

# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

## INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

**Applicant:** Sharp Corporation, Mobile Communication B.U.  
2-13-1, Hachihonmatsu-lida, Higashi-hiroshima-shi,  
Hiroshima 739-0192, Japan

**Manufacturer:** Sharp Corporation  
1 Takumi-cho, Sakai-ku, Sakai City, Osaka 590-8522, Japan

**Product Name:** Smart Phone

**Report Number:** ER/2019/A0071

**FCC ID:** APYHRO00279

**FCC Rule Part:** §15.247, Cat: DTS

**Issue Date:** Dec. 06, 2019

**Date of Test:** Oct. 16, 2019 ~ Nov. 15, 2019

**Date of EUT Received:** Oct. 16, 2019

**We hereby certify that:**

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Approved By: \_\_\_\_\_

Jay Lin

Jay Lin / Asst. Supervisor



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| Revision History |                                   |               |                         |
|------------------|-----------------------------------|---------------|-------------------------|
| Revision         | Description                       | Issue Date    | Remark                  |
| Rev.00           | Original.                         | Nov. 20, 2019 | Revised By: Karen Huang |
| Rev.01           | Update information on section 1.2 | Dec. 06, 2019 | Revised By: Karen Huang |

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## 1. GENERAL INFORMATION

### 1.1 Product Description

|                   |                                        |
|-------------------|----------------------------------------|
| Product Name:     | Smart Phone                            |
| Hardware Version: | DVT                                    |
| Software Version: | N/A                                    |
| Power Supply:     | 3.85V from Rechargeable Li-ion Battery |

|                      |                                            |
|----------------------|--------------------------------------------|
| Radio Technology:    | Bluetooth LE dual mode                     |
| Frequency Range:     | 2.402GHz – 2.480GHz                        |
| Channel Number:      | 40 channels                                |
| Modulation Type:     | GFSK                                       |
| Transmit Power:      | 5.38dBm (BLE 1Mbps)<br>5.80dBm (BLE 2Mbps) |
| Antenna Designation: | Inverted-F Antenna, Gain: -3dBi            |

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## 1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

KDB 558074 D01 v05r02 DTS Meas. Guidance

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards.

## 1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803 (TAF code 0513)

FCC Designation number: TW0001

## 1.4 Special Accessories

There are no special accessories used while test was conducted.

## 1.5 Equipment Modifications

There was no modification incorporated into the EUT.

## 1.6 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m\*9m\*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

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## 2. SYSTEM TEST CONFIGURATION

### 2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

### 2.2 EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

### 2.3 Test Procedure

#### 2.3.1 Conducted Emissions

The EUT is placed on a turn table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

#### 2.3.2 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

#### 2.3.2 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

### 2.4 Measurement Results Explanation Example

#### For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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## 2.5 Configuration of Tested System

Fig. 2-1 Radiated Emission



Fig. 2-2 Conducted (Antenna Port) Emission

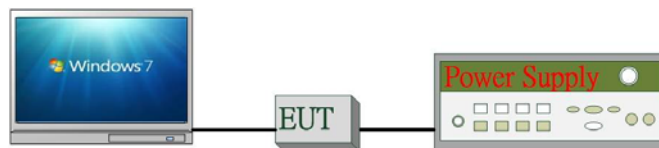


Fig. 2-2 AC Power Line Conducted Emission

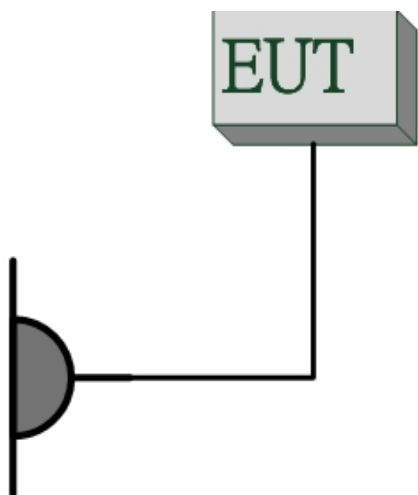


Table 2-1 Equipment Used in Tested System

| Item | Equipment               | Mfr/Brand | Model/Type No. | Series No. | Data Cable | Power Cord |
|------|-------------------------|-----------|----------------|------------|------------|------------|
| 1.   | Bluetooth Test Software | N/A       | N/A            | N/A        | N/A        | N/A        |
| 2.   | DC Power Supply         | Agilent   | E3640A         | MY52410006 | N/A        | N/A        |
| 3.   | Notebook                | Lenovo    | L430           | R9-XFG0X   | N/A        | N/A        |
| 4.   | Notebook                | Lenovo    | L430           | R9-X11BG   | N/A        | N/A        |

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### 3. SUMMARY OF TEST RESULTS

| FCC Rules                        | Description Of Test                       | Result    |
|----------------------------------|-------------------------------------------|-----------|
| §15.207(a)                       | AC Power Line Conducted Emission          | Compliant |
| §15.247(b) (3)                   | Peak Output Power                         | Compliant |
| §15.247(a)(2)                    | 6dB Bandwidth                             | Compliant |
| §15.205<br>§15.209<br>§15.247(d) | Conducted Band Edge and Spurious Emission | Compliant |
| §15.205<br>§15.209<br>§15.247(d) | Radiated Band Edge and Spurious Emission  | Compliant |
| §15.247(e)                       | Peak Power Density                        | Compliant |
| §15.203<br>§15.247(b)            | Antenna Requirement                       | Compliant |

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## 4. DESCRIPTION OF TEST MODES

### 4.1 Operated in 2400 ~ 2483.5MHz Band

40 channels are provided for Bluetooth LE

| ITEM | FREQUENCY | ITEM | FREQUENCY | ITEM | FREQUENCY |
|------|-----------|------|-----------|------|-----------|
| 1    | 2402 MHz  | 15   | 2430 MHz  | 29   | 2458 MHz  |
| 2    | 2404 MHz  | 16   | 2432 MHz  | 30   | 2460 MHz  |
| 3    | 2406 MHz  | 17   | 2434 MHz  | 31   | 2462 MHz  |
| 4    | 2408 MHz  | 18   | 2436 MHz  | 32   | 2464 MHz  |
| 5    | 2410 MHz  | 19   | 2438 MHz  | 33   | 2466 MHz  |
| 6    | 2412 MHz  | 20   | 2440 MHz  | 34   | 2468 MHz  |
| 7    | 2414 MHz  | 21   | 2442 MHz  | 35   | 2470 MHz  |
| 8    | 2416MHz   | 22   | 2444 MHz  | 36   | 2472 MHz  |
| 9    | 2418 MHz  | 23   | 2446 MHz  | 37   | 2474 MHz  |
| 10   | 2420 MHz  | 24   | 2448 MHz  | 38   | 2476 MHz  |
| 11   | 2422 MHz  | 25   | 2450 MHz  | 39   | 2478 MHz  |
| 12   | 2424 MHz  | 26   | 2452 MHz  | 40   | 2480 MHz  |
| 13   | 2426 MHz  | 27   | 2454 MHz  |      |           |
| 14   | 2428 MHz  | 28   | 2456 MHz  |      |           |

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## 4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case.

| MODE                                        | AVAILABLE<br>FREQUENCY<br>(MHz) | TESTED<br>FREQUENCY<br>(MHz) | MODULATION | DATA RATE<br>(Mbps) |
|---------------------------------------------|---------------------------------|------------------------------|------------|---------------------|
| <b>RADIATED EMISSION TEST (BELOW 1 GHz)</b> |                                 |                              |            |                     |
| Bluetooth LE                                | 2402 to 2480                    | 2440                         | GFSK       | 1                   |
| Bluetooth LE                                | 2402 to 2480                    | 2440                         | GFSK       | 2                   |
| <b>RADIATED EMISSION TEST (ABOVE 1 GHz)</b> |                                 |                              |            |                     |
| Bluetooth LE                                | 2402 to 2480                    | 2402, 2440, 2480             | GFSK       | 1                   |
| Bluetooth LE                                | 2402 to 2480                    | 2402, 2440, 2480             | GFSK       | 2                   |

**Note:** The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth LE Transmitter for channel Low, Mid and High, the worst case E2 position was reported.

| <b>ANTENNA PORT CONDUCTED MEASUREMENT:</b> |                                 |                              |            |                     |
|--------------------------------------------|---------------------------------|------------------------------|------------|---------------------|
| MODE                                       | AVAILABLE<br>FREQUENCY<br>(MHz) | TESTED<br>FREQUENCY<br>(MHz) | MODULATION | DATA RATE<br>(Mbps) |
| Bluetooth LE                               | 2402 to 2480                    | 2402, 2440, 2480             | GFSK       | 1                   |
| Bluetooth LE                               | 2402 to 2480                    | 2402, 2440, 2480             | GFSK       | 2                   |

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## 5. MEASUREMENT UNCERTAINTY

| Test Items                                | Uncertainty                 |
|-------------------------------------------|-----------------------------|
| AC Power Line Conducted Emission          | +/- 2.586 dB                |
| Peak Output Power                         | +/- 0.84 dB                 |
| 6dB Bandwidth                             | +/- 51.33 Hz                |
| 100 KHz Bandwidth Of Frequency Band Edges | +/- 0.84 dB                 |
| Peak Power Density                        | +/- 1.3 dB                  |
| Temperature                               | +/- 0.65 °C                 |
| Humidity                                  | +/- 4.6 %                   |
| DC / AC Power Source                      | DC= +/- 0.13%, AC= +/- 0.2% |

| Radiated Spurious Emission Measurement Uncertainty |                            |
|----------------------------------------------------|----------------------------|
| Polarization: Vertical                             | 9kHz~30MHz: +/-2.3dB       |
|                                                    | 30MHz - 180MHz: +/- 3.37dB |
|                                                    | 180MHz -417MHz: +/- 3.19dB |
|                                                    | 0.417GHz-1GHz: +/- 3.19dB  |
|                                                    | 1GHz - 18GHz: +/- 4.04dB   |
|                                                    | 18GHz - 40GHz: +/- 4.04dB  |
| Polarization: Horizontal                           | 9kHz~30MHz: +/-2.3dB       |
|                                                    | 30MHz - 167MHz: +/- 4.22dB |
|                                                    | 167MHz -500MHz: +/- 3.44dB |
|                                                    | 0.5GHz-1GHz: +/- 3.39dB    |
|                                                    | 1GHz - 18GHz: +/- 4.08dB   |
|                                                    | 18GHz - 40GHz: +/- 4.08dB  |

### Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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## 6. CONDUCTED EMISSION TEST

### 6.1 Standard Applicable:

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

| Frequency range<br>MHz                                                                                                                                                         | Limits<br>dB(μV) |          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------|
|                                                                                                                                                                                | Quasi-peak       | Average  |
| 0.15 to 0.50                                                                                                                                                                   | 66 to 56         | 56 to 46 |
| 0.50 to 5                                                                                                                                                                      | 56               | 46       |
| 5 to 30                                                                                                                                                                        | 60               | 50       |
| Note<br>1. The lower limit shall apply at the transition frequencies<br>2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz. |                  |          |

### 6.2 Measurement Equipment Used:

| Conducted Emission Test Site |             |                 |                  |              |            |
|------------------------------|-------------|-----------------|------------------|--------------|------------|
| EQUIPMENT<br>TYPE            | MFR         | MODEL<br>NUMBER | SERIAL<br>NUMBER | LAST<br>CAL. | CAL DUE.   |
| EMI Test Receiver            | R&S         | ESCI 3          | 100335           | 02/12/2019   | 02/11/2020 |
| Coaxial Cables               | N/A         | WK CE Cable     | N/A              | 11/26/2018   | 11/25/2019 |
| LISN                         | SCHWARZBECK | NSLK 8127       | 8127-649         | 04/02/2019   | 04/01/2020 |
| Test Software                | Farad       | EZ-EMC          | Ver.<br>SGS-03A2 | N.C.R        | N.C.R      |

NOTE: N.C.R refers to Not Calibrated Required.

### 6.3 EUT Setup:

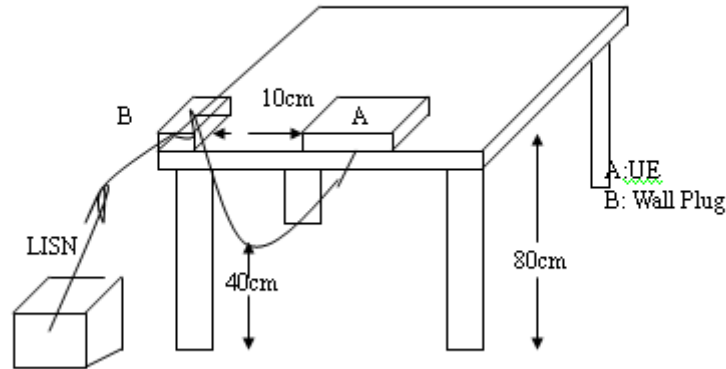
1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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## 6.4 Test SET-UP (Block Diagram of Configuration)



## 6.5 Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plan.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all phases of power being supplied by given UE are completed

## 6.6 Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The \* reveals the worst-case results that closet to the limit

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## AC POWER LINE CONDUCTED EMISSION TEST DATA

Description: Operation (BLE 1Mbps)

Date: 2019/11/11

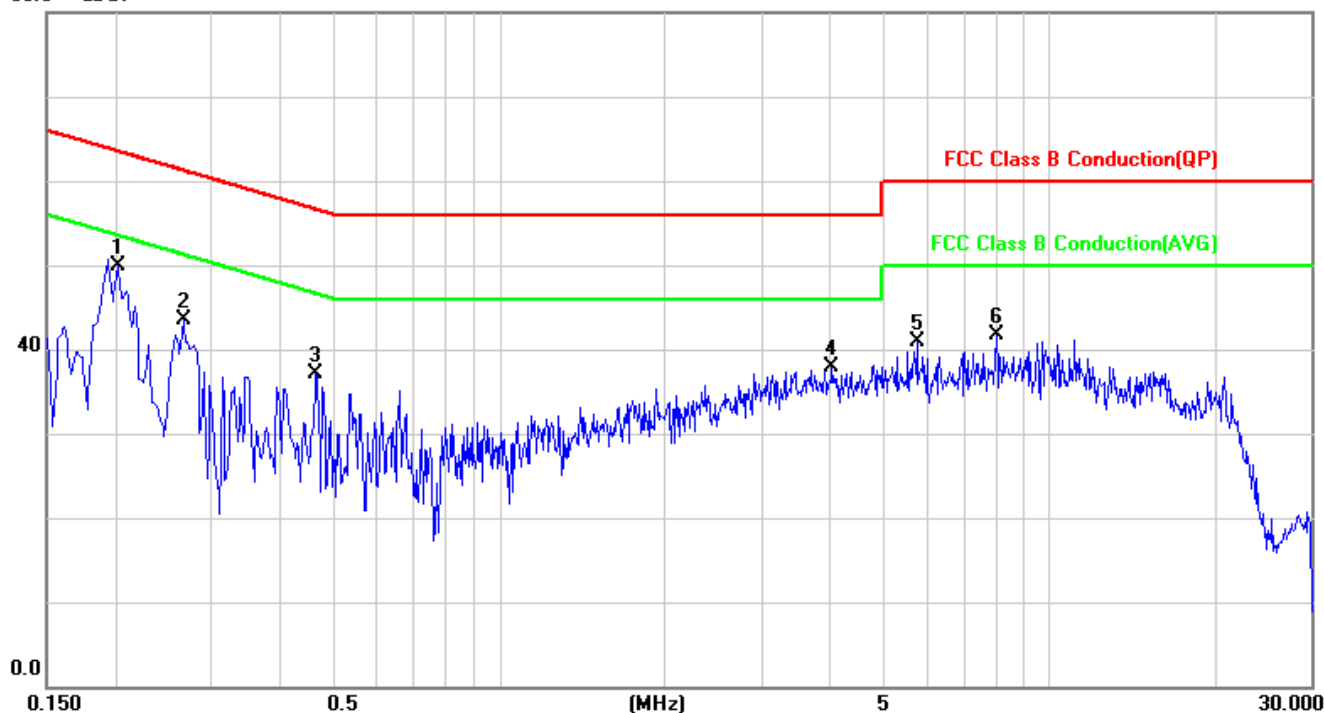
Line: L1

Temp.(°C)/Hum.(%): 24.2(°C)/62%

Test Voltage: AC 120V/60Hz

Test By: Kane

80.0 dBuV



| No. | Mk. | Freq.<br>(MHz) | Reading<br>dBuV | Factor<br>(dB) | Measurement<br>(dBuV) | Limit<br>(dBuV) | Over<br>(dB) | Detector | Comment |
|-----|-----|----------------|-----------------|----------------|-----------------------|-----------------|--------------|----------|---------|
| 1   | *   | 0.2020         | 49.96           | 0.01           | 49.97                 | 63.53           | -13.56       | peak     |         |
| 2   |     | 0.2660         | 43.50           | 0.01           | 43.51                 | 61.24           | -17.73       | peak     |         |
| 3   |     | 0.4660         | 37.14           | 0.01           | 37.15                 | 56.58           | -19.43       | peak     |         |
| 4   |     | 4.0340         | 37.75           | 0.17           | 37.92                 | 56.00           | -18.08       | peak     |         |
| 5   |     | 5.7500         | 40.76           | 0.20           | 40.96                 | 60.00           | -19.04       | peak     |         |
| 6   |     | 8.0500         | 41.37           | 0.24           | 41.61                 | 60.00           | -18.39       | peak     |         |

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Description: Operation (BLE 1Mbps)

Date: 2019/11/11

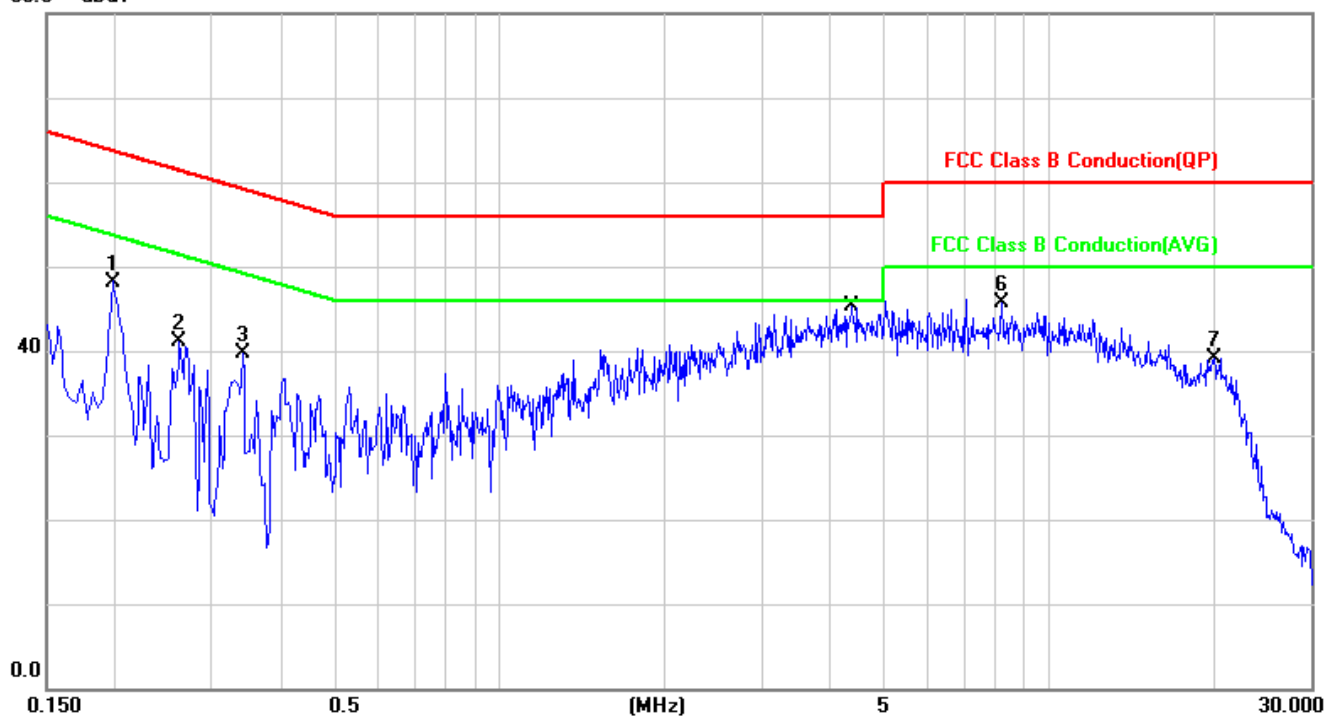
Line: N

Temp.(°C)/Hum.(%): 24.2(°C)/62%

Test Voltage: AC 120V/60Hz

Test By: Kane

80.0 dBuV



| No. | Mk. | Freq.<br>(MHz) | Reading<br>dBuV | Factor<br>(dB) | Measurement<br>(dBuV) | Limit<br>(dBuV) | Over<br>(dB) | Detector | Comment |
|-----|-----|----------------|-----------------|----------------|-----------------------|-----------------|--------------|----------|---------|
| 1   |     | 0.1980         | 48.17           | 0.03           | 48.20                 | 63.69           | -15.49       | peak     |         |
| 2   |     | 0.2620         | 41.06           | 0.03           | 41.09                 | 61.37           | -20.28       | peak     |         |
| 3   |     | 0.3420         | 39.73           | 0.03           | 39.76                 | 59.15           | -19.39       | peak     |         |
| 4   |     | 4.3940         | 37.90           | 0.19           | 38.09                 | 56.00           | -17.91       | QP       |         |
| 5   |     | 4.3940         | 28.80           | 0.19           | 28.99                 | 46.00           | -17.01       | AVG      |         |
| 6   | *   | 8.2060         | 45.39           | 0.26           | 45.65                 | 60.00           | -14.35       | peak     |         |
| 7   |     | 20.0340        | 38.77           | 0.42           | 39.19                 | 60.00           | -20.81       | peak     |         |

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Description: Operation (BLE 2Mbps)

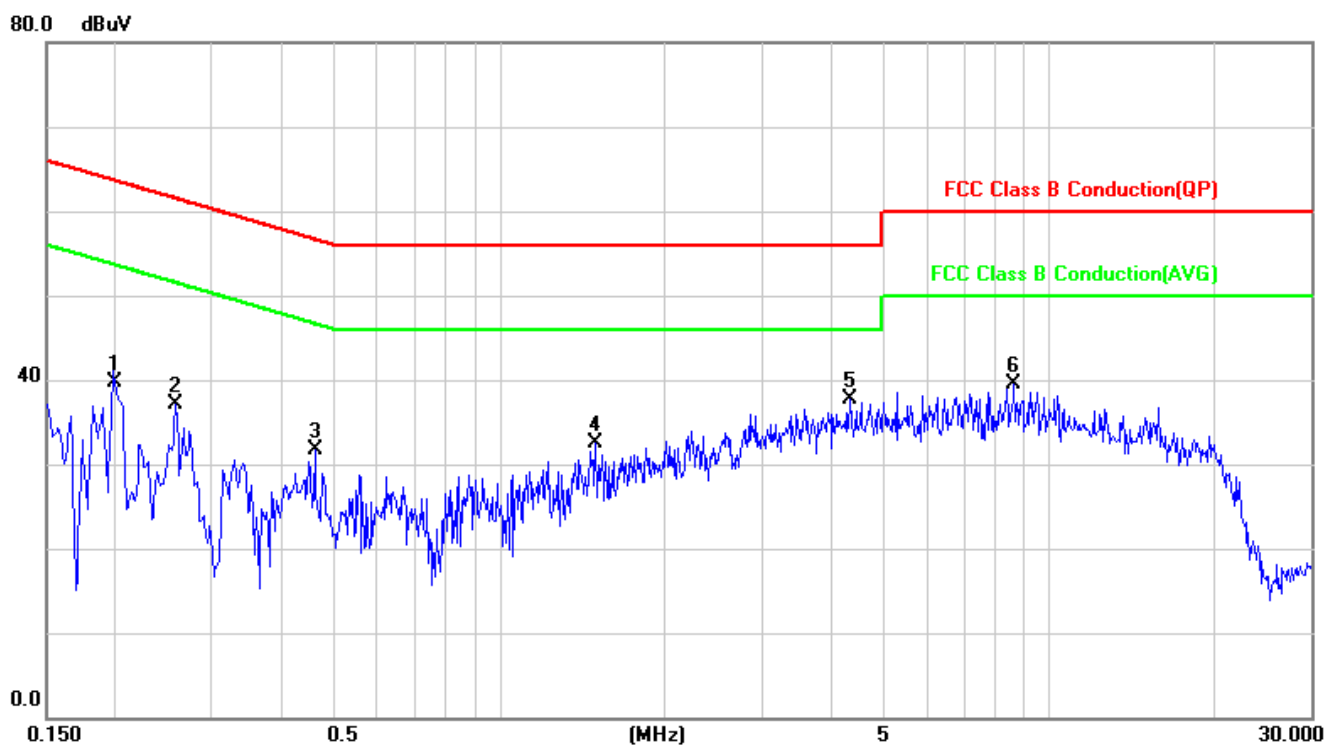
Date: 2019/11/11

Line: L1

Temp.(°C)/Hum.(%): 24.2(°C)/62%

Test Voltage: AC 120V/60Hz

Test By: Kane



| No. | Mk. | Freq.<br>(MHz) | Reading<br>dBuV | Factor<br>(dB) | Measurement<br>(dBuV) | Limit<br>(dBuV) | Over<br>(dB) | Detector | Comment |
|-----|-----|----------------|-----------------|----------------|-----------------------|-----------------|--------------|----------|---------|
| 1   |     | 0.1997         | 39.71           | 0.01           | 39.72                 | 63.62           | -23.90       | peak     |         |
| 2   |     | 0.2580         | 37.08           | 0.01           | 37.09                 | 61.50           | -24.41       | peak     |         |
| 3   |     | 0.4620         | 31.65           | 0.01           | 31.66                 | 56.66           | -25.00       | peak     |         |
| 4   |     | 1.4980         | 32.49           | 0.08           | 32.57                 | 56.00           | -23.43       | peak     |         |
| 5   | *   | 4.3540         | 37.51           | 0.18           | 37.69                 | 56.00           | -18.31       | peak     |         |
| 6   |     | 8.6620         | 39.32           | 0.26           | 39.58                 | 60.00           | -20.42       | peak     |         |

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Description: Operation (BLE 2Mbps)

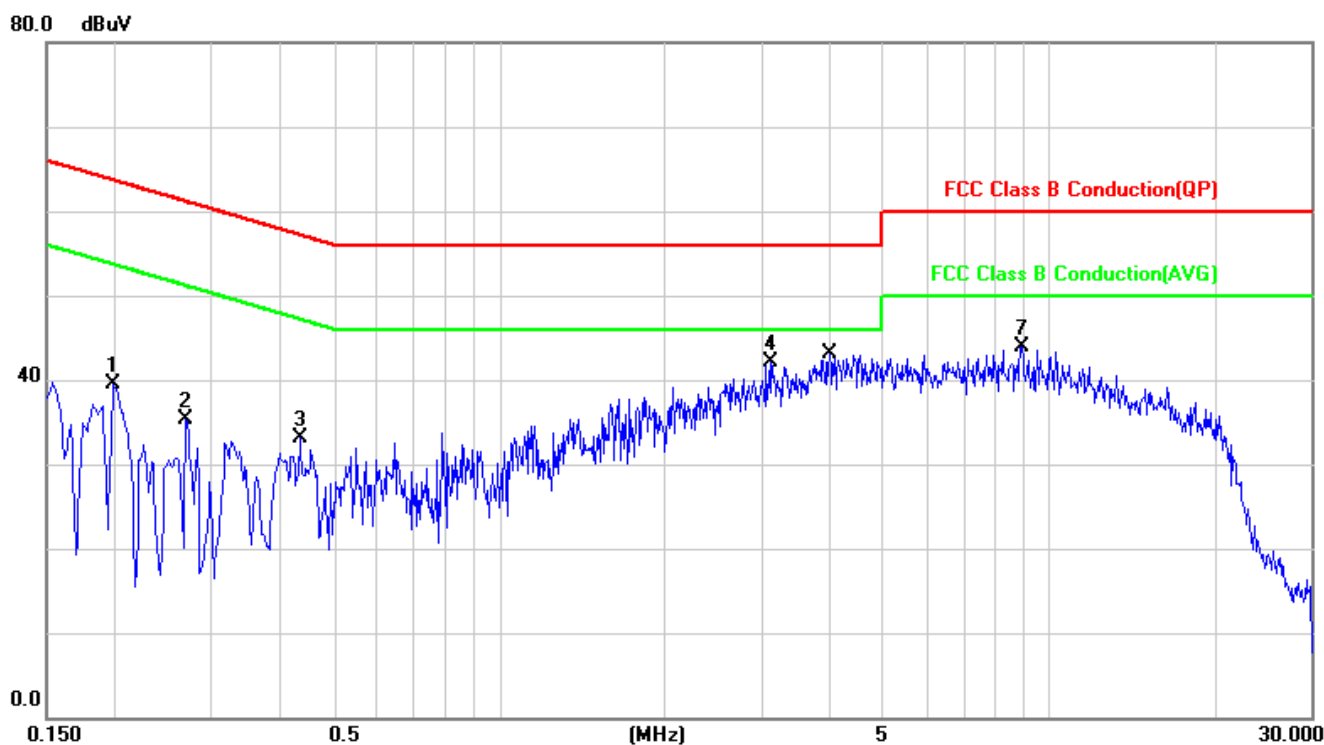
Date: 2019/11/11

Line: N

Temp.(°C)/Hum.(%): 24.2(°C)/62%

Test Voltage: AC 120V/60Hz

Test By: Kane



| No. | Mk. | Freq.<br>(MHz) | Reading<br>dBuV | Factor<br>(dB) | Measurement<br>(dBuV) | Limit<br>(dBuV) | Over<br>(dB) | Detector | Comment |
|-----|-----|----------------|-----------------|----------------|-----------------------|-----------------|--------------|----------|---------|
| 1   |     | 0.1980         | 39.54           | 0.03           | 39.57                 | 63.69           | -24.12       | peak     |         |
| 2   |     | 0.2700         | 35.26           | 0.03           | 35.29                 | 61.12           | -25.83       | peak     |         |
| 3   |     | 0.4340         | 33.03           | 0.03           | 33.06                 | 57.18           | -24.12       | peak     |         |
| 4   | *   | 3.1100         | 41.97           | 0.17           | 42.14                 | 56.00           | -13.86       | peak     |         |
| 5   |     | 3.9940         | 35.90           | 0.18           | 36.08                 | 56.00           | -19.92       | QP       |         |
| 6   |     | 3.9940         | 27.50           | 0.18           | 27.68                 | 46.00           | -18.32       | AVG      |         |
| 7   |     | 8.9180         | 43.67           | 0.27           | 43.94                 | 60.00           | -16.06       | peak     |         |

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## 7. PEAK OUTPUT POWER MEASUREMENT

### 7.1 Standard Applicable:

For systems using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1Watt.

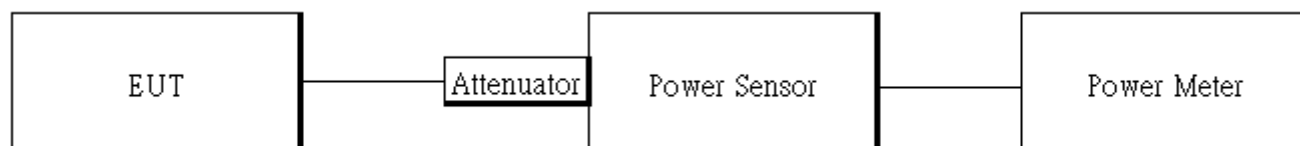
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

### 7.2 Measurement Equipment Used:

| EQUIPMENT TYPE  | MFR          | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-----------------|--------------|--------------|---------------|------------|------------|
| Power Meter     | Anritsu      | ML2496A      | 1804001       | 02/13/2019 | 02/12/2020 |
| Power Sensor    | Anritsu      | MA2411B      | 1726104       | 02/13/2019 | 02/12/2020 |
| Power Sensor    | Anritsu      | MA2411B      | 1726107       | 02/13/2019 | 02/12/2020 |
| DC Power Supply | Agilent      | E3640A       | MY52410006    | 12/04/2018 | 12/03/2019 |
| Attenuator      | Mini-Circuit | BW-S10W2+    | 2             | 01/02/2019 | 01/01/2020 |

### 7.3 Test Set-up:



### 7.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
4. Record the max. Reading as observed from Power Meter.
5. Repeat above procedures until all test default channel measured was complete.

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### Formula:

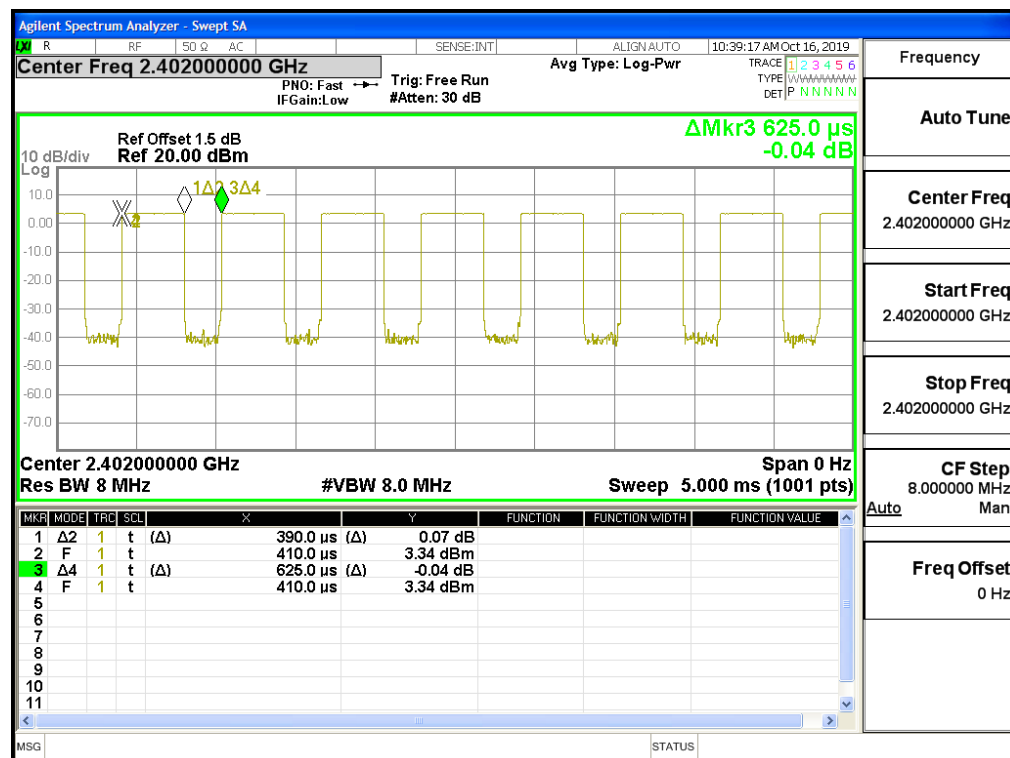
$$\text{Duty Cycle} = \text{Ton} / (\text{Ton} + \text{Toff})$$

### Duty Factor

### DATA RATE 1 Mbps:

|     | Duty Cycle (%)<br>= Ton /<br>(Ton+Toff) | Duty Factor (dB)<br>=10*log ( 1/Duty<br>Cycle ) | 1/T<br>(kHz) | VBW<br>setting<br>(kHz) |
|-----|-----------------------------------------|-------------------------------------------------|--------------|-------------------------|
| BLE | 62.00                                   | 2.08                                            | 2.56         | 3.00                    |

Duty Cycle\_BLE\_1M\_LowCH00-2402



$$\text{Duty Cycle Factor: } 10 * \log(1/(62/100)) = 2.08$$

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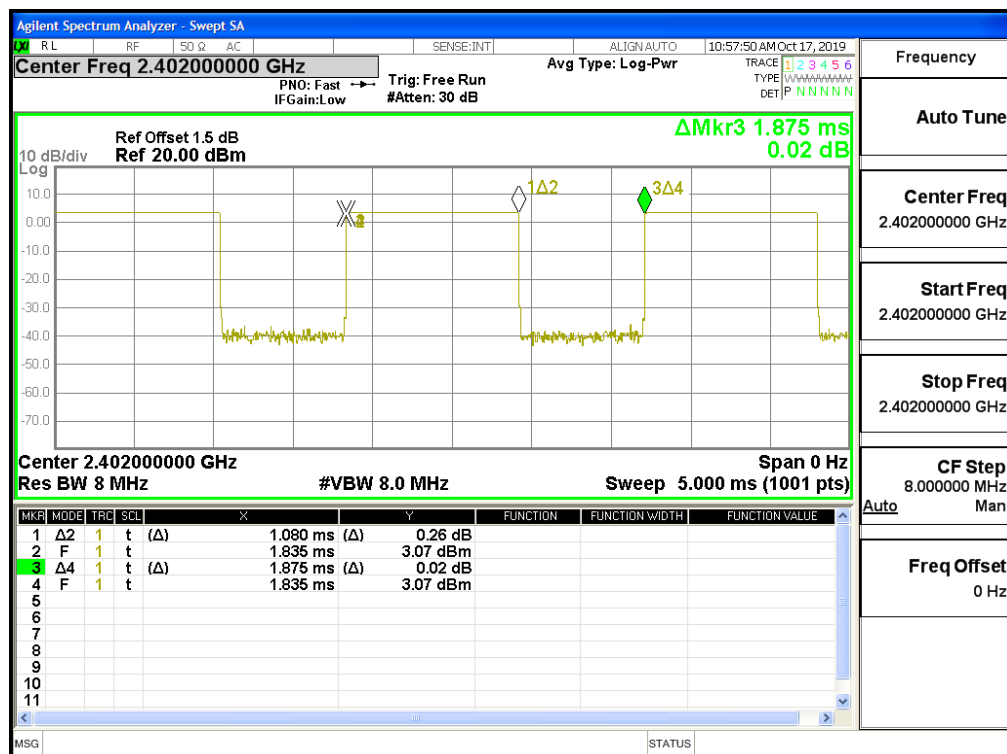
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### DATA RATE 2 Mbps:

|     | Duty Cycle (%)<br>= Ton /<br>(Ton+Toff) | Duty Factor (dB)<br>=10*log ( 1/Duty<br>Cycle ) | 1/T<br>(kHz) | VBW<br>setting<br>(kHz) |
|-----|-----------------------------------------|-------------------------------------------------|--------------|-------------------------|
| BLE | 58.00                                   | 2.37                                            | 0.93         | 1.00                    |

Duty Cycle\_BLE\_2M\_LowCH00-2402



Duty Cycle Factor:  $10 \cdot \log(1/(58/100)) = 2.37$

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## 7.5 Measurement Result:

### DATA RATE 1 Mbps:

| CH   | Frequency (MHz) | Peak Power Output (dBm)                                | Required Limit  |
|------|-----------------|--------------------------------------------------------|-----------------|
| Low  | 2402            | 3.48                                                   | 1 Watt = 30 dBm |
| Mid  | 2440            | <b>5.38</b>                                            | 1 Watt = 30 dBm |
| High | 2480            | 3.97                                                   | 1 Watt = 30 dBm |
| CH   | Frequency (MHz) | Max. Avg. Output include tune up tolerance Power (dBm) | Required Limit  |
| Low  | 2402            | 3.45                                                   | 1 Watt = 30 dBm |
| Mid  | 2440            | 5.33                                                   | 1 Watt = 30 dBm |
| High | 2480            | 3.94                                                   | 1 Watt = 30 dBm |

\*Note: Measured by power meter, cable loss as 1.5 dB that offsets on the power meter in Peak

\*Note: Measured by power meter, as cable loss+ Duty cycle factor that offsets on the power meter

\*Note: Max. Output include tune up tolerance Power is average power

### DATA RATE 2 Mbps:

| CH   | Frequency (MHz) | Peak Power Output (dBm)                                | Required Limit  |
|------|-----------------|--------------------------------------------------------|-----------------|
| Low  | 2402            | 3.96                                                   | 1 Watt = 30 dBm |
| Mid  | 2440            | <b>5.80</b>                                            | 1 Watt = 30 dBm |
| High | 2480            | 4.72                                                   | 1 Watt = 30 dBm |
| CH   | Frequency (MHz) | Max. Avg. Output include tune up tolerance Power (dBm) | Required Limit  |
| Low  | 2402            | 3.82                                                   | 1 Watt = 30 dBm |
| Mid  | 2440            | 5.65                                                   | 1 Watt = 30 dBm |
| High | 2480            | 4.64                                                   | 1 Watt = 30 dBm |

\*Note: Measured by power meter, cable loss as 1.5 dB that offsets on the power meter in Peak

\*Note: Measured by power meter, as cable loss+ Duty cycle factor that offsets on the power meter

\*Note: Max. Output include tune up tolerance Power is average power

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## 8. 6DB BANDWIDTH MEASUREMENT

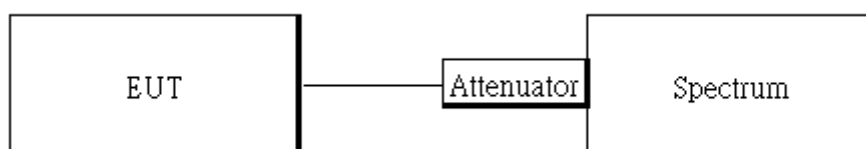
### 8.1 Standard Applicable

The minimum 6 dB bandwidth shall be at least 500 kHz.

### 8.2 Measurement Equipment Used

| EQUIPMENT TYPE        | MFR           | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-----------------------|---------------|--------------|---------------|------------|------------|
| EXA Spectrum Analyzer | Agilent       | N9010A       | MY50420195    | 05/02/2019 | 05/01/2020 |
| DC Power Supply       | Agilent       | E3640A       | MY52410006    | 12/04/2018 | 12/03/2019 |
| DC Block              | Mini-Circuits | BLK-18-S+    | 1             | 01/02/2019 | 01/01/2020 |
| Attenuator            | Mini-Circuit  | BW-S10W2+    | 2             | 01/02/2019 | 01/01/2020 |

### 8.3 Test Set-up:



### 8.4 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. For 6dB Bandwidth:  
Set the spectrum analyzer as RBW=100 kHz, VBW= 3\*RBW, Span = 5MHz, Detector=Peak, Sweep=auto.
5. Mark the peak frequency and -6dB (upper and lower) frequency.
6. Repeat above procedures until all test default channel is completed

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## 8.5 Measurement Result:

### DATA RATE 1 Mbps:

| Frequency (MHz) | 6dB BW (MHz) | Required BW (MHz) | Result |
|-----------------|--------------|-------------------|--------|
| 2402            | 0.6885       | > 0.5             | PASS   |
| 2440            | 0.6856       | > 0.5             | PASS   |
| 2480            | 0.6909       | > 0.5             | PASS   |

### DATA RATE 2 Mbps:

| Frequency (MHz) | 6dB BW (MHz) | Required BW (MHz) | Result |
|-----------------|--------------|-------------------|--------|
| 2402            | 1.153        | > 0.5             | PASS   |
| 2440            | 1.17         | > 0.5             | PASS   |
| 2480            | 1.178        | > 0.5             | PASS   |

*Note: Refer to next page for plots.*

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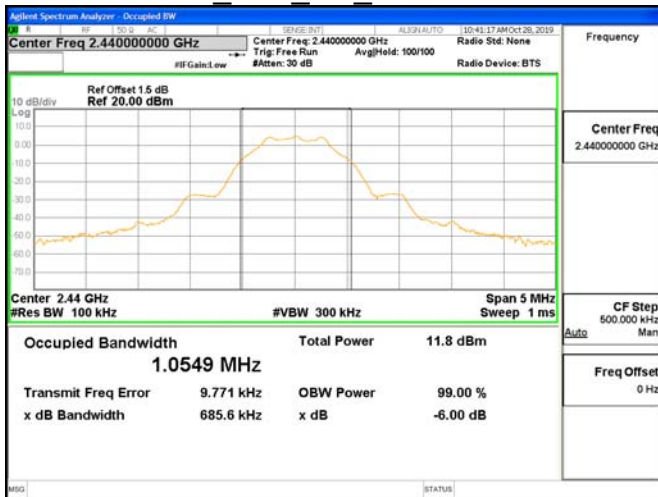
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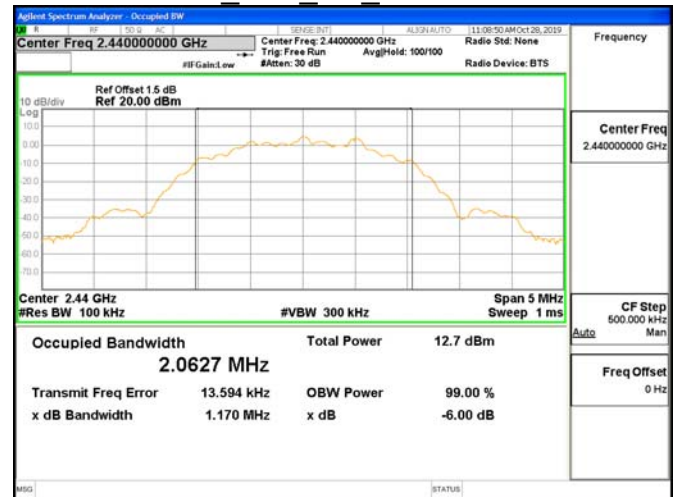
OBW 6dB BLE 2M LowCH00-2402



OBW 6dB BLE 1M MidCH19-2440



OBW 6dB BLE 2M MidCH19-2440



OBW 6dB BLE 1M HighCH39-2480



OBW 6dB BLE 2M HighCH39-2480



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## 9. CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

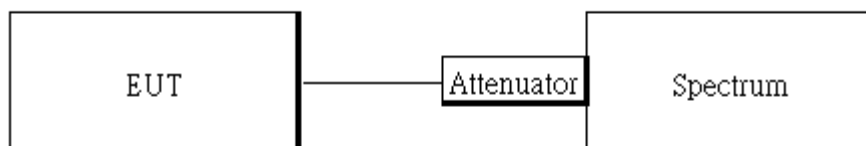
### 9.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

### 9.2 Measurement Equipment Used:

| EQUIPMENT TYPE        | MFR           | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-----------------------|---------------|--------------|---------------|------------|------------|
| EXA Spectrum Analyzer | Agilent       | N9010A       | MY50420195    | 05/02/2019 | 05/01/2020 |
| DC Power Supply       | Agilent       | E3640A       | MY52410006    | 12/04/2018 | 12/03/2019 |
| DC Block              | Mini-Circuits | BLK-18-S+    | 1             | 01/02/2019 | 01/01/2020 |
| Attenuator            | Mini-Circuit  | BW-S10W2+    | 2             | 01/02/2019 | 01/01/2020 |

### 9.3 Test SET-UP:



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## 9.4 Measurement Procedure

### 9.4.1 Reference Level of Emission Limit:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 100kHz & VBW = 300 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

### 9.4.2 Conducted Band Edge:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
6. Mark the highest reading of the emission as the reference level measurement.
7. Marker on frequency, 2.3999GHz and 2.4836GHz, and examine shall 100 kHz immediately outside the authorized (2400~2483.5MHz) be attenuated by 20dB at least relative to the maximum emission of power.
8. Repeat above procedures until all default test channel (low, middle, and high) was complete.

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### 9.4.3 Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set RBW = 100 kHz & VBW=300 kHz, Detector =Peak, Sweep = Auto
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

### 9.5 Measurement Result:

#### DATA RATE 1 Mbps:

##### Reference Level of Limit

| Frequency (MHz) | RF Power Density (dBm) | Reference Level of Limit = PSD - 20dB (dBm) |
|-----------------|------------------------|---------------------------------------------|
| 2402            | 3.14                   | -16.86                                      |
| 2440            | 4.90                   | -15.10                                      |
| 2480            | 3.84                   | -16.16                                      |

**NOTE: cable loss as 1.5dB that offsets in the spectrum**

**NOTE: Refer to next page for plots.**

#### DATA RATE 2 Mbps:

##### Reference Level of Limit

| Frequency (MHz) | RF Power Density (dBm) | Reference Level of Limit = PSD - 20dB (dBm) |
|-----------------|------------------------|---------------------------------------------|
| 2402            | 3.10                   | -16.90                                      |
| 2440            | 4.86                   | -15.14                                      |
| 2480            | 3.74                   | -16.26                                      |

**NOTE: cable loss as 1.5dB that offsets in the spectrum**

**NOTE: Refer to next page for plots.**

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Reference Level\_BLE\_2M\_LowCH00-2402



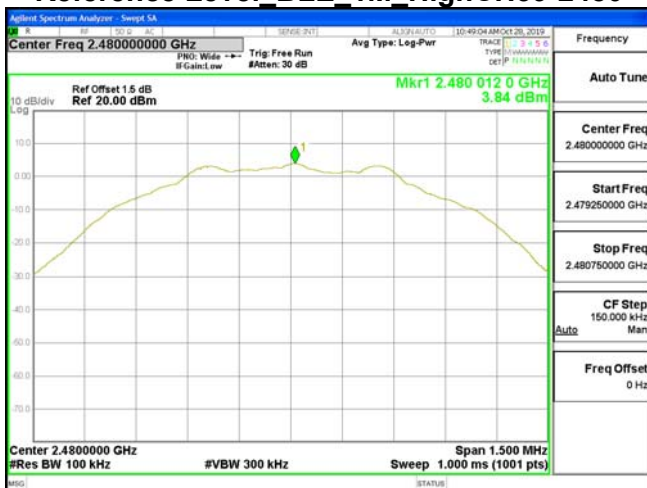
Reference Level\_BLE\_1M\_MidCH19-2440



Reference Level\_BLE\_2M\_MidCH19-2440



Reference Level\_BLE\_1M\_HighCH39-2480



Reference Level\_BLE\_2M\_HighCH39-2480



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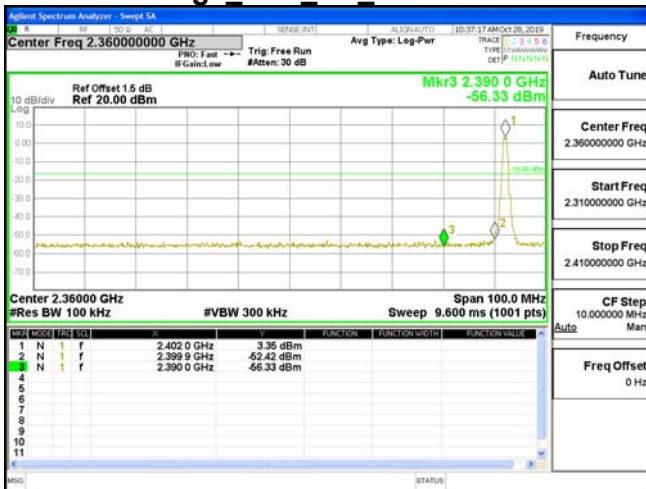
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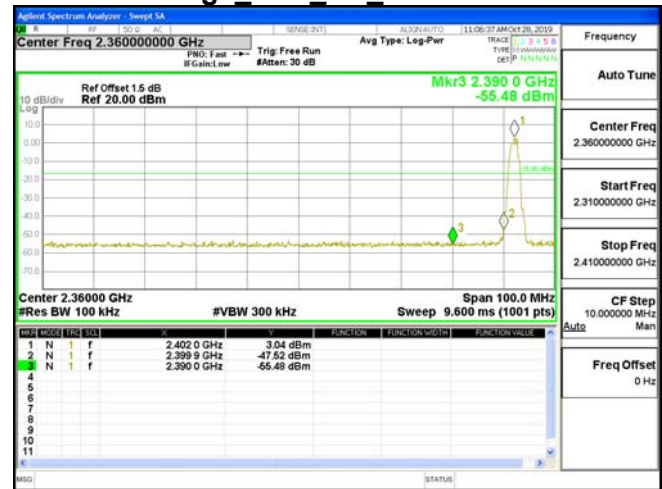
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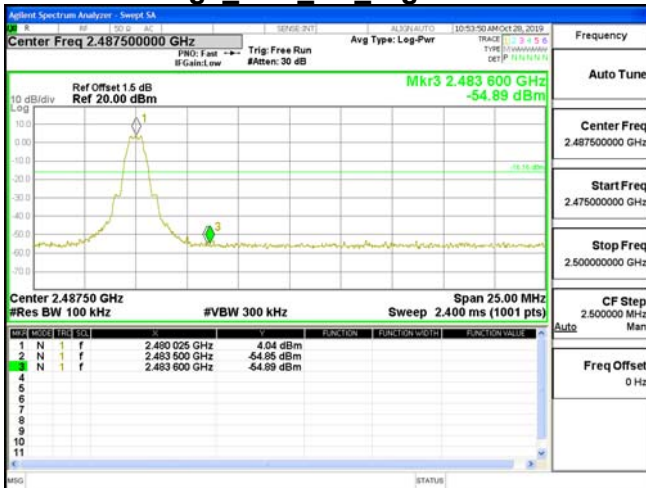
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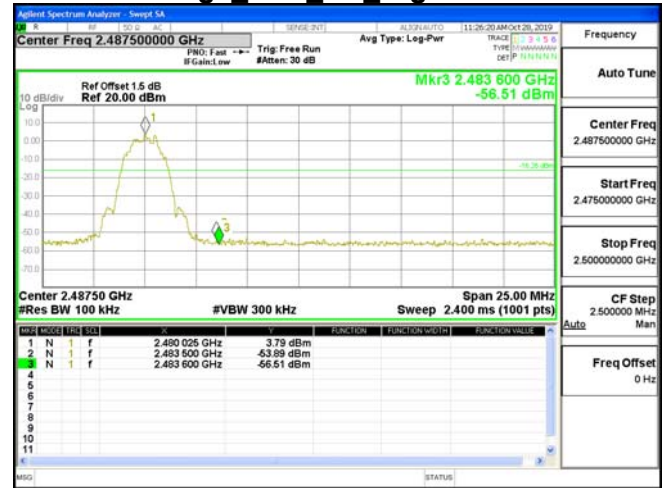
## Band Edge BLE\_2M\_LowCH00-2402



## Band Edge BLE\_1M\_HighCH39-2480



## Band Edge BLE\_2M\_HighCH39-2480



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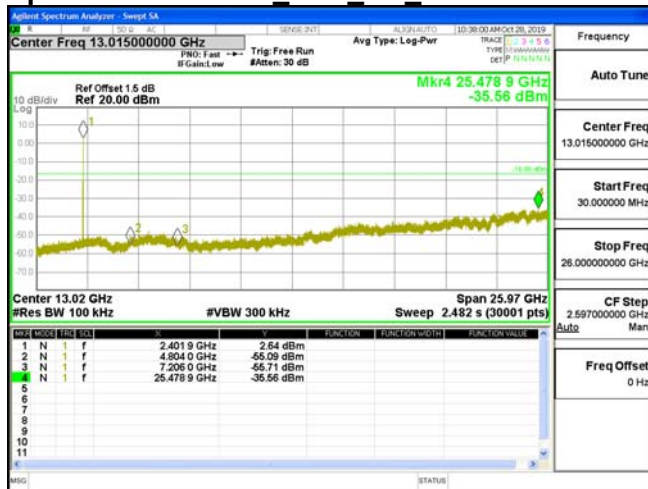
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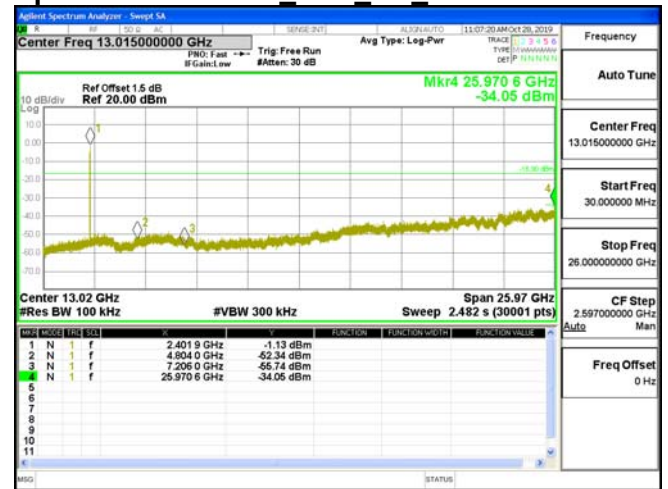
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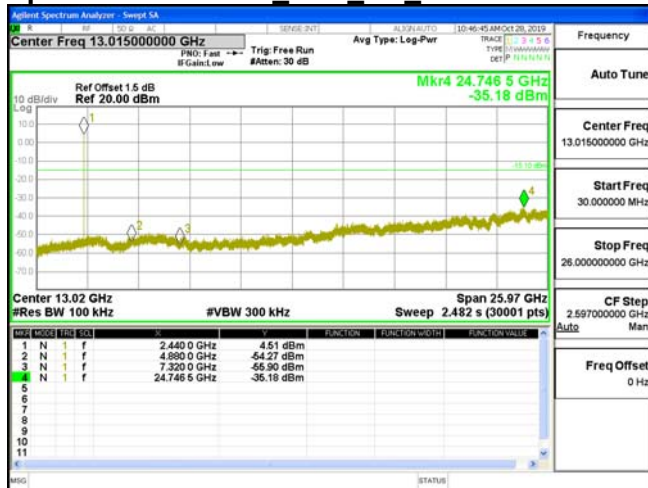
### Spurious Emission BLE\_1M\_LowCH00-2402



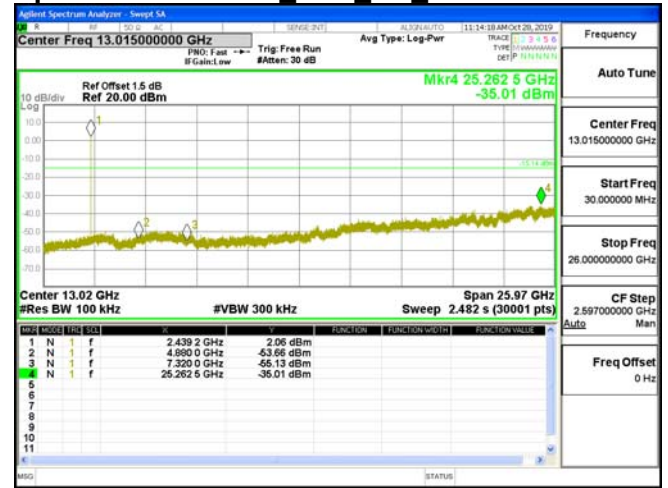
### Spurious Emission BLE\_2M\_LowCH00-2402



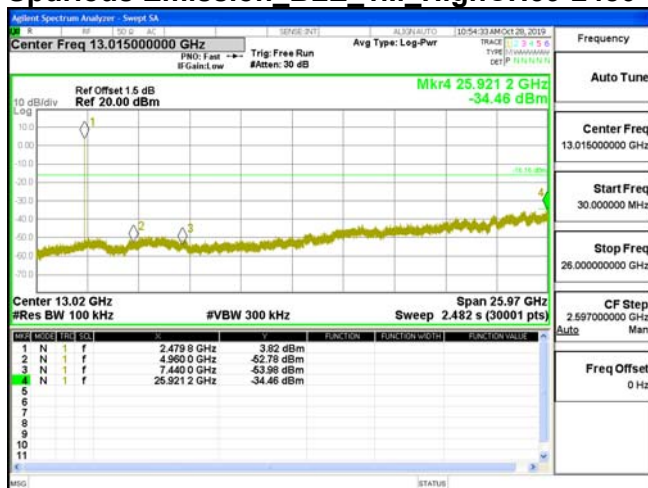
### Spurious Emission BLE\_1M\_MidCH19-2440



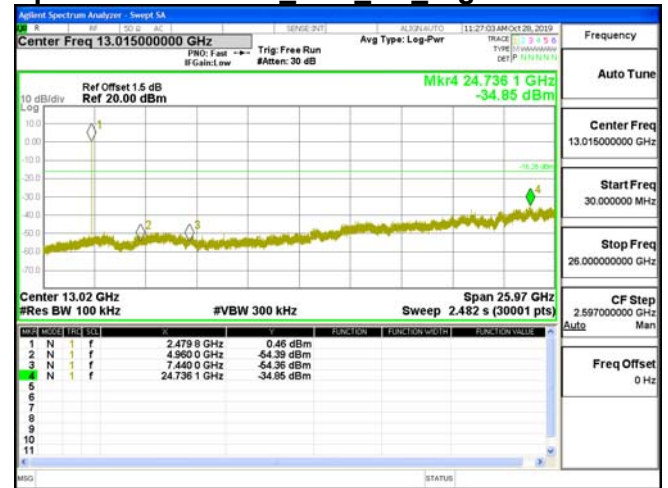
### Spurious Emission BLE\_2M\_MidCH19-2440



### Spurious Emission BLE\_1M\_HighCH39-2480



### Spurious Emission BLE\_2M\_HighCH39-2480



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## 10. RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

### 10.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

And according to §15.33(a) (1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

| Frequency (MHz) | Field strength (microvolts/meter) | Distance (meters) |
|-----------------|-----------------------------------|-------------------|
| 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                 |

#### Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBμV/m) = 20 log Emission level (dBμV/m)

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## 10.2 Measurement Equipment Used

| EQUIPMENT TYPE         | MFR              | MODEL NUMBER     | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|------------------------|------------------|------------------|---------------|------------|------------|
| Bi-log Antenna         | SCHWAZBECK       | VULB9168         | 378           | 01/04/2019 | 01/03/2020 |
| Horn Antenna           | Schwarzbeck      | BBHA9120D        | 1441          | 08/20/2019 | 08/19/2020 |
| Horn Antenna           | Schwarzbeck      | BBHA9170         | 184           | 12/27/2018 | 12/26/2019 |
| 3m Site NSA            | SGS              | 966 chamber      | N/A           | 01/02/2019 | 01/01/2020 |
| Loop Antenna           | ETS.LINDGREN     | 6502             | 148045        | 10/15/2019 | 10/14/2020 |
| PXA Spectrum Analyzer  | Agilent          | N9030A           | MY53120760    | 04/22/2019 | 04/21/2020 |
| EMI Test Receiver      | R&S              | ESCI 3           | 100335        | 02/12/2019 | 02/11/2020 |
| Pre-Amplifier          | HP               | 8449B            | 3008A00578    | 01/02/2019 | 01/01/2020 |
| Pre-Amplifier          | HP               | 8447D            | 2944A07676    | 01/02/2019 | 01/01/2020 |
| Pre-Amplifier          | EMC Instru-ments | EMC184045B       | 980135        | 01/02/2019 | 01/01/2020 |
| Attenuator             | Mini-Circuit     | BW-S10W2+        | 4             | 01/02/2019 | 01/01/2020 |
| Filter 2400-2483.5 MHz | EWT              | EWT-14-0166      | M1            | 01/02/2019 | 01/01/2020 |
| High Pass Filter       | WI               | WHKX4.0/18G-10SS | 22            | 01/01/2019 | 01/02/2020 |
| Low Loss Cable         | Huber Suhner     | 966_RX           | 9             | 01/02/2019 | 01/01/2020 |

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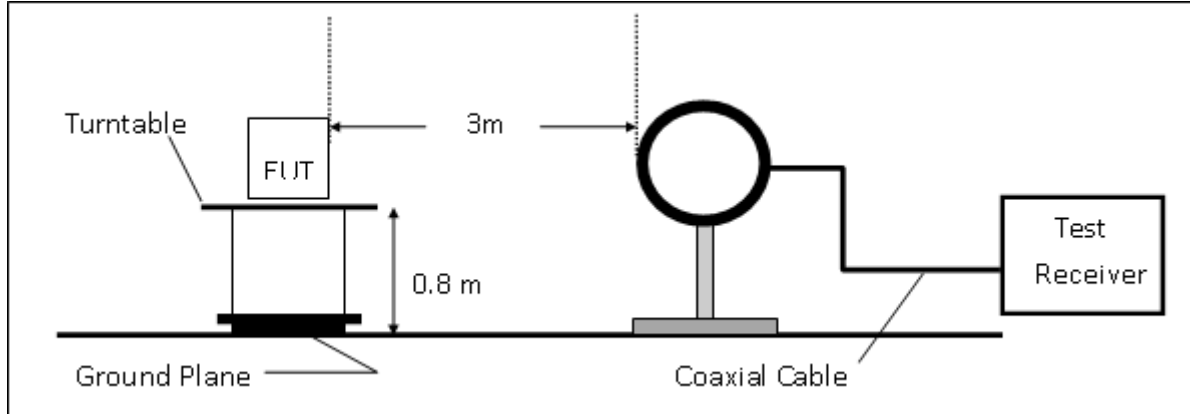
f (886-2) 2298-0488

[www.tw.sgs.com](http://www.tw.sgs.com)

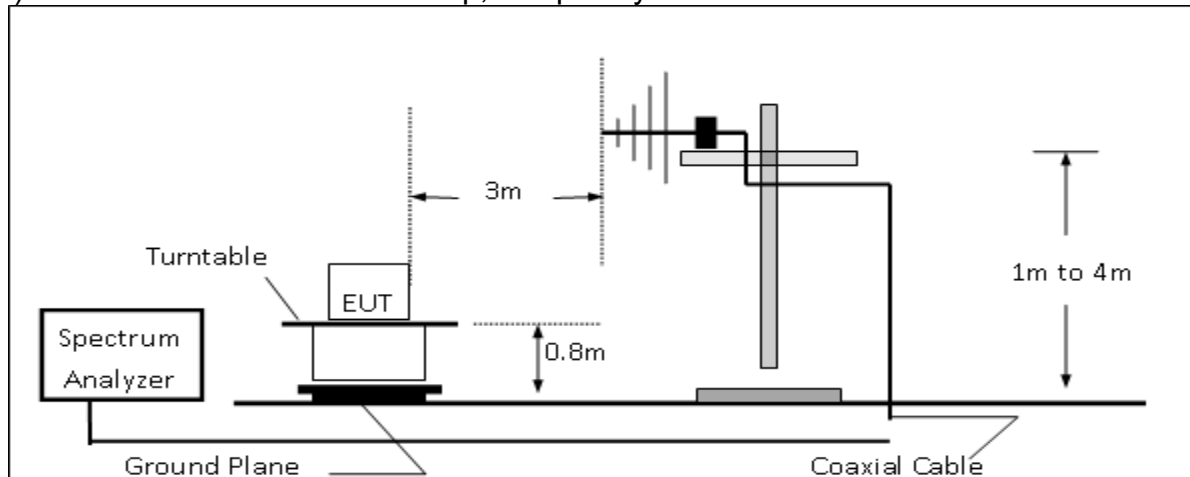
Member of SGS Group

### 10.3 Test SET-UP

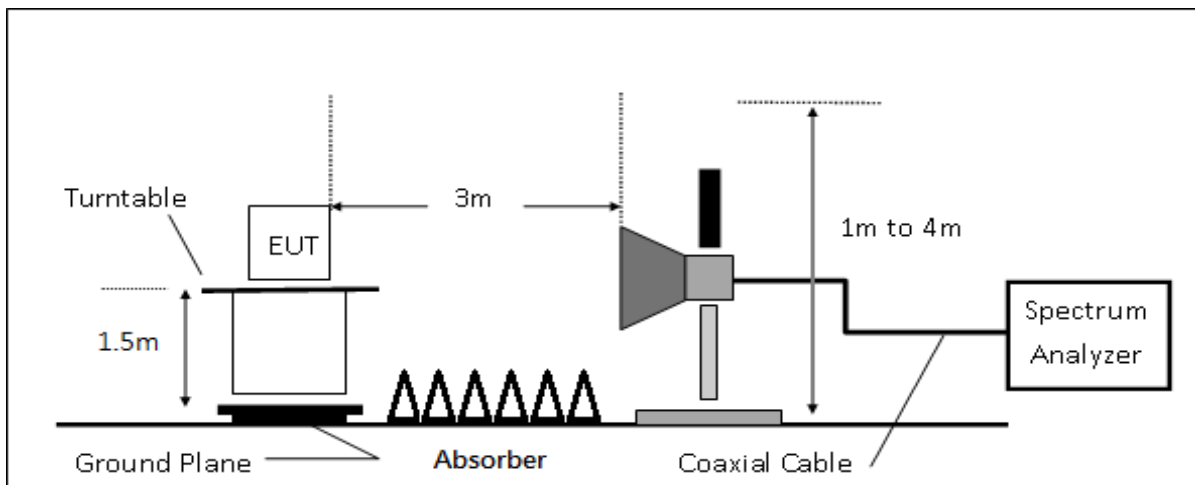
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-UP, Frequency form 30MHz to 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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## 10.4 Measurement Procedure

1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
2. The EUT was placed on a turn table with 0.8m for frequency < 1GHz and 0.8m for frequency > 1GHz above ground plan.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
6. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
7. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
8. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
10. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
11. Repeat above procedures until all default test channel measured were complete.

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### 10.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

**Where** *FS* = Field Strength

*CL* = Cable Attenuation Factor (Cable Loss)

*RA* = Reading Amplitude

*AG* = Amplifier Gain

*AF* = Antenna Factor

The limit of the emission level is expressed in dBuV/m, which converts  $20 \cdot \log(\mu\text{V/m})$

*Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)*

*Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre\_Amplifier Gain(dB)*

### 10.6 Test Results of Radiated Spurious Emissions form 9 kHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

### 10.7 Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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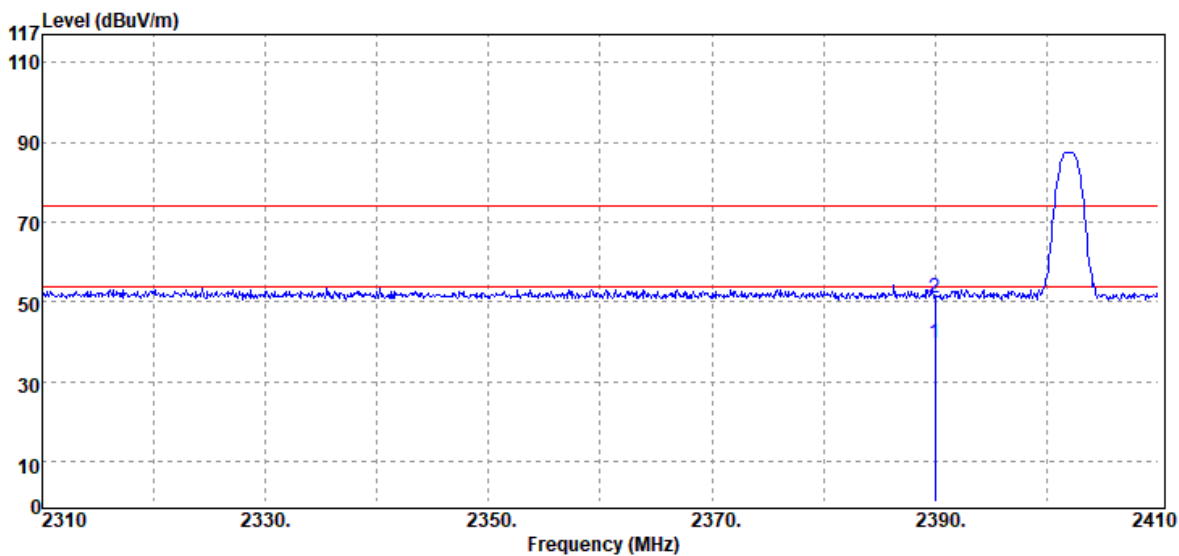
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## Radiated Band Edge Measurement Result (BLE mode)

### DATA RATE 1 Mbps:

|                |                  |              |             |
|----------------|------------------|--------------|-------------|
| Report Number  | :ER/2019/A0071   | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(1M)         | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2402 MHz        | Antenna Pol. | :VERTICAL   |
| Test Mode      | :Bandedge CH Low | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane        |              |             |



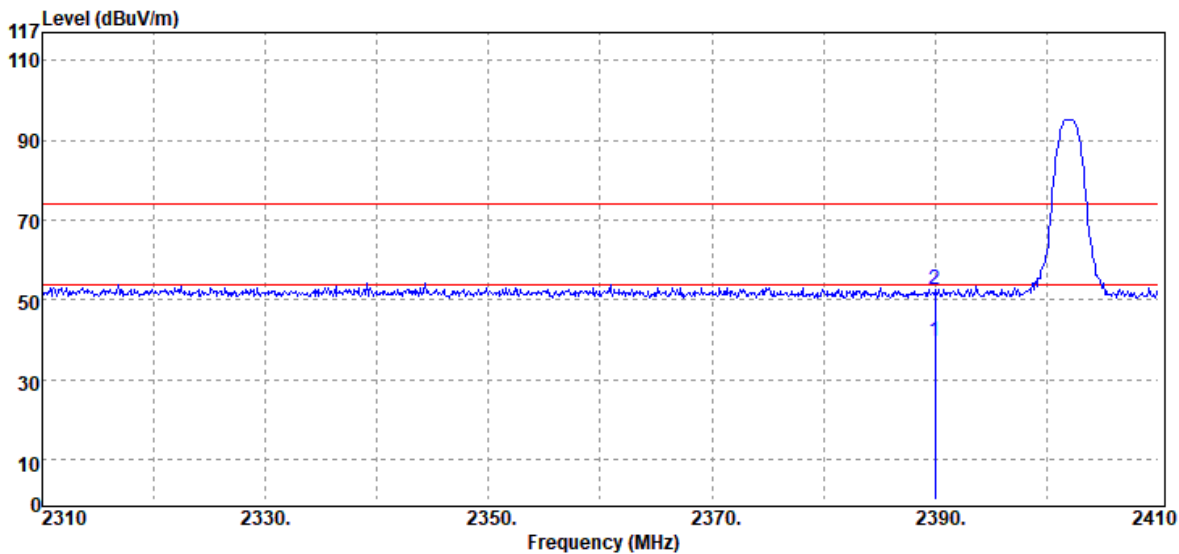
| Freq.   | Detector      | Spectrum | Factor | Actual | Limit  | Margin |
|---------|---------------|----------|--------|--------|--------|--------|
| Mode    | Reading Level |          |        | FS     | @3m    |        |
| MHz     | PK/QP/AV      | dBμV     | dB     | dBμV/m | dBμV/m | dB     |
| 2390.00 | Average       | 39.52    | 0.24   | 39.76  | 54.00  | -14.24 |
| 2390.00 | Peak          | 50.74    | 0.24   | 50.98  | 74.00  | -23.02 |

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|                |                  |              |             |
|----------------|------------------|--------------|-------------|
| Report Number  | :ER/2019/A0071   | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(1M)         | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2402 MHz        | Antenna Pol. | :HORIZONTAL |
| Test Mode      | :Bandedge CH Low | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane        |              |             |



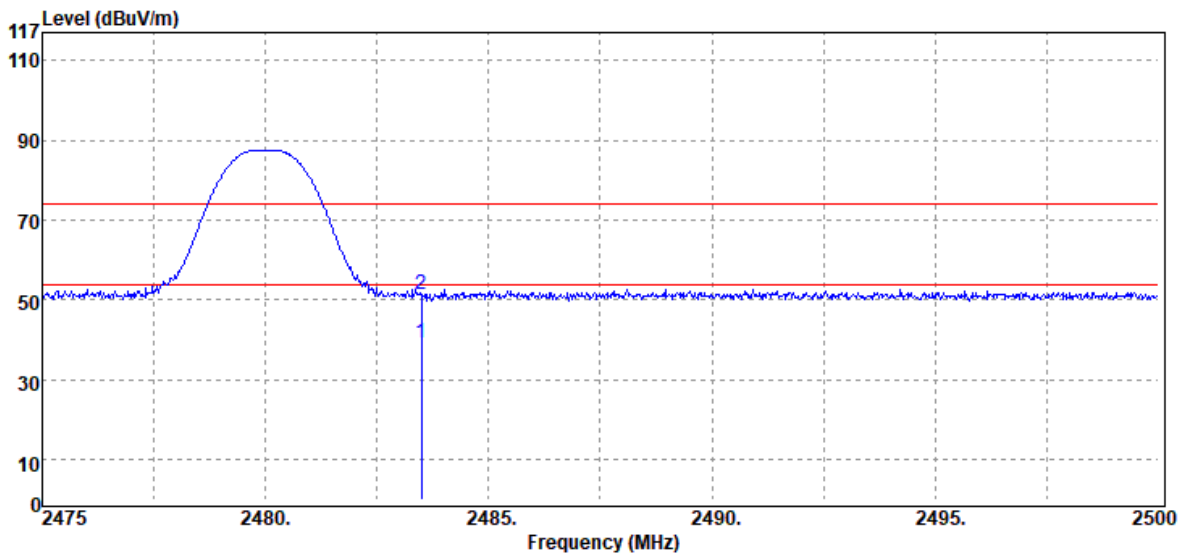
| Freq.   | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| Mode    |          | Reading Level |        | FS     | @3m    |        |
| MHz     | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 2390.00 | Average  | 39.54         | 0.24   | 39.78  | 54.00  | -14.22 |
| 2390.00 | Peak     | 52.28         | 0.24   | 52.52  | 74.00  | -21.48 |

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|                |                   |              |             |
|----------------|-------------------|--------------|-------------|
| Report Number  | :ER/2019/A0071    | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(1M)          | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2480 MHz         | Antenna Pol. | :VERTICAL   |
| Test Mode      | :Bandedge CH High | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane         |              |             |



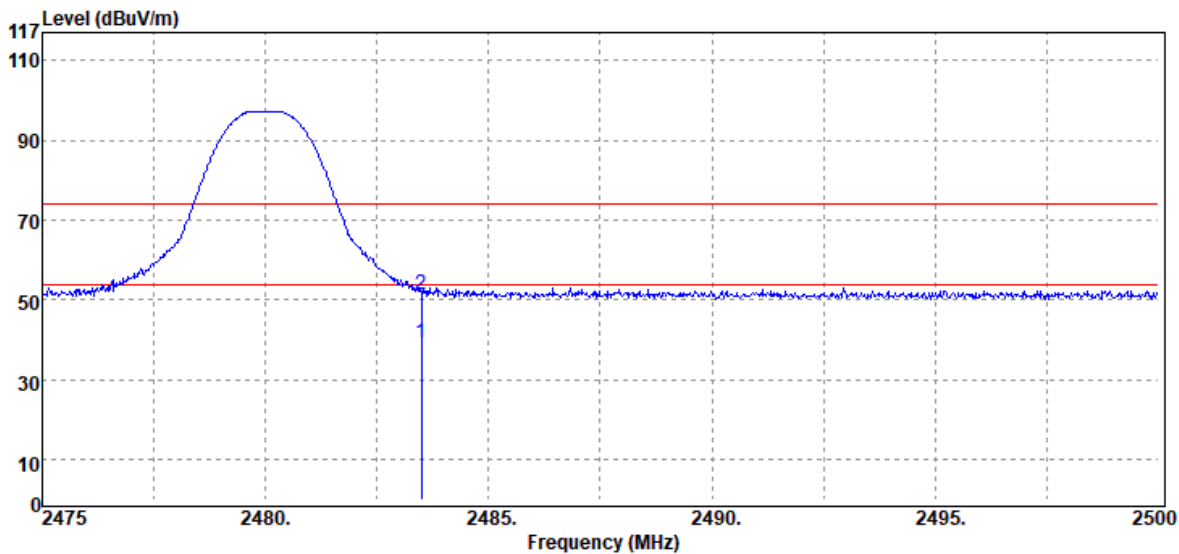
| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| MHz     | Mode     | Reading Level |        | FS           | @3m          |        |
| MHz     | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 2483.50 | Average  | 39.39         | -0.17  | 39.22        | 54.00        | -14.78 |
| 2483.50 | Peak     | 51.58         | -0.17  | 51.41        | 74.00        | -22.59 |

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|                |                   |              |             |
|----------------|-------------------|--------------|-------------|
| Report Number  | :ER/2019/A0071    | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(1M)          | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2480 MHz         | Antenna Pol. | :HORIZONTAL |
| Test Mode      | :Bandedge CH High | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane         |              |             |



| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| MHz     | Mode     | Reading Level |        | FS           | @3m          |        |
| MHz     | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 2483.50 | Average  | 39.27         | -0.17  | 39.10        | 54.00        | -14.90 |
| 2483.50 | Peak     | 51.78         | -0.17  | 51.61        | 74.00        | -22.39 |

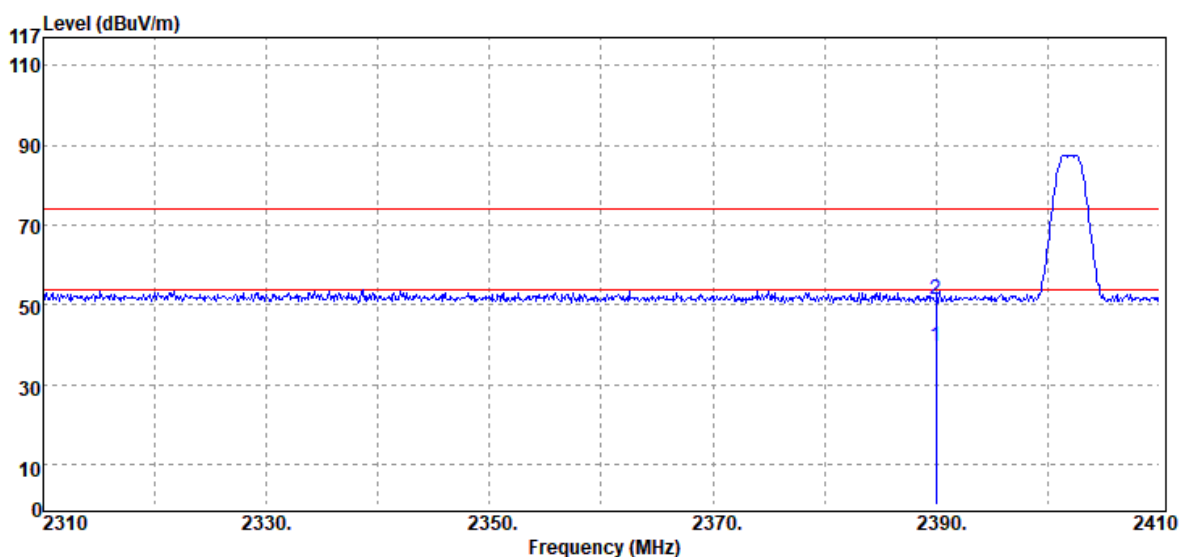
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## DATA RATE 2 Mbps:

|                |                  |              |             |
|----------------|------------------|--------------|-------------|
| Report Number  | :ER/2019/A0071   | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(2M)         | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2402 MHz        | Antenna Pol. | :VERTICAL   |
| Test Mode      | :Bandedge CH Low | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane        |              |             |



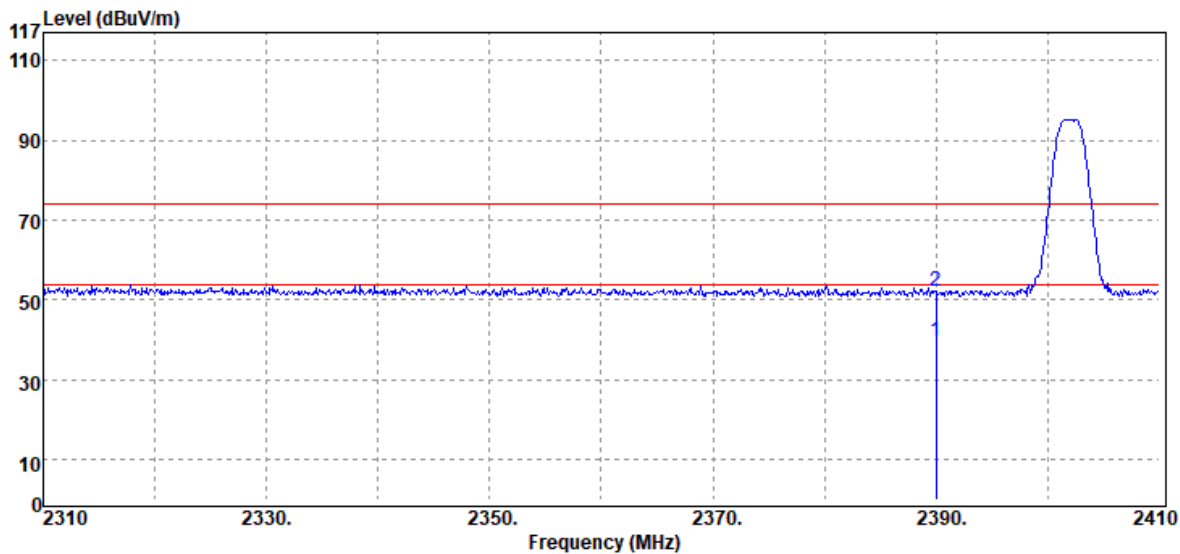
| Freq.   | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
|         | Mode     | Reading Level |        | FS     | @3m    |        |
| MHz     | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 2390.00 | Average  | 39.62         | 0.24   | 39.86  | 54.00  | -14.14 |
| 2390.00 | Peak     | 50.97         | 0.24   | 51.21  | 74.00  | -22.79 |

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|                |                  |              |             |
|----------------|------------------|--------------|-------------|
| Report Number  | :ER/2019/A0071   | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(2M)         | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2402 MHz        | Antenna Pol. | :HORIZONTAL |
| Test Mode      | :Bandedge CH Low | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane        |              |             |



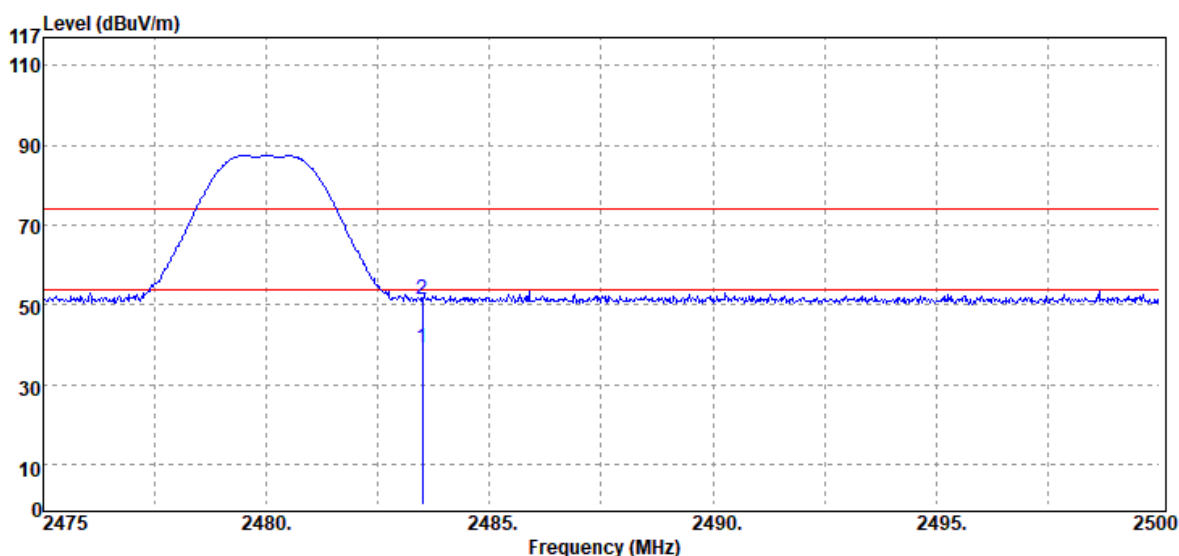
| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| Mode    |          | Reading Level |        | FS           | @3m          |        |
| MHz     | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 2390.00 | Average  | 39.48         | 0.24   | 39.72        | 54.00        | -14.28 |
| 2390.00 | Peak     | 52.09         | 0.24   | 52.33        | 74.00        | -21.67 |

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|                |                   |              |             |
|----------------|-------------------|--------------|-------------|
| Report Number  | :ER/2019/A0071    | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(2M)          | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2480 MHz         | Antenna Pol. | :VERTICAL   |
| Test Mode      | :Bandedge CH High | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane         |              |             |



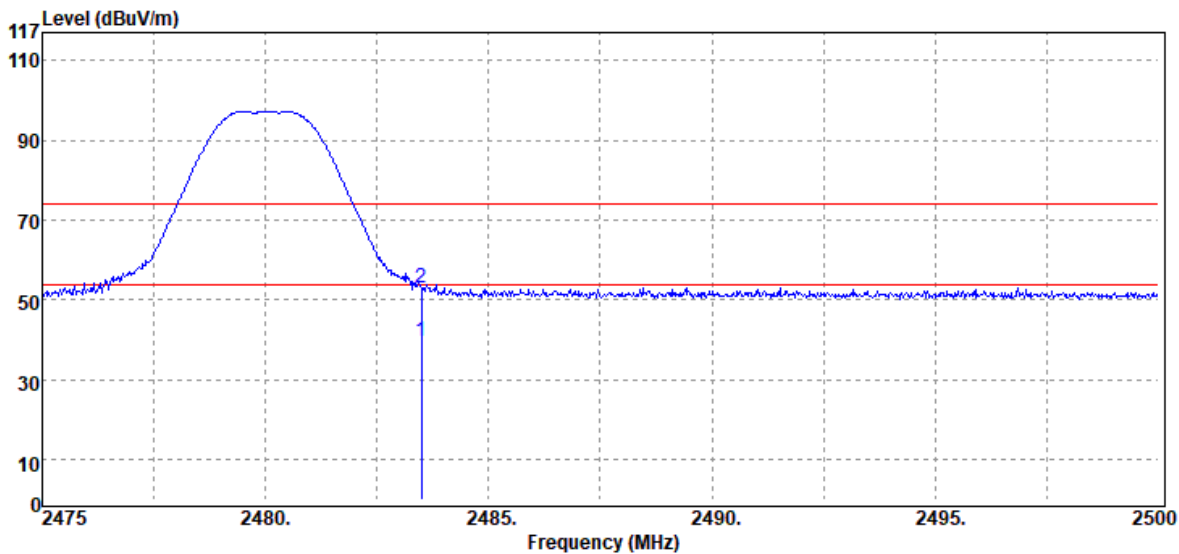
| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| MHz     | Mode     | Reading Level |        | FS           | @3m          |        |
| MHz     | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 2483.50 | Average  | 39.47         | -0.17  | 39.30        | 54.00        | -14.70 |
| 2483.50 | Peak     | 51.60         | -0.17  | 51.43        | 74.00        | -22.57 |

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|                |                   |              |             |
|----------------|-------------------|--------------|-------------|
| Report Number  | :ER/2019/A0071    | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(2M)          | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2480 MHz         | Antenna Pol. | :HORIZONTAL |
| Test Mode      | :Bandedge CH High | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane         |              |             |



| Freq.   | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz     | Mode     | Reading Level |        | FS     | @3m    |        |
| MHz     | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 2483.50 | Average  | 39.68         | -0.17  | 39.51  | 54.00  | -14.49 |
| 2483.50 | Peak     | 53.18         | -0.17  | 53.01  | 74.00  | -20.99 |

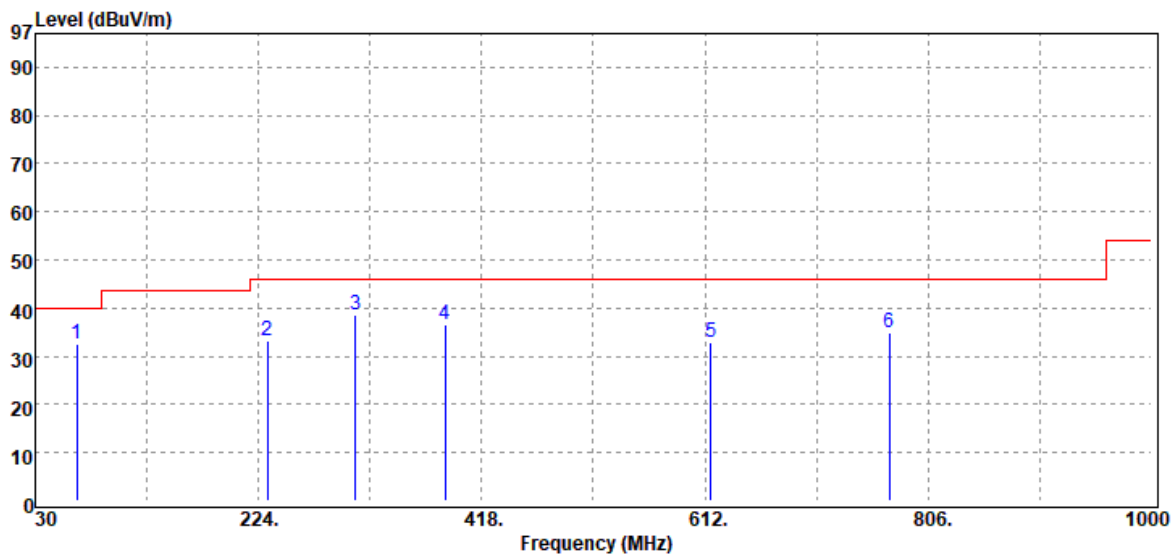
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# Radiated Spurious Emission Measurement Result: (BLE mode) For Frequency from 30MHz to 1000MHz DATA RATE 1 Mbps:

|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(1M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2440 MHz      | Antenna Pol. | :VERTICAL   |
| Test Mode      | :Tx CH Mid     | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



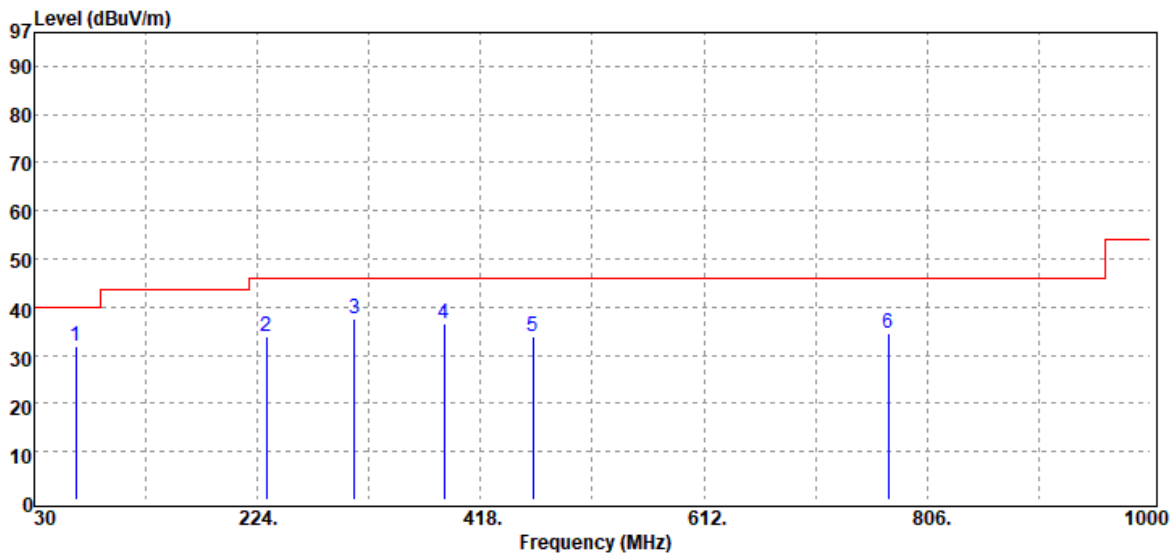
| Freq.  | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|--------|----------|---------------|--------|--------|--------|--------|
| Mode   |          | Reading Level |        | FS     | @3m    |        |
| MHz    | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 65.89  | Peak     | 41.80         | -9.31  | 32.49  | 40.00  | -7.51  |
| 231.76 | Peak     | 41.79         | -8.68  | 33.11  | 46.00  | -12.89 |
| 308.39 | Peak     | 44.58         | -5.93  | 38.65  | 46.00  | -7.35  |
| 385.99 | Peak     | 40.81         | -4.26  | 36.55  | 46.00  | -9.45  |
| 616.85 | Peak     | 33.36         | -0.51  | 32.85  | 46.00  | -13.15 |
| 772.05 | Peak     | 32.63         | 2.24   | 34.87  | 46.00  | -11.13 |

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|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(1M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2440 MHz      | Antenna Pol. | :HORIZONTAL |
| Test Mode      | :Tx CH Mid     | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



| Freq.  | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|--------|----------|---------------|--------|--------|--------|--------|
| MHz    | Mode     | Reading Level |        | FS     | @3m    |        |
| MHz    | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 65.89  | Peak     | 41.32         | -9.31  | 32.01  | 40.00  | -7.99  |
| 231.76 | Peak     | 42.69         | -8.68  | 34.01  | 46.00  | -11.99 |
| 308.39 | Peak     | 43.40         | -5.93  | 37.47  | 46.00  | -8.53  |
| 385.99 | Peak     | 40.74         | -4.26  | 36.48  | 46.00  | -9.52  |
| 463.59 | Peak     | 37.10         | -3.14  | 33.96  | 46.00  | -12.04 |
| 772.05 | Peak     | 32.48         | 2.24   | 34.72  | 46.00  | -11.28 |

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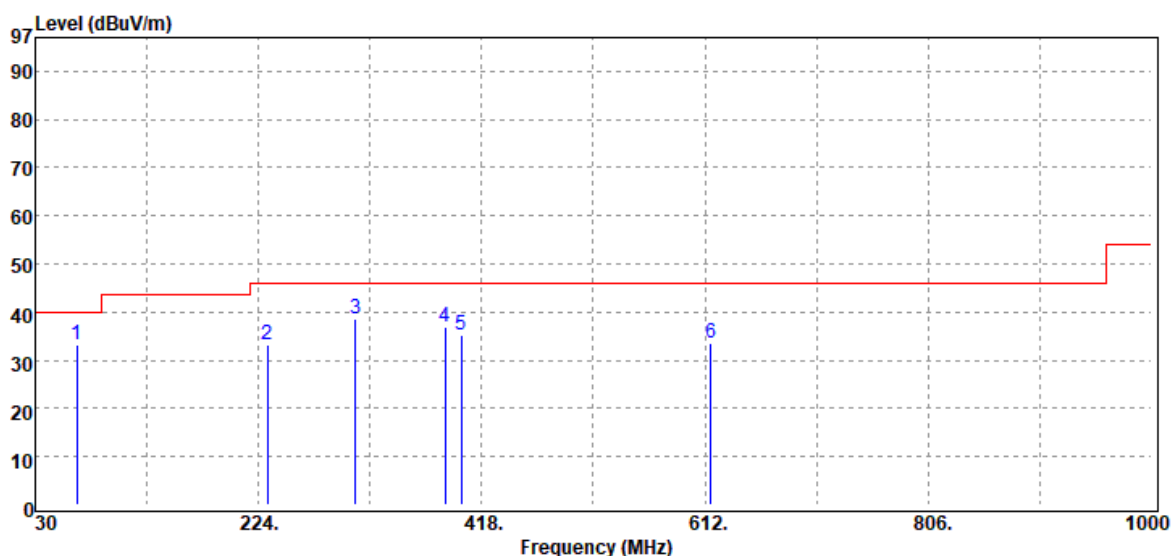
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## DATA RATE 2 Mbps:

Report Number :ER/2019/A0071  
 Operation Mode :BLE(2M)  
 Test Channel :2440 MHz  
 Test Mode :Tx CH Mid  
 EUT Pol :E2 Plane

Test Date :2019-10-25  
 Temp./Humi. :25.3/56  
 Antenna Pol. :VERTICAL  
 Engineer :Kane



| Freq.  | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|--------|----------|---------------|--------|--------|--------|--------|
| MHz    | Mode     | Reading Level |        | FS     | @3m    |        |
| MHz    | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 65.89  | Peak     | 42.38         | -9.31  | 33.07  | 40.00  | -6.93  |
| 231.76 | Peak     | 41.88         | -8.68  | 33.20  | 46.00  | -12.80 |
| 308.39 | Peak     | 44.56         | -5.93  | 38.63  | 46.00  | -7.37  |
| 385.99 | Peak     | 41.26         | -4.26  | 37.00  | 46.00  | -9.00  |
| 400.54 | Peak     | 39.11         | -3.87  | 35.24  | 46.00  | -10.76 |
| 616.85 | Peak     | 34.08         | -0.51  | 33.57  | 46.00  | -12.43 |

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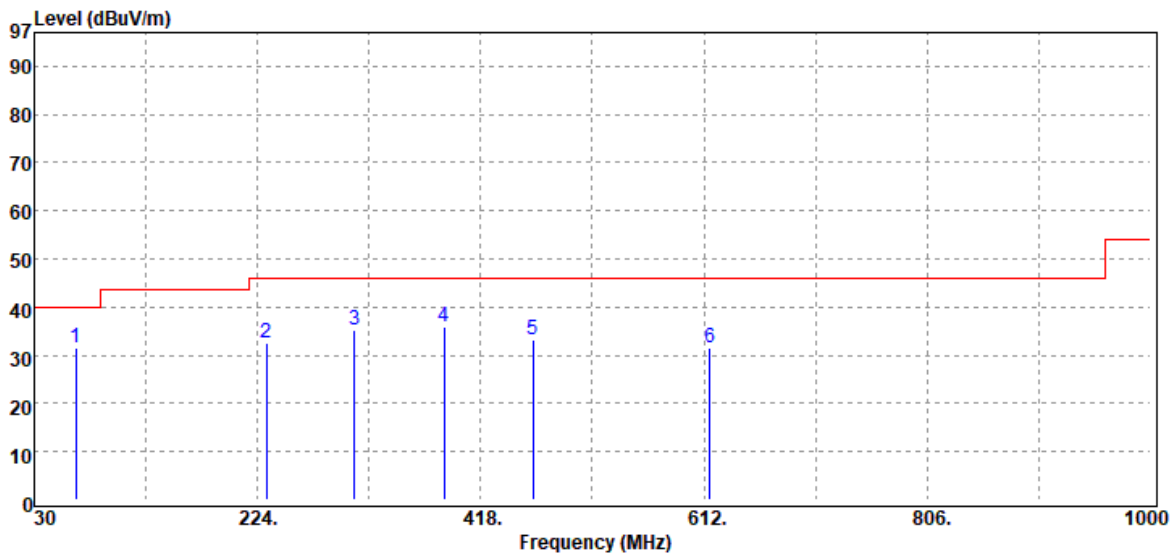
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|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(2M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2440 MHz      | Antenna Pol. | :HORIZONTAL |
| Test Mode      | :Tx CH Mid     | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



| Freq.  | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|--------|----------|---------------|--------|--------|--------|--------|
| Mode   |          | Reading Level |        | FS     | @3m    |        |
| MHz    | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 65.89  | Peak     | 40.98         | -9.31  | 31.67  | 40.00  | -8.33  |
| 231.76 | Peak     | 41.22         | -8.68  | 32.54  | 46.00  | -13.46 |
| 308.39 | Peak     | 41.29         | -5.93  | 35.36  | 46.00  | -10.64 |
| 385.99 | Peak     | 40.14         | -4.26  | 35.88  | 46.00  | -10.12 |
| 463.59 | Peak     | 36.42         | -3.14  | 33.28  | 46.00  | -12.72 |
| 616.85 | Peak     | 32.00         | -0.51  | 31.49  | 46.00  | -14.51 |

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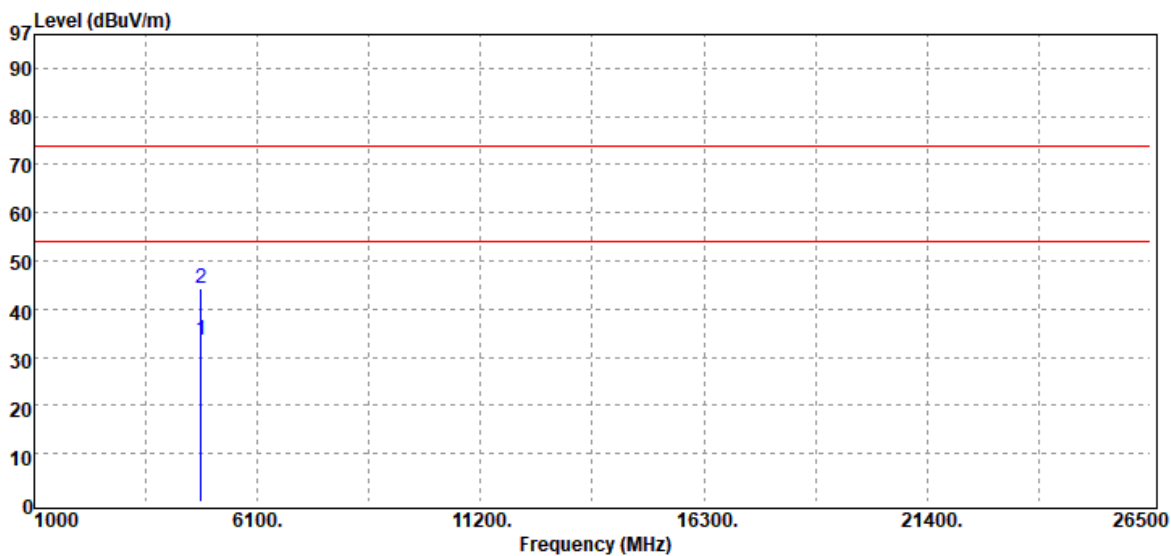
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# Radiated Spurious Emission Measurement Result: (BLE mode) For Frequency above 1 GHz

## DATA RATE 1 Mbps:

|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(1M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2402 MHz      | Antenna Pol. | :VERTICAL   |
| Test Mode      | :Tx CH Low     | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



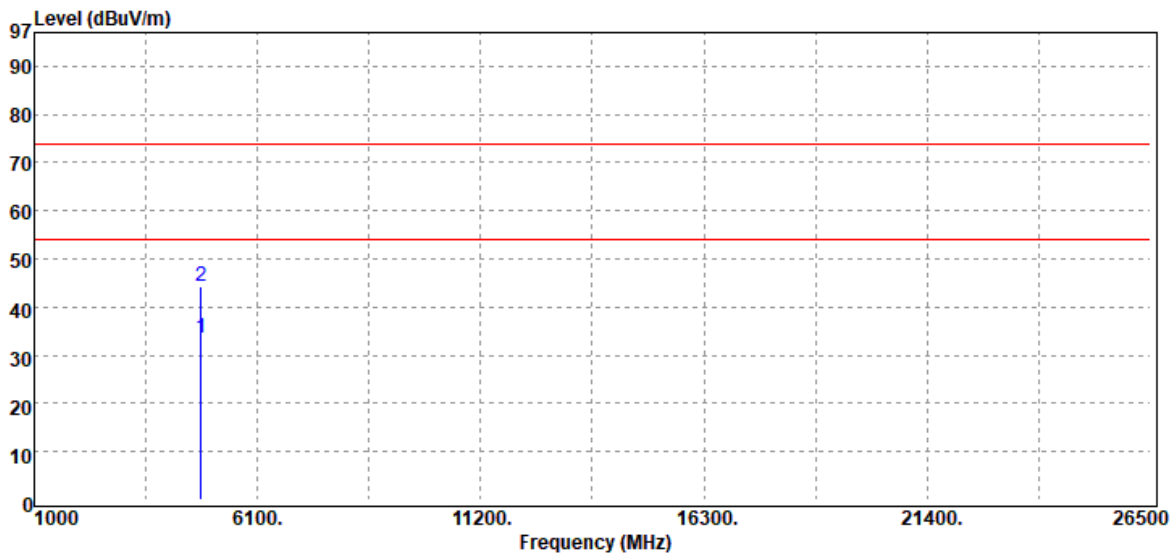
| Freq.   | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz     | Mode     | Reading Level |        | FS     | @3m    |        |
| MHz     | PK/QP/AV | dBuV          | dB     | dBuV/m | dBuV/m | dB     |
| 4804.00 | Average  | 27.04         | 6.41   | 33.45  | 54.00  | -20.55 |
| 4804.00 | Peak     | 37.82         | 6.41   | 44.23  | 74.00  | -29.77 |

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|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(1M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2402 MHz      | Antenna Pol. | :HORIZONTAL |
| Test Mode      | :Tx CH Low     | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| Mode    |          | Reading Level |        | FS           | @3m          |        |
| MHz     | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 4804.00 | Average  | 27.13         | 6.41   | 33.54        | 54.00        | -20.46 |
| 4804.00 | Peak     | 37.85         | 6.41   | 44.26        | 74.00        | -29.74 |

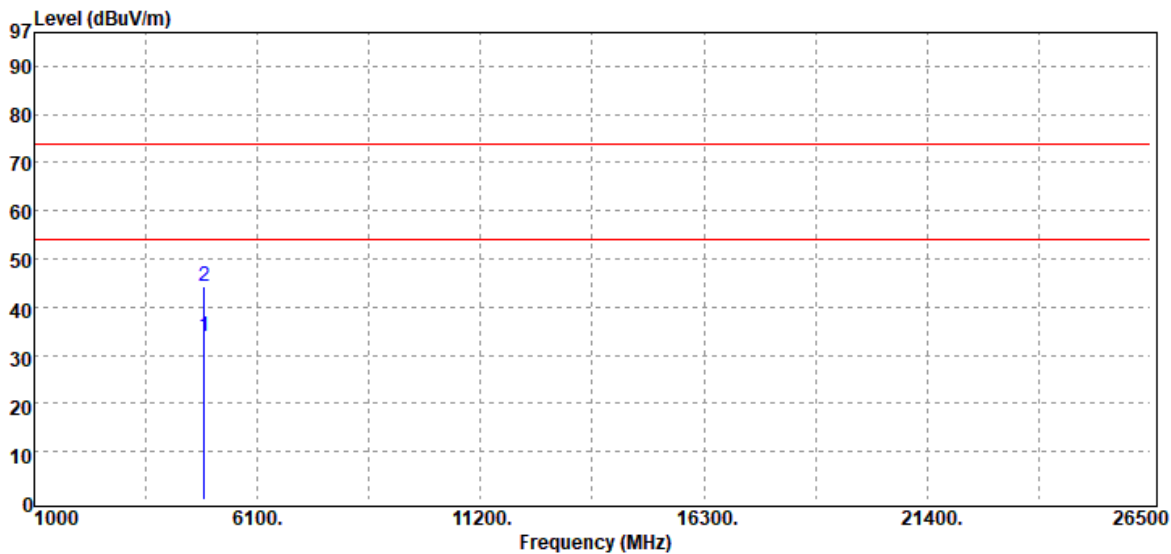
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Report Number :ER/2019/A0071  
Operation Mode :BLE(1M)  
Test Channel :2440 MHz  
Test Mode :Tx CH Mid  
EUT Pol :E2 Plane

Test Date :2019-10-25  
Temp./Humi. :25.3/56  
Antenna Pol. :VERTICAL  
Engineer :Kane



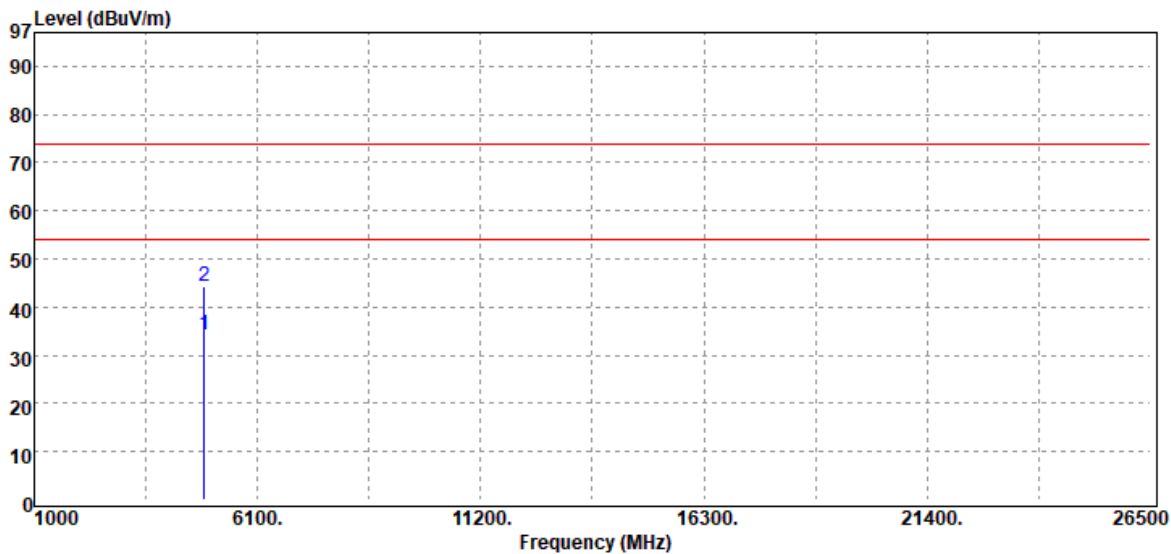
| Freq.   | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| MHz     | Mode     | Reading Level |        | FS     | @3m    |        |
| MHz     | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 4880.00 | Average  | 27.28         | 6.70   | 33.98  | 54.00  | -20.02 |
| 4880.00 | Peak     | 37.48         | 6.70   | 44.18  | 74.00  | -29.82 |

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|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(1M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2440 MHz      | Antenna Pol. | :HORIZONTAL |
| Test Mode      | :Tx CH Mid     | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



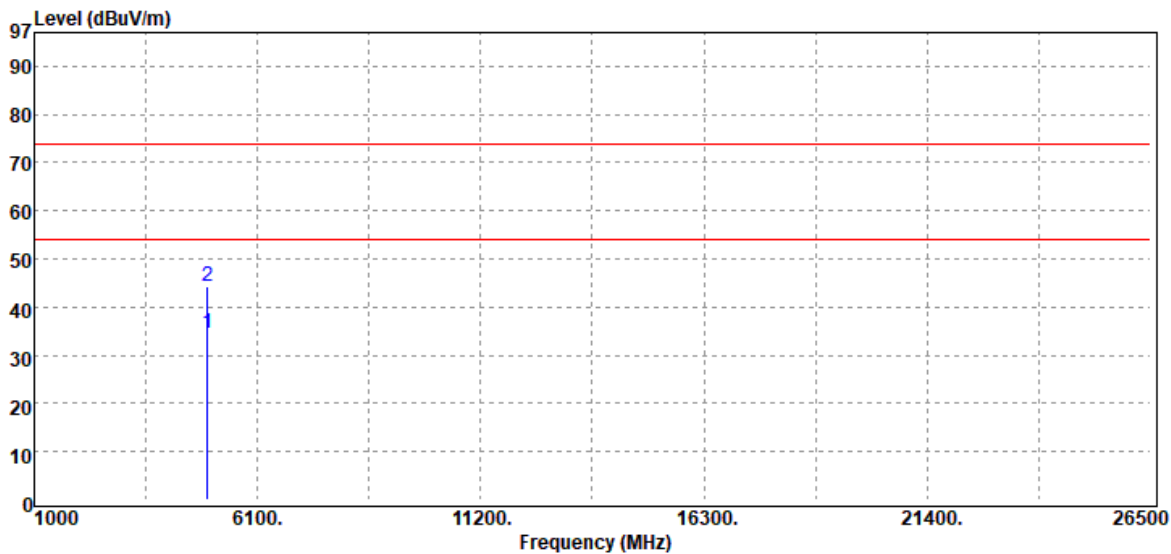
| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| Mode    |          | Reading Level |        | FS           | @3m          |        |
| MHz     | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 4880.00 | Average  | 27.63         | 6.70   | 34.33        | 54.00        | -19.67 |
| 4880.00 | Peak     | 37.76         | 6.70   | 44.46        | 74.00        | -29.54 |

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|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(1M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2480 MHz      | Antenna Pol. | :VERTICAL   |
| Test Mode      | :Tx CH High    | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



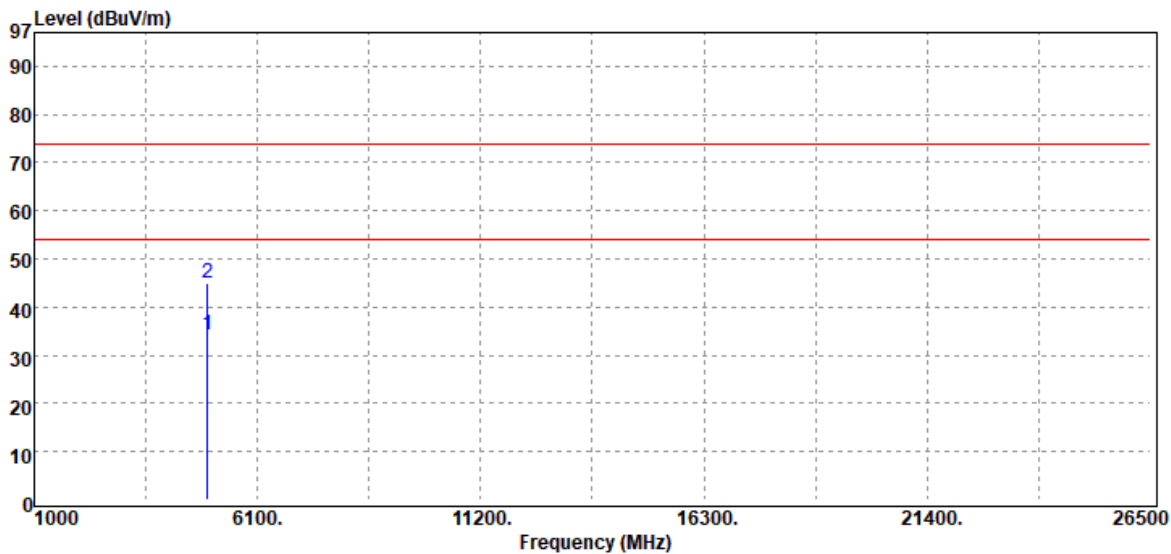
| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| Mode    |          | Reading Level |        | FS           | @3m          |        |
| MHz     | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 4960.00 | Average  | 27.51         | 6.95   | 34.46        | 54.00        | -19.54 |
| 4960.00 | Peak     | 37.32         | 6.95   | 44.27        | 74.00        | -29.73 |

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|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(1M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2480 MHz      | Antenna Pol. | :HORIZONTAL |
| Test Mode      | :Tx CH High    | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| Mode    |          | Reading Level |        | FS           | @3m          |        |
| MHz     | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 4960.00 | Average  | 27.38         | 6.95   | 34.33        | 54.00        | -19.67 |
| 4960.00 | Peak     | 37.88         | 6.95   | 44.83        | 74.00        | -29.17 |

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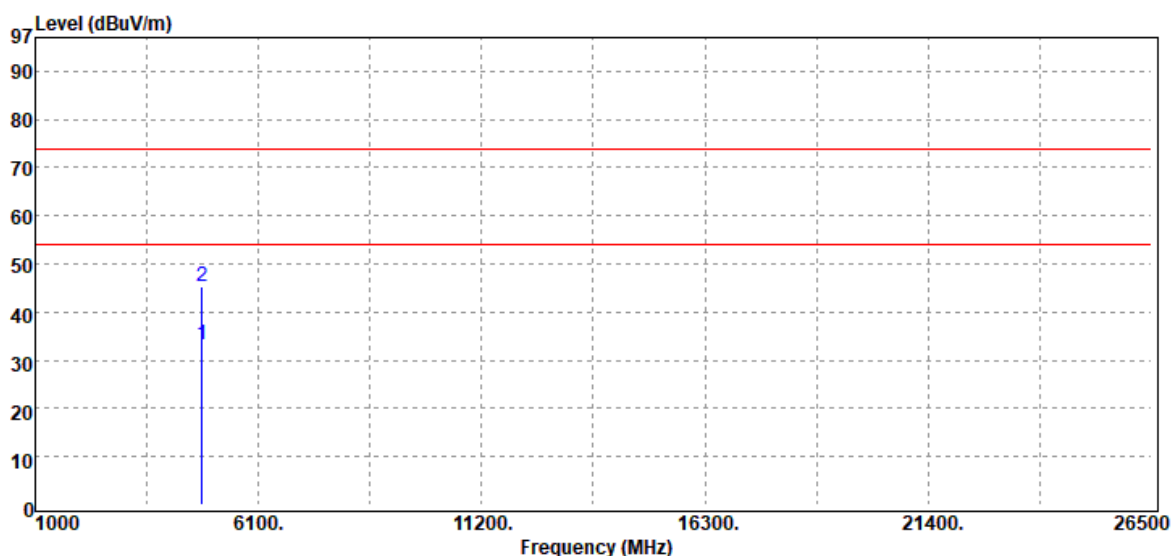
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## DATA RATE 2 Mbps:

Report Number :ER/2019/A0071  
 Operation Mode :BLE(2M)  
 Test Channel :2402 MHz  
 Test Mode :Tx CH Low  
 EUT Pol :E2 Plane

Test Date :2019-10-25  
 Temp./Humi. :25.3/56  
 Antenna Pol. :VERTICAL  
 Engineer :Kane



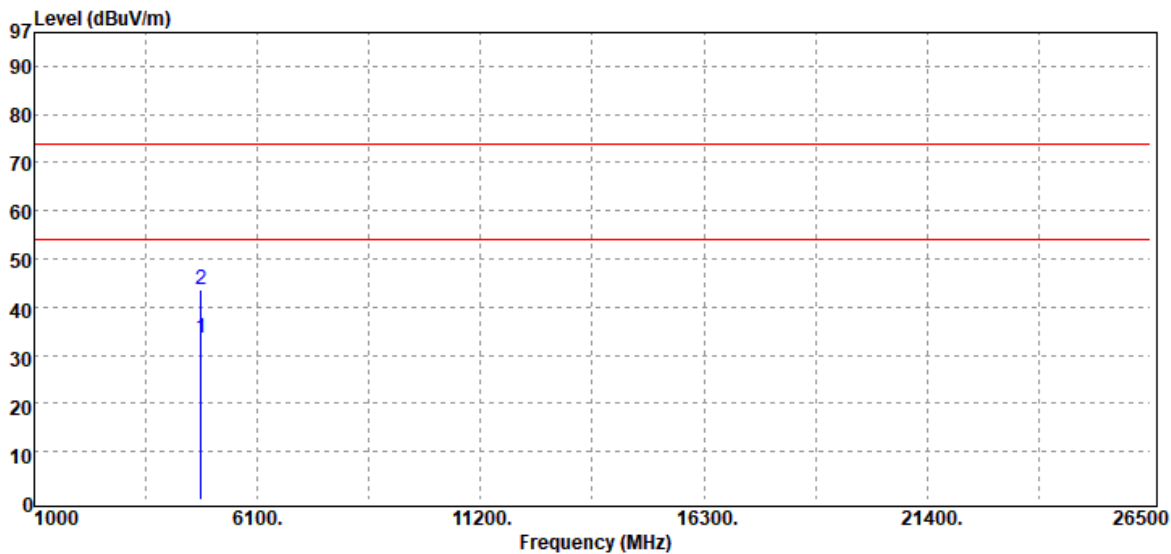
| Freq.   | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| Mode    |          | Reading Level |        | FS     | @3m    |        |
| MHz     | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 4804.00 | Average  | 26.90         | 6.41   | 33.31  | 54.00  | -20.69 |
| 4804.00 | Peak     | 38.90         | 6.41   | 45.31  | 74.00  | -28.69 |

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|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(2M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2402 MHz      | Antenna Pol. | :HORIZONTAL |
| Test Mode      | :Tx CH Low     | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



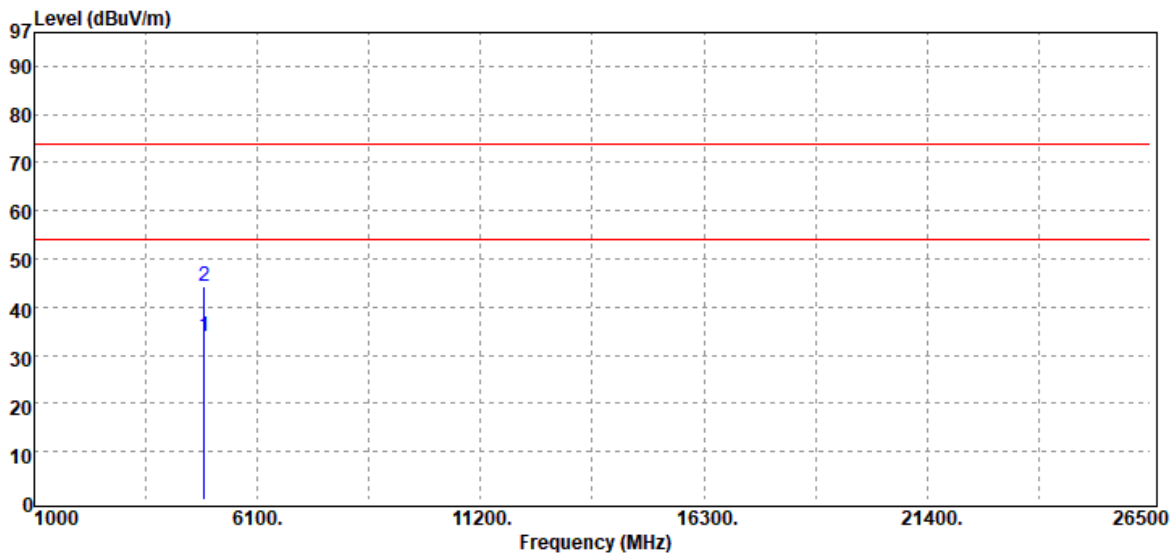
| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| Mode    |          | Reading Level |        | FS           | @3m          |        |
| MHz     | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 4804.00 | Average  | 26.99         | 6.41   | 33.40        | 54.00        | -20.60 |
| 4804.00 | Peak     | 37.23         | 6.41   | 43.64        | 74.00        | -30.36 |

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|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(2M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2440 MHz      | Antenna Pol. | :VERTICAL   |
| Test Mode      | :Tx CH Mid     | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



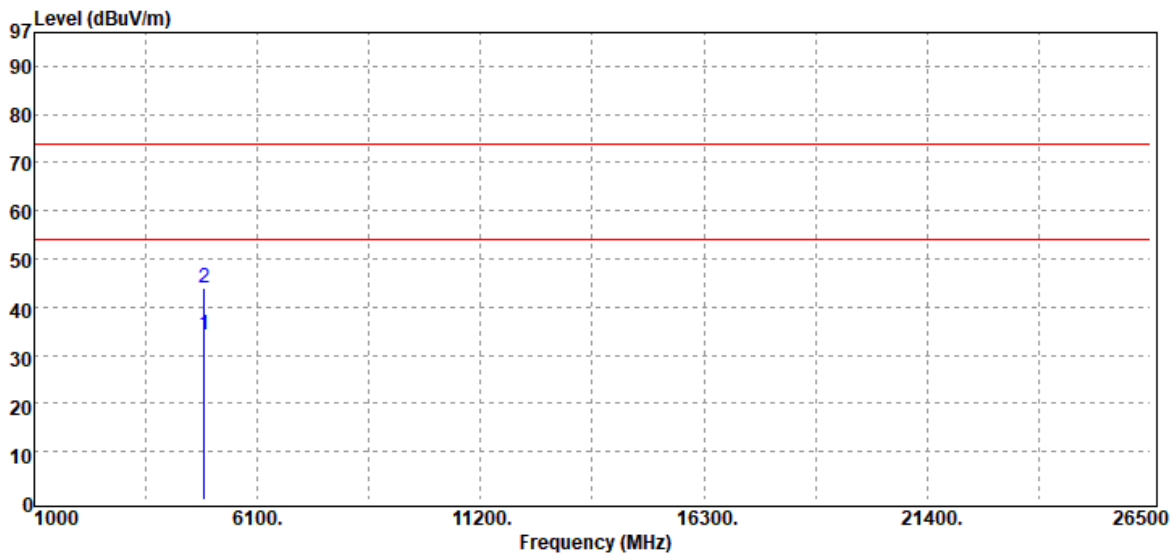
| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| Mode    |          | Reading Level |        | FS           | @3m          |        |
| MHz     | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 4880.00 | Average  | 27.33         | 6.70   | 34.03        | 54.00        | -19.97 |
| 4880.00 | Peak     | 37.64         | 6.70   | 44.34        | 74.00        | -29.66 |

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|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(2M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2440 MHz      | Antenna Pol. | :HORIZONTAL |
| Test Mode      | :Tx CH Mid     | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



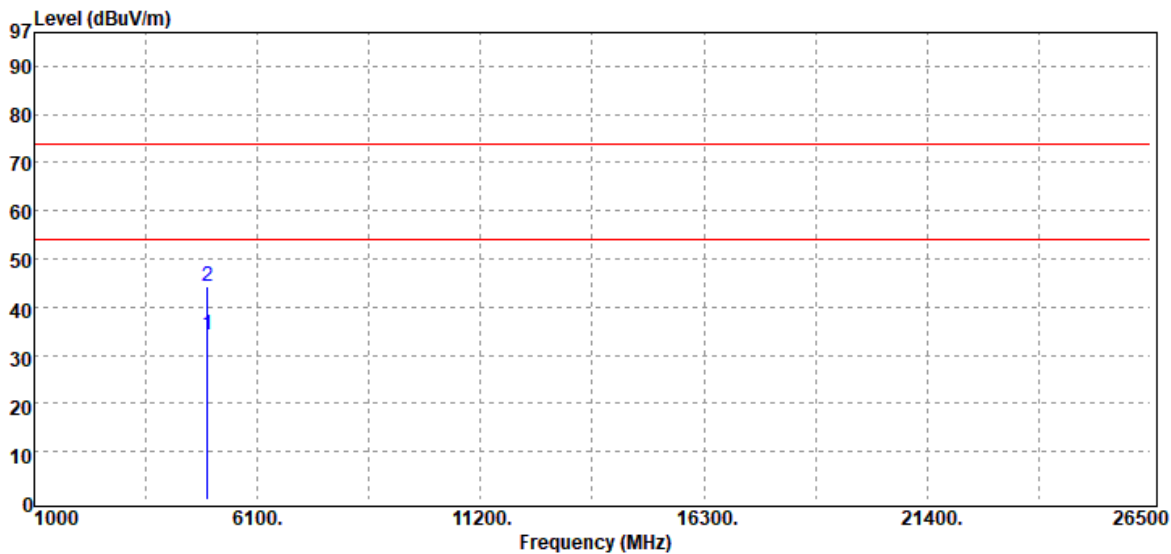
| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| Mode    |          | Reading Level |        | FS           | @3m          |        |
| MHz     | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 4880.00 | Average  | 27.52         | 6.70   | 34.22        | 54.00        | -19.78 |
| 4880.00 | Peak     | 37.42         | 6.70   | 44.12        | 74.00        | -29.88 |

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|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(2M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2480 MHz      | Antenna Pol. | :VERTICAL   |
| Test Mode      | :Tx CH High    | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



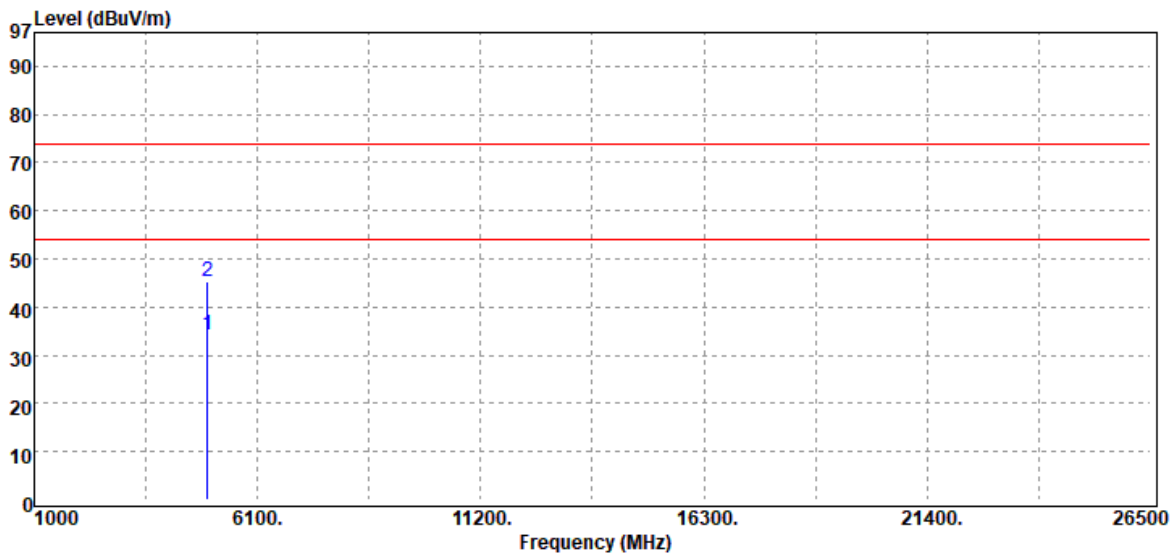
| Freq.   | Detector | Spectrum      | Factor | Actual | Limit  | Margin |
|---------|----------|---------------|--------|--------|--------|--------|
| Mode    |          | Reading Level |        | FS     | @3m    |        |
| MHz     | PK/QP/AV | dBμV          | dB     | dBμV/m | dBμV/m | dB     |
| 4960.00 | Average  | 27.41         | 6.95   | 34.36  | 54.00  | -19.64 |
| 4960.00 | Peak     | 37.39         | 6.95   | 44.34  | 74.00  | -29.66 |

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|                |                |              |             |
|----------------|----------------|--------------|-------------|
| Report Number  | :ER/2019/A0071 | Test Date    | :2019-10-25 |
| Operation Mode | :BLE(2M)       | Temp./Humi.  | :25.3/56    |
| Test Channel   | :2480 MHz      | Antenna Pol. | :HORIZONTAL |
| Test Mode      | :Tx CH High    | Engineer     | :Kane       |
| EUT Pol        | :E2 Plane      |              |             |



| Freq.   | Detector | Spectrum      | Factor | Actual       | Limit        | Margin |
|---------|----------|---------------|--------|--------------|--------------|--------|
| Mode    |          | Reading Level |        | FS           | @3m          |        |
| MHz     | PK/QP/AV | dB $\mu$ V    | dB     | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 4960.00 | Average  | 27.26         | 6.95   | 34.21        | 54.00        | -19.79 |
| 4960.00 | Peak     | 38.27         | 6.95   | 45.22        | 74.00        | -28.78 |

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## 11. PEAK POWER SPECTRAL DENSITY

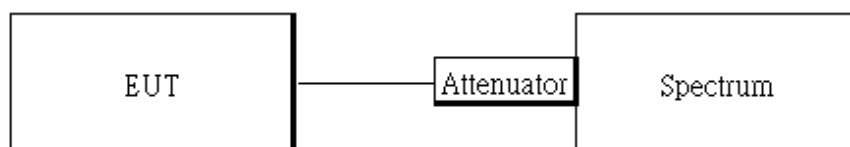
### 11.1 Standard Applicable:

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

### 11.2 Measurement Equipment Used:

| EQUIPMENT TYPE        | MFR           | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-----------------------|---------------|--------------|---------------|------------|------------|
| EXA Spectrum Analyzer | Agilent       | N9010A       | MY50420195    | 05/02/2019 | 05/01/2020 |
| DC Power Supply       | Agilent       | E3640A       | MY52410006    | 12/04/2018 | 12/03/2019 |
| DC Block              | Mini-Circuits | BLK-18-S+    | 1             | 01/02/2019 | 01/01/2020 |
| Attenuator            | Mini-Circuit  | BW-S10W2+    | 2             | 01/02/2019 | 01/01/2020 |

### 11.3 Test Set-up:



### 11.4 Measurement Procedure:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 3 kHz. & the VBW = 10 kHz
5. For defining Restricted Band Edge Limit:  
Set the RBW = 100kHz & VBW = 300 kHz.
6. Detector = peak.
7. Sweep time = auto couple.
8. Trace mode = max hold.
9. Allow trace to fully stabilize.
10. Use the peak marker function to determine the maximum amplitude level.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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**11.5 Measurement Result:****DATA RATE 1 Mbps:**

| Frequency (MHz) | RF Power Density (dBm) | Maximum Limit (dBm) | Result |
|-----------------|------------------------|---------------------|--------|
| 2402            | -11.31                 | 8                   | PASS   |
| 2440            | -9.55                  | 8                   | PASS   |
| 2480            | -10.64                 | 8                   | PASS   |

**NOTE:** cable loss as 1.5dB that offsets in the spectrum

**DATA RATE 2 Mbps:**

| Frequency (MHz) | RF Power Density (dBm) | Maximum Limit (dBm) | Result |
|-----------------|------------------------|---------------------|--------|
| 2402            | -14.94                 | 8                   | PASS   |
| 2440            | -13.19                 | 8                   | PASS   |
| 2480            | -14.40                 | 8                   | PASS   |

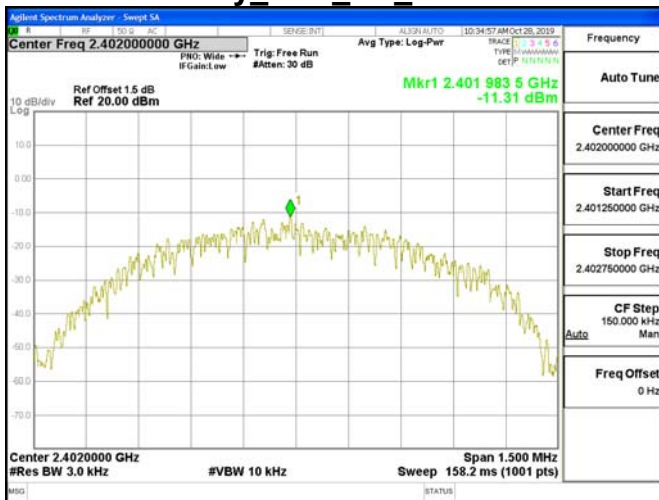
**NOTE:** cable loss as 1.5dB that offsets in the spectrum

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## Power Density BLE 1M LowCH00-2402



## Power Density BLE 2M LowCH00-2402



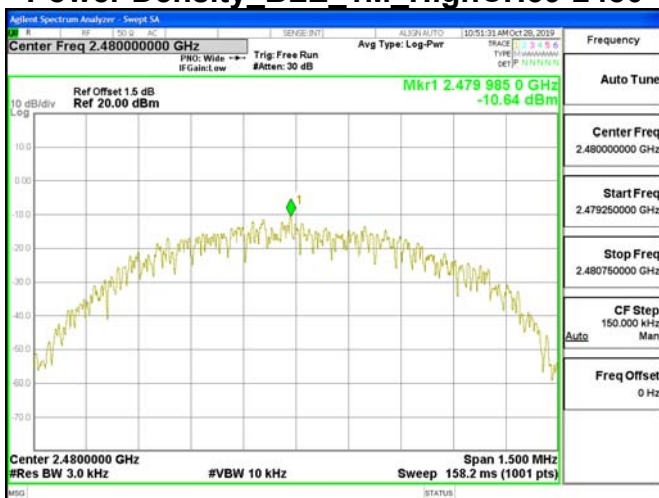
## Power Density BLE 1M MidCH19-2440



## Power Density BLE 2M MidCH19-2440



## Power Density BLE 1M HighCH39-2480



## Power Density BLE 2M HighCH39-2480



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## 12. ANTENNA REQUIREMENT

### 12.1 Standard Applicable:

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

### 12.2 Antenna Connected Construction:

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

*~ End of Report ~*

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