

## 10 Maximum Conducted Output Power

### 10.1 Test Standard and Limit

According to FCC §15.407

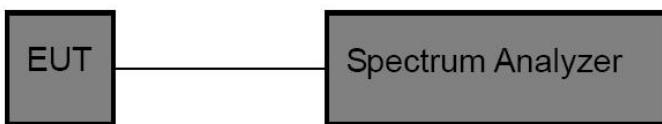
#### (1) For the band 5.15~5.25GHz

- (i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. 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. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).
- (ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. 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.
- (iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1dB reduction in maximum conducted output power is required for each 1 dB of antenna gain in excess of 23 dBi. 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.
- (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. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

#### (2) For 5725~5850MHz

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.

## 10.2 Test Setup



## 10.3 Test Procedure

The EUT was directly connected to the Power meter

### 1. Device Configuration

If possible, configure or modify the operation of the EUT so that it transmits continuously at its maximum power control level (see section II.B.).

The intent is to test at 100 percent duty cycle; however a small reduction in duty cycle (to no lower than 98 percent) is permitted if required by the EUT for amplitude control purposes. Manufacturers are expected to provide software to the test lab to permit such continuous operation.

b) If continuous transmission (or at least 98 percent duty cycle) cannot be achieved due to hardware limitations (e.g., overheating), the EUT shall be operated at its maximum power control level with the transmit duration as long as possible and the duty cycle as high as possible.

### 2. Measurement using a Spectrum Analyzer or EMI Receiver (SA)

Measurement of maximum conducted output power using a spectrum analyzer requires integrating the spectrum across a frequency span that encompasses, at a minimum, either the EBW or the 99-percent occupied bandwidth of the signal.<sup>1</sup> However, the EBW must be used to determine bandwidth dependent limits on maximum conducted output power in accordance with § 15.407(a).

a) The test method shall be selected as follows: (i) Method SA-1 or SA-1 Alternative (averaging with the EUT transmitting at full power throughout each sweep) shall be applied if either of the following conditions can be satisfied:

- The EUT transmits continuously (or with a duty cycle  $\geq$  98 percent).
- Sweep triggering or gating can be implemented in a way that the device transmits at the maximum power control level throughout the duration of each of the instrument sweeps to be averaged. This condition can generally be achieved by triggering the instrument's sweep if the duration of the sweep (with the analyzer configured as in Method SA-1, below) is equal to or shorter than the duration T of each transmission from the EUT and if those transmissions exhibit full power throughout their durations.

(ii) Method SA-2 or SA-2 Alternative (averaging across on and off times of the EUT transmissions, followed by duty cycle correction) shall be applied if the conditions of (i) cannot be achieved and the transmissions exhibit a constant duty cycle during the measurement duration. Duty cycle will be considered to be constant if variations are less than  $\pm 2$  percent.

(iii) Method SA-3 (RMS detection with max hold) or SA-3 Alternative (reduced VBW with max hold) shall be applied if the conditions of (i) and (ii) cannot be achieved.

b) Method SA-1 (trace averaging with the EUT transmitting at full power throughout each sweep):

- (i) Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal.
- (ii) Set RBW = 1 MHz.
- (iii) Set VBW  $\geq$  3 MHz.
- (iv) Number of points in sweep  $\geq$  2 Span / RBW. (This ensures that bin-to-bin spacing is  $\leq$  RBW/2, so that narrowband signals are not lost between frequency bins.)
- (v) Sweep time = auto.
- (vi) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- (vii) If transmit duty cycle  $<$  98 percent, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle  $\geq$  98 percent, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run”.
- (viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
- (ix) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument’s band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum

## 10.4 Test Data

Please see the attachment for WIFI5.2G and WIFI5.8G data

WIFI5.2G.

Type	Channel	AV Output power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Result
802.11a	Low	0.139	1.6266	1.77	24.00	Pass
	Moddle	-0.753	2.5901	1.84		
	High	-0.408	2.3232	1.92		
802.11n(HT20)	Low	-0.268	0.3386	0.07	24.00	Pass
	Moddle	-0.511	0.3948	-0.12		
	High	-0.184	0.3948	0.21		
802.11n(HT40)	Low	-0.749	0.8386	0.09	24.00	Pass
	High	-0.478	0.735	0.26		
802.11ac(HT20)	Low	0.020	0.6844	0.70	24.00	Pass
	Moddle	-0.186	0.8874	0.70		
	High	-0.376	0.8895	0.51		
802.11ac(HT40)	Low	-2.640	0.8428	-1.80	24.00	Pass
	High	-2.396	0.7166	-1.68		

## WIFI5.8G.

Type	Channel	AV Output power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Result
802.11a	Low	0.670	2.1318	2.80	30.00	Pass
	Moddle	0.924	1.4038	2.33		
	High	0.071	2.4169	2.49		
802.11n(HT20)	Low	0.996	0.4316	1.43	30.00	Pass
	Moddle	0.746	0.4316	1.18		
	High	0.317	0.4499	0.77		
802.11n(HT40)	Low	0.118	0.8386	0.96	30.00	Pass
	High	-0.052	0.9399	0.89		
802.11ac(HT20)	Low	-0.103	0.7645	0.66	30.00	Pass
	Moddle	-0.897	0.8587	-0.04		
	High	-1.220	0.92	-0.30		
802.11ac(HT40)	Low	-1.071	0.7484	-0.32	30.00	Pass
	High	-1.538	0.8714	-0.67		

Note: The Duty Cycle Factor is compensated in the graph.

## 11 Out of Band Emissions and Spurious Emission

### 11.1 Test Standard and Limit

According to FCC §15.407(b)

Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

(2) For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz.

RSS-247 Section 6.2

Devices shall comply with the following:

All emissions outside the band 5250-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p.; or

All emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. and its power shall comply with the spectral power density for operation within the band 5150-5250 MHz. The device, except devices installed in vehicles, shall be labelled or include in the user manual the following text "for indoor use only."

Devices operating in the band 5725-5850 MHz shall have e.i.r.p. of unwanted emissions comply with the following:

27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edges;

15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges;

10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to -27 dBm/MHz at 75 MHz above or below the band edges; and -27 dBm/MHz at frequencies more than 75 MHz above or below the band edges.

### 11.2 Test Setup



### 11.3 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 1 MHz with a convenient frequency span.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

### 11.4 Test Data



Mode	Channel	Ant.	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	
IEEE 802.11a	36	0	5148.85	-45.064	-27	-18.060	PASS	
			5148.96	-43.310	-27	-16	PASS	
			5150.00	-44.234	-27	-17	PASS	
			5350.00	-47.708	-27	-21	PASS	
			5458.08	-46.793	-27	-20	PASS	
			21569.1	-53.991	-27	-26.990	PASS	
	40		5126.58	-61.538	-27	-34.540	PASS	
			5141.28	-47.604	-27	-21	PASS	
			5150.00	-47.837	-27	-21	PASS	
			5350.00	-47.935	-27	-21	PASS	
			5459.04	-46.661	-27	-20	PASS	
			21146.1	-55.212	-27	-28.210	PASS	
IEEE 802.11n_20	36		4994.86	-62.429	-27	-35.430	PASS	
			5120.16	-46.785	-27	-20	PASS	
			5150.00	-47.166	-27	-20	PASS	
			5350.00	-46.578	-27	-20	PASS	
			5441.76	-45.308	-27	-18	PASS	
			21141.2	-55.087	-27	-28.090	PASS	
	40		5149.23	-48.885	-27	-21.880	PASS	
			5149.92	-48.368	-27	-21	PASS	
			5150.00	-48.368	-27	-21	PASS	
			5350.00	-46.096	-27	-19	PASS	
			5454.24	-45.279	-27	-18	PASS	
			21144.7	-54.940	-27	-27.940	PASS	

IEEE 802.11n_40	48	Schenzen NCT Testing Technology Co., Ltd.	5350.00	-47.584	-27	-21	PASS	
			5458.08	-47.236	-27	-20	PASS	
			21145.7	-54.700	-27	-27.700	PASS	
			5080.88	-62.249	-27	-35.250	PASS	
			5149.92	-48.457	-27	-21	PASS	
			5150.00	-48.457	-27	-21	PASS	
			5350.00	-47.209	-27	-20	PASS	
			5460.00	-46.227	-27	-19	PASS	
	38		21207.1	-54.416	-27	-27.420	PASS	
			5147.70	-41.608	-27	-14.610	PASS	
			5148.96	-43.445	-27	-16	PASS	
			5150.00	-44.582	-27	-18	PASS	
			5350.00	-47.580	-27	-21	PASS	
			5460.00	-46.346	-27	-19	PASS	
			21530.3	-55.589	-27	-28.590	PASS	
			5142.45	-59.694	-27	-32.690	PASS	
IEEE 802.11ac_20	46		5148.00	-47.384	-27	-20	PASS	
			5150.00	-48.089	-27	-21	PASS	
			5350.00	-46.272	-27	-19	PASS	
			5452.32	-46.035	-27	-19	PASS	
			21148.6	-54.845	-27	-27.840	PASS	
			5143.20	-46.430	-27	-19	PASS	
			5149.87	-48.080	-27	-21.080	PASS	
			5150.00	-47.306	-27	-20	PASS	
	36		5350.00	-48.192	-27	-21	PASS	
			5459.04	-48.124	-27	-21	PASS	
			21142.7	-54.242	-27	-27.240	PASS	
			5117.36	-62.153	-27	-35.150	PASS	
			5148.96	-47.595	-27	-21	PASS	
			5150.00	-48.602	-27	-22	PASS	
			5350.00	-47.516	-27	-21	PASS	

IEEE 802.11ac_40	48	5460.00 21544.5 5081.90 5148.96 5150.00 5350.00 5459.04 24998.0 5148.96 5149.74 5150.00 5350.00 5460.00 21561.2 5147.44 5149.92 5150.00 5350.00 5460.00 21152.0	5460.00	-47.420	-27	-20	PASS	
			21544.5	-54.768	-27	-27.770	PASS	
			5081.90	-62.893	-27	-35.890	PASS	
			5148.96	-46.789	-27	-20	PASS	
			5150.00	-48.122	-27	-21	PASS	
			5350.00	-47.772	-27	-21	PASS	
			5459.04	-47.316	-27	-20	PASS	
			24998.0	-54.938	-27	-27.940	PASS	
	38		5148.96	-42.999	-27	-16	PASS	
			5149.74	-44.098	-27	-17.100	PASS	
			5150.00	-43.052	-27	-16	PASS	
			5350.00	-47.475	-27	-20	PASS	
			5460.00	-46.999	-27	-20	PASS	
			21561.2	-55.092	-27	-28.090	PASS	
			5147.44	-58.032	-27	-31.030	PASS	
	46		5149.92	-47.972	-27	-21	PASS	
			5150.00	-47.972	-27	-21	PASS	
			5350.00	-47.518	-27	-21	PASS	
			5460.00	-46.920	-27	-20	PASS	
			21152.0	-55.662	-27	-28.660	PASS	

Mode	Channel	Ant.	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result	
IEEE 802.11a	149	0	2455.87	-59.977	-27	-32.980	PASS	
			5613.12	-45.503	-27	-18.503	PASS	
			5725.00	-32.030	27	-59.030	PASS	
			5850.00	-47.692	27	-74.690	PASS	
			5949.50	-47.290	-27	-20.290	PASS	
			21151.1	-55.076	-27	-28.080	PASS	
	157		5625.83	-61.392	-27	-34.390	PASS	
			5630.75	-45.507	-27	-18.507	PASS	
			5725.00	-47.726	27	-74.730	PASS	
			5850.00	-48.642	27	-75.640	PASS	
			5930.38	-46.191	-27	-19.191	PASS	
			21186.9	-55.213	-27	-28.210	PASS	
IEEE 802.11n_20	165		5430.68	-62.790	-27	-35.790	PASS	
			5634.50	-45.880	-27	-18.880	PASS	
			5725.00	-47.509	27	-74.510	PASS	
			5850.00	-44.688	27	-71.690	PASS	
			5955.50	-46.911	-27	-19.911	PASS	
			21510.7	-55.659	-27	-28.660	PASS	
	149		5344.83	-62.467	-27	-35.470	PASS	
			5642.75	-46.010	-27	-19.010	PASS	
			5725.00	-38.860	27	-65.860	PASS	
			5850.00	-48.438	27	-75.440	PASS	
			5928.88	-45.918	-27	-18.918	PASS	
			21171.2	-54.713	-27	-27.710	PASS	
	157		5600.00	-45.505	-27	-18.505	PASS	
			5625.55	-61.873	-27	-34.870	PASS	
			5725.00	-48.692	27	-75.690	PASS	

IEEE 802.11n_40	165	151	5850.00	-49.454	27	-76.450	PASS
			5945.00	-46.531	-27	-19.531	PASS
			21116.3	-54.249	-27	-27.250	PASS
			5427.03	-63.325	-27	-36.330	PASS
			5605.62	-45.607	-27	-18.607	PASS
			5725.00	-47.288	27	-74.290	PASS
			5850.00	-46.680	27	-73.680	PASS
			5965.25	-46.657	-27	-19.657	PASS
			21565.1	-55.221	-27	-28.220	PASS
			5578.77	-62.754	-27	-35.750	PASS
			5636.38	-46.132	-27	-19.132	PASS
			5725.00	-35.301	27	-62.300	PASS
			5850.00	-47.796	27	-74.800	PASS
			5955.12	-46.176	-27	-19.176	PASS
			21134.0	-55.665	-27	-28.660	PASS
IEEE 802.11ac_20	159	149	5626.11	-62.545	-27	-35.550	PASS
			5639.75	-45.240	-27	-18.241	PASS
			5725.00	-46.687	27	-73.690	PASS
			5850.00	-48.141	27	-75.140	PASS
			5950.25	-46.397	-27	-19.397	PASS
			21581.8	-54.778	-27	-27.780	PASS
			5585.79	-62.175	-27	-35.170	PASS
			5615.75	-44.750	-27	-17.750	PASS
			5725.00	-47.398	27	-74.400	PASS
			5850.00	-49.050	27	-76.050	PASS
			5953.25	-46.183	-27	-19.183	PASS
			21574.1	-54.645	-27	-27.650	PASS
			5615.75	-45.860	-27	-18.860	PASS
			5624.43	-62.105	-27	-35.100	PASS
			5725.00	-47.490	27	-74.490	PASS
			5850.00	-48.955	27	-75.950	PASS
	157						

IEEE 802.11ac_40	165	NCT Testing Technology	5961.88	-46.421	-27	-19.421	PASS	
			23430.6	-55.467	-27	-28.470	PASS	
			5580.03	-62.829	-27	-35.830	PASS	
			5613.88	-45.890	-27	-18.890	PASS	
			5725.00	-47.067	27	-74.070	PASS	
			5850.00	-49.044	27	-76.040	PASS	
			5950.62	-46.718	-27	-19.718	PASS	
			21583.7	-54.610	-27	-27.610	PASS	
	151		5609.26	-62.163	-27	-35.160	PASS	
			5644.62	-45.312	-27	-18.312	PASS	
			5725.00	-35.389	27	-62.390	PASS	
			5850.00	-49.729	27	-76.730	PASS	
			5949.50	-46.885	-27	-19.884	PASS	
			21606.6	-54.926	-27	-27.930	PASS	
			5602.25	-45.888	-27	-18.888	PASS	
			5648.03	-62.674	-27	-35.670	PASS	
	159		5725.00	-47.066	27	-74.070	PASS	
			5850.00	-48.289	27	-75.290	PASS	
			5927.75	-46.642	-27	-19.642	PASS	
			21592.3	-54.959	-27	-27.960	PASS	

