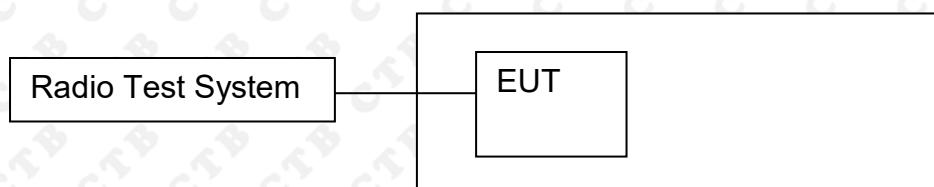


10. EMISSION BANDWIDTH& OCCUPIED BANDWIDTH

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 $11 \text{ dBm} + 10 \log B$, 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.

(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	22.958
	5200	21.728
	5240	22.82
802.11ac20	5180	23.877
	5200	24.342
	5240	24.146
802.11ac40	5190	41.437
	5230	42.005
802.11n(HT20)	5180	26.352
	5200	24.101
	5240	24.677
802.11n(HT40)	5190	42.626
	5230	42.026
802.11ax20	5180	26.397
	5200	24.513
	5240	27.549
802.11ax40	5190	41.506
	5230	40.972

Test mode	Test Channel (MHz)	6dB Bandwidth (MHz)
802.11a	5745	16.399
	5785	16.413
	5825	16.459
802.11ac20	5745	17.665
	5785	17.576
	5825	17.576
802.11ac40	5755	36.358
	5795	36.468
802.11n(HT20)	5745	17.631
	5785	17.778
	5825	17.78
802.11n(HT40)	5755	34.547
	5795	36.3
802.11ax20	5745	18.839
	5785	18.909
	5825	18.85
802.11ax40	5755	36.601
	5795	37.784

Test Graph 5180-5240MHz

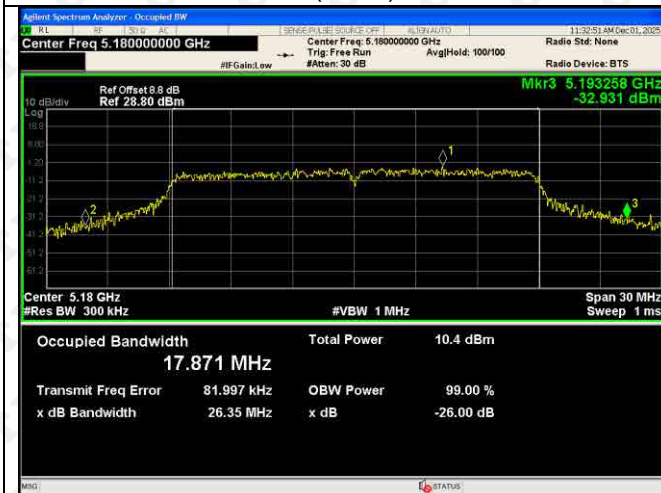




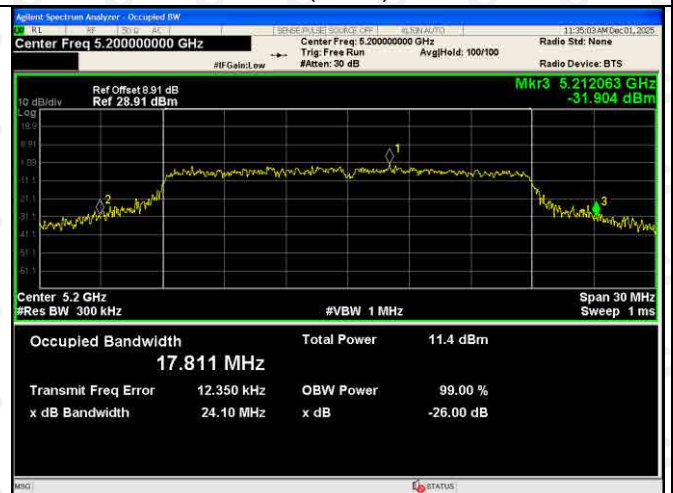
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802.11n(HT20)-5200



802.11n(HT20)-5240



802.11n(HT40)-5190



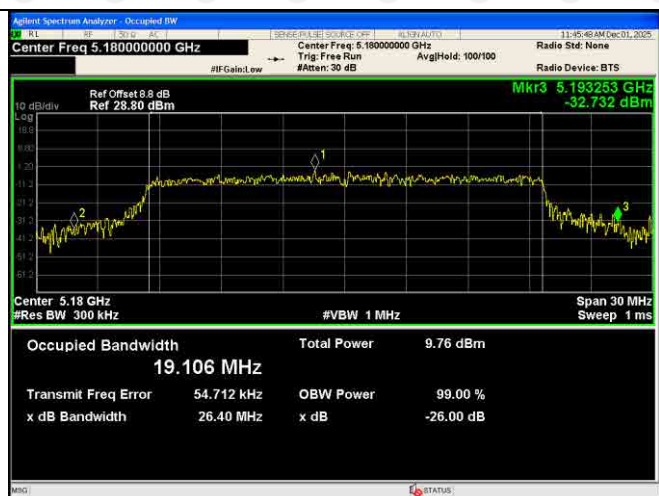
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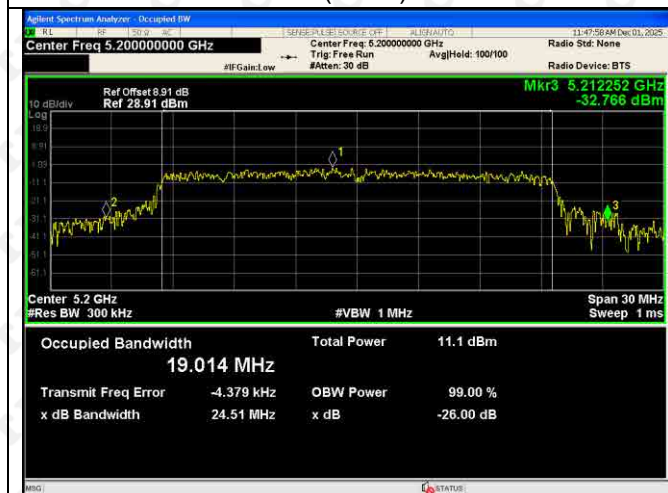
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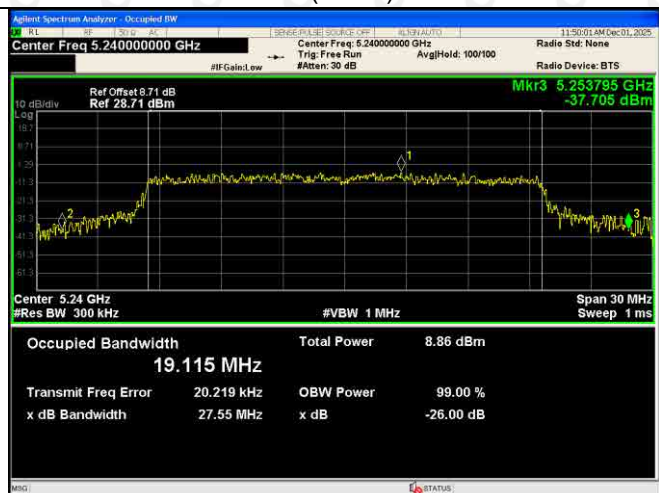
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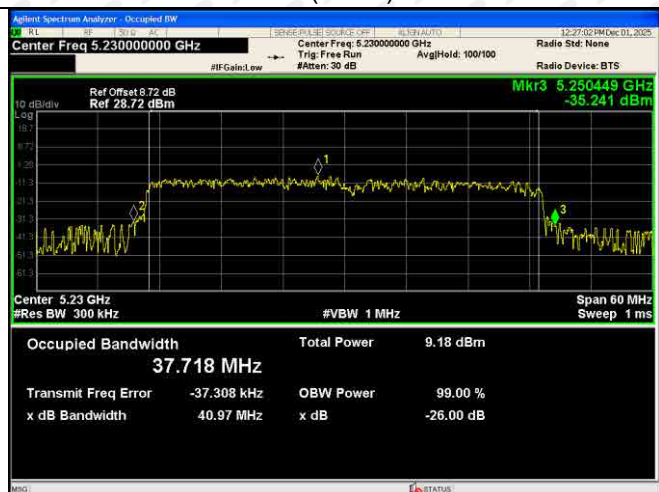
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802.11ax(HE40)-5190



802.11ax(HE40)-5230



5745-5825MHz

802.11a-5745



802.11a-5785



802.11a-5825



802.11ac(VHT20)-5745



802.11ac(VHT20)-5785

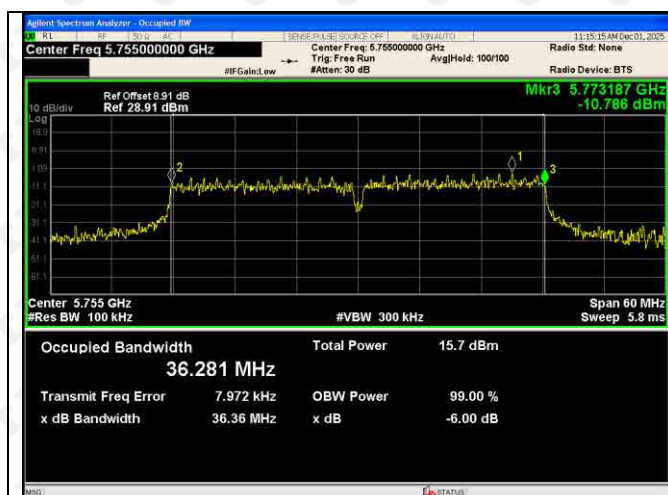


802.11ac(VHT20)-5825

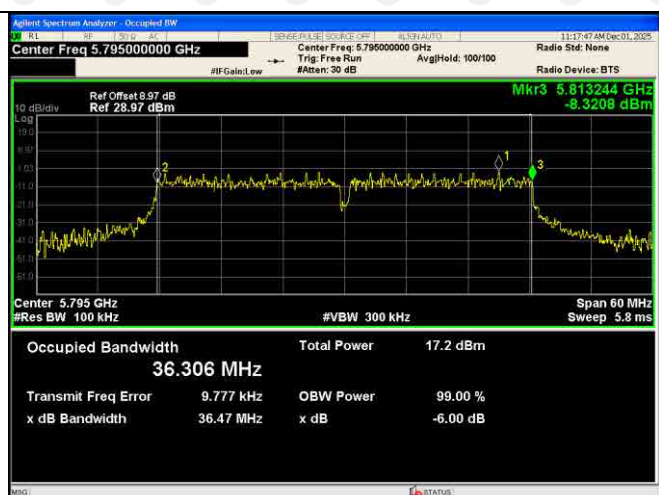


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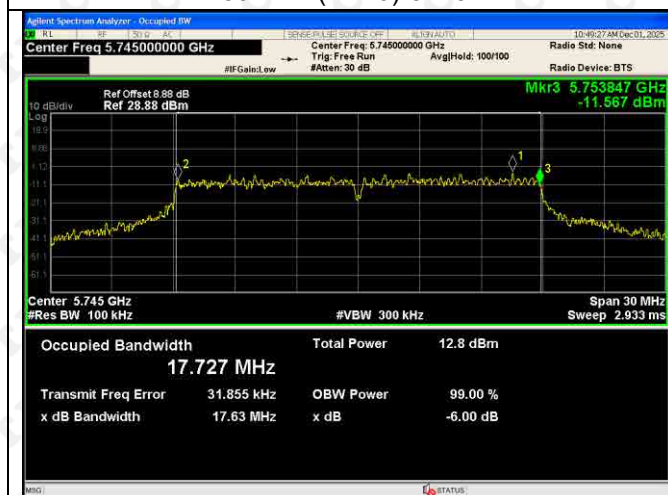
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802.11n(HT20)-5745



802.11n(HT20)-5785



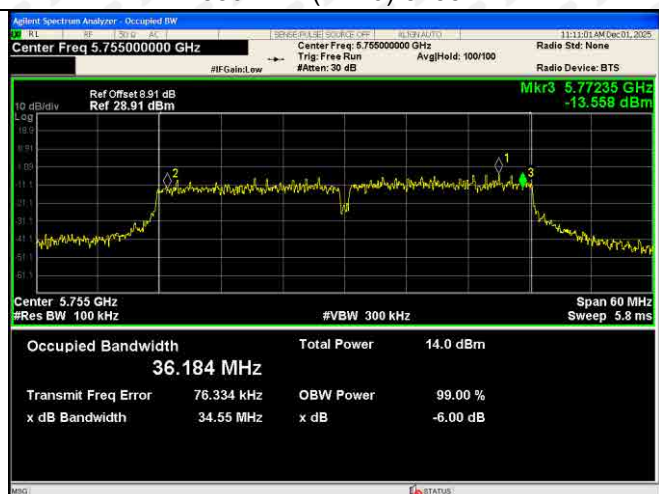
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5802.11n(HT40)-5755



802.11n(HT40)-5795



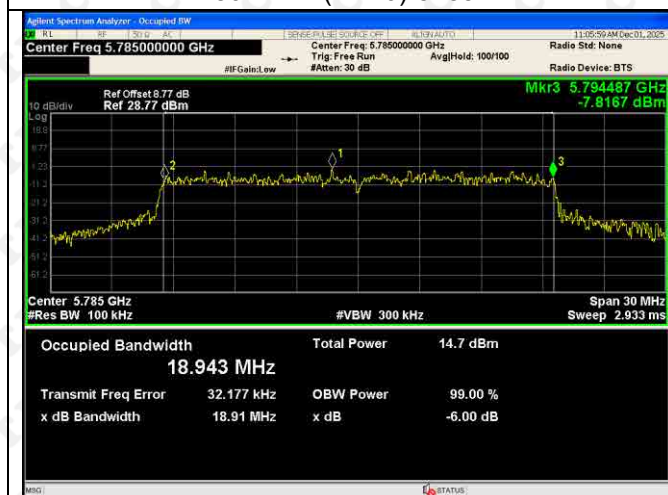
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802.11ax(HE20)-5785



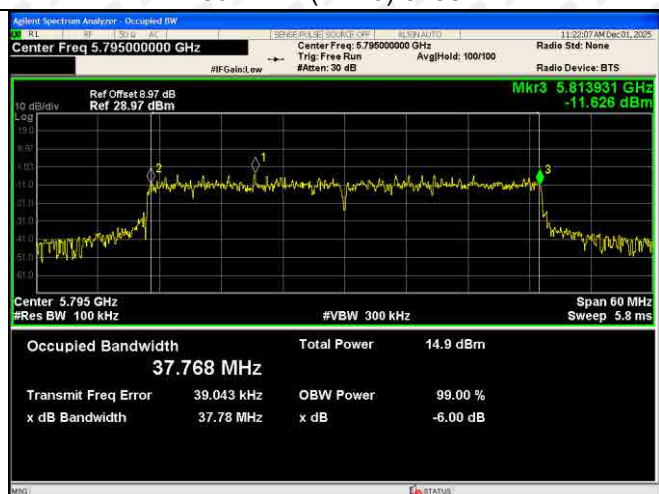
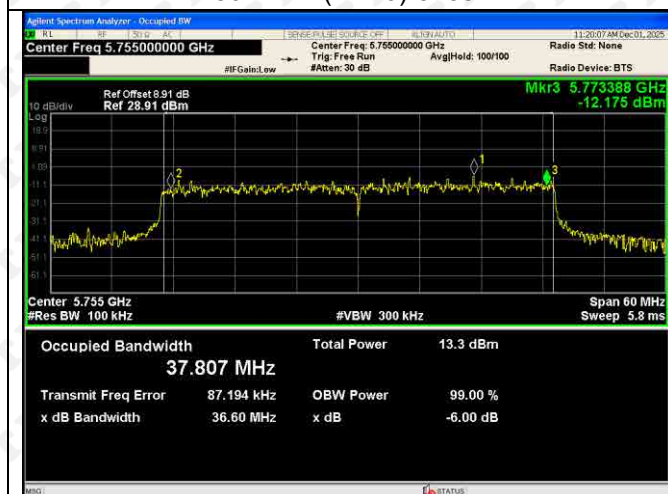
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802.11ax(HE40)-5755

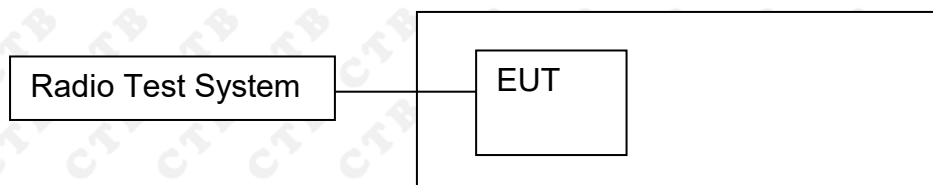


802.11ax(HE40)-5795



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	-11.129	11	Pass
	5200	-10.441	11	Pass
	5240	-12.951	11	Pass
802.11ac(VHT20)	5180	-10.287	11	Pass
	5200	-9.963	11	Pass
	5240	-11.52	11	Pass
802.11ac(VHT40)	5190	-13.852	11	Pass
	5230	-15.095	11	Pass
802.11n(HT20)	5180	-11.259	11	Pass
	5200	-10.036	11	Pass
	5240	-14.079	11	Pass
802.11n(HT40)	5190	-15.418	11	Pass
	5230	-16.856	11	Pass
802.11ax(HE20)	5180	-13.724	11	Pass
	5200	-12.722	11	Pass
	5240	-14.656	11	Pass
802.11ax(HE40)	5190	-17.698	11	Pass
	5230	-18.555	11	Pass

Test mode	Test Channel (MHz)	PSD [dBm/500kHz]	Limit [dBm/MHz]	Result
802.11a	5745	-12.033	30	Pass
	5785	-10.004	30	Pass
	5825	-8.97	30	Pass
802.11ac(VHT20)	5745	-10.867	30	Pass
	5785	-8.873	30	Pass
	5825	-9.041	30	Pass
802.11ac(VHT40)	5755	-15.26	30	Pass
	5795	-13.464	30	Pass
802.11n(HT20)	5745	-11.887	30	Pass
	5785	-9.479	30	Pass
	5825	-8.588	30	Pass
802.11n(HT40)	5755	-15.435	30	Pass
	5795	-14.037	30	Pass
802.11ax(HE20)	5745	-14.857	30	Pass
	5785	-11.732	30	Pass
	5825	-12.363	30	Pass
802.11ax(HE40)	5755	-17.801	30	Pass
	5795	-16.113	30	Pass

5180-5240MHz

802.11a-5180



802.11a-5200



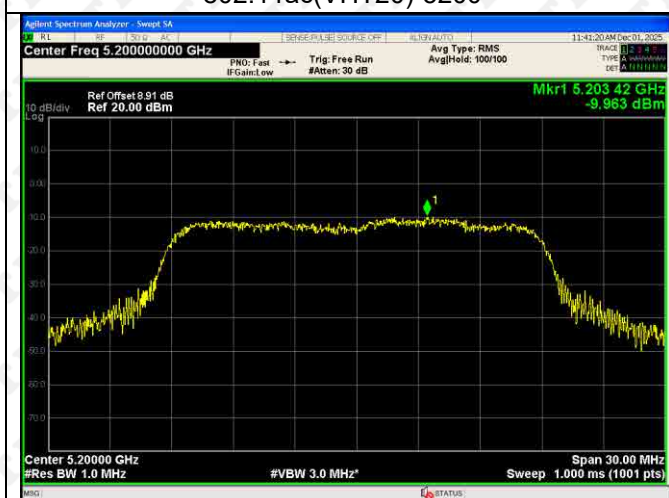
802.11a-5240



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

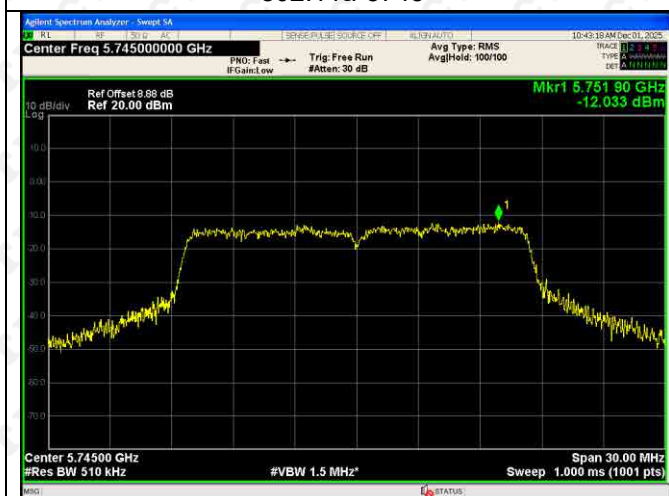


802.11ax(HE40)-5230



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

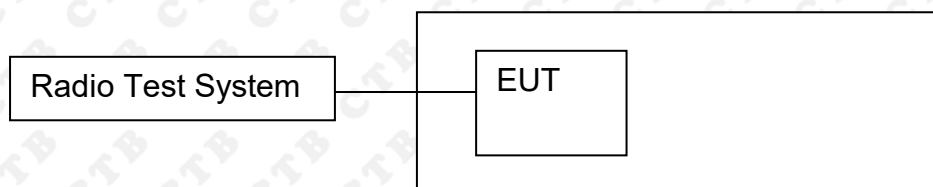


802.11ax(HE40)-5795



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)	120	5180.0366	5180	0.0366	7.0712
		V max (V)	132	5180.0605	5180	0.0605	11.6750
		V min (V)	108	5180.0788	5180	0.0788	15.2096
Limits				±20ppm			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5180MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	120	T (°C)	0	5180.0077	5180	0.0077	1.4949
		T (°C)	10	5180.0377	5180	0.0377	7.2767
		T (°C)	20	5180.0213	5180	0.0213	4.1186
		T (°C)	30	5180.0719	5180	0.0719	13.8759
		T (°C)	40	5180.0865	5180	0.0865	16.6896
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)	120	5200.0359	5200	0.0359	6.9011
		V max (V)	132	5200.0603	5200	0.0603	11.5887
		V min (V)	108	5200.0598	5200	0.0598	11.4937
Limits				±20ppm			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5200MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	120	T (°C)	0	5200.0877	5200	0.0877	16.8740
		T (°C)	10	5200.0926	5200	0.0926	17.8112
		T (°C)	20	5200.0227	5200	0.0227	4.3646
		T (°C)	30	5200.0594	5200	0.0594	11.4163
		T (°C)	40	5200.0392	5200	0.0392	7.5318
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)	120	5240.0142	5240	0.0142	2.7007
		V max (V)	132	5240.0509	5240	0.0509	9.7211
		V min (V)	108	5240.0366	5240	0.0366	6.9780
Limits				±20ppm			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5240MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	120	T (°C)	0	5240.0710	5240	0.0710	13.5534
		T (°C)	10	5240.0435	5240	0.0435	8.3041
		T (°C)	20	5240.0544	5240	0.0544	10.3870
		T (°C)	30	5240.0801	5240	0.0801	15.2776
		T (°C)	40	5240.0657	5240	0.0657	12.5440
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)	120	5745.0929	5745	0.0929	16.1655
		V max (V)	132	5745.0355	5745	0.0355	6.1771
		V min (V)	108	5745.0479	5745	0.0479	8.3407
Limits				±20ppm			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5745MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	120	T (°C)	0	5745.0778	5745	0.0778	13.5340
		T (°C)	10	5745.0395	5745	0.0395	6.8790
		T (°C)	20	5745.0716	5745	0.0716	12.4586
		T (°C)	30	5745.0201	5745	0.0201	3.5063
		T (°C)	40	5745.0624	5745	0.0624	10.8584
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)	120	5785.0355	5785	0.0355	6.1427
		V max (V)	132	5785.0126	5785	0.0126	2.1860
		V min (V)	108	5785.0097	5785	0.0097	1.6770
Limits				±20ppm			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5785MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	120	T (°C)	0	5785.0738	5785	0.0738	12.7560
		T (°C)	10	5785.0344	5785	0.0344	5.9444
		T (°C)	20	5785.0198	5785	0.0198	3.4235
		T (°C)	30	5785.0673	5785	0.0673	11.6333
		T (°C)	40	5785.0930	5785	0.0930	16.0701
		T (°C)	50	5785.0462	5785	0.0462	7.9776
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)	120	5825.0670	5825	0.0670	11.4947
		V max (V)	132	5825.0185	5825	0.0185	3.1723
		V min (V)	108	5825.0229	5825	0.0229	3.9351
Limits				±20ppm			
Result				Complies			

Temperature vs. Frequency Stability

TEST CONDITIONS				Reference Frequency: 5825MHz			
				f	fc	Max. Deviation (MHz)	Max. Deviation (ppm)
V nom (V)	120	T (°C)	0	5825.0325	5825	0.0325	5.5847
		T (°C)	10	5825.0143	5825	0.0143	2.4602
		T (°C)	20	5825.0417	5825	0.0417	7.1665
		T (°C)	30	5825.0468	5825	0.0468	8.0419
		T (°C)	40	5825.0822	5825	0.0822	14.1069
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.

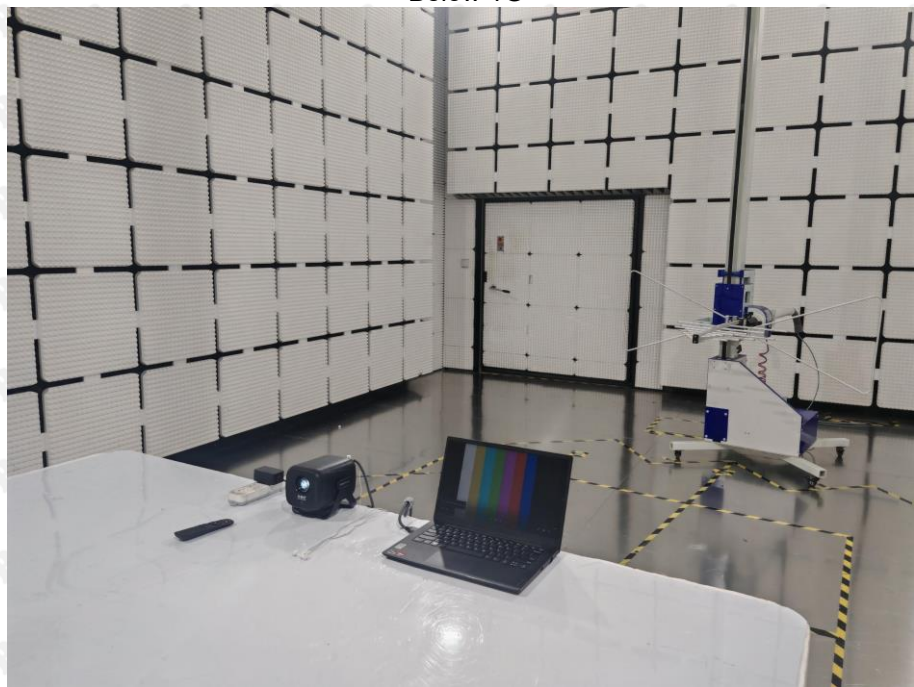
EUT Antenna:

The antenna is FPC antenna and no consideration of replacement. The best case gain of the antenna is WiFi (5.2G): 1.57dBi ,WiFi (5.8G): 2.4dBi

15. EUT TEST SETUP PHOTOGRAPHS

Radiated Emission

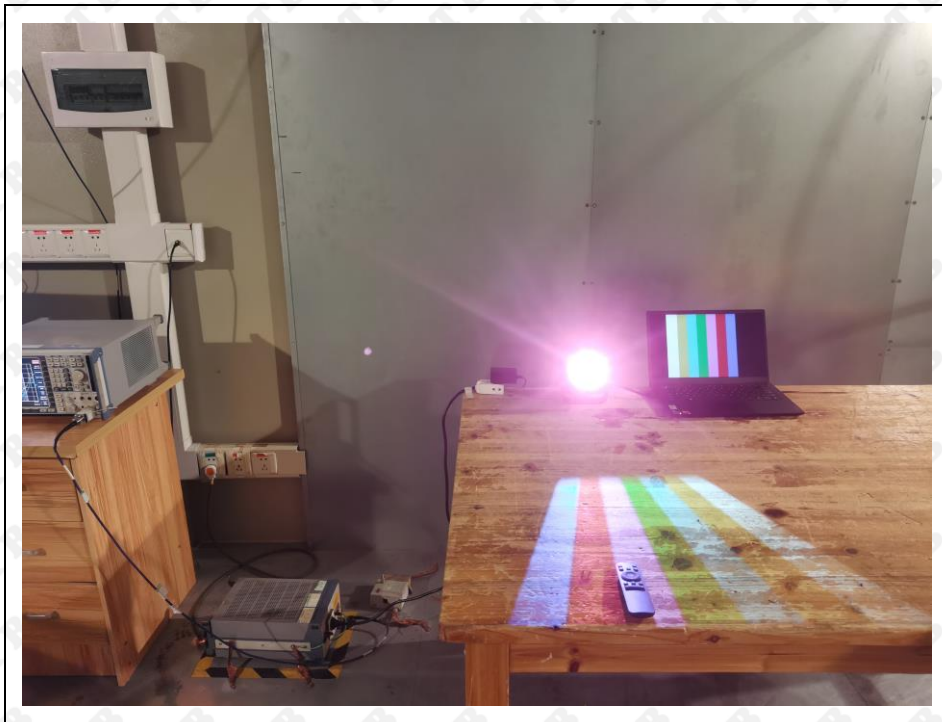
Below 1G



Above 1G



Conducted Emission



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