

Conducted Spurious Emission

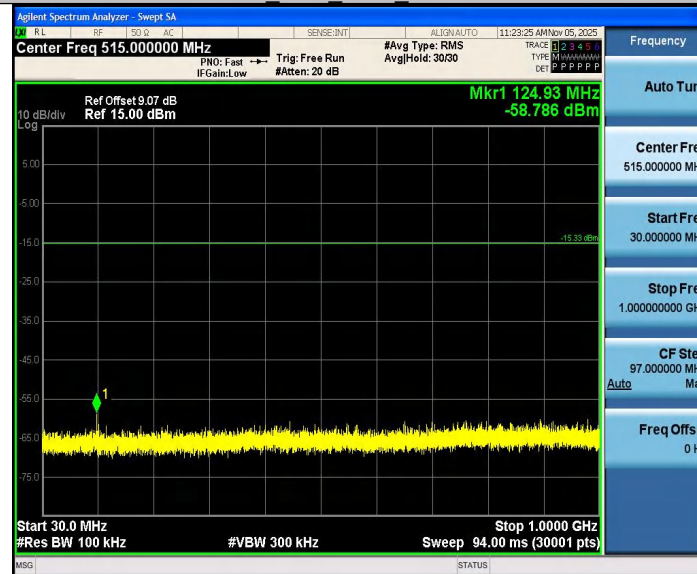
Test Result:

TestMode	Antenna	Frequency[MHz]	FreqRange [Mhz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
11B	Ant1	2412	Reference	4.67	4.67	---	PASS
			30~1000	4.67	-58.79	≤-15.33	PASS
			1000~26500	4.67	-45.43	≤-15.33	PASS
		2437	Reference	5.00	5.00	---	PASS
			30~1000	5.00	-43.51	≤-15	PASS
			1000~26500	5.00	-47.56	≤-15	PASS
		2462	Reference	3.76	3.76	---	PASS
			30~1000	3.76	-40.82	≤-16.24	PASS
			1000~26500	3.76	-47.24	≤-16.24	PASS
11G	Ant1	2412	Reference	-1.30	-1.30	---	PASS
			30~1000	-1.30	-41.61	≤-21.3	PASS
			1000~26500	-1.30	-47.6	≤-21.3	PASS
		2437	Reference	-1.43	-1.43	---	PASS
			30~1000	-1.43	-57.53	≤-21.43	PASS
			1000~26500	-1.43	-46.97	≤-21.43	PASS
		2462	Reference	-0.58	-0.58	---	PASS
			30~1000	-0.58	-45.99	≤-20.58	PASS
			1000~26500	-0.58	-47.62	≤-20.58	PASS
11N20SISO	Ant1	2412	Reference	-3.38	-3.38	---	PASS
			30~1000	-3.38	-44.99	≤-23.38	PASS
			1000~26500	-3.38	-45.25	≤-23.38	PASS
		2437	Reference	0.62	0.62	---	PASS
			30~1000	0.62	-53.37	≤-19.38	PASS
			1000~26500	0.62	-47.65	≤-19.38	PASS
		2462	Reference	-2.50	-2.50	---	PASS
			30~1000	-2.50	-32.85	≤-22.5	PASS
			1000~26500	-2.50	-46.85	≤-22.5	PASS
11N40SISO	Ant1	2422	Reference	-2.73	-2.73	---	PASS
			30~1000	-2.73	-40.3	≤-22.73	PASS
			1000~26500	-2.73	-47.42	≤-22.73	PASS
		2437	Reference	-2.87	-2.87	---	PASS
			30~1000	-2.87	-57.58	≤-22.87	PASS
			1000~26500	-2.87	-47.99	≤-22.87	PASS
		2452	Reference	-6.42	-6.42	---	PASS
			30~1000	-6.42	-57.72	≤-26.42	PASS
			1000~26500	-6.42	-47.47	≤-26.42	PASS

11B_Ant1_2412_0~Reference



11B_Ant1_2412_30~1000



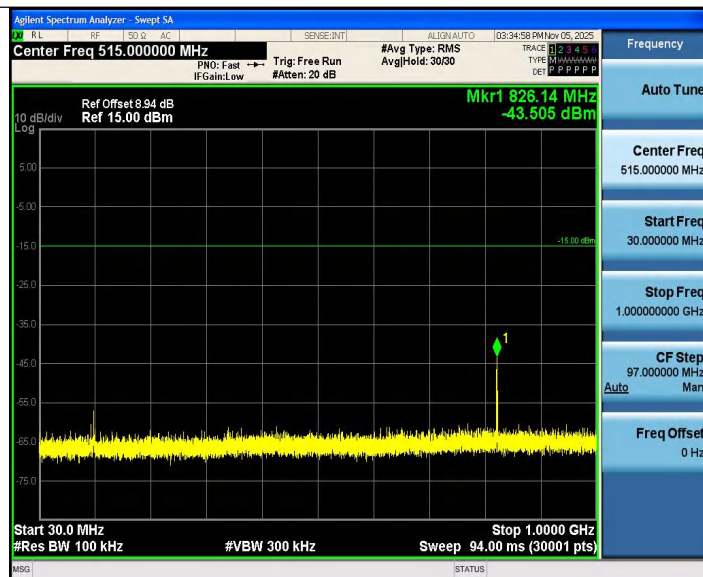
11B_Ant1_2412_1000~26500



11B_Ant1_2437_0~Reference



11B_Ant1_2437_30~1000



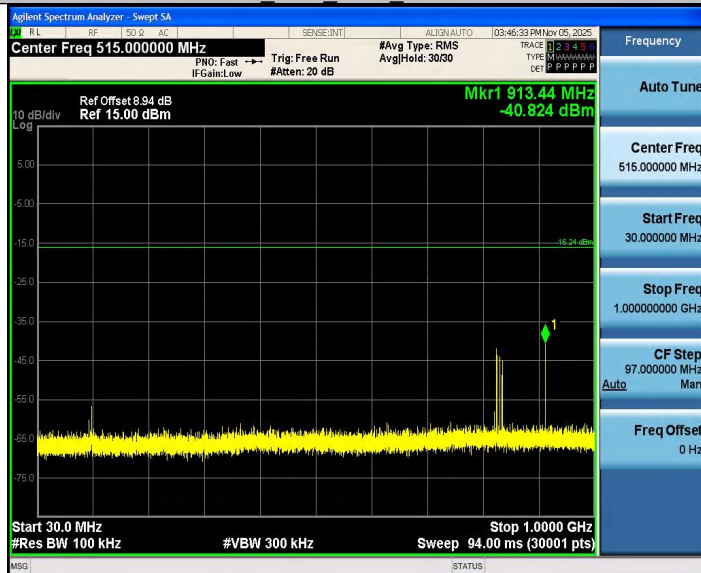
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11B_Ant1_2462_0~Reference



11B_Ant1_2462_30~1000



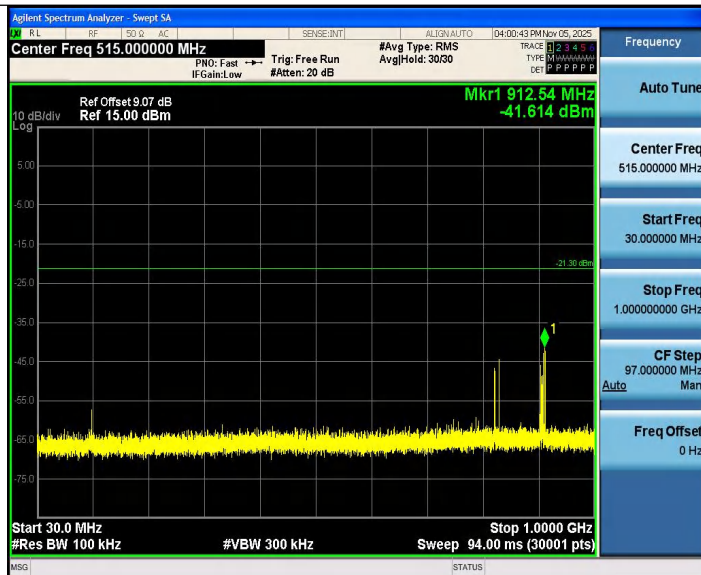
11B_Ant1_2462_1000~26500



11G_Ant1_2412_0~Reference



11G_Ant1_2412_30~1000



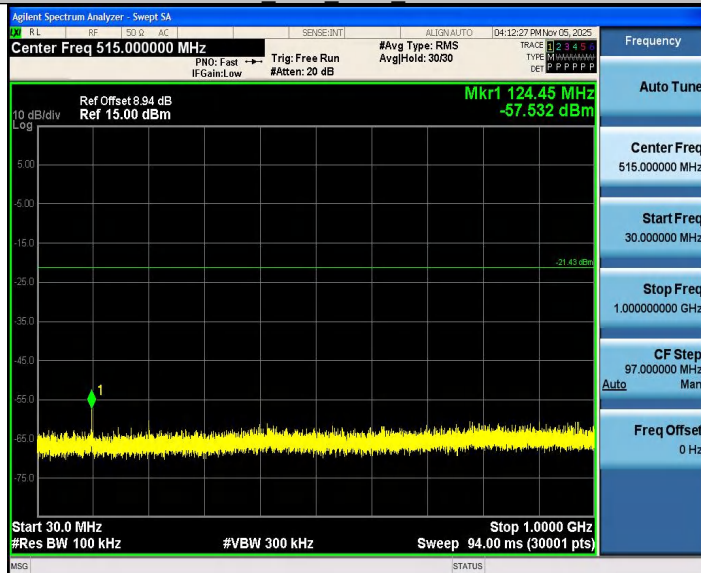
11G_Ant1_2412_1000~26500



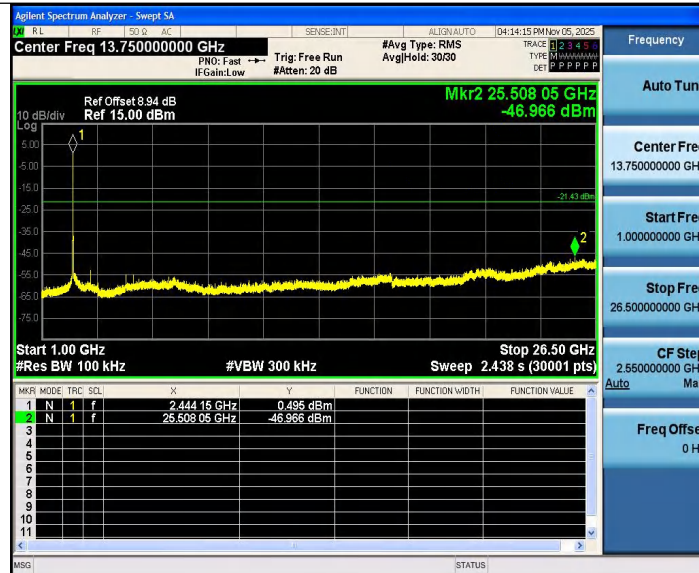
11G_Ant1_2437_0~Reference



11G_Ant1_2437_30~1000



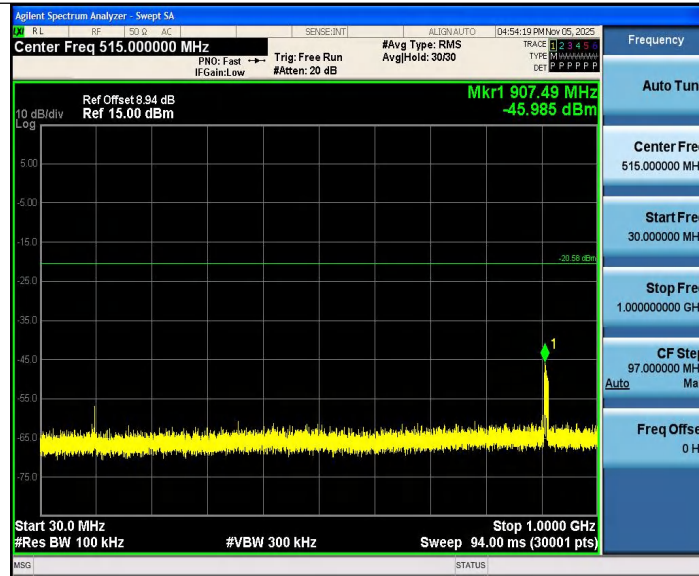
11G_Ant1_2437_1000~26500



11G_Ant1_2462_0~Reference



11G_Ant1_2462_30~1000



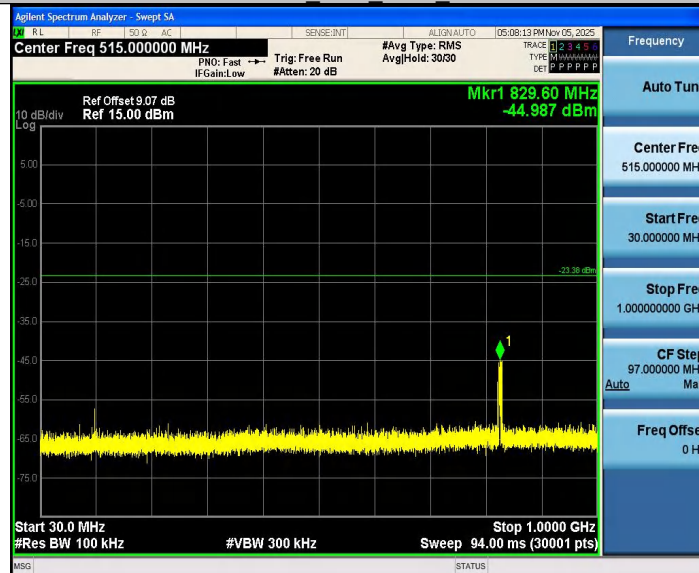
11G_Ant1_2462_1000~26500



11N20SISO_Ant1_2412_0~Reference



11N20SISO_Ant1_2412_30~1000



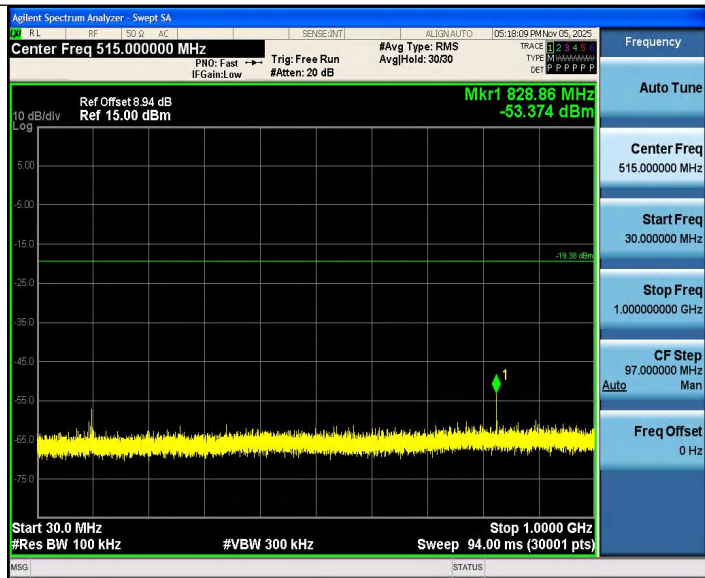
11N20SISO_Ant1_2412_1000~26500



11N20SISO_Ant1_2437_0~Reference



11N20SISO_Ant1_2437_30~1000



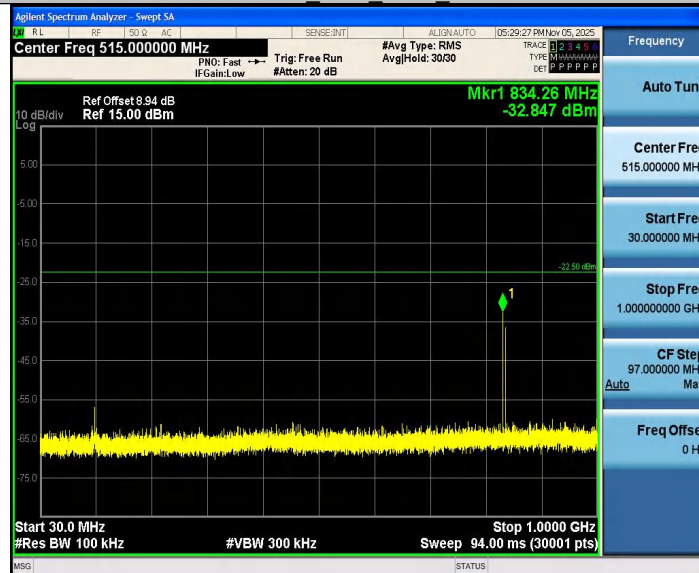
11N20SISO_Ant1_2437_1000~26500



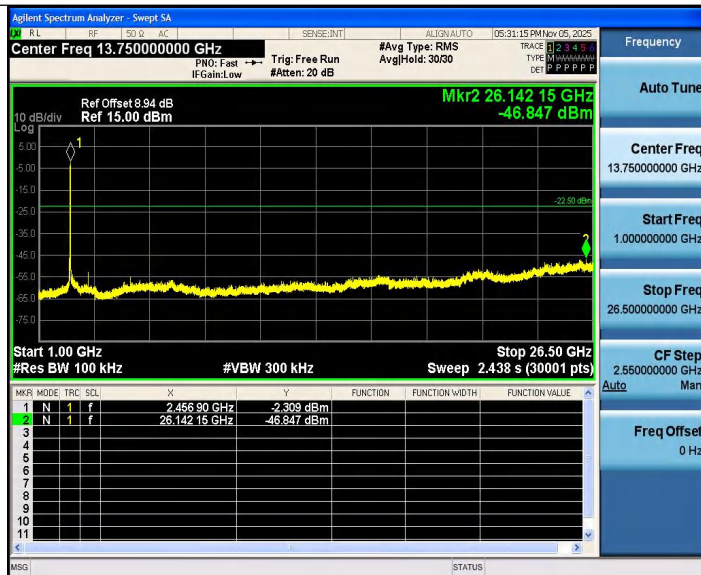
11N20SISO_Ant1_2462_0~Reference



11N20SISO_Ant1_2462_30~1000



11N20SISO_Ant1_2462_1000~26500



11N40SISO_Ant1_2422_0~Reference



11N40SISO_Ant1_2422_30~1000



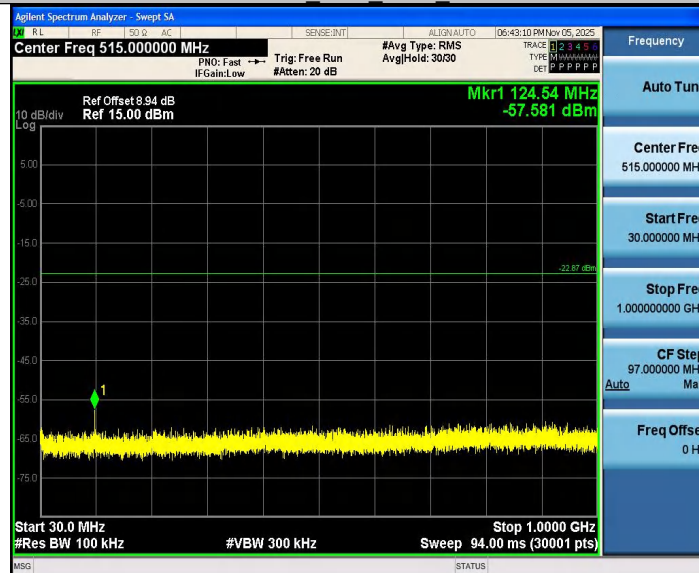
11N40SISO_Ant1_2422_1000~26500



11N40SISO_Ant1_2437_0~Reference



11N40SISO_Ant1_2437_30~1000



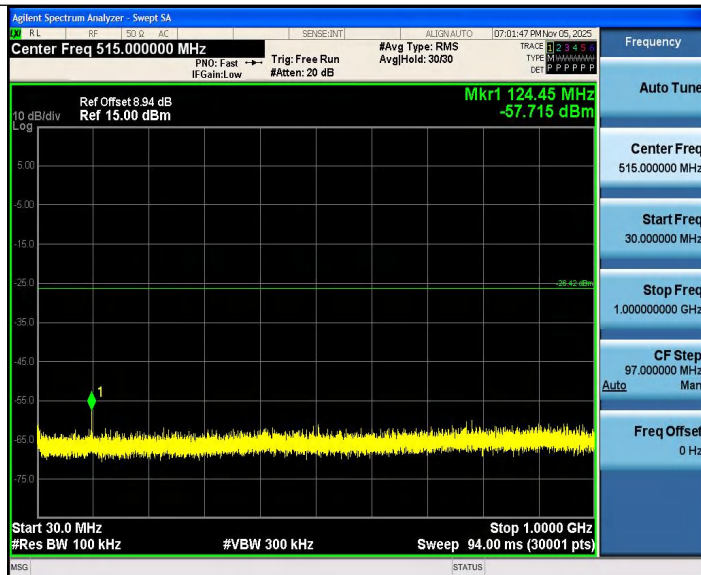
11N40SISO_Ant1_2437_1000~26500



11N40SISO_Ant1_2452_0~Reference



11N40SISO_Ant1_2452_30~1000



11N40SISO Ant1 2452 1000~26500



4.5. RADIATED SPURIOUS EMISSION

4.5.1. Applicable Standard

According to FCC Part 15.247(d) and 15.209 and KDB 558074 D01
15.247 MEAS GUIDANCE v05r02

4.5.2. 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 (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

4.5.3. Test Configuration

Test according to clause 3.2 radio frequency test setup 2

4.5.4. 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 $\geq$ 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

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 C63.10-2020 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.

Test Results:

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

Frequency	Factor	Meter Reading	Emission Level	Limits	Margin	Detector Type	Ant. Pol.
(MHz)	(dB)	(dBμV)	(dBμV/m)	(dBμV/m)	(dB)		H/V
--	--	--	--	--	--	--	--

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

Test mode:	802.11B		Frequency:	Channel 1: 2412MHz		Test Voltage:	DC 7.4V
Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
3414	48.18	-3.56	44.62	74	-29.38	peak	V
4825	44.56	-3.29	41.27	74	-32.73	peak	V
7120	40.39	2.74	43.13	74	-30.87	peak	V
3431	33.86	-3.53	30.33	54	-23.67	AVG	V
4842	33.81	-3.31	30.5	54	-23.5	AVG	V
7103	30.26	2.74	33	54	-21	AVG	V
4825	45.59	-3.29	42.3	74	-31.7	peak	H
7086	40.52	2.76	43.28	74	-30.72	peak	H
9313	43.36	4.17	47.53	74	-26.47	peak	H
4842	34.71	-3.31	31.4	54	-22.6	AVG	H
7103	30.12	2.74	32.86	54	-21.14	AVG	H
9653	30.82	4.31	35.13	54	-18.87	AVG	H

Test mode:	802.11B		Frequency:	Channel 6: 2437MHz		Test Voltage:	DC 7.4V
Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
3414	46.13	-3.56	42.57	74	-31.43	peak	V
4876	45.86	-3.34	42.52	74	-31.48	peak	V
7086	41.14	2.76	43.9	74	-30.1	peak	V
3431	31.97	-3.53	28.44	54	-25.56	AVG	V
4893	33.62	-3.34	30.28	54	-23.72	AVG	V
7103	30.18	2.74	32.92	54	-21.08	AVG	V
1782	58.08	-7.93	50.15	74	-23.85	peak	H
4876	44.07	-3.34	40.73	74	-33.27	peak	H
7103	40.61	2.74	43.35	74	-30.65	peak	H
1799	42.5	-7.91	34.59	54	-19.41	AVG	H
4893	33.16	-3.34	29.82	54	-24.18	AVG	H
7103	30.09	2.74	32.83	54	-21.17	AVG	H

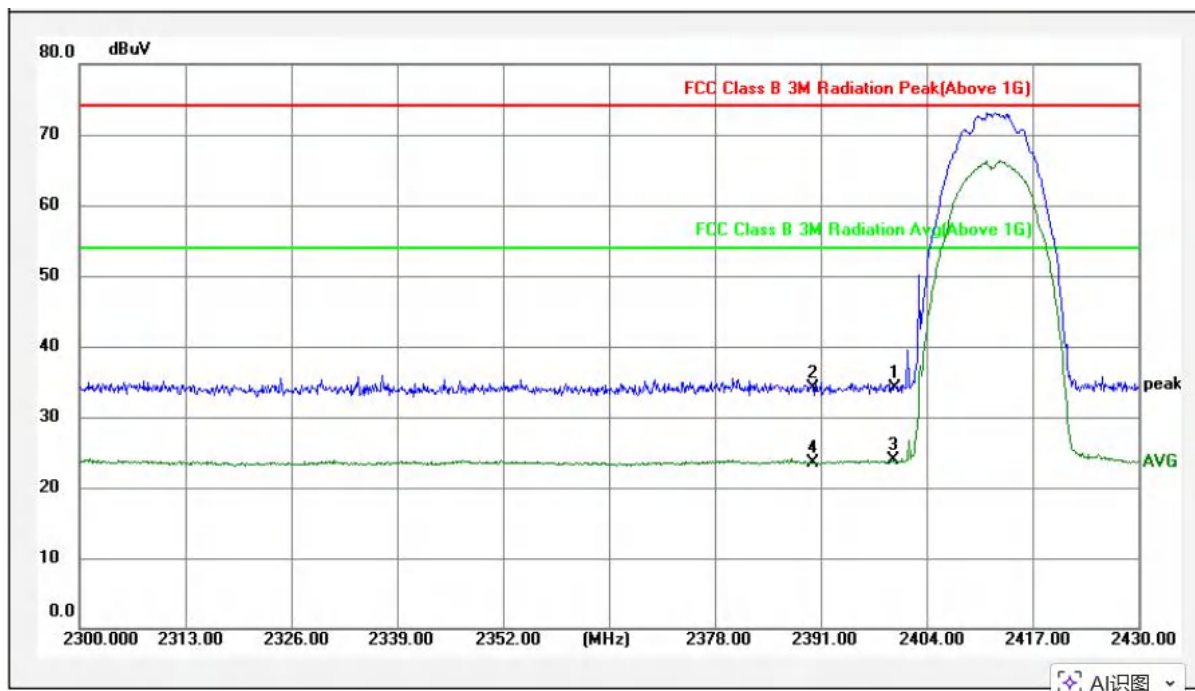
Test mode:		802.11B	Frequency:	Channel 11: 2462MHz		Test Voltage:	DC 7.4V
Frequency	Meter Reading	Factor	Emission Level	Limits	Margin	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
3414	47.87	-3.56	44.31	74	-29.69	peak	V
6049	41.08	0.13	41.21	74	-32.79	peak	V
7698	42.08	2.35	44.43	74	-29.57	peak	V
3431	33.66	-3.53	30.13	54	-23.87	AVG	V
6253	29.08	0.72	29.8	54	-24.2	AVG	V
8208	30.36	2.49	32.85	54	-21.15	AVG	V
1765	66.49	-7.95	58.54	74	-15.46	peak	H
3958	40.78	-2.75	38.03	74	-35.97	peak	H
7120	40.9	2.74	43.64	74	-30.36	peak	H
1782	52.2	-7.93	44.27	54	-9.73	AVG	H
3924	28.75	-2.8	25.95	54	-28.05	AVG	H
7103	30.13	2.74	32.87	54	-21.13	AVG	H

Note: (1) All Readings are Peak Value (VBW=3MHz) and Peak Value (VBW=10Hz).
(2) Emission Level= Reading Level+Probe Factor +Cable Loss.
(3) 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 or the field strength is too small to be measured.

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

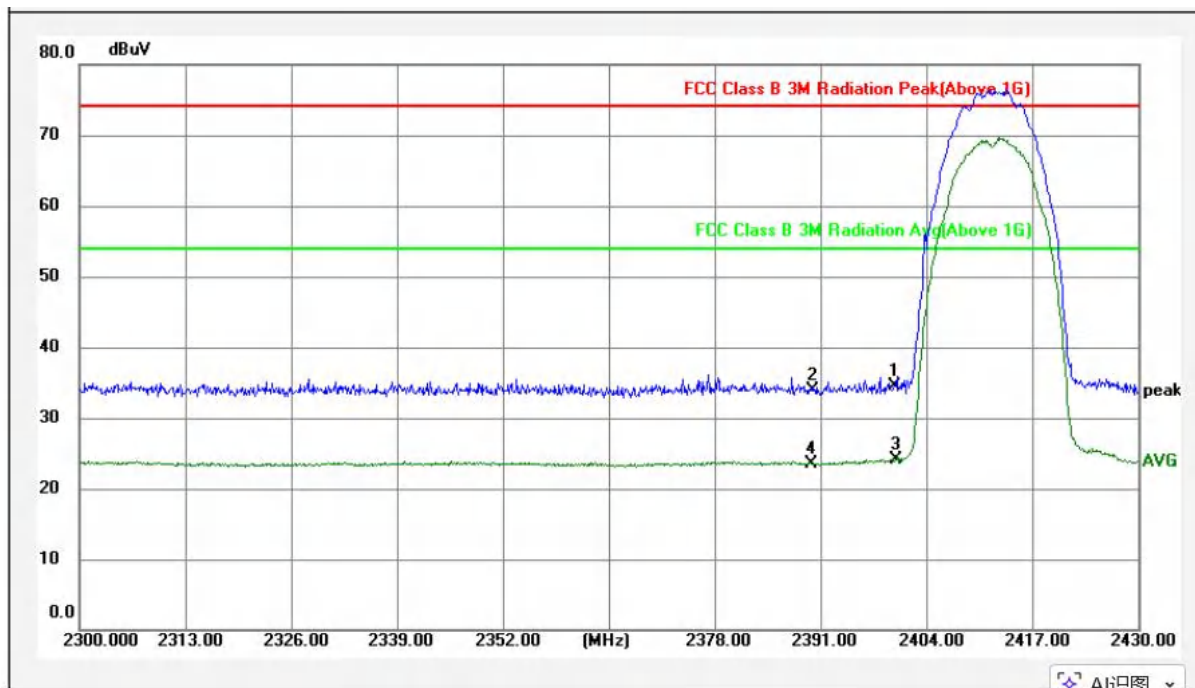
All modes 2.4G 802.11b/g/n have been tested, and the worst result recorded was report as below:

Test Mode:	802.11B	2412MHz	Test Channel	Lowest
Temperature:	23.7℃		Phase:	Vertical
Relative Humidity:	52%		Pressure:	102.6KPa



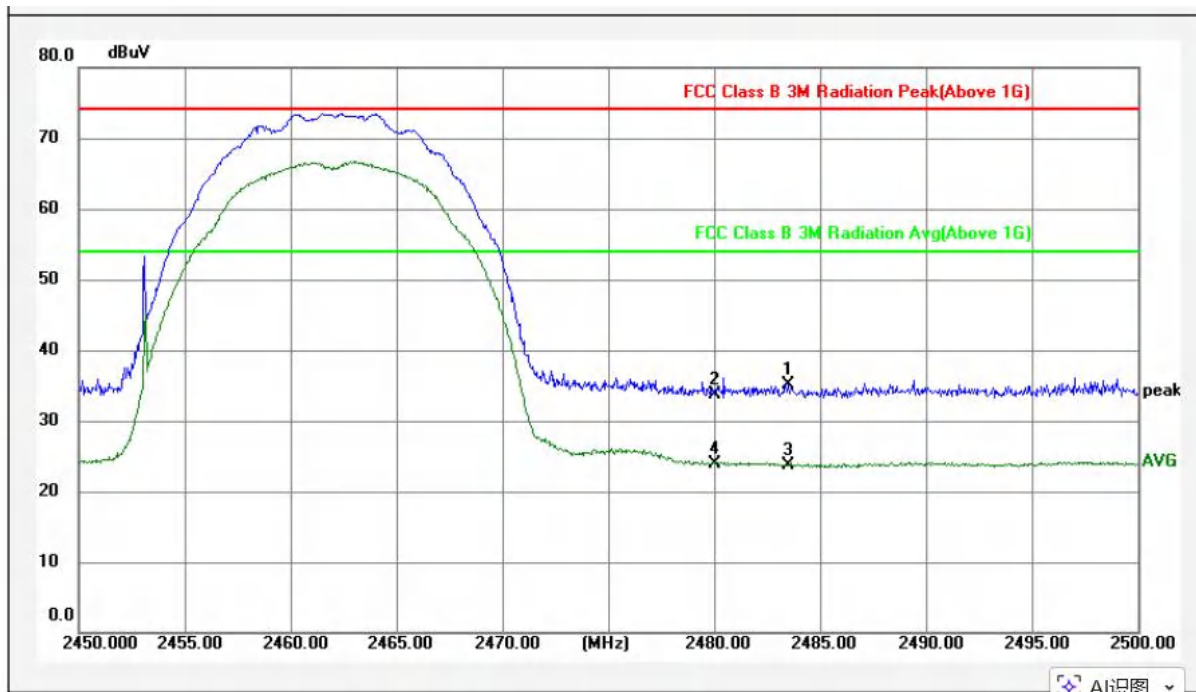
No.	Frequency (MHz)	Factor (dBuV)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	MK.	Remark
1	2400.000	-6.29	40.49	34.20	74.00	-39.80	peak		
2	2390.000	-6.33	40.38	34.05	74.00	-39.95	peak		
3	2399.970	-6.29	30.18	23.89	54.00	-30.11	AVG	*	
4	2389.960	-6.33	29.80	23.47	54.00	-30.53	AVG		

Test Mode:	802.11B	2412MHz	Test Channel	Lowest
Temperature:	23.7℃		Phase:	Horizontal
Relative Humidity:	52%		Pressure:	102.6KPa



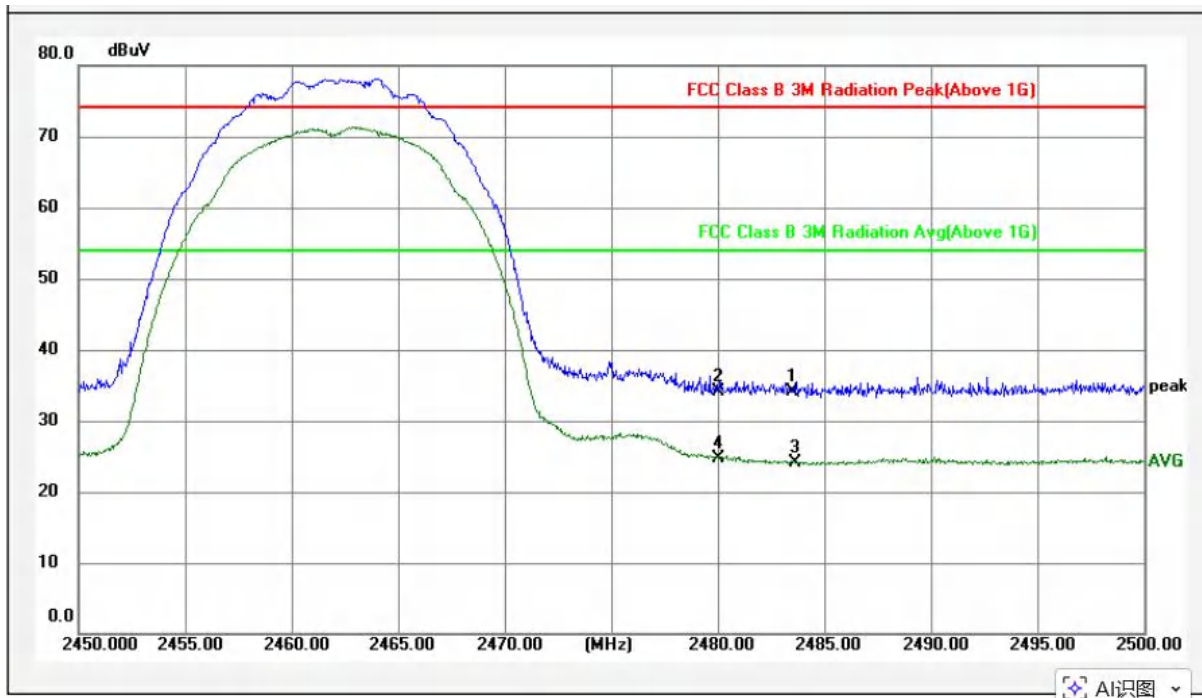
No.	Frequency (MHz)	Factor (dBuV)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	MK.	Remark
1	2400.000	-6.29	40.85	34.56	74.00	-39.44	peak		
2	2390.000	-6.33	40.14	33.81	74.00	-40.19	peak		
3	2400.230	-6.29	30.42	24.13	54.00	-29.87	AVG	*	
4	2389.830	-6.33	29.88	23.55	54.00	-30.45	AVG		

Test Mode:	802.11B	2462MHz	Test Channel	Highest
Temperature:	23.7℃		Phase:	Vertical
Relative Humidity:	52%		Pressure:	102.6KPa



No.	Frequency (MHz)	Factor (dBuV)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	MK.	Remark
1	2483.500	-5.99	41.05	35.06	74.00	-38.94	peak		
2	2480.000	-6.01	39.77	33.76	74.00	-40.24	peak		
3	2483.500	-5.99	29.60	23.61	54.00	-30.39	AVG		
4	2480.000	-6.01	29.98	23.97	54.00	-30.03	AVG	*	

Test Mode:	802.11B	2462MHz	Test Channel	Highest
Temperature:	23.7℃		Phase:	Horizontal
Relative Humidity:	52%		Pressure:	102.6KPa



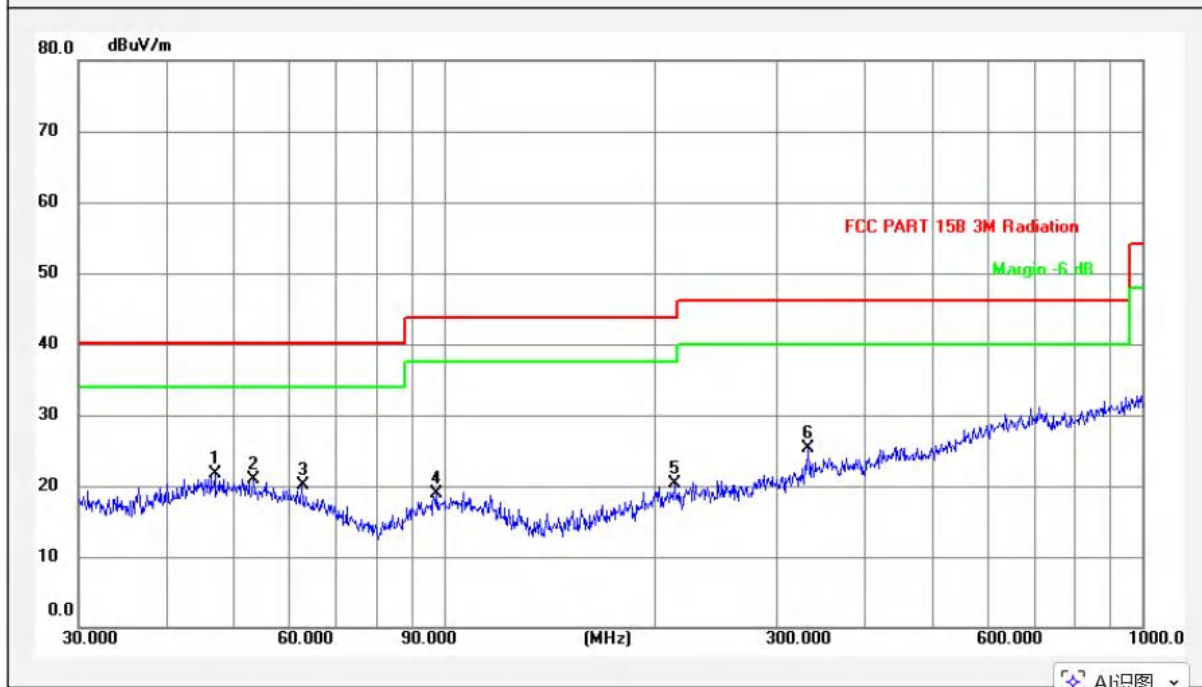
No.	Frequency (MHz)	Factor (dBuV)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	MK.	Remark
1	2483.500	-5.99	40.14	34.15	74.00	-39.85	peak		
2	2480.000	-6.01	40.09	34.08	74.00	-39.92	peak		
3	2483.600	-5.99	30.06	24.07	54.00	-29.93	AVG		
4	2480.000	-6.01	30.63	24.62	54.00	-29.38	AVG	*	

- 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 below 1GHz (30MHz to 1GHz)

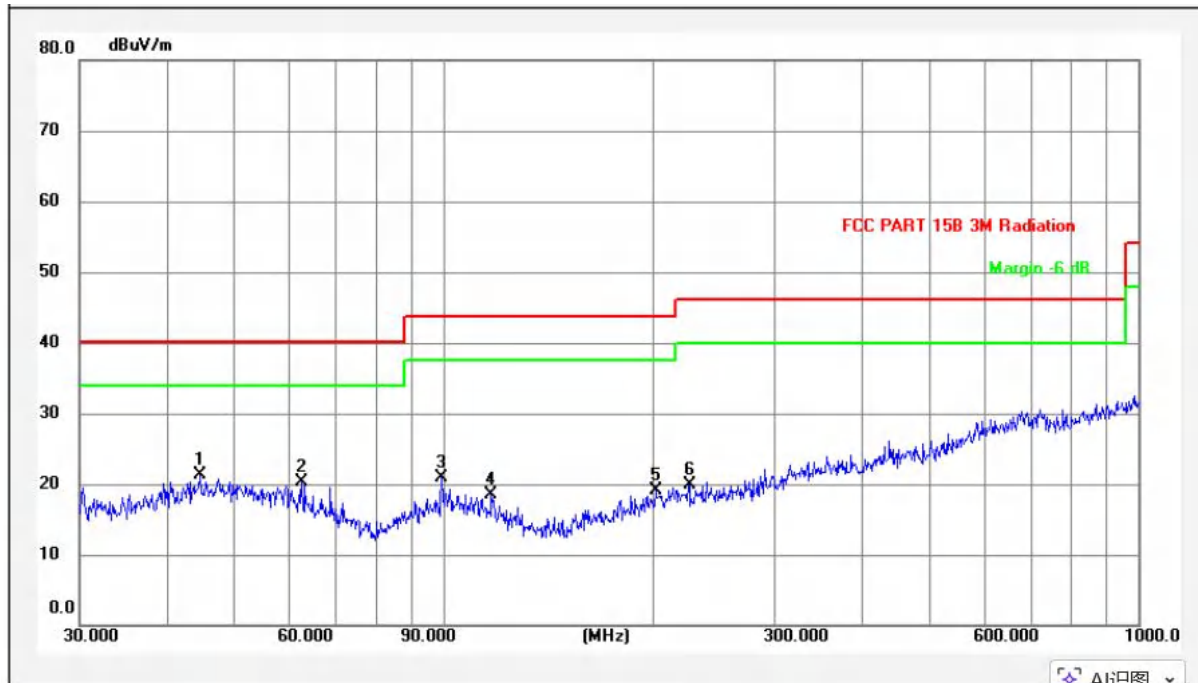
All antenna modes 2.4G 802.11b/g/n have been tested, and the worst result 802.11B recorded was report as below:

Test Mode:	802.11B	2412MHz	Test Voltage:	DC 7.4V
Temperature:	24.2℃		Phase:	Vertical
Relative Humidity:	57%		Pressure:	101.3KPa



No.	Frequency (MHz)	Factor (dBuV/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	MK.	Remark
1	46.9948	12.62	9.12	21.74	40.00	-18.26	QP	*	
2	53.5052	12.04	8.77	20.81	40.00	-19.19	QP		
3	62.6507	10.74	9.35	20.09	40.00	-19.91	QP		
4	97.7983	10.18	8.64	18.82	43.50	-24.68	QP		
5	213.7634	10.91	9.43	20.34	43.50	-23.16	QP		
6	332.5187	13.81	11.42	25.23	46.00	-20.77	QP		

Test Mode:	802.11B	2412MHz	Test Voltage:	DC 7.4V
Temperature:	24.2℃		Phase:	Horizontal
Relative Humidity:	57%		Pressure:	101.3KPa



No.	Frequency (MHz)	Factor (dBuV/m)	Reading (dBuV)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	MK.	Remark
1	44.7433	12.70	8.64	21.34	40.00	-18.66	QP	*	
2	62.6506	10.74	9.60	20.34	40.00	-19.66	QP		
3	99.5281	10.51	10.45	20.96	43.50	-22.54	QP		
4	117.3602	9.47	9.08	18.55	43.50	-24.95	QP		
5	202.1004	10.82	8.37	19.19	43.50	-24.31	QP		
6	226.0994	11.01	8.91	19.92	46.00	-26.08	QP		

4.6. CONDUCTED EMISSION TEST

4.6.1. Applicable Standard

According to FCC Part 15.207(a)

4.6.2. 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.		

Remark: Test results were obtained from the following equation:

Measurement (dBμV) = LISN Factor (dB) + Cable Loss (dB) + Reading (dBμV)

Margin (dB) = Measurement (dBμV) - Limit (dBμV)

4.6.3. Test Configuration

Test according to clause 3.3 conducted emission test setup

4.6.4. Test Procedure

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

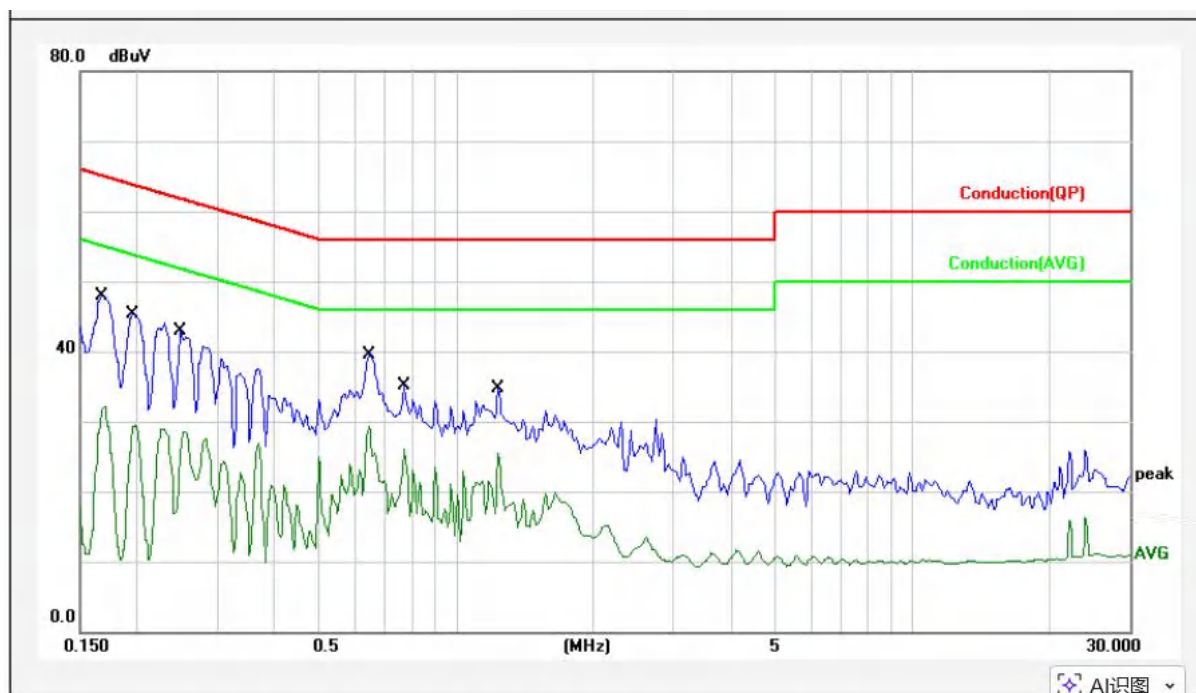
Maximum procedure was performed on the highest emissions to ensure EUT compliance.

Repeat above procedures until all frequency measured were complete.

Test Results :

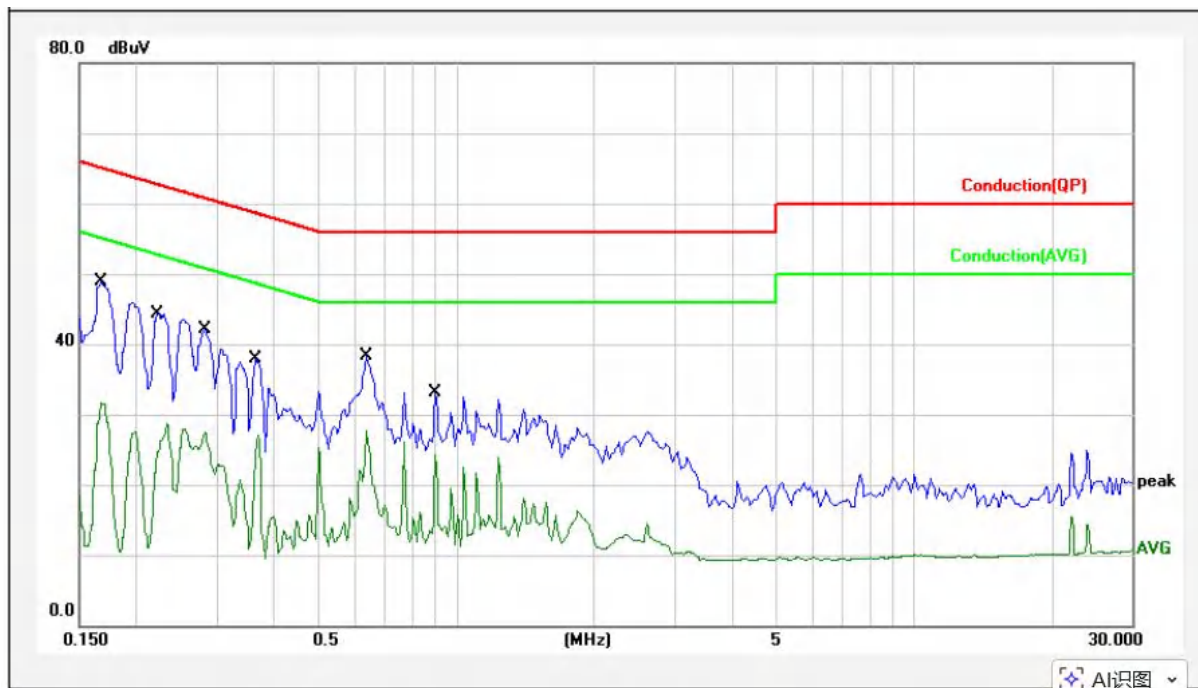
All antenna modes 2.4G 802.11b/g/n have been tested, and the worst result 802.11B recorded was report as below:

Test Mode:	802.11B	2412MHz	Test Voltage:	AC 120V/60Hz
Temperature:	24.1℃		Phase:	L1
Relative Humidity:	51%		Pressure:	101.5KPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1675	10.18	37.82	48.00	65.08	-17.08	QP	P	
2	0.1675	10.18	21.93	32.11	55.08	-22.97	AVG	P	
3	0.1963	10.19	35.18	45.37	63.77	-18.40	QP	P	
4	0.1963	10.19	19.27	29.46	53.77	-24.31	AVG	P	
5	0.2492	10.21	32.60	42.81	61.78	-18.97	QP	P	
6	0.2492	10.21	18.36	28.57	51.78	-23.21	AVG	P	
7	0.6461	10.34	29.26	39.60	56.00	-16.40	QP	P	
8	0.6461	10.34	18.89	29.23	46.00	-16.77	AVG	P	
9	0.7691	10.38	24.68	35.06	56.00	-20.94	QP	P	
10	0.7691	10.38	15.29	25.67	46.00	-20.33	AVG	P	
11	1.2384	10.47	24.24	34.71	56.00	-21.29	QP	P	
12	1.2384	10.47	15.01	25.48	46.00	-20.52	AVG	P	

Test Mode:	802.11B	2412MHz	Test Voltage:	AC 120V/60Hz
Temperature:	24.1℃		Phase:	N
Relative Humidity:	51%		Pressure:	101.5KPa



No.	Frequency (MHz)	Factor (dB)	Reading (dBuV)	Level (dBuV)	Limit (dBuV)	Margin (dB)	Detector	P/F	Remark
1	0.1675	10.23	38.60	48.83	65.08	-16.25	QP	P	
2	0.1675	10.23	21.37	31.60	55.08	-23.48	AVG	P	
3	0.2230	10.24	34.02	44.26	62.71	-18.45	QP	P	
4	0.2230	10.24	18.43	28.67	52.71	-24.04	AVG	P	
5	0.2830	10.26	31.78	42.04	60.73	-18.69	QP	P	
6	0.2830	10.26	17.20	27.46	50.73	-23.27	AVG	P	
7	0.3648	10.29	27.66	37.95	58.62	-20.67	QP	P	
8	0.3648	10.29	16.89	27.18	48.62	-21.44	AVG	P	
9	0.6360	10.35	28.00	38.35	56.00	-17.65	QP	P	
10	0.6360	10.35	17.36	27.71	46.00	-18.29	AVG	P	
11	0.9016	10.43	22.66	33.09	56.00	-22.91	QP	P	
12	0.9016	10.43	13.84	24.27	46.00	-21.73	AVG	P	

4.7. ANTENNA APPLICATION

4.7.1. Antenna Requirement

Standard	Requirement
FCC CRF Part 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. 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.

4.7.2. Result

PASS.

The EUT has 1 antenna: an PCB Antenna for WIFI 2.4G, antenna has a gain of 2.47dBi;

Note:which in accordance to section 15.203, please refer to the internal photos.

----- END OF REPORT -----