# FCC CO-LOCATION RADIO TEST REPORT

| | | |
|---|---|---|
| **FCC ID** | : | **ACJFZA3A** |
| **Equipment** | : | **Tablet Computer** |
| **Brand Name** | : | **Panasonic** |
| **Model Name** | : | **FZ-A3** |
| **Marketing Name** | : | **FZ-A3** |
| **Applicant** | : | **Panasonic Corporation of North America<br>Two Riverfront Plaza, 9th Floor, Newark, NJ 07102-5490** |
| **Manufacturer** | : | **Panasonic Mobile Communications Co., Ltd.<br>600 Saedo-cho, Tsuzuki-ku, Yokohama City 224-8539, Japan** |
| **Standard** | : | **FCC Part 15 Subpart E §15.407** |

**The product was received on May 19, 2020 and testing was started from Jun. 26, 2020 and completed on Jun. 27, 2020. We, SPORTON INTERNATIONAL INC., EMC & Wireless Communications Laboratory, 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 report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.**

**The test results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.**

Louis Wu

**Approved by: Louis Wu**

***SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory***
*No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)*

# Table of Contents

# History of this test report

| Report No. | Version | Description | Issued Date |
|---|---|---|---|
| FR992410-06D | 01 | Initial issue of report | Jun. 27, 2020 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# Summary of Test Result

| Report Clause | Ref Std. Clause | Test Items | Result (PASS/FAIL) | Remark |
|---|---|---|---|---|
| 3.1 | 15.407(b) | Unwanted Emissions | Pass | Under limit 8.32 dB at 2390.000 MHz |
| 3.2 | 15.203<br>15.407(a) | Antenna Requirement | Pass | - |

**Note:** This is a variant report by adding Vehicle Dock and External Antenna.

| **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. |

**Reviewed by: Wii Chang**

**Report Producer: Yvonne Cheng**

# 1 General Description

## 1.1 Product Feature of Equipment Under Test

Bluetooth, Wi-Fi 2.4GHz 802.11b/g/n, Wi-Fi 5GHz 802.11a/n/ac, NFC, and GNSS.

| Product Specification subjective to this standard | |
|---|---|
| **Antenna Type** | WLAN:<br>**<Ant. 0>** Monopole Antenna<br>**<Ant. 1>** Monopole Antenna<br>Bluetooth:<br>**<Ant. 0>** Monopole Antenna<br>GNSS: Monopole Antenna<br>NFC: Loop Antenna |

| Accessories Information | | |
|---|---|---|
| **AC Adapter** | **Brand Name** | Panasonic |
| | **Model Name** | CF-AA6413A |
| **Battery 1 (Small)** | **Brand Name** | Panasonic |
| | **Model Name** | FZ-VZSUT10U |
| **Battery 2 (Large)** | **Brand Name** | Panasonic |
| | **Model Name** | FZ-VZSUT11U |
| **USB Cable 1** | **Brand Name** | Panasonic |
| | **Model Name** | K1HY24YY0021 |
| **USB Cable 2** | **Brand Name** | ELECOM |
| | **Model Name** | USB3-AC10BK |
| **Gadget 1 (2nd USB)** | **Brand Name** | Panasonic |
| | **Model Name** | N/A |
| **Gadget 2 (BCR)** | **Brand Name** | Panasonic |
| | **Model Name** | N/A |
| **Cradle** | **Brand Name** | Panasonic |
| | **Model Name** | FZ-VEBA21U |
| **Shoulder Strap** | **Brand Name** | Panasonic |
| | **Model Name** | CF-VNS331U |
| **Stylus Pen** | **Brand Name** | Panasonic |
| | **Model Name** | CF-VNP025U |
| **Vehicle Dock** | **Brand Name** | Havis |
| | **Model Name** | DS-PAN-1401-2 |
| **External antenna (2.4G+5G+GNSS)** | **Brand Name** | Airgain |
| | **Model Name** | AP-PAN-MMF WG-Q-BL |

**Remark:** The WLAN external antenna can only be connected to the WLAN ant 1 external antenna port of EUT.

## 1.2 Modification of EUT

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

## 1.3 Testing Location

| | |
|---|---|
| **Test Site** | SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory |
| **Test Site Location** | No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist.,<br>Taoyuan 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.

FCC designation No.: TW0007

## 1.4 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 v02r01.
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- FCC KDB 414788 D01 Radiated Test Site v01r01.
- 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.
3. The TAF code is not including all the FCC KDB listed without accreditation.

# 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: 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 for Bluetooth + 802.11n HT20 Mode; Y Plane for Bluetooth + 802.11g Mode) were recorded in this report.

## 2.1 Carrier Frequency and Channel

| 2400-2483.5 MHz<br>Bluetooth | |
|---|---|
| **Channel** | **Freq. (MHz)** |
| 78 | 2480 |

| 2400-2483.5 MHz<br>802.11g | | 5470-5725 MHz<br>802.11n HT20 | |
|---|---|---|---|
| **Channel** | **Freq. (MHz)** | **Channel** | **Channel** |
| 01 | 2412 | 140 | 5700 |

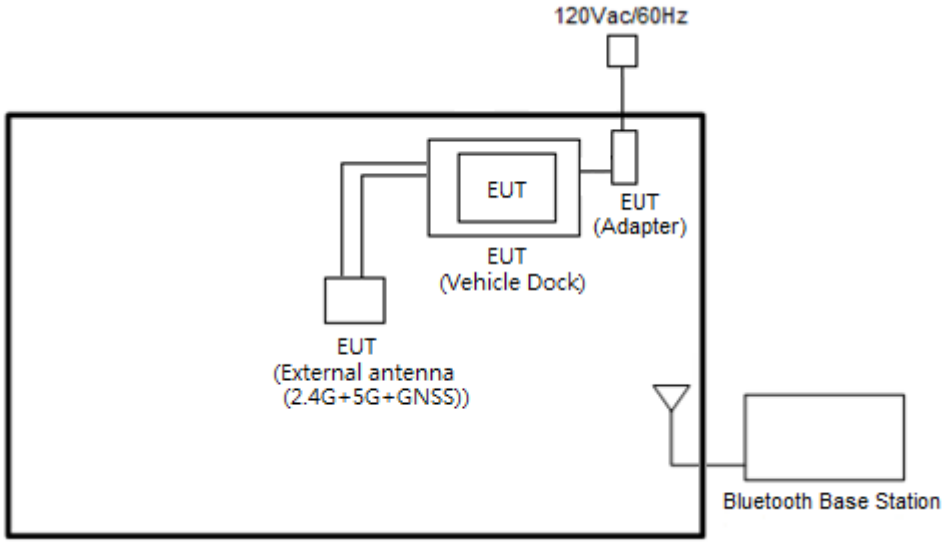
## 2.2 Test Mode

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

**<Co-Location>**

| Modulation | Data Rate |
|---|---|
| **Bluetooth + 2.4GHz 802.11g** | **1Mbps + 6Mbps** |
| **Bluetooth + 5GHz 802.11n HT20** | **1Mbps + MCS0** |

## 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. | Bluetooth Base Station | R&S | CBT32 | N/A | N/A | Unshielded, 1.8 m |

## 2.5 EUT Operation Test Setup

The Bluetooth test items, utility “QRCT4 V4.0-00156” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to contact with base station to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

The RF test items, utility “QRCT4 V4.0-00156” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

# 3 Test Result

## 3.1 Unwanted Emissions Measurement

### 3.1.1 Limit of Unwanted Emissions

(1) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below table:

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009 – 0.490 | 2400/F(kHz) | 300 |
| 0.490 – 1.705 | 24000/F(kHz) | 30 |
| 1.705 – 30.0 | 30 | 30 |
| 30 – 88 | 100 | 3 |
| 88 – 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

**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) |
|---|---|
| - 27 | 68.3 |

(2) KDB789033 D02 v02r01 G)2)c)

(i) Sections 15.407(b)(1-3) specifies the unwanted emissions limit for the U-NII-1 and U-NII-2 bands. As specified, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of −27 dBm/MHz.

(ii) Section 15.407(b)(4) specifies the unwanted emissions limit for the U-NII-3 band. A band emissions mask is specified in Section 15.407(b)(4)(i). The emission limits are based on the use of a peak detector.

### 3.1.2 Measuring Instruments

See list of measuring equipment 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 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

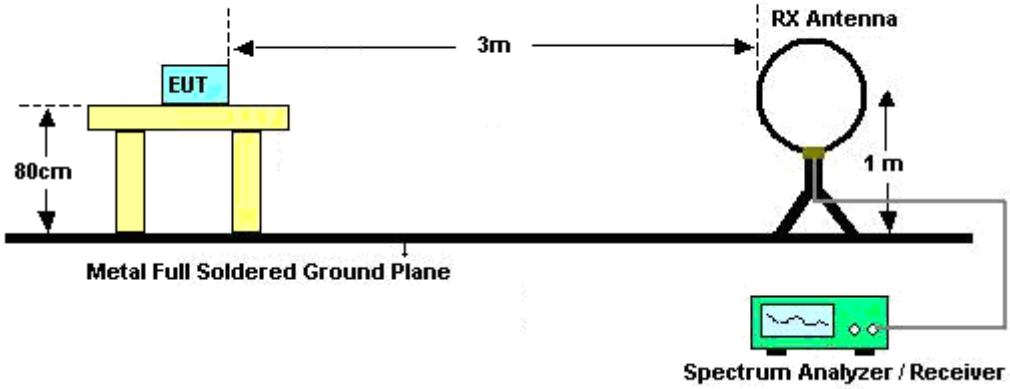
   (3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz

   - 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.

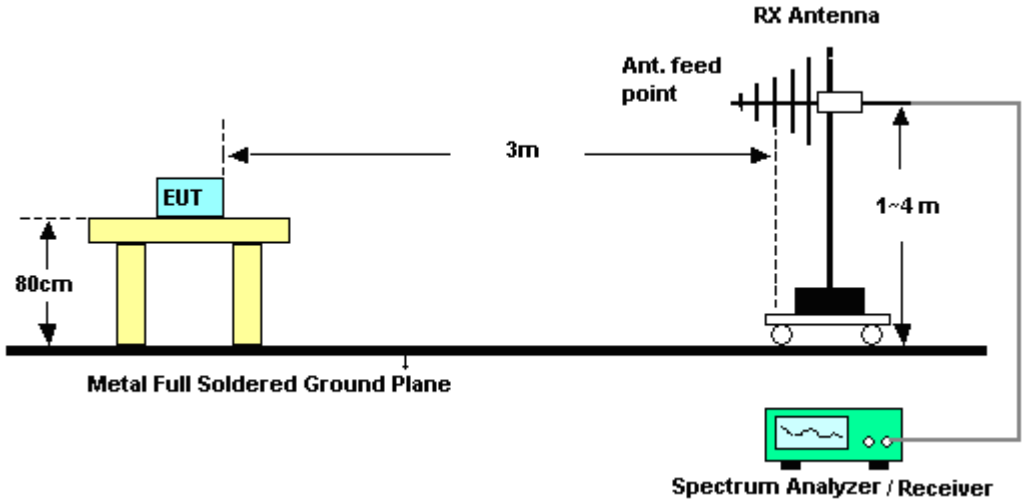
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband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

### 3.1.4 Test Setup

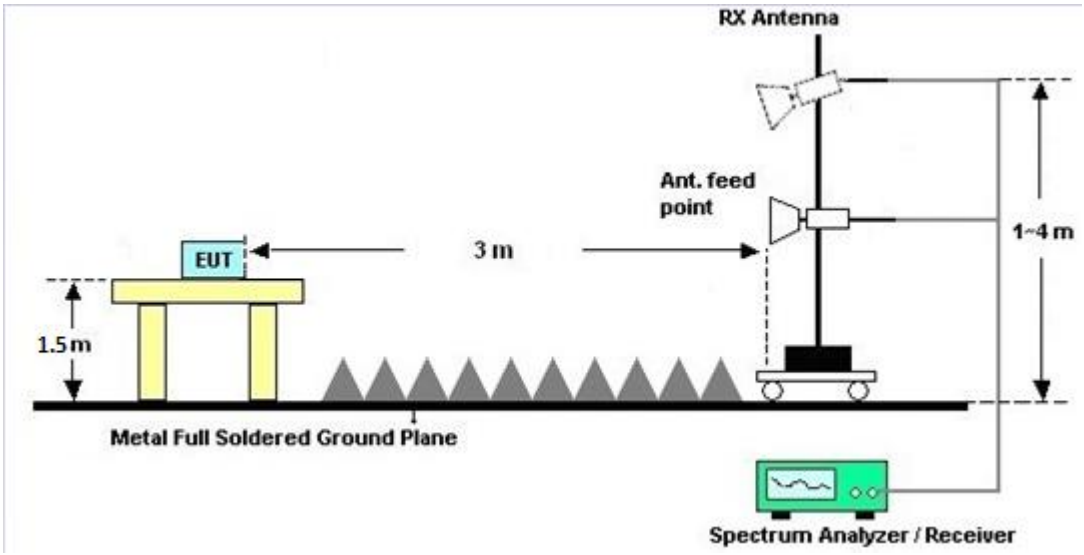
**For radiated emissions below 30MHz**




**For radiated emissions from 30MHz to 1GHz**



**For radiated emissions above 1GHz**




### 3.1.5 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 alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

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

Please refer to Appendix A and B.

### 3.1.7 Duty Cycle

Please refer to Appendix C.

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

Please refer to Appendix A and B.

## 3.2 Antenna Requirements

### 3.2.1 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.

### 3.2.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

### 3.2.3 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 |
|---|---|---|---|---|---|---|---|---|
| Preamplifier | EMCE | EM18G40G | 060715 | 18GHz ~ 40GHz | Dec. 13, 2019 | Jun. 26, 2020~ Jun. 27, 2020 | Dec. 12, 2020 | Radiation (03CH11-HY) |
| Preamplifier | Keysight | 83017A | MY53270080 | 1GHz~26.5GHz | Nov. 13, 2019 | Jun. 26, 2020~ Jun. 27, 2020 | Nov. 12, 2020 | Radiation (03CH11-HY) |
| Preamplifier | Jet-Power | JPA0118-55303K | 1710001800054002 | 1GHz~18GHz | Feb. 07, 2020 | Jun. 26, 2020~ Jun. 27, 2020 | Feb. 06, 2021 | Radiation (03CH11-HY) |
| SHF-EHF Horn Antenna | SCHWARZBECK | BBHA 9170 | BBHA9170576 | 18GHz- 40GHz | May. 22, 2020 | Jun. 26, 2020~ Jun. 27, 2020 | May. 21, 2021 | Radiation (03CH11-HY) |
| Horn Antenna | SCHWARZBECK | BBHA 9120 D | 9120D-1326 | 1GHz ~ 18GHz | Nov. 04, 2019 | Jun. 26, 2020~ Jun. 27, 2020 | Nov. 03, 2020 | Radiation (03CH11-HY) |
| Spectrum Analyzer | Keysight | N9010A | MY54200486 | 10Hz ~ 44GHz | Oct. 28, 2019 | Jun. 26, 2020~ Jun. 27, 2020 | Oct. 27, 2020 | Radiation (03CH11-HY) |
| Controller | EMEC | EM 1000 | N/A | Control Turn table & Ant Mast | N/A | Jun. 26, 2020~ Jun. 27, 2020 | N/A | Radiation (03CH11-HY) |
| Antenna Mast | EMEC | AM-BS-4500-B | N/A | 1~4m | N/A | Jun. 26, 2020~ Jun. 27, 2020 | N/A | Radiation (03CH11-HY) |
| Turn Table | EMEC | TT 2000 | N/A | 0~360 Degree | N/A | Jun. 26, 2020~ Jun. 27, 2020 | N/A | Radiation (03CH11-HY) |
| Software | Audix | E3 6.2009-8-24 | RK-001053 | N/A | N/A | Jun. 26, 2020~ Jun. 27, 2020 | N/A | Radiation (03CH11-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 104 | MY9837/4PE | 9kHz-30MHz | Mar. 12, 2020 | Jun. 26, 2020~ Jun. 27, 2020 | Mar. 11, 2021 | Radiation (03CH11-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 102 | MY2859/2 | 30MHz-40GHz | Mar. 12, 2020 | Jun. 26, 2020~ Jun. 27, 2020 | Mar. 11, 2021 | Radiation (03CH11-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 104 | MY9837/4PE | 30M-18G | Mar. 12, 2020 | Jun. 26, 2020~ Jun. 27, 2020 | Mar. 11, 2021 | Radiation (03CH11-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 102 | MY4274/2 | 30MHz-40GHz | Mar. 12, 2020 | Jun. 26, 2020~ Jun. 27, 2020 | Mar. 11, 2021 | Radiation (03CH11-HY) |
| Filter | Wainwright | WHKX12-2700-3000-18000-60SS | SN3 | 3GHz High Pass Filter | Sep. 15, 2019 | Jun. 26, 2020~ Jun. 27, 2020 | Sep. 14, 2020 | Radiation (03CH11-HY) |
| Hygrometer | TECPEL | DTN-303B | TP140325 | N/A | Nov. 07, 2019 | Jun. 26, 2020~ Jun. 27, 2020 | Nov. 06, 2020 | Radiation (03CH11-HY) |
| Hygrometer | TECPEL | DTN-303B | TP161237 | N/A | Oct. 25, 2019 | Jun. 26, 2020~ Jun. 27, 2020 | Oct. 24, 2020 | Radiation (03CH11-HY) |

# 5 Uncertainty of Evaluation

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

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **52** |

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

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **52** |

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

| | |
|---|---|
| **Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))** | **53** |

# Appendix A. Radiated Spurious Emission

| Test Engineer : | Fu Chen and Troye Hsieh | Temperature : | 20.1~26.4 ℃ |
|---|---|---|---|
| | | Relative Humidity : | 51.7~68.3 % |

**Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11g_Tx_Ch01 (Band Edge @ 3m)**

| WIFI Ant. Simultaneously | Note | Frequency ( MHz ) | Level ( dBμV/m ) | Over Limit ( dB ) | Limit Line ( dBμV/m ) | Read Level ( dBμV ) | Antenna Factor ( dB/m ) | Path Loss ( dB ) | Preamp Factor ( dB ) | Ant Pos ( cm ) | Table Pos ( deg ) | Peak Avg. (P/A) | Pol. (H/V) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bluetooth_Tx Ch78 + 802.11g_Tx Ch01 | * | 2480 | 101.04 | - | - | 100.18 | 27.28 | 6.79 | 33.21 | 184 | 167 | P | H |
| | * | 2480 | 76.28 | - | - | - | - | - | - | - | - | A | H |
| | | 2483.64 | 47.79 | -26.21 | 74 | 46.94 | 27.27 | 6.79 | 33.21 | 184 | 167 | P | H |
| | | 2483.64 | 23.03 | -30.97 | 54 | - | - | - | - | - | - | A | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | * | 2480 | 95.48 | - | - | 94.62 | 27.28 | 6.79 | 33.21 | 100 | 23 | P | V |
| | * | 2480 | 70.72 | - | - | - | - | - | - | - | - | A | V |
| | | 2483.5 | 44.65 | -29.35 | 74 | 43.8 | 27.27 | 6.79 | 33.21 | 100 | 23 | P | V |
| | | 2483.5 | 19.89 | -34.1 | 54 | - | - | - | - | - | - | A | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| Remark | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. | | | | | | | | | | | | |

**Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11g_Tx_Ch01 (Band Edge @ 3m)**

| WIFI Ant. Simultaneously | Note | Frequency ( MHz ) | Level ( dBµV/m ) | Over Limit ( dB ) | Limit Line ( dBµV/m ) | Read Level ( dBµV ) | Antenna Factor ( dB/m ) | Path Loss ( dB ) | Preamp Factor ( dB ) | Ant Pos ( cm ) | Table Pos ( deg ) | Peak Avg. (P/A) | Pol. (H/V) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bluetooth_Tx Ch78 + 802.11g_Tx Ch01 | | 2389.065 | 58.88 | -15.12 | 74 | 47.97 | 27.52 | 16.62 | 33.23 | 300 | 97 | P | H |
| | | 2390 | 45.68 | -8.32 | 54 | 34.77 | 27.52 | 16.62 | 33.23 | 300 | 97 | A | H |
| | * | 2412 | 106.94 | - | - | 96.05 | 27.48 | 16.64 | 33.23 | 300 | 97 | P | H |
| | * | 2412 | 99.3 | - | - | 88.41 | 27.48 | 16.64 | 33.23 | 300 | 97 | A | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | 2388.75 | 56.42 | -17.58 | 74 | 45.51 | 27.52 | 16.62 | 33.23 | 110 | 50 | P | V |
| | | 2390 | 45.36 | -8.64 | 54 | 34.45 | 27.52 | 16.62 | 33.23 | 110 | 50 | A | V |
| | * | 2412 | 105.76 | - | - | 94.87 | 27.48 | 16.64 | 33.23 | 110 | 50 | P | V |
| | * | 2412 | 98.19 | - | - | 87.3 | 27.48 | 16.64 | 33.23 | 110 | 50 | A | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| Remark | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. | | | | | | | | | | | | |

**Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11g_Tx_Ch01 ((Harmonic @ 3m)**

| WIFI Ant. Simultaneously | Note | Frequency ( MHz ) | Level ( dBµV/m ) | Over Limit ( dB ) | Limit Line ( dBµV/m ) | Read Level ( dBµV ) | Antenna Factor ( dB/m ) | Path Loss ( dB ) | Preamp Factor ( dB ) | Ant Pos ( cm ) | Table Pos ( deg ) | Peak Avg. (P/A) | Pol. (H/V) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bluetooth_Tx Ch78 + 802.11g_Tx Ch01 | | 4830 | 41.17 | -32.83 | 74 | 59.66 | 31 | 10.95 | 60.44 | 100 | 0 | P | H |
| | | 4960 | 41.11 | -32.89 | 74 | 59.29 | 31.14 | 11.01 | 60.33 | 100 | 0 | P | H |
| | | 7440 | 43.77 | -30.23 | 74 | 53.22 | 36.38 | 13.21 | 59.04 | 100 | 0 | P | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | 4824 | 39.97 | -34.03 | 74 | 58.47 | 31 | 10.94 | 60.44 | 100 | 0 | P | V |
| | | 4960 | 40.81 | -33.19 | 74 | 58.99 | 31.14 | 11.01 | 60.33 | 100 | 0 | P | V |
| | | 7440 | 42.94 | -31.06 | 74 | 52.39 | 36.38 | 13.21 | 59.04 | 100 | 0 | P | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| **Remark** | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. | | | | | | | | | | | | |

## Emission below 1GHz

### Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11g_Tx_Ch01 (LF)

| WIFI | Note | Frequency | Level | Over | Limit | Read | Antenna | Path | Preamp | Ant | Table | Peak | Pol. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ant. | | | | Limit | Line | Level | Factor | Loss | Factor | Pos | Pos | Avg. | |
| Simultaneously | | ( MHz ) | ( dBµV/m ) | ( dB ) | ( dBµV/m ) | (dBµV) | ( dB/m ) | ( dB ) | ( dB ) | ( cm ) | ( deg ) | (P/A) | (H/V) |
| Bluetooth_Tx Ch78 + 802.11g_Tx Ch01 LF | | 30 | 23.9 | -16.1 | 40 | 31.41 | 24.15 | 0.76 | 32.42 | | | P | H |
| | | 53.28 | 21.42 | -18.58 | 40 | 40.21 | 12.68 | 1.06 | 32.53 | | | P | H |
| | | 169.68 | 25.14 | -18.36 | 43.5 | 40.3 | 15.44 | 1.93 | 32.53 | | | P | H |
| | | 856.44 | 29.04 | -16.96 | 46 | 27.81 | 28.94 | 4.21 | 31.92 | | | P | H |
| | | 865.17 | 29.65 | -16.35 | 46 | 28.28 | 29.02 | 4.23 | 31.88 | | | P | H |
| | | 952.47 | 30.43 | -15.57 | 46 | 26.83 | 30.2 | 4.44 | 31.04 | 100 | 0 | P | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | 53.28 | 30.4 | -9.6 | 40 | 49.19 | 12.68 | 1.06 | 32.53 | 100 | 0 | P | V |
| | | 87.23 | 25.42 | -14.58 | 40 | 42.32 | 14.16 | 1.36 | 32.42 | | | P | V |
| | | 99.84 | 27.38 | -16.12 | 43.5 | 42.65 | 15.66 | 1.45 | 32.38 | | | P | V |
| | | 850.62 | 29.52 | -16.48 | 46 | 28.45 | 28.81 | 4.2 | 31.94 | | | P | V |
| | | 861.29 | 29.67 | -16.33 | 46 | 28.34 | 29.01 | 4.22 | 31.9 | | | P | V |
| | | 949.56 | 31.65 | -14.35 | 46 | 28.25 | 30.04 | 4.44 | 31.08 | | | P | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |

**Remark**

1. No other spurious found.
2. All results are PASS against limit line.

**Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11n HT20_Tx_Ch140 (Band Edge @ 3m)**

| WIFI Ant. Simultaneously | Note | Frequency ( MHz ) | Level ( dBμV/m ) | Over Limit ( dB ) | Limit Line ( dBμV/m ) | Read Level ( dBμV ) | Antenna Factor ( dB/m ) | Path Loss ( dB ) | Preamp Factor ( dB ) | Ant Pos ( cm ) | Table Pos ( deg ) | Peak Avg. (P/A) | Pol. (H/V) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bluetooth_Tx Ch78 + 802.11n HT20_Tx Ch140 | * | 2480 | 101.42 | - | - | 100.56 | 27.28 | 6.79 | 33.21 | 174 | 148 | P | H |
| | * | 2480 | 76.66 | - | - | - | - | - | - | - | - | P | H |
| | | 2483.6 | 49.09 | -24.91 | 74 | 48.24 | 27.27 | 6.79 | 33.21 | 174 | 148 | A | H |
| | | 2483.6 | 24.33 | -29.67 | 54 | - | - | - | - | - | - | P | H |
| | | | | | | | | | | | | A | H |
| | | | | | | | | | | | | P | H |
| | * | 2480 | 95.36 | - | - | 94.5 | 27.28 | 6.79 | 33.21 | 300 | 0 | P | V |
| | * | 2480 | 70.6 | - | - | - | - | - | - | - | - | P | V |
| | | 2483.52 | 44.23 | -29.77 | 74 | 43.38 | 27.27 | 6.79 | 33.21 | 300 | 0 | A | V |
| | | 2483.52 | 19.47 | -34.53 | 54 | - | - | - | - | - | - | P | V |
| | | | | | | | | | | | | A | V |
| | | | | | | | | | | | | P | V |
| Remark | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. | | | | | | | | | | | | |

**Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11n HT20_Tx_Ch140 (Band Edge @ 3m)**

| WIFI Ant. Simultaneously | Note | Frequency ( MHz ) | Level ( dBμV/m ) | Over Limit ( dB ) | Limit Line ( dBμV/m ) | Read Level ( dBμV ) | Antenna Factor ( dB/m ) | Path Loss ( dB ) | Preamp Factor ( dB ) | Ant Pos ( cm ) | Table Pos ( deg ) | Peak Avg. (P/A) | Pol. (H/V) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bluetooth_Tx Ch78 + 802.11n HT20_Tx Ch140 | * | 5700 | 91.47 | - | - | 81.45 | 32.1 | 10.45 | 32.53 | 351 | 30 | P | H |
| | * | 5700 | 83.34 | - | - | 73.32 | 32.1 | 10.45 | 32.53 | 351 | 30 | A | H |
| | | 5737.24 | 51.38 | -16.82 | 68.2 | 41.24 | 32.17 | 10.49 | 32.52 | 351 | 30 | A | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | * | 5700 | 91.37 | - | - | 81.35 | 32.1 | 10.45 | 32.53 | 245 | 9 | P | V |
| | * | 5700 | 83.3 | - | - | 73.28 | 32.1 | 10.45 | 32.53 | 245 | 9 | A | V |
| | | 5751.8 | 51.88 | -16.32 | 68.2 | 41.69 | 32.2 | 10.51 | 32.52 | 245 | 9 | A | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| Remark | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. | | | | | | | | | | | | |

**Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11n HT20_Tx_Ch140 ((Harmonic @ 3m)**

| WIFI Ant. Simultaneously | Note | Frequency ( MHz ) | Level ( dBμV/m ) | Over Limit ( dB ) | Limit Line ( dBμV/m ) | Read Level ( dBμV ) | Antenna Factor ( dB/m ) | Path Loss ( dB ) | Preamp Factor ( dB ) | Ant Pos ( cm ) | Table Pos ( deg ) | Peak Avg. (P/A) | Pol. (H/V) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bluetooth_Tx Ch78 + 802.11n HT20_Tx Ch140 | | 4960 | 53.79 | -20.21 | 74 | 43.84 | 31.14 | 11.68 | 32.87 | 100 | 0 | P | H |
| | | 7440 | 44.82 | -29.18 | 74 | 53.86 | 36.38 | 13.62 | 59.04 | 100 | 0 | P | H |
| | | 11400 | 49.12 | -24.88 | 74 | 53.85 | 39.7 | 17.93 | 62.36 | 100 | 0 | P | H |
| | | 17100 | 48.64 | -19.56 | 68.2 | 44.99 | 39.7 | 22.67 | 58.72 | 100 | 0 | P | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | 4960 | 53.35 | -20.65 | 74 | 43.4 | 31.14 | 11.68 | 32.87 | 100 | 0 | P | V |
| | | 7440 | 44.34 | -29.66 | 74 | 53.38 | 36.38 | 13.62 | 59.04 | 100 | 0 | P | V |
| | | 11400 | 47.58 | -26.42 | 74 | 52.31 | 39.7 | 17.93 | 62.36 | 100 | 0 | P | V |
| | | 17100 | 48.2 | -20 | 68.2 | 44.55 | 39.7 | 22.67 | 58.72 | 100 | 0 | P | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| Remark | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. | | | | | | | | | | | | |

## Emission below 1GHz

### Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11n HT20_Tx_Ch140 (LF @ 3m)

| WIFI | Note | Frequency | Level | Over | Limit | Read | Antenna | Path | Preamp | Ant | Table | Peak | Pol. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ant. | | | | Limit | Line | Level | Factor | Loss | Factor | Pos | Pos | Avg. | |
| Simultaneously | | ( MHz ) | ( dBµV/m ) | ( dB ) | ( dBµV/m ) | (dBµV) | ( dB/m ) | ( dB ) | ( dB ) | ( cm ) | ( deg ) | (P/A) | (H/V) |
| Bluetooth_Tx Ch78 + 802.11n HT20_Tx Ch140 LF | | 30 | 23.55 | -16.45 | 40 | 31.06 | 24.15 | 0.76 | 32.42 | | | P | H |
| | | 53.28 | 21.59 | -18.41 | 40 | 40.38 | 12.68 | 1.06 | 32.53 | | | P | H |
| | | 119.24 | 23.49 | -20.01 | 43.5 | 37.23 | 17.13 | 1.55 | 32.42 | | | P | H |
| | | 857.41 | 29.6 | -16.4 | 46 | 28.34 | 28.95 | 4.22 | 31.91 | | | P | H |
| | | 877.78 | 30.36 | -15.64 | 46 | 28.87 | 29.07 | 4.25 | 31.83 | | | P | H |
| | | 957.32 | 31.21 | -14.79 | 46 | 27.22 | 30.51 | 4.45 | 30.97 | 100 | 0 | P | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | 30 | 25.5 | -14.5 | 40 | 33.01 | 24.15 | 0.76 | 32.42 | | | P | V |
| | | 53.28 | 30.4 | -9.6 | 40 | 49.19 | 12.68 | 1.06 | 32.53 | 100 | 0 | P | V |
| | | 119.24 | 25.72 | -17.78 | 43.5 | 39.46 | 17.13 | 1.55 | 32.42 | | | P | V |
| | | 936.95 | 29.91 | -16.09 | 46 | 27.33 | 29.42 | 4.4 | 31.24 | | | P | V |
| | | 951.5 | 30.06 | -15.94 | 46 | 26.52 | 30.15 | 4.44 | 31.05 | | | P | V |
| | | 959.26 | 31.4 | -14.6 | 46 | 27.25 | 30.64 | 4.46 | 30.95 | | | P | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |

**Remark**

1. No other spurious found.
2. All results are PASS against limit line.

**Note symbol**

| | |
|---|---|
| * | **Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency. |
| ! | Test result is **over limit** line. |
| P/A | **P**eak or **A**verage |
| H/V | **H**orizontal or **V**ertical |

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

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

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =

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

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

**For Peak Limit @ 2390MHz:**

1. Level(dBμV/m)

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

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

**For Average Limit @ 2390MHz:**

1. Level(dBμV/m)

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

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

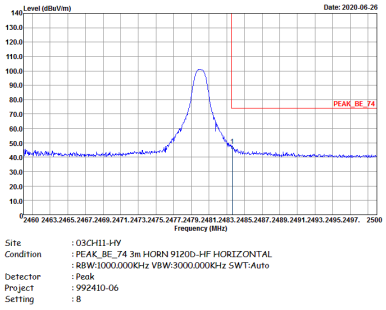
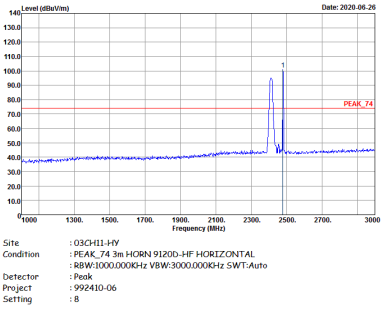
= -10.46(dB)

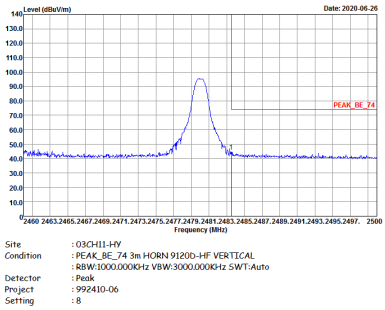
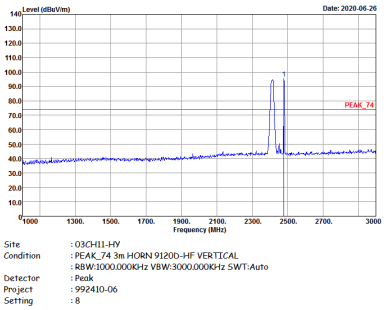
**Both peak and average measured complies with the limit line, so test result is "PASS".**

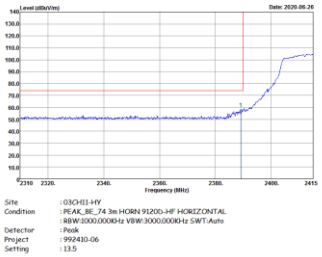
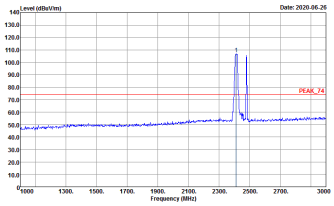
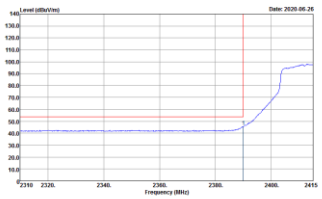
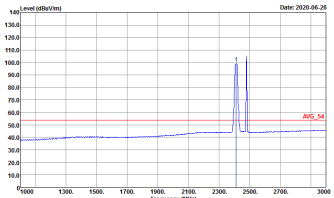
# Appendix B. Radiated Spurious Emission Plots

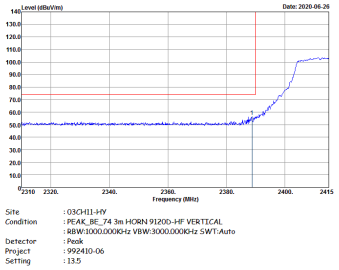
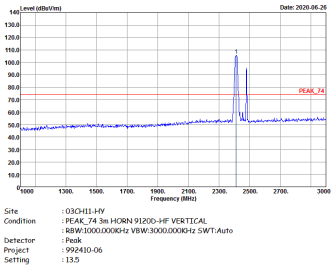
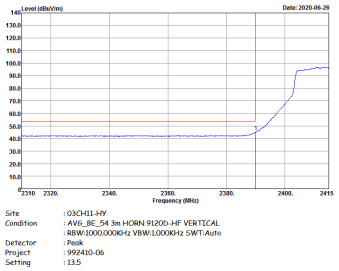
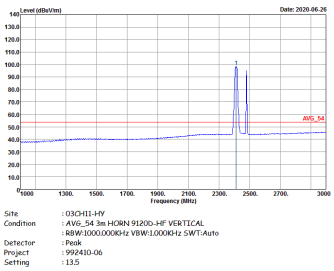
| Test Engineer : | Fu Chen and Troye Hsieh | Temperature : | 20.1~26.4 ℃ |
|---|---|---|---|
| | | Relative Humidity : | 51.7~68.3 % |

## Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11g_Tx_Ch01 (Band Edge @ 3m)

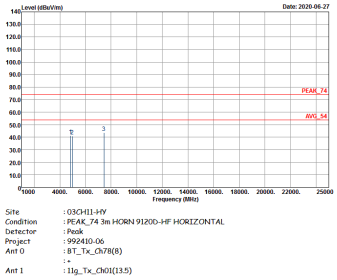
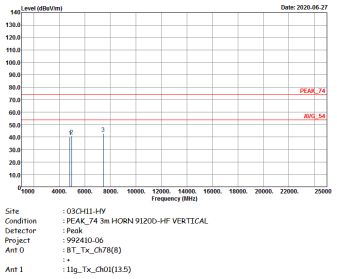
| Ant. | Bluetooth_Tx_Ch78+802.11g_Tx_Ch01 | |
|---|---|---|
| Simultaneously | Horizontal | Fundamental |
| Peak |  |  |

| Ant. | Bluetooth_Tx_Ch78+802.11g_Tx_Ch01 | |
|---|---|---|
| Simultaneously | Vertical | Fundamental |
| Peak |  |  |

| ANT | Bluetooth_Tx_Ch78+802.11g_Tx_Ch01 | |
|---|---|---|
| Simultaneously | Horizontal | Fundamental |
| Peak |  |  |
| Avg. |  |  |

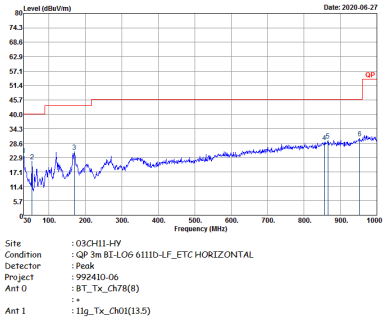
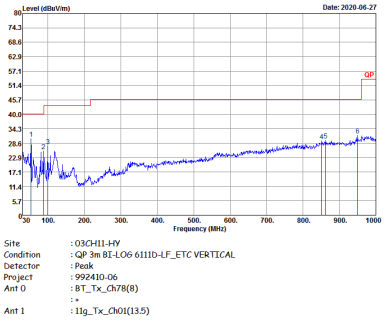
| ANT | Bluetooth_Tx_Ch78+802.11g_Tx_Ch01 | |
|---|---|---|
| Simultaneously | Vertical | Fundamental |
| Peak |  |  |
| Avg. |  |  |

## Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11g_Tx_Ch01 (Harmonic @ 3m)

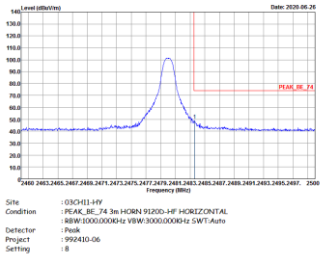
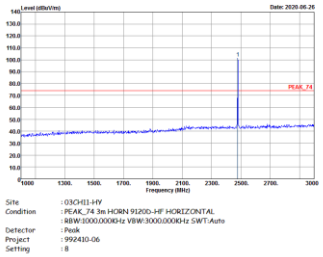
| ANT | Bluetooth_Tx_Ch78+802.11g_Tx_Ch01 | |
|---|---|---|
| Simultaneously | Horizontal | Vertical |
| Peak<br>Avg. |  |  |

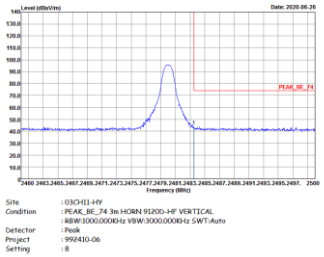
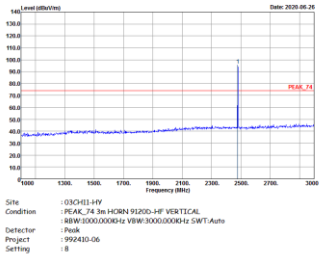
## Emission below 1GHz

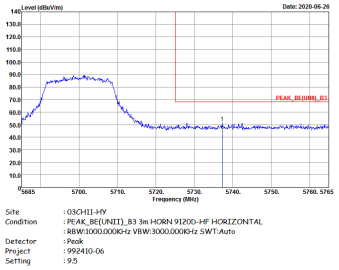
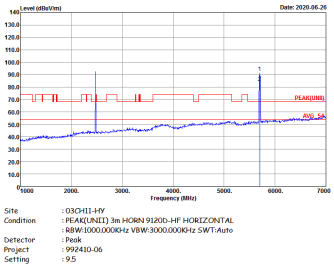
## Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11g_Tx_Ch01 (LF)

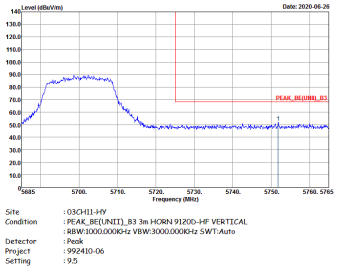
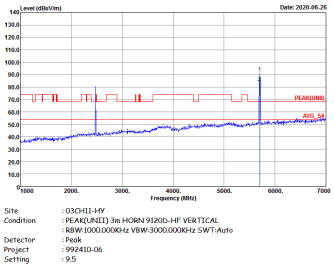
| Ant. | Bluetooth_Tx_Ch78+802.11g_Tx_Ch01 LF | |
|---|---|---|
| Simultaneously | Horizontal | Vertical |
| QP / Peak |  |  |

## Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11n HT20_Tx_Ch140 (Band Edge @ 3m)

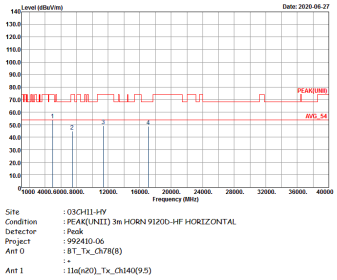
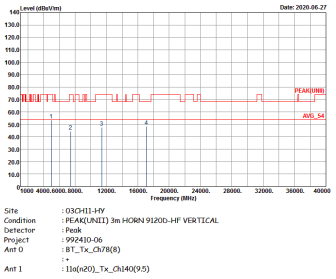
| ANT | Bluetooth_Tx_Ch78+802.11n HT20_Tx_Ch140 | |
|---|---|---|
| Simultaneously | Horizontal | Fundamental |
| Peak |  |  |

| ANT | Bluetooth_Tx_Ch78+802.11n HT20_Tx_Ch140 | |
|---|---|---|
| Simultaneously | Horizontal | Fundamental |
| Peak |  |  |

| ANT | Bluetooth_Tx_Ch78+802.11n HT20_Tx_Ch140 | |
|---|---|---|
| Simultaneously | Vertical | Fundamental |
| Peak |  |  |

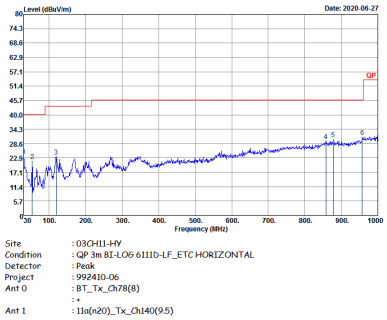
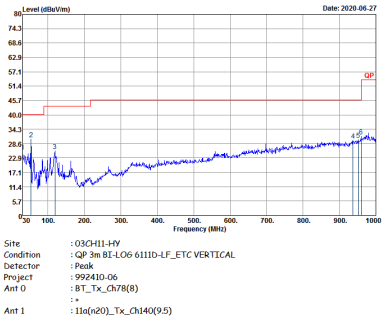
| ANT | Bluetooth_Tx_Ch78+802.11n HT20_Tx_Ch140 | |
|---|---|---|
| Simultaneously | Vertical | Fundamental |
| Peak |  |  |

## Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11n HT20_Tx_Ch140 (Harmonic @ 3m)

| ANT | Bluetooth_Tx_Ch78+802.11n HT20_Tx_Ch140 | |
|---|---|---|
| Simultaneously | Horizontal | Vertical |
| Peak<br>Avg. |  |  |

## Emission below 1GHz

### Ant 0_Bluetooth_Tx_Ch78 + Ant 1_802.11n HT20_Tx_Ch140 (LF)

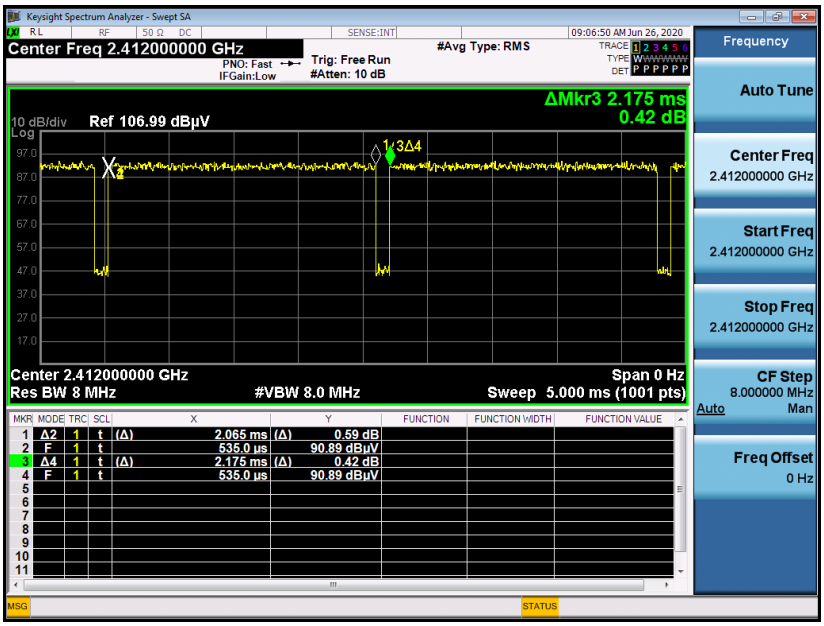
| Ant. | Bluetooth_Tx_Ch78+802.11n HT20_Tx_Ch140 | |
|---|---|---|
| Simultaneously | Horizontal | Vertical |
| QP / Peak |  |  |

# Appendix C. Duty Cycle Plots

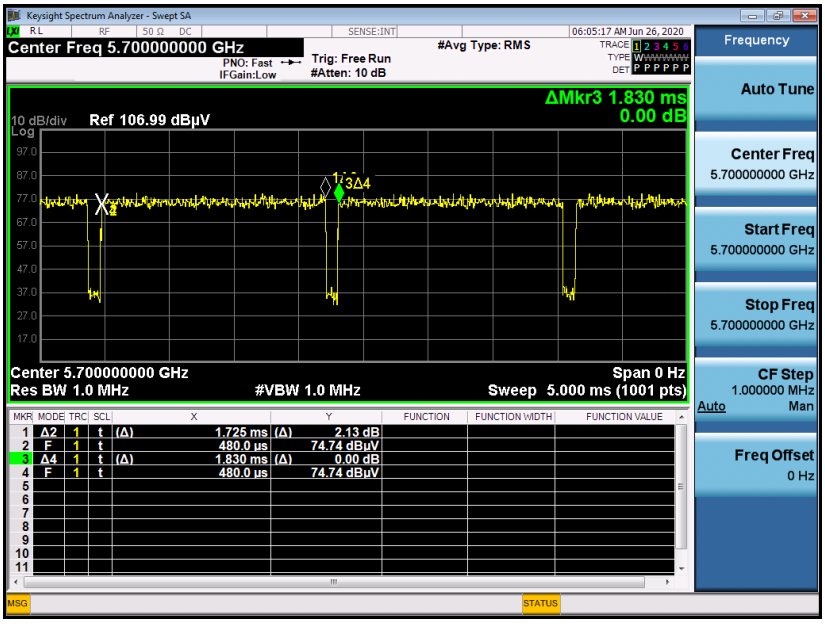
| Antenna | Band | Duty Cycle(%) | T(us) | 1/T(kHz) | VBW Setting | Duty Factor(dB) |
|---|---|---|---|---|---|---|
| 1 | 802.11g | 94.94 | 2065 | 0.48 | 1kHz | 0.23 |
| 1 | 5GHz 802.11n HT20 | 94.26 | 1725 | 0.58 | 1kHz | 0.26 |

**<Ant. 1>**

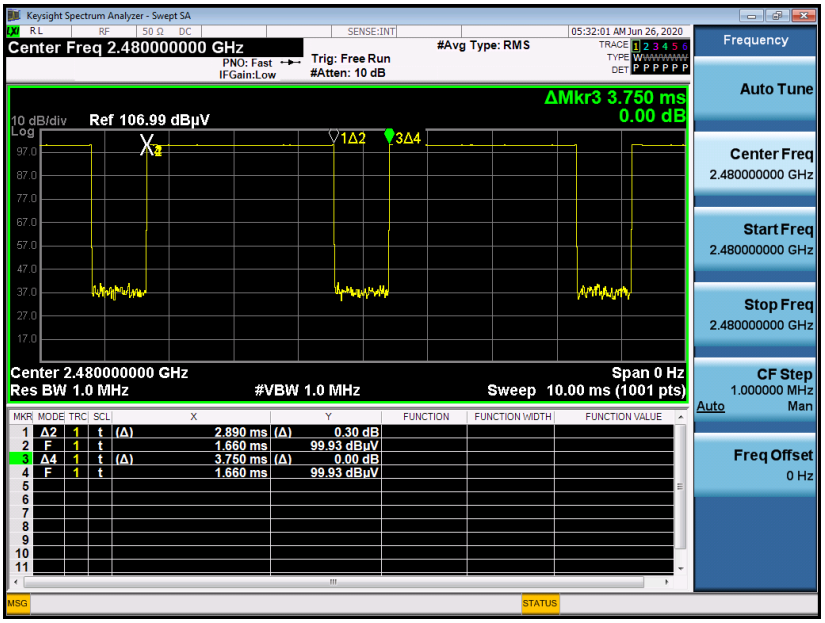
**802.11g**



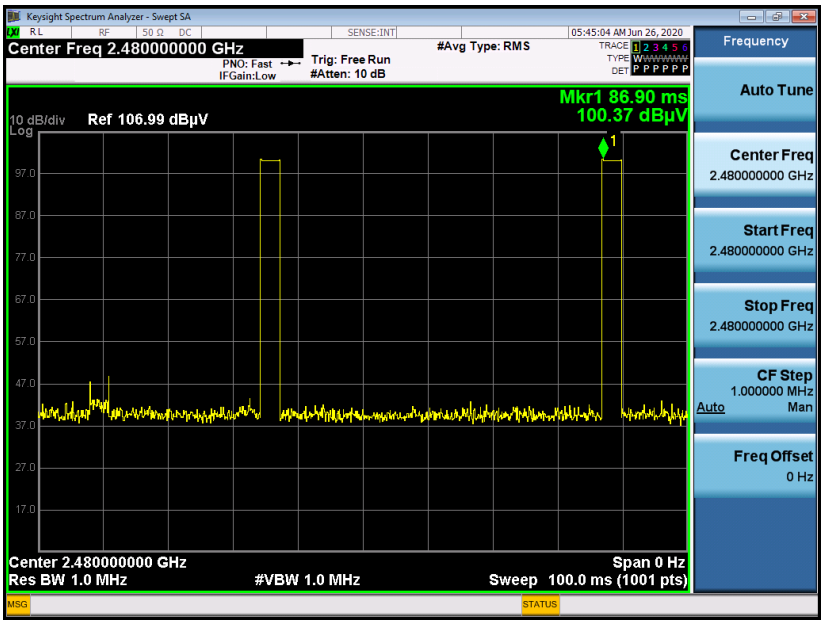

**802.11n HT20**



**DH5 on time (One Pulse) Plot on Channel 78**




**on time (Count Pulses) Plot on Channel 78**




**Note:**

1. Worst case Duty cycle = on time/100 milliseconds = 2 * 2.89 / 100 = 5.78 %
2. Worst case Duty cycle correction factor = 20*log(Duty cycle) = -24.76 dB
3. **DH5** has the highest duty cycle worst case and is reported.

**Duty Cycle Correction Factor Consideration for AFH mode:**

Bluetooth normal hopping rate is 1600Hz and reduced to 800Hz in AFH mode; due to the reduced number of hopping frequencies, with the same packet configuration the dwell time in each channel frequency within 100msec period is longer in AFH mode than normal mode.

In AFH mode, the minimum hopping frequencies are 20, to get the longest dwell time DH5 packet is observed; the period to have DH5 packet completing one hopping sequence is

*2.89 ms x 20 channels = 57.8 ms*

There cannot be 2 complete hopping sequences within 100ms period, considering the random hopping behavior, maximum 2 hops can be possibly observed within the period. [100ms / 57.6ms ] = 2 hops

Thus, the maximum possible ON time:

*2.89 ms x 2 = 5.78 ms*

Worst case Duty Cycle Correction factor, which is derived from the maximum possible ON time,

*20 x log(5.78 ms/100ms) = -24.76 dB*