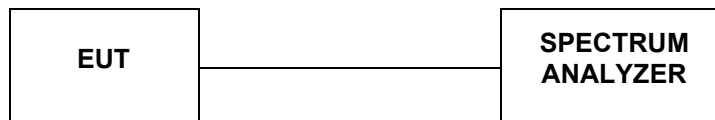


4.6. 6dB Bandwidth

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:

- Set RBW = 100 kHz.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize
- 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

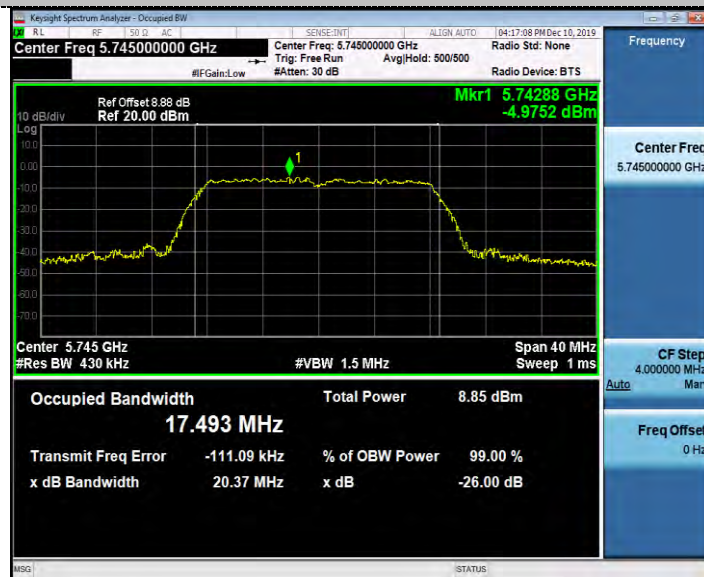
For Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz

TEST RESULTS

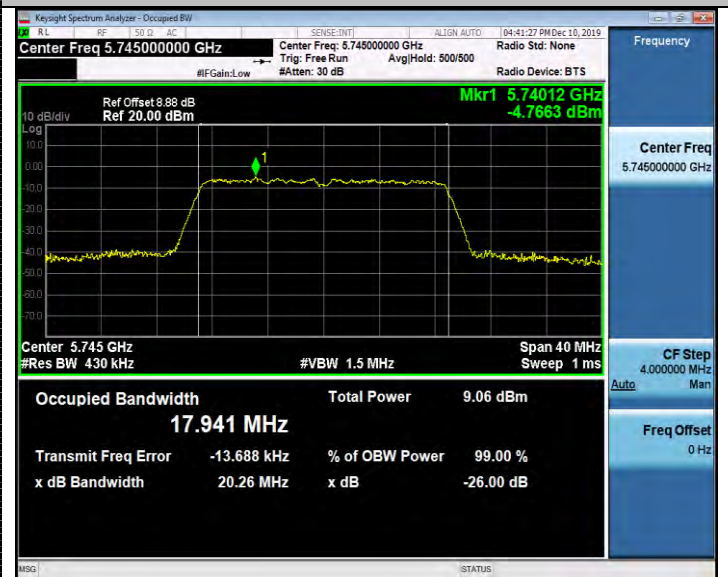
Type	Channel	99%Bandwidth (MHz)	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11a	149	17.493	16.680	≥ 500	Pass
	157	17.268	16.640		
	165	17.405	16.680		
802.11nHT20	149	17.941	17.880	≥ 500	Pass
	157	17.938	17.840		
	165	17.936	17.840		
802.11ac20	149	17.968	17.880	≥ 500	Pass
	157	17.951	17.840		
	165	17.945	17.880		
802.11n40	151	36.587	36.640	≥ 500	Pass
	159	36.539	36.640		
802.11ac40	151	36.582	36.480	≥ 500	Pass
	159	36.569	36.640		
802.11ac80	155	75.753	76.800	≥ 500	Pass

99%Bandwidth

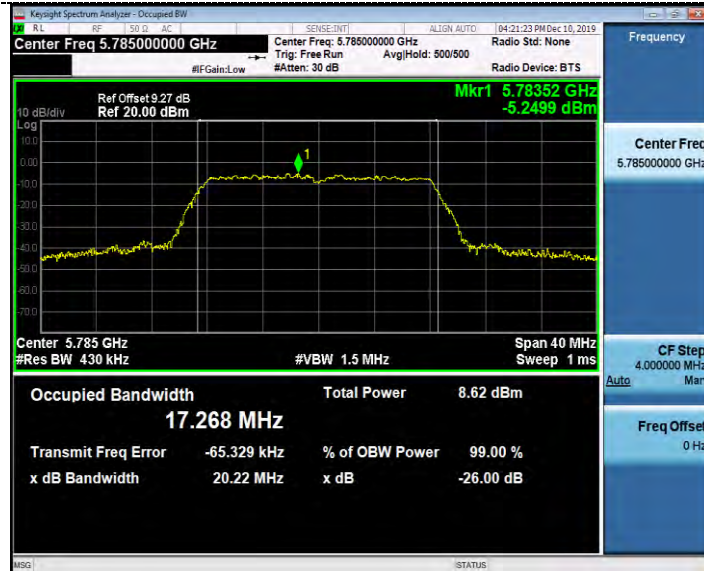
802.11a



802.11n HT20



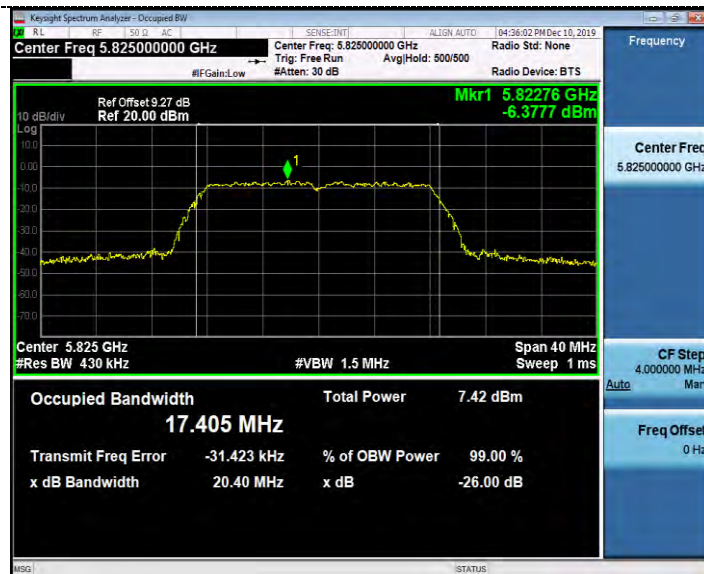
CH149



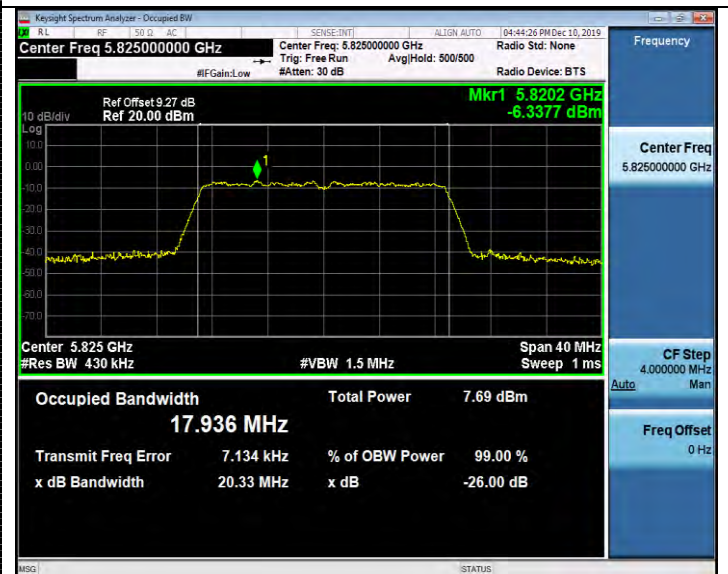
CH149



CH157



CH157

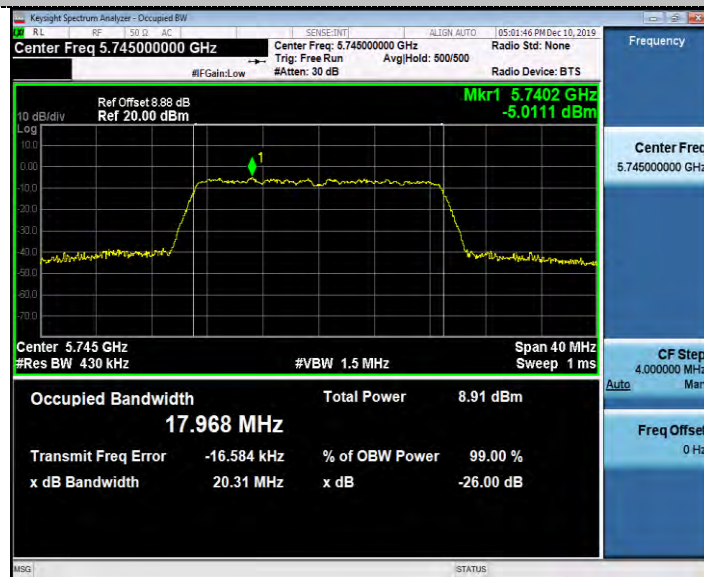


CH165

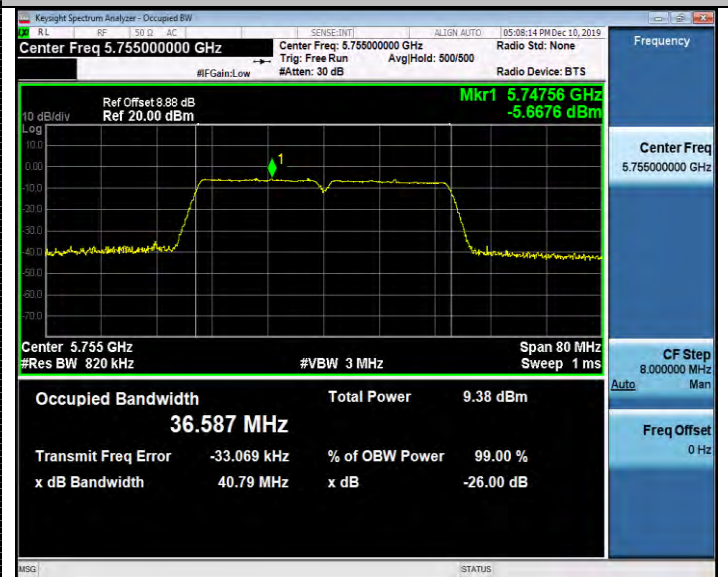
CH165

99%Bandwidth

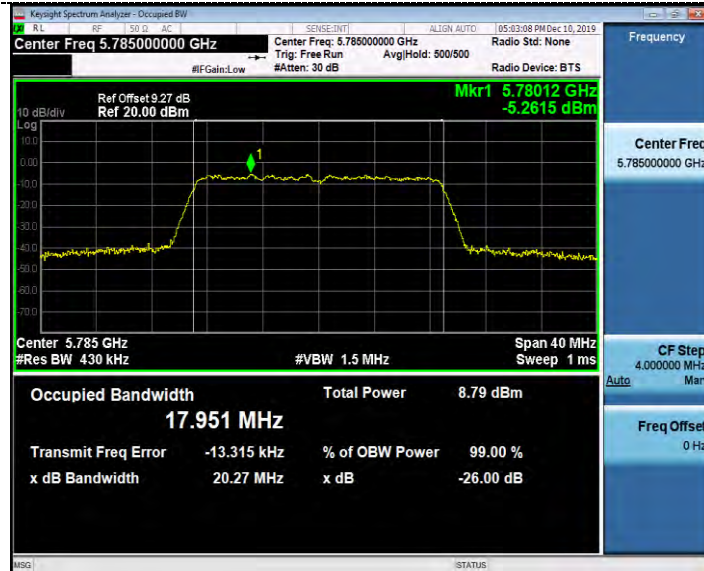
802.11ac20



802.11n HT40



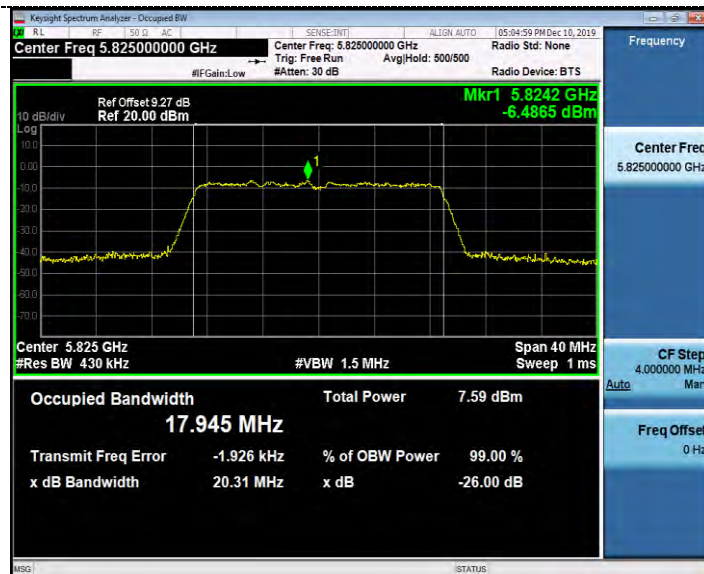
CH149



CH151



CH157



CH159

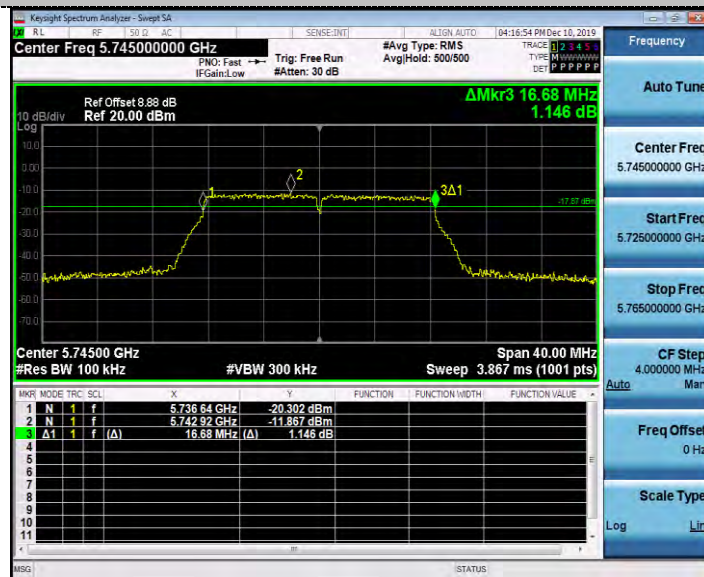


CH165

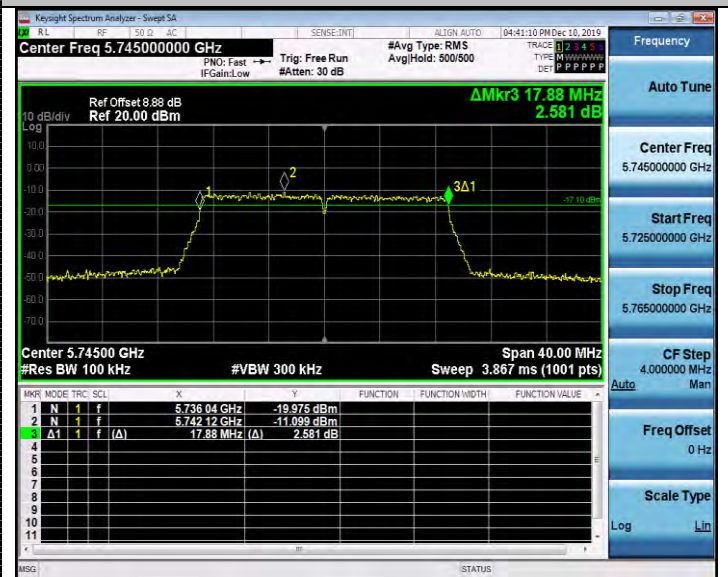


6dB Bandwidth

802.11a



802.11n HT20



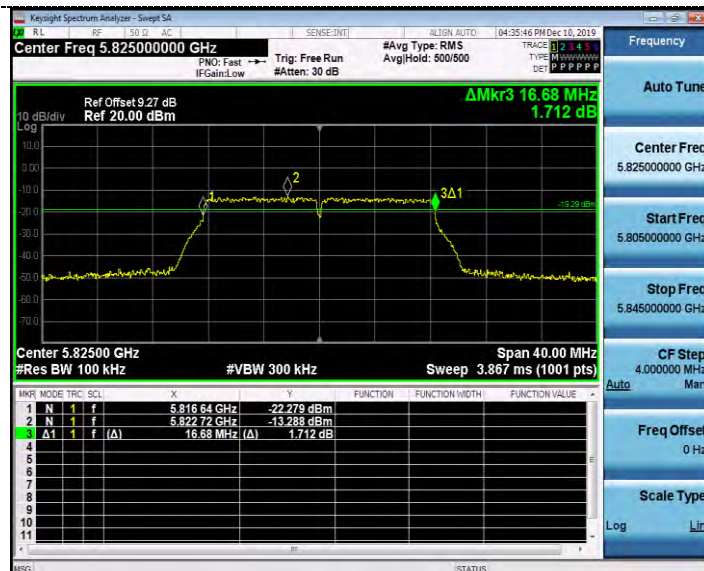
CH149



CH149



CH157



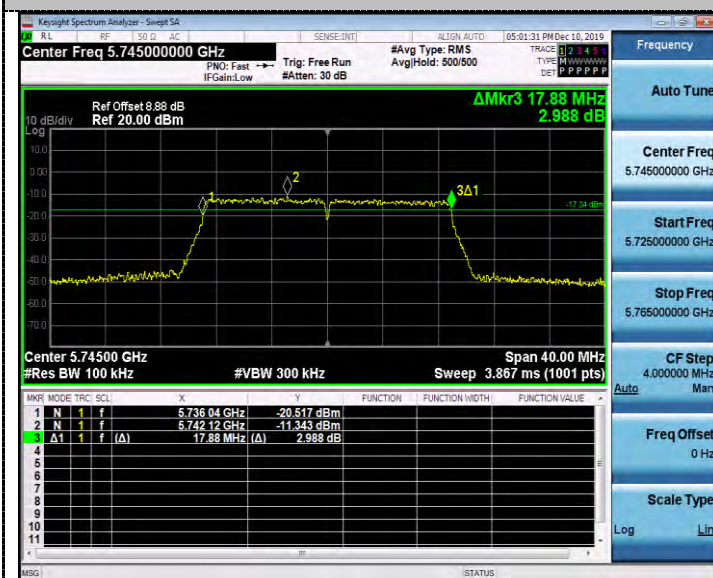
CH157



CH165

CH165

802.11ac20



Keysight Spectrum Analyzer - Swept SA

RL RF FSS G AC SENSE INT ALIGN AUTO 05:49:59 PM Dec 10, 2019

Center Freq 5.755000000 GHz

PNO: Fast → IFcalin:Low Trig: Free Run #Aven: 30 dB

#Avg Type: RMS AvgHold: 500/500

TYPE M WWWWWW DET P P P P P P

Ref Offset 8.88 dB
Ref 20.00 dBm

**ΔMkr3 36.64 MHz
0.134 dB**

The plot shows a spectrum with a central peak. A green horizontal line indicates the reference level at -20.00 dBm. A yellow trace shows the signal spectrum. A peak is marked with a diamond symbol and labeled '3Δ1'. The frequency difference between the center and the peak is indicated as ΔMkr3 36.64 MHz and 0.134 dB.

10 dB/div
Log

Center 5.755000 GHz
#Res BW 100 kHz

#VBW 300 kHz

Span 80.00 MHz
Sweep 7.667 ms (1001 pts)

MKR MODE TRC SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1 N 1 f	5.736 68 GHz	-22.165 dBm			
2 N 1 f	5.757 18 GHz	-14.754 dBm			
3 Δ1 1 f (Δ)	36.64 MHz (Δ)	0.134 dB			

Auto Man

Freq Offset 0 Hz

Scale Type Log Lin

Kaysight Spectrum Analyzer - Sweep SA

Center Freq 5.785000000 GHz

Pk0: Fast IFGainLow

Trig: Free Run #Atten: 30 dB

#Avg Type: RMS Avg/Hz: 500/500

Date: 05-02-22 PM Dec 18, 2019

Trace: 01.2.4.3

Type: M W W W W W W W W W

Det: P P P P P P P P P P

Ref Offset 9.27 dB Ref 20.00 dBm

ΔMkr3 17.84 MHz 0.389 dB

Span 40.00 MHz #Res BW 100 kHz #VBW 300 kHz Sweep 3.867 ms (1001 pts)

MNR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	5.776 08 GHz	-18.030 dBm			
2	N	1	f	5.782 12 GHz	-11.519 dBm			
3	A1	1	f (Δ)	17.84 MHz (Δ)	0.389 dB			

Keysight Spectrum Analyzer - Swept 3A

SENSE:INTI ALIGN:AUTO 05:09:24 PM Dec 10, 2019

Center Freq 5.795000000 GHz #Avg Type: RMS #Avg Freq: 500 MHz

PMO: Fast Trg: Free Run #Atten: 30 dB

TRACE 01 6.3.3 TYPE M000000000 DET P P P P P P

Ref Offset 9.27 dB Ref 20.00 dBm

DMkr3 36.64 MHz 0.175 dB

10 dB/Div Log

Ref 20.00 dBm

Center 5.795000 GHz Span 80.000 MHz

#Res BW 100 kHz #VBW 300 kHz Sweep 7.667 ms (1001 pts)

MNR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	5.776 68 GHz	-22.828 dBm			
2	N	1	f	5.797 18 GHz	-15.220 dBm			
3	A1	1	f (A)	36.64 MHz (A)	0.175 dB			

Keysight Spectrum Analyzer - Swept SA

SENSE:INT1

ALIGN: AUTO

05/04/23 PM Dec 10, 2019

Center Freq 5.825000000 GHz

PW: Fast → IF Gain: Low

Trig: Free Run #Atten: 30 dB

#Avg Type: RMS Avg/Hold: 500/500

TRACE 01: 2.4.3.3

TYPE: M M M M M M M M M M

DET: P P P P P P P

Frequency

Auto Tune

Center Freq 5.825000000 GHz

Start Freq 5.805000000 GHz

Stop Freq 5.845000000 GHz

CF Step 4.000000 MHz

Man

Freq Offset 0 Hz

Scale Type

Log Lin

Log

Ref Offset 9.27 dB

Ref 20.00 dBm

ΔMkr3 17.88 MHz -1.523 dB

10 dB/div

Log

1

2

3 Δ1

-18.75 dBm

Center 5.82500 GHz

#Res BW 100 kHz

#VBW 300 kHz

Span 40.00 MHz

Sweep 3.867 ms (1001 pts)

MNR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	5.816 08 GHz	-19.034 dBm			
2	N	1	f	5.819 64 GHz	-12.760 dBm			
3	Δ1	1	f (Δ)	17.88 MHz (Δ)	-1.523 dB			
4								
5								
6								
7								
8								
9								
10								
11								

NSG

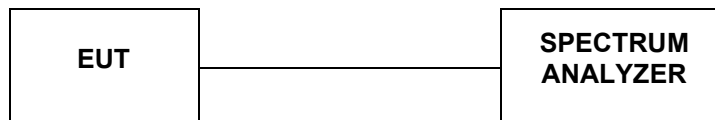
STATUS

CH165



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:

- Set RBW = 300 kHz (approximately 1% of the emission bandwidth).
- Set the video bandwidth (VBW) = 1000 KHz (VBW > RBW)
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize
- 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

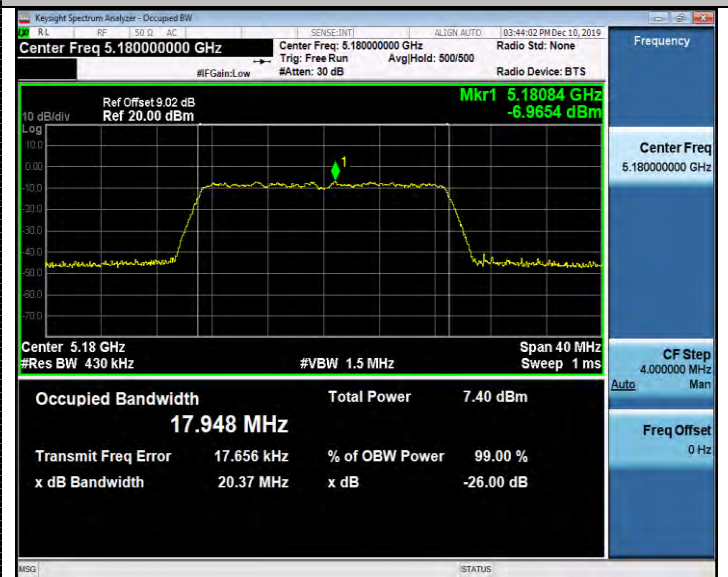
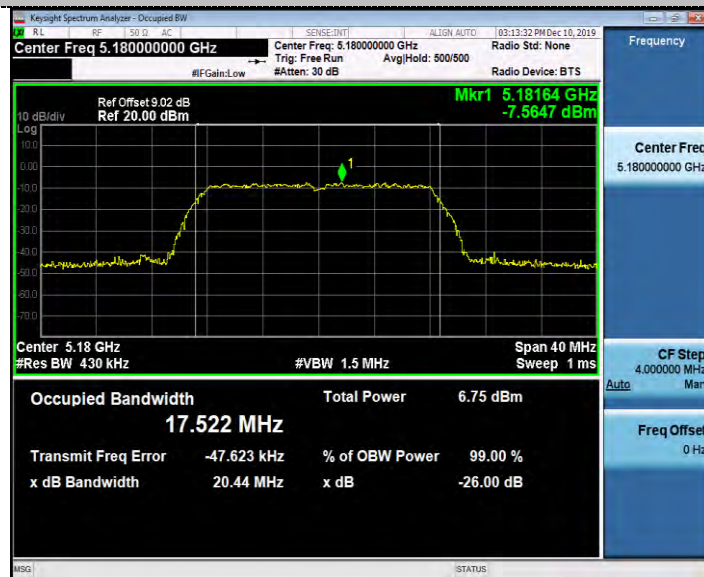
TEST RESULTS

Type	Channel	99%Bandwidth (MHz)	26dB Bandwidth (MHz)	Limit (KHz)	Result
802.11a	36	17.522	20.040	-	Pass
	40	17.295	19.840		
	48	17.489	20.040		
802.11nHT20	36	17.948	20.120	-	Pass
	40	17.935	20.040		
	48	17.944	20.000		
802.11ac20	36	17.937	40.240	-	Pass
	40	17.934	40.160		
	48	17.949	20.040		
802.11n40	38	36.577	20.120	-	Pass
	46	36.540	20.080		
802.11ac40	38	36.553	40.320	-	Pass
	46	36.529	40.320		
802.11ac80	155	75.553	81.920	-	Pass

99%Bandwidth

802.11a

802.11n HT20



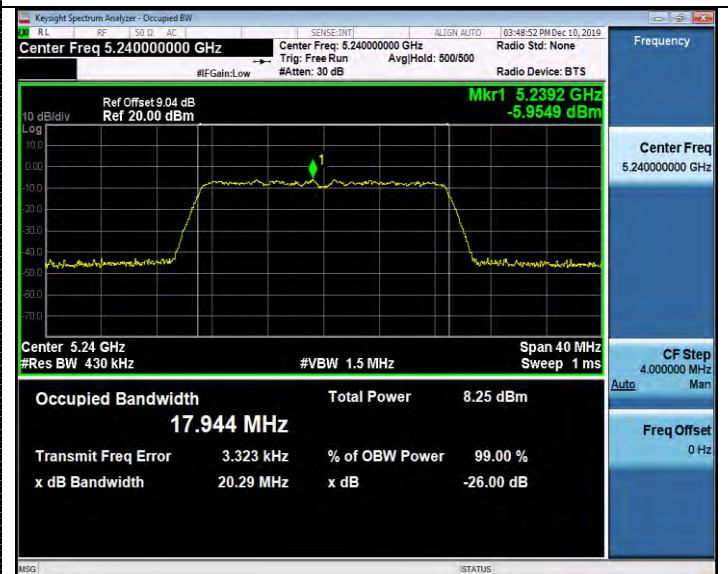
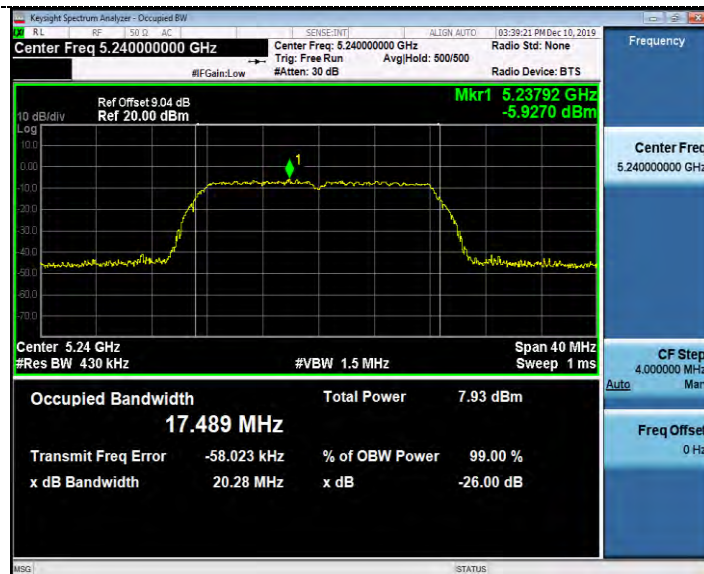
CH36

CH36



CH40

CH40

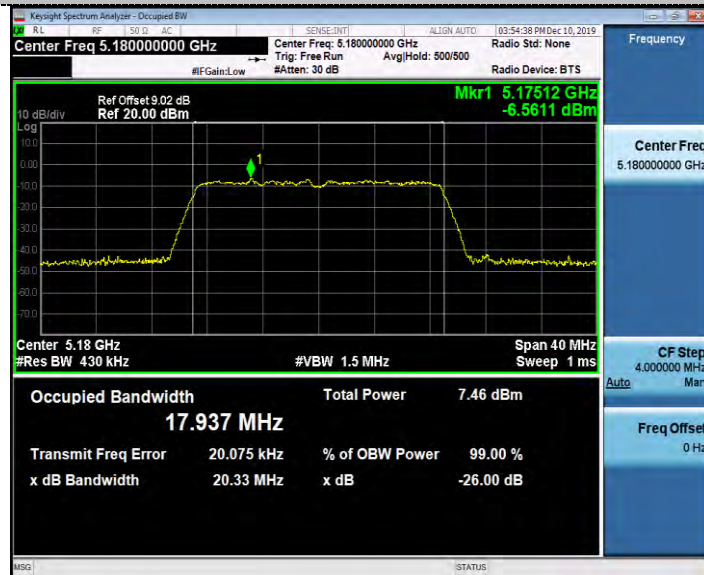


CH48

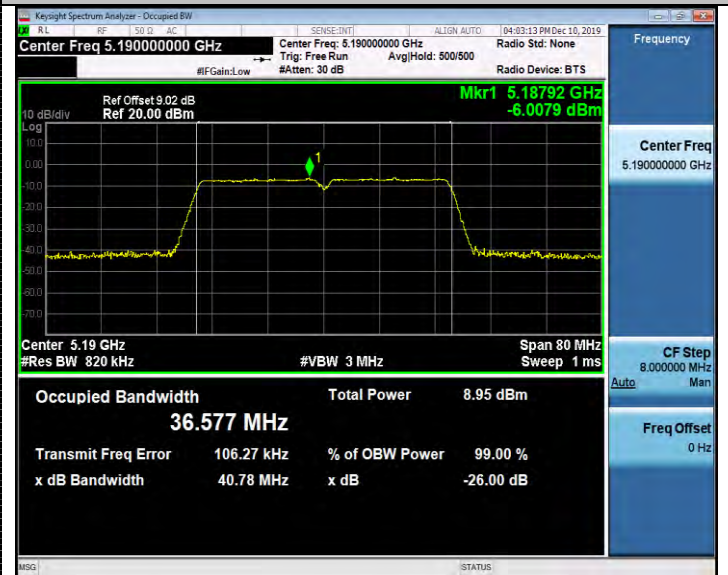
CH48

99%Bandwidth

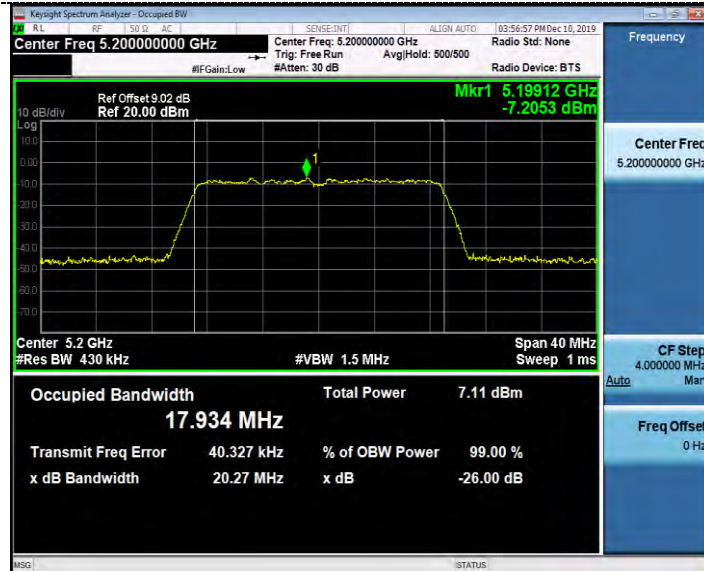
802.11ac20



802.11n HT40



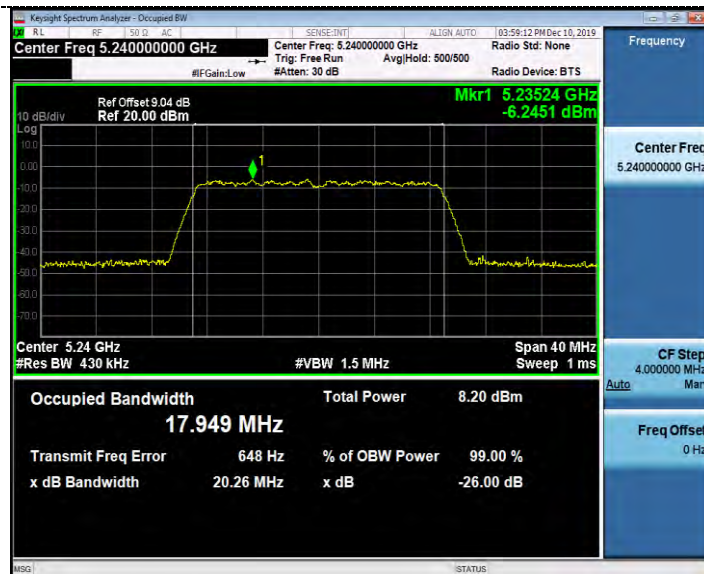
CH36



CH38



CH40



CH46



CH48

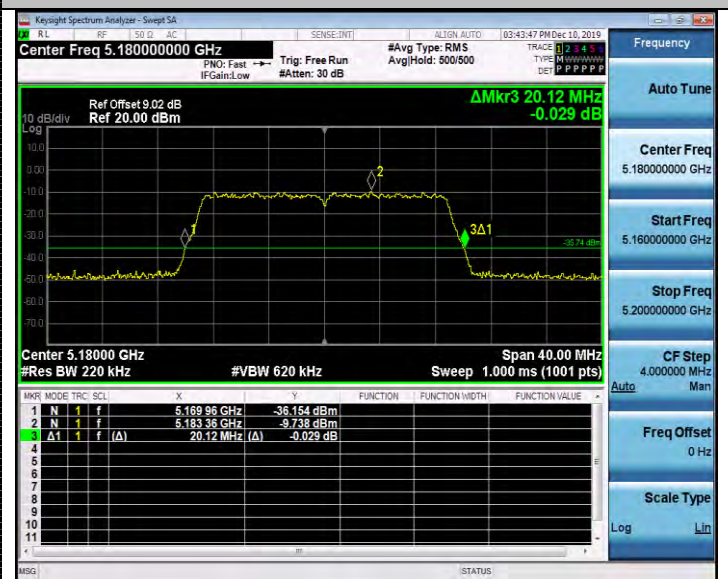


26dB Bandwidth

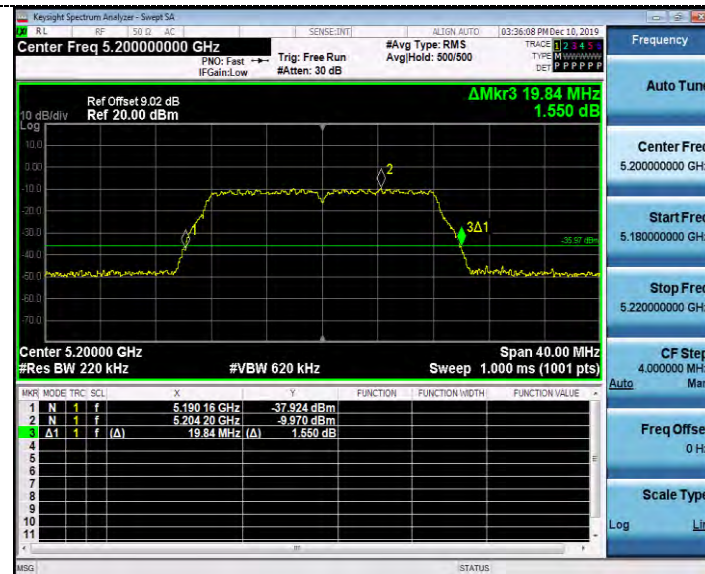
802.11a



802.11n HT20



CH36



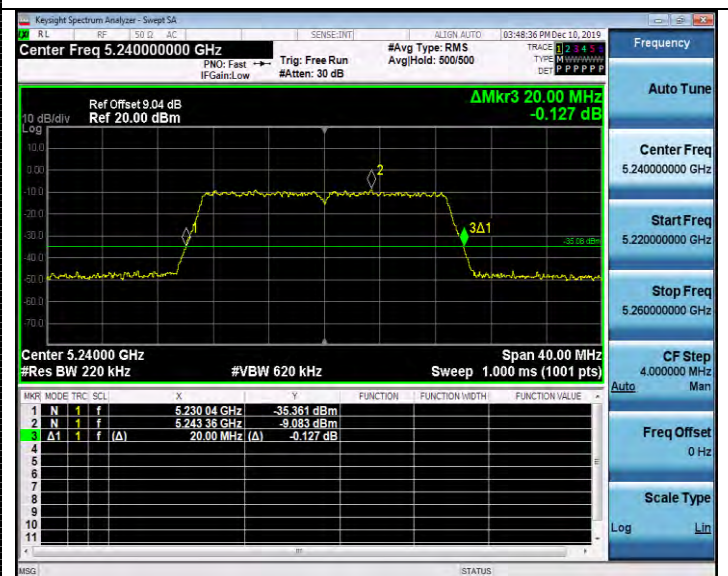
CH36



CH40



CH40



CH48

CH48

26dB Bandwidth

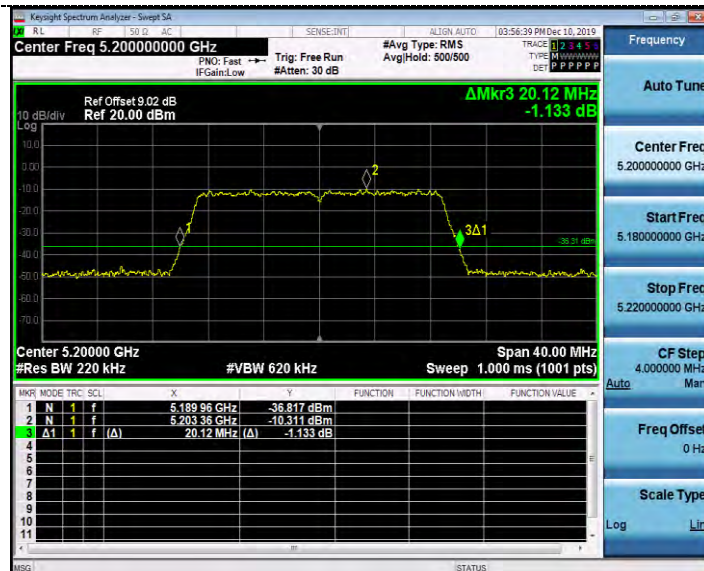
802.11ac20



802.11n HT40



CH36



CH38



CH40



CH46



CH48

26dB Bandwidth

802.11ac40



802.11ac80



CH38



CH42

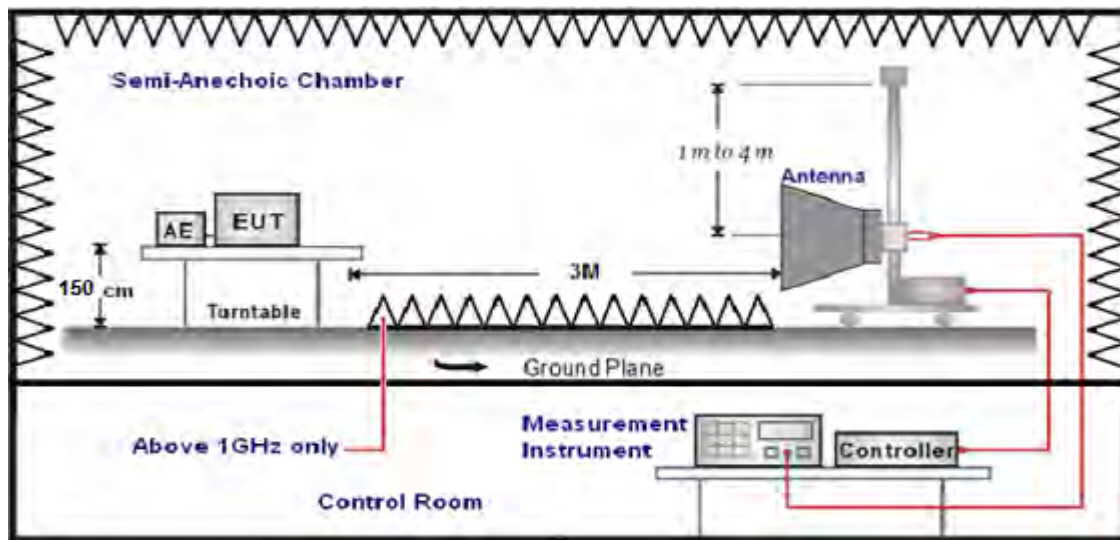


CH46



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	$20\log(2400/F(\text{KHz})) + 40\log(300/3)$	$2400/F(\text{KHz})$
0.49-1.705	3	$20\log(24000/F(\text{KHz})) + 40\log(30/3)$	$24000/F(\text{KHz})$
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): 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

Frequency (MHz)	EIRP Limit (dBm)	Equivalent Field Strength at 3m (dBμV/m)
5150-5250	-27	68.2
5250-5350	-27	68.2
5470-5725	-27	68.2
5725-5850	-27 (beyond 10MHz of the bandedge)	68.2
	-17 (within 10 MHz of band edge)	78.2

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:For radiated bandedge We measured at 802.11 a/802.11 ac/802.11 n mode, recorded worst case at 802.11 a mode;

For Radiated Bandedge Measurement

802.11 a/ 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
4500.0	39.64	35.58	29.04	8.28	54.46	68.20	-13.74	Peak	Horizontal
4500.0	29.10	35.58	29.04	8.28	43.92	54.00	-10.08	AV	Horizontal
5150.0	42.79	35.58	29.04	8.28	57.61	68.20	-10.59	Peak	Horizontal
5150.0	30.26	35.58	29.04	8.28	45.08	54.00	-8.92	AV	Horizontal

802.11 a/ 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
5350.0	40.45	35.42	29.06	8.39	55.20	68.20	-13.00	Peak	Horizontal
5350.0	31.58	35.42	29.06	8.39	46.33	54.00	-7.67	AV	Horizontal
5460.0	42.98	35.42	29.06	8.39	57.73	68.20	-10.47	Peak	Horizontal
5460.0	28.98	35.42	29.06	8.39	43.73	54.00	-10.27	AV	Horizontal

802.11 a/ 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
5650.0	40.58	35.29	29.13	8.65	55.39	68.20	-12.81	Peak	Horizontal
5700.0	30.28	35.29	29.13	8.65	45.09	54.00	-8.91	Peak	Horizontal
5720.0	43.78	35.29	29.13	8.65	58.59	68.20	-9.61	Peak	Horizontal
5725.0	30.04	35.29	29.13	8.65	44.85	54.00	-9.15	Peak	Horizontal

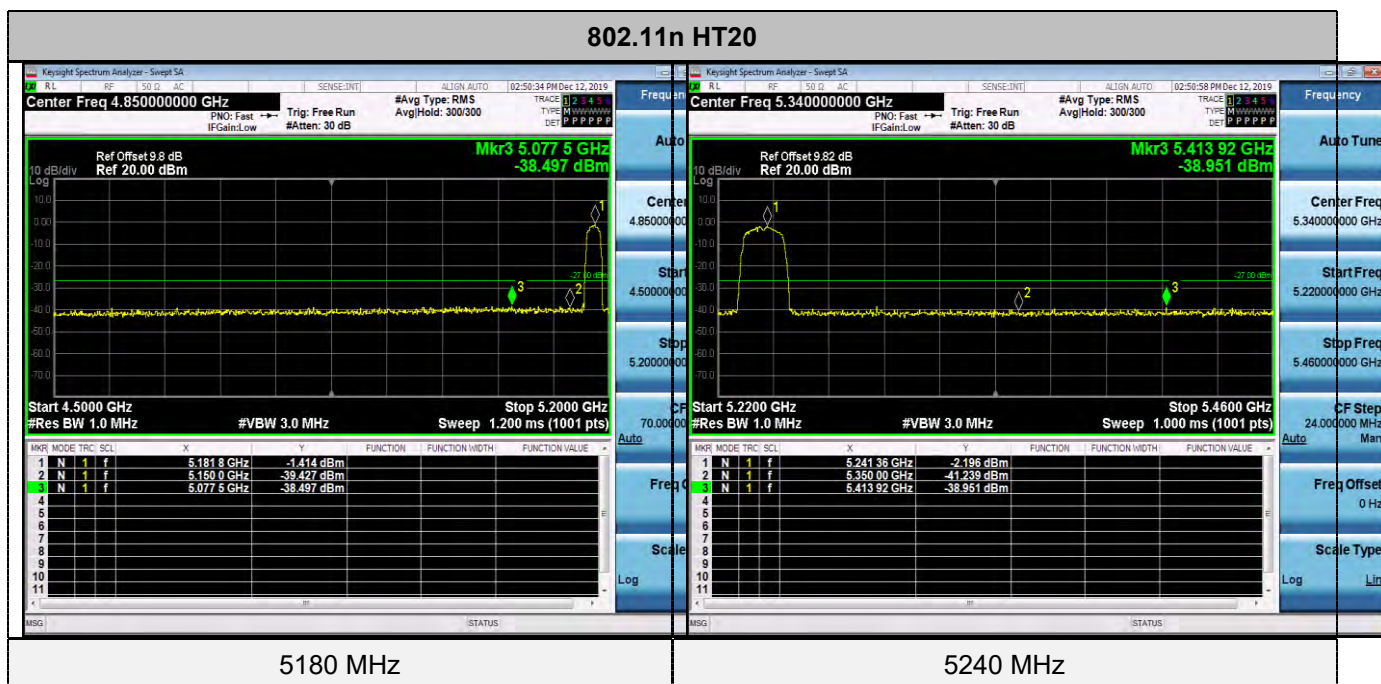
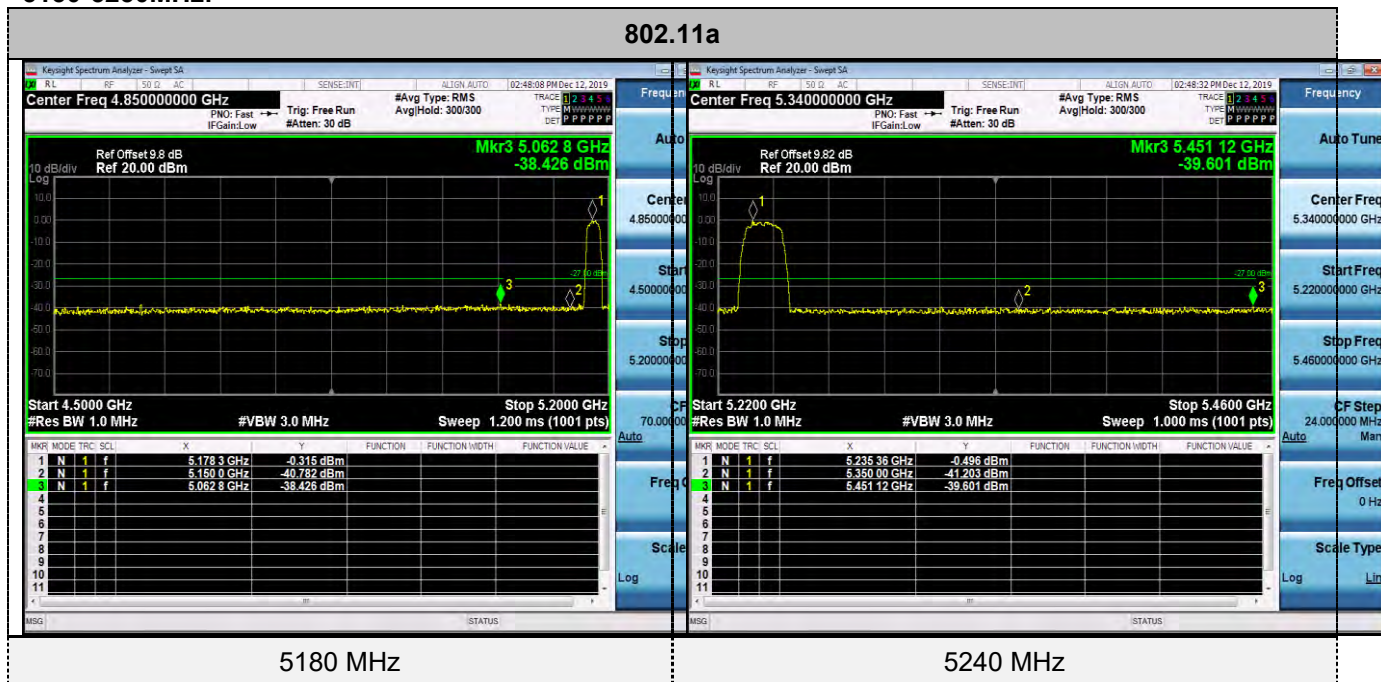
802.11 a/ Channel 165 :5825 MHz									
Freq (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	PRM Factor (dB)	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Margin (dB)	Detector	Polarization
5850.0	41.19	35.29	29.18	8.80	56.10	68.20	-12.10	Peak	Horizontal
5855.0	30.79	35.29	29.18	8.80	45.70	54.00	-8.30	Peak	Horizontal
5875.0	42.23	35.29	29.18	8.80	57.14	68.20	-11.06	Peak	Horizontal
5925.0	28.79	35.29	29.18	8.80	43.70	54.00	-10.30	Peak	Horizontal

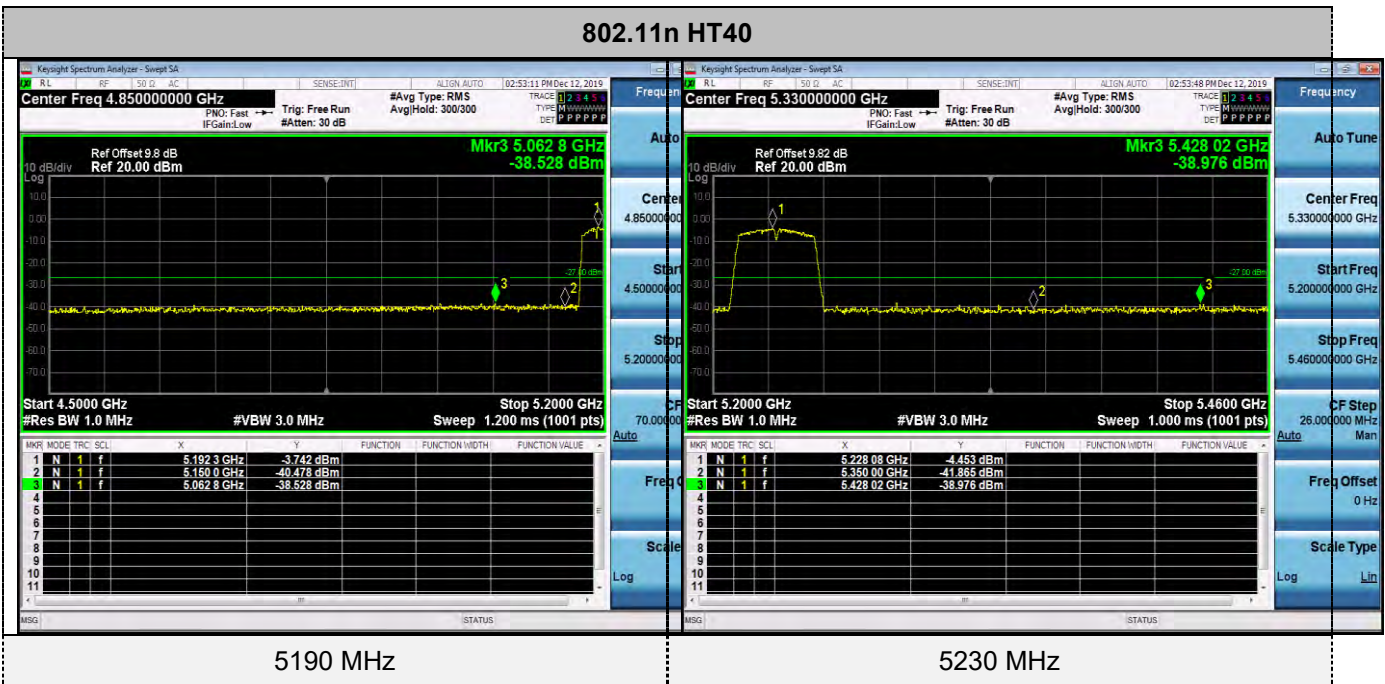
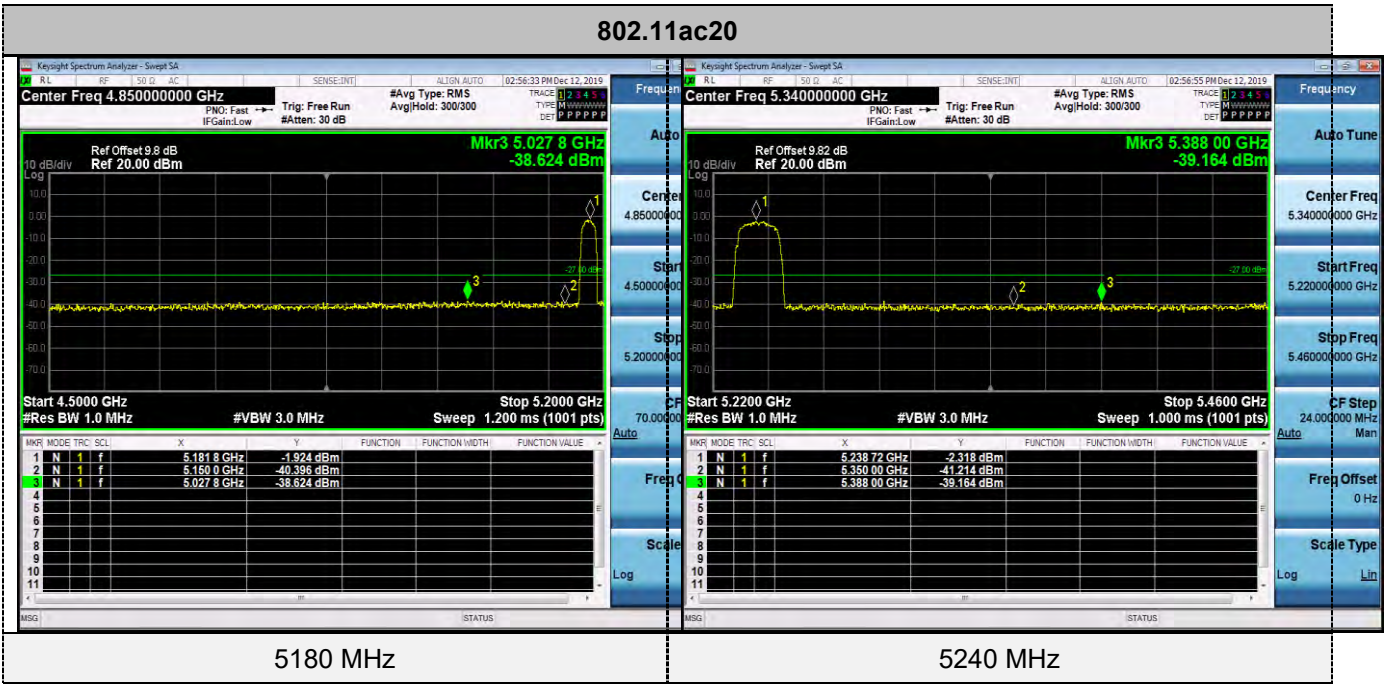
REMARKS:

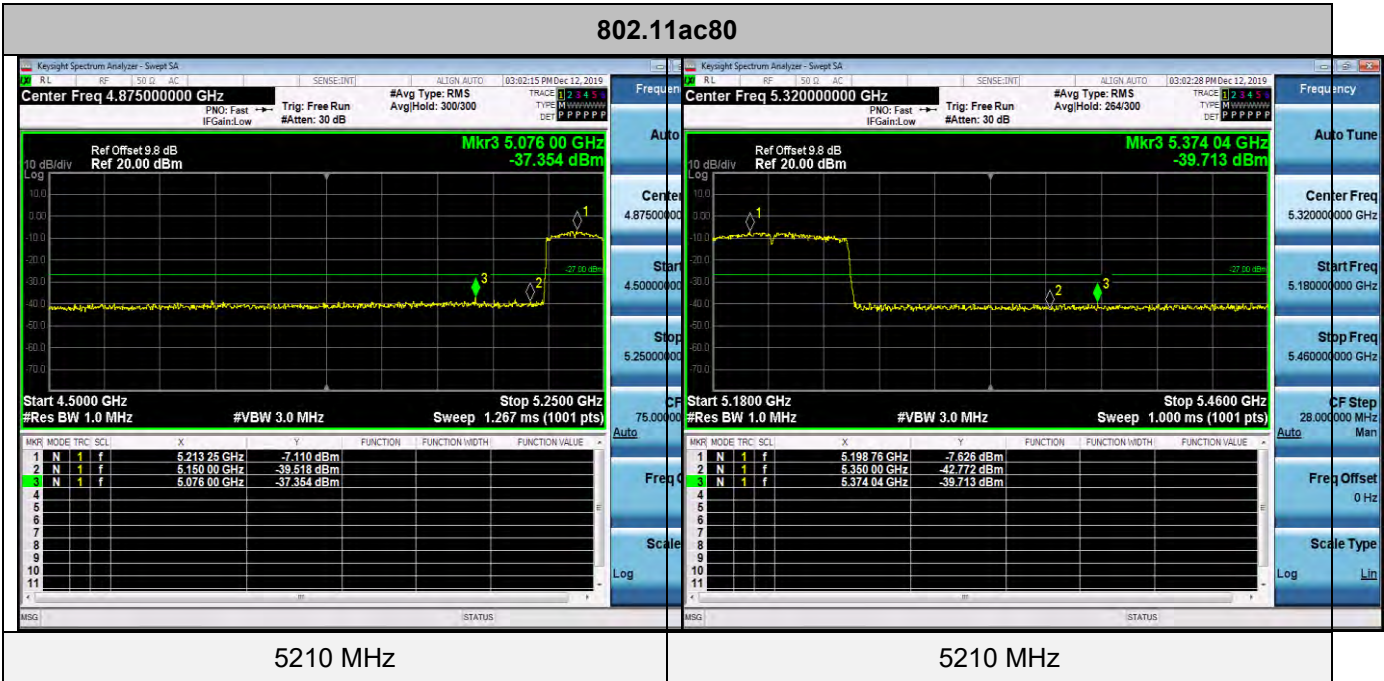
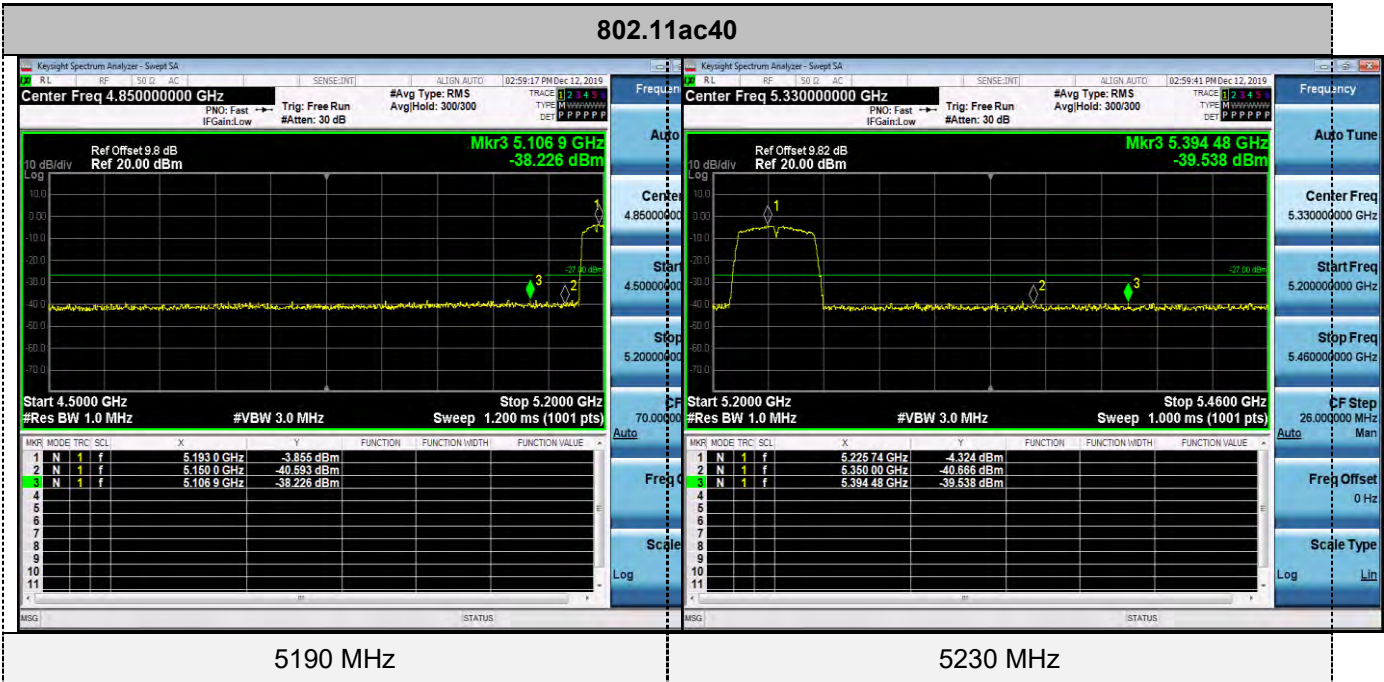
1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. The other emission levels were very low against the limit.
3. The average measurement was not performed when the peak measured data under the limit of average detection.
4. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=10Hz/Sweep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

For Conducted Band edge Measurement
The test results have included the antenna gain

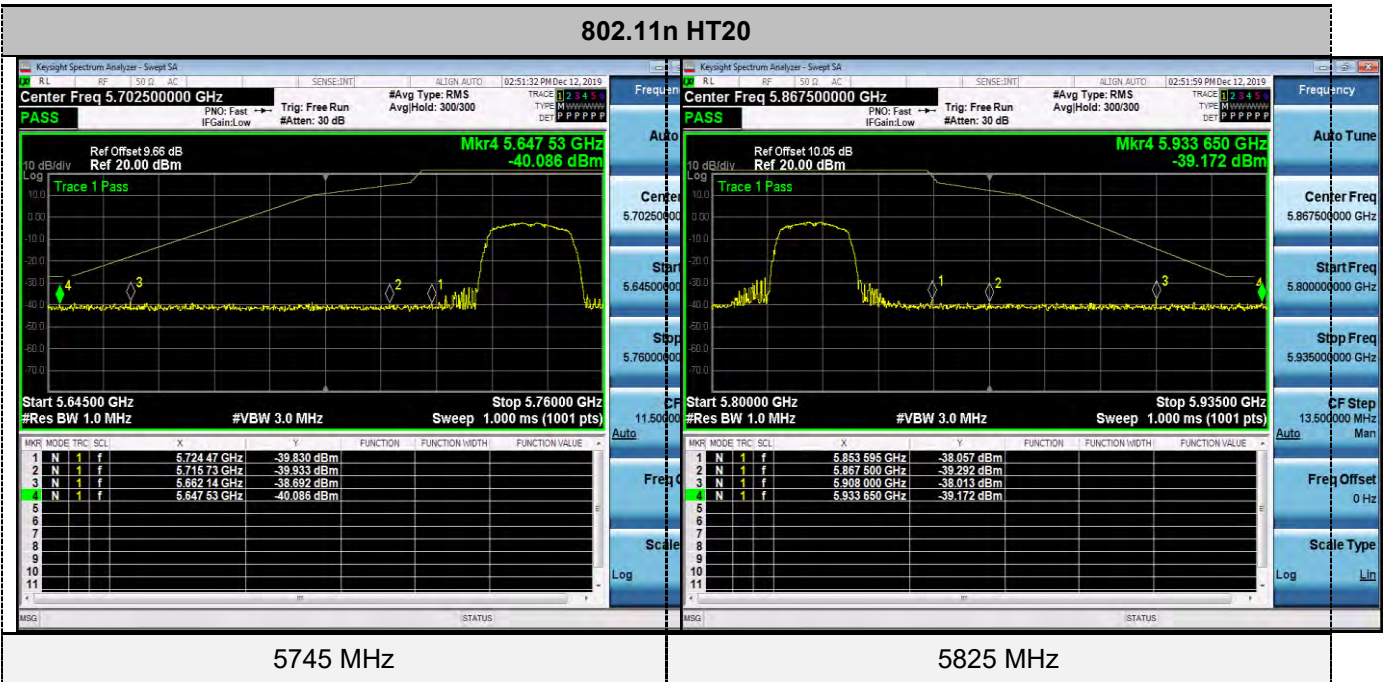
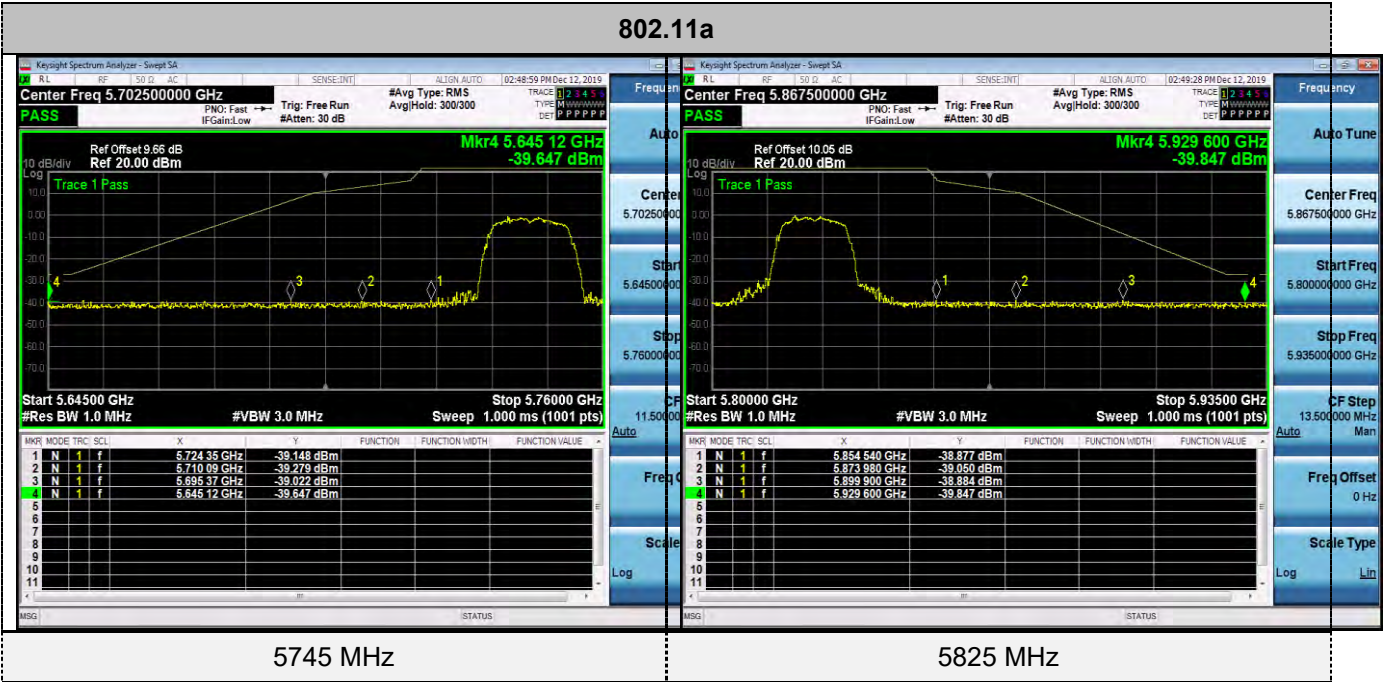
5150-5250MHz:

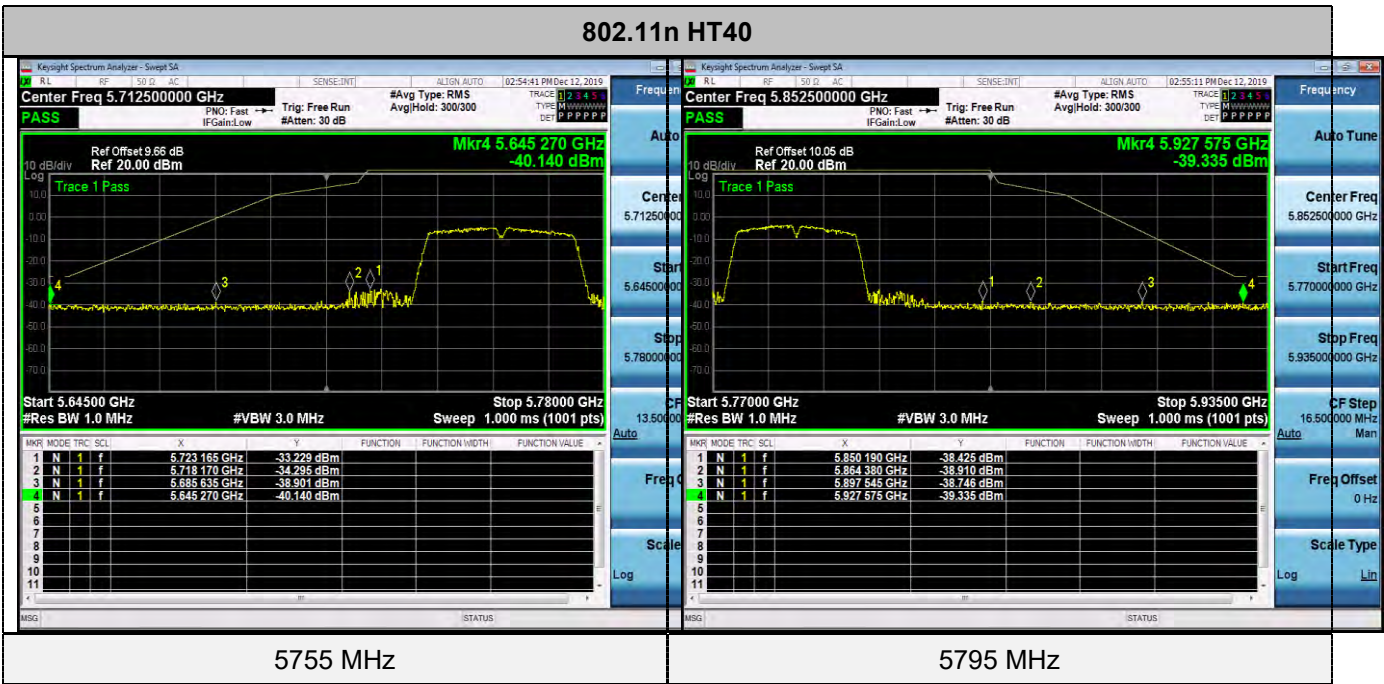
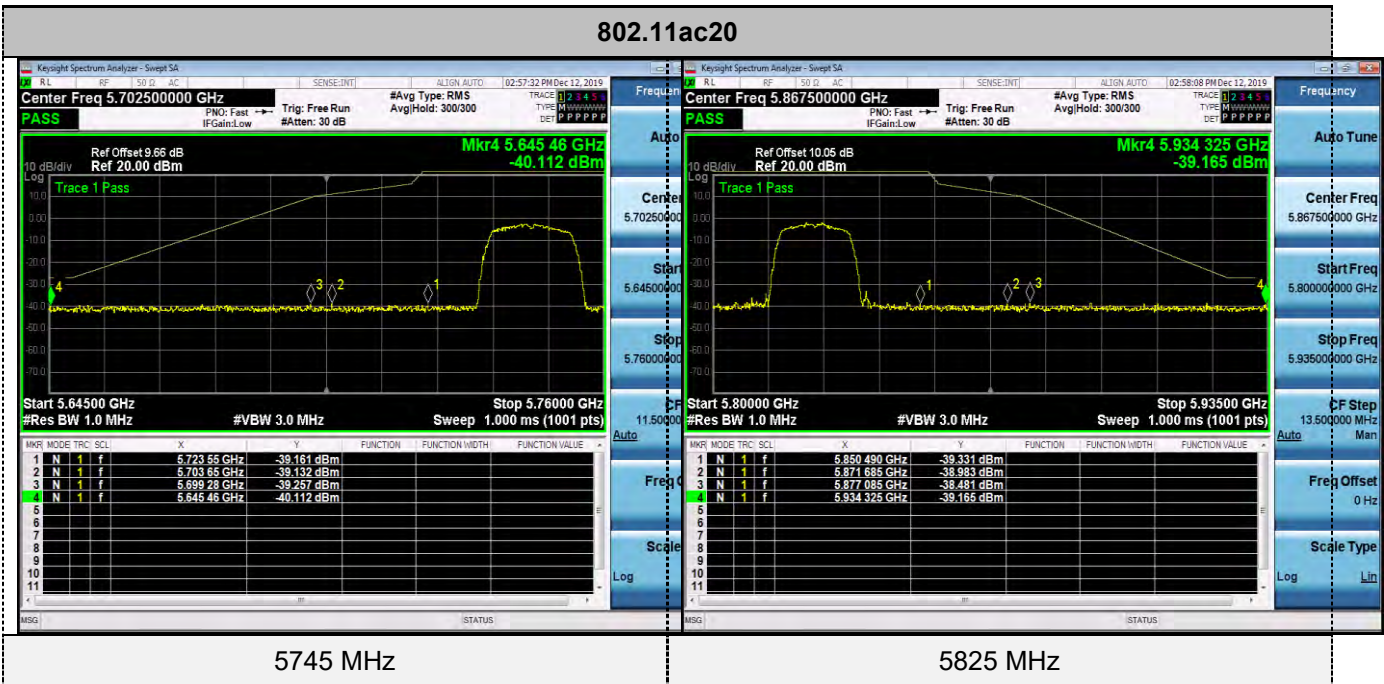


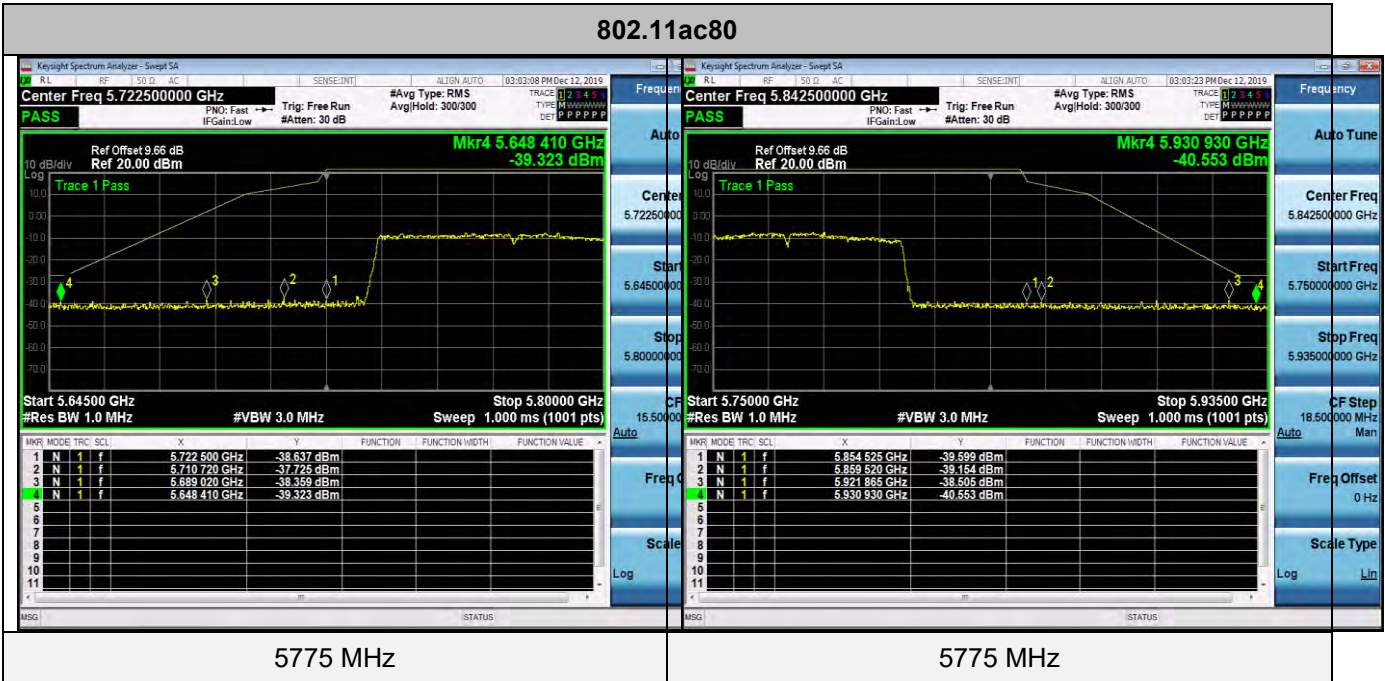
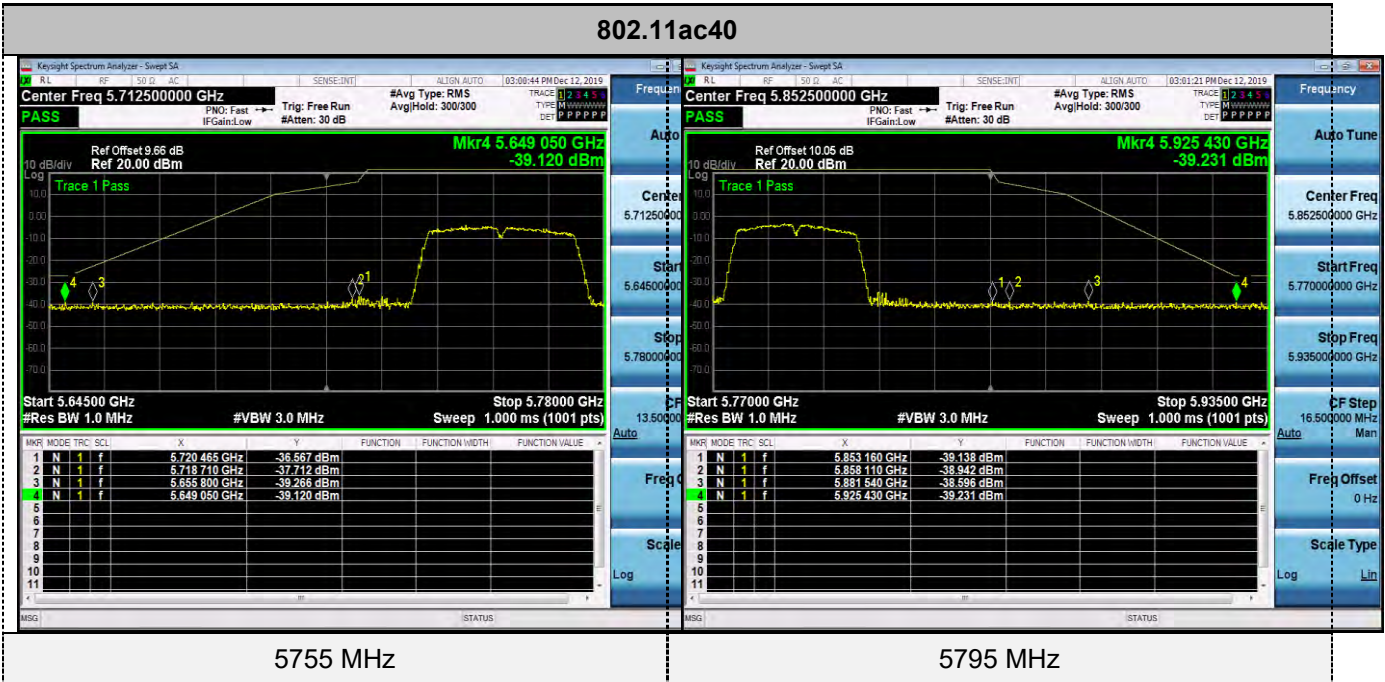




5725-5850MHz:







4.9. Antenna Requirement

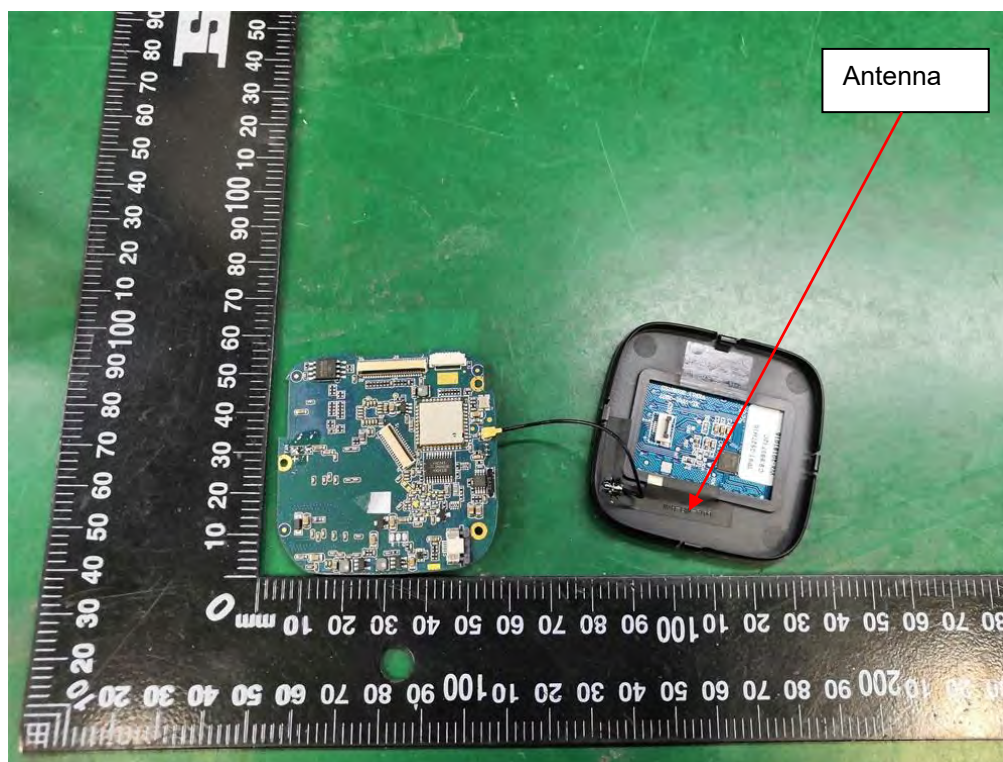
Standard Applicable

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 0.78dBi.



5. TEST SETUP PHOTOS OF THE EUT

Reference to the TEST SETUP PHOTOS

6. EXTERNAL AND INTERNAL PHOTOS OF THE EUT

Reference to the EXTERNAL AND INTERNAL PHOTOS

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