



# **CERTIFICATION TEST REPORT**

**Report Number. :** 12935947-E1V2

**Applicant :** Microsoft Corporation  
One Microsoft Way  
Redmond, WA 98052-6399  
USA

**Model :** 1872

**FCC ID :** C3K1872

**IC :** 3048A-1872

**EUT Description :** Portable Computing Device

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART C  
ISED RSS-247 ISSUE 2  
ISED RSS-GEN ISSUE 5

**Date Of Issue:**  
September 10, 2019

**Prepared by:**  
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NVLAP Lab code: 200065-0

## REPORT REVISION HISTORY

| Rev. | Issue Date | Revisions                                                                            | Revised By       |
|------|------------|--------------------------------------------------------------------------------------|------------------|
| V1   | 8/29/2019  | Initial Issue                                                                        | --               |
| V2   | 9/9/2019   | Section 8.2: 99% OBW updated<br>Section 11: Statement added, Setup photos<br>Removed | Jose<br>Martinez |

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** Microsoft Corporation  
One Microsoft Way  
Redmond, WA 98052-6399  
USA

**EUT DESCRIPTION:** Portable Computing Device

**MODEL:** 1872

**SERIAL NUMBER:** 006404792757(Conducted)  
013880192757(Conducted)  
013885392757(Radiated)  
014813492757(Radiated)

**DATE TESTED:** July 17, 2019 –September 9, 2019

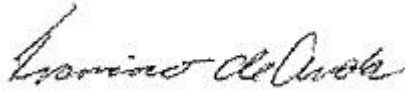
| APPLICABLE STANDARDS     |              |
|--------------------------|--------------|
| STANDARD                 | TEST RESULTS |
| CFR 47 Part 15 Subpart C | Complies     |
| ISED RSS-247 Issue 2     | Complies     |
| ISED RSS-GEN Issue 5     | Complies     |

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

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## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, RSS-GEN Issue 5, and RSS-247 Issue 2.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

| 47173 Benicia Street               | 47266 Benicia Street               | 47658 Kato Road                               |
|------------------------------------|------------------------------------|-----------------------------------------------|
| <input type="checkbox"/> Chamber A | <input type="checkbox"/> Chamber D | <input checked="" type="checkbox"/> Chamber I |
| <input type="checkbox"/> Chamber B | <input type="checkbox"/> Chamber E | <input type="checkbox"/> Chamber J            |
| <input type="checkbox"/> Chamber C | <input type="checkbox"/> Chamber F | <input checked="" type="checkbox"/> Chamber K |
|                                    | <input type="checkbox"/> Chamber G | <input type="checkbox"/> Chamber L            |
|                                    | <input type="checkbox"/> Chamber H | <input type="checkbox"/> Chamber M            |

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code: 2324A.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 4.2. SAMPLE CALCULATION

#### **RADIATED EMISSIONS**

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)  
 $36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$

#### **MAINS CONDUCTED EMISSIONS**

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.  
 $36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$

### 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER                                           | UNCERTAINTY |
|-----------------------------------------------------|-------------|
| Worst Case Conducted Disturbance, 9KHz to 0.15 MHz  | 3.84 dB     |
| Worst Case Conducted Disturbance, 0.15 to 30 MHz    | 3.65 dB     |
| Worst Case Radiated Disturbance, 9KHz to 30 MHz     | 2.52 dB     |
| Worst Case Radiated Disturbance, 30 to 1000 MHz     | 4.88 dB     |
| Worst Case Radiated Disturbance, 1000 to 18000 MHz  | 4.24 dB     |
| Worst Case Radiated Disturbance, 18000 to 26000 MHz | 4.37 dB     |
| Worst Case Radiated Disturbance, 26000 to 40000 MHz | 5.17 dB     |

Uncertainty figures are valid to a confidence level of 95%.

## 5. EQUIPMENT UNDER TEST

### 5.1. EUT DESCRIPTION

The EUT is a Portable Computing Device.

### 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

| Frequency Range (MHz) | Mode | Output Power (dBm) | Output Power (mW) |
|-----------------------|------|--------------------|-------------------|
| 2402 - 2480           | BLE  | 2.29               | 1.69              |

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA antenna, with a maximum gain of -2.2 dBi.

### 5.4. SOFTWARE AND FIRMWARE

The operating system installed on the EUT is MTEOS 1.652.0.

The Bluetooth Driver installed on the EUT is version 21.0.19157.20088.

The test utility software used during testing was version 11.1916.0-09531

### 5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 30MHz, 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels.

The EUT has one intended orientations, X; therefore, all final radiated testing was performed with the EUT in X orientation.

Data rates provided by the client were:

BLE mode: 125kbps  
BLE mode: 500kbps  
BLE mode: 1Mbps  
BLE mode: 2Mbps

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| Support Equipment List   |              |         |               |        |
|--------------------------|--------------|---------|---------------|--------|
| Description              | Manufacturer | Model   | Serial Number | FCC ID |
| AC DC Adapter            | Microsoft    | 1706    | 0C130J02T8396 | DoC    |
| USB Mouse                | Microsoft    | 1113    | X821908-002   | DoC    |
| USB Type C to Audio Jack | SONY         | A1-0231 | N/A           | DoC    |
| Earphone                 | SONY         | AG1100  | N/A           | DoC    |
| Earphone                 | SONY         | AG1100  | N/A           | DoC    |

### I/O CABLES (CONDUCTED TEST)

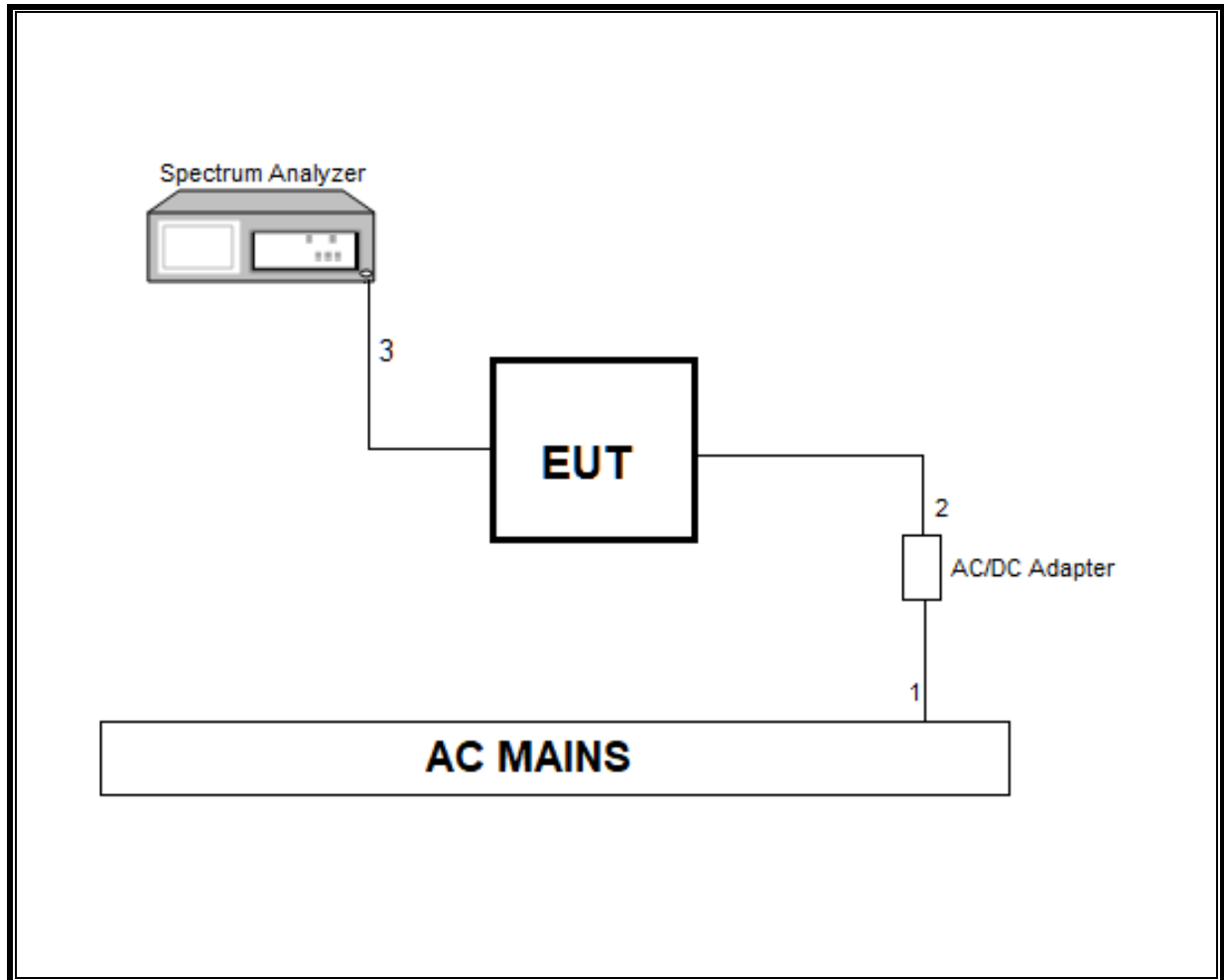
| I/O Cable List |         |                      |                |             |                  |                   |
|----------------|---------|----------------------|----------------|-------------|------------------|-------------------|
| Cable No       | Port    | # of identical ports | Connector Type | Cable Type  | Cable Length (m) | Remarks           |
| 1              | AC      | 1                    | AC             | Un-Shielded | 0.2              | to AC/DC Adaptor  |
| 2              | DC      | 1                    | DC             | Shielded    | 1                | to Laptop, to EUT |
| 3              | Antenna | 1                    | SMA            | Un-Shielded | 0.2              | to Analyzer       |

### I/O CABLES (RADIATED AND CONDUCTED EMISSIONS)

| I/O Cable List |          |                      |                |             |                  |                     |
|----------------|----------|----------------------|----------------|-------------|------------------|---------------------|
| Cable No       | Port     | # of identical ports | Connector Type | Cable Type  | Cable Length (m) | Remarks             |
| 1              | AC       | 1                    | Type C         | Un-shielded | 0.2              | to AC/DC Adapter    |
| 2              | DC       | 1                    | DC             | Shielded    | 1                | to EUT              |
| 3              | USB      | 1                    | Type A         | Shielded    | 1.5              | EUT TO Mouse        |
| 4              | USB      | 1                    | Type C         | Shielded    | 0.1              | EUT to earphone AUX |
| 5              | earphone | 1                    | 3.5mm          | Un-shielded | 1                | EUT to earphone     |

## TEST SETUP

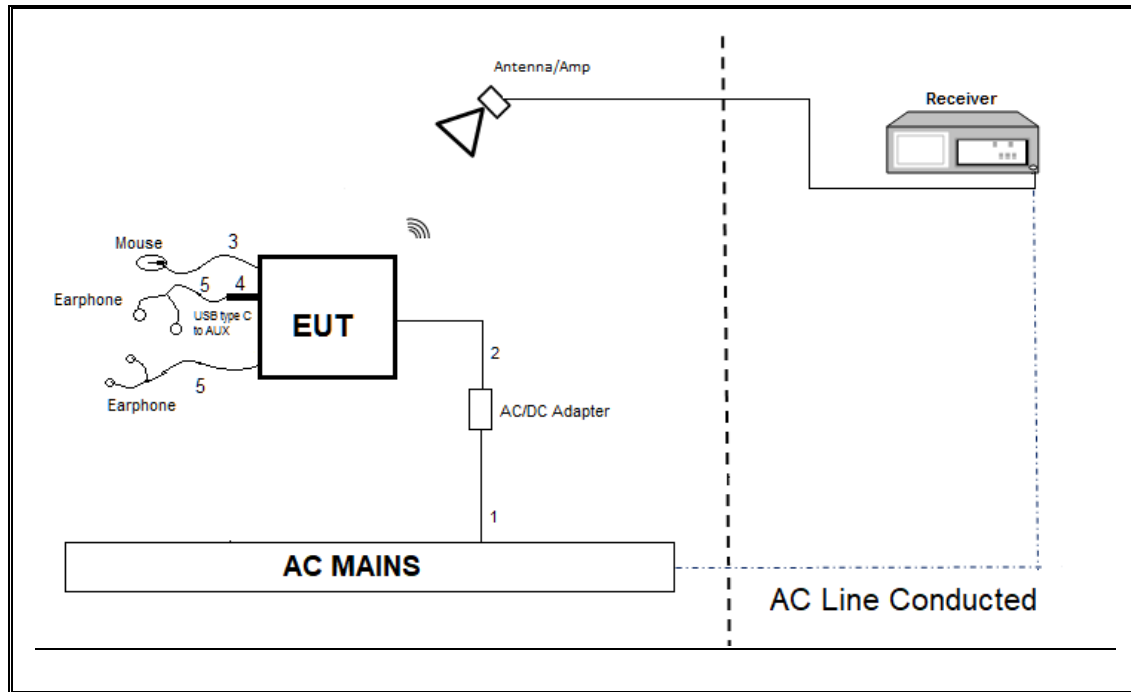
### CONDUCTED TEST SETUP DIAGRAM



## TEST SETUP

For conducted tests, the test software exercises the radio.

### **RADIATED AND AC LINE CONDUCTED EMISSIONS SETUP DIAGRAM**



### **TEST SETUP**

For radiated tests: EUT is connected to all support equipment. The test software exercises the radio.

## 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

| TEST EQUIPMENT LIST                              |                                 |                        |                                       |            |            |
|--------------------------------------------------|---------------------------------|------------------------|---------------------------------------|------------|------------|
| Description                                      | Manufacturer                    | Model                  | ID Num                                | Cal Due    | Last Cal   |
| Antenna, Passive Loop 30Hz to 1MHz               | ELETRO METRICS                  | EM-6871                | PRE0179465                            | 05/31/2020 | 05/31/2019 |
| Antenna, Passive Loop 100kHz to 30MHz            | ELETRO METRICS                  | EM-6872                | PRE0179467                            | 05/31/2020 | 05/31/2019 |
| Amplifier, 9kHz to 1GHz, 32dB                    | Sonoma Instrument               | 310                    | PRE01886650                           | 12/13/2019 | 12/13/2018 |
| Hybrid Antenna, 30MHz to 3GHz                    | Sunol Sciences Corp             | JB3                    | PRE0184971                            | 11/13/2019 | 11/13/2018 |
| Amplifier, 9kHz to 1GHz, 32 dB                   | Sonoma Instrument               | 310                    | PRE0180175                            | 06/29/2020 | 06/29/2019 |
| Antenna, Horn 1-18GHz                            | ETS-Lindgren                    | 3117                   | EMC4294                               | 06/14/2020 | 06/14/2019 |
| Amplifier, 1 to 18GHz, 35dB                      | AMPLICAL                        | AMP1G18-35             | T1569                                 | 06/04/2020 | 06/04/2019 |
| Antenna, Horn 1-18GHz                            | ETS-Lindgren                    | 3117                   | T862                                  | 06/05/2020 | 06/05/2019 |
| Amplifier, 1 to 18GHz                            | MITEQ                           | AFS42-00101800-25-S-42 | PRE018078                             | 08/01/2019 | 08/01/2018 |
| Antenna, Horn 18 to 26.5GHz                      | ARA                             | MWH-1826/B             | PRE0182188                            | 08/29/2019 | 08/29/2018 |
| Rf Amplifier, 18-26.5GHz, 60dB gain              | Amplical                        | AMP18G26.5-60          | PRE0181238                            | 05/01/2020 | 05/01/2019 |
| Power Meter, P-series single channel             | Agilent (Keysight) Technologies | N1911A                 | T1265                                 | 01/29/2020 | 01/29/2019 |
| Power Sensor, P-series, 50MHz to 18GHz, Wideband | Agilent (Keysight) Technologies | N1921A                 | T1227                                 | 02/05/2020 | 02/05/2019 |
| EMI Test Receiver                                | Rohde & Schwarz                 | ESW44                  | PRE0179367                            | 05/16/2020 | 05/16/2019 |
| EMI Test Receiver                                | Rohde & Schwarz                 | ESW44                  | PRE0179372                            | 02/16/2020 | 02/16/2019 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz             | Agilent (Keysight) Technologies | N9030A                 | T908                                  | 01/23/2020 | 01/23/2019 |
| AC Line Conducted                                |                                 |                        |                                       |            |            |
| EMI Receiver                                     | Rohde & Schwarz                 | ESR                    | T1436                                 | 02/14/2020 | 02/14/2019 |
| LISN for Conducted Emissions CISPR-16            | FCC INC.                        | FCC LISN 50/250        | T1310                                 | 01/24/2020 | 01/24/2019 |
| Test Software List                               |                                 |                        |                                       |            |            |
| Radiated Software                                | UL                              | UL EMC                 | Ver 9.5, June 22, 2018 & Jan 11, 2019 |            |            |
| Antenna Port Software                            | UL                              | UL RF                  | Ver 9.9, June 05, 2019                |            |            |
| AC Line Conducted Software                       | UL                              | UL EMC                 | Ver 9.5, May 26, 2015                 |            |            |

### NOTES:

- Equipment listed above that calibrated during the testing period was set for test after the calibration.
- Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

## 7. MEASUREMENT METHOD

On Time and Duty Cycle: ANSI C63.10 Subclause -11.6.

6 dB BW: ANSI C63.10 Subclause -11.8.1

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

Output Power: ANSI C63.10 Subclause -11.9.1.3 Method PKPM1 Peak-reading power meter

Output Power: ANSI C63.10 Subclause -11.9.2.3.2 Method AVGPM-G (Measurement using a gated RF average-reading power meter)

PSD: ANSI C63.10 Subclause -11.10.2 Method PKPSD (peak PSD)

Radiated emissions non-restricted frequency bands: ANSI C63.10 Subclause -11.11

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1

Conducted emissions in restricted frequency bands: ANSI C63.10 Subclause -11.12.2

Band-edge: ANSI C63.10 Subclause -11.13.3.4 Integration method -Trace averaging across ON and OFF times DC correction

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

## 8. ANTENNA PORT TEST RESULTS

### 8.1. ON TIME AND DUTY CYCLE

#### LIMITS

None; for reporting purposes only.

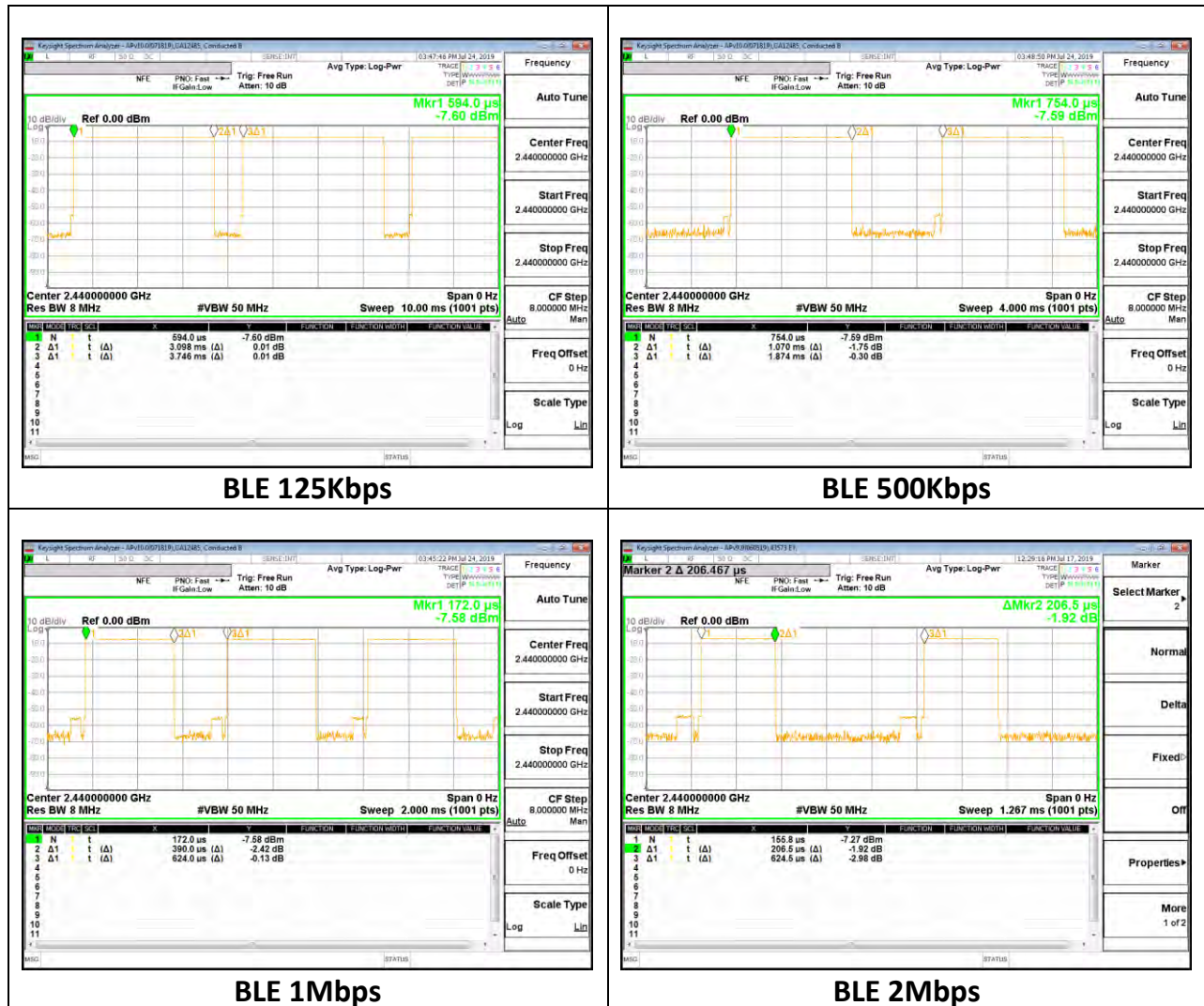
#### PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

#### ON TIME AND DUTY CYCLE RESULTS

| Mode               | ON Time<br>B<br>(msec) | Period<br>(msec) | Duty Cycle<br>x<br>(linear) | Duty<br>Cycle<br>(%) | Duty Cycle<br>Correction Factor<br>(dB) | 1/B<br>Minimum VBW<br>(kHz) |
|--------------------|------------------------|------------------|-----------------------------|----------------------|-----------------------------------------|-----------------------------|
| <b>2.4GHz Band</b> |                        |                  |                             |                      |                                         |                             |
| BLE 125Kbps        | 3.098                  | 3.746            | 0.827                       | 82.70%               | 0.82                                    | 0.323                       |
| BLE 500Kbps        | 1.070                  | 1.874            | 0.571                       | 57.10%               | 2.43                                    | 0.935                       |
| BLE 1Mbps          | 0.390                  | 0.624            | 0.625                       | 62.52%               | 2.04                                    | 2.563                       |
| BLE 2Mbps          | 0.207                  | 0.625            | 0.331                       | 33.07%               | 4.81                                    | 4.843                       |

## DUTY CYCLE PLOTS



## **8.2. 99% BANDWIDTH**

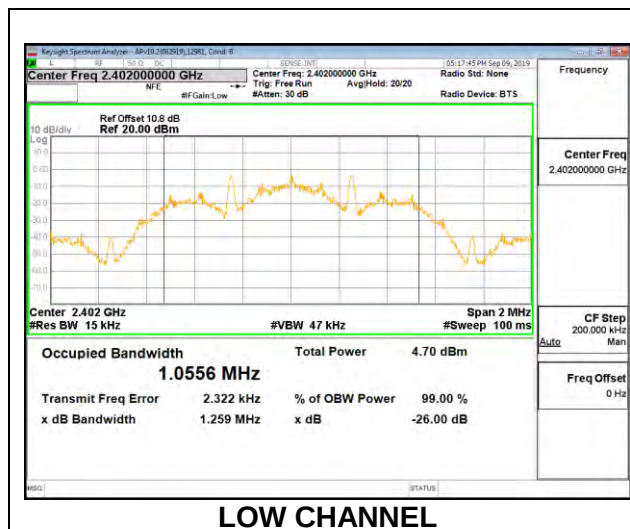
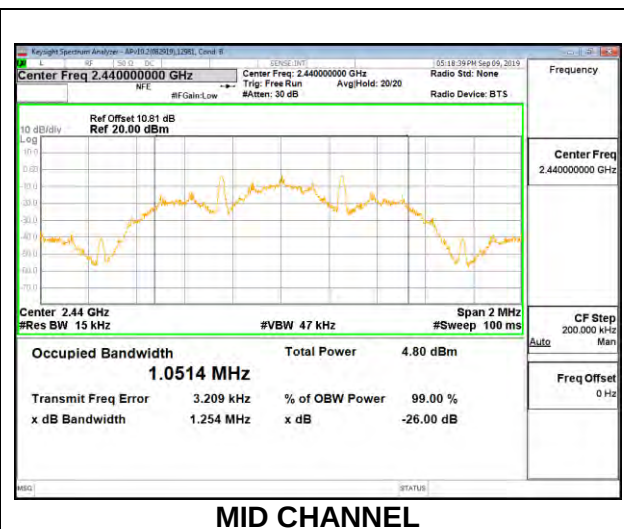
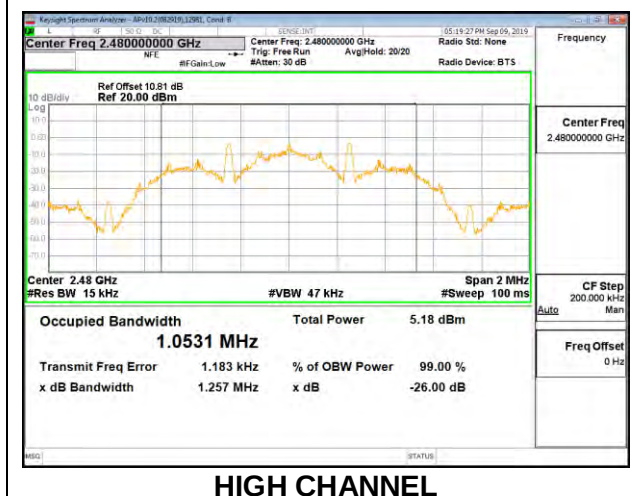
### **LIMITS**

None; for reporting purposes only.

### **RESULTS**

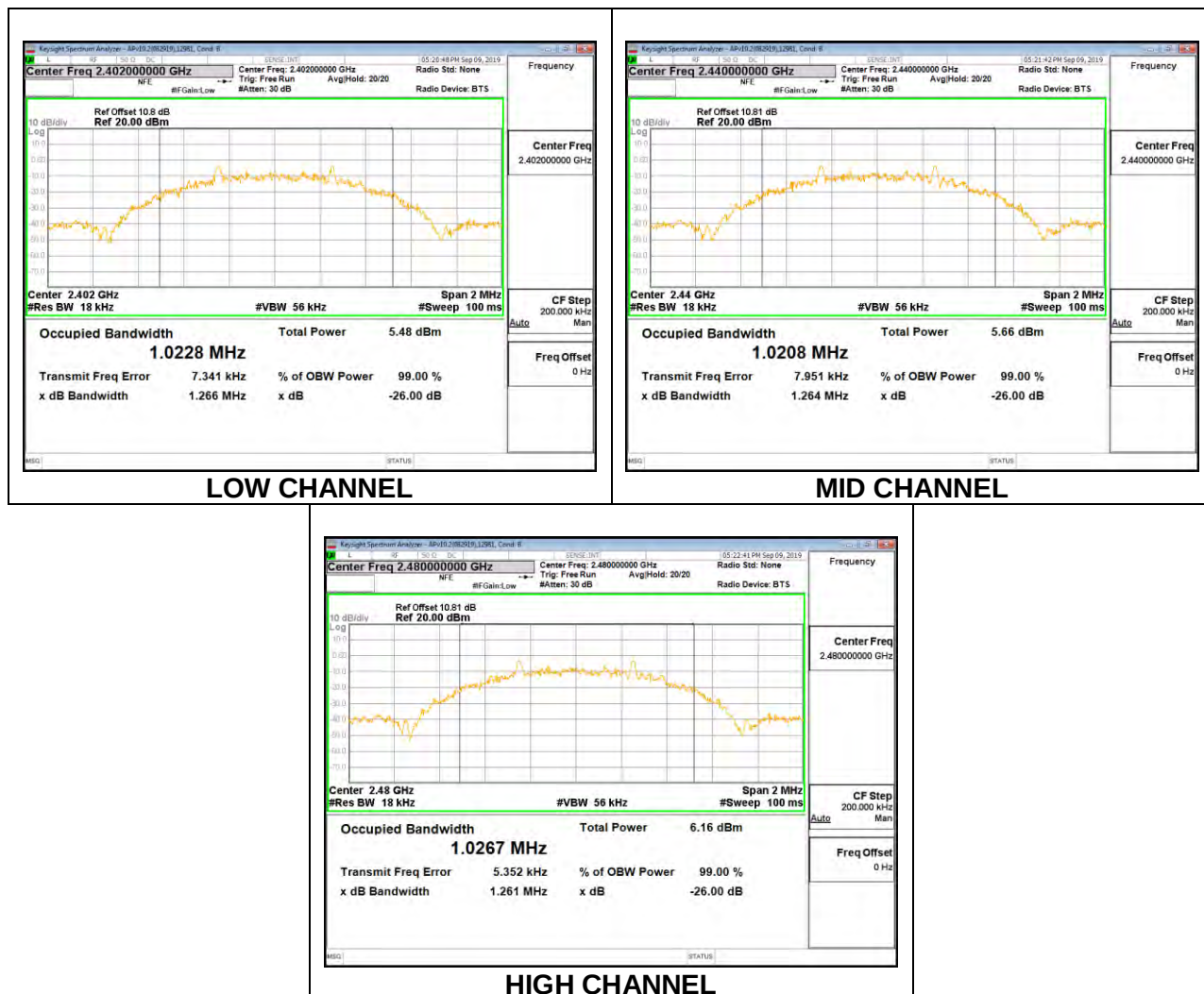
### 8.2.1. BLE (125Kbps)

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 2402            | 1.0556              |
| Middle  | 2440            | 1.0514              |
| High    | 2480            | 1.0531              |



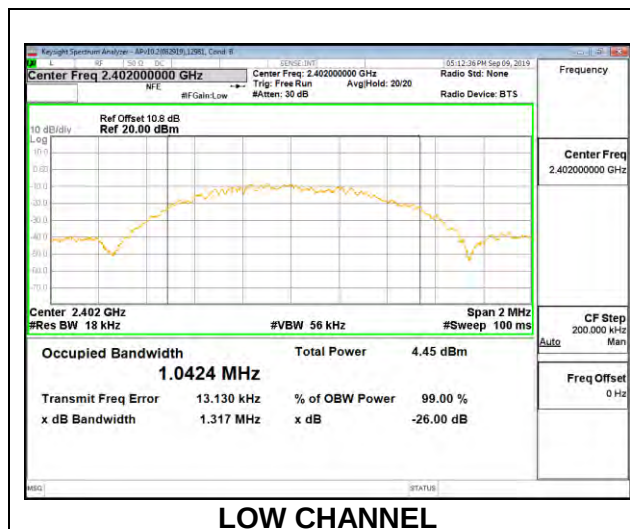
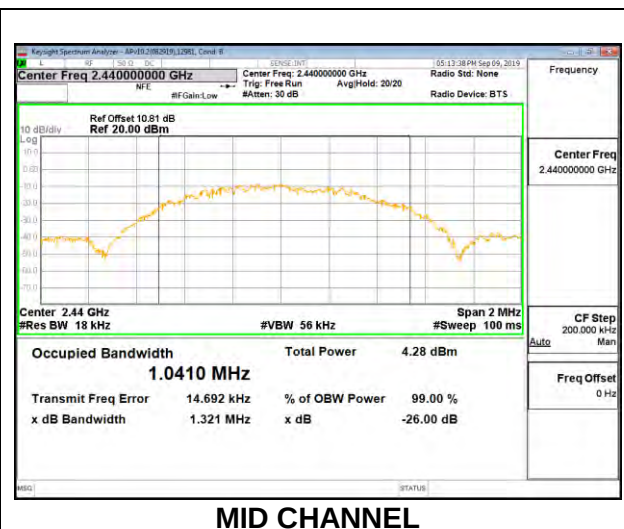
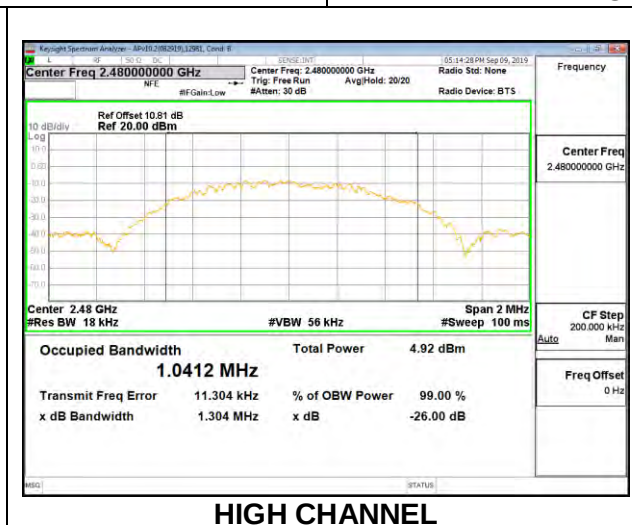
## 8.2.2. BLE (500Kbps)

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 2402            | 1.0228              |
| Middle  | 2440            | 1.0208              |
| High    | 2480            | 1.0267              |



### 8.2.3. BLE (1Mbps)

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 2402            | 1.0424              |
| Middle  | 2440            | 1.0410              |
| High    | 2480            | 1.0412              |



## 8.2.4. BLE (2Mbps)

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 2402            | 2.0547              |
| Middle  | 2440            | 2.0498              |
| High    | 2480            | 2.0509              |



### **8.3. 6 dB BANDWIDTH**

#### **LIMITS**

FCC §15.247 (a) (2)

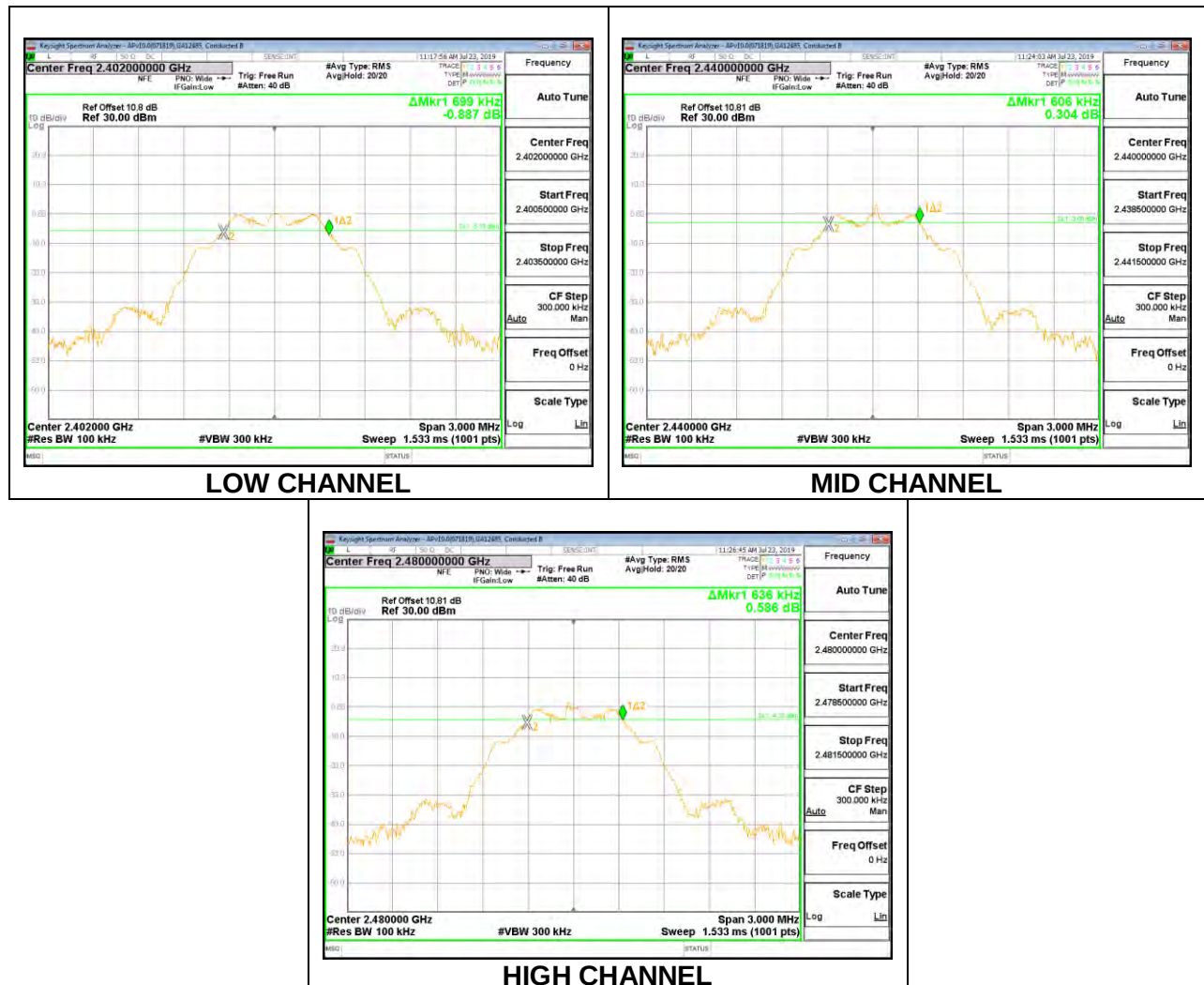
RSS-247 5.2 (a)

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

#### **RESULTS**

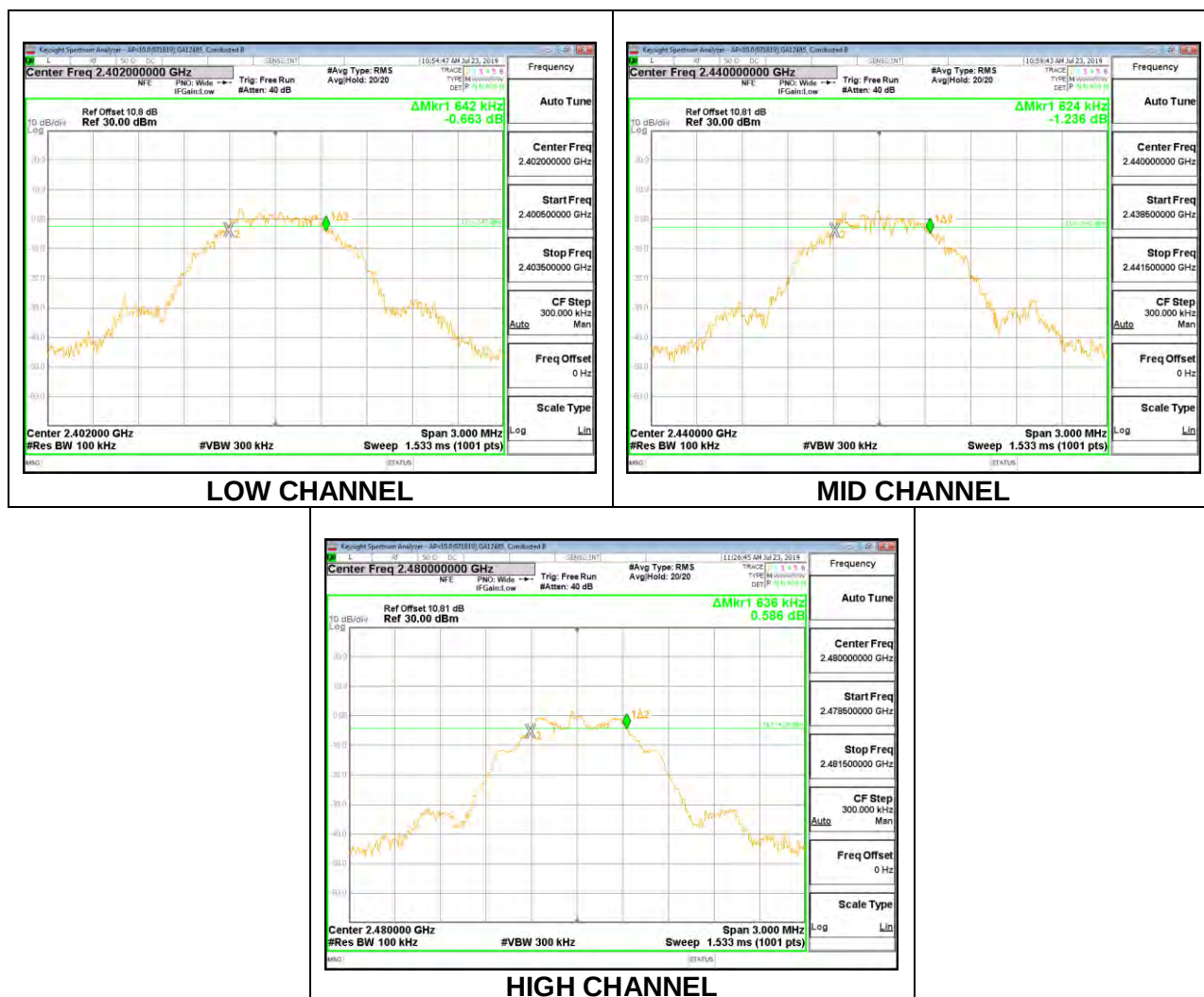
### 8.3.1. BLE (125Kbps)

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low     | 2402            | 0.6990               | 0.5                 |
| Middle  | 2440            | 0.6060               | 0.5                 |
| High    | 2480            | 0.6360               | 0.5                 |



### 8.3.2. BLE (500Kbps)

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low     | 2402            | 0.6420               | 0.5                 |
| Middle  | 2440            | 0.6240               | 0.5                 |
| High    | 2480            | 0.6360               | 0.5                 |



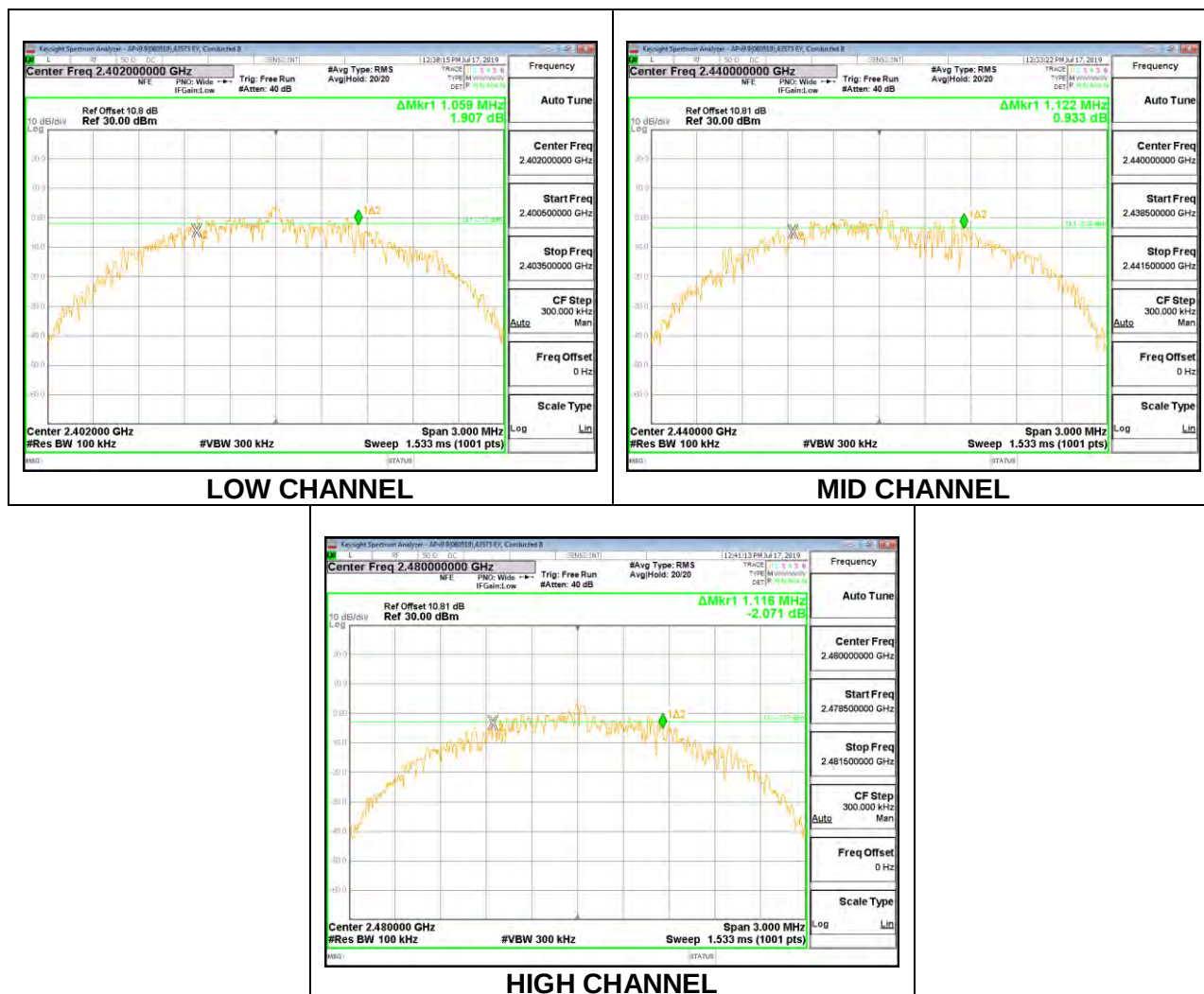
### 8.3.3. BLE (1Mbps)

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low     | 2402            | 0.6330               | 0.5                 |
| Middle  | 2440            | 0.6690               | 0.5                 |
| High    | 2480            | 0.6990               | 0.5                 |



### 8.3.4. BLE (2Mbps)

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low     | 2402            | 1.0590               | 0.5                 |
| Middle  | 2440            | 1.1220               | 0.5                 |
| High    | 2480            | 1.1160               | 0.5                 |



## **8.4. OUTPUT POWER**

### **LIMITS**

FCC §15.247 (b) (3)

RSS-247 5.4 (d)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

### **TEST PROCEDURE**

The transmitter output is connected to a power meter.

The cable assembly insertion loss was entered as an offset in the power meter to allow for a peak reading of power.

### **RESULTS**

#### 8.4.1. BLE (125Kbps)

|                   |           |
|-------------------|-----------|
| <b>Tested By:</b> | 10649 JR  |
| <b>Date:</b>      | 8/22/2019 |

| Channel | Frequency<br>(MHz) | Peak Power<br>Reading<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|--------------------------------|----------------|----------------|
| Low     | 2402               | 2.11                           | 30             | -27.890        |
| Middle  | 2440               | 2.06                           | 30             | -27.940        |
| High    | 2480               | 2.29                           | 30             | -27.710        |

#### 8.4.2. BLE (500Kbps)

|                   |           |
|-------------------|-----------|
| <b>Tested By:</b> | 10649 JR  |
| <b>Date:</b>      | 8/22/2019 |

| Channel | Frequency<br>(MHz) | Peak Power<br>Reading<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|--------------------------------|----------------|----------------|
| Low     | 2402               | 2.16                           | 30             | -27.840        |
| Middle  | 2440               | 2.10                           | 30             | -27.900        |
| High    | 2480               | 2.25                           | 30             | -27.750        |

#### 8.4.3. BLE (1Mbps)

|                   |           |
|-------------------|-----------|
| <b>Tested By:</b> | 10649 JR  |
| <b>Date:</b>      | 8/22/2019 |

| Channel | Frequency<br>(MHz) | Peak Power<br>Reading<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|--------------------------------|----------------|----------------|
| Low     | 2402               | 2.20                           | 30             | -27.800        |
| Middle  | 2440               | 2.07                           | 30             | -27.930        |
| High    | 2480               | 2.26                           | 30             | -27.740        |

#### 8.4.4. BLE (2Mbps)

|                   |           |
|-------------------|-----------|
| <b>Tested By:</b> | 10649 JR  |
| <b>Date:</b>      | 8/22/2019 |

| Channel | Frequency<br>(MHz) | Peak Power<br>Reading<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|--------------------------------|----------------|----------------|
| Low     | 2402               | 2.15                           | 30             | -27.850        |
| Middle  | 2440               | 2.08                           | 30             | -27.920        |
| High    | 2480               | 2.23                           | 30             | -27.770        |

## **8.5. AVERAGE POWER**

### **LIMITS**

None; for reporting purposes only.

### **TEST PROCEDURE**

The transmitter output is connected to a power meter.

The cable assembly insertion loss was entered as an offset in the power meter to allow for a gated average reading of power.

### **RESULTS**

### 8.5.1. BLE (125Kbps)

|                   |           |
|-------------------|-----------|
| <b>Tested By:</b> | 10649 JR  |
| <b>Date:</b>      | 8/22/2019 |

| Channel | Frequency<br>(MHz) | AV power<br>(dBm) |
|---------|--------------------|-------------------|
| Low     | 2402               | 1.97              |
| Middle  | 2440               | 1.93              |
| High    | 2480               | 2.1               |

### 8.5.1. BLE (500Kbps)

|                   |           |
|-------------------|-----------|
| <b>Tested By:</b> | 10649 JR  |
| <b>Date:</b>      | 8/22/2019 |

| Channel | Frequency<br>(MHz) | AV power<br>(dBm) |
|---------|--------------------|-------------------|
| Low     | 2402               | 1.98              |
| Middle  | 2440               | 1.94              |
| High    | 2480               | 2.11              |

### 8.5.1. BLE (1Mbps)

|                   |           |
|-------------------|-----------|
| <b>Tested By:</b> | 10649 JR  |
| <b>Date:</b>      | 8/22/2019 |

| Channel | Frequency<br>(MHz) | AV power<br>(dBm) |
|---------|--------------------|-------------------|
| Low     | 2402               | 2.01              |
| Middle  | 2440               | 1.93              |
| High    | 2480               | 2.10              |

### 8.5.2. BLE (2Mbps)

|                   |           |
|-------------------|-----------|
| <b>Tested By:</b> | 10649 JR  |
| <b>Date:</b>      | 8/22/2019 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>AV power<br/>(dBm)</b> |
|----------------|----------------------------|---------------------------|
| Low            | 2402                       | 1.98                      |
| Middle         | 2440                       | 1.93                      |
| High           | 2480                       | 2.1                       |

## **8.6. POWER SPECTRAL DENSITY**

### **LIMITS**

FCC §15.247 (e)

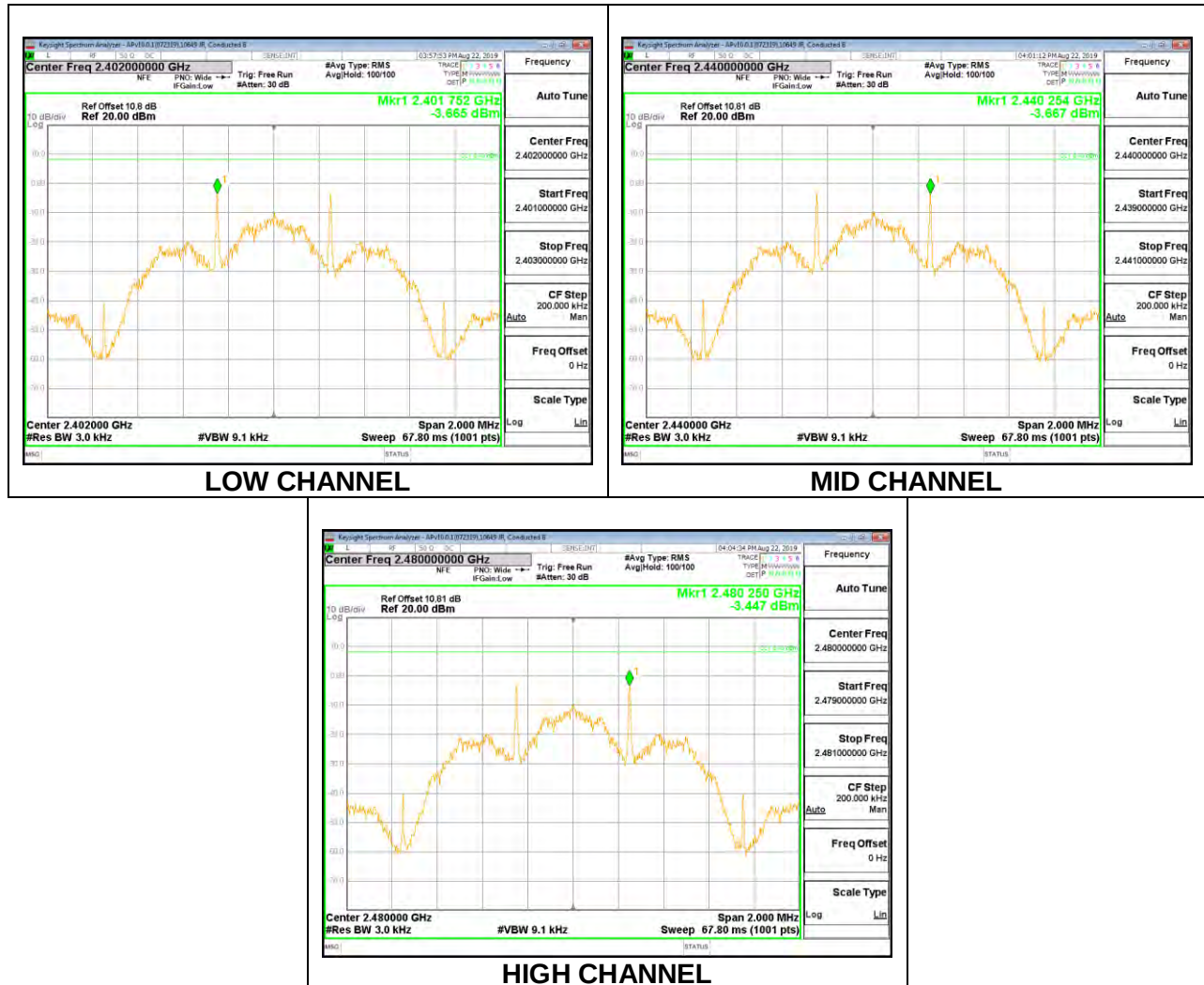
RSS-247 (5.2) (b)

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

### **RESULTS**

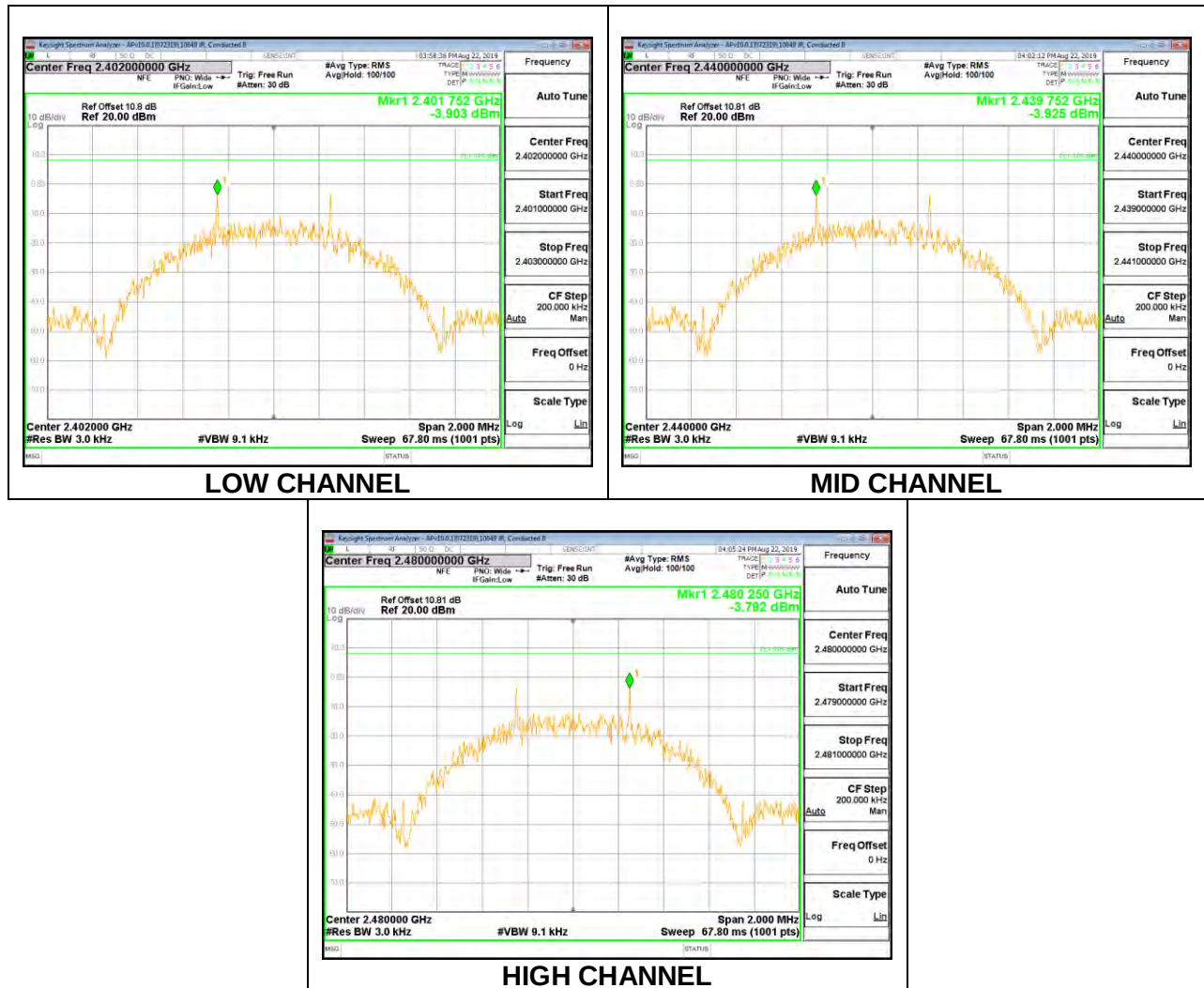
### 8.6.1. BLE (125Kbps)

| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low     | 2402            | -3.67          | 8                | -11.67      |
| Middle  | 2440            | -3.67          | 8                | -11.67      |
| High    | 2480            | -3.45          | 8                | -11.45      |



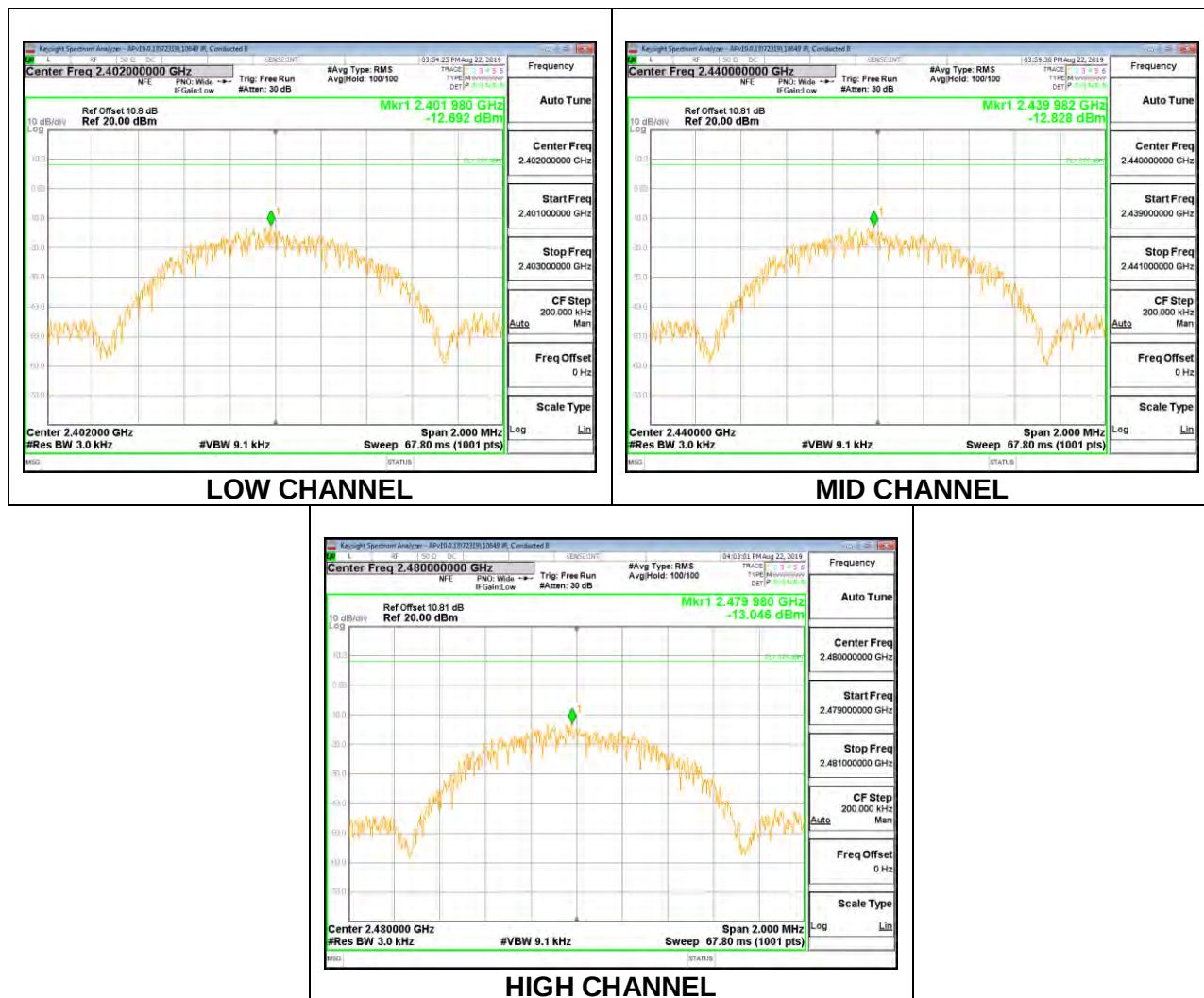
## 8.6.2. BLE (500Kbps)

| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low     | 2402            | -3.99          | 8                | -11.99      |
| Middle  | 2440            | -3.93          | 8                | -11.93      |
| High    | 2480            | -3.79          | 8                | -11.79      |



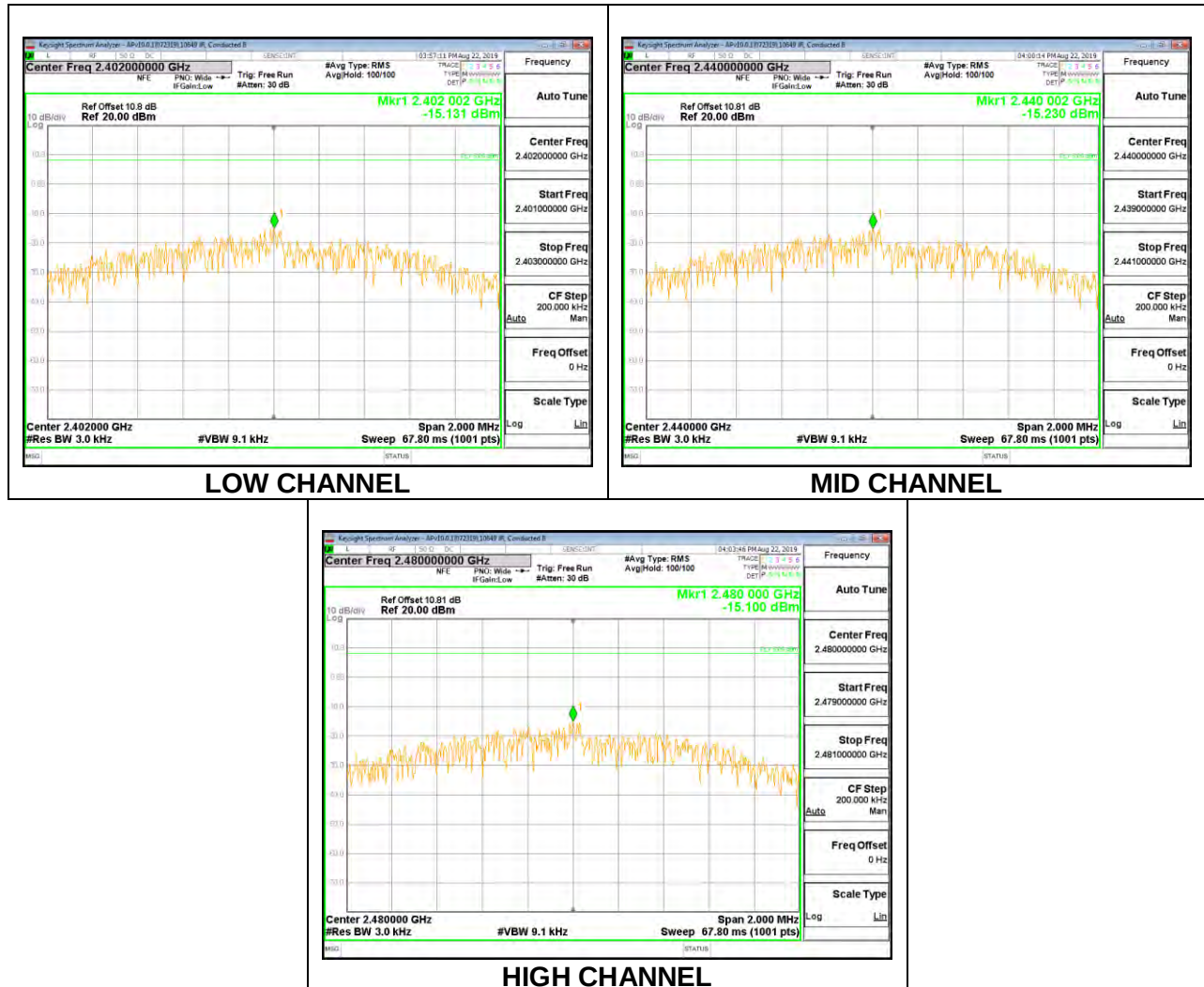
### 8.6.3. BLE (1Mbps)

| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low     | 2402            | -12.69         | 8                | -20.69      |
| Middle  | 2440            | -12.83         | 8                | -20.83      |
| High    | 2480            | -13.05         | 8                | -21.05      |



### 8.6.4. BLE (2Mbps)

| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low     | 2402            | -15.13         | 8                | -23.13      |
| Middle  | 2440            | -15.23         | 8                | -23.23      |
| High    | 2480            | -15.10         | 8                | -23.10      |



## **8.7. CONDUCTED SPURIOUS EMISSIONS**

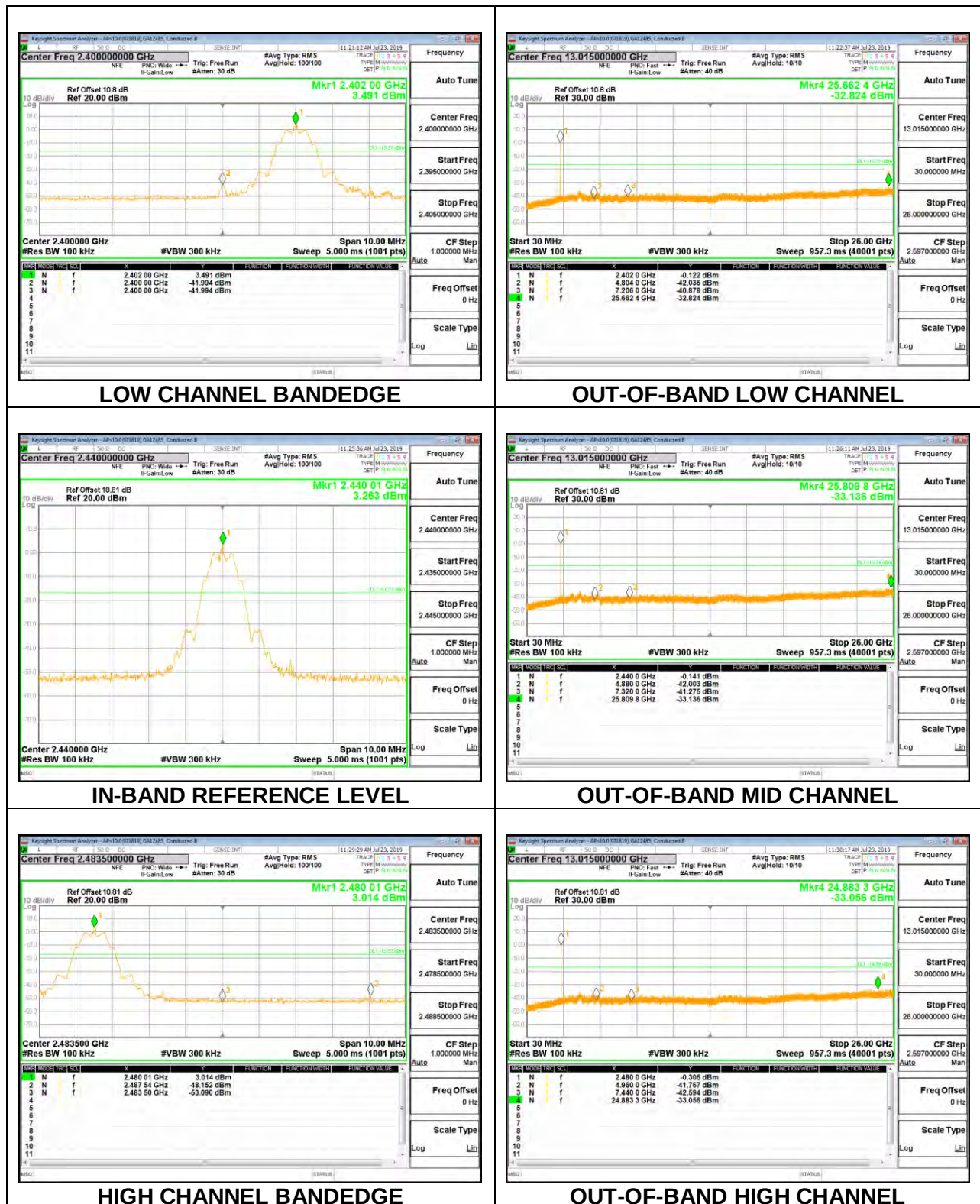
### **LIMITS**

FCC §15.247 (d)

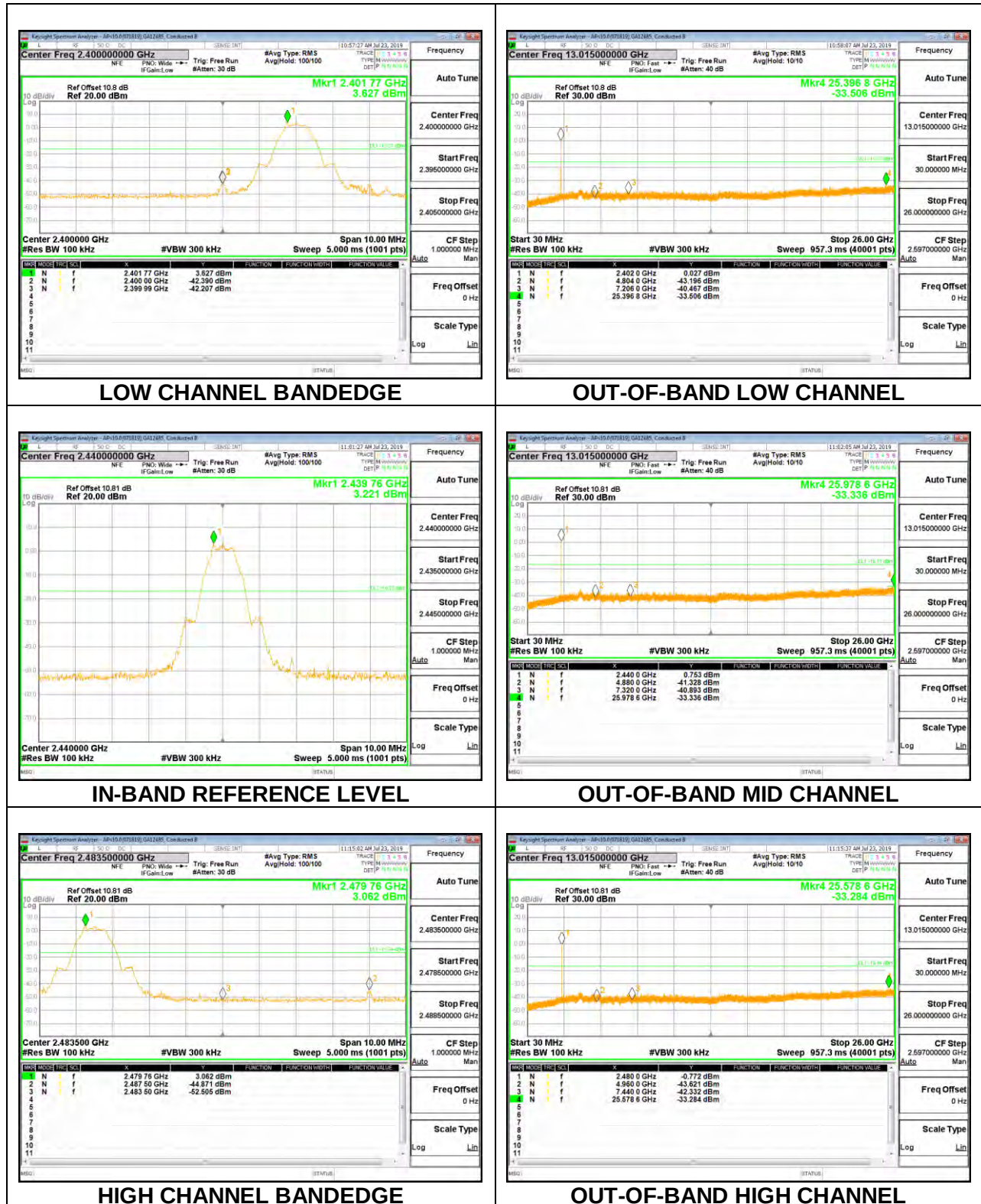
RSS-247 5.5

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

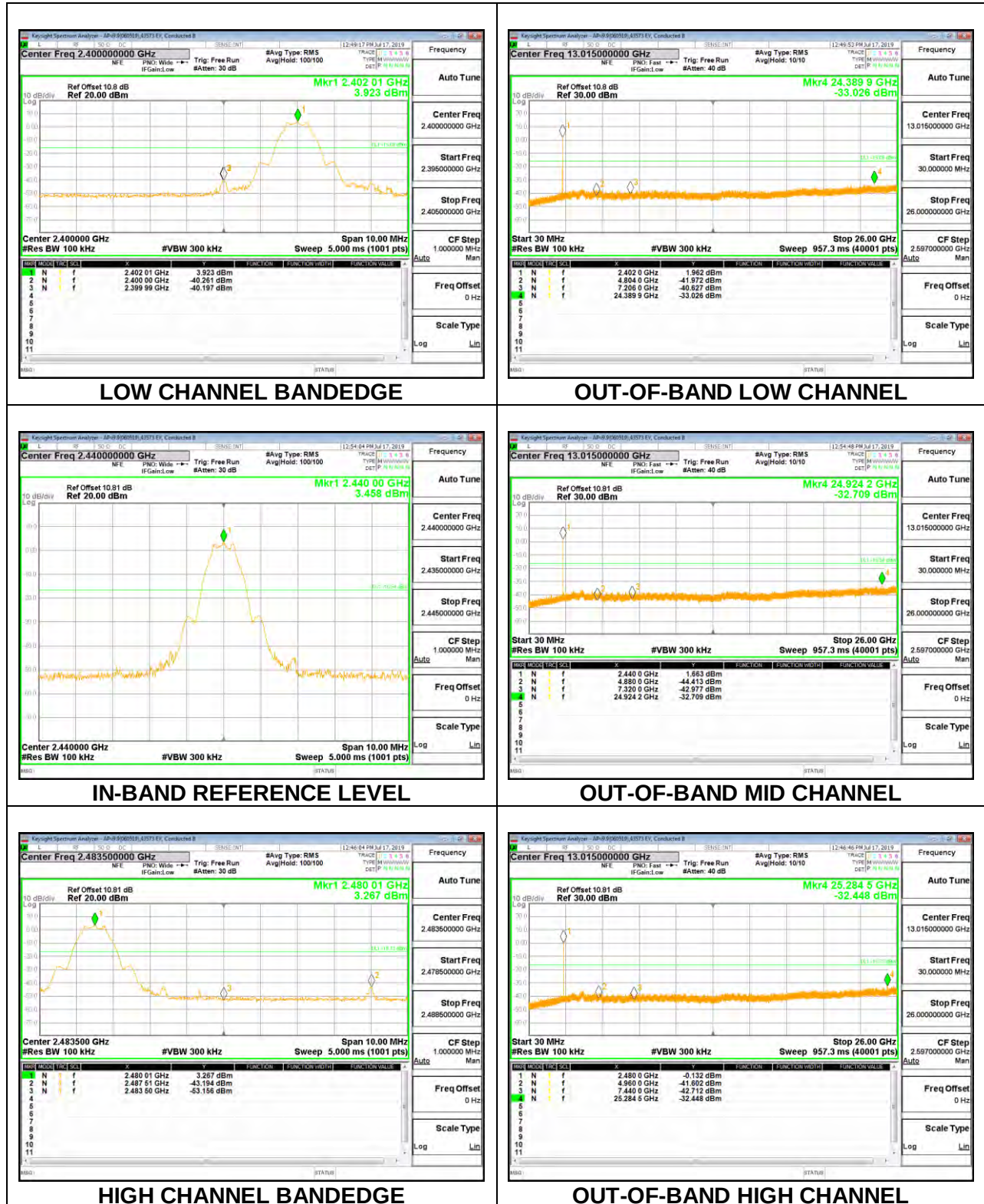
### **RESULTS**



## 8.7.2. BLE (500Kbps)



### 8.7.3. BLE (1Mbps)





## 9. RADIATED TEST RESULTS

### 9.1. LIMITS AND PROCEDURE

#### LIMITS

FCC §15.205 and §15.209

RSS-GEN, Section 8.9 and 8.10.

| Frequency Range (MHz) | Field Strength Limit (uV/m) at 3 m | Field Strength Limit (dBuV/m) at 3 m |
|-----------------------|------------------------------------|--------------------------------------|
| 0.009-0.490           | 2400/F(kHz) @ 300 m                | -                                    |
| 0.490-1.705           | 24000/F(kHz) @ 30 m                | -                                    |
| 1.705 - 30            | 30 @ 30m                           | -                                    |
| 30 - 88               | 100                                | 40                                   |
| 88 - 216              | 150                                | 43.5                                 |
| 216 - 960             | 200                                | 46                                   |
| Above 960             | 500                                | 54                                   |

#### TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 30MHz, below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

2D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.

**KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification**

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

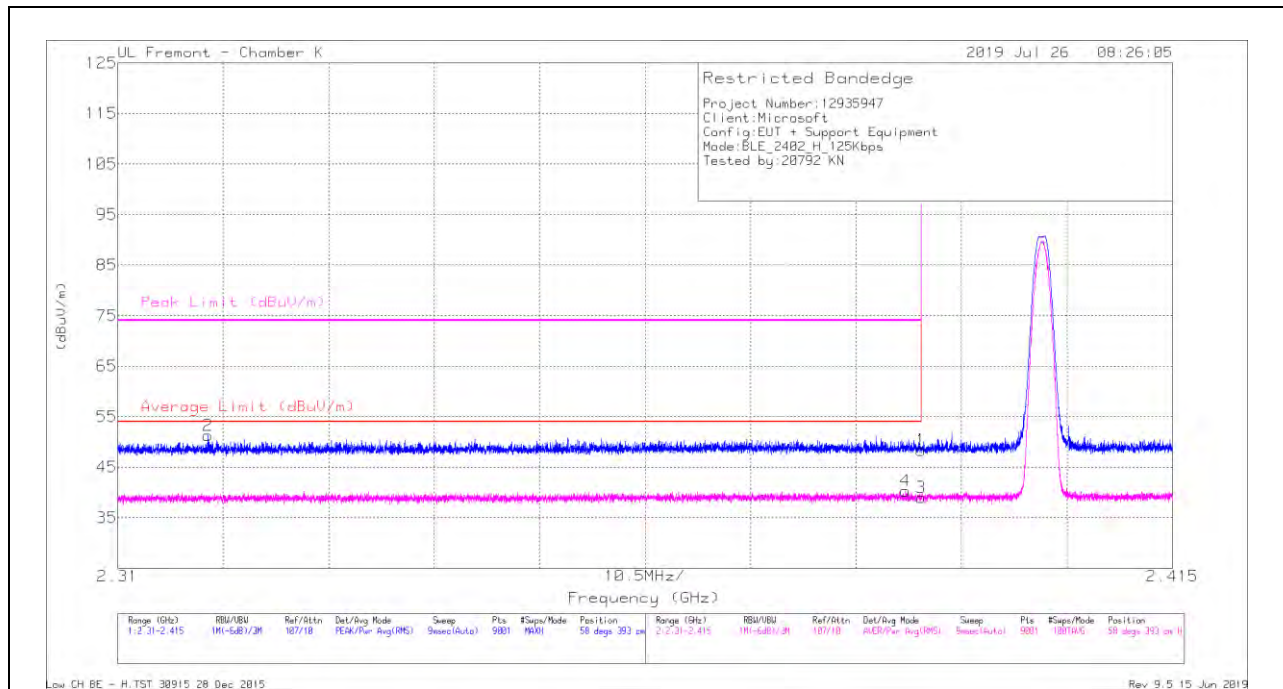
OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

## 9.2. TRANSMITTER ABOVE 1 GHz

### 9.2.1. BLE (125Kbps)

#### BANDEDGE (LOW CHANNEL)

#### HORIZONTAL RESULT



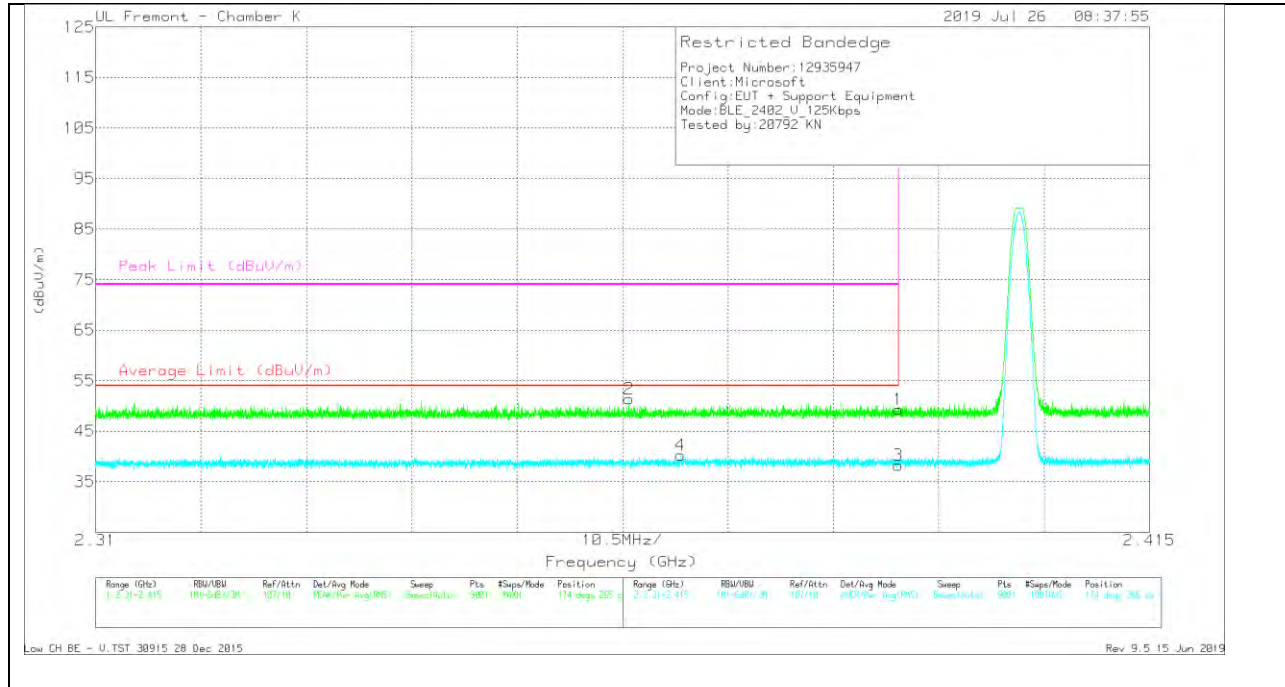
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF EMC4294 (dBm) | Ampl/Chl/Filt/Pa d (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|------------------|-------------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 2.38999       | 41.17                | Pk  | 31.9             | -24.7                   | 0            | 48.37                      | -                      | -           | 74                  | -25.63         | 58             | 393         | H        |
| 2      | * 2.319         | 44.27                | Pk  | 31.6             | -24.6                   | 0            | 51.27                      | -                      | -           | 74                  | -22.73         | 58             | 393         | H        |
| 3      | * 2.38999       | 30.94                | RMS | 31.9             | -24.7                   | .82          | 38.97                      | 54                     | -15.03      | -                   | -              | 58             | 393         | H        |
| 4      | * 2.38845       | 32.17                | RMS | 31.9             | -24.6                   | .82          | 40.3                       | 54                     | -13.7       | -                   | -              | 58             | 393         | H        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

## VERTICAL RESULT



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AP EMC4294 (dBm) | Antp/Chl/Filt/Pa d (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|------------------|-------------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 2.38999       | 42.09                | Pk  | 31.9             | -24.7                   | 0            | 49.29                      | -                      | -           | 74                  | -24.71         | 174            | 265         | V        |
| 2      | * 2.36312       | 44.18                | Pk  | 31.8             | -24.6                   | 0            | 51.38                      | -                      | -           | 74                  | -22.62         | 174            | 265         | V        |
| 3      | * 2.38999       | 30.18                | RMS | 31.9             | -24.7                   | .82          | 38.21                      | 54                     | -15.79      | -                   | -              | 174            | 265         | V        |
| 4      | * 2.36827       | 32.22                | RMS | 31.8             | -24.6                   | .82          | 40.25                      | 54                     | -13.75      | -                   | -              | 174            | 265         | V        |

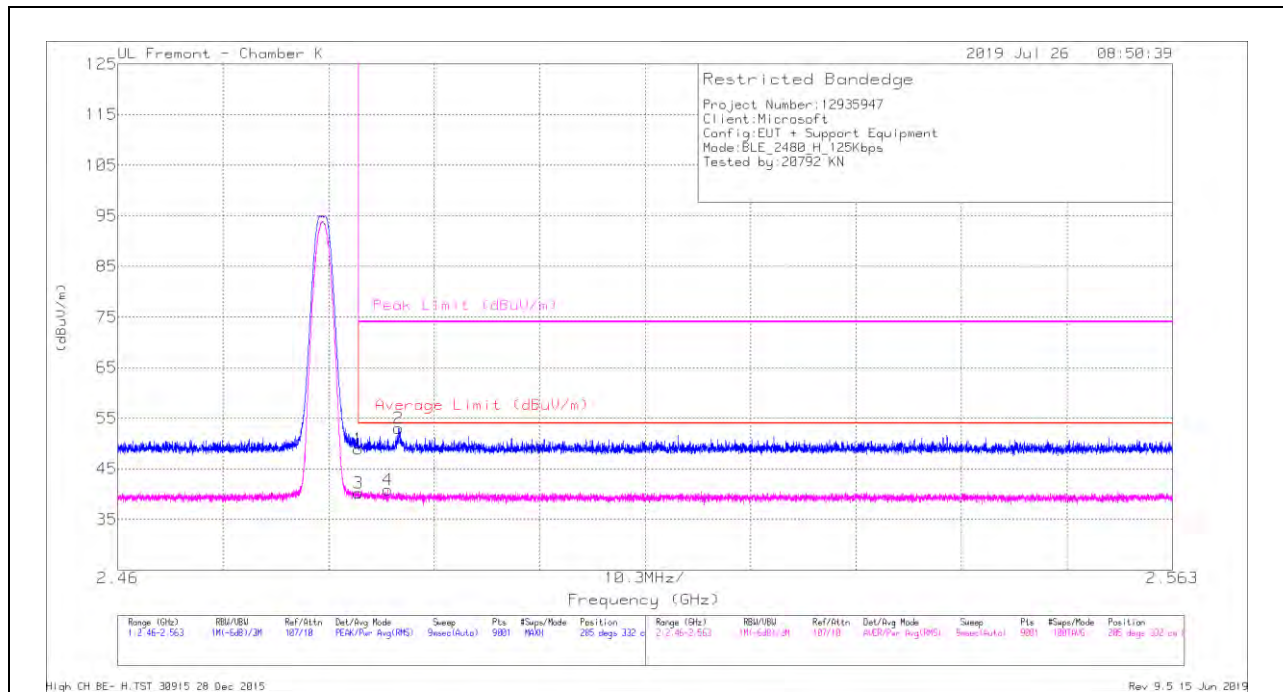
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

## BANDEDGE (HIGH CHANNEL)

### HORIZONTAL RESULT



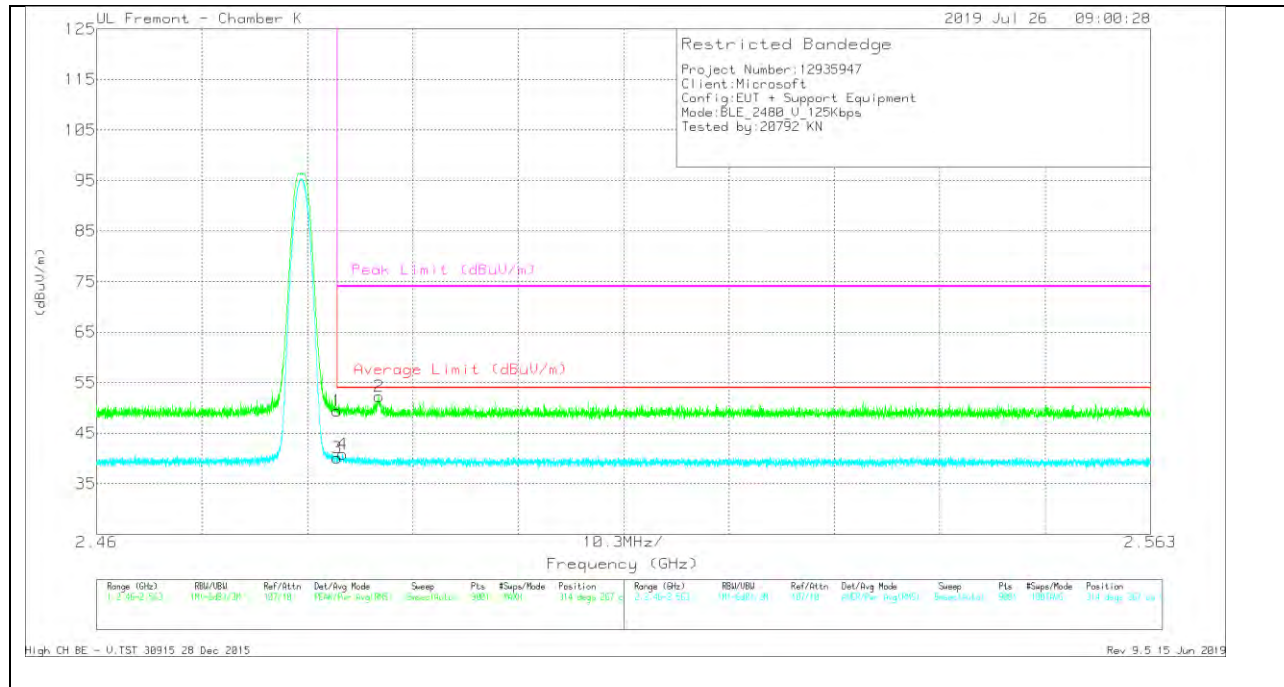
| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF EMC4294 (dBm) | Ampl/Cb/Fltr/Pa d (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|------------------|------------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | *2.48351        | 41.19                | Pk  | 32.5             | -24.8                  | 0            | 48.89                      | -                      | -           | 74                  | -25.11         | 285            | 332         | H        |
| 2      | *2.48743        | 45.32                | Pk  | 32.5             | -24.8                  | 0            | 53.02                      | -                      | -           | 74                  | -20.98         | 285            | 332         | H        |
| 3      | *2.48351        | 31.75                | RMS | 32.5             | -24.8                  | .82          | 40.28                      | 54                     | -13.72      | -                   | -              | 285            | 332         | H        |
| 4      | *2.48638        | 32.35                | RMS | 32.5             | -24.8                  | .82          | 40.88                      | 54                     | -13.12      | -                   | -              | 285            | 332         | H        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

## VERTICAL RESULT



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AP EMC4294 (dBm) | Antp/Chf/Fit/Pa d (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|-----|------------------|------------------------|--------------|----------------------------|------------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | * 2.48351       | 41.71                | Pk  | 32.5             | -24.8                  | 0            | 49.41                      | -                      | -           | 74                  | -24.59         | 314            | 267         | V        |
| 2      | * 2.4876        | 44.54                | Pk  | 32.5             | -24.8                  | 0            | 52.24                      | -                      | -           | 74                  | -21.76         | 314            | 267         | V        |
| 3      | * 2.48351       | 31.62                | RMS | 32.5             | -24.8                  | .82          | 40.15                      | 54                     | -13.85      | -                   | -              | 314            | 267         | V        |
| 4      | * 2.48404       | 32.28                | RMS | 32.5             | -24.8                  | .82          | 40.81                      | 54                     | -13.19      | -                   | -              | 314            | 267         | V        |

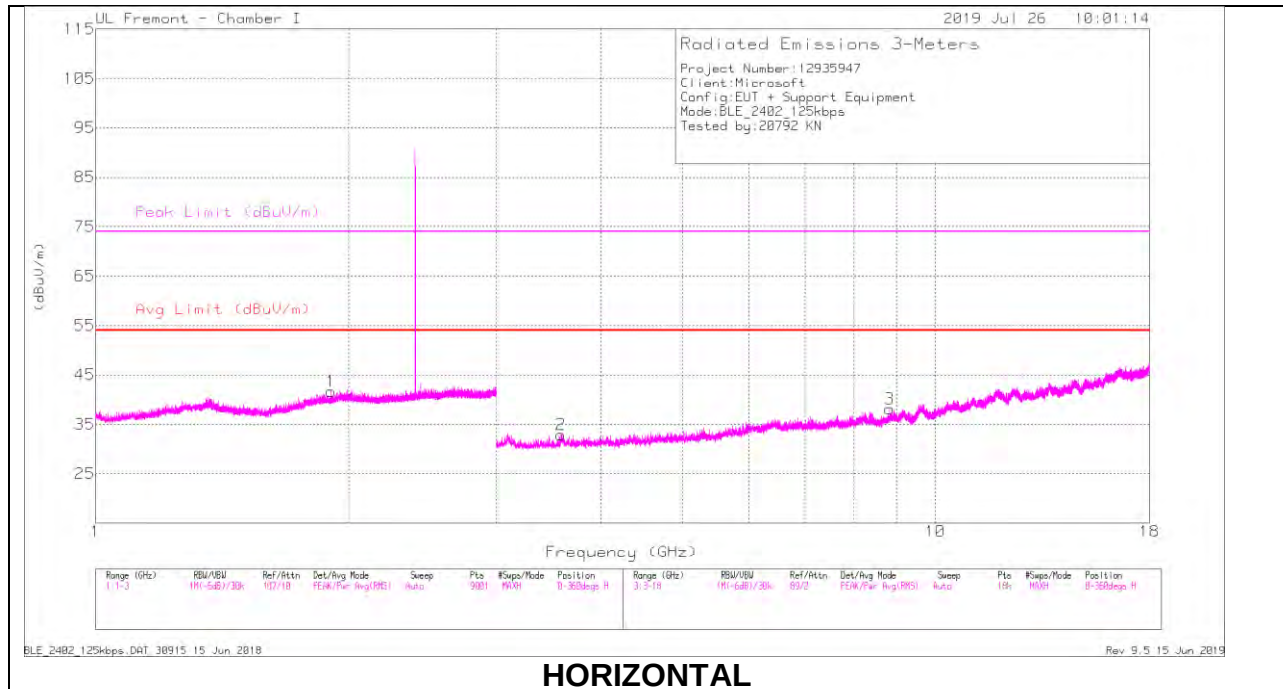
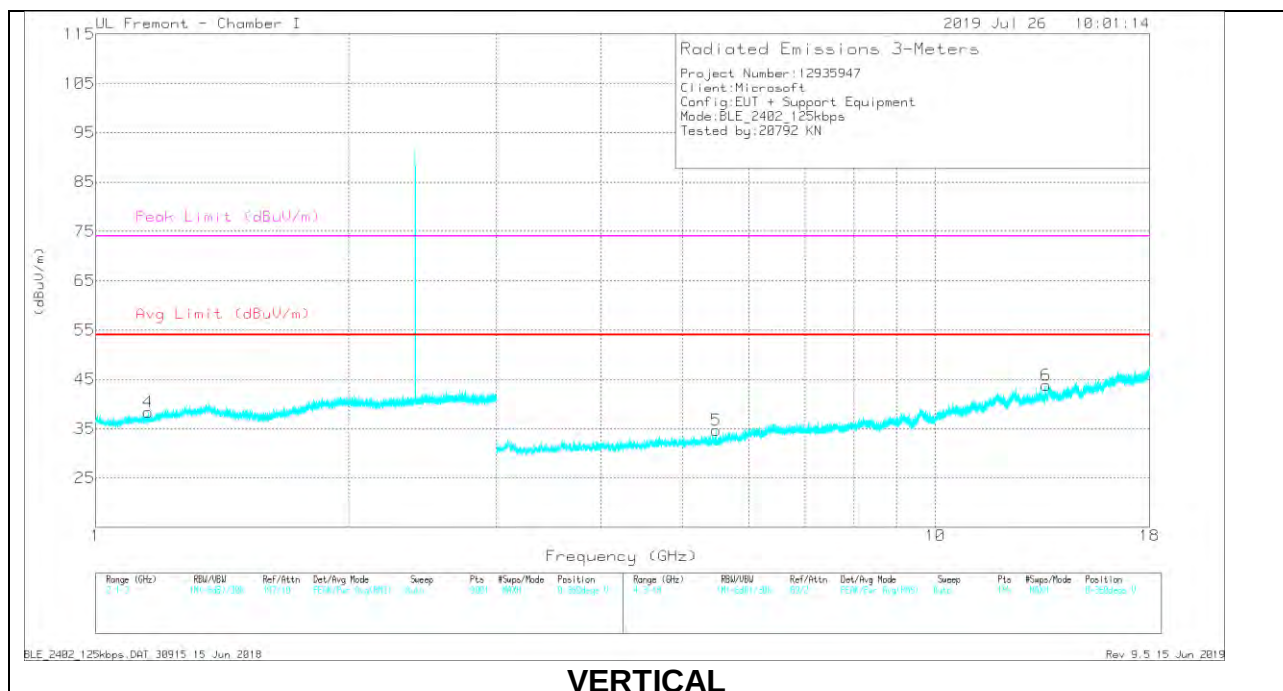
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

## HARMONICS AND SPURIOUS EMISSIONS

### LOW CHANNEL RESULTS



## RADIATED EMISSIONS

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det  | AF EMC4294 (dBm) | Amp/Cbl/Filtr/Pad (dB) | DC Corr (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|--------|-----------------|----------------------|------|------------------|------------------------|--------------|----------------------------|--------------------|-------------|---------------------|----------------|----------------|-------------|----------|
| 1      | 1.90488         | 38.92                | PK2  | 31               | -24.3                  | 0            | 45.62                      | -                  | -           | -                   | -              | 149            | 256         | H        |
| 4      | * 1.15527       | 39.88                | PK2  | 27.7             | -23.9                  | 0            | 43.68                      | -                  | -           | 74                  | -30.32         | 229            | 182         | V        |
|        | * 1.15536       | 29.87                | MAv1 | 27.6             | -23.9                  | .82          | 34.39                      | 54                 | -19.61      | -                   | -              | 229            | 182         | V        |
| 2      | * 3.58148       | 35.68                | PK2  | 33.6             | -32.3                  | 0            | 36.98                      | -                  | -           | 74                  | -37.02         | 308            | 239         | H        |
|        | * 3.57859       | 25.67                | MAv1 | 33.5             | -32.2                  | .82          | 27.79                      | 54                 | -26.21      | -                   | -              | 308            | 239         | H        |
| 3      | 8.82532         | 33.15                | PK2  | 36.1             | -24                    | 0            | 45.25                      | -                  | -           | -                   | -              | 308            | 210         | H        |
| 5      | 5.48605         | 32.72                | PK2  | 34.5             | -29.4                  | 0            | 37.82                      | -                  | -           | -                   | -              | 161            | 265         | V        |
| 6      | 13.54472        | 30.1                 | PK2  | 38.8             | -19                    | 0            | 49.9                       | -                  | -           | -                   | -              | 303            | 251         | V        |

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

## MID CHANNEL RESULTS

