



# FCC RF Test Report

APPLICANT : Opticon Sensors Europe B.V  
EQUIPMENT : Mobile computers  
BRAND NAME : Opticon  
MODEL NAME : H-33  
FCC ID : Q2QH33NCSA  
STANDARD : FCC Part 15 Subpart E §15.407  
CLASSIFICATION : (NII) Unlicensed National Information Infrastructure

The product was received on Aug. 27, 2019 and testing was completed on Nov. 19, 2019. We, Sporton International (Kunshan) Inc., 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 (Kunshan) Inc., the test report shall not be reproduced except in full.

Jason Jia

Reviewed by: Jason Jia / Supervisor

James Huang

Approved by: James Huang / Manager



**Sporton International (Kunshan) Inc.**

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



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## REVISION HISTORY

| REPORT NO. | VERSION | DESCRIPTION             | ISSUED DATE   |
|------------|---------|-------------------------|---------------|
| FR982718E  | Rev. 01 | Initial issue of report | Mar. 04, 2019 |
|            |         |                         |               |
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## SUMMARY OF TEST RESULT

| Report Section | FCC Rule           | Description                            | Limit                    | Result | Remark                              |
|----------------|--------------------|----------------------------------------|--------------------------|--------|-------------------------------------|
| 3.1            | 2.1049 & 15.403(i) | 26dB & 99% Bandwidth                   | -                        | Pass   | -                                   |
| 3.2            | 15.407(a)          | Maximum Conducted Output Power         | $\leq 24$ dBm            | Pass   | -                                   |
| 3.3            | 15.407(a)          | Power Spectral Density                 | $\leq 11$ dBm            | Pass   | -                                   |
| 3.4            | 15.407(b)          | Unwanted Emissions                     | 15.407(b) & 15.209(a)    | Pass   | Under limit 5.03 dB at 5149.980 MHz |
| 3.5            | 15.207             | AC Conducted Emission                  | 15.207(a)                | Pass   | Under limit 13.93 dB at 0.199 MHz   |
| 3.6            | 15.407(c)          | Automatically Discontinue Transmission | Discontinue Transmission | Pass   | -                                   |
| 3.7            | 15.203 & 15.407(a) | Antenna Requirement                    | N/A                      | Pass   | -                                   |

### Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

### Comments and Explanations:

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

Opticon Sensors Europe B.V

Opaallaan 35, 2132 XV Hoofddorp, The Netherlands.

## 1.2 Manufacturer

iWaylink Inc.

6F., No. 288, Sec. 6, Civic Blvd., Xinyi Dist., Taipei City 110, Taiwan (R.O.C.)

## 1.3 Product Feature of Equipment Under Test

| Product Feature                 |                                                                                                                                                                 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Equipment                       | Mobile computers                                                                                                                                                |
| Brand Name                      | Opticon                                                                                                                                                         |
| Model Name                      | H-33                                                                                                                                                            |
| FCC ID                          | Q2QH33NCSA                                                                                                                                                      |
| EUT supports Radios application | GSM/WCDMA/LTE/NFC/GNSS<br>WLAN 2.4GHz 802.11b/g/n HT20/HT40<br>WLAN 5GHz 802.11a/n HT20/HT40<br>WLAN 5GHz 802.11ac VHT20/VHT40/VHT80<br>Bluetooth BR / EDR / LE |
| IMEI Code                       | Conducted: N/A<br>Conduction: 8511193300138<br>Radiation: N/A                                                                                                   |
| HW Version                      | V1.02                                                                                                                                                           |
| SW Version                      | PR02.191205.001                                                                                                                                                 |

**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 |                                                                                                                                                                                                                                                                               |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Tx/Rx Frequency Range</b>            | 5180 MHz ~ 5240 MHz                                                                                                                                                                                                                                                           |
| <b>Maximum Output Power to Antenna</b>  | <b>&lt;5180 MHz ~ 5240 MHz&gt;</b><br>802.11a : 14.07 dBm / 0.0255 W<br>802.11n HT20 : 13.00 dBm / 0.0200 W<br>802.11n HT40 : 13.20 dBm / 0.0209 W<br>802.11ac VHT20 : 12.15 dBm / 0.0164 W<br>802.11ac VHT40 : 12.05 dBm / 0.0160 W<br>802.11ac VHT80 : 12.06 dBm / 0.0161 W |
| <b>99% Occupied Bandwidth</b>           | 802.11a : 18.43 MHz<br>802.11n HT20 : 19.18 MHz<br>802.11n HT40 : 36.66 MHz<br>802.11ac VHT80 : 74.69 MHz                                                                                                                                                                     |
| <b>Antenna Type / Gain</b>              | <b>&lt;5150 MHz ~ 5250 MHz&gt;</b><br>FPC Antenna with gain 2.08 dBi                                                                                                                                                                                                          |
| <b>Type of Modulation</b>               | 802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)<br>802.11ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)                                                                                                                                                                      |

**Remark:** For 802.11n HT20 / ac VHT20 and 802.11n HT40 / ac VHT40 mode, the whole testing have assessed only 802.11n HT20/HT40by referring to the higher output power.

## 1.5 Modification of EUT

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

## 1.6 Testing Location

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

|                           |                                                                                                                                                                          |                            |                                       |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------------------------|
| <b>Test Firm</b>          | Sporton International (Kunshan) Inc.                                                                                                                                     |                            |                                       |
| <b>Test Site Location</b> | No. 1098, Pengxi North Road, Kunshan Economic Development Zone<br>Jiangsu Province 215300 People's Republic of China<br>TEL : +86-512-57900158<br>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<br>03CH05-KS<br>TH01-KS                                                                                                                                          | CN1257                     | 314309                                |



## 1.7 Test Software

| Item | Site      | Manufacture | Name | Version       |
|------|-----------|-------------|------|---------------|
| 1.   | 03CH05-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 (X 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) |
|--------------------------------------|-----------------|-------------|---------|-------------|
| 5150-5250 MHz<br>Band 1<br>(U-NII-1) | 36              | 5180        | 44      | 5220        |
|                                      | 38*             | 5190        | 46*     | 5230        |
|                                      | 40              | 5200        | 48      | 5240        |
|                                      | 42 <sup>#</sup> | 5210        |         |             |

**Note:**

1. The above Frequency and Channel in "\*" were 802.11n HT40 and 802.11ac VHT40.
2. The above Frequency and Channel in "<sup>#</sup>" were 802.11ac VHT80.

## 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      |
| 802.11n HT40   | MCS0      |
| 802.11ac VHT80 | MCS0      |

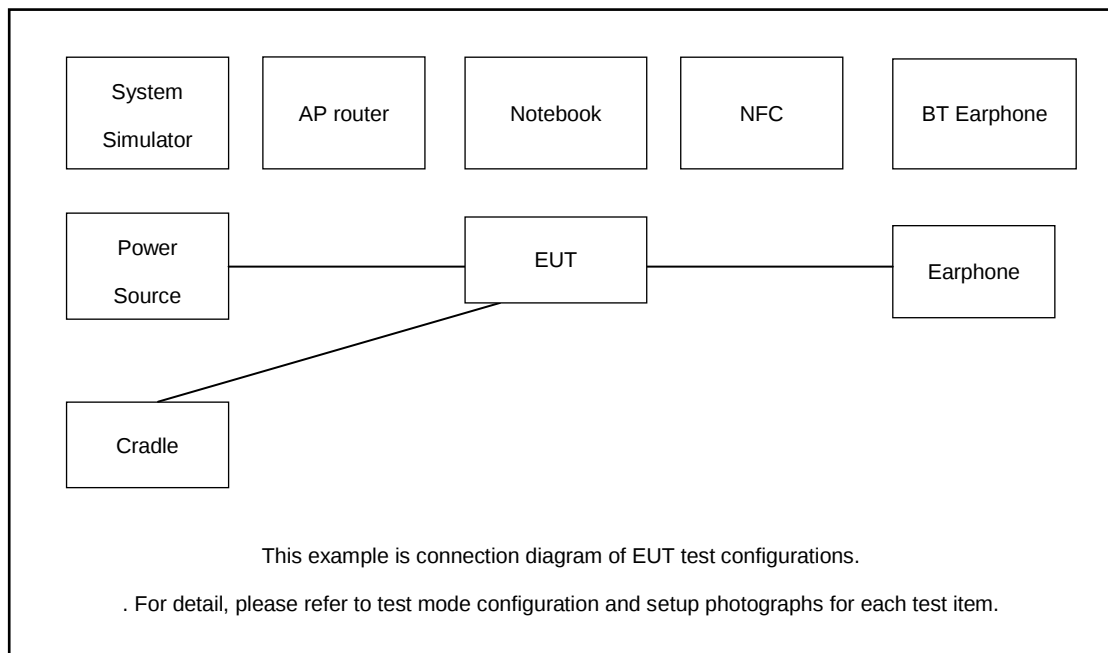
| Test Cases                  |                                                                            |
|-----------------------------|----------------------------------------------------------------------------|
| AC<br>Conducted<br>Emission | Mode 1 : GSM850 Idle + Bluetooth Link + WLAN Link (5G) + Cradle + Earphone |

| Ch. # |        | Band I : 5150-5250 MHz |
|-------|--------|------------------------|
|       |        | 802.11ac VHT20         |
| L     | Low    | 36                     |
| M     | Middle | 44                     |
| H     | High   | 48                     |

| Ch. # |        | Band I : 5150-5250 MHz |
|-------|--------|------------------------|
|       |        | 802.11ac VHT40         |
| L     | Low    | 38                     |
| M     | Middle | -                      |
| H     | High   | 46                     |

| Ch. # |        | Band I : 5150-5250 MHz |
|-------|--------|------------------------|
|       |        | 802.11ac VHT80         |
| L     | Low    | -                      |
| M     | Middle | 42                     |
| H     | High   | -                      |

## 2.3 Connection Diagram of Test System



## 2.4 Support Unit used in test configuration and system

| Item | Equipment          | Trade Name | Model Name | FCC ID        | Data Cable | Power Cord                                                   |
|------|--------------------|------------|------------|---------------|------------|--------------------------------------------------------------|
| 1.   | LTE Base Station   | Anritsu    | MT8820C    | N/A           | N/A        | Unshielded,1.8m                                              |
| 2.   | Bluetooth Earphone | Lenovo     | LBH308     | N/A           | N/A        | N/A                                                          |
| 3.   | Notebook           | Lenovo     | G480       | QDS-BRCM1050I | N/A        | shielded cable DC O/P 1.8m ,<br>Unshielded AC I/P cable 1.8m |
| 4.   | WLAN AP            | D-link     | DIR-655    | KA21R655B1    | N/A        | Unshielded,1.8m                                              |
| 5.   | SD Card            | Kingston   | SDC4/4GB   | N/A           | N/A        | N/A                                                          |



## 2.5 EUT Operation Test Setup

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

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 5.9 dB attenuator.

$$\begin{aligned}\text{Offset(dB)} &= \text{RF cable loss(dB)} \\ &= 5.9 \text{ (dB)}\end{aligned}$$

### 3 Test Result

#### 3.1 26dB & 99% Occupied Bandwidth Measurement

##### 3.1.1 Description of 26dB & 99% Occupied Bandwidth

This section is for reporting purpose only.

There is no restriction limits for bandwidth.

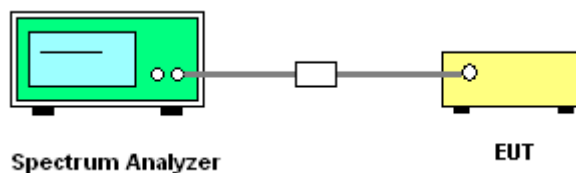
##### 3.1.2 Measuring Instruments

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

##### 3.1.3 Test Procedures

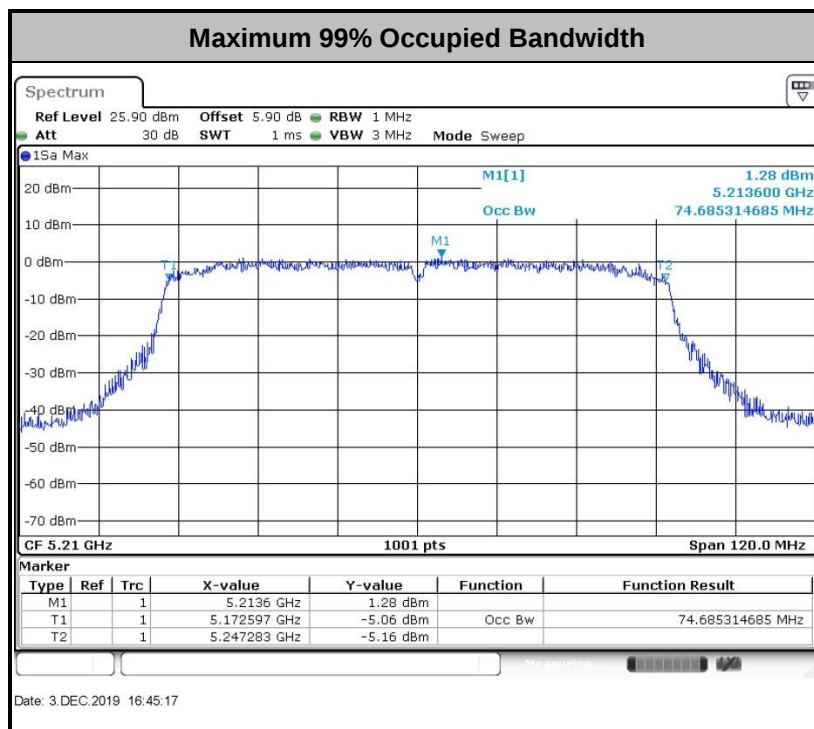
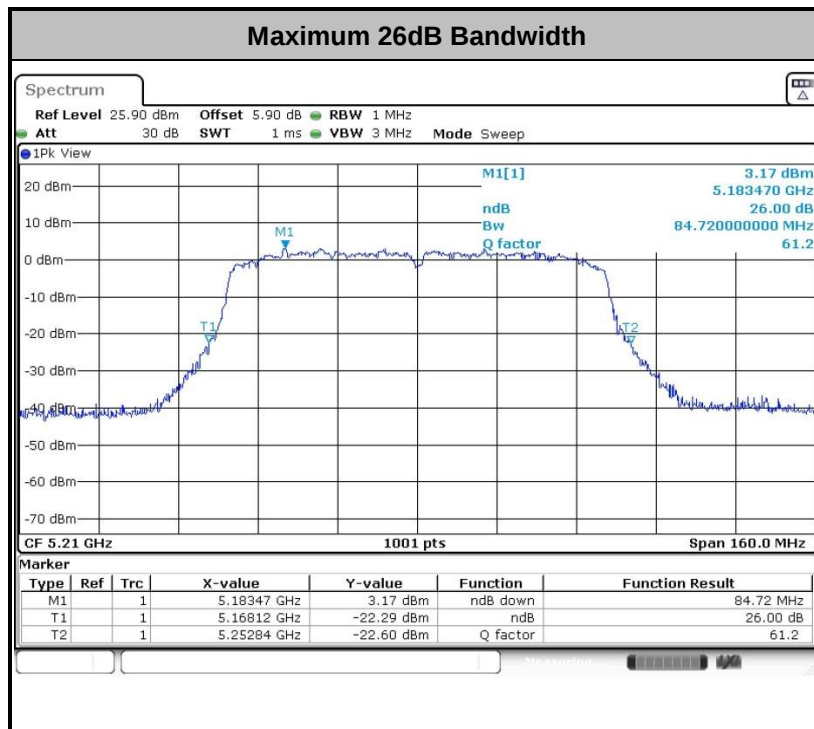
1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section C) Emission bandwidth
2. Set RBW = approximately 1% of the emission bandwidth.
3. Set the VBW > RBW.
4. Detector = Peak.
5. Trace mode = max hold
6. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.
7. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1MHz and set the Video bandwidth (VBW)  $\geq 3 * \text{RBW}$ .
8. Measure and record the results in the test report.

##### 3.1.4 Test Setup



##### 3.1.5 Test Result of 26dB & 99% Occupied 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

#### <FCC 14-30 CFR 15.407>

For mobile and portable client devices in the 5.15–5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW.

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.

Note that U-NII-2 band, devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

### 3.2.2 Measuring Instruments

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

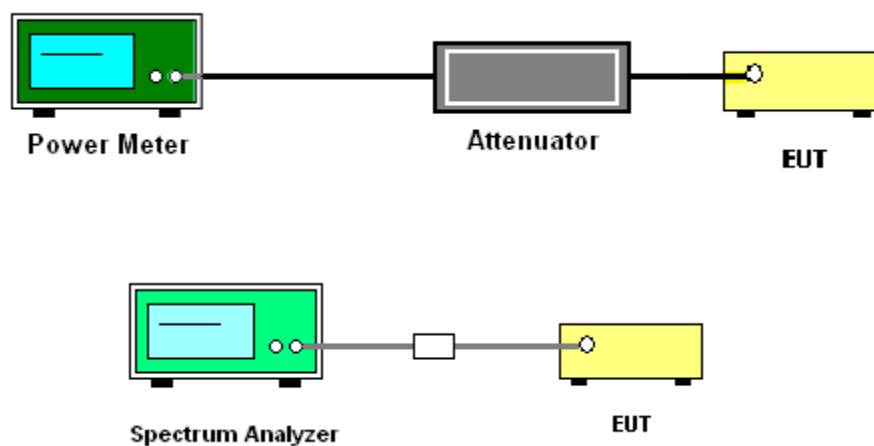
### 3.2.3 Test Procedures

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

**<FCC 14-30 CFR 15.407>**

For mobile and portable client devices in the 5.15–5.25 GHz band, the maximum power spectral density shall not exceed 11dBm in any 1 megahertz band.

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

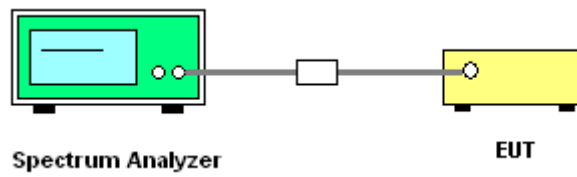
The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.  
Section F) Maximum power spectral density.

**# Method SA-2 #**

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

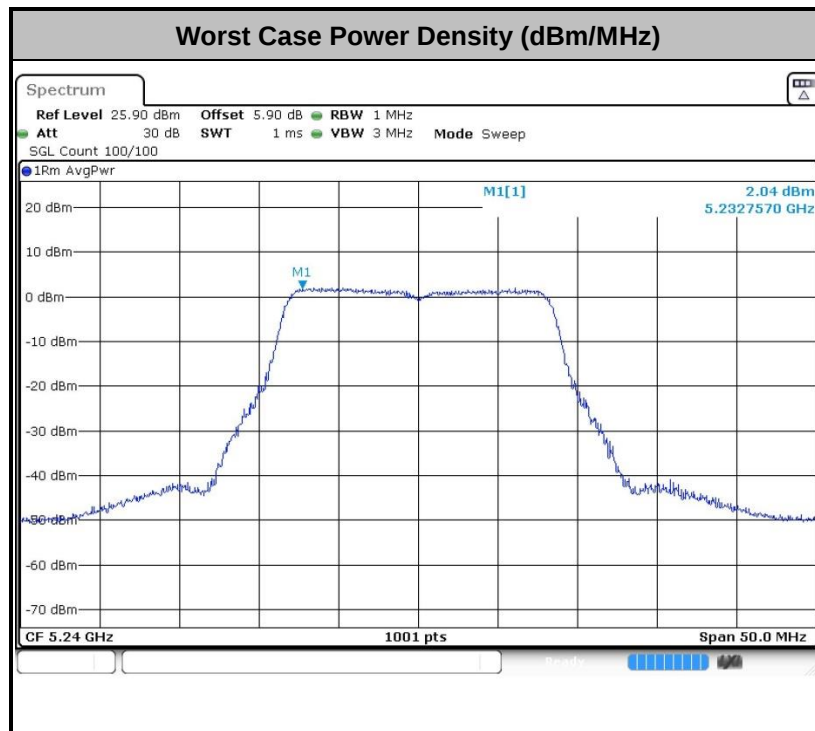
- Measure the duty cycle.
  - Set span to encompass the entire emission bandwidth (EBW) of the signal.
  - Set RBW = 1 MHz.
  - Set VBW  $\geq$  3 MHz.
  - Number of points in sweep  $\geq$  2 Span / RBW.
  - Sweep time = auto.
  - Detector = RMS
  - Trace average at least 100 traces in power averaging mode.
  - Add  $10 \log(1/x)$ , 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 PPSD 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 (dB) = Measured value+ Duty Factor

### 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 5150-5250 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of -27dBm/MHz.
- (2) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below table,

| Frequency<br>(MHz) | Field Strength<br>(microvolts/meter) | Measurement Distance<br>(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.

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

where

EIRP is the equivalent isotropically radiated power, in dBm

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

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

#### 3.4.2 Measuring Instruments

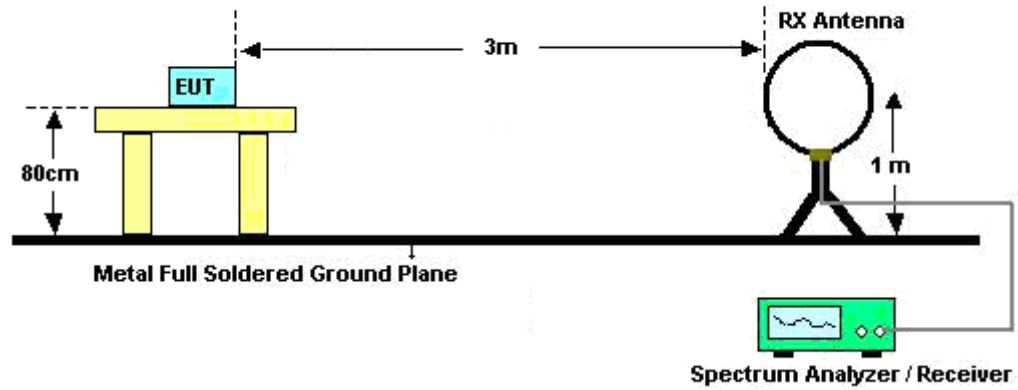
The measuring equipment is listed in the section 4 of this test report.

### 3.4.3 Test Procedures

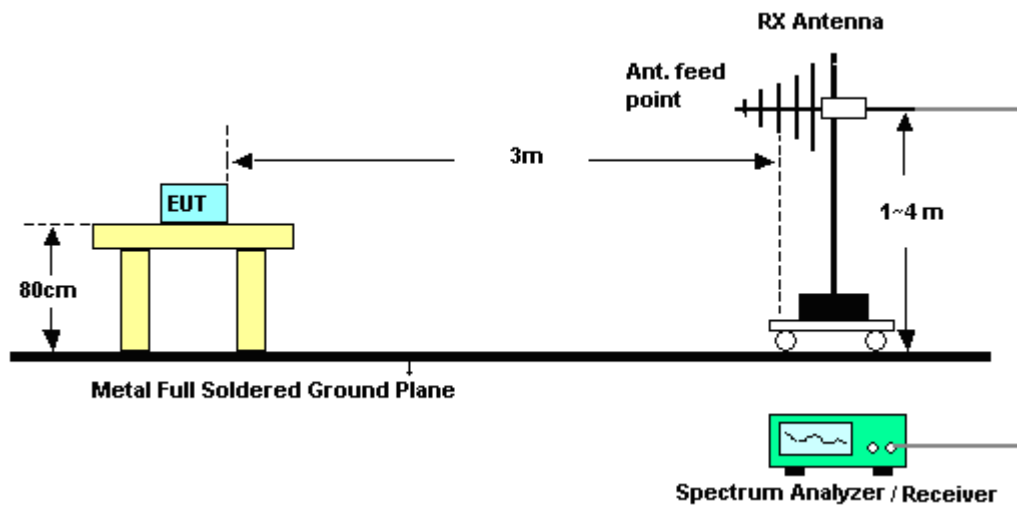
1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.  
Section G) Unwanted emissions measurement.  
  - (1) Procedure for Unwanted Emissions Measurements Below 1000MHz
    - RBW = 120 kHz
    - VBW = 300 kHz
    - Detector = Peak
    - Trace mode = max hold
  - (2) 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 average 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

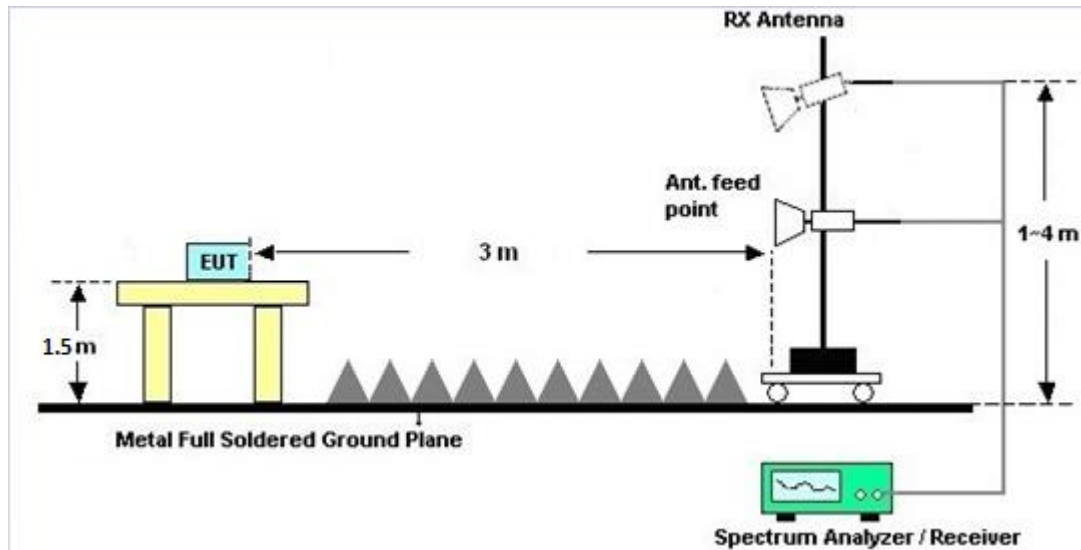
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



### 3.4.5 Test Results of Radiated Spurious 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 Spurious at Band Edges

Please refer to Appendix C.

### 3.4.7 Duty Cycle

Please refer to Appendix D.

### 3.4.8 Test Result of Radiated Spurious Emissions (30MHz ~ 10th Harmonic)

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 (dB $\mu$ V) |           |
|-----------------------------|------------------------------|-----------|
|                             | 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.

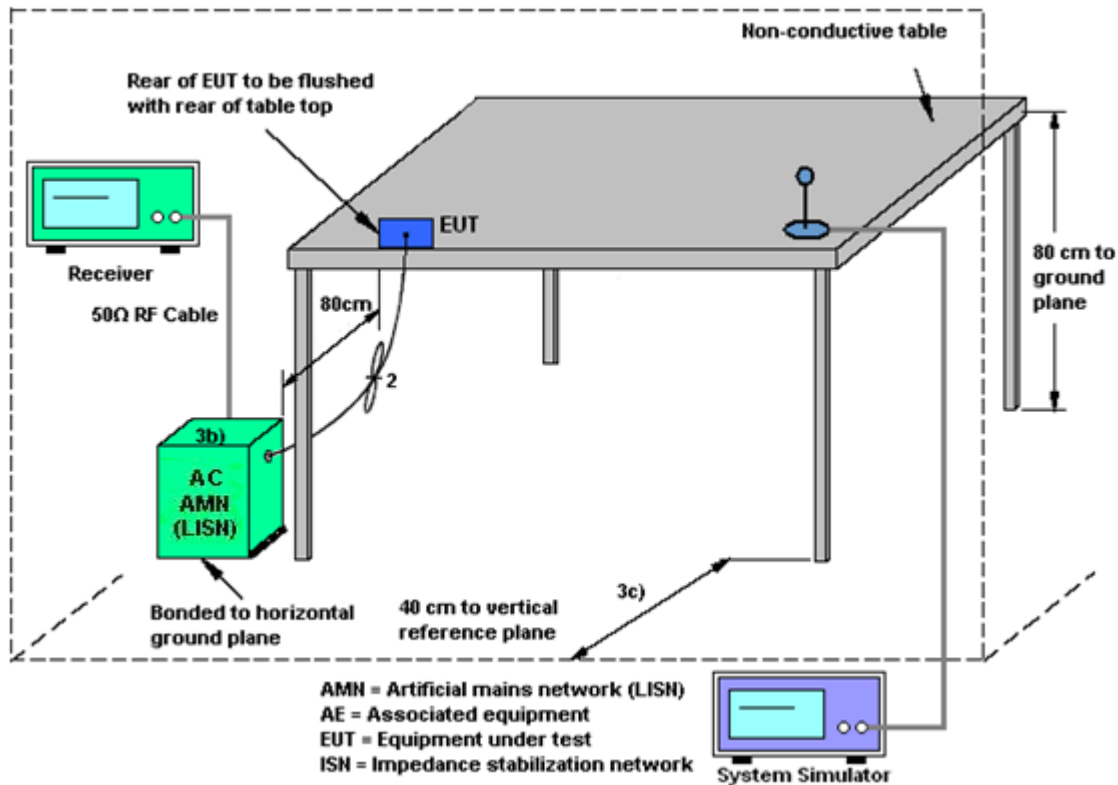
#### 3.5.2 Measuring Instruments

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



### 3.5.5 Test Result of AC Conducted Emission

Please refer to Appendix B.

## 3.6 Automatically Discontinue Transmission

### 3.6.1 Limit of Automatically Discontinue Transmission

The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization to describe how this requirement is met.

### 3.6.2 Measuring Instruments

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

### 3.6.3 Test Result of Automatically Discontinue Transmission

While the EUT is not transmitting any information, the EUT can automatically discontinue transmission and become standby mode for power saving. The EUT can detect the controlling signal of ACK message transmitting from remote device and verify whether it shall resend or discontinue transmission.



## **3.7 Antenna Requirements**

### **3.7.1 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.

### **3.7.2 Antenna Anti-Replacement Construction**

An embedded-in antenna design is used.

### **3.7.3 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              | Aug. 06, 2019    | Nov. 07, 2019 | Aug. 05, 2020 | Conducted (TH01-KS)   |
| Pulse Power Sensor                | Anritsu      | MA2411B                 | 0917070      | 300MHz~40GHz            | Jan. 14, 2019    | Nov. 07, 2019 | Jan. 13, 2020 | Conducted (TH01-KS)   |
| Power Meter                       | Anritsu      | ML2495A                 | 1005002      | 50MHz Bandwidth         | Jan. 14, 2019    | Nov. 07, 2019 | Jan. 13, 2020 | Conducted (TH01-KS)   |
| EMI Test Receiver                 | Keysight     | N9038A                  | MY57290151   | 3Hz~8.5GHz; Max 30dBm   | Jul. 18, 2019    | Nov. 19, 2019 | Jul. 17, 2020 | Radiation (03CH05-KS) |
| EXA Spectrum Analyzer             | Keysight     | N9010A                  | MY55150244   | 10Hz~44G, MAX 30dB      | Apr. 16, 2019    | Nov. 19, 2019 | Apr. 15, 2020 | Radiation (03CH05-KS) |
| Loop Antenna                      | R&S          | HFH2-Z2                 | 100321       | 9kHz~30MHz              | Nov. 10, 2019    | Nov. 19, 2019 | Nov. 09, 2020 | Radiation (03CH05-KS) |
| Bilog Antenna                     | TeseQ        | CBL6111D                | 49922        | 30MHz~1GHz              | May. 30, 2019    | Nov. 19, 2019 | May. 29, 2020 | Radiation (03CH05-KS) |
| Double Ridge Horn Antenna         | ETS-Lindgren | 3117                    | 75959        | 1GHz~18GHz              | Jan. 27, 2019    | Nov. 19, 2019 | Jan. 26, 2020 | Radiation (03CH05-KS) |
| SHF-EHF Horn                      | Com-power    | AH-840                  | 101070       | 18GHz~40GHz             | Jan. 05, 2019    | Nov. 19, 2019 | Jan. 04, 2020 | Radiation (03CH05-KS) |
| Amplifier                         | SONOMA       | 310N                    | 187289       | 9KHz~1GHz               | Aug. 06, 2019    | Nov. 19, 2019 | Aug. 05, 2020 | Radiation (03CH05-KS) |
| Amplifier                         | MITEQ        | TTA1840-35-HG           | 2014749      | 18~40GHz                | Jan. 14, 2019    | Nov. 19, 2019 | Jan. 13, 2020 | Radiation (03CH05-KS) |
| high gain Amplifier               | MITEQ        | AMF-7D-0010 1800-30-10P | 2025788      | 1Ghz~18Ghz              | Aug. 17, 2019    | Nov. 19, 2019 | Aug. 16, 2020 | Radiation (03CH05-KS) |
| Amplifier                         | Keysight     | 83017A                  | MY53270316   | 500MHz~26.5GHz          | Oct. 18, 2019    | Nov. 19, 2019 | Oct. 17, 2020 | Radiation (03CH05-KS) |
| AC Power Source                   | Chroma       | 61601                   | F104090004   | N/A                     | NCR              | Nov. 19, 2019 | NCR           | Radiation (03CH05-KS) |
| Turn Table                        | ChamPro      | EM 1000-T               | 060762-T     | 0~360 degree            | NCR              | Nov. 19, 2019 | NCR           | Radiation (03CH05-KS) |
| Antenna Mast                      | ChamPro      | EM 1000-A               | 060762-A     | 1 m~4 m                 | NCR              | Nov. 19, 2019 | NCR           | Radiation (03CH05-KS) |
| EMI Receiver                      | R&S          | ESCI7                   | 100768       | 9kHz~7GHz;              | Apr. 16, 2019    | Nov. 11, 2019 | Apr. 15, 2020 | Conduction (CO01-KS)  |
| AC LISN (for auxiliary equipment) | MessTec      | AN3016                  | 060103       | 9kHz~30MHz              | Oct. 18, 2019    | Nov. 11, 2019 | Oct. 17, 2020 | Conduction (CO01-KS)  |
| AC LISN                           | MessTec      | AN3016                  | 060105       | 9kHz~30MHz              | Oct. 28, 2019    | Nov. 11, 2019 | Oct. 27, 2020 | Conduction (CO01-KS)  |
| AC Power Source                   | Chroma       | 61602                   | ABP000000811 | AC 0V~300V, 45Hz~1000Hz | Oct. 18, 2019    | Nov. 11, 2019 | Oct. 17, 2020 | 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 Emission Measurement (150kHz ~ 30MHz)

|                                                                         |       |
|-------------------------------------------------------------------------|-------|
| Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ ) | 2.9dB |
|-------------------------------------------------------------------------|-------|

### 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 |
|-------------------------------------------------------------------------|-------|



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

|                |           |                    |       |    |
|----------------|-----------|--------------------|-------|----|
| Test Engineer: | Aly Cao   | Temperature:       | 21~25 | °C |
| Test Date:     | 2019/11/7 | Relative Humidity: | 51~54 | %  |

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

| Band I |           |     |     |             |                     |                       |                                    |                                   |  |  |
|--------|-----------|-----|-----|-------------|---------------------|-----------------------|------------------------------------|-----------------------------------|--|--|
| Mod.   | Data Rate | NTX | CH. | Freq. (MHz) | 99% Bandwidth (MHz) | 26 dB Bandwidth (MHz) | IC 99% Bandwidth Power Limit (dBm) | IC 99% Bandwidth EIRP Limit (dBm) |  |  |
| 11a    | 6Mbps     | 1   | 36  | 5180        | 18.23               | 23.28                 | -                                  | 22.61                             |  |  |
| 11a    | 6Mbps     | 1   | 44  | 5220        | 18.43               | 23.78                 | -                                  | 22.66                             |  |  |
| 11a    | 6Mbps     | 1   | 48  | 5240        | 18.28               | 23.58                 | -                                  | 22.62                             |  |  |
| HT20   | MCS0      | 1   | 36  | 5180        | 19.08               | 23.88                 | -                                  | 22.81                             |  |  |
| HT20   | MCS0      | 1   | 44  | 5220        | 19.18               | 23.73                 | -                                  | 22.83                             |  |  |
| HT20   | MCS0      | 1   | 48  | 5240        | 19.13               | 23.73                 | -                                  | 22.82                             |  |  |
| HT40   | MCS0      | 1   | 38  | 5190        | 36.66               | 44.78                 | -                                  | 23.01                             |  |  |
| HT40   | MCS0      | 1   | 46  | 5230        | 36.46               | 44.42                 | -                                  | 23.01                             |  |  |
| VHT80  | MCS0      | 1   | 42  | 5210        | 74.69               | 84.72                 | -                                  | 23.01                             |  |  |

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

| FCC Band I |           |     |     |             |                  |                               |                                 |          |  |           |
|------------|-----------|-----|-----|-------------|------------------|-------------------------------|---------------------------------|----------|--|-----------|
| Mod.       | Data Rate | NTX | CH. | Freq. (MHz) | Duty Factor (dB) | Average Conducted Power (dBm) | FCC Conducted Power Limit (dBm) | DG (dBi) |  | Pass/Fail |
| 11a        | 6Mbps     | 1   | 36  | 5180        | 0.58             | 13.72                         | 24.00                           | 2.08     |  | Pass      |
| 11a        | 6Mbps     | 1   | 44  | 5220        | 0.58             | 14.07                         | 24.00                           | 2.08     |  | Pass      |
| 11a        | 6Mbps     | 1   | 48  | 5240        | 0.58             | 13.99                         | 24.00                           | 2.08     |  | Pass      |
| HT20       | MCS0      | 1   | 36  | 5180        | 0.62             | 12.56                         | 24.00                           | 2.08     |  | Pass      |
| HT20       | MCS0      | 1   | 44  | 5220        | 0.62             | 12.99                         | 24.00                           | 2.08     |  | Pass      |
| HT20       | MCS0      | 1   | 48  | 5240        | 0.62             | 13.00                         | 24.00                           | 2.08     |  | Pass      |
| HT40       | MCS0      | 1   | 38  | 5190        | 0.63             | 12.88                         | 24.00                           | 2.08     |  | Pass      |
| HT40       | MCS0      | 1   | 46  | 5230        | 0.63             | 13.20                         | 24.00                           | 2.08     |  | Pass      |
| VHT20      | MCS0      | 1   | 36  | 5180        | 0.82             | 11.73                         | 24.00                           | 2.08     |  | Pass      |
| VHT20      | MCS0      | 1   | 44  | 5220        | 0.82             | 12.15                         | 24.00                           | 2.08     |  | Pass      |
| VHT20      | MCS0      | 1   | 48  | 5240        | 0.82             | 12.09                         | 24.00                           | 2.08     |  | Pass      |
| VHT40      | MCS0      | 1   | 38  | 5190        | 1.48             | 11.80                         | 24.00                           | 2.08     |  | Pass      |
| VHT40      | MCS0      | 1   | 46  | 5230        | 1.48             | 12.05                         | 24.00                           | 2.08     |  | Pass      |
| VHT80      | MCS0      | 1   | 42  | 5210        | 2.58             | 12.06                         | 24.00                           | 2.08     |  | Pass      |

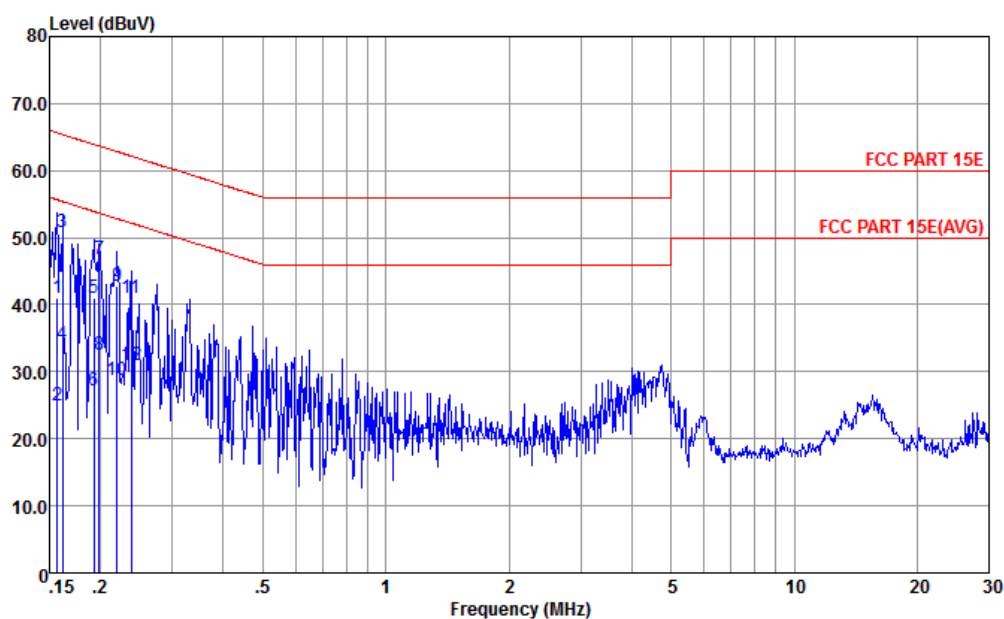
**TEST RESULTS DATA**  
**Power Spectral Density**

| FCC Band I |           |     |     |             |                  |                                 |                             |          |   |           |
|------------|-----------|-----|-----|-------------|------------------|---------------------------------|-----------------------------|----------|---|-----------|
| Mod.       | Data Rate | NTX | CH. | Freq. (MHz) | Duty Factor (dB) | Average Power Density (dBm/MHz) | Average PSD Limit (dBm/MHz) | DG (dBi) | - | Pass/Fail |
| 11a        | 6Mbps     | 1   | 36  | 5180        | 0.58             | 2.26                            | 11.00                       | 2.08     |   | Pass      |
| 11a        | 6Mbps     | 1   | 44  | 5220        | 0.58             | 2.60                            | 11.00                       | 2.08     |   | Pass      |
| 11a        | 6Mbps     | 1   | 48  | 5240        | 0.58             | 2.62                            | 11.00                       | 2.08     |   | Pass      |
| HT20       | MCS0      | 1   | 36  | 5180        | 0.62             | 1.04                            | 11.00                       | 2.08     |   | Pass      |
| HT20       | MCS0      | 1   | 44  | 5220        | 0.62             | 1.74                            | 11.00                       | 2.08     |   | Pass      |
| HT20       | MCS0      | 1   | 48  | 5240        | 0.62             | 1.45                            | 11.00                       | 2.08     |   | Pass      |
| HT40       | MCS0      | 1   | 38  | 5190        | 0.63             | -1.83                           | 11.00                       | 2.08     |   | Pass      |
| HT40       | MCS0      | 1   | 46  | 5230        | 0.63             | -1.46                           | 11.00                       | 2.08     |   | Pass      |
| VHT80      | MCS0      | 1   | 42  | 5210        | 2.58             | -4.57                           | 11.00                       | 2.08     |   | Pass      |



## Appendix B. AC Conducted Emission Test Results

|                 |                                                                                 |                     |            |
|-----------------|---------------------------------------------------------------------------------|---------------------|------------|
| Test Engineer : | Amos Zhang                                                                      | Temperature :       | 28.2~29.6℃ |
|                 |                                                                                 | Relative Humidity : | 42~46%     |
| Test Voltage :  | 120Vac / 60Hz                                                                   | Phase :             | Line       |
| Remark :        | All emissions not reported here are more than 10 dB below the prescribed limit. |                     |            |



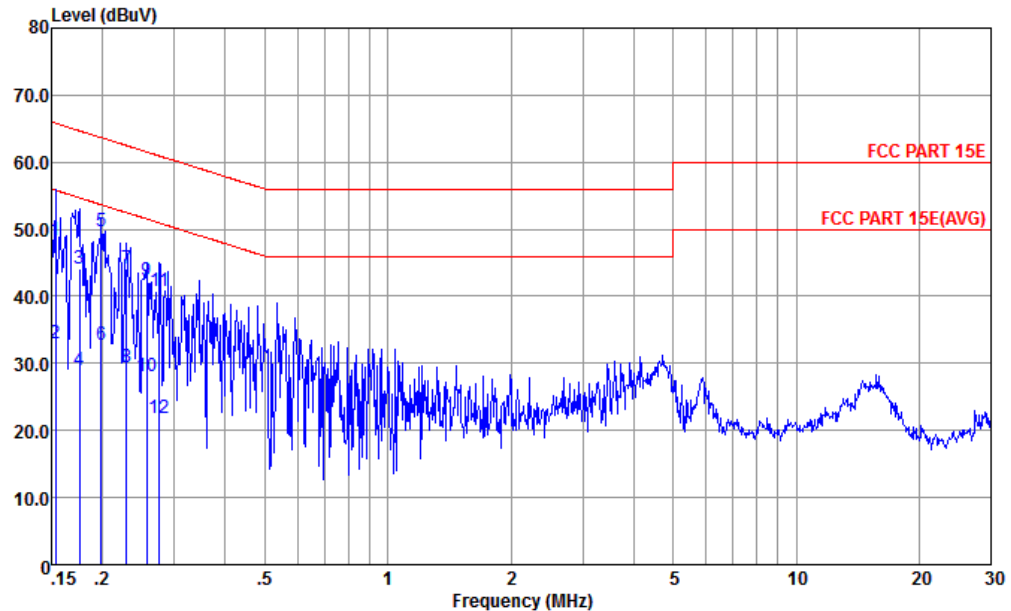
Site : CO01-KS  
Condition : FCC PART 15E LISN-I-181119-060105 LINE

mode : Mode 1  
: 8511193300138 #8

|     | Freq  | Level | Over   | Limit | Read  | LISN   | Cable |         |
|-----|-------|-------|--------|-------|-------|--------|-------|---------|
|     | MHz   | dBuV  | Limit  | Line  | Level | Factor | Loss  | Remark  |
|     |       |       | dB     | dBuV  | dBuV  | dB     | dB    |         |
| 1   | 0.156 | 41.06 | -24.59 | 65.65 | 30.51 | 0.09   | 10.46 | QP      |
| 2   | 0.156 | 25.06 | -30.59 | 55.65 | 14.51 | 0.09   | 10.46 | Average |
| 3 * | 0.162 | 50.75 | -14.63 | 65.38 | 40.20 | 0.10   | 10.45 | QP      |
| 4   | 0.162 | 34.05 | -21.33 | 55.38 | 23.50 | 0.10   | 10.45 | Average |
| 5   | 0.192 | 41.09 | -22.84 | 63.93 | 30.59 | 0.12   | 10.38 | QP      |
| 6   | 0.192 | 27.29 | -26.64 | 53.93 | 16.79 | 0.12   | 10.38 | Average |
| 7   | 0.199 | 46.69 | -16.98 | 63.67 | 36.20 | 0.12   | 10.37 | QP      |
| 8   | 0.199 | 32.59 | -21.08 | 53.67 | 22.10 | 0.12   | 10.37 | Average |
| 9   | 0.220 | 42.68 | -20.15 | 62.83 | 32.20 | 0.13   | 10.35 | QP      |
| 10  | 0.220 | 28.68 | -24.15 | 52.83 | 18.20 | 0.13   | 10.35 | Average |
| 11  | 0.238 | 41.07 | -21.10 | 62.17 | 30.60 | 0.13   | 10.34 | QP      |
| 12  | 0.238 | 30.97 | -21.20 | 52.17 | 20.50 | 0.13   | 10.34 | Average |



|                 |                                                                                 |                     |            |
|-----------------|---------------------------------------------------------------------------------|---------------------|------------|
| Test Engineer : | Amos Zhang                                                                      | Temperature :       | 28.2~29.6℃ |
|                 |                                                                                 | Relative Humidity : | 42~46%     |
| 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-N-181119-060105 NEUTRAL

mode : Mode 1  
: 8511193300138 #8

|     | Freq  | Level | Over   | Limit | Read  | LISN   | Cable | Remark  |
|-----|-------|-------|--------|-------|-------|--------|-------|---------|
|     | MHz   | dBuV  | Limit  | Line  | Level | Factor | Loss  |         |
|     |       |       | dB     | dBuV  | dBuV  | dB     | dB    |         |
| 1   | 0.153 | 48.25 | -17.57 | 65.82 | 37.60 | 0.18   | 10.47 | QP      |
| 2   | 0.153 | 32.95 | -22.87 | 55.82 | 22.30 | 0.18   | 10.47 | Average |
| 3   | 0.176 | 44.09 | -20.59 | 64.68 | 33.49 | 0.18   | 10.42 | QP      |
| 4   | 0.176 | 28.89 | -25.79 | 54.68 | 18.29 | 0.18   | 10.42 | Average |
| 5 * | 0.199 | 49.74 | -13.93 | 63.67 | 39.20 | 0.17   | 10.37 | QP      |
| 6   | 0.199 | 32.84 | -20.83 | 53.67 | 22.30 | 0.17   | 10.37 | Average |
| 7   | 0.229 | 44.11 | -18.37 | 62.48 | 33.59 | 0.17   | 10.35 | QP      |
| 8   | 0.229 | 29.47 | -23.01 | 52.48 | 18.95 | 0.17   | 10.35 | Average |
| 9   | 0.256 | 42.40 | -19.16 | 61.56 | 31.90 | 0.17   | 10.33 | QP      |
| 10  | 0.256 | 28.00 | -23.56 | 51.56 | 17.50 | 0.17   | 10.33 | Average |
| 11  | 0.276 | 40.68 | -20.26 | 60.94 | 30.20 | 0.16   | 10.32 | QP      |
| 12  | 0.276 | 21.78 | -29.16 | 50.94 | 11.30 | 0.16   | 10.32 | Average |

Note:

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



## Appendix C. Radiated Spurious Emission

### Band 1 - 5150~5250MHz

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

| WIFI Ant.                   | Note                                                                                        | Frequency | Level      | Over Limit | Limit Line | Read Level | Antenna Factor | Cable Loss | Preamplifier 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<br>CH 36<br>5180MHz |                                                                                             | 5127.68   | 54.67      | -19.33     | 74         | 43.25      | 34.05          | 8.14       | 30.77               | 107     | 97        | P         | H     |
|                             |                                                                                             | 5127.36   | 46.16      | -7.84      | 54         | 34.74      | 34.05          | 8.14       | 30.77               | 107     | 97        | A         | H     |
|                             | *                                                                                           | 5182      | 104.49     | -          | -          | 92.99      | 34.12          | 8.17       | 30.79               | 107     | 97        | P         | H     |
|                             |                                                                                             | 5182      | 96.58      | -          | -          | 85.08      | 34.12          | 8.17       | 30.79               | 107     | 97        | A         | H     |
|                             |                                                                                             | 5127.68   | 54.26      | -19.74     | 74         | 42.84      | 34.05          | 8.14       | 30.77               | 100     | 45        | P         | V     |
|                             |                                                                                             | 5127.84   | 45.44      | -8.56      | 54         | 34.02      | 34.05          | 8.14       | 30.77               | 100     | 45        | A         | V     |
|                             | *                                                                                           | 5176      | 101.78     | -          | -          | 90.28      | 34.12          | 8.17       | 30.79               | 100     | 45        | P         | V     |
|                             |                                                                                             | 5176      | 94.63      | -          | -          | 83.13      | 34.12          | 8.17       | 30.79               | 100     | 45        | A         | V     |
| Remark                      | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. |           |            |            |            |            |                |            |                     |         |           |           |       |



## Band 1 5150~5250MHz

## WIFI 802.11a (Harmonic @ 3m)

| WIFI<br>Ant.<br>1           | Note                                                                                        | Frequency<br>( MHz ) | Level<br>( dBμV/m ) | Over<br>Limit<br>( dB ) | Limit<br>Line<br>( dBμV/m ) | Read<br>Level<br>(dBμV) | Antenna<br>Factor<br>( dB/m ) | Cable<br>Loss<br>( dB ) | Preamp<br>Factor<br>( dB ) | Ant<br>Pos<br>( cm ) | Table<br>Pos<br>( deg ) | Peak<br>Avg.<br>(P/A) | Pol.<br>(H/V) |
|-----------------------------|---------------------------------------------------------------------------------------------|----------------------|---------------------|-------------------------|-----------------------------|-------------------------|-------------------------------|-------------------------|----------------------------|----------------------|-------------------------|-----------------------|---------------|
| 802.11a<br>CH 36<br>5180MHz |                                                                                             | 10360                | 42.58               | -25.72                  | 68.3                        | 56.75                   | 37.02                         | 11.87                   | 63.06                      | 100                  | 360                     | P                     | H             |
|                             |                                                                                             | 10360                | 40.69               | -27.61                  | 68.3                        | 54.86                   | 37.02                         | 11.87                   | 63.06                      | 100                  | 315                     | P                     | V             |
| 802.11a<br>CH 44<br>5220MHz |                                                                                             | 10440                | 43.59               | -24.71                  | 68.3                        | 57.64                   | 37.06                         | 11.93                   | 63.04                      | 100                  | 360                     | P                     | H             |
|                             |                                                                                             | 10440                | 42.82               | -25.48                  | 68.3                        | 56.87                   | 37.06                         | 11.93                   | 63.04                      | 100                  | 0                       | P                     | V             |
| 802.11a<br>CH 48<br>5240MHz |                                                                                             | 10480                | 42.52               | -25.78                  | 68.3                        | 56.49                   | 37.09                         | 11.97                   | 63.03                      | 100                  | 360                     | P                     | H             |
|                             |                                                                                             | 10480                | 40.67               | -27.63                  | 68.3                        | 54.64                   | 37.09                         | 11.97                   | 63.03                      | 100                  | 323                     | P                     | V             |
| Remark                      | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. |                      |                     |                         |                             |                         |                               |                         |                            |                      |                         |                       |               |



## Band 1 5150~5250MHz

## WIFI 802.11n HT20 (Band Edge @ 3m)

| WIFI<br>Ant.<br>1                   | Note                                                                                        | Frequency<br>( MHz ) | Level<br>( dBμV/m ) | Over<br>Limit<br>( dB ) | Limit<br>Line<br>( dBμV/m ) | Read<br>Level<br>(dBμV) | Antenna<br>Factor<br>( dB/m ) | Cable<br>Loss<br>( dB ) | Preamp<br>Factor<br>( dB ) | Ant<br>Pos<br>( cm ) | Table<br>Pos<br>( deg ) | Peak<br>Avg.<br>(P/A) | Pol.<br>(H/V) |
|-------------------------------------|---------------------------------------------------------------------------------------------|----------------------|---------------------|-------------------------|-----------------------------|-------------------------|-------------------------------|-------------------------|----------------------------|----------------------|-------------------------|-----------------------|---------------|
| 802.11n<br>HT20<br>CH 36<br>5180MHz |                                                                                             | 5128.16              | 54.9                | -19.1                   | 74                          | 43.48                   | 34.05                         | 8.14                    | 30.77                      | 100                  | 147                     | P                     | H             |
|                                     |                                                                                             | 5128.32              | 45.86               | -8.14                   | 54                          | 34.44                   | 34.05                         | 8.14                    | 30.77                      | 100                  | 147                     | A                     | H             |
|                                     | *                                                                                           | 5176                 | 101.88              | -                       | -                           | 90.38                   | 34.12                         | 8.17                    | 30.79                      | 100                  | 147                     | P                     | H             |
|                                     |                                                                                             | 5176                 | 94.84               | -                       | -                           | 83.34                   | 34.12                         | 8.17                    | 30.79                      | 100                  | 147                     | A                     | H             |
|                                     |                                                                                             | 5146.72              | 54.33               | -19.67                  | 74                          | 42.9                    | 34.07                         | 8.14                    | 30.78                      | 100                  | 53                      | P                     | V             |
|                                     |                                                                                             | 5128.32              | 45.56               | -8.44                   | 54                          | 34.14                   | 34.05                         | 8.14                    | 30.77                      | 100                  | 53                      | A                     | V             |
|                                     | *                                                                                           | 5170                 | 100.77              | -                       | -                           | 89.29                   | 34.09                         | 8.17                    | 30.78                      | 100                  | 53                      | P                     | V             |
|                                     |                                                                                             | 5170                 | 93.45               | -                       | -                           | 81.97                   | 34.09                         | 8.17                    | 30.78                      | 100                  | 53                      | A                     | V             |
| Remark                              | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. |                      |                     |                         |                             |                         |                               |                         |                            |                      |                         |                       |               |



**Band 1 5150~5250MHz**  
**WIFI 802.11n HT20 (Harmonic @ 3m)**

| WIFI<br>Ant.<br>1                   | Note                                                                                        | Frequency<br>( MHz ) | Level<br>( dBμV/m ) | Over<br>Limit<br>( dB ) | Limit<br>Line<br>( dBμV/m ) | Read<br>Level<br>(dBμV) | Antenna<br>Factor<br>( dB/m ) | Cable<br>Loss<br>( dB ) | Preamp<br>Factor<br>( dB ) | Ant<br>Pos<br>( cm ) | Table<br>Pos<br>( deg ) | Peak<br>Avg.<br>(P/A) | Pol.<br>(H/V) |
|-------------------------------------|---------------------------------------------------------------------------------------------|----------------------|---------------------|-------------------------|-----------------------------|-------------------------|-------------------------------|-------------------------|----------------------------|----------------------|-------------------------|-----------------------|---------------|
| 802.11n<br>HT20<br>CH 36<br>5180MHz |                                                                                             | 10360                | 41.84               | -26.46                  | 68.3                        | 56.01                   | 37.02                         | 11.87                   | 63.06                      | 100                  | 360                     | P                     | H             |
|                                     |                                                                                             | 10360                | 41.3                | -27                     | 68.3                        | 55.47                   | 37.02                         | 11.87                   | 63.06                      | 100                  | 0                       | P                     | V             |
| 802.11n<br>HT20<br>CH 44<br>5220MHz |                                                                                             | 10440                | 42.59               | -25.71                  | 68.3                        | 56.64                   | 37.06                         | 11.93                   | 63.04                      | 100                  | 360                     | P                     | H             |
|                                     |                                                                                             | 10440                | 40.99               | -27.31                  | 68.3                        | 55.04                   | 37.06                         | 11.93                   | 63.04                      | 100                  | 264                     | P                     | V             |
| 802.11n<br>HT20<br>CH 48<br>5240MHz |                                                                                             | 10480                | 43.69               | -24.61                  | 68.3                        | 57.66                   | 37.09                         | 11.97                   | 63.03                      | 100                  | 360                     | P                     | H             |
|                                     |                                                                                             | 10480                | 42.56               | -25.74                  | 68.3                        | 56.53                   | 37.09                         | 11.97                   | 63.03                      | 100                  | 0                       | P                     | V             |
| Remark                              | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. |                      |                     |                         |                             |                         |                               |                         |                            |                      |                         |                       |               |



## Band 1 5150~5250MHz

## WIFI 802.11n HT40 (Band Edge @ 3m)

| WIFI<br>Ant.<br>1                   | Note                                                                                        | Frequency<br>( MHz ) | Level<br>( dBμV/m ) | Over<br>Limit<br>( dB ) | Limit<br>Line<br>( dBμV/m ) | Read<br>Level<br>(dBμV) | Antenna<br>Factor<br>( dB/m ) | Cable<br>Loss<br>( dB ) | Preamp<br>Factor<br>( dB ) | Ant<br>Pos<br>( cm ) | Table<br>Pos<br>( deg ) | Peak<br>Avg.<br>(P/A) | Pol.<br>(H/V) |
|-------------------------------------|---------------------------------------------------------------------------------------------|----------------------|---------------------|-------------------------|-----------------------------|-------------------------|-------------------------------|-------------------------|----------------------------|----------------------|-------------------------|-----------------------|---------------|
| 802.11n<br>HT40<br>CH 38<br>5190MHz |                                                                                             | 5147.04              | 57.29               | -16.71                  | 74                          | 45.86                   | 34.07                         | 8.14                    | 30.78                      | 112                  | 146                     | P                     | H             |
|                                     |                                                                                             | 5149.44              | 47.33               | -6.67                   | 54                          | 35.9                    | 34.07                         | 8.14                    | 30.78                      | 112                  | 146                     | A                     | H             |
|                                     | *                                                                                           | 5200                 | 99.3                | -                       | -                           | 87.75                   | 34.14                         | 8.2                     | 30.79                      | 112                  | 146                     | P                     | H             |
|                                     |                                                                                             | 5200                 | 92.21               | -                       | -                           | 80.66                   | 34.14                         | 8.2                     | 30.79                      | 112                  | 146                     | A                     | H             |
|                                     |                                                                                             | 5394.96              | 51.24               | -22.76                  | 74                          | 39.32                   | 34.4                          | 8.32                    | 30.8                       | 112                  | 146                     | P                     | H             |
|                                     |                                                                                             | 5393.16              | 42.05               | -11.95                  | 54                          | 30.15                   | 34.38                         | 8.32                    | 30.8                       | 112                  | 146                     | A                     | H             |
|                                     |                                                                                             | 5148.48              | 56.65               | -17.35                  | 74                          | 45.22                   | 34.07                         | 8.14                    | 30.78                      | 101                  | 58                      | P                     | V             |
|                                     |                                                                                             | 5149.92              | 47.11               | -6.89                   | 54                          | 35.68                   | 34.07                         | 8.14                    | 30.78                      | 101                  | 58                      | A                     | V             |
|                                     | *                                                                                           | 5206                 | 98.22               | -                       | -                           | 86.67                   | 34.14                         | 8.2                     | 30.79                      | 101                  | 58                      | P                     | V             |
|                                     |                                                                                             | 5206                 | 91.36               | -                       | -                           | 79.81                   | 34.14                         | 8.2                     | 30.79                      | 101                  | 58                      | A                     | V             |
|                                     |                                                                                             | 5361.12              | 51.68               | -22.32                  | 74                          | 39.83                   | 34.35                         | 8.3                     | 30.8                       | 101                  | 58                      | P                     | V             |
|                                     |                                                                                             | 5375.7               | 42.05               | -11.95                  | 54                          | 30.2                    | 34.35                         | 8.3                     | 30.8                       | 101                  | 58                      | A                     | V             |
| Remark                              | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. |                      |                     |                         |                             |                         |                               |                         |                            |                      |                         |                       |               |



## Band 1 5150~5250MHz

## WIFI 802.11n HT40 (Harmonic @ 3m)

| WIFI<br>Ant.<br>1                   | Note                                                                                        | Frequency<br>( MHz ) | Level<br>( dBμV/m ) | Over<br>Limit<br>( dB ) | Limit<br>Line<br>( dBμV/m ) | Read<br>Level<br>(dBμV) | Antenna<br>Factor<br>( dB/m ) | Cable<br>Loss<br>( dB ) | Preamp<br>Factor<br>( dB ) | Ant<br>Pos<br>( cm ) | Table<br>Pos<br>( deg ) | Peak<br>Avg.<br>(P/A) | Pol.<br>(H/V) |
|-------------------------------------|---------------------------------------------------------------------------------------------|----------------------|---------------------|-------------------------|-----------------------------|-------------------------|-------------------------------|-------------------------|----------------------------|----------------------|-------------------------|-----------------------|---------------|
| 802.11n<br>HT40<br>CH 38<br>5190MHz |                                                                                             | 10380                | 41.58               | -26.72                  | 68.3                        | 55.7                    | 37.03                         | 11.9                    | 63.05                      | 100                  | 360                     | P                     | H             |
|                                     |                                                                                             | 10380                | 40.96               | -27.34                  | 68.3                        | 55.08                   | 37.03                         | 11.9                    | 63.05                      | 100                  | 324                     | P                     | V             |
| 802.11n<br>HT40<br>CH 46<br>5230MHz |                                                                                             | 10460                | 41.97               | -26.33                  | 68.3                        | 55.97                   | 37.07                         | 11.97                   | 63.04                      | 100                  | 360                     | P                     | H             |
|                                     |                                                                                             | 10460                | 41.67               | -26.63                  | 68.3                        | 55.67                   | 37.07                         | 11.97                   | 63.04                      | 100                  | 312                     | P                     | V             |
| Remark                              | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. |                      |                     |                         |                             |                         |                               |                         |                            |                      |                         |                       |               |



## Band 1 5150~5250MHz

## WIFI 802.11ac VHT80 (Band Edge @ 3m)

| WIFI<br>Ant.<br>1                     | Note                                                                                        | Frequency<br>( MHz ) | Level<br>( dBμV/m ) | Over<br>Limit<br>( dB ) | Limit<br>Line<br>( dBμV/m ) | Read<br>Level<br>( dBμV ) | Antenna<br>Factor<br>( dB/m ) | Cable<br>Loss<br>( dB ) | Preamp<br>Factor<br>( dB ) | Ant<br>Pos<br>( cm ) | Table<br>Pos<br>( deg ) | Peak<br>Avg.<br>( P/A ) | Pol.<br>( H/V ) |
|---------------------------------------|---------------------------------------------------------------------------------------------|----------------------|---------------------|-------------------------|-----------------------------|---------------------------|-------------------------------|-------------------------|----------------------------|----------------------|-------------------------|-------------------------|-----------------|
| 802.11ac<br>VHT80<br>CH 42<br>5210MHz |                                                                                             | 5138.72              | 57.3                | -16.7                   | 74                          | 45.89                     | 34.05                         | 8.14                    | 30.78                      | 100                  | 146                     | P                       | H               |
|                                       |                                                                                             | 5149.98              | 48.97               | -5.03                   | 54                          | 37.54                     | 34.07                         | 8.14                    | 30.78                      | 100                  | 146                     | A                       | H               |
|                                       | *                                                                                           | 5212                 | 95.87               | -                       | -                           | 84.32                     | 34.16                         | 8.2                     | 30.81                      | 100                  | 146                     | P                       | H               |
|                                       |                                                                                             | 5212                 | 88.85               | -                       | -                           | 77.3                      | 34.16                         | 8.2                     | 30.81                      | 100                  | 146                     | A                       | H               |
|                                       |                                                                                             | 5397.48              | 51.27               | -22.73                  | 74                          | 39.35                     | 34.4                          | 8.32                    | 30.8                       | 100                  | 146                     | P                       | H               |
|                                       |                                                                                             | 5398.56              | 43.3                | -10.7                   | 54                          | 31.37                     | 34.4                          | 8.32                    | 30.79                      | 100                  | 146                     | A                       | H               |
|                                       |                                                                                             | 5145.28              | 56.88               | -17.12                  | 74                          | 45.45                     | 34.07                         | 8.14                    | 30.78                      | 100                  | 51                      | P                       | V               |
|                                       |                                                                                             | 5149.6               | 48.28               | -5.72                   | 54                          | 36.85                     | 34.07                         | 8.14                    | 30.78                      | 100                  | 51                      | A                       | V               |
|                                       | *                                                                                           | 5230                 | 94.35               | -                       | -                           | 82.8                      | 34.18                         | 8.2                     | 30.83                      | 100                  | 51                      | P                       | V               |
|                                       |                                                                                             | 5230                 | 87.45               | -                       | -                           | 75.9                      | 34.18                         | 8.2                     | 30.83                      | 100                  | 51                      | A                       | V               |
|                                       |                                                                                             | 5394.78              | 52.87               | -21.13                  | 74                          | 40.95                     | 34.4                          | 8.32                    | 30.8                       | 100                  | 51                      | P                       | V               |
|                                       |                                                                                             | 5358.06              | 43.29               | -10.71                  | 54                          | 31.47                     | 34.33                         | 8.3                     | 30.81                      | 100                  | 51                      | A                       | V               |
| Remark                                | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. |                      |                     |                         |                             |                           |                               |                         |                            |                      |                         |                         |                 |

**Band 1 5150~5250MHz****WIFI 802.11ac VHT80 (Harmonic @ 3m)**

| WIFI<br>Ant.<br>1 | Note                                                                                        | Frequency<br>( MHz ) | Level<br>( dBμV/m ) | Over<br>Limit<br>( dB ) | Limit<br>Line<br>( dBμV/m ) | Read<br>Level<br>(dBμV) | Antenna<br>Factor<br>( dB/m ) | Cable<br>Loss<br>( dB ) | Preamp<br>Factor<br>( dB ) | Ant<br>Pos<br>( cm ) | Table<br>Pos<br>( deg ) | Peak<br>Avg.<br>(P/A) | Pol.<br>(H/V) |
|-------------------|---------------------------------------------------------------------------------------------|----------------------|---------------------|-------------------------|-----------------------------|-------------------------|-------------------------------|-------------------------|----------------------------|----------------------|-------------------------|-----------------------|---------------|
| 802.11ac<br>VHT80 |                                                                                             | 10420                | 42.19               | -26.11                  | 68.3                        | 56.26                   | 37.05                         | 11.93                   | 63.05                      | 100                  | 360                     | P                     | H             |
| CH 42<br>5210MHz  |                                                                                             | 10420                | 43.12               | -25.18                  | 68.3                        | 57.19                   | 37.05                         | 11.93                   | 63.05                      | 100                  | 0                       | P                     | V             |
| Remark            | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. |                      |                     |                         |                             |                         |                               |                         |                            |                      |                         |                       |               |



## Emission below 1GHz

## WIFI 802.11ac VHT80 (LF @ 3m)

| WIFI                    | Note                                                                       | Frequency | Level      | Over   | Limit      | Read   | Antenna  | Cable  | 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) |
| 802.11ac<br>VHT80<br>LF |                                                                            | 36.79     | 16.32      | -23.68 | 40         | 26.42  | 21.14    | 0.72   | 31.96  | -      | -       | P     | H     |
|                         |                                                                            | 190.05    | 17.45      | -26.05 | 43.5       | 32.26  | 15.51    | 1.59   | 31.91  | -      | -       | P     | H     |
|                         |                                                                            | 298.69    | 23.04      | -22.96 | 46         | 33.85  | 19.29    | 1.98   | 32.08  | -      | -       | P     | H     |
|                         |                                                                            | 430.61    | 21.98      | -24.02 | 46         | 29.19  | 22.64    | 2.33   | 32.18  | -      | -       | P     | H     |
|                         |                                                                            | 883.6     | 27.33      | -18.67 | 46         | 26.25  | 29.23    | 3.42   | 31.57  | -      | -       | P     | H     |
|                         |                                                                            | 945.68    | 28.57      | -17.43 | 46         | 25.29  | 30.77    | 3.54   | 31.03  | 100    | 0       | P     | H     |
|                         |                                                                            | 35.82     | 32.65      | -7.35  | 40         | 42.27  | 21.62    | 0.72   | 31.96  | 100    | 0       | P     | V     |
|                         |                                                                            | 41.64     | 29.91      | -10.09 | 40         | 42.52  | 18.62    | 0.72   | 31.95  | -      | -       | P     | V     |
|                         |                                                                            | 189.08    | 23.14      | -20.36 | 43.5       | 37.92  | 15.55    | 1.58   | 31.91  | -      | -       | P     | V     |
|                         |                                                                            | 433.52    | 21.33      | -24.67 | 46         | 28.46  | 22.71    | 2.34   | 32.18  | -      | -       | P     | V     |
|                         |                                                                            | 748.77    | 26.14      | -19.86 | 46         | 26.79  | 28.46    | 3.14   | 32.25  | -      | -       | P     | V     |
|                         |                                                                            | 956.35    | 28.44      | -17.56 | 46         | 24.96  | 30.85    | 3.56   | 30.93  | -      | -       | P     | V     |
| Remark                  | 1. No other spurious found.<br>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  | Cable  | 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. Level(dBμV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

**For Peak Limit @ 2390MHz:**

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable 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) + Cable 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)

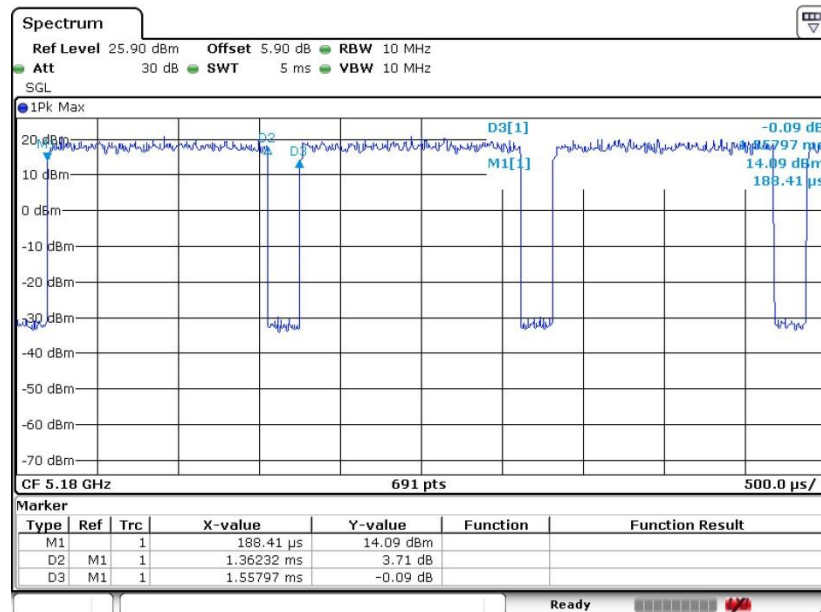
= -10.46(dB)

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

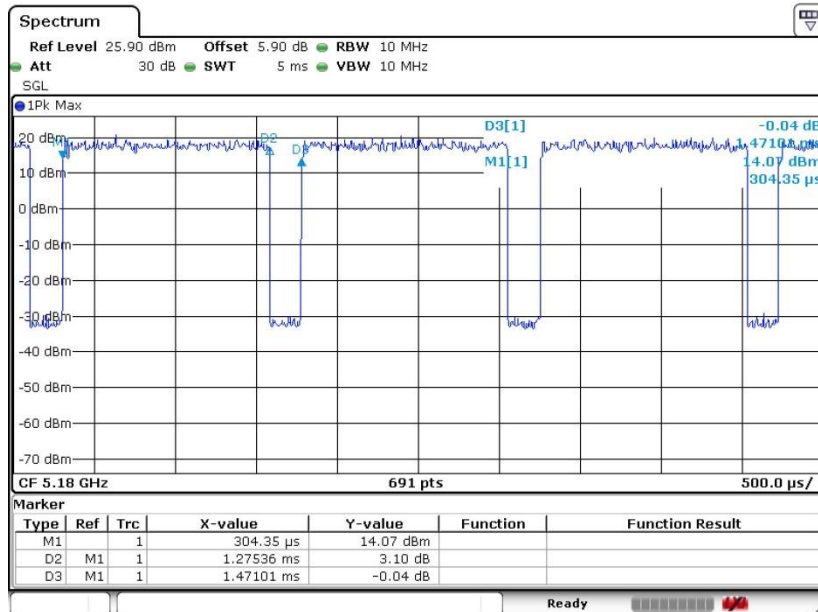
## Appendix D. Duty Cycle Plots

| Band           | Duty Cycle(%) | T(ms) | 1/T(kHz) | VBW Setting |
|----------------|---------------|-------|----------|-------------|
| 802.11a        | 87.44         | 1.362 | 0.734    | 0.75KHz     |
| 802.11n HT20   | 86.70         | 1.275 | 0.784    | 0.82KHz     |
| 802.11n HT40   | 86.47         | 1.232 | 0.812    | 0.82KHz     |
| 802.11ac VHT80 | 55.20         | 0.246 | 4.059    | 4.3KHz      |

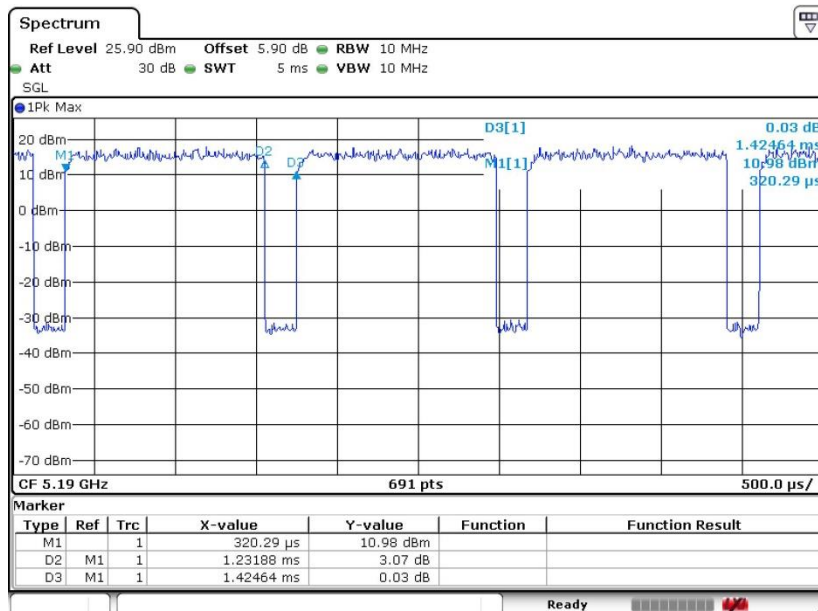
### 802.11a



### 802.11n HT20



### 802.11n HT40



802.11ac VHT80

