

FCC RF Test Report

| APPLICANT | : Espressif Systems (Shanghai) Co.,Ltd. |
|----------------|---|
| EQUIPMENT | : 2.4GHz Wi-Fi & BT IoT Module |
| BRAND NAME | : ESPRESSIF |
| MODEL NAME | : ESP8684-WROOM-07 |
| FCC ID | : 2AC7Z-ESP868407 |
| STANDARD | : FCC Part 15 Subpart C §15.247 |
| CLASSIFICATION | : (DTS) Digital Transmission System |
| TEST DATE(S) | : Apr. 21, 2023 ~ Dec. 21, 2023 |

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

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

JasonJia

Approved by: Jason Jia



Sporton International Inc. (Kunshan) No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China



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APPENDIX E. SETUP PHOTOGRAPHS



REVISION HISTORY

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|------------|---------|-------------------------|---------------|
| FR310907A | Rev. 01 | Initial issue of report | Jan. 04, 2024 |
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SUMMARY OF TEST RESULT

| Report Section | FCC Rule | Description | Limit | Result | Remark |
|-------------------|--------------------|---|--------------------------|-------------|--|
| 3.1 | 15.247(a)(2) | 6dB Bandwidth | ≥ 0.5MHz | Pass | - |
| 3.1 | - | 99% Bandwidth | - | Report only | - |
| 3.2 | 15.247(b)(3) | Peak Output Power | ≤ 30dBm | Pass | - |
| 3.3 | 15.247(e) | Power Spectral Density | ≤ 8dBm/3kHz | Pass | - |
| 3.4 | 15.247(d) | Conducted Band Edges and Spurious Emission | ≤ 20dBc | Pass | - |
| 3.5 | 15.247(d) | Radiated Band Edges and Spurious Emission | 15.209(a) & 15.247(d) | Pass | Under limit 1.40 dB at 2483.56 MHz |
| 3.6 | 15.207 | AC Conducted Emission | 15.207(a) | Pass | Under limit 12.91 dB at 0.157 MHz |
| 3.7 | 15.203 & 15.247(b) | Antenna Requirement | 15.203 & 15.247(b) | Pass | - |

Conformity Assessment Condition:

 The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.

2. The measurement uncertainty please refer to each test result in the section "Measurement Uncertainty"

Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.



1 General Description

1.1 Applicant

Espressif Systems (Shanghai) Co.,Ltd. Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China

1.2 Manufacturer

Espressif Systems (Shanghai) Co.,Ltd.

Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China

1.3 Product Feature of Equipment Under Test

| Product Feature | | | | |
|-----------------|------------------------------|--|--|--|
| Equipment | 2.4GHz Wi-Fi & BT IoT Module | | | |
| Brand Name | ESPRESSIF | | | |
| Model Name | ESP8684-WROOM-07 | | | |
| FCC ID | 2AC7Z-ESP868407 | | | |
| HW Version | V1.0 | | | |
| SW Version | v1.1.3.4 | | | |
| EUT Stage | Identical Prototype | | | |

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

1.4 Product Specification of Equipment Under Test

| Standards-related Product Specification | | | | |
|---|--|--|--|--|
| Tx/Rx Frequency Range | 2402 MHz ~ 2480 MHz | | | |
| Number of Channels | 40 | | | |
| Carrier Frequency of Each Channel | 40 Channel(37 hopping + 3 advertising channel) | | | |
| | BLE 1Mbps: 18.46 dBm (0.0701 W) | | | |
| Maximum Output Dowar to Antonno | BLE 2Mbps: 18.57 dBm (0.0719 W) | | | |
| Maximum Output Power to Antenna | BLE 125kbps: 18.13 dBm (0.0650 W) | | | |
| | BLE 500kbps: 18.24 dBm (0.0667 W) | | | |
| 99% Occupied Bandwidth | BLE 1Mbps:1.08MHz | | | |
| 35% Occupied Balluwidth | BLE 2Mbps:2.06MHz | | | |
| Antenna Type / Gain | Monopole Antenna with gain 2.33 dBi | | | |
| Type of Modulation | Bluetooth LE : GFSK | | | |

Note: For Bluetooth LE 125Kbps & 500Kbps & 1Mbps & 2Mbps mode, the whole testing has assessed only BLE 1Mbps & 2Mbps mode by referring to their higher conducted power.

1.5 Modification of EUT

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



1.6 Testing Location

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

| Test Firm | Sporton International Inc. (Kunshan) | | | | |
|--------------------|--------------------------------------|---------------------------|---------------------|--|--|
| | No. 1098, Pengxi North | n Road, Kunshan Econom | ic Development Zone | | |
| Test Site Location | Jiangsu Province 2153 | 00 People's Republic of C | hina | | |
| | TEL : +86-512-57900158 | | | | |
| | Sporton Site No. ECC Designation No. | | FCC Test Firm | | |
| Toot Site No | Sporton Site No. | FCC Designation No. | Registration No. | | |
| Test Site No. | CO01-KS 03CH06-KS TH01-KS | CN1257 | 314309 | | |

1.7 Test Software

| ltem | Site | Manufacturer | Name | Version |
|------|-----------|--------------|---|-------------|
| 1. | TH01-KS | SPORTON | FCC 15C-15E Test Tools Ver10.0_210607 | 10.0 |
| 2. | 03CH06-KS | AUDIX | E3 | 210616 |
| 3. | CO01-KS | AUDIX | E3 | 6.2009-8-24 |

1.8 Applicable Standards

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

- 47 CFR Part 15 Subpart C §15.247
- FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ANSI C63.10-2013

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.



2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

| Frequency Band | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|-----------------|-----------------|----------------|---------|----------------|
| | 0 | 2402 | 21 | 2444 |
| | 1 | 2404 | 22 | 2446 |
| | 2 | 2406 | 23 | 2448 |
| | 3 | 2408 | 24 | 2450 |
| | 4 | 2410 | 25 | 2452 |
| | 5 | 2412 | 26 | 2454 |
| | 6 | 2414 | 27 | 2456 |
| | 7 | 2416 | 28 | 2458 |
| | 8 9 Iz 10 | 2418 | 29 | 2460 |
| | | 2420 | 30 | 2462 |
| 2400-2483.5 MHz | | 2422 | 31 | 2464 |
| | 11 | 2424 | 32 | 2466 |
| | 12 | 2426 | 33 | 2468 |
| | 13 | 2428 | 34 | 2470 |
| | 14 | 2430 | 35 | 2472 |
| | 15 | 2432 | 36 | 2474 |
| | 16 | 2434 | 37 | 2476 |
| | 17 | 2436 | 38 | 2478 |
| | 18 | 2438 | 39 | 2480 |
| | 19 | 2440 | - | - |
| | 20 | 2442 | - | - |



2.2 Test Mode

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

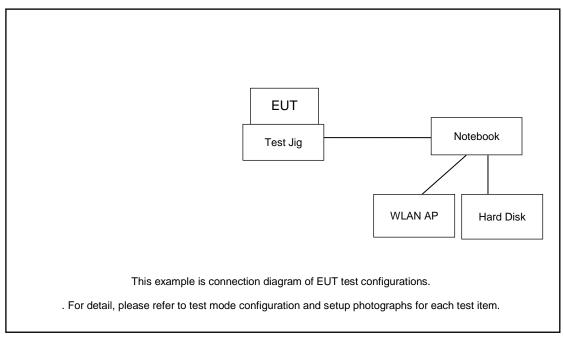
| The fall studie as a transmission | tale la la ale studia | g all test modes to demo | maturate in a surpline as well | امسمام منمنهم مطلاطا |
|-----------------------------------|-----------------------|--------------------------|--------------------------------|----------------------|
| I DE TOILOWING SUMMARY | / tanie is snowin | a all test modes to demo | nstrate in compliance wi | in the standard |
| The following summar | y lubic 15 5110 Will | ig un test modes to demo | monute in compliance m | in the standard. |

| | Summary table of Test Cases | | | |
|-------------|--|--|--|--|
| Test Item | Data Rate / Modulation | | | |
| Test item | Bluetooth – LE / GFSK | | | |
| | Mode 1: Bluetooth Tx CH00_2402 MHz_BLE 1Mbps | | | |
| | Mode 2: Bluetooth Tx CH19_2440 MHz_BLE 1Mbps | | | |
| | Mode 3: Bluetooth Tx CH38_2478 MHz_BLE 1Mbps | | | |
| Conducted | Mode 4: Bluetooth Tx CH39_2480 MHz_BLE 1Mbps | | | |
| TCs | Mode 5: Bluetooth Tx CH01_2404 MHz_BLE 2Mbps | | | |
| | Mode 6: Bluetooth Tx CH19_2440 MHz_BLE 2Mbps | | | |
| | Mode 7: Bluetooth Tx CH38_2478 MHz_BLE 2Mbps | | | |
| | Mode 8: Bluetooth Tx CH39_2480 MHz_BLE 2Mbps | | | |
| | Mode 1: Bluetooth Tx CH00_2402 MHz_BLE 1Mbps | | | |
| | Mode 2: Bluetooth Tx CH19_2440 MHz_BLE 1Mbps | | | |
| | Mode 3: Bluetooth Tx CH38_2478 MHz_BLE 1Mbps | | | |
| Radiated | Mode 4: Bluetooth Tx CH39_2480 MHz_BLE 1Mbps | | | |
| TCs | Mode 5: Bluetooth Tx CH01_2404 MHz_BLE 2Mbps | | | |
| | Mode 6: Bluetooth Tx CH19_2440 MHz_BLE 2Mbps | | | |
| | Mode 7: Bluetooth Tx CH38_2478 MHz_BLE 2Mbps | | | |
| | Mode 8: Bluetooth Tx CH39_2480 MHz_BLE 2Mbps | | | |
| AC | | | | |
| Conducted | Mode 1: BLE Tx + power from test Jig | | | |
| Emission | | | | |
| Remark: For | Radiated Test Cases, The tests were performance with Test Jig and Notebook | | | |

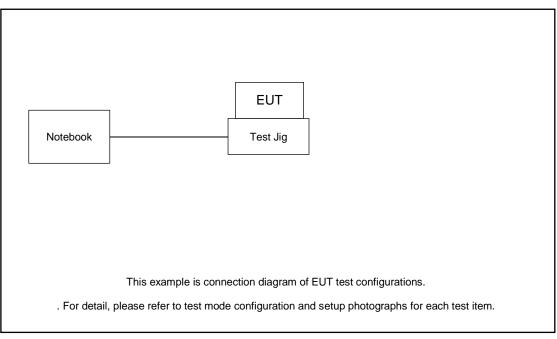


2.3 Connection Diagram of Test System

AC Conducted Emission:



Radiated Emission:





| 2.4 | Support | Unit used | in test | t configurat | tion and | system | |
|-----|---------|-----------|---------|--------------|----------|--------|--|
| | | | | | | | |

| ltem | Equipment | Trade Name | Model Name | FCC ID | Data Cable | Power Cord |
|------|-----------|------------|---------------|------------|----------------|--|
| 1. | WLAN AP | D-link | DIR-655 | KA21R655B1 | N/A | Unshielded,1.8m |
| 2. | Notebook | Lenovo | V130-14IKB004 | N/A | N/A | AC I/P: Unshielded, 1.8 m DC O/P: Shielded, 1.8 m |
| 3. | Hard Disk | Lenovo | F310 | DoC | Shielded, 1.2m | N/A |
| 4. | Test Jig | Amphenol | W106C_EVB | N/A | N/A | N/A |

2.5 EUT Operation Test Setup

For BLE function, the engineering test program was provided and enabled to make EUT continuous transmit.

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

2.6 Measurement Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss 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.

Following shows an offset computation example with cable loss 5.6 dB.

 $Offset(dB) = RF \ cable \ loss(dB).$ = 5.6 (dB)



3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

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

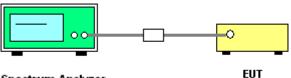
3.1.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.1.3 Test Procedures

- 1. The testing follows ANSI C63.10-2013 clause 11.8
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
- 5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1% to 5% of the 99% OBW and the VBW is set to 3 times of the RBW.
- 6. Measure and record the results in the test report.

3.1.4 Test Setup



Spectrum Analyzer



3.1.5 Test Result of 6dB Bandwidth

Please refer to Appendix A.

BLE 1Mbps

6 dB Bandwidth Plot on Channel 00



Date: 18.DEC.2023 13:43:55

6 dB Bandwidth Plot on Channel 19



Date: 18.DEC.2023 13:47:27

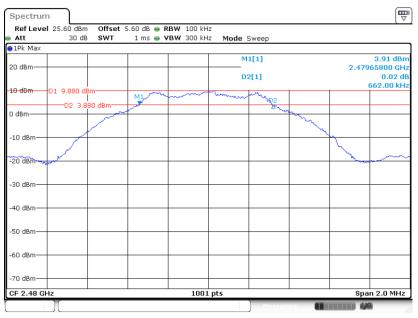




6 dB Bandwidth Plot on Channel 38

Date: 19.DEC.2023 08:34:29

6 dB Bandwidth Plot on Channel 39



Date: 18.DEC.2023 13:50:14



BLE 2Mbps

6 dB Bandwidth Plot on Channel 00



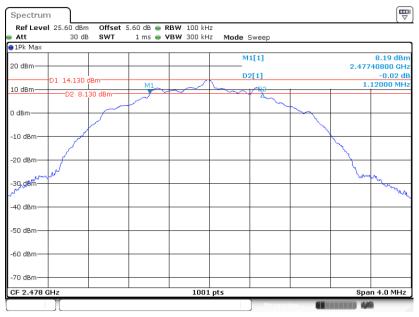
Date: 18.DEC.2023 13:53:21

6 dB Bandwidth Plot on Channel 19



Date: 18.DEC.2023 13:56:17

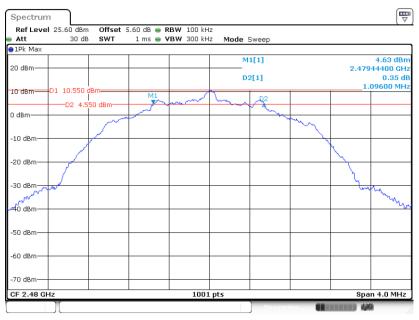




6 dB Bandwidth Plot on Channel 38

Date: 19.DEC.2023 08:47:07

6 dB Bandwidth Plot on Channel 39



Date: 18.DEC.2023 13:58:38

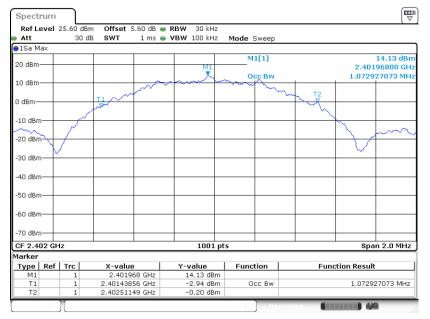


3.1.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.

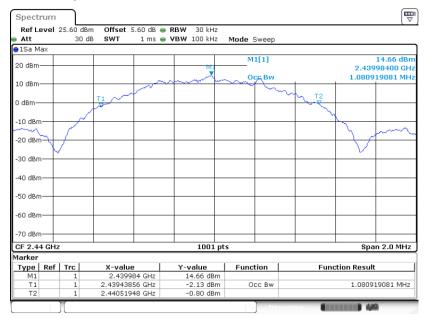
BLE 1Mbps

99% Occupied Bandwidth Plot on Channel 00



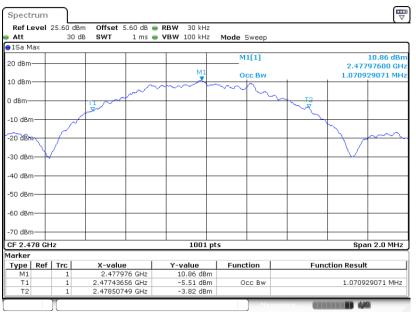
Date: 18.DEC.2023 13:45:41

99% Occupied Bandwidth Plot on Channel 19



Date: 18.DEC.2023 13:48:55

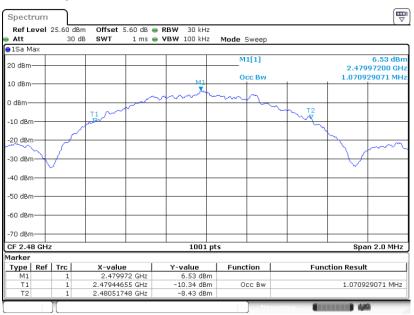




99% Occupied Bandwidth Plot on Channel 38

Date: 19.DEC.2023 08:36:16

99% Occupied Bandwidth Plot on Channel 39

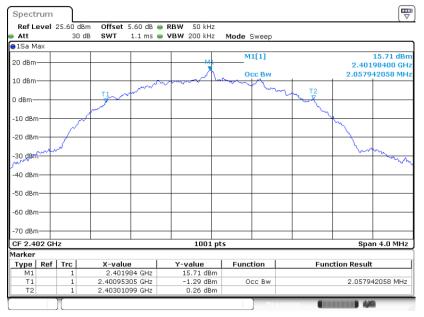


Date: 18.DEC.2023 13:52:01



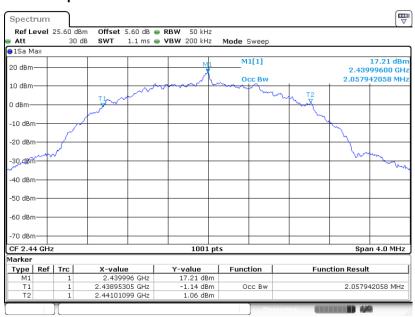
BLE 2Mbps

99% Occupied Bandwidth Plot on Channel 00



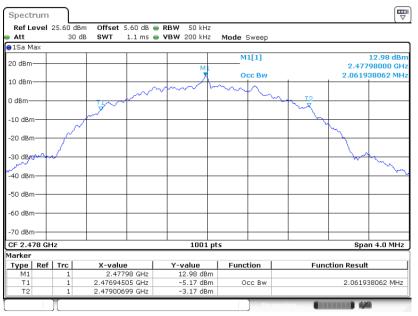
Date: 18.DEC.2023 13:55:29

99% Occupied Bandwidth Plot on Channel 19



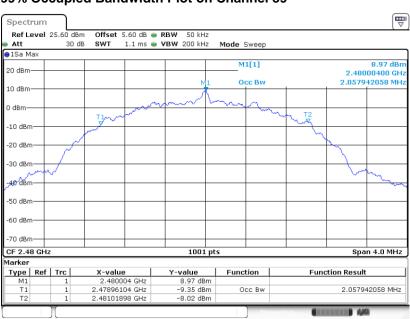
Date: 18.DEC.2023 13:58:03





99% Occupied Bandwidth Plot on Channel 38

Date: 19.DEC.2023 08:49:01



99% Occupied Bandwidth Plot on Channel 39

Date: 18.DEC.2023 14:01:09

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



3.2 Output Power Measurement

3.2.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6 dBi.

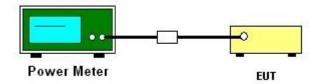
3.2.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.2.3 Test Procedures

- The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.1.3 PKPM1 Peak power meter or ANSI C63.10-2013 clause 11.9.2.3.1 Method AVGPM method.
- 2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Peak Output Power

Please refer to Appendix A.

3.2.6 Test Result of Average Output Power (Reporting Only)

Please refer to Appendix A.



3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

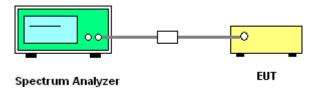
3.3.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.3.3 Test Procedures

- 1. The testing follows Measurement Procedure of ANSI C63.10-2013 clause 11.10.2 Method PKPSD.
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz.
 Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
- 5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
- 6. Measure and record the results in the test report.
- 7. The Measured power density (dBm)/ 100kHz is a reference level and used as 20dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.3.4 Test Setup



3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

3.3.6 Test Result of Power Spectral Density Plots (100kHz)

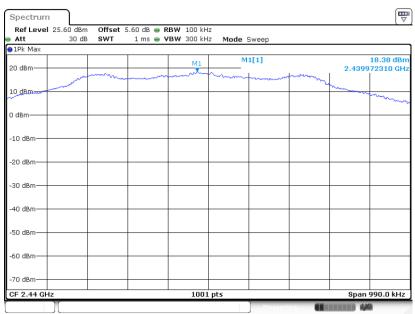
BLE 1Mbps

PSD 100kHz Plot on Channel 00



Date: 18.DEC.2023 13:44:33

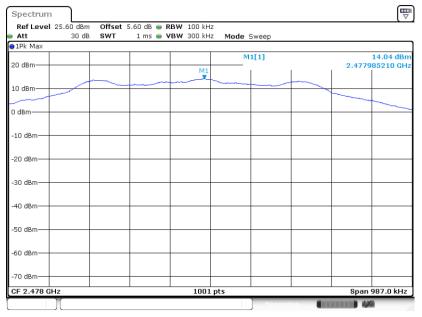
PSD 100kHz Plot on Channel 19



Date: 18.DEC.2023 13:48:05

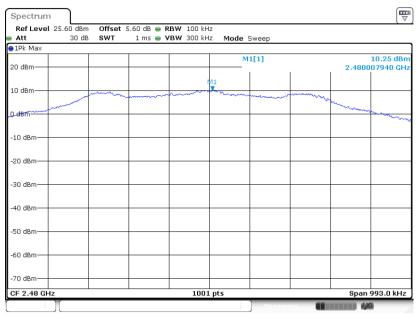


PSD 100kHz Plot on Channel 38



Date: 19.DEC.2023 08:35:07

PSD 100kHz Plot on Channel 39

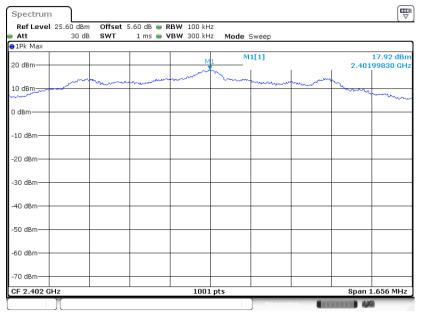


Date: 18.DEC.2023 13:50:52



BLE 2Mbps

PSD 100kHz Plot on Channel 00



Date: 18.DEC.2023 13:53:59

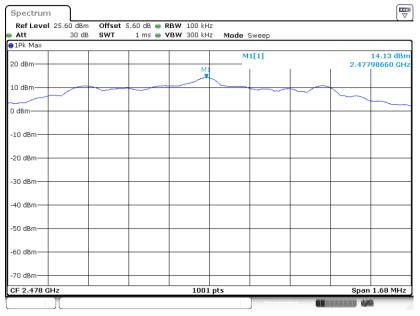
PSD 100kHz Plot on Channel 19



Date: 18.DEC.2023 13:56:54

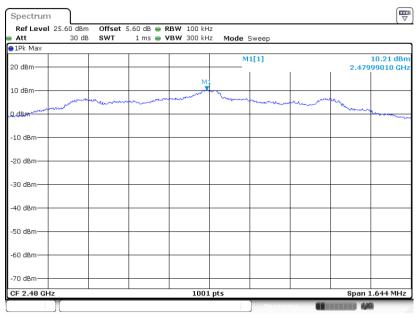


PSD 100kHz Plot on Channel 38



Date: 19.DEC.2023 08:47:45

PSD 100kHz Plot on Channel 39

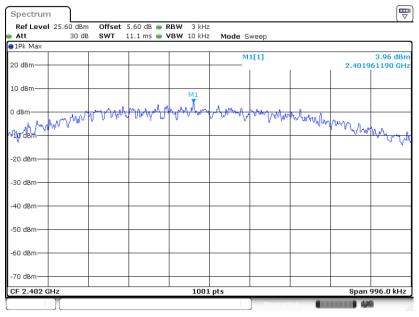


Date: 18.DEC.2023 13:59:16

3.3.7 Test Result of Power Spectral Density Plots (3kHz)

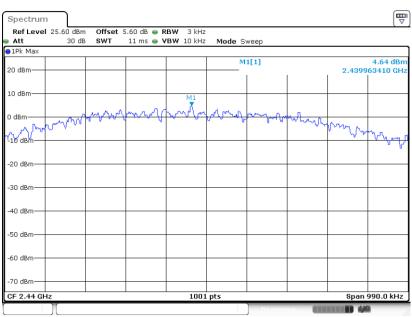
BLE 1Mbps

PSD 3kHz Plot on Channel 00



Date: 18.DEC.2023 13:44:14

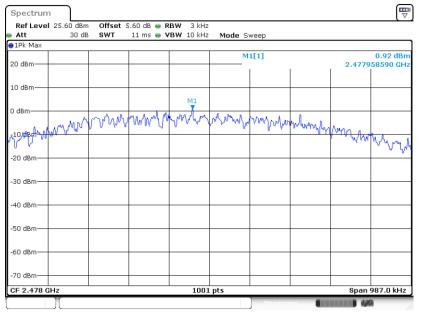
PSD 3kHz Plot on Channel 19



Date: 18.DEC.2023 13:47:46

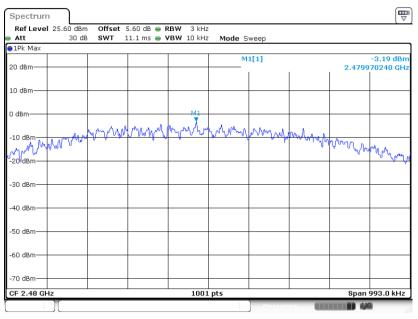


PSD 3kHz Plot on Channel 38



Date: 19.DEC.2023 08:34:48

PSD 3kHz Plot on Channel 39

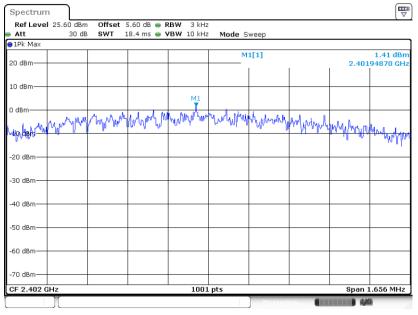


Date: 18.DEC.2023 13:50:33



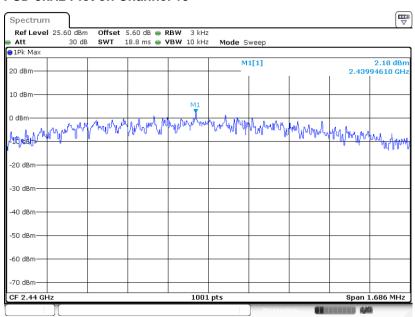
BLE 2Mbps

PSD 3kHz Plot on Channel 00



Date: 18.DEC.2023 13:53:40

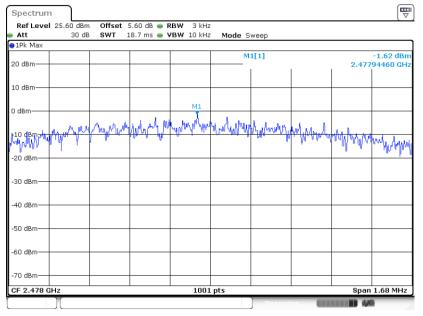
PSD 3kHz Plot on Channel 19



Date: 18.DEC.2023 13:56:36

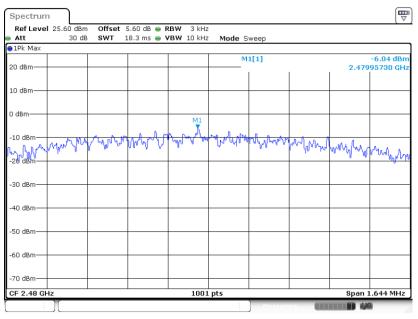


PSD 3kHz Plot on Channel 38



Date: 19.DEC.2023 08:47:26

PSD 3kHz Plot on Channel 39



Date: 18.DEC.2023 13:58:57



3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

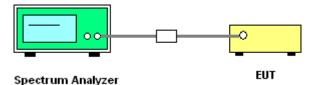
3.4.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.4.3 Test Procedure

- 1. The testing follows ANSI C63.10-2013 clause 11.13
- 2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
- 3. Set to the maximum power setting and enable the EUT transmit continuously.
- 4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.
- 5. Measure and record the results in the test report.
- 6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

3.4.4 Test Setup

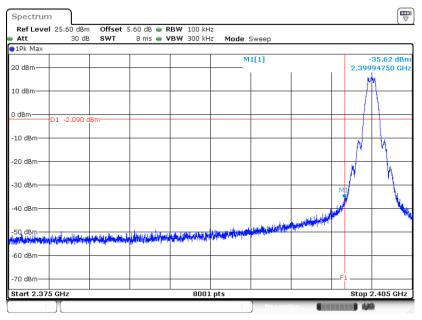




3.4.5 Test Result of Conducted Band Edges Plots

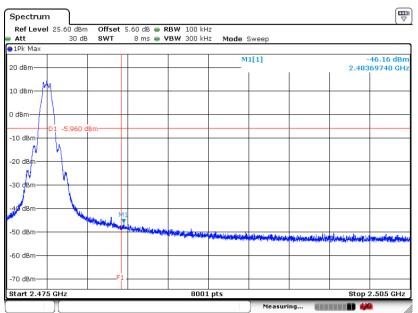
BLE 1Mbps

Low Band Edge Plot on Channel 00



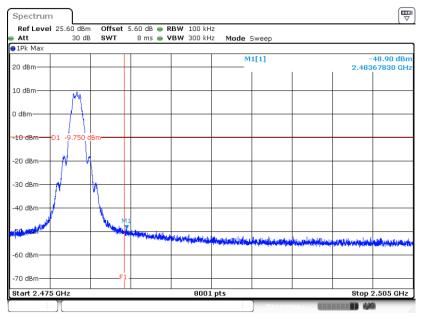
Date: 18.DEC.2023 13:46:32

High Band Edge Plot on Channel 38



Date: 19.DEC.2023 08:45:01



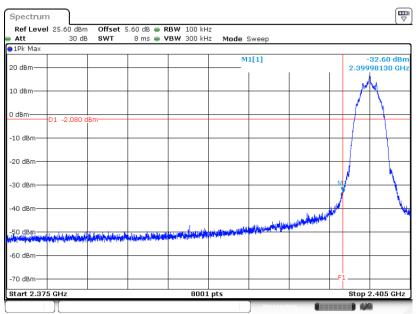


High Band Edge Plot on Channel 39

Date: 18.DEC.2023 13:51:11

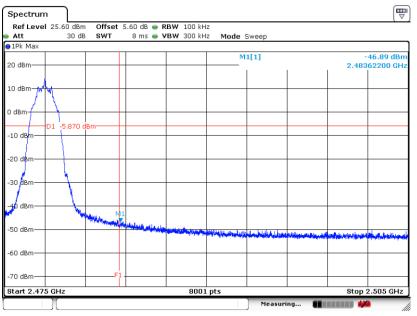
BLE 2Mbps

Low Band Edge Plot on Channel 00



Date: 18.DEC.2023 13:54:18

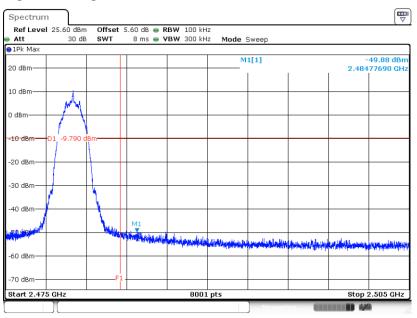




High Band Edge Plot on Channel 38

Date: 19.DEC.2023 08:50:54

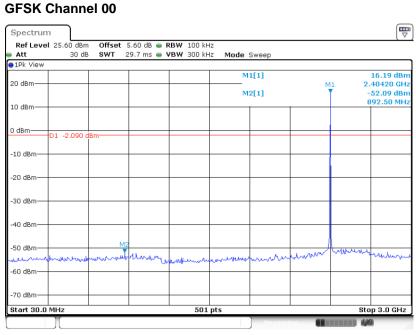
High Band Edge Plot on Channel 39



Date: 18.DEC.2023 14:00:35

3.4.6 Test Result of Conducted Spurious Emission Plots

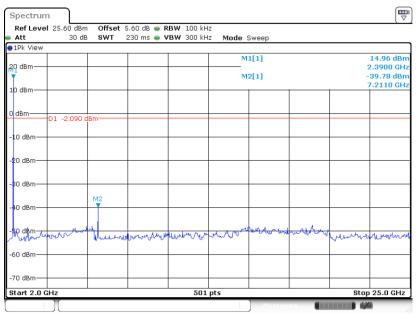
Conducted Spurious Emission Plot on Bluetooth LE 1Mbps



Date: 18.DEC.2023 13:45:13

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

GFSK Channel 00



Date: 18.DEC.2023 13:45:32

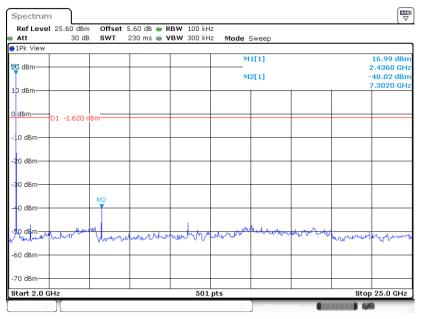


GFSK Channel 19 Spectrum Offset 5.60 dB ■ RBW 100 kHz SWT 29.7 ms ■ VBW 300 kHz Ref Level 25.60 dBm Att 30 dB Mode Sweep ⊖1Pk Viev 16.83 dBm 2.43980 GHz -51.83 dBm M1[1] 20 dBm М1 M2[1] 975.50 MH 10 dBm-0 dBm-D1 -1.620 -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm hm 1 shad wh. hopener much home NAN -60 dBrr -70 dBm Start 30.0 MHz Stop 3.0 GHz 501 pts

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps

Date: 18.DEC.2023 13:48:26

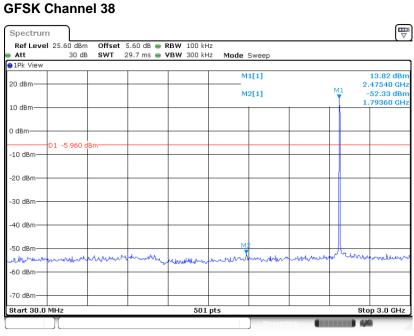
Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 19



Date: 18.DEC.2023 13:48:46

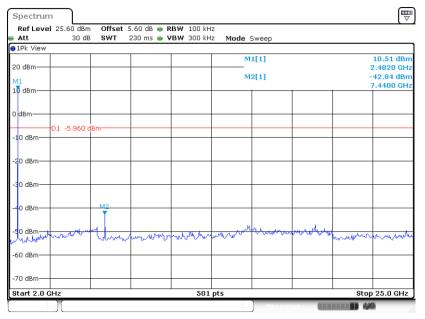


Conducted Spurious Emission Plot on Bluetooth LE 1Mbps



Date: 19.DEC.2023 08:39:44

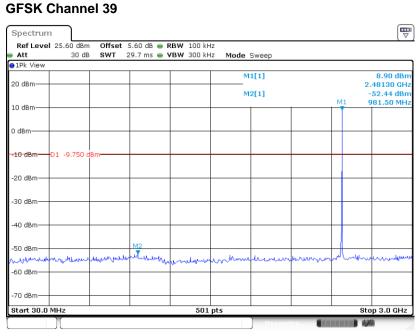
Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 38



Date: 19.DEC.2023 08:39:55

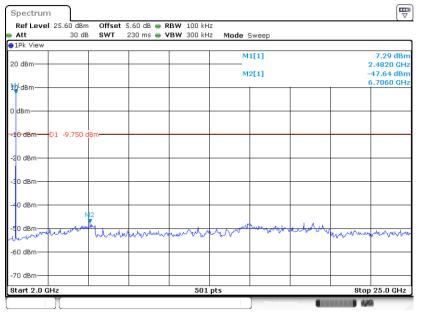


Conducted Spurious Emission Plot on Bluetooth LE 1Mbps



Date: 18.DEC.2023 13:51:32

Conducted Spurious Emission Plot on Bluetooth LE 1Mbps GFSK Channel 39



Date: 18.DEC.2023 13:51:52

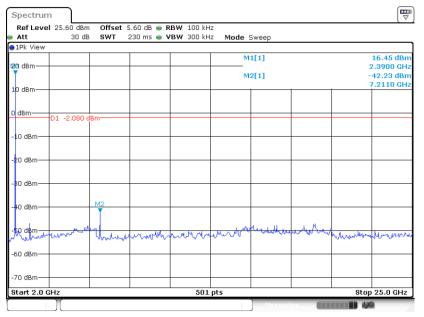


GFSK Channel 00 Spectrum Offset 5.60 dB ■ RBW 100 kHz SWT 29.7 ms ■ VBW 300 kHz Ref Level 25.60 dBm Att 30 dB Mode Sweep ⊖1Pk Viev M1[1] 16.27 dBr 2.40420 GHz -49.31 dBn 20 dBm м1 M2[1] 2.60580 GHz 10 dBm 0 dBm--10 dBm -20 dBm -30 dBm -40 dBm M2 -50 dBm Alunt Section whole -60 dBm -70 dBm Start 30.0 MHz Stop 3.0 GHz 501 pts

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps

Date: 18.DEC.2023 13:54:39

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 00



Date: 18.DEC.2023 13:54:59

M2

ment

mound

many

Stop 3.0 GHz



GFSK Channel 19 Spectrum Offset 5.60 dB ■ RBW 100 kHz SWT 29.7 ms ■ VBW 300 kHz Ref Level 25.60 dBm Att 30 dB Mode Sweep ⊖1Pk Viev M1[1] 14.21 dBn 2.43980 GHz -49.22 dBn 20 dBm М1 M2[1] 2.51690 GHz 10 dBm-0 dBm-D1 -1.480 -10 dBm

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps

Date: 18.DEC.2023 13:57:15

Acres

imm

-20 dBm -30 dBm -40 dBm

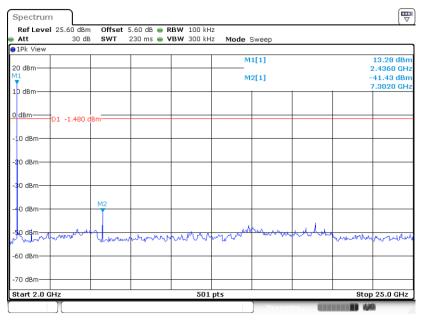
-50 dBm

-60 dBm -70 dBm Start 30.0 MHz

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 19

501 pts

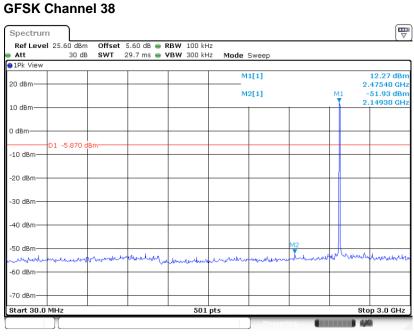
which



Date: 18.DEC.2023 13:57:35

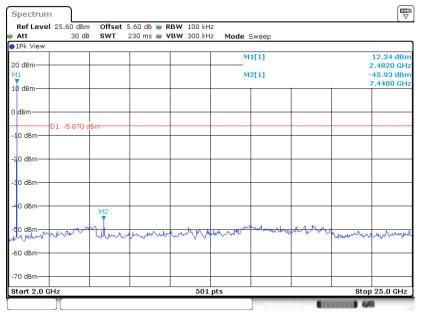


Conducted Spurious Emission Plot on Bluetooth LE 2Mbps



Date: 19.DEC.2023 08:48:06

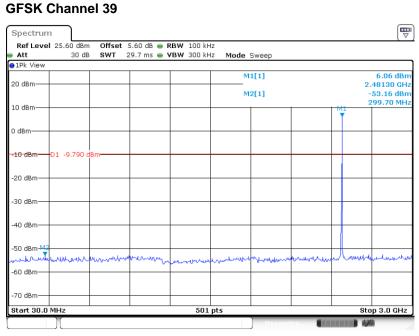
Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 38



Date: 19.DEC.2023 08:48:26

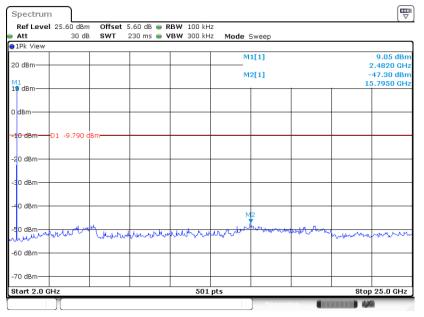


Conducted Spurious Emission Plot on Bluetooth LE 2Mbps



Date: 18.DEC.2023 13:59:56

Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 39



Date: 18.DEC.2023 14:00:16



3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated Band Edges and Spurious Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

| Frequency | Field Strength | Measurement Distance | | |
|---------------|--------------------|----------------------|--|--|
| (MHz) | (microvolts/meter) | (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 | | |

3.5.2 Measuring Instruments

The section 4.0 of List of Measuring Equipment of this test report is used for test.



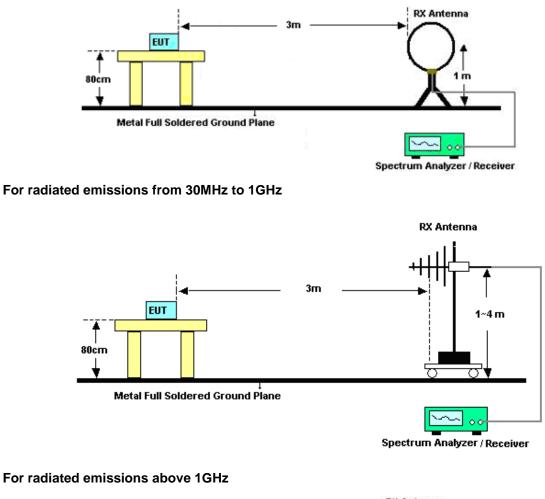
3.5.3 Test Procedures

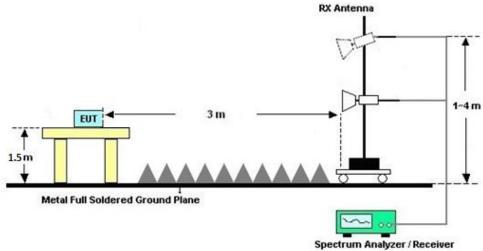
- 1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
- 2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
- 3. 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.
- 4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
- 5. Corrected Reading: Antenna Factor + Cable Loss + Read Level Preamp Factor = Level
- 6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
- 7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than peak limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
- 8. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \ge 1$ GHz for peak measurement. For average measurement:
 - 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.



3.5.4 Test Setup

For radiated emissions below 30MHz





Sporton International Inc. (Kunshan) TEL : +86-512-57900158 FCC ID: 2AC7Z-ESP868407



3.5.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

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

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

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C.

3.5.7 Duty Cycle

Please refer to Appendix D.

3.5.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)

Please refer to Appendix C.



3.6 AC Conducted Emission Measurement

3.6.1 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) |
|-----------------------------|------------|--------------|
| Frequency of emission (MHZ) | 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.

3.6.2 Measuring Instruments

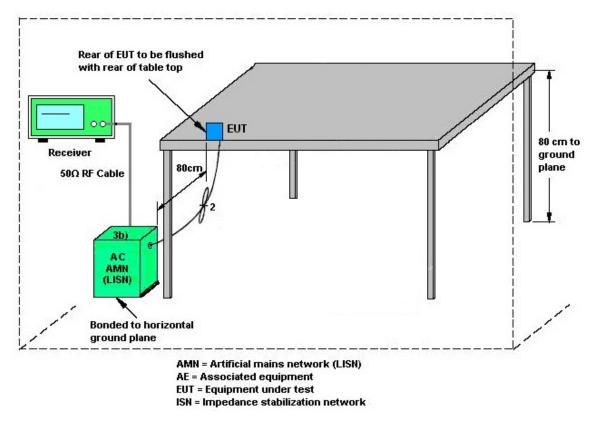
The section 4.0 of List of Measuring Equipment of this test report is used for test.

3.6.3 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.
- Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.



3.6.4 Test Setup



3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



3.7 Antenna Requirements

3.7.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 Antenna Gain

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



4 List of Measuring Equipment

| Instrument | Manufacturer | Model No. | Serial No. | Characteristics | Calibration Date | Test Date | Due Date | Remark |
|---|--------------|----------------------------|------------------|----------------------------|---------------------|---------------------------------|---------------|--------------------------|
| Spectrum Analyzer | R&S | FSV40 | 101040 | 10Hz~40GHz | Oct. 11, 2023 | Dec. 18, 2023~ Dec. 19, 2023 | Oct. 10, 2024 | Conducted (TH01-KS) |
| Pulse Power Senor | Anritsu | MA2411B | 0917070 | 300MHz~40GH z | Jan. 05, 2023 | Dec. 18, 2023~ Dec. 19, 2023 | Jan. 04, 2024 | Conducted (TH01-KS) |
| Power Meter | Anritsu | ML2495A | 1005002 | 50MHz Bandwidth | Jan. 05, 2023 | Dec. 18, 2023~ Dec. 19, 2023 | Jan. 04, 2024 | Conducted (TH01-KS) |
| EMI Test Receiver | Keysight | N9038A | MY564000 04 | 3Hz~8.5GHz;M ax 30dBm | Oct. 10, 2023 | Dec. 21, 2023 | Oct. 09, 2024 | Radiation (03CH06-KS) |
| EXA Spectrum Analyzer | Keysight | N9010B | MY602421 26 | 10Hz-44GHz | Oct. 10, 2023 | Dec. 21, 2023 | Oct. 09, 2024 | Radiation (03CH06-KS) |
| Loop Antenna | R&S | HFH2-Z2 | 100321 | 9kHz~30MHz | Oct. 10, 2023 | Dec. 21, 2023 | Oct. 09, 2024 | Radiation (03CH06-KS) |
| Bilog Antenna | TeseQ | CBL6111D | 49921 | 30MHz-1GHz | Apr. 09, 2023 | Dec. 21, 2023 | Apr. 08, 2024 | Radiation (03CH06-KS) |
| Double Ridge Horn Antenna | ETS-Lindgren | 3117 | 00218652 | 1GHz~18GHz | Apr. 06, 2023 | Dec. 21, 2023 | Apr. 05, 2024 | Radiation (03CH06-KS) |
| SHF-EHF Horn | Com-power | AH-840 | 101093 | 18GHz~40GHz | Jan. 08, 2023 | Dec. 21, 2023 | Jan. 07, 2024 | Radiation (03CH06-KS) |
| Amplifier | SONOMA | 310N | 380827 | 9KHz ~1GHZ | Jul. 06, 2023 | Dec. 21, 2023 | Jul. 05, 2024 | Radiation (03CH06-KS) |
| Amplifier | MITEQ | EM18G40GG A | 060728 | 18~40GHz | Jan. 05, 2023 | Dec. 21, 2023 | Jan. 04, 2024 | Radiation (03CH06-KS) |
| high gain Amplifier | MITEQ | AMF-7D-0010 1800-30-10P | 2082395 | 1Ghz-18Ghz | Jan. 05, 2023 | Dec. 21, 2023 | Jan. 04, 2024 | Radiation (03CH06-KS) |
| Amplifier | Keysight | 83017A | MY532703 19 | 500MHz~26.5G Hz | Oct. 10, 2023 | Dec. 21, 2023 | Oct. 09, 2024 | Radiation (03CH06-KS) |
| AC Power Source | Chroma | 61601 | F1040900 04 | N/A | NCR | Dec. 21, 2023 | NCR | Radiation (03CH06-KS) |
| Turn Table | ChamPro | EM 1000-T | 060762-T | 0~360 degree | NCR | Dec. 21, 2023 | NCR | Radiation (03CH06-KS) |
| Antenna Mast | ChamPro | EM 1000-A | 060762-A | 1 m~4 m | NCR | Dec. 21, 2023 | NCR | Radiation (03CH06-KS) |
| EMI Receiver | R&S | ESCI7 | 100768 | 9kHz~7GHz; | May 24, 2022 | Apr. 21, 2023 | May 23, 2023 | Conduction (CO01-KS) |
| AC LISN (for auxiliary equipment) | MessTec | AN3016 | 060103 | 9kHz~30MHz | Oct. 13, 2022 | Apr. 21, 2023 | Oct. 12, 2023 | Conduction (CO01-KS) |
| AC LISN | MessTec | AN3016 | 060105 | 9kHz~30MHz | May. 24, 2022 | Apr. 21, 2023 | May. 23, 2023 | Conduction (CO01-KS) |
| AC Power Source | Chroma | 61602 | ABP00000 0811 | AC 0V~300V, 45Hz~1000Hz | Oct. 12, 2022 | Apr. 21, 2023 | Oct. 11, 2023 | Conduction (CO01-KS) |

NCR: No Calibration Required



5 Measurement Uncertainty

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

Uncertainty of Conducted Measurement

| Conducted Spurious Emission & Bandedge | ±2.26 dB |
|--|----------|
| Occupied Channel Bandwidth | ±0.1% |
| Conducted Power | ±0.46 dB |
| Conducted Power Spectral Density | ±0.88 dB |
| Frequency | ±0.4 Hz |

Uncertainty of AC Conducted Emission Measurement (0.15 MHz ~ 30 MHz)

| Measuring Uncertainty for a Level of Confidence | 2.94 dB |
|---|---------|
| of 95% (U = 2Uc(y)) | 2.54 UB |

Uncertainty of Radiated Emission Measurement (9 KHz ~ 30 MHz)

| Measuring Uncertainty for a Level of Confidence | 3.32 dB |
|---|---------|
| of 95% (U = 2Uc(y)) | 3.32 UB |

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

| Measuring Uncertainty for a Level of Confidence | 6.26 dB |
|---|---------|
| of 95% (U = 2Uc(y)) | 0.20 UB |

Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

| Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y)) | 5.02 dB |
|--|---------|
|--|---------|

Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

| Measuring Uncertainty for a Level of Confidence | 5.26 dB |
|---|---------|
| of 95% (U = 2Uc(y)) | 5.20 UB |

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



Appendix A. Conducted Test Results

Report Number : FR310907A

Bluetooth Low Energy

| Test Engineer: | Jiang Jun | Temperature: | 20~26 | °C |
|----------------|-----------------------|--------------------|-------|----|
| Test Date: | 2023.12.18~2023.12.19 | Relative Humidity: | 40~51 | % |

| Power | setting |
|-------|---------|
| CH 00 | 14 |
| CH 19 | 14 |
| CH 38 | 13 |
| CH 39 | 11 |

| | <u>TEST RESULTS DATA</u> <u>6dB and 99% Occupied Bandwidth</u> | | | | | | | |
|------|---|-----|-----|----------------|--------------------------------|-----------------|--------------------------|-----------|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | 99% Occupied BW (MHz) | 6dB BW (MHz) | 6dB BW Limit (MHz) | Pass/Fail |
| BLE | 1Mbps | 1 | 0 | 2402 | 1.07 | 0.66 | 0.50 | Pass |
| BLE | 1Mbps | 1 | 19 | 2440 | 1.08 | 0.66 | 0.50 | Pass |
| BLE | 1Mbps | 1 | 38 | 2478 | 1.07 | 0.66 | 0.50 | Pass |
| BLE | 1Mbps | 1 | 39 | 2480 | 1.07 | 0.66 | 0.50 | Pass |

| | <u>TEST RESULTS DATA</u> <u>Peak Power Table</u> | | | | | | | | | | | | |
|------|---|-----|-----|----------------|-------------------------------------|--------------------------------------|-------------|------------------------|---------------------------------|---------------|--|--|--|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Peak Conducted Power (dBm) | Conducted Power Limit (dBm) | DG (dBi) | EIRP Power (dBm) | EIRP Power Limit (dBm) | Pass /Fail | | | |
| BLE | 1Mbps | 1 | 0 | 2402 | 17.98 | 30.00 | 2.33 | 20.31 | 36.00 | Pass | | | |
| BLE | 1Mbps | 1 | 19 | 2440 | 18.46 | 30.00 | 2.33 | 20.79 | 36.00 | Pass | | | |
| BLE | 1Mbps | 1 | 38 | 2478 | 15.05 | 30.00 | 2.33 | 17.38 | 36.00 | Pass | | | |
| BLE | 1Mbps | 1 | 39 | 2480 | 10.47 | 30.00 | 2.33 | 12.80 | 36.00 | Pass | | | |

| | | | | | | <u>TEST </u> <u>Avera</u> (Re |
|------|--------------|-----|-----|----------------|------------------------|--|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Duty Factor (dB) | Average Conducted Power (dBm) |
| BLE | 1Mbps | 1 | 0 | 2402 | 0.23 | 16.46 |
| BLE | 1Mbps | 1 | 19 | 2440 | 0.23 | 17.00 |
| BLE | 1Mbps | 1 | 38 | 2478 | 0.23 | 14.05 |
| BLE | 1Mbps | 1 | 39 | 2480 | 0.23 | 9.11 |

| | | | | | | <u>Peak</u> | Power De | ensity | | |
|------|--------------|-----|-----|----------------|------------------------------|----------------------------|-------------|-------------------------------------|-----------|--|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Peak PSD (dBm /100kHz) | Peak PSD (dBm /3kHz) | DG (dBi) | Peak PSD Limit (dBm /3kHz) | Pass/Fail | |
| BLE | 1Mbps | 1 | 0 | 2402 | 17.91 | 3.96 | 2.33 | 8.00 | Pass | |
| BLE | 1Mbps | 1 | 19 | 2440 | 18.38 | 4.64 | 2.33 | 8.00 | Pass | |
| BLE | 1Mbps | 1 | 38 | 2478 | 14.04 | 0.92 | 2.33 | 8.00 | Pass | |
| BLE | 1Mbps | 1 | 39 | 2480 | 10.25 | -3.19 | 2.33 | 8.00 | Pass | |

Report Number : FR310907A

Bluetooth Low Energy

| Test Engineer: | Jiang Jun | Temperature: | 20~26 | °C |
|----------------|-----------------------|--------------------|-------|----|
| Test Date: | 2023.12.18~2023.12.19 | Relative Humidity: | 40~51 | % |

| Power | setting |
|-------|---------|
| CH 00 | 14 |
| CH 19 | 14 |
| CH 38 | 13 |
| CH 39 | 11 |

| | | | | | <u>6d</u> | - | <u>RESULTS</u> 6 Occupie | <u>DATA</u> d Bandwid | l <u>th</u> |
|------|--------------|-----|-----|----------------|--------------------------------|-----------------|-----------------------------|--------------------------|-------------|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | 99% Occupied BW (MHz) | 6dB BW (MHz) | 6dB BW Limit (MHz) | Pass/Fail | |
| BLE | 2Mbps | 1 | 0 | 2402 | 2.06 | 1.10 | 0.50 | Pass | |
| BLE | 2Mbps | 1 | 19 | 2440 | 2.06 | 1.12 | 0.50 | Pass | |
| BLE | 2Mbps | 1 | 38 | 2478 | 2.06 | 1.12 | 0.50 | Pass | |
| BLE | 2Mbps | 1 | 39 | 2480 | 2.06 | 1.10 | 0.50 | Pass | |

| | <u>TEST RESULTS DATA</u> <u>Peak Power Table</u> | | | | | | | | | | | | |
|------|---|-----|-----|----------------|-------------------------------------|--------------------------------------|-------------|------------------------|---------------------------------|---------------|--|--|--|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Peak Conducted Power (dBm) | Conducted Power Limit (dBm) | DG (dBi) | EIRP Power (dBm) | EIRP Power Limit (dBm) | Pass /Fail | | | |
| BLE | 2Mbps | 1 | 0 | 2402 | 18.15 | 30.00 | 2.33 | 20.48 | 36.00 | Pass | | | |
| BLE | 2Mbps | 1 | 19 | 2440 | 18.57 | 30.00 | 2.33 | 20.90 | 36.00 | Pass | | | |
| BLE | 2Mbps | 1 | 38 | 2478 | 15.05 | 30.00 | 2.33 | 17.38 | 36.00 | Pass | | | |
| BLE | 2Mbps | 1 | 39 | 2480 | 10.72 | 30.00 | 2.33 | 13.05 | 36.00 | Pass | | | |

| | | | | | | Avera | RESULTS DATA ge Power Table porting Only) |
|------|--------------|-----|-----|----------------|------------------------|--|---|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Duty Factor (dB) | Average Conducted Power (dBm) | |
| BLE | 2Mbps | 1 | 0 | 2402 | 0.42 | 16.47 | |
| BLE | 2Mbps | 1 | 19 | 2440 | 0.42 | 16.72 | |
| BLE | 2Mbps | 1 | 38 | 2478 | 0.42 | 13.94 | |
| BLE | 2Mbps | 1 | 39 | 2480 | 0.42 | 9.29 | |

| <u>TEST RESULTS DATA</u> <u>Peak Power Density</u> | | | | | | | | | | | | |
|---|--------------|-----|-----|----------------|------------------------------|----------------------------|-------------|-------------------------------------|-----------|--|--|--|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Peak PSD (dBm /100kHz) | Peak PSD (dBm /3kHz) | DG (dBi) | Peak PSD Limit (dBm /3kHz) | Pass/Fail | | | |
| BLE | 2Mbps | 1 | 0 | 2402 | 17.92 | 1.41 | 2.33 | 8.00 | Pass | | | |
| BLE | 2Mbps | 1 | 19 | 2440 | 18.52 | 2.18 | 2.33 | 8.00 | Pass | | | |
| BLE | 2Mbps | 1 | 38 | 2478 | 14.13 | -1.62 | 2.33 | 8.00 | Pass | | | |
| BLE | 2Mbps | 1 | 39 | 2480 | 10.21 | -6.04 | 2.33 | 8.00 | Pass | | | |

Report Number : FR310907A

Bluetooth Low Energy

| Test Engineer: | Jiang Jun | Temperature: | 20~26 | °C |
|----------------|-----------------------|--------------------|-------|----|
| Test Date: | 2023.12.18~2023.12.19 | Relative Humidity: | 40~51 | % |

| BLE | 125K |
|-------|---------|
| Power | setting |
| CH 00 | 14 |
| CH 19 | 14 |
| CH 38 | 13 |
| CH 39 | 11 |

TEST RESULTS DATA Peak Power Table

| Mod. | Data Rate | N⊤x | CH. | Freq. (MHz) | Peak Conducted Power (dBm) | Conducted Power Limit (dBm) | DG (dBi) | EIRP Power (dBm) | EIRP Power Limit (dBm) | Pass /Fail |
|------|--------------|-----|-----|----------------|-------------------------------------|--------------------------------------|-------------|------------------------|---------------------------------|---------------|
| BLE | 125K | 1 | 0 | 2402 | 17.20 | 30.00 | 2.33 | 19.53 | 36.00 | Pass |
| BLE | 125K | 1 | 19 | 2440 | 18.13 | 30.00 | 2.33 | 20.46 | 36.00 | Pass |
| BLE | 125K | 1 | 38 | 2478 | 15.48 | 30.00 | 2.33 | 17.81 | 36.00 | Pass |
| BLE | 125K | 1 | 39 | 2480 | 10.07 | 30.00 | 2.33 | 12.40 | 36.00 | Pass |

| | <u>TEST RESULTS DATA</u> <u>Average Power Table</u> <u>(Reporting Only)</u> | | | | | | | | |
|------|---|-----|-----|----------------|------------------------|--|--|--|--|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Duty Factor (dB) | Average Conducted Power (dBm) | | | |
| BLE | 125K | 1 | 0 | 2402 | 0.10 | 16.19 | | | |
| BLE | 125K | 1 | 19 | 2440 | 0.10 | 16.67 | | | |
| BLE | 125K | 1 | 38 | 2478 | 0.10 | 13.86 | | | |
| BLE | 125K | 1 | 39 | 2480 | 0.10 | 9.02 | | | |



Bluetooth Low Energy

| Test Engineer: | Jiang Jun | Temperature: | 20~26 | °C |
|----------------|-----------------------|--------------------|-------|----|
| Test Date: | 2023.12.18~2023.12.19 | Relative Humidity: | 40~51 | % |

| BLE 500K | | | | | | | |
|---------------|----|--|--|--|--|--|--|
| Power setting | | | | | | | |
| CH 00 | 14 | | | | | | |
| CH 19 | 14 | | | | | | |
| CH 38 | 13 | | | | | | |
| CH 39 | 11 | | | | | | |

139 11 <u>TEST RESULTS DATA</u> <u>Peak Power Table</u>

| Mod. | Data Rate | N⊤x | CH. | Freq. (MHz) | Peak Conducted Power (dBm) | Conducted Power Limit (dBm) | DG (dBi) | EIRP Power (dBm) | EIRP Power Limit (dBm) | Pass /Fail |
|------|--------------|-----|-----|----------------|-------------------------------------|--------------------------------------|-------------|------------------------|---------------------------------|---------------|
| BLE | 500K | 1 | 0 | 2402 | 17.12 | 30.00 | 2.33 | 19.45 | 36.00 | Pass |
| BLE | 500K | 1 | 19 | 2440 | 18.24 | 30.00 | 2.33 | 20.57 | 36.00 | Pass |
| BLE | 500K | 1 | 38 | 2478 | 14.93 | 30.00 | 2.33 | 17.26 | 36.00 | Pass |
| BLE | 500K | 1 | 39 | 2480 | 9.88 | 30.00 | 2.33 | 12.21 | 36.00 | Pass |

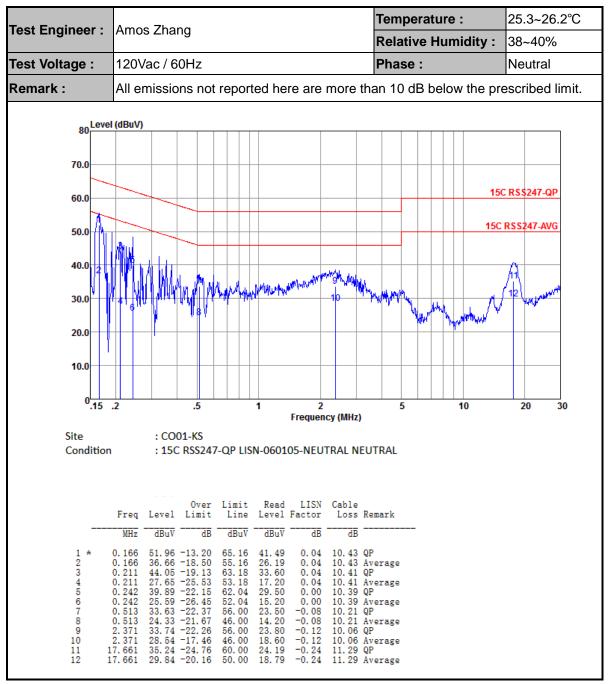
| | <u>TEST RESULTS DATA</u> <u>Average Power Table</u> (Reporting Only) | | | | | | | | | |
|------|--|-----|-----|----------------|------------------------|--|--|--|--|--|
| Mod. | Data Rate | Ntx | CH. | Freq. (MHz) | Duty Factor (dB) | Average Conducted Power (dBm) | | | | |
| BLE | 500K | 1 | 0 | 2402 | 0.04 | 16.31 | | | | |
| BLE | 500K | 1 | 19 | 2440 | 0.04 | 16.62 | | | | |
| BLE | 500K | 1 | 38 | 2478 | 0.04 | 13.89 | | | | |
| BLE | 500K | 1 | 39 | 2480 | 0.04 | 9.05 | | | | |



Appendix B. AC Conducted Emission Test Results

| Teet Engineers | Amer Zhang | | Temperature : | 25.3~26.2°C | | | | | | | |
|-------------------|---------------------------------------|--|-----------------------|-----------------|--|--|--|--|--|--|--|
| Test Engineer : | Amos Zhang | | Relative Humidity : | 38~40% | | | | | | | |
| Test Voltage : | 120Vac / 60Hz | | Phase : | Line | | | | | | | |
| Remark : | All emissions not re | ported here are more th | an 10 dB below the pr | escribed limit. | | | | | | | |
| Leve | 80 <mark>_Level (dBuV)</mark> | | | | | | | | | | |
| 80 | | | | | | | | | | | |
| 70.0 | | | | | | | | | | | |
| 60.0 | | | 150 | C RSS247-QP | | | | | | | |
| 00.0 | | | | | | | | | | | |
| 50.0 | | | 150 | RSS247-AVG | | | | | | | |
| 40.0 | | | | | | | | | | | |
| | MANA MURINALAND. | Lan annaly toon why my when | man III. A | MIN | | | | | | | |
| 30.0 | | har har water a start of the st | Myrmmur V | 12 | | | | | | | |
| 20.0 | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | | | | | | | | | | |
| | | | | | | | | | | | |
| 10.0 | | | | | | | | | | | |
| 0.15 | .2 .5 | 1 2 | 5 10 | 20 30 | | | | | | | |
| | | Frequency (MHz) | | | | | | | | | |
| Site Condition | : CO01-KS : 15C BSS247-O | P LISN-060105-LINE LINE | | | | | | | | | |
| condition | . 150 155247-Q | | | | | | | | | | |
| | | | | | | | | | | | |
| | Over Li | mit Read LISN Cable ine Level Factor Loss Re | emark | | | | | | | | |
| | MHz dBuV dB d | IBuV dBuV dB dB | | | | | | | | | |
| 1 * 2 | | 5.60 42.20 0.06 10.43 Q 5.60 19.60 0.06 10.43 A | | | | | | | | | |
| 4 | 0.190 35.25 -18.77 54 | L 02 39.60 0.03 10.42 Q L 02 24.80 0.03 10.42 A | verage | | | | | | | | |
| 6 | 0.211 28.64 -24.54 53 | 3. 18 31. 50 0. 03 10. 41 Q 3. 18 18. 20 0. 03 10. 41 A 22 26 20 0. 04 10 20 0 | verage | | | | | | | | |
| 8 | 0.237 24.63 -27.59 52 | 2.22 26.80 0.04 10.39 Q 2.22 14.20 0.04 10.39 A 3.54 20.60 -0.02 10.24 Q | verage | | | | | | | | |
| 10 | 0.469 21.82 -24.72 46 | | verage | | | | | | | | |
| | 8.721 25.91 -24.09 50 | | | | | | | | | | |





Note:

- 1. Level(dB μ V) = Read Level(dB μ V) + LISN Factor(dB) + Cable Loss(dB)
- 2. Over Limit(dB) = Level(dB μ V) Limit Line(dB μ V)



Appendix C. Radiated Spurious Emission Test Data

| Test Engineer : | Jiankang Jiang | Relative Humidity : | 41~42 % |
|-----------------|----------------|---------------------|-----------|
| rest Engineer. | | Temperature : | 22~ 23 ℃ |

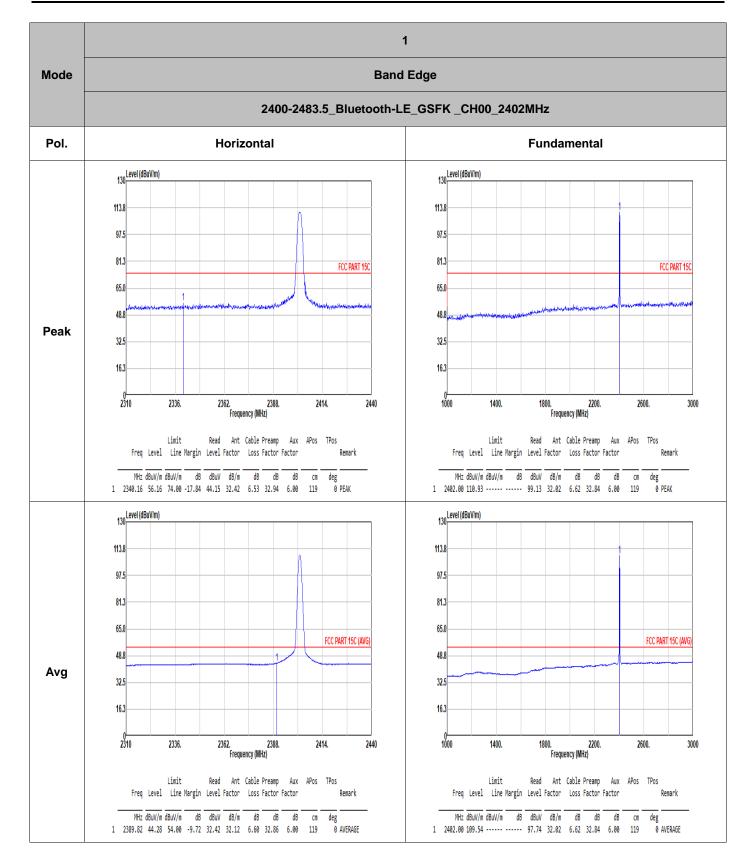
Radiated Spurious Emission Test Modes

| Mode | Band (MHz) | Modulation | Channel | Frequency | Data Rate | Power setting | Remark |
|--------|---------------|-------------------|---------|-----------|--------------|---------------|--------|
| Mode 1 | 2400-2483.5 | Bluetooth-LE_GSFK | 00 | 2402 | 1Mbps | 14 | - |
| Mode 2 | 2400-2483.5 | Bluetooth-LE_GSFK | 19 | 2440 | 1Mbps | 14 | - |
| Mode 3 | 2400-2483.5 | Bluetooth-LE_GSFK | 39 | 2480 | 1Mbps | 11 | - |
| Mode 4 | 2400-2483.5 | Bluetooth-LE_GSFK | 00 | 2402 | 2Mbps | 14 | - |
| Mode 5 | 2400-2483.5 | Bluetooth-LE_GSFK | 19 | 2440 | 2Mbps | 14 | - |
| Mode 6 | 2400-2483.5 | Bluetooth-LE_GSFK | 39 | 2480 | 2Mbps | 11 | - |
| Mode 7 | 2400-2483.5 | Bluetooth-LE_GSFK | 38 | 2478 | 1Mbps | 13 | |
| Mode 7 | 2400-2483.5 | Bluetooth-LE_GSFK | 38 | 2478 | 1Mbps | 13 | LF |
| Mode 8 | 2400-2483.5 | Bluetooth-LE_GSFK | 38 | 2478 | 2Mbps | 13 | |

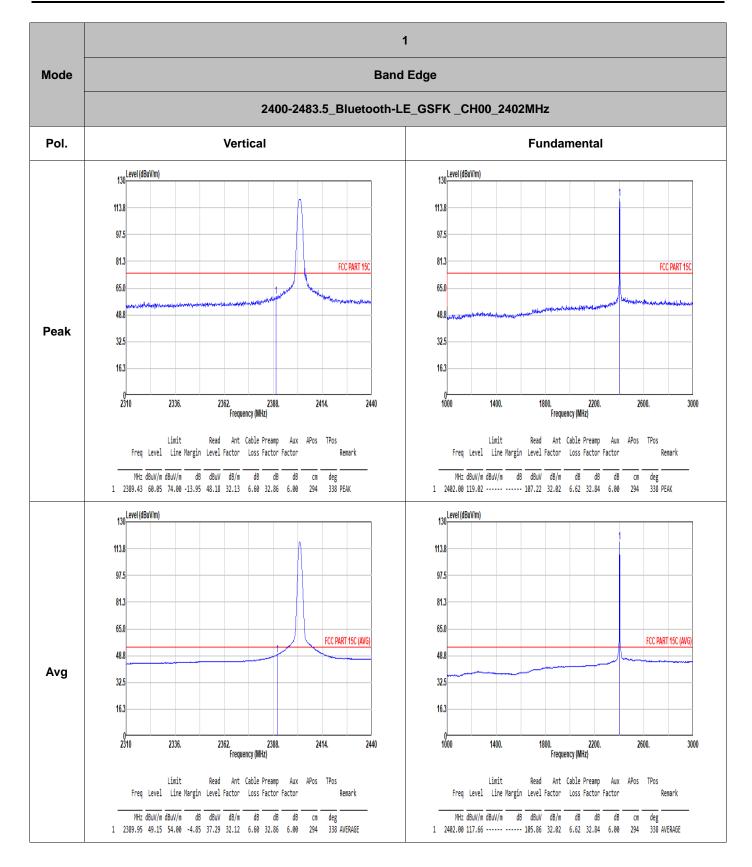
Summary of each worse mode

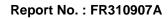
| Mode | Modulation | Ch. | Freq. (MHz) | Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Pol. | Peak Avg. | Result | Remark |
|------|-------------------|-----|----------------|-------------------|-------------------|----------------|------|--------------|--------|-----------|
| 1 | Bluetooth-LE_GSFK | 00 | 2389.95 | 49.15 | 54.00 | -4.85 | V | AVERAGE | Pass | Band Edge |
| I | Bluetooth-LE_GSFK | 00 | 4804.00 | 49.90 | 54.00 | -4.10 | V | AVERAGE | Pass | Harmonic |
| 2 | Bluetooth-LE_GSFK | 19 | - | - | - | - | - | - | - | Band Edge |
| 2 | Bluetooth-LE_GSFK | 19 | 4880.00 | 50.41 | 54.00 | -3.59 | V | AVERAGE | Pass | Harmonic |
| 0 | Bluetooth-LE_GSFK | 39 | 2483.50 | 49.33 | 54.00 | -4.67 | V | AVERAGE | Pass | Band Edge |
| 3 | Bluetooth-LE_GSFK | 39 | 7440.00 | 43.46 | 74.00 | -30.54 | V | PEAK | Pass | Harmonic |
| 4 | Bluetooth-LE_GSFK | 00 | 2389.82 | 48.30 | 54.00 | -5.70 | V | AVERAGE | Pass | Band Edge |
| 4 | Bluetooth-LE_GSFK | 00 | 4804.00 | 46.45 | 54.00 | -7.55 | V | AVERAGE | Pass | Harmonic |
| 5 | Bluetooth-LE_GSFK | 19 | - | - | - | - | - | - | - | Band Edge |
| 5 | Bluetooth-LE_GSFK | 19 | 4880.00 | 47.59 | 54.00 | -6.41 | V | AVERAGE | Pass | Harmonic |
| 6 | Bluetooth-LE_GSFK | 39 | 2483.50 | 49.49 | 54.00 | -4.51 | V | AVERAGE | Pass | Band Edge |
| 6 | Bluetooth-LE_GSFK | 39 | 7440.00 | 43.71 | 74.00 | -30.29 | V | PEAK | Pass | Harmonic |
| | Bluetooth-LE_GSFK | 38 | 2483.56 | 52.60 | 54.00 | -1.40 | Н | AVERAGE | Pass | Band Edge |
| 7 | Bluetooth-LE_GSFK | 38 | 4926.00 | 48.83 | 54.00 | -5.17 | Н | AVERAGE | Pass | Harmonic |
| | Bluetooth-LE_GSFK | 38 | 42.61 | 29.51 | 40.00 | -10.49 | V | PEAK | Pass | LF |
| 8 | Bluetooth-LE_GSFK | 38 | 2483.50 | 52.55 | 54.00 | -1.45 | Н | AVERAGE | Pass | Band Edge |
| ð | Bluetooth-LE_GSFK | 38 | 4956.00 | 46.83 | 54.00 | -7.17 | Н | PEAK | Pass | Harmonic |



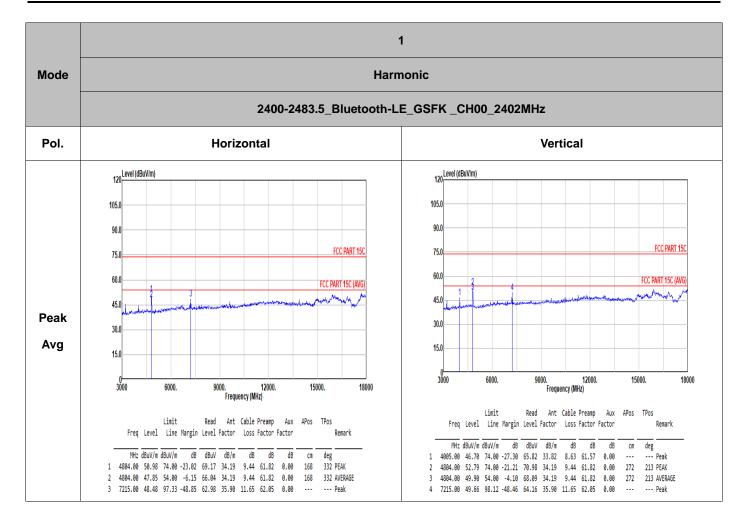




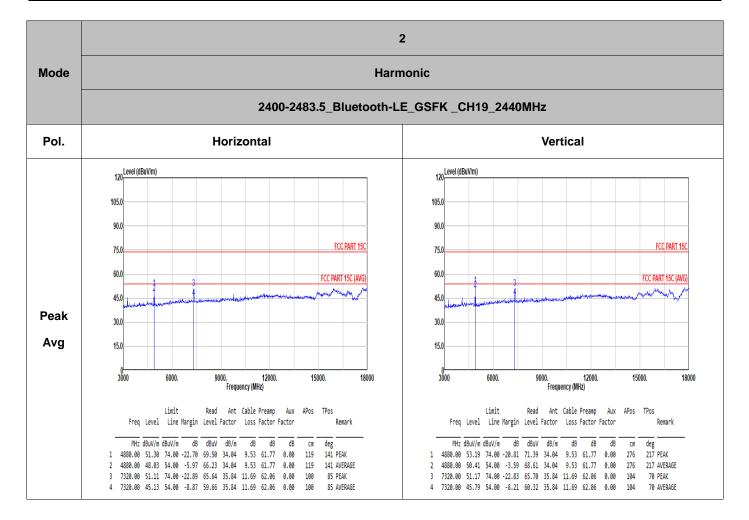




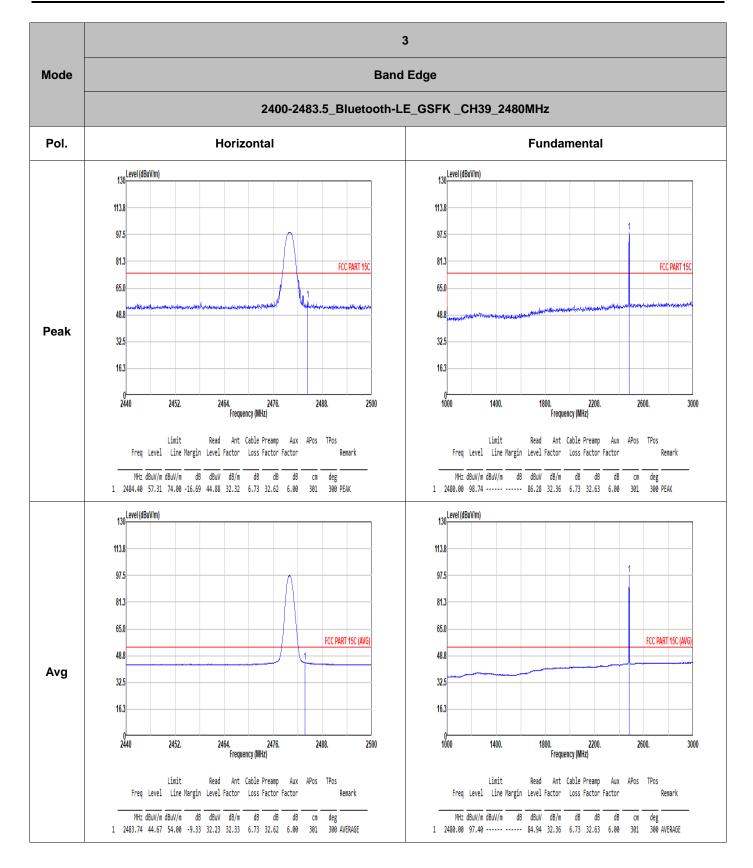




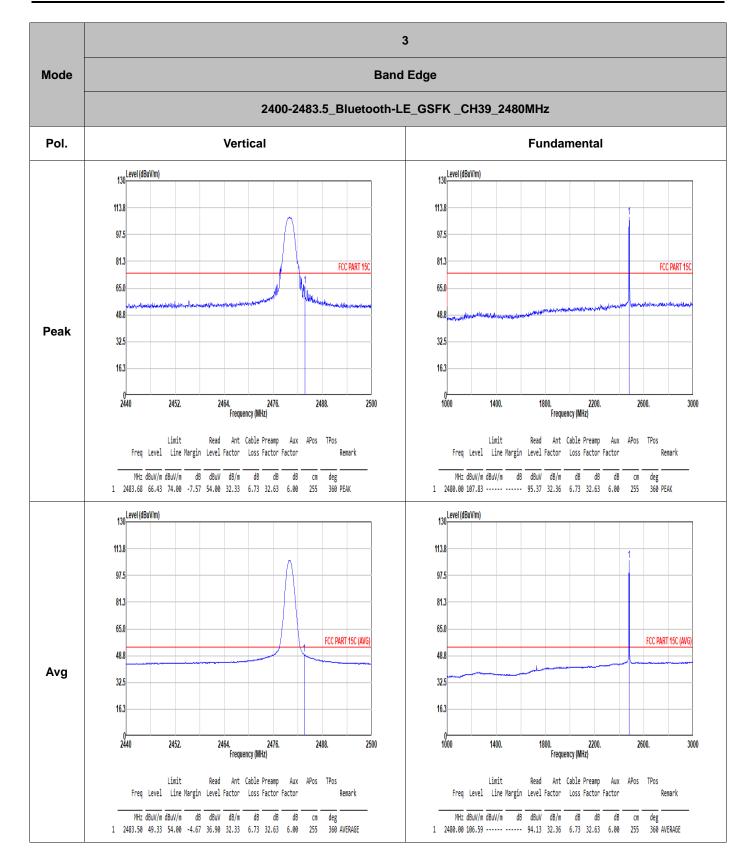




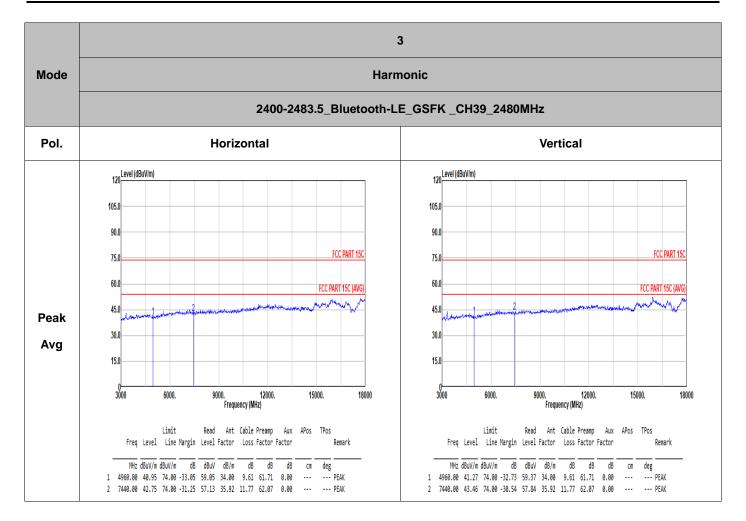




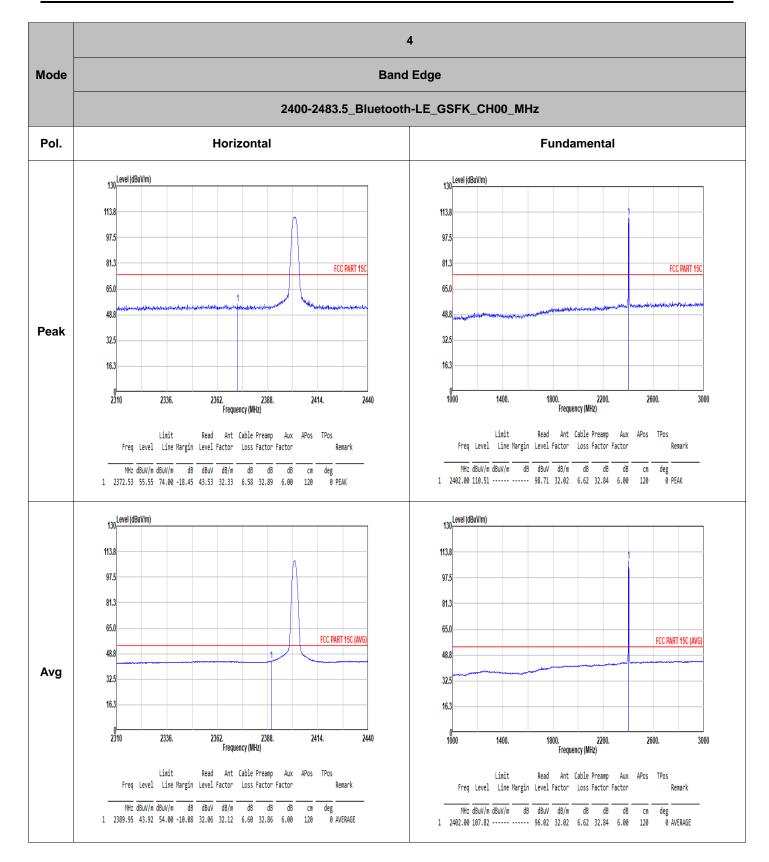




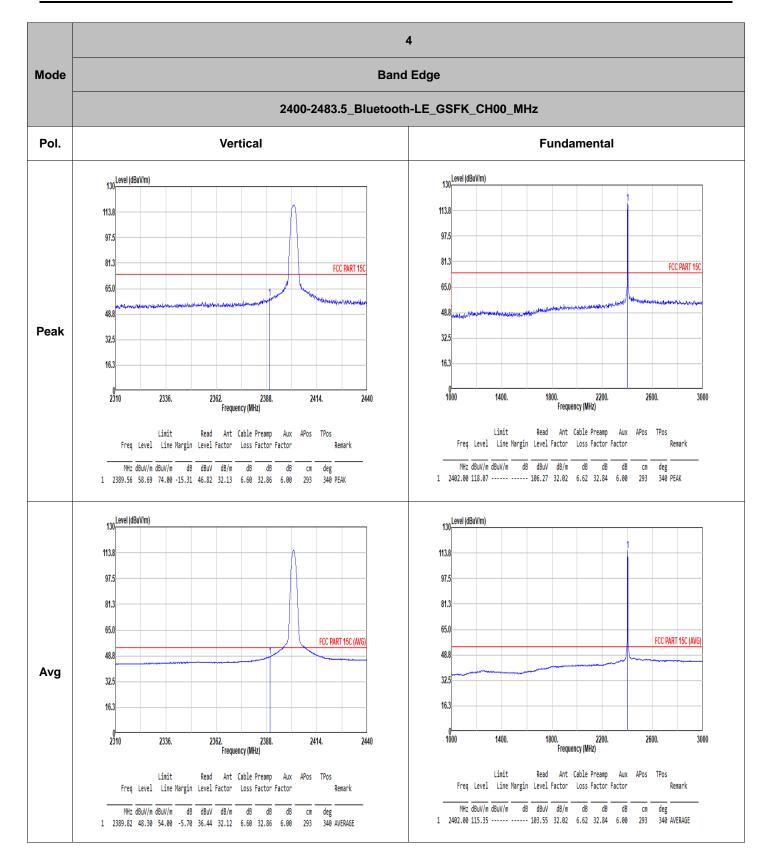




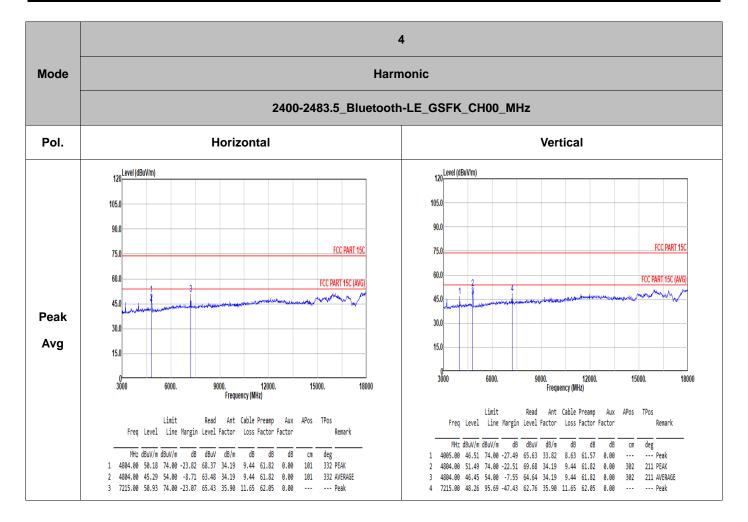




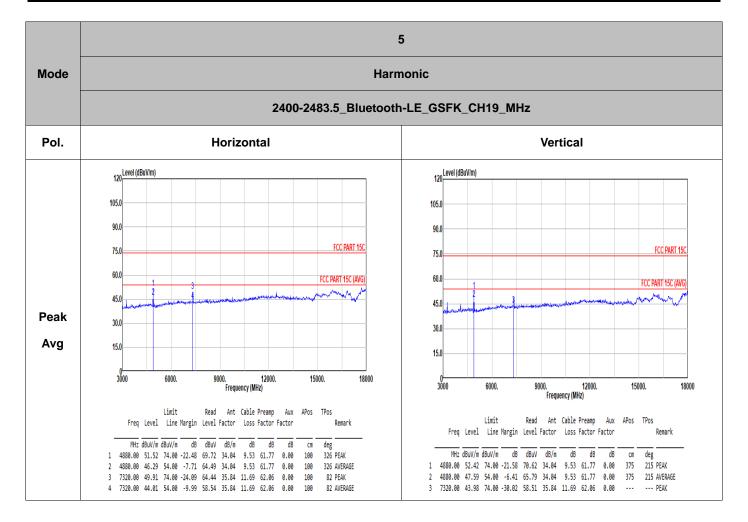




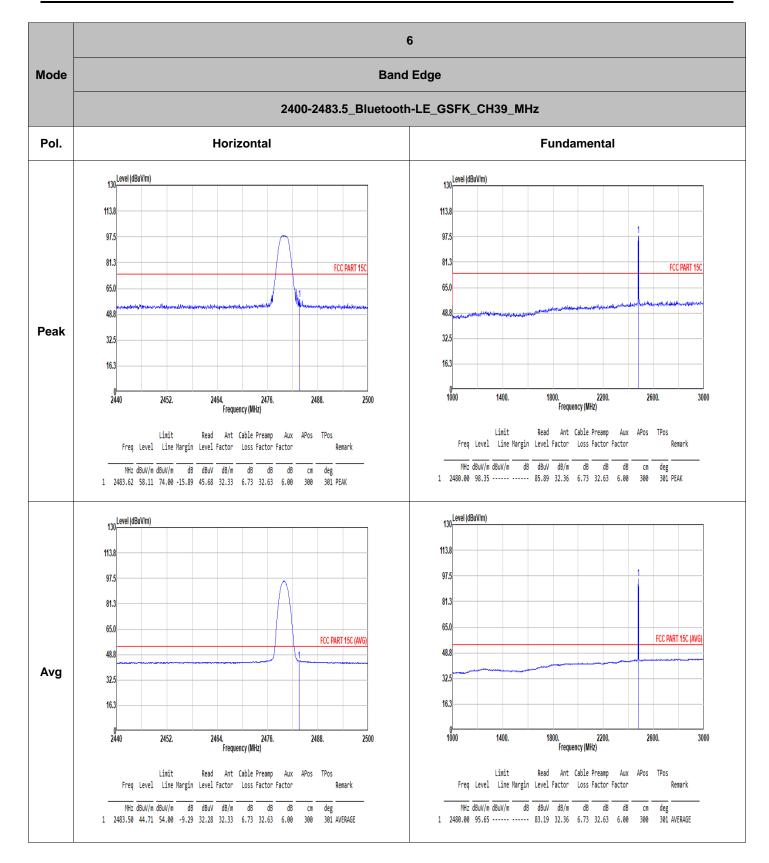




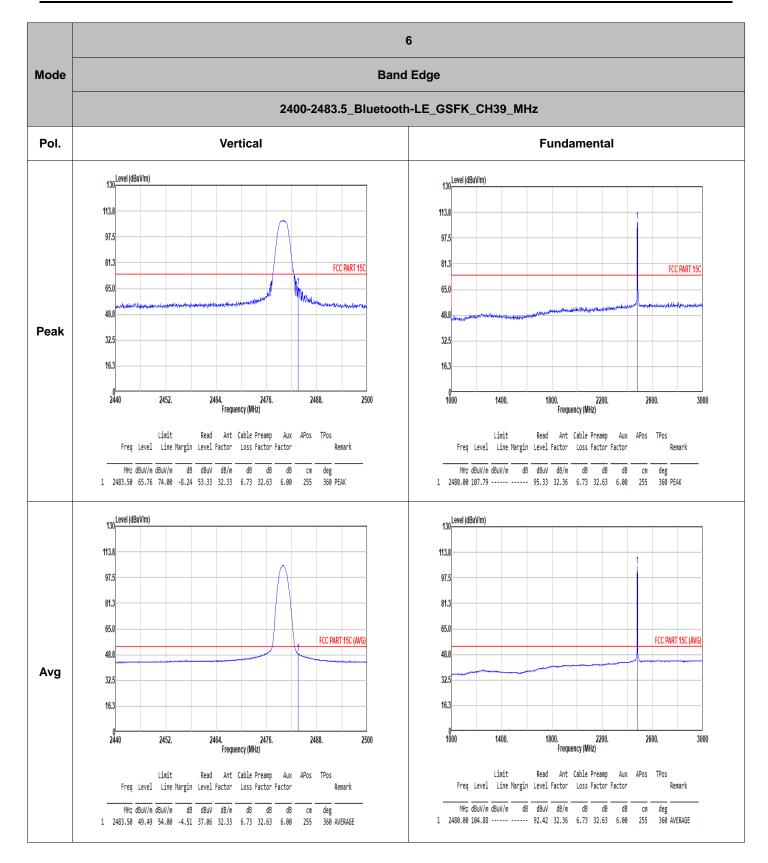




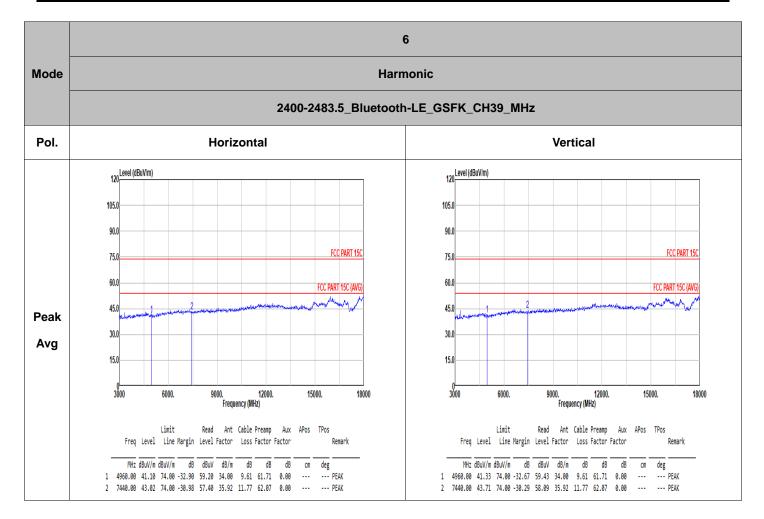




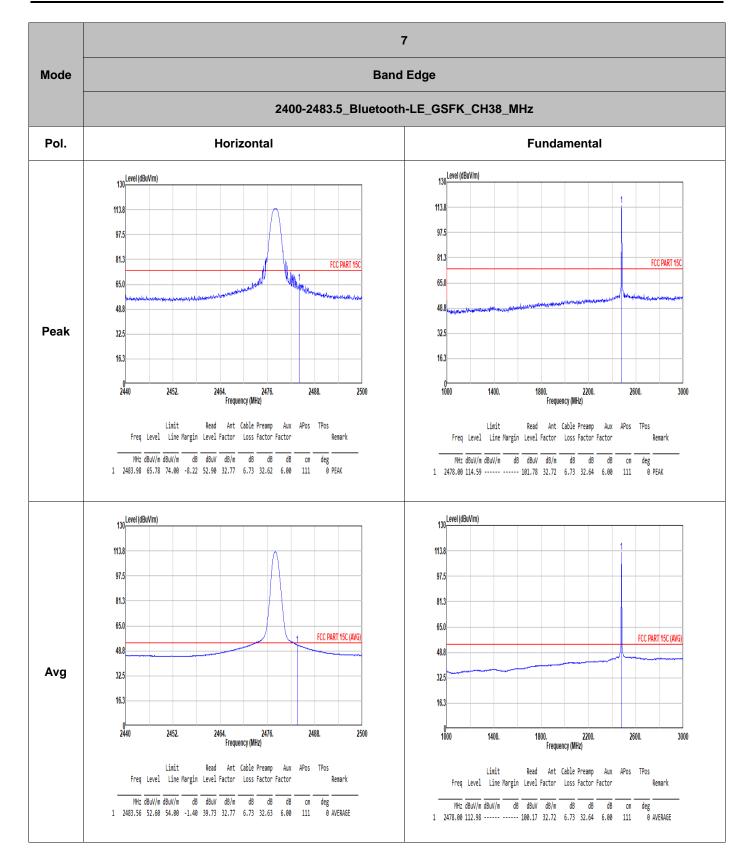




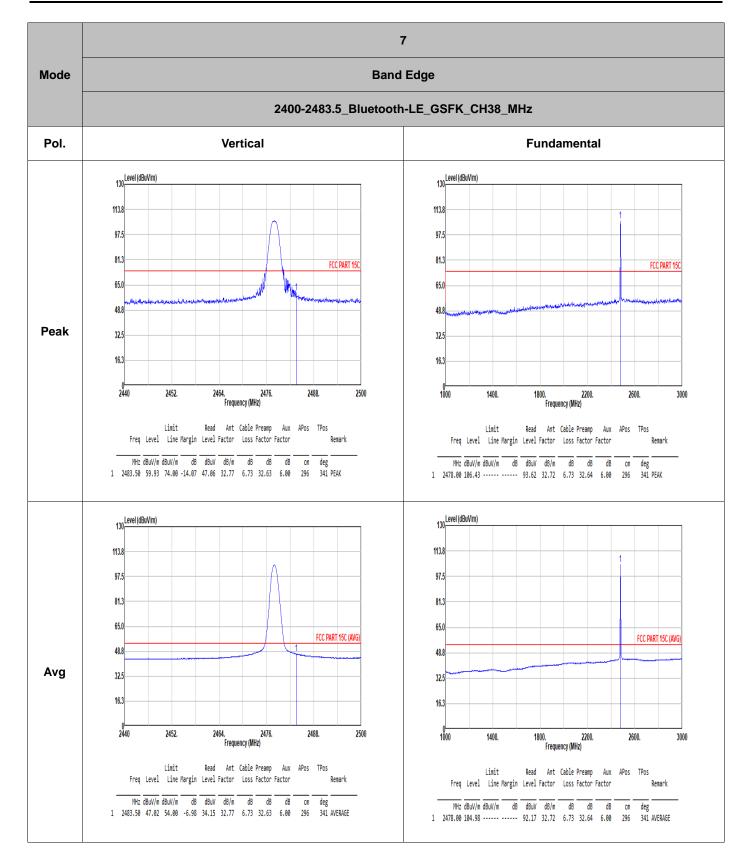




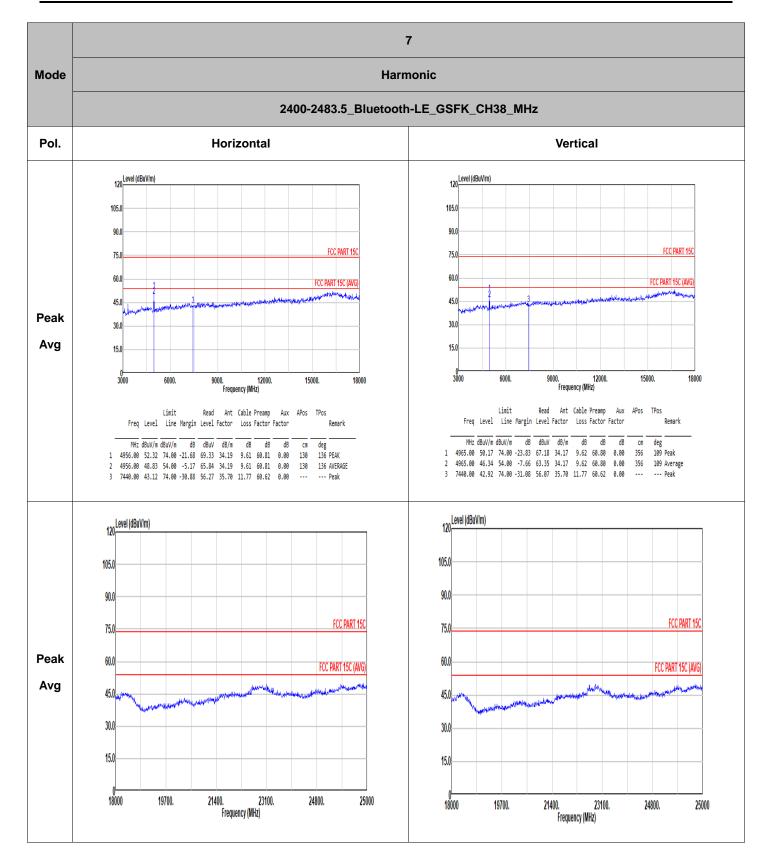




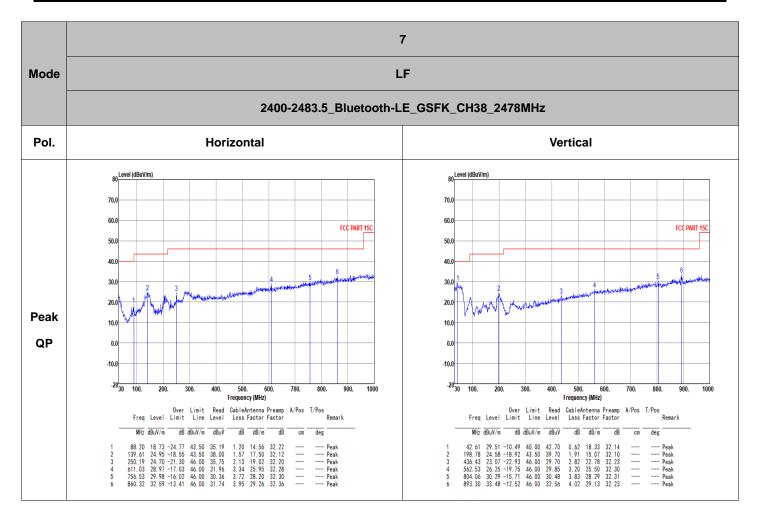




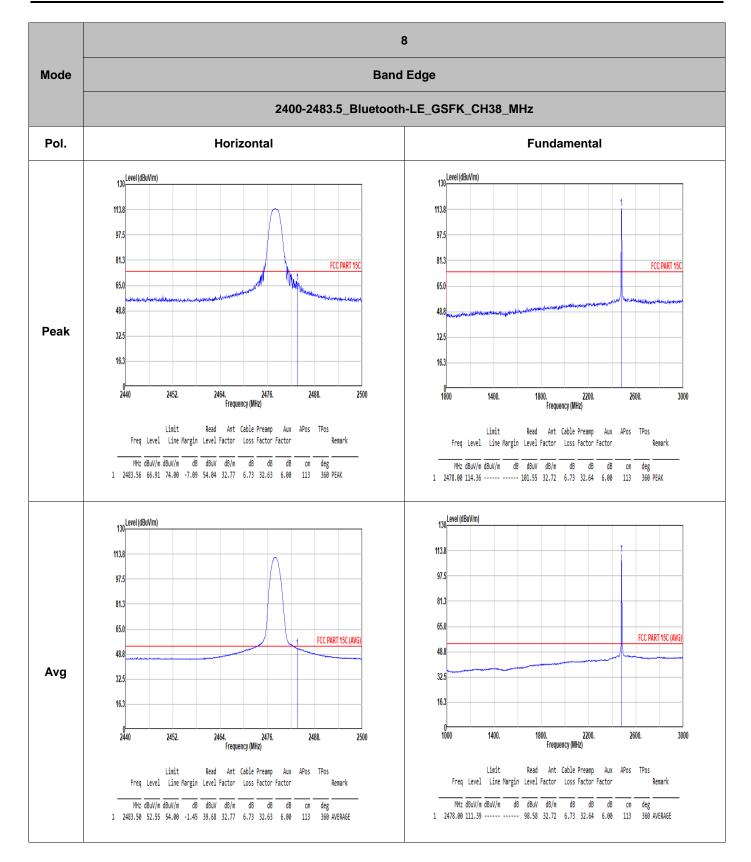




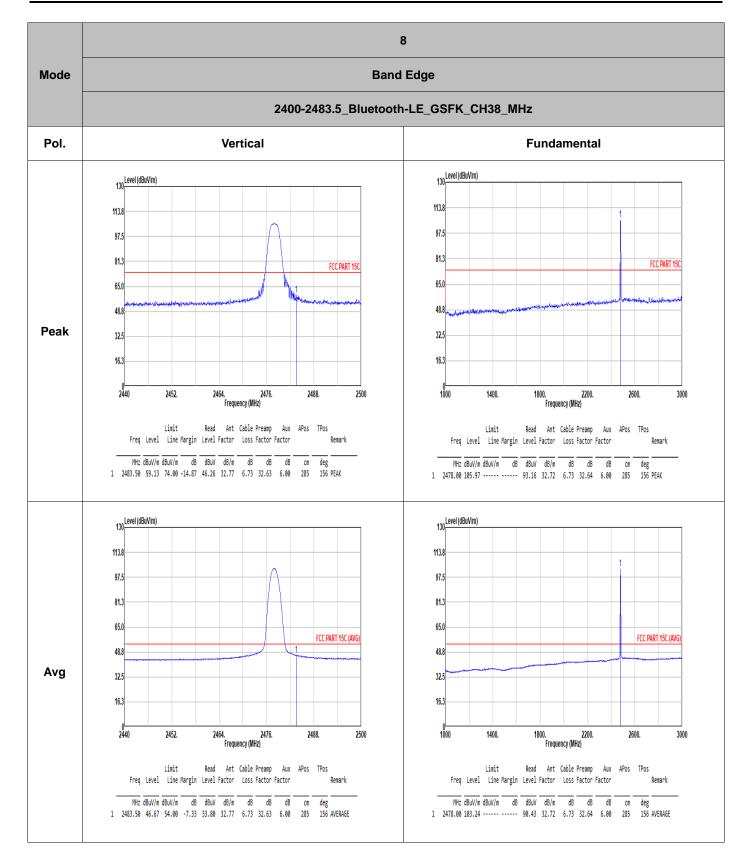




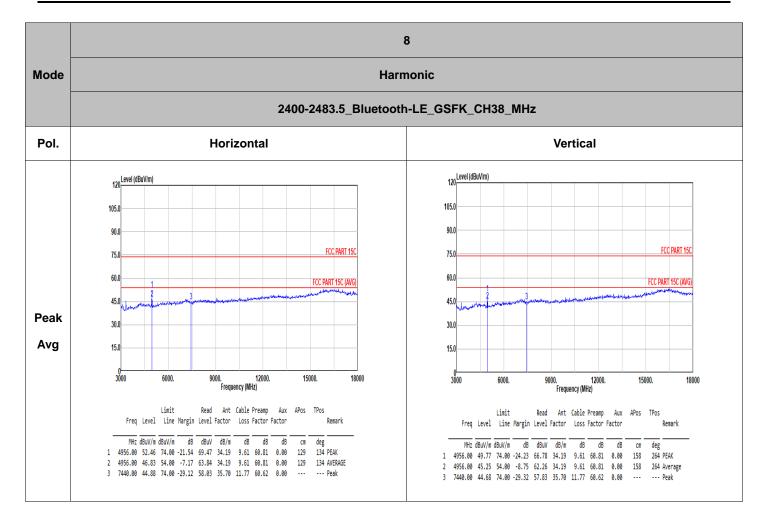










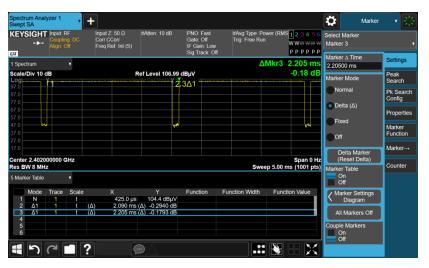




Appendix D. Duty Cycle Plots

| Band | Duty Cycle(%) | T(ms) | 1/T(kHz) | VBW Setting | |
|--------------------|---------------|-------|----------|----------------|--|
| Bluetooth LE 1Mbps | 94.78 | 2.090 | 0.478 | 0.51KHz | |
| Bluetooth LE 2Mbps | 90.17 | 1.055 | 0.948 | 1KHz | |

Bluetooth LE 1Mbps



Bluetooth LE 2Mbps

