

# TEST REPORT

## CERTIFICATE OF CONFORMITY

**Standard:** 47 CFR FCC Part 15, Subpart C (Section 15.247)

**Report No.:** RFBENL-WTW-P24060724-6

**FCC ID:** RYK-WNFQ291BEBT

**Product:** WiFi 7/BT module

**Brand:** Sparklan

**Model No.:** WNFQ-291BEI(BT)

**Series Model:** WNFQ-291BE(BT)

**Received Date:** 2024/8/16

**Test Date:** 2024/10/26 ~ 2024/12/20

**Issued Date:** 2025/4/11

**Applicant:** SparkLAN Communications, Inc.

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**Issued By:** Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch  
Hsin Chu Laboratory

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**Test Location:** E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan

**FCC Registration /** 723255 / TW2022

**Designation Number:**

**Approved by:** \_\_\_\_\_, **Date:** \_\_\_\_\_ 2025/4/11

May Chen / Manager

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Prepared by : Phoenix Huang / Specialist



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## Release Control Record

| Issue No.              | Description       | Date Issued |
|------------------------|-------------------|-------------|
| RFBENL-WTW-P24060724-6 | Original release. | 2025/4/11   |

## 1 Certificate

**Product:** WiFi 7/BT module

**Brand:** Sparklan

**Test Model:** WNFQ-291BEI(BT)

**Series Model:** WNFQ-291BE(BT)

**Sample Status:** Engineering sample

**Applicant:** SparkLAN Communications, Inc.

**Test Date:** 2024/10/26 ~ 2024/12/20

**Standard:** 47 CFR FCC Part 15, Subpart C (Section 15.247)

**Measurement**

**procedure:** ANSI C63.10-2013

KDB 558074 D01 15.247 Meas Guidance v05r02

KDB 662911 D01 Multiple Transmitter Output v02r01

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, 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 RF characteristics under the conditions specified in this report.

## 2 Summary of Test Results

| 47 CFR FCC Part 15, Subpart C (Section 15.247) |                                 |        |                                                                                               |
|------------------------------------------------|---------------------------------|--------|-----------------------------------------------------------------------------------------------|
| Standard / Clause                              | Test Item                       | Result | Remark                                                                                        |
| 15.247(b)                                      | RF Output Power                 | Pass   | Meet the requirement of limit.                                                                |
| 15.247(e)                                      | Power Spectral Density          | N/A    | Refer to Note 1 below                                                                         |
| 15.247(a)(2)                                   | 6 dB Bandwidth                  | N/A    | Refer to Note 1 below                                                                         |
| 15.247(d)                                      | Conducted Out of Band Emissions | N/A    | Refer to Note 1 below                                                                         |
| 15.207                                         | AC Power Conducted Emissions    | N/A    | Refer to Note 1 below                                                                         |
| 15.205 /<br>15.209 /<br>15.247(d)              | Unwanted Emissions below 1 GHz  | Pass   | Minimum passing margin is -1.3 dB at 199.60 MHz                                               |
| 15.205 /<br>15.209 /<br>15.247(d)              | Unwanted Emissions above 1 GHz  | Pass   | Minimum passing margin is -17.6 dB at 7320.00 MHz                                             |
| 15.203                                         | Antenna Requirement             | Pass   | Antenna connector is MHF 4L, I-PEX MHF4, RP-SMA (M), MHF4L to SMA-F not a standard connector. |

Note:

- Only RF Output Power and Unwanted Emissions test items were performed for this addendum. The others testing data refer to original test report (Original FCC ID: J9C-QCNCM865).
- Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

### 2.1 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:

| Measurement                    | Specification   | Expanded Uncertainty (k=2)<br>( $\pm$ ) |
|--------------------------------|-----------------|-----------------------------------------|
| RF Output Power                | -               | 1.1 dB                                  |
| Unwanted Emissions below 1 GHz | 9 kHz ~ 30 MHz  | 3.1 dB                                  |
|                                | 30 MHz ~ 1 GHz  | 5.1 dB                                  |
| Unwanted Emissions above 1 GHz | 1 GHz ~ 18 GHz  | 5.1 dB                                  |
|                                | 18 GHz ~ 40 GHz | 5.3 dB                                  |

The other instruments specified are routine verified to remain within the calibrated levels, no measurement uncertainty is required to be calculated.

### 2.2 Supplementary Information

There is not any deviation from the test standards for the test method, and no modifications required for compliance.

### 3 General Information

#### 3.1 General Description

|                       |                                                                       |
|-----------------------|-----------------------------------------------------------------------|
| Product               | WiFi 7/BT module                                                      |
| Brand                 | Sparklan                                                              |
| Test Model            | WNFQ-291BEI(BT)                                                       |
| Series Model          | WNFQ-291BE(BT)                                                        |
| Status of EUT         | Engineering sample                                                    |
| Power Supply Rating   | 3.3 Vdc from host equipment                                           |
| Modulation Type       | GFSK                                                                  |
| Modulation Technology | DTS                                                                   |
| Transfer Rate         | Up to 2 Mbps                                                          |
| Operating Frequency   | 2.402 GHz ~ 2.48 GHz                                                  |
| Number of Channel     | 40                                                                    |
| Output Power          | <b>1Tx:</b> 41.21 mW (16.15 dBm)<br><b>2Tx:</b> 50.761 mW (17.06 dBm) |

Note:

1. This report is prepared for FCC class II permissive change. The difference compared with the original design is as the following:
  - ◆ Add Dipole antenna and Chip antenna (Refer to section 3.2)
  - ◆ Change shielding case and add thermal pad.
  - ◆ Change temperature operating range to -40 °C ~ 85 °C
2. According to above conditions, there are RF Output Power and Unwanted Emissions test items need to be performed. All data for meeting the requirement is verified.
3. All models are listed as below.

| Brand    | Model           | Difference                                                                              |
|----------|-----------------|-----------------------------------------------------------------------------------------|
| Sparklan | WNFQ-291BEI(BT) | All models are electrically identical, different model names are for marketing purpose. |
|          | WNFQ-291BE(BT)  |                                                                                         |

From the above models, model: WNFQ-291BEI(BT) was selected as representative model for the test and its data was recorded in this report.

4. There are Bluetooth (EDR, BLE, QHS) and WLAN (2.4 GHz & 5 GHz & 5.9 GHz & 6 GHz) technology used for the EUT.
5. Simultaneously transmission combination.

| DBS         |                       |                     |
|-------------|-----------------------|---------------------|
| Combination | Technology            |                     |
| 1           | WLAN(2.4GHz)_Ant 0+1  | WLAN(5GHz) _Ant 0+1 |
| 2           | WLAN(2.4GHz) _Ant 0+1 | WLAN(6GHz) _Ant 0+1 |

| HBS+BT      |                                         |                                                   |                     |
|-------------|-----------------------------------------|---------------------------------------------------|---------------------|
| Combination | Technology                              |                                                   |                     |
| 3           | Bluetooth_Ant 0+1                       |                                                   | WLAN(5GHz) _Ant 0+1 |
| 4           | Bluetooth_Ant 0+1                       |                                                   | WLAN(6GHz) _Ant 0+1 |
| 5           | WLAN(5GHz_U-NII-1, U-NII-2A)<br>Ant 0+1 | WLAN(5GHz_U-NII-2C, U-NII-3,<br>U-NII-4) _Ant 0+1 | Bluetooth           |
| 6           | WLAN(5GHz_U-NII-1, U-NII-2A)<br>Ant 0+1 | WLAN(6GHz) _Ant 0+1                               | Bluetooth           |

Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.

6. 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.

### 3.2 Antenna Description of EUT

1. The antenna information is listed as below.

| Original    |              |          |               |                                                                              |                                                                                                                                                   |                                                                              |                |                   |                   |
|-------------|--------------|----------|---------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------|-------------------|-------------------|
| Antenna Set | RF Chain No. | Brand    | Model         | Antenna Net Gain (dBi)                                                       | Frequency Range (GHz)                                                                                                                             | Cable Loss (dB)                                                              | Antenna Type   | Connector Type    | Cable Length (mm) |
| 1           | Chain0/1     | Hong-Bo  | 260-25094     | 3.53<br>3.06<br>3.07<br>4.81<br>4.2                                          | 2.4~2.4835<br>5.15~5.25<br>5.25~5.35<br>5.47~5.725<br>5.725~5.850                                                                                 | 0.74<br>1.16<br>1.18<br>1.26<br>1.28                                         | PIFA           | MHF 4L            | 300               |
| 2           | Chain0/1     | Hong-Bo  | 260-25083     | 5.09<br>5.14<br>5.09<br>5.16<br>5.12                                         | 5.850~5.895<br>5.925~6.425<br>6.425~6.525<br>6.525~6.875<br>6.875~7.125                                                                           | 1.29<br>1.35<br>1.38<br>1.45<br>1.50                                         | PIFA           | MHF 4L            | 300               |
| 3           | Chain0/1     | Hong-Bo  | 260-25084     | 3.22<br>3.35<br>3.42<br>4.77<br>4.72<br>4.71<br>4.75<br>4.29<br>4.81<br>4.74 | 2.4~2.4835<br>5.150~5.250<br>5.250~5.350<br>5.470~5.725<br>5.725~5.850<br>5.850~5.895<br>5.925~6.425<br>6.425~6.525<br>6.525~6.875<br>6.875~7.125 | 0.49<br>0.76<br>0.77<br>0.80<br>0.84<br>0.84<br>0.86<br>0.91<br>0.96<br>0.98 | Monopole       | MHF 4L            | 200               |
| Newly       |              |          |               |                                                                              |                                                                                                                                                   |                                                                              |                |                   |                   |
| Antenna Set | RF Chain No. | Brand    | Model         | Antenna Net Gain (dBi)                                                       | Frequency Range (GHz)                                                                                                                             | Antenna Type                                                                 | Connector Type | Cable Length (mm) |                   |
| 4           | Chain0/1     | SparkLAN | AD-513AX      | 3.11<br>4.46<br>4.07<br>4.53<br>4.06<br>4.04<br>3.97                         | 2.4~2.4835<br>5.150~5.850<br>5.850~5.895<br>5.925~6.425<br>6.425~6.525<br>6.525~6.875<br>6.875~7.125                                              | Dipole                                                                       | I-PEX MHF4     | 150               |                   |
| 5           | Chain0/1     | SparkLAN | AD-510AX      | 2.27<br>2.88<br>2.6<br>3.23<br>3.34<br>3.52<br>3.52                          | 2.4~2.4835<br>5.150~5.850<br>5.850~5.895<br>5.925~6.425<br>6.425~6.525<br>6.525~6.875<br>6.875~7.125                                              | Dipole                                                                       | RP-SMA (M)     | 150               |                   |
| 6           | Chain0/1     | SparkLAN | AD-512AX      | 2.35<br>3.00<br>2.80<br>2.87<br>3.02<br>3.02<br>2.61                         | 2.4~2.4835<br>5.150~5.850<br>5.850~5.895<br>5.925~6.425<br>6.425~6.525<br>6.525~6.875<br>6.875~7.125                                              | Dipole                                                                       | RP-SMA (M)     | 150               |                   |
| 7           | Chain0/1     | SparkLAN | AD-516AX      | 1.65<br>4.3<br>3.98<br>4<br>4<br>3.91<br>3.78                                | 2.4~2.4835<br>5.150~5.850<br>5.850~5.895<br>5.925~6.425<br>6.425~6.525<br>6.525~6.875<br>6.875~7.125                                              | Dipole                                                                       | I-PEX MHF4     | 250               |                   |
| 8           | Chain0/1     | Johanson | 2450AD18A6050 | 2<br>1.5<br>2.7<br>2.7<br>2.7<br>2.7<br>2.7                                  | 2.4~2.4835<br>5.150~5.850<br>5.850~5.895<br>5.925~6.425<br>6.425~6.525<br>6.525~6.875<br>6.875~7.125                                              | Chip                                                                         | MHF4L to SMA-F | -                 |                   |

\* Detail antenna specification please refer to antenna datasheet and/or antenna measurement report.

### 3.3 Channel List

40 channels are provided for BT-LE:

| Channel | Frequency (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            |

### 3.4 Test Mode Applicability and Tested Channel Detail

|             |                                                                                                                                                                                                                                                                                                                                          |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pre-Scan:   | 1. The Dipole and Chip of antenna type in antennas can be used in the following ways: X / Y / Z axis.<br>Pre-scan in these ways and find the worst case as a representative test condition.<br>2. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates. |
| Worst Case: | 1. Dipole antenna the worst case was found when positioned on (X / Y / Z axis): Y axis<br>2. Chip antenna the worst case was found when positioned on (X / Y / Z axis): Y axis                                                                                                                                                           |

Following channel(s) was (were) selected for the final test as listed below:

| Test Item                      | EUT Configure Mode | Mode                                                                         | Tested Channel | Tx Antenna | Modulation | Data Rate Parameter |
|--------------------------------|--------------------|------------------------------------------------------------------------------|----------------|------------|------------|---------------------|
| RF Output Power                | -                  | BT-LE 1M                                                                     | 0, 19, 39      | 1Tx / 2Tx  | GFSK       | 1Mb/s               |
|                                |                    | BT-LE 2M                                                                     | 0, 19, 39      |            | GFSK       | 2Mb/s               |
| Unwanted Emissions below 1 GHz | A, B               | BT-LE 1M                                                                     | 19             | 1Tx        | GFSK       | 1Mb/s               |
| Unwanted Emissions above 1 GHz | C, D               | BT-LE 1M                                                                     | 19             | 1Tx / 2Tx  | GFSK       | 1Mb/s               |
| EUT Configure Mode:            | A                  | EUT only (remove 50 ohm terminator and Connect to the appropriate equipment) |                |            |            |                     |
|                                | B                  | EUT with 50 ohm terminator                                                   |                |            |            |                     |
|                                | C                  | EUT with Dipole antenna (Model: AD-513AX)                                    |                |            |            |                     |
|                                | D                  | EUT with Chip antenna (Model: 2450AD18A6050)                                 |                |            |            |                     |

#### Note:

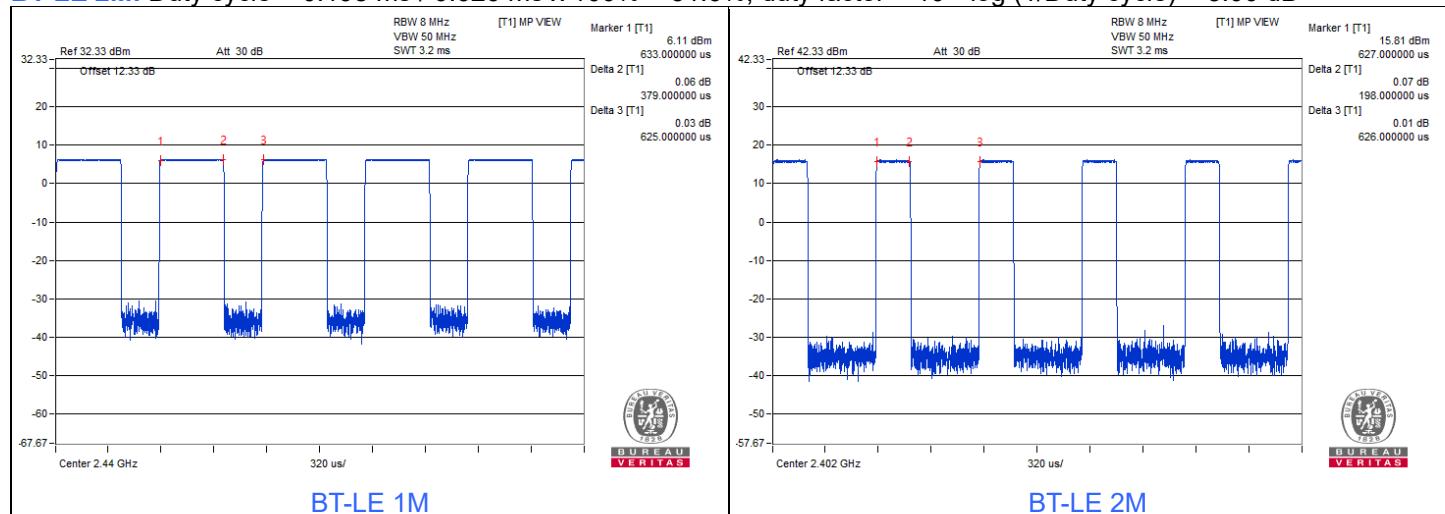
1. For 1Tx diversity configuration the worst chain is: Chain 0.
2. For unwanted emission test items, the tested channel was chosen the worst case as mode represent to report.

### 3.5 Duty Cycle of Test Signal

#### 1Tx

**BT-LE 1M:** Duty cycle =  $0.379 \text{ ms} / 0.625 \text{ ms} \times 100\% = 60.6\%$ , duty factor =  $10 \times \log(1/\text{Duty cycle}) = 2.17 \text{ dB}$

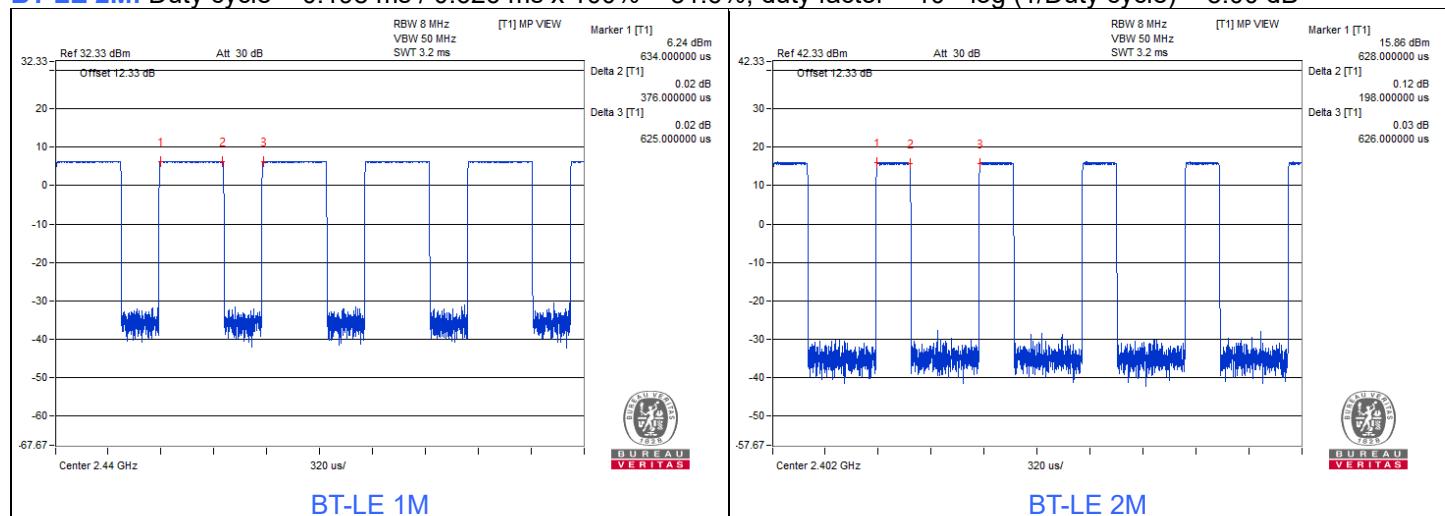
**BT-LE 2M:** Duty cycle =  $0.198 \text{ ms} / 0.626 \text{ ms} \times 100\% = 31.6\%$ , duty factor =  $10 \times \log(1/\text{Duty cycle}) = 5.00 \text{ dB}$



#### 2Tx

**BT-LE 1M:** Duty cycle =  $0.376 \text{ ms} / 0.625 \text{ ms} \times 100\% = 60.2\%$ , duty factor =  $10 \times \log(1/\text{Duty cycle}) = 2.21 \text{ dB}$

**BT-LE 2M:** Duty cycle =  $0.198 \text{ ms} / 0.626 \text{ ms} \times 100\% = 31.6\%$ , duty factor =  $10 \times \log(1/\text{Duty cycle}) = 5.00 \text{ dB}$



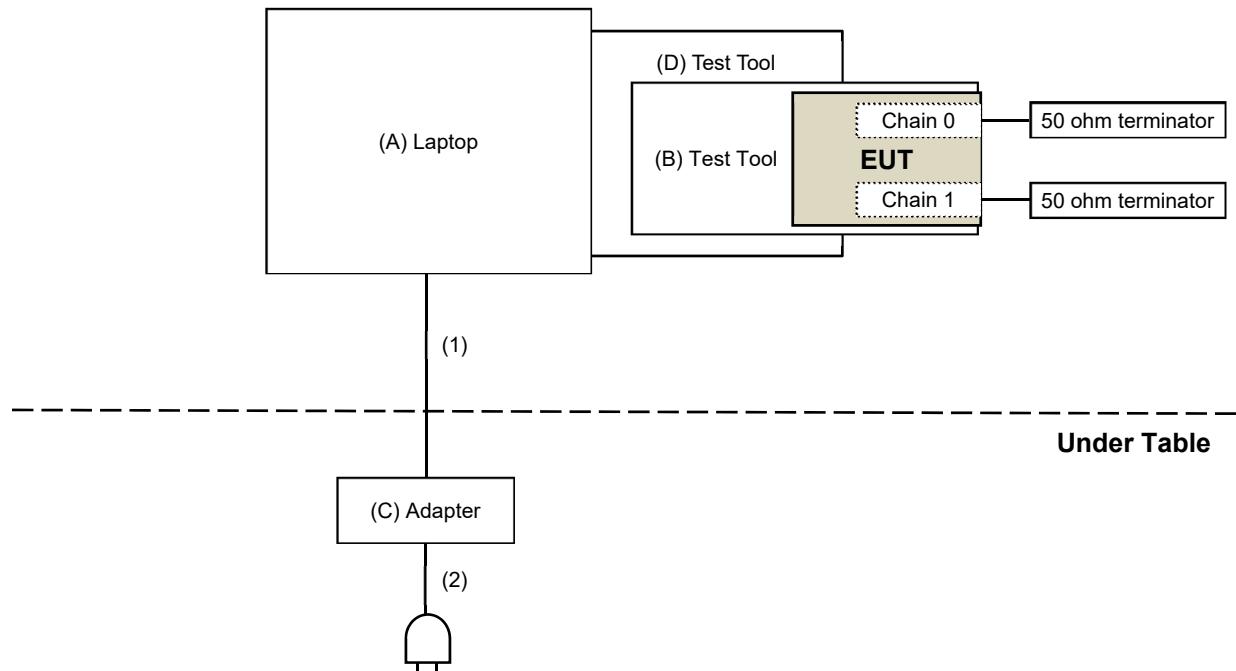
### 3.6 Test Program Used and Operation Descriptions

Controlling software (Bluetooth and ANT QRCT Module V4.0.00031.1) has been activated to set the EUT under transmission condition continuously at specific channel frequency.

### 3.7 Connection Diagram of EUT and Peripheral Devices

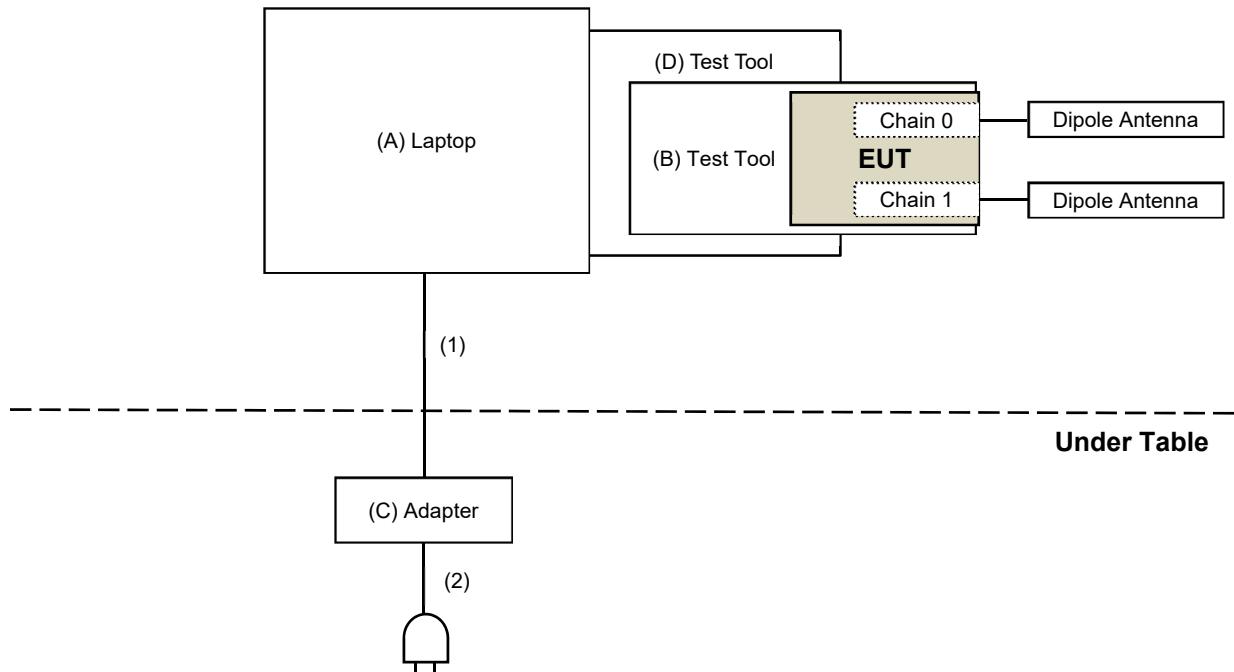
For Unwanted Emission test below 1G

Mode B

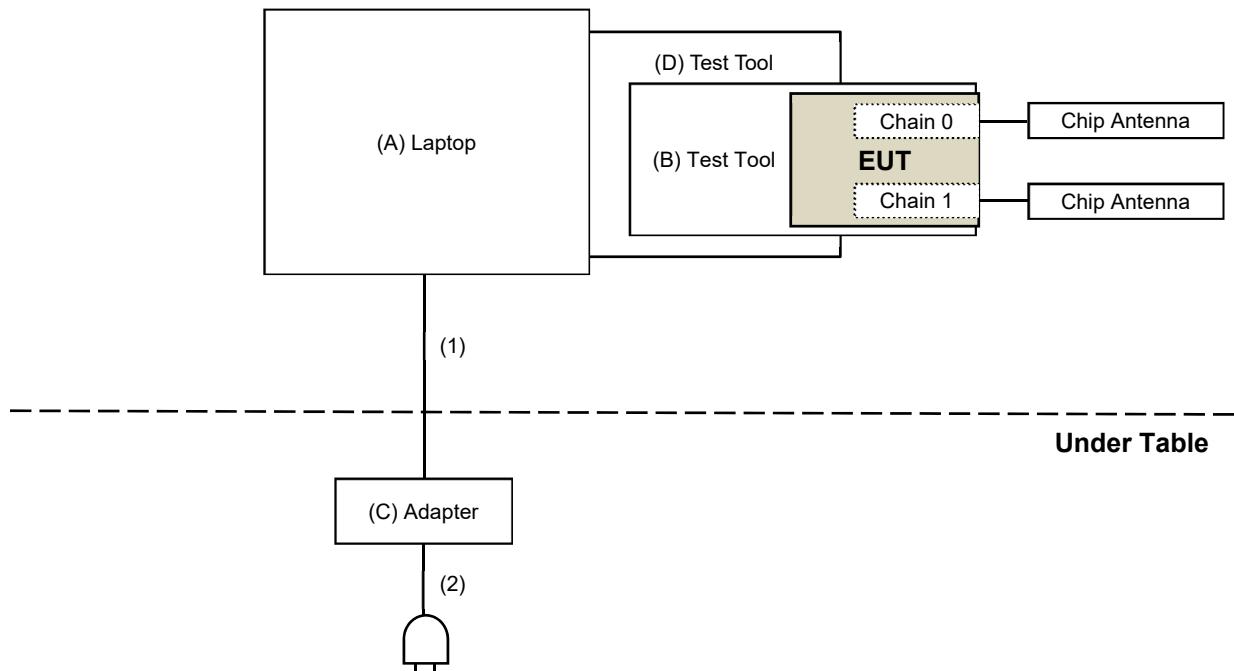


For Unwanted Emission test above 1G

Mode C



Mode D



### 3.8 Configuration of Peripheral Devices and Cable Connections

| ID | Product   | Brand    | Model No. | Serial No. | FCC ID | Remarks               |
|----|-----------|----------|-----------|------------|--------|-----------------------|
| A  | Laptop    | Dell     | E6430     | N/A        | N/A    | Supplied by applicant |
| B  | Test Tool | Qualcomm | N/A       | N/A        | N/A    | Supplied by applicant |
| C  | Adapter   | Dell     | LA65NM130 | N/A        | N/A    | Supplied by applicant |
| D  | Test Tool | Qualcomm | N/A       | N/A        | N/A    | Supplied by applicant |

| ID | Cable Descriptions | Qty. | Length (m) | Shielding (Yes/No) | Cores (Qty.) | Remarks               |
|----|--------------------|------|------------|--------------------|--------------|-----------------------|
| 1  | DC Cable           | 1    | 1.8        | No                 | 0            | Supplied by applicant |
| 2  | AC Cable           | 1    | 1.5        | No                 | 0            | Supplied by applicant |

## 4 Test Instruments

The calibration interval of the all test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

### 4.1 RF Output Power

| Description<br>Manufacturer   | Model No. | Serial No. | Calibrated<br>Date | Calibrated<br>Until |
|-------------------------------|-----------|------------|--------------------|---------------------|
| Pulse Power Sensor<br>Anritsu | MA2411B   | 1726434    | 2024/6/7           | 2025/6/6            |
| RF Power Meter<br>Anritsu     | ML2495A   | 1529002    | 2024/6/7           | 2025/6/6            |

Notes:

1. The test was performed in Oven room 2.
2. Tested Date: 2024/10/26

### 4.2 Unwanted Emissions below 1 GHz

#### Mode A

| Description<br>Manufacturer     | Model No.                        | Serial No. | Calibrated<br>Date | Calibrated<br>Until |
|---------------------------------|----------------------------------|------------|--------------------|---------------------|
| MXA Signal Analyzer<br>Keysight | N9020B                           | MY60112408 | 2024/3/7           | 2025/3/6            |
| Software                        | ADT_RF Test Software<br>V7.6.5.4 | N/A        | N/A                | N/A                 |

Notes:

1. The test was performed in Oven room 2.
2. Tested Date: 2024/10/26

#### Mode B

| Description<br>Manufacturer                         | Model No.            | Serial No.  | Calibrated<br>Date | Calibrated<br>Until |
|-----------------------------------------------------|----------------------|-------------|--------------------|---------------------|
| Bi_Log Antenna<br>Schwarzbeck                       | VULB 9168            | 9168-0842   | 2024/10/8          | 2025/10/7           |
| Boresight Antenna Tower & Turn<br>Table<br>Max-Full | MF-7802BS            | MF780208530 | N/A                | N/A                 |
| EMI Test Receiver<br>R&S                            | ESR7                 | 102026      | 2024/3/25          | 2025/3/24           |
| Fixed Attenuator<br>Mini-Circuits                   | UNAT-5+              | PAD-ATT5-02 | 2024/3/30          | 2025/3/29           |
| Loop Antenna<br>TESEQ                               | HLA 6121             | 63620       | 2024/10/17         | 2025/10/16          |
| Preamplifier<br>EMCI                                | EMC330N              | 980538      | 2024/3/30          | 2025/3/29           |
| PXA Signal Analyzer<br>Keysight                     | EMC001340            | 980142      | 2024/2/19          | 2025/2/18           |
|                                                     | N9030B               | MY57141948  | 2024/5/20          | 2025/5/19           |
| RF Coaxial Cable<br>JYEBAO                          | 5D-FB                | LOOPCAB-001 | 2024/2/19          | 2025/2/18           |
|                                                     |                      | LOOPCAB-002 | 2024/2/19          | 2025/2/18           |
| RF Coaxial Cable<br>PEWC                            | 8D                   | 966-5-1     | 2024/3/30          | 2025/3/29           |
|                                                     |                      | 966-5-2     | 2024/3/30          | 2025/3/29           |
|                                                     |                      | 966-5-3     | 2024/3/30          | 2025/3/29           |
| Software                                            | ADT_Radiated_V8.7.08 | N/A         | N/A                | N/A                 |

Notes:

1. The test was performed in 966 Chamber No. 5.
2. Tested Date: 2024/10/29

#### 4.3 Unwanted Emissions above 1 GHz

| Description<br>Manufacturer                      | Model No.            | Serial No.  | Calibrated<br>Date       | Calibrated<br>Until     |
|--------------------------------------------------|----------------------|-------------|--------------------------|-------------------------|
| Boresight Antenna Tower & Turn Table<br>Max-Full | MF-7802BS            | MF780208530 | N/A                      | N/A                     |
| EMI Test Receiver<br>R&S                         | ESR7                 | 102026      | 2024/3/25                | 2025/3/24               |
| Horn Antenna<br>Schwarzbeck                      | BBHA 9120D           | 9120D-1819  | 2023/11/12<br>2024/11/10 | 2024/11/11<br>2025/11/9 |
|                                                  | BBHA 9170            | 9170-739    | 2023/11/12<br>2024/11/10 | 2024/11/11<br>2025/11/9 |
| Preamplifier<br>EMCI                             | EMC12630SE           | 980509      | 2024/1/29                | 2025/1/28               |
|                                                  | EMC184045SE          | 980387      | 2024/8/8                 | 2025/8/7                |
| PXA Signal Analyzer<br>Keysight                  | N9030B               | MY57141948  | 2024/5/20                | 2025/5/19               |
| RF Coaxial Cable<br>EMCI                         | EMC102-KM-KM-1200    | 160924      | 2024/1/29                | 2025/1/28               |
|                                                  | EMC102-KM-KM-4000    | 200214      | 2024/1/29                | 2025/1/28               |
|                                                  | EMC104-SM-SM-1500    | 180503      | 2024/3/16                | 2025/3/15               |
|                                                  | EMC104-SM-SM-2000    | 180501      | 2024/3/16                | 2025/3/15               |
|                                                  | EMC104-SM-SM-6000    | 180506      | 2024/3/16                | 2025/3/15               |
| Software                                         | ADT_Radiated_V8.7.08 | N/A         | N/A                      | N/A                     |

##### Notes:

1. The test was performed in 966 Chamber No. 5.
2. Tested Date: 2024/10/30 ~ 2024/12/20

## 5 Limits of Test Items

### 5.1 RF Output Power

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

Per KDB 662911 D01 Multiple Transmitter Output Method of conducted output power measurement on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for  $N_{ANT} \leq 4$ ;

Array Gain = 0 dB (i.e., no array gain) for channel widths  $\geq 40$  MHz for any  $N_{ANT}$ ;

Array Gain =  $5 \log(N_{ANT}/N_{SS})$  dB or 3 dB, whichever is less, for 20-MHz channel widths with  $N_{ANT} \geq 5$ .

For power measurements on all other devices: Array Gain =  $10 \log(N_{ANT}/N_{SS})$  dB.

### 5.2 Unwanted Emissions below 1 GHz

Radiated emissions up to 1 GHz which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20 dB below the highest level of the desired power:

| Frequencies (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-------------------|-----------------------------------|-------------------------------|
| 0.009 ~ 0.490     | $2400/F(\text{kHz})$              | 300                           |
| 0.490 ~ 1.705     | $24000/F(\text{kHz})$             | 30                            |
| 1.705 ~ 30.0      | 30                                | 30                            |
| 30 ~ 88           | 100                               | 3                             |
| 88 ~ 216          | 150                               | 3                             |
| 216 ~ 960         | 200                               | 3                             |
| Above 960         | 500                               | 3                             |

Notes:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB<sub>uV</sub>/m) = 20 log Emission level (uV/m).

### 5.3 Unwanted Emissions above 1 GHz

Radiated emissions above 1 GHz which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20 dB below the highest level of the desired power:

| Frequencies (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-------------------|-----------------------------------|-------------------------------|
| Above 960         | 500                               | 3                             |

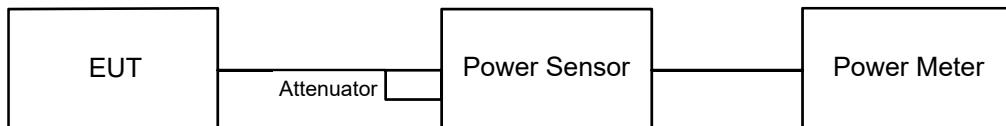
Notes:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB<sub>uV</sub>/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, 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 20 dB under any condition of modulation.

## 6 Test Arrangements

### 6.1 RF Output Power

#### 6.1.1 Test Setup



#### 6.1.2 Test Procedure

##### Peak Power:

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor. Record the power level.

##### Average Power:

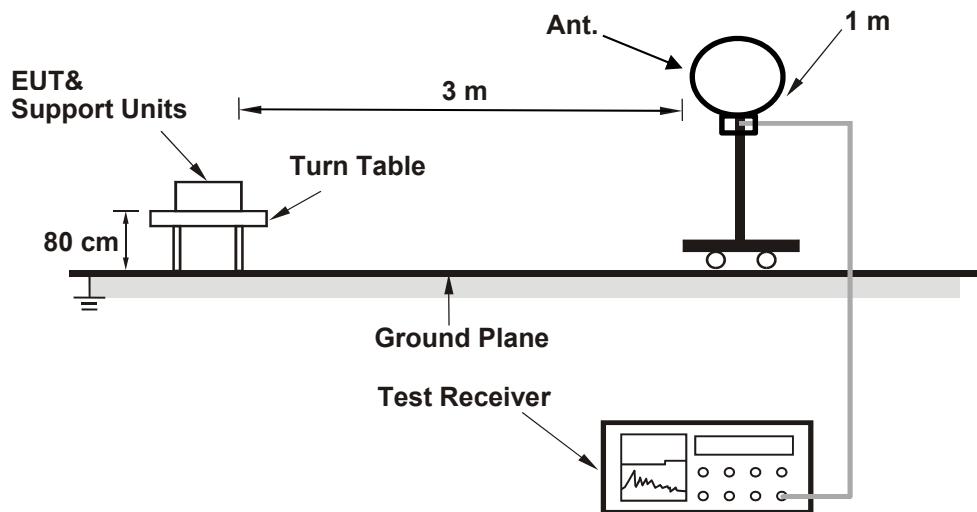
Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

## 6.2 Unwanted Emissions below 1 GHz

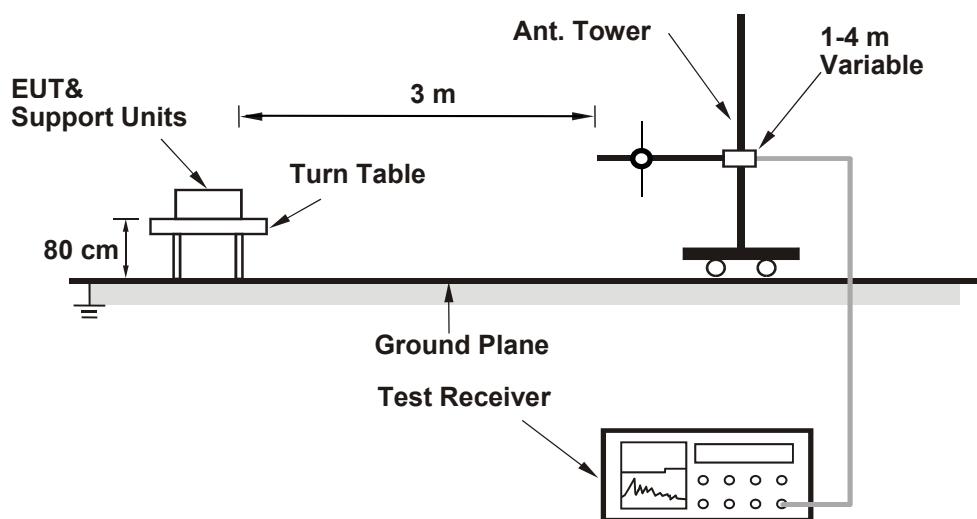
### 6.2.1 Test Setup

**For Radiated Configuration:**

**For Radiated emission below 30 MHz**



**For Radiated emission above 30 MHz**



**For Conducted Configuration:**



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

## 6.2.2 Test Procedure

### Radiated versus Conducted Measurement.

The unwanted emission limits in both the restricted and non-restricted bands are based on antenna-port conducted measurements in conjunction with cabinet emissions tests are permitted to demonstrate compliance.

The following steps was performed:

- a. Cabinet emissions measurements. Radiated measurement was performed to ensure that cabinet emissions are below the emission limits. For the cabinet-emission measurements the antenna was replaced by a termination matching the nominal impedance of the antenna.
- b. Conducted tests was performed using equipment that matches the nominal impedance of the antenna assembly used with the EUT.
- c. EIRP calculation. A value representative of an upper bound on out-of-band antenna gain (in dBi) shall be added to the measured antenna-port conducted emission power to compute EIRP within the specified measurement bandwidth. (For emissions in the restricted bands, additional calculations are required to convert EIRP to field strength at the specified distance.) The upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands or 2 dBi, whichever is greater.
- d. EIRP adjustments for multiple outputs. (Follow the procedures specified in FCC KDB Publication 662911)
- e. For all of Radiation emission test

#### For Radiated emission below 30 MHz

- e-1.1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- e-1.2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- e-1.3. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- e-1.4. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e-1.5. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode, except for the frequency band (9 kHz to 90 kHz and 110 kHz to 490 kHz) set to average detect function and peak detect function.

Notes:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 200 Hz at frequency below 150 kHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz or 10 kHz at frequency (150 kHz to 30 MHz).
3. All modes of operation were investigated and the worst-case emissions are reported.

#### For Radiated emission above 30 MHz

- e-2.1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- e-2.2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- e-2.3. 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.
- e-2.4. 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.
- e-2.5. 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.

Notes:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

## Radiated versus Conducted Measurement

### For Radiated measurement:

The level of unwanted emissions was measured when radiated by the cabinet or structure of the equipment with the antenna connector(s) terminated by a specified load (cabinet radiation).

### For Conducted measurement:

The level of unwanted emissions was measured as their power in a specified load (conducted spurious emissions).

## Conducted Unwanted Emission Convert Formula

- a. Emission Level (dB<sub>UV</sub>/m) = EIRP Level (dBm) – 20log(d) + 104.8

d = measurement distance in 3 meters.

- b. EIRP Level (dBm) = Raw Value(dBm) + Correction Factor(dB)

- c. Correction Factor is directional gain, and the composite gain will be used when signal support the correlated signal.

For the out of band spurious the gain for the specific band may have been used rather than the highest gain across all bands.

For the band edge the gain for the specific band may have been used.

### Notes:

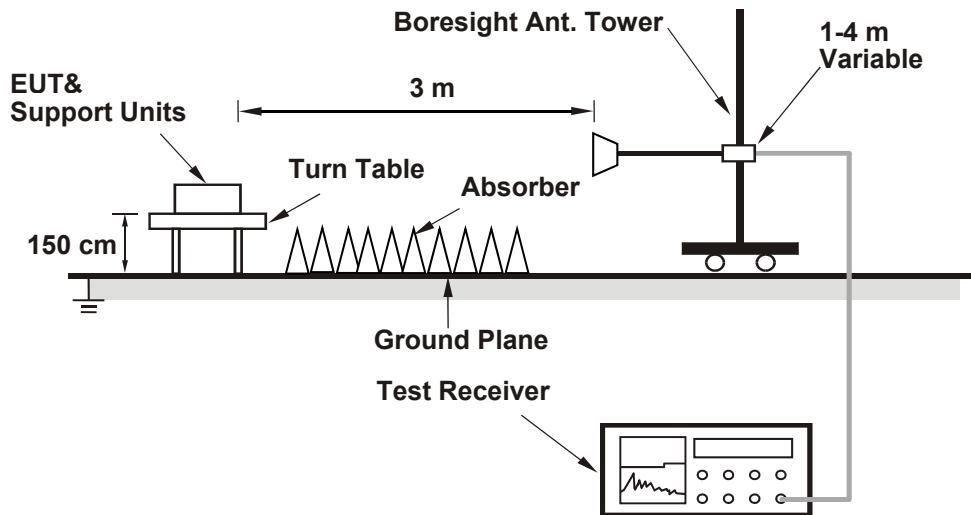
1. In restricted bands below 1000 MHz, add upper bound on ground plane reflection:

For frequencies between 30 MHz and 1000 MHz, add 4.7 dB.

2. The conducted emission test was considered some factor to compute test result.

## 6.3 Unwanted Emissions above 1 GHz

### 6.3.1 Test Setup



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

### 6.3.2 Test Procedure

- The EUT was placed on the top of a rotating table 1.5 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 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.
- 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.
- The test-receiver/spectrum analyzer was set to peak and average detects 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.

Notes:

- The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) and Average detection (AV) at frequency above 1 GHz.
- For harmonic signal measurement, the resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle < 98%) or 10 Hz (Duty cycle  $\geq 98\%$ ) for Average detection (AV) at frequency above 1 GHz.
- All modes of operation were investigated and the worst-case emissions are reported.

## 7 Test Results of Test Item

### 7.1 RF Output Power

|              |         |                           |              |            |          |
|--------------|---------|---------------------------|--------------|------------|----------|
| Input Power: | 3.3 Vdc | Environmental Conditions: | 25°C, 60% RH | Tested By: | Kevin Ko |
|--------------|---------|---------------------------|--------------|------------|----------|

#### 1Tx

##### For Peak Power

##### BT-LE 1M

| Chan. | Chan. Freq. (MHz) | Peak Power (mW) | Peak Power (dBm) | Power Limit (dBm) | Test Result |
|-------|-------------------|-----------------|------------------|-------------------|-------------|
| 0     | 2402              | 37.67           | 15.76            | 30                | Pass        |
| 19    | 2440              | 41.02           | 16.13            | 30                | Pass        |
| 39    | 2480              | 30.903          | 14.90            | 30                | Pass        |

Note: The antenna gain is 3.53 dBi < 6 dBi, so the output power limit shall not be reduced.

##### BT-LE 2M

| Chan. | Chan. Freq. (MHz) | Peak Power (mW) | Peak Power (dBm) | Power Limit (dBm) | Test Result |
|-------|-------------------|-----------------|------------------|-------------------|-------------|
| 0     | 2402              | 37.411          | 15.73            | 30                | Pass        |
| 19    | 2440              | 41.21           | 16.15            | 30                | Pass        |
| 39    | 2480              | 31.989          | 15.05            | 30                | Pass        |

Note: The antenna gain is 3.53 dBi < 6 dBi, so the output power limit shall not be reduced.

##### For Average Power

##### BT-LE 1M

| Chan. | Chan. Freq. (MHz) | Average Power (mW) | Average Power (dBm) |
|-------|-------------------|--------------------|---------------------|
| 0     | 2402              | 35.237             | 15.47               |
| 19    | 2440              | 38.637             | 15.87               |
| 39    | 2480              | 29.242             | 14.66               |

##### BT-LE 2M

| Chan. | Chan. Freq. (MHz) | Average Power (mW) | Average Power (dBm) |
|-------|-------------------|--------------------|---------------------|
| 0     | 2402              | 33.884             | 15.30               |
| 19    | 2440              | 38.371             | 15.84               |
| 39    | 2480              | 30.761             | 14.88               |

|              |         |                           |              |            |          |
|--------------|---------|---------------------------|--------------|------------|----------|
| Input Power: | 3.3 Vdc | Environmental Conditions: | 25°C, 60% RH | Tested By: | Kevin Ko |
|--------------|---------|---------------------------|--------------|------------|----------|

## 2Tx

### For Peak Power

#### BT-LE 1M

| Chan. | Chan. Freq.<br>(MHz) | Peak Power (dBm) |         | Total Power<br>(mW) | Total Power<br>(dBm) | Power Limit<br>(dBm) | Test Result |
|-------|----------------------|------------------|---------|---------------------|----------------------|----------------------|-------------|
|       |                      | Chain 0          | Chain 1 |                     |                      |                      |             |
| 0     | 2402                 | 13.94            | 12.98   | 44.635              | 16.50                | 30                   | Pass        |
| 19    | 2440                 | 14.33            | 13.74   | 50.761              | 17.06                | 30                   | Pass        |
| 39    | 2480                 | 13.24            | 12.58   | 39.2                | 15.93                | 30                   | Pass        |

Note: The directional gain is 3.53 dBi < 6 dBi, so the output power limit shall not be reduced.

#### BT-LE 2M

| Chan. | Chan. Freq.<br>(MHz) | Peak Power (dBm) |         | Total Power<br>(mW) | Total Power<br>(dBm) | Power Limit<br>(dBm) | Test Result |
|-------|----------------------|------------------|---------|---------------------|----------------------|----------------------|-------------|
|       |                      | Chain 0          | Chain 1 |                     |                      |                      |             |
| 0     | 2402                 | 13.88            | 13.01   | 44.433              | 16.48                | 30                   | Pass        |
| 19    | 2440                 | 14.19            | 13.74   | 49.901              | 16.98                | 30                   | Pass        |
| 39    | 2480                 | 13.26            | 12.66   | 39.634              | 15.98                | 30                   | Pass        |

Note: The directional gain is 3.53 dBi < 6 dBi, so the output power limit shall not be reduced.

### For Average Power

#### BT-LE 1M

| Chan. | Chan. Freq.<br>(MHz) | Average Power (dBm) |         | Total Average<br>Power (mW) | Total Average<br>Power (dBm) |
|-------|----------------------|---------------------|---------|-----------------------------|------------------------------|
|       |                      | Chain 0             | Chain 1 |                             |                              |
| 0     | 2402                 | 13.72               | 12.65   | 41.958                      | 16.23                        |
| 19    | 2440                 | 14.06               | 13.51   | 47.907                      | 16.80                        |
| 39    | 2480                 | 12.86               | 12.12   | 35.613                      | 15.52                        |

#### BT-LE 2M

| Chan. | Chan. Freq.<br>(MHz) | Average Power (dBm) |         | Total Average<br>Power (mW) | Total Average<br>Power (dBm) |
|-------|----------------------|---------------------|---------|-----------------------------|------------------------------|
|       |                      | Chain 0             | Chain 1 |                             |                              |
| 0     | 2402                 | 13.49               | 12.71   | 41                          | 16.13                        |
| 19    | 2440                 | 13.99               | 13.45   | 47.192                      | 16.74                        |
| 39    | 2480                 | 13.08               | 12.38   | 37.622                      | 15.75                        |

## 7.2 Unwanted Emissions below 1 GHz

### Mode A

#### 1Tx

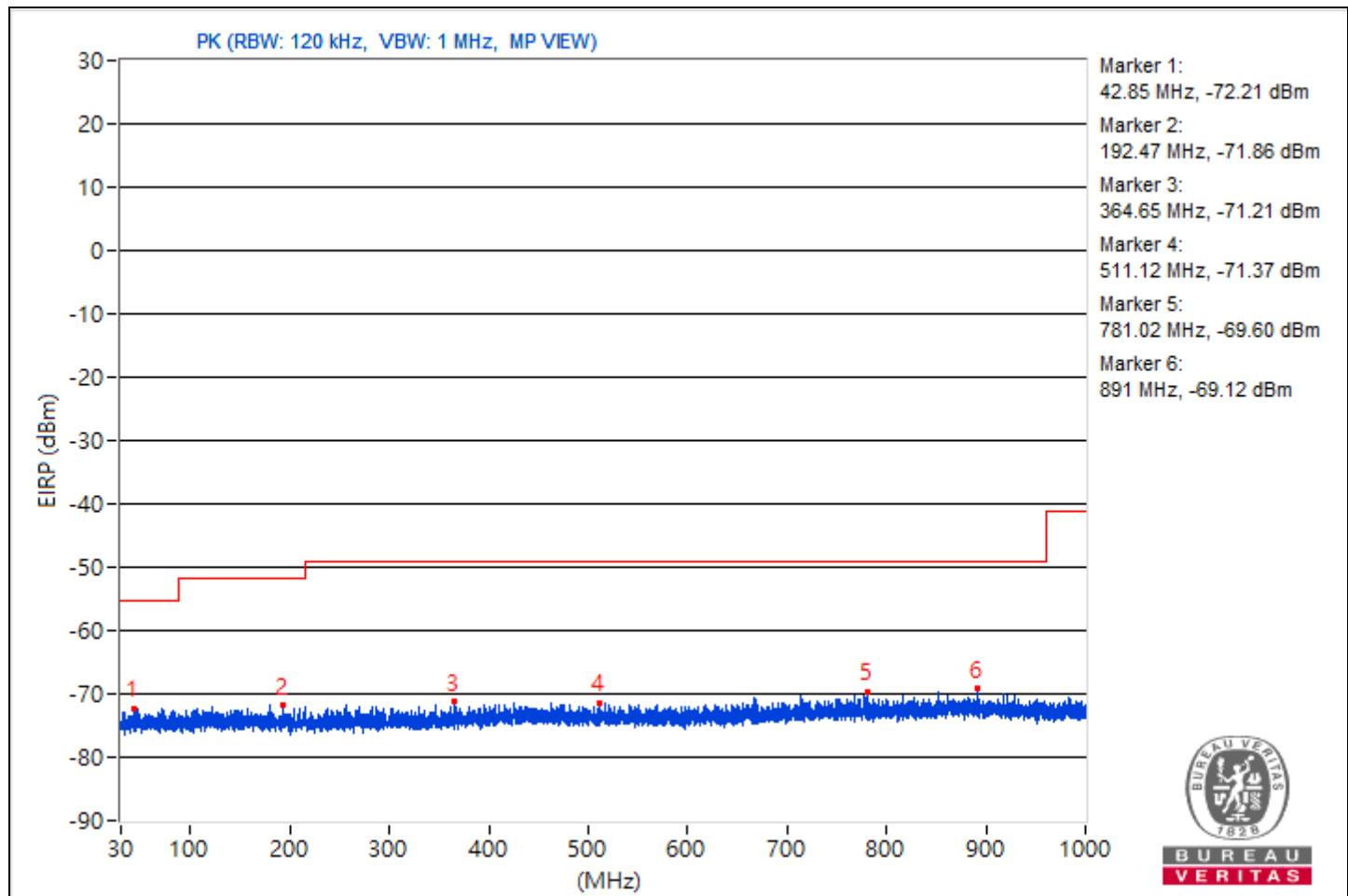
|                 |                |                          |                  |
|-----------------|----------------|--------------------------|------------------|
| RF Mode         | BT-LE 1M       | Channel                  | CH 19 : 2440 MHz |
| Frequency Range | 30 MHz ~ 1 GHz | Environmental Conditions | 22°C, 11% RH     |
| Tested By       | Kevin Ko       |                          |                  |

#### Conducted Unwanted Emissions

| No. | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Raw Value Chain 0 (dBm) | Correction Factor (dB) | EIRP Level (dBm) |
|-----|-----------------|-------------------------|----------------|-------------|-------------------------|------------------------|------------------|
| 1   | 42.85           | 23.05 PK                | 40             | -16.95      | -82.07                  | 9.86                   | -72.21           |
| 2   | 192.47          | 23.4 PK                 | 43.5           | -20.1       | -81.72                  | 9.86                   | -71.86           |
| 3   | 364.65          | 24.05 PK                | 46             | -21.95      | -81.07                  | 9.86                   | -71.21           |
| 4   | 511.12          | 23.89 PK                | 46             | -22.11      | -81.23                  | 9.86                   | -71.37           |
| 5   | 781.02          | 25.66 PK                | 46             | -20.34      | -79.46                  | 9.86                   | -69.6            |
| 6   | 891             | 26.14 PK                | 46             | -19.86      | -78.98                  | 9.86                   | -69.12           |

#### Notes:

1. Margin value = Emission Level - Limit value
2. The frequency range 9 kHz ~ 30 MHz: all emissions are more than 20 dB below the limit, therefore do not be recorded in this report.



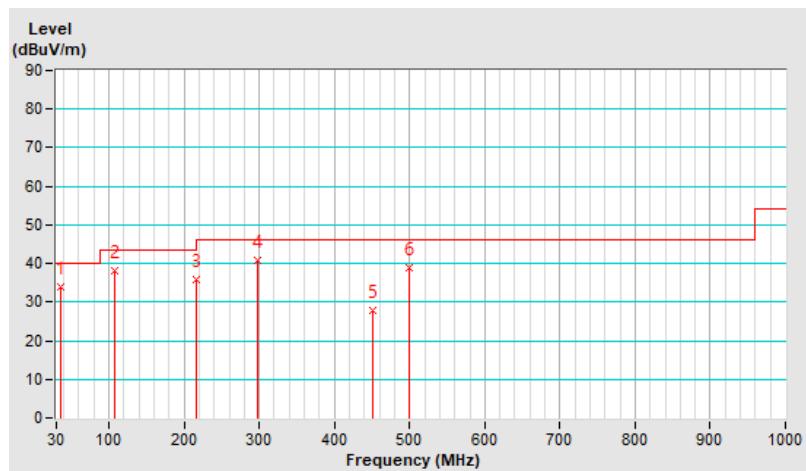
**Mode B**
**1Tx**

|                             |                |                                          |                               |
|-----------------------------|----------------|------------------------------------------|-------------------------------|
| <b>RF Mode</b>              | BT-LE 1M       | <b>Channel</b>                           | CH 19 : 2440 MHz              |
| <b>Frequency Range</b>      | 30 MHz ~ 1 GHz | <b>Detector Function &amp; Bandwidth</b> | QP: RB=120kHz, DET=Quasi-Peak |
| <b>Input Power (System)</b> | 120 Vac, 60 Hz | <b>Environmental Conditions</b>          | 24 °C, 65 % RH                |
| <b>Tested By</b>            | Willy Lin      |                                          |                               |

| Antenna Polarity & Test Distance : Horizontal at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|------------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                   | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                    | 35.61           | 33.9 QP                 | 40.0           | -6.1        | 2.00 H             | 281                  | 52.3             | -18.4                    |
| 2                                                    | 108.20          | 38.1 QP                 | 43.5           | -5.4        | 2.00 H             | 332                  | 58.8             | -20.7                    |
| 3                                                    | 216.40          | 35.9 QP                 | 46.0           | -10.1       | 1.50 H             | 140                  | 56.8             | -20.9                    |
| 4                                                    | 297.47          | 40.8 QP                 | 46.0           | -5.2        | 1.50 H             | 177                  | 57.8             | -17.0                    |
| 5                                                    | 451.47          | 27.7 QP                 | 46.0           | -18.3       | 3.00 H             | 313                  | 40.4             | -12.7                    |
| 6                                                    | 499.58          | 38.9 QP                 | 46.0           | -7.1        | 1.50 H             | 200                  | 50.9             | -12.0                    |

**Remarks:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30 MHz ~ 1 GHz.
5. The frequency range 9 kHz ~ 30 MHz: all emissions are more than 20 dB below the limit, therefore do not be recorded in this report.

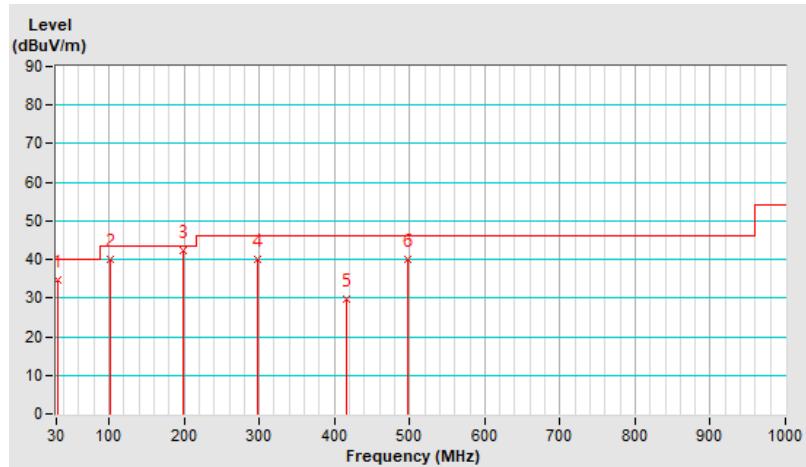


|                             |                |                                          |                               |
|-----------------------------|----------------|------------------------------------------|-------------------------------|
| <b>RF Mode</b>              | BT-LE 1M       | <b>Channel</b>                           | CH 19 : 2440 MHz              |
| <b>Frequency Range</b>      | 30 MHz ~ 1 GHz | <b>Detector Function &amp; Bandwidth</b> | QP: RB=120kHz, DET=Quasi-Peak |
| <b>Input Power (System)</b> | 120 Vac, 60 Hz | <b>Environmental Conditions</b>          | 24 °C, 65 % RH                |
| <b>Tested By</b>            | Willy Lin      |                                          |                               |

| Antenna Polarity & Test Distance : Vertical at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|----------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                 | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                  | 32.25           | 34.8 QP                 | 40.0           | -5.2        | 1.50 V             | 260                  | 53.4             | -18.6                    |
| 2                                                  | 102.66          | 40.1 QP                 | 43.5           | -3.4        | 1.50 V             | 294                  | 61.7             | -21.6                    |
| <b>3</b>                                           | <b>199.60</b>   | <b>42.2 QP</b>          | <b>43.5</b>    | <b>-1.3</b> | <b>2.00 V</b>      | <b>164</b>           | <b>63.1</b>      | <b>-20.9</b>             |
| 4                                                  | 296.91          | 40.1 QP                 | 46.0           | -5.9        | 1.00 V             | 180                  | 57.1             | -17.0                    |
| 5                                                  | 416.35          | 29.6 QP                 | 46.0           | -16.4       | 1.50 V             | 211                  | 43.4             | -13.8                    |
| 6                                                  | 498.33          | 40.0 QP                 | 46.0           | -6.0        | 3.00 V             | 316                  | 52.0             | -12.0                    |

**Remarks:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30 MHz ~ 1 GHz.
5. The frequency range 9 kHz ~ 30 MHz: all emissions are more than 20 dB below the limit, therefore do not be recorded in this report.



### 7.3 Unwanted Emissions above 1 GHz

#### Mode C

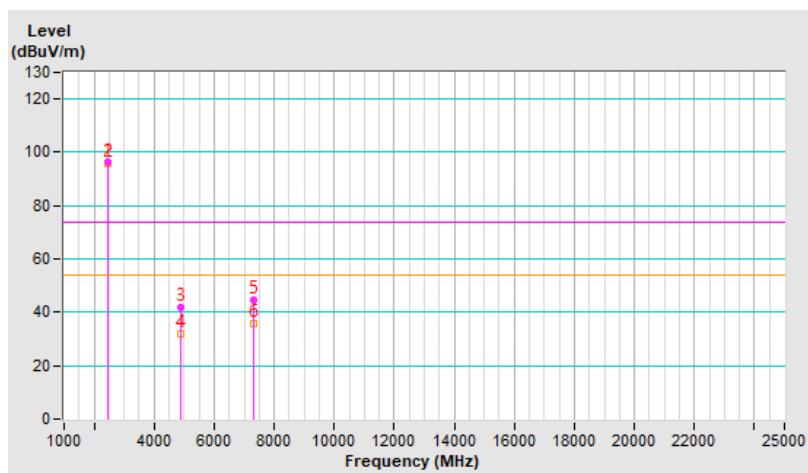
##### 1Tx

|                      |                |                               |                                                                      |
|----------------------|----------------|-------------------------------|----------------------------------------------------------------------|
| RF Mode              | BT-LE 1M       | Channel                       | CH 19 : 2440 MHz                                                     |
| Frequency Range      | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | PK: RB=1 MHz, VB=3 MHz, DET=Peak<br>AV: RB=1 MHz, VB=3 kHz, DET=Peak |
| Input Power (System) | 120 Vac, 60 Hz | Environmental Conditions      | 21 °C, 64 % RH                                                       |
| Tested By            | Willy Lin      |                               |                                                                      |

| Antenna Polarity & Test Distance : Horizontal at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|------------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                   | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                    | *2440.00        | 96.6 PK                 |                |             | 1.05 H             | 115                  | 100.0            | -3.4                     |
| 2                                                    | *2440.00        | 95.6 AV                 |                |             | 1.05 H             | 115                  | 99.0             | -3.4                     |
| 3                                                    | 4880.00         | 41.7 PK                 | 74.0           | -32.3       | 1.64 H             | 144                  | 40.2             | 1.5                      |
| 4                                                    | 4880.00         | 31.8 AV                 | 54.0           | -22.2       | 1.64 H             | 144                  | 30.3             | 1.5                      |
| 5                                                    | 7320.00         | 44.7 PK                 | 74.0           | -29.3       | 1.81 H             | 252                  | 37.1             | 7.6                      |
| 6                                                    | 7320.00         | 35.8 AV                 | 54.0           | -18.2       | 1.81 H             | 252                  | 28.2             | 7.6                      |

#### Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency, the limit was restricted at the RF Output Power.

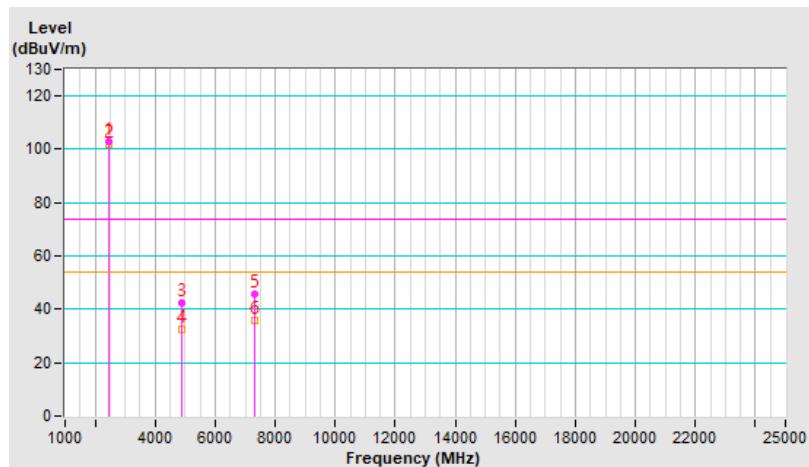


|                             |                |                                          |                                                                      |
|-----------------------------|----------------|------------------------------------------|----------------------------------------------------------------------|
| <b>RF Mode</b>              | BT-LE 1M       | <b>Channel</b>                           | CH 19 : 2440 MHz                                                     |
| <b>Frequency Range</b>      | 1 GHz ~ 25 GHz | <b>Detector Function &amp; Bandwidth</b> | PK: RB=1 MHz, VB=3 MHz, DET=Peak<br>AV: RB=1 MHz, VB=3 kHz, DET=Peak |
| <b>Input Power (System)</b> | 120 Vac, 60 Hz | <b>Environmental Conditions</b>          | 21 °C, 64 % RH                                                       |
| <b>Tested By</b>            | Willy Lin      |                                          |                                                                      |

| Antenna Polarity & Test Distance : Vertical at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|----------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                 | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                  | *2440.00        | 103.1 PK                |                |             | 1.50 V             | 282                  | 106.5            | -3.4                     |
| 2                                                  | *2440.00        | 102.1 AV                |                |             | 1.50 V             | 282                  | 105.5            | -3.4                     |
| 3                                                  | 4880.00         | 42.6 PK                 | 74.0           | -31.4       | 1.65 V             | 157                  | 41.1             | 1.5                      |
| 4                                                  | 4880.00         | 32.4 AV                 | 54.0           | -21.6       | 1.65 V             | 157                  | 30.9             | 1.5                      |
| 5                                                  | 7320.00         | 45.8 PK                 | 74.0           | -28.2       | 1.95 V             | 299                  | 38.2             | 7.6                      |
| 6                                                  | 7320.00         | 35.9 AV                 | 54.0           | -18.1       | 1.95 V             | 299                  | 28.3             | 7.6                      |

**Remarks:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency, the limit was restricted at the RF Output Power.



## 2Tx

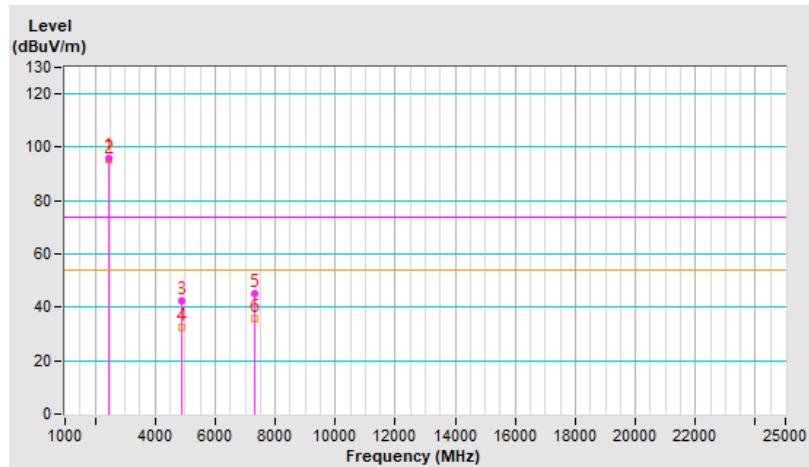
|                      |                |                               |                                                                      |
|----------------------|----------------|-------------------------------|----------------------------------------------------------------------|
| RF Mode              | BT-LE 1M       | Channel                       | CH 19 : 2440 MHz                                                     |
| Frequency Range      | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | PK: RB=1 MHz, VB=3 MHz, DET=Peak<br>AV: RB=1 MHz, VB=3 kHz, DET=Peak |
| Input Power (System) | 120 Vac, 60 Hz | Environmental Conditions      | 21 °C, 64 % RH                                                       |
| Tested By            | Willy Lin      |                               |                                                                      |

## Antenna Polarity &amp; Test Distance : Horizontal at 3 m

| No | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
|----|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| 1  | *2440.00        | 96.1 PK                 |                |             | 1.06 H             | 113                  | 99.5             | -3.4                     |
| 2  | *2440.00        | 95.3 AV                 |                |             | 1.06 H             | 113                  | 98.7             | -3.4                     |
| 3  | 4880.00         | 42.6 PK                 | 74.0           | -31.4       | 1.67 H             | 151                  | 41.1             | 1.5                      |
| 4  | 4880.00         | 32.4 AV                 | 54.0           | -21.6       | 1.67 H             | 151                  | 30.9             | 1.5                      |
| 5  | 7320.00         | 45.3 PK                 | 74.0           | -28.7       | 1.87 H             | 254                  | 37.7             | 7.6                      |
| 6  | 7320.00         | 35.8 AV                 | 54.0           | -18.2       | 1.87 H             | 254                  | 28.2             | 7.6                      |

## Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency, the limit was restricted at the RF Output Power.

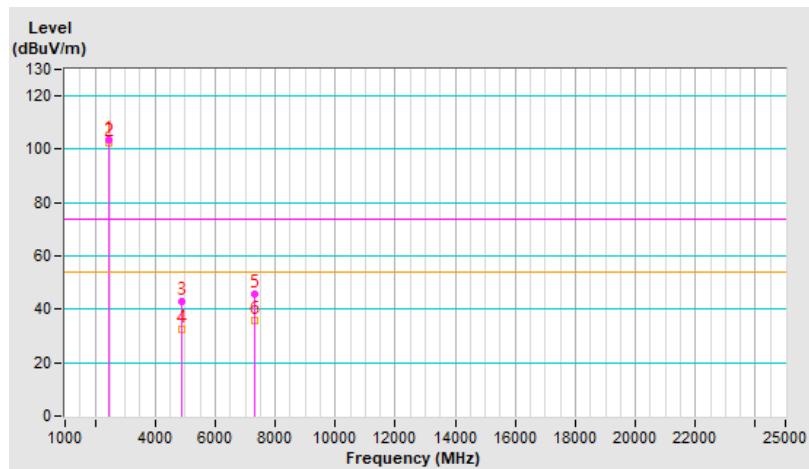


|                             |                |                                          |                                                                      |
|-----------------------------|----------------|------------------------------------------|----------------------------------------------------------------------|
| <b>RF Mode</b>              | BT-LE 1M       | <b>Channel</b>                           | CH 19 : 2440 MHz                                                     |
| <b>Frequency Range</b>      | 1 GHz ~ 25 GHz | <b>Detector Function &amp; Bandwidth</b> | PK: RB=1 MHz, VB=3 MHz, DET=Peak<br>AV: RB=1 MHz, VB=3 kHz, DET=Peak |
| <b>Input Power (System)</b> | 120 Vac, 60 Hz | <b>Environmental Conditions</b>          | 21 °C, 64 % RH                                                       |
| <b>Tested By</b>            | Willy Lin      |                                          |                                                                      |

| Antenna Polarity & Test Distance : Vertical at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|----------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                 | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                  | *2440.00        | 103.4 PK                |                |             | 1.43 V             | 276                  | 106.8            | -3.4                     |
| 2                                                  | *2440.00        | 102.3 AV                |                |             | 1.43 V             | 276                  | 105.7            | -3.4                     |
| 3                                                  | 4880.00         | 42.7 PK                 | 74.0           | -31.3       | 1.68 V             | 138                  | 41.2             | 1.5                      |
| 4                                                  | 4880.00         | 32.5 AV                 | 54.0           | -21.5       | 1.68 V             | 138                  | 31.0             | 1.5                      |
| 5                                                  | 7320.00         | 45.9 PK                 | 74.0           | -28.1       | 1.93 V             | 269                  | 38.3             | 7.6                      |
| 6                                                  | 7320.00         | 35.9 AV                 | 54.0           | -18.1       | 1.93 V             | 269                  | 28.3             | 7.6                      |

**Remarks:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency, the limit was restricted at the RF Output Power.



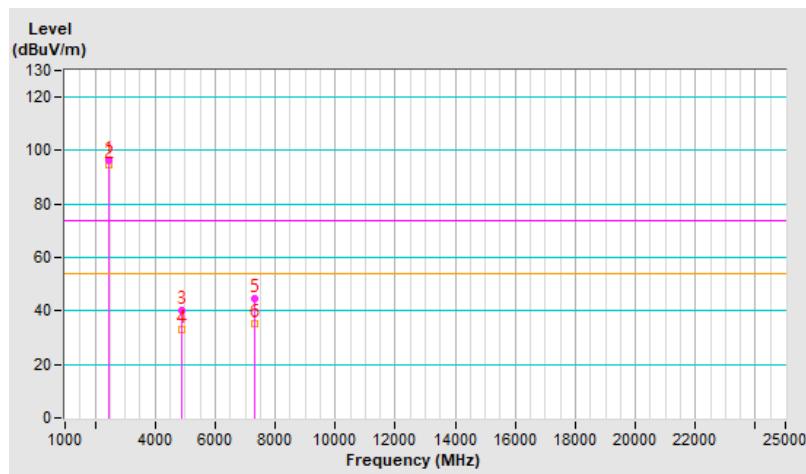
**Mode D**
**1Tx**

|                             |                |                                          |                                                                      |
|-----------------------------|----------------|------------------------------------------|----------------------------------------------------------------------|
| <b>RF Mode</b>              | BT-LE 1M       | <b>Channel</b>                           | CH 19 : 2440 MHz                                                     |
| <b>Frequency Range</b>      | 1 GHz ~ 25 GHz | <b>Detector Function &amp; Bandwidth</b> | PK: RB=1 MHz, VB=3 MHz, DET=Peak<br>AV: RB=1 MHz, VB=3 kHz, DET=Peak |
| <b>Input Power (System)</b> | 120 Vac, 60 Hz | <b>Environmental Conditions</b>          | 25 °C, 75 % RH                                                       |
| <b>Tested By</b>            | Tank Wu        |                                          |                                                                      |

| Antenna Polarity & Test Distance : Horizontal at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|------------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                   | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                    | *2440.00        | 96.2 PK                 |                |             | 3.76 H             | 224                  | 99.9             | -3.7                     |
| 2                                                    | *2440.00        | 94.8 AV                 |                |             | 3.76 H             | 224                  | 98.5             | -3.7                     |
| 3                                                    | 4880.00         | 40.4 PK                 | 74.0           | -33.6       | 2.39 H             | 253                  | 39.0             | 1.4                      |
| 4                                                    | 4880.00         | 33.1 AV                 | 54.0           | -20.9       | 2.39 H             | 253                  | 31.7             | 1.4                      |
| 5                                                    | 7320.00         | 44.7 PK                 | 74.0           | -29.3       | 1.31 H             | 359                  | 37.5             | 7.2                      |
| 6                                                    | 7320.00         | 35.2 AV                 | 54.0           | -18.8       | 1.31 H             | 359                  | 28.0             | 7.2                      |

**Remarks:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency, the limit was restricted at the RF Output Power.

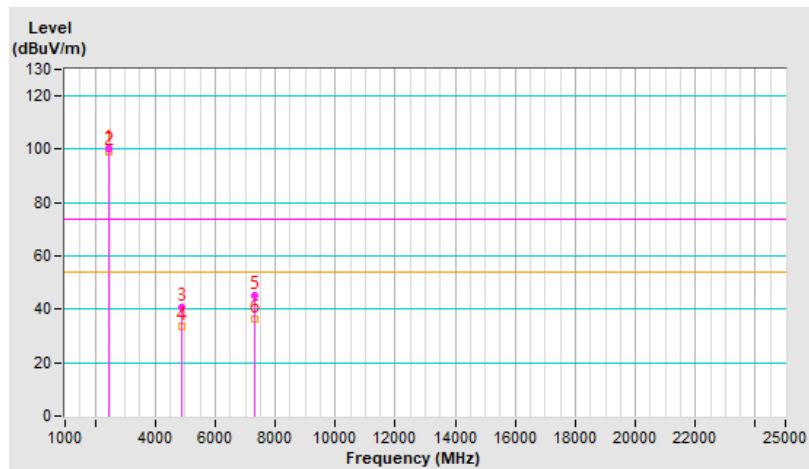


|                             |                |                                          |                                                                      |
|-----------------------------|----------------|------------------------------------------|----------------------------------------------------------------------|
| <b>RF Mode</b>              | BT-LE 1M       | <b>Channel</b>                           | CH 19 : 2440 MHz                                                     |
| <b>Frequency Range</b>      | 1 GHz ~ 25 GHz | <b>Detector Function &amp; Bandwidth</b> | PK: RB=1 MHz, VB=3 MHz, DET=Peak<br>AV: RB=1 MHz, VB=3 kHz, DET=Peak |
| <b>Input Power (System)</b> | 120 Vac, 60 Hz | <b>Environmental Conditions</b>          | 25 °C, 75 % RH                                                       |
| <b>Tested By</b>            | Tank Wu        |                                          |                                                                      |

| Antenna Polarity & Test Distance : Vertical at 3 m |                 |                         |                |              |                    |                      |                  |                          |
|----------------------------------------------------|-----------------|-------------------------|----------------|--------------|--------------------|----------------------|------------------|--------------------------|
| No                                                 | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB)  | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                  | *2440.00        | 100.2 PK                |                |              | 1.06 V             | 7                    | 103.9            | -3.7                     |
| 2                                                  | *2440.00        | 99.1 AV                 |                |              | 1.06 V             | 7                    | 102.8            | -3.7                     |
| 3                                                  | 4880.00         | 40.7 PK                 | 74.0           | -33.3        | 1.52 V             | 108                  | 39.3             | 1.4                      |
| 4                                                  | 4880.00         | 33.7 AV                 | 54.0           | -20.3        | 1.52 V             | 108                  | 32.3             | 1.4                      |
| 5                                                  | 7320.00         | 45.3 PK                 | 74.0           | -28.7        | 1.65 V             | 305                  | 38.1             | 7.2                      |
| 6                                                  | <b>7320.00</b>  | <b>36.4 AV</b>          | <b>54.0</b>    | <b>-17.6</b> | <b>1.65 V</b>      | <b>305</b>           | <b>29.2</b>      | <b>7.2</b>               |

**Remarks:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency, the limit was restricted at the RF Output Power.



## 2Tx

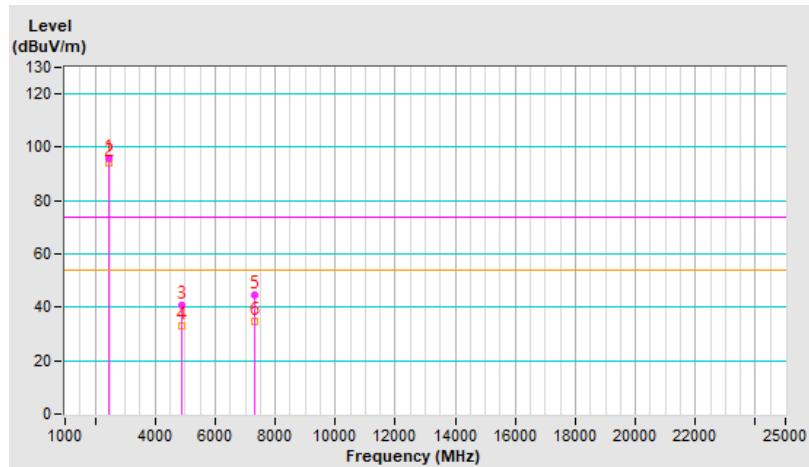
|                      |                |                               |                                                                      |
|----------------------|----------------|-------------------------------|----------------------------------------------------------------------|
| RF Mode              | BT-LE 1M       | Channel                       | CH 19 : 2440 MHz                                                     |
| Frequency Range      | 1 GHz ~ 25 GHz | Detector Function & Bandwidth | PK: RB=1 MHz, VB=3 MHz, DET=Peak<br>AV: RB=1 MHz, VB=3 kHz, DET=Peak |
| Input Power (System) | 120 Vac, 60 Hz | Environmental Conditions      | 25 °C, 75 % RH                                                       |
| Tested By            | Tank Wu        |                               |                                                                      |

## Antenna Polarity &amp; Test Distance : Horizontal at 3 m

| No | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
|----|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| 1  | *2440.00        | 95.8 PK                 |                |             | 1.00 H             | 167                  | 99.5             | -3.7                     |
| 2  | *2440.00        | 94.2 AV                 |                |             | 1.00 H             | 167                  | 97.9             | -3.7                     |
| 3  | 4880.00         | 40.6 PK                 | 74.0           | -33.4       | 2.27 H             | 268                  | 39.2             | 1.4                      |
| 4  | 4880.00         | 32.8 AV                 | 54.0           | -21.2       | 2.27 H             | 268                  | 31.4             | 1.4                      |
| 5  | 7320.00         | 44.6 PK                 | 74.0           | -29.4       | 1.02 H             | 269                  | 37.4             | 7.2                      |
| 6  | 7320.00         | 34.7 AV                 | 54.0           | -19.3       | 1.02 H             | 269                  | 27.5             | 7.2                      |

## Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency, the limit was restricted at the RF Output Power.

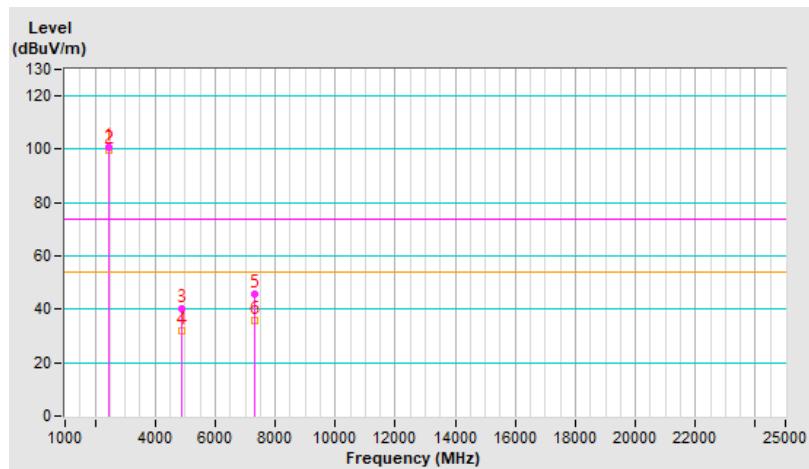


|                             |                |                                          |                                                                      |
|-----------------------------|----------------|------------------------------------------|----------------------------------------------------------------------|
| <b>RF Mode</b>              | BT-LE 1M       | <b>Channel</b>                           | CH 19 : 2440 MHz                                                     |
| <b>Frequency Range</b>      | 1 GHz ~ 25 GHz | <b>Detector Function &amp; Bandwidth</b> | PK: RB=1 MHz, VB=3 MHz, DET=Peak<br>AV: RB=1 MHz, VB=3 kHz, DET=Peak |
| <b>Input Power (System)</b> | 120 Vac, 60 Hz | <b>Environmental Conditions</b>          | 25 °C, 75 % RH                                                       |
| <b>Tested By</b>            | Tank Wu        |                                          |                                                                      |

| Antenna Polarity & Test Distance : Vertical at 3 m |                 |                         |                |             |                    |                      |                  |                          |
|----------------------------------------------------|-----------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| No                                                 | Frequency (MHz) | Emission Level (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (m) | Table Angle (Degree) | Raw Value (dBuV) | Correction Factor (dB/m) |
| 1                                                  | *2440.00        | 100.8 PK                |                |             | 2.75 V             | 125                  | 104.5            | -3.7                     |
| 2                                                  | *2440.00        | 99.9 AV                 |                |             | 2.75 V             | 125                  | 103.6            | -3.7                     |
| 3                                                  | 4880.00         | 40.4 PK                 | 74.0           | -33.6       | 2.24 V             | 118                  | 39.0             | 1.4                      |
| 4                                                  | 4880.00         | 31.9 AV                 | 54.0           | -22.1       | 2.24 V             | 118                  | 30.5             | 1.4                      |
| 5                                                  | 7320.00         | 45.7 PK                 | 74.0           | -28.3       | 1.32 V             | 295                  | 38.5             | 7.2                      |
| 6                                                  | 7320.00         | 35.9 AV                 | 54.0           | -18.1       | 1.32 V             | 295                  | 28.7             | 7.2                      |

**Remarks:**

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency, the limit was restricted at the RF Output Power.



## 8 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo)

## 9 Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

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

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### **Hwa Ya EMC/RF/Safety Lab**

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**Web Site:** <http://ee.bureauveritas.com.tw>

The address and road map of all our labs can be found in our web site also.

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