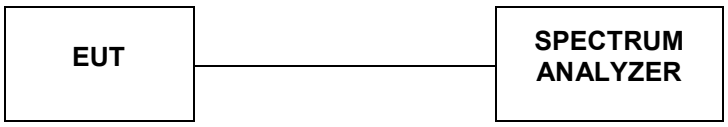
4.6. 6dB Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

According to KDB789033 D02 General U-NII Test Procedures New Rules v02r01 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) ≥ 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 above.

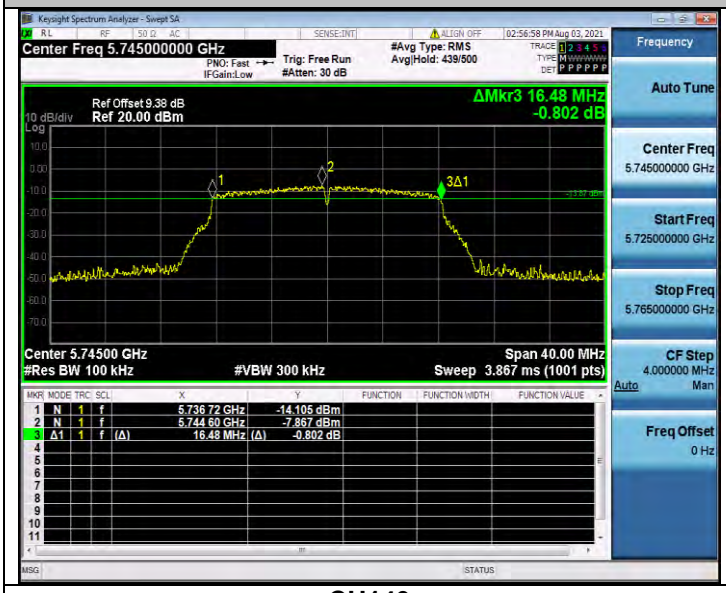
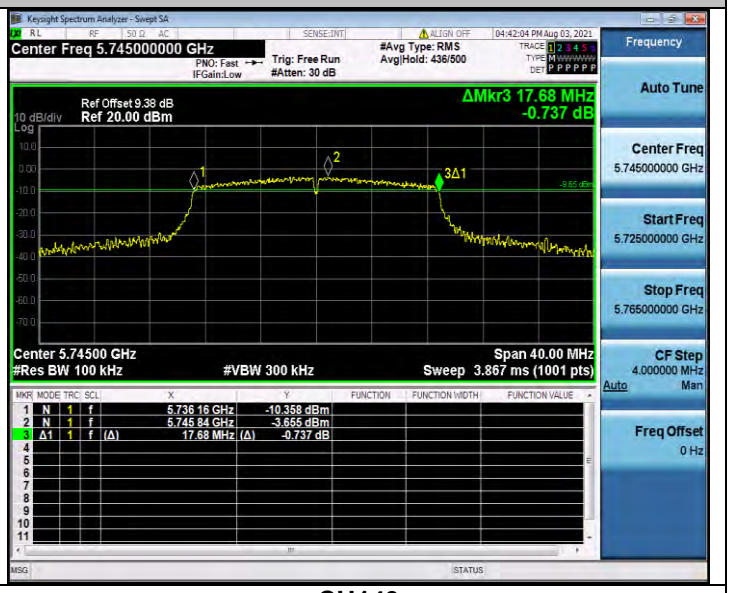
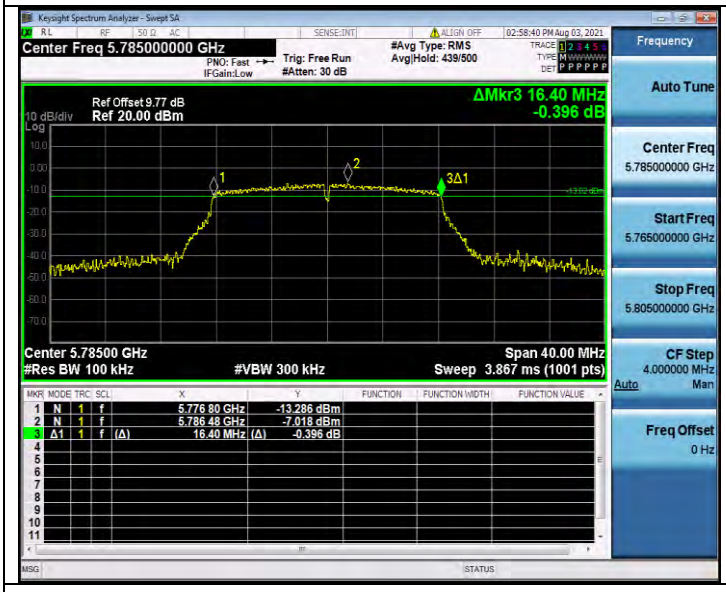
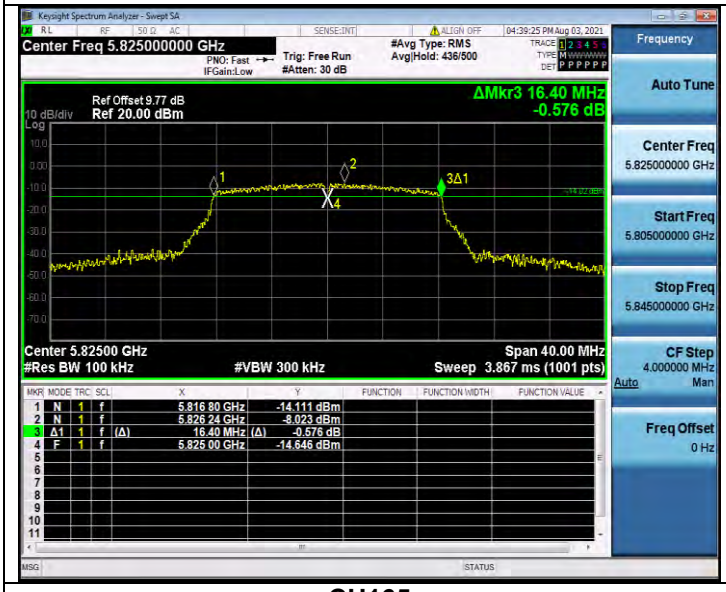
LIMIT

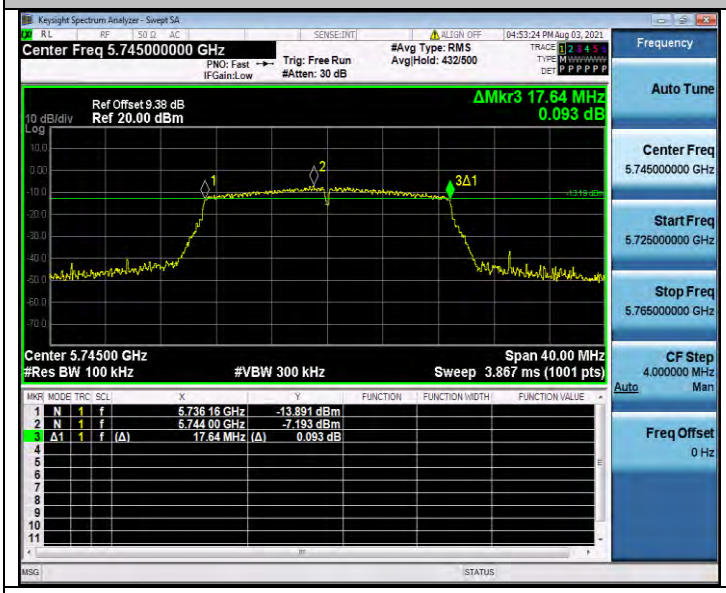
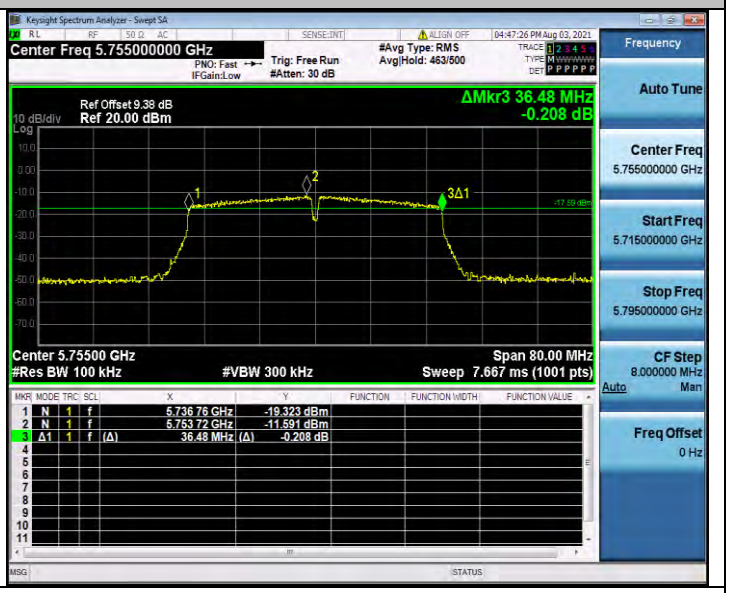
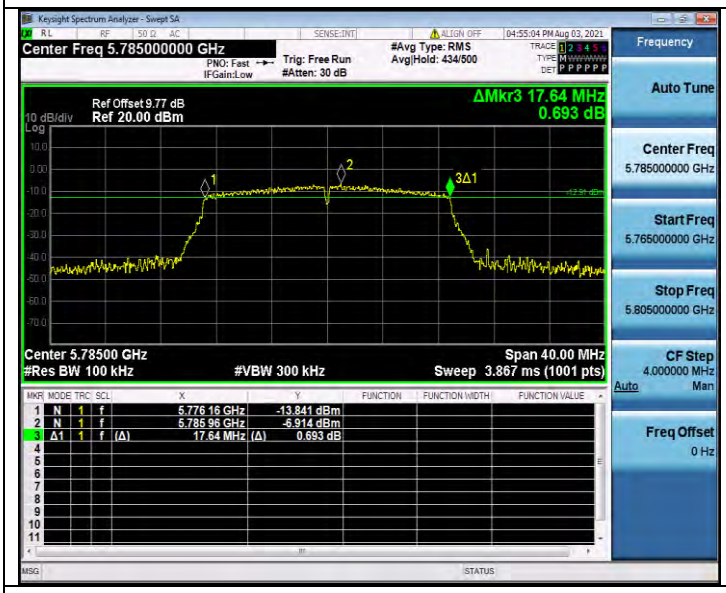
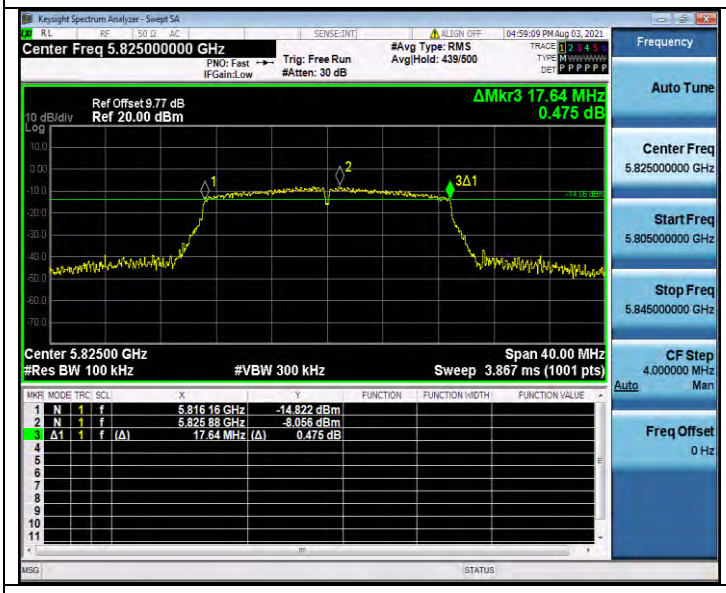
For Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz

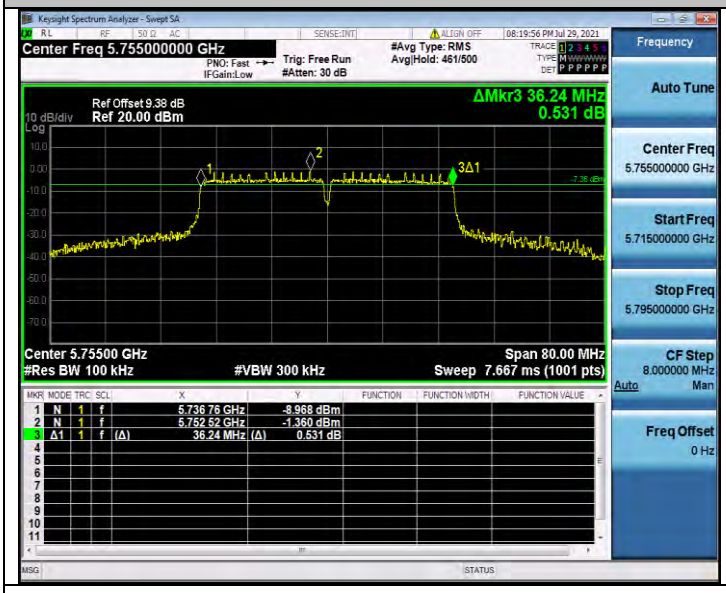
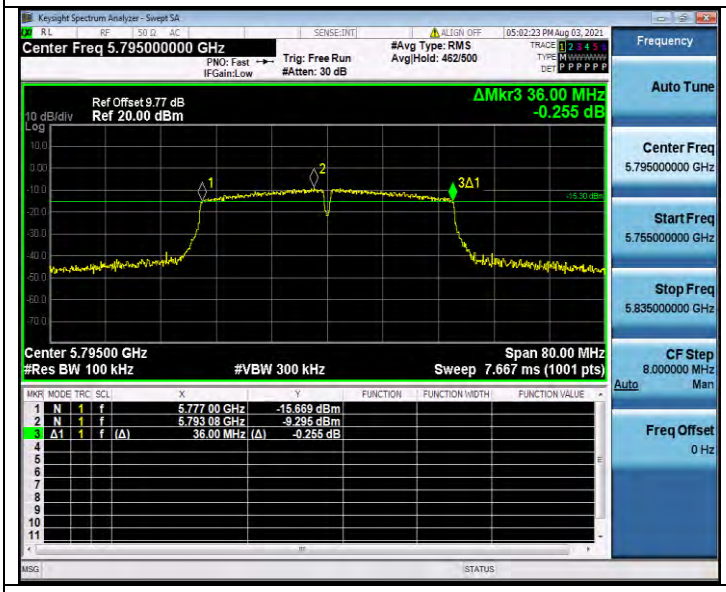
TEST RESULTS

Temperature	23.6℃	Humidity	55.7%
Test Engineer	Oliver Ou	Configurations	IEEE 802.11a/n/ac

Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11a	149	16.480	>500	Pass
	157	16.400		
	165	16.400		
802.11nHT20	149	17.680	>500	Pass
	157	17.680		
	165	17.640		
802.11n40	151	36.480	>500	Pass
	159	36.320		
802.11ac20	149	17.640	>500	Pass
	157	17.640		
	165	17.640		
802.11ac40	151	36.240	>500	Pass
	159	36.000		
802.11ac80	155	76.480	>500	Pass

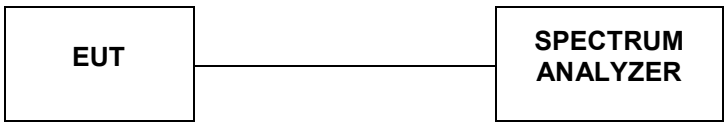
6dB Bandwidth	
802.11a	802.11n HT20
	
CH149	CH149
	
CH157	CH157
	
CH165	CH165
6dB Bandwidth	

802.11ac20	802.11n HT40
	
CH149	CH151
	
CH157	CH159
	
CH165	

6dB Bandwidth	
802.11ac40	802.11ac80
	
CH151	CH155
	
CH159	

4.7. 26dBc Bandwidth

TEST CONFIGURATION



TEST PROCEDURE

According to KDB789033 D02 General U-NII Test Procedures New Rules v02r01 for one of the following procedures may be used for Emission Bandwidth (EBW) measurement:

a. Set RBW = 220 kHz/430 kHz /820 kHz (approximately 1% of the emission bandwidth).
b. Set the video bandwidth (VBW) = 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 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.

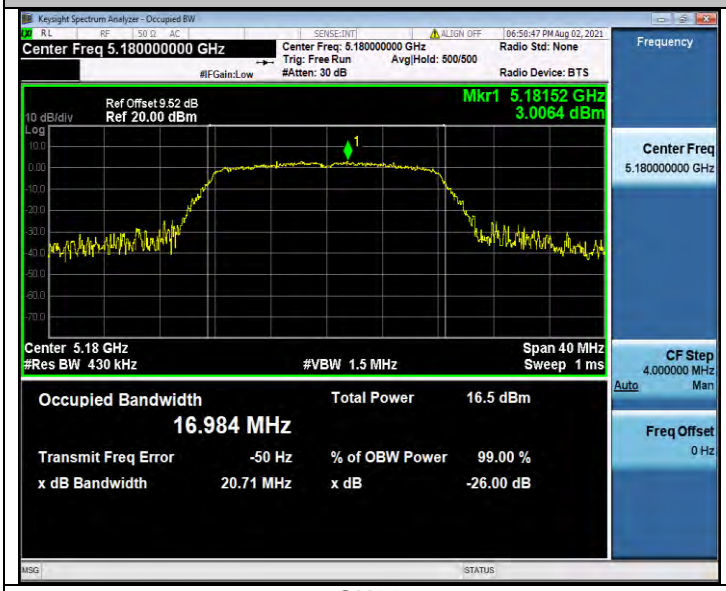
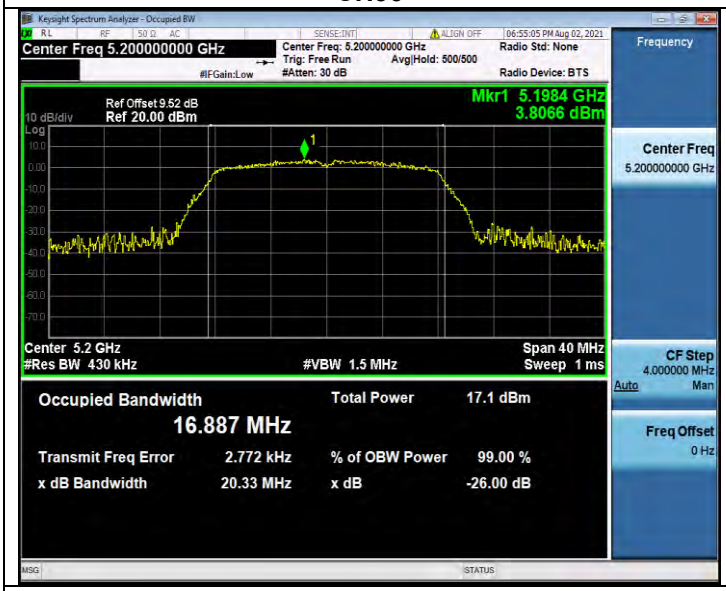
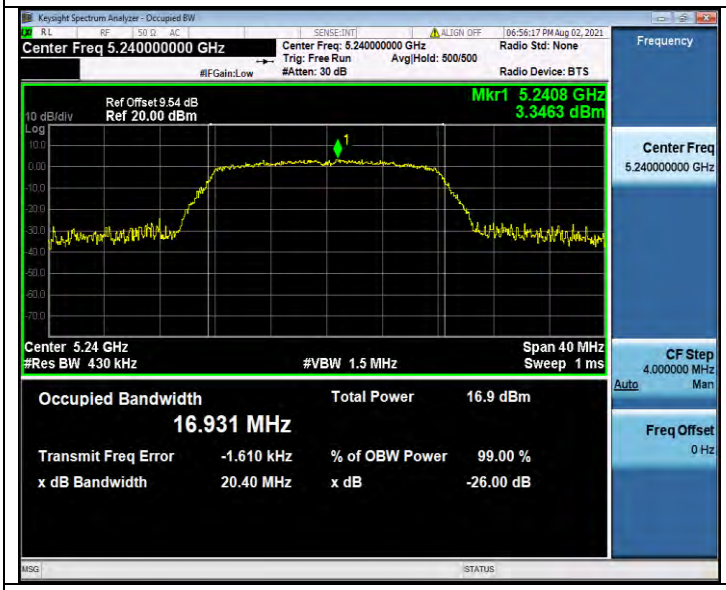
LIMIT

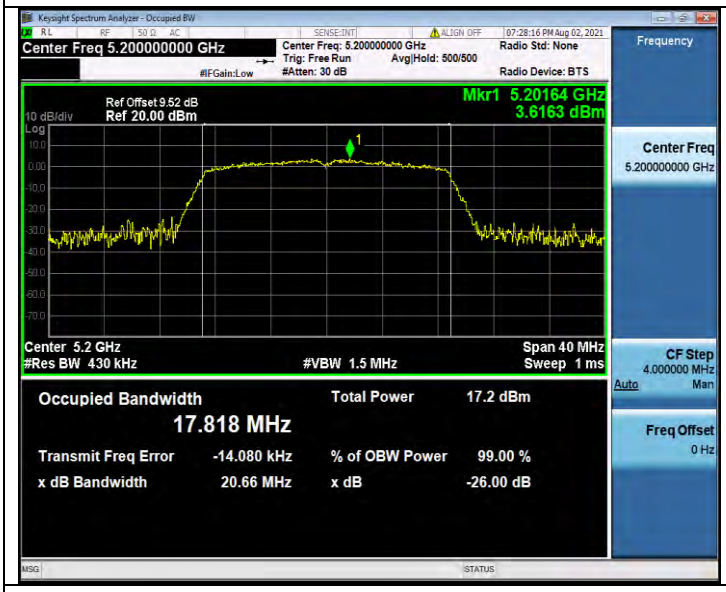
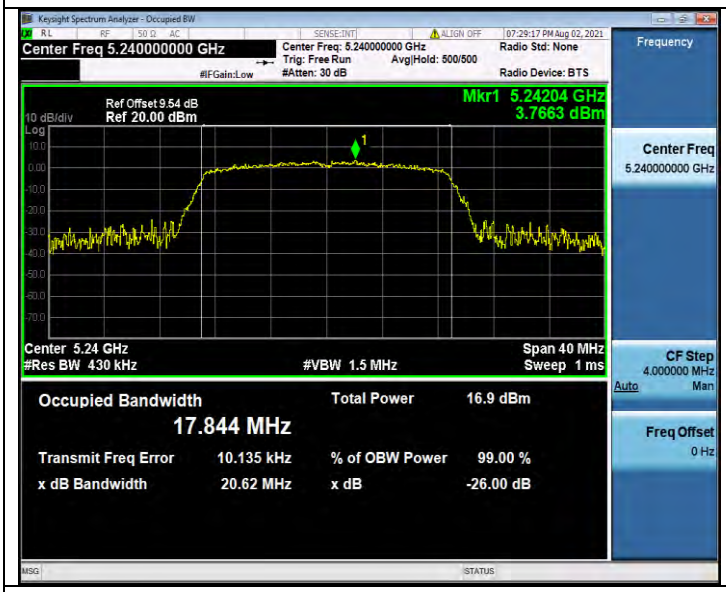
No Limits for 26dBc Bandwith

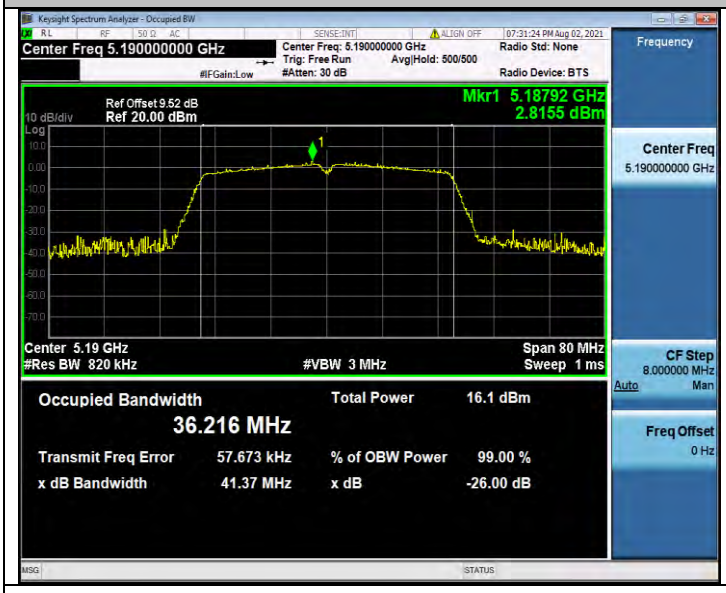
TEST RESULTS

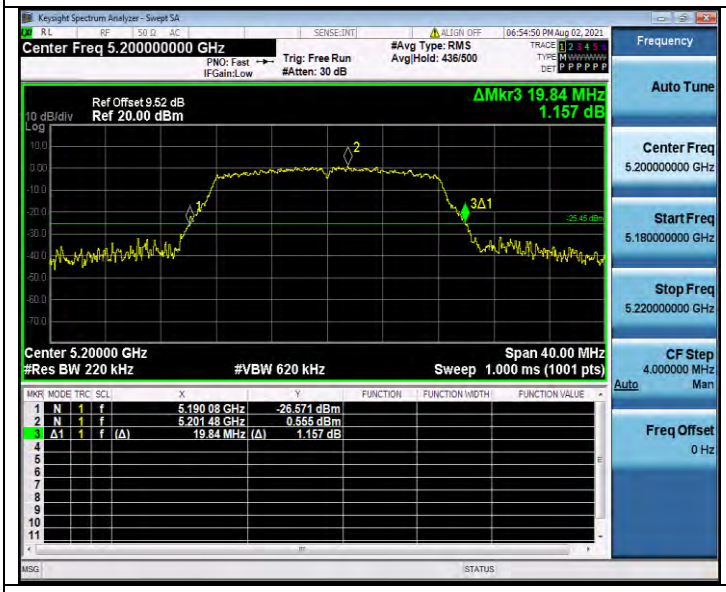
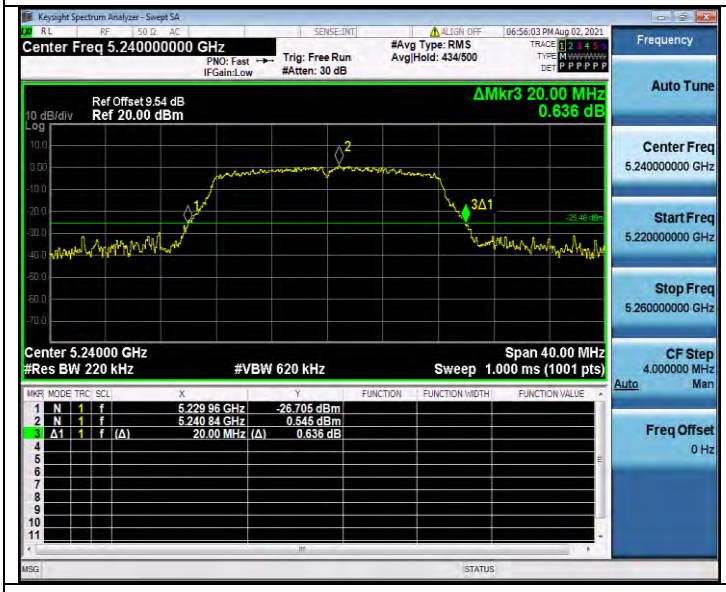
Temperature	23.6℃	Humidity	55.7%
Test Engineer	Oliver Ou	Configurations	IEEE 802.11a/n/ac

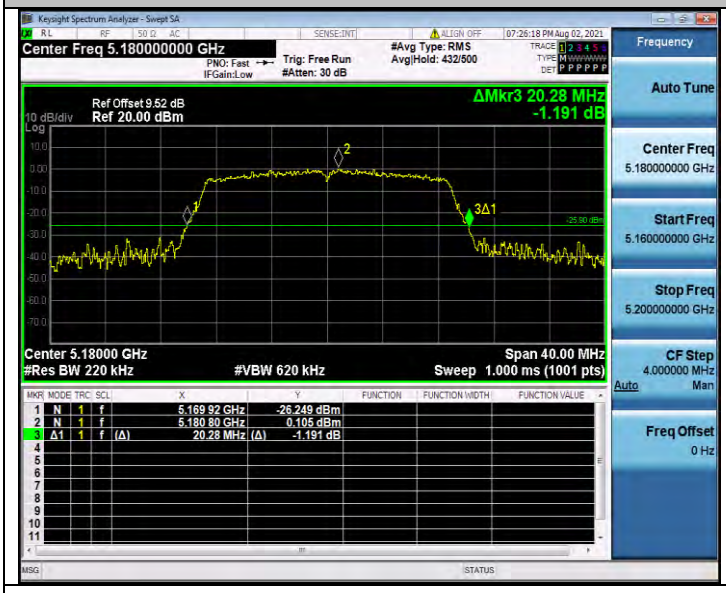
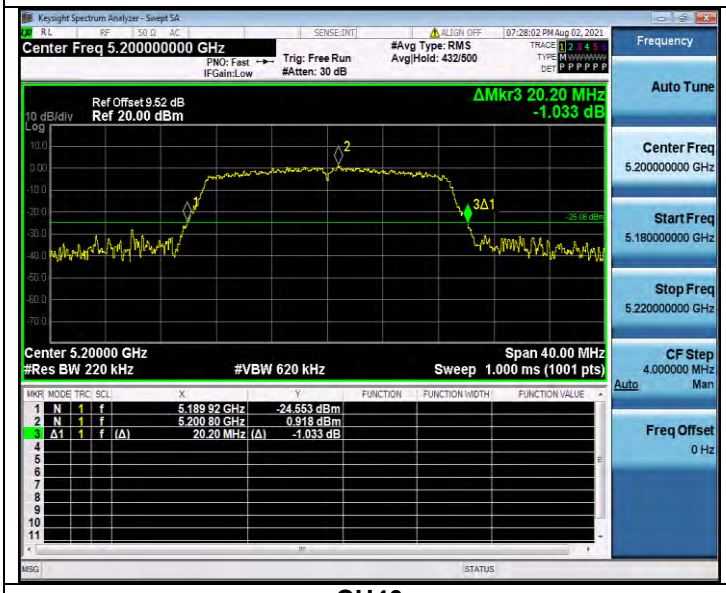
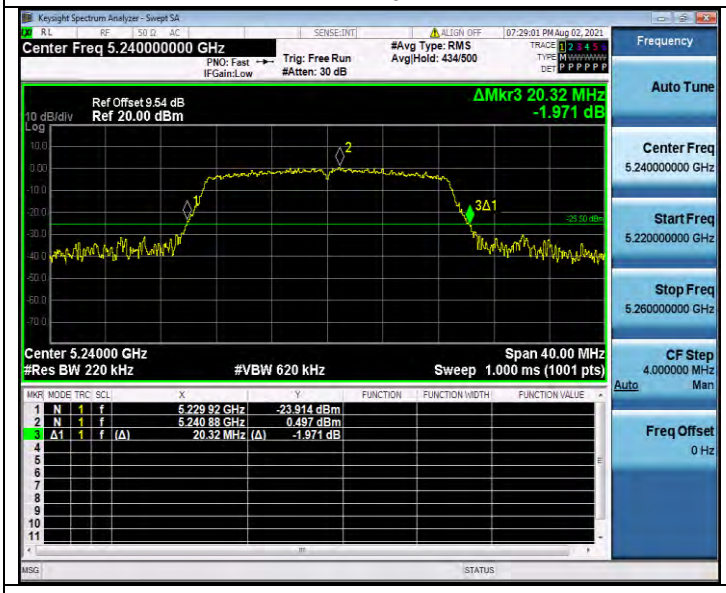
Type	Channel	99%Bandwidth (MHz)	26dB Bandwidth (MHz)	Limit (KHz)	Result
802.11a	36	16.984	20.160	-	Pass
	40	16.887	19.840		
	48	16.931	20.000		
802.11nHT20	36	18.003	21.640	-	Pass
	40	17.969	23.200		
	48	17.954	20.400		
802.11n40	38	36.203	40.640	-	Pass
	46	36.309	40.160		
802.11ac20	36	17.857	20.280	-	Pass
	40	17.818	20.200		
	48	17.844	20.320		
802.11ac40	38	36.216	40.480	-	Pass
	46	36.287	40.640		
802.11ac80	42	75.192	80.640	-	Pass

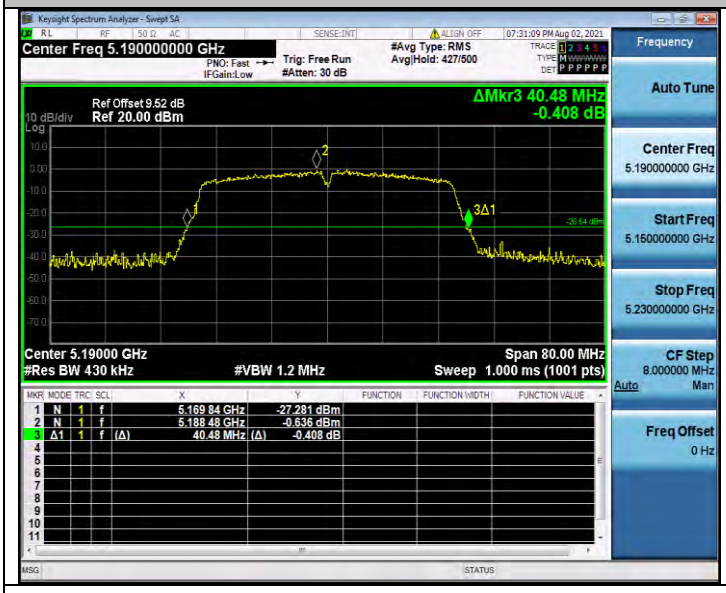
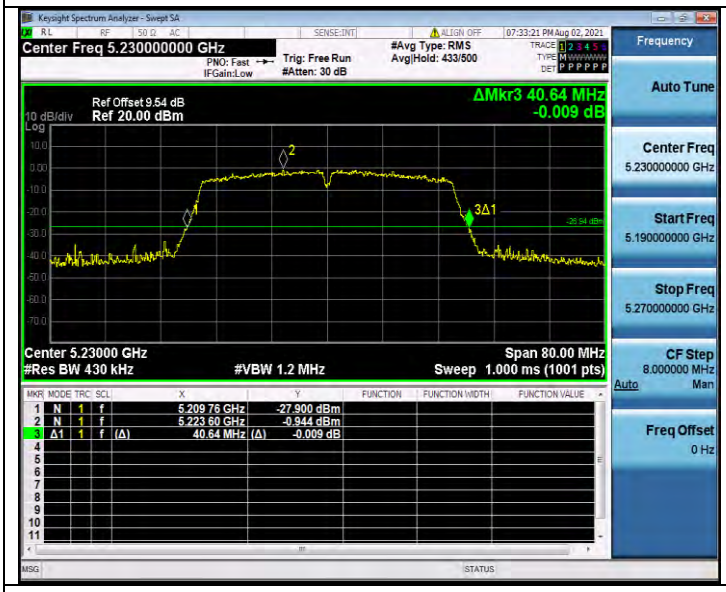
99%Bandwidth	
802.11a	802.11n HT20
	
CH36	CH36
	
CH40	CH40
	
CH48	CH48

99%Bandwidth	
802.11ac20	802.11n HT40
	
CH36	CH38
	
CH40	CH46
	
CH48	

99%Bandwidth	
802.11ac40	802.11ac80
	
CH38	CH42
	
CH46	

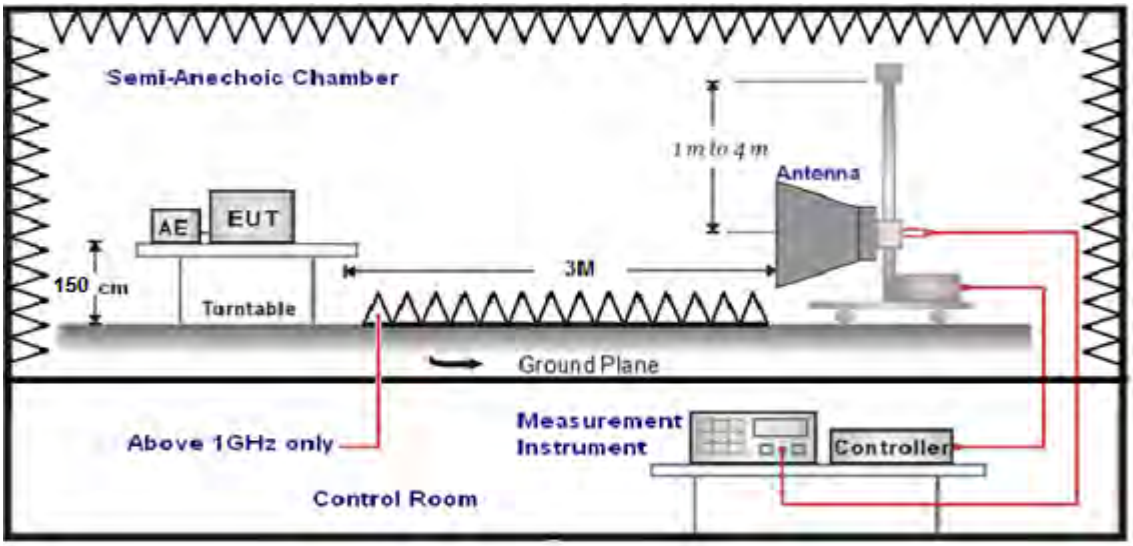
26dB Bandwidth	
802.11a	802.11n HT20
	
CH36	CH36
	
CH40	CH40
	
CH48	CH48

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	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(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 both mode, recorded worst case in antenna 0's 802.11 ac20 mode;

For Radiated Bandedge Measurement

Temperature	23.4℃	Humidity	54.5%
Test Engineer	Oliver Ou	Configurations	IEEE 802.11a/n/ac

802.11 ac20/ 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	35.21	35.58	29.04	8.28	50.03	74.00	-23.97	Peak	Horizontal
4500.0	30.24	35.58	29.04	8.28	45.06	54.00	-8.94	AV	Horizontal
5150.0	39.28	35.58	29.04	8.28	54.10	74.00	-19.90	Peak	Horizontal
5150.0	30.59	35.58	29.04	8.28	45.41	54.00	-8.59	AV	Horizontal

802.11 ac20/ 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	35.06	35.42	29.06	8.39	49.81	74.00	-24.19	Peak	Horizontal
5350.0	30.18	35.42	29.06	8.39	44.93	54.00	-9.07	AV	Horizontal
5460.0	39.28	35.42	29.06	8.39	54.03	74.00	-19.97	Peak	Horizontal
5460.0	30.75	35.42	29.06	8.39	45.50	54.00	-8.50	AV	Horizontal

802.11 ac20/ 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	35.29	35.35	29.07	8.43	50.00	68.20	-18.20	Peak	Horizontal
5700.0	30.00	35.35	29.07	8.43	44.71	68.20	-23.49	Peak	Horizontal
5720.0	39.20	35.35	29.07	8.43	53.91	68.20	-14.29	Peak	Horizontal
5725.0	30.54	35.35	29.07	8.43	45.25	68.20	-22.95	Peak	Horizontal

802.11 ac20/ 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	35.14	35.3	29.11	8.51	49.84	68.20	-18.36	Peak	Horizontal
5855.0	30.31	35.3	29.11	8.51	45.01	68.20	-23.19	Peak	Horizontal
5875.0	39.12	35.3	29.11	8.51	53.82	68.20	-14.38	Peak	Horizontal
5925.0	30.55	35.3	29.11	8.51	45.25	68.20	-22.95	Peak	Horizontal

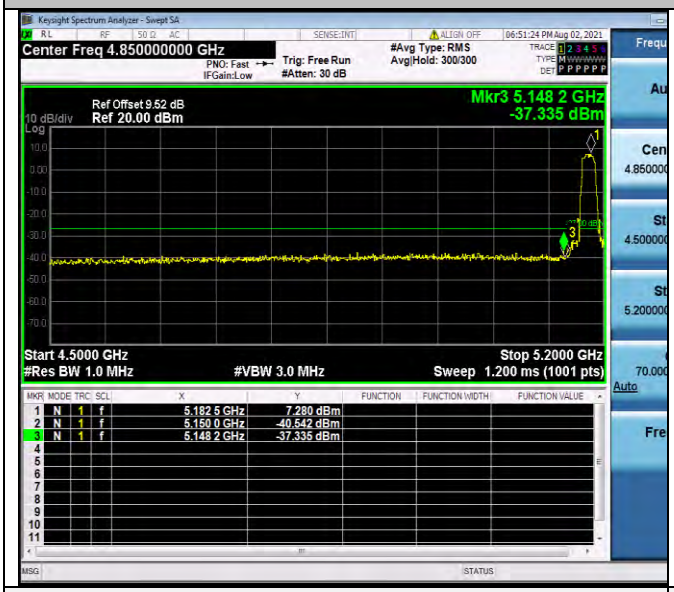
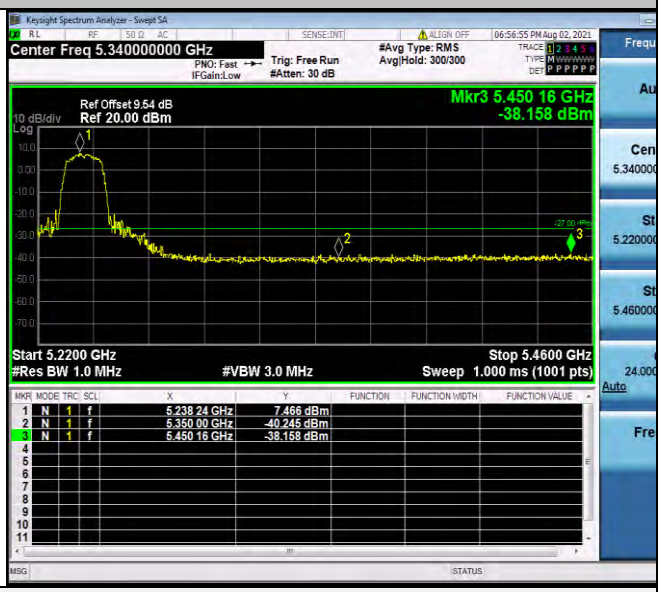
REMARKS:
1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. Margin value = Result Level-Limit value.
2. The other emission levels were very low against the limit.
3. The average measurement was not performed when the peak measured data under the limit of average detection.
4.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

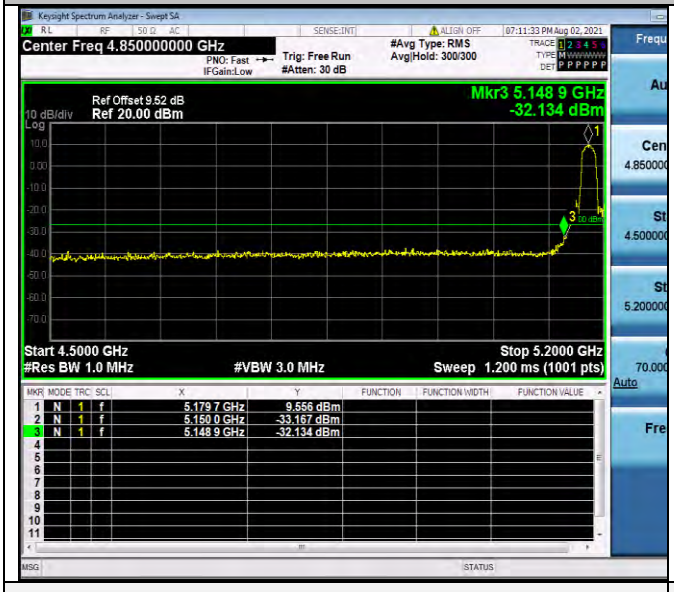
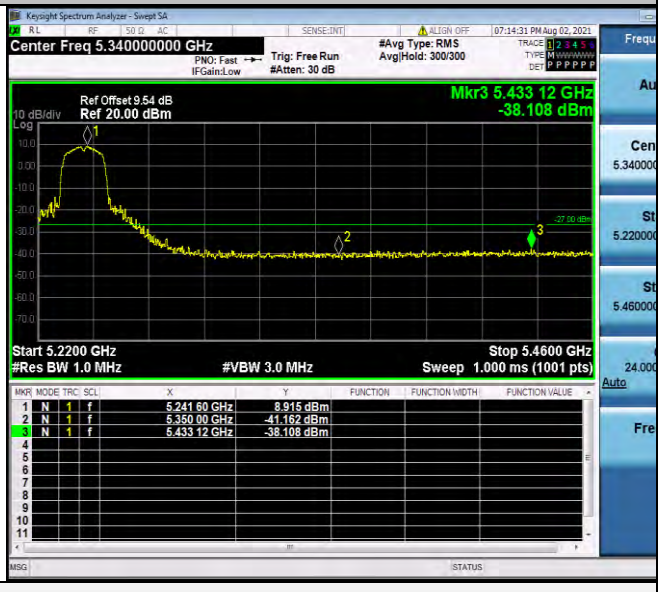
For Conducted Band edge Measurement

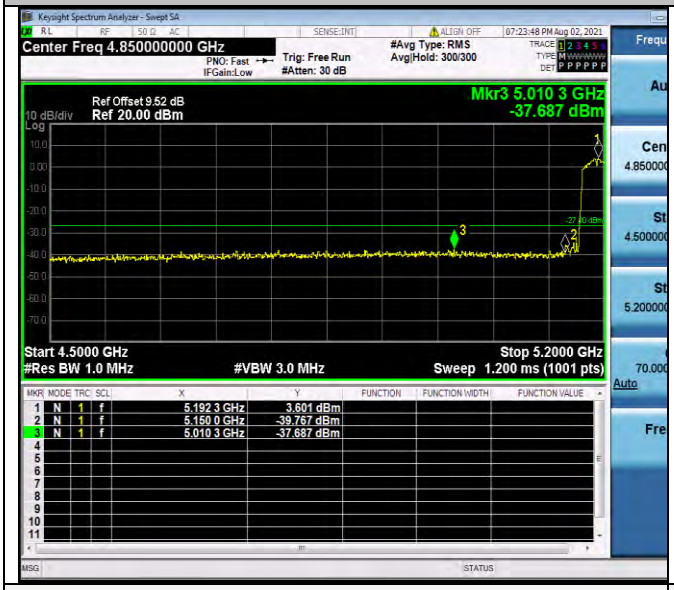
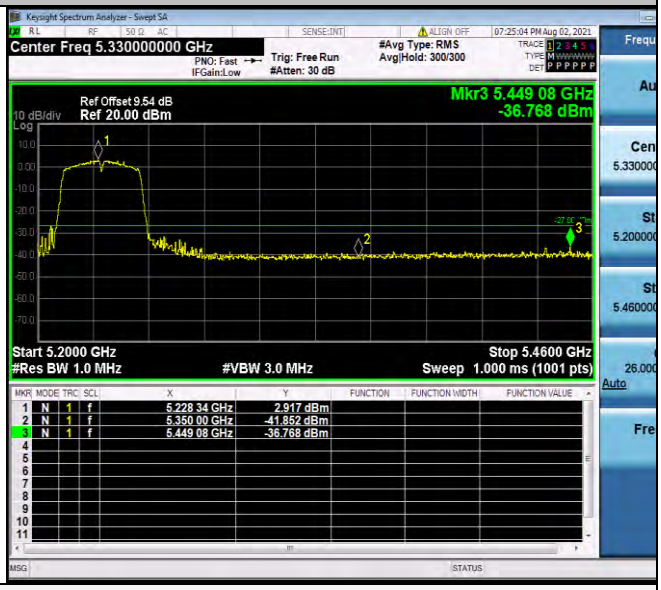
Temperature	23.6℃	Humidity	55.7%
Test Engineer	Oliver Ou	Configurations	IEEE 802.11a/n/ac

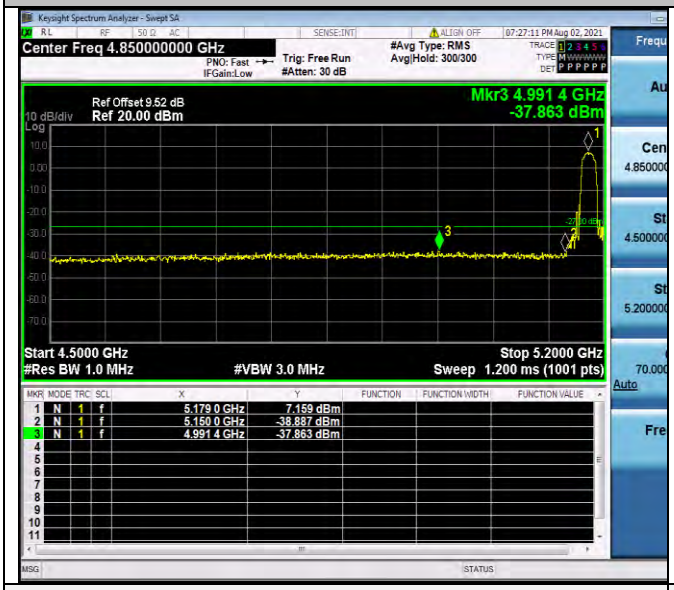
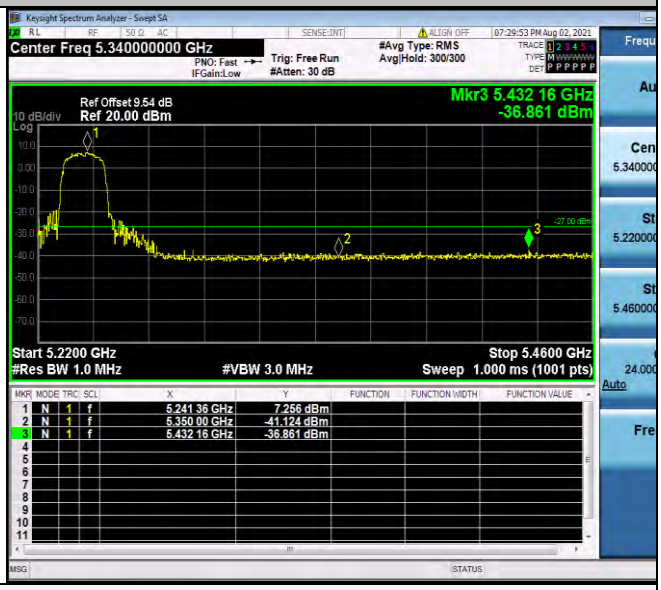
The test results have included the antenna gain

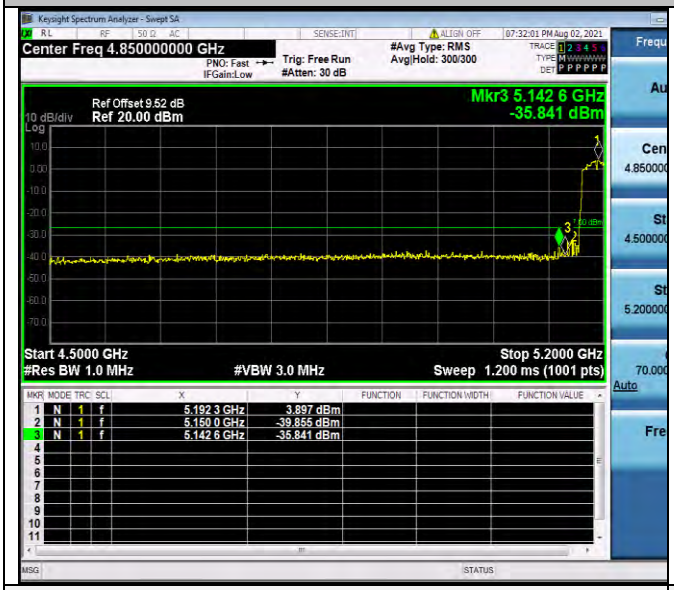
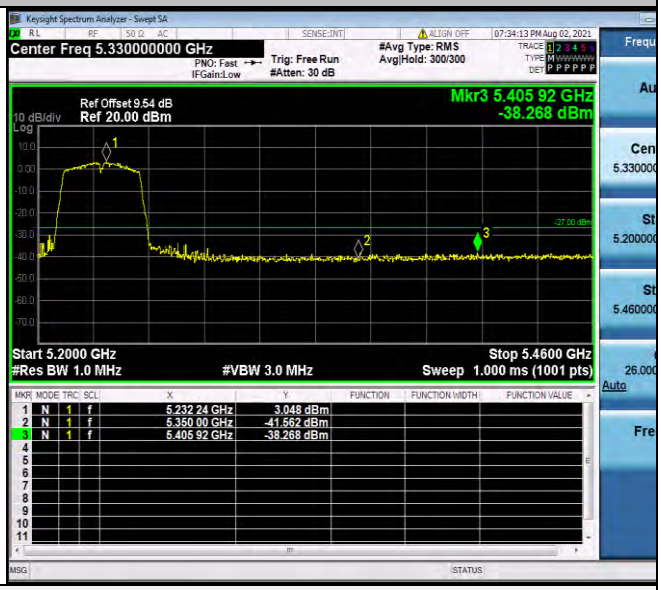
5150-5250MHz:

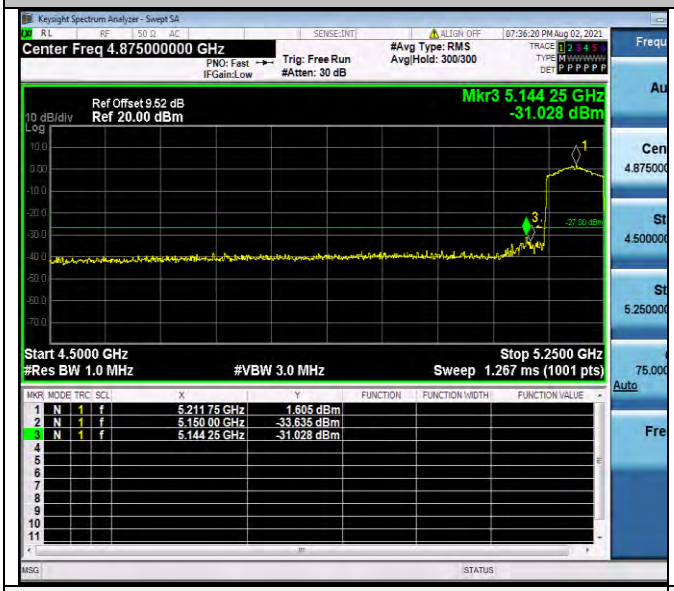
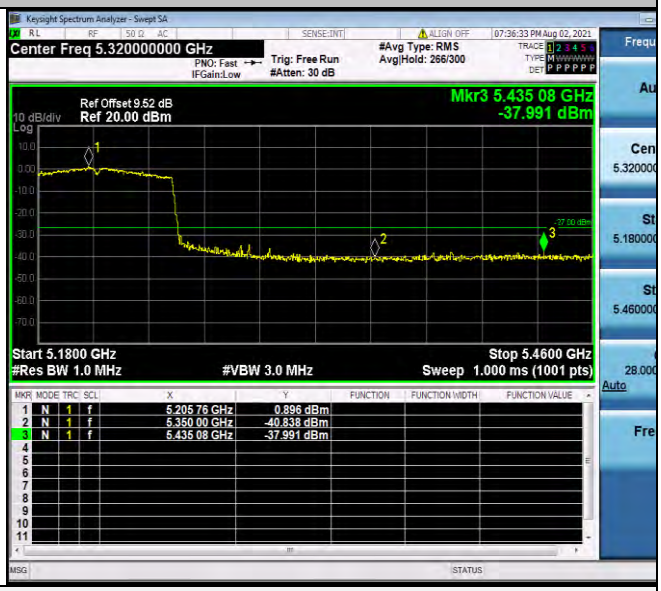
802.11a	
	
5180 MHz	5240 MHz

802.11n HT20	
	
5180 MHz	5240 MHz

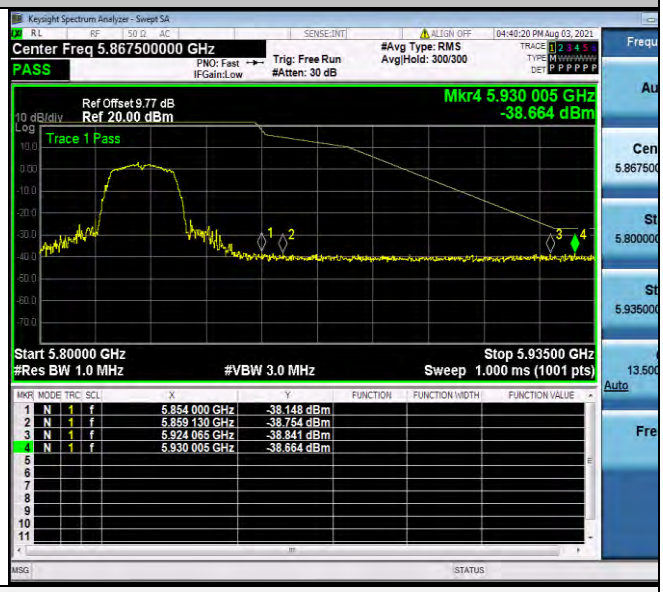
802.11n HT40	
	
5190 MHz	5230 MHz

802.11ac20	
	
5180 MHz	5240 MHz

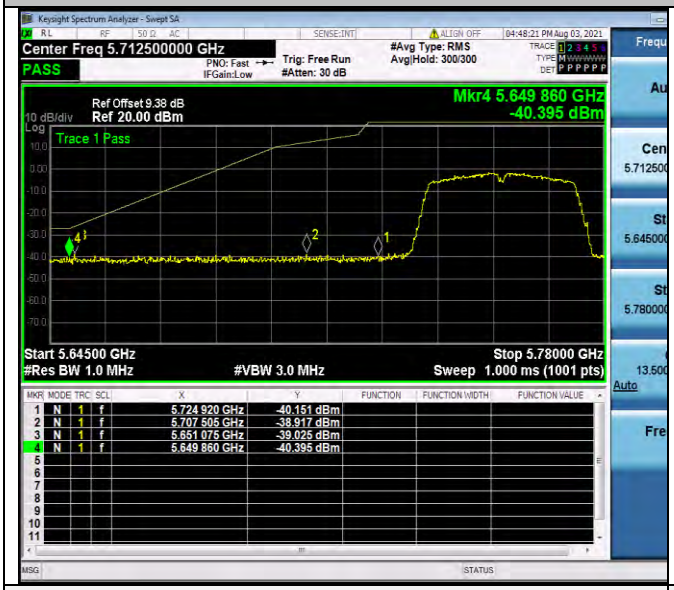
802.11ac40	
	
5190 MHz	5230 MHz

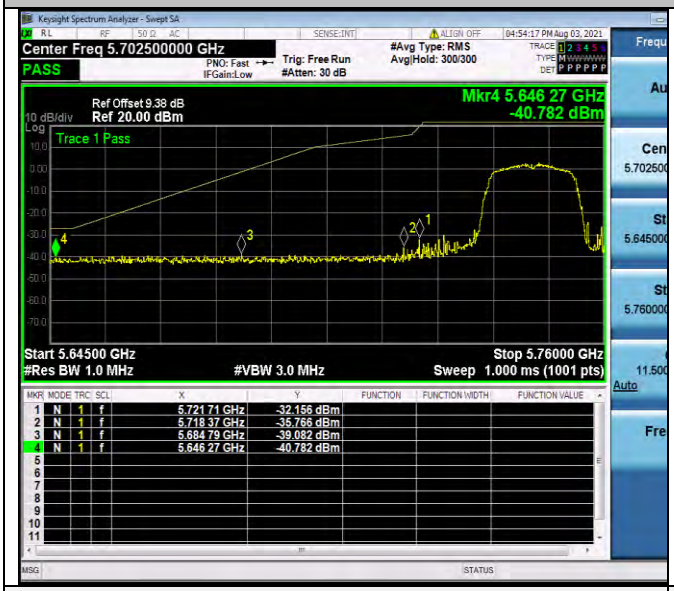
802.11ac80	
	
5210 MHz	

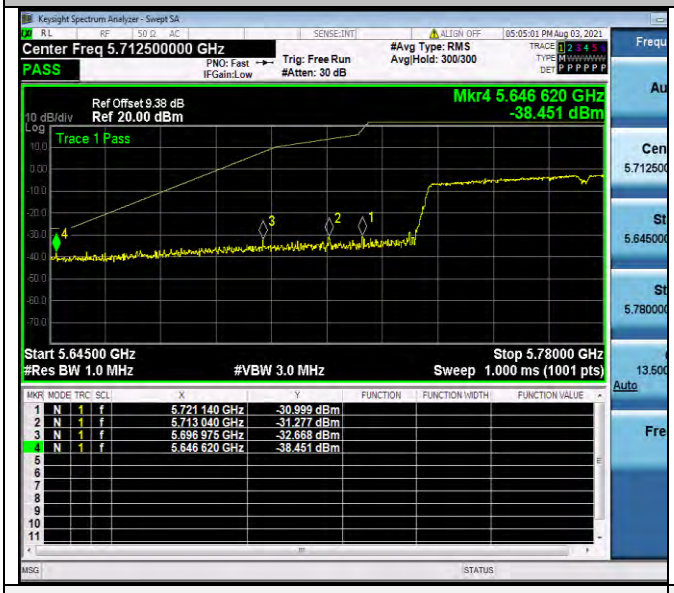
5725-5850MHz:

802.11a	
	
5745 MHz	5825 MHz

802.11n HT20	
	
5745 MHz	5825 MHz

802.11n HT40	
	
5755 MHz	5795 MHz

802.11ac20	
	
5745 MHz	5825 MHz

802.11ac40	
	
5755 MHz	5795 MHz

802.11ac80	
	
5775 MHz	

4.9. Frequency Stability

Standard Applicable

According to FCC §15.407(g) “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 manual.”

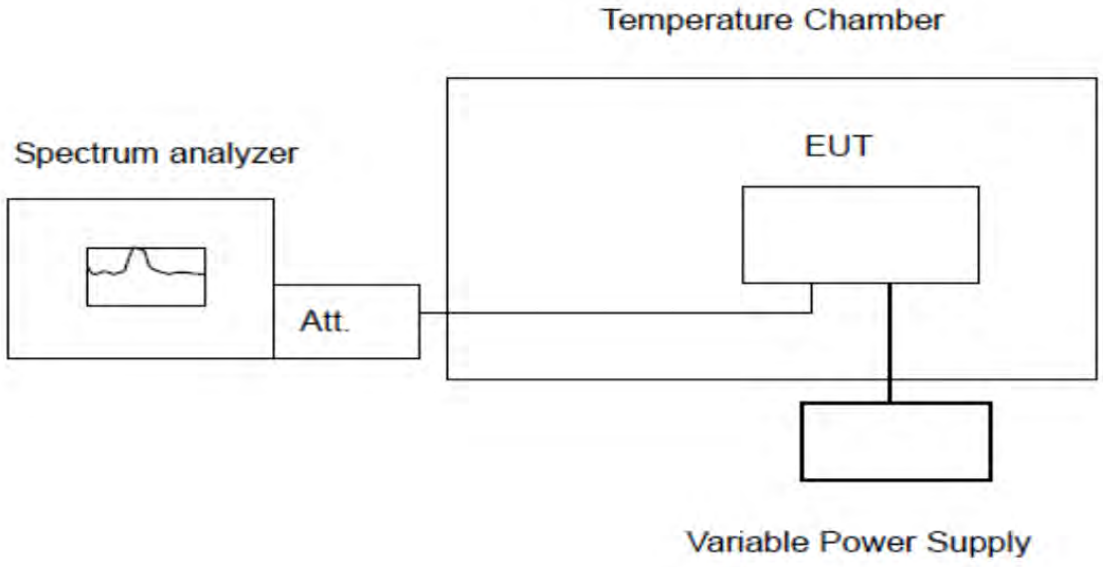
According to FCC §2.1055(a) “The frequency stability shall be measured with variation of ambient temperature as follows:”

(1) From -30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(2) From -20° to + 50° centigrade for equipment to be licensed for use in the Maritime Services under part 80 of this chapter, except for Class A, B, and S Emergency Position Indicating Radiobeacons (EPIRBS), and equipment to be licensed for use above 952 MHz at operational fixed stations in all services, stations in the Local Television Transmission Service and Point-to-Point Microwave Radio Service under part 21 of this chapter, equipment licensed for use aboard aircraft in the Aviation Services under part 87 of this chapter, and equipment authorized for use in the Family Radio Service under part 95 of this chapter.

(3) From 0° to + 50° centigrade for equipment to be licensed for use in the Radio Broadcast Services under part 73 of this chapter.

Test Configuration



Test Procedure

The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum anzlyer via feed through attenators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low engouh to obtain the desired frequency resoluation and measure EUT 20 degree operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30 degree. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure wuth 10 degree increased per stage until the highest temperature of +50 degree reached.

Test Results

PASS

Remark:

1. Measured all conditions and recorded worst case.

IEEE 802.11a Mode / 5180 – 5240 MHz / 5180 MHz

Enviroment Temperature (Dregree)	Voltage (V)	Measured Frequency (MHz)	Limit Range (MHz)	Test Results
20	DC 13.2V	5180.253748	5150 – 5250	PASS
20	DC 10.8V	5179.604056	5150 – 5250	PASS
50	DC 12V	5179.971790	5150 – 5250	PASS
40	DC 12V	5180.599083	5150 – 5250	PASS
30	DC 12V	5179.922614	5150 – 5250	PASS
20	DC 12V	5180.134908	5150 – 5250	PASS
10	DC 12V	5179.780446	5150 – 5250	PASS
0	DC 12V	5180.519489	5150 – 5250	PASS
-10	DC 12V	5179.806526	5150 – 5250	PASS
-20	DC 12V	5180.549308	5150 – 5250	PASS
-30	DC 12V	5180.401214	5150 – 5250	PASS

IEEE 802.11a Mode / 5180 – 5240 MHz / 5240 MHz

Enviroment Temperature (Dregree)	Voltage (V)	Measured Frequency (MHz)	Limit Range (MHz)	Test Results
20	DC 13.2V	5239.643619	5150 – 5250	PASS
20	DC 10.8V	5240.045336	5150 – 5250	PASS
50	DC 12V	5239.758452	5150 – 5250	PASS
40	DC 12V	5239.926645	5150 – 5250	PASS
30	DC 12V	5239.973126	5150 – 5250	PASS
20	DC 12V	5240.358717	5150 – 5250	PASS
10	DC 12V	5239.839772	5150 – 5250	PASS
0	DC 12V	5240.555185	5150 – 5250	PASS
-10	DC 12V	5239.664426	5150 – 5250	PASS
-20	DC 12V	5240.016474	5150 – 5250	PASS
-30	DC 12V	5240.268425	5150 – 5250	PASS

IEEE 802.11a Mode / 5745 – 5825 MHz / 5745 MHz

Enviroment Temperature (Dregree)	Voltage (V)	Measured Frequency (MHz)	Limit Range (MHz)	Test Results
20	DC 13.2V	5744.859134	5725 – 5850	PASS
20	DC 10.8V	5744.621496	5725 – 5850	PASS
50	DC 12V	5745.040072	5725 – 5850	PASS
40	DC 12V	5744.796518	5725 – 5850	PASS
30	DC 12V	5745.018639	5725 – 5850	PASS
20	DC 12V	5745.240953	5725 – 5850	PASS
10	DC 12V	5745.478097	5725 – 5850	PASS
0	DC 12V	5745.305599	5725 – 5850	PASS
-10	DC 12V	5745.184560	5725 – 5850	PASS
-20	DC 12V	5745.245461	5725 – 5850	PASS
-30	DC 12V	5744.751248	5725 – 5850	PASS

IEEE 802.11a Mode / 5745 – 5825 MHz / 5825 MHz

Enviroment Temperature (Dregree)	Voltage (V)	Measured Frequency (MHz)	Limit Range (MHz)	Test Results
20	DC 13.2V	5824.623891	5725 – 5850	PASS
20	DC 10.8V	5825.332743	5725 – 5850	PASS
50	DC 12V	5824.894736	5725 – 5850	PASS
40	DC 12V	5825.539525	5725 – 5850	PASS
30	DC 12V	5824.821215	5725 – 5850	PASS
20	DC 12V	5825.346272	5725 – 5850	PASS
10	DC 12V	5825.122463	5725 – 5850	PASS
0	DC 12V	5824.732417	5725 – 5850	PASS
-10	DC 12V	5825.221370	5725 – 5850	PASS
-20	DC 12V	5824.639720	5725 – 5850	PASS
-30	DC 12V	5824.825875	5725 – 5850	PASS

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 Internal Aantenna, through the buckle stretched out, The directional gains of antenna used for transmitting is 3.33dBi.

Reference to the Test Report: **GTS20210624005-1-3.**

5. TEST SETUP PHOTOS OF THE EUT

Reference to the test report No. **GTS20210624005-1-3.**

6. EXTERNAL AND INTERNAL PHOTOS OF THE EUT

Reference to the test report No. **GTS20210624005-1-3.**

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