidth and 99% Occupied Bandwidth

4.4.1. Test Specification

Test Requirement:	47 CFR Part 15C Section 15.407 (a)& Part 2 J Section 2.1049
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 C2. 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 Due
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 27, 2019
RF cable	Times	1-40G	HKE-034	Dec. 27, 2019
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 27, 2019

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


4.4.3. Test 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 The e.i.r.p spectral density for Band I 5150MHz – 5250 MHz should not exceed 10dBm/MHz
Test Setup:	 <p style="text-align: center;">Spectrum Analyzer EUT</p>
Test Mode:	Transmitting mode with modulation
Test Procedure:	1. Set the spectrum analyzer or EMI receiver span to view the entire emission bandwidth. 1. Set RBW = 510 kHz/1 MHz, VBW $\geq 3 \times$ RBW, Sweep time = Auto, Detector = RMS. 2. Allow the sweeps to continue until the trace stabilizes. 3. Use the peak marker function to determine the maximum amplitude level. 4. The E.I.R.P spectral density used radiated test method. At a test site that has been validated using the procedures of ANSI C63.4 or the latest CISPR 16-1-4 for measurements above 1 GHz, so as to simulate a near free-space environment.
Test Result:	PASS

4.5.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 27, 2019
RF cable	Times	1-40G	HKE-034	Dec. 27, 2019
RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 27, 2019

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



4.5.3. Test data

Antenna 1

Configuration Band IV (5725 - 5850 MHz)						
Mode	Test channel	Level [dBm/500kHz]	10log(1/x) Factor[dB]	Power Spectral Density	Limit (dBm/500kHz)	Result
11a	CH149	1.71	0	1.71	30	PASS
11a	CH157	4.15	0	4.15	30	PASS
11a	CH161	3.95	0	3.95	30	PASS

Antenna 2

Configuration Band IV (5725 - 5850 MHz)						
Mode	Test channel	Level [dBm/500kHz]	10log(1/x) Factor[dB]	Power Spectral Density	Limit (dBm/500kHz)	Result
11a	CH149	4.54	0	4.54	30	PASS
11a	CH157	4.98	0	4.98	30	PASS
11a	CH161	4.36	0	4.36	30	PASS

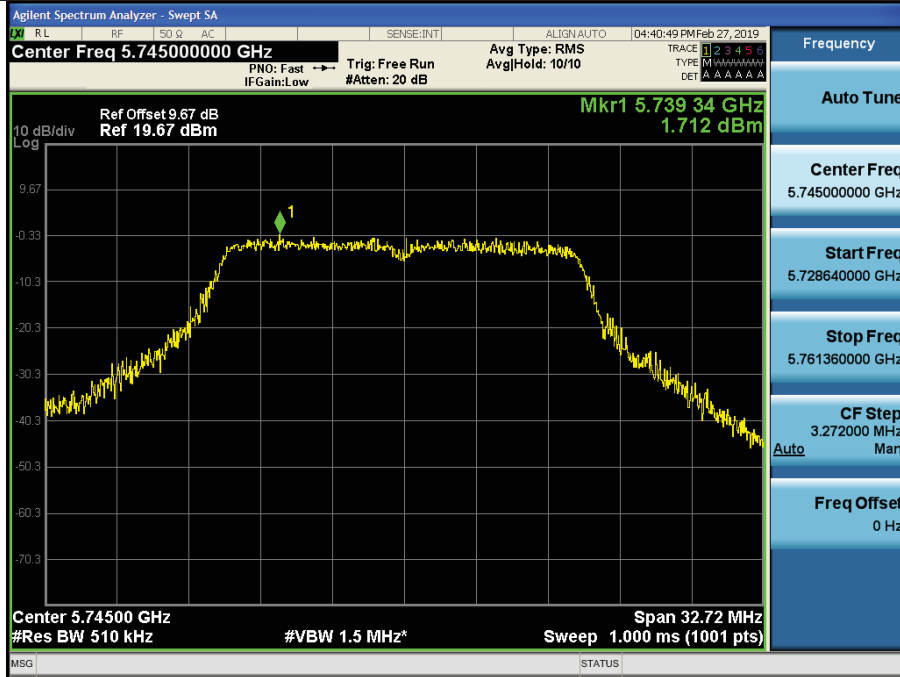
Test plots as follows:



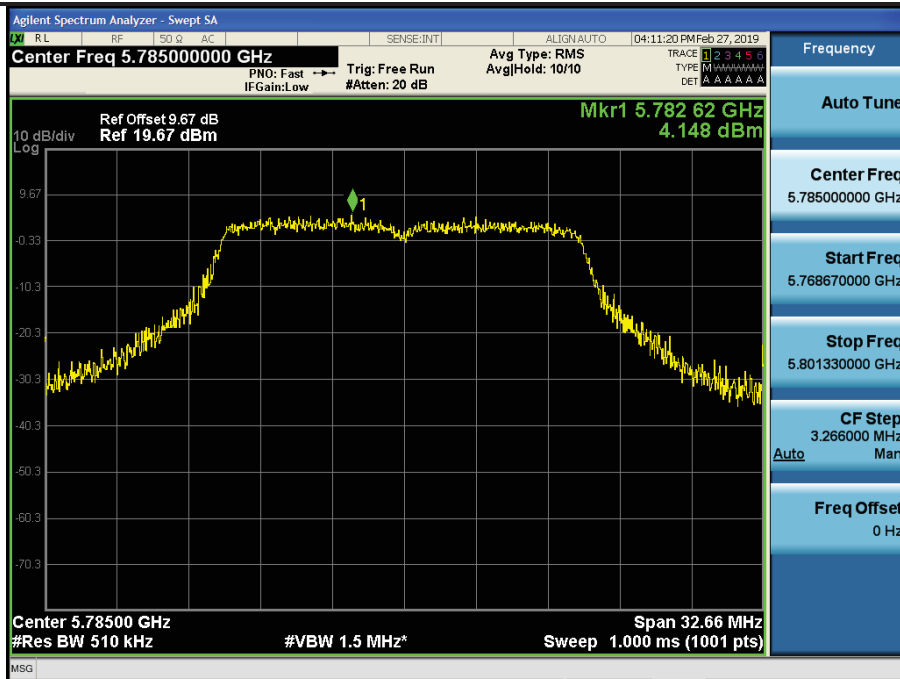
Antenna 1

Band IV (5725 – 5850 MHz)

802.11a



Low



Mid

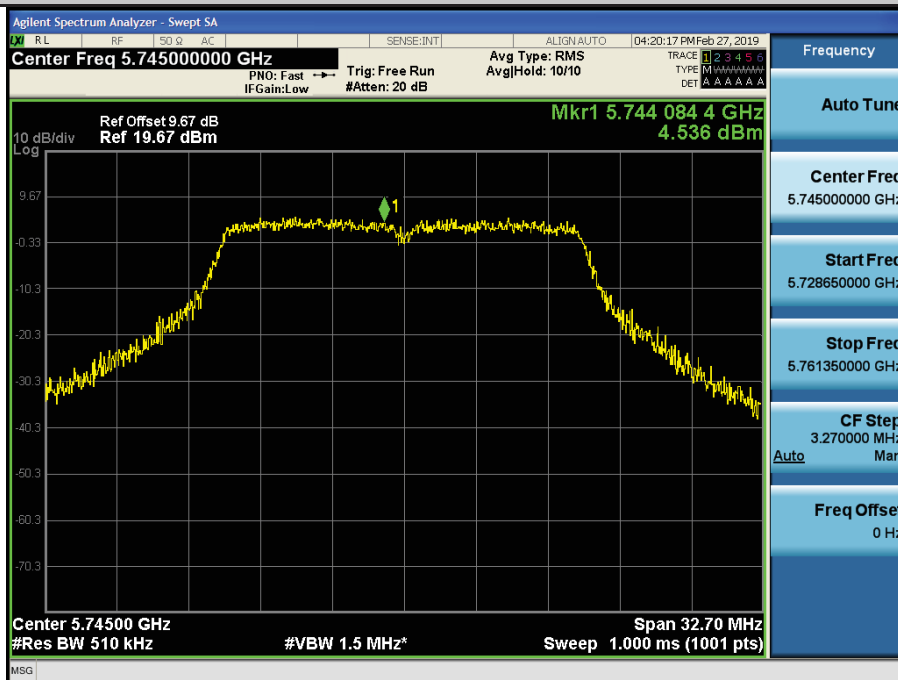




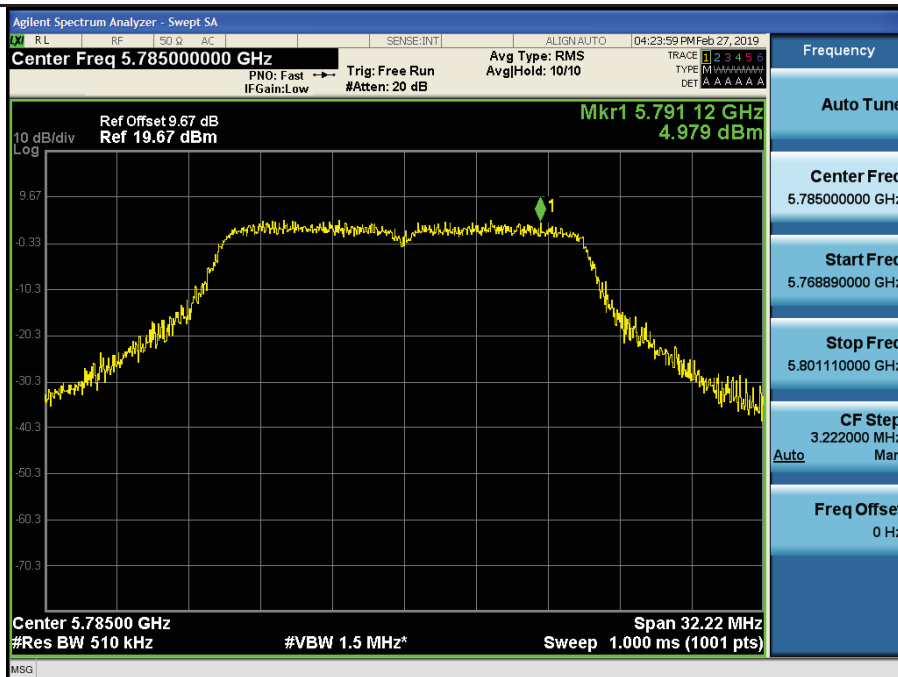
Antenna 2

Band IV (5725 – 5850 MHz)

802.11a



Low



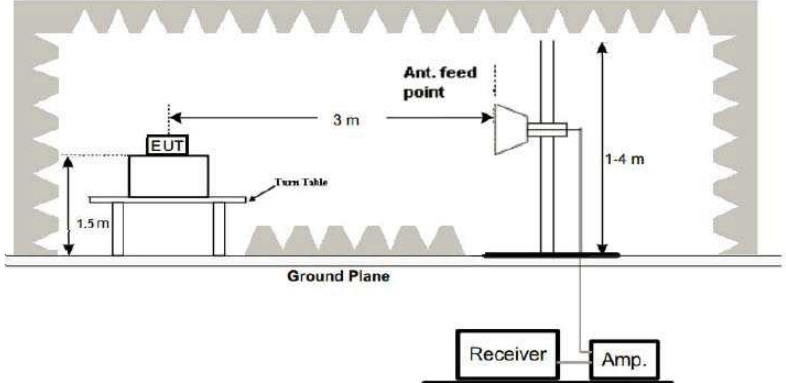
Mid





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>For band I&II&III: $E[\text{dB}\mu\text{V}/\text{m}] = \text{EIRP}[\text{dBm}] + 95.2 = 68.2 \text{ dB}\mu\text{V}/\text{m}$, for $\text{EIRP}(\text{dBm}) = -27\text{dBm}$</p> <p>For transmitters operating in the 5.725-5.85 GHz band:</p> <p>All emissions shall be limited to a level of $-27 \text{ dBm}/\text{MHz}$ at 75 MHz or more above or below the band edge increasing linearly to $10 \text{ dBm}/\text{MHz}$ 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 $15.6 \text{ dBm}/\text{MHz}$ 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 $27 \text{ dBm}/\text{MHz}$ at the band edge.</p> <p>For band IV(5715-5725MHz&5850-5860MHz): $E[\text{dB}\mu\text{V}/\text{m}] = \text{EIRP}[\text{dBm}] + 95.2 = 78.2 \text{ dB}\mu\text{V}/\text{m}$, for $\text{EIRP}(\text{dBm}) = -27\text{dBm}$;</p> <p>For band IV(other un-restricted band): $E[\text{dB}\mu\text{V}/\text{m}] = \text{EIRP}[\text{dBm}] + 95.2 = 68.2 \text{ dB}\mu\text{V}/\text{m}$, for $\text{EIRP}(\text{dBm}) = -27\text{dBm}$</p>
Test Setup:	 <p>The diagram illustrates the test setup. An EUT (Equipment Under Test) is placed on a turn table at a height of 1.5 m. The turn table is 3 m away from the antenna feed point. The antenna is mounted on a variable-height tower, with the feed point at a height of 1-4 m. The entire setup is on a ground plane. A receiver and amplifier are connected to the antenna feed point.</p>
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



	<p>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, quasipeak 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 Due
Receiver	R&S	ESRP3	HKE-005	Dec. 27, 2019
Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 27, 2019
Preamplifier	EMCI	EMC051845S E	HKE-015	Dec. 27, 2019
Preamplifier	Agilent	83051A	HKE-016	Dec. 27, 2019
Loop antenna	Schwarzbeck	FMZB 1519 B	HKE-014	Sep. 26, 2019
Broadband antenna	Schwarzbeck	VULB 9163	HKE-012	Sep. 26, 2019
Horn antenna	Schwarzbeck	9120D	HKE-013	Sep. 26, 2019
Antenna Mast	Keleto	CC-A-4M	N/A	N/A
Position controller	Taiwan MF	MF7802	HKE-011	Dec. 27, 2019
Radiated test software	Tonscend	TS+ Rev 2.5.0.0	HKE-082	N/A
RF cable (9KHz-1GHz)	Times	381806-001	N/A	N/A
Hf antenna	Schwarzbeck	LB-180400-KF	HKE-031	Sep. 27, 2019
RF cable	Tonscend	1-18G	HKE-099	Dec. 27, 2019
RF cable	Times	1-40G	HKE-034	Dec. 27, 2019

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

**4.6.3. Test Data**

Antenna 1

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	57.51	-2.06	55.45	68.2	-12.75	peak
5650	38.82	-2.06	36.76	48.2	-11.44	AVG
5700	89.43	-1.96	87.47	105.2	-17.73	peak
5700	69.16	-1.96	67.2	85.2	-18	AVG
5720	90.83	-2.87	87.96	110.8	-22.84	peak
5720	78.43	-2.87	75.56	90.8	-15.24	AVG
5725	105.97	-2.14	103.83	122.2	-18.37	peak
5725	89.17	-2.14	87.03	102.2	-15.17	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)	
5650	58.95	-2.06	56.89	68.2	-11.31	peak
5650	38.71	-2.06	36.65	48.2	-11.55	AVG
5700	88.43	-1.96	86.47	105.2	-18.73	peak
5700	65.42	-1.96	63.46	85.2	-21.74	AVG
5720	95.16	-2.87	92.29	110.8	-18.51	peak
5720	80.43	-2.87	77.56	90.8	-13.24	AVG
5725	108.94	-2.14	106.8	122.2	-15.4	peak
5725	88.72	-2.14	86.58	102.2	-15.62	AVG
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	113.05	-1.97	111.08	122.2	-11.12	peak
5850	88.74	-1.97	86.77	102.2	-15.43	AVG
5855	95.93	-2.13	93.8	110.8	-17	peak
5855	76.41	-2.13	74.28	90.8	-16.52	AVG
5875	89.35	-2.65	86.7	105.2	-18.5	peak
5875	64.29	-2.65	61.64	85.2	-23.56	AVG
5925	56.08	-2.28	53.8	68.2	-14.4	peak
5925	38.14	-2.28	35.86	48.2	-12.34	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)	
5850	113.81	-1.97	111.84	122.2	-10.36	peak
5850	88.76	-1.97	86.79	102.2	-15.41	AVG
5855	96.32	-2.13	94.19	110.8	-16.61	peak
5855	77.59	-2.13	75.46	90.8	-15.34	AVG
5875	88.15	-2.65	85.5	105.2	-19.7	peak
5875	68.41	-2.65	65.76	85.2	-19.44	AVG
5925	57.69	-2.28	55.41	68.2	-12.79	peak
5925	35.97	-2.28	33.69	48.2	-14.51	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						



Antenna 2

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	58.63	-2.06	56.57	68.2	-11.63	peak
5650	39.41	-2.06	37.35	48.2	-10.85	AVG
5700	88.54	-1.96	86.58	105.2	-18.62	peak
5700	68.93	-1.96	66.97	85.2	-18.23	AVG
5720	91.57	-2.87	88.7	110.8	-22.1	peak
5720	77.94	-2.87	75.07	90.8	-15.73	AVG
5725	106.25	-2.14	104.11	122.2	-18.09	peak
5725	88.43	-2.14	86.29	102.2	-15.91	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5650	59.17	-2.06	57.11	68.2	-11.09	peak
5650	39.42	-2.06	37.36	48.2	-10.84	AVG
5700	89.75	-1.96	87.79	105.2	-17.41	peak
5700	66.08	-1.96	64.12	85.2	-21.08	AVG
5720	96.72	-2.87	93.85	110.8	-16.95	peak
5720	81.94	-2.87	79.07	90.8	-11.73	AVG
5725	109.51	-2.14	107.37	122.2	-14.83	peak
5725	89.24	-2.14	87.1	102.2	-15.1	AVG
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	112.83	-1.97	110.86	122.2	-11.34	peak
5850	87.96	-1.97	85.99	102.2	-16.21	AVG
5855	96.14	-2.13	94.01	110.8	-16.79	peak
5855	75.94	-2.13	73.81	90.8	-16.99	AVG
5875	88.72	-2.65	86.07	105.2	-19.13	peak
5875	65.43	-2.65	62.78	85.2	-22.42	AVG
5925	57.42	-2.28	55.14	68.2	-13.06	peak
5925	38.39	-2.28	36.11	48.2	-12.09	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

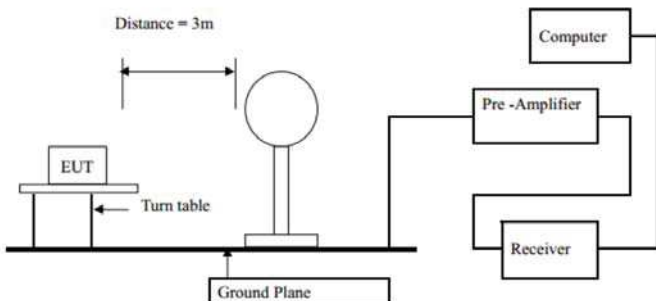
Vertical:

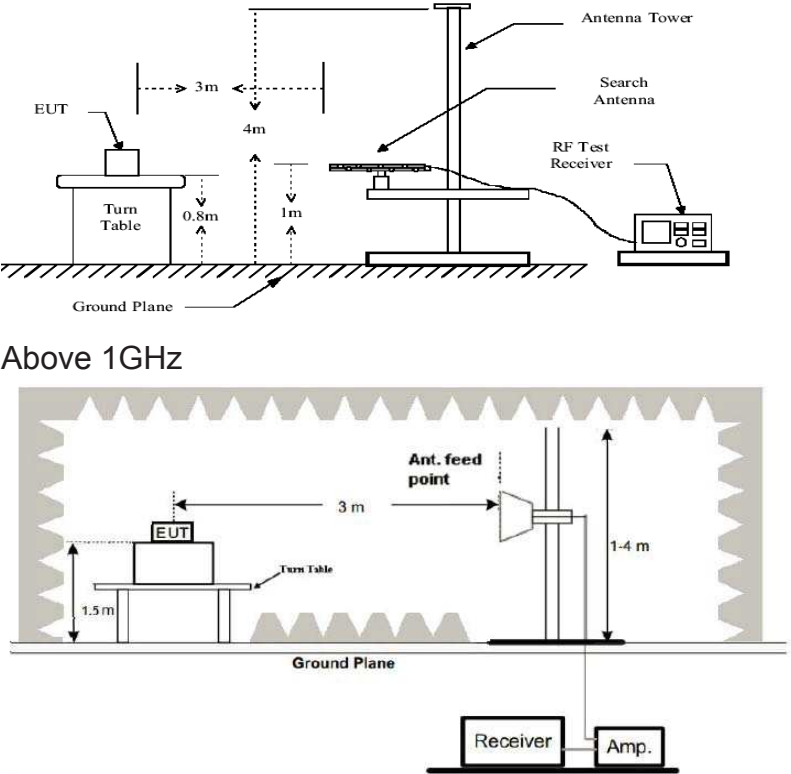
Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
5850	115.08	-1.97	113.11	122.2	-9.09	peak
5850	89.63	-1.97	87.66	102.2	-14.54	AVG
5855	97.42	-2.13	95.29	110.8	-15.51	peak
5855	78.61	-2.13	76.48	90.8	-14.32	AVG
5875	89.57	-2.65	86.92	105.2	-18.28	peak
5875	69.02	-2.65	66.37	85.2	-18.83	AVG
5925	58.14	-2.28	55.86	68.2	-12.34	peak
5925	37.35	-2.28	35.07	48.2	-13.13	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						



4.7. Spurious Emission

4.7.1.1. Test Specification

Test Requirement:	FCC CFR47 Part 15 Section 15.407 & 15.209 & 15.205				
Test Method:	KDB 789033 D02 v02r01				
Frequency Range:	9kHz to 40GHz				
Measurement Distance:	3 m				
Antenna Polarization:	Horizontal & Vertical				
Operation mode:	Transmitting mode with modulation				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	9kHz- 150kHz	Quasi-peak	200Hz	1kHz	Quasi-peak Value
	150kHz- 30MHz	Quasi-peak	9kHz	30kHz	Quasi-peak Value
	30MHz-1GHz	Quasi-peak	100KHz	300KHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
Peak		1MHz	10Hz	Average Value	
Limit:	Unwanted spurious emissions fallen in restricted bands per FCC Part15.205 shall comply with the general field strength limits set forth in § 15.209 as below table,				
	Frequency		Field Strength (microvolts/meter)	Measurement Distance (meters)	
	0.009-0.490		2400/F(KHz)	300	
	0.490-1.705		24000/F(KHz)	30	
	1.705-30		30	30	
	30-88		100	3	
	88-216		150	3	
	216-960		200	3	
	Above 960		500	3	
	Frequency		Limit (dBuV/m @3m)	Detector	
Above 1G		74.0	Peak		
		54.0	Average		
Test setup:	For radiated emissions below 30MHz				
					
	30MHz to 1GHz				

	 <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 center. 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 rotating 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 results:	PASS



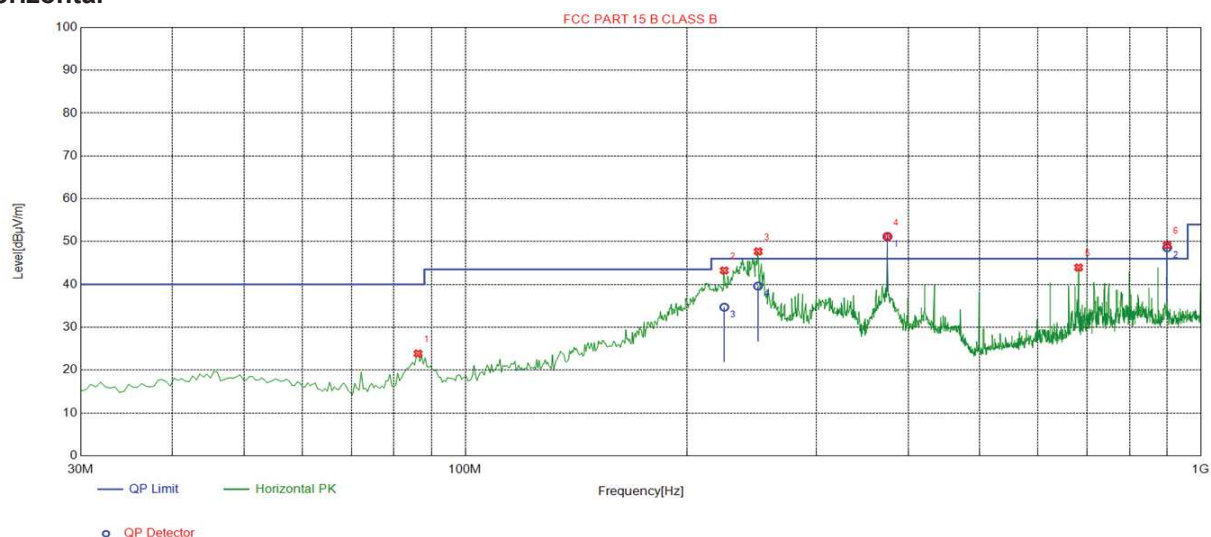
4.7.2. Test Data

Remark: We tested all Channels, the worst result of 802.11a low channel was recorded.

Please refer to following diagram for individual

Below 1GHz

Horizontal



Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	86.2600	23.85	-17.97	40.00	16.15	100	295	Horizontal
2	224.970	43.25	-14.44	46.00	2.75	100	76	Horizontal
3	250.190	47.70	-13.39	46.00	-1.70	100	288	Horizontal
4	374.835	51.16	-10.92	46.00	-5.16	100	292	Horizontal
5	682.325	43.94	-4.96	46.00	2.06	100	339	Horizontal
6	900.090	49.18	-1.78	46.00	-3.18	100	43	Horizontal

Final Data List

NO.	Freq. [MHz]	Factor [dB]	QP Value [dBμV/m]	QP Limit [dBμV/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	375.007	-10.91	51.18	46.00	-5.18	140	72.7	Horizontal
2	900.000	-1.78	48.57	46.00	-2.57	150	270.7	Horizontal
3	224.983	-14.44	34.69	46.00	11.31	140	344.2	Horizontal
4	250.024	-13.39	39.62	46.00	6.38	160	175.1	Horizontal

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

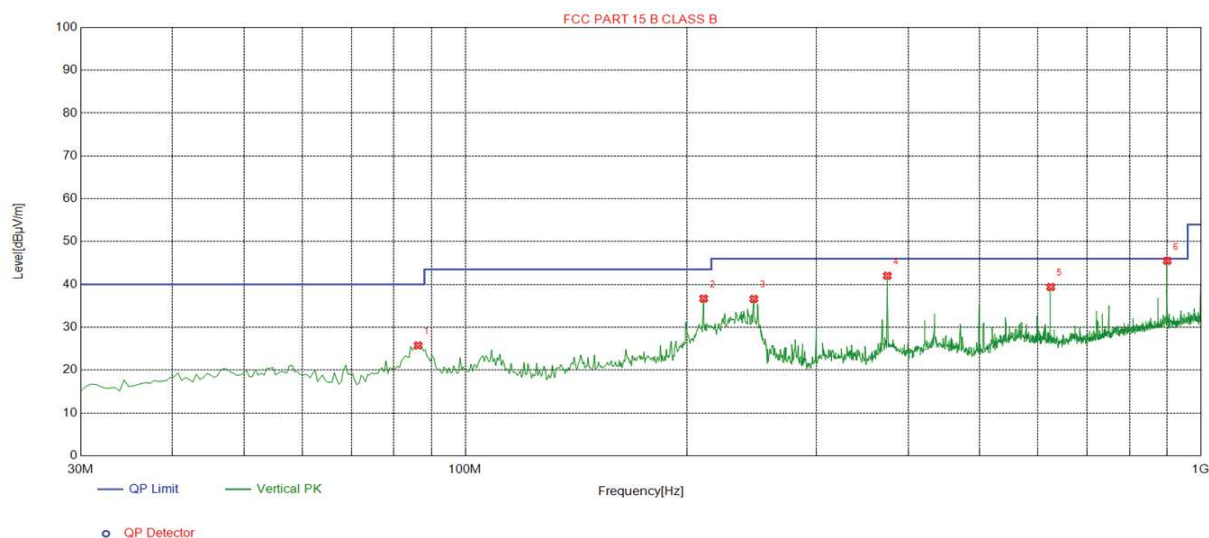
Remark: This equipment belongs to class A product, which meets the requirements of class A.

The measurements above the limit pertain to digital circuit (not intentional radiator part).

It was checked with the radio off.



Vertical



Suspected List

NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	86.2600	25.74	-17.97	40.00	14.26	100	161	Vertical
2	210.905	36.68	-14.78	43.50	6.82	100	297	Vertical
3	246.795	36.61	-13.54	46.00	9.39	100	202	Vertical
4	374.835	42.03	-10.92	46.00	3.97	100	328	Vertical
5	625.095	39.39	-5.50	46.00	6.61	100	232	Vertical
6	900.090	45.51	-1.78	46.00	0.49	100	27	Vertical

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Remark: This equipment belongs to class A product, which meets the requirements of class A.

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

**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	65.18	-4.59	60.59	74	-13.41	peak
3647	47.52	-4.59	42.93	54	-11.07	AVG
11570	54.39	4.21	58.6	74	-15.4	peak
11570	40.94	4.21	45.15	54	-8.85	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	64.29	-4.59	59.7	74	-14.3	peak
3647	50.59	-4.59	46	54	-8	AVG
11570	55.72	4.21	59.93	74	-14.07	peak
11570	37.69	4.21	41.9	54	-12.1	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	60.75	-4.59	56.16	74	-17.84	peak
3647	48.84	-4.59	44.25	54	-9.75	AVG
11570	54.53	4.21	58.74	74	-15.26	peak
11570	42.59	4.21	46.8	54	-7.2	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	63.06	-4.59	58.47	74	-15.53	peak
3647	48.13	-4.59	43.54	54	-10.46	AVG
11570	50.74	4.21	54.95	74	-19.05	peak
11570	38.71	4.21	42.92	54	-11.08	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	61.69	-4.59	57.1	74	-16.9	peak
3647	69.71	-4.59	65.12	54	11.12	AVG
11650	55.71	4.84	60.55	74	-13.45	peak
11650	39.42	4.84	44.26	54	-9.74	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	59.15	-4.59	54.56	74	-19.44	peak
3647	47.36	-4.59	42.77	54	-11.23	AVG
11650	51.59	4.84	56.43	74	-17.57	peak
11650	40.83	4.84	45.67	54	-8.33	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Remark:

- (1) Measuring frequencies from 1 GHz to the 40 GHz.
- (2) "F" denotes fundamental frequency; "H" denotes spurious frequency. "E" denotes band edge frequency.
- (3) * denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
- (4) Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.
- (6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.



4.8. Frequency Stability Measurement

4.8.1. Test Specification

Test Requirement:	FCC Part15 Section 15.407(g) &Part2 J Section 2.1055
Test Method:	ANSI C63.10: 2013
Limit:	The frequency tolerance shall be maintained within the band of operation frequency over a temperature variation of 0 degrees to 35 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.
Test Setup:	<pre>graph LR; SA[Spectrum Analyzer] --- EUT[EUT]; EUT --- P[AC/DC Power supply]; EUT --- TC[Temperature Chamber]; P --- TC;</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	7.4V	5744.962	38	5824.976	24
	8.51 V	5745.027	27	5825.018	18
	6.19 V	5745.032	32	5824.984	16

Mode	Temperature (°C)	FHL (5745MHz)	Deviation (KHz)	FHH (5825MHz)	Deviation (KHz)
5.8G Band	-30	5745.024	24	5824.974	26
	-20	5744.976	24	5824.983	17
	-10	5744.983	17	5824.974	26
	0	5745.021	21	5825.031	31
	10	5744.985	15	5824.984	16
	20	5744.989	11	5824.982	18
	30	5745.026	26	5824.970	30
	40	5744.978	22	5824.976	24
	50	5744.975	25	5824.981	19

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.

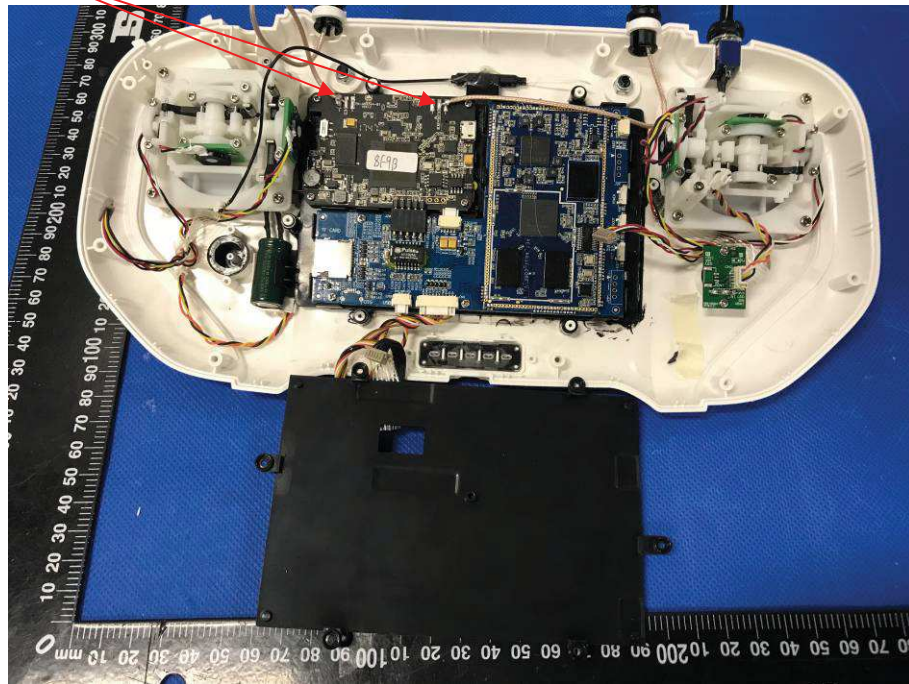
Refer to statement below for compliance.

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, and the best case gain of the antenna is Antenna port 1:1dBi and Antenna port 2:1dBi.

WIFI ANTENNA





4.10. Photographs of Test Setup

