



# **CERTIFICATION TEST REPORT**

**Report Number. :** 11792476-E2V3

**Applicant :** APPLE, INC.  
1 INFINITE LOOP  
CUPERTINO, CA 95014, U.S.A.

**Model :** A1902

**FCC ID :** BCG-E3176A

**IC :** 579C-E3176A

**EUT Description :** SMARTPHONE

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART C  
INDUSTRY CANADA RSS - 247 ISSUE 2

**Date Of Issue:**  
August 25, 2017

**Prepared by:**  
UL Verification Services Inc.  
47173 Benicia Street  
Fremont, CA 94538, U.S.A.  
TEL: (510) 771-1000  
FAX: (510) 661-0888



NVLAP LAB CODE 200065-0

Revision History

| Rev. | Issue Date | Revisions               | Revised By |
|------|------------|-------------------------|------------|
| V1   | 8/17/2017  | Initial Issue           | Hung Thai  |
| V2   | 8/21/2017  | Address TCB's Questions | Chin Pang  |
| V3   | 8/25/2017  | Address TCB's Questions | Chin Pang  |

## TABLE OF CONTENTS

|                                                       |           |
|-------------------------------------------------------|-----------|
| <b>1. ATTESTATION OF TEST RESULTS .....</b>           | <b>6</b>  |
| <b>2. TEST METHODOLOGY .....</b>                      | <b>7</b>  |
| <b>3. FACILITIES AND ACCREDITATION .....</b>          | <b>7</b>  |
| <b>4. CALIBRATION AND UNCERTAINTY .....</b>           | <b>8</b>  |
| 4.1. MEASURING INSTRUMENT CALIBRATION .....           | 8         |
| 4.2. SAMPLE CALCULATION .....                         | 8         |
| 4.3. MEASUREMENT UNCERTAINTY.....                     | 8         |
| <b>5. EQUIPMENT UNDER TEST .....</b>                  | <b>9</b>  |
| 5.1. DESCRIPTION OF EUT .....                         | 9         |
| 5.2. MAXIMUM OUTPUT POWER.....                        | 9         |
| 5.3. DESCRIPTION OF AVAILABLE ANTENNAS .....          | 9         |
| 5.4. SOFTWARE AND FIRMWARE.....                       | 9         |
| 5.5. WORST-CASE CONFIGURATION AND MODE.....           | 10        |
| 5.6. DESCRIPTION OF TEST SETUP.....                   | 11        |
| <b>6. TEST AND MEASUREMENT EQUIPMENT .....</b>        | <b>16</b> |
| <b>7. ANTENNA PORT TEST RESULTS .....</b>             | <b>17</b> |
| 7.1. MEASUREMENT METHODS .....                        | 17        |
| 7.2. ON TIME, DUTY CYCLE .....                        | 18        |
| 7.3. UAT 1 BLE 1M Pmax.....                           | 20        |
| 7.3.1. 6 dB BANDWIDTH.....                            | 20        |
| 7.3.2. 99% BANDWIDTH.....                             | 23        |
| 7.3.3. AVERAGE POWER .....                            | 26        |
| 7.3.4. OUTPUT POWER .....                             | 27        |
| 7.3.5. POWER SPECTRAL DENSITY .....                   | 28        |
| 7.3.6. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS..... | 31        |
| 7.4. UAT 1 BLE 1M Plow .....                          | 35        |
| 7.4.1. 6 dB BANDWIDTH.....                            | 35        |
| 7.4.2. 99% BANDWIDTH.....                             | 38        |
| 7.4.3. AVERAGE POWER .....                            | 41        |
| 7.4.4. OUTPUT POWER .....                             | 42        |
| 7.4.5. POWER SPECTRAL DENSITY .....                   | 43        |
| 7.4.6. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS..... | 46        |
| 7.5. UAT 1 BLE 2M Pmax.....                           | 50        |
| 7.5.1. AVERAGE POWER .....                            | 50        |
| 7.5.2. OUTPUT POWER .....                             | 51        |
| 7.6. UAT 1 BLE 2M Plow .....                          | 52        |

|           |                                                |            |
|-----------|------------------------------------------------|------------|
| 7.6.1.    | AVERAGE POWER .....                            | 52         |
| 7.6.2.    | OUTPUT POWER .....                             | 53         |
| 7.7.      | LAT 3 BLE 1M P <sub>max</sub> .....            | 54         |
| 7.7.1.    | 6 dB BANDWIDTH.....                            | 54         |
| 7.7.2.    | 99% BANDWIDTH.....                             | 57         |
| 7.7.3.    | AVERAGE POWER .....                            | 60         |
| 7.7.4.    | OUTPUT POWER .....                             | 61         |
| 7.7.5.    | POWER SPECTRAL DENSITY .....                   | 62         |
| 7.7.6.    | CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS..... | 65         |
| 7.8.      | LAT 3 BLE 1M P <sub>low</sub> .....            | 69         |
| 7.8.1.    | 6 dB BANDWIDTH.....                            | 69         |
| 7.8.2.    | 99% BANDWIDTH.....                             | 72         |
| 7.8.3.    | AVERAGE POWER .....                            | 75         |
| 7.8.4.    | OUTPUT POWER .....                             | 76         |
| 7.8.5.    | POWER SPECTRAL DENSITY .....                   | 77         |
| 7.8.6.    | CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS..... | 80         |
| 7.9.      | LAT 3 BLE 2M P <sub>max</sub> .....            | 84         |
| 7.9.1.    | AVERAGE POWER .....                            | 84         |
| 7.9.2.    | OUTPUT POWER .....                             | 85         |
| 7.10.     | LAT 3 BLE 2M P <sub>low</sub> .....            | 86         |
| 7.10.1.   | AVERAGE POWER .....                            | 86         |
| 7.10.2.   | OUTPUT POWER.....                              | 87         |
| <b>8.</b> | <b>RADIATED TEST RESULTS.....</b>              | <b>88</b>  |
| 8.1.      | LIMITS AND PROCEDURE .....                     | 88         |
| 8.2.      | UAT 1 BLE 1M P <sub>max</sub> .....            | 89         |
| 8.2.1.    | RESTRICTED BANDEDGE (LOW CHANNEL).....         | 89         |
| 8.2.2.    | AUTHORIZED BANDEDGE (HIGH CHANNEL).....        | 91         |
| 8.2.3.    | HARMONICS AND SPURIOUS EMISSIONS .....         | 93         |
| 8.3.      | UAT 1 BLE 1M P <sub>low</sub> .....            | 99         |
| 8.3.1.    | RESTRICTED BANDEDGE (LOW CHANNEL).....         | 99         |
| 8.3.2.    | AUTHORIZED BANDEDGE (HIGH CHANNEL).....        | 101        |
| 8.3.3.    | HARMONICS AND SPURIOUS EMISSIONS .....         | 103        |
| 8.4.      | LAT 3 BLE 1M P <sub>max</sub> .....            | 109        |
| 8.4.1.    | RESTRICTED BANDEDGE (LOW CHANNEL).....         | 109        |
| 8.4.2.    | AUTHORIZED BANDEDGE (HIGH CHANNEL).....        | 111        |
| 8.4.3.    | HARMONICS AND SPURIOUS EMISSIONS .....         | 113        |
| 8.5.      | LAT 3 BLE 1M P <sub>low</sub> .....            | 119        |
| 8.5.1.    | RESTRICTED BANDEDGE (LOW CHANNEL).....         | 119        |
| 8.5.2.    | AUTHORIZED BANDEDGE (HIGH CHANNEL).....        | 121        |
| 8.5.3.    | HARMONICS AND SPURIOUS EMISSIONS .....         | 123        |
| 8.6.      | WORST-CASE BELOW 1 GHz.....                    | 129        |
| 8.7.      | WORST-CASE ABOVE 18 GHz .....                  | 131        |
| <b>9.</b> | <b>AC POWER LINE CONDUCTED EMISSIONS.....</b>  | <b>133</b> |
| 9.1.      | EUT POWER BY AC/DC ADAPTER VIA USB CABLE ..... | 134        |
| 9.2.      | EUT POWER BY HOST PC VIA USB CABLE .....       | 136        |

---

|                                  |            |
|----------------------------------|------------|
| <b>10.    SETUP PHOTOS .....</b> | <b>138</b> |
|----------------------------------|------------|

## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** APPLE, INC.  
1 INFINITE LOOP  
CUPERTINO, CA 95014, U.S.A.

**EUT DESCRIPTION:** SMARTPHONE

**MODEL:** A1902

**SERIAL NUMBER:** C39TX005J954

**DATE TESTED:** MAY 25, 2017 – JULY 27, 2017

| APPLICABLE STANDARDS            |              |
|---------------------------------|--------------|
| STANDARD                        | TEST RESULTS |
| CFR 47 Part 15 Subpart C        | Pass         |
| INDUSTRY CANADA RSS-247 Issue 2 | Pass         |
| INDUSTRY CANADA RSS-GEN Issue 4 | Pass         |

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. 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 any government.

Approved & Released For  
UL Verification Services Inc. By:

Prepared By:

CHIN PANG  
Senior Engineer  
UL VERIFICATION SERVICES INC.

HUNG THAI  
Test Engineer  
UL VERIFICATION SERVICES INC.

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, KDB 558074 D01 v04, ANSI C63.10-2013, RSS-GEN Issue 4, 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, 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                                        |
|-------------------------------------------------|-------------------------------------------------------------|
| <input type="checkbox"/> Chamber A (IC:2324B-1) | <input checked="" type="checkbox"/> Chamber D (IC: 22541-1) |
| <input type="checkbox"/> Chamber B (IC:2324B-2) | <input checked="" type="checkbox"/> Chamber E (IC: 22541-2) |
| <input type="checkbox"/> Chamber C (IC:2324B-3) | <input checked="" type="checkbox"/> Chamber F (IC: 22541-3) |
|                                                 | <input type="checkbox"/> Chamber G (IC: 22541-4)            |
|                                                 | <input type="checkbox"/> Chamber H (IC: 22541-5)            |

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

## 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

Where relevant, the following sample calculation is provided:

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

### 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     | 3.15 dB     |
| Worst Case Radiated Disturbance, 30 to 1000 MHz     | 5.36 dB     |
| Worst Case Radiated Disturbance, 1000 to 18000 MHz  | 4.32 dB     |
| Worst Case Radiated Disturbance, 18000 to 26000 MHz | 4.45 dB     |
| Worst Case Radiated Disturbance, 26000 to 40000 MHz | 5.24 dB     |
| Occupied Channel Bandwidth                          | ±0.39 %     |

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The equipment under Test is a mobile phone with GSM, GPRS, EGPRS, UMTS, LTE and TD-SCDMA technologies. It also supports IEEE 802.11a/b/g/n/ac, Bluetooth®, GPS and NFC. The device has a built-in inductive charging receiver which is not user accessible. The rechargeable battery is not user accessible.

### 5.2. MAXIMUM OUTPUT POWER

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

| Antenna | Configuration | Frequency Range (MHz) | Mode   | Output Power (dBm) | Output Power (mW) |
|---------|---------------|-----------------------|--------|--------------------|-------------------|
| UAT 1   | Pmax          | 2402 - 2480           | BLE 1M | 20.26              | 106.17            |
|         | Plow          |                       |        | 10.18              | 10.42             |
|         | Pmax          |                       | BLE 2M | 20.13              | 103.04            |
|         | Plow          |                       |        | 10.14              | 10.33             |
| LAT 3   | Pmax          | 2402 - 2480           | BLE 1M | 20.25              | 105.93            |
|         | Plow          |                       |        | 10.17              | 10.40             |
|         | Pmax          |                       | BLE 2M | 20.20              | 104.71            |
|         | Plow          |                       |        | 10.08              | 10.19             |

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

| Frequency Band (GHz) | Antenna Gain (dBi) |       |
|----------------------|--------------------|-------|
| 2.4                  | UAT 1              | LAT 3 |
|                      | -2.37              | -5.49 |

### 5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was version 15.1.40.176.

## 5.5. WORST-CASE CONFIGURATION AND MODE

Radiated band edge, harmonic, and spurious emissions from 1GHz to 18GHz were performed with the EUT set to transmit at highest power on Low/Middle/High channels.

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

The fundamental of the EUT was investigated in three orthogonal orientations, X (Flatbed), Y (Landscape), and Z (Portrait), on both UAT 1 and LAT 3 antennas. In addition, the EUT was also investigated with and without AC/DC charger, headphones & laptop, it was determined that Y (Landscape) orientation was the worst-case orientation on both UAT 1 and LAT 3 without AC/DC charger, headphones & laptop. Therefore, all final radiated testing was performed with the EUT only in Y-orientation for 1 - 18GHz and 18 – 26GHz. And for 30-1000MHz EUT was tested with AC/DC charger.

Worst-case data rate as provided by the client and baseline scan was:

BLE: 1Mbps

BLE 1M mode has been verified to have the highest power.

There are two vendors of the WiFi/Bluetooth radio modules: variant 1 and variant 2. The Wi-Fi/Bluetooth radio modules have the same mechanical outline (e.g., the same package dimension and pin-out layout), use the same on-board antenna matching circuit, have an identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances.

Baseline testing was performed on the two variants to determine the worst case on all conducted power and radiated emissions.

For simultaneous transmission of multiple channels from the same antenna LAT 3 in the 2.4GHz BT and 5GHz bands, tests were conducted for various configurations having the highest power. No noticeable new emission was found.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| Support Equipment List |              |           |               |        |
|------------------------|--------------|-----------|---------------|--------|
| Description            | Manufacturer | Model     | Serial Number | FCC ID |
| Laptop AC/DC adapter   | Apple        | A1344     | T1580         | NA     |
| Laptop                 | Apple        | A1278     | C02HJ0A7DTY4  | NA     |
| DC power supply        | Lambda       | GEN 60-25 | SCPV56329     | NA     |

### I/O CABLES (CONDUCTED TEST)

| I/O Cable List |               |                      |                |             |                  |                        |
|----------------|---------------|----------------------|----------------|-------------|------------------|------------------------|
| Cable No       | Port          | # of identical ports | Connector Type | Cable Type  | Cable Length (m) | Remarks                |
| 1              | Antenna       | 1                    | SMA            | Shielded    | 1                | N/A                    |
| 2              | USB           | 1                    | USB            | Shielded    | 1                | Laptop to EUT          |
| 3              | AC            | 1                    | AC             | Un-shielded | 3                | N/A                    |
| 4              | Aligator clip | 1                    | minigrabber    | Un-Shielded | 1                | DC power supply to EUT |

### I/O CABLES (RADIATED ABOVE 1 GHZ)

| I/O Cable List |      |                      |                |            |                  |         |
|----------------|------|----------------------|----------------|------------|------------------|---------|
| Cable No       | Port | # of identical ports | Connector Type | Cable Type | Cable Length (m) | Remarks |
| NA             |      |                      |                |            |                  |         |

### I/O CABLES (AC POWER CONDUCTED TEST AND BELOW 1 GHZ)

| I/O Cable List |      |                      |                |             |                  |         |
|----------------|------|----------------------|----------------|-------------|------------------|---------|
| Cable No       | Port | # of identical ports | Connector Type | Cable Type  | Cable Length (m) | Remarks |
| 1              | AC   | 1                    | AC             | Un-shielded | 3                | N/A     |

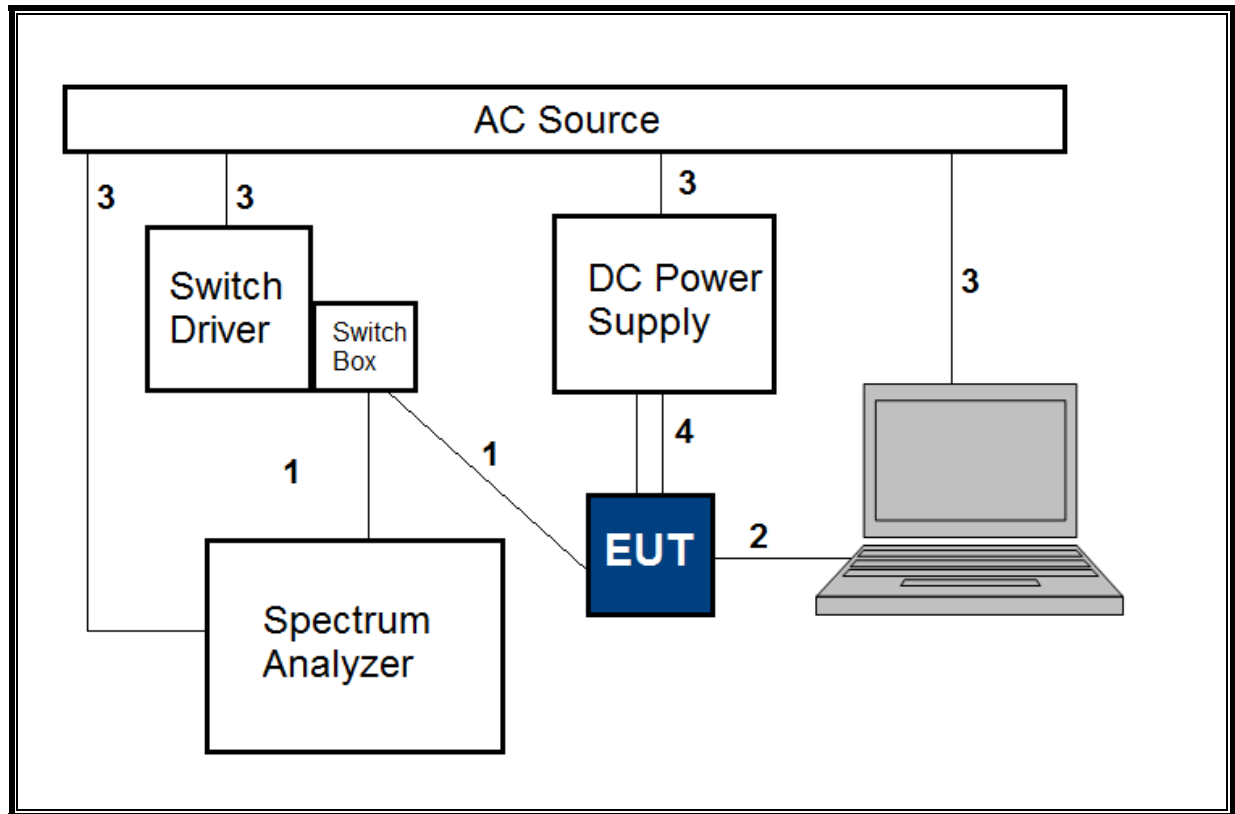
### I/O CABLES (AC LINE CONDUCTED: LAPTOP CONFIGUARTION)

| I/O Cable List |      |                |                |             |                  |         |
|----------------|------|----------------|----------------|-------------|------------------|---------|
| Cable No       | Port | # of identical | Connector Type | Cable Type  | Cable Length (m) | Remarks |
| 1              | AC   | 1              | AC             | Un-shielded | 3                | N/A     |
| 2              | USB  | 1              | USB            | Shielded    | 1                | N/A     |

## TEST SETUP

The EUT was tested connected to a host Laptop via USB cable adapter and SMA cable connected to antenna port. Test software exercised the EUT.

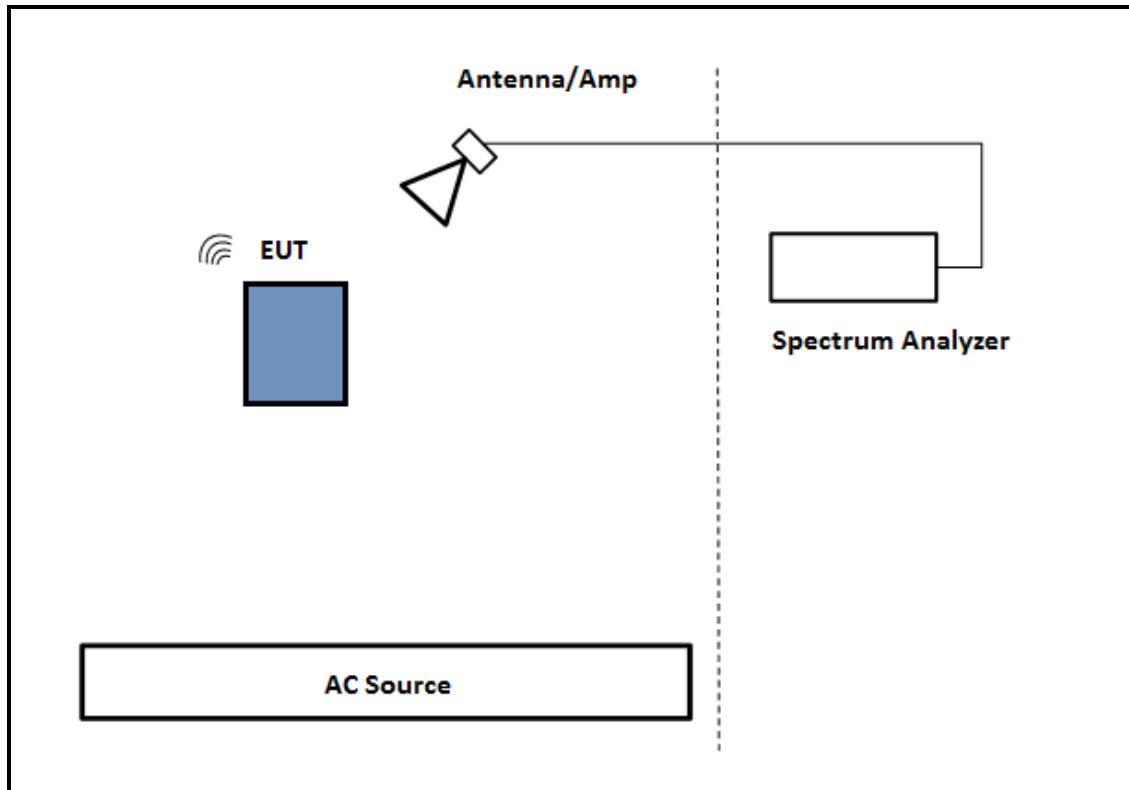
## SETUP DIAGRAM



### **TEST SETUP- RADIATED-ABOVE 1 GHZ**

The EUT was powered by battery. Test software exercised the EUT.

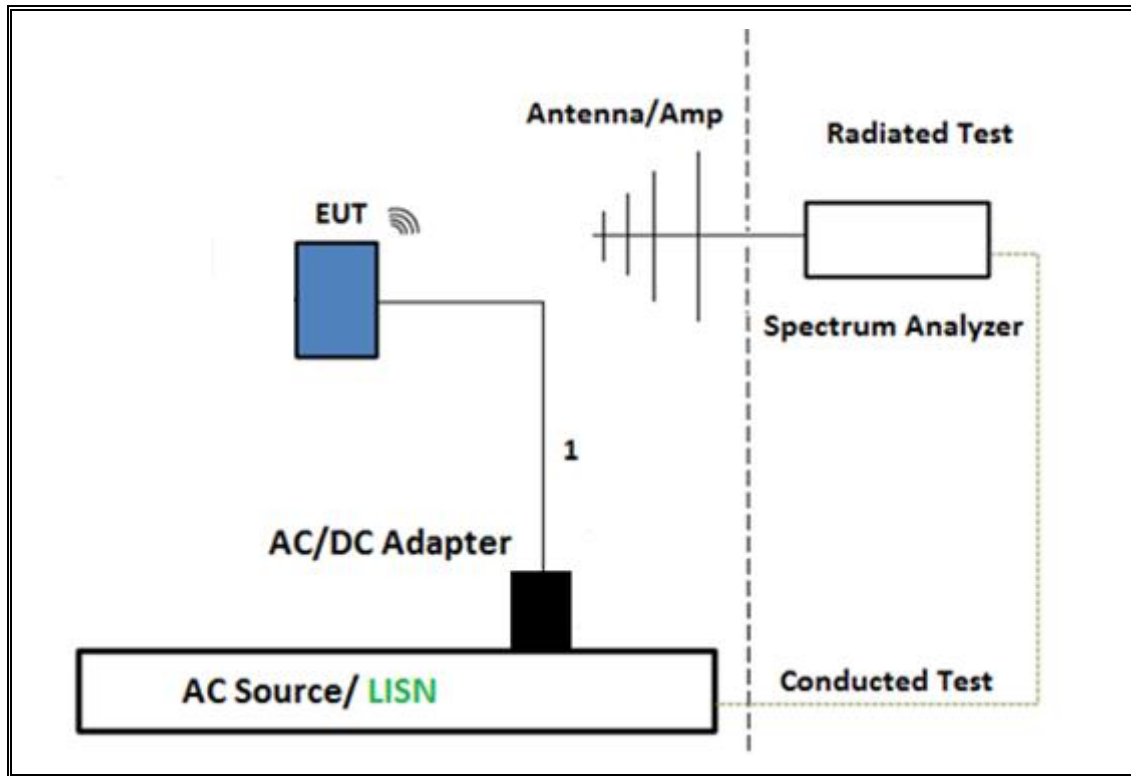
### **SETUP DIAGRAM**



### TEST SETUP- BELOW 1GHZ & AC LINE CONDUCTED TESTS

The EUT was powered by AC/DC adapter. Test software exercised the EUT.

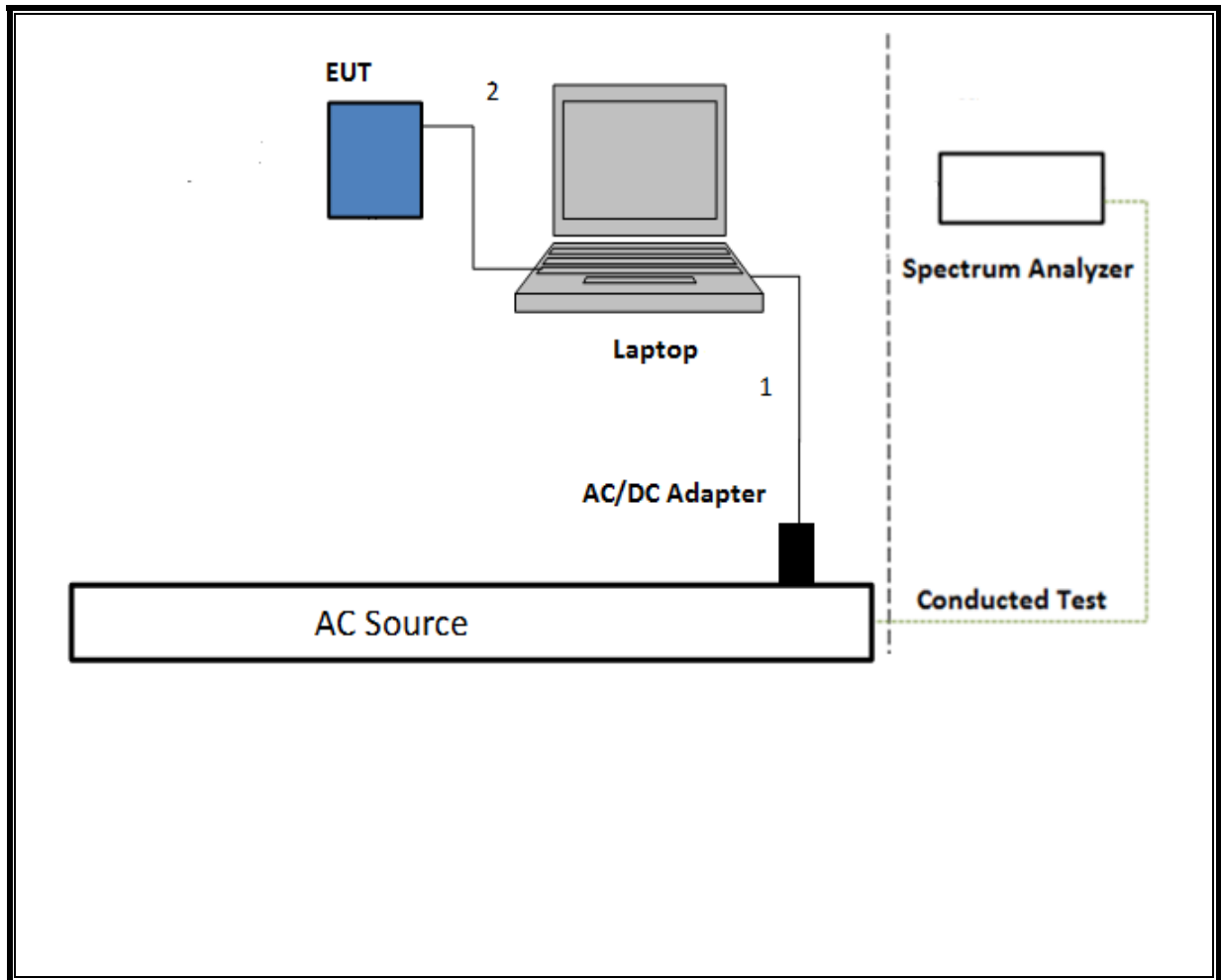
### SETUP DIAGRAM



**TEST SETUP- AC LINE CONDUCTED TEST (LAPTOP CONFIGURATION)**

The EUT was tested connected to a host Laptop via USB cable. Test software exercised the EUT.

**SETUP DIAGRAM**



## 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                  | Asset                     | Cal Due    |
| Antenna, Horn 1-18GHz                       | ETS Lindgren                    | 3117                   | T119                      | 3/28/2018  |
| Antenna, Broadband Hybrid, 30MHz to 2000MHz | Sunol Sciences                  | JB1                    | T243                      | 10/11/2017 |
| Amplifier, 1 to 18GHz                       | Miteq                           | AFS42-00101800-25-S-42 | T741                      | 11/29/2017 |
| *Amplifier, 10KHz to 1GHz, 32dB             | Sonoma                          | 310N                   | T285                      | 6/20/2017  |
| Spectrum Analyzer, PXA 3Hz to 44GHz         | Keysight                        | N9030A                 | T1113                     | 12/20/2017 |
| *Power Meter, P-series single channel       | Keysight                        | N1912A                 | T1273                     | 07/08/2017 |
| Power Sensor                                | Keysight                        | N1921A                 | T750                      | 10/1/2017  |
| *Antenna Horn, 18 to 26GHz                  | ARA                             | MWH-1826               | T447                      | 6/16/2017  |
| Spectrum Analyzer, 40GHz                    | Agilent                         | 8564E                  | T106                      | 9/7/2017   |
| *Spectrum Analyzer, PXA, 3Hz to 44GHz       | Agilent (Keysight) Technologies | N9030A                 | T459                      | 06/13/2017 |
| *Pre-Amp 18-26GHz                           | Agilent Technology              | 8449B                  | T404                      | 7/5/2017   |
| AC Line Conducted                           |                                 |                        |                           |            |
| EMI Test Receiver 9KHz-7GHz                 | Rohde & Schwarz                 | ESCI7                  | T1436                     | 1/6/2018   |
| *LISN for Conducted Emissions CISPR-16      | Fischer                         | 50/250-25-2-01         | T1310                     | 06/08/2017 |
| Power Cable, Line Conducted Emissions       | UL                              | PG1                    | T861                      | 9/1/2017   |
| UL AUTOMATION SOFTWARE                      |                                 |                        |                           |            |
| Radiated Software                           | UL                              | UL EMC                 | Ver 9.5, April 26, 2016   |            |
| Conducted Software                          | UL                              | UL EMC                 | Ver 5.4, October 13, 2016 |            |
| AC Line Conducted Software                  | UL                              | UL EMC                 | Ver 9.5, May 26, 2015     |            |

NOTE: \*testing is completed before equipment calibration expiration date.

## 7. ANTENNA PORT TEST RESULTS

### 7.1. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01 v04, Section 8.1.

Output Power: KDB 558074 D01 v04, Section 9.1.3.

Power Spectral Density: KDB 558074 D01 v04, Section 10.2.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v04, Section 11.0.

Out-of-band emissions in restricted bands: KDB 558074 D01 v04, Section 12.1.

Band-edge: KDB 558074 D01 v04, Section 12.1.

Conducted line emissions: C63.10, Clause 6.2

## 7.2. ON TIME, DUTY CYCLE

### LIMITS

None; for reporting purposes only.

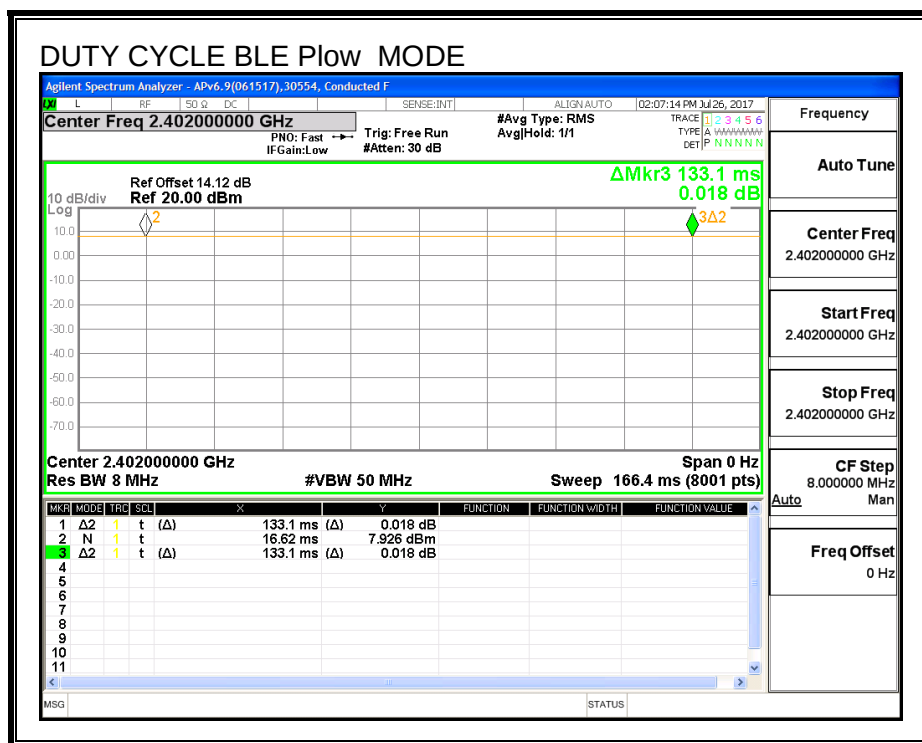
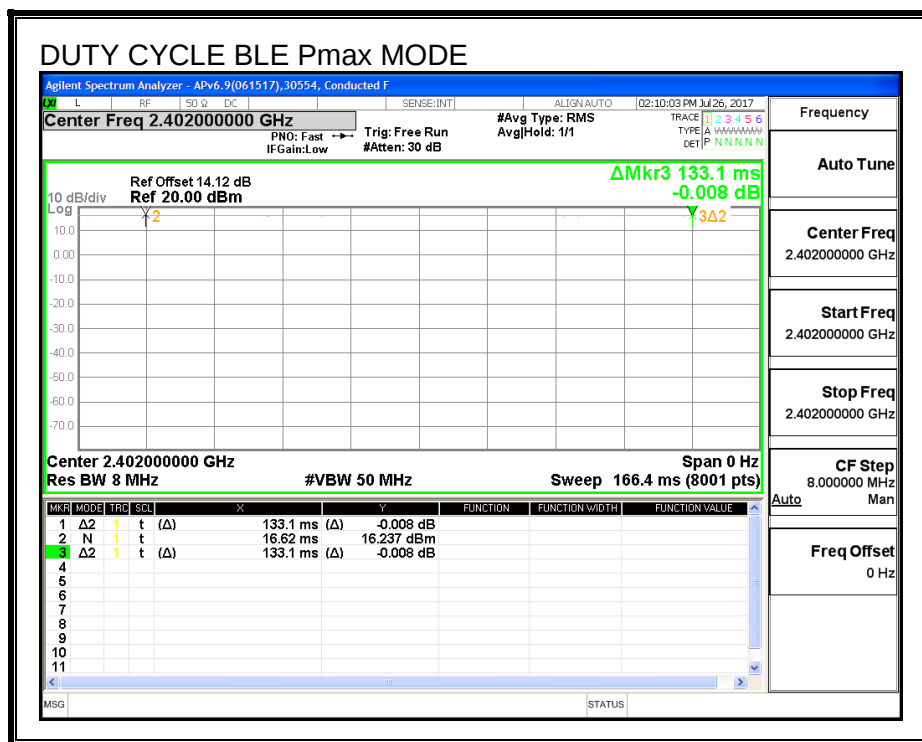
### PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

### ON TIME AND DUTY CYCLE RESULTS

| Mode     | ON Time<br>B (msec) | Period<br>(msec) | Duty<br>Cycle x<br>(linear) | Duty<br>Cycle<br>(%) | Duty Cycle<br>Correction<br>Factor (dB) | 1/B<br>Minimum<br>VBW (khz) |
|----------|---------------------|------------------|-----------------------------|----------------------|-----------------------------------------|-----------------------------|
| BLE Pmax | 133.1               | 133.1            | 1.000                       | 100%                 | 0.00                                    | 0.010                       |
| BLE Plow | 133.1               | 133.1            | 1.000                       | 100%                 | 0.00                                    | 0.010                       |

## DUTY CYCLE PLOTS



## **7.3. UAT 1 BLE 1M Pmax**

### **7.3.1. 6 dB BANDWIDTH**

#### **LIMITS**

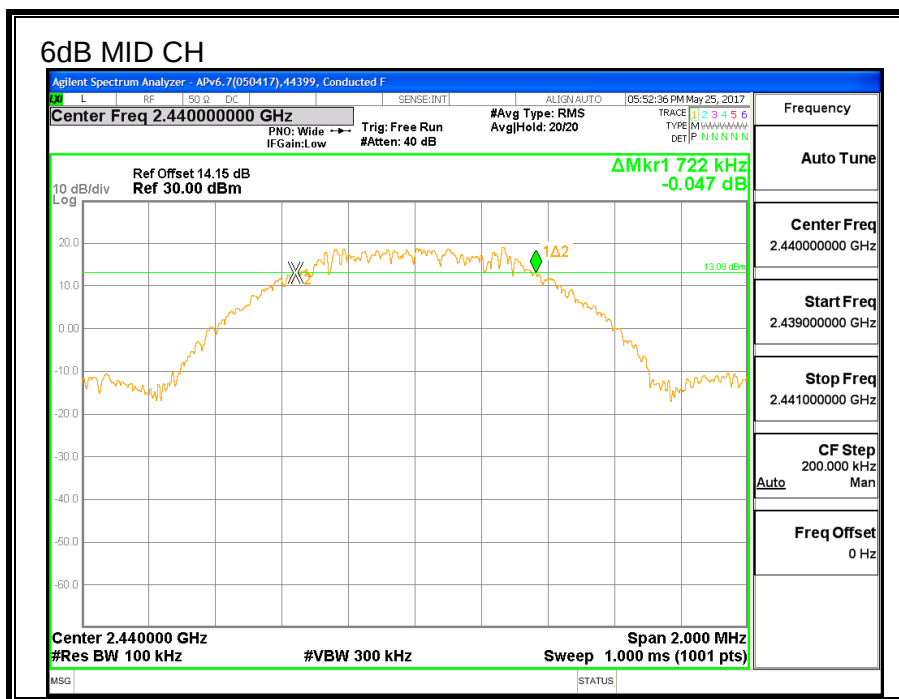
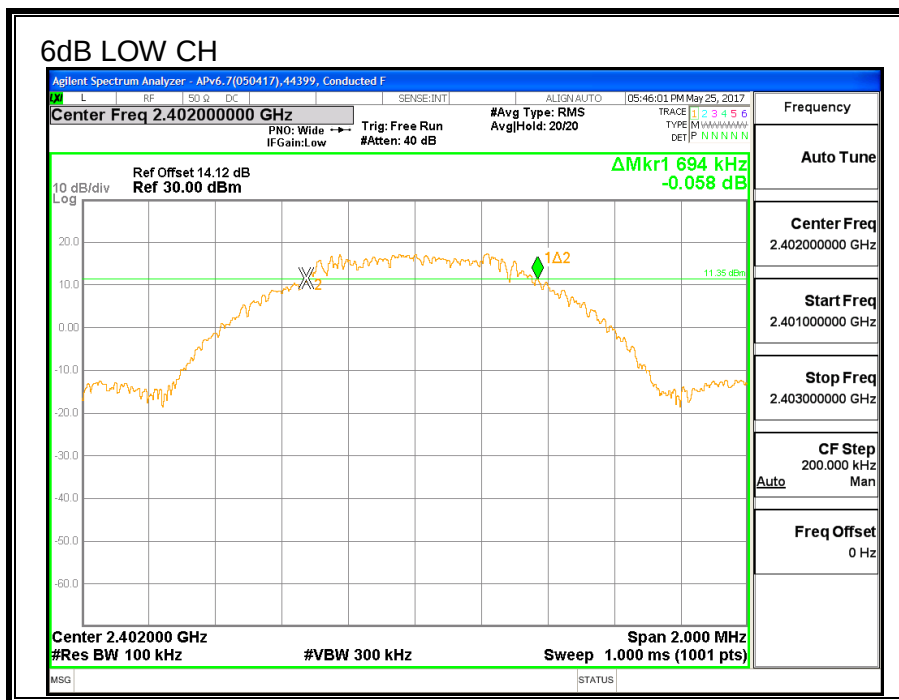
FCC §15.247 (a) (2)

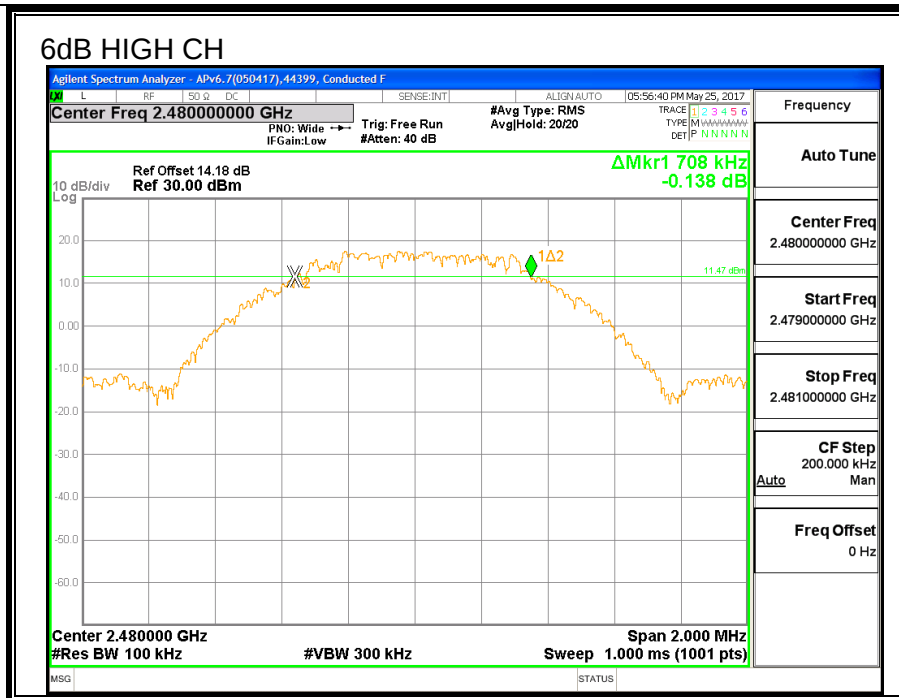
IC RSS-247 (5.2) (a)

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

#### **RESULTS**

| <b>Channel</b> | <b>Frequency</b> | <b>6 dB Bandwidth (MHz)</b> | <b>Minimum Limit (MHz)</b> |
|----------------|------------------|-----------------------------|----------------------------|
| Low            | 2402             | 0.694                       | 0.5                        |
| Middle         | 2440             | 0.722                       | 0.5                        |
| High           | 2480             | 0.708                       | 0.5                        |





### 7.3.2. 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

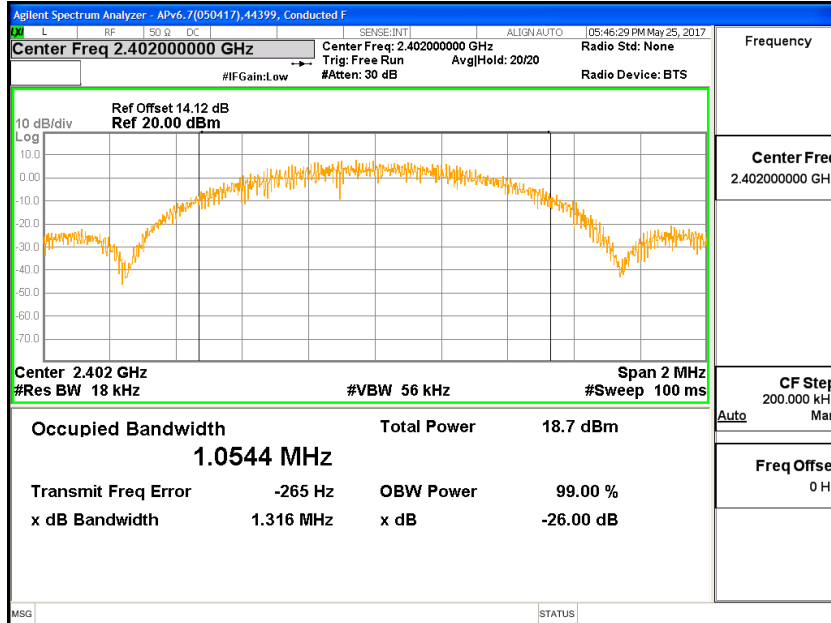
#### Test Procedure

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

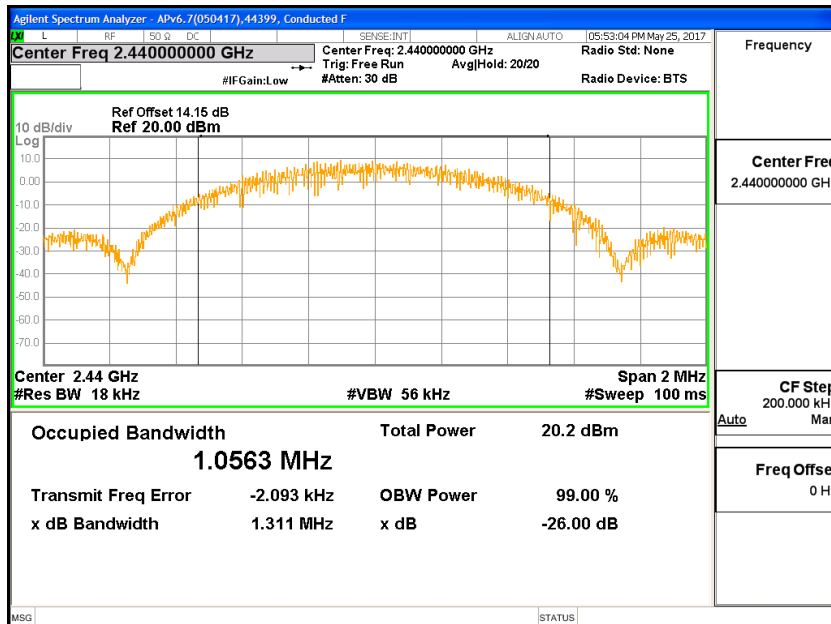
#### RESULTS

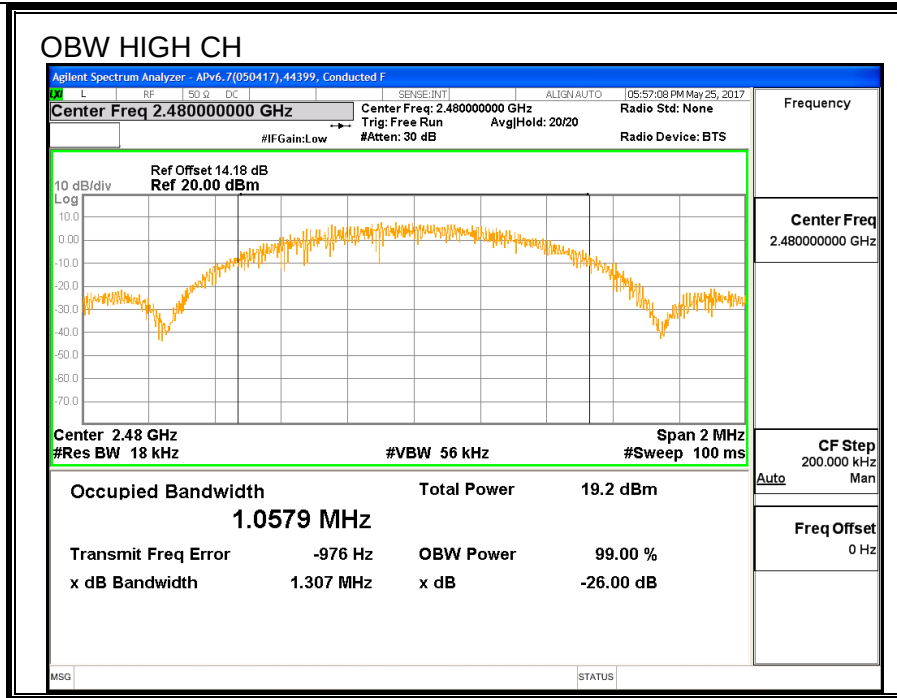
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low     | 2402               | 1.054                  |
| Middle  | 2440               | 1.056                  |
| High    | 2480               | 1.058                  |

### OBW LOW CH



### OBW MID CH





### 7.3.3. AVERAGE POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 30606 | <b>Date:</b> | 7/27/2017 |
|------------|-------|--------------|-----------|

#### LIMITS

None; for reporting purposes only.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

| <b>Channel</b> | <b>Frequency (MHz)</b> | <b>AV Power (dBm)</b> |
|----------------|------------------------|-----------------------|
| Low            | 2402                   | 19.45                 |
| Middle         | 2440                   | 19.92                 |
| High           | 2480                   | 19.77                 |

### 7.3.4. OUTPUT POWER

#### LIMITS

FCC §15.247 (b)

IC RSS-247 (5.4) (d)

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

#### RESULTS

| Channel | Frequency (MHz) | Peak Power Reading (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|--------------------------|-------------|-------------|
| Low     | 2402            | 19.78                    | 30          | -10.22      |
| Middle  | 2440            | 20.26                    | 30          | -9.74       |
| High    | 2480            | 20.09                    | 30          | -9.91       |

### 7.3.5. POWER SPECTRAL DENSITY

#### LIMITS

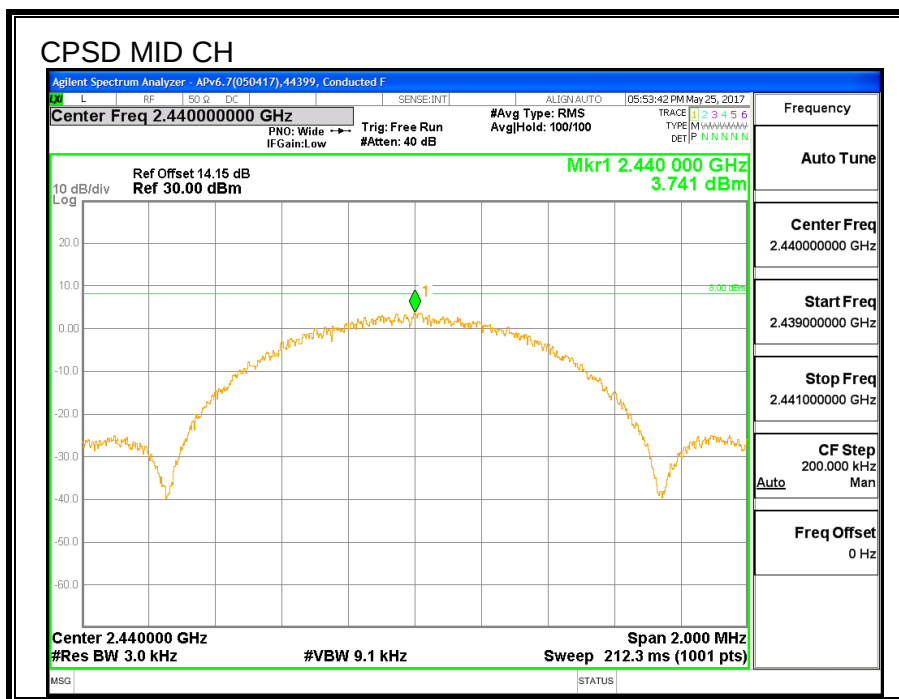
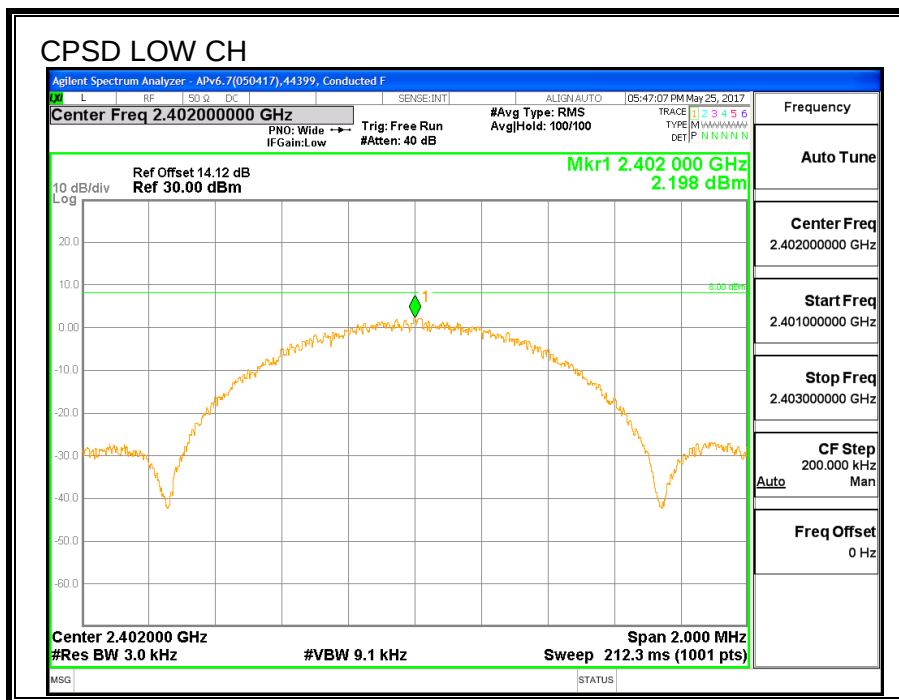
FCC §15.247 (e)

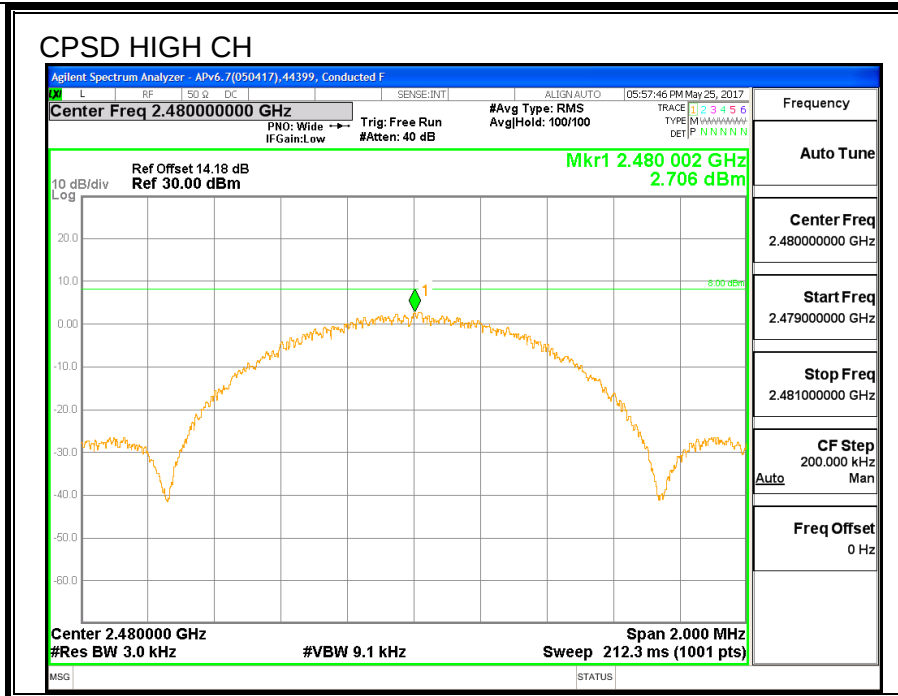
IC RSS-247 (5.2) (b)

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

| Channel | Frequency (MHz) | PSD (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|-----------|-------------|-------------|
| Low     | 2402            | 2.2       | 8           | -5.80       |
| Middle  | 2440            | 3.74      | 8           | -4.26       |
| High    | 2480            | 2.71      | 8           | -5.29       |





### 7.3.6. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

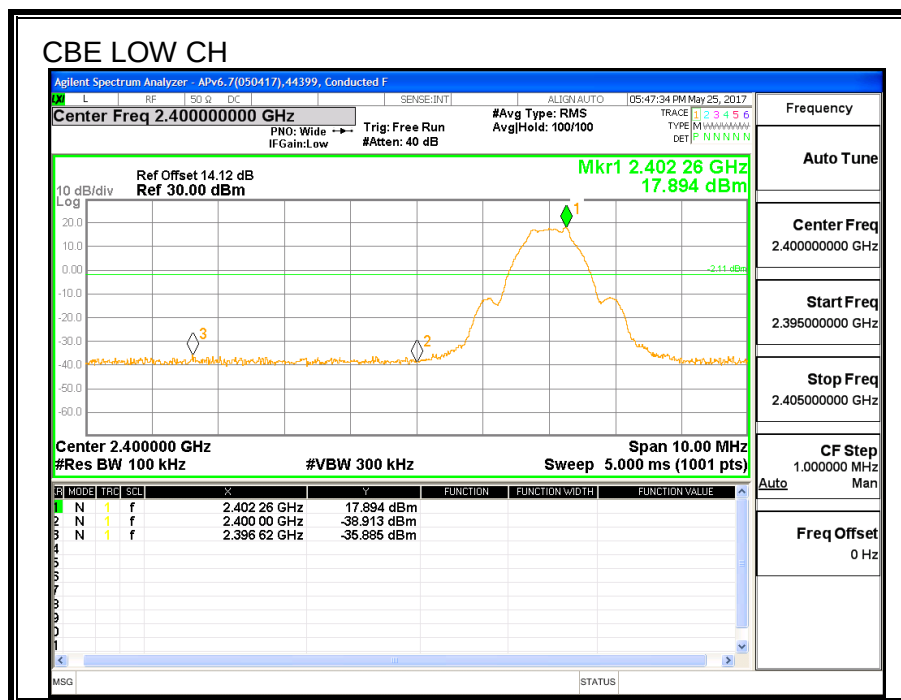
#### LIMITS

FCC §15.247 (d)

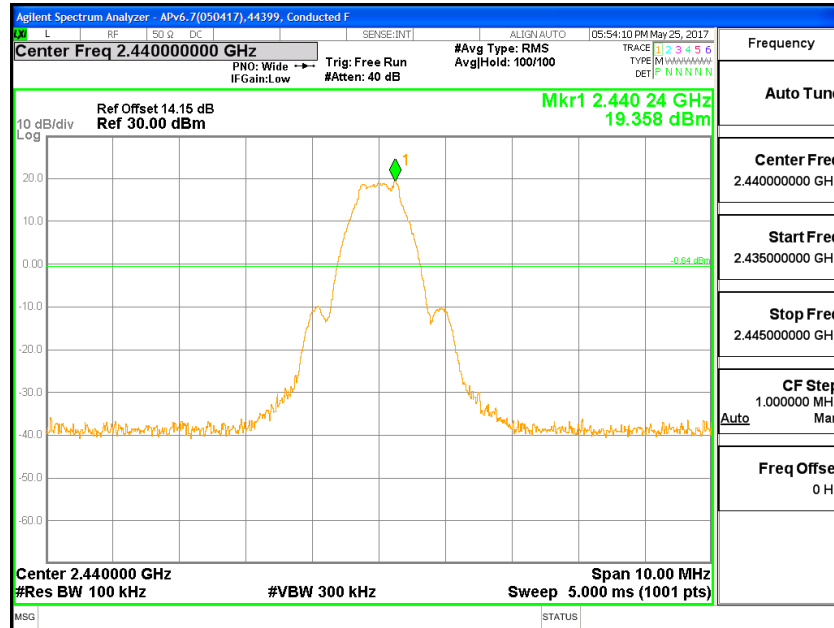
IC RSS-247 (5.5)

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

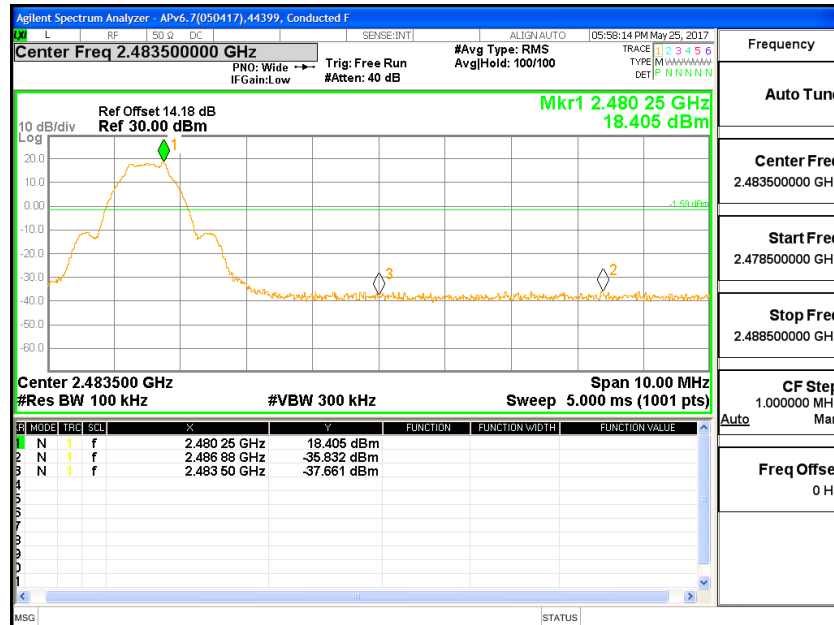
#### RESULTS



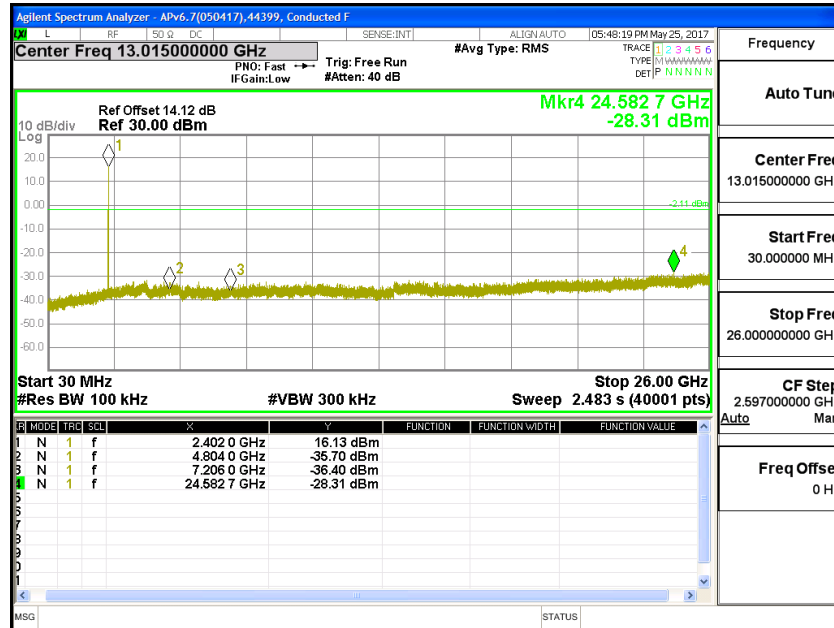
### CBE MID CH



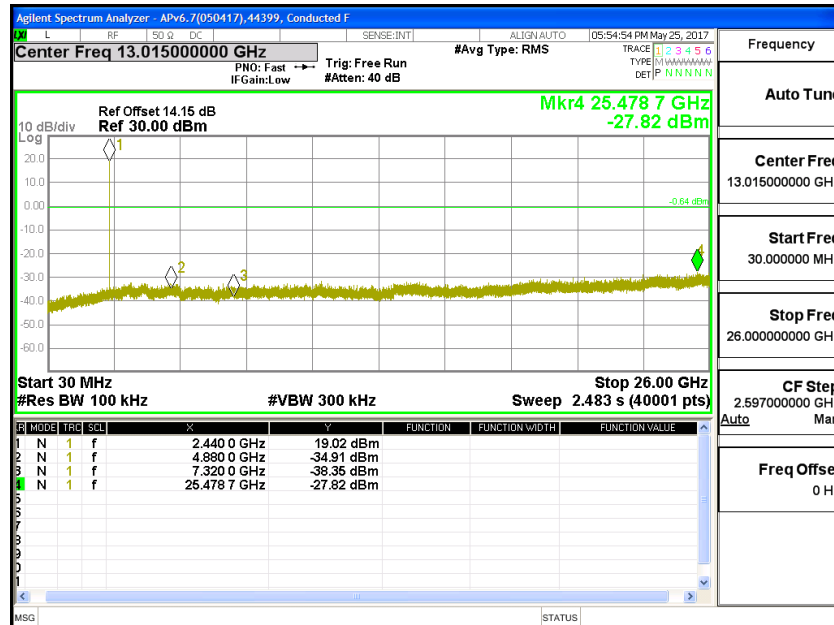
### CBE HIGH CH

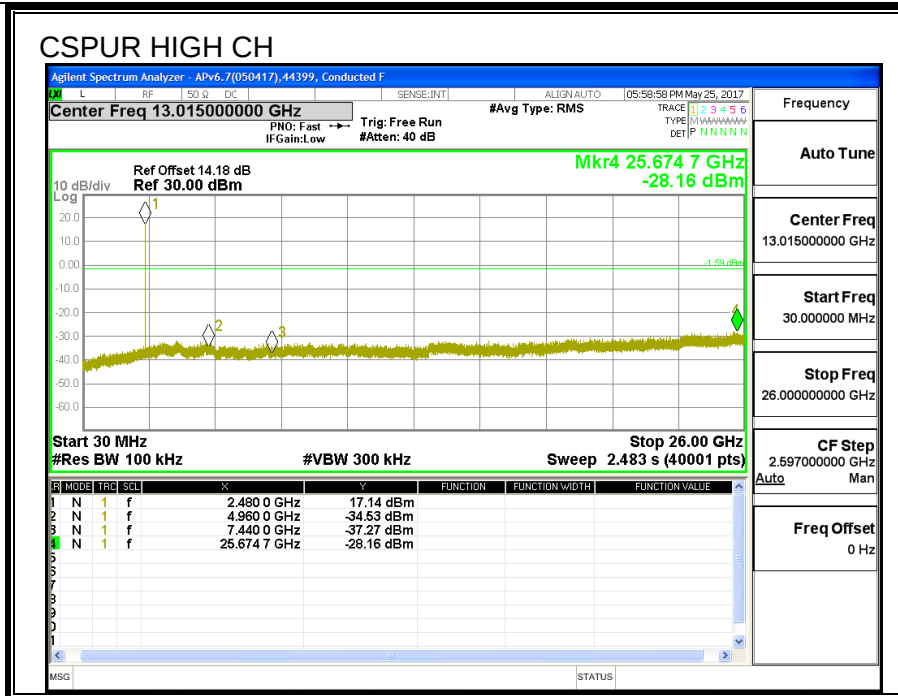


### CSPUR LOW CH



### CSPUR MID CH





## **7.4. UAT 1 BLE 1M Plow**

### **7.4.1. 6 dB BANDWIDTH**

#### **LIMITS**

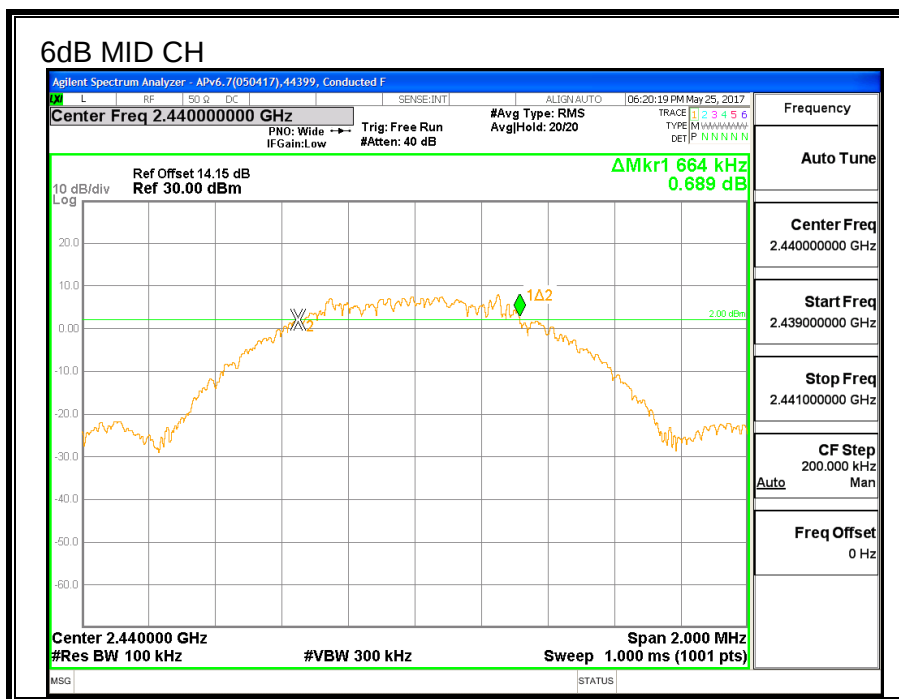
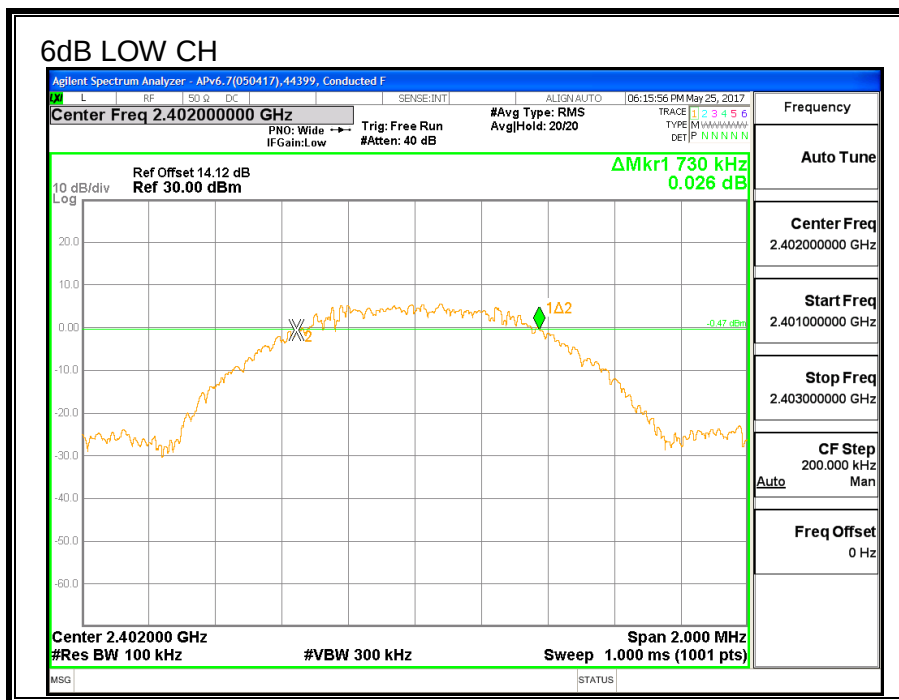
FCC §15.247 (a) (2)

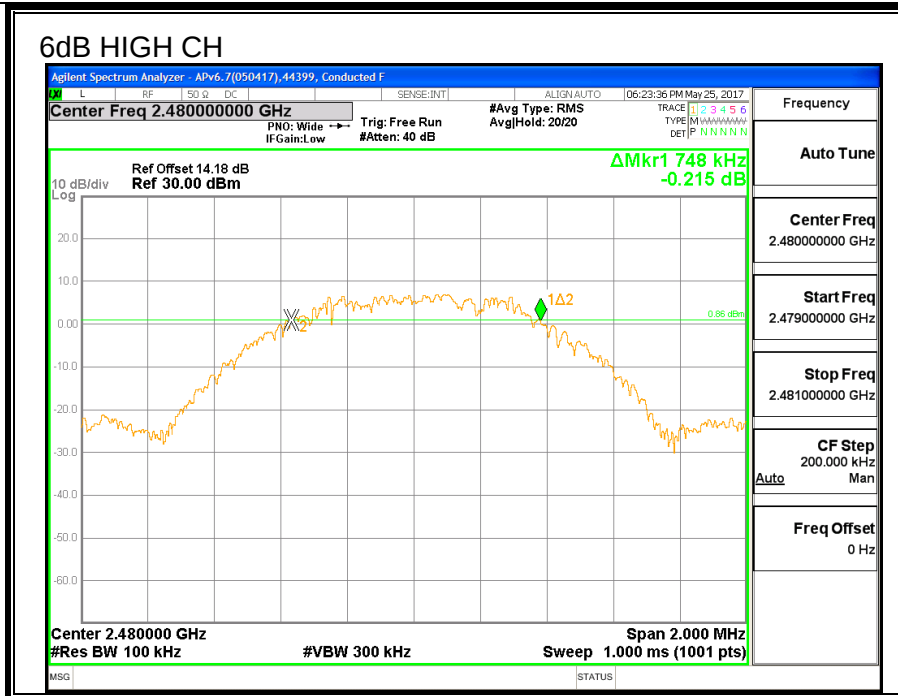
IC RSS-247 (5.2) (a)

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

#### **RESULTS**

| <b>Channel</b> | <b>Frequency</b> | <b>6 dB Bandwidth (MHz)</b> | <b>Minimum Limit (MHz)</b> |
|----------------|------------------|-----------------------------|----------------------------|
| Low            | 2402             | 0.73                        | 0.5                        |
| Middle         | 2440             | 0.664                       | 0.5                        |
| High           | 2480             | 0.748                       | 0.5                        |





### **7.4.2. 99% BANDWIDTH**

#### **LIMITS**

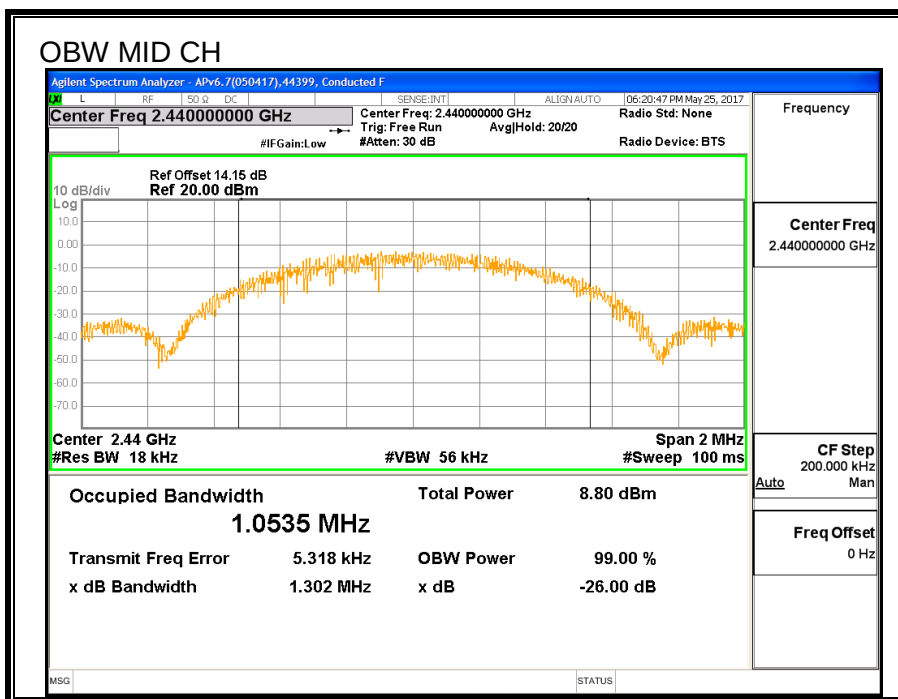
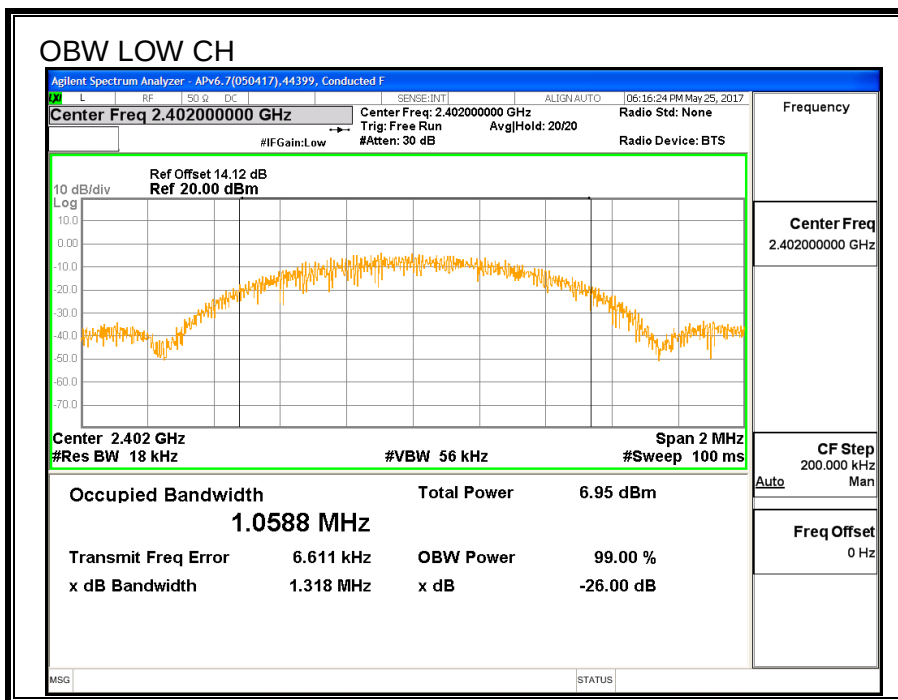
None; for reporting purposes only.

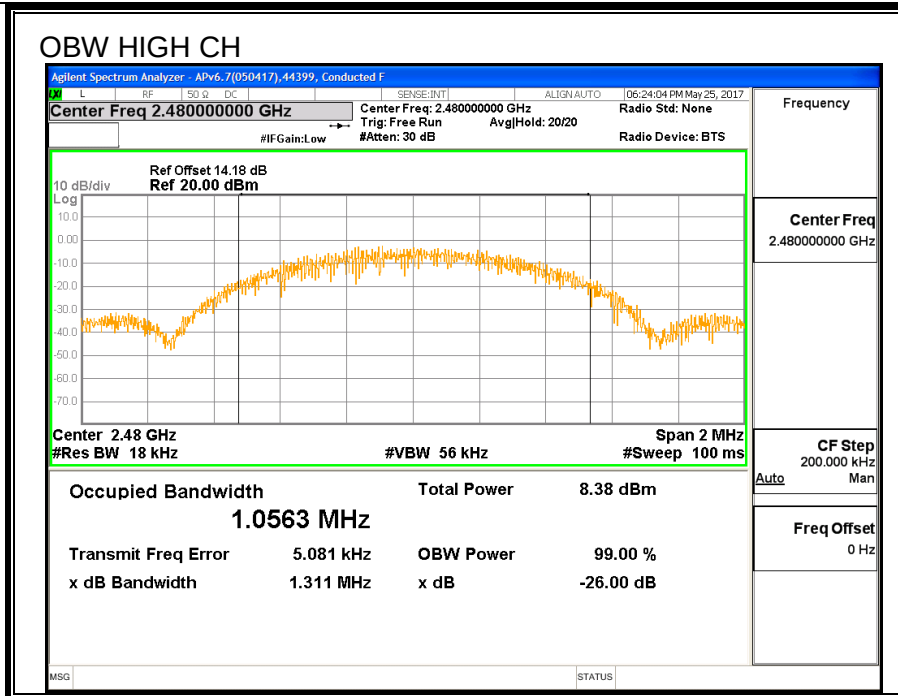
#### **Test Procedure**

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

#### **RESULTS**

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>99% Bandwidth<br/>(MHz)</b> |
|----------------|----------------------------|--------------------------------|
| Low            | 2402                       | 1.059                          |
| Middle         | 2440                       | 1.054                          |
| High           | 2480                       | 1.056                          |





### 7.4.3. AVERAGE POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 30606 | <b>Date:</b> | 7/27/2017 |
|------------|-------|--------------|-----------|

#### LIMITS

None; for reporting purposes only.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

| Channel | Frequency (MHz) | AV Power (dBm) |
|---------|-----------------|----------------|
| Low     | 2402            | 9.21           |
| Middle  | 2440            | 9.84           |
| High    | 2480            | 9.80           |

#### 7.4.4. OUTPUT POWER

##### LIMITS

FCC §15.247 (b)

IC RSS-247 (5.4) (d)

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

##### RESULTS

| Channel | Frequency (MHz) | Peak Power Reading (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|--------------------------|-------------|-------------|
| Low     | 2402            | 9.54                     | 30          | -20.46      |
| Middle  | 2440            | 10.18                    | 30          | -19.82      |
| High    | 2480            | 10.12                    | 30          | -19.88      |

## 7.4.5. POWER SPECTRAL DENSITY

### LIMITS

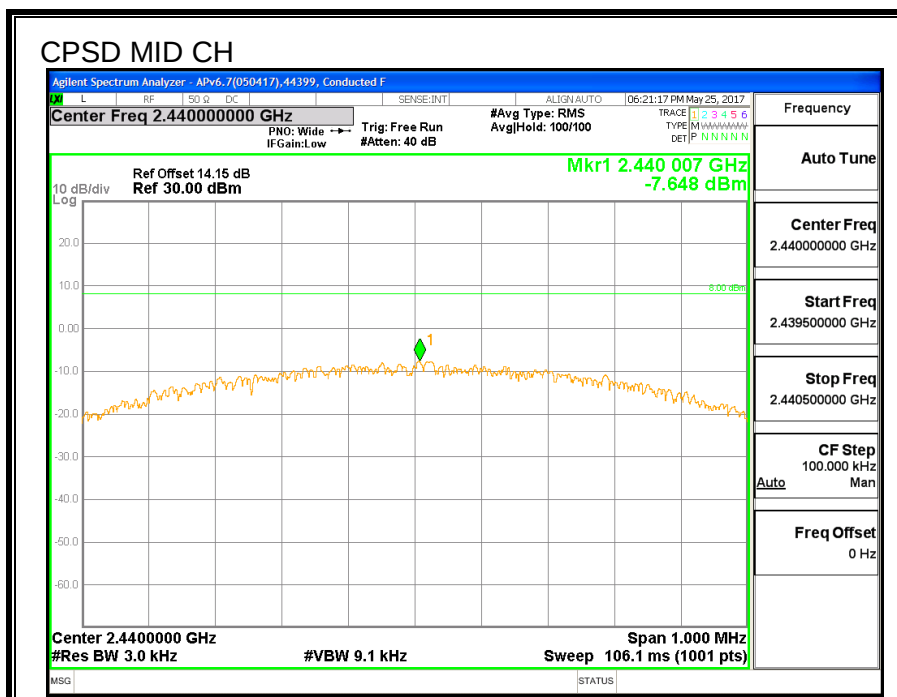
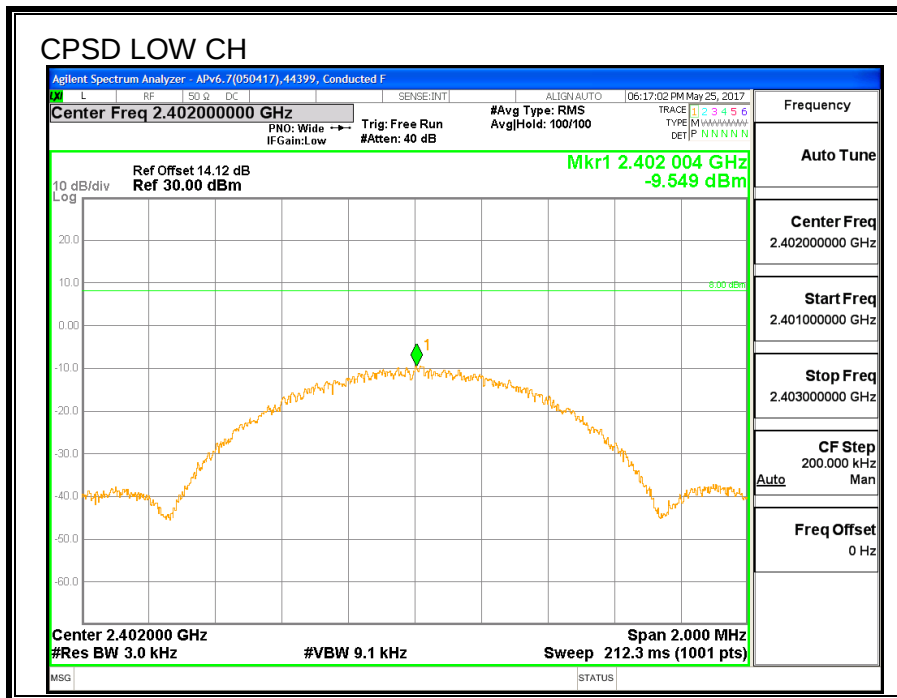
FCC §15.247 (e)

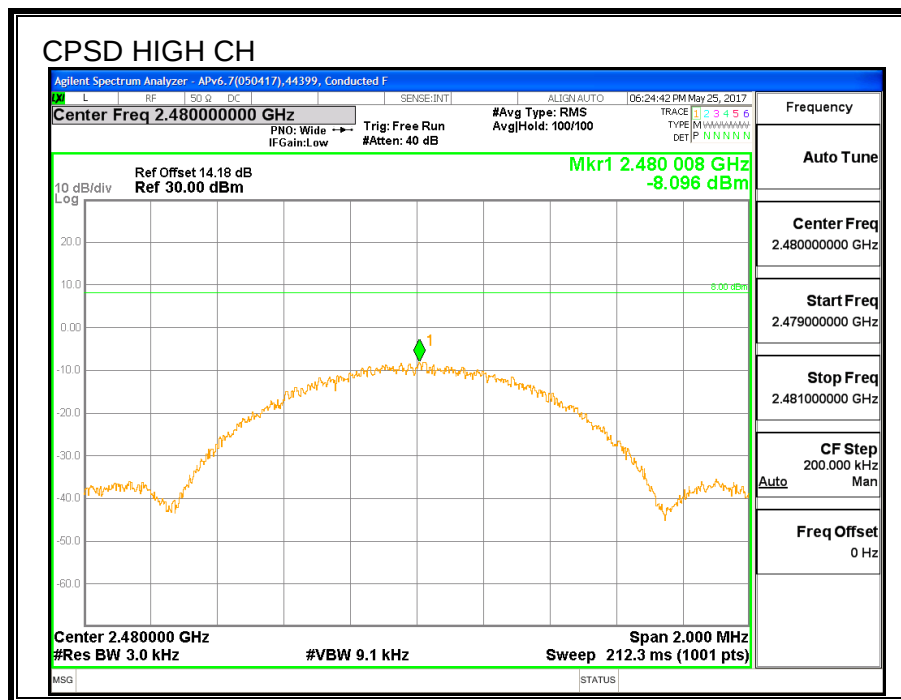
IC RSS-247 (5.2) (b)

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

| Channel | Frequency (MHz) | PSD (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|-----------|-------------|-------------|
| Low     | 2402            | -9.549    | 8           | -17.549     |
| Middle  | 2440            | -7.648    | 8           | -15.648     |
| High    | 2480            | -8.096    | 8           | -16.096     |





## 7.4.6. CONDUCTED BANEDGE AND SPURIOUS EMISSIONS

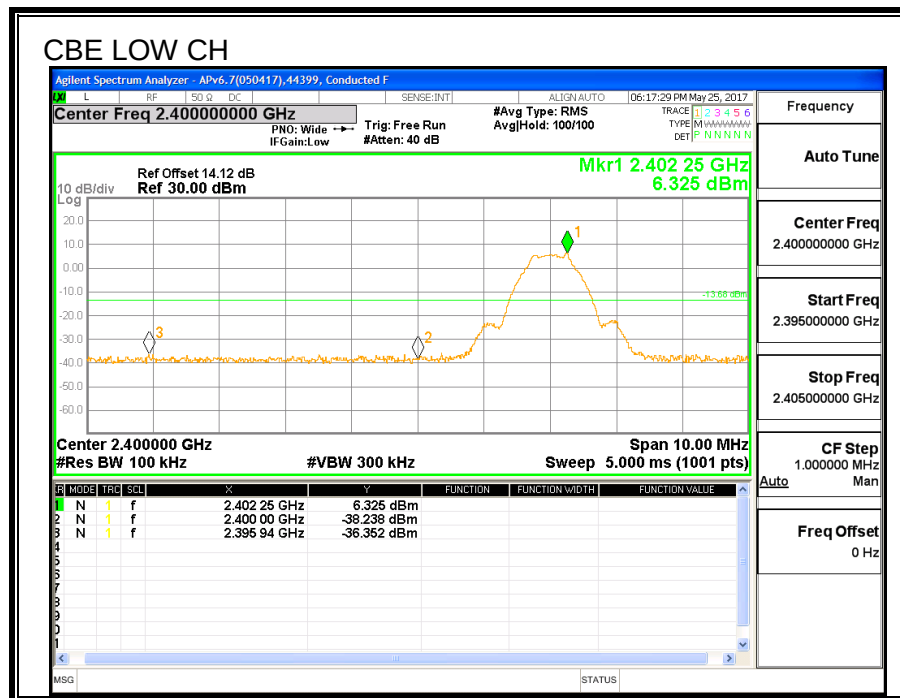
### LIMITS

FCC §15.247 (d)

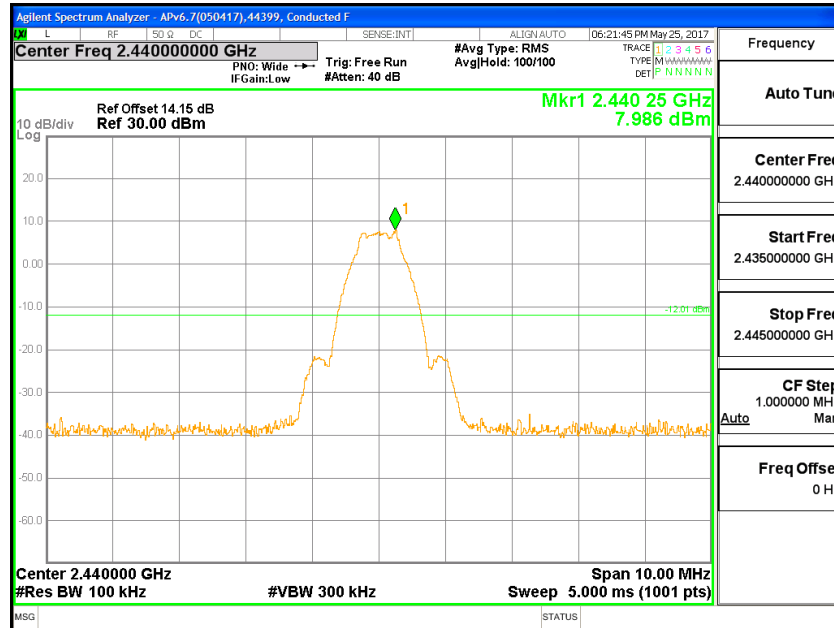
IC RSS-247 (5.5)

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

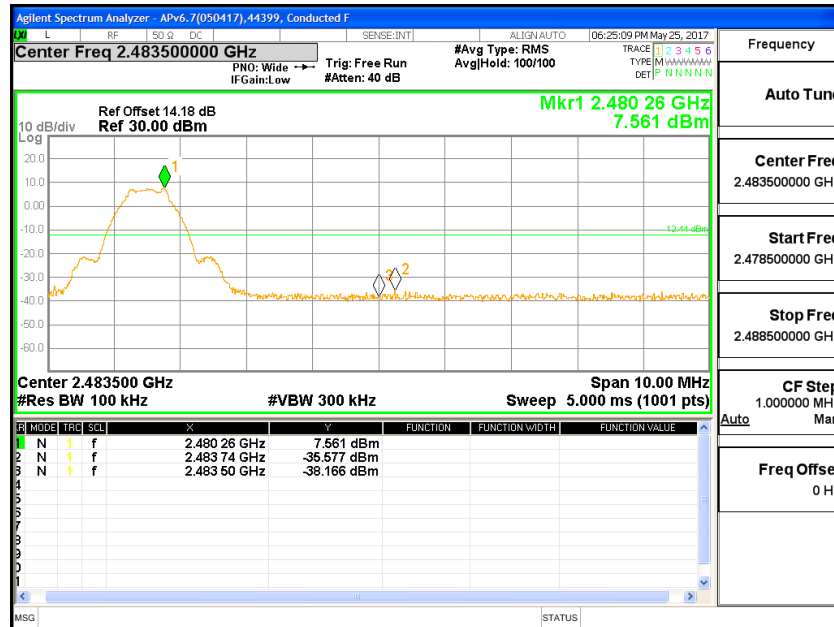
### RESULTS



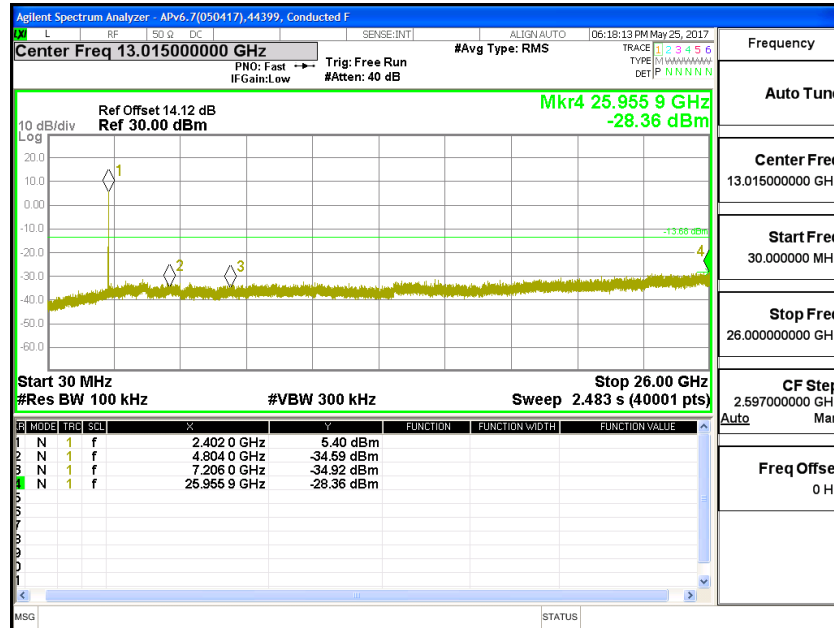
### CBE MID CH



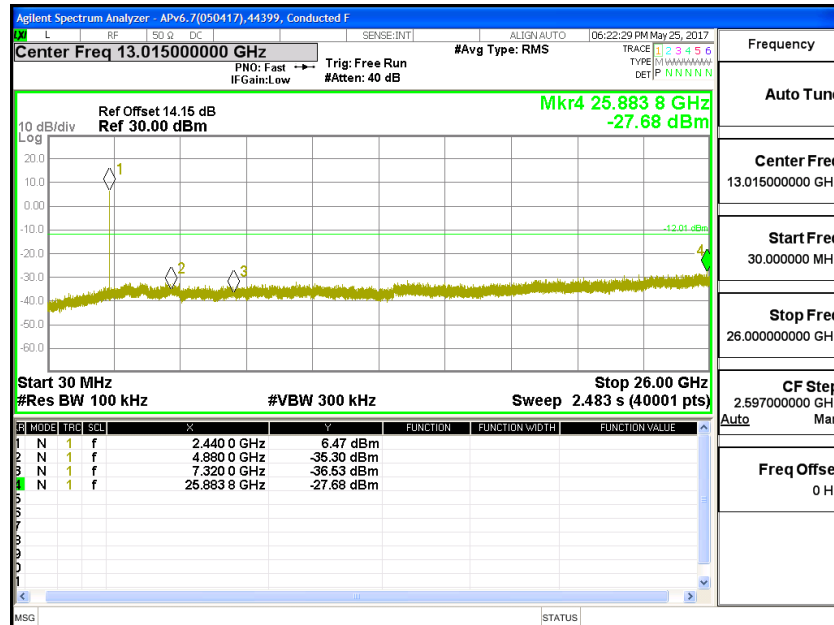
### CBE HIGH CH

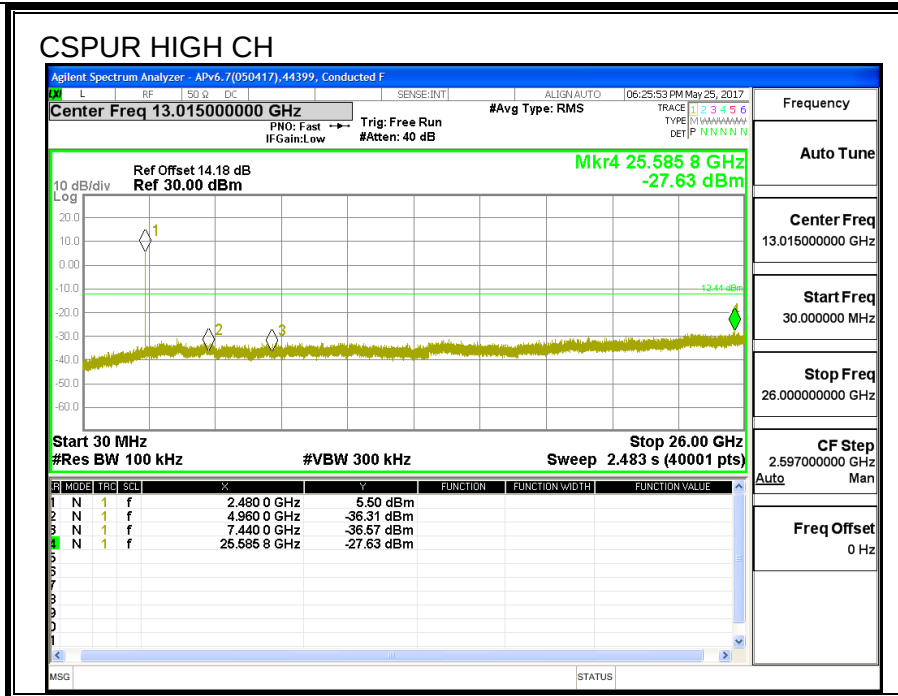


### CSPUR LOW CH



### CSPUR MID CH





## 7.5. UAT 1 BLE 2M Pmax

### 7.5.1. AVERAGE POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 30606 | <b>Date:</b> | 7/27/2017 |
|------------|-------|--------------|-----------|

#### LIMITS

None; for reporting purposes only.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

| Channel | Frequency (MHz) | AV Power (dBm) |
|---------|-----------------|----------------|
| Low     | 2402            | 19.40          |
| Middle  | 2440            | 19.79          |
| High    | 2480            | 19.66          |

## 7.5.2. OUTPUT POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 30606 | <b>Date:</b> | 7/27/2017 |
|------------|-------|--------------|-----------|

### LIMITS

FCC §15.247 (b)

IC 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 broadband Peak/average RF power meter

### RESULTS

| Channel | Frequency (MHz) | Peak Power Reading (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|--------------------------|-------------|-------------|
| Low     | 2402            | 19.73                    | 30          | -10.27      |
| Middle  | 2440            | 20.13                    | 30          | -9.87       |
| High    | 2480            | 19.98                    | 30          | -10.02      |

## 7.6. UAT 1 BLE 2M Plow

### 7.6.1. AVERAGE POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 30606 | <b>Date:</b> | 7/27/2017 |
|------------|-------|--------------|-----------|

#### LIMITS

None; for reporting purposes only.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

| Channel | Frequency (MHz) | AV Power (dBm) |
|---------|-----------------|----------------|
| Low     | 2402            | 9.18           |
| Middle  | 2440            | 9.80           |
| High    | 2480            | 9.77           |

## 7.6.2. OUTPUT POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 30606 | <b>Date:</b> | 7/27/2017 |
|------------|-------|--------------|-----------|

### LIMITS

FCC §15.247 (b)

IC 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 broadband Peak/average RF power meter

### RESULTS

| Channel | Frequency (MHz) | Peak Power Reading (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|--------------------------|-------------|-------------|
| Low     | 2402            | 9.51                     | 30          | -20.49      |
| Middle  | 2440            | 10.14                    | 30          | -19.86      |
| High    | 2480            | 10.09                    | 30          | -19.91      |

## **7.7. LAT 3 BLE 1M Pmax**

### **7.7.1. 6 dB BANDWIDTH**

#### **LIMITS**

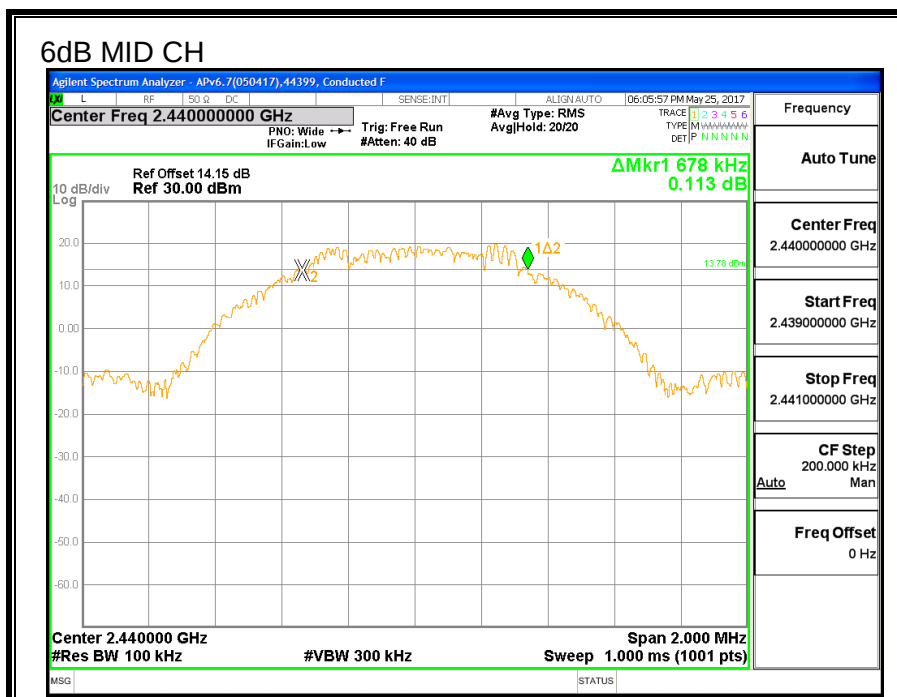
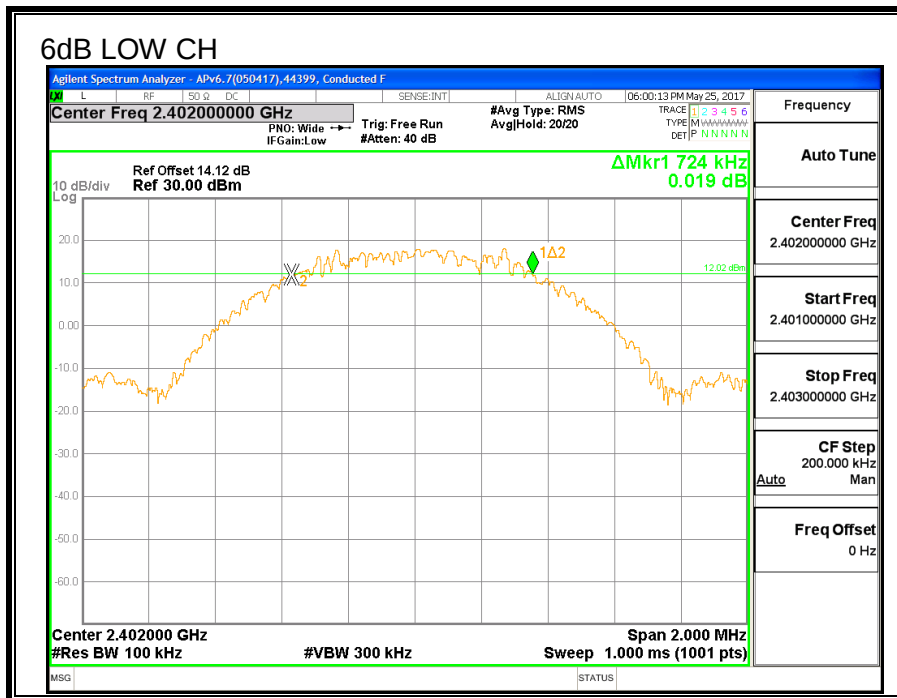
FCC §15.247 (a) (2)

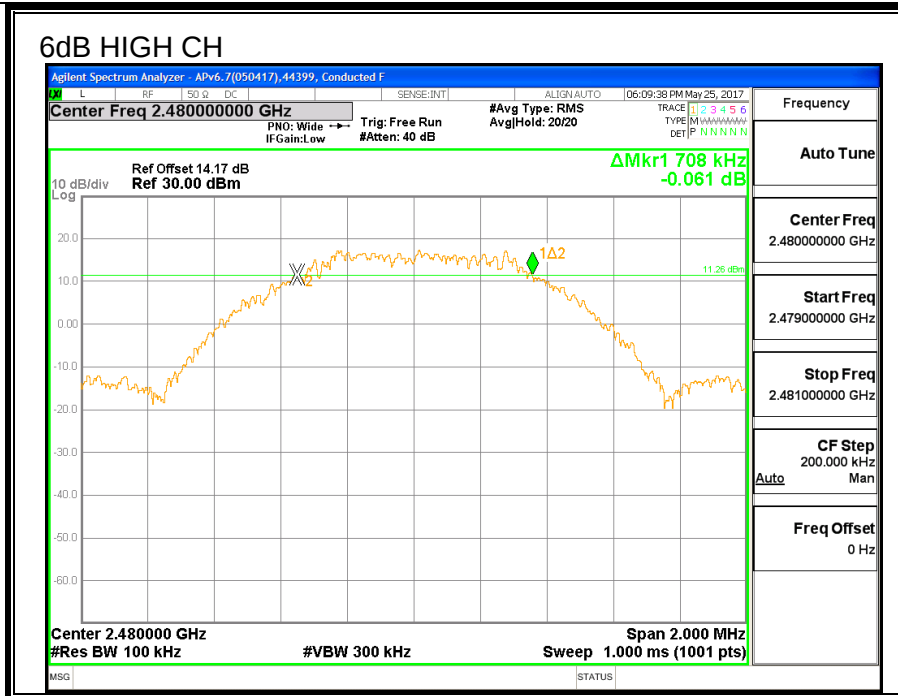
IC RSS-247 (5.2) (a)

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

#### **RESULTS**

| <b>Channel</b> | <b>Frequency</b> | <b>6 dB Bandwidth<br/>(MHz)</b> | <b>Minimum Limit<br/>(MHz)</b> |
|----------------|------------------|---------------------------------|--------------------------------|
| Low            | 2402             | 0.724                           | 0.5                            |
| Middle         | 2440             | 0.678                           | 0.5                            |
| High           | 2480             | 0.708                           | 0.5                            |





### **7.7.2. 99% BANDWIDTH**

#### **LIMITS**

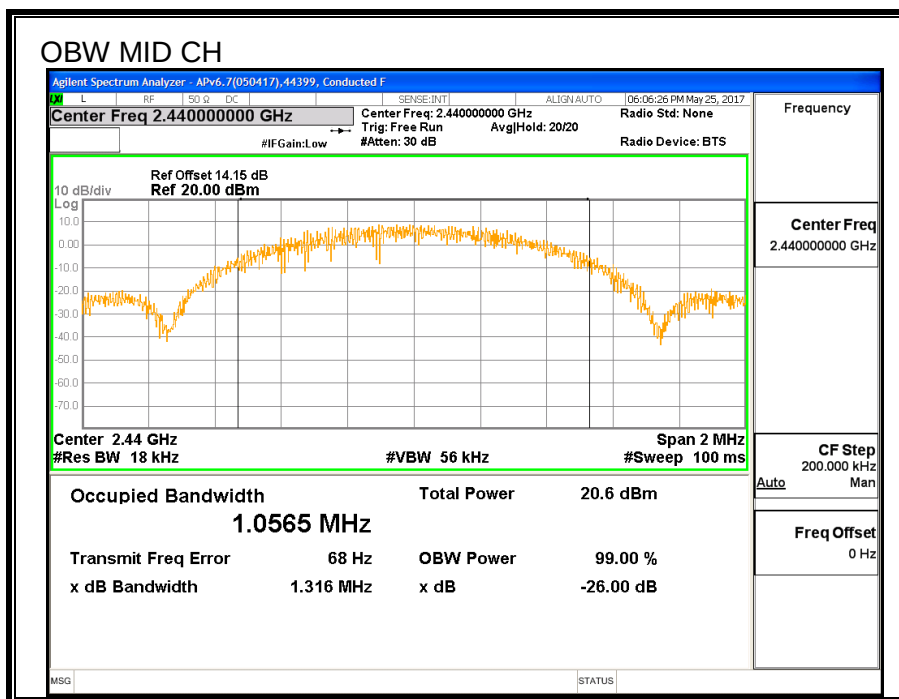
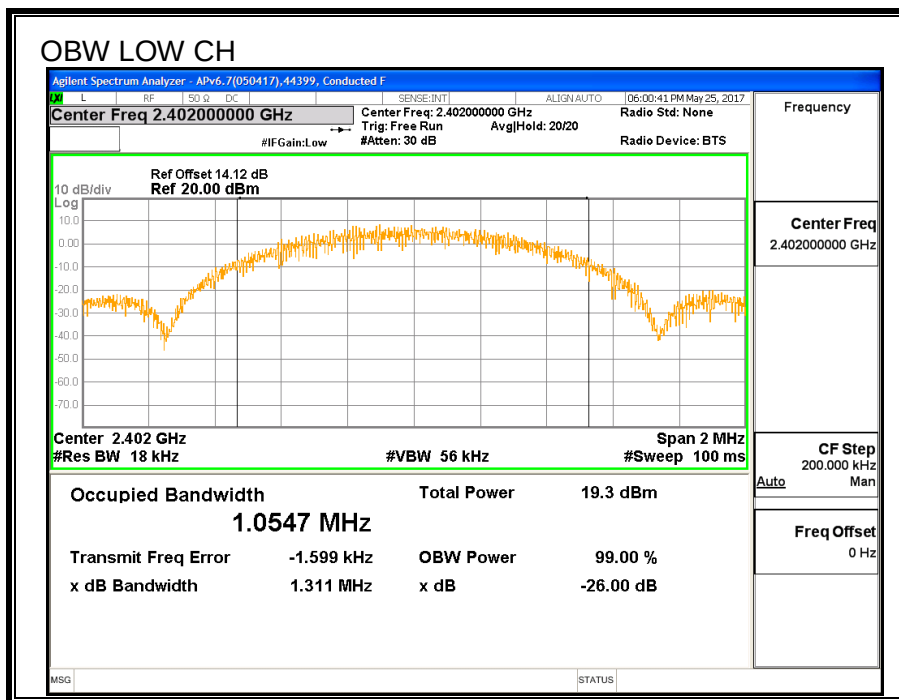
None; for reporting purposes only.

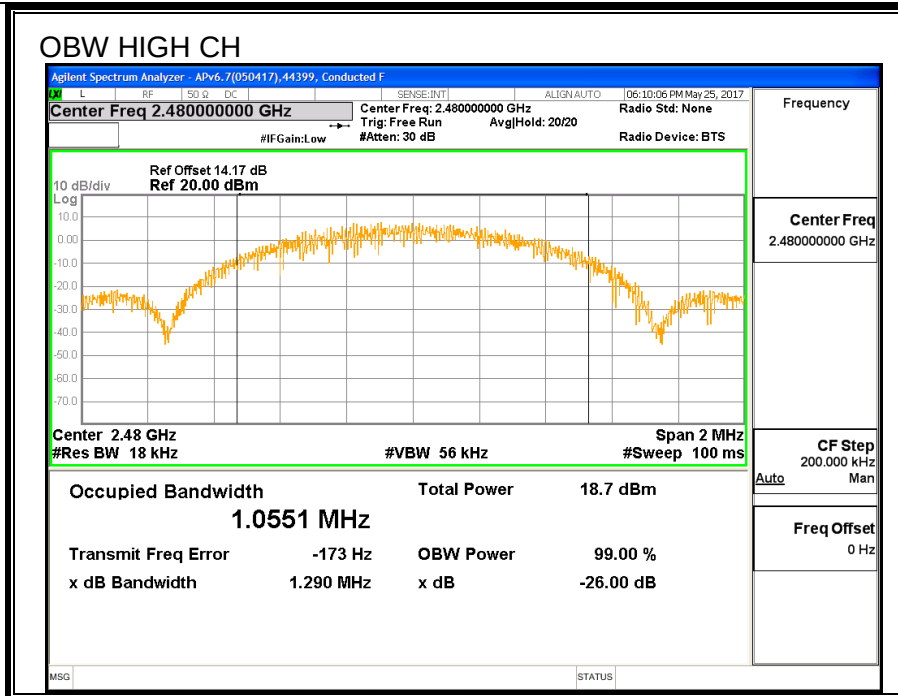
#### **Test Procedure**

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

#### **RESULTS**

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>99% Bandwidth<br/>(MHz)</b> |
|----------------|----------------------------|--------------------------------|
| Low            | 2402                       | 1.055                          |
| Middle         | 2440                       | 1.057                          |
| High           | 2480                       | 1.055                          |





### 7.7.3. AVERAGE POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 44353 | <b>Date:</b> | 8/25/2017 |
|------------|-------|--------------|-----------|

#### LIMITS

None; for reporting purposes only.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

| Channel | Frequency (MHz) | AV Power (dBm) |
|---------|-----------------|----------------|
| Low     | 2402            | 19.69          |
| Middle  | 2440            | 19.91          |
| High    | 2480            | 19.84          |

#### 7.7.4. OUTPUT POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 44353 | <b>Date:</b> | 8/25/2017 |
|------------|-------|--------------|-----------|

#### LIMITS

FCC §15.247 (b)

IC RSS-247 (5.4) (d)

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

#### RESULTS

| Channel | Frequency (MHz) | Peak Power Reading (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|--------------------------|-------------|-------------|
| Low     | 2402            | 20.02                    | 30          | -9.98       |
| Middle  | 2440            | 20.25                    | 30          | -9.75       |
| High    | 2480            | 20.16                    | 30          | -9.84       |

### 7.7.5. POWER SPECTRAL DENSITY

#### LIMITS

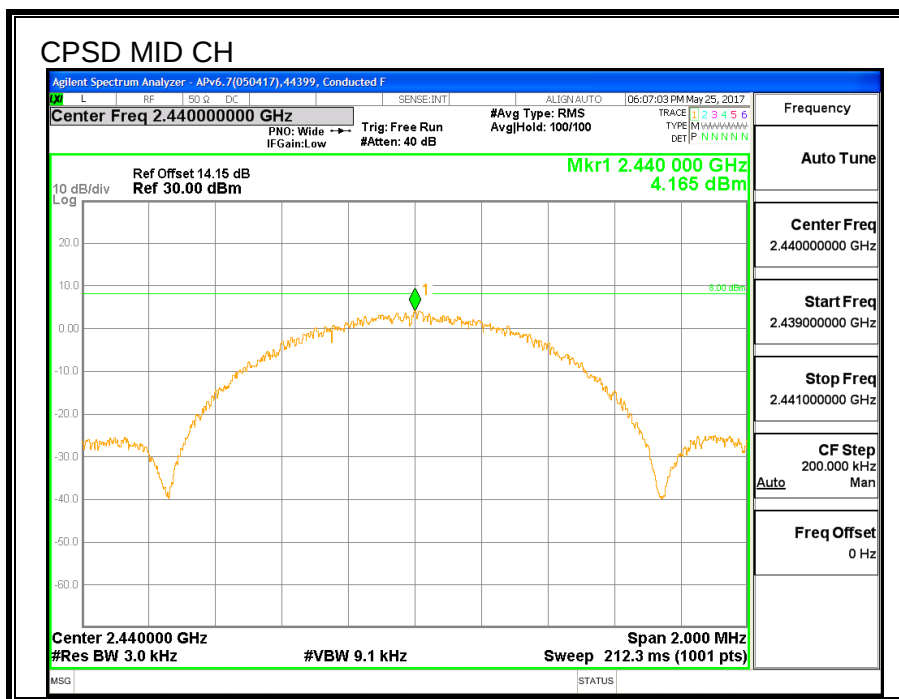
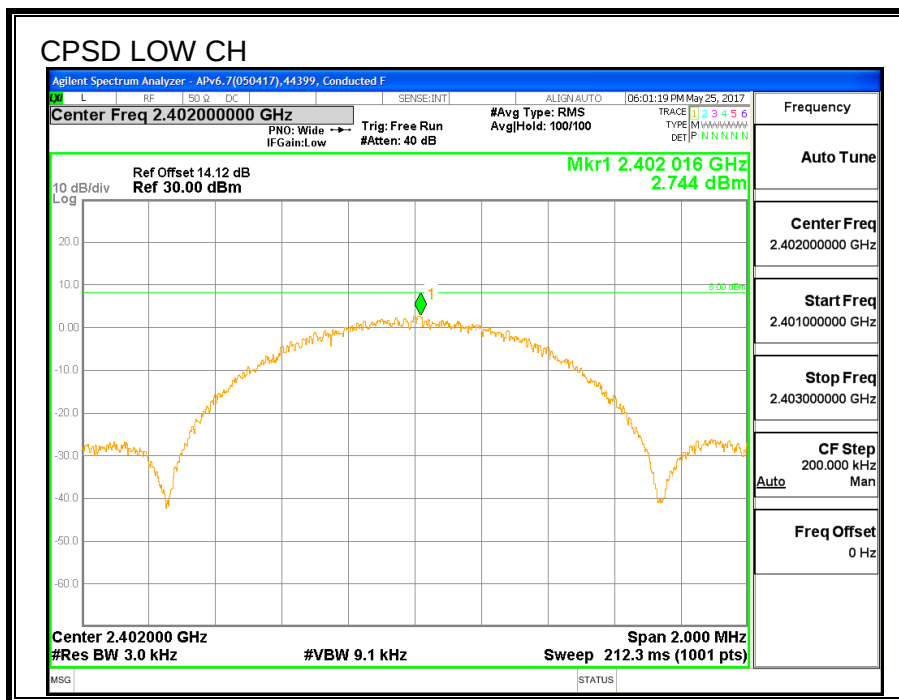
FCC §15.247 (e)

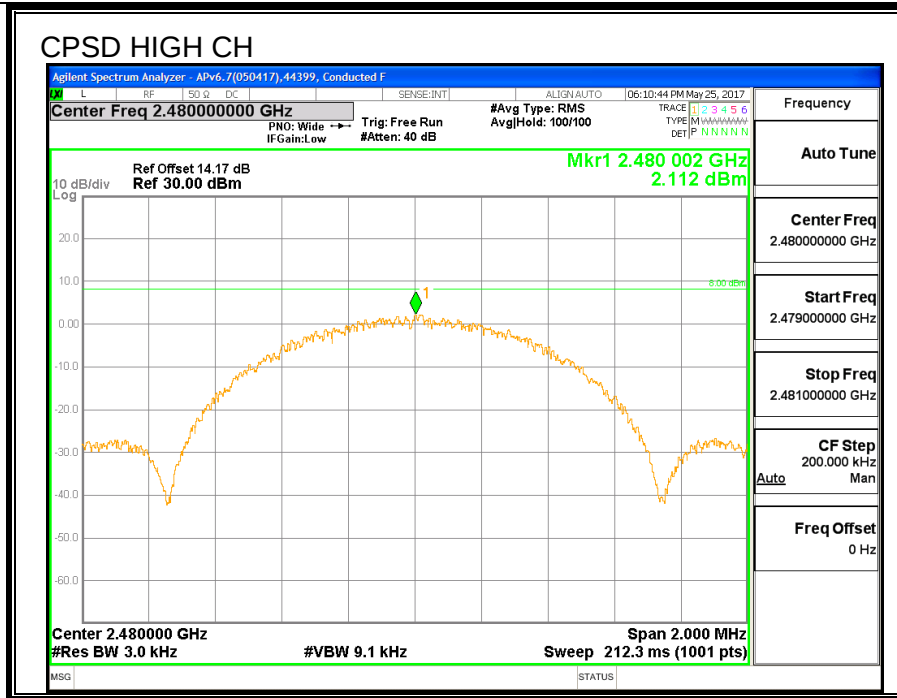
IC RSS-247 (5.2) (b)

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

| Channel | Frequency (MHz) | PSD (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|-----------|-------------|-------------|
| Low     | 2402            | 2.74      | 8           | -5.26       |
| Middle  | 2440            | 4.17      | 8           | -3.83       |
| High    | 2480            | 2.11      | 8           | -5.89       |





## 7.7.6. CONDUCTED BANEDGE AND SPURIOUS EMISSIONS

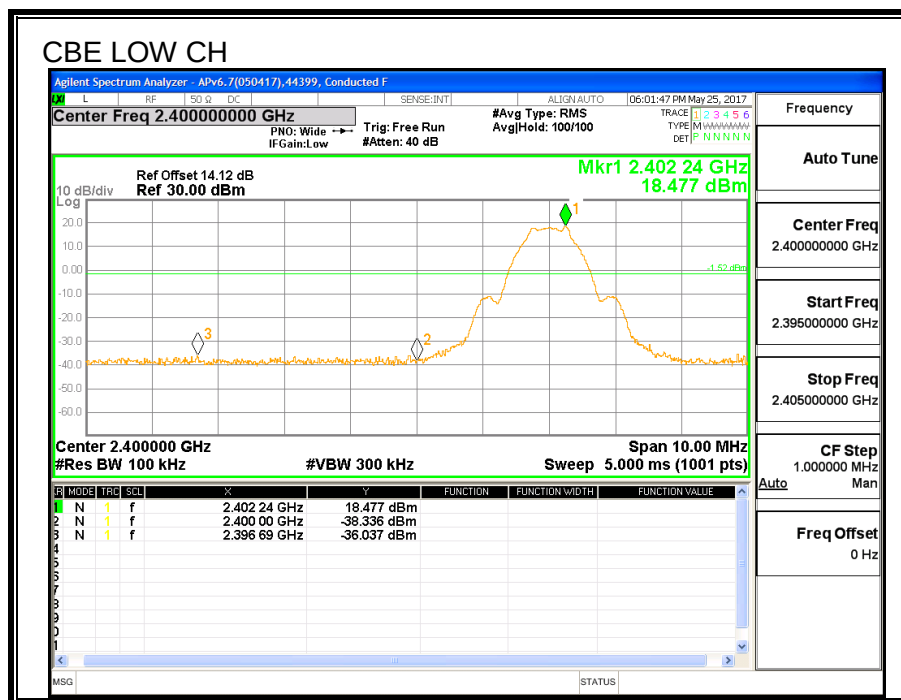
### LIMITS

FCC §15.247 (d)

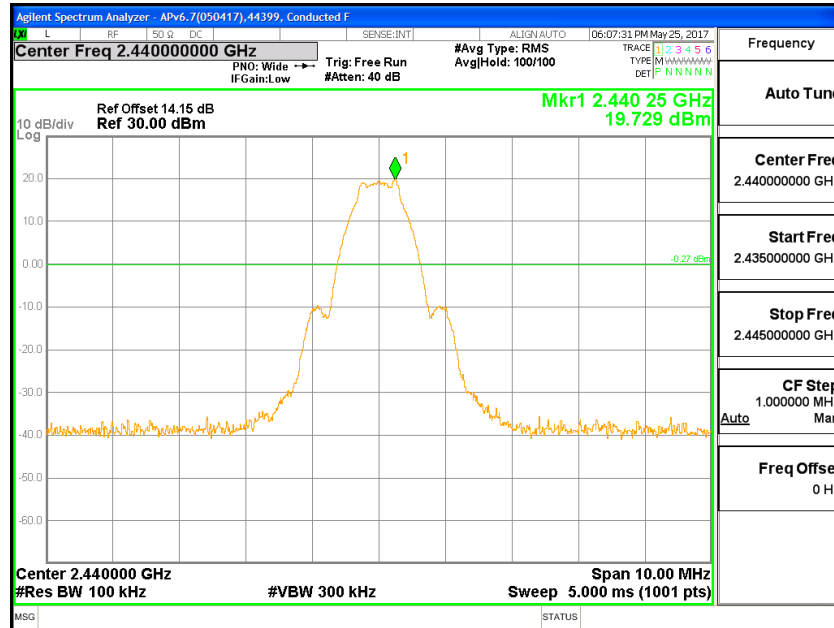
IC RSS-247 (5.5)

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

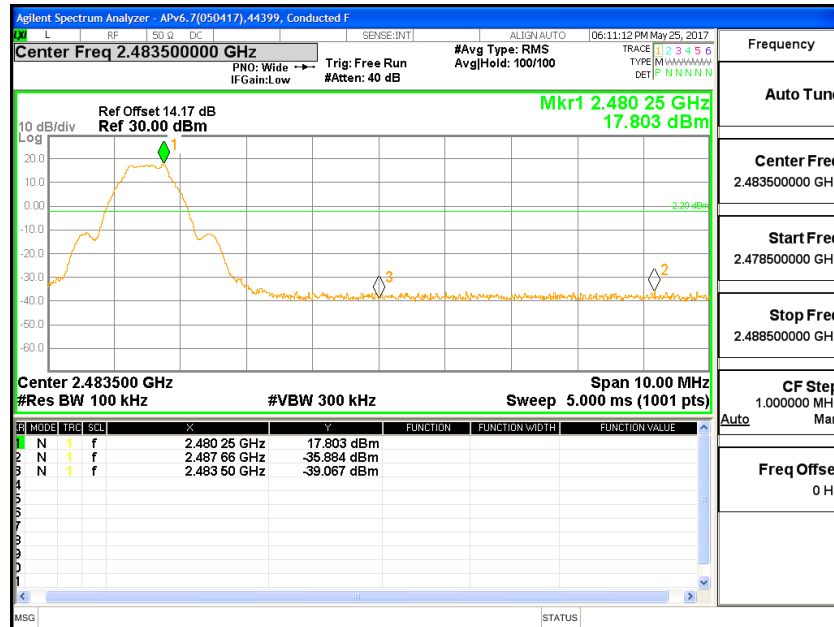
### RESULTS



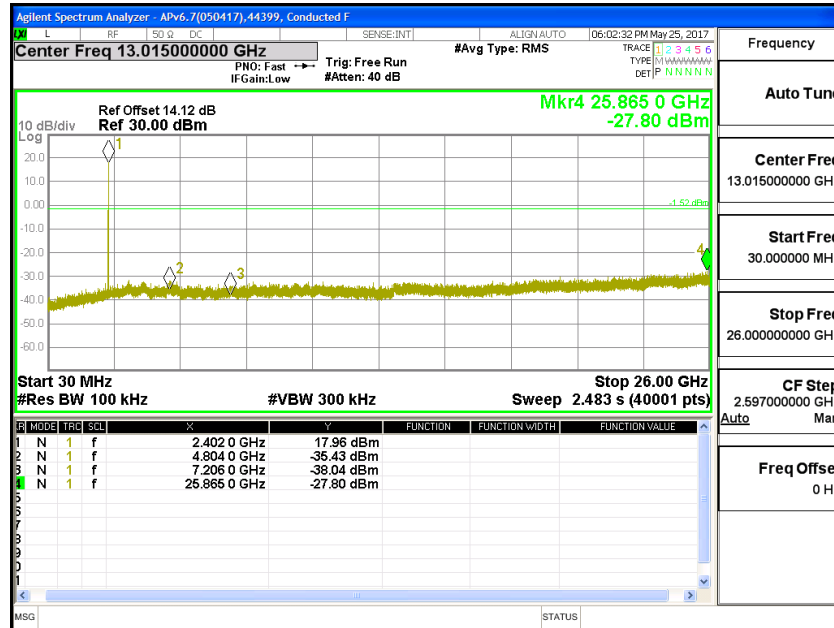
### CBE MID CH



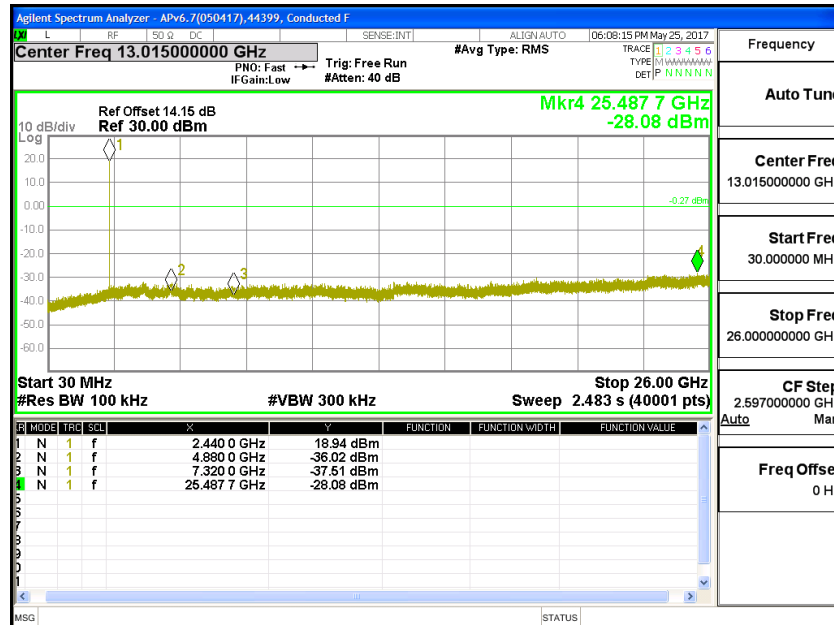
### CBE HIGH CH

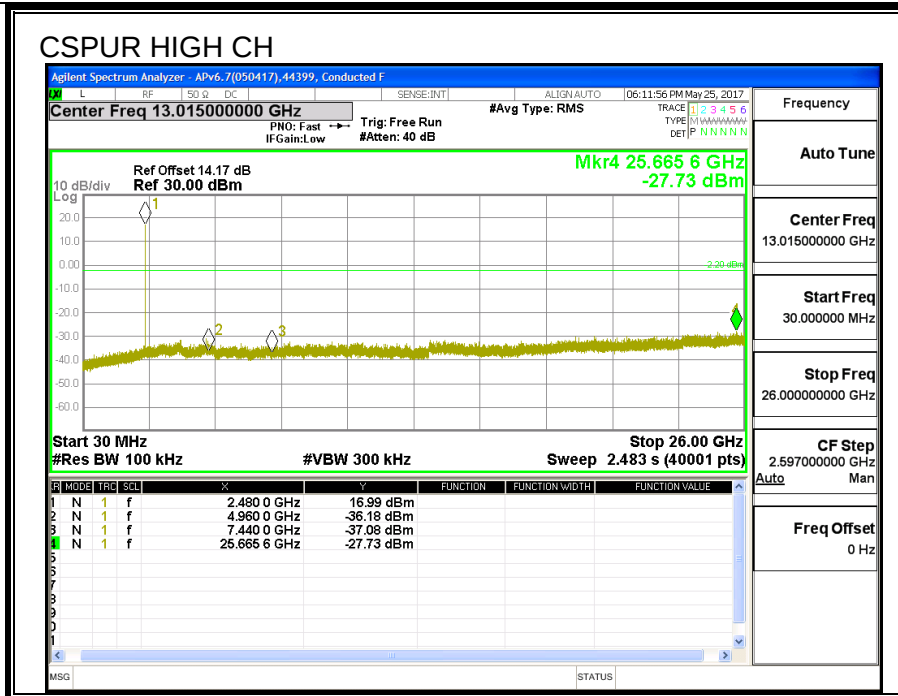


### CSPUR LOW CH



### CSPUR MID CH





## **7.8. LAT 3 BLE 1M Plow**

### **7.8.1. 6 dB BANDWIDTH**

#### **LIMITS**

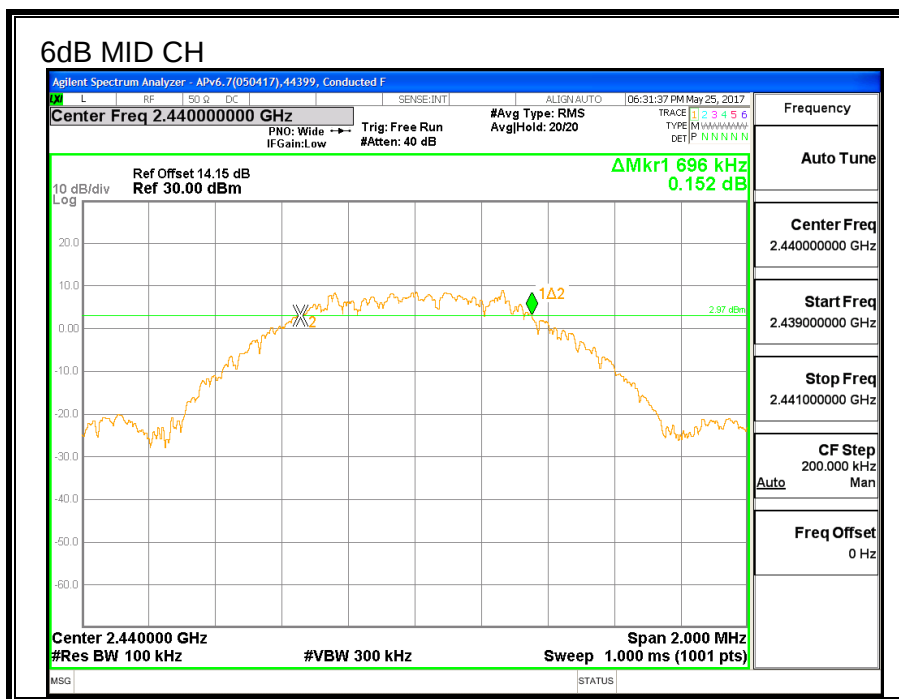
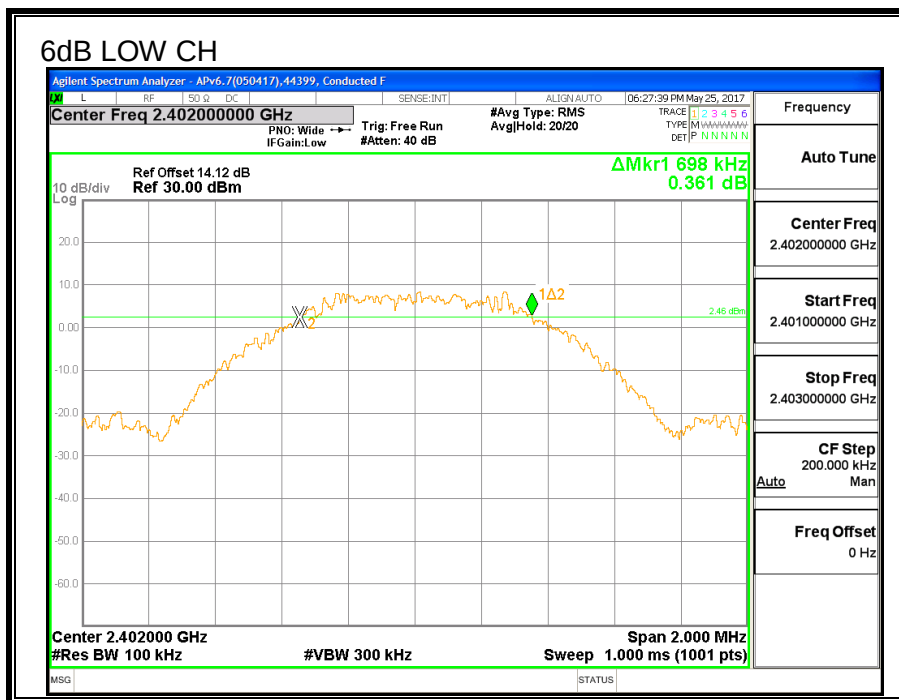
FCC §15.247 (a) (2)

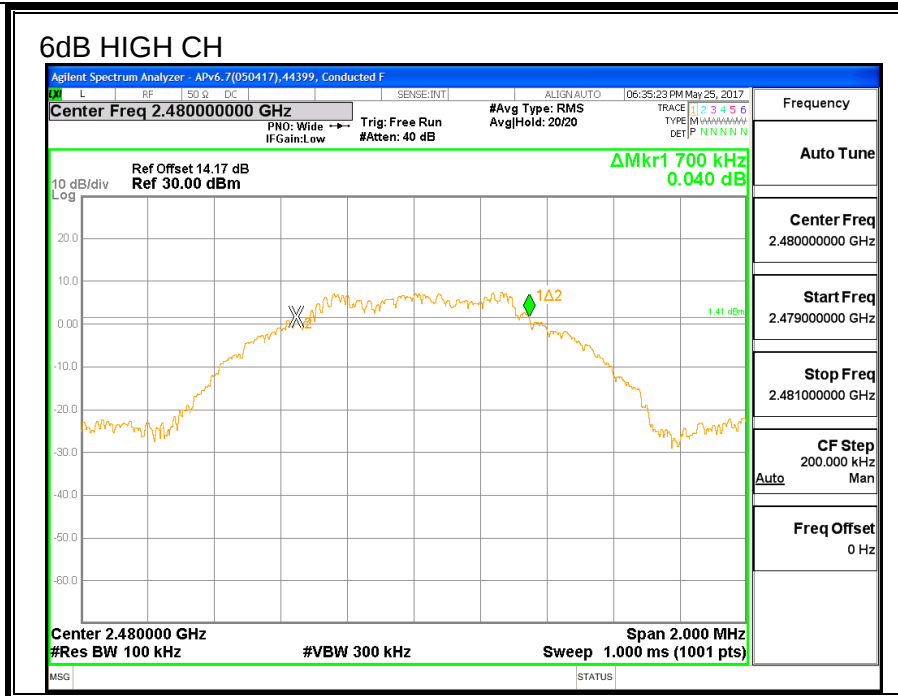
IC RSS-247 (5.2) (a)

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

#### **RESULTS**

| <b>Channel</b> | <b>Frequency</b> | <b>6 dB Bandwidth<br/>(MHz)</b> | <b>Minimum Limit<br/>(MHz)</b> |
|----------------|------------------|---------------------------------|--------------------------------|
| Low            | 2402             | 0.698                           | 0.5                            |
| Middle         | 2440             | 0.696                           | 0.5                            |
| High           | 2480             | 0.700                           | 0.5                            |





## 7.8.2. 99% BANDWIDTH

### LIMITS

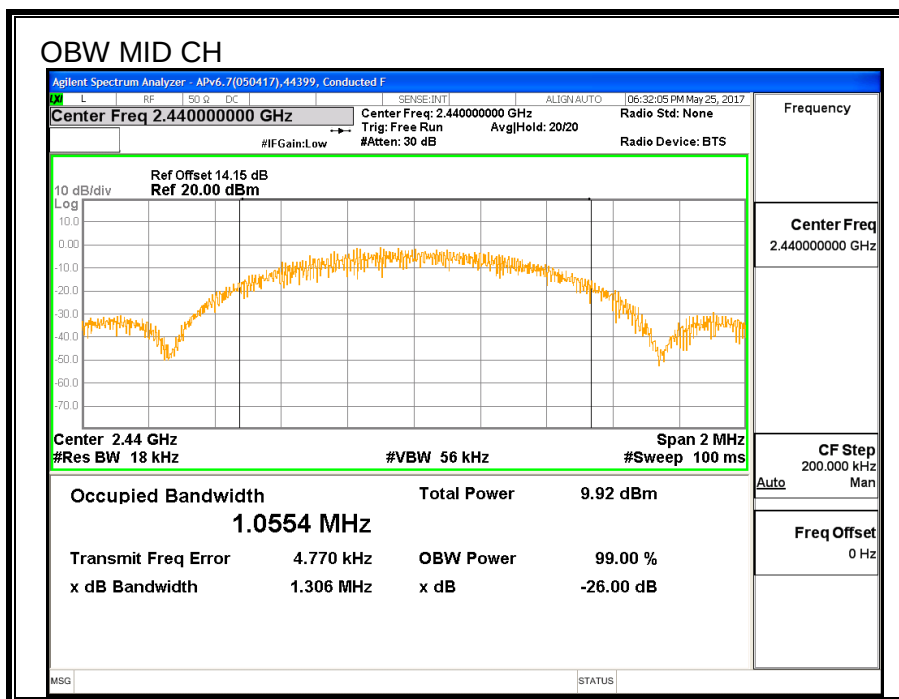
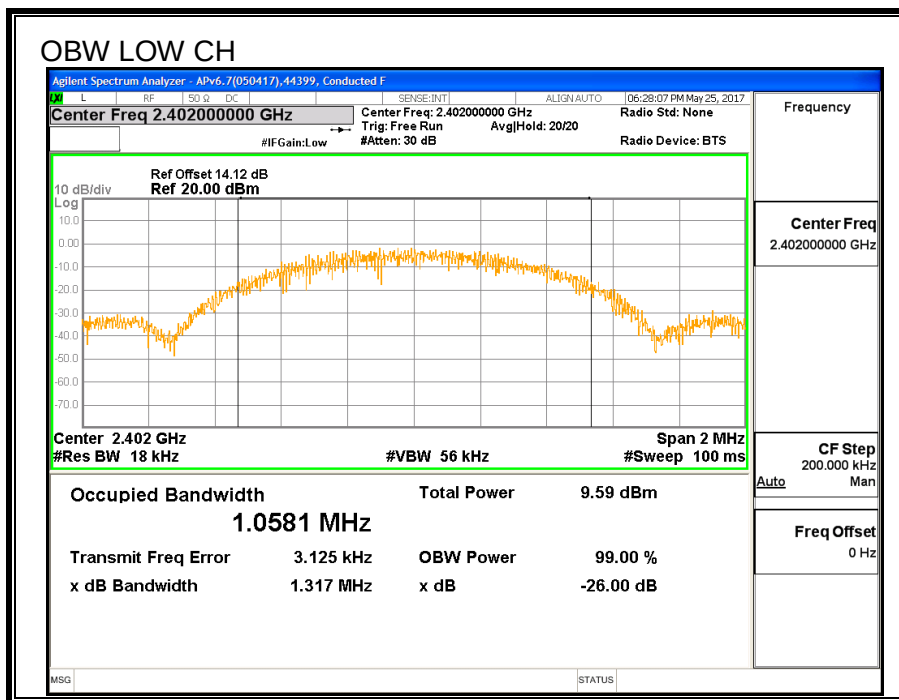
None; for reporting purposes only.

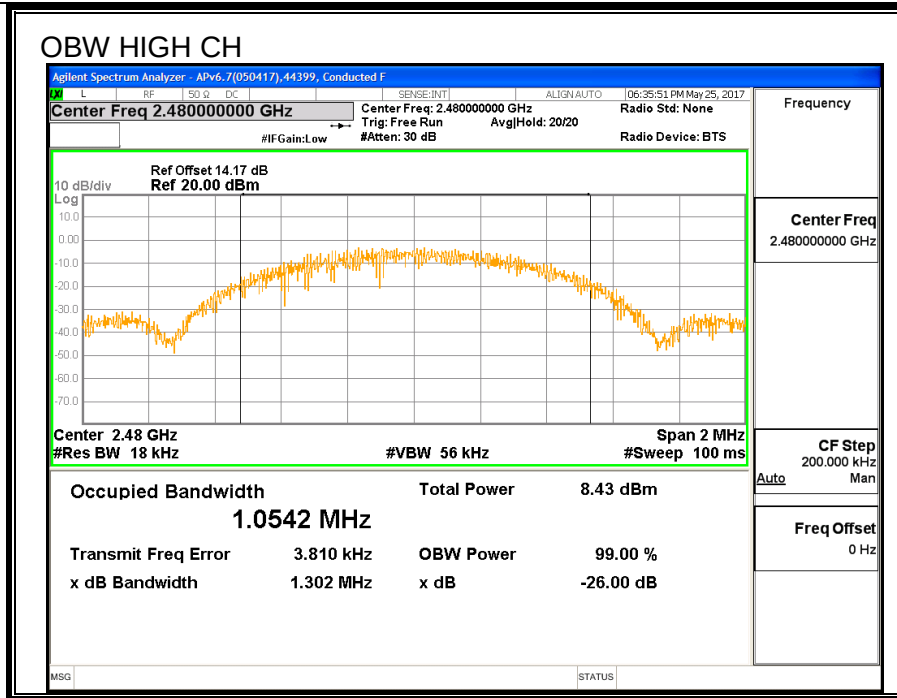
### Test Procedure

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

### RESULTS

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low     | 2402               | 1.058                  |
| Middle  | 2440               | 1.055                  |
| High    | 2480               | 1.054                  |





### 7.8.3. AVERAGE POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 44353 | <b>Date:</b> | 8/25/2017 |
|------------|-------|--------------|-----------|

#### LIMITS

None; for reporting purposes only.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

| Channel | Frequency (MHz) | AV Power (dBm) |
|---------|-----------------|----------------|
| Low     | 2402            | 9.66           |
| Middle  | 2440            | 9.83           |
| High    | 2480            | 9.72           |

#### 7.8.4. OUTPUT POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 44353 | <b>Date:</b> | 8/25/2017 |
|------------|-------|--------------|-----------|

#### LIMITS

FCC §15.247 (b)

IC RSS-247 (5.4) (d)

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

#### RESULTS

| Channel | Frequency (MHz) | Peak Power Reading (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|--------------------------|-------------|-------------|
| Low     | 2402            | 9.99                     | 30          | -20.01      |
| Middle  | 2440            | 10.17                    | 30          | -19.83      |
| High    | 2480            | 10.04                    | 30          | -19.96      |

## 7.8.5. POWER SPECTRAL DENSITY

### LIMITS

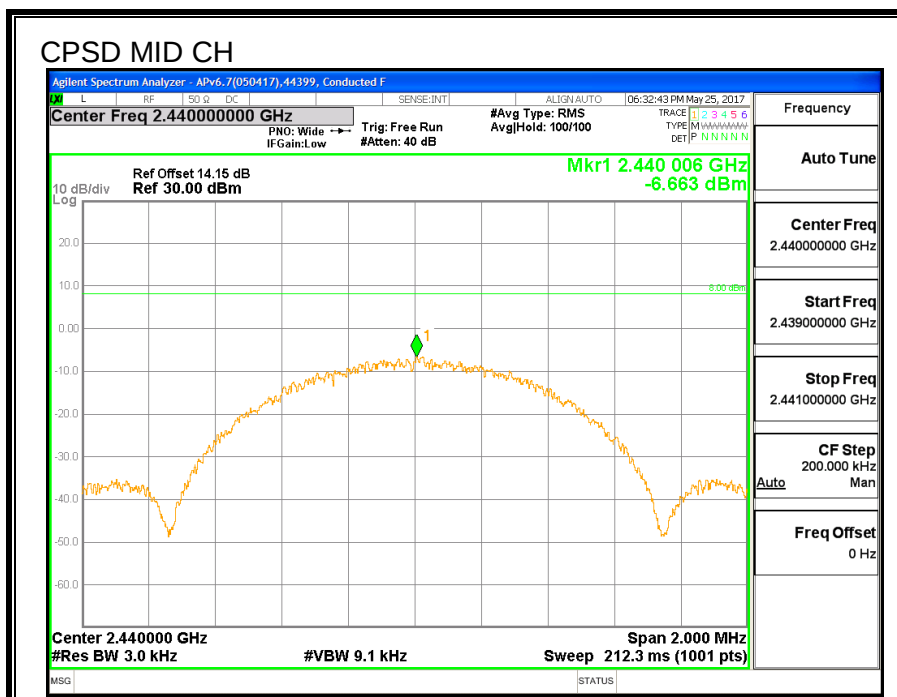
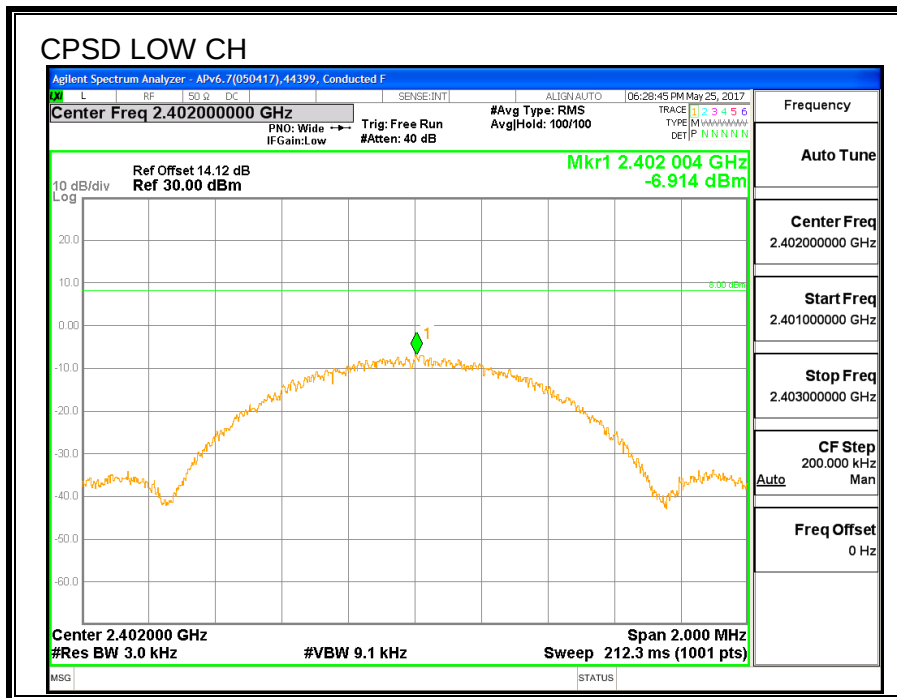
FCC §15.247 (e)

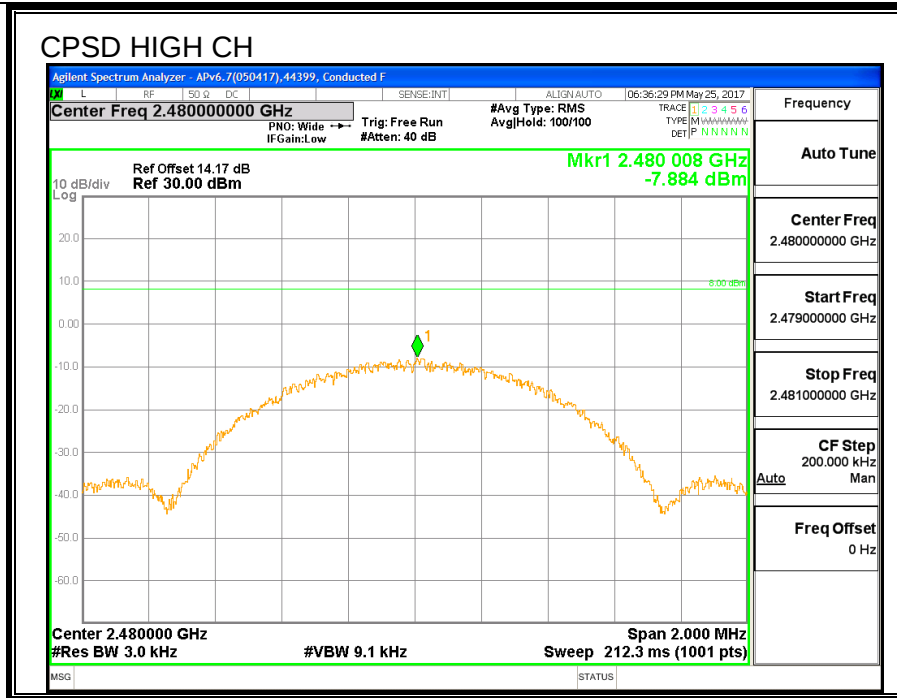
IC RSS-247 (5.2) (b)

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

| Channel | Frequency (MHz) | PSD (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|-----------|-------------|-------------|
| Low     | 2402            | -6.91     | 8           | -14.91      |
| Middle  | 2440            | -6.66     | 8           | -14.66      |
| High    | 2480            | -7.88     | 8           | -15.879     |





## 7.8.6. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

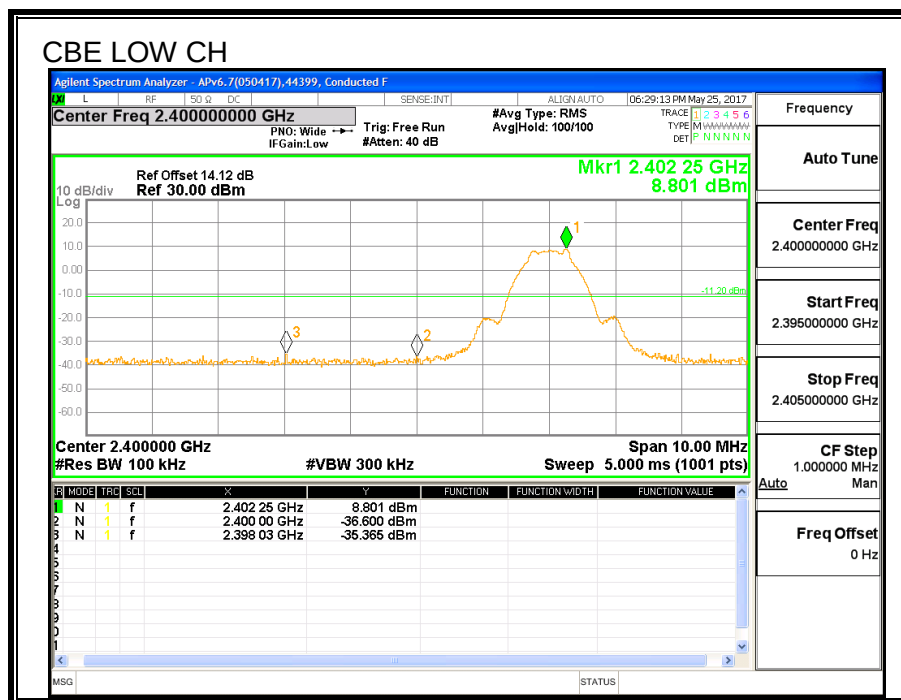
### LIMITS

FCC §15.247 (d)

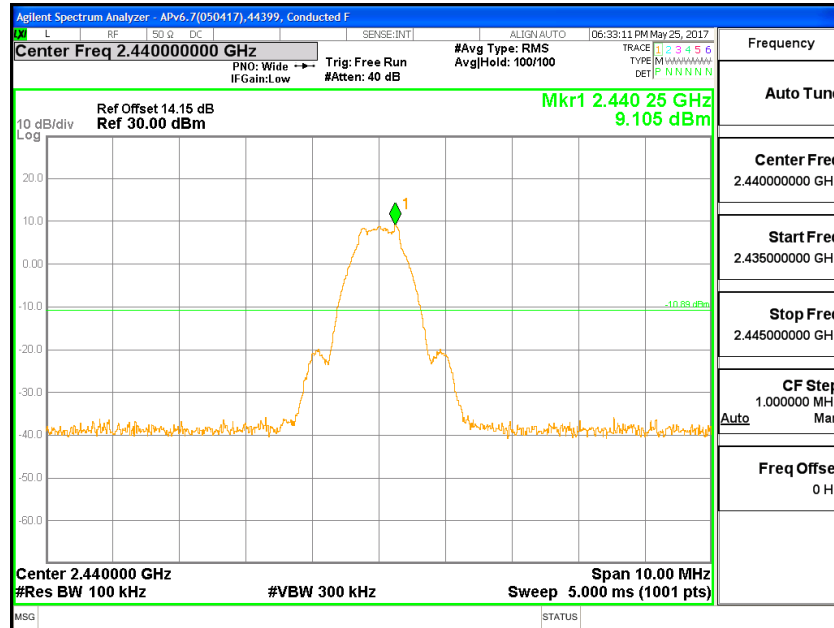
IC RSS-247 (5.5)

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

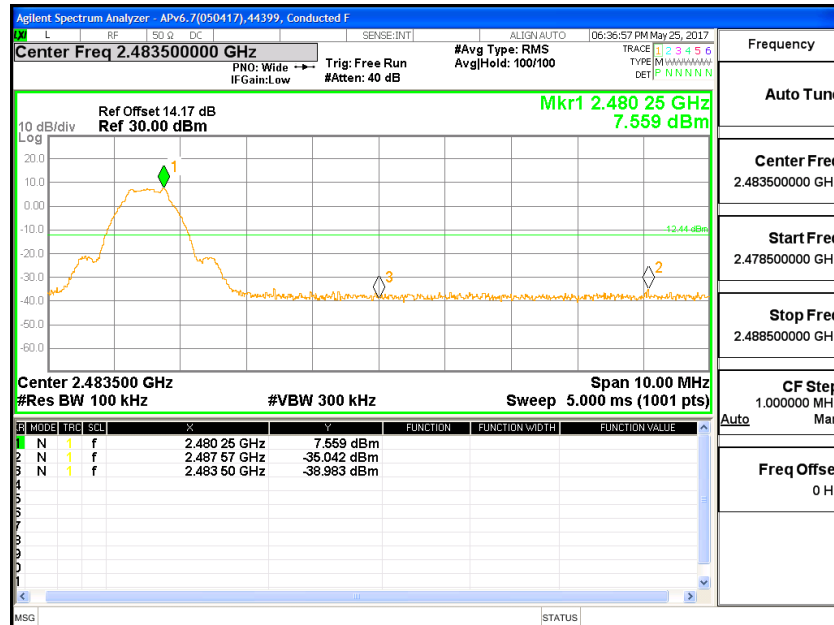
### RESULTS



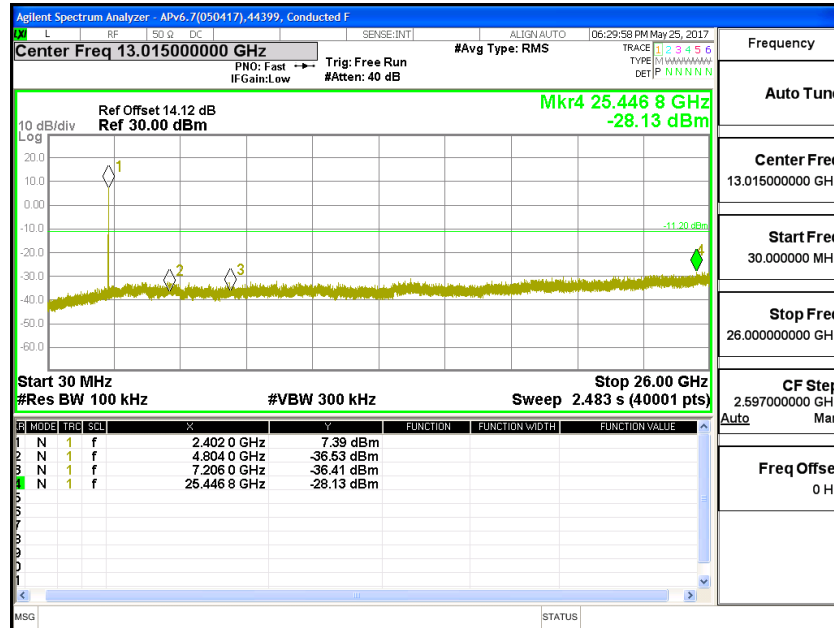
### CBE MID CH



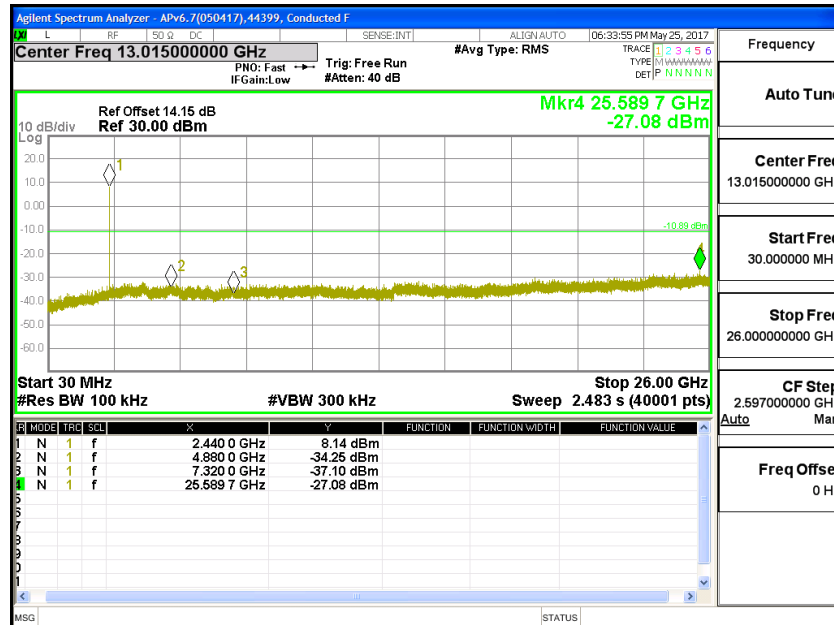
### CBE HIGH CH

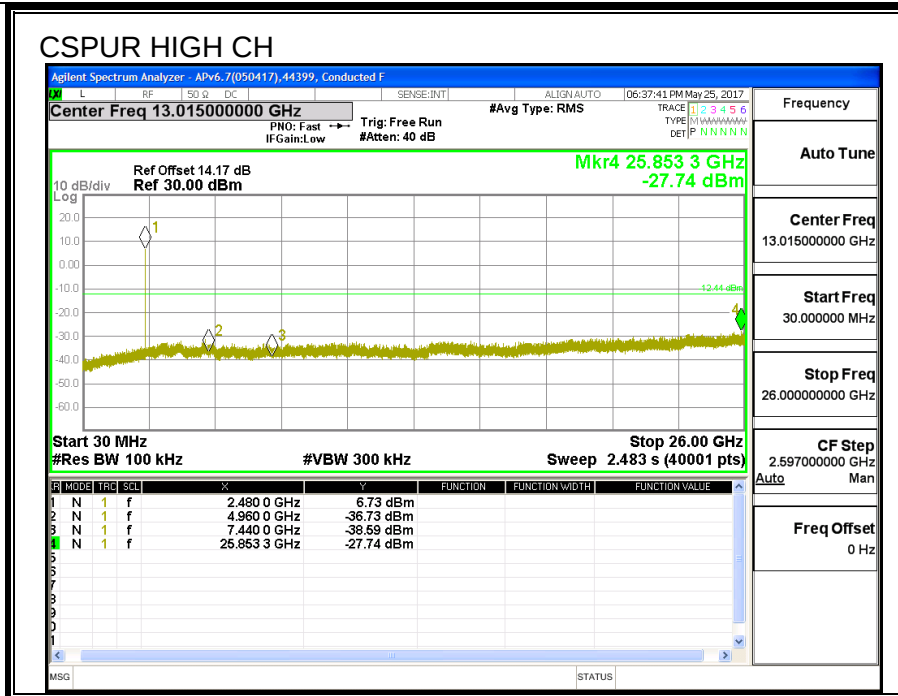


### CSPUR LOW CH



### CSPUR MID CH





## 7.9. LAT 3 BLE 2M Pmax

### 7.9.1. AVERAGE POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 44353 | <b>Date:</b> | 8/25/2017 |
|------------|-------|--------------|-----------|

#### LIMITS

None; for reporting purposes only.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

| Channel | Frequency (MHz) | AV Power (dBm) |
|---------|-----------------|----------------|
| Low     | 2402            | 19.66          |
| Middle  | 2440            | 19.86          |
| High    | 2480            | 19.75          |

## 7.9.2. OUTPUT POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 44353 | <b>Date:</b> | 8/25/2017 |
|------------|-------|--------------|-----------|

### LIMITS

FCC §15.247 (b)

IC 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 broadband Peak/average RF power meter

### RESULTS

| Channel | Frequency (MHz) | Peak Power Reading (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|--------------------------|-------------|-------------|
| Low     | 2402            | 19.99                    | 30          | -10.01      |
| Middle  | 2440            | 20.20                    | 30          | -9.80       |
| High    | 2480            | 20.07                    | 30          | -9.93       |

## 7.10. LAT 3 BLE 2M P1ow

### 7.10.1. AVERAGE POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 44353 | <b>Date:</b> | 8/25/2017 |
|------------|-------|--------------|-----------|

#### LIMITS

None; for reporting purposes only.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

| Channel | Frequency (MHz) | AV Power (dBm) |
|---------|-----------------|----------------|
| Low     | 2402            | 9.59           |
| Middle  | 2440            | 9.74           |
| High    | 2480            | 9.68           |

## 7.10.2. OUTPUT POWER

|            |       |              |           |
|------------|-------|--------------|-----------|
| <b>ID:</b> | 44353 | <b>Date:</b> | 8/25/2017 |
|------------|-------|--------------|-----------|

### LIMITS

FCC §15.247 (b)

IC 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 broadband Peak/average RF power meter

### RESULTS

| Channel | Frequency (MHz) | Peak Power Reading (dBm) | Limit (dBm) | Margin (dB) |
|---------|-----------------|--------------------------|-------------|-------------|
| Low     | 2402            | 9.92                     | 30          | -20.08      |
| Middle  | 2440            | 10.08                    | 30          | -19.92      |
| High    | 2480            | 10.00                    | 30          | -20.00      |