



FCC RADIO TEST REPORT

FCC ID : HD5-CT30PL0N
Equipment : Mobile computer
Brand Name : Honeywell
Model Name : CT30PL0N
Applicant : Honeywell International Inc.
9680 Old Bailes Road, Fort Mill, SC 29707 USA
Manufacturer : Honeywell International Inc.
9680 Old Bailes Road, Fort Mill, SC 29707 USA
Standard : FCC Part 15 Subpart C §15.247

The product was received on Nov. 11, 2021 and testing was performed from Nov. 15, 2021 to Dec. 27, 2021. We, Sporton International Inc. Wensan 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 test results in this report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Approved by: Louis Wu

Sportun International Inc. Wensan Laboratory

No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)



Table of Contents

| | |
|--|-----------|
| History of this test report..... | 3 |
| Summary of Test Result..... | 4 |
| 1 General Description..... | 5 |
| 1.1 Product Feature of Equipment Under Test..... | 5 |
| 1.2 Modification of EUT | 5 |
| 1.3 Testing Location | 6 |
| 1.4 Applicable Standards..... | 6 |
| 2 Test Configuration of Equipment Under Test..... | 7 |
| 2.1 Carrier Frequency Channel | 7 |
| 2.2 Test Mode..... | 8 |
| 2.3 Connection Diagram of Test System | 9 |
| 2.4 Support Unit used in test configuration and system | 9 |
| 2.5 EUT Operation Test Setup | 10 |
| 2.6 Measurement Results Explanation Example..... | 10 |
| 3 Test Result..... | 11 |
| 3.1 6dB and 99% Bandwidth Measurement | 11 |
| 3.2 Output Power Measurement..... | 16 |
| 3.3 Power Spectral Density Measurement | 17 |
| 3.4 Conducted Band Edges and Spurious Emission Measurement | 22 |
| 3.5 Radiated Band Edges and Spurious Emission Measurement | 27 |
| 3.6 AC Conducted Emission Measurement..... | 31 |
| 3.7 Antenna Requirements..... | 33 |
| 4 List of Measuring Equipment | 34 |
| 5 Uncertainty of Evaluation..... | 36 |
| Appendix A. Conducted Test Results | |
| Appendix B. AC Conducted Emission Test Result | |
| Appendix C. Radiated Spurious Emission | |
| Appendix D. Radiated Spurious Emission Plots | |
| Appendix E. Duty Cycle Plots | |
| Appendix F. Setup Photographs | |



History of this test report



Summary of Test Result

| Report Clause | Ref Std. Clause | Test Items | Result (PASS/FAIL) | Remark |
|---------------|--------------------|--|--------------------|---|
| 3.1 | 15.247(a)(2) | 6dB Bandwidth | Pass | - |
| 3.1 | 2.1049 | 99% Occupied Bandwidth | Reporting only | - |
| 3.2 | 15.247(b)(3) | Output Power | Pass | - |
| 3.3 | 15.247(e) | Power Spectral Density | Pass | - |
| 3.4 | 15.247(d) | Conducted Band Edges and Spurious Emission | Pass | - |
| 3.5 | 15.247(d) | Radiated Band Edges and Spurious Emission | Pass | 6.00 dB under the limit at 2483.680 MHz |
| 3.6 | 15.207 | AC Conducted Emission | Pass | 13.60 dB under the limit at 0.708 MHz |
| 3.7 | 15.203 & 15.247(b) | Antenna Requirement | Pass | - |

Declaration of Conformity:

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

Comments and Explanations:

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

Reviewed by: Wei Chen

Report Producer: Celery Wei



1 General Description

1.1 Product Feature of Equipment Under Test

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

| Product Feature | |
|------------------------------|--|
| Sample 1 | with Scanner (S0703) |
| Sample 2 | Non Scanner |
| HW Version | EVT1.5 |
| SW Version | 311.C0.00.0630-N-DEBUG |
| Antenna Type | WLAN <Ant. 1> WLAN5G: PIFA Antenna <Ant. 2> WLAN2.4G: PIFA Antenna Bluetooth: PIFA Antenna NFC: Loop Antenna |
| Antenna information | |
| 2400 MHz ~ 2483.5 MHz | Peak Gain (dBi) 2.5 |

Remark: The above EUT's information is declared by manufacturer. Please refer to Comments and Explanations in report summary.

1.2 Modification of EUT

No modifications made to the EUT during the testing.



1.3 Testing Location

| | |
|---------------------------|---|
| Test Site | Sportun International Inc. EMC & Wireless Communications Laboratory |
| Test Site Location | No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978 |
| Test Site No. | Sportun Site No. CO05-HY (TAF Code: 1190) |
| Remark | The Conducted Emission test item subcontracted to Sporton International Inc. EMC & Wireless Communications Laboratory. |

| | |
|---------------------------|--|
| Test Site | Sportun International Inc. Wensan Laboratory |
| Test Site Location | No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855 |
| Test Site No. | Sportun Site No. TH05-HY, 03CH13-HY |

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

FCC designation No.: TW1190 and TW3786

1.4 Applicable Standards

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

- FCC Part 15 Subpart C §15.247
- 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 the test items were validated and recorded in accordance with the standards without any modification during the testing.
2. The TAF code is not including all the FCC KDB listed without accreditation.



2 Test Configuration of Equipment Under Test

2.1 Carrier Frequency Channel

| Frequency Band | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|-----------------|---------|----------------|---------|----------------|
| 2400-2483.5 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 | 2418 | 29 | 2460 |
| | 9 | 2420 | 30 | 2462 |
| | 10 | 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 | - | - |



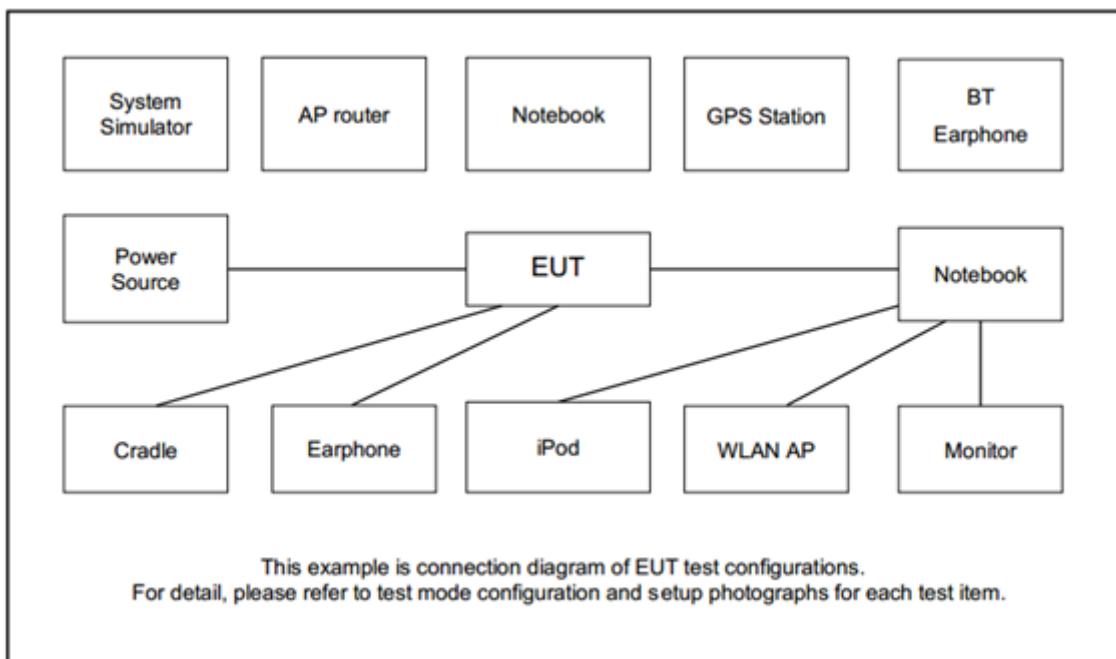
2.2 Test Mode

- 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, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and find X plane as worst plane.
- b. AC power line Conducted Emission was tested under maximum output power.

The following summary table is showing all test modes to demonstrate in compliance with the standard.

| Summary table of Test Cases | |
|---|--|
| Test Item | Data Rate / Modulation |
| Conducted Test Cases | Bluetooth – LE / GFSK |
| | Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps |
| | Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps |
| | Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps |
| | Mode 4: Bluetooth Tx CH00_2402 MHz_2Mbps |
| | Mode 5: Bluetooth Tx CH19_2440 MHz_2Mbps |
| Radiated Test Cases | Mode 6: Bluetooth Tx CH39_2480 MHz_2Mbps |
| | Mode 1: Bluetooth Tx CH00_2402 MHz_1Mbps |
| | Mode 2: Bluetooth Tx CH19_2440 MHz_1Mbps |
| | Mode 3: Bluetooth Tx CH39_2480 MHz_1Mbps |
| | Mode 4: Bluetooth Tx CH00_2402 MHz_2Mbps |
| | Mode 5: Bluetooth Tx CH19_2440 MHz_2Mbps |
| AC Conducted Emission | Mode 6: Bluetooth Tx CH39_2480 MHz_2Mbps |
| Mode 1: Bluetooth Link + WLAN Link + USB Cable (Charging from AC Adapter) for Sample 1 | |
| Remark: For Radiated Test Cases, the tests were performed with Sample 1. | |

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

| Item | Equipment | Brand Name | Model Name | FCC ID | Data Cable | Power Cord |
|------|--------------------|---------------|---------------|-------------|------------|--|
| 1. | Bluetooth Earphone | Sony Ericsson | MW600 | PY700A2029 | N/A | N/A |
| 2. | WLAN AP | ASUS | RT-AC66U | MSQ-RTAC66U | N/A | Unshielded, 1.8m |
| 3. | Notebook | Dell | Latitude 3400 | FCC DoC | N/A | AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m |
| 4. | Notebook | Acer | N18Q13 | FCC DoC | N/A | AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m |



2.5 EUT Operation Test Setup

The RF test items, utility “QRCT 4.0.00195.0” 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.

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 + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10 dB attenuator.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)} \\ &= 4.2 + 10 = 14.2 \text{ (dB)} \end{aligned}$$

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.

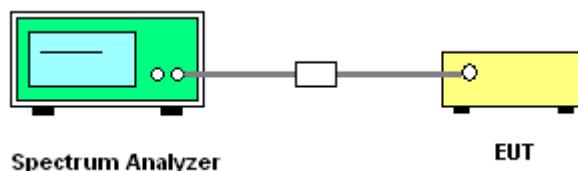
3.1.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. 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 6dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) $\geq 3 * \text{RBW}$.
6. Measure and record the results in the test report.

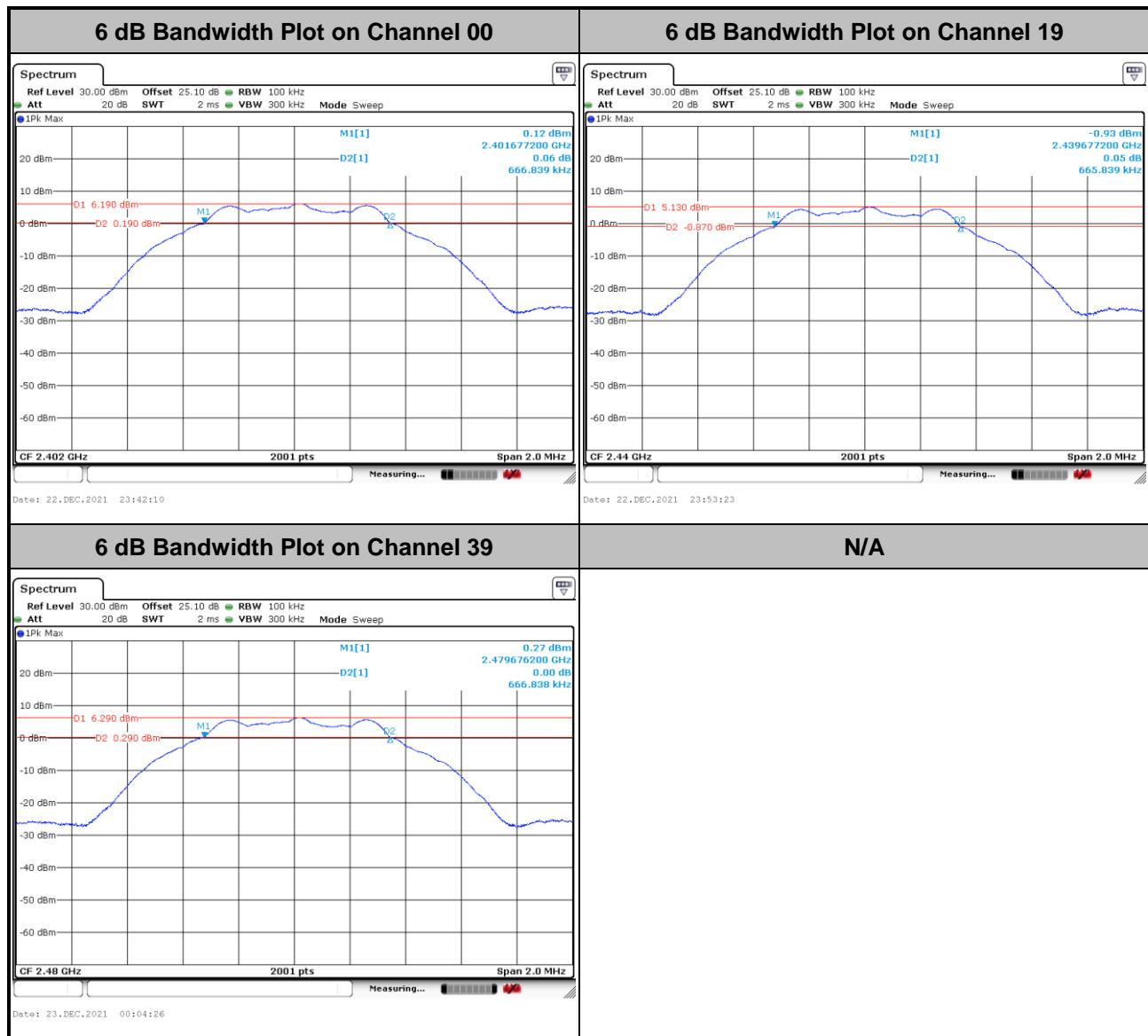
3.1.4 Test Setup



3.1.5 Test Result of 6dB Bandwidth

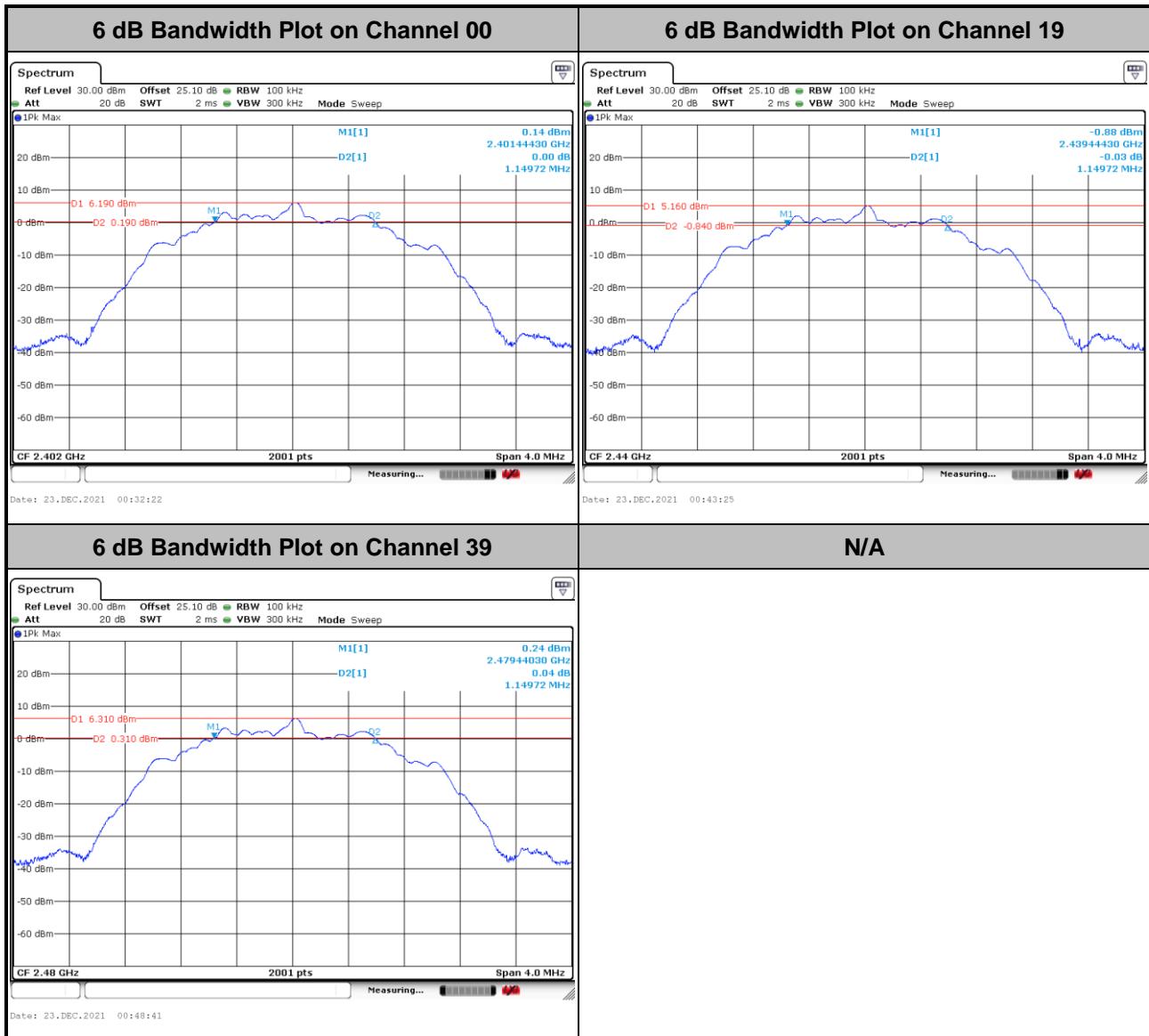
Please refer to Appendix A.

<1Mbps>





<2Mbps>

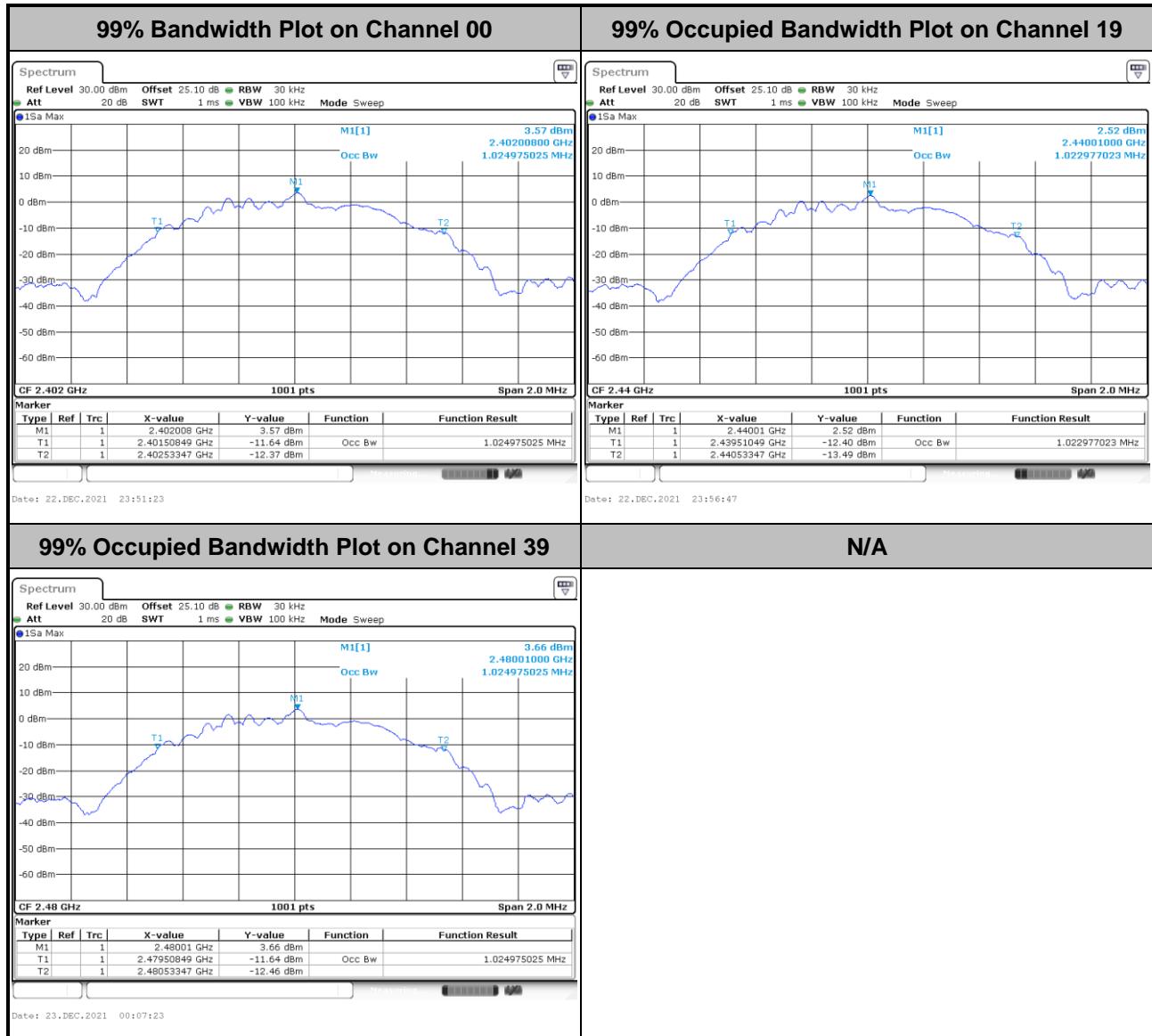




3.1.6 Test Result of 99% Occupied Bandwidth

Please refer to Appendix A.

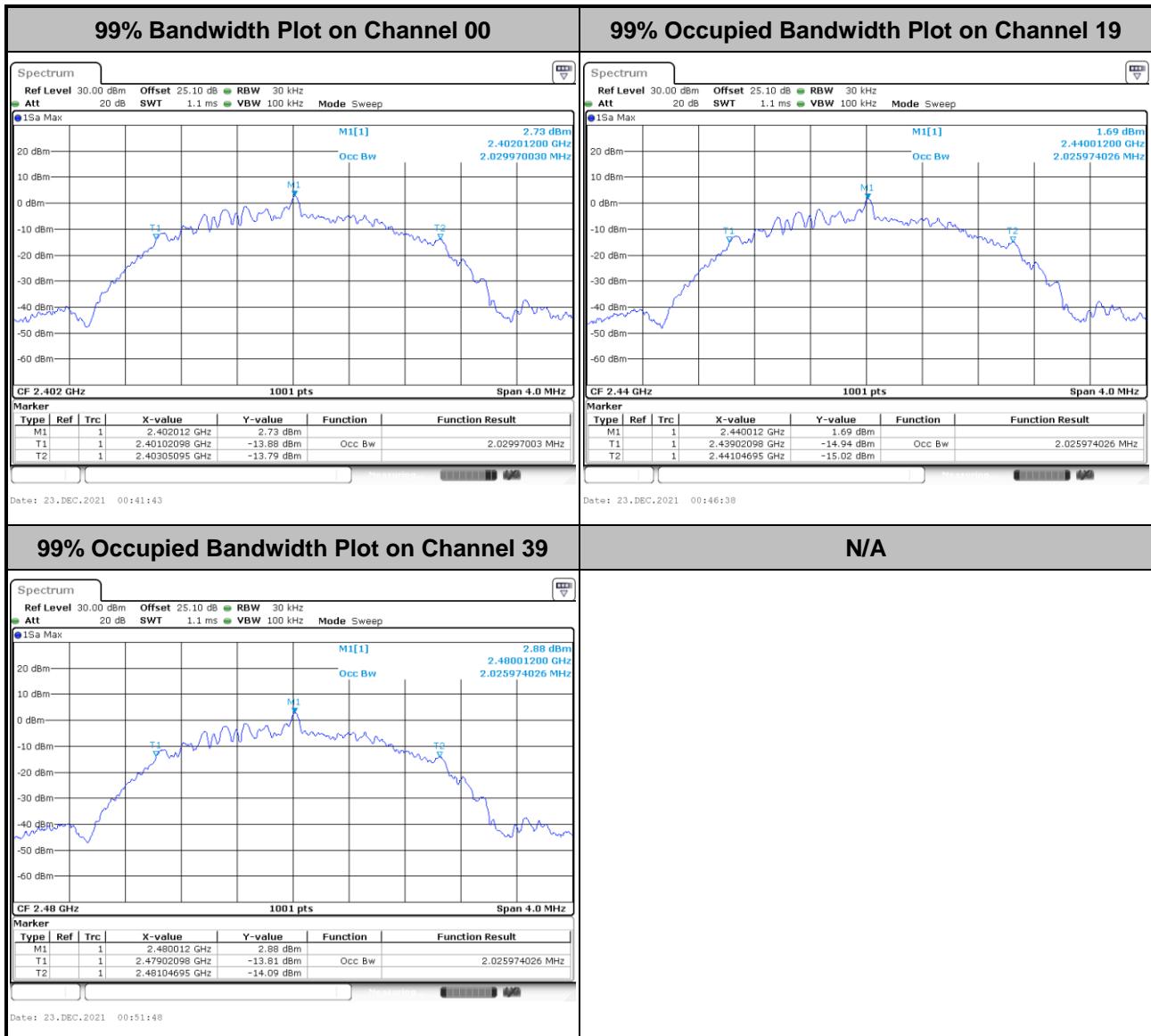
<1Mbps>



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



<2Mbps>



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 2400-2483.5 MHz, the limit for output power is 30 dBm. If transmitting antenna of directional gain greater than 6 dBi 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 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

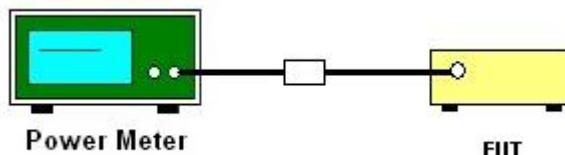
3.2.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.2.3 Test Procedures

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
2. The RF output of EUT is connected to the power meter by RF cable and attenuator.
3. The path loss is compensated to the results for each measurement.
4. Set the maximum power setting and enable the EUT to transmit continuously.
5. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Average Output Power

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 8 dBm in any 3 kHz band at any time interval of continuous transmission.

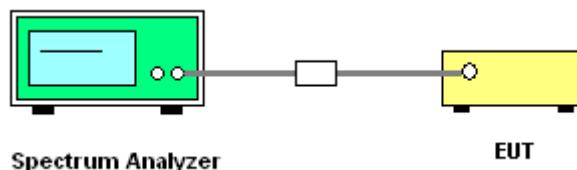
3.3.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.3.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. 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. (6 dB 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)/ 100 kHz is a reference level and is used as 20 dBc down limit line for Conducted Band Edges and Conducted Spurious Emission.

3.3.4 Test Setup



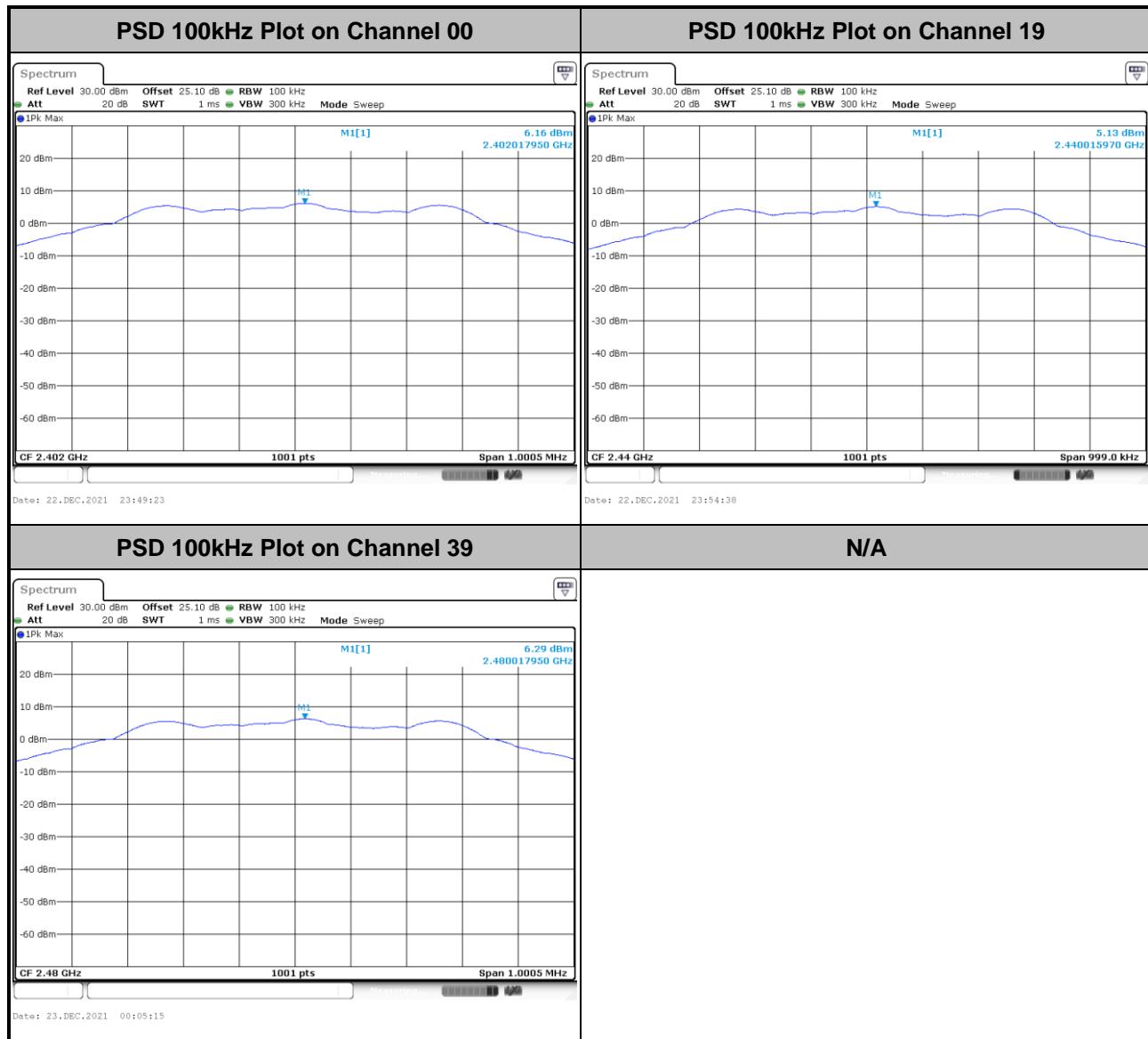
3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.



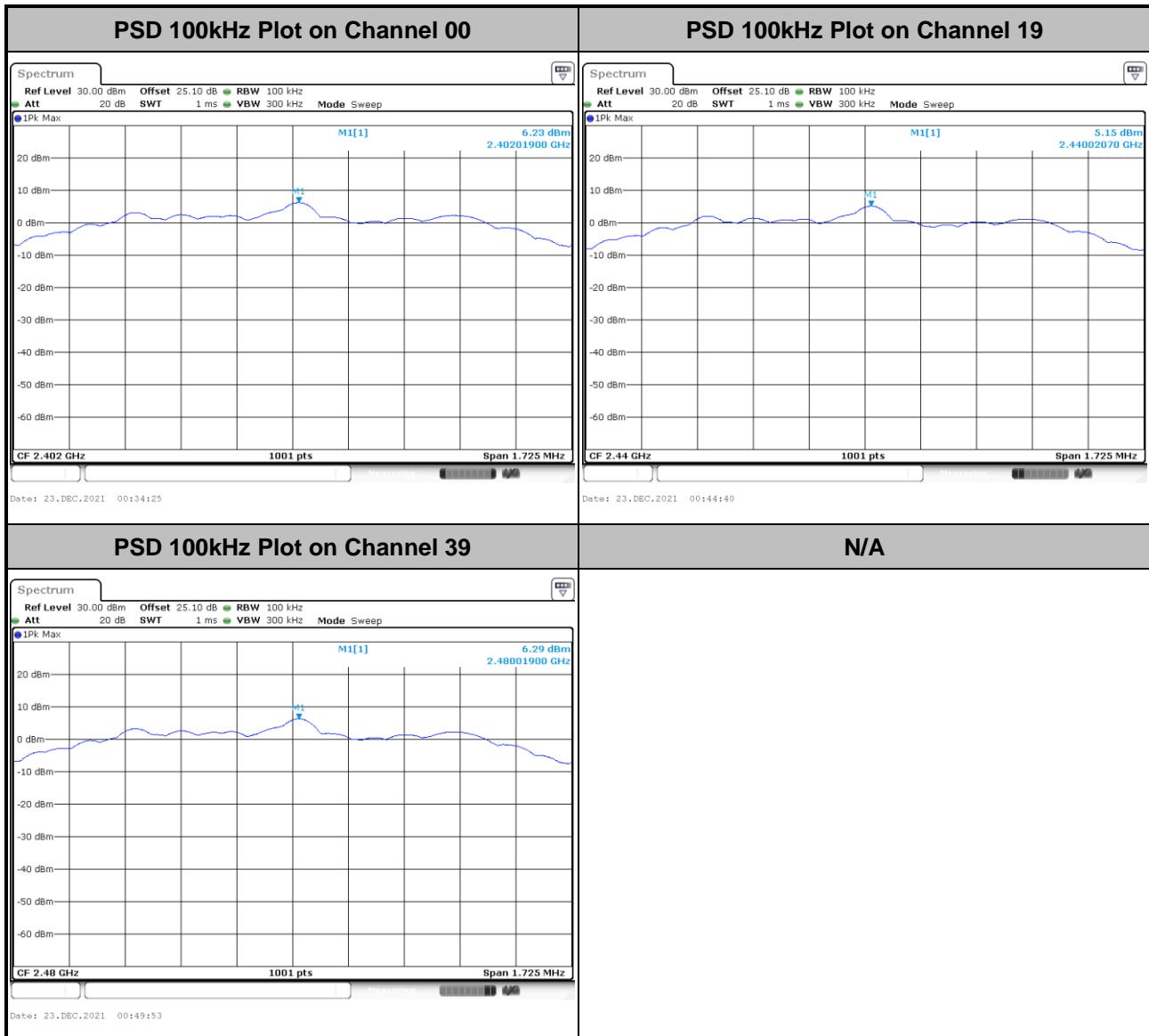
3.3.6 Test Result of Power Spectral Density Plots (100kHz)

<1Mbps>





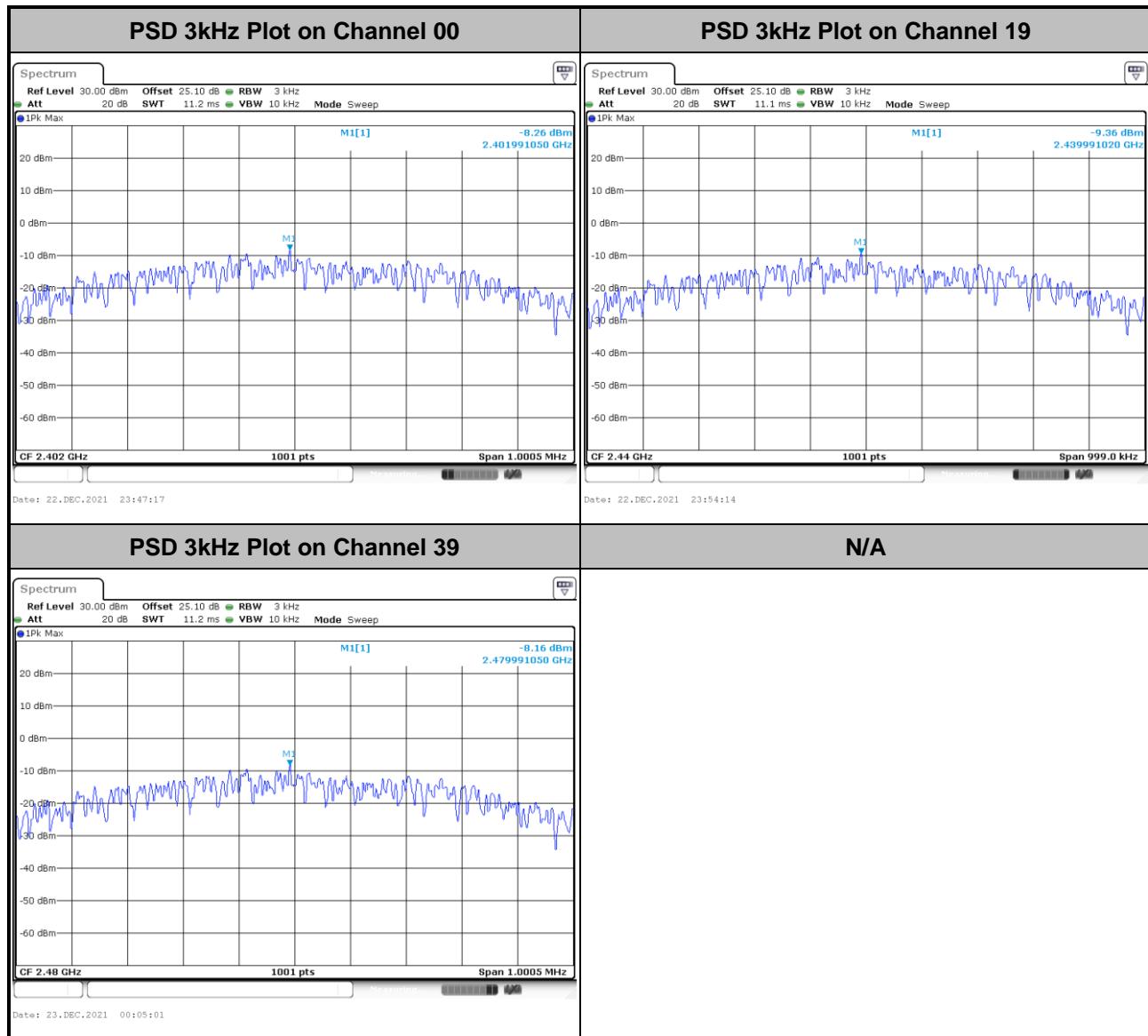
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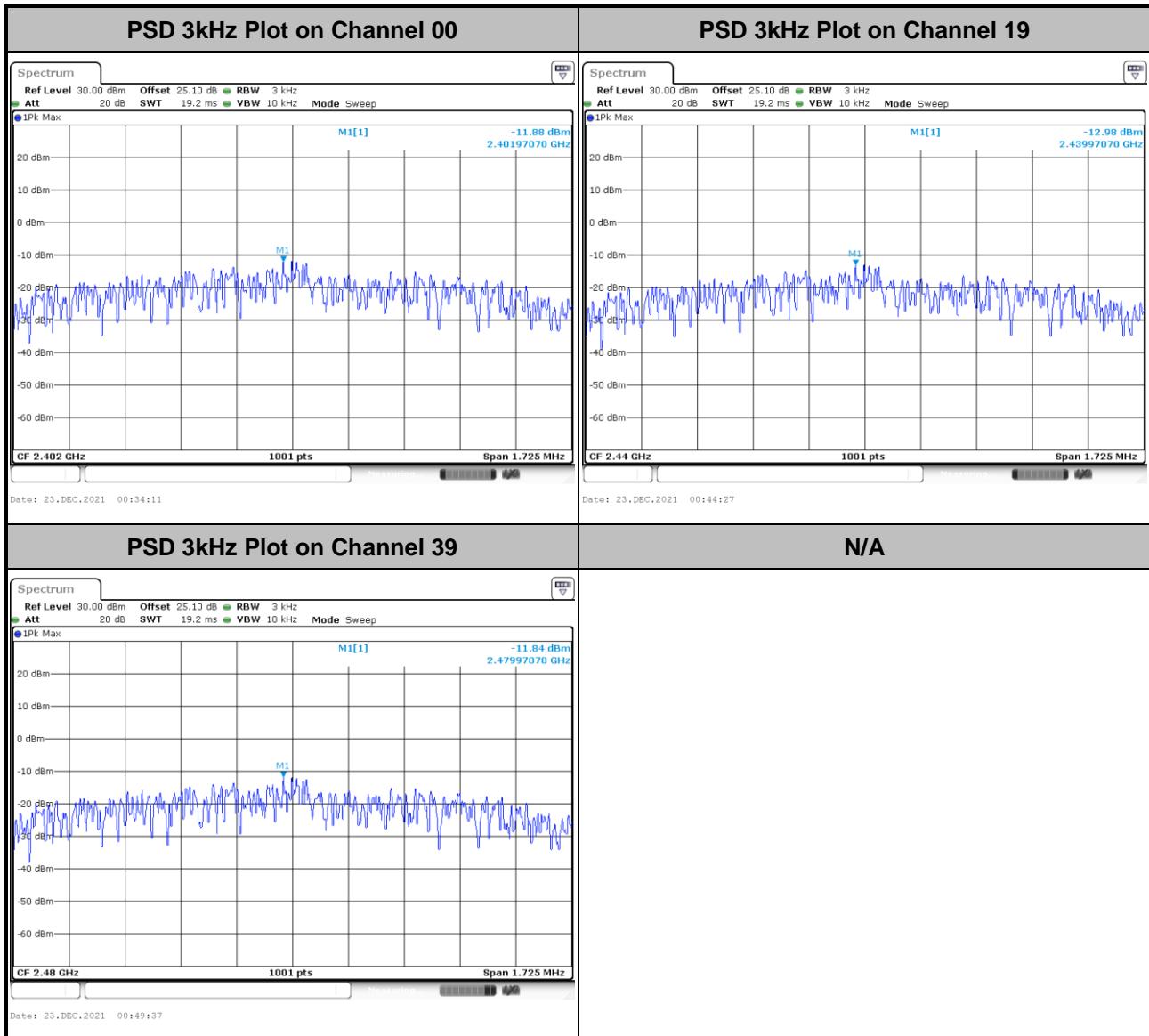
3.3.7 Test Result of Power Spectral Density Plots (3kHz)

<1Mbps>





<2Mbps>



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.

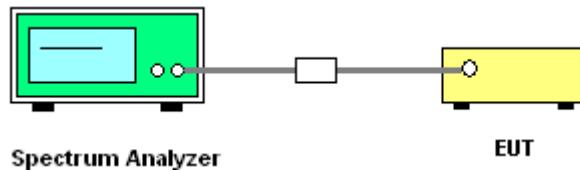
3.4.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.4.3 Test Procedure

1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to 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.

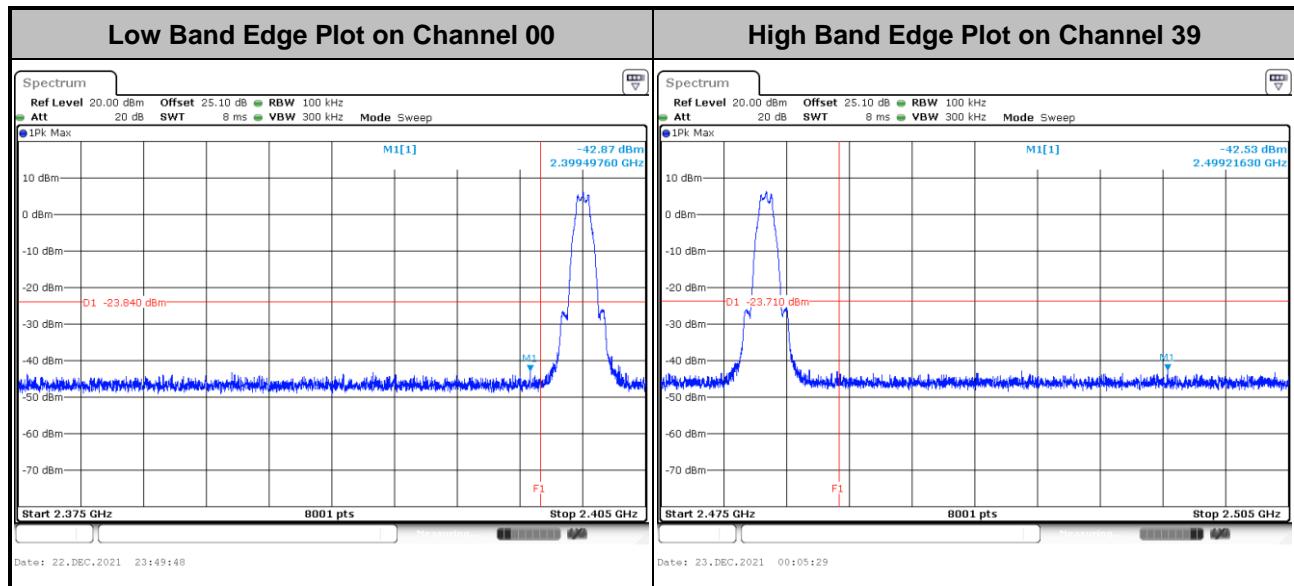
3.4.4 Test Setup



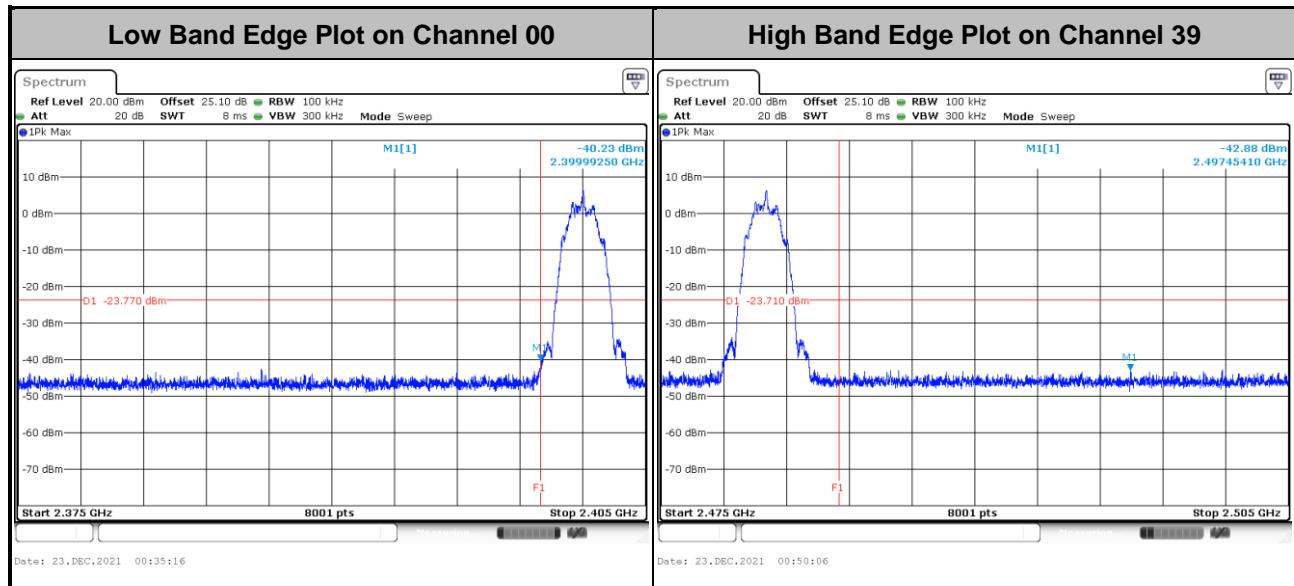


3.4.5 Test Result of Conducted Band Edges Plots

<1Mbps>



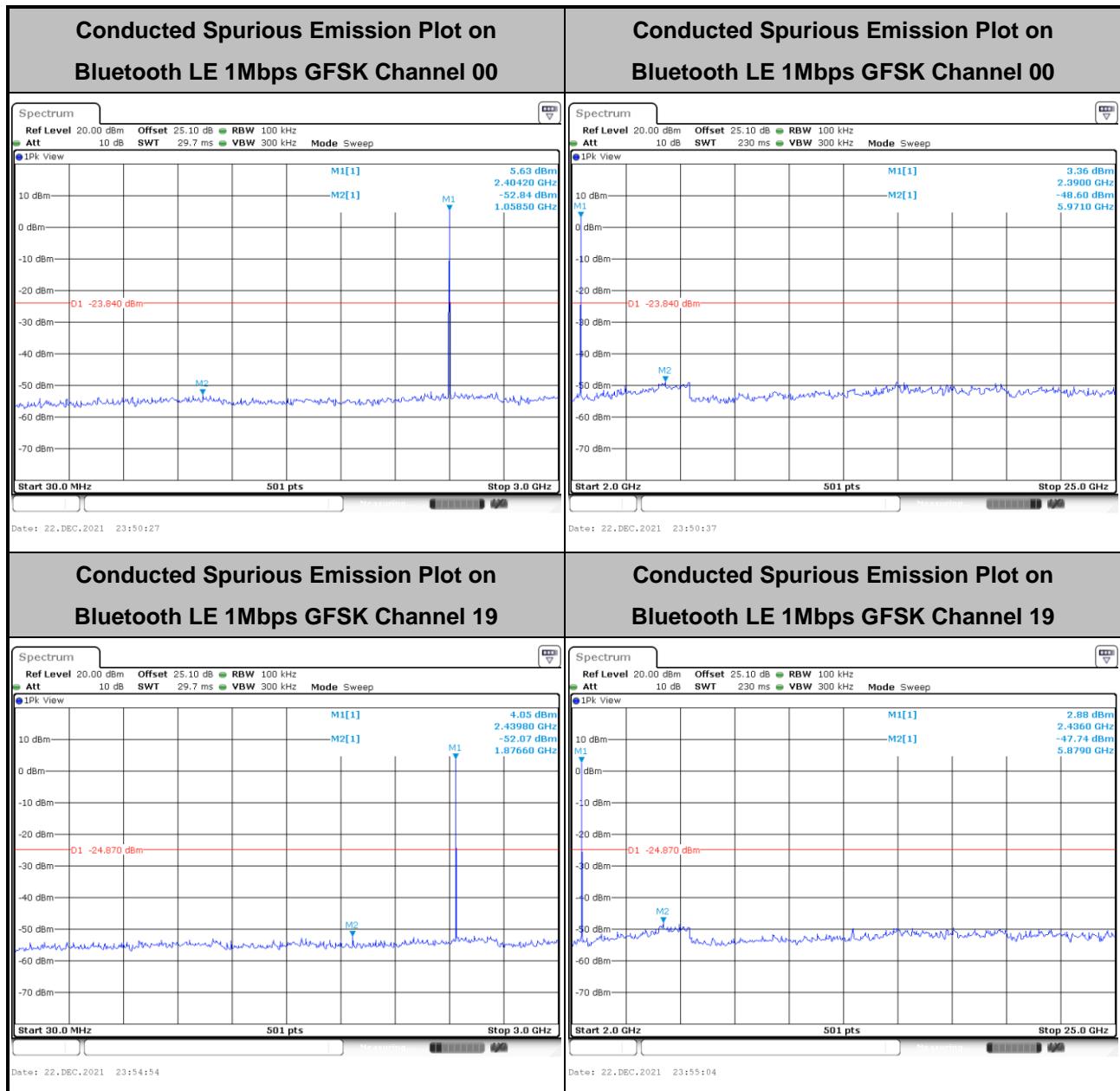
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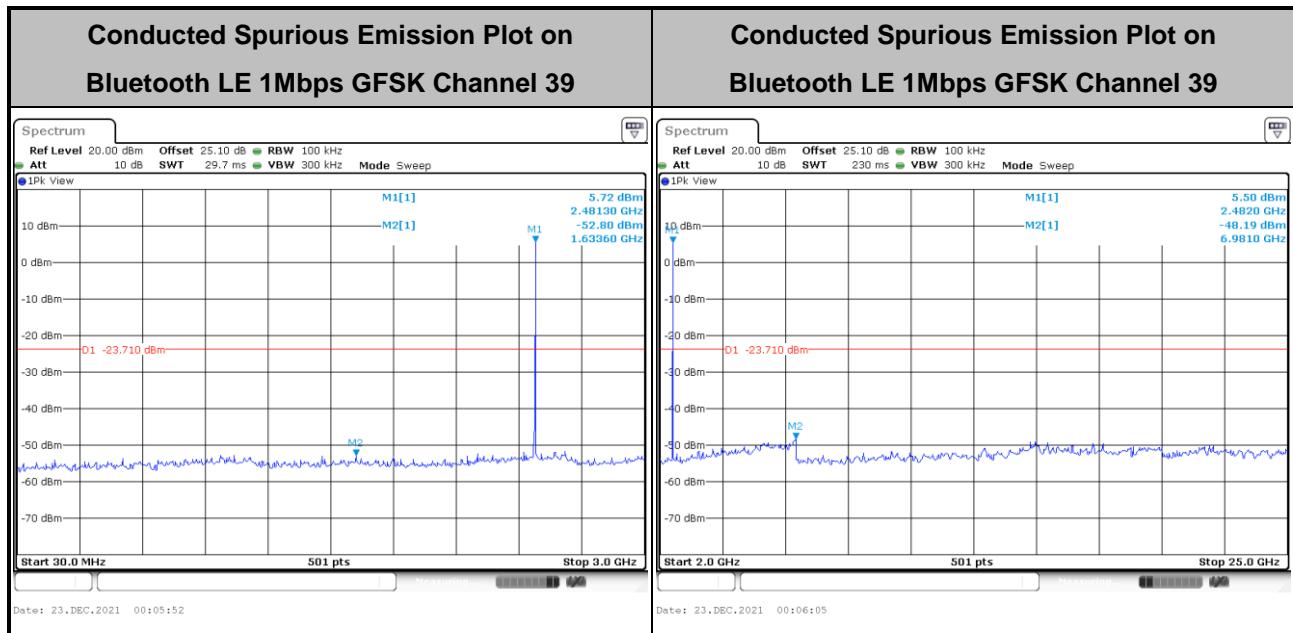




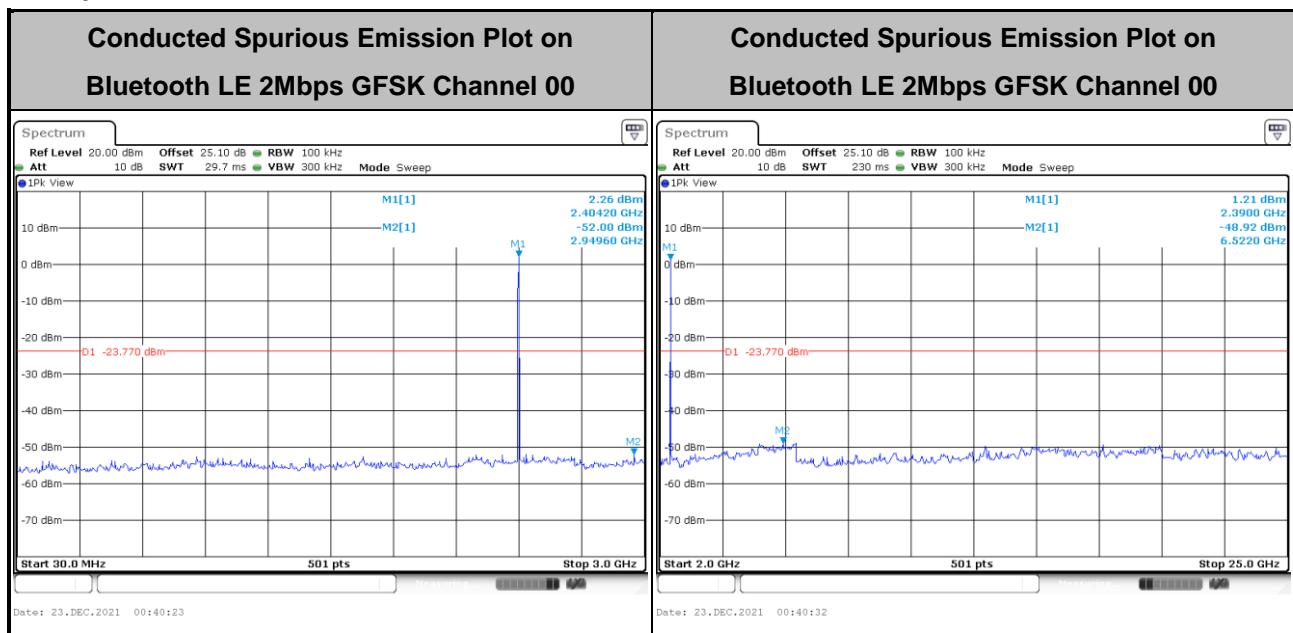
3.4.6 Test Result of Conducted Spurious Emission Plots

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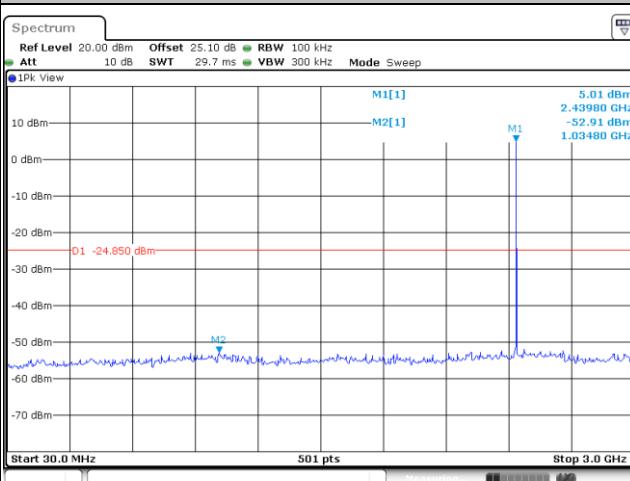


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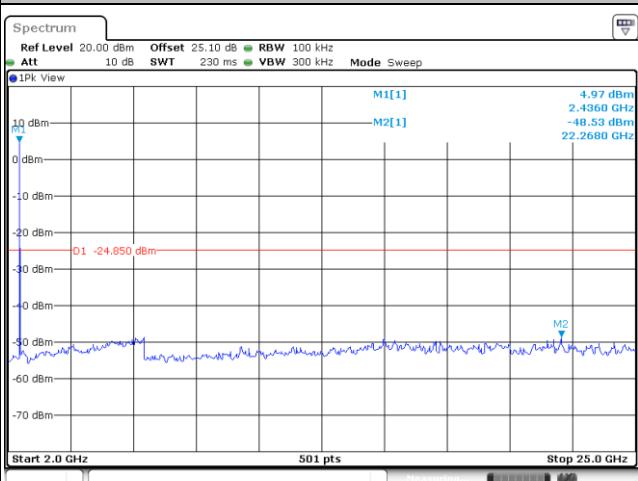




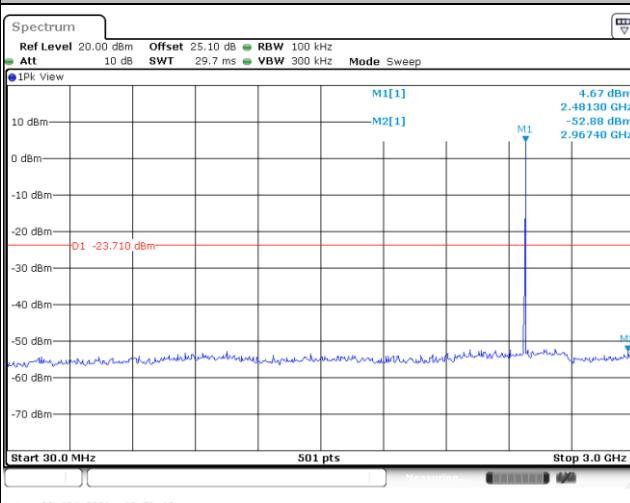
Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 19



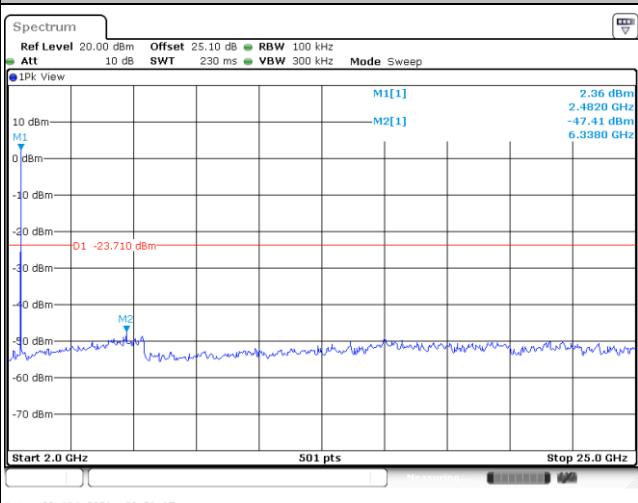
Conducted Spurious Emission Plot on Bluetooth LE 2Mbps GFSK Channel 19



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



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





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 is 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 (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 |

3.5.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.



3.5.3 Test Procedures

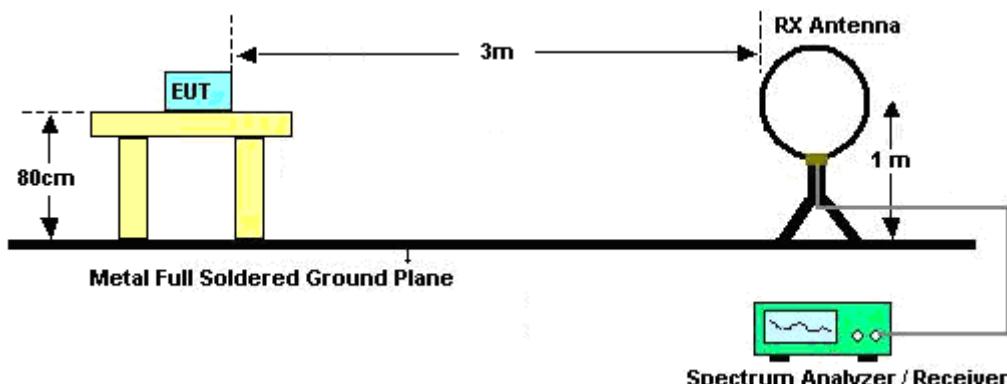
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
4. The EUT is set 3 meters away from the receiving antenna, which is mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as “-”.
7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as “-”.
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 \geq RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW = 3 MHz for $f \geq 1$ GHz for peak measurement.

For average measurement:

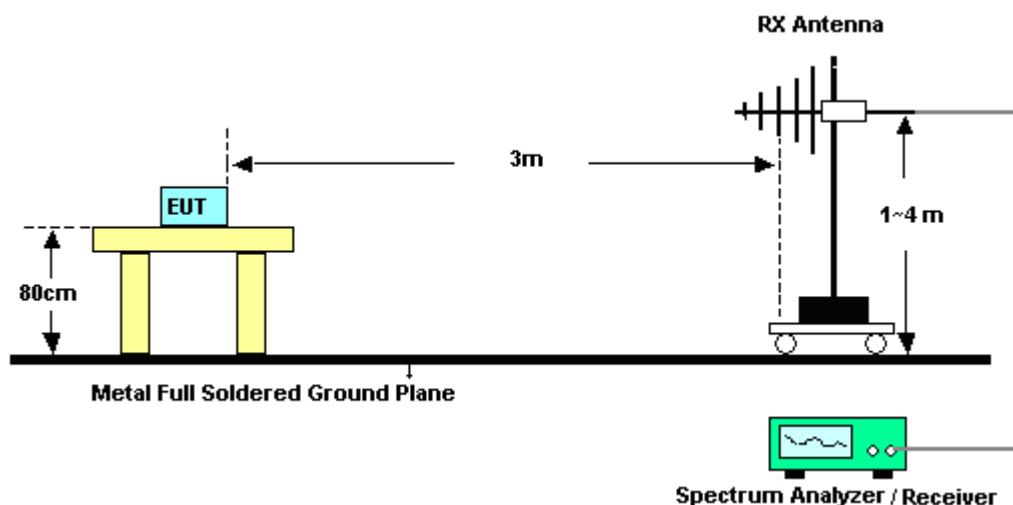
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.5.4 Test Setup

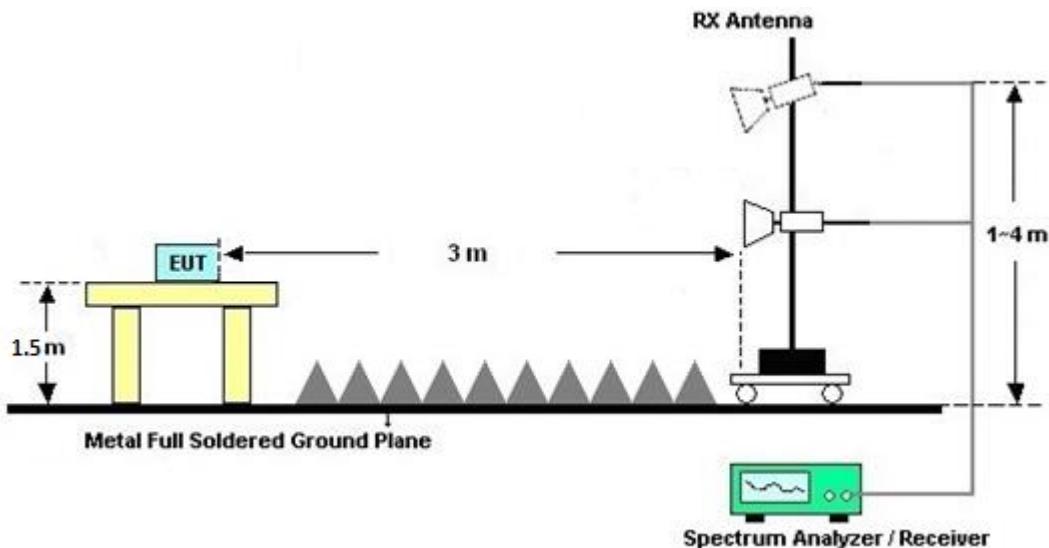
For radiated test below 30MHz



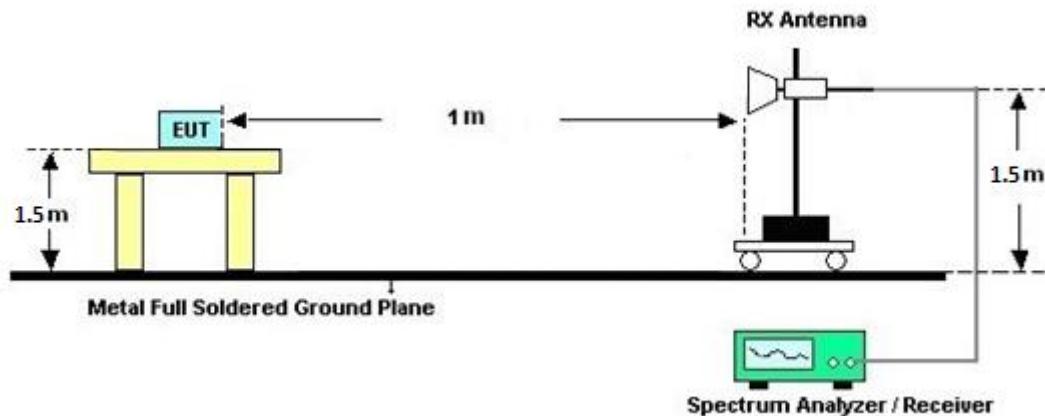
For radiated test from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



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

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

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result comes out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C and D.

3.5.7 Duty Cycle

Please refer to Appendix E.

3.5.8 Test Result of Radiated Spurious Emission (30 MHz ~ 10th Harmonic)

Please refer to Appendix C and D.



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 (dB μ V) | |
|-----------------------------|------------------------------|-----------|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

*Decreases with the logarithm of the frequency.

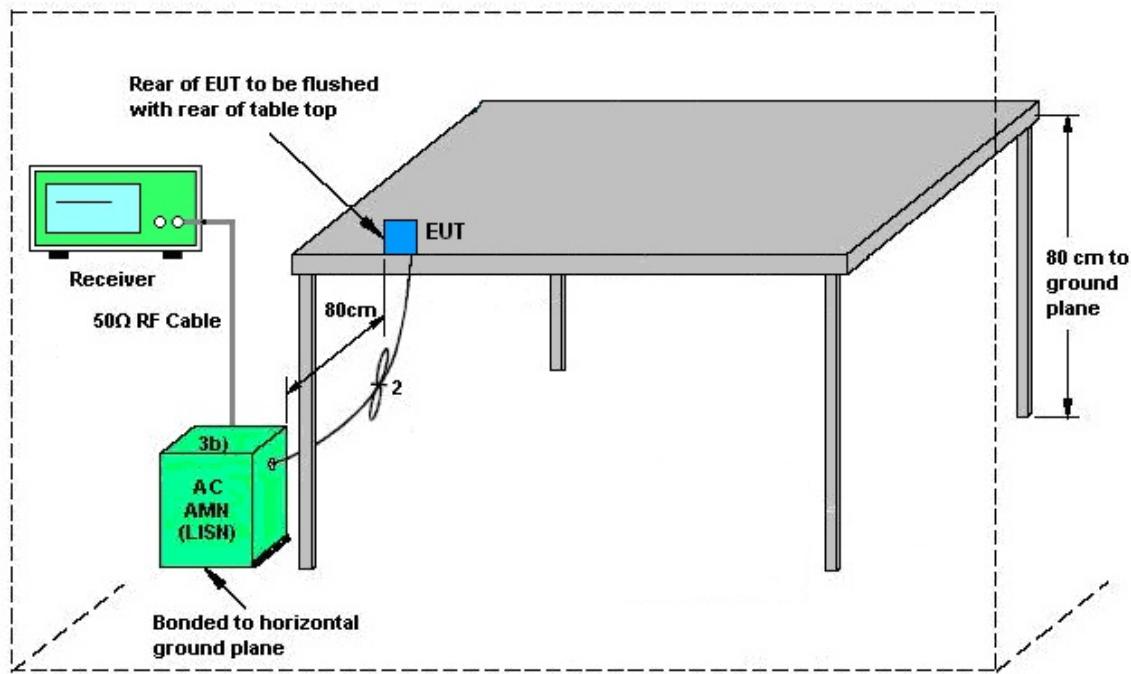
3.6.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.6.3 Test Procedures

1. The EUT is placed 0.4 meter away from the conducting wall of the shielding room, and is 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 shall be used.
6. Both Line and Neutral shall be tested in order to find out the maximum conducted emission.
7. The frequency range from 150 kHz to 30 MHz is scanned.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9 kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.6.4 Test Setup



AMN = Artificial mains network (LISN)

AE = Associated equipment

EUT = Equipment under test

ISN = Impedance stabilization network

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 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. 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 | Brand Name | Model No. | Serial No. | Characteristics | Calibration Date | Test Date | Due Date | Remark |
|----------------------|-------------------|------------------------------|-------------|--------------------------|------------------|-----------------------------|---------------|-----------------------|
| Loop Antenna | Rohde & Schwarz | HFH2-Z2 | 100315 | 9 kHz~30 MHz | Jan. 04, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Jan. 03, 2022 | Radiation (03CH13-HY) |
| Horn Antenna | SCHWARZBECK | BBHA 9120 D | 9120D-1241 | 1GHz ~ 18GHz | Jul. 13, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Jul. 12, 2022 | Radiation (03CH13-HY) |
| SHF-EHF Horn Antenna | SCHWARZBECK | BBHA 9170 | BBHA9170576 | 18GHz- 40GHz | May 21, 2021 | Nov. 19, 2021~Dec. 27, 2021 | May 20, 2022 | Radiation (03CH13-HY) |
| Amplifier | Sonoma-Instrument | 310 N | 187282 | 9KHz~1GHz | Dec. 16, 2020 | Nov. 19, 2021~Dec. 14, 2021 | Dec. 15, 2021 | Radiation (03CH13-HY) |
| Amplifier | Sonoma-Instrument | 310 N | 187282 | 9KHz~1GHz | Dec. 15, 2021 | Dec. 15, 2021~Dec. 27, 2021 | Dec. 14, 2022 | Radiation (03CH13-HY) |
| Preamplifier | MITEQ | AMF-7D-0010 1800-30-10P | 1590074 | 1GHz~18GHz | May 18, 2021 | Nov. 19, 2021~Dec. 27, 2021 | May 17, 2022 | Radiation (03CH13-HY) |
| Preamplifier | Keysight | 83017A | MY53270147 | 1GHz~26.5GHz | Oct. 26, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Oct. 25, 2022 | Radiation (03CH13-HY) |
| Preamplifier | EMEC | EM18G40G | 060801 | 18GHz ~ 40GHz | Jun. 22, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Jun. 21, 2022 | Radiation (03CH13-HY) |
| Spectrum Analyzer | Keysight | N9010A | MY55370526 | 10Hz~44GHz | Mar. 18, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Mar. 17, 2022 | Radiation (03CH13-HY) |
| Antenna Mast | EMEC | AM-BS-4500-B | N/A | 1m~4m | N/A | Nov. 19, 2021~Dec. 27, 2021 | N/A | Radiation (03CH13-HY) |
| Turn Table | EMEC | TT2000 | N/A | 0~360 Degree | N/A | Nov. 19, 2021~Dec. 27, 2021 | N/A | Radiation (03CH13-HY) |
| Software | Audix | E3 6.2009-8-24 | RK-000992 | N/A | N/A | Nov. 19, 2021~Dec. 27, 2021 | N/A | Radiation (03CH13-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 126E | 0030/126E | 30M-18G | Feb. 10, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Feb. 09, 2022 | Radiation (03CH13-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 104 | 804793/4 | 30M-18G | Feb. 10, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Feb. 09, 2022 | Radiation (03CH13-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 102 | 505134/2 | 30M~40GHz | Feb. 22, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Feb. 21, 2022 | Radiation (03CH13-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 102 | MY4274/2 | 30MHz~40GHz | Mar. 11, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Mar. 10, 2022 | Radiation (03CH13-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 104 | MY24961/4 | 30M-18G | Feb. 10, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Feb. 09, 2022 | Radiation (03CH13-HY) |
| RF Cable | HUBER + SUHNER | SUCOFLEX 104 | MY9837/4PE | 9kHz~30MHz | Mar. 11, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Mar. 10, 2022 | Radiation (03CH13-HY) |
| Filter | Wainwright | WLK4-1000-15 30-8000-40SS | SN12 | 1.53GHz Low Pass Filter | Sep. 14, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Sep. 13, 2022 | Radiation (03CH13-HY) |
| Filter | Wainwright | WHKX8-5872.5-6750-18000-40ST | SN5 | 6.75GHz High Pass Filter | Mar. 11, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Mar. 10, 2022 | Radiation (03CH13-HY) |
| Filter | Wainwright | WHKX12-2700-3000-18000-60SS | SN2 | 3GHz High Pass Filter | Jul. 12, 2021 | Nov. 19, 2021~Dec. 27, 2021 | Jul. 11, 2022 | Radiation (03CH13-HY) |



| Instrument | Brand Name | Model No. | Serial No. | Characteristics | Calibration Date | Test Date | Due Date | Remark |
|-----------------------|-----------------|--------------|-----------------------|-----------------|------------------|-----------------------------|---------------|----------------------|
| Hygrometer | TECPEL | DTM-303A | TP201996 | N/A | Nov. 16, 2021 | Dec. 21, 2021~Dec. 23, 2021 | Nov. 15, 2022 | Conducted (TH05-HY) |
| Power Meter | DARE | RPR3006W | 13I00030SNO31(NO:182) | 10MHz~6GHz | Dec. 30, 2020 | Dec. 21, 2021~Dec. 23, 2021 | Dec. 29, 2021 | Conducted (TH05-HY) |
| Signal Analyzer | Rohde & Schwarz | FSV40 | 101566 | 10Hz~40GHz | Aug. 30, 2021 | Dec. 21, 2021~Dec. 23, 2021 | Aug. 29, 2022 | Conducted (TH05-HY) |
| Switch Box & RF Cable | EM Electronics | EMSW18SE | SW191204(B OX8) | N/A | Jan. 07, 2021 | Dec. 21, 2021~Dec. 23, 2021 | Jan. 06, 2022 | Conducted (TH05-HY) |
| AC Power Source | ChainTek | APC-1000W | N/A | N/A | N/A | Nov. 15, 2021 | N/A | Conduction (CO05-HY) |
| EMI Test Receiver | Rohde & Schwarz | ESR3 | 102388 | 9kHz~3.6GHz | Nov. 30, 2020 | Nov. 15, 2021 | Nov. 29, 2021 | Conduction (CO05-HY) |
| Hygrometer | Testo | 608-H1 | 34913912 | N/A | Nov. 18, 2020 | Nov. 15, 2021 | Nov. 17, 2021 | Conduction (CO05-HY) |
| LISN | Rohde & Schwarz | ENV216 | 100080 | 9kHz~30MHz | Dec. 01, 2020 | Nov. 15, 2021 | Nov. 30, 2021 | Conduction (CO05-HY) |
| Software | Rohde & Schwarz | EMC32 V10.30 | N/A | N/A | N/A | Nov. 15, 2021 | N/A | Conduction (CO05-HY) |
| Pulse Limiter | SCHWARZBECK | VTSD 9561-FN | 00691 | N/A | Jul. 28, 2021 | Nov. 15, 2021 | Jul. 27, 2022 | Conduction (CO05-HY) |
| LISN Cable | MVE | RG-400 | 260260 | N/A | Dec. 31, 2020 | Nov. 15, 2021 | Dec. 30, 2021 | Conduction (CO05-HY) |



5 Uncertainty of Evaluation

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

| | |
|---|--------|
| Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_{C(y)}$) | 3.1 dB |
|---|--------|

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

| | |
|---|--------|
| Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_{C(y)}$) | 6.0 dB |
|---|--------|

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

| | |
|---|--------|
| Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_{C(y)}$) | 5.2 dB |
|---|--------|

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

| | |
|---|--------|
| Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_{C(y)}$) | 5.9 dB |
|---|--------|

Appendix A. Test Result of Conducted Test Items

| | | | | | | | | |
|----------------|-----------------------|--|--|--|--------------------|-----------|--|----|
| Test Engineer: | Mina Liu/Shiming Liu | | | | Temperature: | 20.9~24.2 | | °C |
| Test Date: | 2021/12/21~2021/12/23 | | | | Relative Humidity: | 52.9~57.1 | | % |

| <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 | 1.025 | 0.667 | 0.50 | Pass |
| BLE | 1Mbps | 1 | 19 | 2440 | 1.023 | 0.666 | 0.50 | Pass |
| BLE | 1Mbps | 1 | 39 | 2480 | 1.025 | 0.667 | 0.50 | Pass |

| <u>TEST RESULTS DATA</u> <u>Average Power Table</u> | | | | | | | | | | |
|--|-----------|-----|-----|-------------|-------------------------------|-----------------------------|----------|------------------|------------------------|------------|
| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Average Conducted Power (dBm) | Conducted Power Limit (dBm) | DG (dBi) | EIRP Power (dBm) | EIRP Power Limit (dBm) | Pass /Fail |
| BLE | 1Mbps | 1 | 0 | 2402 | 6.10 | 30.00 | 2.50 | 8.60 | 36.00 | Pass |
| BLE | 1Mbps | 1 | 19 | 2440 | 4.90 | 30.00 | 2.50 | 7.40 | 36.00 | Pass |
| BLE | 1Mbps | 1 | 39 | 2480 | 6.10 | 30.00 | 2.50 | 8.60 | 36.00 | Pass |

| <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 | 1Mbps | 1 | 0 | 2402 | 6.16 | -8.26 | 2.50 | 8.00 | Pass |
| BLE | 1Mbps | 1 | 19 | 2440 | 5.13 | -9.36 | 2.50 | 8.00 | Pass |
| BLE | 1Mbps | 1 | 39 | 2480 | 6.29 | -8.16 | 2.50 | 8.00 | Pass |

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.

TEST RESULTS DATA
6dB and 99% Occupied Bandwidth

| 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 | 2.030 | 1.150 | 0.50 | Pass |
| BLE | 2Mbps | 1 | 19 | 2440 | 2.026 | 1.150 | 0.50 | Pass |
| BLE | 2Mbps | 1 | 39 | 2480 | 2.026 | 1.150 | 0.50 | Pass |

TEST RESULTS DATA
Average Power Table

| Mod. | Data Rate | NTX | CH. | Freq. (MHz) | Average Conducted Power (dBm) | Conducted Power Limit (dBm) | DG (dBi) | EIRP Power (dBm) | EIRP Power Limit (dBm) | Pass /Fail |
|------|-----------|-----|-----|-------------|-------------------------------|-----------------------------|----------|------------------|------------------------|------------|
| BLE | 2Mbps | 1 | 0 | 2402 | 6.00 | 30.00 | 2.50 | 8.50 | 36.00 | Pass |
| BLE | 2Mbps | 1 | 19 | 2440 | 4.80 | 30.00 | 2.50 | 7.30 | 36.00 | Pass |
| BLE | 2Mbps | 1 | 39 | 2480 | 6.00 | 30.00 | 2.50 | 8.50 | 36.00 | Pass |

TEST RESULTS DATA
Peak Power Density

| 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 | 6.23 | -11.88 | 2.50 | 8.00 | Pass |
| BLE | 2Mbps | 1 | 19 | 2440 | 5.15 | -12.98 | 2.50 | 8.00 | Pass |
| BLE | 2Mbps | 1 | 39 | 2480 | 6.29 | -11.84 | 2.50 | 8.00 | Pass |

Note: PSD (dBm/ 100kHz) is a reference level used for Conducted Band Edges and Conducted Spurious Emission 30dBc limit.



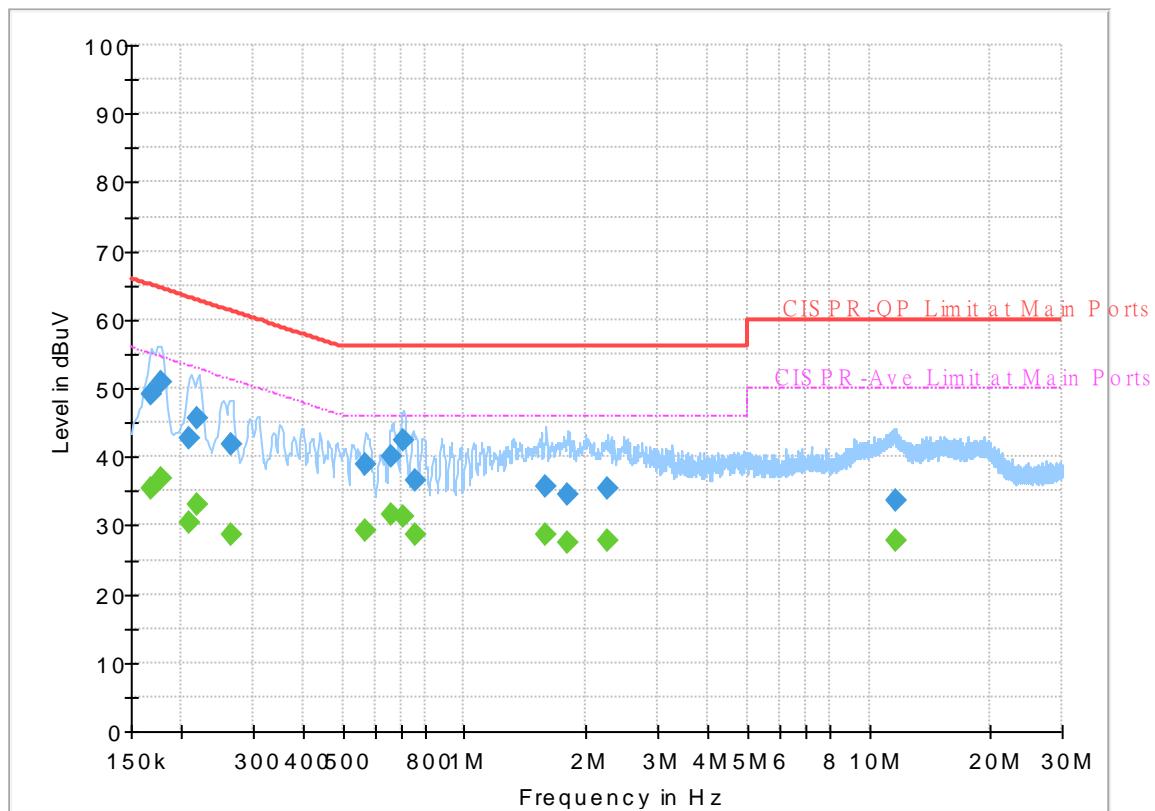
Appendix B. AC Conducted Emission Test Results

| | | | |
|------------------------|-------------|----------------------------|---------|
| Test Engineer : | Calvin Wang | Temperature : | 23~26°C |
| | | Relative Humidity : | 45~55% |

EUT Information

Report NO : 1N0506
 Test Mode : Mode 1
 Test Voltage : 120Vac/60Hz
 Phase : Line

Full Spectrum



Final Result

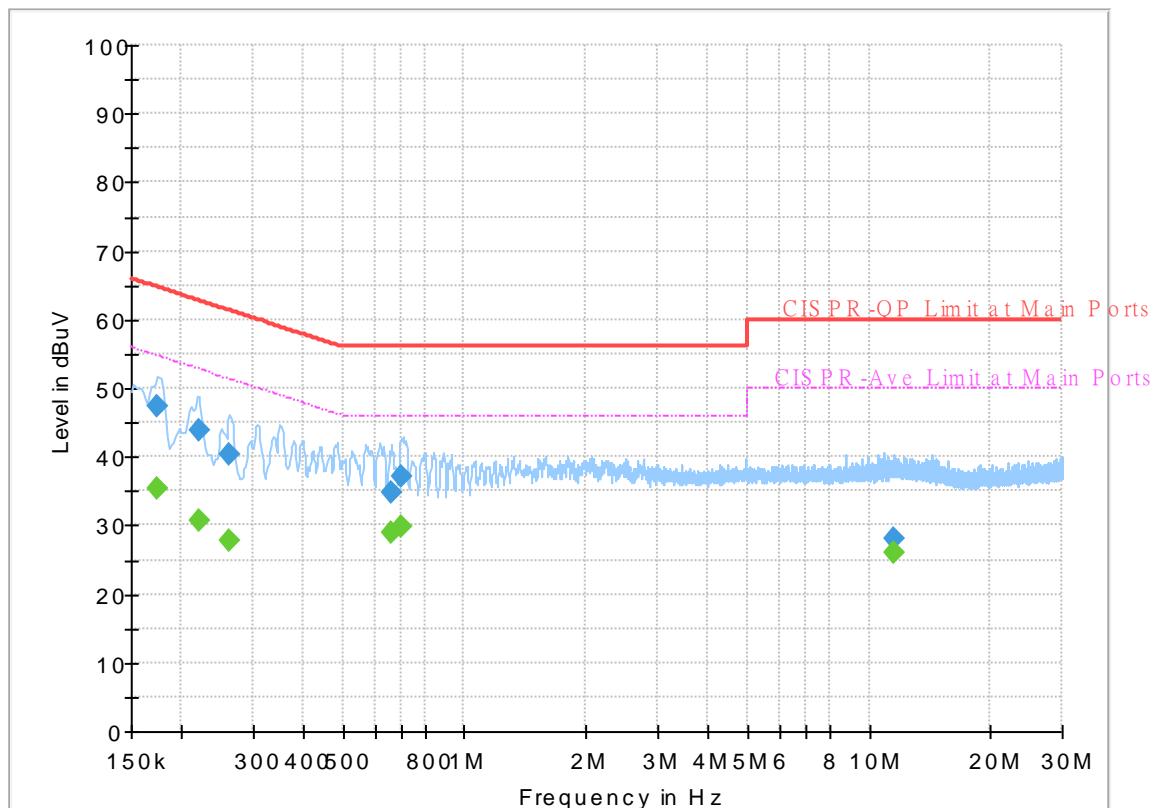
| Frequency (MHz) | QuasiPeak (dBuV) | CAverage (dBuV) | Limit (dBuV) | Margin (dB) | Line | Filter | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|-------------|------|--------|------------|
| 0.168000 | --- | 35.28 | 55.06 | 19.78 | L1 | OFF | 19.7 |
| 0.168000 | 49.02 | --- | 65.06 | 16.04 | L1 | OFF | 19.7 |
| 0.177000 | --- | 36.93 | 54.63 | 17.70 | L1 | OFF | 19.7 |
| 0.177000 | 50.78 | --- | 64.63 | 13.85 | L1 | OFF | 19.7 |
| 0.208500 | --- | 30.27 | 53.27 | 23.00 | L1 | OFF | 19.7 |
| 0.208500 | 42.83 | --- | 63.27 | 20.44 | L1 | OFF | 19.7 |
| 0.217500 | --- | 33.05 | 52.91 | 19.86 | L1 | OFF | 19.7 |
| 0.217500 | 45.52 | --- | 62.91 | 17.39 | L1 | OFF | 19.7 |
| 0.264750 | --- | 28.79 | 51.28 | 22.49 | L1 | OFF | 19.7 |
| 0.264750 | 41.93 | --- | 61.28 | 19.35 | L1 | OFF | 19.7 |
| 0.568500 | --- | 29.19 | 46.00 | 16.81 | L1 | OFF | 19.9 |
| 0.568500 | 38.77 | --- | 56.00 | 17.23 | L1 | OFF | 19.9 |
| 0.658500 | --- | 31.66 | 46.00 | 14.34 | L1 | OFF | 20.0 |
| 0.658500 | 39.94 | --- | 56.00 | 16.06 | L1 | OFF | 20.0 |
| 0.708000 | --- | 31.31 | 46.00 | 14.69 | L1 | OFF | 20.0 |
| 0.708000 | 42.40 | --- | 56.00 | 13.60 | L1 | OFF | 20.0 |
| 0.759750 | --- | 28.63 | 46.00 | 17.37 | L1 | OFF | 20.0 |
| 0.759750 | 36.47 | --- | 56.00 | 19.53 | L1 | OFF | 20.0 |
| 1.592250 | --- | 28.68 | 46.00 | 17.32 | L1 | OFF | 20.2 |
| 1.592250 | 35.57 | --- | 56.00 | 20.43 | L1 | OFF | 20.2 |
| 1.794750 | --- | 27.38 | 46.00 | 18.62 | L1 | OFF | 20.2 |

| | | | | | | | |
|------------------|--------------|--------------|--------------|--------------|-----------|------------|-------------|
| 1.794750 | 34.45 | --- | 56.00 | 21.55 | L1 | OFF | 20.2 |
| 2.253750 | --- | 27.91 | 46.00 | 18.09 | L1 | OFF | 20.1 |
| 2.253750 | 35.38 | --- | 56.00 | 20.62 | L1 | OFF | 20.1 |
| 11.638500 | --- | 27.68 | 50.00 | 22.32 | L1 | OFF | 20.2 |
| 11.638500 | 33.54 | --- | 60.00 | 26.46 | L1 | OFF | 20.2 |

EUT Information

Report NO : 1N0506
 Test Mode : Mode 1
 Test Voltage : 120Vac/60Hz
 Phase : Neutral

Full Spectrum



Final Result

| Frequency (MHz) | QuasiPeak (dBuV) | CAverage (dBuV) | Limit (dBuV) | Margin (dB) | Line | Filter | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|-------------|------|--------|------------|
| 0.174750 | --- | 35.27 | 54.73 | 19.46 | N | OFF | 19.7 |
| 0.174750 | 47.48 | --- | 64.73 | 17.25 | N | OFF | 19.7 |
| 0.219750 | --- | 30.75 | 52.83 | 22.08 | N | OFF | 19.7 |
| 0.219750 | 43.84 | --- | 62.83 | 18.99 | N | OFF | 19.7 |
| 0.262500 | --- | 27.84 | 51.35 | 23.51 | N | OFF | 19.7 |
| 0.262500 | 40.34 | --- | 61.35 | 21.01 | N | OFF | 19.7 |
| 0.660750 | --- | 28.97 | 46.00 | 17.03 | N | OFF | 20.0 |
| 0.660750 | 34.94 | --- | 56.00 | 21.06 | N | OFF | 20.0 |
| 0.699000 | --- | 29.70 | 46.00 | 16.30 | N | OFF | 20.0 |
| 0.699000 | 37.18 | --- | 56.00 | 18.82 | N | OFF | 20.0 |
| 11.492250 | --- | 25.94 | 50.00 | 24.06 | N | OFF | 20.2 |
| 11.492250 | 27.95 | --- | 60.00 | 32.05 | N | OFF | 20.2 |



Appendix C. Radiated Spurious Emission

| | | | |
|-----------------|--|---------------------|---------|
| Test Engineer : | Yuan Lee, Jacky Hong, Wilson Wu and Peter Liao | Temperature : | 20~25°C |
| | | Relative Humidity : | 50~60% |

<1Mbps>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

| BLE | Note | Frequency | Level | Over Limit | Limit Line | Read Level | Antenna Factor | Path Loss | Preamp Factor | Ant Pos | Table Pos | Peak Avg. | Pol. |
|-------------------------|------|-----------|------------------|------------|------------------|----------------|----------------|-----------|---------------|---------|-----------|-----------|---------|
| | | (MHz) | (dB μ V/m) | (dB) | (dB μ V/m) | (dB μ V) | (dB/m) | (dB) | (dB) | (cm) | (deg) | (P/A) | (H/V) |
| BLE CH 00 2402MHz | | 2379.405 | 55.24 | -18.76 | 74 | 40.46 | 27.74 | 14.11 | 27.07 | 107 | 97 | P | H |
| | | 2310.63 | 46.13 | -7.87 | 54 | 31.07 | 28.11 | 14.04 | 27.09 | 107 | 97 | A | H |
| | * | 2402 | 102.24 | - | - | 87.47 | 27.7 | 14.13 | 27.06 | 107 | 97 | P | H |
| | * | 2402 | 101.73 | - | - | 86.96 | 27.7 | 14.13 | 27.06 | 107 | 97 | A | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | 2362.08 | 55.34 | -18.66 | 74 | 40.54 | 27.78 | 14.09 | 27.07 | 100 | 78 | P | V |
| | | 2322.285 | 46.51 | -7.49 | 54 | 31.53 | 28.02 | 14.05 | 27.09 | 100 | 78 | A | V |
| | * | 2402 | 95.91 | - | - | 81.14 | 27.7 | 14.13 | 27.06 | 100 | 78 | P | V |
| | * | 2402 | 95.37 | - | - | 80.6 | 27.7 | 14.13 | 27.06 | 100 | 78 | A | V |
| BLE CH 19 2440MHz | | | | | | | | | | | | | V |
| | | 2380.14 | 55.47 | -18.53 | 74 | 40.69 | 27.74 | 14.11 | 27.07 | 100 | 96 | P | H |
| | | 2376.5 | 46.32 | -7.68 | 54 | 31.53 | 27.75 | 14.11 | 27.07 | 100 | 96 | A | H |
| | * | 2440 | 100.32 | - | - | 85.59 | 27.62 | 14.16 | 27.05 | 100 | 96 | P | H |
| | * | 2440 | 99.76 | - | - | 85.03 | 27.62 | 14.16 | 27.05 | 100 | 96 | A | H |
| | | 2496.22 | 56.34 | -17.66 | 74 | 41.47 | 27.69 | 14.21 | 27.03 | 100 | 96 | P | H |
| | | 2497.06 | 46.13 | -7.87 | 54 | 31.26 | 27.69 | 14.21 | 27.03 | 100 | 96 | A | H |
| | | 2389.66 | 55.81 | -18.19 | 74 | 41.04 | 27.72 | 14.12 | 27.07 | 103 | 77 | P | V |
| | | 2314.76 | 46.36 | -7.64 | 54 | 31.33 | 28.08 | 14.04 | 27.09 | 103 | 77 | A | V |
| | * | 2440 | 94.88 | - | - | 80.15 | 27.62 | 14.16 | 27.05 | 103 | 77 | P | V |
| | * | 2440 | 94.24 | - | - | 79.51 | 27.62 | 14.16 | 27.05 | 103 | 77 | A | V |
| | | 2484.32 | 55.88 | -18.12 | 74 | 41.05 | 27.67 | 14.2 | 27.04 | 103 | 77 | P | V |
| | | 2486.98 | 46.37 | -7.63 | 54 | 31.53 | 27.67 | 14.2 | 27.03 | 103 | 77 | A | V |



| BLE CH 39 2480MHz | * | 2480 | 101.83 | - | - | 87.02 | 27.66 | 14.19 | 27.04 | 100 | 93 | P | H |
|-------------------------|---|---------|--------|--------|----|-------|-------|-------|-------|-----|----|---|---|
| | * | 2480 | 101.32 | - | - | 86.51 | 27.66 | 14.19 | 27.04 | 100 | 93 | A | H |
| | | 2485.16 | 55.43 | -18.57 | 74 | 40.59 | 27.67 | 14.2 | 27.03 | 100 | 93 | P | H |
| | | 2493.32 | 46.18 | -7.82 | 54 | 31.32 | 27.69 | 14.2 | 27.03 | 100 | 93 | A | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | * | 2480 | 96.36 | - | - | 81.55 | 27.66 | 14.19 | 27.04 | 100 | 77 | P | V |
| | * | 2480 | 95.82 | - | - | 81.01 | 27.66 | 14.19 | 27.04 | 100 | 77 | A | V |
| | | 2499.64 | 55.49 | -18.51 | 74 | 40.61 | 27.7 | 14.21 | 27.03 | 100 | 77 | P | V |
| | | 2499.2 | 46.19 | -7.81 | 54 | 31.31 | 27.7 | 14.21 | 27.03 | 100 | 77 | A | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| Remark | 1. No other spurious found. 2. All results are PASS against Peak and Average limit line. | | | | | | | | | | | | |



2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)





| BLE | Note | Frequency (MHz) | Level (dB μ V/m) | Over Limit (dB) | Limit Line (dB μ V/m) | Read Level (dB μ V) | Antenna Factor (dB/m) | Path Loss (dB) | Preamp Factor (dB) | Ant Pos (cm) | Table Pos (deg) | Peak Avg. (P/A) | Pol. (H/V) |
|-------------------------|------|--|---------------------------|-------------------------|-----------------------------------|---------------------------------|-------------------------------|------------------------|----------------------------|----------------------|-------------------------|-----------------------|---------------|
| BLE CH 39 2480MHz | | 4960 | 41.03 | -32.97 | 74 | 58.98 | 31.72 | 7.14 | 56.81 | - | - | P | H |
| | | 7440 | 44.84 | -29.16 | 74 | 56.37 | 37.02 | 8.62 | 57.17 | - | - | P | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
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| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| Remark | 1. | No other spurious found. | | | | | | | | | | | |
| | 2. | All results are PASS against Peak and Average limit line. | | | | | | | | | | | |
| | 3. | The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only. | | | | | | | | | | | |



<2Mbps>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

| BLE | Note | Frequency | Level | Over Limit | Limit Line | Read Level | Antenna Factor | Path Loss | Preamp Factor | Ant Pos | Table Pos | Peak Avg. | Pol. |
|-------------------------|------|-----------|------------------|------------|------------------|----------------|----------------|-----------|---------------|---------|-----------|-----------|-------|
| | | (MHz) | (dB μ V/m) | (dB) | (dB μ V/m) | (dB μ V) | (dB/m) | (dB) | (dB) | (cm) | (deg) | (P/A) | (H/V) |
| BLE CH 00 2402MHz | | 2346.645 | 55.61 | -18.39 | 74 | 40.78 | 27.83 | 14.08 | 27.08 | 273 | 89 | P | H |
| | | 2320.71 | 47.67 | -6.33 | 54 | 32.68 | 28.03 | 14.05 | 27.09 | 273 | 89 | A | H |
| | * | 2402 | 102.97 | - | - | 88.2 | 27.7 | 14.13 | 27.06 | 273 | 89 | P | H |
| | * | 2402 | 101.62 | - | - | 86.85 | 27.7 | 14.13 | 27.06 | 273 | 89 | A | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | 2314.095 | 55.5 | -18.5 | 74 | 40.46 | 28.09 | 14.04 | 27.09 | 318 | 40 | P | V |
| | | 2317.035 | 47.63 | -6.37 | 54 | 32.61 | 28.06 | 14.05 | 27.09 | 318 | 40 | A | V |
| | * | 2402 | 96.84 | - | - | 82.07 | 27.7 | 14.13 | 27.06 | 318 | 40 | P | V |
| | * | 2402 | 95.39 | - | - | 80.62 | 27.7 | 14.13 | 27.06 | 318 | 40 | A | V |
| | | | | | | | | | | | | | V |
| | | | | | | | | | | | | | V |
| BLE CH 19 2440MHz | | 2316.44 | 55.62 | -18.38 | 74 | 40.59 | 28.07 | 14.05 | 27.09 | 267 | 93 | P | H |
| | | 2379.44 | 47.53 | -6.47 | 54 | 32.75 | 27.74 | 14.11 | 27.07 | 267 | 93 | A | H |
| | * | 2440 | 100.85 | - | - | 86.12 | 27.62 | 14.16 | 27.05 | 267 | 93 | P | H |
| | * | 2440 | 99.58 | - | - | 84.85 | 27.62 | 14.16 | 27.05 | 267 | 93 | A | H |
| | | 2488.87 | 55.8 | -18.2 | 74 | 40.95 | 27.68 | 14.2 | 27.03 | 267 | 93 | P | H |
| | | 2484.53 | 47.5 | -6.5 | 54 | 32.66 | 27.67 | 14.2 | 27.03 | 267 | 93 | P | H |
| | | 2318.68 | 55.45 | -18.55 | 74 | 40.44 | 28.05 | 14.05 | 27.09 | 315 | 41 | P | V |
| | | 2317.98 | 47.61 | -6.39 | 54 | 32.59 | 28.06 | 14.05 | 27.09 | 315 | 41 | A | V |
| | * | 2440 | 95.55 | - | - | 80.82 | 27.62 | 14.16 | 27.05 | 315 | 41 | P | V |
| | * | 2440 | 94.3 | - | - | 79.57 | 27.62 | 14.16 | 27.05 | 315 | 41 | A | V |
| | | 2495.87 | 55 | -19 | 74 | 40.13 | 27.69 | 14.21 | 27.03 | 315 | 41 | P | V |
| | | 2487.89 | 47.77 | -6.23 | 54 | 32.92 | 27.68 | 14.2 | 27.03 | 315 | 41 | A | V |



| BLE CH 39 2480MHz | * | 2480 | 102.07 | - | - | 87.26 | 27.66 | 14.19 | 27.04 | 253 | 91 | P | H | |
|-------------------------|---|---------|--------|--------|----|-------|-------|-------|-------|-----|----|---|---|--|
| | * | 2480 | 100.86 | - | - | 86.05 | 27.66 | 14.19 | 27.04 | 253 | 91 | A | H | |
| | | 2493.52 | 55.26 | -18.74 | 74 | 40.4 | 27.69 | 14.2 | 27.03 | 253 | 91 | P | H | |
| | | 2483.68 | 48 | -6 | 54 | 33.17 | 27.67 | 14.2 | 27.04 | 253 | 91 | A | H | |
| | | | | | | | | | | | | | H | |
| | | | | | | | | | | | | | H | |
| | * | 2480 | 96.58 | - | - | 81.77 | 27.66 | 14.19 | 27.04 | 303 | 42 | P | V | |
| | * | 2480 | 95.3 | - | - | 80.49 | 27.66 | 14.19 | 27.04 | 303 | 42 | A | V | |
| | | 2497.36 | 55.79 | -18.21 | 74 | 40.92 | 27.69 | 14.21 | 27.03 | 303 | 42 | P | V | |
| | | 2491.12 | 47.8 | -6.2 | 54 | 32.95 | 27.68 | 14.2 | 27.03 | 303 | 42 | A | V | |
| | | | | | | | | | | | | | V | |
| | | | | | | | | | | | | | V | |
| Remark | 1. No other spurious found. 2. All results are PASS against Peak and Average limit line. | | | | | | | | | | | | | |



2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)





| BLE | Note | Frequency (MHz) | Level (dB μ V/m) | Over Limit (dB) | Limit Line (dB μ V/m) | Read Level (dB μ V) | Antenna Factor (dB/m) | Path Loss (dB) | Preamp Factor (dB) | Ant Pos (cm) | Table Pos (deg) | Peak Avg. (P/A) | Pol. (H/V) |
|-------------------------|------|--|---------------------------|-------------------------|-----------------------------------|---------------------------------|-------------------------------|------------------------|----------------------------|----------------------|-------------------------|-----------------------|---------------|
| BLE CH 39 2480MHz | | 4960 | 40.16 | -33.84 | 74 | 58.11 | 31.72 | 7.14 | 56.81 | - | - | P | H |
| | | 7440 | 44.95 | -29.05 | 74 | 56.48 | 37.02 | 8.62 | 57.17 | - | - | P | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| | | | | | | | | | | | | | H |
| Remark | 1. | No other spurious found. | | | | | | | | | | | |
| | 2. | All results are PASS against Peak and Average limit line. | | | | | | | | | | | |
| | 3. | The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only. | | | | | | | | | | | |



Emission below 1GHz

2.4GHz BLE (LF)

**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 | Peak or Average |
| H/V | Horizontal or Vertical |



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

| BLE | Note | Frequency | Level | Over | Limit | Read | Antenna | Path | Preamp | Ant | Table | Peak | Pol. |
|----------------------------------|------|-----------|------------------|--------|------------------|----------------|----------|--------|--------|--------|---------|-------|-------|
| | | | Limit | Line | Level | Factor | Loss | Factor | Pos | Pos | Avg. | | |
| | | (MHz) | (dB μ V/m) | (dB) | (dB μ V/m) | (dB μ V) | (dB/m) | (dB) | (dB) | (cm) | (deg) | (P/A) | (H/V) |
| BLE CH 00 2402MHz | | 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(dB μ V/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dB μ V/m)

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

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

= 55.45 (dB μ V/m)

2. Over Limit(dB)

= Level(dB μ V/m) – Limit Line(dB μ V/m)

= 55.45(dB μ V/m) – 74(dB μ V/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dB μ V/m)

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

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

= 43.54 (dB μ V/m)

2. Over Limit(dB)

= Level(dB μ V/m) – Limit Line(dB μ V/m)

= 43.54(dB μ V/m) – 54(dB μ V/m)

= -10.46(dB)

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



Appendix D. Radiated Spurious Emission Plots

| | | | |
|------------------------|--|----------------------------|---------|
| Test Engineer : | Yuan Lee, Jacky Hong, Wilson Wu and Peter Liao | Temperature : | 20~25°C |
| | | Relative Humidity : | 50~60% |

Note symbol

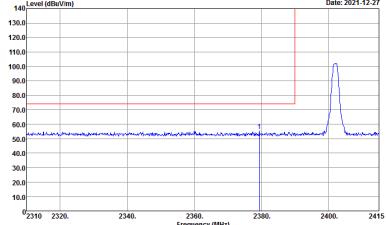
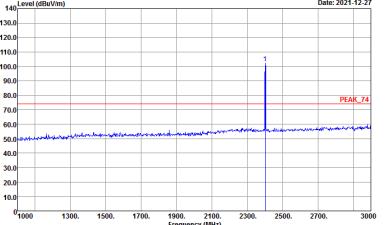
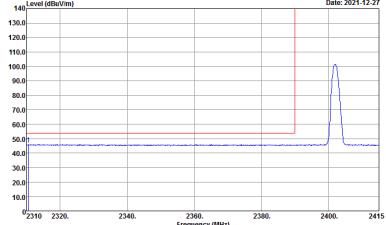
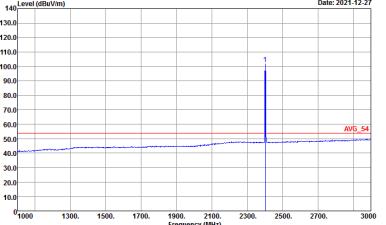
| | |
|----|------------------------------|
| -L | Low channel location |
| -R | High channel location |

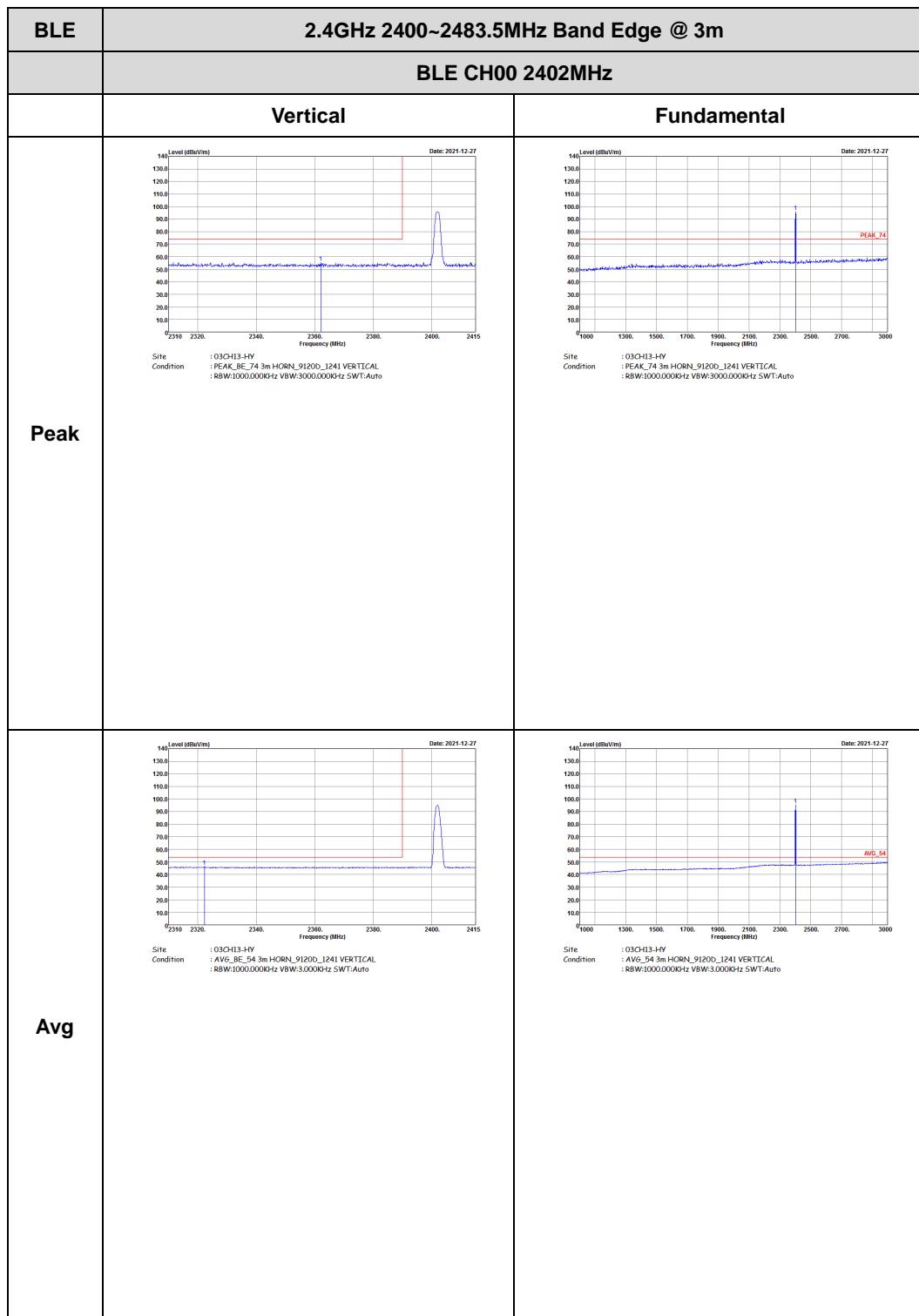


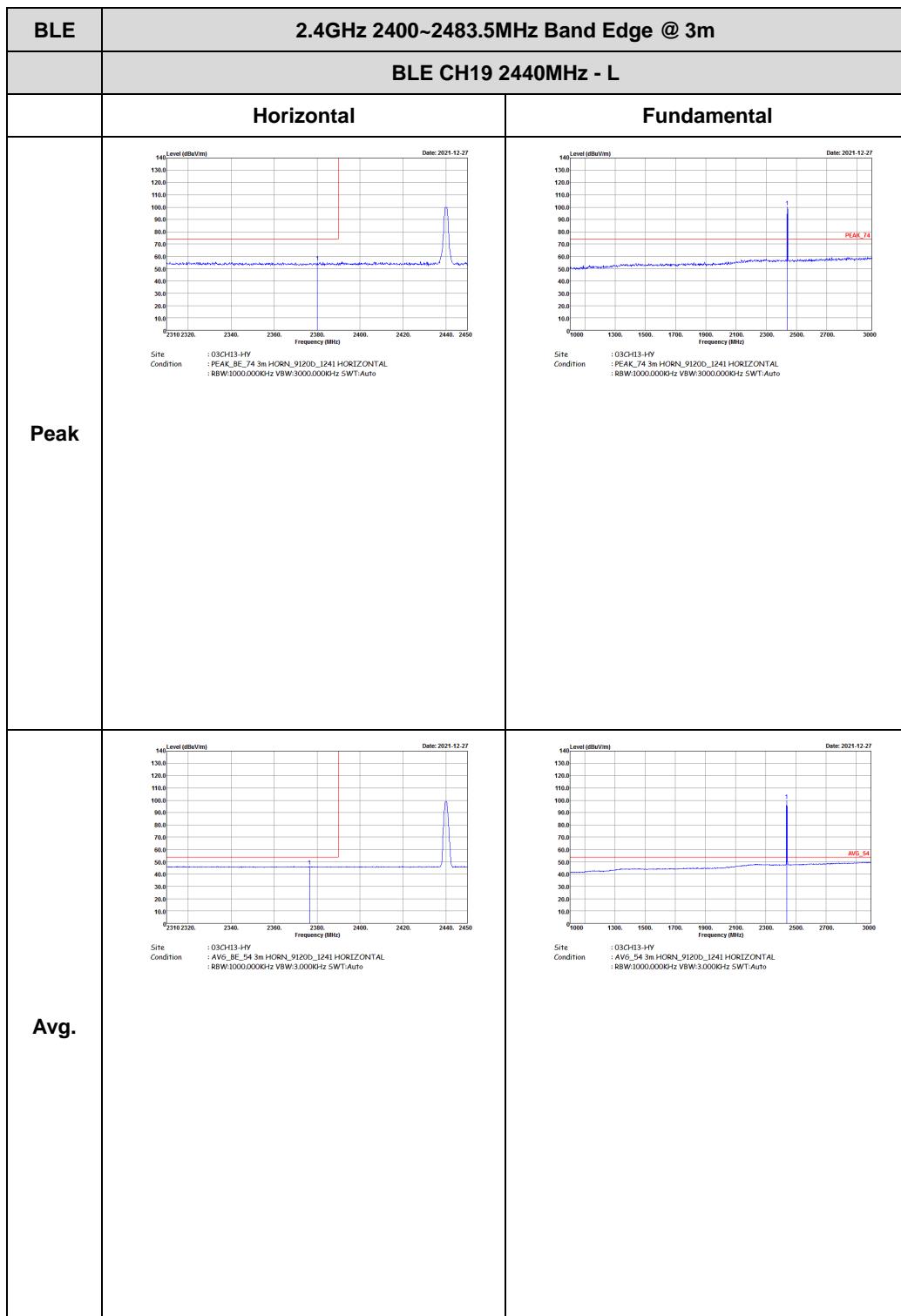
<1Mbps>

2.4GHz 2400~2483.5MHz

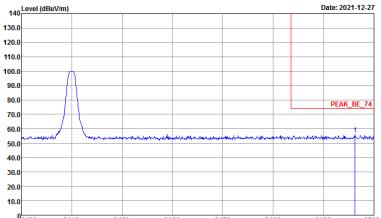
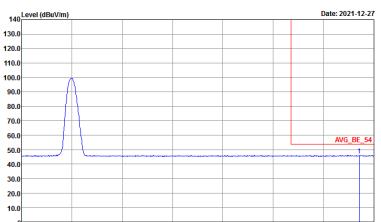
BLE (Band Edge @ 3m)

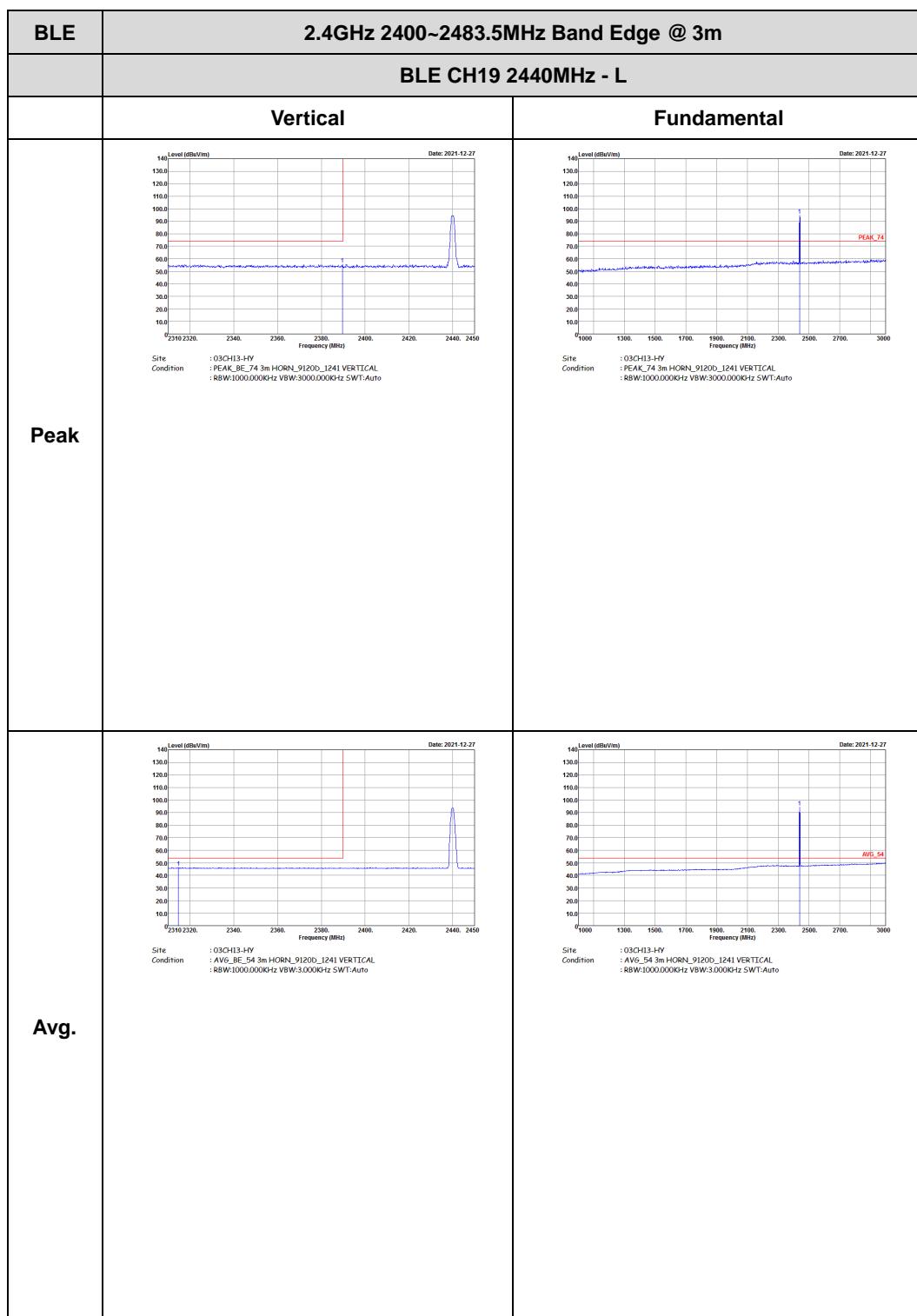
| BLE | 2.4GHz 2400~2483.5MHz Band Edge @ 3m | |
|------|--|--|
| | BLE CH00 2402MHz | |
| | Horizontal | Fundamental |
| Peak |  <p>Level (dBuV/m) Date: 2021-12-27 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0.0 2310 2320. 2340. 2360. 2380. 2400. 2415. Frequency (MHz) Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000kHz VBW:3000.000Hz SWT:Auto</p> |  <p>Level (dBuV/m) Date: 2021-12-27 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0.0 1000 1300. 1500. 1700. 1900. 2100. 2300. 2500. 2700. 3000. Frequency (MHz) Site : 03CH13-HY Condition : PEAK_74 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000kHz VBW:3000.000Hz SWT:Auto</p> |
| Avg. |  <p>Level (dBuV/m) Date: 2021-12-27 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0.0 2310 2320. 2340. 2360. 2380. 2400. 2415. Frequency (MHz) Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000kHz VBW:3.000Hz SWT:Auto</p> |  <p>Level (dBuV/m) Date: 2021-12-27 140.0 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0.0 1000 1300. 1500. 1700. 1900. 2100. 2300. 2500. 2700. 3000. Frequency (MHz) Site : 03CH13-HY Condition : AVG_54 3m HORN_91200_1241 HORIZONTAL : RBW:1000.000kHz VBW:3.000Hz SWT:Auto</p> |



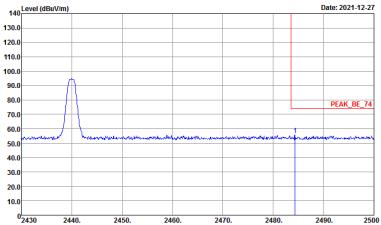
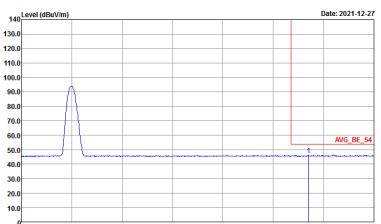


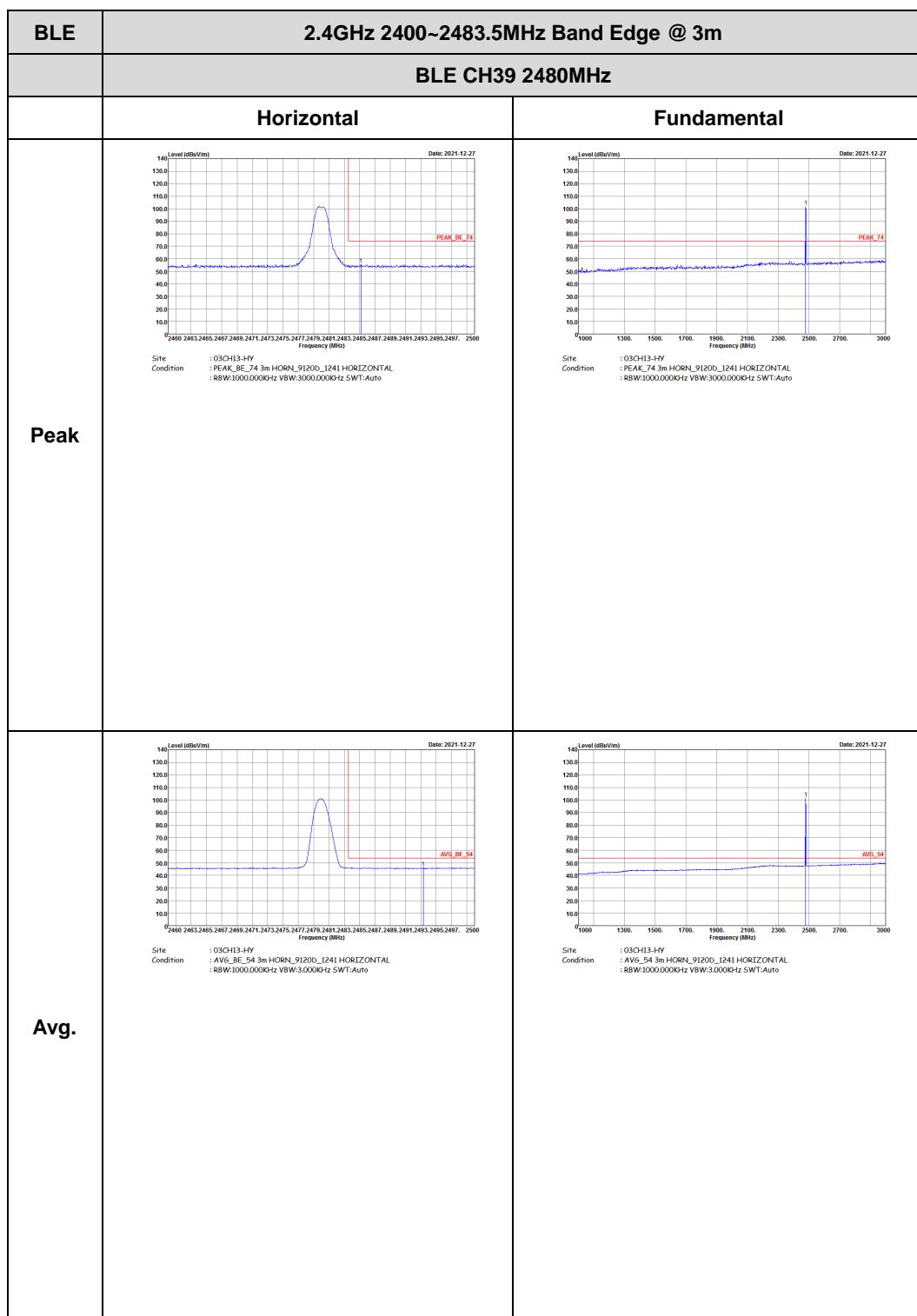


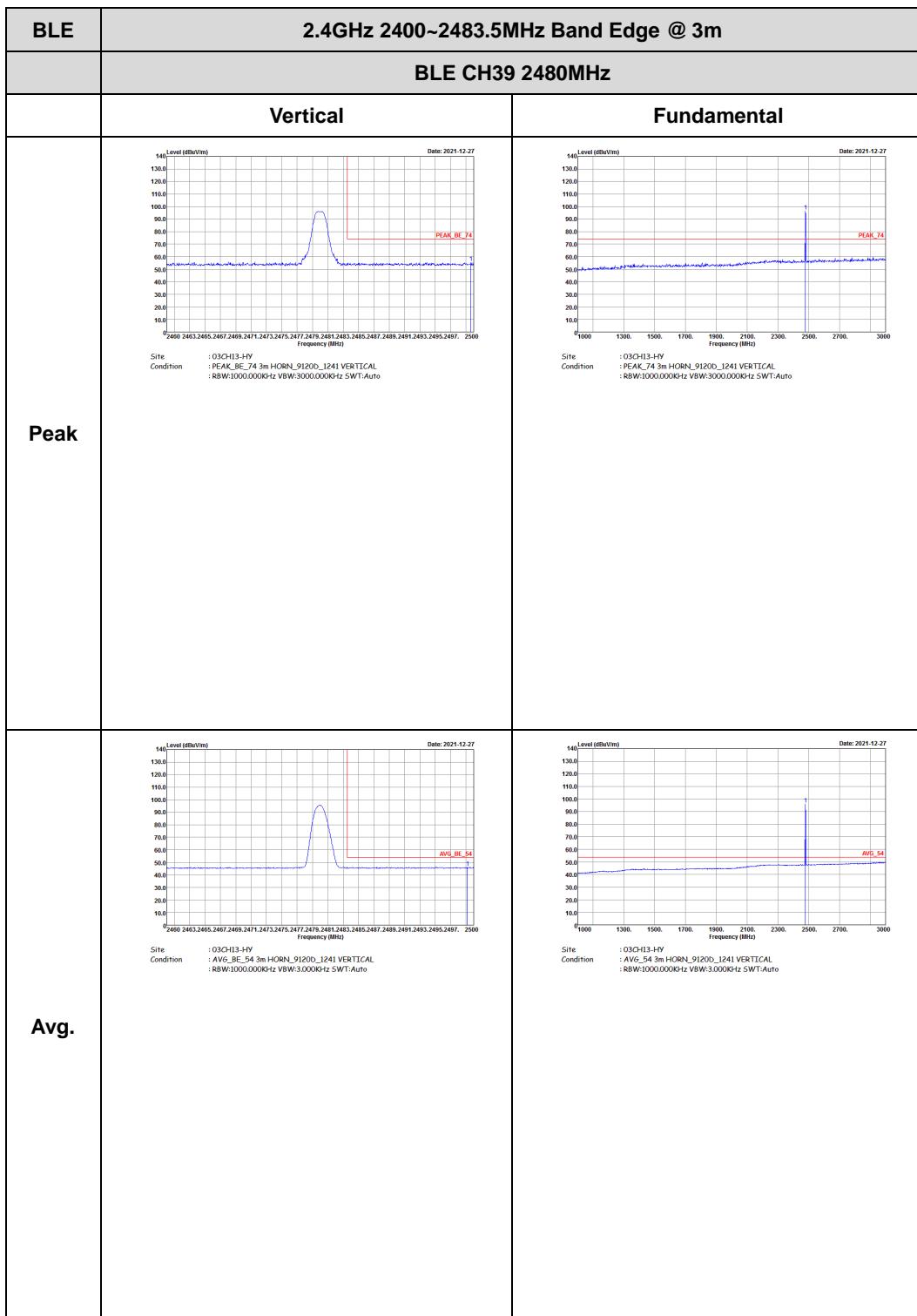
| | | |
|----------------------|---|-------------|
| BLE | 2.4GHz 2400~2483.5MHz Band Edge @ 3m | |
| BLE CH19 2440MHz - R | | |
| Horizontal | | Fundamental |
| Peak |  <p>Level (dBuV/m)</p> <p>Date: 2021-12-27</p> <p>Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 HORIZONTAL : R8W:1000.000kHz VBW:3.0000Hz SWT:Auto</p> | Left blank |
| Avg. |  <p>Level (dBuV/m)</p> <p>Date: 2021-12-27</p> <p>Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 HORIZONTAL : R8W:1000.000kHz VBW:3.0000Hz SWT:Auto</p> | Left blank |





| | | |
|----------------------|---|-------------|
| BLE | 2.4GHz 2400~2483.5MHz Band Edge @ 3m | |
| BLE CH19 2440MHz - R | | |
| Vertical | | Fundamental |
| Peak |  <p>Level (dBuV/m)</p> <p>Date: 2021-12-27</p> <p>Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 VERTICAL : R8W:1000.000kHz VBW:3.0000Hz SWT:Auto</p> | Left blank |
| Avg. |  <p>Level (dBuV/m)</p> <p>Date: 2021-12-27</p> <p>Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 VERTICAL : R8W:1000.000kHz VBW:3.0000Hz SWT:Auto</p> | Left blank |

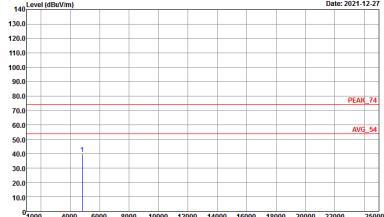
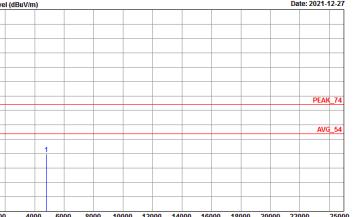


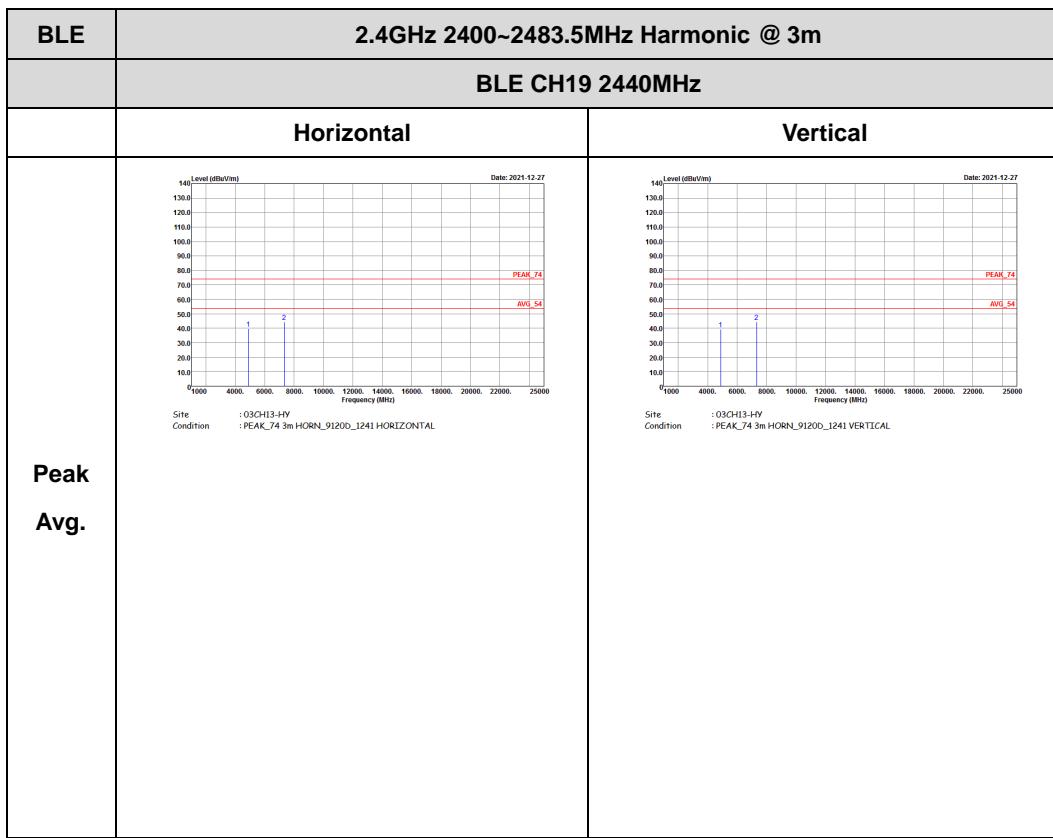


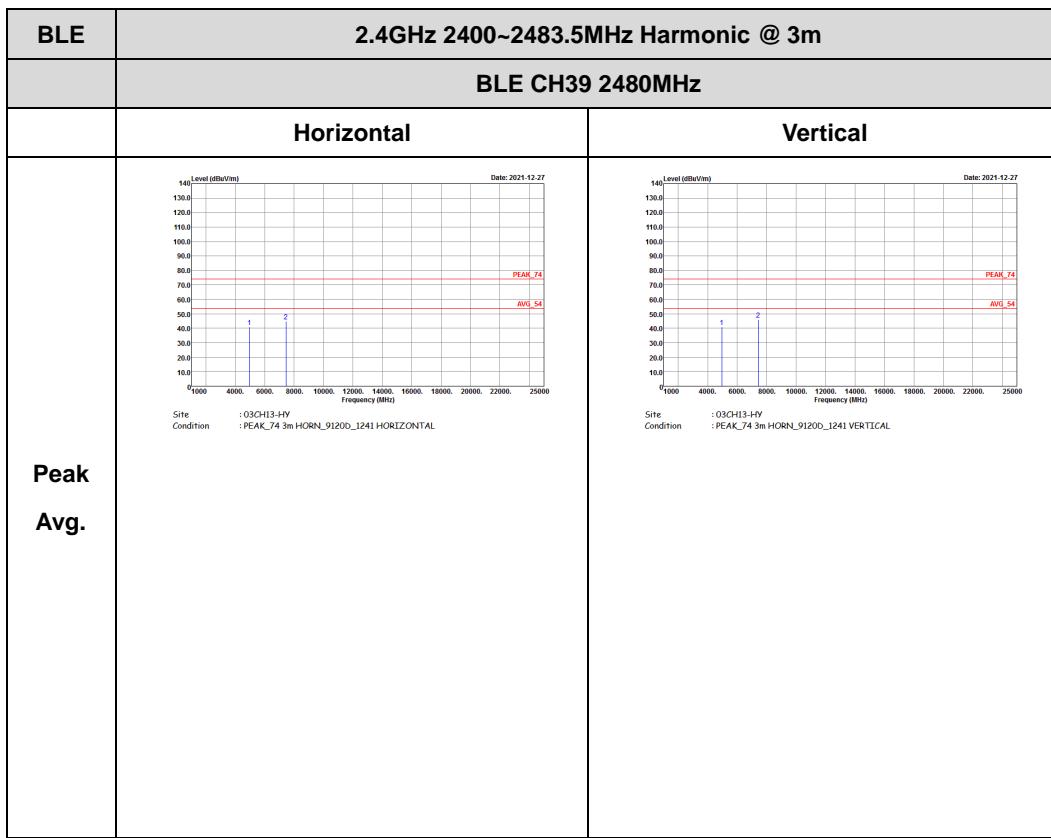


2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

| BLE | 2.4GHz 2400~2483.5MHz Harmonic @ 3m | |
|--------------|--|---|
| | BLE CH00 2402MHz | |
| | Horizontal | Vertical |
| Peak Avg. |  <p>140 Level (dBuV/m) Date: 2021-12-27 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0.0 1000 4000 6000 8000 10000 12000 14000 16000 18000 20000 22000 25000 Frequency (MHz) Site : 03CH13-HY Condition : PEAK_74 3m HORN_9120D_1241 HORIZONTAL</p> |  <p>140 Level (dBuV/m) Date: 2021-12-27 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0.0 1000 4000 6000 8000 10000 12000 14000 16000 18000 20000 22000 25000 Frequency (MHz) Site : 03CH13-HY Condition : PEAK_74 3m HORN_9120D_1241 VERTICAL</p> |



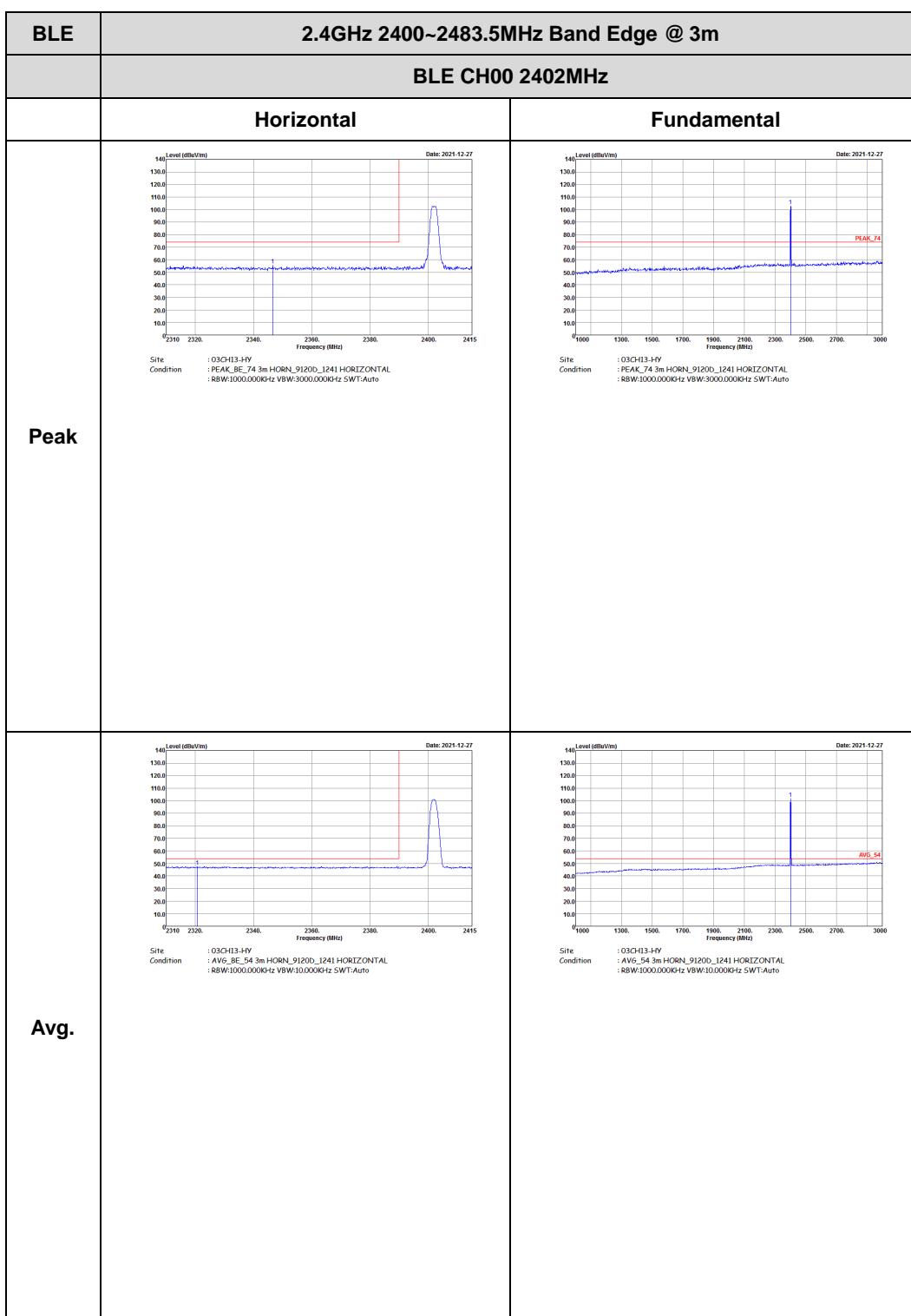


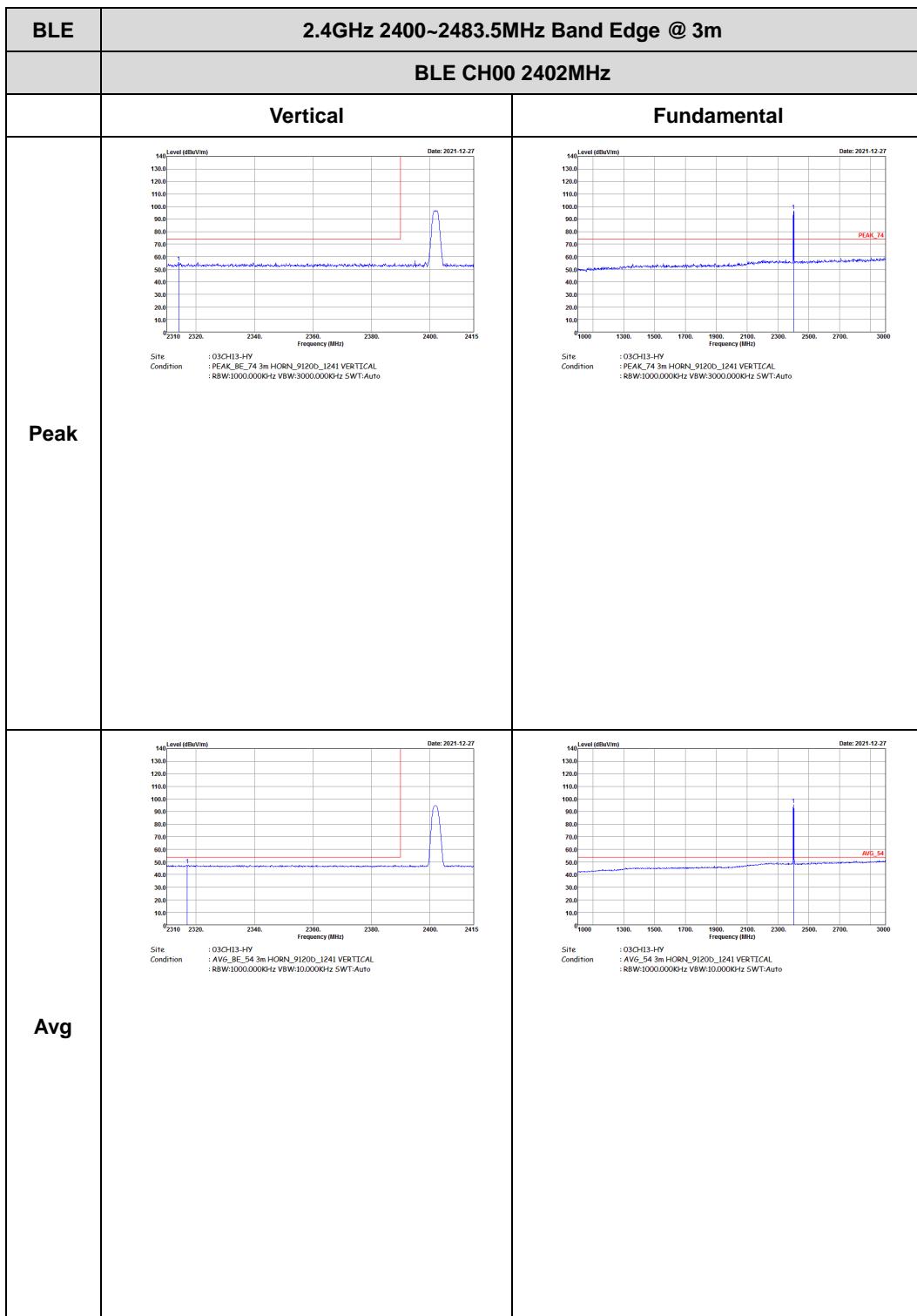


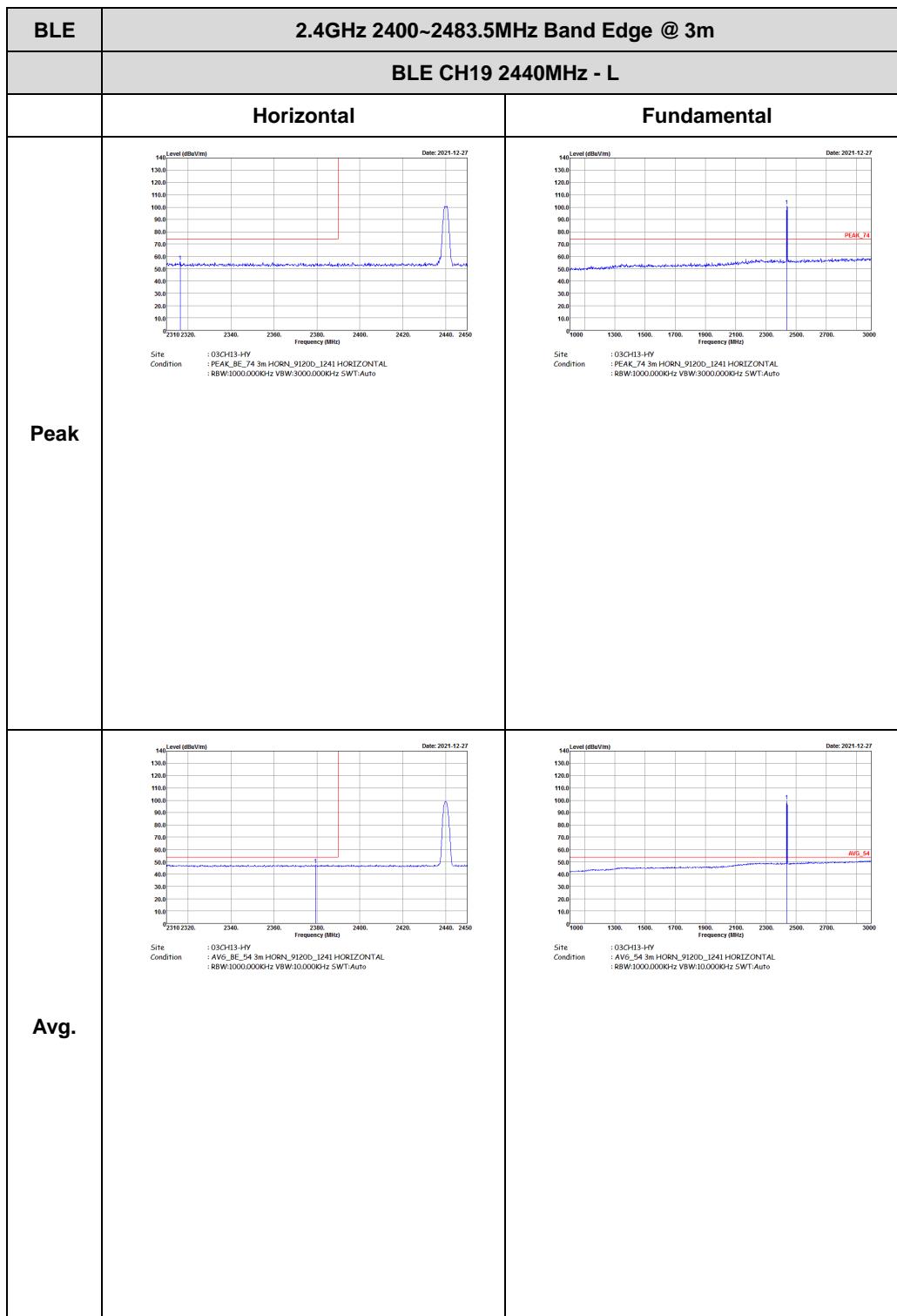
<2Mbps>

2.4GHz 2400~2483.5MHz

BLE (Band Edge @ 3m)

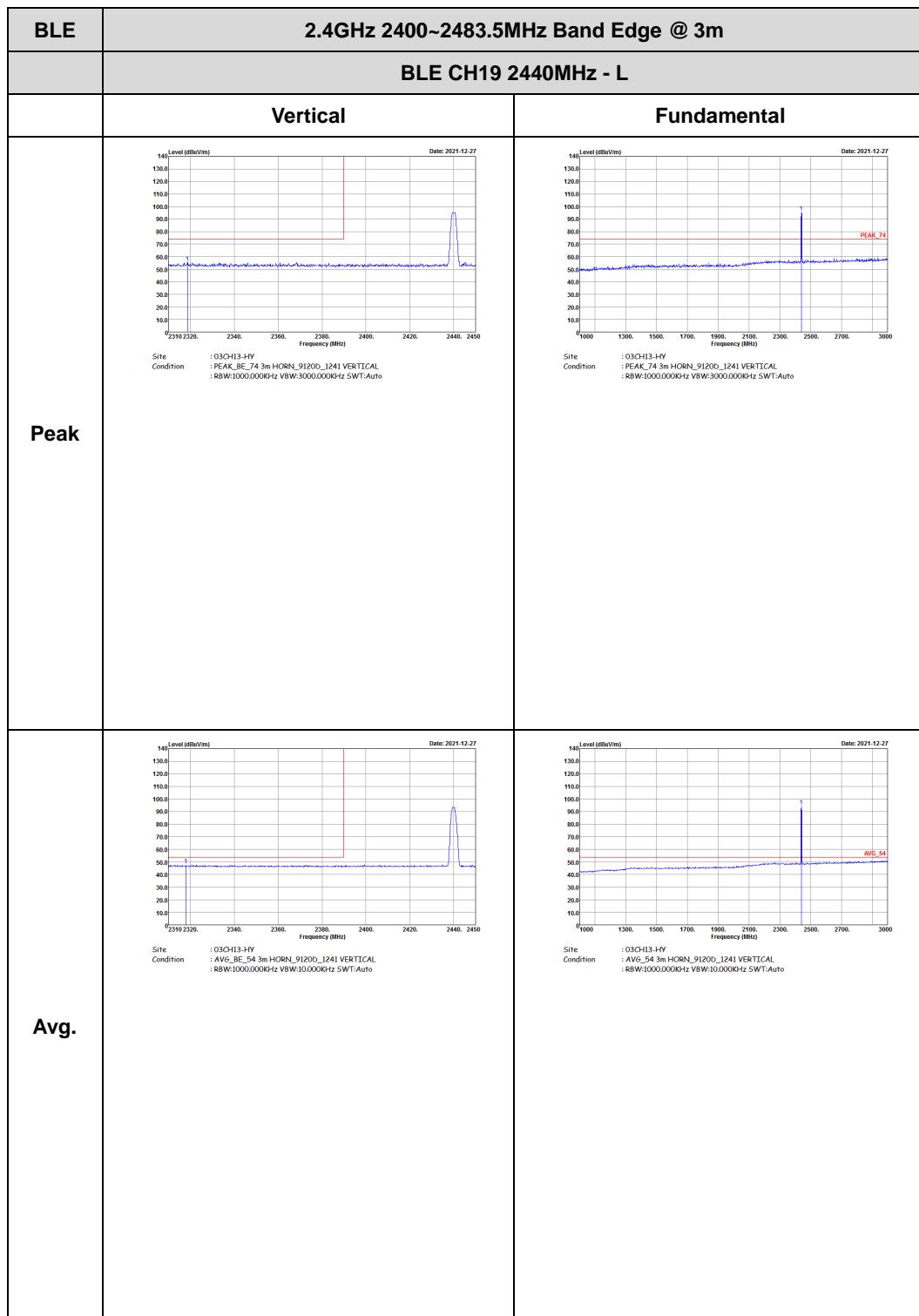




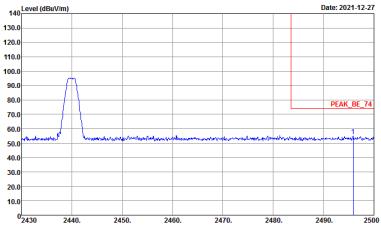
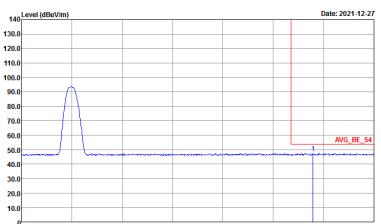


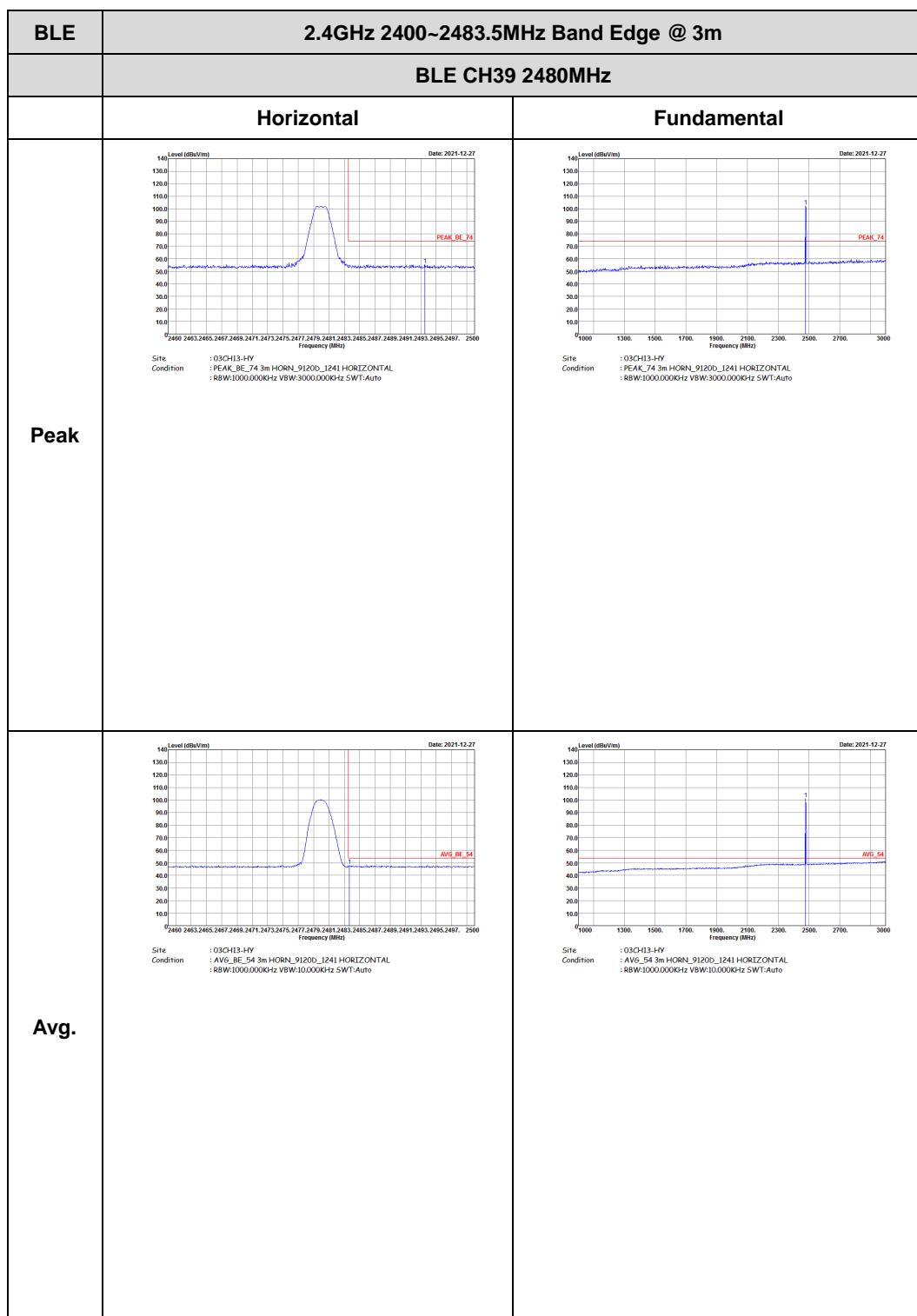


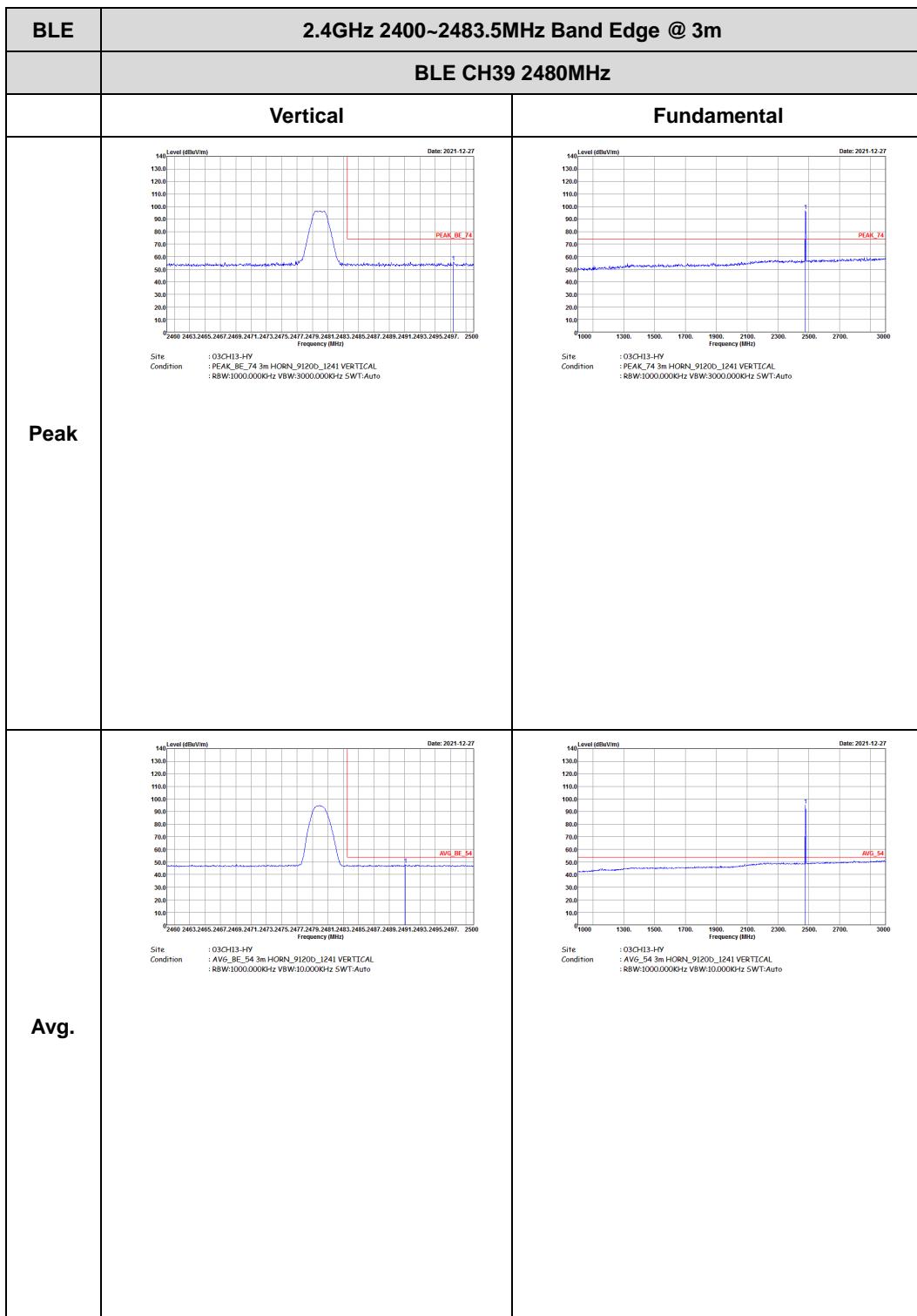
| | | |
|----------------------|---|-------------|
| BLE | 2.4GHz 2400~2483.5MHz Band Edge @ 3m | |
| BLE CH19 2440MHz - R | | |
| Horizontal | | Fundamental |
| Peak | <p>Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 HORIZONTAL : R8W:1000.000kHz VBW:3000.000kHz SWT:Auto</p> | Left blank |
| Avg. | <p>Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 HORIZONTAL : R8W:1000.000kHz VBW:10.000kHz SWT:Auto</p> | Left blank |





| | | |
|----------------------|---|-------------|
| BLE | 2.4GHz 2400~2483.5MHz Band Edge @ 3m | |
| BLE CH19 2440MHz - R | | |
| Vertical | | Fundamental |
| Peak |  <p>Level (dBuV/m)</p> <p>Date: 2021-12-27</p> <p>Site : 03CH13-HY Condition : PEAK_BE_74 3m HORN_9120D_1241 VERTICAL : R8W:1000.000kHz VBW:3000.000kHz SWT:Auto</p> | Left blank |
| Avg. |  <p>Level (dBuV/m)</p> <p>Date: 2021-12-27</p> <p>Site : 03CH13-HY Condition : AVG_BE_54 3m HORN_9120D_1241 VERTICAL : R8W:1000.000kHz VBW:10.000kHz SWT:Auto</p> | Left blank |

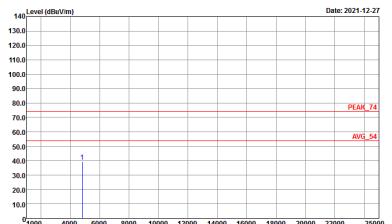
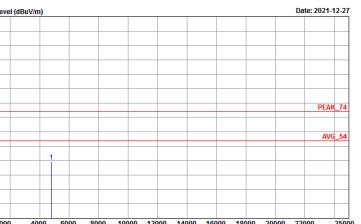


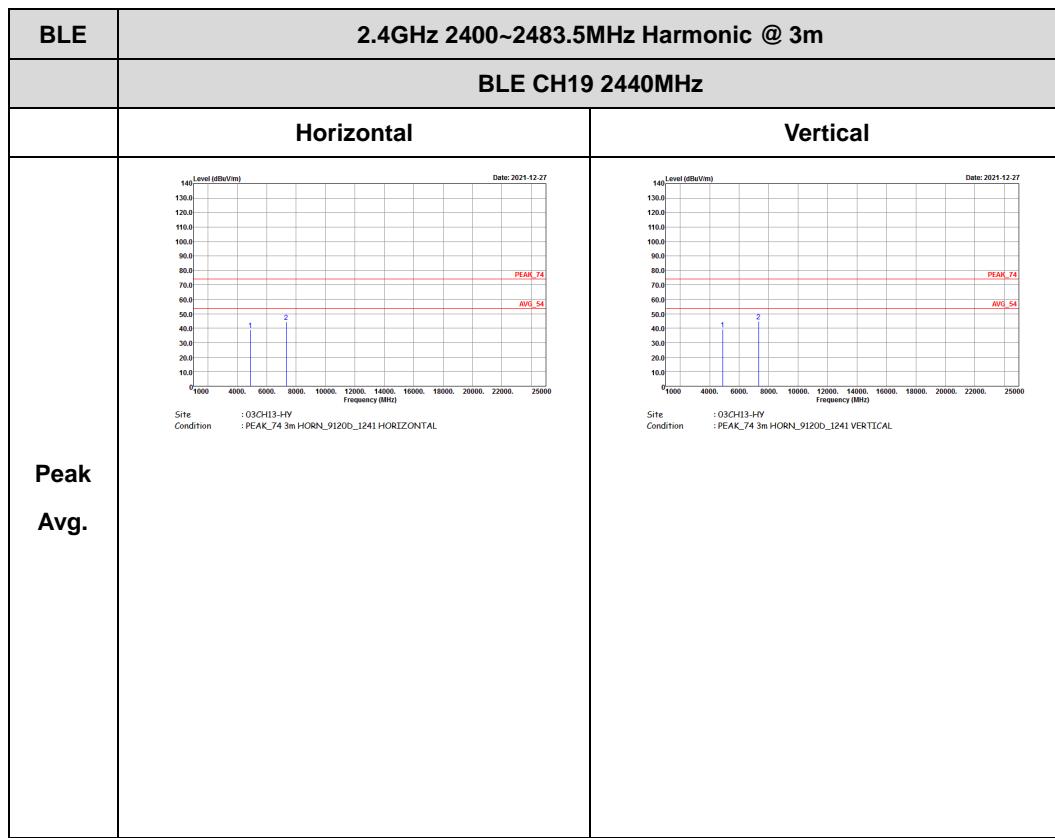


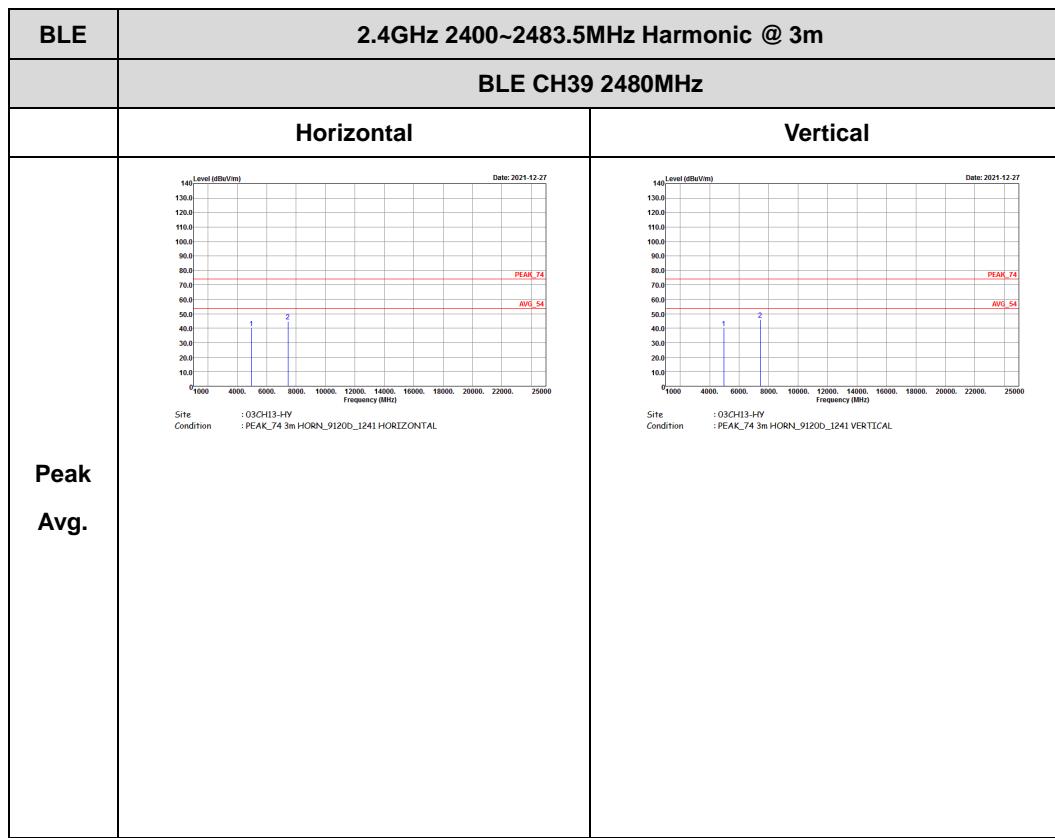


2.4GHz 2400~2483.5MHz

BLE (Harmonic @ 3m)

| BLE | 2.4GHz 2400~2483.5MHz Harmonic @ 3m | |
|--------------|--|---|
| | BLE CH00 2402MHz | |
| | Horizontal | Vertical |
| Peak Avg. |  <p>140 Level (dBuV/m) Date: 2021-12-27 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0.0 1000 4000 6000 8000 10000 12000 14000 16000 18000 20000 22000 24000 25000 Frequency (MHz) Site : 03CH13-HY Condition : PEAK_74 3m HORN_9120D_1241 HORIZONTAL</p> |  <p>140 Level (dBuV/m) Date: 2021-12-27 130.0 120.0 110.0 100.0 90.0 80.0 70.0 60.0 50.0 40.0 30.0 20.0 10.0 0.0 1000 4000 6000 8000 10000 12000 14000 16000 18000 20000 22000 24000 25000 Frequency (MHz) Site : 03CH13-HY Condition : PEAK_74 3m HORN_9120D_1241 VERTICAL</p> |

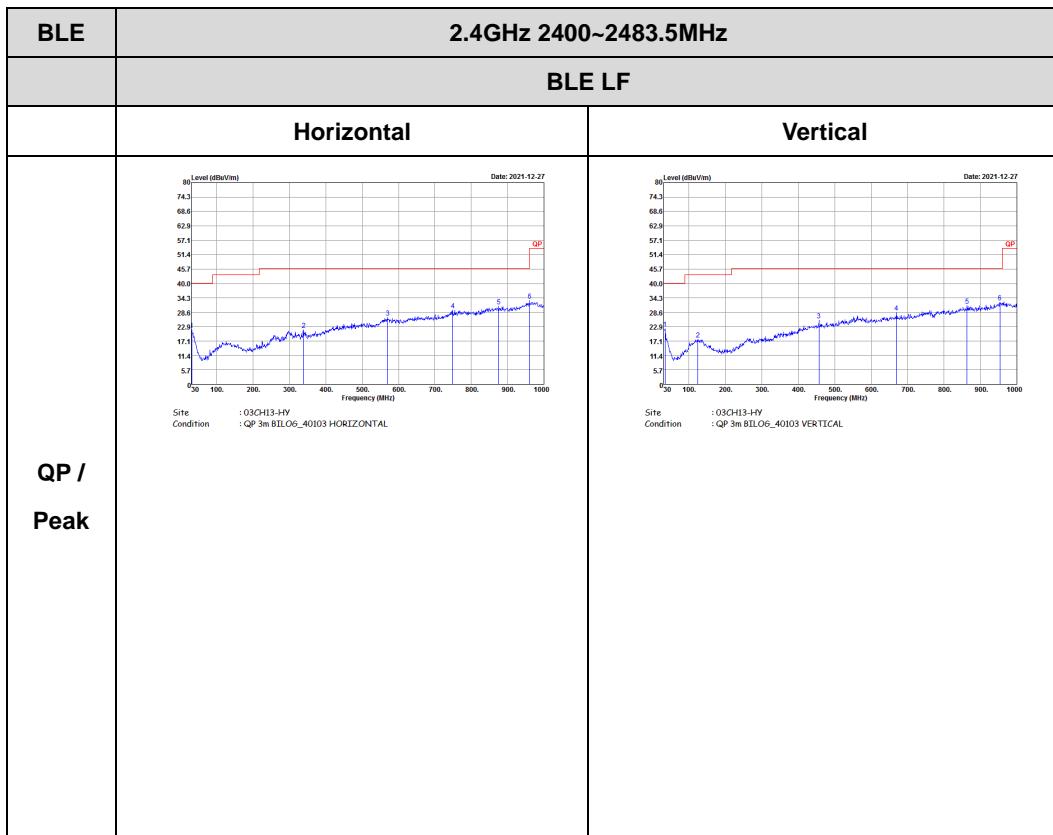






Emission below 1GHz

2.4GHz BLE (LF)



Appendix E. Duty Cycle Plots

| Band | Duty Cycle(%) | T(us) | 1/T(kHz) | VBW Setting |
|--------------------------|---------------|-------|----------|-------------|
| Bluetooth - LE for 1Mbps | 62.45 | 390 | 2.56 | 3kHz |
| Bluetooth - LE for 2Mbps | 32.26 | 200 | 5.00 | 10kHz |

