

## FCC/ISED Test Report

**Prepared for:**           **Garmin International, Inc.**

**Address:**               **1200 E. 151<sup>st</sup> Street**  
                                  **Olathe, Kansas, 66062, USA**

**EUT:**                    **A04111**

**Test Report No:**       **R20210128-20-E8A**

**Approved by:**

  
**Nic S. Johnson, NCE**  
Technical Manager  
iNARTE Certified EMC Engineer #EMC-003337-NE

**DATE:**                 **November 29, 2021**

**Total Pages:**         **77**

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**REVISION PAGE**

Rev. No.	Date	Description
0	29 October 2021	Original – NJohnson Prepared by FLane
A	29 November 2021	Comments on margin for other measurements Added conducted spurious emissions - FL



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**1.0 SUMMARY OF TEST RESULTS**

The worst-case measurements were reported in this report. Summary of test results presented in this report correspond to the following section (Please see the checked box below for the rule part used):

**FCC Part 15.247**

The EUT has been tested according to the following specifications:

- (1) US Code of Federal Regulations, Title 47, Part 15
- (2) ISED RSS-Gen, Issue 5
- (3) ISED RSS-247, Issue 2

APPLIED STANDARDS AND REGULATIONS		
Standard Section	Test Type	Result
FCC Part 15.35 RSS Gen, Issue 5, Section 6.10	Duty Cycle	Pass
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Peak output power	Pass
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Bandwidth	Pass
FCC Part 15.209 RSS-Gen Issue 4, Section 7.1	Receiver Radiated Emissions	Pass
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 2 Section 5.5, RSS-Gen Issue 4, Section 8.9	Transmitter Radiated Emissions	Pass
FCC Part 15.247(a)(1) RSS-247 Issue 2 Section 5.2	Power Spectral Density	Pass
FCC Part 15.209, 15.247(d) RSS-247 Issue 2 Section 11.13	Band Edge Measurement	Pass
FCC Part 15.207 RSS-Gen Issue 4, Section 7.1	Conducted Emissions	Pass



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## 2.0 EUT DESCRIPTION

### 2.1 EQUIPMENT UNDER TEST

#### Summary and Operating Condition:

EUT	A04111
EUT Received	9 March 2021
EUT Tested	9 March 2021- 6 October 2021
Serial No.	3378818230 (Radiated Sample) 3378818167 (Conducted Sample)
Operating Band	2400 – 2483.5 MHz
Device Type	<input type="checkbox"/> GMSK <input type="checkbox"/> GFSK <input type="checkbox"/> BT BR <input type="checkbox"/> BT EDR 2MB <input type="checkbox"/> BT EDR 3MB <input checked="" type="checkbox"/> 802.11x
Power Supply / Voltage	Internal Battery/ 5VDC Charger: Garmin (Phi Hong) MN: PSAI10R-050Q (Representative Power Supply)

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.

### 2.2 DESCRIPTION OF TEST MODES

The operating range of the EUT is dependent on the device type found in section 2.1:

For Bluetooth Transmissions:

Channel	Frequency
Low	2402 MHz
Mid	2440/2441 MHz
High	2480 MHz

For 802.11x Transmissions:

Channel	Frequency
Low	2412 MHz
Mid	2437 MHz
High	2462 MHz

These are the only representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequency and designations.

### 2.3 DESCRIPTION OF SUPPORT UNITS

None

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### 3.0 LABORATORY AND GENERAL TEST DESCRIPTION

#### 3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)  
 4740 Discovery Drive  
 Lincoln, NE 68521

A2LA Certificate Number:	1953.01
FCC Accredited Test Site Designation No:	US1060
Industry Canada Test Site Registration No:	4294A-1
NCC CAB Identification No:	US0177

Environmental conditions varied slightly throughout the tests:

Relative humidity of  $35 \pm 4\%$   
 Temperature of  $22 \pm 3^\circ$  Celsius



#### 3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Nic Johnson	Technical Manager	Review/editing
2	Fox Lane	Test Engineer	Testing and report
3	Karthik Vepuri	Test Engineer	Testing and report
4	Grace Larsen	Test Technician	Testing
5	Samuel Probst	Test Technician	Testing
6	Matthew Emory	Test Technician	Testing

**Notes:**

All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.



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### 3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (44GHz)	N9038A	MY59050109	July 21, 2021	July 21, 2023
Keysight MXE Signal Analyzer (26.5GHz)	N9038A	MY56400083	May 5, 2020	May 5, 2022
Keysight EXA Signal Analyzer	N9010A	MY56070862	July 20, 2021	July 20, 2023
SunAR RF Motion	JB1	A091418	July 27, 2021	July 27, 2022
EMCO Horn Antenna	3115	6415	March 16, 2020	March 16, 2022
Com-Power LISN 50 $\mu$ H / 250 $\mu$ H - 50 $\Omega$	LI-220C	20070017	September 22, 2020	September 22, 2022
8447F POT H64 Preamplifier*	8447F POT H64	3113AD4667	February 1, 2021	February 1, 2022
Rohde & Schwarz Preamplifier*	TS-PR18	3545700803	April 14, 2020	April 14, 2022
Trilithic High Pass Filter*	6HC330	23042	April 14, 2020	April 14, 2022
TDK Emissions Lab Software	V11.25	700307	NA	NA

\*Internal Characterization

**Notes:**

All equipment is owned by NCEE Labs and stored permanently at NCEE Labs facilities.

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### 3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMENTS

Measurement type presented in this report (Please see the checked box below):

#### Conducted

The conducted measurements were performed by connecting the output of the transmitter directly into a spectrum analyzer using an impedance matched cable and connector soldered to the EUT in place of the antenna. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in the Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

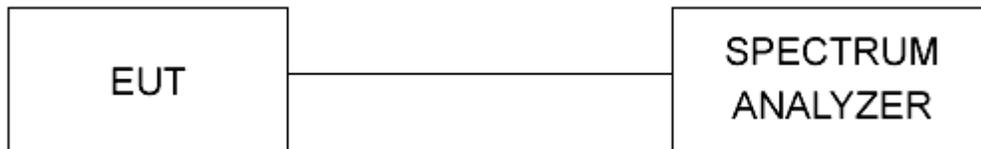


Figure 1 - Bandwidth Measurements Test Setup

#### Radiated

All the radiated measurements were taken at a distance of 3m from the EUT. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in the Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

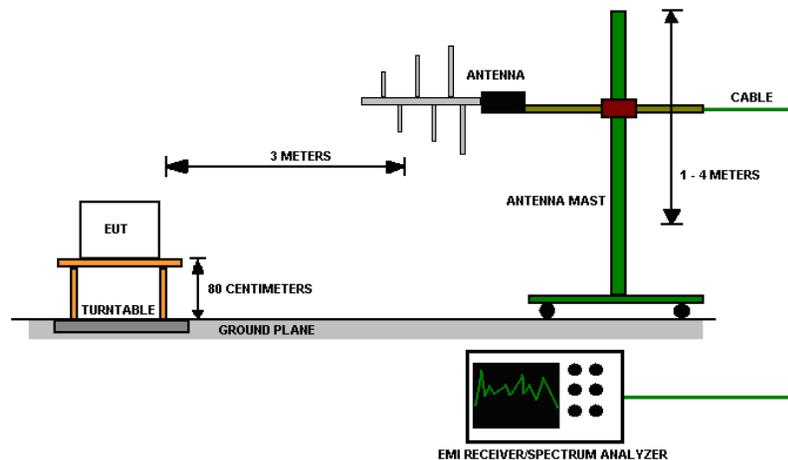


Figure 2 - Radiated Emissions Test Setup



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#### 4.0 RESULTS

DTS Radio Measurements							
CHANNEL	Transmitter	Occupied Bandwidth (MHz)	6 dB Bandwidth (MHz)	OUTPUT POWER (dBm)	OUTPUT POWER (mW)	PSD (dBm)	RESULT
Low	802.11 b	14.86	8.81	22.620	182.810	3.818	PASS
Mid	802.11 b	14.83	8.46	23.010	199.986	3.926	PASS
High	802.11 b	14.86	8.80	22.780	189.671	2.853	PASS
Low	802.11 g	16.43	16.53	20.420	110.154	-13.066	PASS
Mid	802.11 g	16.43	16.53	20.010	100.231	-12.968	PASS
High	802.11 g	16.44	16.52	19.540	89.950	-13.322	PASS
Low	802.11 n	17.53	17.62	19.380	86.696	-12.338	PASS
Mid	802.11 n	17.56	17.63	22.650	184.077	-10.24	PASS
High	802.11 n	17.54	17.66	18.330	68.077	-14.98	PASS
Occupied Bandwidth = N/A; 6 dB Bandwidth Limit =500 kHz				Output Power Limit = 30 dBm; PSD Limit = 8 dBm			
Unrestricted Band-Edge							
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBm)	Relative Fundamental (dBm)	Delta (dB)	Min Delta (dB)	Result
Low	802.11 b	2400.00	79.99	115.64	35.65	20.00	PASS
Low	802.11 g	2400.00	77.53	107.16	29.63	20.00	PASS
Low	802.11 n	2400.00	68.66	104.59	35.93	20.00	PASS
High	802.11 b	2483.50	64.23	115.06	50.83	20.00	PASS
High	802.11 g	2483.50	65.70	105.70	40.00	20.00	PASS
High	802.11 n	2483.50	62.26	103.91	41.65	20.00	PASS
Peak Restricted Band-Edge							
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)	Margin	Result
Low	802.11 b	2390.00	60.18	Peak	73.98	13.80	PASS
Low	802.11 g	2390.00	65.31	Peak	73.98	8.68	PASS
Low	802.11 n	2390.00	67.57	Peak	73.98	6.41	PASS
High	802.11 b	2483.50	58.00	Peak	73.98	15.98	PASS
High	802.11 g	2483.50	66.98	Peak	73.98	7.00	PASS
High	802.11 n	2483.50	65.22	Peak	73.98	8.76	PASS
*Limit shown is the peak limit taken from FCC Part 15.209							



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Average Restricted Band-Edge							
CHANNEL	Mode	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)	Margin	Result
Low	802.11 b	2390.00	50.17	Average	53.98	3.82	PASS
Low	802.11 g	2390.00	47.64	Average	53.98	6.34	PASS
Low	802.11 n	2390.00	51.51	Average	53.98	2.47	PASS
High	802.11 b	2483.50	48.05	Average	53.98	5.93	PASS
High	802.11 g	2483.50	49.57	Average	53.98	4.41	PASS
High	802.11 n	2483.50	51.49	Average	53.98	2.49	PASS

\*Limit shown is the average limit taken from FCC Part 15.209



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#### 4.1 OUTPUT POWER

**Test Method:** All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

**Limits of power measurements:**

**For FCC Part 15.247 Device:**

The maximum allowed peak output power is 30 dBm.

**Test procedures:**

Details can be found in section 3.4 of this report.

**Deviations from test standard:**

No deviation.

**Test setup:**

Details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.

**Test results:**

**Pass**

Comments:

1. All the output power plots can be found in the Appendix C.
2. All the measurements were found to be compliant.
3. The measurements are listed in the tables below.



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## 4.2 BANDWIDTH

**Test Method:** All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

**Limits of bandwidth measurements:**

**For FCC Part 15.247 Device:**

The 99% occupied bandwidth is for informational purpose only. The 6dB bandwidth of the signal must be greater than 500 kHz.

**Test procedures:**

Details can be found in section 3.4 of this report.

**Deviations from test standard:**

No deviation.

**Test setup:**

Test setup details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.

**Test results:**

**Pass**

Comments:

1. All the bandwidth plots can be found in the Appendix C.
2. All the measurements were found to be compliant.



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### 4.3 DUTY CYCLE

**Test Method:**

Duty Cycle of Modulations/Transmitters tested was found to be >98%.



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#### 4.4 RADIATED EMISSIONS

**Test Method:** ANSI C63.10-2013, Section 6.5, 6.6

**Limits for radiated emissions measurements:**

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH ( $\mu\text{V/m}$ )	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

**NOTE:**

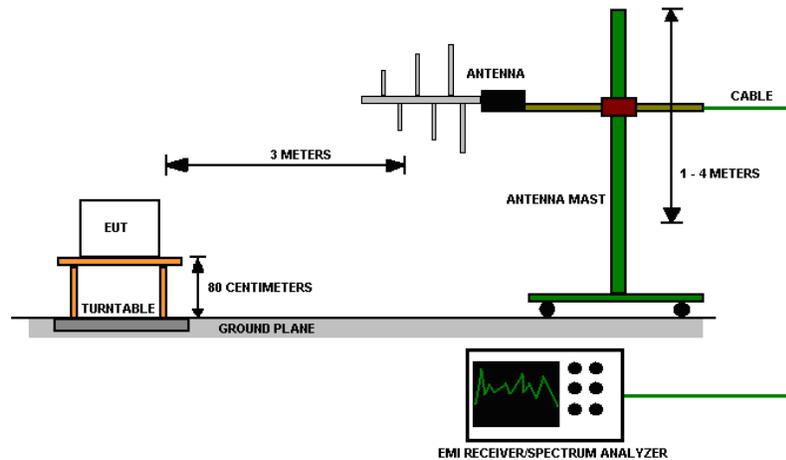
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) =  $20 * \log * \text{Emission level } (\mu\text{V/m})$ .
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.
4. The EUT was tested for spurious emissions while running off of battery power and external USB power. The worse-case emissions were produced while running off of USB power, so results from this mode are presented.



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**Test procedures:**

- a. The EUT was placed on the top of a rotating table above the ground plane in a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements from 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.
- d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.
- e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.
- f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- g. The EUT was maximized in all 3 orthogonal positions. The results are presented for the axis that had the highest emissions.

**Test setup:**

**Figure 3 - Radiated Emissions Test Setup**
**NOTE:**

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.
2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

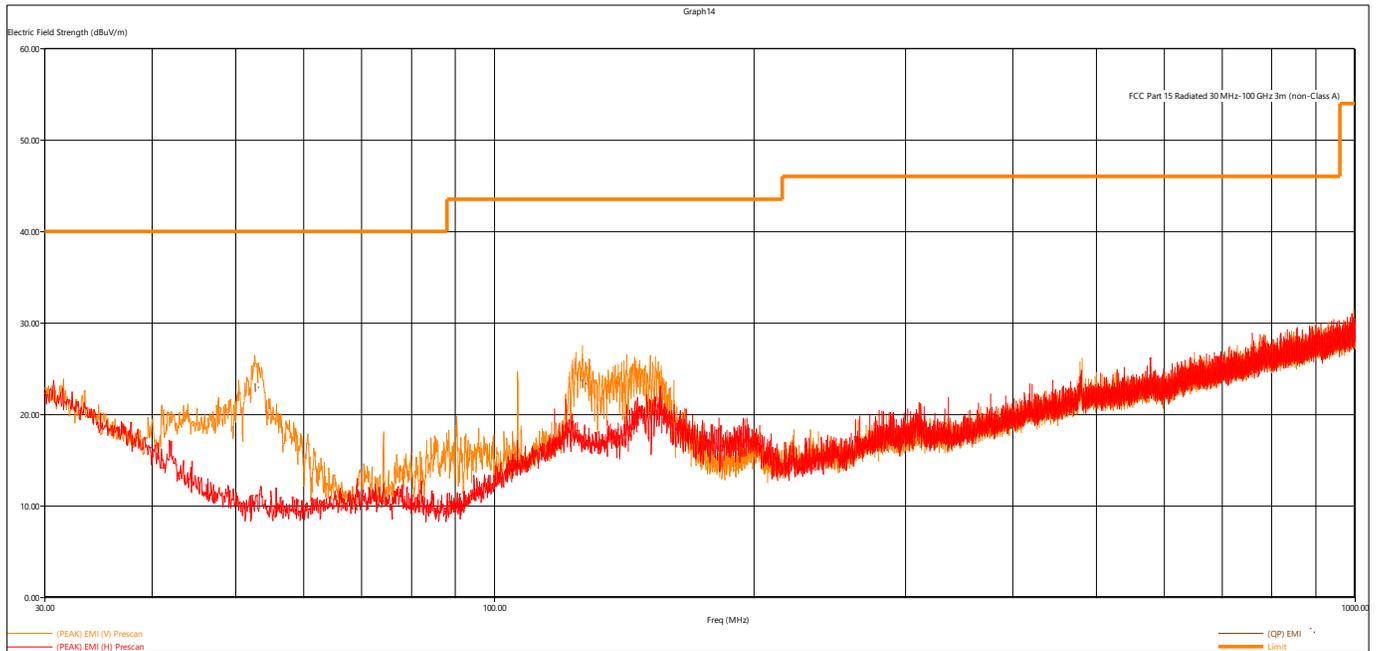
**Deviations from test standard:**

No deviation.

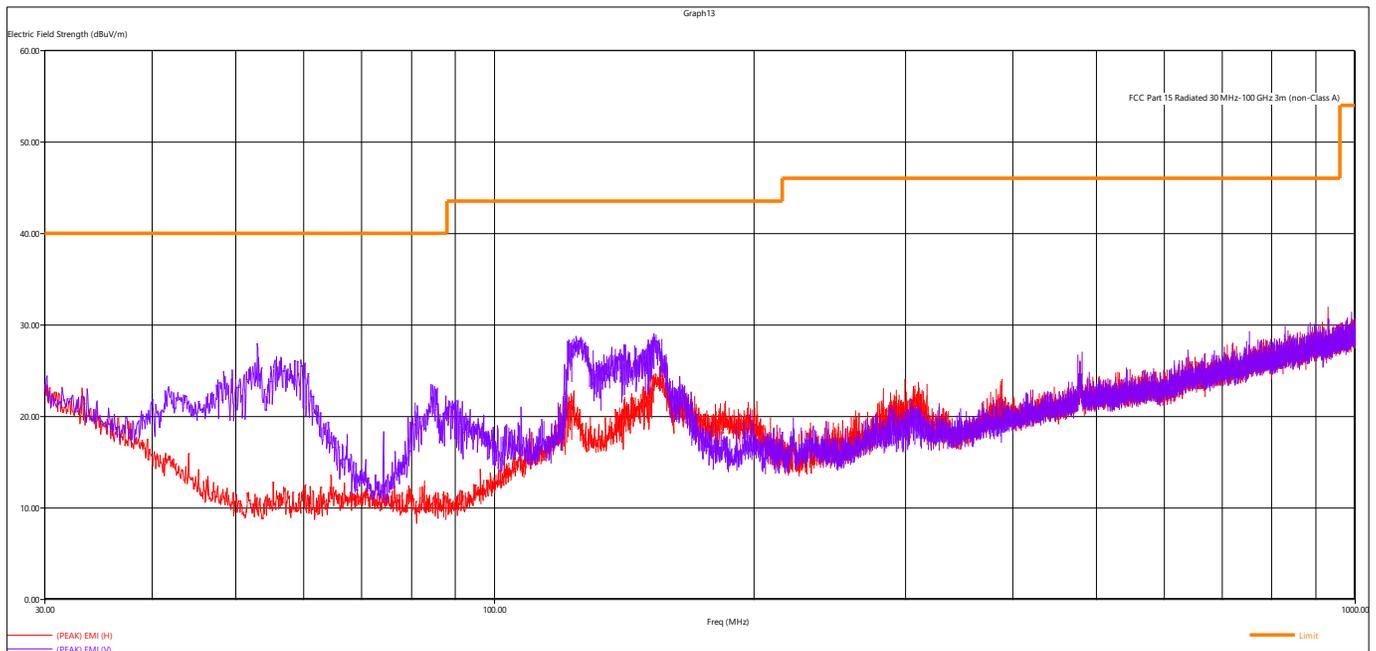
**EUT operating conditions**

Details can be found in section 2.1 of this report.

**Test results:**



**Figure 4 - Radiated Emissions Plot, Receive**



**Figure 5 - Radiated Emissions Plot, 802.11b**

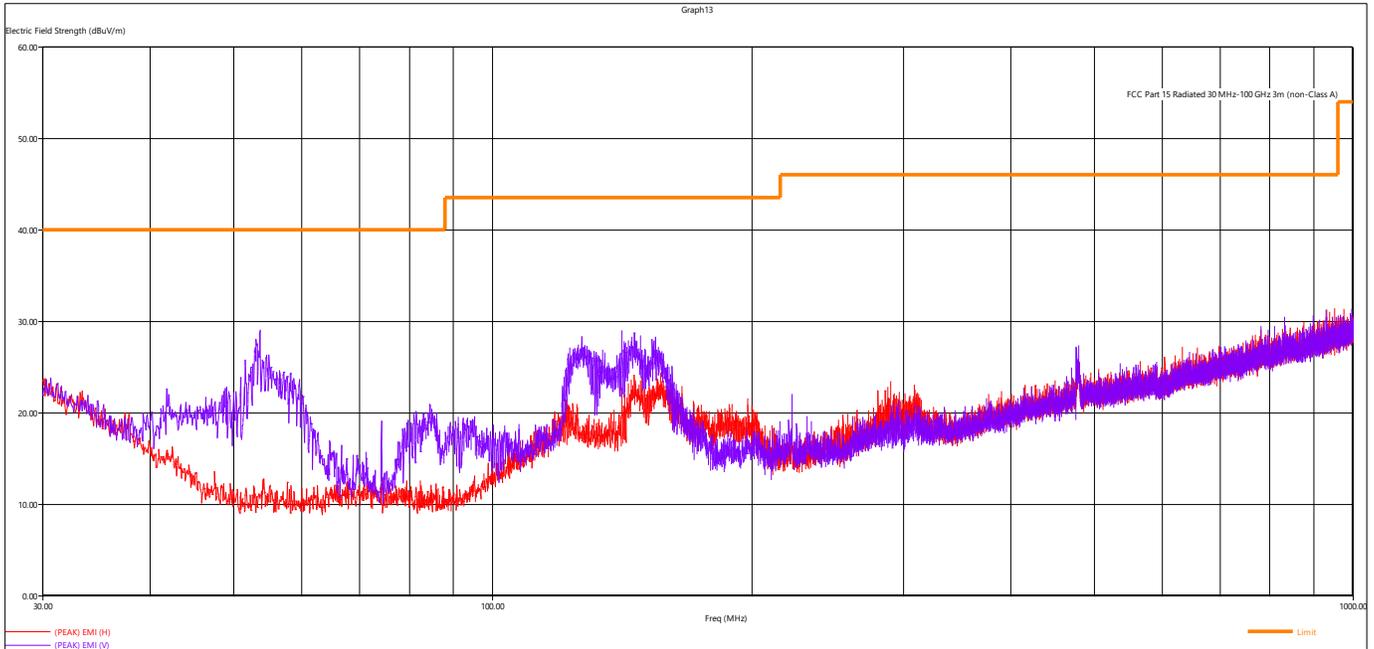


Figure 6 - Radiated Emissions Plot, 802.11g

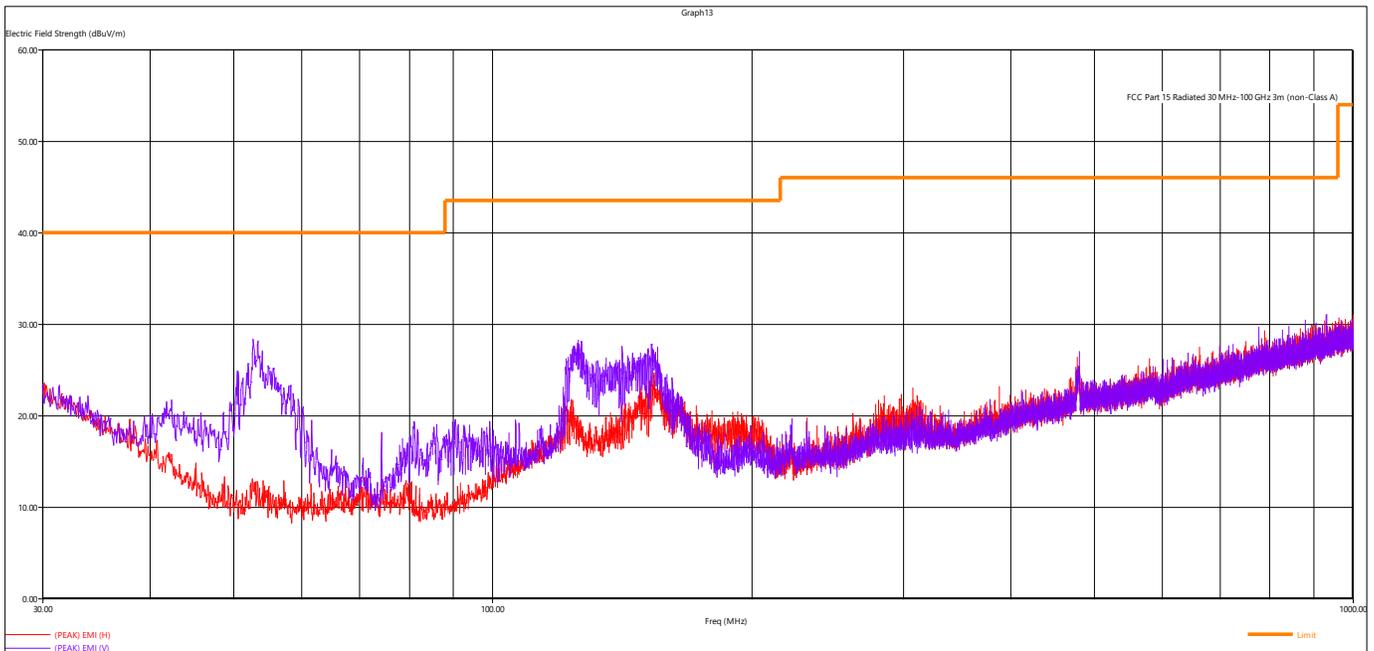


Figure 7 - Radiated Emissions Plot, 802.11n

**REMARKS:**

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value



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Quasi-Peak Measurements, 802.11x								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dB $\mu$ V/m	dB $\mu$ V/m	dB	cm.	deg.			
52.817760	22.91	40.00	17.09	104.00	328.00	V	NA	Receive
126.430800	23.26	43.52	20.26	106.00	204.00	V	NA	Receive

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the plot and table above. Measurements below 1 GHz were found to be at least 10 dB Below the limit.

Peak Measurements, 802.11x								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dB $\mu$ V/m	dB $\mu$ V/m	dB	cm.	deg.			
2411.898000	107.60	NA	NA	254	194	V	Low	802.11b
2436.128000	109.05	NA	NA	288	187	V	Mid	802.11b
2463.238000	107.05	NA	NA	285	187	V	High	802.11b
7286.406000	46.74	73.98	27.24	122	130	H	Mid	802.11b
2409.318000	101.81	NA	NA	352	188	V	Low	802.11g
2439.300000	102.63	NA	NA	288	194	V	Mid	802.11g
2460.370000	100.74	NA	NA	306	191	V	High	802.11g
2409.688000	99.09	NA	NA	234	191	V	Low	802.11n
2435.976000	99.85	NA	NA	332	179	V	Mid	802.11n
2463.148000	97.51	NA	NA	243	192	V	High	802.11n

All other emissions >1GHz were found to be at least 6 dB Below the limit.



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Average Measurements, 802.11x								
Frequency	Level	Limit	Margin	Height	Angle	Pol	Channel	Modulation
MHz	dB $\mu$ V/m	dB $\mu$ V/m	dB	cm.	deg.			
2411.898000	99.93	NA	NA	254	194	V	Low	802.11b
2436.128000	101.45	NA	NA	288	187	V	Mid	802.11b
2463.238000	98.38	NA	NA	285	187	V	High	802.11b
7286.406000	33.46	53.98	20.52	122	130	H	Mid	802.11b
2409.318000	91.75	NA	NA	352	188	V	Low	802.11g
2439.300000	92.20	NA	NA	288	194	V	Mid	802.11g
2460.370000	90.40	NA	NA	306	191	V	High	802.11g
2409.688000	88.53	NA	NA	234	191	V	Low	802.11n
2435.976000	89.03	NA	NA	332	179	V	Mid	802.11n
2463.148000	86.73	NA	NA	243	192	V	High	802.11n

All other emissions >1GHz were found to be at least 6 dB Below the limit.



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#### 4.5 CONDUCTED SPURIOUS EMISSIONS

**Test Method:** ANSI C63.10-2013, Section 7.8.8

**Limits of spurious emissions:**

From FCC Part 15.247:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

**Test procedures:**

The highest emissions level was measured and recorded. All spurious measurements were evaluated to 20dB below the fundamental. More details can be found in section 3.4 of this report.

**Deviations from test standard:**

No deviation.

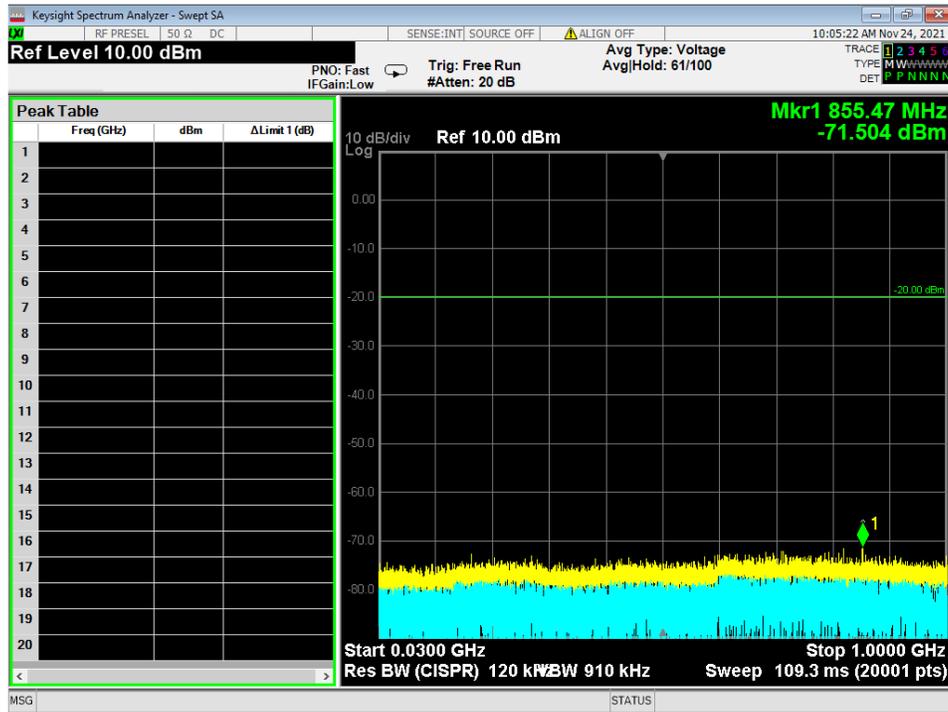
**Test setup:**

Test setup details can be found in section 3.4 of this report.

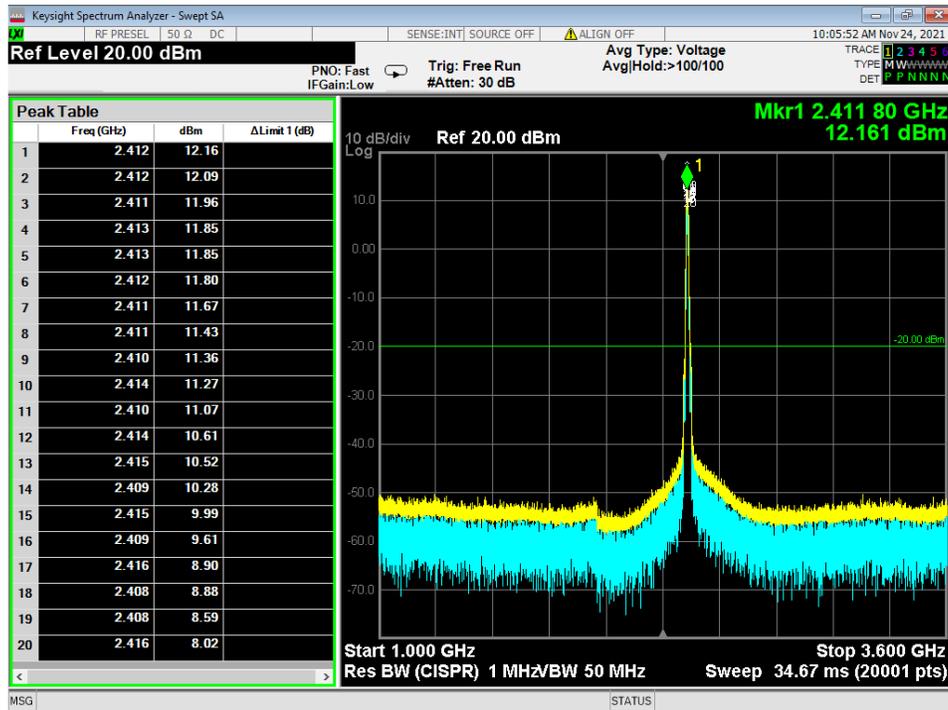
**EUT operating conditions:**

Details can be found in section 2.1 of this report.

**Test results:**



**Figure 8 - Radiated Emissions Plot, WIFI 802.11b, 30M – 1G**



**Figure 9 - Radiated Emissions Plot, WIFI 802.11b, 1G – 3.6G**



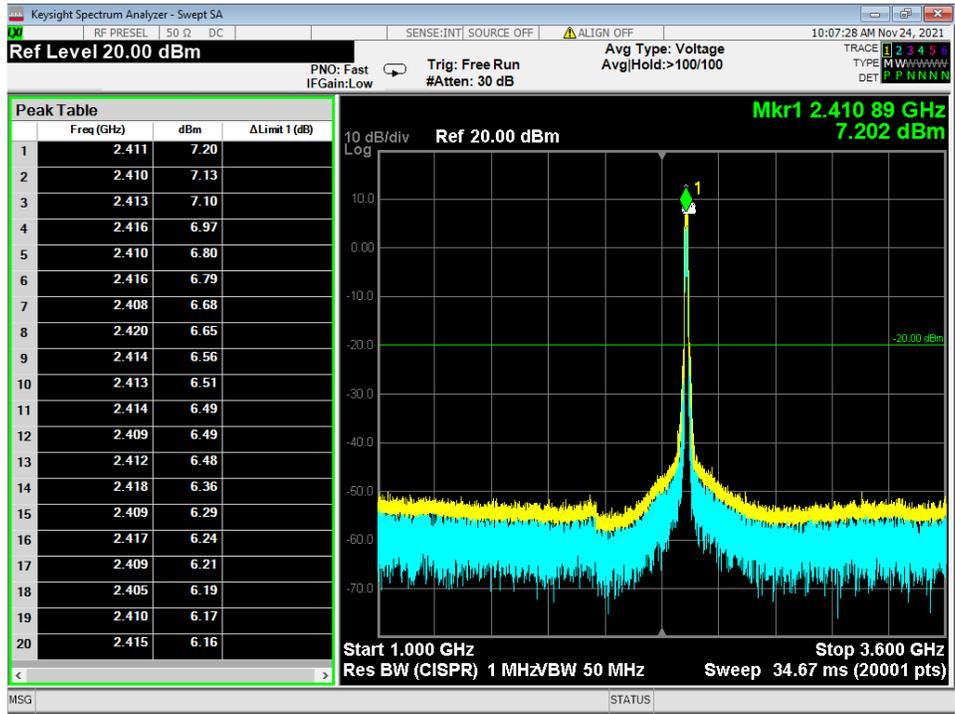


Figure 12 - Radiated Emissions Plot, WIFI 802.11g, 1G – 3.6G

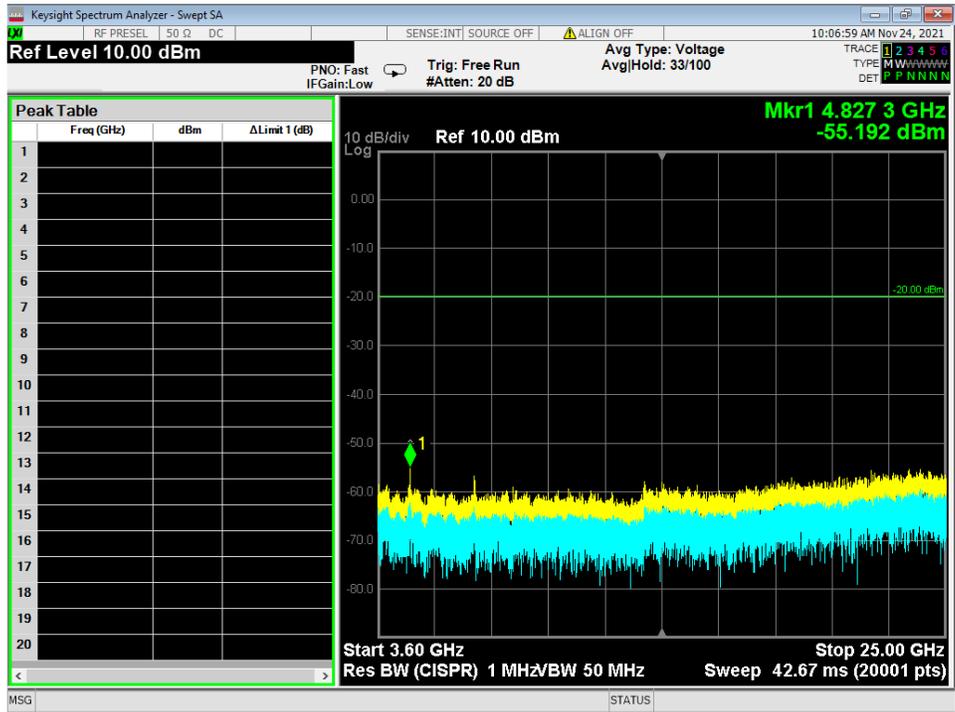


Figure 13 - Radiated Emissions Plot, WIFI 802.11g, 3.6G – 25G





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#### 4.6 BAND EDGES

**Test Method:** All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

**Limits of band-edge measurements:**

**For FCC Part 15.249 Device:**

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

**For FCC Part 15.247 Device:**

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

**Test procedures:**

The highest emissions level beyond the band-edge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209. More details can be found in section 3.4 of this report.

**Deviations from test standard:**

No deviation.

**Test setup:**

Test setup details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.



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**Test results:**

**Pass**

Comments:

1. All the band edge plots can be found in the Appendix C.
2. If the device falls under FCC Part 15.247 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 20 dB between peak and the band edge.
3. If the device falls under FCC Part 15.249 (Details can be found in summary of test results), compliance is shown in the unrestricted band edges by showing minimum delta of 50 dB between peak and the band edge.
4. The restricted band edge compliance is shown by comparing to the general limit defined in Part 15.209. The limit shown in the graph accounts for the antenna gain of the device.



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## 4.7 POWER SPECTRAL DENSITY

**Test Method:** All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

**Limits of power measurements:**

**For FCC Part 15.249 Device:**

Not Applicable

**For FCC Part 15.247 Device:**

The maximum PSD allowed is 8 dBm.

**Test procedures:**

Details can be found in section 3.4 of this report.

**Deviations from test standard:**

No deviation.

**Test setup:**

Details can be found in section 3.4 of this report.

**EUT operating conditions:**

Details can be found in section 2.1 of this report.

**Test results:**

**Pass**

Comments:

4. All the Power Spectral Density (PSD) plots can be found in the Appendix C.
5. All the measurements were found to be compliant.
6. The measurements are reported on the graph.

## 4.8 CONDUCTED AC MAINS EMISSIONS

**Test Method:** ANSI C63.10-2013, Section(s) 6.2

**Limits for conducted emissions measurements:**

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dB $\mu$ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

**Notes:**

1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz
3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

**Test Procedures:**

- a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.
- c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits are not reported.
- d. Results were compared to the 15.207 limits.

**Deviation from the test standard:**

No deviation

**EUT operating conditions:**

Details can be found in section 2.1 of this report.

**Test Results:**

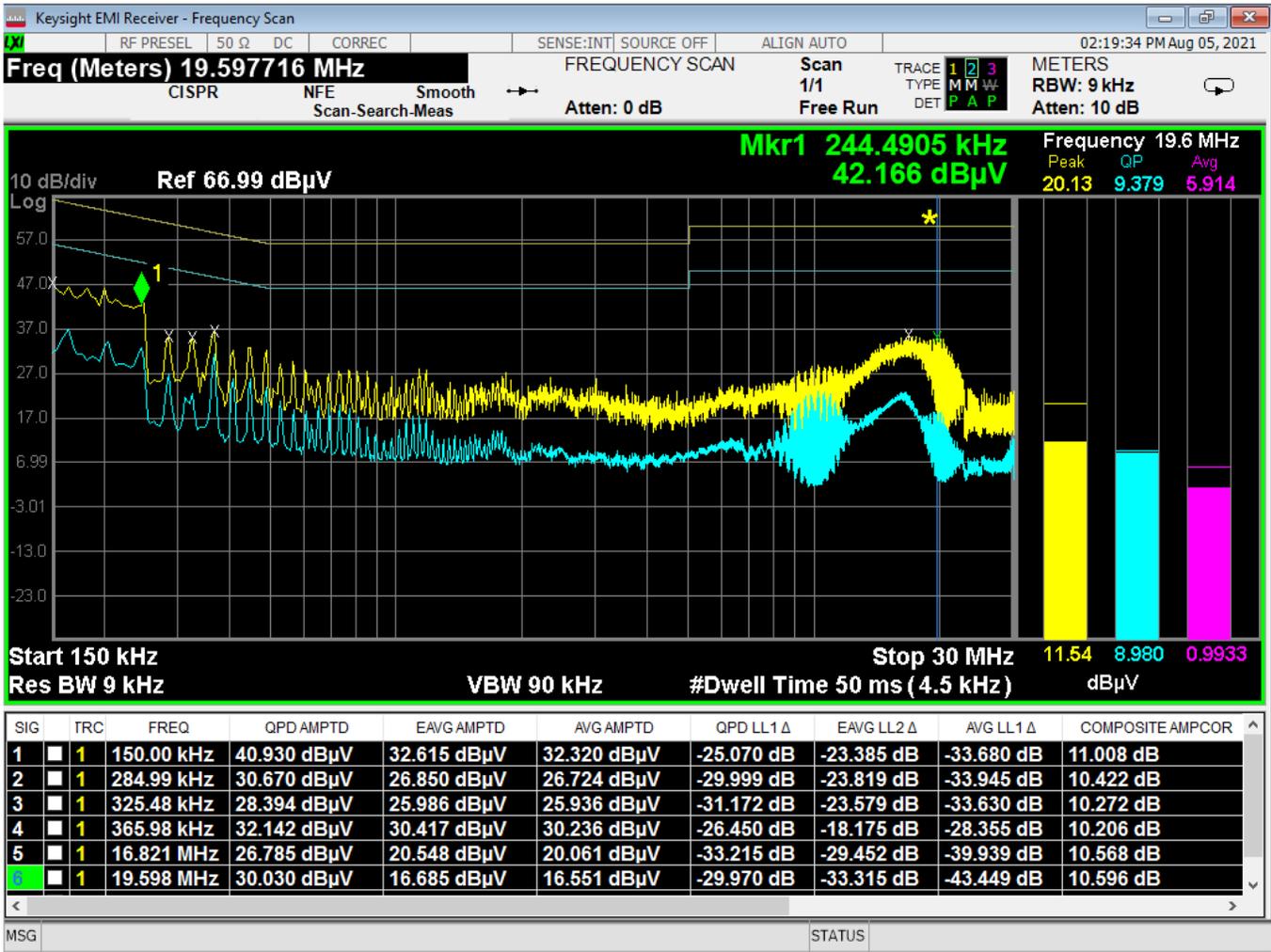


Figure 17 - Conducted Emissions Plot, Line, TX

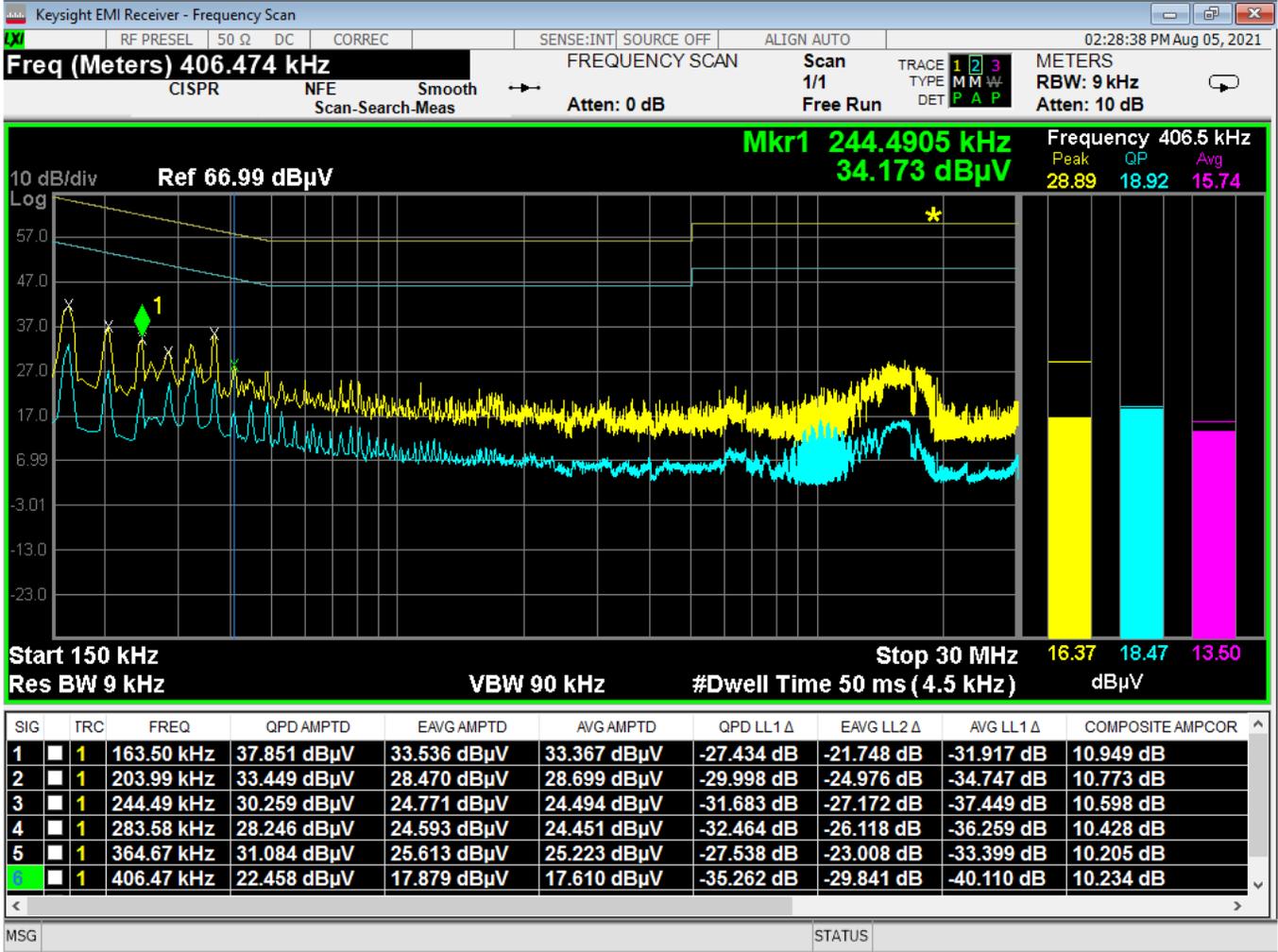


Figure 18 - Conducted Emissions Plot, Neutral, TX

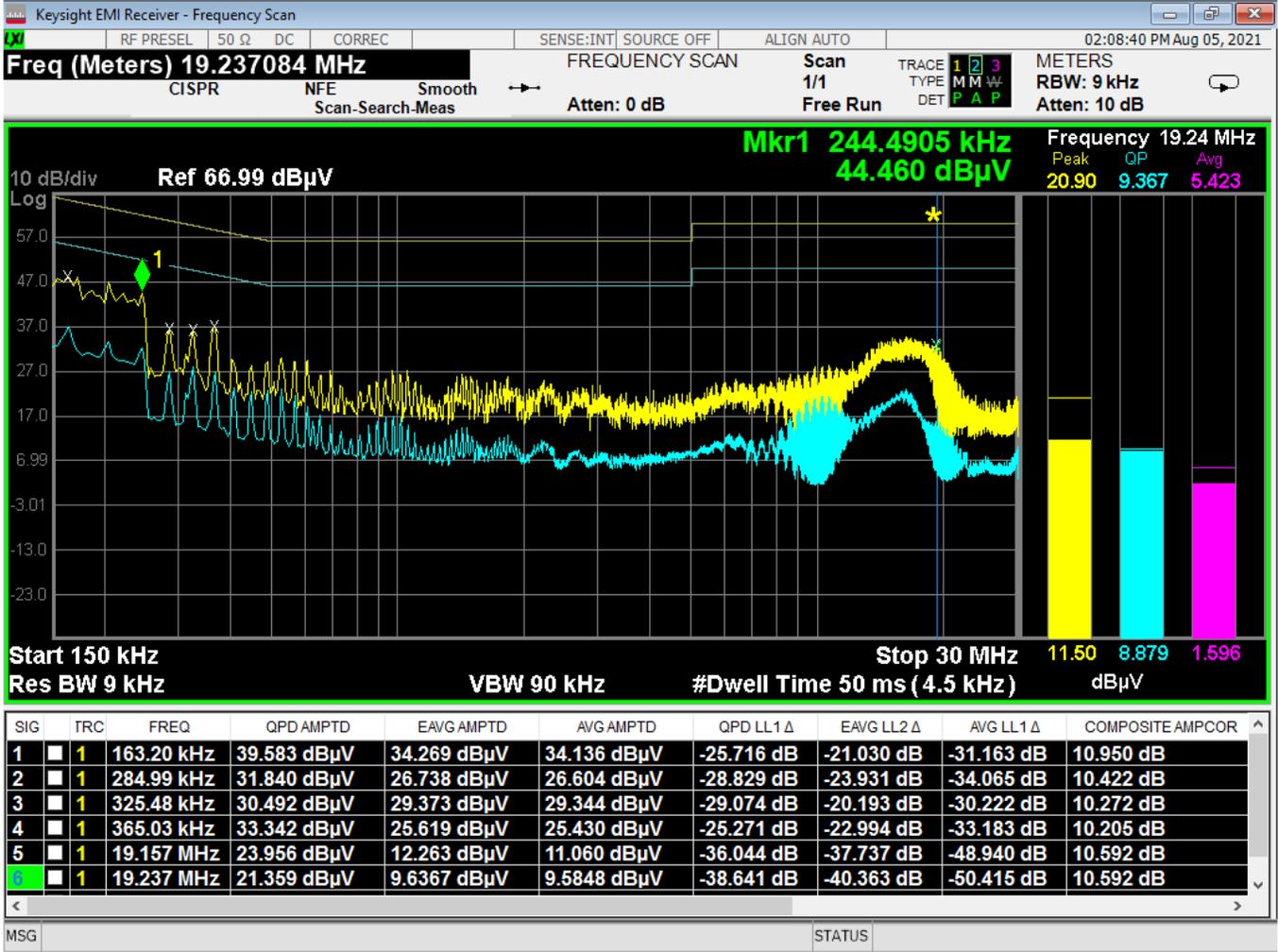


Figure 19 - Conducted Emissions Plot, Line, IDLE

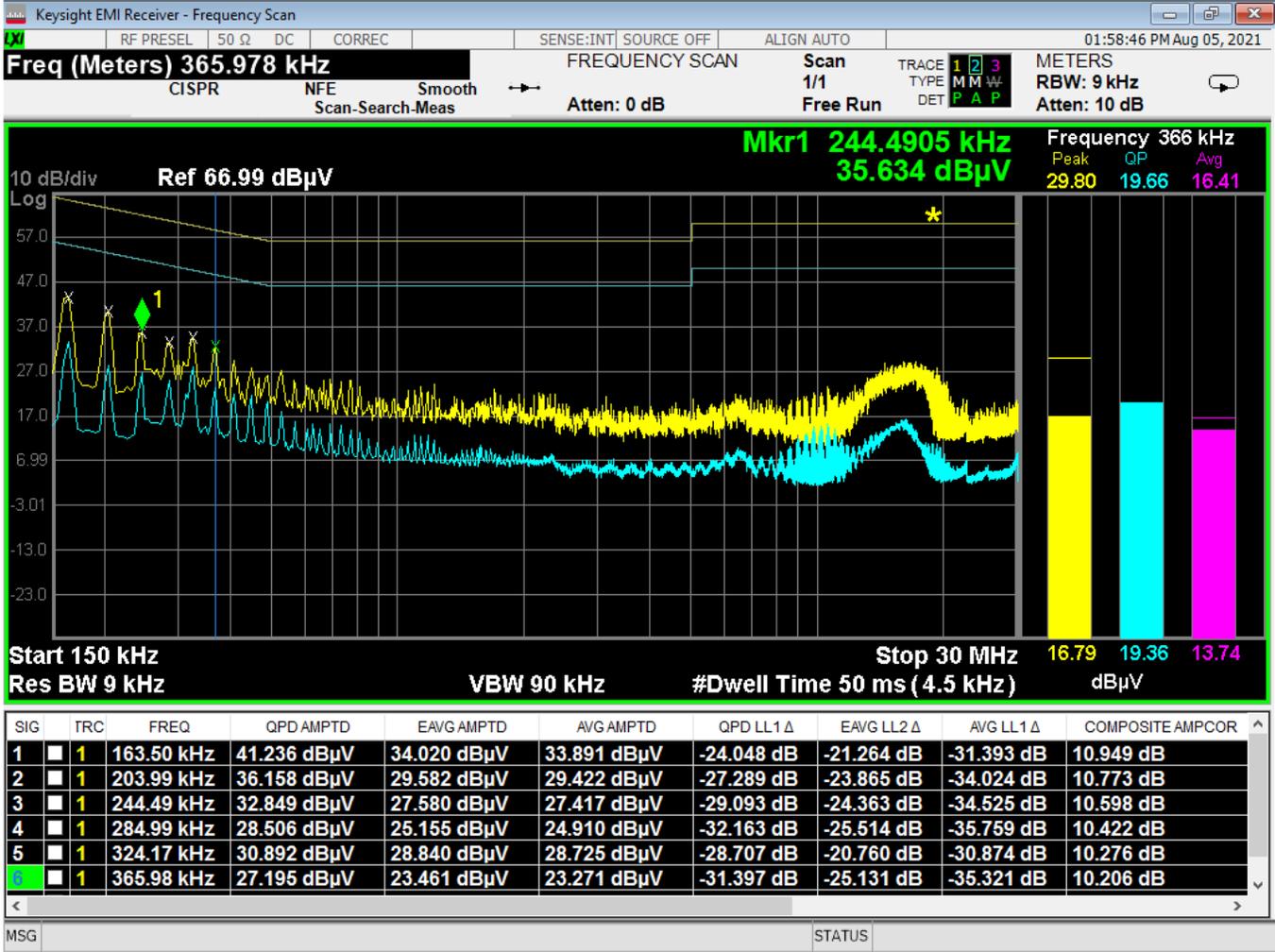


Figure 20 - Conducted Emissions Plot, Neutral, IDLE



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**APPENDIX A: SAMPLE CALCULATION**

**Field Strength Calculation**

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF - (-CF + AG) + AV$$

where FS = Field Strength

- RA = Receiver Amplitude
- AF = Antenna Factor
- CF = Cable Attenuation Factor
- AG = Amplifier Gain
- AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dB $\mu$ V is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dB $\mu$ V/m.

$$FS = 55 + 12 - (-1.1 + 20) + 0 = 48.1 \text{ dB}\mu\text{V/m}$$

The 48.1 dB $\mu$ V/m value can be mathematically converted to its corresponding level in  $\mu$ V/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(48.1 \text{ dB}\mu\text{V/m})/20] = 254.1 \mu\text{V/m}$$

AV is calculated by the taking the  $20 \cdot \log(T_{on}/100)$  where  $T_{on}$  is the maximum transmission time in any 100ms window.



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### EIRP Calculations

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

$$EIRP \text{ (Watts)} = [\text{Field Strength (V/m)} \times \text{antenna distance (m)}]^2 / 30$$

$$\text{Power (watts)} = 10^{[\text{Power (dBm)}/10]} / 1000$$

$$\text{Voltage (dB}\mu\text{V)} = \text{Power (dBm)} + 107 \text{ (for } 50\Omega \text{ measurement systems)}$$

$$\text{Field Strength (V/m)} = 10^{[\text{Field Strength (dB}\mu\text{V/m)} / 20]} / 10^6$$

$$\text{Gain} = 1 \text{ (numeric gain for isotropic radiator)}$$

Conversion from 3m field strength to EIRP (d=3):

$$EIRP = [\text{FS(V/m)} \times d^2] / 30 = \text{FS [0.3]} \quad \text{for } d = 3$$

$$EIRP(\text{dBm}) = \text{FS}(\text{dB}\mu\text{V/m}) - 10(\log 10^9) + 10\log[0.3] = \text{FS}(\text{dB}\mu\text{V/m}) - 95.23$$

*10log( 10^9) is the conversion from micro to milli*



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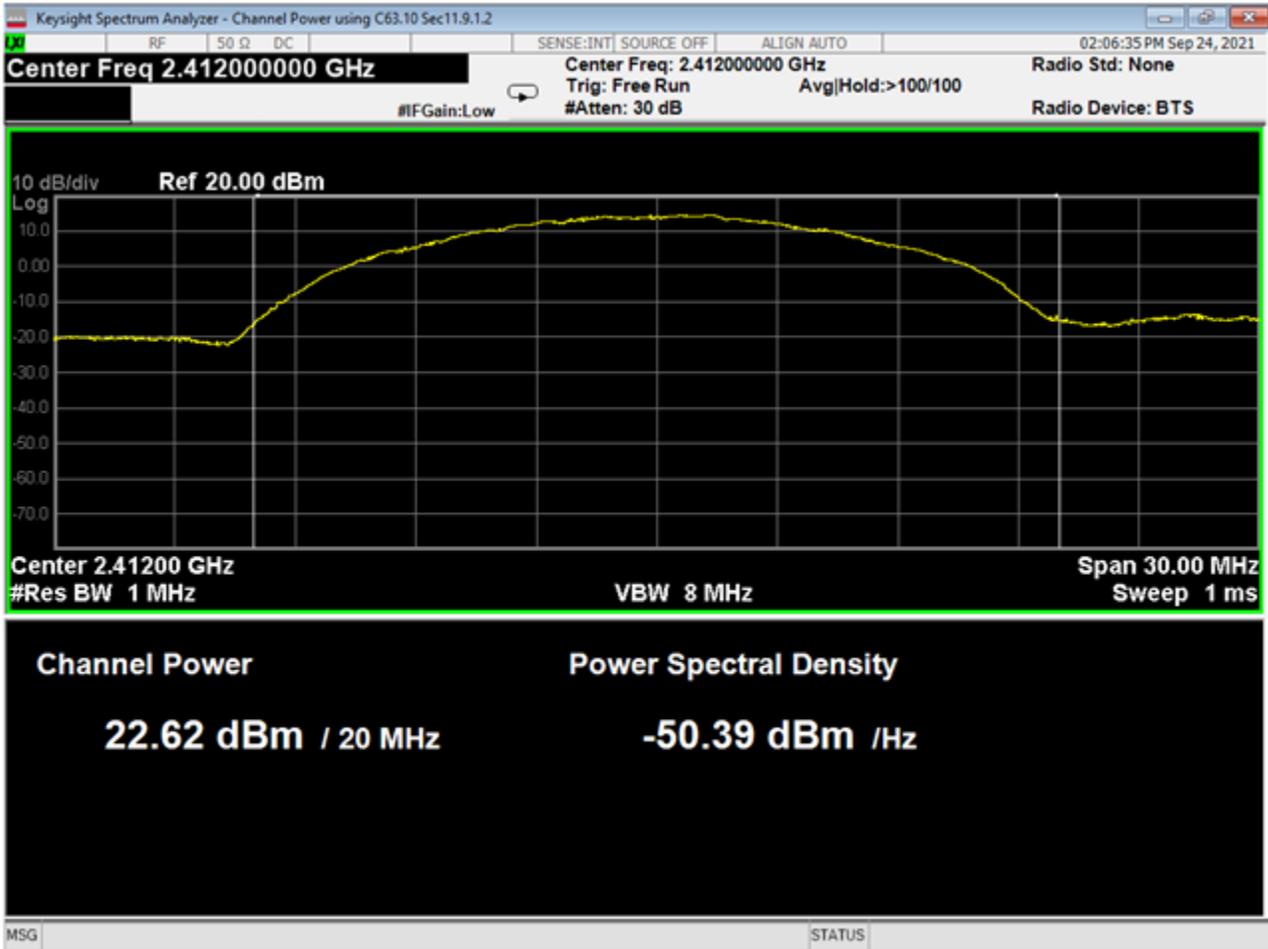
**APPENDIX B – MEASUREMENT UNCERTAINTY**

Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

<b>Test</b>	<b>Frequency Range</b>	<b>Uncertainty Value (dB)</b>
Radiated Emissions, 3m	30MHz - 1GHz	3.82
Radiated Emissions, 3m	1GHz - 18GHz	4.44
Emissions limits, conducted	30MHz – 18GHz	±3.30 dB

Expanded uncertainty values are calculated to a confidence level of 95%.

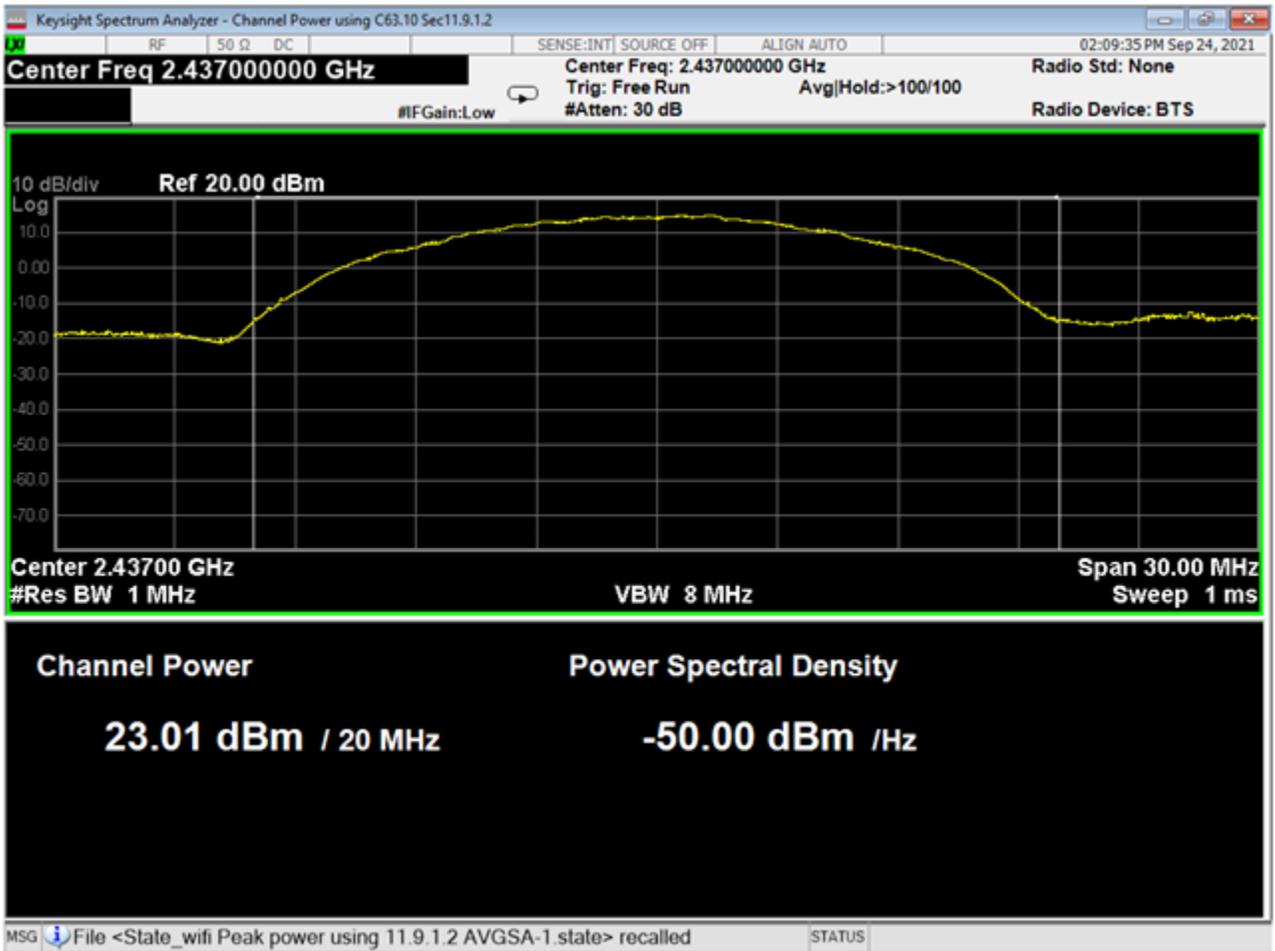
## APPENDIX C – GRAPHS AND TABLES



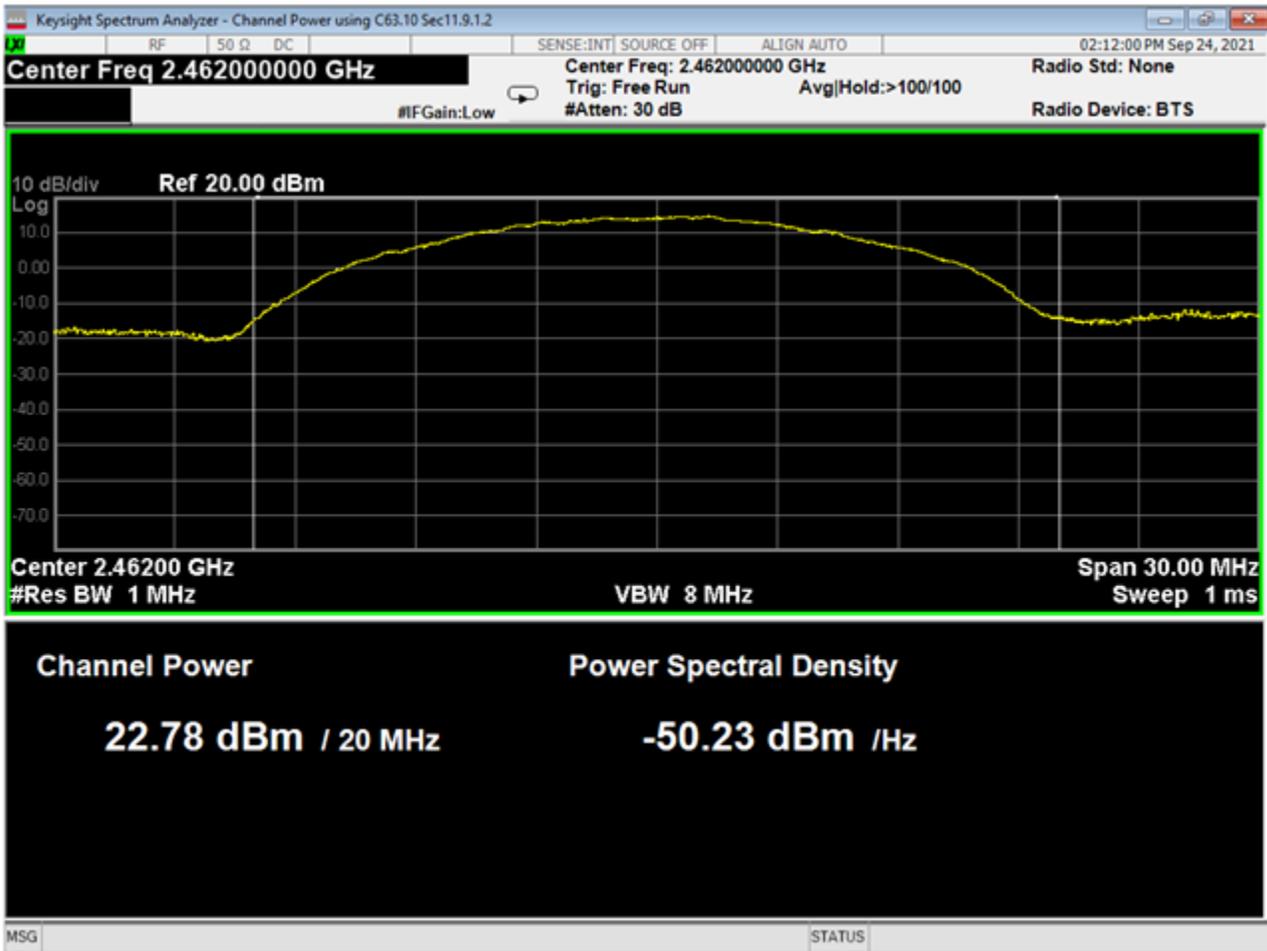
01 Pwr, Low, Wifi B



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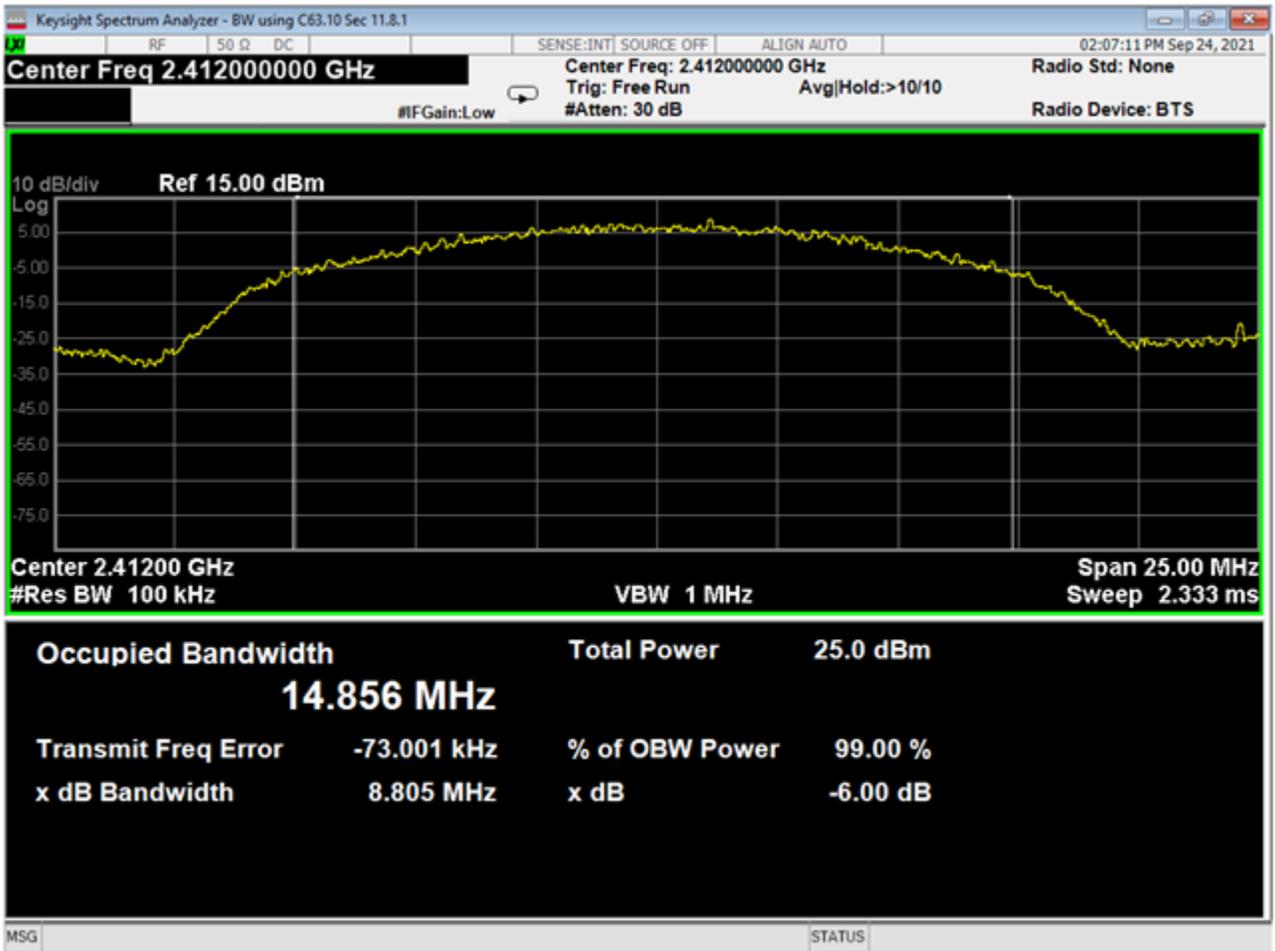
02 Pwr, Mid, Wifi B



03 Pwr, High, Wifi B



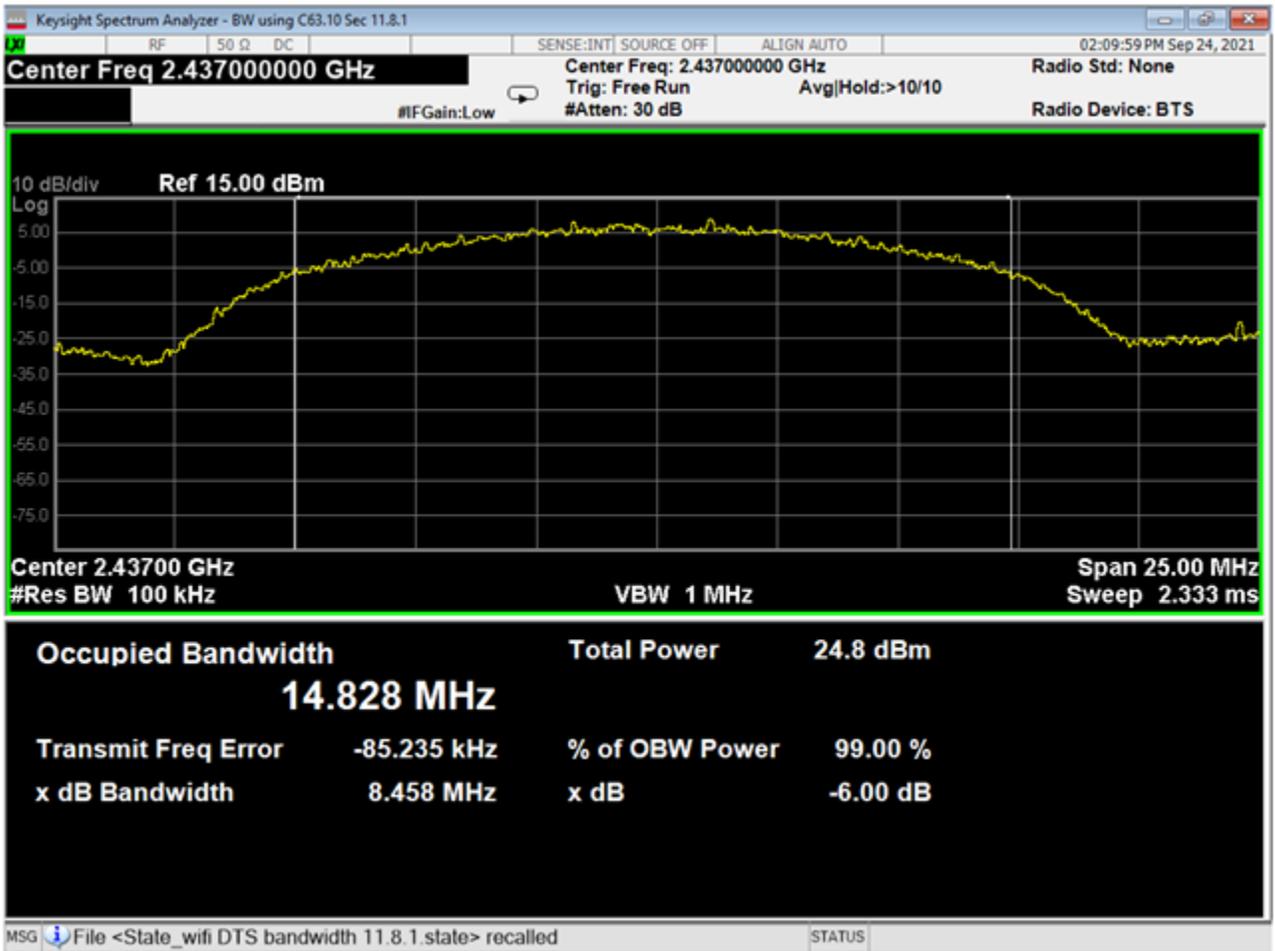
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04 OBW-6dB, Low, Wifi B



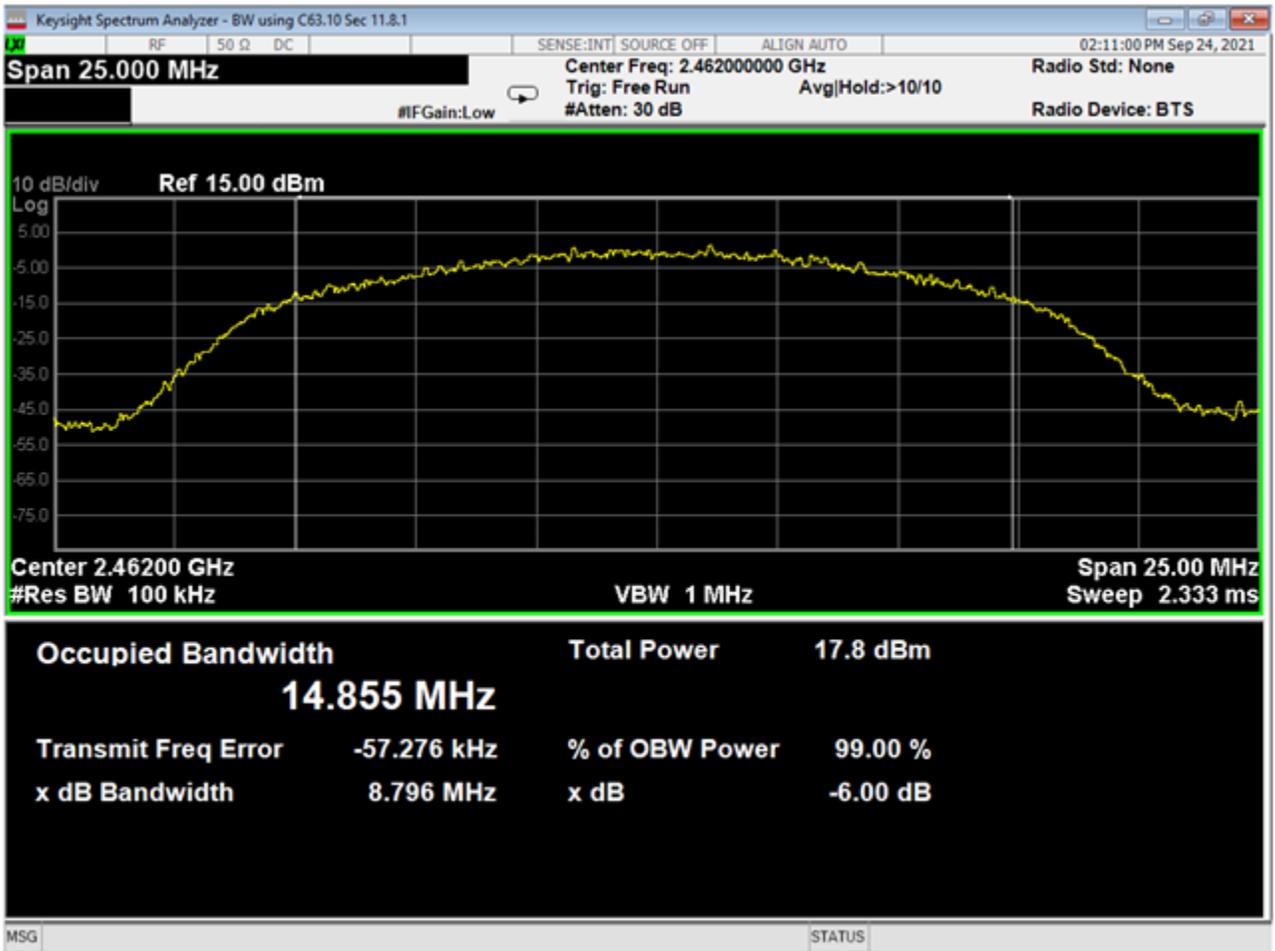
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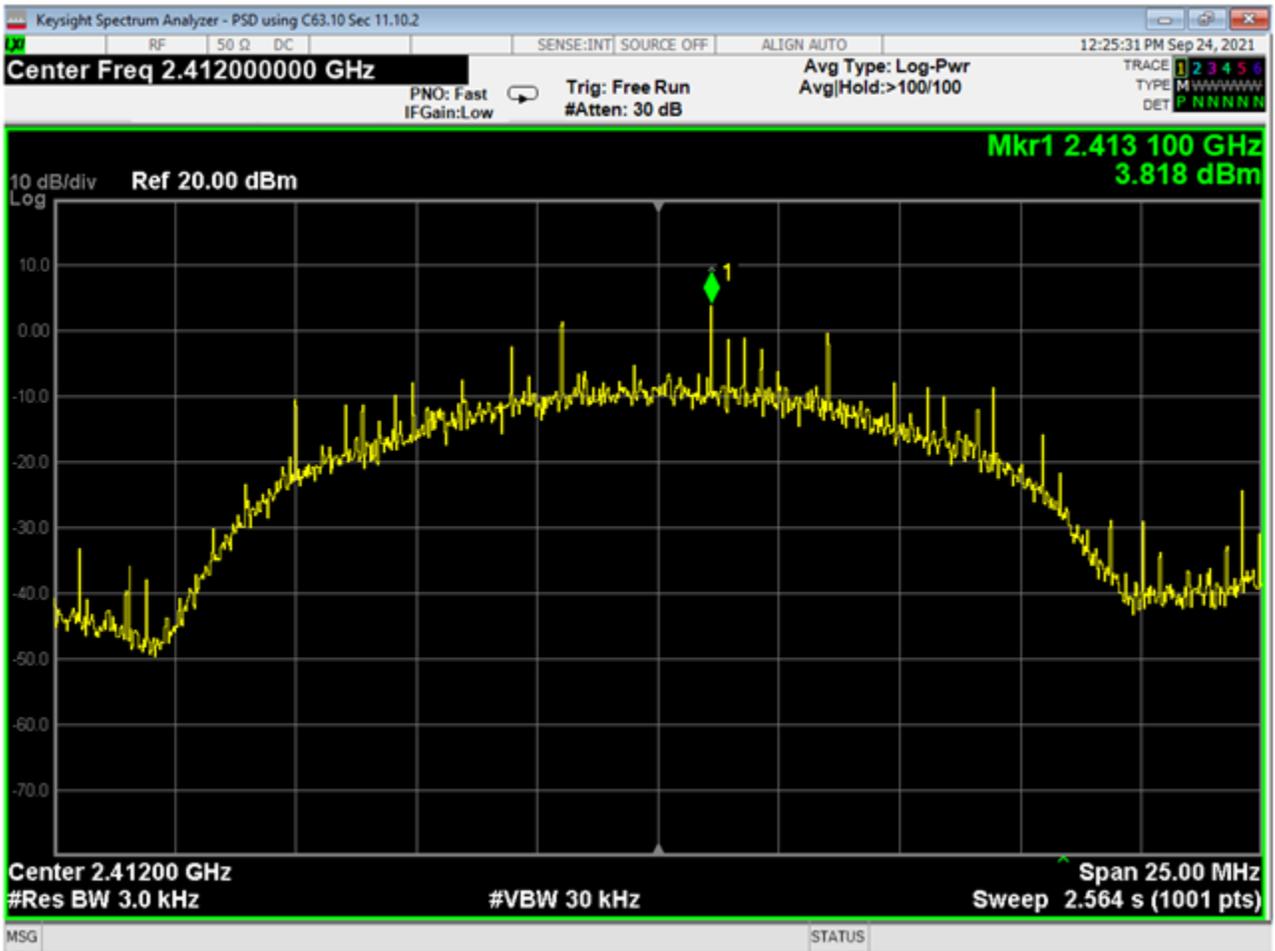
05 OBW-6dB, Mid, Wifi B



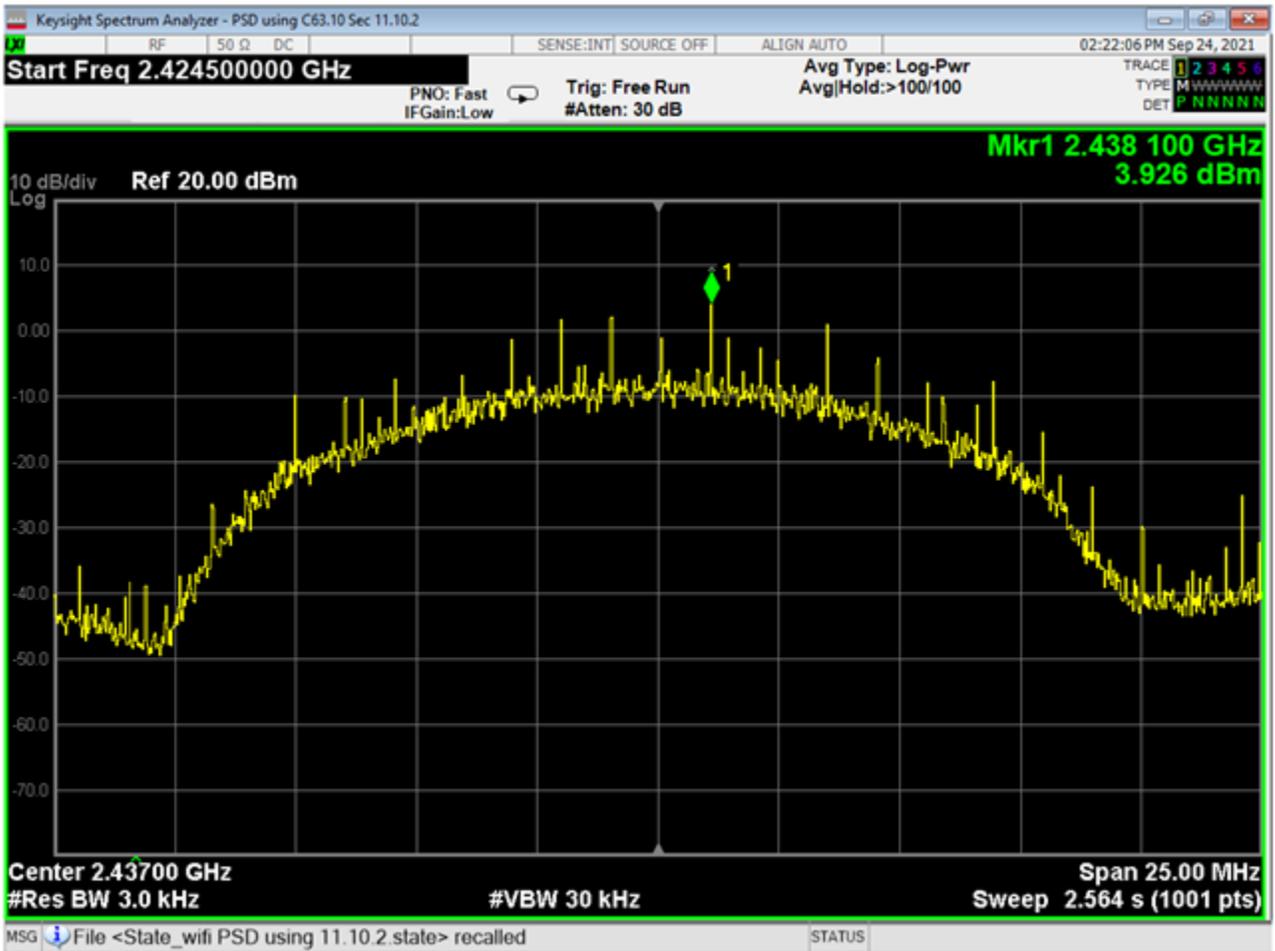
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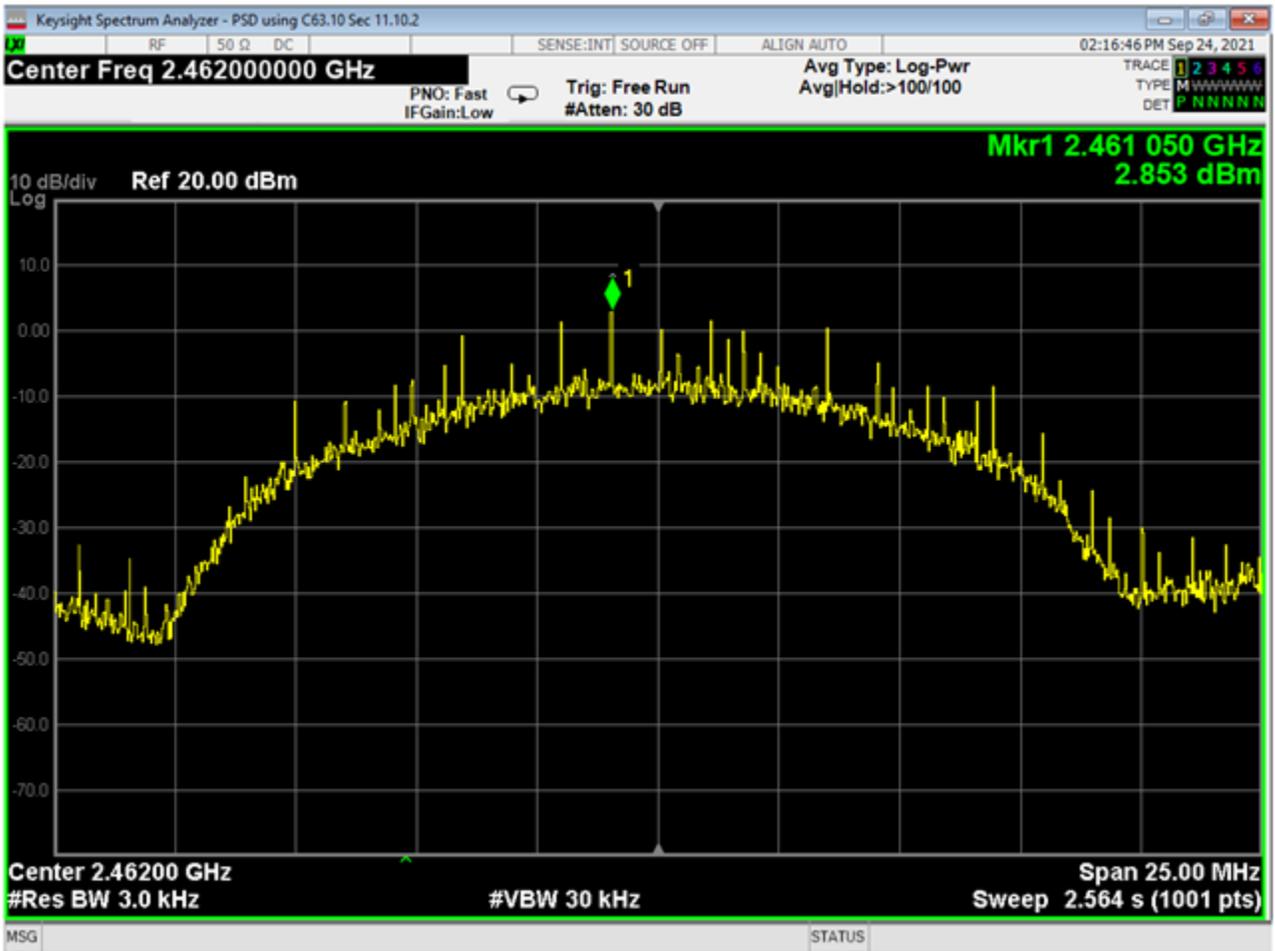
06 OBW-6dB, High, Wifi B



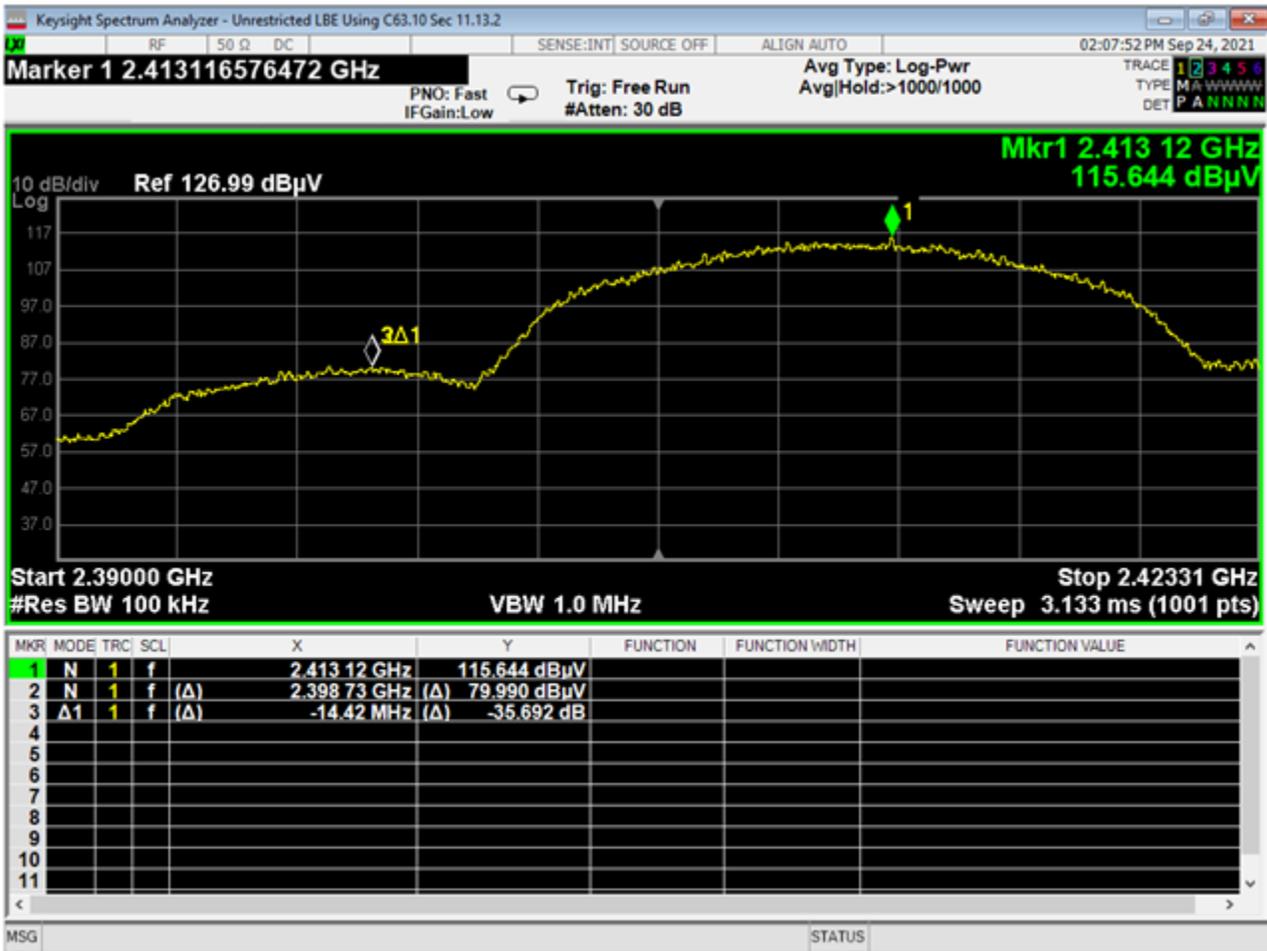
07 PSD, Low, Wifi B



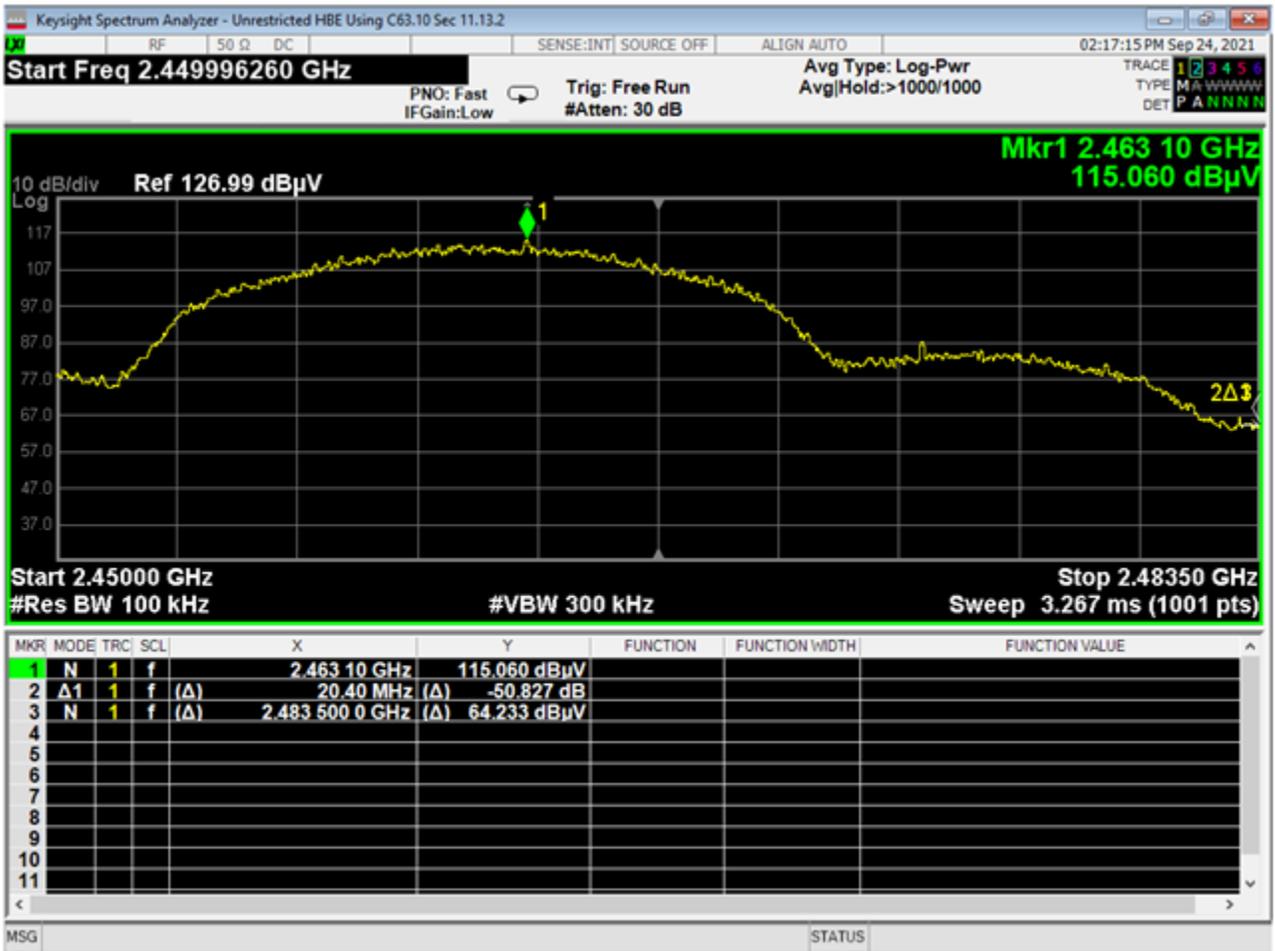
08 PSD, Mid, Wifi B



09 PSD, High, Wifi B



10 Lower Bandedge, Unrestricted, Wifi B



11 Higher Bandedge, Unrestricted, Wifi B



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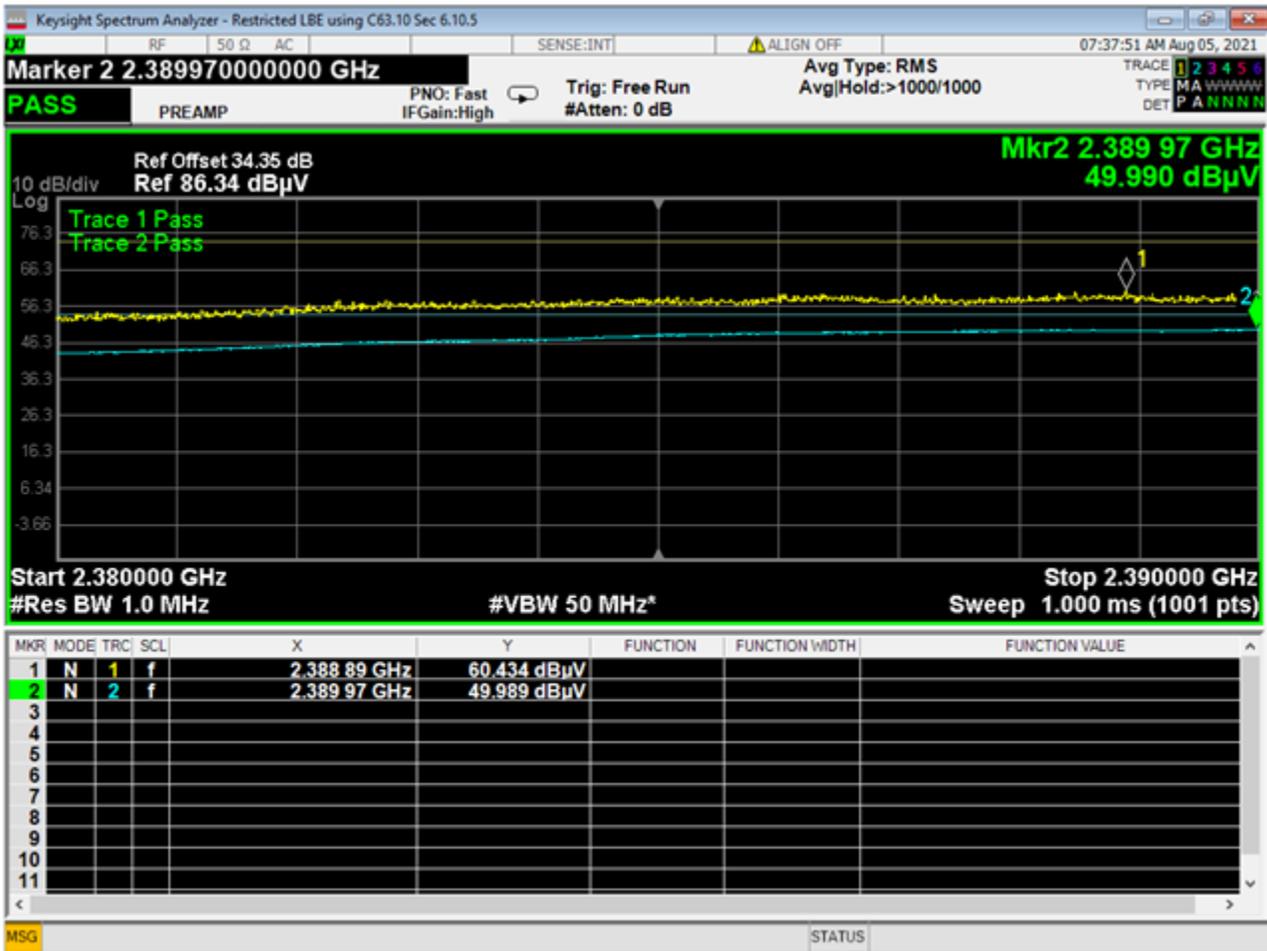
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12 Lower Bandedge, Wifi b, Restricted



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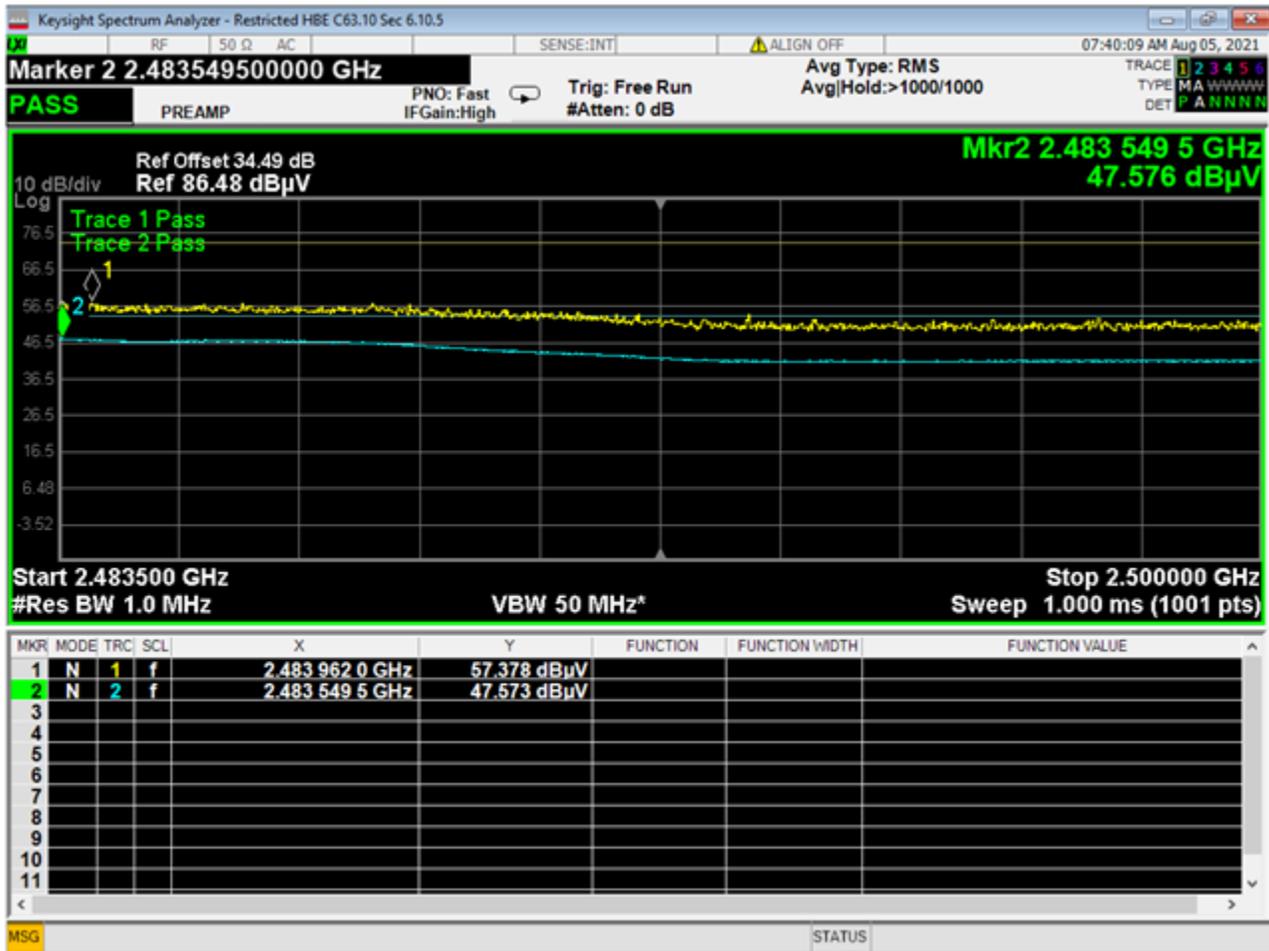
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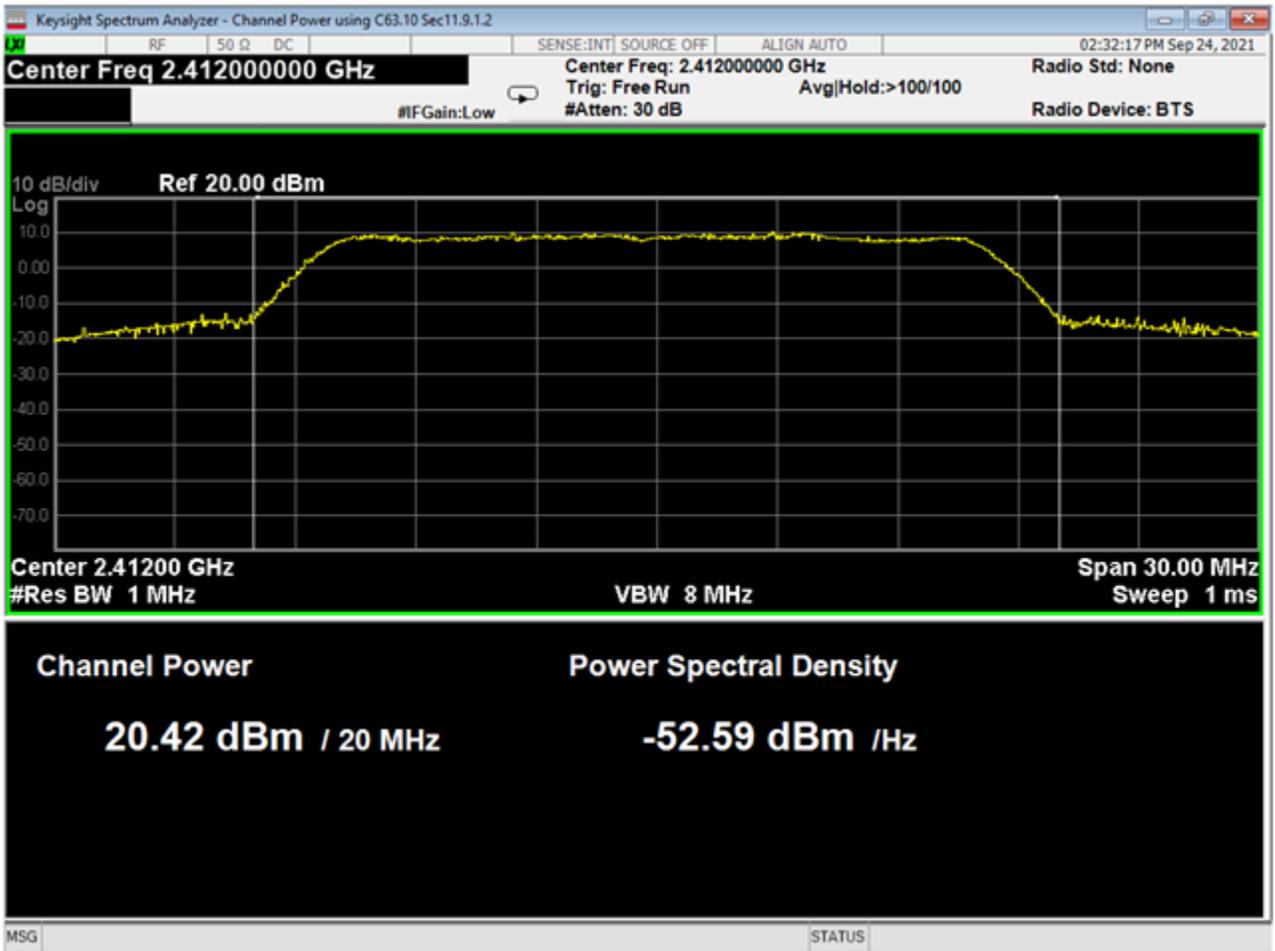
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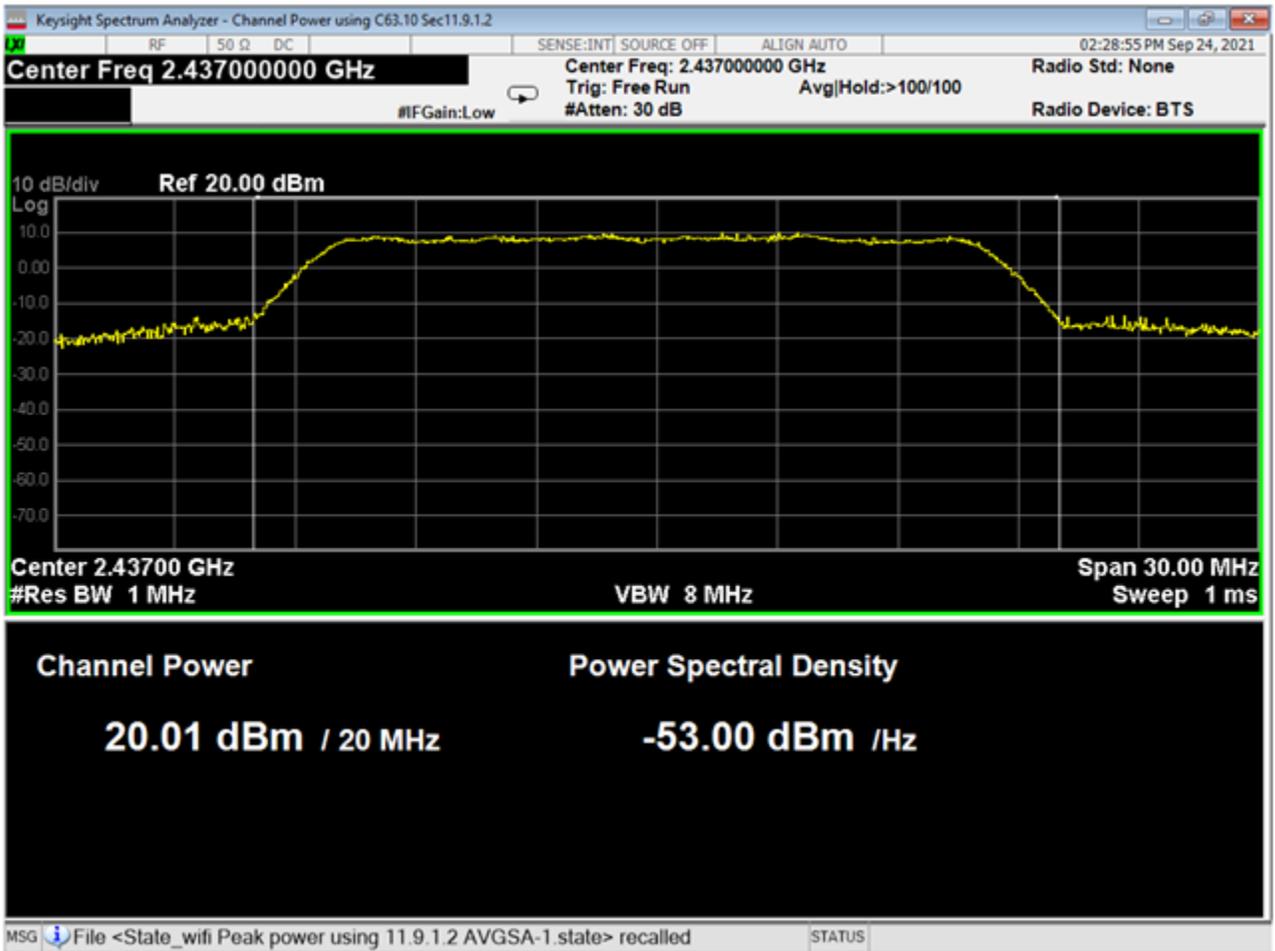
13 Higher Bandedge, Wifi b, Restricted



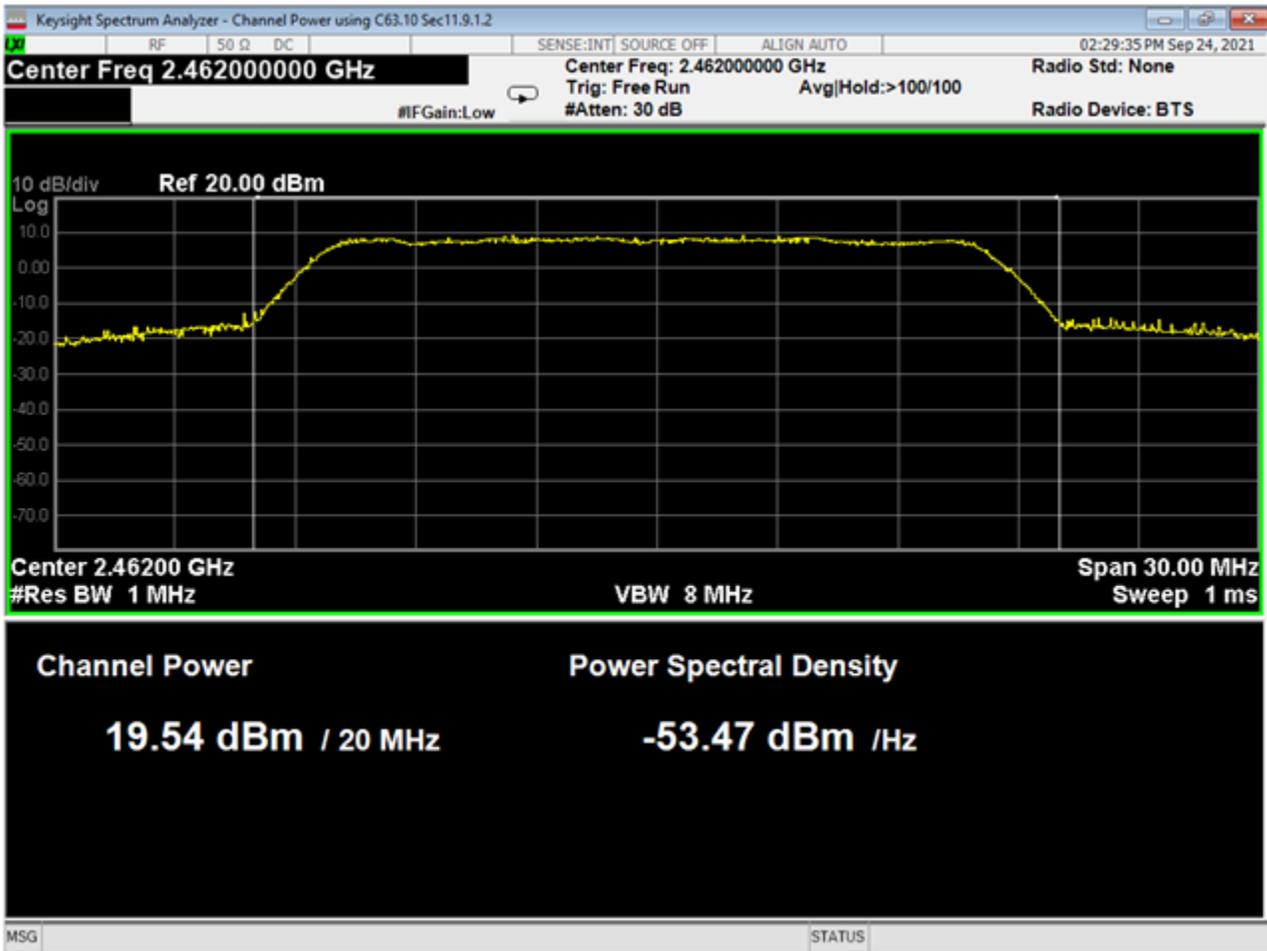
14 Pwr, Low, Wifi G



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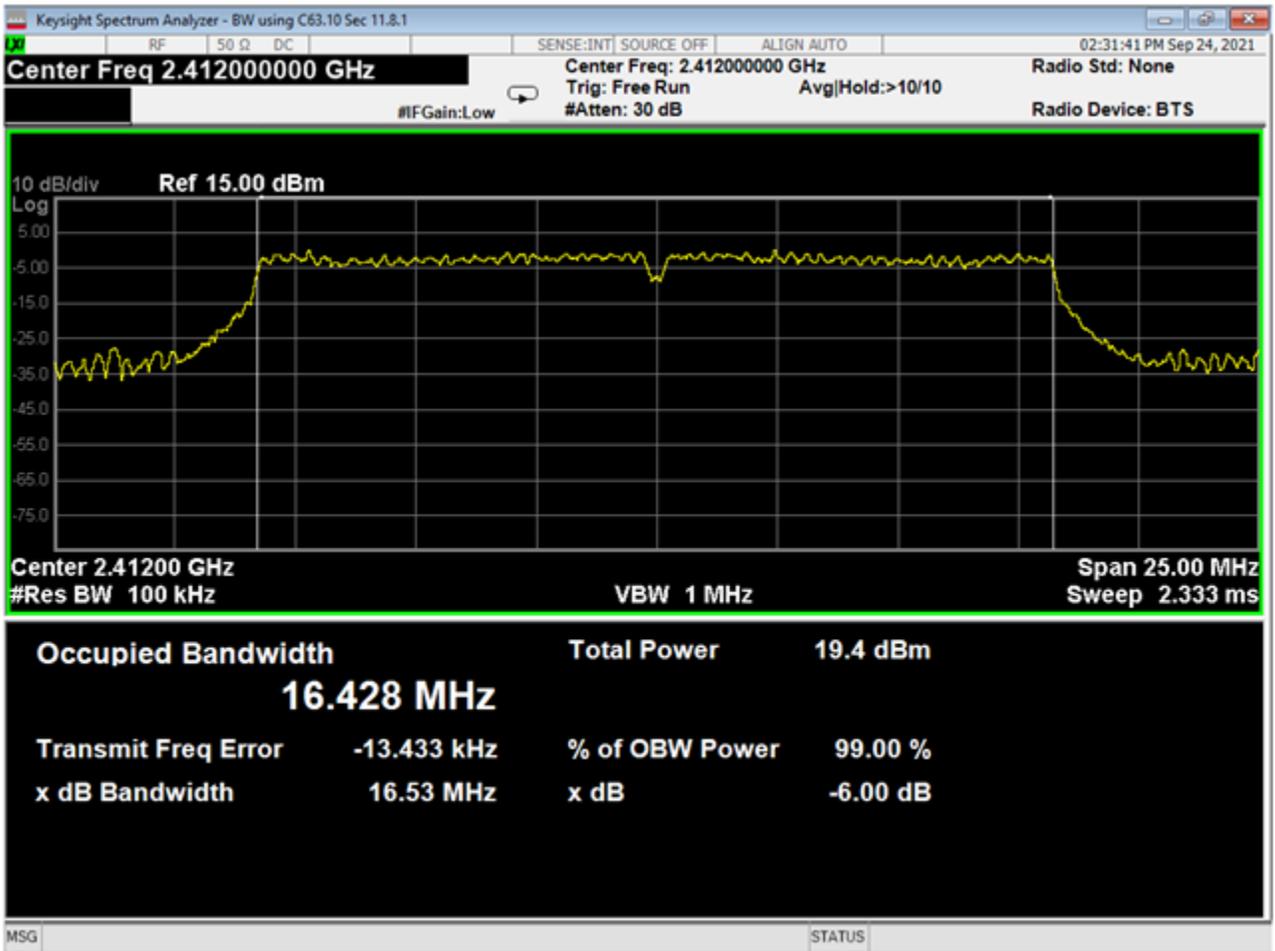
15 Pwr, Mid, Wifi G



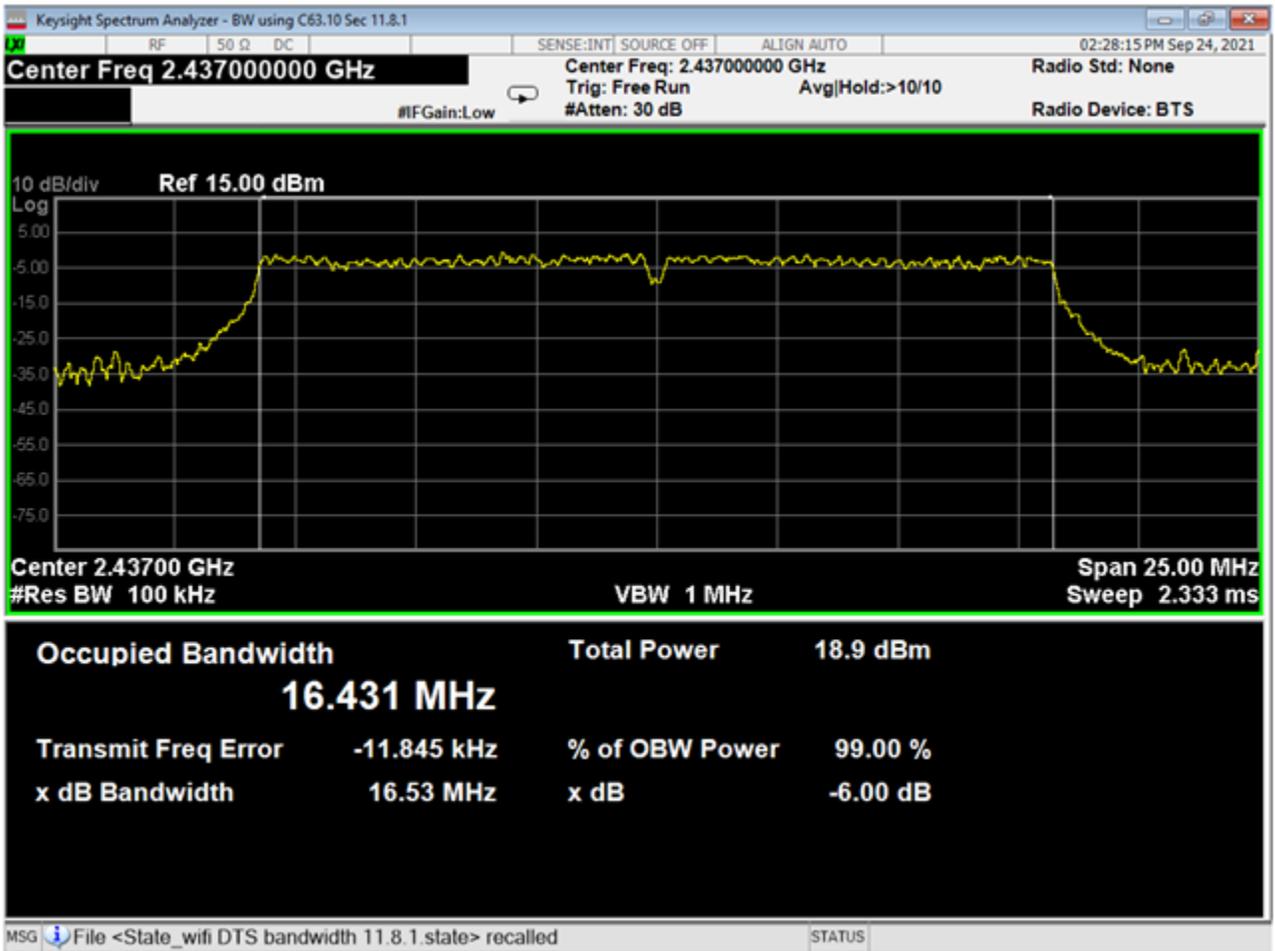
16 Pwr, High, Wifi G



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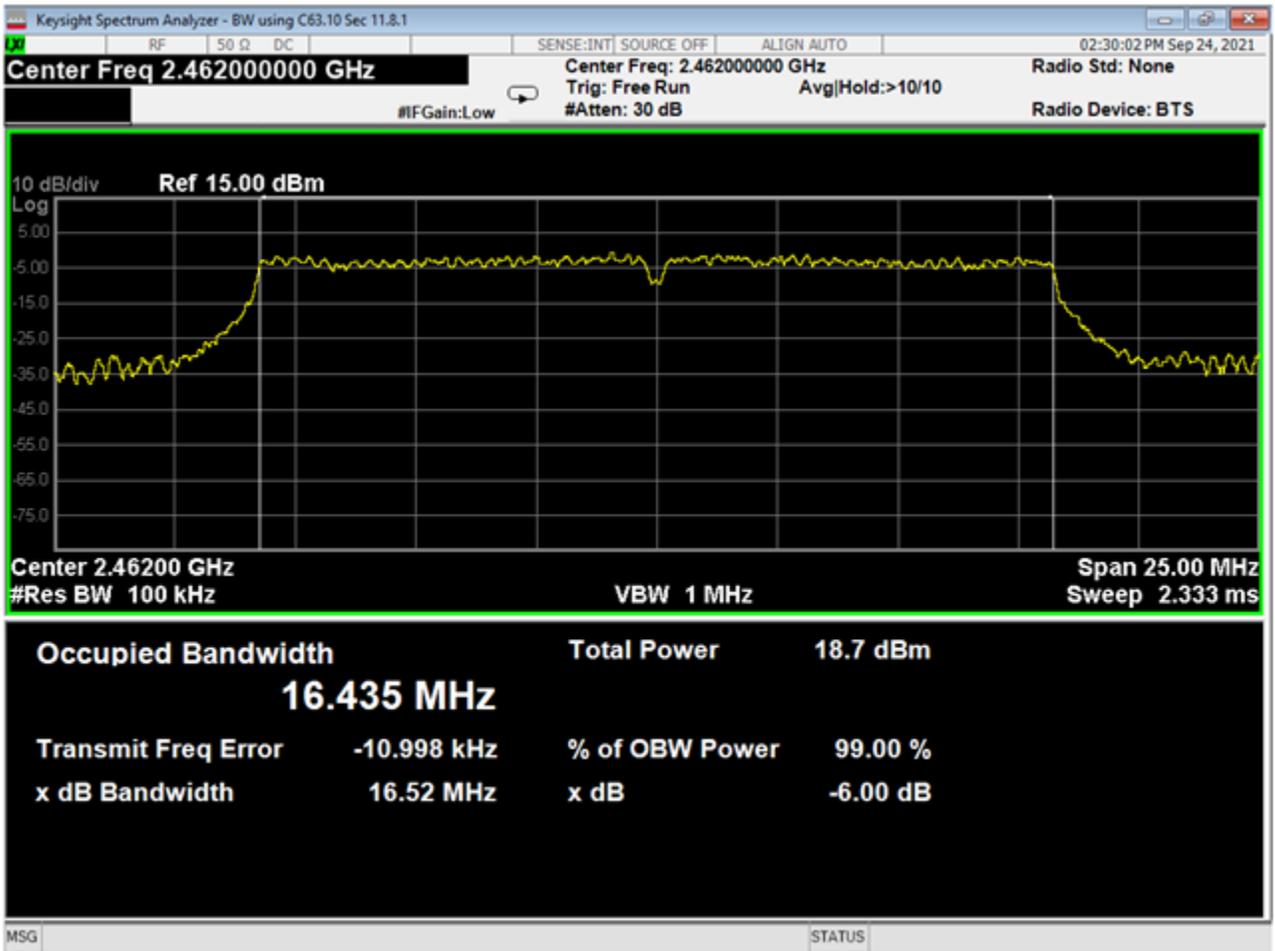
17 OBW-6dB, Low, Wifi G



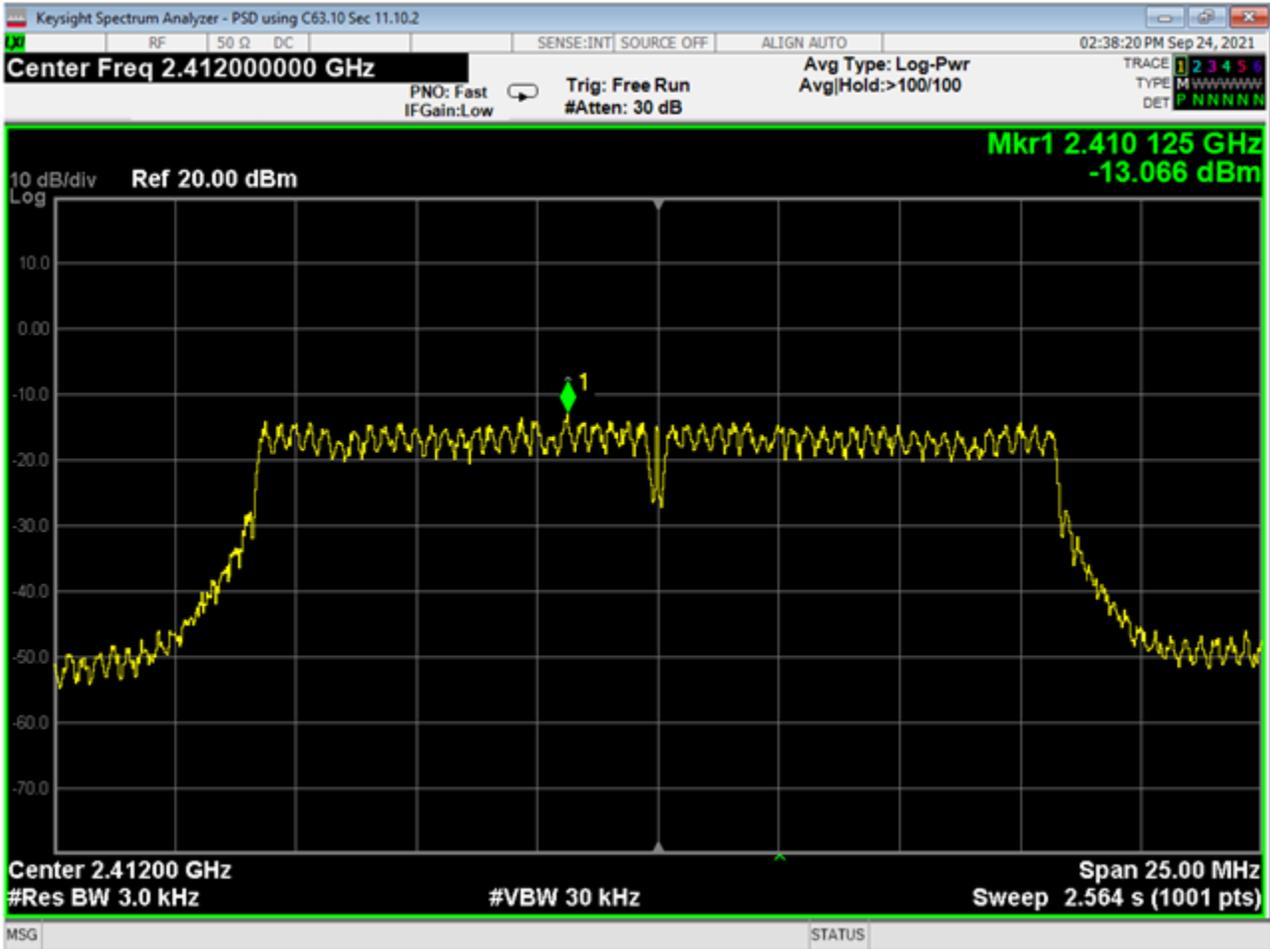
18 OBW-6dB, Mid, Wifi G



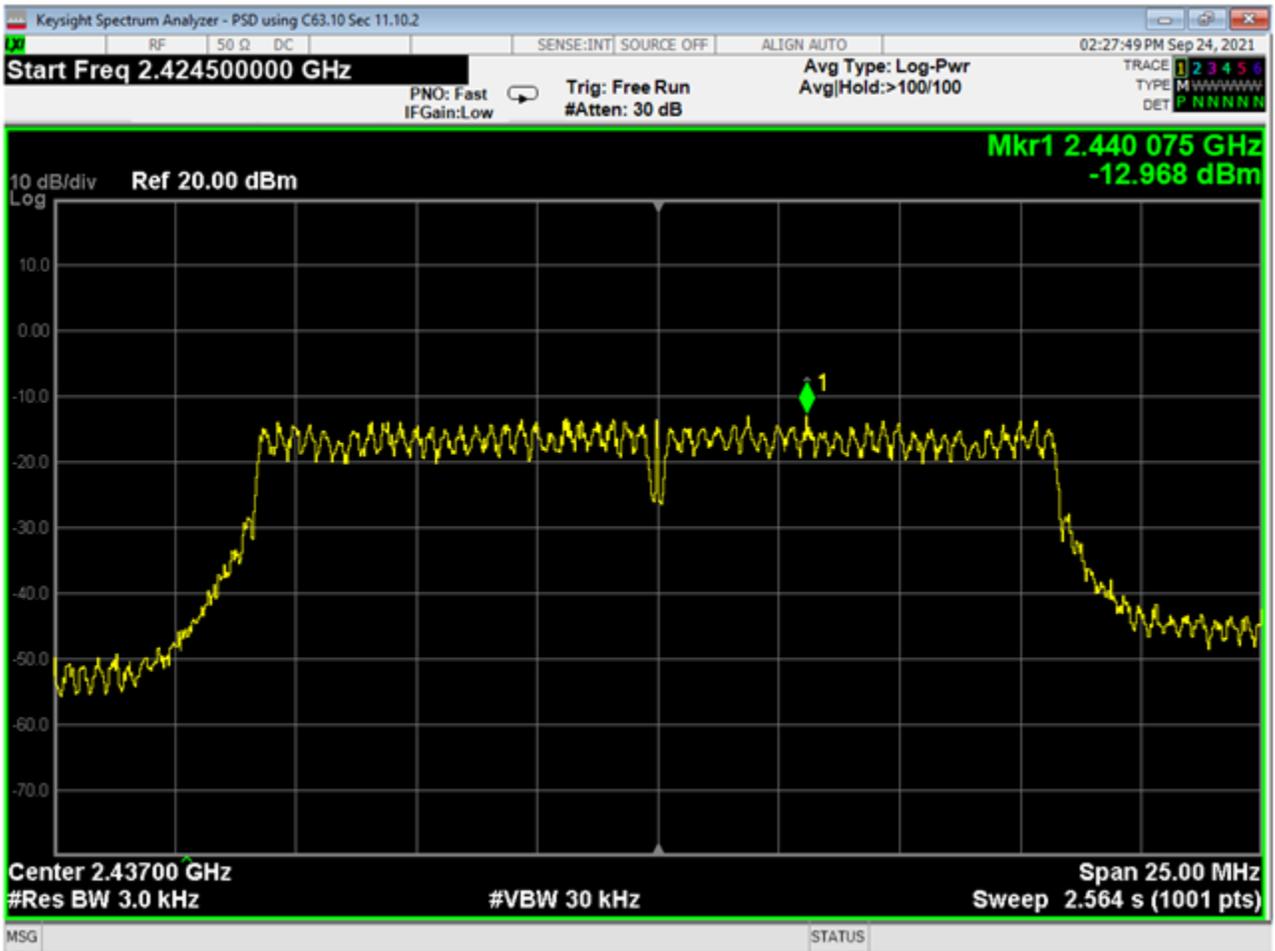
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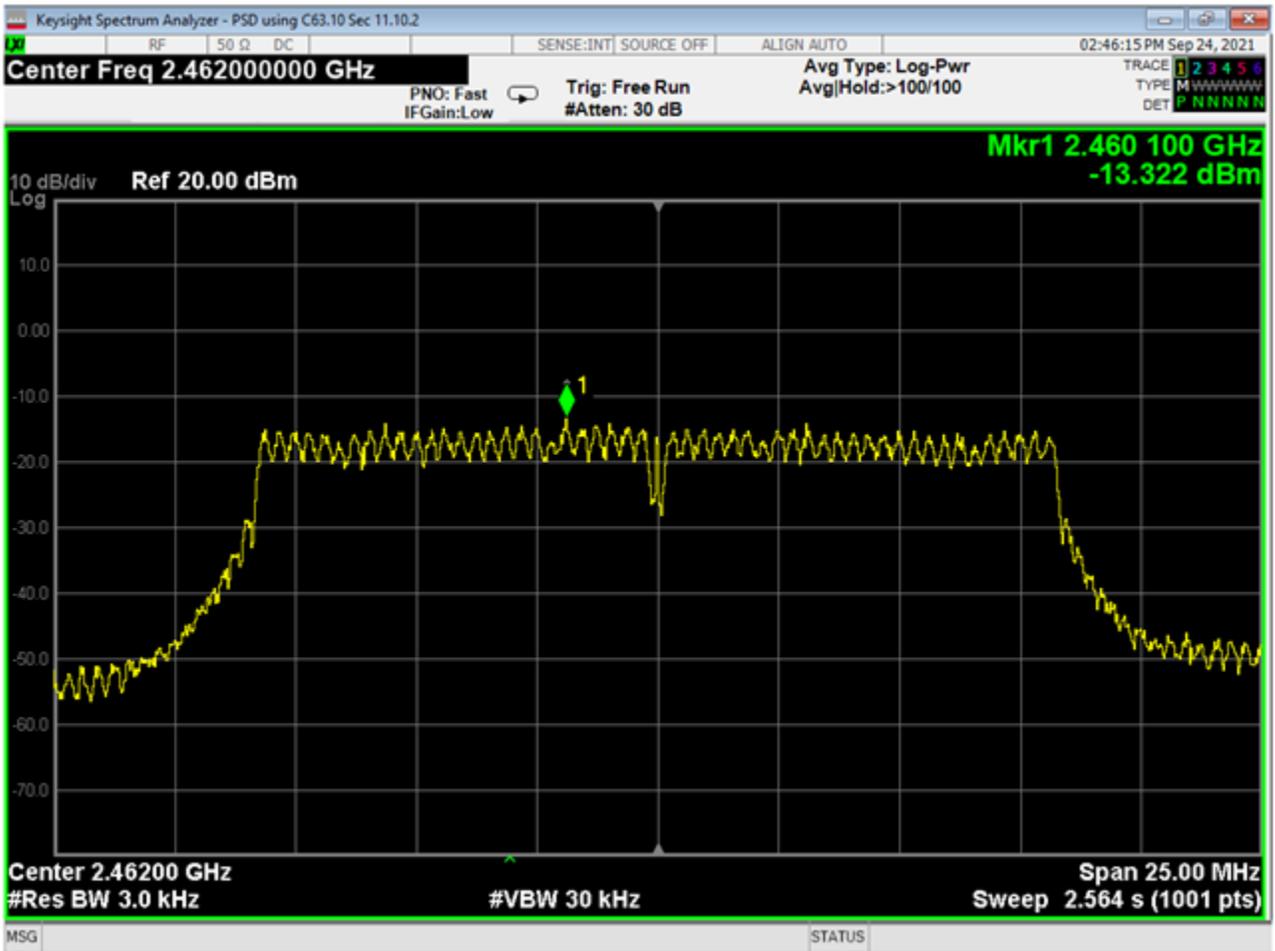


19 OBW-6dB, High, Wifi G

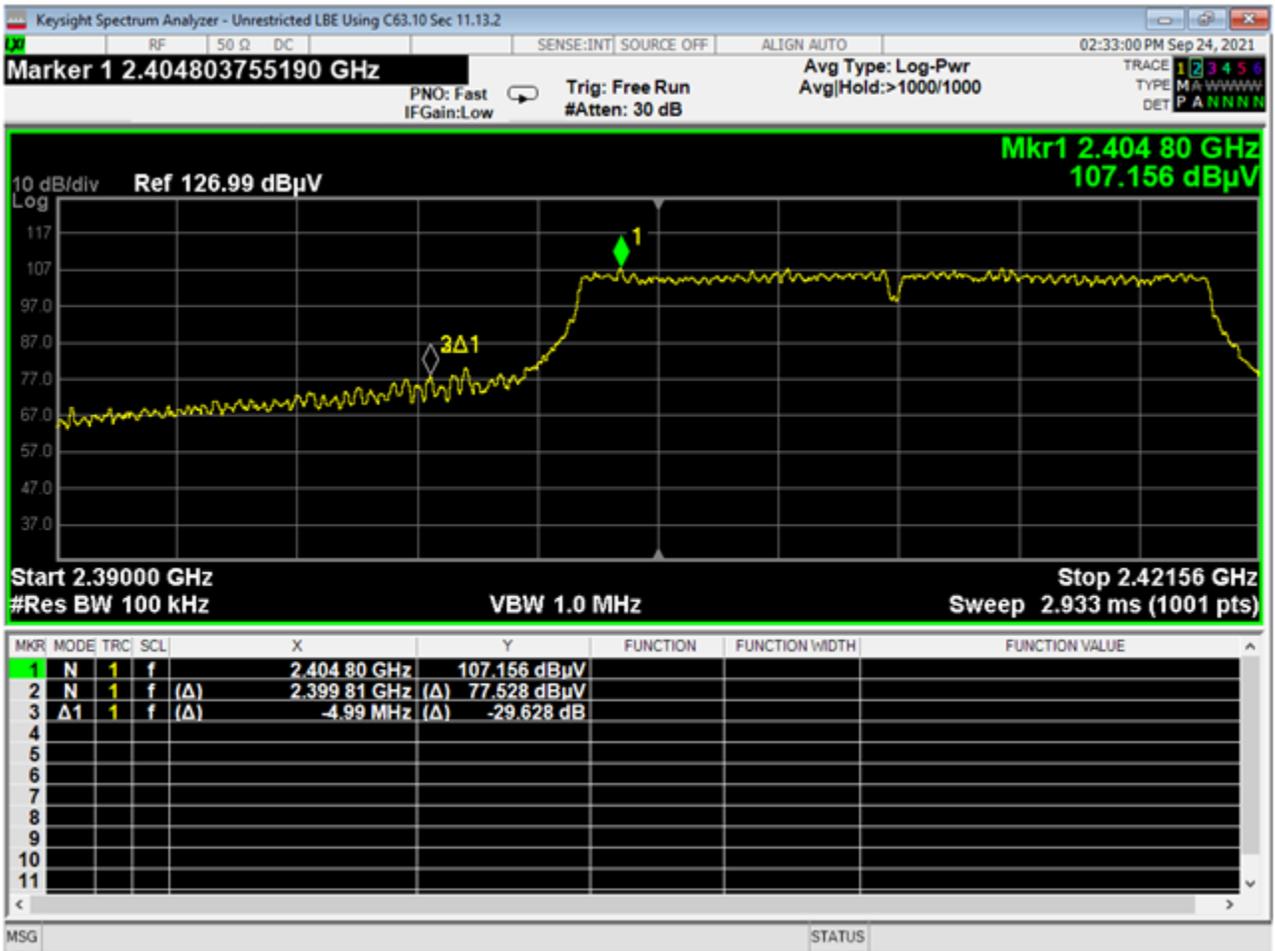


20 PSD, Low, Wifi G

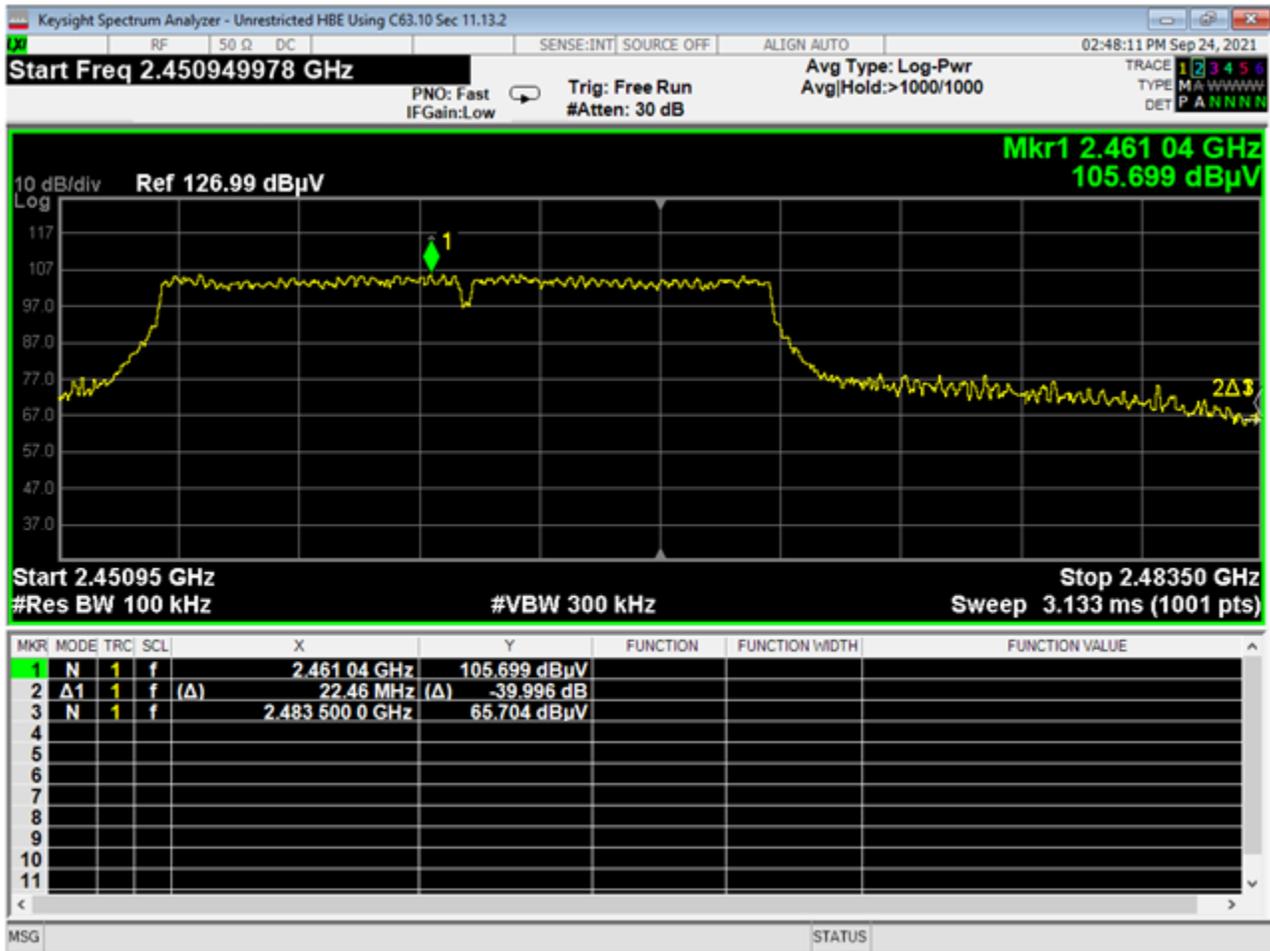




22 PSD, High, Wifi G



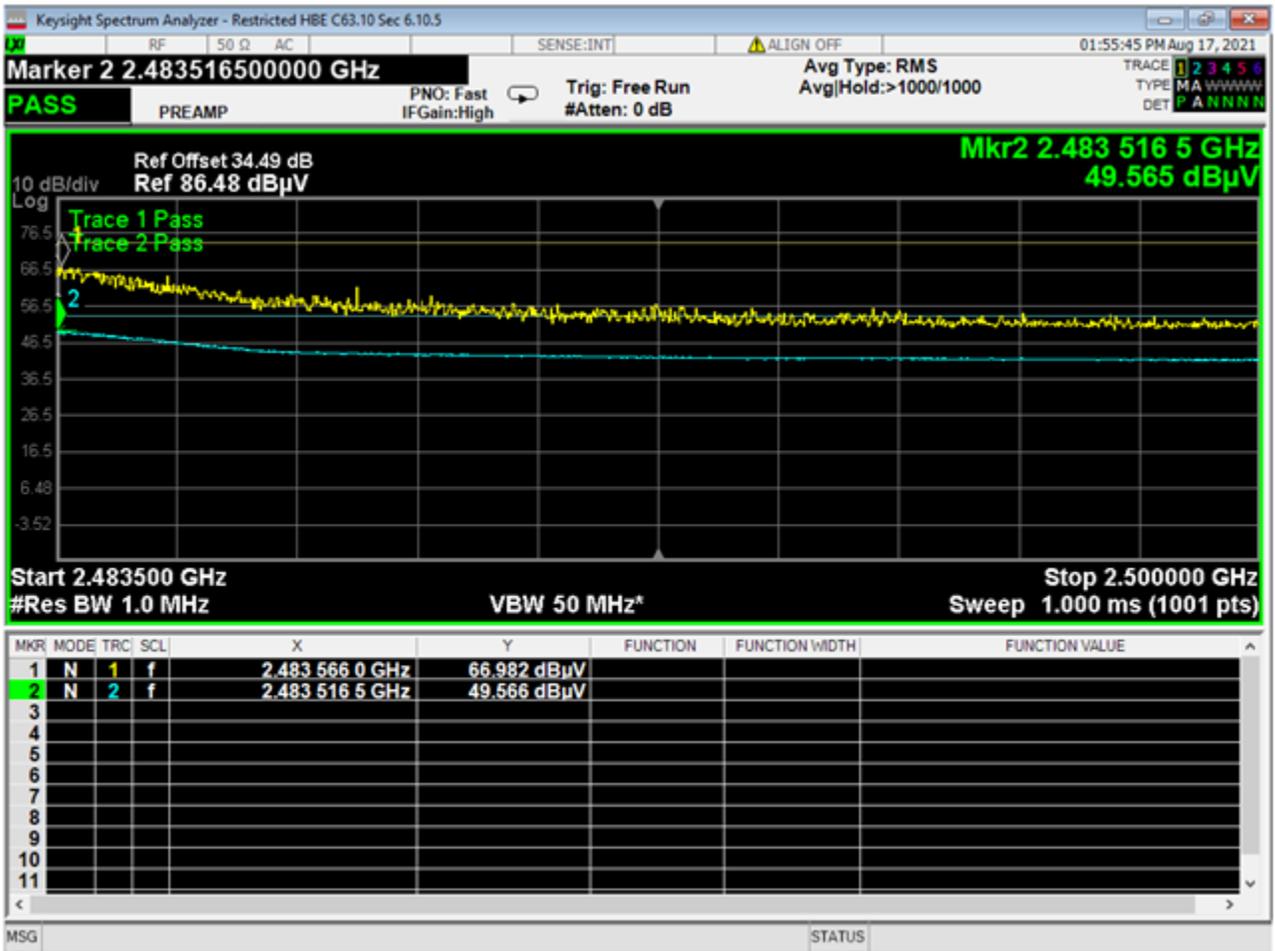
23 Lower Bandedge, Unrestricted, Wifi G



24 Higher Bandedge, Unrestricted, Wifi G



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25 Higher Bandedge, Restricted, Wifi G



Report Number:

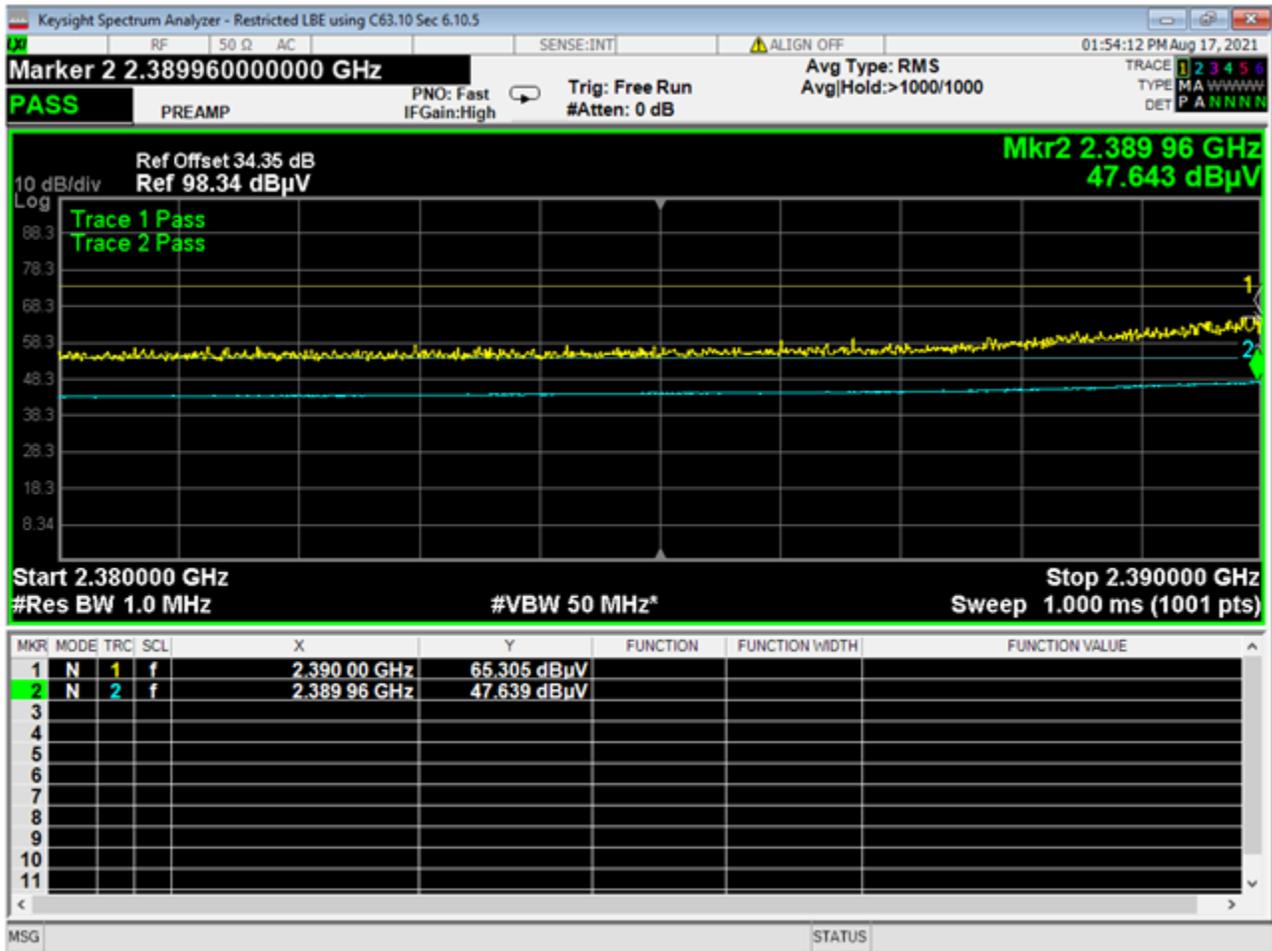
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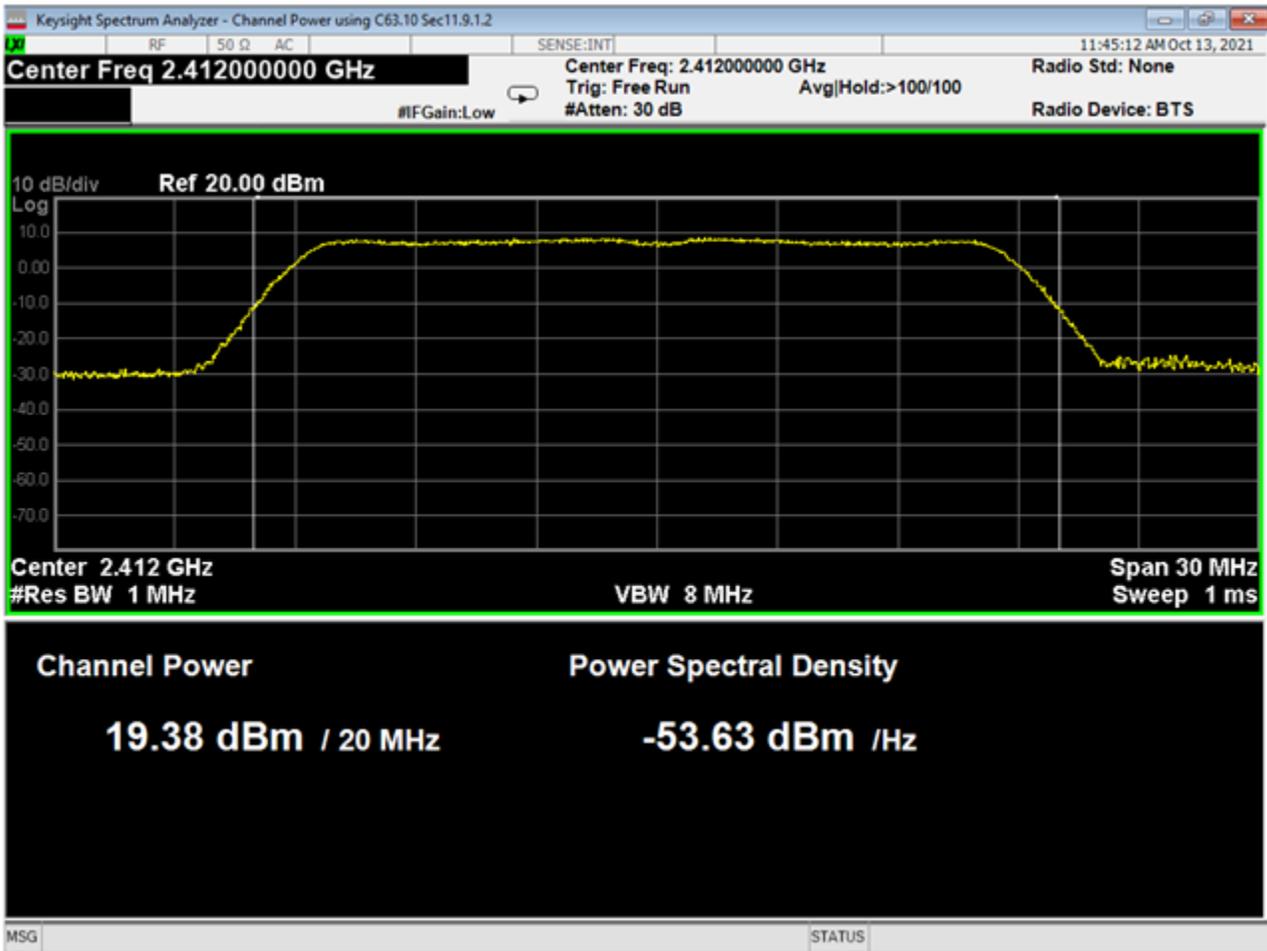
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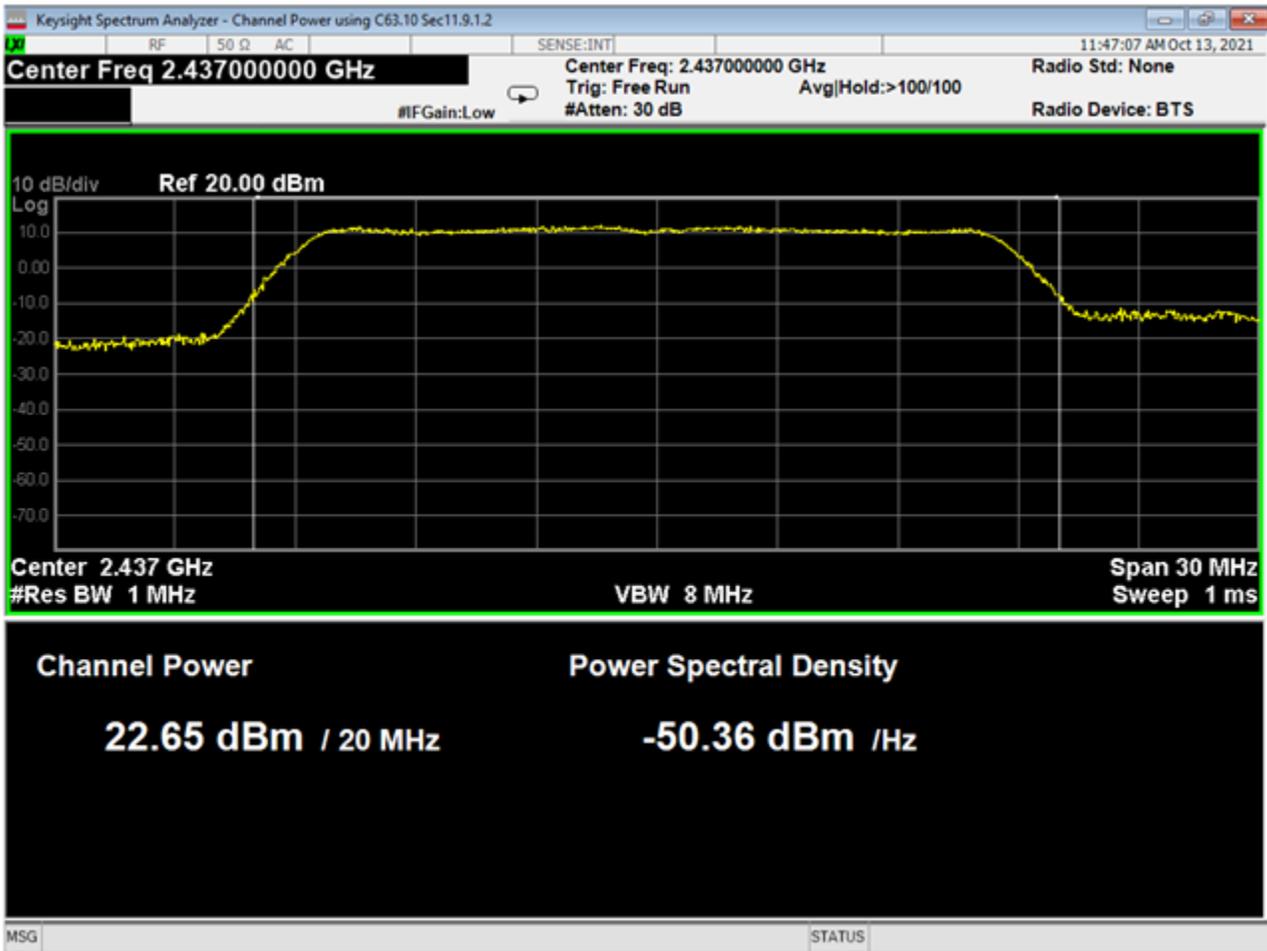
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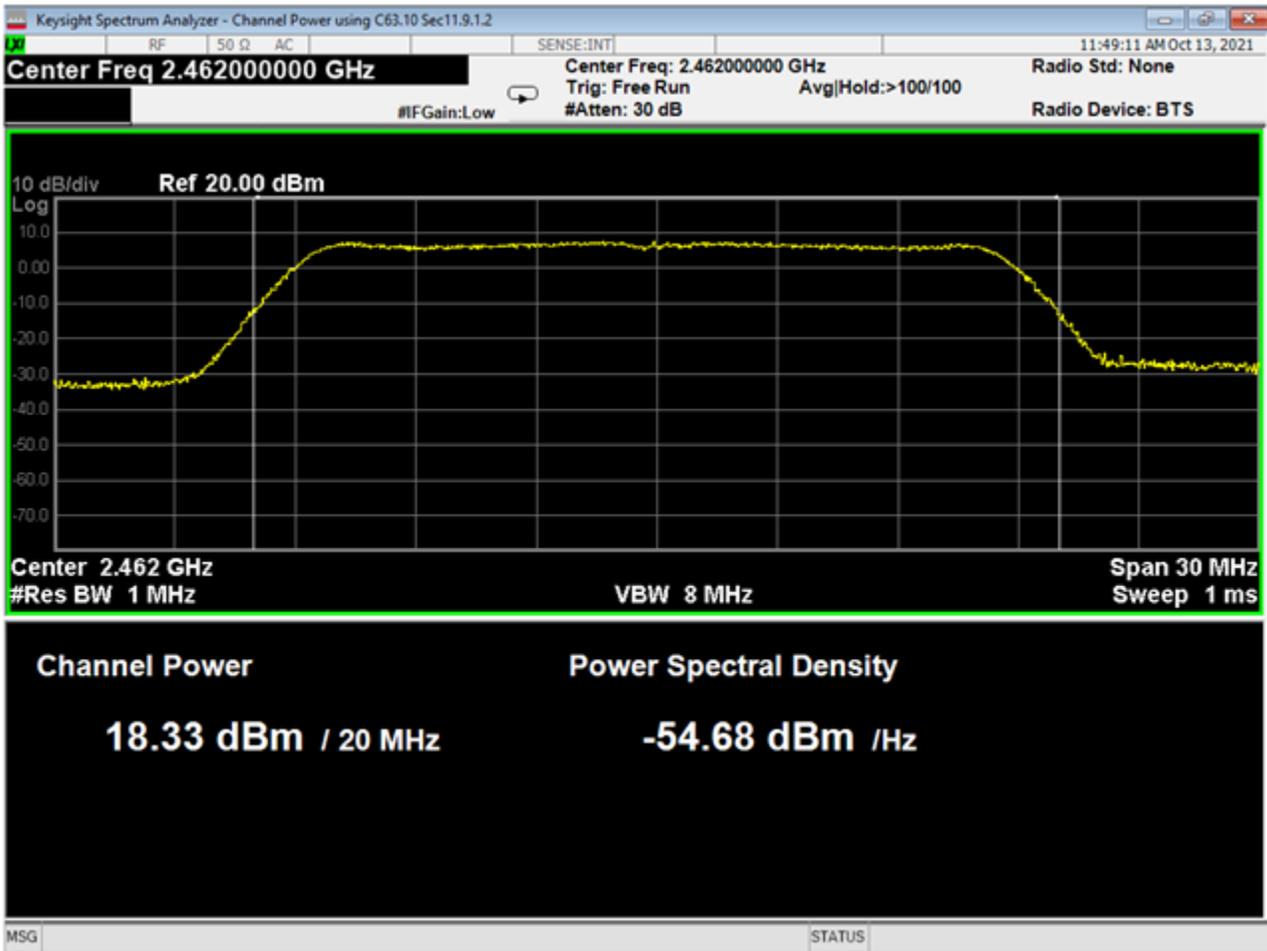
26 Lower Bandedge, Restricted, Wifi G



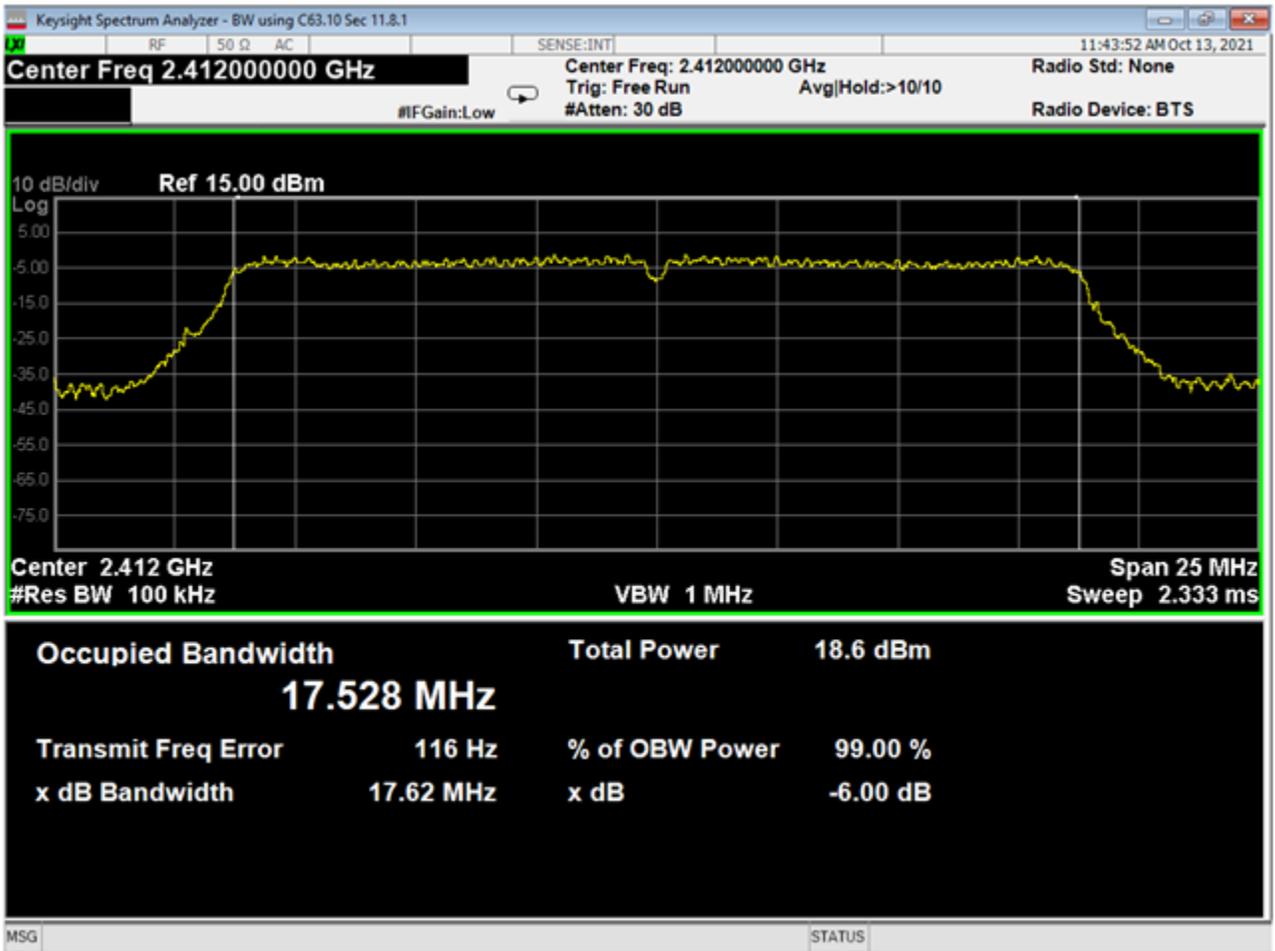
27 Power, Low, Wifi N



28 Power, Mid, Wifi N



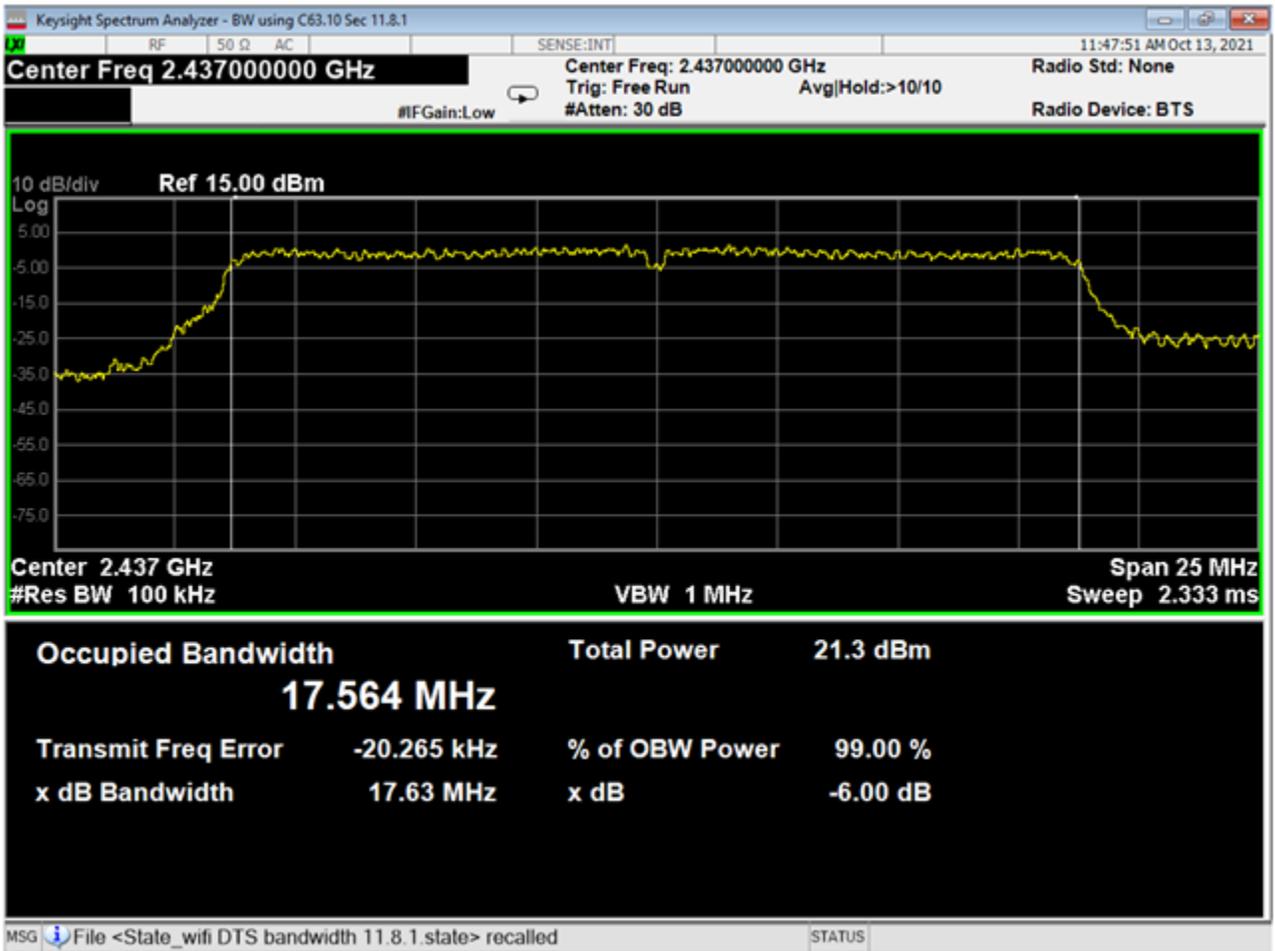
29 Power, High, Wifi N



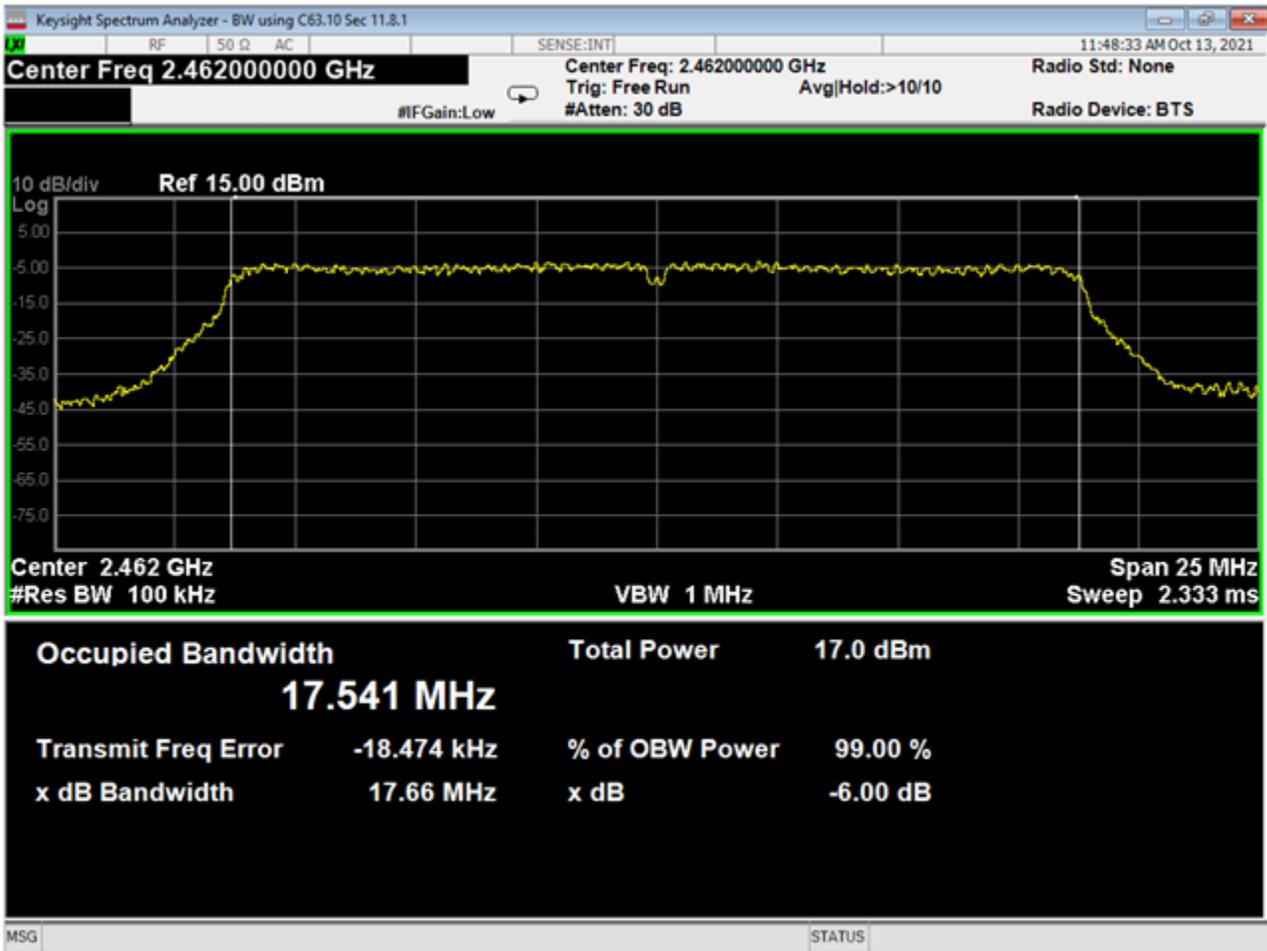
30 OBW-6dB, Low, Wifi N



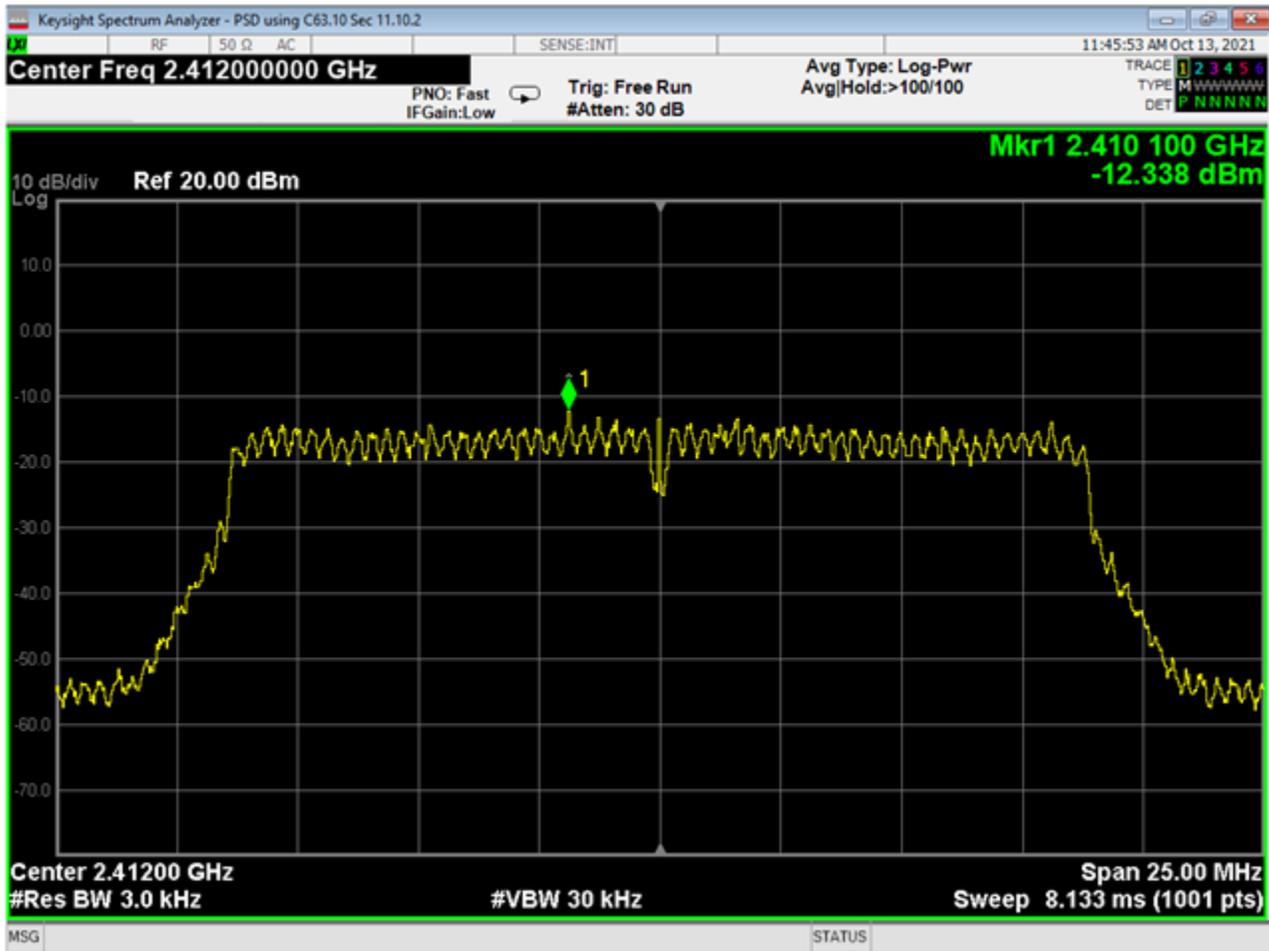
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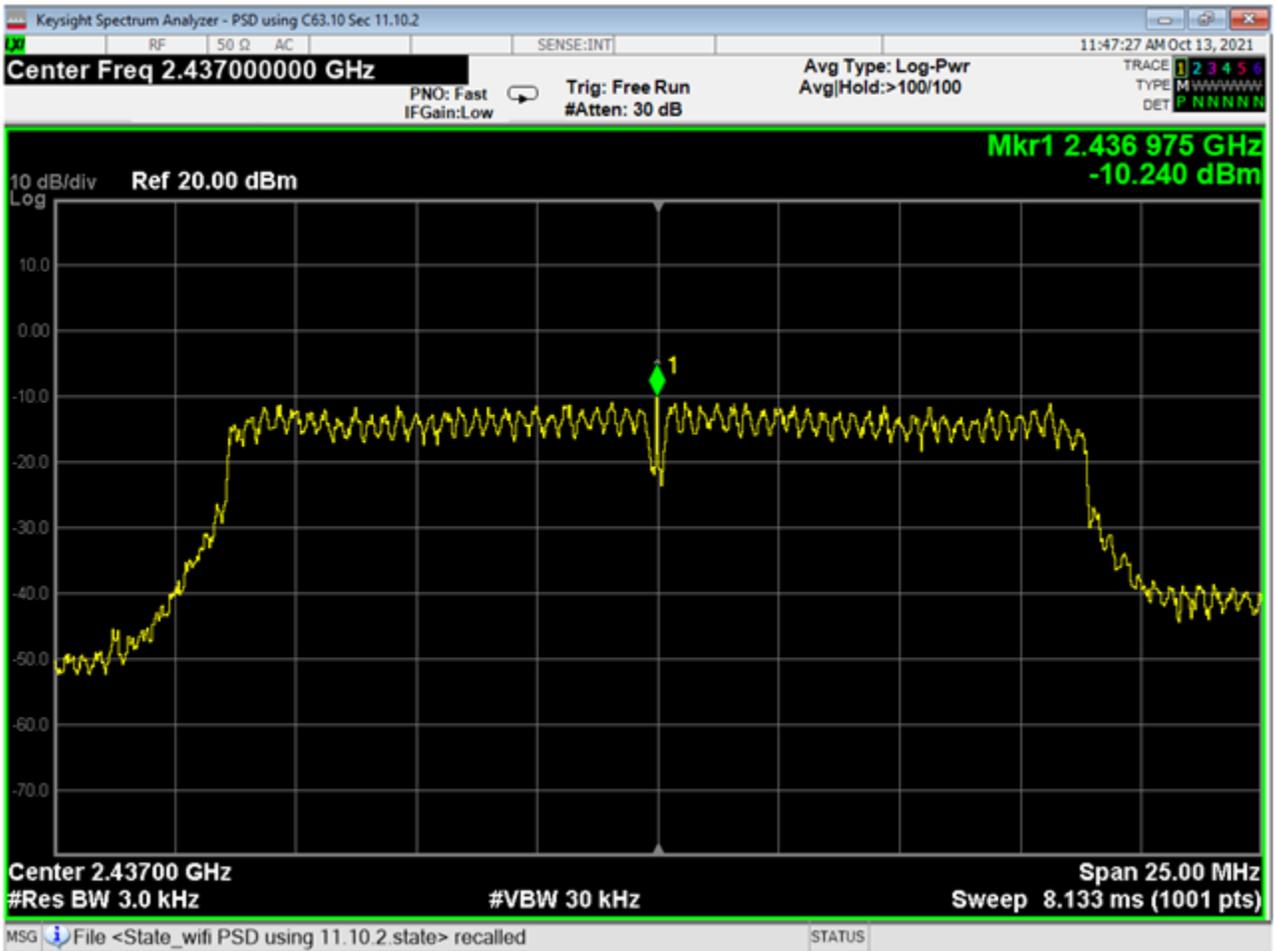
31 OBW-6dB, Mid, Wifi N



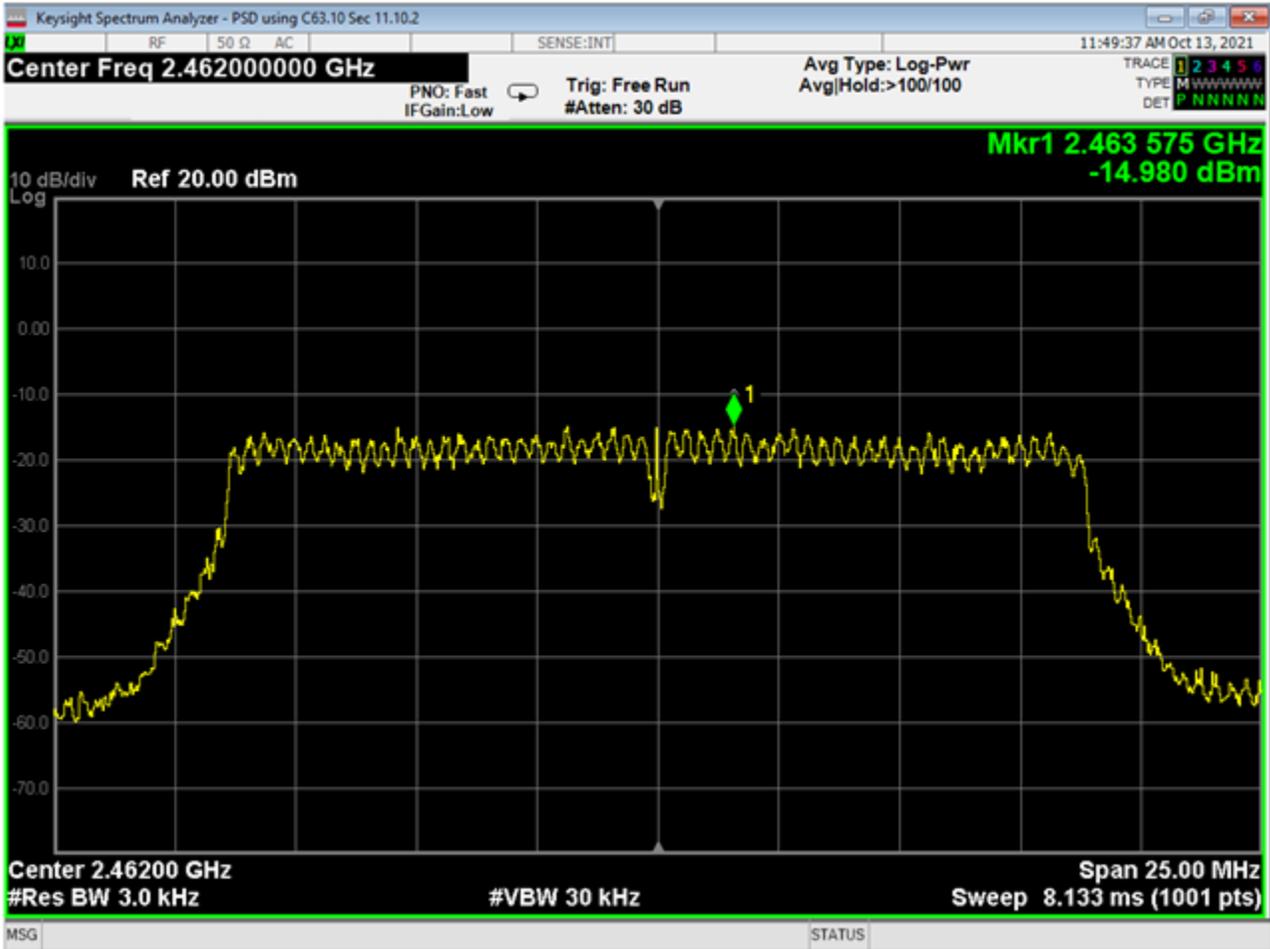
32 OBW-6dB, High, Wifi N



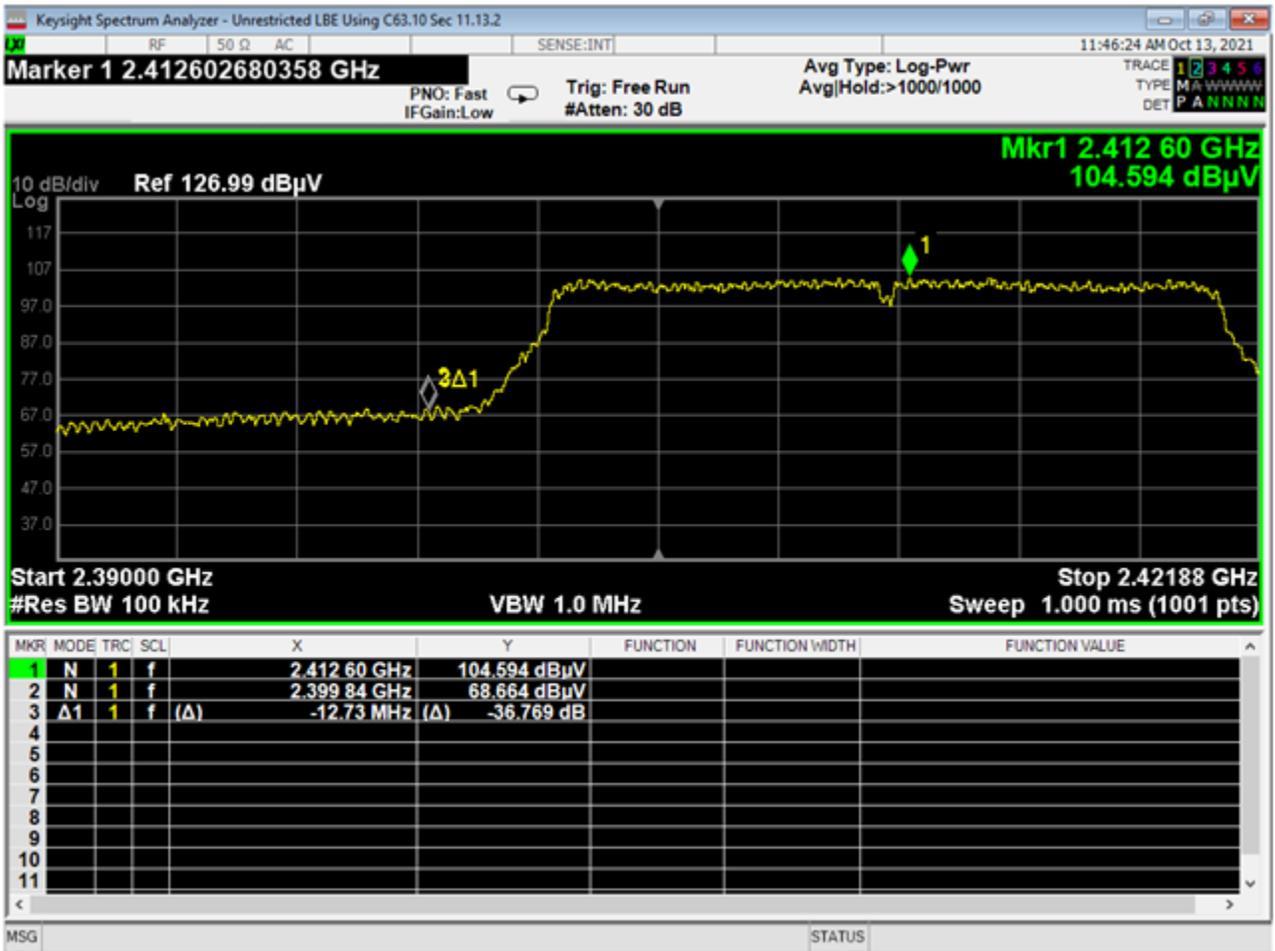
33 PSD, Low, Wifi N



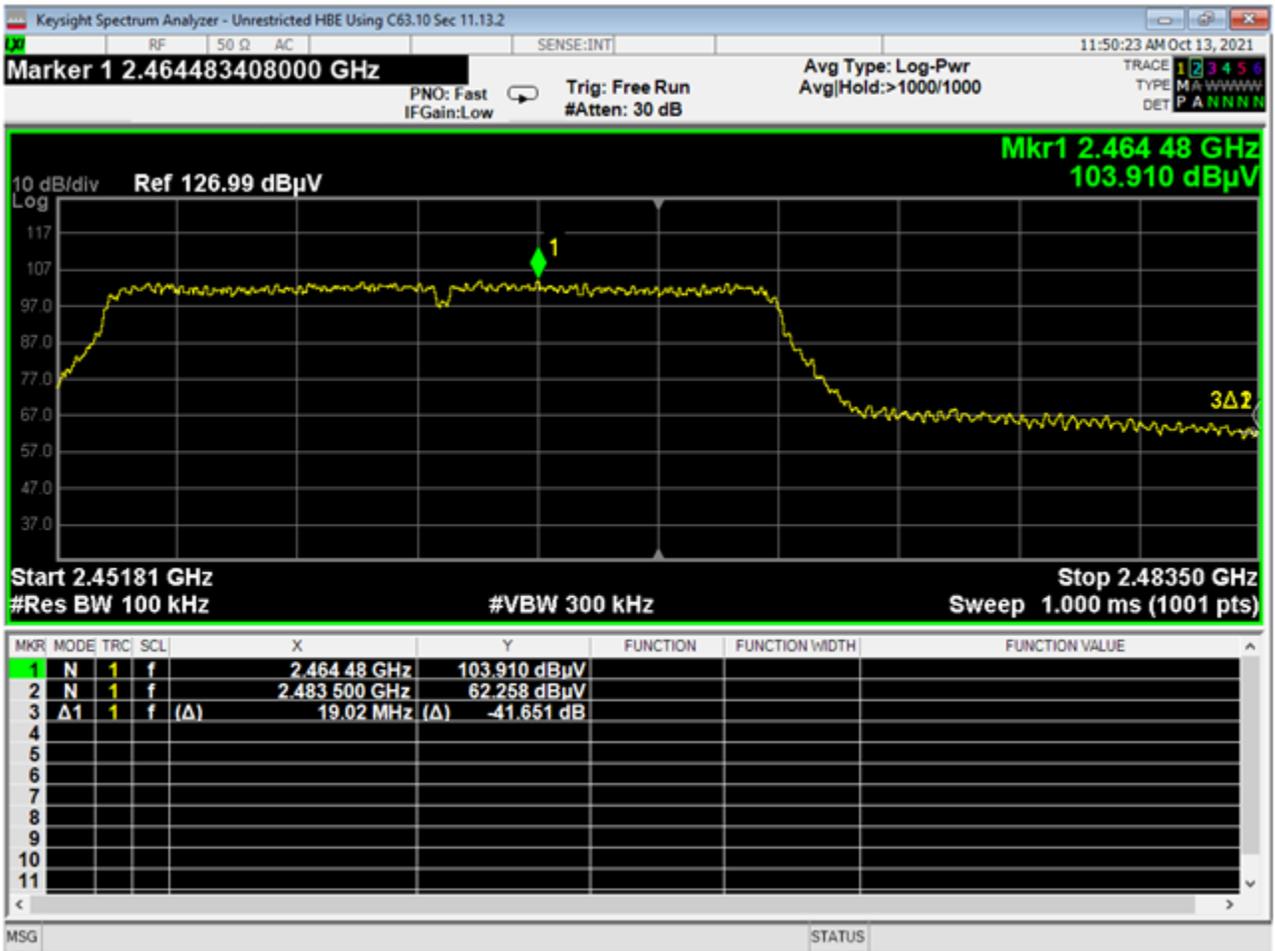
34 PSD, Mid, Wifi N



35 PSD, High, Wifi N



36 Lower Bandedge, Unrestricted, Wifi N



37 Higher Bandedge, Unrestricted, Wifi N



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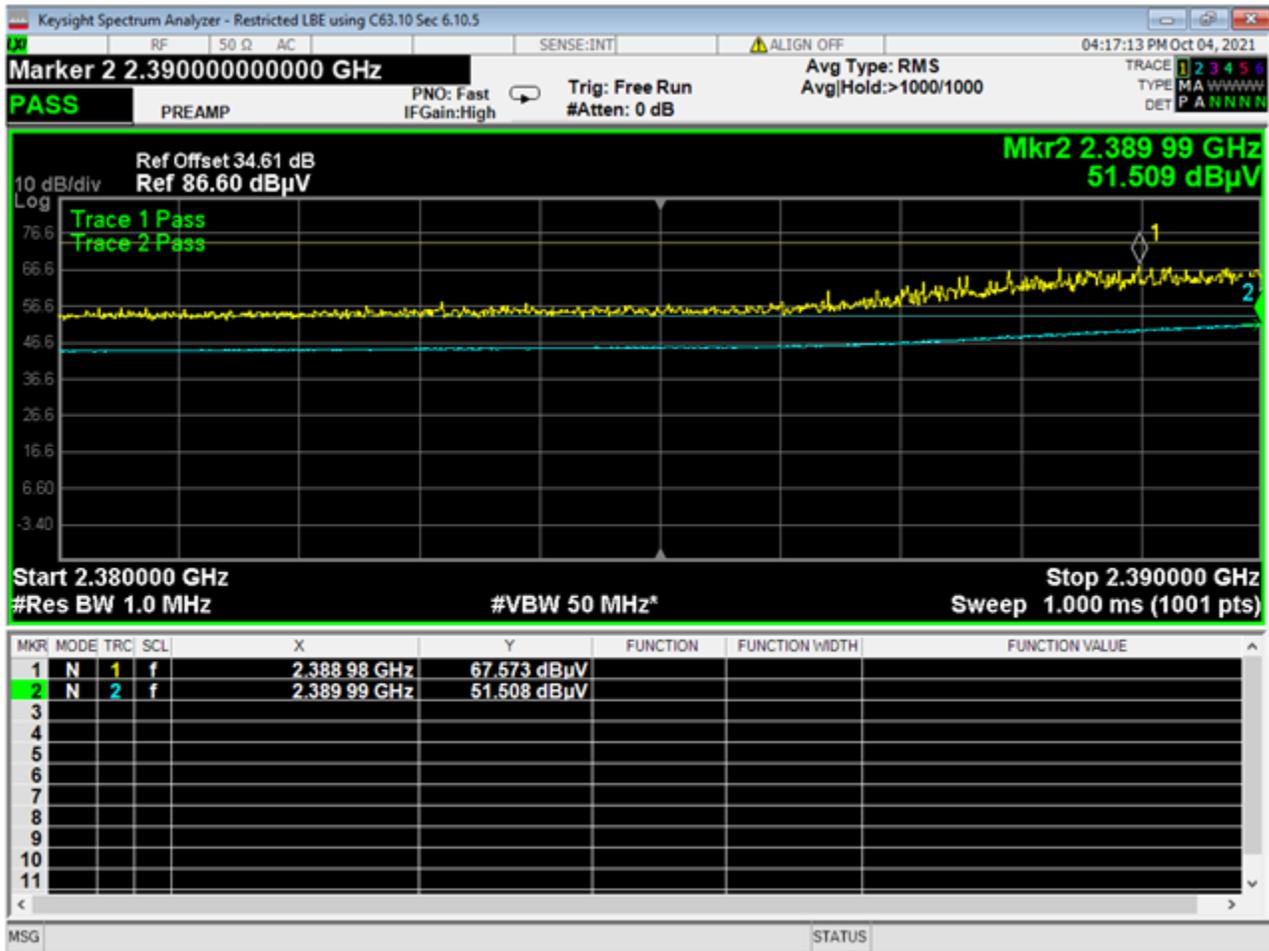
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38 Lower Bandedge, Restricted, Wifi N



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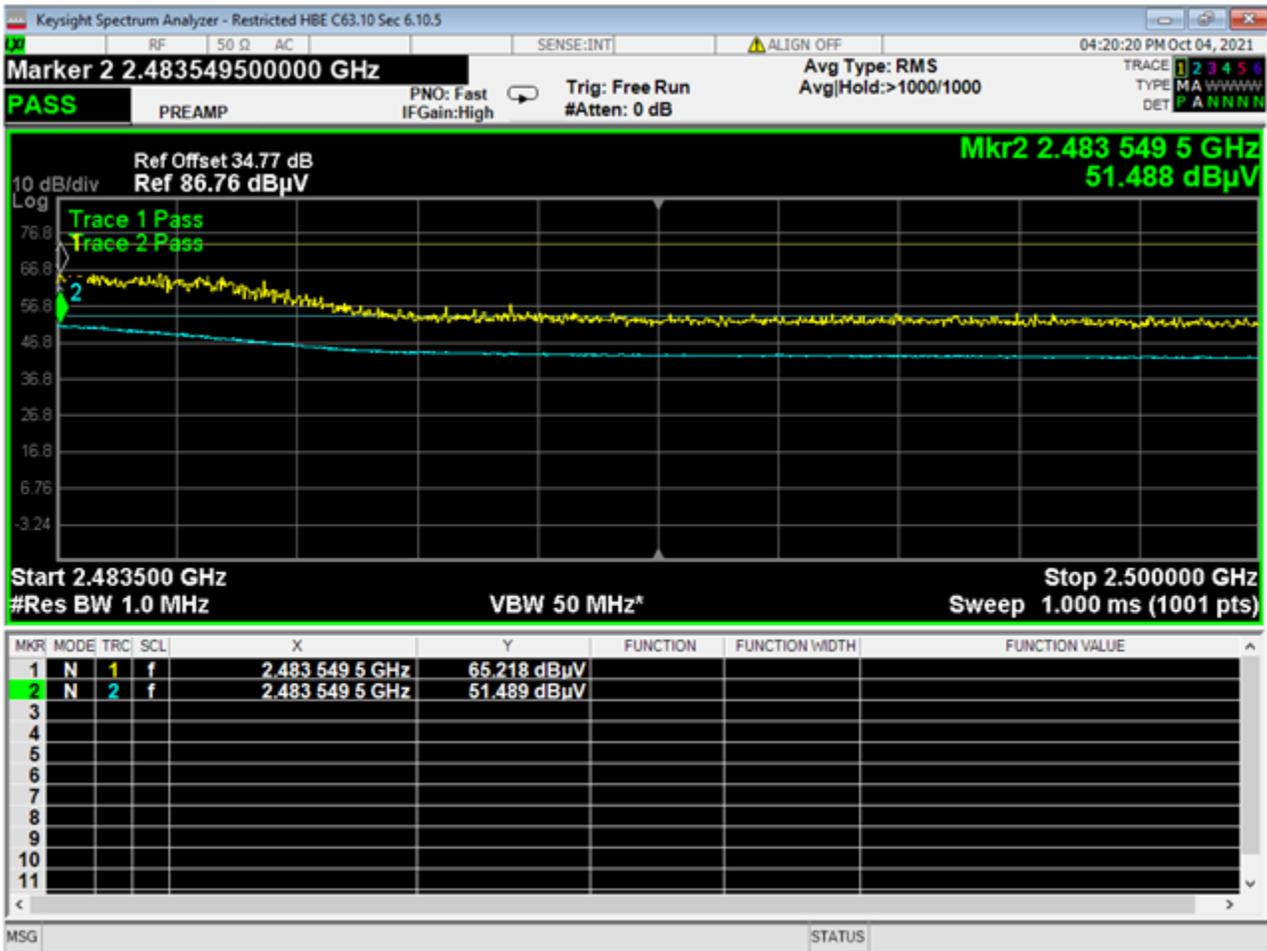
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39 Higher Bandedge, Restricted, Wifi N



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