



# **CERTIFICATION TEST REPORT**

**Report Number:** 13018973-E6V3

**Applicant :** APPLE, INC.  
1 APPLE PARK WAY  
CUPERTINO, CA 95014, U.S.A

**Model :** A2275, A2297, A2298

**FCC ID :** BCG-E3500A

**IC :** 579C-E3500A

**EUT Description :** SMARTPHONE

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

**Date Of Issue:**  
March 25, 2020

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NVLAP Lab code: 200065-0

## REPORT REVISION HISTORY

| Rev. | Issue Date | Revisions                                     | Revised By         |
|------|------------|-----------------------------------------------|--------------------|
| V1   | 2/10/2020  | Initial Issue                                 | Jingang Li         |
| V2   | 3/21/2020  | Address TCB Questions                         | Francisco Guarnero |
| V3   | 3/25/2020  | Add test method on radiated multiple antennas | Chin Pang          |

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** APPLE INC.  
1 APPLE PARK WAY  
CUPERTINO, CA 95014, U.S.A

**EUT DESCRIPTION:** Smartphone

**MODEL:** A2275, A2297, A2298

**SERIAL NUMBER:** FFMZV04ZPM63, FFMZW0B3PM63

**DATE TESTED:** AUGUST 29, 2019 – JANUARY 03, 2020

| 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.

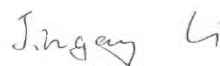
This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This 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, KDB662911, 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 Rd.                                   |
|------------------------------------------------------------|------------------------------------------------------------|--------------------------------------------------|
| <input checked="" type="checkbox"/> Chamber A (IC:2324B-1) | <input checked="" type="checkbox"/> Chamber D (IC:22541-1) | <input type="checkbox"/> Chamber I (IC: 2324A-5) |
| <input type="checkbox"/> Chamber B (IC:2324B-2)            | <input checked="" type="checkbox"/> Chamber E (IC:22541-2) | <input type="checkbox"/> Chamber J (IC: 2324A-6) |
| <input type="checkbox"/> Chamber C (IC:2324B-3)            | <input checked="" type="checkbox"/> Chamber F (IC:22541-3) | <input type="checkbox"/> Chamber K (IC: 2324A-1) |
|                                                            | <input checked="" type="checkbox"/> Chamber G (IC:22541-4) | <input type="checkbox"/> Chamber L (IC: 2324A-3) |
|                                                            | <input checked="" type="checkbox"/> Chamber H (IC:22541-5) | <input type="checkbox"/> Chamber M (IC: 2324A-2) |

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.

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

## 4. DECISION RULES AND MEASUREMENT UNCERTAINTY

### 4.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

### 4.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

### 4.3. MEASUREMENT UNCERTAINTY

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

| PARAMETER                                           | U <sub>LAB</sub> |
|-----------------------------------------------------|------------------|
| Worst Case Conducted Disturbance, 9KHz to 0.15 MHz  | 3.39 dB          |
| Worst Case Conducted Disturbance, 0.15 to 30 MHz    | 3.07 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

EUT is a smartphone with multimedia functions (music, application support, and video), cellular GSM, GPRS, EGPRS, UMTS, LTE, TD-SCDMA, CDMA, IEEE 802.11a/b/g/n/ac/ax, Bluetooth, GPS and NFC. All models support at least one UICC based SIM. The second SIM, if present, is either UICC based pSIM (physical SIM) or e-SIM (electronic SIM). The device has a built-in inductive charging receiver. The rechargeable battery is also not user accessible.

### 5.2. DIFFERENCE IN MODEL NUMBER

Model A2275, A2297 and A2298 is electrically identical to Model A2275. Three model numbers are allocated for marketing and logistic purposes only. A2275 was used to perform all final tests.

### 5.3. 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            | High Power    | 2404 - 2478           | HDR4 | 14.51              | 28.25             |
|                  | Low Power     |                       |      | 9.06               | 8.05              |
|                  | High Power    |                       | HDR8 | 15.04              | 31.92             |
|                  | Low Power     |                       |      | 9.57               | 9.06              |
| LAT 3            | High Power    | 2404 - 2478           | HDR4 | 14.43              | 27.73             |
|                  | Low Power     |                       |      | 8.94               | 7.83              |
|                  | High Power    |                       | HDR8 | 14.96              | 31.33             |
|                  | Low Power     |                       |      | 9.49               | 8.89              |
| BF, UAT 1+ LAT 3 | High Power    | 2404 - 2478           | HDR4 | 17.49              | 56.10             |
|                  | Low Power     |                       |      | 12.53              | 17.91             |
|                  | High Power    |                       | HDR8 | 17.47              | 55.85             |
|                  | Low Power     |                       |      | 12.50              | 17.78             |

### 5.4. DESCRIPTION OF AVAILABLE ANTENNAS

| Frequency Range (GHz) | UAT 1 (dBi) | LAT 3 (dBi) |
|-----------------------|-------------|-------------|
| 2.4                   | -2.5        | -1.30       |

### 5.5. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was BT FW Version: 17.1.210.2193.

## **5.6. WORST-CASE CONFIGURATION AND MODE**

The EUT was investigated in three orthogonal orientations X, Y and Z on both UAT1 and LAT3, it was determined that X(Flatbed) orientation was the worst-case orientation for UAT1 and 2TX, Y (Landscape) for LAT3.

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, 18-26GHz and power line conducted emissions were performed with the EUT transmits at the channel with the highest output power as worst-case scenario.

For below 1GHz tests were performed with EUT connected to AC power adapter as the worst case; and for above 1GHz, the worst-case configuration reported was tested with EUT only. For AC line conducted emission, test was investigated with AC power adapter and with laptop.

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.

## 5.7. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| Support Equipment List |                   |             |                   |              |
|------------------------|-------------------|-------------|-------------------|--------------|
| Description            | Manufacturer      | Model       | Serial Number     | FCC ID       |
| Laptop                 | Apple             | A1398       | C02PM012G3QD      | QDS-BRCM1069 |
| Laptop AC/DC adapter   | Liteon Technology | PA-1450-BA1 | B123              | NA           |
| EUT AC Adapter         | Apple             | A1385       | D29325SM03XDHLHC9 | NA           |

### I/O CABLES

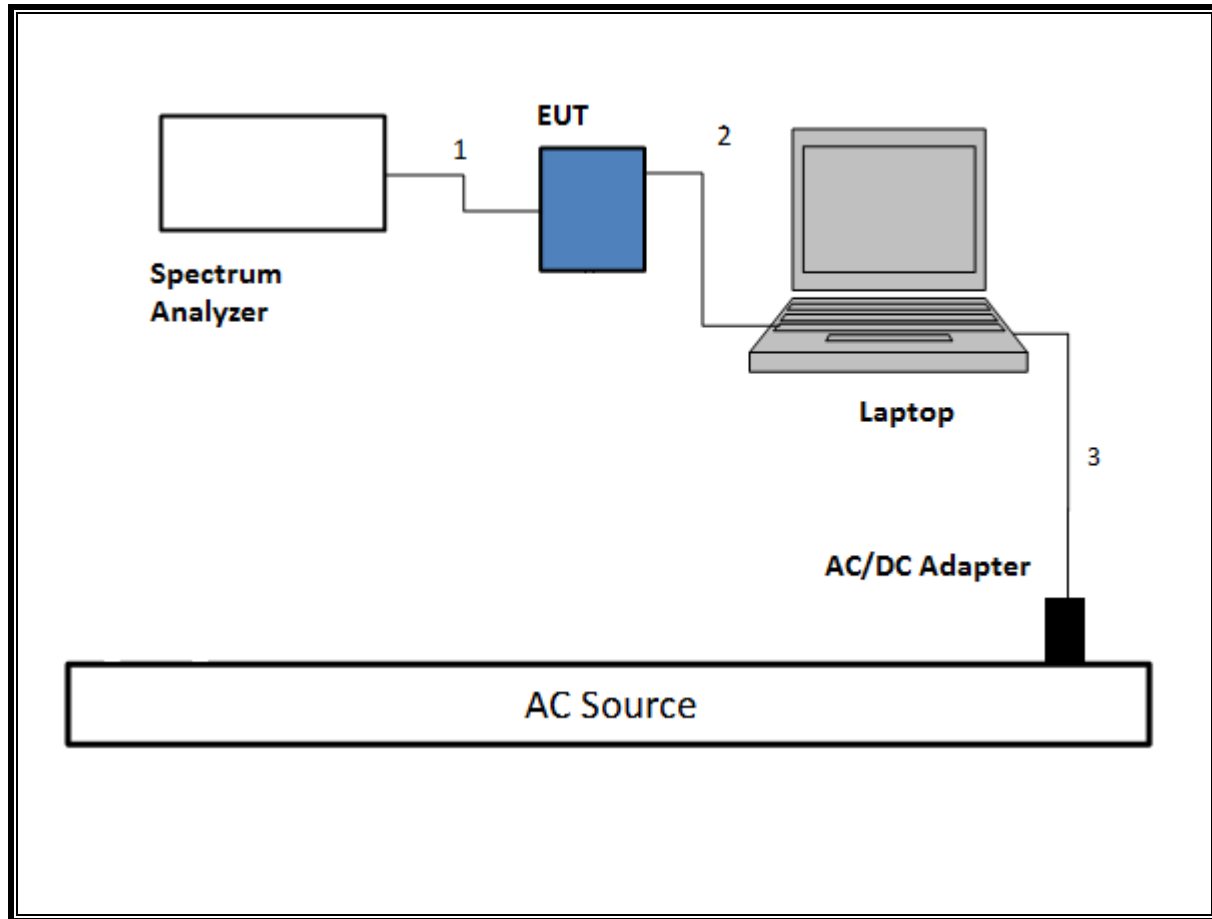
| I/O Cable List |         |                      |                |             |                  |                      |
|----------------|---------|----------------------|----------------|-------------|------------------|----------------------|
| Cable No       | Port    | # of identical ports | Connector Type | Cable Type  | Cable Length (m) | Remarks              |
| 1              | Antenna | 1                    | SMA            | Un-Shielded | 0.2              | To spectrum Analyzer |
| 2              | USB     | 1                    | USB            | Shielded    | 1                | N/A                  |
| 3              | AC      | 1                    | AC             | Un-shielded | 2                | N/A                  |

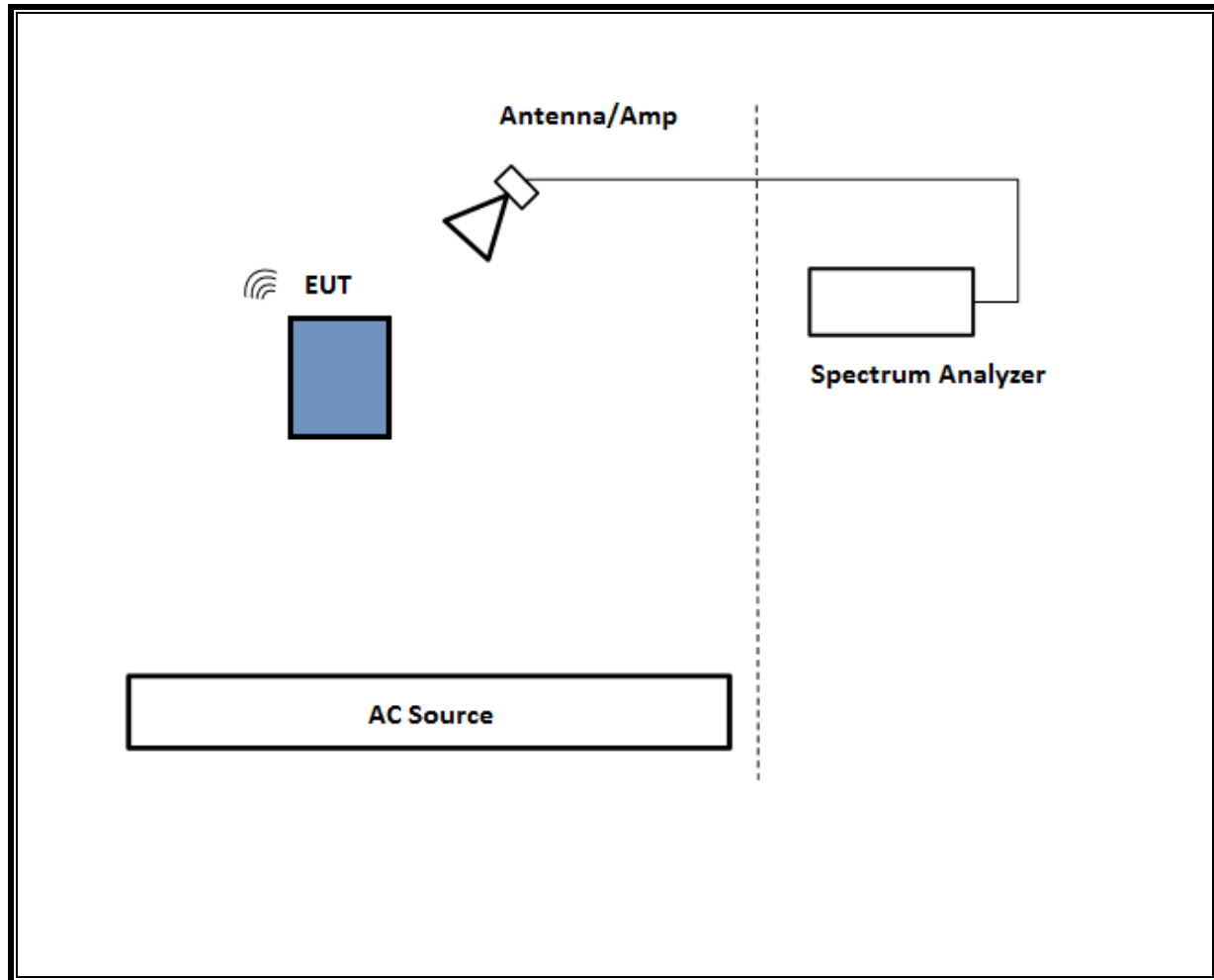
### I/O CABLES (BELOW 1GHz AND AC POWER LINE TEST WITH ADAPTER AND LAPTOP)

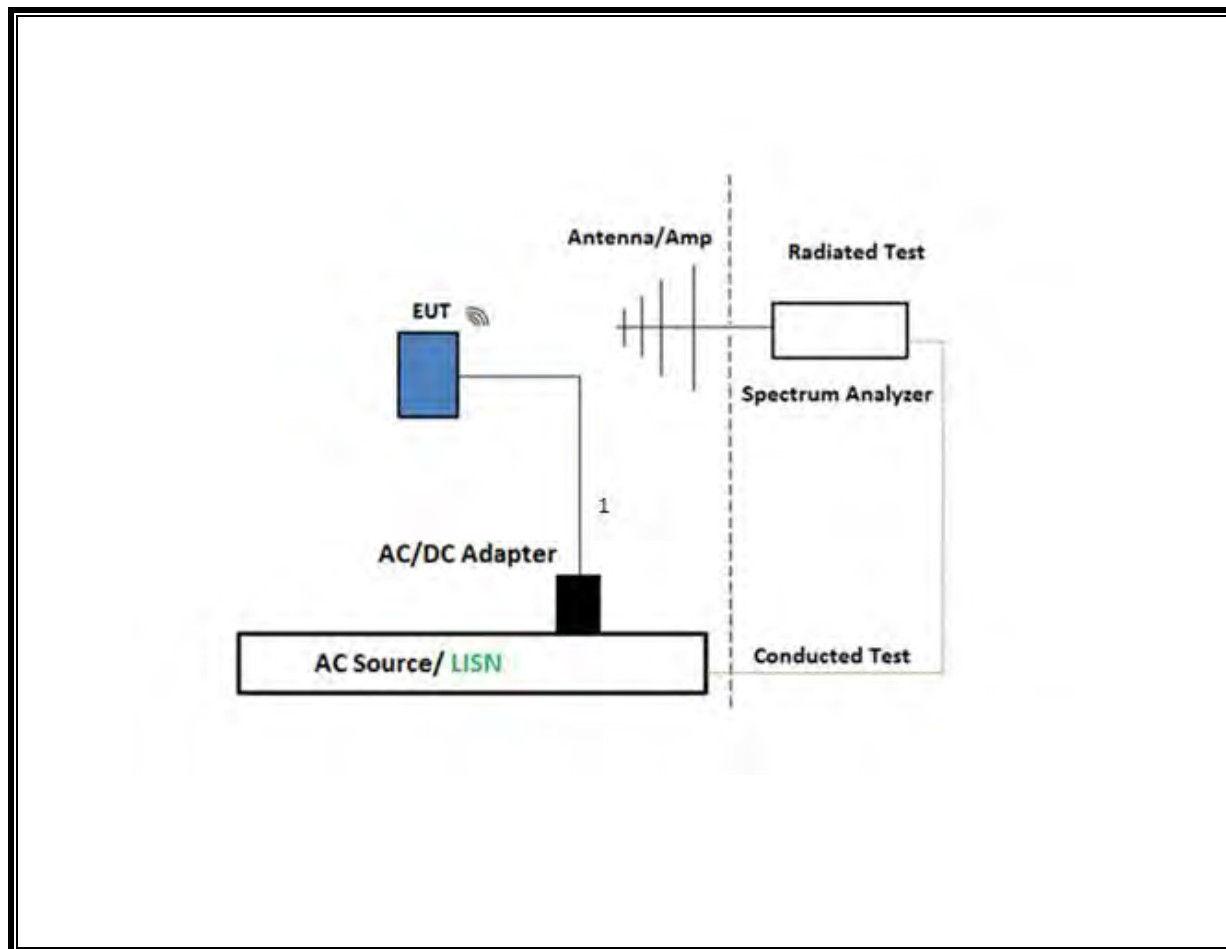
| I/O Cable List |      |                |                |             |                  |         |
|----------------|------|----------------|----------------|-------------|------------------|---------|
| Cable No       | Port | # of identical | Connector Type | Cable Type  | Cable Length (m) | Remarks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

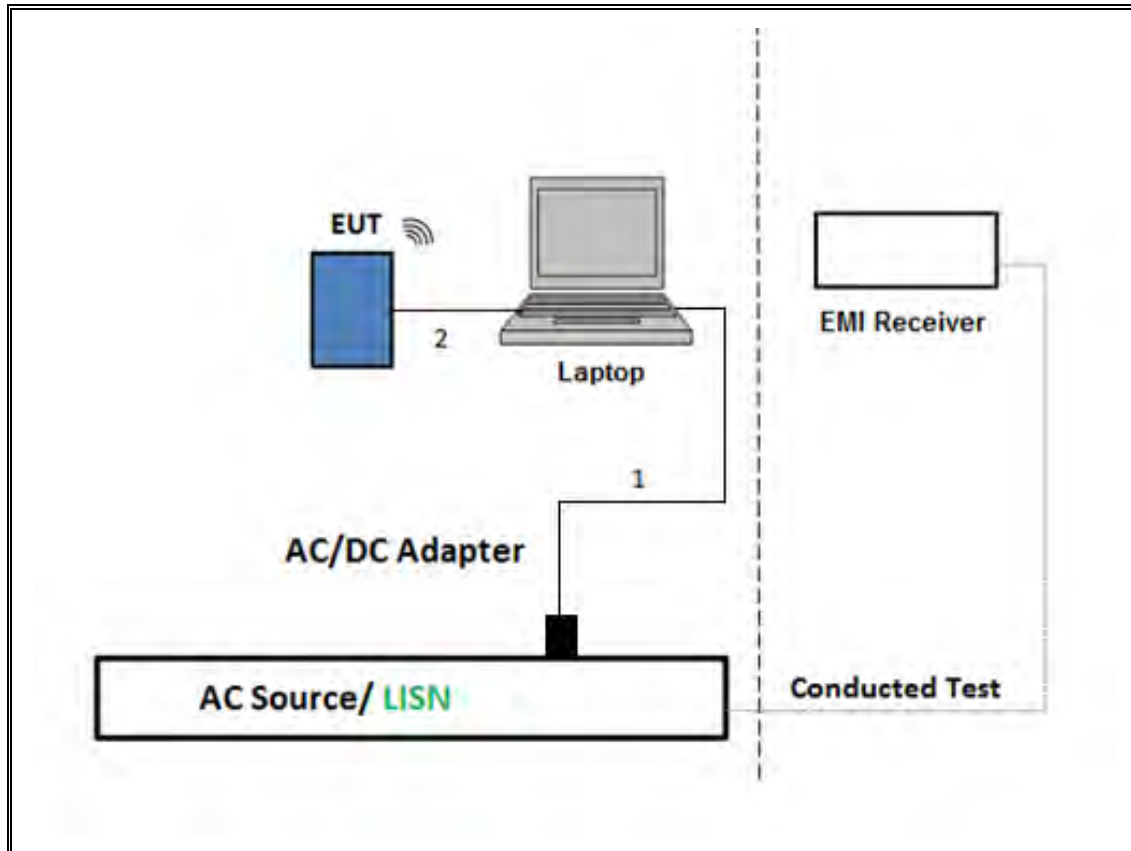
### TEST SETUP

The EUT is connected to a test laptop during the tests. Test software exercised the radio card.

**SETUP DIAGRAM FOR CONDUCTED TESTS**

**SETUP DIAGRAM FOR RADIATED TESTS Above 1 GHz**

**SETUP DIAGRAM FOR Below 1GHz and AC LINE CONDUCTED TEST**

**TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION**

## 6. MEASUREMENT METHOD

On Time and Duty Cycle: KDB 558074 D01 v05r02, Section 6.

6 dB BW: ANSI C63.10 Subclause -11.8.1 RBW  $\geq$  DTS BW

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 Measurement using gated average power meter.

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

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1 & Clause 13

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

Band-edge: ANSI C63.10 Subclause -11.13.3.2 & Clause 13: Integration method -Peak detection

Band-edge: ANSI C63.10 Subclause -11.13.3.3 & Clause 13: Integration method -Trace averaging with continuous transmission at full power

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

Radiated emissions non-restricted frequency bands: ANSI C63.10 Subclause -11.11 & Clause 13

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4 & 13

**NOTE:** All conducted antenna port tests for Beamforming applied the same test procedures as HDR normal modes.



## 7. 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, Horn 1-18GHz                       | ETS-Lindgren                             | 3117                   | T345   | 04/20/2020 | 04/20/2019 |
| *Amplifier, 1 to 18GHz                      | Miteq                                    | AFS42-00101800-25-S-42 | T742   | 12/15/2019 | 12/15/2018 |
| Antenna, Horn 1-18GHz                       | ETS Lindgren                             | 3117                   | T136   | 06/14/2020 | 06/14/2019 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz        | Agilent (Keysight) Technologies          | N9030A                 | T342   | 01/23/2020 | 01/23/2019 |
| *Amplifier, 1 to 18GHz, 35dB                | Amplical                                 | AFS42-00101800-25-S-42 | T1567  | 01/26/2020 | 01/26/2019 |
| Filter, HPF 3.0GHz                          | MICRO-TRONICS                            | HPM17543               | T428   | 07/31/2020 | 07/31/2019 |
| Antenna, Horn 1-18GHz                       | ETS Lindgren                             | 3117                   | T712   | 02/26/2020 | 02/26/2019 |
| Amplifier, 1 to 18GHz                       | Miteq                                    | AFS42-00101800-25-S-42 | T1165  | 05/24/2020 | 05/24/2019 |
| *Spectrum Analyzer, PXA, 3Hz to 44GHz       | Agilent (Keysight) Technologies          | N9030A                 | T340   | 01/22/2020 | 01/22/2019 |
| Antenna, Horn 1-18GHz                       | ETS Lindgren                             | 3117                   | T119   | 03/22/2020 | 03/22/2019 |
| Amplifier, 1 to 18GHz                       | Miteq                                    | AFS42-00101800-25-S-42 | T740   | 07/31/2020 | 07/31/2019 |
| *Spectrum Analyzer, PXA 3Hz to 44GHz        | Keysight                                 | N9030A                 | T905   | 01/24/2020 | 01/24/2019 |
| Antenna, Horn 1-18GHz                       | ETS-Lindgren                             | 3117                   | T863   | 05/30/2020 | 05/30/2019 |
| Amplifier, 1 to 18GHz                       | Miteq                                    | AFS42-00101800-25-S-42 | T931   | 05/11/2020 | 05/11/2019 |
| *Spectrum Analyzer, PXA 3Hz to 44GHz        | Keysight                                 | N9030A                 | T1454  | 01/23/2020 | 01/23/2019 |
| *Spectrum Analyzer, PXA, 3Hz to 44GHz       | Keysight Technologies (Formerly Agilent) | N9030A                 | T906   | 01/22/2020 | 01/22/2019 |
| Antenna, Broadband Hybrid, 30MHz to 2000MHz | Sunol Sciences                           | JB1                    | T407   | 05/11/2020 | 05/11/2019 |
| Amplifier, 10KHz to 1GHz, 32dB              | Sonoma                                   | 310N                   | T285   | 06/06/2020 | 06/06/2019 |
| Antenna Horn, 18 to 26GHz                   | ARA                                      | MWH-1826               | T447   | 08/13/2020 | 08/13/2019 |
| Pre-Amp 18-26GHz                            | Agilent Technology                       | 8449B                  | T404   | 03/23/2020 | 03/23/2019 |
| *Power Meter, P-series single channel       | Keysight                                 | N1912A                 | T1244  | 01/30/2020 | 01/30/2019 |
| Power Sensor                                | Keysight                                 | N1921A                 | T1224  | 02/22/2020 | 02/22/2019 |
| Antenna, Active Loop 9KHz to 30MHz          | EMCO                                     | 6502                   | T35    | 06/06/2020 | 06/06/2019 |

| AC Line Conducted                      |                 |                |                           |            |            |
|----------------------------------------|-----------------|----------------|---------------------------|------------|------------|
| EMI Test Receiver 9KHz-7GHz            | Rohde & Schwarz | ESCI7          | T1436                     | 02/14/2020 | 02/14/2019 |
| *Power Cable, Line Conducted Emissions | UL              | PG1            | T861                      | 10/19/2019 | 10/19/2018 |
| *LISN for Conducted Emissions CISPR-16 | Fischer         | 50/250-25-2-01 | T1310                     | 01/24/2020 | 01/24/2019 |
| 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     |            |            |

\*Testing is completed before equipment expiration date.

## 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

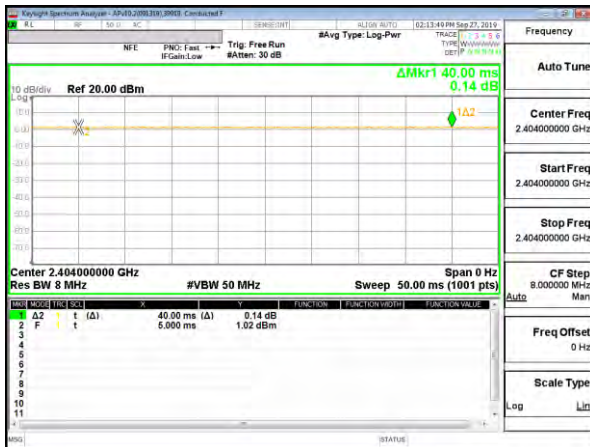
| Mode               | ON Time<br>B<br>(msec) | Period<br>(msec) | Duty Cycle<br>x<br>(linear) | Duty<br>Cycle<br>(%) | Duty Cycle<br>Correction Factor<br>(dB) | 1/B<br>Minimum VBW<br>(kHz) |
|--------------------|------------------------|------------------|-----------------------------|----------------------|-----------------------------------------|-----------------------------|
| <b>2.4GHz Band</b> |                        |                  |                             |                      |                                         |                             |
| HDR4               | 50.000                 | 50.000           | 1.000                       | 100.00%              | 0.00                                    | 0.010                       |
| HDR8               | 50.000                 | 50.000           | 1.000                       | 100.00%              | 0.00                                    | 0.010                       |
| HDR4, TXBF         | 40.000                 | 40.000           | 1.000                       | 100.00%              | 0.00                                    | 0.010                       |
| HDR8, TXBF         | 40.000                 | 40.000           | 1.000                       | 100.00%              | 0.00                                    | 0.010                       |



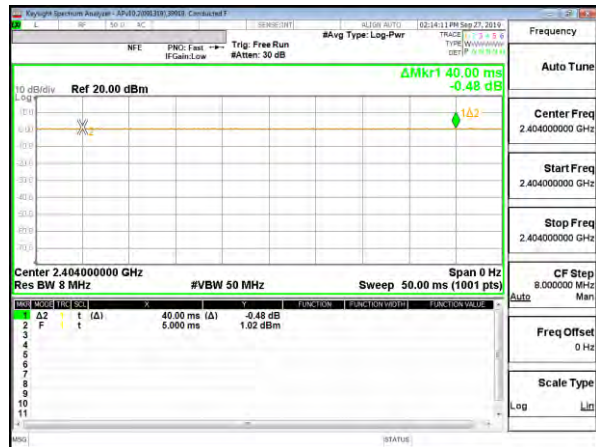
DUTY CYCLE HDR4



DUTY CYCLE HDR8



DUTY CYCLE HDR4 TXBF



DUTY CYCLE HDR8 TXBF

## **8.2. 99% BANDWIDTH**

### **LIMITS**

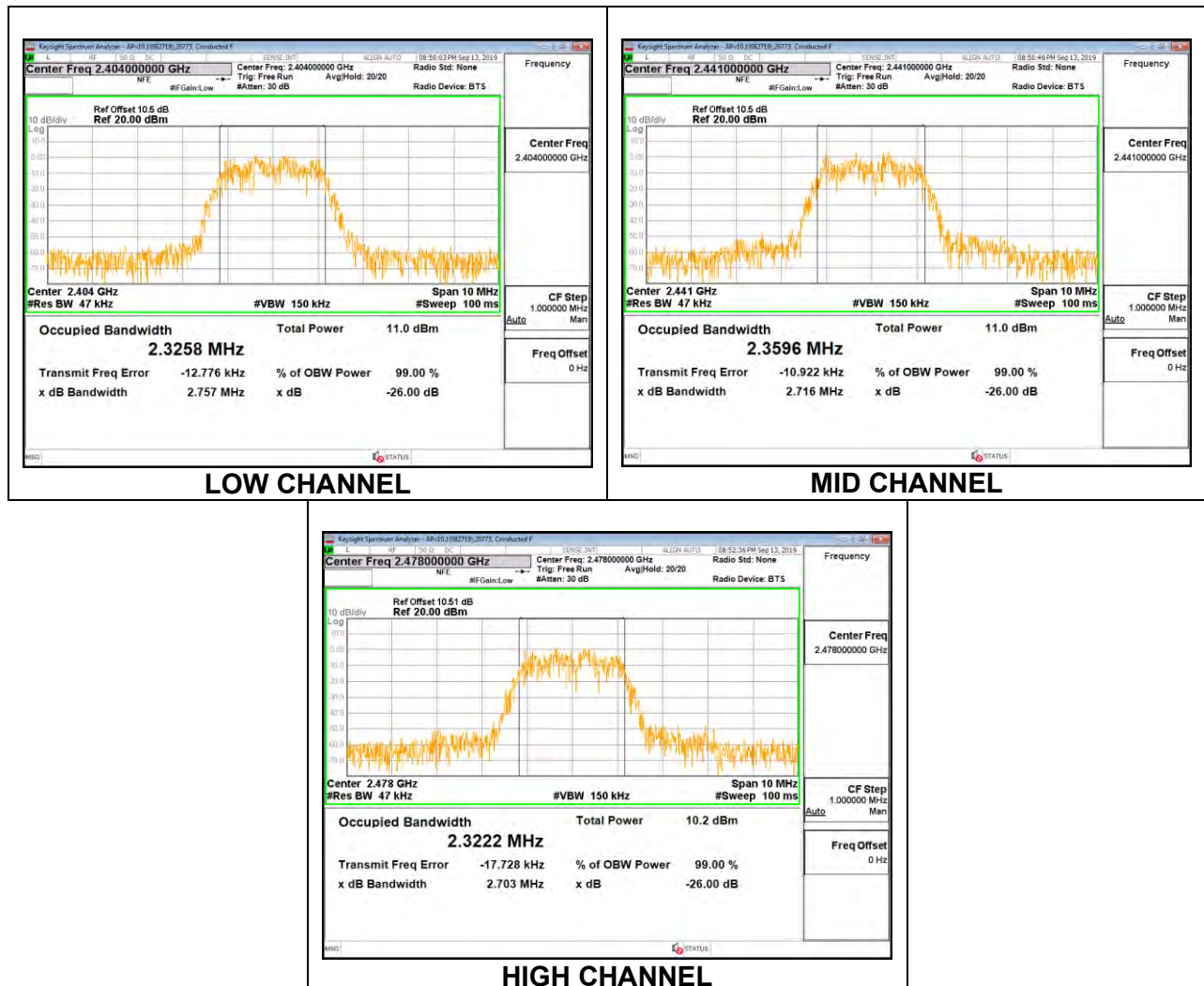
None; for reporting purposes only.

### **RESULTS**

## 8.2.1. HIGH POWER HDR (HDR4)

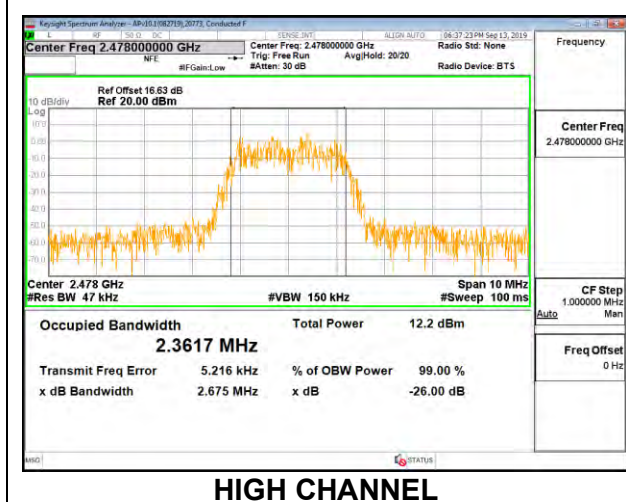
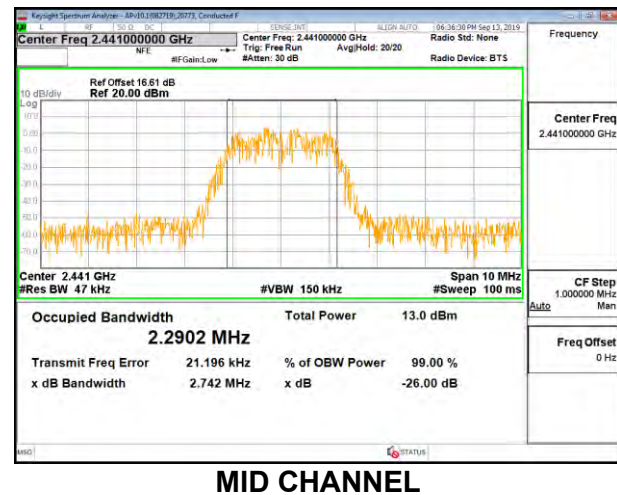
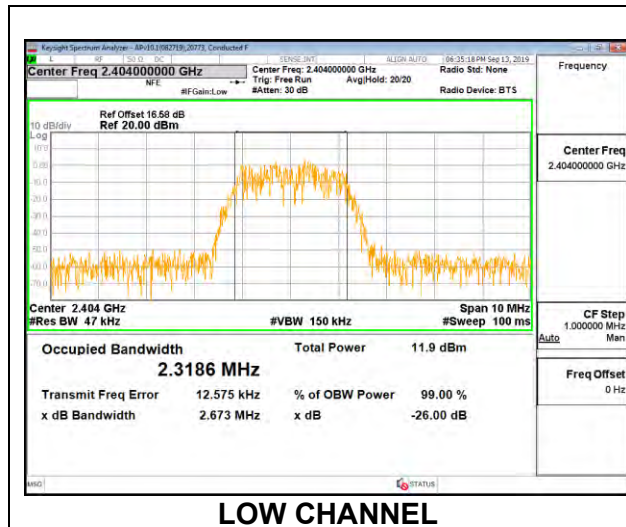
### UAT1

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 2404            | 2.326               |
| Middle  | 2441            | 2.360               |
| High    | 2478            | 2.322               |



**LAT 3**

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 2404            | 2.319               |
| Middle  | 2441            | 2.290               |
| High    | 2478            | 2.362               |

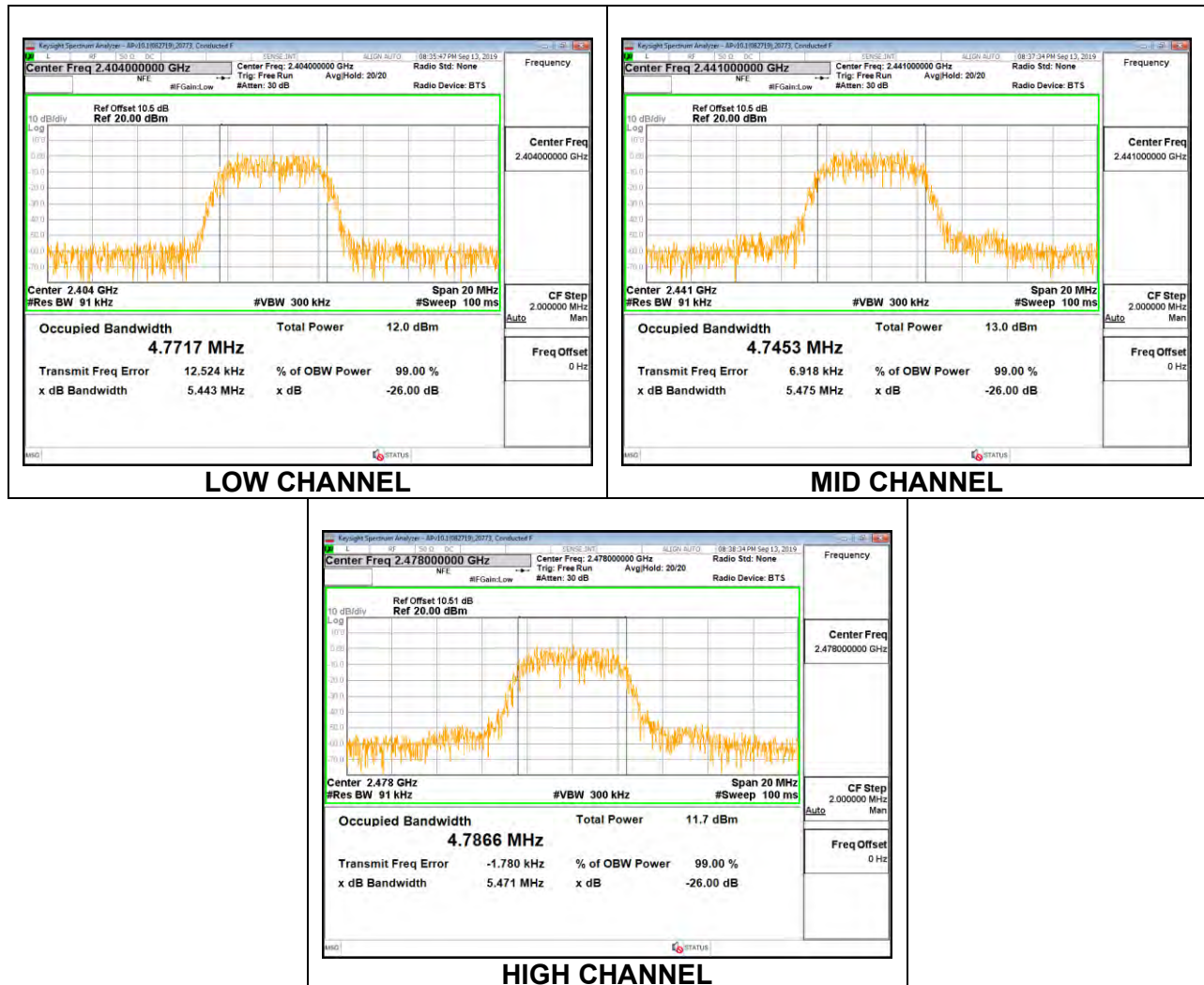




## 8.2.2. HIGH POWER HDR (HDR8)

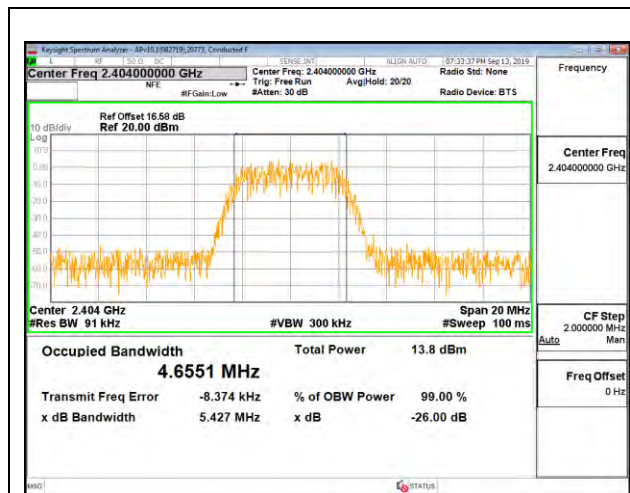
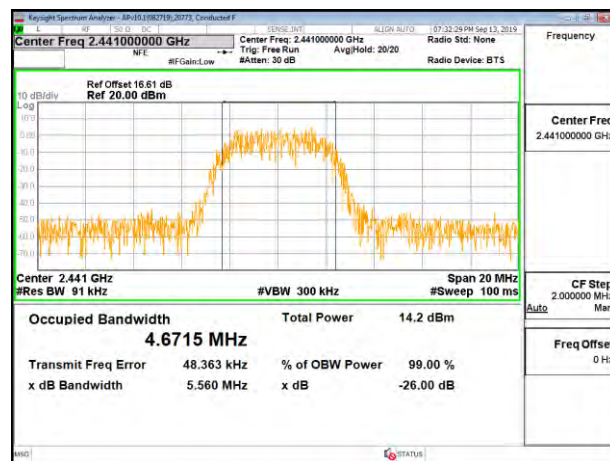
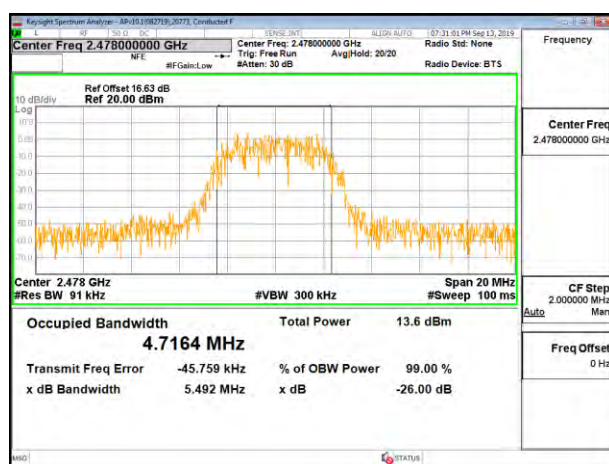
### UAT1

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 2404            | 4.772               |
| Middle  | 2441            | 4.745               |
| High    | 2478            | 4.787               |



**LAT 3**

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 2404            | 4.655               |
| Middle  | 2441            | 4.672               |
| High    | 2478            | 4.716               |

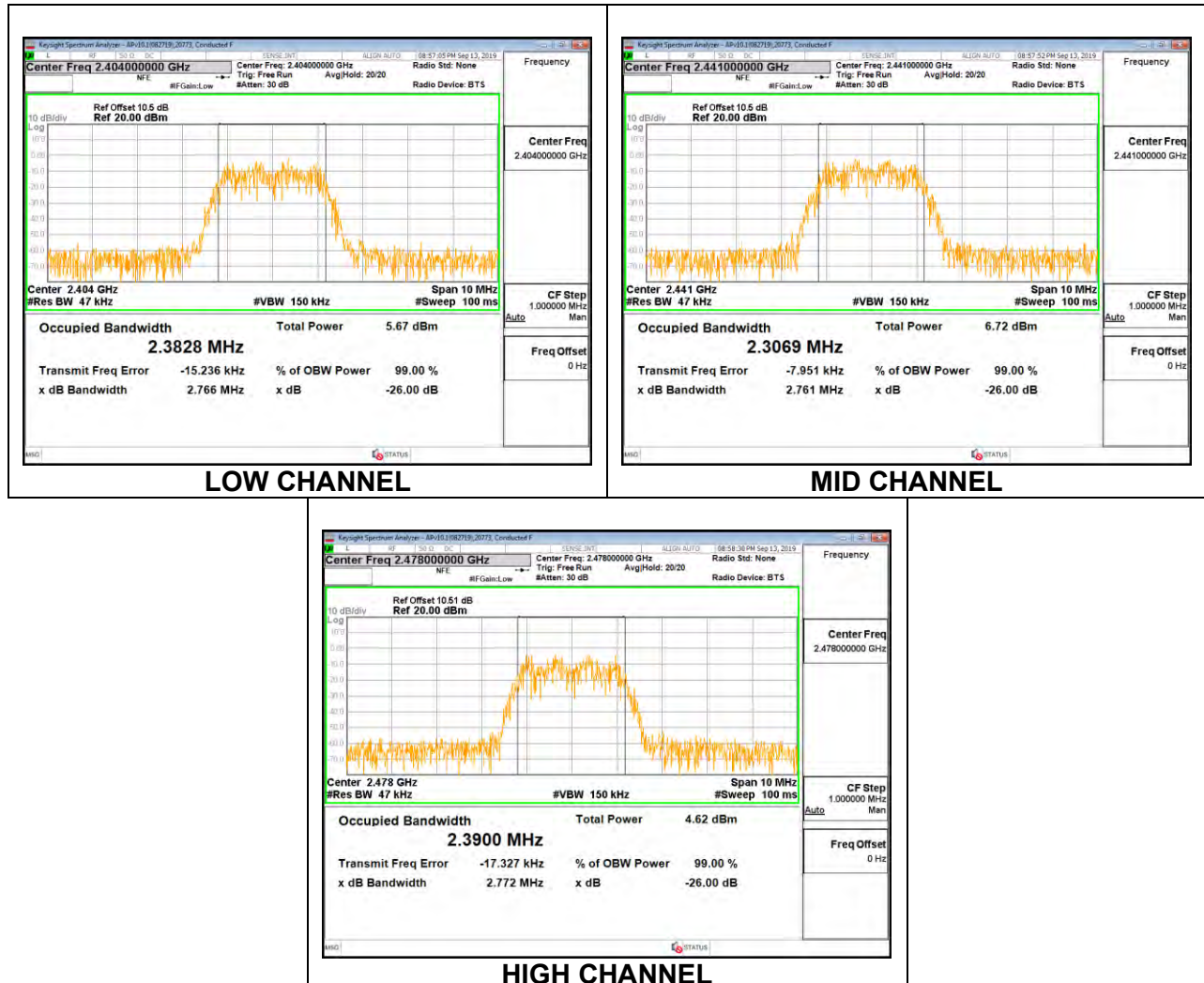
**LOW CHANNEL****MID CHANNEL****HIGH CHANNEL**



### 8.2.3. LOW POWER HDR (HDR4)

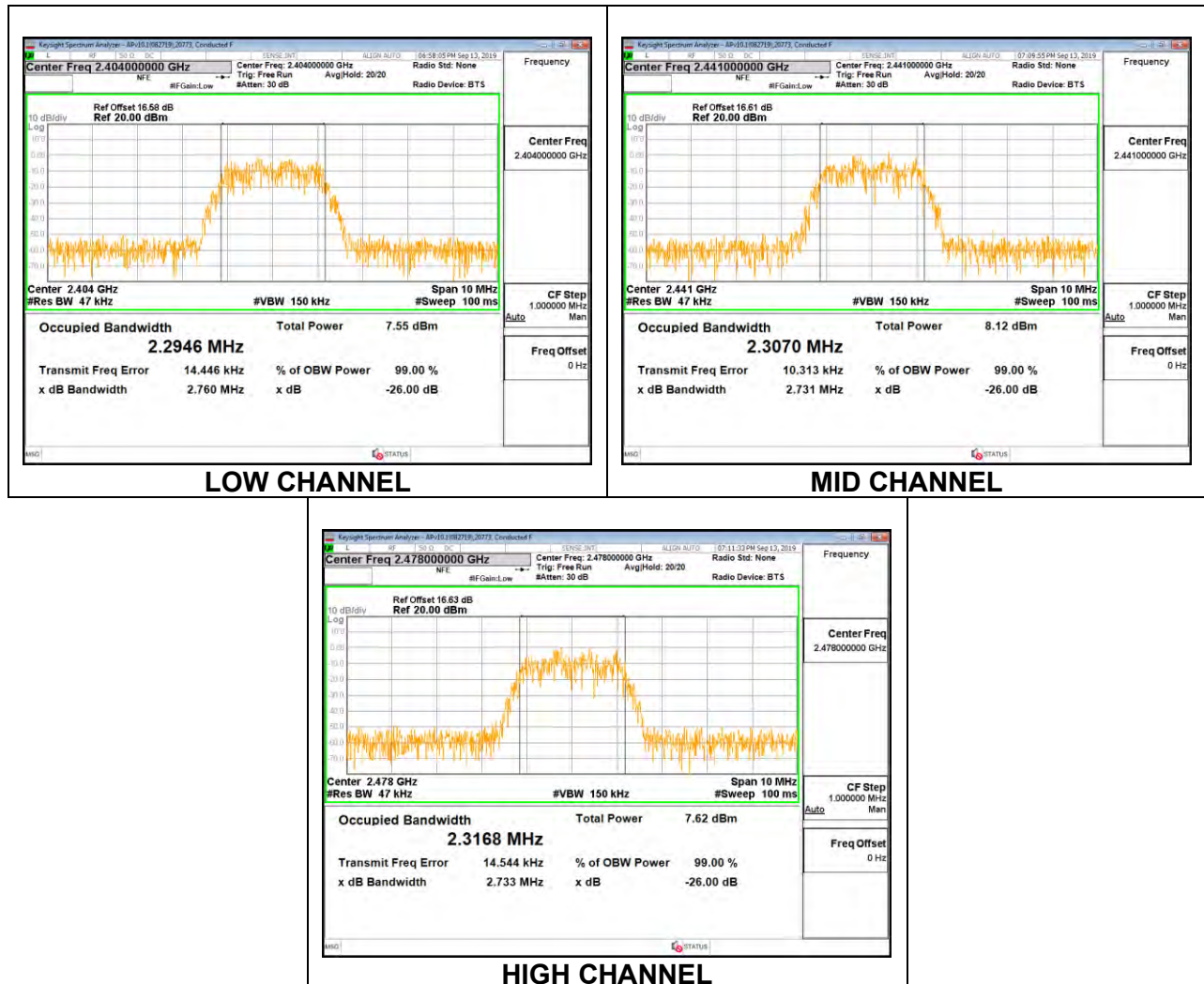
#### UAT1

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 2404            | 2.383               |
| Middle  | 2441            | 2.307               |
| High    | 2478            | 2.390               |



**LAT 3**

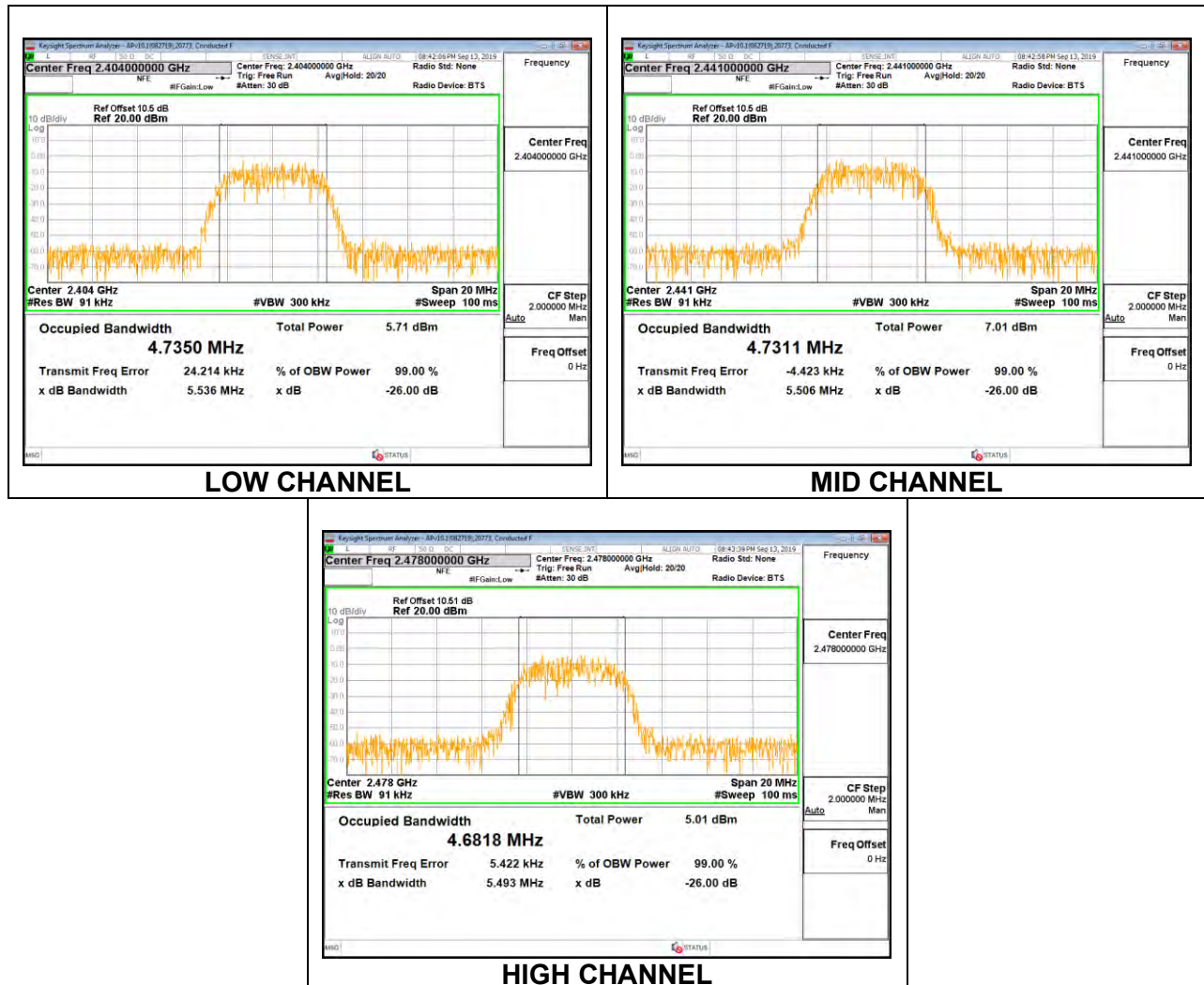
| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 2404            | 2.295               |
| Middle  | 2441            | 2.307               |
| High    | 2478            | 2.317               |



## 8.2.4. LOW POWER HDR (HDR8)

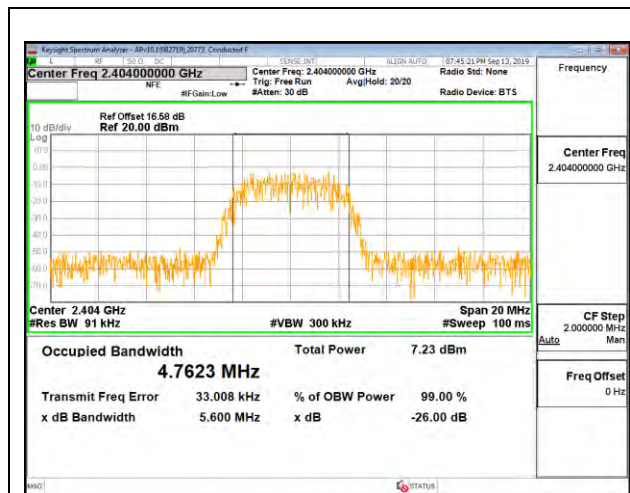
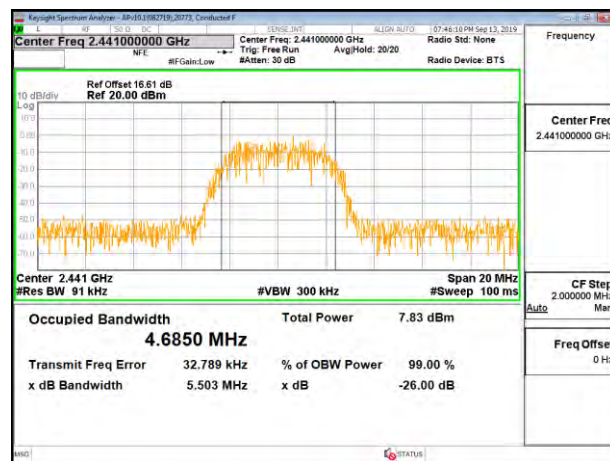
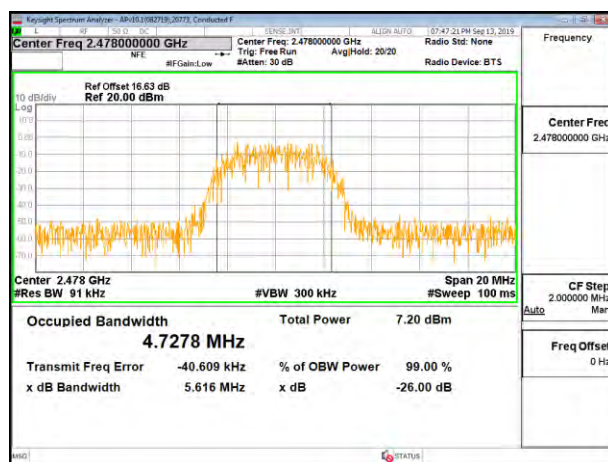
### UAT1

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 2404            | 4.735               |
| Middle  | 2441            | 4.731               |
| High    | 2478            | 4.682               |



**LAT 3**

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---------|-----------------|---------------------|
| Low     | 2404            | 4.762               |
| Middle  | 2441            | 4.685               |
| High    | 2478            | 4.728               |

**LOW CHANNEL****MID CHANNEL****HIGH CHANNEL**

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

#### **LIMITS**

FCC §15.407 (e)

RSS-247 5.2 (a)

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

#### **RESULTS**



**8.3.1. HIGH POWER HDR (HDR4)****UAT1**

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low     | 2404            | 2.104                | 0.5                 |
| Middle  | 2441            | 2.112                | 0.5                 |
| High    | 2478            | 2.108                | 0.5                 |



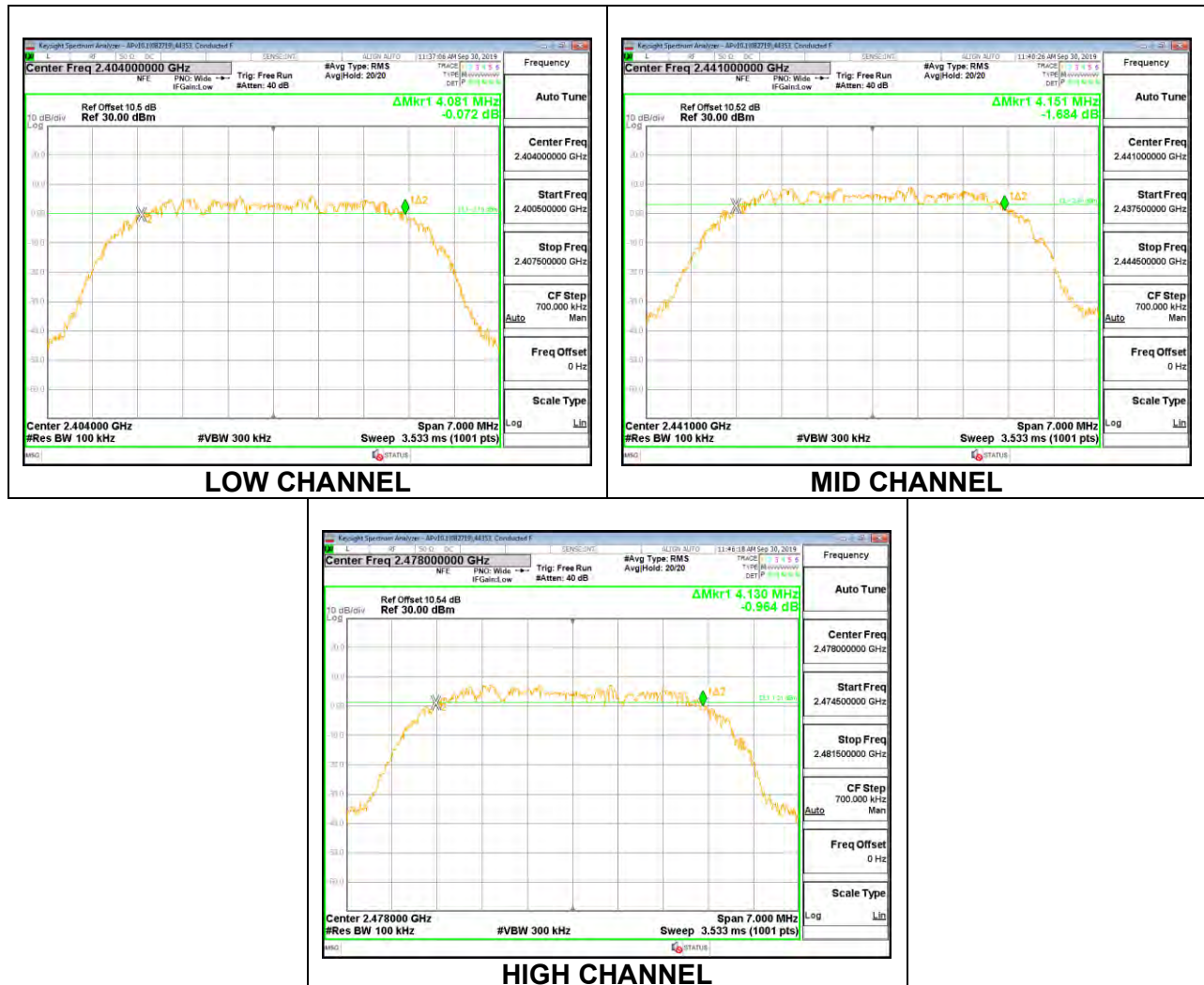
**LAT 3**

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low     | 2404            | 2.092                | 0.5                 |
| Middle  | 2441            | 2.088                | 0.5                 |
| High    | 2478            | 2.080                | 0.5                 |



**8.3.2. HIGH POWER HDR (HDR8)****UAT1**

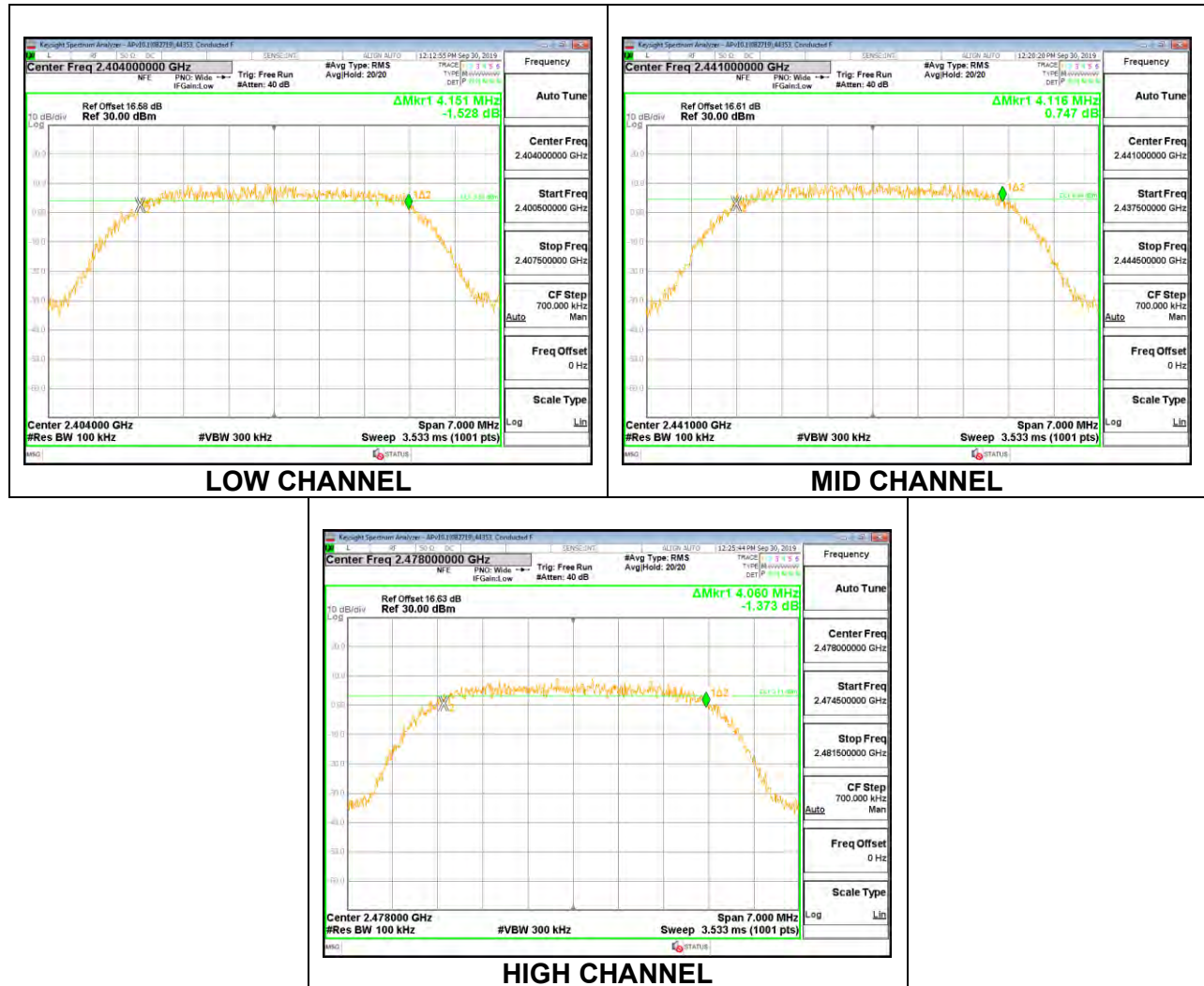
| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low     | 2404            | 4.081                | 0.5                 |
| Middle  | 2441            | 4.151                | 0.5                 |
| High    | 2478            | 4.130                | 0.5                 |





**LAT 3**

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low     | 2404            | 4.151                | 0.5                 |
| Middle  | 2441            | 4.116                | 0.5                 |
| High    | 2478            | 4.060                | 0.5                 |



**8.3.3. LOW POWER HDR (HDR4)****UAT1**

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low     | 2404            | 2.100                | 0.5                 |
| Middle  | 2441            | 2.084                | 0.5                 |
| High    | 2478            | 2.112                | 0.5                 |



**LAT 3**

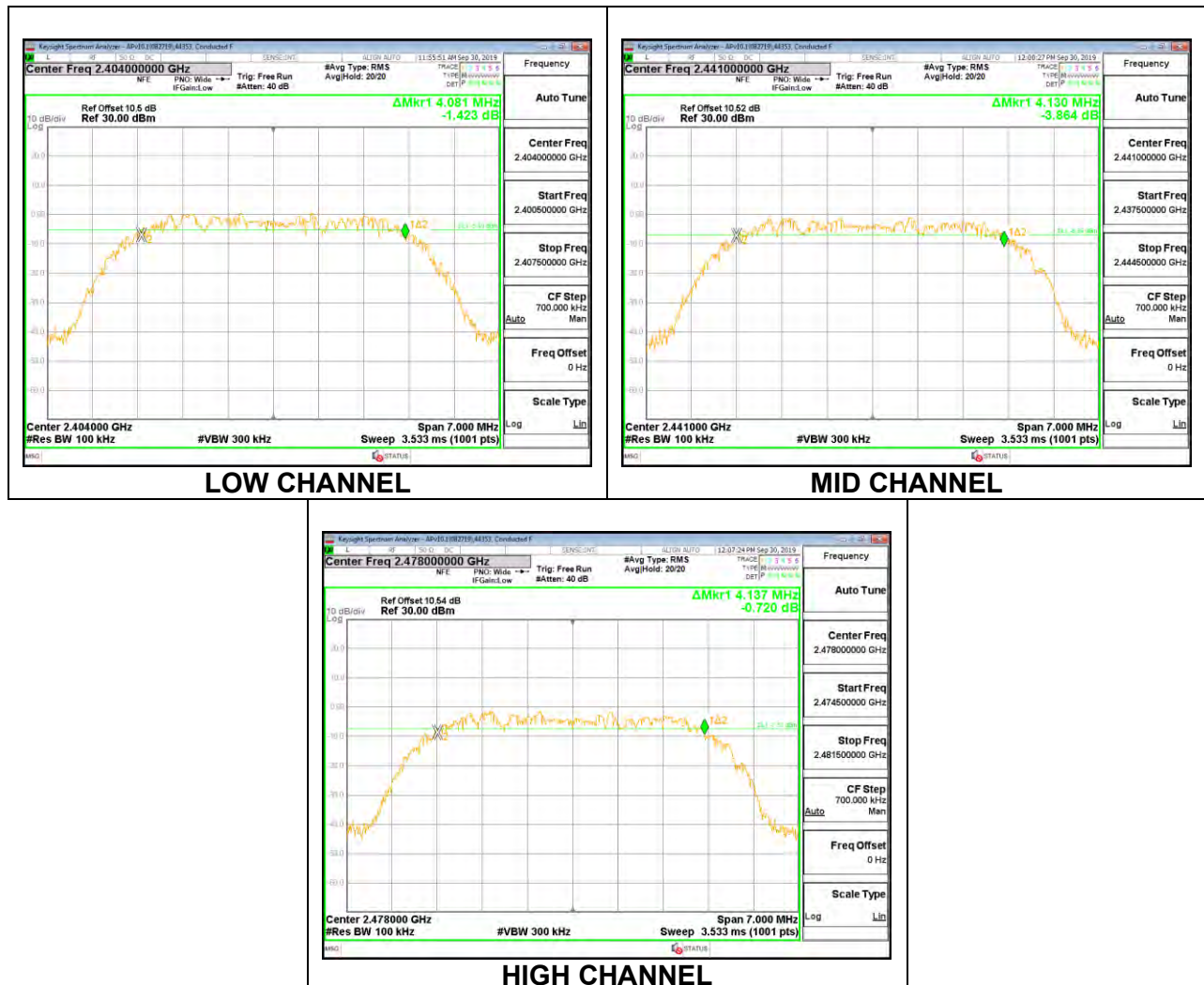
| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low     | 2404            | 2.064                | 0.5                 |
| Middle  | 2441            | 2.048                | 0.5                 |
| High    | 2478            | 2.056                | 0.5                 |



### 8.3.4. LOW POWER HDR (HDR8)

#### UAT1

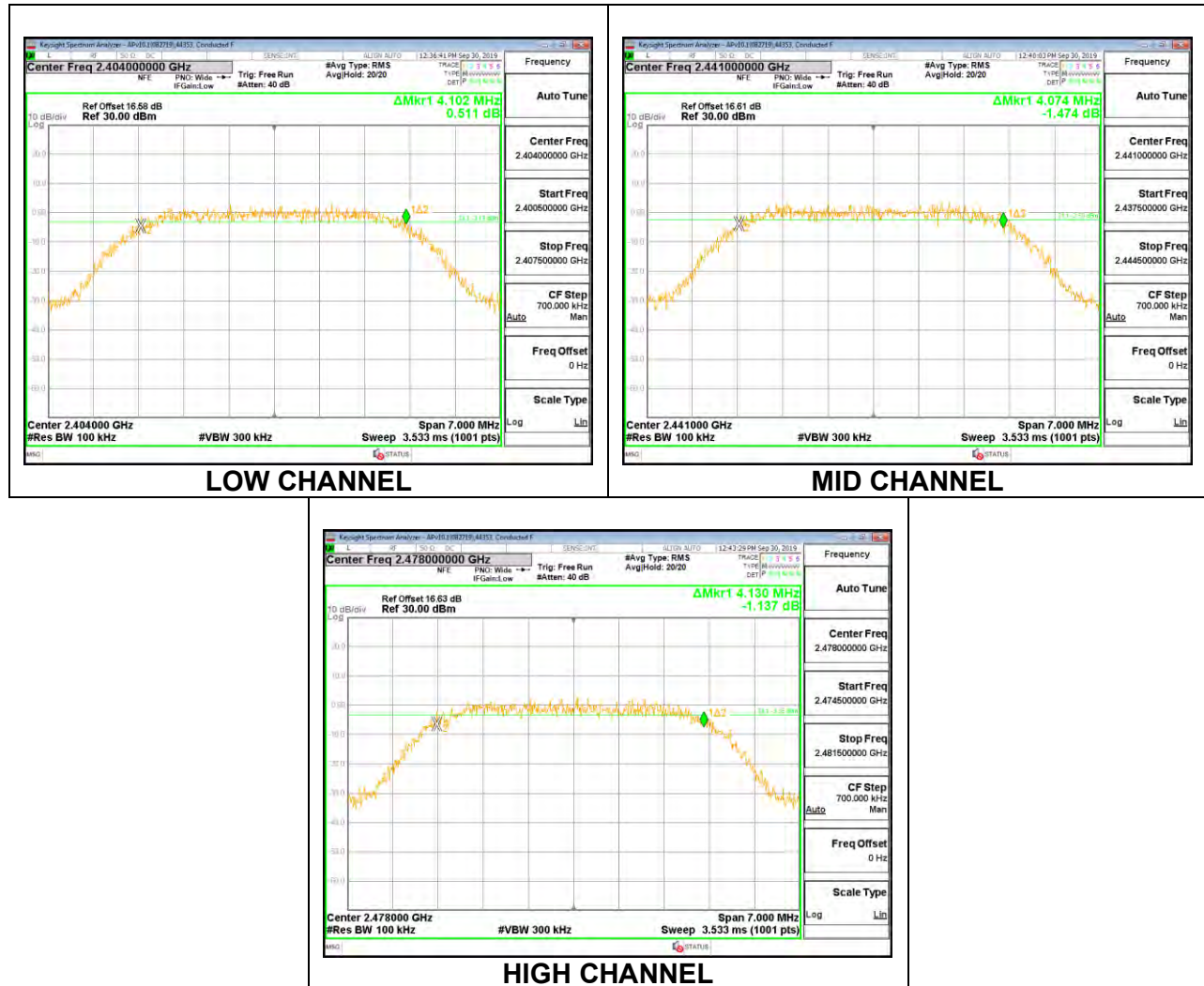
| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low     | 2404            | 4.081                | 0.5                 |
| Middle  | 2441            | 4.130                | 0.5                 |
| High    | 2478            | 4.137                | 0.5                 |





**LAT 3**

| Channel | Frequency (MHz) | 6 dB Bandwidth (MHz) | Minimum Limit (MHz) |
|---------|-----------------|----------------------|---------------------|
| Low     | 2404            | 4.102                | 0.5                 |
| Middle  | 2441            | 4.074                | 0.5                 |
| High    | 2478            | 4.130                | 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 of 10.5 dB (including 10 dB pad and 0.5 dB cable) was entered as an offset in the power meter to allow for a gated peak reading of power.

### **DIRECTIONAL ANTENNA GAIN**

For 1 TX:

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

For 2 TX:

Tx chains are correlated for power and PSD due to the device supporting Beamforming mode documented in section 8.10. The directional gains are as follows:

| <b>Band<br/>(GHz)</b> | <b>UAT 1<br/>Antenna<br/>Gain<br/>(dBi)</b> | <b>LAT 3<br/>Antenna<br/>Gain<br/>(dBi)</b> | <b>Uncorrelated Chains<br/>Directional<br/>Gain<br/>(dBi)</b> | <b>Correlated Chains<br/>Directional<br/>Gain<br/>(dBi)</b> |
|-----------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------|
| 2.4                   | -2.50                                       | -1.30                                       | -1.86                                                         | 1.13                                                        |

### **RESULTS**

#### 8.4.1. HIGH POWER HDR (HDR4)

##### UAT1

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>Peak Power<br/>Reading<br/>(dBm)</b> | <b>Limit<br/>(dBm)</b> | <b>Margin<br/>(dB)</b> |
|----------------|----------------------------|-----------------------------------------|------------------------|------------------------|
| Low            | 2404                       | 14.42                                   | 30                     | -15.58                 |
| Middle         | 2441                       | 14.51                                   | 30                     | -15.49                 |
| High           | 2478                       | 14.51                                   | 30                     | -15.49                 |

##### LAT 3

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>Peak Power<br/>Reading<br/>(dBm)</b> | <b>Limit<br/>(dBm)</b> | <b>Margin<br/>(dB)</b> |
|----------------|----------------------------|-----------------------------------------|------------------------|------------------------|
| Low            | 2404                       | 14.37                                   | 30                     | -15.63                 |
| Middle         | 2441                       | 14.35                                   | 30                     | -15.65                 |
| High           | 2478                       | 14.43                                   | 30                     | -15.57                 |

#### 8.4.2. HIGH POWER HDR (HDR8)

##### UAT1

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>Peak Power<br/>Reading<br/>(dBm)</b> | <b>Limit<br/>(dBm)</b> | <b>Margin<br/>(dB)</b> |
|----------------|----------------------------|-----------------------------------------|------------------------|------------------------|
| Low            | 2404                       | 14.94                                   | 30                     | -15.06                 |
| Middle         | 2441                       | 14.93                                   | 30                     | -15.07                 |
| High           | 2478                       | 15.04                                   | 30                     | -14.96                 |

##### LAT 3

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>Peak Power<br/>Reading<br/>(dBm)</b> | <b>Limit<br/>(dBm)</b> | <b>Margin<br/>(dB)</b> |
|----------------|----------------------------|-----------------------------------------|------------------------|------------------------|
| Low            | 2404                       | 14.93                                   | 30                     | -15.07                 |
| Middle         | 2441                       | 14.87                                   | 30                     | -15.13                 |
| High           | 2478                       | 14.96                                   | 30                     | -15.04                 |



### 8.4.3. LOW POWER HDR (HDR4)

#### UAT1

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| Channel | Frequency<br>(MHz) | Peak Power<br>Reading<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|--------------------------------|----------------|----------------|
| Low     | 2404               | 8.91                           | 30             | -21.090        |
| Middle  | 2441               | 8.96                           | 30             | -21.040        |
| High    | 2478               | 9.06                           | 30             | -20.940        |

#### LAT 3

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| Channel | Frequency<br>(MHz) | Peak Power<br>Reading<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|--------------------------------|----------------|----------------|
| Low     | 2404               | 8.92                           | 30             | -21.080        |
| Middle  | 2441               | 8.90                           | 30             | -21.100        |
| High    | 2478               | 8.94                           | 30             | -21.060        |

#### 8.4.4. LOW POWER HDR (HDR8)

##### UAT1

|            |          |
|------------|----------|
| Tested By: | 12492    |
| Date:      | 1/3/2020 |

| Channel | Frequency<br>(MHz) | Peak Power<br>Reading<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|--------------------------------|----------------|----------------|
| Low     | 2404               | 9.39                           | 30             | -20.61         |
| Middle  | 2441               | 9.46                           | 30             | -20.54         |
| High    | 2478               | 9.57                           | 30             | -20.43         |

##### LAT 3

|            |          |
|------------|----------|
| Tested By: | 12492    |
| Date:      | 1/3/2020 |

| Channel | Frequency<br>(MHz) | Peak Power<br>Reading<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|--------------------------------|----------------|----------------|
| Low     | 2404               | 9.42                           | 30             | -20.58         |
| Middle  | 2441               | 9.47                           | 30             | -20.53         |
| High    | 2478               | 9.49                           | 30             | -20.51         |

## **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 of 10.5 dB (including 10 dB pad and 0.5 dB cable) was entered as an offset in the power meter to allow for a gated average reading of power.

### **RESULTS**

### 8.5.1. HIGH POWER HDR (HDR4)

#### UAT1

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>AV power<br/>(dBm)</b> |
|----------------|----------------------------|---------------------------|
| Low            | 2404                       | 11.87                     |
| Middle         | 2441                       | 11.94                     |
| High           | 2478                       | 11.95                     |

#### LAT 3

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>AV power<br/>(dBm)</b> |
|----------------|----------------------------|---------------------------|
| Low            | 2404                       | 11.80                     |
| Middle         | 2441                       | 11.82                     |
| High           | 2478                       | 11.85                     |

### 8.5.2. HIGH POWER HDR (HDR8)

#### UAT1

|            |          |
|------------|----------|
| Tested By: | 12492    |
| Date:      | 1/3/2020 |

| Channel | Frequency<br>(MHz) | AV power<br>(dBm) |
|---------|--------------------|-------------------|
| Low     | 2404               | 11.90             |
| Middle  | 2441               | 11.87             |
| High    | 2478               | 11.96             |

#### LAT 3

|            |          |
|------------|----------|
| Tested By: | 12492    |
| Date:      | 1/3/2020 |

| Channel | Frequency<br>(MHz) | AV power<br>(dBm) |
|---------|--------------------|-------------------|
| Low     | 2404               | 11.79             |
| Middle  | 2441               | 11.80             |
| High    | 2478               | 11.82             |

### 8.5.3. LOW POWER HDR (HDR4)

#### UAT1

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>AV power<br/>(dBm)</b> |
|----------------|----------------------------|---------------------------|
| Low            | 2404                       | 6.39                      |
| Middle         | 2441                       | 6.42                      |
| High           | 2478                       | 6.48                      |

#### LAT 3

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>AV power<br/>(dBm)</b> |
|----------------|----------------------------|---------------------------|
| Low            | 2404                       | 6.40                      |
| Middle         | 2441                       | 6.37                      |
| High           | 2478                       | 6.38                      |

#### 8.5.4. LOW POWER HDR (HDR8)

##### UAT1

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>AV power<br/>(dBm)</b> |
|----------------|----------------------------|---------------------------|
| Low            | 2404                       | 6.37                      |
| Middle         | 2441                       | 6.42                      |
| High           | 2478                       | 6.48                      |

##### LAT 3

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>AV power<br/>(dBm)</b> |
|----------------|----------------------------|---------------------------|
| Low            | 2404                       | 6.39                      |
| Middle         | 2441                       | 6.41                      |
| High           | 2478                       | 6.42                      |



## **8.6. POWER SPECTRAL DENSITY**

### **LIMITS**

FCC §15.247 (e)

RSS-247 (5.2) (b)

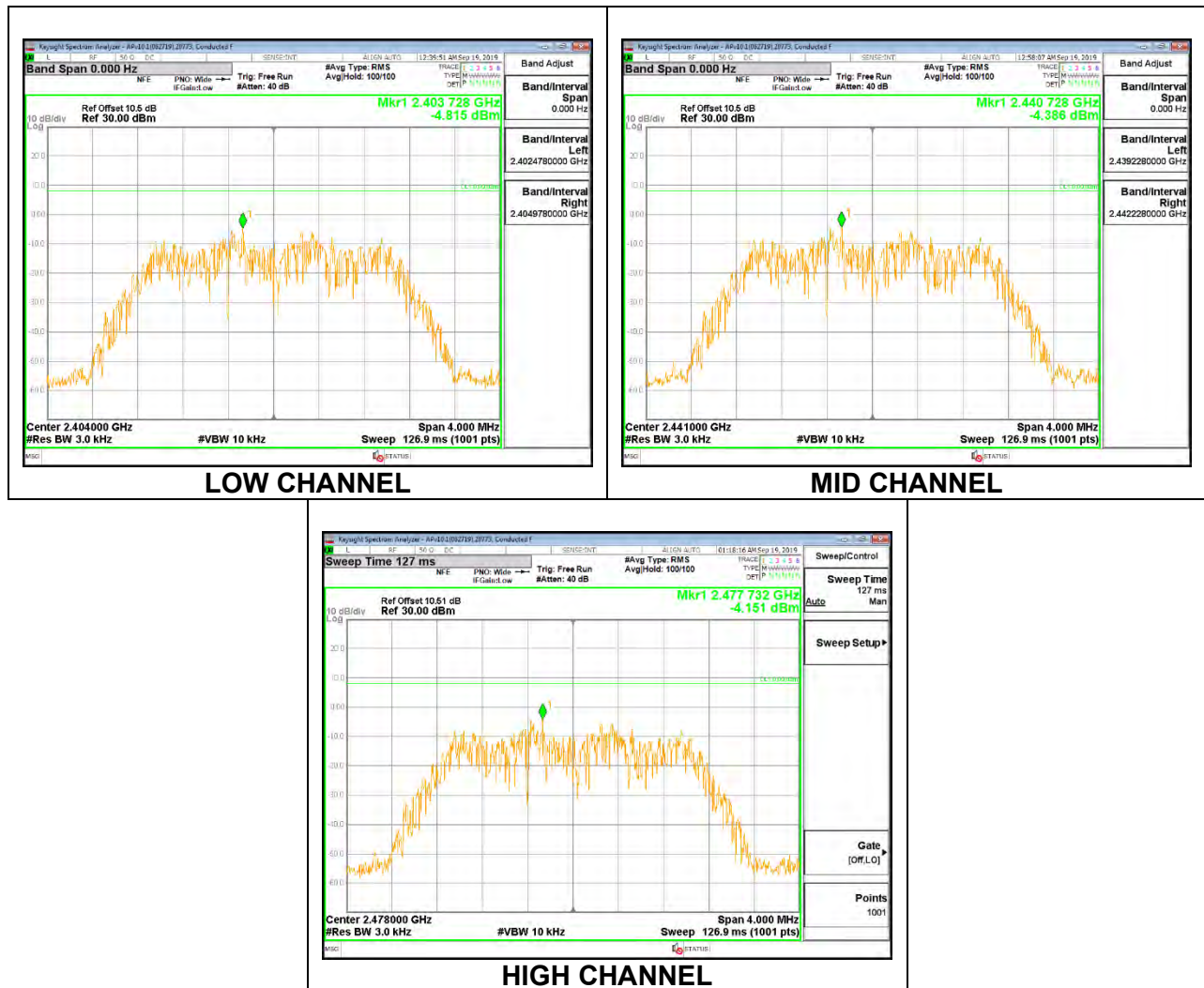
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### **RESULTS**

### 8.6.1. HIGH POWER HDR (HDR4)

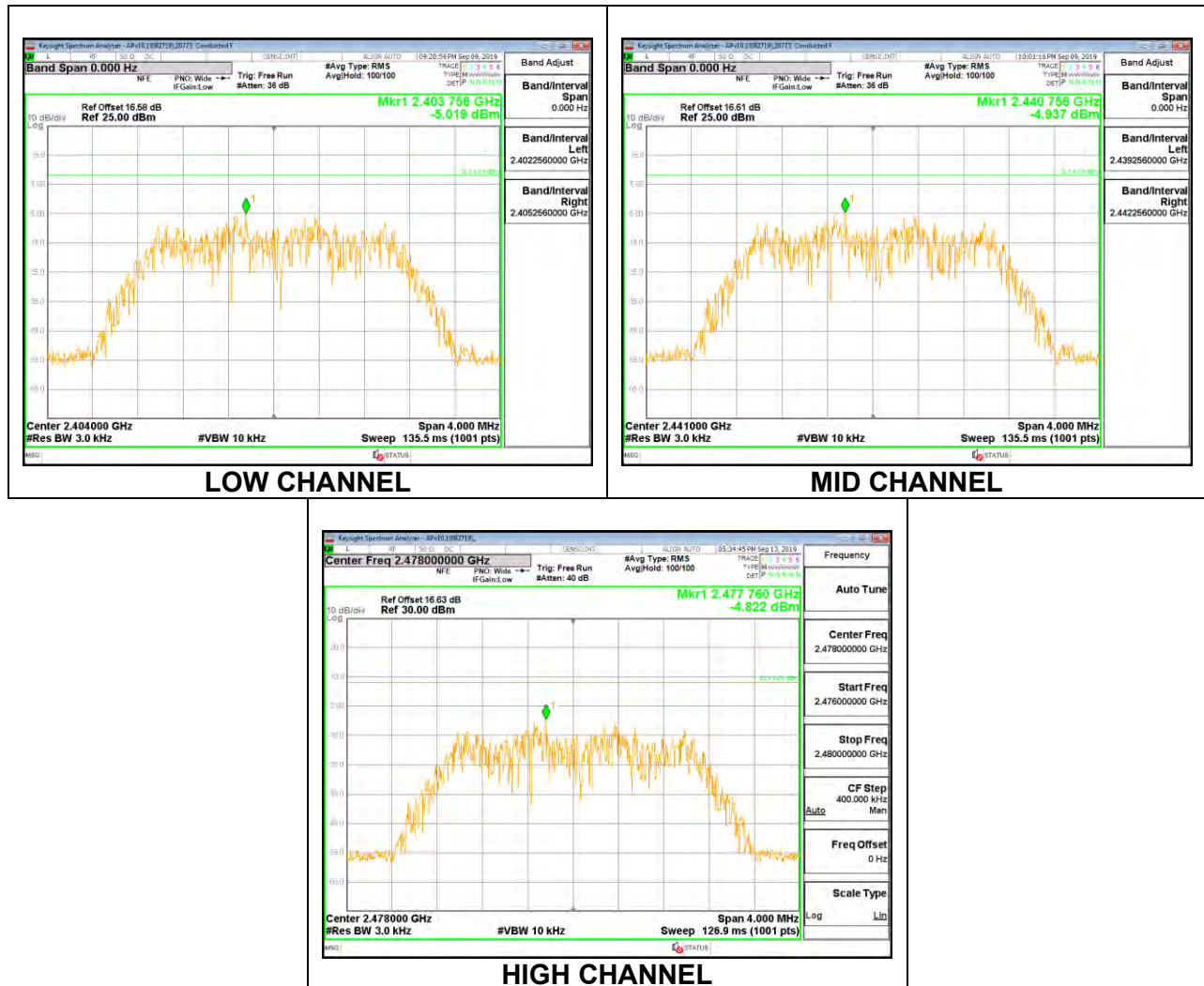
#### UAT1

| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low     | 2404            | -4.815         | 8                | -12.82      |
| Middle  | 2441            | -4.386         | 8                | -12.39      |
| High    | 2478            | -4.151         | 8                | -12.15      |



**LAT 3**

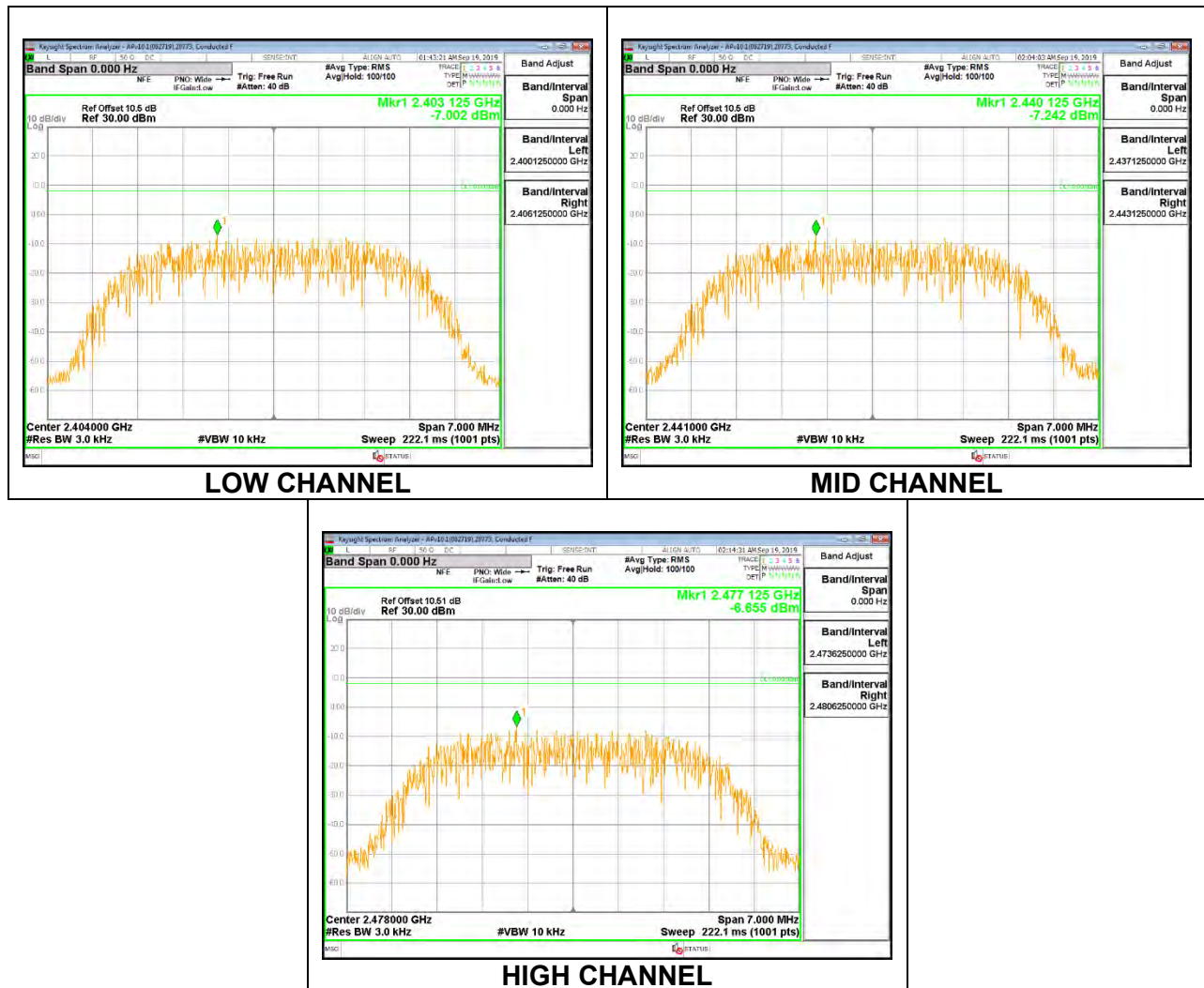
| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low     | 2404            | -5.019         | 8                | -13.02      |
| Middle  | 2441            | -4.937         | 8                | -12.94      |
| High    | 2478            | -4.822         | 8                | -12.82      |



## 8.6.2. HIGH POWER HDR (HDR8)

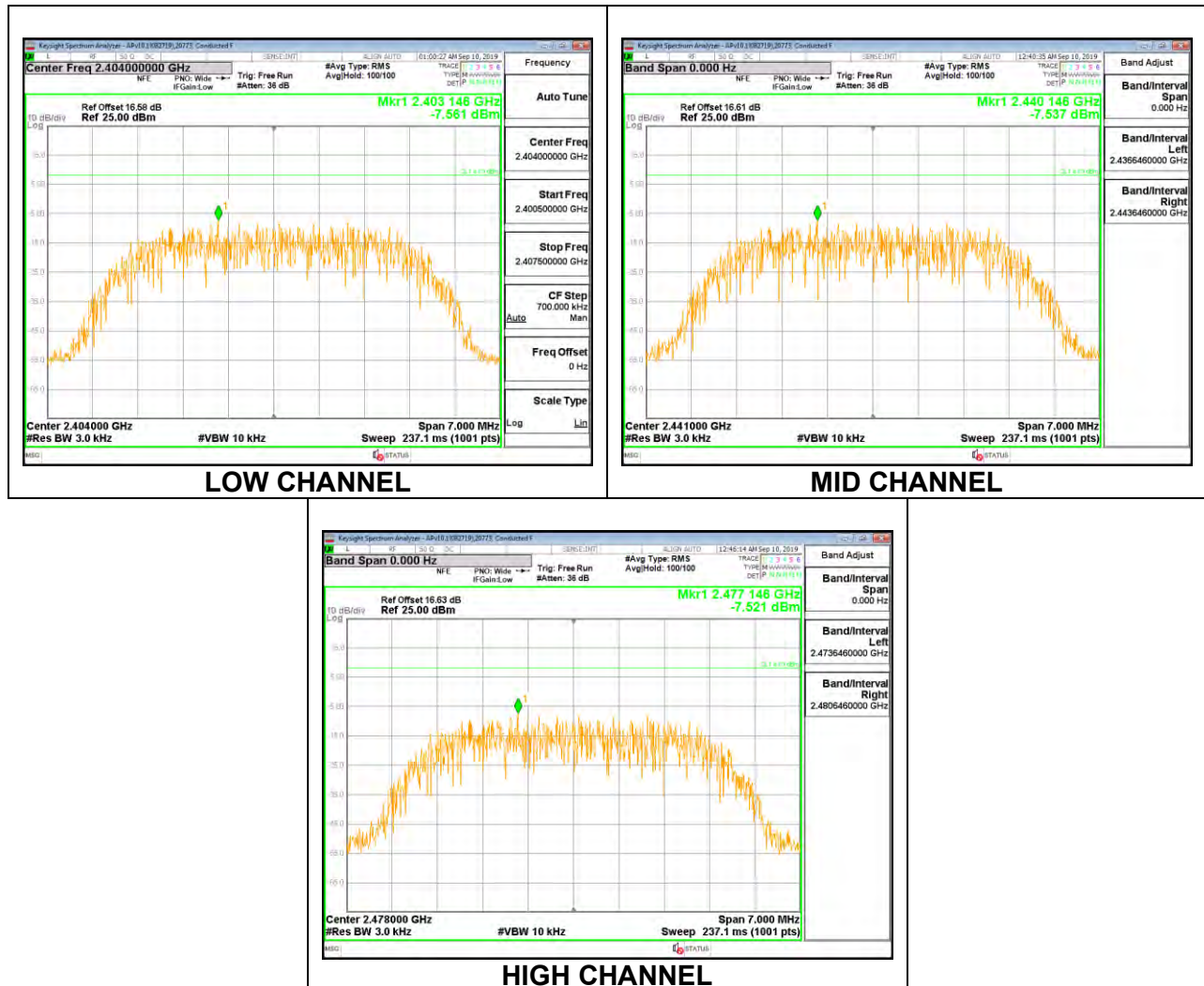
### UAT1

| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low     | 2404            | -7.002         | 8                | -15.00      |
| Middle  | 2441            | -7.242         | 8                | -15.24      |
| High    | 2478            | -6.655         | 8                | -14.66      |



**LAT 3**

| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low     | 2404            | -7.561         | 8                | -15.56      |
| Middle  | 2441            | -7.537         | 8                | -15.54      |
| High    | 2478            | -7.521         | 8                | -15.52      |

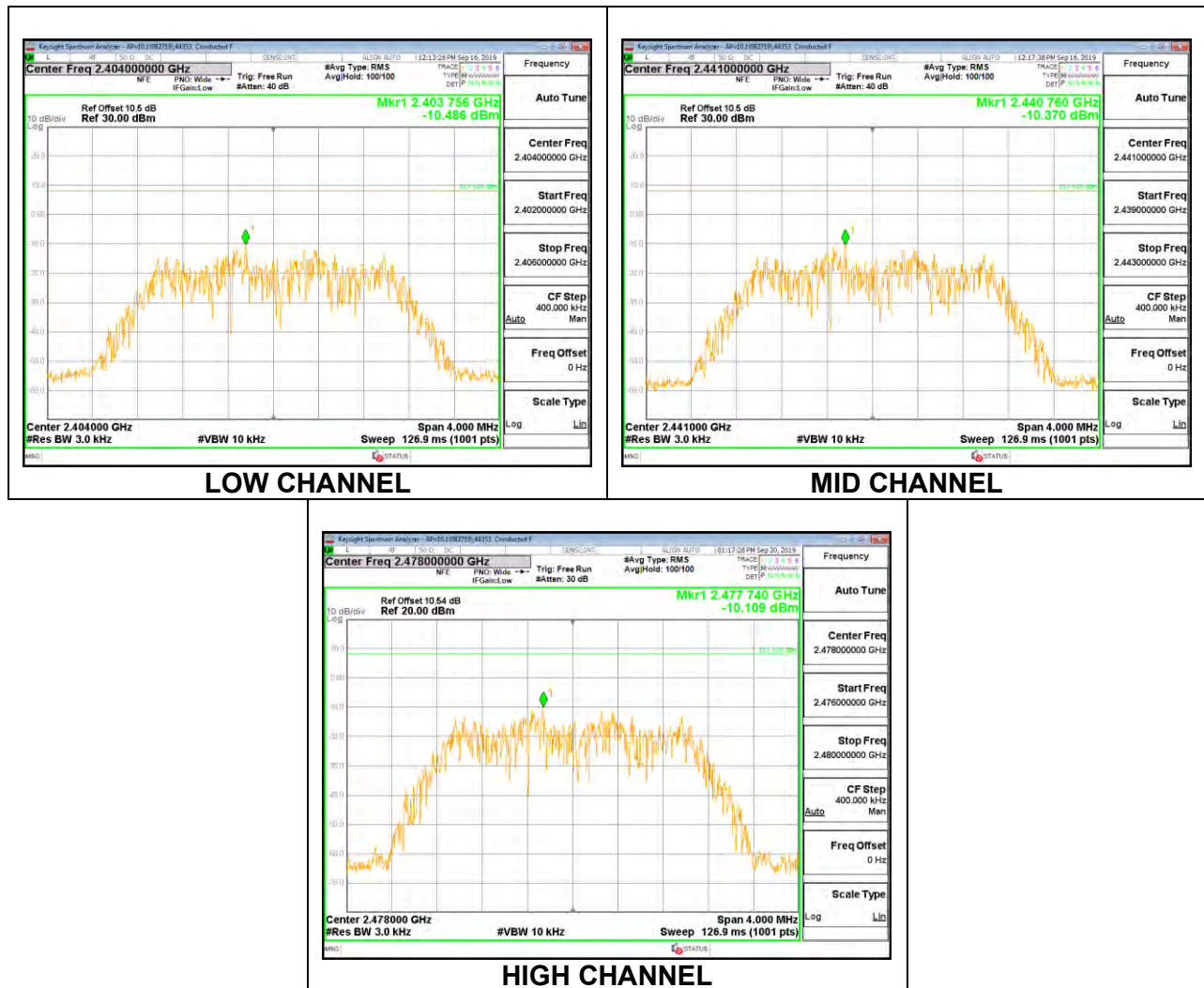




### 8.6.3. LOW POWER HDR (HDR4)

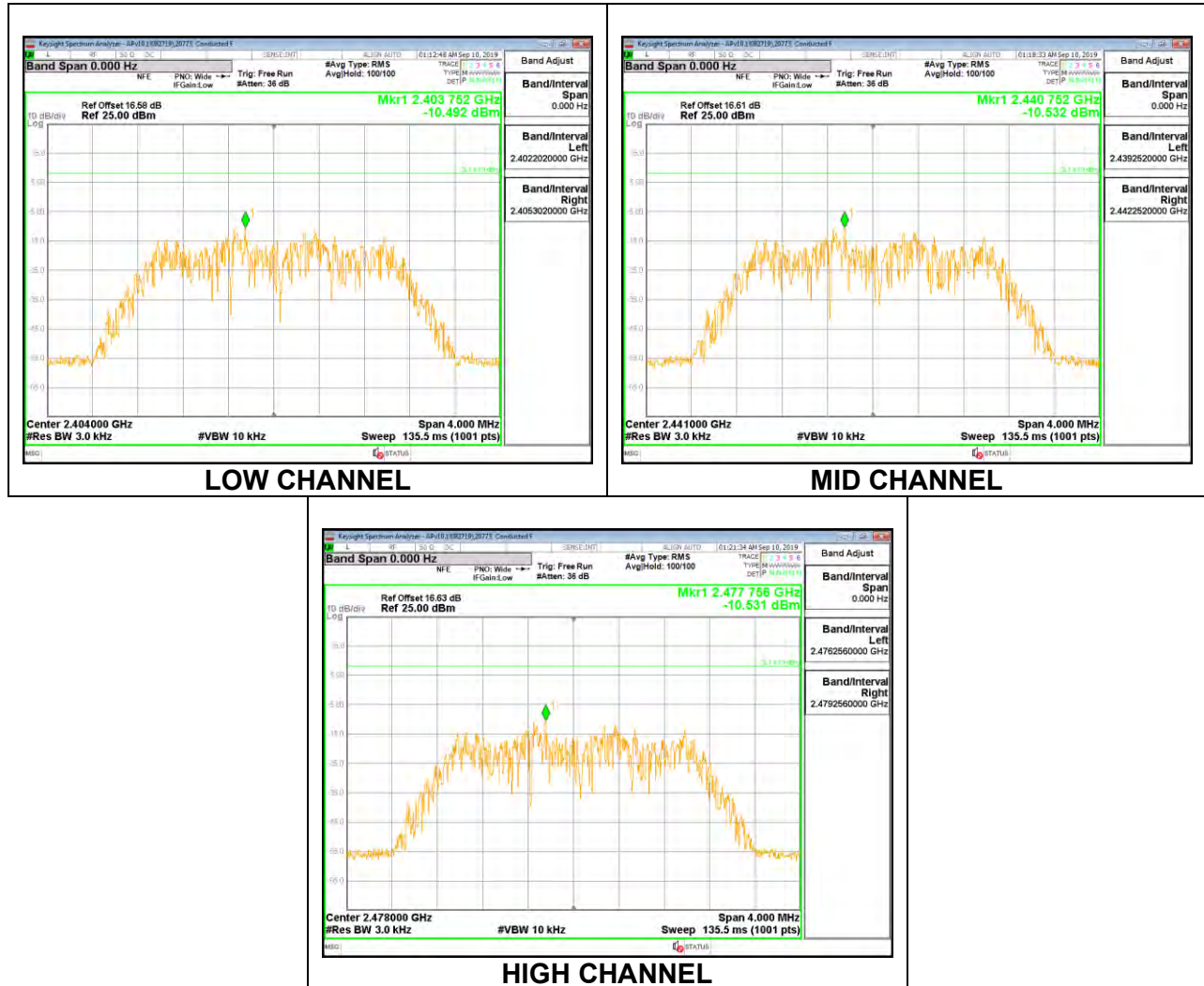
#### UAT1

| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low     | 2404            | -10.486        | 8                | -18.49      |
| Middle  | 2441            | -10.370        | 8                | -18.37      |
| High    | 2478            | -10.109        | 8                | -18.11      |



**LAT 3**

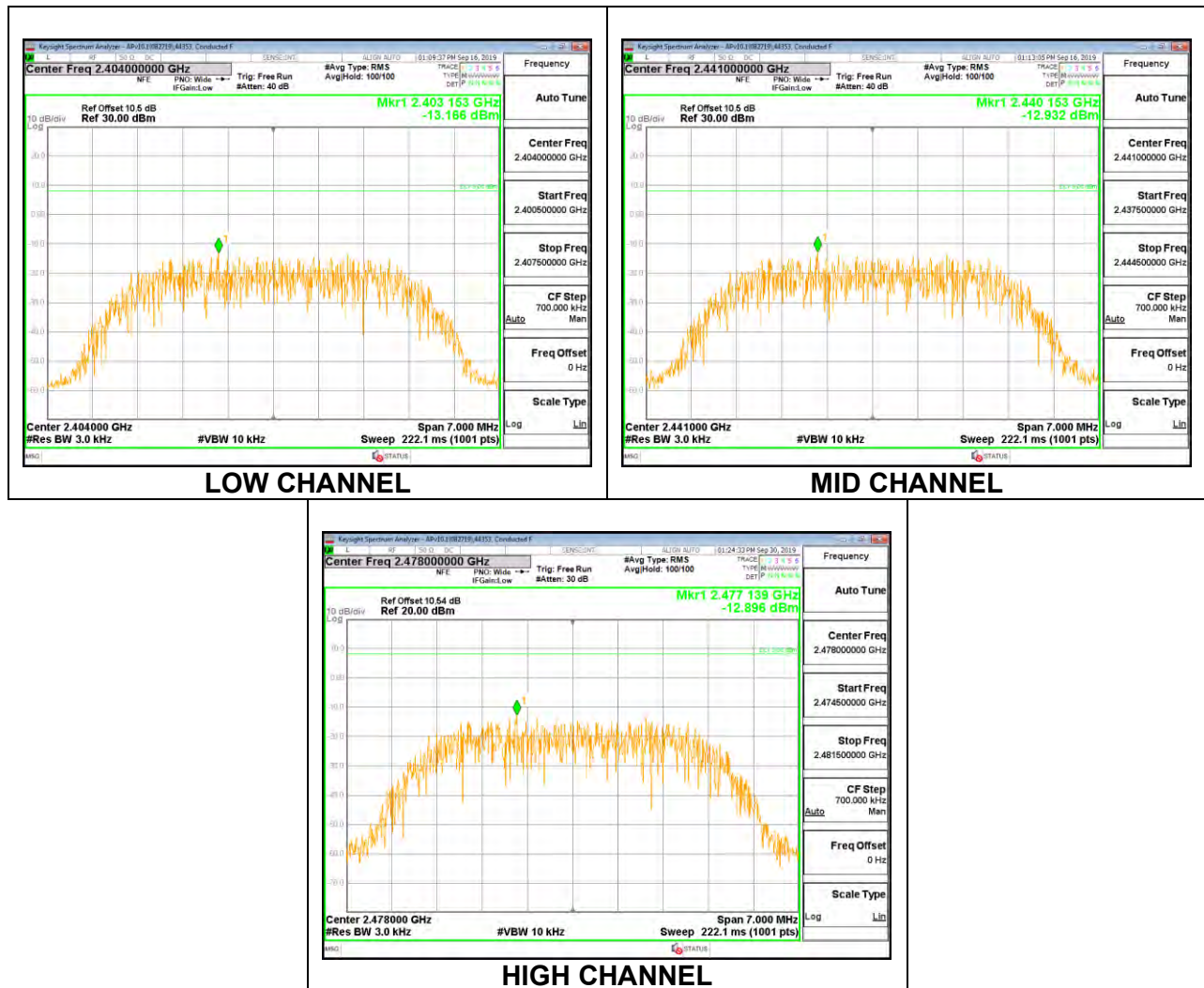
| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low     | 2404            | -10.492        | 8                | -18.49      |
| Middle  | 2441            | -10.532        | 8                | -18.53      |
| High    | 2478            | -10.531        | 8                | -18.53      |



# 8.6.4. LOW POWER HDR (HDR8)

## UAT1

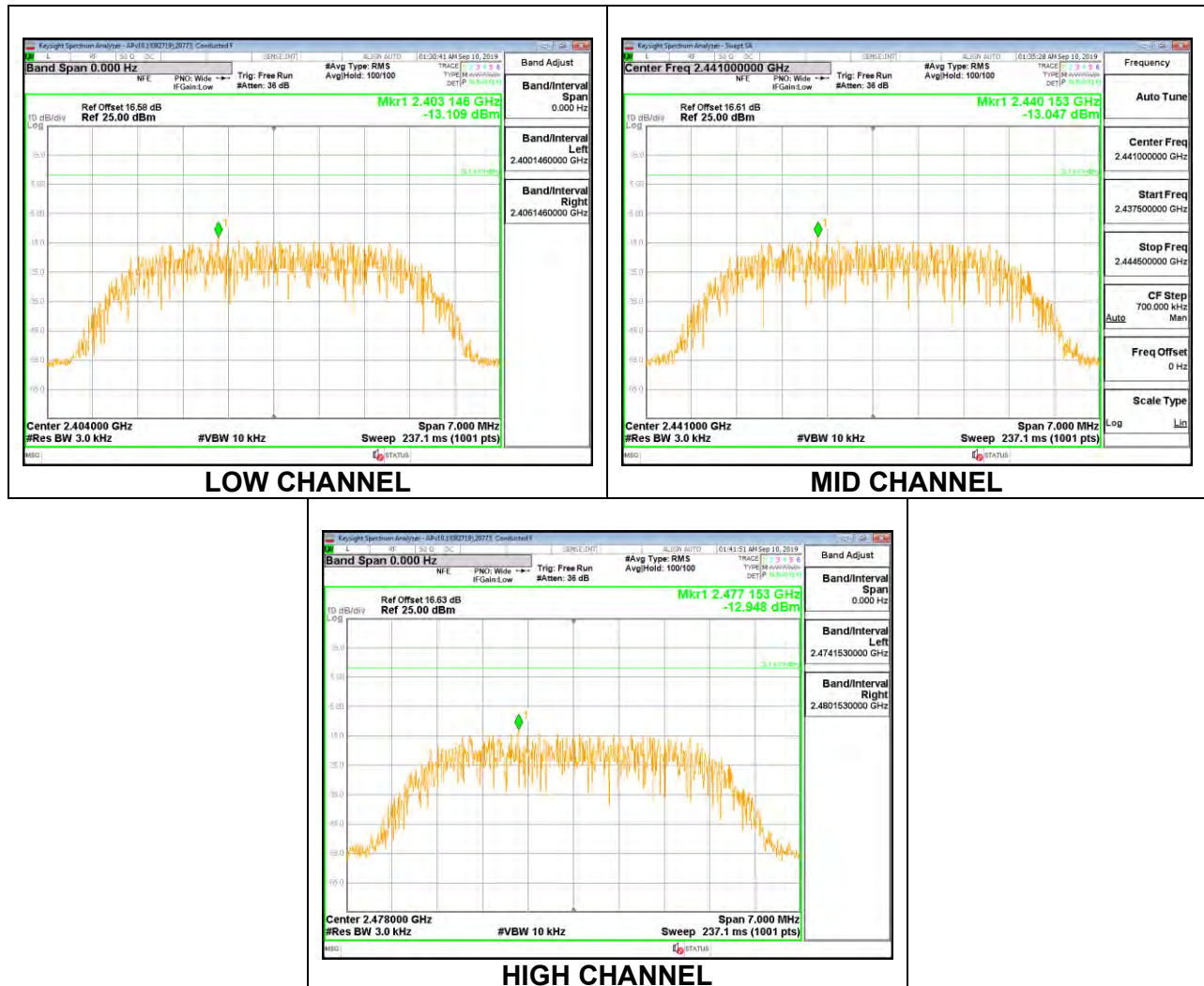
| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low     | 2404            | -13.166        | 8                | -21.17      |
| Middle  | 2441            | -12.932        | 8                | -20.93      |
| High    | 2478            | -12.896        | 8                | -20.90      |





**LAT 3**

| Channel | Frequency (MHz) | PSD (dBm/3kHz) | Limit (dBm/3kHz) | Margin (dB) |
|---------|-----------------|----------------|------------------|-------------|
| Low     | 2404            | -13.109        | 8                | -21.11      |
| Middle  | 2441            | -13.047        | 8                | -21.05      |
| High    | 2478            | -12.948        | 8                | -20.95      |



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## **8.7. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

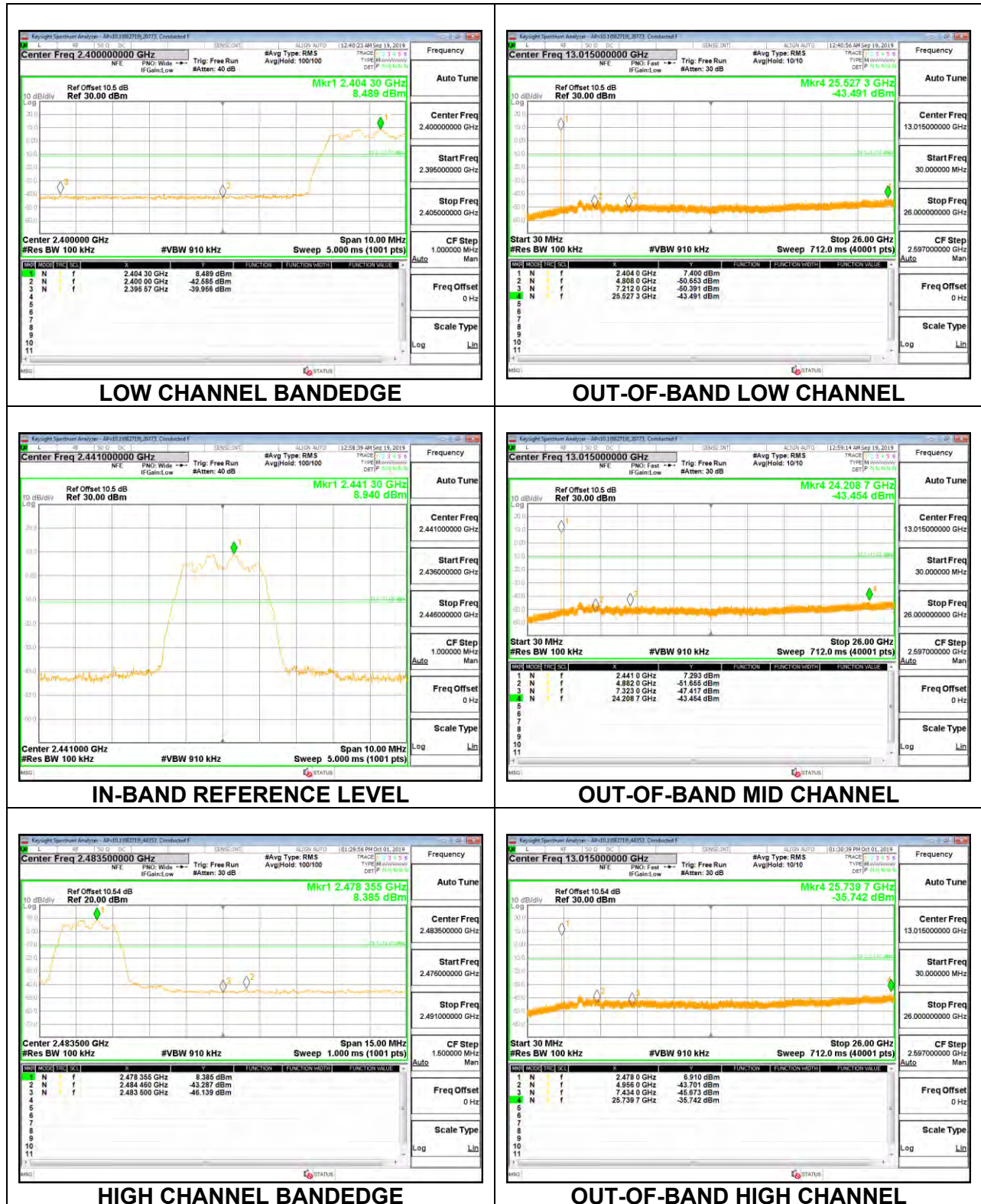
RSS-247 5.5

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

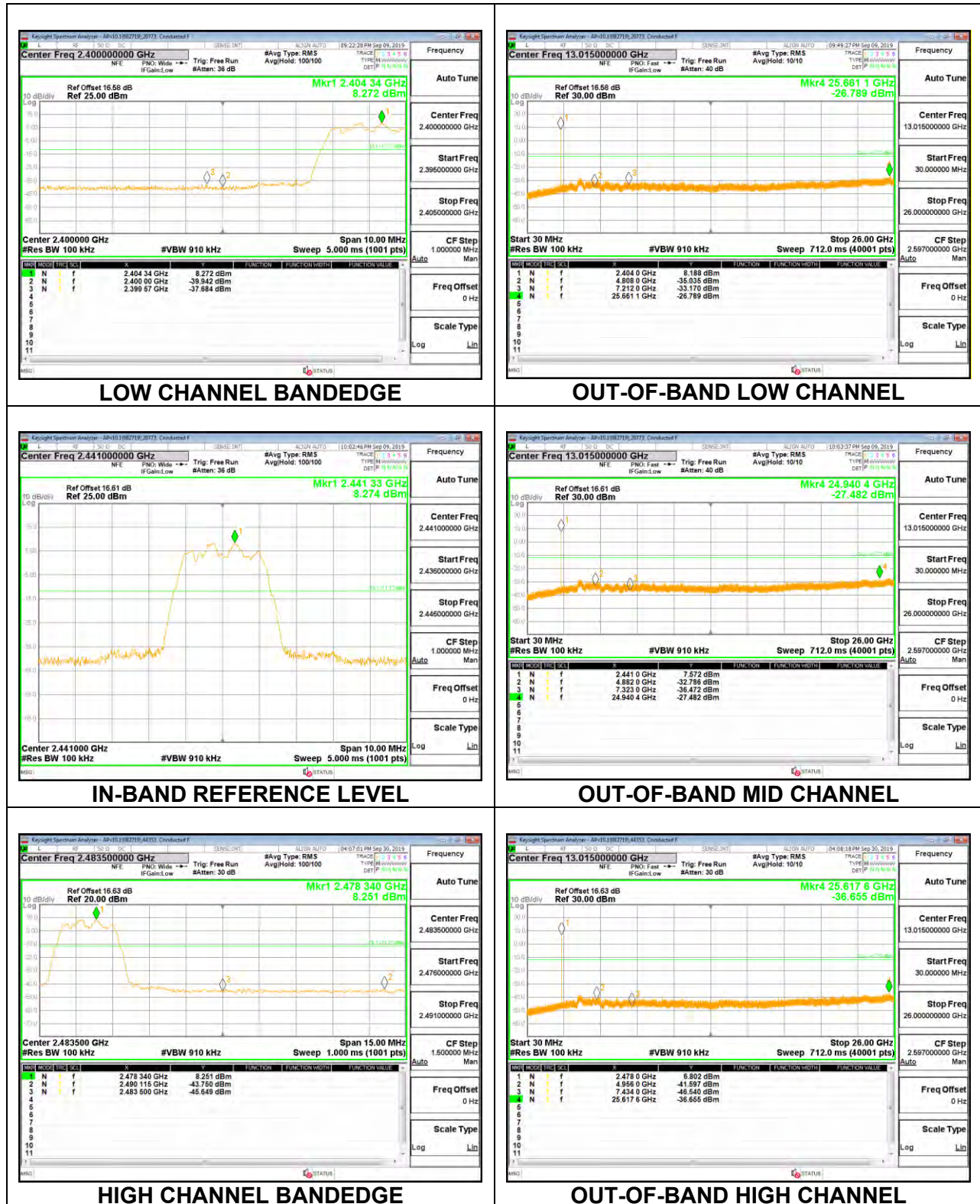
### **RESULTS**

# 8.7.1. HIGH POWER HDR (HDR4)

## UAT1

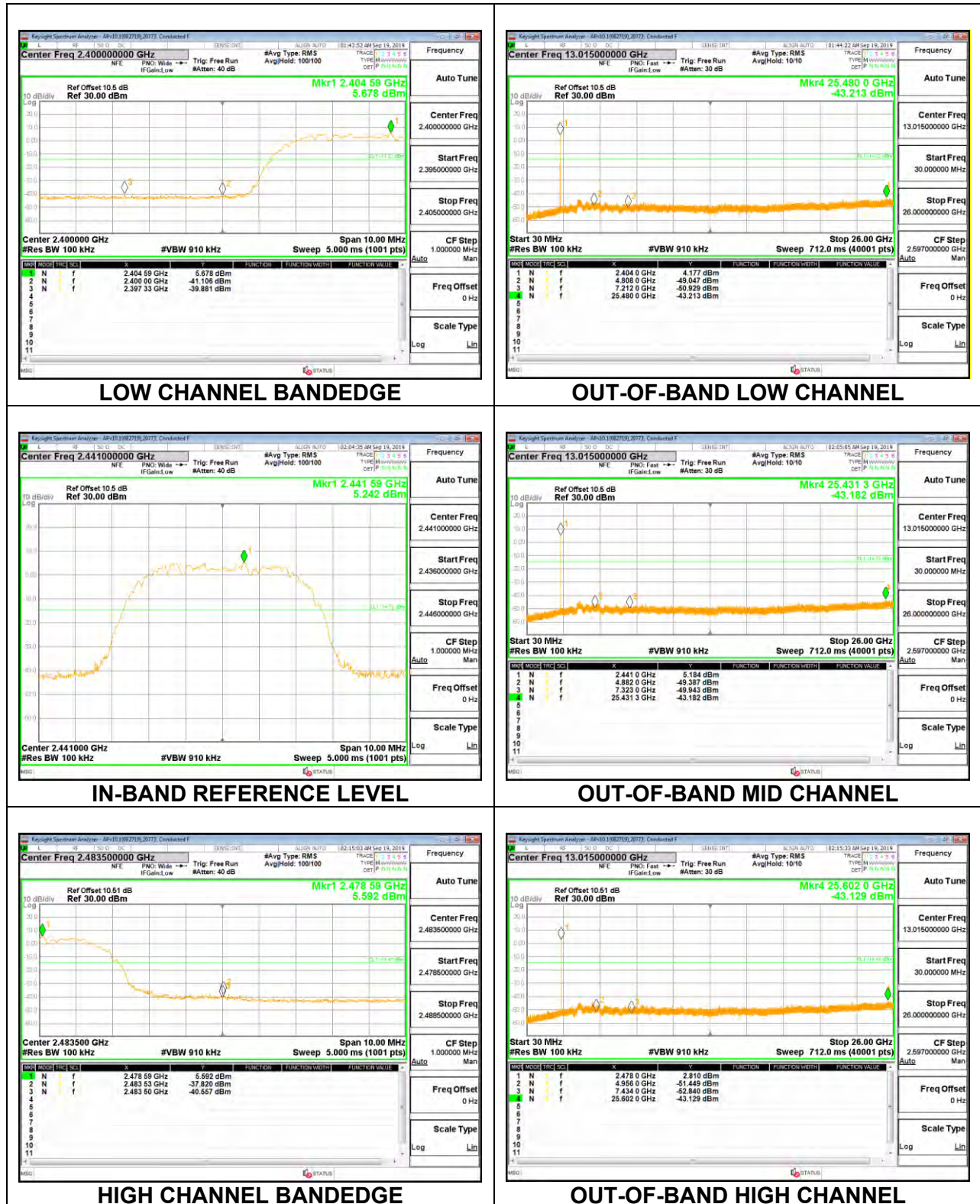




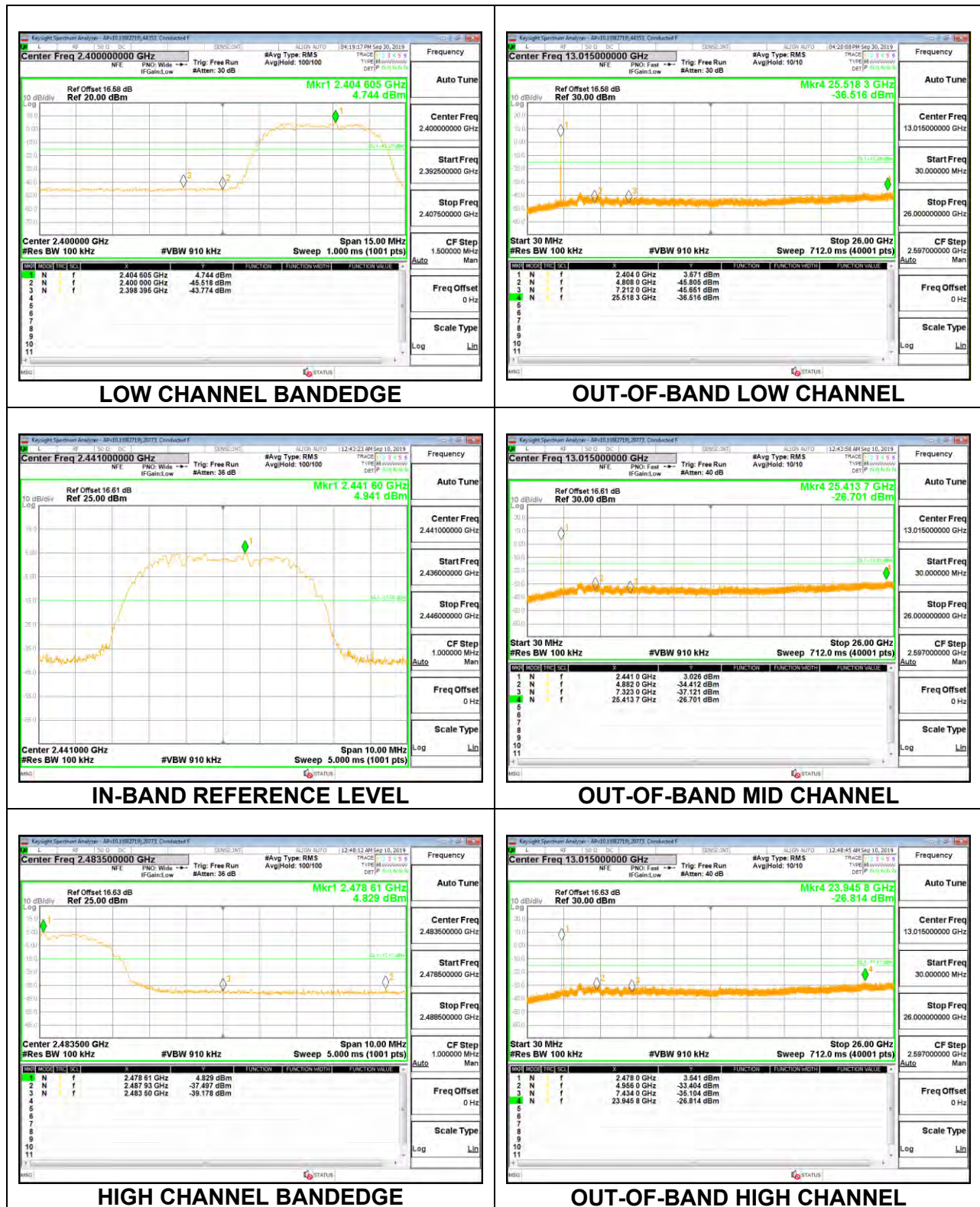
**LAT 3**

## 8.7.2. HIGH POWER HDR (HDR8)

### UAT1

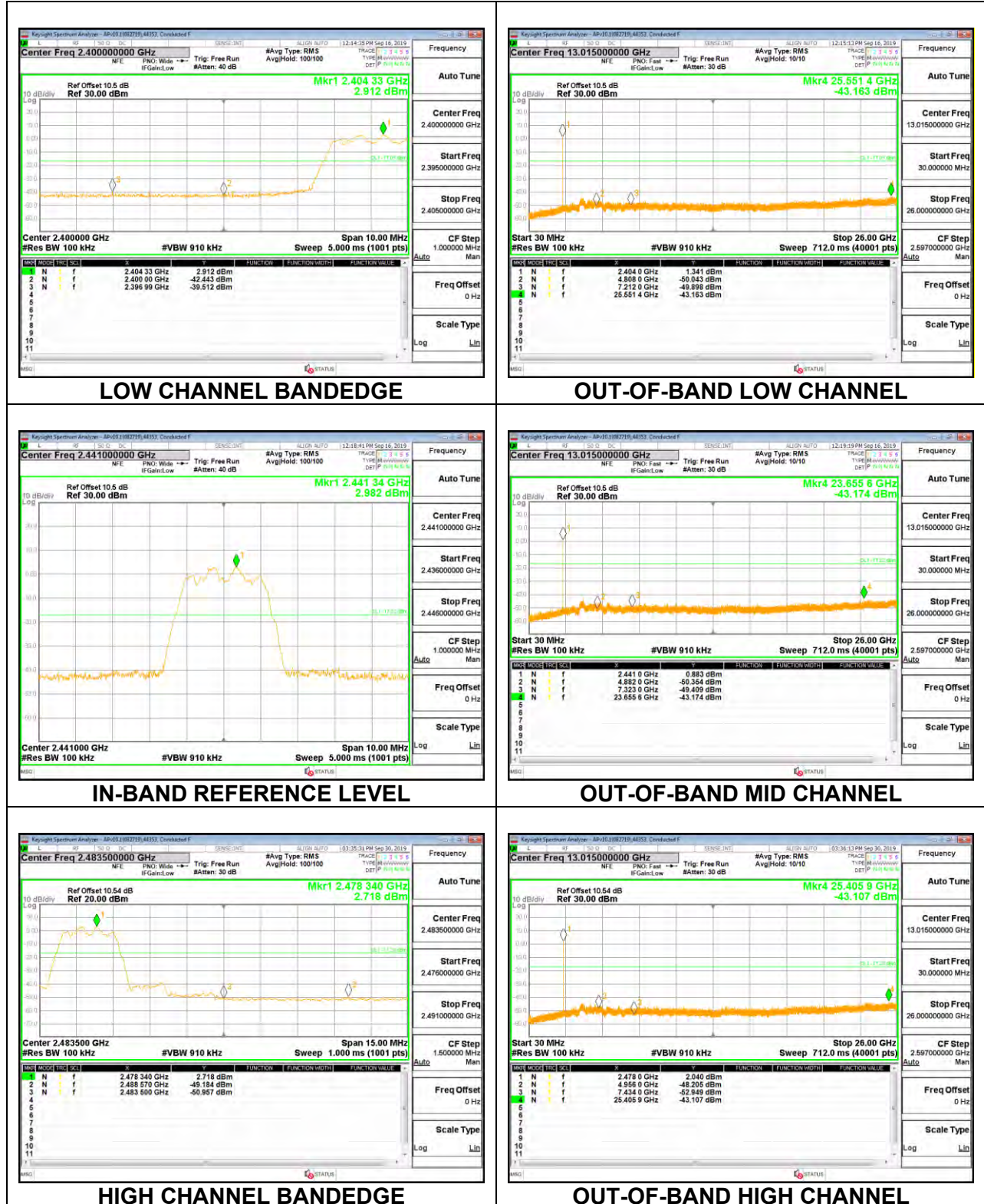




**LAT 3**

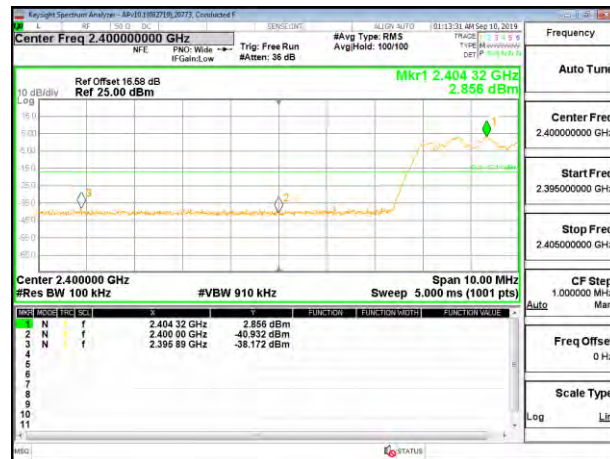
### 8.7.3. LOW POWER HDR (HDR4)

#### UAT1

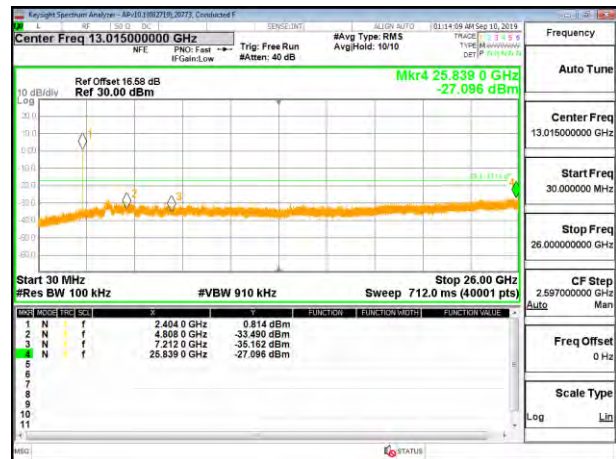




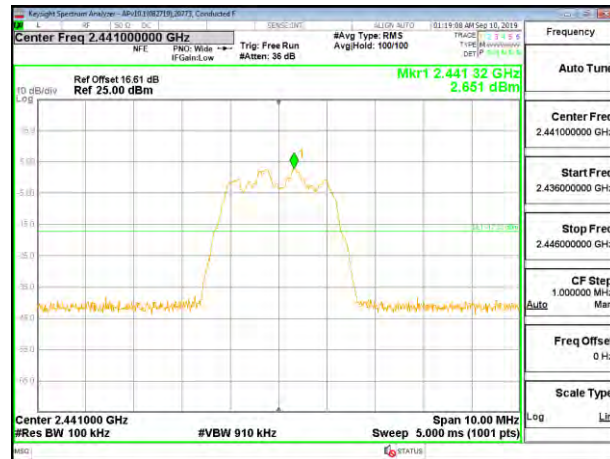
**LAT 3**



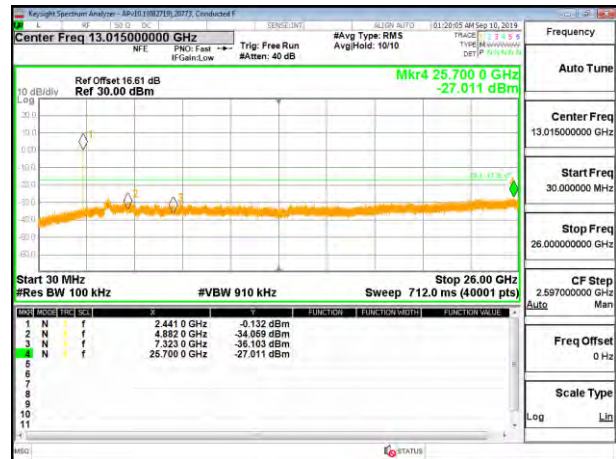
**LOW CHANNEL BANDEDGE**



**OUT-OF-BAND LOW CHANNEL**



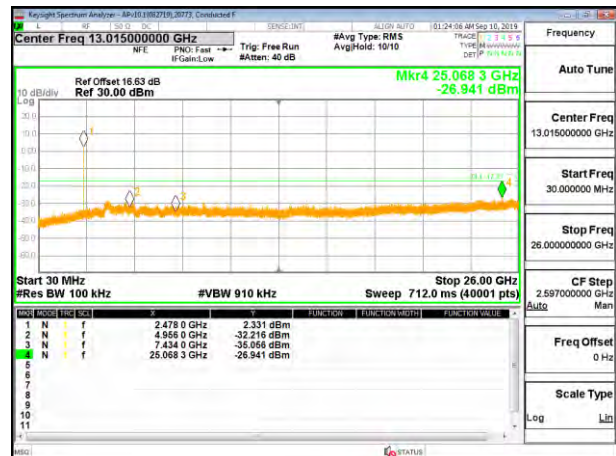
**IN-BAND REFERENCE LEVEL**



**OUT-OF-BAND MID CHANNEL**

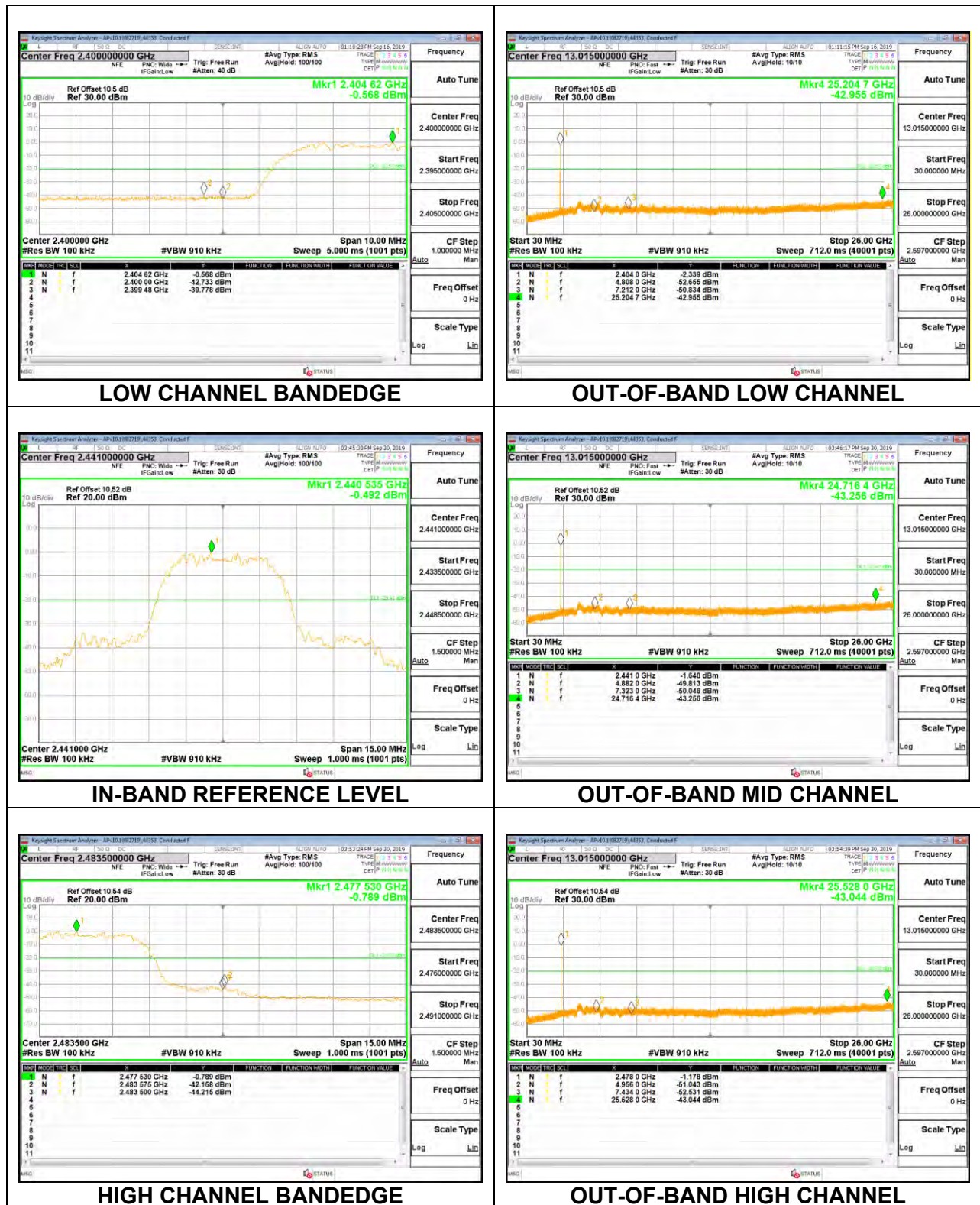


**HIGH CHANNEL BANDEDGE**



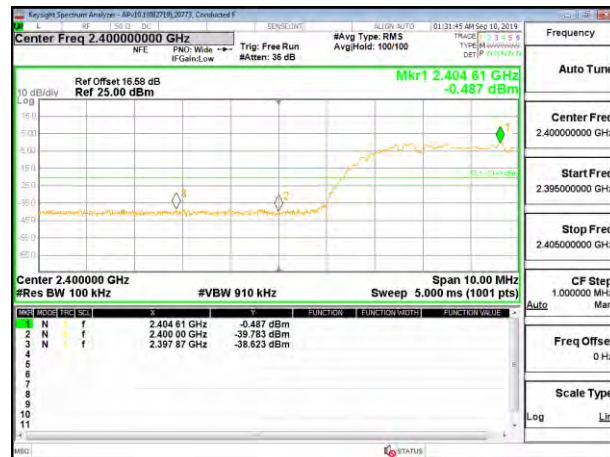
**OUT-OF-BAND HIGH CHANNEL**

# **8.7.4. LOW POWER HDR (HDR8)** **UAT1**





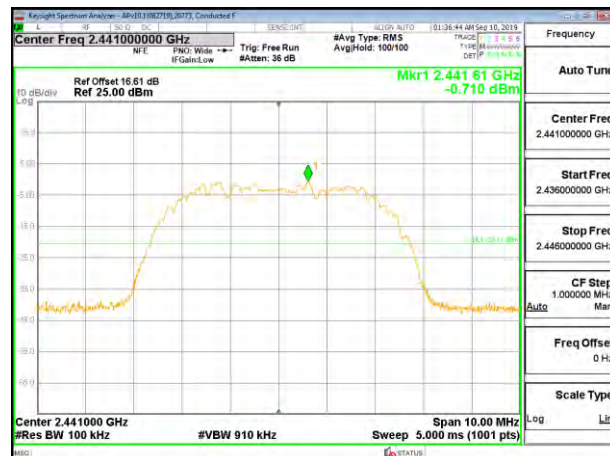
**LAT 3**



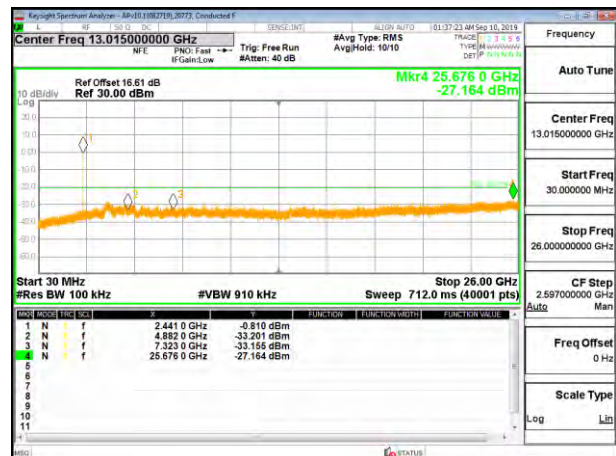
**LOW CHANNEL BANDEDGE**



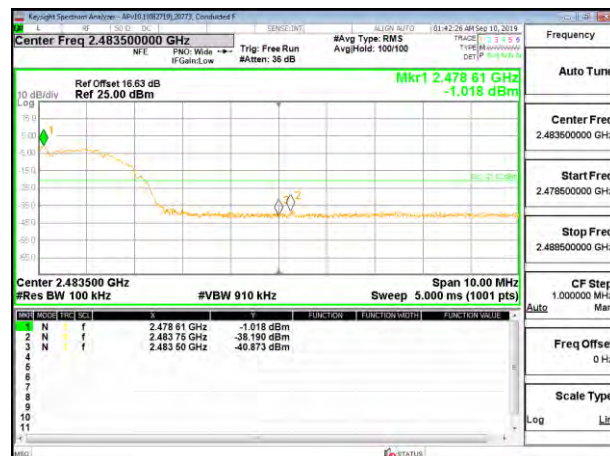
**OUT-OF-BAND LOW CHANNEL**



**IN-BAND REFERENCE LEVEL**



**OUT-OF-BAND MID CHANNEL**



**HIGH CHANNEL BANDEDGE**



**OUT-OF-BAND HIGH CHANNEL**

## **8.8. BEAMFORMING 99% BANDWIDTH**

### **LIMITS**

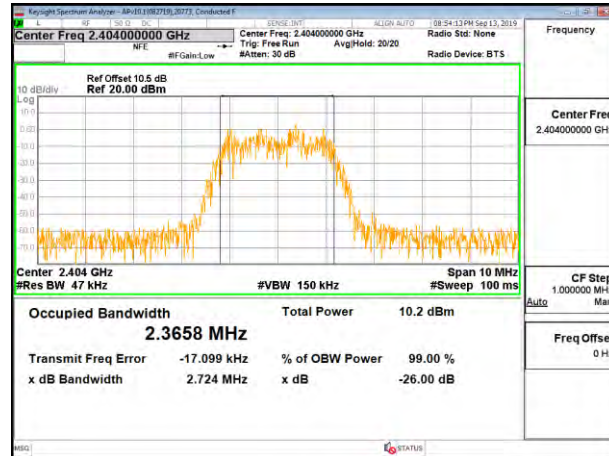
None; for reporting purposes only.

### **RESULTS**

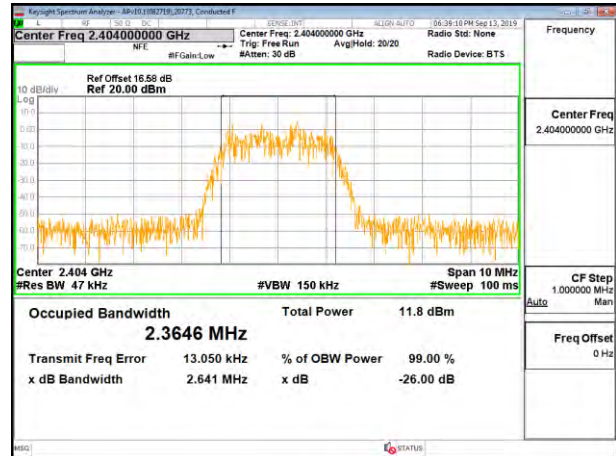
Note: Test procedures and setting are same as HDR normal mode.

#### 8.8.1. HIGH POWER HDR (HDR4)

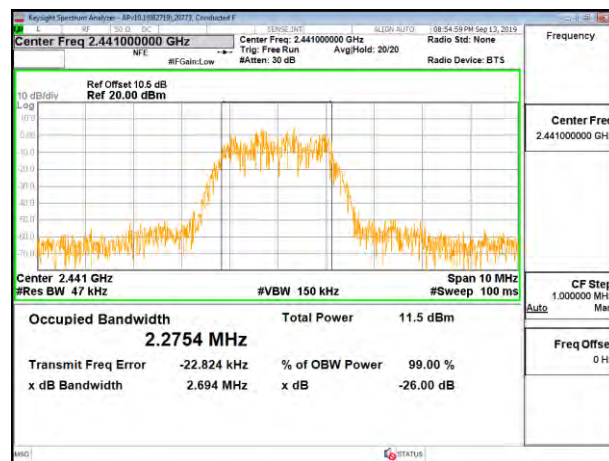
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>UAT 1<br>(MHz) | 99% Bandwidth<br>LAT 3<br>(MHz) |
|---------|--------------------|---------------------------------|---------------------------------|
| Low     | 2404               | 2.366                           | 2.365                           |
| Middle  | 2441               | 2.275                           | 2.275                           |
| High    | 2478               | 2.284                           | 2.331                           |



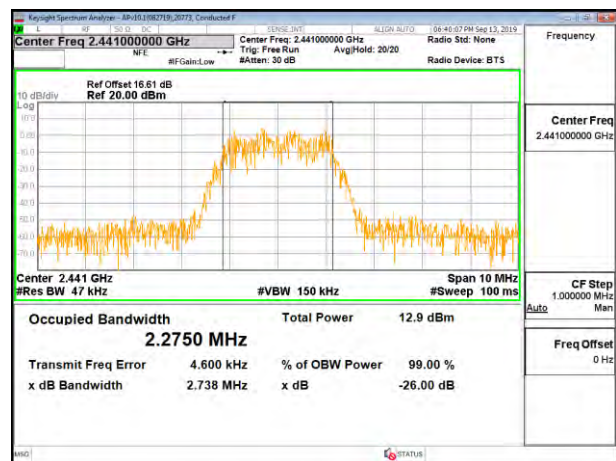
LOW CHANNEL UAT 1



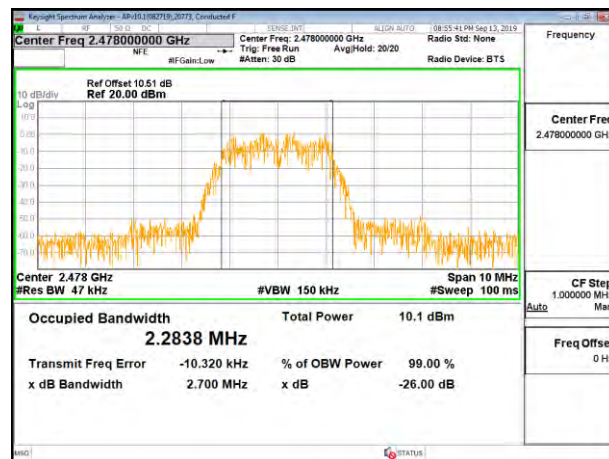
LOW CHANNEL LAT 3



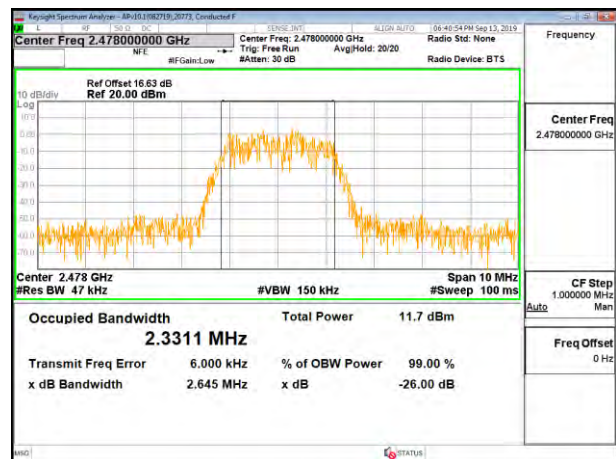
MID CHANNEL UAT 1



MID CHANNEL LAT 3



HIGH CHANNEL UAT 1



HIGH CHANNEL LAT 3

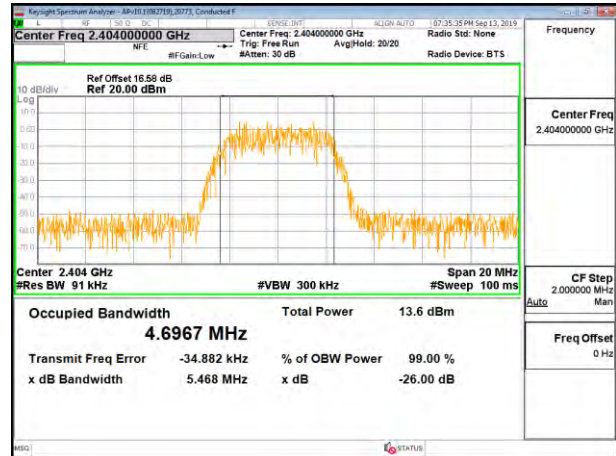


### 8.8.2. HIGH POWER HDR (HDR8)

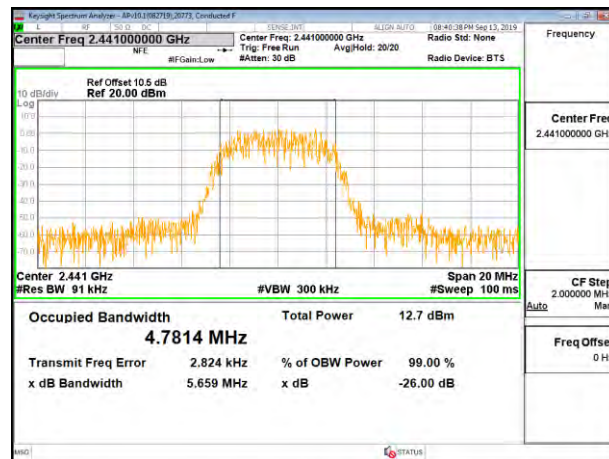
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>UAT 1<br>(MHz) | 99% Bandwidth<br>LAT 3<br>(MHz) |
|---------|--------------------|---------------------------------|---------------------------------|
| Low     | 2404               | 4.702                           | 4.697                           |
| Middle  | 2441               | 4.781                           | 4.688                           |
| High    | 2478               | 4.748                           | 4.739                           |



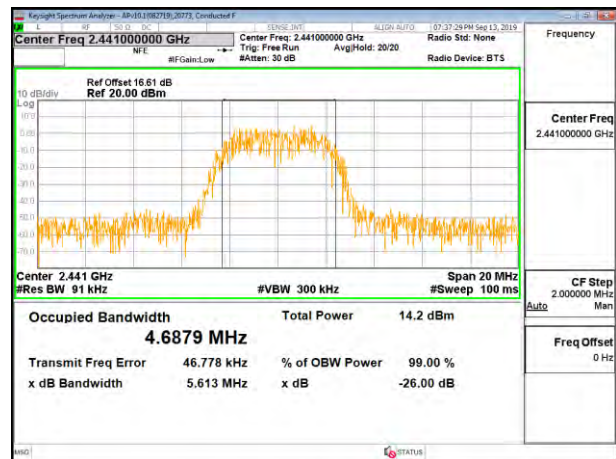
LOW CHANNEL UAT 1



LOW CHANNEL LAT 3



MID CHANNEL UAT 1



MID CHANNEL LAT 3



HIGH CHANNEL UAT 1



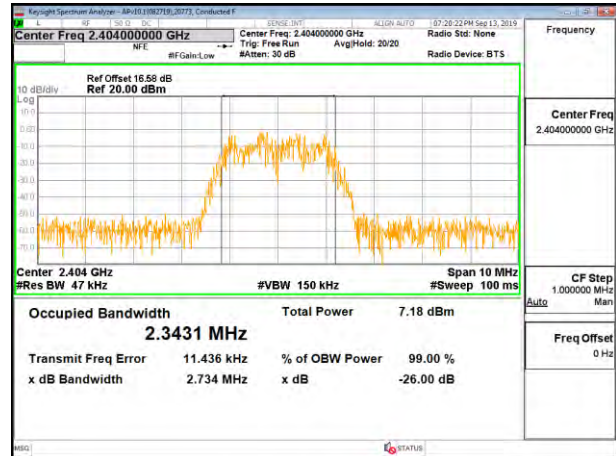
HIGH CHANNEL LAT 3

### 8.8.3. LOW POWER HDR (HDR4)

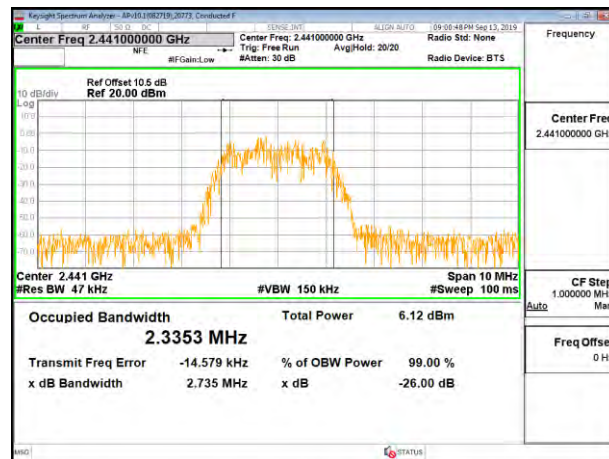
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>UAT 1<br>(MHz) | 99% Bandwidth<br>LAT 3<br>(MHz) |
|---------|--------------------|---------------------------------|---------------------------------|
| Low     | 2404               | 2.314                           | 2.343                           |
| Middle  | 2441               | 2.335                           | 2.395                           |
| High    | 2478               | 2.274                           | 2.273                           |



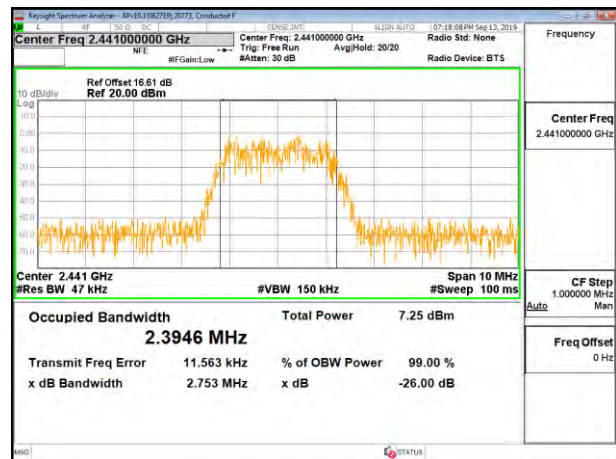
LOW CHANNEL UAT 1



LOW CHANNEL LAT 3



MID CHANNEL UAT 1



MID CHANNEL LAT 3



HIGH CHANNEL UAT 1

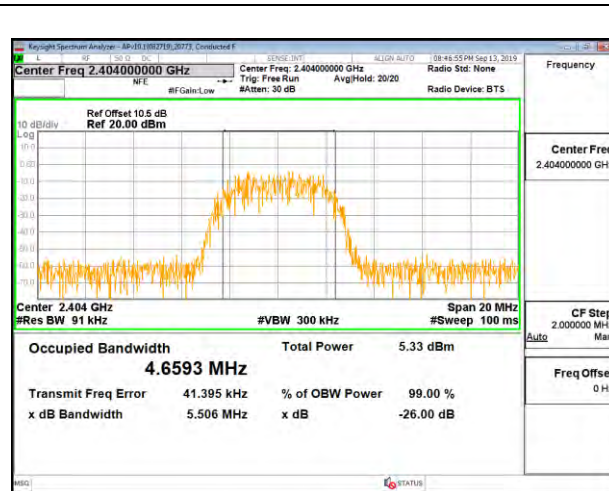


HIGH CHANNEL LAT 3

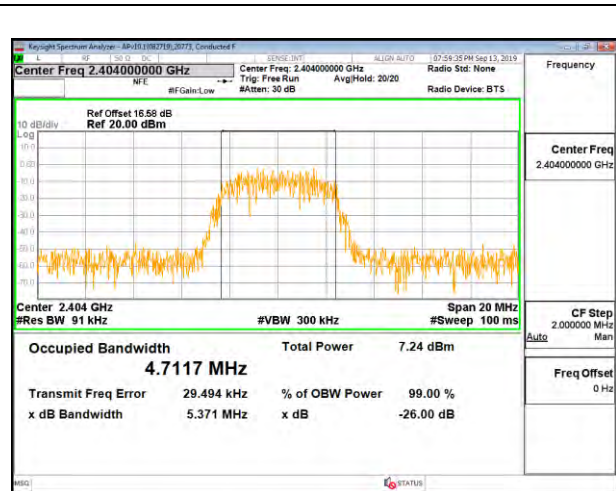
#### 8.8.4. LOW POWER HDR (HDR8)

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>UAT 1<br>(MHz) | 99% Bandwidth<br>LAT 3<br>(MHz) |
|---------|--------------------|---------------------------------|---------------------------------|
| Low     | 2404               | 4.659                           | 4.712                           |
| Middle  | 2441               | 4.774                           | 4.712                           |
| High    | 2478               | 4.701                           | 4.762                           |

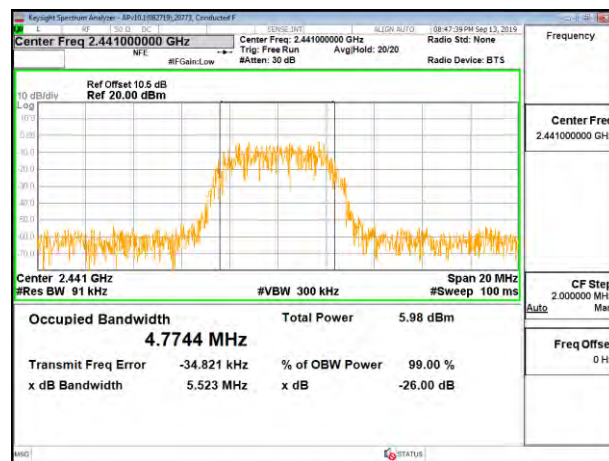




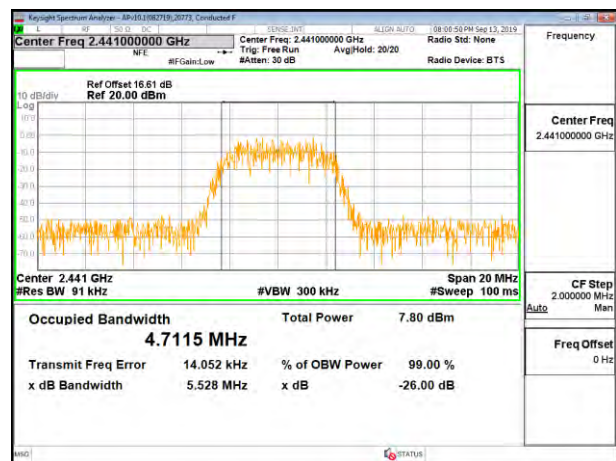
LOW CHANNEL UAT 1



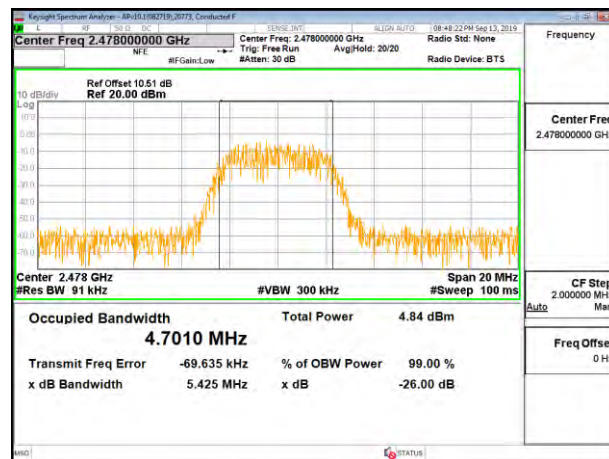
LOW CHANNEL LAT 3



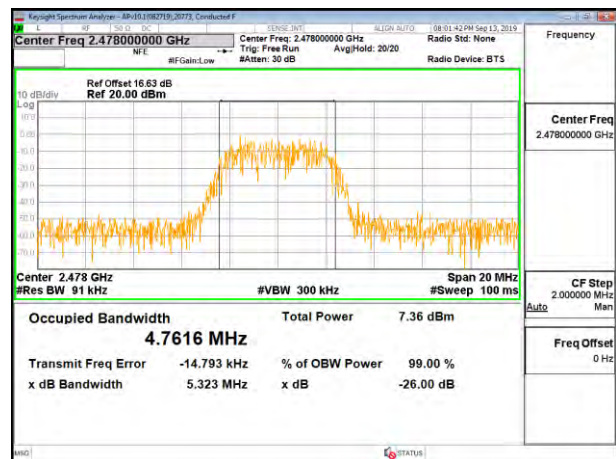
MID CHANNEL UAT 1



MID CHANNEL LAT 3



HIGH CHANNEL UAT 1



HIGH CHANNEL LAT 3

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## **8.9. BEAMFORMING 6 dB BANDWIDTH**

### **LIMITS**

FCC §15.407 (e)

RSS-247 5.2 (a)

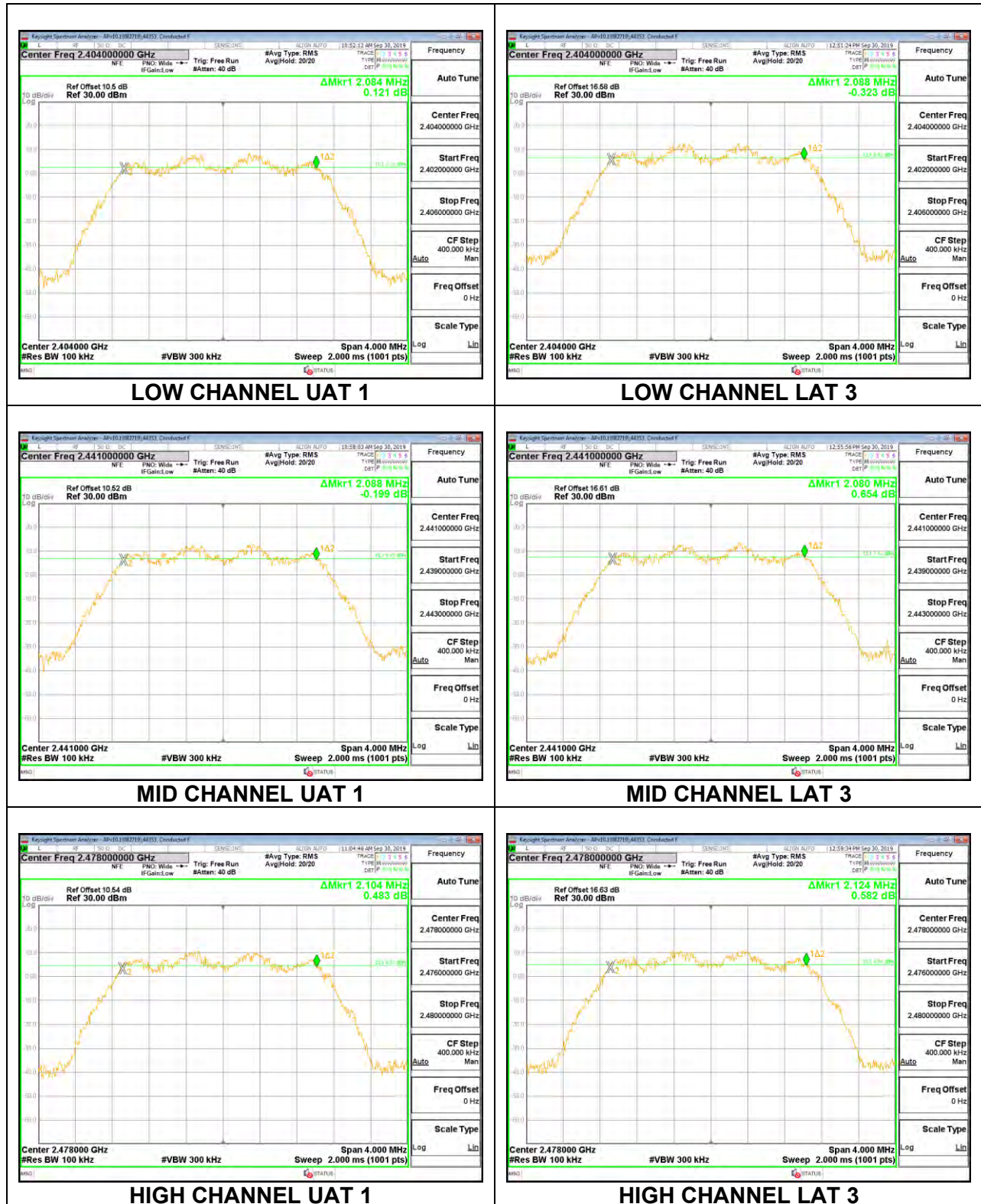
The minimum 6 dB bandwidth shall be at least 500 kHz.

### **RESULTS**

Note: Test procedures and setting are same as HDR normal mode.

#### 8.9.1. HIGH POWER HDR (HDR4)

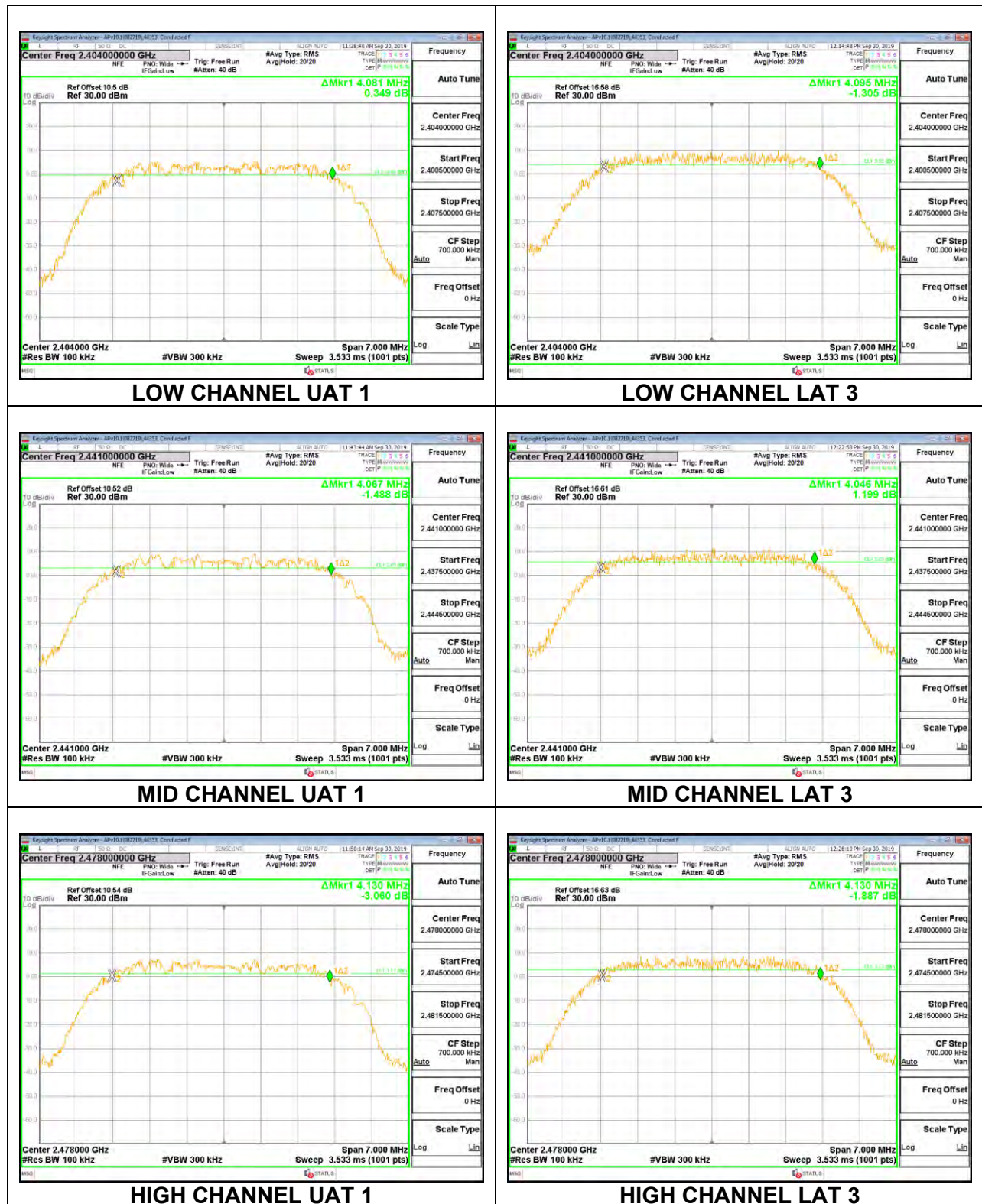
| Channel | Frequency<br>(MHz) | 6 dB Bandwidth<br>UAT 1<br>(MHz) | 6 dB Bandwidth<br>LAT 3<br>(MHz) | Minimum Limit<br>(MHz) |
|---------|--------------------|----------------------------------|----------------------------------|------------------------|
| Low     | 2404               | 2.084                            | 2.088                            | 0.5                    |
| Middle  | 2441               | 2.088                            | 2.080                            | 0.5                    |
| High    | 2478               | 2.104                            | 2.124                            | 0.5                    |



### 8.9.2. HIGH POWER HDR (HDR8)

| Channel | Frequency<br>(MHz) | 6 dB Bandwidth<br>UAT 1<br>(MHz) | 6 dB Bandwidth<br>LAT 3<br>(MHz) | Minimum Limit<br>(MHz) |
|---------|--------------------|----------------------------------|----------------------------------|------------------------|
| Low     | 2404               | 4.081                            | 4.095                            | 0.5                    |
| Middle  | 2441               | 4.067                            | 4.046                            | 0.5                    |
| High    | 2478               | 4.130                            | 4.130                            | 0.5                    |





### 8.9.3. LOW POWER HDR (HDR4)

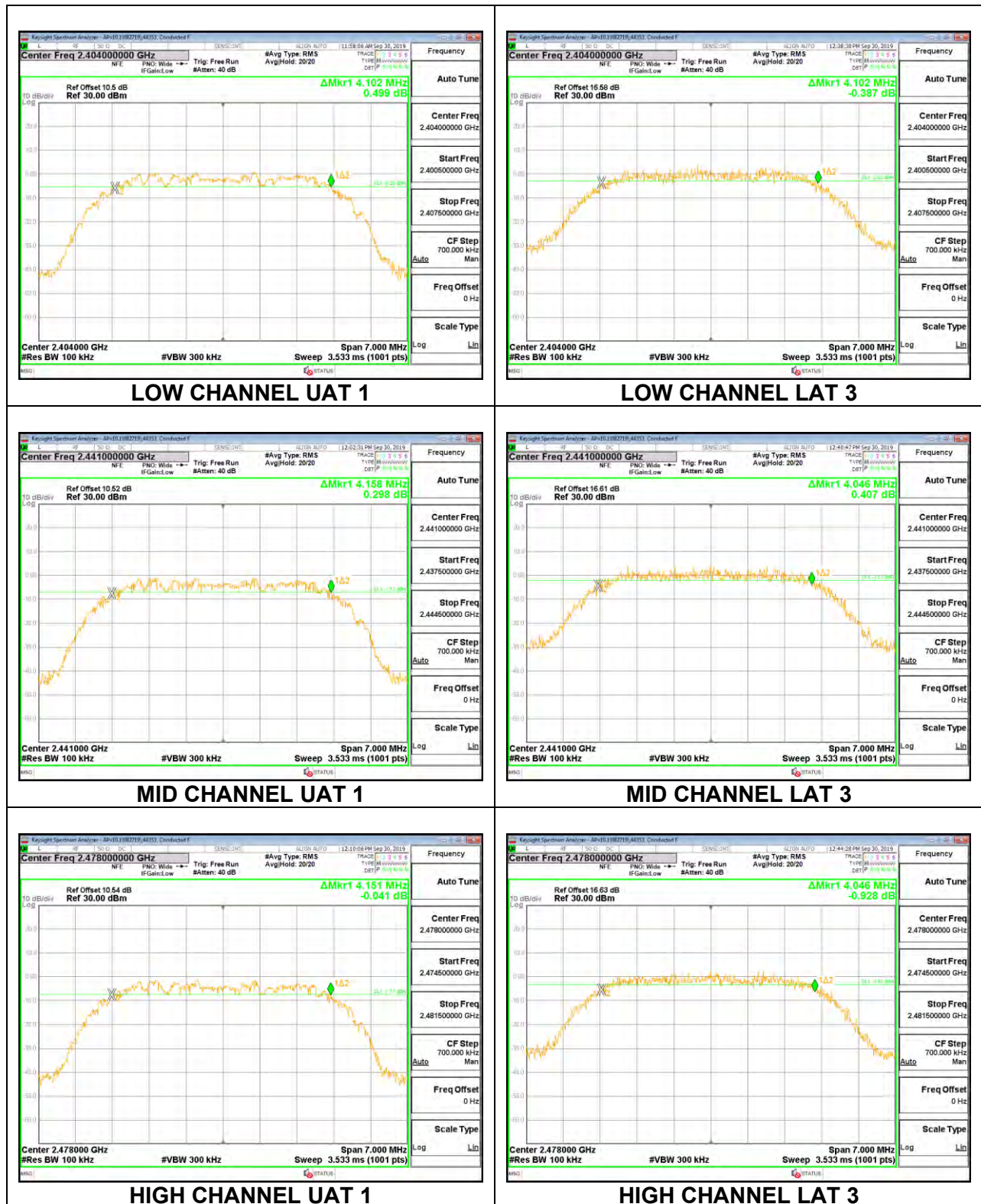
| Channel | Frequency<br>(MHz) | 6 dB Bandwidth<br>UAT 1<br>(MHz) | 6 dB Bandwidth<br>LAT 3<br>(MHz) | Minimum Limit<br>(MHz) |
|---------|--------------------|----------------------------------|----------------------------------|------------------------|
| Low     | 2404               | 2.104                            | 2.080                            | 0.5                    |
| Middle  | 2441               | 2.104                            | 2.068                            | 0.5                    |
| High    | 2478               | 2.100                            | 2.032                            | 0.5                    |



#### 8.9.4. LOW POWER HDR (HDR8)

| Channel | Frequency<br>(MHz) | 6 dB Bandwidth<br>UAT 1<br>(MHz) | 6 dB Bandwidth<br>LAT 3<br>(MHz) | Minimum Limit<br>(MHz) |
|---------|--------------------|----------------------------------|----------------------------------|------------------------|
| Low     | 2404               | 4.102                            | 4.102                            | 0.5                    |
| Middle  | 2441               | 4.158                            | 4.046                            | 0.5                    |
| High    | 2478               | 4.151                            | 4.046                            | 0.5                    |







## 8.10. BEAMFORMING 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 of 10.5 dB (including 10 dB pad and 0.5 dB cable) was entered as an offset in the power meter to allow for a gated peak reading of power.

### RESULTS

#### 8.10.1. HIGH POWER HDR (HDR4)

|            |          |
|------------|----------|
| Tested By: | 12492    |
| Date:      | 1/3/2020 |

| Channel | Frequency<br>(MHz) | Peak Power<br>Reading<br>UAT 1<br>(dBm) | Peak Power<br>Reading<br>LAT 3<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|-----------------------------------------|-----------------------------------------|-----------------------------------|----------------|----------------|
| Low     | 2404               | 14.39                                   | 14.36                                   | 17.39                             | 30.00          | -12.61         |
| Middle  | 2441               | 14.37                                   | 14.40                                   | 17.40                             | 30.00          | -12.60         |
| High    | 2478               | 14.53                                   | 14.43                                   | 17.49                             | 30.00          | -12.51         |

#### 8.10.2. HIGH POWER HDR (HDR8)

|            |          |
|------------|----------|
| Tested By: | 12492    |
| Date:      | 1/3/2020 |

| Channel | Frequency<br>(MHz) | Peak Power<br>Reading<br>UAT 1<br>(dBm) | Peak Power<br>Reading<br>LAT 3<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|-----------------------------------------|-----------------------------------------|-----------------------------------|----------------|----------------|
| Low     | 2404               | 14.47                                   | 14.39                                   | 17.44                             | 30.00          | -12.56         |
| Middle  | 2441               | 14.48                                   | 14.37                                   | 17.44                             | 30.00          | -12.56         |
| High    | 2478               | 14.53                                   | 14.38                                   | 17.47                             | 30.00          | -12.53         |

### 8.10.3. LOW POWER HDR (HDR4)

|            |          |
|------------|----------|
| Tested By: | 12492    |
| Date:      | 1/3/2020 |

| Channel | Frequency<br>(MHz) | Peak Power<br>Reading<br>UAT 1<br>(dBm) | Peak Power<br>Reading<br>LAT 3<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|-----------------------------------------|-----------------------------------------|-----------------------------------|----------------|----------------|
| Low     | 2404               | 9.43                                    | 9.32                                    | 12.39                             | 30.00          | -17.61         |
| Middle  | 2441               | 9.48                                    | 9.41                                    | 12.46                             | 30.00          | -17.54         |
| High    | 2478               | 9.53                                    | 9.50                                    | 12.53                             | 30.00          | -17.47         |

### 8.10.4. LOW POWER HDR (HDR8)

|            |          |
|------------|----------|
| Tested By: | 12492    |
| Date:      | 1/3/2020 |

| Channel | Frequency<br>(MHz) | Peak Power<br>Reading<br>UAT 1<br>(dBm) | Peak Power<br>Reading<br>LAT 3<br>(dBm) | Total<br>Corr'd<br>Power<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|-----------------------------------------|-----------------------------------------|-----------------------------------|----------------|----------------|
| Low     | 2404               | 9.54                                    | 9.43                                    | 12.50                             | 30.00          | -17.50         |
| Middle  | 2441               | 9.41                                    | 9.53                                    | 12.48                             | 30.00          | -17.52         |
| High    | 2478               | 9.50                                    | 9.36                                    | 12.44                             | 30.00          | -17.56         |

Note: Test procedures and setting are same as HDR normal mode.

## 8.11. BEAMFORMING AVERAGE POWER LIMITS

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.5 dB (including 10 dB pad and 0.5 dB cable) was entered as an offset in the power meter to allow for a gated average reading of power.

### RESULTS

#### 8.11.1. HIGH POWER HDR (HDR4)

|            |          |
|------------|----------|
| Tested By: | 12492    |
| Date:      | 1/3/2020 |

| Channel | Frequency<br>(MHz) | Average Power<br>UAT 1<br>(dBm) | Average Power<br>LAT 3<br>(dBm) | Total Power<br>(dBm) |
|---------|--------------------|---------------------------------|---------------------------------|----------------------|
| Low     | 2404               | 11.86                           | 11.81                           | 14.85                |
| Middle  | 2441               | 11.83                           | 11.82                           | 14.84                |
| High    | 2478               | 11.96                           | 11.87                           | 14.93                |

#### 8.11.2. HIGH POWER HDR (HDR8)

|            |          |
|------------|----------|
| Tested By: | 12492    |
| Date:      | 1/3/2020 |

| Channel | Frequency<br>(MHz) | Average Power<br>UAT 1<br>(dBm) | Average Power<br>LAT 3<br>(dBm) | Total Power<br>(dBm) |
|---------|--------------------|---------------------------------|---------------------------------|----------------------|
| Low     | 2404               | 11.88                           | 11.83                           | 14.87                |
| Middle  | 2441               | 11.94                           | 11.85                           | 14.91                |
| High    | 2478               | 11.97                           | 11.87                           | 14.93                |

Note: Test procedures and setting are same as HDR normal mode.

### 8.11.3. LOW POWER HDR (HDR4)

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>Average Power<br/>UAT 1<br/>(dBm)</b> | <b>Average Power<br/>LAT 3<br/>(dBm)</b> | <b>Total Power<br/>(dBm)</b> |
|----------------|----------------------------|------------------------------------------|------------------------------------------|------------------------------|
| Low            | 2404                       | 6.40                                     | 6.31                                     | 9.37                         |
| Middle         | 2441                       | 6.44                                     | 6.38                                     | 9.42                         |
| High           | 2478                       | 6.48                                     | 6.48                                     | 9.49                         |

### 8.11.4. LOW POWER HDR (HDR8)

|                   |          |
|-------------------|----------|
| <b>Tested By:</b> | 12492    |
| <b>Date:</b>      | 1/3/2020 |

| <b>Channel</b> | <b>Frequency<br/>(MHz)</b> | <b>Average Power<br/>UAT 1<br/>(dBm)</b> | <b>Average Power<br/>LAT 3<br/>(dBm)</b> | <b>Total Power<br/>(dBm)</b> |
|----------------|----------------------------|------------------------------------------|------------------------------------------|------------------------------|
| Low            | 2404                       | 6.48                                     | 6.36                                     | 9.43                         |
| Middle         | 2441                       | 6.37                                     | 6.45                                     | 9.42                         |
| High           | 2478                       | 6.47                                     | 6.30                                     | 9.40                         |

## 8.12. BEAMFORMING 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

Note: Test procedures and setting are same as HDR normal mode.

#### 8.12.1. HIGH POWER HDR (HDR4)

##### PSD Results

| Channel | Frequency<br>(MHz) | UAT 1<br>Meas<br>(dBm/<br>3kHz) | LAT 3<br>Meas<br>(dBm/<br>3kHz) | Total<br>Corr'd<br>PSD<br>(dBm/<br>3kHz) | Limit<br>(dBm/<br>3kHz) | Margin<br>(dB) |
|---------|--------------------|---------------------------------|---------------------------------|------------------------------------------|-------------------------|----------------|
| Low     | 2404               | -4.723                          | -4.912                          | -1.81                                    | 8.0                     | -9.8           |
| Mid     | 2441               | -5.062                          | -4.841                          | -1.94                                    | 8.0                     | -9.9           |
| High    | 2478               | -4.201                          | -4.598                          | -1.38                                    | 8.0                     | -9.4           |