

Amended FCC/ISED Test Report

Prepared for: **Raven Industries**

Address: **1101 W Algonquin St
Sioux Falls, SD 57104**

EUT: **CR7+**

Test Report No: **R221109-20-E1E**

FCC ID: **2BE68-RAV001**

IC: **2004B-RAV001**

Approved by:


Blake Winter
EMC Test Engineer,
iNARTE #EMC-50662-E

DATE: **July 19, 2024**

Total Pages: **75**

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REVISION PAGE

Rev. No.	Date	Description
Original	18 March 2024	Issued by BWinter Reviewed by KVepuri Prepared by BWinter
A	19 March 2024	Revision A – BWinter <ul style="list-style-type: none">1. Change references from CR7+ Display to CR7+.2. Change references from Bluetooth to WiFi.
B	20 June 2024	Revision B – BWinter <ul style="list-style-type: none">1. Change FCC ID and IC on front page.
C	11 July 2024	Revision C – BWinter <ul style="list-style-type: none">1. Page 25: Add maximization statement.2. Page 28: Add limits to table for 4000MHz WiFi N High-channel, low data rate peak.3. Page 26 and 30: Replace anomalous data in WiFi B Mid-channel, low data rate peak and average tables with data that was re-measured numerous times during troubleshooting.4. Page 29: Add limits statement.5. Page 4: Add “15.207(c)” to explain that Conducted Emissions is Not Applicable (NA).
D	18 July 2024	Revision D – KVepuri <ul style="list-style-type: none">1. Below 1GHz, show worst-case of axes, channels, modulations, and data rates.
E	19 July 2024	Revision E – BWinter <ul style="list-style-type: none">1. Add Receive Only data below 1GHz.2. Correct limits of transmitter spurious below 1GHz.3. Receive Only Peak and Average data were incorrectly juxtaposed. Change headings and tables of >1GHz Receive Only data.4. Add noise floor statement.



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1.0 SUMMARY OF TEST RESULTS

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 3

ANSI C63.10-2020 was used as a test method, with guidance from KBD 558074 D01 v05

APPLIED STANDARDS AND REGULATIONS		
Standard Section	Test Type	Result
FCC Part 15.203	Unique Antenna Requirement	Internal Antenna
FCC Part 15.35 RSS Gen, Issue 5, Section 6.10	Duty Cycle	NA (100% duty cycle)
FCC Part 15.247(b)(3) RSS-247 Issue 3 Section 5.4(d)	Peak output power	Pass
FCC Part 15.247(a)(2) RSS-247 Issue 3 Section 5.2	Bandwidth	Pass
FCC Part 15.209 RSS-Gen Issue 5, Section 7.3	Receiver Radiated Emissions	Pass
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 3 Section 5.5, RSS-Gen Issue 5, Section 8.9	Transmitter Radiated Emissions	Pass
FCC Part 15.247(e) RSS-247 Issue 3 Section 5.2 (b)	Power Spectral Density	Pass
FCC Part 15.209, 15.247(d) RSS-247 Issue 3 Section 5.5	Band Edge Measurement	Pass
FCC Part 15.207 RSS-Gen Issue 5, Section 8.8	Conducted Emissions	Not Applicable per 15.207(c): Battery Powered equipment.



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2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary

The Equipment Under Test (EUT) was a CR7+ manufactured by Raven Industries. It has a WiFi module that transmits and receives in the 2400 to 2483.5 MHz band. The measurements in this report verify that a Class 2 Permissive Change to the hardware is acceptable. Bandwidth measurements are provided for informational purposes only.

EUT	CR7+
EUT Received	1/8/2024
EUT Tested	1/15/2024 - 7/18/2024
Serial No.	1009, 1005
Operating Band	2400 – 2483.5 MHz
Device Type	DTS
Power Supply	12V Battery (no AC power)
Antenna	Internal Antenna

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



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2.2 DESCRIPTION OF TEST MODES

The EUT operates on, and was tested at the frequencies below:

Channel	Frequency (MHz)
Low	2412
Middle	2437
High	2462

These are the only three 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.

This EUT was set to transmit in a worse-case scenario with modulation on. The manufacturer modified the unit to transmit continuously on the lowest, highest and one channel in the middle.

2.3 DESCRIPTION OF SUPPORT UNITS

None



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3.0 LABORATORY 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.



3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Karthik Vepuri	Test Engineer	Review of Results
2	Blake Winter	Test Engineer	Testing and Report

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 (26.5GHz)**	N9038A	MY56400083	July 17, 2023	July 17, 2025
SunAR RF Motion	JB1	A091418	July 26, 2023	July 26, 2024
ETS EMCO Red Horn Antenna	3115	00218576	July 31, 2023	July 31, 2024
ETS EMCO Amplifier*	3115-PA	00218576	January 22, 2024	January 22, 2026
Trilithic High Pass Filter*	6HC330	23042	June 5, 2023	June 5, 2025
ETS – Lindgren- VSWR on 10m Chamber***	10m Semi-anechoic chamber-VSWR	4740 Discovery Drive	July 30, 2020	July 30, 2024
ETS – Lindgren- VSWR on 10m Chamber***	10m Semi-anechoic chamber-VSWR	4740 Discovery Drive	May 15, 2024	May 15, 2027
NCEE Labs-NSA on 10m Chamber*	10m Semi-anechoic chamber-NSA	NCEE-001	May 25, 2022	May 25, 2024
NCEE Labs-NSA on 10m Chamber*	10m Semi-anechoic chamber-NSA	NCEE-001	June 18, 2024	June 18, 2026
TDK Emissions Lab Software	V11.25	700307	NA	NA
RF Cable (preamplifier to antenna)*	MFR-57500	90-195-040	June 5, 2023	June 5, 2025
RF Cable (antenna to 10m chamber bulkhead)*	FSCM 64639	01E3872	June 5, 2023	June 5, 2025
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3864	June 5, 2023	June 5, 2025
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	June 5, 2023	June 5, 2025
N connector bulkhead (10m chamber)*	PE9128	NCEEBH1	June 5, 2023	June 5, 2025
N connector bulkhead (control room)*	PE9128	NCEEBH2	June 5, 2023	June 5, 2025

*Internal Calibration

**2 year cal cycle

***Two cal cycles were provided for reference to cover the testing interval.

***3 Year Cal Cycle

Notes:

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

3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMNTS

Radiated Test Setup

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.

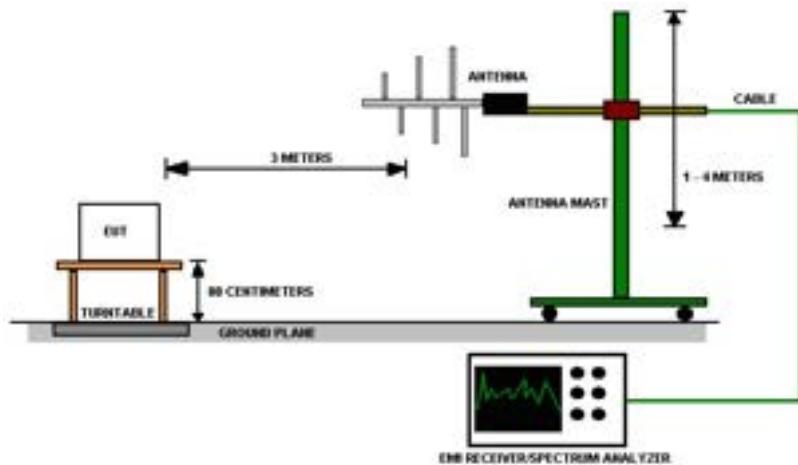


Figure 1 - Radiated Emissions Test Setup, 30MHz – 1GHz

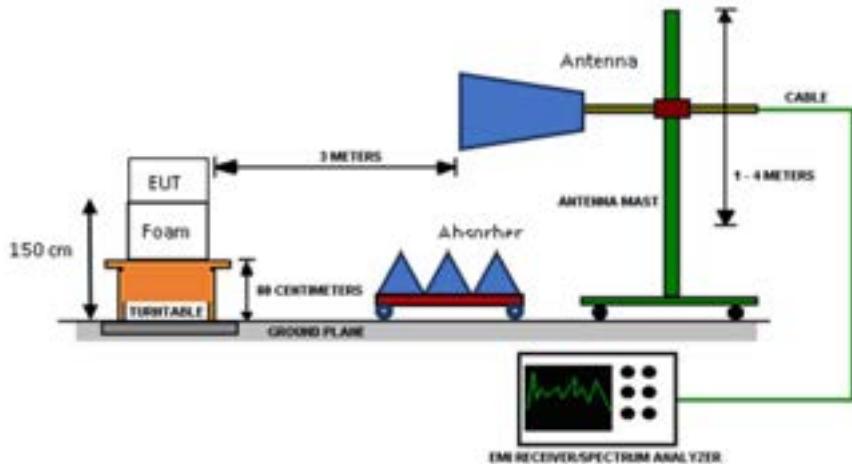


Figure 2 - Radiated Emissions Test Setup, 1GHz – 18GHz



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4.0 DETAILED RESULTS

Radiated Radio Measurements, WiFi B, Low Data Rate								
CHANNEL	Occupied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Field Strength (dBuV)	Radiated EIRP (dBm)*	Radiated EIRP (mW)	Field Strength PSD (dBuV)	PSD EIRP (dBm)*	RESULT
Low	13.35	9.63	110.6	15.4	34.7	85.33	-9.90	Pass
Mid	13.95	9.65	113.5	18.3	67.6	86.80	-8.43	Pass
High	13.54	9.65	110.8	15.6	36.3	84.36	-10.87	Pass
6 dB Bandwidth Limit >= 500 kHz			Peak Output Power Limit = 30 dBm; PSD Limit = 8 dBm					

*EIRP (dBm) = Field Strength (dBuV) – 95.23 dB at 3m.

Unrestricted Band-Edge, WiFi B, Low Data Rate							
CHANNEL	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBuV)	Relative Fundamental (dBuV)	Measurement Type	Delta (dB)	Min Delta (dB)	Result
Low	2400	50.89	100.89	Peak	50.00	20	Pass
High	2483.5	50.30	100.25	Peak	49.95	20	Pass

Peak Limit- Restricted Band-Edge						
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result
Low	2389.93	64.44	Peak	73.98	9.54	Pass
High	2483.83	65.4	Peak	73.98	8.6	Pass

*Limit shown is the peak limit taken from FCC Part 15.209.



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Average Limit- Restricted Band-Edge						
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result
Low	2389.92	39.63	Average	53.98	14.35	Pass
High	2487.81	40.14	Average	53.98	13.84	Pass

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

Radiated Radio Measurements, WiFi G, Low Data Rate								
CHANNEL	Occupied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Field Strength (dBuV)	Radiated EIRP (dBm)*	Radiated EIRP (mW)	Field Strength PSD (dBuV)	PSD EIRP (dBm)*	RESULT
Low	16.81	16.45	101.6	6.4	4.4	74.29	-20.94	Pass
Mid	16.45	16.43	104.1	8.9	7.8	79.35	-15.88	Pass
High	16.47	16.52	101.6	6.4	4.4	75.70	-19.53	Pass
6 dB Bandwidth Limit >= 500 kHz		Peak Output Power Limit = 30 dBm; PSD Limit = 8 dBm						

*EIRP (dBm) = Field Strength (dBuV) – 95.23 dB at 3m.

Unrestricted Band-Edge, WiFi G, Low Data Rate							
CHANNEL	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBuV)	Relative Fundamental (dBuV)	Measurement Type	Delta (dB)	Min Delta (dB)	Result
Low	2400	18.07	54.11	Peak	36.04	20	Pass
High	2483.5	50.3	86.0	Peak	35.72	20	Pass

Peak Limit- Restricted Band-Edge						
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result
Low	2388.21	48.71	Peak	73.98	25.27	Pass
High	2490.43	59.4	Peak	73.98	14.6	Pass

*Limit shown is the peak limit taken from FCC Part 15.209.



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Average Limit- Restricted Band-Edge						
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result
Low	2389.90	38.92	Average	53.98	15.06	Pass
High	2483.52	40.41	Average	53.98	13.57	Pass

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

Radiated Radio Measurements, WiFi N, Low Data Rate								
CHANNEL	Occupied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Field Strength (dBuV)	Radiated EIRP (dBm)*	Radiated EIRP (mW)	Field Strength PSD (dBuV)	PSD EIRP (dBm)*	RESULT
Low	17.73	17.81	101.6	6.4	4.4	76.37	-18.86	Pass
Mid	17.68	17.63	104.0	8.8	7.6	78.42	-16.81	Pass
High	17.70	17.76	101.4	6.2	4.2	75.64	-19.59	Pass

*EIRP (dBm) = Field Strength (dBuV) – 95.23 dB at 3m.



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Unrestricted Band-Edge, WiFi N, Low Data Rate							
CHANNEL	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBuV)	Relative Fundamental (dBuV)	Measurement Type	Delta (dB)	Min Delta (dB)	Result
Low	2400	51.63	87.49	Peak	35.86	20	Pass
High	2483.5	50.3	86.2	Peak	35.93	20	Pass

Peak Limit- Restricted Band-Edge, WiFi N, Low Data Rate							
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result	
Low	2388.21	49.02	Peak	73.98	24.96	Pass	
High	2483.91	53.0	Peak	73.98	21.0	Pass	

*Limit shown is the peak limit taken from FCC Part 15.209.

Average Limit- Restricted Band-Edge, WiFi N, Low Data Rate						
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result
Low	2390.00	38.93	Average	53.98	15.05	Pass
High	2483.53	41.33	Average	53.98	12.65	Pass

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

Radiated Radio Measurements, WiFi B, High Data Rate								
CHANNEL	Occupied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Field Strength (dBuV)	Radiated EIRP (dBm)*	Radiated EIRP (mW)	Field Strength PSD (dBuV)	PSD EIRP (dBm)*	RESULT
Low	13.34	10.16	111.0	15.8	38.0	87.54	-7.69	Pass
Mid	13.53	9.55	113.5	18.3	67.6	89.90	-5.33	Pass
High	13.47	9.94	110.8	15.6	36.3	87.30	-7.93	Pass

6 dB Bandwidth Limit >= 500 kHz Peak Output Power Limit = 30 dBm; PSD Limit = 8 dBm

**EIRP (dBm) = Field Strength (dBuV) – 95.23 dB at 3m.



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Unrestricted Band-Edge, WiFi B, High Data Rate							
CHANNEL	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBuV)	Relative Fundamental (dBuV)	Measurement Type	Delta (dB)	Min Delta (dB)	Result
Low	2400	21.11	69.01	Peak	47.90	20	Pass
High	2483.5	50.3	99.45	Peak	49.15	20	Pass

Peak Limit- Restricted Band-Edge, WiFi B, High Data Rate							
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result	
Low	2388.21	50.90	Peak	73.98	23.08	Pass	
High	2483.83	50.4	Peak	73.98	23.6	Pass	

*Limit shown is the peak limit taken from FCC Part 15.209.

Average Limit- Restricted Band-Edge, WiFi B, High Data Rate						
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result
Low	2389.96	39.62	Average	53.98	14.36	Pass
High	2483.57	41.22	Average	53.98	12.76	Pass

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



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Radiated Radio Measurements, WiFi G, High Data Rate								
CHANNEL	Occupied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Field Strength (dBuV)	Radiated EIRP (dBm)*	Radiated EIRP (mW)	Field Strength PSD (dBuV)	PSD EIRP (dBm)*	RESULT
Low	16.49	16.53	101.0	5.8	3.8	78.85	-16.38	Pass
Mid	16.46	16.53	104.1	8.9	7.8	81.98	-13.25	Pass
High	16.49	16.56	101.1	5.9	3.9	78.20	-17.03	Pass
6 dB Bandwidth Limit >= 500 kHz			Peak Output Power Limit = 30 dBm; PSD Limit = 8 dBm					

*EIRP (dBm) = Field Strength (dBuV) – 95.23 dB at 3m.

Unrestricted Band-Edge, WiFi G, High Data Rate							
CHANNEL	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBuV)	Relative Fundamental (dBuV)	Measurement Type	Delta (dB)	Min Delta (dB)	Result
Low	2400	17.93	55.28	Peak	37.35	20	Pass
High	2483.5	50.3	86.23	Peak	35.93	20	Pass

Peak Limit- Restricted Band-Edge, WiFi G, High Data Rate						
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result
Low	2388.21	49.82	Peak	73.98	24.16	Pass
High	2483.5	54.0	Peak	73.98	20.0	Pass

*Limit shown is the peak limit taken from FCC Part 15.209.

Average Limit- Restricted Band-Edge, WiFi G, High Data Rate						
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result
Low	2390.00	41.27	Average	53.98	12.71	Pass
High	2483.68	42.55	Average	53.98	11.43	Pass

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



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Radiated Radio Measurements, WiFi N, High Data Rate								
CHANNEL	Occupied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Field Strength (dBuV)	Radiated EIRP (dBm)*	Radiated EIRP (mW)	Field Strength PSD (dBuV)	PSD EIRP (dBm)*	RESULT
Low	17.73	17.81	101.5	6.3	4.3	75.80	-19.43	Pass
Mid	17.69	17.81	104.5	9.3	8.5	79.77	-15.46	Pass
High	17.72	17.82	101.3	6.1	4.1	75.23	-20.00	Pass
6 dB Bandwidth Limit >= 500 kHz			Peak Output Power Limit = 30 dBm; PSD Limit = 8 dBm					

*EIRP (dBm) = Field Strength (dBuV) – 95.23 dB at 3m.

Unrestricted Band-Edge, WiFi N, High Data Rate							
CHANNEL	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBuV)	Relative Fundamental (dBuV)	Measurement Type	Delta (dB)	Min Delta (dB)	Result
Low	2400	51.09	88.48	Peak	37.39	20	Pass
High	2483.5	17.0	53.64	Peak	36.64	20	Pass

Peak Limit- Restricted Band-Edge, WiFi N, High Data Rate						
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result
Low	2388.21	48.58	Peak	73.98	25.40	Pass
High	2483.83	54.0	Peak	73.98	20.0	Pass

*Limit shown is the peak limit taken from FCC Part 15.209.

Average Limit- Restricted Band-Edge, WiFi N, High Data Rate						
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result
Low	2389.81	39.05	Average	53.98	14.93	Pass
High	2483.52	41.36	Average	53.98	12.62	Pass

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



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4.1 DUTY CYCLE

Duty cycle is 100%. No correction factor is applied.



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4.2 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 (μ 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 (dB_uV/m) = 20 * log * Emission level (μ 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.



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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 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 6dB 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 6 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.
- h. The orientation with the worst-case emissions was used for final measurements.

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.

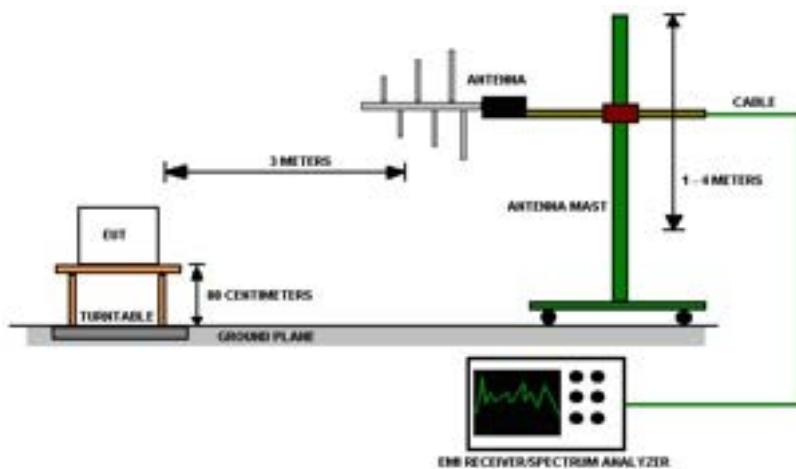
Test setup:

Figure 3 - Radiated Emissions Test Setup, 30MHz – 1GHz

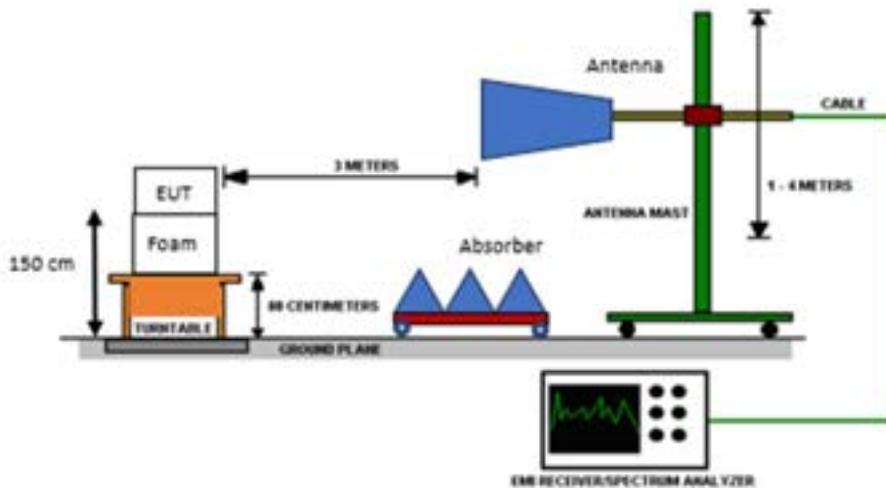


Figure 4 - Radiated Emissions Test Setup, 1GHz – 18GHz

EUT operating conditions

The EUT was powered by a 12V battery. The EUT was set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

Test results:

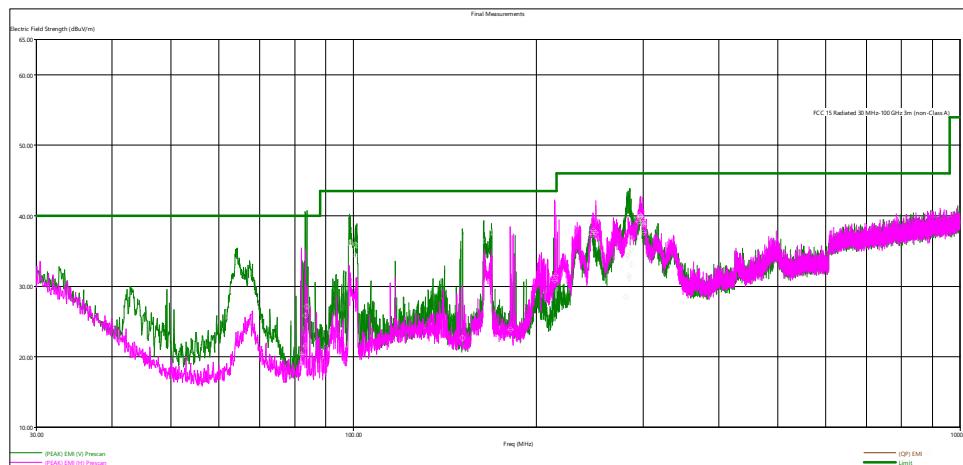


Figure 5 - Radiated Emissions Plot, 30 MHz-1 GHz, WiFi N, High Data Rate, Mid Channel, x-axis

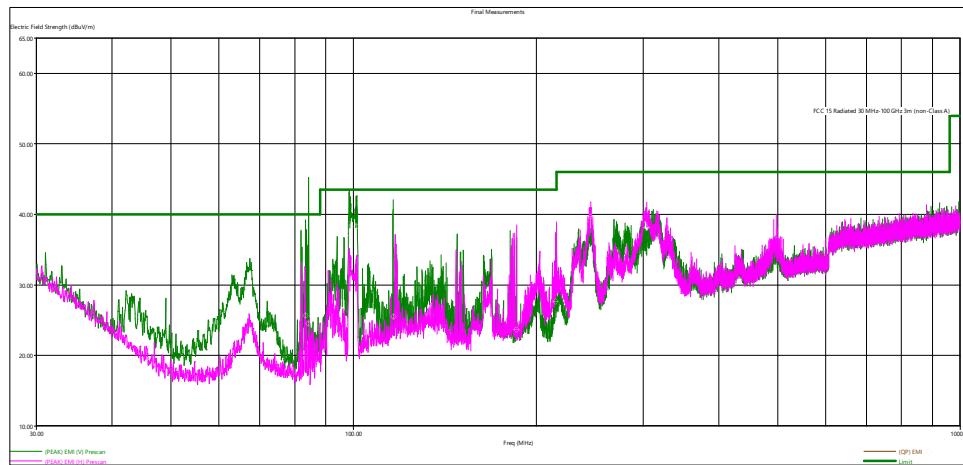


Figure 6 - Radiated Emissions Plot, 30 MHz-1 GHz, Receive Only, x-axis

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 = Limit value - Emission level.
5. The EUT was measured in both the horizontal and vertical orientation. The position with the highest emissions was used for all testing.
6. SN 1005 was used for emissions < 1GHz.



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The EUT was maximized in all 3 orthogonal axes. The worst-case axis is shown in the plots above and the tables below. All other measurements were found to be at least 6 dB below the limit, and the noise floor was found to be at least 6dB below the limit.

In the transmitter emissions less than 1GHz, WiFi N, High Data Rate, mid-channel, had the worst-case emissions of the low, mid, and high channels, and it had the worst-case emissions of all the modulations and data rates.

For emissions below 1GHz and above 1GHz only the worst-case data is provided in the following tables:

Quasi-Peak Measurements, 30 MHz - 1 GHz, WiFi N, High Data Rate, Mid Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
215.726640	31.65	43.52	11.87	146.02	6.50	H
248.333520	37.90	46.02	8.12	116.41	123.75	H
295.536960	40.31	46.02	5.71	173.01	234.75	H
64.251119	32.39	40.00	13.63	110.80	158.00	V
98.700240	36.22	43.52	9.80	102.80	164.25	V
168.817440	37.65	43.52	8.37	104.17	250.50	V

Quasi-Peak Measurements, 30 MHz - 1 GHz, Receive Only						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
185.552400	23.66	43.52	19.86	162.50	359.50	H
215.304240	27.76	43.52	15.76	135.40	349.25	H
245.826000	39.74	46.02	6.28	124.47	141.50	H
304.226160	38.12	46.02	7.90	141.55	287.75	H
83.215200	25.79	40.00	14.21	145.01	321.50	V
84.109200	24.57	40.00	15.43	145.55	255.50	V
98.337120	37.31	43.52	6.21	106.14	195.50	V
101.232960	38.34	43.52	5.18	104.35	253.75	V
116.378880	25.63	43.52	17.89	106.38	219.25	V



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Peak Measurements, 1 GHz - 25 GHz, WiFi B, Low Data Rate, Low Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4000.310000	53.74	73.98	20.24	410.65	165.25	H
4823.568000	49.79	73.98	24.19	222.83	250.50	H
Peak Measurements, 1 GHz - 25 GHz, WiFi B, Low Data Rate, Mid Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4873.506000	50.65	73.98	23.33	258.00	162.25	V
Peak Measurements, 1 GHz - 25 GHz, WiFi B, Low Data Rate, High Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4923.946000	54.97	73.98	19.01	345.46	114.00	V
Peak Measurements, 1 GHz - 25 GHz, WiFi B, High Data Rate, Low Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4824.302000	48.72	73.98	25.26	195.67	225.50	H
Peak Measurements, 1 GHz - 25 GHz, WiFi B, High Data Rate, Mid Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4873.492000	53.18	73.98	20.80	167.97	63.75	V
7312.008000	58.60	73.98	15.38	122.41	180.50	V
Peak Measurements, 1 GHz - 25 GHz, WiFi B, High Data Rate, High Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4924.030000	54.26	73.98	19.72	168.50	63.75	V
Peak Measurements, 1 GHz - 25 GHz, WiFi G, Low Data Rate, Low Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
3999.994000	55.39	73.98	18.59	343.79	172.25	H



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Peak Measurements, 1 GHz - 25 GHz, WiFi G, Low Data Rate, Mid Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4000.638000	54.83	73.98	19.15	400.44	178.50	H
Peak Measurements, 1 GHz - 25 GHz, WiFi N, Low Data Rate, Low Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
3999.476000	51.37	73.98	22.61	280.16	182.50	H
Peak Measurements, 1 GHz - 25 GHz, WiFi N, Low Data Rate, Mid Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
3999.388000	51.06	73.98	22.92	490.00	185.00	H
Peak Measurements, 1 GHz - 25 GHz, WiFi N, Low Data Rate, High Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4000.242000	50.18	73.98	23.8	225.17	179.25	H
Peak Measurements, 1 GHz - 25 GHz, WiFi N, High Data Rate, Low Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
3999.780000	52.03	73.98	21.95	340.82	185.25	H
Peak Measurements, 1 GHz - 25 GHz, WiFi N, High Data Rate, Mid Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4000.574000	52.53	73.98	21.45	287.32	176.00	H
Peak Measurements, 1 GHz - 25 GHz, WiFi N, High Data Rate, High Channel						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4000.356000	52.61	73.98	21.37	275.44	176.50	H



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Peak Measurements, 1 GHz - 25 GHz, Receive Mode						
Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
1130.776000	46.1	73.98	33.40	173.65	181.50	V
1862.586000	42.52	73.98	36.98	403.50	206.75	V
4000.662000	52.58	73.98	26.92	490.00	185.00	H



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Average Measurements, 1 GHz- 25 GHz, WiFi B, Low Data Rate, Low Channel						
Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4000.310000	44.04	53.98	9.94	410.65	165.25	H
4823.568000	44.05	53.98	9.93	222.83	250.50	H
Average Measurements, 1 GHz- 25 GHz, WiFi B, Low Data Rate, Mid Channel						
Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4873.506000	45.45	53.98	8.53	258.00	162.25	V
Average Measurements, 1 GHz - 25 GHz, WiFi B, Low Data Rate, High Channel						
Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4923.946000	52.08	53.98	1.90	345.46	114.00	V
Average Measurements, 1 GHz- 25 GHz, WiFi B, High Data Rate, Low Channel						
Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4824.302000	35.39	53.98	18.59	195.67	225.50	H
Average Measurements, 1 GHz- 25 GHz, WiFi B, High Data Rate, Mid Channel						
Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4873.492000	41.68	53.98	12.30	167.97	63.75	V
7312.008000	46.58	53.98	7.40	122.41	180.50	V



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Average Measurements, 1 GHz - 25 GHz, WiFi B, High Data Rate, High Channel						
Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4924.030000	39.01	53.98	14.97	168.50	63.75	V
Average Measurements, 1 GHz- 25 GHz, WiFi G, Low Data Rate, Low Channel						
Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
3999.994000	44.13	53.98	9.85	343.79	172.25	H
Average Measurements, 1 GHz- 25 GHz, WiFi G, Low Data Rate, Mid Channel						
Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4000.638000	43.39	53.98	10.59	400.44	178.50	H
Average Measurements, 1 GHz- 25 GHz, WiFi N, Low Data Rate, Low Channel						
Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
3999.476000	36.79	53.98	17.19	280.16	182.50	H
Average Measurements, 1 GHz- 25 GHz, WiFi N, Low Data Rate, Mid Channel						
Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
3999.388000	38.83	53.98	15.15	490.00	185.00	H
Average Measurements, 1 GHz - 25 GHz, WiFi N, Low Data Rate, High Channel						
Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4000.242000	40.2	53.98	13.78	225.17	179.25	H
Average Measurements, 1 GHz- 25 GHz, WiFi N, High Data Rate, Low Channel						
Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
3999.780000	38.93	53.98	15.05	340.82	185.25	H



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Average Measurements, 1 GHz- 25 GHz, WiFi N, High Data Rate, Mid Channel

Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4000.574000	41.3	53.98	12.68	287.32	176.00	H

Average Measurements, 1 GHz - 25 GHz, WiFi N, High Data Rate, High Channel

Frequency	Average Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
4000.356000	42.24	53.98	11.74	275.44	176.50	H

Average Measurements, 1 GHz - 25 GHz, Receive Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol
MHz	dB μ V/m	dB μ V/m	dB	cm.	deg.	
1130.776000	34.55	53.98	19.43	173.65	181.50	V
1862.586000	37.09	53.98	16.89	403.50	206.75	V
4000.662000	41.42	53.98	12.56	490.00	185.00	H



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4.3 PEAK OUTPUT POWER

Test Method: ANSI C63.10, Section(s) 7.8.5

Limits of bandwidth measurements:

For a DTS system, the output power is required to be less than 1000 mW or 30 dBm.

Power was measured over the air and calculated from field strength measurements at 3m at the maximum EIRP

Test procedure: Radiated.

Deviations from test standard:

No deviation.

Test setup:

See Section 3.4 and 4.2

EUT operating conditions:

The EUT was powered by a 12V battery. The EUT was set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

Test results:

Refer to section 4.0 for the results table.

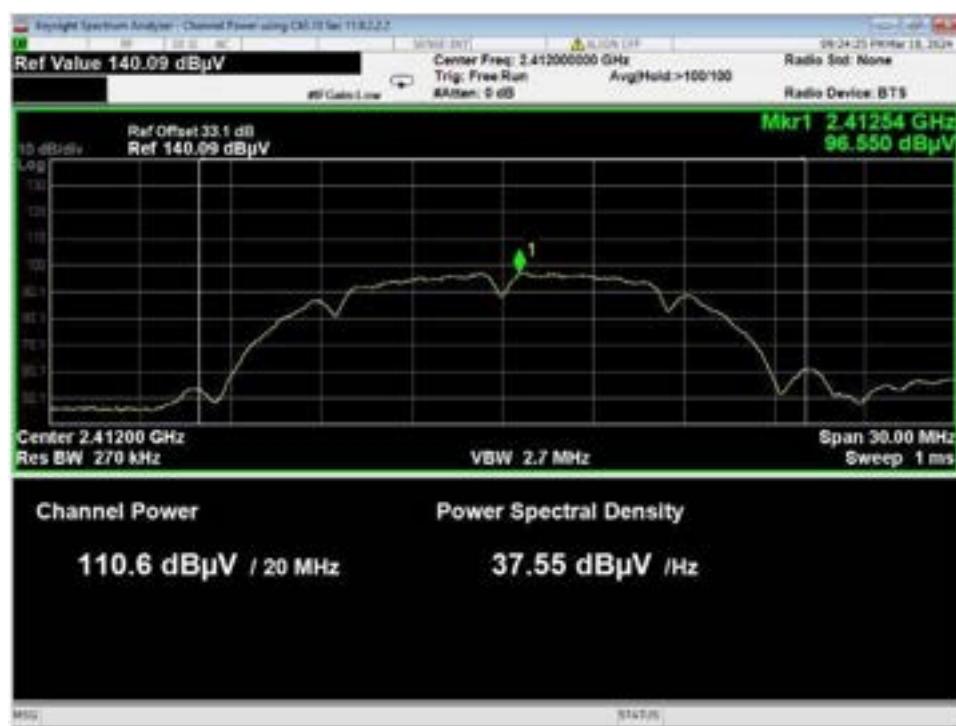


Figure 7 – Radiated Output Power Field Strength, WiFi B, Low Data Rate, Low Channel.



Figure 8 – Radiated Output Power Field Strength, WiFi B, Low Data Rate, Mid Channel

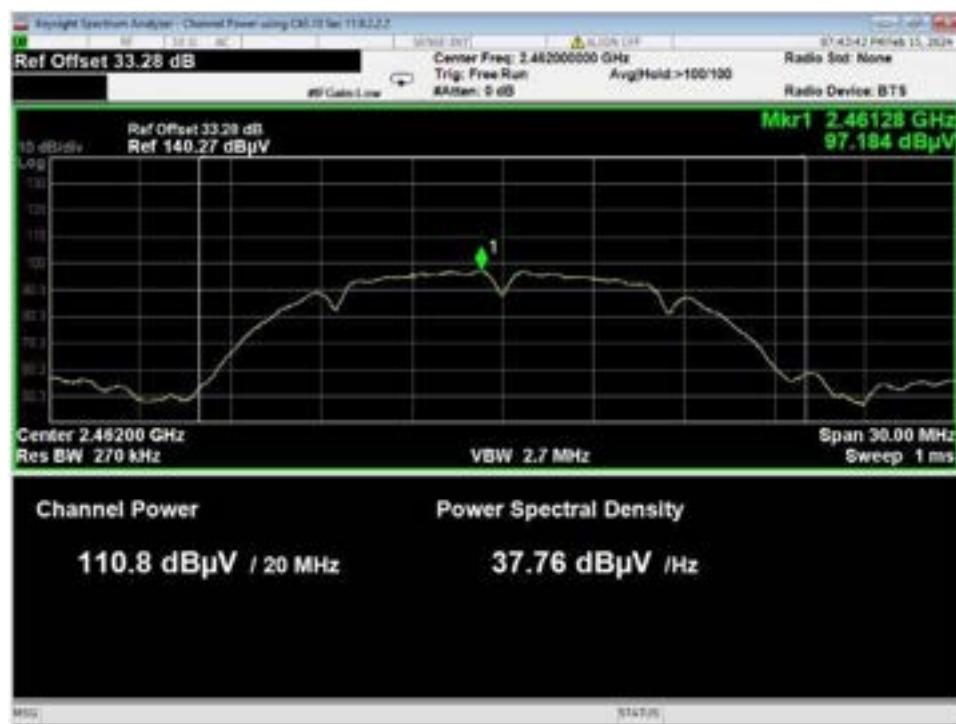


Figure 9 – Radiated Output Power Field Strength, WiFi B, Low Data Rate, High Channel

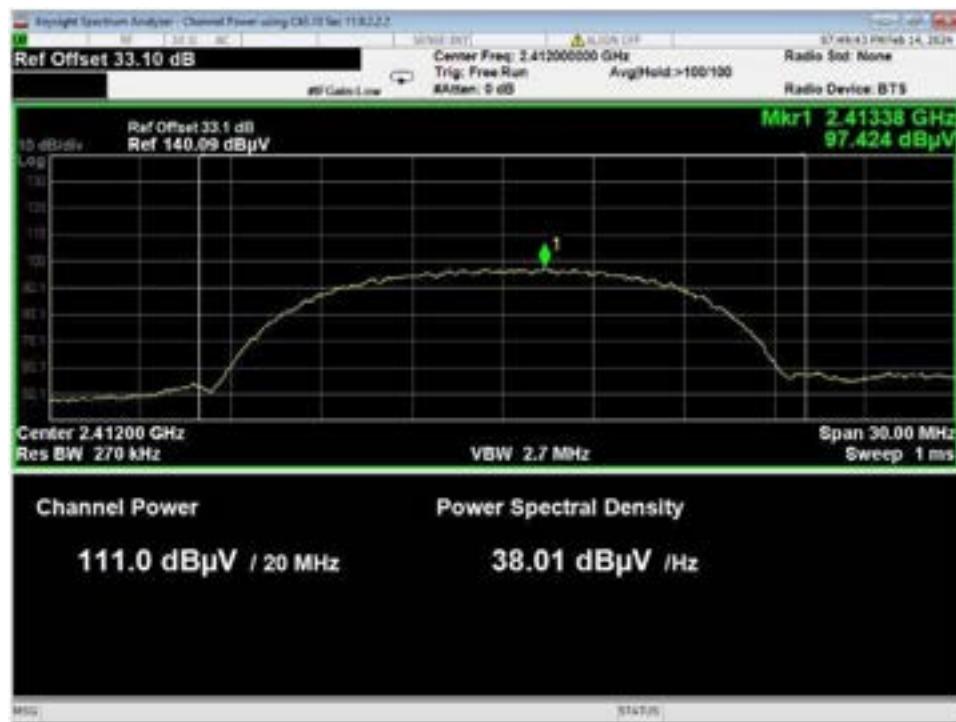


Figure 10 – Radiated Output Power Field Strength, WiFi B, High Data Rate, Low Channel.

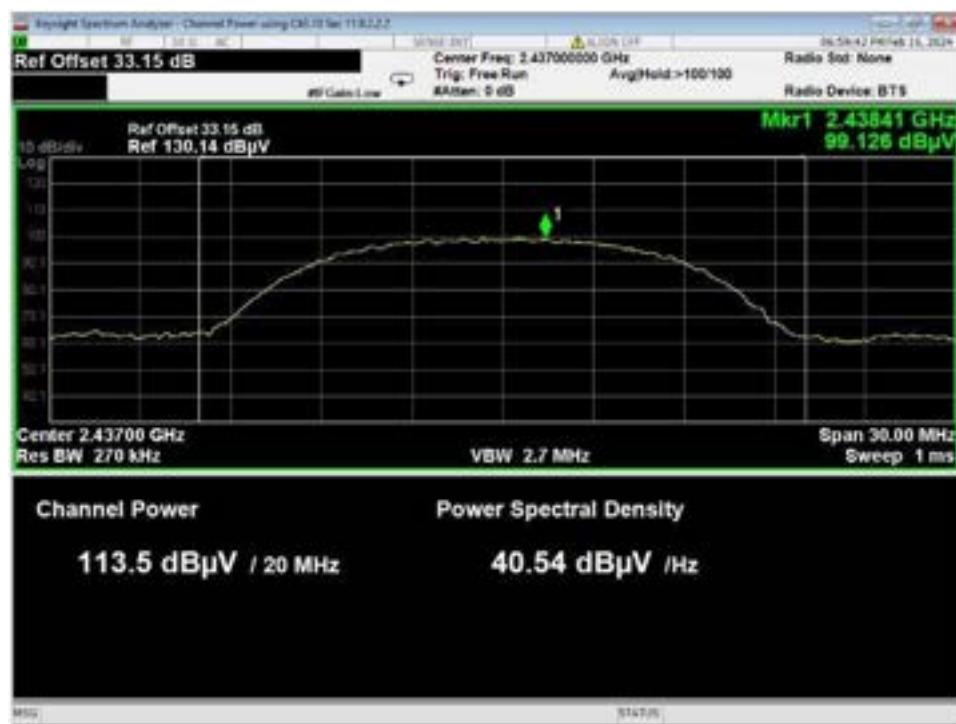


Figure 11 – Radiated Output Power Field Strength, WiFi B, High Data Rate, Mid Channel

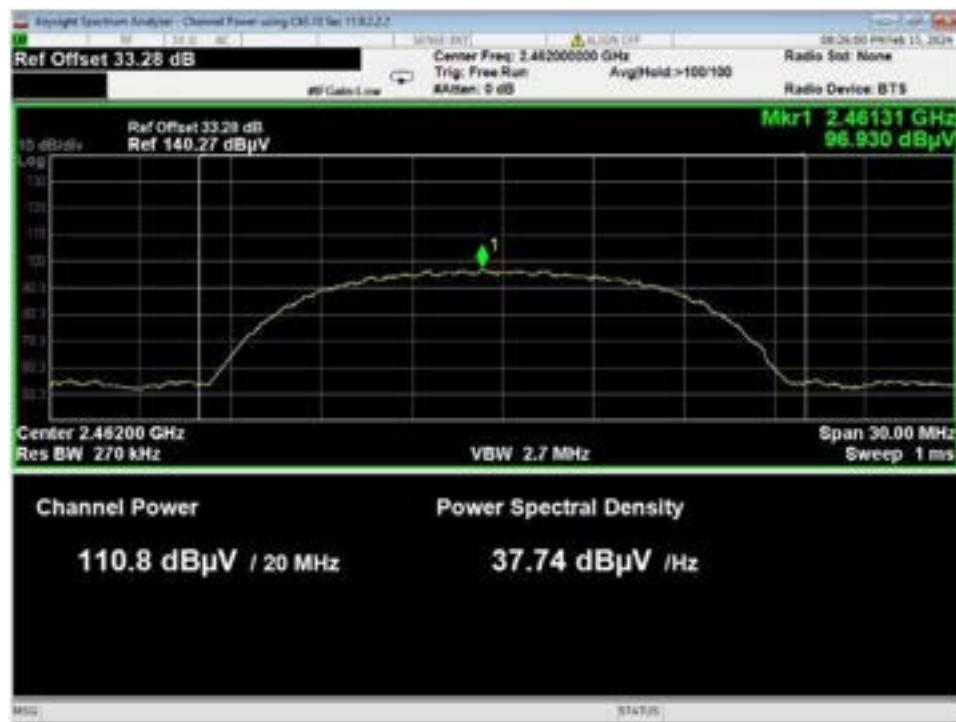


Figure 12 – Radiated Output Power Field Strength, WiFi B, High Data Rate, High Channel

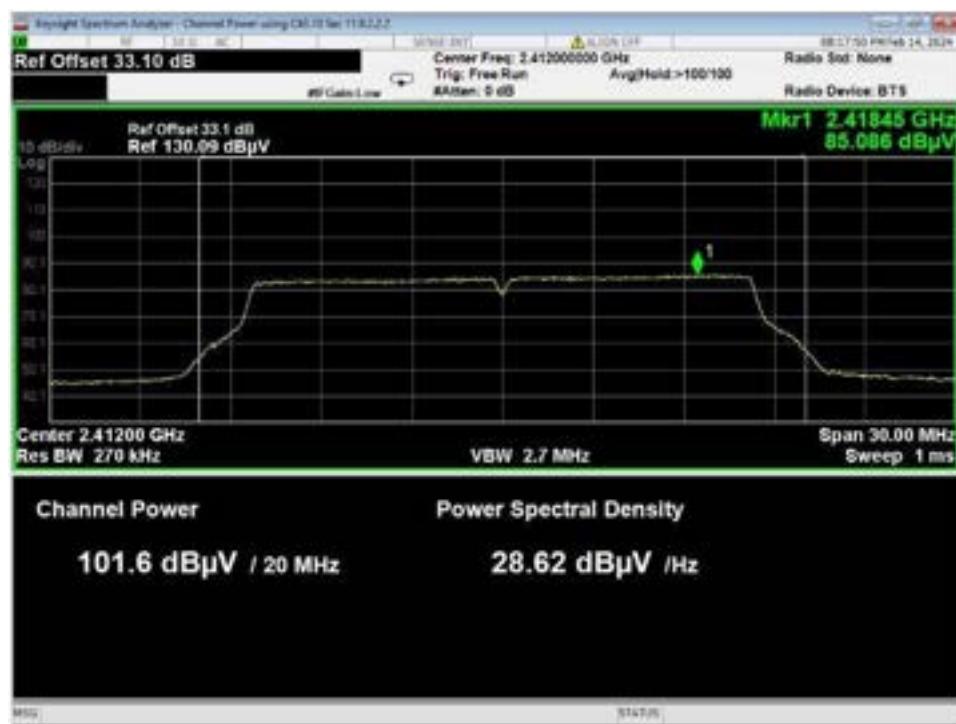


Figure 13 – Radiated Output Power Field Strength, WiFi G, Low Data Rate, Low Channel.

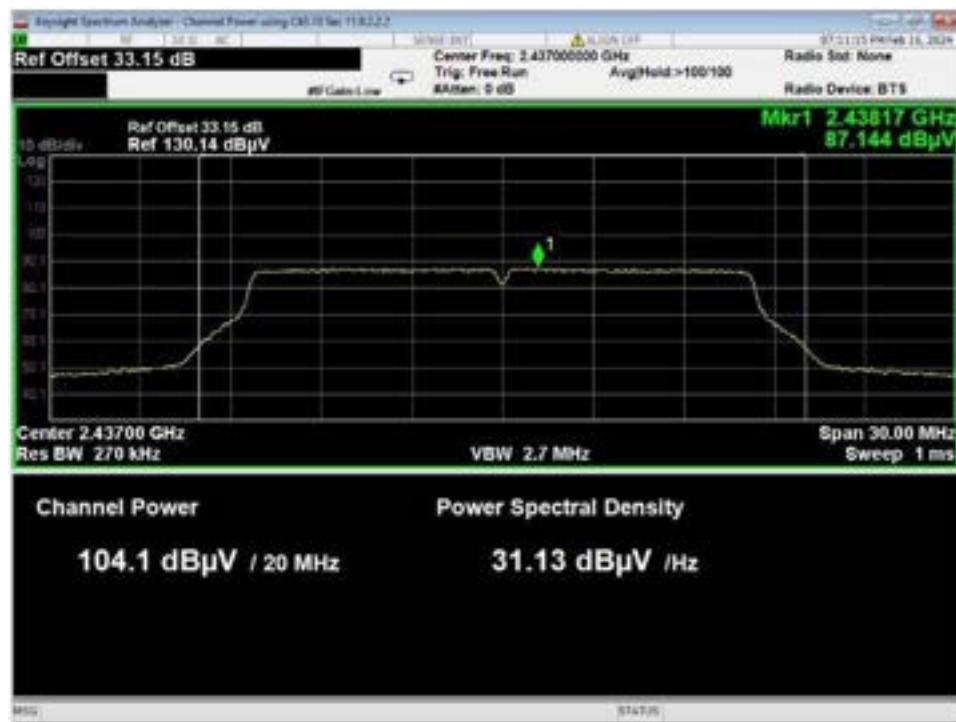


Figure 14 – Radiated Output Power Field Strength, WiFi G, Low Data Rate, Mid Channel

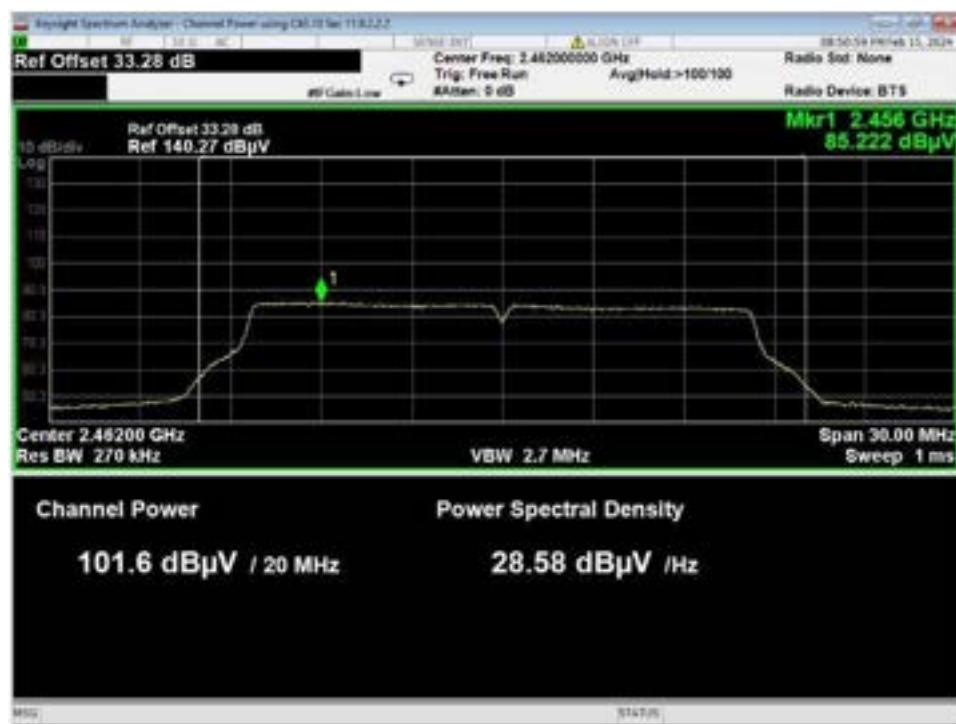


Figure 15 – Radiated Output Power Field Strength, WiFi G, Low Data Rate, High Channel

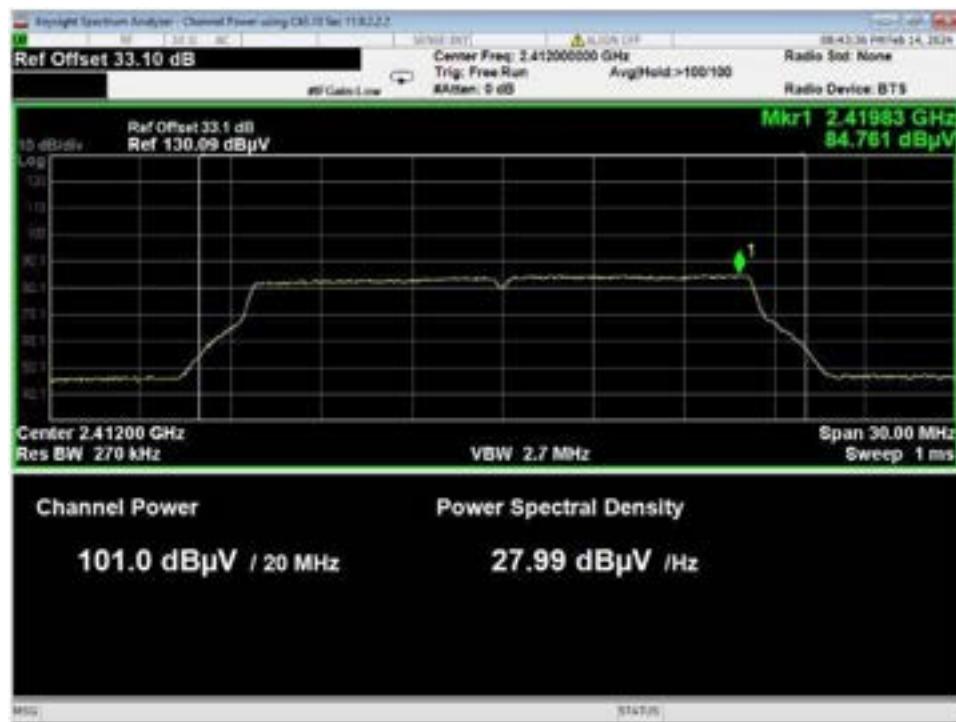


Figure 16 – Radiated Output Power Field Strength, WiFi G, High Data Rate, Low Channel.

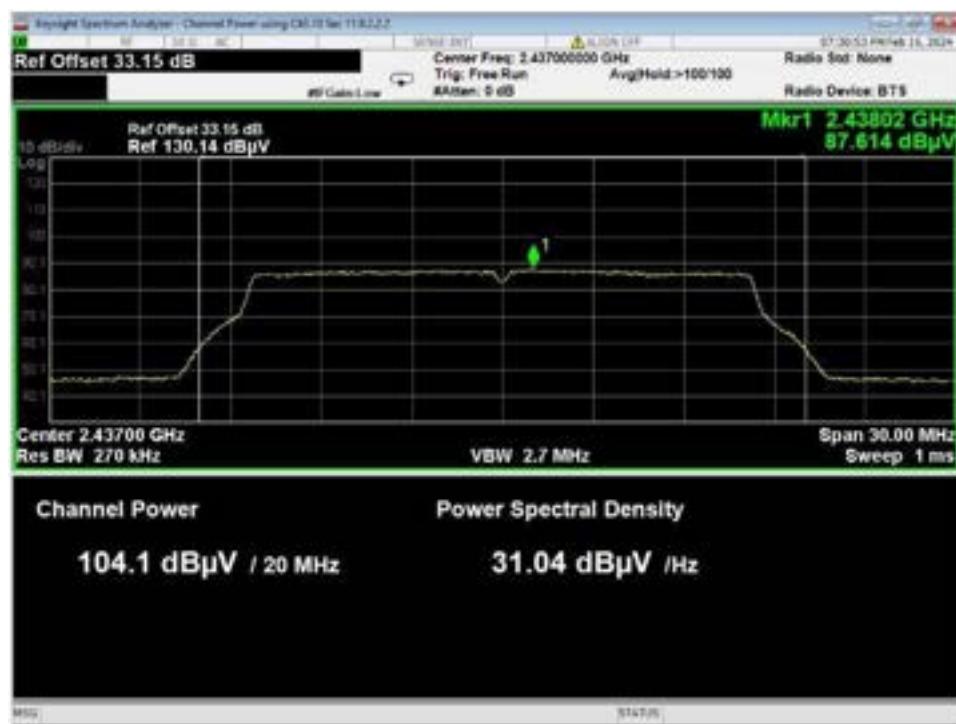


Figure 17 – Radiated Output Power Field Strength, WiFi G, High Data Rate, Mid Channel

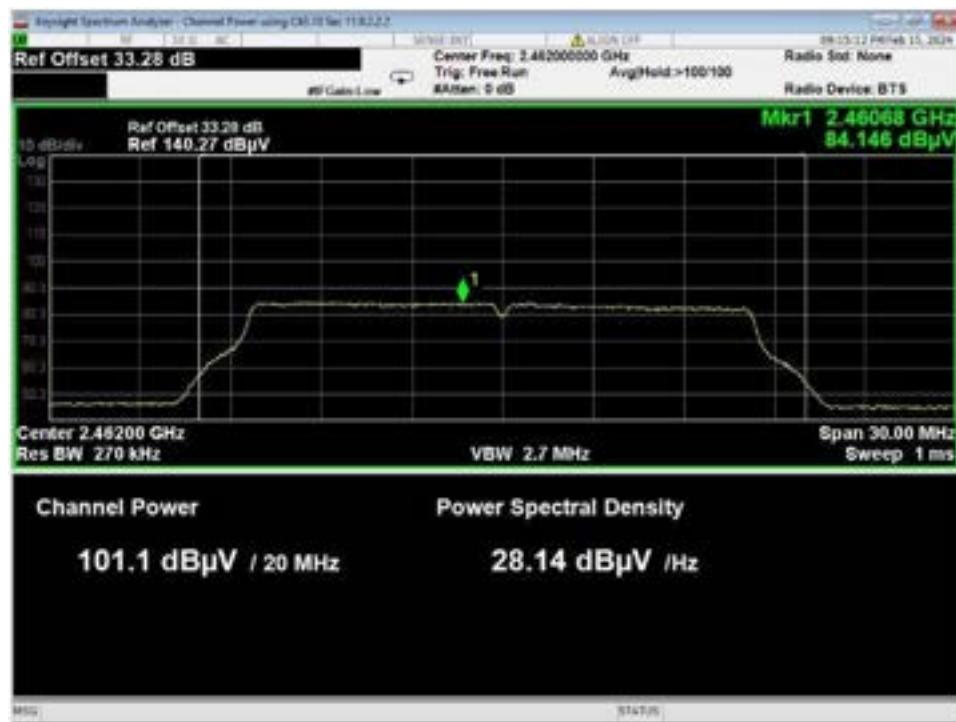


Figure 18 – Radiated Output Power Field Strength, WiFi G, High Data Rate, High Channel

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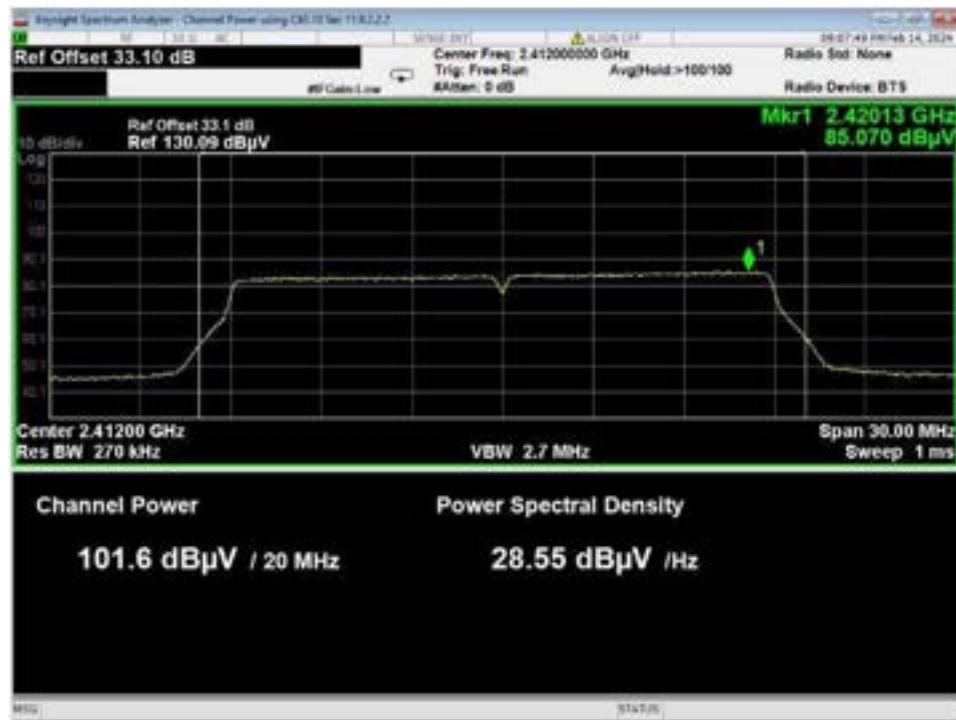


Figure 19 – Radiated Output Power Field Strength, WiFi N, Low Data Rate, Low Channel.

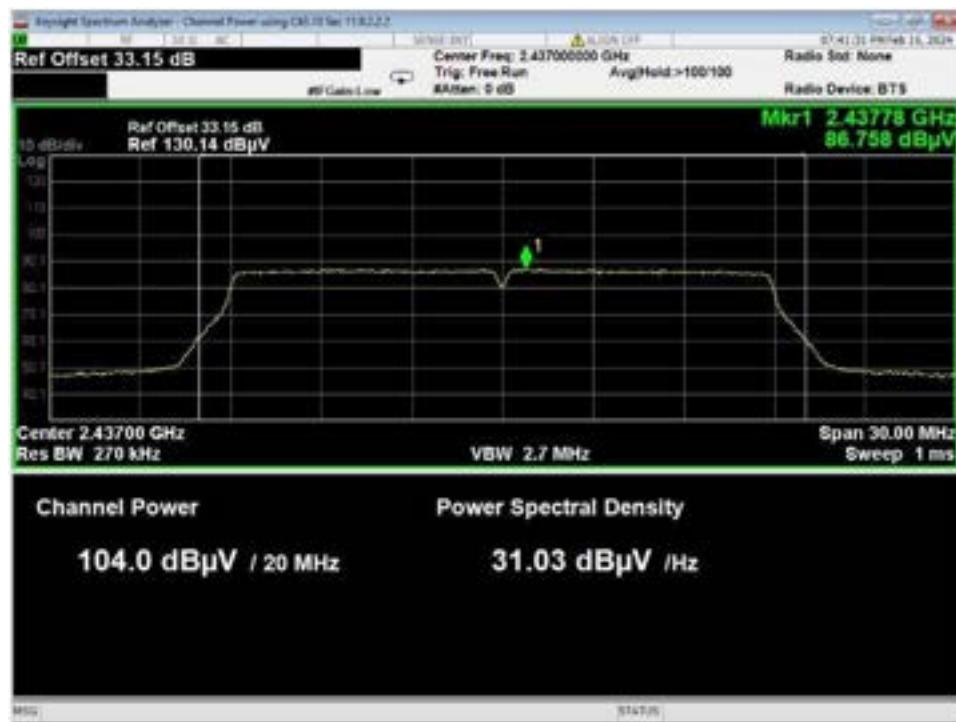


Figure 20 – Radiated Output Power Field Strength, WiFi N, Low Data Rate, Mid Channel

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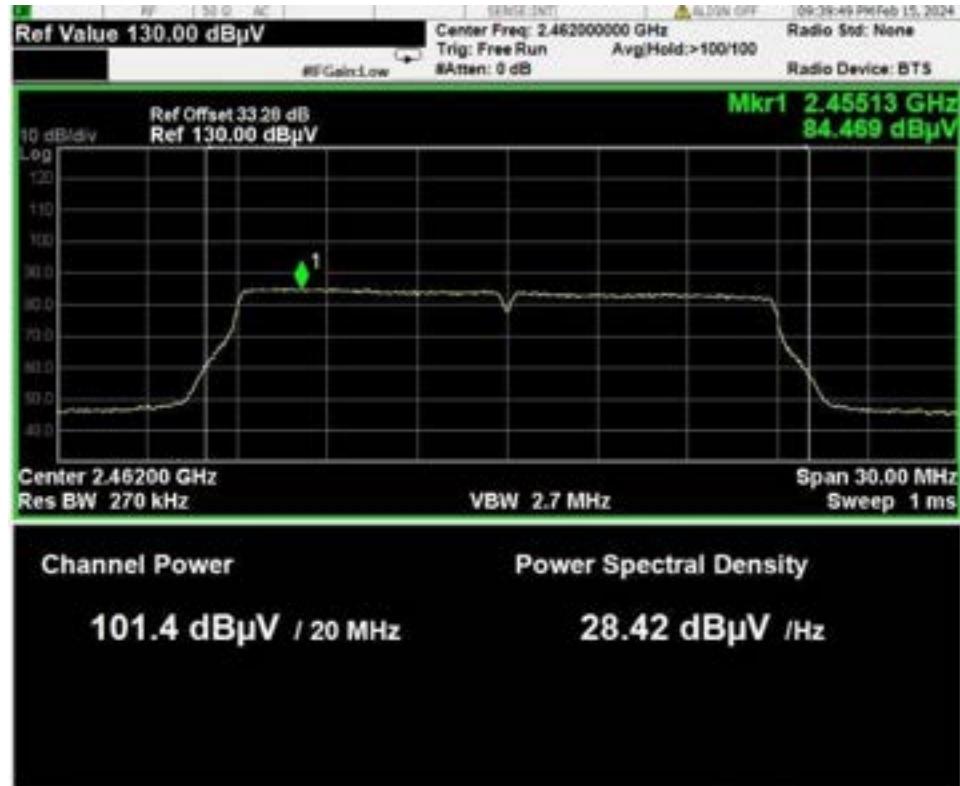


Figure 21 – Radiated Output Power Field Strength, WiFi N, Low Data Rate, High Channel

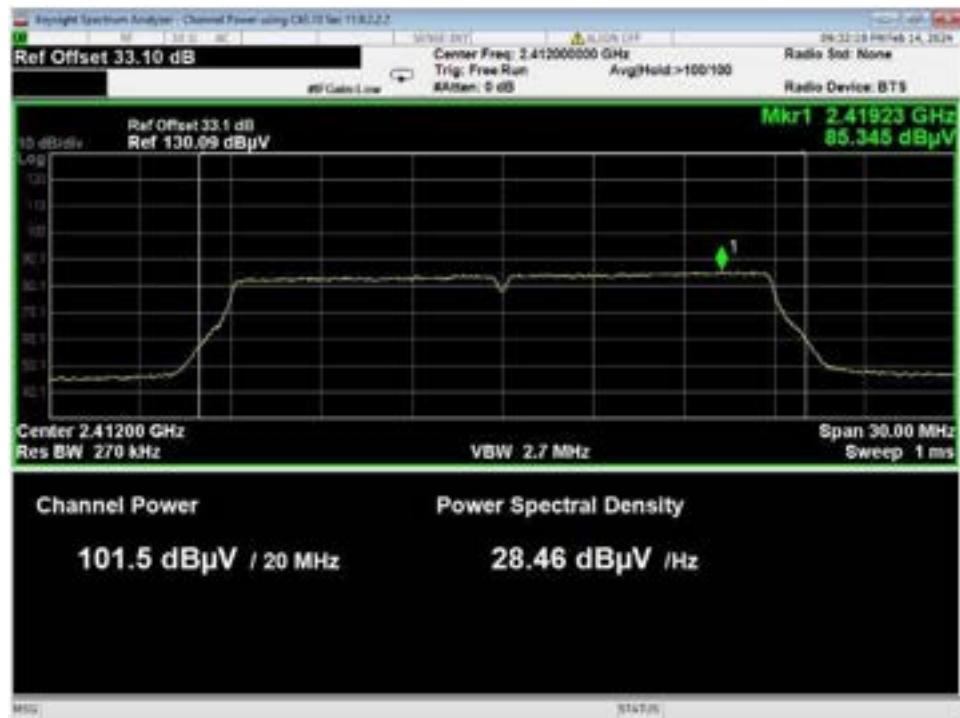


Figure 22 – Radiated Output Power Field Strength, WiFi N, High Data Rate, Low Channel.

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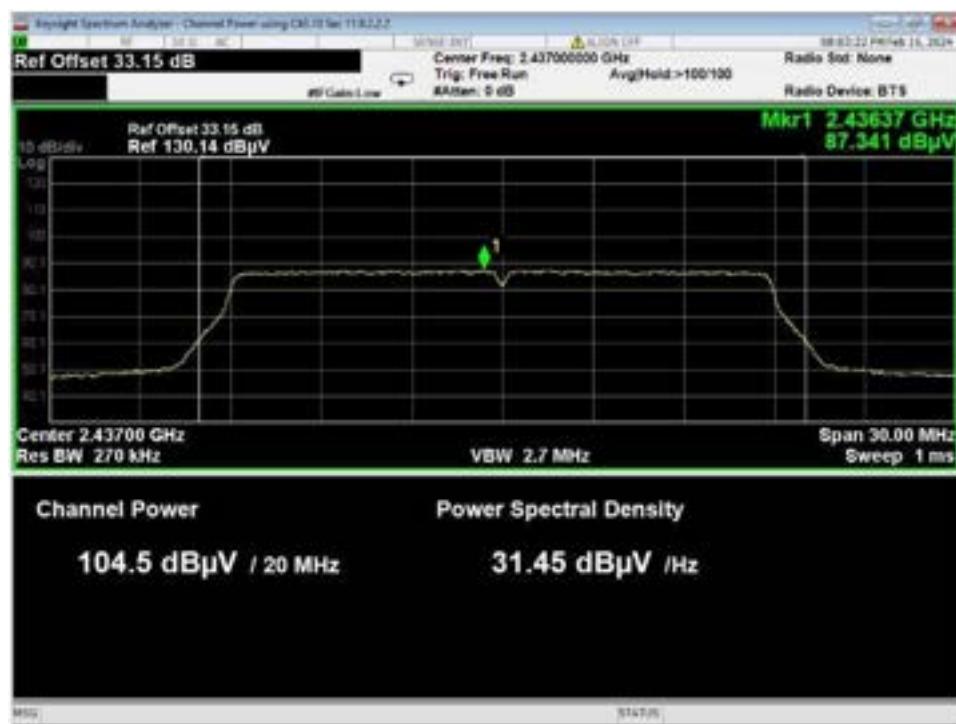


Figure 23 – Radiated Output Power Field Strength, WiFi N, High Data Rate, Mid Channel

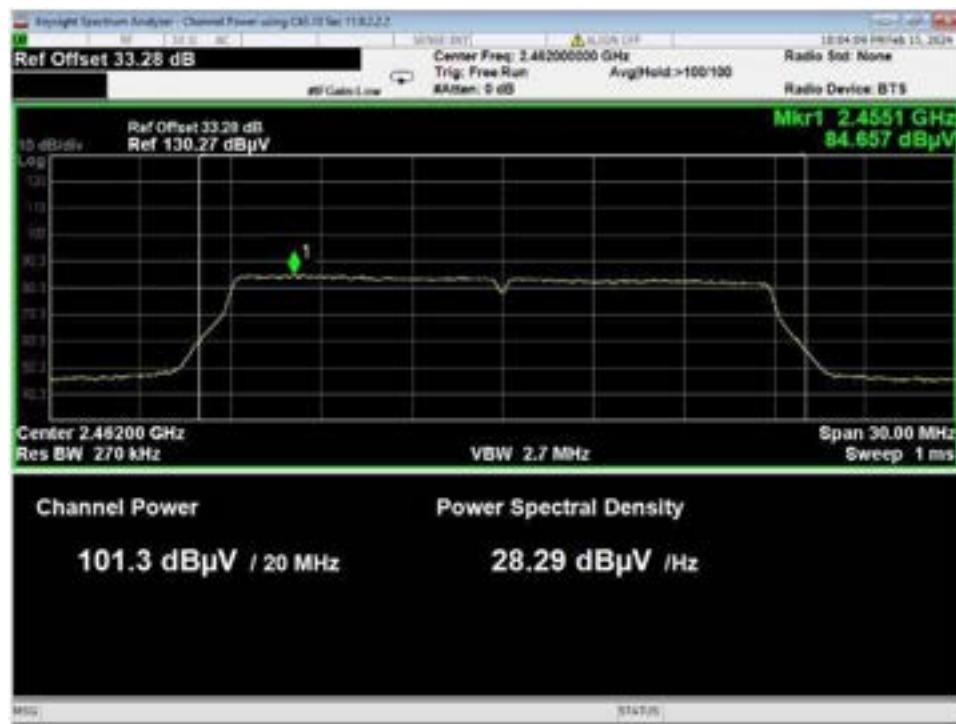


Figure 24 – Radiated Output Power Field Strength, WiFi N, High Data Rate, High Channel



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4.4 BANDWIDTH

Test Method: ANSI C63.10, Section(s) 6.9.2 (6 dB BW)
ANSI C63.10, Section(s) 6.9.3 (99% BW)

Limits of bandwidth measurements:
From FCC Part 15.247 (1) (i) and RSS-247 5.1(c)

The minimum allowed 6 dB bandwidth of the DTS channel is 500 kHz.

Test procedures:

Bandwidth measurement was taken at a distance of 3m from the EUT. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 3 kHz RBW.

The 6dB bandwidth is defined as the bandwidth of which is higher than peak power minus 6dB.

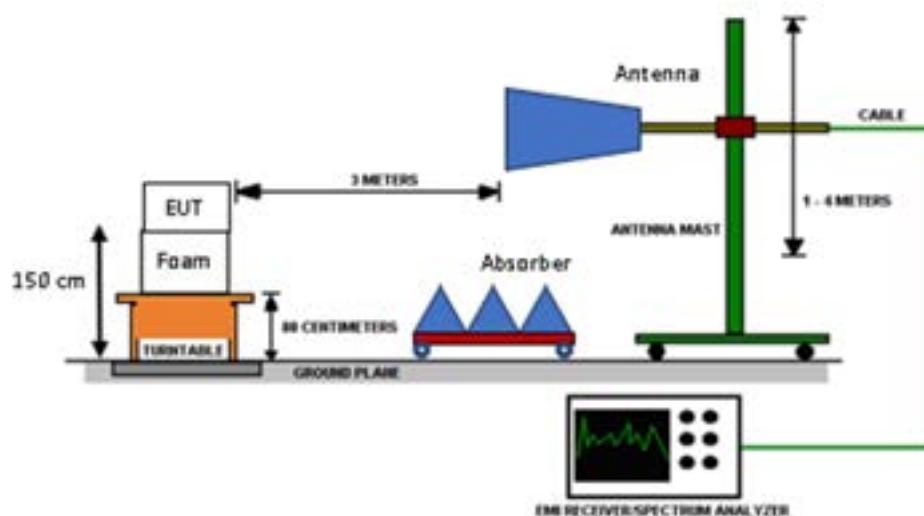
The 99% occupied bandwidth was measured using the test receiver's occupied bandwidth function.

Test setup:

All the measurements were done at 3m test distance while operating at low, mid, and high channels. See Section 4.3 for more details.

Deviations from test standard:

No deviation.

Test setup:**Figure 25 - Bandwidth Measurements Test Setup****EUT operating conditions:**

The EUT was powered by internal battery unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

Test results:**Figure 26 –Bandwidth, WiFi B, Low Data Rate, Low Channel**

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Figure 27 - Bandwidth, WiFi B, Low Data Rate, Mid Channel

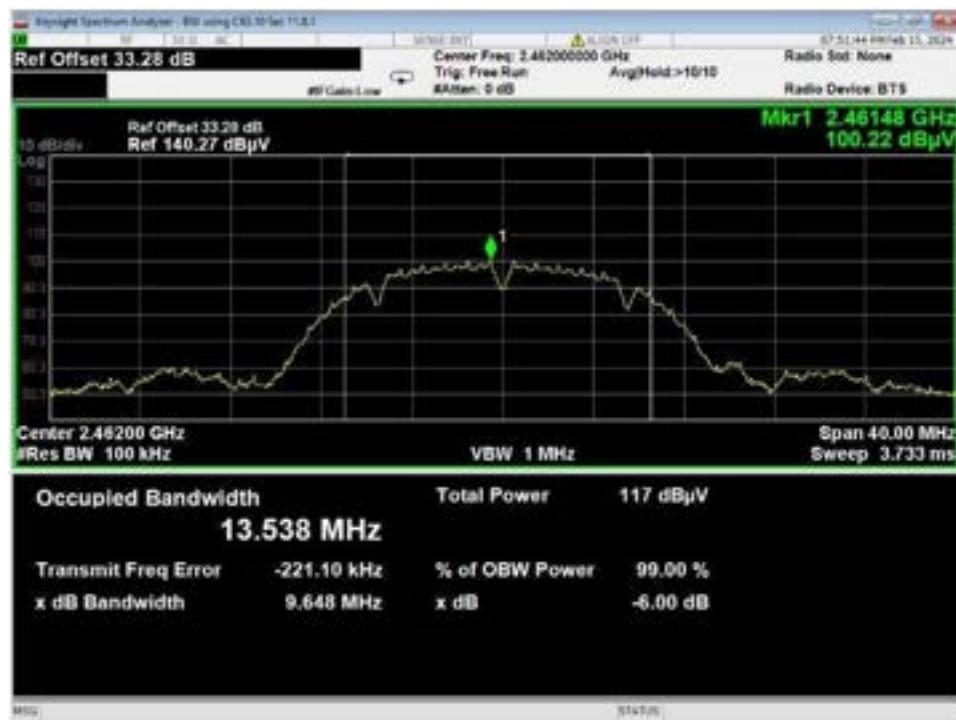


Figure 28 - Bandwidth, WiFi B, Low Data Rate, High Channel

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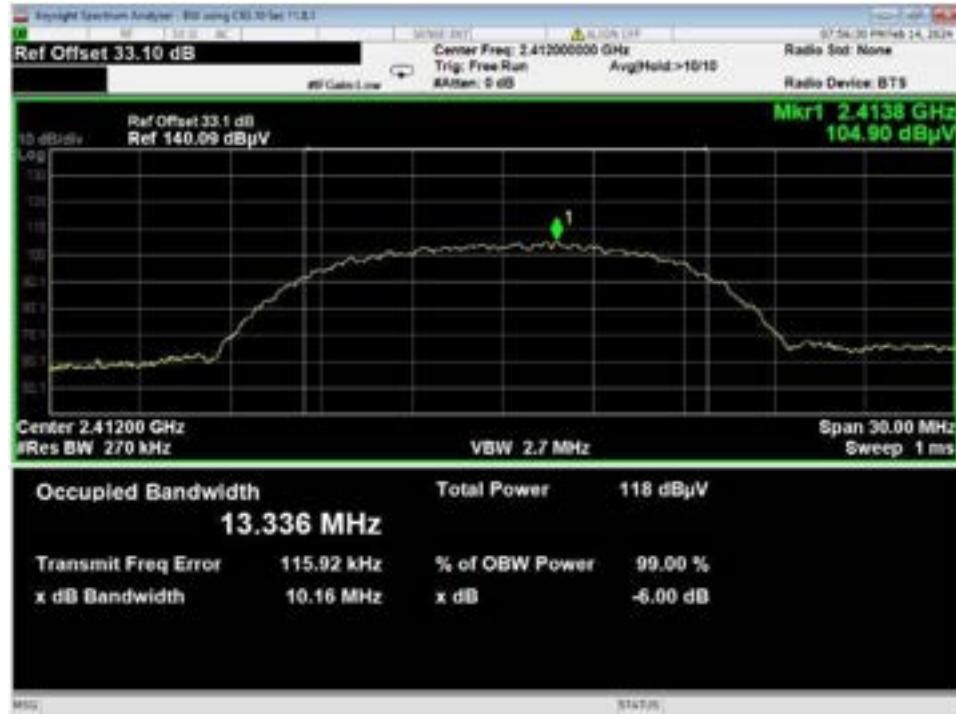


Figure 29 –Bandwidth, WiFi B, High Data Rate, Low Channel

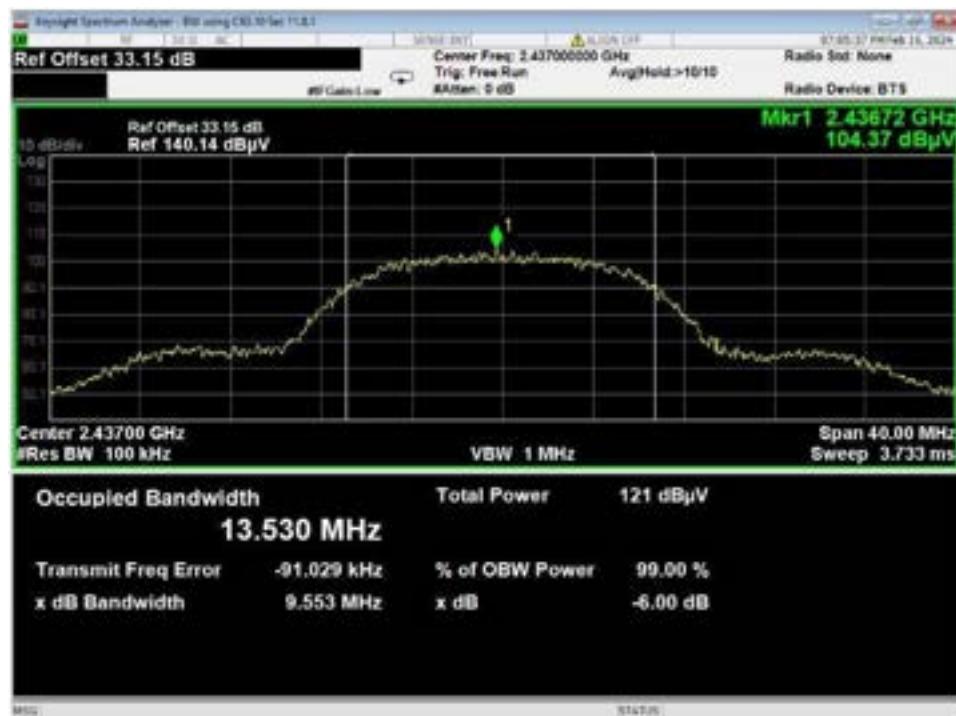


Figure 30 - Bandwidth, WiFi B, High Data Rate, Mid Channel

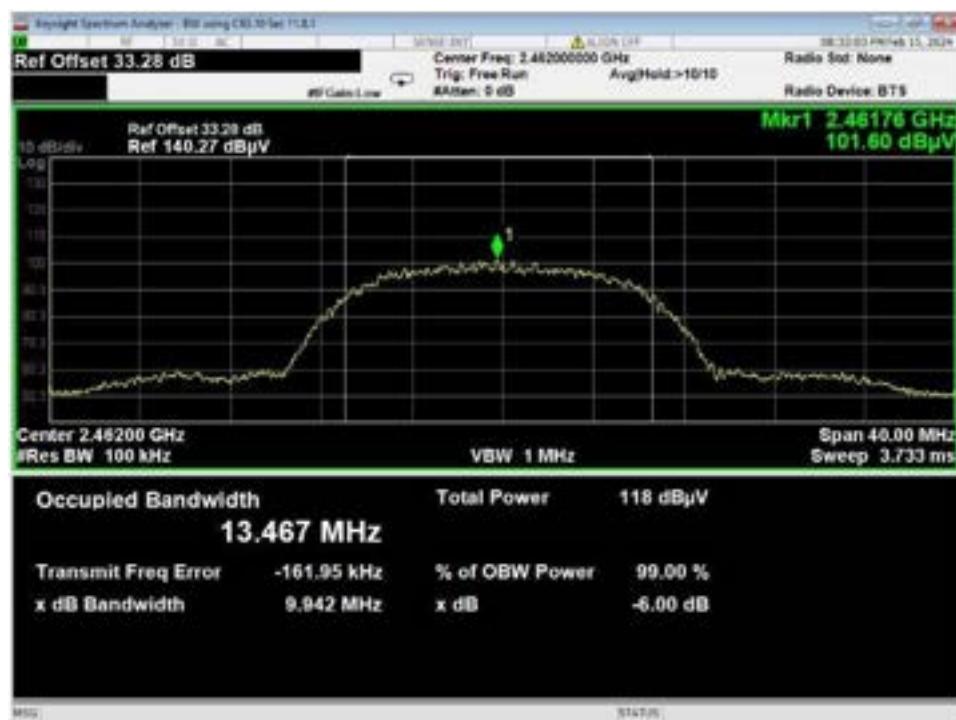


Figure 31 - Bandwidth, WiFi B, High Data Rate, High Channel

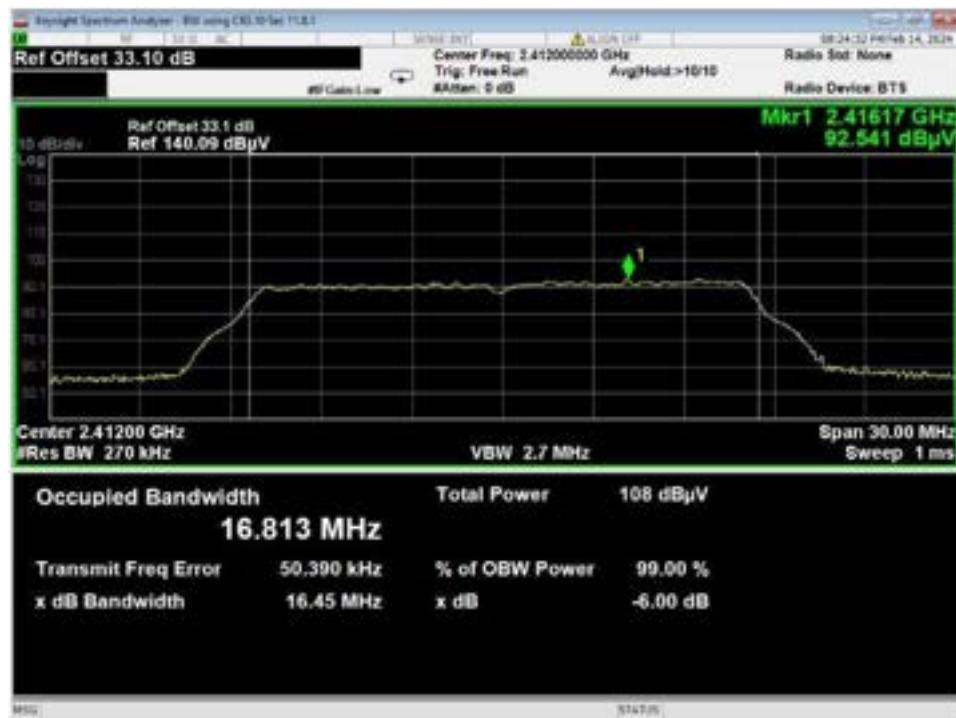


Figure 32 –Bandwidth, WiFi G, Low Data Rate, Low Channel



Figure 33 - Bandwidth, WiFi G, Low Data Rate, Mid Channel

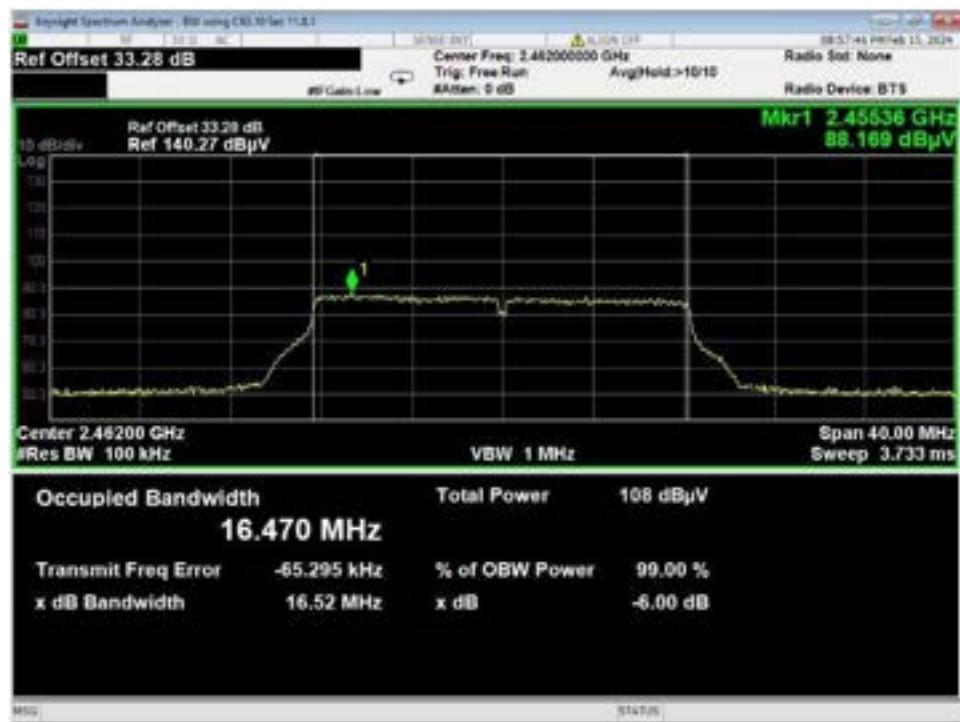


Figure 34 - Bandwidth, WiFi G, Low Data Rate, High Channel

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	Prepared for:	Raven Industries		

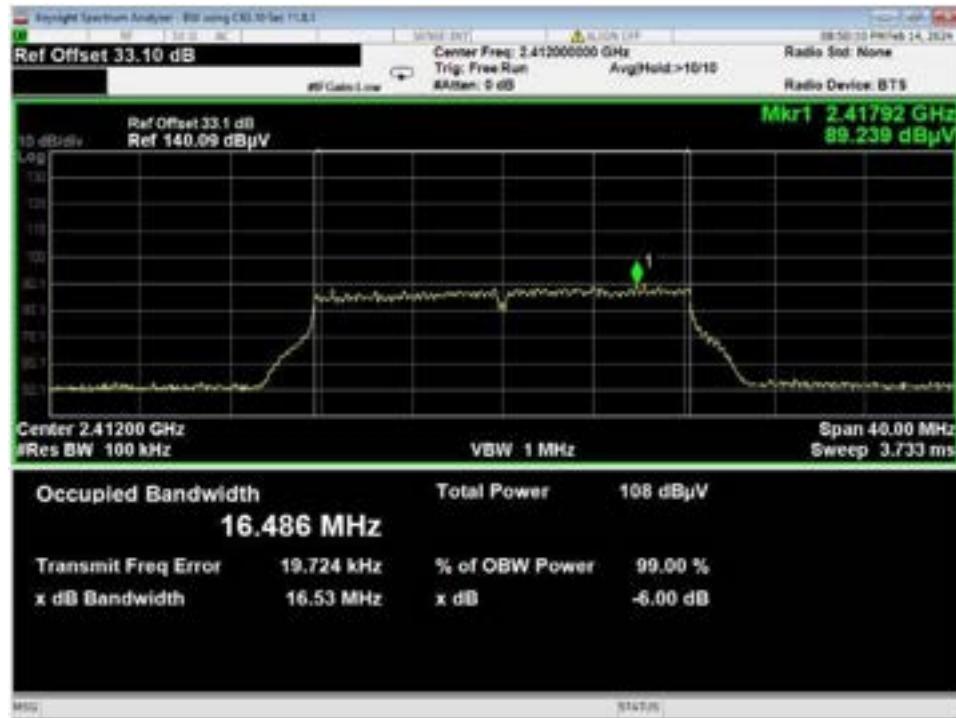


Figure 35 –Bandwidth, WiFi G, High Data Rate, Low Channel

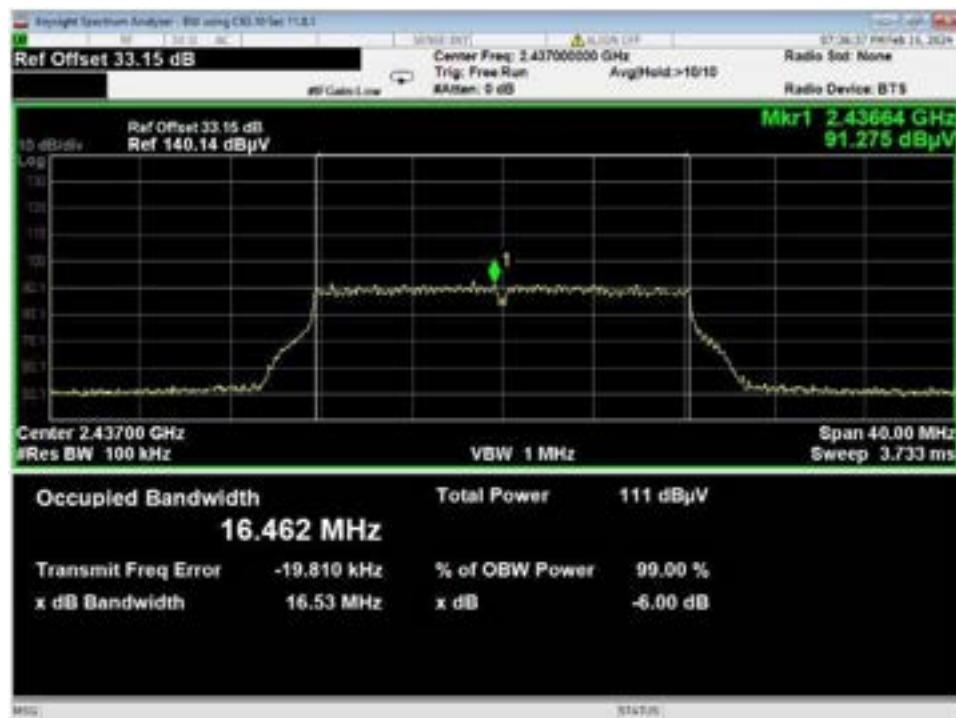


Figure 36 - Bandwidth, WiFi G, High Data Rate, Mid Channel

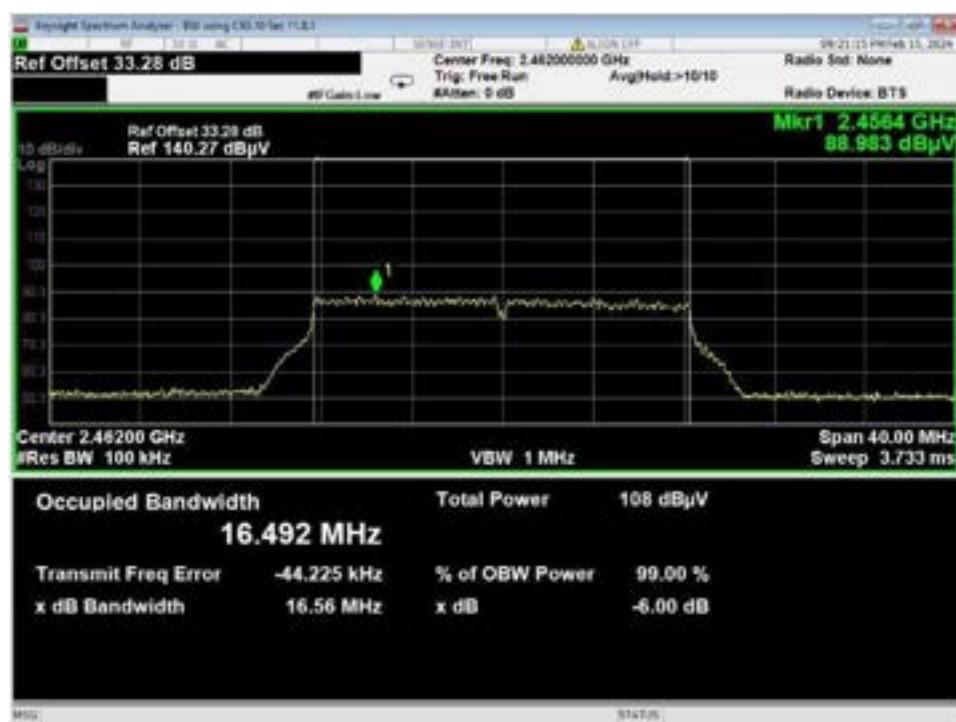


Figure 37 - Bandwidth, WiFi G, High Data Rate, High Channel



Figure 38 –Bandwidth, WiFi N, Low Data Rate, Low Channel

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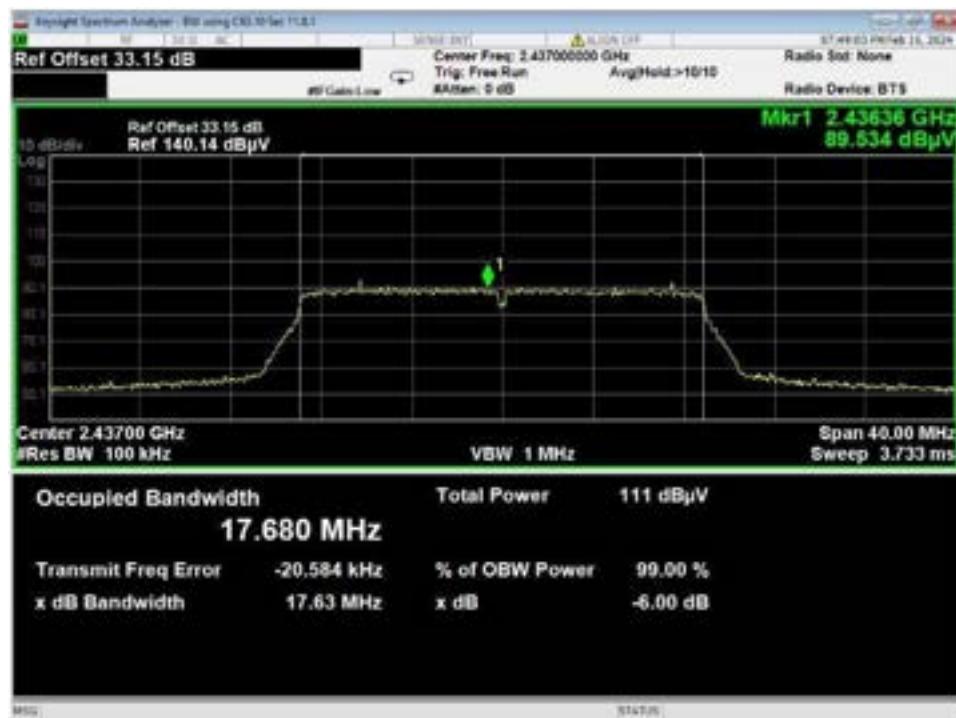


Figure 39 - Bandwidth, WiFi N, Low Data Rate, Mid Channel

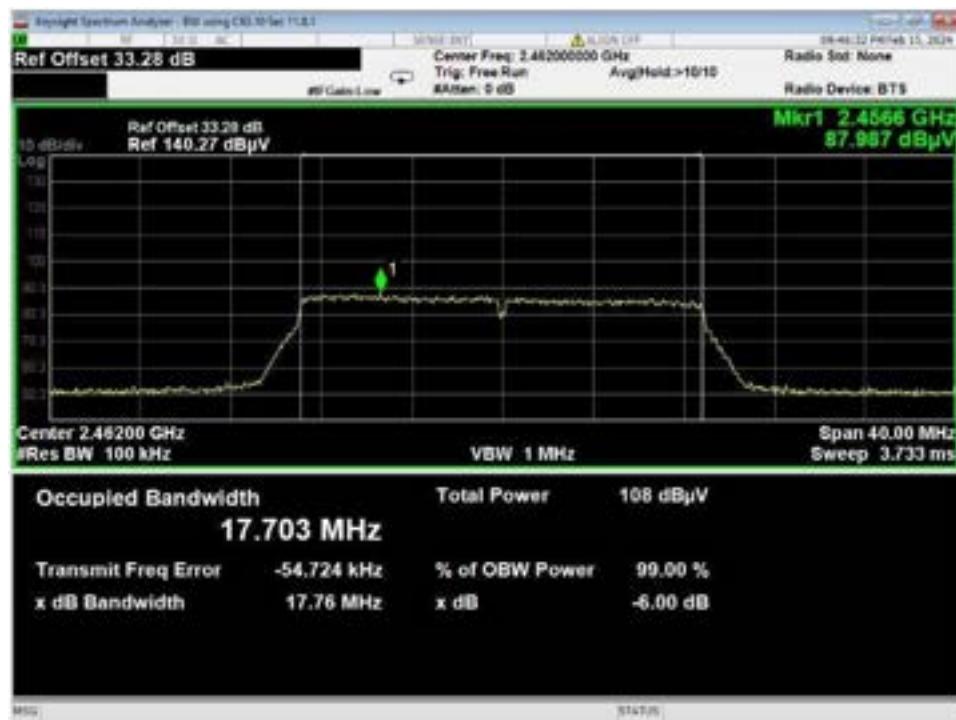


Figure 40 - Bandwidth, WiFi N, Low Data Rate, High Channel

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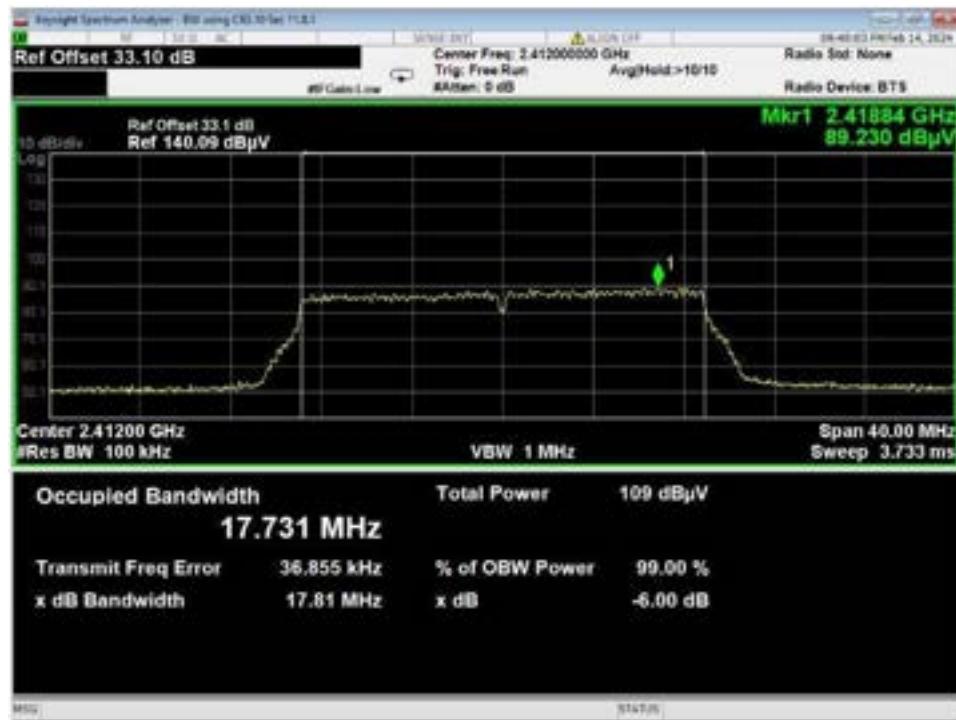


Figure 41 –Bandwidth, WiFi N, High Data Rate, Low Channel

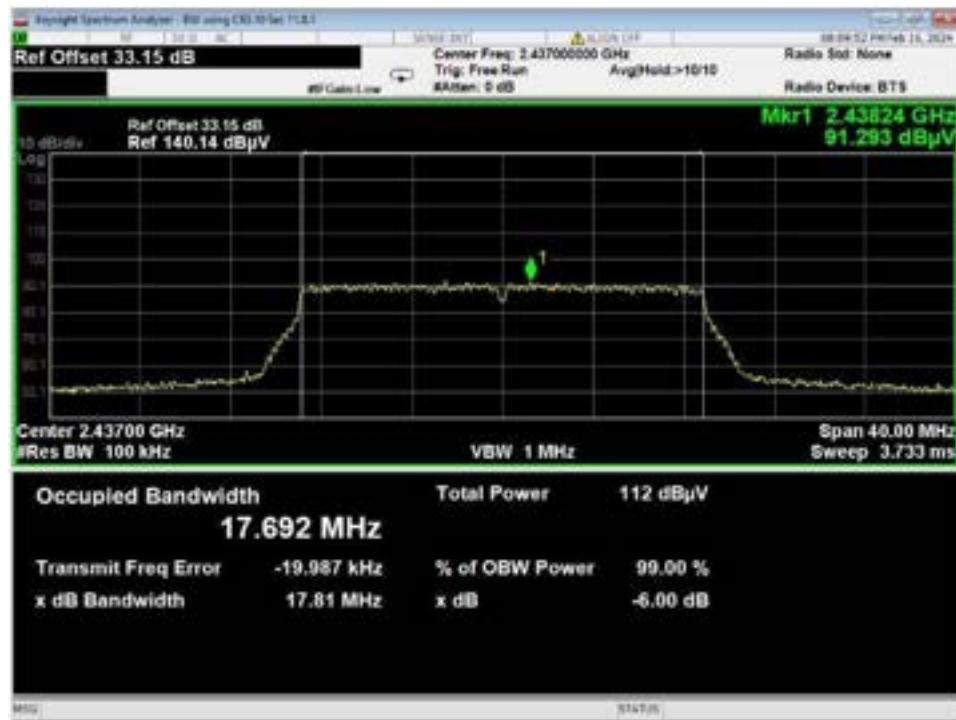


Figure 42 - Bandwidth, WiFi N, High Data Rate, Mid Channel

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Figure 43 - Bandwidth, WiFi N, High Data Rate, High Channel



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4.5 BANDEDGES

Test Method: ANSI C63.10, Section(s) 6.10.6

Limits of bandedge measurements:

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:

All measurements were taken at a distance of 3m from the EUT.

The EUT was maximized in all 3 orthogonal positions in a similar manner as described in Section 4.2.

Deviations from test standard:

No deviation.

Test setup:

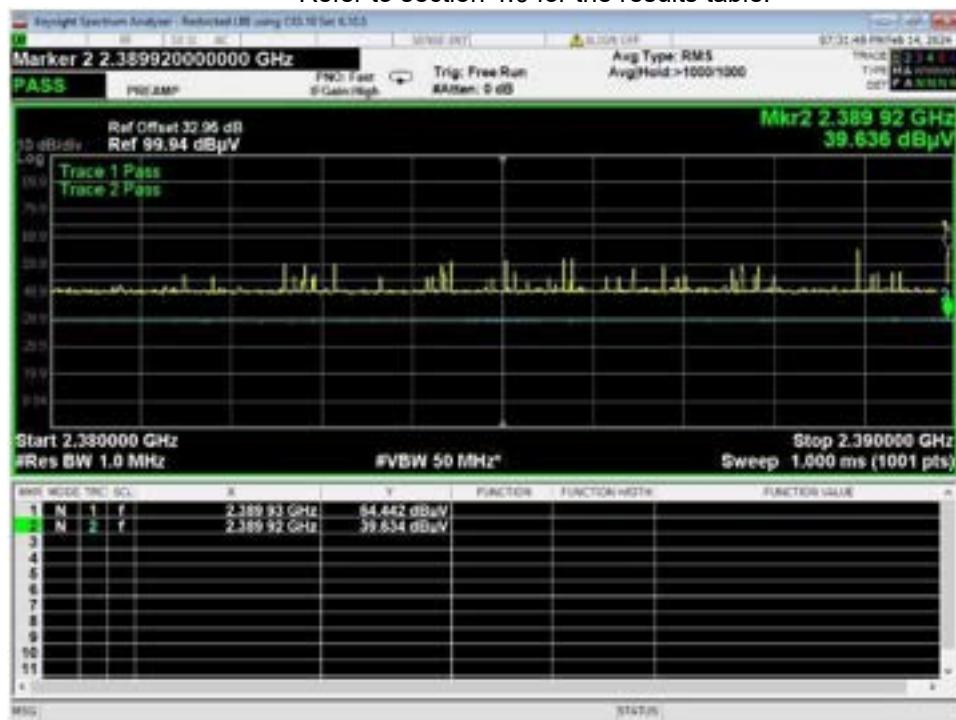
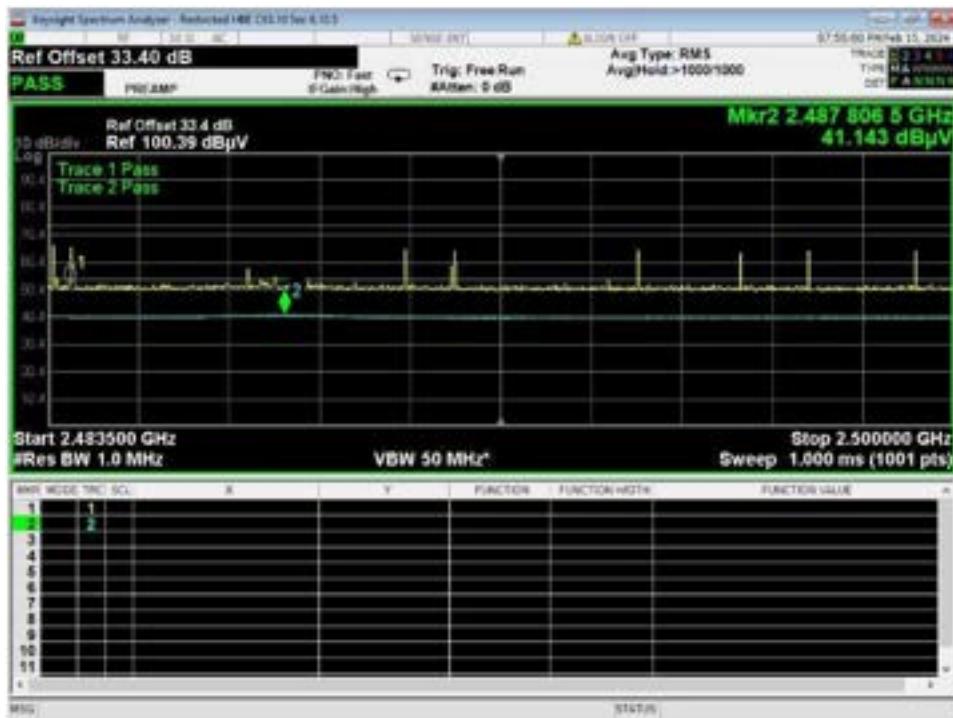
All the measurements were done at 3m test distance while operating on the highest and lowest channel depending on which band edge was investigated.

EUT operating conditions:

The EUT was powered by a 12Vbattery and set to transmit continuously on the lowest frequency channel and the highest frequency channel.

Test results:

Refer to section 4.0 for the results table.


Figure 44 – Band-edge Measurement, WiFi B, Low Data Rate, Low Channel, Restricted Frequency

Figure 45 – Band-edge Measurement, WiFi B, Low Data Rate, High Channel, Restricted Frequency

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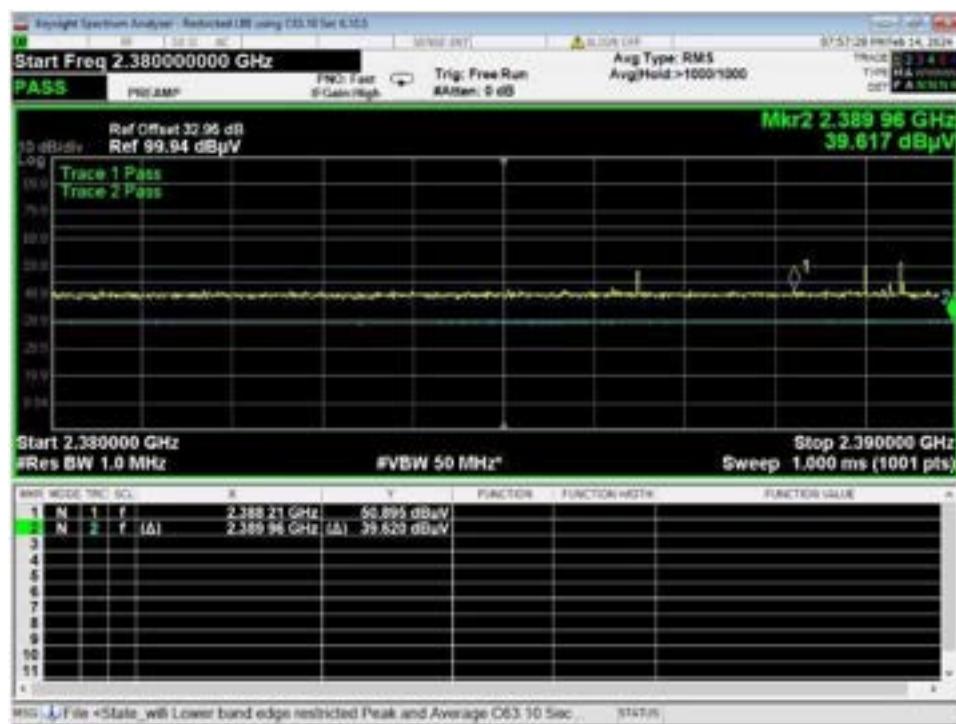


Figure 46 – Band-edge Measurement, WiFi B, High Data Rate, Low Channel, Restricted Frequency

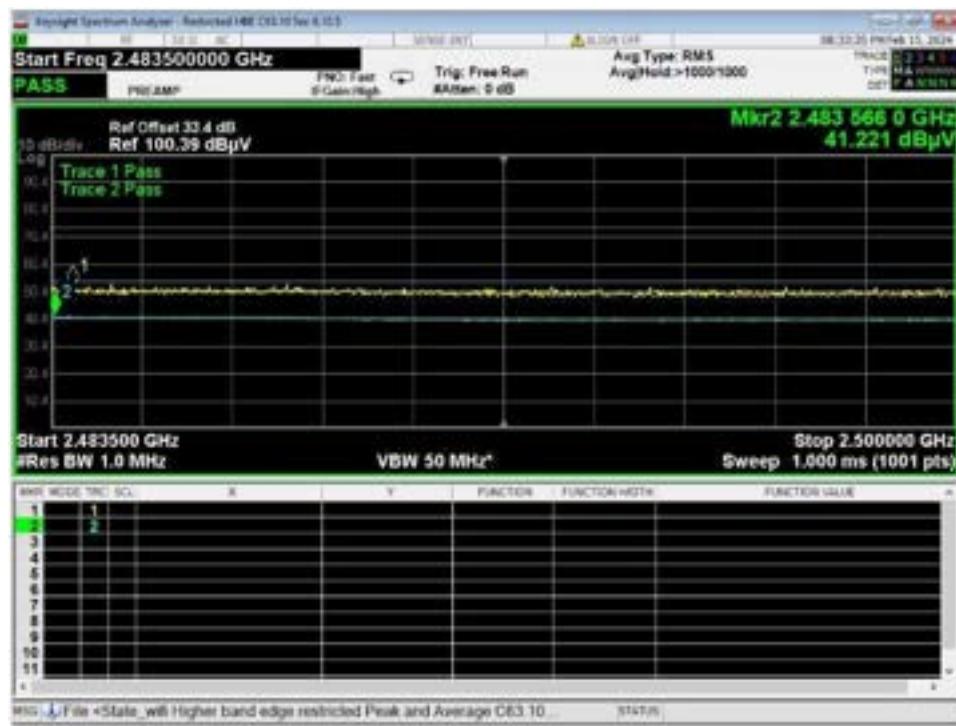


Figure 47 – Band-edge Measurement, WiFi B, High Data Rate, High Channel, Restricted Frequency

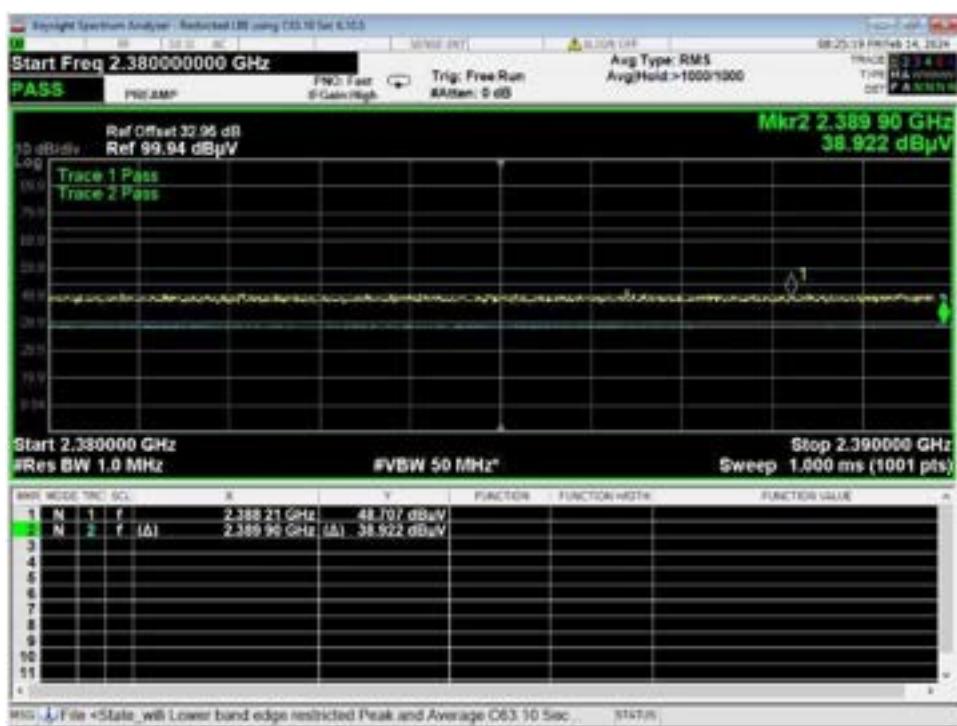


Figure 48 – Band-edge Measurement, WiFi G, Low Data Rate, Low Channel, Restricted Frequency

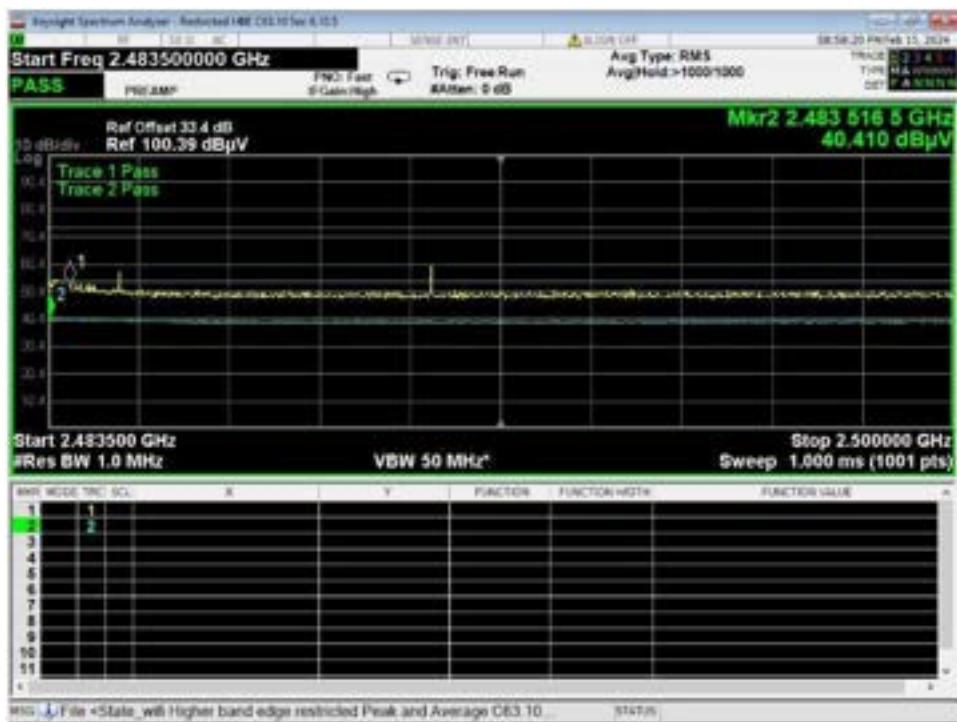


Figure 49 – Band-edge Measurement, WiFi G, Low Data Rate, High Channel, Restricted Frequency

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Figure 50 – Band-edge Measurement, WiFi G, High Data Rate, Low Channel, Restricted Frequency

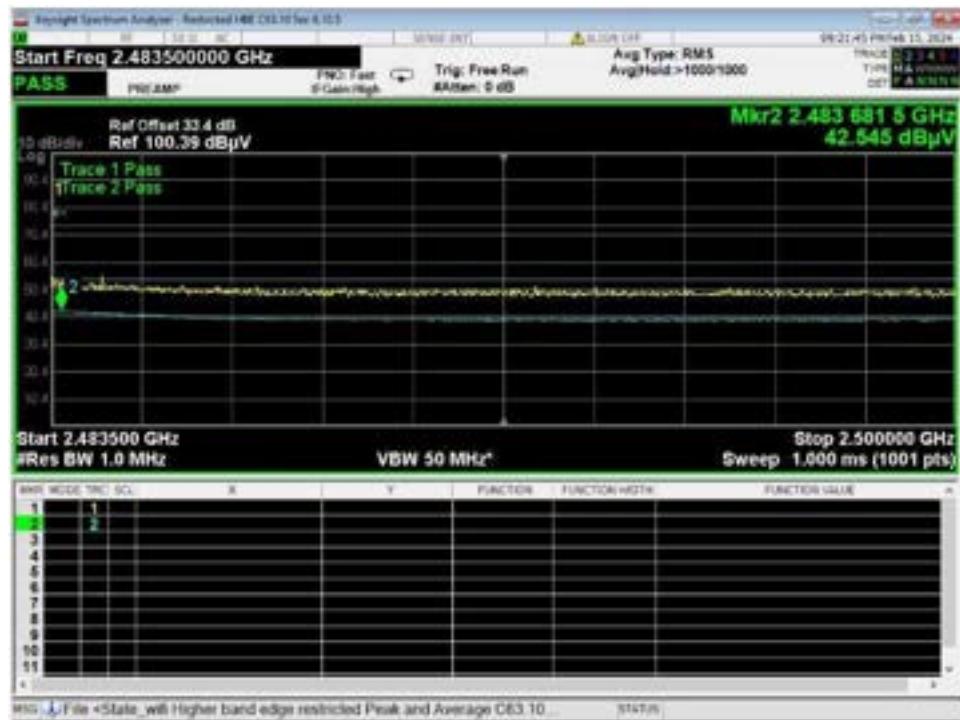


Figure 51 – Band-edge Measurement, WiFi G, High Data Rate, High Channel, Restricted Frequency

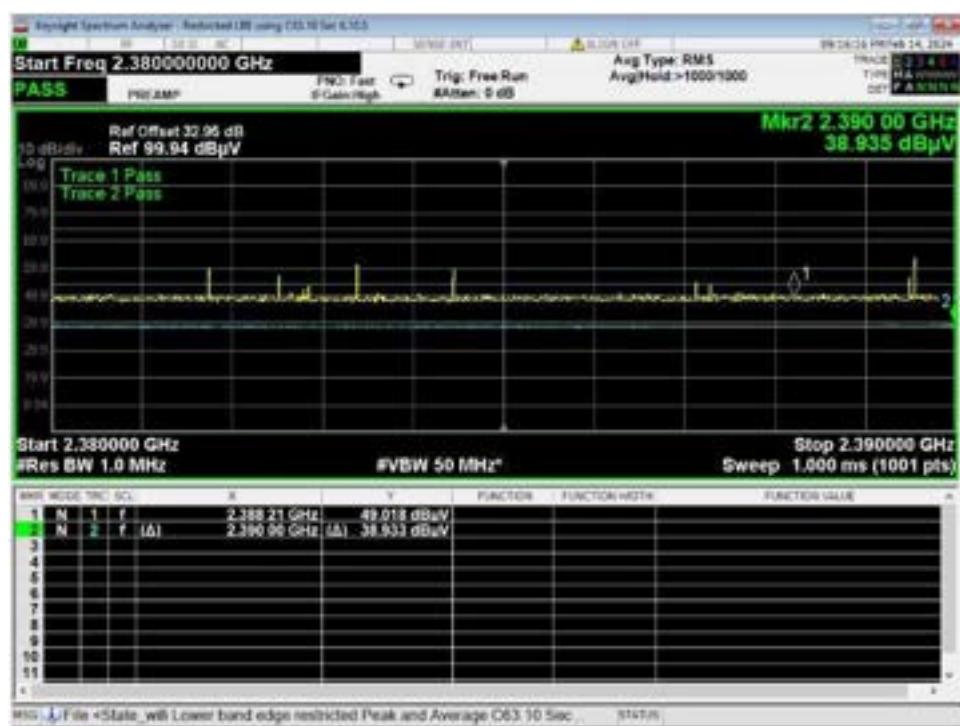


Figure 52 – Band-edge Measurement, WiFi N, Low Data Rate, Low Channel, Restricted Frequency

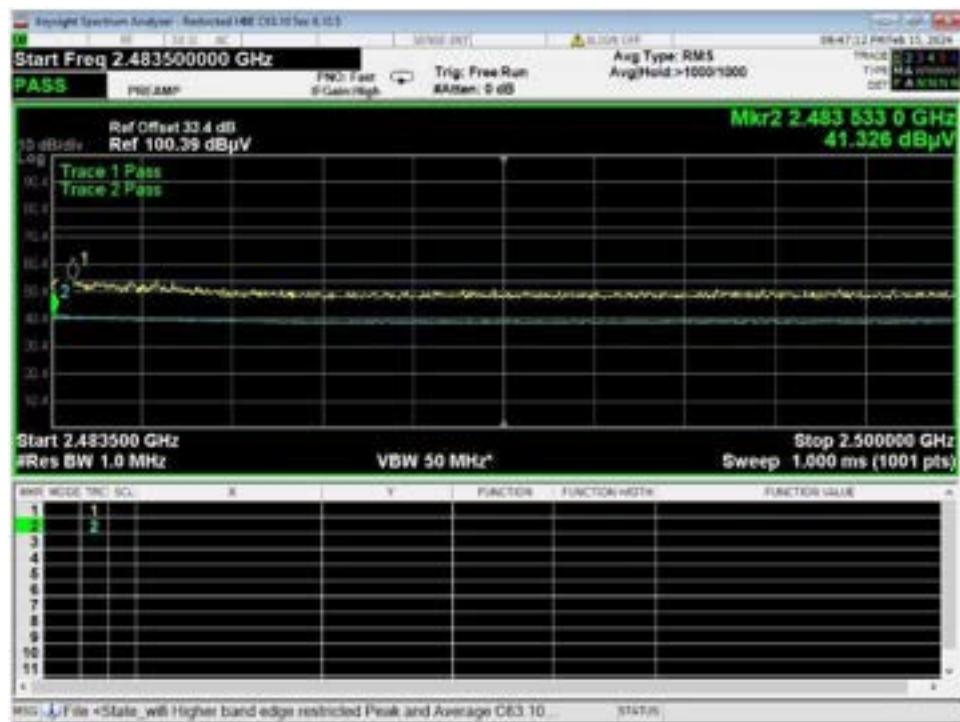


Figure 53 – Band-edge Measurement, WiFi N, Low Data Rate, High Channel, Restricted Frequency

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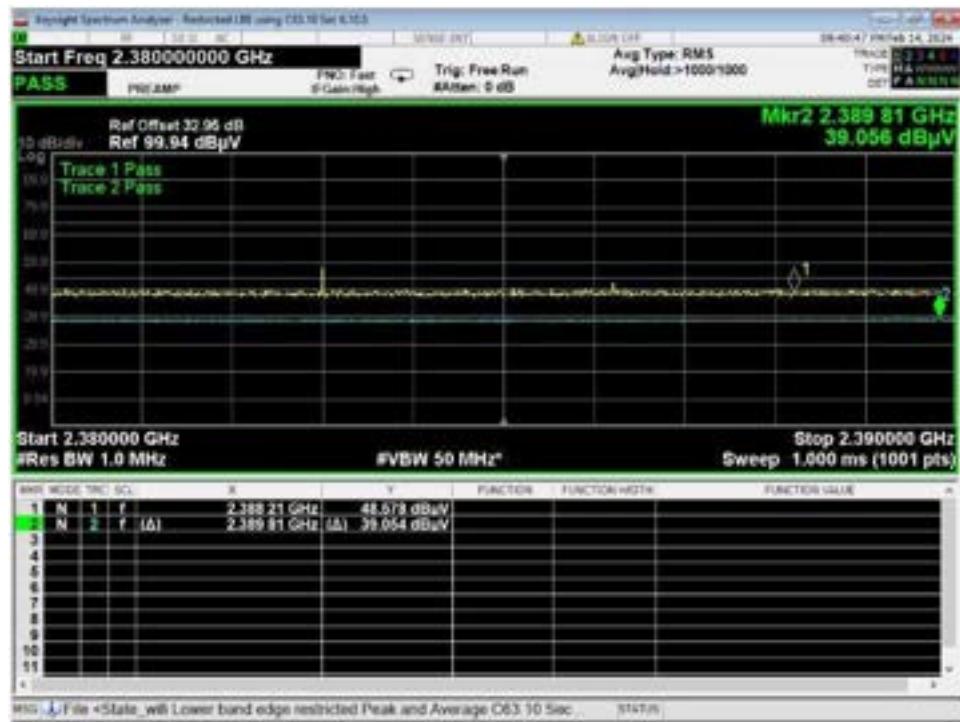


Figure 54 – Band-edge Measurement, WiFi N, High Data Rate, Low Channel, Restricted Frequency

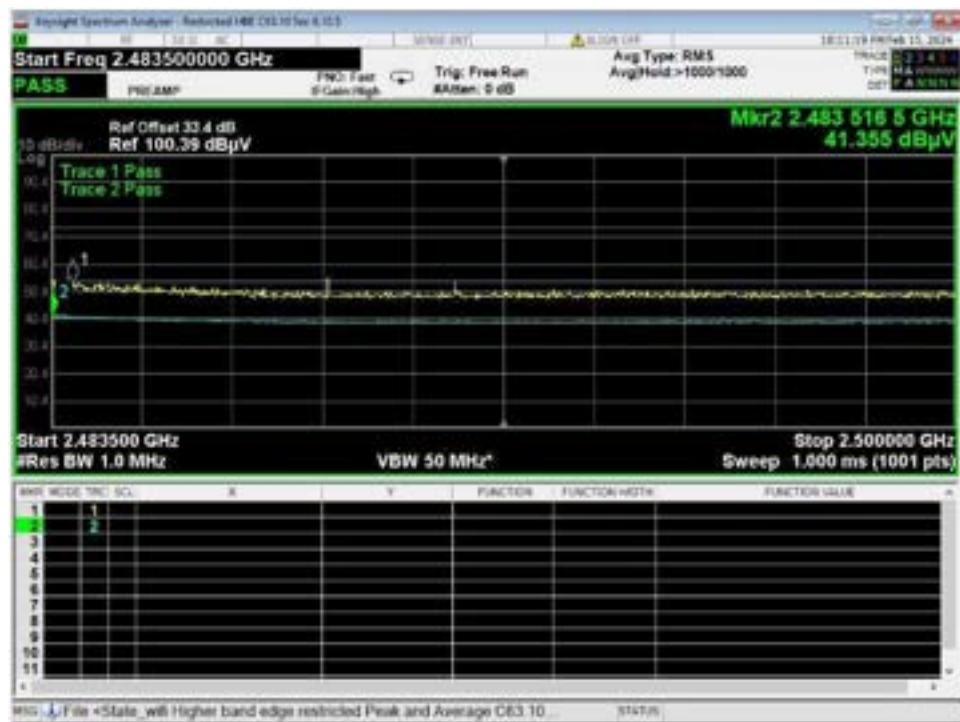


Figure 55 – Band-edge Measurement, WiFi N, High Data Rate, High Channel, Restricted Frequency

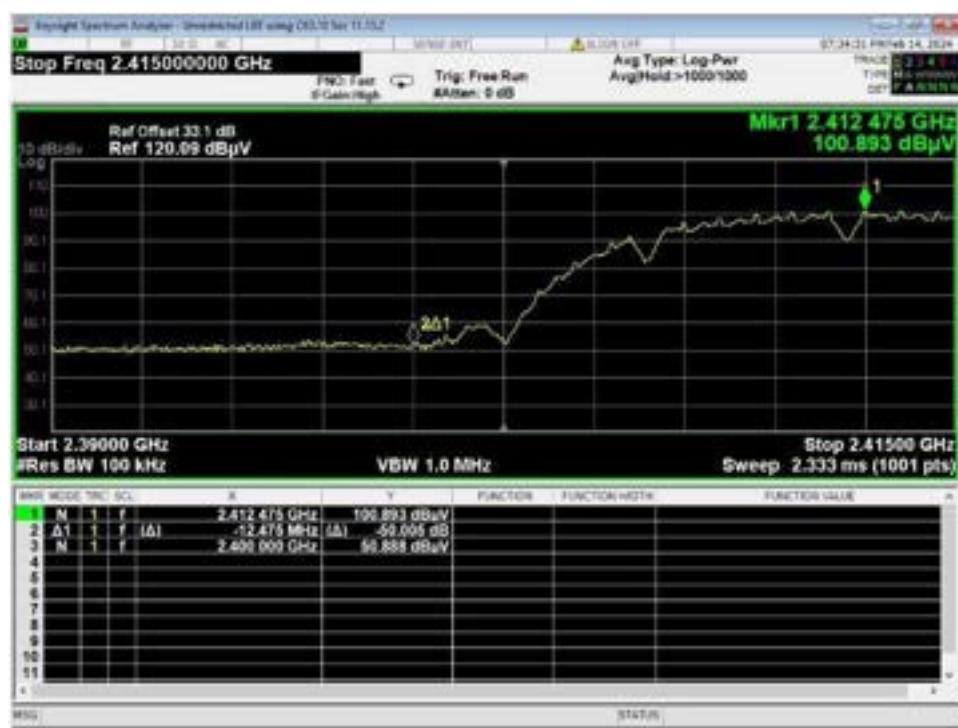


Figure 56 – Band-edge Measurement, WiFi B, Low Data Rate, Low Channel, Unrestricted Frequency



Figure 57 – Band-edge Measurement, WiFi B, Low Data Rate, High Channel, Unrestricted Frequency



Figure 58 – Band-edge Measurement, WiFi B, High Data Rate, Low Channel, Unrestricted Frequency



Figure 59 – Band-edge Measurement, WiFi B, High Data Rate, High Channel, Unrestricted Frequency

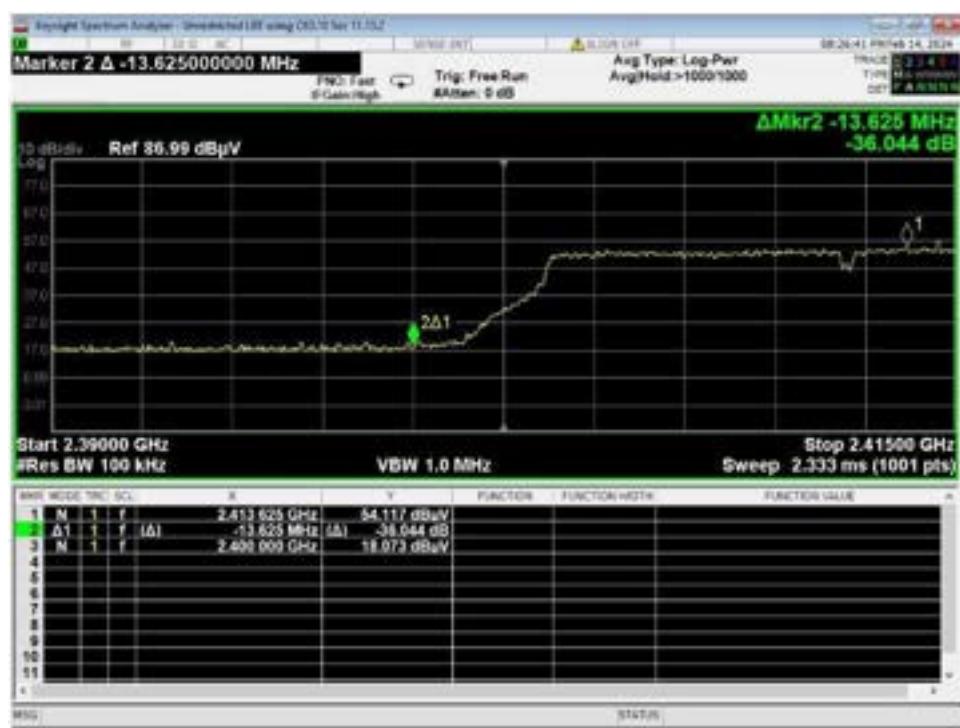


Figure 60 – Band-edge Measurement, WiFi G, Low Data Rate, Low Channel, Unrestricted Frequency



Figure 61 – Band-edge Measurement, WiFi G, Low Data Rate, High Channel, Unrestricted Frequency

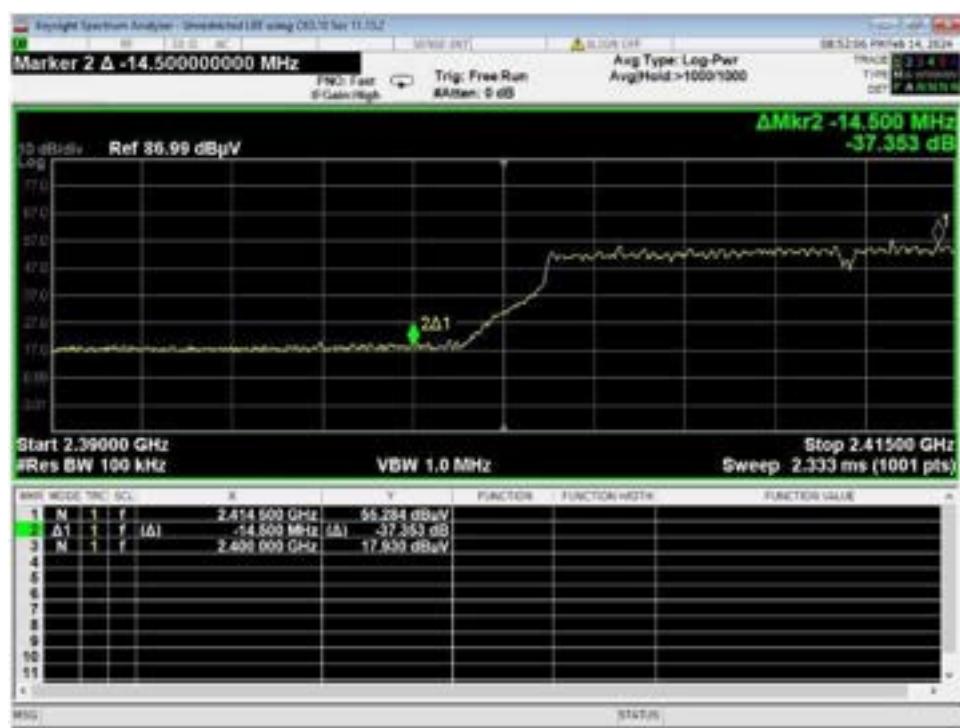


Figure 62 – Band-edge Measurement, WiFi G, High Data Rate, Low Channel, Unrestricted Frequency



Figure 63 – Band-edge Measurement, WiFi G, High Data Rate, High Channel, Unrestricted Frequency

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Figure 64 – Band-edge Measurement, WiFi N, Low Data Rate, Low Channel, Unrestricted Frequency

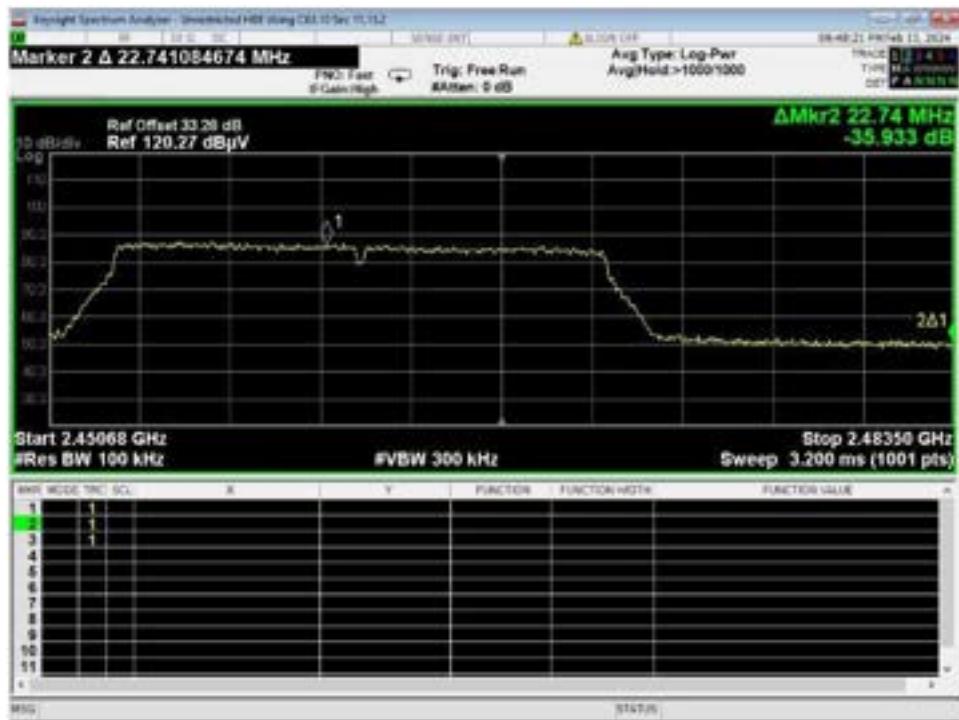


Figure 65 – Band-edge Measurement, WiFi N, Low Data Rate, High Channel, Unrestricted Frequency



Figure 66 – Band-edge Measurement, WiFi N, High Data Rate, Low Channel, Unrestricted Frequency

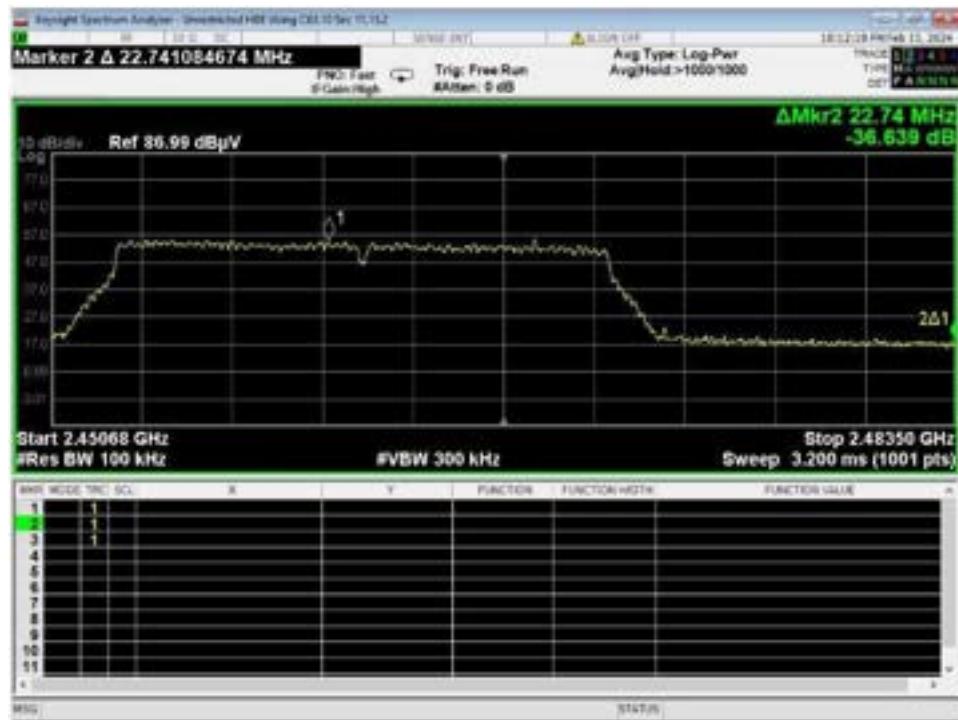


Figure 67 – Band-edge Measurement, WiFi N, High Data Rate, High Channel, Unrestricted Frequency

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:

The EUT was powered by a 12V battery and set to transmit mode.

Test results:

Pass

Comments:

1. All the measurements were found to be compliant.
2. Tabulated data is listed in section 4.0.



Figure 68 – Radiated EIRP Power Spectral Density, WiFi B, Low Data Rate, Low Channel



Figure 69 – Radiated EIRP Power Spectral Density, WiFi B, Low Data Rate, Mid Channel



Figure 70 – Radiated EIRP Power Spectral Density, WiFi B, Low Data Rate, High Channel

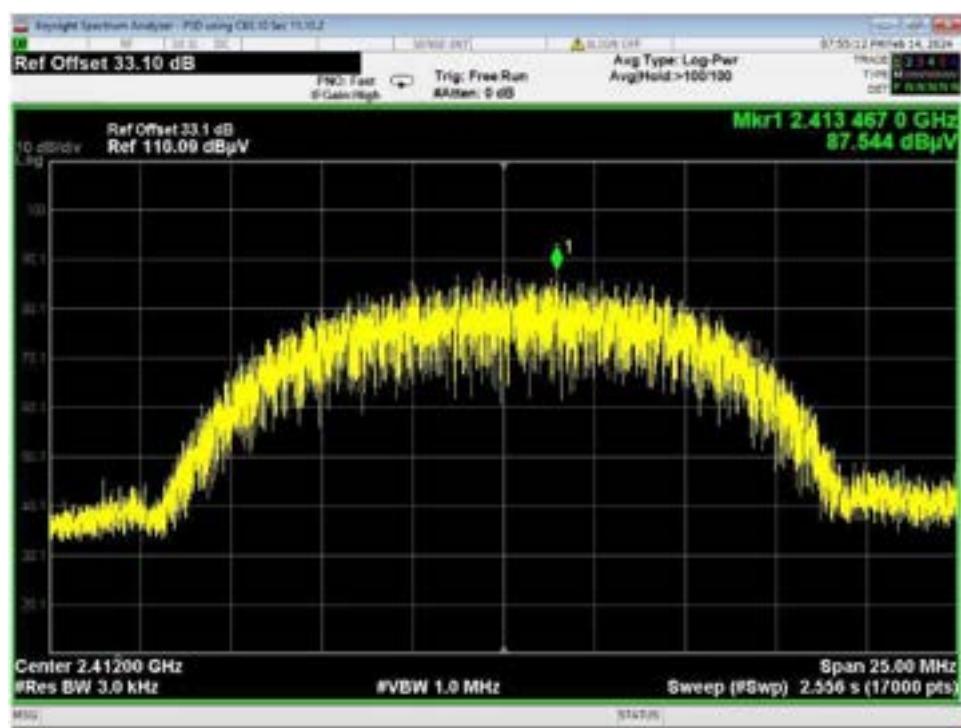


Figure 71 – Radiated EIRP Power Spectral Density, WiFi B, High Data Rate, Low Channel

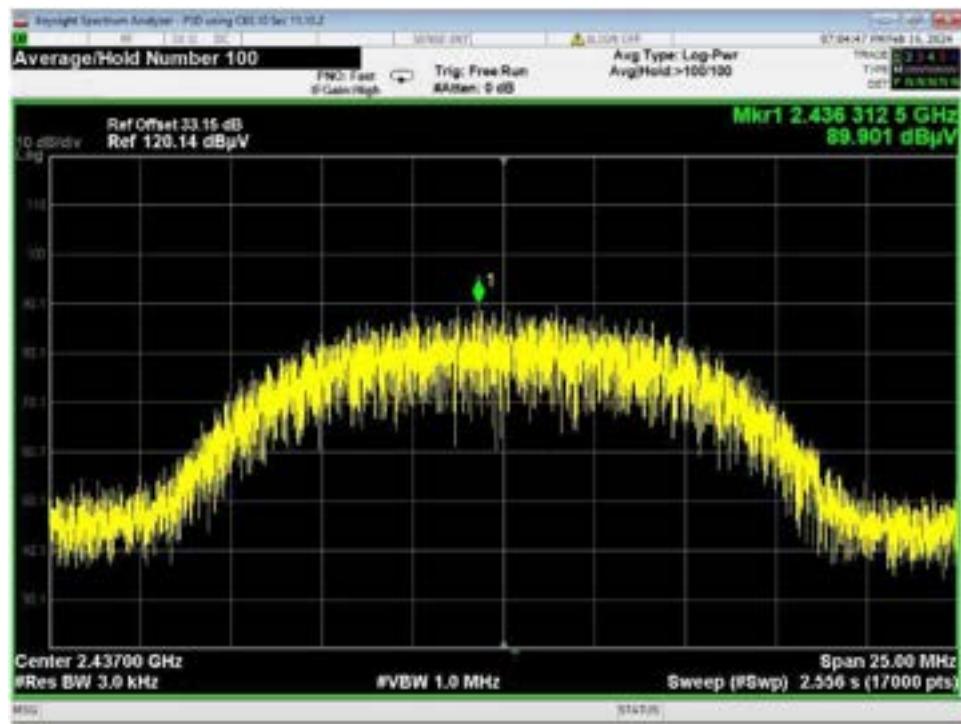


Figure 72 – Radiated EIRP Power Spectral Density, WiFi B, High Data Rate, Mid Channel

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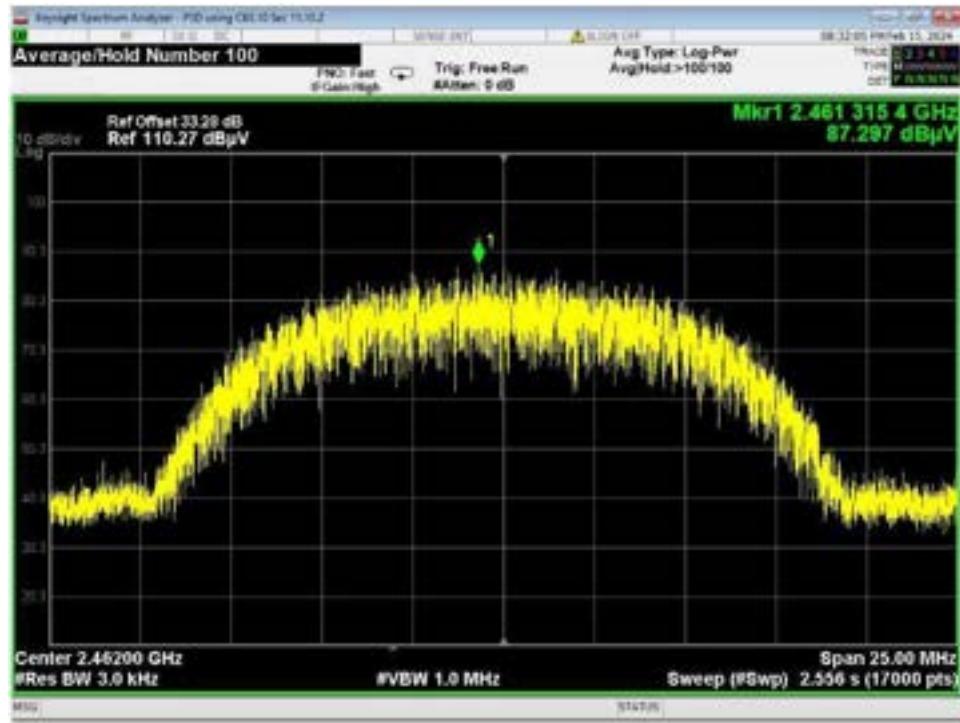


Figure 73 – Radiated EIRP Power Spectral Density, WiFi B, High Data Rate, High Channel

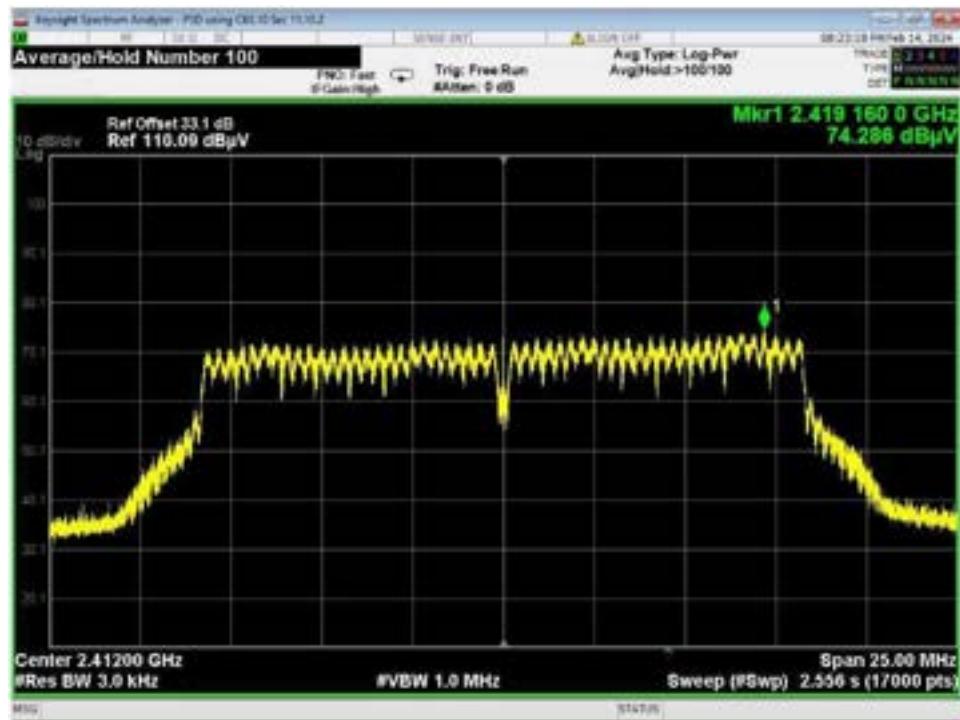


Figure 74 – Radiated EIRP Power Spectral Density, WiFi G, Low Data Rate, Low Channel

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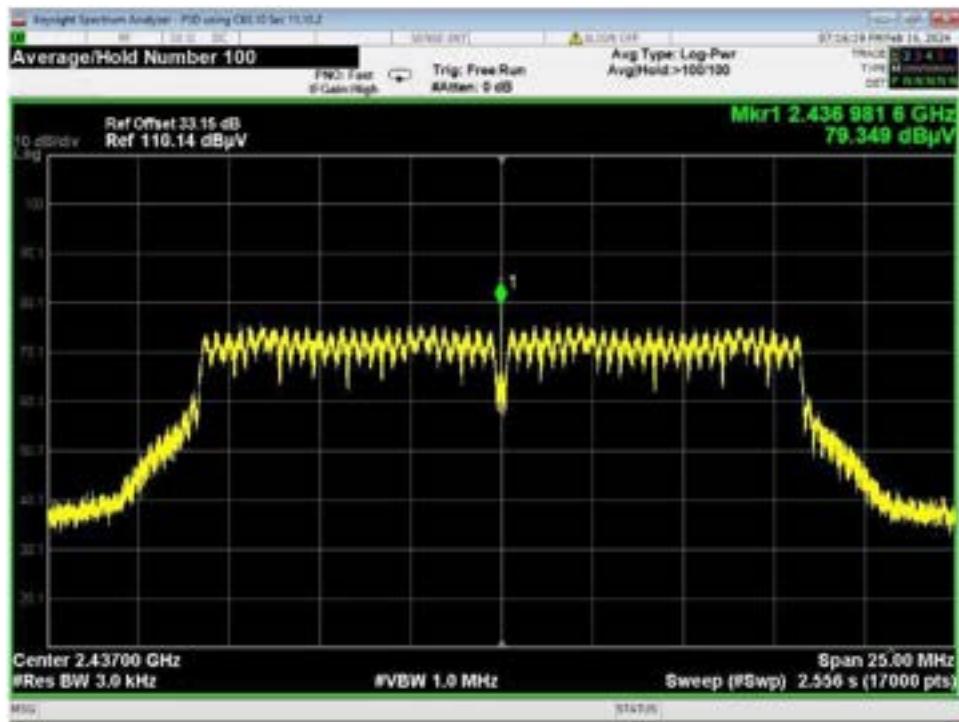


Figure 75 – Radiated EIRP Power Spectral Density, WiFi G, Low Data Rate, Mid Channel

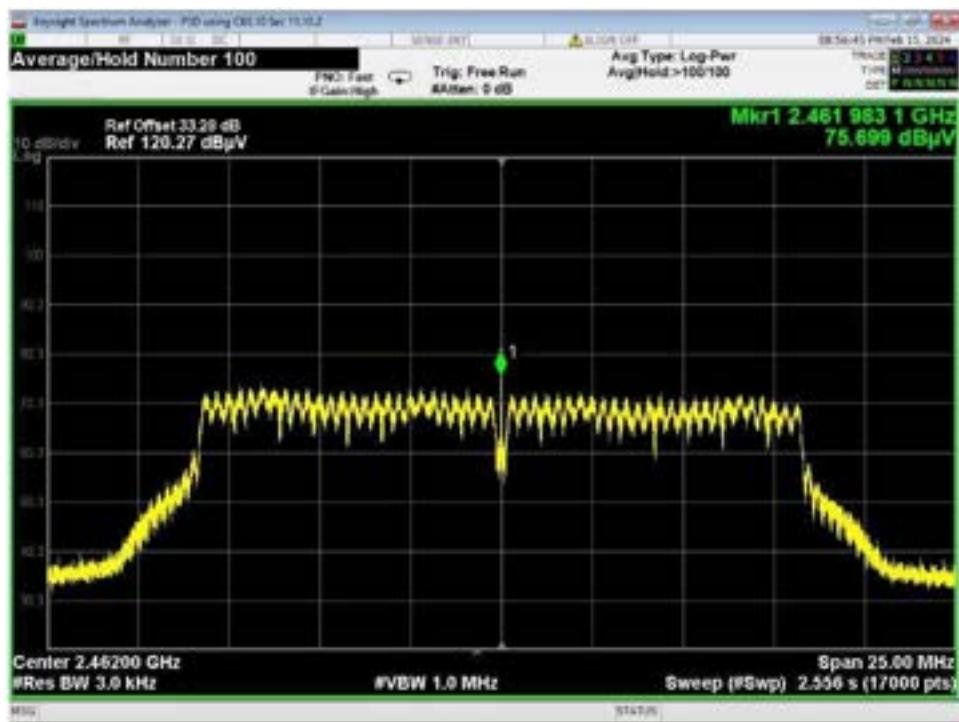


Figure 76 – Radiated EIRP Power Spectral Density, WiFi G, Low Data Rate, High Channel

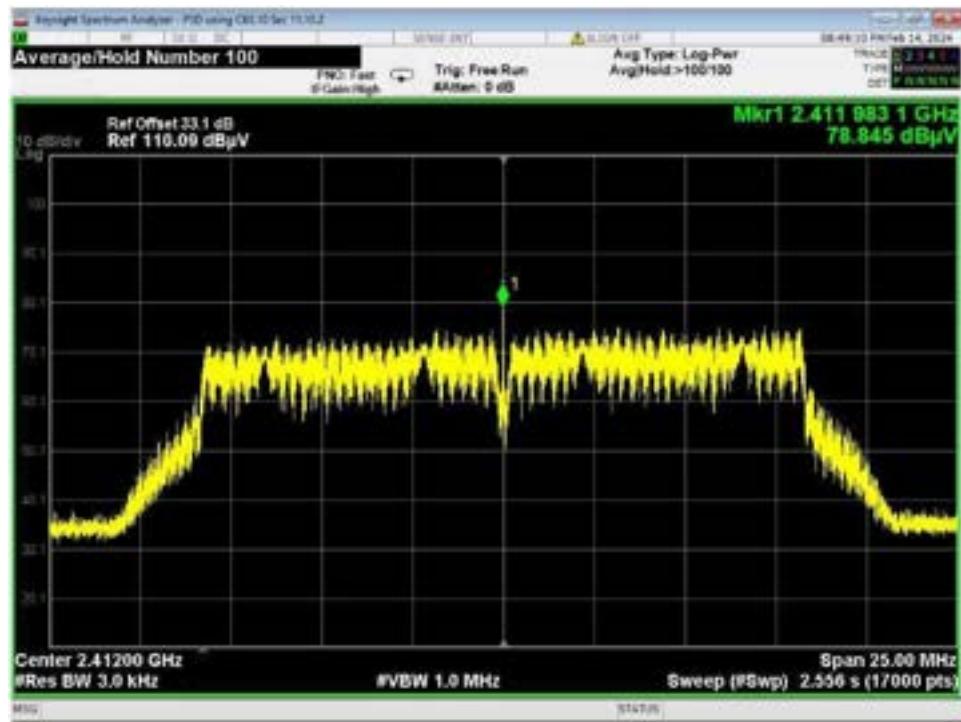


Figure 77 – Radiated EIRP Power Spectral Density, WiFi G, High Data Rate, Low Channel

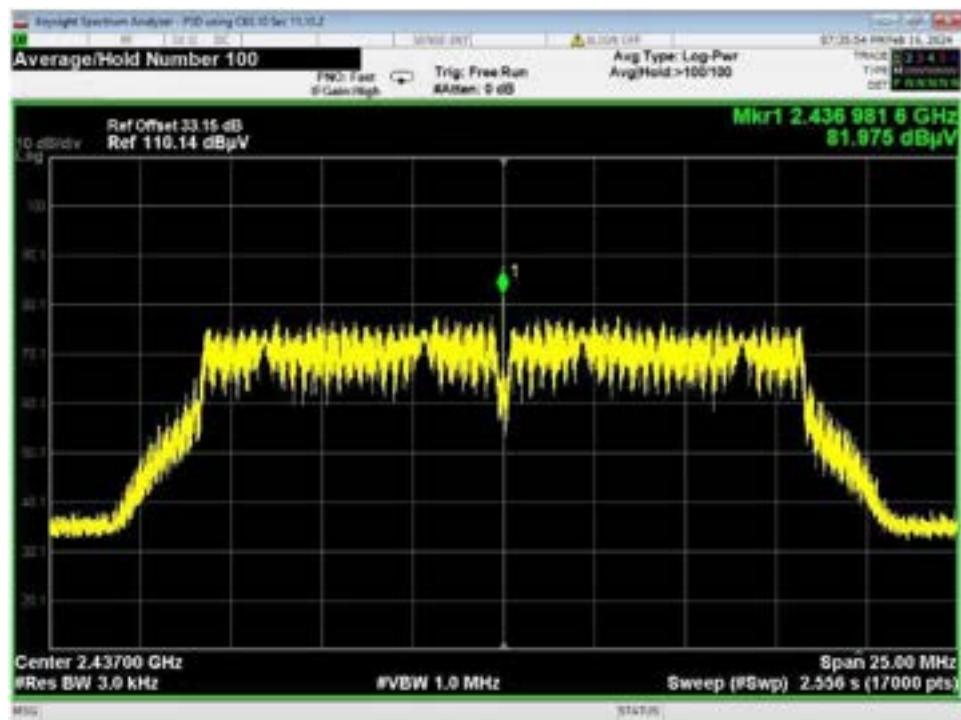


Figure 78 – Radiated EIRP Power Spectral Density, WiFi G, High Data Rate, Mid Channel

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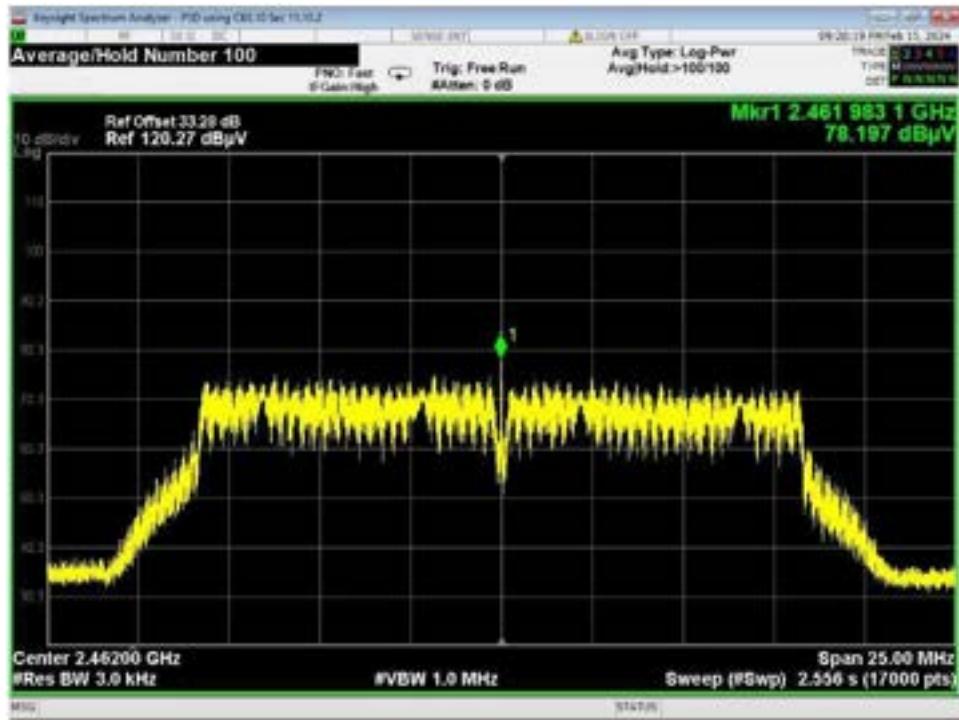


Figure 79 – Radiated EIRP Power Spectral Density, WiFi G, High Data Rate, High Channel

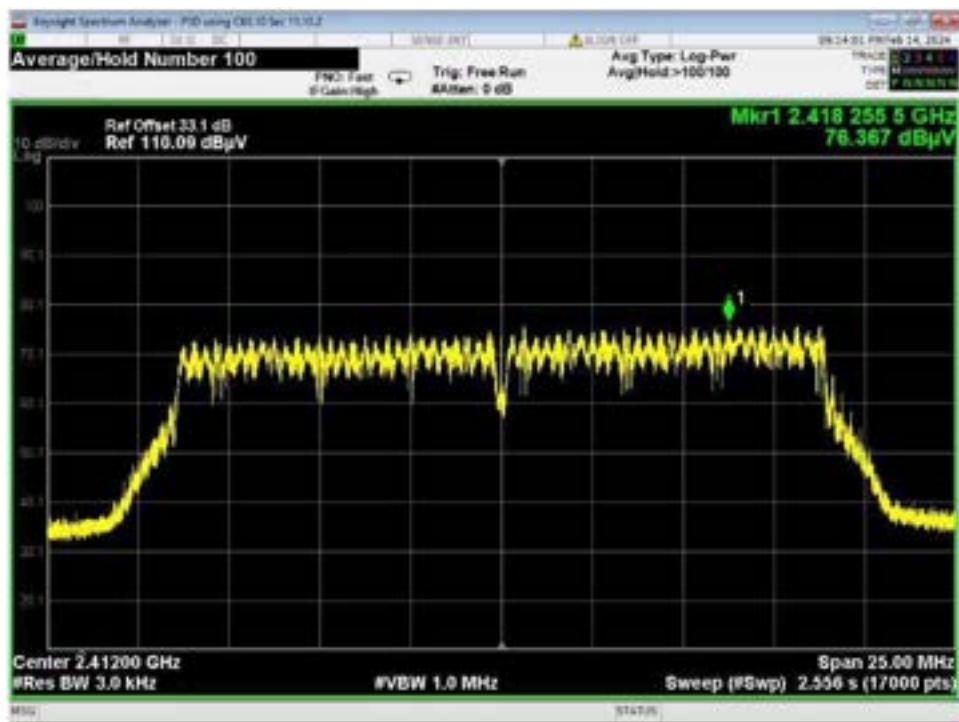


Figure 80 – Radiated EIRP Power Spectral Density, WiFi N, Low Data Rate, Low Channel

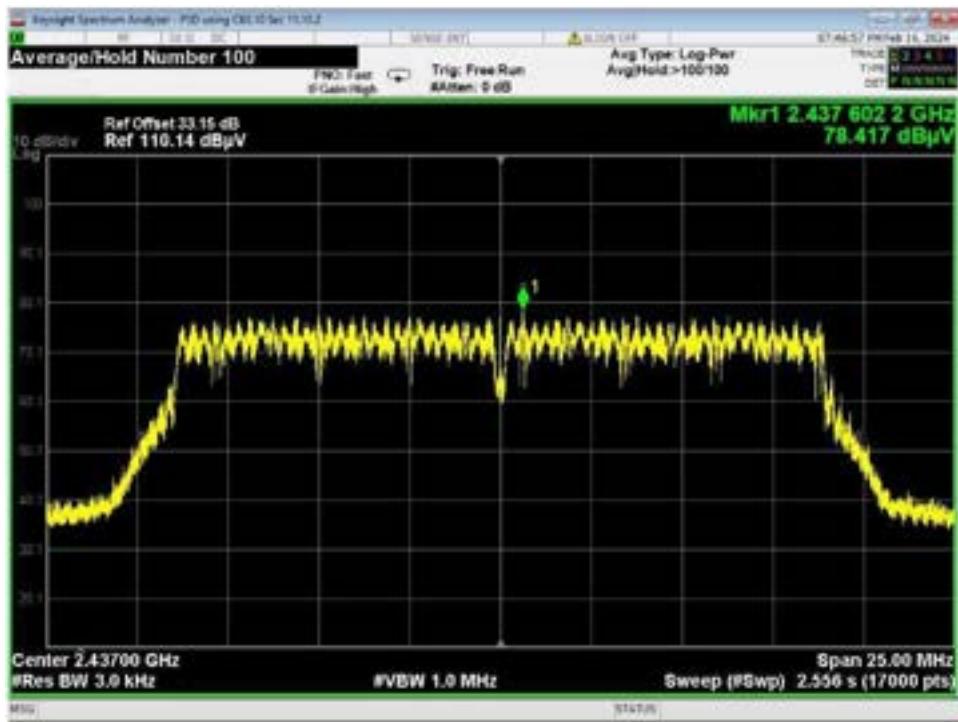


Figure 81 – Radiated EIRP Power Spectral Density, WiFi N, Low Data Rate, Mid Channel

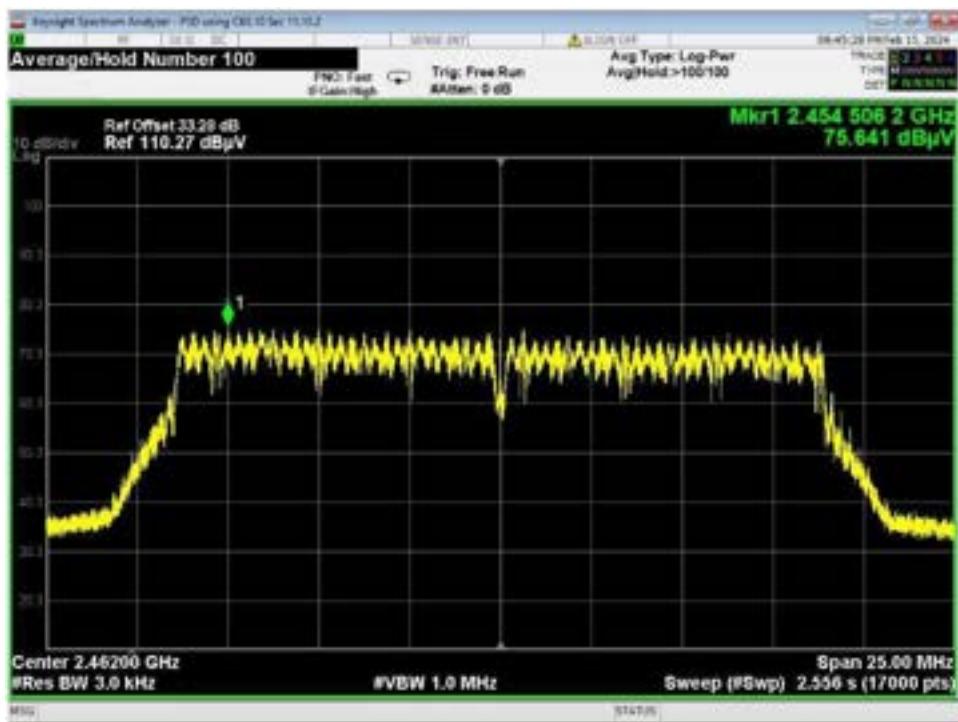


Figure 82 – Radiated EIRP Power Spectral Density, WiFi N, Low Data Rate, High Channel

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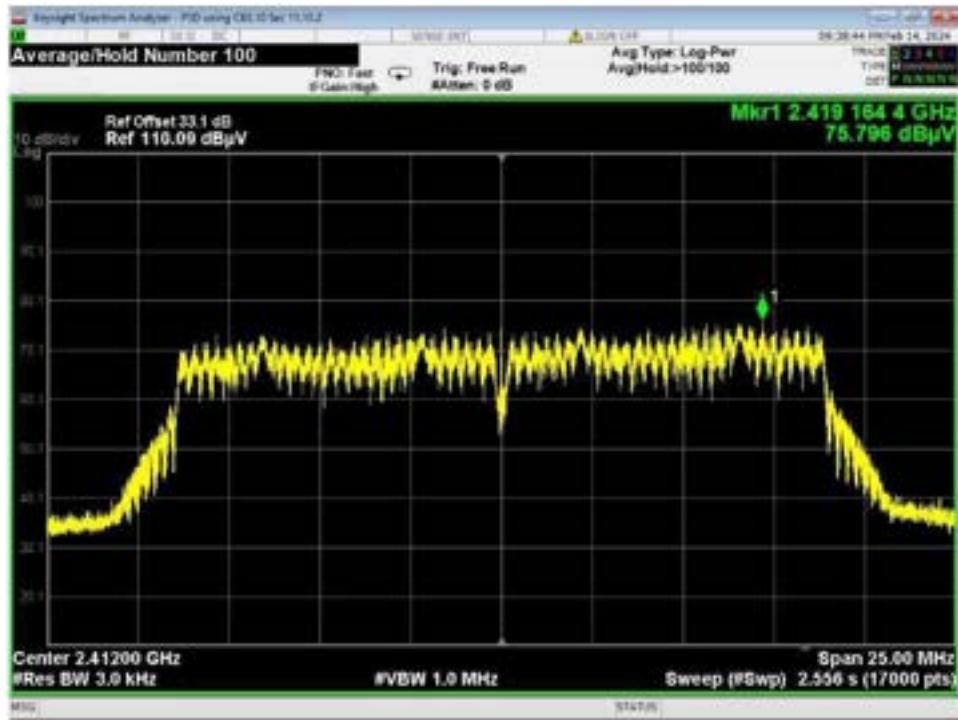


Figure 83 – Radiated EIRP Power Spectral Density, WiFi N, High Data Rate, Low Channel

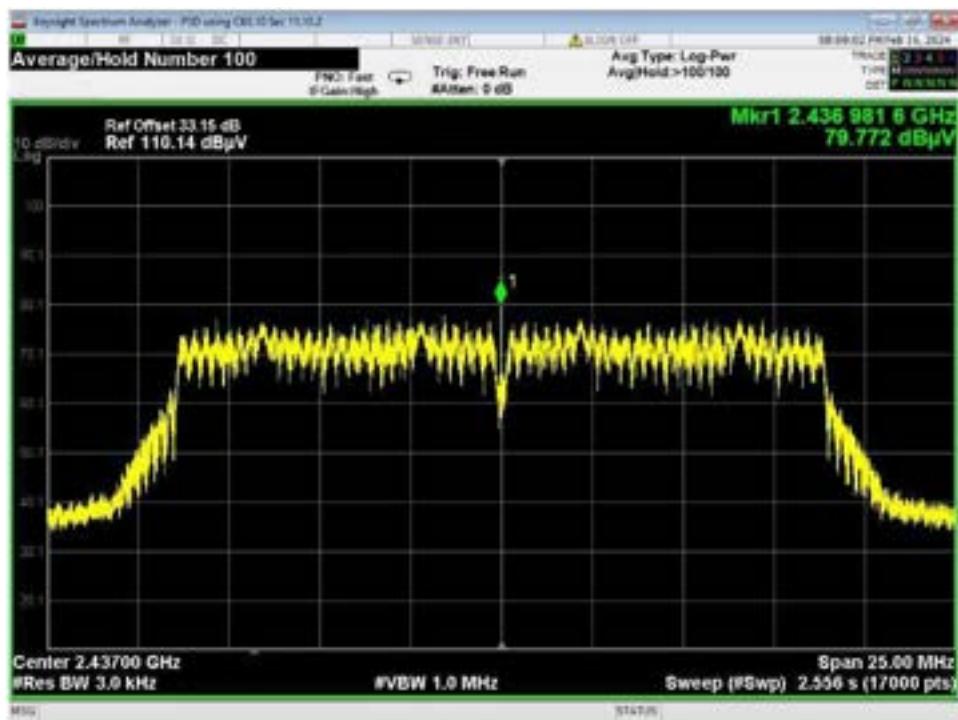


Figure 84 – Radiated EIRP Power Spectral Density, WiFi N, High Data Rate, Mid Channel

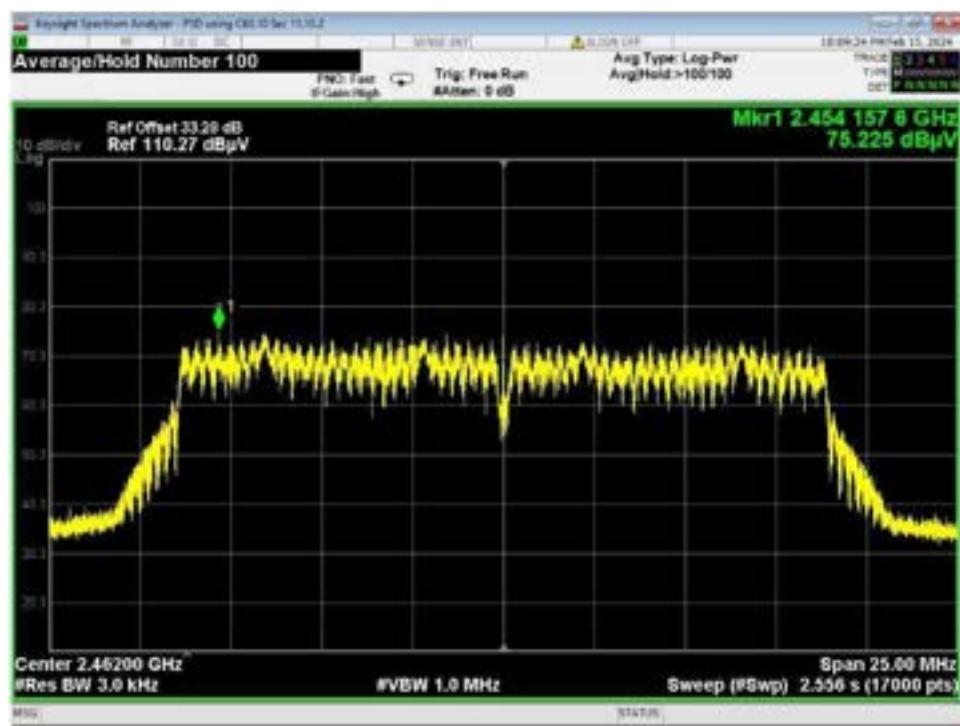


Figure 85 – Radiated EIRP Power Spectral Density, WiFi N, High Data Rate, High Channel



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APPENDIX A: SAMPLE CALCULATION

Radiated Emissions

The field strength is calculated in decibels (dB) 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:

$$FS = R + AF - (-CF + AG)$$

where FS = Field Strength

R = Receiver Amplitude Receiver reading in dB μ V

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Preamplifier Amplifier Gain

Assume a receiver reading of 55.00 dB μ V is obtained. The Antenna Factor of 12.00 and a Cable Factor of 1.10 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.10 dB μ V/m.

$$FS = 55.00 + 12.00 - (-1.10 + 20.00) = 48.1 \text{ dB}\mu\text{V/m}$$

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

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

Conducted Emissions

Receiver readings are compared directly to the conducted emissions limits in decibels (dB) by adding the cable loss and LISN insertion loss to the receiver reading. The basic equations with a sample calculation is as follows;

$$FS = R + IL - (-CF)$$

where V = Conducted Emissions Voltage Measurement

R = Receiver reading in dB μ V

IL = LISN Insertion Loss

CF = Cable Attenuation Factor



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APPENDIX B – MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels apply to tests performed in this test report:

Test	Frequency Range	NCEE Labs Uncertainty Value (dB)	Maximum Uncertainty Values per CISPR 16-4-2:2011/A1:2018
AC Line Conducted Emissions	150kHz - 30MHz	3.03	3.60
Radiated Emissions, 3m	30MHz - 1GHz	4.19	5.34
Radiated Emissions, 3m	1GHz – 18GHz	5.08	5.48

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

NCEE Labs meets the maximum uncertainty requirements per CISPR 16-4-2:2011/A1:2018, and therefore does not require a minimum passing margin to state that an EUT is less than the field strength limits of the applicable CISPR, IEC or EN limit per CISPR 16-4-2:2011/A1:2018, Section 4.1.

NCEE Labs employs tilting when testing at 3m test distance. The maximum uncertainty associated with this method is used.

Maximum uncertainty values show the worst-case of all test distances used.



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REPORT END