# FCC RF Test Report

| | | |
|---|---|---|
| **APPLICANT** | : | **Verifone, Inc.** |
| **EQUIPMENT** | : | **Point of Sales Terminal** |
| **BRAND NAME** | : | **Verifone** |
| **MODEL NAME** | : | **C680 3G-BT-WiFi** |
| **FCC ID** | : | **B32C6803GBTW** |
| **STANDARD** | : | **FCC Part 15 Subpart E §15.407** |
| **CLASSIFICATION** | : | **(NII) Unlicensed National Information Infrastructure** |

**The product was received on Sep. 21, 2016 and testing was completed on Oct. 17, 2016. We, SPORTON INTERNATIONAL 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 INC., the test report shall not be reproduced except in full.**

**Reviewed by: Joseph Lin / Supervisor**

**Approved by: Jones Tsai / Manager**

Testing Laboratory 1190

***SPORTON INTERNATIONAL INC.***

***No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.***

# TABLE OF CONTENTS

**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 ..... 6
1.5 Modification of EUT ..... 6
1.6 Testing Location ..... 7
1.7 Applicable Standards ..... 7

**2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST ..... 8**

2.1 Carrier Frequency Channel ..... 8
2.2 Pre-Scanned RF Power ..... 9
2.3 Test Mode ..... 9
2.4 Connection Diagram of Test System ..... 11
2.5 Support Unit used in test configuration and system ..... 12
2.6 EUT Operation Test Setup ..... 12
2.7 Measurement Results Explanation Example ..... 12

**3 TEST RESULT ..... 13**

3.1 26dB & 99% Occupied Bandwidth Measurement ..... 13
3.2 Maximum Conducted Output Power Measurement ..... 15
3.3 Power Spectral Density Measurement ..... 17
3.4 Unwanted Radiated Emission Measurement ..... 20
3.5 AC Conducted Emission Measurement ..... 25
3.6 Frequency Stability Measurement ..... 29
3.7 Automatically Discontinue Transmission ..... 30
3.8 Antenna Requirements ..... 31

**4 LIST OF MEASURING EQUIPMENTS ..... 32**

**5 UNCERTAINTY OF EVALUATION ..... 33**

**APPENDIX A. CONDUCTED TEST RESULTS**

**APPENDIX B. RADIATED SPURIOUS EMISSION**

**APPENDIX C. RADIATED SPURIOUS EMISSION PLOTS**

**APPENDIX D. DUTY CYCLE PLOTS**

**APPENDIX E. SETUP PHOTOGRAPHS**

# REVISION HISTORY

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|---|---|---|---|
| FR692114E | Rev. 01 | Initial issue of report | Oct. 24, 2016 |
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# SUMMARY OF TEST RESULT

| Report Section | FCC Rule | Description | Limit | Result | Remark |
|---|---|---|---|---|---|
| 3.1 | 2.1049<br>15.403(i) | 26dB & 99% Bandwidth | - | Pass | - |
| 3.2 | 15.407(a) | Maximum Conducted Output Power | FCC<br>≤ 24 dBm<br>(depend on band) | Pass | - |
| 3.3 | 15.407(a) | Power Spectral Density | FCC<br>≤ 11 dBm<br>(depend on band) | Pass | - |
| 3.4 | 15.407(b) | Unwanted Emissions | ≤ -17, -27 dBm<br>(depend on band)&15.209(a) | Pass | Under limit 3.01 dB at 5150.000 MHz |
| 3.5 | 15.207 | AC Conducted Emission | 15.207(a) | Pass | Under limit 19.70 dB at 0.518 MHz |
| 3.6 | 15.407(g) | Frequency Stability | Within Operation Band | Pass | - |
| 3.7 | 15.407(c) | Automatically Discontinue Transmission | Discontinue Transmission | Pass | - |
| 3.8 | 15.203 &<br>15.407(a) | Antenna Requirement | N/A | Pass | - |

# 1 General Description

## 1.1 Applicant

**Verifone, Inc.**
1400 West Stanford Ranch Road, Suite 100, 150 & 200, Rocklin CA 95765 USA

## 1.2 Manufacturer

**Inventec Appliances (Pudong) Corporation**
Building 1 - 3, No.789 Pu Xing Road, Caohejing Export Processing Zone, Shanghai, P.R.C.

## 1.3 Product Feature of Equipment Under Test

| Product Feature | |
|---|---|
| **Equipment** | Point of Sales Terminal |
| **Brand Name** | Verifone |
| **Model Name** | C680 3G-BT-WiFi |
| **FCC ID** | B32C6803GBTW |
| **EUT supports Radios application** | GSM/EGPRS/WCDMA/HSPA/RFID<br>WLAN 11b/g/n HT20<br>WLAN 11a/n HT20/HT40<br>Bluetooth BR/EDR/LE |
| **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.

| Specification of Accessory | | |
|---|---|---|
| **AC Adapter 1** | **Brand Name** | Verifone, Inc. |
| | **Manufacturer** | Elementech |
| | **Model Name** | A111-3050223U |
| | **Power Rating** | Input : 100-240 V AC 50/60Hz, 0.5A<br>Output: 5.0V DC 2.2A |
| | **Power Cord** | 1.8meter, non-shielded cable, without ferrite core |
| **AC Adapter 2** | **Brand Name** | Verifone, Inc. |
| | **Manufacturer** | PHIHONG |
| | **Model Name** | AM11A-050A-R |
| | **Power Rating** | Input : 100-240 V AC 50/60Hz, 0.5A<br>Output: 5.0V DC 2.2A |
| | **Power Cord** | 1.8meter, non-shielded cable, without ferrite core |
| **Battery 1** | **Brand Name** | Verifone, Inc. |
| | **Manufacturer** | Palladium Energy Inc. |
| | **Model Name** | BPK260-001 |
| **Battery 2** | **Brand Name** | Verifone, Inc. |
| | **Manufacturer** | Panasonic Corporation |
| | **Model Name** | BPK260-001 |

## 1.4 Product Specification of Equipment Under Test

| Standards-related Product Specification | |
|---|---|
| **Tx/Rx Frequency Range** | 5180 MHz ~ 5240 MHz<br>5260 MHz ~ 5320 MHz<br>5500 MHz ~ 5700 MHz |
| **Maximum Output Power to Antenna** | **<5180 MHz ~ 5240 MHz>**<br>802.11a : 11.19 dBm / 0.0132 W<br>802.11n HT20 : 11.09 dBm / 0.0129 W<br>802.11n HT40 : 11.34 dBm / 0.0136 W<br>**<5260 MHz ~ 5320 MHz>**<br>802.11a : 10.91 dBm / 0.0123 W<br>802.11n HT20 : 10.87 dBm / 0.0122 W<br>802.11n HT40 : 11.10 dBm / 0.0129 W<br>**<5500 MHz ~ 5700 MHz >**<br>802.11a : 8.02 dBm / 0.0063 W<br>802.11n HT20 : 7.95 dBm / 0.0062 W<br>802.11n HT40 : 8.11 dBm / 0.0065 W |
| **99% Occupied Bandwidth** | 802.11a : 17.15 MHz<br>802.11n HT20 : 18.00 MHz<br>802.11n HT40 : 36.30 MHz |
| **Antenna Gain / Gain** | **<5150 MHz ~ 5250 MHz>**<br>PIFA Antenna with gain 3.76 dBi<br>**<5250 MHz ~ 5350 MHz>**<br>PIFA Antenna with gain 3.71 dBi<br>**<5470 MHz ~ 5725 MHz>**<br>PIFA Antenna with gain 3.61 dBi |
| **Type of Modulation** | 802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM) |

**Note:** WLAN operation in 5600 MHz ~ 5650 MHz is notched.

## 1.5 Modification of EUT

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

## 1.6 Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1022 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

| | | |
|---|---|---|
| **Test Site** | SPORTON INTERNATIONAL INC. | |
| **Test Site Location** | No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park,<br>Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.<br>TEL: +886-3-327-3456<br>FAX: +886-3-328-4978 | |
| **Test Site No.** | **Sporton Site No.** | |
| | TH05-HY | CO05-HY |

**Note:** The test site complies with ANSI C63.4 2014 requirement.

| | |
|---|---|
| **Test Site** | SPORTON INTERNATIONAL INC. |
| **Test Site Location** | No.58, Aly. 75, Ln. 564, Wenhua 3rd Rd., Kwei-Shan District, Tao Yuan City, Taiwan R.O.C.<br>TEL: +886-3-327-0868<br>FAX: +886-3-327-0855 |
| **Test Site No.** | **Sporton Site No.** |
| | 03CH11-HY |

**Note:** The test site complies with ANSI C63.4 2014 requirement.

## 1.7 Applicable Standards

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

- FCC Part 15 Subpart E
- FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r03
- 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

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: conducted emission (150 kHz to 30 MHz) and radiated 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 were recorded in this report.

## 2.1 Carrier Frequency Channel

| Frequency Band | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|---|---|---|---|---|
| 5150-5250 MHz Band 1 (U-NII-1) | 36 | 5180 | 44 | 5220 |
| | 38* | 5190 | 46* | 5230 |
| | 40 | 5200 | 48 | 5240 |
| | 42# | 5210 | | |

| Frequency Band | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|---|---|---|---|---|
| 5250-5350 MHz Band 2 (U-NII-2A) | 52 | 5260 | 60 | 5300 |
| | 54* | 5270 | 62* | 5310 |
| | 56 | 5280 | 64 | 5320 |
| | 58# | 5290 | | |

| Frequency Band | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|---|---|---|---|---|
| 5470-5725 MHz Band 3 (U-NII-2C) | 100 | 5500 | 112 | 5560 |
| | 102* | 5510 | 116 | 5580 |
| | 104 | 5520 | 132 | 5660 |
| | 106# | 5530 | 134* | 5670 |
| | 108 | 5540 | 136 | 5680 |
| | 110* | 5550 | 140 | 5700 |

**Note:**

1. The above Frequency and Channel in "*" were 802.11n HT40 and 802.11ac VHT40.
2. The above Frequency and Channel in "#" were 802.11ac VHT80.

## 2.2 Pre-Scanned RF Power

Preliminary tests were performed in different data rate and data rate associated with the highest power were chosen for full test in the following tables. Final Output Power equals to Measured Output Power adds the duty factor.

## 2.3 Test Mode

**Final test mode of conducted test items and radiated spurious emissions 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 |

| | |
|---|---|
| **AC Conducted Emission** | Mode 1 : GSM1900 (GPRS Class 8) Idle + WLAN (5GHz) Link+ Magnetic Card Reader + RFID Off + Battery 1 + Charging from Adapter 1 + RS-232/4-Pin Cable (Load) + RS-232/RJ-11 Cable (Load) + Printer + SAM Card + Micro SD Card + primary micro-USB port (Cable Load) + secondary micro-USB port (Data Link with USB Storage device) + Smart Card Reader |
| **Remark:** All the Radiated test items were performed with Adapter 1 and Battery 1. | |

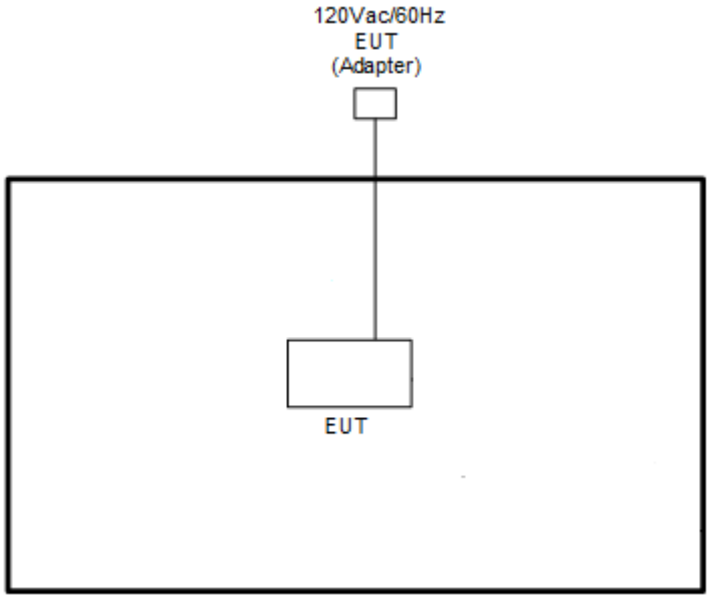
| Ch. # | | Band I : 5150-5250 MHz | Band II : 5250-5350 MHz | Band III : 5470-5725MHz |
|---|---|---|---|---|
| | | 802.11a | 802.11a | 802.11a |
| L | Low | 36 | 52 | 100 |
| M | Middle | 44 | 60 | 116 |
| H | High | 48 | 64 | 140 |

| Ch. # | | Band I : 5150-5250 MHz | Band II : 5250-5350 MHz | Band III : 5470-5725MHz |
|---|---|---|---|---|
| | | 802.11n HT20 | 802.11n HT20 | 802.11n HT20 |
| L | Low | 36 | 52 | 100 |
| M | Middle | 44 | 60 | 116 |
| H | High | 48 | 64 | 140 |

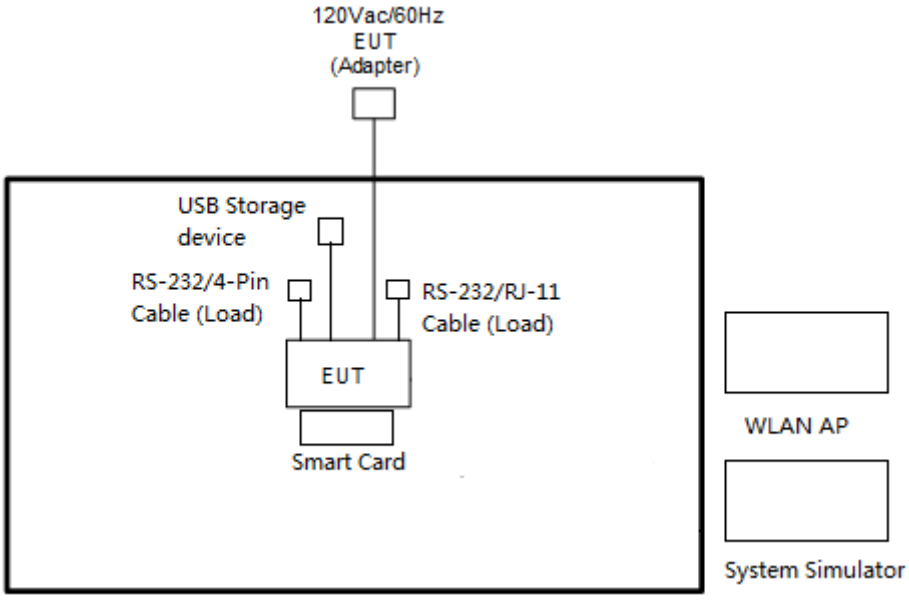
| Ch. # | | Band I : 5150-5250 MHz | Band II : 5250-5350 MHz | Band III : 5470-5725MHz |
|---|---|---|---|---|
| | | 802.11n HT40 | 802.11n HT40 | 802.11n HT40 |
| L | Low | 38 | 54 | 102 |
| M | Middle | - | - | 110 |
| H | High | 46 | 62 | 134 |

## 2.4 Connection Diagram of Test System

**<WLAN Tx Mode>**




**<AC Conducted Emission Mode>**



## 2.5 Support Unit used in test configuration and system

| Item | Equipment | Trade Name | Model Name | FCC ID | Data Cable | Power Cord |
|---|---|---|---|---|---|---|
| 1. | System Simulator | Anritsu | MT8820C | N/A | N/A | Unshielded, 1.8 m |
| 2. | WLAN AP | ASUS | RT-AC66U | MSQ-RTAC66U | N/A | Unshielded, 1.8 m |
| 3. | SD Card | SanDisk | MicroSD HC | FCC DoC | N/A | N/A |
| 4. | USB flash drive | Transcend | N/A | N/A | N/A | N/A |
| 5. | Smart Card | N/A | N/A | N/A | N/A | N/A |

## 2.6 EUT Operation Test Setup

The programmed RF utility "WIFI", is installed in EUT to provide channel selection, power level, data rate and the application type. RF Utility can send transmitting signal for all testing. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

## 2.7 Measurement Results Explanation Example

**For all conducted test items:**

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor 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 and attenuator factor.
*Offset = RF cable loss + attenuator factor.*
Following shows an offset computation example with cable loss 4.2 dB and 10dB attenuator.

*Offset(dB) = RF cable loss(dB) + attenuator factor(dB).*
= 4.2 + 10 = 14.2 (dB)

# 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.

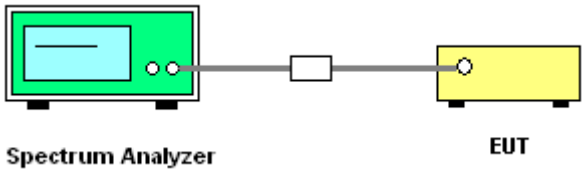
### 3.1.2 Measuring Instruments

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 v01r03. 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) ≥ 3 * RBW.
8. Measure and record the results in the test report.

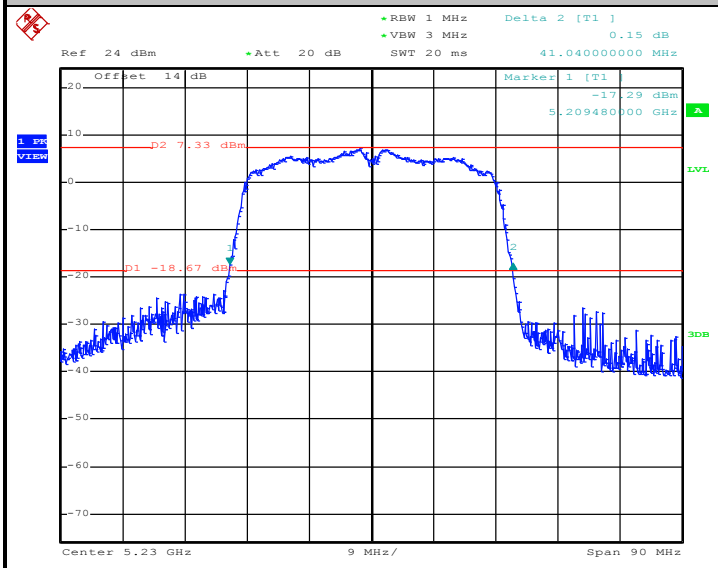
### 3.1.4 Test Setup



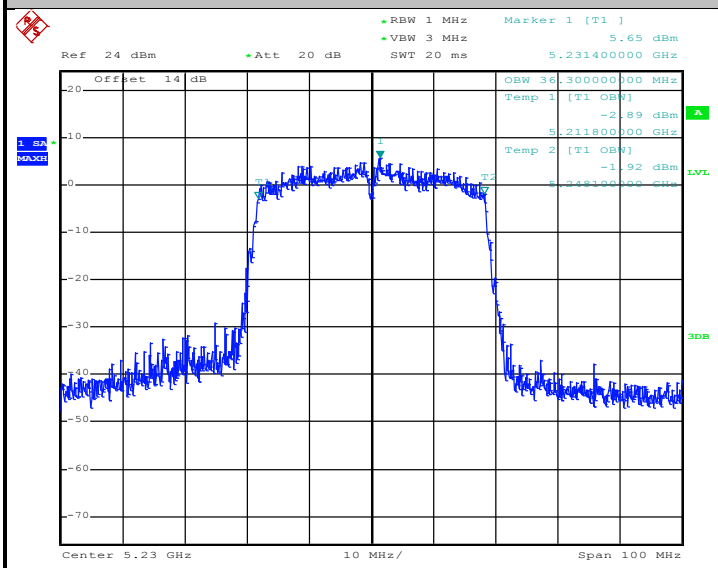
### 3.1.5 Test Result of 26dB & 99% Occupied Bandwidth Plots

Please refer to Appendix A.

**Maximum 26dB Bandwidth**




**Maximum 99% Occupied Bandwidth**



## 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.

For the 5.25–5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm 10 log B, where B is the 26 dB emission bandwidth in megahertz.

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

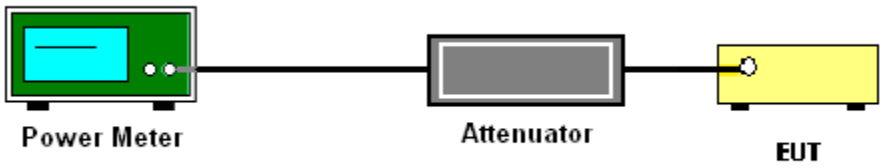
The testing follows Method PM of FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r03.

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

**For normal channel:**




### 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.

For the 5.25–5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm 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

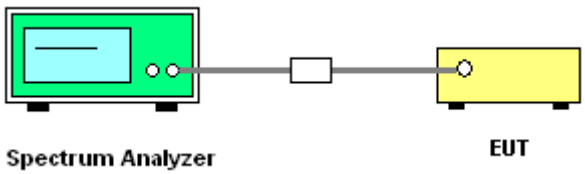
The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r03. Section F) Maximum power spectral density.

**# Method SA-2 #**

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

1. The testing follows Method SA-2 of FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r03.
   - Measure the duty cycle.
   - Set span to encompass the entire emission bandwidth (EBW) of the signal.
   - Set RBW = 1 MHz.
   - Set VBW ≥ 3 MHz.
   - Number of points in sweep ≥ 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.
2. The RF output of EUT was connected to the spectrum analyzer by a low loss cable.
3. Each plot has already offset with cable loss, and attenuator loss. Measure the PPSD and record it.

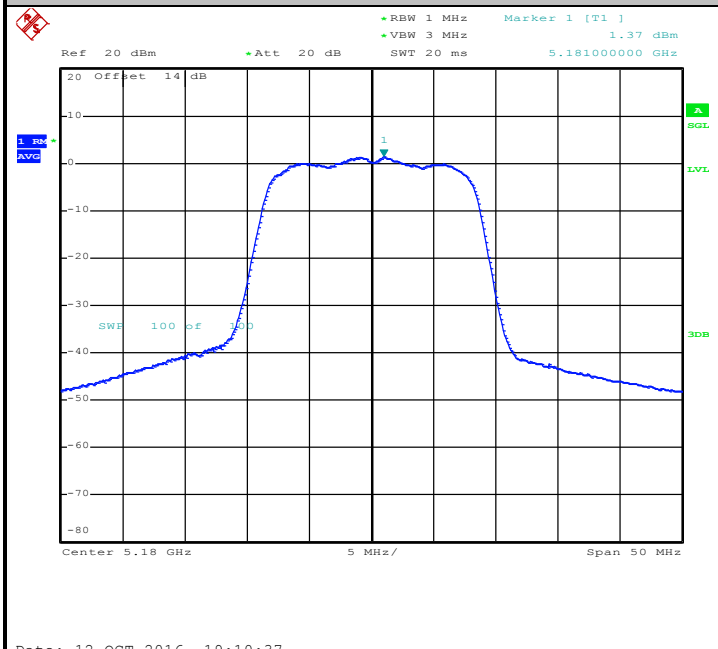
### 3.3.4 Test Setup



### 3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

**Worst Case Power Spectral Density(dBm/MHz)**




**Note:** Average Power Density (dB) = Measured value+ Duty Factor

## 3.4 Unwanted Radiated Emission Measurement

This section as specified in FCC Part 15.407(b) is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement. The unwanted emissions shall comply with 15.407(b)(1) to (6), and restricted bands per FCC Part15.205.

### 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.

For transmitters operating in the 5250-5350 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of -27 dBm/MHz. Devices operating in the 5250-5350 MHz band that generate emissions in the 5150-5250 MHz band must meet all applicable technical requirements for operation in the 5150-5250 MHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5150-5250 MHz band.

For transmitters operating in the 5470-5725MHz band: all emissions outside of the 5470-5725MHz band shall not exceed an EIRP of -27 dBm/MHz.

(2) Unwanted spurious emissions fallen in restricted bands per FCC Part15.205 shall comply with the general field strength limits set forth in § 15.209 as below table,

| Frequency (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 |

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

$$E=\frac{1000000\sqrt{30P}}{3}$$ μV/m, where P is the eirp (Watts)

| EIRP (dBm) | Field Strength at 3m (dBμV/m) |
|---|---|
| -17 | 78.3 |
| - 27 | 68.3 |

(3) KDB789033 D01 v01r03 G)2)c) As specified in 15.407(b), emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of -27 dBm/MHz (or -17 dBm/MHz as specified in 15.407(b)(4)). However, an out-of-band emission that complies with both the average and peak limits of 15.209 is not required to satisfy the -27 dBm/MHz or -17 dBm/MHz 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 v01r03. 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 ≥ 3 MHz
   - Detector = Peak
   - Sweep time = auto
   - Trace mode = max hold

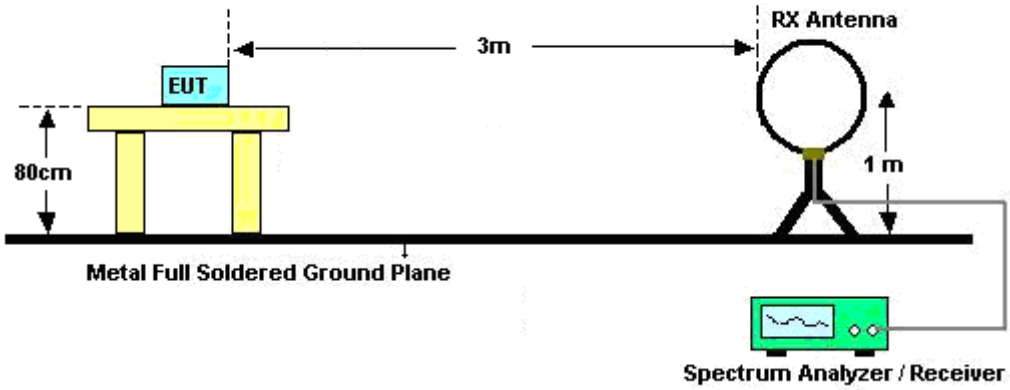
   (3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz

   - RBW = 1 MHz
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 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.

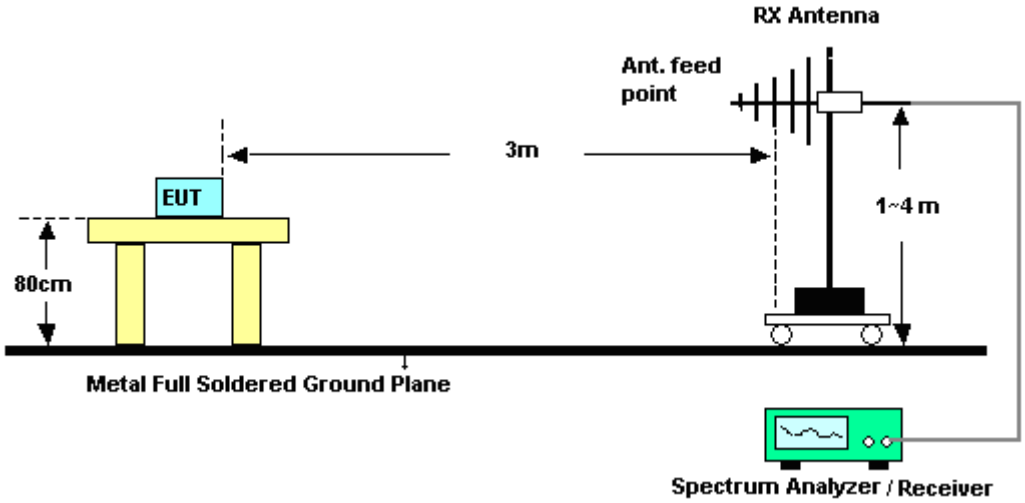
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband 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

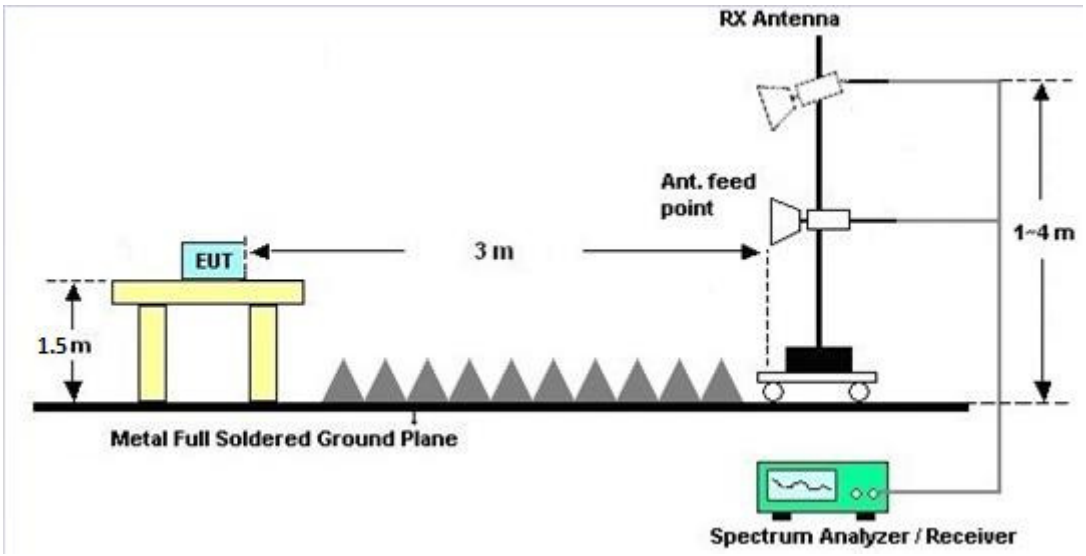
**For radiated emissions below 30MHz**



**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 per 15.31(o) was not reported.

### 3.4.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B and 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 B and 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.

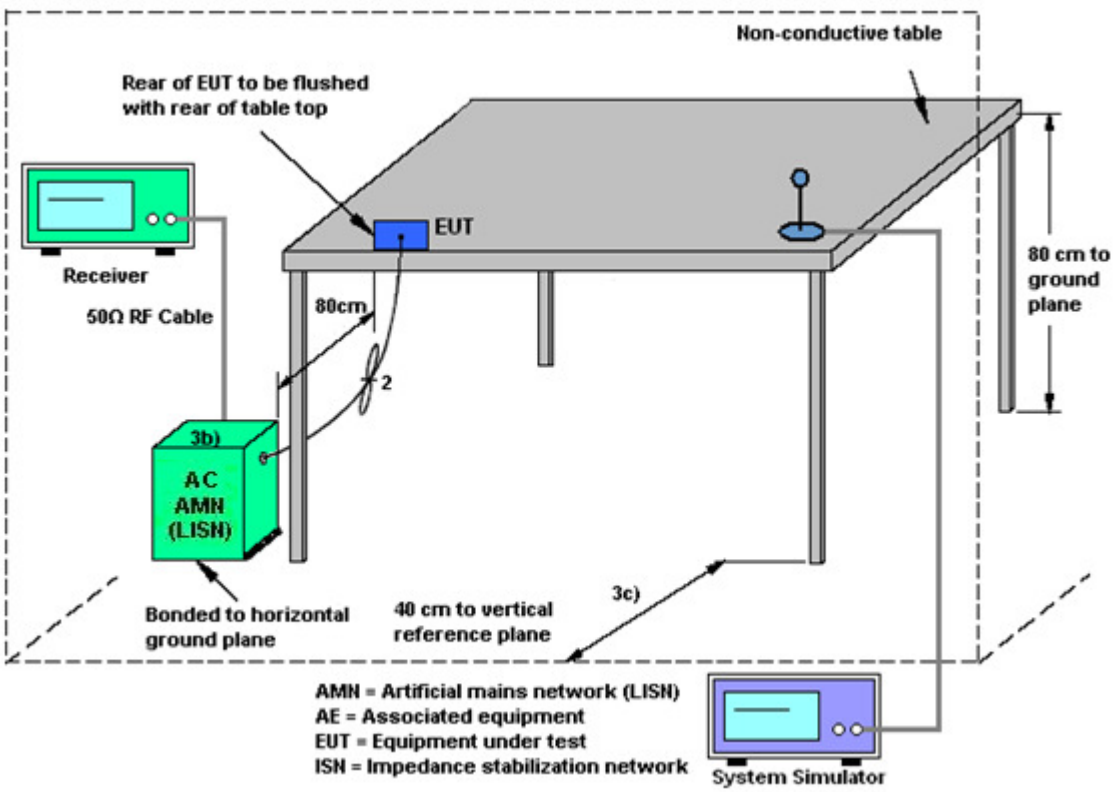
## 3.5.2 Measuring Instruments

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

## 3.5.3 Test Procedures

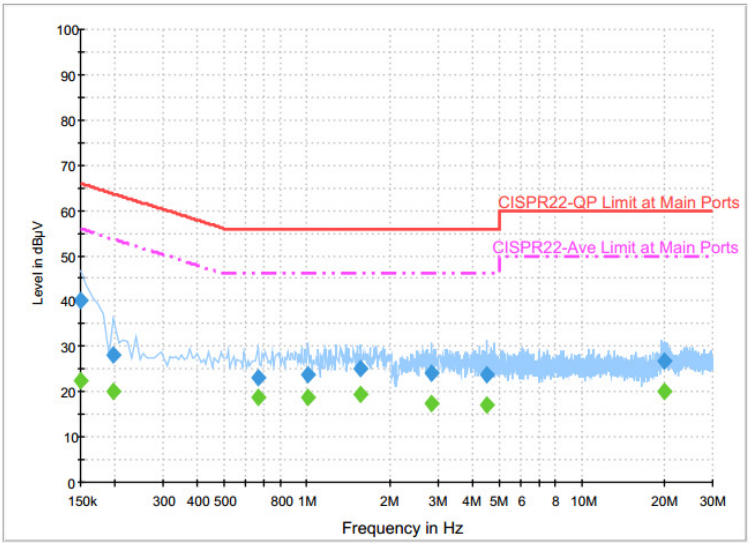
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
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



## 3.5.5 Test Result of AC Conducted Emission

| Test Mode : | Mode 1 | Temperature : | 24~25℃ |
|---|---|---|---|
| Test Engineer : | Kai-Chun Chu | Relative Humidity : | 45~46% |
| Test Voltage : | 120Vac / 60Hz | Phase : | Line |
| Function Type : | GSM1900 (GPRS Class 8) Idle + WLAN (5GHz) Link+ Magnetic Card Reader + RFID Off + Battery 1 + Charging from Adapter 1 + RS-232/4-Pin Cable (Load) + RS-232/RJ-11 Cable (Load) + Printer + SAM Card + Micro SD Card + primary micro-USB port (Cable Load) + secondary micro-USB port (Data Link with USB Storage device) + Smart Card Reader | | |



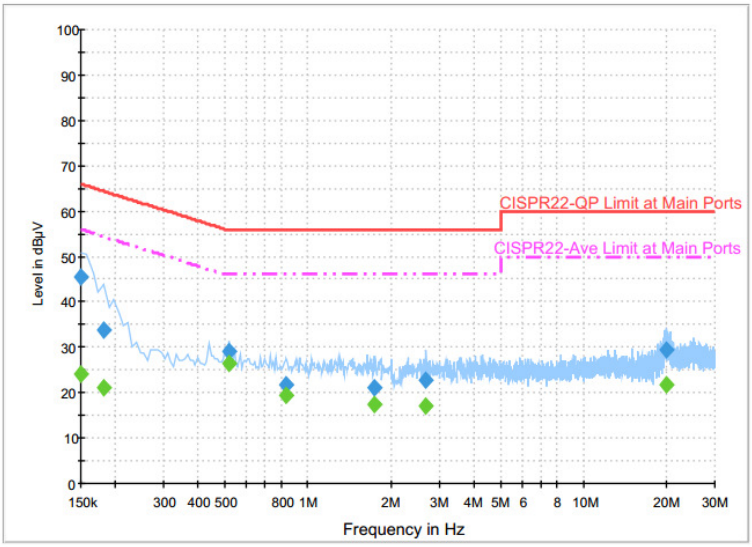

**Final Result : QuasiPeak**

| Frequency (MHz) | QuasiPeak (dBµV) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|
| 0.150000 | 40.3 | Off | L1 | 19.6 | 25.7 | 66.0 |
| 0.198000 | 28.0 | Off | L1 | 19.6 | 35.7 | 63.7 |
| 0.662000 | 23.2 | Off | L1 | 19.6 | 32.8 | 56.0 |
| 1.006000 | 23.8 | Off | L1 | 19.7 | 32.2 | 56.0 |
| 1.574000 | 25.2 | Off | L1 | 19.7 | 30.8 | 56.0 |
| 2.846000 | 24.1 | Off | L1 | 19.5 | 31.9 | 56.0 |
| 4.518000 | 23.6 | Off | L1 | 19.9 | 32.4 | 56.0 |
| 20.070000 | 26.9 | Off | L1 | 20.7 | 33.1 | 60.0 |

**Final Result : Average**

| Frequency (MHz) | Average (dBµV) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|
| 0.150000 | 22.5 | Off | L1 | 19.6 | 33.5 | 56.0 |
| 0.198000 | 20.2 | Off | L1 | 19.6 | 33.5 | 53.7 |
| 0.662000 | 18.8 | Off | L1 | 19.6 | 27.2 | 46.0 |
| 1.006000 | 18.6 | Off | L1 | 19.7 | 27.4 | 46.0 |
| 1.574000 | 19.4 | Off | L1 | 19.7 | 26.6 | 46.0 |
| 2.846000 | 17.4 | Off | L1 | 19.5 | 28.6 | 46.0 |
| 4.518000 | 16.9 | Off | L1 | 19.9 | 29.1 | 46.0 |
| 20.070000 | 20.1 | Off | L1 | 20.7 | 29.9 | 50.0 |

| Test Mode : | Mode 1 | Temperature : | 24~25℃ |
|---|---|---|---|
| Test Engineer : | Kai-Chun Chu | Relative Humidity : | 45~46% |
| Test Voltage : | 120Vac / 60Hz | Phase : | Neutral |
| Function Type : | GSM1900 (GPRS Class 8) Idle + WLAN (5GHz) Link+ Magnetic Card Reader + RFID Off + Battery 1 + Charging from Adapter 1 + RS-232/4-Pin Cable (Load) + RS-232/RJ-11 Cable (Load) + Printer + SAM Card + Micro SD Card + primary micro-USB port (Cable Load) + secondary micro-USB port (Data Link with USB Storage device) + Smart Card Reader | | |




**Final Result : QuasiPeak**

| Frequency (MHz) | QuasiPeak (dBµV) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|
| 0.150000 | 45.4 | Off | N | 19.6 | 20.6 | 66.0 |
| 0.182000 | 33.8 | Off | N | 19.6 | 30.6 | 64.4 |
| 0.518000 | 29.0 | Off | N | 19.6 | 27.0 | 56.0 |
| 0.838000 | 21.6 | Off | N | 19.6 | 34.4 | 56.0 |
| 1.742000 | 21.0 | Off | N | 19.7 | 35.0 | 56.0 |
| 2.686000 | 22.8 | Off | N | 19.4 | 33.2 | 56.0 |
| 20.094000 | 29.5 | Off | N | 20.8 | 30.5 | 60.0 |

**Final Result : Average**

| Frequency (MHz) | Average (dBµV) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|
| 0.150000 | 24.0 | Off | N | 19.6 | 32.0 | 56.0 |
| 0.182000 | 20.9 | Off | N | 19.6 | 33.5 | 54.4 |
| 0.518000 | 26.3 | Off | N | 19.6 | 19.7 | 46.0 |
| 0.838000 | 19.3 | Off | N | 19.6 | 26.7 | 46.0 |
| 1.742000 | 17.3 | Off | N | 19.7 | 28.7 | 46.0 |
| 2.686000 | 17.0 | Off | N | 19.4 | 29.0 | 46.0 |
| 20.094000 | 21.8 | Off | N | 20.8 | 28.2 | 50.0 |

# 3.6 Frequency Stability Measurement

## 3.6.1 Limit of Frequency Stability

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

## 3.6.2 Measuring Instruments

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

## 3.6.3 Test Procedures

1. To ensure emission at the band edge is maintained within the authorized band, those values shall be measured by radiation emissions at upper and lower frequency points, and finally compensated by frequency deviation as procedures below.
2. The EUT was operated at the maximum output power, and connected to the spectrum analyzer, which is set to maximum hold function and peak detector. The peak value of the power envelope was measured and noted. The upper and lower frequency points were respectively measured relatively 10dB lower than the measured peak value.
3. The frequency deviation was calculated by adding the upper frequency point and the lower frequency point divided by two. Those detailed values of frequency deviation are provided in table below.

## 3.6.4 Test Setup


## 3.6.5 Test Result of Frequency Stability

Please refer to Appendix A.

# 3.7 Automatically Discontinue Transmission

## 3.7.1 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.

## 3.7.2 Measuring Instruments

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

## 3.7.3 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.

# 3.8 Antenna Requirements

## 3.8.1 Standard Applicable

According to FCC 47 CFR Section 15.407(a)(1)(2) ,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.

## 3.8.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

## 3.8.3 Antenna Gain

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

# 4 List of Measuring Equipments

| Instrument | Manufacturer | Model No. | Serial No. | Characteristics | Calibration Date | Test Date | Due Date | Remark |
|---|---|---|---|---|---|---|---|---|
| Power Meter | Anritsu | ML2495A | 1132003 | 300MHz~40GHz | Aug. 04, 2016 | Oct. 03, 2016 ~ Oct. 13, 2016 | Aug. 03, 2017 | Conducted (TH05-HY) |
| Power Sensor | Anritsu | MA2411B | 1126017 | 300MHz~40GHz | Aug. 04, 2016 | Oct. 03, 2016 ~ Oct. 13, 2016 | Aug. 03, 2017 | Conducted (TH05-HY) |
| Spectrum Analyzer | Rohde & Schwarz | FSP40 | 100057 | 9kHz-40GHz | Nov. 23, 2015 | Oct. 03, 2016 ~ Oct. 13, 2016 | Nov. 22, 2016 | Conducted (TH05-HY) |
| Temperature Chamber | ESPEC | SU-241 | 92003713 | -30℃ ~95℃ | Jun. 06, 2016 | Oct. 03, 2016 ~ Oct. 13, 2016 | Jun. 05, 2017 | Conducted (TH05-HY) |
| Programmable Power Supply | GW Instek | PSS-2005 | GEO821763 | N/A | Nov. 13, 2015 | Oct. 03, 2016 ~ Oct. 13, 2016 | Nov. 12, 2016 | Conducted (TH05-HY) |
| AC Power Source | ChainTek | APC-1000W | N/A | N/A | N/A | Oct. 12, 2016 | N/A | Conduction (CO05-HY) |
| EMI Test Receiver | Rohde & Schwarz | ESCI 7 | 100724 | 9kHz~7GHz | Aug. 30, 2016 | Oct. 12, 2016 | Aug. 29, 2017 | Conduction (CO05-HY) |
| LISN | Rohde & Schwarz | ENV216 | 100080 | 9kHz~30MHz | Dec. 02, 2015 | Oct. 12, 2016 | Dec. 01, 2016 | Conduction (CO05-HY) |
| LISN | Rohde & Schwarz | ENV216 | 100081 | 9kHz~30MHz | Dec. 14, 2015 | Oct. 12, 2016 | Dec. 13, 2016 | Conduction (CO05-HY) |
| LF Cable | HUBER + SUHNER | RG-214/U | LF01 | N/A | Jan. 06, 2016 | Oct. 12, 2016 | Jan. 05, 2017 | Conduction (CO05-HY) |
| Pulse Limiter | Rohde & Schwarz | ESH3-Z2 | 100851 | N/A | Jan. 08, 2016 | Oct. 12, 2016 | Jan. 07, 2017 | Conduction (CO05-HY) |
| Amplifier | SONOMA | 310N | 187312 | 9kHz~1GHz | Nov. 20, 2015 | Oct. 14, 2016 ~ Oct. 17, 2016 | Nov. 19, 2016 | Radiation (03CH11-HY) |
| Loop Antenna | Rohde & Schwarz | HFH2-Z2 | 100315 | 9 kHz~30 MHz | Sep. 02, 2015 | Oct. 14, 2016 ~ Oct. 17, 2016 | Sep. 01, 2017 | Radiation (03CH11-HY) |
| Bilog Antenna | TESEQ | CBL 6111D | 35414 | 30MHz~1GHz | Nov. 17, 2015 | Oct. 14, 2016 ~ Oct. 17, 2016 | Nov. 16, 2016 | Radiation (03CH11-HY) |
| Horn Antenna | SCHWARZBECK | BBHA 9120 D | 9120D-1522 | 1GHz ~ 18GHz | Mar. 30, 2016 | Oct. 14, 2016 ~ Oct. 17, 2016 | Mar. 31, 2017 | Radiation (03CH11-HY) |
| Preamplifier | Keysight | 83017A | MY53270080 | 1GHz~26.5GHz | Nov. 19, 2015 | Oct. 14, 2016 ~ Oct. 17, 2016 | Nov. 18, 2016 | Radiation (03CH11-HY) |
| Spectrum Analyzer | Keysight | N9010A | MY52350276 | 10Hz ~ 44GHZ | Mar. 21, 2016 | Oct. 14, 2016 ~ Oct. 17, 2016 | Mar. 20, 2017 | Radiation (03CH11-HY) |
| Antenna Mast | EMEC | AM-BS-4500-B | N/A | 1~4m | N/A | Oct. 14, 2016 ~ Oct. 17, 2016 | N/A | Radiation (03CH11-HY) |
| Turn Table | EMEC | TT 2000 | N/A | 0~360 Degree | N/A | Oct. 14, 2016 ~ Oct. 17, 2016 | N/A | Radiation (03CH11-HY) |
| Preamplifier | MITEQ | TTA0204 | 1872107 | 2GHz~40GHz | Feb. 15, 2016 | Oct. 14, 2016 ~ Oct. 17, 2016 | Feb. 14, 2017 | Radiation (03CH11-HY) |
| Signal Generator | Rohde & Schwarz | SMF100A | 101107 | 100kHz~40GHz | May 19, 2016 | Oct. 14, 2016 ~ Oct. 17, 2016 | May 18, 2017 | Radiation (03CH11-HY) |
| SHF-EHF Horn Antenna | SCHWARZBECK | BBHA 9170 | BBHA9170584 | 18GHz- 40GHz | Nov. 02, 2015 | Oct. 14, 2016 ~ Oct. 17, 2016 | Nov. 01, 2016 | Radiation (03CH11-HY) |

# 5 Uncertainty of Evaluation

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

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **2.26** |

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

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **5.20** |

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

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **5.50** |

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

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **5.20** |

# Appendix A. Conducted Test Results