

# FCC Test Report

|              |                     |
|--------------|---------------------|
| Product Name | Wireless USB Dongle |
| Model No.    | END988W             |
| FCC ID.      | BCE-END988W         |

|           |                                          |
|-----------|------------------------------------------|
| Applicant | GN Audio A/S                             |
| Address   | Lautrupbjerg 7,DK-2750 Ballerup,Denmark. |

|                 |                     |
|-----------------|---------------------|
| Date of Receipt | Nov. 28, 2017       |
| Issued Date     | Jan. 03, 2018       |
| Report No.      | 17B0489R-RFUSP02V00 |
| Report Version  | V1.0                |



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.

This report must not be used to claim product endorsement by TAF or any agency of the government.

The test report shall not be reproduced without the written approval of DEKRA Testing and Certification Co., Ltd.

# Test Report

Issued Date: Jan. 03, 2018

Report No.: 17B0489R-RFUSP02V00



|                     |                                                                                                                         |
|---------------------|-------------------------------------------------------------------------------------------------------------------------|
| Product Name        | Wireless USB Dongle                                                                                                     |
| Applicant           | GN Audio A/S                                                                                                            |
| Address             | Lautrupbjerg 7,DK-2750 Ballerup,Denmark.                                                                                |
| Manufacturer        | GN Audio A/S                                                                                                            |
| Model No.           | END988W                                                                                                                 |
| FCC ID.             | BCE-END988W                                                                                                             |
| EUT Rated Voltage   | DC 5V                                                                                                                   |
| EUT Test Voltage    | DC 5V                                                                                                                   |
| Trade Name          | ALIENWARE                                                                                                               |
| Applicable Standard | FCC CFR Title 47 Part 15 Subpart C: 2016<br>ANSI C63.4: 2014, ANSI C63.10: 2013<br>KDB 558074 D01 DTS Meas Guidance v04 |
| Test Result         | Complied                                                                                                                |

Documented By :



( Senior Adm. Specialist / Joanne Lin )

Tested By :



( Engineer / Kevin Liu )

Approved By :



( Director / Vincent Lin )

## TABLE OF CONTENTS

| Description                                                     | Page      |
|-----------------------------------------------------------------|-----------|
| <b>1. GENERAL INFORMATION .....</b>                             | <b>4</b>  |
| 1.1. EUT Description.....                                       | 4         |
| 1.2. Operational Description.....                               | 6         |
| 1.3. Tested System Details.....                                 | 7         |
| 1.4. Configuration of Tested System .....                       | 7         |
| 1.5. EUT Exercise Software .....                                | 7         |
| 1.6. Test Facility .....                                        | 8         |
| 1.7. List of Test Equipment.....                                | 9         |
| <b>2. CONDUCTED EMISSION .....</b>                              | <b>10</b> |
| 2.1. Test Setup .....                                           | 10        |
| 2.2. Limits.....                                                | 10        |
| 2.3. Test Procedure .....                                       | 11        |
| 2.4. Uncertainty .....                                          | 11        |
| 2.5. Test Result of Conducted Emission.....                     | 12        |
| <b>3. PEAK POWER OUTPUT .....</b>                               | <b>14</b> |
| 3.1. Test Setup .....                                           | 14        |
| 3.2. Limit .....                                                | 14        |
| 3.3. Test Procedure .....                                       | 14        |
| 3.4. Uncertainty .....                                          | 14        |
| 3.5. Test Result of Peak Power Output.....                      | 15        |
| <b>4. RADIATED EMISSION .....</b>                               | <b>16</b> |
| 4.1. Test Setup .....                                           | 16        |
| 4.2. Limits.....                                                | 17        |
| 4.3. Test Procedure .....                                       | 18        |
| 4.4. Uncertainty .....                                          | 19        |
| 4.5. Test Result of Radiated Emission.....                      | 20        |
| <b>5. RF ANTENNA CONDUCTED TEST .....</b>                       | <b>24</b> |
| 5.1. Test Setup .....                                           | 24        |
| 5.2. Limits.....                                                | 24        |
| 5.3. Test Procedure .....                                       | 24        |
| 5.4. Uncertainty .....                                          | 24        |
| 5.5. Test Result of RF Antenna Conducted Test .....             | 25        |
| <b>6. BAND EDGE .....</b>                                       | <b>26</b> |
| 6.1. Test Setup .....                                           | 26        |
| 6.2. Limit .....                                                | 27        |
| 6.3. Test Procedure .....                                       | 27        |
| 6.4. Uncertainty .....                                          | 28        |
| 6.5. Test Result of Band Edge .....                             | 29        |
| <b>7. 6DB BANDWIDTH .....</b>                                   | <b>33</b> |
| 7.1. Test Setup .....                                           | 33        |
| 7.2. Limits.....                                                | 33        |
| 7.3. Test Procedure .....                                       | 33        |
| 7.4. Uncertainty .....                                          | 33        |
| 7.5. Test Result of 6dB Bandwidth.....                          | 34        |
| <b>8. POWER DENSITY .....</b>                                   | <b>36</b> |
| 8.1. Test Setup .....                                           | 36        |
| 8.2. Limits.....                                                | 36        |
| 8.3. Test Procedure .....                                       | 36        |
| 8.4. Uncertainty .....                                          | 36        |
| 8.5. Test Result of Power Density .....                         | 37        |
| <b>9. DUTY CYCLE .....</b>                                      | <b>39</b> |
| 9.1. Test Setup .....                                           | 39        |
| 9.2. Test Procedure .....                                       | 39        |
| 9.3. Uncertainty .....                                          | 39        |
| 9.4. Test Result of Duty Cycle.....                             | 40        |
| <b>10. EMI REDUCTION METHOD DURING COMPLIANCE TESTING .....</b> | <b>41</b> |

## 1. GENERAL INFORMATION

### 1.1. EUT Description

|                    |                                   |
|--------------------|-----------------------------------|
| Product Name       | Wireless USB Dongle               |
| Trade Name         | ALIENWARE                         |
| Model No.          | END988W                           |
| FCC ID.            | BCE-END988W                       |
| Frequency Range    | 2403.35-2477.35MHz                |
| Channel Number     | 38CH                              |
| Type of Modulation | $\pi/4$ DQPSK                     |
| Antenna Type       | IFA Antenna                       |
| Channel Control    | Auto                              |
| Antenna Gain       | Refer to the table “Antenna List” |

#### Antenna List

| No. | Manufacturer | Part No. | Antenna Type | Peak Gain |
|-----|--------------|----------|--------------|-----------|
| 1   | GN           | N/A      | IFA Antenna  | -2.81dBi  |

Note: The antenna of EUT is conforming to FCC 15.203.

## Center Frequency of Each Channel:

| Channel     | Frequency   | Channel     | Frequency   | Channel     | Frequency  | Channel     | Frequency  |
|-------------|-------------|-------------|-------------|-------------|------------|-------------|------------|
| Channel 01: | 2403.35 MHz | Channel 02: | 2405.35 MHz | Channel 03: | 2407.35MHz | Channel 04: | 2409.35MHz |
| Channel 05: | 2411.35MHz  | Channel 06: | 2413.35MHz  | Channel 07: | 2415.35MHz | Channel 08: | 2417.35MHz |
| Channel 09: | 2419.35MHz  | Channel 10: | 2421.35MHz  | Channel 11: | 2423.35MHz | Channel 12: | 2425.35MHz |
| Channel 13: | 2427.35MHz  | Channel 14: | 2429.35MHz  | Channel 15: | 2431.35MHz | Channel 16: | 2433.35MHz |
| Channel 17: | 2435.35MHz  | Channel 18: | 2437.35MHz  | Channel 19: | 2439.35MHz | Channel 20: | 2441.35MHz |
| Channel 21: | 2443.35MHz  | Channel 22: | 2445.35MHz  | Channel 23: | 2447.35MHz | Channel 24: | 2449.35MHz |
| Channel 25: | 2451.35MHz  | Channel 26: | 2453.35MHz  | Channel 27: | 2455.35MHz | Channel 28: | 2457.35MHz |
| Channel 29: | 2459.35MHz  | Channel 30: | 2461.35MHz  | Channel 31: | 2463.35MHz | Channel 32: | 2465.35MHz |
| Channel 33: | 2467.35MHz  | Channel 34: | 2469.35MHz  | Channel 35: | 2471.35MHz | Channel 36: | 2473.35MHz |
| Channel 37: | 2475.35MHz  | Channel 38: | 2477.35MHz  |             |            |             |            |

## Note:

1. The EUT is a Wireless USB Dongle with a built-in 2.4GHz transmitter.
2. These tests were conducted on a sample for the purpose of demonstrating compliance of 2.4GHz transmitter with Part 15 Subpart C Paragraph 15.247 for spread spectrum devices.
3. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.

|           |                  |
|-----------|------------------|
| Test Mode | Mode 1: Transmit |
|-----------|------------------|

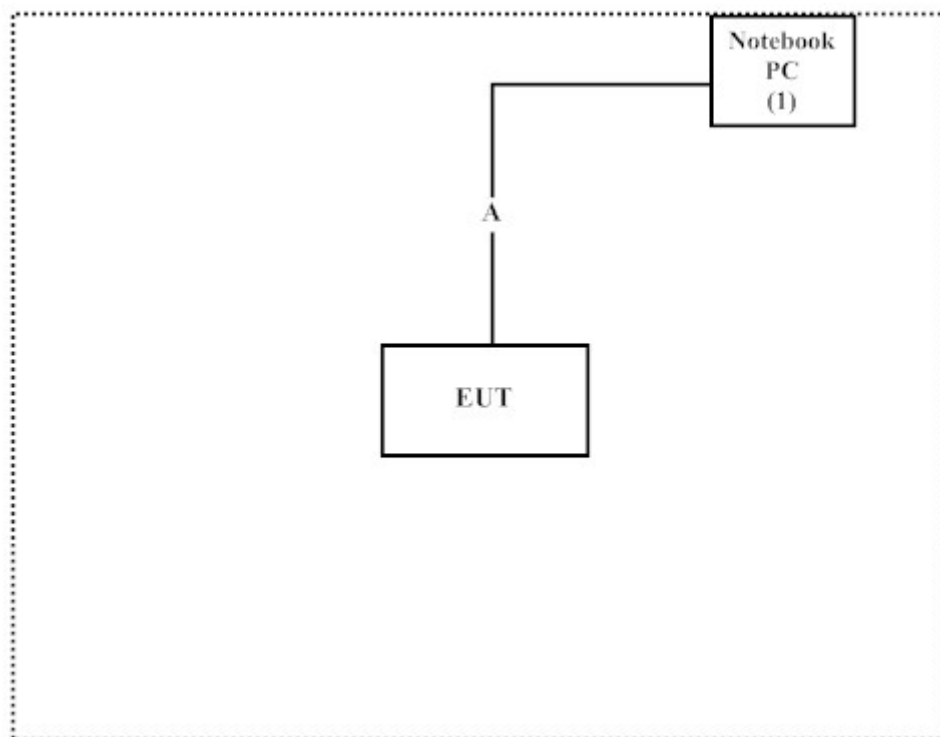
### 1.3. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

| Product |             | Manufacturer | Model No.        | Serial No. | Power Cord |
|---------|-------------|--------------|------------------|------------|------------|
| 1       | Notebook PC | DELL         | Inspiron 15 3000 | GT5JPJ2    | N/A        |

| Signal Cable Type |           | Signal cable Description |
|-------------------|-----------|--------------------------|
| A                 | USB Cable | Shielded, 1.8m           |

### 1.4. Configuration of Tested System



### 1.5. EUT Exercise Software

- (1) Setup the EUT as shown in Section 1.4.
- (2) Execute “VMidebug V1.1.6.56” program on the Notebook.
- (3) Configure the test mode, the test channel.
- (4) Start the continuous Transmit.
- (5) Verify that the EUT works properly.

## 1.6. Test Facility

Ambient conditions in the laboratory:

| Items                      | Required (IEC 68-1) | Actual   |
|----------------------------|---------------------|----------|
| Temperature (°C)           | 15-35               | 20-35    |
| Humidity (%RH)             | 25-75               | 50-65    |
| Barometric pressure (mbar) | 860-1060            | 950-1000 |

The related certificate for our laboratories about the test site and management system can be downloaded from DEKRA Testing and Certification Co., Ltd. Web Site:

<http://www.dekra.com.tw/english/about/certificates.aspx?bval=5>

The address and introduction of DEKRA Testing and Certification Co., Ltd. laboratories can be founded in our Web site: [http://www.dekra.com.tw/index\\_en](http://www.dekra.com.tw/index_en)

Site Description: Accredited by TAF  
Accredited Number: 3023

Site Name: DEKRA Testing and Certification Co., Ltd.  
Site Address: No.159, Sec. 2, Wenhua 1st Rd., Linkou Dist.,  
New Taipei City 24457, Taiwan.  
TEL: 886-2-2602-7968 / FAX : 866-2-2602-3286  
E-Mail : [info.tw@dekra.com](mailto:info.tw@dekra.com)

FCC Accreditation Number: TW3023

## 1.7. List of Test Equipment

### For Conduction measurements /ASR1

|   | Equipment          | Manufacturer | Model No. | Serial No. | Cali. Data | Due. Data  |
|---|--------------------|--------------|-----------|------------|------------|------------|
| X | EMI Test Receiver  | R&S          | ESR7      | 101601     | 2017.01.06 | 2018.01.05 |
| X | Two-Line V-Network | R&S          | ENV216    | 101306     | 2017.02.16 | 2018.02.15 |
| X | Two-Line V-Network | R&S          | ENV216    | 101307     | 2017.03.17 | 2018.03.16 |
| X | Coaxial Cable      | Quietek      | RG400_BNC | RF001      | 2017.05.24 | 2018.05.23 |

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : QuieTek EMI 2.0 V2.1.113

### For Conducted measurements /ASR4

|   | Equipment         | Manufacturer | Model No. | Serial No. | Cali. Data | Due. Data  |
|---|-------------------|--------------|-----------|------------|------------|------------|
| X | Spectrum Analyzer | R&S          | FSV30     | 103464     | 2017.01.09 | 2018.01.08 |
| X | Power Meter       | Anritsu      | ML2496A   | 1548003    | 2017.12.11 | 2018.12.10 |
| X | Power Sensor      | Anritsu      | MA2411B   | 1531024    | 2017.12.11 | 2018.12.10 |
| X | Power Sensor      | Anritsu      | MA2411B   | 1531025    | 2017.12.11 | 2018.12.10 |
|   | Bluetooth Tester  | R&S          | CBT       | 101238     | 2017.01.03 | 2018.01.02 |

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : QuieTek Conduction Test System V8.0.110

### For Radiated measurements /ACB1

|   | Equipment         | Manufacturer  | Model No.    | Serial No. | Cali. Data | Due. Data  |
|---|-------------------|---------------|--------------|------------|------------|------------|
| X | Loop Antenna      | TESEQ         | HLA6121      | 37133      | 2016.03.18 | 2018.03.17 |
| X | Bi-Log Antenna    | SCHWARZBECK   | VULB9168     | 9168-674   | 2017.02.13 | 2018.02.12 |
| X | Horn Antenna      | ETS-Lindgren  | 3117         | 00203800   | 2017.11.10 | 2018.11.09 |
| X | Horn Antenna      | Com-Power     | AH-840       | 101087     | 2017.05.24 | 2018.05.23 |
| X | Pre-Amplifier     | EMCI          | EMC001330    | 980316     | 2017.05.16 | 2018.05.15 |
| X | Pre-Amplifier     | EMCI          | EMC051835SE  | 980311     | 2017.05.17 | 2018.05.16 |
| X | Pre-Amplifier     | EMCI          | EMC05820SE   | 980310     | 2017.05.17 | 2018.05.16 |
| X | Pre-Amplifier     | EMCI          | EMC184045SE  | 980314     | 2017.05.17 | 2018.05.16 |
| X | Filter            | MICRO TRONICS | BRM50702     | G249       | 2017.08.11 | 2018.08.10 |
|   | Filter            | MICRO TRONICS | BRM50716     | G187       | 2017.08.16 | 2018.08.15 |
| X | EMI Test Receiver | R&S           | ESR7         | 101602     | 2017.12.11 | 2018.12.10 |
| X | Spectrum Analyzer | R&S           | FSV40        | 101148     | 2017.12.11 | 2018.12.10 |
| X | Coaxial Cable     | SUHNER        | SUCOFLEX 106 | RF002      | 2017.05.25 | 2018.05.24 |
| X | Mircoflex Cable   | HUBER SUHNER  | SUCOFLEX 102 | MY3381/2   | 2017.08.11 | 2018.08.10 |

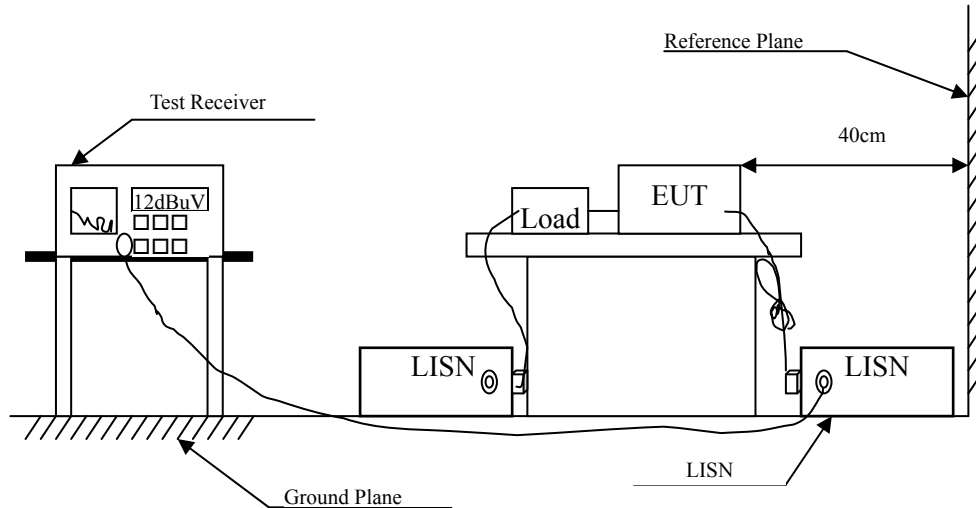
Note:

1. Loop Antenna is calibrated every two year, the other equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : QuieTek EMI 2.0 V2.1.113



## 2. Conducted Emission

### 2.1. Test Setup



### 2.2. Limits

| FCC Part 15 Subpart C Paragraph 15.207 (dBuV) Limit |        |       |
|-----------------------------------------------------|--------|-------|
| Frequency<br>MHz                                    | Limits |       |
|                                                     | QP     | AV    |
| 0.15 - 0.50                                         | 66-56  | 56-46 |
| 0.50-5.0                                            | 56     | 46    |
| 5.0 - 30                                            | 60     | 50    |

Remarks: In the above table, the tighter limit applies at the band edges.

### **2.3. Test Procedure**

The EUT and Peripherals are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement.

Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

The EUT was setup to ANSI C63.4, 2014; tested to DTS test procedure of FCC KDB-558074 for compliance to FCC 47CFR Subpart C requirements.

### **2.4. Uncertainty**

±2.35dB

## 2.5. Test Result of Conducted Emission

Product : Wireless USB Dongle  
 Test Item : Conducted Emission Test  
 Power Line : Line 1  
 Test Date : 2017/12/03  
 Test Mode : Mode 1: Transmit (2441.35MHz)

| Frequency<br>MHz  | Correct<br>Factor<br>dB | Reading<br>Level<br>dBμV | Measurement<br>Level<br>dBμV | Margin<br>dB | Limit<br>dBμV |
|-------------------|-------------------------|--------------------------|------------------------------|--------------|---------------|
| <b>LINE 1</b>     |                         |                          |                              |              |               |
| <b>Quasi-Peak</b> |                         |                          |                              |              |               |
| 0.168             | 9.652                   | 38.668                   | 48.320                       | -17.166      | 65.486        |
| 0.361             | 9.691                   | 32.208                   | 41.898                       | -18.073      | 59.971        |
| 0.454             | 9.697                   | 32.271                   | 41.968                       | -15.346      | 57.314        |
| 1.417             | 9.730                   | 27.775                   | 37.505                       | -18.495      | 56.000        |
| 3.100             | 9.781                   | 24.795                   | 34.576                       | -21.424      | 56.000        |
| 16.985            | 10.050                  | 18.148                   | 28.198                       | -31.802      | 60.000        |
| <b>Average</b>    |                         |                          |                              |              |               |
| 0.168             | 9.652                   | 28.074                   | 37.726                       | -17.760      | 55.486        |
| 0.361             | 9.691                   | 19.727                   | 29.417                       | -20.554      | 49.971        |
| 0.454             | 9.697                   | 20.665                   | 30.362                       | -16.952      | 47.314        |
| 1.417             | 9.730                   | 17.094                   | 26.824                       | -19.176      | 46.000        |
| 3.100             | 9.781                   | 15.463                   | 25.244                       | -20.756      | 46.000        |
| 16.985            | 10.050                  | 12.622                   | 22.672                       | -27.328      | 50.000        |

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " " means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product : Wireless USB Dongle  
 Test Item : Conducted Emission Test  
 Power Line : Line 2  
 Test Date : 2017/12/03  
 Test Mode : Mode 1: Transmit (2441.35MHz)

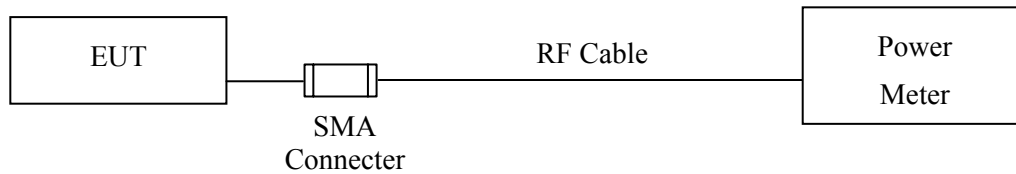
| Frequency         | Correct | Reading    | Measurement | Margin  | Limit      |
|-------------------|---------|------------|-------------|---------|------------|
| MHz               | Factor  | Level      | Level       |         |            |
|                   | dB      | dB $\mu$ V | dB $\mu$ V  | dB      | dB $\mu$ V |
| <b>LINE 2</b>     |         |            |             |         |            |
| <b>Quasi-Peak</b> |         |            |             |         |            |
| 0.166             | 9.955   | 36.278     | 46.233      | -19.310 | 65.543     |
| 0.445             | 9.981   | 28.217     | 38.198      | -19.373 | 57.571     |
| 0.685             | 9.951   | 22.131     | 32.082      | -23.918 | 56.000     |
| 1.437             | 9.880   | 20.420     | 30.300      | -25.700 | 56.000     |
| 13.065            | 10.031  | 24.148     | 34.179      | -25.821 | 60.000     |
| 16.879            | 10.095  | 22.676     | 32.771      | -27.229 | 60.000     |
| <b>Average</b>    |         |            |             |         |            |
| 0.166             | 9.955   | 21.491     | 31.446      | -24.097 | 55.543     |
| 0.445             | 9.981   | 13.399     | 23.380      | -24.191 | 47.571     |
| 0.685             | 9.951   | 11.791     | 21.742      | -24.258 | 46.000     |
| 1.437             | 9.880   | 8.112      | 17.993      | -28.007 | 46.000     |
| 13.065            | 10.031  | 18.543     | 28.574      | -21.426 | 50.000     |
| 16.879            | 10.095  | 16.721     | 26.816      | -23.184 | 50.000     |

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " " means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

### 3. Peak Power Output

#### 3.1. Test Setup



#### 3.2. Limit

The maximum peak power shall be less 1Watt.

#### 3.3. Test Procedure

Tested according to DTS test procedure of KDB 558074 for compliance to FCC 47CFR 15.247 requirements. The maximum peak conducted output power using KDB 558074 section 9.1.3 PKPM1 Peak power meter method.

#### 3.4. Uncertainty

$\pm 0.86$  dB

### 3.5. Test Result of Peak Power Output

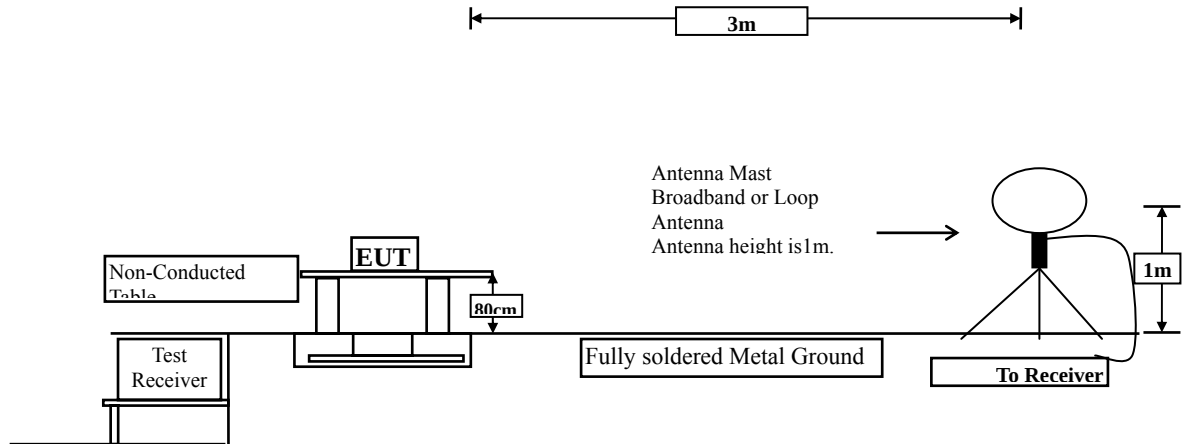
Product : Wireless USB Dongle  
Test Item : Peak Power Output  
Test Mode : Mode 1: Transmit  
Test Date : 2017/12/14

| Channel No. | Frequency<br>(MHz) | Measurement<br>(dBm) | Required Limit | Result |
|-------------|--------------------|----------------------|----------------|--------|
| Channel 01  | 2403.35            | 3.95                 | 1 Watt= 30 dBm | Pass   |
| Channel 20  | 2441.35            | 4.04                 | 1 Watt= 30 dBm | Pass   |
| Channel 38  | 2477.35            | 3.81                 | 1 Watt= 30 dBm | Pass   |

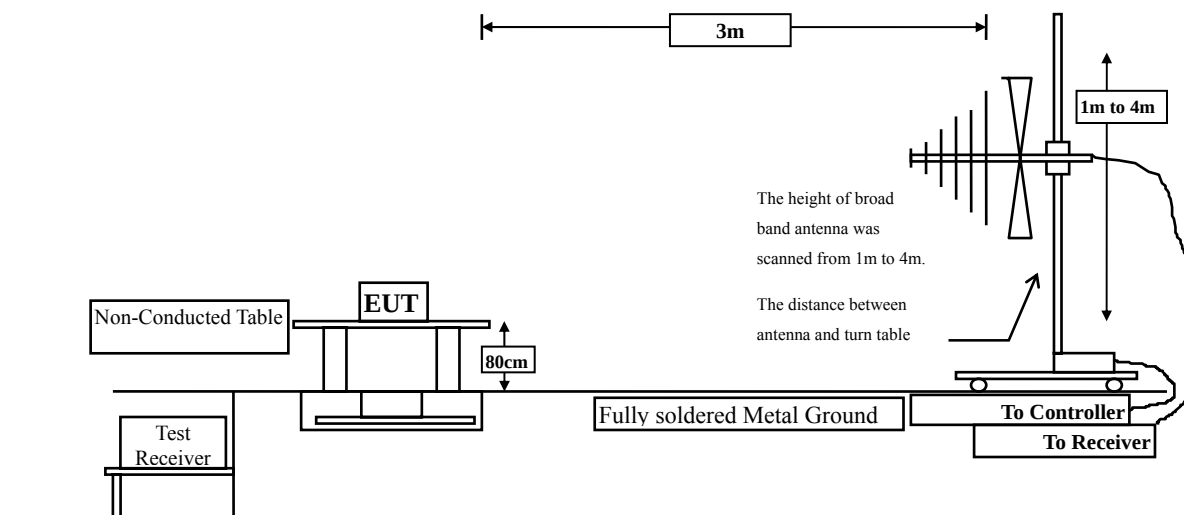
## 4. Radiated Emission

### 4.1. Test Setup

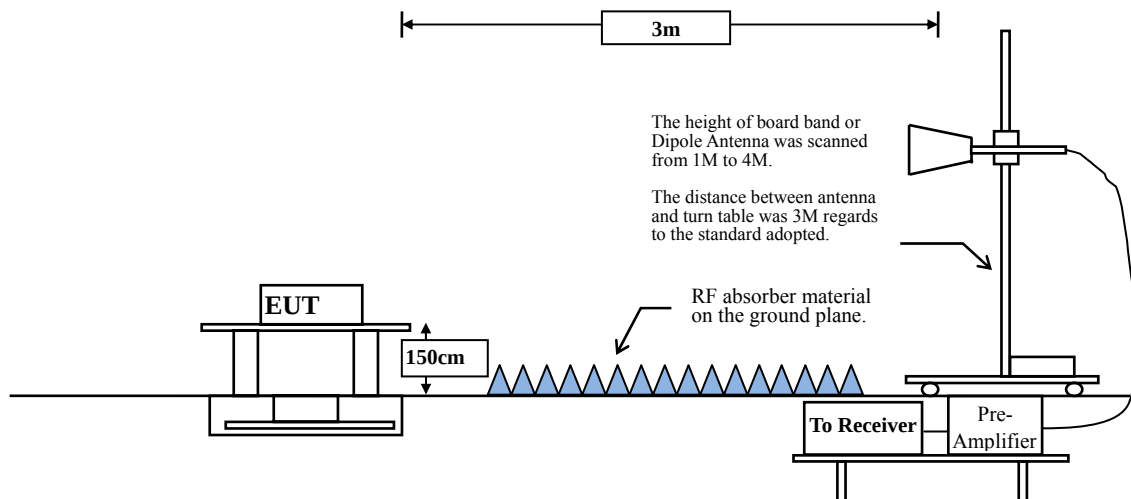
Radiated Emission Under 30MHz



Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



## 4.2. Limits

### ➤ General Radiated Emission Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

| FCC Part 15 Subpart C Paragraph 15.209 Limits |                                      |                                 |
|-----------------------------------------------|--------------------------------------|---------------------------------|
| Frequency<br>MHz                              | Field strength<br>(microvolts/meter) | Measurement distance<br>(meter) |
| 0.009-0.490                                   | 2400/F(kHz)                          | 300                             |
| 0.490-1.705                                   | 24000/F(kHz)                         | 30                              |
| 1.705-30                                      | 30                                   | 30                              |
| 30-88                                         | 100                                  | 3                               |
| 88-216                                        | 150                                  | 3                               |
| 216-960                                       | 200                                  | 3                               |
| Above 960                                     | 500                                  | 3                               |

- Remarks:
1. RF Voltage (dBuV) = 20 log RF Voltage (uV)
  2. In the Above Table, the tighter limit applies at the band edges.
  3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.



### 4.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013 and tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Measuring the frequency range below 1GHz, the EUT is placed on a turn table which is 0.8 meter above ground, when measuring the frequency range above 1GHz, the EUT is placed on a turn table which is 1.5 meter above ground.

The turn table is rotated 360 degrees to determine the position of the maximum emission level.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10: 2013 on radiated measurement.

The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and 30MHz~1GHz is 120kHz and above 1GHz is 1MHz.

Radiated emission measurements below 30MHz are made using Loop Antenna and 30MHz~1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna. The measurement frequency range from 9kHz - 10th Harmonic of fundamental was investigated.

**RBW and VBW Parameter setting:**

According to KDB 558074 section 12.2.4. Peak power measurement procedure

RBW = as specified in Table 1.

$VBW \geq 3 \times RBW$ .

**Table 1 —RBW as a function of frequency**

| Frequency   | RBW         |
|-------------|-------------|
| 9-150 kHz   | 200-300 Hz  |
| 0.15-30 MHz | 9-10 kHz    |
| 30-1000 MHz | 100-120 kHz |
| > 1000 MHz  | 1 MHz       |

According to KDB 558074 section 12.2.5. Average power measurement procedure

RBW = 1MHz.

VBW = 10Hz, when duty cycle  $\geq 98 \%$

$VBW \geq 1/T$ , when duty cycle  $< 98 \%$

( T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

| 2.4GHz band | Duty Cycle (%) | T (ms) | 1/T (Hz) | VBW (Hz) |
|-------------|----------------|--------|----------|----------|
| 2403.35     | 100            | --     | --       | 10       |

Note: Duty Cycle Refer to Section 9

**4.4. Uncertainty**

Horizontal polarization :

30-300MHz:  $\pm 4.08\text{dB}$  ; 300M-1GHz:  $\pm 3.86\text{dB}$  ; 1-18GHz:  $\pm 3.77\text{dB}$  ; 18-40GHz:  $\pm 3.98\text{dB}$

Vertical polarization :

30-300MHz:  $\pm 4.81\text{dB}$  ; 300M-1GHz:  $\pm 3.87\text{dB}$  ; 1-18GHz :  $\pm 3.83\text{dB}$  ; 18-40GHz:  $\pm 3.98\text{dB}$

#### 4.5. Test Result of Radiated Emission

Product : Wireless USB Dongle  
 Test Item : Harmonic Radiated Emission  
 Test Mode : Mode 1: Transmit (2403.35MHz)  
 Test Date : 2017/12/05

| Frequency             | Correct Factor | Reading Level | Measurement Level | Margin  | Limit  |
|-----------------------|----------------|---------------|-------------------|---------|--------|
| MHz                   | dB             | dBuV          | dBuV/m            | dB      | dBuV/m |
| <b>Horizontal</b>     |                |               |                   |         |        |
| <b>Peak Detector:</b> |                |               |                   |         |        |
| 4806.700              | -2.873         | 47.450        | 44.578            | -29.422 | 74.000 |
| 7210.050              | 0.384          | 51.310        | 51.693            | -22.307 | 74.000 |
| 9613.400              | 2.348          | 44.600        | 46.948            | -27.052 | 74.000 |
| <b>Average</b>        |                |               |                   |         |        |
| <b>Detector:</b>      |                |               |                   |         |        |
| --                    |                |               |                   |         |        |
| <b>Vertical</b>       |                |               |                   |         |        |
| <b>Peak Detector:</b> |                |               |                   |         |        |
| 4806.700              | -2.873         | 48.950        | 46.078            | -27.922 | 74.000 |
| 7210.050              | 0.384          | 49.380        | 49.763            | -24.237 | 74.000 |
| 9613.400              | 2.348          | 45.720        | 48.068            | -25.932 | 74.000 |
| <b>Average</b>        |                |               |                   |         |        |
| <b>Detector:</b>      |                |               |                   |         |        |
| --                    |                |               |                   |         |        |

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Wireless USB Dongle  
 Test Item : Harmonic Radiated Emission  
 Test Mode : Mode 1: Transmit (2441.35MHz)  
 Test Date : 2017/12/26

| Frequency             | Correct | Reading | Measurement | Margin  | Limit  |
|-----------------------|---------|---------|-------------|---------|--------|
| MHz                   | Factor  | Level   | Level       |         |        |
|                       | dB      | dBuV    | dBuV/m      | dB      | dBuV/m |
| <b>Horizontal</b>     |         |         |             |         |        |
| <b>Peak Detector:</b> |         |         |             |         |        |
| 4882.700              | -2.813  | 49.550  | 46.737      | -27.263 | 74.000 |
| 7324.050              | 0.464   | 51.110  | 51.574      | -22.426 | 74.000 |
| 9765.400              | 2.617   | 46.770  | 49.387      | -24.613 | 74.000 |
| <b>Average</b>        |         |         |             |         |        |
| <b>Detector:</b>      |         |         |             |         |        |
| --                    |         |         |             |         |        |
| <b>Vertical</b>       |         |         |             |         |        |
| <b>Peak Detector:</b> |         |         |             |         |        |
| 4882.700              | -2.813  | 49.580  | 46.767      | -27.233 | 74.000 |
| 7432.050              | 0.495   | 51.440  | 51.936      | -22.064 | 74.000 |
| 9765.400              | 2.617   | 47.020  | 49.637      | -24.363 | 74.000 |
| <b>Average</b>        |         |         |             |         |        |
| <b>Detector:</b>      |         |         |             |         |        |
| --                    |         |         |             |         |        |

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Wireless USB Dongle  
 Test Item : Harmonic Radiated Emission  
 Test Mode : Mode 1: Transmit (2477.35MHz)  
 Test Date : 2017/12/05

| Frequency             | Correct | Reading | Measurement | Margin  | Limit  |
|-----------------------|---------|---------|-------------|---------|--------|
| MHz                   | Factor  | Level   | Level       |         |        |
|                       | dB      | dBuV    | dBuV/m      | dB      | dBuV/m |
| <b>Horizontal</b>     |         |         |             |         |        |
| <b>Peak Detector:</b> |         |         |             |         |        |
| 4954.700              | -2.787  | 49.150  | 46.364      | -27.636 | 74.000 |
| 7432.050              | 0.495   | 51.050  | 51.546      | -22.454 | 74.000 |
| 9909.400              | 2.877   | 46.610  | 49.487      | -24.513 | 74.000 |
| <b>Average</b>        |         |         |             |         |        |
| <b>Detector:</b>      |         |         |             |         |        |
| --                    |         |         |             |         |        |
| <b>Vertical</b>       |         |         |             |         |        |
| <b>Peak Detector:</b> |         |         |             |         |        |
| 4954.700              | -2.787  | 48.420  | 45.634      | -28.366 | 74.000 |
| 7432.050              | 0.495   | 48.550  | 49.046      | -24.954 | 74.000 |
| 9909.400              | 2.877   | 46.320  | 49.197      | -24.803 | 74.000 |
| <b>Average</b>        |         |         |             |         |        |
| <b>Detector:</b>      |         |         |             |         |        |
| --                    |         |         |             |         |        |

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Wireless USB Dongle  
 Test Item : General Radiated Emission  
 Test Mode : Mode 1: Transmit (2441.35MHz)  
 Test Date : 2017/12/06

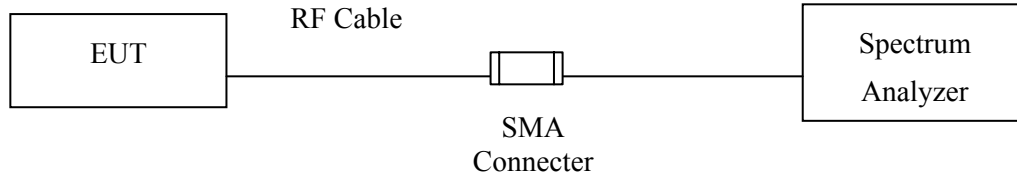
| Frequency         | Correct | Reading | Measurement | Margin  | Limit  |
|-------------------|---------|---------|-------------|---------|--------|
| MHz               | Factor  | Level   | Level       |         |        |
|                   | dB      | dBuV    | dBuV/m      | dB      | dBuV/m |
| <b>Horizontal</b> |         |         |             |         |        |
| 148.087           | -10.672 | 34.332  | 23.661      | -19.839 | 43.500 |
| 374.420           | -8.063  | 27.329  | 19.266      | -26.734 | 46.000 |
| 523.435           | -4.813  | 27.753  | 22.940      | -23.060 | 46.000 |
| 658.391           | -2.464  | 27.260  | 24.796      | -21.204 | 46.000 |
| 793.348           | -0.402  | 27.511  | 27.108      | -18.892 | 46.000 |
| 921.275           | 1.140   | 27.684  | 28.824      | -17.176 | 46.000 |
| <b>Vertical</b>   |         |         |             |         |        |
| 152.304           | -10.566 | 35.833  | 25.267      | -18.233 | 43.500 |
| 311.159           | -9.650  | 26.932  | 17.282      | -28.718 | 46.000 |
| 474.232           | -5.752  | 27.318  | 21.566      | -24.434 | 46.000 |
| 609.188           | -2.989  | 27.665  | 24.676      | -21.324 | 46.000 |
| 758.203           | -0.793  | 28.067  | 27.275      | -18.725 | 46.000 |
| 893.159           | 0.847   | 28.535  | 29.381      | -16.619 | 46.000 |

## Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The emission levels of other frequencies are very lower than the limit and not show in test report.
5. No emission found between lowest internal used/generated frequency to 30MHz.

## 5. RF Antenna Conducted Test

### 5.1. Test Setup



### 5.2. Limits

According to FCC Section 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 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, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

### 5.3. Test Procedure

The EUT was tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Set RBW = 100 kHz, Set VBW > RBW, scan up through 10th harmonic.

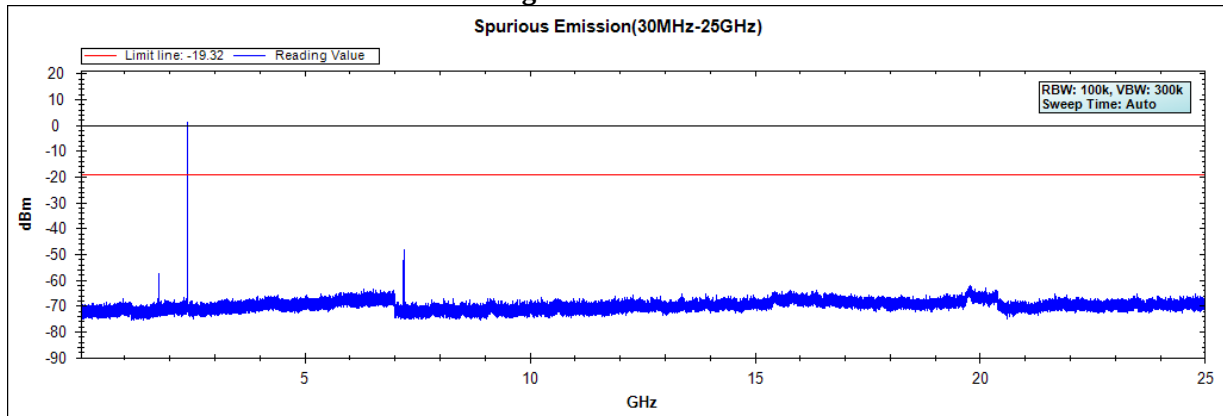
### 5.4. Uncertainty

±1.23dB

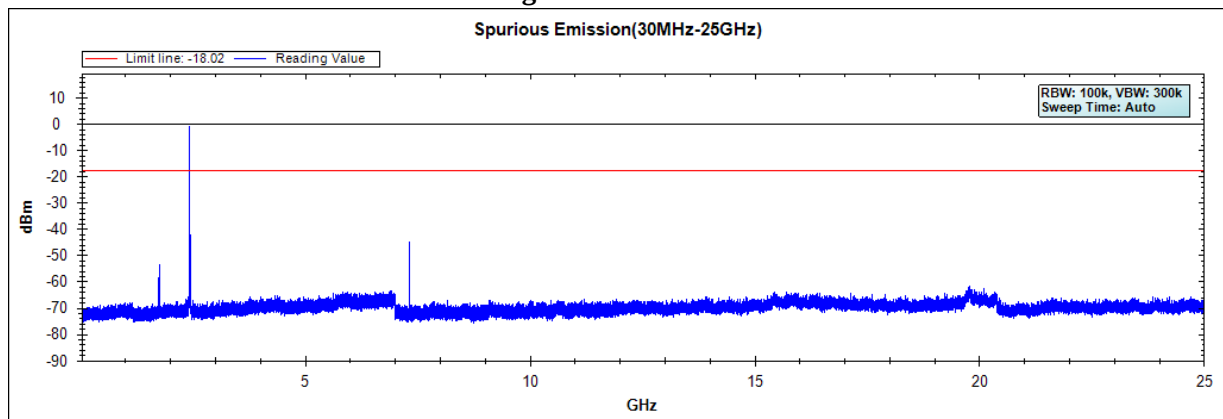
## 5.5. Test Result of RF Antenna Conducted Test

Product : Wireless USB Dongle  
Test Item : RF Antenna Conducted Test  
Test Mode : Mode 1: Transmit  
Test Date : 2017/12/06

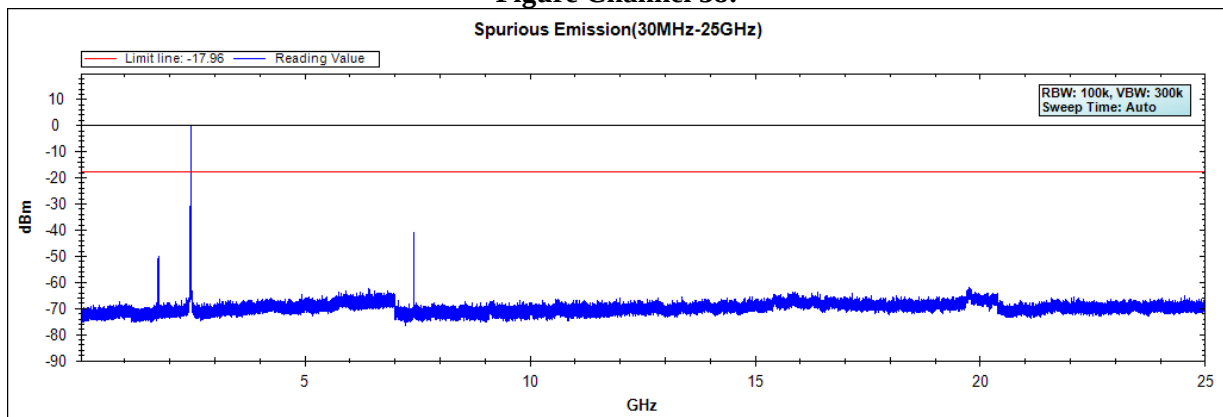
**Figure Channel 01:**



**Figure Channel 20:**



**Figure Channel 38:**



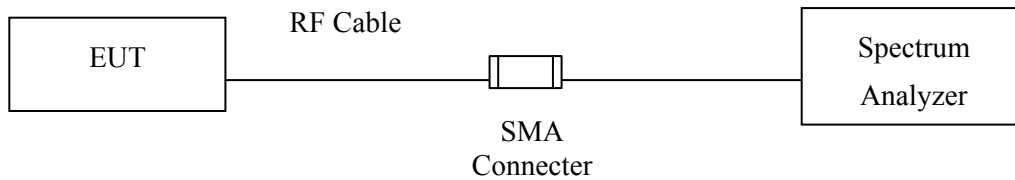
Note: The above test pattern is synthesized by multiple of the frequency range.



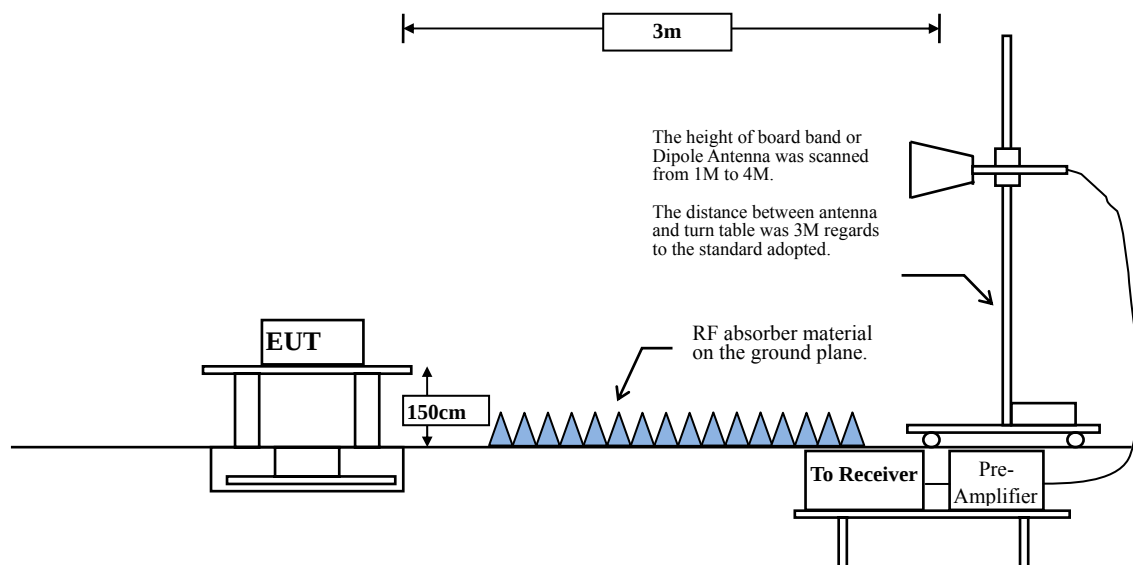
## 6. Band Edge

### 6.1. Test Setup

#### RF Conducted Measurement



#### RF Radiated Measurement:



## 6.2. Limit

According to FCC Section 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 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, 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 emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

## 6.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013 and tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.

**RBW and VBW Parameter setting:**

According to KDB 558074 section 12.2.4. Peak power measurement procedure

RBW = as specified in Table 1.

$VBW \geq 3 \times RBW$ .

**Table 1 —RBW as a function of frequency**

| Frequency   | RBW         |
|-------------|-------------|
| 9-150 kHz   | 200-300 Hz  |
| 0.15-30 MHz | 9-10 kHz    |
| 30-1000 MHz | 100-120 kHz |
| > 1000 MHz  | 1 MHz       |

According to KDB 558074 section 12.2.5. Average power measurement procedure

RBW = 1MHz.

VBW = 10Hz, when duty cycle  $\geq 98\%$

$VBW \geq 1/T$ , when duty cycle  $< 98\%$

( T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

| 2.4GHz band | Duty Cycle<br>(%) | T<br>(ms) | 1/T<br>(Hz) | VBW<br>(Hz) |
|-------------|-------------------|-----------|-------------|-------------|
| 2403.35     | 100               | --        | --          | 10          |

Note: Duty Cycle Refer to Section 9

**6.4. Uncertainty**

Conducted:  $\pm 1.23\text{dB}$

Radiated:

Horizontal polarization : 1-18GHz:  $\pm 3.77\text{dB}$

Vertical polarization : 1-18GHz :  $\pm 3.83\text{dB}$

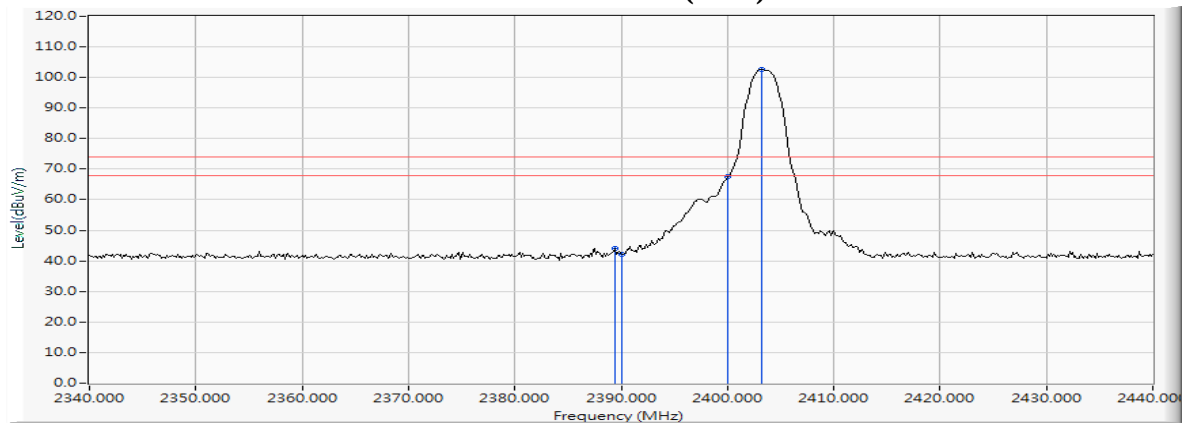
## 6.5. Test Result of Band Edge

Product : Wireless USB Dongle  
 Test Item : Band Edge  
 Test Mode : Mode 1: Transmit (2403.35MHz)  
 Test Date : 2017/12/05

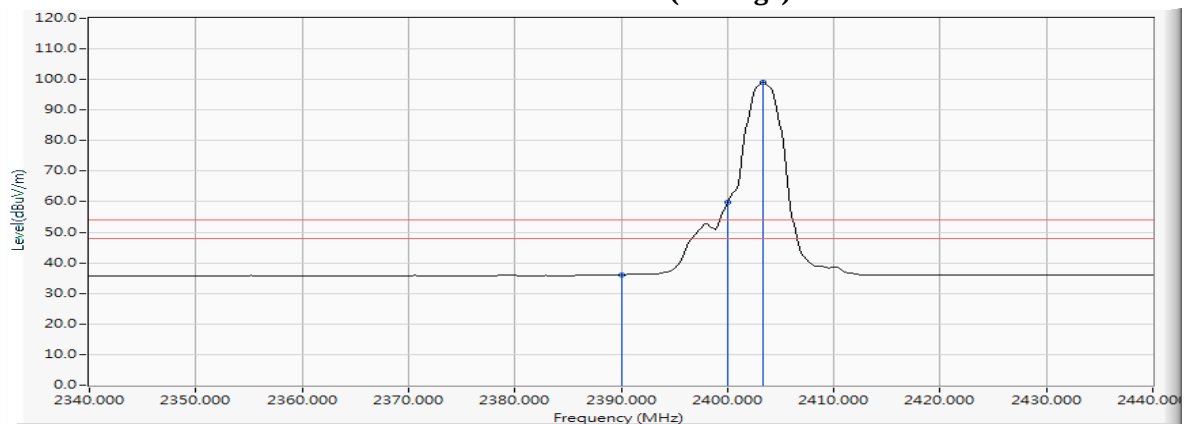
### RF Radiated Measurement (Horizontal):

| Channel No.  | Frequency (MHz) | Correct Factor (dB) | Reading Level (dBμV) | Emission Level (dBμV/m) | Peak Limit (dBμV/m) | Average Limit (dBμV/m) | Result |
|--------------|-----------------|---------------------|----------------------|-------------------------|---------------------|------------------------|--------|
| 01 (Peak)    | 2389.420        | 12.147              | 31.941               | 44.087                  | 74.00               | 54.00                  | Pass   |
| 01 (Peak)    | 2390.000        | 12.148              | 29.854               | 42.002                  | 74.00               | 54.00                  | Pass   |
| 01 (Peak)    | 2400.000        | 12.176              | 55.435               | 67.611                  | --                  | --                     | --     |
| 01 (Peak)    | 2403.188        | 12.184              | 90.351               | 102.535                 | --                  | --                     | --     |
| 01 (Average) | 2390.000        | 12.148              | 23.976               | 36.124                  | 74.00               | 54.00                  | Pass   |
| 01 (Average) | 2400.000        | 12.176              | 47.823               | 59.999                  | --                  | --                     | --     |
| 01 (Average) | 2403.333        | 12.185              | 86.944               | 99.128                  | --                  | --                     | --     |

**Figure Channel 01: Horizontal (Peak)**



**Figure Channel 01: Horizontal (Average)**



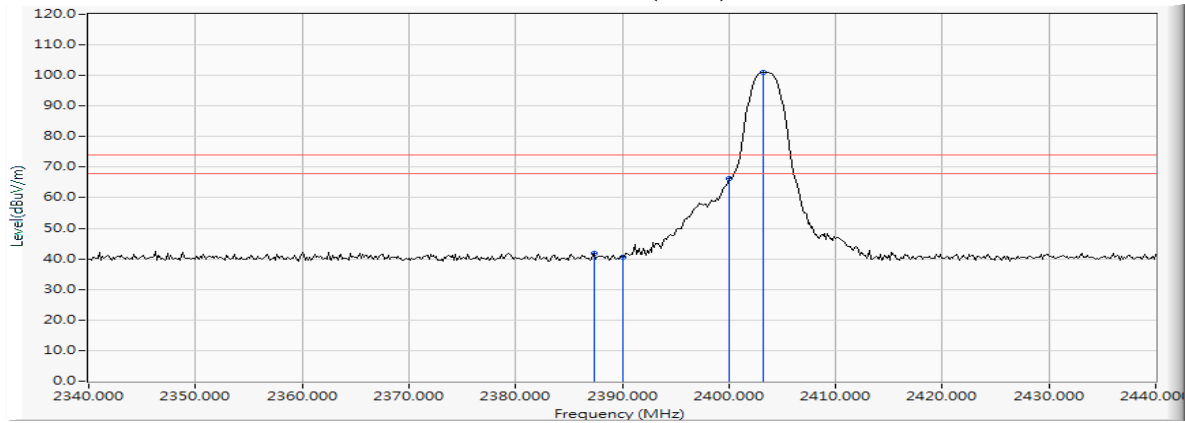
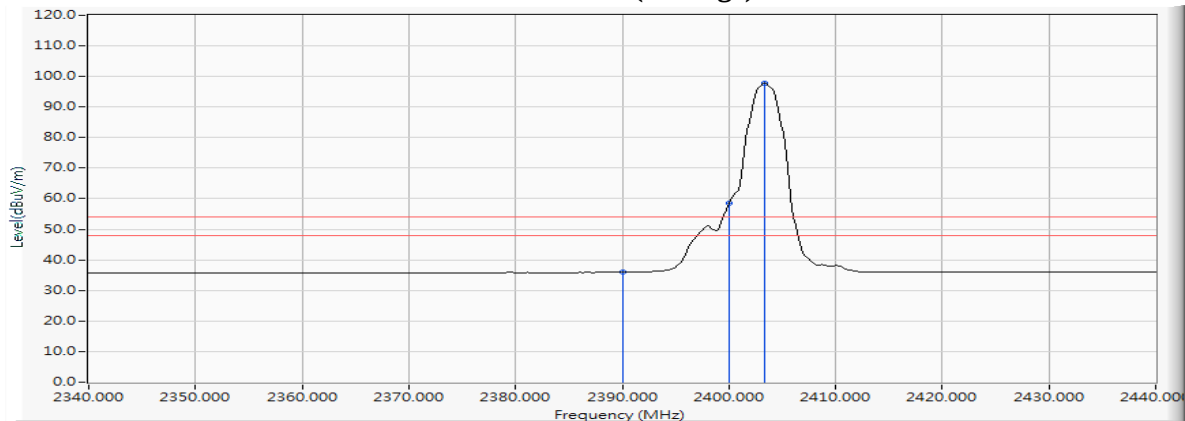
Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Wireless USB Dongle  
 Test Item : Band Edge  
 Test Mode : Mode 1: Transmit (2403.35MHz)  
 Test Date : 2017/12/05

**RF Radiated Measurement (Vertical):**

| Channel No.  | Frequency (MHz) | Correct Factor (dB) | Reading Level (dB $\mu$ V) | Emission Level (dB $\mu$ V/m) | Peak Limit (dB $\mu$ V/m) | Average Limit (dB $\mu$ V/m) | Result |
|--------------|-----------------|---------------------|----------------------------|-------------------------------|---------------------------|------------------------------|--------|
| 01 (Peak)    | 2387.391        | 12.141              | 29.754                     | 41.895                        | 74.00                     | 54.00                        | Pass   |
| 01 (Peak)    | 2390.000        | 12.148              | 28.461                     | 40.609                        | 74.00                     | 54.00                        | Pass   |
| 01 (Peak)    | 2400.000        | 12.176              | 54.014                     | 66.190                        | --                        | --                           | --     |
| 01 (Peak)    | 2403.188        | 12.184              | 88.963                     | 101.147                       | --                        | --                           | --     |
| 01 (Average) | 2390.000        | 12.148              | 23.925                     | 36.073                        | 74.00                     | 54.00                        | Pass   |
| 01 (Average) | 2400.000        | 12.176              | 46.401                     | 58.577                        | --                        | --                           | --     |
| 01 (Average) | 2403.333        | 12.185              | 85.631                     | 97.815                        | --                        | --                           | --     |

**Figure Channel 01: Vertical (Peak)**

**Figure Channel 01: Vertical (Average)**


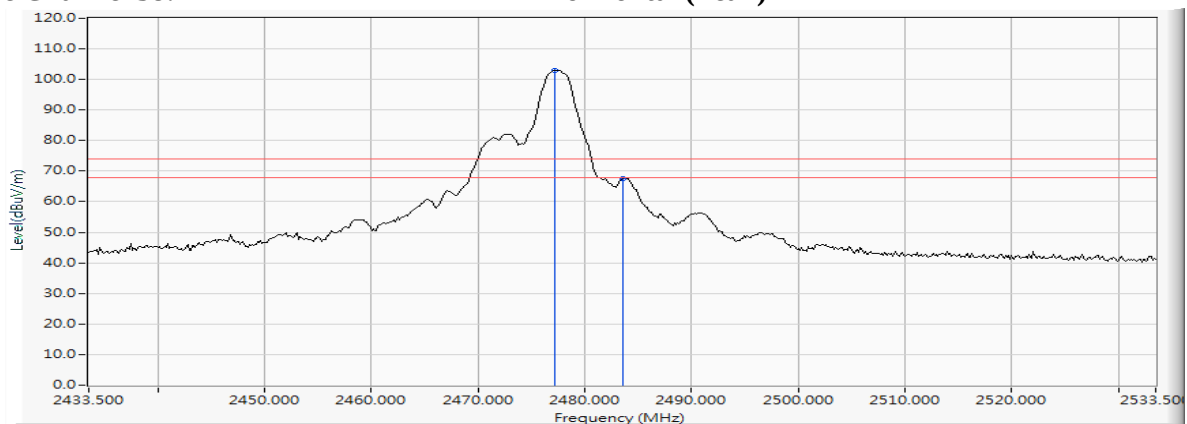
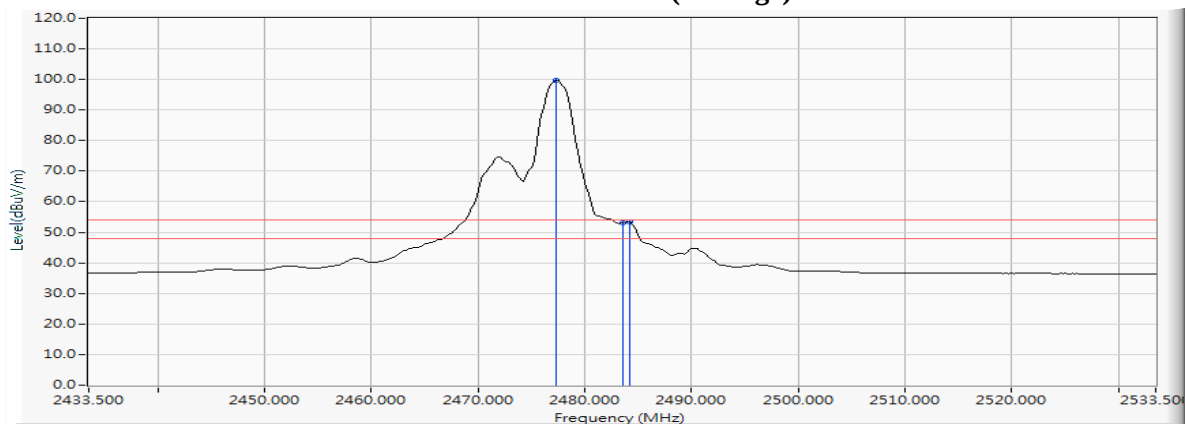
Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Wireless USB Dongle  
 Test Item : Band Edge  
 Test Mode : Mode 1: Transmit (2477.35MHz)  
 Test Date : 2017/12/05

**RF Radiated Measurement (Horizontal):**

| Channel No.  | Frequency (MHz) | Correct Factor (dB) | Reading Level (dBμV) | Emission Level (dBμV/m) | Peak Limit (dBμV/m) | Average Limit (dBμV/m) | Result |
|--------------|-----------------|---------------------|----------------------|-------------------------|---------------------|------------------------|--------|
| 38 (Peak)    | 2477.123        | 12.385              | 90.567               | 102.952                 | --                  | --                     | --     |
| 38 (Peak)    | 2483.500        | 12.403              | 55.262               | 67.665                  | 74.00               | 54.00                  | Pass   |
| 38 (Average) | 2477.268        | 12.386              | 87.467               | 99.852                  | --                  | --                     | --     |
| 38 (Average) | 2483.500        | 12.403              | 40.701               | 53.104                  | 74.00               | 54.00                  | Pass   |
| 38 (Average) | 2484.225        | 12.404              | 40.882               | 53.287                  | 74.00               | 54.00                  | Pass   |

**Figure Channel 38: Horizontal (Peak)**

**Figure Channel 38: Horizontal (Average)**


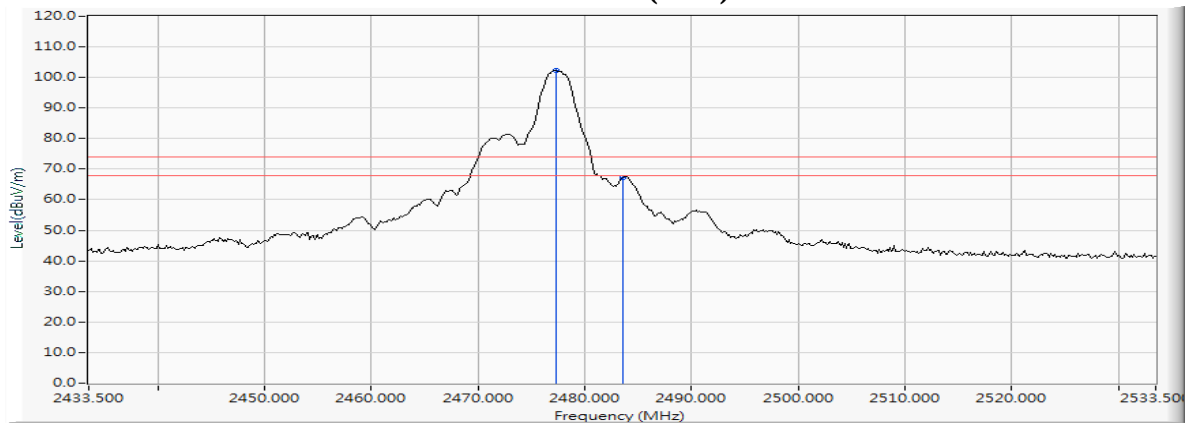
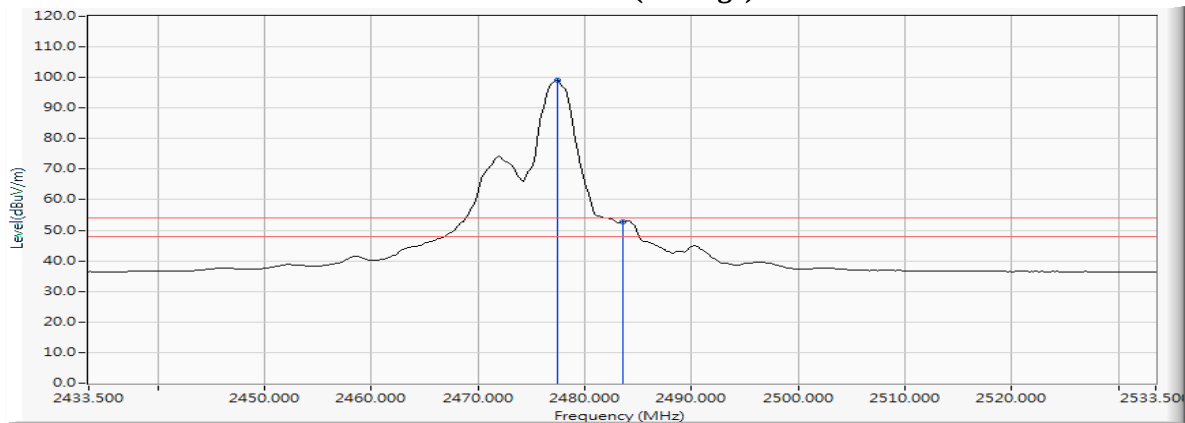
Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Wireless USB Dongle  
 Test Item : Band Edge  
 Test Mode : Mode 1: Transmit (2477.35MHz)  
 Test Date : 2017/12/05

**RF Radiated Measurement (Vertical):**

| Channel No.  | Frequency (MHz) | Correct Factor (dB) | Reading Level (dBμV) | Emission Level (dBμV/m) | Peak Limit (dBμV/m) | Average Limit (dBμV/m) | Result |
|--------------|-----------------|---------------------|----------------------|-------------------------|---------------------|------------------------|--------|
| 38 (Peak)    | 2477.268        | 12.386              | 89.773               | 102.158                 | --                  | --                     | --     |
| 38 (Peak)    | 2483.500        | 12.403              | 54.846               | 67.249                  | 74.00               | 54.00                  | Pass   |
| 38 (Average) | 2477.413        | 12.386              | 86.692               | 99.078                  | --                  | --                     | --     |
| 38 (Average) | 2483.500        | 12.403              | 40.389               | 52.792                  | 74.00               | 54.00                  | Pass   |

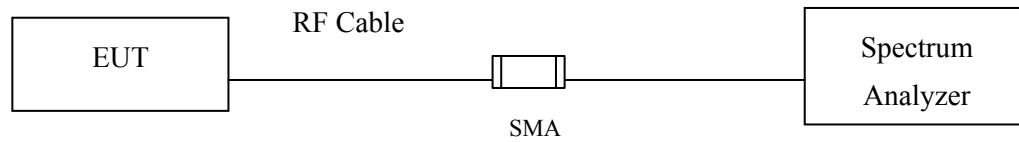
**Figure Channel 38: Vertical (Peak)**

**Figure Channel 38: Vertical (Average)**


Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

## 7. 6dB Bandwidth

### 7.1. Test Setup



### 7.2. Limits

The minimum bandwidth shall be at least 500 kHz.

### 7.3. Test Procedure

The EUT was setup according to ANSI C63.10 2013; tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Set RBW = 1-5% of the emission bandwidth,  $VBW \geq 3 * RBW$

### 7.4. Uncertainty

$\pm 279.2 \text{ Hz}$

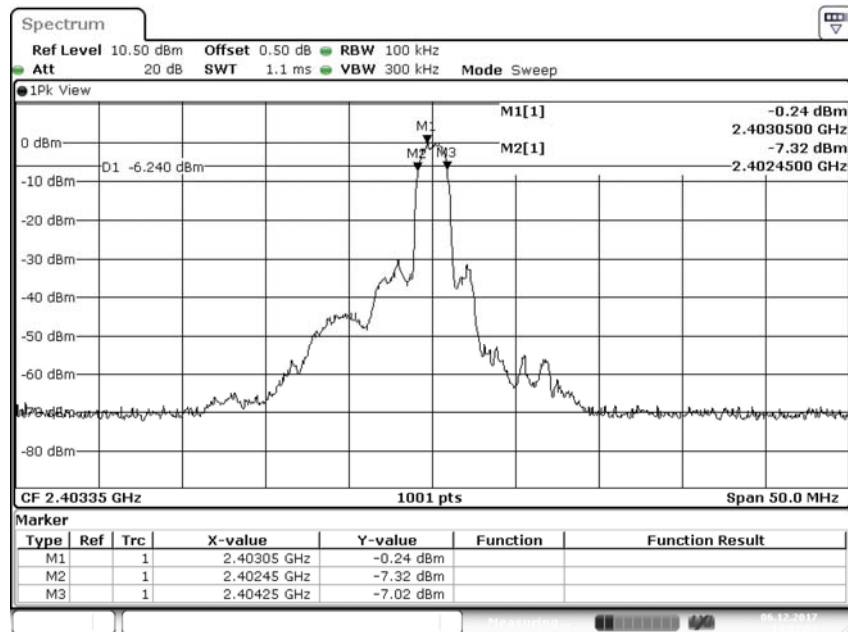


## 7.5. Test Result of 6dB Bandwidth

Product : Wireless USB Dongle  
 Test Item : 6dB Bandwidth Data  
 Test Mode : Mode 1: Transmit

| Channel No. | Frequency (MHz) | Measurement Level (kHz) | Required Limit (kHz) | Result |
|-------------|-----------------|-------------------------|----------------------|--------|
| 01          | 2403.35         | 1800                    | >500                 | Pass   |
| 20          | 2441.35         | 1750                    | >500                 | Pass   |
| 38          | 2477.35         | 1750                    | >500                 | Pass   |

Figure Channel 01:



Date: 6.DEC.2017 14:01:54

Figure Channel 20:

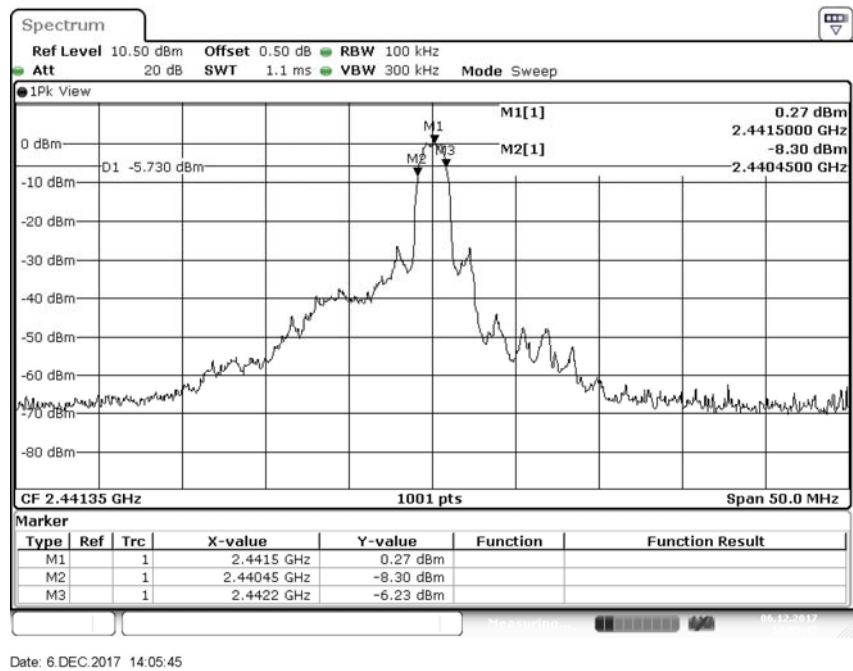
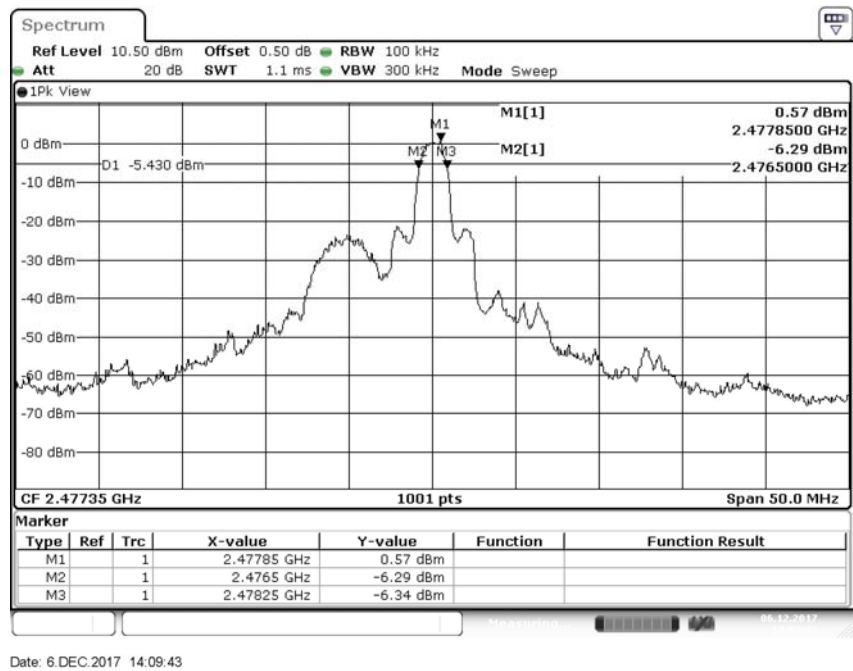
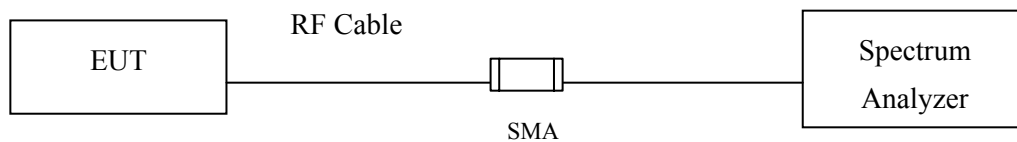


Figure Channel 38:



## 8. Power Density

### 8.1. Test Setup



### 8.2. Limits

The transmitted power density averaged over any 1 second interval shall not be greater +8dBm in any 3kHz bandwidth.

### 8.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013, the maximum power spectral density using KDB 558074 section 10.2 PKPSD (peak PSD) method.

### 8.4. Uncertainty

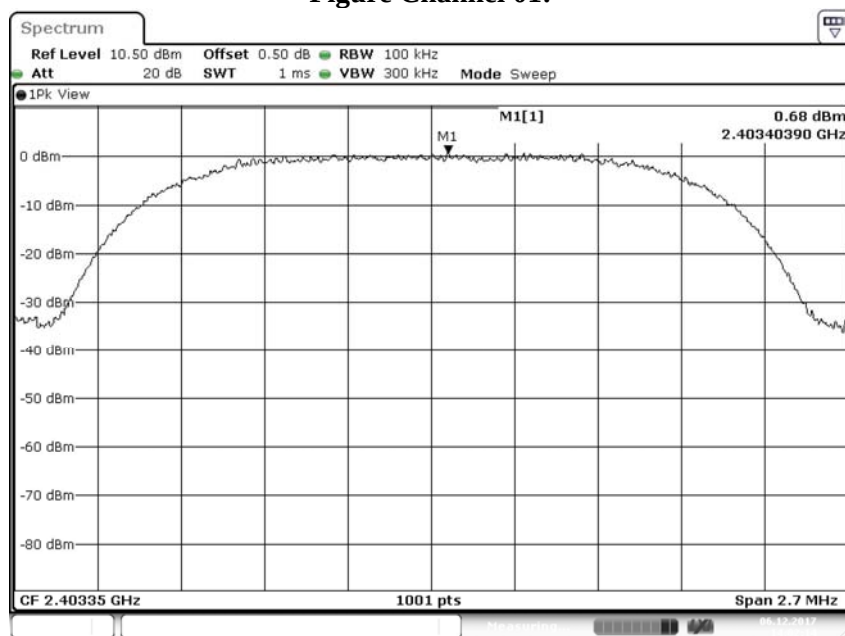
$\pm 1.23\text{dB}$

### 8.5. Test Result of Power Density

Product : Wireless USB Dongle  
 Test Item : Power Density Data  
 Test Mode : Mode 1: Transmit

| Channel No. | Frequency (MHz) | Measure Level (dBm) | Limit (dBm)        | Result |
|-------------|-----------------|---------------------|--------------------|--------|
| 01          | 2403.35         | 0.680               | $\leq 8\text{dBm}$ | Pass   |
| 20          | 2441.35         | 1.980               | $\leq 8\text{dBm}$ | Pass   |
| 38          | 2477.35         | 2.040               | $\leq 8\text{dBm}$ | Pass   |

**Figure Channel 01:**



Date: 6 DEC 2017 14:02:15

Figure Channel 20:

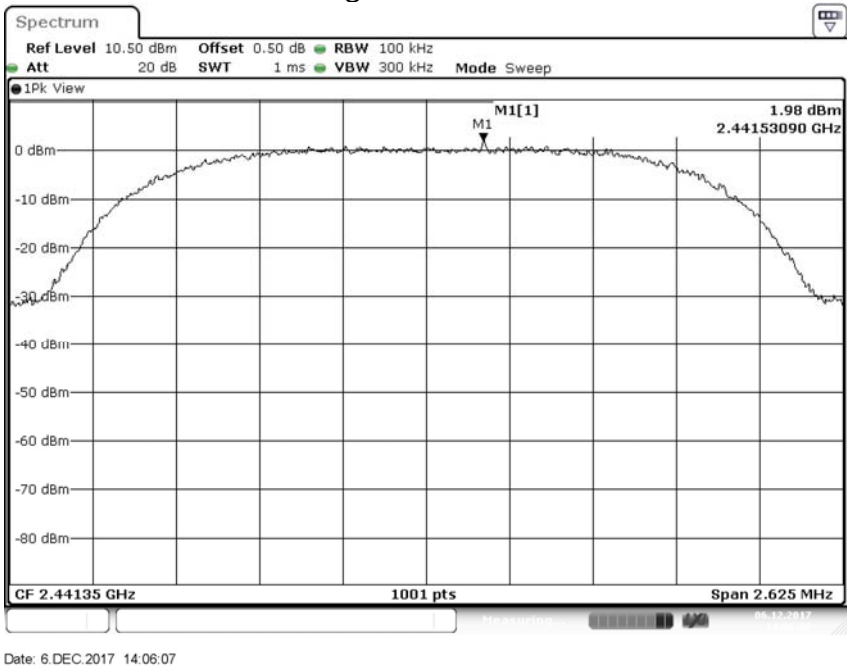
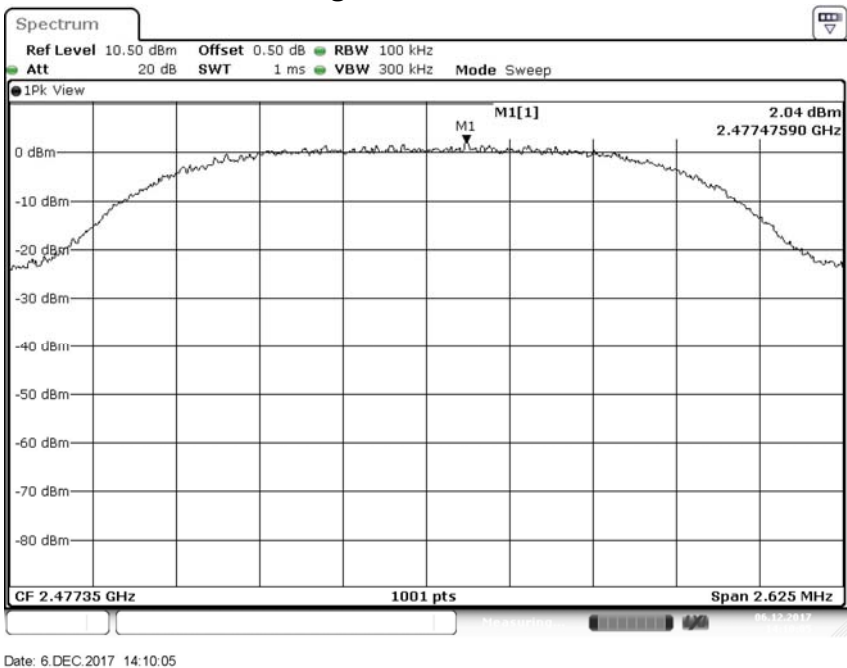
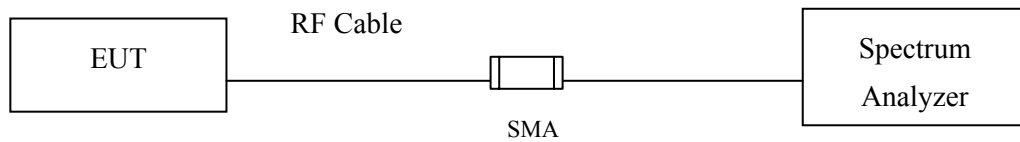


Figure Channel 38:



## 9. Duty Cycle

### 9.1. Test Setup



### 9.2. Test Procedure

The EUT was setup according to ANSI C63.10 2013; tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

### 9.3. Uncertainty

$\pm 2.31\text{msec}$

#### 9.4. Test Result of Duty Cycle

Product : Wireless USB Dongle  
 Test Item : Duty Cycle  
 Test Mode : Mode 1: Transmit

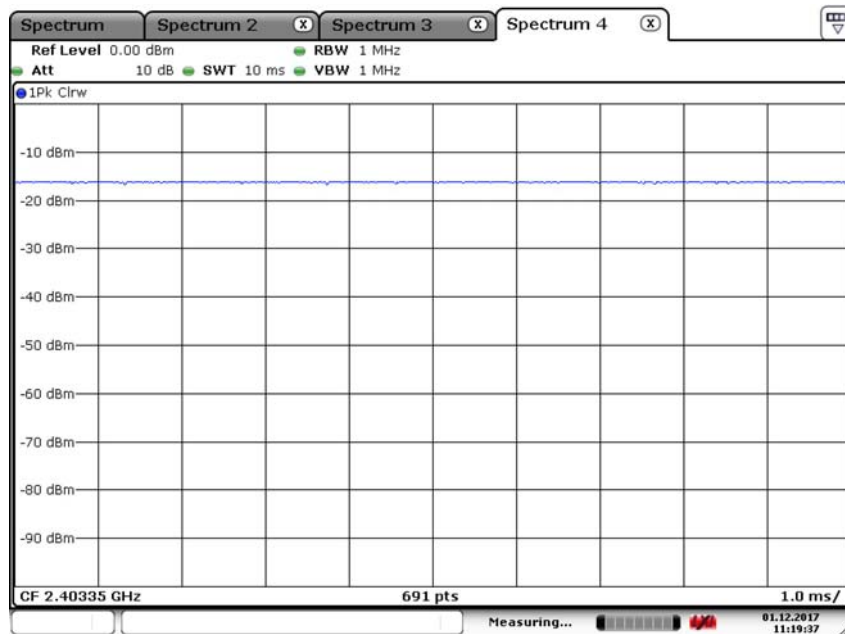
Duty Cycle Formula:

Duty Cycle = Ton / (Ton + Toff)

Duty Factor = 10 Log (1/Duty Cycle)

Results:

| 2.4GHz band | Ton<br>(ms) | Ton + Toff<br>(ms) | Duty Cycle<br>(%) | Duty Factor<br>(dB) |
|-------------|-------------|--------------------|-------------------|---------------------|
| 2403.35     | --          | --                 | 100               | 0                   |



Date: 1.DEC.2017 11:19:37

## **10. EMI Reduction Method During Compliance Testing**

No modification was made during testing.