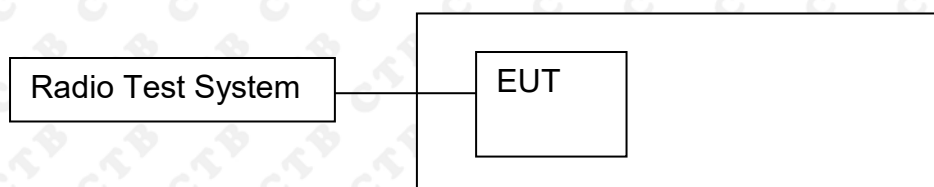


10. EMISSION BANDWIDTH& OCCUPIED BANDWIDTH

10.1 Block Diagram Of Test Setup



10.2 Limits

(1) For the band 5.15-5.25 GHz.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(e) Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

10.3 Test Procedure

According to KDB789033 D02v02r01 sectionE, the following is the measurement procedure.

1. Emission Bandwidth (EBW)

- Set RBW = approximately 1% of the emission bandwidth.
- Set the VBW > RBW.
- Detector = Peak.
- Trace mode = max hold.
- Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

2. Minimum Emission Bandwidth for the band 5.725–5.85 GHz

Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 kHz for the band 5.725–5.85 GHz. The following procedure shall be used for measuring this bandwidth:

- Set RBW = 100 kHz.

- b) Set the video bandwidth (VBW) $\geq 3 * RBW$.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described in this section. For devices that use channel aggregation refer to III.A and III.C for determining emission bandwidth.

D. 99% Occupied Bandwidth

The 99% occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. Measurement of the 99% occupied bandwidth is *required* only as a condition for using the optional band-edge measurement techniques described in II.G.3.d). Measurements of 99% occupied bandwidth may also optionally be used in lieu of the EBW to define the minimum frequency range over which the 789033 D02 General UNII Test Procedures New Rules v02r01 Page 4 spectrum is integrated when measuring maximum conducted output power as described in II.E. However, the EBW must be measured to determine bandwidth dependent limits on maximum conducted output power in accordance with Section 15.407(a).

The following procedure shall be used for measuring (99%) power bandwidth:

1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1% to 5% of the OBW
4. Set VBW $\geq 3 * RBW$
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6. Use the 99% power bandwidth function of the instrument (if available).
7. If the instrument does not have a 99% power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

10.4 Test Results

Test mode	Test Channel (MHz)	26dB Bandwidth (MHz)
802.11a	5180	24.707
	5200	23.776
	5240	25.716
802.11ac20	5180	24.794
	5200	26.29
	5240	26.076
802.11ac40	5190	43.258
	5230	43.045
802.11n(HT20)	5180	25.664
	5200	26.585
	5240	24.953
802.11n(HT40)	5190	41.554
	5230	41.664
802.11ax20	5180	24.546
	5200	21.297
	5240	23.806
802.11ax40	5190	41.52
	5230	44.737

Test mode	Test Channel (MHz)	6dB Bandwidth (MHz)
802.11a	5745	16.421
	5785	16.393
	5825	16.556
802.11ac20	5745	17.672
	5785	17.596
	5825	17.801
802.11ac40	5755	36.361
	5795	36.332
802.11n(HT20)	5745	17.752
	5785	17.698
	5825	17.799
802.11n(HT40)	5755	36.337
	5795	36.257
802.11ax20	5745	19.086
	5785	18.235
	5825	19.04
802.11ax40	5755	37.786
	5795	38.144

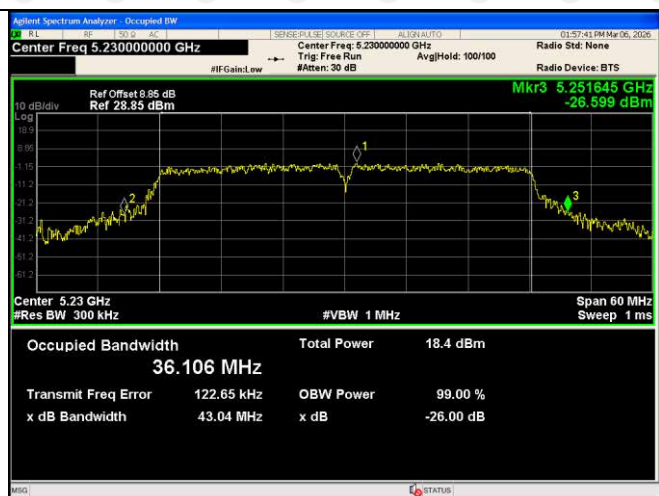
Test Graph

5180-5240MHz





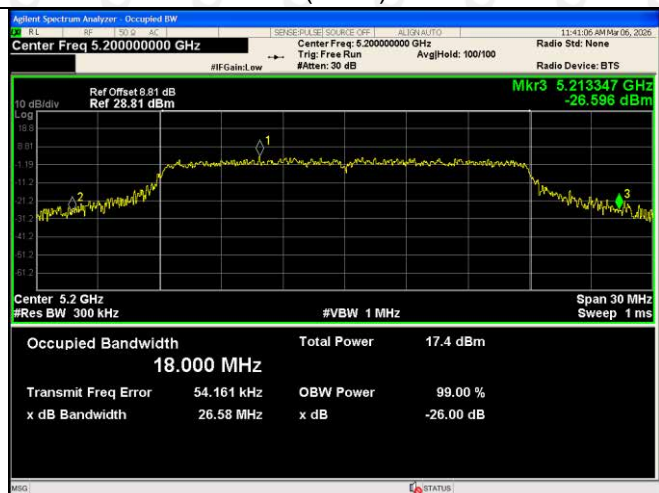
802.11n(HT20)-5180



802.11n(HT20)-5200



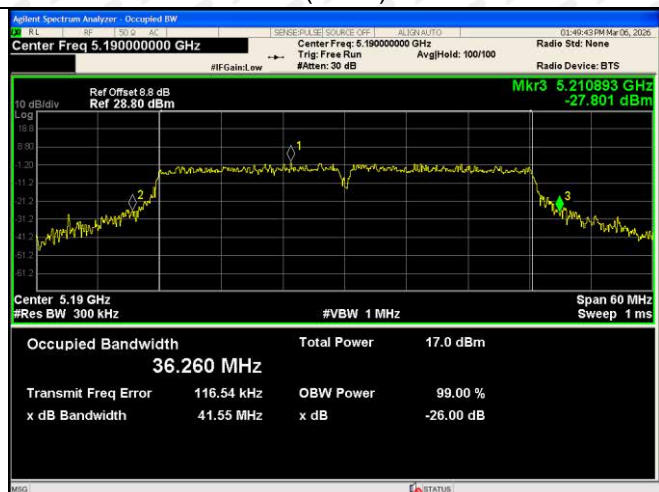
802.11n(HT20)-5240



802.11n(HT20)-5200



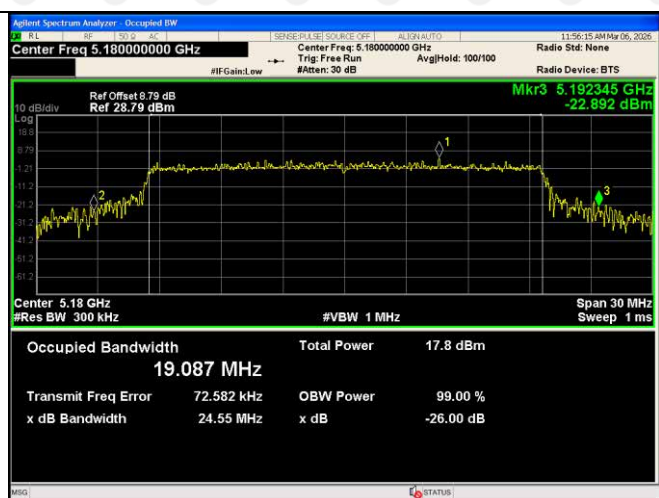
802.11n(HT40)-5230



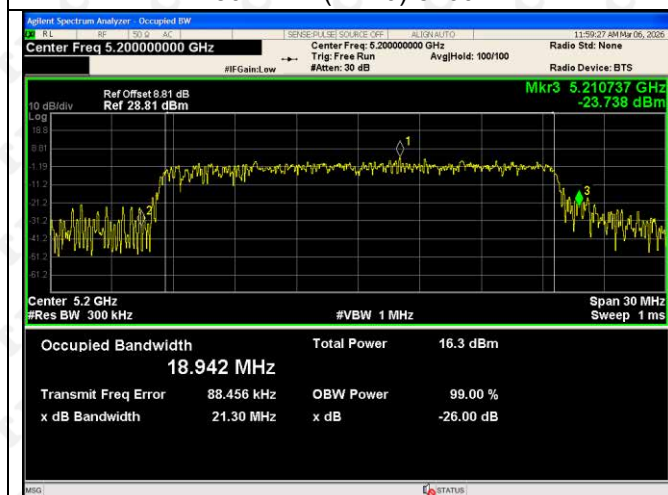
802.11ax(HE20)-5180



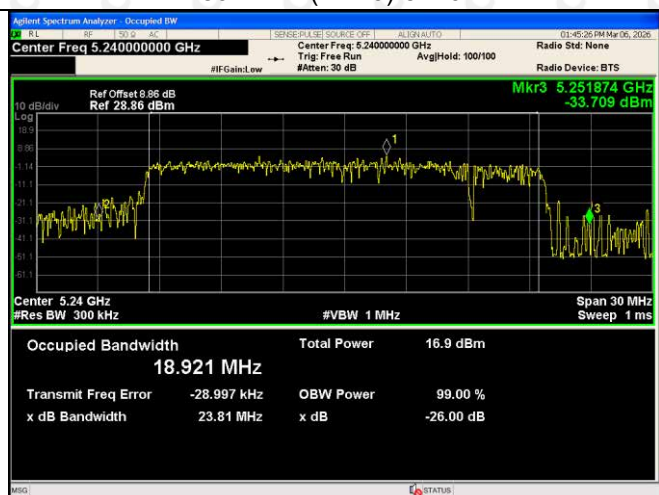
802.11ax(HE20)-5200



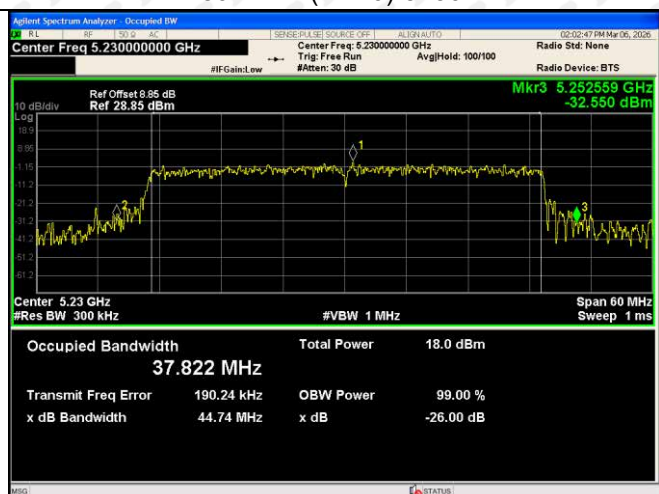
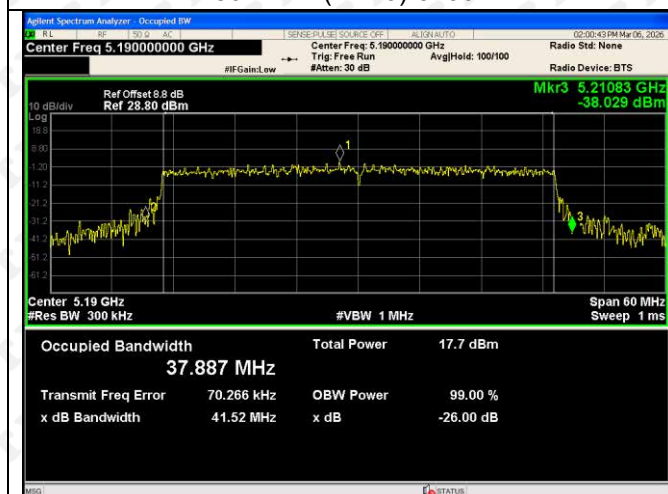
802.11ax(HE20)-5240



802.11ax(HE40)-5190



802.11ax(HE40)-5230



5745-5825MHz

802.11a-5745



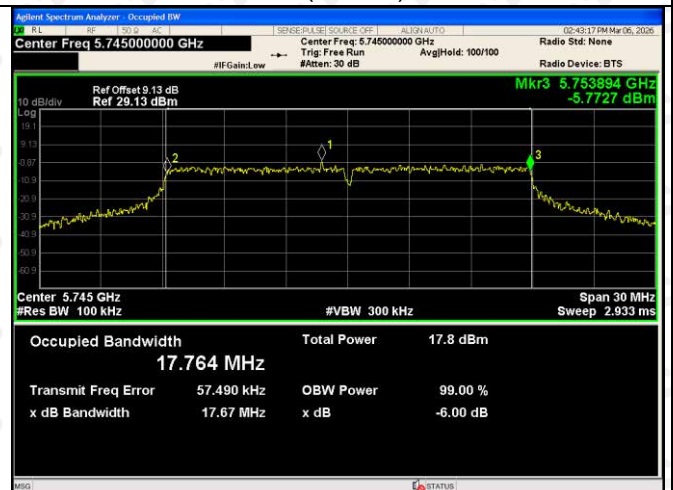
802.11a-5785



802.11a-5825



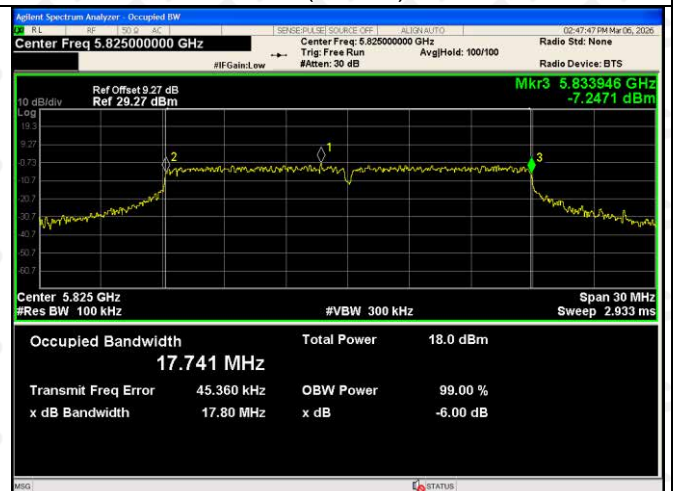
802.11ac(VHT20)-5745



802.11ac(VHT20)-5785



802.11ac(VHT20)-5825



802.11ac(VHT40)-5755

802.11ac(VHT40)-5795



802.11n(HT20)-5745



802.11n(HT20)-5785



802.11n(HT20)-5825



5802.11n(HT40)-5755



802.11n(HT40)-5795



802.11ax(HE20)-5745



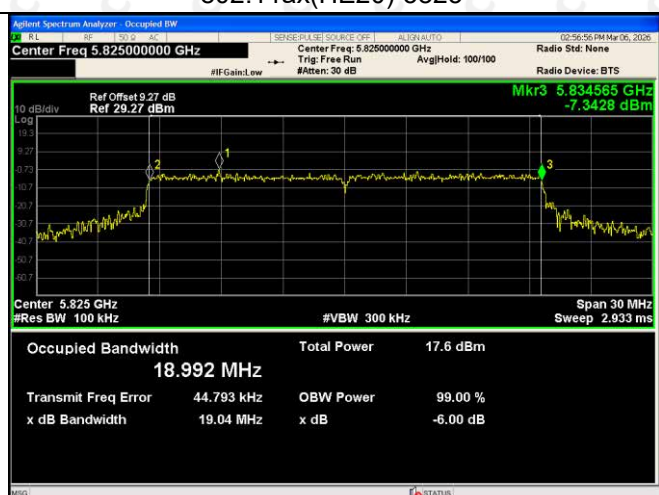
802.11ax(HE20)-5785



802.11ax(HE20)-5825



802.11ax(HE40)-5785

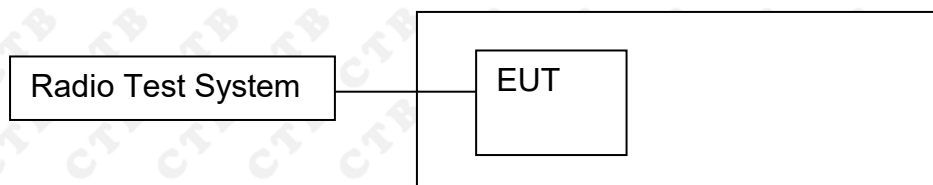


802.11ax(HE40)-5795



11. POWER SPECTRAL DENSITY

11.1 Block Diagram Of Test Setup



11.2 Limit

(1) For the band 5.15-5.25 GHz.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

11.3 Test procedure

According to KDB789033 D02v02r01 sectionE, the following is the measurement procedure.

For devices operating in the bands 5.15–5.25 GHz, 5.25–5.35 GHz, and 5.47–5.725 GHz, the preceding procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in Section 15.407(a)(5). For devices operating in the band 5.725–5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 kHz bandwidth, the following adjustments to the procedures apply:

a) Set $\text{RBW} \geq 1/T$, where T is defined in II.B.I.a).

b) Set $\text{VBW} \geq 3 \text{ RBW}$.

c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10 \log (500 \text{ kHz/RBW})$ to the measured result, whereas RBW ($< 500 \text{ kHz}$) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.

d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add $10 \log (1 \text{ MHz/RBW})$ to the measured result, whereas RBW ($< 1 \text{ MHz}$) is the reduced resolution bandwidth of spectrum analyzer set during measurement.

e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Note: As a practical matter, it is recommended to use reduced RBW of 100 kHz for the II.F.5.c) and II.F.5.d), since RBW=100 kHz is available on nearly all spectrum analyzers.

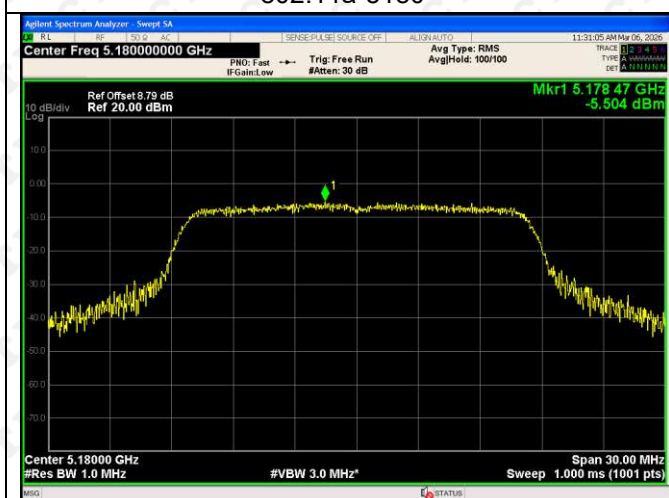
11.4 Test Result

Test mode	Test Channel (MHz)	PSD [dBm/MHz]	Limit [dBm/MHz]	Result
802.11a	5180	-5.504	11	Pass
	5200	-4.592	11	Pass
	5240	-3.875	11	Pass
802.11ac(VHT20)	5180	-4.64	11	Pass
	5200	-6.644	11	Pass
	5240	-3.261	11	Pass
802.11ac(VHT40)	5190	-10.002	11	Pass
	5230	-8.975	11	Pass
802.11n(HT20)	5180	-4.905	11	Pass
	5200	-4.603	11	Pass
	5240	-3.619	11	Pass
802.11n(HT40)	5190	-9.343	11	Pass
	5230	-8.893	11	Pass
802.11ax(HE20)	5180	-5.521	11	Pass
	5200	-5.821	11	Pass
	5240	-4.606	11	Pass
802.11ax(HE40)	5190	-9.866	11	Pass
	5230	-7.721	11	Pass

Test mode	Test Channel (MHz)	PSD [dBm/500kHz]	Limit [dBm/MHz]	Result
802.11a	5745	-7.02	30	Pass
	5785	-7.511	30	Pass
	5825	-7.048	30	Pass
802.11ac(VHT20)	5745	-7.901	30	Pass
	5785	-7.045	30	Pass
	5825	-8.043	30	Pass
802.11ac(VHT40)	5755	-13.059	30	Pass
	5795	-12.259	30	Pass
802.11n(HT20)	5745	-9.887	30	Pass
	5785	-6.677	30	Pass
	5825	-7.336	30	Pass
802.11n(HT40)	5755	-13.374	30	Pass
	5795	-13.283	30	Pass
802.11ax(HE20)	5745	-8.425	30	Pass
	5785	-8.49	30	Pass
	5825	-7.474	30	Pass
802.11ax(HE40)	5755	-14.269	30	Pass
	5795	-11.768	30	Pass

5180-5240MHz

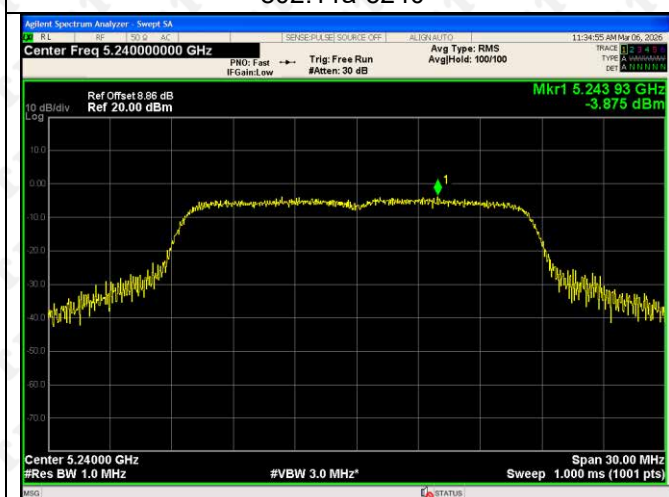
802.11a-5180



802.11a-5200



802.11a-5240



802.11ac(VHT20)-5180



802.11ac(VHT20)-5200



802.11ac(VHT20)-5240



802.11ac(VHT40)-5190



802.11ac(VHT40)-5230





802.11n(HT20)-5180



802.11n(HT20)-5200



802.11n(HT20)-5240



802.11n(HT40)-5190



802.11n(HT40)-5230



802.11ax(HE20)-5180



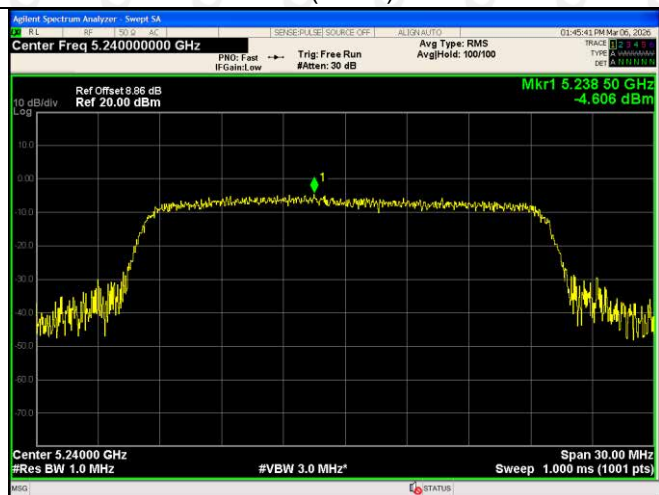
802.11ax(HE20)-5200



802.11ax(HE20)-5240



802.11ax(HE40)-5190



802.11ax(HE40)-5230



5745-5825MHz

802.11a-5745



802.11a-5785



802.11a-5825



802.11ac(VHT20)-5745



802.11ac(VHT20)-5785



802.11ac(VHT20)-5825

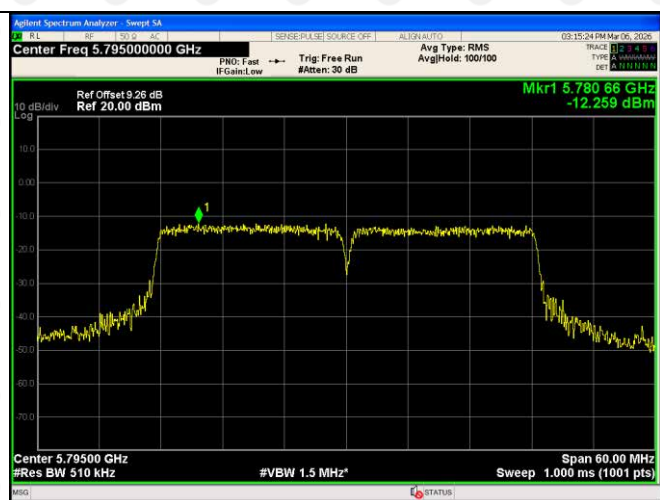


802.11ac(VHT40)-5755

802.11ac(VHT40)-5795



802.11n(HT20)-5745



802.11n(HT20)-5785



802.11n(HT20)-5825



5802.11n(HT40)-5755



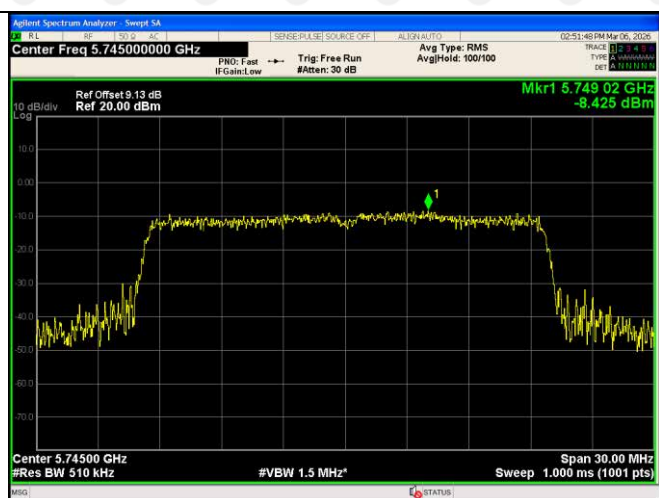
802.11n(HT40)-5795



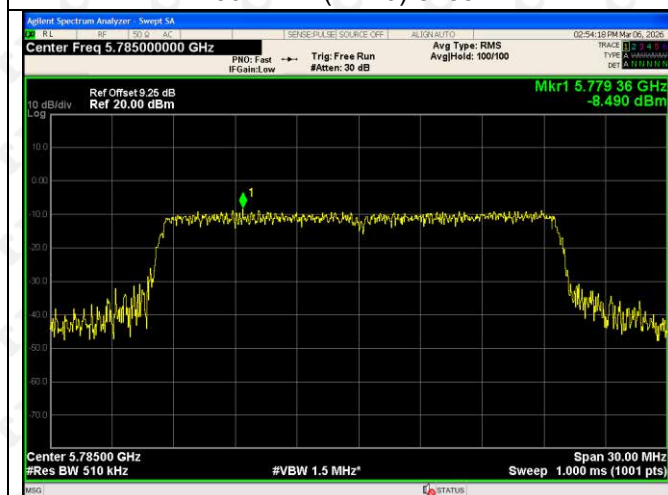
802.11ax(HE20)-5745



802.11ax(HE20)-5785



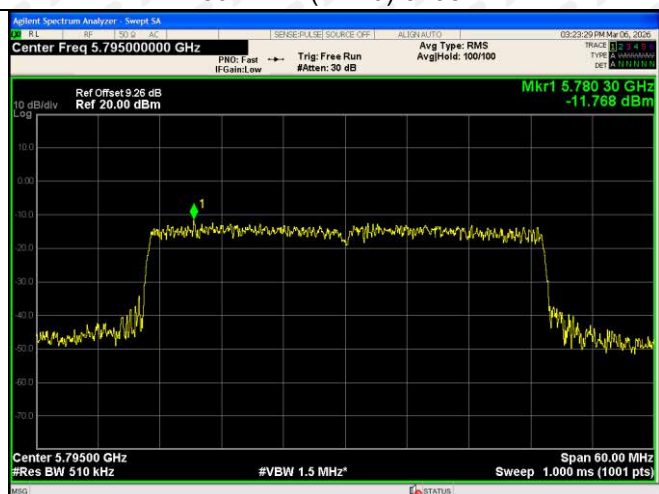
802.11ax(HE20)-5825



802.11ax(HE40)-5755

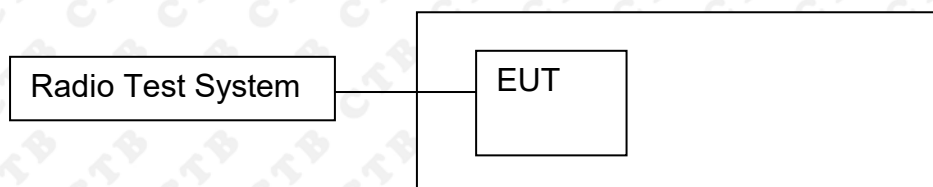


802.11ax(HE40)-5795



12. FREQUENCY STABILITY

12.1 Block Diagram Of Test Setup



12.2 Limit

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

12.3 Test procedure

1. The EUT was placed inside temperature chamber and powered and powered by nominal DC voltage.
2. Set EUT as normal operation.
3. Turn the EUT on and couple its output to spectrum.
4. Turn the EUT off and set the chamber to the highest temperature specified.
5. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT and measure the operating frequency.
6. Repeat step with the temperature chamber set to the lowest temperature.

12.4 Test Result

TX Frequency (5150-5250MHz)

Voltage vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5180MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
T nom (°C)	20	V nom (V)	3.70	5180.0079	5180	0.0079	1.5259
		V max (V)	4.07	5180.0435	5180	0.0435	8.4029
		V min (V)	3.33	5180.0504	5180	0.0504	9.7243
Limits				±20ppm			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5180MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	3.7	T (°C)	0	5180.0466	5180	0.0466	8.9876
		T (°C)	10	5180.0500	5180	0.0500	9.6579
		T (°C)	20	5180.0567	5180	0.0567	10.9389
		T (°C)	30	5180.0246	5180	0.0246	4.7411
		T (°C)	40	5180.0098	5180	0.0098	1.8917
Limits				±20ppm			
Result				Complies			

Voltage vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5200MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
T nom (°C)	20	V nom (V)	3.70	5200.0074	5200	0.0074	1.4321
		V max (V)	4.07	5200.0755	5200	0.0755	14.5218
		V min (V)	3.33	5200.0310	5200	0.0310	5.9632
Limits				±20ppm			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5200MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	3.7	T (°C)	0	5200.0429	5200	0.0429	8.2528
		T (°C)	10	5200.0161	5200	0.0161	3.0974
		T (°C)	20	5200.0103	5200	0.0103	1.9761
		T (°C)	30	5200.0247	5200	0.0247	4.7480
		T (°C)	40	5200.0768	5200	0.0768	14.7745
Limits				±20ppm			
Result				Complies			

Voltage vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5240MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
T nom (°C)	20	V nom (V)	3.70	5240.0012	5240	0.0012	0.2350
		V max (V)	4.07	5240.0367	5240	0.0367	7.0049
		V min (V)	3.33	5240.0617	5240	0.0617	11.7664
Limits				±20ppm			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5240MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	3.7	T (°C)	0	5240.0501	5240	0.0501	9.5664
		T (°C)	10	5240.0777	5240	0.0777	14.8239
		T (°C)	20	5240.0047	5240	0.0047	0.9051
		T (°C)	30	5240.0693	5240	0.0693	13.2226
		T (°C)	40	5240.0646	5240	0.0646	12.3233
Limits				±20ppm			
Result				Complies			

TX Frequency (5725-5850MHz)

Voltage vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5745MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
T nom (°C)	20	V nom (V)	3.70	5745.0171	5745	0.0171	2.9710
		V max (V)	4.07	5745.0556	5745	0.0556	9.6859
		V min (V)	3.33	5745.0641	5745	0.0641	11.1605
Limits				±20ppm			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5745MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	3.7	T (°C)	0	5745.0049	5745	0.0049	0.8443
		T (°C)	10	5745.0655	5745	0.0655	11.3980
		T (°C)	20	5745.0165	5745	0.0165	2.8669
		T (°C)	30	5745.0809	5745	0.0809	14.0833
		T (°C)	40	5745.0874	5745	0.0874	15.2166
Limits				±20ppm			
Result				Complies			

Voltage vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5785MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
T nom (° C)	20	V nom (V)	3.70	5785.0892	5785	0.0892	15.4191
		V max (V)	4.07	5785.0658	5785	0.0658	11.3796
		V min (V)	3.33	5785.0525	5785	0.0525	9.0807
Limits				±20ppm			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5785MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	3.7	T (°C)	0	5785.0895	5785	0.0895	15.4727
		T (°C)	10	5785.0105	5785	0.0105	1.8197
		T (°C)	20	5785.0576	5785	0.0576	9.9527
		T (°C)	30	5785.0189	5785	0.0189	3.2654
		T (°C)	40	5785.0056	5785	0.0056	0.9622
		T (°C)	50	5785.0871	5785	0.0871	15.0503
Limits				±20ppm			
Result				Complies			

Voltage vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5825MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
T nom (°C)	20	V nom (V)	3.70	5825.0832	5825	0.0832	14.2892
		V max (V)	4.07	5825.0100	5825	0.0100	1.7099
		V min (V)	3.33	5825.0426	5825	0.0426	7.3121
Limits				±20ppm			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5825MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	3.7	T (°C)	0	5825.0373	5825	0.0373	6.4042
		T (°C)	10	5825.0389	5825	0.0389	6.6705
		T (°C)	20	5825.0121	5825	0.0121	2.0748
		T (°C)	30	5825.0679	5825	0.0679	11.6590
		T (°C)	40	5825.0162	5825	0.0162	2.7738
Limits				±20ppm			
Result				Complies			

13. OPERATION IN THE ABSENCE OF INFORMATION TO THE TRANSMIT

13.1 Requirement

15.407(c) requirement:

The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signal ling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization a description of how this requirement is met.

13.2 Test Results

Operation in the absence of information to the transmit:

While the EUT is not transmitting any information, the EUT can automatically discontinue transmission and become standby mode for power saving. The EUT can detect the controlling signal of WLAN message transmitting from remote device and verify whether it shall reconnect. (manufacturer declare)

14. ANTENNA REQUIREMENT

15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

EUT Antenna:

The antenna is Rod antenna and no consideration of replacement. The best case gain of the antenna is WiFi (5.2G): 3.07dBi, WiFi (5.8G): 5.38dBi.

15. EUT TEST SETUP PHOTOGRAPHS

Radiated Emission

Below 1G



Above 1G



Conducted Emission



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