4. Radiated Spurious Emissions and Restricted Band

Test Requirement(s):	§15.247(d), 15.209(a), 15.205	**Test Engineer(s):**	Sean E.
Test Results:	Pass	**Test Date(s):**	11/23/2022

Test Procedures: As required by 47 CFR 15.247, Radiated spurious measurements were made in accordance with the procedures of the FCC Guidance Document 558074 D01 and ANSI C63.10.

The EUT was placed on a non-reflective table inside a 3-meter semi-anechoic room. The EUT was set on continuous transmit.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The frequency range up to the 10th harmonic was investigated included all the restricted band frequencies include 2483.5MHz. Measurement 10dB below the limits were not reported.

To get a maximum emission level from the EUT, the EUT was rotated throughout the X-axis, Y-axis and Z-axis. Worst case is X-axis

Detector Setting	Resolution Bandwidth	Video Bandwidth	Span
Peak	1MHz	3MHz	As necessary
Average	1MHz	10Hz	0 Hz

Table 15. Analyzer Settings

Test Setup:

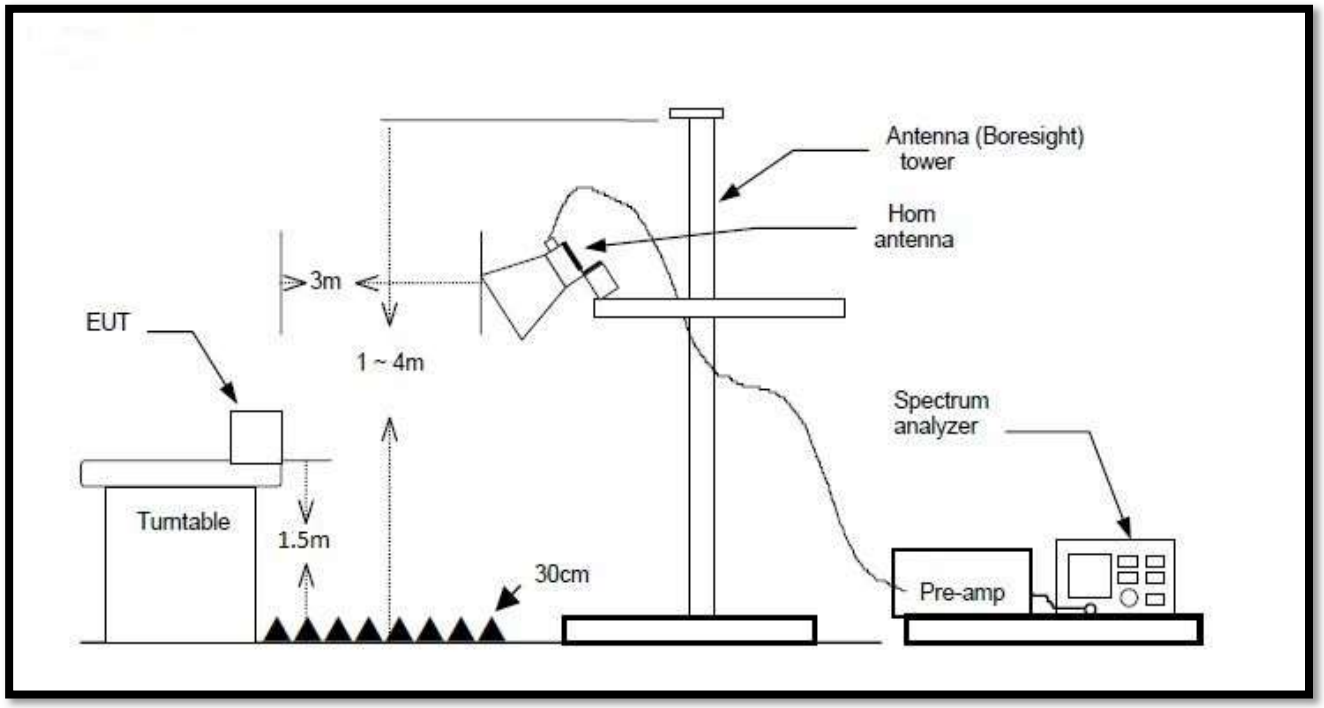


Figure 5. Radiated Emission Above 1GHz Test Setup

Test Results:

Transmit Frequency (MHz)	Measured Frequency (MHz)	Peak Amplitude (dbuV/m)	Peak Limit (dBuV/m)	Average Amplitude (dBuV/m))	Average Limit (dBuV/m)
2412	2412	105.83	Fundamental	Fundamental	Fundamental
	4824*	45.17	74.0	-	54.0
	7236	43.83	85.83	-	65.83
2437	2437	106.00	Fundamental	Fundamental	Fundamental
	4874*	50.17	74.0	-	54.0
	7311*	43.67	74.0	-	54.0
2462	2462	107.5	Fundamental	Fundamental	Fundamental
	4924*	48.5	74.0	-	54.0
	7386*	42.83	74.0	-	54.0

Table 16 - Spurious Radiated Emission Data – 802.11b Operation Mode

Transmit Frequency (MHz)	Measured Frequency (MHz)	Peak Amplitude (dbuV/m)	Peak Limit (dBuV/m)	Average Amplitude (dBuV/m))	Average Limit (dBuV/m)
2412	2412	101.17	Fundamental	Fundamental	Fundamental
	4824*	42.83	74.0	-	54.0
	7236	43.17	81.17	-	61.17
2437	2437	103.0	Fundamental	Fundamental	Fundamental
	4874*	44.17	74.0	-	54.0
	7311*	44.5	74.0	-	54.0
2462	2462	103.5	Fundamental	Fundamental	Fundamental
	4924*	43.33	74.0	-	54.0
	7386*	43.5	74.0	-	54.0

Table 17– Spurious Radiated Emission Data – 802.11g Operation Mode

Transmit Frequency (MHz)	Measured Frequency (MHz)	Peak Amplitude (dbuV/m)	Peak Limit (dBuV/m)	Average Amplitude (dBuV/m))	Average Limit (dBuV/m)
2412	2412	101.83	Fundamental	Fundamental	Fundamental
	4824*	43.83	74.0	-	54.0
	7236	43.0	81.83	-	61.83
2437	2437	102.83	Fundamental	Fundamental	Fundamental
	4874*	43.5	74.0	-	54.0
	7311*	43.5	74.0	-	54.0
2462	2462	102.67	Fundamental	Fundamental	Fundamental
	4924*	43.17	74.0	-	54.0
	7386*	43.5	74.0	-	54.0

Table 18- Spurious Radiated Emission Data – 802.11n (20 MHz) Operation Mode

Transmit Frequency (MHz)	Measured Frequency (MHz)	Peak Amplitude (dbuV/m)	Peak Limit (dBuV/m)	Average Amplitude (dBuV/m))	Average Limit (dBuV/m)
2422	2422	99.0	Fundamental	Fundamental	Fundamental
	4844*	44.33	74.0	-	54.0
	7266*	43.17	74.0	-	54.0
2437	2437	99.67	Fundamental	Fundamental	Fundamental
	4874*	45.0	74.0	-	54.0
	7311*	43.0	74.0	-	54.0
2452	2452	99.83	Fundamental	Fundamental	Fundamental
	4904*	43.67	74.0	-	54.0
	7356*	43.0	74.0	-	54.0

Table 19- Spurious Radiated Emission Data – 802.11n (40 MHz) Operation Mode

NOTE 1: There were no detectable emissions above the 3rd harmonic.

NOTE 2: Frequency marked with "*" falls under the restricted band

6. Emissions At Band Edges

Test Requirement(s):	§15.247(d) and RSS Gen 8.0	**Test Engineer(s):**	Sean E.
Test Results:	Pass	**Test Date(s):**	11/22/2022

Test Procedures: As required by 47 CFR 15.247, Band edge radiated emissions measurements were made at the RF antenna output terminals of the EUT using the marker-delta method.

Customer provided a test mode internal to the EUT to control the RF modulation, and frequency channel. The EUT output was connected directly to the spectrum analyzer through an attenuator. The EUT was set up at maximum power, first on the lowest operating channel, then on the highest operating channel of the transmit band.

Detector Setting	Resolution Bandwidth	Video Bandwidth	Sweep Time
Peak	100 kHz	300 kHz	Auto

Table 20 – Analyzer settings

Test Setup:

Figure 6. Band Edge Test Setup

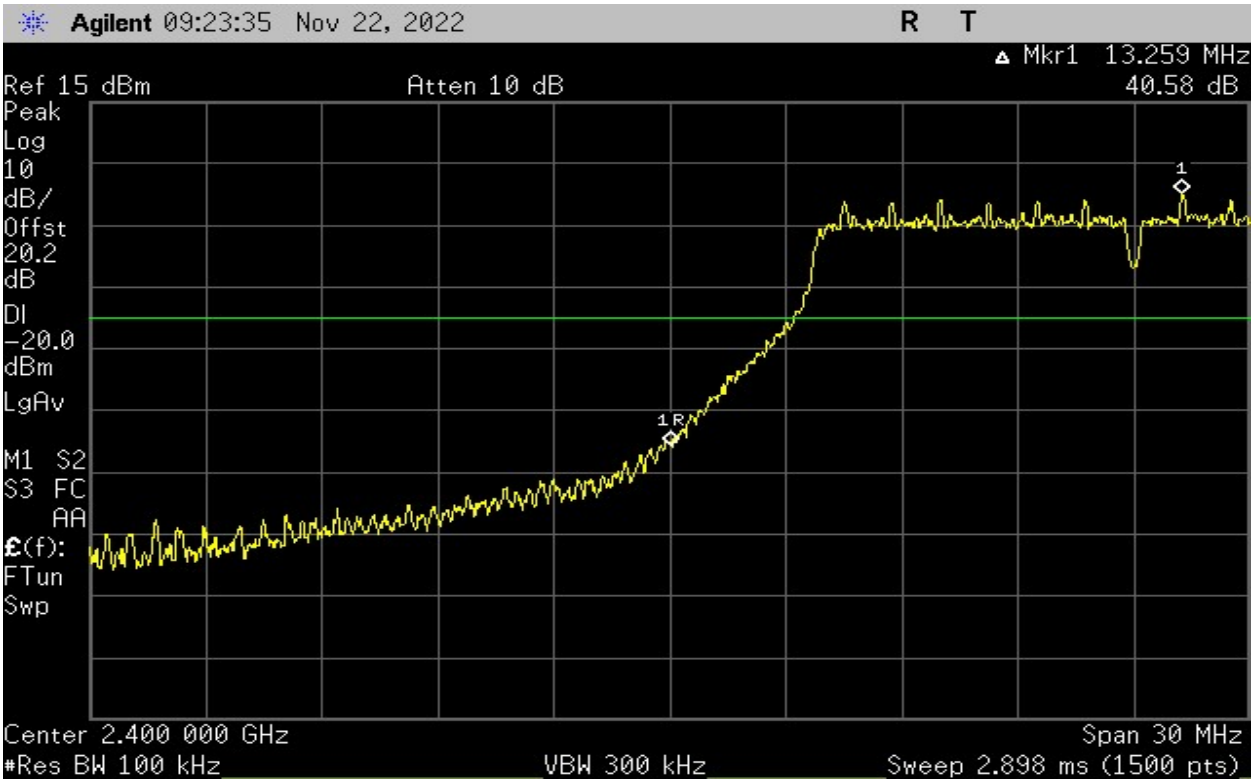
Test Results:

Operational Mode	Frequency (MHz)	Measured Level	Detector	Limit
802.11b	2400	-51.24 dBc	Peak	-20dBc
	2483.5	-63.16 dBc	Peak	-20dBc
802.11g	2400	-40.58 dBc	Peak	-20dBc
	2483.5	-51.31 dBc	Peak	-20dBc
802.11n (20 MHz)	2400	-38.96 dBc	Peak	-20dBc
	2483.5	-49.39 dBc	Peak	-20dBc
802.11n (40 MHz)	2400	-34.83 dBc	Peak	-20dBc
	2483.5	-45.40 dBc	Peak	-20dBc

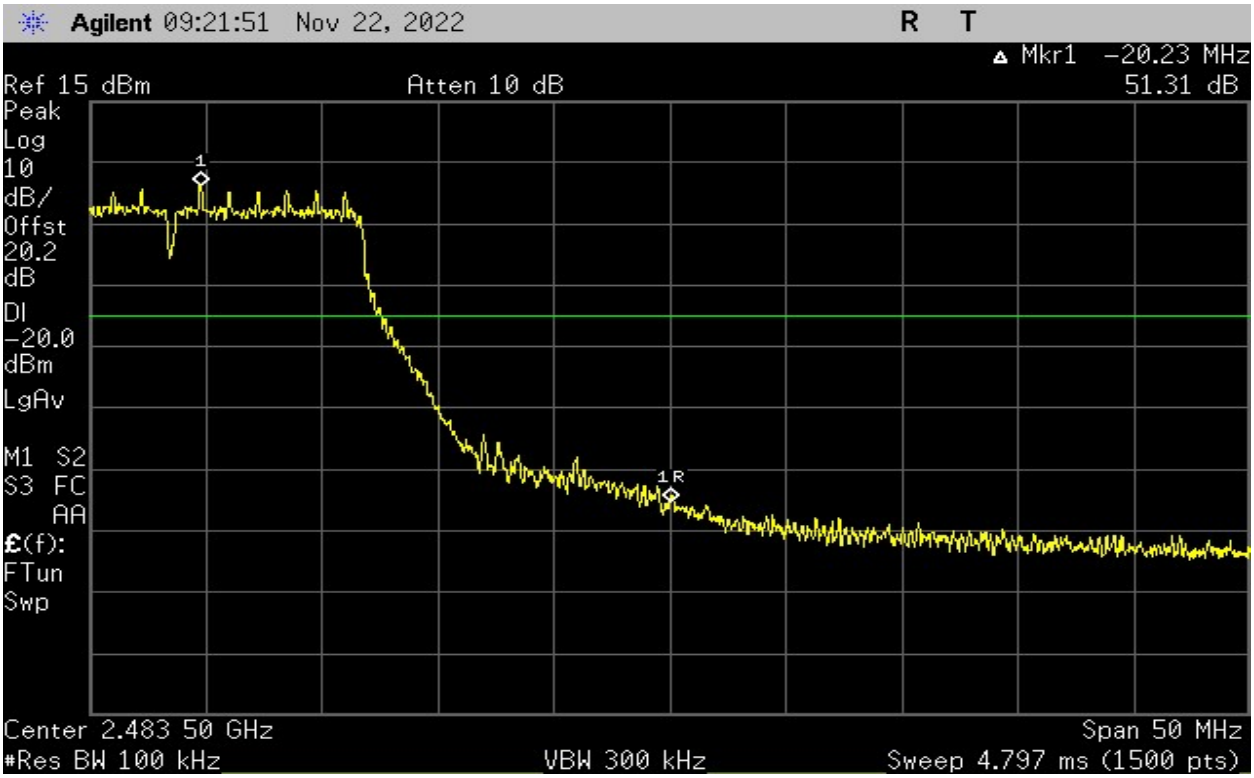
Table 21 – Band Edge Emissions Summary

Plot 63 – 802.11b Lowest Channel – Band Edge

Plot 64 – 802.11b Highest Channel – Band Edge

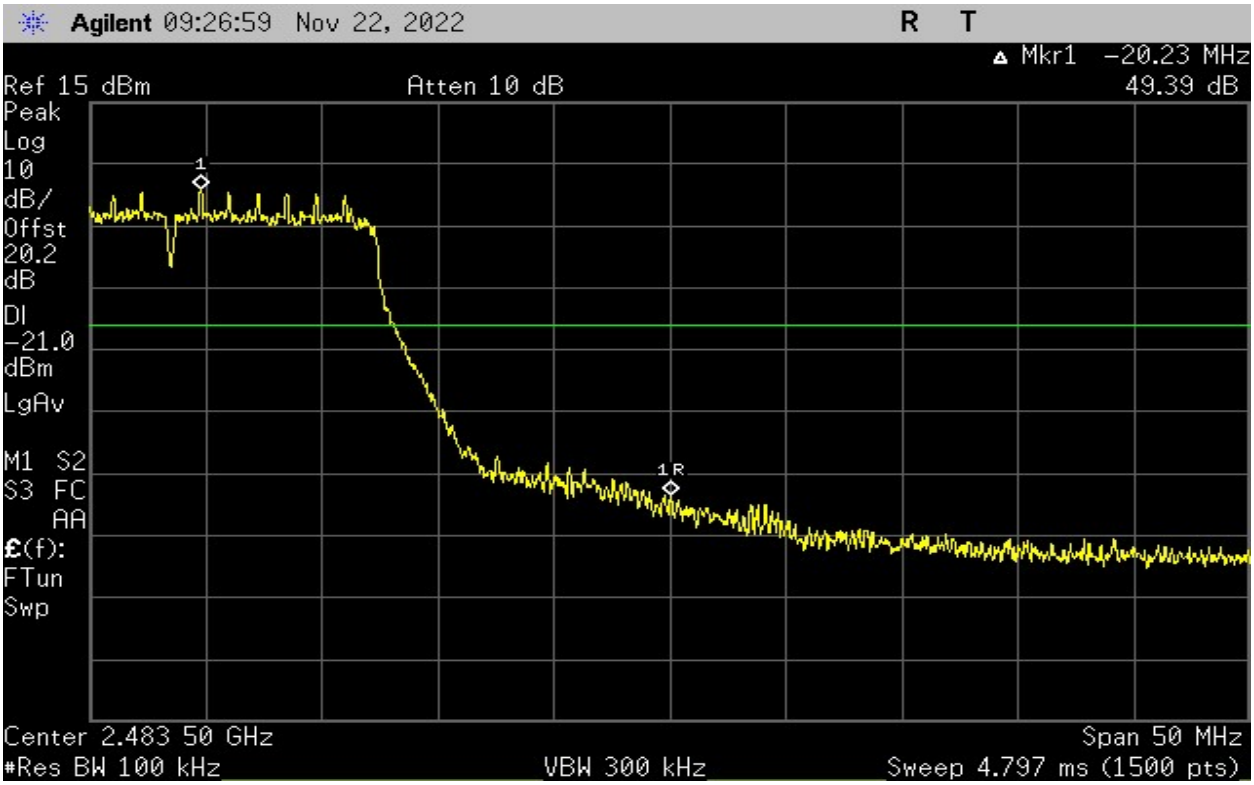


Plot 65 – 802.11g Lowest Channel – Band Edge

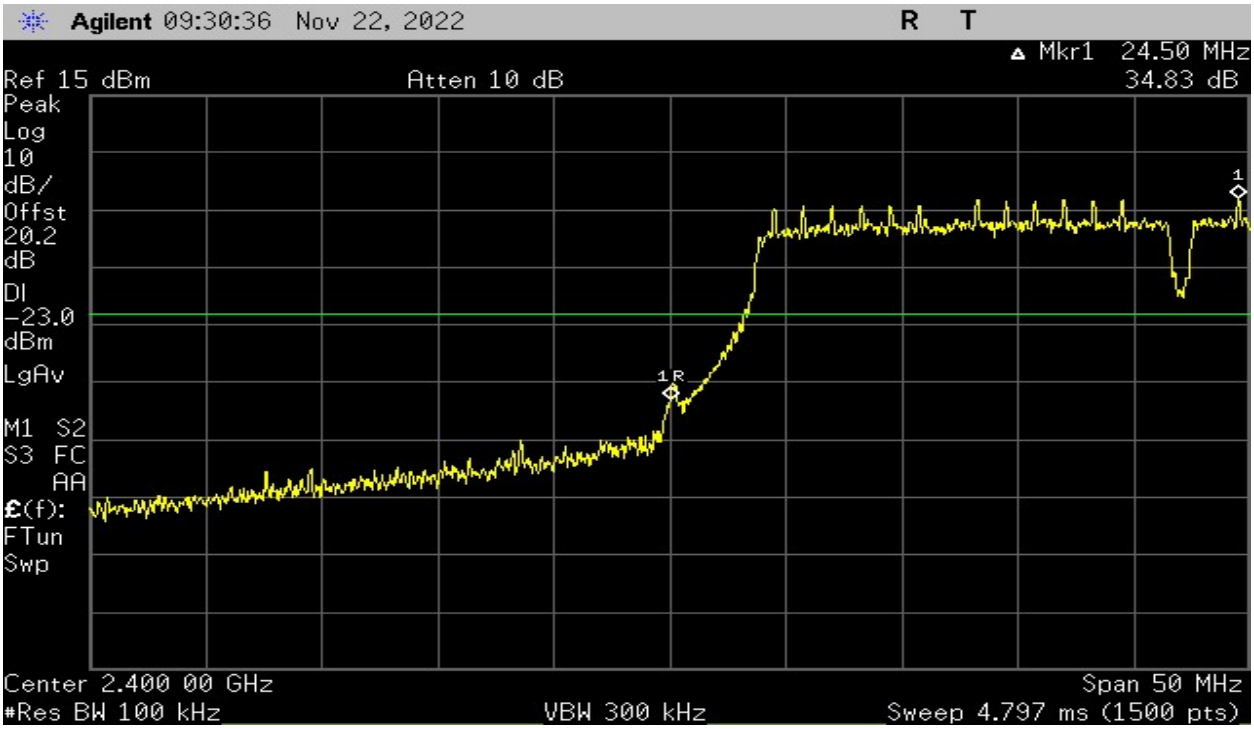


Plot 66 – 802.11g Highest Channel – Band Edge

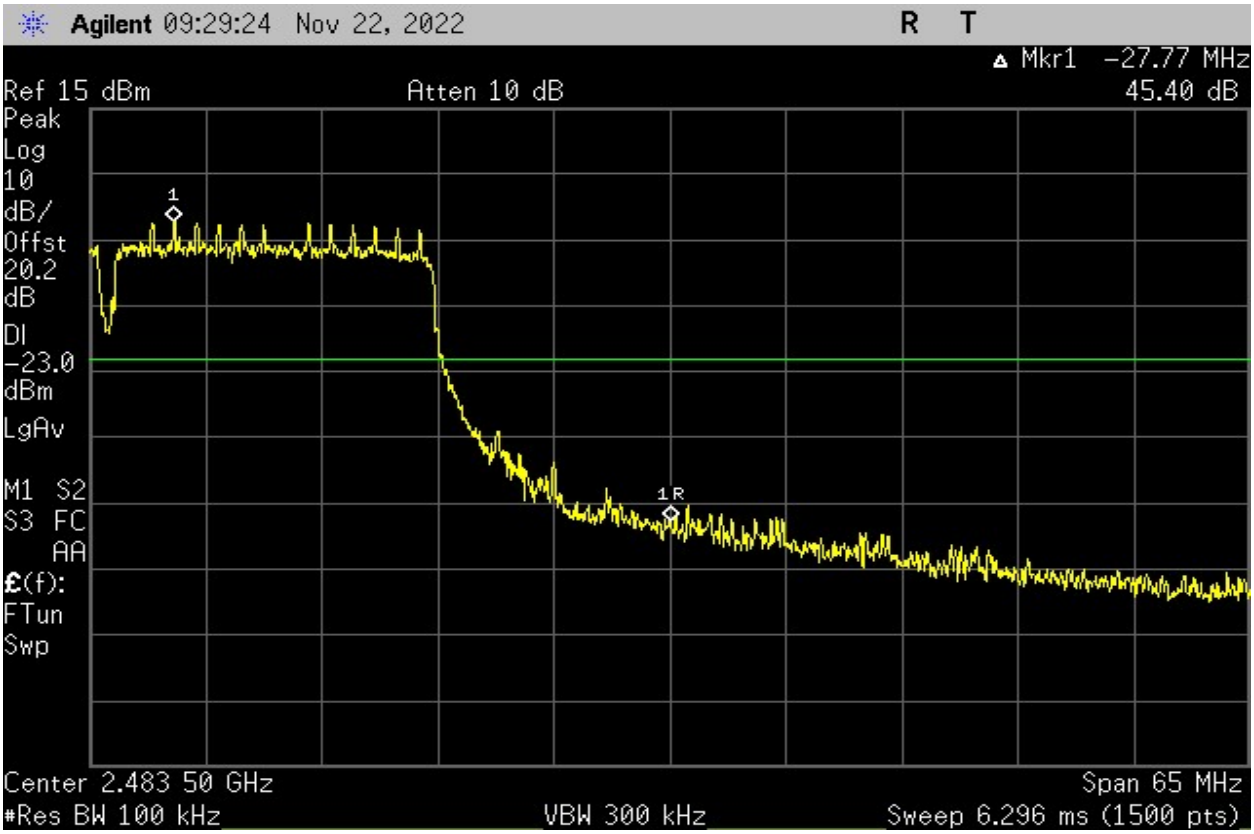
Plot 67 – 802.11n (20 MHz) Lowest Channel – Band Edge



Plot 68 – 802.11n (20 MHz) Highest Channel – Band Edge



Plot 69 – 802.11n (40 MHz) Lowest Channel – Band Edge



Plot 70 – 802.11n (40 MHz) Highest Channel – Band Edge

7. Power Spectral Density

Test Requirement(s):	§15.247(f), ANSI C63.10 and RSS-247 5.2(b)	**Test Engineer(s):**	Sean E.
Test Results:	Pass	**Test Date(s):**	11/21/2022

Test Procedures: As required by 47 CFR 15.247(d), For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3kHz band during any time interval of continuous transmission. Power spectral density measurements were made at the RF antenna output terminals of the EUT using the DTS methods section 8.4 was used for DTS mode.

The EUT output was connected directly to the spectrum analyzer through an attenuator. The measurements were made at the RF antenna output terminals of the EUT.

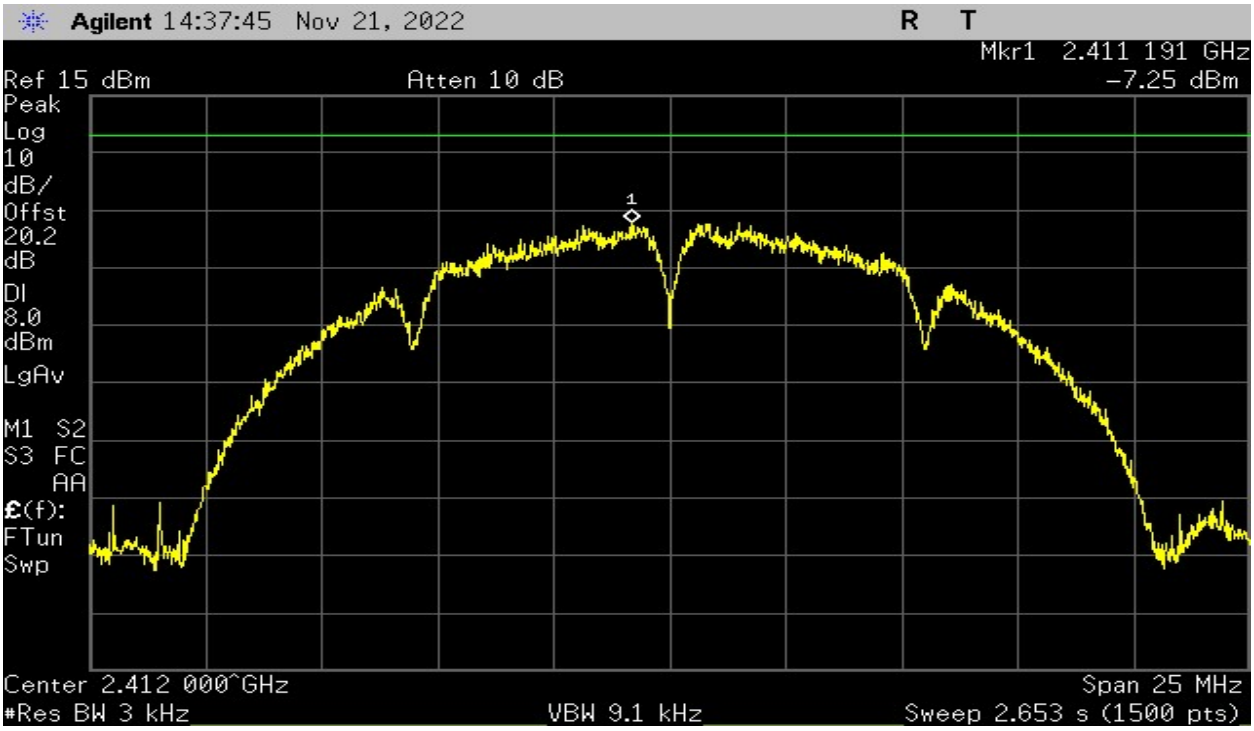
Detector Setting	Resolution Bandwidth	Sweep Time	Span
Peak	3KHz	Auto	As necessary

Table 22 – Analyzer settings

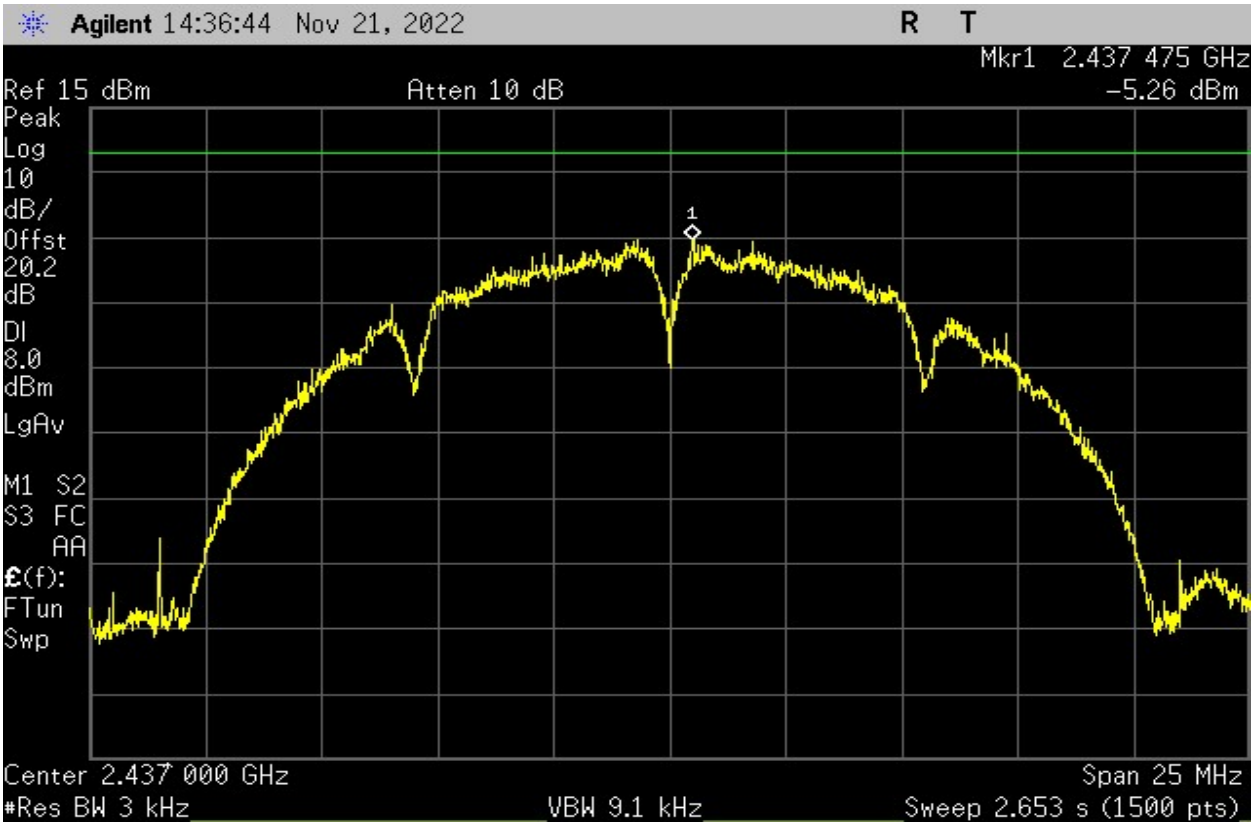
Test Results:

Operational Mode	Frequency (MHz)	Measured Level (dBm)	Limit
802.11b	2412	-7.25	8 dBm
	2437	-5.26	8 dBm
	2462	-5.86	8 dBm
802.11g	2412	-14.18	8 dBm
	2437	-13.76	8 dBm
	2462	-13.49	8 dBm
802.11n (20 MHz)	2412	-14.04	8 dBm
	2437	-14.18	8 dBm
	2462	-14.60	8 dBm
802.11n (40 MHz)	2422	-17.77	8 dBm
	2437	-14.29	8 dBm
	2452	-16.22	8 dBm

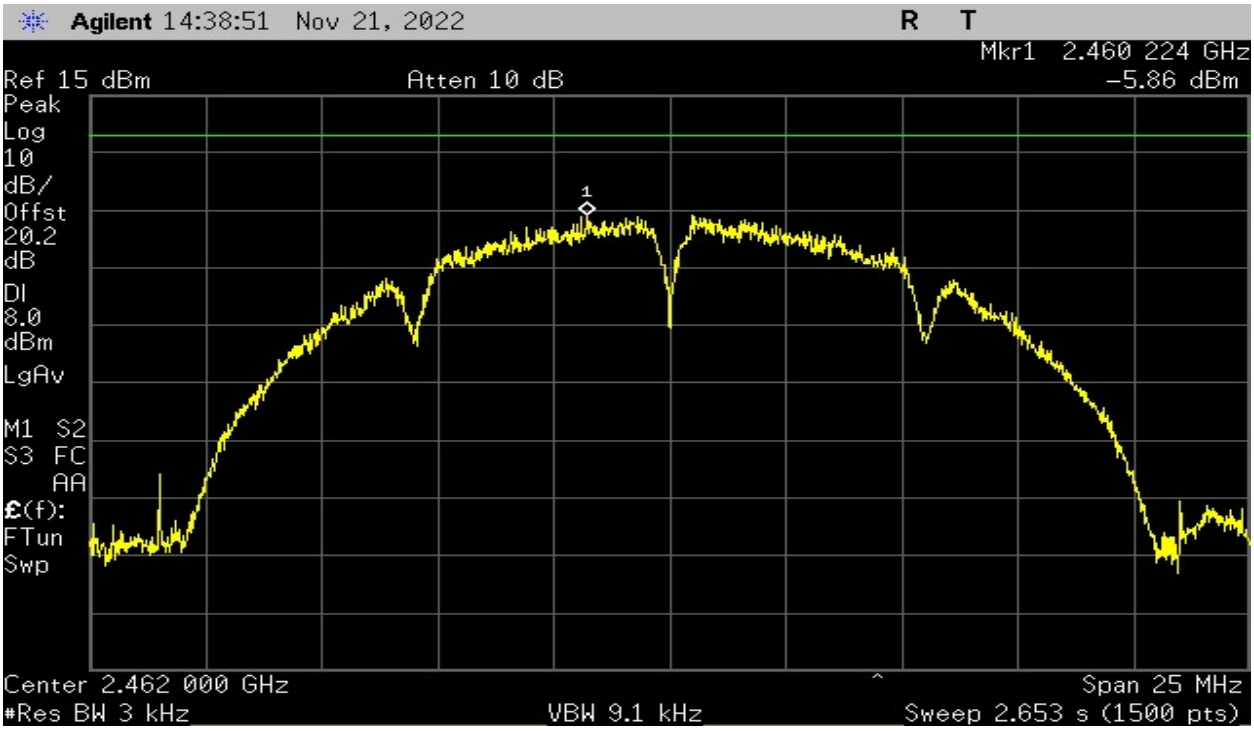
Table 23 – All Power Spectral Density Test Results



Plot 71 – 802.11b Lowest Channel – Power Spectral Density

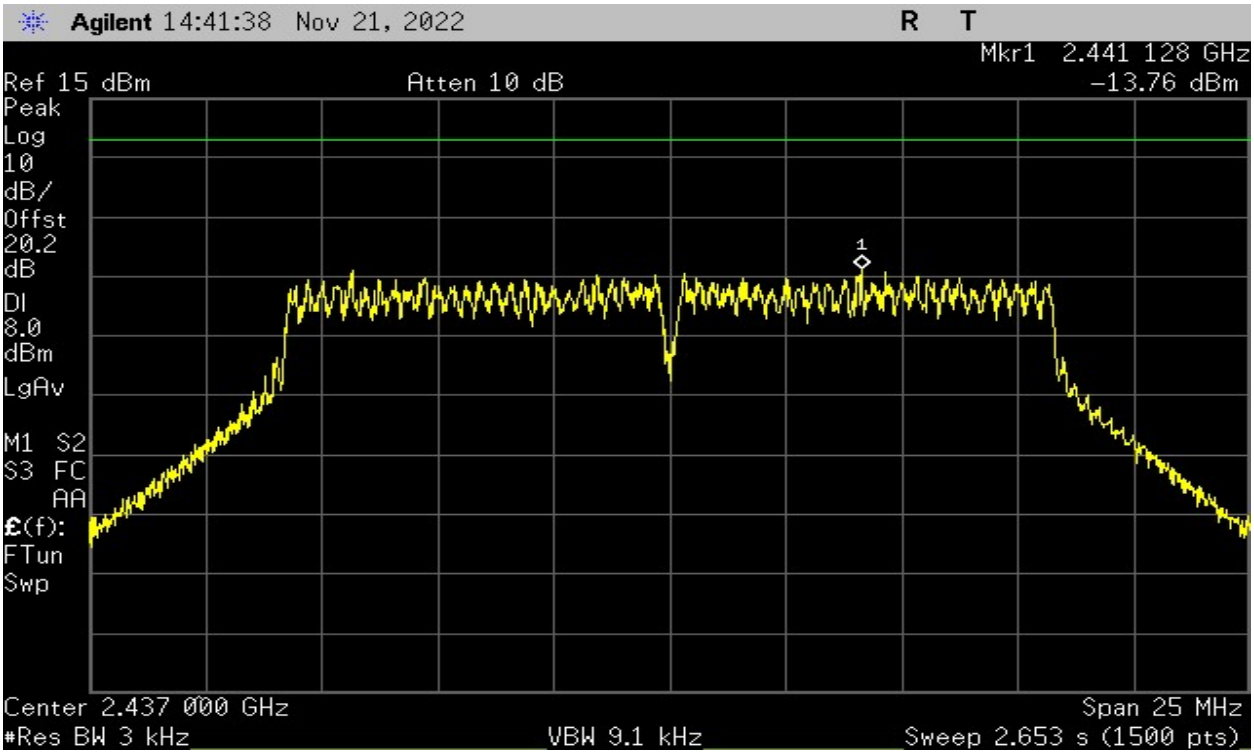


Plot 72 – 802.11b Middle Channel – Power Spectral Density

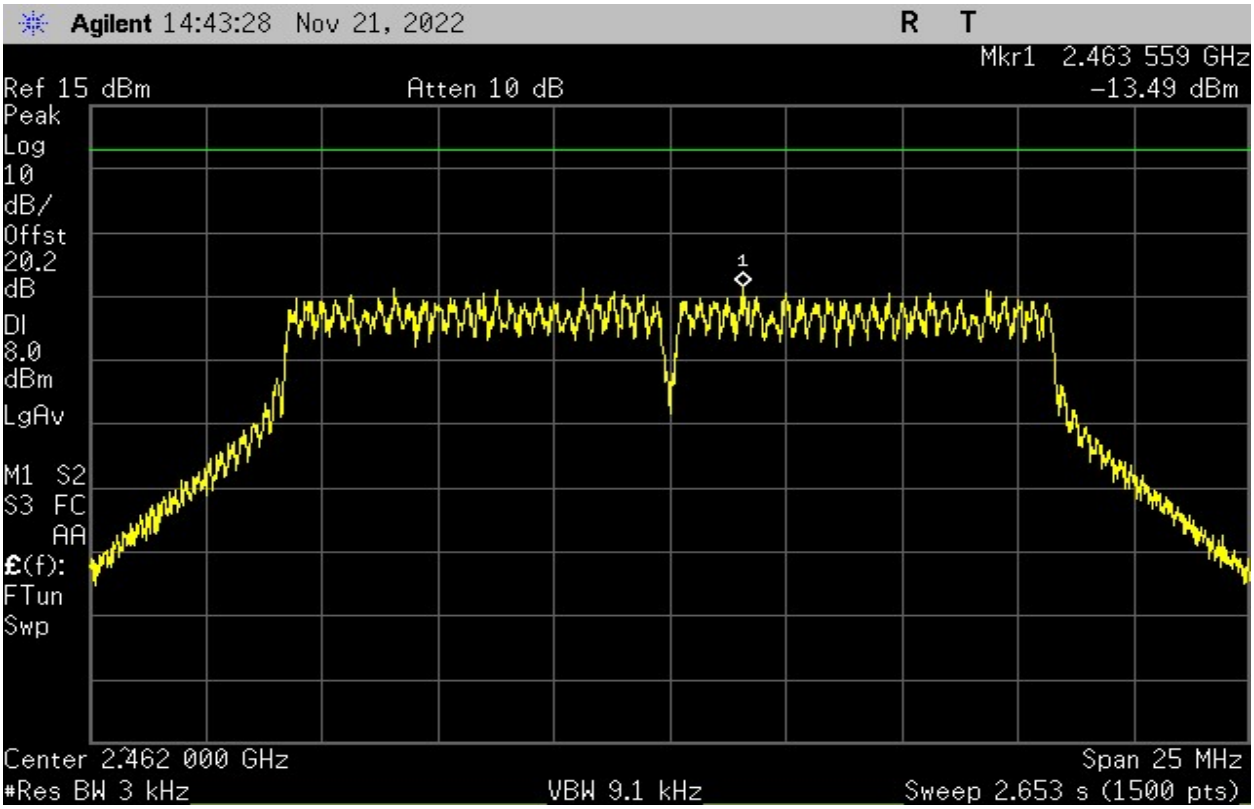


Plot 73 – 802.11b Highest Channel – Power Spectral Density

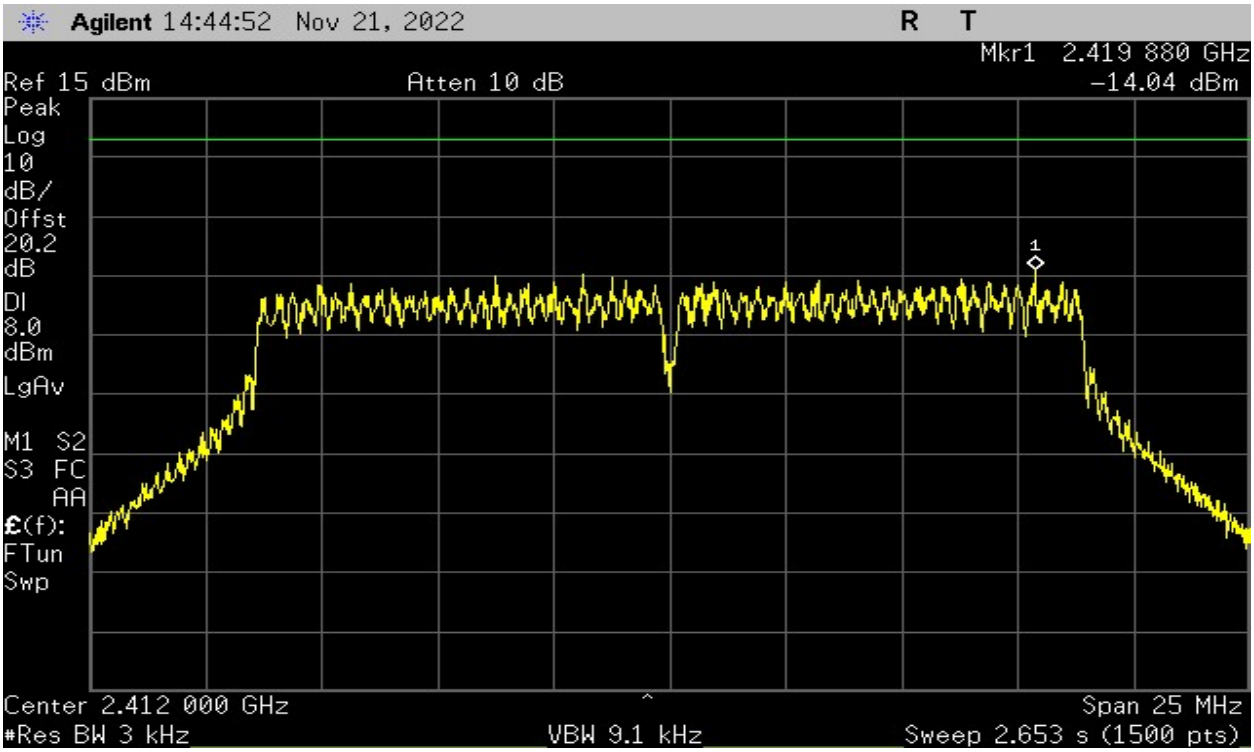
Plot 74 – 802.11g Lowest Channel – Power Spectral Density



Plot 75 – 802.11g Middle Channel – Power Spectral Density

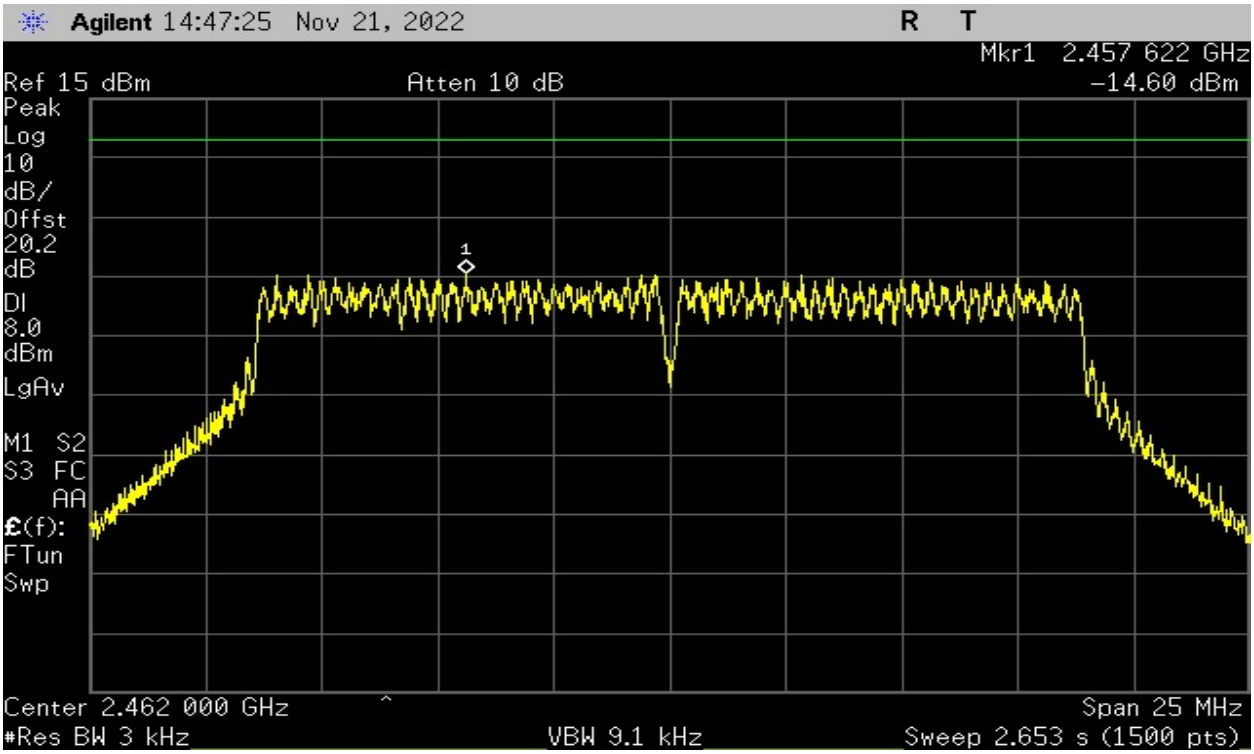


Plot 76 – 802.11g Highest Channel – Power Spectral Density

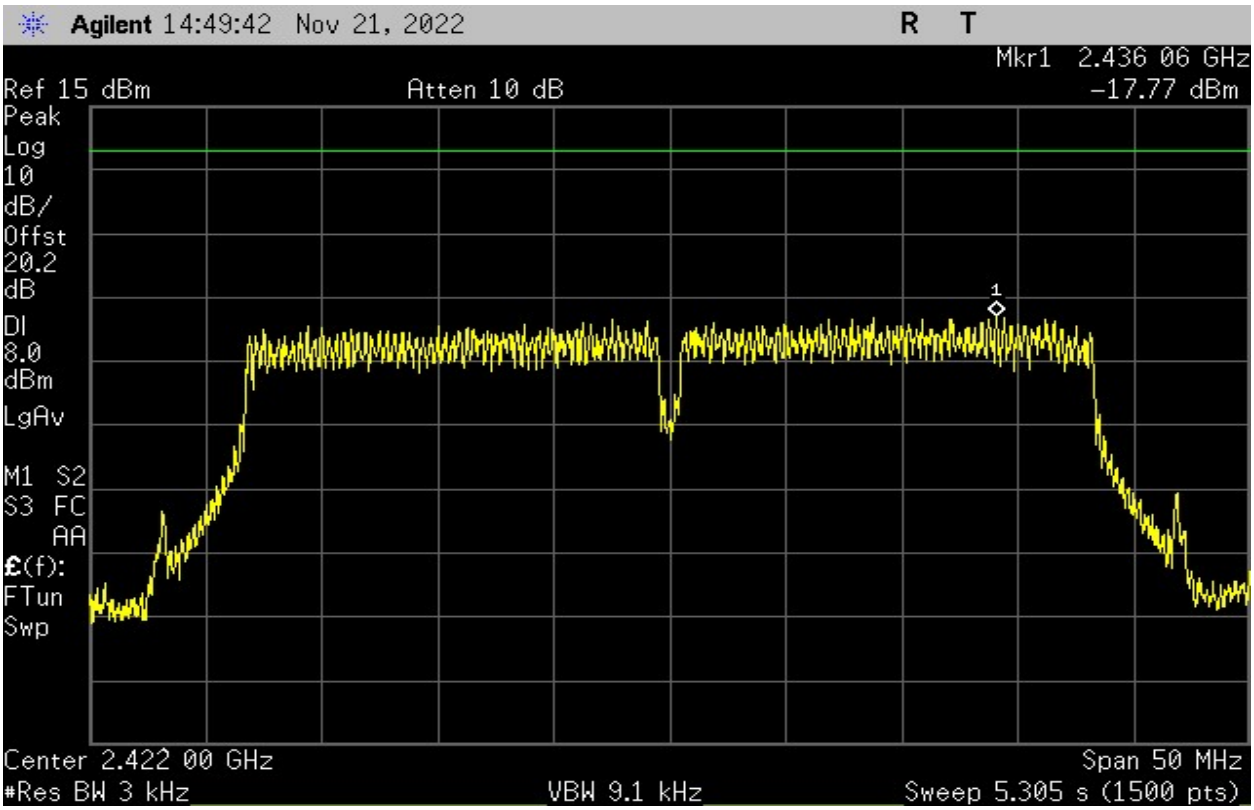


Plot 77 – 802.11n (20 MHz) Lowest Channel – Power Spectral Density

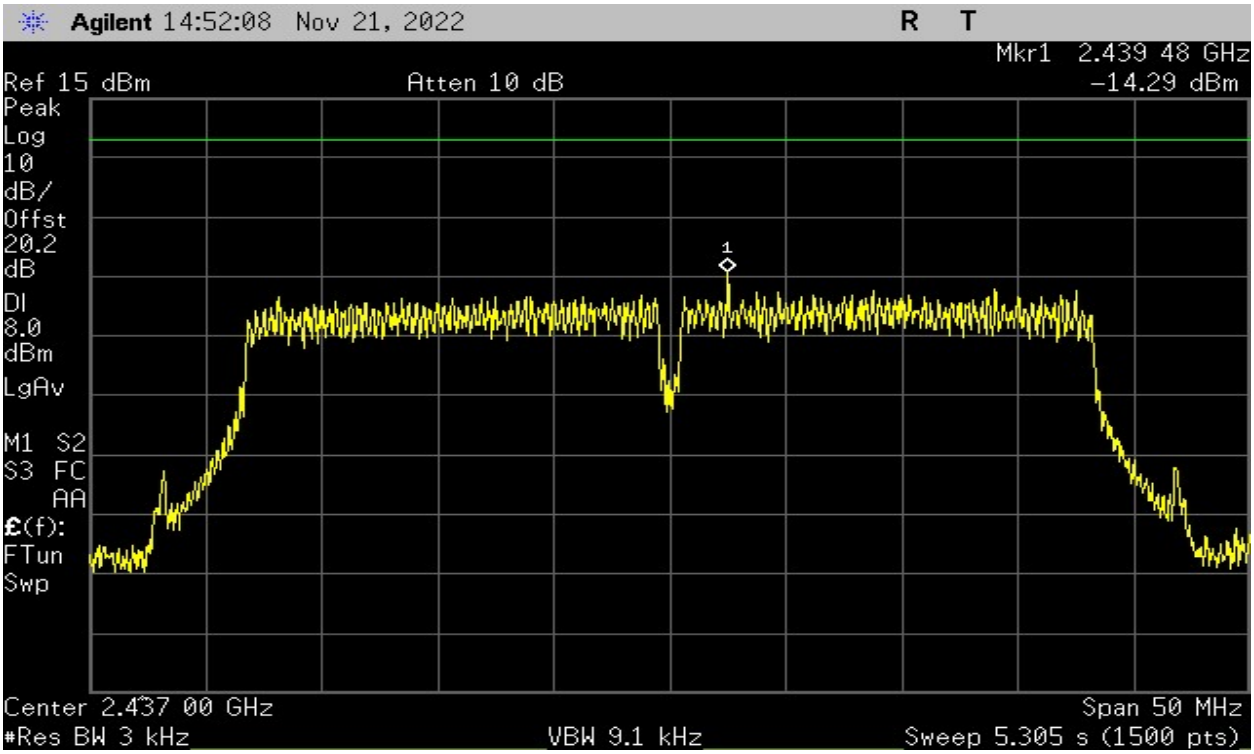
Plot 78 – 802.11n (20 MHz) Middle Channel – Power Spectral Density



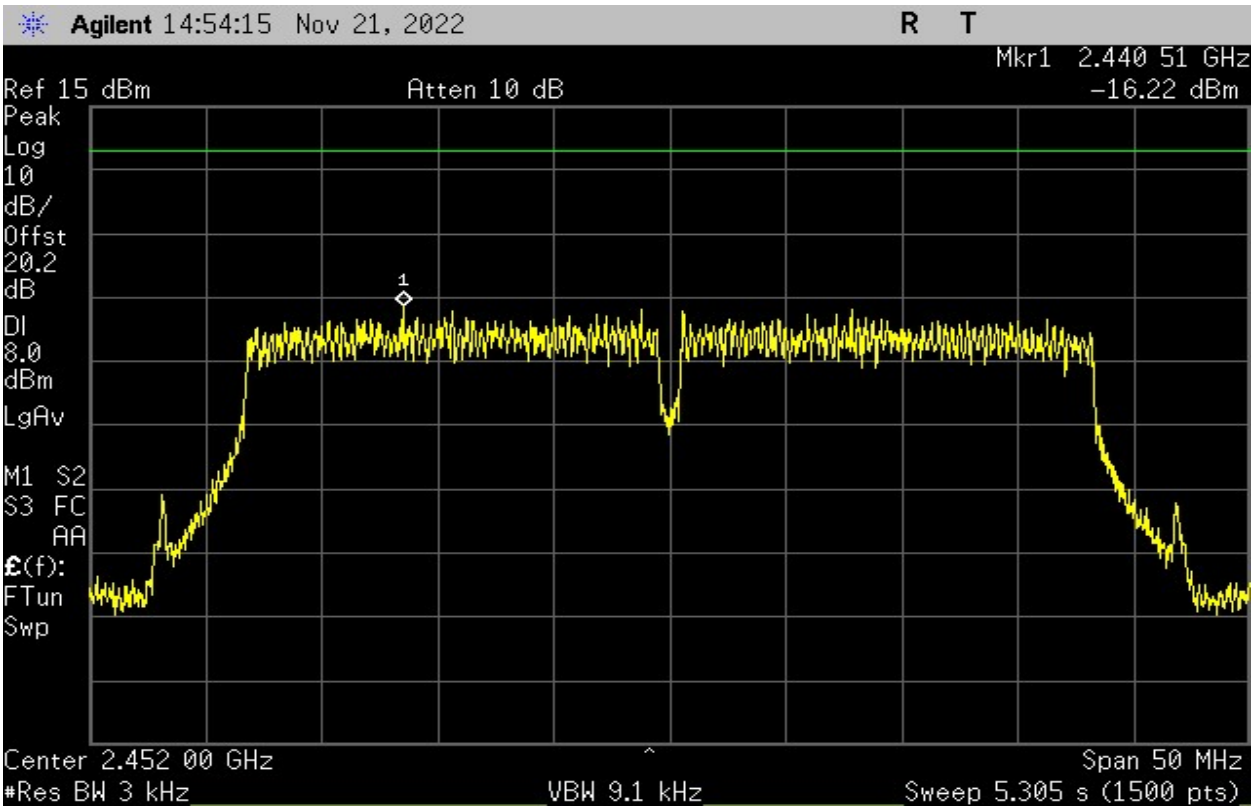
Plot 79 – 802.11n (20 MHz) Highest Channel – Power Spectral Density



Plot 80 – 802.11n (40 MHz) Lowest Channel – Power Spectral Density



Plot 81 – 802.11n (40 MHz) Middle Channel – Power Spectral Density



Plot 82 – 802.11n (40 MHz) Highest Channel – Power Spectral Density

8. Test Equipment

Equipment	Manufacturer	Model	Serial #	Last Cal Date	Cal Due Date
Spectrum Analyzer	Agilent	E4443A	US41420164	Mar-15-22	Mar-15-23
Spectrum Analyzer	Hewlett Packard	8563E	3821A09316	May-03-22	May-03-23
High Pass Filter	Mini-Circuits	VHF-3100+	1023	Verified	
Power Supply	Hewlett Packard	E3610A	KR83021468	Verified	
EMI Receiver	Hewlett Packard	8666B	2747A05264	Dec-07-21	Dec-07-22
Power Supply	Hewlett Packard	Lambda	LA2-AA20-143 3535	NCR	None
High Pass Filter	Mini-Circuits	VHF-1320+	1034	Verified	
Attenuator 20dB	Weinschel	41-20-12	86332	May-27-21	May-27-23
Attenuator 10dB	HuberSuhner	6810.17A	757300	May-27-21	May-27-23
Horn Antenna	Com-Power	AHA-118	711150	Dec-17-20	Dec-17-22
Antenna	EMCO	GTEM 5417	1063	Verified	
Wideband Power Sensor	Agilent	U2021XA	MY54210014	Oct-26-22	Oct-26-23

Table 24 – Test Equipment List

***Statement of Traceability:** Test equipment is maintained and calibrated on a regular basis. All calibrations have been performed by a 17025 accredited test facility, traceable to National Institute of Standards and Technology (NIST)

9. Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. These measurements figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2. Instrumentation measurement uncertainty has **not** been taken into account to determine compliance.

The following measurement uncertainty values have been calculated as show in the table below:

Measured Parameter	Measurement Unit	Frequency Range	Expanded Uncertainty
Conducted Emissions (AC Power)	dBuV or dBuA	150kHz – 30MHz	± 4.3dB
Radiated Emission below 30MHz	dBuV/m	9kHz-30MHz	± 2.96dB
Radiated Emissions below 1GHz	dBuV/m	30 – 1000MHz	± 5.6dB
Radiated Emissions above 1GHz	dBuV/m	1 – 26.5GHz	± 4.1dB

The reported expanded uncertainty has been estimated at a 95% confidence level (k=2)

END OF TEST REPORT