









7.5 RADIATED EMISSION

7.5.1 Applicable Standard

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

7.5.2 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 Part 15.205, 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 Part 15.205 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 (μV/m)	Field Strength (dBμV/m)	Measurement Distance
0.009-0.490	2400/F(KHz)	20 log (uV/m)	300
0.490-1.705	24000/F(KHz)	20 log (uV/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

7.5.3 Test Configuration

Test according to clause 6.2 radio frequency test setup

7.5.4 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:

For Above 1GHz:

The EUT was placed on a turn table which is 1.5m 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

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

For Below 1GHz:

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 = 100 kHz for

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

For Below 30MHz:

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 = 9kHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

For Below 150KHz:

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 = 200Hz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Follow the guidelines in ANSI C63.10 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. 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. 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 limit. Submit this data.

Repeat above procedures until all frequency measured was complete.

7.5.5 Test Results

Temperature:	28.1° C
Relative Humidity:	43%
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
--	--	--	--	--	--	--	--

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

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

- Spurious Emission Above 1GHz(1GHz to 25GHz)
- All antenna modes 2.4G 802.11b/g/n have been tested, and the worst result recorded was report as below:

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

Freq. (MHz)	Ant.Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
	H/V	PK	AV	PK	AV	PK	AV
4824.287	V	52.64	34.74	74.00	54.00	-21.36	-19.26
11251.95	V	58.17	40.19	74.00	54.00	-15.83	-13.81
17950.64	V	68.37	50.22	74.00	54.00	-5.63	-3.78
4823.590	H	49.52	31.19	74.00	54.00	-24.48	-22.81
13244.18	H	58.09	41.02	74.00	54.00	-15.91	-12.98
17922.12	H	68.32	51.38	74.00	54.00	-5.68	-2.62

Test mode: 802.11 b Frequency: Channel 6: 2437MHz

Freq. (MHz)	Ant.Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
	H/V	PK	AV	PK	AV	PK	AV
5310.934	V	47.29	30.15	74.00	54.00	-26.71	-23.85
10578.59	V	56.93	39.29	74.00	54.00	-17.07	-14.71
17971.40	V	68.74	50.38	74.00	54.00	-5.26	-3.62
5397.597	H	46.51	28.96	74.00	54.00	-27.49	-25.04
8311.423	H	51.37	33.87	74.00	54.00	-22.63	-20.13
17901.42	H	68.26	51.34	74.00	54.00	-5.74	-2.66

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

Freq. (MHz)	Ant.Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
	H/V	PK	AV	PK	AV	PK	AV
6103.969	V	46.88	28.73	74.00	54.00	-27.12	-25.27
10749.65	V	56.38	38.99	74.00	54.00	-17.62	-15.01
17865.23	V	67.60	51.02	74.00	54.00	-6.40	-2.98
5435.170	H	46.19	28.99	74.00	54.00	-27.81	-25.01
9876.775	H	54.03	36.84	74.00	54.00	-19.97	-17.16
17989.59	H	67.94	50.26	74.00	54.00	-6.06	-3.74

- 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 - Preamp
 - (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 have been tested, and the worst result recorded was report as below:

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

Frequency (MHz)	Polarity	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	AV(dBuV/m) (VBW=10Hz)	Limit 3m (dBuV/m)
2384.988	H	49.86	74	32.23	54
2389.668	V	49.64	74	32.26	54

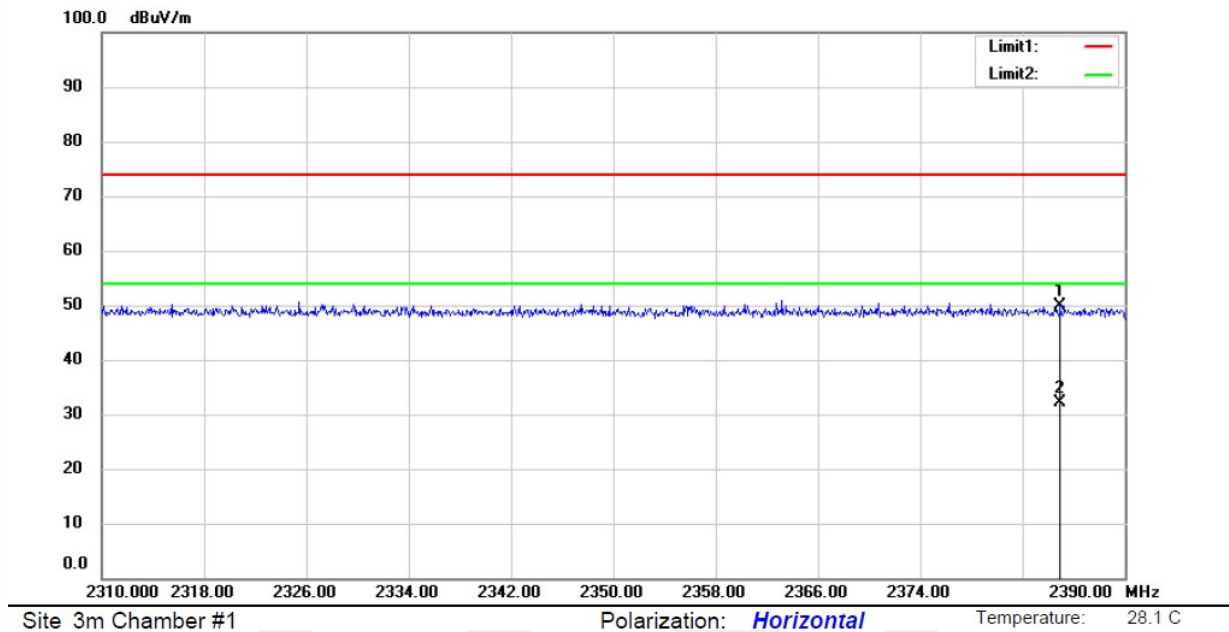
Test mode: 802.11 b Frequency: Channel 11: 2462MHz

Frequency (MHz)	Polarity	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	AV(dBuV/m) (VBW=10Hz)	Limit 3m (dBuV/m)
2483.912	H	51.32	74	33.86	54
2484.598	V	49.16	74	32.55	54

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

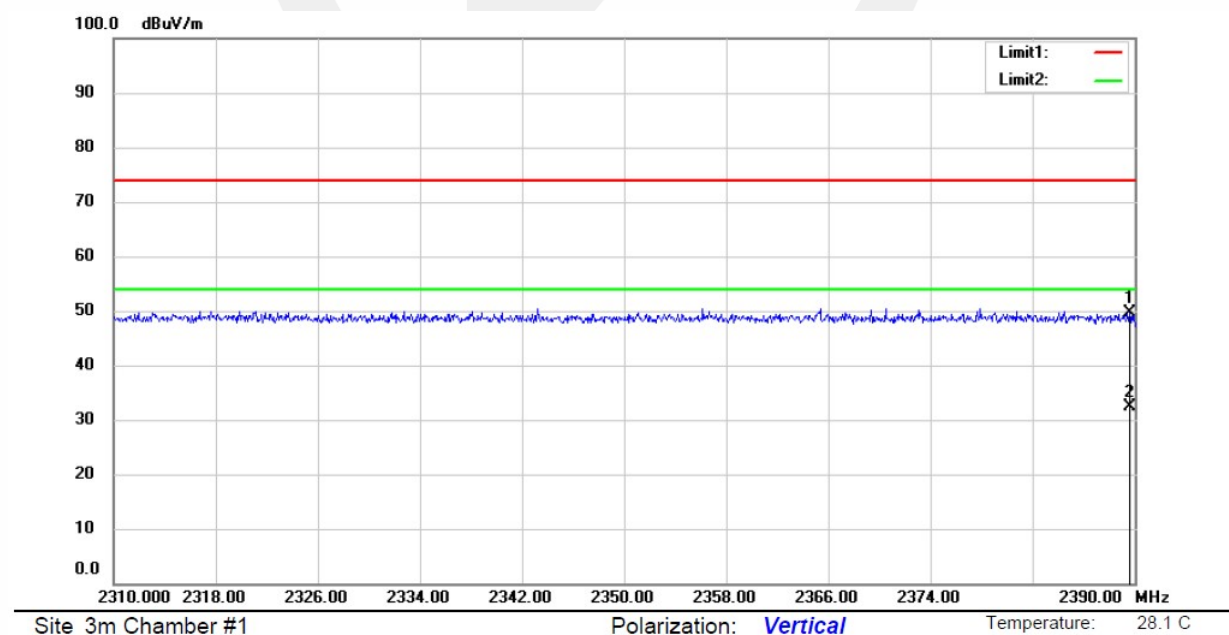
Spurious Emission in Restricted Band 2310-2390MHz

Test Model ☐ 802.11b ☐ 802.11g ☒ 802.11n(HT20) ☐ 802.11n(HT40)
☒ Channel 1:2412MHz ☐ Channel 3: 2422MHz Polarity: H
 VBW=3MHz



Spurious Emission in Restricted Band 2310-2390MHz

Test Model ☐ 802.11b ☐ 802.11g ☒ 802.11n(HT20) ☐ 802.11n(HT40)
☒ Channel 1:2412MHz ☐ Channel 3: 2422MHz Polarity: V
 VBW=3MHz

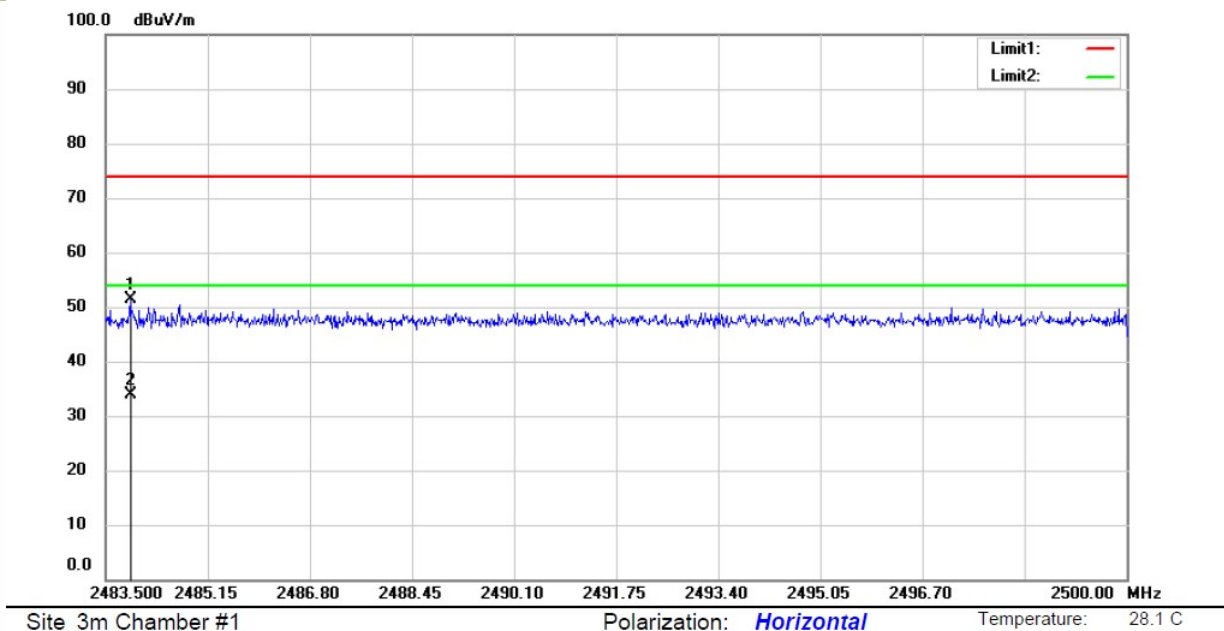


Spurious Emission in Restricted Band 2483.5-2500MHz

Test Model ☐ 802.11b ☐ 802.11g ☒ 802.11n(HT20) ☐ 802.11n(HT40)

☒ Channel 11: 2462MHz ☐ Channel 9: 2452MHz ☐ Channel 13: 2484MHz

VBW=3MHz Polarity: H

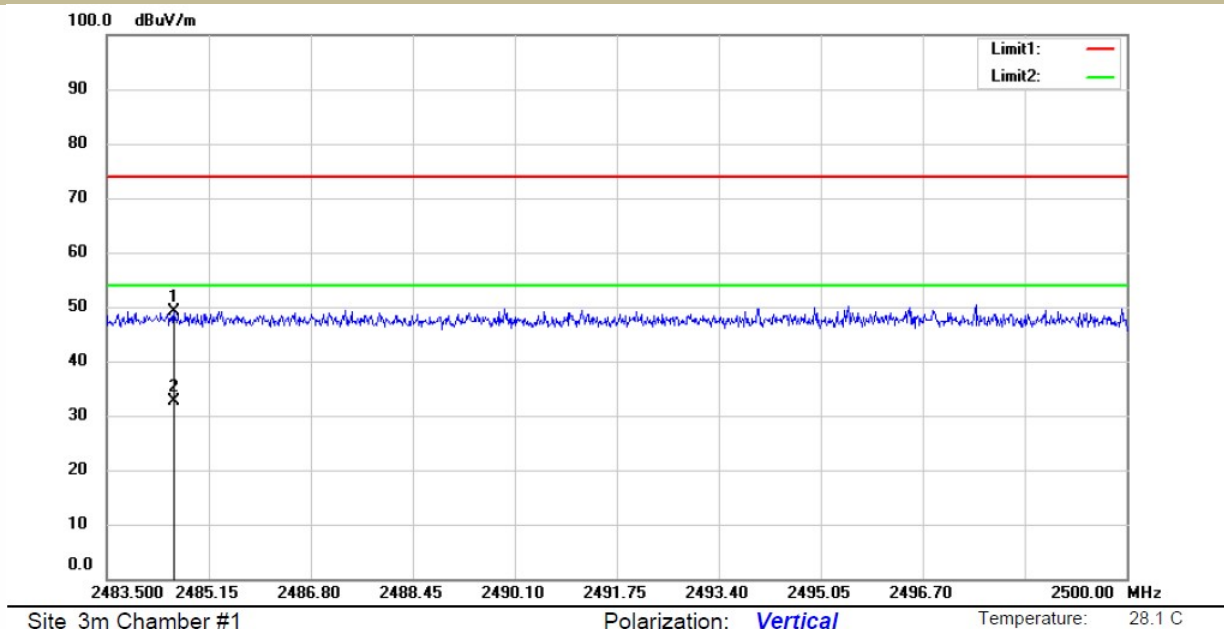


Spurious Emission in Restricted Band 2483.5-2500MHz

Test Model ☐ 802.11b ☐ 802.11g ☒ 802.11n(HT20) ☐ 802.11n(HT40)

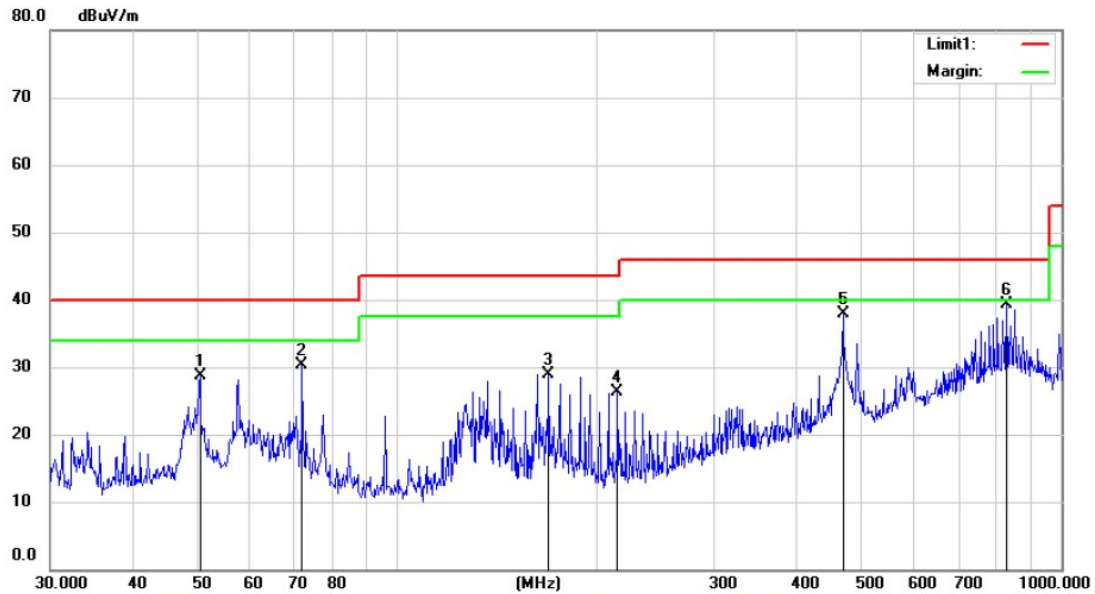
☒ Channel 11: 2462MHz ☐ Channel 9: 2452MHz ☐ Channel 13: 2484MHz

VBW=3MHz Polarity: V



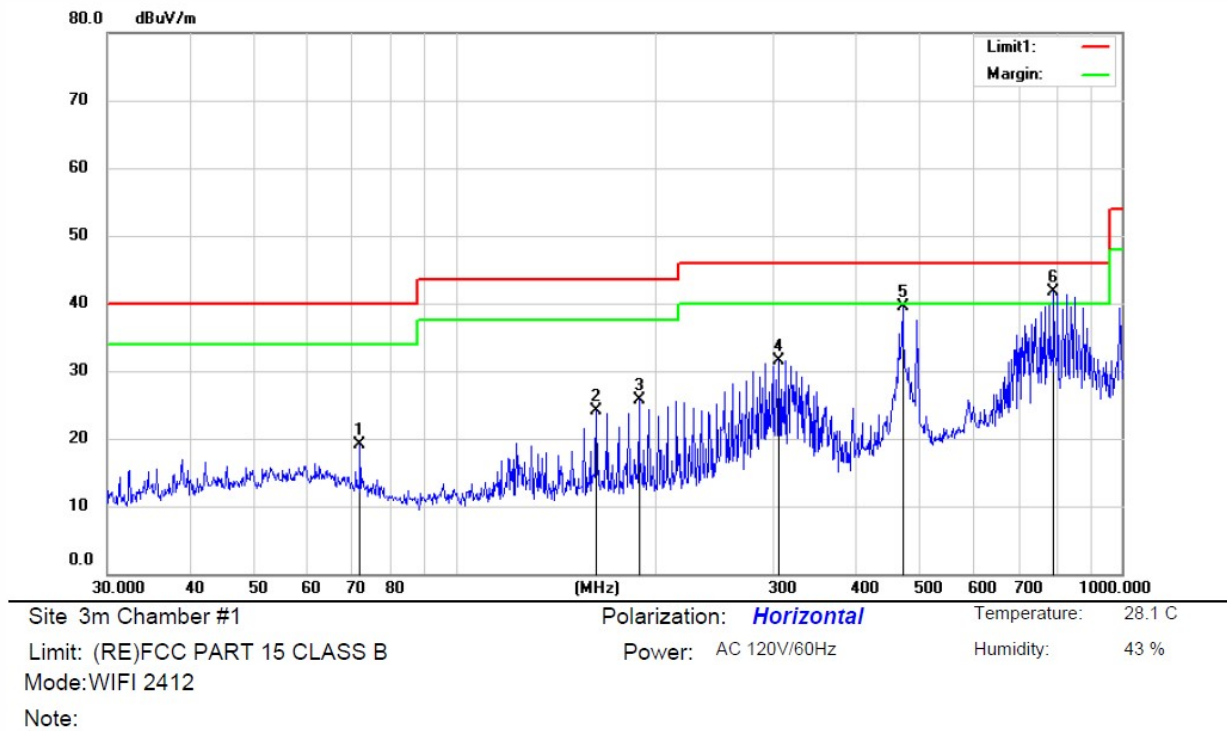
■ Spurious Emission below 1GHz (30MHz to 1GHz)

All antenna modes 2.4G 802.11b/g/n have been tested, and the worst result 802.11n20 recorded was report as below:

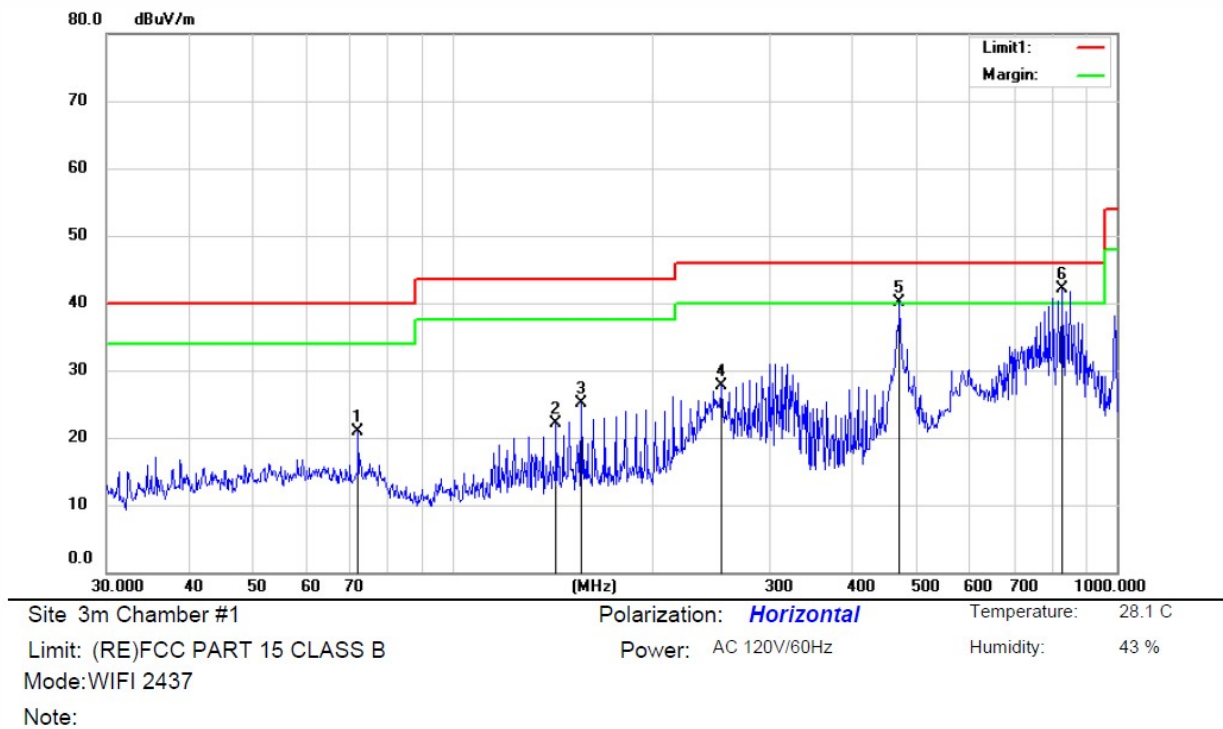


Site 3m Chamber #1 Polarization: **Vertical** Temperature: 28.1 C
Limit: (RE)FCC PART 15 CLASS B Power: AC 120V/60Hz Humidity: 43 %
Mode:WIFI 2412
Note:

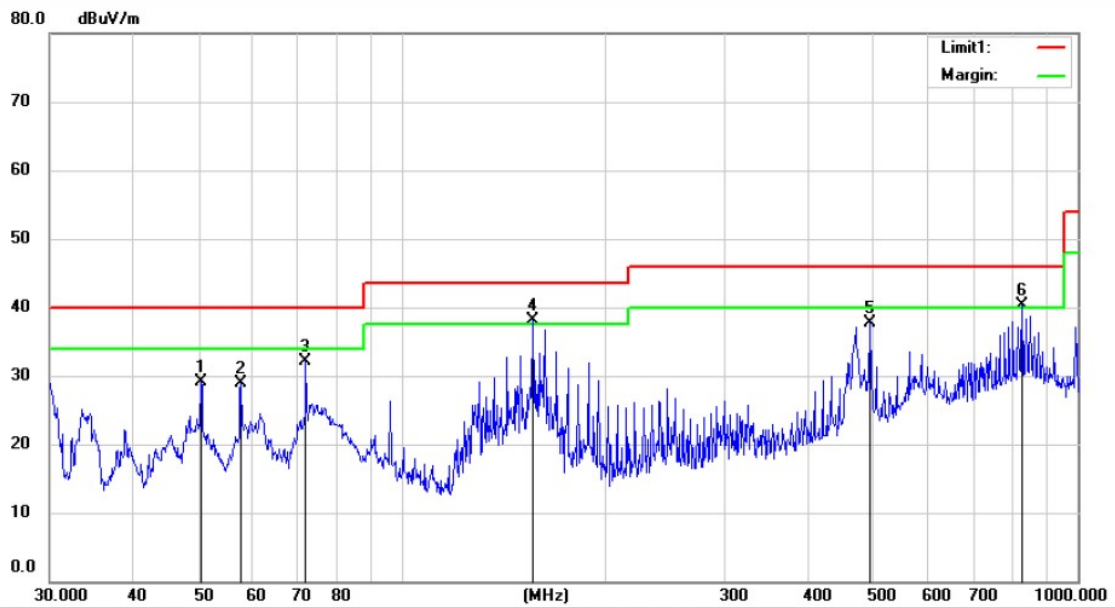
No. Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1	50.4090	40.63	-11.96	28.67	40.00	-11.33	QP		
2	71.9896	43.86	-13.57	30.29	40.00	-9.71	QP		
3	169.2277	43.00	-14.06	28.94	43.50	-14.56	QP		
4	214.7024	39.64	-13.32	26.32	43.50	-17.18	QP		
5	470.3170	43.55	-5.64	37.91	46.00	-8.09	QP		
6 *	828.2191	37.02	2.35	39.37	46.00	-6.63	QP		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		71.9896	32.66	-13.57	19.09	40.00	-20.91	QP		
2		162.6820	38.12	-14.07	24.05	43.50	-19.45	QP		
3		188.6604	39.51	-13.83	25.68	43.50	-17.82	QP		
4		305.8140	40.64	-9.10	31.54	46.00	-14.46	QP		
5		469.6990	45.08	-5.65	39.43	46.00	-6.57	QP		
6	*	792.0062	39.90	1.75	41.65	46.00	-4.35	QP		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		71.9896	34.52	-13.57	20.95	40.00	-19.05	QP		
2		143.1377	36.40	-14.29	22.11	43.50	-21.39	QP		
3		156.1153	38.92	-13.91	25.01	43.50	-18.49	QP		
4		253.8367	38.85	-11.14	27.71	46.00	-18.29	QP		
5	!	470.7295	45.70	-5.64	40.06	46.00	-5.94	QP		
6	*	828.2191	39.67	2.35	42.02	46.00	-3.98	QP		



Site 3m Chamber #1

Polarization: **Vertical**

Temperature: 28.1 C

Limit: (RE)FCC PART 15 CLASS B

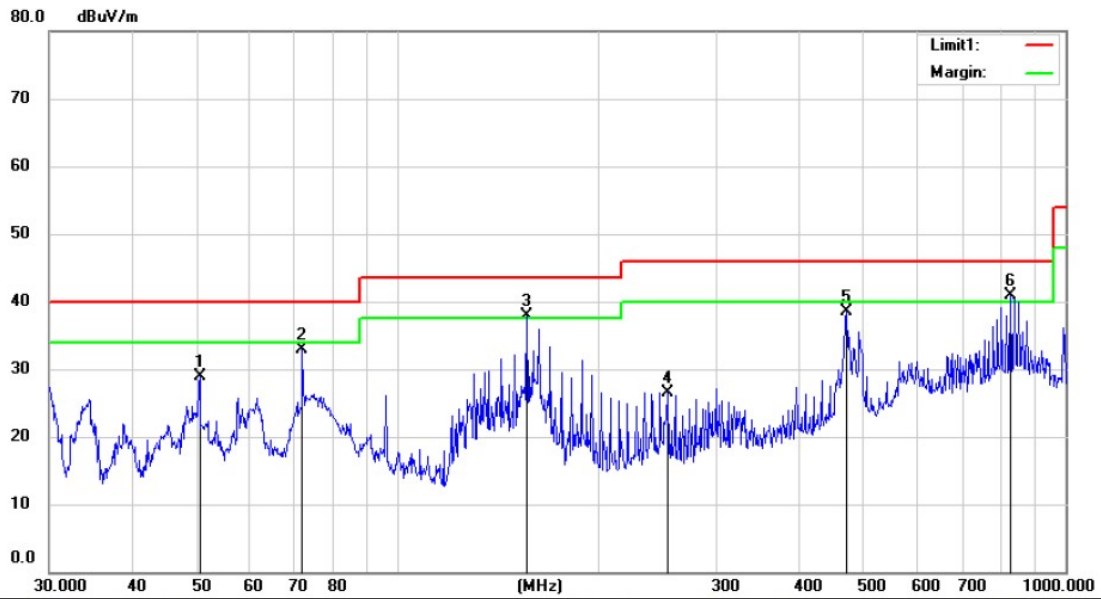
Power: AC 120V/60Hz

Humidity: 43 %

Mode:WIFI 2437

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		50.3868	41.03	-11.96	29.07	40.00	-10.93	QP		
2		57.5940	40.89	-12.08	28.81	40.00	-11.19	QP		
3		72.0211	45.66	-13.57	32.09	40.00	-7.91	QP		
4	*	156.1837	52.09	-13.91	38.18	43.50	-5.32	QP		
5		493.3327	42.98	-5.28	37.70	46.00	-8.30	QP		
6	!	828.2191	37.93	2.35	40.28	46.00	-5.72	QP		



Site 3m Chamber #1

Polarization: **Vertical**

Temperature: 28.1 C

Limit: (RE)FCC PART 15 CLASS B

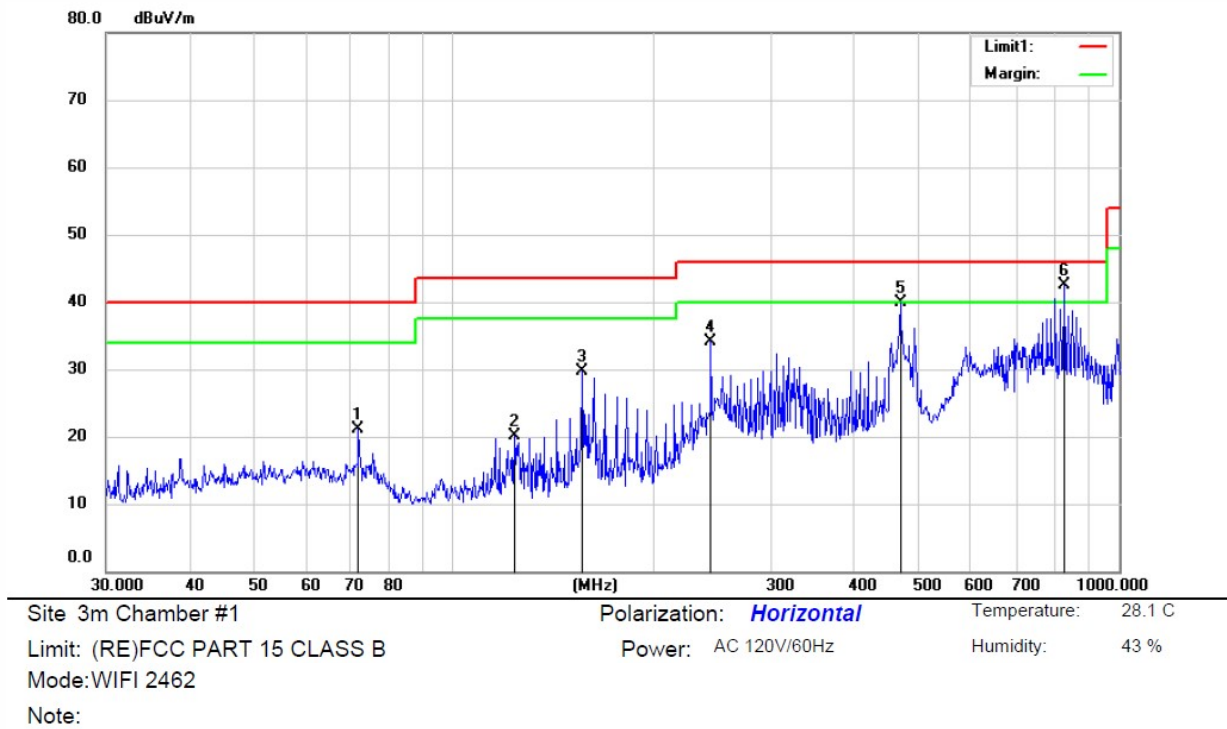
Power: AC 120V/60Hz

Humidity: 43 %

Mode:WIFI 2462

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Antenna Height	Table Degree	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	cm	degree	Comment
1		50.4090	40.91	-11.96	28.95	40.00	-11.05	QP		
2		72.0211	46.40	-13.57	32.83	40.00	-7.17	QP		
3	!	156.1837	51.85	-13.91	37.94	43.50	-5.56	QP		
4		253.7255	37.68	-11.15	26.53	46.00	-19.47	QP		
5		469.0818	44.19	-5.67	38.52	46.00	-7.48	QP		
6	*	828.2191	38.65	2.35	41.00	46.00	-5.00	QP		



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		71.9581	34.64	-13.56	21.08	40.00	-18.92	QP		
2		123.6442	34.56	-14.38	20.18	43.50	-23.32	QP		
3		156.1837	43.60	-13.91	29.69	43.50	-13.81	QP		
4		243.5906	46.17	-12.01	34.16	46.00	-11.84	QP		
5		469.2874	45.64	-5.66	39.98	46.00	-6.02	QP		
6	*	828.2191	40.06	2.35	42.41	46.00	-3.59	QP		

7.6 CONDUCTED EMISSION TEST

7.6.1 Applicable Standard

According to FCC Part 15.207(a)

7.6.2 Conformance Limit

Frequency(MHz)	Conducted Emission Limit	
	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.

7.6.3 Test Configuration

Test according to clause 6.3 conducted emission test setup

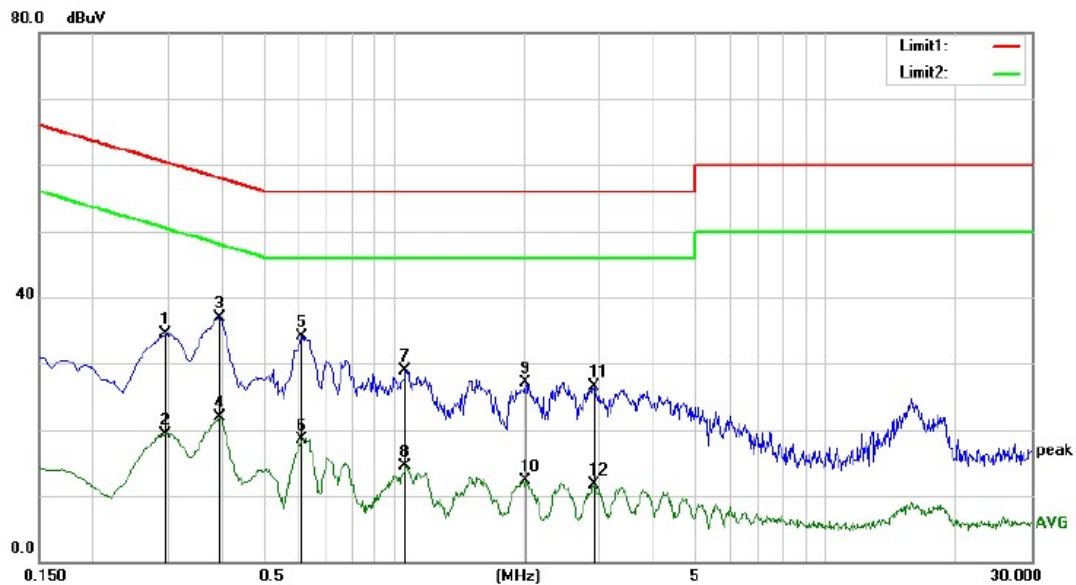
7.6.4 Test Procedure

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.

7.6.5 Test Results

Pass

The AC120V &240V voltage have been tested, and the worst result recorded was report as below:



Site Conduction #1

Phase: L1

Temperature: 22.4

Limit: (CE)FCC PART 15 class B_QP

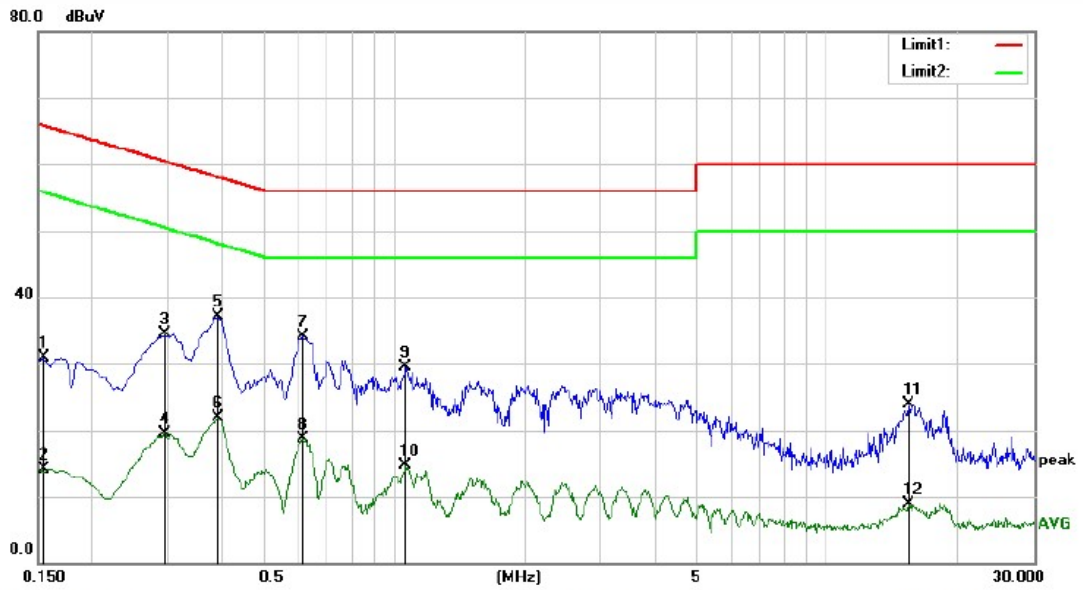
Power: AC 120V/60Hz

Humidity: 55 %

Mode: WiFi Mode

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.2950	25.22	9.30	34.52	60.38	-25.86	QP	
2		0.2950	10.09	9.30	19.39	50.38	-30.99	AVG	
3	*	0.3950	27.54	9.33	36.87	57.96	-21.09	QP	
4		0.3950	12.65	9.33	21.98	47.96	-25.98	AVG	
5		0.6100	24.76	9.27	34.03	56.00	-21.97	QP	
6		0.6100	9.33	9.27	18.60	46.00	-27.40	AVG	
7		1.0600	19.00	9.90	28.90	56.00	-27.10	QP	
8		1.0600	4.53	9.90	14.43	46.00	-31.57	AVG	
9		2.0200	17.19	9.94	27.13	56.00	-28.87	QP	
10		2.0200	2.45	9.94	12.39	46.00	-33.61	AVG	
11		2.9100	16.46	9.95	26.41	56.00	-29.59	QP	
12		2.9100	1.67	9.95	11.62	46.00	-34.38	AVG	



Site Conduction #1 Phase: **N** Temperature: 22.4
 Limit: (CE)FCC PART 15 class B_QP Power: AC 120V/60Hz Humidity: 55 %
 Mode: WiFi Mode
 Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1550	21.27	9.56	30.83	65.73	-34.90	QP	
2		0.1550	4.64	9.56	14.20	55.73	-41.53	AVG	
3		0.2950	25.28	9.30	34.58	60.38	-25.80	QP	
4		0.2950	10.17	9.30	19.47	50.38	-30.91	AVG	
5	*	0.3900	27.72	9.33	37.05	58.06	-21.01	QP	
6		0.3900	12.58	9.33	21.91	48.06	-26.15	AVG	
7		0.6150	24.76	9.27	34.03	56.00	-21.97	QP	
8		0.6150	9.44	9.27	18.71	46.00	-27.29	AVG	
9		1.0650	19.64	9.90	29.54	56.00	-26.46	QP	
10		1.0650	4.74	9.90	14.64	46.00	-31.36	AVG	
11		15.4550	13.69	10.17	23.86	60.00	-36.14	QP	
12		15.4550	-1.22	10.17	8.95	50.00	-41.05	AVG	

7.7 ANTENNA APPLICATION

7.7.1 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..

7.7.2 Result

PASS.

- The EUT has one antenna: antenna gain is 3.2 dBi;
 - ☒ 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 ***