



**FCC CFR47 PART 15 SUBPART C**

**CERTIFICATION TEST REPORT**

**FOR**

**GSM/WCDMA/LTE + BLUETOOTH, DTS/UNII a/b/g/n/ac, ANT+ and NFC**

**FCC ID: PY7-PM0794**

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** SONY MOBILE COMMUNICATIONS, INC.  
**EUT DESCRIPTION:** GSM/WCDMA/LTE + BLUETOOTH, DTS/UNII a/b/g/n/ac, ANT+ and NFC  
**SERIAL NUMBER:** 159243-6 (Conducted), 153033-5 (Radiated)  
**DATE TESTED:** MARCH 9-27, 2015

| APPLICABLE STANDARDS     |              |
|--------------------------|--------------|
| STANDARD                 | TEST RESULTS |
| CFR 47 Part 15 Subpart C | Pass         |

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

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## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, and ANSI C63.4-2009.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

| 47173 Benicia Street                                       | 47266 Benicia Street                                       |
|------------------------------------------------------------|------------------------------------------------------------|
| <input checked="" type="checkbox"/> Chamber A(IC: 2324B-1) | <input type="checkbox"/> Chamber D(IC: 2324B-4)            |
| <input type="checkbox"/> Chamber B(IC: 2324B-2)            | <input type="checkbox"/> Chamber E(IC: 2324B-5)            |
| <input checked="" type="checkbox"/> Chamber C(IC: 2324B-3) | <input type="checkbox"/> Chamber F(IC: 2324B-6)            |
|                                                            | <input checked="" type="checkbox"/> Chamber G(IC: 2324B-7) |
|                                                            | <input type="checkbox"/> Chamber H(IC: 2324B-8)            |

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\text{Field Strength (dBuV/m)} = \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Preamp Gain (dB)}$$

$$36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$$

### 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER                             | UNCERTAINTY |
|---------------------------------------|-------------|
| Conducted Disturbance, 0.15 to 30 MHz | 3.52 dB     |
| Radiated Disturbance, 30 to 18000 MHz | 4.94 dB     |

Uncertainty figures are valid to a confidence level of 95%.

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

This EUT is a GSM/WCDMA/LTE + BLUETOOTH, DTS/UNII a/b/g/n/ac , ANT+ and NFC.

The model FCC ID: PY7-PM0794 shares the same enclosure and circuit board as mode FCC ID: PY7-PM0793. The unlicensed radios (WLAN/BT/NFC/ANT+) including antenna and GPS receiver, are identical between the two units.

After confirming through preliminary radiated emissions that the performance of the FCC ID: PY7-PM0793 data remains representative of this model (FCC ID: PY7-PM0794), FCC ID: PY7-PM0794 leveraged test data from FCC ID: PY7-PM0793.

### 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum total conducted output power as follows:

| Frequency Range<br>(MHz) | Mode         | Total Output<br>Power<br>(dBm) | Total Output<br>Power<br>(mW) |
|--------------------------|--------------|--------------------------------|-------------------------------|
| 2412 - 2467              | 802.11b      | 12.3                           | 16.98                         |
| 2472                     | 802.11b      | 11.7                           | 14.79                         |
| 2412 - 2467              | 802.11g      | 13.8                           | 23.99                         |
| 2472                     | 802.11g      | 10.7                           | 11.69                         |
| 2412 - 2467              | 802.11n HT20 | 14.3                           | 26.79                         |
| 2472                     | 802.11n HT20 | 10.7                           | 11.69                         |

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antenna, with a maximum gain as below

| Frequency (MHz) | Antenna Gain (dBi) |       |
|-----------------|--------------------|-------|
|                 | Core0              | Core1 |
| 2.4             | -1.5               | -4.5  |
| 2.44            | -1.5               | -3.8  |
| 2.48            | -1.4               | -4.4  |

### 5.4. LIST OF TEST REDUCTION AND MODES

| 2400 - 2483.5 MHz Authorized Frequency Band (Antenna Port & Radiated Testing) |                       |                      |
|-------------------------------------------------------------------------------|-----------------------|----------------------|
| Frequency Range (MHz)                                                         | Mode                  | Covered by           |
| 2412 - 2472                                                                   | 802.11b Legacy 1TX    | 802.11b Legacy 1TX   |
| 2412 - 2472                                                                   | 802.11g Legacy 1TX    | 802.11g CDD 2TX      |
| 2412 - 2472                                                                   | 802.11n 1TX           | 802.11n HT20 CDD 2TX |
| 2412 - 2472                                                                   | 802.11n STBC 2TX      | 802.11n HT20 CDD 2TX |
| 2412 - 2472                                                                   | 802.11n HT40 1TX      | 802.11n HT40 CDD 2TX |
| 2412 - 2472                                                                   | 802.11n HT40 STBC 2TX | 802.11n HT40 CDD 2TX |

## **5.5. WORST-CASE CONFIGURATION AND MODE**

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

Based on the baseline scan, the worst-case data rates were:

802.11b mode: 1 Mbps

802.11g mode: 6 Mbps

802.11n HT20mode: MCS0

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| Support Equipment List |              |        |                 |        |
|------------------------|--------------|--------|-----------------|--------|
| Description            | Manufacturer | Model  | Serial Number   | FCC ID |
| AC Adapter             | SONY         | EP880  | 3514W 01 S08328 | N/A    |
| Earphone               | SONY         | MH410C | N/A             | N/A    |

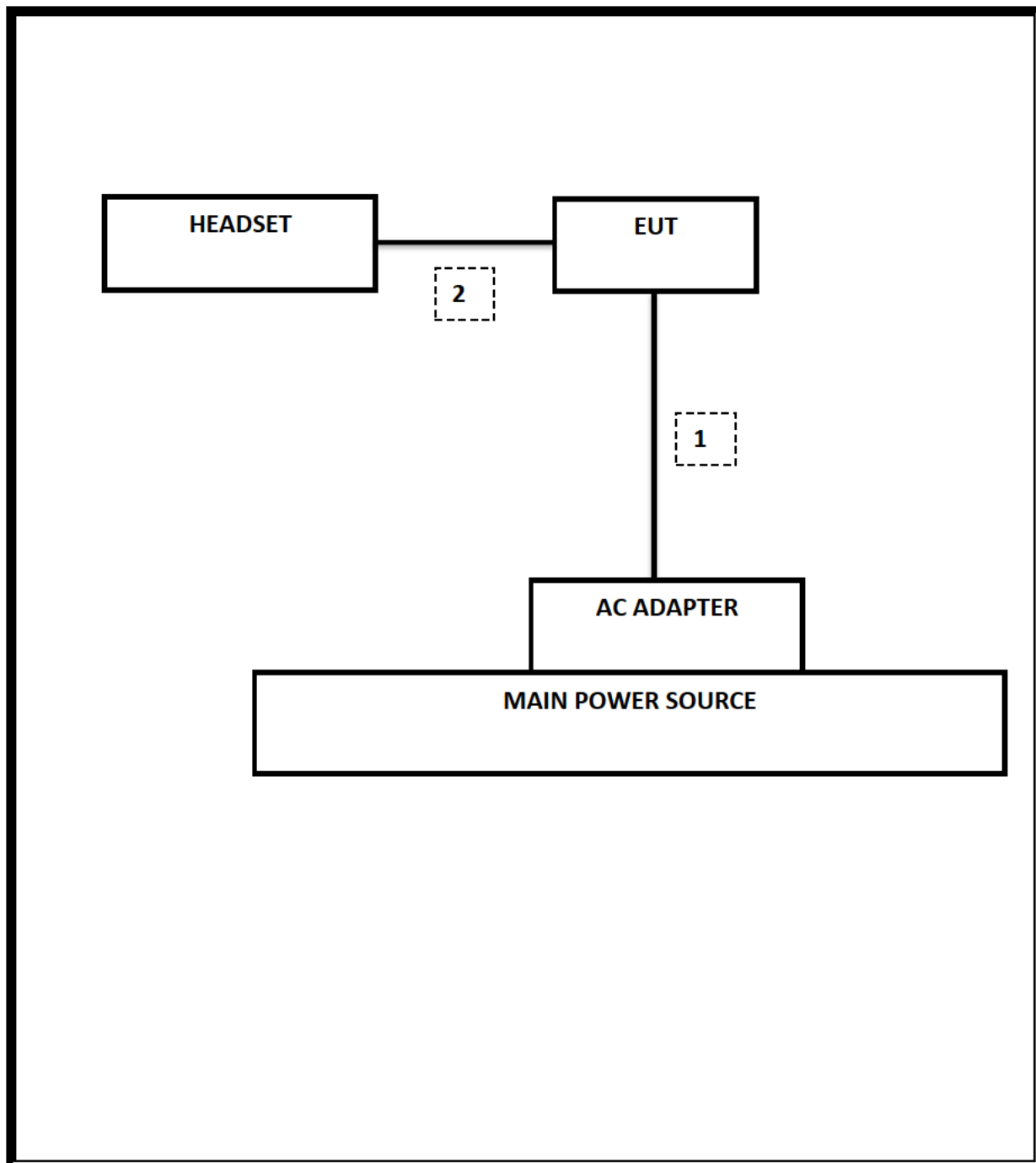
### I/O CABLES

| I/O Cable List |          |                      |                |            |                  |         |
|----------------|----------|----------------------|----------------|------------|------------------|---------|
| Cable No       | Port     | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| 1              | DC Power | 1                    | Mini-USB       | Shielded   | 1.2m             | N/A     |
| 2              | Audio    | 1                    | Mini-Jack      | Unshielded | 1m               | N/A     |

### TEST SETUP

The EUT is a stand-alone unit during the tests. Test software exercised the radio card.

**SETUP DIAGRAM FOR TESTS**



## 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

| Test Equipment List                |                |                        |         |          |
|------------------------------------|----------------|------------------------|---------|----------|
| Description                        | Manufacturer   | Model                  | Asset   | Cal Due  |
| Spectrum Analyzer, 44 GHz          | Agilent / HP   | E4446A                 | C01069  | 12/20/15 |
| Spectrum Analyzer, 9KHz-40GHz      | HP             | 8564E                  | C00986  | 04/01/15 |
| EMI Test Receiver, 9 kHz-7 GHz     | R & S          | ESCI 7                 | 100773  | 08/15/15 |
| Peak Power Meter                   | Agilent / HP   | E4416A                 | C00963  | 12/13/15 |
| Peak / Average Power Sensor        | Agilent / HP   | E9327A                 | C00964  | 12/13/15 |
| Antenna, Horn, 18GHz               | EMCO           | 3115                   | C00783  | 10/25/15 |
| Antenna, Horn, 18- 26 GHz          | ARA            | MWH-1826/B             | C00946  | 11/12/15 |
| Antenna, Horn, 26-40 GHz           | ARA            | MWH-2640               | C00891  | 06/28/15 |
| Antenna, Bilog, 30MHz-1 GHz        | Sunol Sciences | JB1                    | T243    | 12/08/15 |
| RF Preamplifier, 100KHz -> 1300MHz | HP             | TBD                    | C00825  | 06/01/15 |
| RF Preamplifier, 1GHz - 18GHz      | Miteq          | NSP4000-SP2            | 924343  | 09/03/15 |
| RF Preamplifier, 1GHz - 26.5GHz    | HP             | 8449B                  | F00351  | 06/27/15 |
| AC Power Supply, 2,500VA 45-500Hz  | Elgar-Ametek   | CW2501M                | F00013  | CNR      |
| RF Preamplifier, 1GHz - 18GHz      | Miteq          | AFS42-00101800-25-S-42 | 1818466 | 05/09/15 |
| Attenuator / Switch driver         | HP             | 11713A                 | F00204  | CNR      |
| Low Pass Filter 3GHz               | Micro-Tronics  | LPS17541               | F00219  | 05/23/15 |
| High Pass Filter 5GHz              | Micro-Tronics  | HPS17542               | F00222  | 05/22/15 |
| High Pass Filter 6GHz              | Micro-Tronics  | HPM17543               | F00224  | 05/22/15 |

| Test Software List    |              |        |                          |
|-----------------------|--------------|--------|--------------------------|
| Description           | Manufacturer | Model  | Version                  |
| Radiated Software     | UL           | UL EMC | Version 9.5, 07/22/14    |
| Conducted Software    | UL           | UL EMC | Version 9.5, 05/17/14    |
| CLT Software          | UL           | UL RF  | Version 1.0, 02/02/15    |
| Antenna Port Software | UL           | UL RF  | Version 2.1.1.1, 1/20/15 |

## 7. MEASUREMENT METHODS

KDB 558074 D01 DTS Meas Guidance v03r02:Measurement Procedure AVGPM-G is used for power and AVGPS-3 is used for power spectral density.

Unwanted emissions within Restricted Bands are measured using traditional radiated procedures.

Band edge emissions within Restricted Bands are measured using RMS with duty cycle factor offset method.

MIMO Device: KDB 662911 v02r01

## **8. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS**

### **LIMITS**

None; for reporting purposes only.

### **PROCEDURE**

KDB 789033 Zero-Span Spectrum Analyzer Method.

### **8.1. ON TIME AND DUTY CYCLE RESULTS**

Please refer to DTS test report of FCC ID: PY7-PM0793.

## 9. SUMMARY TABLE

| FCC Part Section   | RSS Section(s)                       | Test Description                        | Test Limit | Test Condition | Test Result | Worst Case     |
|--------------------|--------------------------------------|-----------------------------------------|------------|----------------|-------------|----------------|
| 15.247 (a)(2)      | RSS-210 A8.2(a)                      | Occupied Band width (6dB)               | >500KHz    | Conducted      | Pass        | 8.06 MHz       |
| 2.1051, 15.247 (d) | RSS-210 A8.5                         | Band Edge / Conducted Spurious Emission | -20dBc     |                | Pass        | -35.4 dBm      |
| 15.247             | RSS-210 A8.4                         | TX conducted output power               | <30dBm     |                | Pass        | 16.9 dBm       |
| 15.247             | RSS-210 A8.2                         | PSD                                     | <8dBm      |                | Pass        | -8.04 dBm      |
| 15.207 (a)         | RSS-GEN 7.2.2                        | AC Power Line conducted emissions       | Section 10 | Radiated       | Pass        | 44.8 dBuV (AV) |
| 15.205, 15.209     | RSS-210 Clause 2.6, RSS-210 Clause 6 | Radiated Spurious Emission              | < 54dBuV/m |                | Pass        | 43.24 dBuV/m   |

## **10. ANTENNA PORT TEST RESULTS**

### **10.1. 6 dB BANDWIDTH**

#### **LIMITS**

FCC §15.247 (a) (2)

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

#### **TEST PROCEDURE**

Reference to KDB 558074 D01 DTS Meas Guidance v03r01: The transmitter output is connected to a spectrum analyzer with the RBW set to 100KHz, the VBW  $\geq 3 \times$  RBW, peak detector and max hold.

#### **RESULTS**

##### **10.1.1. 802.11b MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793.

##### **10.1.2. 802.11g MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793.

##### **10.1.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793.

##### **10.1.4. 6 dB BANDWIDTH MID CH PLOTS**

Please refer to DTS test report of FCC ID: PY7-PM0793.

## **10.2. 99% BANDWIDTH**

### **LIMITS**

None; for reporting purposes only.

### **RESULTS**

Please refer to DTS test report of FCC ID: PY7-PM0793.

#### **10.2.1. 802.11b MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793

#### **10.2.2. 802.11g MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793

#### **10.2.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793

#### **10.2.4. 99% BANDWIDTH MID CH PLOTS**

Please refer to DTS test report of FCC ID: PY7-PM0793

## 10.3. OUTPUT POWER

### LIMITS

FCC §15.247

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### DIRECTIONAL ANTENNA GAIN

The TX chains are correlated and the antenna gain is the same for each chain. The directional gain is:

2.4GHz

| Chain 0<br>Antenna<br>Gain<br>(dBi) | Chain 1<br>Antenna<br>Gain<br>(dBi) | Uncorrelated Chains<br>Directional<br>Gain<br>(dBi) |
|-------------------------------------|-------------------------------------|-----------------------------------------------------|
| -1.40                               | -3.80                               | -2.44                                               |

For PSD: The TX chains are correlated and the antenna gain is unequal among the chains. The directional gain is:

2.4GHz

| Chain 0<br>Antenna<br>Gain<br>(dBi) | Chain 1<br>Antenna<br>Gain<br>(dBi) | Correlated Chains<br>Directional<br>Gain<br>(dBi) |
|-------------------------------------|-------------------------------------|---------------------------------------------------|
| -1.40                               | -3.80                               | 0.49                                              |

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**RESULTS**

**10.3.1. 802.11b MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793

**10.3.2. 802.11g MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793

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**10.3.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793

## **10.4. PSD**

### **LIMITS**

FCC §15.247

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### **RESULTS**

#### **10.4.1. 802.11b MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793.

#### **10.4.2. 802.11g MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793.

#### **10.4.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793.

#### **10.4.4. PSD MID CH PLOTS**

Please refer to DTS test report of FCC ID: PY7-PM0793

## **10.5. OUT-OF-BAND EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

### **TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer with RBW = 100 kHz, VBW = 300 kHz, peak detector, and max hold. Measurements utilizing these settings are made of the in-band reference level, bandedge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

### **RESULTS**

Please refer to DTS test report of FCC ID: PY7-PM0793.

## 11. RADIATED TEST RESULTS

### 11.1. LIMITS AND PROCEDURE LIMITS

FCC §15.205 and §15.209

| Frequency Range<br>(MHz) | Field Strength Limit<br>( $\mu\text{V}/\text{m}$ ) at 3 m | Field Strength Limit<br>( $\text{dB}\mu\text{V}/\text{m}$ ) at 3 m |
|--------------------------|-----------------------------------------------------------|--------------------------------------------------------------------|
| 30 - 88                  | 100                                                       | 40                                                                 |
| 88 - 216                 | 150                                                       | 43.5                                                               |
| 216 - 960                | 200                                                       | 46                                                                 |
| Above 960                | 500                                                       | 54                                                                 |

### TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and add duty cycle factor for average measurements. Duty cycle factor =  $10\log(1/x)$  For this sample B mode = 0dB (duty cycle >98%); G mode = 0.3dB; N mode = 0.32dB.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

## **11.2. TRANSMITTER ABOVE 1 GHz**

### **11.2.1. TX ABOVE 1 GHz 802.11b MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793.

### **11.2.2. TX ABOVE 1 GHz 802.11g MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793.

### **11.2.3. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 2.4 GHz BAND**

Please refer to DTS test report of FCC ID: PY7-PM0793.

## **11.3. WORST-CASE BELOW 1 GHz**

Please refer to DTS test report of FCC ID: PY7-PM0793.

## 12. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

FCC §15.207 (a)

| Frequency of Emission (MHz) | Conducted Limit (dBuV) |            |
|-----------------------------|------------------------|------------|
|                             | 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.

### TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4 2009.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

### RESULTS

Please refer to DTS test report of FCC ID: PY7-PM0793.

### 13. GEOLOCATION MECHANISM TEST VALIDATION

Set up with wifi link in channel 13 and way to measure power (coupler or antenna).

Step1: Start with no cellular connection and check power.

Step2: Set cellular connection with EU country code.

Measure power (should be high)

Step3: Set country code to US

Measure power (should be low)

Step4: Set country code to Japan

Measure power (should be high)

Step5: Set country code to other

Measure power (should be low)

|        |        | C-code       | No Sim | UK    | US   | JP    | other(AR) |
|--------|--------|--------------|--------|-------|------|-------|-----------|
|        |        | MCC          | -      | 234   | 310  | 440   | 722       |
| Chain0 | 11b_1M | target [dBm] | 9.00   | 16.50 | 9.00 | 16.50 | 11.25     |
|        |        | actual [dBm] | 8.27   | 16.40 | 8.19 | 16.29 | 11.23     |
|        | 11g_6M | target [dBm] | 2.50   | 15.50 | 2.50 | 15.50 | 10.75     |
|        |        | actual [dBm] | 2.03   | 15.06 | 2.18 | 15.02 | 10.94     |
| Chain1 | 11b_1M | target [dBm] | 8.20   | 15.70 | 7.45 | 15.70 | 7.45      |
|        |        | actual [dBm] | 8.09   | 15.88 | 7.05 | 15.65 | 7.02      |
|        | 11g_6M | target [dBm] | 2.20   | 15.20 | 1.45 | 15.20 | 7.45      |
|        |        | actual [dBm] | 1.34   | 14.32 | 0.59 | 14.25 | 5.96      |