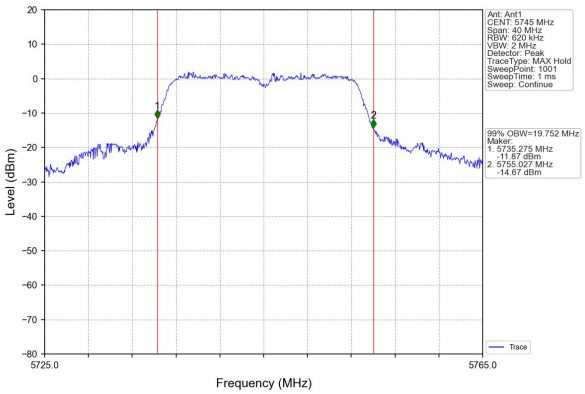
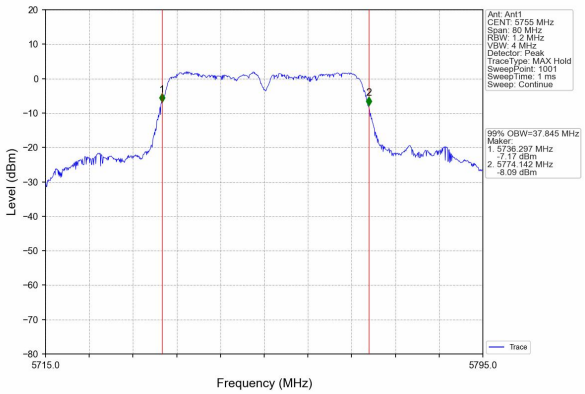
Test plot

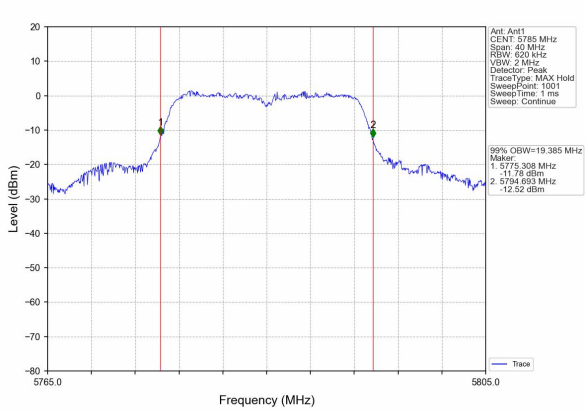
(802.11ac20) channel 149



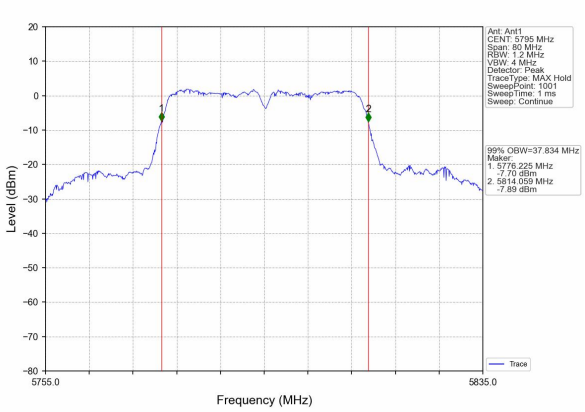
(802.11 ac40) channel 151



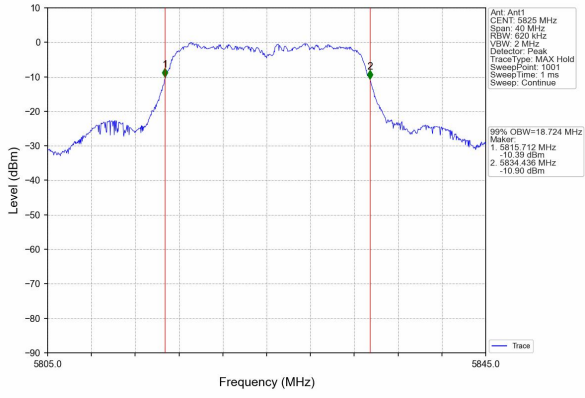
(802.11ac20) channel 157



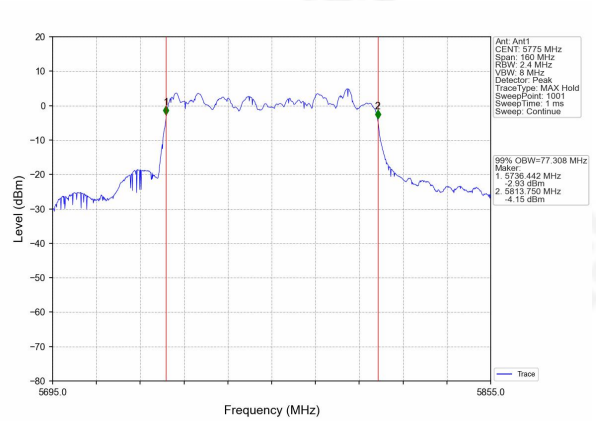
(802.11 ac40) channel 159



(802.11ac20) channel 165



(802.11 ac80) channel 155



7.MAXIMUM CONDUCTED OUTPUT POWER

7.1 PPLIED PROCEDURES / LIMIT

According to FCC §15.407
The maximum conduced output power should not exceed:

Frequency Band(MHz)	Limit
5725~5850	1W

7.2 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.).
a) 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.

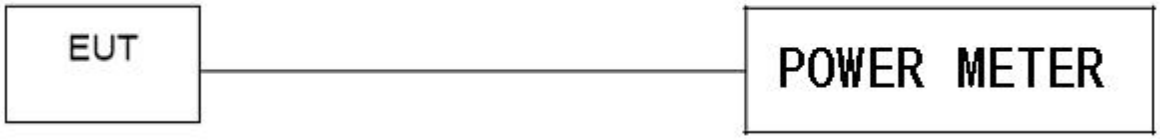
2. Measurement using a Spectrum Analyzer or EMI Receiver (SA)
Measurement of maximum conducted output power using a spectrum analyzer requires integrating the spectrum across a frequency span that encompasses, at a minimum, either the EBW or the 99-percent occupied bandwidth of the signal.1 However, 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 ≥ 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 ± 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 ≥ 3 MHz.
(iv) Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ 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 ≥ 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

7.3 DEVIATION FROM STANDARD

No deviation.

7.4 TEST SETUP



7.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

7.6 TEST RESULTS

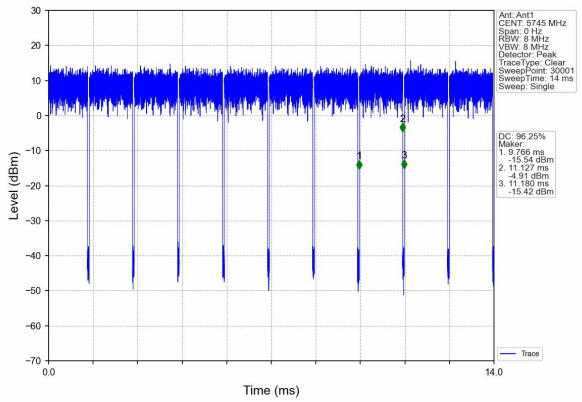
Temperature :	26 ℃	Relative Humidity :	54%
Pressure :	1012 hPa	Test Voltage :	DC 5V
Test Mode :	TX		

Test Channel	Frequency (MHz)	Maximum output power. (dBm)	LIMIT dBm	Result
TX 802.11 a Mode				
CH149	5745	6.74	30	Pass
CH157	5785	6.62	30	Pass
CH165	5825	6.09	30	Pass
TX 802.11 n20M Mode				
CH149	5745	6.07	30	Pass
CH157	5785	6.00	30	Pass
CH165	5825	5.51	30	Pass
TX 802.11 n40M Mode				
CH151	5755	6.98	30	Pass
CH159	5795	6.78	30	Pass
TX 802.11 ac20M Mode				
CH149	5745	6.29	30	Pass
CH157	5785	6.00	30	Pass
CH165	5825	4.42	30	Pass
TX 802.11 ac40M Mode				
CH151	5755	5.86	30	Pass
CH159	5795	5.67	30	Pass
TX 802.11 AC80M Mode				
CH155	5775	6.07	30	Pass

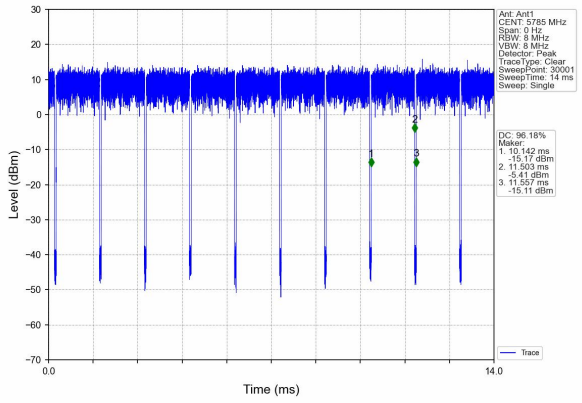
Mode	Frequency (MHz)	T_on (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	Max. DC Variation (%)
802.11a	5745	1.361	1.414	96.25	0.17	0.03
	5785	1.361	1.415	96.18	0.17	0.03
	5825	1.362	1.415	96.25	0.17	0.03
802.11n (HT20)	5745	1.274	1.327	96.01	0.18	0.03
	5785	1.273	1.327	95.93	0.18	0.04
	5825	1.274	1.327	96.01	0.18	0.03
802.11n (HT40)	5755	0.633	0.686	92.27	0.35	0.03
	5795	0.633	0.686	92.27	0.35	0.03
802.11ac (VHT20)	5745	1.274	1.327	96.01	0.18	0.00
	5785	1.274	1.327	96.01	0.18	0.04
	5825	1.274	1.327	96.01	0.18	0.04
802.11ac (VHT40)	5755	0.634	0.687	92.29	0.35	0.03
	5795	0.633	0.686	92.27	0.35	0.03
802.11ac (VHT80)	5775	0.317	0.370	85.68	0.67	0.04

Test plot

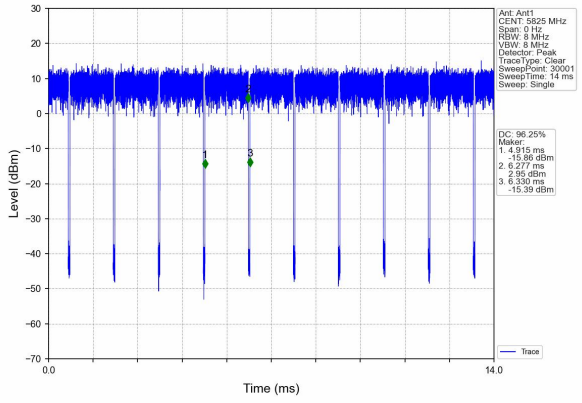
(802.11a) channel 149



(802.11a) channel 157

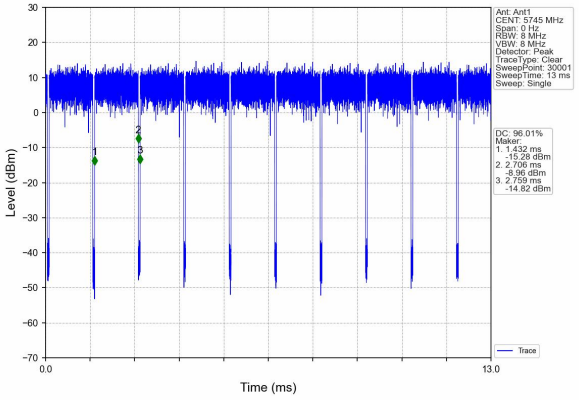


(802.11a) channel 165

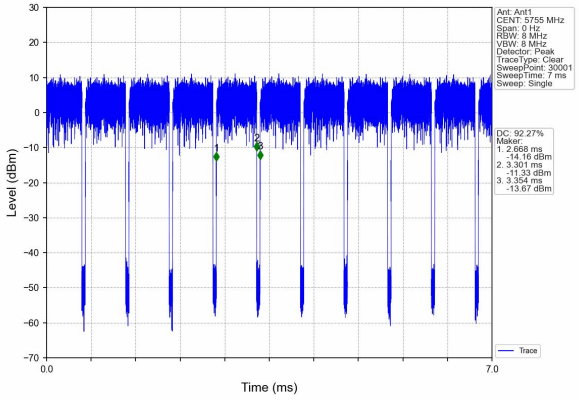


Test plot

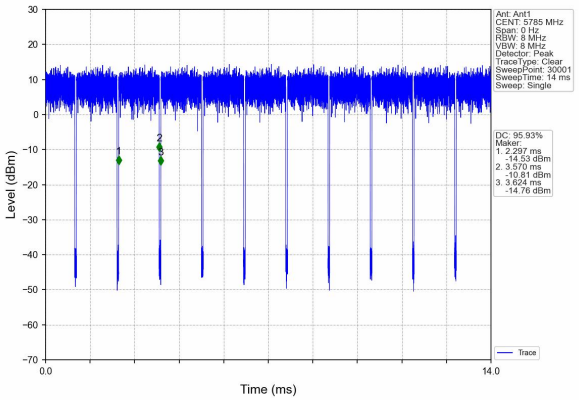
(802.11n20) channel 149



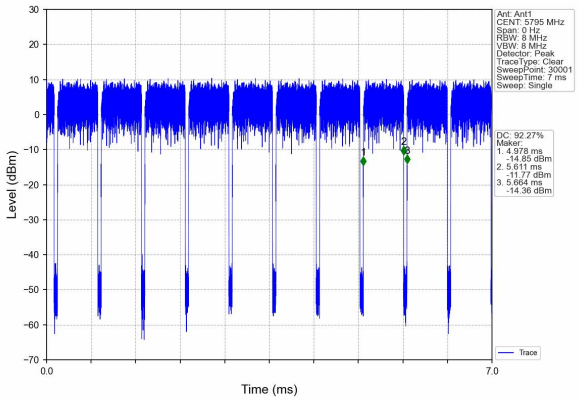
(802.11 n40) channel 151



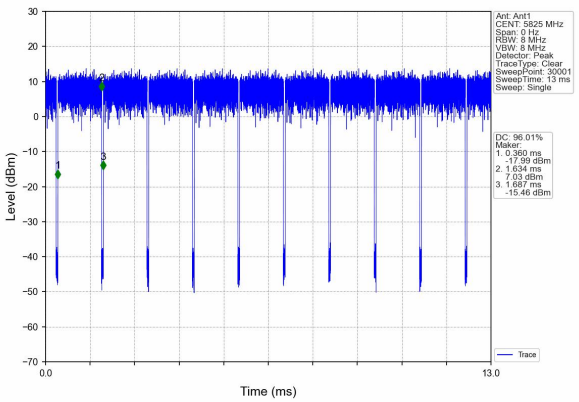
(802.11n20) channel 157



(802.11 n40) channel 159

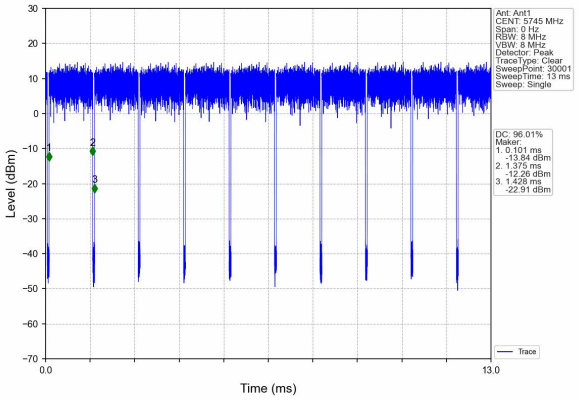


(802.11n20) channel 165

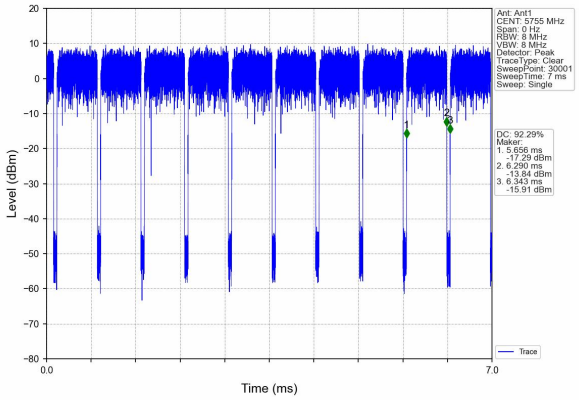


Test plot

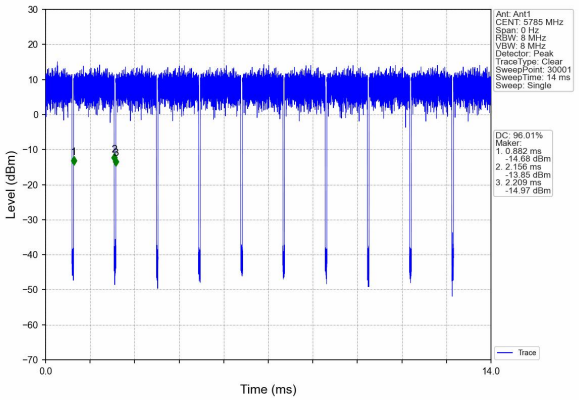
(802.11ac20) channel 149



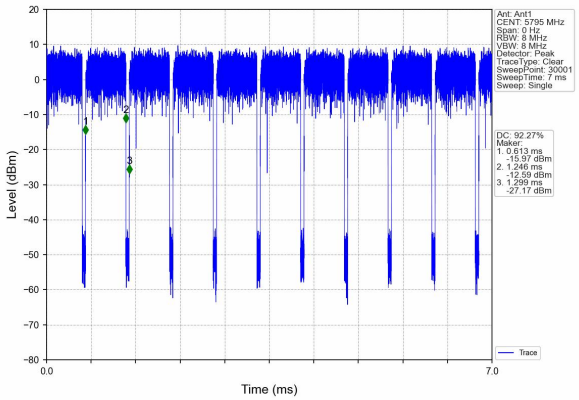
(802.11 ac40) channel 151



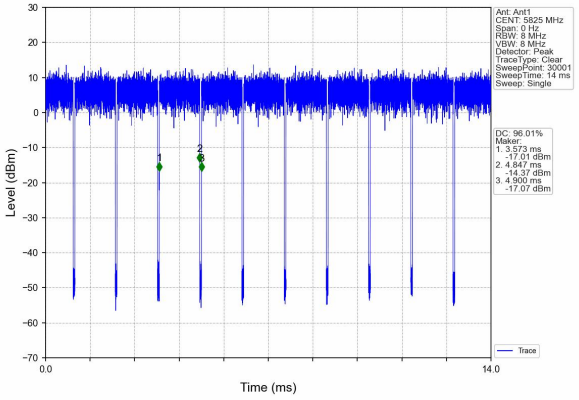
(802.11ac20) channel 157



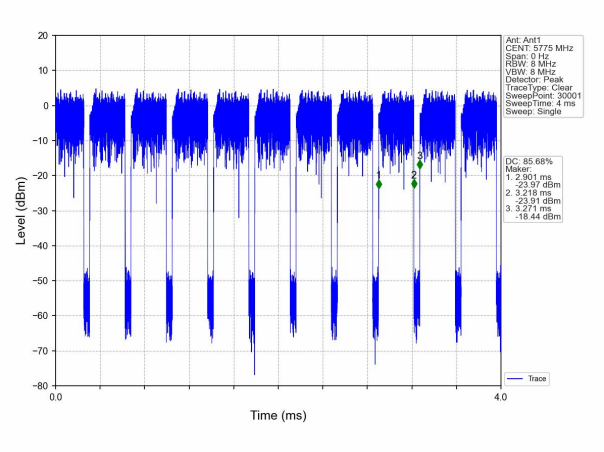
(802.11 ac40) channel 159



(802.11ac20) channel 165



(802.11 ac80) channel 155



8.OUT OF BAND EMISSIONS

8.1 APPLICABLE STANDARD

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 5.725-5.85 GHz band: All emissions outside of the 5.725-5.85 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(2)

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

8.2 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.

8.3 DEVIATION FROM STANDARD

No deviation.

8.4 TEST SETUP

8.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

8.6 TEST RESULTS

Temperature：	26 ℃	Relative Humidity：	54%
Pressure：	1012 hPa	Test Voltage ：	DC 5V

(802.11a) 5.745~5.825 GHz

Test CH.	Test Segment MHz	Result dBm/MHz	Limit dBm/MHz
	Below 5650	-40.56	-27
Lowest	5650 to 5700	-35.28	10
	5700 to 5720	-34.08	15.6
	5855 to 5875	-37.34	15.6
Highest	5875 to 5925	-35.44	10
	Above 5925	-43.53	-27

Note: the data just list the worst cases

(802.11n HT20) 5.745~5.825 GHz

Test CH.	Test Segment MHz	Result dBm/MHz	Limit dBm/MHz
	Below 5650	-41.66	-27
Lowest	5650 to 5700	-32.64	10
	5700 to 5720	-32.08	15.6
	5855 to 5875	-36.94	15.6
Highest	5875 to 5925	-39.84	10
	Above 5925	-43.17	-27

Note: the data just list the worst cases

(802.11n HT40) 5.745~5.825 GHz

Test CH.	Test Segment MHz	Result dBm/MHz	Limit dBm/MHz
	Below 5650	-40.76	-27
Lowest	5650 to 5700	-38.09	10
	5700 to 5720	-35.28	15.6
	5855 to 5875	-39.77	15.6
Highest	5875 to 5925	-42.62	10
	Above 5925	-44.27	-27

Note: the data just list the worst cases

(802.11ac VHT80) 5.745~5.825 GHz

Test CH.	Test Segment MHz	Result dBm/MHz	Limit dBm/MHz

	Below 5650	-39.84	-27
Lowest	5650 to 5700	-38.61	10
	5700 to 5720	-34.06	15.6
	5855 to 5875	-40.16	15.6
Highest	5875 to 5925	-42.58	10
	Above 5925	-42.28	-27

Note: the data just list the worst cases

9.Frequency Stability Measurement

9.1 LIMIT

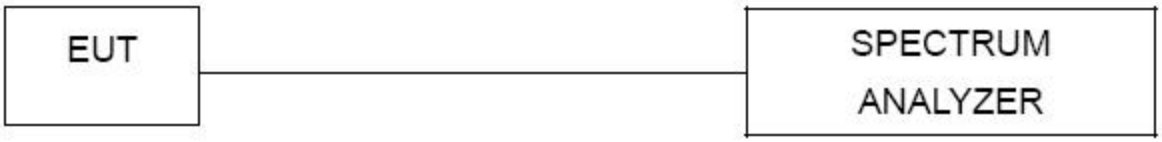
Manufactures of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

The transmitter center frequency tolerance shall be ± 20 ppm maximum for the 5 GHz band (IEEE 802.11n specification).

9.2 TEST PROCEDURES

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. EUT have transmitted absence of modulation signal and fixed channelize.
3. Set the spectrum analyzer span to view the entire absence of modulation emissions bandwidth.
4. Set RBW = 10 kHz, VBW = 10 kHz with peak detector and maxhold settings.
5. fc is declaring of channel frequency. Then the frequency error formula is (fc-f)/fc × 106 ppm and the limit is less than ±20ppm (IEEE 802.11nspecification).
6. The test extreme voltage is to change the primary supply voltage from 85 to 115 percent of the nominal value
7. Extreme temperature is -20°C~70°C.

9.3 TEST SETUP LAYOUT



9.4 EUT OPERATION DURING TEST

The EUT was programmed to be in continuously un-modulation transmitting mode.

9.5 TEST RESULTS

Temperature :	26 ℃	Relative Humidity :	54%
Pressure :	1012 hPa	Test Voltage :	AC 120V/60Hz
Test Mode :	TX		

5.8G

802.11a

Reference Frequency(Middle Channel): 5785MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		MCF	Error (ppm)
50	5.0	45	0.00769
40	5.0	26	0.00444
30	5.0	37	0.00587
20	5.0	22	0.00445
10	5.0	15	0.00268
0	5.0	14	0.00237
-10	5.0	16	0.00248
-20	5.0	24	0.00383
-30	5.0	37	0.0058

802.11n_HT20

Reference Frequency(Middle Channel): 5785MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		MCF	Error (ppm)
50	5.0	42	0.00738
40	5.0	24	0.00427
30	5.0	32	0.00565
20	5.0	24	0.00427
10	5.0	13	0.00237
0	5.0	12	0.00219
-10	5.0	13	0.00237
-20	5.0	21	0.00375
-30	5.0	32	0.00565

802.11n_HT40

Reference Frequency(Middle Channel): 5795MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		MCF	Error (ppm)
50	5.0	61	0.01065
40	5.0	54	0.00944
30	5.0	42	0.00737
20	5.0	44	0.00771
10	5.0	34	0.00599
0	5.0	32	0.00564
-10	5.0	34	0.00599
-20	5.0	42	0.00737
-30	5.0	51	0.00892

802.11ac20

Reference Frequency(Middle Channel): 5785 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		MCF	Error (ppm)
50	5.0	43	0.00755
40	5.0	51	0.00894
30	5.0	23	0.0041
20	5.0	26	0.00461
10	5.0	23	0.0041
0	5.0	26	0.00461
-10	5.0	22	0.00392
-20	5.0	36	0.00634
-30	5.0	26	0.00461

802.11ac40

Reference Frequency(Middle Channel): 5795MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		MCF	Error (ppm)
50	5.0	61	0.01065
40	5.0	24	0.00427
30	5.0	32	0.00565
20	5.0	24	0.00427
10	5.0	34	0.00599
0	5.0	32	0.00564
-10	5.0	34	0.00599
-20	5.0	34	0.00601
-30	5.0	32	0.00566

802.11ac80

Reference Frequency(Middle Channel): 5775MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		MCF	Error (ppm)
50	5.0	52	0.00912
40	5.0	41	0.00722
30	5.0	43	0.00757
20	5.0	41	0.00722
10	5.0	36	0.00635
0	5.0	32	0.00566
-10	5.0	34	0.00601
-20	5.0	32	0.00566
-30	5.0	52	0.00912

So, Frequency Stability Versus Input Voltage is:

802.11a

Reference Frequency(Middle Channel): 5785 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Frequency	Error (ppm)
20	4.5	37	0.00587
	5.0	24	0.00427
	5.5	32	0.00565

802.11n_HT20

Reference Frequency(Middle Channel): 5785 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Frequency	Error (ppm)
20	4.5	33	0.00570
	5.0	21	0.00363
	5.5	43	0.00743

802.11n_HT40

Reference Frequency(Middle Channel): 5795 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Frequency	Error (ppm)
20	4.5	42	0.00737
	5.0	44	0.00771
	5.5	43	0.00755

802.11ac20

Reference Frequency(Middle Channel): 5785 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Frequency	Error (ppm)
20	4.5	55	0.00963
	5.0	32	0.00565
	5.5	33	0.00582

802.11ac40

Reference Frequency(Middle Channel): 5795 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Frequency	Error (ppm)
20	4.5	32	0.00565
	5.0	33	0.00582
	5.5	43	0.00755

802.11ac80

Reference Frequency(Middle Channel): 5775 MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Frequency	Error (ppm)
20	4.5	43	0.00755
	5.0	44	0.00774
	5.5	42	0.00739

10.ANTENNA REQUIREMENT

Standard requirement:	FCC Part15 C Section 15.203
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 External antenna, the best case gain of the antenna is 5.0 dBi, reference to the appendix II for details	

11. TEST SETUP PHOTO

Reference to the appendix I for details.

12. EUT CONSTRUCTIONAL DETAILS

Reference to the appendix II for details.

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