



# **CERTIFICATION TEST REPORT**

**Report Number. :** 12607353-E3V2

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

**Model :** A2215

**FCC ID :** BCG-E3307A

**IC :** 579C-E3307A

**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:**  
August 09, 2019

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

## REPORT REVISION HISTORY

| Rev. | Issue Date | Revisions                                                            | Revised By  |
|------|------------|----------------------------------------------------------------------|-------------|
| V1   | 8/1/2019   | Initial Issue                                                        | Chris Xiong |
| V2   | 8/9/2019   | Addressed TCB Questions on Sections 2, 5.5, 6, 7, 8.3, 8.4, 9, 9.1.4 | Tony Li     |

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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:** A2215

**SERIAL NUMBER:** Radiated & Conducted  
C39YT00TN2RK, C39YT01JN2RK, C39YT053N2RK,  
C39YT0CCN2R1

**DATE TESTED:** APRIL 10, 2019 – AUGUST 09, 2019

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

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

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

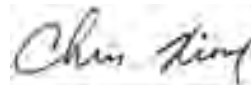
This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This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

Approved & Released For  
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Prepared By:



Chris Xiong  
Test Engineer  
Consumer Technology Division  
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## 2. TEST METHODOLOGY

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

## 3. FACILITIES AND ACCREDITATION

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

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

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

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

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

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

### 4.2. SAMPLE CALCULATION

#### RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

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

#### MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

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

### 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     | 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, Ultra-Wide band, 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. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

#### 2.4GHz BAND

| Frequency Range<br>(MHz) | Mode                     | Output Power<br>(dBm)       | Output Power<br>(mW) |
|--------------------------|--------------------------|-----------------------------|----------------------|
| <b>1Tx</b>               |                          |                             |                      |
| 2412 - 2472              | 802.11b                  | 21.22                       | 132.43               |
| 2412 - 2472              | 802.11g                  | Covered by 802.11n HT20 1TX |                      |
| 2412 - 2472              | 802.11n HT20             | 21.2                        | 131.83               |
| 2412 - 2472              | 802.11ax HE20, 242-Tones | 21.15                       | 130.32               |
| 2412 - 2472              | 802.11ax HE20, 26-Tones  | 21.24                       | 133.05               |

|             |                          |                                 |        |
|-------------|--------------------------|---------------------------------|--------|
| <b>2Tx</b>  |                          |                                 |        |
| 2412 - 2472 | 802.11n HT20 CDD         | 23.02                           | 200.45 |
| 2412 - 2472 | 802.11g SDM/STBC         | Covered by 802.11n HT20 2TX CDD |        |
| 2412 - 2472 | 802.11ax HE20, 242-Tones | 23.01                           | 199.99 |
| 2412 - 2472 | 802.11ax HE20, 26-Tones  | 22.14                           | 163.68 |

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

| Frequency Range | Antenna 4 | Antenna ANT 3 |
|-----------------|-----------|---------------|
| 2400-2480       | -1.7      | -1.9          |

### 5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was v1.29.99992



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

EUT was investigated in three orthogonal orientations X, Y and Z on ANT 4 (Antenna 4) and ANT 3 (Antenna 3). It was determined that Y (Landscape) orientation was worst-case orientation for ANT 3. For ANT 4 and 2Tx, X (Flatbed) orientation was the worst case for 2TX.

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, 1-18GHz, 18-26GHz and power line conducted emissions were performed with the EUT transmitting at the channel with the highest output power as worst-case scenario. Output power test results were performed with respect to Client's target powers.

For radiated harmonics spurious below 1GHz, 1-18GHz L/M/H channels, 18-26GHz, and power line conducted emissions were performed with the EUT set at the 2TX CDD mode among the CDD/SDM modes and 2TX HE mode with power setting equal or higher than SISO modes as worst-case scenario. G mode covered by HT20 mode since it has the same power as HT20.

Below 1GHz tests were performed with EUT connected to AC power adapter as the worst case; and for above 1GHz tests, the worst-case configuration reported was with EUT only. For AC line conducted emission, test was investigated with AC power adapter and with laptop. There were no emissions found below 30MHz within 20dB of the limit.

The output power and psd for the 802.11 ax mode were investigated between all different tones, and we found that the highest tone had the highest output power and PSD readings, the lowest tone had the highest PSD readings. Therefore, full testing was performed on both the highest and lowest tones.

The peak PSD were performed as worst case mode.

Worst-case data rates as provided by the client were:

802.11b mode: 1 Mbps  
802.11n HT20mode: MCS0  
802.11ax HE20mode: MCS0

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.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| Support Equipment List |                   |             |                   |              |
|------------------------|-------------------|-------------|-------------------|--------------|
| Description            | Manufacturer      | Model       | Serial Number     | FCC ID       |
| laptop                 | Apple             | A1502       | HRP003436         | QDS-BRCM1080 |
| 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                  |

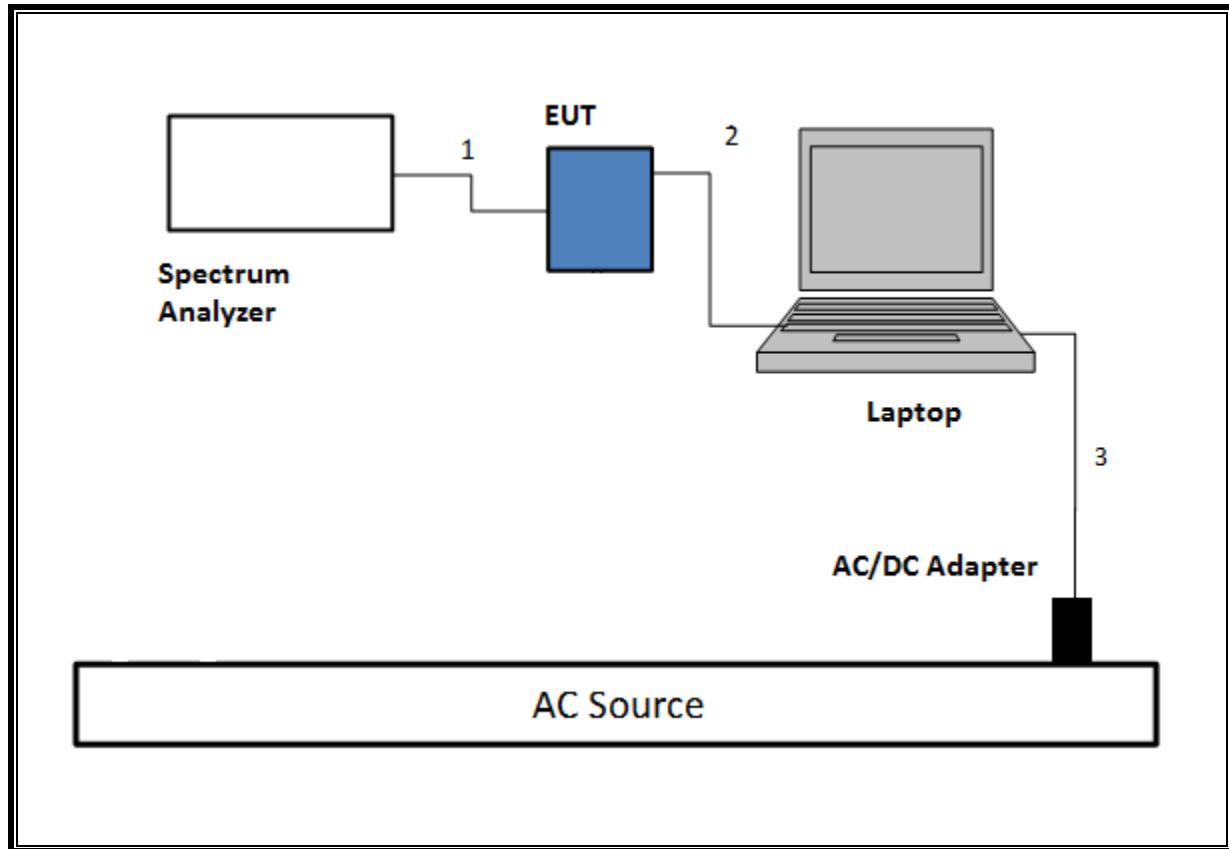
### I/O CABLES (BELOW 1GHz AND AC POWER LINE TEST WITH ADAPTER AND LAPTOP)

| 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     |

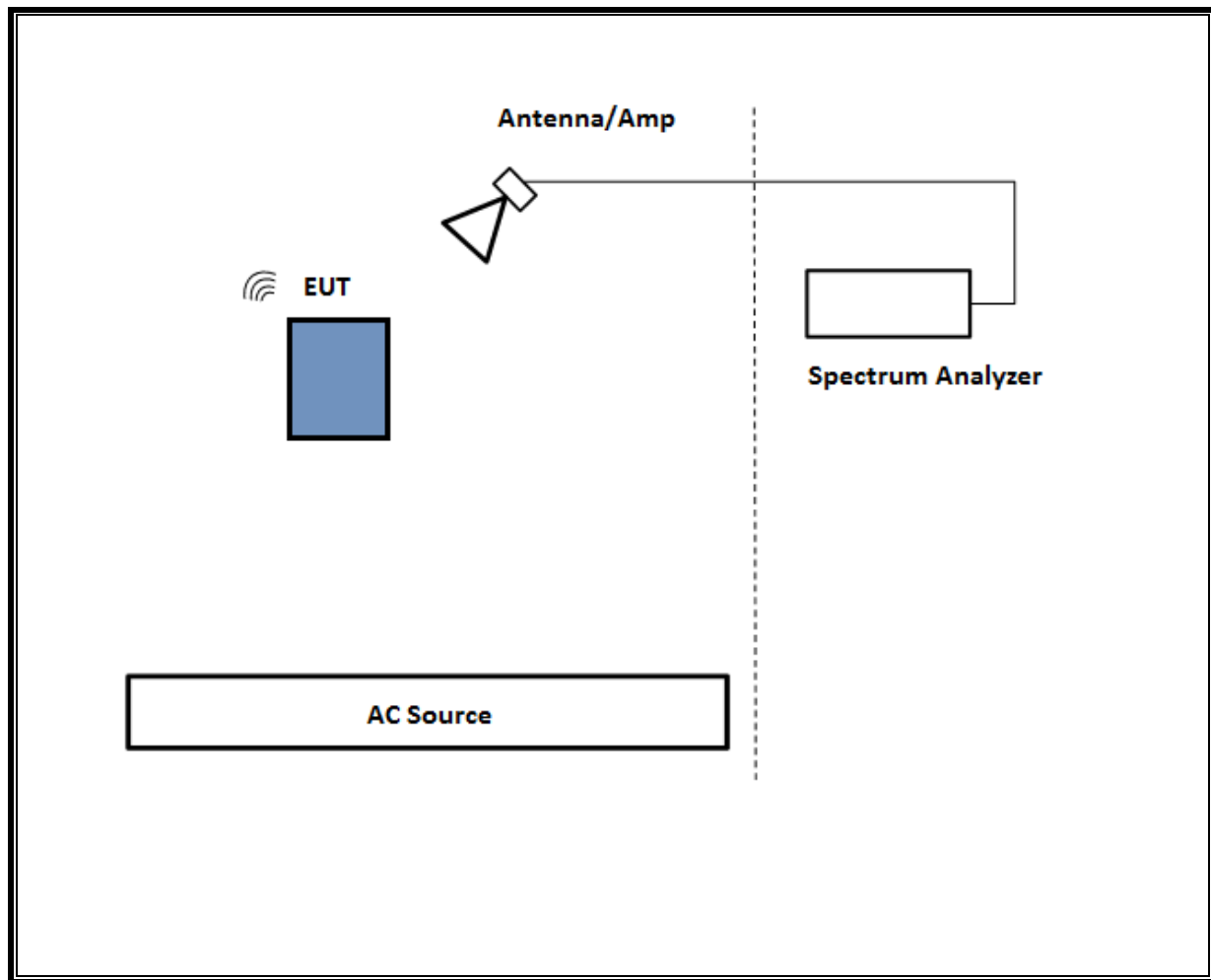
### TEST SETUP

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

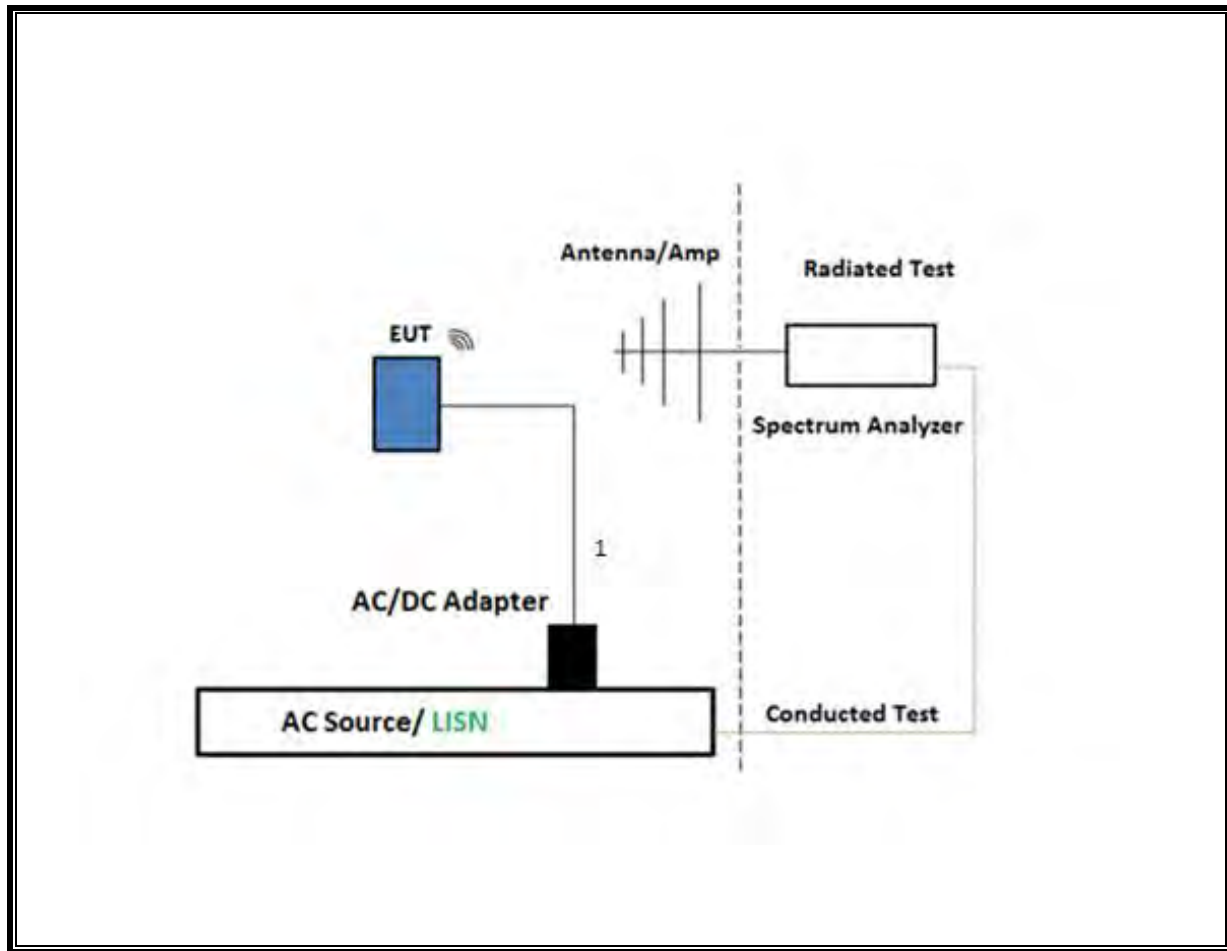
**SETUP DIAGRAM FOR CONDUCTED TESTS**



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



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



## 6. MEASUREMENT METHOD

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

99% BW: ANSI C63.10-2013, Section 6.9.3.

Output Power: ANSI C63.10 Subclause -11.9.2.3.1 Method AVGPM (Measurement using an RF average-reading power meter)

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

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

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

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

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

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

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

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

## 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                   | T863       | 05/30/2020 | 05/30/2019 |
| Amplifier, 1 to 18GHz, 35dB               | Amplical                        | AFS42-00101800-25-S-42 | T1567      | 01/26/2020 | 01/26/2019 |
| Antenna, Horn 1-18GHz                     | ETS-Lindgren                    | 3117                   | T344       | 05/07/2020 | 05/07/2019 |
| Amplifier, 1 to 18GHz                     | MITEQ                           | AFS42-00101800-25-S-42 | T931       | 05/11/2020 | 05/11/2019 |
| *Antenna, Horn 1-18GHz                    | ETS-Lindgren                    | 3117                   | T120       | 07/02/2019 | 07/02/2018 |
| Amplifier, 1 to 18GHz                     | MITEQ                           | AFS42-00101800-25-S-42 | T491       | 05/30/2020 | 05/30/2019 |
| 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       | 10/06/2019 | 10/06/2018 |
| *Antenna, Horn 1-18GHz                    | ETS Lindgren                    | 3117                   | T136       | 07/02/2019 | 07/02/2018 |
| Amplifier, 1 to 18GHz, 35dB               | Amplical                        | AFS42-00101800-25-S-42 | T1567      | 01/26/2020 | 01/26/2019 |
| Antenna, Horn 1-18GHz                     | ETS-Lindgren                    | 3117                   | T345       | 04/20/2020 | 04/20/2019 |
| Amplifier, 1 to 18GHz                     | Miteq                           | AFS42-00101800-25-S-42 | 138301     | 09/15/2019 | 09/15/2018 |
| Antenna, Horn 1-18GHz                     | ETS-Lindgren                    | 3117                   | T712       | 02/26/2020 | 02/26/2019 |
| Amplifier, 1 to 18GHz                     | MITEQ                           | AFS42-00101800-25-S-42 | T740       | 05/31/2020 | 05/31/2019 |
| Antenna, Horn 1-18GHz                     | ETS-Lindgren                    | 3117                   | T346       | 05/14/2020 | 05/14/2019 |
| RF Amplifier, 1 to 18GHz                  | MITEQ                           | AFS42-00101800-25-S-42 | T1165      | 05/24/2020 | 05/24/2019 |
| *Antenna, Broadband Hybrid, 30MHz to 3GHz | SunAR rf motion                 | JB3                    | PRE0181574 | 08/01/2020 | 08/01/2019 |
| Amplifier, 100KHz to 1GHz, 32dB           | Agilent (Keysight) Technologies | 8447D                  | T15        | 10/20/2019 | 10/20/2018 |
| 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 |
| Spectrum Analyzer, PXA 3Hz to 44GHz       | Agilent (Keysight) Technologies | N9030A                 | T906       | 01/22/2020 | 01/22/2019 |
| Spectrum Analyzer, PXA 3Hz to 44GHz       | Agilent (Keysight) Technologies | N9030A                 | T340       | 01/22/2020 | 01/22/2019 |
| Spectrum Analyzer, PXA 3Hz to 44GHz       | Agilent (Keysight) Technologies | N9030A                 | T905       | 01/24/2020 | 01/24/2019 |
| Spectrum Analyzer, PXA 3Hz to 44GHz       | Keysight                        | N9030A                 | T1454      | 01/23/2020 | 01/23/2019 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz      | Agilent (Keysight) Technologies | N9030A                 | T908       | 01/23/2020 | 01/23/2019 |
| *Antenna Horn, 18 to 26GHz                | ARA                             | MWH-1826               | T447       | 06/16/2019 | 06/16/2018 |
| Pre-Amp 18-26GHz                          | Agilent Technology              | 8449B                  | T404       | 03/23/2020 | 03/23/2019 |
| Power Meter, P-series single channel      | Agilent (Keysight) Technologies | N1911A                 | T227       | 10/29/2019 | 10/29/2018 |
| *Power Sensor                             | Keysight                        | N1921A                 | T1228      | 07/10/2020 | 07/10/2019 |

\*Note: All testing done before calibration due date

| AC Line Conducted                      |                 |                |                           |            |            |
|----------------------------------------|-----------------|----------------|---------------------------|------------|------------|
| Description                            | Manufacturer    | Model          | ID Num                    | Cal Due    | Last Cal   |
| EMI Test Receiver 9Khz-7GHz            | Rohde & Schwarz | ESCI7          | T1436                     | 02/14/2020 | 02/14/2019 |
| Power Cable, Line Conducted Emissions  | UL              | PG1            | T861                      | 08/31/2019 | 08/31/2018 |
| *LISN for Conducted Emissions CISPR-16 | Fischer         | 50/250-25-2-01 | T1310                     | 06/19/2019 | 06/19/2018 |
| 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     |            |            |



## 8. ANTENNA PORT TEST RESULTS

### 8.1. ON TIME AND DUTY CYCLE

#### LIMITS

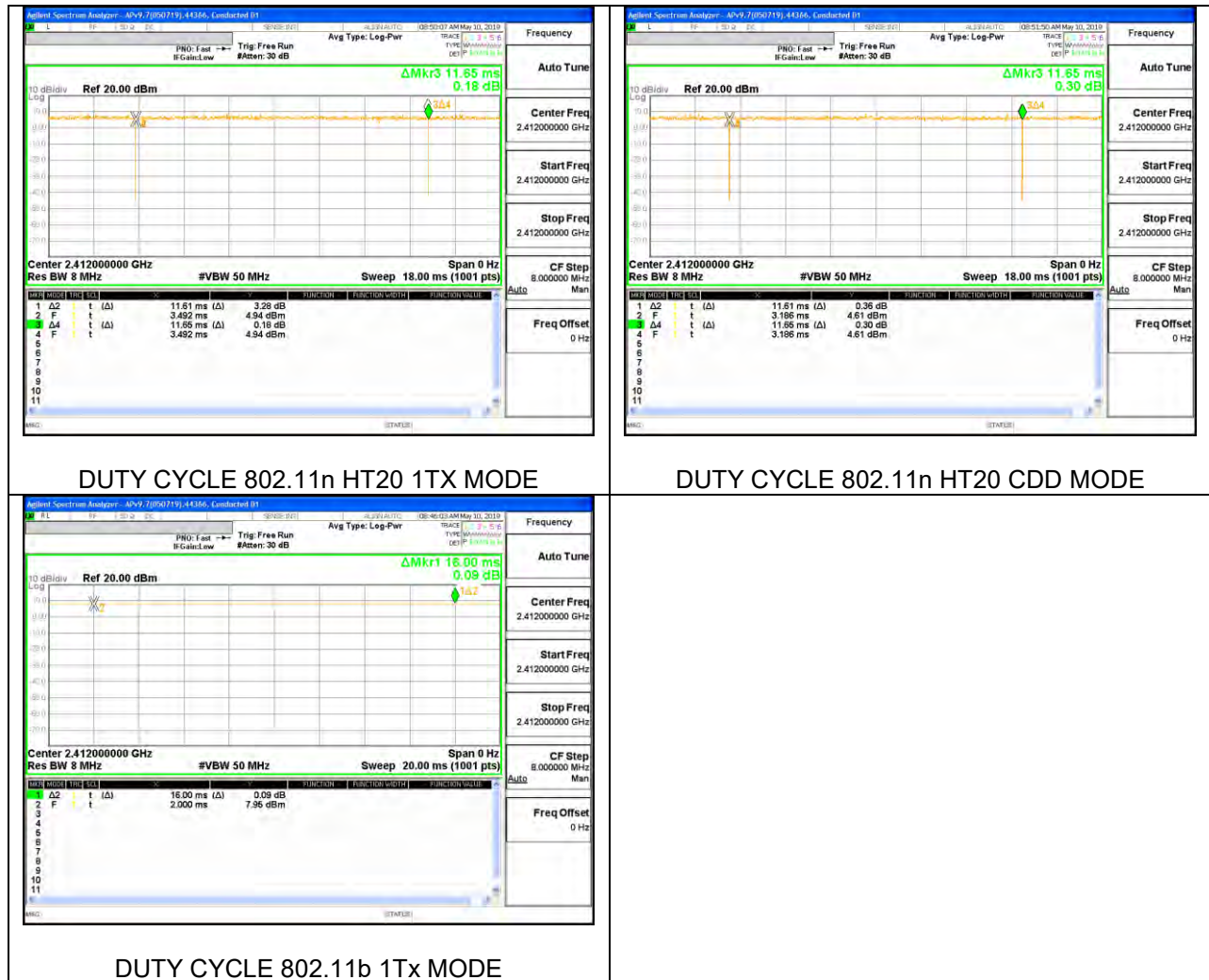
None; for reporting purposes only.

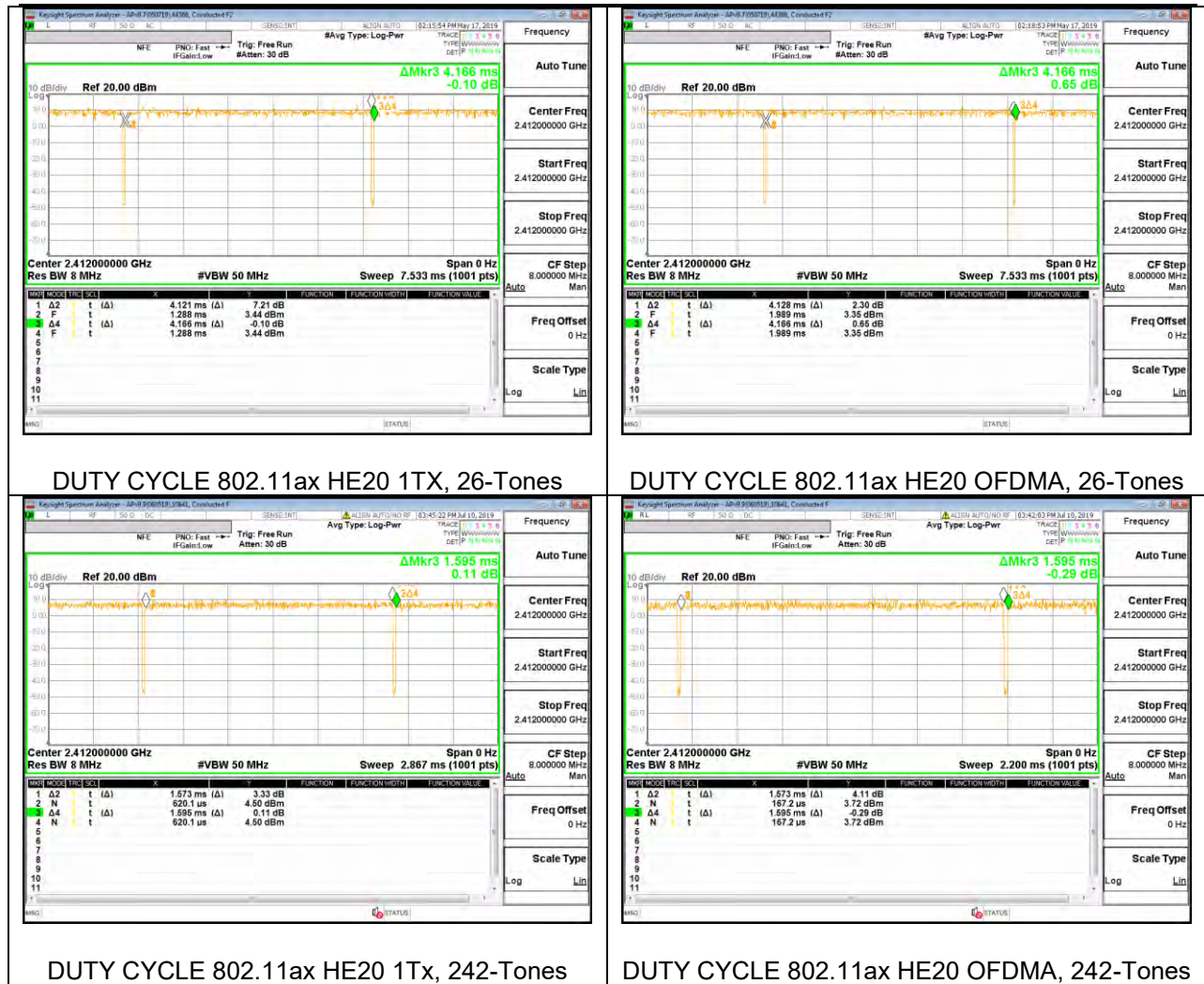
#### PROCEDURE

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>             |                        |                  |                             |                      |                                         |                             |
| 802.11b 1Tx                    | 2.000                  | 2.000            | 1.000                       | 100.00%              | 0.00                                    | 0.010                       |
| 802.11n HT20 1Tx               | 11.610                 | 11.650           | 0.997                       | 99.66%               | 0.00                                    | 0.010                       |
| 802.11n HT20 CDD               | 11.610                 | 11.650           | 0.997                       | 99.66%               | 0.00                                    | 0.010                       |
| 802.11ax HE20 1Tx, 26-Tones    | 4.121                  | 4.166            | 0.989                       | 98.92%               | 0.00                                    | 0.010                       |
| 802.11ax HE20 1Tx, 242-Tones   | 1.573                  | 1.595            | 0.986                       | 98.62%               | 0.00                                    | 0.010                       |
| 802.11ax HE20 OFMDA, 26-Tones  | 4.128                  | 4.166            | 0.991                       | 99.09%               | 0.00                                    | 0.010                       |
| 802.11ax HE20 OFMDA, 242-Tones | 1.573                  | 1.595            | 0.986                       | 98.62%               | 0.00                                    | 0.010                       |





## **8.2. 99% BANDWIDTH**

### **LIMITS**

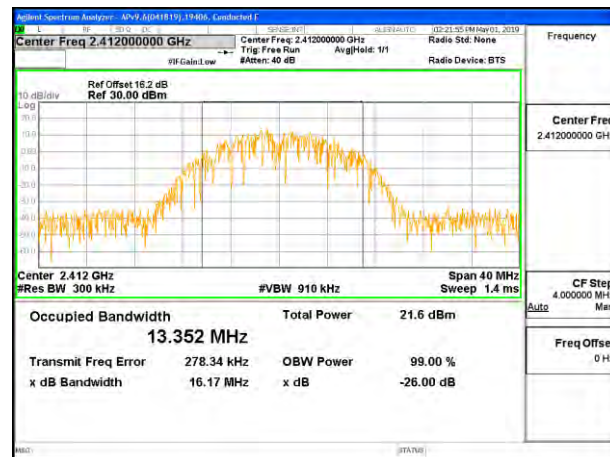
None; for reporting purposes only.

### **RESULTS**

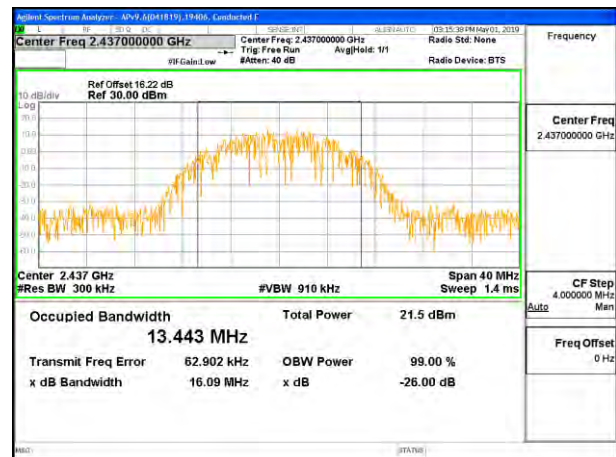
### 8.2.1. 802.11b MODE

#### 1TX Antenna 4 MODE

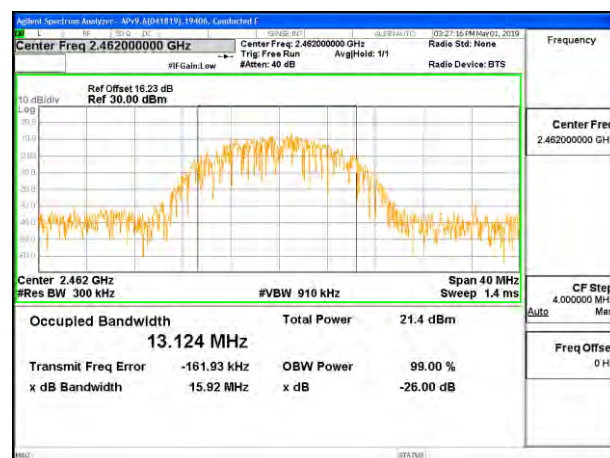
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 13.3520                |
| Mid 6   | 2437               | 13.4430                |
| High 11 | 2462               | 13.1240                |
| High 12 | 2467               | 12.8920                |
| High 13 | 2472               | 13.3590                |



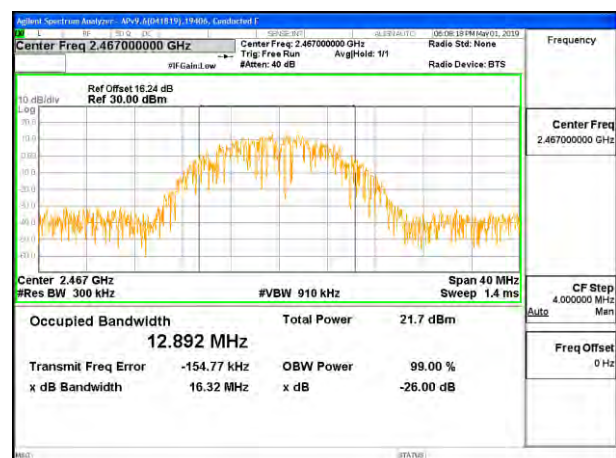
LOW CHANNEL 1



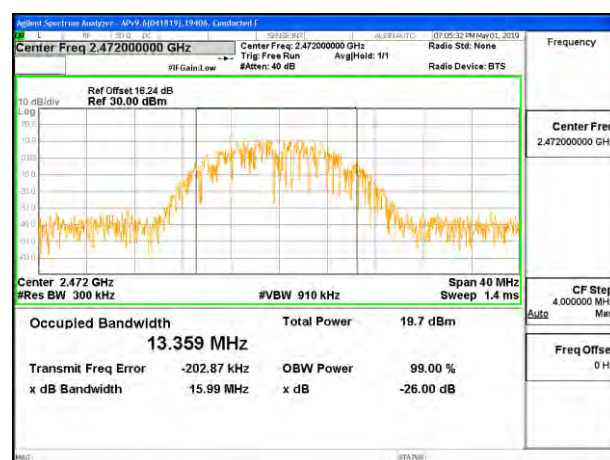
MID CHANNEL 6



HIGH CHANNEL 11



HIGH CHANNEL 12

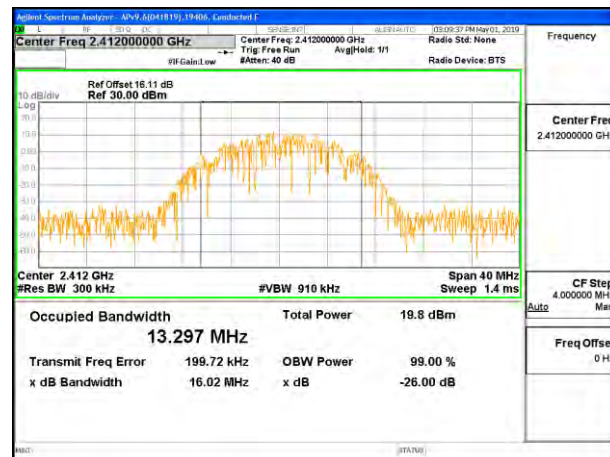


HIGH CHANNEL 13

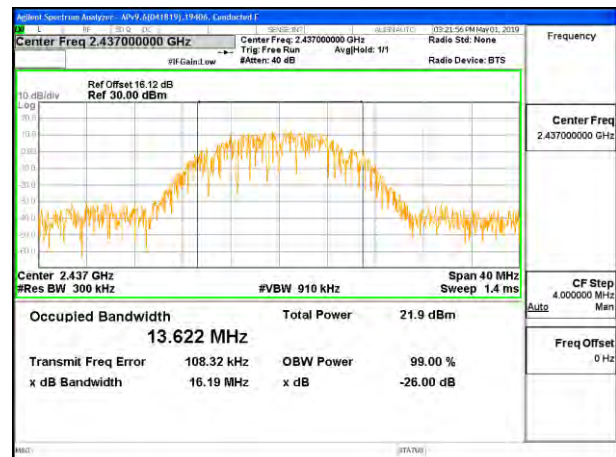
**1TX Antenna 3 MODE**

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 13.2970                |
| Mid 6   | 2437               | 13.6220                |
| High 11 | 2462               | 13.0890                |
| High 12 | 2467               | 13.0760                |
| High 13 | 2472               | 13.3080                |





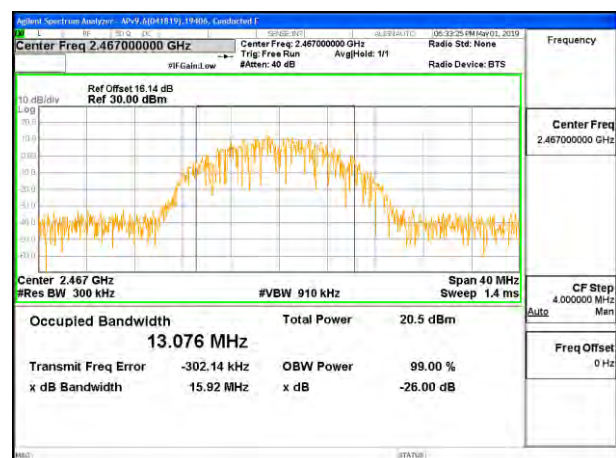
LOW CHANNEL 1



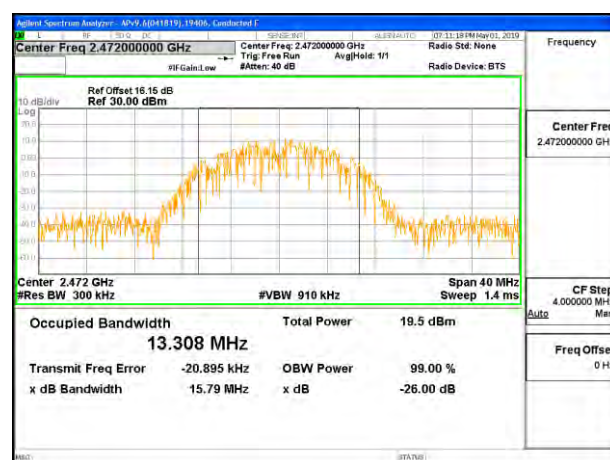
MID CHANNEL 6



HIGH CHANNEL 11



HIGH CHANNEL 12



HIGH CHANNEL 13



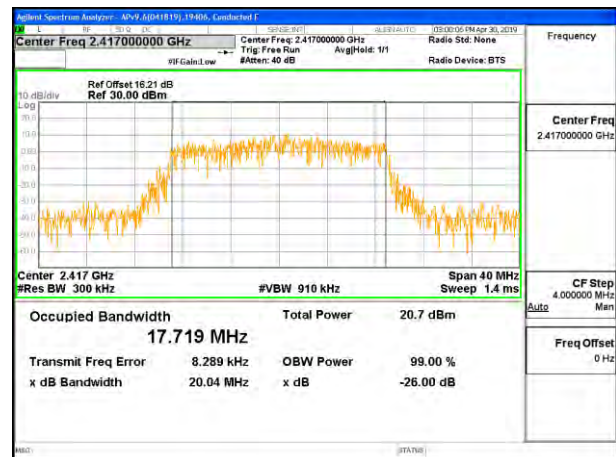
### 8.2.2. 802.11n HT20 MODE

#### 1TX Antenna 4 MODE

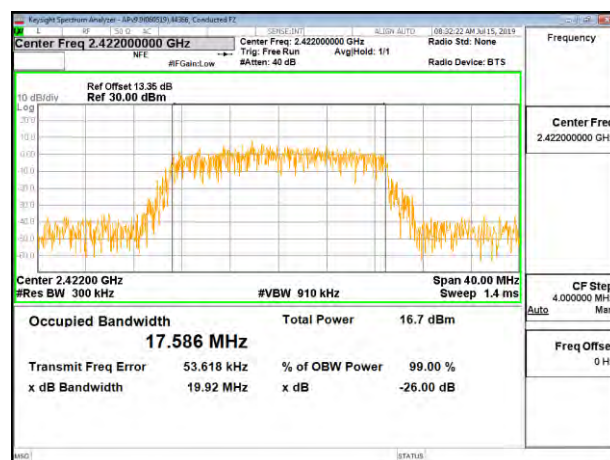
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 17.7940                |
| Low 2   | 2417               | 17.7190                |
| Low 3   | 2422               | 17.5860                |
| Mid 6   | 2437               | 17.6370                |
| High 9  | 2452               | 17.7530                |
| High 10 | 2457               | 17.5170                |
| High 11 | 2462               | 17.5880                |
| High 12 | 2467               | 17.6180                |
| High 13 | 2472               | 17.7370                |



LOW CHANNEL 1



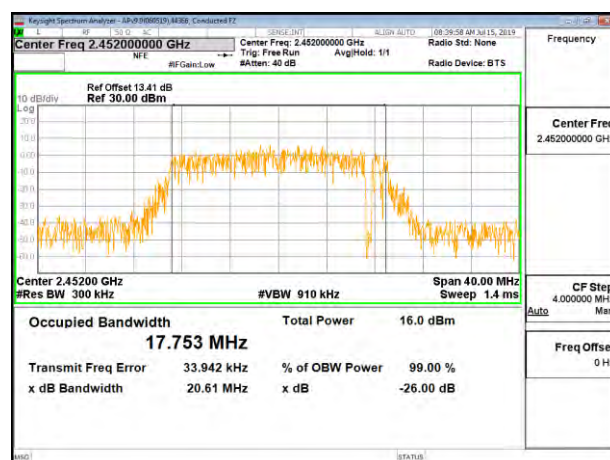
LOW CHANNEL 2



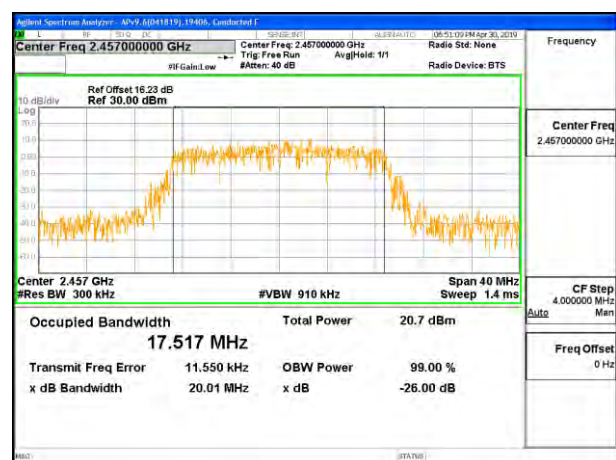
LOW CHANNEL 3



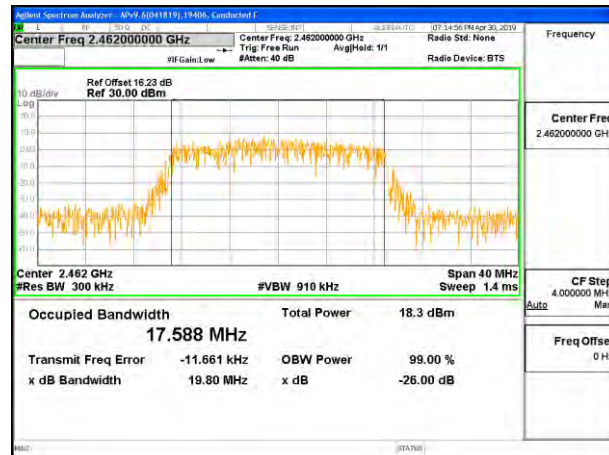
MID CHANNEL 6



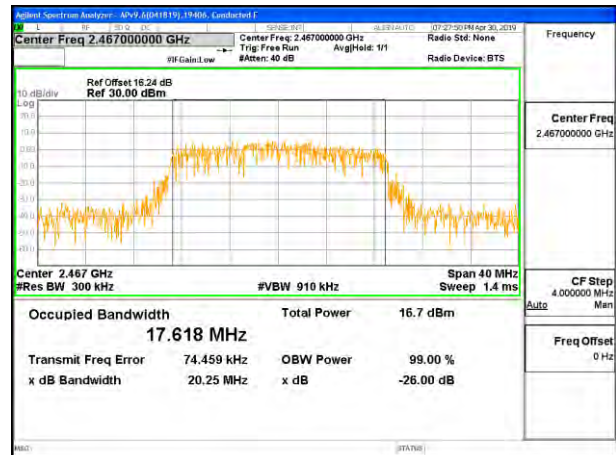
HIGH CHANNEL 9



HIGH CHANNEL 10



HIGH CHANNEL 11



HIGH CHANNEL 12



HIGH CHANNEL 13

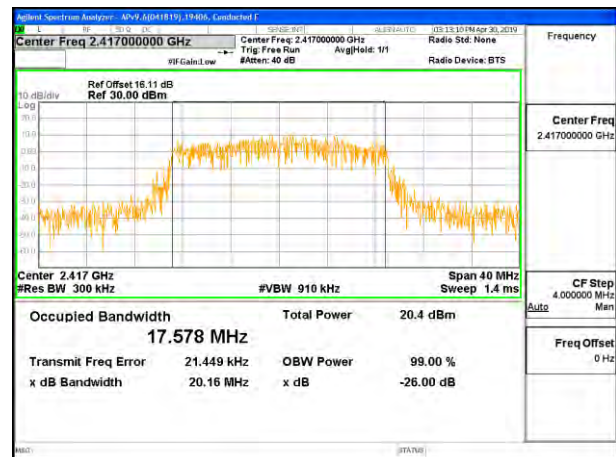
**1TX Antenna 3 MODE**

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 17.7010                |
| Low 2   | 2417               | 17.5780                |
| Low 3   | 2422               | 17.5560                |
| Mid 6   | 2437               | 17.6610                |
| High 9  | 2452               | 17.7090                |
| High 10 | 2457               | 17.5960                |
| High 11 | 2462               | 17.6550                |
| High 12 | 2467               | 17.7180                |
| High 13 | 2472               | 17.7500                |

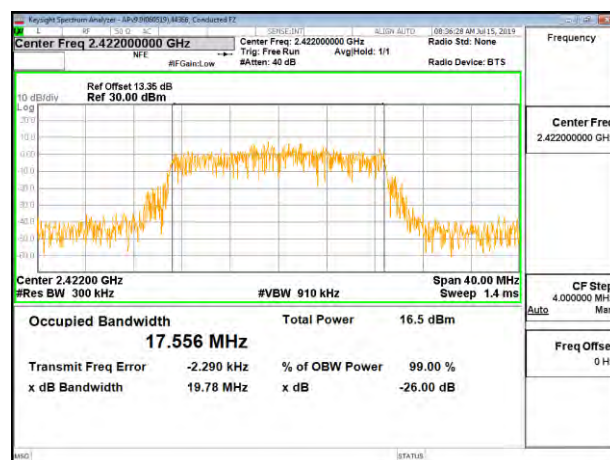




LOW CHANNEL 1



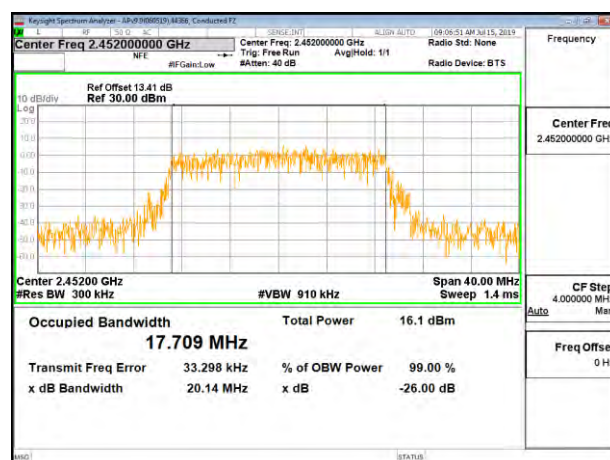
LOW CHANNEL 2



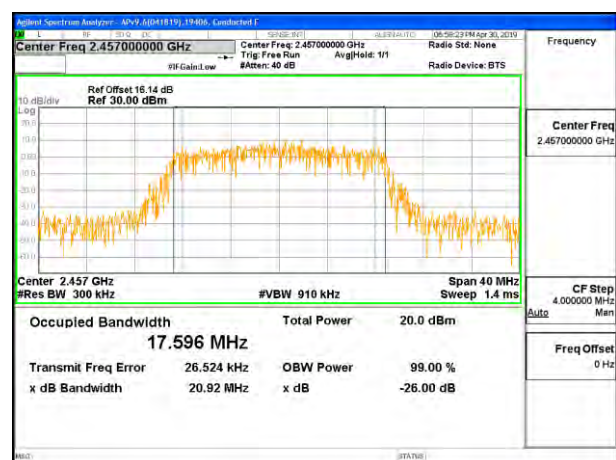
LOW CHANNEL 3



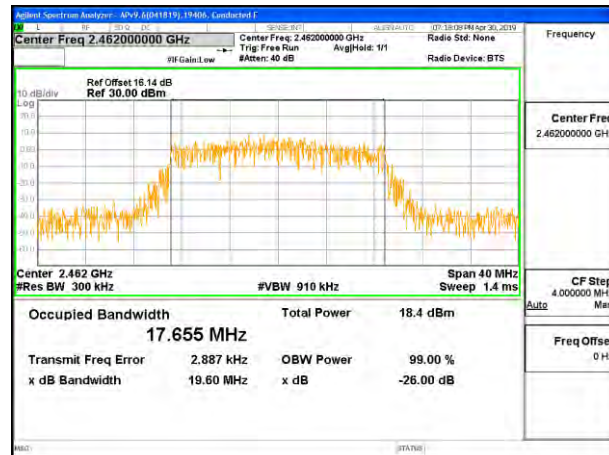
MID CHANNEL 6



HIGH CHANNEL 9



HIGH CHANNEL 10



HIGH CHANNEL 11



HIGH CHANNEL 12

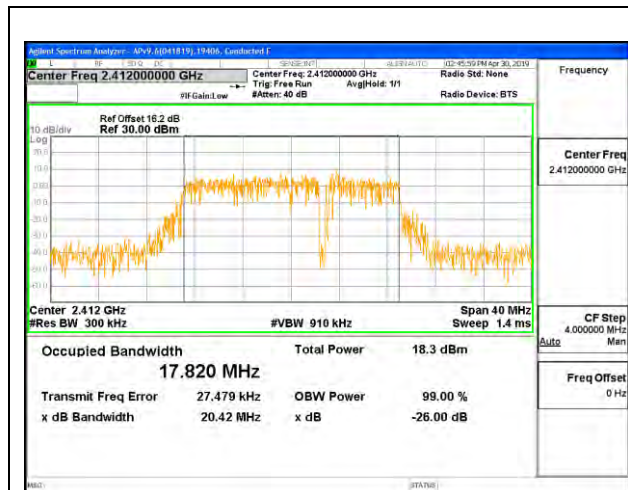


HIGH CHANNEL 13

**2TX Antenna 4 + Antenna 3 CDD MODE**

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>Ant 4<br>(MHz) | 99% Bandwidth<br>Ant 3<br>(MHz) |
|---------|--------------------|---------------------------------|---------------------------------|
| Low 1   | 2412               | 17.8200                         | 17.6330                         |
| Low 2   | 2417               | 17.5490                         | 17.6210                         |
| Low 3   | 2422               | 17.5360                         | 17.6230                         |
| Mid 6   | 2437               | 17.6860                         | 17.7280                         |
| High 9  | 2452               | 17.5870                         | 17.6590                         |
| High 10 | 2457               | 17.5860                         | 17.6140                         |
| High 11 | 2462               | 17.5890                         | 17.6860                         |
| High 12 | 2467               | 17.5410                         | 17.6600                         |
| High 13 | 2472               | 17.7990                         | 17.7270                         |

## LOW CHANNEL 1



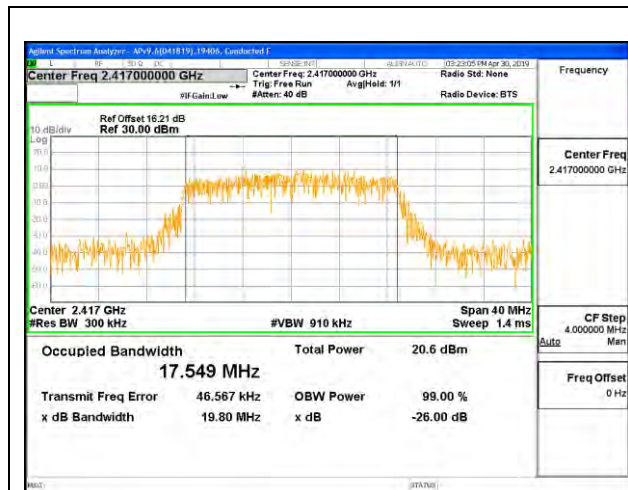
LOW CHANNEL 1 ANTENNA 4



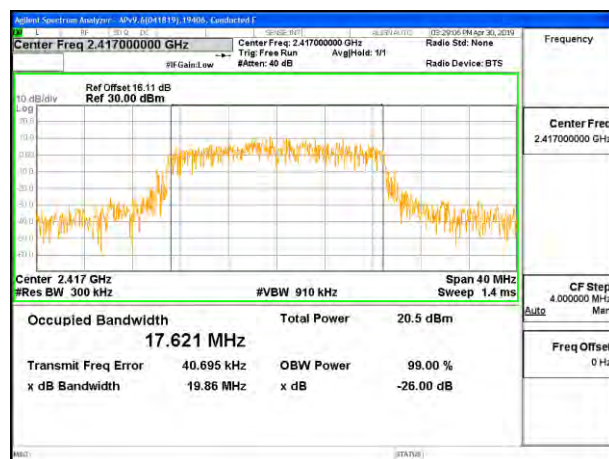
LOW CHANNEL 1 ANTENNA 3



## LOW CHANNEL 2

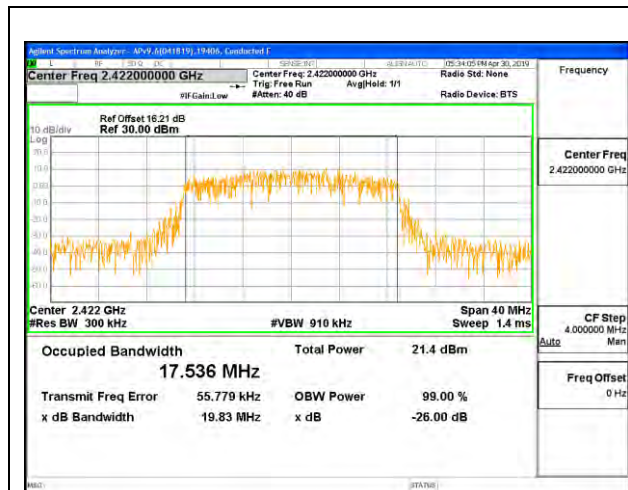


LOW CHANNEL 2 ANTENNA 4

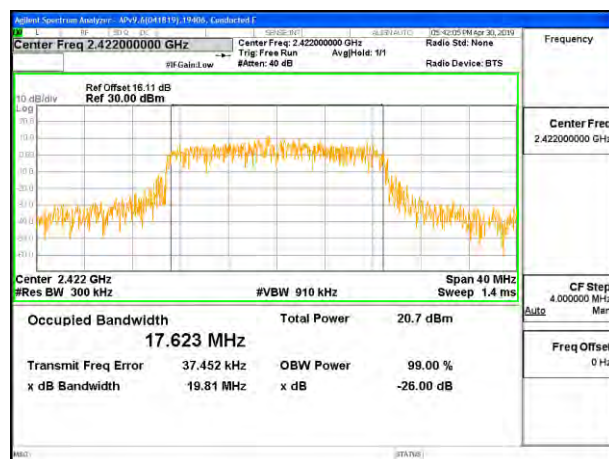


LOW CHANNEL 2 ANTENNA 3

## LOW CHANNEL 3



LOW CHANNEL 3 ANTENNA 4



LOW CHANNEL 3 ANTENNA 3

## MID CHANNEL 6



MID CHANNEL 6 ANTENNA 4

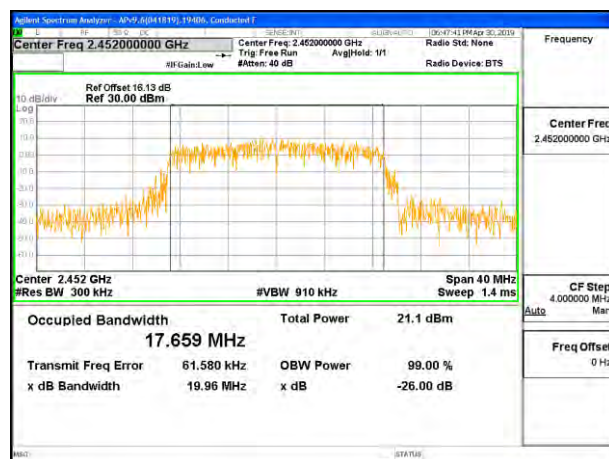


MID CHANNEL 6 ANTENNA 3

## HIGH CHANNEL 9

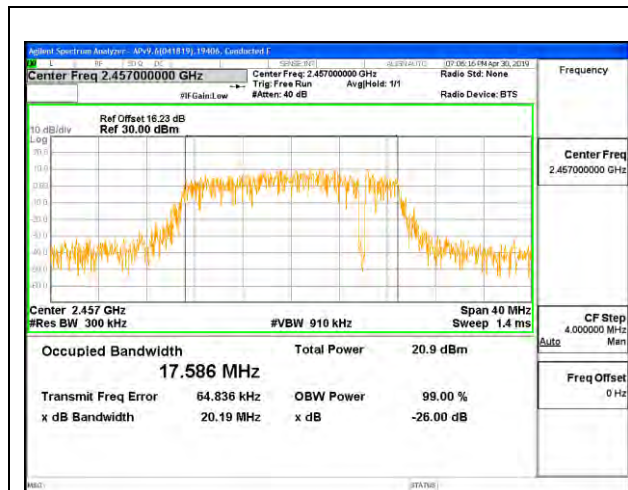


HIGH CHANNEL 9 ANTENNA 4



HIGH CHANNEL 9 ANTENNA 3

## HIGH CHANNEL 10

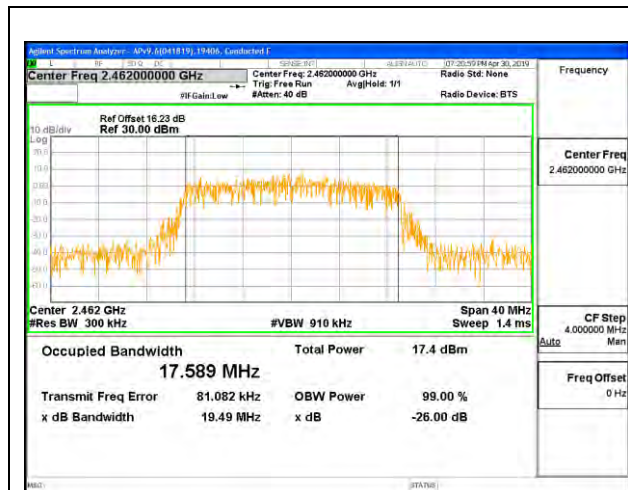


HIGH CHANNEL 10 ANTENNA 4



HIGH CHANNEL 10 ANTENNA 3

## HIGH CHANNEL 11



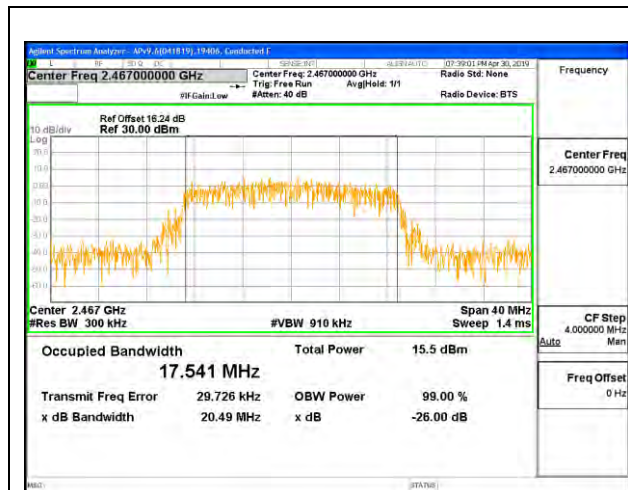
HIGH CHANNEL 11 ANTENNA 4



HIGH CHANNEL 11 ANTENNA 3



## HIGH CHANNEL 12



HIGH CHANNEL 12 ANTENNA 4

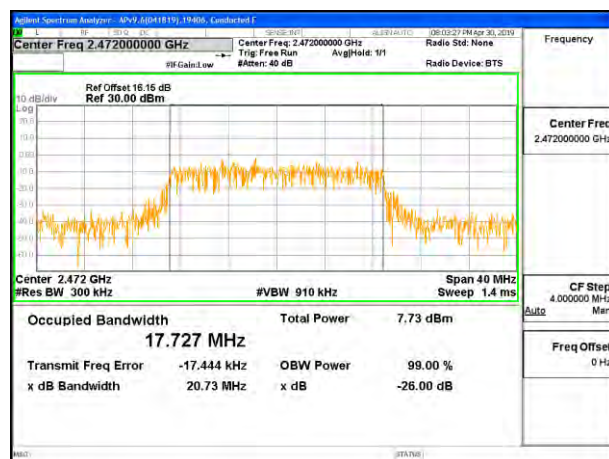


HIGH CHANNEL 12 ANTENNA 3

## HIGH CHANNEL 13



HIGH CHANNEL 13 ANTENNA 4



HIGH CHANNEL 13 ANTENNA 3

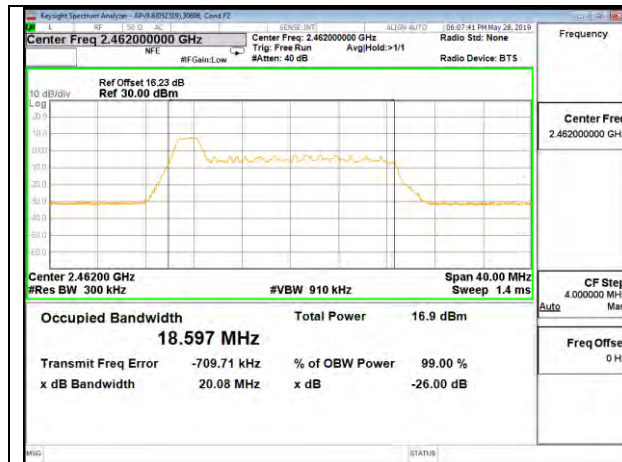


### 8.2.3. 802.11ax HE20 MODE

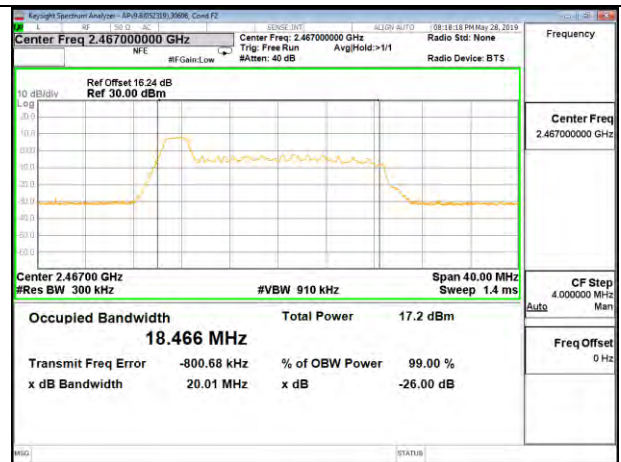
#### Antenna 4, LEGACY SISO MODE: 26-Tones, RU index 0

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 18.6070                |
| Low 2   | 2417               | 18.6340                |
| Low 3   | 2422               | 18.6020                |
| Mid 6   | 2437               | 18.5000                |
| High 9  | 2452               | 18.6750                |
| High 10 | 2457               | 18.6330                |
| High 11 | 2462               | 18.5970                |
| High 12 | 2467               | 18.4660                |
| High 13 | 2472               | 18.2770                |

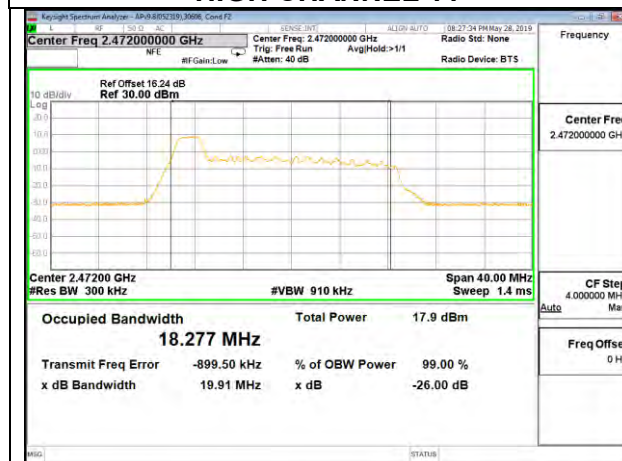




HIGH CHANNEL 11



HIGH CHANNEL 12

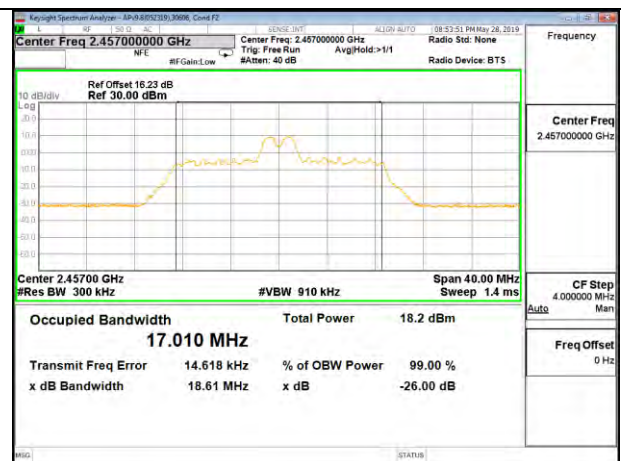
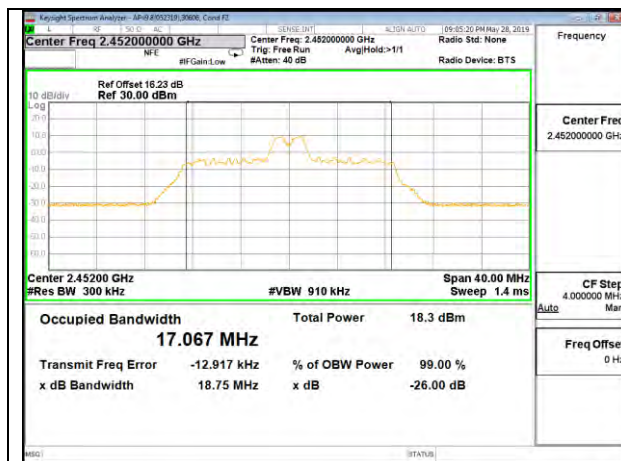
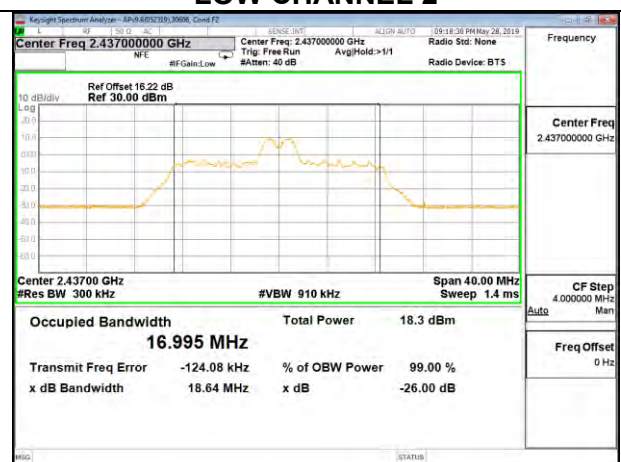
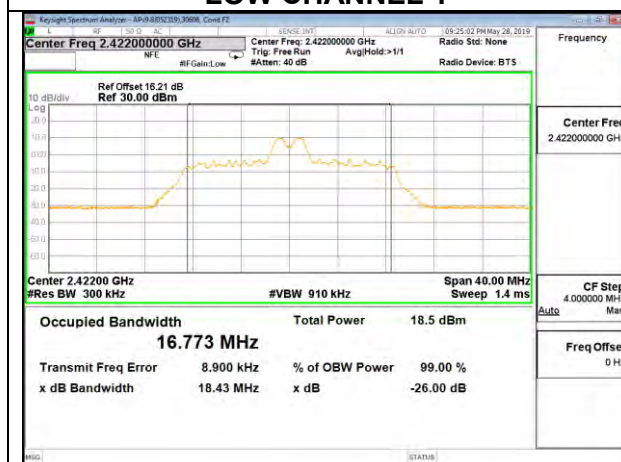
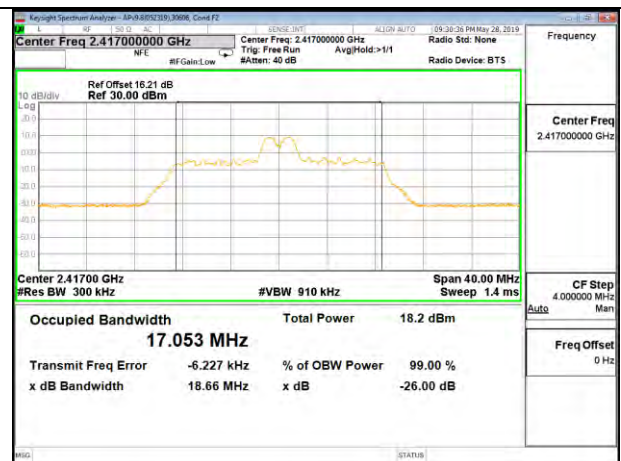
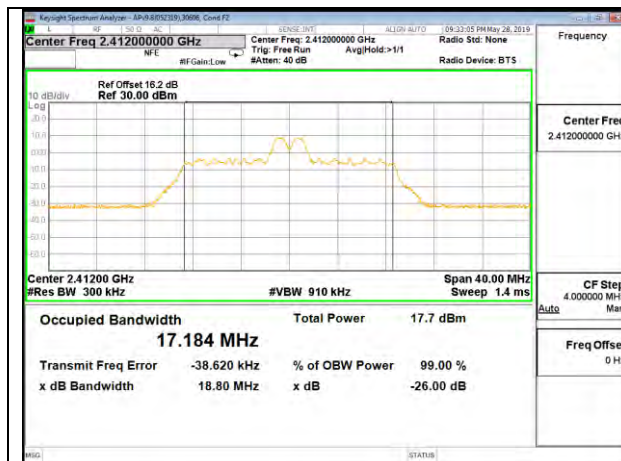


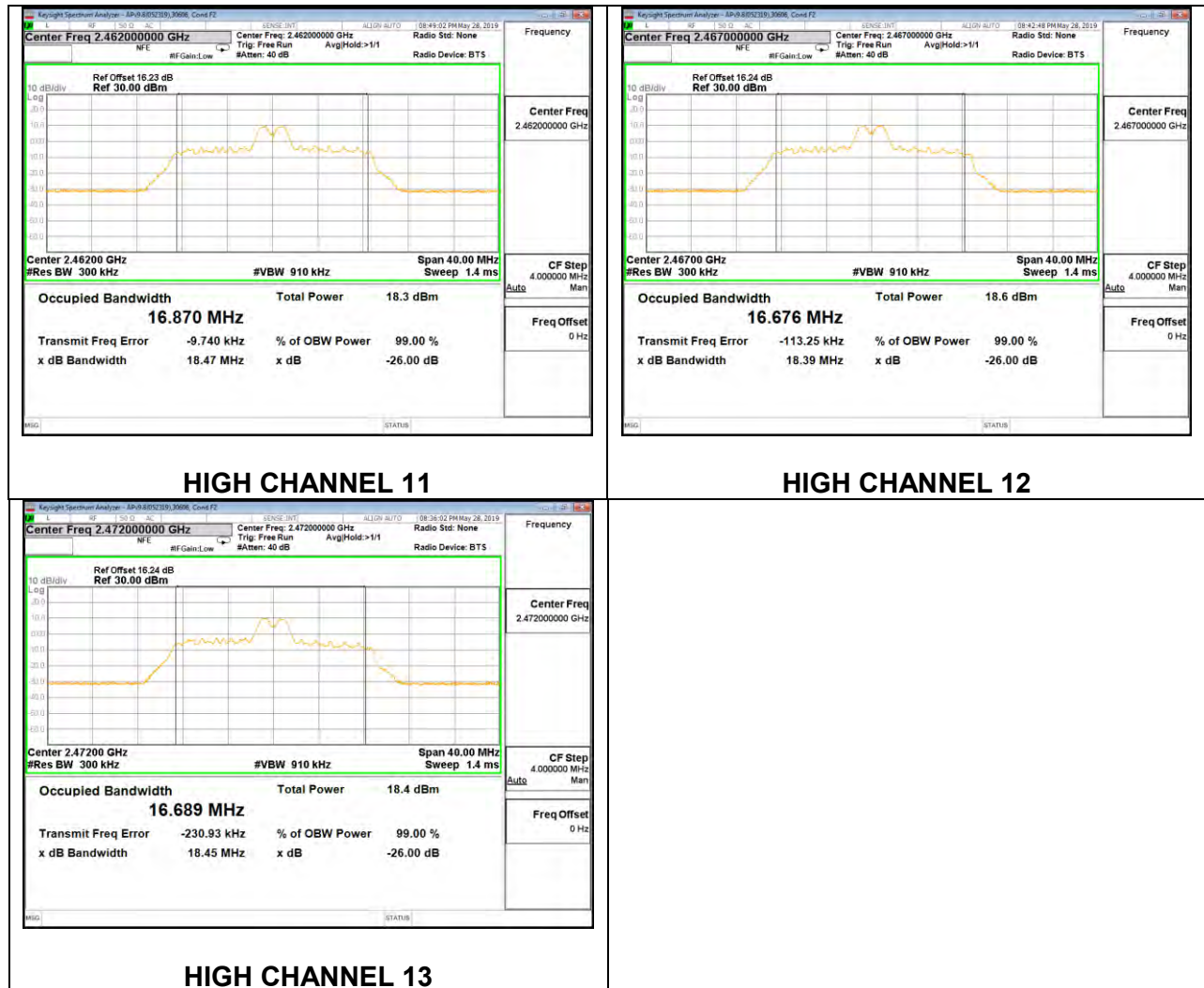
HIGH CHANNEL 13

**Antenna 4, LEGACY SISO MODE: 26-Tones, RU index 4**

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 17.1840                |
| Low 2   | 2417               | 17.0530                |
| Low 3   | 2422               | 16.7730                |
| Mid 6   | 2437               | 16.9950                |
| High 9  | 2452               | 17.0670                |
| High 10 | 2457               | 17.0100                |
| High 11 | 2462               | 16.8700                |
| High 12 | 2467               | 16.6760                |
| High 13 | 2472               | 16.6890                |



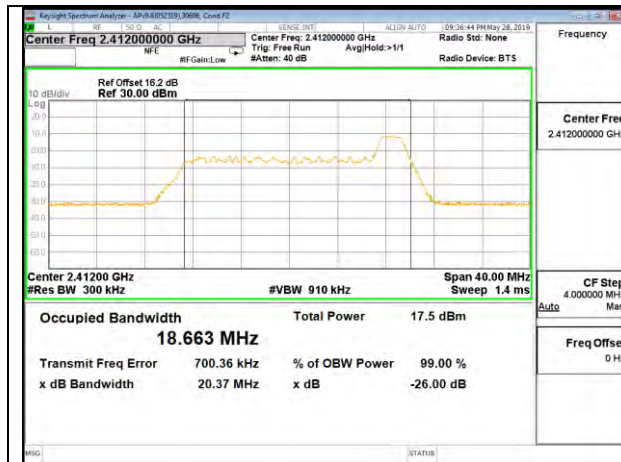




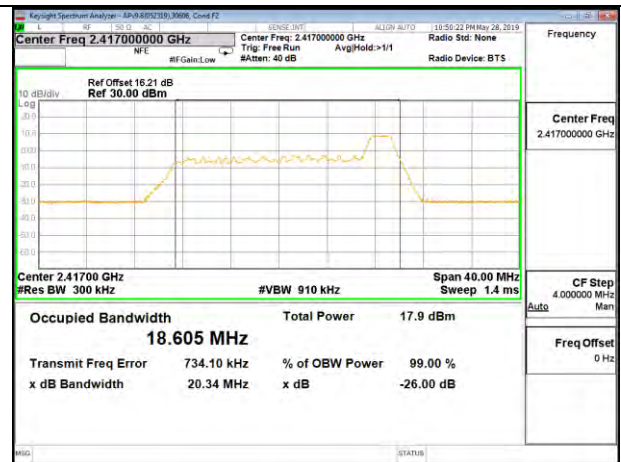
**Antenna 4, LEGACY SISO MODE: 26-Tones, RU index 8**

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 18.6630                |
| Low 2   | 2417               | 18.6050                |
| Low 3   | 2422               | 18.4700                |
| Mid 6   | 2437               | 18.7350                |
| High 9  | 2452               | 18.6290                |
| High 10 | 2457               | 18.5210                |
| High 11 | 2462               | 18.5390                |
| High 12 | 2467               | 18.6610                |
| High 13 | 2472               | 18.7460                |

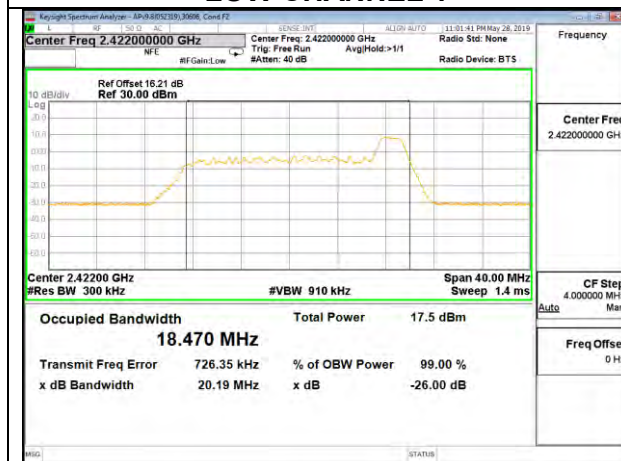




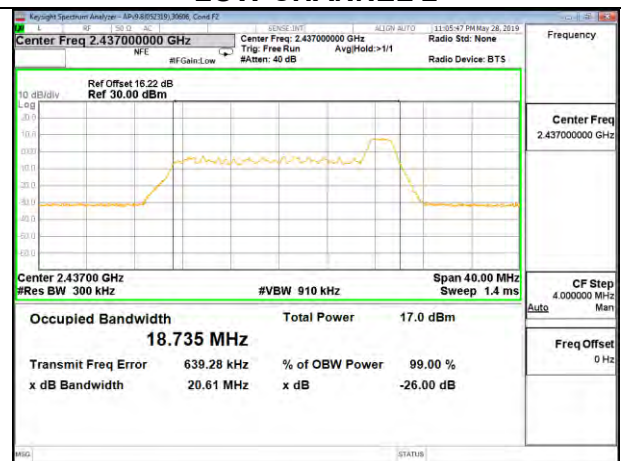
LOW CHANNEL 1



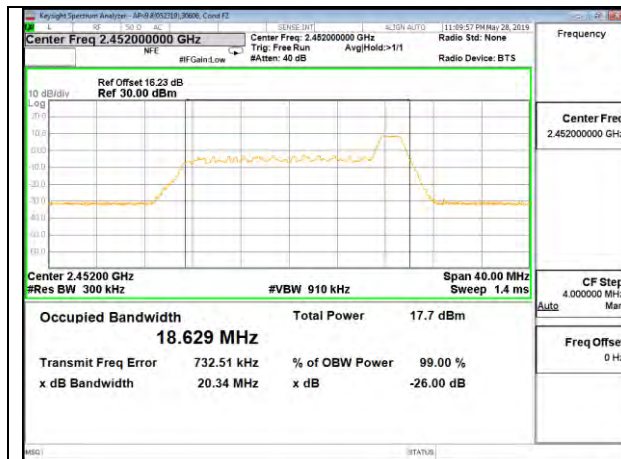
LOW CHANNEL 2



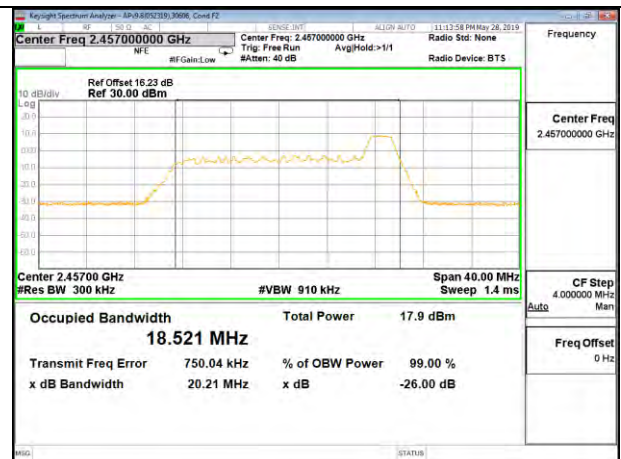
LOW CHANNEL 3



MID CHANNEL 6

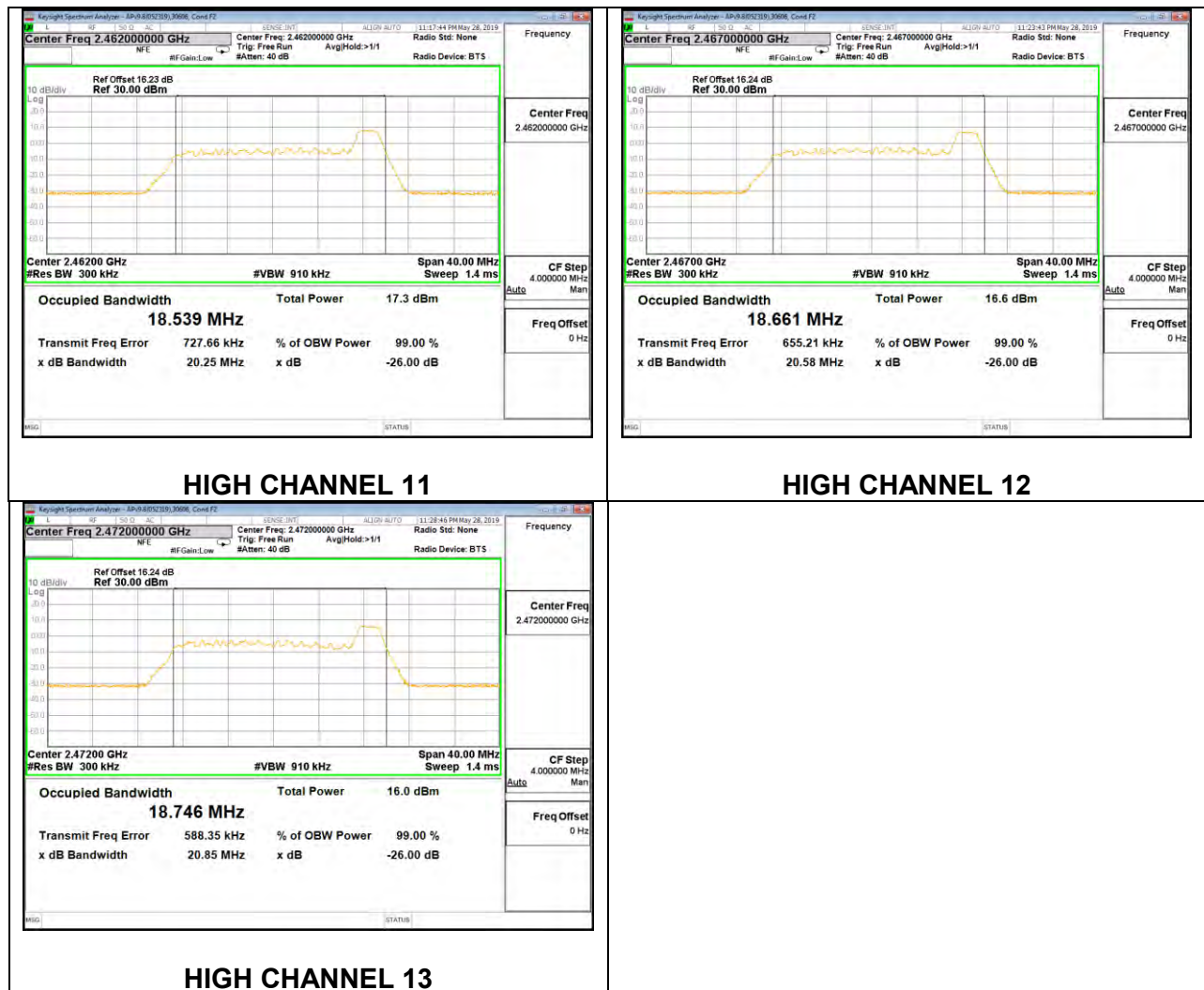


HIGH CHANNEL 9



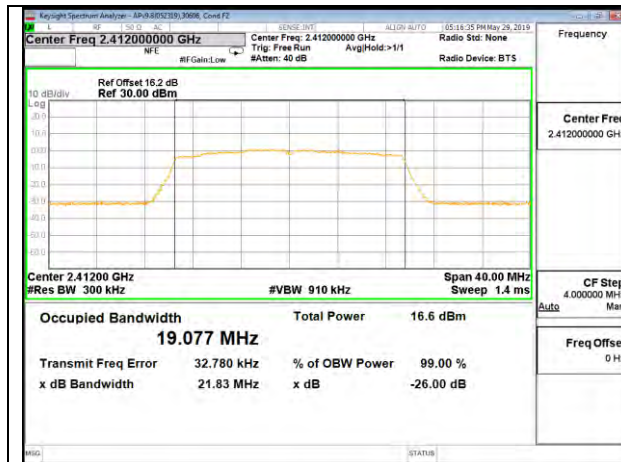
HIGH CHANNEL 10



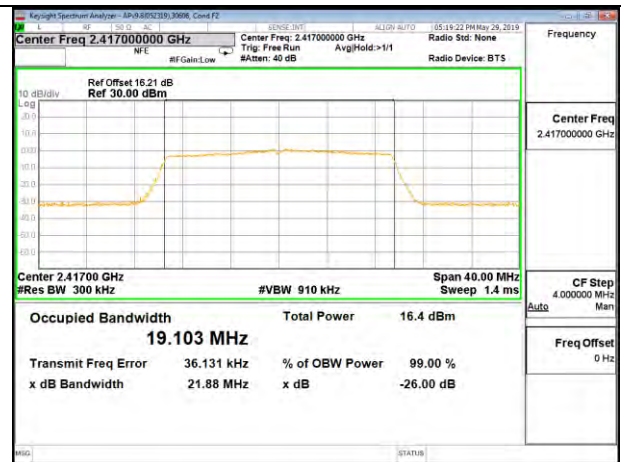


**Antenna 4, LEGACY SISO MODE: 242-Tones, RU index 61**

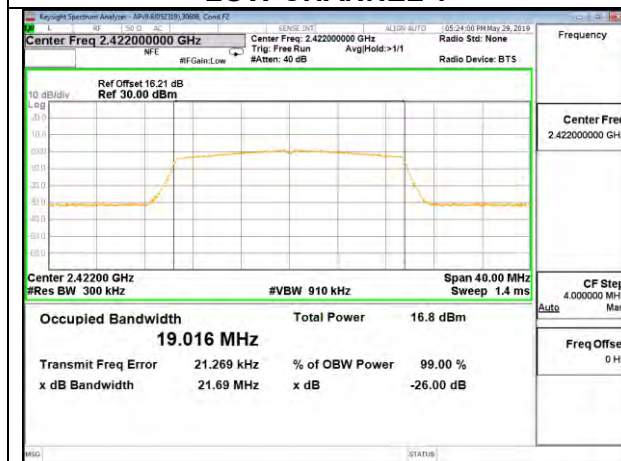
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 19.0770                |
| Low 2   | 2417               | 19.1030                |
| Low 3   | 2422               | 19.0160                |
| Mid 6   | 2437               | 19.1810                |
| High 9  | 2452               | 19.1380                |
| High 10 | 2457               | 19.0840                |
| High 11 | 2462               | 19.0380                |
| High 12 | 2467               | 19.0130                |
| High 13 | 2472               | 18.9790                |



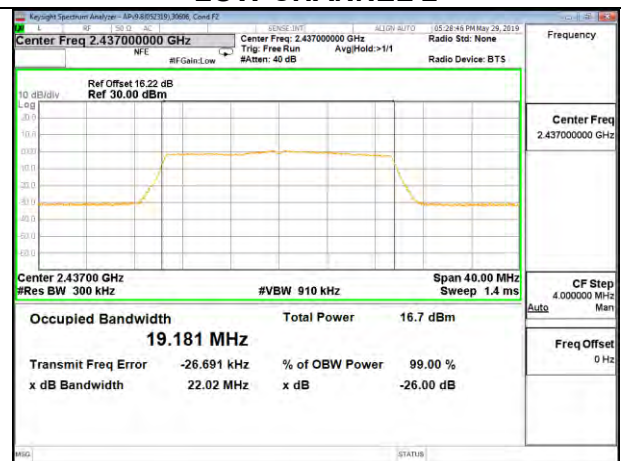
LOW CHANNEL 1



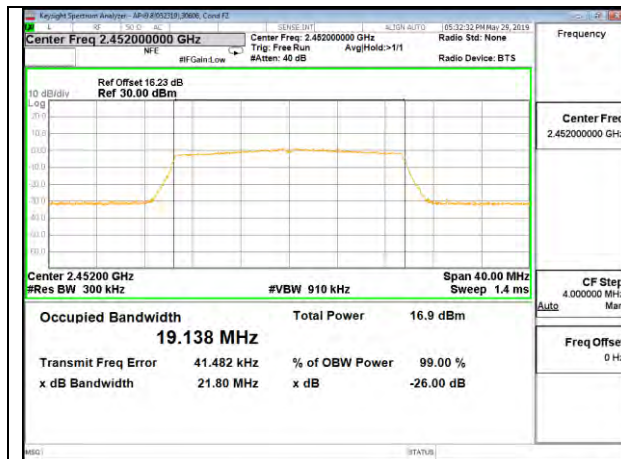
LOW CHANNEL 2



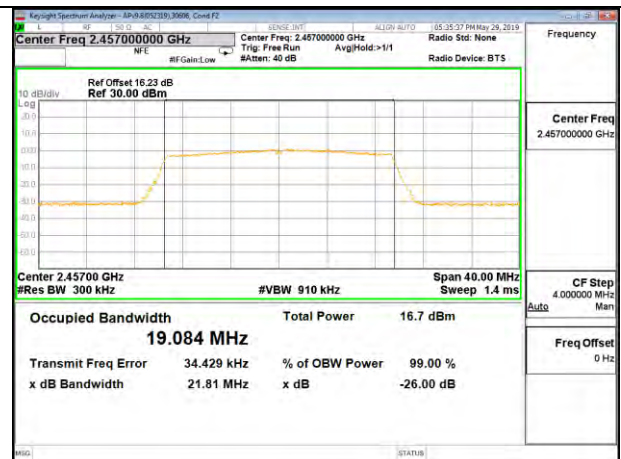
LOW CHANNEL 3



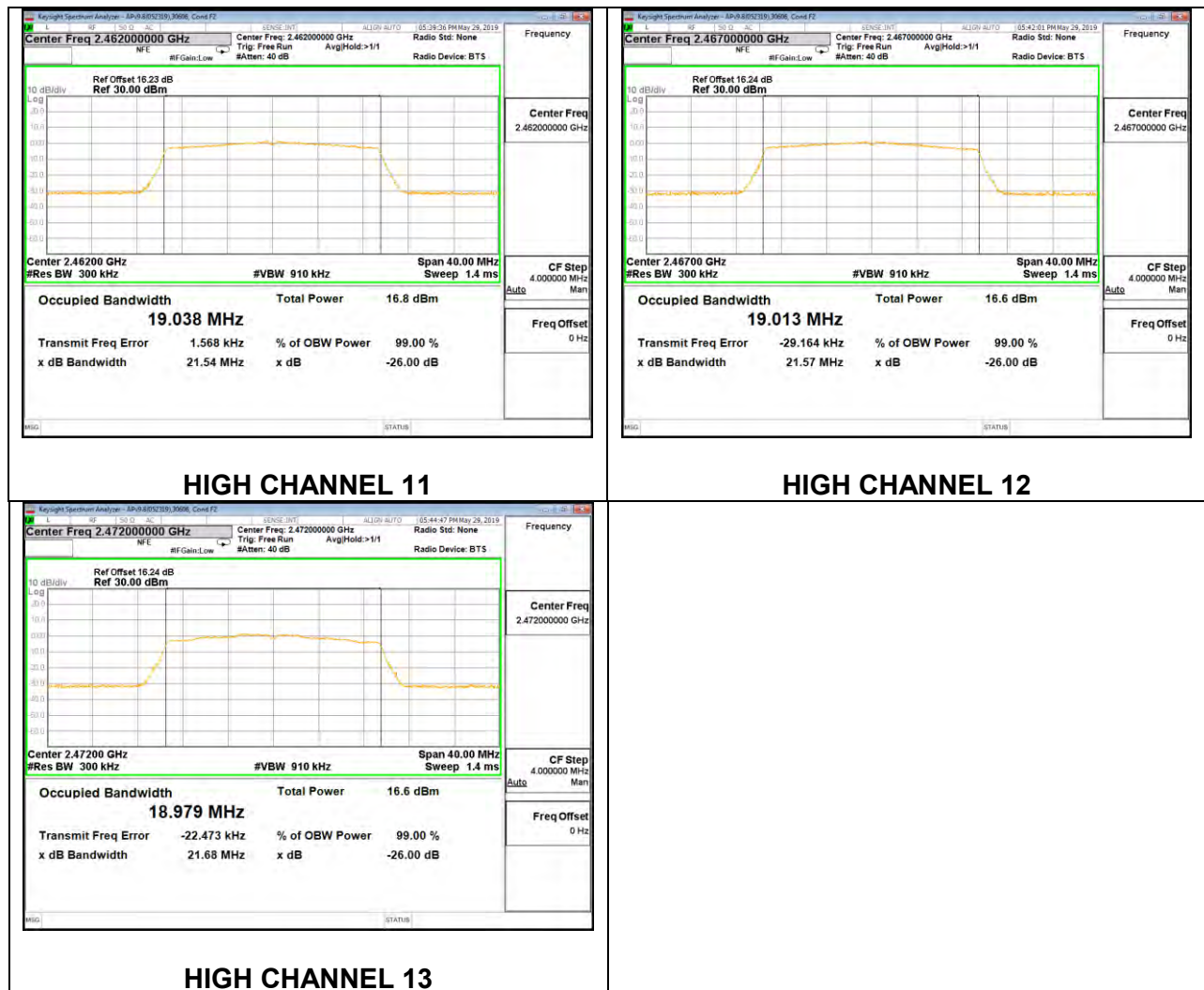
MID CHANNEL 6



HIGH CHANNEL 9



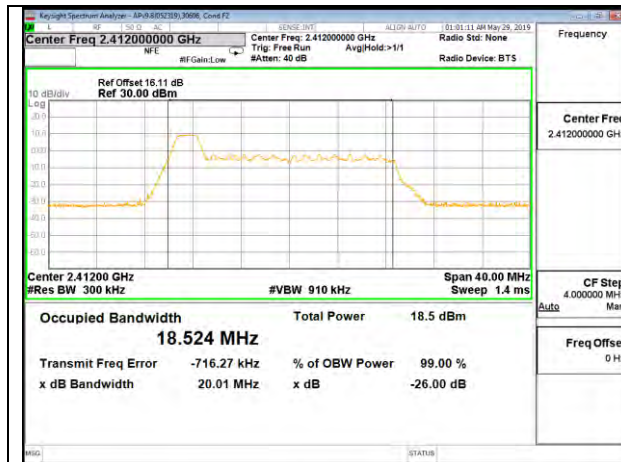
HIGH CHANNEL 10



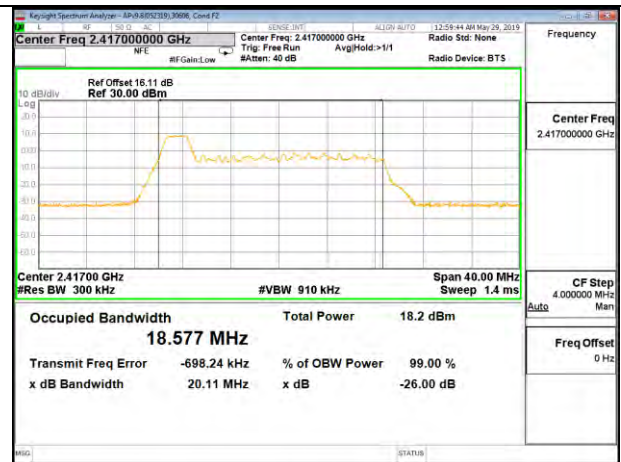
**Antenna 3, LEGACY SISO MODE: 26-Tones, RU index 0**

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 18.5240                |
| Low 2   | 2417               | 18.5770                |
| Low 3   | 2422               | 18.5140                |
| Mid 6   | 2437               | 18.3910                |
| High 9  | 2452               | 18.5560                |
| High 10 | 2457               | 18.5600                |
| High 11 | 2462               | 18.5240                |
| High 12 | 2467               | 18.3990                |
| High 13 | 2472               | 18.2130                |

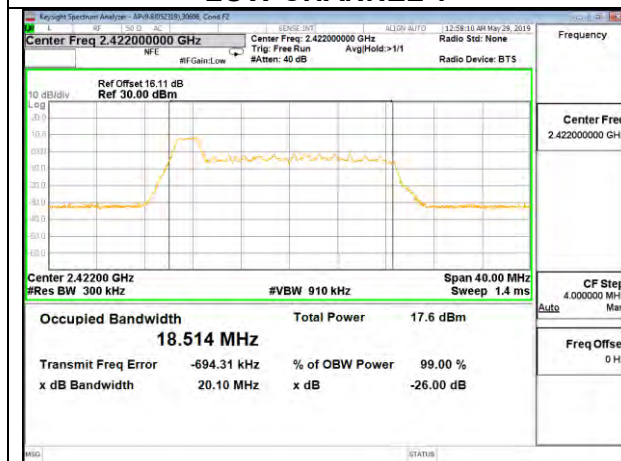




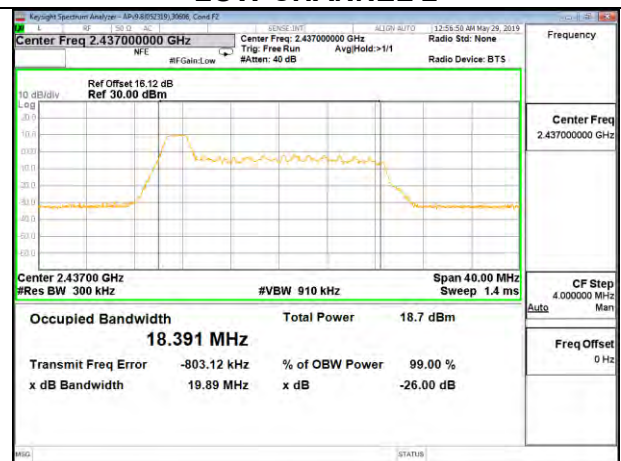
LOW CHANNEL 1



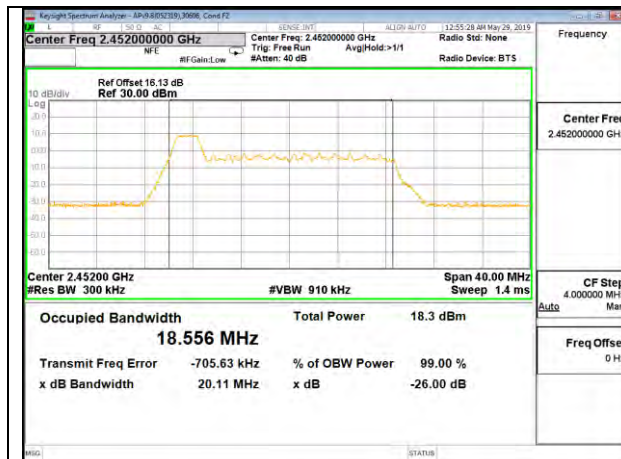
LOW CHANNEL 2



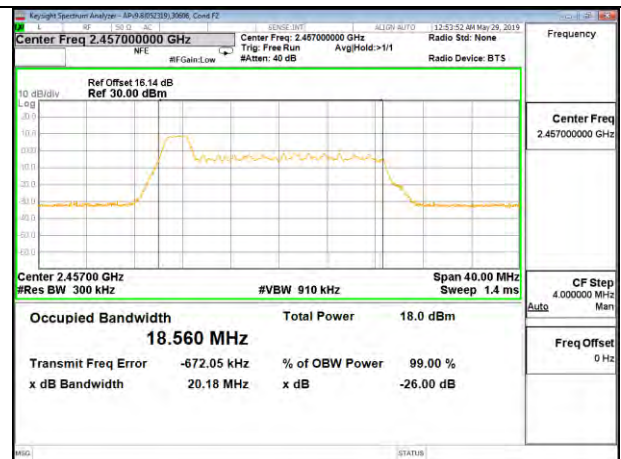
LOW CHANNEL 3



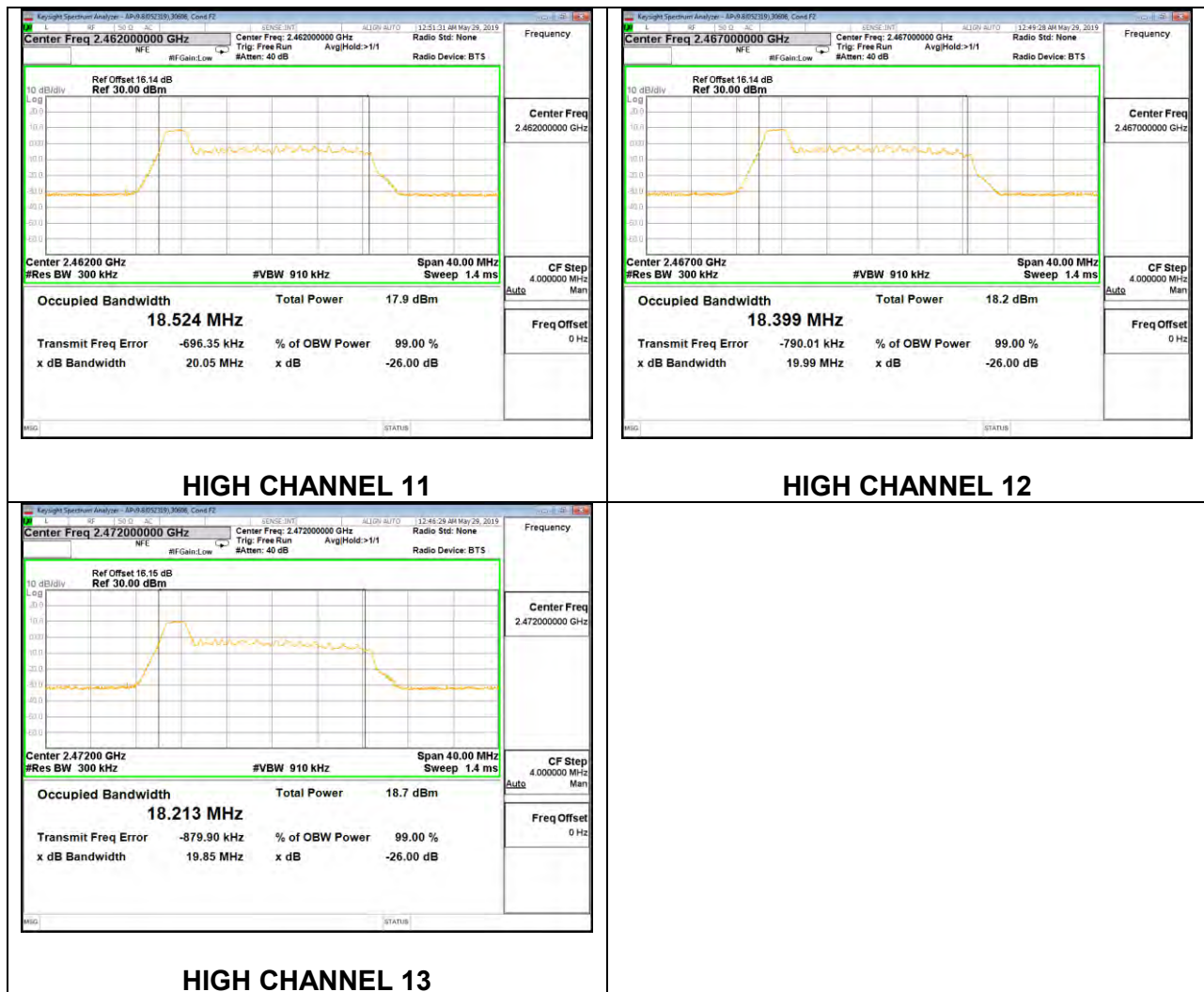
MID CHANNEL 6



HIGH CHANNEL 9



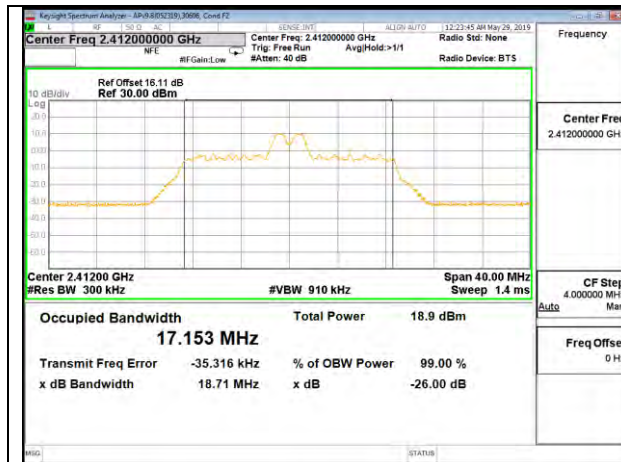
HIGH CHANNEL 10



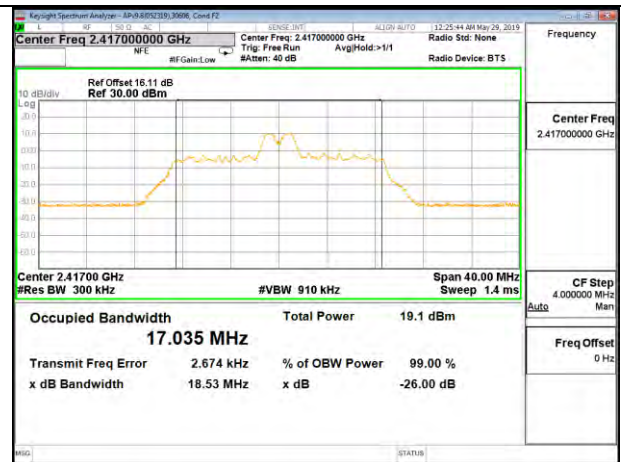


**Antenna 3, LEGACY SISO MODE: 26-Tones, RU index 4**

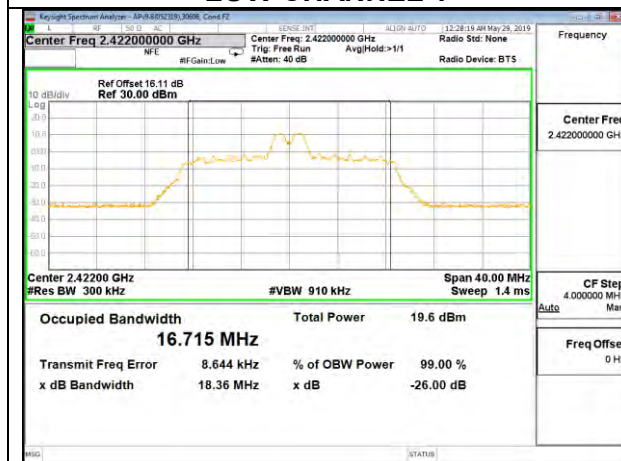
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 17.1530                |
| Low 2   | 2417               | 17.0350                |
| Low 3   | 2422               | 16.7150                |
| Mid 6   | 2437               | 16.9850                |
| High 9  | 2452               | 17.0530                |
| High 10 | 2457               | 16.9990                |
| High 11 | 2462               | 16.8280                |
| High 12 | 2467               | 16.6720                |
| High 13 | 2472               | 16.7000                |



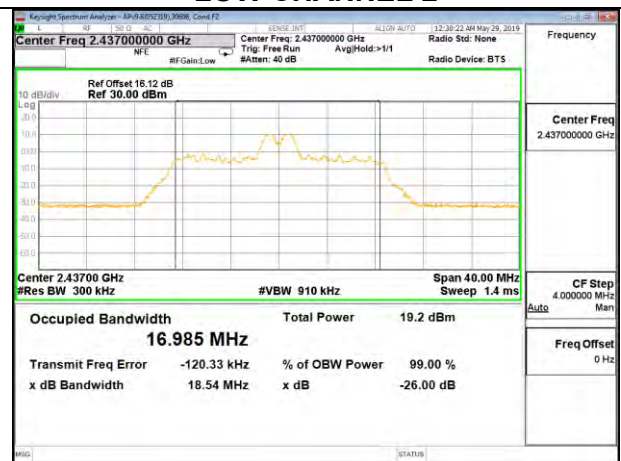
LOW CHANNEL 1



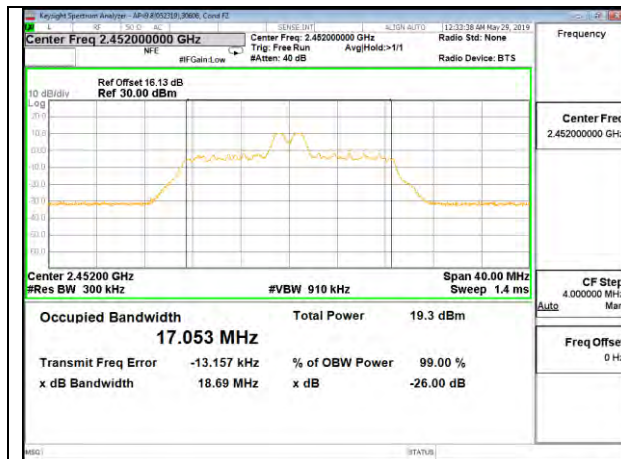
LOW CHANNEL 2



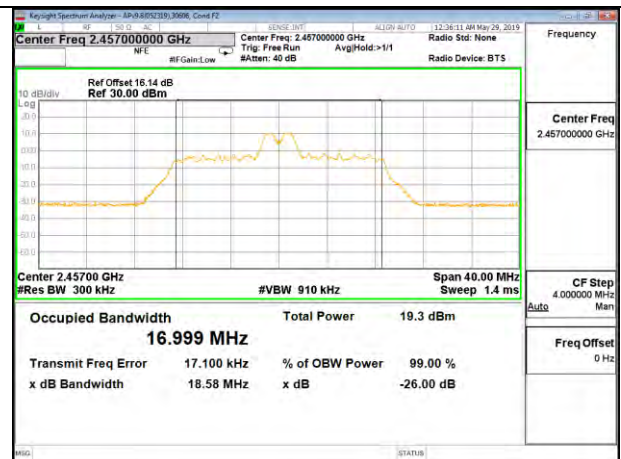
LOW CHANNEL 3



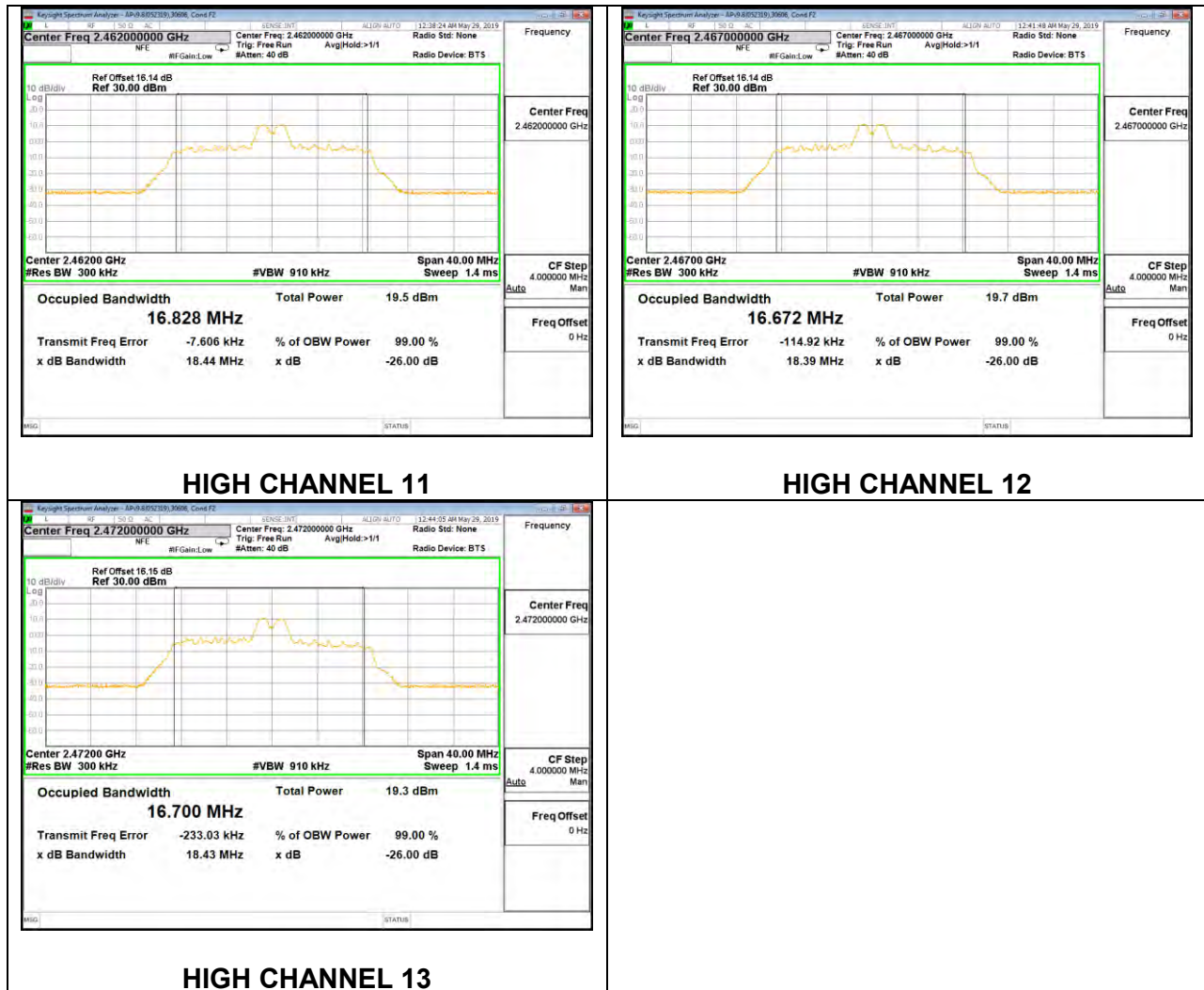
MID CHANNEL 6



HIGH CHANNEL 9



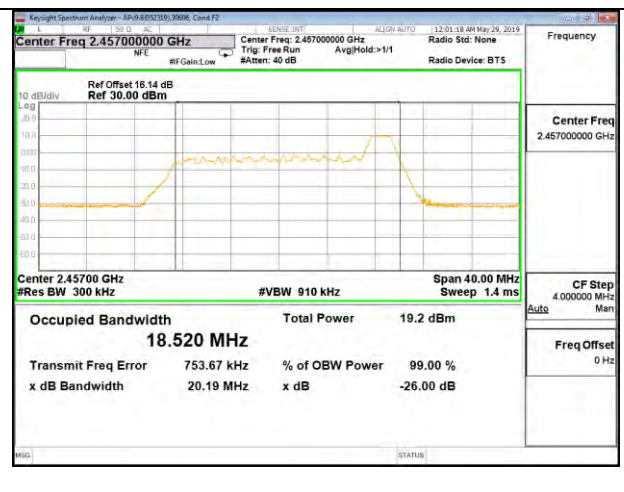
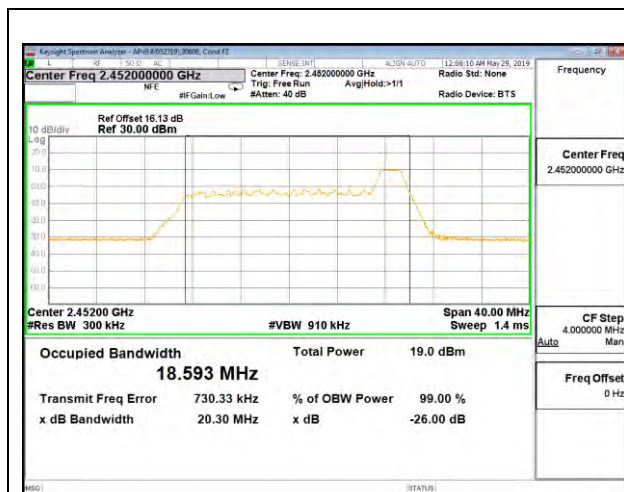
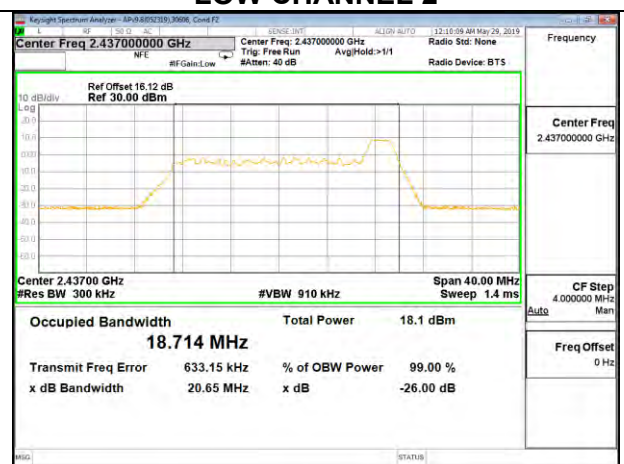
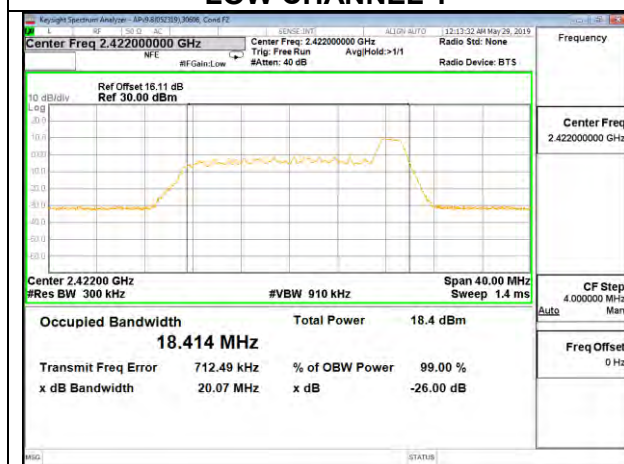
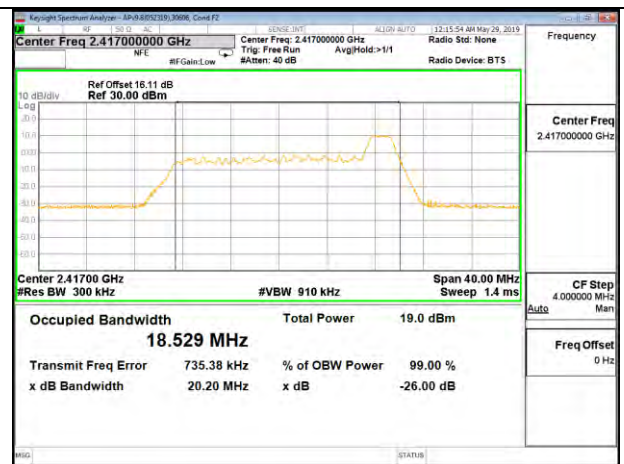
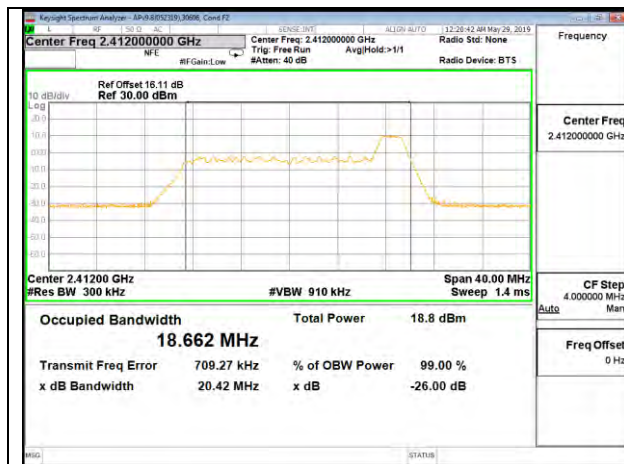
HIGH CHANNEL 10

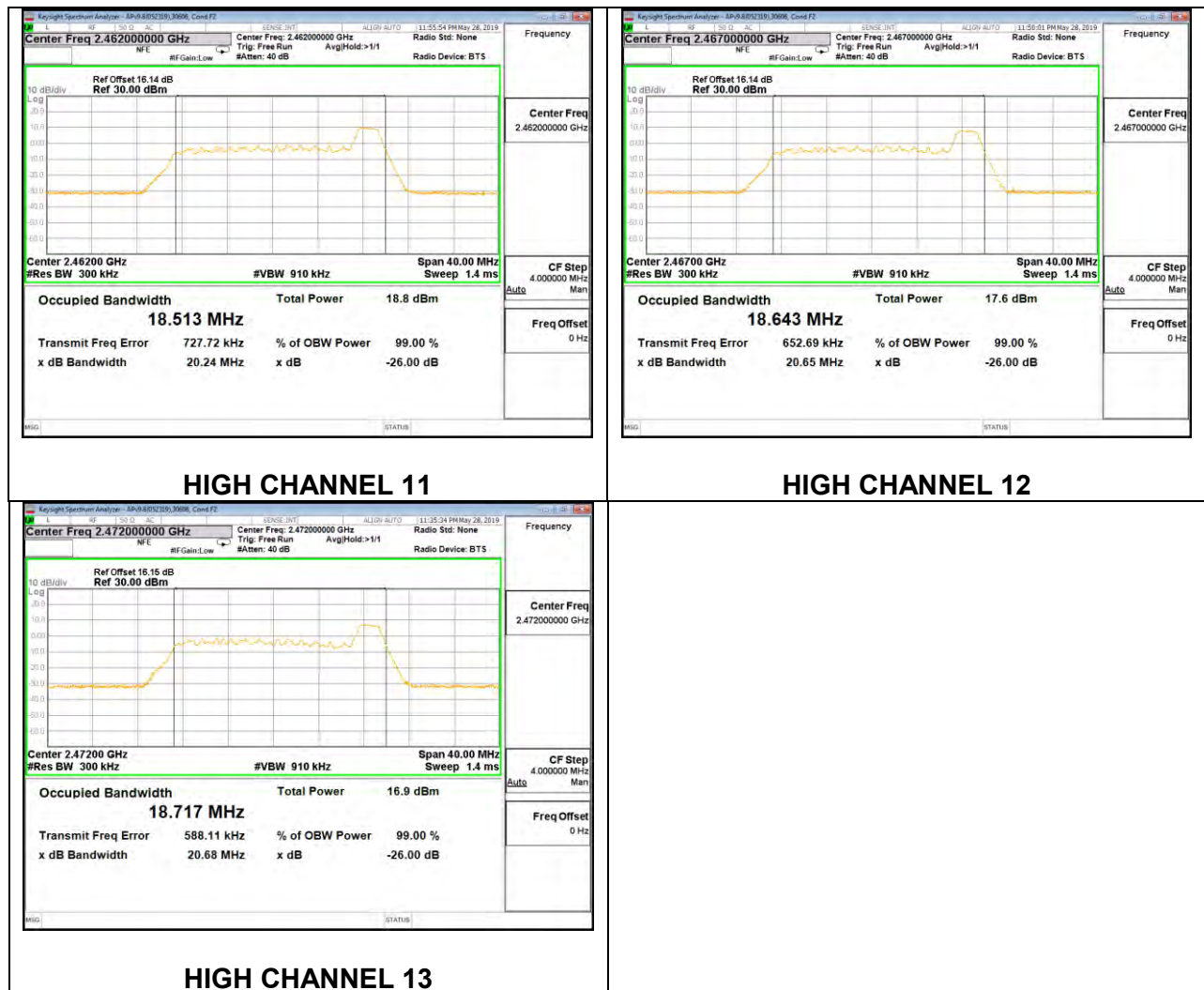


**Antenna 3, LEGACY SISO MODE: 26-Tones, RU index 8**

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 18.6620                |
| Low 2   | 2417               | 18.5290                |
| Low 3   | 2422               | 18.4140                |
| Mid 6   | 2437               | 18.7140                |
| High 9  | 2452               | 18.5930                |
| High 10 | 2457               | 18.5200                |
| High 11 | 2462               | 18.5130                |
| High 12 | 2467               | 18.6430                |
| High 13 | 2472               | 18.7170                |



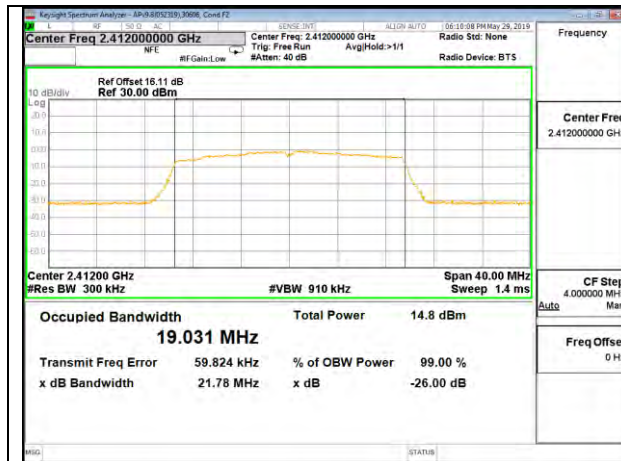




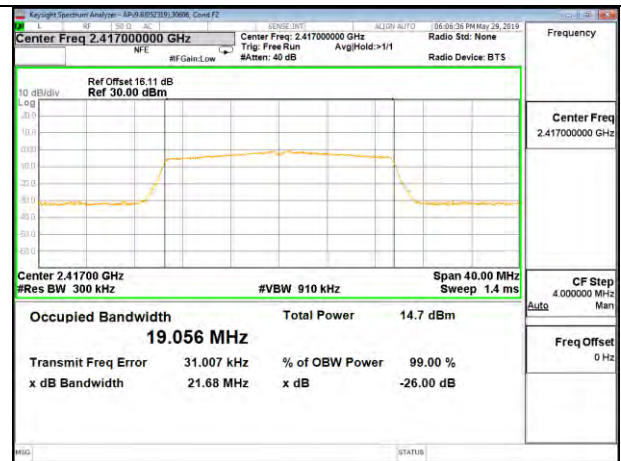


**Antenna 3, LEGACY SISO MODE: 242-Tones, RU index 61**

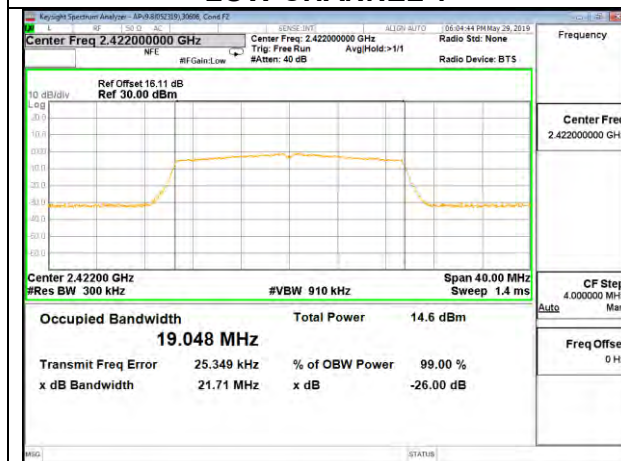
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|---------|--------------------|------------------------|
| Low 1   | 2412               | 19.0310                |
| Low 2   | 2417               | 19.0560                |
| Low 3   | 2422               | 19.0480                |
| Mid 6   | 2437               | 19.1810                |
| High 9  | 2452               | 19.0780                |
| High 10 | 2457               | 19.0560                |
| High 11 | 2462               | 19.0510                |
| High 12 | 2467               | 19.1180                |
| High 13 | 2472               | 19.0140                |



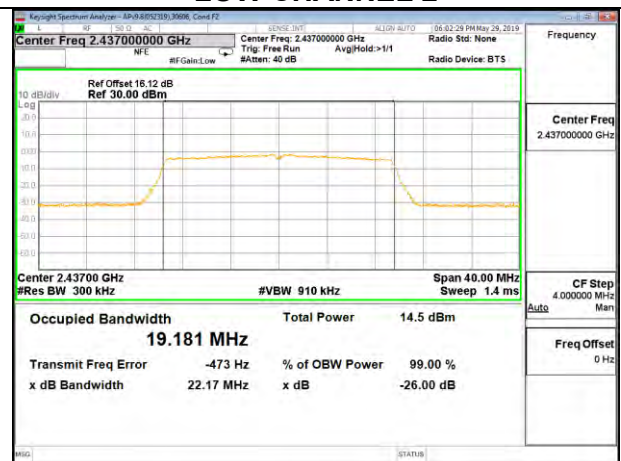
LOW CHANNEL 1



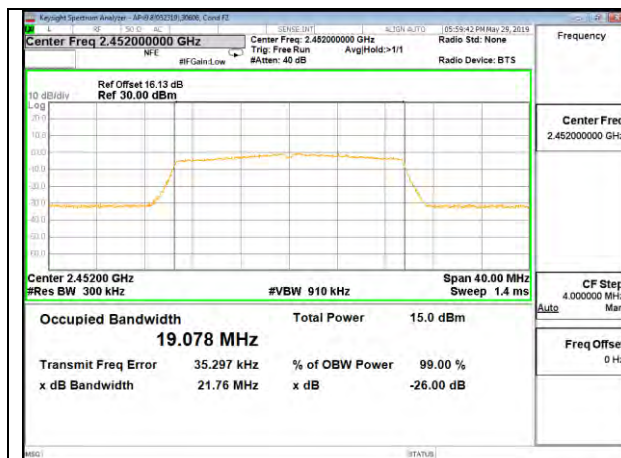
LOW CHANNEL 2



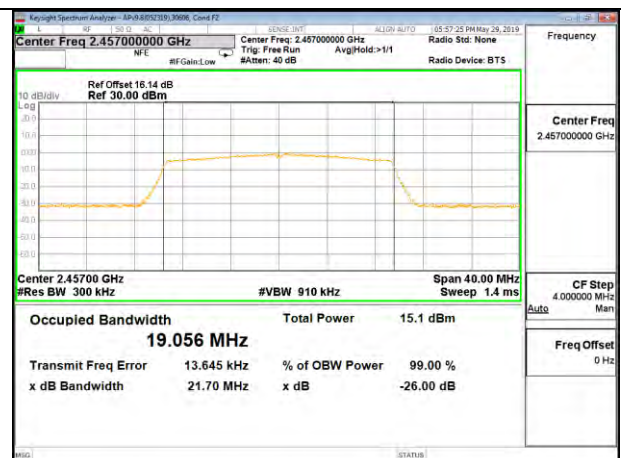
LOW CHANNEL 3



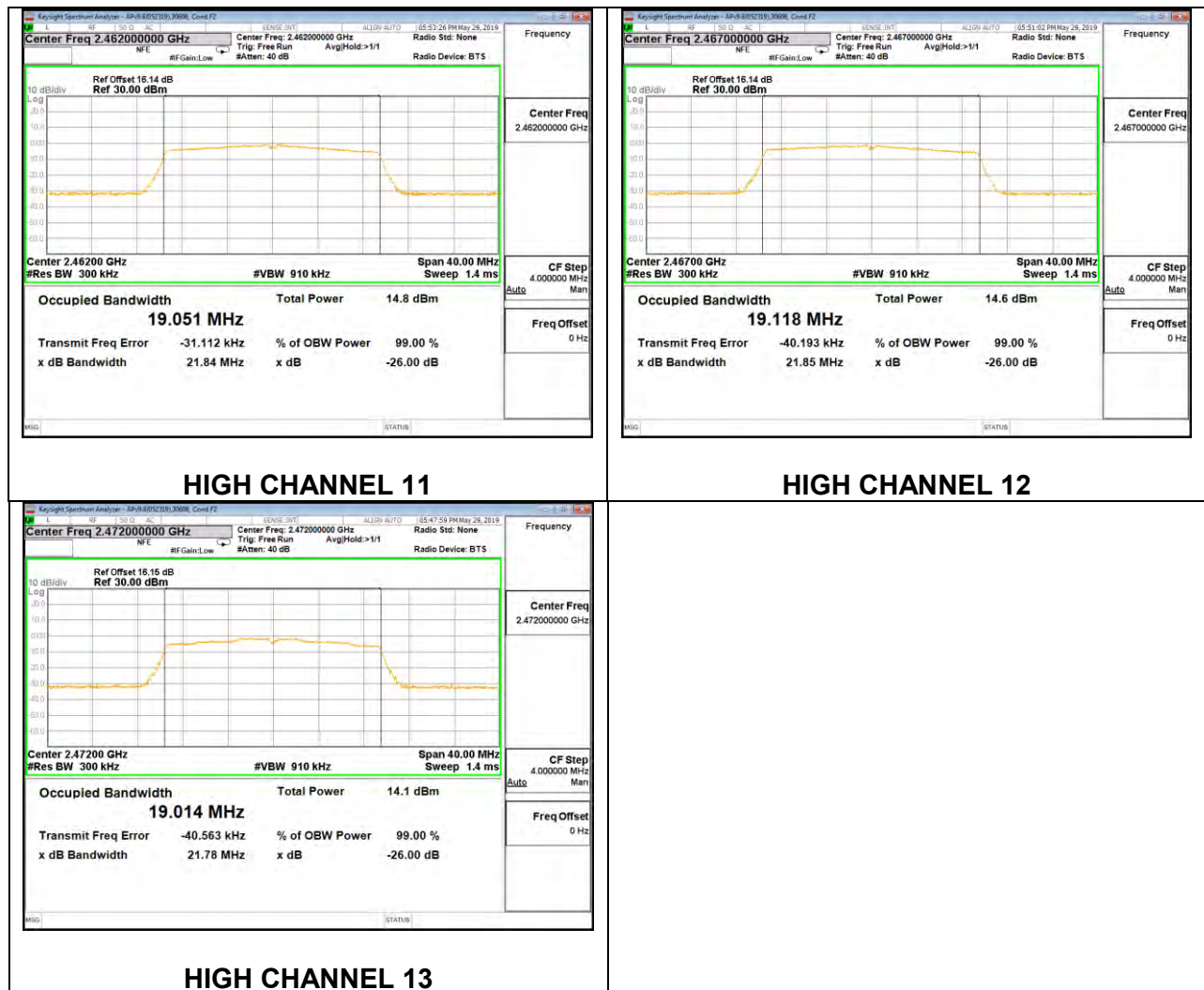
MID CHANNEL 6



HIGH CHANNEL 9



HIGH CHANNEL 10

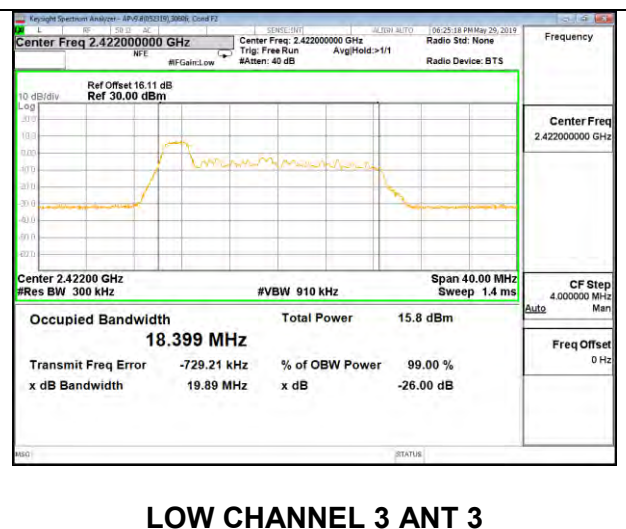
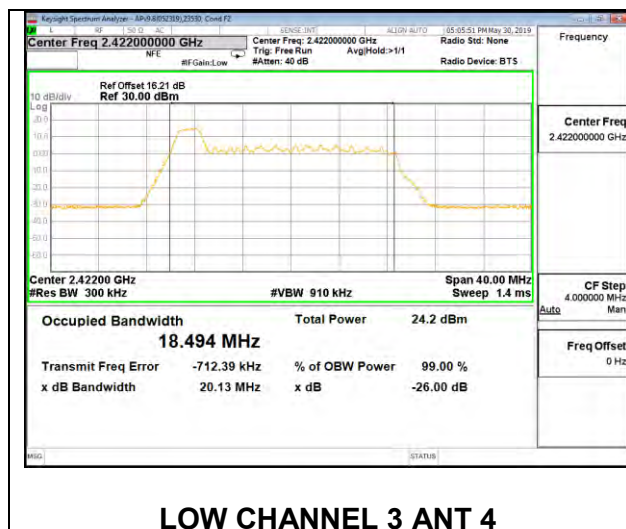
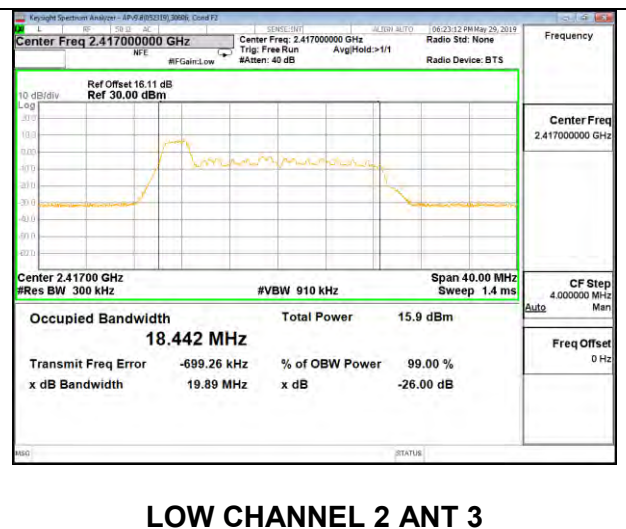
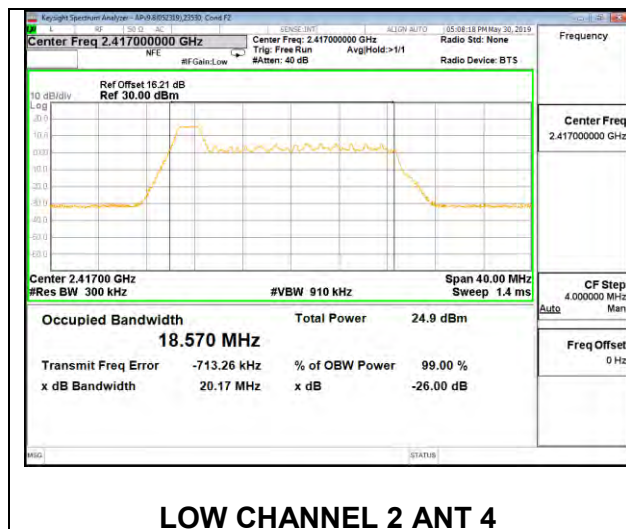
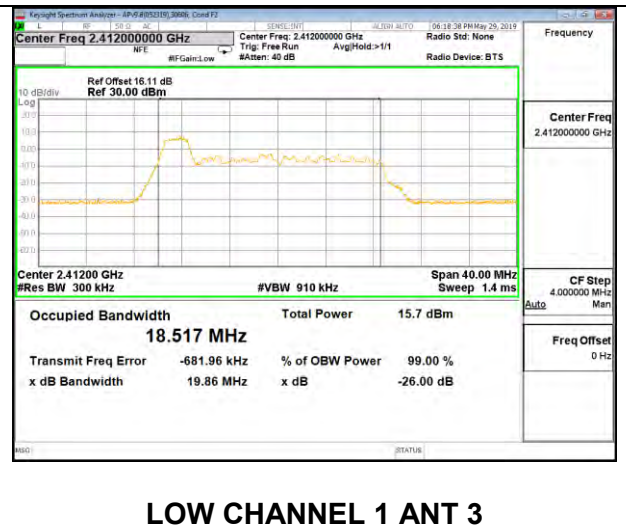
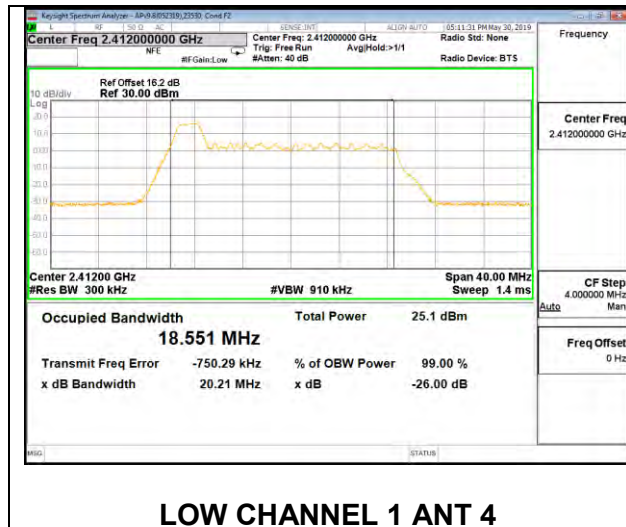


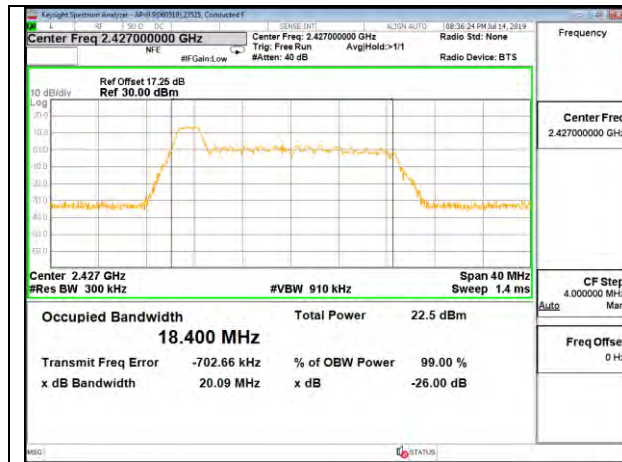
## 8.2.4. 802.11ax HE20 OFDMA MODE 2TX

### Antenna 4 + Antenna 3 2TX MODE: 26-Tones, RU Index 0

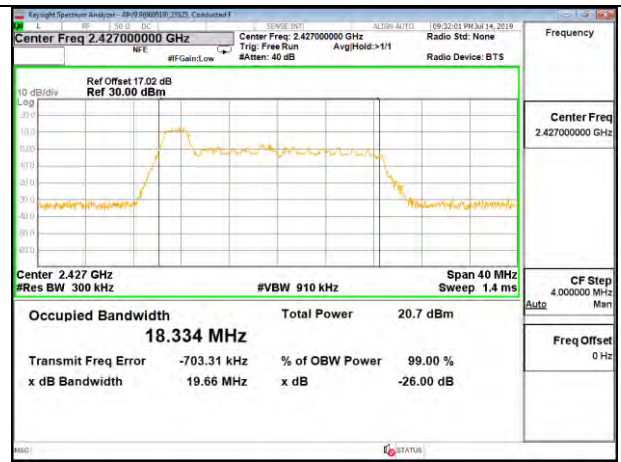
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>Ant 4<br>(MHz) | 99% Bandwidth<br>Ant 3<br>(MHz) |
|---------|--------------------|---------------------------------|---------------------------------|
| Low 1   | 2412               | 18.5510                         | 18.5170                         |
| Low 2   | 2417               | 18.5700                         | 18.4420                         |
| Low 3   | 2422               | 18.4940                         | 18.3990                         |
| Low 4   | 2427               | 18.4000                         | 18.3340                         |
| Mid 6   | 2437               | 18.3730                         | 18.4360                         |
| High 9  | 2452               | 18.5220                         | 18.4810                         |
| High 10 | 2457               | 18.5330                         | 18.3890                         |
| High 11 | 2462               | 18.4660                         | 18.2720                         |
| High 12 | 2467               | 18.4310                         | 18.2460                         |
| High 13 | 2472               | 18.1010                         | 18.3300                         |



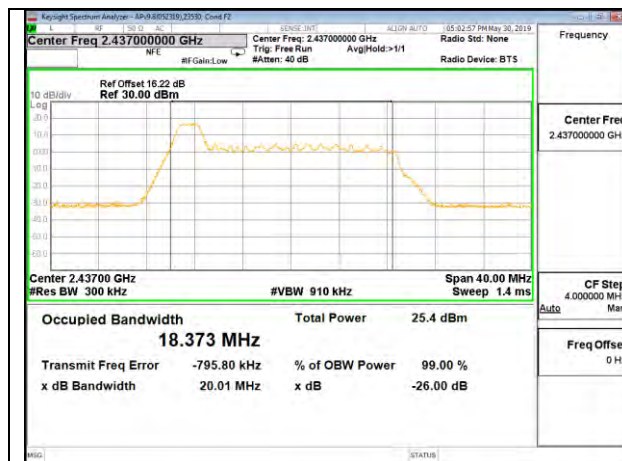




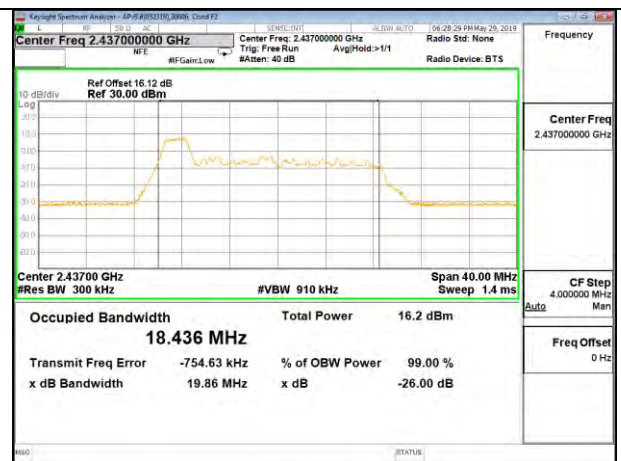
LOW CHANNEL 4 ANT 4



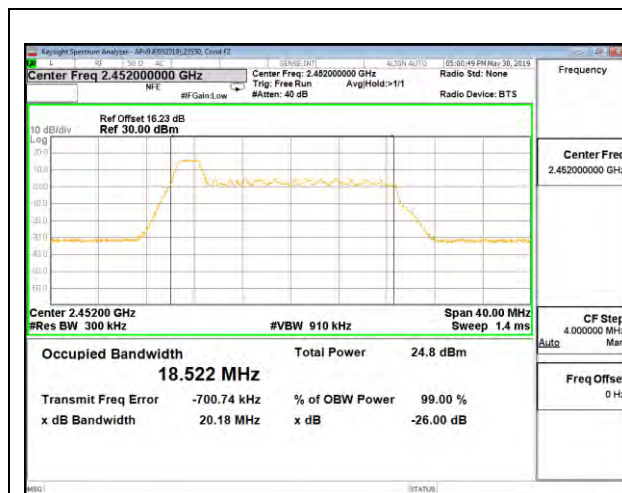
LOW CHANNEL 4 ANT 3



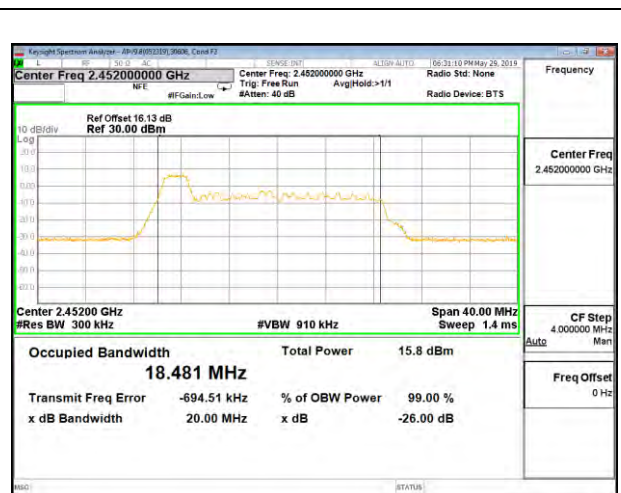
MID CHANNEL 6 ANT 4



MID CHANNEL 6 ANT 3

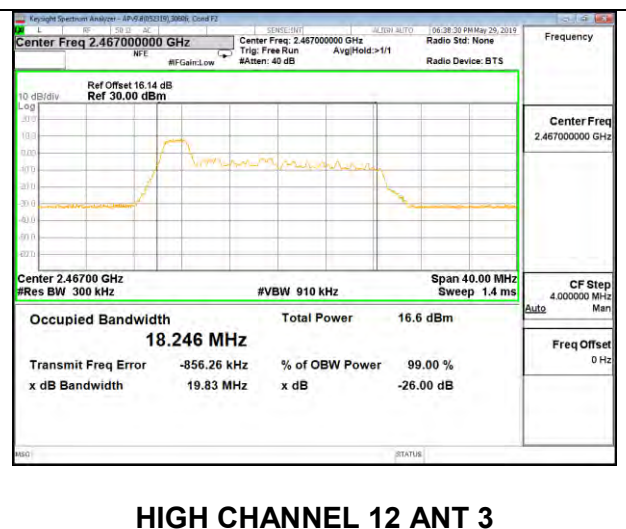
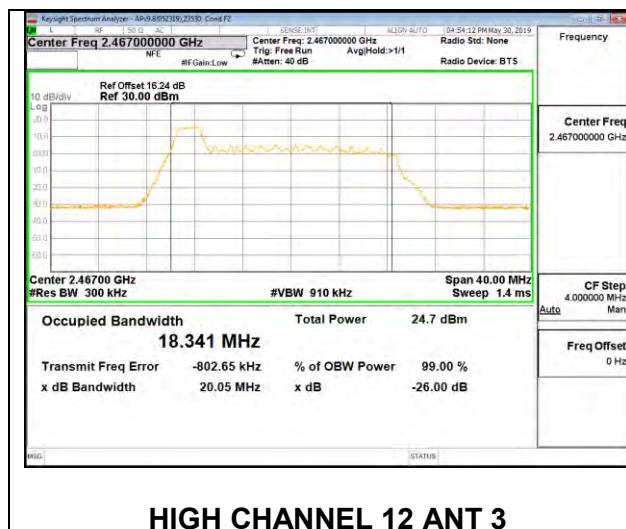
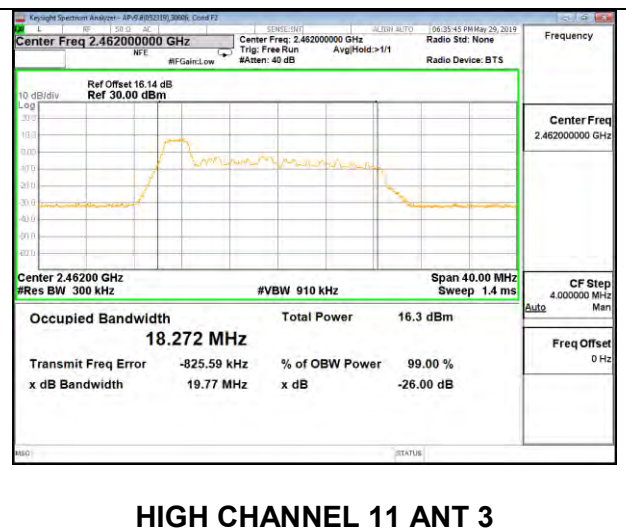
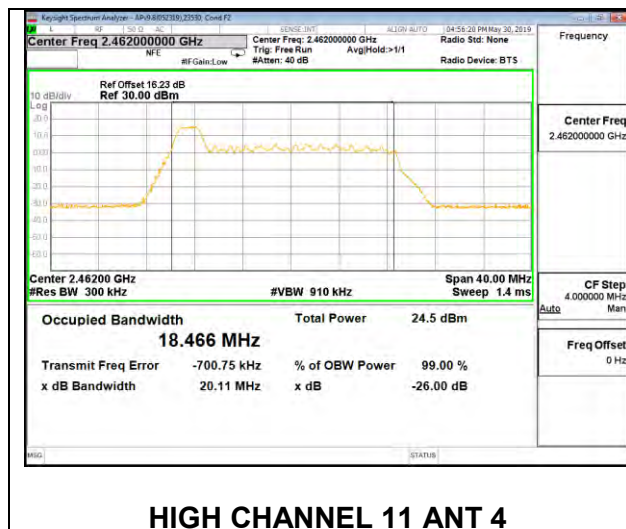
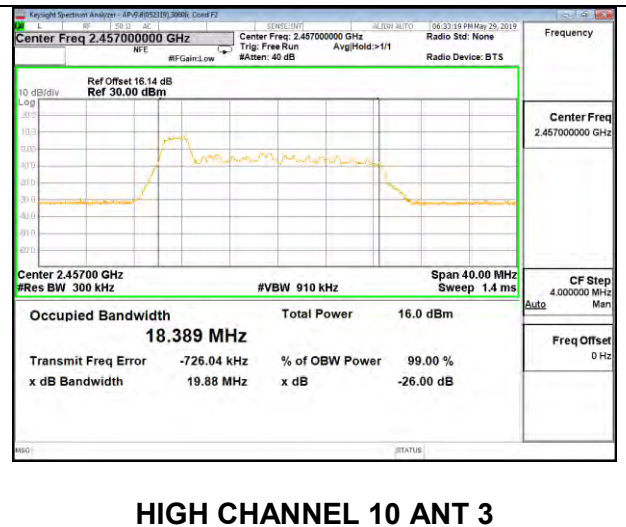
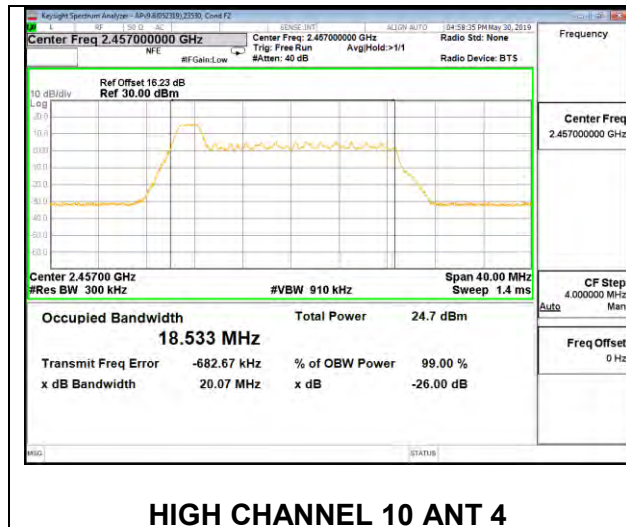


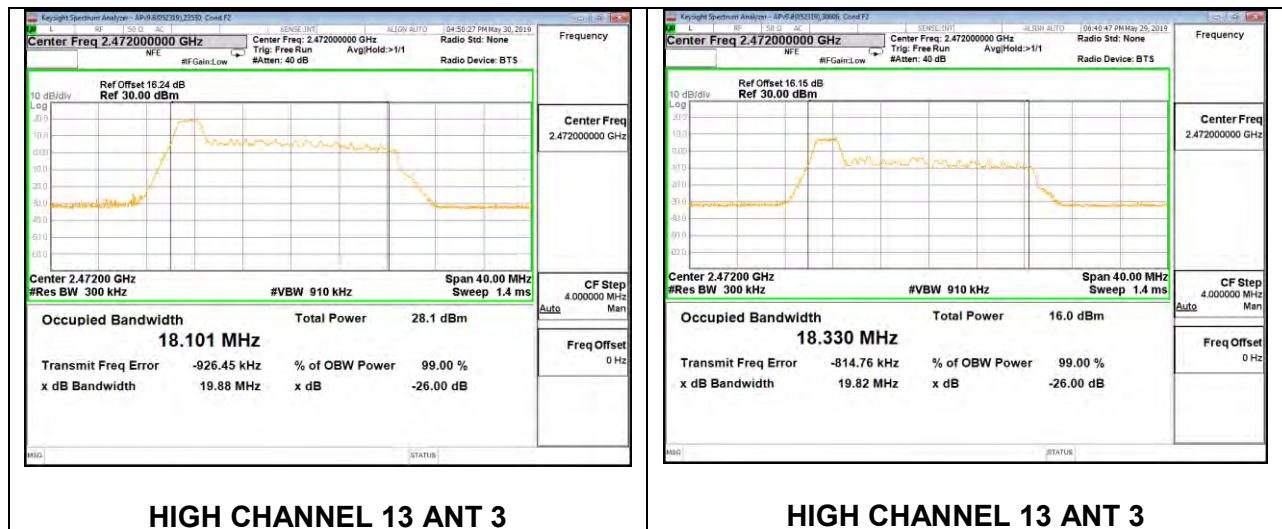
HIGH CHANNEL 9 ANT 4



HIGH CHANNEL 9 ANT 3

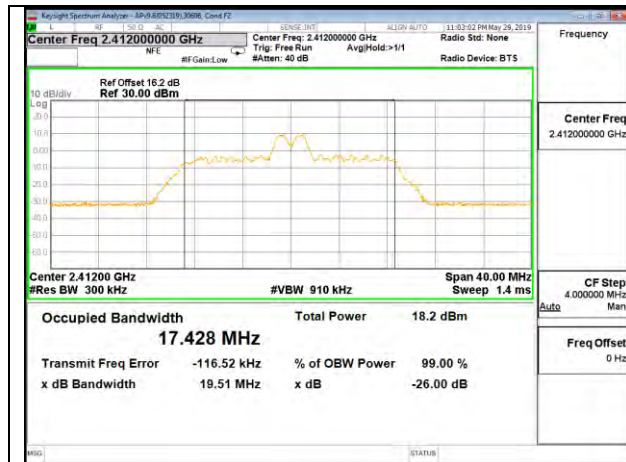




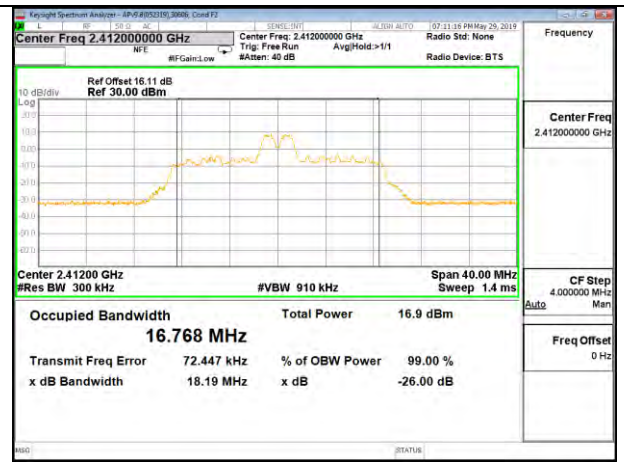


**Antenna 4 + Antenna 3 2TX MODE: 26-Tones, RU Index 4**

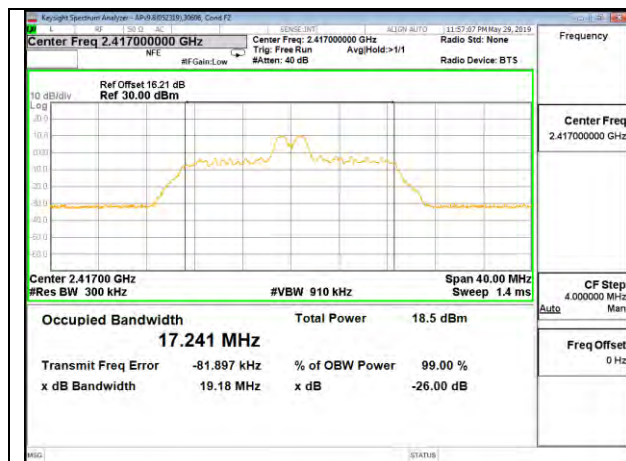
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>ANT 4<br>(MHz) | 99% Bandwidth<br>ANT 3<br>(MHz) |
|---------|--------------------|---------------------------------|---------------------------------|
| Low 1   | 2412               | 17.4280                         | 16.7680                         |
| Low 2   | 2417               | 17.4210                         | 16.6740                         |
| Low 3   | 2422               | 17.0500                         | 16.6320                         |
| Low 4   | 2427               | 17.0640                         | 16.6130                         |
| Mid 6   | 2437               | 17.4190                         | 16.9800                         |
| High 9  | 2452               | 17.3150                         | 16.7500                         |
| High 10 | 2457               | 17.2360                         | 16.5800                         |
| High 11 | 2462               | 17.1390                         | 16.6400                         |
| High 12 | 2467               | 17.1440                         | 16.8200                         |
| High 13 | 2472               | 17.3480                         | 16.8980                         |



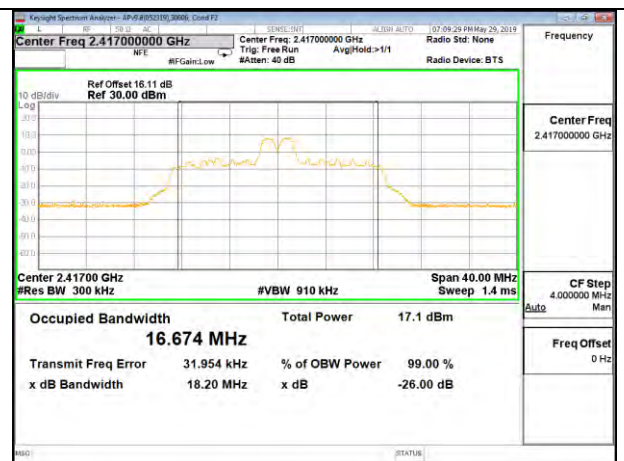
LOW CHANNEL 1 ANT 4



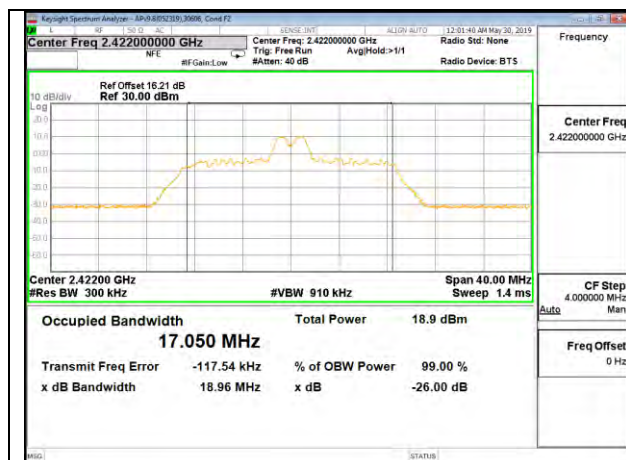
LOW CHANNEL 1 ANT 3



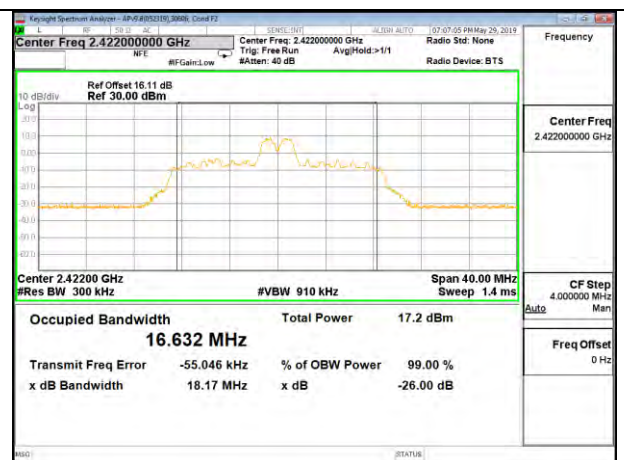
LOW CHANNEL 2 ANT 4



LOW CHANNEL 2 ANT 3

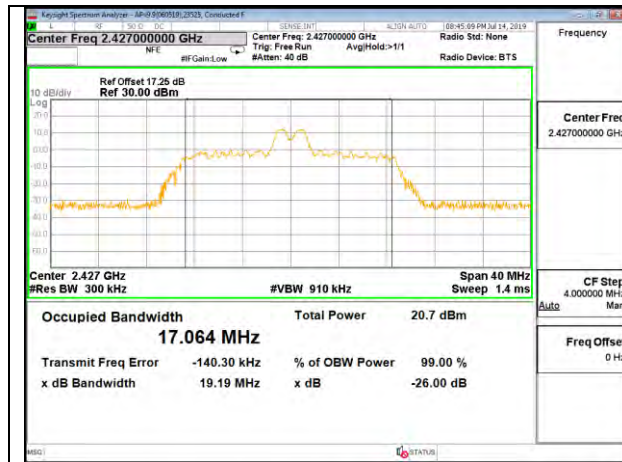


LOW CHANNEL 3 ANT 4

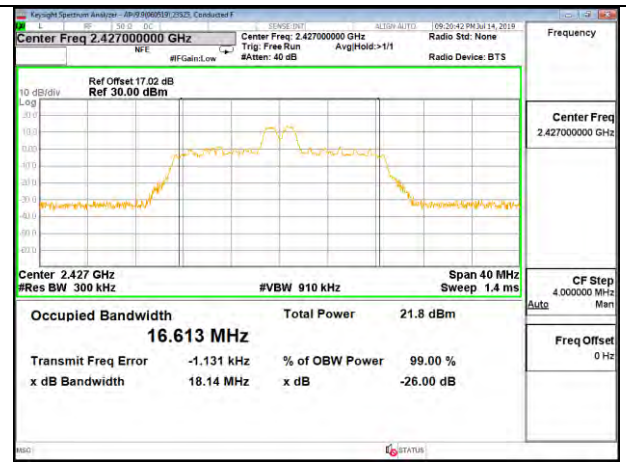


LOW CHANNEL 3 ANT 3

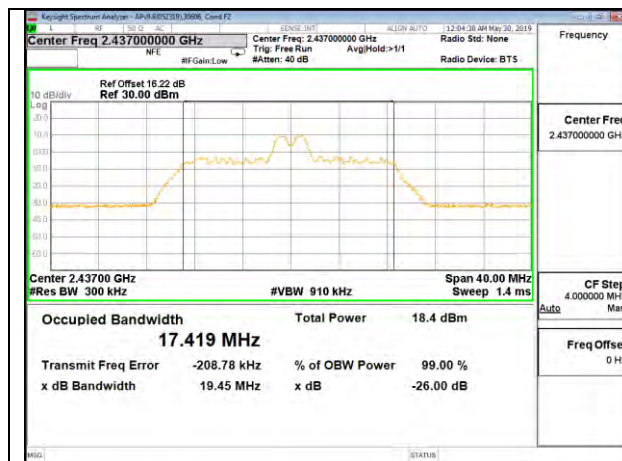




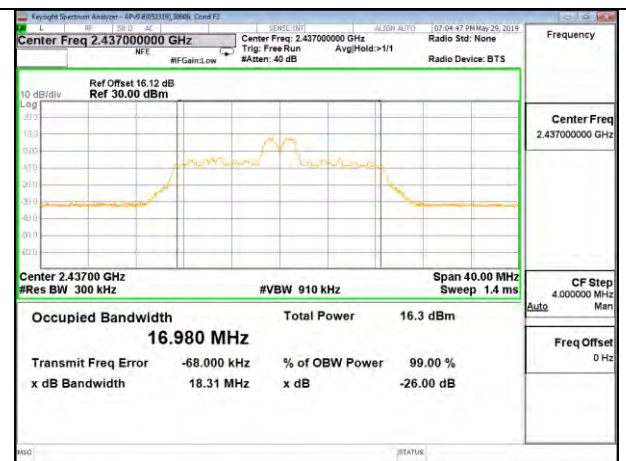
LOW CHANNEL 4 ANT 4



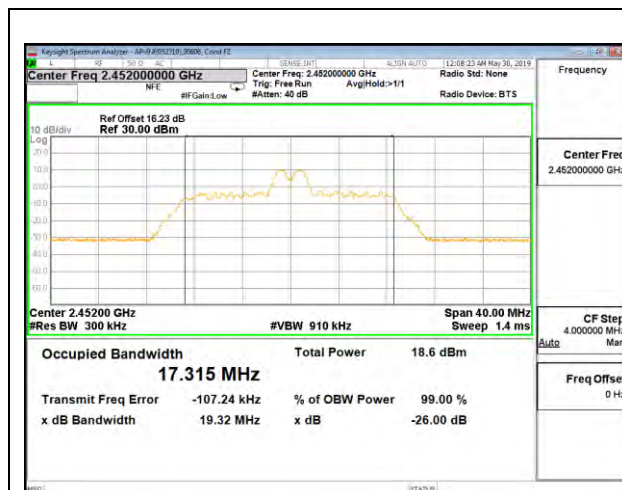
LOW CHANNEL 4 ANT 3



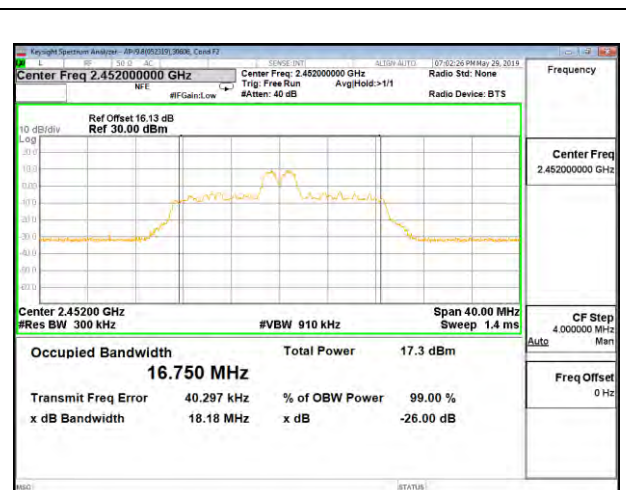
MID CHANNEL 6 ANT 4



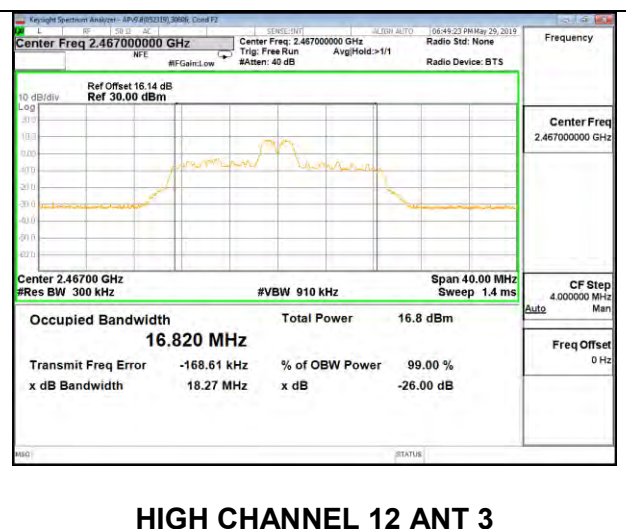
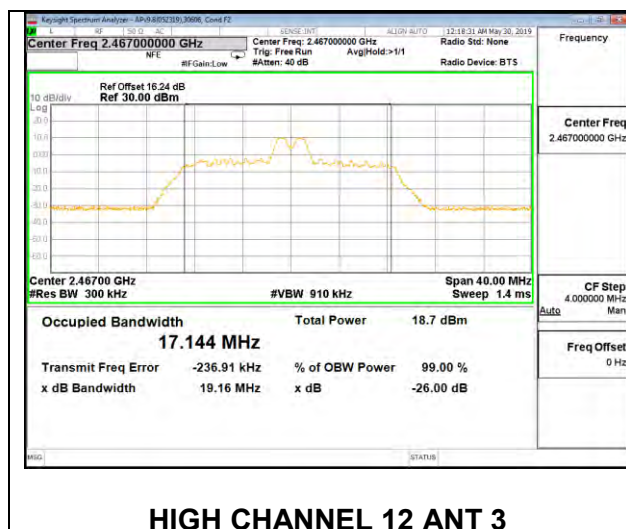
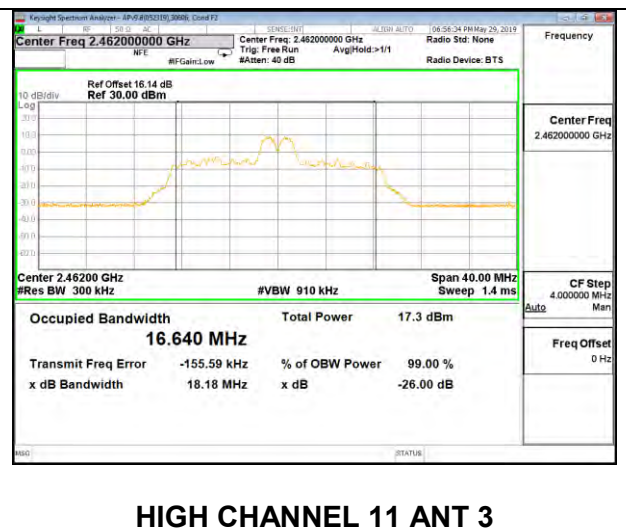
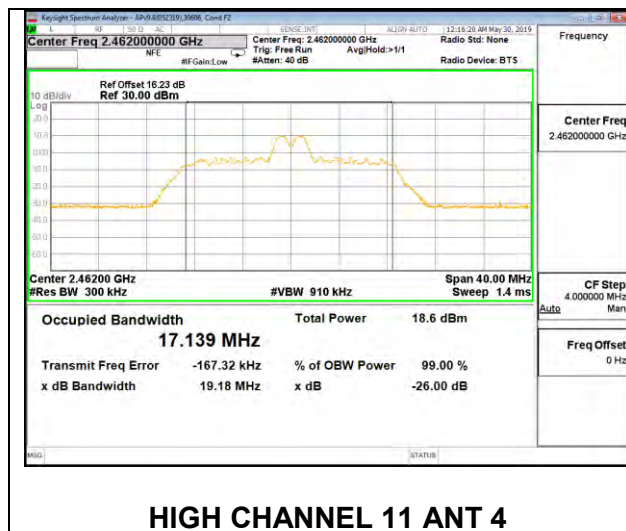
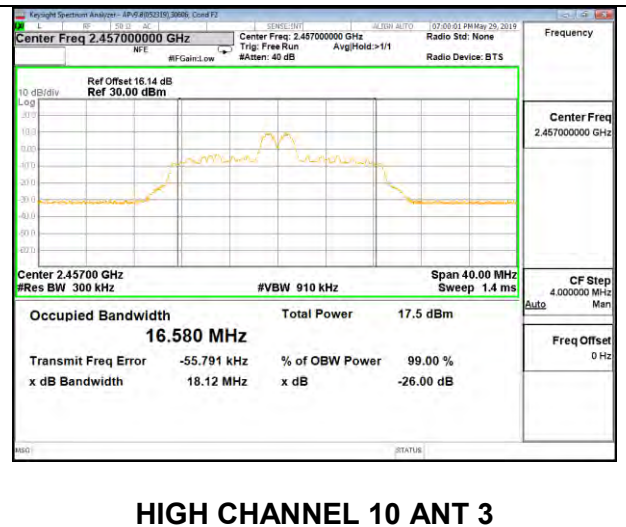
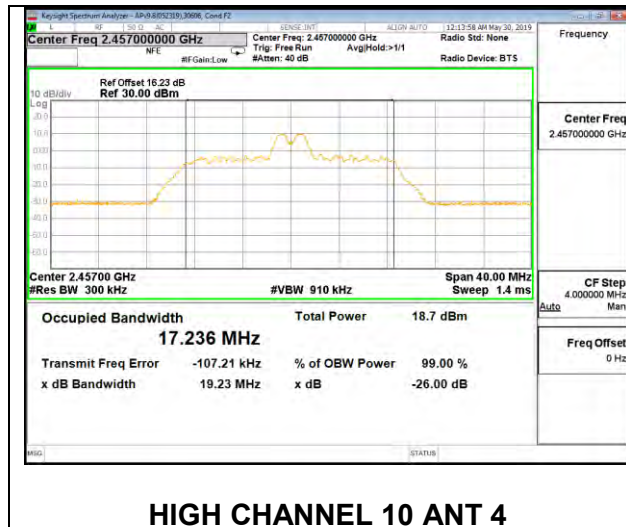
MID CHANNEL 6 ANT 3



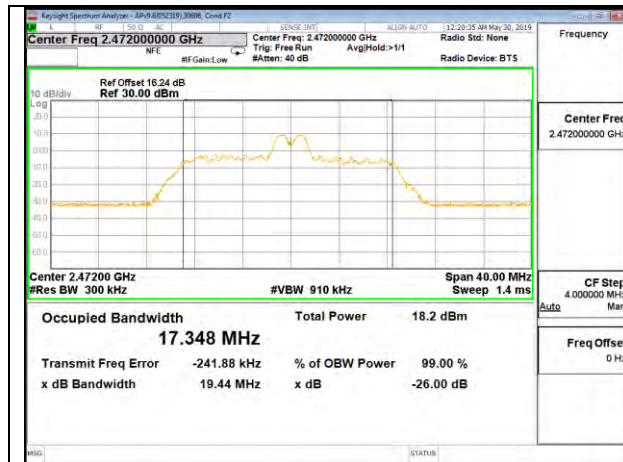
HIGH CHANNEL 9 ANT 4



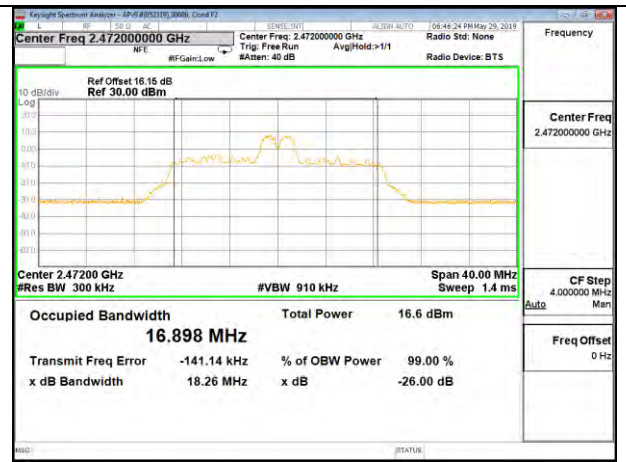
HIGH CHANNEL 9 ANT 3







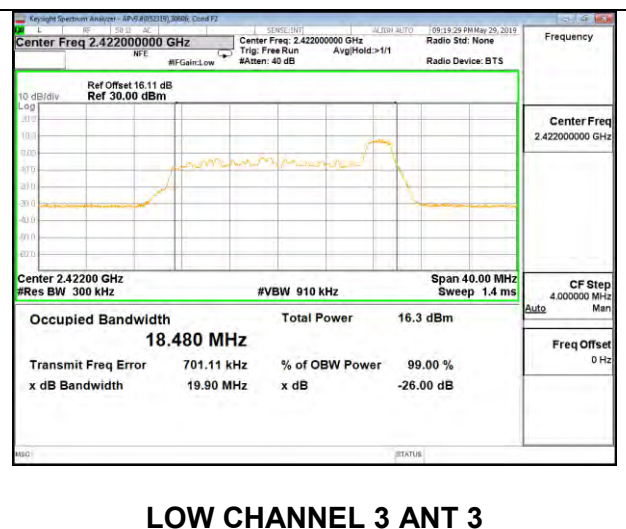
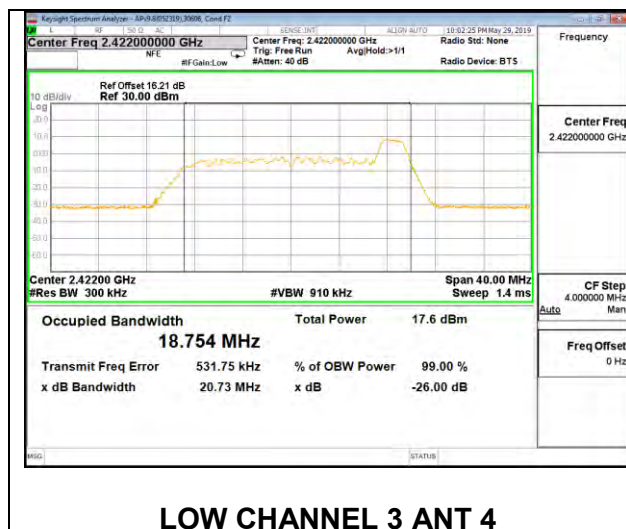
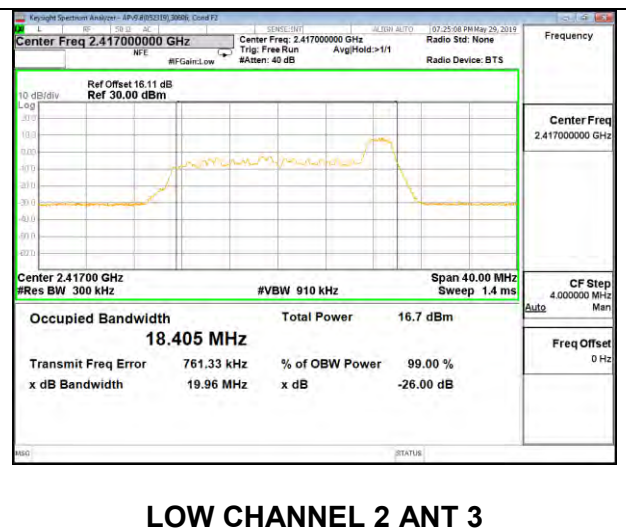
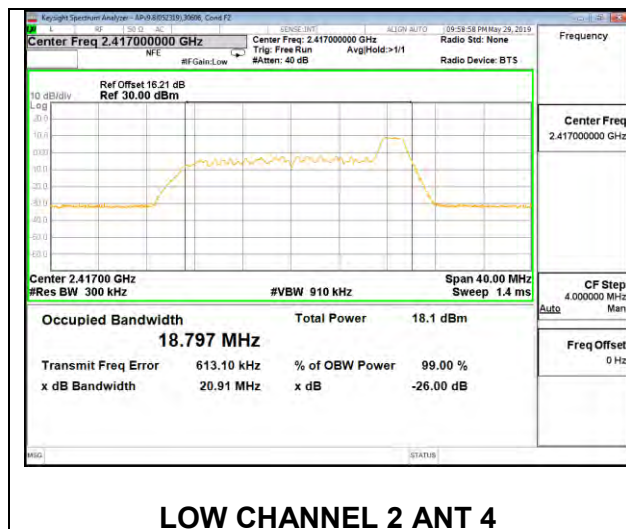
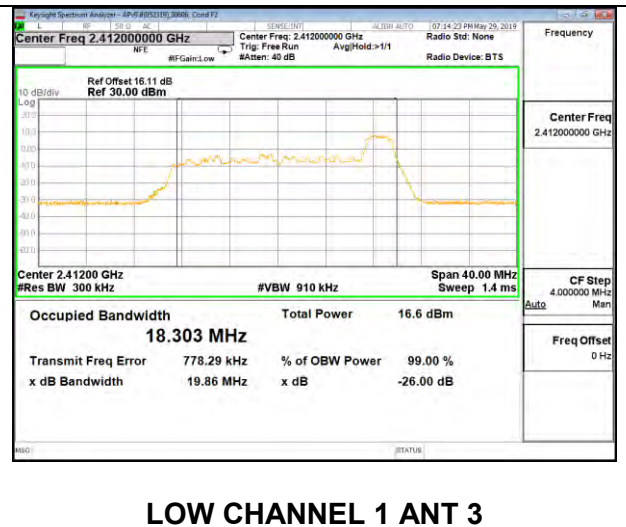
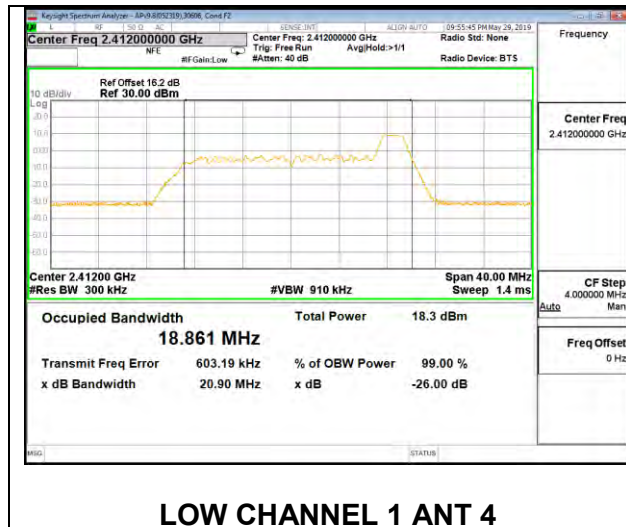
HIGH CHANNEL 13 ANT 3

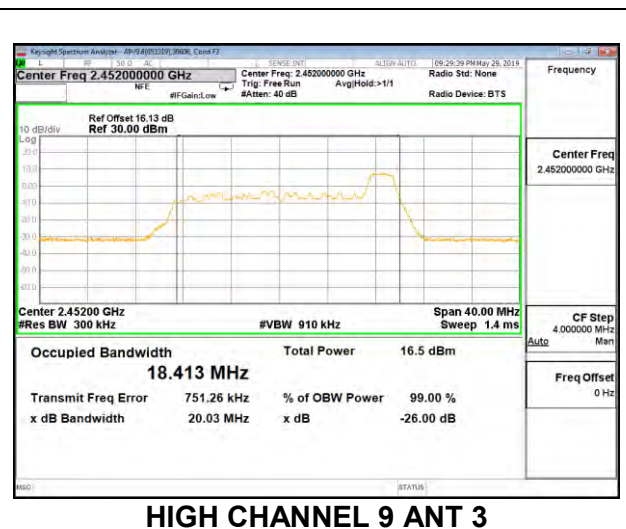
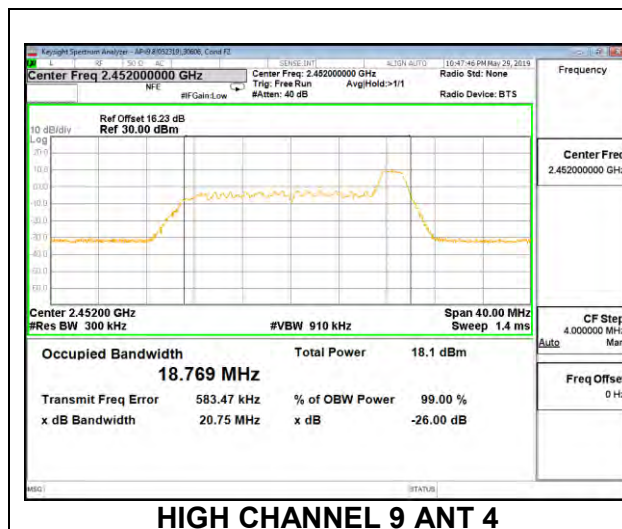
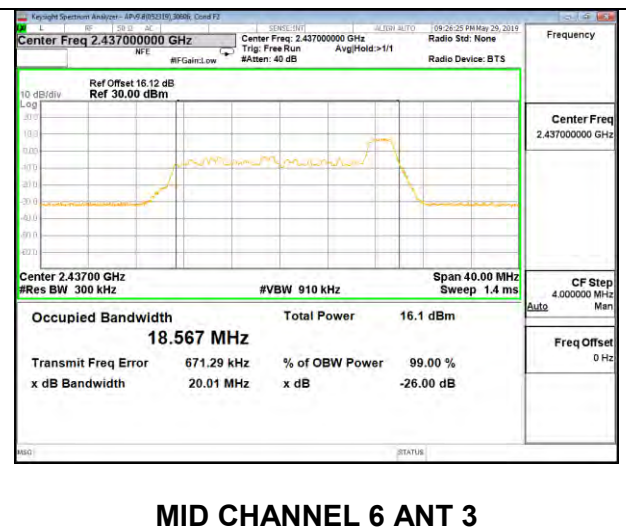
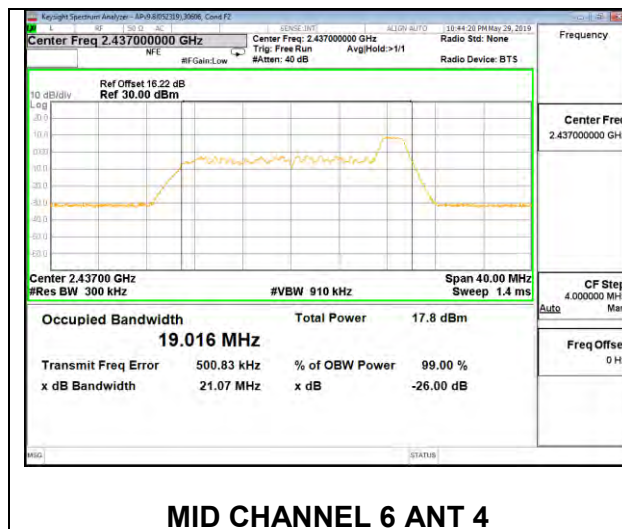
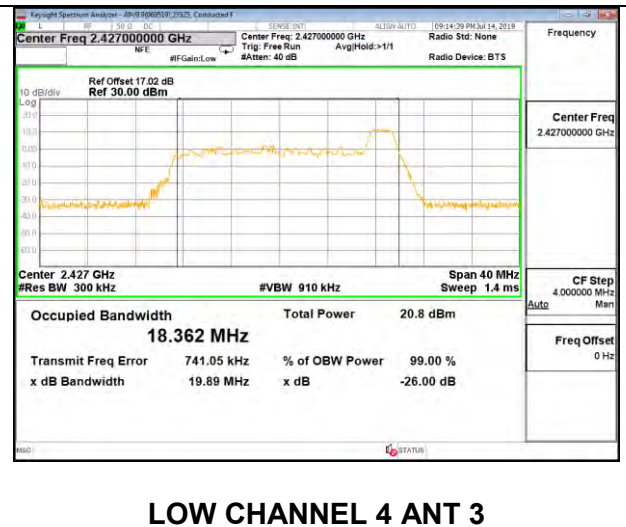
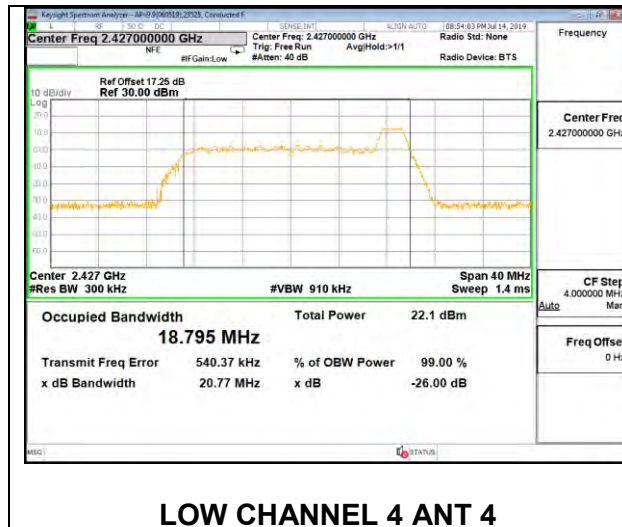


HIGH CHANNEL 13 ANT 3

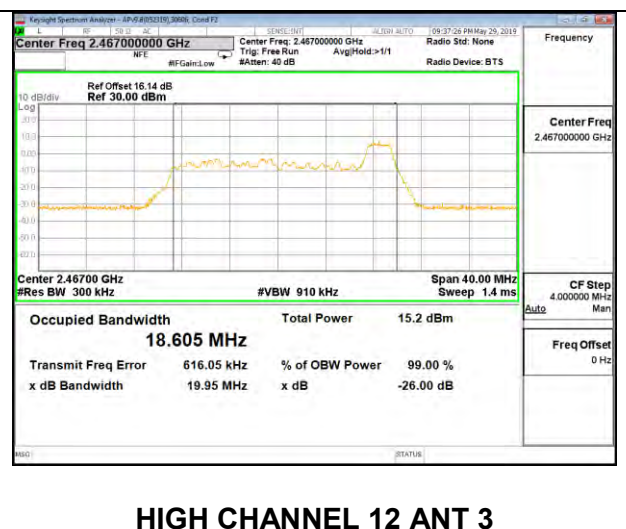
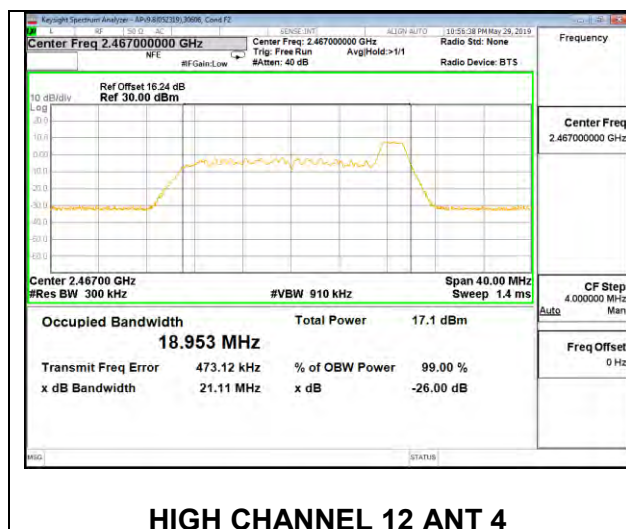
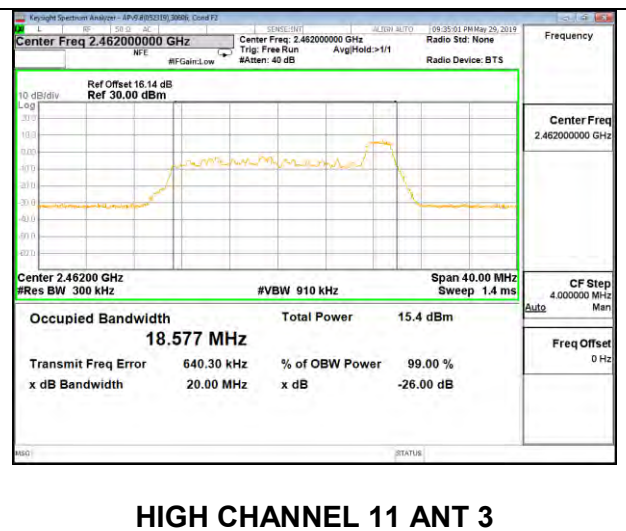
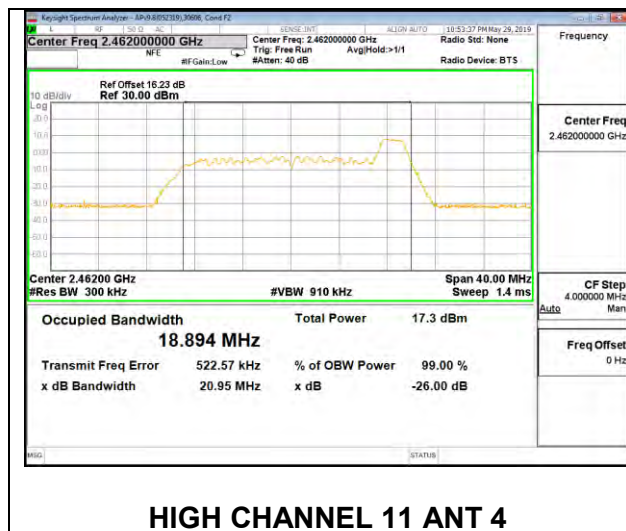
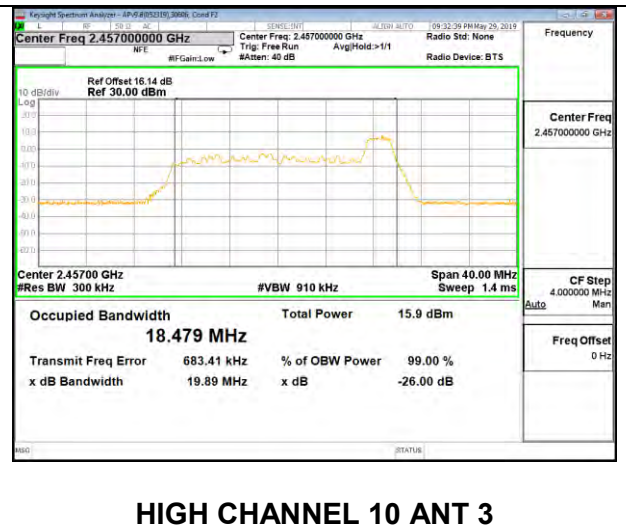
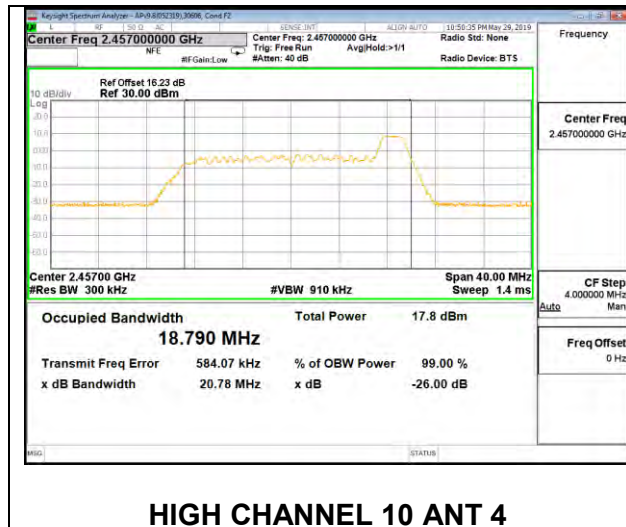
**Antenna 4 + Antenna 3 2TX MODE: 26-Tones, RU Index 8**

| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>ANT 4<br>(MHz) | 99% Bandwidth<br>ANT 3<br>(MHz) |
|---------|--------------------|---------------------------------|---------------------------------|
| Low 1   | 2412               | 18.8610                         | 18.3030                         |
| Low 2   | 2417               | 18.7970                         | 18.4050                         |
| Low 3   | 2422               | 18.7540                         | 18.4800                         |
| Low 4   | 2427               | 18.7950                         | 18.3620                         |
| Mid 6   | 2437               | 19.0160                         | 18.5670                         |
| High 9  | 2452               | 18.7690                         | 18.4130                         |
| High 10 | 2457               | 18.7900                         | 18.4790                         |
| High 11 | 2462               | 18.8940                         | 18.5770                         |
| High 12 | 2467               | 18.9530                         | 18.6050                         |
| High 13 | 2472               | 19.0290                         | 18.5920                         |

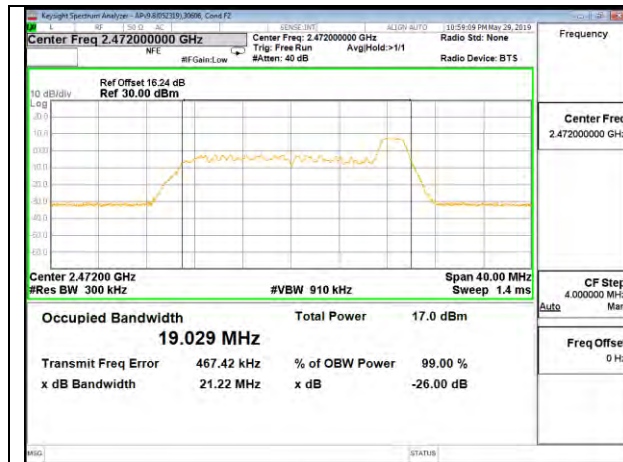




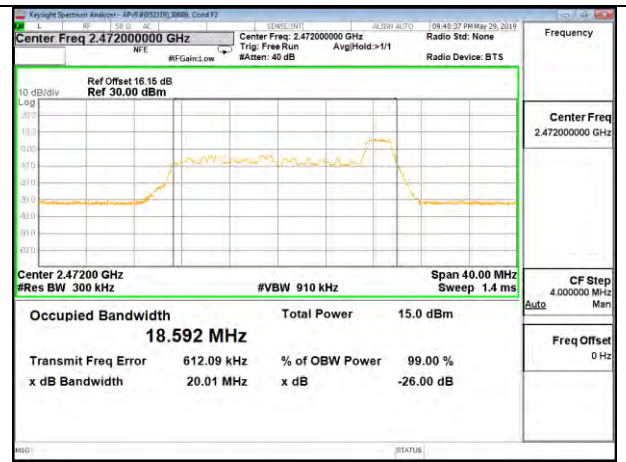








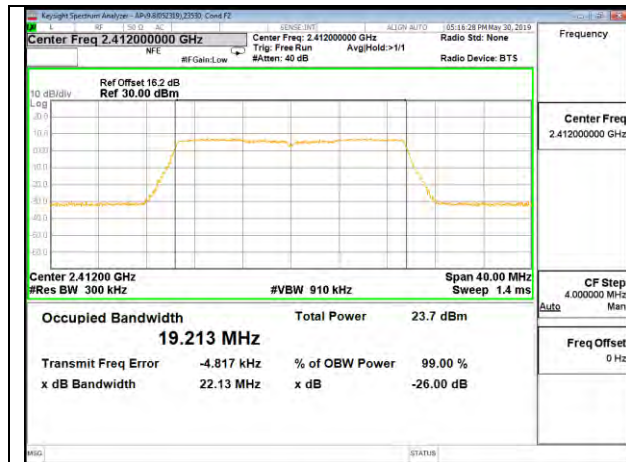
HIGH CHANNEL 13 ANT 4



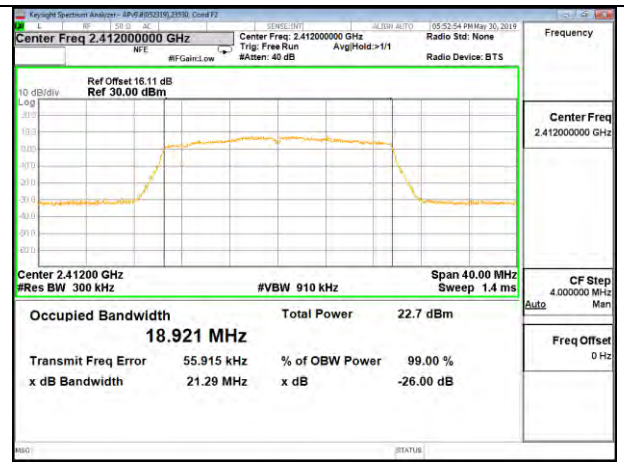
HIGH CHANNEL 13 ANT 3

**Antenna 4 + Antenna 3 2TX MODE: 242T-Tones, RU Index 61**

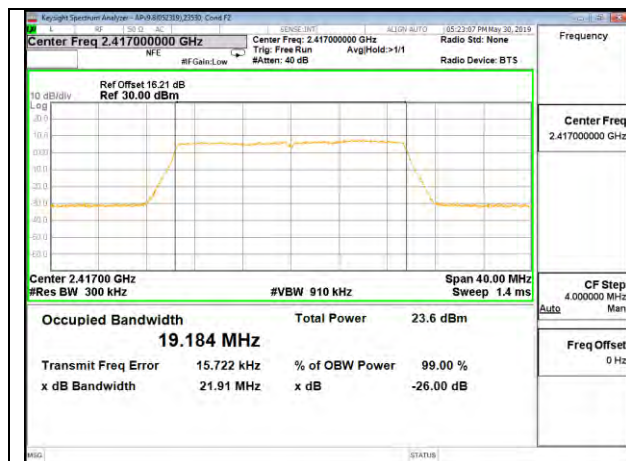
| Channel | Frequency<br>(MHz) | 99% Bandwidth<br>ANT 4<br>(MHz) | 99% Bandwidth<br>ANT 3<br>(MHz) |
|---------|--------------------|---------------------------------|---------------------------------|
| Low 1   | 2412               | 19.2130                         | 18.9210                         |
| Low 2   | 2417               | 19.1840                         | 18.9640                         |
| Low 3   | 2422               | 19.0050                         | 18.9550                         |
| Low 4   | 2427               | 18.9300                         | 18.9380                         |
| Mid 6   | 2437               | 19.2380                         | 19.0690                         |
| High 9  | 2452               | 19.1970                         | 19.0230                         |
| High 10 | 2457               | 19.1870                         | 18.9650                         |
| High 11 | 2462               | 19.1030                         | 18.9370                         |
| High 12 | 2467               | 19.0480                         | 19.0040                         |
| High 13 | 2472               | 19.1090                         | 18.9290                         |



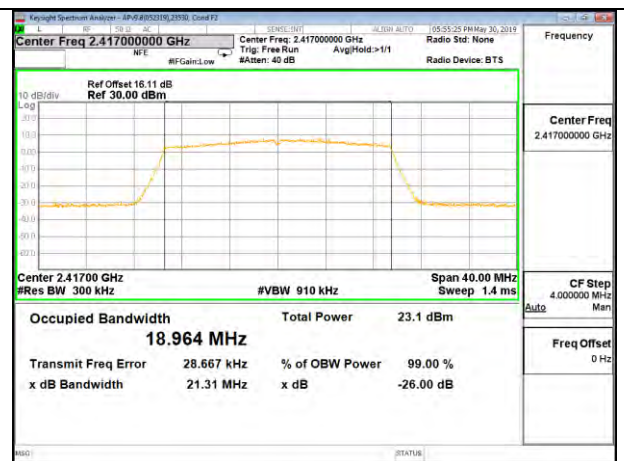
LOW CHANNEL 1 ANT 4



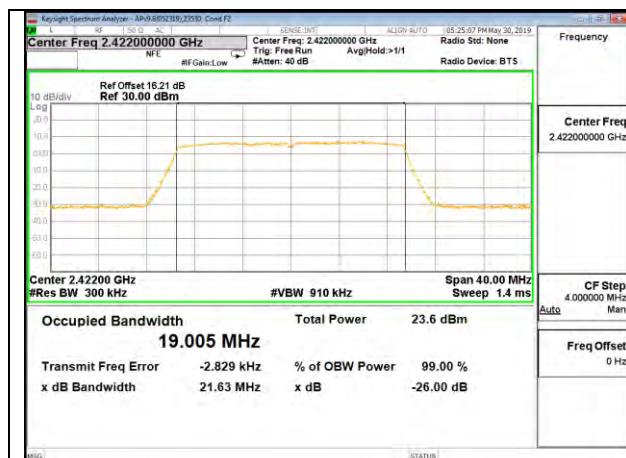
LOW CHANNEL 1 ANT 3



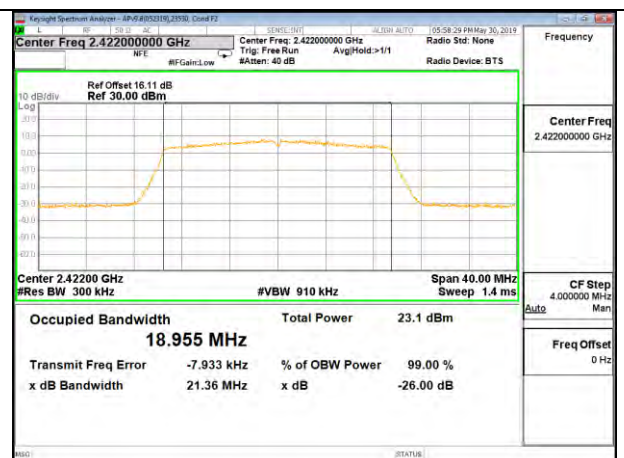
LOW CHANNEL 2 ANT 4



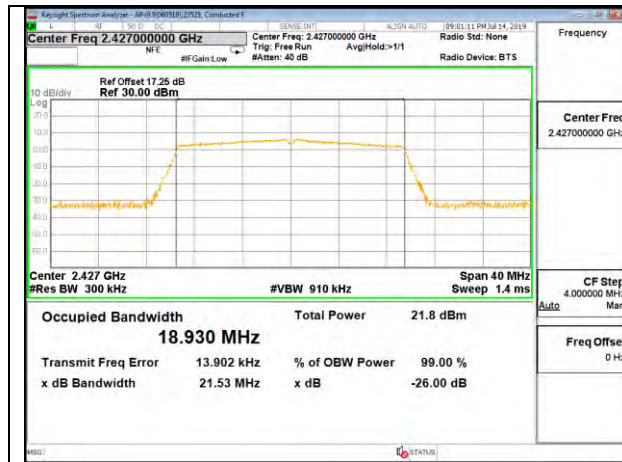
LOW CHANNEL 2 ANT 3



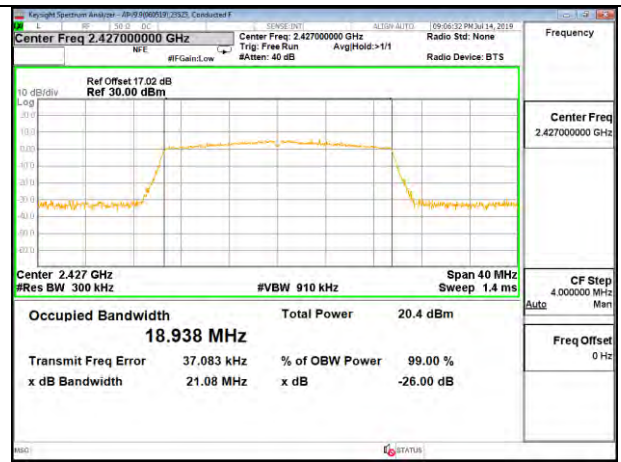
LOW CHANNEL 3 ANT 4



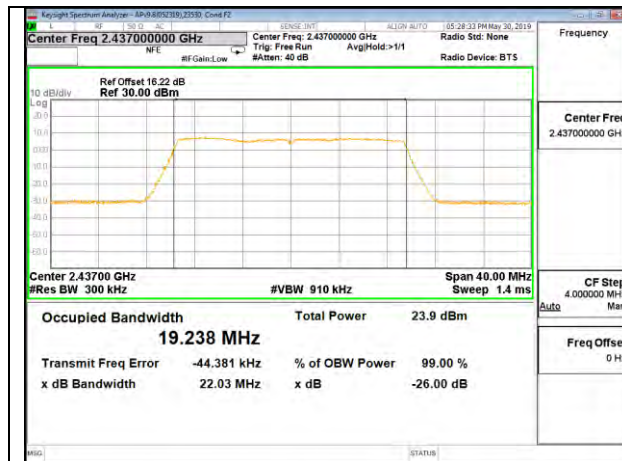
LOW CHANNEL 3 ANT 3



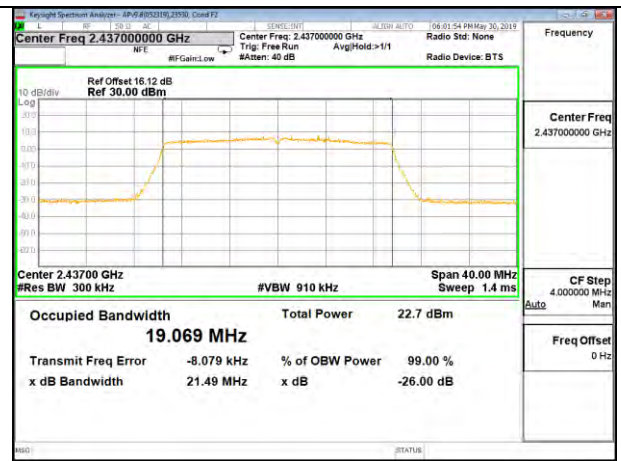
LOW CHANNEL 4 ANT 4



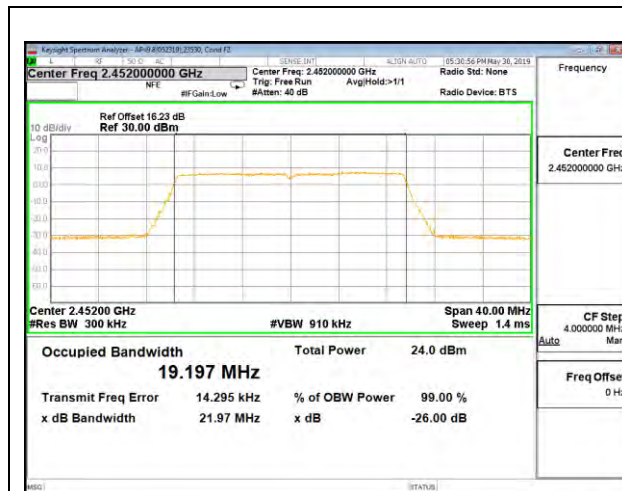
LOW CHANNEL 4 ANT 3



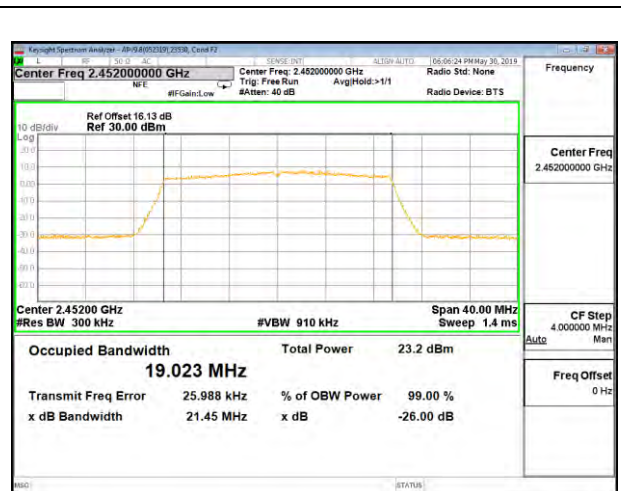
MID CHANNEL 6 ANT 4



MID CHANNEL 6 ANT 3

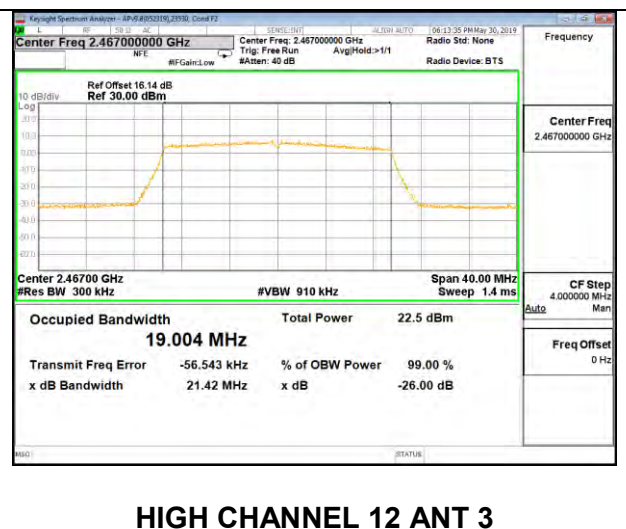
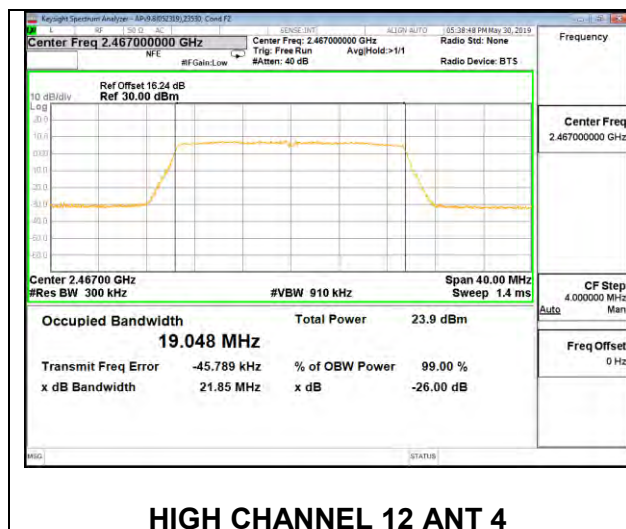
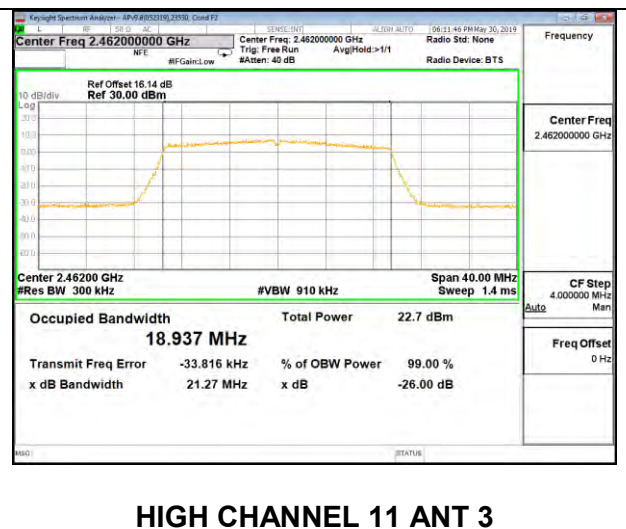
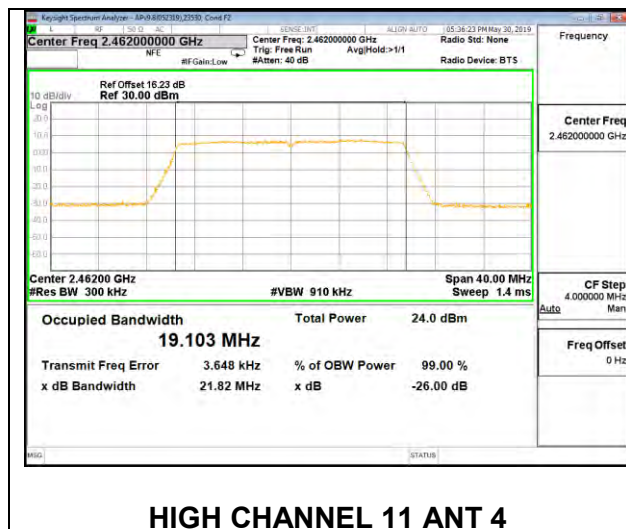
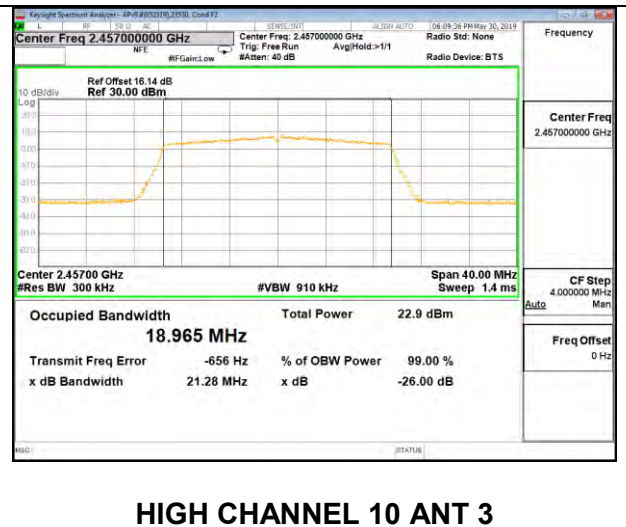
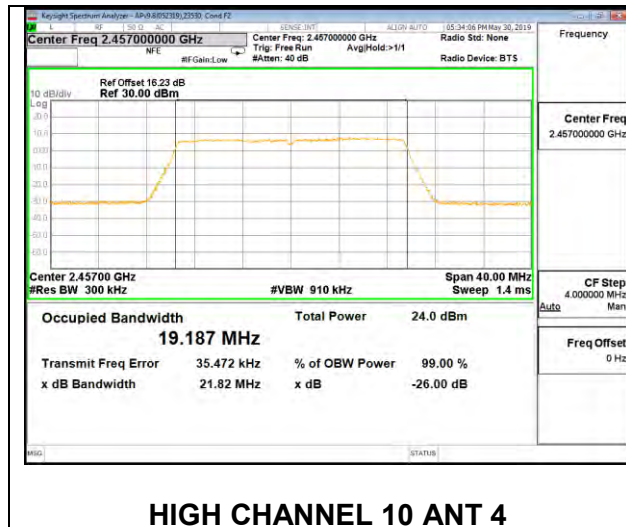


HIGH CHANNEL 9 ANT 4

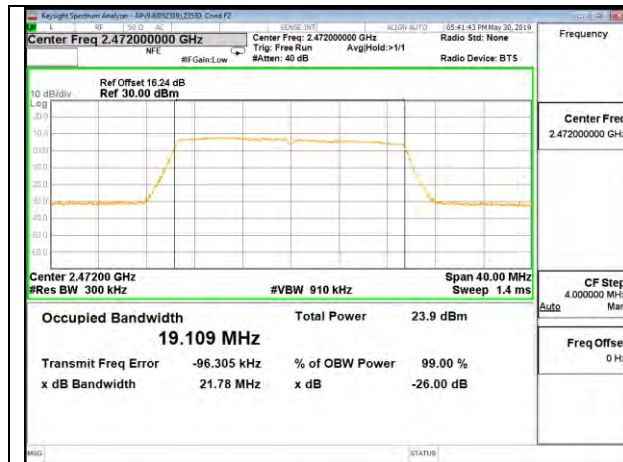


HIGH CHANNEL 9 ANT 3

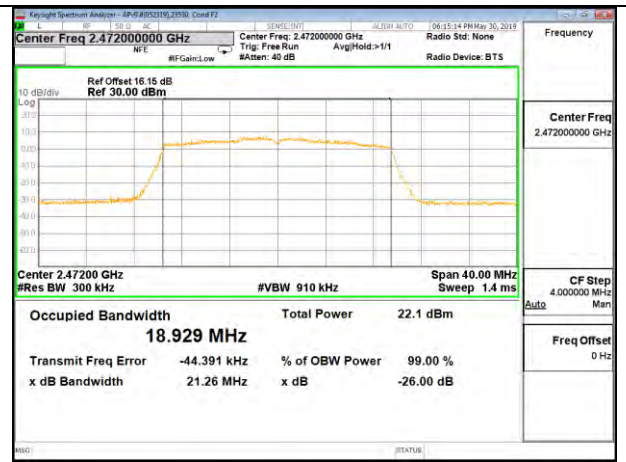








HIGH CHANNEL 13 ANT 4



HIGH CHANNEL 13 ANT 3

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

#### **LIMITS**

FCC §15.247 (a) (2)

RSS-247 5.2 (a)

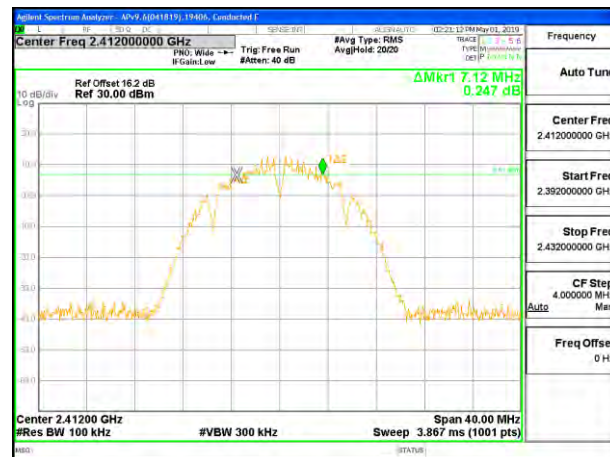
The minimum 6 dB bandwidth shall be at least 500 kHz.

#### **RESULTS**

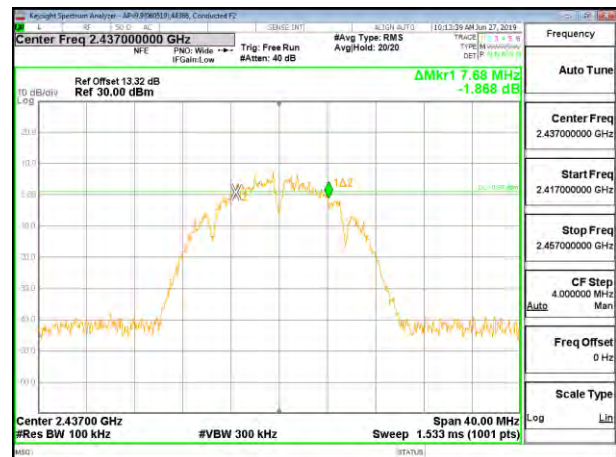
### 8.3.1. 802.11b MODE

#### 1TX Antenna 4 MODE

| Channel | Frequency<br>(MHz) | 6 dB Bandwidth<br>(MHz) | Minimum Limit<br>(MHz) |
|---------|--------------------|-------------------------|------------------------|
| Low 1   | 2412               | 7.1200                  | 0.5                    |
| Mid 6   | 2437               | 7.6800                  | 0.5                    |
| High 11 | 2462               | 8.1200                  | 0.5                    |
| High 12 | 2467               | 7.6000                  | 0.5                    |
| High 13 | 2472               | 8.6000                  | 0.5                    |



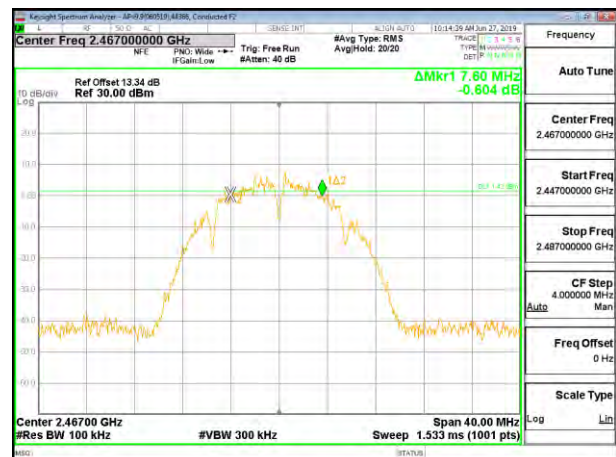
LOW CHANNEL 1



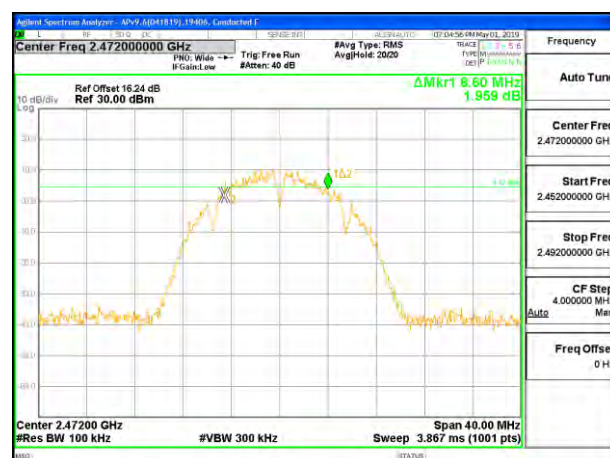
MID CHANNEL 6



HIGH CHANNEL 11



HIGH CHANNEL 12



HIGH CHANNEL 13

**1TX Antenna 3 MODE**

| Channel | Frequency<br>(MHz) | 6 dB Bandwidth<br>(MHz) | Minimum Limit<br>(MHz) |
|---------|--------------------|-------------------------|------------------------|
| Low 1   | 2412               | 8.6400                  | 0.5                    |
| Mid 6   | 2437               | 7.6800                  | 0.5                    |
| High 11 | 2462               | 8.6400                  | 0.5                    |
| High 12 | 2467               | 7.7200                  | 0.5                    |
| High 13 | 2472               | 7.6800                  | 0.5                    |