

## ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

**Applicant:** Quanta Computer Inc.  
No. 188, Wenhua 2nd Road, Guishan District, Taoyuan City  
33377, Taiwan

**Product Name:** Clover Card Reader

**Brand Name:** Clover

**Model No.:** C600

**Model Difference:** N/A

**Report Number:** E2/2020/80016

**FCC ID:** HFS-C600

**FCC Rule Part:** §15.247, Cat: DTS

**Issue Date:** Sep. 04, 2020

**Date of Test:** Aug. 06, 2020 ~ Sep. 01, 2020

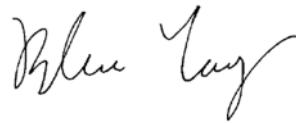
**Date of EUT Received:** Aug. 06, 2020

**We hereby certify that:**

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab. 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:**



**Blue Yang / Asst. Manager**



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## Revision History

| Report Number | Revision | Description | Issue Date    | Remark                |
|---------------|----------|-------------|---------------|-----------------------|
| E2/2020/80016 | Rev.00   | Original.   | Sep. 04, 2020 | Revised By: Susan Lin |

**Note:****1、Disclaimer**

Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

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## 1 GENERAL INFORMATION

### 1.1 Product Description

|                   |                                                  |                                       |
|-------------------|--------------------------------------------------|---------------------------------------|
| Product Name:     | Clover Card Reader                               |                                       |
| Brand Name:       | Clover                                           |                                       |
| Model No.:        | C600                                             |                                       |
| Model Difference: | N/A                                              |                                       |
| Hardware Version: | 1.01                                             |                                       |
| Software Version: | N/A                                              |                                       |
| Power Supply:     | 3.85Vdc from Rechargeable Li-ion Polymer Battery |                                       |
|                   | Battery:                                         | Model No.: 141028,<br>Supplier: VEKEN |

|                      |                                       |
|----------------------|---------------------------------------|
| Radio Technology:    | Bluetooth LE Single mode              |
| Frequency Range:     | 2402 – 2480MHz                        |
| Channel number:      | 40 channels                           |
| Modulation type:     | GFSK                                  |
| Transmit Power:      | BLE 1M: -0.59dBm<br>BLE 2M: -0.61dBm  |
| Antenna Designation: | Monopole Antenna, Peak Gain: -3.64dBi |

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## 1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

ANSI C63.10:2013

## 1.3 Test Facility

SGS Taiwan Ltd. Central RF Lab (TAF code 3702)

No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333

FCC Designation number: TW0028

## 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.

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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 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. The two LISNs provide 50  $\mu$ H/50 ohm 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.

#### 2.3.3 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.

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## 2.4 Measurement Results Explanation Example

### 2.4.1 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.

### 2.4.2 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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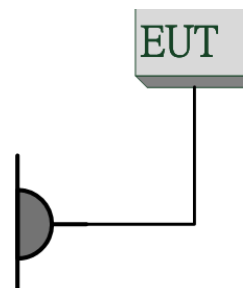
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## 2.5 Configuration of Tested System

**Fig. 2-1 Conducted (Antenna Port) Emission**



**Fig 2-3 Conduction (AC Power Line) Emission**



**Fig 2-2 Radiated 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    | Notebook                | Lenovo    | L412           | S0011357   | Shielded   | Unshielded |

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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 (MHz) | MODULATION | DATA RATE<br>(Mbps) |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------------------------|------------|---------------------|
| <b>RADIATED EMISSION TEST (BELOW 1 GHz)</b>                                                                                                                                                                                                  |                                 |                           |            |                     |
| Bluetooth LE                                                                                                                                                                                                                                 | 2402 to 2480                    | 2402, 2442, 2480          | GFSK       | 1                   |
| Bluetooth LE                                                                                                                                                                                                                                 | 2402 to 2480                    | 2402, 2442, 2480          | GFSK       | 2                   |
| <b>RADIATED EMISSION TEST (ABOVE 1 GHz)</b>                                                                                                                                                                                                  |                                 |                           |            |                     |
| Bluetooth LE                                                                                                                                                                                                                                 | 2402 to 2480                    | 2402, 2442, 2480          | GFSK       | 1                   |
| Bluetooth LE                                                                                                                                                                                                                                 | 2402 to 2480                    | 2402, 2442, 2480          | GFSK       | 2                   |
| <b>Note:</b> 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 H position was reported. |                                 |                           |            |                     |

| <b>ANTENNA PORT CONDUCTED MEASUREMENT</b> |                                 |                           |            |                     |
|-------------------------------------------|---------------------------------|---------------------------|------------|---------------------|
| MODE                                      | AVAILABLE<br>FREQUENCY<br>(MHz) | TESTED<br>FREQUENCY (MHz) | MODULATION | DATA RATE<br>(Mbps) |
| Bluetooth LE                              | 2402 to 2480                    | 2402, 2442, 2480          | GFSK       | 1                   |
| Bluetooth LE                              | 2402 to 2480                    | 2402, 2442, 2480          | GFSK       | 2                   |

Note: EUT serial number is C060UQ2-87007.

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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 TYPE               | MFR                            | MODEL NUM-BER | SERIAL NUM-BER | LAST CAL.  | CAL DUE.   |
| LISN                         | SCHWARZBECK<br>Mess-Elektronik | NSLK8127      | 974            | 03/25/2020 | 03/24/2021 |
| EMI Test Receiver            | R&S                            | ESCI          | 101342         | 04/28/2020 | 04/27/2021 |

### 6.3 EUT Setup:

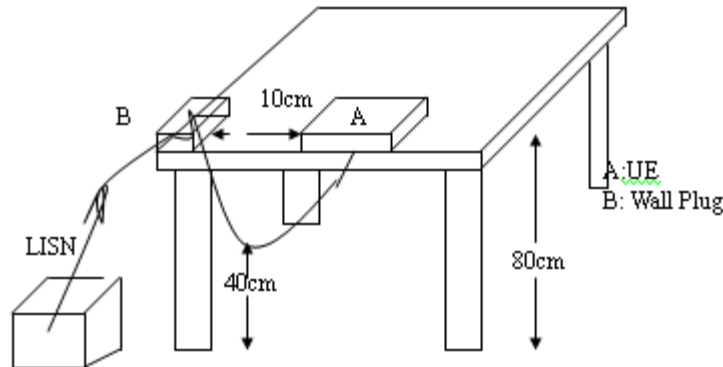
1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

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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.

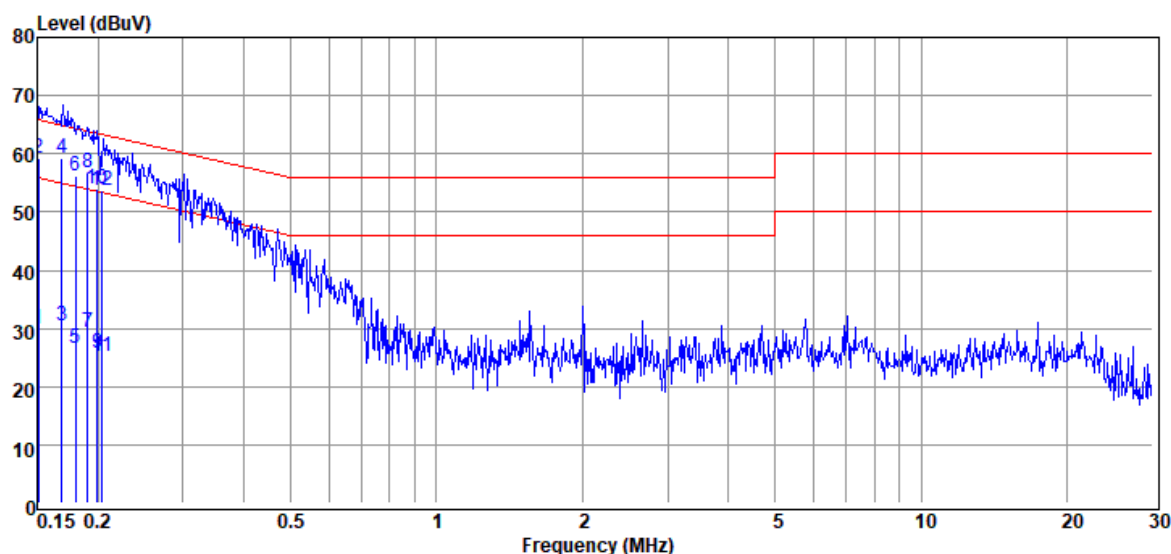
Note2: The \* reveals the worst-case results that closet to the limit.

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## AC POWER LINE CONDUCTED EMISSION TEST DATA

|               |                     |             |                    |
|---------------|---------------------|-------------|--------------------|
| Report Number | :E2-2020-80016      | Test Site   | :Conduction Room C |
| Test Mode     | :BLE 1M             | Test Date   | :2020-08-28        |
| Power         | :120V/60Hz          | Temp./Humi. | :23.5/64           |
| Probe         | :L1                 | Engineer    | :Ashton            |
| Note:         | : Adapter:AD2081320 |             |                    |



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV | Limit<br>dBμV | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|----------------------|---------------|--------------|
| 0.15         | Average                      | 19.75                             | 10.22        | 29.97                | 55.95         | -25.98       |
| 0.15         | QP                           | 49.07                             | 10.22        | 59.29                | 65.95         | -6.66        |
| 0.17         | Average                      | 20.32                             | 10.22        | 30.54                | 55.04         | -24.50       |
| 0.17         | QP                           | 49.00                             | 10.22        | 59.22                | 65.04         | -5.82        |
| 0.18         | Average                      | 16.43                             | 10.22        | 26.65                | 54.48         | -27.83       |
| 0.18         | QP                           | 46.09                             | 10.22        | 56.31                | 64.48         | -8.17        |
| 0.19         | Average                      | 19.24                             | 10.22        | 29.46                | 54.02         | -24.56       |
| 0.19         | QP                           | 46.41                             | 10.22        | 56.63                | 64.02         | -7.39        |
| 0.20         | Average                      | 15.45                             | 10.22        | 25.67                | 53.61         | -27.94       |
| 0.20         | QP                           | 43.64                             | 10.22        | 53.86                | 63.61         | -9.75        |
| 0.20         | Average                      | 15.02                             | 10.22        | 25.24                | 53.43         | -28.19       |
| 0.20         | QP                           | 43.43                             | 10.22        | 53.65                | 63.43         | -9.78        |

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Report Number :E2-2020-80016

Test Site :Conduction Room C

Test Mode :BLE 1M

Test Date :2020-08-28

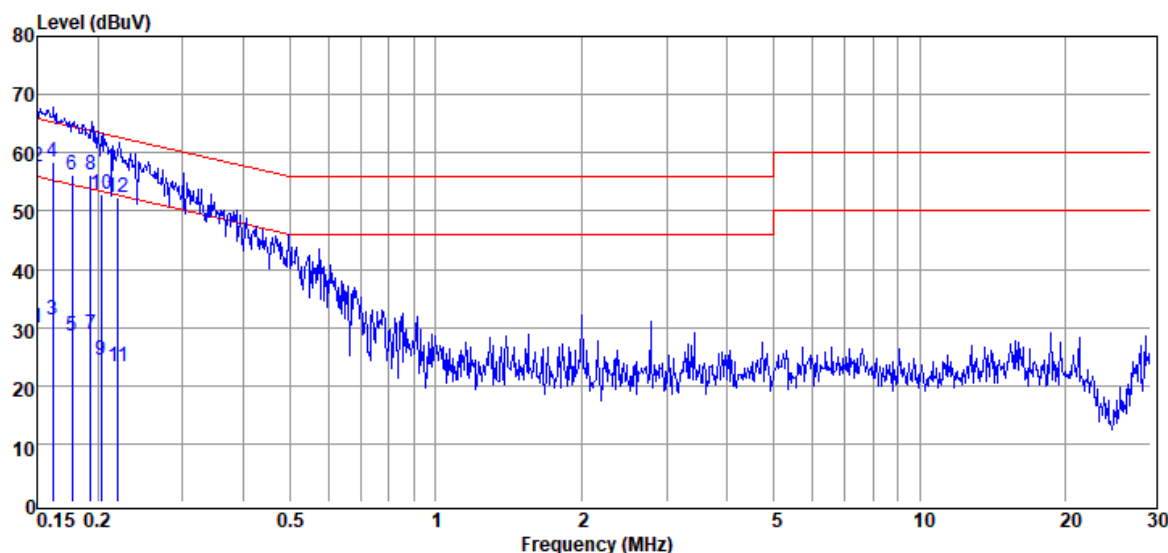
Power :120V/60Hz

Temp./Humi. :23.5/64

Probe :N

Engineer :Ashton

Note: : Adapter:AD2081320



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV | Limit<br>dBμV | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|----------------------|---------------|--------------|
| 0.15         | Average                      | 19.78                             | 10.21        | 29.99                | 55.99         | -26.00       |
| 0.15         | QP                           | 47.50                             | 10.21        | 57.71                | 65.99         | -8.28        |
| 0.16         | Average                      | 21.19                             | 10.21        | 31.40                | 55.39         | -23.99       |
| 0.16         | QP                           | 48.27                             | 10.21        | 58.48                | 65.39         | -6.91        |
| 0.18         | Average                      | 18.33                             | 10.21        | 28.54                | 54.60         | -26.06       |
| 0.18         | QP                           | 46.07                             | 10.21        | 56.28                | 64.60         | -8.32        |
| 0.19         | Average                      | 18.52                             | 10.21        | 28.73                | 53.89         | -25.16       |
| 0.19         | QP                           | 45.90                             | 10.21        | 56.11                | 63.89         | -7.78        |
| 0.20         | Average                      | 14.05                             | 10.21        | 24.26                | 53.47         | -29.21       |
| 0.20         | QP                           | 42.76                             | 10.21        | 52.97                | 63.47         | -10.50       |
| 0.22         | Average                      | 12.99                             | 10.21        | 23.20                | 52.79         | -29.59       |
| 0.22         | QP                           | 42.04                             | 10.21        | 52.25                | 62.79         | -10.54       |

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Report Number :E2-2020-80016

Test Site :Conduction Room C

Test Mode :BLE 2M

Test Date :2020-08-28

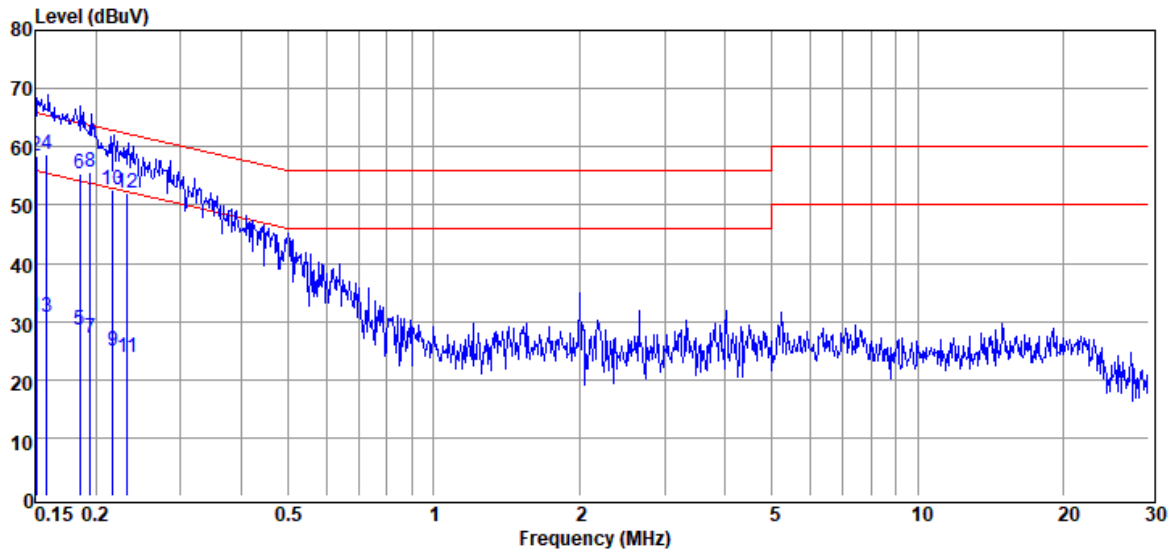
Power :120V/60Hz

Temp./Humi. :23.5/64

Probe :L1

Engineer :Ashton

Note: : Adapter:AD2081320



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV | Limit<br>dBμV | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|----------------------|---------------|--------------|
| 0.15         | Average                      | 20.39                             | 10.22        | 30.61                | 55.94         | -25.33       |
| 0.15         | QP                           | 48.28                             | 10.22        | 58.50                | 65.94         | -7.44        |
| 0.16         | Average                      | 20.42                             | 10.22        | 30.64                | 55.53         | -24.89       |
| 0.16         | QP                           | 48.52                             | 10.22        | 58.74                | 65.53         | -6.79        |
| 0.19         | Average                      | 18.27                             | 10.22        | 28.49                | 54.23         | -25.74       |
| 0.19         | QP                           | 45.28                             | 10.22        | 55.50                | 64.23         | -8.73        |
| 0.20         | Average                      | 16.94                             | 10.22        | 27.16                | 53.82         | -26.66       |
| 0.20         | QP                           | 45.35                             | 10.22        | 55.57                | 63.82         | -8.25        |
| 0.22         | Average                      | 14.74                             | 10.22        | 24.96                | 52.93         | -27.97       |
| 0.22         | QP                           | 42.25                             | 10.22        | 52.47                | 62.93         | -10.46       |
| 0.23         | Average                      | 13.69                             | 10.22        | 23.91                | 52.36         | -28.45       |
| 0.23         | QP                           | 41.83                             | 10.22        | 52.05                | 62.36         | -10.31       |

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Test Site :Conduction Room C

Test Mode :BLE 2M

Test Date :2020-08-28

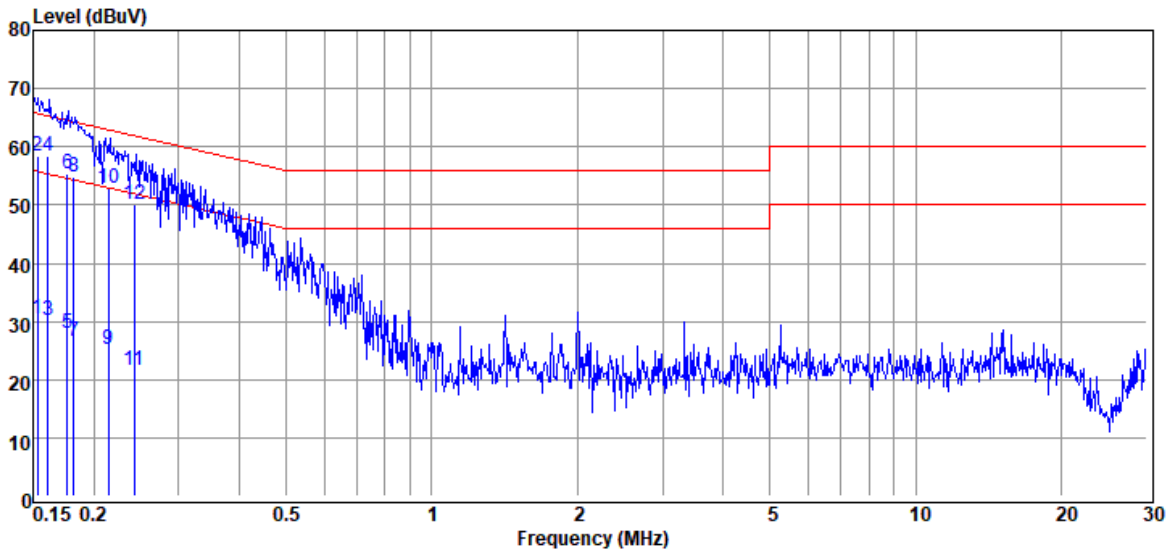
Power :120V/60Hz

Temp./Humi. :23.5/64

Probe :N

Engineer :Ashton

Note: : Adapter:AD2081320



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV | Limit<br>dBμV | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|----------------------|---------------|--------------|
| 0.15         | Average                      | 20.30                             | 10.21        | 30.51                | 55.84         | -25.33       |
| 0.15         | QP                           | 48.22                             | 10.21        | 58.43                | 65.84         | -7.41        |
| 0.16         | Average                      | 19.94                             | 10.21        | 30.15                | 55.42         | -25.27       |
| 0.16         | QP                           | 48.14                             | 10.21        | 58.35                | 65.42         | -7.07        |
| 0.18         | Average                      | 17.65                             | 10.21        | 27.86                | 54.64         | -26.78       |
| 0.18         | QP                           | 45.04                             | 10.21        | 55.25                | 64.64         | -9.39        |
| 0.18         | Average                      | 16.24                             | 10.21        | 26.45                | 54.41         | -27.96       |
| 0.18         | QP                           | 44.65                             | 10.21        | 54.86                | 64.41         | -9.55        |
| 0.21         | Average                      | 15.05                             | 10.21        | 25.26                | 53.02         | -27.76       |
| 0.21         | QP                           | 42.64                             | 10.21        | 52.85                | 63.02         | -10.17       |
| 0.24         | Average                      | 11.40                             | 10.21        | 21.61                | 52.00         | -30.39       |
| 0.24         | QP                           | 39.79                             | 10.21        | 50.00                | 62.00         | -12.00       |

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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

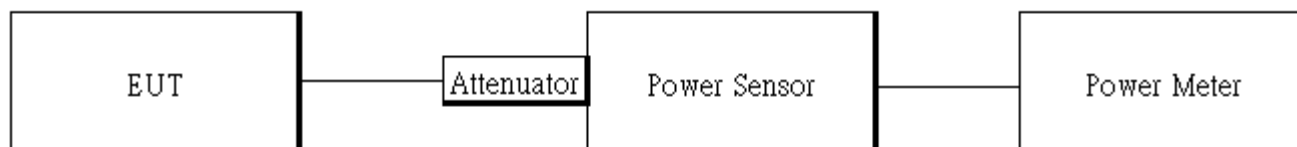
If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

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:

| Conducted Emission Test Site |         |              |               |            |            |
|------------------------------|---------|--------------|---------------|------------|------------|
| EQUIPMENT TYPE               | MFR     | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
| Power Meter                  | Anritsu | ML2496A      | 1804002       | 04/06/2020 | 04/05/2021 |
| Power Sensor                 | Anritsu | MA2411B      | 1726105       | 04/06/2020 | 04/05/2021 |
| Power Sensor                 | Anritsu | MA2411B      | 1726106       | 04/06/2020 | 04/05/2021 |

### 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.

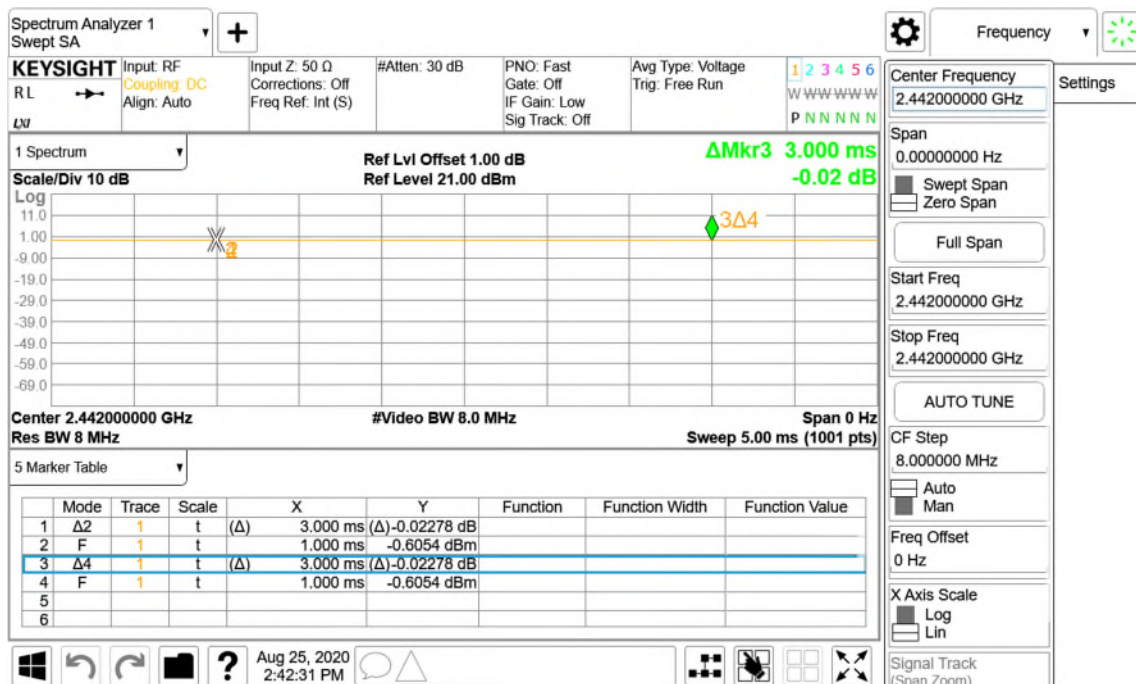
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## 7.5 Duty Factor:

|        | Duty Cycle (%)<br>= Ton / (Ton+Toff) | Duty Factor (dB)<br>= 10*log ( 1/Duty<br>Cycle ) | 1/T<br>(kHz) | VBW<br>setting<br>(kHz) |
|--------|--------------------------------------|--------------------------------------------------|--------------|-------------------------|
| BLE 1M | 100.00                               | 0.00                                             | 1.00         | 0.01                    |

Duty Cycle Factor:  $10 \cdot \log(1/(100/100)) = 0$



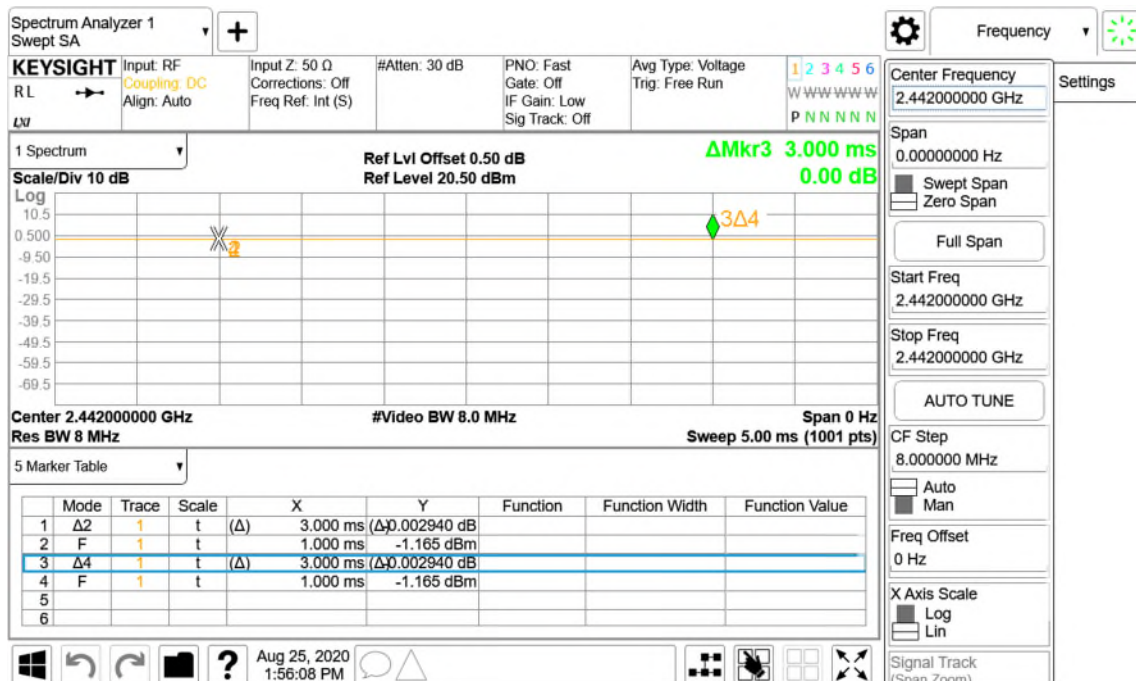
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|        | Duty Cycle (%)<br>= Ton / (Ton+Toff) | Duty Factor (dB)<br>=10*log ( 1/Duty Cycle ) | 1/T<br>(kHz) | VBW<br>setting<br>(kHz) |
|--------|--------------------------------------|----------------------------------------------|--------------|-------------------------|
| BLE 2M | 100.00                               | 0.00                                         | 0.33         | 0.01                    |

Duty Cycle Factor:10\*log(1/(100/100))=0



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## 7.6 Output Power:

### 7.6.1 Peak & Avg

#### BLE 1M

| CH   | Frequency (MHz) | Peak Power Output (dBm)                                | Required Limit  |
|------|-----------------|--------------------------------------------------------|-----------------|
| Low  | 2402            | -0.59                                                  | 1 Watt = 30 dBm |
| Mid  | 2442            | -0.62                                                  | 1 Watt = 30 dBm |
| High | 2480            | -0.60                                                  | 1 Watt = 30 dBm |
| CH   | Frequency (MHz) | Max. Avg. Output include tune up tolerance Power (dBm) | Required Limit  |
| Low  | 2402            | -0.70                                                  | 1 Watt = 30 dBm |
| Mid  | 2442            | -0.71                                                  | 1 Watt = 30 dBm |
| High | 2480            | -0.69                                                  | 1 Watt = 30 dBm |

*\*Note: Measured by power meter, cable loss 1 dB + Duty cycle factor has been offsetted to the power meter for Peak power measurement.*

#### BLE 2M

| CH   | Frequency (MHz) | Peak Power Output (dBm)                                | Required Limit  |
|------|-----------------|--------------------------------------------------------|-----------------|
| Low  | 2402            | -0.61                                                  | 1 Watt = 30 dBm |
| Mid  | 2442            | -0.63                                                  | 1 Watt = 30 dBm |
| High | 2480            | -0.69                                                  | 1 Watt = 30 dBm |
| CH   | Frequency (MHz) | Max. Avg. Output include tune up tolerance Power (dBm) | Required Limit  |
| Low  | 2402            | -0.70                                                  | 1 Watt = 30 dBm |
| Mid  | 2442            | -0.72                                                  | 1 Watt = 30 dBm |
| High | 2480            | -0.79                                                  | 1 Watt = 30 dBm |

*\*Note: Measured by power meter, cable loss 1 dB + Duty cycle factor has been offsetted to the power meter for Peak power measurement.*

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## 8 6DB BANDWIDTH MEASUREMENT

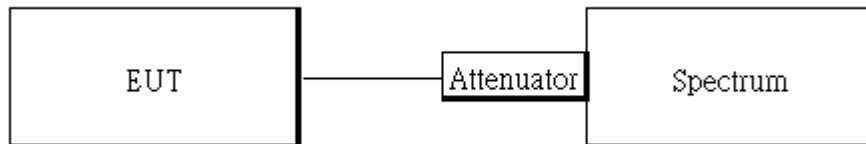
### 8.1 Standard Applicable

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

### 8.2 Measurement Equipment Used

| Conducted Emission Test Site |           |              |               |            |            |
|------------------------------|-----------|--------------|---------------|------------|------------|
| EQUIPMENT TYPE               | MFR       | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
| DC Block                     | PASTERNAK | PE8210       | RF32          | 11/20/2019 | 11/19/2020 |
| Spectrum Analyzer            | KEYSIGHT  | N9010B       | MY59071573    | 06/26/2020 | 06/25/2021 |

### 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. Set the spectrum analyzer as  
 RBW= 1 % to 5% of OBW ,  
 VBW = 3 X RBW,  
 Span= 2 to 5 times of the OBW,  
 Sweep=auto,  
 Detector = Peak, and Max hold for 20dB Bandwidth test.
5. Mark the peak frequency and -20dB (upper and lower) frequency
6. Repeat above procedures until all test default channel is completed

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## 8.5 Measurement Result:

### BLE 1M

| Frequency<br>(MHz) | 6dB<br>BW<br>(MHz) | Required<br>BW<br>(MHz) | Result |
|--------------------|--------------------|-------------------------|--------|
| 2402               | 0.5045             | > 0.5                   | PASS   |
| 2442               | 0.5017             | > 0.5                   | PASS   |
| 2480               | 0.5007             | > 0.5                   | PASS   |

### BLE 2M

| Frequency<br>(MHz) | 6dB<br>BW<br>(MHz) | Required<br>BW<br>(MHz) | Result |
|--------------------|--------------------|-------------------------|--------|
| 2402               | 0.9257             | > 0.5                   | PASS   |
| 2442               | 0.9141             | > 0.5                   | PASS   |
| 2480               | 0.873              | > 0.5                   | PASS   |

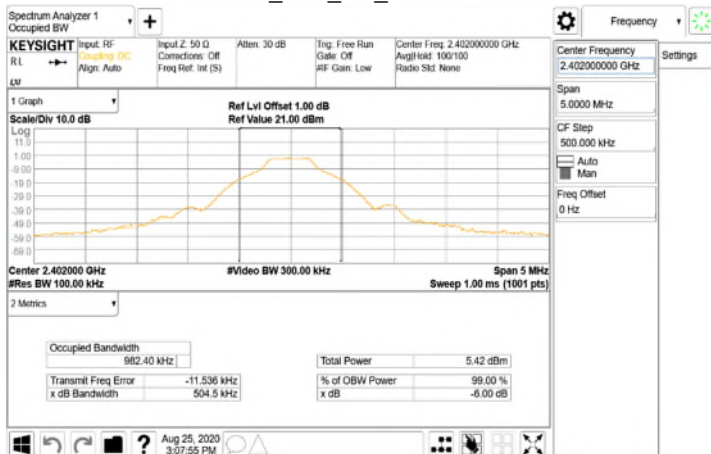
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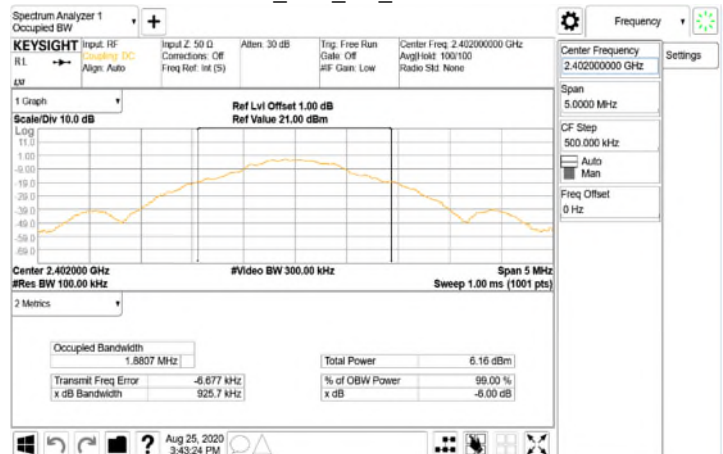
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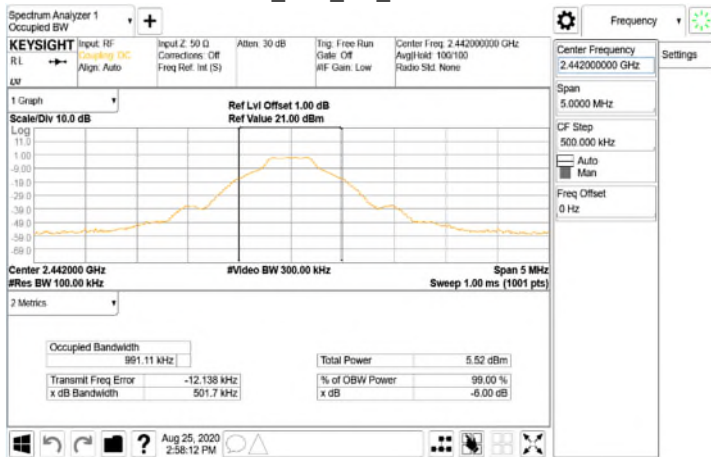
OBW 6dB\_BLE\_1M\_LowCH00-2402



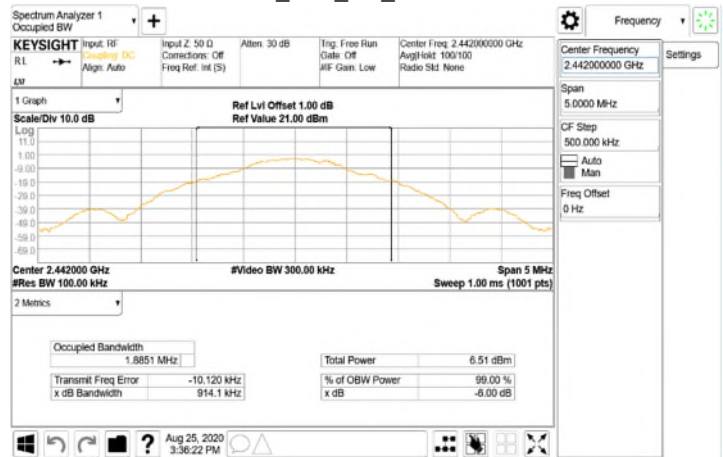
OBW 6dB\_BLE\_2M\_LowCH00-2402



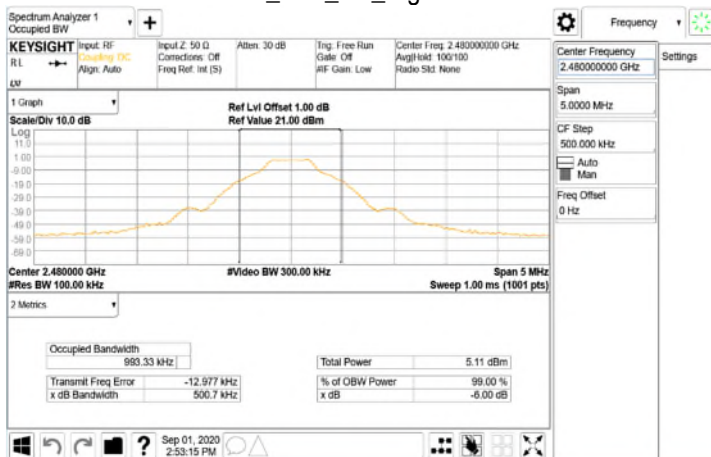
OBW 6dB\_BLE\_1M\_MidCH20-2442



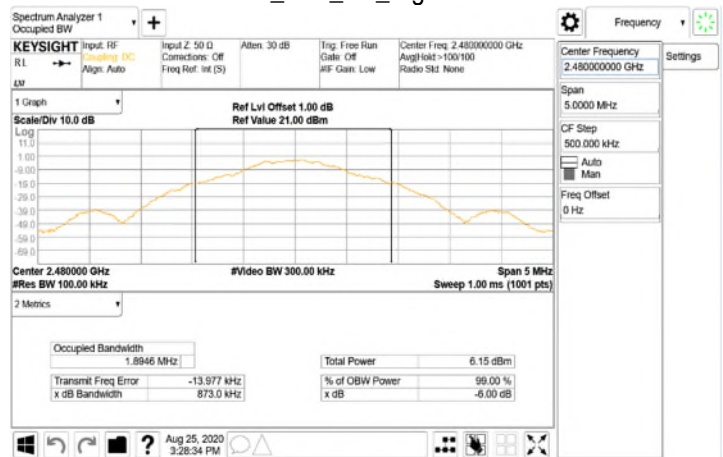
OBW 6dB\_BLE\_2M\_MidCH20-2442



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

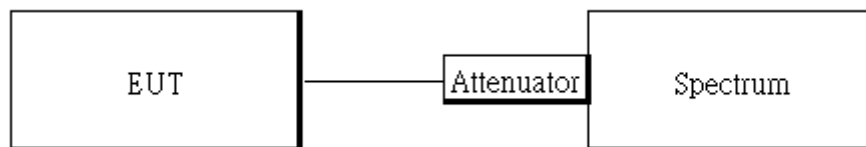
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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:

Conducted Emission Test Site

| EQUIPMENT TYPE    | MFR       | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-------------------|-----------|--------------|---------------|------------|------------|
| DC Block          | PASTERNAK | PE8210       | RF32          | 11/20/2019 | 11/19/2020 |
| Spectrum Analyzer | KEYSIGHT  | N9010B       | MY59071573    | 06/26/2020 | 06/25/2021 |

### 9.3 Test SET-UP:



### 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.

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#### 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, 2399.9MHz and 2483.6MHz, 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 and high) was complete.

#### 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.

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## 9.5 Measurement Result

### BLE 1M

#### Reference Level of Limit

| Frequency (MHz) | RF Power Density (dBm) | Reference Level of Limit<br>= PSD - 20dB (dBm) |
|-----------------|------------------------|------------------------------------------------|
| 2402            | -1.01                  | -21.01                                         |
| 2442            | -0.95                  | -20.95                                         |
| 2480            | -1.11                  | -21.11                                         |

**NOTE:** cable loss as 1dB that offsets in the spectrum

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

### BLE 2M

#### Reference Level of Limit

| Frequency (MHz) | RF Power Density (dBm) | Reference Level of Limit<br>= PSD - 20dB (dBm) |
|-----------------|------------------------|------------------------------------------------|
| 2402            | -1.95                  | -21.95                                         |
| 2442            | -1.73                  | -21.73                                         |
| 2480            | -1.88                  | -21.88                                         |

**NOTE:** cable loss as 1dB that offsets in the spectrum

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

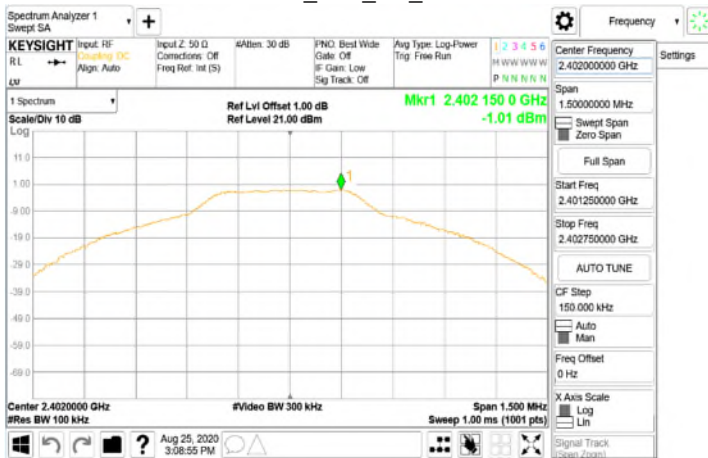
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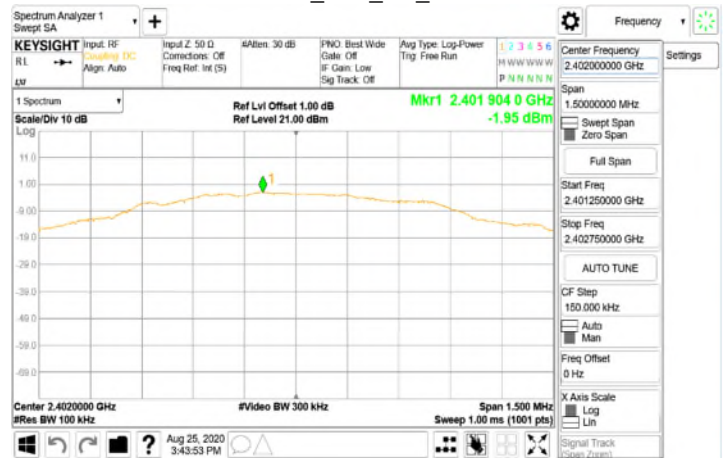
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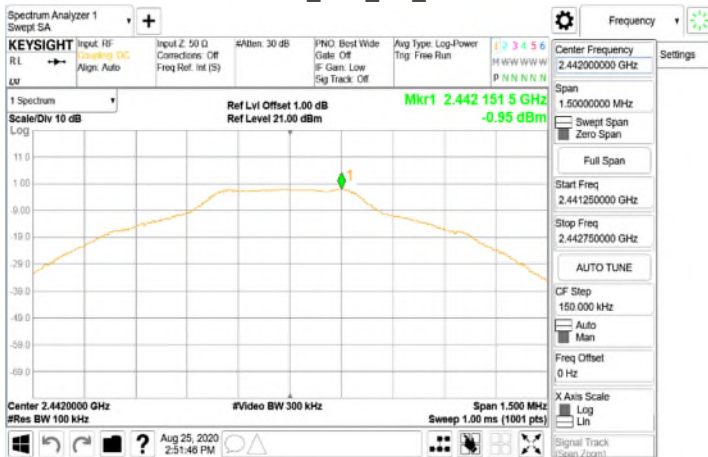
Reference Level\_BLE\_1M\_LowCH00-2402



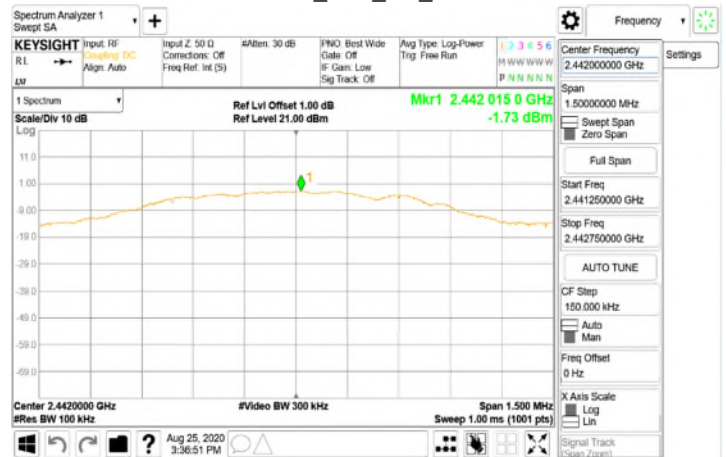
Reference Level\_BLE\_2M\_LowCH00-2402



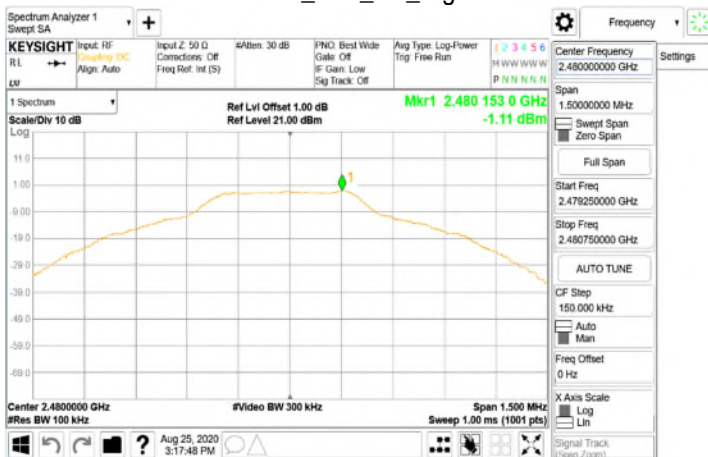
Reference Level\_BLE\_1M\_MidCH20-2442



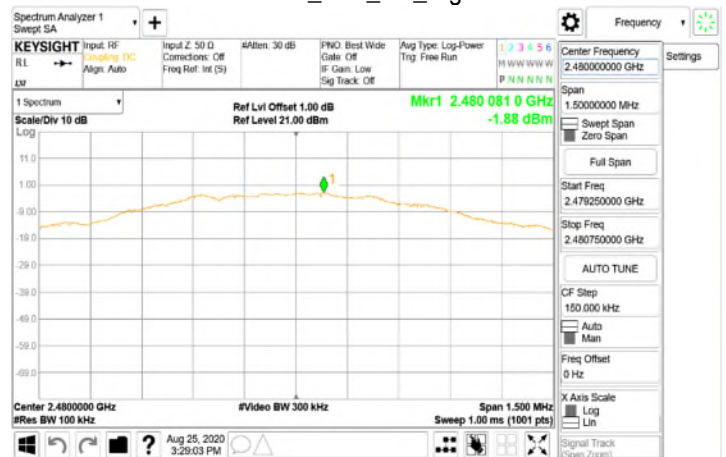
Reference Level\_BLE\_2M\_MidCH20-2442



Reference Level\_BLE\_1M\_HighCH39-2480



Reference Level\_BLE\_2M\_HighCH39-2480

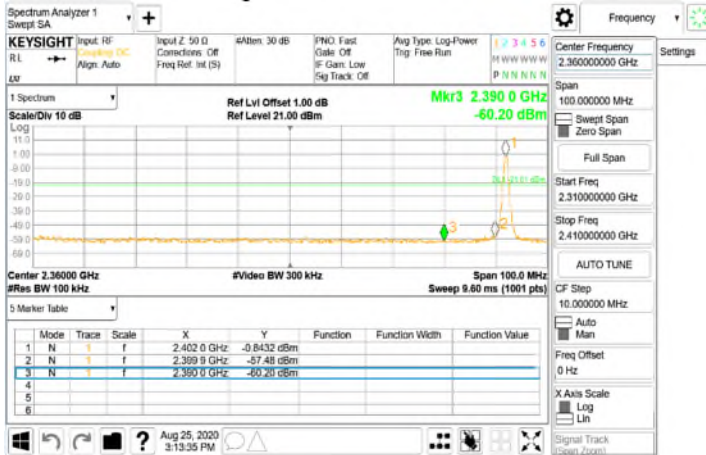


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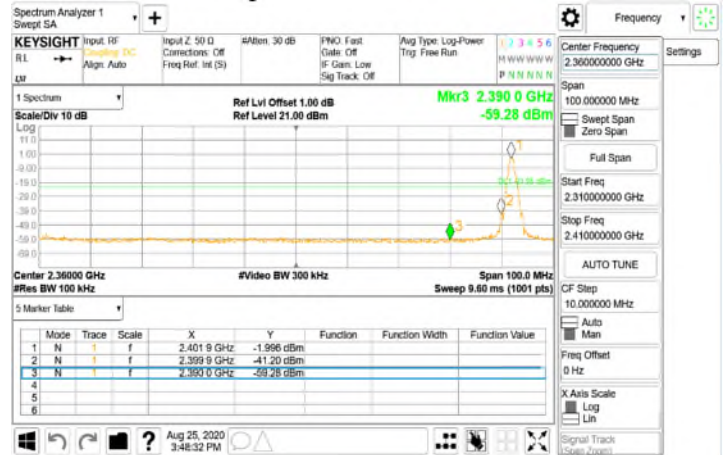
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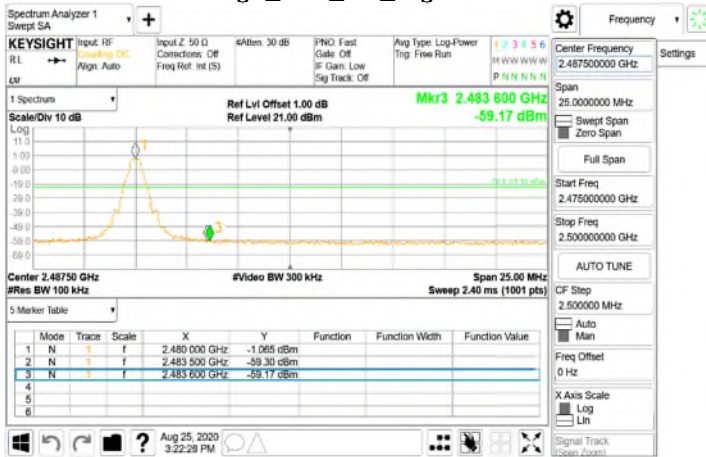
Band Edge\_BLE\_1M\_LowCH00-2402



Band Edge\_BLE\_2M\_LowCH00-2402



Band Edge\_BLE\_1M\_HighCH39-2480



Band Edge\_BLE\_2M\_HighCH39-2480



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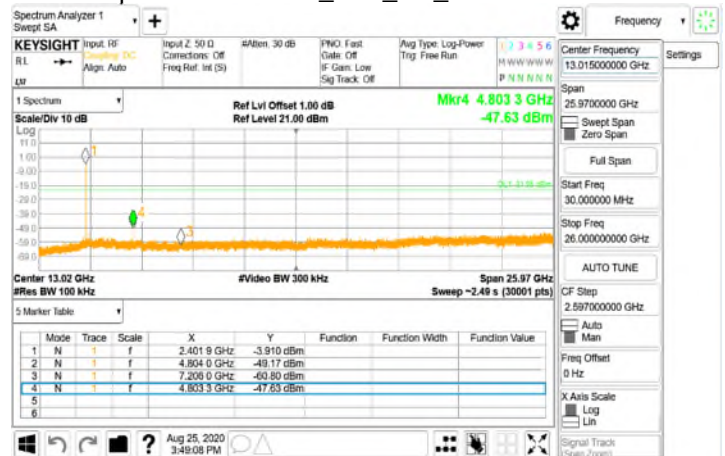
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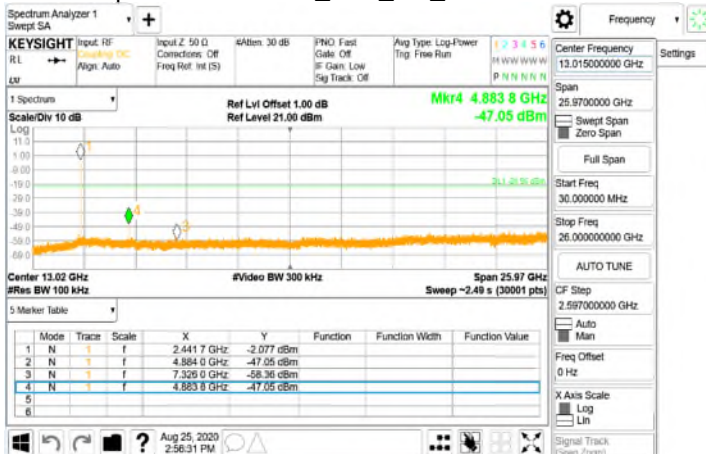
Spurious Emission\_BLE\_1M\_LowCH00-2402



Spurious Emission\_BLE\_2M\_LowCH00-2402



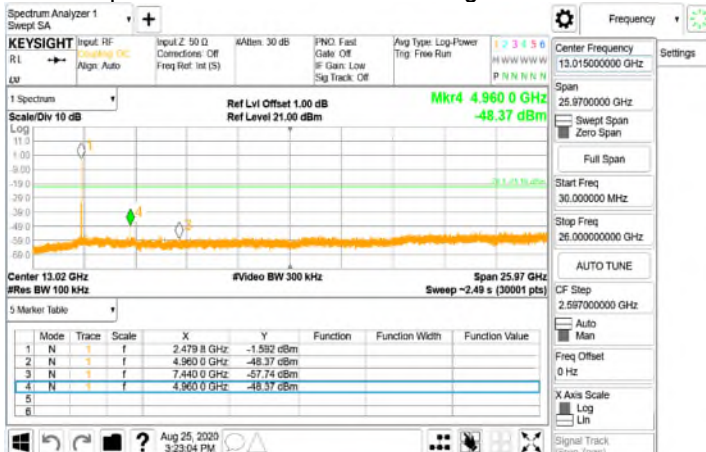
Spurious Emission\_BLE\_1M\_MidCH20-2442



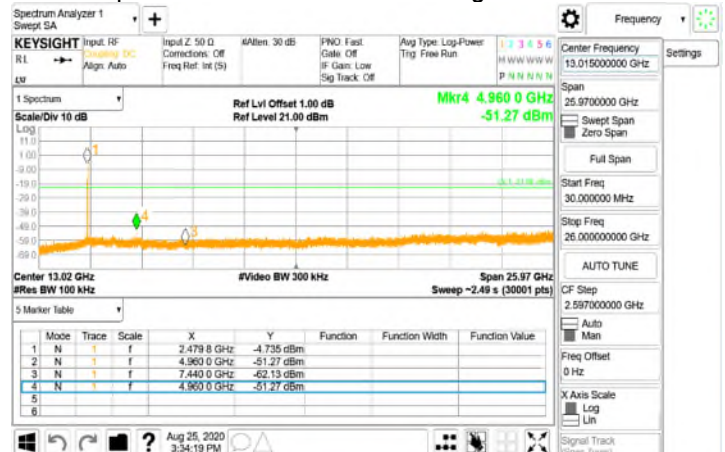
Spurious Emission\_BLE\_2M\_MidCH20-2442



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) & RSS-Gen §6.13.2.a 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 (μV/m)

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## 10.2 Measurement Equipment Used

| 966 Chamber       |                 |               |               |            |            |
|-------------------|-----------------|---------------|---------------|------------|------------|
| EQUIPMENT TYPE    | MFR             | MODEL NUMBER  | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
| Broadband Antenna | TESEQ           | CBL 6112D     | 35240         | 09/09/2019 | 09/08/2020 |
| Horn Antenna      | Schwarzbeck     | BBHA9170      | 184           | 12/25/2019 | 12/24/2020 |
| Horn Antenna      | Schwarzbeck     | BBHA9120D     | 1187          | 01/10/2020 | 01/09/2021 |
| Loop Antenna      | ETS.LINDGREN    | 6502          | 143303        | 04/28/2020 | 04/27/2021 |
| EMI Test Receiver | R&S             | ESU 40        | 100363        | 04/29/2020 | 04/28/2021 |
| Pre-Amplifier     | EMC Instruments | EMC330        | 980096        | 11/20/2019 | 11/19/2020 |
| Pre-Amplifier     | EMC Instruments | EMC0011830    | 980199        | 11/20/2019 | 11/19/2020 |
| Pre-Amplifier     | EMC Instruments | EMC184045B    | 980135        | 11/20/2019 | 11/19/2020 |
| Attenuator        | Woken           | WATT-218FS-10 | RF25          | 11/20/2019 | 11/19/2020 |
| Highpass Filter   | Micro Tronics   | BRM50701-01   | G008          | 11/20/2019 | 11/19/2020 |
| Coaxial Cable     | Huber Suhner    | SUCOFLEX 104  | MY17388/4     | 11/20/2019 | 11/19/2020 |
| Coaxial Cable     | Huber Suhner    | RG 214/U      | W22.03        | 11/20/2019 | 11/19/2020 |

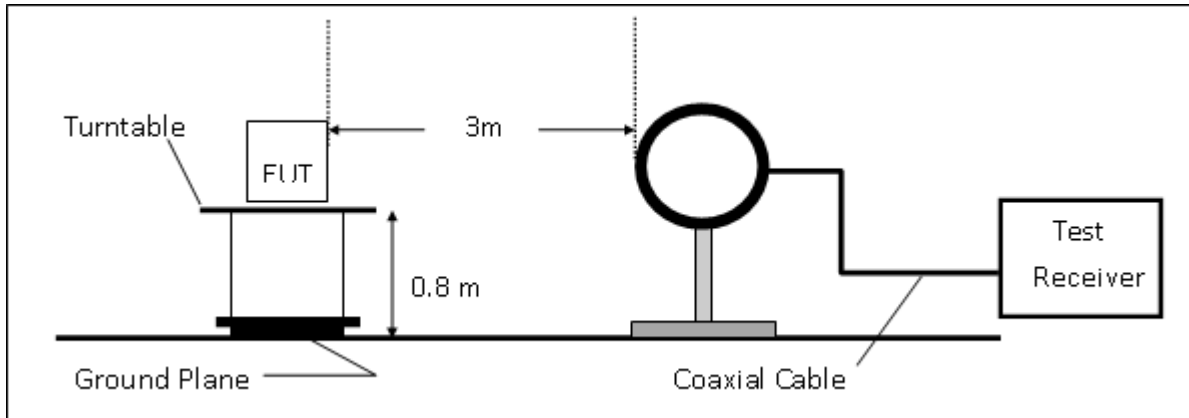
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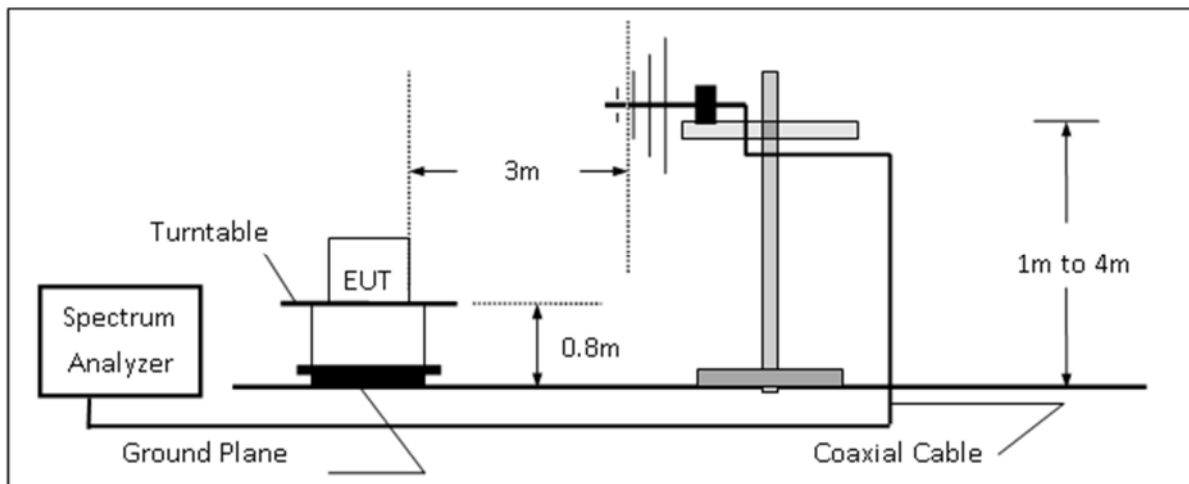
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### 10.3 Test SET-UP

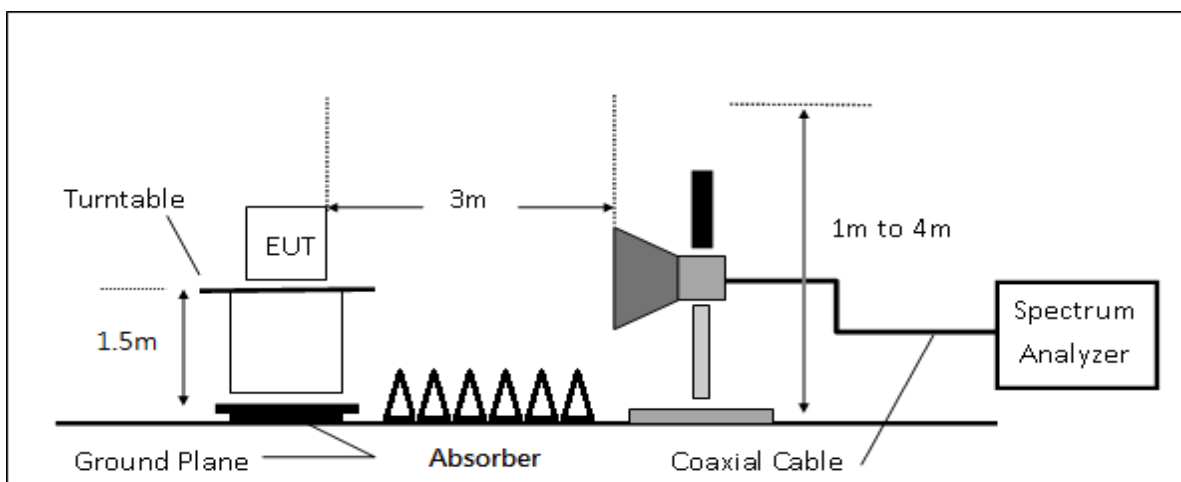
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(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 1.5m 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  $20 \cdot \log(uV/m)$

*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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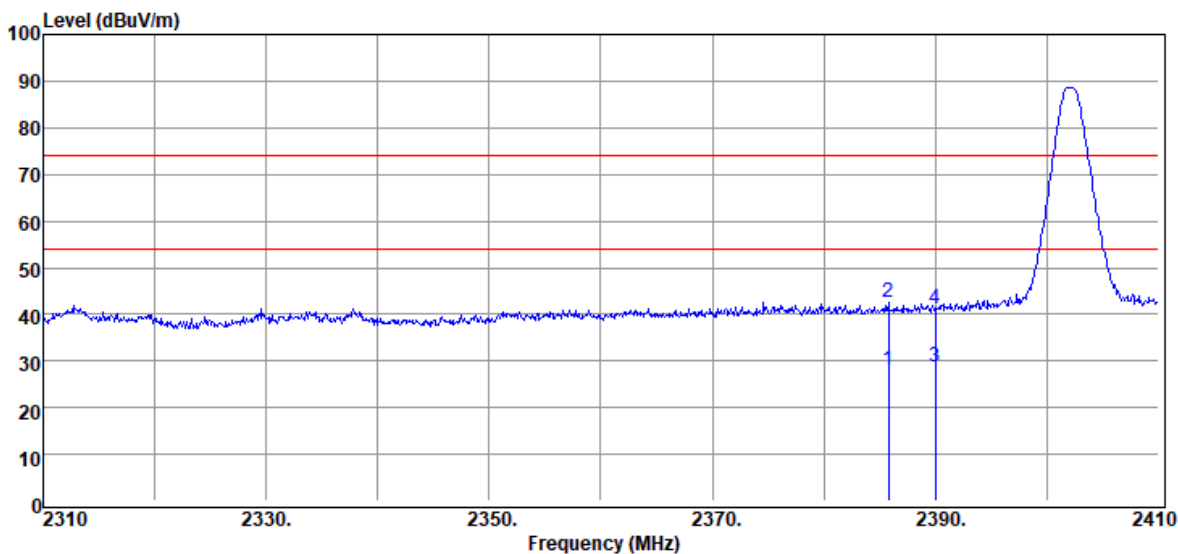
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### 10.7.1 Radiated Band Edge Measurement Result

#### BLE 1M

|                |                |              |                |
|----------------|----------------|--------------|----------------|
| Report Number  | :E2/2020/80016 | Test Site    | :966 Chamber C |
| Operation Mode | :BLE 1M        | Test Date    | :2020-08-27    |
| Test Frequency | :2402 MHz      | Temp./Humi.  | :22.2/57       |
| Test Mode      | :BE CH LOW     | Antenna Pol. | :VERTICAL      |
| EUT Pol        | :H Plan        | Engineer     | :Ashton        |



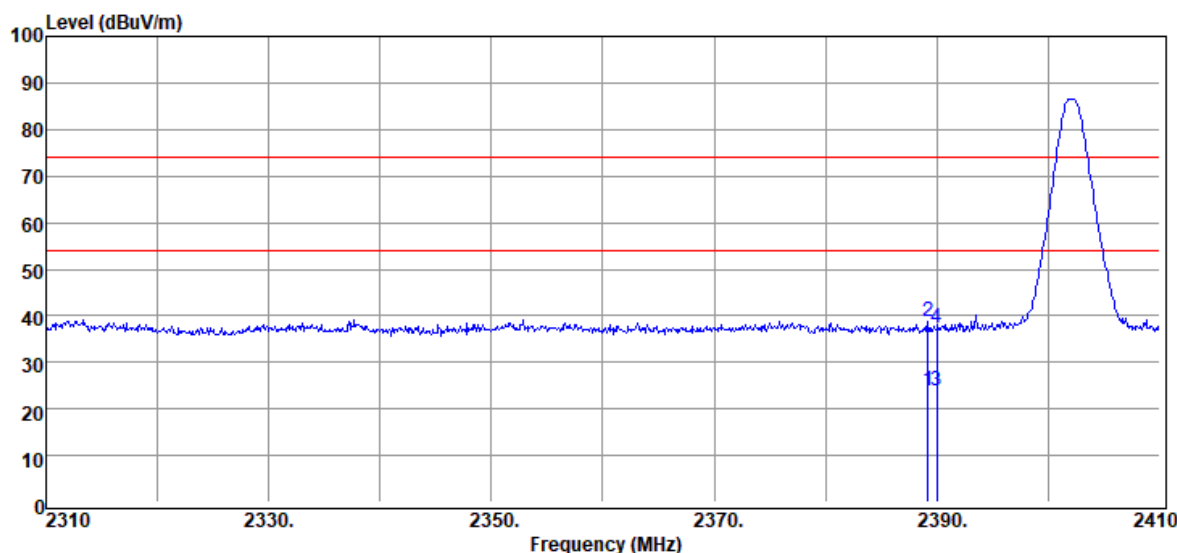
| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBuV | Factor<br>dB | Actual<br>FS<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2385.80      | Average                      | 24.32                             | 3.75         | 28.07                  | 54.00                  | -25.93       |
| 2385.80      | Peak                         | 38.81                             | 3.75         | 42.56                  | 74.00                  | -31.44       |
| 2390.00      | Average                      | 24.93                             | 3.76         | 28.69                  | 54.00                  | -25.31       |
| 2390.00      | Peak                         | 37.27                             | 3.76         | 41.03                  | 74.00                  | -32.97       |

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Report Number :E2/2020/80016  
Operation Mode :BLE 1M  
Test Frequency :2402 MHz  
Test Mode :BE CH LOW  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.2/57  
Antenna Pol. :HORIZONTAL  
Engineer :Ashton



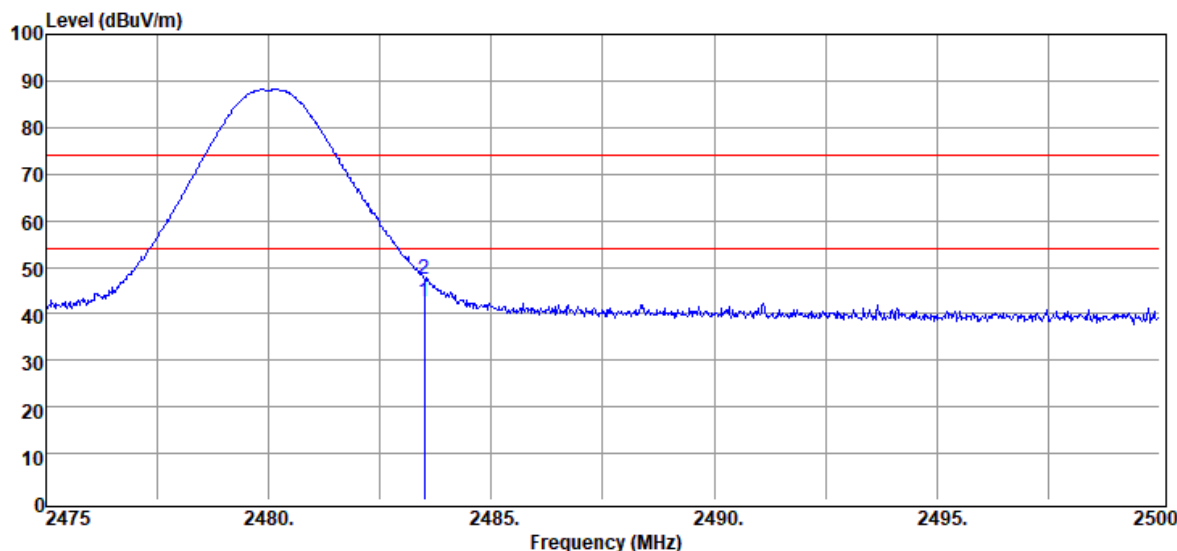
| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2389.20      | Average                      | 20.05                             | 3.76         | 23.81                  | 54.00                  | -30.19       |
| 2389.20      | Peak                         | 35.15                             | 3.76         | 38.91                  | 74.00                  | -35.09       |
| 2390.00      | Average                      | 20.08                             | 3.76         | 23.84                  | 54.00                  | -30.16       |
| 2390.00      | Peak                         | 33.76                             | 3.76         | 37.52                  | 74.00                  | -36.48       |

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Report Number :E2/2020/80016  
Operation Mode :BLE 1M  
Test Frequency :2480 MHz  
Test Mode :BE CH HIGH  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :23.2/54  
Antenna Pol. :VERTICAL  
Engineer :Ashton


| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50      | Average                      | 38.24                             | 4.42         | 42.66                  | 54.00                  | -11.34       |
| 2483.50      | Peak                         | 43.04                             | 4.42         | 47.46                  | 74.00                  | -26.54       |

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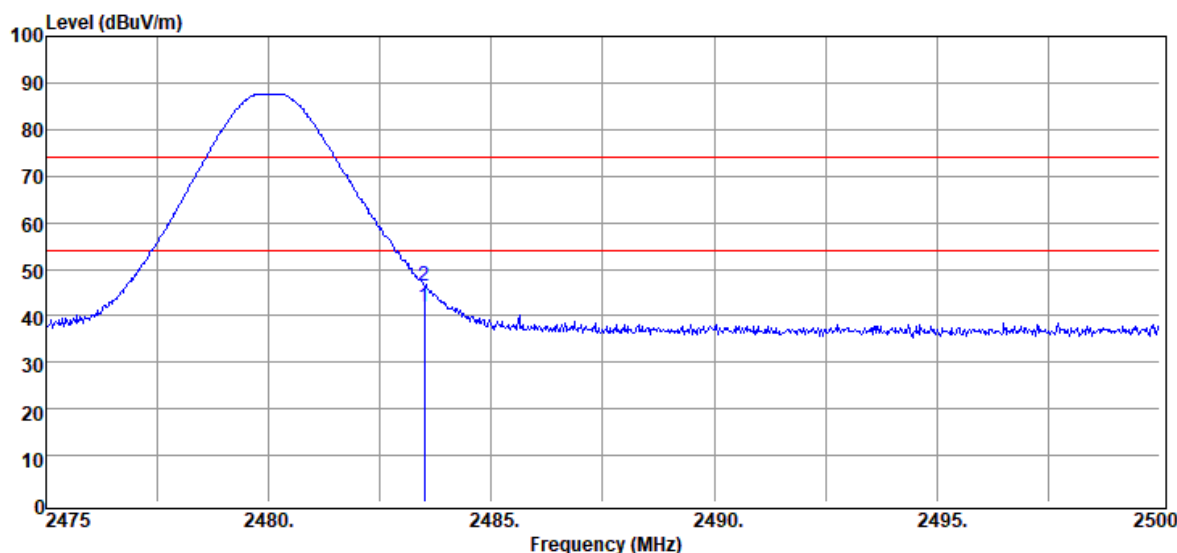
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Report Number :E2/2020/80016  
Operation Mode :BLE 1M  
Test Frequency :2480 MHz  
Test Mode :BE CH HIGH  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :23.2/54  
Antenna Pol. :HORIZONTAL  
Engineer :Ashton



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50      | Average                      | 37.56                             | 4.42         | 41.98                  | 54.00                  | -12.02       |
| 2483.50      | Peak                         | 41.90                             | 4.42         | 46.32                  | 74.00                  | -27.68       |

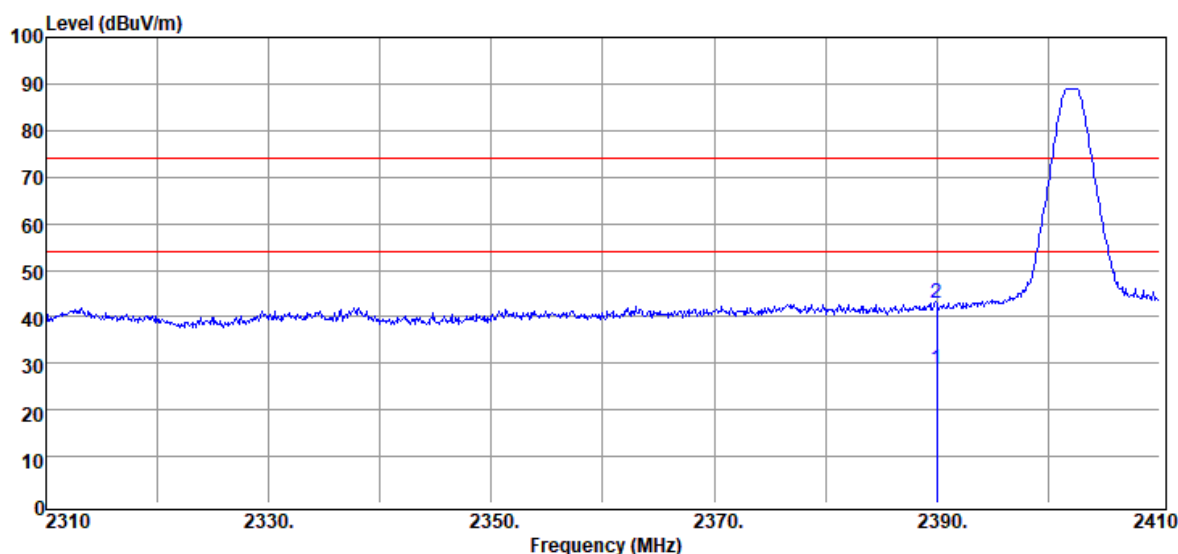
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## BLE 2M

Report Number :E2/2020/80016  
Operation Mode :BLE 2M  
Test Frequency :2402 MHz  
Test Mode :BE CH LOW  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :23.3/54  
Antenna Pol. :VERTICAL  
Engineer :Ashton



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2390.00      | Average                      | 25.12                             | 3.76         | 28.88                  | 54.00                  | -25.12       |
| 2390.00      | Peak                         | 39.32                             | 3.76         | 43.08                  | 74.00                  | -30.92       |

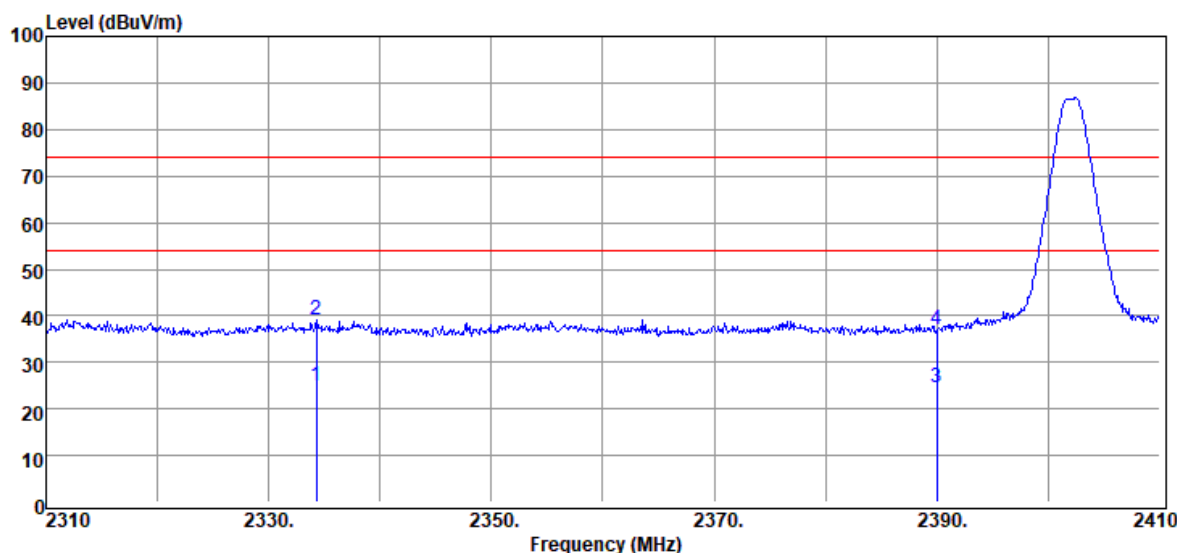
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Report Number :E2/2020/80016  
Operation Mode :BLE 2M  
Test Frequency :2402 MHz  
Test Mode :BE CH LOW  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :23.3/54  
Antenna Pol. :HORIZONTAL  
Engineer :Ashton



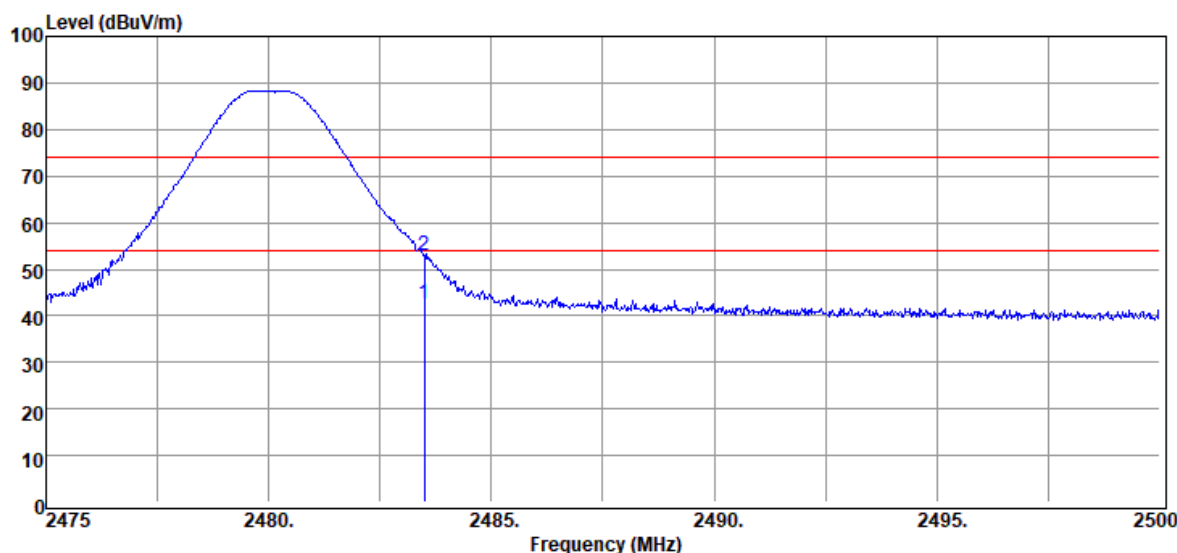
| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2334.30      | Average                      | 21.30                             | 3.66         | 24.96                  | 54.00                  | -29.04       |
| 2334.30      | Peak                         | 35.31                             | 3.66         | 38.97                  | 74.00                  | -35.03       |
| 2390.00      | Average                      | 20.76                             | 3.76         | 24.52                  | 54.00                  | -29.48       |
| 2390.00      | Peak                         | 33.22                             | 3.76         | 36.98                  | 74.00                  | -37.02       |

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Report Number :E2/2020/80016  
Operation Mode :BLE 2M  
Test Frequency :2480 MHz  
Test Mode :BE CH HIGH  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :23.2/52  
Antenna Pol. :VERTICAL  
Engineer :Ashton


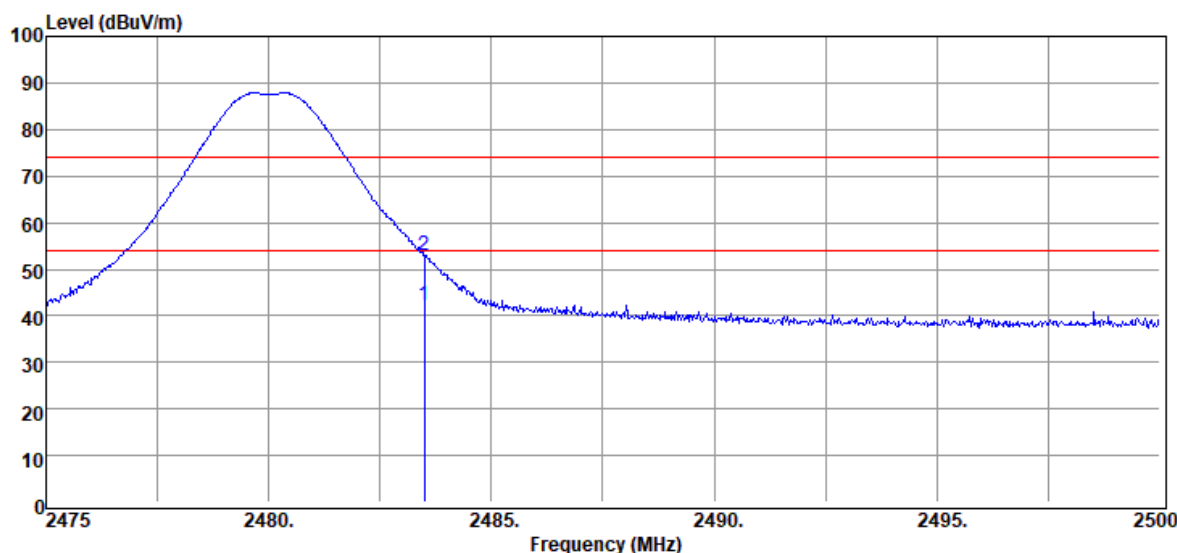
| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50      | Average                      | 38.30                             | 4.42         | 42.72                  | 54.00                  | -11.28       |
| 2483.50      | Peak                         | 48.42                             | 4.42         | 52.84                  | 74.00                  | -21.16       |

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Report Number :E2/2020/80016  
Operation Mode :BLE 2M  
Test Frequency :2480 MHz  
Test Mode :BE CH HIGH  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :23.2/52  
Antenna Pol. :HORIZONTAL  
Engineer :Ashton



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 2483.50      | Average                      | 37.74                             | 4.42         | 42.16                  | 54.00                  | -11.84       |
| 2483.50      | Peak                         | 48.65                             | 4.42         | 53.07                  | 74.00                  | -20.93       |

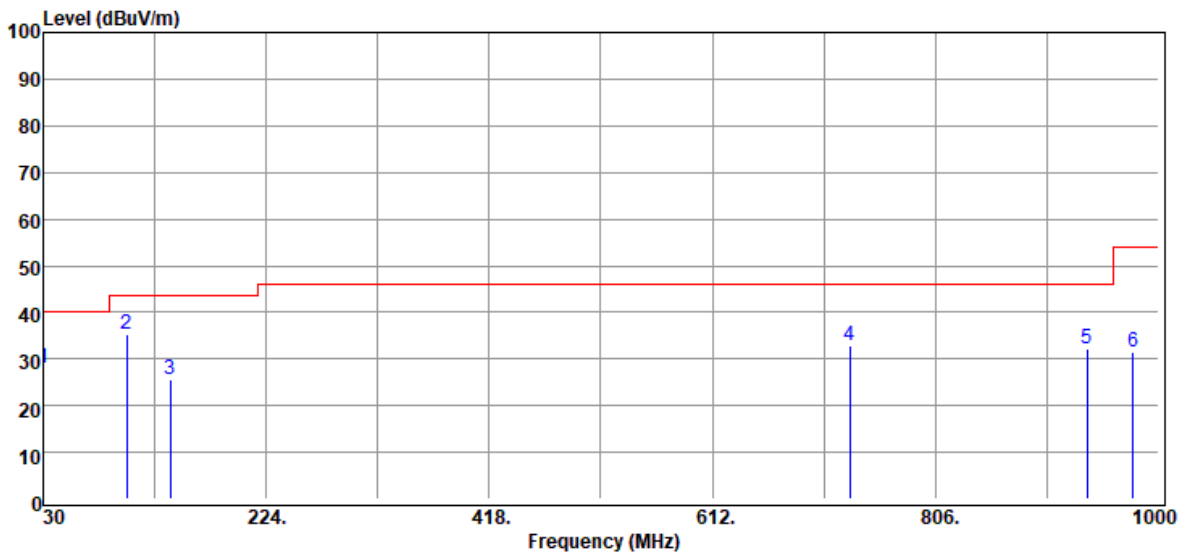
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## 10.7.2 Radiated Spurious Emission from 30MHz to 1000MHz

## BLE 1M

|                |                |              |                |
|----------------|----------------|--------------|----------------|
| Report Number  | :E2/2020/80016 | Test Site    | :966 Chamber C |
| Operation Mode | :BLE 1M        | Test Date    | :2020-08-27    |
| Test Frequency | :2442 MHz      | Temp./Humi.  | :22.4/56       |
| Test Mode      | :TX CH MID     | Antenna Pol. | :VERTICAL      |
| EUT Pol        | :H Plan        | Engineer     | :Ashton        |



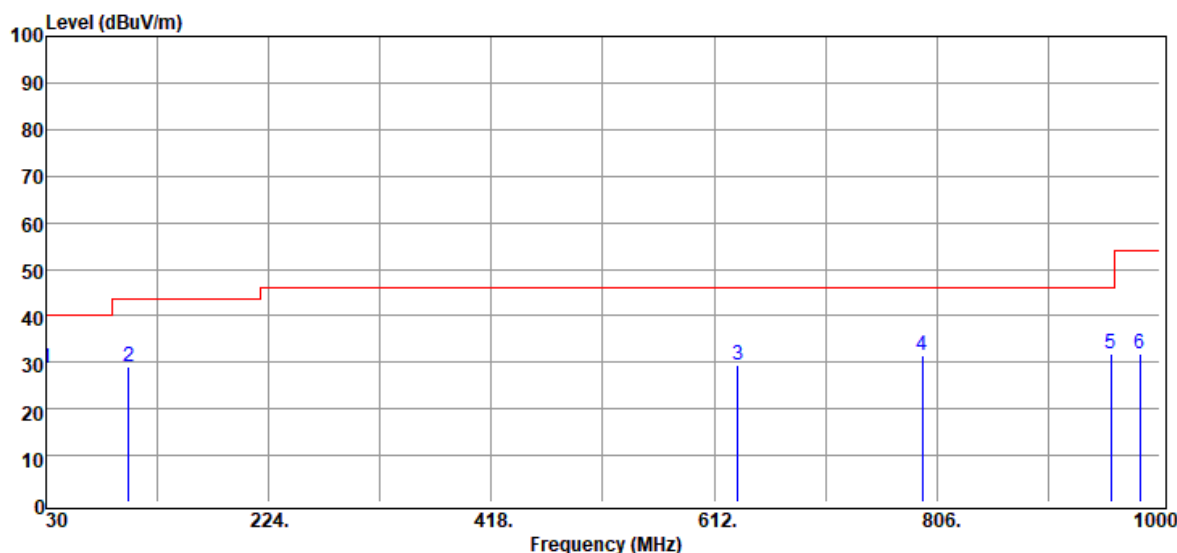
| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBuV | Factor<br>dB | Actual<br>FS<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 30.00        | Peak                         | 31.45                             | -3.33        | 28.12                  | 40.00                  | -11.88       |
| 102.75       | Peak                         | 50.34                             | -15.14       | 35.20                  | 43.50                  | -8.30        |
| 140.58       | Peak                         | 38.85                             | -13.18       | 25.67                  | 43.50                  | -17.83       |
| 731.31       | Peak                         | 35.01                             | -2.02        | 32.99                  | 46.00                  | -13.01       |
| 937.92       | Peak                         | 30.94                             | 1.36         | 32.30                  | 46.00                  | -13.70       |
| 977.69       | Peak                         | 29.61                             | 1.75         | 31.36                  | 54.00                  | -22.64       |

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Report Number :E2/2020/80016  
Operation Mode :BLE 1M  
Test Frequency :2442 MHz  
Test Mode :TX CH MID  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.4/56  
Antenna Pol. :HORIZONTAL  
Engineer :Ashton


| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 30.00        | Peak                         | 31.91                             | -3.33        | 28.58                  | 40.00                  | -11.42       |
| 101.78       | Peak                         | 44.28                             | -15.21       | 29.07                  | 43.50                  | -14.43       |
| 632.37       | Peak                         | 31.16                             | -1.86        | 29.30                  | 46.00                  | -16.70       |
| 793.39       | Peak                         | 31.14                             | 0.24         | 31.38                  | 46.00                  | -14.62       |
| 957.32       | Peak                         | 30.45                             | 1.48         | 31.93                  | 46.00                  | -14.07       |
| 982.54       | Peak                         | 29.90                             | 1.82         | 31.72                  | 54.00                  | -22.28       |

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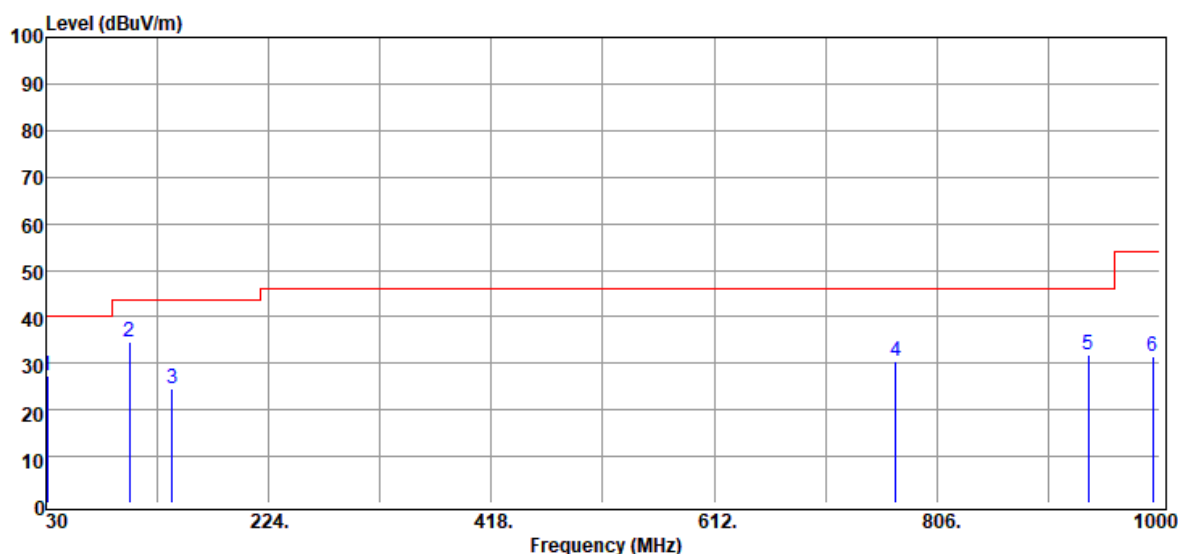
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## BLE 2M

Report Number :E2/2020/80016  
Operation Mode :BLE 2M  
Test Frequency :2442 MHz  
Test Mode :TX CH MID  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.4/56  
Antenna Pol. :VERTICAL  
Engineer :Ashton



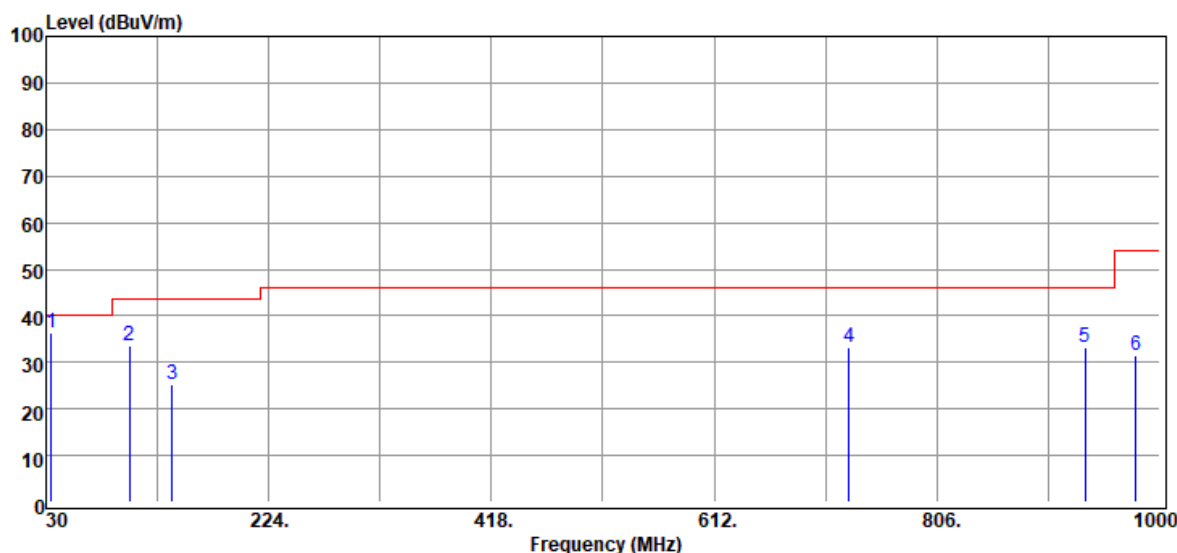
| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 30.97        | Peak                         | 31.16                             | -3.89        | 27.27                  | 40.00                  | -12.73       |
| 102.75       | Peak                         | 49.74                             | -15.14       | 34.60                  | 43.50                  | -8.90        |
| 139.61       | Peak                         | 37.83                             | -13.15       | 24.68                  | 43.50                  | -18.82       |
| 770.11       | Peak                         | 30.81                             | -0.36        | 30.45                  | 46.00                  | -15.55       |
| 937.92       | Peak                         | 30.41                             | 1.36         | 31.77                  | 46.00                  | -14.23       |
| 994.18       | Peak                         | 29.83                             | 1.69         | 31.52                  | 54.00                  | -22.48       |

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Report Number :E2/2020/80016  
Operation Mode :BLE 2M  
Test Frequency :2442 MHz  
Test Mode :TX CH MID  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.4/56  
Antenna Pol. :HORIZONTAL  
Engineer :Ashton



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 34.85        | Peak                         | 40.69                             | -5.52        | 35.17                  | 40.00                  | -4.83        |
| 102.75       | Peak                         | 48.63                             | -15.14       | 33.49                  | 43.50                  | -10.01       |
| 139.61       | Peak                         | 38.28                             | -13.15       | 25.13                  | 43.50                  | -18.37       |
| 729.37       | Peak                         | 35.38                             | -2.08        | 33.30                  | 46.00                  | -12.70       |
| 935.01       | Peak                         | 31.94                             | 1.37         | 33.31                  | 46.00                  | -12.69       |
| 979.63       | Peak                         | 29.47                             | 1.86         | 31.33                  | 54.00                  | -22.67       |

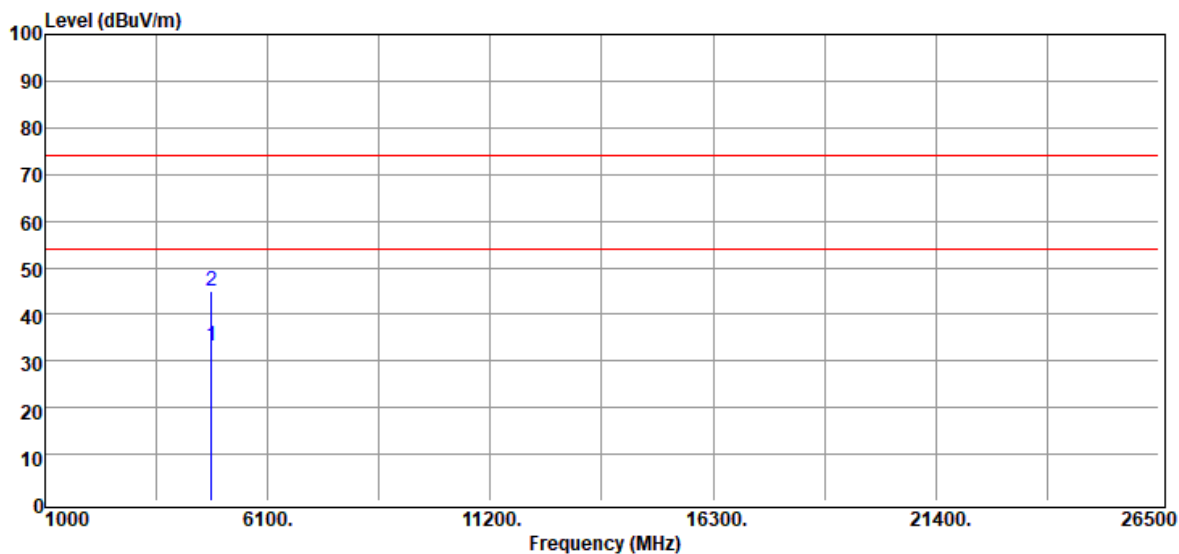
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### 10.7.3 Radiated Spurious Emission above 1GHz

#### BLE 1M

|                |                |              |                |
|----------------|----------------|--------------|----------------|
| Report Number  | :E2/2020/80016 | Test Site    | :966 Chamber C |
| Operation Mode | :BLE 1M        | Test Date    | :2020-08-27    |
| Test Frequency | :2402 MHz      | Temp./Humi.  | :22.9/52       |
| Test Mode      | :TX CH LOW     | Antenna Pol. | :VERTICAL      |
| EUT Pol        | :H Plan        | Engineer     | :Ashton        |



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBuV | Factor<br>dB | Actual<br>FS<br>dBuV/m | Limit<br>@3m<br>dBuV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4804.00      | Average                      | 18.98                             | 14.07        | 33.05                  | 54.00                  | -20.95       |
| 4804.00      | Peak                         | 30.93                             | 14.07        | 45.00                  | 74.00                  | -29.00       |

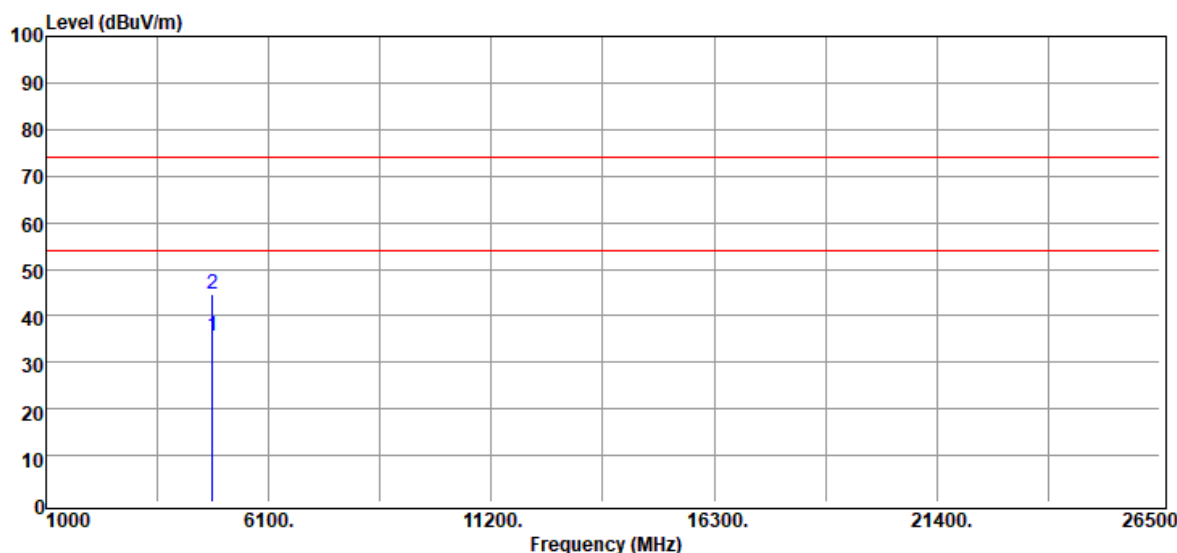
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Report Number :E2/2020/80016  
Operation Mode :BLE 1M  
Test Frequency :2402 MHz  
Test Mode :TX CH LOW  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.9/52  
Antenna Pol. :HORIZONTAL  
Engineer :Ashton



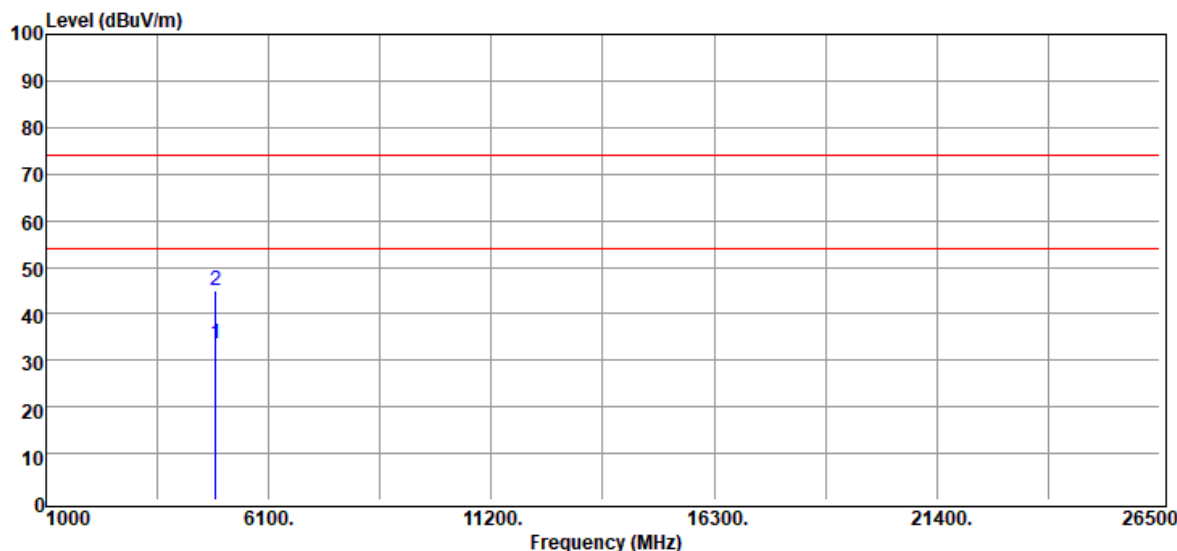
| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4804.00      | Average                      | 21.41                             | 14.07        | 35.48                  | 54.00                  | -18.52       |
| 4804.00      | Peak                         | 30.66                             | 14.07        | 44.73                  | 74.00                  | -29.27       |

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Report Number :E2/2020/80016  
Operation Mode :BLE 1M  
Test Frequency :2442 MHz  
Test Mode :TX CH MID  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.9/52  
Antenna Pol. :VERTICAL  
Engineer :Ashton



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4884.00      | Average                      | 19.49                             | 14.21        | 33.70                  | 54.00                  | -20.30       |
| 4884.00      | Peak                         | 30.81                             | 14.21        | 45.02                  | 74.00                  | -28.98       |

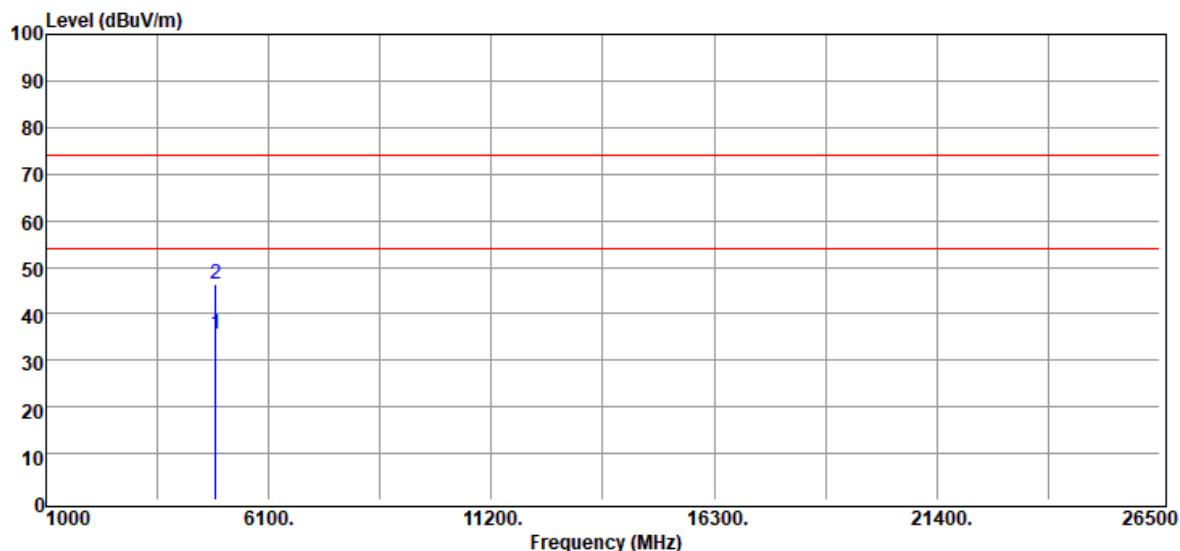
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Report Number :E2/2020/80016  
Operation Mode :BLE 1M  
Test Frequency :2442 MHz  
Test Mode :TX CH MID  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.9/52  
Antenna Pol. :HORIZONTAL  
Engineer :Ashton



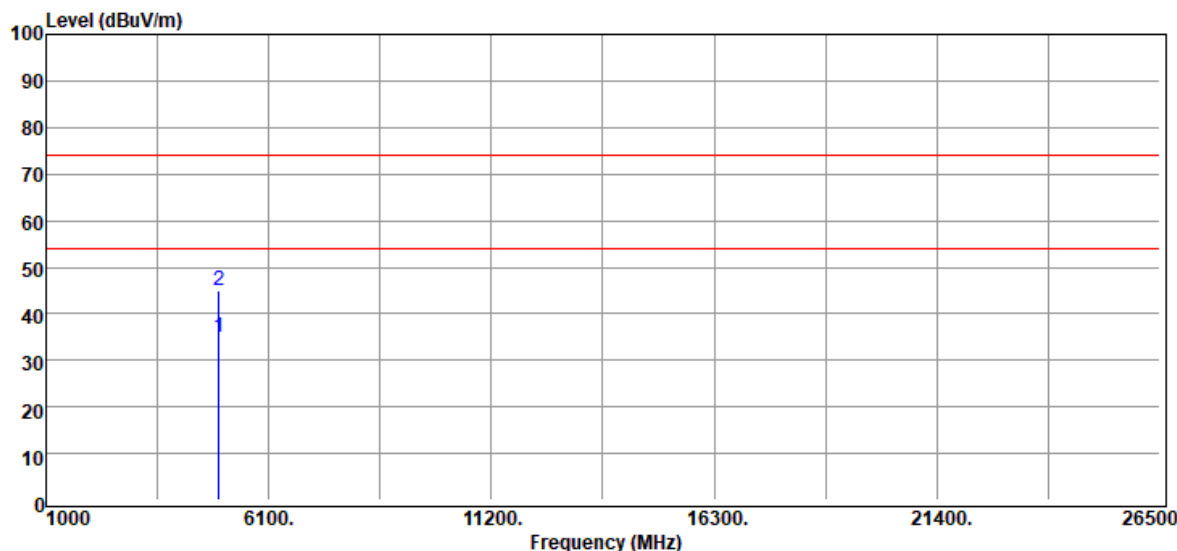
| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4884.00      | Average                      | 21.37                             | 14.21        | 35.58                  | 54.00                  | -18.42       |
| 4884.00      | Peak                         | 32.23                             | 14.21        | 46.44                  | 74.00                  | -27.56       |

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Report Number :E2/2020/80016  
Operation Mode :BLE 1M  
Test Frequency :2480 MHz  
Test Mode :TX CH HIGH  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.9/52  
Antenna Pol. :VERTICAL  
Engineer :Ashton


| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4960.00      | Average                      | 20.91                             | 14.13        | 35.04                  | 54.00                  | -18.96       |
| 4960.00      | Peak                         | 31.00                             | 14.13        | 45.13                  | 74.00                  | -28.87       |

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.

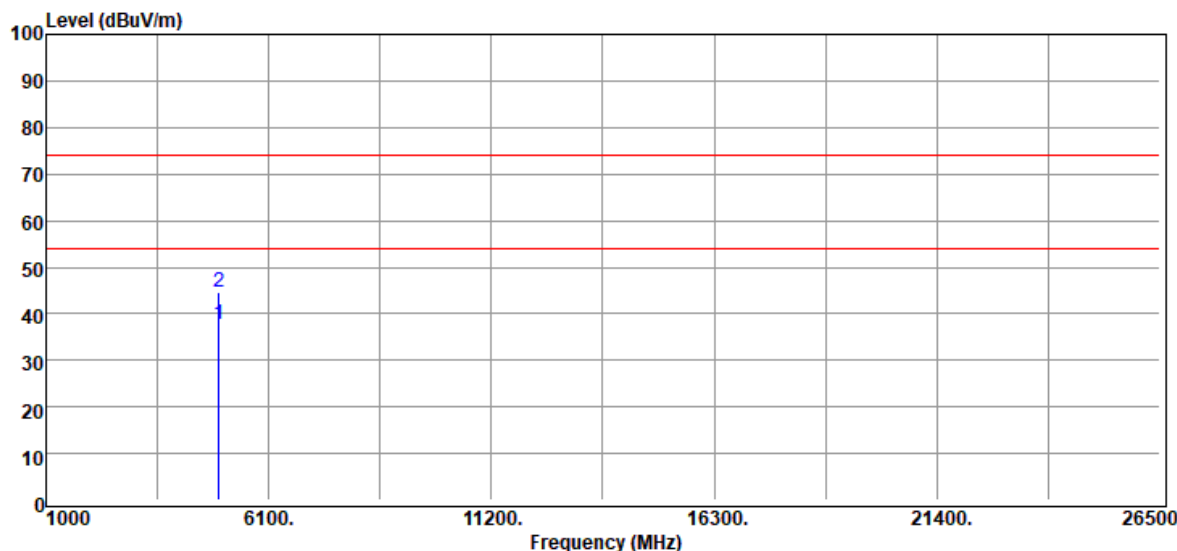
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Report Number :E2/2020/80016  
Operation Mode :BLE 1M  
Test Frequency :2480 MHz  
Test Mode :TX CH HIGH  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.9/52  
Antenna Pol. :HORIZONTAL  
Engineer :Ashton



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4960.00      | Average                      | 23.50                             | 14.13        | 37.63                  | 54.00                  | -16.37       |
| 4960.00      | Peak                         | 30.50                             | 14.13        | 44.63                  | 74.00                  | -29.37       |

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**BLE 2M**

Report Number :E2/2020/80016

Test Site :966 Chamber C

Operation Mode :BLE 2M

Test Date :2020-08-27

Test Frequency :2402 MHz

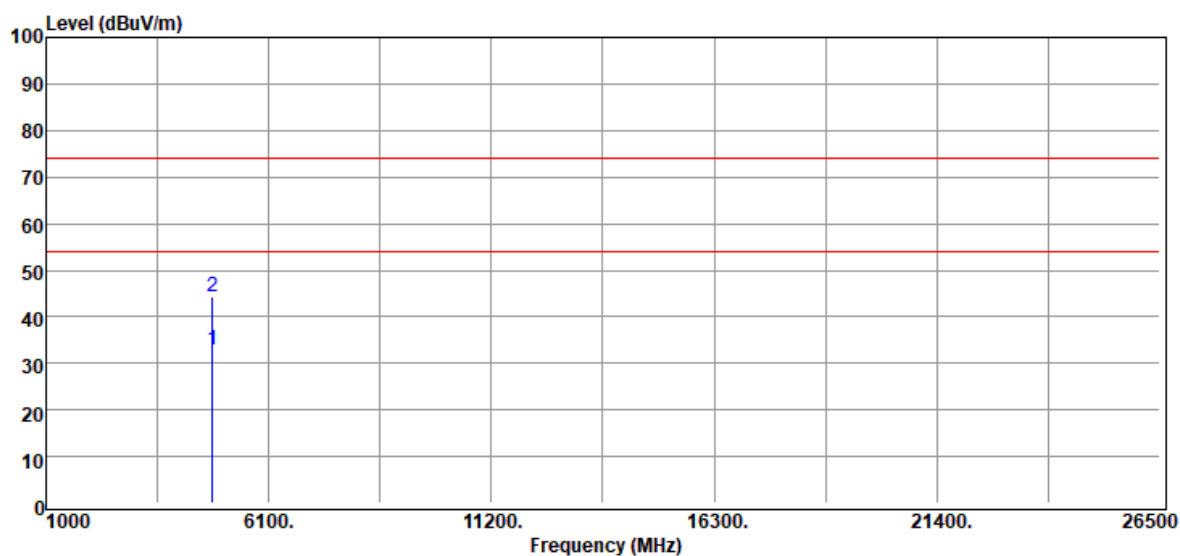
Temp./Humi. :22.5/56

Test Mode :TX CH LOW

Antenna Pol. :VERTICAL

EUT Pol :H Plan

Engineer :Ashton



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4804.00      | Average                      | 18.70                             | 14.07        | 32.77                  | 54.00                  | -21.23       |
| 4804.00      | Peak                         | 30.28                             | 14.07        | 44.35                  | 74.00                  | -29.65       |

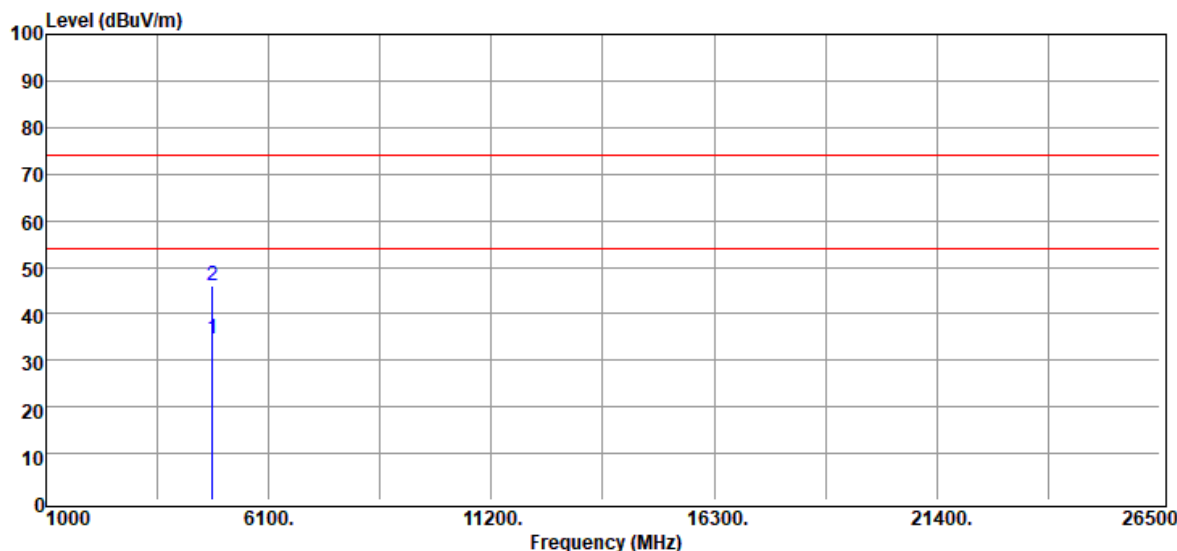
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Report Number :E2/2020/80016  
Operation Mode :BLE 2M  
Test Frequency :2402 MHz  
Test Mode :TX CH LOW  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.5/56  
Antenna Pol. :HORIZONTAL  
Engineer :Ashton



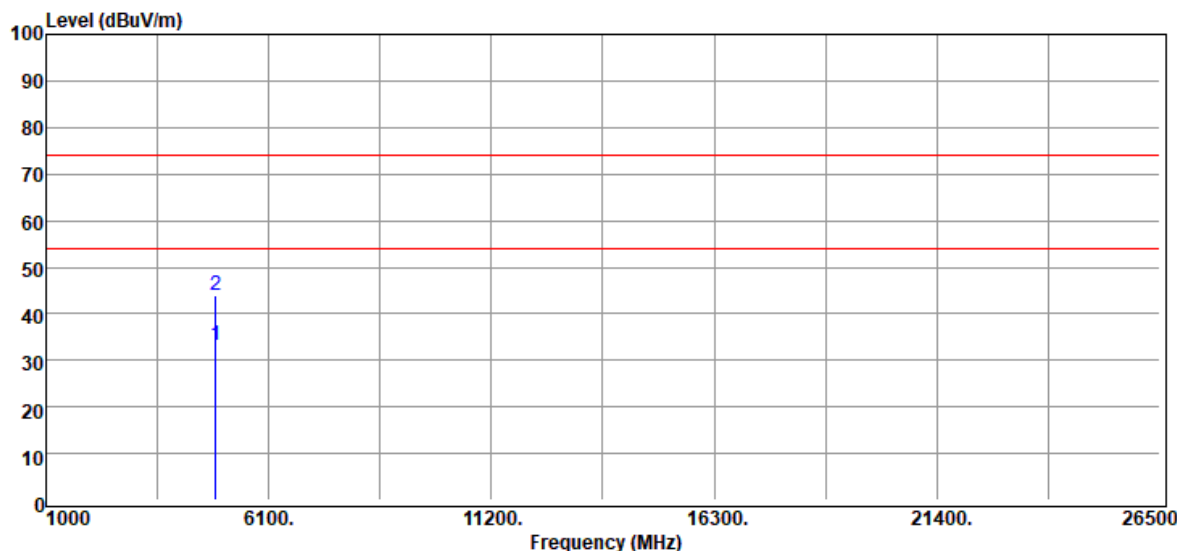
| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4804.00      | Average                      | 20.60                             | 14.07        | 34.67                  | 54.00                  | -19.33       |
| 4804.00      | Peak                         | 31.82                             | 14.07        | 45.89                  | 74.00                  | -28.11       |

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Report Number :E2/2020/80016  
Operation Mode :BLE 2M  
Test Frequency :2442 MHz  
Test Mode :TX CH MID  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.5/56  
Antenna Pol. :VERTICAL  
Engineer :Ashton


| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4884.00      | Average                      | 19.01                             | 14.21        | 33.22                  | 54.00                  | -20.78       |
| 4884.00      | Peak                         | 29.71                             | 14.21        | 43.92                  | 74.00                  | -30.08       |

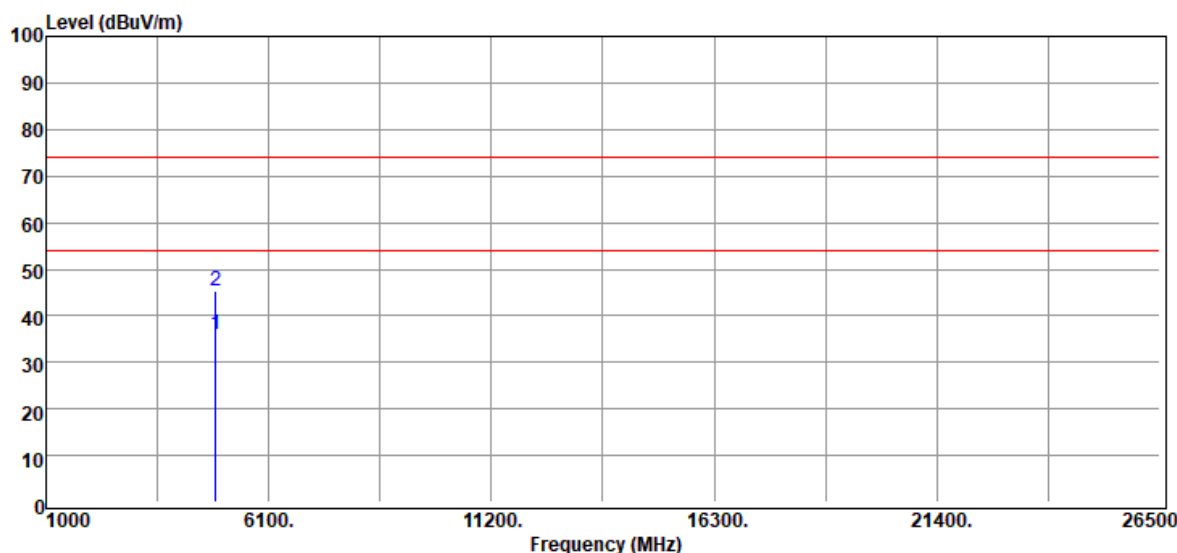
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Report Number :E2/2020/80016  
Operation Mode :BLE 2M  
Test Frequency :2442 MHz  
Test Mode :TX CH MID  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.5/56  
Antenna Pol. :HORIZONTAL  
Engineer :Ashton



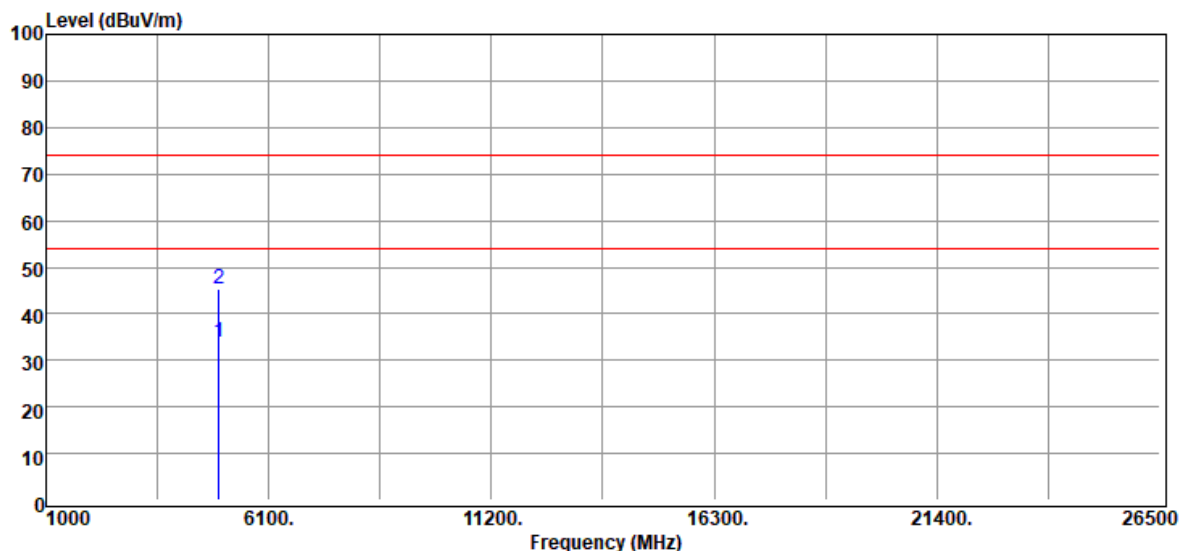
| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4884.00      | Average                      | 21.72                             | 14.21        | 35.93                  | 54.00                  | -18.07       |
| 4884.00      | Peak                         | 31.12                             | 14.21        | 45.33                  | 74.00                  | -28.67       |

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Report Number :E2/2020/80016  
Operation Mode :BLE 2M  
Test Frequency :2480 MHz  
Test Mode :TX CH HIGH  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.5/56  
Antenna Pol. :VERTICAL  
Engineer :Ashton



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4960.00      | Average                      | 19.81                             | 14.13        | 33.94                  | 54.00                  | -20.06       |
| 4960.00      | Peak                         | 31.04                             | 14.13        | 45.17                  | 74.00                  | -28.83       |

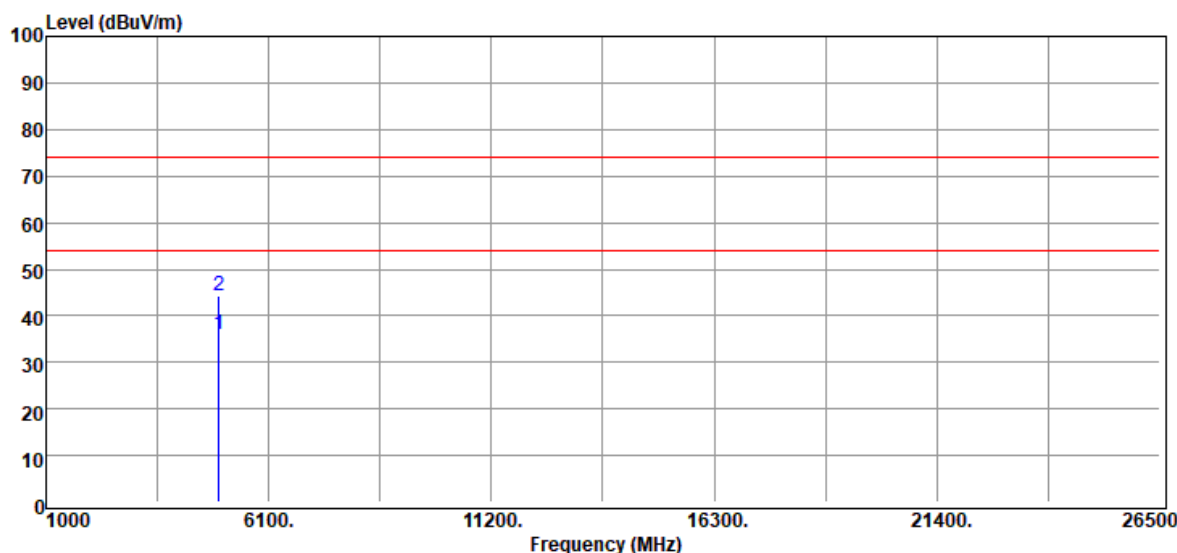
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Report Number :E2/2020/80016  
Operation Mode :BLE 2M  
Test Frequency :2480 MHz  
Test Mode :TX CH HIGH  
EUT Pol :H Plan

Test Site :966 Chamber C  
Test Date :2020-08-27  
Temp./Humi. :22.5/56  
Antenna Pol. :HORIZONTAL  
Engineer :Ashton



| Freq.<br>MHz | Detector<br>Mode<br>PK/QP/AV | Spectrum<br>Reading Level<br>dBμV | Factor<br>dB | Actual<br>FS<br>dBμV/m | Limit<br>@3m<br>dBμV/m | Margin<br>dB |
|--------------|------------------------------|-----------------------------------|--------------|------------------------|------------------------|--------------|
| 4960.00      | Average                      | 21.90                             | 14.13        | 36.03                  | 54.00                  | -17.97       |
| 4960.00      | Peak                         | 30.21                             | 14.13        | 44.34                  | 74.00                  | -29.66       |

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## 11 POWER SPECTRAL DENSITY

### 11.1 Standard Applicable:

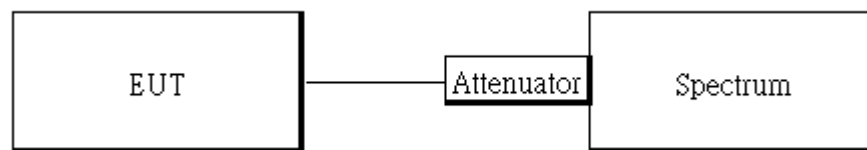
The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

### 11.2 Measurement Equipment Used:

Conducted Emission Test Site

| EQUIPMENT TYPE    | MFR       | MODEL NUMBER | SERIAL NUMBER | LAST CAL.  | CAL DUE.   |
|-------------------|-----------|--------------|---------------|------------|------------|
| DC Block          | PASTERNAK | PE8210       | RF32          | 11/20/2019 | 11/19/2020 |
| Spectrum Analyzer | KEYSIGHT  | N9010B       | MY59071573    | 06/26/2020 | 06/25/2021 |

### 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. 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.

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## 11.5 Measurement Result:

### BLE 1M

| Frequency (MHz) | RF Power Density (dBm) | Maximum Limit (dBm) | Result |
|-----------------|------------------------|---------------------|--------|
| 2402            | -11.18                 | 8                   | PASS   |
| 2442            | -11.32                 | 8                   | PASS   |
| 2480            | -11.68                 | 8                   | PASS   |

**NOTE:** cable loss as 1dB that offsets in the spectrum

### BLE 2M

| Frequency (MHz) | RF Power Density (dBm) | Maximum Limit (dBm) | Result |
|-----------------|------------------------|---------------------|--------|
| 2402            | -11.31                 | 8                   | PASS   |
| 2442            | -13.67                 | 8                   | PASS   |
| 2480            | -13.56                 | 8                   | PASS   |

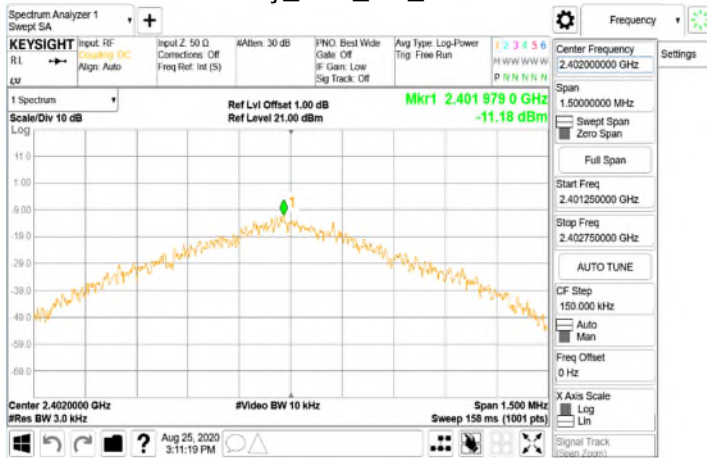
**NOTE:** cable loss as 1dB that offsets in the spectrum

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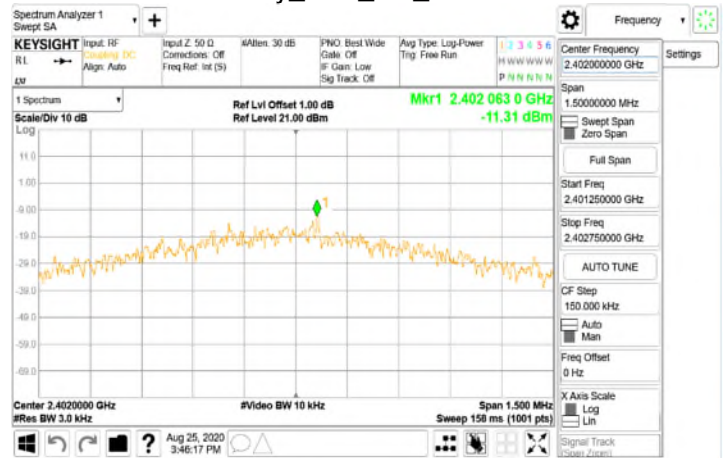
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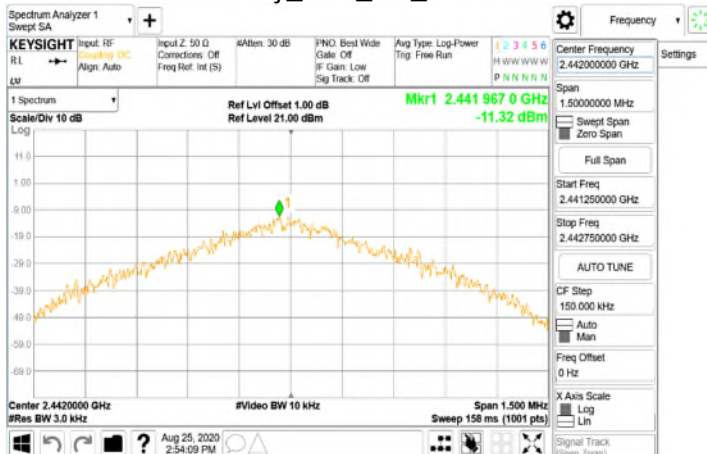
Power Density\_BLE\_1M\_LowCH00-2402



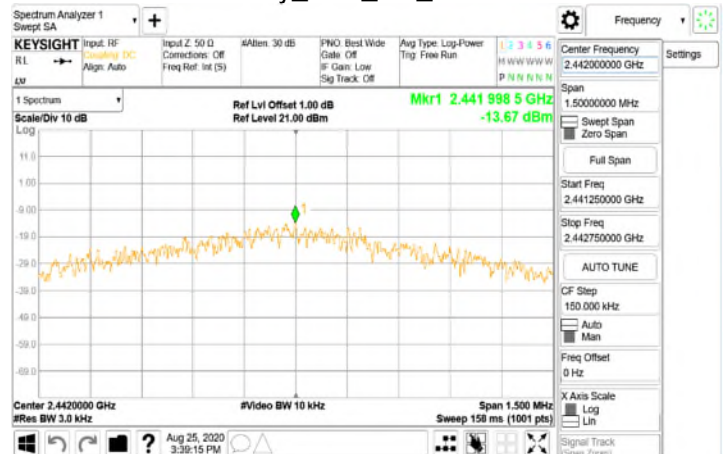
Power Density\_BLE\_2M\_LowCH00-2402



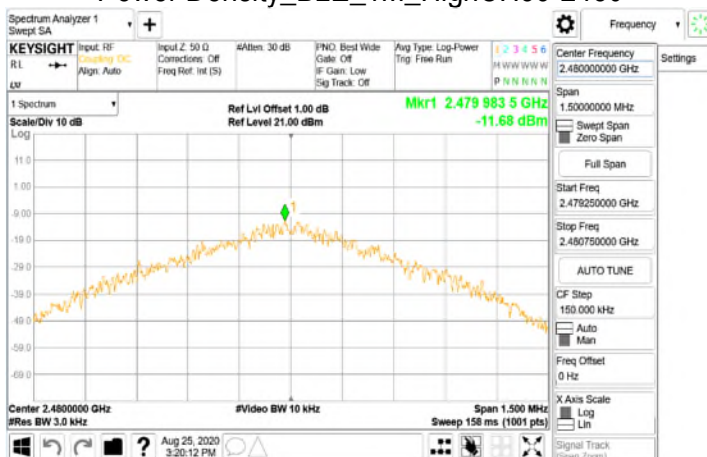
Power Density\_BLE\_1M\_MidCH19-2440



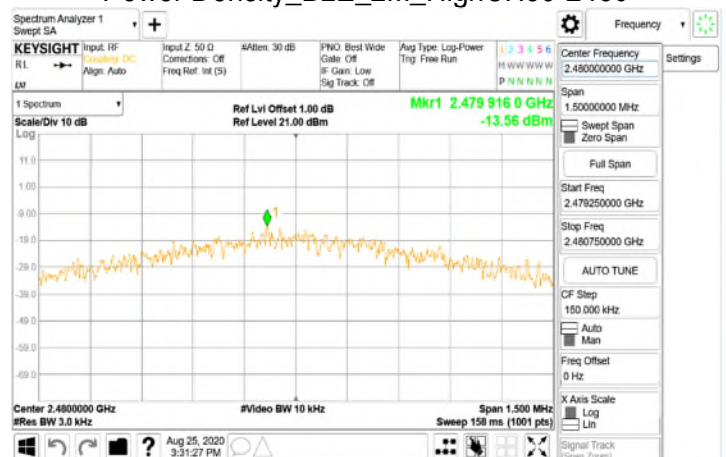
Power Density\_BLE\_2M\_MidCH19-2440



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.

### 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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