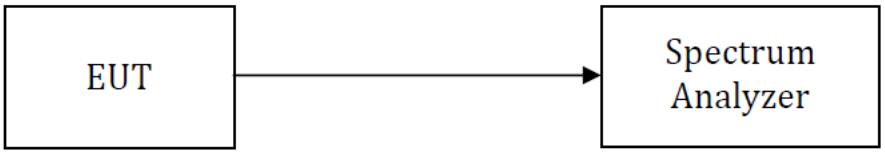
8. Occupied Bandwidth

8.1 Standard and Limit

According to 15.247(a)(2), Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.2 Test Procedure

According to the ANSI 63.10-2013, section 6.9, the emission bandwidth test method as follows.
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto.
4) Set a reference level on the measuring instrument equal to the highest peak value.
5) Measure the frequency difference of two frequencies that were attenuated 6dB from the reference level. Record the frequency difference as the emission bandwidth.
6) Repeat the above procedures until all frequencies measured were complete.



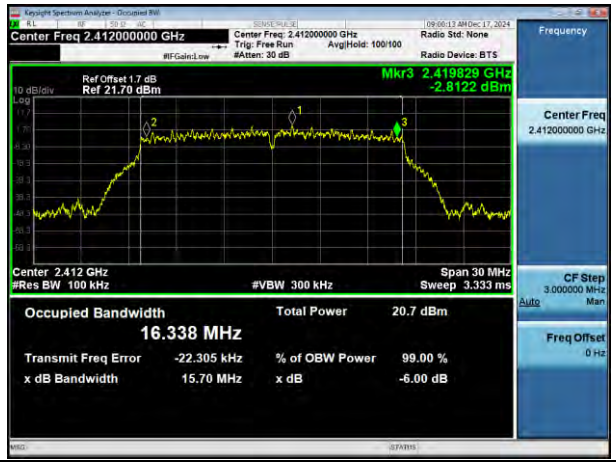
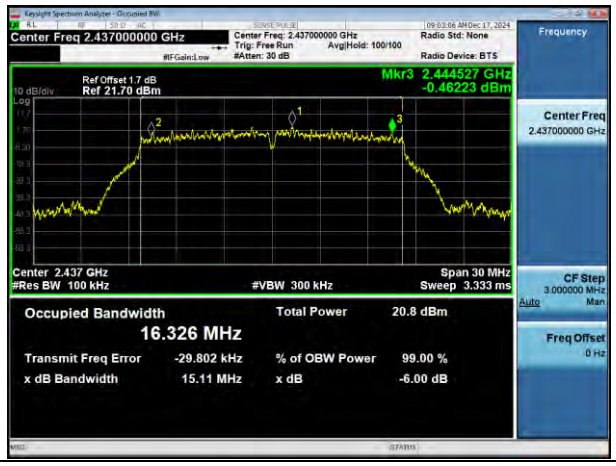
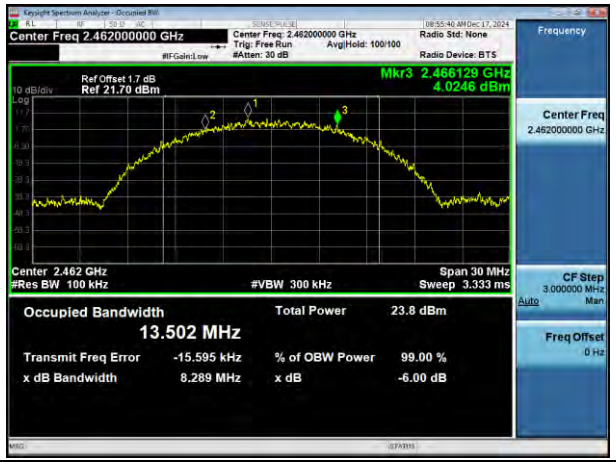
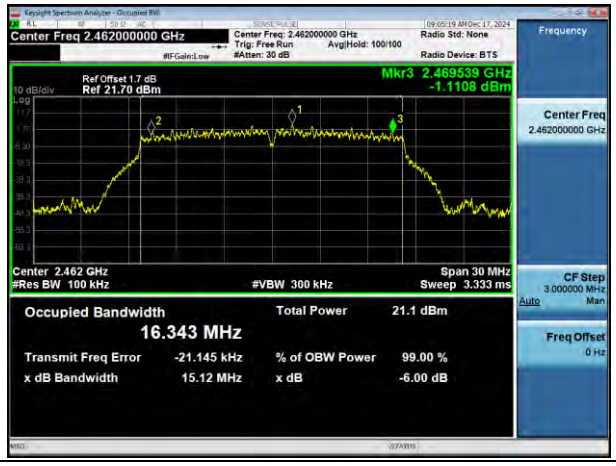
Test Setup Block Diagram

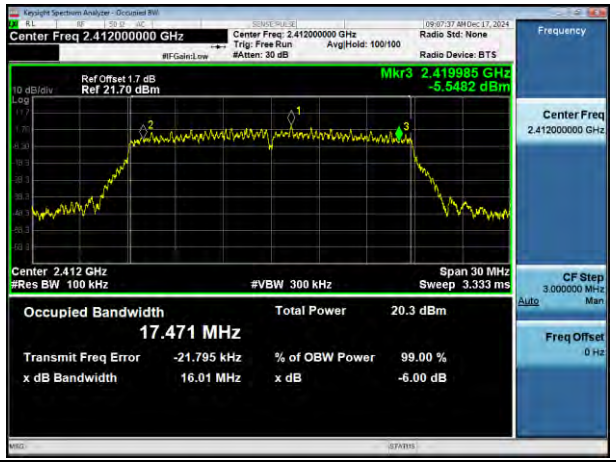
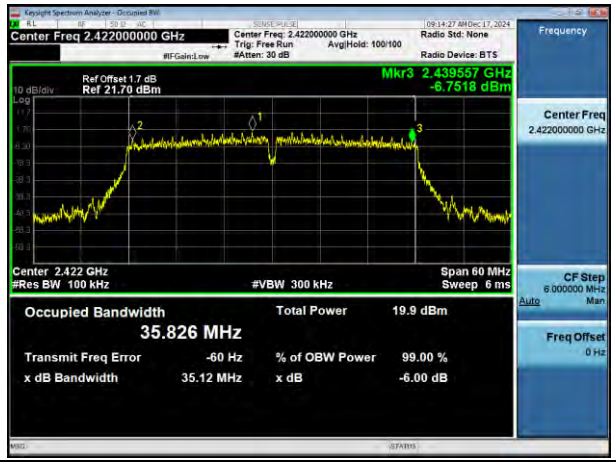
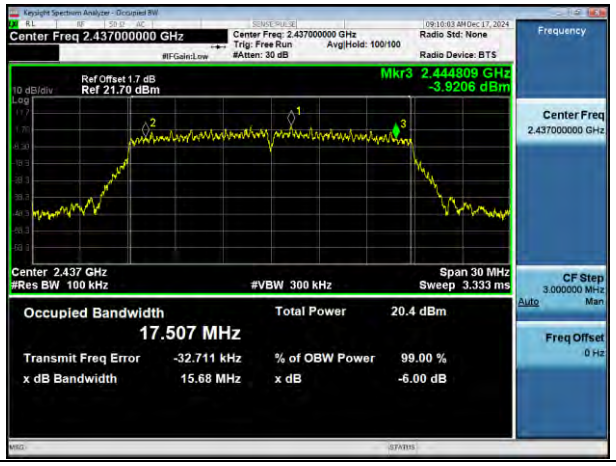
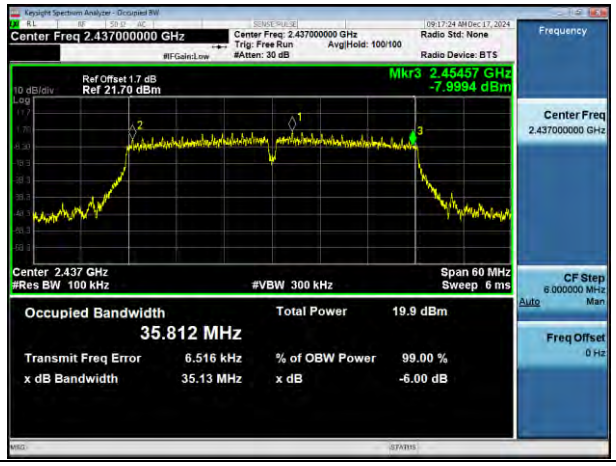
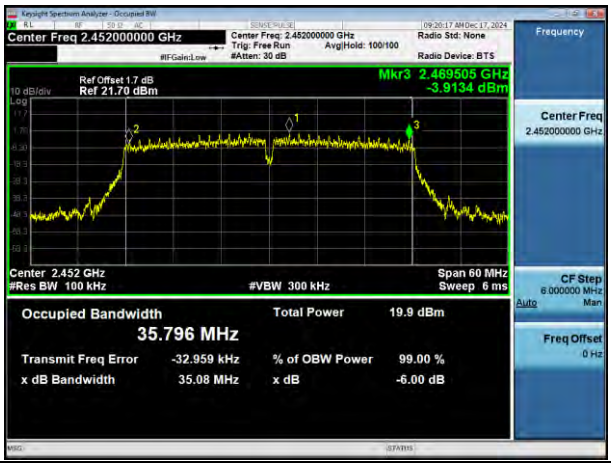
8.3 Test Data and Results

Test Mode	Antenna	Test Channel (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	6dB BW Limit (MHz)	Test Result
802.11b	ANT 1	2412	8.744	13.253	0.5	Pass
		2437	8.35	13.338	0.5	Pass
		2462	8.289	13.38	0.5	Pass
	ANT 2	2412	7.868	13.287	0.5	Pass
		2437	8.348	13.314	0.5	Pass
		2462	8.3	13.368	0.5	Pass
802.11g	ANT 1	2412	15.70	16.378	0.5	Pass
		2437	15.11	16.364	0.5	Pass
		2462	15.12	16.366	0.5	Pass
	ANT 2	2412	15.12	16.369	0.5	Pass
		2437	15.71	16.375	0.5	Pass
		2462	15.13	16.384	0.5	Pass
802.11n(HT20)	ANT 1	2412	16.01	17.509	0.5	Pass
		2437	15.68	17.538	0.5	Pass
		2462	16.01	17.547	0.5	Pass
	ANT 2	2412	16.03	17.518	0.5	Pass
		2437	15.08	17.554	0.5	Pass
		2462	16	17.512	0.5	Pass
802.11n(HT40)	ANT 1	2422	35.12	35.98	0.5	Pass
		2437	35.13	36.02	0.5	Pass
		2452	35.08	35.945	0.5	Pass
	ANT 2	2412	35.11	36.004	0.5	Pass
		2437	35.14	36.015	0.5	Pass
		2462	35.11	36.02	0.5	Pass

ANT1:

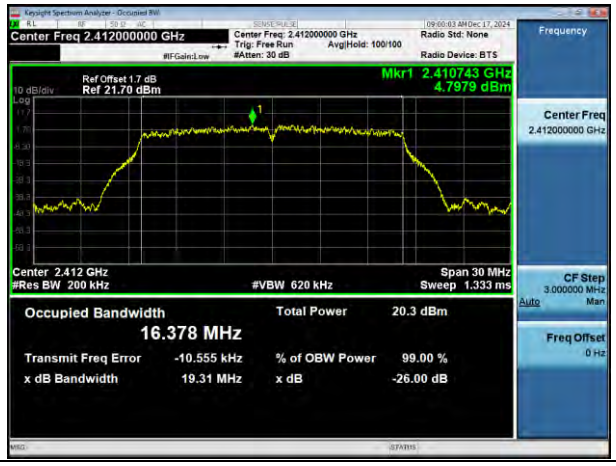
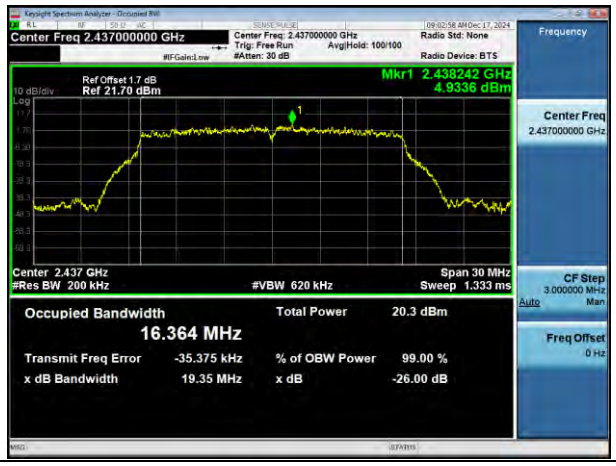
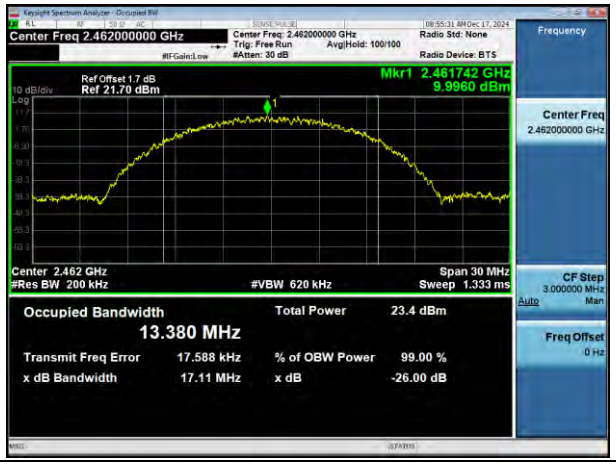
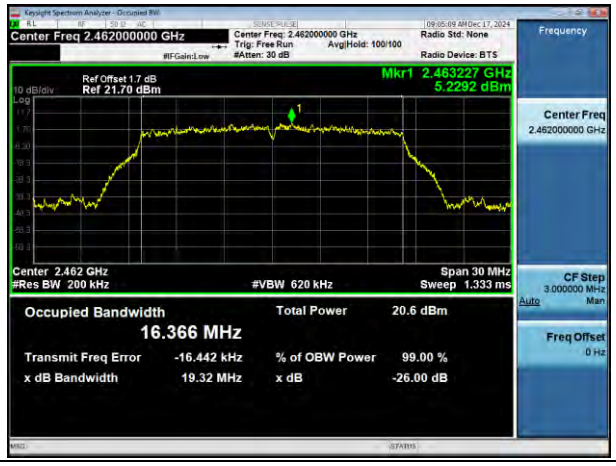
6dB Bandwidth:

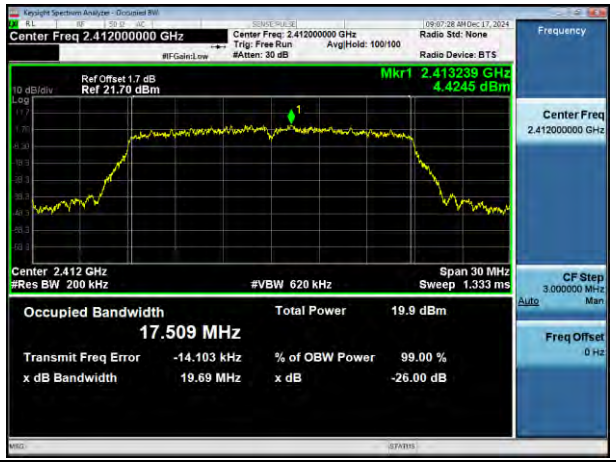
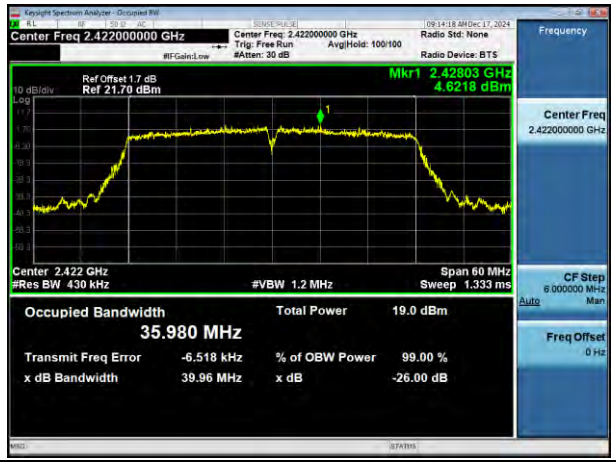
802.11b	802.11g
2412MHz	2412MHz
	
2437MHz	2437MHz
	
2462MHz	2462MHz
	

802.11n(HT20)	802.11n(HT40)
2412MHz	2422MHz
	
2437MHz	2437MHz
	
2462MHz	2452MHz
	

ANT1:

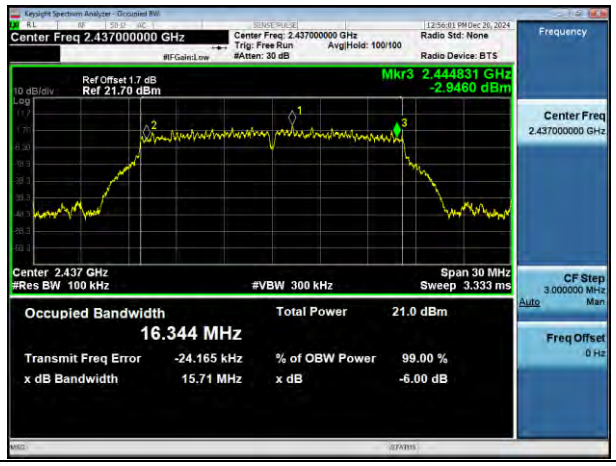
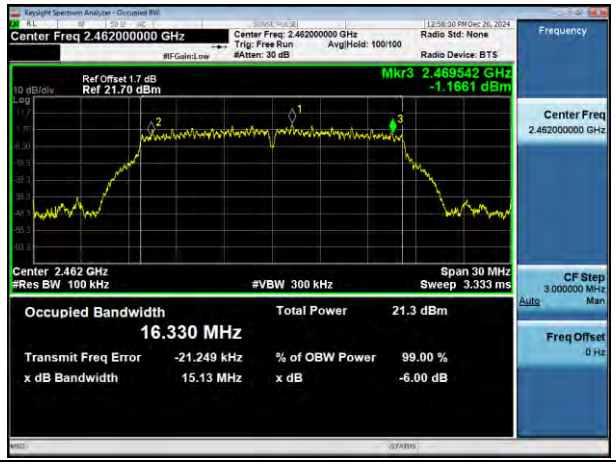
99% Bandwidth:

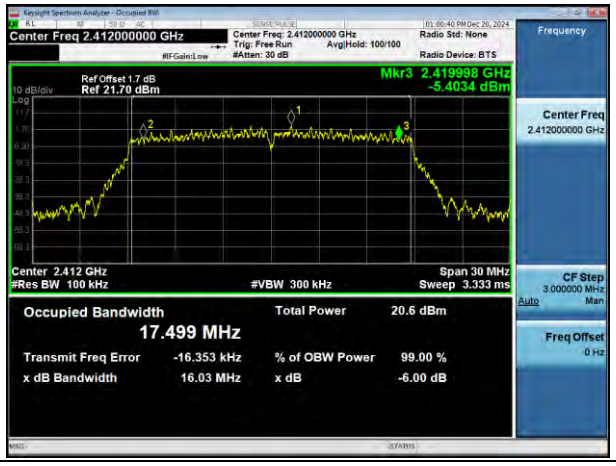
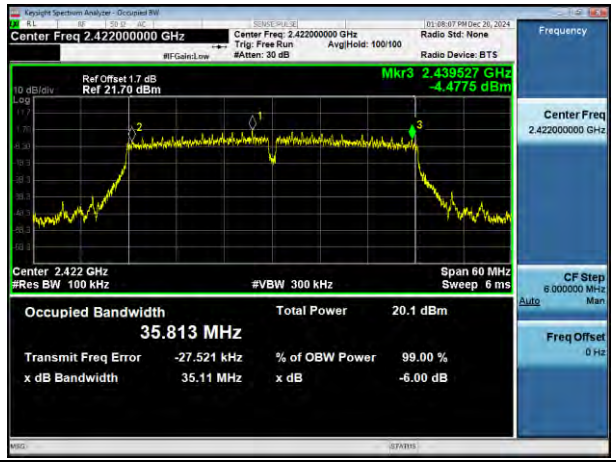
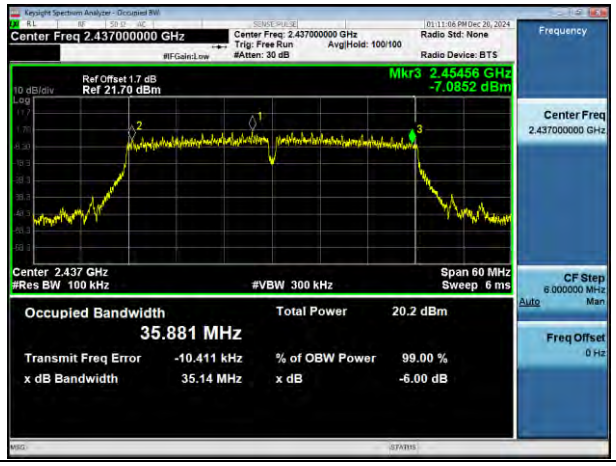
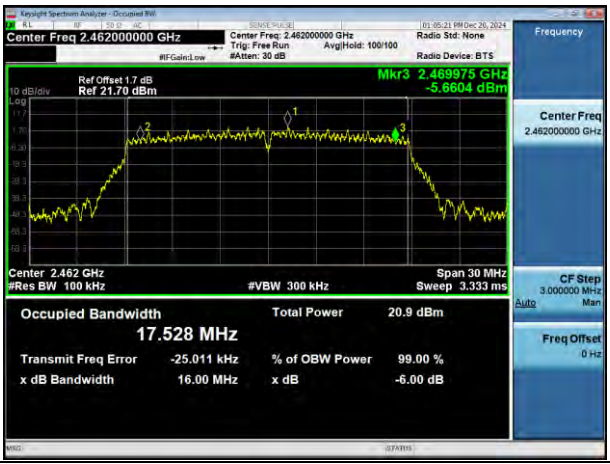
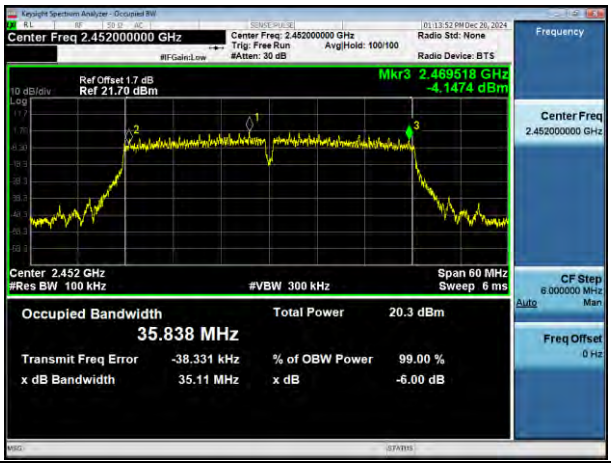
802.11b	802.11g
2412MHz	2412MHz
	
2437MHz	2437MHz
	
2462MHz	2462MHz
	

802.11n(HT20)	802.11n(HT40)
2412MHz	2422MHz
	
2437MHz	2437MHz
	
2462MHz	2452MHz
	

ANT2:

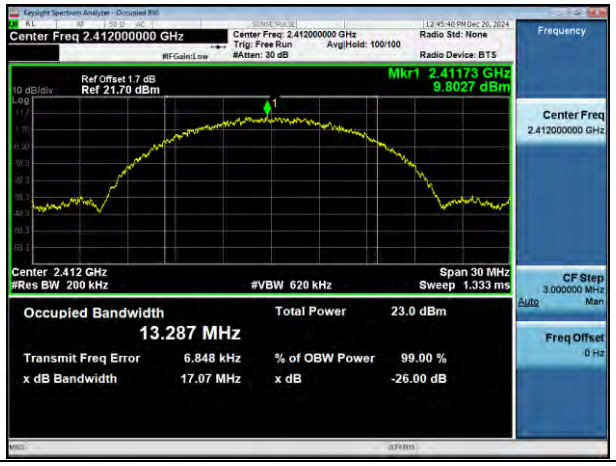
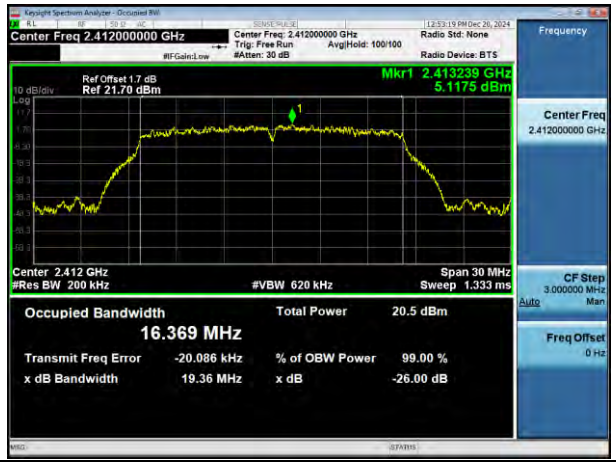
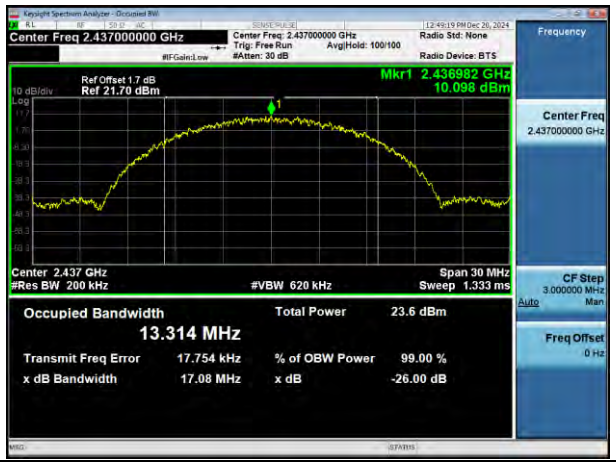
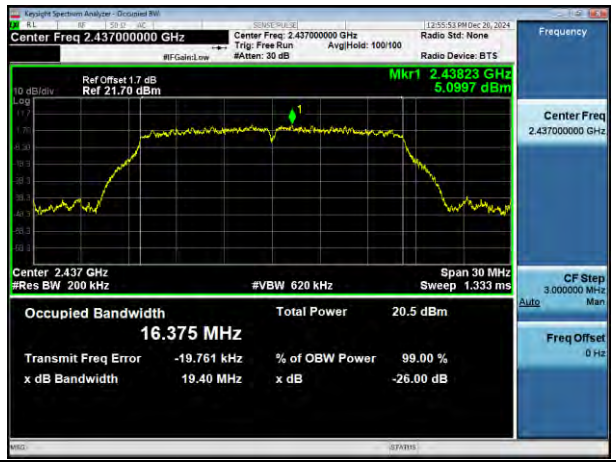
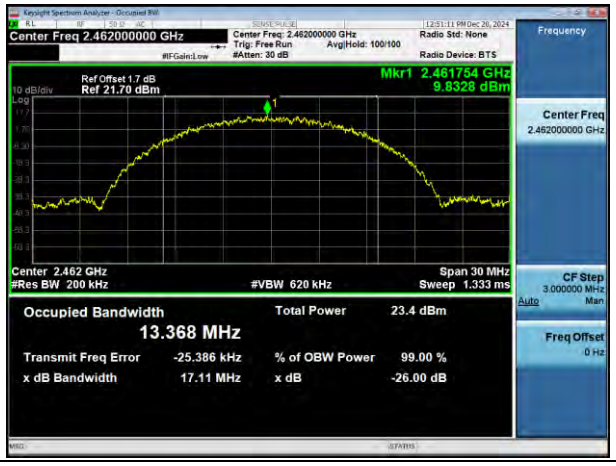
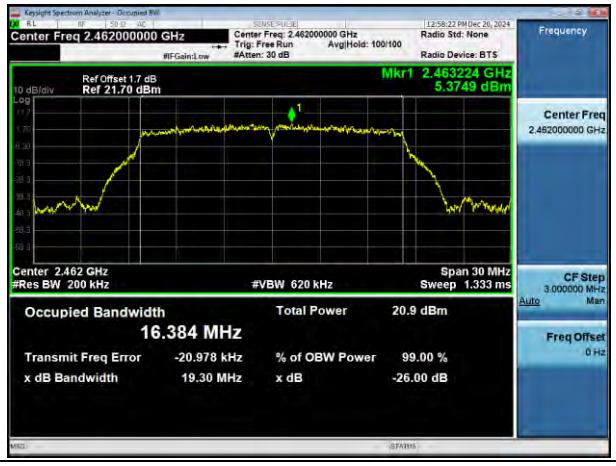
6dB Bandwidth:

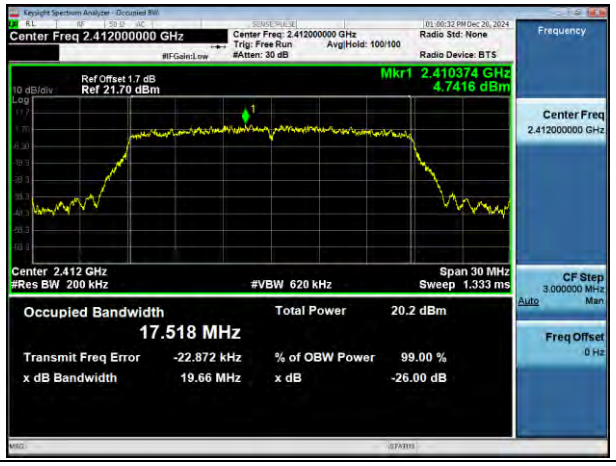
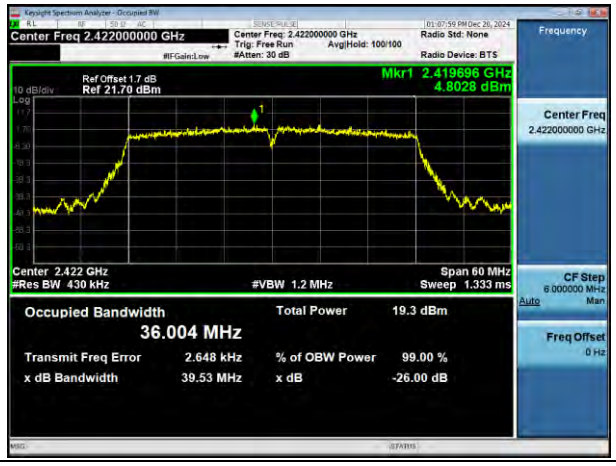
802.11b	802.11g
2412MHz	2412MHz
	
2437MHz	2437MHz
	
2462MHz	2462MHz
	

802.11n(HT20)	802.11n(HT40)
2412MHz	2422MHz
	
2437MHz	2437MHz
	
2462MHz	2452MHz
	

ANT2:

99% Bandwidth:

802.11b	802.11g
2412MHz	2412MHz
	
2437MHz	2437MHz
	
2462MHz	2462MHz
	

802.11n(HT20)	802.11n(HT40)
2412MHz	2422MHz
	
2437MHz	2437MHz
	
2462MHz	2452MHz
	

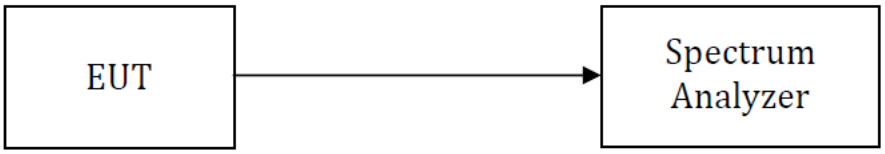
9. Maximum Power Spectral Density

9.1 Standard and Limit

According to FCC 15.247(e), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

9.2 Test Procedure

1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 3kHz, VBW = 10kHz, Sweep = Auto, Detector = RMS.
4) Measure the highest amplitude appearing on spectral display and mark the value.
5) Repeat above procedures until all frequencies measured were complete.



Test Setup Block Diagram

9.3 Test Data and Results

SISO mode:

Test Mode	Antenna	Test Channel (MHz)	Conducted PSD (dBm/3kHz)	Duty Factor (dB)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Test Result
802.11b	ANT 1	2412	-11.57	0.21	-11.36	8	Pass
		2437	-12.09	0.21	-11.88	8	Pass
		2462	-11.52	0.22	-11.3	8	Pass
	ANT 2	2412	-10.05	0.24	-9.81	8	Pass
		2437	-11.66	0.21	-11.45	8	Pass
		2462	-12.04	0.21	-11.83	8	Pass
802.11g	ANT 1	2412	-19.23	1.11	-18.12	8	Pass
		2437	-19.01	1.11	-17.9	8	Pass
		2462	-18.45	1.11	-17.34	8	Pass
	ANT 2	2412	-18.55	1.16	-17.39	8	Pass
		2437	-18.89	1.11	-17.78	8	Pass
		2462	-17.44	1.11	-16.33	8	Pass
802.11n(HT20)	ANT 1	2412	-18.67	1.14	-17.53	8	Pass
		2437	-18.89	1.18	-17.71	8	Pass
		2462	-18.2	1.13	-17.07	8	Pass
	ANT 2	2412	-18.16	1.24	-16.92	8	Pass
		2437	-18.62	1.24	-17.38	8	Pass
		2462	-18.34	1.18	-17.16	8	Pass
802.11n(HT40)	ANT 1	2422	-23.01	1.79	-21.22	8	Pass
		2437	-23.07	1.73	-21.34	8	Pass
		2452	-22.48	1.79	-20.69	8	Pass
	ANT 2	2422	-22.73	1.82	-20.91	8	Pass
		2437	-22.98	1.79	-21.19	8	Pass
		2452	-22.49	1.82	-20.67	8	Pass

Note: Total PSD = Conducted PSD + Duty Factor

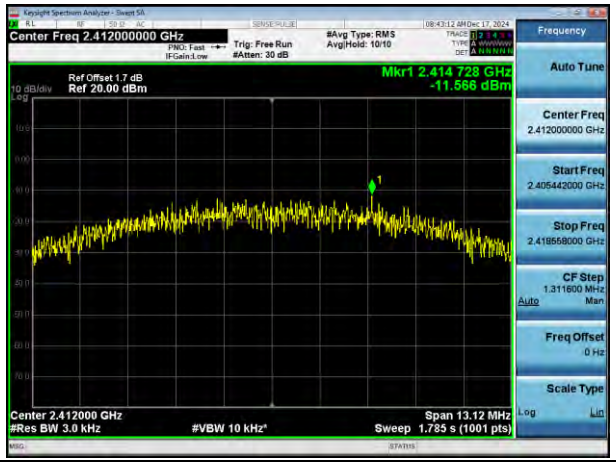
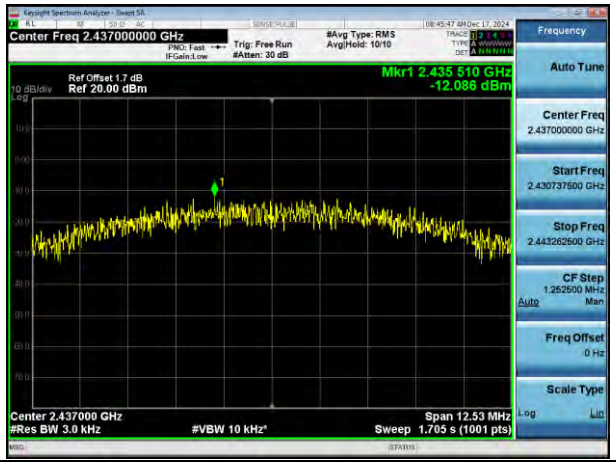
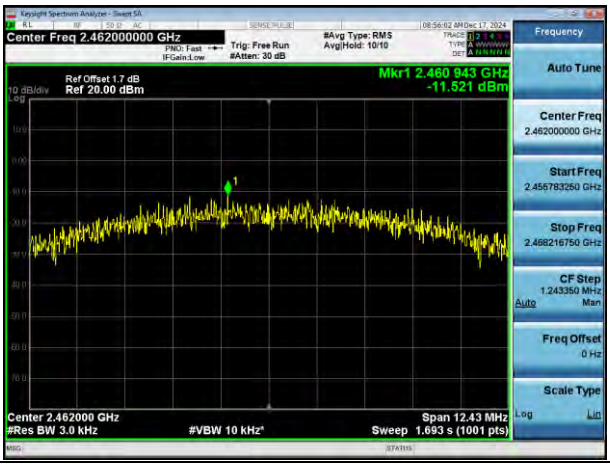
MIMO mode:

Test Mode	Antenna	Test Channel (MHz)	PSD (dBm/3kHz)	Duty Factor (dB)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Test Result
802.11n(HT20) MIMO	ANT 1	2412	-13.52	1.14	-12.38	8	Pass
		2437	-13.8	1.18	-12.62	8	Pass
		2462	-13.44	1.13	-12.31	8	Pass
	ANT 2	2412	-12.95	1.24	-11.71	8	Pass
		2437	-13.08	1.24	-11.84	8	Pass
		2462	-11.38	1.18	-10.2	8	Pass
	MIMO	2412	-10.22	-	-8.86	8	Pass
		2437	-10.41	-	-9.21	8	Pass
		2462	-9.28	-	-7.96	8	Pass
802.11n(HT40) MIMO	ANT 1	2422	-15.83	1.79	-14.04	8	Pass
		2437	-16.12	1.73	-14.39	8	Pass
		2452	-16.4	1.79	-14.61	8	Pass
	ANT 2	2422	-16.23	1.82	-14.41	8	Pass
		2437	-16.48	1.79	-14.69	8	Pass
		2452	-15.44	1.82	-13.62	8	Pass
	MIMO	2422	-13.02	-	-10.97	8	Pass
		2437	-13.29	-	-11.55	8	Pass
		2452	-12.88	-	-11.55	8	Pass

Note: Total PSD=PSD +Duty factor

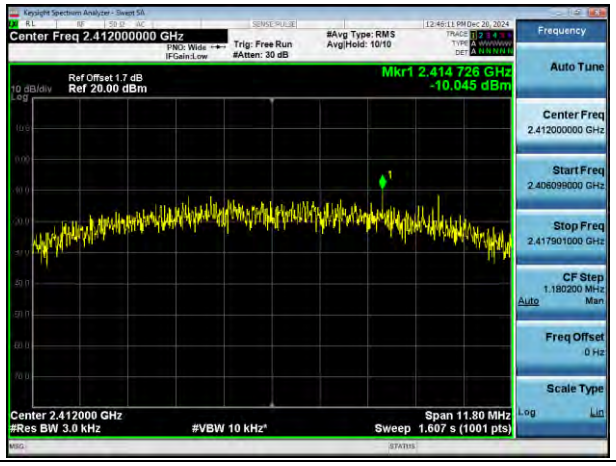
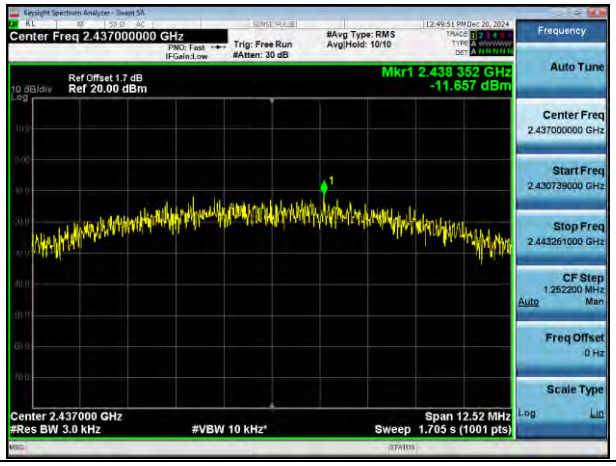
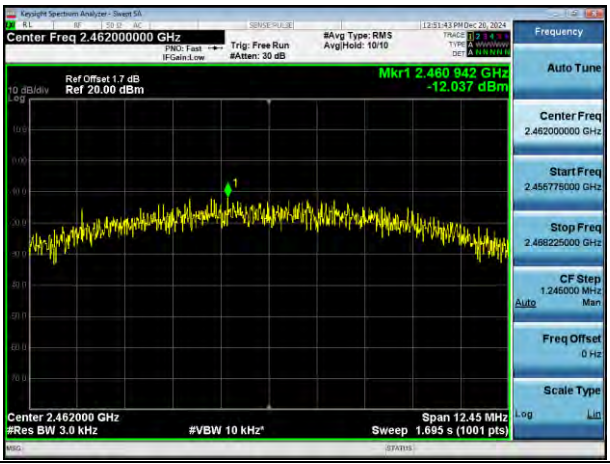
Note: MIMO PSD=ANT1 PSD+ANT2 PSD

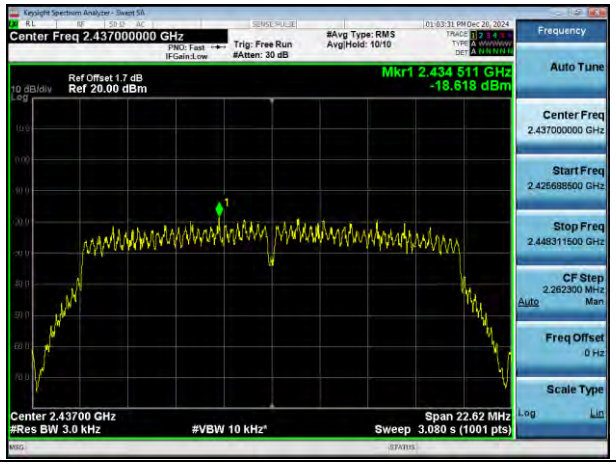
ANT1:

802.11b	802.11g
2412MHz	2412MHz
	
2437MHz	2437MHz
	
2462MHz	2462MHz
	

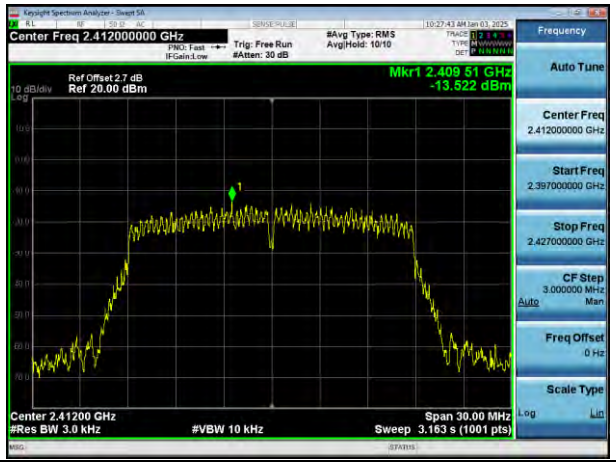
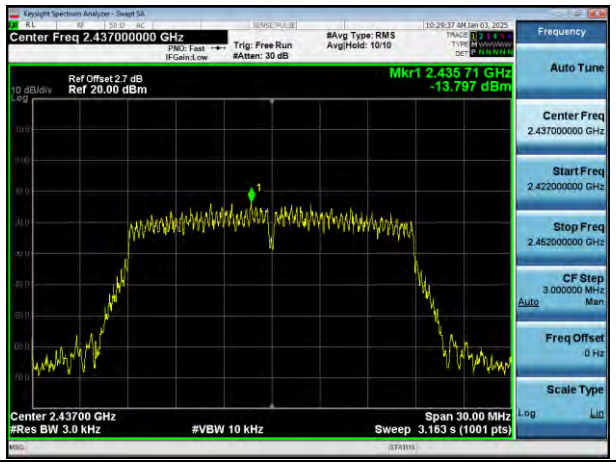
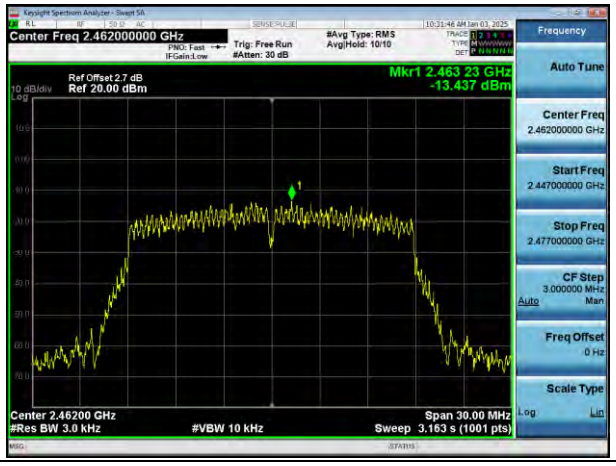
802.11n(HT20)	802.11n(HT40)
2412MHz	2422MHz
	
2437MHz	2437MHz
	
2462MHz	2452MHz
	

ANT2:

802.11b	802.11g
2412MHz	2412MHz
	
2437MHz	2437MHz
	
2462MHz	2462MHz
	

802.11n(HT20)	802.11n(HT40)
2412MHz	2422MHz
	
2437MHz	2437MHz
	
2462MHz	2452MHz
	

MIMO:

802.11n(HT20) ANT 1	802.11n(HT20) ANT 2
2412MHz	2412MHz
	
2437MHz	2437MHz
	
2462MHz	2462MHz
	

802.11n(HT40) ANT 1	802.11n(HT40) ANT 2
2422MHz	2422MHz
	
2437MHz	2437MHz
	
2452MHz	2452MHz
	

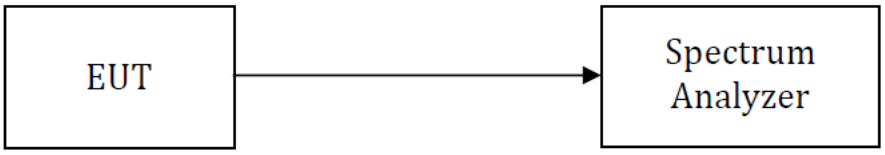
10. Band-edge Emission(Conducted)

10.1 Standard and Limit

According to §15.247(d), 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)).

10.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.10.
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = Peak.
4) Measure the highest amplitude appearing on spectral display and set it as a reference level.
5) Set a convenient frequency span including 100 kHz bandwidth from band edge.
6) Measure the emission and marking the edge frequency.
7) Repeat above procedures until all frequencies measured were complete.



Test Setup Block Diagram

10.3 Test Data and Results

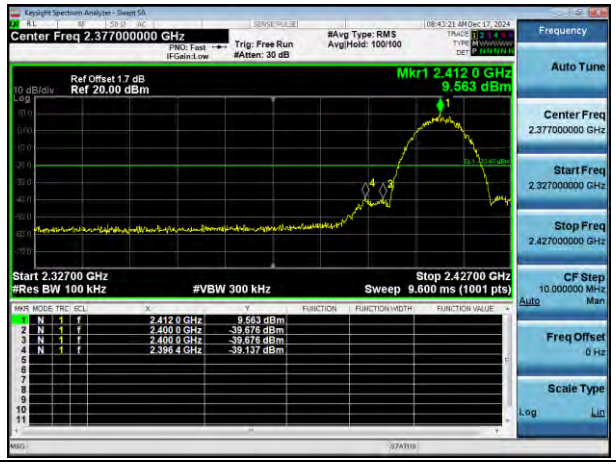
Test Mode	Antenna	Band-edge	Test Channel (MHz)	Max. Value (dBc)	Limit (dBc)	Test Result
802.11b	ANT 1	Lowest	2412	-48.68	-30	Pass
		Highest	2462	-61.95	-30	Pass
	ANT 2	Lowest	2412	-48.63	-30	Pass
		Highest	2462	-63.71	-30	Pass
802.11g	ANT 1	Lowest	2412	-45.88	-30	Pass
		Highest	2462	-53.08	-30	Pass
	ANT 2	Lowest	2412	-43.13	-30	Pass
		Highest	2462	-53.98	-30	Pass
802.11n(HT20)	ANT 1	Lowest	2412	-44.54	-30	Pass
		Highest	2462	-53.33	-30	Pass
	ANT 2	Lowest	2412	-43.12	-30	Pass
		Highest	2462	-54.1	-30	Pass
802.11n(HT40)	ANT 1	Lowest	2422	-38.91	-30	Pass
		Highest	2452	-44.53	-30	Pass
	ANT 2	Lowest	2422	-38.49	-30	Pass
		Highest	2452	-45.67	-30	Pass

ANT1:

802.11b Lowest

Reference Power

Band-edge Emission



802.11b Highest

Reference Power

Band-edge Emission

802.11g Lowest

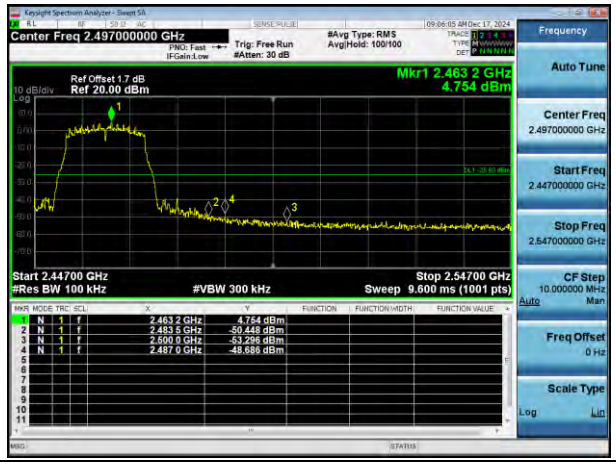
Reference Power

Band-edge Emission

802.11g Highest

Reference Power

Band-edge Emission



802.11n(HT20) Lowest

Reference Power

Band-edge Emission

802.11n(HT20) Highest

Reference Power

Band-edge Emission

802.11n(HT40) Lowest

Reference Power

Band-edge Emission

802.11n(HT40) Highest

Reference Power

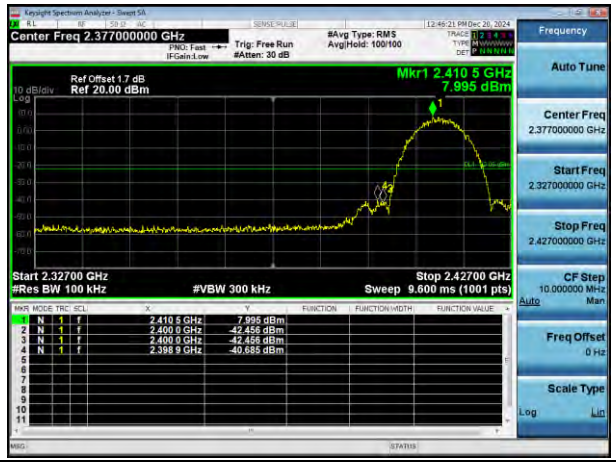
Band-edge Emission

ANT2:

802.11b Lowest

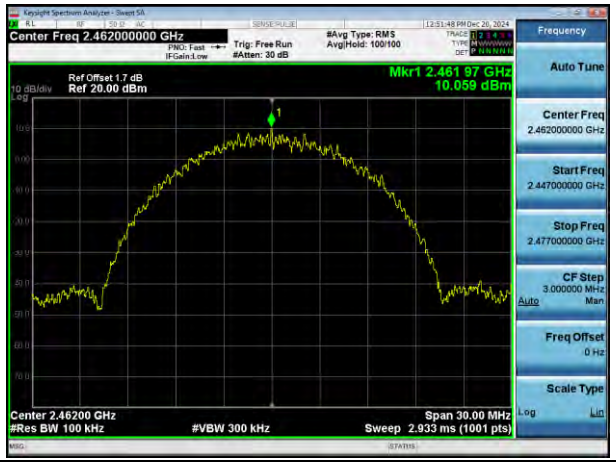
Reference Power

Band-edge Emission



802.11b Highest

Reference Power



Band-edge Emission

802.11g Lowest

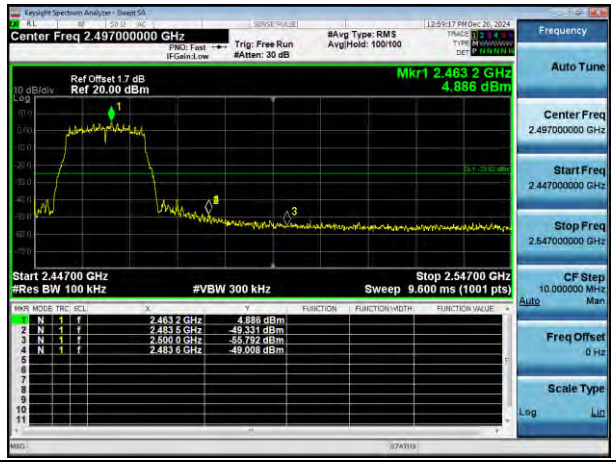
Reference Power

Band-edge Emission

802.11g Highest

Reference Power

Band-edge Emission



802.11n(HT20) Lowest

Reference Power

Band-edge Emission

802.11n(HT20) Highest

Reference Power

Band-edge Emission

802.11n(HT40) Lowest

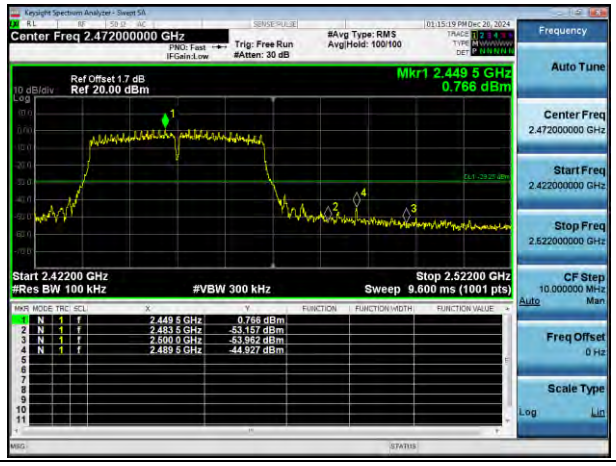
Reference Power

Band-edge Emission

802.11n(HT40) Highest

Reference Power

Band-edge Emission



11. Conducted RF Spurious Emissions

11.1 Standard and Limit

According to §15.247(d), 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)).

11.2 Test Procedure

Test is conducting under the description of ANSI C63.10 - 2013 section 6.7.
1) Remove the antenna from the EUT and connect to the spectrum analyzer via a low loss RF cable.
2) Set the spectrum analyzer to any one measured frequency within its operating range.
3) Set RBW = 100kHz, VBW = 300kHz, Sweep = Auto, Detector = Peak.
4) Measure the highest amplitude appearing on spectral display and set it as a reference level.
5) Measure the spurious emissions with frequency range from 9kHz to 26.5GHz.
6) Repeat above procedures until all measured frequencies were complete.

Test Setup Block Diagram

11.3 Test Data and Results

Note: The measurement frequency range is from 9kHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions measurement data.

ANT1:

802.11b Lowest

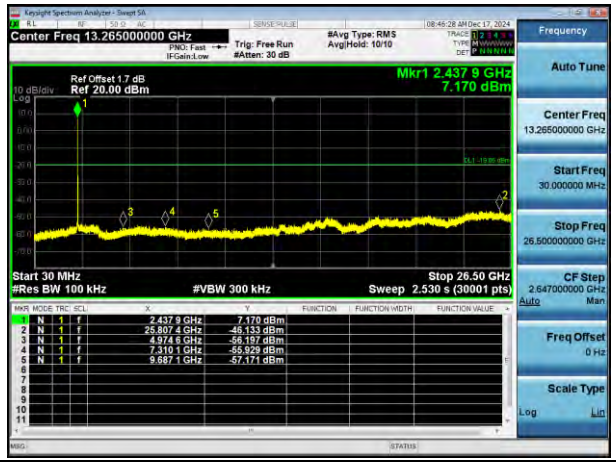
Reference Power

Spurious Emissions

802.11b Middle

Reference Power

Spurious Emissions



802.11b Highest

Reference Power

Spurious Emissions

802.11g Lowest

Reference Power

Spurious Emissions

802.11g Middle

Reference Power

Spurious Emissions

802.11g Highest

Reference Power

Spurious Emissions

802.11n(HT20) Lowest

Reference Power

Spurious Emissions

802.11n(HT20) Middle

Reference Power

Spurious Emissions

802.11n(HT20) Highest

Reference Power

Spurious Emissions

802.11n(HT40) Lowest

Reference Power

Spurious Emissions

802.11n(HT40) Middle

Reference Power

Spurious Emissions

802.11n(HT40) Highest

Reference Power

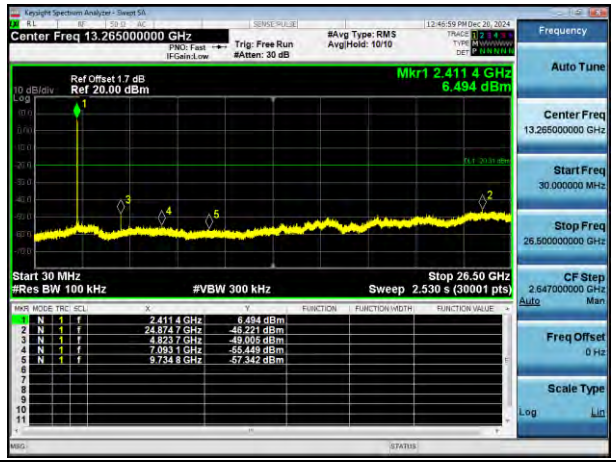
Spurious Emissions

ANT2:

802.11b Lowest

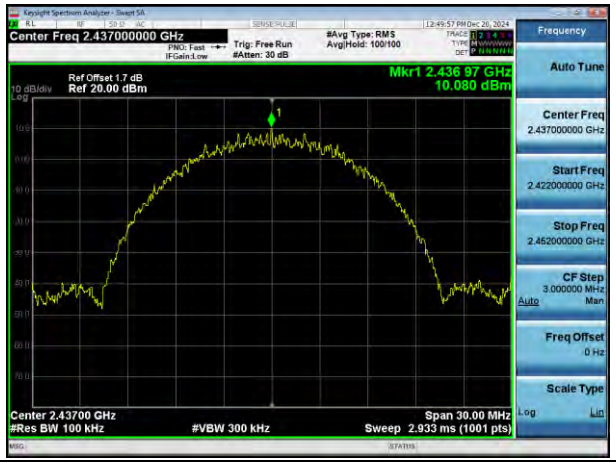
Reference Power

Spurious Emissions

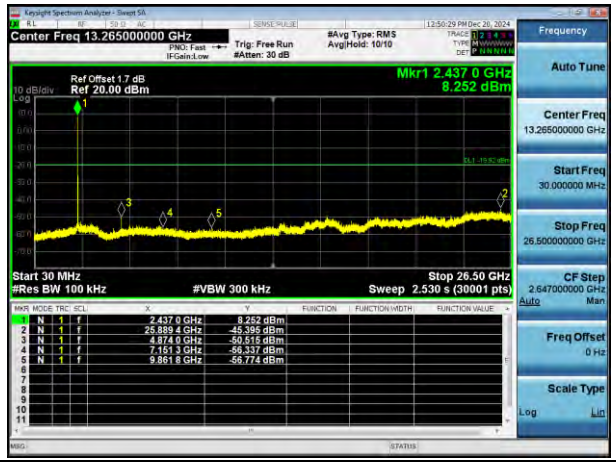


802.11b Middle

Reference Power



Spurious Emissions



802.11b Highest

Reference Power

Spurious Emissions

802.11g Lowest

Reference Power

Spurious Emissions

802.11g Middle

Reference Power

Spurious Emissions

802.11g Highest

Reference Power

Spurious Emissions

802.11n(HT20) Lowest

Reference Power

Spurious Emissions

802.11n(HT20) Middle

Reference Power

Spurious Emissions

802.11n(HT20) Highest

Reference Power

Spurious Emissions

802.11n(HT40) Lowest

Reference Power

Spurious Emissions

802.11n(HT40) Middle

Reference Power

Spurious Emissions

802.11n(HT40) Highest

Reference Power

Spurious Emissions

******* END OF REPORT *******