

FCC/ISED Test Report

Prepared for: Garmin International, Inc.

Address: 1200 E. 151st Street
Olathe, Kansas, 66062, USA

Product: A04252

Test Report No: R20210128-20-E28

Approved by:



Mahendra Karthik Vepuri, NCE

EMC Test Engineer,

iNARTE Certified EMC Engineer #EMC-041453-E

DATE: December 8, 2021

Total Pages: 77

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REVISION PAGE

| Rev. No. | Date | Description |
|-----------------|-----------------|--|
| 0 | 8 December 2021 | Original – KVeuri Prepared by FLane |



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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:

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 | A04252 |
| EUT Received | 9 March 2021 |
| EUT Tested | 9 March 2021- 3 December 2021 |
| Serial No. | 3388435202 (Conducted Unit) 3388435284 (Radiated Unit) |
| 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.

Power Settings used:

| Modulation | Low | Mid | High |
|------------|-----|-----|------|
| 802.11b | 42 | 42 | 42 |
| 802.11g | 42 | 42 | 42 |
| 802.11n | 35 | 42 | 31 |

2.3 DESCRIPTION OF SUPPORT UNITS

None

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 | Karthik Vepuri | Test Engineer | Review/editing |
| 2 | Fox Lane | Test Engineer | Testing and report |
| 3 | Grace Larsen | Test Technician | Testing |
| 4 | Samuel Probst | Test Technician | Testing |
| 5 | 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 |
| EMCO Horn Antenna | 3116 | 2576 | March 9, 2020 | March 9, 2022 |
| Com-Power LISN 50µH / 250µH - 50Ω | LI-220C | 20070017 | September 22, 2020 | September 22, 2022 |
| 8447F POT H64 Preampfier* | 8447F POT H64 | 3113AD4667 | February 1, 2021 | February 1, 2022 |
| Rohde & Schwarz Preampfier* | TS-PR18 | 3545700803 | April 14, 2020 | April 14, 2022 |
| Trilithic High Pass Filter* | 6HC330 | 23042 | April 14, 2020 | April 14, 2022 |
| ETS – Lindgren- VSWR on 10m Chamber | 10m Semi-anechoic chamber-VSWR | 4740 Discovery Drive | July 30, 2020 | July 30, 2023 |
| NCEE Labs-NSA on 10m Chamber | 10m Semi-anechoic chamber-NSA | NCEE-001 | October 25, 2019 | October 25, 2022 |
| TDK Emissions Lab Software | V11.25 | 700307 | NA | NA |
| RF Cable (preampfier to antenna)* | MFR-57500 | 01-07-002 | April 14, 2020 | April 14, 2022 |
| RF Cable (antenna to 10m chamber bulkhead)* | FSCM 64639 | 01E3872 | September 24, 2021 | September 24, 2023 |
| RF Cable (10m chamber bulkhead to control room bulkhead)* | FSCM 64639 | 01E3864 | September 24, 2021 | September 24, 2023 |
| RF Cable (control room bulkhead to test receiver)* | FSCM 64639 | 01F1206 | September 24, 2021 | September 24, 2023 |
| N connector bulkhead (10m chamber)** | PE9128 | NCEEBH1 | September 24, 2021 | September 24, 2023 |
| N connector bulkhead (control room)** | PE9128 | NCEEBH2 | September 24, 2021 | September 24, 2023 |

*Internal Characterization

Notes:

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

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.

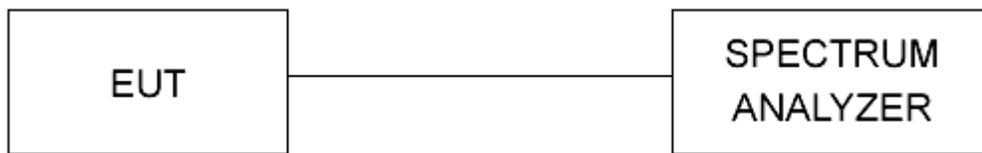


Figure 1 - Bandwidth Measurements Test Setup

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.

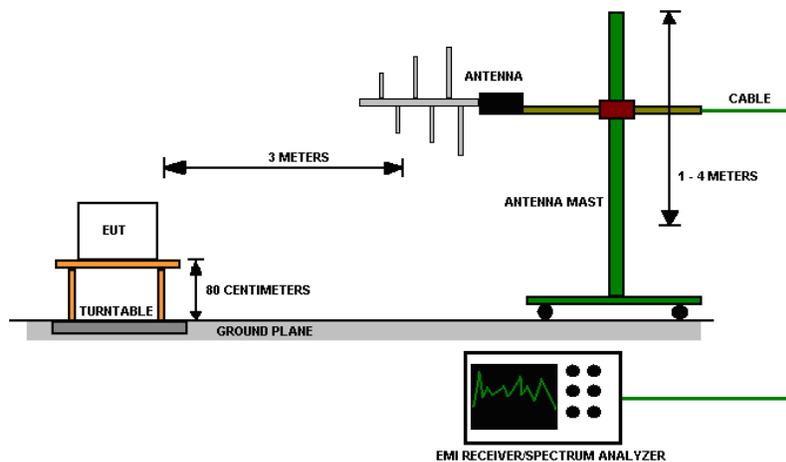


Figure 2 - Radiated Emissions Test Setup



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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 | 14.63 | 9.04 | 23.010 | 199.986 | -5.953 | PASS |
| Mid | 802.11 b | 14.64 | 9.03 | 23.050 | 201.837 | -6.331 | PASS |
| High | 802.11 b | 14.60 | 9.50 | 22.640 | 183.654 | -6.624 | PASS |
| Low | 802.11 g | 16.53 | 16.52 | 23.650 | 231.739 | -7.838 | PASS |
| Mid | 802.11 g | 16.51 | 16.49 | 22.800 | 190.546 | -8.701 | PASS |
| High | 802.11 g | 16.50 | 16.51 | 22.700 | 186.209 | -9.289 | PASS |
| Low | 802.11 n | 17.50 | 17.59 | 21.660 | 146.555 | -11.343 | PASS |
| Mid | 802.11 n | 17.51 | 17.60 | 23.930 | 247.172 | -9.01 | PASS |
| High | 802.11 n | 17.49 | 17.58 | 19.570 | 90.573 | -13.565 | 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 (dBuV) | Relative Fundamental (dBuV) | Delta (dB) | Min Delta (dB) | Result |
| Low | 802.11 b | 2400.00 | 82.06 | 115.45 | 33.39 | 20.00 | PASS |
| Low | 802.11 g | 2400.00 | 73.03 | 109.37 | 36.34 | 20.00 | PASS |
| Low | 802.11 n | 2400.00 | 70.48 | 106.72 | 36.24 | 20.00 | PASS |
| High | 802.11 b | 2483.50 | 61.69 | 114.61 | 52.92 | 20.00 | PASS |
| High | 802.11 g | 2483.50 | 73.11 | 108.34 | 35.23 | 20.00 | PASS |
| High | 802.11 n | 2483.50 | 63.32 | 105.55 | 42.23 | 20.00 | PASS |
| Radiated 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 | 55.43 | Peak | 73.98 | 18.55 | PASS |
| Low | 802.11 g | 2390.00 | 63.40 | Peak | 73.98 | 10.58 | PASS |
| Low | 802.11 n | 2390.00 | 63.86 | Peak | 73.98 | 10.12 | PASS |
| High | 802.11 b | 2483.50 | 57.23 | Peak | 73.98 | 16.75 | PASS |
| High | 802.11 g | 2483.50 | 68.34 | Peak | 73.98 | 5.64 | PASS |
| High | 802.11 n | 2483.50 | 65.81 | Peak | 73.98 | 8.17 | PASS |
| *Limit shown is the peak limit taken from FCC Part 15.209 | | | | | | | |



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| Radiated 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 | 43.83 | Average | 53.98 | 10.16 | PASS |
| Low | 802.11 g | 2390.00 | 49.08 | Average | 53.98 | 4.90 | PASS |
| Low | 802.11 n | 2390.00 | 50.36 | Average | 53.98 | 3.62 | PASS |
| High | 802.11 b | 2483.50 | 46.79 | Average | 53.98 | 7.19 | PASS |
| High | 802.11 g | 2483.50 | 52.65 | Average | 53.98 | 1.33 | PASS |
| High | 802.11 n | 2483.50 | 53.84 | Average | 53.98 | 0.14 | 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:

All Modulations/Transmitters in this report had a duty cycle of >98%

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:

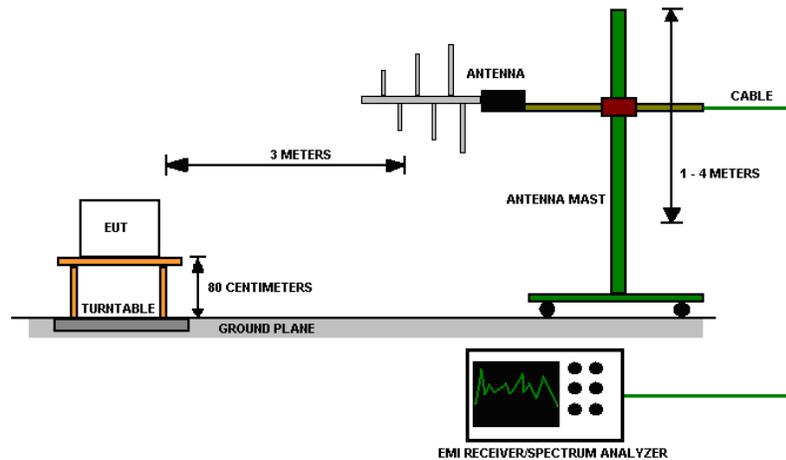
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = $20 * \log * \text{Emission level } (\mu\text{V/m})$.
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission 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:

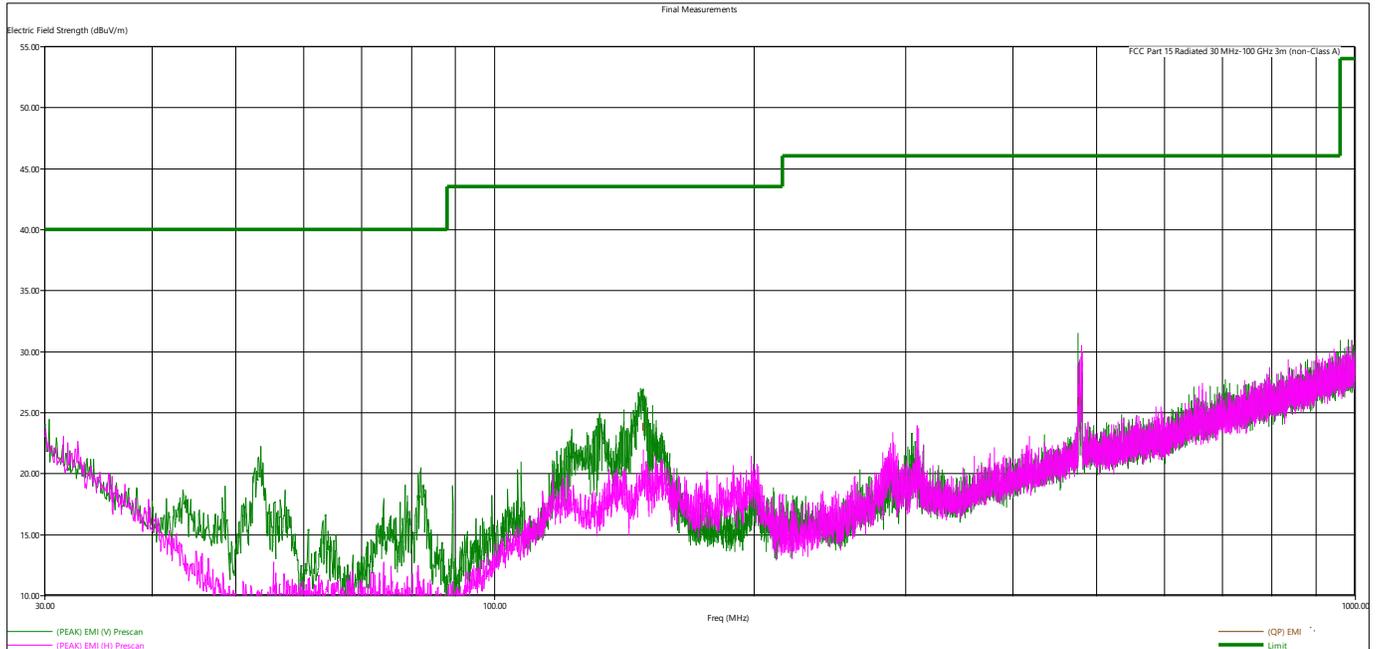


Figure 4 - Radiated Emissions Plot, Receive

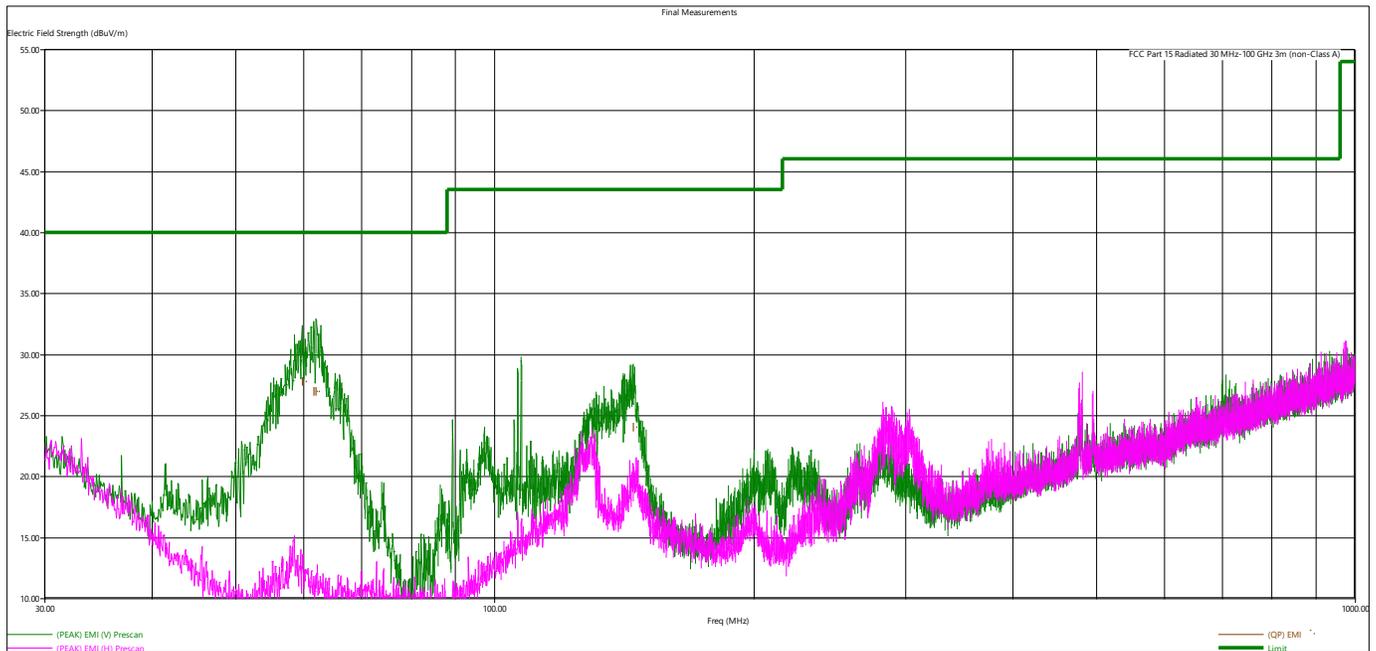


Figure 5 - Radiated Emissions Plot, 802.11b

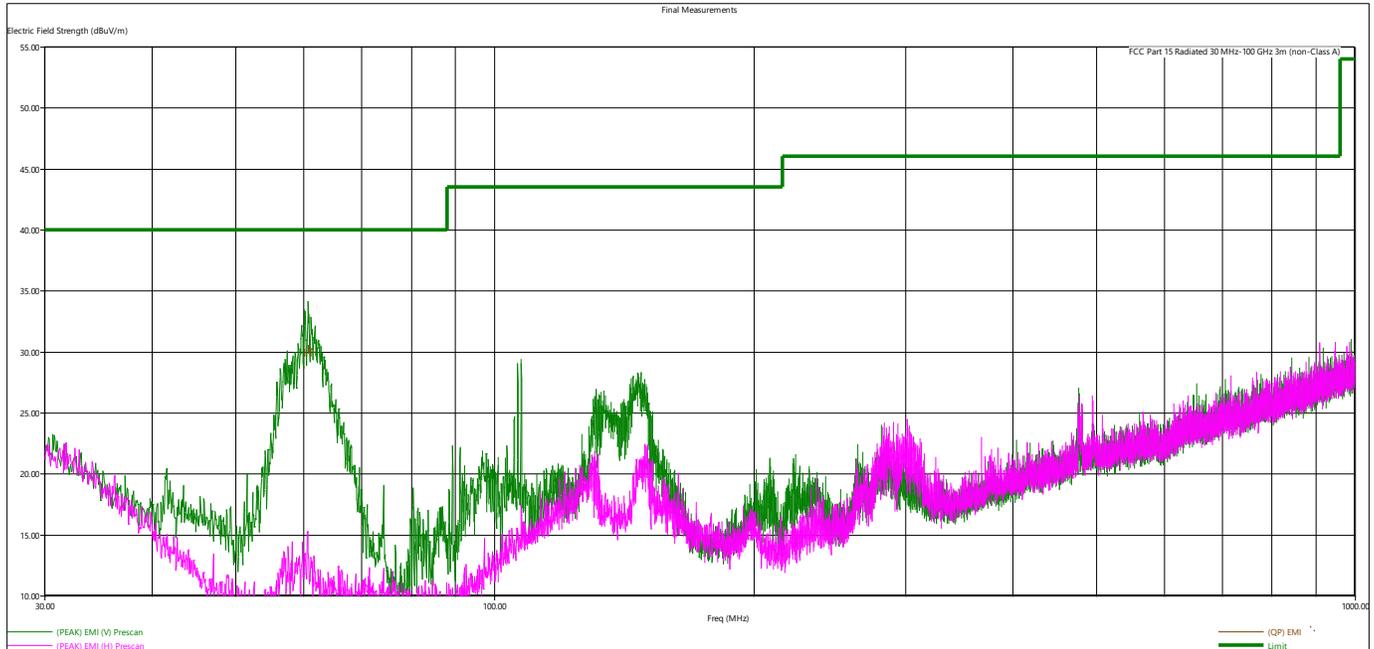


Figure 6 - Radiated Emissions Plot, 802.11g

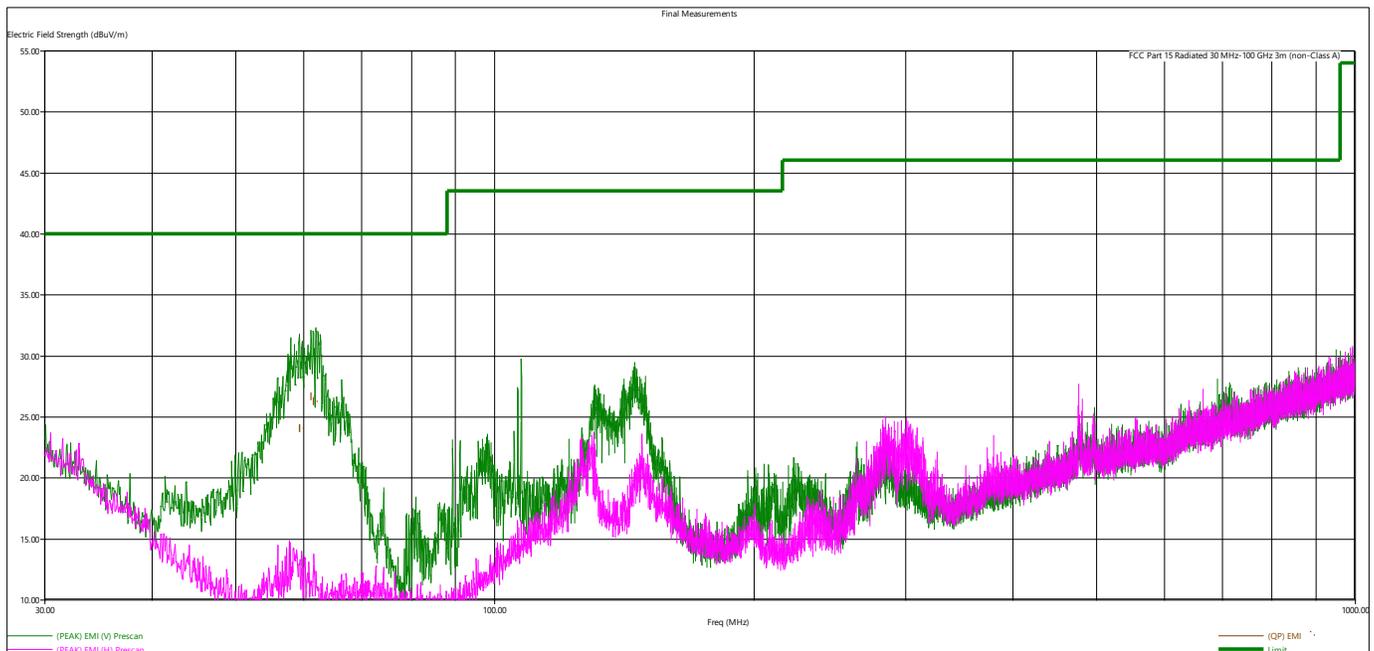


Figure 7 - Radiated Emissions Plot, 802.11n

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, 802.11 | | | | | | | | |
|---------------------------------|--------|--------|--------|--------|-------|-----|---------|------------|
| Frequency | Level | Limit | Margin | Height | Angle | Pol | Channel | Modulation |
| MHz | dBµV/m | dBµV/m | dB | cm. | deg. | | | |
| 59.717040 | 27.73 | 40.00 | 12.27 | 105 | 2 | V | Low | 802.11b |
| 61.398480 | 26.92 | 40.00 | 13.08 | 136 | 280 | V | Low | 802.11b |
| 62.129040 | 26.94 | 40.00 | 13.06 | 132 | 354 | V | Low | 802.11b |
| 144.709200 | 24.02 | 43.52 | 19.50 | 119 | 57 | V | Low | 802.11b |
| 60.192000 | 29.87 | 40.00 | 10.13 | 105 | 301 | V | Low | 802.11g |
| 60.730320 | 30.15 | 40.00 | 9.85 | 106 | 300 | V | Low | 802.11g |
| 61.122480 | 29.93 | 40.00 | 10.07 | 109 | 315 | V | Low | 802.11g |
| 59.460480 | 24.01 | 40.00 | 15.99 | 142 | 270 | V | Low | 802.11n |
| 61.309680 | 26.66 | 40.00 | 13.34 | 112 | 347 | V | Low | 802.11n |
| 61.429680 | 26.25 | 40.00 | 13.75 | 121 | 289 | V | Low | 802.11n |
| 148.543920 | 23.78 | 43.52 | 19.74 | 115 | 103 | V | Receive | |
| 476.324400 | 25.89 | 46.02 | 20.13 | 107 | 64 | V | Receive | |

All other measurements were found to be at least 6 dB Below the limit. Worst case emissions are reported.

| Peak Measurements, 802.11x | | | | | | | | |
|----------------------------|--------|--------|--------|--------|-------|-----|---------|------------|
| Frequency | Level | Limit | Margin | Height | Angle | Pol | Channel | Modulation |
| MHz | dBµV/m | dBµV/m | dB | cm. | deg. | | | |
| 2413.810000 | 102.45 | NA | NA | 221 | 144 | H | Low | 802.11b |
| 2436.372000 | 101.5 | NA | NA | 140 | 145 | H | Mid | 802.11b |
| 2463.222000 | 100.35 | NA | NA | 134 | 142 | H | High | 802.11b |
| 2410.836000 | 97.09 | NA | NA | 128 | 160 | H | Low | 802.11g |
| 2434.884000 | 96.97 | NA | NA | 239 | 201 | V | Mid | 802.11g |
| 2460.964000 | 94.27 | NA | NA | 112 | 164 | H | High | 802.11g |
| 2407.572000 | 96.42 | NA | NA | 263 | 206 | V | Low | 802.11n |
| 2437.798000 | 95.94 | NA | NA | 230 | 203 | V | Mid | 802.11n |
| 2459.664000 | 94.94 | NA | NA | 281 | 198 | V | High | 802.11n |

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the plot and table above.
All other measurements 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 μ V/m | dB μ V/m | dB | cm. | deg. | | | |
| 2413.810000 | 95.03 | NA | NA | 221 | 144 | H | Low | 802.11b |
| 2436.372000 | 93.72 | NA | NA | 140 | 145 | H | Mid | 802.11b |
| 2463.222000 | 91.94 | NA | NA | 134 | 142 | H | High | 802.11b |
| 2410.836000 | 86.84 | NA | NA | 128 | 160 | H | Low | 802.11g |
| 2434.884000 | 86.8 | NA | NA | 239 | 201 | V | Mid | 802.11g |
| 2460.964000 | 84.25 | NA | NA | 112 | 164 | H | High | 802.11g |
| 2407.572000 | 85.68 | NA | NA | 263 | 206 | V | Low | 802.11n |
| 2437.798000 | 86.21 | NA | NA | 230 | 203 | V | Mid | 802.11n |
| 2459.664000 | 84.98 | NA | NA | 281 | 198 | V | High | 802.11n |

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the plot and table above.

All other measurements 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:

The highest value measured was 7.631 dBm at the fundamental emissions. All other values were at least 20 dB below the fundamental. All 3 channels were investigated and worst case was reported.

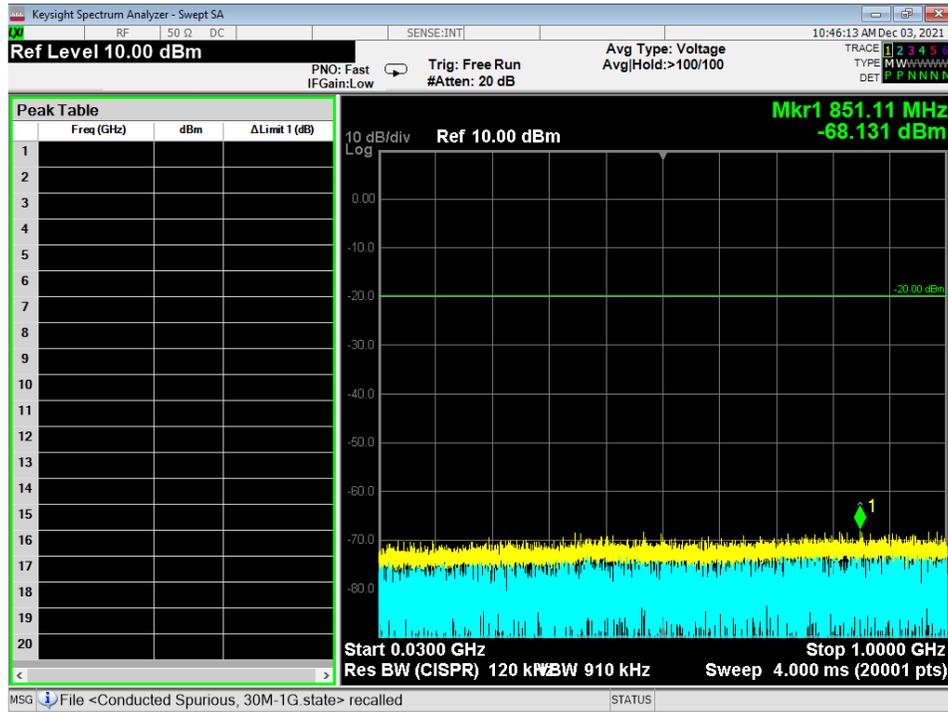


Figure 8 - Radiated Emissions Plot, WIFI 802.11b, 30M – 1G, Low

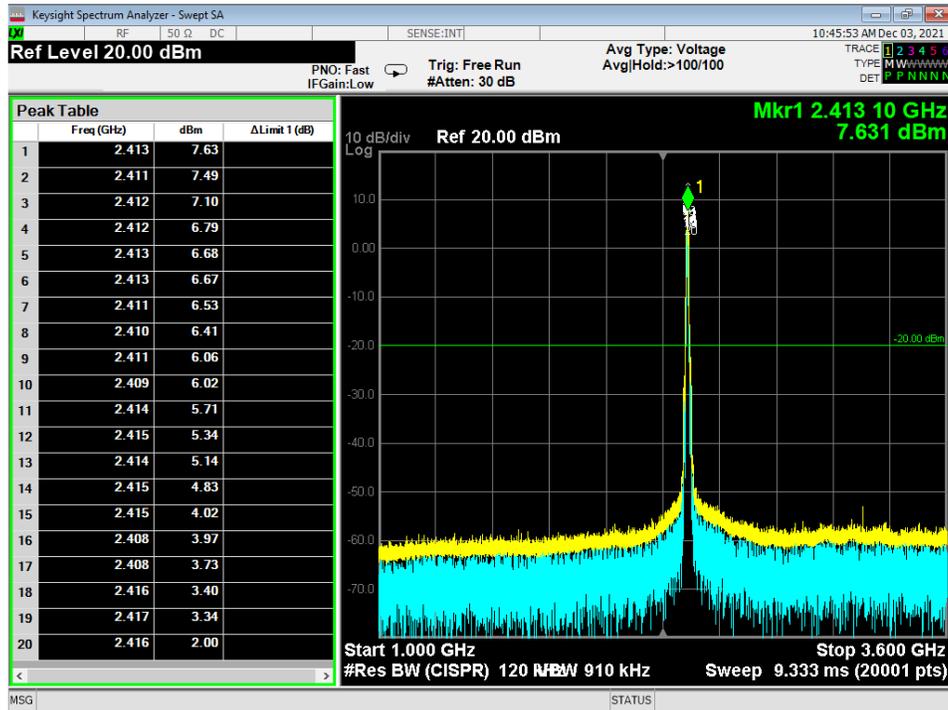


Figure 9 - Radiated Emissions Plot, WIFI 802.11b, 1G – 3.6G, Low

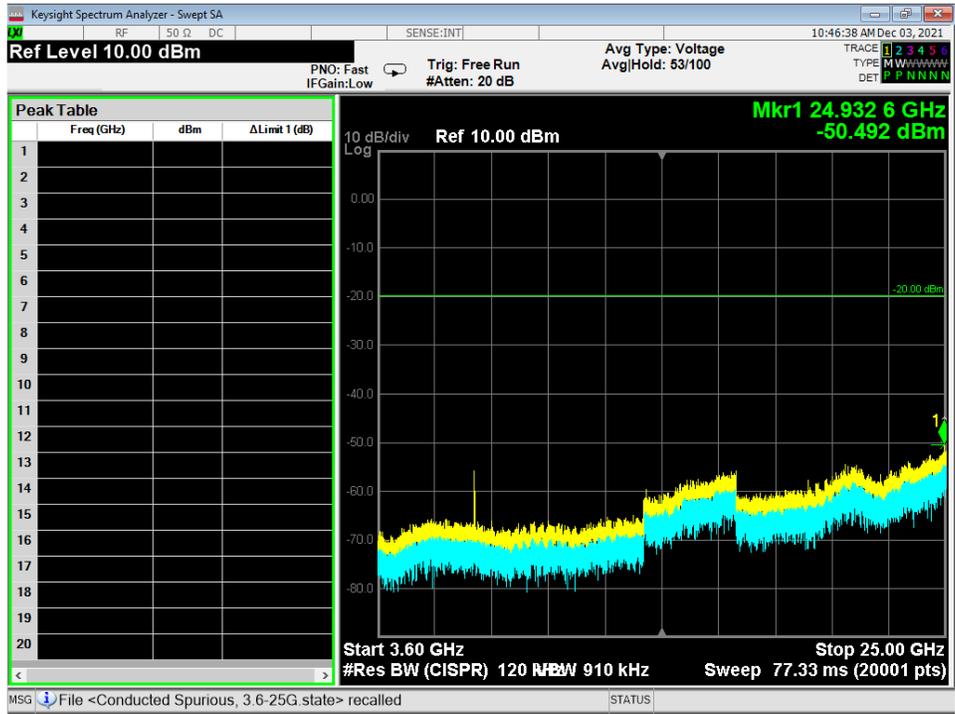


Figure 10 - Radiated Emissions Plot, WIFI 802.11b, 3.6G – 25G, Low

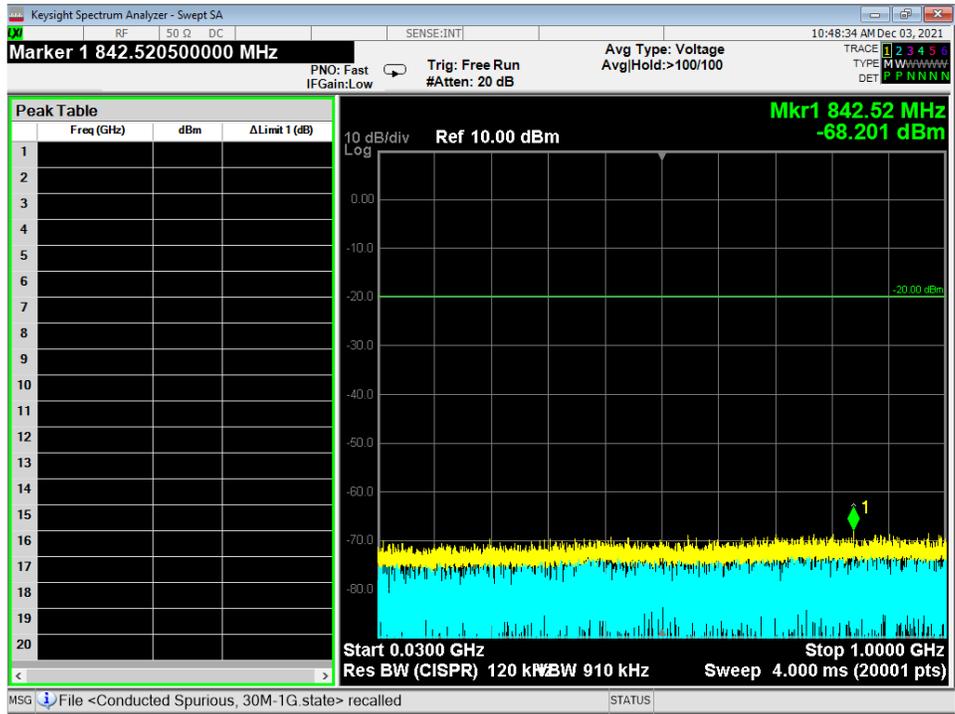


Figure 11 - Radiated Emissions Plot, WIFI 802.11g, 30M – 1G, Low

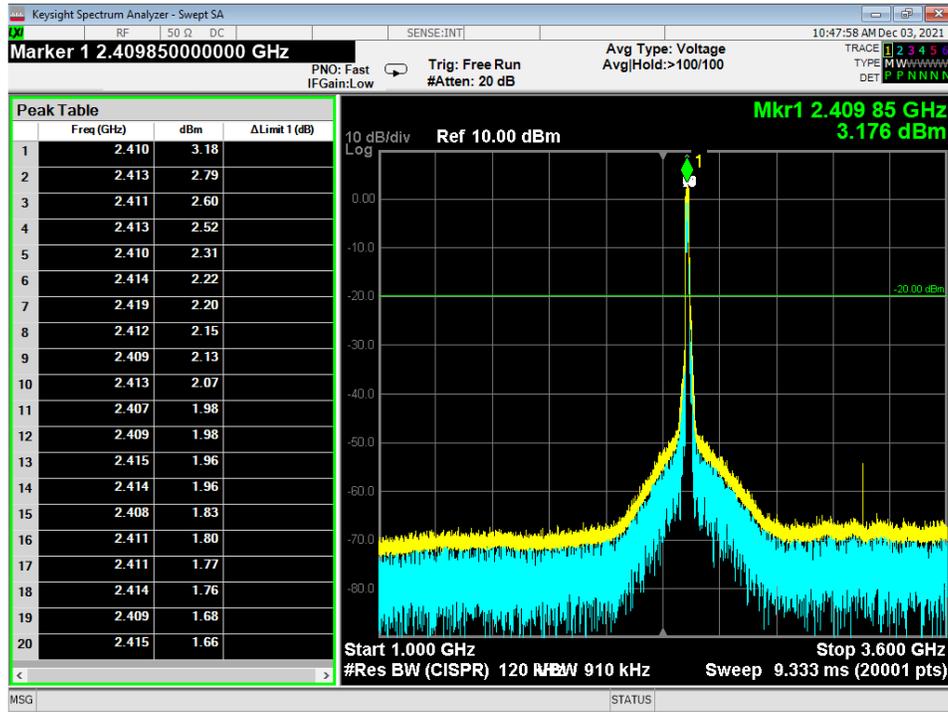


Figure 12 - Radiated Emissions Plot, WIFI 802.11g, 1G – 3.6G, Low

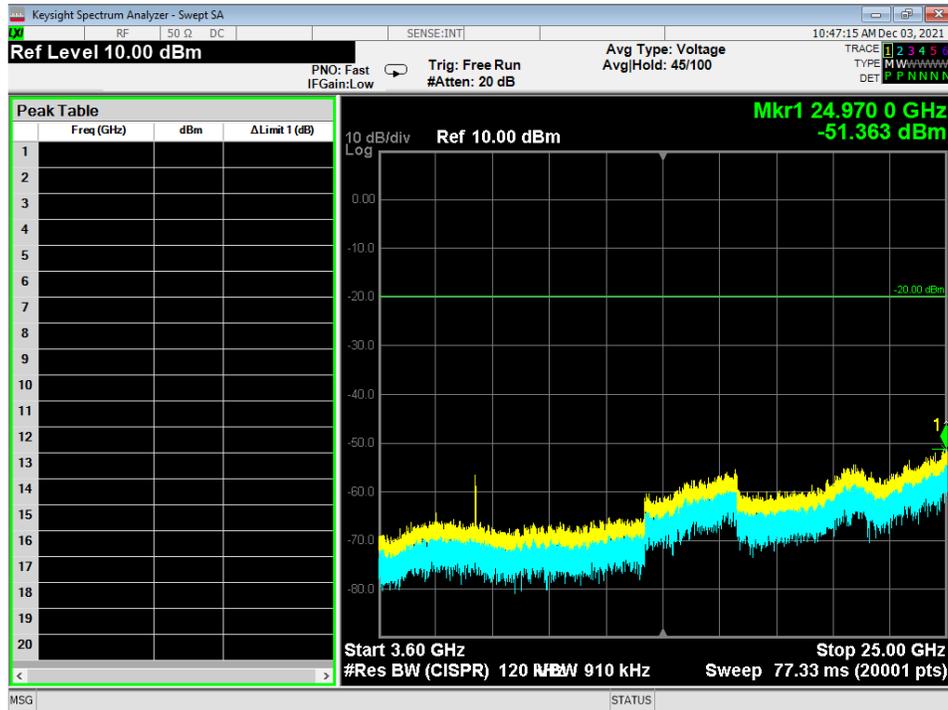


Figure 13 - Radiated Emissions Plot, WIFI 802.11g, 3.6G – 25G, Low

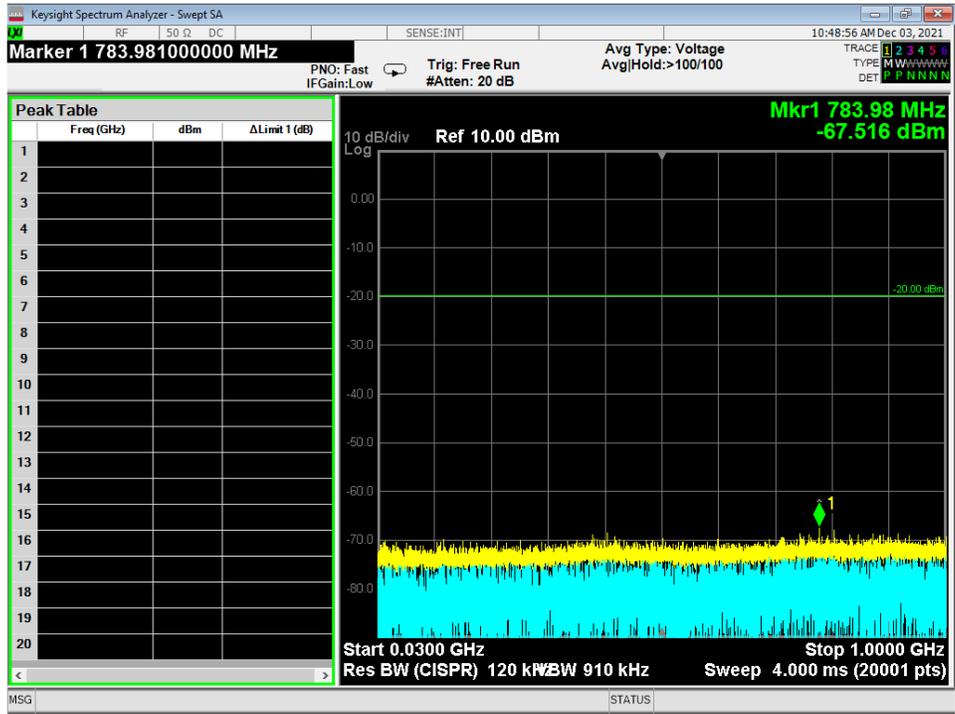


Figure 14 - Radiated Emissions Plot, WIFI 802.11n, 30M – 1G, Low

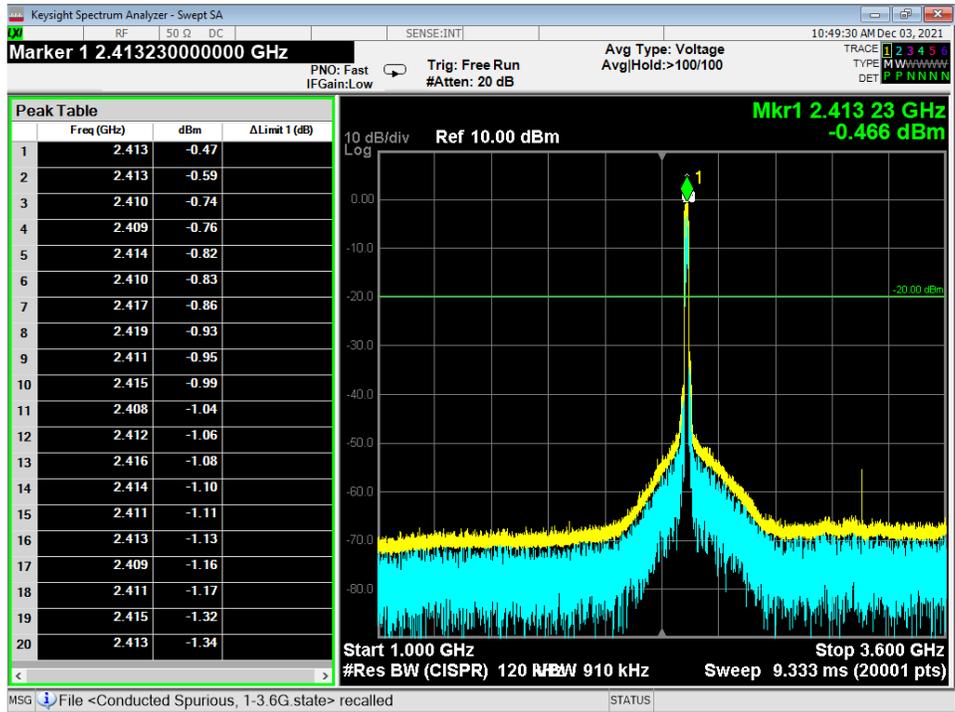


Figure 15 - Radiated Emissions Plot, WIFI 802.11n, 1G – 3.6G, Low

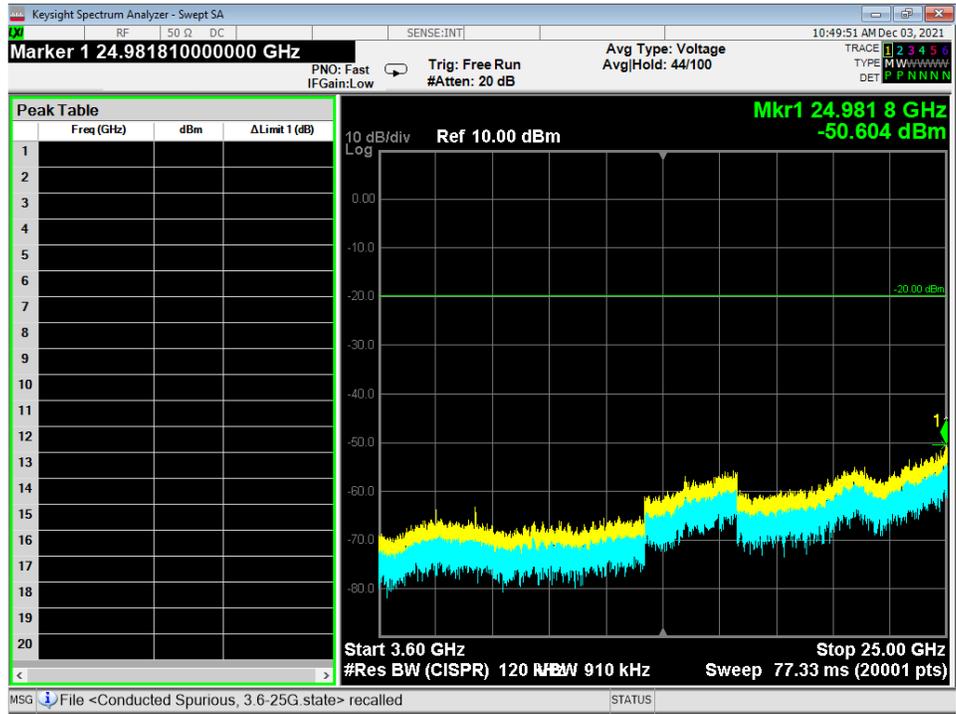


Figure 16 - Radiated Emissions Plot, WIFI 802.11n, 3.6G – 25G, Low



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|----------------|----------------------------|-----|---|
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4.5 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 15.247 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. 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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4.6 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 15.247 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.

4.7 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 μ 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:

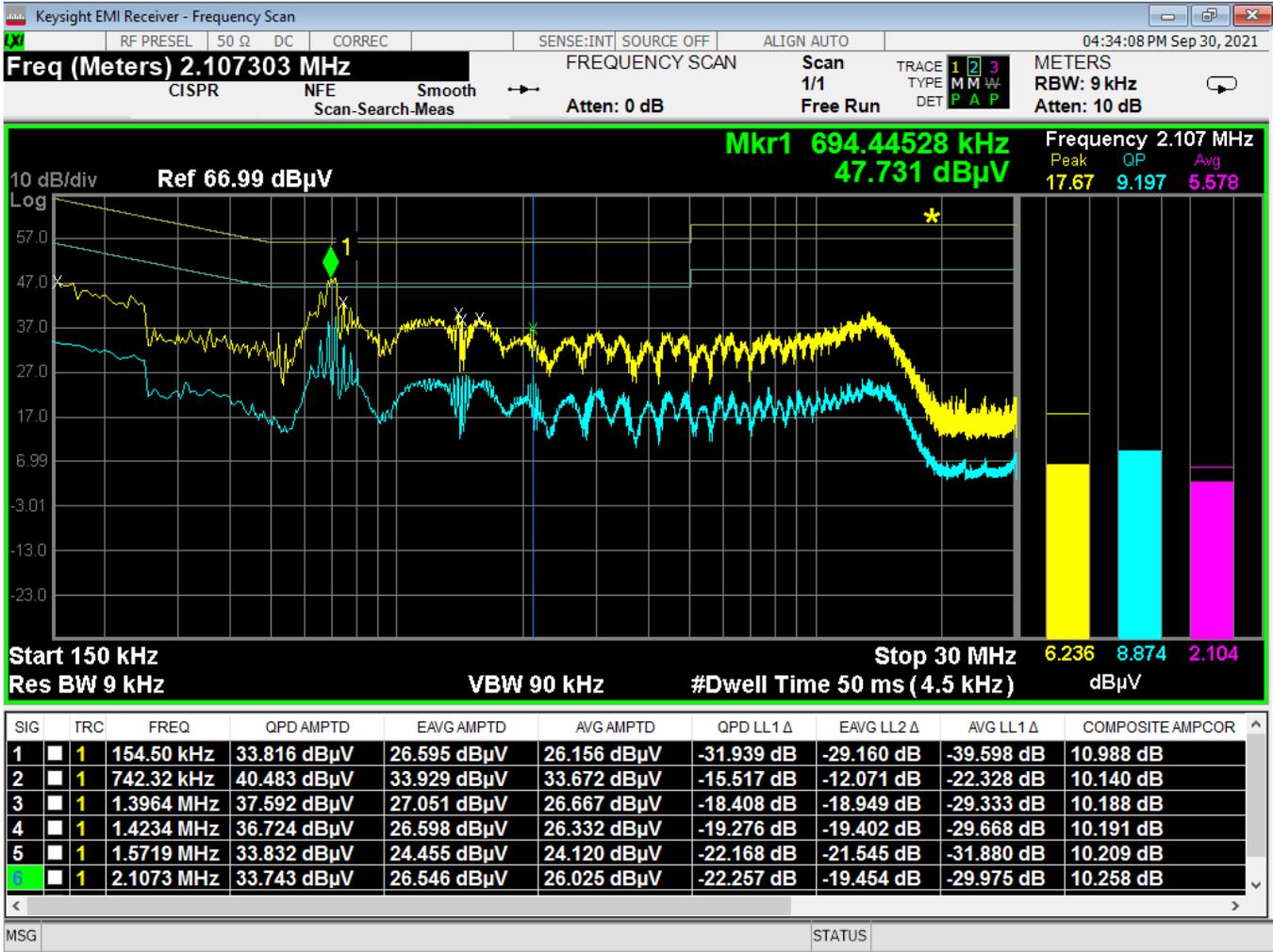


Figure 17 - Conducted Emissions Plot, Line, TX



Figure 18 - Conducted Emissions Plot, Neutral, TX

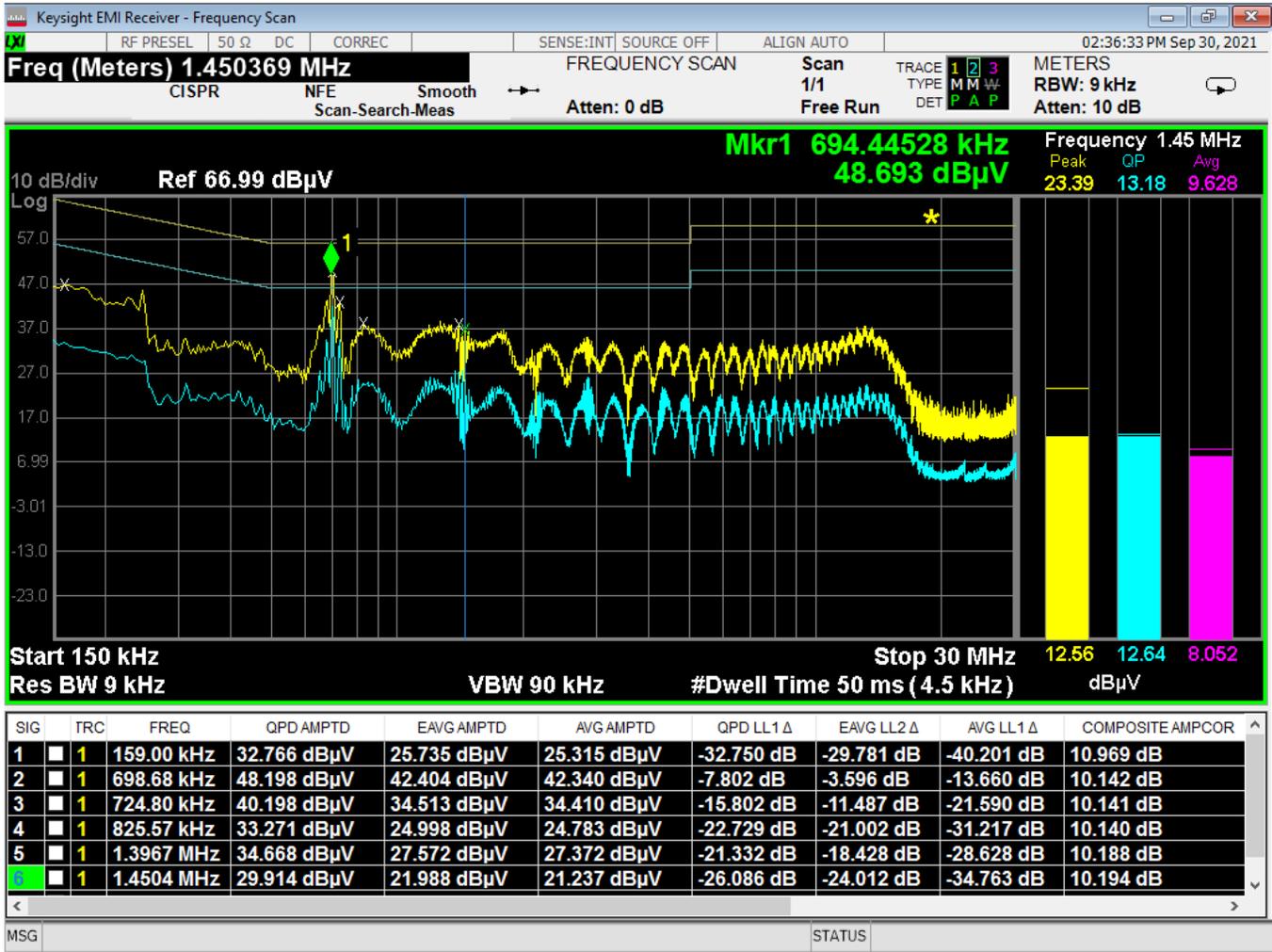


Figure 19 - Conducted Emissions Plot, Line, IDLE

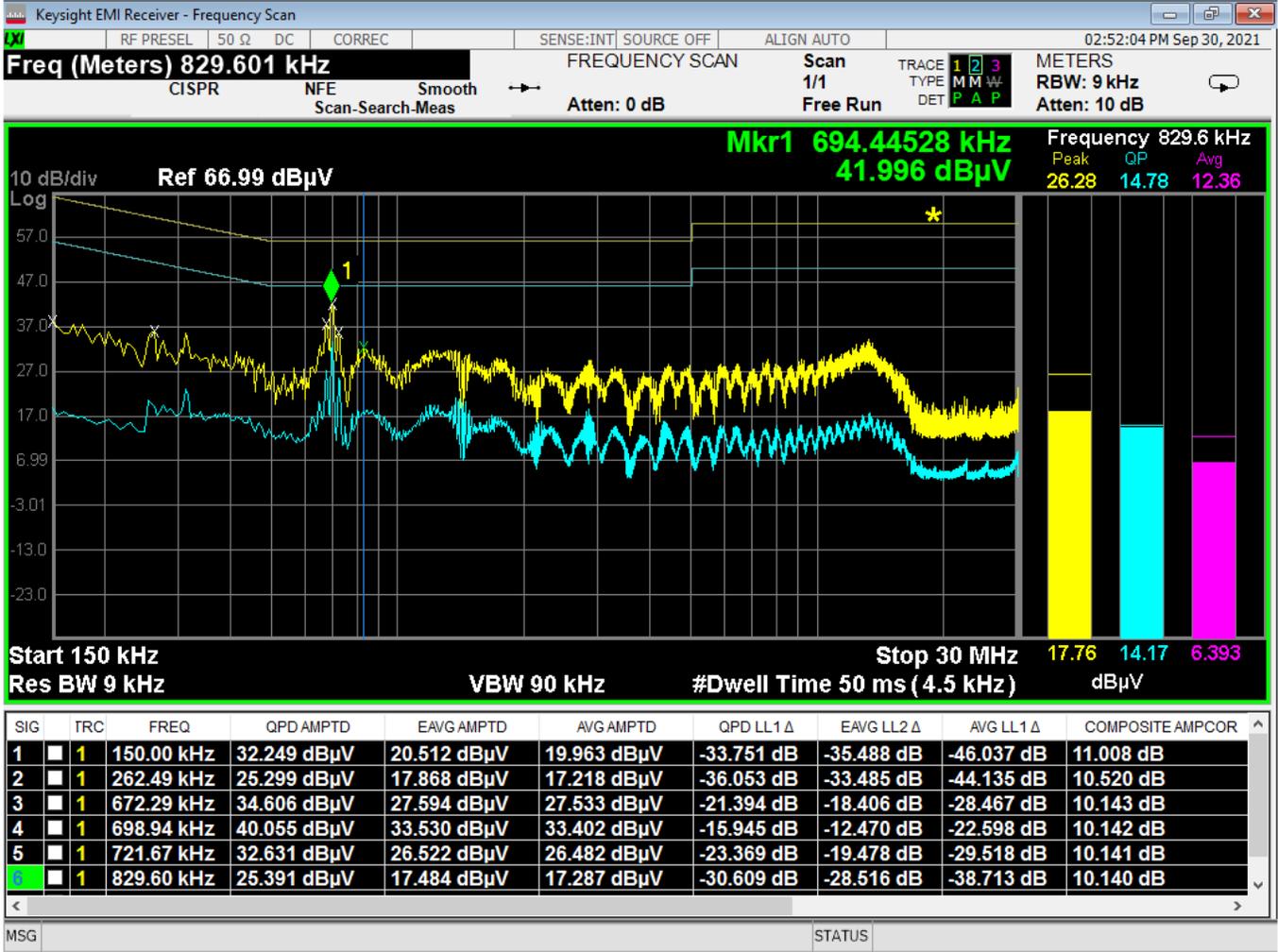


Figure 20 - Conducted Emissions Plot, Neutral, IDLE



| | | | |
|----------------|----------------------------|-----|---|
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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 μ 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 μ V/m.

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

The 48.1 dB μ V/m value can be mathematically converted to its corresponding level in μ 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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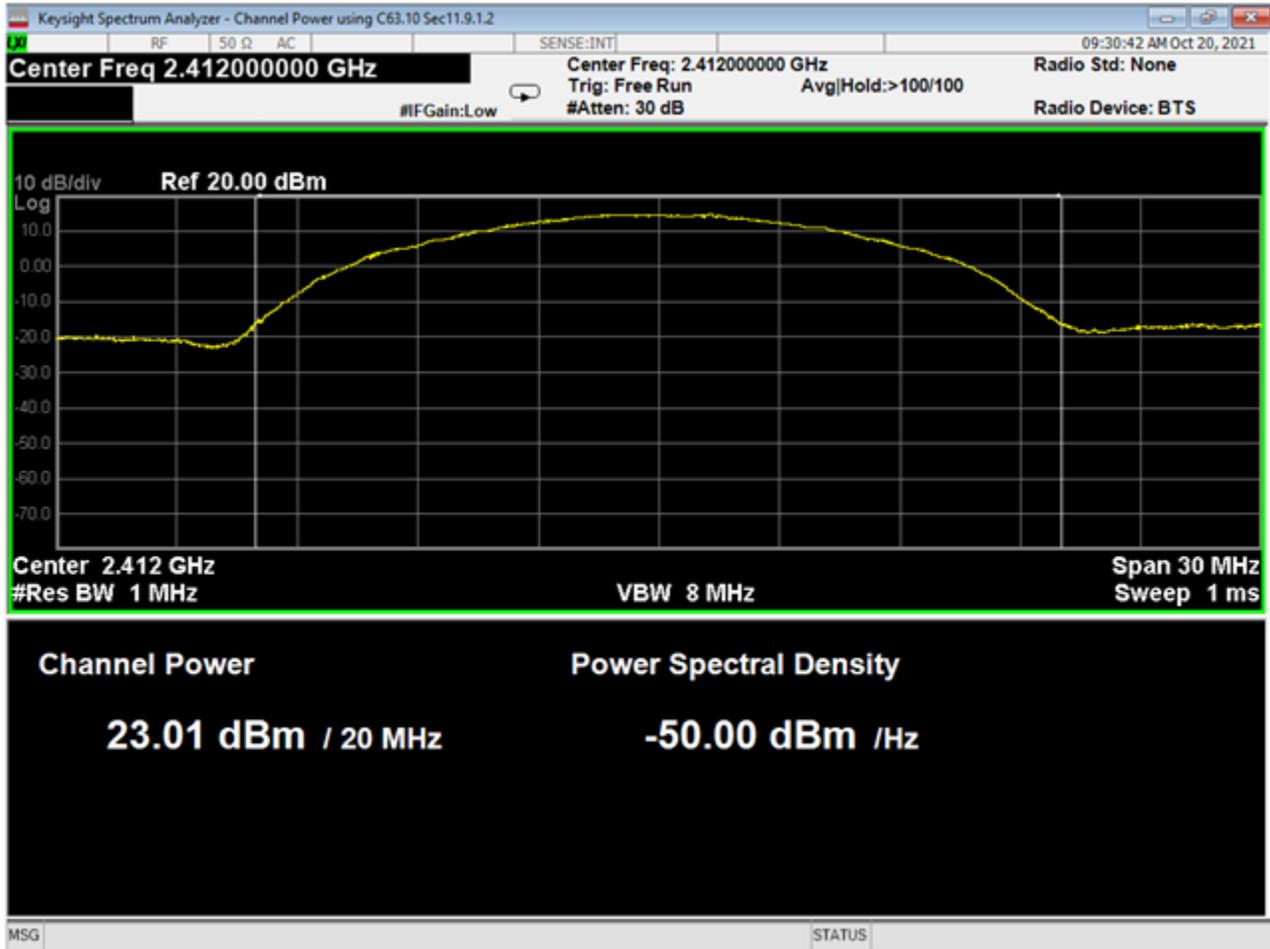
APPENDIX B – MEASUREMENT UNCERTAINTY

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

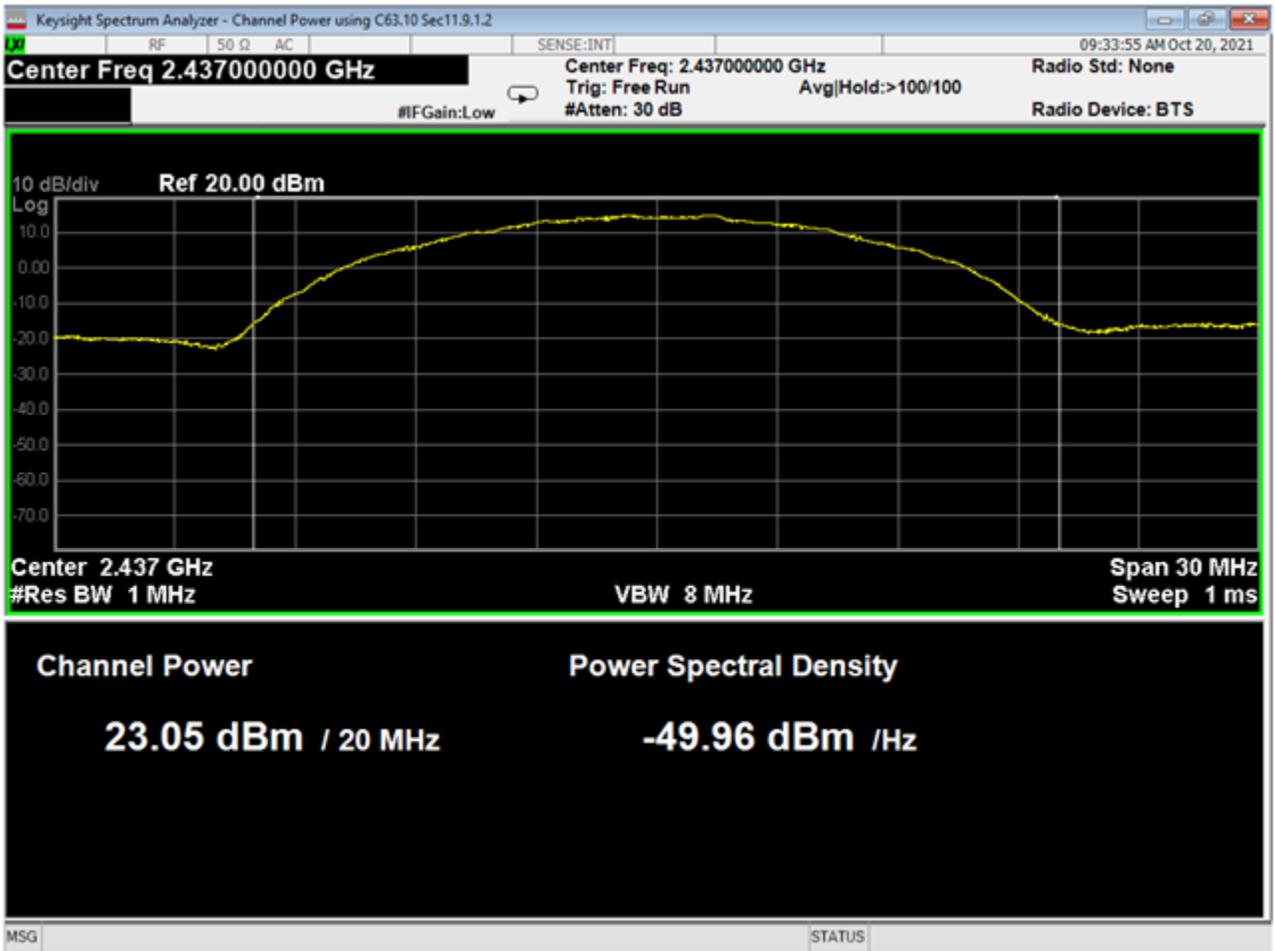
| Test | Frequency Range | Uncertainty Value (dB) |
|-----------------------------|-----------------|------------------------|
| Radiated Emissions, 3m | 30MHz - 1GHz | 3.82 |
| Radiated Emissions, 3m | 1GHz - 18GHz | 4.44 |
| Emissions limits, conducted | 30MHz – 18GHz | ±3.30 dB |

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

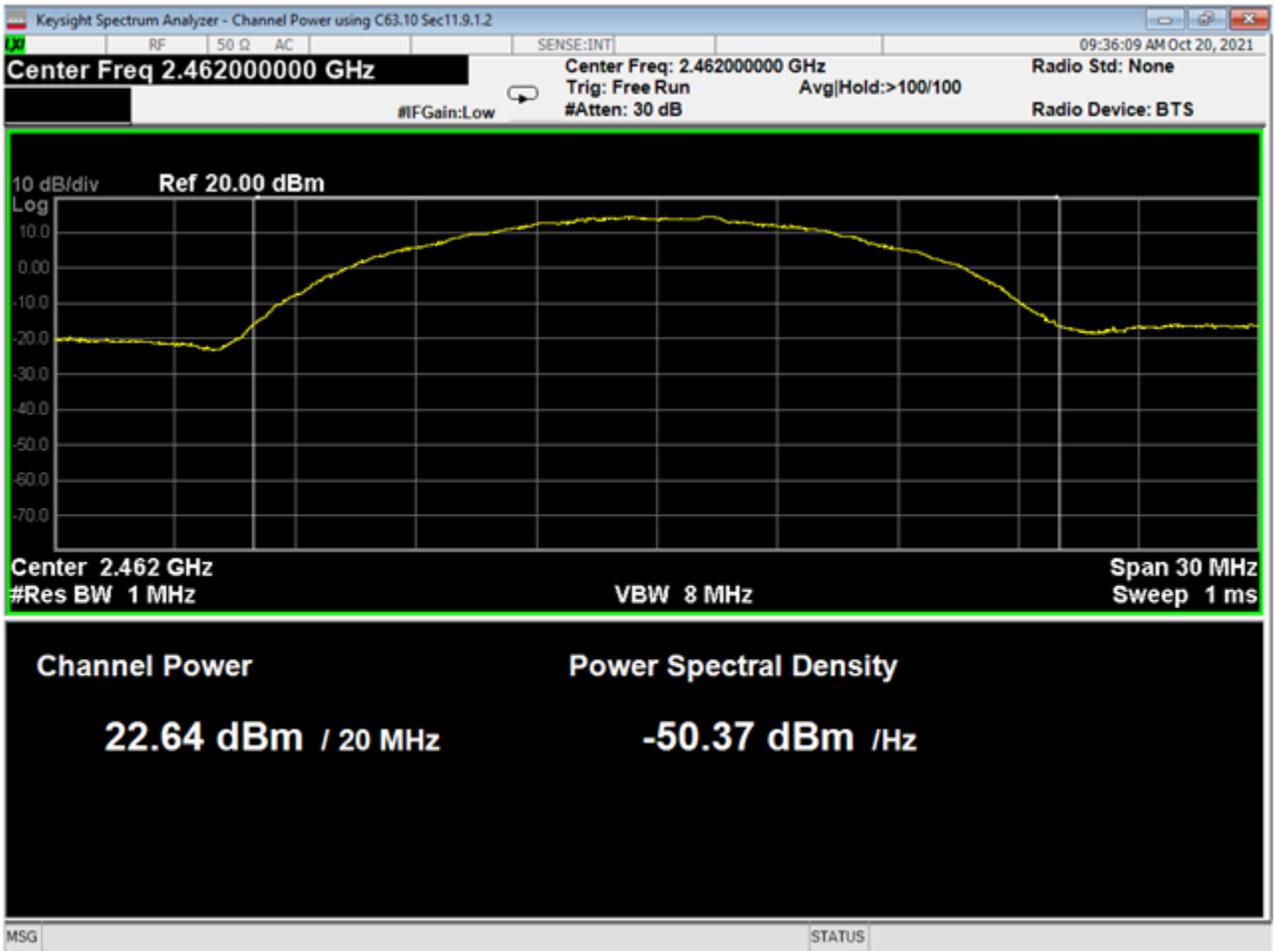
APPENDIX C – GRAPHS AND TABLES



01 Power, Low, Wifi B



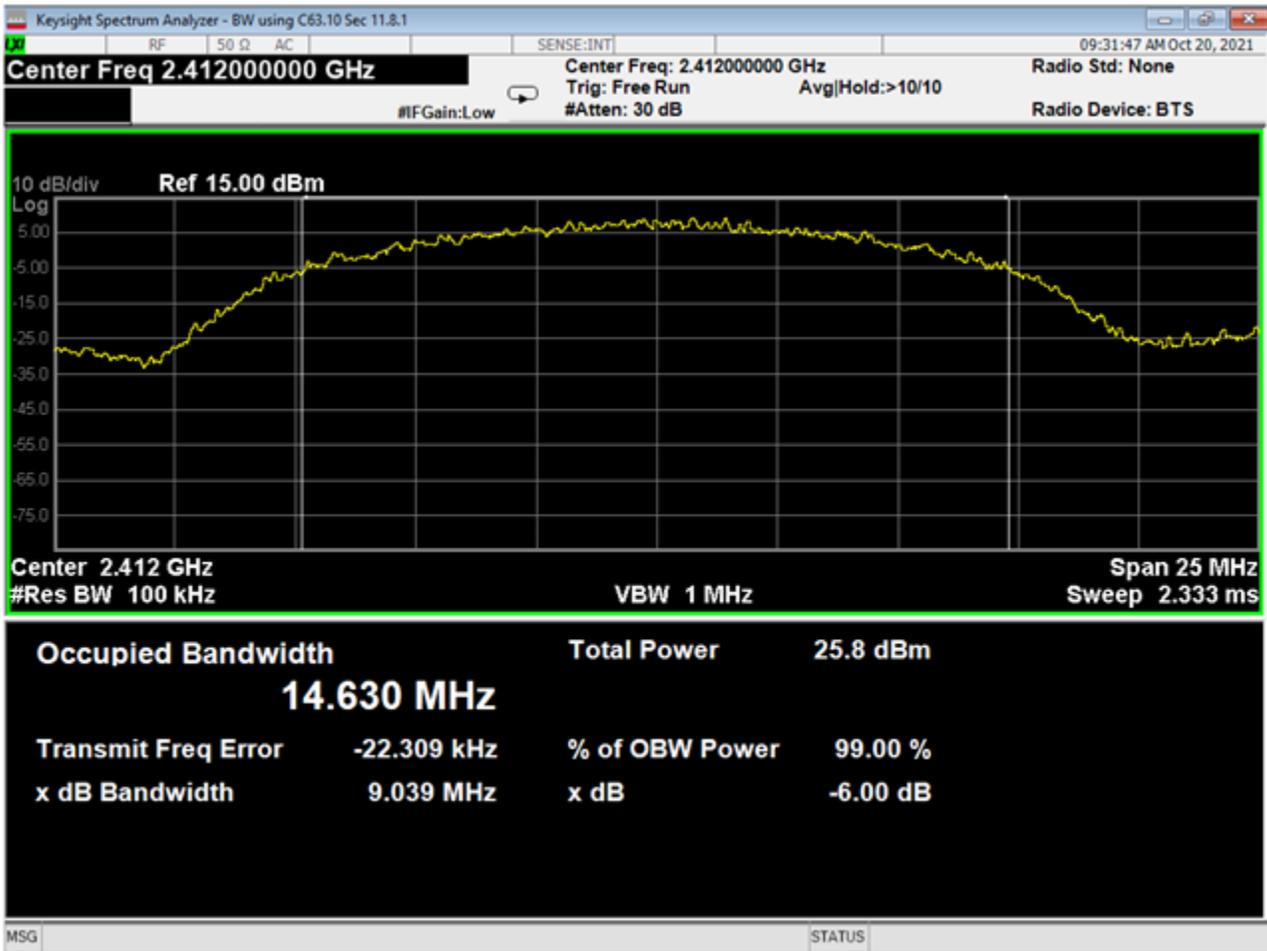
02 Power, Mid, Wifi B



03 Power, High, Wifi B



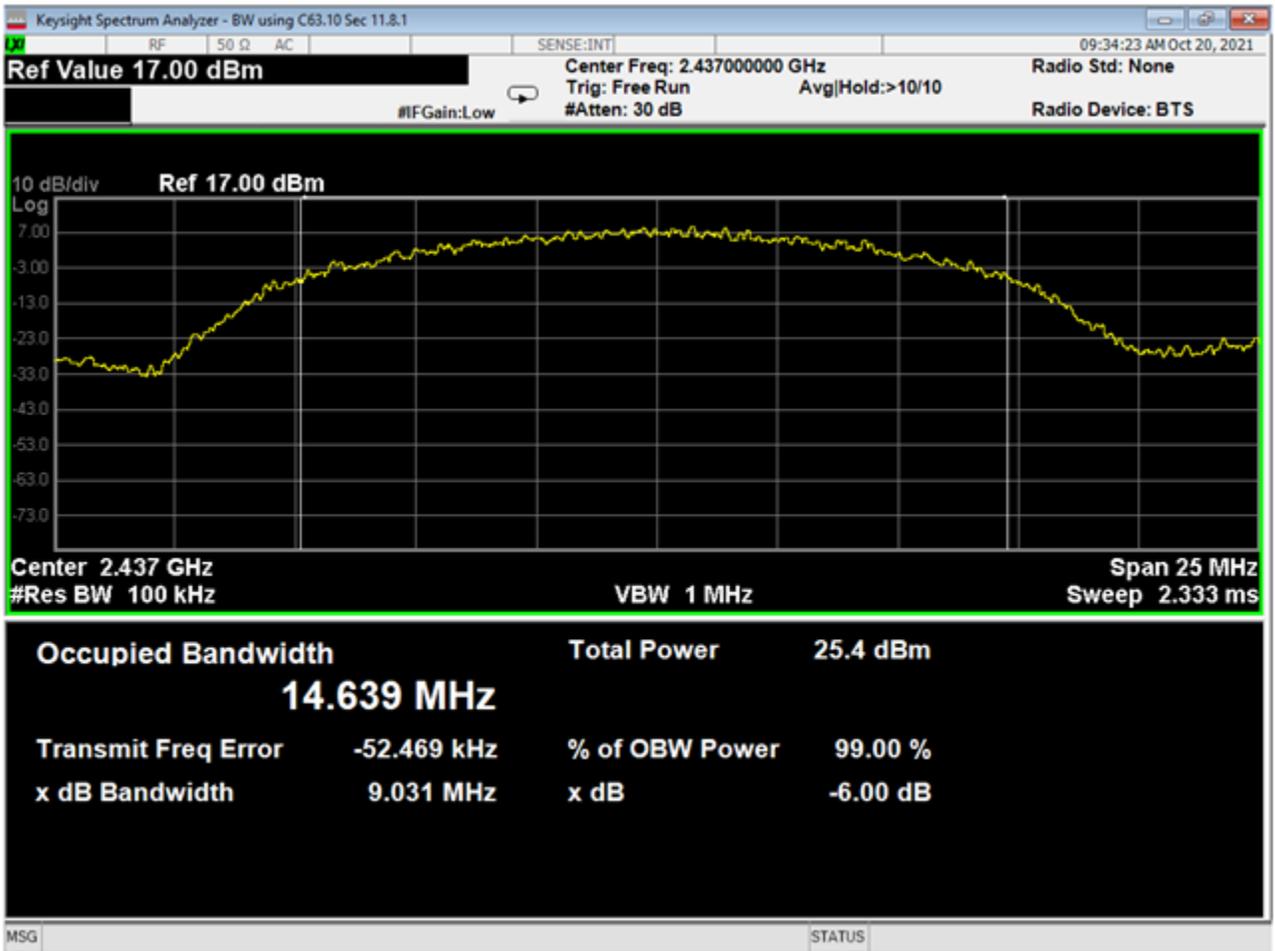
| | | | |
|----------------|----------------------------|-----|---|
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04 OBW-6dB, Low, Wifi B



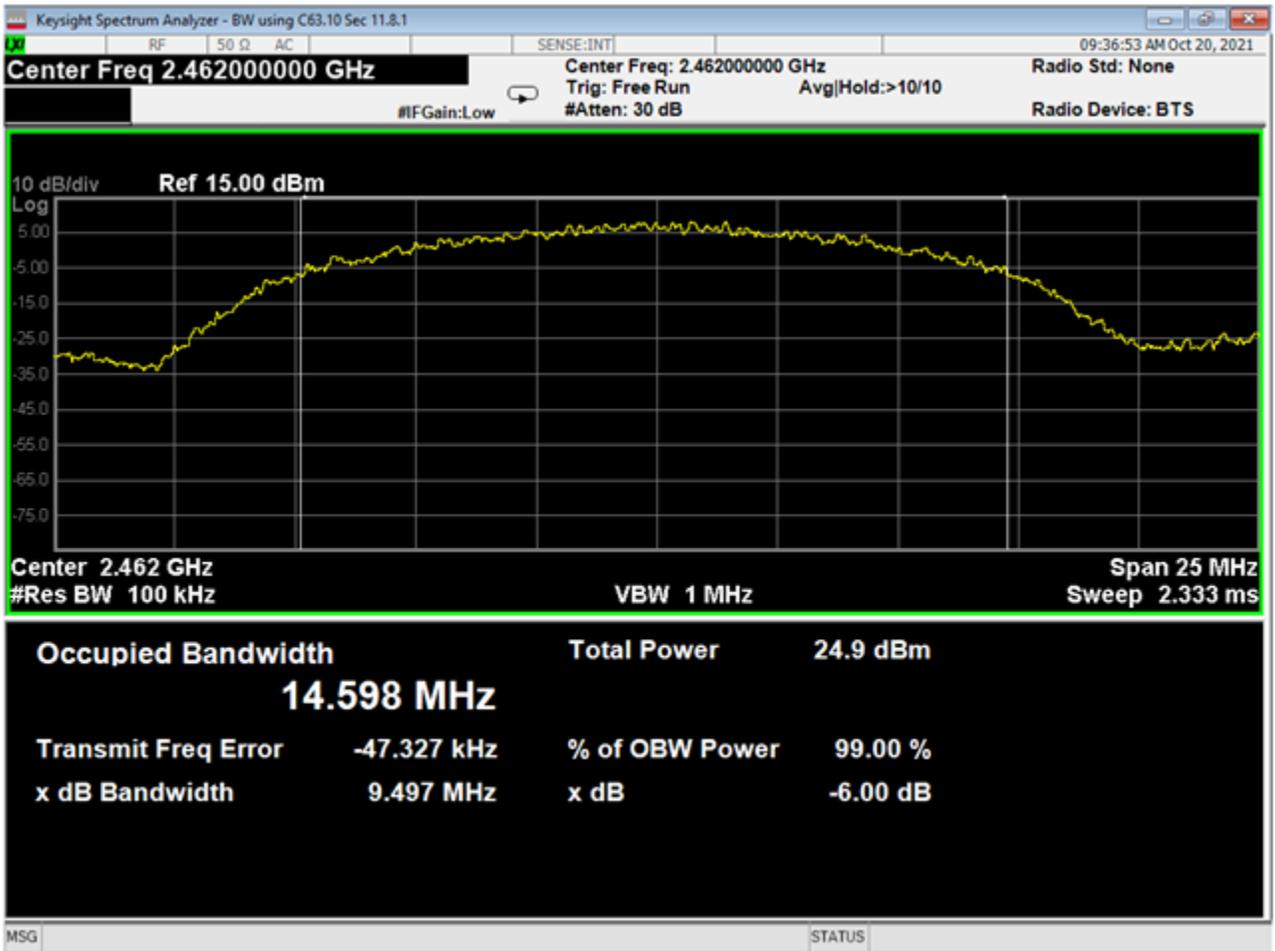
| | | | |
|----------------|----------------------------|-----|---|
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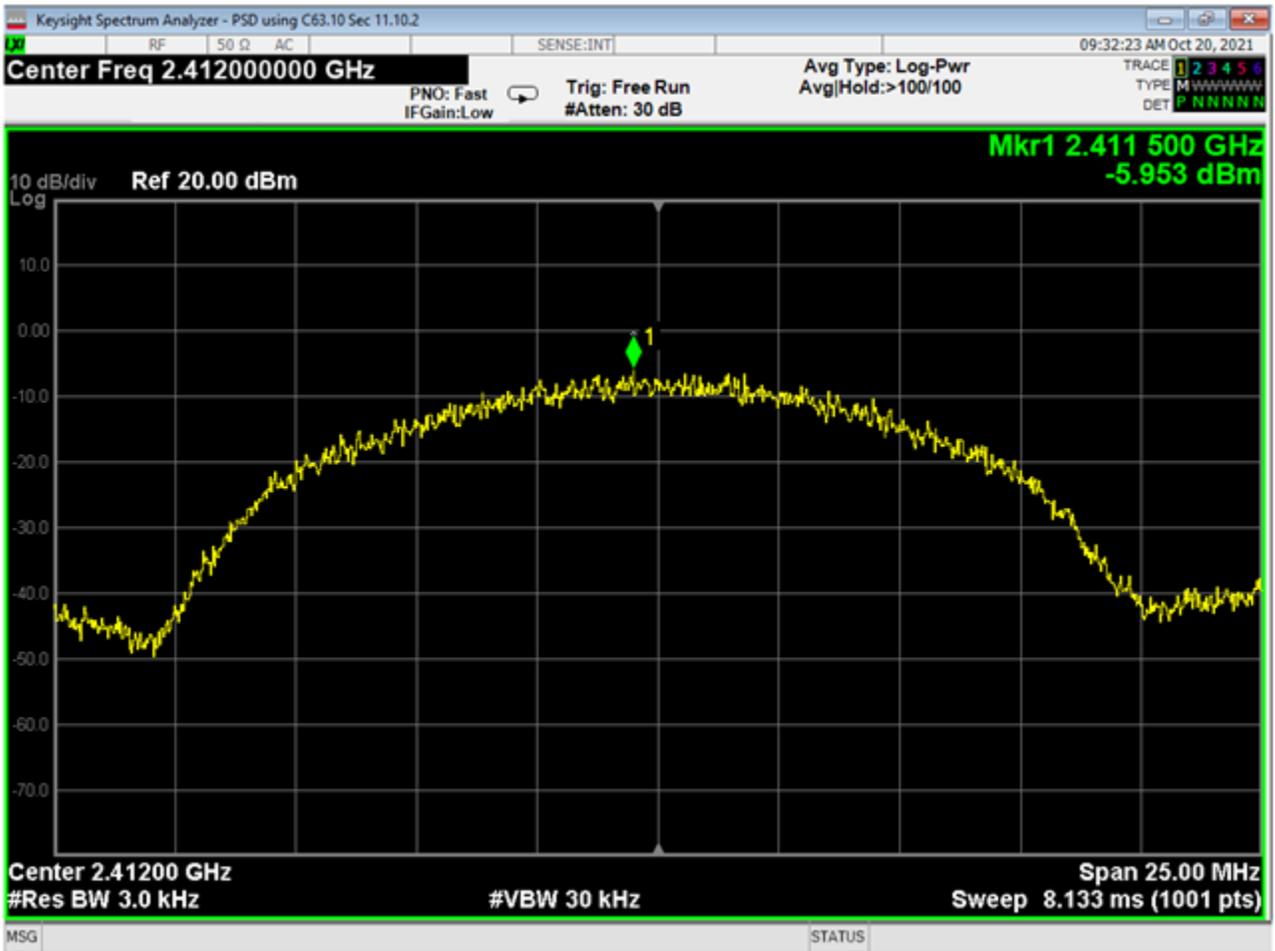
05 OBW-6dB, Mid, Wifi B



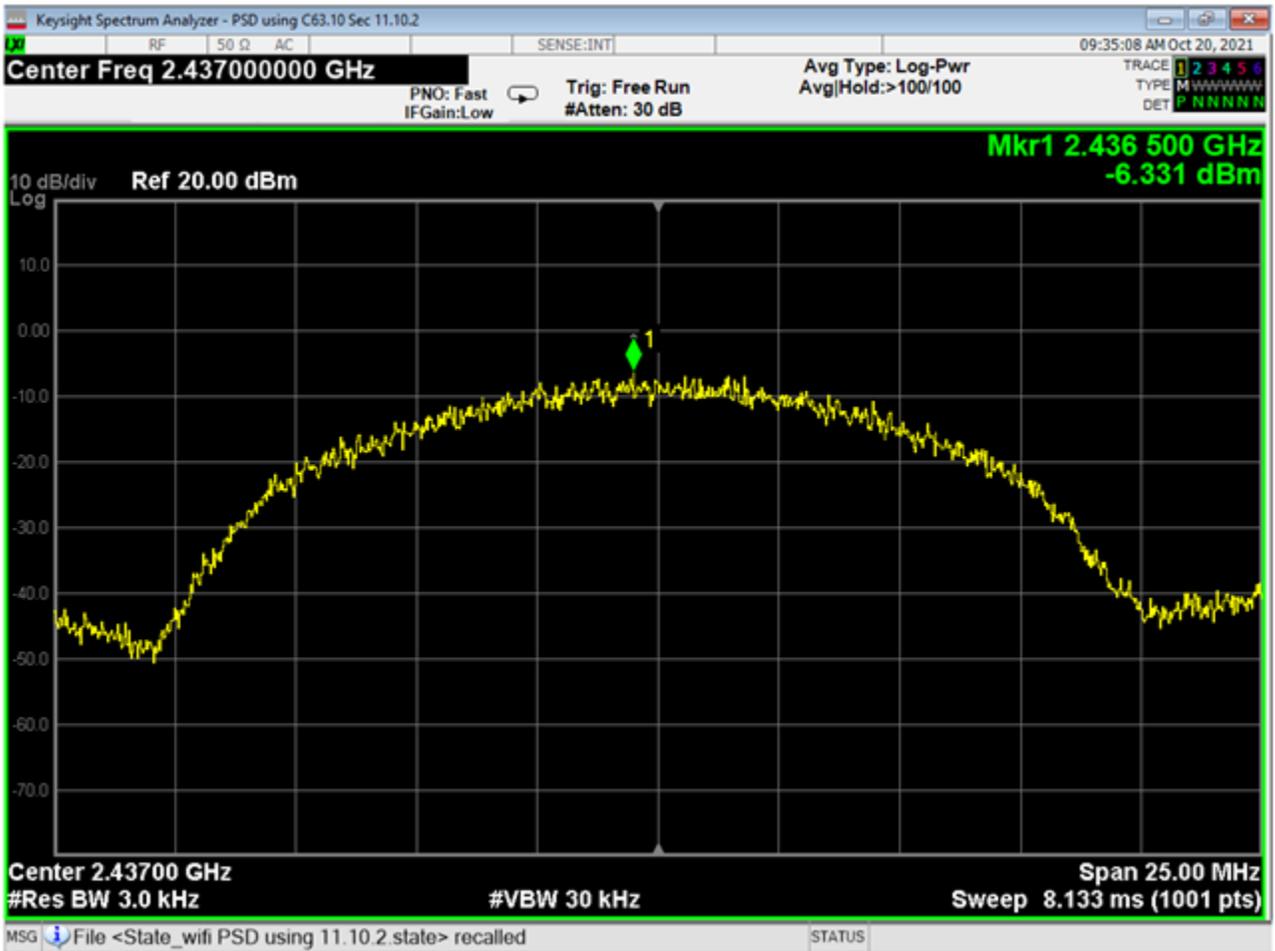
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|----------------|----------------------------|-----|---|
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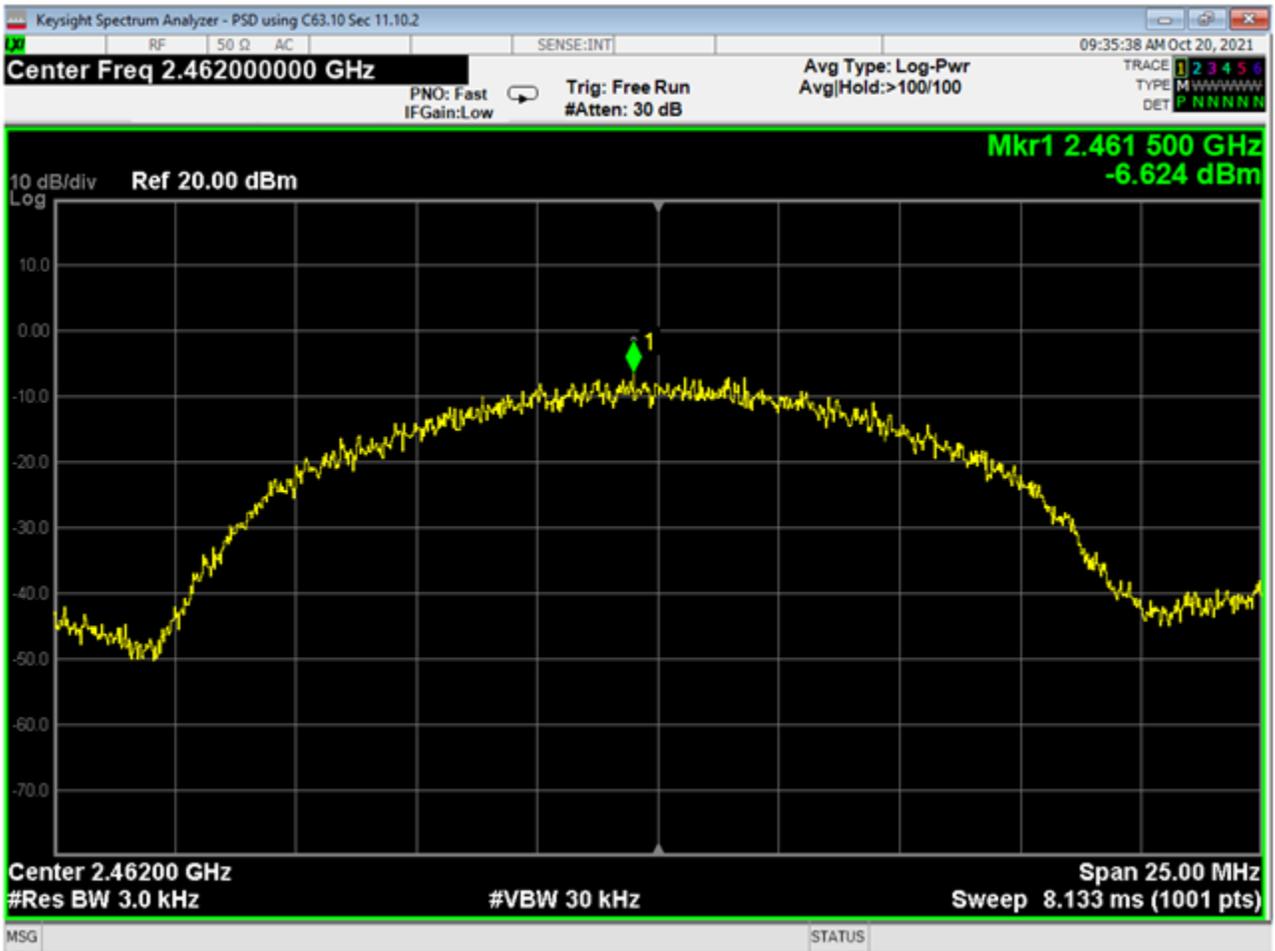
06 OBW-6dB, High, Wifi B



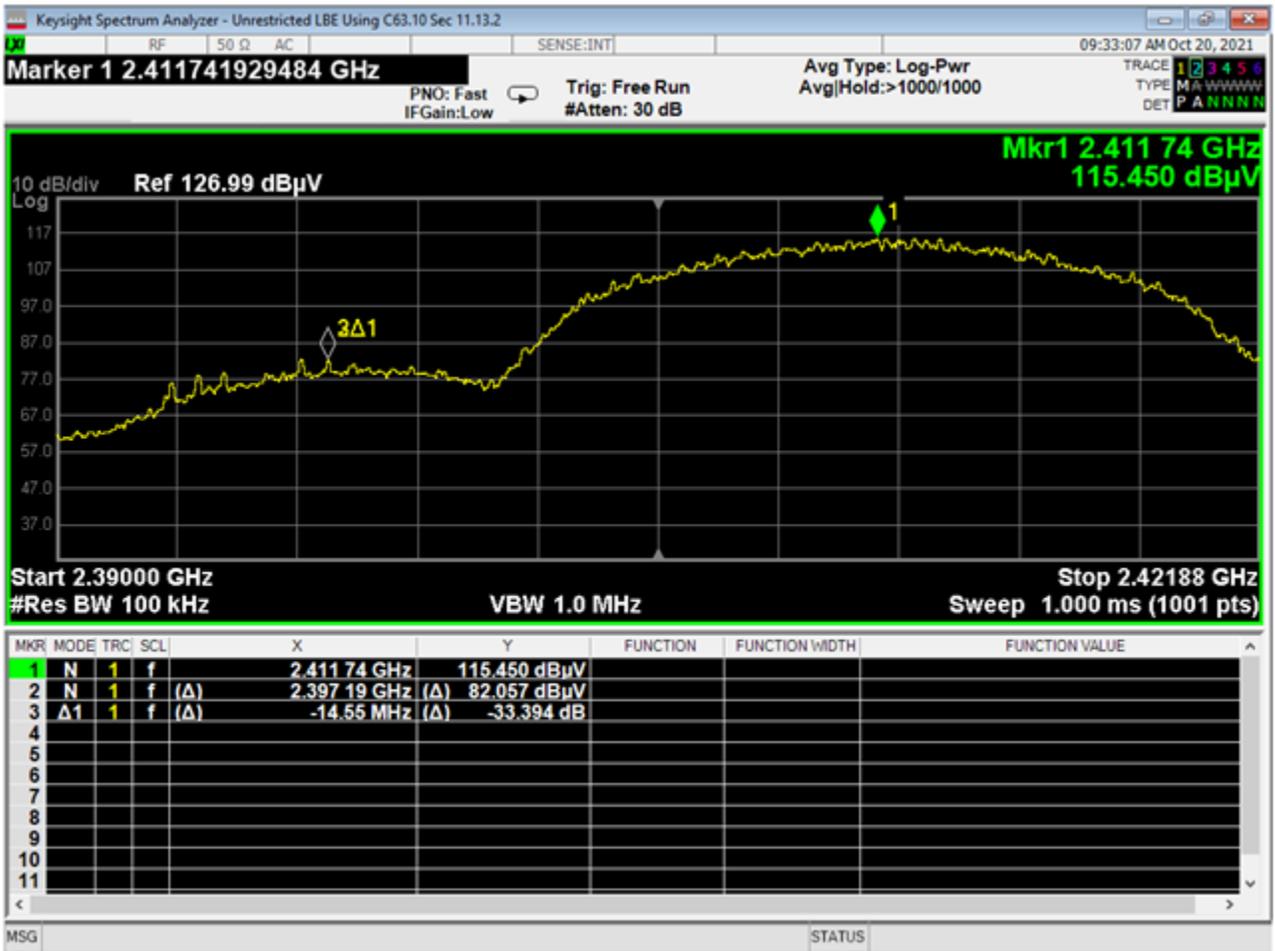
07 PSD, Low, Wifi B



08 PSD, Mid, Wifi B



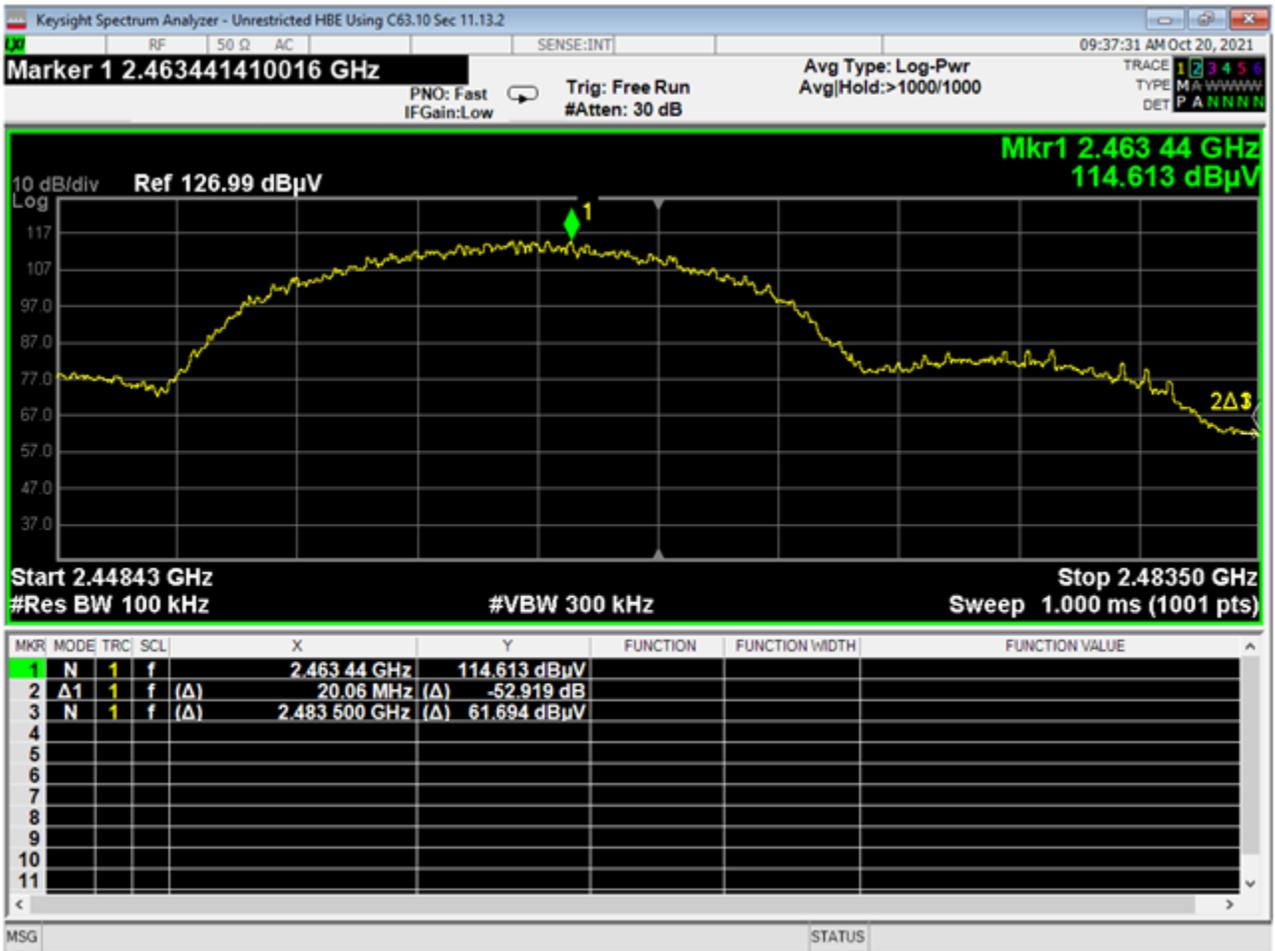
09 PSD, High, Wifi B



10 Lower Bandedge, Unrestricted, Wifi B



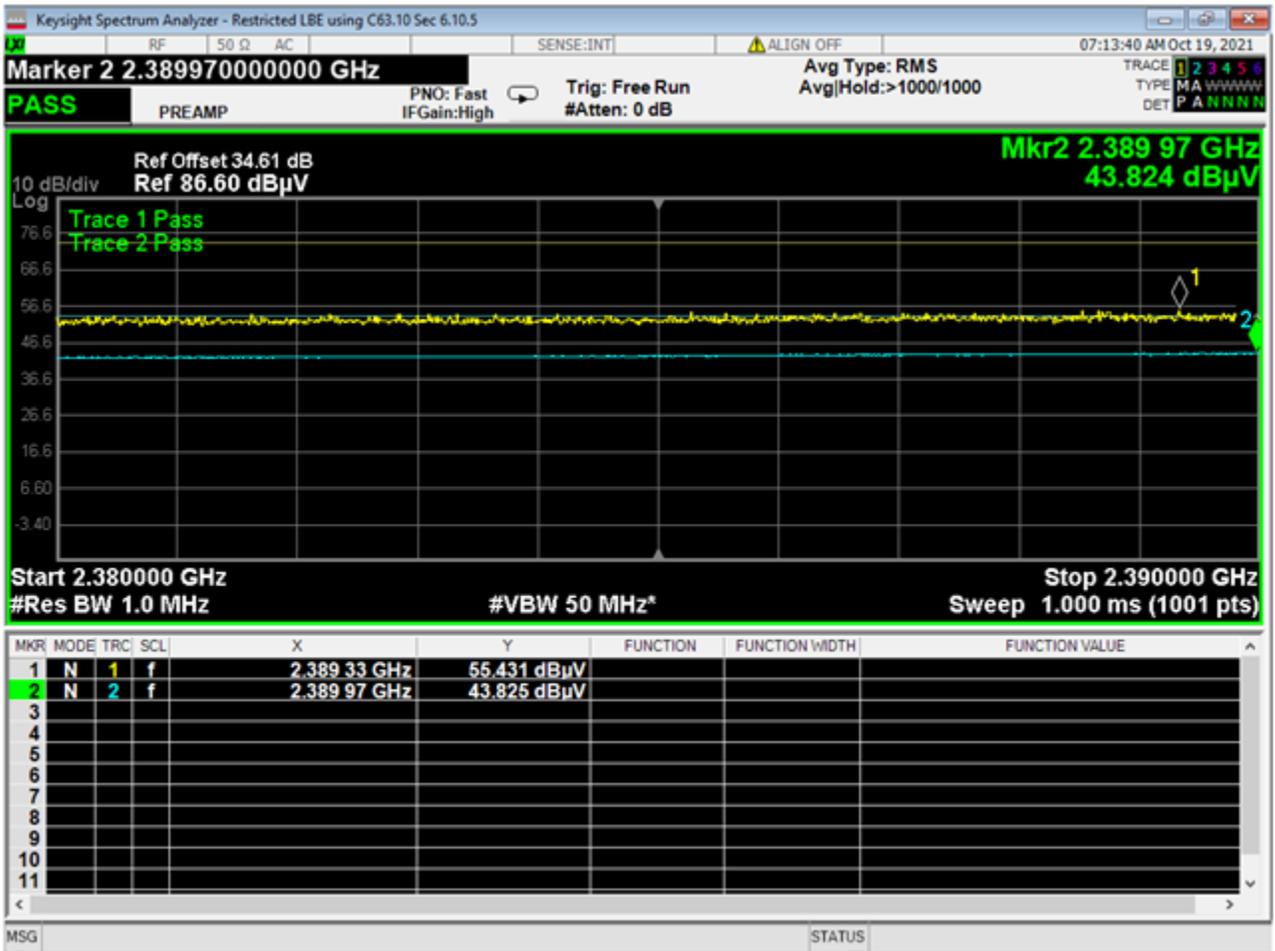
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|----------------|----------------------------|-----|---|
| Report Number: | R20210128-20-E28 | Rev | 0 |
| Prepared for: | Garmin International, Inc. | | |



11 Higher Bandedge, Unrestricted, Wifi B



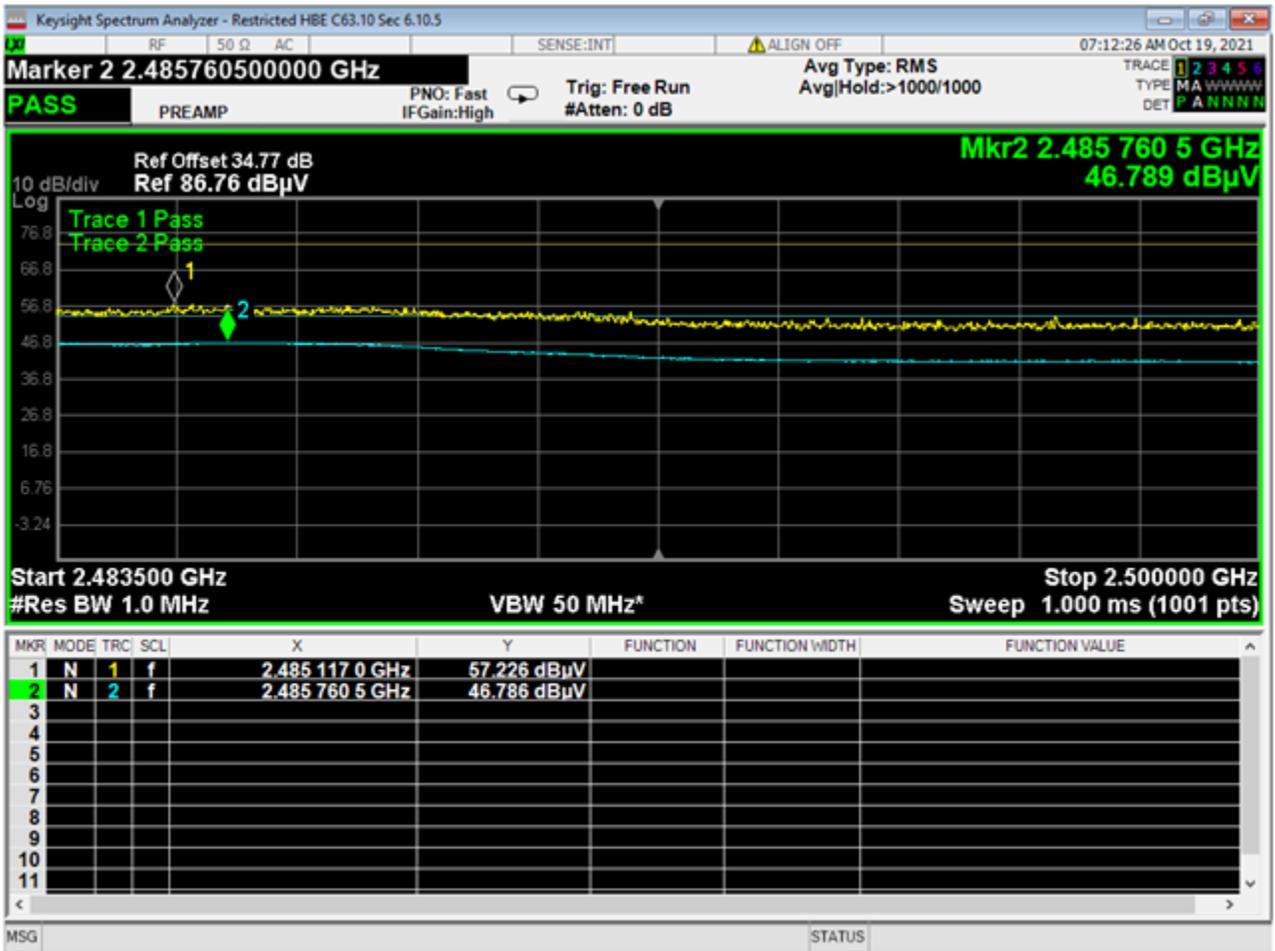
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|----------------|----------------------------|-----|---|
| Report Number: | R20210128-20-E28 | Rev | 0 |
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12 Lower Bandedge, Restricted, Wifi B



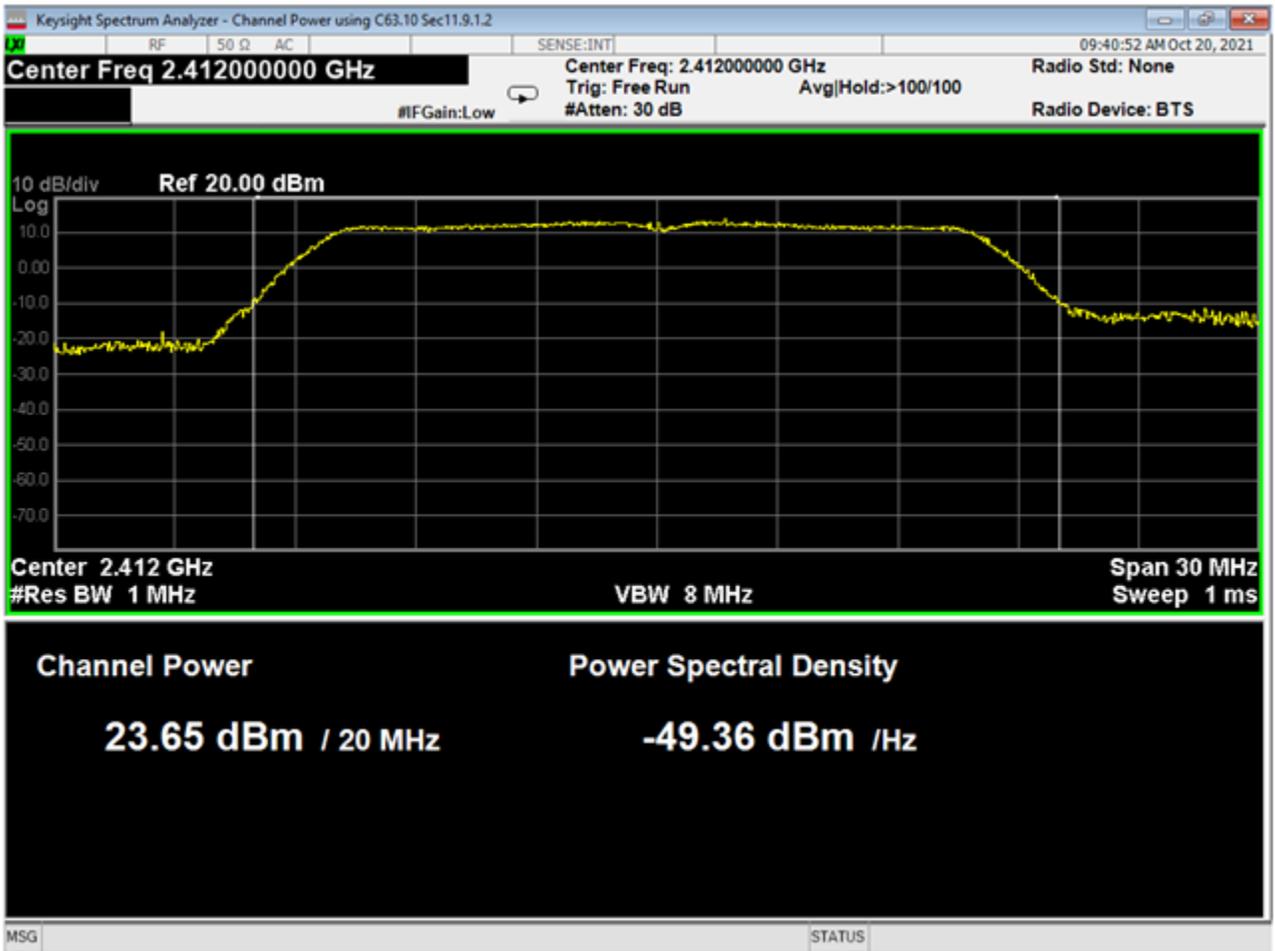
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|----------------|----------------------------|-----|---|
| Report Number: | R20210128-20-E28 | Rev | 0 |
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13 Higher Bandedge, Restricted, Wifi B



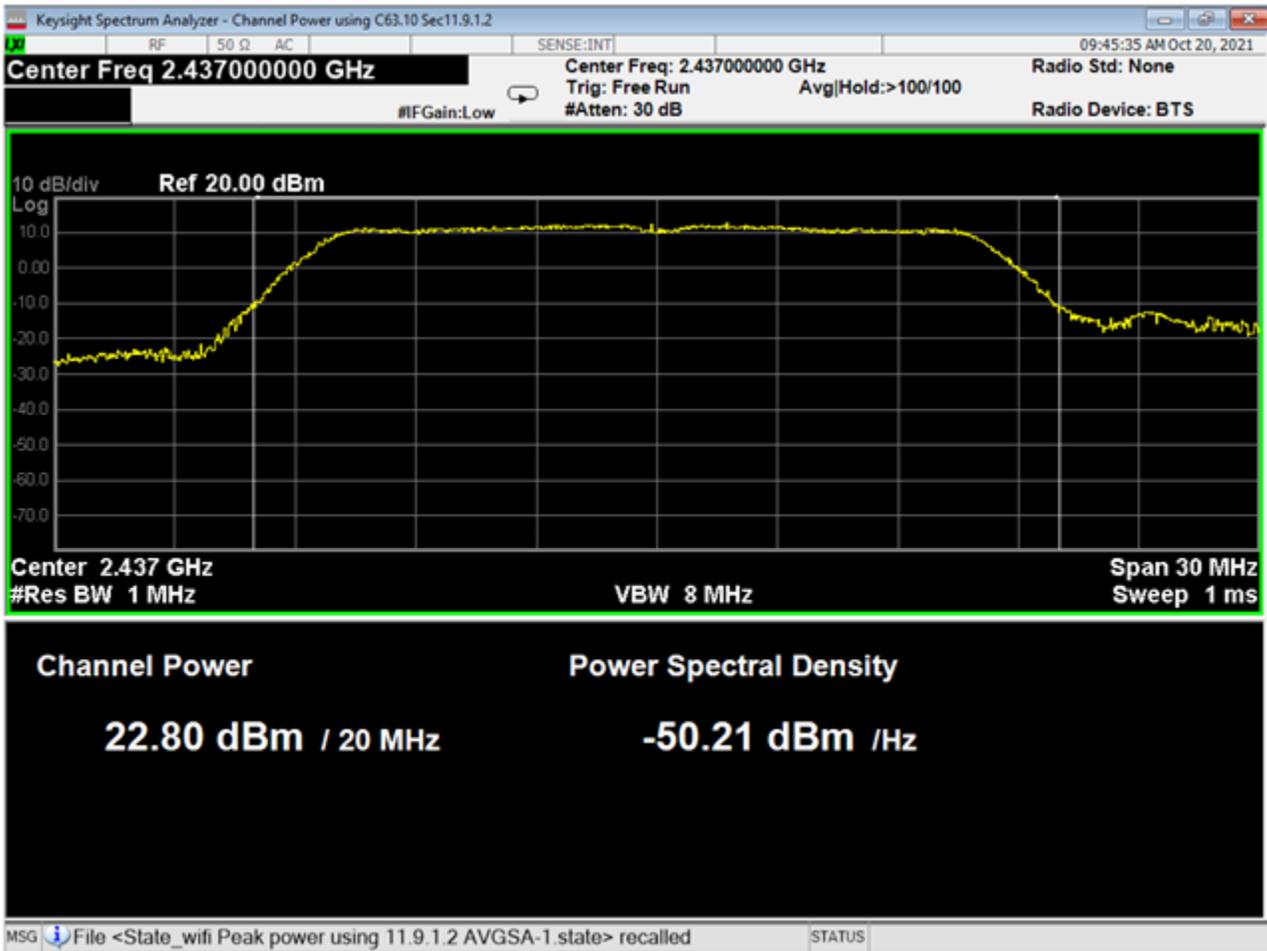
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| Report Number: | R20210128-20-E28 | Rev | 0 |
| Prepared for: | Garmin International, Inc. | | |



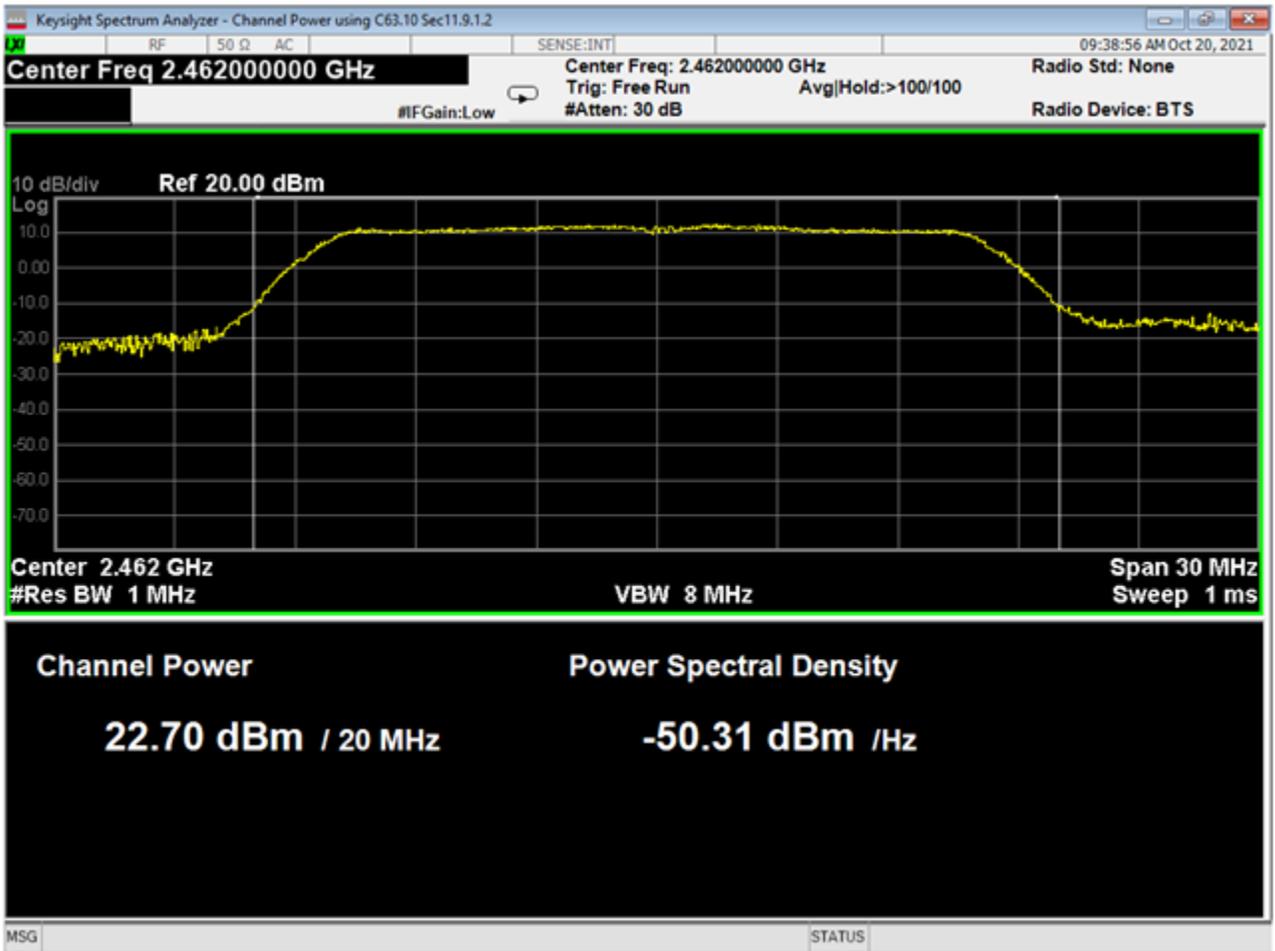
14 Power, Low, Wifi G



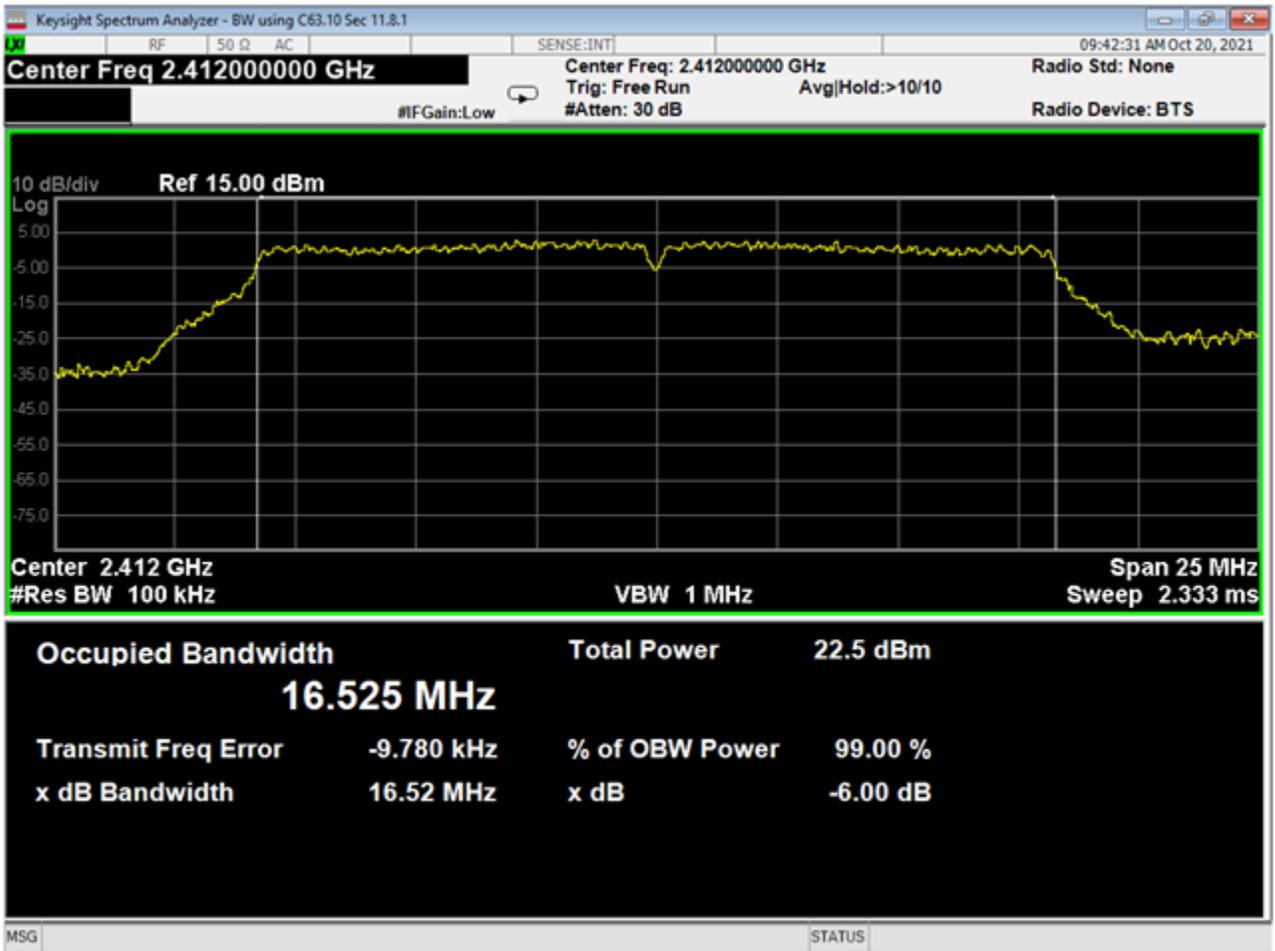
| | | | |
|----------------|----------------------------|-----|---|
| Report Number: | R20210128-20-E28 | Rev | 0 |
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15 Power, Mid, Wifi G



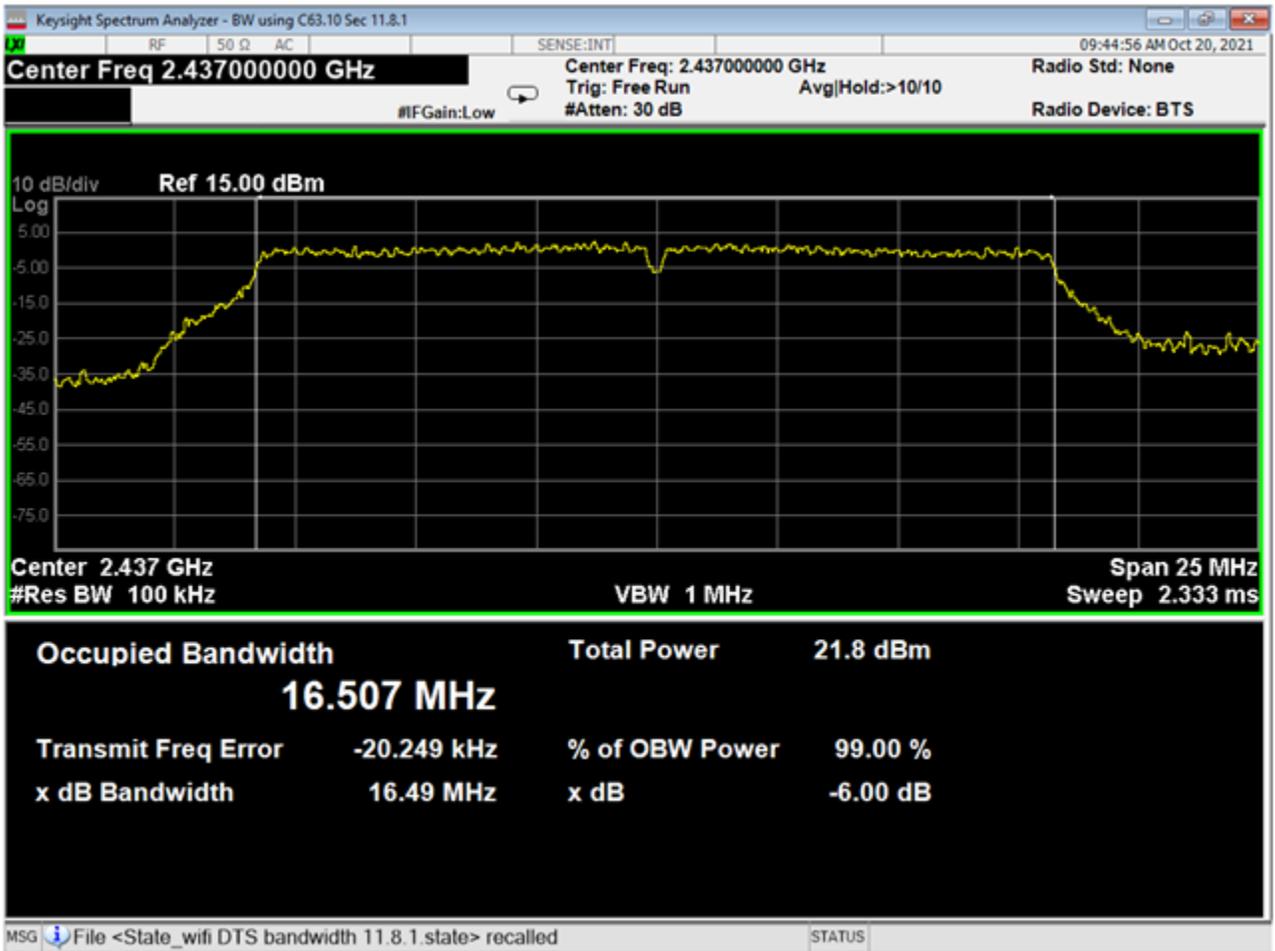
16 Power, High, Wifi G



17 OBW-6dB, Low, Wifi G



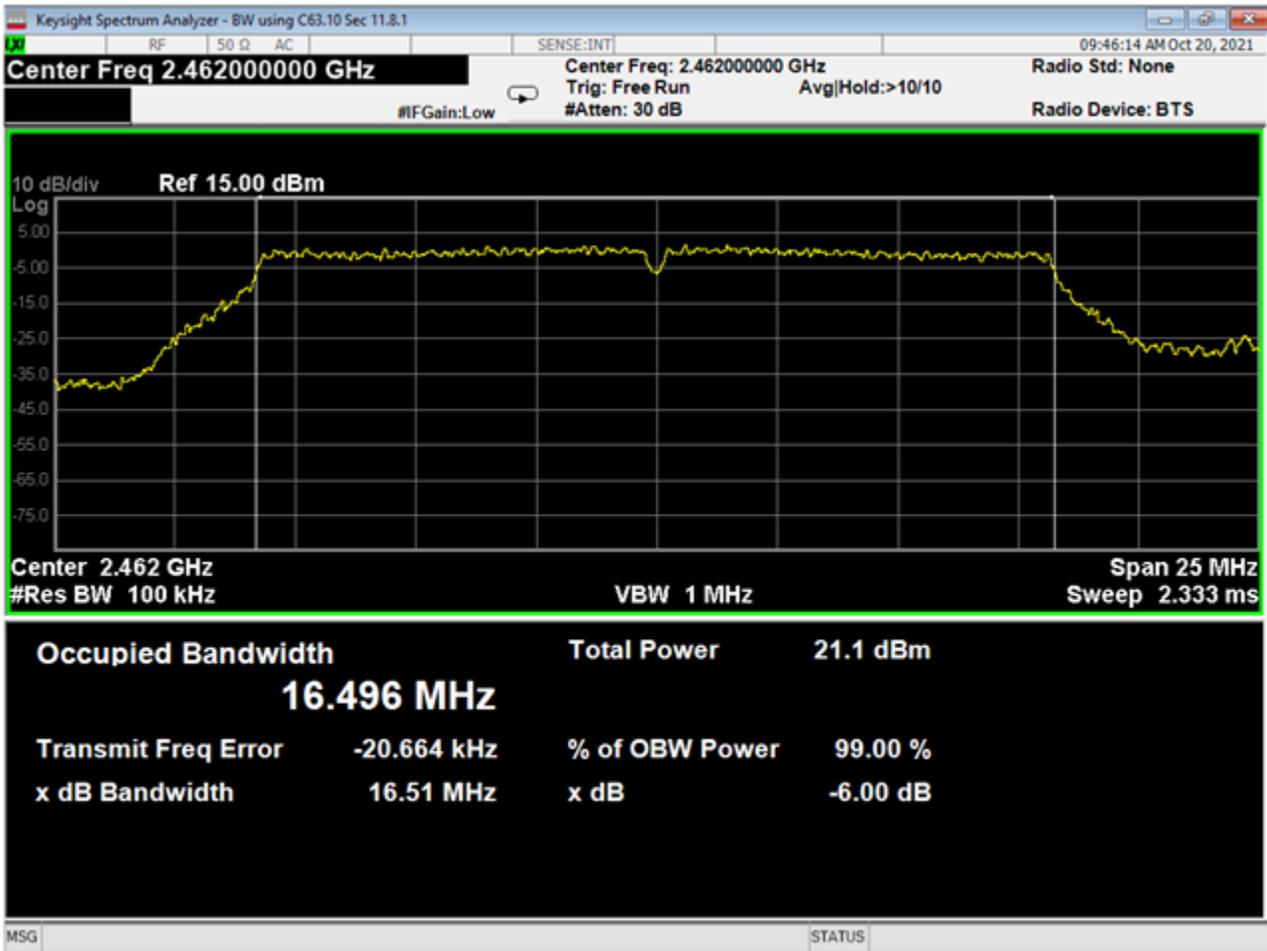
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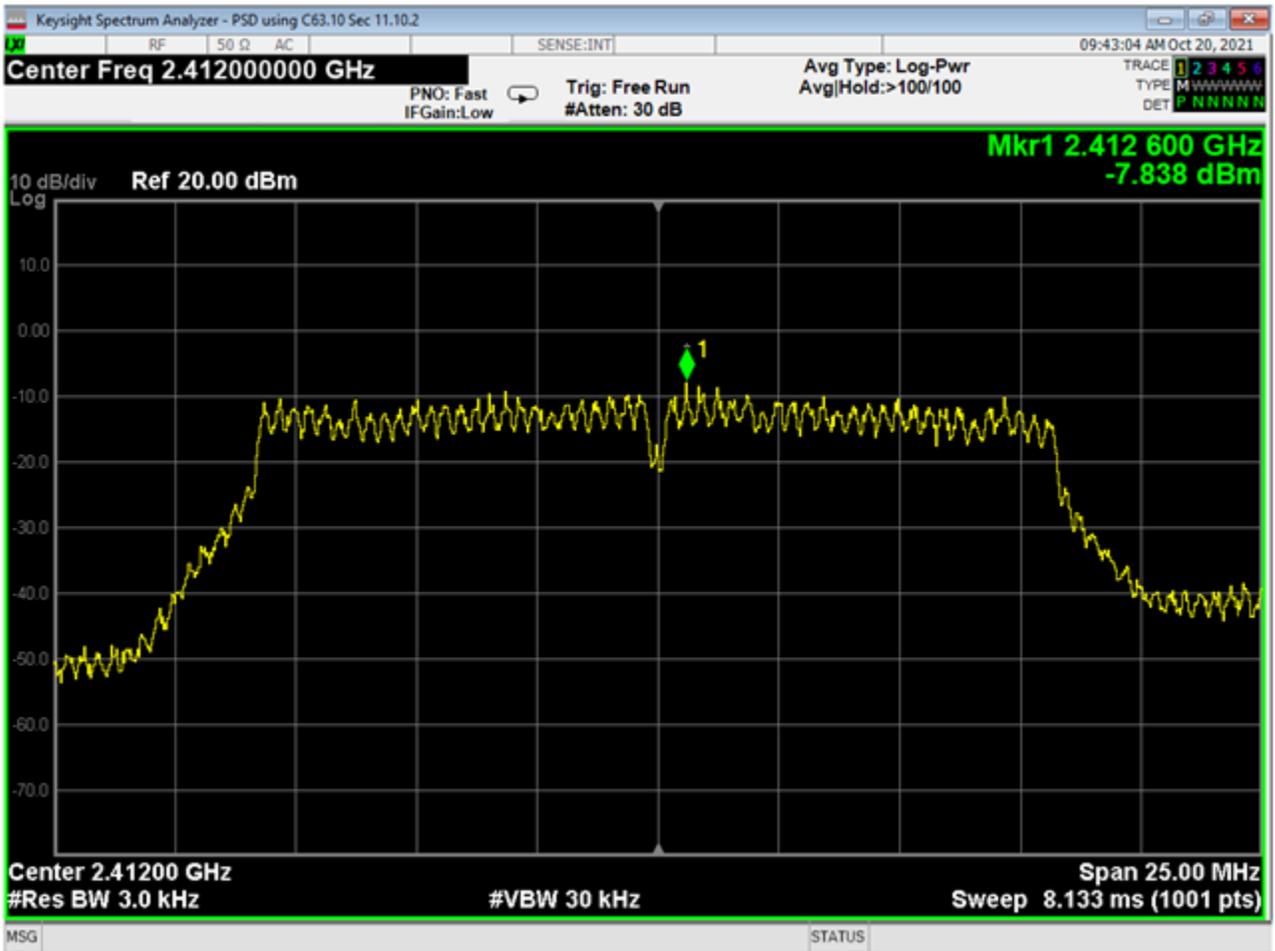
18 OBW-6dB, Mid, Wifi G



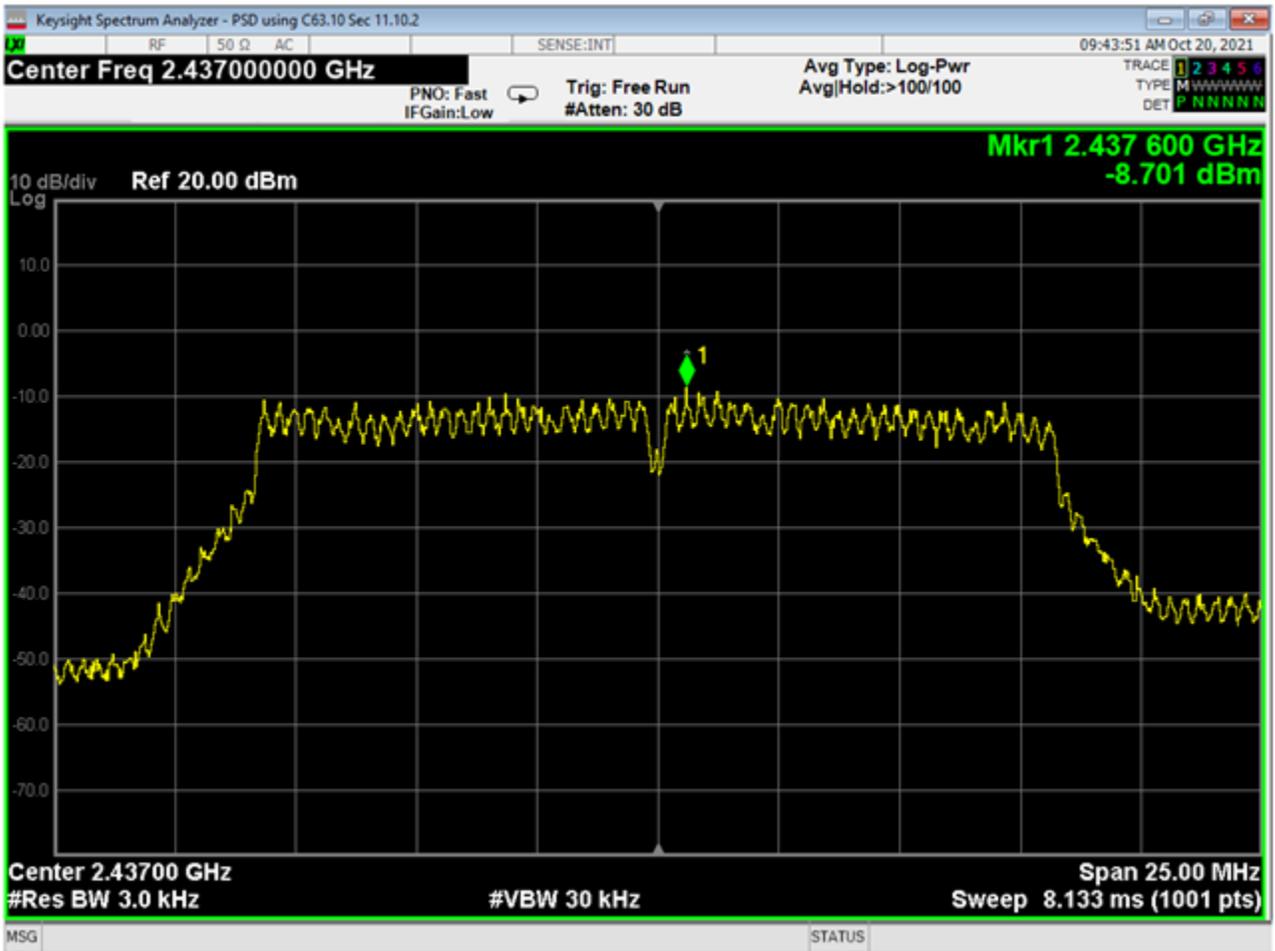
| | | | |
|----------------|----------------------------|-----|---|
| Report Number: | R20210128-20-E28 | Rev | 0 |
| Prepared for: | Garmin International, Inc. | | |



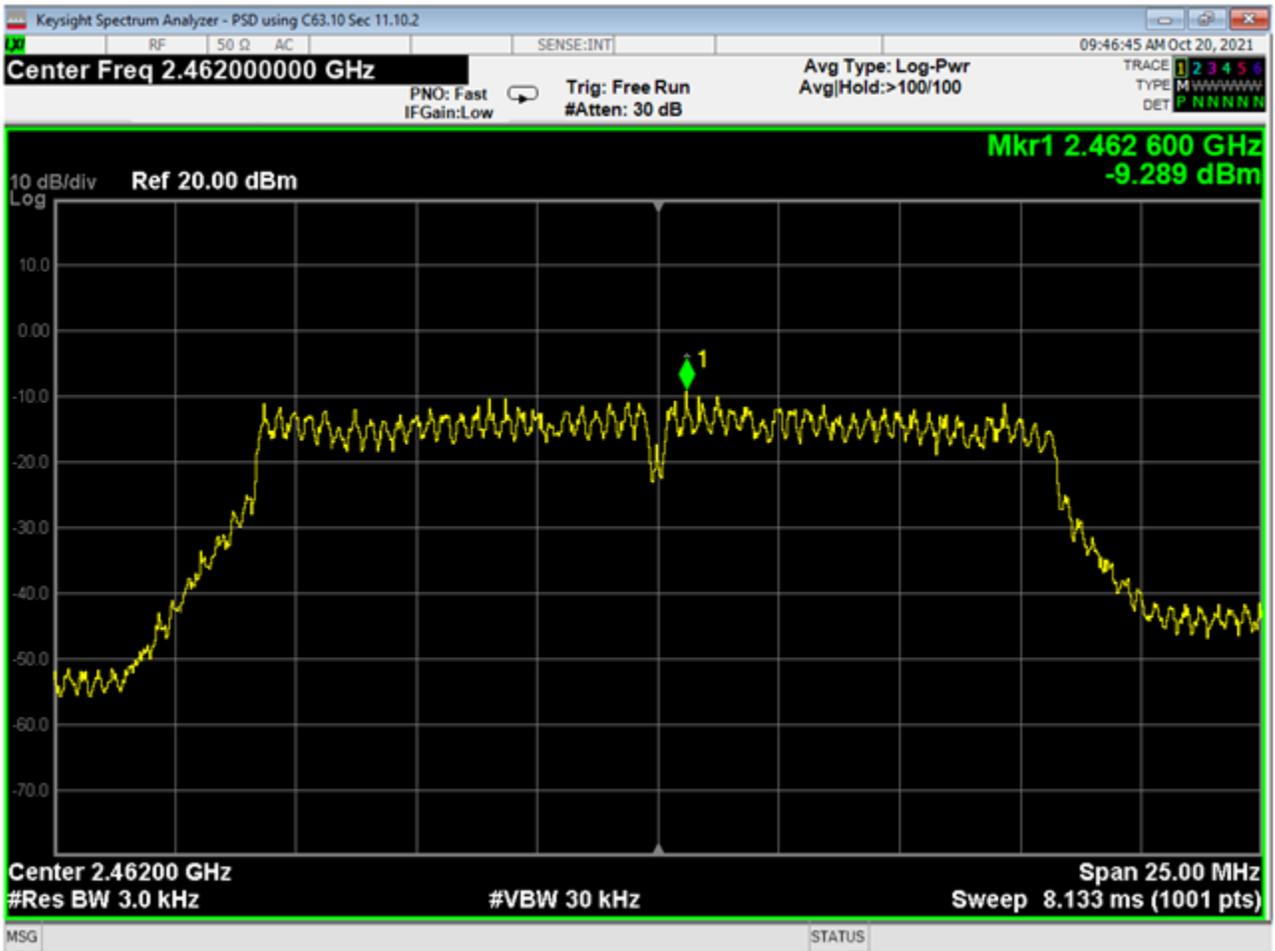
19 OBW-6dB, High, Wifi G



20 PSD, Low, Wifi G



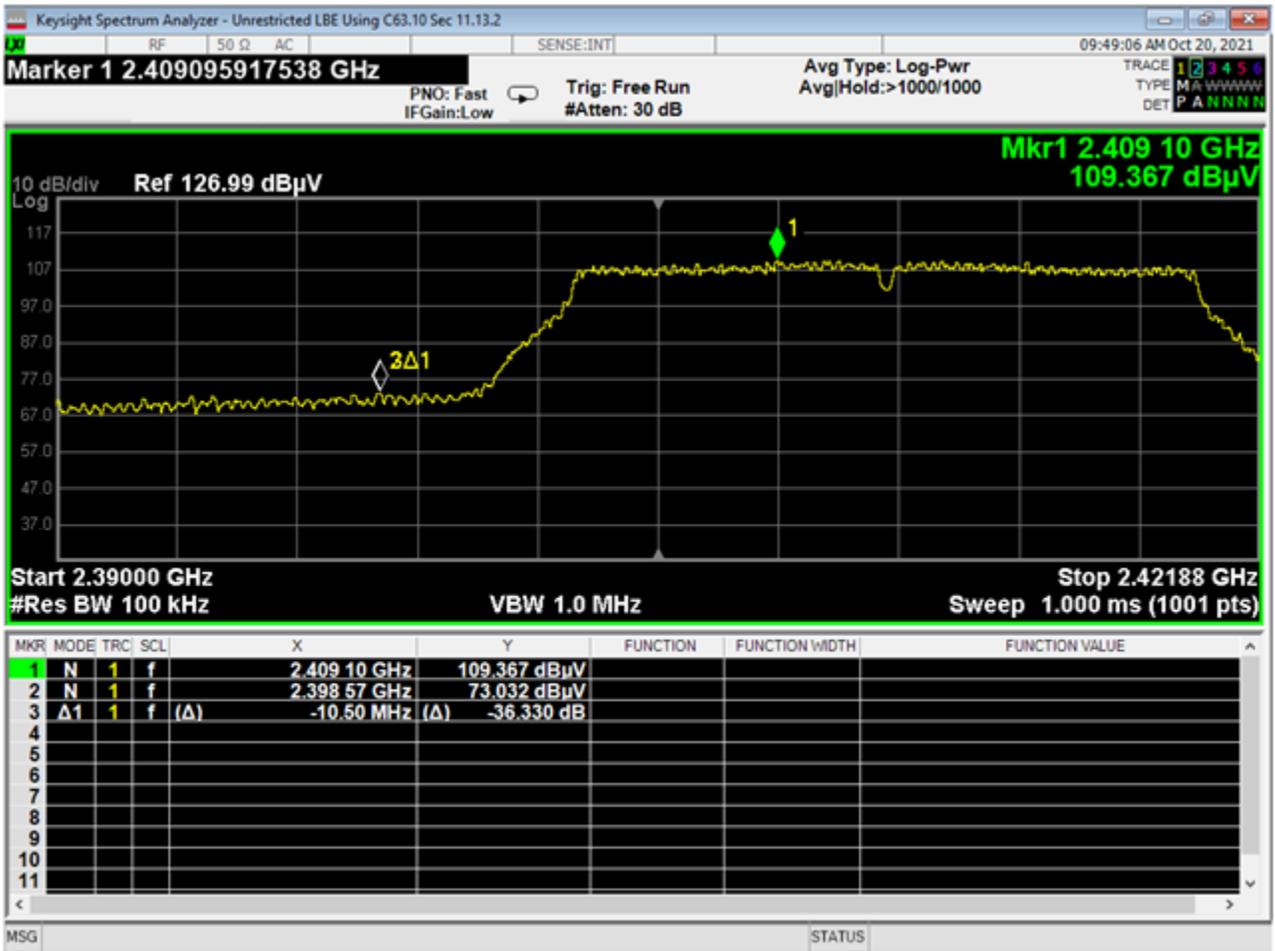
21 PSD, Mid, Wifi G



22 PSD, High, Wifi G



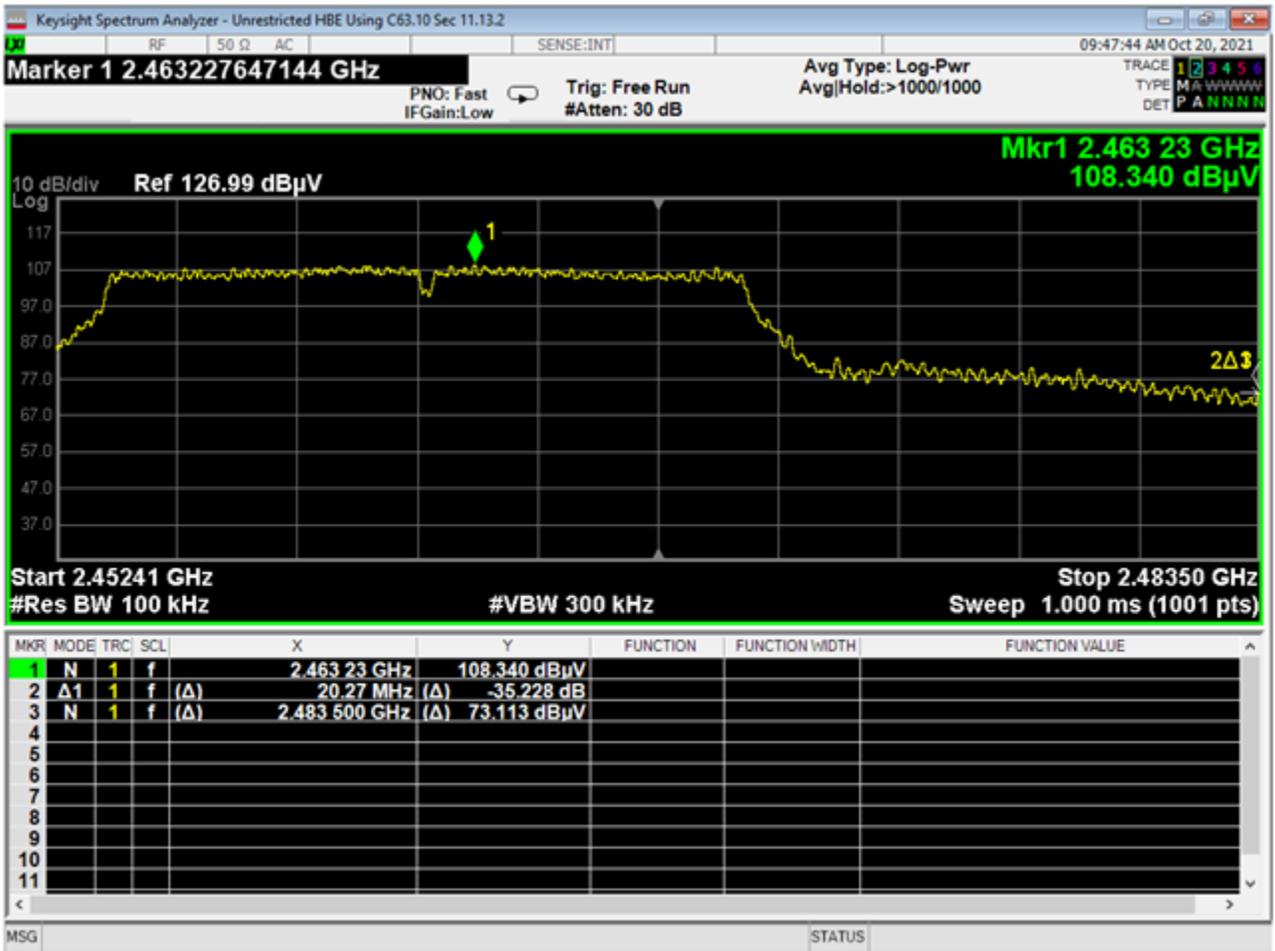
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|----------------|----------------------------|-----|---|
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23 Lower Bandedge, Unrestricted, Wifi G



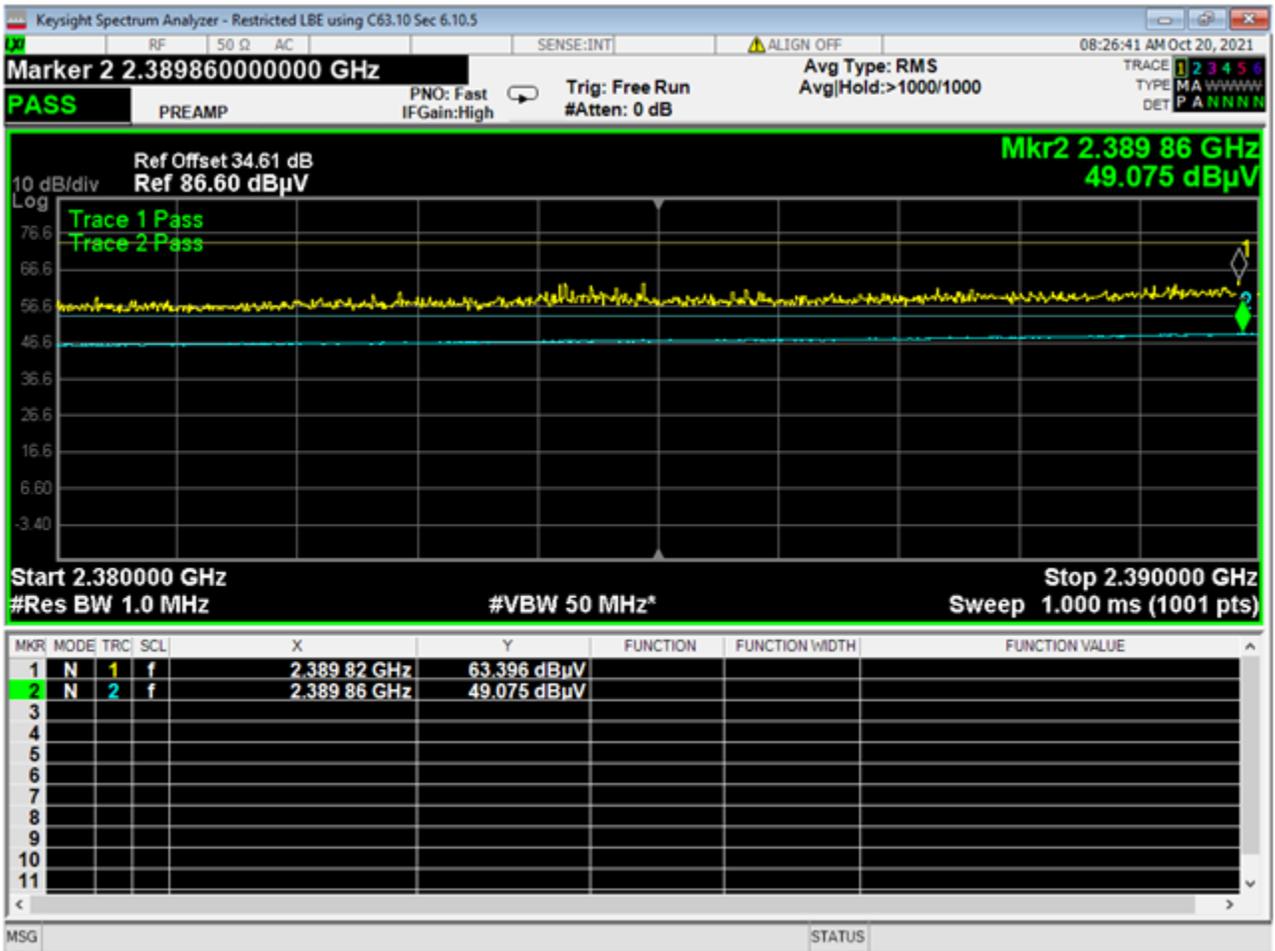
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24 Higher Bandedge, Unrestricted, Wifi G



| | | | |
|----------------|----------------------------|-----|---|
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| Prepared for: | Garmin International, Inc. | | |



25 Lower Bandedge, Restricted, Wifi G



Report Number:

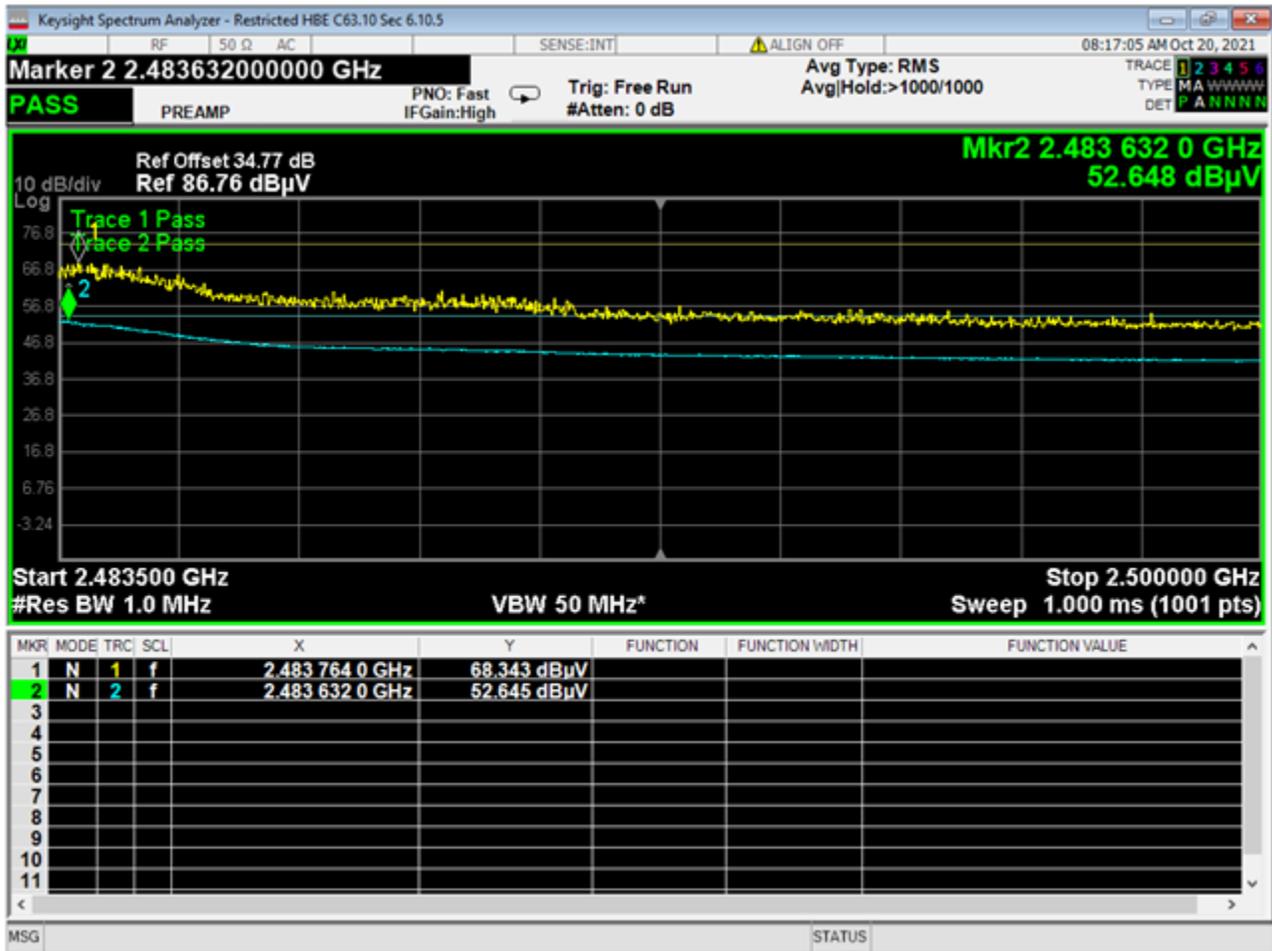
R20210128-20-E28

Rev

0

Prepared for:

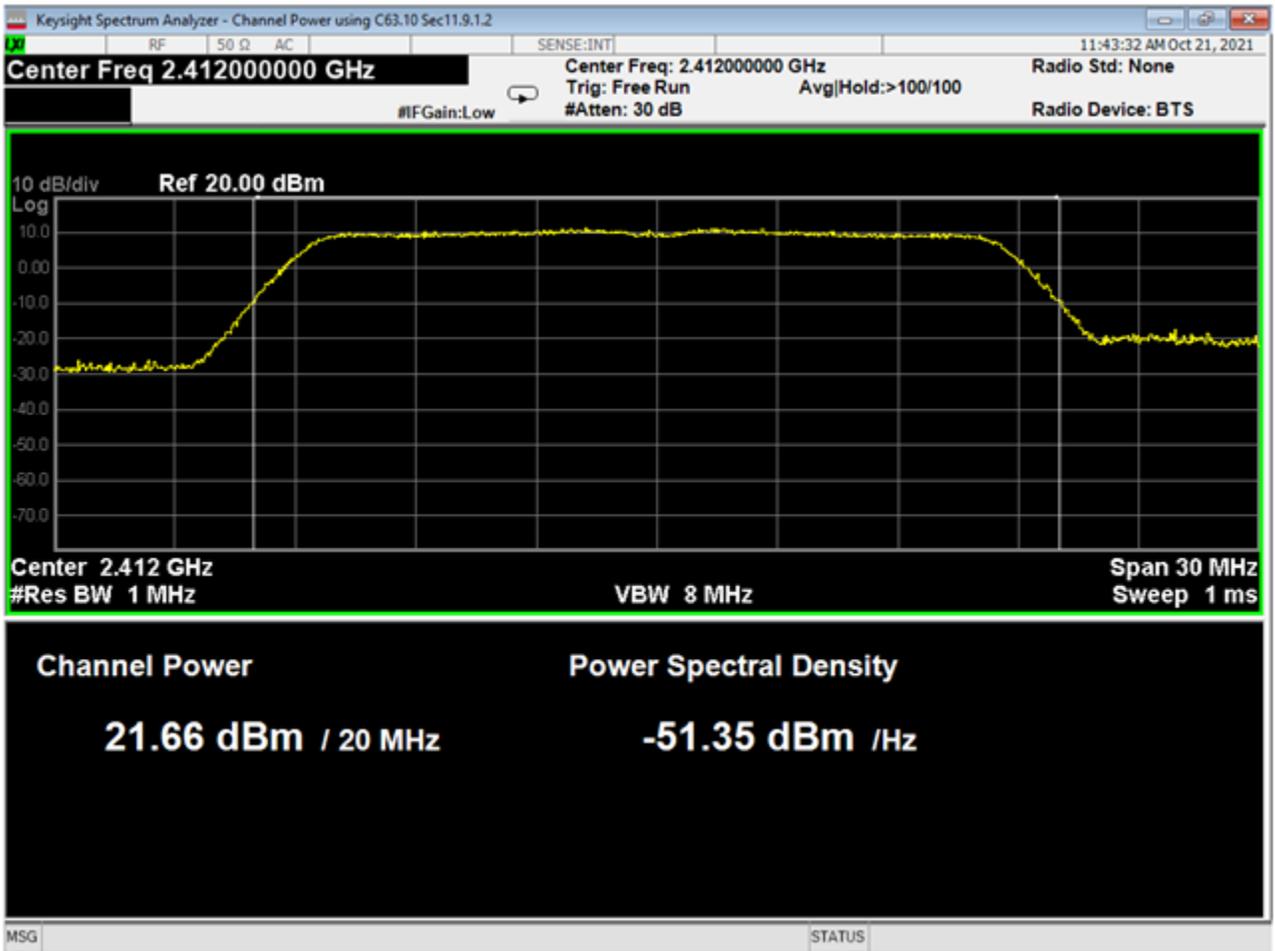
Garmin International, Inc.



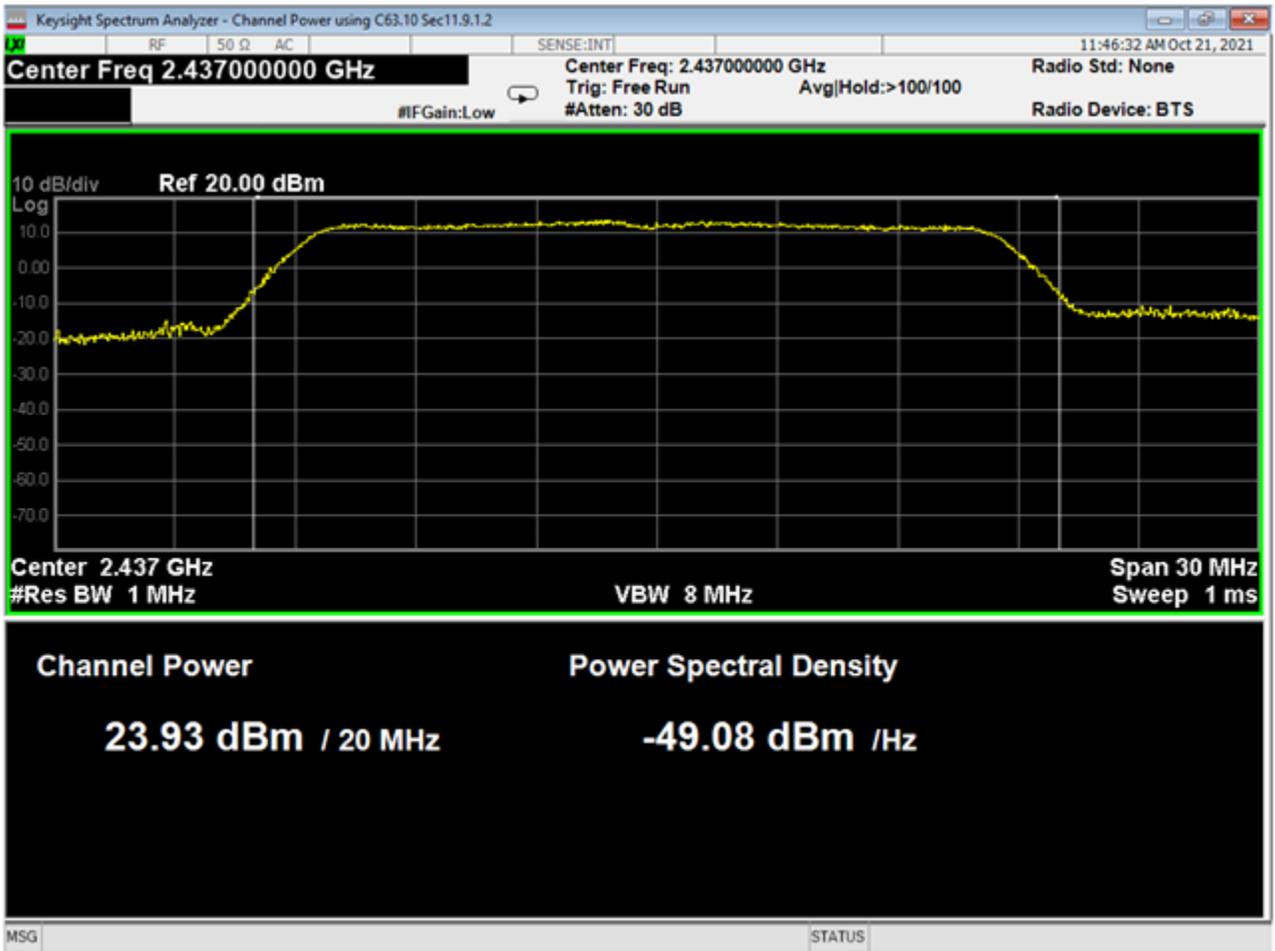
26 Higher Bandedge, Restricted, Wifi G



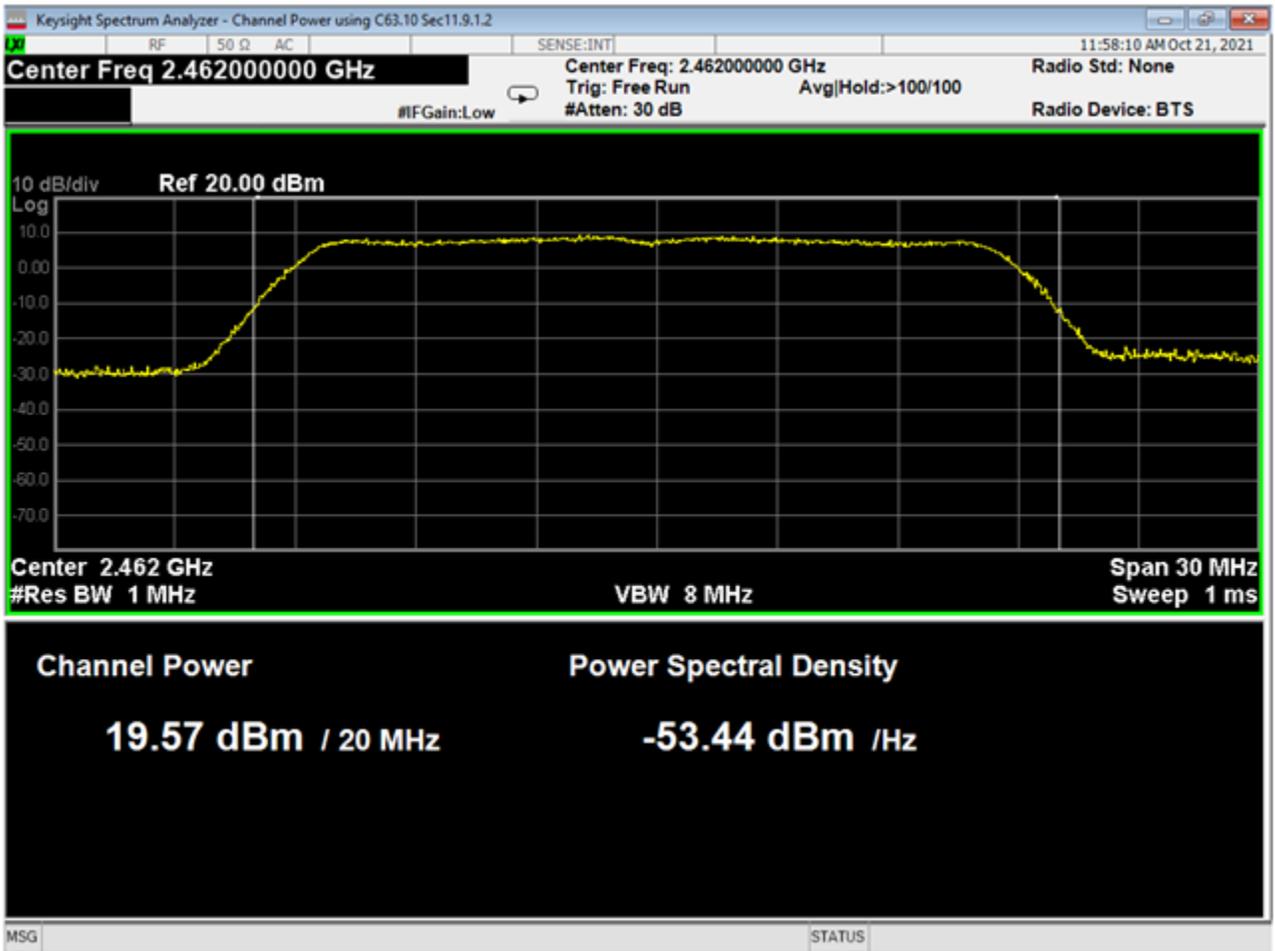
| | | | |
|----------------|----------------------------|-----|---|
| Report Number: | R20210128-20-E28 | Rev | 0 |
| Prepared for: | Garmin International, Inc. | | |



27 Power, Low, Wifi N



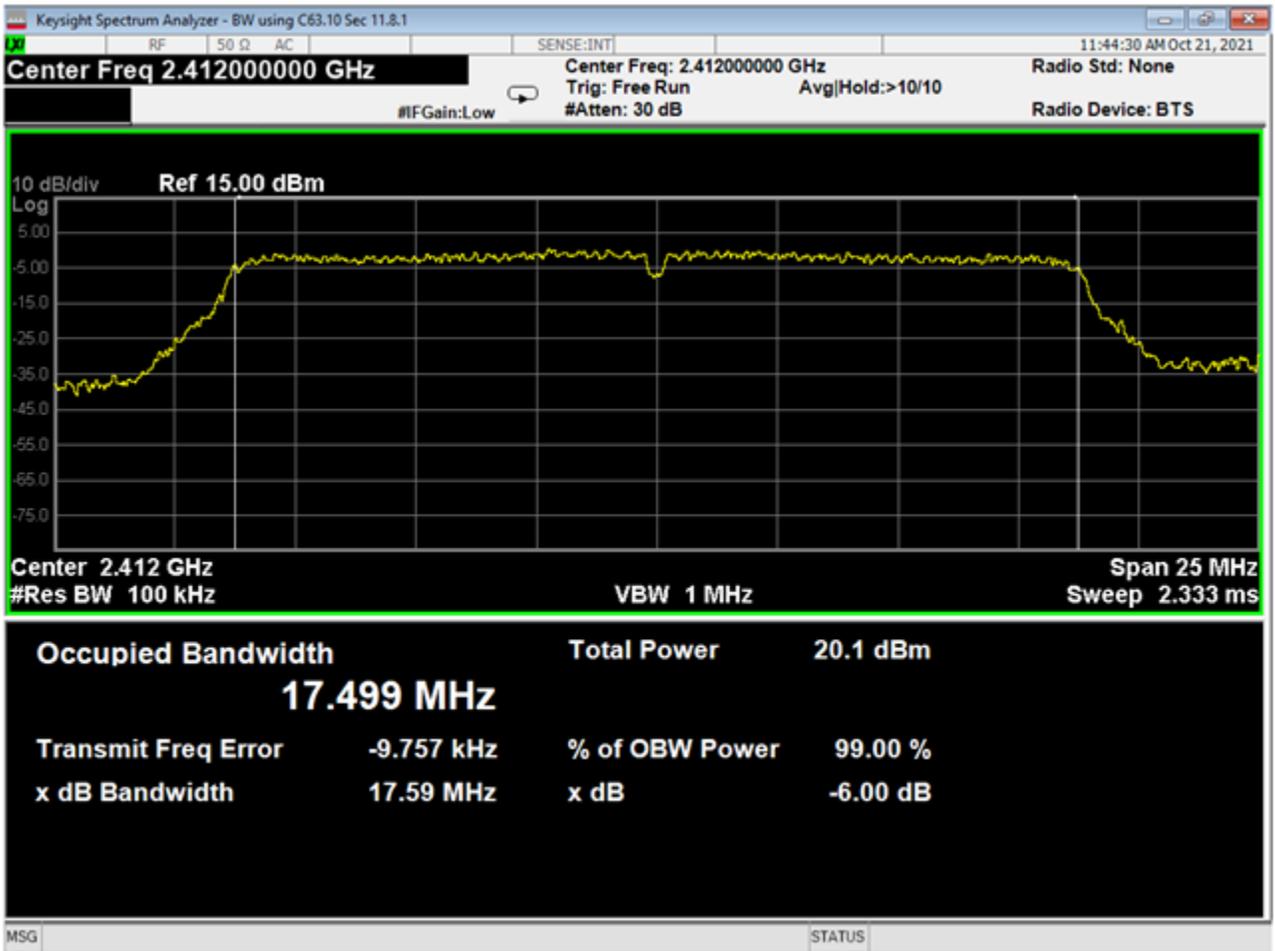
28 Power, Mid, Wifi N



29 Power, High, Wifi N



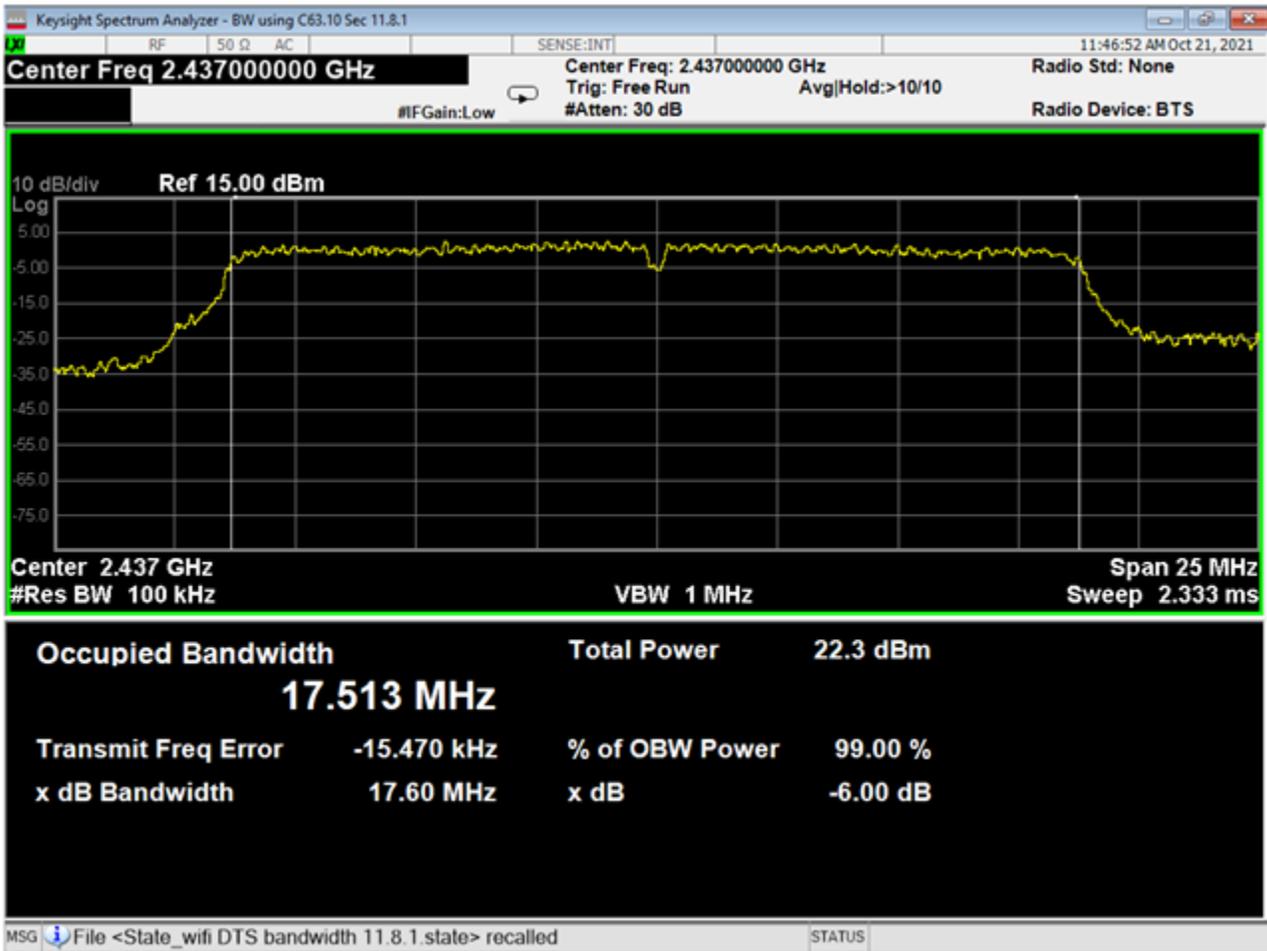
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|----------------|----------------------------|-----|---|
| Report Number: | R20210128-20-E28 | Rev | 0 |
| Prepared for: | Garmin International, Inc. | | |



30 OBW-6dB, Low, Wifi N



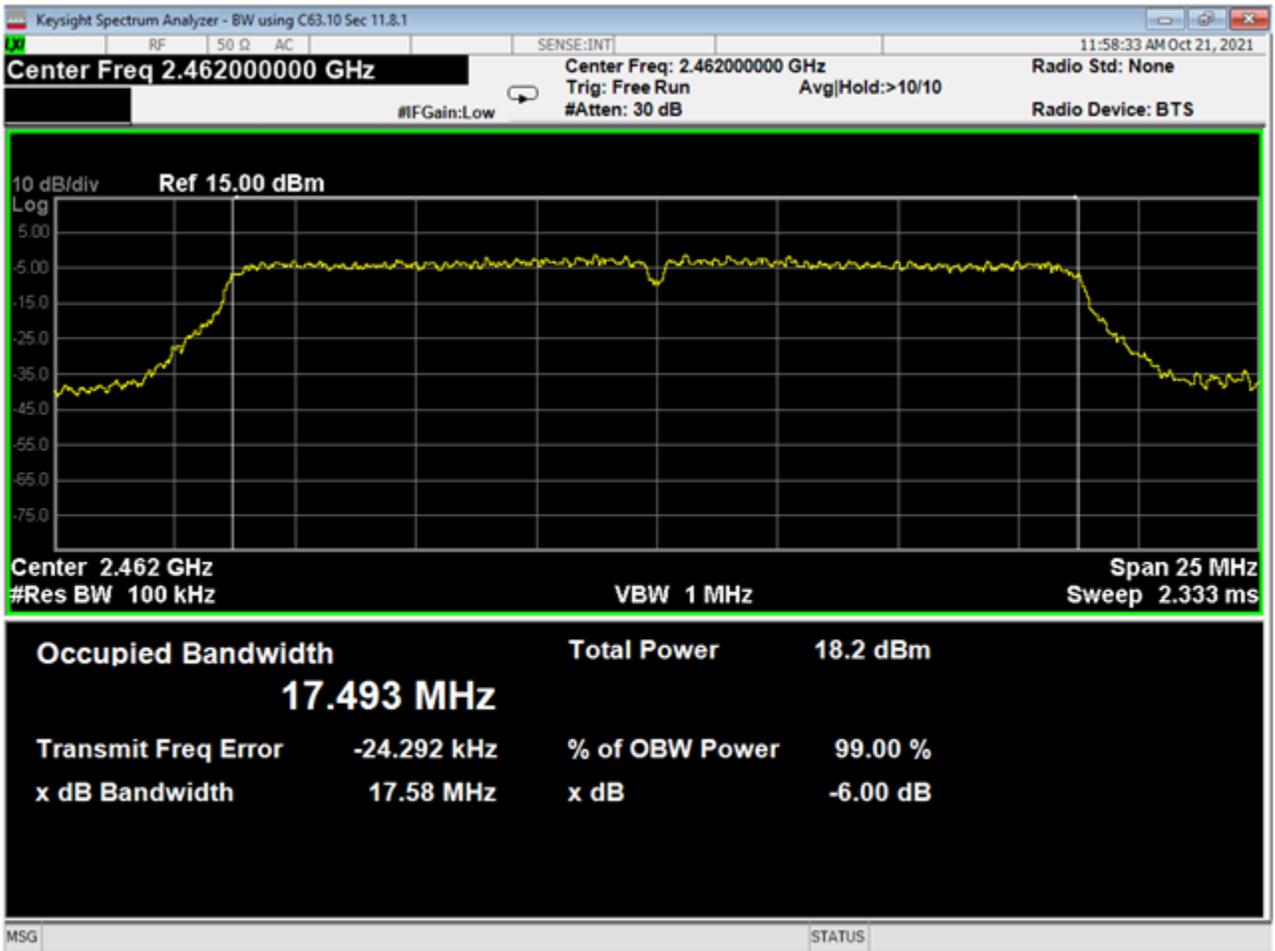
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|----------------|----------------------------|-----|---|
| Report Number: | R20210128-20-E28 | Rev | 0 |
| Prepared for: | Garmin International, Inc. | | |



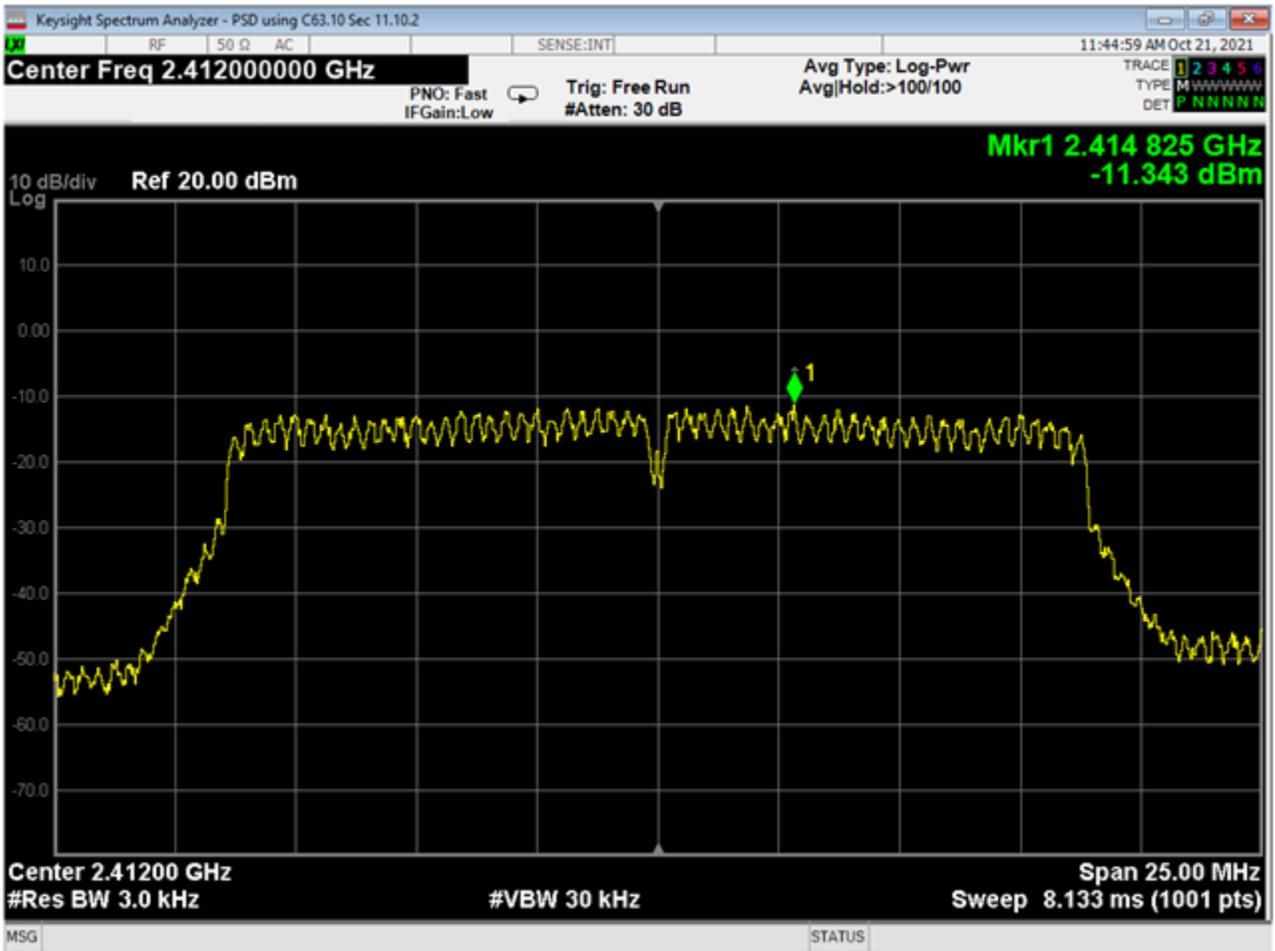
31 OBW-6dB, Mid, Wifi N



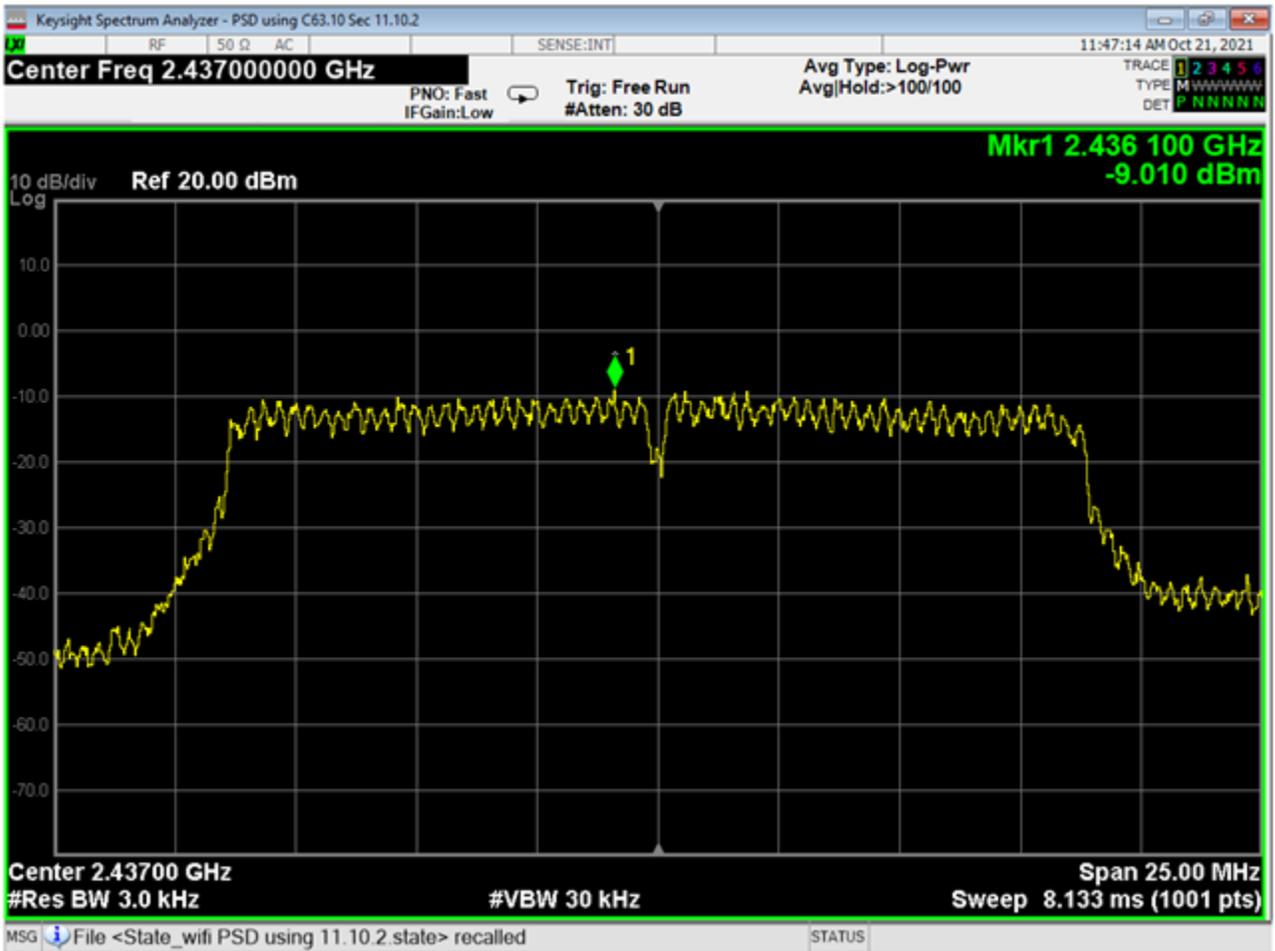
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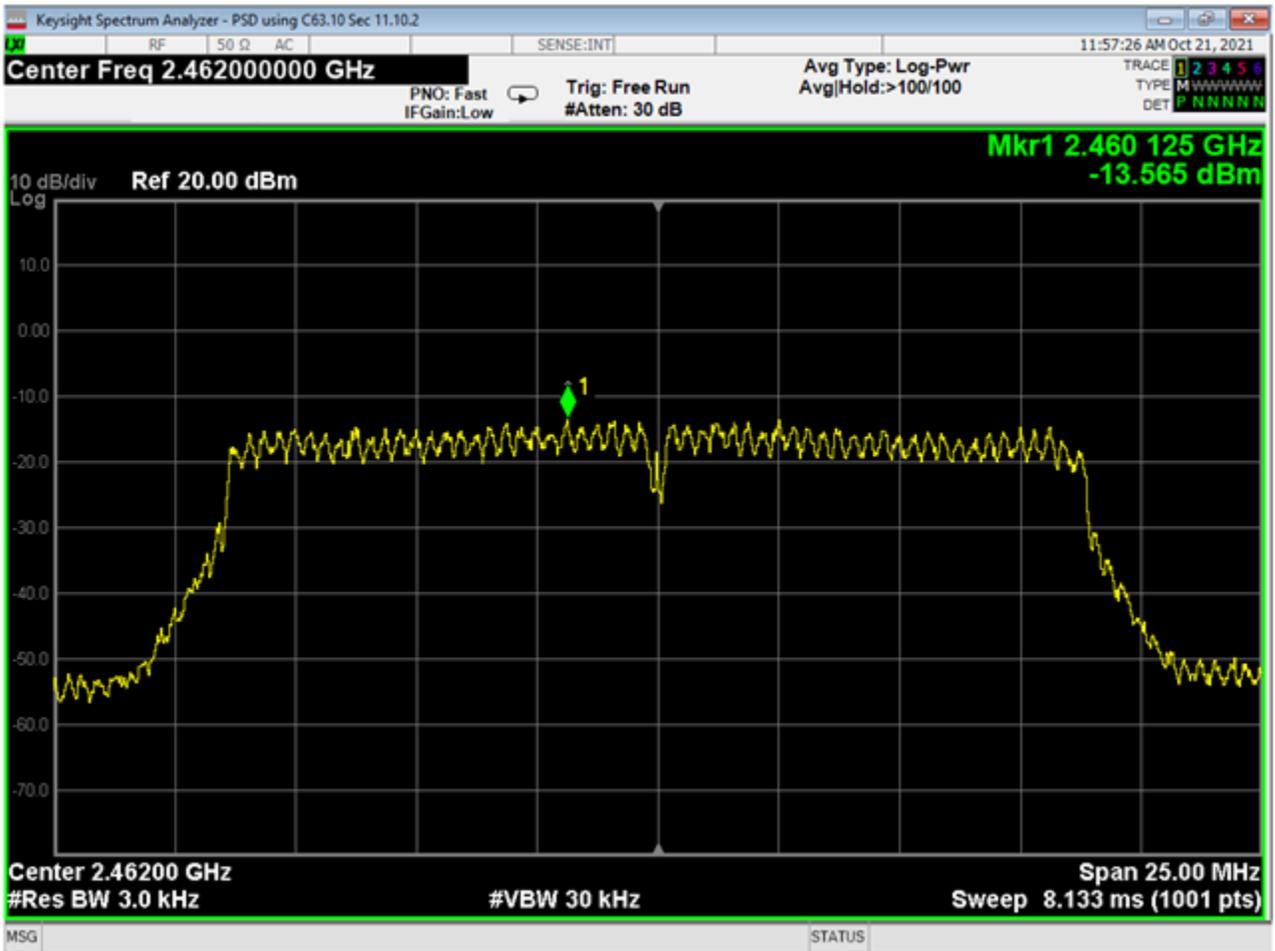
32 OBW-6dB, High, Wifi N



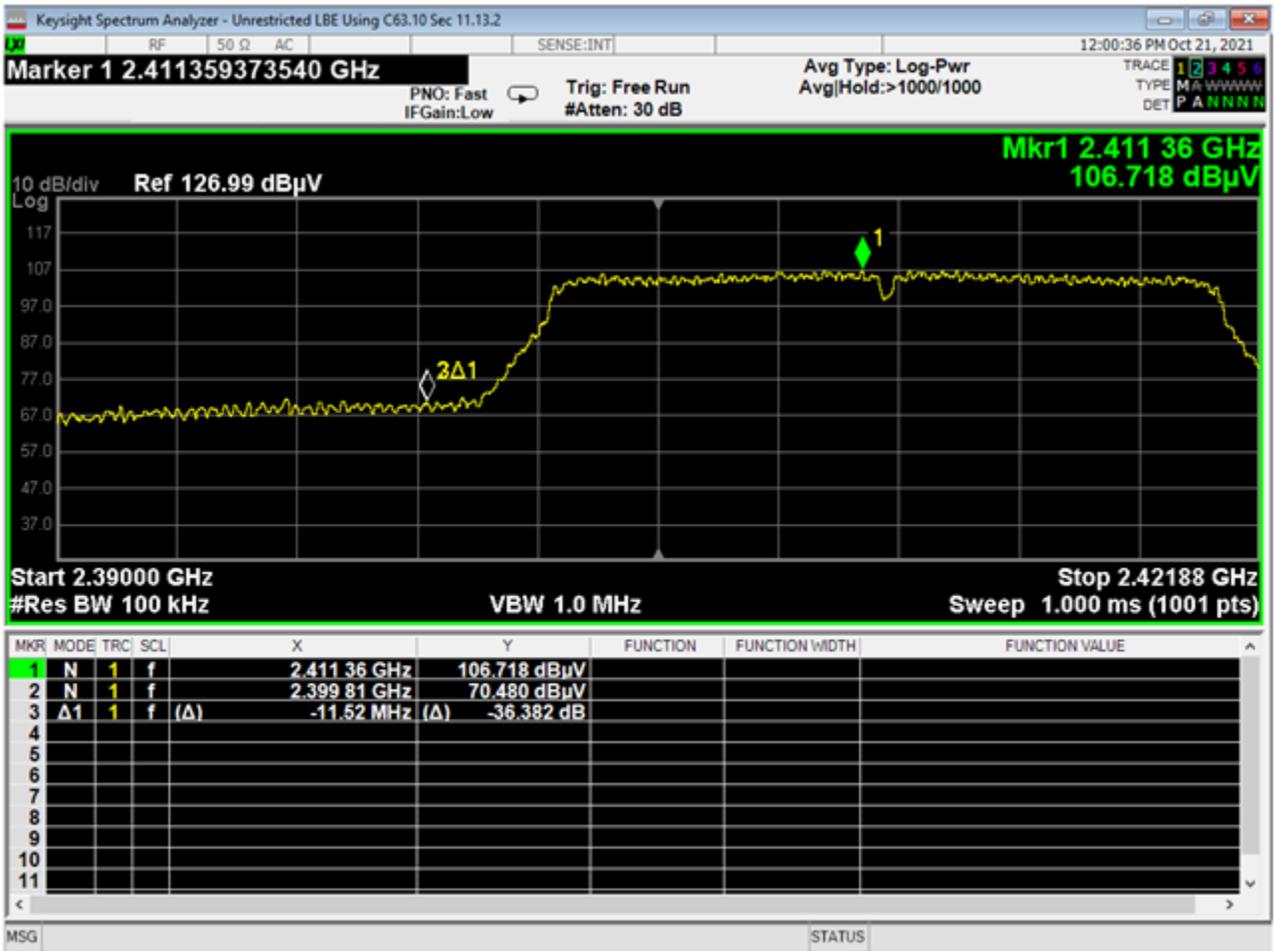
33 PSD, Low, Wifi N



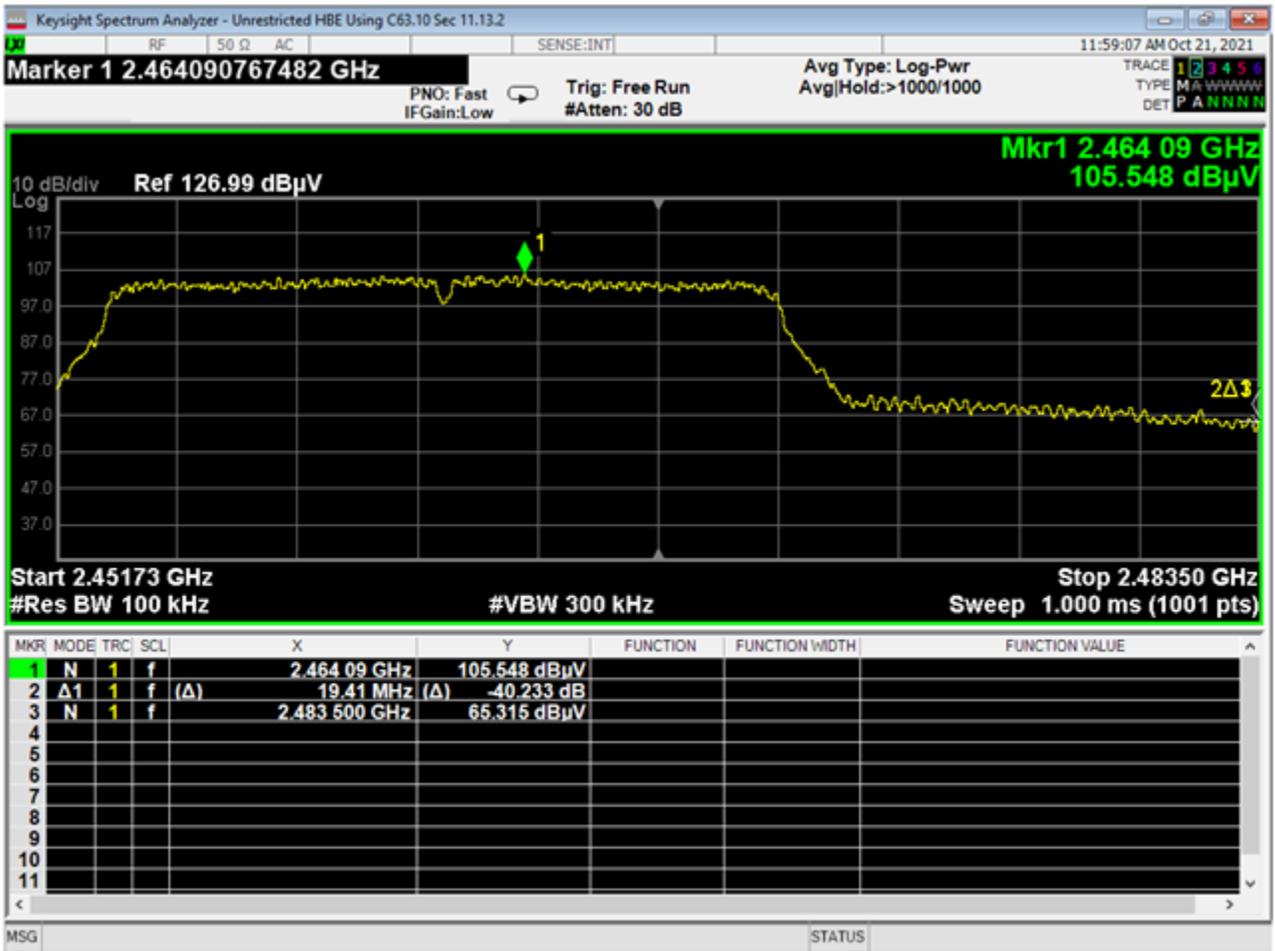
34 PSD, Mid, Wifi N



35 PSD, High, Wifi N



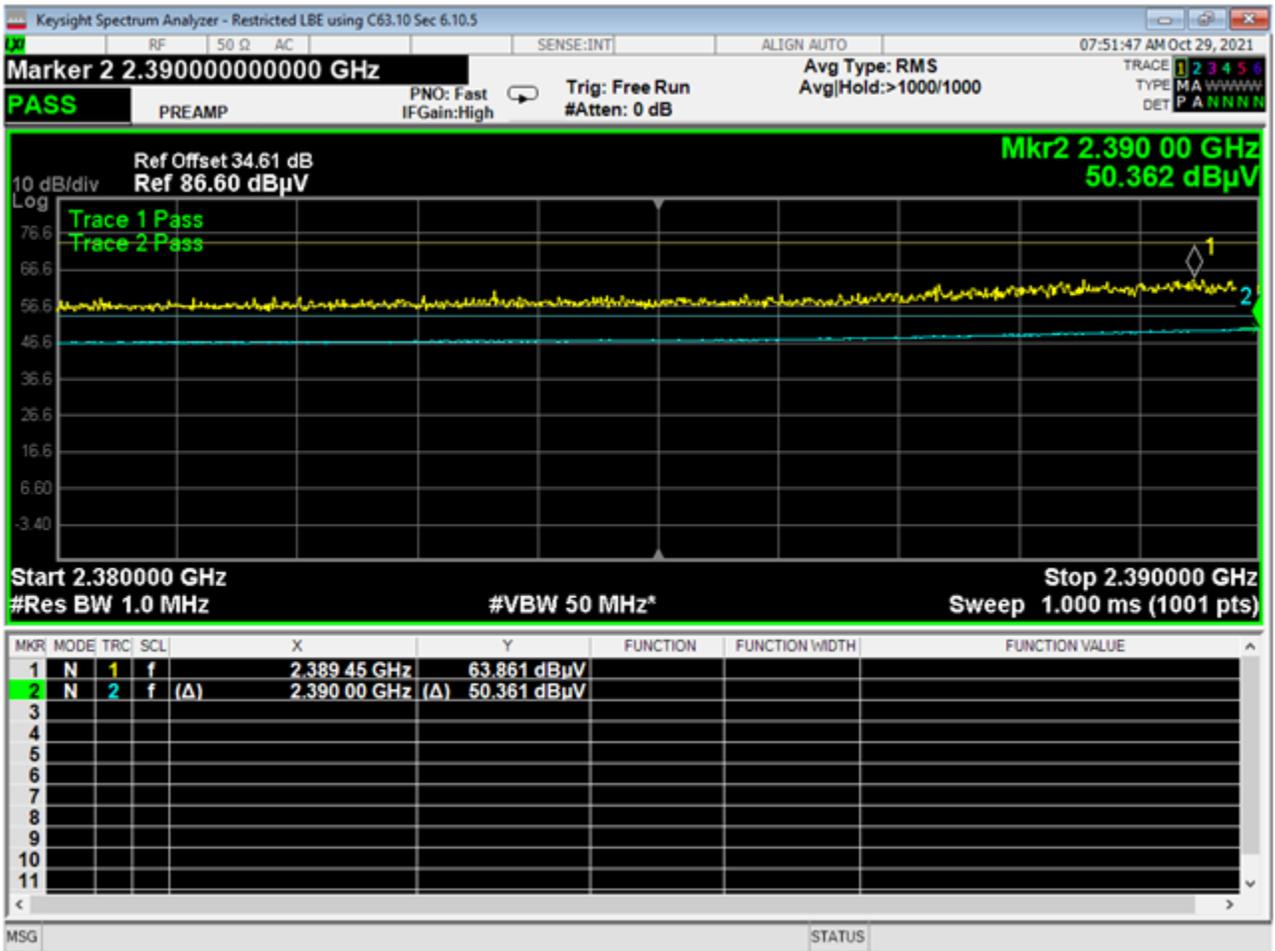
36 Lower Bandedge, Unrestricted, Wifi N



37 Higher Bandedge, Unrestricted, Wifi N



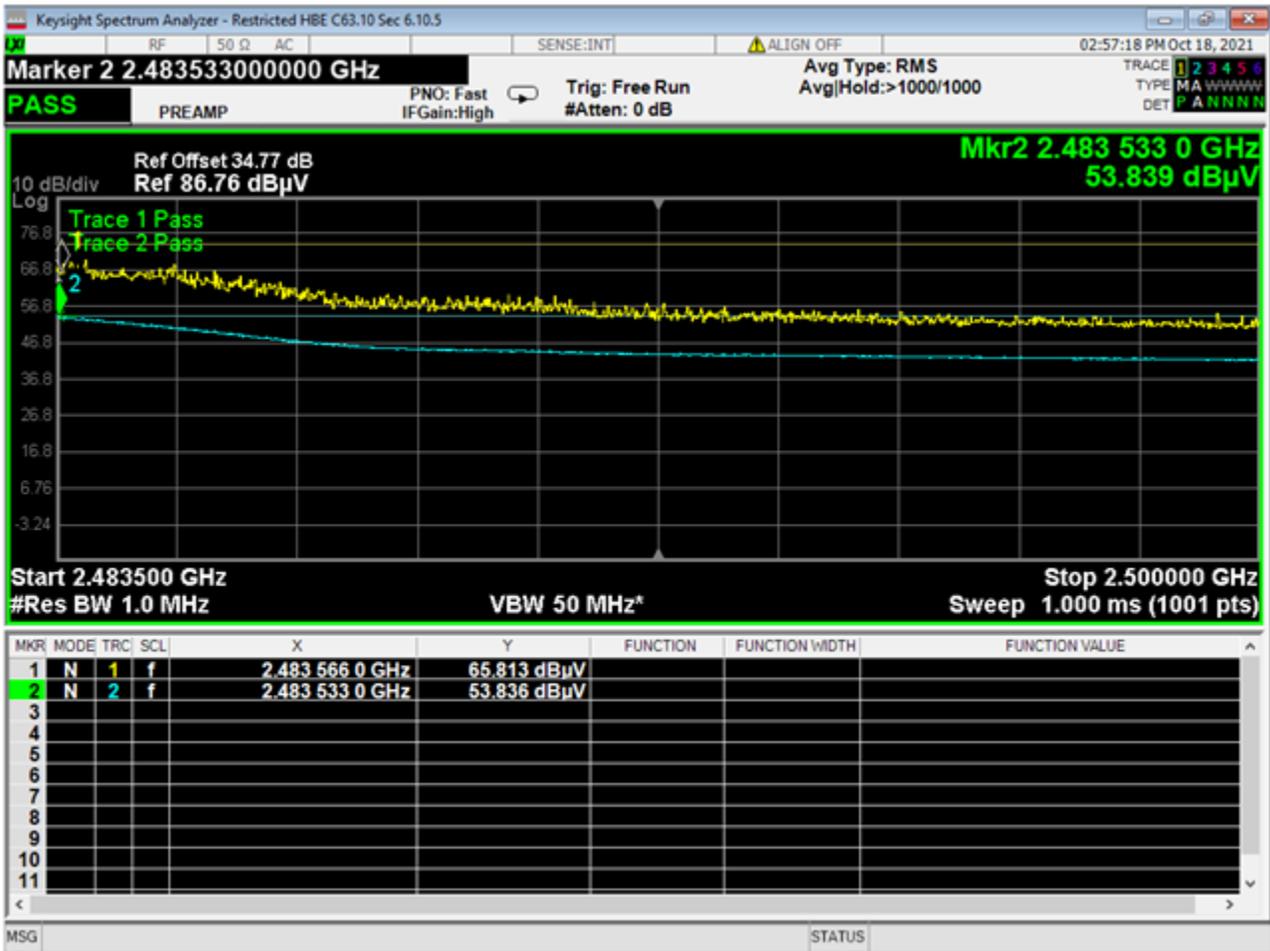
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|----------------|----------------------------|-----|---|
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38 Lower Bandedge, Restricted, Wifi N



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39 Higher Bandedge, Restricted, Wifi N



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REPORT END