

7.4 UNWANTED SPURIOUS EMISSIONS

7.4.1 Applicable Standard

According to FCC Part15.247(d) and KDB 558074 D01 15.247 Meas Guidance v05r02

7.4.2 Conformance Limit

According to FCC Part 15.247(d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

7.4.3 Test Configuration

Test according to clause 6.1 radio frequency test setup

7.4.4 Test Procedure

The transmitter output (antenna port) was connected to the spectrum analyzer

■ Reference level measurement

Establish a reference level by using the following procedure:

Set instrument center frequency to DTS channel center frequency.

Set the span to ≥ 1.5 times the DTS bandwidth.

Set the RBW = 100 kHz.

Set the VBW $\geq 3 \times$ RBW.

Set Detector = peak.

Set Sweep time = auto couple.

Set Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum PSD level.

Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

■ Emission level measurement

Set the center frequency and span to encompass frequency range to be measured.

Set the RBW = 100 kHz.

Set the VBW = 300 kHz.

Set Detector = peak

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements. Report the three highest emissions relative to the limit.

7.4.5 Test Results

All modulation modes were tested, and the worst data is shown in the table below:

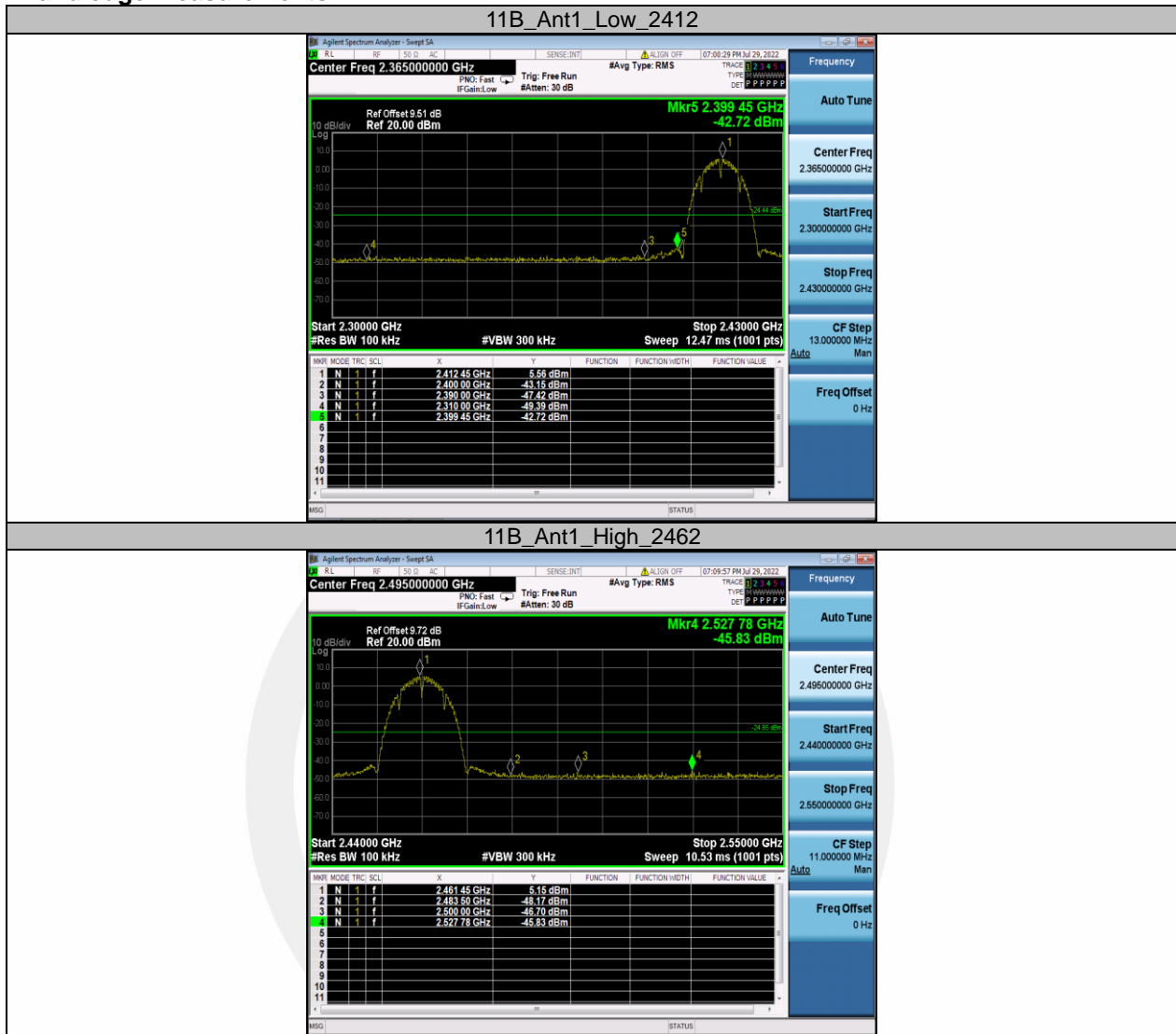
Band edge measurements

TestMode	Antenna	ChName	Frequency[MHz]	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
11B	Ant1	Low	2412	5.56	-42.72	≤-24.44	PASS
		High	2462	5.15	-45.83	≤-24.85	PASS

Conducted Spurious Emission

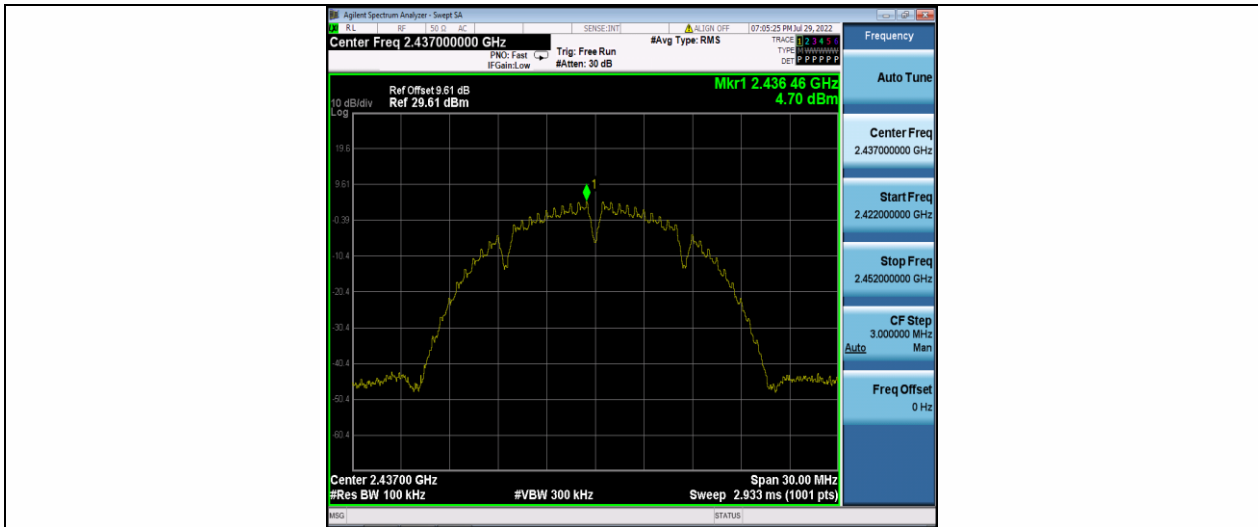
TestMode	Antenna	Frequency[MHz]	FreqRange [Mhz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
11B	Ant1	2412	Reference	5.55	5.55	---	PASS
			30~1000	5.55	-55.74	≤-24.45	PASS
			1000~26500	5.55	-39.54	≤-24.45	PASS
		2437	Reference	4.70	4.70	---	PASS
			30~1000	4.70	-55.9	≤-25.3	PASS
			1000~26500	4.70	-40.01	≤-25.3	PASS
		2462	Reference	5.14	5.14	---	PASS
			30~1000	5.14	-55.26	≤-24.86	PASS
			1000~26500	5.14	-40.14	≤-24.86	PASS

Band edge measurements

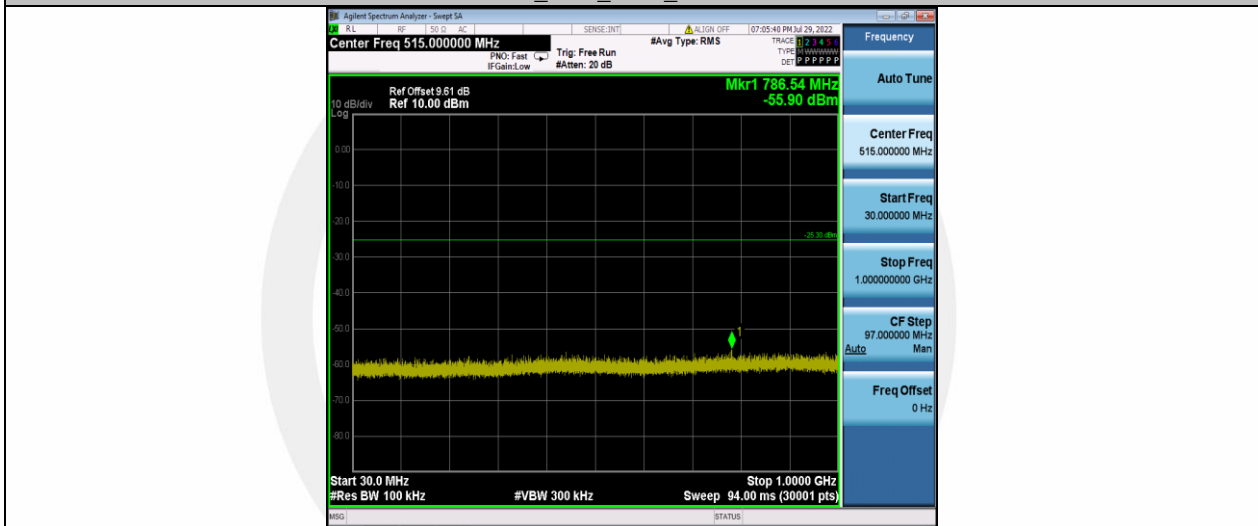


Conducted Spurious Emission

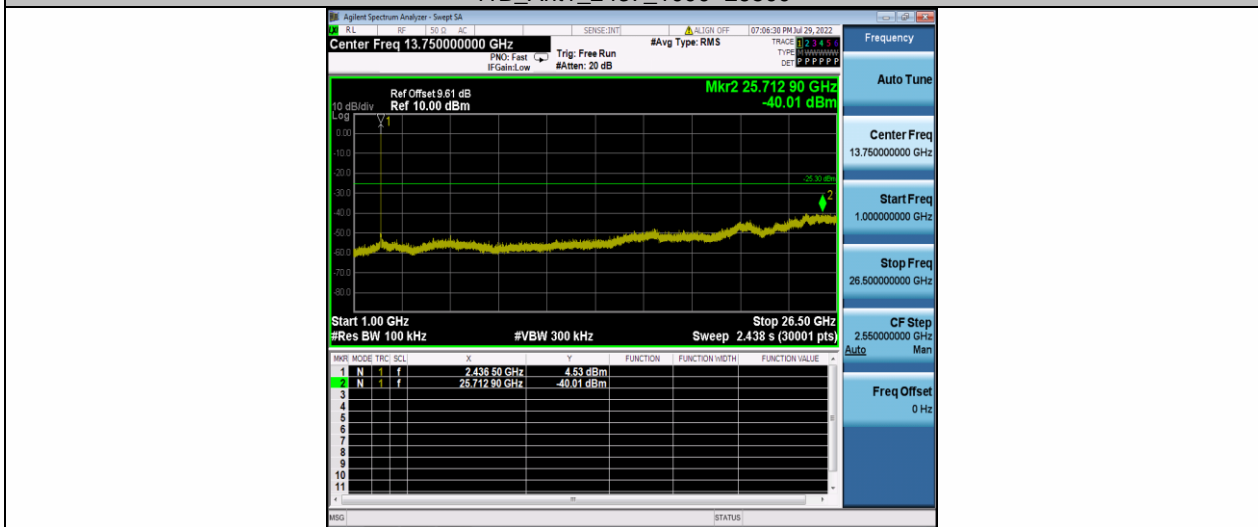




11B_Ant1_2437_30~1000



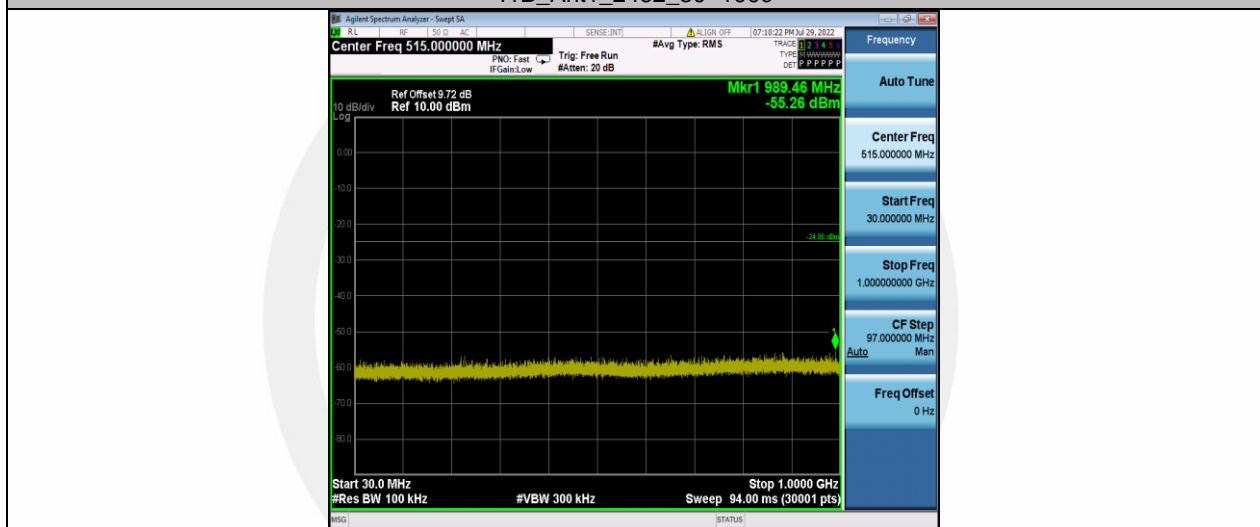
11B_Ant1_2437_1000~26500



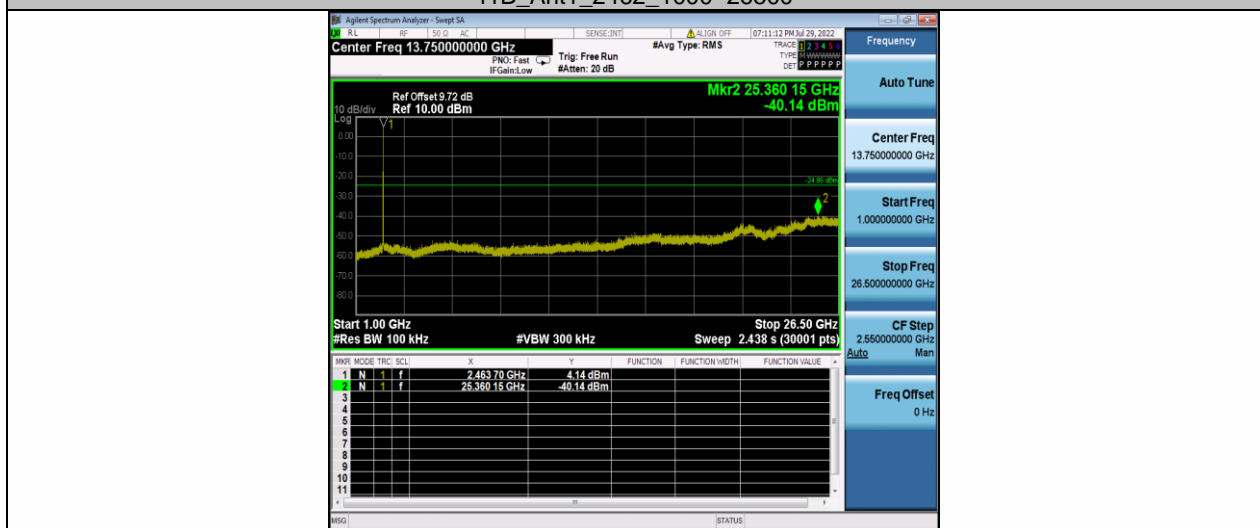
11B_Ant1_2462_0~Reference



11B_Ant1_2462_30~1000



11B_Ant1_2462_1000~26500



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 ≥ 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 ≥ 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 ≥ 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:	26° C
Relative Humidity:	54%
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 = $40\log(\text{Specific distance}/ \text{test distance})$ (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
10980.46	V	54.99	34.26	74.00	54.00	-19.01	-19.74
15003.42	V	59.31	38.34	74.00	54.00	-14.69	-15.66
17948.04	V	64.41	43.24	74.00	54.00	-9.59	-10.76
7717.518	H	51.77	33.64	74.00	54.00	-22.23	-20.36
14366.84	H	59.26	38.52	74.00	54.00	-14.74	-15.48
17844.59	H	65.28	44.28	74.00	54.00	-8.72	-9.72

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
8059.475	V	50.70	34.12	74.00	54.00	-23.30	-19.88
14325.37	V	59.52	38.66	74.00	54.00	-14.48	-15.34
18000.00	V	64.60	45.28	74.00	54.00	-9.40	-8.72
7411.461	H	49.91	34.33	74.00	54.00	-24.09	-19.67
15046.85	H	59.74	39.47	74.00	54.00	-14.26	-14.53
17896.24	H	64.07	43.28	74.00	54.00	-9.93	-10.72

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
10980.46	V	54.17	33.62	74.00	54.00	-19.83	-20.38
15046.85	V	58.48	35.49	74.00	54.00	-15.52	-18.51
18000.00	V	63.80	44.18	74.00	54.00	-10.20	-9.82
10980.46	H	54.35	33.44	74.00	54.00	-19.65	-20.56
14450.13	H	59.09	38.57	74.00	54.00	-14.91	-15.43
17948.04	H	64.27	44.37	74.00	54.00	-9.73	-9.63

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

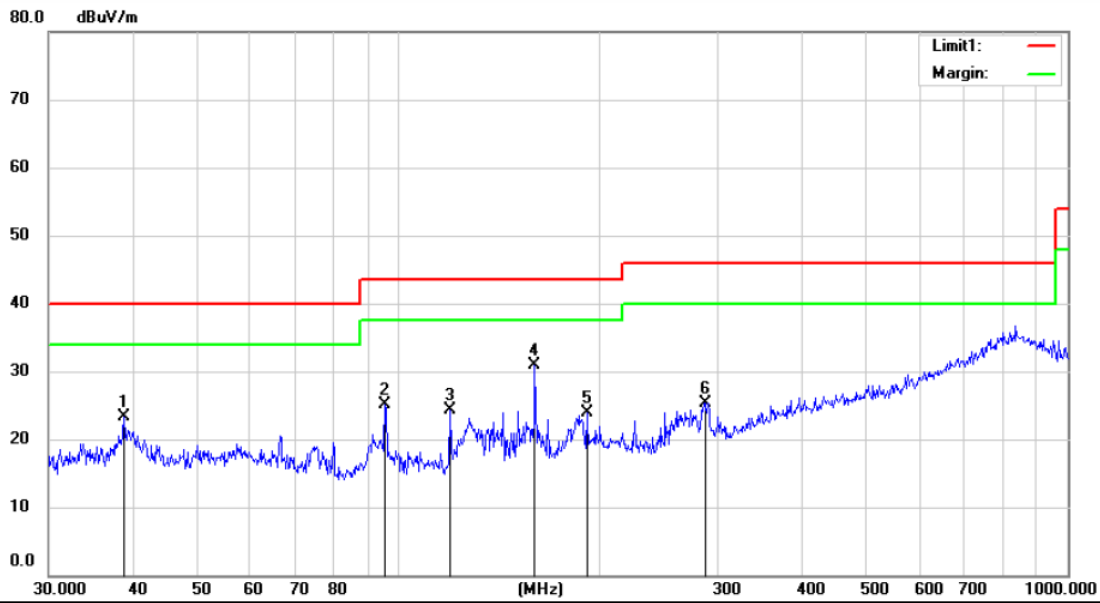
Test mode: 802.11n(20MHz) Frequency: Channel 1: 2412MHz

Frequency (MHz)	Polarity	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	AV(dBuV/m) (VBW=10Hz)	Limit 3m (dBuV/m)
2389.280	H	52.97	74	36.33	54
2388.960	V	54.04	74	37.25	54

Test mode: 802.11n(20MHz) Frequency: Channel 11: 2462MHz

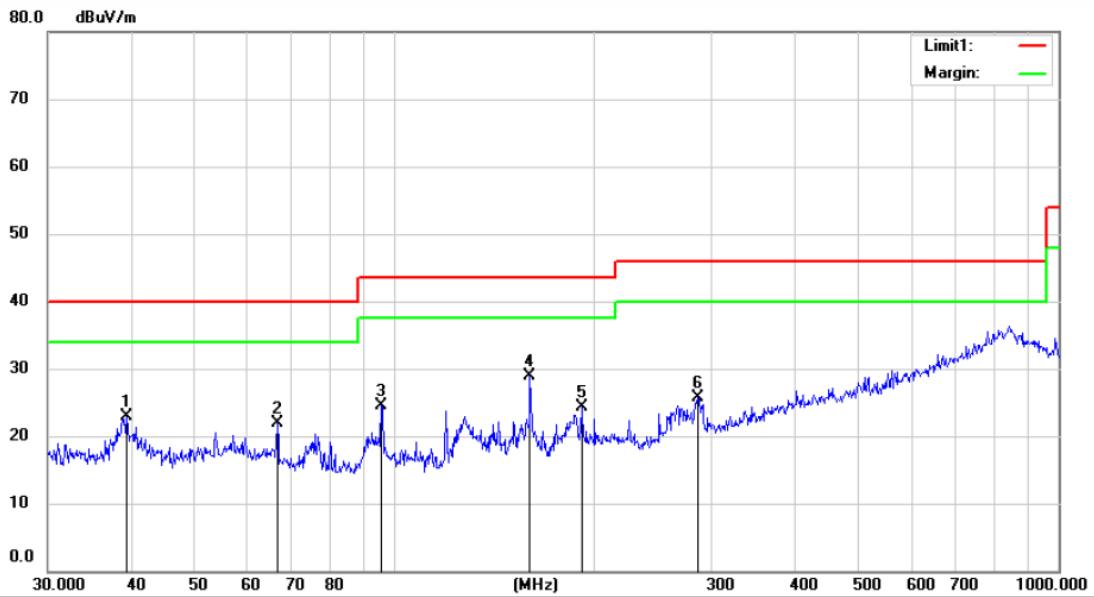
Frequency (MHz)	Polarity	PK(dBuV/m) (VBW=3MHz)	Limit 3m (dBuV/m)	AV(dBuV/m) (VBW=10Hz)	Limit 3m (dBuV/m)
2483.830	H	53.69	74	35.44	54
2483.731	V	53.06	74	35.17	54

- 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.



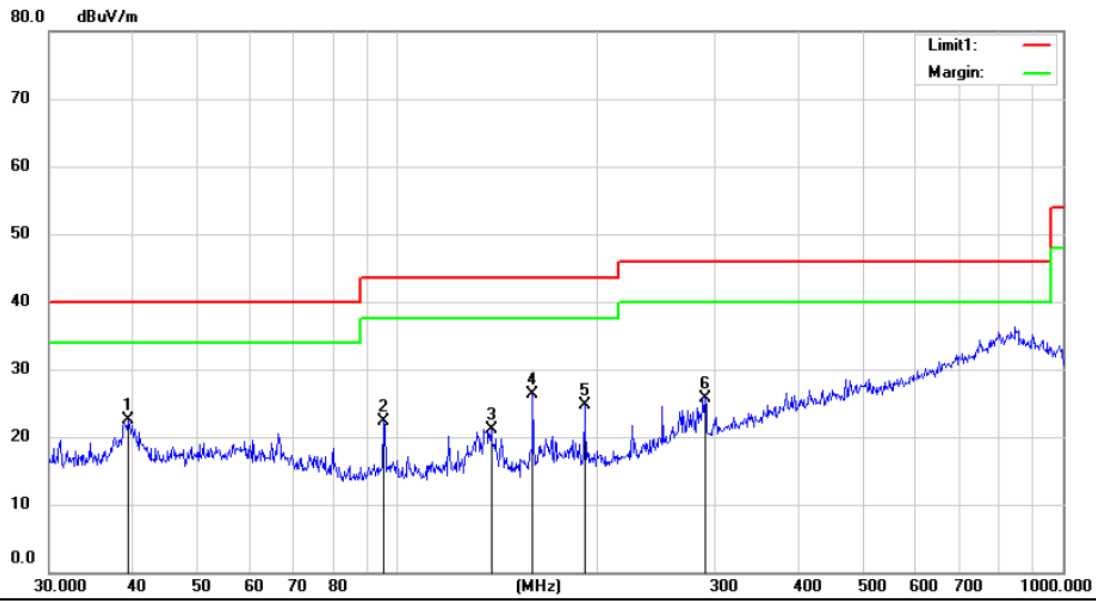
Site 3m Chamber #3 Polarization: **Vertical** Temperature: 25.7 C
 Limit: (RE)FCC PART 15 CLASS B Power: AC 120V/60Hz Humidity: 55 %
 Mode:WIFI2.4G 2412
 Note:

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		38.8878	33.08	-9.74	23.34	40.00	-16.66	QP		
2		95.4270	36.61	-11.52	25.09	43.50	-18.41	QP		
3		119.4361	35.80	-11.50	24.30	43.50	-19.20	QP		
4	*	159.7844	42.28	-11.33	30.95	43.50	-12.55	QP		
5		191.0738	35.19	-11.33	23.86	43.50	-19.64	QP		
6		286.9823	32.93	-7.54	25.39	46.00	-20.61	QP		



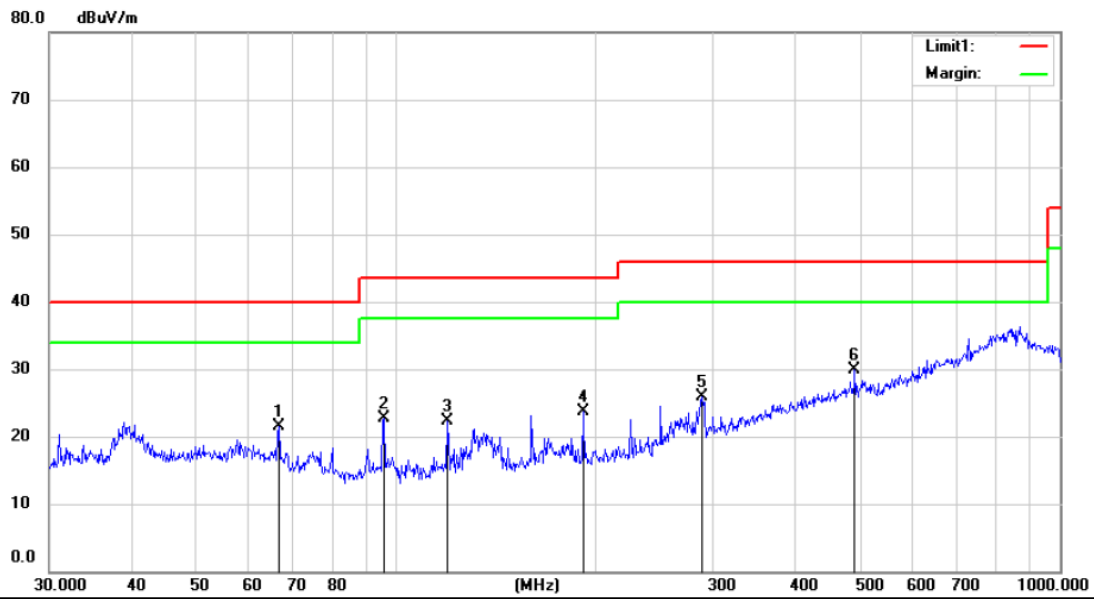
Site 3m Chamber #3 Polarization: **Vertical** Temperature: 25.7 C
 Limit: (RE)FCC PART 15 CLASS B Power: AC 120V/60Hz Humidity: 55 %
 Mode:WIFI2.4G 2437
 Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Antenna Height cm	Table Degree degree	Comment
1		39.4371	32.54	-9.63	22.91	40.00	-17.09	QP			
2		66.4990	31.03	-9.08	21.95	40.00	-18.05	QP			
3		95.4270	35.94	-11.52	24.42	43.50	-19.08	QP			
4	*	159.7844	40.26	-11.33	28.93	43.50	-14.57	QP			
5		191.0738	35.73	-11.33	24.40	43.50	-19.10	QP			
6		285.9778	33.19	-7.58	25.61	46.00	-20.39	QP			



Site 3m Chamber #3 Polarization: **Horizontal** Temperature: 25.7 C
 Limit: (RE)FCC PART 15 CLASS B Power: AC 120V/60Hz Humidity: 55 %
 Mode: WIFI2.4G 2437
 Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	Detector	Antenna Height	Table Degree	Comment
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB		cm	degree	
1		39.4371	32.09	-9.63	22.46	40.00	-17.54	QP			
2		95.4270	33.91	-11.52	22.39	43.50	-21.11	QP			
3		138.3873	32.86	-11.66	21.20	43.50	-22.30	QP			
4	*	159.7844	37.60	-11.33	26.27	43.50	-17.23	QP			
5		191.0738	36.03	-11.33	24.70	43.50	-18.80	QP			
6		290.0172	33.19	-7.42	25.77	46.00	-20.23	QP			



Site 3m Chamber #3 Polarization: **Horizontal** Temperature: 25.7 C
 Limit: (RE)FCC PART 15 CLASS B Power: AC 120V/60Hz Humidity: 55 %
 Mode:WIFI2.4G 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		66.4990	30.56	-9.08	21.48	40.00	-18.52	QP		
2		95.7622	34.19	-11.53	22.66	43.50	-20.84	QP		
3		119.4360	33.88	-11.50	22.38	43.50	-21.12	QP		
4		191.0738	35.01	-11.33	23.68	43.50	-19.82	QP		
5		289.0020	33.44	-7.46	25.98	46.00	-20.02	QP		
6	*	490.7446	31.84	-1.86	29.98	46.00	-16.02	QP		

7.6 CONDUCTED EMISSION TEST

7.6.1 Applicable Standard

According to IC RSS-Gen 8.8

7.6.2 Conformance Limit

FCC Part 15, Subpart B, Class A

Frequency MHz	Limits dB(μ V)	
	Quasi-peak Level	Average Level
0.15 ~ 0.50	79	66
0.50 ~ 30.00	73	60

7.6.3 Test Configuration

Test according to clause 6.3 conducted emission test setup

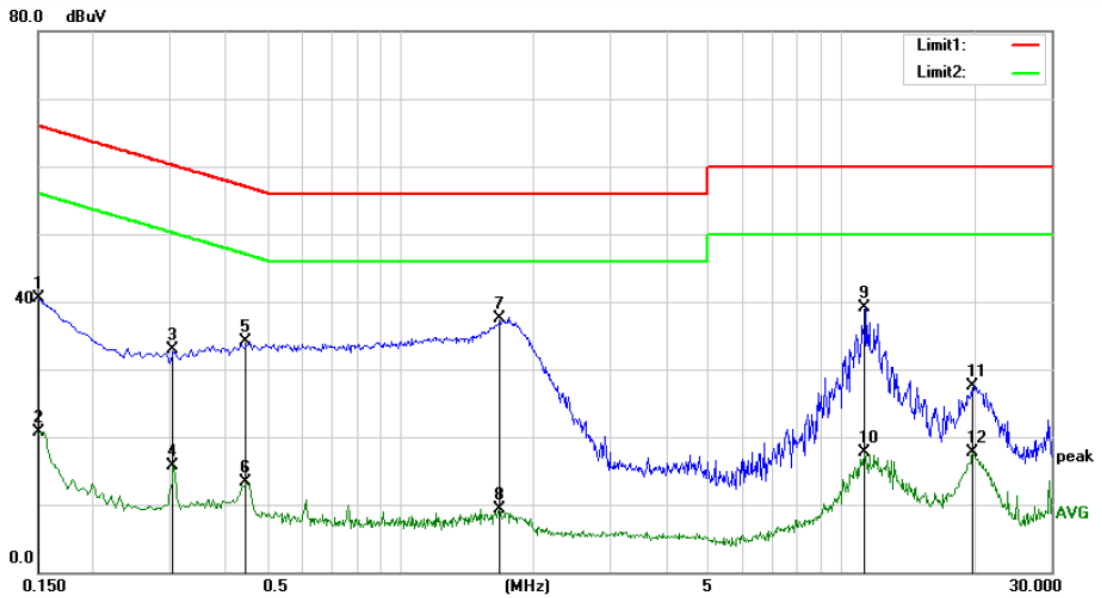
7.6.4 Test Procedure

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

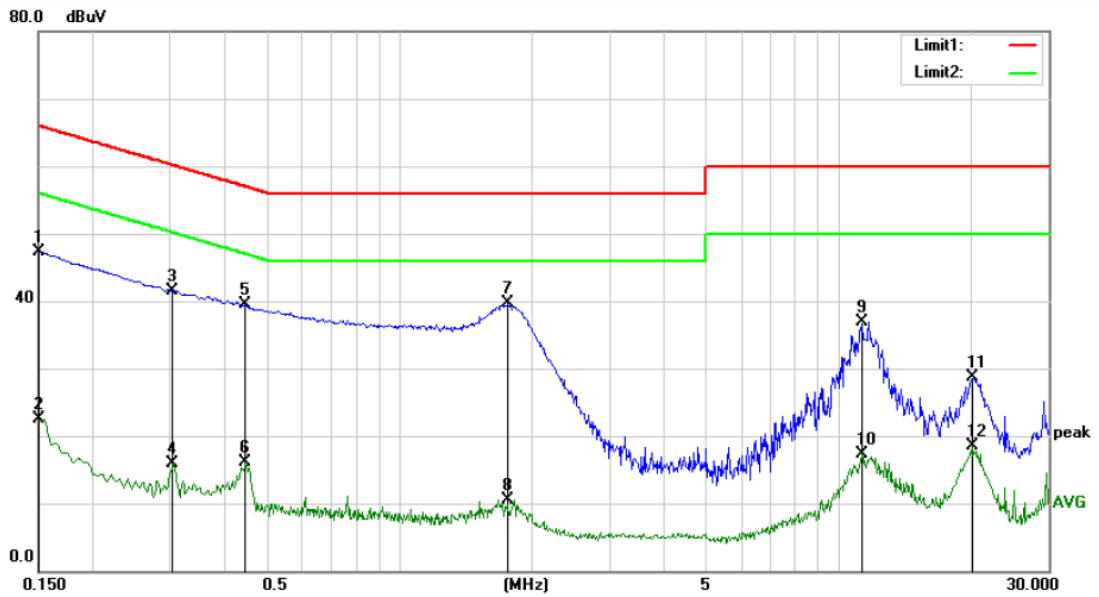
Pass

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



Site Conduction #1 Phase: **N** Temperature: 21.9
 Limit: (CE)FCC PART 15 class B_QP Power: AC 120V/60Hz Humidity: 58 %
 Mode: WIFI mode
 Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1500	30.99	9.53	40.52	66.00	-25.48	QP	
2		0.1500	11.24	9.53	20.77	56.00	-35.23	AVG	
3		0.3050	23.38	9.53	32.91	60.11	-27.20	QP	
4		0.3050	6.08	9.53	15.61	50.11	-34.50	AVG	
5		0.4450	24.48	9.54	34.02	56.97	-22.95	QP	
6		0.4450	3.76	9.54	13.30	46.97	-33.67	AVG	
7	*	1.6750	28.05	9.55	37.60	56.00	-18.40	QP	
8		1.6750	-0.33	9.55	9.22	46.00	-36.78	AVG	
9		11.2800	29.35	9.74	39.09	60.00	-20.91	QP	
10		11.2800	7.88	9.74	17.62	50.00	-32.38	AVG	
11		19.8800	17.59	9.95	27.54	60.00	-32.46	QP	
12		19.8800	7.76	9.95	17.71	50.00	-32.29	AVG	



Site Conduction #1 Phase: **L1** Temperature: 21.9
 Limit: (CE)FCC PART 15 class B_QP Power: AC 120V/60Hz Humidity: 58 %
 Mode: WIFI mode
 Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1		0.1500	37.87	9.53	47.40	66.00	-18.60	QP	
2		0.1500	12.88	9.53	22.41	56.00	-33.59	AVG	
3		0.3050	32.05	9.53	41.58	60.11	-18.53	QP	
4		0.3050	6.40	9.53	15.93	50.11	-34.18	AVG	
5		0.4450	29.90	9.54	39.44	56.97	-17.53	QP	
6		0.4450	6.65	9.54	16.19	46.97	-30.78	AVG	
7	*	1.7700	30.13	9.55	39.68	56.00	-16.32	QP	
8		1.7700	0.86	9.55	10.41	46.00	-35.59	AVG	
9		11.2800	27.19	9.74	36.93	60.00	-23.07	QP	
10		11.2800	7.63	9.74	17.37	50.00	-32.63	AVG	
11		20.1800	18.78	9.96	28.74	60.00	-31.26	QP	
12		20.1800	8.59	9.96	18.55	50.00	-31.45	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 2.54 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

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