









8.5 RADIATED SPURIOUS EMISSION

8.5.1 Applicable Standard

According to FCC Part 15.247(d) and 15.209 and KDB 558074 D01 15.247 Meas Guidance v05r02

8.5.2 Conformance Limit

According to FCC Part 15.247(d): radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

According to FCC Part15.205, Restricted bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

According to FCC Part15.205,the level of any transmitter spurious emission in Restricted bands shall not exceed the level of the emission specified in the following table

Restricted Frequency(MHz)	Field Strength (μ V/m)	Field Strength ($\text{dB}\mu\text{V/m}$)	Measurement Distance
0.009-0.490	2400/F(KHz)	20 log (μ V/m)	300
0.490-1.705	24000/F(KHz)	20 log (μ V/m)	30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

8.5.3 Test Configuration

Test according to clause 7.2 radio frequency test setup 2

8.5.4 Test Procedure

This test is required for any spurious emission that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

The EUT was placed on a turn table which is 0.8m above ground plane.

Maximum procedure was performed on the highest emissions to ensure EUT compliance.

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz(1GHz to 25GHz), 100 kHz for $f < 1$ GHz(30MHz to 1GHz), 200Hz for $f < 150$ KHz(9KHz to 150KHz), 9KHz for $f < 30$ MHz(150KHz to 30KHz)

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Follow the guidelines in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in

order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from $20\log(\text{dwell time}/100 \text{ ms})$, in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

Repeat above procedures until all frequency measured was complete.

8.5.5 Test Results

Temperature:	25.7° C
Relative Humidity:	55%
ATM Pressure:	1011 mbar

■ Spurious Emission below 30MHz(9KHz to 30MHz)

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
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Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Distance extrapolation factor = $40\log(\text{Specific distance}/ \text{test distance})(\text{ dB})$;

Limit line=Specific limits(dBuV) + distance extrapolation factor

■ Spurious Emission Above 1GHz(1GHz to 25GHz)

All modes 2.4G 802.11b/g/n have been tested, and the worst result 802.11b was recorded as below:

Test mode: 802.11 b Frequency: Channel 1: 2412MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
4831.962	V	59.20	51.08	74	54	-14.80	-2.92
6432.733	V	53.14	35.26	74	54	-20.86	-18.74
17948.04	V	64.92	46.84	74	54	-9.08	-7.16
4831.962	H	53.87	35.79	74	54	-20.13	-18.21
9809.916	H	53.86	35.41	74	54	-20.14	-18.59
17948.04	H	64.95	46.86	74	54	-9.05	-7.14

Test mode: 802.11 b

Frequency:

Channel 6: 2437MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
4874.043	V	58.99	51.68	74	54	-15.01	-2.32
6432.733	V	53.02	35.03	74	54	-20.98	-18.97
18000.00	V	65.54	48.49	74	54	-8.46	-5.51
4874.043	H	51.98	33.99	74	54	-22.02	-20.01
11467.00	H	56.80	38.78	74	54	-17.20	-15.22
17948.04	H	64.95	46.89	74	54	-9.05	-7.11

Test mode: 802.11 b

Frequency:

Channel 11: 2462MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
4930.721	V	59.42	51.99	74	54	-14.58	-2.01
6432.733	V	53.34	35.18	74	54	-20.66	-18.82
18000.00	V	65.74	48.33	74	54	-8.26	-5.67
4930.721	H	52.41	34.59	74	54	-21.59	-19.41
10885.66	H	55.41	38.62	74	54	-18.59	-15.38
18000.00	H	65.11	48.18	74	54	-8.89	-5.82

Note: (1) All Readings are Peak Value (VBW=3MHz) and Average Value (VBW=10Hz).

(2) Emission Level= Reading Level+Correct Factor.

(3) Correct Factor= Ant_F + Cab_L - Preampl

(4) The reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

■ Spurious Emission in Restricted Band 2310-2390MHz and 2483.5-2500MHz

All modes 2.4G 802.11b/g/n/ax have been tested, and the worst result 802.11b was recorded as below:

Test mode: 802.11 b Frequency: Channel 1: 2412MHz

Frequency (MHz)	Polarity	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	Over(dB)	AV(dBuV/m) (VBW=10Hz)	Limit 3m (dBuV/m)	Over(dB)
2389.884	H	61.45	74	-12.55	41.15	54	-12.85
2389.976	V	72.25	74	-1.75	46.27	54	-7.73

Test mode: 802.11 b Frequency: Channel 11: 2462MHz

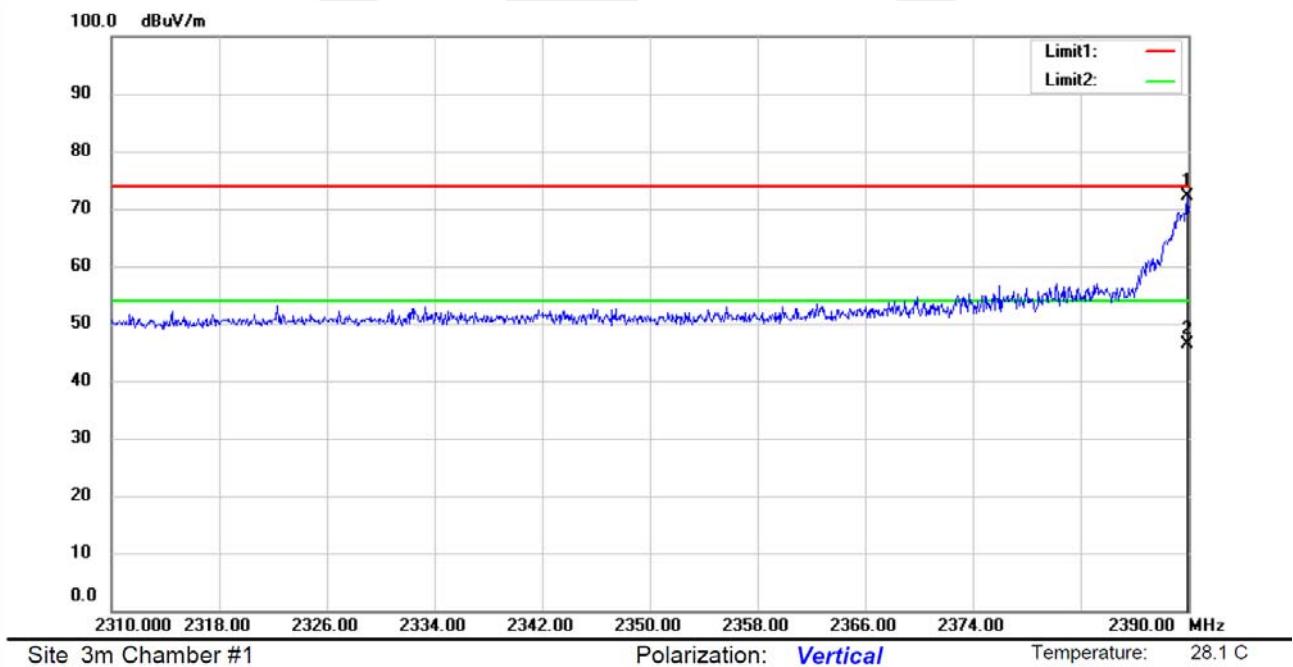
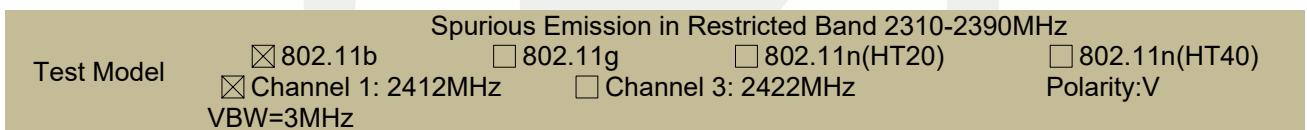
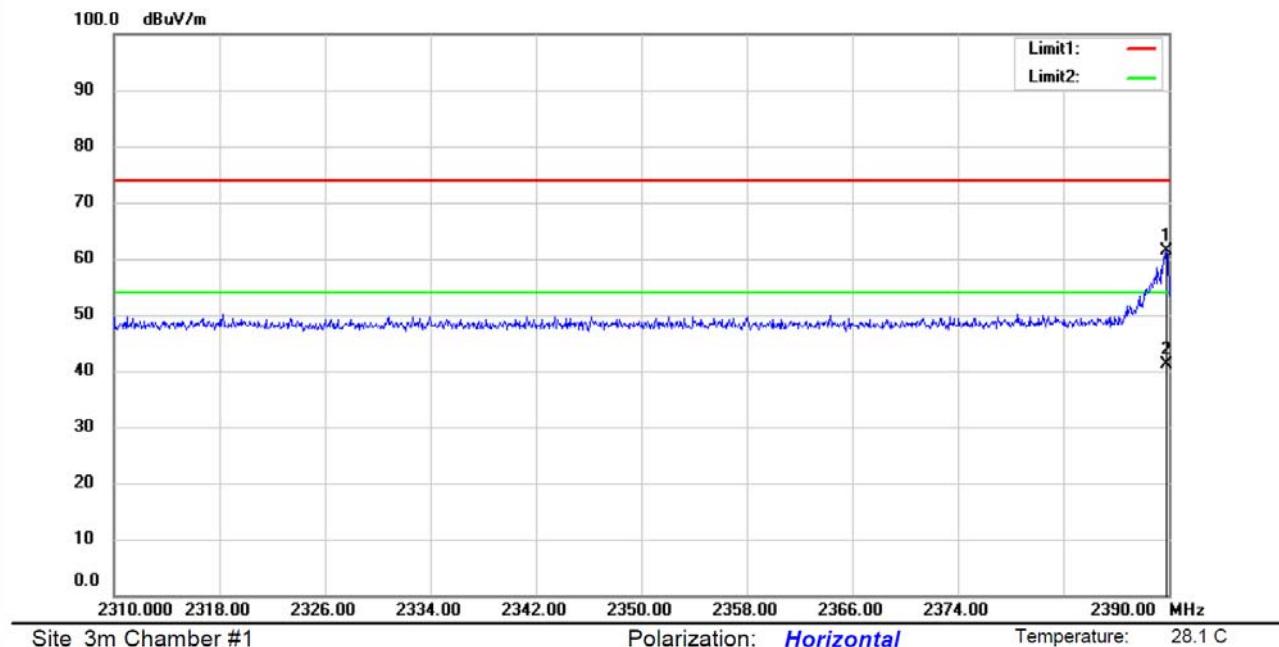
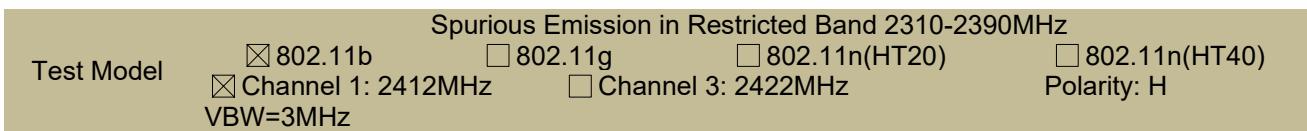
Frequency (MHz)	Polarity	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	Over(dB)	AV(dBuV/m) (VBW=10Hz)	Limit 3m (dBuV/m)	Over(dB)
2483.526	H	61.83	74	-12.17	40.25	54	-13.75
2483.511	V	71.06	74	-2.94	47.38	54	-6.62

Note: (1) All Readings are Peak Value (VBW=3MHz) and Average Value (VBW=10Hz).

(2) Emission Level= Reading Level+Correct Factor.

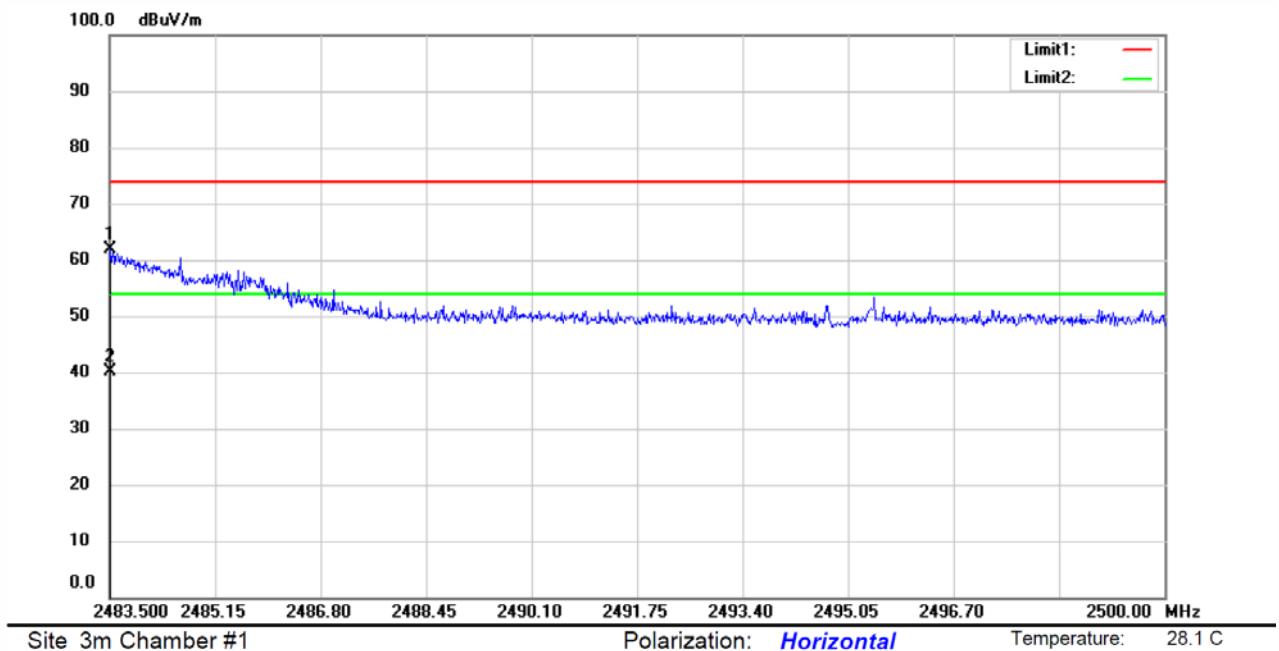
(3) Correct Factor= Ant_F + Cab_L - Preamplifier

(4) The reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.



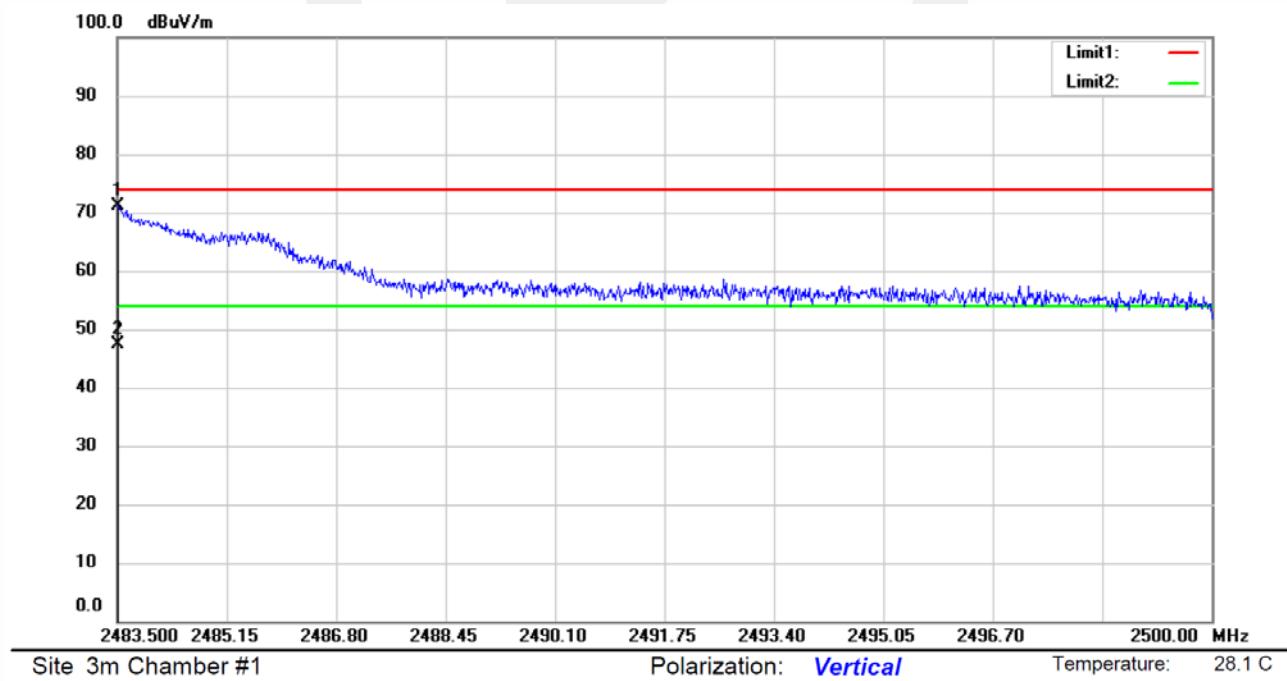
Spurious Emission in Restricted Band 2483.5-2500MHz

Test Model 802.11b 802.11g 802.11n(HT20) 802.11n(HT40)
 Channel 11: 2462MHz Channel 9: 2452MHz Polarity: H
 VBW=3MHz



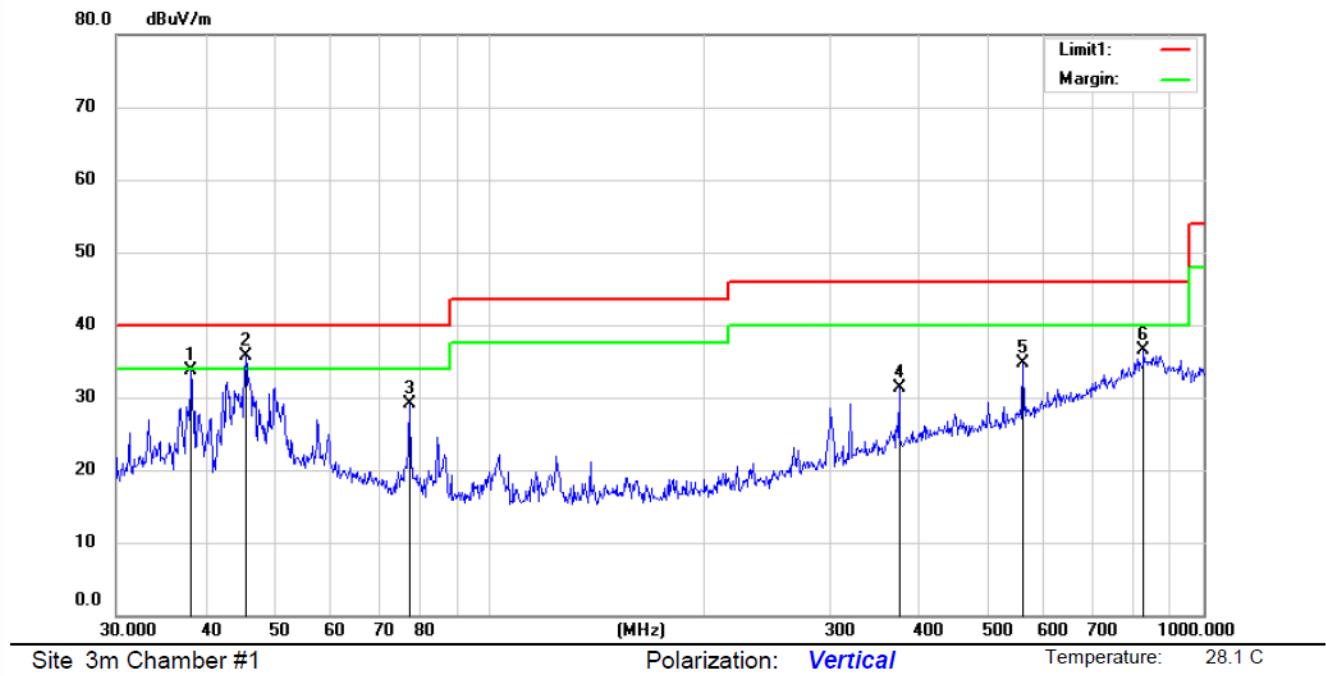
Spurious Emission in Restricted Band 2483.5-2500MHz

Test Model 802.11b 802.11g 802.11n(HT20) 802.11n(HT40)
 Channel 11: 2462MHz Channel 9: 2452MHz Polarity: V
 VBW=3MHz



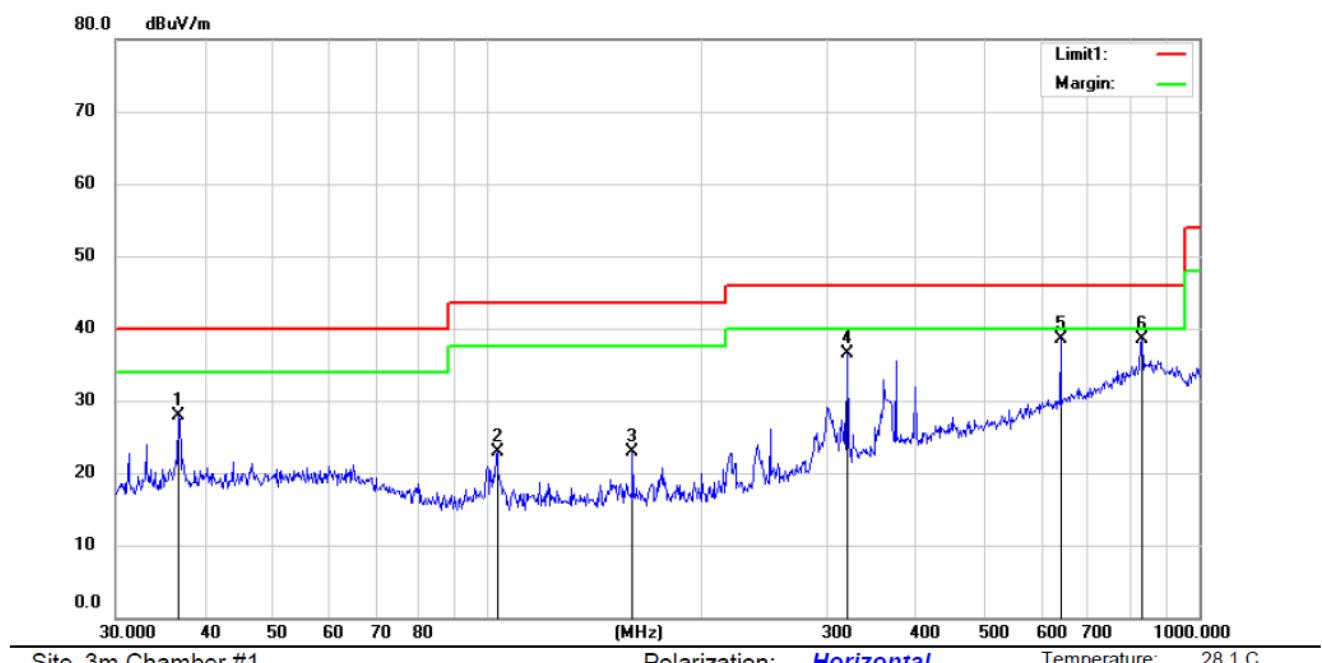
■ Spurious Emission below 1GHz (30MHz to 1GHz)

All modes 2.4G 802.11b/g/n have been tested, and the worst result 802.11b was recorded as below:



Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table		
			Level	Factor	ment						
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		38.2455	42.52	-8.72	33.80	40.00	-6.20	QP			
2	*	45.5548	43.42	-7.74	35.68	40.00	-4.32	QP			
3		77.3890	39.21	-10.04	29.17	40.00	-10.83	QP			
4		374.9511	34.71	-3.34	31.37	46.00	-14.63	QP			
5		560.2015	34.66	0.05	34.71	46.00	-11.29	QP			
6		826.4060	30.29	6.17	36.46	46.00	-9.54	QP			



Site 3m Chamber #1

 Polarization: **Horizontal**

Temperature: 28.1 C

Limit: (RE)FCC PART 15 CLASS B

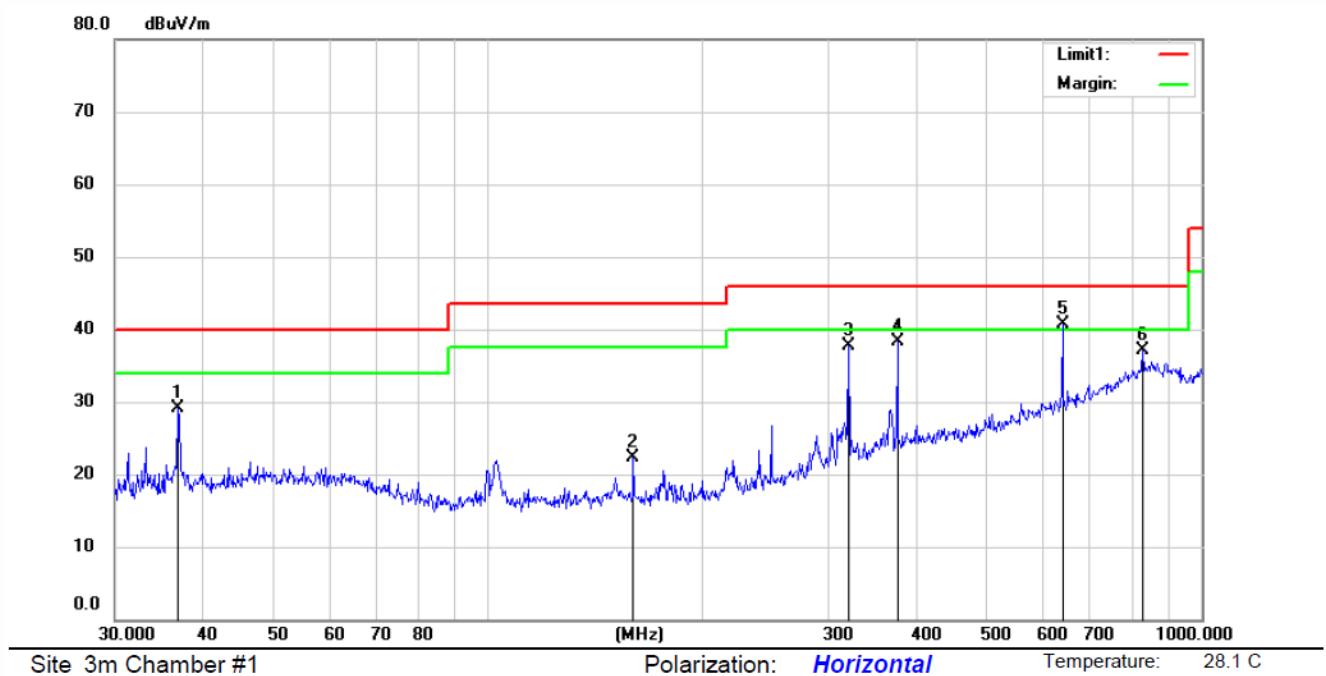
Power: AC 120V/60Hz

Humidity: 43 %

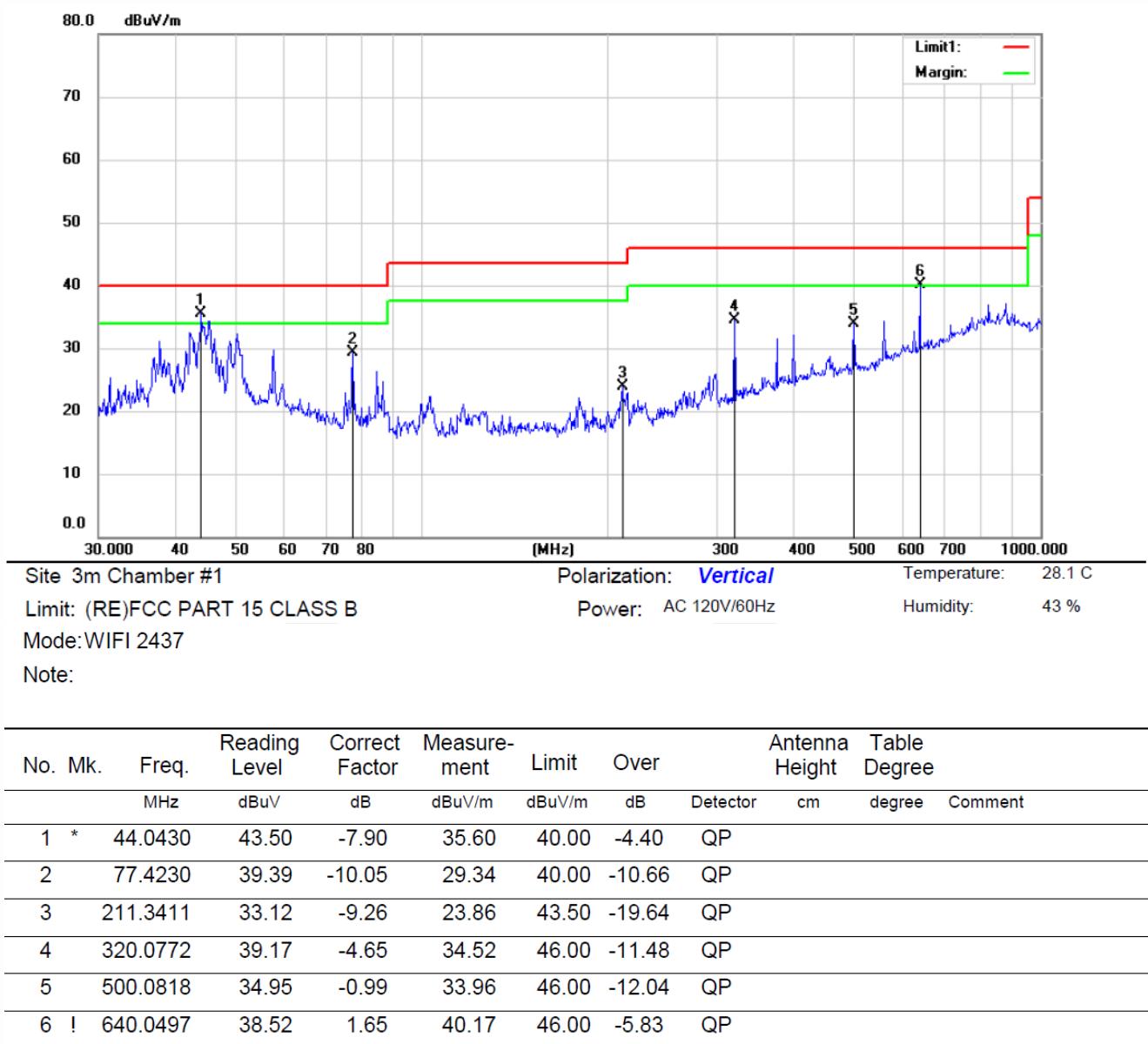
Mode: WIFI 2412

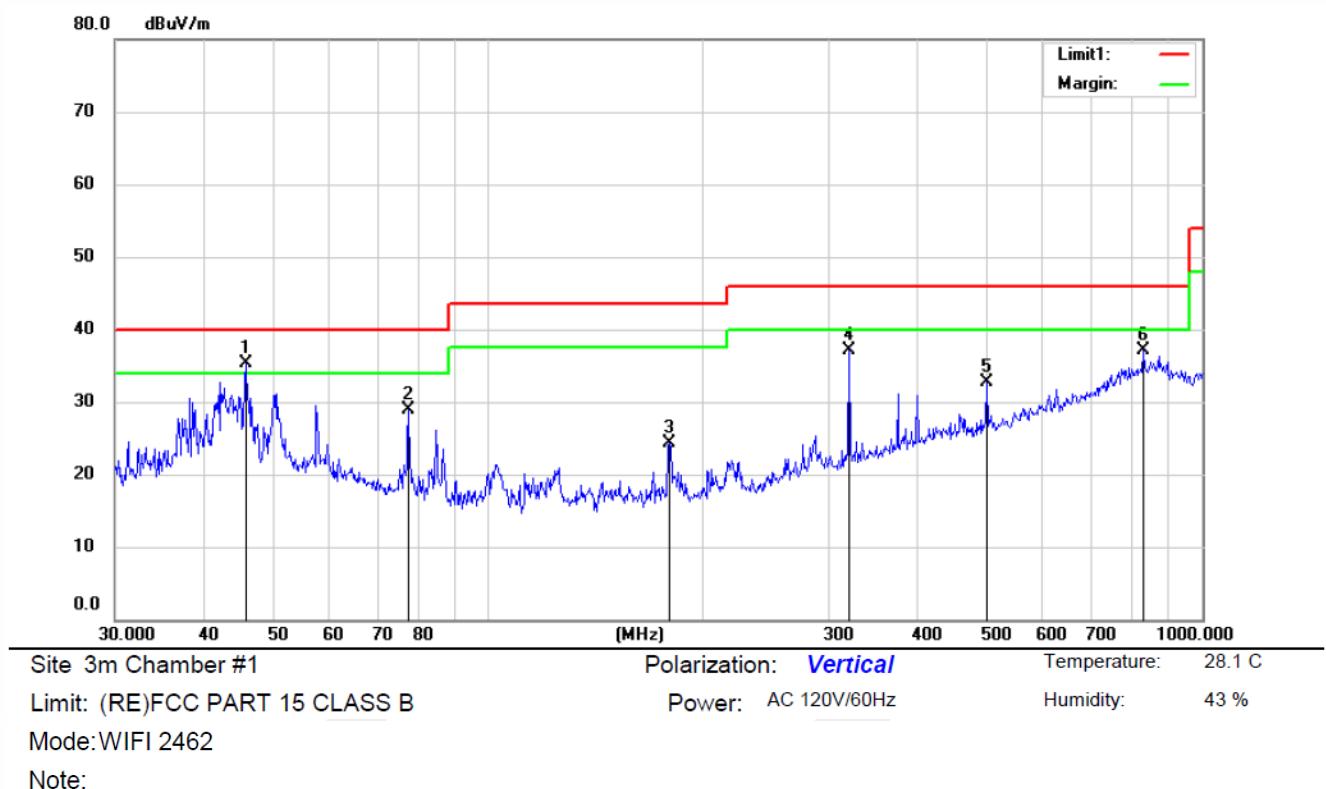
Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table			
			Level	Factor	ment							
			MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1		36.8468	36.82	-8.85	27.97	40.00	-12.03	QP				
2		103.1704	33.18	-10.27	22.91	43.50	-20.59	QP				
3		160.0648	32.57	-9.60	22.97	43.50	-20.53	QP				
4		320.0772	41.11	-4.65	36.46	46.00	-9.54	QP				
5 *		640.0497	36.87	1.65	38.52	46.00	-7.48	QP				
6		830.4002	32.15	6.37	38.52	46.00	-7.48	QP				

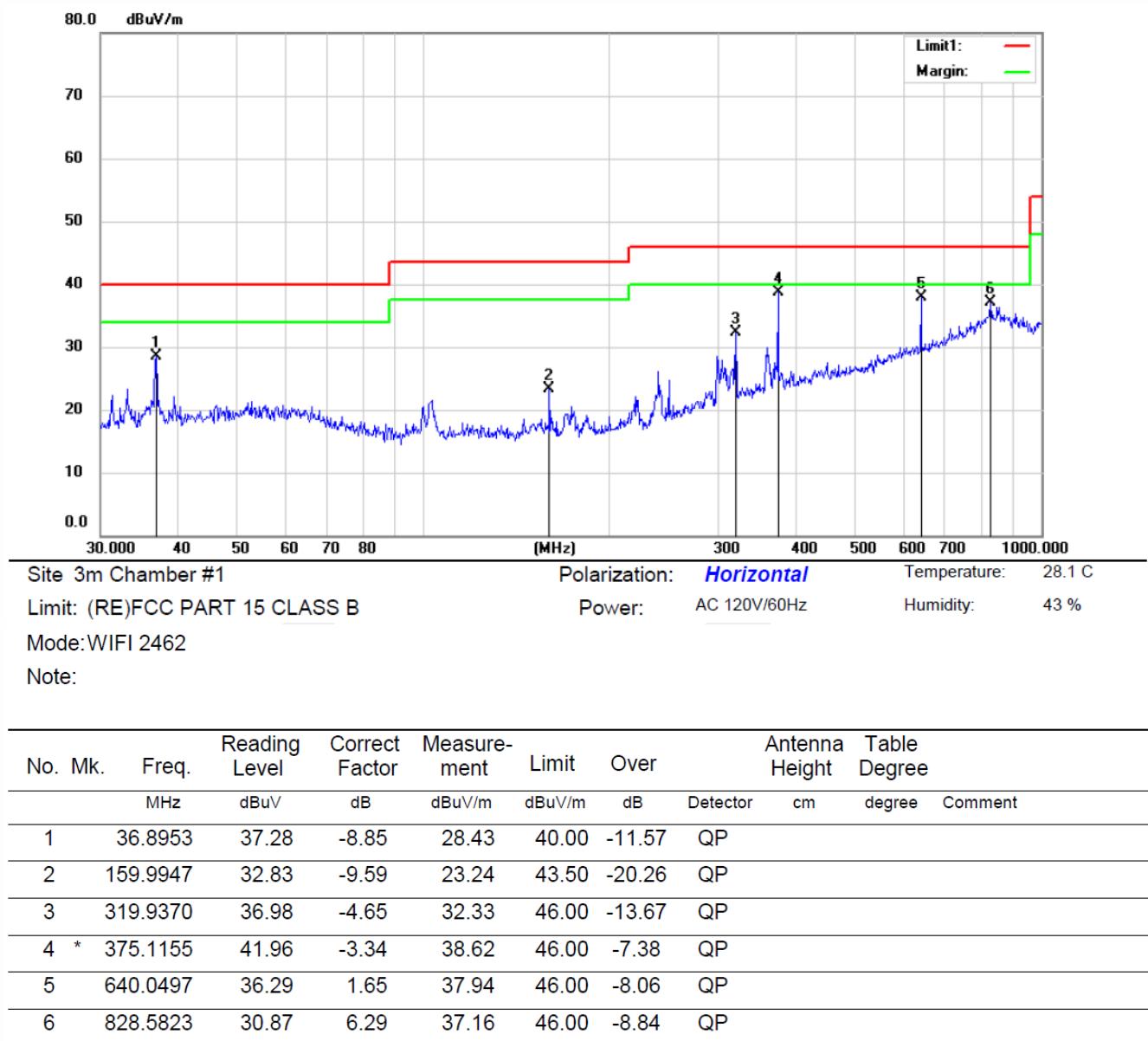


No.	Mk.	Reading		Correct Factor	Measure- ment	Limit	Over	Antenna Height	Table Degree	Comment			
		Freq.	Level			MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm
1	36.8630	37.94	-8.85	29.09	40.00	-10.91	QP						
2	160.0648	31.97	-9.60	22.37	43.50	-21.13	QP						
3	320.0772	42.45	-4.65	37.80	46.00	-8.20	QP						
4	375.1155	41.58	-3.34	38.24	46.00	-7.76	QP						
5 *	640.0497	39.15	1.65	40.80	46.00	-5.20	QP						
6	829.3090	30.80	6.34	37.14	46.00	-8.86	QP						





No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Antenna	Table		
			Level	Factor	ment					Height	Degree
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	cm	degree	Comment
1	*	45.8151	43.01	-7.72	35.29	40.00	-4.71	QP			
2		77.3890	38.87	-10.04	28.83	40.00	-11.17	QP			
3		179.7011	34.09	-9.86	24.23	43.50	-19.27	QP			
4		320.0772	41.69	-4.65	37.04	46.00	-8.96	QP			
5		500.0818	33.79	-0.99	32.80	46.00	-13.20	QP			
6		827.4934	30.91	6.23	37.14	46.00	-8.86	QP			



8.6 CONDUCTED EMISSIONS TEST

8.6.1 Applicable Standard

According to FCC Part 15.207(a)

8.6.2 Conformance Limit

Conducted Emission Limit		
Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

8.6.3 Test Configuration

Test according to clause 7.3 conducted emission test setup

8.6.4 Test Procedure

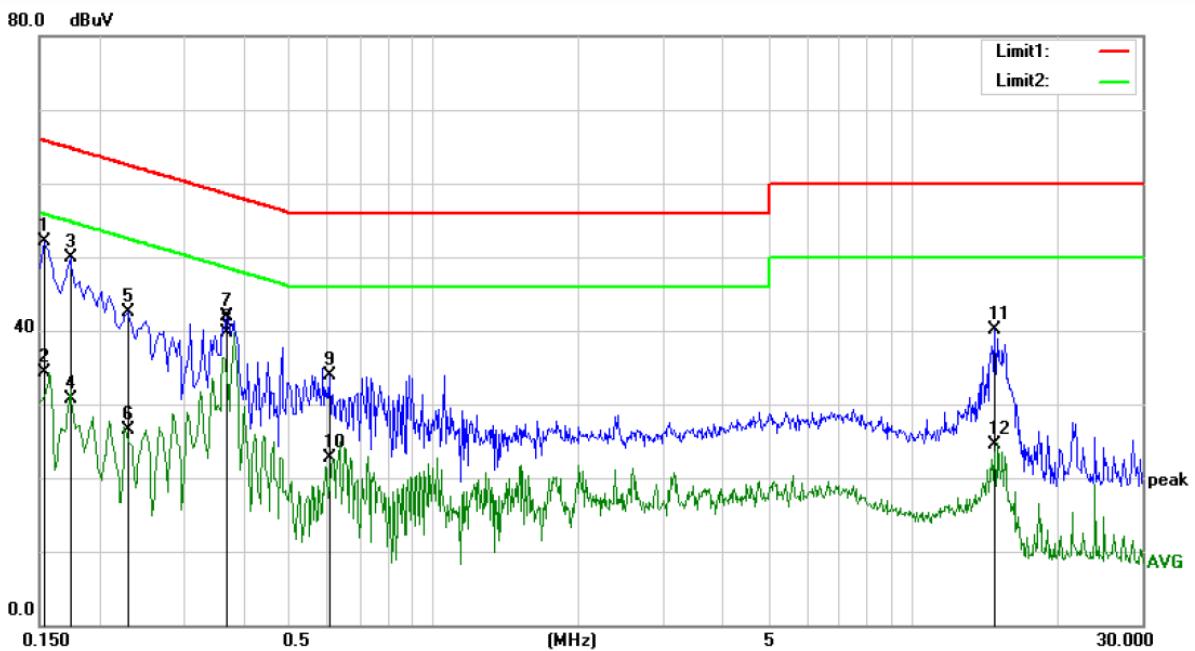
The EUT was placed on a table which is 0.8m above ground plane.

Maximum procedure was performed on the highest emissions to ensure EUT compliance.

Repeat above procedures until all frequency measured were complete.

8.6.5 Test Results

Pass



Site Conduction #2

 Phase: **L1**

Temperature: 25.1

Limit: (CE)FCC PART 15 class B_QP

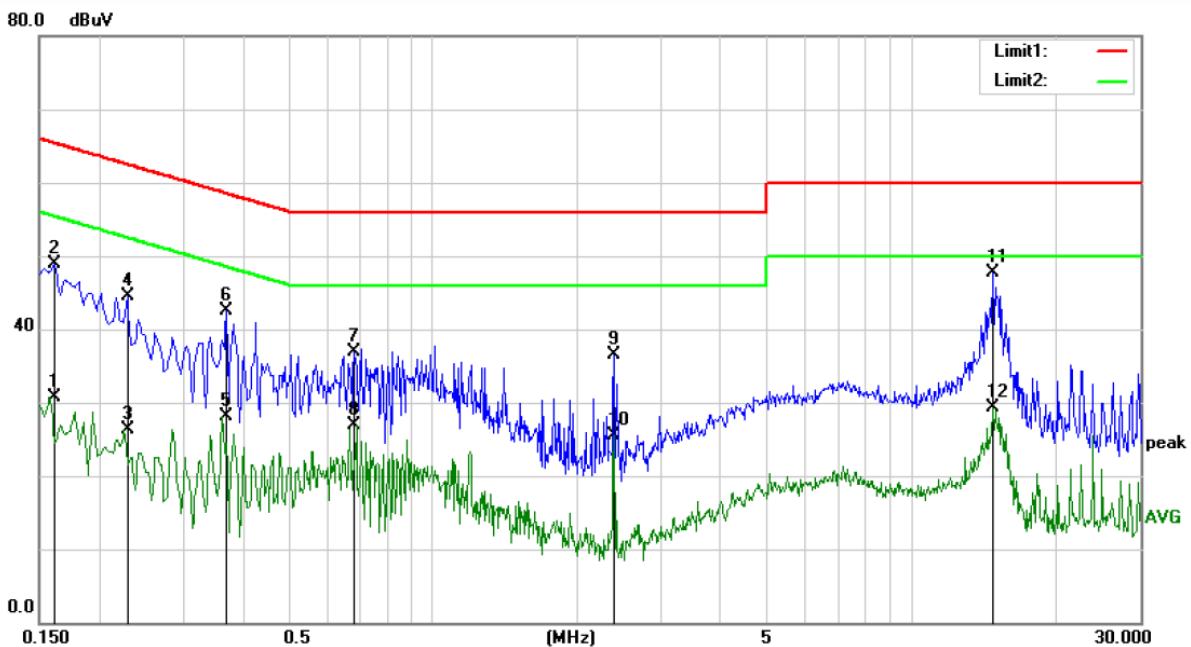
Power: AC 120V/60Hz

Humidity: 45 %

Mode: WIFI

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over					
							MHz	dBuV	dB	dBuV	dB	Detector
1		0.1540	42.00	10.09	52.09	65.78	-13.69					QP
2		0.1540	24.19	10.09	34.28	55.78	-21.50					AVG
3		0.1740	39.74	10.09	49.83	64.77	-14.94					QP
4		0.1740	20.67	10.09	30.76	54.77	-24.01					AVG
5		0.2300	32.47	10.10	42.57	62.45	-19.88					QP
6		0.2300	16.34	10.10	26.44	52.45	-26.01					AVG
7		0.3700	31.72	10.10	41.82	58.50	-16.68					QP
8 *		0.3700	29.67	10.10	39.77	48.50	-8.73					AVG
9		0.6060	23.73	10.12	33.85	56.00	-22.15					QP
10		0.6060	12.60	10.12	22.72	46.00	-23.28					AVG
11		14.7660	29.56	10.53	40.09	60.00	-19.91					QP
12		14.7660	14.07	10.53	24.60	50.00	-25.40					AVG



Site Conduction #2

 Phase: **L1**

Temperature: 25.1

Limit: (CE)FCC PART 15 class B_QP

Power: AC 120V/60Hz

Humidity: 45 %

Mode: WIFI

Note:

No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Comment
			Level	Factor	ment			
		MHz	dBuV	dB	dBuV	dB	Detector	
1		0.1620	20.70	10.09	30.79	55.36	-24.57	AVG
2		0.1620	38.82	10.09	48.91	65.36	-16.45	QP
3		0.2300	16.11	10.10	26.21	52.45	-26.24	AVG
4		0.2300	34.40	10.10	44.50	62.45	-17.95	QP
5		0.3700	17.94	10.10	28.04	48.50	-20.46	AVG
6		0.3700	32.36	10.10	42.46	58.50	-16.04	QP
7		0.6860	26.81	10.14	36.95	56.00	-19.05	QP
8		0.6860	16.73	10.14	26.87	46.00	-19.13	AVG
9		2.3860	26.41	10.14	36.55	56.00	-19.45	QP
10		2.3860	15.30	10.14	25.44	46.00	-20.56	AVG
11	*	14.7900	37.15	10.53	47.68	60.00	-12.32	QP
12		14.7900	18.84	10.53	29.37	50.00	-20.63	AVG

8.7 ANTENNA APPLICATION

8.7.1 Antenna Requirement

Standard	Requirement
FCC CRF Part15.203	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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. 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. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

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 15.247 (b), 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.

8.7.2 Result

PASS.

- The EUT has two External Antennas for WiFi 2.4G: The two antennas are 5.0dBi

Note: Antenna uses a permanently attached antenna which is not replaceable.

Not using a standard antenna jack or electrical connector for antenna replacement
 The antenna has to be professionally installed (please provide method of installation)

Which in accordance to section 15.203, please refer to the internal photos

Detail of factor for radiated emission

Frequency(MHz)	Ant_F(dB)	Cab_L(dB)	Preamp(dB)	Correct Factor(dB)
0.009	20.6	0.03	\	20.63
0.15	20.7	0.1	\	20.8
1	20.9	0.15	\	21.05
10	20.1	0.28	\	20.38
30	18.8	0.45	\	19.25
30	11.7	0.62	27.9	-15.58
100	12.5	1.02	27.8	-14.28
300	12.9	1.91	27.5	-12.69
600	19.2	2.92	27	-4.88
800	21.1	3.54	26.6	-1.96
1000	22.3	4.17	26.2	0.27
1000	25.6	1.76	41.4	-14.04
3000	28.9	3.27	43.2	-11.03
5000	31.1	4.2	44.6	-9.3
8000	36.2	5.95	44.7	-2.55
10000	38.4	6.3	43.9	0.8
12000	38.5	7.14	42.3	3.34
15000	40.2	8.15	41.4	6.95
18000	45.4	9.02	41.3	13.12
18000	37.9	1.81	47.9	-8.19
21000	37.9	1.95	48.7	-8.85
25000	39.3	2.01	42.8	-1.49
28000	39.6	2.16	46.0	-4.24
31000	41.2	2.24	44.5	-1.06
34000	41.5	2.29	46.6	-2.81
37000	43.8	2.30	46.4	-0.3
40000	43.2	2.50	42.2	3.5

*** End of Report ***