

8. Occupied Bandwidth

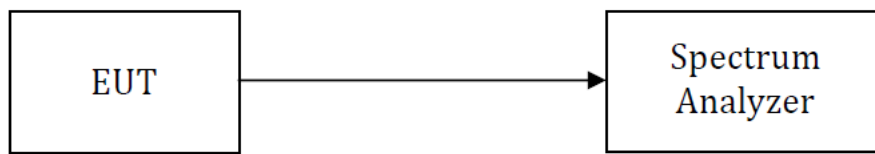
8.1 Standard and Limit

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.



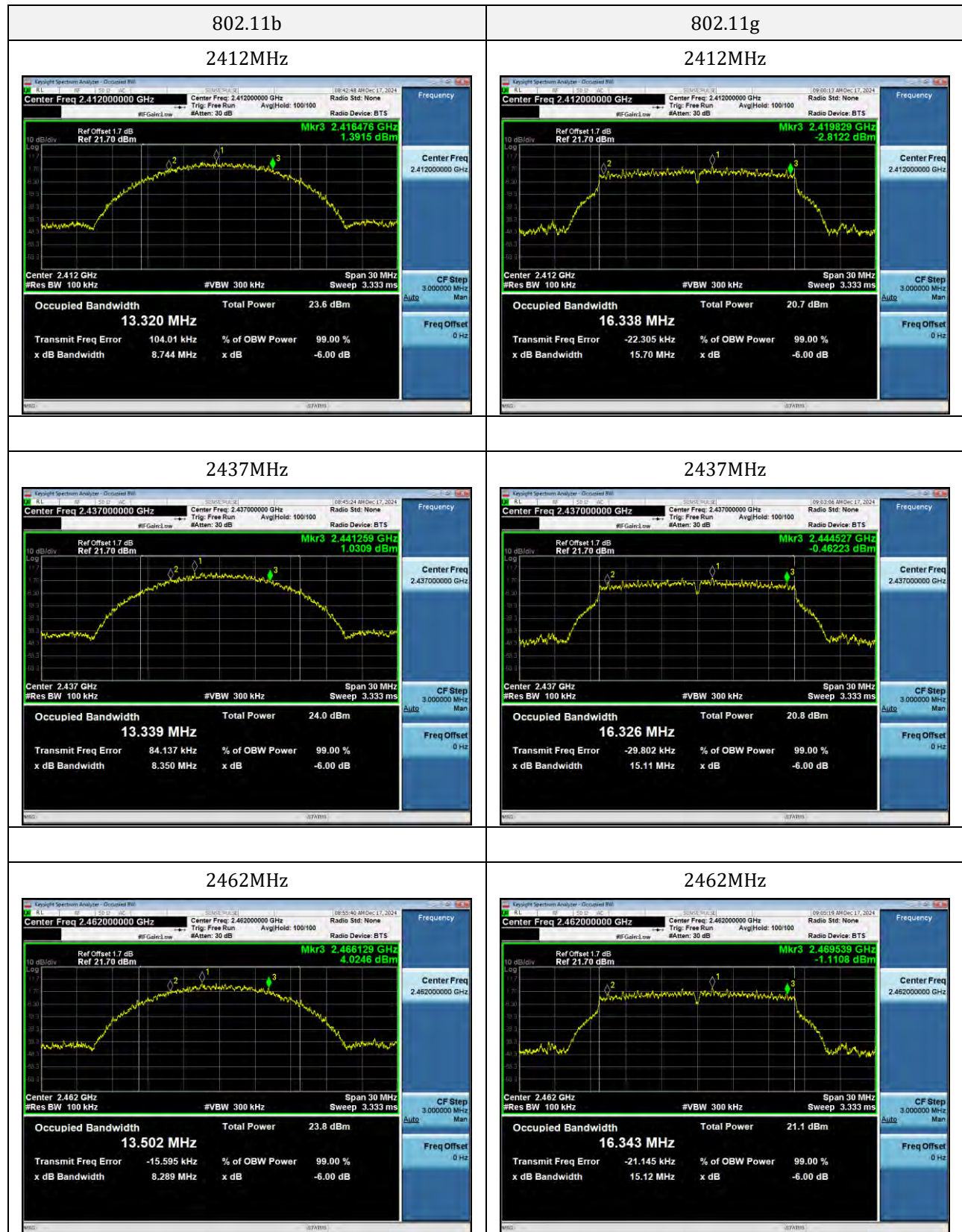
Test Setup Block Diagram

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:



802.11n(HT20)

2412MHz



802.11n(HT40)

2422MHz



2437MHz



2437MHz



2462MHz

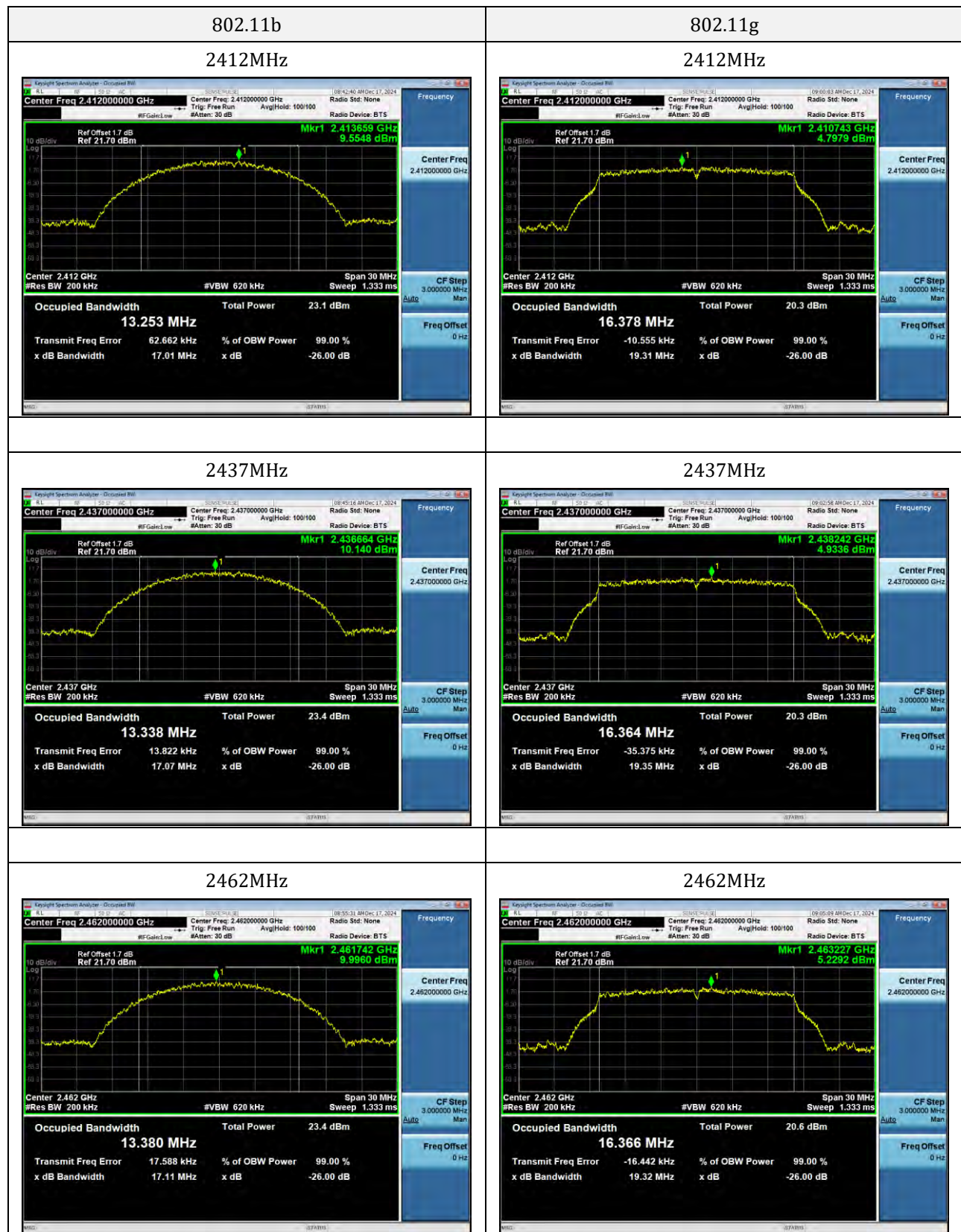


2452MHz



ANT1:

99% Bandwidth:



802.11n(HT20)

2412MHz



802.11n(HT40)

2422MHz



2437MHz



2437MHz



2462MHz

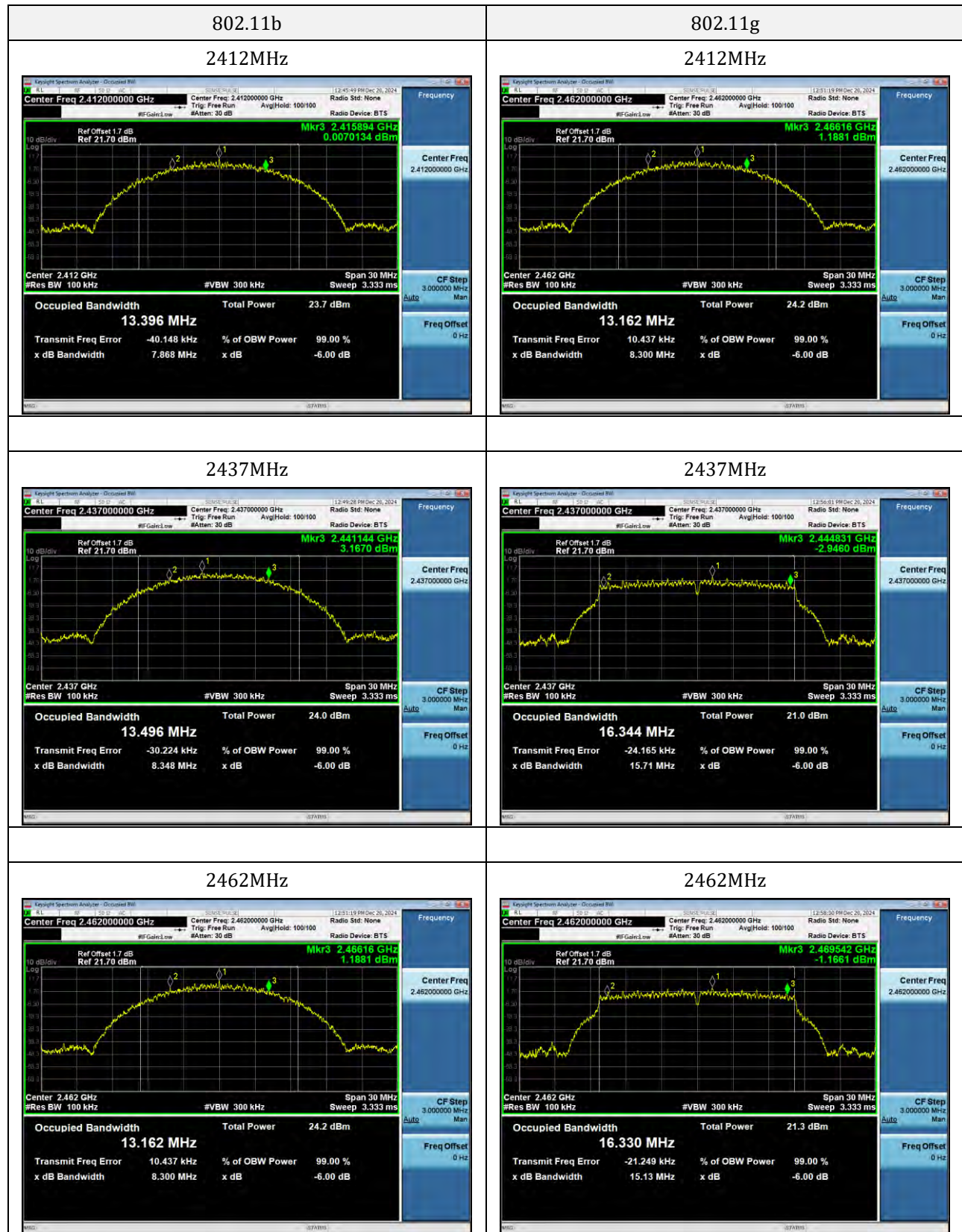


2452MHz



ANT2:

6dB Bandwidth:



802.11n(HT20)

2412MHz



802.11n(HT40)

2422MHz



2437MHz



2437MHz



2462MHz

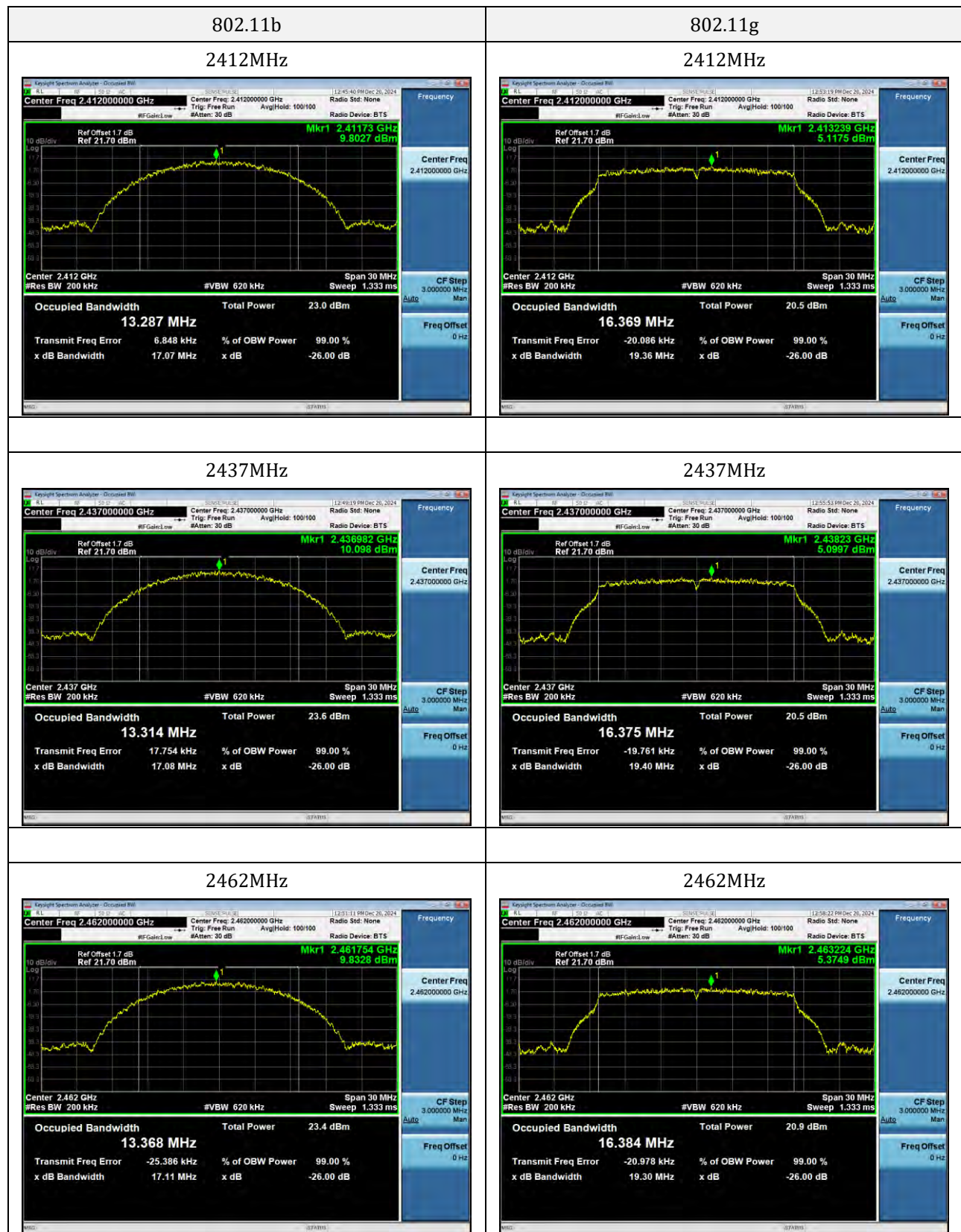


2452MHz



ANT2:

99% Bandwidth:



802.11n(HT20)

2412MHz



802.11n(HT40)

2422MHz



2437MHz



2437MHz



2462MHz



2452MHz



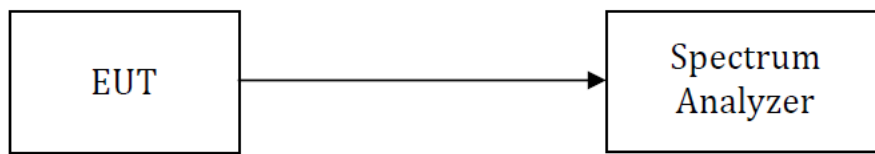
9. Maximum Power Spectral Density

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

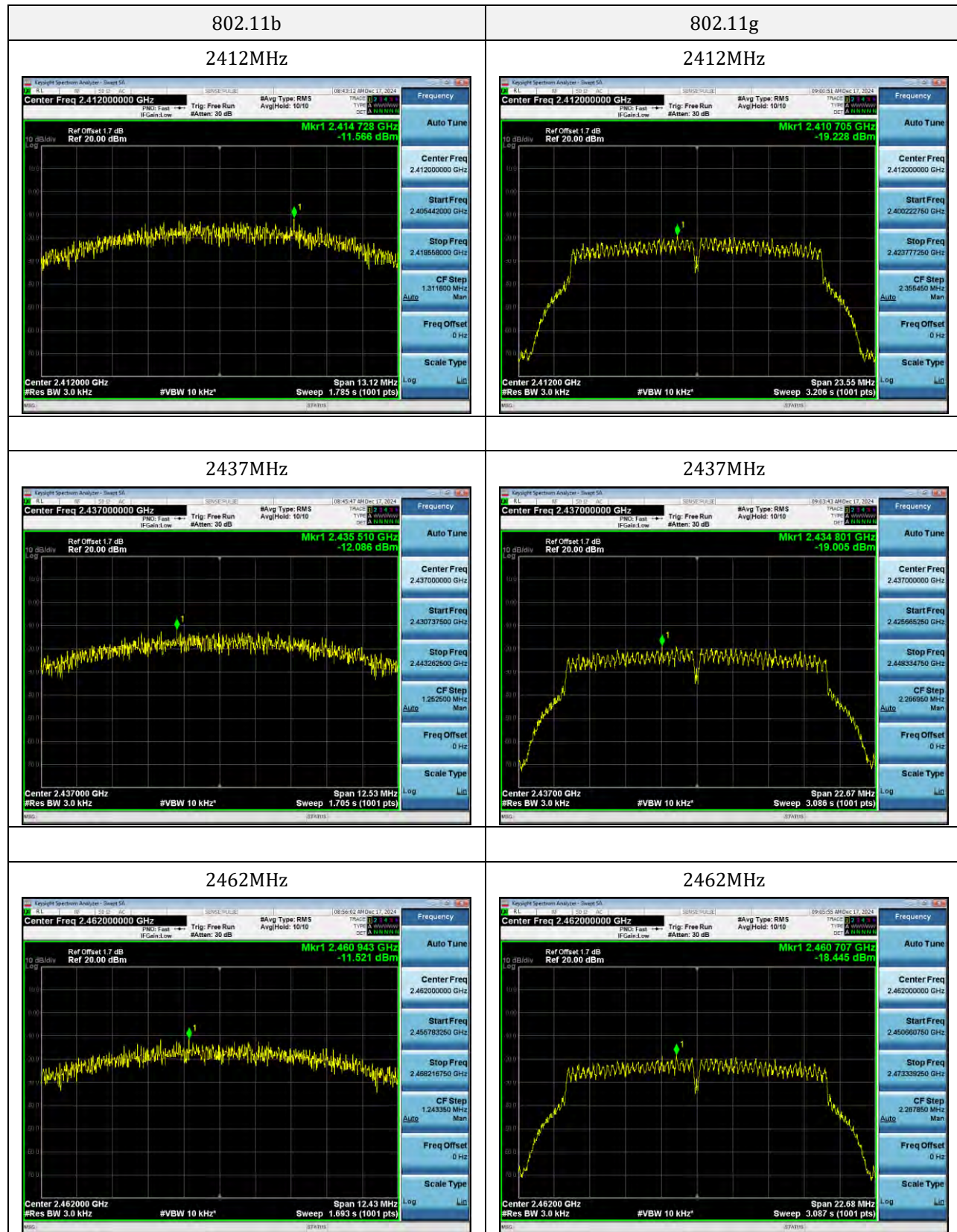
MIMO mode:

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:



802.11n(HT20)

2412MHz

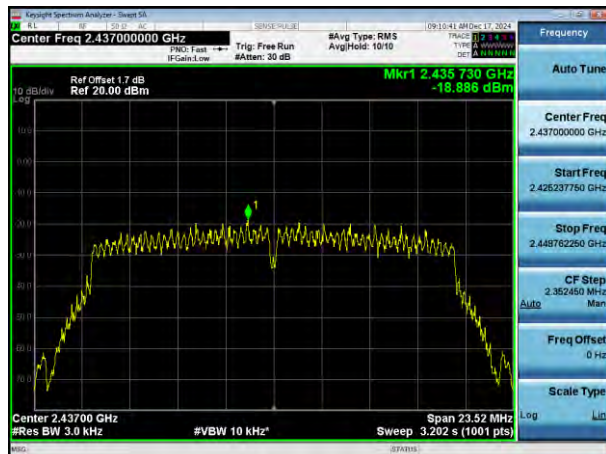


802.11n(HT40)

2422MHz



2437MHz



2437MHz



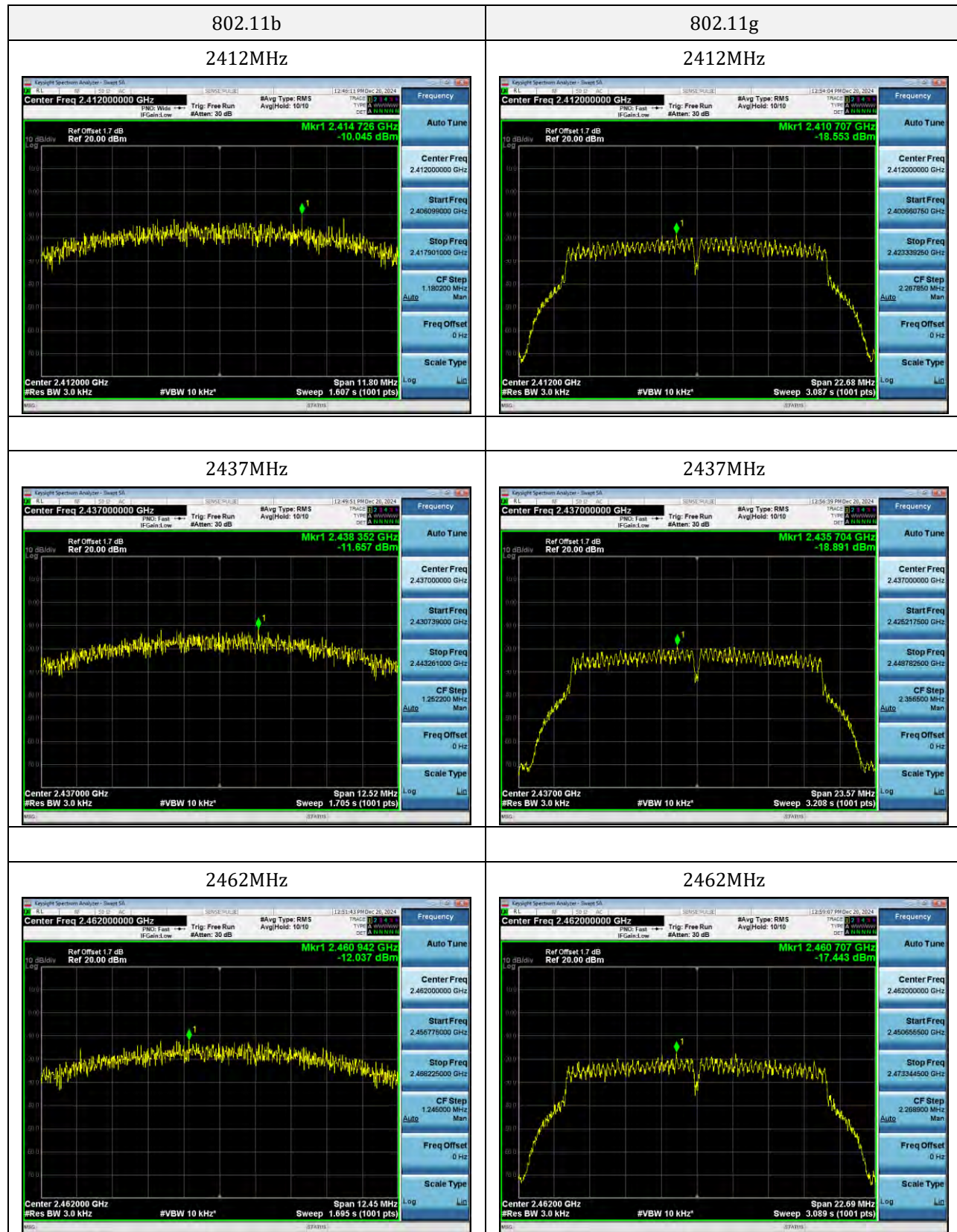
2462MHz



2452MHz



ANT2:



802.11n(HT20)

2412MHz



802.11n(HT40)

2422MHz



2437MHz



2437MHz



2462MHz



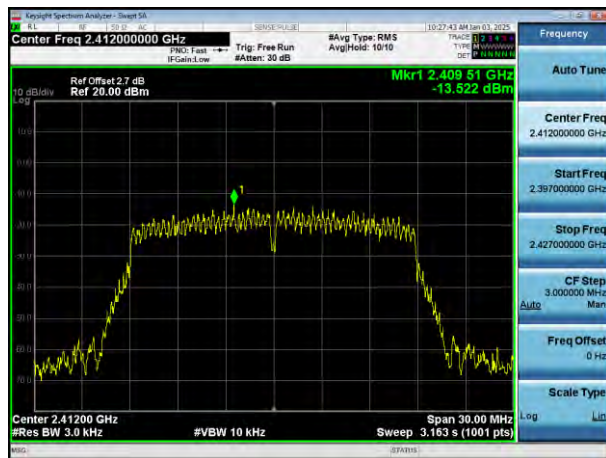
2452MHz



MIMO:

802.11n(HT20) ANT 1

2412MHz

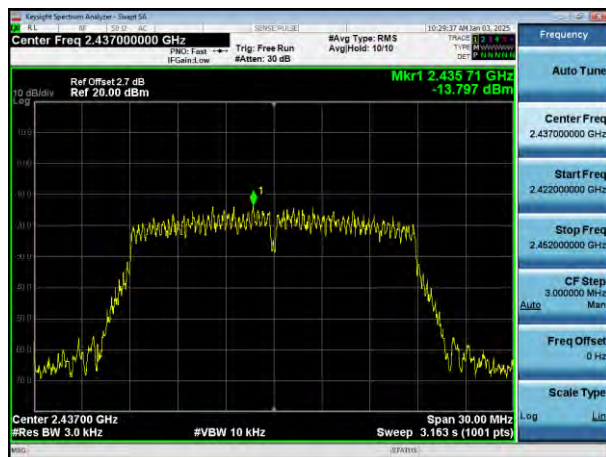


802.11n(HT20) ANT 2

2412MHz



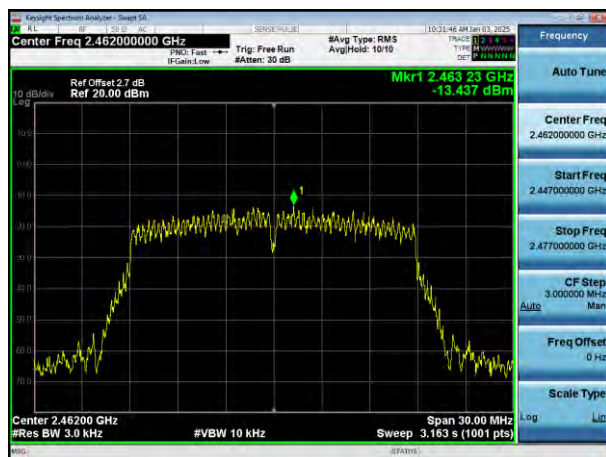
2437MHz



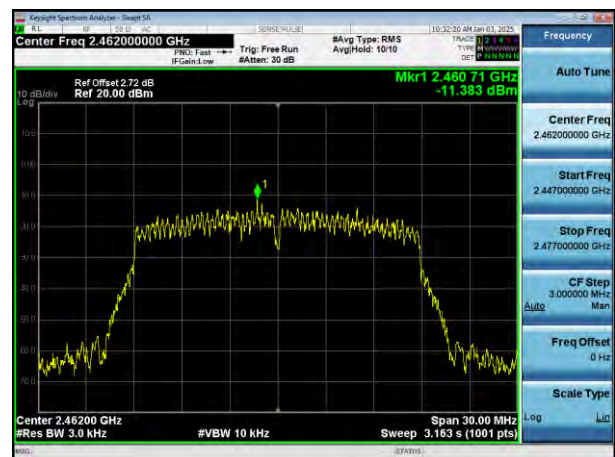
2437MHz



2462MHz



2462MHz



802.11n(HT40) ANT 1

2422MHz

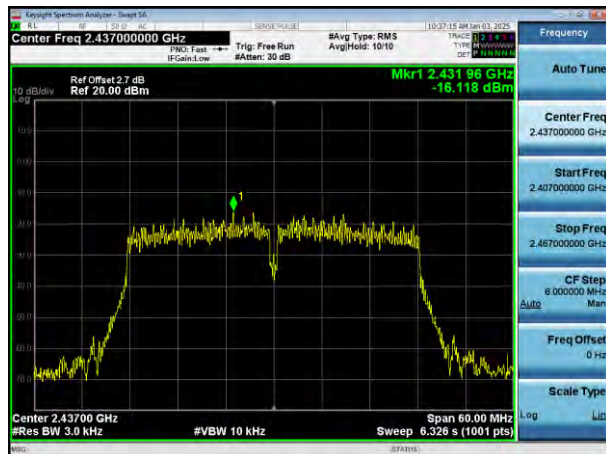


802.11n(HT40) ANT 2

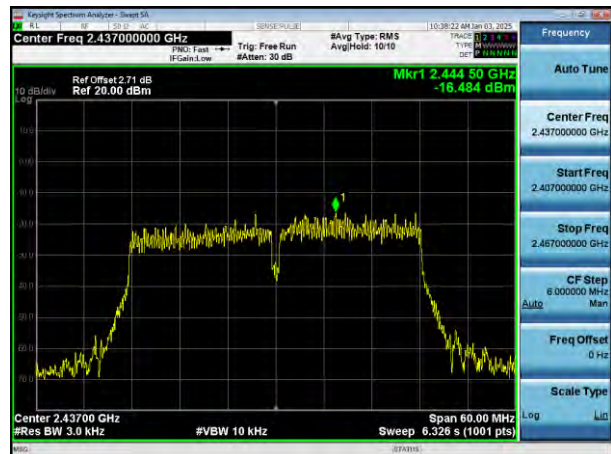
2422MHz



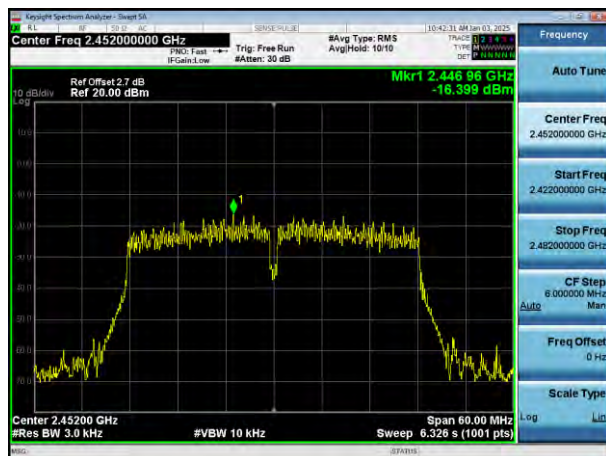
2437MHz



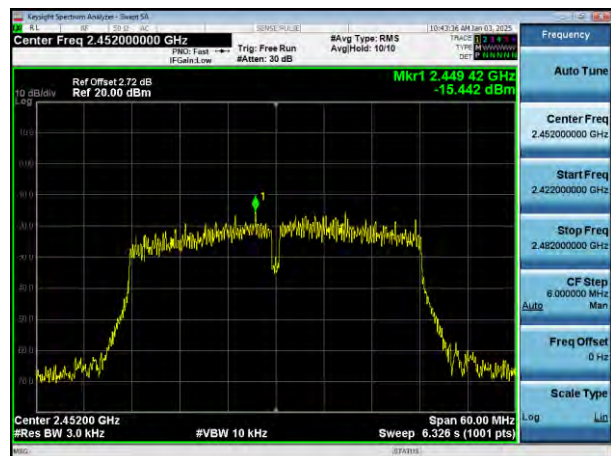
2437MHz



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

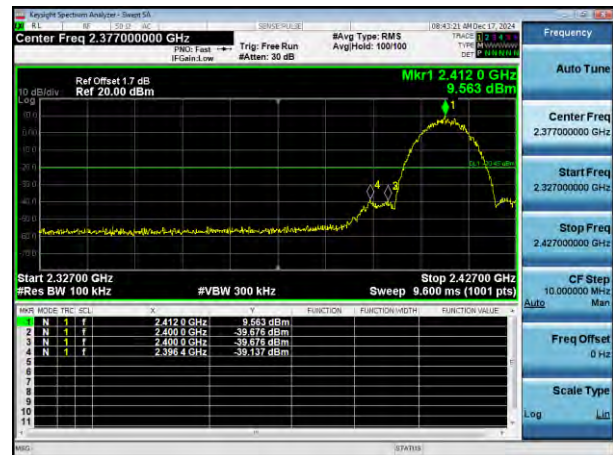
ANT1:

802.11b Lowest

Reference Power



Band-edge Emission



802.11b Highest

Reference Power

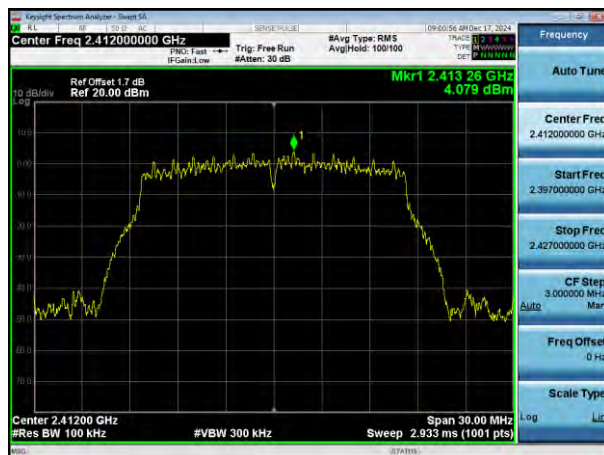


Band-edge Emission

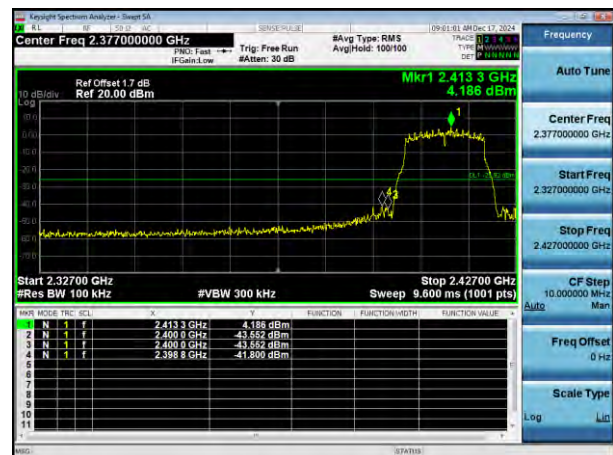


802.11g Lowest

Reference Power

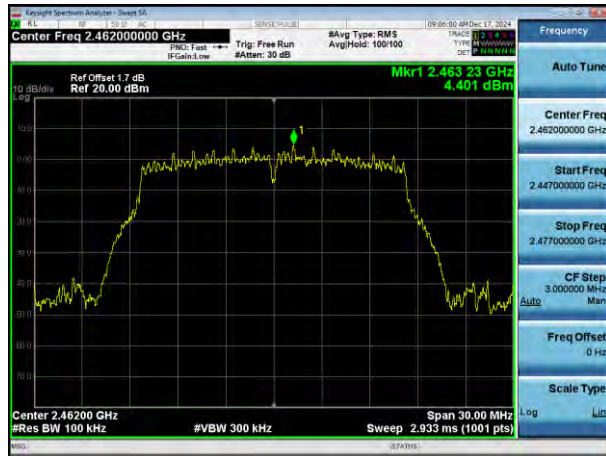


Band-edge Emission

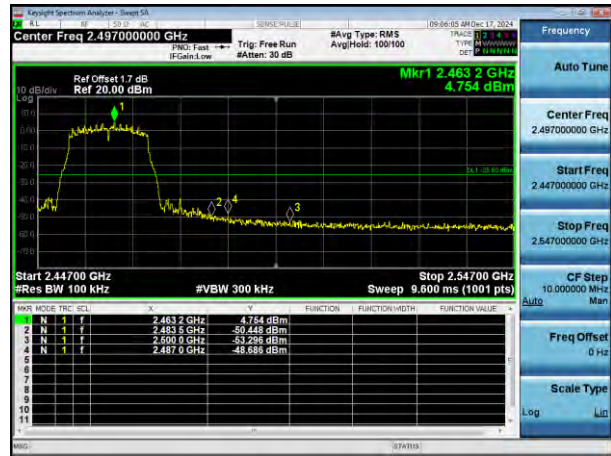


802.11g Highest

Reference Power



Band-edge Emission

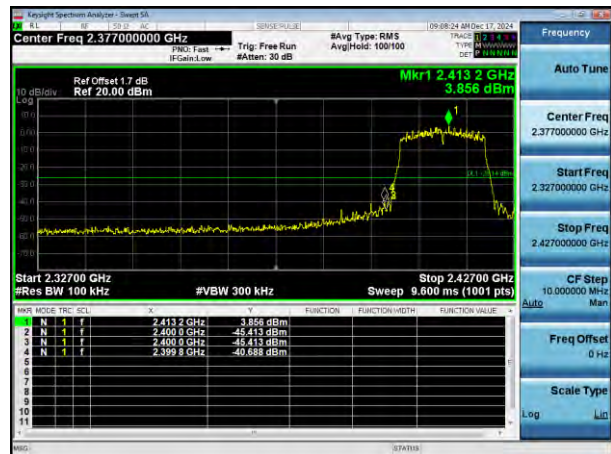


802.11n(HT20) Lowest

Reference Power

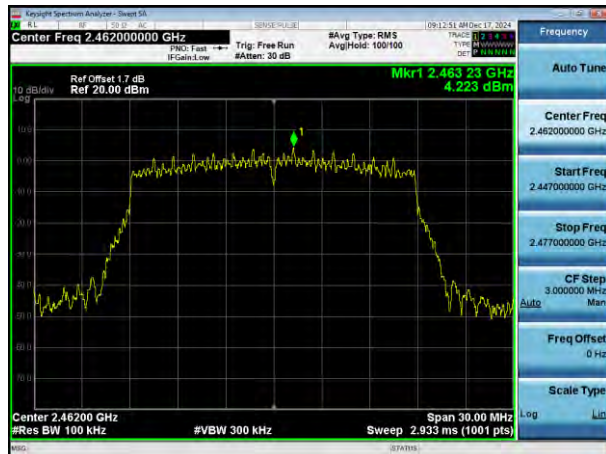


Band-edge Emission

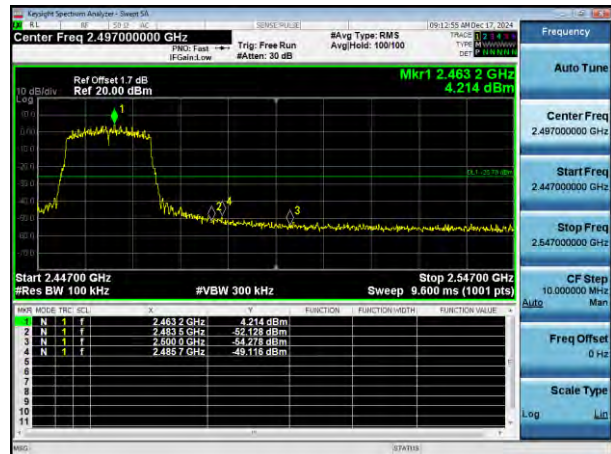


802.11n(HT20) Highest

Reference Power

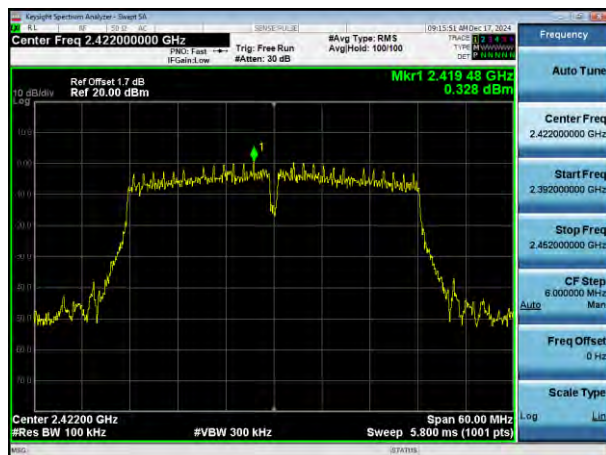


Band-edge Emission

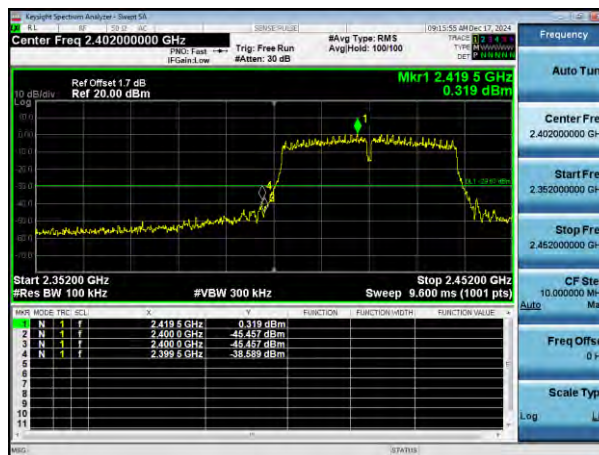


802.11n(HT40) Lowest

Reference Power

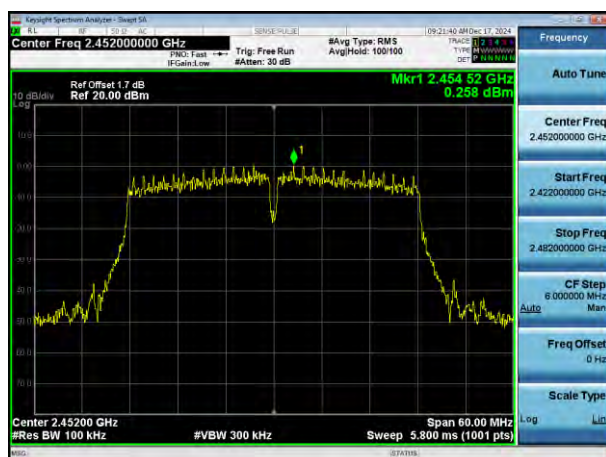


Band-edge Emission



802.11n(HT40) Highest

Reference Power



Band-edge Emission



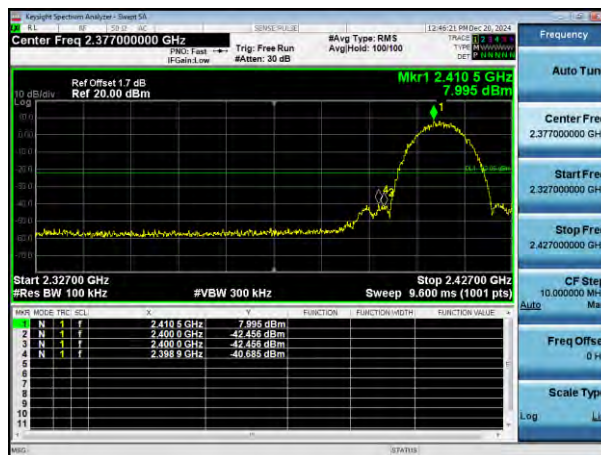
ANT2:

802.11b Lowest

Reference Power



Band-edge Emission

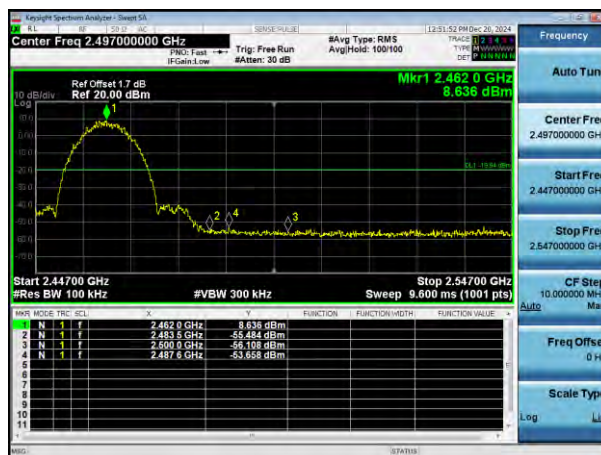


802.11b Highest

Reference Power

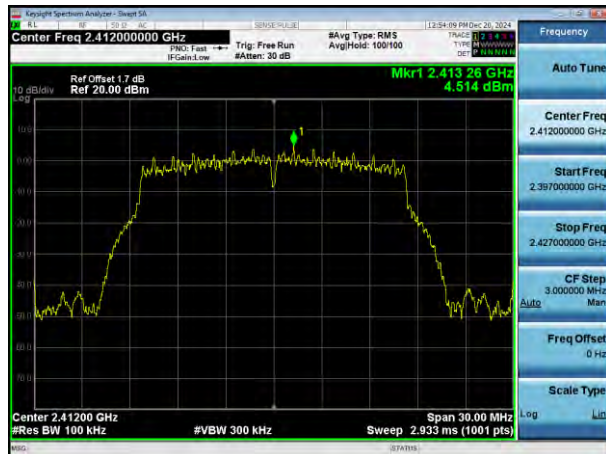


Band-edge Emission



802.11g Lowest

Reference Power



Band-edge Emission

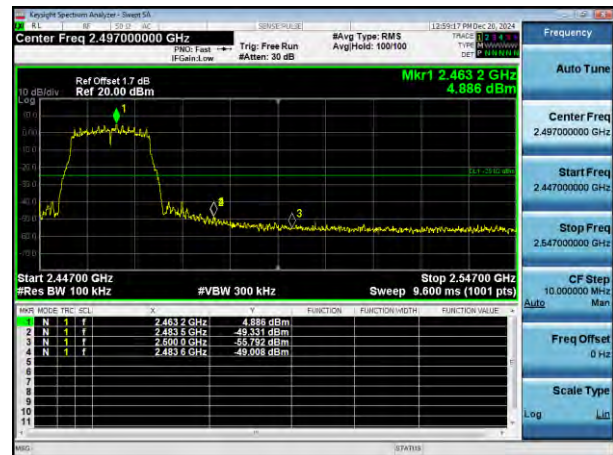


802.11g Highest

Reference Power

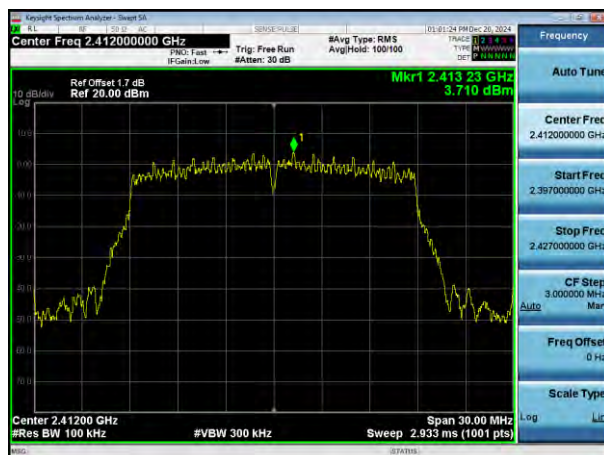


Band-edge Emission



802.11n(HT20) Lowest

Reference Power

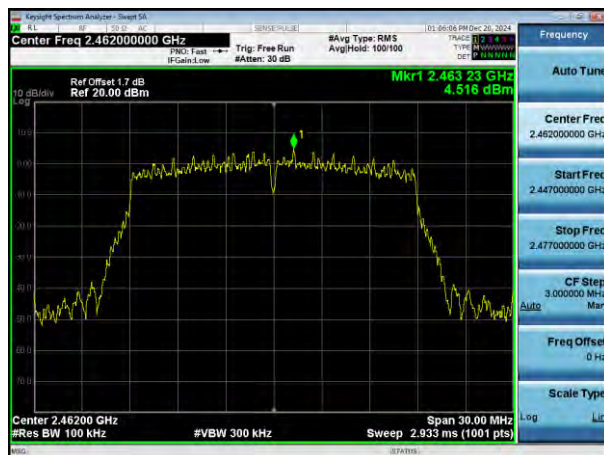


Band-edge Emission

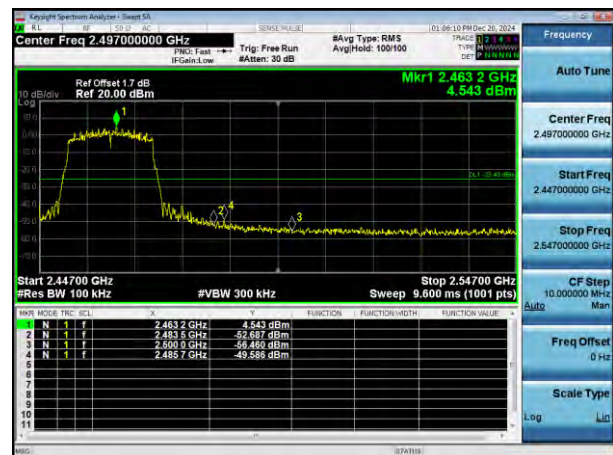


802.11n(HT20) Highest

Reference Power



Band-edge Emission

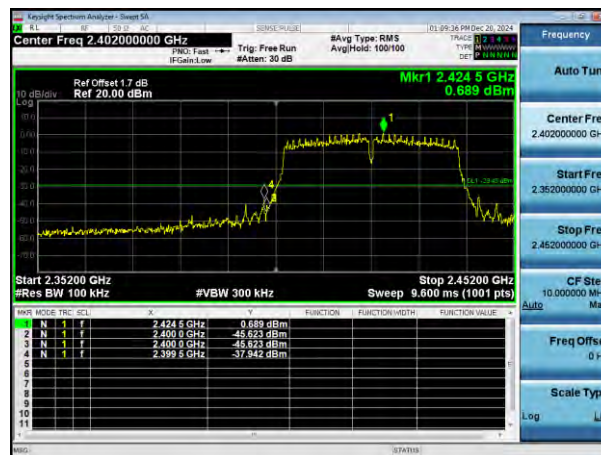


802.11n(HT40) Lowest

Reference Power

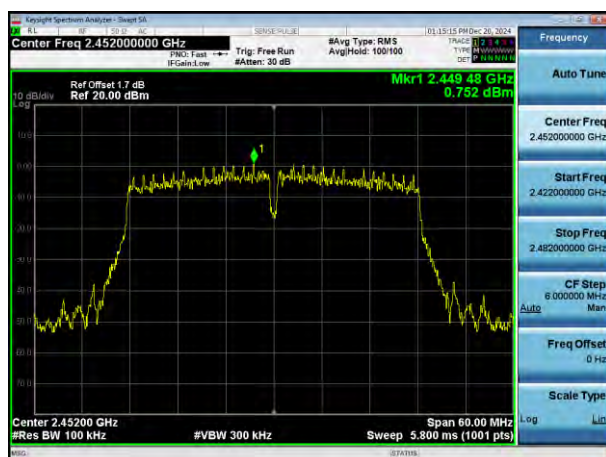


Band-edge Emission



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.

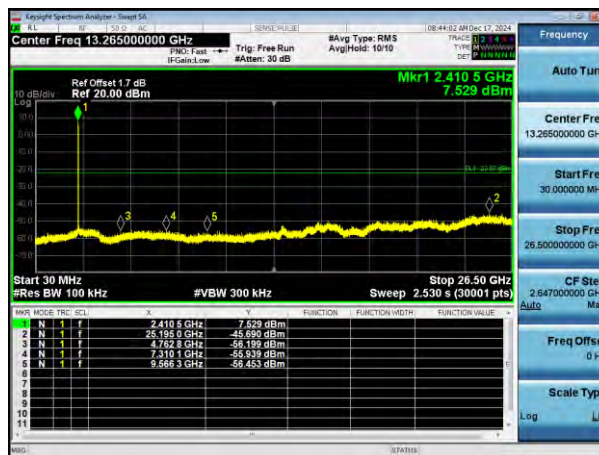
ANT1:

802.11b Lowest

Reference Power



Spurious Emissions

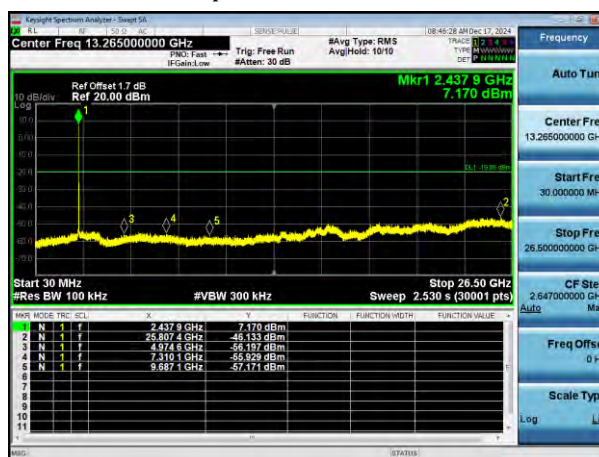


802.11b Middle

Reference Power



Spurious Emissions

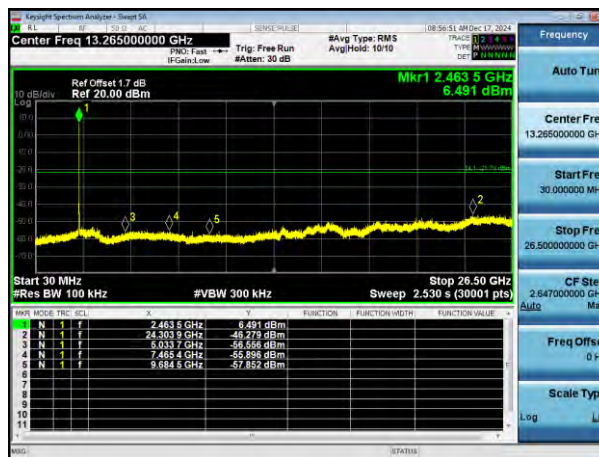


802.11b Highest

Reference Power



Spurious Emissions

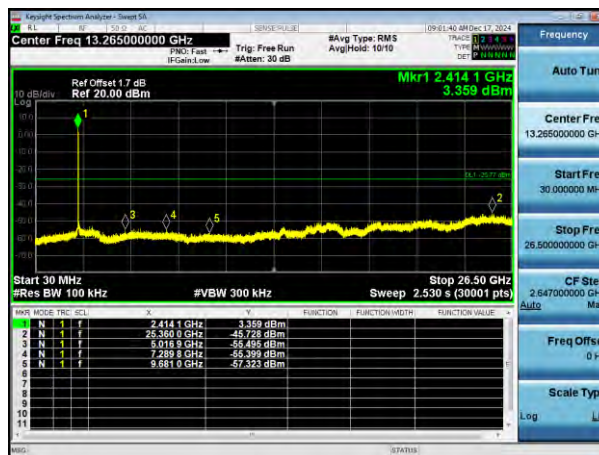


802.11g Lowest

Reference Power

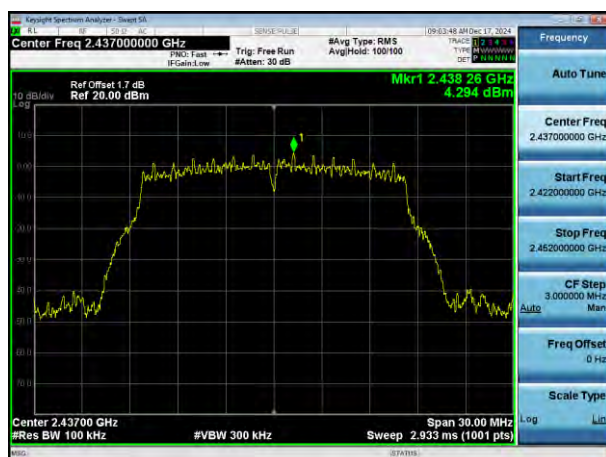


Spurious Emissions

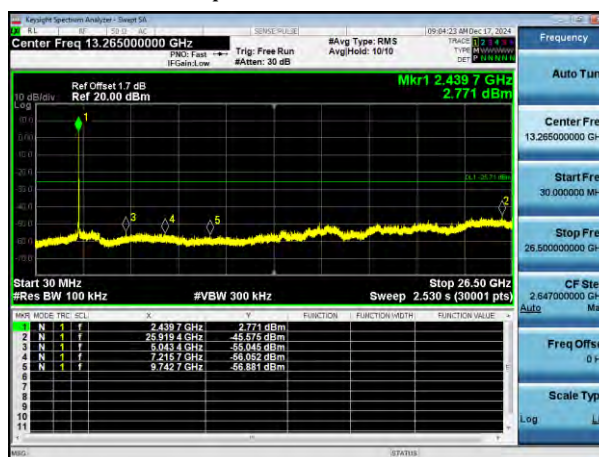


802.11g Middle

Reference Power



Spurious Emissions

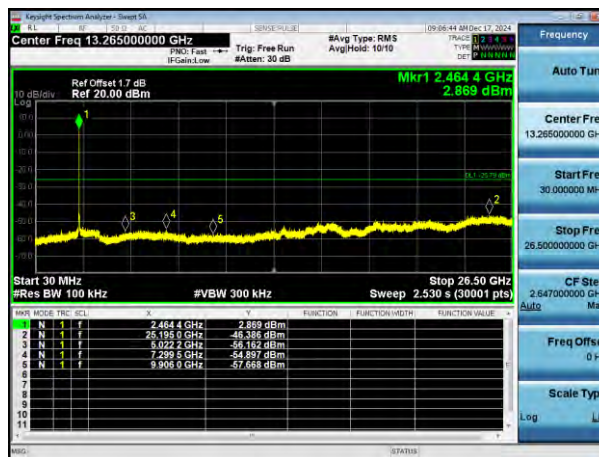


802.11g Highest

Reference Power



Spurious Emissions

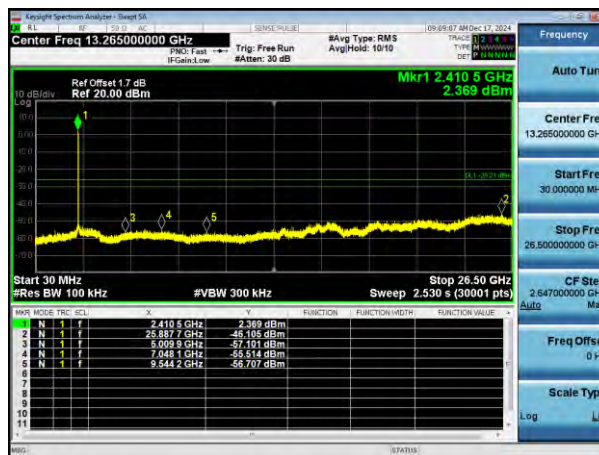


802.11n(HT20) Lowest

Reference Power

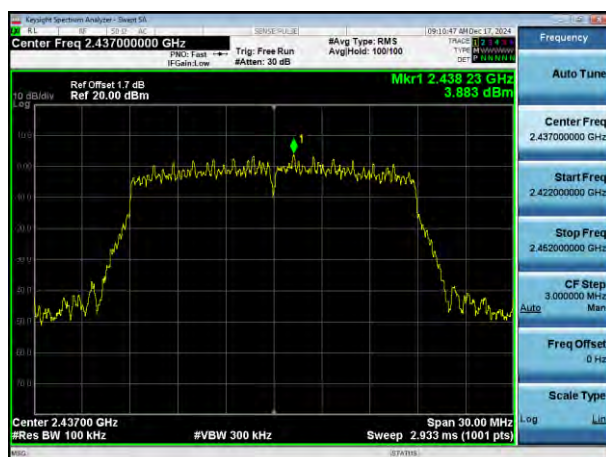


Spurious Emissions

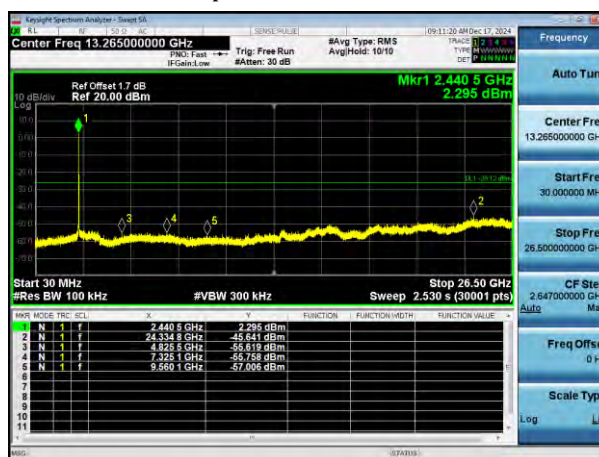


802.11n(HT20) Middle

Reference Power



Spurious Emissions

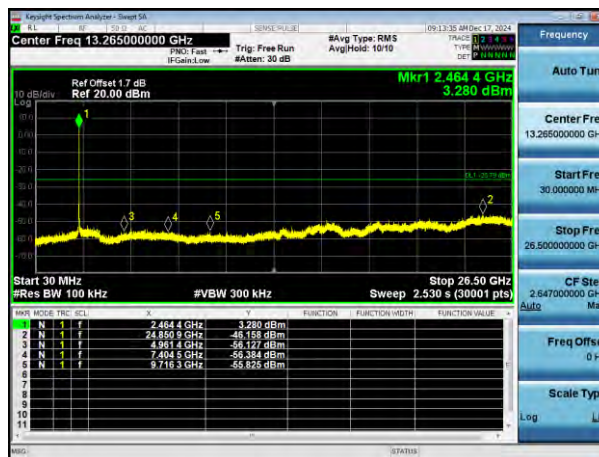


802.11n(HT20) Highest

Reference Power



Spurious Emissions



Reference Power

Spurious Emissions

Reference Power

Spurious Emissions

MKR	MODE	TRC	SCN	F	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f		2.434 4 GHz	-0.378 dBm			
2	N	1	f		25.368 0 GHz	-45.293 dBm			
3	N	1	f		4.843 1 GHz	-56.845 dBm			
4	N	1	f		7.266 0 GHz	-55.783 dBm			
5	N	1	f		9.782 4 GHz	-55.719 dBm			

802.11n(HT40) Highest

Reference Power

Center Freq 2.452000000 GHz

Ref Offset 1.7 dB
Ref 20.00 dBm

Mkr1 2.454 52 GHz
0.260 dBm

Center Freq 2.45200000 GHz

Start Freq 2.422000000 GHz

Stop Freq 2.482000000 GHz

CF Step 6.000000 MHz

Freq Offset 0 Hz

Scale Type Log

Center 2.45200 GHz

#Res BW 100 kHz

#VBW 300 kHz

Sweep 5.800 ms (1001 pts)

Spurious Emissions

Center Freq 13.265000000 GHz

Ref Offset 1.7 dB
Ref 20.00 dBm

Mkr1 13.248 4 GHz
0.263 dBm

Center Freq 13.265000000 GHz

Start Freq 13.000000000 GHz

Stop Freq 13.500000000 GHz

CF Step 2.647000000 MHz

Freq Offset 0 Hz

Scale Type Log

Start 13.000 MHz

#Res BW 100 kHz

#VBW 300 kHz

Sweep 2.530 s (30001 pts)

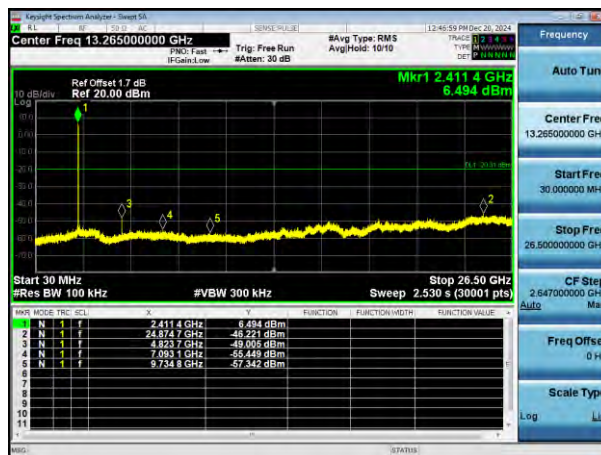
ANT2:

802.11b Lowest

Reference Power



Spurious Emissions

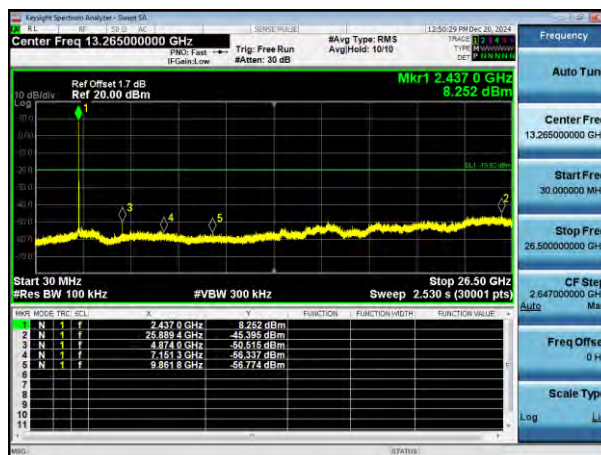


802.11b Middle

Reference Power

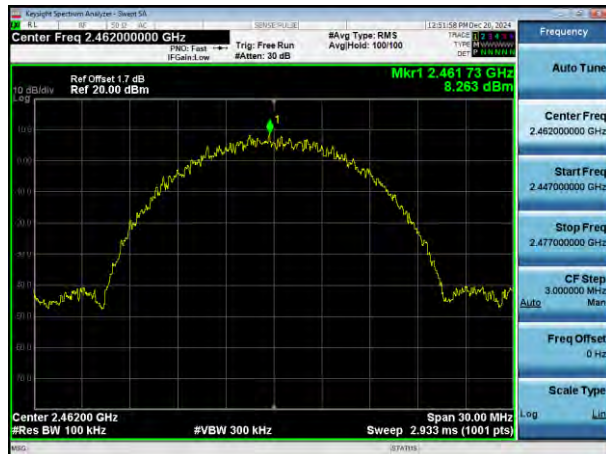


Spurious Emissions

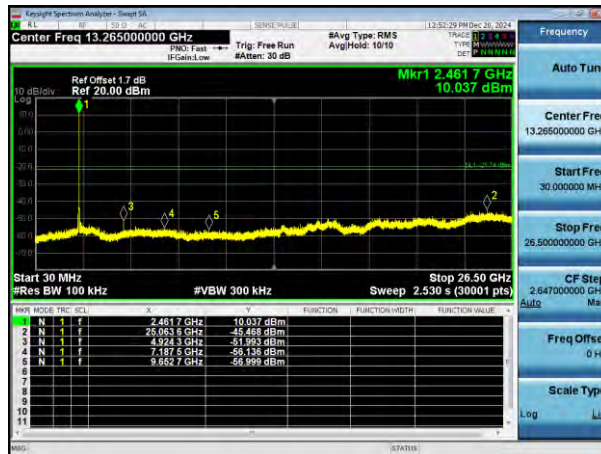


802.11b Highest

Reference Power



Spurious Emissions

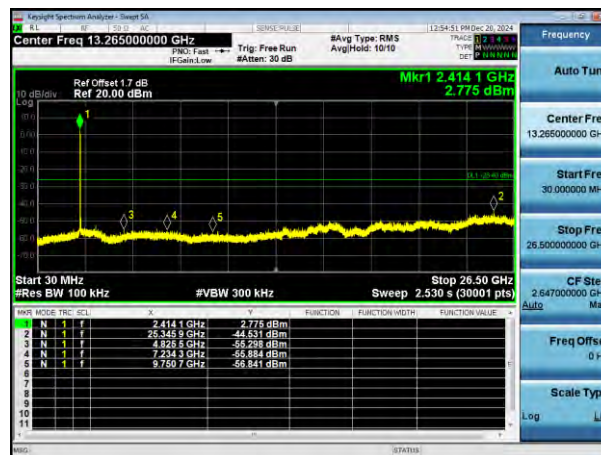


802.11g Lowest

Reference Power

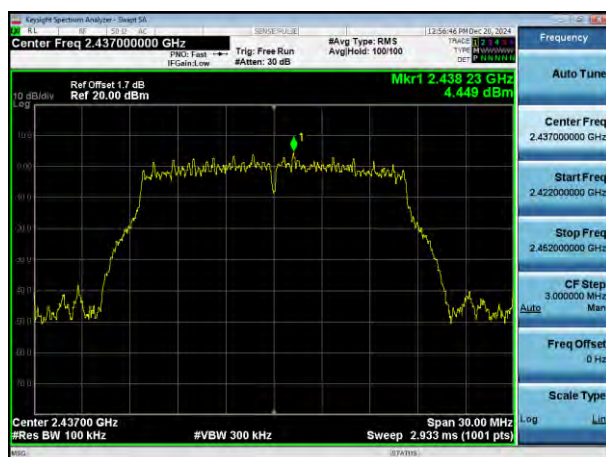


Spurious Emissions

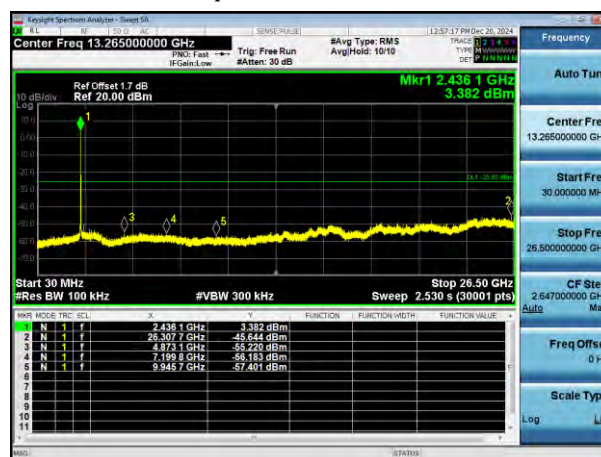


802.11g Middle

Reference Power

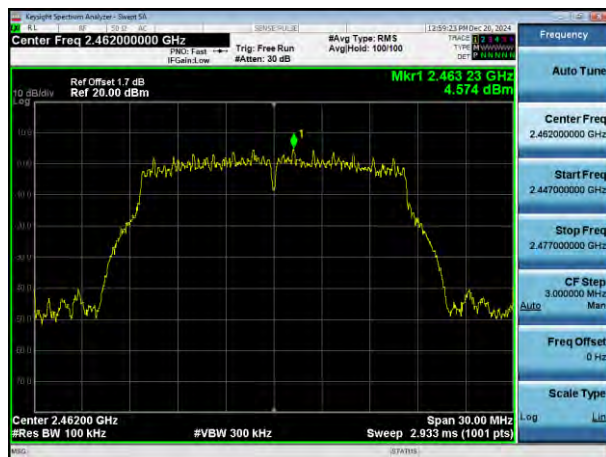


Spurious Emissions

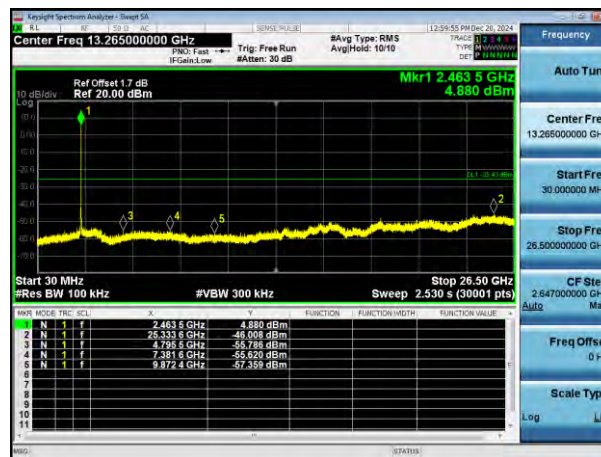


802.11g Highest

Reference Power



Spurious Emissions

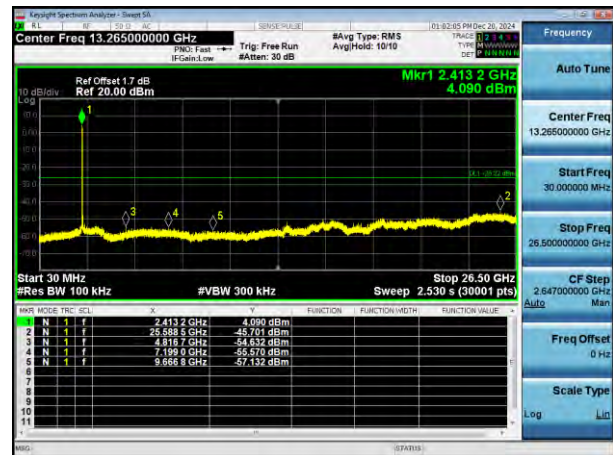


802.11n(HT20) Lowest

Reference Power



Spurious Emissions

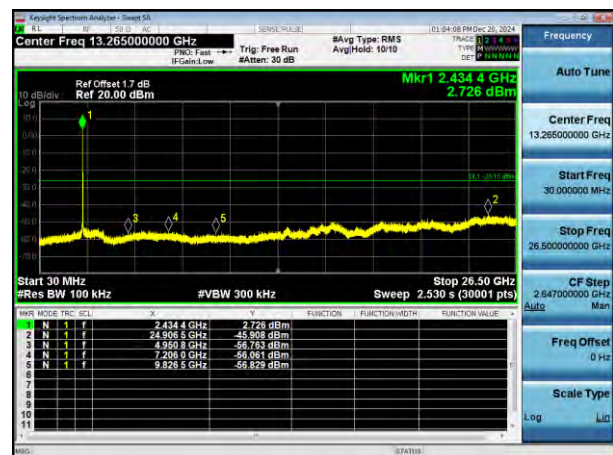


802.11n(HT20) Middle

Reference Power



Spurious Emissions

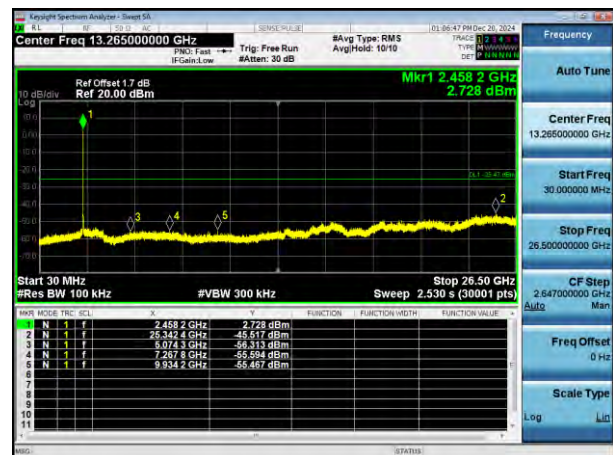


802.11n(HT20) Highest

Reference Power

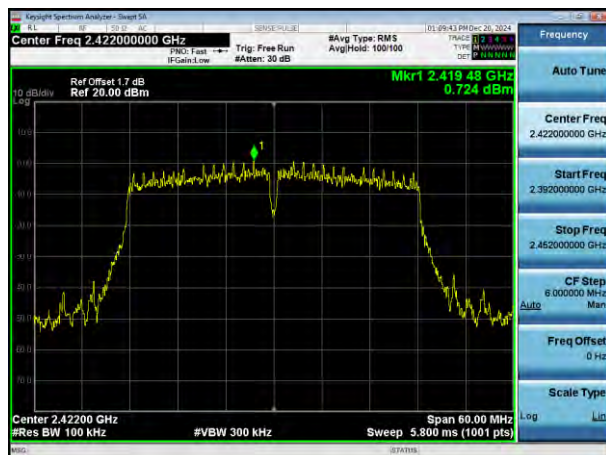


Spurious Emissions

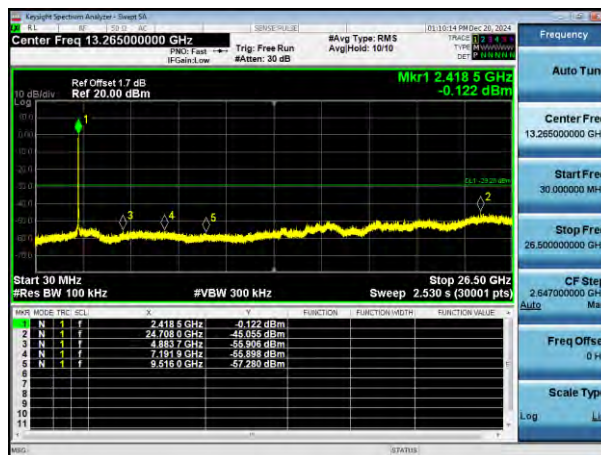


802.11n(HT40) Lowest

Reference Power

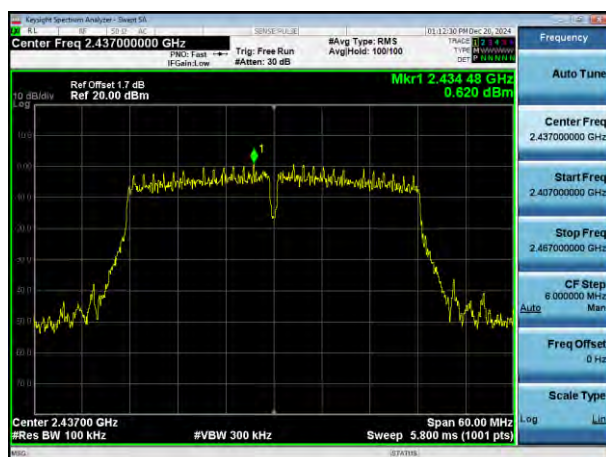


Spurious Emissions

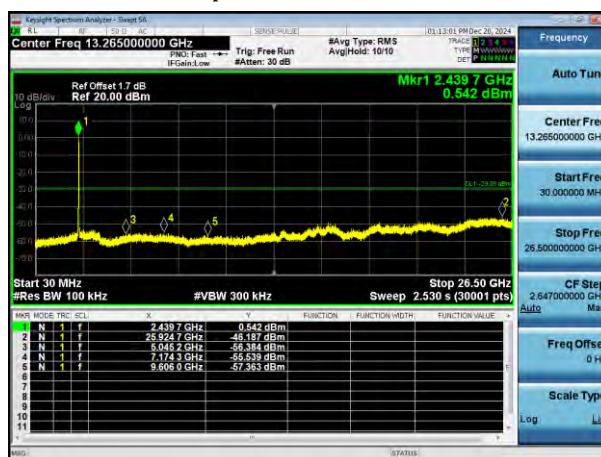


802.11n(HT40) Middle

Reference Power



Spurious Emissions

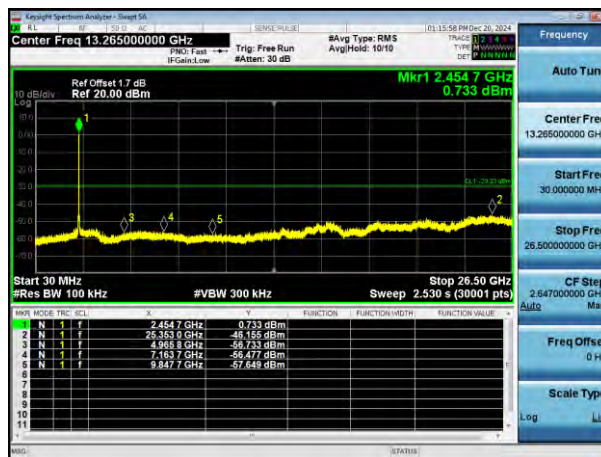


802.11n(HT40) Highest

Reference Power



Spurious Emissions



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