

U-NII 3

802.11a



Left bandedge



Right bandedge

802.11n(HT20)



Left bandedge



Right bandedge

802.11n(HT40)



Left bandedge



Right bandedge

802.11ac(HT20)



Left bandedge



Right bandedge

802.11ac(HT40)



Left bandedge



Right bandedge

802.11ac(HT80)



Right bandedge

5.4 Maximum Conducted Average Output Power

Limit

For the band 5.15-5.25 GHz.

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

(iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.

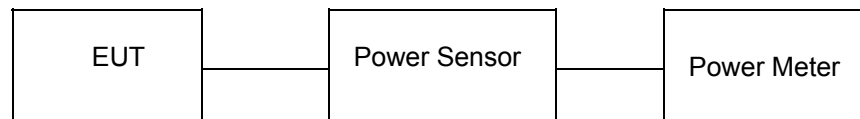
For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W

Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

Test Configuration



Test Results**U-NII 1**

Type	Channel	Output power (dBm)	Limit (dBm)	Result
802.11a	36	14.14	24.00	Pass
	40	14.22		
	48	14.05		
802.11n(HT20)	36	14.06	24.00	Pass
	40	14.21		
	48	14.42		
802.11n(HT40)	38	14.06	24.00	Pass
	46	14.06		
802.11ac(HT20)	36	12.56	24.00	Pass
	40	12.64		
	48	12.53		
802.11ac(HT40)	38	11.52	24.00	Pass
	46	10.64		
802.11ac(HT80)	42	9.69	24.00	Pass

U-NII 2A

Type	Channel	Output power (dBm)	Limit (dBm)	Result
802.11a	52	14.12	24.00	Pass
	56	14.05		
	64	14.16		
802.11n(HT20)	52	13.42	24.00	Pass
	56	14.05		
	64	14.13		
802.11n(HT40)	54	13.52	24.00	Pass
	62	14.05		
802.11ac(HT20)	52	14.13	24.00	Pass
	56	14.06		
	64	13.85		
802.11ac(HT40)	54	12.65	24.00	Pass
	62	11.25		
802.11ac(HT80)	58	10.06	24.00	Pass

U-NII 2C

Type	Channel	Output power (dBm)	Limit (dBm)	Result
802.11a	100	14.84	24.00	Pass
	120	14.26		
	140	14.03		
802.11n(HT20)	100	14.13	24.00	Pass
	120	14.10		
	140	14.06		
802.11n(HT40)	100	13.52	24.00	Pass
	120	14.03		
	134	14.15		
802.11ac(HT20)	100	13.56	24.00	Pass
	120	13.84		
	140	13.62		
802.11ac(HT40)	100	13.52	24.00	Pass
	120	12.86		
	134	11.86		
802.11ac(HT80)	106	11.87	24.00	Pass
	122	10.52	24.00	Pass

U-NII 3

Type	Channel	Output power (dBm)	Limit (dBm)	Result
802.11a	149	14.52	30.00	Pass
	157	14.62		
	165	14.25		
802.11n(HT20)	149	14.13	30.00	Pass
	157	14.25		
	165	14.05		
802.11n(HT40)	151	13.99	30.00	Pass
	159	13.84		
802.11ac(HT20)	149	12.95	30.00	Pass
	157	13.06		
	165	12.76		
802.11ac(HT40)	151	11.98	30.00	Pass
	159	11.56		
802.11ac(HT80)	155	10.49	30.00	Pass

5.5 Power Spectral Density

Limit

(1) For the band 5.15 - 5.25 GHz.

(i) For an outdoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band.^{note1}

(ii) For an indoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band.^{note1}

(iii) For fixed point-to-point access points operating in the band 5.15 - 5.25 GHz, transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

(iv) For mobile and portable client devices in the 5.15 - 5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 MHz band.^{note1}

(2) For the 5.25 - 5.35 GHz and 5.47 - 5.725 GHz bands, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band.^{note1}

(3) For the band 5.725 - 5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500 kHz band.^{note1, note2}

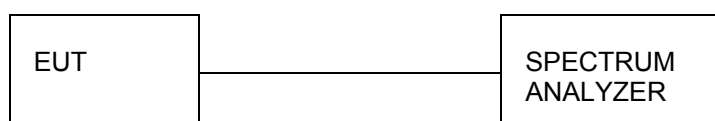
Note1: If transmitting antennas of directional gain greater than 6 dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note2: Fixed point - to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information.

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 1MHz for U-NII 1, U-NII 2A, U-NII C band and 510KHz for U-NII 3 band.
3. Set the VBW $\geq 3 \times$ RBW.
4. Set the span to encompass the entire EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level.

Test Configuration



Test Results

Type	Bands	Channel	Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)	Result
802.11a	U-NII 1	36	9.456	17.0	Pass
		40	10.475		
		48	10.149		
802.11n (HT20)	U-NII 1	36	9.075		
		40	8.826		
		48	9.220		
802.11n (HT40)	U-NII 1	38	1.527		
		46	6.189		
802.11ac (HT20)	U-NII 1	36	10.214		
		40	8.762		
		48	9.020		
802.11ac (HT40)	U-NII 1	38	1.500		
		46	5.985		
802.11ac (HT80)	U-NII 1	42	-3.520		

Type	Bands	Channel	Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)	Result
802.11a	U-NII 2A	52	10.493	17.0	Pass
		56	10.013		
		64	10.697		
802.11n (HT20)	U-NII 2A	52	9.423		
		56	10.025		
		64	8.556		
802.11n (HT40)	U-NII 2A	54	6.639		
		62	3.736		
802.11ac (HT20)	U-NII 2A	52	9.262		
		56	9.252		
		64	8.599		
802.11ac (HT40)	U-NII 2A	54	7.289		
		62	5.033		
802.11ac (HT80)	U-NII 2A	58	-1.399		

Type	Bands	Channel	Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)	Result
802.11a	U-NII 2C	100	7.638	17.0	Pass
		120	8.701		
		140	7.479		
802.11n (HT20)	U-NII 2C	100	6.809		
		120	7.298		
		140	6.044		
802.11n (HT40)	U-NII 2C	102	0.450		
		118	5.324		
		134	3.287		
802.11ac (HT20)	U-NII 2C	100	6.430		
		120	7.481		
		140	7.105		
802.11ac (HT40)	U-NII 2C	102	0.309		
		118	4.806		
		134	3.917		
802.11ac (HT80)	U-NII 2C	106	7.585		
		122	-1.827		

Type	Bands	Channel	Power Spectral Density (dBm/300KHz)	Power Spectral Density (dBm/500KHz)	Limit (dBm/500KHz)	Result
802.11a	U-NII 3	149	5.848	8.068	30.0	Pass
		157	4.233	6.453		
		165	3.020	5.24		
802.11n (HT20)	U-NII 3	149	4.401	6.621		
		157	3.315	5.535		
		165	2.866	5.086		
802.11n (HT40)	U-NII 3	151	0.917	3.137		
		159	-3.984	-1.764		
802.11ac (HT20)	U-NII 3	149	4.446	6.666		
		157	3.316	5.536		
		165	2.962	5.182		
802.11ac (HT40)	U-NII 3	151	0.981	3.201		
		159	-3.412	-1.192		
802.11ac (HT80)	U-NII 3	155	-16.397	-14.177		

Remark: P.S.D(dBm/500KHz)= P.S.D(dBm/300KHz)+10 log (500 kHz/300KHz).

Test plot as follows:

802.11a

U-NII 1



U-NII 3



CH36



CH149



CH40



CH157



CH48

CH165

802.11a

U-NII 2A



U-NII 2C



CH52



CH100



CH56



CH120



CH64

CH140

802.11n(HT20)

U-NII 1



U-NII 3



CH36



CH149



CH40



CH157



CH48

CH165

802.11n(HT20)

U-NII 2A



U-NII 2C



CH52



CH100



CH56



CH120



CH64

CH140

802.11n(HT40)

U-NII 1



CH38

U-NII 3



CH151



CH46



CH159

802.11n(HT40)

U-NII 2A



CH54

U-NII 2C



CH102



CH62



CH118



CH134

802.11ac(HT20)

U-NII 1



U-NII 3



CH36



CH149



CH40



CH157



CH48



CH165



802.11ac(HT20)

U-NII 2A



U-NII 2C



CH52



CH100



CH56



CH120



CH64

CH140

802.11ac(HT40)

U-NII 1



U-NII 3



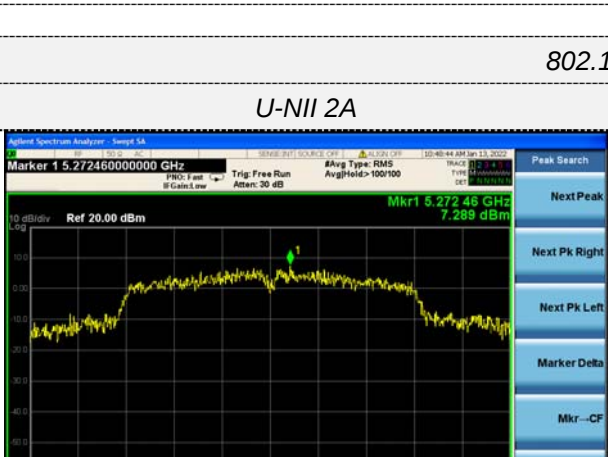
CH38



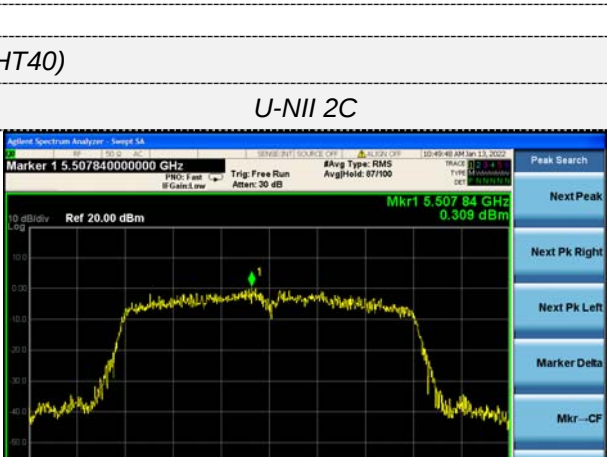
CH151



CH46



CH159



802.11ac(HT40)

U-NII 2A



U-NII 2C



CH54



CH102





CH62



CH118



CH134

802.11ac(HT80)

U-NII 1



CH42

U-NII 3



CH155

802.11ac(HT80)

U-NII 2A

U-NII 2C



CH58



CH106



CH122

5.6 Emission Bandwidth (26dBm Bandwidth)

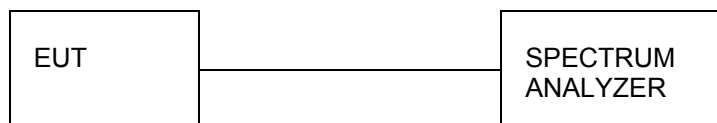
Limit

N/A

Test Procedure

1. Set resolution bandwidth (RBW) = approximately 1 % of the EBW.
2. Set the video bandwidth (VBW) > RBW.
3. Detector = Peak.
4. Trace mode = Max hold.
5. Measure the maximum width of the emission that is 26 dB down from the peak 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 %.

Test Configuration



Test Results

Type	Bands	Channel	26dB Bandwidth (MHz)	Limit (MHz)	Result
802.11a	U-NII 1	36	29.15	N/A	Pass
		40	29.63		
		48	29.86		
802.11n(HT20)	U-NII 1	36	29.68		
		40	29.63		
		48	29.97		
802.11n(HT40)	U-NII 1	38	49.66		
		46	58.83		
802.11ac(HT20)	U-NII 1	36	29.69		
		40	29.87		
		48	29.98		
802.11ac(HT40)	U-NII 1	38	45.68		
		46	58.35		
802.11ac(HT80)	U-NII 1	42	79.70		

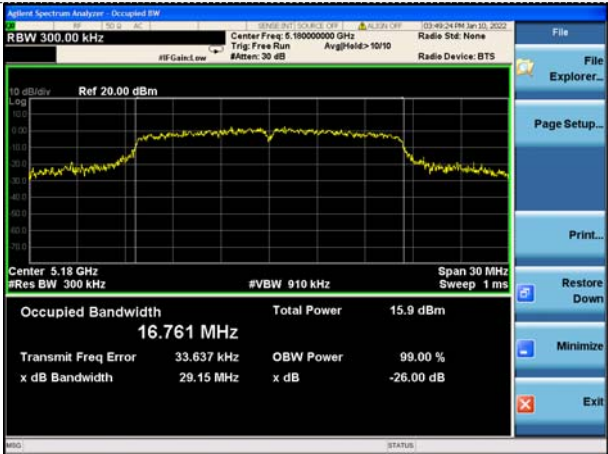
Type	Bands	Channel	26dB Bandwidth (MHz)	Limit (MHz)	Result
802.11a	U-NII 2A	52	29.96	N/A	Pass
		56	28.85		
		64	28.36		
802.11n(HT20)	U-NII 2A	52	28.63		
		56	29.31		
		64	29.26		
802.11n(HT40)	U-NII 2A	54	59.24		
		62	59.90		
802.11ac(HT20)	U-NII 2A	52	27.28		
		56	28.43		
		64	29.25		
802.11ac(HT40)	U-NII 2A	54	58.88		
		62	59.55		
802.11ac(HT80)	U-NII 2A	58	92.93		

Type	Bands	Channel	26dB Bandwidth (MHz)	Limit (MHz)	Result
802.11a	U-NII 2C	100	19.52	N/A	Pass
		120	19.41		
		140	19.92		
802.11n(HT20)	U-NII 2C	100	19.18		
		120	19.81		
		140	19.32		
802.11n(HT40)	U-NII 2C	102	39.45		
		118	39.63		
		134	40.00		
802.11ac(HT20)	U-NII 2C	100	19.57		
		120	19.81		
		140	19.32		
802.11ac(HT40)	U-NII 2C	102	39.82		
		118	39.74		
		134	40.07		
802.11ac(HT80)	U-NII 2C	106	80.37		
		122	79.40		

Test plot as follows:

U-NII 1

802.11a



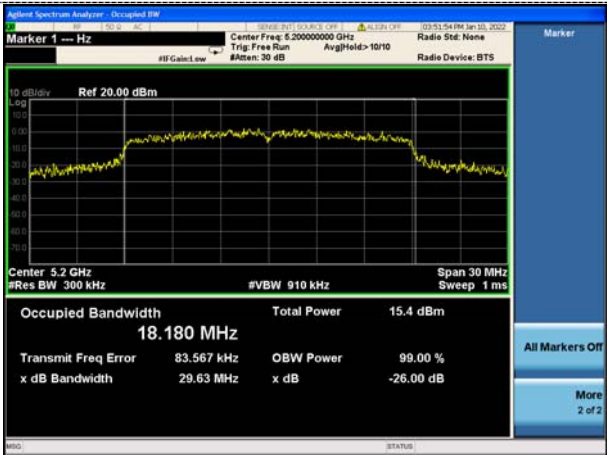
802.11n(HT20)



CH36



CH36



CH40



CH40



CH48

CH48

802.11n(HT40)



802.11ac(HT20)



CH38



CH36



CH46



CH40



CH48

802.11ac(HT40)



802.11ac(HT80)



CH38



CH42

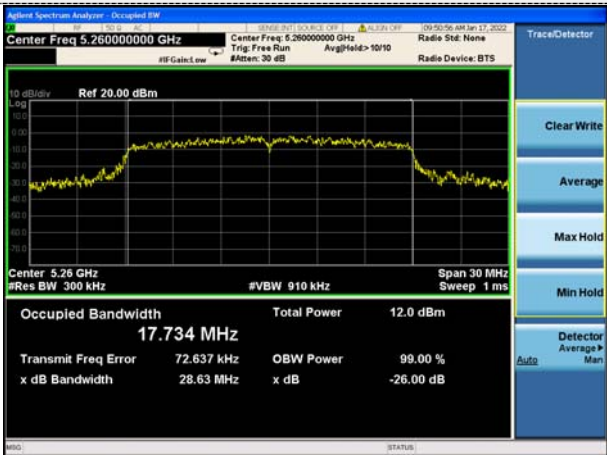
CH46

U-NII 2A

802.11a



802.11n(HT20)



CH52

CH52



CH56



CH56



CH64



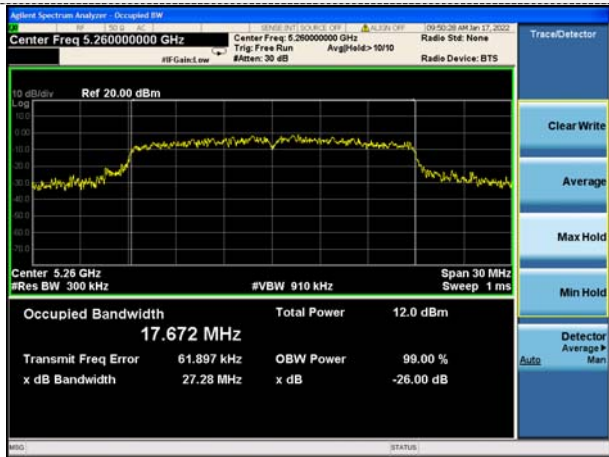
CH64

802.11n(HT40)



CH54

802.11ac(HT20)



CH52



CH62



CH56



CH64

802.11ac(HT40)

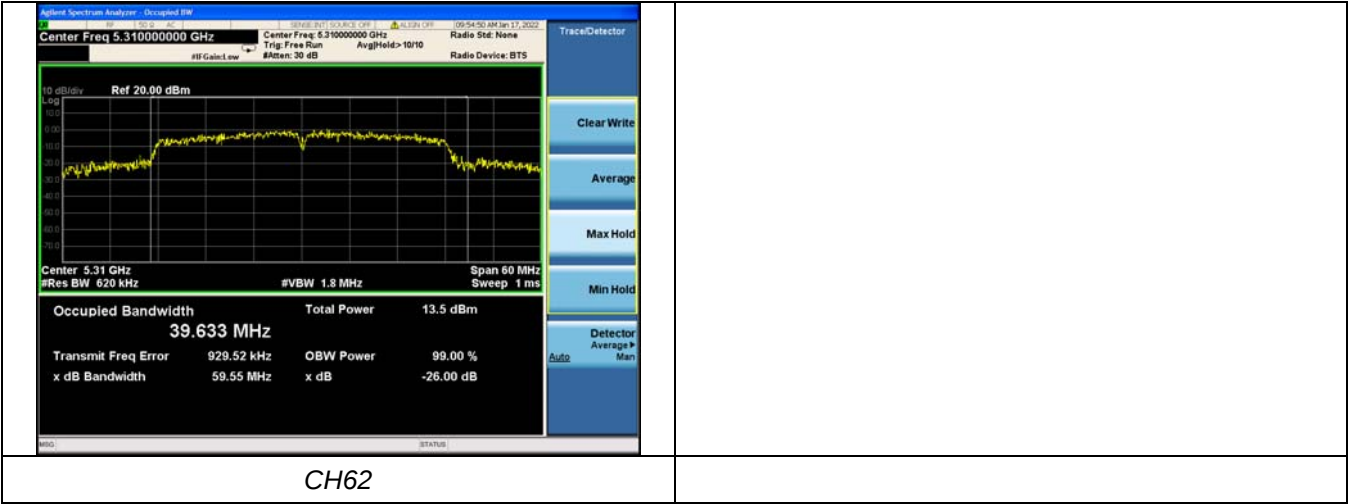


CH54

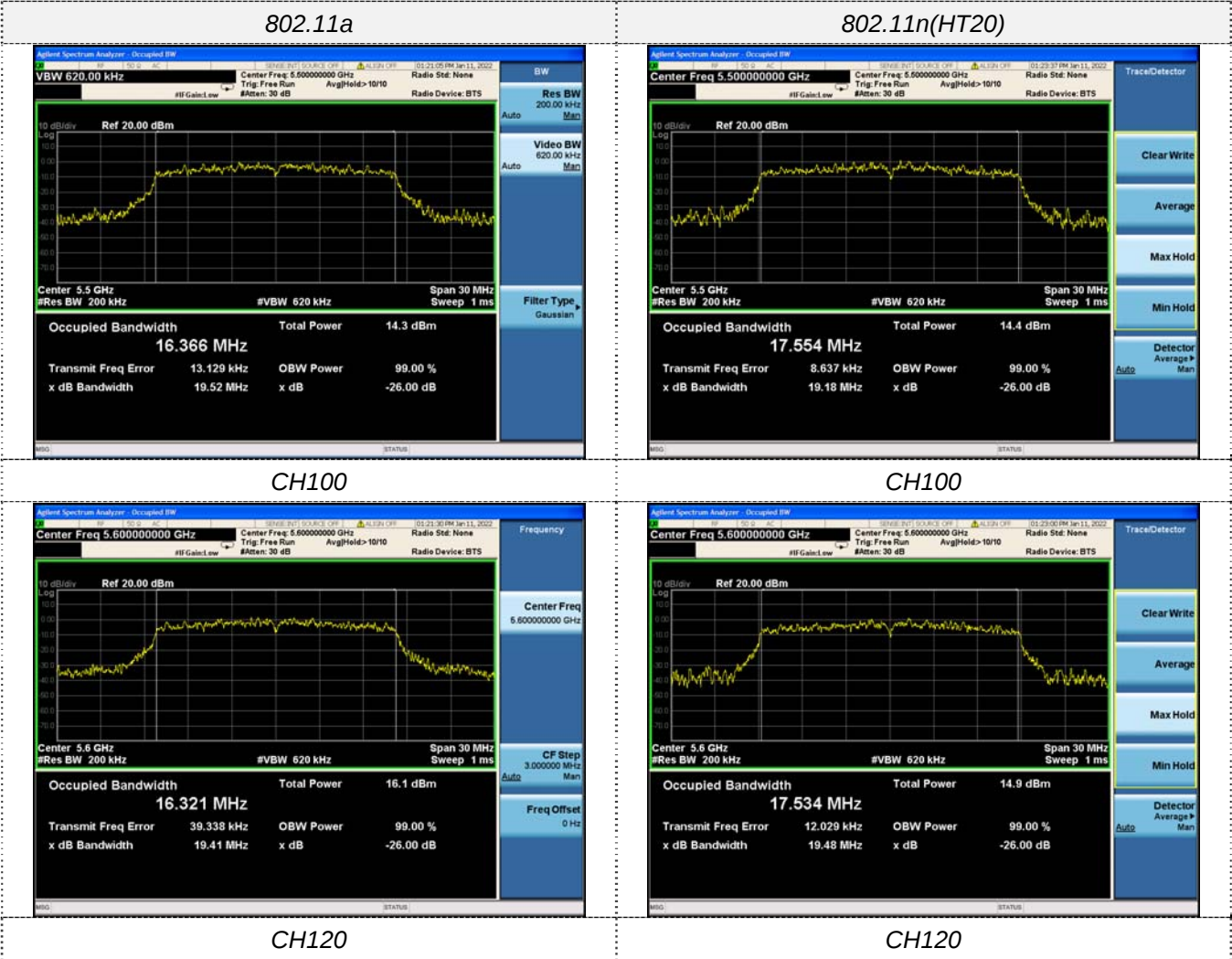
802.11ac(HT80)



CH58



U-NII 2C





CH140



CH140

802.11n(HT40)



CH102

802.11ac(HT20)



CH100



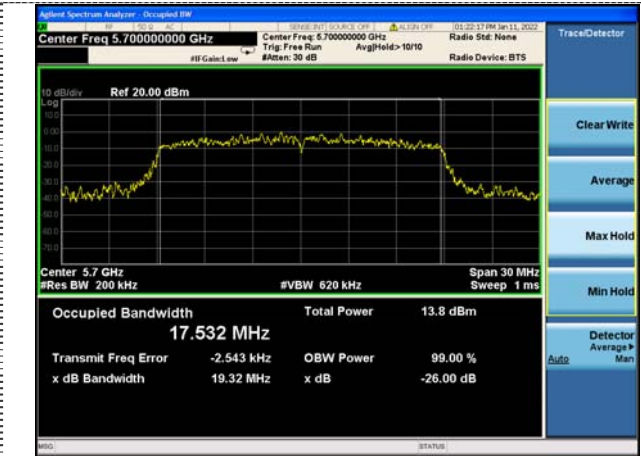
CH118



CH120



CH134



CH140

802.11ac(HT40)



802.11ac(HT80)



CH102



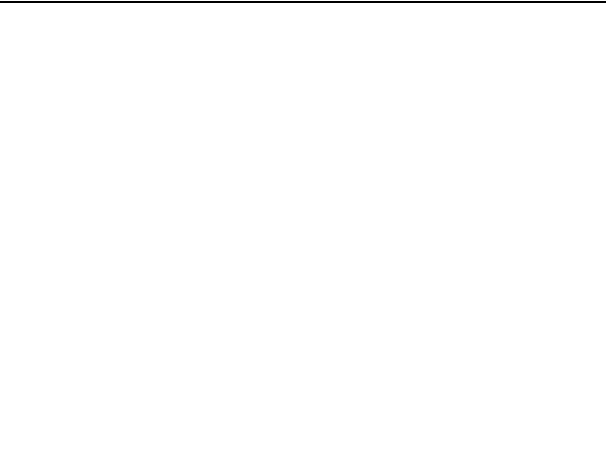
CH106



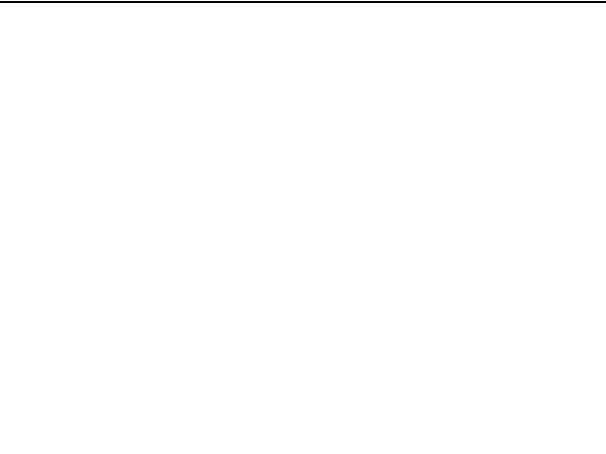
CH118



CH122



CH134



5.7 Minimum Emission Bandwidth (6dBm Bandwidth)

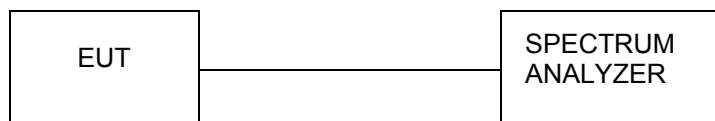
Limit

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

Test Procedure

1. Set resolution bandwidth (RBW) = 100 kHz
2. Set the video bandwidth 3 x RBW.
3. Detector = Peak.
4. Trace mode = Max hold.
5. 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.

Test Configuration

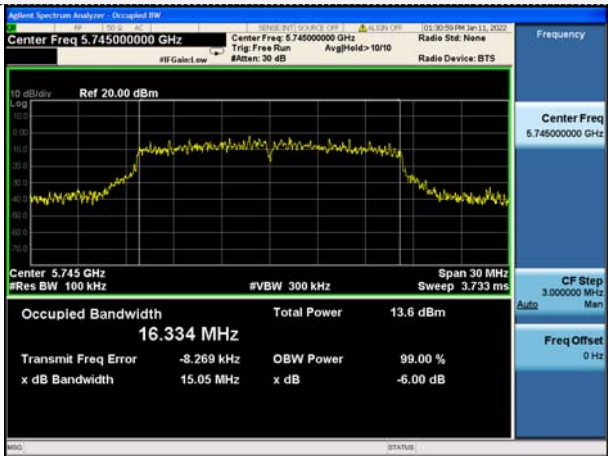


Test Results

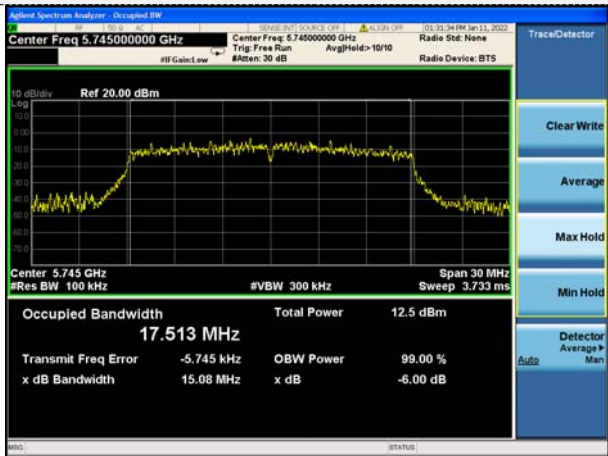
Type	Bands	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
802.11a	U-NII 3	149	15.05	≥500KHz	Pass
		157	15.46		
		165	17.56		
802.11n(HT20)	U-NII 3	149	17.513		
		157	17.492		
		165	17.535		
802.11n(HT40)	U-NII 3	151	35.781		
		159	35.797		
802.11ac(HT20)	U-NII 3	149	15.13		
		157	15.07		
		165	15.04		
802.11ac(HT40)	U-NII 3	151	32.56		
		159	35.04		
802.11ac(HT80)	U-NII 3	155	71.94		

Test plot as follows:

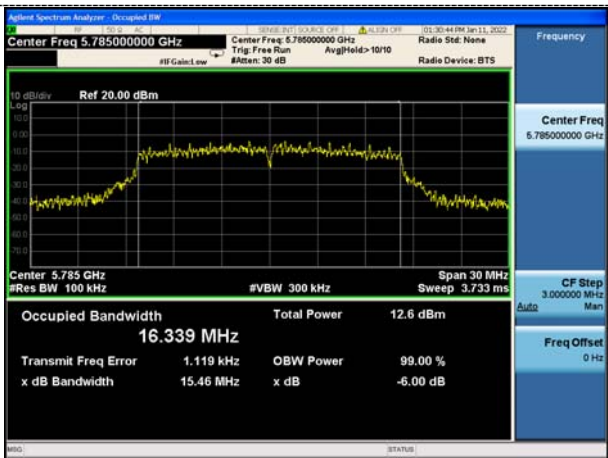
802.11a



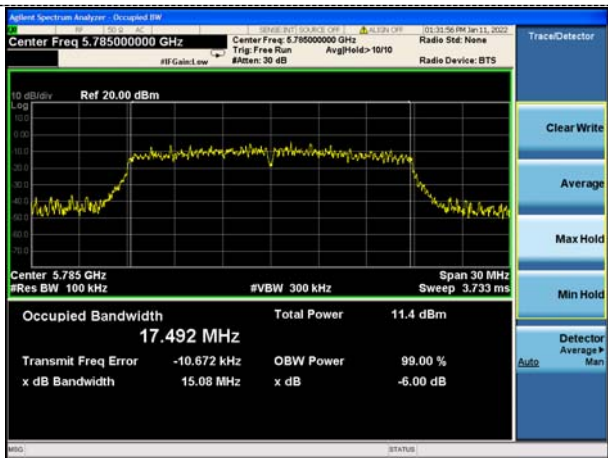
802.11n(HT20)



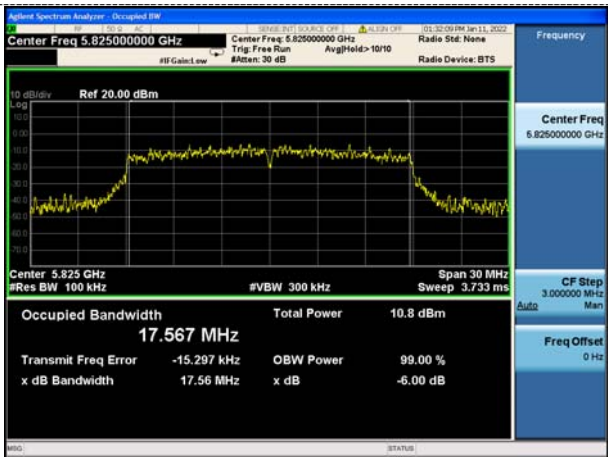
CH149



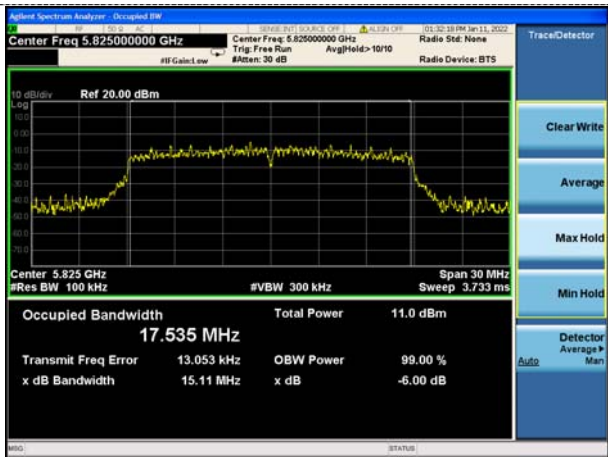
CH149



CH157



CH157



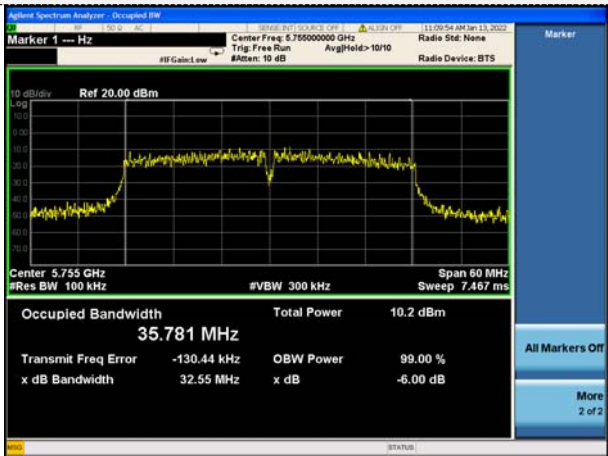
CH165



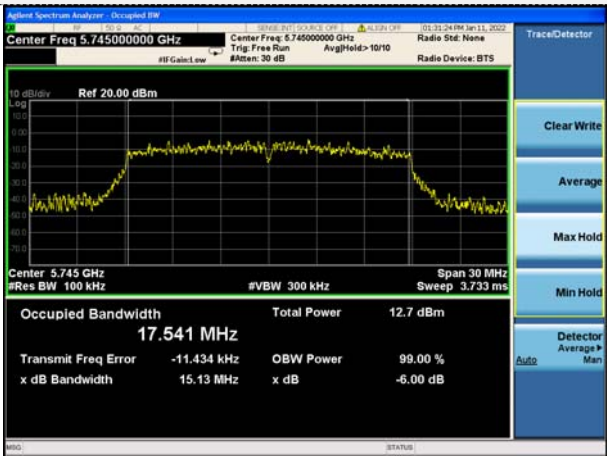
CH165



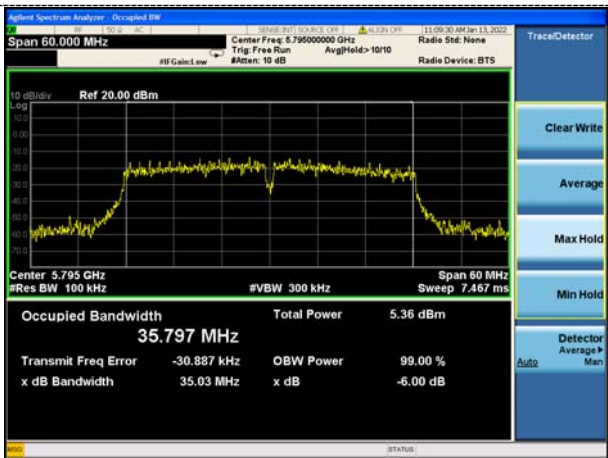
802.11n(HT40)



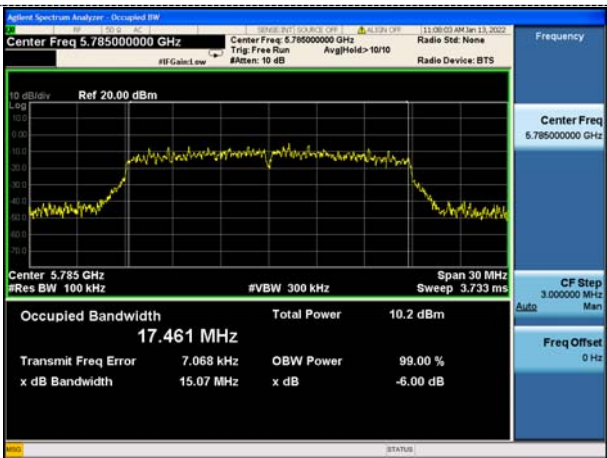
802.11ac(HT20)



CH151



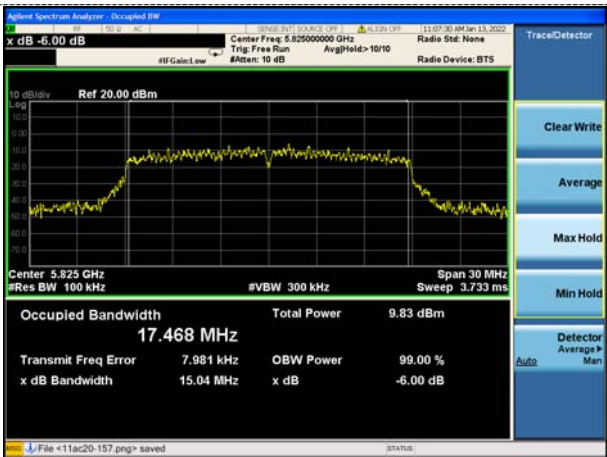
CH149



CH159

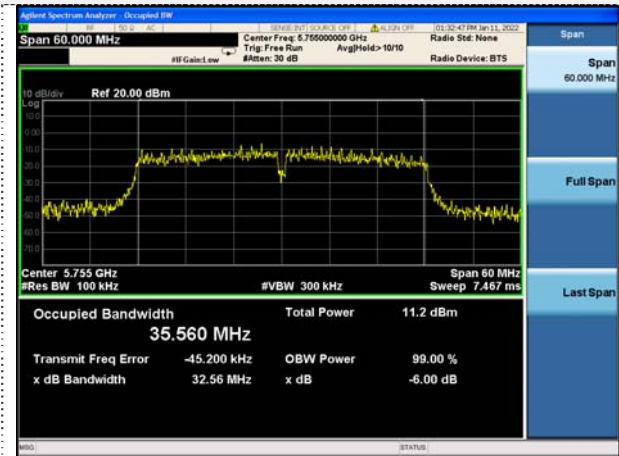


CH157



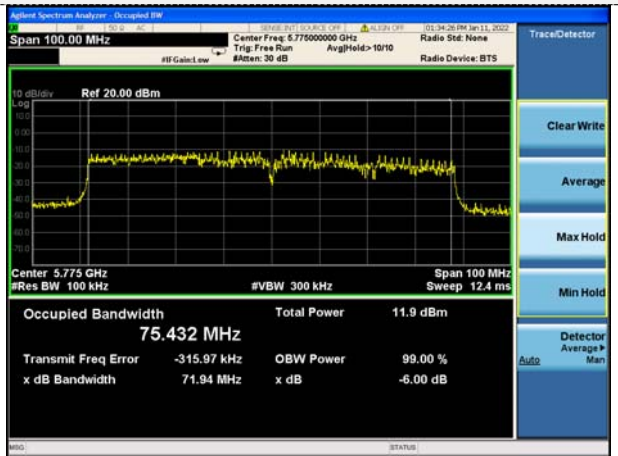
CH165

802.11ac(HT40)

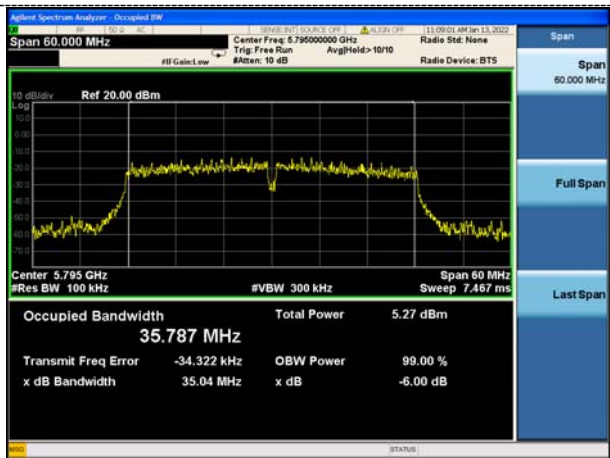


CH151

802.11ac(HT80)



CH155



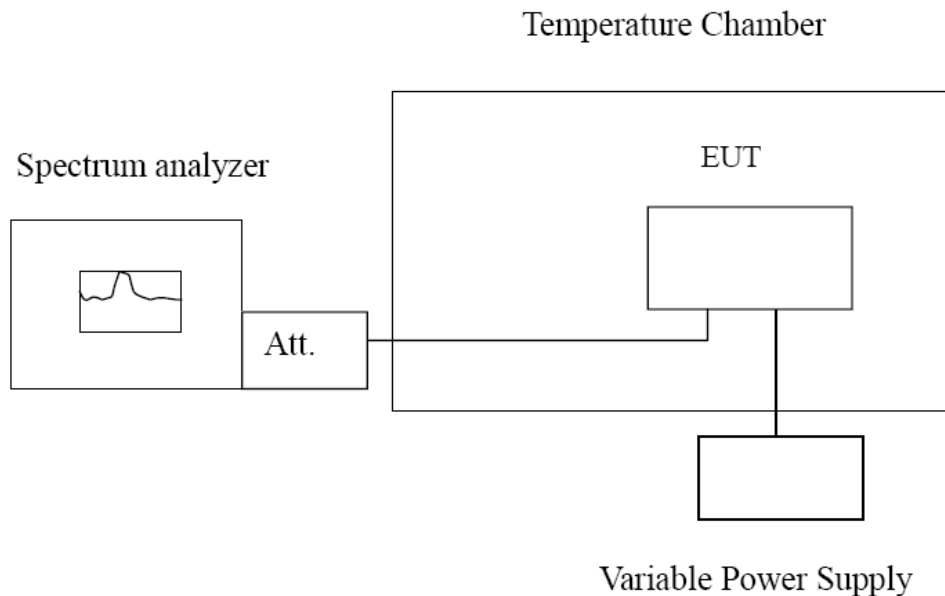
CH159

5.8 Frequency Stability

LIMIT

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 users manual.

TEST CONFIGURATION



TEST PROCEDURE

Frequency Stability under Temperature Variations:

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 analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30°C. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C increased per stage until the highest temperature of +50°C reached.

Frequency Stability under Voltage Variations:

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation ($\pm 15\%$) and endpoint, record the maximum frequency change.

TEST RESULTS

Record worst case as below:

Reference Frequency: 802.11ac channel=36 frequency=5180MHz					
Voltage (V)	Temperature (°C)	Frequency error		Limit (ppm)	Result
		MHz	ppm		
3.7	-30	0.012	2.51	Within the band of operation	Pass
	-20	0.014	2.90		
	-10	0.016	2.70		
	0	0.016	2.51		
	10	0.016	2.90		
	20	0.012	2.70		
	30	0.016	2.90		
	40	0.012	2.51		
	50	0.014	2.32		
4.26	25	0.013	3.09	Within the band of operation	Pass
3.15	25	0.013	2.51		

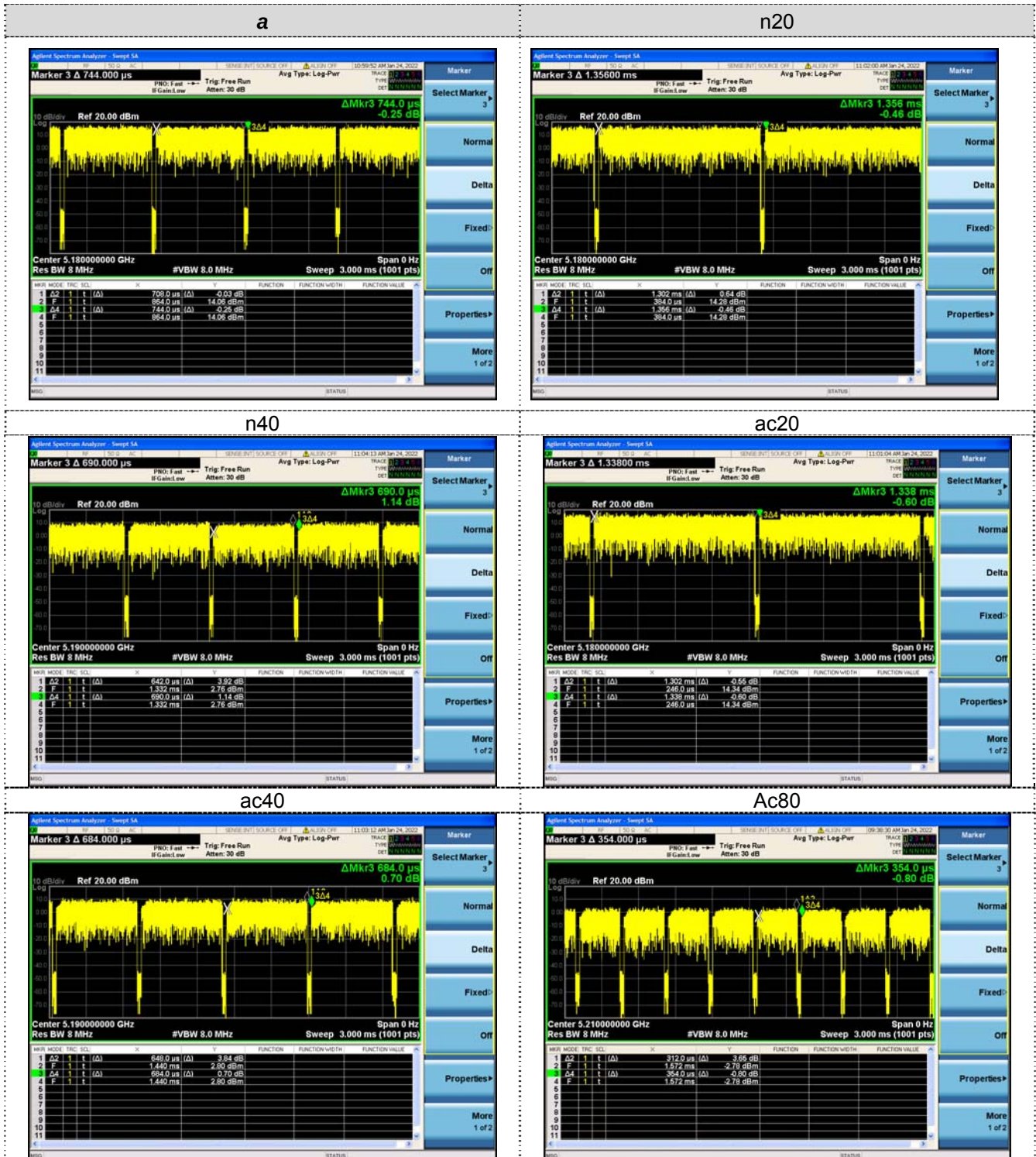
Reference Frequency: 802.11ac channel=58 frequency=5290MHz					
Voltage (V)	Temperature (°C)	Frequency error		Limit (ppm)	Result
		MHz	ppm		
3.7	-30	0.012	2.27	Within the band of operation	Pass
	-20	0.013	2.46		
	-10	0.014	2.65		
	0	0.015	2.84		
	10	0.012	2.27		
	20	0.012	2.27		
	30	0.015	2.84		
	40	0.012	2.27		
	50	0.016	3.02		
4.26	25	0.013	2.46	Within the band of operation	Pass
3.15	25	0.013	2.46		

Reference Frequency: 802.11ac channel=122 frequency=5610MHz					
Voltage (V)	Temperature (°C)	Frequency error		Limit (ppm)	Result
		MHz	ppm		
3.7	-30	0.015	2.67	Within the band of operation	Pass
	-20	0.014	2.50		
	-10	0.015	2.67		
	0	0.014	2.50		
	10	0.013	2.32		
	20	0.012	2.14		
	30	0.013	2.32		
	40	0.012	2.14		
	50	0.015	2.67		
4.26	25	0.016	2.85	Within the band of operation	Pass
3.15	25	0.014	2.50		

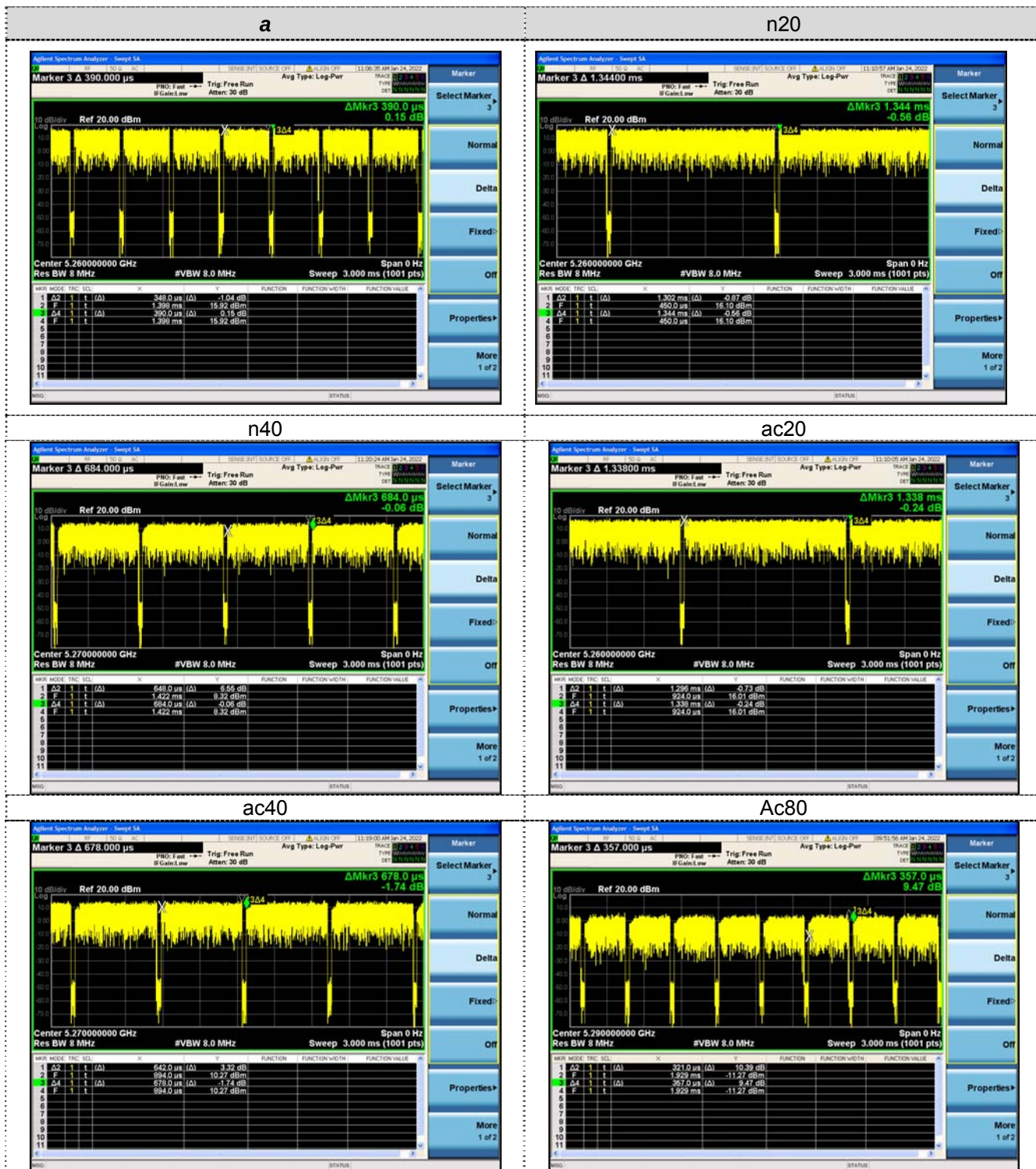
Reference Frequency: 802.11ac channel=149 frequency=5745MHz					
Voltage (V)	Temperature (°C)	Frequency error		Limit (ppm)	Result
		MHz	ppm		
3.7	-30	0.012	2.09	Within the band of operation	Pass
	-20	0.013	2.26		
	-10	0.012	2.09		
	0	0.016	2.79		
	10	0.015	2.61		
	20	0.015	2.61		
	30	0.014	2.44		
	40	0.012	2.09		
	50	0.012	2.09		
4.26	25	0.012	2.09	Within the band of operation	Pass
3.15	25	0.016	2.79		

5.9 Duty Cycle Information

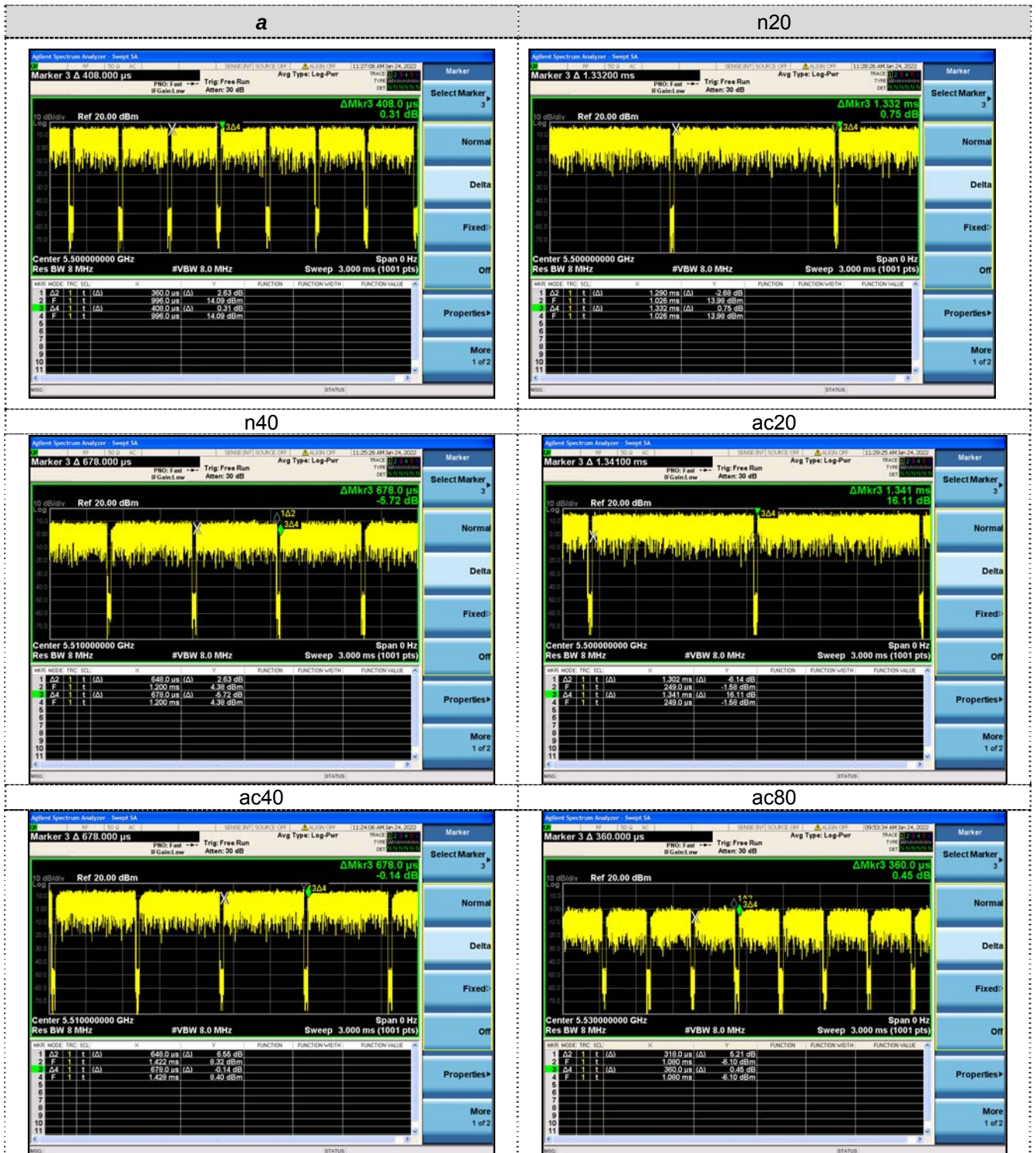
U-NII 1				
Test Mode	Maximum Achievable Duty Cycle (x) = On / (On+Off)			Duty Cycle Correction Factor [dB]
	On Time [ms]	(On+Off) Time [ms]	x	
a	0.708	0.744	95.16%	0.062
n20	1.302	1.356	96.02%	0.051
n40	0.642	0.690	93.04%	0.062
ac20	1.302	1.338	97.31%	0.051
ac40	0.648	0.684	94.74%	0.055
ac80	0.312	0.354	88.14%	0.045



U-NII 2A				
Test Mode	Maximum Achievable Duty Cycle (x) = On / (On+Off)			Duty Cycle Correction Factor [dB]
	On Time [ms]	(On+Off) Time [ms]	x	
a	0.348	0.390	89.23%	0.061
n20	1.302	1.344	96.88%	0.051
n40	0.648	0.684	94.74%	0.064
ac20	1.296	1.338	96.86%	0.052
ac40	0.642	0.678	94.69%	0.053
ac80	0.321	0.357	89.92%	0.046



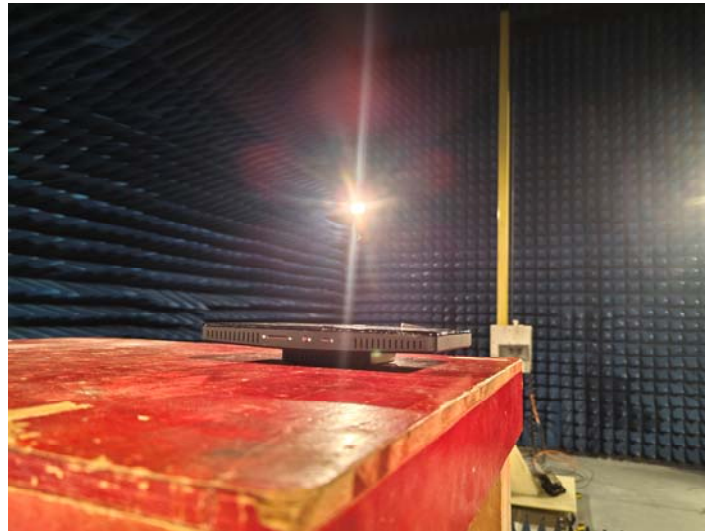
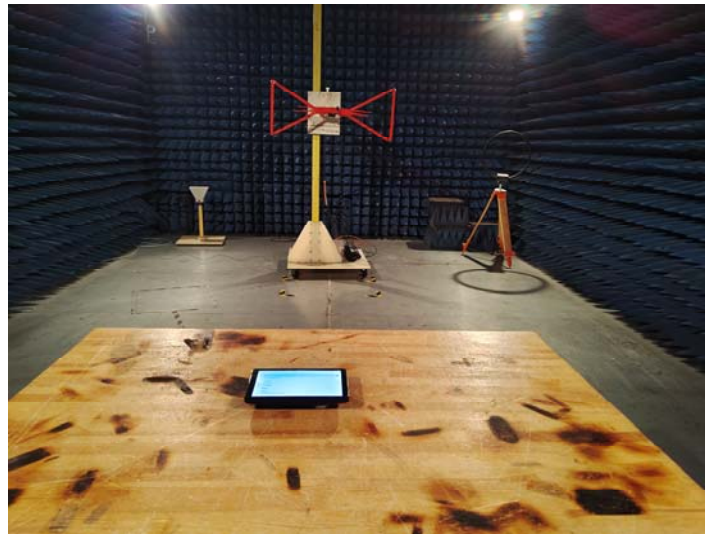
U-NII 2C				
Test Mode	Maximum Achievable Duty Cycle (x) = On / (On+Off)			Duty Cycle Correction Factor [dB]
	On Time [ms]	(On+Off) Time [ms]	x	
a	0.360	0.408	88.24%	0.062
n20	1.290	1.332	96.95%	0.052
n40	0.648	0.678	95.58%	0.063
ac20	1.302	1.341	97.09%	0.054
ac40	0.648	0.678	95.58%	0.050
ac80	0.318	0.360	88.33%	0.048



U-NII 3				
Test Mode	Maximum Achievable Duty Cycle (x) = On / (On+Off)			Duty Cycle Correction Factor [dB]
	On Time [ms]	(On+Off) Time [ms]	x	
a	0.354	0.396	89.39%	0.060
n20	1.290	1.326	97.29%	0.060
n40	0.642	0.684	93.86%	0.058
ac20	1.305	1.344	97.10%	0.058
ac40	0.642	0.690	93.04%	0.055
ac80	0.324	0.360	90.00%	0.061



6 Test Setup Photos of the EUT



7 Photos of the EUT

see photo report.

***** End of Report *****