

| Test Report   |   |                              |                                 |                           |                |  |
|---|---|------------------------------|---------------------------------|---------------------------|----------------|--|
| 1. Client<br>• Name :<br>• Address :  |   |                              | nnology Co., Lt<br>2, Songdogwa | d.<br>Ihak-ro, Yeonsu-gu, | Incheon, South |  |
| 2. Use of Repo  |   | FCC Appro                    | oval                            |                           |                |  |
| <ul> <li>3. Sample Desc</li> <li>• Product Nar</li> <li>• Model Name</li> </ul> | ne :  | X-POINTE<br>XPG140N          | R                               |                           |                |  |
| 4. Date of Rece   | eipt:   | 2022-10-                     | 12                              |                           |                |  |
| 5. Date of Test   | :   | 2022-10-31 ~ 2022-11-03      |                                 |                           |                |  |
| 6. Test Method  | •   | FCC Part 15 Subpart C 15.247 |                                 |                           |                |  |
| 7. Test Results   | :   | Refer to th                  | Refer to the test results       |                           |                |  |
| The results show  | This test report must not be reproduced or reproduced in any way.<br>The results shown in this test report are the results of testing the samples provided.<br>This test report is prepared according to the requirements of ISO / IEC 17025. |                              |                                 |                           |                |  |
|   | Tested b  | у                            | Yes                             | Technical Manager         | 1              |  |
| Affirmation   | Yong-M  | n, Won                       | (signature)                     | Jong-Myoung, Shin         | DelScentine)   |  |
|   |   |                              |                                 | Nov 2                     | 21, 2022       |  |
|   |   |                              | EMC Lab                         | s Co., Ltd.               | 不可以可以          |  |

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 1 / 37



36

# <u>Contents</u>

| 1.  | Applicant & Manufacturer & Test Laboratory Information        | 4  |
|-----|---|----|
| 2.  | Equipment under Test(EUT) Information                         | 5  |
| 3.  | Test Summary·····   | 6  |
| 4.  | Used equipment on test······                                  | 7  |
| 5.  | Antenna Requirement·····                                      | 8  |
| 6.  | 6 dB Bandwidth·····   | 9  |
| 7.  | Maximum Peak Output Power                                     | 13 |
| 8.  | Peak Power Spectral Density                                   | 16 |
| 9.  | TX Radiated Spurious Emission and Conducted Spurious Emission | 19 |
| 10. | Conducted Emission  | 33 |
|     | APPENDIX  |    |
| APP | ENDIX I TEST SETUP  | 34 |

APPENDIX II UNCERTAINTY .....

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 2 / 37

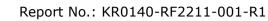


# <u>Version</u>

| TEST REPORT NO.      | DATE         | DESCRIPTION  |
|----------------------|--------------|--|
| KR0140-RF2211-001    | Nov 03, 2022 | Initial Issue  |
| KR0140-RF2211-001-R1 | Nov 21, 2022 | <ol> <li>Modified the battery type on Test<br/>Summary</li> <li>Modified the typo in DCF Calculation<br/>for Radiated Spurious Emission</li> </ol> |
|                      |              |  |

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 3 / 37

This test report shall not be reproduced except in full, Without the written approval.





# 1. Applicant & Manufacturer & Test Laboratory Information

#### 1.1 Applicant Information

| Applicant         | Chois Technology Co., Ltd.                                   |
|-------------------|--|
| Applicant Address | S-1404, 32, Songdogwahak-ro, Yeonsu-gu, Incheon, South Korea |
| Contact Person    | Daeheung, Son  |
| Telephone No.     | +82-70-5118-5568   |
| Fax No.           | +82-32-246-3406  |
| E-mail            | rnd1@choistec.com  |

#### 1.2. Manufacturer Information

| Manufacturer         | Chois Technology Co., Ltd.                                   |  |  |
|----------------------|--|--|--|
| Manufacturer Address | S-1404, 32, Songdogwahak-ro, Yeonsu-gu, Incheon, South Korea |  |  |

## 1.3 Test Laboratory Information

| Laboratory           | EMC Labs Co., Ltd.  |
|----------------------|---|
| Laboratory Address   | 100, Jangjateo-ro, Hobeop-myeon, Icheon-si, Gyeonggi-do, Republic of<br>Korea |
| Contact Person       | Yong-Min, Won   |
| Telephone No.        | +82-31-637-8895   |
| Fax No.              | +82-505-116-8895  |
| FCC Designation No.  | KR0140  |
| FCC Registration No. | 58000   |

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 4 / 37



# 2. Equipment under Test(EUT) Information

#### 2.1 General Information

| Product Name | X-POINTER  |
|--------------|------------|
| Model Name   | XPG140N    |
| FCC ID       | RVBXPG140N |
| Power Supply | DC 3.0 V   |

#### 2.2 Additional Information

| Operating Frequency 2 402 MHz ~ 2 480 MHz |                |
|---|----------------|
| Number of channel                         | 40             |
| Modulation Type GFSK                      |                |
| Antenna Type PCB Pattern Antenna          |                |
| Antenna Gain                              | -1.794 dBi     |
| Firmware Version                          | 1.0            |
| Hardware Version                          | 1.0            |
| Test software                             | nRF_DTM v2.4.0 |

#### 2.3 Test Frequency

| Test mode | Test Frequency (MHz) |                  |                |  |
|-----------|----------------------|------------------|----------------|--|
|           | Low Frequency        | Middle Frequency | High Frequency |  |
| BLE       | 2 402                | 2 442            | 2 480          |  |

#### 2.4 Used Test Software Setting Value

| Test Mode | Setting Item |  |
|-----------|--------------|--|
|           | Power        |  |
| BLE       | 2            |  |

#### 2.5 Mode of operation during the test

- The EUT continuous transmission mode during the test with set at Low Channel, Middle Channel, and High Channel. To get a maximum radiated emission levels from the EUT, the EUT was moved throughout the XY, YZ, XZ planes.

#### 2.6 Modifications of EUT

- None

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 5 / 37



# 3. Test Summary

| Applied   | FCC Rule                        | IC Rule                                  | Test Items                  | Test<br>Condition    | Result               |
|-----------|---------------------------------|--|-----------------------------|----------------------|----------------------|
| $\square$ | 15.203                          | _  | Antenna Requirement         |                      | С                    |
| $\square$ | 15.247(a)                       | RSS-247 (5.2)                            | 7 (5.2) 6 dB Bandwidth      |                      | С                    |
|           | _                               | RSS GEN (6.7)                            | Occupied Bandwidth (99%)    | Canduated            | С                    |
|           | 15.247(b)                       | RSS-247 (5.4)                            | Maximum Peak Output Power   |                      | С                    |
|           | 15.247(e)                       | RSS-247 (5.2)                            | Peak Power Spectral Density |                      | С                    |
| $\square$ | 15.247(d)                       | RSS-247 (5.5)                            | Conducted Spurious Emission |                      | С                    |
| $\square$ | 15.247(d)<br>15.205 &<br>15.209 | RSS-247 (5.5)<br>RSS-GEN<br>(8.9 & 8.10) | Radiated Spurious Emission  | Radiated             | С                    |
|           | 15.207                          | RSS-GEN (8.8)                            | Conducted Emissions         | AC Line<br>Conducted | NA <sup>Note 2</sup> |

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: This product is only using Battery(1.5V AAA). So, AC conducted emission test has not been performed.

The sample was tested according to the following specification: ANSI C63.10:2013.

Compliance was determined by specification limits of the applicable standard according to customer requirements.



## 4. Used equipment on test

| Description                     | Manufacturer      | Model Name               | Serial Name       | Next Cal.  |
|---------------------------------|-------------------|--------------------------|-------------------|------------|
| TEMP & HUMID CHAMBER            | JFM               | JFMA-001                 | 20200929-01       | 2022.12.17 |
| CONTROLLER                      | AMWON TECHNOLOGY  | TEMI2500                 | S7800VK191 0707   | 2022.12.17 |
| PSA SERIES SPECTRUM<br>ANALYZER | AGILENT           | E4440A                   | MY45304057        | 2022.12.15 |
| MXG ANALOG SIGNAL<br>GENERATOR  | AGILENT           | N5183A                   | MY50141890        | 2022.12.15 |
| SYSTEM DC POWER SUPPLY          | AGILENT           | 6674A                    | MY53000118        | 2022.12.15 |
| VECTOR SIGNAL<br>GENERATOR      | ROHDE & SCHWARZ   | SMBV100A                 | 257524            | 2022.12.15 |
| BLUETOOTH TESTER                | TESCOM            | TC-3000A                 | 3000A480088       | 2022.12.15 |
| DIRECTIONAL COUPLER             | AGILENT           | 773D                     | 2839A01855        | 2022.12.15 |
| ATTENUATOR                      | AGILENT           | 8493C                    | 73193             | 2022.12.15 |
| ATTENUATOR                      | ACE RF COMM       | ATT SMA 20W 20dB<br>8GHz | A-0820.SM20.2     | 2023.04.11 |
| TERMINATIOM                     | HEWLETT PACKARD   | 909D                     | 07492             | 2022.12.15 |
| POWER DIVIDER                   | HEWLETT PACKARD   | 11636A                   | 06916             | 2022.12.15 |
| SLIDE-AC                        | DAEKWANG TECH     | SV-1023                  | _                 | -          |
| DIGITAL MULTIMETER              | HUMANTECHSTORE    | 15B+                     | 50561541WS        | 2022.12.15 |
| ACTIVE LOOP ANTENNA             | TESEQ             | HLA 6121                 | 55685             | 2022.12.30 |
| Biconilog ANT                   | Schwarzbeck       | VULB 9160                | 3260              | 2023.02.03 |
| Biconilog ANT                   | Schwarzbeck       | VULB9168                 | 902               | 2023.01.14 |
| Horn Ant.                       | Schwarzbeck       | BBHA9120D                | 974               | 2023.01.08 |
| Horn Ant.                       | S/B               | BBHA9120D                | 1497              | 2023.01.25 |
| Amplifier                       | TESTEK            | TK-PA18H                 | 200104-L          | 2023.03.17 |
| EMI TEST RECEIVER               | ROHDE&<br>SCHWARZ | ESW44                    | 101952            | 2023.04.07 |
| PROGRAMMABLE<br>DC POWER SUPPLY | ODA               | OPE-305Q                 | oda-01-09-23-1831 | 2023.01.10 |
| DC POWER SUPPLY                 | AGILENT           | E3634A                   | MY40012120        | 2023.02.03 |
| POWER SENSOR                    | AGILENT           | U2001H                   | MY51140028        | 2023.02.19 |
| Test Receiver                   | ROHDE & SCHWARZ   | ESR7                     | 101616            | 2023.06.28 |
| LISN                            | ROHDE & SCHWARZ   | ENV216                   | 100409            | 2023.01.10 |
| PULSE LIMITER                   | lignex1           | EPL-30                   | NONE              | 2023.01.24 |

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 7 / 37



## 5. Antenna Requirement

Accoding to §15.203 An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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 provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Accoding to §15.247(b)(4) e conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

#### 5.1 Result

#### Complies

(The transmitter has a PCB Pattern Antenna. The directional peak gain of the antenna is -1.794 dBi.)



## 6. 6 dB Bandwidth

#### 6.1 Test Setup

Refer to the APPENDIX I.

## 6.2 Limit

The minimum permissible 6 dB bandwidth is 500 kHz.

## 6.3 Test Procedure

The bandwidth at 6 dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the EUT's antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

- 1. Set resolution bandwidth (RBW) = 100 kHz
- 2. Set the video bandwidth (VBW)  $\geq$  3 x RBW.
- 3. Detector = Peak.
- 4. Trace mode = Max Hold.
- 5. Sweep = Auto
- 6. Allow the trace to stabilize.
- 7. Option 1 Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost 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 X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 x RBW, 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.

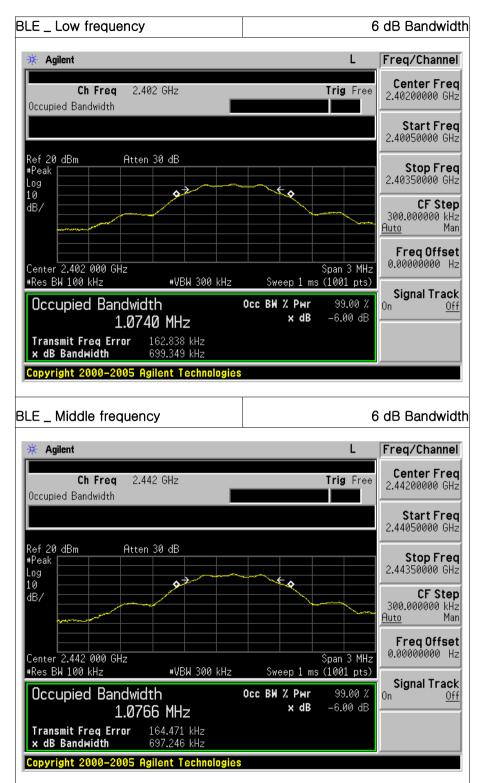
#### 6.4 Test Result

| Test Mode | Test Frequency | 6 dB Bandwidth<br>(MHz) | Occupied Bandwidth<br>(MHz) |
|-----------|----------------|-------------------------|-----------------------------|
|           | Low            | 0.699                   | 1.056                       |
| BLE       | Middle         | 0.697                   | 1.059                       |
|           | High           | 0.701                   | 1.060                       |

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 9 / 37



#### 6.5 Test Plot



EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 10 / 37

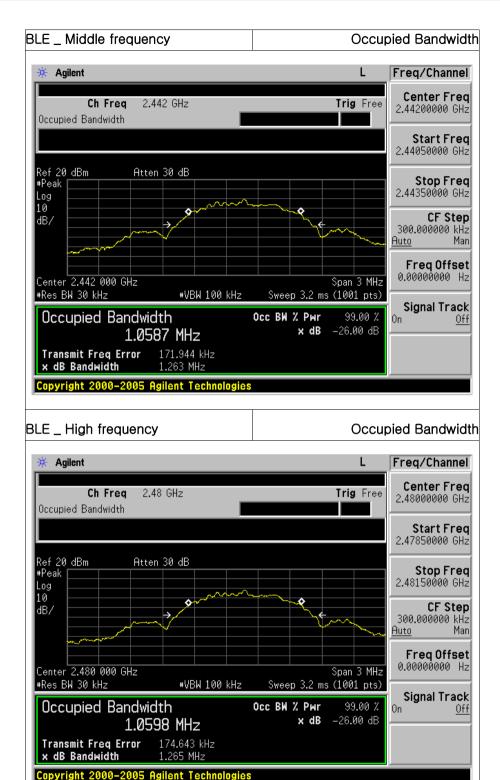




Occupied Bandwidth

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 11 / 37





EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 12 / 37



## 7. Maximum Peak Output Power

## 7.1 Test Setup

Refer to the APPENDIX I.

## 7.2 Limit

The maximum permissible conducted output power is 1 Watt.

## 7.3 Test Procedure

A transmitter antenna terminal of EUT is connected to the input of a spectrum analyzer. Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.

- 1. Set the RBW  $\geq$  DTS bandwidth
- 2. Set VBW  $\geq$  3 x RBW
- 3. Set span  $\geq$  3 x RBW.
- 4. Sweep time = auto couple
- 5. Detector = peak
- 6. Trace mode = max hold
- 7. Allow trace to fully stabilize
- 8. Use peak search function to determine the peak amplitude level.

#### 7.4 Test Result

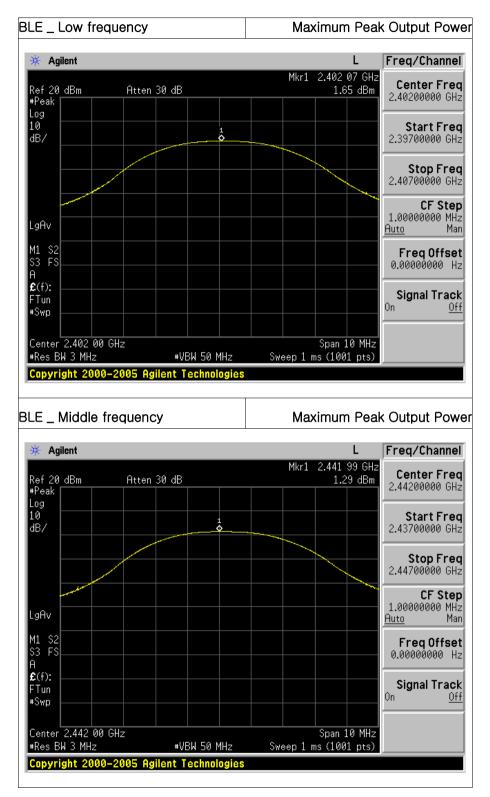
| Test Mode | Test Frequency | Peak Out | out Power |
|-----------|----------------|----------|-----------|
| Test Mode | rest Frequency | dBm      | mW        |
|           | Low            | 1.65     | 1.46      |
| BLE       | Middle         | 1.29     | 1.35      |
|           | High           | 0.34     | 1.08      |

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 13 / 37





## 7.5 Test Plot



EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 14 / 37



| LE _ High frequenc                   | у                    | Maximum Peal                         | < Output Powe         |
|--------------------------------------|----------------------|--------------------------------------|-----------------------|
| * Agilent                            |                      | L                                    | Peak Search           |
| Ref 20 dBm Atte<br>#Peak             | n 30 dB              | Mkr1 2.480 18 GHz<br>0.34 dBm        |                       |
| Log<br>10<br>dB/                     |                      |                                      | Next Pk Right         |
|                                      |                      |                                      | Next Pk Left          |
| LgAv                                 |                      |                                      | Min Search            |
| M1 S2<br>S3 FS<br>A                  |                      |                                      | Pk-Pk Search          |
| £(f):<br>FTun<br>#Swp                |                      |                                      | Mkr → CF              |
| Center 2.480 00 GHz<br>#Res BW 3 MHz | #VBW 50 MHz          | Span 10 MHz<br>Sweep 1 ms (1001 pts) | <b>More</b><br>1 of 2 |
| Copyright 2000-2005 (                | Agilent Technologies |                                      |                       |

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 15 / 37



## 8. Peak Power Spectral Density

## 8.1 Test Setup

Refer to the APPENDIX I.

## 8.2 Limit

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

## 8.3 Test Procedure

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

(ANSI C63.10-2013 \_ Section 11.10.2 - Method PKPSD)

- 1. Set analyzer center frequency to DTS channel center frequency.
- 2. Set the span to 1.5 times the DTS bandwidth.
- 3. Set the RBW : 3 kHz  $\leq$  RBW  $\leq$  100 kHz.
- 4. Set the VBW  $\geq$  3 x RBW.
- 5. Detector = Peak.
- 6. Sweep time = Auto
- 7. Trace mode = Max Hold.
- 8. Allow trace to fully stabilize.
- 9. Use the peak marker function to determine the maximum amplitude level within the RBW.
- 10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

| Test Mode | Test Frequency | Peak Power Spectral Density<br>(dBm) |
|-----------|----------------|--------------------------------------|
|           | Low            | -13.45                               |
| BLE       | Middle         | -13.96                               |
|           | High           | -15.09                               |

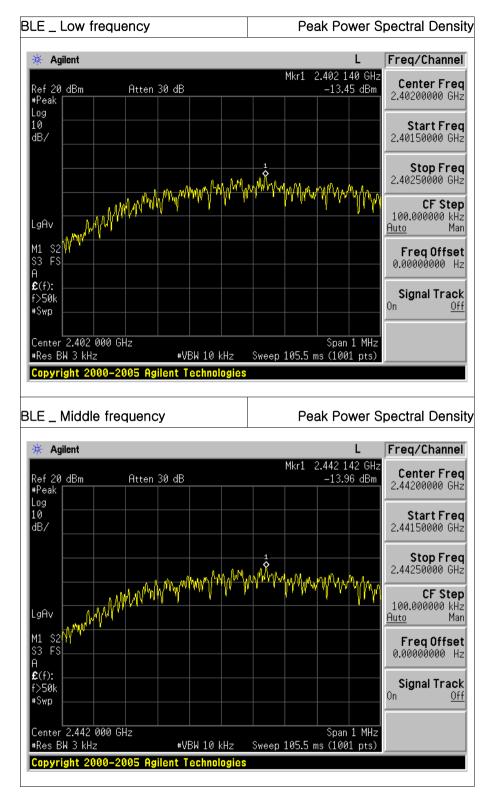
#### 8.4 Test Result

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 16 / 37



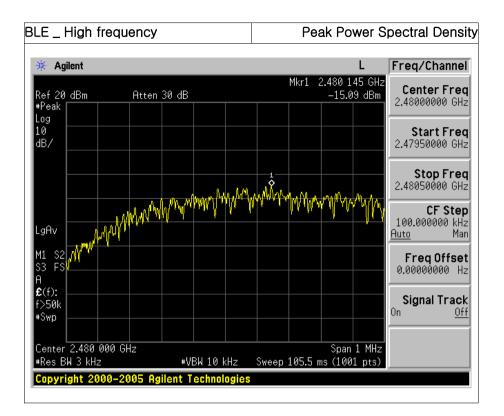


#### 8.5 Test Plot



EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 17 / 37







# 9. TX Radiated Spurious Emission and Conducted Spurious Emission

## 9.1 Test Setup

Refer to the APPENDIX I.

## 9.2 Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional

|                 | na otronigti iovolo opocinica in i | the following table          |
|-----------------|------------------------------------|------------------------------|
| Frequency (MHz) | Limit (uV/m)                       | Measurement Distance (meter) |
| 0.009 ~ 0.490   | 2400/F (kHz)                       | 300                          |
| 0.490 ~ 1705    | 24000/F (kHz)                      | 30                           |
| 1705 ~ 30.0     | 30                                 | 30                           |
| 30 ~ 88         | 100 **                             | 3                            |
| 88 ~ 216        | 150 **                             | 3                            |
| 216 ~ 960       | 200 **                             | 3                            |
| Above 960       | 500                                | 3                            |

radiator shall not exceed the field strength levels specified in the following table

\*\* Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 - 72 MHz, 76 - 88 MHz, 174 - 216 MHz or 470 - 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.



According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

| MHz                 | MHz                   | MHz             | GHz           |
|---------------------|-----------------------|-----------------|---------------|
| 0.009 ~ 0.110       | 16.42 ~ 16.423        | 399.90 ~ 410    | 4.5 ~ 5.15    |
| 0.495 ~ 0.505       | 16.69475 ~ 16.69525   | 608 ~ 614       | 5.35 ~ 5.46   |
| 2.1735 ~ 2.1905     | 16.80425 ~ 16.80475   | 960 ~ 1240      | 7.25 ~ 7.75   |
| 4.125 ~ 4.128       | 25.5 ~ 25.67          | 1300 ~ 1427     | 8.025 ~ 8.5   |
| 4.17725 ~ 4.17775   | 37.5 ~ 38.            | 1435 ~ 1626.5   | 9.0 ~ 9.2     |
| 4.20725 ~ 4.20775   | 25 73 ~ 74.6          | 1645.5 ~ 1646.5 | 9.3 ~ 9.5     |
| 4.17725 ~ 4.17775   | 74.8 ~ 75.2           | 1660 ~ 1710     | 10.6 ~ 12.7   |
| 6.215 ~ 6.218       | 108 ~ 121.94          | 1718.8 ~ 1722.2 | 13.25 ~ 13.4  |
| 6.26775 ~ 6.26825   | 149.9 ~ 150.05        | 2200 ~ 2300     | 14.47 ~ 14.5  |
| 6.31175 ~ 6.31225   | 156.52475 ~ 156.52525 | 2310 ~ 2390     | 15.35 ~ 16.2  |
| 8.291 ~ 8.294       | 156.7 ~ 156.9         | 2483.5 ~ 2500   | 17.7 ~ 21.4   |
| 8.362 ~ 8.366       | 162.0125 ~ 167.17     | 2690 ~ 2900     | 22.01 ~ 23.12 |
| 8.37625 ~ 8.38675   | 3345.8 ~ 3358         | 3260 ~ 3267     | 23.6 ~ 24.0   |
| 8.41425 ~ 8.41475   | 3600 ~ 4400           | 3332 ~ 3339     | 31.2 ~ 31.8   |
| 12.51975 ~ 12.52025 | 3345.8 ~ 3358         | 240 ~ 285       | 36.43 ~ 36.5  |
| 12.57675 ~ 12.57725 | 3600 ~ 4400           | 322 ~ 335.4     | Above 38.6    |
| 13.36 ~ 13.41       |                       |                 |               |

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.



#### 9.3 Test Procedure for Radiated Spurious Emission

- 1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 3.75 meter away from the interference-receiving antenna.
- 3. For measurements above 1 GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.
- 4. The antenna is a Broadband antenna, and its height 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.
- 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 table was turned from 0 degrees to 360 degrees to find the maximum reading. (The EUT was pre-tested with three axes (X, Y, Z) and the final test was performed at the worst case.)
- 6. Repeat above procedures until the measurements for all frequencies are complete.

#### Measurement Instrument Setting

- 1. Frequency Range: Below 1 GHz RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak
- 2. Frequency Range: Above 1 GHz

```
Peak Measurement
RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto,
Trace mode = Max Hold until the trace stabilizes
```

Average Measurement RBW = 1 MHz, VBW = 3 MHz, Detector = RMS (Number of points ≥ 2 x Span / RBW), Trace Mode = Average (Averaging type = power(i.e. RMS)), Sweep Time = Auto, Sweep Count = at least 100 traces

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

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 21 / 37



- 1) If power averaging (RMS) mode was used in step 4, then the applicable correction factor is 10 log(1/x), where x is the duty cycle.
- 2) If linear voltage averaging mode was used in step 4, then the applicable correction factor is 20 log(1/x), where x is the duty cycle.
- If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than tuming on and off with the transmit cycle, then no duty cycle correction is required for that emission.

#### 9.4 Test Procedure for Conducted Spurious Emission

- 1. The transmitter output was connected to the spectrum analyzer.
- 2. The reference level of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 300 kHz.
- 3. The conducted spurious emission was tested each ranges were set as below. Frequency range: 30 MHz ~ 26.5 GHz
   RBW = 100 kHz, VBW = 300 kHz, Sweep Time = Auto, Detector = Peak, Trace = Max Hold

LIMIT LINE = 20 dB below of the reference level of above measurement procedure Step 2. (RBW = 100 kHz, VBW = 300 kHz)



#### 9.5 Test Result

#### 9 kHz $\sim$ 25 GHz Data BLE

#### • Low frequency

| Frequency | Rea   | ding   |      | <b>.</b>    | 0.05        | Lin  | nits  | Re   | sult | Mai  | rgin |
|-----------|-------|--------|------|-------------|-------------|------|-------|------|------|------|------|
| Fiequency | (dBu  | V/m)   | Pol. | T.F<br>(dB) | DCF<br>(dB) | (dBu | IV/m) | (dBu | V/m) | (d   | в)   |
| (MHz)     | AV /  | / Peak |      | (48)        | (00)        | AV / | Peak  | AV / | Peak | AV / | Peak |
| 4 804.14  | 27.11 | 39.29  | V    | 6.24        | 2.04        | 54.0 | 74.0  | 35.4 | 45.5 | 18.6 | 28.5 |
|           |       |        |      |             |             |      |       |      |      |      |      |
|           |       |        |      |             |             |      |       |      |      |      |      |
|           |       |        |      |             |             |      |       |      |      |      |      |
|           |       |        |      |             |             |      |       |      |      |      |      |

#### • Middle frequency

| Fraguanay | Rea   | ding   |      |             | 0.05        | Lin  | nits | Re   | sult  | Mai  | rgin |
|-----------|-------|--------|------|-------------|-------------|------|------|------|-------|------|------|
| Frequency | (dBu  | V/m)   | Pol. | T.F<br>(dB) | DCF<br>(dB) | (dBu | V/m) | (dBu | IV/m) | (d   | в)   |
| (MHz)     | AV /  | / Peak |      | (42)        | (00)        | AV / | Peak | AV / | Peak  | AV / | Peak |
| 4 884.53  | 28.56 | 40.00  | V    | 5.98        | 2.04        | 54.0 | 74.0 | 36.6 | 46.0  | 17.4 | 28.0 |
|           |       |        |      |             |             |      |      |      |       |      |      |
|           |       |        |      |             |             |      |      |      |       |      |      |
|           |       |        |      |             |             |      |      |      |       |      |      |
|           |       |        |      |             |             |      |      |      |       |      |      |

#### • High frequency

| Fraguanay | Rea   | ding   |      |             | 0.05        | Lin  | nits  | Re   | sult  | Mai  | gin  |
|-----------|-------|--------|------|-------------|-------------|------|-------|------|-------|------|------|
| Frequency | (dBu  | V/m)   | Pol. | T.F<br>(dB) | DCF<br>(dB) | (dBu | IV/m) | (dBu | IV/m) | (d   | в)   |
| (MHz)     | AV ,  | / Peak |      | (00)        | (00)        | AV / | Peak  | AV / | Peak  | AV / | Peak |
| 4 960.86  | 28.64 | 40.42  | V    | 6.15        | 2.04        | 54.0 | 74.0  | 36.8 | 46.6  | 17.2 | 27.4 |
|           |       |        |      |             |             |      |       |      |       |      |      |
|           |       |        |      |             |             |      |       |      |       |      |      |
|           |       |        |      |             |             |      |       |      |       |      |      |
|           |       |        |      |             |             |      |       |      |       |      |      |

Note 1: The radiated emissions were investigated 9 kHz to 25 GHz. And no other spurious and harmonic emissions were found above listed frequencies.

Note 2: DCF(Duty Cycle Factor)

-  $T_{on}$  = 0.391 ms /  $T_{off}$  = 0.235 ms

- Duty Cycle = T<sub>on</sub> / (T<sub>on</sub>+T<sub>off</sub>) = 0.391 / (0.391+0.235) = 0.625

- DCF =  $10 \times \log(1/\text{Duty Cycle}) \text{ dB} = 10 \times \log(1/0.625) \text{ dB} = 2.04 \text{ dB}$ 

Note 3: Sample Calculation.

Margin = Limit - Result / Peak Result = Peak Reading + TF / Average Result = Average Reading + TF + DCF

TF = Ant factor + Cable Loss + Filter Loss - Amp Gain + Distance Factor

Distance Factor = 20log(applied distance/required distance) = 20log(3.75m/3m) = 1.94



## 9.6 Test Plot for Radiated Spurious Emission

• BLE \_ Low frequency

|   |   |                                     |                 |        |                |              | Spuriou       |  |
|---|---|-------------------------------------|-----------------|--------|----------------|--------------|---------------|--|
| Multi¥iew 🕀 Sp.,um  | Spm2  | Spem3                               | Spem4           | Spe_m5 | Spem6          | Spe_m7       | X             | ▽  |
| Ref Level 87.00 dB  |   | • RBW 1 MHz                         | Mode Auto Sweep |        |                |              |               | 040000 GHz                                 |
| Input 1 A<br>Frequency Sweep  | AC PS Off                                       | Notch Off                           |                 |        |                |              | equency 1.0   | • 1Pk Max                                  |
| 30 dBµV   |   |                                     |                 |        |                |              | M1[1]<br>4    | 39.29 dBµV<br>80414000 GHz                 |
| 10 ubji v   |   |                                     |                 |        |                |              |               |  |
| 70 dBµV   |   |                                     |                 |        |                |              |               |  |
| i0 dBµV   |   |                                     |                 |        |                |              |               |  |
|   |   |                                     |                 |        |                |              |               |  |
| 0 dBµV  |   |                                     |                 |        |                |              |               |  |
| 0 dBµV  |   |                                     |                 | M1     |                |              |               |  |
|   | New Schwart Ward                                | Whitehand                           | leventeralling  |        | merrinduration | en Vehlander | understanding | whiteman                                   |
| 0 dBµV  |   |                                     |                 |        |                |              |               |  |
| 0 dBµV  |   |                                     |                 |        |                |              |               |  |
| 0 dBµV  |   |                                     |                 |        |                |              |               |  |
| o uppv  |   |                                     |                 |        |                |              |               |  |
| dBµV  |   |                                     |                 |        |                |              |               |  |
| 10 dBµV   |   |                                     |                 |        |                |              |               |  |
| F 4.804 GHz   |   | 10                                  | 01 pts          | 1      | .0 MHz/        |              |               | Span 10.0 MHz                              |
|   |   |                                     |                 |        |                |              |               |  |
| (ulti¥iew 📯 Sp.,um  | Spm2  | Spem3                               | Spem4           | Spem5  | Spemő          |              | urious –      |  |
| NultiView S Spum<br>Ref Level 87.00 dBµ<br>Att 10 d   | dB SWT 1.01 ms                                  | Spem3<br>• RBW 1 MHz<br>• VBW 3 MHz | Spem4           | SGL    | Spemó          | Spe_m7       | X             |  |
| Ref Level 87.00 dB  | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | • RBW 1 MHz                         |                 | SGL    | Spem6          | Spe_m7       | requency 4.80 | ⊽<br>040000 GHz<br>● 1Rm Avg               |
| Ref Level 87.00 dBµ<br>Att 10 d<br>Input 1 A<br>Frequency Sweep   | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | Spem6          | Spe_m7       | Equency 4.80  | <br>040000 GHz                             |
| Ref Level 87.00 dBµ<br>Att 10 d<br>Input 1 A<br>Frequency Sweep   | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | Spemb          | Spe_m7       | Equency 4.80  | ▼<br>040000 GHz<br>• 1Rm Avg<br>27.11 dBµV |
| Ref Level         87.00 dBµ           Att         10 c           Input         1 f           Frequency         Sweep           0 dBµV   | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | Spem8          | Spe_m7       | Equency 4.80  | ▼<br>040000 GHz<br>• 1Rm Avg<br>27.11 dBµV |
| Ref Level 87.00 dBy           Att         10 c           Input         1 A           Frequency Sweep           0 dBµV   | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | () Spe.mb      | Spe_m7       | Equency 4.80  | ▼<br>040000 GHz<br>• 1Rm Avg<br>27.11 dBµV |
| Ref Level 87.00 dB, Att         10 k           Att         10 k           Input         14 k           Input              | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | 5 Spemb        | Spe_m7       | Equency 4.80  | ▼<br>040000 GHz<br>• 1Rm Avg<br>27.11 dBµV |
| Ref Level 87.00 dB, Att         10 k           Att         10 k           Input         14 k           Input              | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | Spr.mk         | Spe_m7       | Equency 4.80  | ▼<br>040000 GHz<br>• 1Rm Avg<br>27.11 dBµV |
| Ref Level 87.00 dB, Att         10 c           Input         1 H           O dB, V         0           0 dB, V         0           0 dB, V         0           0 dB, V         0  | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | Spemb          | Spe_m7       | Equency 4.80  | ▼<br>040000 GHz<br>• 1Rm Avg<br>27.11 dBµV |
| Ref Level 87.00 dB,<br>Att 10 K           Input 1 K  <  | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | Spr.mb         | Spe_m7       | Equency 4.80  | ▼<br>040000 GHz<br>• 1Rm Avg<br>27.11 dBµV |
| Ref Level 87.00 dB,<br>Att 10 K           Input 1 K  <  | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | 5 Spe.m6       | Spe_m7       | Equency 4.80  | ▼<br>040000 GHz<br>• 1Rm Avg<br>27.11 dBµV |
| Ref Level 87.00 dB,<br>Att 10 G           Input 1 / G | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | 5 Spemb        | Spe_m7       | Equency 4.80  | ▼<br>040000 GHz<br>• 1Rm Avg<br>27.11 dBµV |
| Ref Level 87.00 dB;<br>Att 10 C           Input 1 / C | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | Spenne         | Spe_m7       | Equency 4.80  | ⊽<br>040000 GHz<br>1Rm Avg<br>27.11 dBµV   |
| Ref Level 87.00 dB;<br>Att 10 C           Input 1 / C | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | 5 Spe.mb       | Spe_m7       | Equency 4.80  | ▼<br>040000 GHz<br>• 1Rm Avg<br>27.11 dBµV |
| Ref Level 87.00 dB,<br>Att 10 C           Input 1 / C           Input 1 / C           o dB, V           0 dB, V   | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | 5 Spr.mb       | Spe_m7       | Equency 4.80  | ▼<br>040000 GHz<br>• 1Rm Avg<br>27.11 dBµV |
| Ref Level 87.00 dB<br>Att 10 c<br>Input 1 A   | JV<br>dB <b>SWT</b> 1.01 ms<br>AC <b>PS</b> Off | RBW 1 MHz     VBW 3 MHz             |                 | SGL    | 5 Spe.mb       | Spe_m7       | Equency 4.80  | ▼<br>040000 GHz<br>• 1Rm Avg<br>27.11 dBµV |

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 24 / 37



• BLE \_ Middle frequency

|  |   |            |   |  |              |                      |                |              | Spuriou                                  | s – Pea   |
|--|---|------------|---|--|--------------|----------------------|----------------|--------------|--|---|
| ulti¥iew 🔠 Sp  | .um 🛛                                     | Spm2       | Spe.  | m3                                       | Spem4        | Spem5                | Spemő          | Spe_m7       | X  | ▽   |
| Ref Level 87<br>Att<br>Input   |   | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> <li>Notch</li> </ul> | 3 MHz Mode                               | e Auto Sweep |                      |                | Fn           | equency 4.88                             | 340000 GH:  |
| Frequency  |   |            | Noteri  | 01                                       |              |                      |                |              | MILLI                                    | <ul> <li>1Pk Max</li> <li>40.00 dBµV</li> </ul>                   |
| 0 dBµV   |   |            |   |  |              |                      |                |              | M1[1]<br>4.                              | 40.00 dBpv<br>88452900 GHz  |
|  |   |            |   |  |              |                      |                |              |  |   |
| 0 dBµV   |   |            |   |  |              |                      |                |              |  |   |
| 0 dBµV   |   |            |   |  |              |                      |                |              |  |   |
| o ubp v  |   |            |   |  |              |                      |                |              |  |   |
| ) dBµV   |   |            |   |  |              |                      |                |              |  |   |
|  |   |            |   |  |              | M1                   |                |              |  |   |
| ) dBµV   |   |            | 4   | . hanne                                  | manung       | unirenturit          | Municipalitica |              |  |   |
| о dBµV   | www.www.www.w                             | www.www.   | www.www.w   | an a |              |                      |                | an water and | hand hand and hand hand hand hand hand h | man and a strength  |
| ј ubµv   |   |            |   |  |              |                      |                |              |  |   |
| ) dBµV   |   | _          |   |  |              |                      |                |              |  |   |
|  |   |            |   |  |              |                      |                |              |  |   |
| ) dBµV   |   |            |   |  |              |                      |                |              |  |   |
|  |   |            |   |  |              |                      |                |              |  |   |
| dBµV   |   |            |   |  |              |                      |                |              |  |   |
| ιο dBμV  |   |            |   |  |              |                      |                |              |  |   |
| to dop i   |   |            |   |  |              |                      |                | 1            |  |   |
|  | <u> </u>                                  |            |   | 1001 pt                                  | 15           | 1                    | .0 MHz/        | Spu          | irious –                                 | -   |
| F 4.884 GHz  |   |            |   |  |              |                      | ~              |              | irious –                                 | Averag  |
| F 4.884 GHz  | .um 🕅                                     | Spm2       | RBW   | <b>.m3</b> X                             | Spem4        | Spem5                | ~              | Spe_m7       | irious –                                 | Averag  |
| Htview ES Sp<br>Ref Level 87<br>Att<br>input   | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | RBW   | 1 MHz<br>3 MHz Mode                      | Spem4        | Spem5 ∑              | ~              | Spe_m7       | irious –                                 | Averac  |
| F 4.884 GHz  | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | Spem5                | ~              | Spe_m7       | equency 4.88                             | Averag<br>340000 GH:<br>28.56 dBpt                                |
| Huview EE Sp<br>Ref Level 87<br>Att<br>Input<br>Frequency  | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | Spem5                | ~              | Spe_m7       | equency 4.88                             | Averag<br>340000 GH:<br>28.56 dBpt                                |
| E 4.884 GHz  | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | Spem5                | ~              | Spe_m7       | equency 4.88                             | Averag<br>340000 GH:<br>28.56 dBpt                                |
| E 4.884 GHz  | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | Spem5                | ~              | Spe_m7       | equency 4.88                             | Averag<br>340000 GH:<br>28.56 dBpt                                |
| E 4.884 GHz  | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | Spem5                | ~              | Spe_m7       | equency 4.88                             | Averag<br>340000 GH:<br>28.56 dBpt                                |
| E 4.884 GHz  | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | Spem5                | ~              | Spe_m7       | equency 4.88                             | Averac<br>340000 GH<br>• IRm Avg<br>28.56 dBp <sup>1</sup>        |
| = 4.884 GHz<br>начини :: [sp<br>Ref Level 87<br>ttt<br>Frequency<br>) dBµV   | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | Spem5                | ~              | Spe_m7       | equency 4.88                             | Averag<br>340000 GH:<br>28.56 dBpt                                |
| attrium         \$\$           attrium         \$\$           Sef Level         \$7           Attriput         \$\$           Frequency         \$\$           0         dBµV           0         dBµV           0         dBµV  | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | Spem5                | ~              | Spe_m7       | equency 4.88                             | Averag<br>340000 GH:<br>28.56 dBpt                                |
| attrium         \$\$           attrium         \$\$           Sef Level         \$7           Attriput         \$\$           Frequency         \$\$           0         dBµV           0         dBµV           0         dBµV  | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | Spem5                | ~              | Spe_m7       | equency 4.88                             | Averag<br>340000 GH:<br>28.56 dBpt                                |
| abbview         \$p           abbview         \$p           sef_Level         87 Att           input         FFequency           0         dBµV           0         dBµV           0         dBµV           0         dBµV           0         dBµV  | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | Spem5                | ~              | Spe_m7       | equency 4.88                             | Averag<br>340000 GH:<br>28.56 dBpt                                |
| abbview         \$p           abbview         \$p           sef_Level         87 Att           input         FFequency           0         dBµV           0         dBµV           0         dBµV           0         dBµV           0         dBµV  | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | SGL<br>Count 100/100 | ~              | Spe_m7       | equency 4.88                             | Averag<br>340000 GH:<br>28.56 dBpt                                |
| wttview         \$p           wttview         \$p           seturiew         \$p           Att         Input           Frequency         0           0         dBµV  | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | SGL<br>Count 100/100 | ~              | Spe_m7       | Irious –<br>equency 4.88                 | Averaç<br>▼ 340000 GH;<br>●1Rm Avg<br>28.56 dby<br>8425000 GH;    |
| F 4.884 GHz           wittriew         \$\$\$           Ref Level 87 Att           Input           Frequency           0 dBµV   | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | SGL<br>Count 100/100 | ~              | Spe_m7       | Irious –<br>equency 4.88                 | Averag<br>340000 GH:<br>28.56 dBµ<br>38425000 GH:                 |
| wttview         \$p           wttview         \$p           Ref Level         87           Input         Frequency           0         dBµV           0         dBµV | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | SGL<br>Count 100/100 | ~              | Spe_m7       | Irious –<br>equency 4.88                 | Averaç<br>▼ 340000 GH;<br>●1Rm Avg<br>28.56 dby<br>8425000 GH;    |
| attiview         Sp           settiview         Sp           Ref Level         87           Input         Frequency           o         dBµV           0         dBµV                         | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | SGL<br>Count 100/100 | ~              | Spe_m7       | Irious –<br>equency 4.88                 | Averaç<br>▼ 340000 GH;<br>●1Rm Avg<br>28.56 dby<br>8425000 GH;    |
| attiview         Sp           settiview         Sp           Ref Level         87           Input         Frequency           o         dBµV           0         dBµV                         | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | SGL<br>Count 100/100 | ~              | Spe_m7       | Irious –<br>equency 4.88                 | Averag<br>340000 GH:<br>28.56 dBµ<br>38425000 GH:                 |
| wttview         \$p           wttview         \$p           seturiew         \$p           Att         Input           Frequency         0           0         dBµV  | .um 22<br>.00 dBµV<br>10 dB SV<br>1 AC PS | VT 1.01 ms | <ul> <li>RBW</li> <li>VBW</li> </ul>                | 1 MHz<br>3 MHz Mode                      | Spem4        | SGL<br>Count 100/100 | ~              | Spe_m7       | Irious –<br>equency 4.88                 | ▼<br><b>340000 GH:</b><br>● 1Rm Avg<br>28.55 dBµA<br>38425000 GH2 |

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 25 / 37



#### • BLE \_ High frequency

|   |                    |  |                                     |               |   |            | i                 | Spuriou  | 12 - LG  |
|---|--------------------|--|-------------------------------------|---------------|---|------------|-------------------|--|--|
| liti¥iew 🔠 Sp.  | um                 | Spm2   | Spem3                               | Spem4         | Spem5   | Spemő      | Spe_m7            | X  | ▽  |
| Ref Level 87<br>Att   |                    |  | W 1 MHz<br>W 3 MHz Mode             | Auto Sween    |   |            | En                |  | 600000 GH  |
| Input<br>Frequency  | 1 AC PS            | Off No   | tch Off                             |               |   |            |                   | equency 4.5                                    | • 1Pk Max  |
|   |                    |  |                                     |               |   |            |                   | M1[1]  | 40.42 dBµ<br>1.96085900 GH                           |
| O dBµV−−−−  |                    |  |                                     |               |   |            |                   |  |  |
| ) dBµV  |                    |  |                                     |               |   |            |                   |  |  |
|   |                    |  |                                     |               |   |            |                   |  |  |
| I dBµV  |                    |  |                                     |               |   |            |                   |  |  |
| I dBµV  |                    |  |                                     |               |   |            |                   |  |  |
|   |                    |  |                                     |               | M1  |            |                   |  |  |
| ) dBμV  |                    |  | monulan                             | a Murral many | ann an the second se | aboundance | 11. 000 A. A. I.  |  |  |
| ) dBµV  | and the associated | Hard and the second | and the second second               |               |   |            | anow a vilion low | and and an | all managed and the second                           |
|   |                    |  |                                     |               |   |            |                   |  |  |
| ) dBµV  |                    |  |                                     |               |   |            |                   |  |  |
| 10.41   |                    |  |                                     |               |   |            |                   |  |  |
| I dBµV−−−−  |                    |  |                                     |               |   |            |                   |  |  |
| dBµ∨  |                    |  |                                     |               |   |            |                   |  |  |
|   |                    |  |                                     |               |   |            |                   |  |  |
| n albuss  |                    |  |                                     |               |   |            |                   |  |  |
|   |                    |  |                                     | S             | 1   | .0 MHz/    | Spu               |  | -  |
| E 4.96 GHz  |                    |  |                                     |               |   |            |                   | irious -                                       | Span 10.0 MH   |
| F 4,96 GHz  |                    |  | <b>5pem3</b> ☑                      | Spem4         | Spem5 2   |            | Spe_m7            | irious -                                       | - Averag   |
| Htview E Sp<br>Ref Level 87<br>Att<br>input   |                    | $\cup$   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Spem5   |            | Spe_m7            | irious -                                       | - Averac   |
| F 4.96 GHz  |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Spem5 2   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| Hand the second |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Spem5 2   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| E 4.96 GHz  |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Spem5 2   |            | Spe_m7            | equency 4.9                                    | - Averaç<br>( - 600000 GH                            |
| E 4.96 GHz  |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Spem5 2   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| E 4.96 GHz  |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Spem5 2   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| 4.96 GHz           Iteview         E           Sef Level         87           Att         input           Frequency         dBμV           0         dBμV           0         dBμV  |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Spem5 2   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| E 4.96 GHz<br>attriev   |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Spem5 2   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| E 4.96 GHz  states sta |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Spem5 2   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| 4.96 GHz           Iвчее         5           Ref Level 87         5           Ref Level 87         1           Input         Frequency           0         dBµV           0         dBµV           0         dBµV           0         dBµV           0         dBµV           0         dBµV  |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Spem5 2   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| 4.96 GHz           Iвчее         5           Ref Level 87         5           Ref Level 87         1           Input         Frequency           0         dBµV           0         dBµV           0         dBµV           0         dBµV           0         dBµV           0         dBµV  |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Spem5 2   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| 4.96 GHz           вичее         5           Ref Level 87         5           Xtt         1           Input         Frequency           0         dBµV  |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Sol.<br>Count 100/100   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| atoriev         E         4.96 GHz           atoriev         E         5e           Ref Level         87 Att         10put           Frequency         0         dBµV           0         dBµV         0  |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Sol.<br>Count 100/100   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| 4.96 GHz           вичее         5           Ref Level 87         5           Xtt         1           Input         Frequency           0         dBµV  |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Sol.<br>Count 100/100   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| 4.96 GHz           IBVIEW         SP           Xef Level         S7           Xtt         Input           Frequency         dBµV           0         dBµV  |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Sol.<br>Count 100/100   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |
| ■ 4.96 GHz           #89/ew         ● sp           2kef Level         87           2kef Level         87           1         dbµv           0         dbµv  |                    | • RE<br>T 1.01 ms • VB   | spe_m3 ☑<br>₩ 1 MHz<br>₩ 3 MHz Mode | Spem4         | Sol.<br>Count 100/100   |            | Spe_m7            | equency 4.9                                    | - Averag<br>⊽<br>6000000 GH<br>•18m Avg<br>28.64 dBµ |

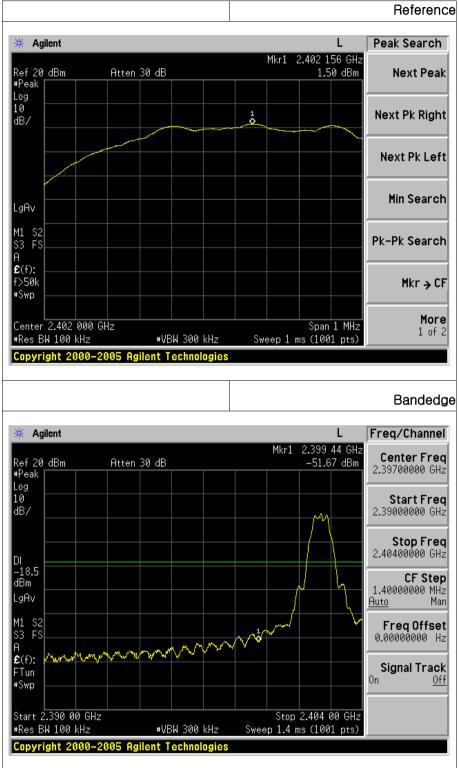
EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 26 / 37





## 9.7 Test Plot for Conducted Spurious Emission

BLE \_ Low frequency



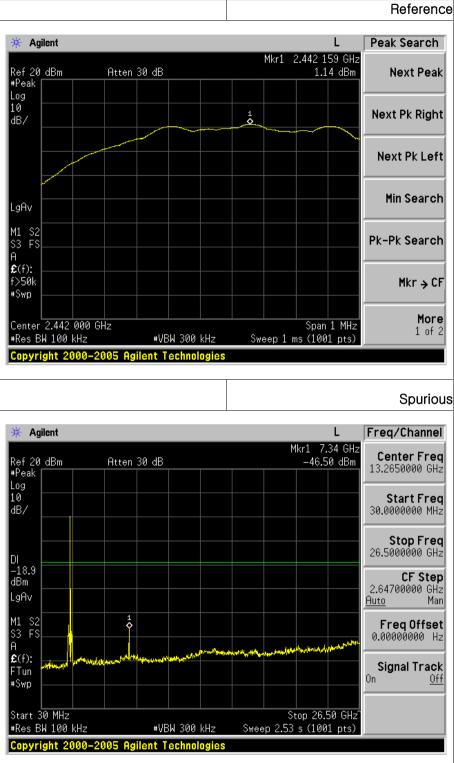
EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 27 / 37



| 🔆 Agilent                       |   |           |  | L                                  | Freq/Channe                                       |
|---------------------------------|---|-----------|--|------------------------------------|---|
| Ref 20 dBm<br>#Peak             | Atten 30 dB   |           | M  | kr1 7.20 GHz<br>-42.35 dBm         | Center Fred<br>13.2650000 GH                      |
| Log<br>10<br>dB/                |   |           |  |                                    | Start Free<br>30.0000000 MH                       |
|                                 |   |           |  |                                    | Stop Fred<br>26.5000000 GH                        |
| -18.5<br>dBm<br>_gAv            | 1   |           |  |                                    | <b>CF Stej</b><br>2.64700000 GH<br><u>Auto</u> Ma |
| M1 S2<br>S3 FS                  |   | 1 ANI (14 | مليني جريب معيرينية  | Hower and the second second second | Freq Offse<br>0.00000000 H                        |
| €(f):<br>FTun<br>#Swp           | a, ing t, <mark>bibliographin Malant 1</mark> 540 min apada ang Pen |           | <sup>ا</sup> روستر الاروم المراجع ا<br>المراجع المراجع |                                    | <b>Signal Tracl</b><br>On <u>Of</u>               |
| Start 30 MHz<br>≉Res BW 100 kHz |   | W 300 kHz |  | op 26.50 GHz<br>s (1001 pts)       |   |



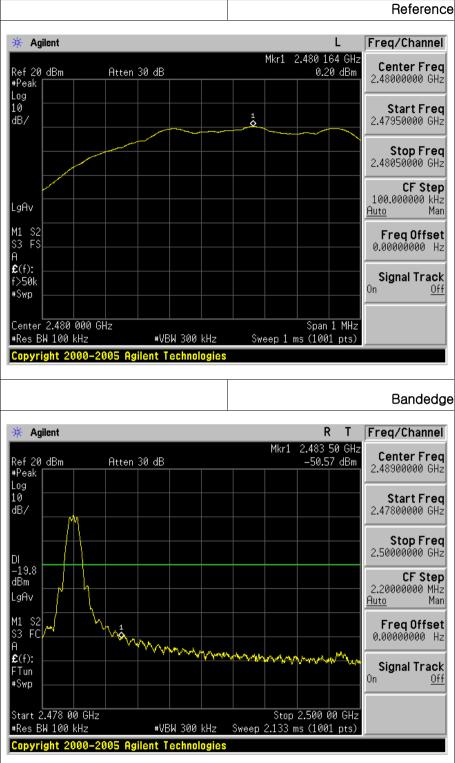
BLE \_ Middle frequency



EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 29 / 37



BLE \_ High frequency



EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 30 / 37



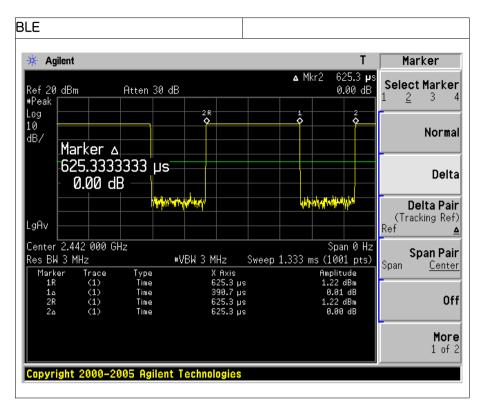
| 🗧 Agilent                     |  |   |                              | L  | Freq/Channe                                      |
|-------------------------------|--|---|------------------------------|--|--|
| ef 20 dBm<br><sup>D</sup> eak | Atten 30 dB  |   |                              | Mkr1 7.44 GHz<br>-49.42 dBm  | Center Fre<br>13.2650000 GH                      |
| 99<br>0<br>3/                 |  |   |                              |  | <b>Start Fre</b><br>30.0000000 MH                |
|                               |  |   |                              |  | <b>Stop Fre</b><br>26.5000000 GF                 |
| 19.8<br>3m<br>gAv             |  |   |                              |  | <b>CF Ste</b><br>2.64700000 GH<br><u>Auto</u> Ma |
| 1 S2<br>3 FS                  | 1  | , deseture  | مېرىرىيە يەر يېرىمى يەلمۇرىي | لارم میروند.<br>مراجع میروند او کم و مدو مال او مار مور مدو مال او | FreqOffse<br>0.00000000 H                        |
| (f):<br>Tun<br>Swp            | and and a start of the start of | hele and the hele of the hele |                              |  | <b>Signal Trac</b><br>On <u>O</u>                |
| tart 30 MHz<br>Res BW 100 kHz |  | <br> BW 300 kHz   |                              | Stop 26.50 GHz^<br>3 s (1001 pts)                                  |  |

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 31 / 37

This test report shall not be reproduced except in full, Without the written approval.



## 9.8 Test Plot for Duty Cycle





## 10. Conducted Emission

#### 10.1 Test Setup

See test photographs for the actual connections between EUT and support equipment.

## 10.2 Limit

According to §15.207(a) for an intentional radiator 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, as measured using a 50 uH/50 ohm line impedance stabilization network (LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

| Frequency Range (MHz) | Conducted Limit (dBuV) |            |            |
|-----------------------|------------------------|------------|------------|
| Fieque                |                        | 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

## 10.3 Test Procedure

Conducted emissions from the EUT were measured according to the ANSI C63.10.

- The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
- 2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
- 3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
- 4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

#### 10.4 Test Result

#### Not Applicable

(This products is only using Coin Battery power. So, AC conducted emission test has not been perfomed.)

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 33 / 37



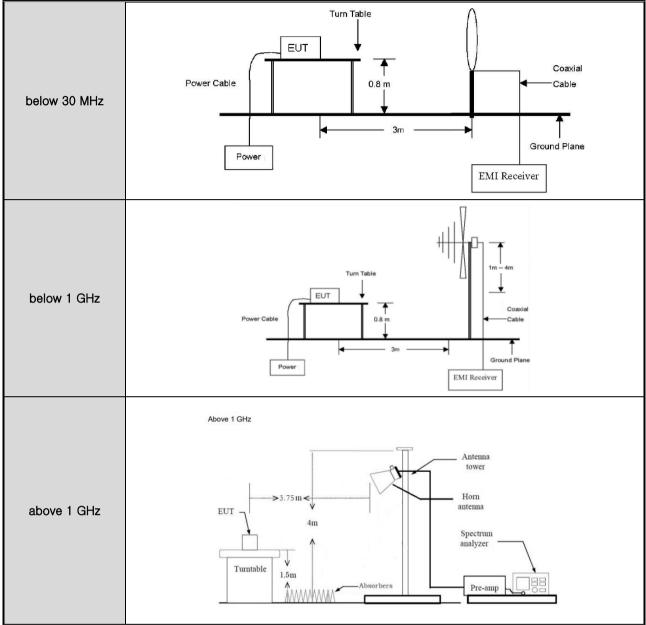
APPENDIX I

TEST SETUP

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 34 / 37



#### Radiated Measurement



#### • Conducted Measurement

| Conducted | EUT | Attenuator | Spectrum<br>Analyzer |
|-----------|-----|------------|----------------------|

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 35 / 37



APPENDIX II

UNCERTAINTY

EMCLabs-QPF-26-25 [Enactment\_00 / 2022. 09. 07] Page 36 / 37



| Measurement Item             | Expanded Uncertainty<br>U = <i>k</i> Uc ( <i>k</i> =2) |
|------------------------------|--|
| Conducted RF power           | 0.32 dB  |
| Conducted Spurious Emissions | 0.32 dB  |
| Radiated Spurious Emissions  | 6.34 dB  |
| Conducted Emissions          | 1.74 dB  |