



# FCC RF Test Report

APPLICANT : Ring LLC  
EQUIPMENT : Spotlight Cam Pro  
BRAND NAME : Ring  
MODEL NAME : 5E62E9  
FCC ID : 2AEUPBHASP001  
STANDARD : FCC Part 15 Subpart E §15.407  
CLASSIFICATION : (NII) Unlicensed National Information Infrastructure  
TEST DATE(S) : Dec. 29, 2021 ~ Jun. 23, 2022

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia



Approved by: Jason Jia

**Sporton International Inc. (Kunshan)**

**No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300  
People's Republic of China**



# TABLE OF CONTENTS

**REVISION HISTORY..... 3**

**SUMMARY OF TEST RESULT ..... 4**

**1 GENERAL DESCRIPTION ..... 5**

    1.1 Applicant ..... 5

    1.2 Manufacturer ..... 5

    1.3 Product Feature of Equipment Under Test..... 5

    1.4 Product Specification of Equipment Under Test..... 5

    1.5 Modification of EUT ..... 5

    1.6 Testing Location ..... 6

    1.7 Test Software..... 6

    1.8 Applicable Standards..... 6

**2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST ..... 7**

    2.1 Carrier Frequency and Channel ..... 7

    2.2 Test Mode..... 7

    2.3 Connection Diagram of Test System..... 8

    2.4 Support Unit used in test configuration and system ..... 8

    2.5 EUT Operation Test Setup ..... 9

    2.6 Measurement Results Explanation Example..... 9

**3 TEST RESULT ..... 10**

    3.1 6dB and 26dB and 99% Occupied Bandwidth Measurement ..... 10

    3.2 Maximum Conducted Output Power Measurement ..... 13

    3.3 Power Spectral Density Measurement ..... 14

    3.4 Unwanted Emissions Measurement..... 16

    3.5 AC Conducted Emission Measurement..... 21

    3.6 Antenna Requirements..... 23

**4 LIST OF MEASURING EQUIPMENT ..... 24**

**5 UNCERTAINTY OF EVALUATION ..... 25**

**APPENDIX A. CONDUCTED TEST RESULTS**

**APPENDIX B. AC CONDUCTED EMISSION TEST RESULT**

**APPENDIX C. RADIATED SPURIOUS EMISSION**

**APPENDIX D. DUTY CYCLE PLOTS**

**APPENDIX E. SETUP PHOTOGRAPHS**



### REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR1D0812G	Rev. 01	Initial issue of report	Aug. 16, 2022



### SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.403(i)	6dB, 26dB and 99% Occupied Bandwidth	> 500kHz	Pass	-
3.2	15.407(a)	Maximum Conducted Output Power	≤ 30 dBm	Pass	-
3.3	15.407(a)	Power Spectral Density	≤ 30 dBm/500kHz	Pass	-
3.4	15.407(b)	Unwanted Emissions	15.407(b)(4)(i) & 15.209(a)	Pass	Under limit 5.18 dB at 37.76 MHz
3.5	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 17.60 dB at 0.154 MHz
3.6	15.203 & 15.407(a)	Antenna Requirement	15.203 & 15.407(a)	Pass	-

<b>Declaration of Conformity:</b>
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
<b>Comments and Explanations:</b>
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.



# 1 General Description

## 1.1 Applicant

Ring LLC  
12515 Cerise Ave, Hawthorne, CA 90250 USA

## 1.2 Manufacturer

Goertek Inc.  
No.268 Dongfang Road High-Tech Industrial Development District, Weifang Shandong, China

## 1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Spotlight Cam Pro
Brand Name	Ring
Model Name	5E62E9
FCC ID	2AEUPBHASP001
HW Version	DVT2
SW Version	1.5.17
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

## 1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Channel Frequency Range	5745 MHz ~ 5825 MHz
Maximum Output Power	<5745 MHz ~ 5825 MHz> 802.11a : 15.50 dBm / 0.0355 W 802.11n HT20 : 15.44 dBm / 0.0350 W
99% Occupied Bandwidth	802.11a : 16.58 MHz 802.11n HT20 : 17.63 MHz
Type of Modulation	802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)
Antenna Type / Gain	Stamping antenna with gain 4.51 dBi

## 1.5 Modification of EUT

No modifications are made to the EUT during all test items.



### 1.6 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

<b>Test Firm</b>	Sporton International Inc. (Kunshan)		
<b>Test Site Location</b>	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People’s Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
<b>Test Site No.</b>	<b>Sporton Site No.</b>	<b>FCC Designation No.</b>	<b>FCC Test Firm Registration No.</b>
	CO01-KS 03CH06-KS TH01-KS	CN1257	314309

### 1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH06-KS	AUDIX	E3	6.2009-8-24al
2.	CO01-KS	AUDIX	E3	6.2009-8-24

### 1.8 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 15 Subpart E
- FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- ANSI C63.10-2013

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



## 2 Test Configuration of Equipment Under Test

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Y plane) were recorded in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

### 2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5745-5825 MHz U-NII-3	149	5745	161	5805
	153	5765	165	5825
	157	5785	-	-

### 2.2 Test Mode

Final test modes are considering the modulation and worse data rates as below table.

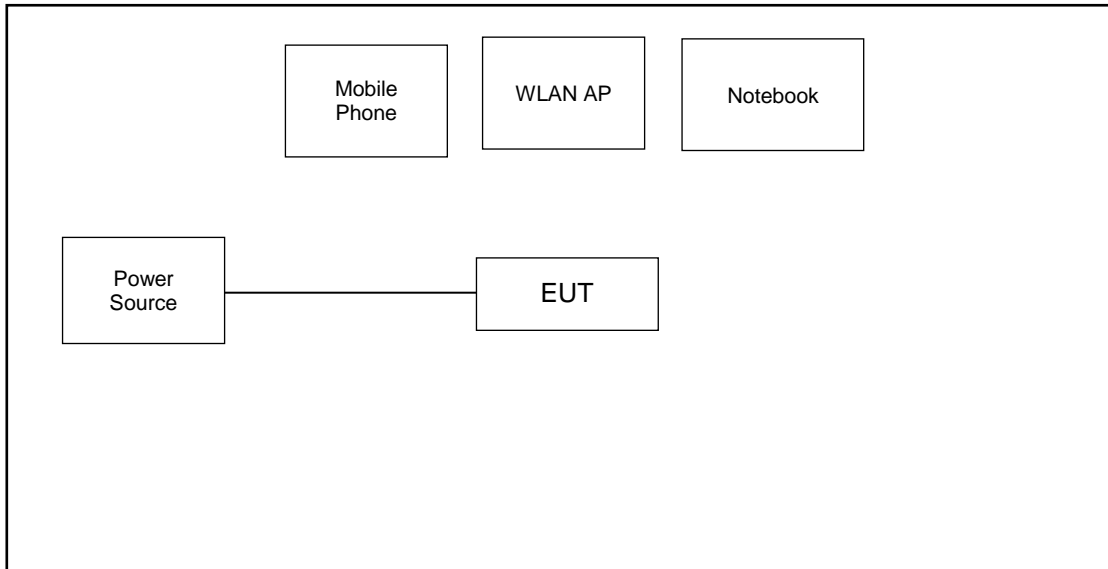
Modulation	Data Rate
802.11a	6 Mbps
802.11n HT20	MCS0

<b>AC Conducted Emission</b>	Mode 1 : Lora Tx + Bluetooth Link + WLAN(5G)Link + USB Cable 1(Charging from Adapter 1) + Battery3+24G Radar Tx
--------------------------------------	---

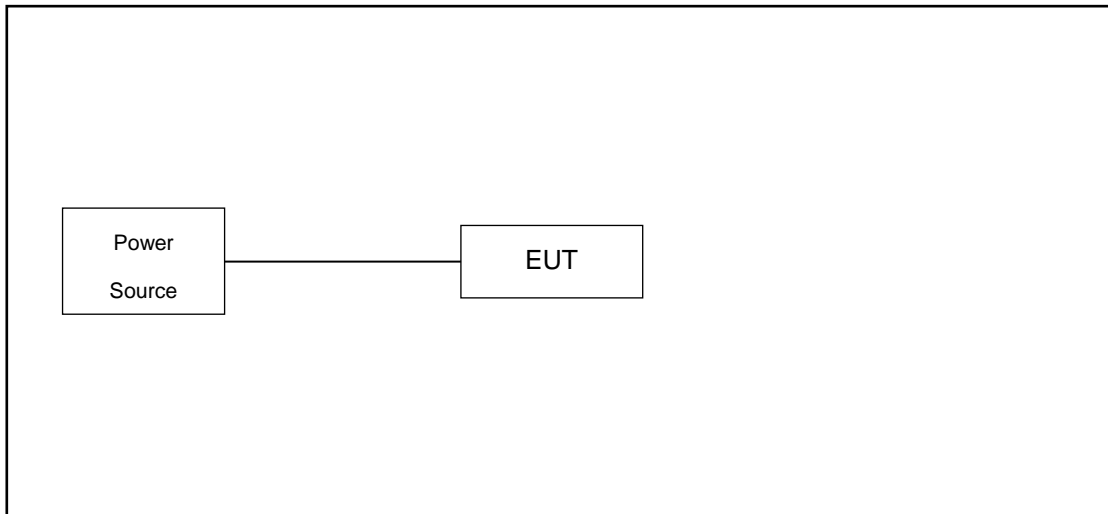
Ch. #	U-NII-3 : 5745-5825 MHz	
	802.11a	802.11n HT20
L Low	149	149
M Middle	157	157
H High	165	165

### 2.3 Connection Diagram of Test System

For AC Conducted Emission:



For Radiated Emission:



### 2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	WLAN AP	D-link	DIR-655	KA21R655B1	N/A	Unshielded, 1.8m
2.	Notebook	Lenovo	V130-15IKB005	N/A	N/A	AC I/P: Unshielded, 1.8 m DC O/P: Shielded, 1.8 m





## 2.5 EUT Operation Test Setup

For WLAN RF test items, an engineering test program was provided and enabled to make EUT continuous transmit.

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.

## 2.6 Measurement Results Explanation Example

**For all conducted test items:**

The offset level is set in the spectrum analyzer to compensate the RF cable loss between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss.

*Offset = RF cable loss.*

Following shows an offset computation example with cable loss 7.0 dB.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)}. \\ &= 7.0 \text{ (dB)} \end{aligned}$$

### 3 Test Result

#### 3.1 6dB and 26dB and 99% Occupied Bandwidth Measurement

##### 3.1.1 Description of 6dB and 26dB and 99% Occupied Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

26dB and 99% Occupied bandwidth are reporting only.

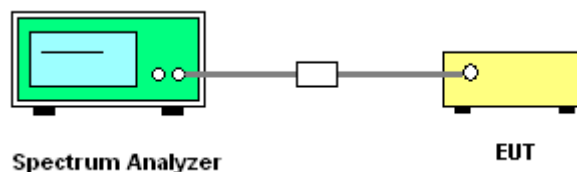
##### 3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

##### 3.1.3 Test Procedures

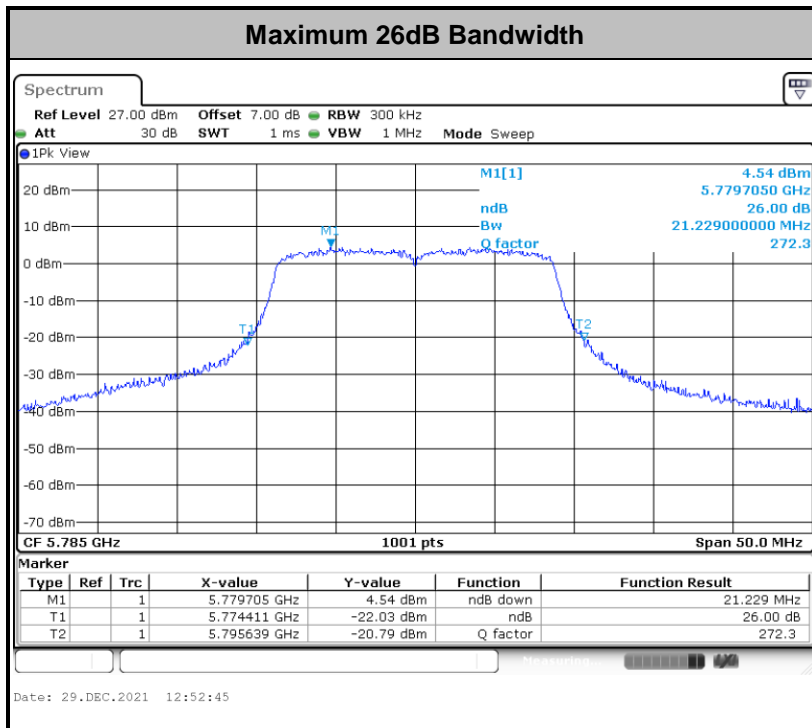
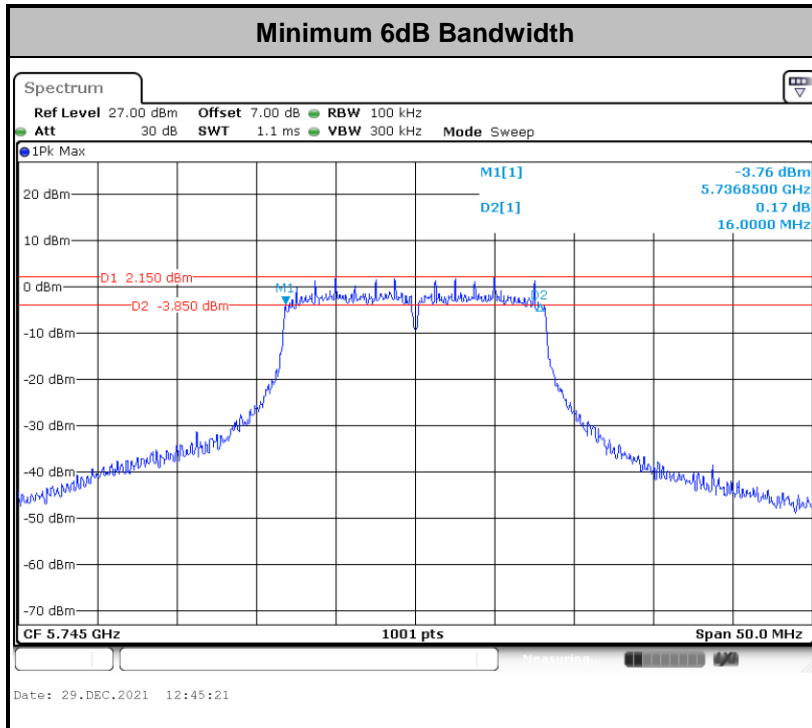
1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section C) Emission bandwidth for the band 5.725-5.85GHz
2. For 6dB BW, Set RBW = 100kHz.  
For 26dB BW, Set RBW = approximately 1% of the emission bandwidth.  
For 99% OBW, Set RBW = 1% to 5% of the OBW.
3. For 26dB BW, Set the VBW > RBW.  
For 6dB BW & 99% OBW, Set the VBW  $\geq 3 \times$  RBW.
4. Detector = Peak.
5. Trace mode = max hold
6. Measure the maximum width of the emission that is 6 dB down from the peak of the emission.
7. Measure and record the results in the test report.

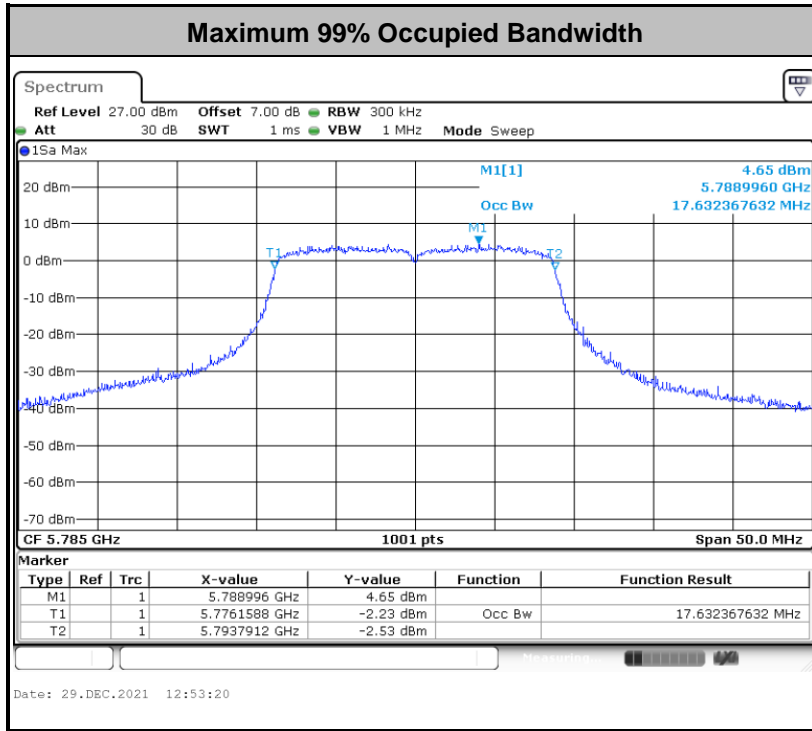
##### 3.1.4 Test Setup



##### 3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.





**Note:** The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

## 3.2 Maximum Conducted Output Power Measurement

### 3.2.1 Limit of Maximum Conducted Output Power

For the band 5.725–5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

For Straddle Channel, According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, If the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### 3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

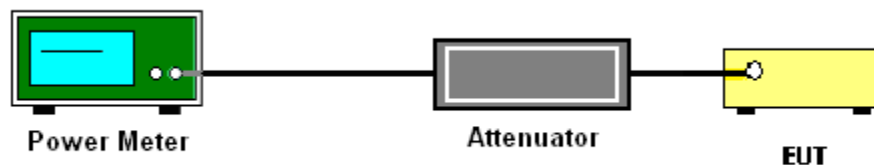
### 3.2.3 Test Procedures

The testing follows Method PM of FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

Method PM (Measurement using an RF average power meter):

1. Measurement is performed using a wideband RF power meter.
2. The EUT is configured to transmit continuously with a consistent duty cycle at its maximum power control level.
3. Measure the average power of the transmitter, and the average power is corrected with duty factor,  $10 \log(1/x)$ , where  $x$  is the duty cycle.

### 3.2.4 Test Setup



### 3.2.5 Test Result of Maximum Conducted Output Power

Please refer to Appendix A.



### 3.3 Power Spectral Density Measurement

#### 3.3.1 Limit of Power Spectral Density

For the band 5.725–5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

For Straddle Channel, According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, If the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

#### 3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

#### 3.3.3 Test Procedures

The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section F) Maximum power spectral density.

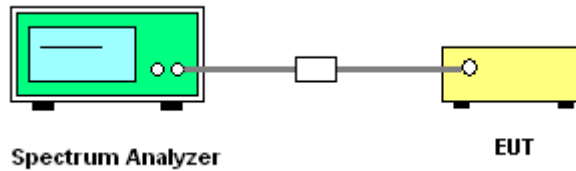
##### # Method SA-2 #

(trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).

- Measure the duty cycle.
- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 300 kHz.
- Set VBW  $\geq$  1 MHz.
- Number of points in sweep  $\geq$  2 Span / RBW.
- Sweep time = auto.
- Detector = RMS
- Trace average at least 100 traces in power averaging mode.
- Add  $10 \log(500\text{kHz}/\text{RBW})$  to the test result.
- Add  $10 \log(1/x)$ , where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times. For example, add  $10 \log(1/0.25) = 6$  dB if the duty cycle is 25 percent.

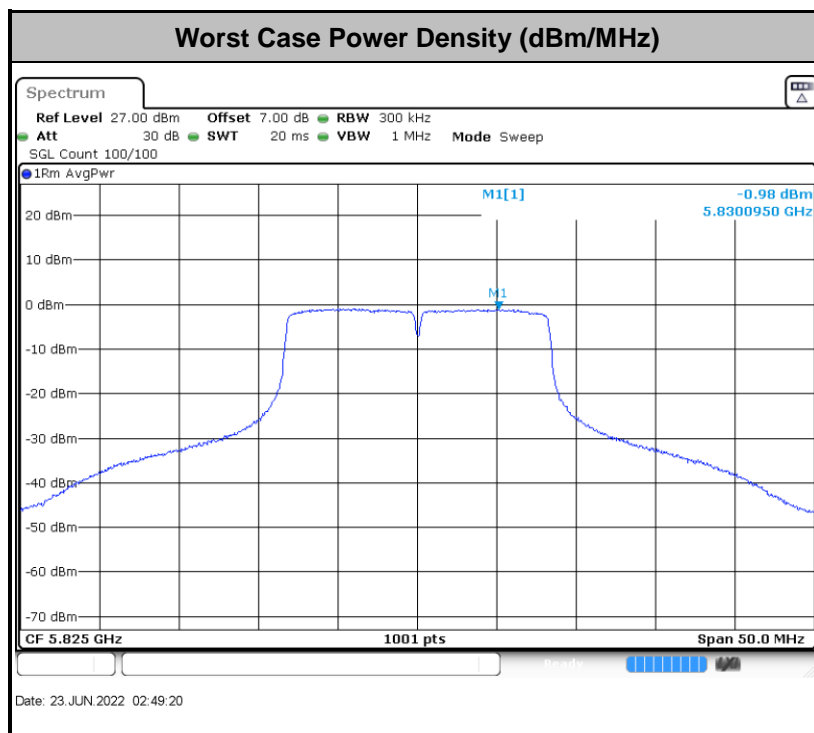
1. The RF output of EUT was connected to the spectrum analyzer by a low loss cable.
2. Each plot has already offset with cable loss, and attenuator loss. Measure the PSD and record it.

### 3.3.4 Test Setup



### 3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.



**Note:** Average Power Density (1.32dBm/500KHz) = Measured value (-0.98dBm/300KHz) + Duty Factor(0.08dB) + RBW offset (2.22dB)



### 3.4 Unwanted Emissions Measurement

This section is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement.

#### 3.4.1 Limit of Unwanted Emissions

- (1) For transmitters operating in the 5.725-5.85 GHz band:  
 15.407(b)(4)(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.
- (2) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below table,

Frequency (MHz)	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 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3





EIRP (dBm)	Field Strength at 3m (dBµV/m)
- 27	68.2

**Note:** The following formula is used to convert the EIRP to field strength.

$$EIRP = E_{Meas} + 20\log (d_{Meas}) - 104.7$$

where

EIRP is the equivalent isotropically radiated power, in dBm

$E_{Meas}$  is the field strength of the emission at the measurement distance, in dBµV/m

$d_{Meas}$  is the measurement distance, in m

(3) ANSI C63.10-2013 clause 12.7.3 note 97

As specified by regulatory requirements, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit. However, an out-of-band emission that complies with both the average and peak general regulatory limits is not required to satisfy the peak emission limit.

### 3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

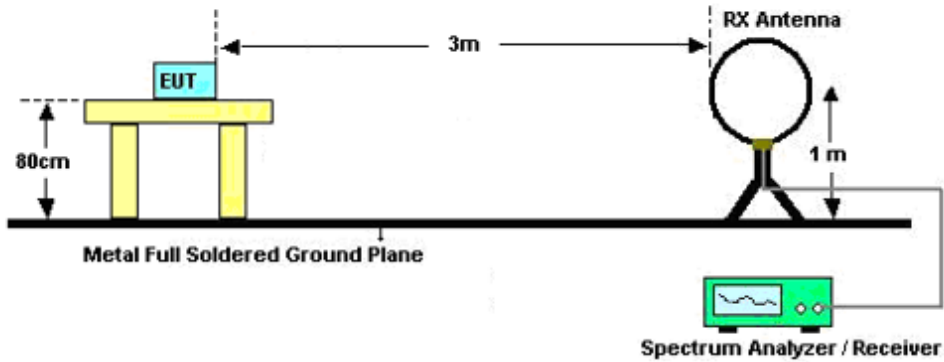


### 3.4.3 Test Procedures

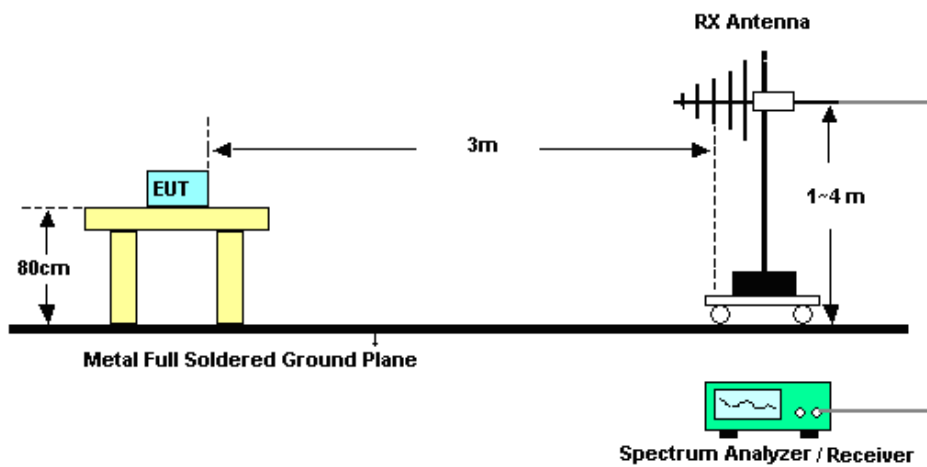
1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section G) Unwanted emissions measurement.
  - (1) Procedure for Unwanted Emissions Measurements Below 1000MHz
    - RBW = 120 kHz
    - VBW = 300 kHz
    - Detector = Peak
    - Trace mode = max hold
  - (2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz
    - RBW = 1 MHz
    - VBW  $\geq$  3 MHz
    - Detector = Peak
    - Sweep time = auto
    - Trace mode = max hold
  - (3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz
    - RBW = 1 MHz
    - VBW = 10 Hz, when duty cycle is no less than 98 percent.
    - VBW  $\geq$  1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT was arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

### 3.4.4 Test Setup

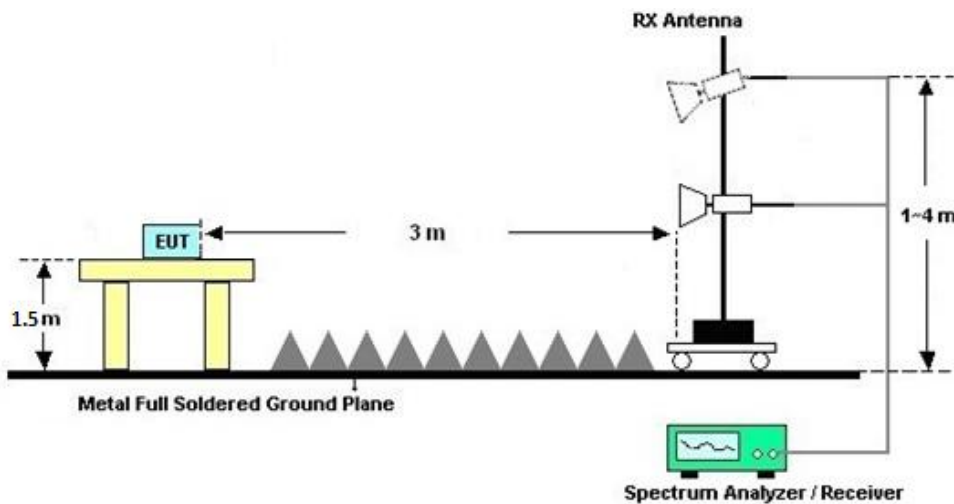
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz





### **3.4.5 Test Results of Radiated Emissions (9 kHz ~ 30 MHz)**

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

### **3.4.6 Test Result of Radiated Band Edges**

Please refer to Appendix C.

### **3.4.7 Duty Cycle**

Please refer to Appendix D.

### **3.4.8 Test Result of Unwanted Radiated Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)**

Please refer to Appendix C.



### 3.5 AC Conducted Emission Measurement

#### 3.5.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.

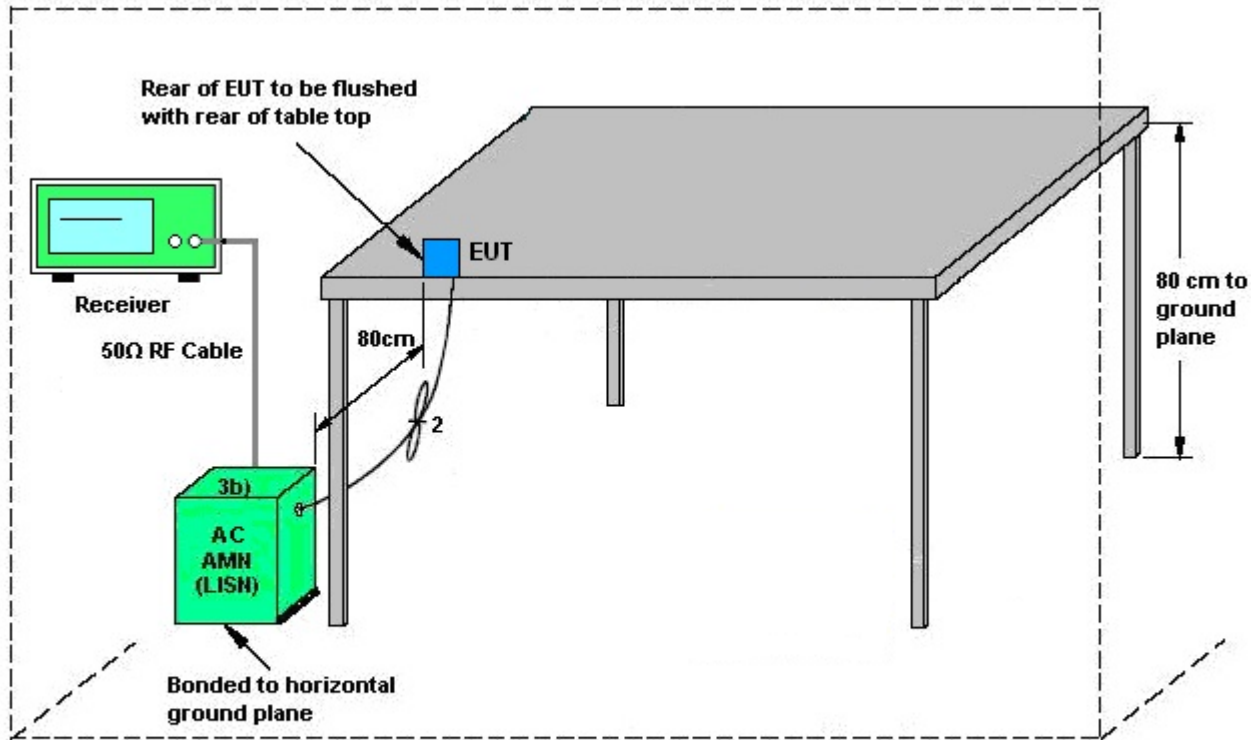
#### 3.5.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

#### 3.5.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.

### 3.5.4 Test Setup



AMN = Artificial mains network (LISH)  
AE = Associated equipment  
EUT = Equipment under test  
ISN = Impedance stabilization network

### 3.5.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



## **3.6 Antenna Requirements**

### **3.6.1 Standard Applicable**

If transmitting antenna directional gain is greater than 6 dBi, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### **3.6.2 Antenna Anti-Replacement Construction**

An embedded-in antenna design is used.

### **3.6.3 Antenna Gain**

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



## 4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 14, 2021	Dec. 29, 2021~ Jun. 23, 2022	Oct. 13, 2022	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 05, 2021	Dec. 29, 2021~ Jun. 23, 2022	Jan. 04, 2023	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 05, 2021	Dec. 29, 2021~ Jun. 23, 2022	Jan. 04, 2023	Conducted (TH01-KS)
Temperature & humidity chamber	Hongzhan	LP-150U	H2014011440	-40~+150°C 20%~95%RH	Jul. 12, 2021	Dec. 29, 2021~ Jun. 23, 2022	Jul. 11, 2022	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz; Max 30dBm	Oct. 16, 2021	May 12, 2022	Oct. 15, 2022	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY60242126	10Hz~44GHz	Oct. 26, 2021	May 12, 2022	Oct. 25, 2022	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 30, 2021	May 12, 2022	Oct. 29, 2022	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	49921	30MHz~1GHz	May 24, 2021	May 12, 2022	May 23, 2022	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00240138	1GHz~18GHz	Jul. 19, 2021	May 12, 2022	Jul. 18, 2022	Radiation (03CH06-KS)
SHF-EHF Horn	Com-power	AH-840	101093	18GHz~40GHz	Jan. 05, 2022	May 12, 2022	Jan. 04, 2023	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	380827	9KHz ~1GHZ	Jul. 30, 2021	May 12, 2022	Jul. 29, 2022	Radiation (03CH06-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 05, 2022	May 12, 2022	Jan. 04, 2023	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2025788	1Ghz-18Ghz	Jul. 30, 2021	May 12, 2022	Jul. 29, 2022	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270319	500MHz~26.5GHz	Oct. 14, 2021	May 12, 2022	Oct. 13, 2022	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	May 12, 2022	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	May 12, 2022	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	May 12, 2022	NCR	Radiation (03CH06-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	May 24, 2022	Jun. 11, 2022	May 23, 2023	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 14, 2021	Jun. 11, 2022	Oct. 13, 2022	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	May 24, 2022	Jun. 11, 2022	May 23, 2023	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP00000811	AC 0V~300V, 45Hz~1000Hz	Oct. 14, 2021	Jun. 11, 2022	Oct. 13, 2022	Conduction (CO01-KS)

NCR: No Calibration Required





## 5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

### Uncertainty of Conducted Measurement

Test Item	Uncertainty
Conducted Power	±0.56 dB
Conducted Emissions	±0.92 dB
Occupied Channel Bandwidth	±0.03 %
Conducted Power Spectral Density	±0.54 dB

### Uncertainty of Conducted Emission Measurement (150kHz ~ 30MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.94dB
---	--------

### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0dB
---	-------

### Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0dB
---	-------

### Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0dB
---	-------

----- THE END -----



## **Appendix A. Conducted Test Results**

Test Engineer:	Kib Shi	Temperature:	21~25	°C
Test Date:	2021/12/29~2022/6/23	Relative Humidity:	51~54	%

**TEST RESULTS DATA**  
**6dB and 26dB EBW and 99% OBW**

U-NII-3									
Mod.	Data Rate	N <sub>TX</sub>	CH.	Freq. (MHz)	99% Bandwidth (MHz)	26 dB Bandwidth (MHz)	6 dB Bandwidth (MHz)	6dB Bandwidth min. Limit (MHz)	Pass/Fail
11a	6M bps	1	149	5745	16.58	20.68	16	0.5	Pass
11a	6Mbps	1	157	5785	16.58	20.58	16.3	0.5	Pass
11a	6Mbps	1	165	5825	16.53	20.38	16.25	0.5	Pass
HT20	MCS 0	1	149	5745	17.58	21.13	16.75	0.5	Pass
HT20	MCS 0	1	157	5785	17.63	21.23	16.55	0.5	Pass
HT20	MCS 0	1	165	5825	17.63	21.18	16.5	0.5	Pass

**TEST RESULTS DATA**  
**Average Power Table**

U-NII-3										
Mod.	Data Rate	N <sub>TX</sub>	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)	FCC Conducted Power Limit (dBm)	DG (dBi)		Pass/Fail
11a	6M bps	1	149	5745	0.08	15.20	30.00	4.51		Pass
11a	6Mbps	1	157	5785	0.08	14.63	30.00	4.51		Pass
11a	6Mbps	1	165	5825	0.08	15.50	30.00	4.51		Pass
HT20	MCS 0	1	149	5745	0.08	15.09	30.00	4.51		Pass
HT20	MCS 0	1	157	5785	0.08	15.40	30.00	4.51		Pass
HT20	MCS 0	1	165	5825	0.08	15.44	30.00	4.51		Pass

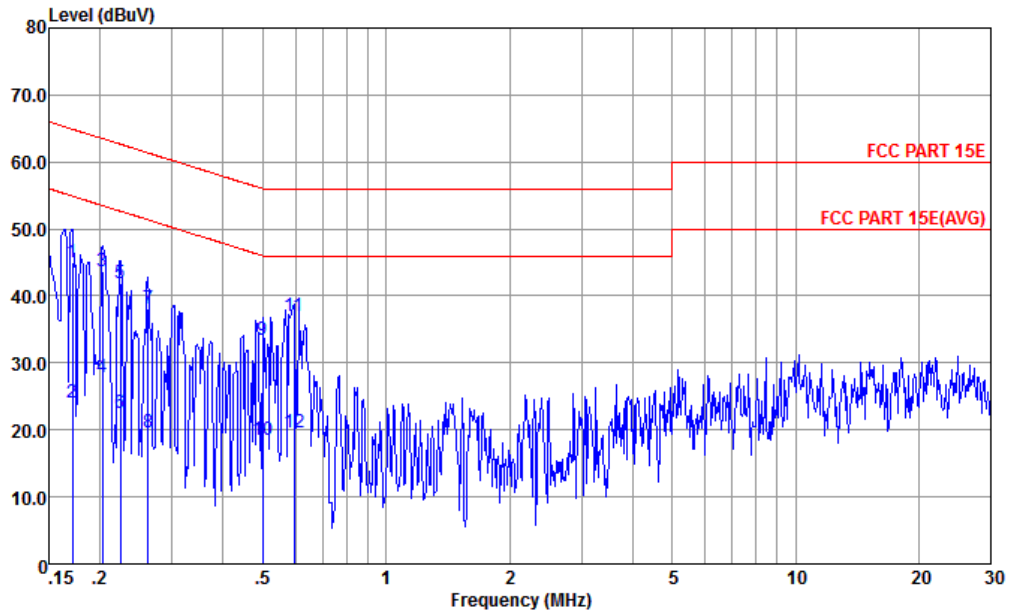
**TEST RESULTS DATA**  
**Power Spectral Density**

U-NII-3										
Mod.	Data Rate	N <sub>TX</sub>	CH.	Freq. (MHz)	Duty Factor (dB)	10log (500kHz /RBW) Factor (dB)	Average Power Density (dBm/500kHz)	Average PSD Limit (dBm/500kHz)	DG (dBi)	Pass/Fail
11a	6M bps	1	149	5745	0.08	2.22	1.19	30.00	4.51	Pass
11a	6Mbps	1	157	5785	0.08	2.22	-0.26	30.00	4.51	Pass
11a	6Mbps	1	165	5825	0.08	2.22	1.32	30.00	4.51	Pass
HT20	MCS 0	1	149	5745	0.08	2.22	0.60	30.00	4.51	Pass
HT20	MCS 0	1	157	5785	0.08	2.22	1.17	30.00	4.51	Pass
HT20	MCS 0	1	165	5825	0.08	2.22	1.17	30.00	4.51	Pass



## Appendix B. AC Conducted Emission Test Results

Test Engineer :	Amos Zhang	Temperature :	24.2~25.6°C
		Relative Humidity :	37~39%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		

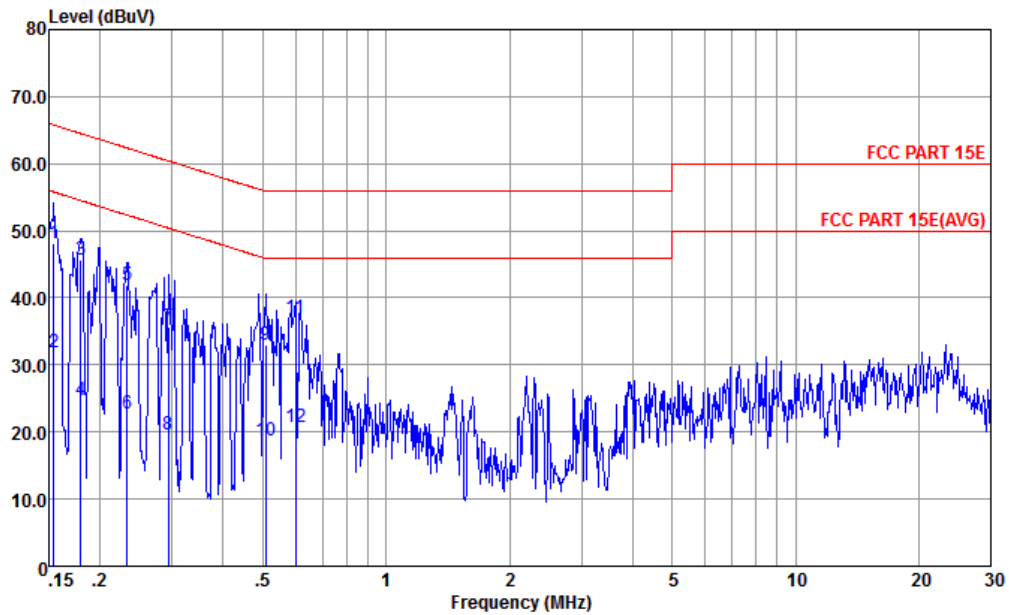


Site : CO01-KS  
 Condition : FCC PART 15E LISN-060105-L LINE

	Freq	Level	Over	Limit	Read	LISN	Cable	Remark
	MHz	dBuV	Limit	Line	Level	Factor	Loss	
			dB	dBuV	dBuV	dB	dB	
1	0.171	45.06	-19.84	64.90	34.60	0.03	10.43	QP
2	0.171	23.96	-30.94	54.90	13.50	0.03	10.43	Average
3	0.203	43.60	-19.89	63.49	33.20	0.04	10.36	QP
4	0.203	27.90	-25.59	53.49	17.50	0.04	10.36	Average
5	0.224	42.00	-20.66	62.66	31.60	0.05	10.35	QP
6	0.224	22.60	-30.06	52.66	12.20	0.05	10.35	Average
7	0.262	38.19	-23.19	61.38	27.80	0.06	10.33	QP
8	0.262	19.59	-31.79	51.38	9.20	0.06	10.33	Average
9	0.499	33.53	-22.48	56.01	23.20	0.10	10.23	QP
10	0.499	18.53	-27.48	46.01	8.20	0.10	10.23	Average
11 *	0.595	36.94	-19.06	56.00	26.59	0.11	10.24	QP
12	0.595	19.64	-26.36	46.00	9.29	0.11	10.24	Average



Test Engineer :	Amos Zhang	Temperature :	24.2~25.6°C
		Relative Humidity :	37~39%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



Site : CO01-KS  
 Condition : FCC PART 15E LISN-060105-N NEUTRAL

	Freq	Level	Over	Limit	Read	LISN	Cable	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1 *	0.154	48.18	-17.60	65.78	37.60	0.11	10.47	QP
2	0.154	31.78	-24.00	55.78	21.20	0.11	10.47	Average
3	0.180	45.71	-18.79	64.50	35.20	0.10	10.41	QP
4	0.180	24.71	-29.79	54.50	14.20	0.10	10.41	Average
5	0.233	41.94	-20.41	62.35	31.50	0.10	10.34	QP
6	0.233	22.64	-29.71	52.35	12.20	0.10	10.34	Average
7	0.294	35.61	-24.80	60.41	25.20	0.10	10.31	QP
8	0.294	19.71	-30.70	50.41	9.30	0.10	10.31	Average
9	0.507	32.95	-23.05	56.00	22.60	0.11	10.24	QP
10	0.507	18.65	-27.35	46.00	8.30	0.11	10.24	Average
11	0.601	36.95	-19.05	56.00	26.60	0.11	10.24	QP
12	0.601	20.65	-25.35	46.00	10.30	0.11	10.24	Average

Note:

- Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
- Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)





## Appendix C. Radiated Spurious Emission

### UNII-3\_5725~5850MHz

#### WIFI 802.11a (Band Edge @ 3m)

WIFI Ant.	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
1		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
802.11a CH 149 5745MHz		5636.4	55.69	-12.61	68.3	42.94	34.57	10.28	32.1	294	187	P	H
		5674.4	54.74	-31.66	86.4	41.87	34.65	10.3	32.08	294	187	P	H
		5720	60.98	-49.92	110.9	47.84	34.83	10.35	32.04	294	187	P	H
		5724.4	65.13	-55.8	120.93	51.99	34.83	10.35	32.04	294	187	P	H
		5752	106.69	-	-	93.4	34.93	10.37	32.01	294	187	P	H
		5752	99.08	-	-	85.79	34.93	10.37	32.01	294	187	A	H
		5645.2	54.24	-14.06	68.3	41.49	34.57	10.28	32.1	370	63	P	V
		5699.2	55.7	-49.01	104.71	42.74	34.7	10.32	32.06	370	63	P	V
		5720	62.82	-48.08	110.9	49.68	34.83	10.35	32.04	370	63	P	V
		5724.4	67.06	-53.87	120.93	53.92	34.83	10.35	32.04	370	63	P	V
		5746	108.18	-	-	94.93	34.9	10.36	32.01	370	63	P	V
		5746	100.75	-	-	87.5	34.9	10.36	32.01	370	63	A	V
802.11a CH 165 5825MHz		5830	108.61	-	-	95	35.13	10.43	31.95	337	201	P	H
		5830	100.62	-	-	87.01	35.13	10.43	31.95	337	201	A	H
		5851.6	63.92	-54.73	118.65	50.21	35.2	10.44	31.93	337	201	P	H
		5856.4	60.11	-50.4	110.51	46.35	35.23	10.46	31.93	337	201	P	H
		5907.2	57.05	-24.39	81.44	43.18	35.33	10.51	31.97	337	201	P	H
		5982.4	56.56	-11.74	68.3	42.63	35.4	10.56	32.03	337	201	P	H
		5824	110.66	-	-	97.05	35.13	10.43	31.95	366	74	P	V
		5824	102.2	-	-	88.59	35.13	10.43	31.95	366	74	A	V
		5850	64.8	-57.5	122.3	51.09	35.2	10.44	31.93	366	74	P	V
		5855.2	62.4	-48.44	110.84	48.64	35.23	10.46	31.93	366	74	P	V
		5905.2	57.77	-25.14	82.91	43.9	35.33	10.51	31.97	366	74	P	V
		5958	56.33	-11.97	68.3	42.39	35.4	10.55	32.01	366	74	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



UNII-3\_5725~5850MHz
WIFI 802.11a (Harmonic @ 3m)

Table with 14 columns: WIFI Ant. 1, Note, Frequency (MHz), Level (dBµV/m), Over Limit (dB), Limit Line (dBµV/m), Read Level (dBµV), Antenna Factor (dB/m), Path Loss (dB), Preamp Factor (dB), Ant Pos (cm), Table Pos (deg), Peak Avg. (P/A), Pol. (H/V). Rows include channels 149, 157, and 165 at various frequencies.



**UNII-3\_5725~5850MHz**  
**WIFI 802.11n HT20 (Band Edge @ 3m)**

WIFI Ant. 1	Note	Frequency ( MHz )	Level ( dBμV/m )	Over Limit ( dB )	Limit Line ( dBμV/m )	Read Level ( dBμV )	Antenna Factor ( dB/m )	Path Loss ( dB )	Preamp Factor ( dB )	Ant Pos ( cm )	Table Pos ( deg )	Peak Avg. ( P/A )	Pol. ( H/V )
802.11n HT20 CH 149 5745MHz		5614.8	54.71	-13.59	68.3	42.04	34.5	10.25	32.08	170	206	P	H
		5678	54.48	-34.58	89.06	41.61	34.65	10.3	32.08	170	206	P	H
		5720	64.61	-46.29	110.9	51.47	34.83	10.35	32.04	170	206	P	H
		5723.2	68.15	-50.05	118.2	55.01	34.83	10.35	32.04	170	206	P	H
		5740	107.84	-	-	94.59	34.9	10.36	32.01	170	206	P	H
		5740	100.04	-	-	86.79	34.9	10.36	32.01	170	206	A	H
		5603.6	54.95	-13.35	68.3	42.28	34.5	10.25	32.08	364	65	P	V
		5693.2	54.15	-46.14	100.29	41.19	34.7	10.32	32.06	364	65	P	V
		5720	61.53	-49.37	110.9	48.39	34.83	10.35	32.04	364	65	P	V
		5724.8	68.83	-53.01	121.84	55.69	34.83	10.35	32.04	364	65	P	V
		5746	108.4	-	-	95.15	34.9	10.36	32.01	364	65	P	V
		5746	100.09	-	-	86.84	34.9	10.36	32.01	364	65	A	V
802.11n HT20 CH 165 5825MHz		5824	110	-	-	96.39	35.13	10.43	31.95	317	199	P	H
		5824	101.43	-	-	87.82	35.13	10.43	31.95	317	199	A	H
		5850.4	64.62	-56.77	121.39	50.91	35.2	10.44	31.93	317	199	P	H
		5855.2	61.35	-49.49	110.84	47.59	35.23	10.46	31.93	317	199	P	H
		5898.4	56.17	-31.78	87.95	42.35	35.3	10.49	31.97	317	199	P	H
		5944.8	57.34	-10.96	68.3	43.42	35.4	10.53	32.01	317	199	P	H
		5824	110.24	-	-	96.63	35.13	10.43	31.95	364	75	P	V
		5824	101.91	-	-	88.3	35.13	10.43	31.95	364	75	A	V
		5850.4	65.01	-56.38	121.39	51.3	35.2	10.44	31.93	364	75	P	V
		5856.8	63.58	-46.82	110.4	49.82	35.23	10.46	31.93	364	75	P	V
	5910.4	56.54	-22.53	79.07	42.69	35.33	10.51	31.99	364	75	P	V	
	5957.2	55.67	-12.63	68.3	41.73	35.4	10.55	32.01	364	75	P	V	
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



**UNII-3\_5725~5850MHz**  
**WIFI 802.11n HT20 (Harmonic @ 3m)**

WIFI Ant. 1	Note	Frequency ( MHz )	Level ( dBμV/m )	Over Limit ( dB )	Limit Line ( dBμV/m )	Read Level ( dBμV )	Antenna Factor ( dB/m )	Path Loss ( dB )	Preamp Factor ( dB )	Ant Pos ( cm )	Table Pos ( deg )	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 149 5745MHz		11488	49.07	-24.93	74	57	38.68	14.91	61.52	300	0	P	H
		11488	54.94	-19.06	74	62.87	38.68	14.91	61.52	322	349	P	V
		11488	45.46	-8.54	54	53.39	38.68	14.91	61.52	322	349	A	V
802.11n HT20 CH 157 5785MHz		11576	49.73	-24.27	74	57.55	38.7	14.97	61.49	300	0	P	H
		11565	53.87	-20.13	74	61.71	38.7	14.96	61.5	100	0	P	V
		11565	43.93	-10.07	54	51.77	38.7	14.96	61.5	100	0	A	V
802.11n HT20 CH 165 5825MHz		11653	48.66	-25.34	74	56.4	38.7	15.03	61.47	300	0	P	H
		11653	56.51	-17.49	74	64.25	38.7	15.03	61.47	376	324	P	V
		11653	45.56	-8.44	54	53.3	38.7	15.03	61.47	376	324	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Emission below 1GHz

WIFI 802.11a (LF @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
802.11a LF		30	23.62	-16.38	40	29.25	25.15	0.45	31.23	-	-	P	H
		74.62	21.95	-18.05	40	39.88	12.91	1.02	31.86	-	-	P	H
		140.58	26.68	-16.82	43.5	39.77	16.75	1.58	31.42	-	-	P	H
		165.8	25.82	-17.68	43.5	39.19	16.24	1.72	31.33	-	-	P	H
		244.37	31.99	-14.01	46	43.02	18.22	2.11	31.36	-	-	P	H
		353.98	25.92	-20.08	46	34.5	20.51	2.53	31.62	-	-	P	H
		37.76	34.82	-5.18	40	44.68	21.1	0.56	31.52	100	0	P	V
		55.22	30.86	-9.14	40	47.14	14.2	0.78	31.26	-	-	P	V
		139.61	24.89	-18.61	43.5	37.12	17.63	1.57	31.43	-	-	P	V
		175.5	28.06	-15.44	43.5	40.72	16.89	1.78	31.33	-	-	P	V
		246.31	28.78	-17.22	46	38.86	19.16	2.12	31.36	-	-	P	V
		353.01	26.13	-19.87	46	33.75	21.48	2.53	31.63	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												



**Note symbol**

*	<b>Fundamental Frequency</b> which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is <b>over limit</b> line.
P/A	<b>Peak</b> or <b>Average</b>
H/V	<b>Horizontal</b> or <b>Vertical</b>



A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
802.11b		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 01													
2412MHz		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) = Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

**For Peak Limit @ 2390MHz:**

1. Level(dBμV/m)  
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)  
= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)  
= 55.45 (dBμV/m)
2. Over Limit(dB)  
= Level(dBμV/m) – Limit Line(dBμV/m)  
= 55.45(dBμV/m) – 74(dBμV/m)  
= -18.55(dB)

**For Average Limit @ 2390MHz:**

1. Level(dBμV/m)  
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)  
= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)  
= 43.54 (dBμV/m)
2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)  
= 43.54(dBμV/m) – 54(dBμV/m)  
= -10.46(dB)

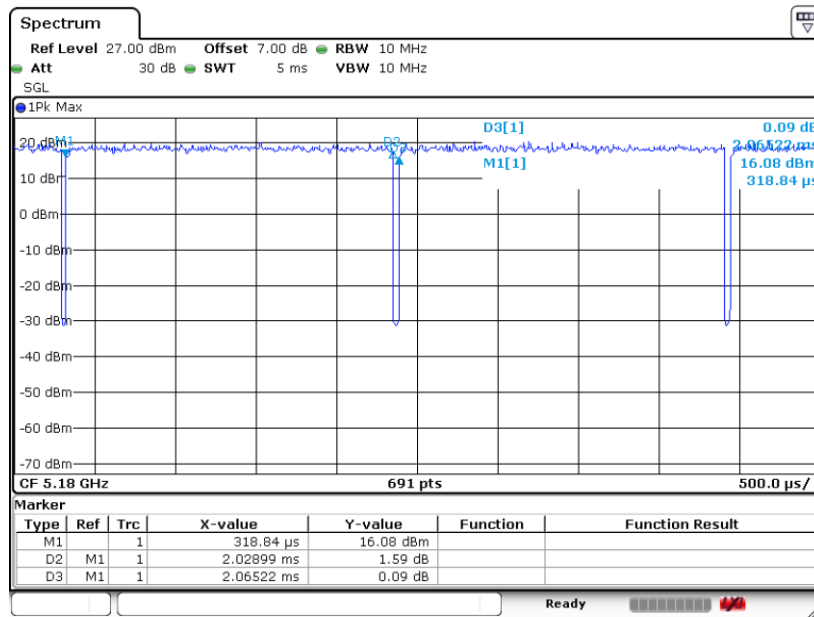
**Both peak and average measured complies with the limit line, so test result is “PASS”.**



## Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
802.11a	98.25	-	-	10Hz
802.11n HT20	98.12	-	-	10Hz

### 802.11a

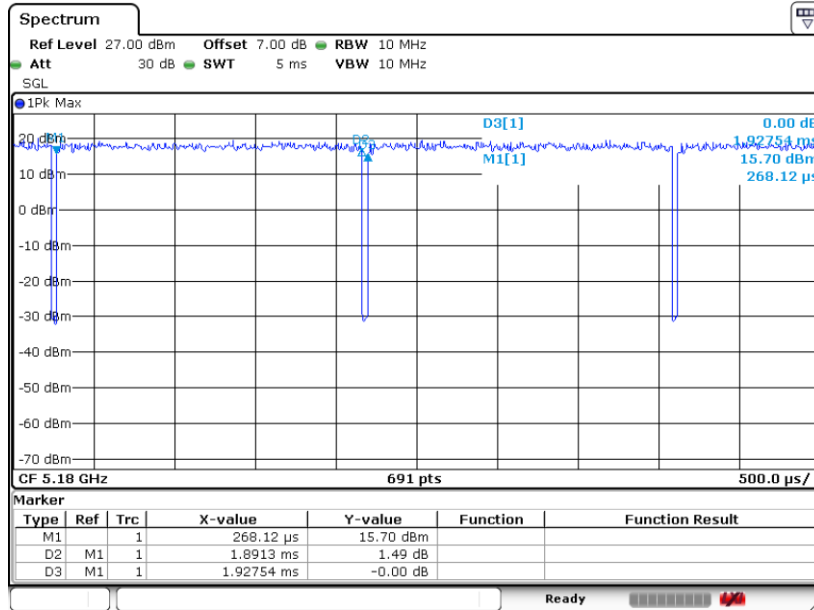


Date: 20.DEC.2021 21:21:40





802.11n HT20



Date: 20.DEC.2021 21:56:04