# FCC Part 15, Subpart C
# Test Report

| | |
|---|---|
| FCC ID: | 2AAGF-MIDTON |
| Applicant: | Zound Industries International AB |
| Address: | Centralplan 15 SE-111 20 Stockholm Sweden |
| Manufacturer: | Zound Industries International AB |
| Address: | Centralplan 15 SE-111 20 Stockholm Sweden |
| Product(s): | PORTABLE LOUDSPEAKER |
| Brand(s): | Marshall |
| Test Model(s): | MIDDLETON |
| Series Model(s): | N/A |
| Test Date: | May 02, 2022~ Jun. 08, 2022 |
| Issued Date: | Jun. 08, 2022 |
| Issued By: | Hwa-Hsing (Dongguan) Testing Co., Ltd. |
| Address: | No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park, HuangJiang Town, Dongguan, China |
| Test Firm Registration No.: | 915896 |
| Standards: | 47 CFR FCC Part 15, Subpart C (Section 15.247)<br>ANSI C63.10:2013 |

The above equipment has been tested by **Hwa-Hsing (Dongguan) Testing Co., Ltd.**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : *Tank Tan*

Reviewed by : *Scott He*

Approved by : *Harry Li*

This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into the account to declare the compliance or non-compliance to the specification. The report must not be used by the client to claim product certification, approval, or endorsement by A2LA or any agency of the federal government. The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any government agencies.

# Table of Contents

**Release Control Record ..... 4**

**1. Summary of Test Results ..... 5**

1.1 Measurement Uncertainty ..... 5
1.2 Modification Record ..... 5

**2. General Information ..... 6**

2.1 General Description of EUT ..... 6
2.2 Description of Test Channels ..... 7
2.3 Test Mode Applicability and Tested Channel Detail ..... 7
2.4 Description of Support Units ..... 9
2.5 Configuration of System under Test ..... 9
2.6 Duty Cycle of Test Signal ..... 10

**3. Test Types and Results ..... 11**

3.1 Radiated Emission and Band-edge Measurement ..... 11
3.1.1 Limits of radiated emission and band-edge measurement ..... 11
3.1.2 Test Instruments ..... 12
3.1.3 Test Procedures ..... 13
3.1.4 Deviation from Test Standard ..... 14
3.1.5 Test Setup ..... 15
3.1.6 EUT Operating Conditions ..... 16
3.1.7 Test Results ..... 17
3.2 Conducted Emission Measurement ..... 29
3.2.1 Limits of Conducted Emission Measurement ..... 29
3.2.2 Test Instruments ..... 29
3.2.3 Test Procedures ..... 29
3.2.4 Deviation from Test Standard ..... 29
3.2.5 Test setup ..... 30
3.2.6 EUT Operating Conditions ..... 30
3.2.7 Test Results ..... 31
3.3 6dB Bandwidth Measurement ..... 33
3.3.1 Limits of 6dB Bandwidth Measurement ..... 33
3.3.2 Test Setup ..... 33
3.3.3 Test Instruments ..... 33
3.3.4 Test Procedure ..... 33
3.3.5 Deviation from Test Standard ..... 34
3.3.6 EUT Operating Conditions ..... 34
3.3.7 Test Result ..... 34
3.4 Occupied Bandwidth Measurement ..... 36
3.4.1 Test Setup ..... 36
3.4.2 Test Instruments ..... 36
3.4.3 Test Procedure ..... 36
3.4.4 Deviation from Test Standard ..... 36
3.4.5 EUT Operating Conditions ..... 36
3.4.6 Test Results ..... 37
3.5 Conducted Output Power Measurement ..... 39
3.5.1 Limits of Conducted Output Power Measurement ..... 39
3.5.2 Test Setup ..... 39
3.5.3 Test Instruments ..... 39
3.5.4 Test Procedures ..... 39
3.5.5 Deviation from Test Standard ..... 40
3.5.6 EUT Operating Conditions ..... 40
3.5.7 Test Results ..... 41
3.6 Power Spectral Density Measurement ..... 44

3.6.1 Limits of Power Spectral Density Measurement ..... 44
3.6.2 Test Setup ..... 44
3.6.3 Test Instruments ..... 44
3.6.4 Test Procedure ..... 45
3.6.5 Deviation from Test Standard ..... 45
3.6.6 EUT Operating Condition ..... 45
3.6.7 Test Results ..... 46
3.7 Conducted Out of Band Emission Measurement ..... 48
3.7.1 Limits of Conducted Out of Band Emission Measurement ..... 48
3.7.2 Test Setup ..... 48
3.7.3 Test Instruments ..... 48
3.7.4 Test Procedure ..... 49
3.7.5 Deviation from Test Standard ..... 49
3.7.6 EUT Operating Condition ..... 49
3.7.7 Test results ..... 50

**4. Pictures of Test Arrangements ..... 54**

**5. Test Instruments ..... 55**

**Appendix – Information on The Testing Laboratories ..... 56**

**Release Control Record**

| Issue No. | Description | Date Issued |
|---|---|---|
| 220420EL24-RF-US-01 | Original Release | Jun. 08, 2022 |

## 1. Summary of Test Results

| 47 CFR FCC Part 15, Subpart C (Section 15.247)<br>KDB 558074 D01 15.247 Meas Guidance v05r02<br>ANSI C63.10:2013 | | | |
|---|---|---|---|
| Clause | Test Item | Result | Remarks |
| 15.207 | AC Power Conducted Emission | Pass | Meet the requirement of limit. |
| 15.205 & 209 | Radiated Emissions | Pass | Meet the requirement of limit. |
| 15.247(d) | Band Edge Measurement | Pass | Meet the requirement of limit. |
| 15.247(d) | Antenna Port Emission | Pass | Meet the requirement of limit. |
| 15.247(a)(2) | 6dB Bandwidth | Pass | Meet the requirement of limit. |
| --- | Occupied Bandwidth Measurement | Pass | Reference only |
| 15.247(b) | Conducted power | Pass | Meet the requirement of limit. |
| 15.247(e) | Power Spectral Density | Pass | Meet the requirement of limit. |
| 15.203 | Antenna Requirement | Pass | No antenna connector is used.<br>The device is professionally installed |

**Note:** The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (sDoC). The test report has been issued separately.

### 1.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:
The listed uncertainties are the worst cases uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

| Measurement | Frequency | Expended Uncertainty (k=2) (±) |
|---|---|---|
| Conducted Emissions at mains ports | 150kHz ~ 30MHz | 2.66 dB |
| Radiated Emissions up to 1 GHz | 9KHz ~ 30MHz | 2.16 dB |
| | 30MHz ~ 1000MHz | 3.47 dB |
| Radiated Emissions above 1 GHz | 1GHz ~ 18GHz | 4.84 dB |
| | 18GHz ~ 40GHz | 4.67 dB |

### 1.2 Modification Record

There were no modifications required for compliance.

## 2. General Information

### 2.1 General Description of EUT

| | |
|---|---|
| Product(s) | PORTABLE LOUDSPEAKER |
| Test Model(s) | MIDDLETON |
| Sample No. | HS220423-01-16 |
| Series Model(s) | N/A |
| Status of EUT | Engineering Prototype |
| Power Supply Rating | Input: 5V/9V/12V/20V⎓3A<br>Output: 5V⎓1A<br>Or DC 11.1V from battery |
| Modulation Type | BT-LE(GFSK) |
| Transfer Rate | 1Mbps & 2Mbps |
| Operating Frequency | 2402 ~ 2480MHz |
| Number of Channel | 40 |
| Maximum Output Power | 3.737dBm (Peak) |
| Antenna Type | PCB Antenna |
| Antenna Gain | 1.95dBi Maximum peak Gain |
| Antenna Connector | N/A |
| Accessory Device | N/A |
| Data Cable Supplied | USB Cable: Unshielded, 100cm |

Note:

1. Please refer to the EUT photo document (Reference No.: 220420EL24-1&-2) for detailed product photo.
2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

## 2.2 Description of Test Channels

40 channels are provided to this EUT:

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

## 2.3 Test Mode Applicability and Tested Channel Detail

| EUT Configure Mode | Applicable test items | X-Axis | Y-Axis | Z-Axis | Voltage Supply |
|---|---|---|---|---|---|
| Conducted | AC Power Conducted Emission | N/A | N/A | N/A | DC11.1V from battery |
| Radiated | Radiated Emissions | √ | √ | √ | |
| Antenna Port Conducted Measurement | Band Edge Measurement | N/A | N/A | N/A | |
| | Antenna Port Emission | N/A | N/A | N/A | |
| | 6dB Bandwidth | N/A | N/A | N/A | |
| | Occupied Bandwidth Measurement | N/A | N/A | N/A | |
| | Conducted power | N/A | N/A | N/A | |
| | Power Spectral Density | N/A | N/A | N/A | |

1. *: The EUT had been pre-tested on the positioned of each 3 Axis. The worst case was found when positioned on **Z-plane**.
2. "N/A" means no effect.

**Test Condition:**

| Applicable test items | Test Conditions | Power supply | Tested by |
|---|---|---|---|
| AC Power Conducted Emission | 24.3deg. C, 54%RH | AC120/60Hz | Jim Xu |
| Radiated Emissions | 23deg. C, 45%RH | AC120/60Hz | Jim Xu |
| Antenna Port Conducted Measurement | 26deg. C, 69%RH | AC120/60Hz | Dragon Long |

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.

**Radiated Emission Test (Above 1GHz):**

| EUT Configure Mode | Available Channel | Tested Channel | Modulation Type | Data Rate (Mbps) |
|---|---|---|---|---|
| - | 0 to 39 | 0, 19, 39 | GFSK | 1 |
| - | 0 to 39 | 0, 19, 39 | GFSK | 2 |

**Radiated Emission Test (Below 1GHz):**

| EUT Configure Mode | Available Channel | Tested Channel | Modulation Type | Data Rate (Mbps) |
|---|---|---|---|---|
| - | 0 to 39 | 0 | GFSK | 1 |

**Power Line Conducted Emission Test:**

| EUT Configure Mode | Available Channel | Tested Channel | Modulation Type | Data Rate (Mbps) |
|---|---|---|---|---|
| - | 0 to 39 | 39 | GFSK | 1 |
| - | 0 to 39 | 39 | GFSK | 2 |

**Antenna Port Conducted Measurement:**

*This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

| EUT Configure Mode | Available Channel | Tested Channel | Modulation Type | Data Rate (Mbps) |
|---|---|---|---|---|
| - | 0 to 39 | 0, 19, 39 | GFSK | 1 |
| - | 0 to 39 | 0, 19, 39 | GFSK | 2 |

## 2.4 Description of Support Units

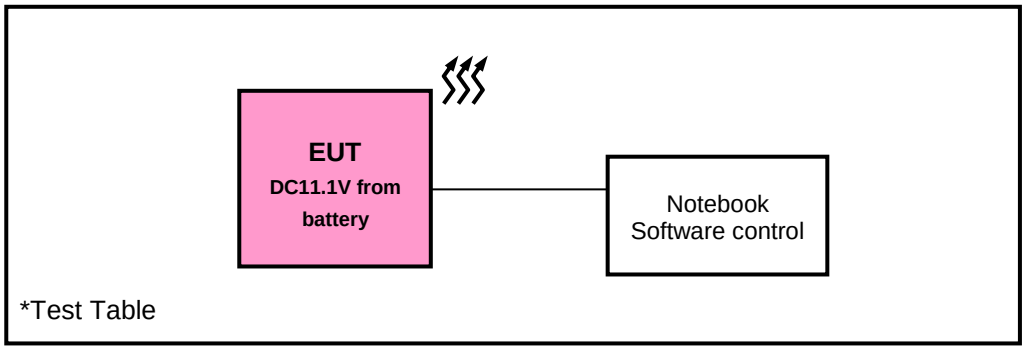
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

| No. | Product | Brand | Model No. | Serial No. | FCC ID |
|---|---|---|---|---|---|
| 1. | Notebook | DELL | Latitude 5300 | N/A | N/A |

Insert Cable Connections to/from EUT provided by test team.

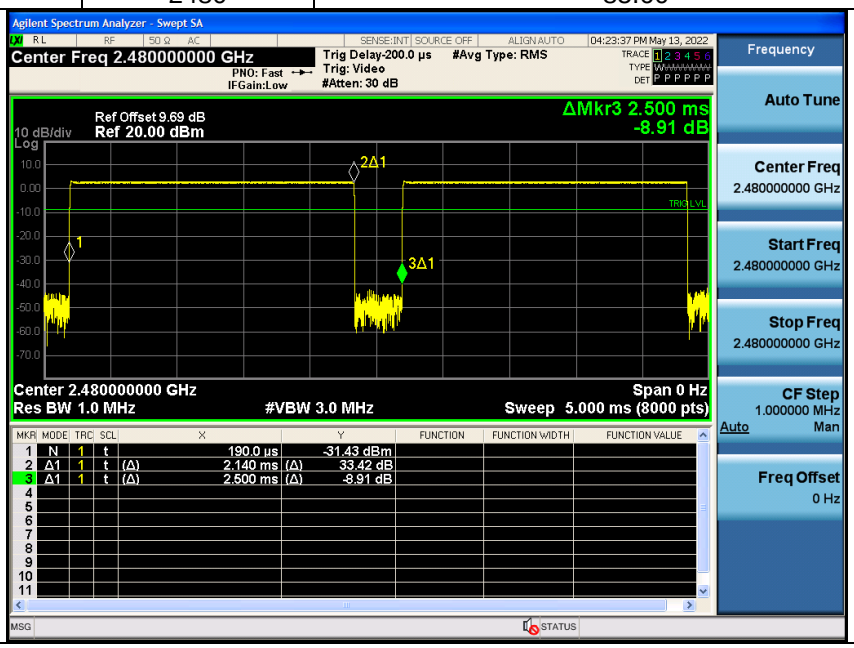
| No. | Signal Cable Description of The Above Support Units |
|---|---|
| 1. | AC cable Un-shielding 1.2m |

## 2.5 Configuration of System under Test

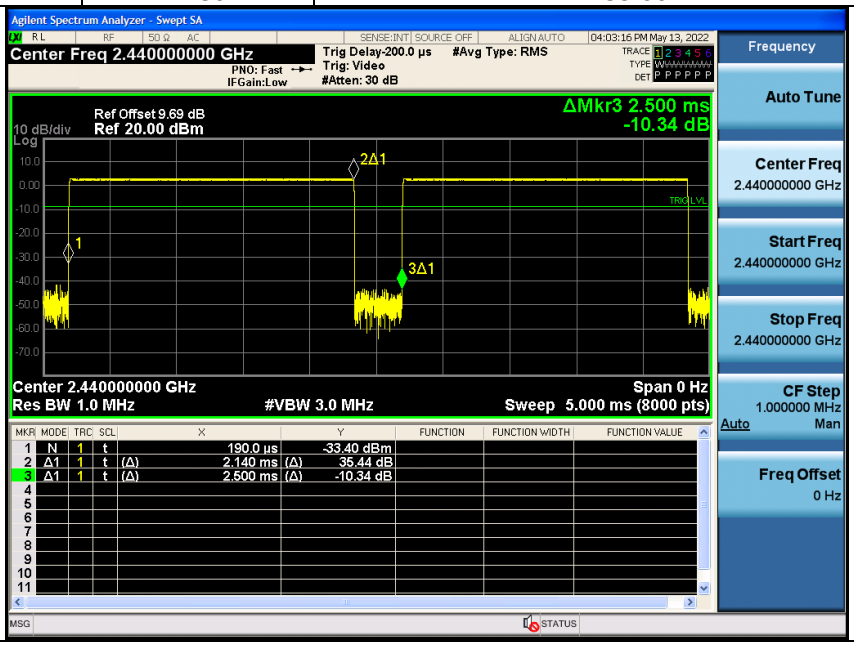


## 2.6 Duty Cycle of Test Signal

| Test Mode | Channel | Duty Cycle [%] |
|---|---|---|
| GFSK-1MHz | 2402 | 85.60 |
| | 2440 | 85.60 |
| | 2480 | 85.60 |




| Test Mode | Channel | Duty Cycle [%] |
|---|---|---|
| GFSK-2MHz | 2402 | 85.60 |
| | 2440 | 85.60 |
| | 2480 | 85.60 |



## 3. Test Types and Results

### 3.1 Radiated Emission and Band-edge Measurement

3.1.1 Limits of radiated emission and band-edge measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

| Frequencies (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 |
| * DTS emissions in non-restricted frequency bands Subclause 11.11 of ANSI C63.10 is applicable.<br>* DTS emissions in restricted frequency bands Subclause 11.12 of ANSI C63.10 is applicable | | |

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

3.1.2 Test Instruments

Radiated emission below 30MHz:

| Equipment | Manufacturer | Model No. | Serial No. | Next Cal. |
|---|---|---|---|---|
| EMI Test Receiver | Rohde&Schwarz | ESR7 | 100962 | 2023/01/12 |
| 3m Semi-anechoic Chamber | MAORUI | 9m*6m*6m | NSEMC003 | 2023/04/14* |
| Test software | FARAD | FARAD | EZ_EMCV1.1.4.2 | N/A |
| Loop Antenna | EMCI | HLA 6121 | 45745 | 2023/04/13* |
| Preamplifier | EMCI | EMC001340 | 980201 | 2022/09/12 |
| Antenna Tower | MF | MFA-440H | NA | NA |
| Turn Table | MF | MFT-201SS | NA | NA |
| Antenna Tower&Turn Table Controller | MF | MF-7802 | NA | NA |

Frequency Range below 1GHz:

| Equipment | Manufacturer | Model No. | Serial No. | Next Cal. |
|---|---|---|---|---|
| EMI Test Receiver | Rohde&Schwarz | ESR7 | 100962 | 2023/01/12 |
| Broadband antenna | Schwarzbeck | VULB 9168 | 00937 | 2023/04/15* |
| 3m Semi-anechoic Chamber | MAORUI | 9m*6m*6m | NSEMC003 | 2023/04/14* |
| Signal Amplifier | Com-power | PAM-103 | 18020051 | 2022/09/07 |
| Attenuator | Rohde&Schwarz | TS2GA-6dB | 18101101 | N/A |
| Test software | FARAD | FARAD | EZ_EMCV1.1.4.2 | N/A |

Frequency Range 1-18GHz:

| Equipment | Manufacturer | Model No. | Serial No. | Next Cal. |
|---|---|---|---|---|
| 3m Semi-anechoic Chamber | MAORUI | 9m*6m*6m | NSEMC003 | 2023/04/14* |
| Horn Antenna | Schwarzbeck | BBHA 9170 | 01959 | 2023/04/15* |
| Broadband Coaxial Preamplifier | Schwarzbeck | PAM-118A | 1804003 | 2022/09/07 |
| Spectrum | Keysight | N9020A | MY51240612 | 2022/09/12 |
| Antenna Tower | MF | MFA-440H | NA | NA |
| Turn Table | MF | MFT-201SS | NA | NA |
| Antenna Tower&Turn Table Controller | MF | MF-7802 | NA | NA |

Frequency Range 18-40GHz:

| Equipment | Manufacturer | Model No. | Serial No. | Next Cal. |
|---|---|---|---|---|
| 3m Semi-anechoic Chamber | MAORUI | 9m*6m*6m | NSEMC003 | 2023/04/14* |
| Spectrum Analyzer | Rohde&Schwarz | FSV-40N | 101783 | 2023/01/12 |
| Horn Antenna | Schwarzbeck | BBHA 9170 | BBHA9170242 | 2023/04/15* |
| Pre-Amplifier | EMCI | EMC 184045 | 980102 | 2023/01/12 |
| Antenna Tower | MF | MFA-440H | NA | NA |
| Turn Table | MF | MFT-201SS | NA | NA |
| Antenna Tower&Turn Table Controller | MF | MF-7802 | NA | NA |

Note: 1. The calibration interval of the above test instruments is 12months (The Antenna and Chamber was 24* mounths) and the calibrations are traceable to CEPREI/CHINA.

2. The test was performed in 966.

3.1.3 Test Procedures

**a. Peak emission levels are measured by setting the instrument as follow:**

1) RBW & VBW setting as a function of frequency:

| Frequency | RBW | VBW |
|---|---|---|
| 9kHz~150kHz | 200Hz | 600Hz |
| 0.15MHz~30MHz | 9kHz | 30kHz |
| 30MHz~1000MHz | 120kHz | 300kHz |
| >1000MHz | 1MHz | 3MHz |

2) Detector = peak.
3) Sweep time = auto.
4) Trace mode = max hold.
5) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be lengthened for low-duty-cycle applications.)

Note: If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement

**b. Average emission levels are measured by setting the instrument as follow:**

- **Trace averaging with continuous EUT transmission at full power**

If the EUT can be configured or modified to transmit continuously (D ≥ 98%). then the average emission levels shall be measured using the following method (with EUT transmitting continuously):

1) RBW=1 MHz (unless otherwise specified).
2) VBW ≥ 3 *RBW.
3) Detector =RMS
4) Sweep time = auto.
5) Perform a trace average of at least 100 traces.

- **Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction**

If continuous transmission of the EUT (D ≥ 98%) cannot be achieved and the duty cycle is constant (duty cycle variations are less than ±2%). then the following procedure shall be used

1) The EUT shall be configured to operate at the maximum achievable duty cycle.
2) Measure the duty cycle D of the transmitter output signal as described in 11.6.
3) RBW=1 MHz (unless otherwise specified).
4) VBW ≥ 3 *RBW.
5) Detector =RMS
6) Sweep time = auto.
7) Perform a trace average of at least 100 traces.

A correction factor shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:

*If power averaging (rms) mode was used in step 5). then the applicable correction factor is [10 10g (1/ D)], where D is the duty cycle.

**If linear voltage averaging mode was used in step f). then the applicable correction factor is [20 10g (1/D)], where D is the duty cycle.

***If a specific emission is demonstrated to be continuous (D > 98%) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that

- **Reduced VBW Averaqing across ON and OFF times of the EUT transmissions with max hold**

If continuous transmission of the EUT (D > 98%) cannot be achieved and the duty cycle is not constant (duty cycle variations exceed ±2%), then the following procedure shall be used:

1) RBW = 1 MHz.
2) VBW ≥ 1/T.
3) Detector =peak
4) Sweep time = auto.
5) Trace mode = max hold.
6) Allow max hold to run for at least [50 x (1/ D)] traces

c. The EUT was placed on the top of a rotating table 0.8 meters (below 1GHz) / 1.5 meters (1-18GHz) / 1.5 meters (18-40GHz) above the reference ground. The table was rotated 360 degrees to determine the position of the highest radiation.
d. The EUT was set 3 meters away from the interference-receiving antenna (Below 1GHz) & (Above 1-18GHz), which was mounted on the top of a variable-height antenna tower. The EUT was set 1meters away from the interference-receiving antenna (18-40GHz).
e. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
f. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
g. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
h. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

**Note:**

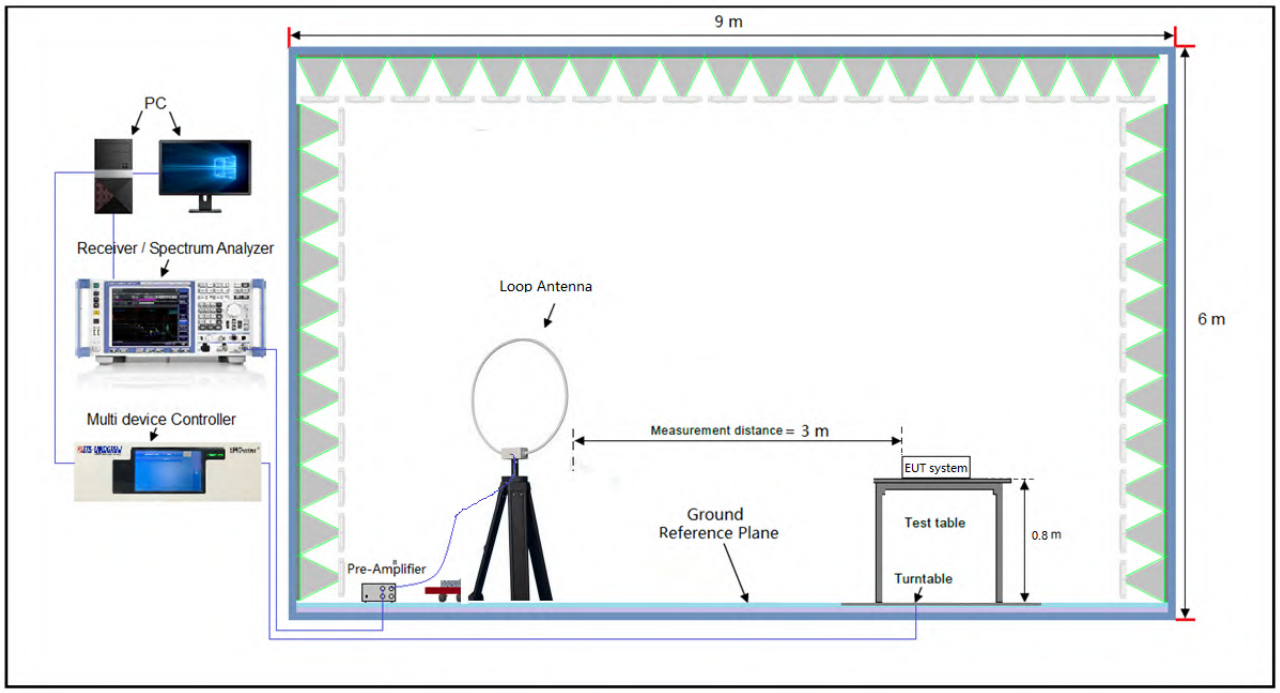
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth =3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth =1/T for Average (Duty cycle < 98 %) detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is =10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

### 3.1.4 Deviation from Test Standard

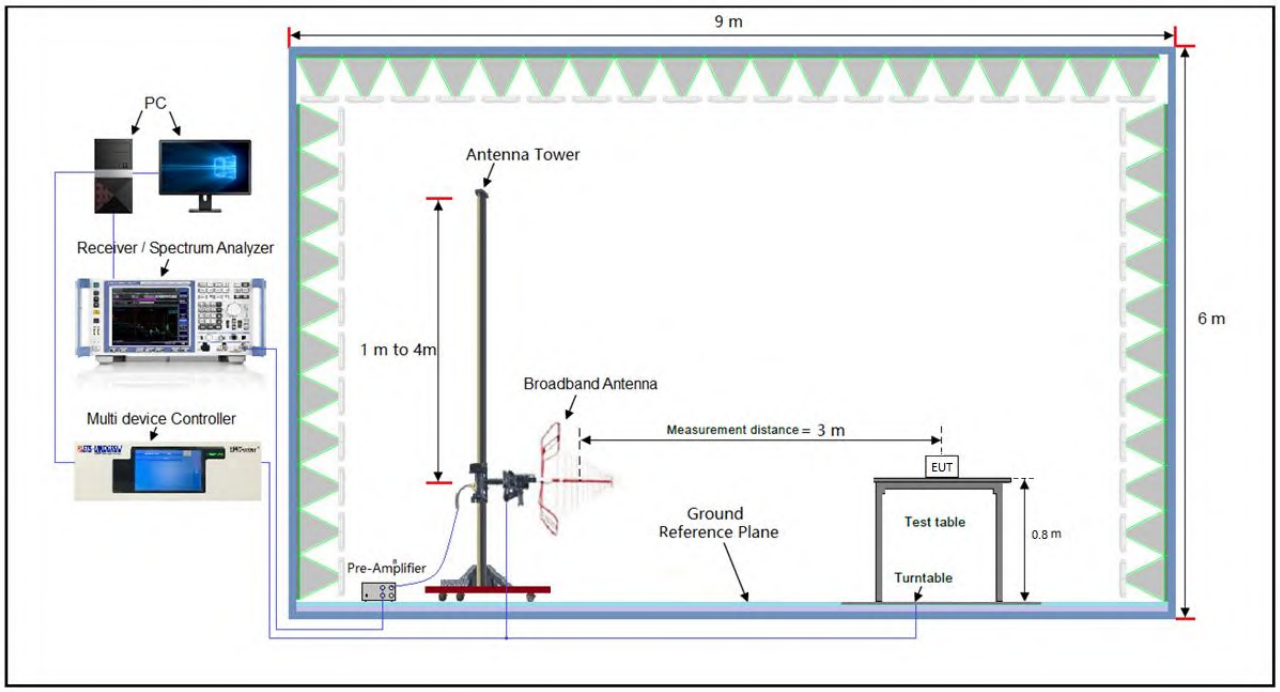
No deviation.

3.1.5 Test Setup

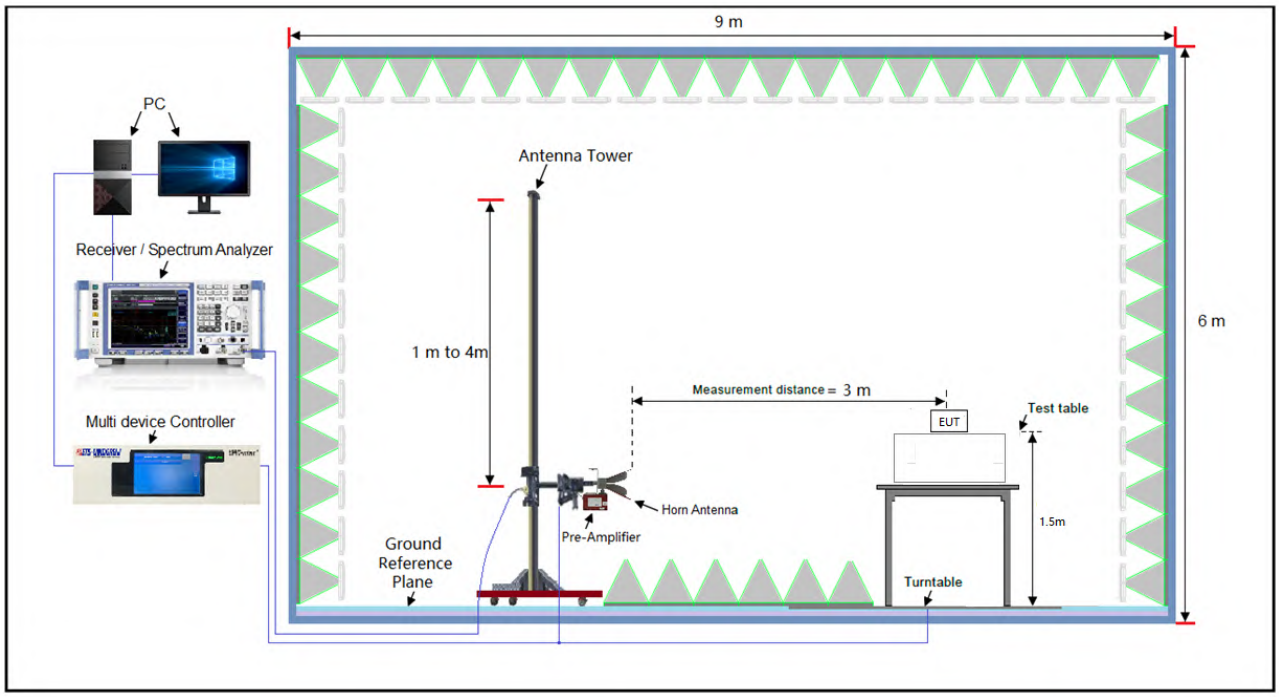
Radiated emission below 30MHz:



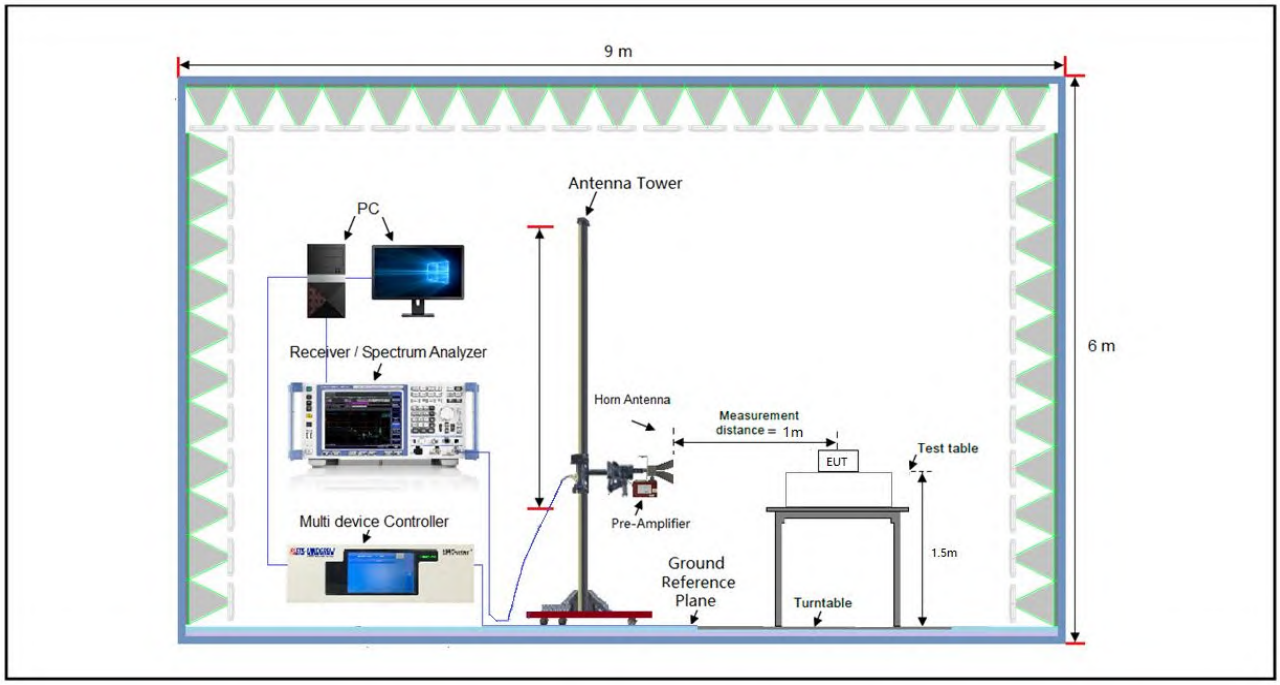

Frequency Range below 1GHz:



Frequency Range 1-18GHz:




Frequency Range 18-40GHz:




For the actual test configuration, please refer to the attached file (Test Setup Photo).

### 3.1.6 EUT Operating Conditions

a. Placed the EUT on the testing table.

b. Set the EUT under transmission condition continuously at specific channel frequency.

3.1.7 Test Results

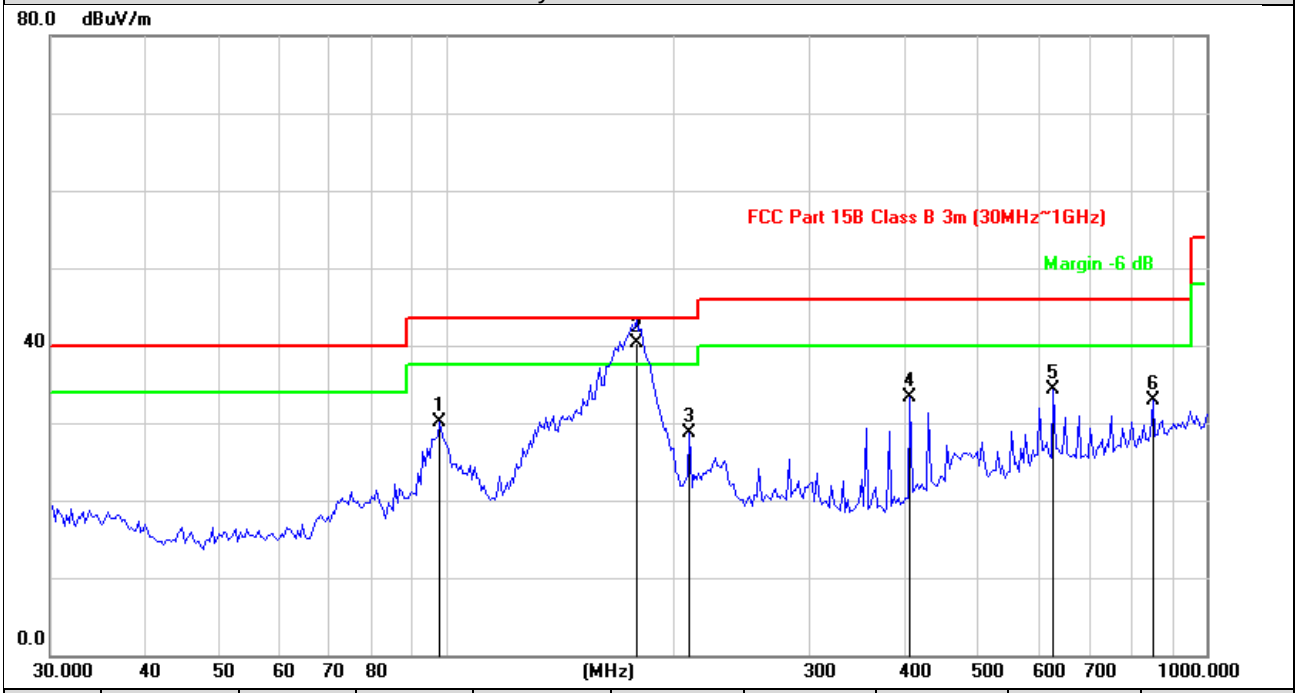
**9kHz ~ 30MHz Data:**

The amplitude of spurious emissions attenuated more than 20dB below the permissible value is not required to be report.

**30MHz ~ 1GHz Worst-Case Data:**

| Test Channel | Channel 0 | Frequency Range | 30MHz ~ 1GHz |
|---|---|---|---|
| Detector Function | Peak (PK)<br>Quasi-peak (QP) | Tested By | Jim Xu |

Antennal Polarity &Test Distance: Horizontal at 3m



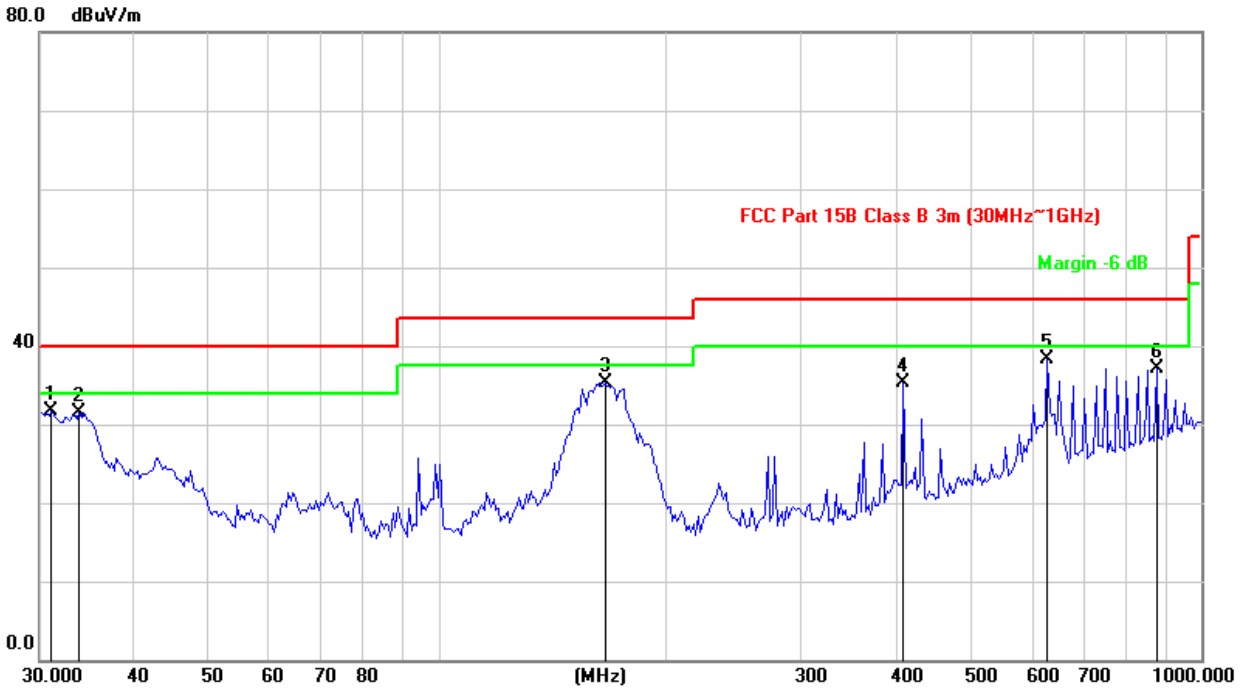

| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 97.6864 | 53.76 | -23.57 | 30.19 | 43.50 | -13.31 | peak | 100 | 89 |
| 2 | 177.4270 | 59.92 | -19.56 | 40.36 | 43.50 | -3.14 | QP | 200 | 0 |
| 3 | 208.6579 | 51.14 | -22.37 | 28.77 | 43.50 | -14.73 | peak | 100 | 125 |
| 4 | 406.7819 | 50.83 | -17.57 | 33.26 | 46.00 | -12.74 | peak | 200 | 178 |
| 5 | 628.8935 | 46.45 | -12.07 | 34.38 | 46.00 | -11.62 | peak | 100 | 255 |
| 6 | 850.7603 | 40.82 | -7.97 | 32.85 | 46.00 | -13.15 | peak | 200 | 236 |

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value

| Test Channel | Channel 0 | Frequency Range | 30MHz ~ 1GHz |
|---|---|---|---|
| Detector Function | Peak (PK)<br>Quasi-peak (QP) | Tested By | Jim Xu |

Antennal Polarity& Test Distance: Vertical at 3m




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 31.0728 | 54.40 | -22.65 | 31.75 | 40.00 | -8.25 | peak | 300 | 236 |
| 2 | 33.8066 | 54.12 | -22.64 | 31.48 | 40.00 | -8.52 | peak | 200 | 125 |
| 3 | 165.4716 | 54.01 | -18.70 | 35.31 | 43.50 | -8.19 | peak | 100 | 51 |
| 4 | 406.7820 | 52.88 | -17.57 | 35.31 | 46.00 | -10.69 | peak | 200 | 196 |
| 5 | 628.8936 | 50.37 | -12.07 | 38.30 | 46.00 | -7.70 | peak | 100 | 47 |
| 6 | 875.0131 | 44.55 | -7.41 | 37.14 | 46.00 | -8.86 | peak | 200 | 288 |

Remarks:

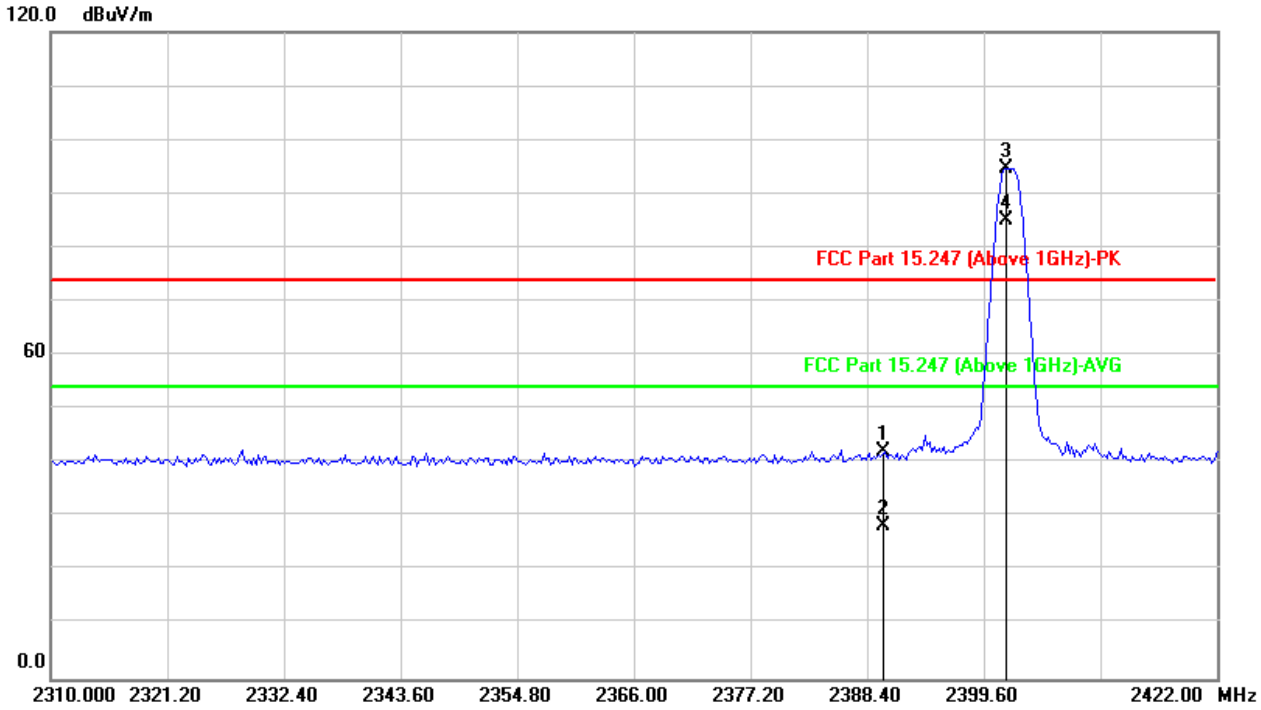
1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value

**Above 1GHz Data:**

**BLE-1Mbps**

| Test channel | Channel 0 | Frequency Range | 1GHz ~ 25GHz |
|---|---|---|---|
| Detector Function | Peak (PK)<br>Average (AVG) | Tested By | King Ye |

Antennal Polarity& Test distance: Horizontal at 3 M



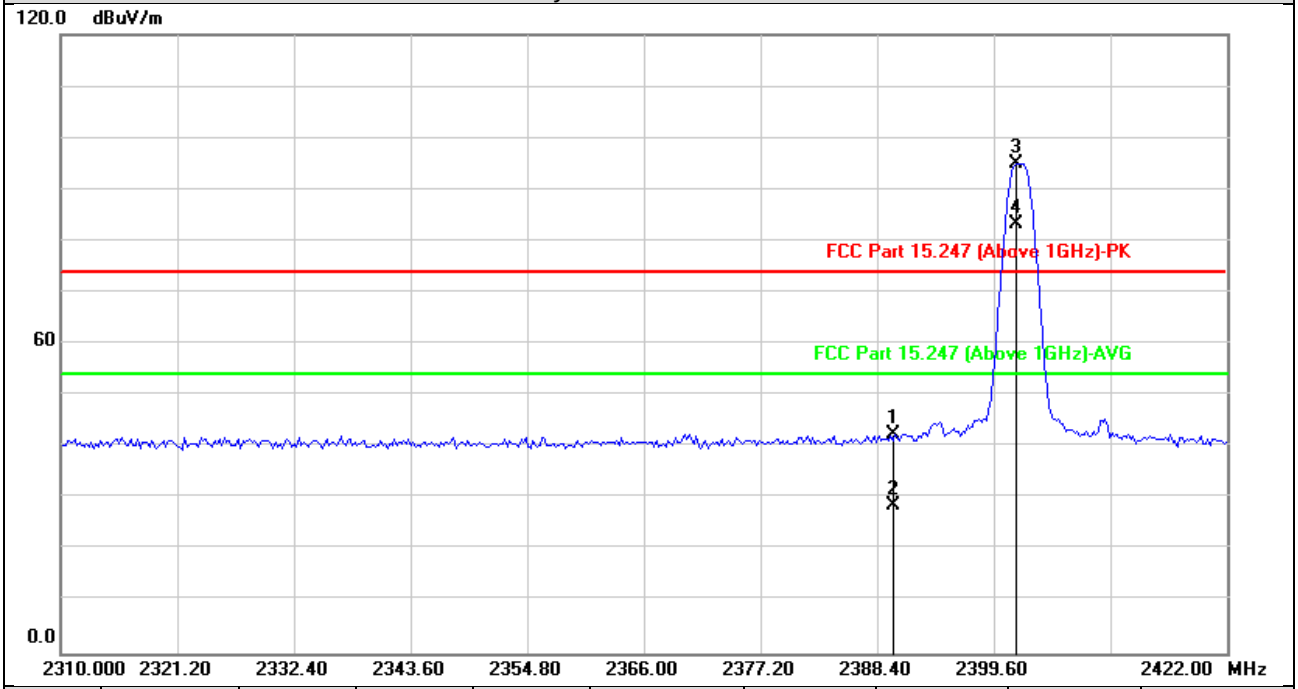

| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2390.000 | 41.50 | 0.69 | 42.19 | 74.00 | -31.81 | peak | 352 | 47 |
| 2 | 2390.000 | 27.79 | 0.69 | 28.48 | 54.00 | -25.52 | AVG | 352 | 47 |
| 3 # | 2401.800 | 94.05 | 0.70 | 94.75 | | | peak | 352 | 47 |
| 4 # | 2401.800 | 84.39 | 0.70 | 85.09 | | | AVG | 352 | 47 |
| 5 | 4804.000 | 35.94 | 7.10 | 43.04 | 74.00 | -30.96 | peak | 100 | 317 |
| 6 | 4804.000 | 23.87 | 7.10 | 30.97 | 54.00 | -23.03 | AVG | 100 | 317 |
| 7 | 7206.000 | 34.89 | 12.08 | 46.97 | 74.00 | -27.03 | peak | 100 | 76 |
| 8 | 7206.000 | 23.71 | 12.08 | 35.79 | 54.00 | -18.21 | AVG | 100 | 76 |

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2402MHz: Fundamental frequency.

| Test channel | Channel 0 | Frequency Range | 1GHz ~ 25GHz |
|---|---|---|---|
| Detector Function | Peak (PK)<br>Average (AVG) | Tested By | Jim Xu |

Antennal Polarity& Test Distance: Vertical at 3m




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2390.000 | 41.77 | 0.69 | 42.46 | 74.00 | -31.54 | peak | 290 | 297 |
| 2 | 2390.000 | 27.99 | 0.69 | 28.68 | 54.00 | -25.32 | AVG | 290 | 297 |
| 3 # | 2401.800 | 94.26 | 0.70 | 94.96 | | | peak | 290 | 297 |
| 4 # | 2401.800 | 82.61 | 0.70 | 83.31 | | | AVG | 290 | 297 |
| 5 | 4804.000 | 34.42 | 7.10 | 41.52 | 74.00 | -32.48 | peak | 100 | 56 |
| 6 | 4804.000 | 24.48 | 7.10 | 31.58 | 54.00 | -22.42 | AVG | 100 | 56 |
| 7 | 7206.000 | 32.51 | 12.08 | 44.59 | 74.00 | -29.41 | peak | 100 | 166 |
| 8 | 7206.000 | 21.88 | 12.08 | 33.96 | 54.00 | -20.04 | AVG | 100 | 166 |

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2402MHz: Fundamental frequency.

| Test channel | Channel 19 | Frequency Range | 1GHz ~ 25GHz |
|---|---|---|---|
| Detector Function | Peak (PK)<br>Average (AVG) | Tested By | Jim Xu |

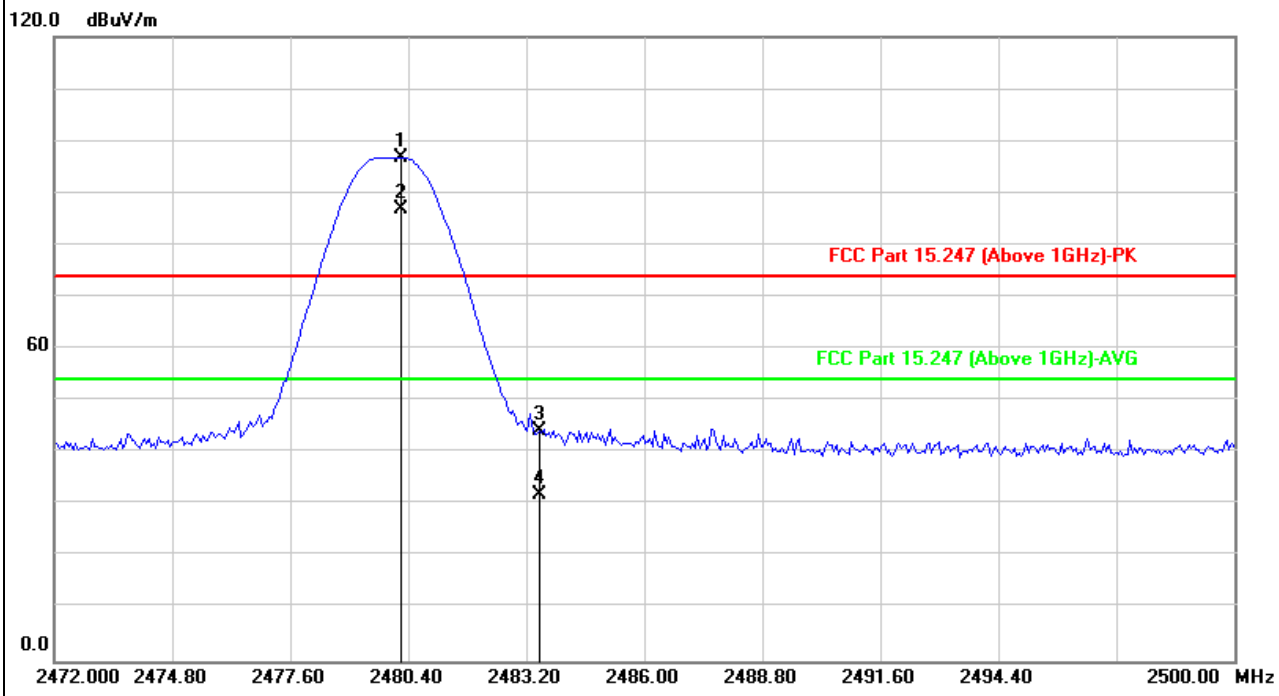
| Antennal Polarity& Test Distance: Horizontal at 3m | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
| 1# | 2440.000 | 96.39 | 0.76 | 97.15 | | | peak | 216 | 187 |
| 2# | 2440.000 | 85.55 | 0.76 | 86.31 | | | AVG | 216 | 187 |
| 3 | 4880.000 | 35.33 | 7.33 | 42.66 | 74.00 | -31.34 | peak | 100 | 258 |
| 4 | 4880.000 | 24.19 | 7.33 | 31.52 | 54.00 | -22.48 | AVG | 100 | 258 |
| 5 | 7320.000 | 34.72 | 12.26 | 46.98 | 74.00 | -27.02 | peak | 100 | 115 |
| 6 | 7320.000 | 19.88 | 12.26 | 32.14 | 54.00 | -21.86 | AVG | 100 | 115 |
| Antennal Polarity& Test Distance: Vertical at 3 M | | | | | | | | | |
| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
| 1# | 2440.000 | 98.98 | 0.76 | 99.74 | | | peak | 150 | 164 |
| 2# | 2440.000 | 88.55 | 0.76 | 89.31 | | | AVG | 150 | 164 |
| 3 | 4880.000 | 35.84 | 7.33 | 43.17 | 74.00 | -30.83 | peak | 100 | 285 |
| 4 | 4880.000 | 25.45 | 7.33 | 32.78 | 54.00 | -21.22 | AVG | 100 | 285 |
| 5 | 7320.000 | 33.88 | 12.26 | 46.14 | 74.00 | -27.86 | peak | 100 | 211 |
| 6 | 7320.000 | 19.31 | 12.26 | 31.57 | 54.00 | -22.43 | AVG | 100 | 211 |

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2440MHz: Fundamental frequency.

| Test channel | Channel 39 | Frequency Range | 1GHz ~ 25GHz |
|---|---|---|---|
| Detector Function | Peak (PK)<br>Average (AVG) | Tested By | Jim Xu |

Antennal Polarity& Test Distance: Horizontal at 3 M



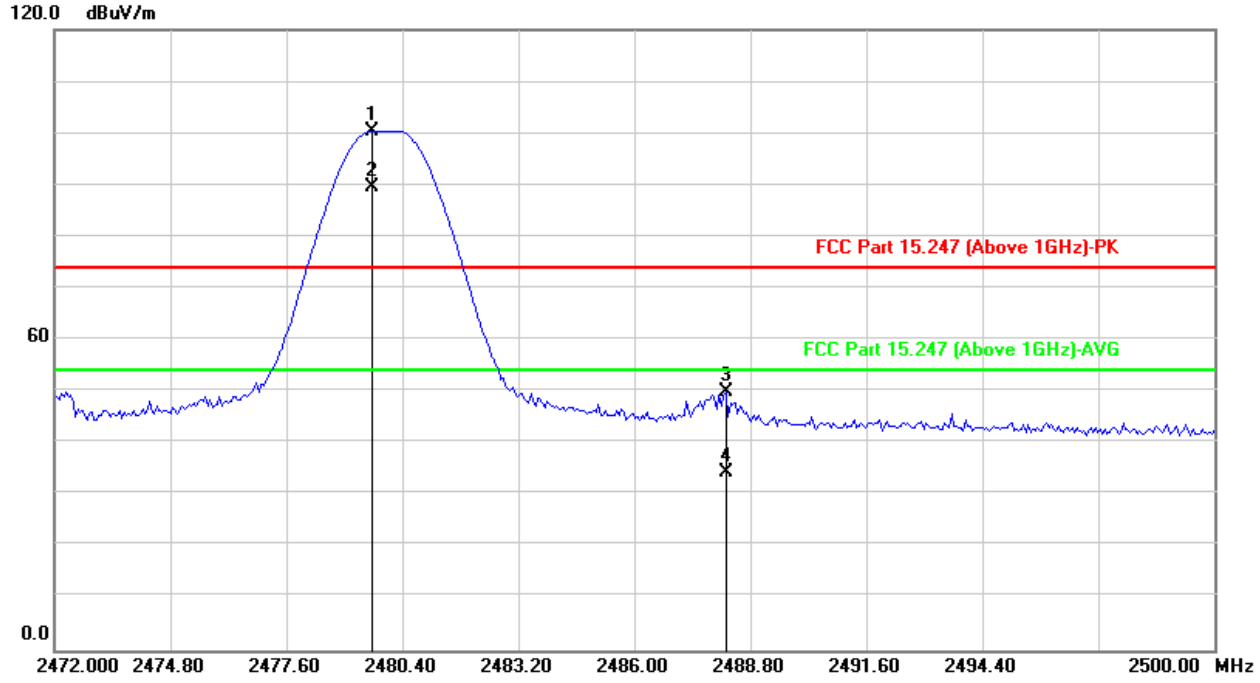

| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
|---|---|---|---|---|---|---|---|---|---|
| 1# | 2480.249 | 95.95 | 0.84 | 96.79 | | | peak | 388 | 110 |
| 2# | 2480.249 | 86.06 | 0.84 | 86.90 | | | AVG | 388 | 110 |
| 3 | 2483.500 | 43.53 | 0.84 | 44.37 | 74.00 | -29.63 | peak | 388 | 110 |
| 4 | 2483.500 | 31.08 | 0.84 | 31.92 | 54.00 | -22.08 | AVG | 388 | 110 |
| 5 | 4960.000 | 36.56 | 7.56 | 44.12 | 74.00 | -29.88 | peak | 100 | 34 |
| 6 | 4960.000 | 24.85 | 7.56 | 32.41 | 54.00 | -21.59 | AVG | 100 | 34 |
| 7 | 7440.000 | 31.97 | 12.43 | 44.40 | 74.00 | -29.60 | peak | 100 | 161 |
| 8 | 7440.000 | 21.17 | 12.43 | 33.60 | 54.00 | -20.40 | AVG | 100 | 161 |

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2480MHz: Fundamental frequency.

| Test channel | Channel 39 | Frequency Range | 1GHz ~ 25GHz |
|---|---|---|---|
| Detector Function | Peak (PK)<br>Average (AVG) | Tested By | Jim Xu |

Antennal Polarity& Test Distance: Vertical at 3 M




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
|---|---|---|---|---|---|---|---|---|---|
| 1# | 2479.687 | 99.62 | 0.84 | 100.46 | | | peak | 388 | 346 |
| 2# | 2479.687 | 88.61 | 0.84 | 89.45 | | | AVG | 388 | 346 |
| 3 | 2488.216 | 49.08 | 0.84 | 49.92 | 74.00 | -24.08 | peak | 388 | 346 |
| 4 | 2488.216 | 33.37 | 0.84 | 34.21 | 54.00 | -19.79 | AVG | 388 | 346 |
| 5 | 4960.000 | 35.33 | 7.56 | 42.89 | 74.00 | -31.11 | peak | 100 | 222 |
| 6 | 4960.000 | 25.38 | 7.56 | 32.94 | 54.00 | -21.06 | AVG | 100 | 222 |
| 7 | 7440.000 | 29.64 | 12.43 | 42.07 | 74.00 | -31.93 | peak | 100 | 65 |
| 8 | 7440.000 | 19.96 | 12.43 | 32.39 | 54.00 | -21.61 | AVG | 100 | 65 |

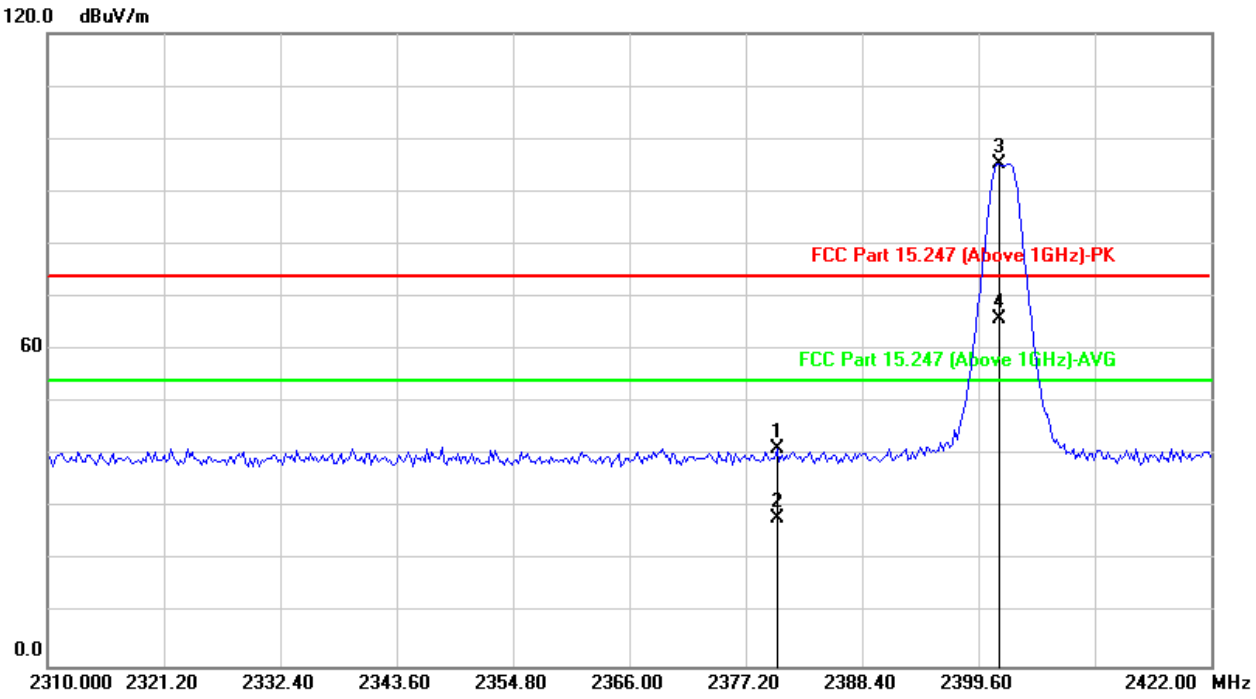
Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2480MHz: Fundamental frequency.

## BLE-2Mbps

| Test channel | Channel 0 | Frequency Range | 1GHz ~ 25GHz |
|---|---|---|---|
| Detector Function | Peak (PK)<br>Average (AVG) | Tested By | King Ye |

Antennal Polarity& Test distance: Horizontal at 3 M



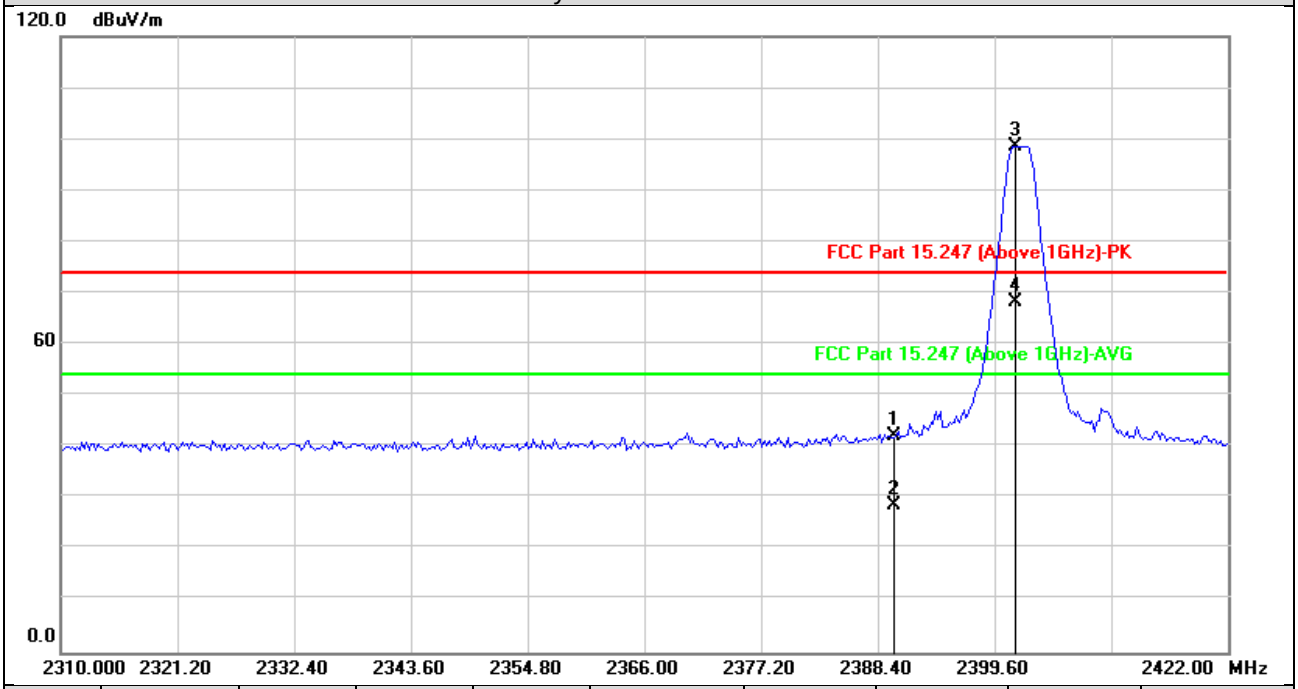

| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2380.253 | 40.70 | 0.68 | 41.38 | 74.00 | -32.62 | peak | 363 | 114 |
| 2 | 2380.253 | 27.34 | 0.68 | 28.02 | 54.00 | -25.98 | AVG | 363 | 114 |
| 3 # | 2401.575 | 94.56 | 0.70 | 95.26 | | | peak | 363 | 114 |
| 4 # | 2401.575 | 65.24 | 0.70 | 65.94 | | | AVG | 363 | 114 |
| 5 | 4804.000 | 33.57 | 7.10 | 40.67 | 74.00 | -33.33 | peak | 100 | 195 |
| 6 | 4804.000 | 22.36 | 7.10 | 29.46 | 54.00 | -24.54 | AVG | 100 | 195 |
| 7 | 7206.000 | 32.79 | 12.08 | 44.87 | 74.00 | -29.13 | peak | 100 | 218 |
| 8 | 7206.000 | 21.43 | 12.08 | 33.51 | 54.00 | -20.49 | AVG | 100 | 218 |

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2402MHz: Fundamental frequency.

| Test channel | Channel 0 | Frequency Range | 1GHz ~ 25GHz |
|---|---|---|---|
| Detector Function | Peak (PK)<br>Average (AVG) | Tested By | Jim Xu |

Antennal Polarity& Test Distance: Vertical at 3m




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2390.000 | 41.40 | 0.69 | 42.09 | 74.00 | -31.91 | peak | 366 | 16 |
| 2 | 2390.000 | 27.87 | 0.69 | 28.56 | 54.00 | -25.44 | AVG | 366 | 16 |
| 3 # | 2401.575 | 97.97 | 0.70 | 98.67 | | | peak | 366 | 16 |
| 4 # | 2401.575 | 67.64 | 0.70 | 68.34 | | | AVG | 366 | 16 |
| 5 | 4804.000 | 34.04 | 7.10 | 41.14 | 74.00 | -32.86 | peak | 100 | 248 |
| 6 | 4804.000 | 22.31 | 7.10 | 29.41 | 54.00 | -24.59 | AVG | 100 | 248 |
| 7 | 7206.000 | 32.09 | 12.08 | 44.17 | 74.00 | -29.83 | peak | 100 | 184 |
| 8 | 7206.000 | 21.65 | 12.08 | 33.73 | 54.00 | -20.27 | AVG | 100 | 184 |

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2402MHz: Fundamental frequency.

| Test channel | Channel 19 | Frequency Range | 1GHz ~ 25GHz |
|---|---|---|---|
| Detector Function | Peak (PK)<br>Average (AVG) | Tested By | Jim Xu |

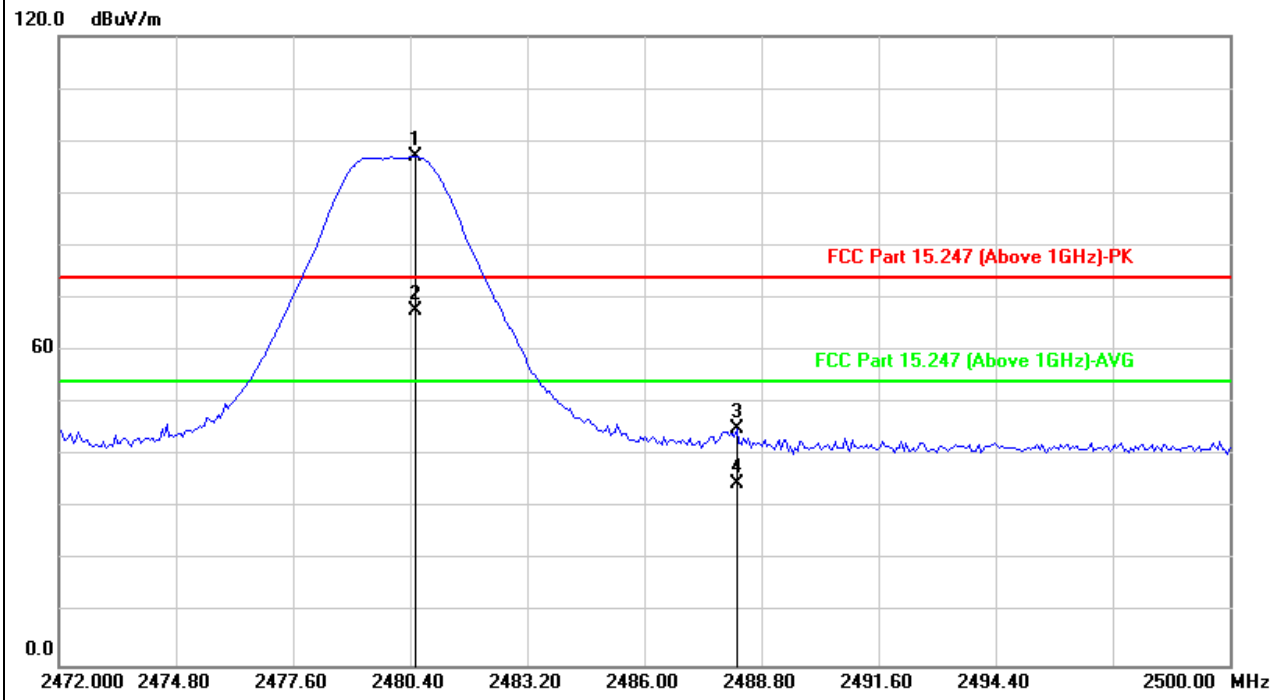
| Antennal Polarity& Test Distance: Horizontal at 3m | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
| 1# | 2440.000 | 96.05 | 0.76 | 96.81 | | | peak | 157 | 103 |
| 2# | 2440.000 | 66.05 | 0.76 | 66.81 | | | AVG | 157 | 103 |
| 3 | 4880.000 | 34.62 | 7.33 | 41.95 | 74.00 | -32.05 | peak | 100 | 84 |
| 4 | 4880.000 | 23.39 | 7.33 | 30.72 | 54.00 | -23.28 | AVG | 100 | 84 |
| 5 | 7320.000 | 32.92 | 12.26 | 45.18 | 74.00 | -28.82 | peak | 100 | 211 |
| 6 | 7320.000 | 19.51 | 12.26 | 31.77 | 54.00 | -22.23 | AVG | 100 | 211 |
| Antennal Polarity& Test Distance: Vertical at 3 M | | | | | | | | | |
| No. | Frequency (MHz) | Reading (dBuV) | Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
| 1# | 2440.000 | 99.36 | 0.76 | 100.12 | | | peak | 216 | 195 |
| 2# | 2440.000 | 68.41 | 0.76 | 69.17 | | | AVG | 216 | 195 |
| 3 | 4880.000 | 34.82 | 7.33 | 42.15 | 74.00 | -31.85 | peak | 100 | 175 |
| 4 | 4880.000 | 23.31 | 7.33 | 30.64 | 54.00 | -23.36 | AVG | 100 | 175 |
| 5 | 7320.000 | 33.02 | 12.26 | 45.28 | 74.00 | -28.72 | peak | 100 | 158 |
| 6 | 7320.000 | 20.30 | 12.26 | 32.56 | 54.00 | -21.44 | AVG | 100 | 158 |

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2440MHz: Fundamental frequency.

| Test channel | Channel 39 | Frequency Range | 1GHz ~ 25GHz |
|---|---|---|---|
| Detector Function | Peak (PK)<br>Average (AVG) | Tested By | Jim Xu |

Antennal Polarity& Test Distance: Horizontal at 3 M



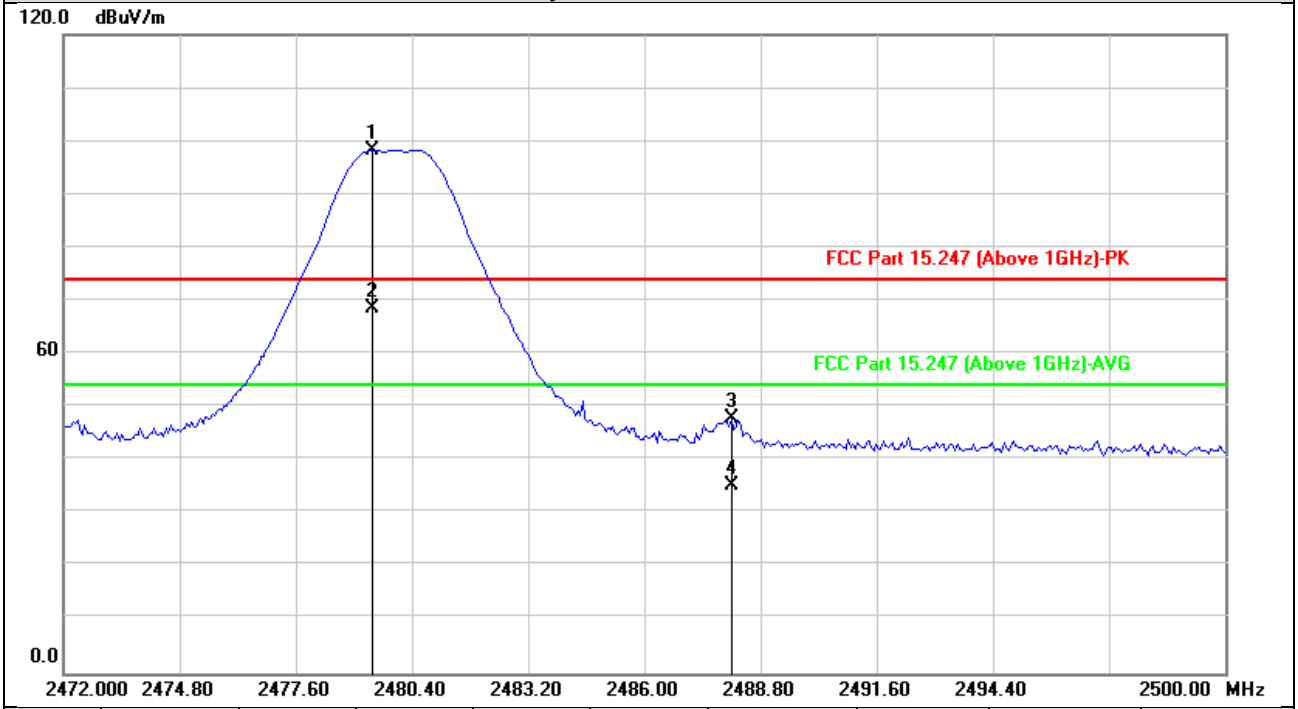

| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
|---|---|---|---|---|---|---|---|---|---|
| 1# | 2480.529 | 96.13 | 0.84 | 96.97 | | | peak | 388 | 109 |
| 2# | 2480.529 | 66.78 | 0.84 | 67.62 | | | AVG | 388 | 109 |
| 3 | 2488.216 | 44.43 | 0.84 | 45.27 | 74.00 | -28.73 | peak | 388 | 109 |
| 4 | 2488.216 | 33.75 | 0.84 | 34.59 | 54.00 | -19.41 | AVG | 388 | 109 |
| 5 | 4960.000 | 33.58 | 7.56 | 41.14 | 74.00 | -32.86 | peak | 100 | 264 |
| 6 | 4960.000 | 22.52 | 7.56 | 30.08 | 54.00 | -23.92 | AVG | 100 | 264 |
| 7 | 7440.000 | 32.48 | 12.43 | 44.91 | 74.00 | -29.09 | peak | 100 | 187 |
| 8 | 7440.000 | 21.70 | 12.43 | 34.13 | 54.00 | -19.87 | AVG | 100 | 187 |

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2480MHz: Fundamental frequency.

| Test channel | Channel 39 | Frequency Range | 1GHz ~ 25GHz |
|---|---|---|---|
| Detector Function | Peak (PK)<br>Average (AVG) | Tested By | Jim Xu |

Antennal Polarity& Test Distance: Vertical at 3 M




| No. | Frequency (MHz) | Reading (dBuV) | Correct Factor (dB) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Height (cm) | Table Angle (Degree) |
|---|---|---|---|---|---|---|---|---|---|
| 1# | 2479.463 | 97.44 | 0.84 | 98.28 | | | peak | 357 | 293 |
| 2# | 2479.463 | 67.73 | 0.84 | 68.57 | | | AVG | 327 | 293 |
| 3 | 2488.104 | 47.08 | 0.84 | 47.92 | 74.00 | -26.08 | peak | 357 | 293 |
| 4 | 2488.104 | 34.56 | 0.84 | 35.40 | 54.00 | -18.60 | AVG | 327 | 293 |
| 5 | 4960.000 | 34.62 | 7.56 | 42.18 | 74.00 | -31.82 | peak | 100 | 184 |
| 6 | 4960.000 | 23.28 | 7.56 | 30.84 | 54.00 | -23.16 | AVG | 100 | 184 |
| 7 | 7440.000 | 32.93 | 12.43 | 45.36 | 74.00 | -28.64 | peak | 100 | 229 |
| 8 | 7440.000 | 22.22 | 12.43 | 34.65 | 54.00 | -19.35 | AVG | 100 | 229 |

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2480MHz: Fundamental frequency.

## 3.2 Conducted Emission Measurement

### 3.2.1 Limits of Conducted Emission Measurement

| Frequency (MHz) | Conducted Limit (dBuV) | |
|---|---|---|
| | Quasi-Peak | Average |
| 0.15 - 0.5 | 66 - 56 | 56 - 46 |
| 0.50 - 5.0 | 56 | 46 |
| 5.0 - 30.0 | 60 | 50 |

Note: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to0.50MHz.

### 3.2.2 Test Instruments

| Description & Manufacturer | Model No. | Serial No. | Due Date of Calibration |
|---|---|---|---|
| EMI Test Receiver Rohde&Schwarz | ESCI3 | 101418 | 2022/09/12 |
| Artificial Mains Network Rohde&Schwarz | ENV216 | 3560.6550.15 | 2022/09/12 |
| Test software FARAD | EZ_EMC V1.1.4.2 | N/A | N/A |

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.
2. The test was performed in Shielded Room 1.

### 3.2.3 Test Procedures

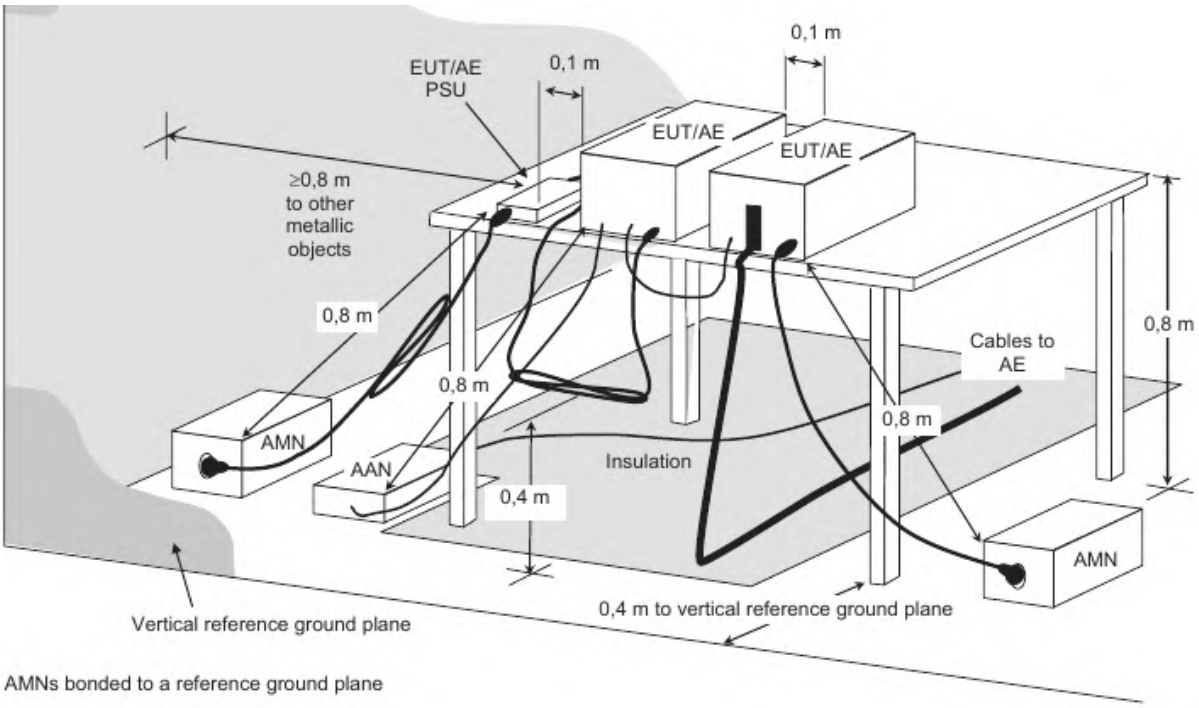
a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50uH of coupling impedance for the measuring instrument.
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit –20dB) was not recorded.

**Note:** All modes of operation were investigated and the worst-case emissions are reported.

### 3.2.4 Deviation from Test Standard

No deviation.

3.2.5 Test setup




3.2.6 EUT Operating Conditions

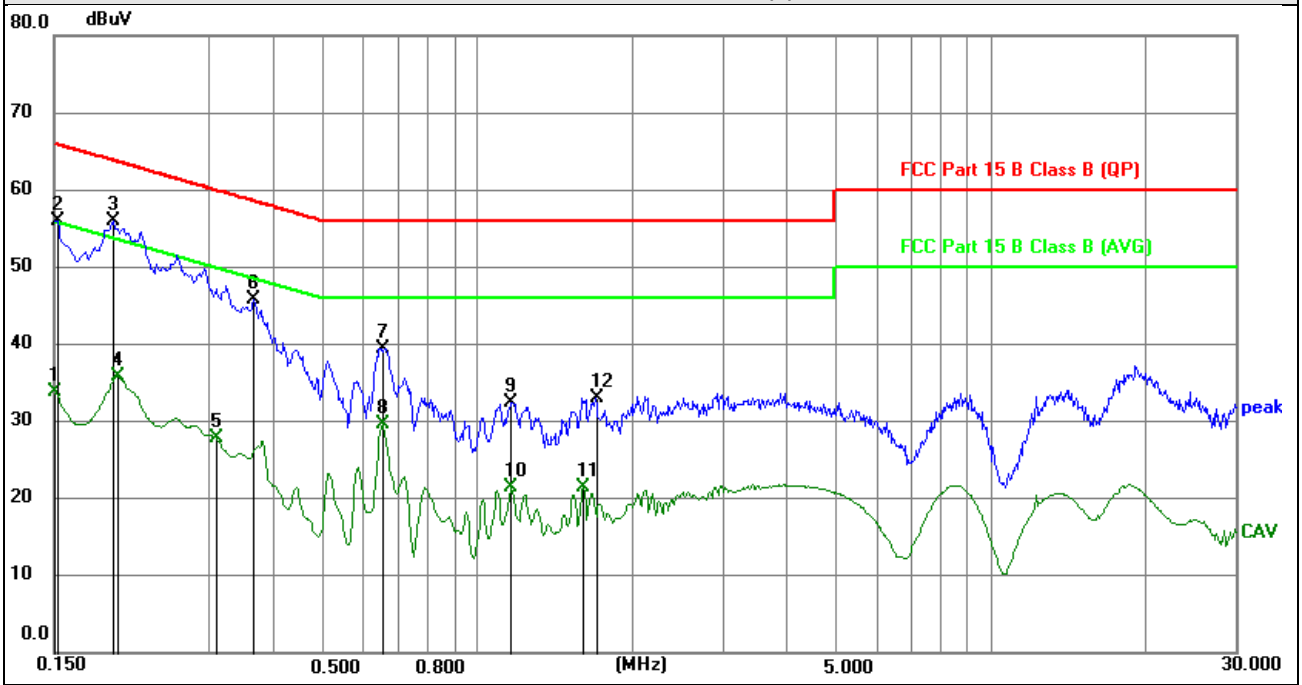
a. Placed the EUT on the testing table.

b. Set the EUT under transmission condition continuously at specific channel frequency.

3.2.7 Test Results

| | | | |
|---|---|---|---|
| Frequency Range | 150kHz ~ 30MHz | Detector Function & Resolution bandwidth | Quasi-Peak (QP) / Average (AV), 9kHz |
| Power supply | AC 120V/60Hz | Environmental Conditions | 26℃, 60%RH |

Phase of Power: Line (L)



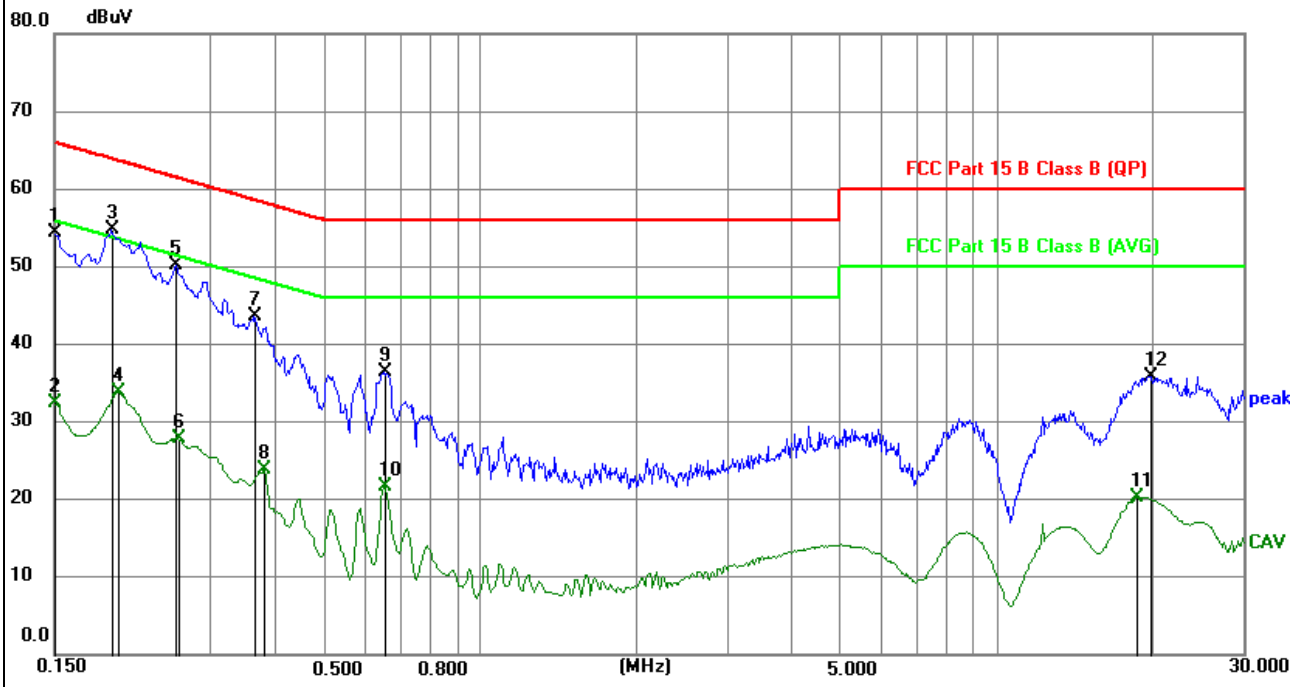

| No | Frequency | Reading | Correction Factor | Emission Level | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | dB | (dBuV) | (dBuV) | (dB) | Detector |
| 1 | 0.1500 | 23.53 | 10.19 | 33.72 | 56.00 | -22.28 | AVG |
| 2 | 0.1522 | 45.75 | 10.18 | 55.93 | 65.88 | -9.95 | peak |
| 3 | 0.1949 | 45.73 | 10.14 | 55.87 | 63.83 | -7.96 | peak |
| 4 | 0.1995 | 25.68 | 10.14 | 35.82 | 53.63 | -17.81 | AVG |
| 5 | 0.3097 | 17.70 | 10.19 | 27.89 | 49.98 | -22.09 | AVG |
| 6 | 0.3682 | 35.58 | 10.14 | 45.72 | 58.54 | -12.82 | peak |
| 7 | 0.6540 | 29.31 | 10.11 | 39.42 | 56.00 | -16.58 | peak |
| 8 | 0.6561 | 19.43 | 10.11 | 29.54 | 46.00 | -16.46 | AVG |
| 9 | 1.1692 | 22.42 | 10.05 | 32.47 | 56.00 | -23.53 | peak |
| 10 | 1.1692 | 11.33 | 10.05 | 21.38 | 46.00 | -24.62 | AVG |
| 11 | 1.6125 | 11.34 | 10.07 | 21.41 | 46.00 | -24.59 | AVG |
| 12 | 1.7003 | 23.00 | 10.08 | 33.08 | 56.00 | -22.92 | peak |

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

| | | | |
|---|---|---|---|
| Frequency Range | 150kHz ~ 30MHz | Detector Function & Resolution bandwidth | Quasi-Peak (QP) / Average (AV), 9kHz |
| Power supply | AC 120V/60Hz | Environmental Conditions | 26℃, 60%RH |

Phase of Power: Neutral (N)




| No. | Frequency | Reading | Correction Factor | Emission Level | Limit | Margin | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBuV) | dB | (dBuV) | (dBuV) | (dB) | Detector |
| 1 | 0.1500 | 44.09 | 10.19 | 54.28 | 66.00 | -11.72 | peak |
| 2 | 0.1500 | 22.22 | 10.19 | 32.41 | 56.00 | -23.59 | AVG |
| 3 | 0.1928 | 44.59 | 10.15 | 54.74 | 63.92 | -9.18 | peak |
| 4 | 0.1995 | 23.73 | 10.14 | 33.87 | 53.63 | -19.76 | AVG |
| 5 | 0.2580 | 40.10 | 10.16 | 50.26 | 61.50 | -11.24 | peak |
| 6 | 0.2602 | 17.67 | 10.16 | 27.83 | 51.43 | -23.60 | AVG |
| 7 | 0.3660 | 33.50 | 10.12 | 43.62 | 58.59 | -14.97 | peak |
| 8 | 0.3817 | 13.81 | 10.10 | 23.91 | 48.24 | -24.33 | AVG |
| 9 | 0.6540 | 26.36 | 10.10 | 36.46 | 56.00 | -19.54 | peak |
| 10 | 0.6561 | 11.53 | 10.10 | 21.63 | 46.00 | -24.37 | AVG |
| 11 | 18.6788 | 9.93 | 10.36 | 20.29 | 50.00 | -29.71 | AVG |
| 12 | 19.7678 | 25.48 | 10.40 | 35.88 | 60.00 | -24.12 | peak |

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

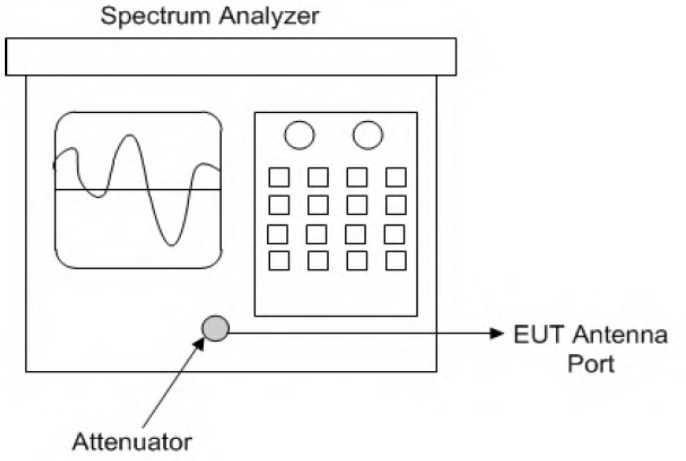
## 3.3 6dB Bandwidth Measurement

### 3.3.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5MHz.

### 3.3.2 Test Setup

Subclause 11.8 of ANSI C63.10 is applicable.




Spectrum analyzer test configuration

### 3.3.3 Test Instruments

Refer to section 5 to get information of above instrument.

### 3.3.4 Test Procedure

Option 1:

a. Set resolution bandwidth (RBW) = 30kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW
c. Detector = Peak.
d. Trace mode = max hold.
e. Sweep = auto couple.
f. Allow the trace to stabilize.
g. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

Option 2:

The automatic bandwidth measurement capability of an instrument may be employed using the dB bandwidth mode with *X* set to 6 dB. if the functionality described in 11.8.1 (i.e. RBW= 100 kHz. VBW ≥ 3*RBW. and peak detector with maximum hold) is implemented by the instrumentation function. When using this capability. care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥6 dB

3.3.5 Deviation from Test Standard

No deviation.

3.3.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.3.7 Test Result

Down 6dB

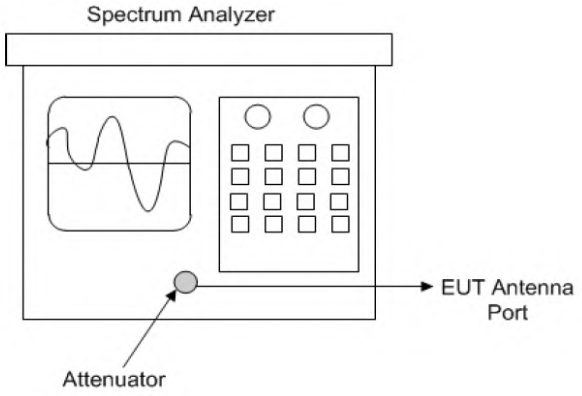
| BLE-1Mbps | | | |
|---|---|---|---|
| Operation Channel | Frequency | Bandwidth (MHz) | |
| | | Result | Limit |
| 0 | 2402MHz | 0.756 | >0.5 |
| 19 | 2440MHz | 0.700 | >0.5 |
| 39 | 2480MHz | 0.684 | >0.5 |

| BLE-2Mbps | | | |
|---|---|---|---|
| Operation Channel | Frequency | Down 6dB Bandwidth (MHz) | |
| | | Result | Limit |
| 0 | 2402MHz | 1.232 | >0.5 |
| 19 | 2440MHz | 1.272 | >0.5 |
| 39 | 2480MHz | 1.248 | >0.5 |

| BLE 1Mbps | BLE 2Mbps |
|---|---|
| | |
| CH0 | CH0 |
| | |
| CH19 | CH19 |
| | |
| CH39 | CH39 |

## 3.4 Occupied Bandwidth Measurement

### 3.4.1 Test Setup




### 3.4.2 Test Instruments

Refer to section 5 to get information of above instrument.

### 3.4.3 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to peak. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 %of the total mean power of a given emission.

### 3.4.4 Deviation from Test Standard

No deviation.

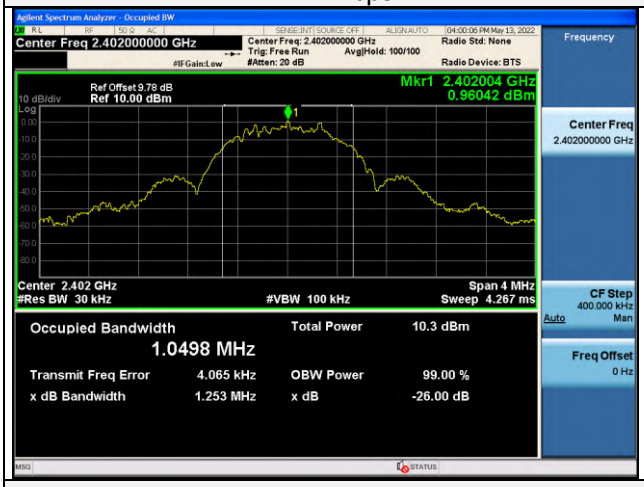
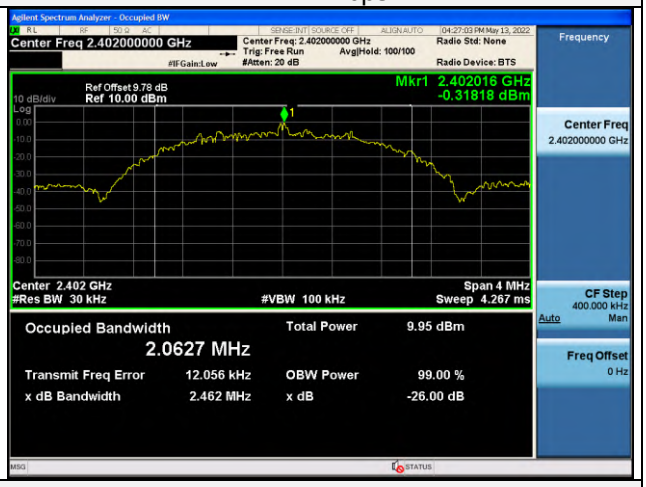
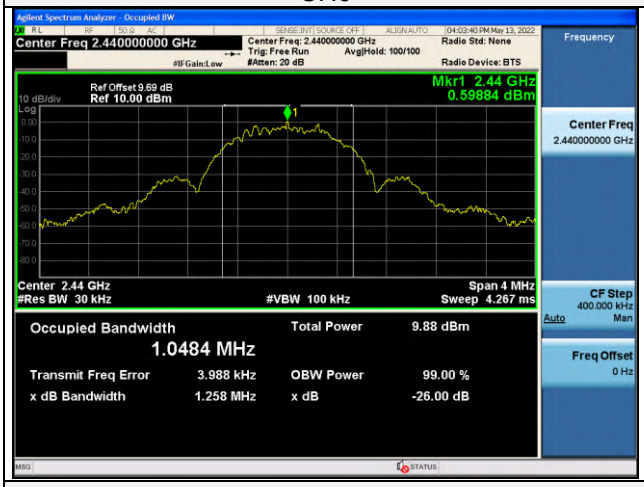
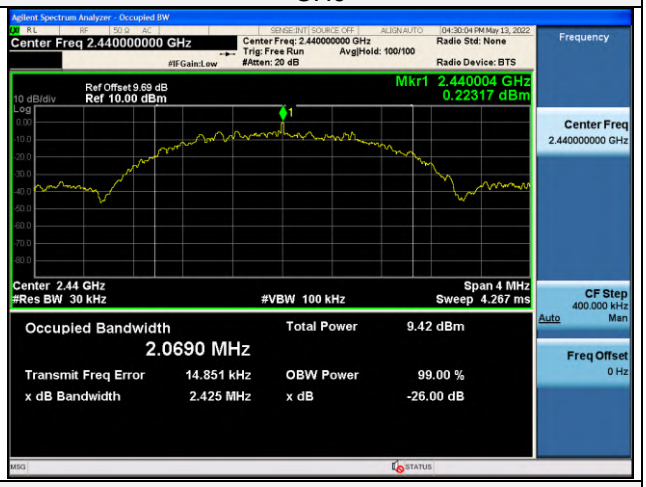
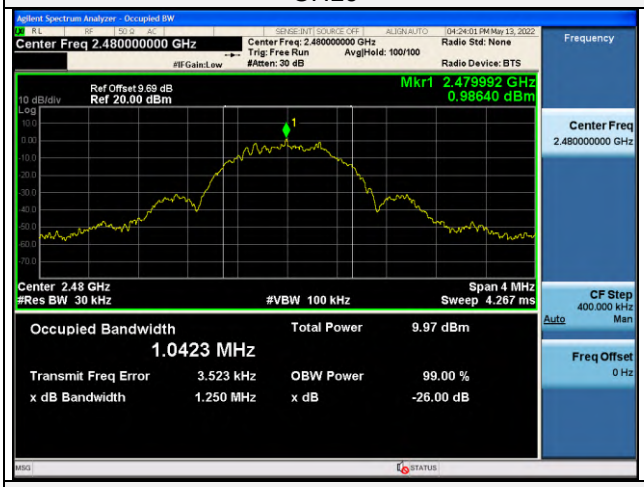
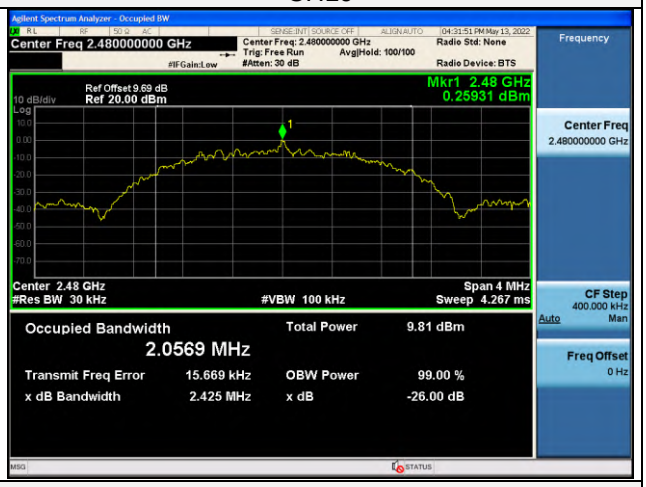
### 3.4.5 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.4.6 Test Results

| BLE-1Mbps | | | |
|---|---|---|---|
| Operation Channel | Frequency | Occupied Bandwidth (MHz) | |
| | | Result | Limit |
| 0 | 2402MHz | 1.0498 | 2400~2483.5 |
| 19 | 2440MHz | 1.0484 | 2400~2483.5 |
| 39 | 2480MHz | 1.0423 | 2400~2483.6 |

| BLE-2Mbps | | | |
|---|---|---|---|
| Operation Channel | Frequency | Occupied Bandwidth (MHz) | |
| | | Result | Limit |
| 0 | 2402MHz | 2.0627 | 2400~2483.5 |
| 19 | 2440MHz | 2.0690 | 2400~2483.5 |
| 39 | 2480MHz | 2.0569 | 2400~2483.6 |

| BLE 1Mbps | BLE 2Mbps |
|---|---|
|  |  |
| CH0 | CH0 |
|  |  |
| CH19 | CH19 |
|  |  |
| CH39 | CH39 |

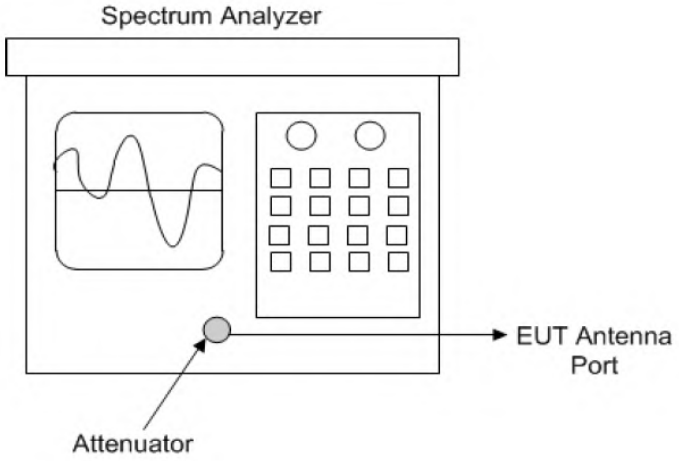
## 3.5 Conducted Output Power Measurement

### 3.5.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

### 3.5.2 Test Setup

- Measurement using a spectrum analyzer (SA) Subclause 11.9.2.2 of ANSI C63.10 is applicable




Spectrum analyzer output power test configuration

### 3.5.3 Test Instruments

Refer to section 5 to get information of above instrument.

### 3.5.4 Test Procedures

Measurement using a spectrum analyzer (SA)，Selection of test method：

The proper test method is selected based on the following criteria:

a) **Method AVGSA-1 or method AVGSA-1A (alternative)** shall be applied if either of the following conditions can be satisfied:
1) The EUT transmits continuously (or with a D> 98%).
2) Sweep triggering can be implemented in such a way that the device transmits at the maximum power control level throughout the duration of each of the instrument sweeps to be averaged. This condition can generally be achieved by triggering the instrument's sweep if the duration of the sweep (with the instrument configured as in method AVGSA-1) is equal to or shorter than the duration T of each transmission from the EUT, and if those transmissions exhibit full power throughout their durations.

b) **Method AVGSA-2 or method AVGSA-2A (alternative)** shall be applied if the conditions of the preceding item a) cannot be achieved and the transmissions exhibit a constant duty cycle during the measurement duration. Duty cycle will be considered to be constant if variations are less than +2%.

c) **Method AVGSA-3 or method AVGSA-3A** (alternative) shall be applied if the conditions of the preceding item a) and item b) cannot be achieved.

**Method AVGSA-3 or method AVGSA-3A:**

a) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b) Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
c) SA Setting:
1* Set span to at least 1.5 times the OBW
2* Set sweep trigger to "free run."
3* Set RBW= 1% to 5% of the OBW. not to exceed 1MHz.
4* Set VBW ≥ 3 x RBW
5* Number of points in sweep≥ 2 x span /RBW. (This gives bin-to-bin spacing ≤ RBW / 2. so that narrowband signals are not lost between frequency bins).
6* Sweep time ≤ (number of points in sweep) x T. where T is defined in 11.6. If this gives a sweep time less than the auto sweep time of the instrument. then method AVGSA-3 shall not be used (use AVGSA-3A). The purpose of this step is so that the averaging time in each bin is less than or equal to the minimum time of a transmission.
7* Detector =RMS (power averaging).
8* Trace mode =max hold.
9* Allow max hold to run for at least 60 s or longer as needed to allow the trace to stabilize.
10* Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function. then sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW
d. Measure the captured power within the band and recording the plot.
e. Repeat above procedures until all frequencies required were complete.

### 3.5.5 Deviation from Test Standard

No deviation.

### 3.5.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

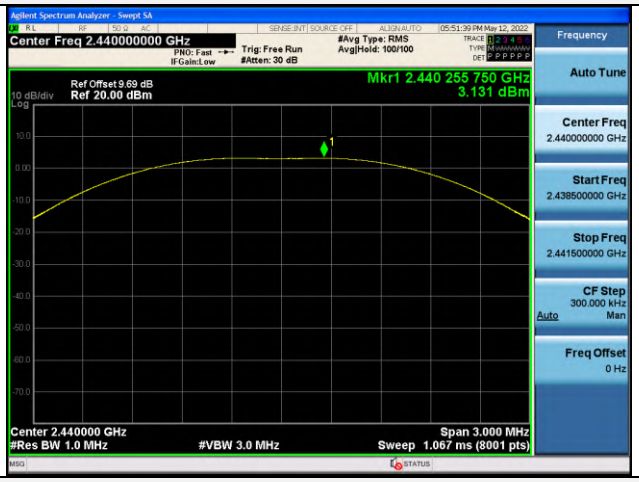
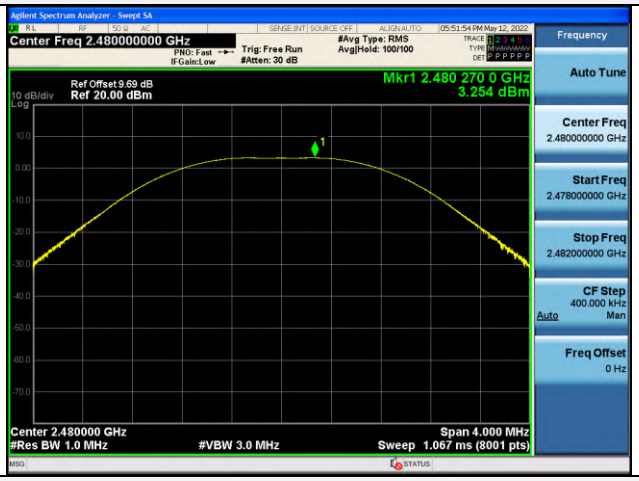
3.5.7 Test Results

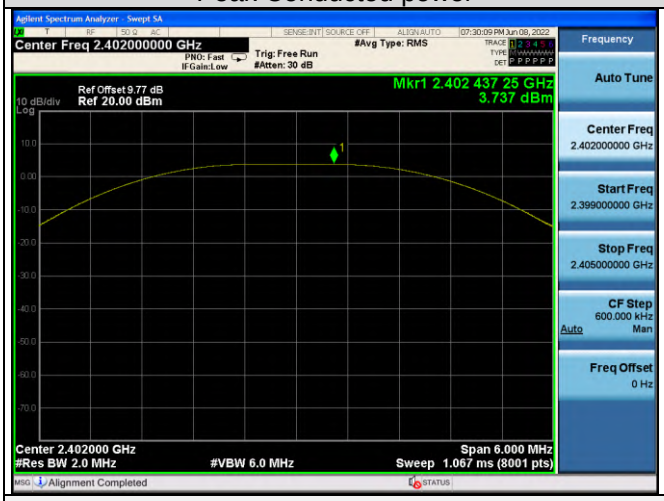
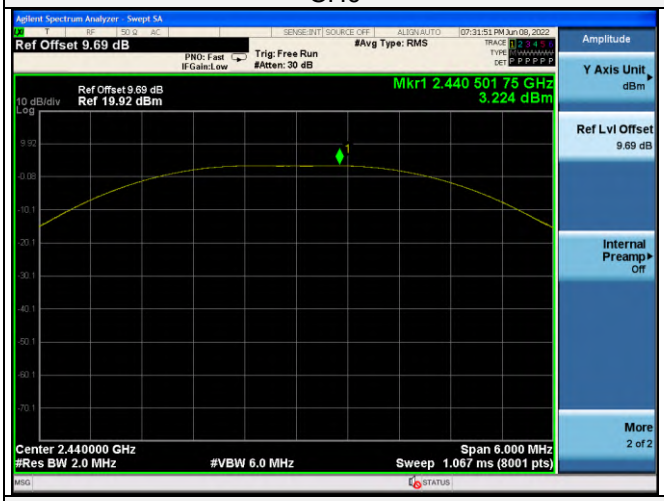
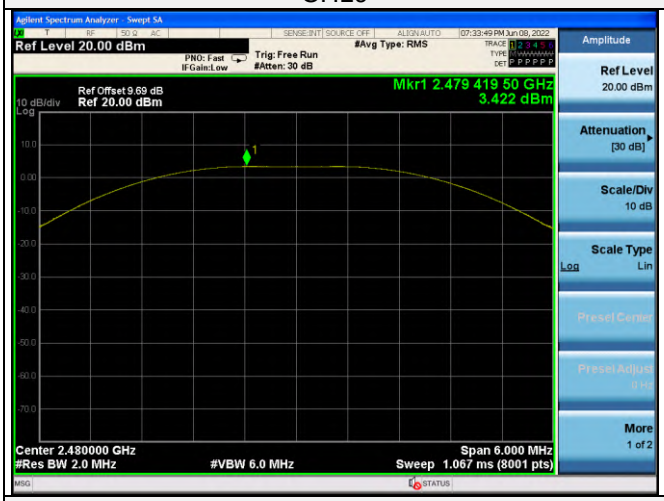
| BLE-1Mbps | | | | | | |
|---|---|---|---|---|---|---|
| Peak Power | | | | | | |
| Channel | Freq. | RF Output Power | | Limit (mW) | | Verdict |
| No. | (MHz) | (dBm) | (mW) | Rss-247 | FCC | |
| 0 | 2402 | 3.545 | 2.262 | <125 | <1000 | Pass |
| 19 | 2440 | 3.131 | 2.056 | <125 | <1000 | Pass |
| 39 | 2480 | 3.254 | 2.115 | <125 | <1000 | Pass |

| Average Power | | | | | | |
|---|---|---|---|---|---|---|
| Channel | Freq. | RF Output Power | | Limit (mW) | | Verdict |
| No. | (MHz) | (dBm) | (mW) | Rss-247 | FCC | |
| 0 | 2402 | -1.207 | 0.757 | <125 | <1000 | Pass |
| 19 | 2440 | -1.442 | 0.717 | <125 | <1000 | Pass |
| 39 | 2480 | -0.973 | 0.799 | <125 | <1000 | Pass |

| BLE-2Mbps | | | | | | |
|---|---|---|---|---|---|---|
| Peak Power | | | | | | |
| Channel | Freq. | RF Output Power | | Limit (mW) | | Verdict |
| No. | (MHz) | (dBm) | (mW) | Rss-247 | FCC | |
| 0 | 2402 | **3.737** | 2.364 | <125 | <1000 | Pass |
| 19 | 2440 | 3.224 | 2.101 | <125 | <1000 | Pass |
| 39 | 2480 | 3.422 | 2.199 | <125 | <1000 | Pass |

| Average Power | | | | | | |
|---|---|---|---|---|---|---|
| Channel | Freq. | RF Output Power | | Limit (mW) | | Verdict |
| No. | (MHz) | (dBm) | (mW) | Rss-247 | FCC | |
| 0 | 2402 | 0.098 | 1.023 | <125 | <1000 | Pass |
| 19 | 2440 | -0.201 | 0.955 | <125 | <1000 | Pass |
| 39 | 2480 | 0.576 | 1.142 | <125 | <1000 | Pass |

| BLE-1Mbps | |
|---|---|
| Peak Conducted power | Average Conducted power |
| | |
| CH0 | CH0 |
|  | |
| CH19 | CH19 |
|  | |
| CH39 | CH39 |

| BLE-2Mbps | |
|---|---|
| Peak Conducted power | Average Conducted power |
|  | |
| CH0 | CH0 |
|  | |
| CH19 | CH19 |
|  | |
| CH39 | CH39 |

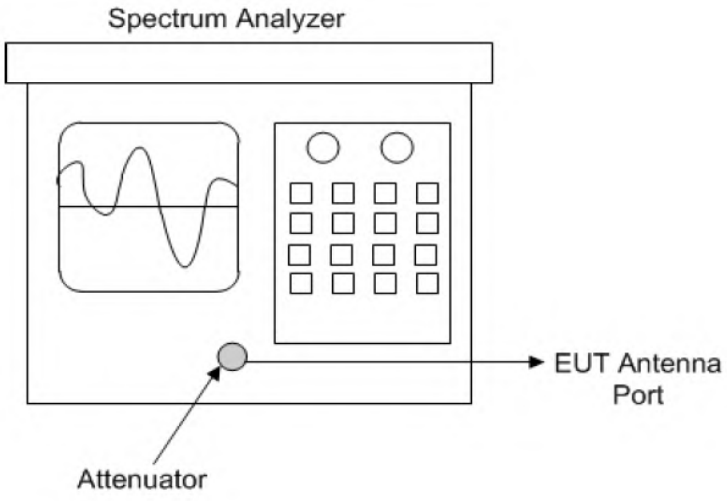
## 3.6 Power Spectral Density Measurement

### 3.6.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm/3kHz.

### 3.6.2 Test Setup

- DTS maximum power spectral density level in the fundamental emission Subclause 11.10 of ANSI C63.10 is applicable




Spectrum analyzer test configuration

### 3.6.3 Test Instruments

Refer to section 5 to get information of above instrument.

3.6.4 Test Procedure

a. **Method AVGPSD-1 or method AVGPSD-1A (alternative)** shall be applied if either of the following conditions can be satisfied:
   1) The EUT transmits continuously (or with a D ≥98%).
   2) Sweep triggering can be implemented in such a way that the device transmits at the maximum power control level throughout the duration of each of the instrument sweeps to be averaged. This condition can generally be achieved by triggering the instrument's sweep if the duration of the sweep is equal to or shorter than the duration I of each transmission from the EUT, and if those transmissions exhibit full power throughout these durations.

b. **Method AVGPSD-2 or method AVGPSD-2A (alternative)** shall be applied if the conditions of the preceding item a) cannot be achieved. and the transmissions exhibit a constant duty cycle during the measurement duration. Duty cycle will be considered to be constant if variations are less than ±2%.

c. **Method AVGPSD-3 or method AVGPSD-3A (alternative)** shall be applied if the conditions of the preceding paragraphs a) and b) cannot be achieved.

**Method AVGPSD-3:**

Method AVGPSD-3 uses mms detection across ON and OFE times of the EUT with max hold. The following procedure is applicable when the EUT cannot be configured to transmit continuously (i.e. D<98%), when sweep triggering/signal gating cannot be used to measure only when the EUT is transmitting at its maximum power control level. and when the transmission duty cycle is not constant (i.e., duty cycle variations exceed ±2%),

SA Setting:

a. Set the instrument span to a minimum of 1.5 times the OBW.
b. Set sweep trigger to "free run."
c. Set the RBW = 3 kHz, VBW =10 kHz,
d. Detector = RMS (power averaging).
e. Sweep time = Auto couple,
f. Allow max hold to run for at least 60 s or longer as needed to allow the trace to stabilize.
g. Use the peak marker function to determine the maximum PSD level

- If the measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced).

3.6.5 Deviation from Test Standard

No deviation.

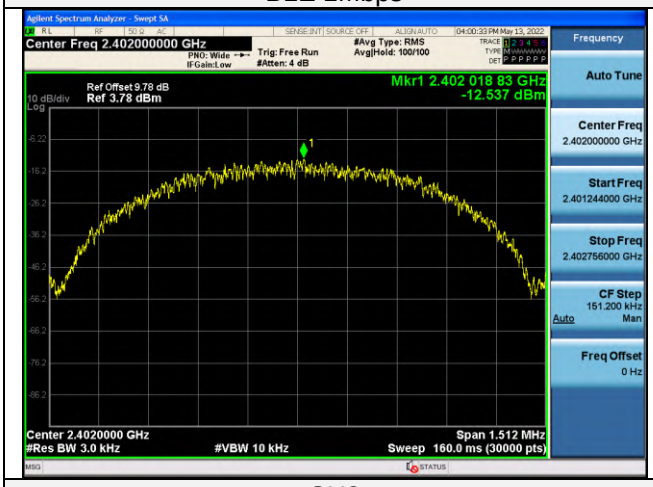
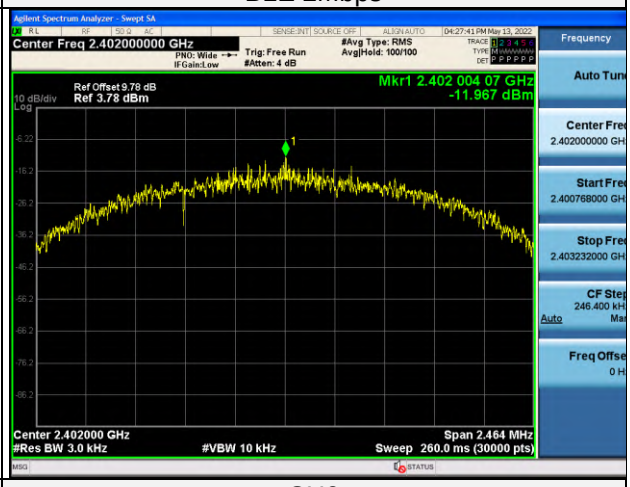
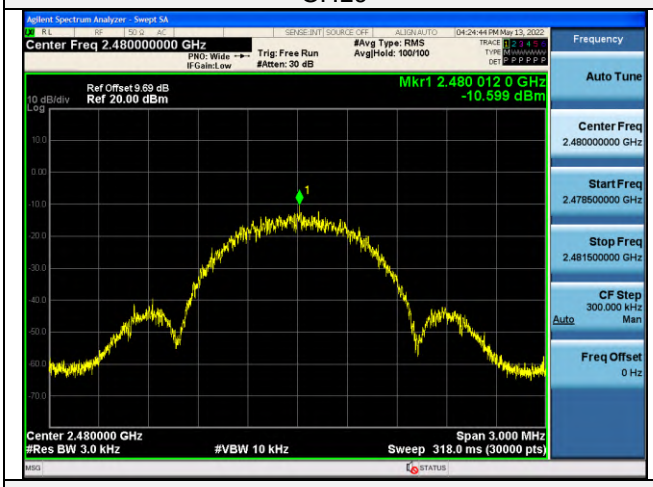
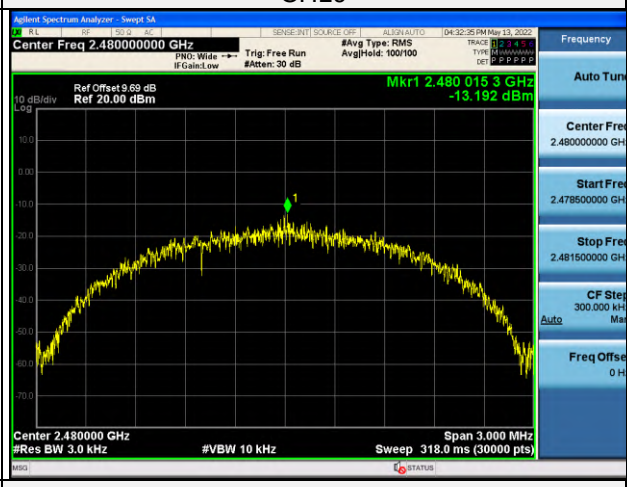
3.6.6 EUT Operating Condition

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.6.7 Test Results

| BLE-1Mbps | Power Density | | |
|---|---|---|---|
| Test Channel | Channel Frequency | Test Result (dBm/3kHz) | Limit (dBm/3kHz) |
| 0 | 2402MHz | -12.537 | <8 |
| 19 | 2440MHz | -12.681 | <8 |
| 39 | 2480MHz | -10.599 | <8 |

| BLE-2Mbps | Power Density | | |
|---|---|---|---|
| Test Channel | Channel Frequency | Test Result (dBm/3kHz) | Limit (dBm/3kHz) |
| 0 | 2402MHz | -11.967 | <8 |
| 19 | 2440MHz | -13.992 | <8 |
| 39 | 2480MHz | -13.192 | <8 |

| BLE 1Mbps | BLE 2Mbps |
|---|---|
|  |  |
| CH0 | CH0 |
| | |
| CH19 | CH19 |
|  |  |
| CH39 | CH39 |

## 3.7 Conducted Out of Band Emission Measurement

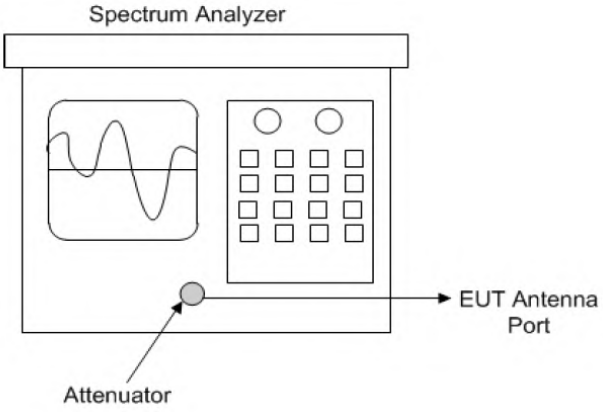
### 3.7.1 Limits of Conducted Out of Band Emission Measurement

a. **If the maximum peak conducted output power procedure was used to determine compliance as described in 11.9.1**, then the peak output power 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 (i.e., 20 dBc).

b. **If maximum conducted (average) output power was used to determine compliance as described in 11.9.2**. then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).

### 3.7.2 Test Setup

- DTS emissions in non-restricted frequency bands Subclause 11.11 of ANSI C63.10 is applicable.
- DTS emissions in restricted frequency bands Subclause 11.12 of ANSI C63.10 is applicable




Spectrum analyzer test configuration

### 3.7.3 Test Instruments

Refer to section 5 to get information of above instrument.

### 3.7.4 Test Procedure

a. Establish a reference level by using the following procedure:

1) Set instrument center frequency to DTS channel center frequency.
2) Set the span to 1.5 times the DTS bandwidth)
3) Set the RBW= 100 kHz)
4) Set the VBW ≥3 x RBW
5) Detector = peak
6) Sweep time = auto coupling
7) Trace mode =max hold
8) Allow trace to fully stabilize
9) Use the peak marker function to determine the maximum PSD level.

Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

b. Establish an emission level by using the following procedure:

1) Set the center frequency and span to encompass frequency range to be measured.
2) Set the RBW = 100 kHz
3) Set the VBW ≥ 300 kHz.
4) Detector = peak.
5) Sweep time = auto couple.
6) Trace mode = max hold.
7) Allow trace to fully stabilize.
8) Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

### 3.7.5 Deviation from Test Standard

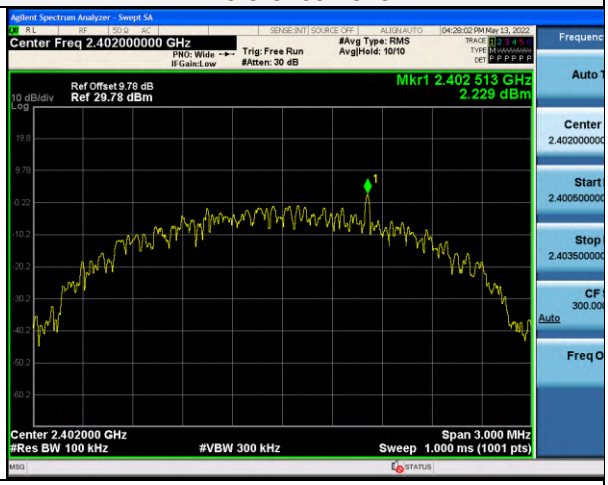
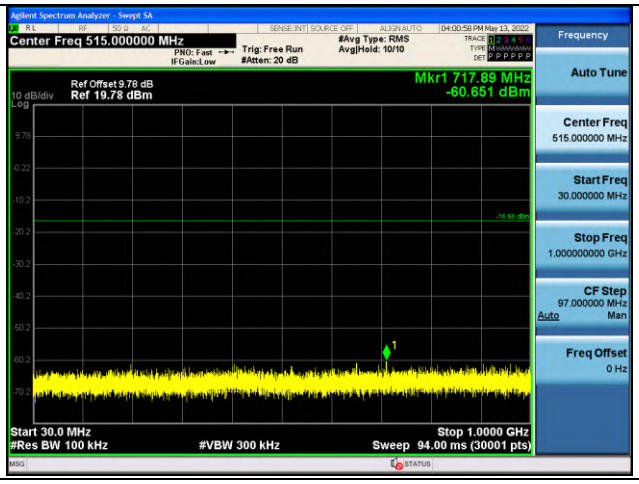
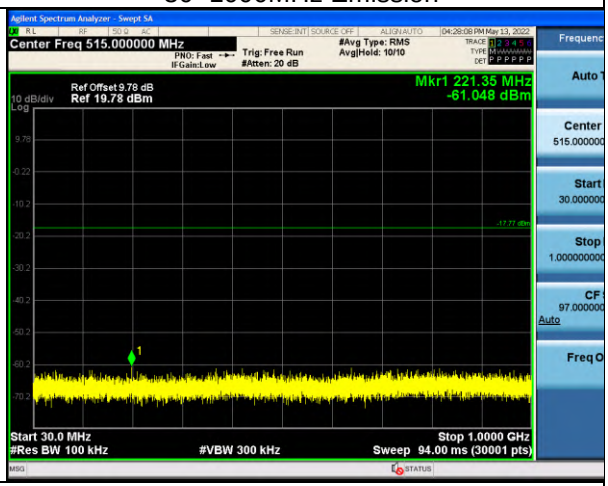
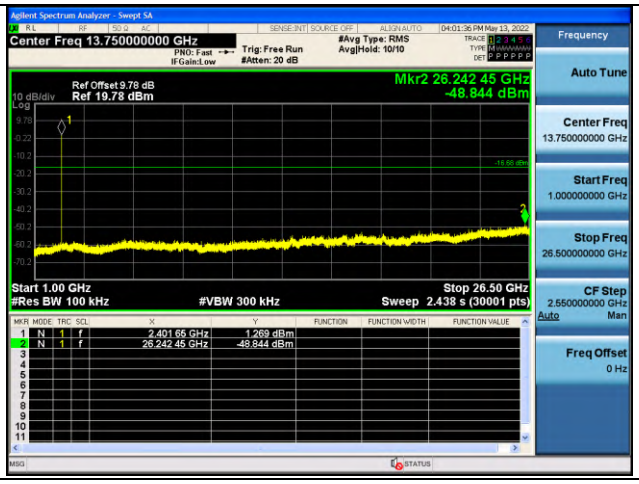
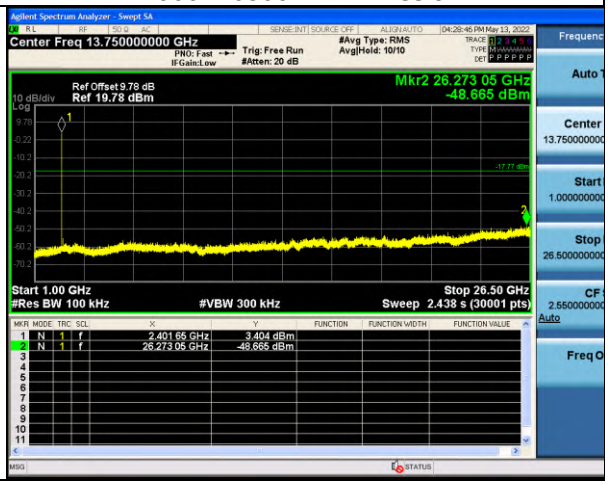
No deviation.

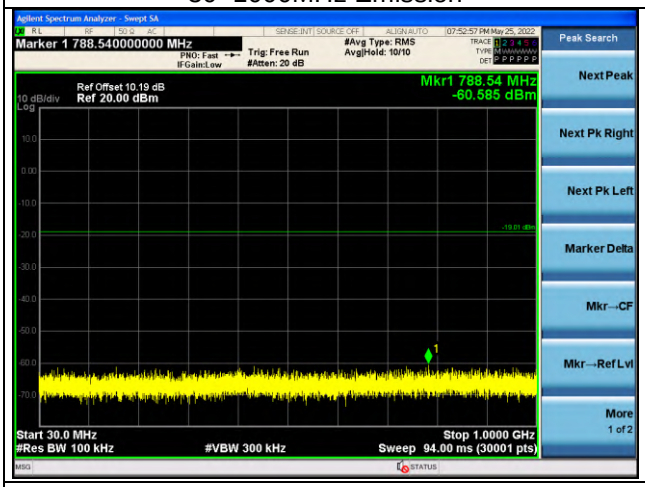
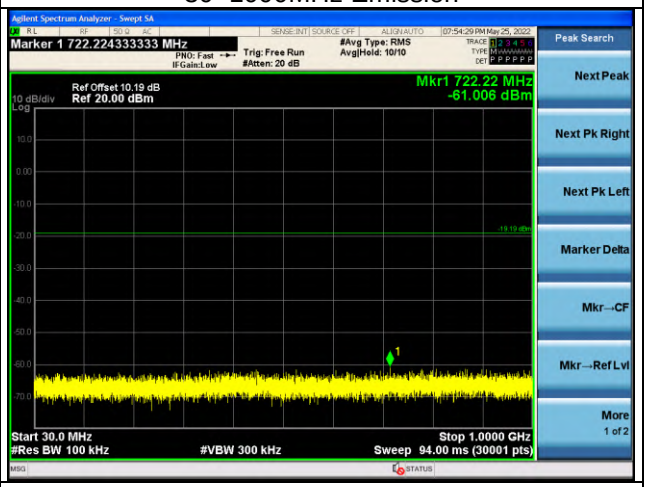
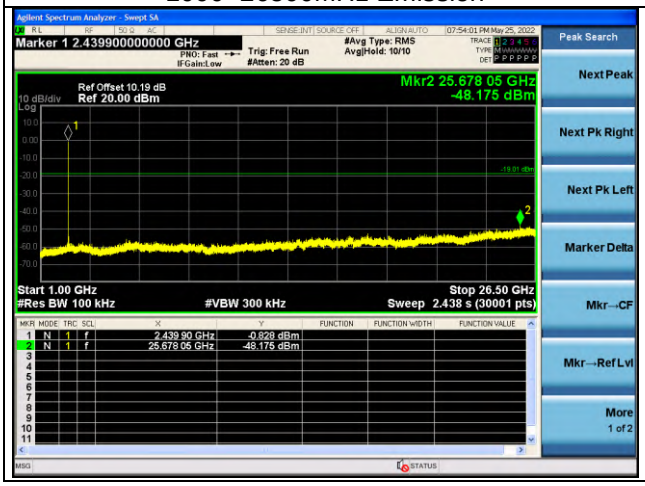
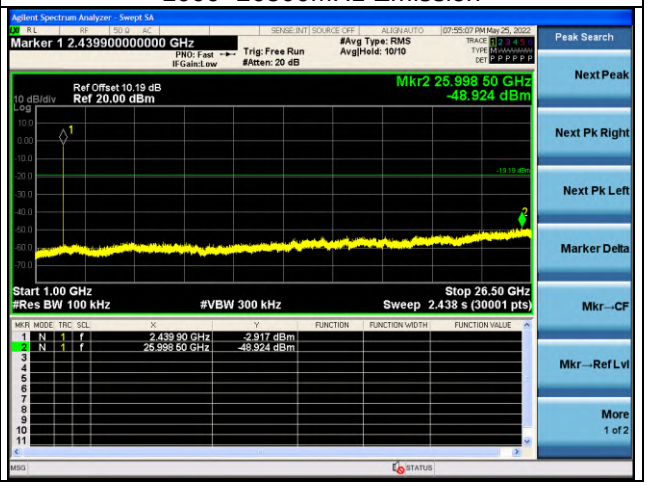
### 3.7.6 EUT Operating Condition

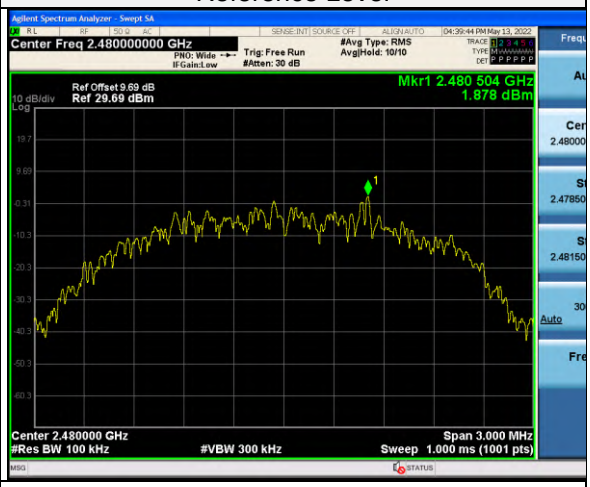
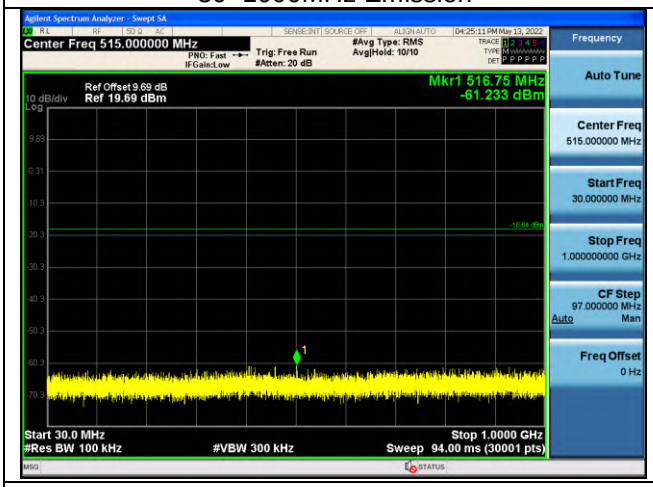
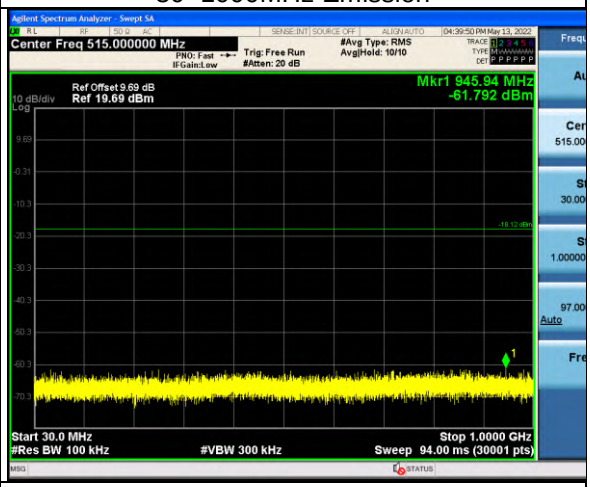
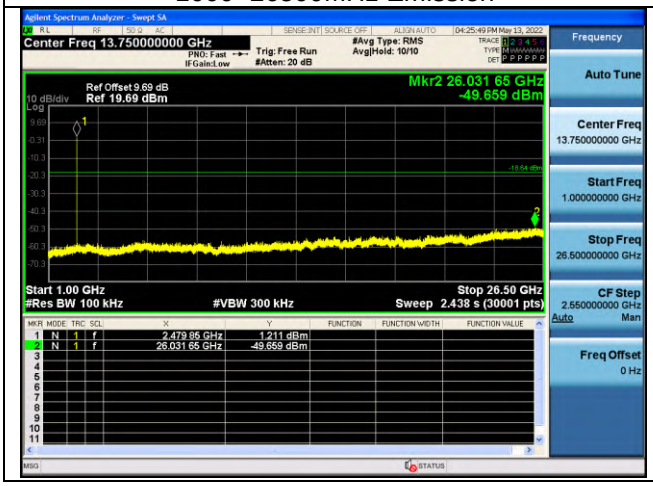
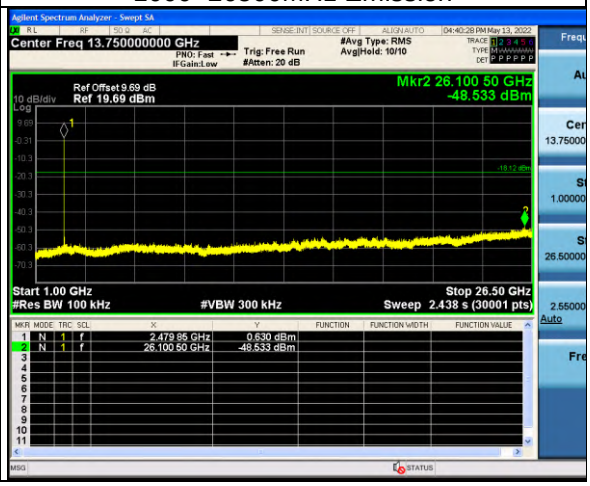
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.7.7 Test results

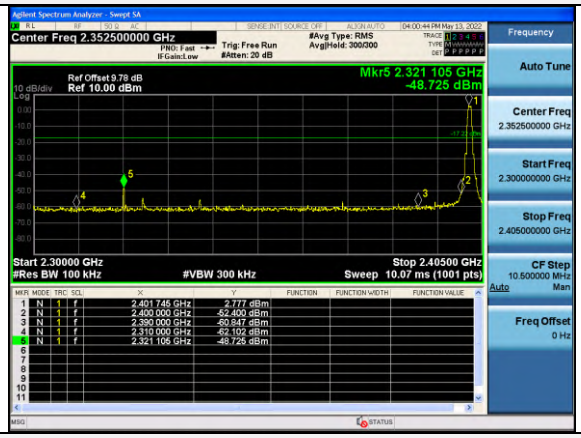
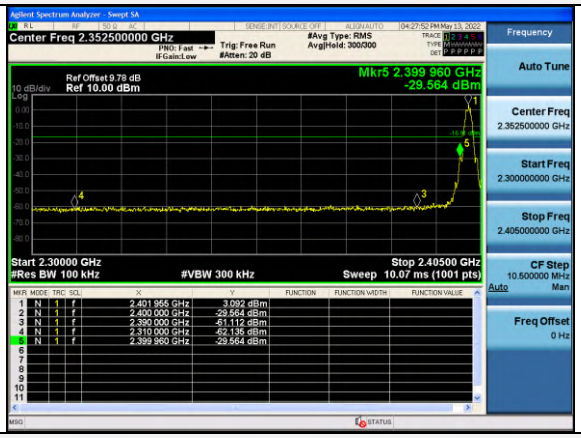
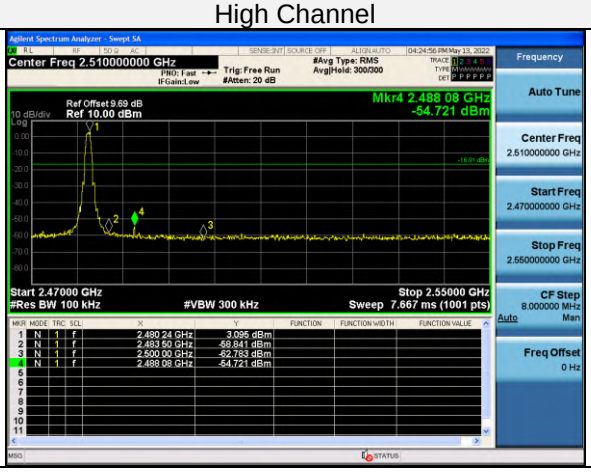
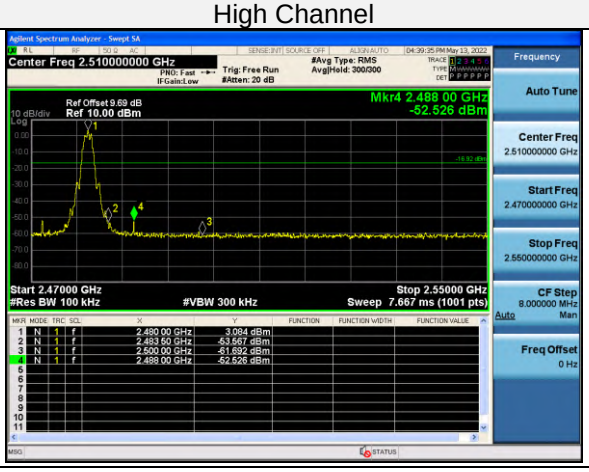
Out of band Emission

| BLE 1Mbps | BLE 2Mbps |
|---|---|
| Low Channel | Low Channel |
| Reference Level | Reference Level |
| |  |
| 30~1000MHz Emission | 30~1000MHz Emission |
|  |  |
| 1000~26500MHz Emission | 1000~26500MHz Emission |
|  |  |

| BLE 1Mbps | BLE 2Mbps |
|---|---|
| Middle Channel | Middle Channel |
| Reference Level | Reference Level |
| | |
| 30~1000MHz Emission | 30~1000MHz Emission |
|  |  |
| 1000~26500MHz Emission | 1000~26500MHz Emission |
|  |  |

| BLE 1Mbps | BLE 2Mbps |
|---|---|
| High Channel | High Channel |
| Reference Level | Reference Level |
| |  |
| 30~1000MHz Emission | 30~1000MHz Emission |
|  |  |
| 1000~26500MHz Emission | 1000~26500MHz Emission |
|  |  |

Band-edge

| BLE 1Mbps | BLE 2Mbps |
|---|---|
| Low Channel | Low Channel |
|  |  |
| High Channel | High Channel |
|  |  |

## 4. Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

## 5. Test Instruments

| Description & Manufacturer | Model No. | Serial No. | Due Date of Calibration |
|---|---|---|---|
| Spectrum<br>Keysight | N9020A | MY51240612 | 2022/09/12 |
| Spectrum Analyzer<br>Rohde&Schwarz | FSV-40N | 101783 | 2022/09/12 |
| Power Meter 10Hz~18GHz<br>Tonscend | JS0806-2 | 188060126 | 2022/09/12 |
| Signal generator<br>Keysight | E4421B | GB40051020 | 2022/09/12 |
| Signal generator<br>Keysight | N5182A | MY47420944 | 2022/09/12 |
| Test Software<br>Tonscend | JS0806-2 | NA | NA |
| Hygrothermograph<br>Yuhuaze | HTC-1 | NA | 2022/09/12 |

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.
2. The test was performed in Chamber 1.

**Appendix – Information on The Testing Laboratories**

We, Hwa-Hsing (Dongguan) Co., Ltd., A global provider of TESTING and CERTIFICATION services for consumer products, electronic products and wireless information technology products. Adhering to the core values “HONEST and TRUSTWORTHY, OBJECTIVE and IMPARTIALITY, RIGOROUS and AFFICIENT”, commitment to provide professional, perfect and efficient comprehensive ONE-STOP solution of TESTING and CERTIFICATION services for Manufacturers, Buyers, Traders, Brands, Retailers. Assist client to better manage risk, protect their brands, reduce costs and cut time to over 150 markets in global. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Lab Address: No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park, HuangJiang Town, Dongguan, China
Contact Tel: 0769-83078199
Email: Customerservice.dg@hwa-hsing.com
Web Site: www.hwa-hsing.com

**--- END ---**