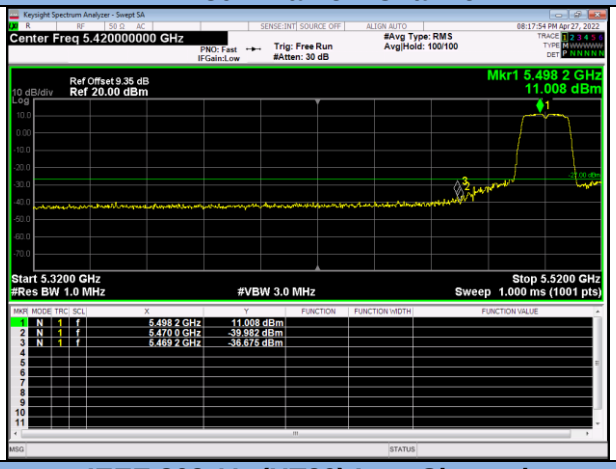
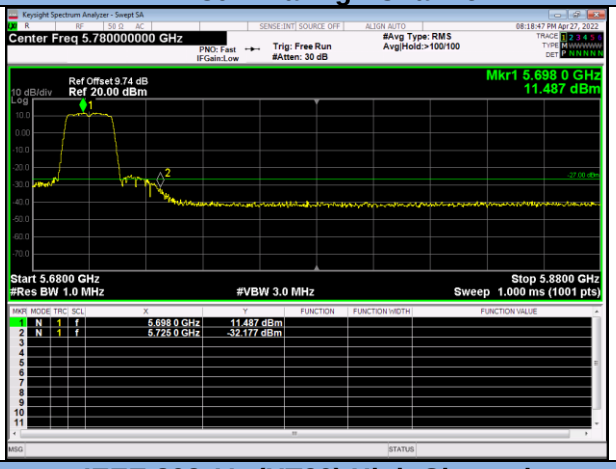
U-NII-2C Band

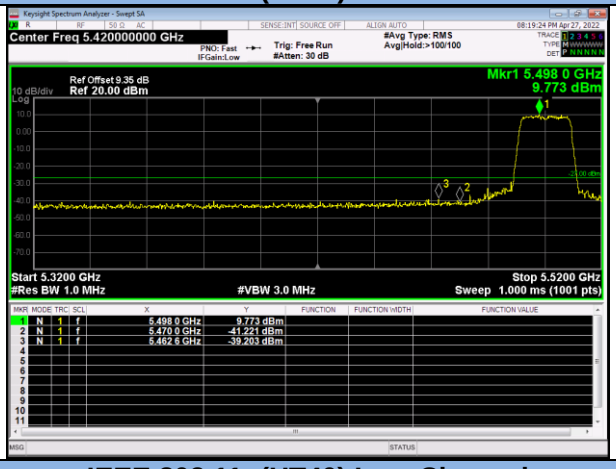
IEEE 802.11a Low Channel



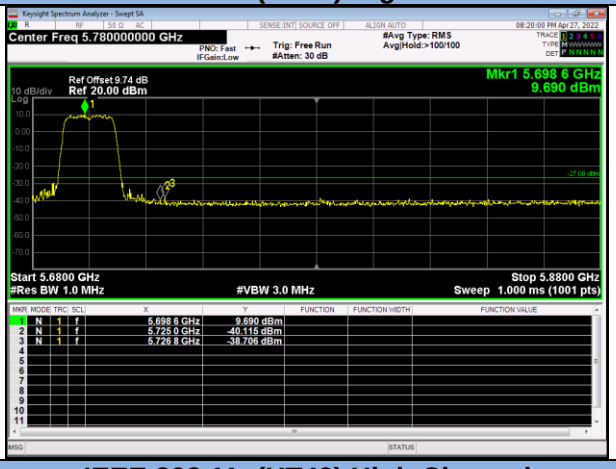
IEEE 802.11a High Channel



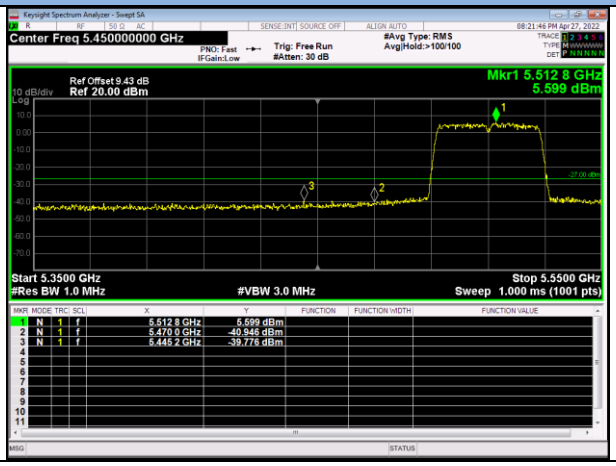
IEEE 802.11n(HT20) Low Channel



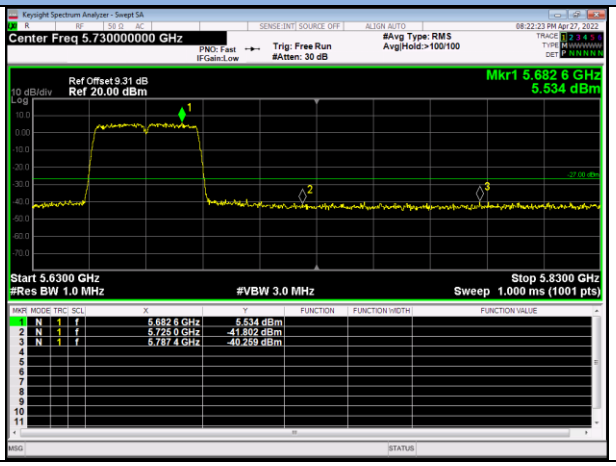
IEEE 802.11n(HT20) High Channel



IEEE 802.11n(HT40) Low Channel

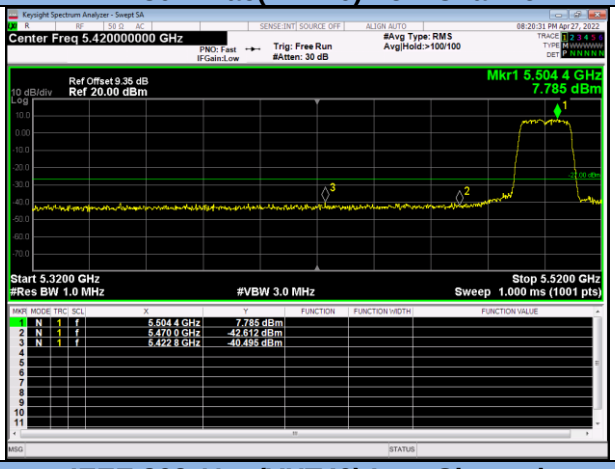


IEEE 802.11n(HT40) High Channel

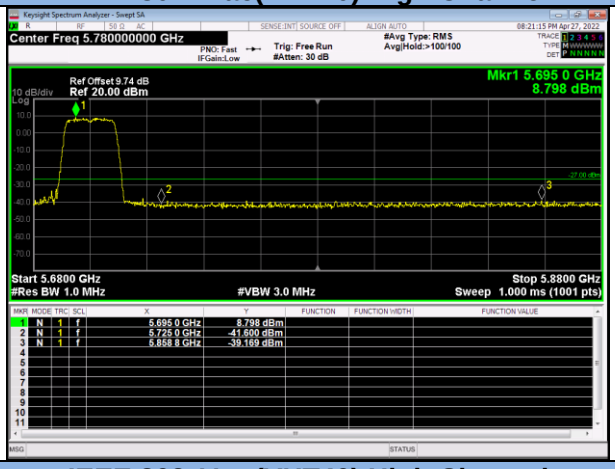


U-NII-2C Band

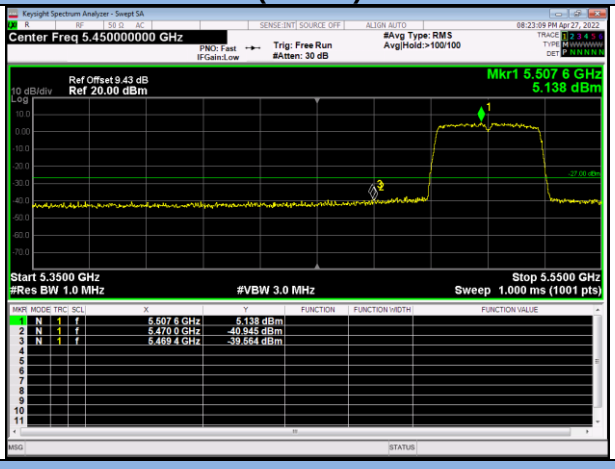
IEEE 802.11ac(VHT20) Low Channel



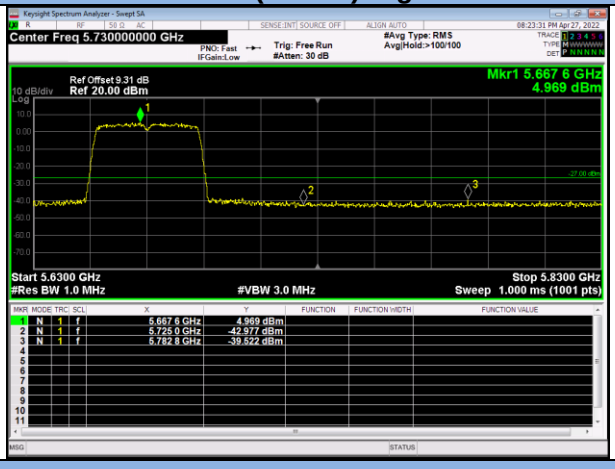
IEEE 802.11ac(VHT20) High Channel



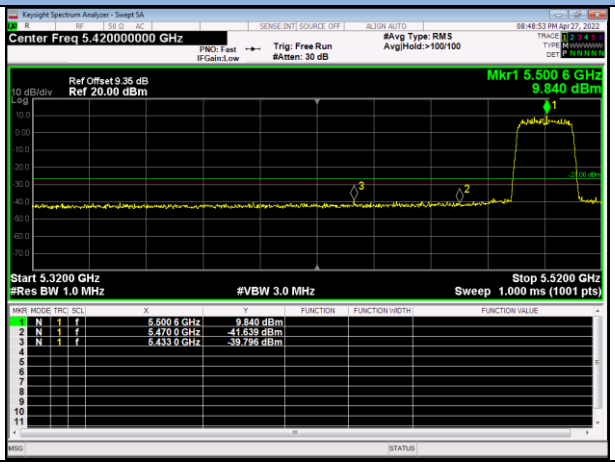
IEEE 802.11ac(VHT40) Low Channel



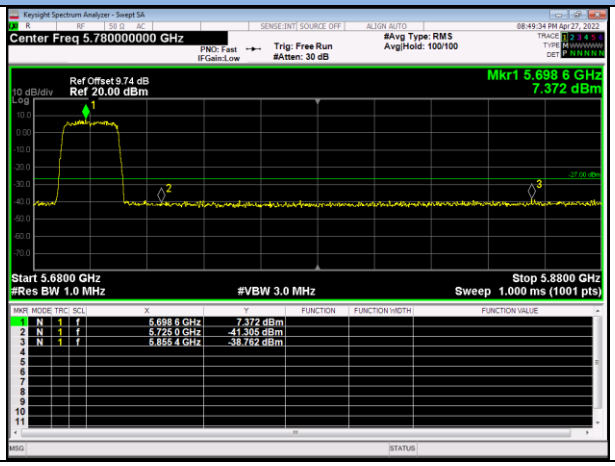
IEEE 802.11ac(VHT40) High Channel

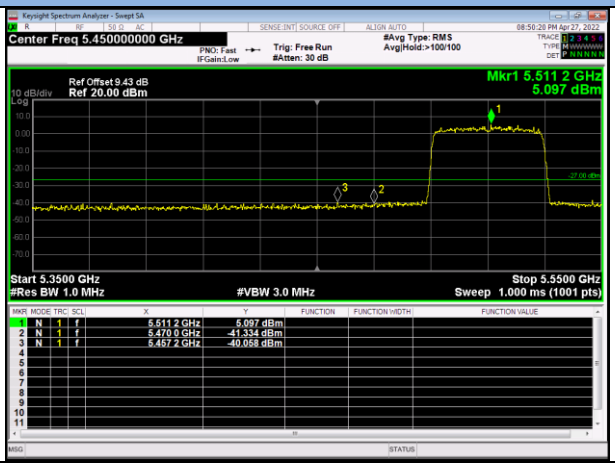
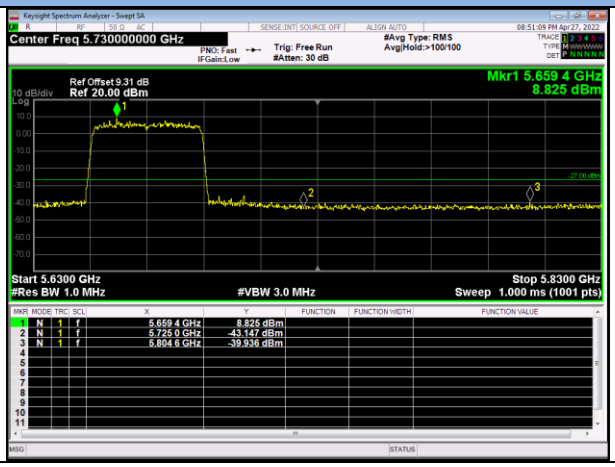


IEEE 802.11ax(HE20) Low Channel



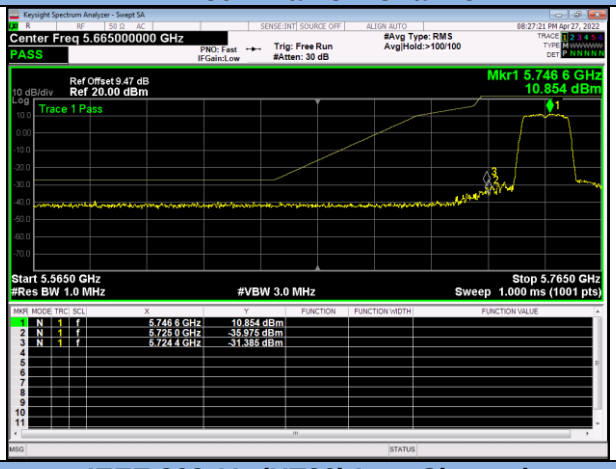
IEEE 802.11 ax(HE20) High Channel



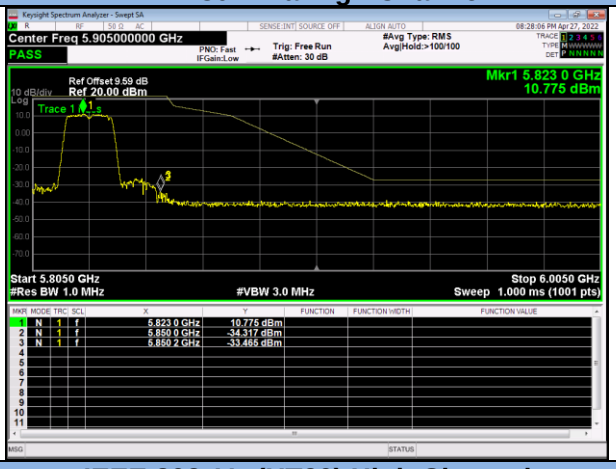
U-NII-2C Band	
IEEE 802.11ax(HE40) Low Channel	IEEE 802.11ax(HE40) High Channel
	

U-NII-3 Band

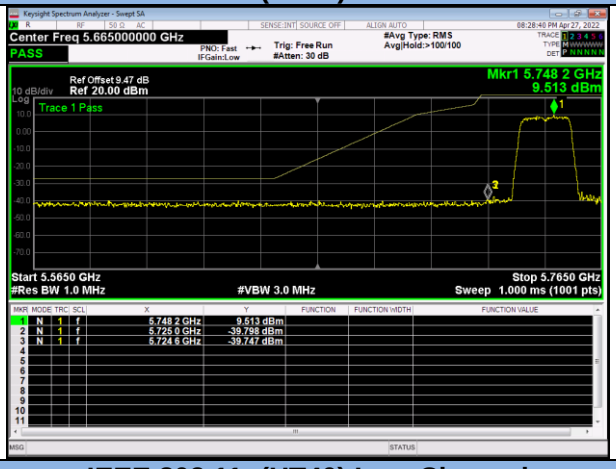
IEEE 802.11a Low Channel



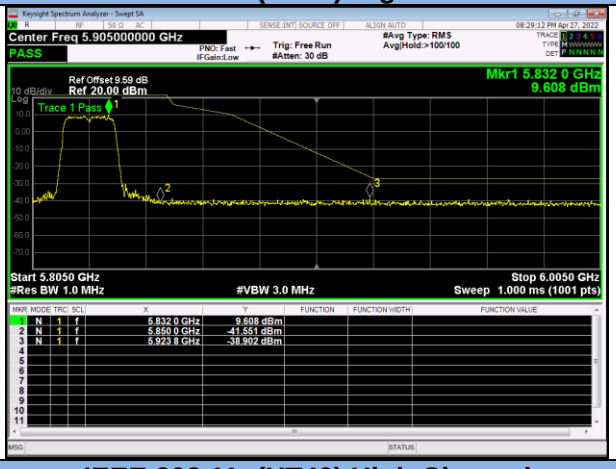
IEEE 802.11a High Channel



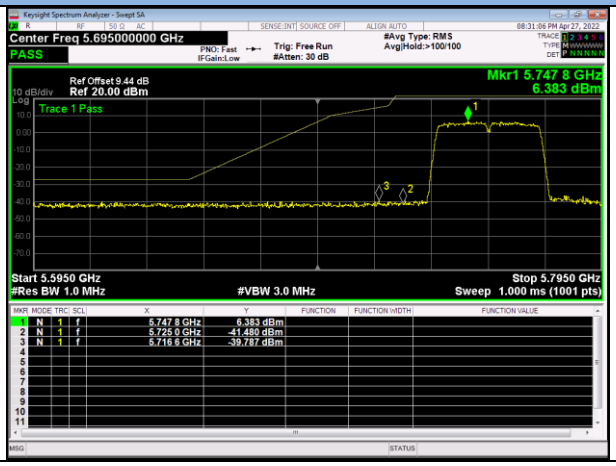
IEEE 802.11n(HT20) Low Channel



IEEE 802.11n(HT20) High Channel



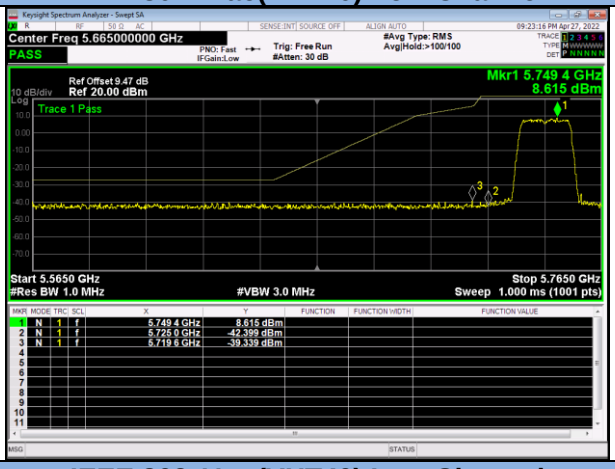
IEEE 802.11n(HT40) Low Channel



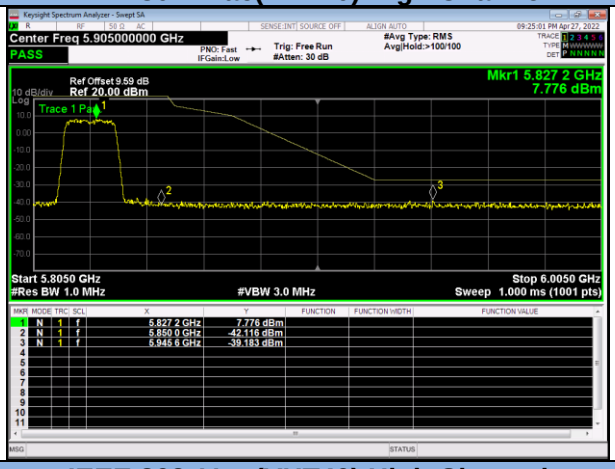
IEEE 802.11n(HT40) High Channel

U-NII-3 Band

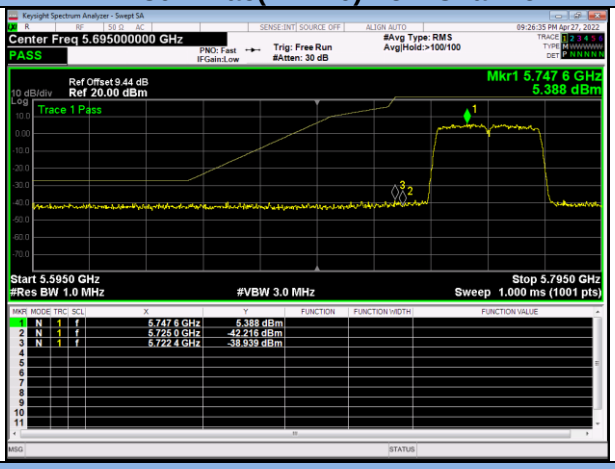
IEEE 802.11ac(VHT20) Low Channel



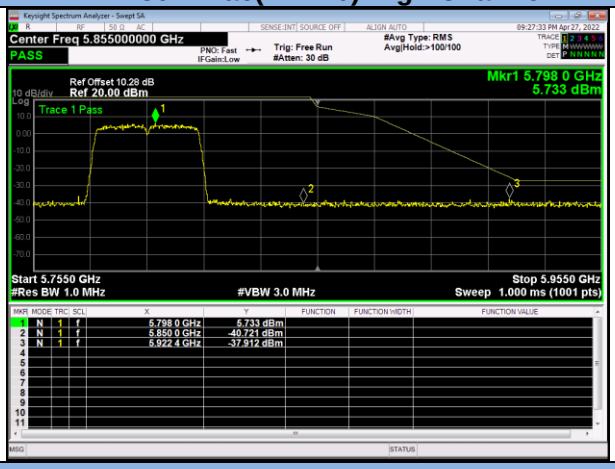
IEEE 802.11ac(VHT20) High Channel



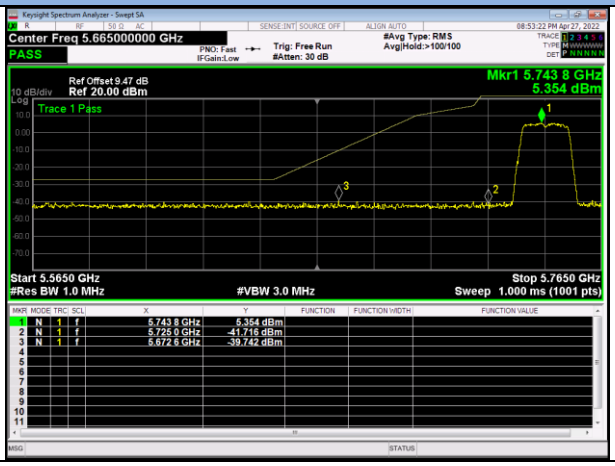
IEEE 802.11ac(VHT40) Low Channel



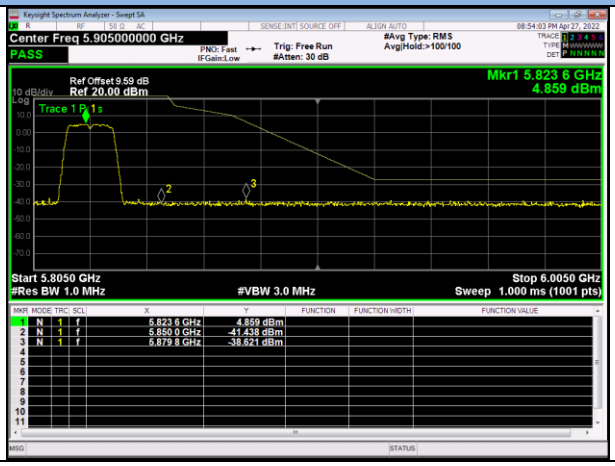
IEEE 802.11ac(VHT40) High Channel

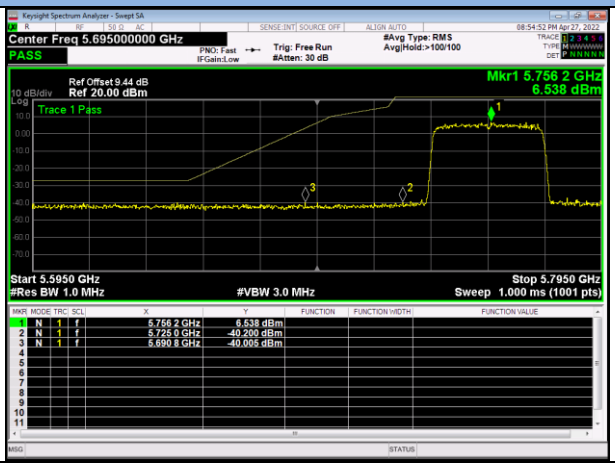
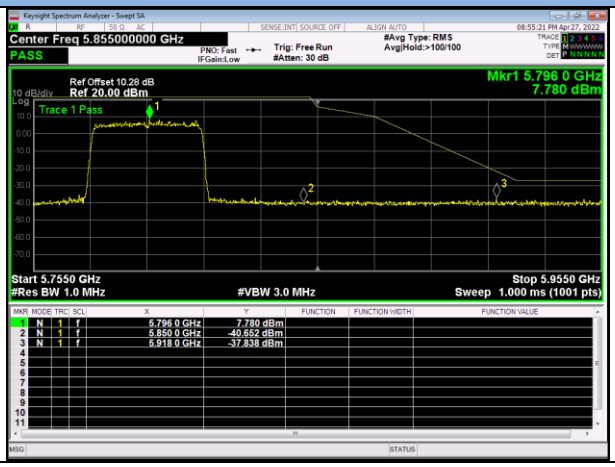


IEEE 802.11ax(HE20) Low Channel



IEEE 802.11 ax(HE20) High Channel



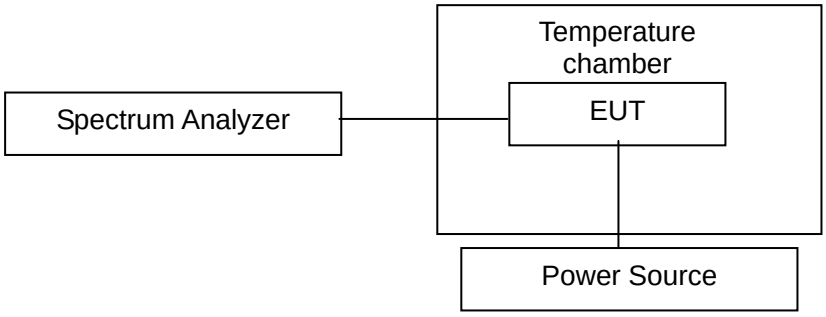
U-NII-3 Band	
IEEE 802.11ax(HE40) Low Channel	IEEE 802.11ax(HE40) High Channel
	

14.7 Frequency Stability

LIMITS

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

BLOCK DIAGRAM OF TEST SETUP



TEST PROCEDURES

a. The EUT was placed inside the environmental test chamber and powered byPower source.
b. Turn the EUT on and couple its output to a spectrum analyzer.
c. Turn the EUT off and set the chamber to the highest temperature specified.
d. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency after 2, 5, and 10 minutes.
e. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
f. The chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.
Note: The EUT set at un-modulation mode during frequency stability test.

TEST RESULTS

PASS

Please refer to the following pages of the worst case ANT_1.

U-NII-1 Band						
Lowest channel 5180MHz						
Temperature (℃)	Power Supplied (Vdc)	Measured Frequency (MHz)				Test Result
		0 Minute	2 Minute	5 Minute	10 Minute	
-30	3.3	5179.9800	5180.0122	5180.0163	5180.0124	Pass
-10		5180.0123	5180.0154	5180.0142	5180.0124	Pass
0		5180.0135	5180.0147	5180.0123	5180.0154	Pass
20		5180.0154	5180.0125	5180.0167	5180.0122	Pass
40		5180.0123	5180.0121	5180.0143	5180.0158	Pass
60		5180.0145	5180.0153	5180.0156	5180.0155	Pass
85		5180.0155	5180.0148	5180.0124	5180.0146	Pass
20	2.97	5180.0163	5180.0153	5180.0140	5180.0132	Pass
20	3.63	5180.0172	5180.0164	5180.0123	5180.0164	Pass
Highest channel 5240MHz						
Temperature (℃)	Power Supplied (Vdc)	Measured Frequency (MHz)				Test Result
		0 Minute	2 Minute	5 Minute	10 Minute	
-30	3.3	5240.0111	5240.0227	5240.0141	5240.0135	Pass
-10		5240.0149	5240.0124	5240.0124	5240.0141	Pass
0		5240.0133	5240.0137	5240.0158	5240.0148	Pass
20		5240.0145	5240.0157	5240.0169	5240.0152	Pass
40		5240.0134	5240.0145	5240.0145	5240.0166	Pass
60		5240.0137	5240.0121	5240.0178	5240.0171	Pass
85		5240.0145	5240.0111	5240.0187	5240.0136	Pass
20	2.97	5240.0163	5240.0123	5240.0155	5240.0152	Pass
20	3.63	5240.0145	5240.0134	5240.0145	5240.0153	Pass

Note: EUT temperature working range is -30 to 85.

U-NII-2A Band						
Lowest channel 5260MHz						
Temperature (℃)	Power Supplied (Vdc)	Measured Frequency (MHz)				Test Result
		0 Minute	2 Minute	5 Minute	10 Minute	
-30	3.3	5260.0114	5260.0146	5260.0156	5260.0155	Pass
-10		5260.0115	5260.0149	5260.0141	5260.0145	Pass
0		5260.0126	5260.0166	5260.0131	5260.0138	Pass
20		5260.0138	5260.0133	5260.0133	5260.0142	Pass
40		5260.0153	5260.0135	5260.0127	5260.0158	Pass
60		5260.0164	5260.0153	5260.0126	5260.0143	Pass
85		5260.0154	5260.0148	5260.0145	5260.0156	Pass
20	2.97	5260.0143	5260.0156	5260.0140	5260.0172	Pass
20	3.63	5260.0152	5260.0163	5260.0134	5260.0141	Pass
Highest channel 5320MHz						
Temperature (℃)	Power Supplied (Vdc)	Measured Frequency (MHz)				Test Result
		0 Minute	2 Minute	5 Minute	10 Minute	
-30	3.3	5320.0123	5320.0237	5320.0153	5320.0135	Pass
-10		5320.0139	5320.0148	5320.0143	5320.0111	Pass
0		5320.0135	5320.0146	5320.0154	5320.0128	Pass
20		5320.0152	5320.0137	5320.0113	5320.0181	Pass
40		5320.0134	5320.0124	5320.0115	5320.0146	Pass
60		5320.0164	5320.0121	5320.0148	5320.0143	Pass
85		5320.0158	5320.0121	5320.0152	5320.0142	Pass
20	2.97	5320.0163	5320.0143	5320.0154	5320.0143	Pass
20	3.63	5320.0154	5320.0121	5320.0115	5320.0153	Pass

Note: EUT temperature working range is -30 to 85.

U-NII-2C Band						
Lowest channel 5500MHz						
Temperature (℃)	Power Supplied (Vdc)	Measured Frequency (MHz)				Test Result
		0 Minute	2 Minute	5 Minute	10 Minute	
-30	3.3	5500.0114	5500.0125	5500.0146	5500.0155	Pass
-10		5500.0123	5500.0149	5500.0153	5500.0142	Pass
0		5500.0134	5500.0134	5500.0141	5500.0138	Pass
20		5500.0148	5500.0133	5500.0147	5500.0142	Pass
40		5500.0135	5500.0123	5500.0134	5500.0144	Pass
60		5500.0125	5500.0156	5500.0151	5500.0125	Pass
85		5500.0134	5500.0158	5500.0125	5500.0146	Pass
20	2.97	5500.0144	5500.0152	5500.0123	5500.0143	Pass
20	3.63	5500.0185	5500.0157	5500.0134	5500.0151	Pass
Highest channel 5700MHz						
Temperature (℃)	Power Supplied (Vdc)	Measured Frequency (MHz)				Test Result
		0 Minute	2 Minute	5 Minute	10 Minute	
-30	3.3	5700.0121	5700.0227	5700.0173	5700.0115	Pass
-10		5700.0149	5700.0128	5700.0146	5700.0121	Pass
0		5700.0117	5700.0146	5700.0158	5700.0138	Pass
20		5700.0145	5700.0127	5700.0149	5700.0142	Pass
40		5700.0144	5700.0135	5700.0125	5700.0156	Pass
60		5700.0127	5700.0135	5700.0148	5700.0111	Pass
85		5700.0118	5700.0132	5700.0117	5700.0146	Pass
20	2.97	5700.0145	5700.0135	5700.0135	5700.0132	Pass
20	3.63	5700.0134	5700.0131	5700.0141	5700.0173	Pass

Note: EUT temperature working range is -30 to 85.

U-NII-3 Band						
Lowest channel 5745MHz						
Temperature (℃)	Power Supplied (Vdc)	Measured Frequency (MHz)				Test Result
		0 Minute	2 Minute	5 Minute	10 Minute	
-30	3.3	5745.0122	5745.0142	5745.0155	5745.0124	Pass
-10		5745.0147	5745.0147	5745.0148	5745.0115	Pass
0		5745.0112	5745.0126	5745.0126	5745.0149	Pass
20		5745.0135	5745.0135	5745.0146	5745.0133	Pass
40		5745.0154	5745.0158	5745.0156	5745.0141	Pass
60		5745.0132	5745.0117	5745.0114	5745.0117	Pass
85		5745.0158	5745.0142	5745.0125	5745.0127	Pass
20	2.97	5745.0148	5745.0157	5745.0144	5745.0177	Pass
20	3.63	5745.0124	5745.0178	5745.0135	5745.0167	Pass
Highest channel 5825MHz						
Temperature (℃)	Power Supplied (Vdc)	Measured Frequency (MHz)				Test Result
		0 Minute	2 Minute	5 Minute	10 Minute	
-30	3.3	5825.0113	5825.0111	5825.0124	5825.0145	Pass
-10		5825.0135	5825.0128	5825.0117	5825.0121	Pass
0		5825.0146	5825.0142	5825.0144	5825.0142	Pass
20		5825.0117	5825.0134	5825.0121	5825.0151	Pass
40		5825.0129	5825.0129	5825.0141	5825.0143	Pass
60		5825.0145	5825.0146	5825.0113	5825.0134	Pass
85		5825.0122	5825.0141	5825.0121	5825.0175	Pass
20	2.97	5825.0144	5825.0140	5825.0143	5825.0136	Pass
20	3.63	5825.0123	5825.0116	5825.0112	5825.0114	Pass

Note: EUT temperature working range is -30 to 85.

14.8 Radiated Spurious Emissions and Restricted Bands Measurement and Band Edge

LIMITS

Frequency range MHz	Distance Meters	Field Strengths Limit (15.209)
		μV/m
0.009 ~ 0.490	300	2400/F(kHz)
0.490 ~ 1.705	30	24000/F(kHz)
1.705 ~ 30	30	30
30 ~ 88	3	100
88 ~ 216	3	150
216 ~ 960	3	200
Above 960	3	500

Remark:
(1) Emission level (dB)μV = 20 log Emission level μV/m
(2) The smaller limit shall apply at the cross point between two frequency bands.
(3) As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.
(4) The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.
(5) §15.407 specifies that emissions which fall in the restricted bands, as defined in §15.205 comply with radiated emission limits specified in §15.209.

For transmitters operating in the 5.15-5.25 GHz band:
All emissions outside of the 5.15-5.35GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

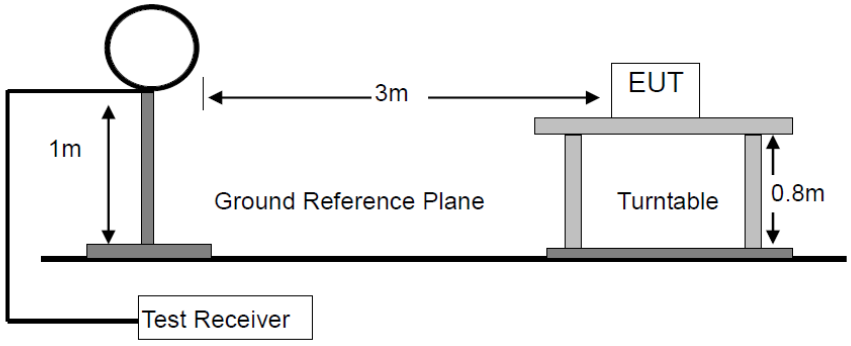
For transmitters operating in the 5.25-5.35 GHz band:
All emissions outside of the 5.15-5.35GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

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.

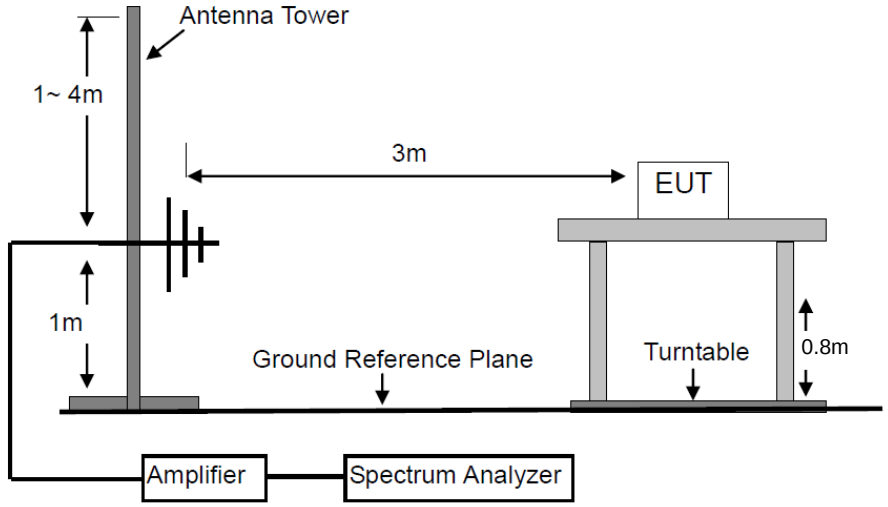
For transmitters operating in the 5.725-5.85 GHz band:
All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25MHz above or below the band edge increasing linearly to a 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 27dBm/MHz at the band edge.

BLOCK DIAGRAM OF TEST SETUP

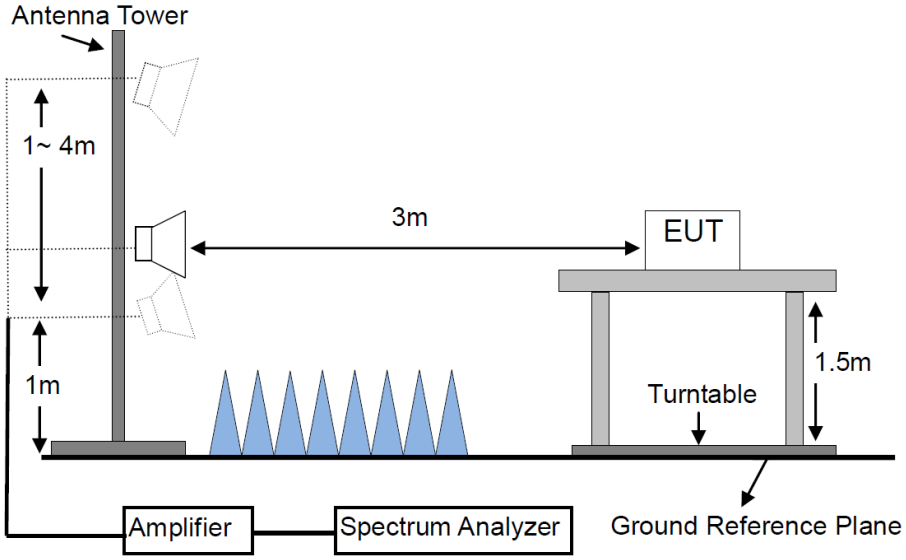
For Radiated Emission below 30MHz



For Radiated Emission 30-1000MHz



For Radiated Emission Above 1000MHz.



TEST PROCEDURES

a. Below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi- anechoic chamber room.

b. For the radiated emission test above 1GHz:

The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

c. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to peak detect function and specified bandwidth with maximum hold mode.

f. A Quasi-peak measurement was then made for that frequency point for below 1GHz test. PK and AV for above 1GHz emission test.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

Frequency Band (MHz)	Detector	Resolution Bandwidth	Video Bandwidth
30 to 1000	QP	120 kHz	300 kHz
Above 1000	Peak	1 MHz	3 MHz
	Average	1 MHz	10 Hz

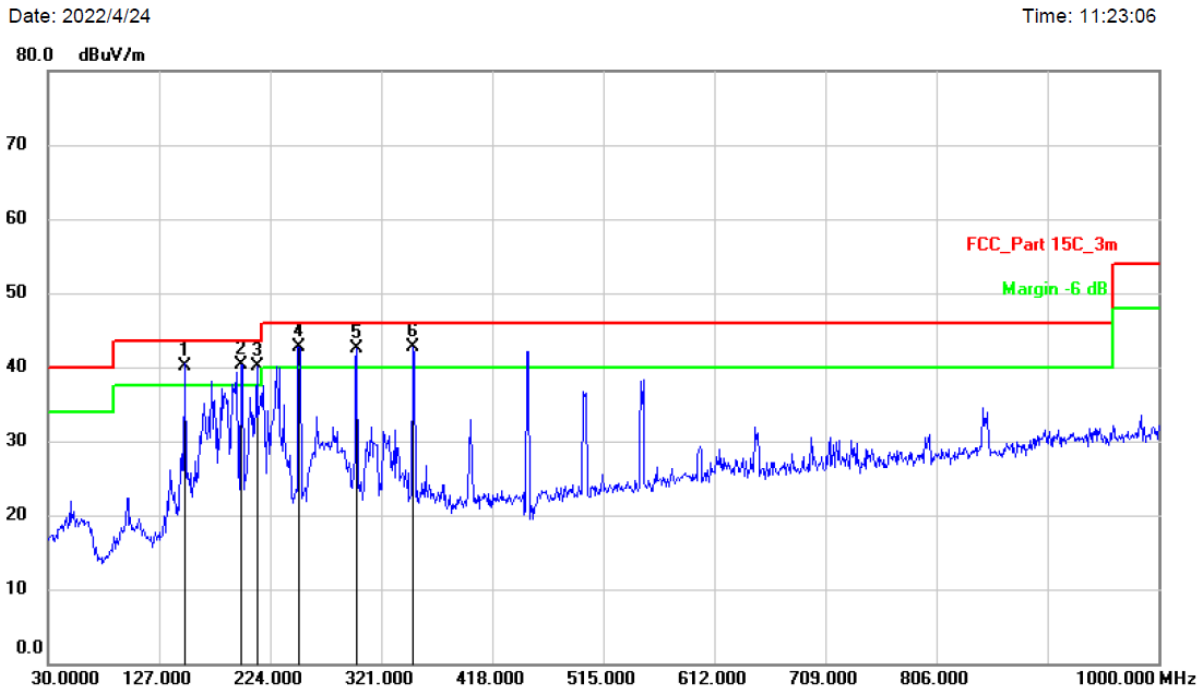
TEST RESULTS

PASS

Please refer to the following pages of the worst case.

M/N: 6252B-SR	Testing Voltage: DC 3.3V
Polarization: Horizontal	Detector: QP
Test Mode: 2	Distance: 3m

Radiated Emission Measurement

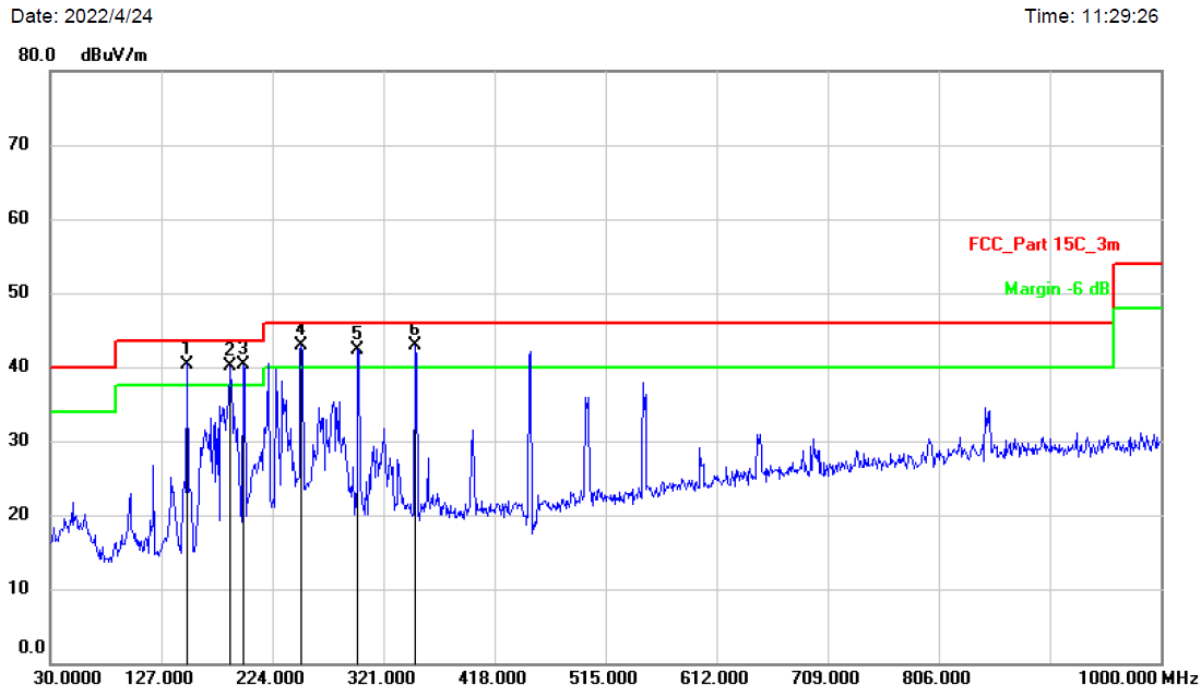


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1	!	149.3100	51.01	-10.89	40.12	43.50	-3.38	QP	
2	*	198.7800	48.13	-7.76	40.37	43.50	-3.13	QP	
3	!	212.3600	47.70	-7.56	40.14	43.50	-3.36	QP	
4	!	249.2200	49.15	-6.38	42.77	46.00	-3.23	QP	
5	!	299.6600	48.10	-5.52	42.58	46.00	-3.42	QP	
6	!	348.1600	46.80	-4.19	42.61	46.00	-3.39	QP	

Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.

M/N: 6252B-SR	Testing Voltage: DC 3.3V
Polarization: Vertical	Detector: QP
Test Mode: 2	Distance: 3m

Radiated Emission Measurement



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Detector	Comment
1	!	149.3100	51.22	-10.89	40.33	43.50	-3.17	QP	
2	!	187.1400	48.56	-8.53	40.03	43.50	-3.47	QP	
3	!	198.7800	48.07	-7.76	40.31	43.50	-3.19	QP	
4	!	249.2200	49.21	-6.38	42.83	46.00	-3.17	QP	
5	!	298.6900	47.90	-5.54	42.36	46.00	-3.64	QP	
6	*	348.1600	47.05	-4.19	42.86	46.00	-3.14	QP	

Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.

Modulation: N-UII-1(5180-5240 MHz) TX (IEEE 802.11n(HT20) the worst case)		Test Result: PASS					Test frequency range: 1-40GHz			
Freq. (MHz)	Ant. Pol. (H/V)	Reading Level(dBuV)		Factor (dB/m)	Emission Level (dBuV/m)		Limit 3m (dBuV/m)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
Operation Mode: TX Mode (Low)										
10360	V	49.81	---	14.04	63.85	---	68.20	---	-4.35	---
15540	V	43.73	29.30	21.12	64.85	50.42	74.00	54.00	-9.15	-3.58

10360	H	49.74	---	14.04	63.78	---	68.20	---	-4.42	---
15540	H	43.13	28.66	21.12	64.25	49.78	74.00	54.00	-9.75	-4.22

Operation Mode: TX Mode (Mid)										
10400	V	49.74	---	14.12	63.86	---	68.20	---	-4.34	---
15600	V	43.96	29.52	20.82	64.78	50.34	74.00	54.00	-9.22	-3.66

10400	H	47.75	---	14.12	61.87	---	68.20	---	-6.33	---
15600	H	43.30	29.06	20.82	64.12	49.88	74.00	54.00	-9.88	-4.12

Operation Mode: TX Mode (High)										
10480	V	48.75	---	14.29	63.04	---	68.20	---	-5.16	---
15720	V	44.58	30.07	20.20	64.78	50.27	74.00	54.00	-9.22	-3.73

10480	H	48.49	---	14.29	62.78	---	68.20	---	-5.42	---
15720	H	44.80	29.26	20.20	65.00	49.46	74.00	54.00	-9.00	-4.54

Remark: 1. Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits.

2. Others emissions are attenuated 20dB below the limits, so it does not record in report.

Modulation: N-UII-1(5260-5320 MHz) TX (IEEE 802.11n(HT20) the worst case)		Test Result: PASS					Test frequency range: 1-40GHz			
Freq. (MHz)	Ant. Pol. (H/V)	Reading Level(dBuV)		Factor (dB/m)	Emission Level (dBuV/m)		Limit 3m (dBuV/m)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
Operation Mode: TX Mode (Low)										
10520	V	49.65	---	14.04	63.69	---	68.20	---	-4.51	---
15780	V	44.42	30.20	21.12	65.54	51.32	74.00	54.00	-8.46	-2.68

10520	H	49.55	---	14.04	63.59	---	68.20	---	-4.61	---
15780	H	43.26	29.27	21.12	64.38	50.39	74.00	54.00	-9.62	-3.61

Operation Mode: TX Mode (Mid)										
10600	V	49.38	---	14.12	63.50	---	68.20	---	-4.70	---
15900	V	45.44	30.39	20.82	66.26	51.21	74.00	54.00	-7.74	-2.79

10600	H	49.30	---	14.12	63.42	---	68.20	---	-4.78	---
15900	H	45.65	30.03	20.82	66.47	50.85	74.00	54.00	-7.53	-3.15

Operation Mode: TX Mode (High)										
10640	V	48.61	---	14.29	62.90	---	68.20	---	-5.30	---
15960	V	45.74	31.17	20.20	65.94	51.37	74.00	54.00	-8.06	-2.63

10640	H	48.43	---	14.29	62.72	---	68.20	---	-5.48	---
15960	H	45.89	31.01	20.20	66.09	51.21	74.00	54.00	-7.91	-2.79

Remark: 1. Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits.

2. Others emissions are attenuated 20dB below the limits, so it does not record in report.

Modulation: N-UII-1(5500-5700 MHz) TX (IEEE 802.11n(HT20) the worst case)		Test Result: PASS					Test frequency range: 1-40GHz			
Freq. (MHz)	Ant. Pol. (H/V)	Reading Level(dBuV)		Factor (dB/m)	Emission Level (dBuV/m)		Limit 3m (dBuV/m)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
Operation Mode: TX Mode (Low)										
11000	V	48.99	34.35	16.86	65.85	51.21	74.00	54.00	-8.15	-2.79
16500	V	45.25	---	22.23	67.48	---	68.20	---	-0.72	---

11000	H	48.38	33.93	16.81	65.19	50.74	74.00	54.00	-8.81	-3.26
16500	H	44.61	---	22.23	66.84	---	68.20	---	-1.36	---

Operation Mode: TX Mode (Mid)										
11200	V	47.71	33.91	17.01	64.72	50.92	74.00	54.00	-9.28	-3.08
16800	V	44.17	---	22.62	66.79	---	68.20	---	-1.41	---

11200	H	47.19	33.30	17.01	64.20	50.31	74.00	54.00	-9.80	-3.69
16800	H	20.73	---	22.62	43.35	---	68.20	---	-24.85	---

Operation Mode: TX Mode (High)										
11400	V	46.96	33.23	17.16	64.12	50.39	74.00	54.00	-9.88	-3.61
17100	V	43.13	---	23.01	66.14	---	68.20	---	-2.06	---

11400	H	46.06	32.15	17.16	63.22	49.31	74.00	54.00	-10.78	-4.69
17100	H	41.64	---	23.01	64.65	---	68.20	---	-3.55	---

Remark: 1. Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits.

2. Others emissions are attenuated 20dB below the limits, so it does not record in report.

Modulation: N-UII-3 (5745-5825 MHz) TX (IEEE 802.11n(HT20) the worst case)		Test Result: PASS					Test frequency range: 1-40GHz			
Freq. (MHz)	Ant. Pol. (H/V)	Reading Level(dBuV)		Factor (dB/m)	Emission Level (dBuV/m)		Limit 3m (dBuV/m)		Margin (dB)	
		PK	AV		PK	AV	PK	AV	PK	AV
Operation Mode: TX Mode (Low)										
11490	V	47.09	33.94	16.86	63.95	50.80	74.00	54.00	-10.05	-3.20
17235	V	42.02	---	22.23	64.25	---	68.20	---	-3.95	---

11490	H	45.60	33.51	16.81	62.41	50.32	74.00	54.00	-11.59	-3.68
17235	H	41.76	---	22.23	63.99	---	68.20	---	-4.21	---

Operation Mode: TX Mode (Mid)										
11570	V	46.88	33.61	17.01	63.89	50.62	74.00	54.00	-10.11	-3.38
17355	V	41.13	---	22.62	63.75	---	68.20	---	-4.45	---

11570	H	45.71	32.65	17.01	62.72	49.66	74.00	54.00	-11.28	-4.34
17355	H	40.96	---	22.62	63.58	---	68.20	---	-4.62	---

Operation Mode: TX Mode (High)										
11650	V	46.56	33.50	17.16	63.72	50.66	74.00	54.00	-10.28	-3.34
17475	V	40.80	---	23.01	63.81	---	68.20	---	-4.39	---

11650	H	44.99	32.86	17.16	62.15	50.02	74.00	54.00	-11.85	-3.98
17475	H	40.48	---	23.01	63.49	---	68.20	---	-4.71	---

Remark: 1. Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits.

2. Others emissions are attenuated 20dB below the limits, so it does not record in report.

14.9 Dynamic Frequency Selection

List of Measurement and Examinations

EUT Operational mode:

DFS Operational mode	Operating Frequency Range	
	U-NII-2A	U-NII-2C
Slave without radar Interference detection function	√	√

Devices with radar detection

Maximum Transmit Power	Value (See Note 1 and 2)
≥200 mw	-64 dBm
EIRP < 200 mw and power spectral density < 10 dBm/MHz	-62 dBm
E IRP < 200 mw that do not meet the power spectral density requirement	-64 dBm
Note: 1. This is the level at the input of the receiver assuming a 0 dBi receive antena. 2. Throughout these test procedures an adtioial 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response. 3: EIRP is based on the highest antenna gain. For MIMO dviese reter to KDB Publication 662911 D01.	

Applicability of DFS requirements prior to use of a channel

Requirement Radar	Operational Mode		
	Master	Client without Radar Detecion	Client with Radar Detection
Non-Occupancy Period	√	Not required	Yes
DFS Detection Threshold	√	Not required	Yes
Channel Availability Check Time	√	Not required	Not Required
U-NII Detection Bandwidth	√	Not required	Yes
Note: Regarding KDB 905462 D03 Client Without DFS New Rules section (b)(5/6), If the client moves with the master, the device is considered compliant if nothing appears in the client non- occupancy period test. For devices that shut down (rather than moving channels), no beacons should appear. An analyzer plot that contains a single 30-minute sweep on the original channel.			

Applicability of DFS requirements during normal operation

Requirement Radar	Operational Mode		
	Master	Client without Radar Detecion	Client with Radar Detection
DFS Detection Threshold	√	Not required	Yes
Channel Closing Transmission Time	√	Yes	Yes
Channel Move Time	√	Yes	Yes
U-NII Detection Bandwidth	√	Not required	Yes
Note: Regarding KDB 905462 D03 Client Without DFS New Rules section (b)(5/6), If the client moves with the master, the device is considered compliant if nothing appears in the client non- occupancy period test. For devices that shut down (rather than moving channels), no beacons should appear. An analyzer plot that contains a single 30-minute sweep on the original channel.			
Additional requirements for devices with multiple bandwidth modes	Master or Client with radar detection	Client without radar detection	
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be ested	Not required	
Channel Move Time and Channel Closing Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest Test using the widest BW mode available for the link	
All other	Any single BW mode	Not required	
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.			

DFS Radar Signal Parameter Values:

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds (See Note 1)
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60ms over remaining 10 second period (See Notes 1 and 2)
U-NII Detection Bandwidth	Minimum 100% of the U-NII 99% transmission power bandwidth (See Note 3.)
Note: 1. Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. 2. The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions. 3. During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.	

DFS Radar Signal Parameter:
Radar Type 0 was used in the evaluation of the Client device for the purpose of measuring the Channel Move Time and the Channel Closing Transmission Time

Table 1: Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (μsec)	PRI (μsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A, Test B	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\left(\frac{19\cdot 10^6}{\text{PRI}_{\mu sec}}\right)\right\}$	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120

Note: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.

Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a

Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A.

Remark1: A minimum of 30 unique waveforms are required for each of the Short Pulse Radar Types 2 through 4. If more than 30 waveforms are used for Short Pulse Radar Types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms.

Remark2: If more than 30 waveforms are used for Short Pulse Radar Type 1, then each additional waveform is generated with Test B and must also be unique and not repeated from the previous waveforms in Tests A or B.

Remark3: The aggregate is the average of the percentage of successful detections of short pulse radar types 1-4.

Table 2: Long Pulse Radar Test Waveform

Radar Type	Pulse Width (μsec)	Chirp Width (MHz)	PRI (μsec)	Number of Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

Table 3: Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (μsec)	PRI (μsec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	9	0.333	300	70%	30

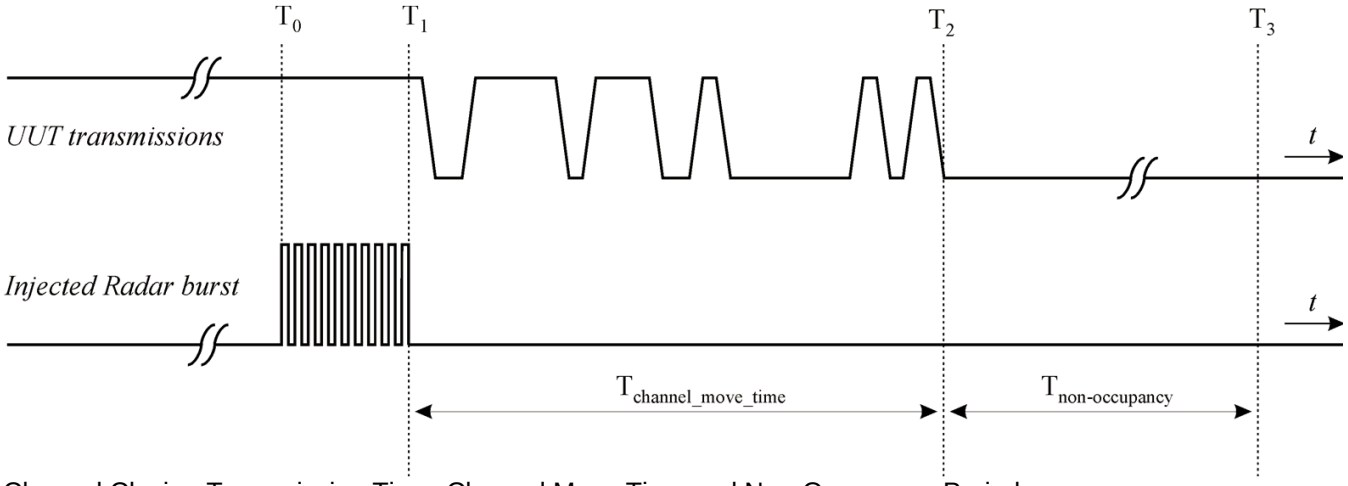
In-Service Monitoring: Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period

Limit of In-Service Monitoring

Reference to DFS Radar Signal Parameter Values.

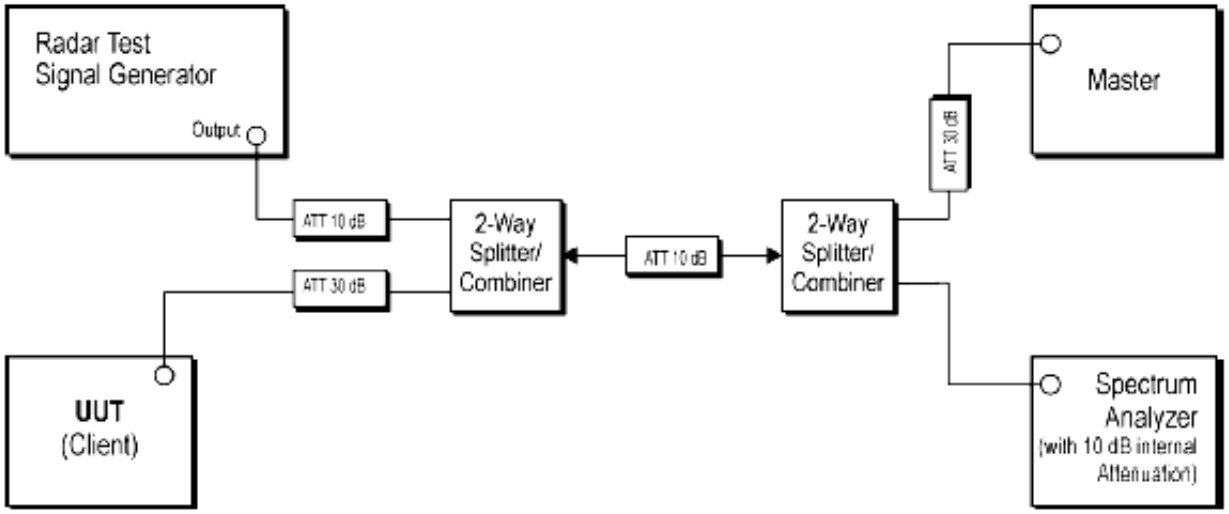
Test Procedures

1. One frequency will be chosen from the Operating Channels of the EUT within the 5250-5350 MHz or 5470-5725 MHz bands. For 802.11 devices, the test frequency must contain control signals. This can be verified by disabling channel loading and monitoring the spectrum analyzer. If no control signals are detected, another frequency must be selected within the emission bandwidth where control signals are detected.
2. In case the EUT is a Master Device, a U-NII device operating as a Client Device will be used and it is assumed that the Client will associate with the EUT (Master). For radiated tests, the emissions of the Radar Waveform generator will be directed towards the Master Device. If the Master Device has antenna gain, the main beam of the antenna will be directed toward the radar emitter. Vertical polarization is used for testing.
3. The TCP protocol unicast data stream was generated by the iperf software command line with at least 17% activity ratio over any 100ms period.
4. Timing plots are reported with calculations demonstrating a minimum channel loading of approximately 17% or greater. For example, channel loading can be estimated by setting the spectrum analyzer for zero span and approximate the Time On/ (Time On + Off Time).
5. At time T0 the Radar Waveform generator sends a Burst of pulses for one of the Short Pulse Radar Types 1-4 at DFS Detection Threshold levels on the Operating Channel. An additional 1dB is added to the radar test signal to ensure it is at or above the DFS Detection Threshold, accounting for equipment variations/errors.
6. Observe the transmissions of the EUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the EUT during the observation time (Channel Move Time). Measure and record the Channel Move Time and Channel Closing Transmission Time if radar detection occurs.
7. When operating as a Master Device, monitor the EUT for more than 30 minutes following instant T2 to verify that the EUT does not resume any transmissions on this Channel. Perform this test once and record the measurement result.



Channel Closing Transmission Time, Channel Move Time and Non-Occupancy Period

Test Set-Up



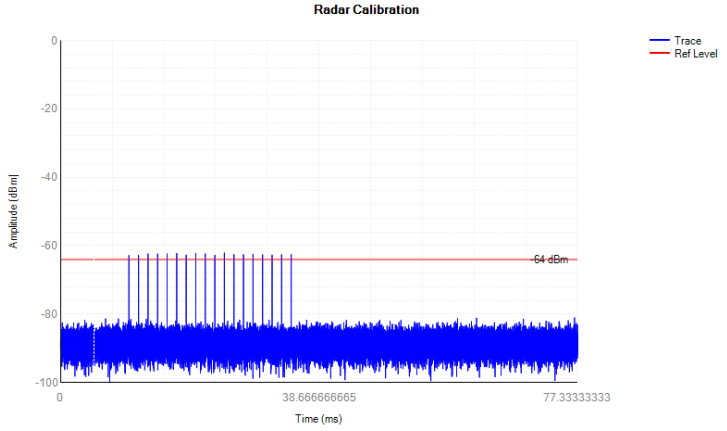
Setup for Client with injection at the Master

Measurement Results

Pass
Please refer to following plots of the worst case.

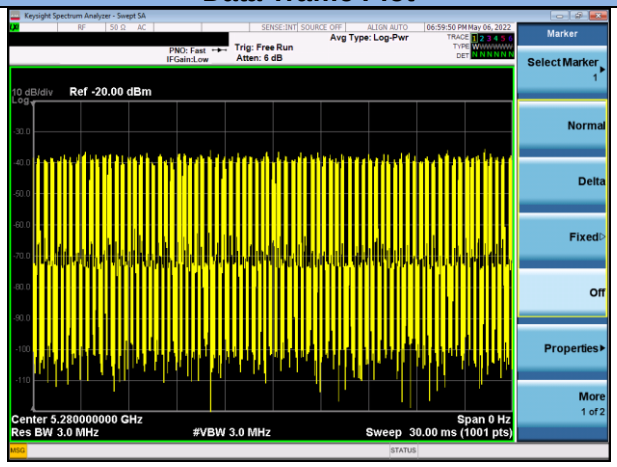
Channel	Test Item	Test Result	Limit	Pass/Fail
5280MHz	Channel Move Time	3.12 s	＜10s	Pass
	Channel Closing Transmission Time	15 ms	＜200+60ms	Pass
	Non-Occupancy Period	No transmission	30 minutes	Pass

Radar Waveform Calibration Plot - 5280MHz

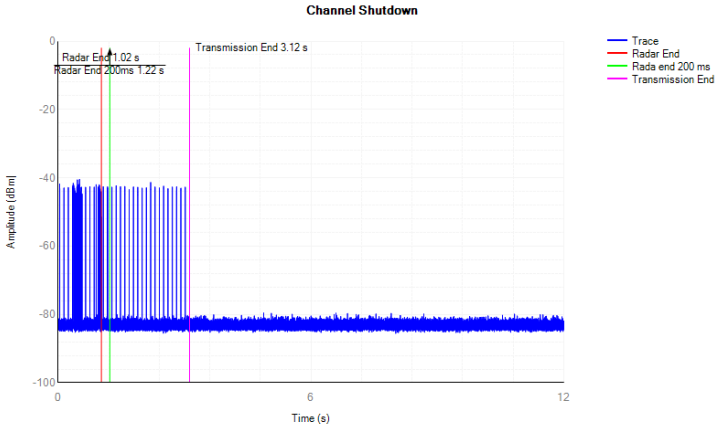


The Worst Case - 5280MHz

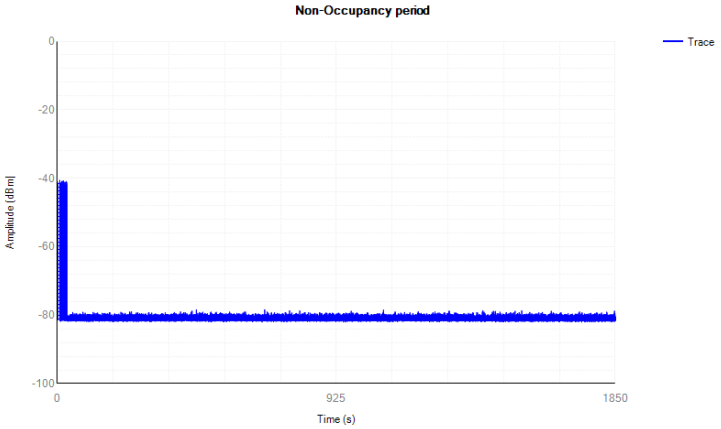
Data Traffic Plot



Channel Move Time & Channel Closing Transmission Time Plot



Non-Occupancy Period Plot



14.10 Antenna Requirement

STANDARD APPLICABLE

According to of FCC part 15C section 15.203:

furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section 15.203 of the rules.

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

ANTENNA CONNECTED CONSTRUCTION

The EUT is a limited single-modular transmitter with external Diople antenna that no antenna other than furnished by the responsible party shall be used with the device, and the best case gain of the antenna is 4.56dBi, therefore, the antenna is consider meet the requirement.

15. Test Equipment List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Test Receiver	Rohde & Schwarz	ESCI7	100837	Mar. 13, 2022	1 Year
2.	Antenna	Schwarzbeck	VULB9162	9162-010	Mar. 23, 2022	2 Year
3.	Spectrum Analyzer	Rohde & Schwarz	FSU26	200409/026	Mar. 13, 2022	1 Year
4.	Spectrum Analyzer	Keysight	N9020A	MY54200831	Mar. 13, 2022	1 Year
5.	Spectrum Analyzer	Rohde & Schwarz	FSV40	101094	Mar. 13, 2022	1 Year
6.	Horn Antenna	Schwarzbeck	BBHA9170	9170-172	Mar. 23, 2022	2 Year
7.	Power Sensor	DARE	RPR3006W	15I00041SNO64	Mar. 13, 2022	1 Year
8.	Horn Antenna	COM-Power	AH-118	071078	Mar. 23, 2022	2 Year
9.	Pre-Amplifier	HP	HP 8449B	3008A00964	Mar. 13, 2022	1 Year
10.	Pre-Amplifier	HP	HP 8447D	1145A00203	Mar. 13, 2022	1 Year
11.	Loop Antenna	Schwarzbeck	FMZB 1513	1513-272	Mar. 23, 2022	2 Year
12.	Test Receiver	Rohde & Schwarz	ESCI	101152	Mar. 13, 2022	1 Year
13.	L.I.S.N	Rohde & Schwarz	ENV 216	101317	Mar. 13, 2022	1 Year
14.	RF Switching Unit	Compliance Direction Systems Inc.	RSU-M2	38311	Mar.13, 2022	1 Year
15.	Temporary antenna connector	TESCOM	SS402	N/A	N/A	N/A
16.	Test Software	EZ	EZ_EMC	N/A	N/A	N/A

Note: For photographs of EUT and measurement, please refer to appendix in separate documents.

---End---