

4.3 OUTPUT POWER MEASUREMENT

4.3.1 Test Limit

According to §15.407 (a)(1), 15.407(a)(2) and 15.407(a)(3)

UNII-1 :

The maximum conducted output power over the frequency band of operation shall not exceed 250 mW (24 dBm), whichever power is less. B is the 99% emission bandwidth in megahertz, provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

UNII-2a and 2c:

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. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

UNII-3:

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

UNII-1 Limit	<input checked="" type="checkbox"/> Antenna not exceed 6 dBi : 24dBm <input type="checkbox"/> Antenna with DG greater than 6 dBi : [Limit = 24 – (DG – 6)]
UNII-2a/2c Limit	<input checked="" type="checkbox"/> Antenna not exceed 6 dBi : 24dBm <input type="checkbox"/> Antenna with DG greater than 6 dBi : [Limit = 24 – (DG – 6)]
UNII-3 Limit	<input checked="" type="checkbox"/> Antenna not exceed 6 dBi : 30dBm <input type="checkbox"/> Antenna with DG greater than 6 dBi : [Limit = 30 – (DG – 6)]

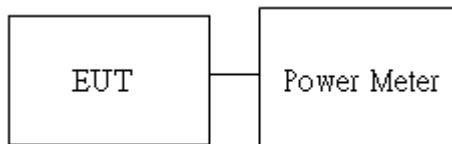
4.3.2 Test Procedure

Test method Refer as KDB 789033 D02, Section E.3.b for BW 20MHz, 40MHz and 80MHz, E.2.b for BW 160MHz.

1. The EUT RF output connected to the power meter or spectrum by RF cable.
2. Setting maximum power transmit of EUT.
3. The path loss was compensated to the results for each measurement.
4. Measure and record the result of Average output power. in the test report.

4.3.3 Test Setup

For BW 20MHz ,40MHz and 80MHz



For BW 160MHz



4.3.4 Test Result

Conducted output power :

Temperature: 23.2 ~ 25.4°C

Test date: June 9 ~ 16, 2023

Humidity: 57 ~ 61% RH

Tested by: Allen Shen

802.11a_Ch0

CH	Frequency (MHz)	Data Rate	Power set	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
36	5180	6	61	15.26	33.606	23.98	PASS
44	5220	6	70	18.18	65.829	23.98	PASS
48	5240	6	68	17.81	60.453	23.98	PASS
52	5260	6	68	17.38	54.754	23.98	PASS
60	5300	6	68	17.48	56.030	23.98	PASS
64	5320	6	63	15.99	39.757	23.98	PASS
100	5500	6	57	14.11	25.788	23.98	PASS
116	5580	6	72	17.19	52.411	23.98	PASS
140	5700	6	65	15.07	32.168	23.98	PASS
149	5745	6	77	18.67	73.692	30	PASS
157	5785	6	77	18.62	72.848	30	PASS
165	5825	6	77	18.60	72.514	30	PASS

Note: Since DG<6dBi, there is no need to modify the limit value.

802.11n_HT20_Ch0

CH	Frequency (MHz)	Data Rate	Power set	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
36	5180	MCS0	61	15.30	33.914	23.98	PASS
44	5220	MCS0	69	17.96	62.571	23.98	PASS
48	5240	MCS0	69	17.97	62.716	23.98	PASS
52	5260	MCS0	69	17.54	56.803	23.98	PASS
60	5300	MCS0	69	17.63	57.993	23.98	PASS
64	5320	MCS0	65	16.44	44.094	23.98	PASS
100	5500	MCS0	50	12.46	17.635	23.98	PASS
116	5580	MCS0	71	17.05	50.743	23.98	PASS
140	5700	MCS0	61	14.20	26.325	23.98	PASS
149	5745	MCS0	78	18.76	75.227	30	PASS
157	5785	MCS0	78	18.68	73.854	30	PASS
165	5825	MCS0	78	18.81	76.098	30	PASS

802.11ac_VHT20_Ch0

CH	Frequency (MHz)	Data Rate	Power set	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
36	5180	MCS0	61	15.14	32.663	23.98	PASS
44	5220	MCS0	69	17.92	61.952	23.98	PASS
48	5240	MCS0	69	17.90	61.668	23.98	PASS
52	5260	MCS0	69	17.47	55.854	23.98	PASS
60	5300	MCS0	69	17.56	57.024	23.98	PASS
64	5320	MCS0	65	16.27	42.370	23.98	PASS
100	5500	MCS0	50	12.42	17.461	23.98	PASS
116	5580	MCS0	71	16.95	49.551	23.98	PASS
140	5700	MCS0	61	14.11	25.767	23.98	PASS
149	5745	MCS0	78	18.72	74.483	30	PASS
157	5785	MCS0	78	18.60	72.453	30	PASS
165	5825	MCS0	78	18.72	74.483	30	PASS

Note: Since DG<6dBi, there is no need to modify the limit value.

802.11n_HT40_Ch0

CH	Frequency (MHz)	Data Rate	Power set	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
38	5190	MCS0	41	10.70	11.742	23.98	PASS
46	5230	MCS0	64	16.66	46.318	23.98	PASS
54	5270	MCS0	67	17.37	54.545	23.98	PASS
62	5310	MCS0	48	12.54	17.937	23.98	PASS
102	5510	MCS0	41	10.21	10.489	23.98	PASS
110	5550	MCS0	65	16.03	40.064	23.98	PASS
134	5670	MCS0	63	15.09	32.267	23.98	PASS
151	5755	MCS0	78	19.23	83.705	30	PASS
159	5795	MCS0	78	19.20	83.129	30	PASS

802.11ac_VHT40_Ch0

CH	Frequency (MHz)	Data Rate	Power set	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
38	5190	MCS0	41	10.64	11.575	23.98	PASS
46	5230	MCS0	64	16.60	45.658	23.98	PASS
54	5270	MCS0	67	17.36	54.389	23.98	PASS
62	5310	MCS0	48	12.50	17.763	23.98	PASS
102	5510	MCS0	41	10.12	10.269	23.98	PASS
110	5550	MCS0	65	15.99	39.675	23.98	PASS
134	5670	MCS0	63	15.06	32.027	23.98	PASS
151	5755	MCS0	78	19.16	82.321	30	PASS
159	5795	MCS0	78	19.12	81.567	30	PASS

802.11ac_VHT80_Ch0

CH	Frequency (MHz)	Data Rate	Power set	TOTAL POWER (dBm)	TOTAL POWER (mW)	REQUIRED LIMIT (dBm)	RESULT
42	5210	MCS0	47	12.60	18.192	23.98	PASS
58	5290	MCS0	53	13.40	21.872	23.98	PASS
106	5530	MCS0	48	12.25	16.783	23.98	PASS
122	5610	MCS0	67	16.40	43.639	23.98	PASS
155	5775	MCS0	73	16.88	48.739	30	PASS

Note: Since DG<6dBi, there is no need to modify the limit value.

4.4 POWER SPECTRAL DENSITY

4.4.1 Test Limit

According to §15.407 (a)(1), 15.407(a)(2) and 15.407(a)(3)

UNII-1 :

The maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

UNII-2a and 2c:

The maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

UNII-3:

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

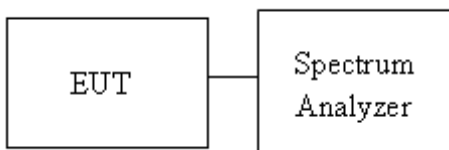
UNII-1 Limit	<input checked="" type="checkbox"/> Antenna not exceed 6 dBi : 11 dBm <input type="checkbox"/> Antenna with DG greater than 6 dBi : [Limit = 11 – (DG – 6)]
UNII-2a Limit	<input checked="" type="checkbox"/> Antenna not exceed 6 dBi : 11 dBm/MHz <input type="checkbox"/> Antenna with DG greater than 6 dBi : [Limit = 11 – (DG – 6)]
UNII-2c Limit	<input checked="" type="checkbox"/> Antenna not exceed 6 dBi : 11 dBm/MHz <input type="checkbox"/> Antenna with DG greater than 6 dBi : [Limit = 11 – (DG – 6)]
UNII-3 Limit	<input checked="" type="checkbox"/> Antenna not exceed 6 dBi : 30 dBm/500kHz <input type="checkbox"/> Antenna with DG greater than 6 dBi : [Limit = 30 – (DG – 6) dBm/500kHz]

4.4.2 Test Procedure

Test method Refer as KDB 789033 D02

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. UNII-1, UNII-2a and UNII-2c, SA set RBW = 1MHz, VBW = 3MHz and Detector = RMS, to measurement Power Density.
4. UNII-3, SA set RBW = 500kHz, VBW = 2MHz and Detector = RMS, to measurement Power Density
5. The path loss and Duty Factor were compensated to the results for each measurement by SA.
6. Mark the maximum level.
7. Measure and record the result of power spectral density. in the test report.

4.4.3 Test Setup



4.4.4 Test Result

Temperature: 23.2 ~ 25.4°C

Test date: June 9 ~ 17, 2023

Humidity: 57 ~ 61% RH

Tested by: Allen Shen

POWER DENSITY 802.11a MODE						
Frequency (MHz)	Ch0 meas PSD (dBm/MHz)	Duty Factor (dB)	Maxmum Corr'd PSD(dBm/MHz)		Limit	Margin (dB)
5180	5.68	0.00	5.68		11.00 dBm/MHz	-5.32
5220	8.47	0.00	8.47		11.00 dBm/MHz	-2.53
5240	7.70	0.00	7.70		11.00 dBm/MHz	-3.30
5260	7.35	0.00	7.35		11.00 dBm/MHz	-3.65
5300	6.71	0.00	6.71		11.00 dBm/MHz	-4.29
5320	5.03	0.00	5.03		11.00 dBm/MHz	-5.97
5500	4.58	0.00	4.58		11.00 dBm/MHz	-6.42
5580	7.03	0.00	7.03		11.00 dBm/MHz	-3.98
5700	4.25	0.00	4.25		11.00 dBm/MHz	-6.75
Frequency (MHz)	Ch0 meas PSD (dBm/300kHz)	Duty Factor (dB)	10log (500kHz/RBW) Factor(dB)	Maxmum Corr'd PSD (dBm/500kHz)	Limit	Margin (dB)
5745	3.73	0.00	2.22	5.95	30.00 dBm/500kHz	-24.05
5785	3.32	0.00	2.22	5.54	30.00 dBm/500kHz	-24.46
5825	3.78	0.00	2.22	6.00	30.00 dBm/500kHz	-24.00

Note: Since DG<6dBi, there is no need to modify the limit value.

POWER DENSITY 802.11n HT20 MODE						
Frequency (MHz)	Ch0 meas PSD (dBm/MHz)	Duty Factor (dB)	Maxmum Corr'd PSD(dBm/MHz)		Limit	Margin (dB)
5180	5.10	0.00	5.10		11.00 dBm/MHz	-5.90
5220	7.72	0.00	7.72		11.00 dBm/MHz	-3.28
5240	7.62	0.00	7.62		11.00 dBm/MHz	-3.38
5260	7.12	0.00	7.12		11.00 dBm/MHz	-3.88
5300	6.97	0.00	6.97		11.00 dBm/MHz	-4.03
5320	5.31	0.00	5.31		11.00 dBm/MHz	-5.69
5500	2.39	0.00	2.39		11.00 dBm/MHz	-8.61
5580	7.09	0.00	7.09		11.00 dBm/MHz	-3.91
5700	2.80	0.00	2.80		11.00 dBm/MHz	-8.20
Frequency (MHz)	Ch0 meas PSD (dBm/300kHz)	Duty Factor (dB)	10log (500kHz/RBW) Factor(dB)	Maxmum Corr'd PSD (dBm/500kHz)	Limit	Margin (dB)
5745	2.46	0.00	2.22	4.68	30.00 dBm/500kHz	-25.32
5785	3.06	0.00	2.22	5.28	30.00 dBm/500kHz	-24.72
5825	3.81	0.00	2.22	6.03	30.00 dBm/500kHz	-23.97

Note: Since DG<6dBi, there is no need to modify the limit value.

POWER DENSITY 802.11n HT40 MODE						
Frequency (MHz)	Ch0 meas PSD (dBm/MHz)	Duty Factor (dB)	Maxmum Corr'd PSD(dBm/MHz)	Limit	Margin (dB)	
5190	-2.91	0.12	-2.79	11.00 dBm/MHz	-13.79	
5230	2.74	0.12	2.86	11.00 dBm/MHz	-8.14	
5270	3.52	0.12	3.64	11.00 dBm/MHz	-7.36	
5310	-1.97	0.12	-1.85	11.00 dBm/MHz	-12.85	
5510	-3.47	0.12	-3.35	11.00 dBm/MHz	-14.35	
5550	2.19	0.12	2.31	11.00 dBm/MHz	-8.69	
5670	0.51	0.12	0.63	11.00 dBm/MHz	-10.37	
Frequency (MHz)	Ch0 meas PSD (dBm/300kHz)	Duty Factor (dB)	10log (500kHz/RBW) Factor(dB)	Maxmum Corr'd PSD (dBm/500kHz)	Limit	Margin (dB)
5755	-0.34	0.12	2.22	2.00	30.00 dBm/500kHz	-28.00
5795	0.03	0.12	2.22	2.37	30.00 dBm/500kHz	-27.64

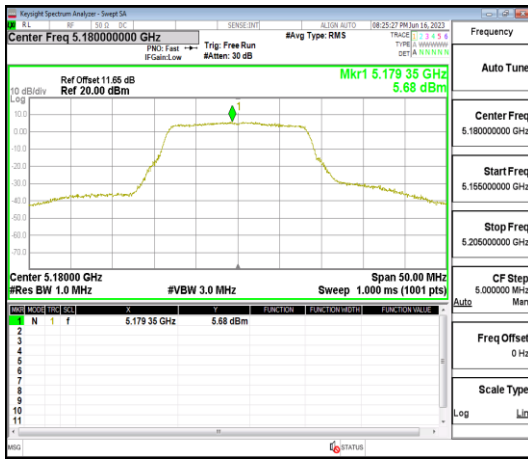
POWER DENSITY 802.11ac VHT80 MODE						
Frequency (MHz)	Ch0 meas PSD (dBm/MHz)	Duty Factor (dB)	Maxmum Corr'd PSD(dBm/MHz)	Limit	Margin (dB)	
5210	-3.95	0.24	-3.71	11.00 dBm/MHz	-14.71	
5290	-4.00	0.24	-3.76	11.00 dBm/MHz	-14.76	
5530	-5.22	0.24	-4.98	11.00 dBm/MHz	-15.98	
5610	-1.46	0.24	-1.22	11.00 dBm/MHz	-12.22	
Frequency (MHz)	Ch0 meas PSD (dBm/300kHz)	Duty Factor (dB)	10log (500kHz/RBW) Factor(dB)	Maxmum Corr'd PSD (dBm/500kHz)	Limit	Margin (dB)
5775	-5.61	0.24	2.22	-3.15	30.00 dBm/500kHz	-33.15

Note: Since $DG < 6\text{dBi}$, there is no need to modify the limit value.

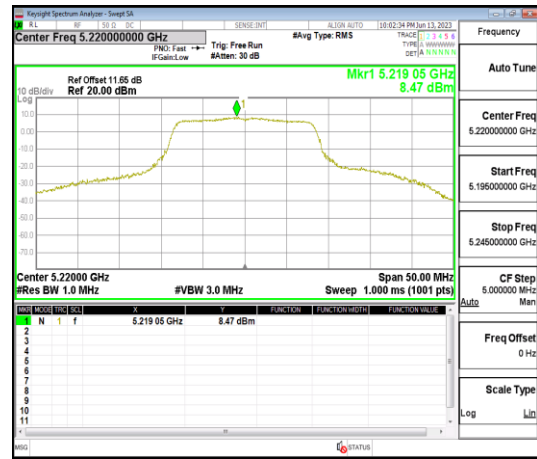
Test Plots:

UNII-1 IEEE 802.11a mode

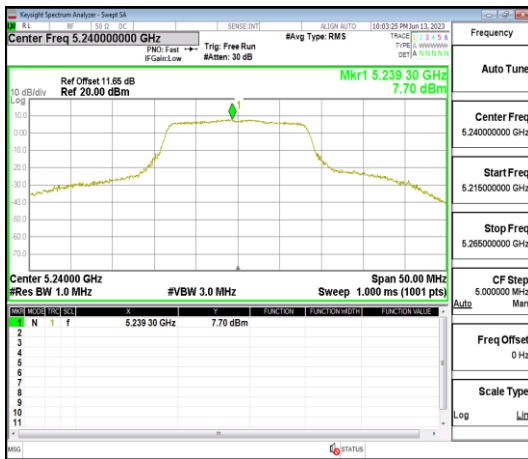
5180 MHz



5220 MHz

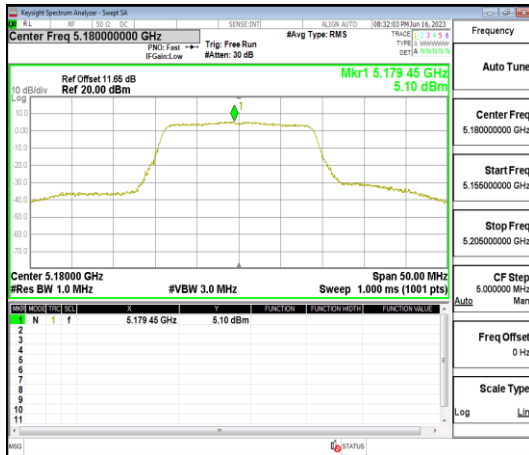


5240 MHz

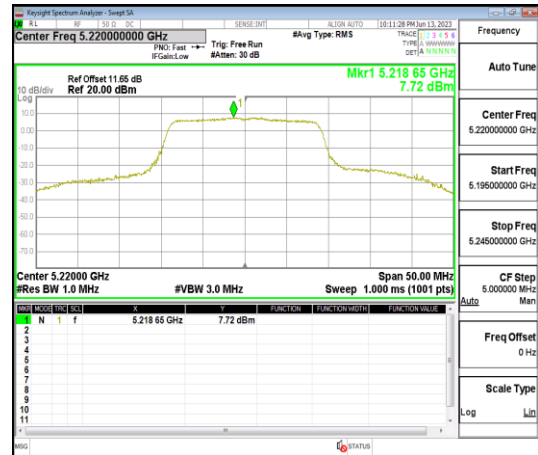


UNII-1 IEEE 802.11n HT20 mode

5180 MHz

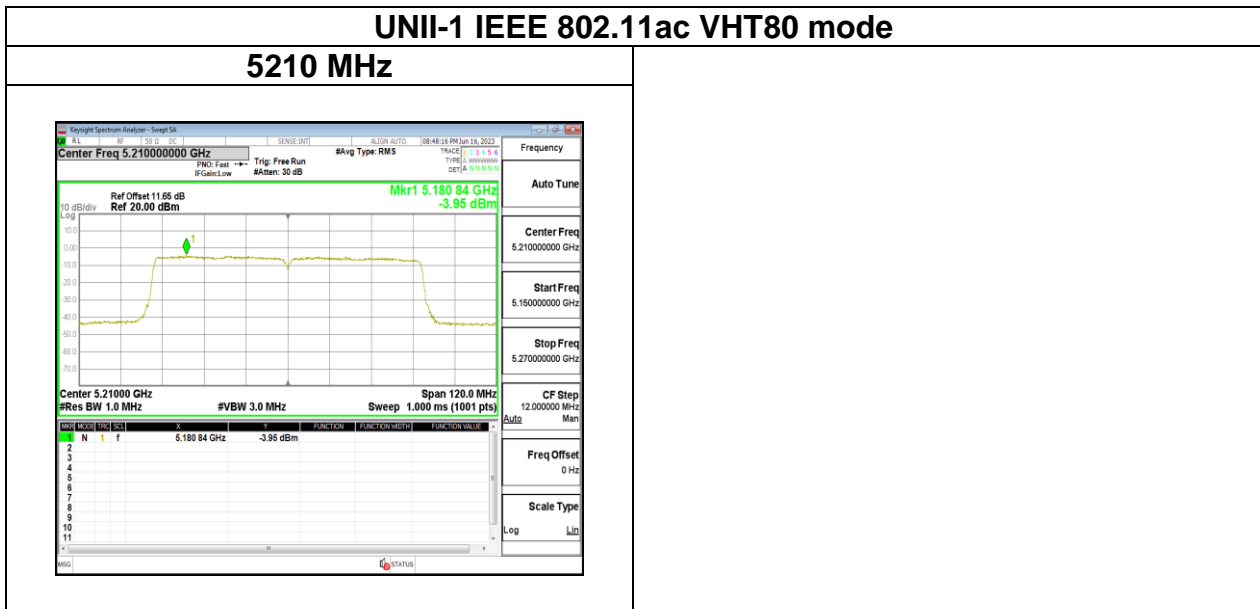
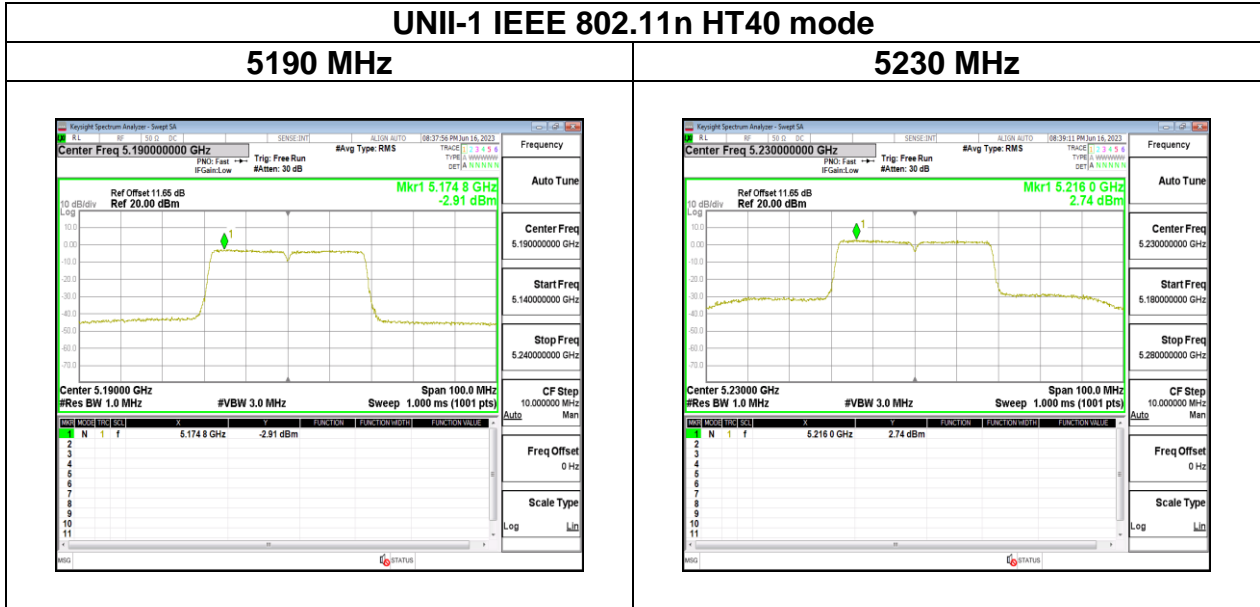


5220 MHz



5240 MHz



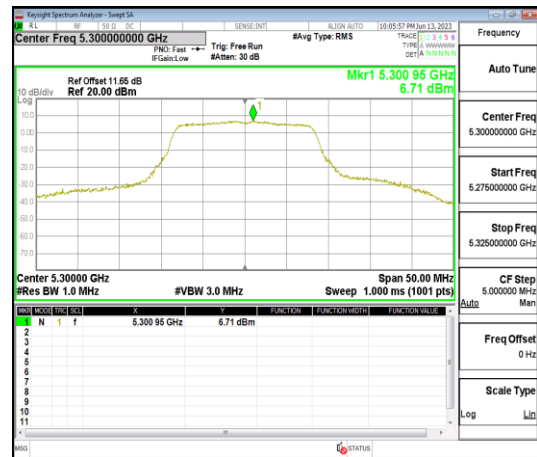


UNII-2a IEEE 802.11a mode

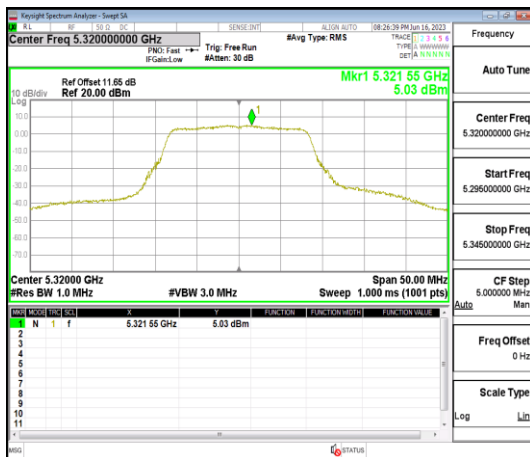
5260 MHz



5300 MHz

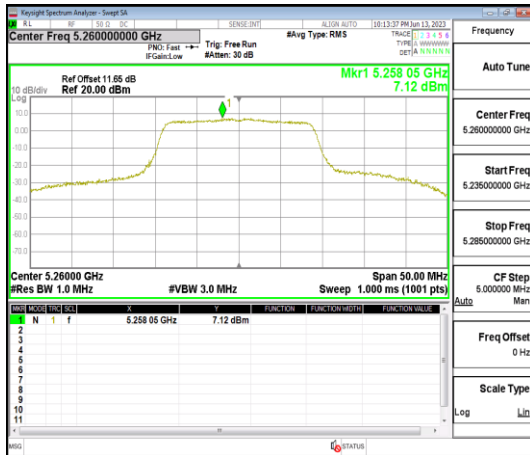


5320 MHz

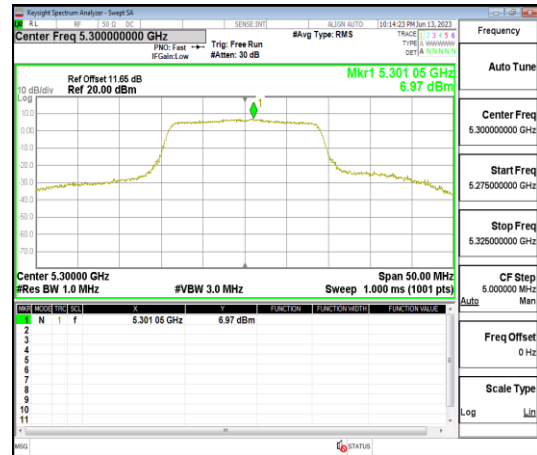


UNII-2a IEEE 802.11n HT20 mode

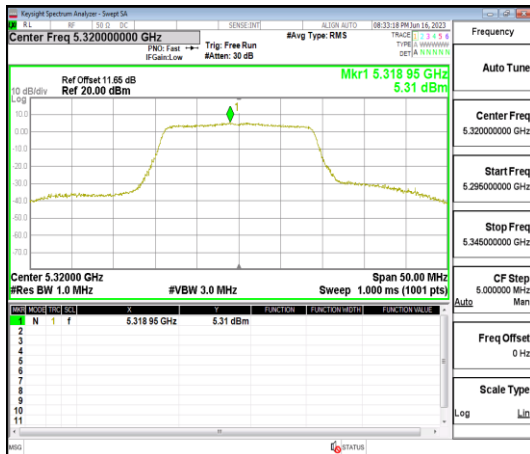
5260 MHz

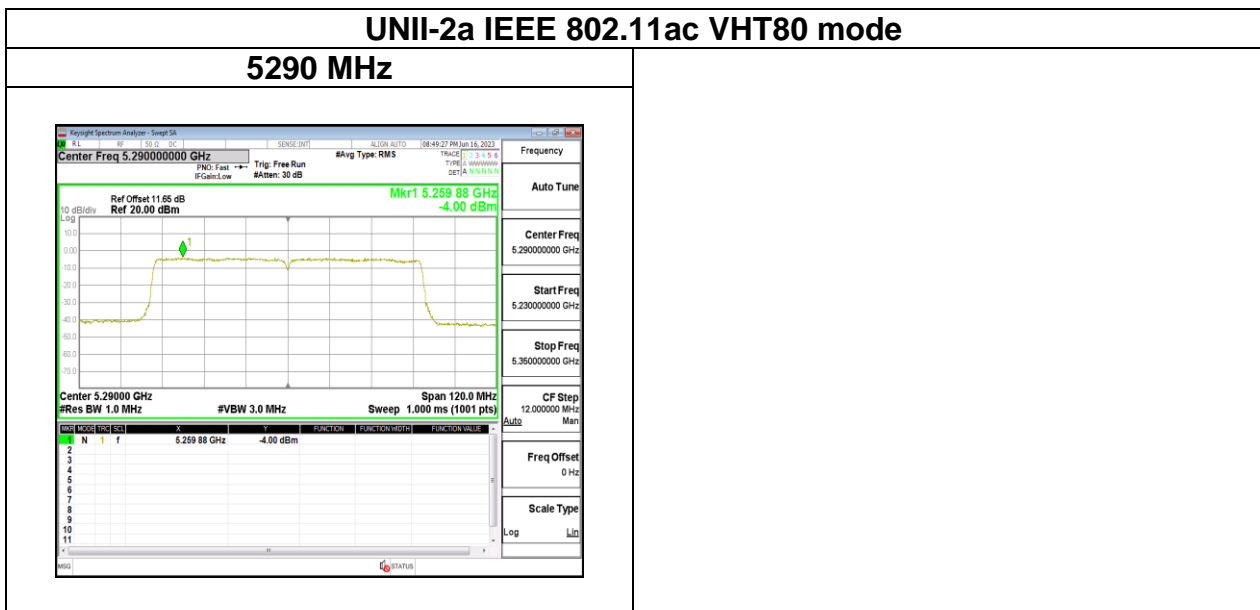
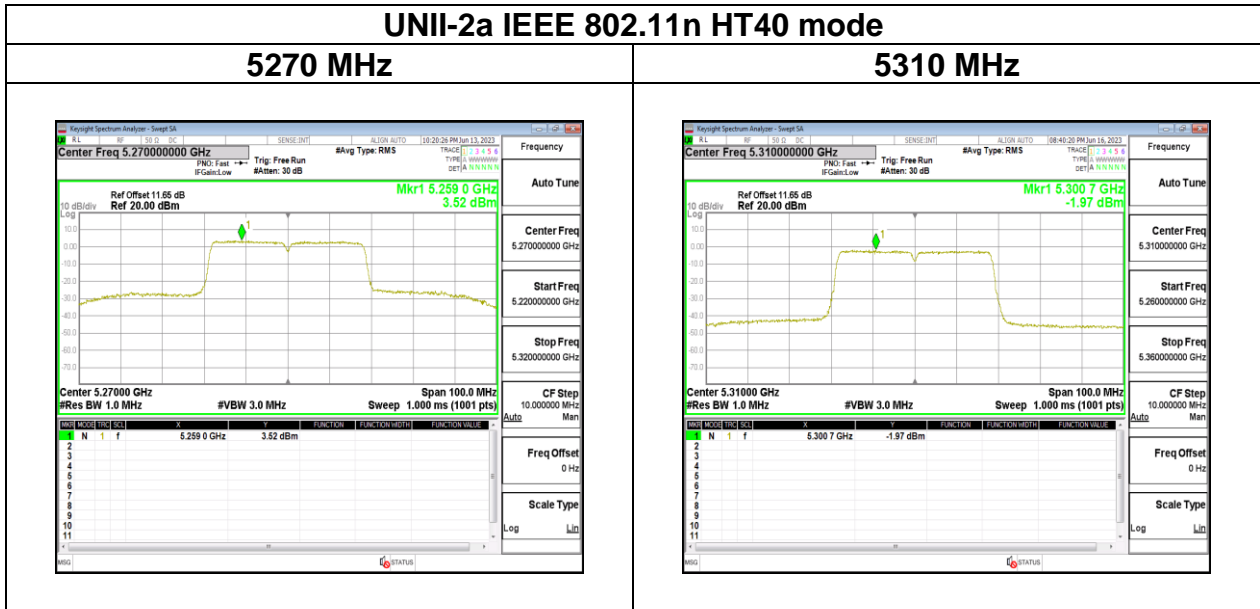


5300 MHz



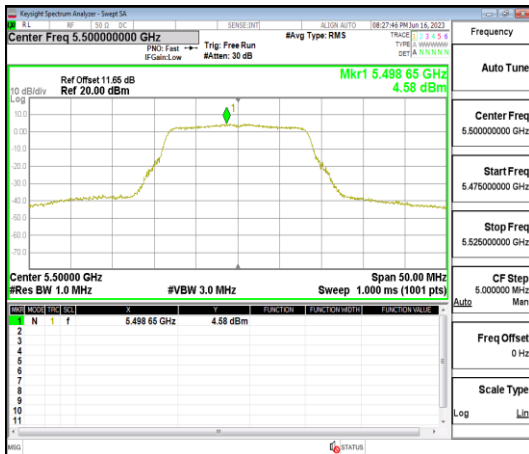
5320 MHz





UNII-2c IEEE 802.11a mode

5500 MHz



5580 MHz



5700 MHz

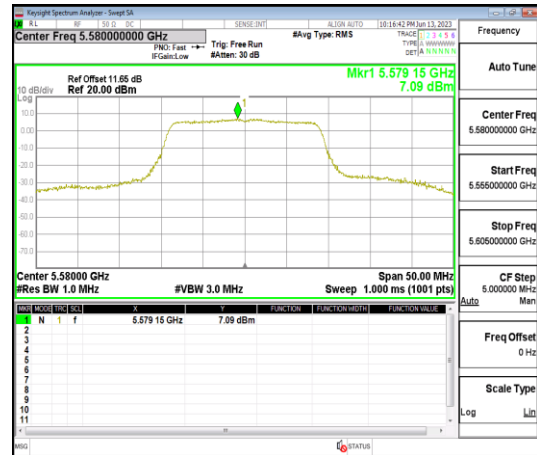


UNII-2c IEEE 802.11n HT20 mode

5500 MHz



5580 MHz



5700 MHz

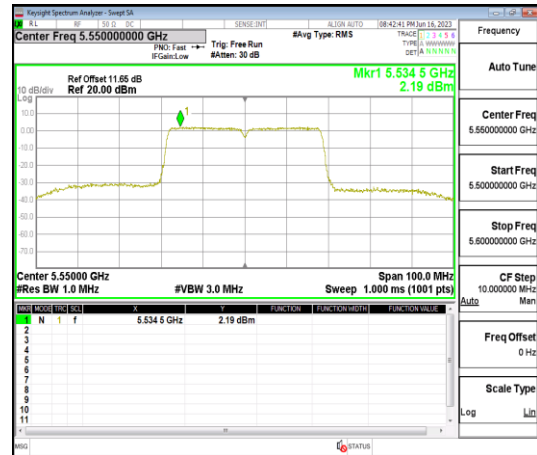


UNII-2c IEEE 802.11n HT40 mode

5510 MHz

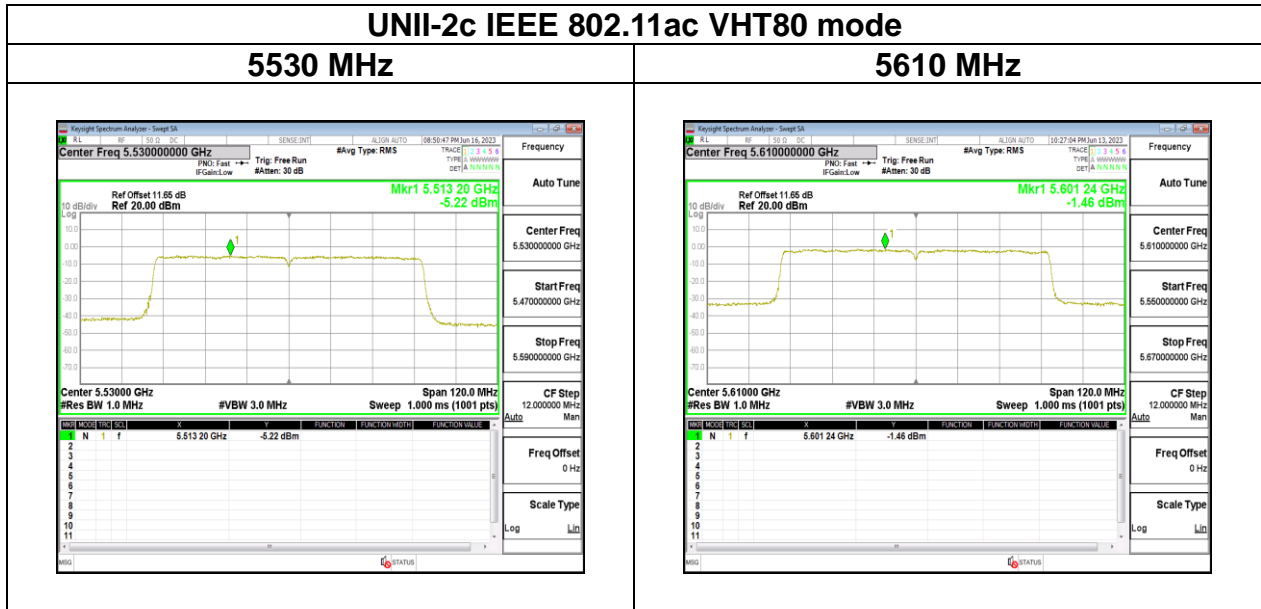


5550 MHz



5670 MHz



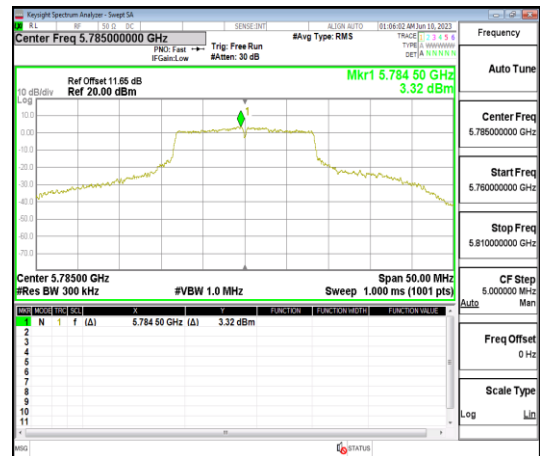


UNII-3 IEEE 802.11 a mode

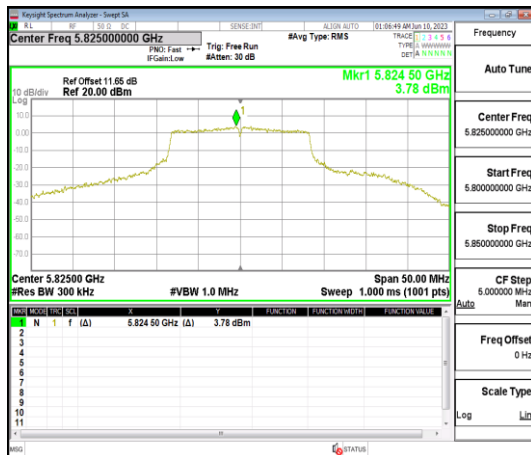
5745 MHz



5785 MHz



5825 MHz

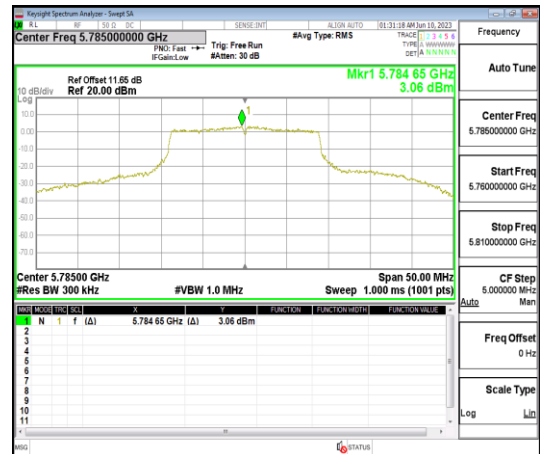


UNII-3 IEEE 802.11n HT20 mode

5745 MHz

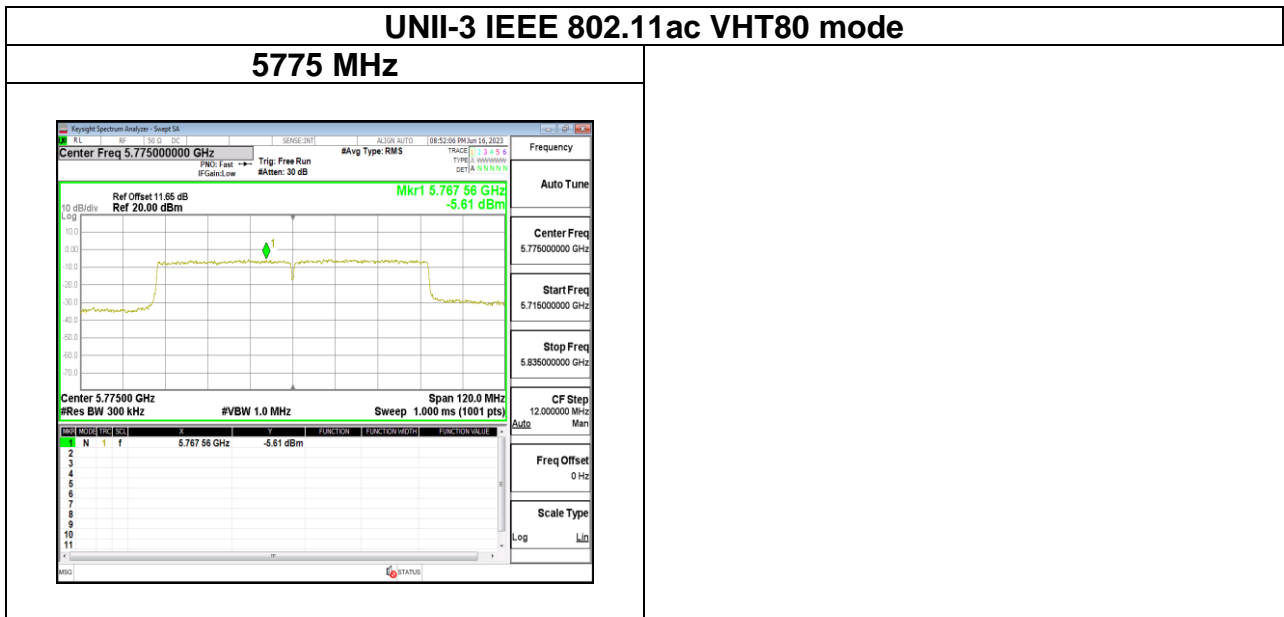
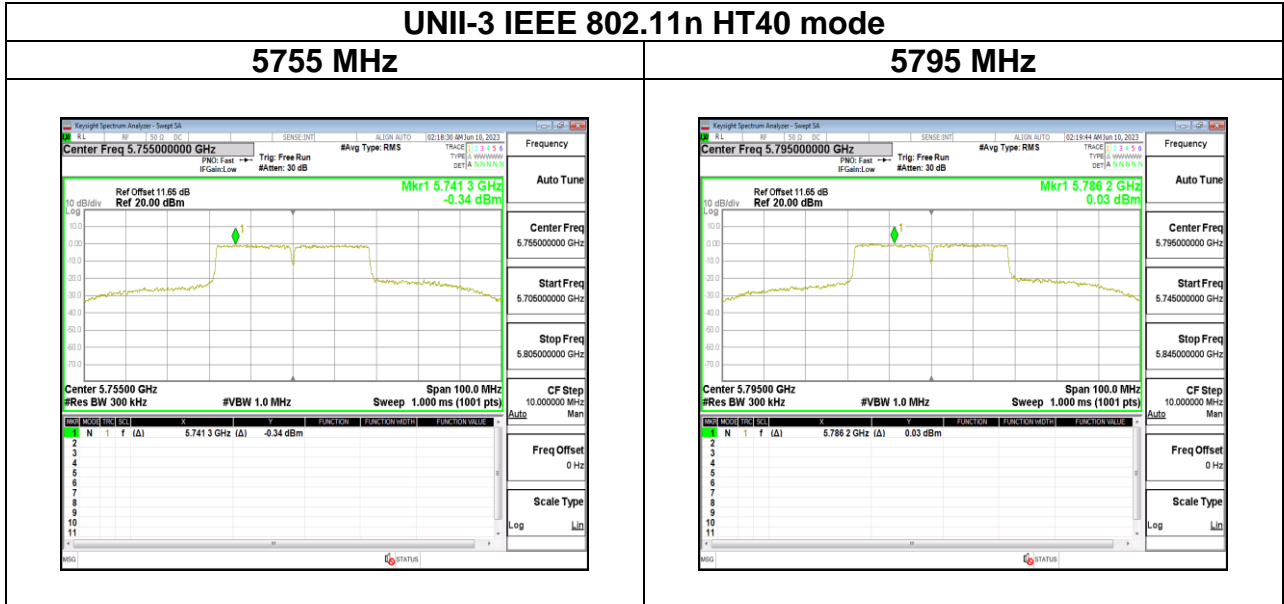


5785 MHz



5825 MHz





4.5 RADIATION BANDEDGE AND SPURIOUS EMISSION

4.5.1 Test Limit

FCC according to §15.407, §15.209 and §15.205,

Below 30 MHz

Frequency	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/F (F in kHz)	30
1.705-30 MHz	30	N/A	30

Above 30 MHz

Frequency (MHz)	Field Strength microvolts/m at 3 metres (watts, e.i.r.p.)	
	Transmitters	Receivers
30-88	100 (3 nW)	100 (3 nW)
88-216	150 (6.8 nW)	150 (6.8 nW)
216-960	200 (12 nW)	200 (12 nW)
Above 960	500 (75 nW)	500 (75 nW)

UNII-1 :

For transmitters operating in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. However, any unwanted emissions that fall into the band 5250-5350 MHz must be 26 dBc, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth, above 5.25 GHz. Otherwise, the transmission is considered as intentional and the devices shall implement dynamic frequency selection (DFS) and transmitter power control (TPC) as per the requirements for the band 5250-5350 MHz

UNII-2a and 2c :

For devices with operating frequencies in the band 5250-5350 MHz but having a channel bandwidth that overlaps the band 5150-5250 MHz, the devices' unwanted emission shall not exceed -27 dBm/MHz e.i.r.p. outside the band 5150-5350 MHz and its power shall comply with the spectral power density for operation within the band 5150-5250 MHz. The device shall be labelled "for indoor use only." Emissions outside the band 5470-5725 MHz shall not exceed -27 dBm/MHz e.i.r.p.

UNII-3:

All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

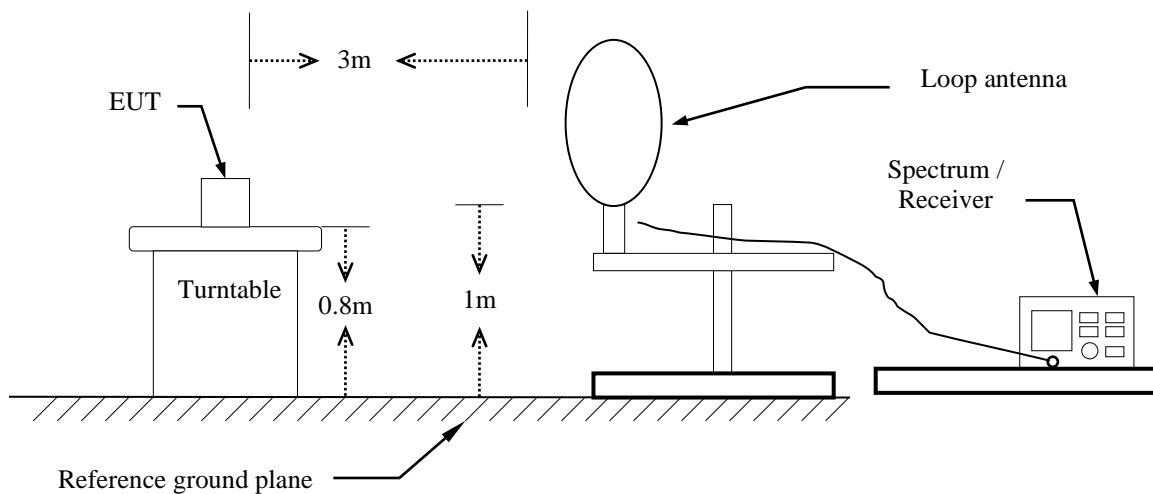
4.5.2 Test Procedure

Test method Refer as KDB 789033 D02.

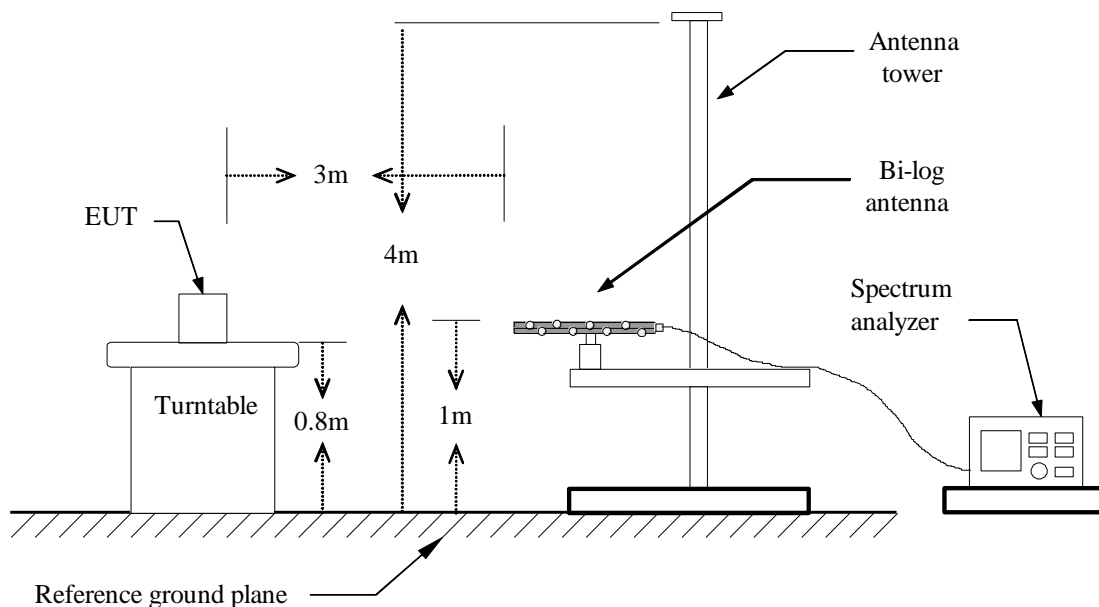
1. The EUT is placed on a turntable, Above 1 GHz is 1.5m and below 1 GHz is 0.8m above ground plane. The EUT Configured un accordance with ANSI C63.10: 2013, and the EUT set in a continuous mode.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level. And EUT is set 3m away from the receiving antenna, which is scanned from 1m to 4m above the ground plane to find out the highest emissions. Measurement are made polarized in both the vertical and the horizontal positions with antenna.
3. Span shall wide enough to full capture the emission measured. The SA from 9kHz to 40GHz set to the low, Mid and High channels with the EUT transmit.
4. No emission found between lowest internal used/generated frequency to 30MHz (9KHz~30MHz)
5. The SA setting following :
 - (1) Below 1G : RBW = 100kHz, VBW $\geq 3 \times$ RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.
 - (2) Above 1G :
 - (2.1) For Peak measurement : RBW = 1MHz, VBW ≥ 3 RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.
 - (2.2) For Average measurement : RBW = 1MHz, VBW
 - 'If Duty Cycle $\geq 98\%$, VBW=10Hz.
 - 'If Duty Cycle $< 98\%$, VBW=1/T.

4.5.3 Test Setup

9kHz ~ 30MHz



30MHz ~ 1GHz



Above 1 GHz

