

Antenna 4

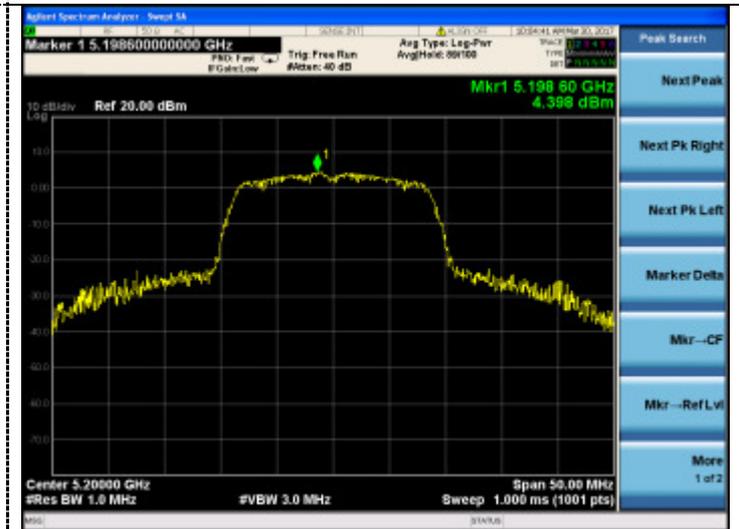
802.11ac

802.11n HT20



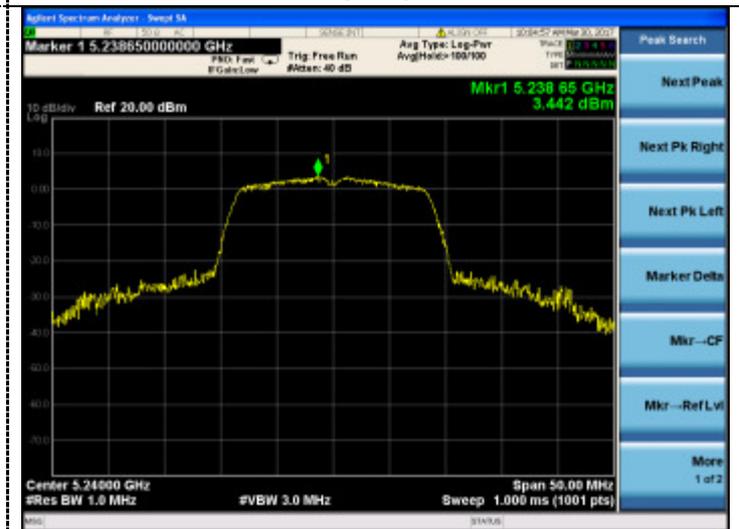
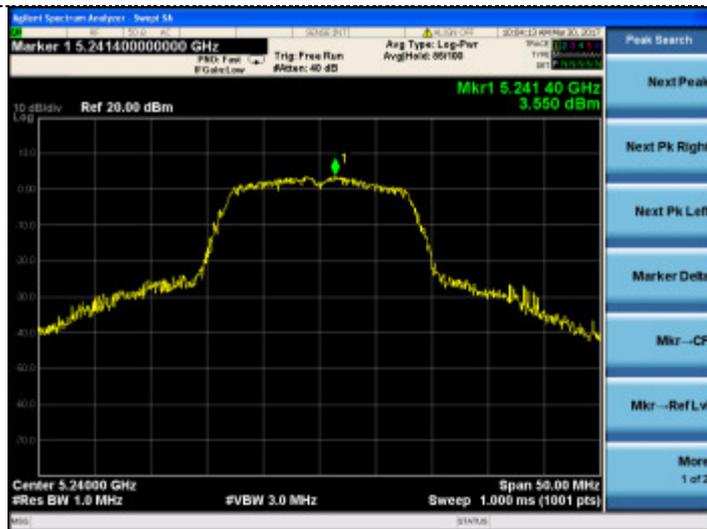
CH 36

CH 36



CH 40

CH 40



CH 48

CH 48

802.11ac

802.11n HT20



CH 149

CH 149



CH 157

CH 157

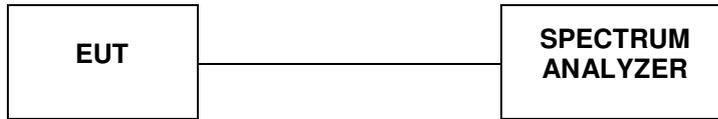


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4.6. 6dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

According to KDB789033 D02 General UNII Test Procedures New Rules v01 for one of the following procedures may be used for section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:

- a. Set RBW = 100 kHz.
- b. Set the video bandwidth (VBW) $\geq 3 \times$ 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 above.

LIMIT

For Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz

TEST RESULTS

Antenna 1

Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11ac	149	16.41	≥500	Pass
	157	16.43		
	165	16.40		
802.11nHT20	149	17.61	≥500	Pass
	157	17.61		
	165	17.62		

Antenna 2

Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11ac	149	16.44	≥500	Pass
	157	16.39		
	165	16.43		
802.11nHT20	149	17.62	≥500	Pass
	157	17.62		
	165	17.63		

Antenna 3

Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11ac	149	16.41	≥500	Pass
	157	16.39		
	165	16.40		
802.11nHT20	149	17.63	≥500	Pass
	157	17.61		
	165	17.64		

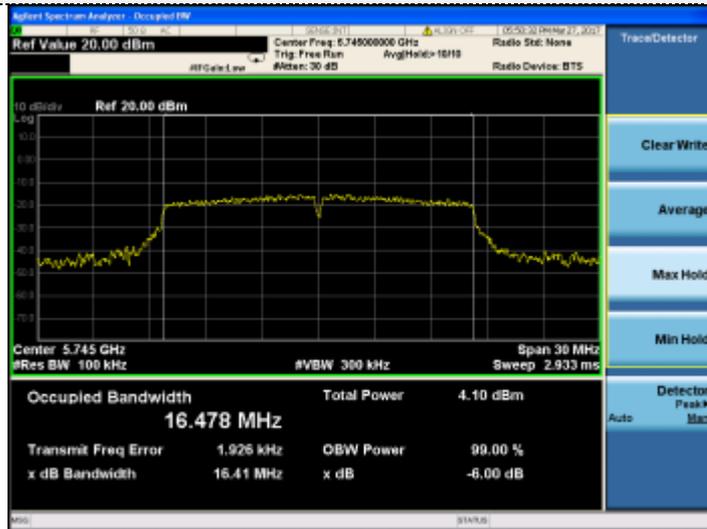
Antenna 4

Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11ac	149	16.41	≥500	Pass
	157	16.41		
	165	16.40		
802.11nHT20	149	17.62	≥500	Pass
	157	17.61		
	165	17.64		

Antenna 1

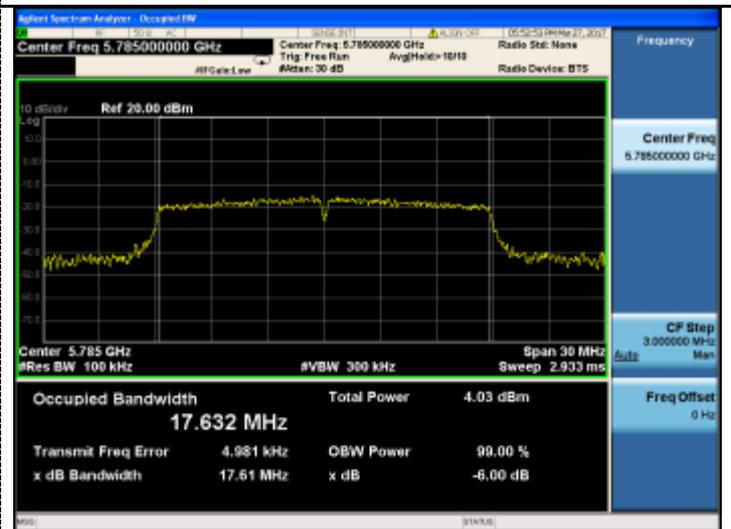
802.11ac

802.11n HT20



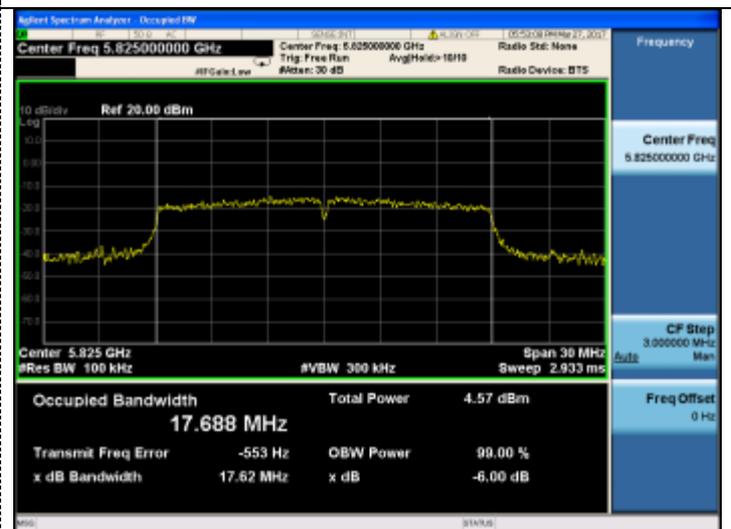
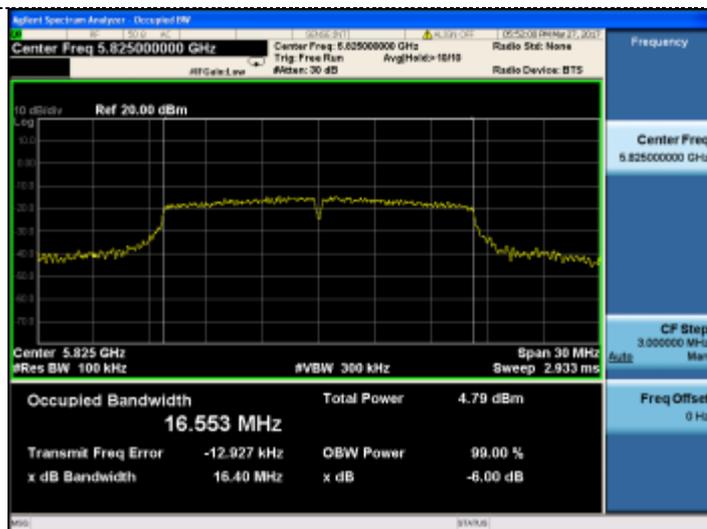
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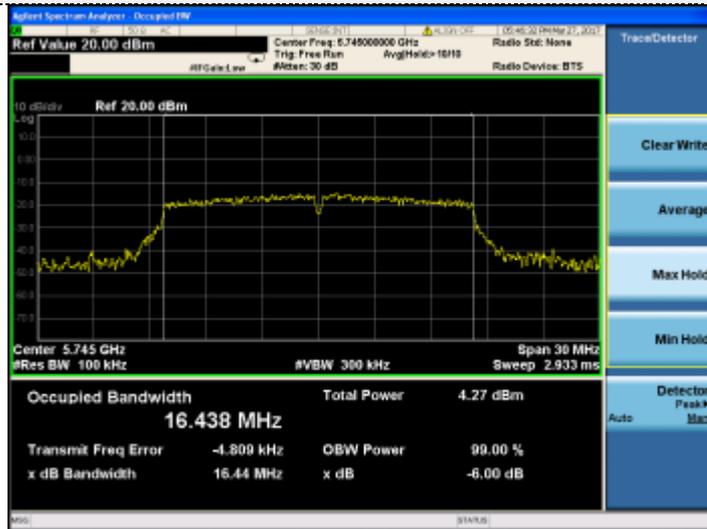
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Antenna 2

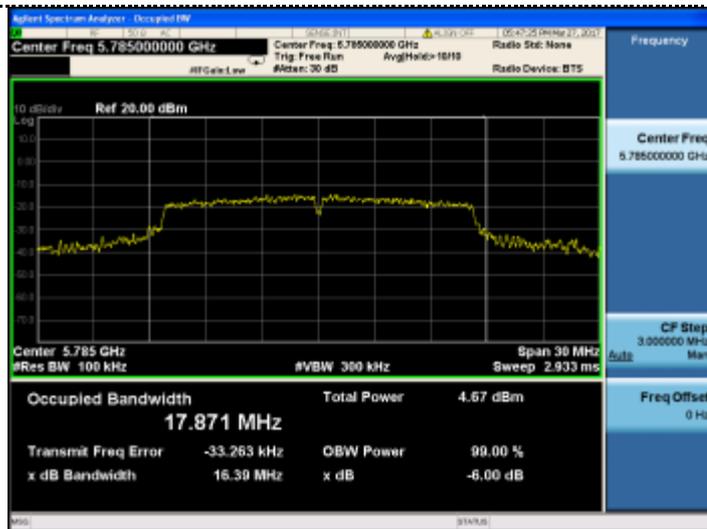
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802.11n HT20



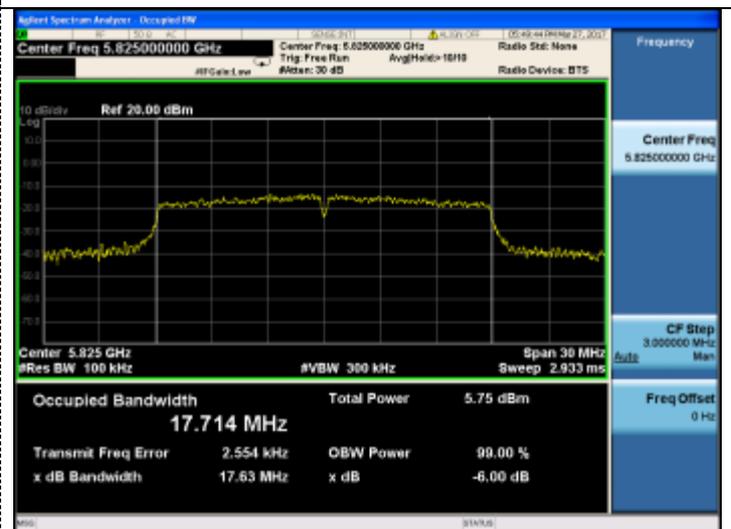
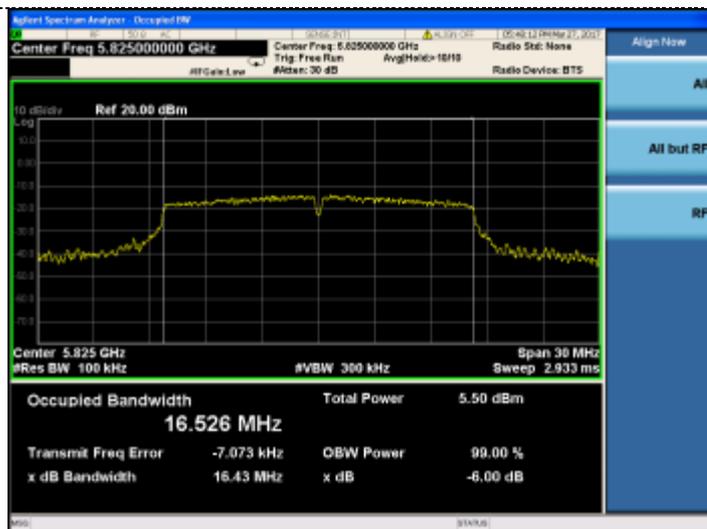
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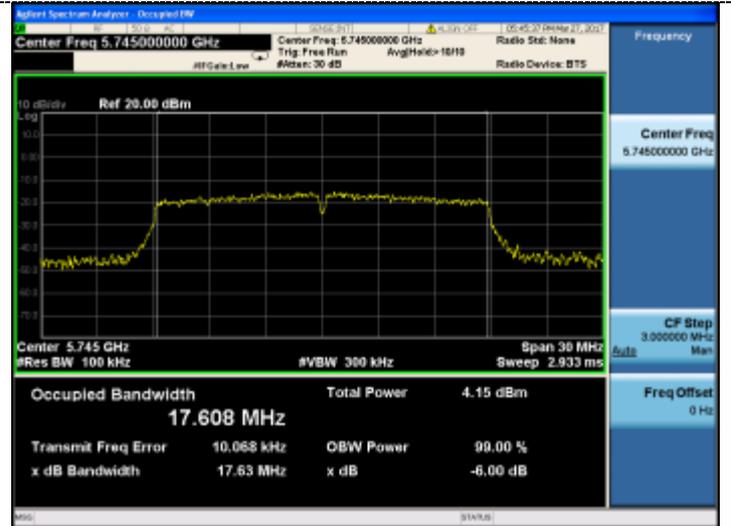
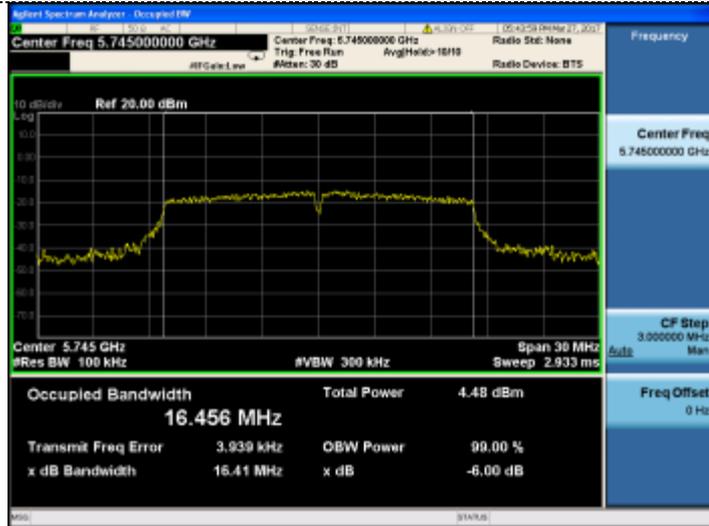
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Antenna 3

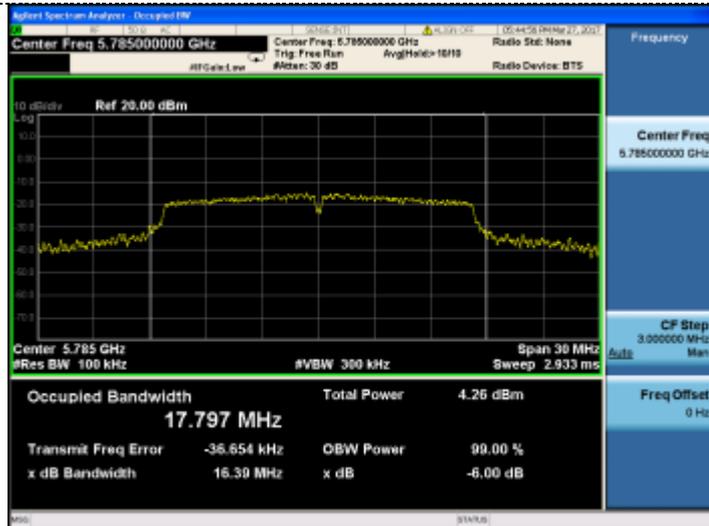
802.11ac

802.11n HT20



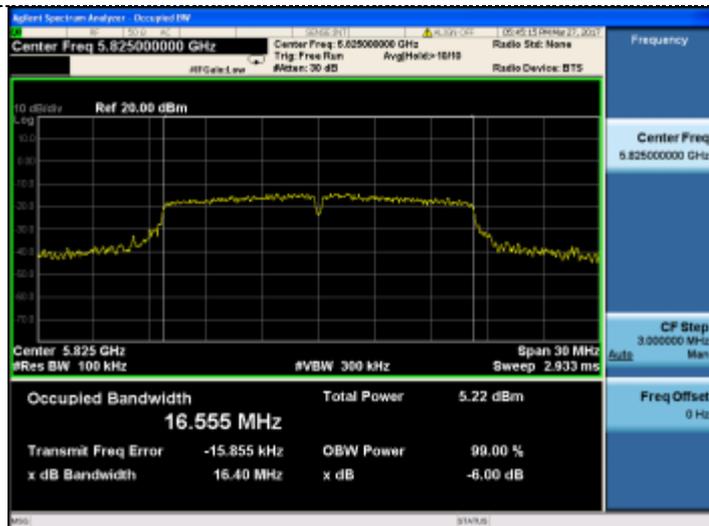
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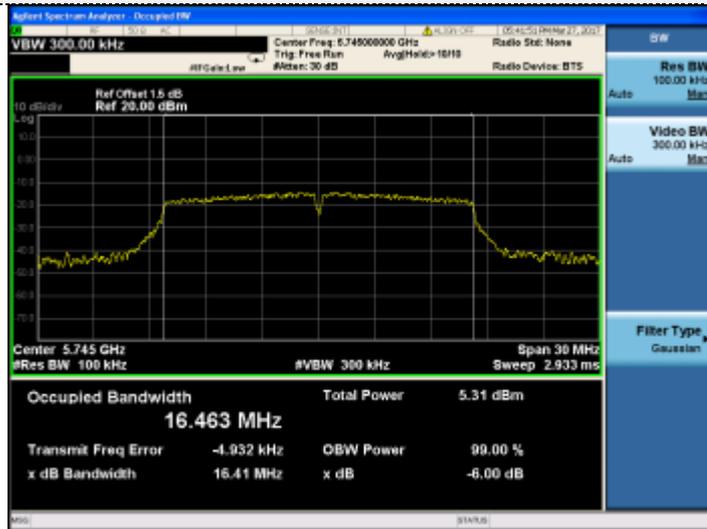
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Antenna 4

802.11ac

802.11n HT20



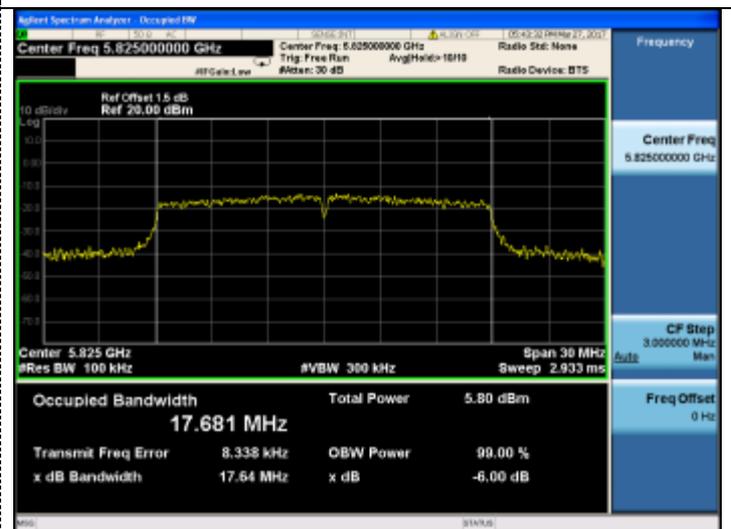
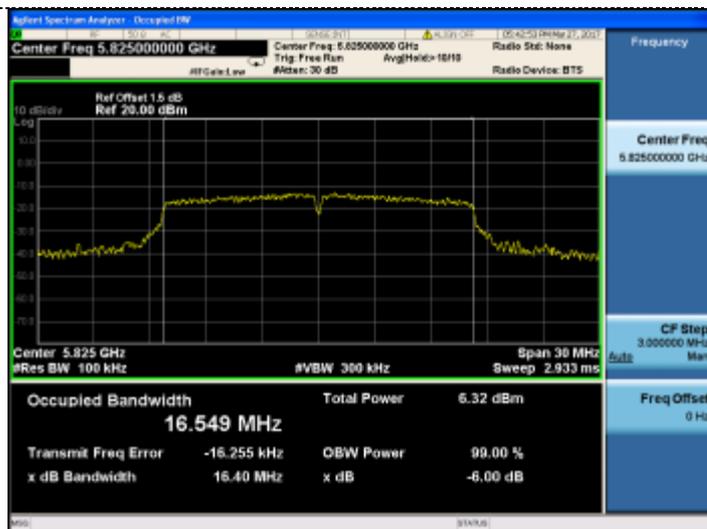
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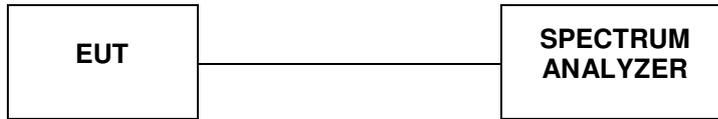


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4.7. 26dBc Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

According to KDB789033 D02 General UNII Test Procedures New Rules v01 for one of the following procedures may be used for Emission Bandwidth (EBW) measurement:

- a. Set RBW = 300 kHz (approximately 1% of the emission bandwidth).
- b. Set the video bandwidth (VBW) = 1000 KHz (VBW > 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 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%.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

LIMIT

No Limits for 26dBc Bandwidth

TEST RESULTS

Antenna 1

Type	Channel	26dB Bandwidth (MHz)	Limit (KHz)	Result
802.11ac	36	22.69	---	Pass
	40	20.94		
	48	19.67		
802.11nHT20	36	22.42	---	Pass
	40	23.17		
	48	20.02		

Antenna 2

Type	Channel	26dB Bandwidth (MHz)	Limit (KHz)	Result
802.11ac	36	21.35	---	Pass
	40	20.68		
	48	20.25		
802.11nHT20	36	21.10	---	Pass
	40	22.48		
	48	20.14		

Antenna 3

Type	Channel	26dB Bandwidth (MHz)	Limit (KHz)	Result
802.11ac	36	20.23	---	Pass
	40	20.03		
	48	21.15		
802.11nHT20	36	20.94	---	Pass
	40	23.94		
	48	20.98		

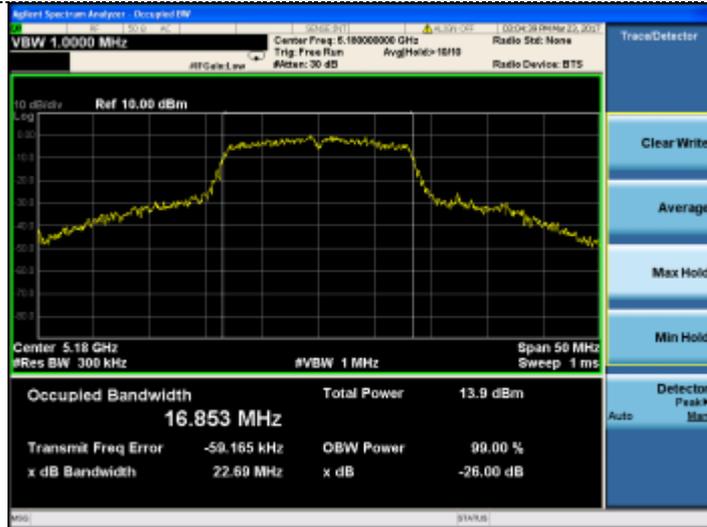
Antenna 4

Type	Channel	26dB Bandwidth (MHz)	Limit (KHz)	Result
802.11ac	36	23.39	---	Pass
	40	23.43		
	48	19.58		
802.11nHT20	36	20.11	---	Pass
	40	21.28		
	48	20.19		

Antenna 1

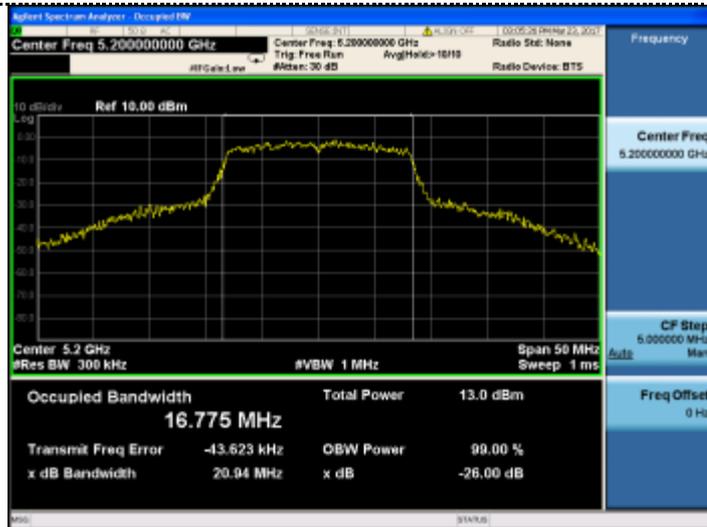
802.11ac

802.11n HT20



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Antenna 2

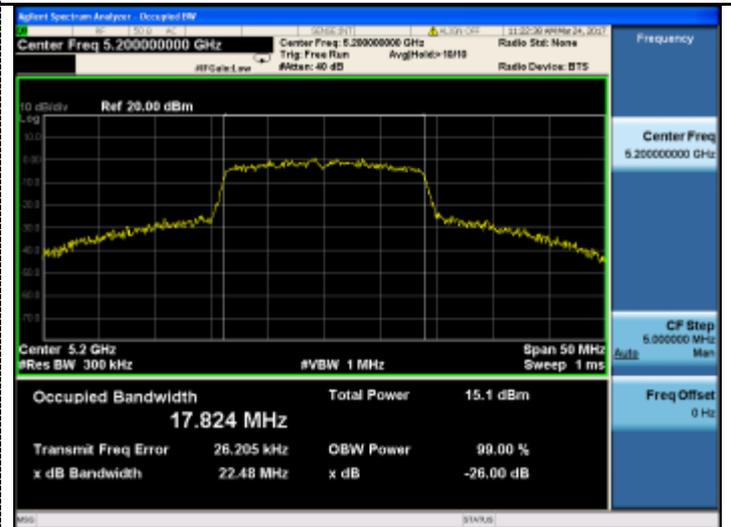
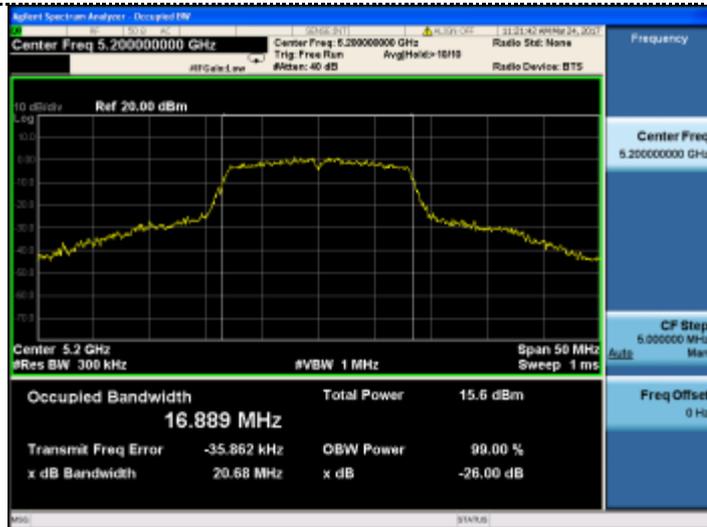
802.11ac

802.11n HT20



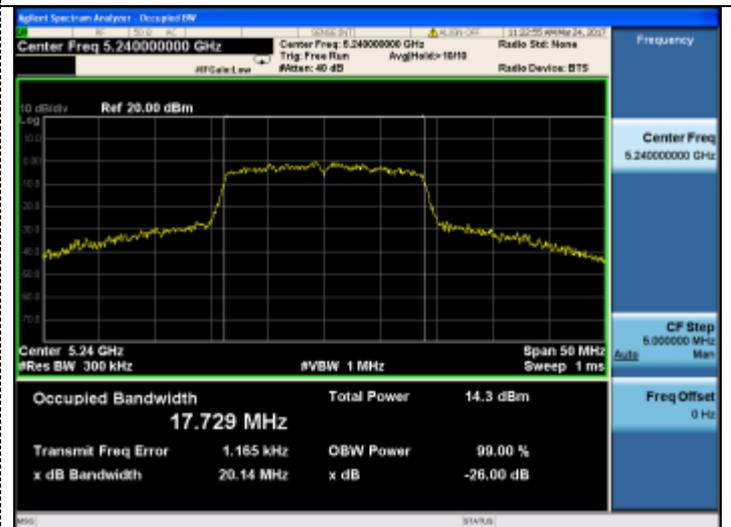
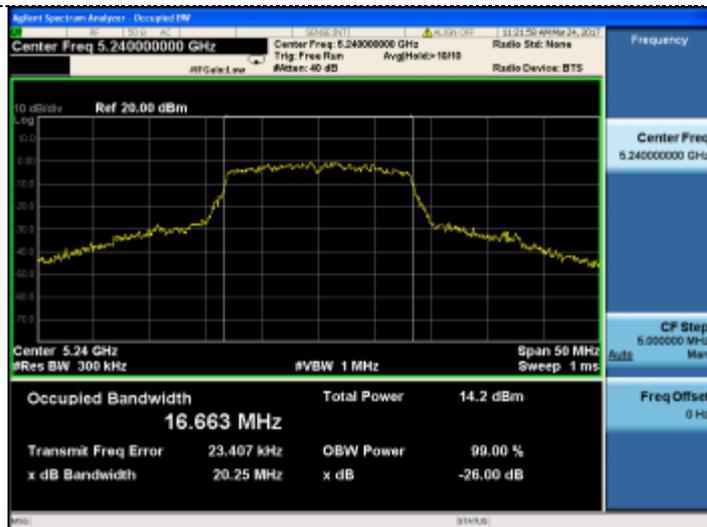
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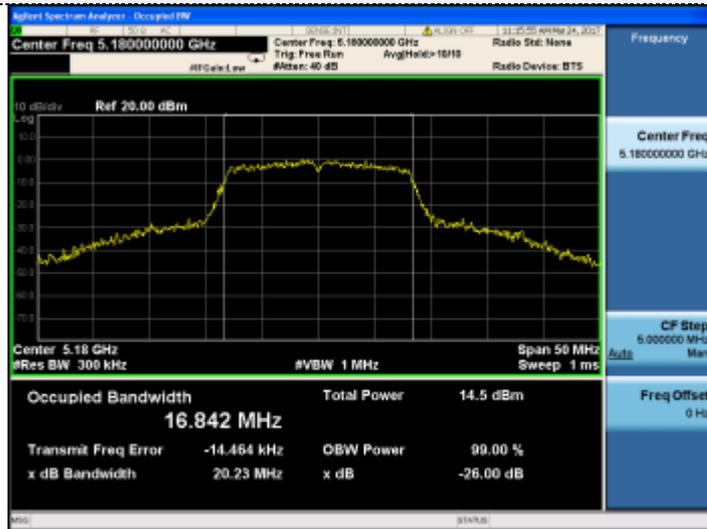
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Antenna 3

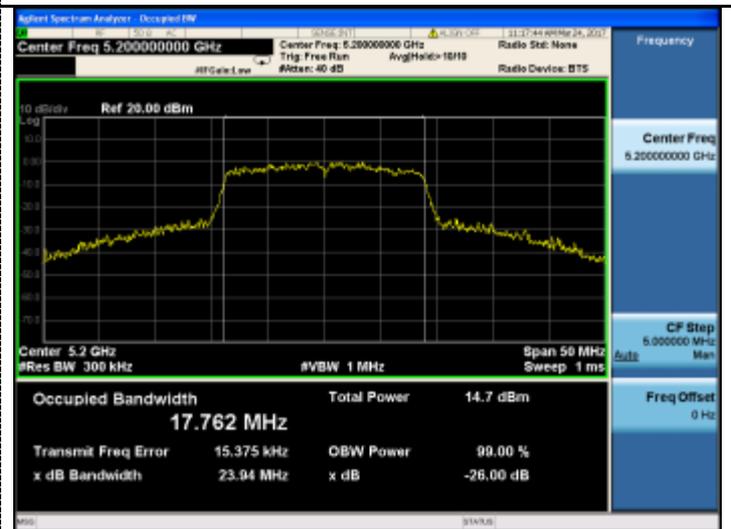
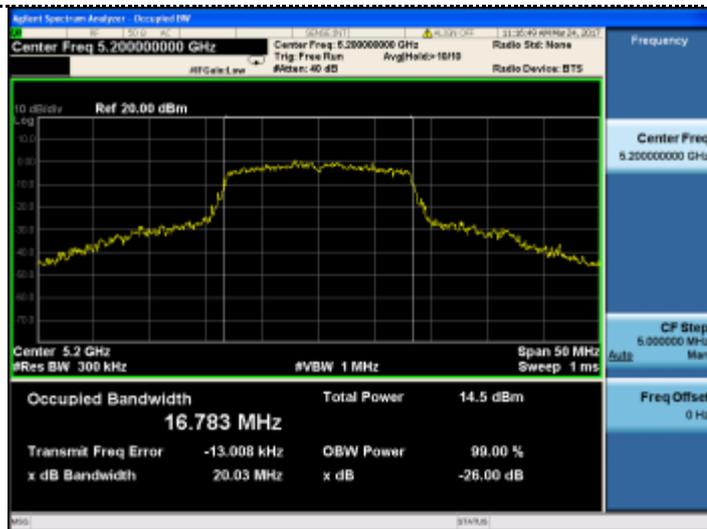
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802.11n HT20



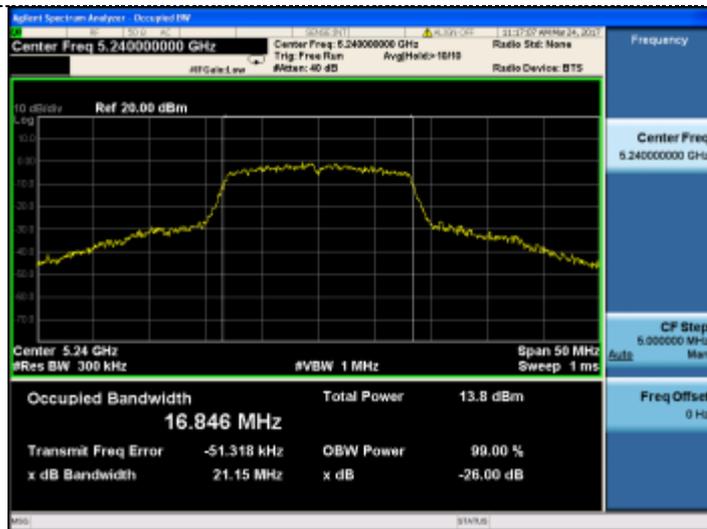
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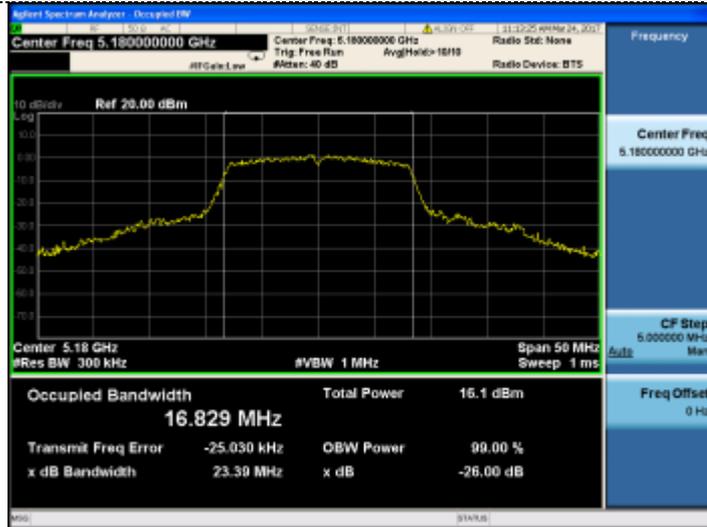
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Antenna 4

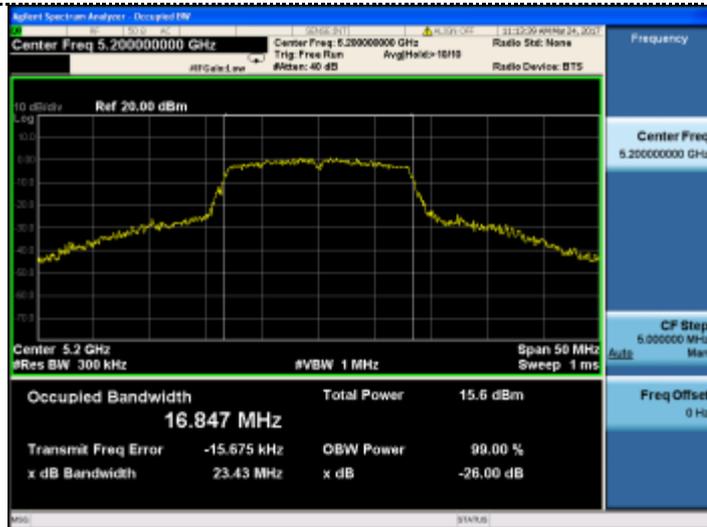
802.11ac

802.11n HT20



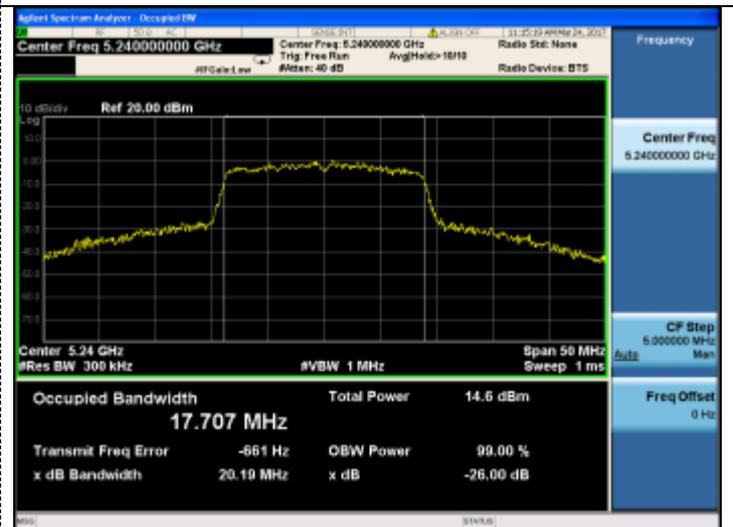
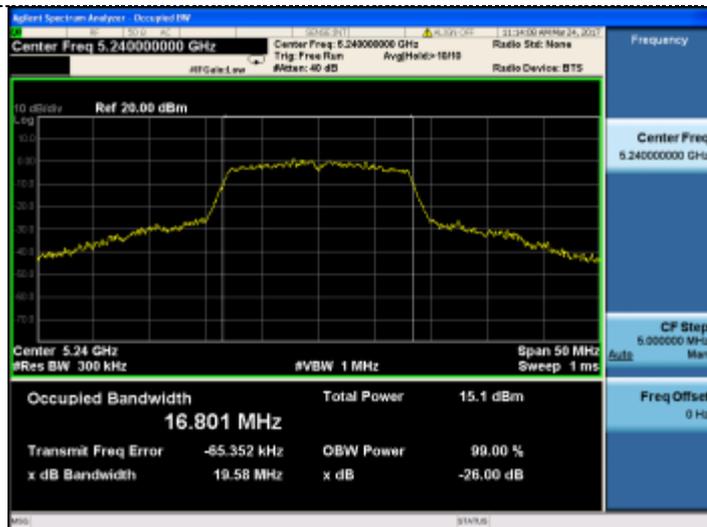
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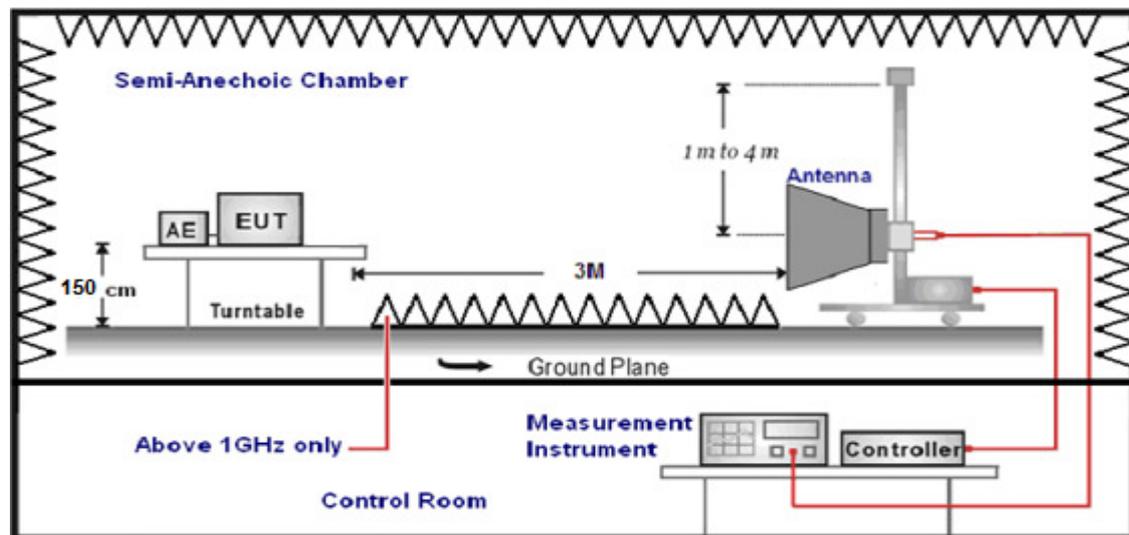


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4.8. Band Edge Compliance

TEST CONFIGURATION



LIMIT

20dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequency (MHz)	Distance (Meters)	Radiated (dBµV/m)	Radiated (µV/m)
0.009-0.49	3	$20\log(2400/F(KHz))+40\log(300/3)$	$2400/F(KHz)$
0.49-1.705	3	$20\log(24000/F(KHz))+ 40\log(30/3)$	$24000/F(KHz)$
1.705-30	3	$20\log(30)+ 40\log(30/3)$	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

According to §15.407 (b):

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.

For transmitters operating in the 5.25-5.35 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.

For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

For transmitters operating in the 5.725-5.85 GHz band:

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.

Frequency (MHz)		EIRP Limit (dBm)	Equivalent Field Strength at 3m (dBμV/m)
5150-5250		-27	68.3
5250-5350		-27	68.3
5470-5725		-27	68.3
5725-5850	Below 5650	-27	68.3
	5650-5700	-27~10	68.3~105.3
	5700-5720	10~15.6	105.3~110.9
	5720-5725	15.6~27	110.9~68.3
	5725-5850	27	122.3
	5850-5855	27~15.6	122.3~110.9
	5855-5875	15.6~10	110.9~105.3
	5875-5925	10~-27	105.3~68.3
Above 5925		-27	68.3

TEST PROCEDURE

1. The EUT was placed on a turn table which is 1.5m above 1GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed..
5. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
1GHz-18GHz	Double Ridged Horn Antenna	3

6. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
1GHz-18GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

TEST RESULTS

Remark: We tested at 802.11ac/802.11n HT20 mode at the antenna single transmitting mode and the Mimo mode, and recored the worst data at the Mimo mode of the 802.11ac Mode.

Test site: Shenzhen CTL Testing Technology Co., Ltd.

For Radiated Bandedge Measurement

802.11 ac/ Channel 36 :5180 MHz									
Freq (MHz)	Read Level (dBµV)	Antenna Factor (dB/m)	PRM Factor (dB)	Cable Loss (dB)	Result Level (dBµV/m)	Limit Line (dBµV/m)	Margin (dB)	Detector	Polarization
5150.00	35.32	35.58	29.04	8.28	50.14	68.30	18.16	Peak	Horizontal
5150.00	24.76	35.58	29.04	8.28	39.58	54.00	14.42	AV	Horizontal
5180.00	75.66	35.55	29.02	8.30	90.49	---	---	Peak	Horizontal
5180.00	74.96	35.55	29.02	8.30	89.79	---	---	AV	Horizontal
5150.00	34.93	35.58	29.04	8.28	49.75	68.30	18.55	Peak	Vertical
5150.00	23.40	35.58	29.04	8.28	38.22	54.00	15.78	AV	Vertical
5180.00	76.39	35.55	29.02	8.30	91.22	---	---	Peak	Vertical
5180.00	74.54	35.55	29.02	8.30	89.37	---	---	AV	Vertical

802.11 ac/ Channel 48 :5240 MHz									
Freq (MHz)	Read Level (dBµV)	Antenna Factor (dB/m)	PRM Factor (dB)	Cable Loss (dB)	Result Level (dBµV/m)	Limit Line (dBµV/m)	Margin (dB)	Detector	Polarization
5240.00	75.86	35.51	29.05	8.32	90.64	---	---	Peak	Horizontal
5240.00	73.88	35.51	29.05	8.32	88.66	---	---	AV	Horizontal
5350.00	33.53	35.42	29.06	8.39	48.28	68.30	20.02	Peak	Horizontal
5350.00	24.89	35.42	29.06	8.39	39.64	54.00	14.36	AV	Horizontal
5240.00	77.33	35.51	29.05	8.32	92.11	---	---	Peak	Vertical
5240.00	74.57	35.51	29.05	8.32	89.35	---	---	AV	Vertical
5350.00	35.52	35.42	29.06	8.39	50.27	68.30	18.03	Peak	Vertical
5350.00	24.87	35.42	29.06	8.39	39.62	54.00	14.38	AV	Vertical

802.11 ac/ Channel 149 :5745 MHz									
Freq (MHz)	Read Level (dBµV)	Antenna Factor (dB/m)	PRM Factor (dB)	Cable Loss (dB)	Result Level (dBµV/m)	Limit Line (dBµV/m)	Margin (dB)	Detector	Polarization
5725.00	35.82	35.69	29.13	8.65	51.03	122.3	71.27	Peak	Horizontal
5725.00	25.54	35.69	29.13	8.65	40.75	---	---	AV	Horizontal
5745.00	77.23	35.70	29.14	8.69	92.48	---	---	Peak	Horizontal
5745.00	74.92	35.70	29.14	8.69	90.17	---	---	AV	Horizontal
5725.00	35.48	35.69	29.13	8.65	50.69	122.3	71.61	Peak	Vertical
5725.00	25.20	35.69	29.13	8.65	40.41	---	---	AV	Vertical
5745.00	76.43	35.70	29.14	8.69	91.68	---	---	Peak	Vertical
5745.00	73.37	35.70	29.14	8.69	88.62	---	---	AV	Vertical

802.11 ac/ Channel 165 :5825 MHz									
Freq (MHz)	Read Level (dBµV)	Antenna Factor (dB/m)	PRM Factor (dB)	Cable Loss (dB)	Result Level (dBµV/m)	Limit Line (dBµV/m)	Margin (dB)	Detector	Polarization
5825.00	75.42	35.82	29.16	8.77	90.85	---	---	Peak	Horizontal
5825.00	73.93	35.82	29.16	8.77	89.36	---	---	AV	Horizontal
5850.00	35.32	35.85	29.18	8.80	50.79	122.3	71.51	Peak	Horizontal
5850.00	24.36	35.85	29.18	8.80	39.83	---	---	AV	Horizontal
5825.00	75.81	35.82	29.16	8.77	91.24	---	---	Peak	Vertical
5825.00	73.22	35.82	29.16	8.77	88.65	---	---	AV	Vertical
5850.00	33.82	35.85	29.18	8.80	49.29	122.3	73.01	Peak	Vertical
5850.00	24.45	35.85	29.18	8.80	39.92	---	---	AV	Vertical

REMARKS:

1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. The other emission levels were very low against the limit.
3. The average measurement was not performed when the peak measured data under the limit of average detection.
4. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=10Hz/Sweep time=Auto/Detector=Peak;

For Conducted Bandedge Measurement

Antenna 1

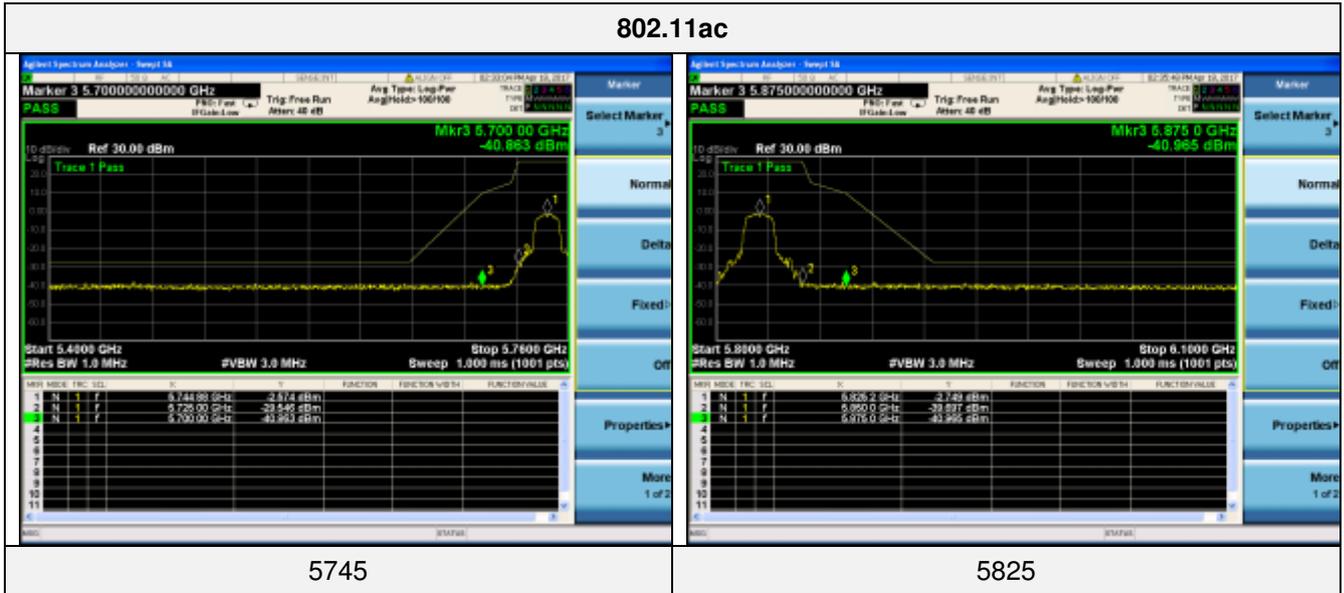
802.11ac			
Frequency (MHz)	Delta Peak to Band emission (dBc)	Limit (dBc)	Verdict
5150.00	-49.20	-27	PASS
5350.00	-55.95	-27	PASS

5180	5240

802.11n HT20			
Frequency (MHz)	Delta Peak to Band emission (dBc)	Limit (dBc)	Verdict
5150.00	-45.99	-27	PASS
5350.00	-54.94	-27	PASS

5180	5240

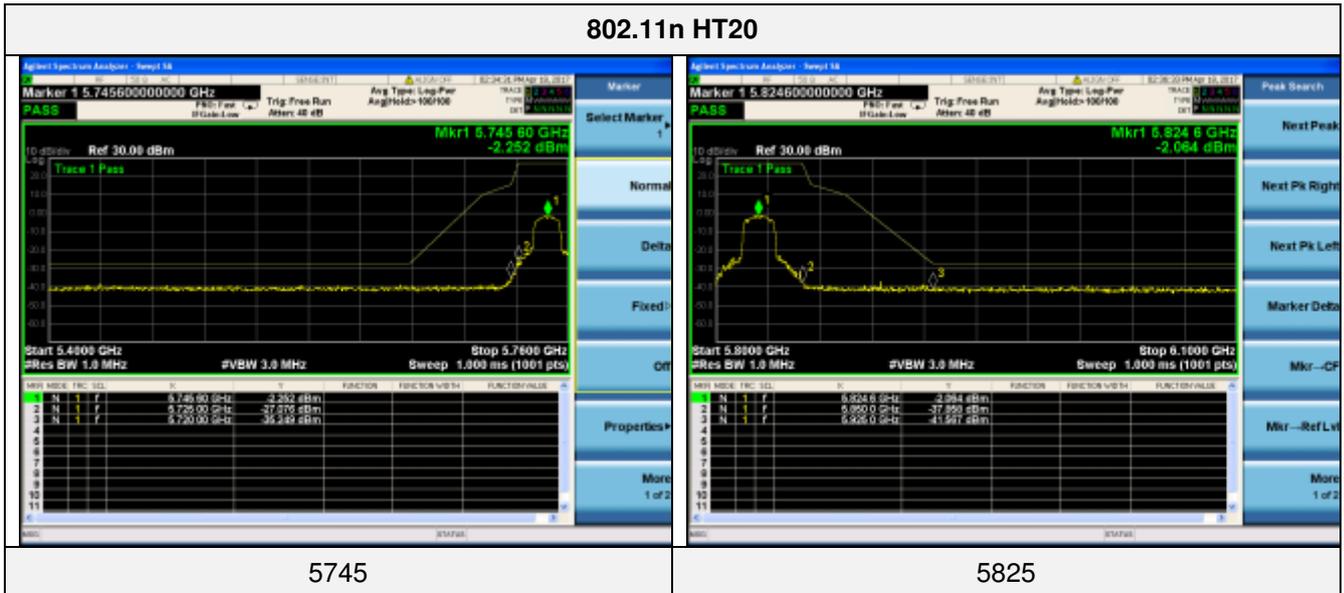
802.11ac



5745

5825

802.11n HT20



5745

5825

Antenna 2

802.11ac

Frequency (MHz)	Delta Peak to Band emission (dBc)	Limit (dBc)	Verdict
5150.00	-48.22	-27	PASS
5350.00	-55.32	-27	PASS

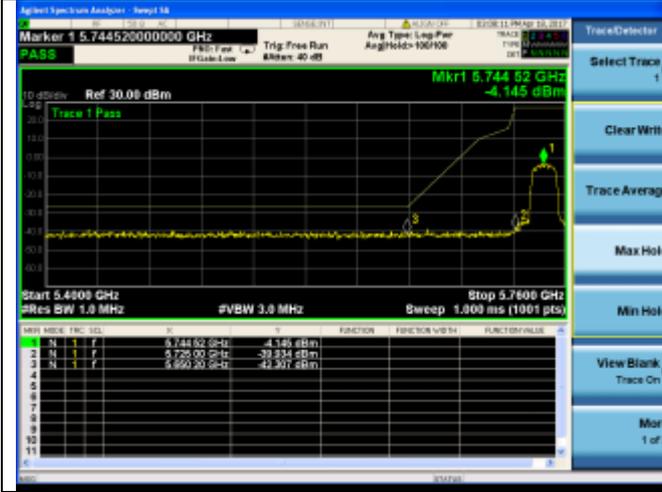
5180	5240

802.11n HT20

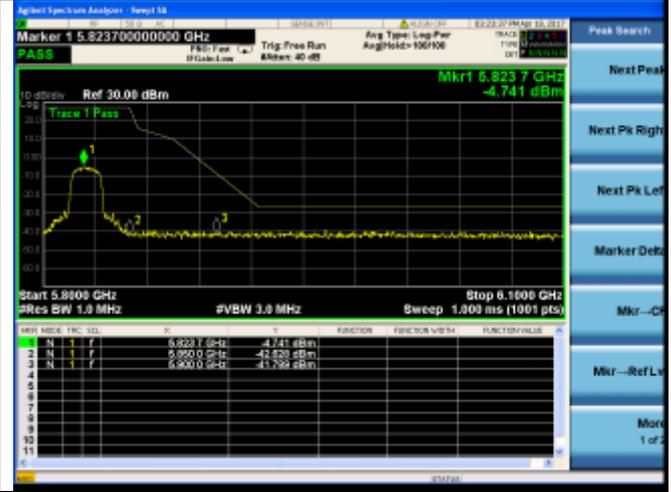
Frequency (MHz)	Delta Peak to Band emission (dBc)	Limit (dBc)	Verdict
5150.00	-47.52	-27	PASS
5350.00	-56.05	-27	PASS

5180	5240

802.11ac

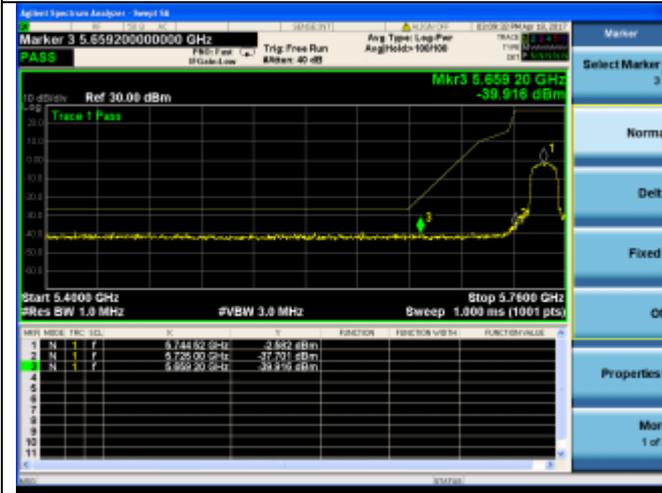


5745



5825

802.11n HT20



5745



5825

Antenna 3

802.11ac			
Frequency (MHz)	Delta Peak to Band emission (dBc)	Limit (dBc)	Verdict
5150.00	-46.99	-27	PASS
5350.00	-46.49	-27	PASS

	5180		5240
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802.11n HT20			
Frequency (MHz)	Delta Peak to Band emission (dBc)	Limit (dBc)	Verdict
5150.00	-44.75	-27	PASS
5350.00	-47.24	-27	PASS

	5180		5240
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802.11ac



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802.11n HT20



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Antenna 4

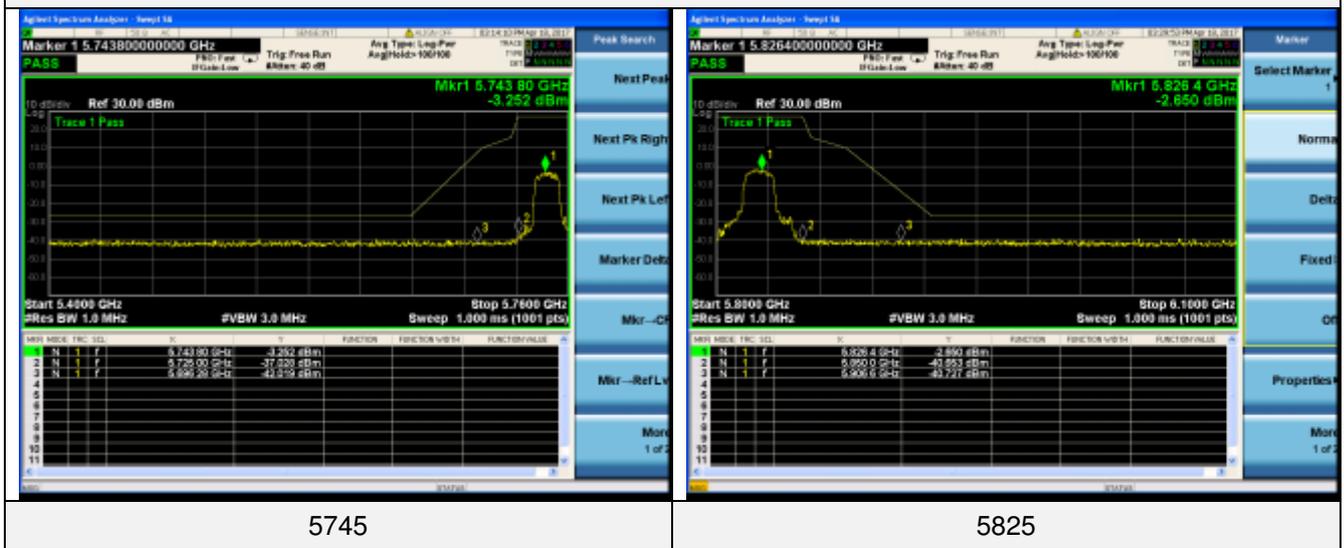
802.11ac			
Frequency (MHz)	Delta Peak to Band emission (dBc)	Limit (dBc)	Verdict
5150.00	-45.69	-27	PASS
5350.00	-48.62	-27	PASS

5180	5240

802.11n HT20			
Frequency (MHz)	Delta Peak to Band emission (dBc)	Limit (dBc)	Verdict
5150.00	-46.44	-27	PASS
5350.00	-46.30	-27	PASS

5180	5240

802.11ac



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802.11n HT20

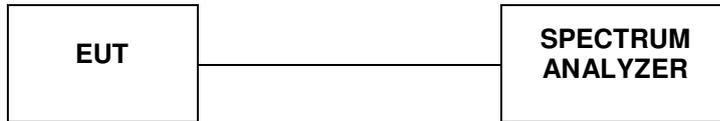


5745

5825

4.9. Frequency Stability

TEST CONFIGURATION



TEST PROCEDURE

- a. The EUT was directly connected to the spectrum analyzer and antenna output port
- b. Spectrum setting as follows:
 RBW=10KHz
 VBW=30KHz
 Span= Entire absence of modulation emissionsbandwidth
 Sweep Time= Auto
 Attenuation= Auto
- c. The test extreme voltage is to change the primary supply voltage from 85 to 115 percent of the nominal value.

LIMIT

Frequency Range (MHz)	Limit
5150-5250	Specified in the user's manual
5250-5350	
5470-5725	
5725-5850	

TEST RESULTS

Antenna 1

802.11 ac/ Channel 36: 5180MHz

Voltage. Frequency Stability

Voltage (V)	Measurement Frequency (MHz)
13.8	5180.000024
12.0	5180.000016
10.2	5180.000022
Maximum Deviation (MHz)	0.000024
Maximum Deviation (ppm)	0.0046

Temperature. Frequency Stability

Temperature (°C)	Measurement Frequency (MHz)
-10	5180.000018
5	5180.000021
15	5180.000019
25	5180.000016
35	5180.000022
45	5180.000020
55	5180.000019
Maximum Deviation (MHz)	0.000021
Maximum Deviation (ppm)	0.0041

802.11 ac/ Channel 149: 5745MHz

Voltage. Frequency Stability

Voltage (V)	Measurement Frequency (MHz)
13.8	5745.000017
12.0	5745.000012
10.2	5745.000018
Maximum Deviation (MHz)	0.000018
Maximum Deviation (ppm)	0.0031

Temperature. Frequency Stability

Temperature (°C)	Measurement Frequency (MHz)
-10	5745.000019
5	5745.000012
15	5745.000018
25	5745.000017
35	5745.000020
45	5745.000016
55	5745.000015
Maximum Deviation (MHz)	0.000020
Maximum Deviation (ppm)	0.0035

Antenna 2

802.11 ac/ Channel 36: 5180MHz

Voltage. Frequency Stability

Voltage (V)	Measurement Frequency (MHz)
13.8	5180.000013
12.0	5180.000018
10.2	5180.000012
Maximum Deviation (MHz)	0.000018
Maximum Deviation (ppm)	0.0035

Temperature. Frequency Stability

Temperature (°C)	Measurement Frequency (MHz)
-10	5180.000014
5	5180.000018
15	5180.000011
25	5180.000016
35	5180.000023
45	5180.000020
55	5180.000017
Maximum Deviation (MHz)	0.000023
Maximum Deviation (ppm)	0.0044

802.11 ac/ Channel 149: 5745MHz

Voltage. Frequency Stability

Voltage (V)	Measurement Frequency (MHz)
13.8	5745.000018
12.0	5745.000015
10.2	5745.000019
Maximum Deviation (MHz)	0.000019
Maximum Deviation (ppm)	0.0033

Temperature. Frequency Stability

Temperature (°C)	Measurement Frequency (MHz)
-10	5745.000021
5	5745.000013
15	5745.000018
25	5745.000022
35	5745.000018
45	5745.000020
55	5745.000016
Maximum Deviation (MHz)	0.000022
Maximum Deviation (ppm)	0.0038

Antenna 3

802.11 ac/ Channel 36: 5180MHz

Voltage. Frequency Stability

Voltage (V)	Measurement Frequency (MHz)
13.8	5180.000016
12.0	5180.000012
10.2	5180.000019
Maximum Deviation (MHz)	0.000019
Maximum Deviation (ppm)	0.0037

Temperature. Frequency Stability

Temperature (°C)	Measurement Frequency (MHz)
-10	5180.000021
5	5180.000012
15	5180.000017
25	5180.000015
35	5180.000016
45	5180.000013
55	5180.000017
Maximum Deviation (MHz)	0.000021
Maximum Deviation (ppm)	0.0041

802.11 ac/ Channel 149: 5745MHz

Voltage. Frequency Stability

Voltage (V)	Measurement Frequency (MHz)
13.8	5745.000015
12.0	5745.000024
10.2	5745.000016
Maximum Deviation (MHz)	0.000024
Maximum Deviation (ppm)	0.0042

Temperature. Frequency Stability

Temperature (°C)	Measurement Frequency (MHz)
-10	5745.000018
5	5745.000014
15	5745.000019
25	5745.000022
35	5745.000017
45	5745.000023
55	5745.000020
Maximum Deviation (MHz)	0.000023
Maximum Deviation (ppm)	0.0040

Antenna 4

802.11 ac/ Channel 36: 5180MHz

Voltage. Frequency Stability

Voltage (V)	Measurement Frequency (MHz)
13.8	5180.000016
12.0	5180.000013
10.2	5180.000019
Maximum Deviation (MHz)	0.000019
Maximum Deviation (ppm)	0.0037

Temperature. Frequency Stability

Temperature (°C)	Measurement Frequency (MHz)
-10	5180.000015
5	5180.000012
15	5180.000020
25	5180.000013
35	5180.000015
45	5180.000019
55	5180.000017
Maximum Deviation (MHz)	0.000020
Maximum Deviation (ppm)	0.0039

802.11 ac/ Channel 149: 5745MHz

Voltage. Frequency Stability

Voltage (V)	Measurement Frequency (MHz)
13.8	5745.000017
12.0	5745.000024
10.2	5745.000015
Maximum Deviation (MHz)	0.000024
Maximum Deviation (ppm)	0.0042

Temperature. Frequency Stability

Temperature (°C)	Measurement Frequency (MHz)
-10	5745.000016
5	5745.000022
15	5745.000017
25	5745.000026
35	5745.000023
45	5745.000018
55	5745.000014
Maximum Deviation (MHz)	0.000026
Maximum Deviation (ppm)	0.0045

4.10. Antenna Requirement

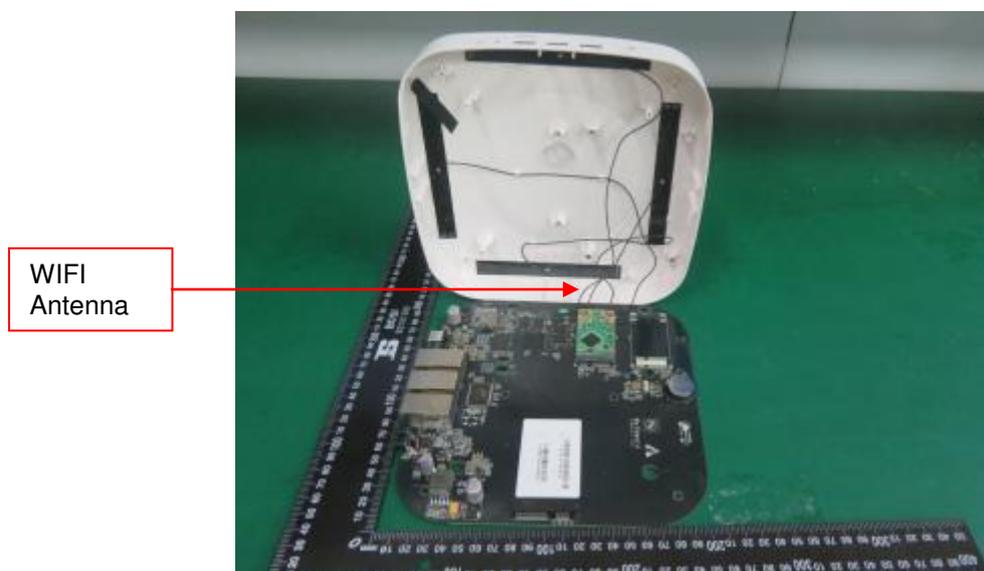
Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, 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.

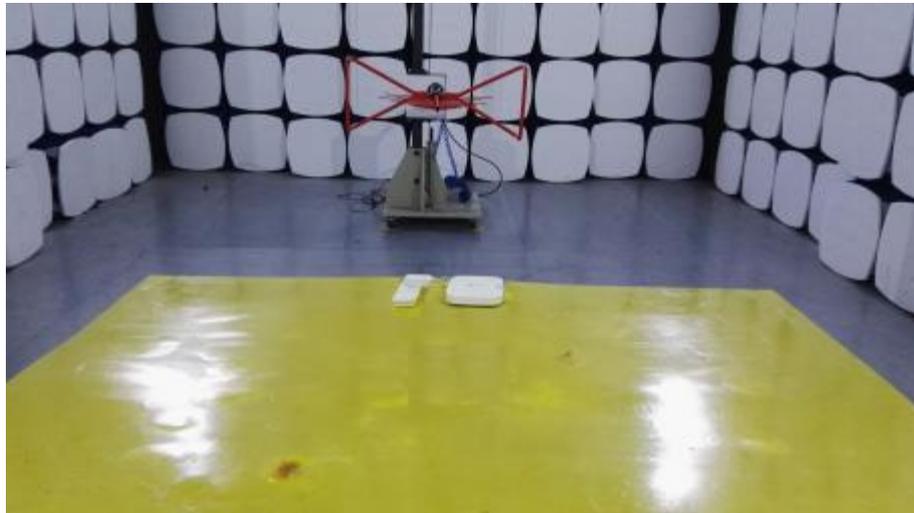
And according to FCC 47 CFR Section 15.407 (a), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

Antenna Information

The antenna is FPC antenna, through the buckle stretched out, The directional gains of antenna used for transmitting is 1.06dBi.



5. Test Setup Photos of the EUT





6. External and Internal Photos of the EUT

Reference to the test report No. GTSR17020073-01.

.....End of Report.....