FCC/ISED - TEST REPORT

Report Number	:	**68.910.22.0009.01**	Date of Issue:	May 23, 2022
Model	:	**T2193, T2194, T2181, T2182**		
Product Type	:	RoboVac LR30 Hybrid+		
Applicant	:	Anker Innovations Limited		
Address	:	Room 1318-19, Hollywood Plaza, 610 Nathan Road, Mongkok, Kowloon, HongKong		
Production Facility	:	Guangdong Wangjia Intelligent Robot Co., Ltd.		
Address	:	Room 301, The Fifth Building, No.1 Junma Road, Humen Town, 523900 Dongguan, Guangdong, PEOPLE'S REPUBLIC OF CHINA		
Test Result	:	■ **Positive** ☐ **Negative**		
Total pages including Appendices	:	57		

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1 Table of Contents

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2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

Company name:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch Building 12 & 13, Zhiheng Wisdomland Business Park, Guankou Erlu, Nantou, Nanshan District, Shenzhen, Guangdong 518052, China
FCC Registration Number:	514049
FCC Designation Number:	CN5009
ISED#:	10320A
CAB identifier:	CN0077
Telephone:	86 755 8828 6998
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3 Description of the Equipment under Test

Description of the Equipment Under Test

Product/PMN:	RoboVac LR30 Hybrid+
Model no./HVIN:	T2193, T2194, T2181, T2182
HMN:	NIL
FCC ID:	2AOKB-T2182
IC:	23451-T2182
Options and accessories:	NIL
Ratings:	24V⎓; 1A (for RoboVac LR30 Hybrid+)
Adapter:	Model: NLD100240W1A4 Input: 100-240V~; 50/60Hz; 0,6A Max Output: 24V⎓; 1A
Dust collector	100-120V~; 50/60Hz; 1050W (for Dust collector)
RF Transmission Frequency:	2412-2462MHz
No. of Operated Channel:	11
Modulation:	CCK, DQPSK, DBPSK for 802.11b QPSK,BPSK for 802.11g/n
Duty Cycle:	100%
Antenna Type:	Integral Antenna
Antenna Gain:	2.0 dBi
Description of the EUT:	This Equipment Under Test is a Robotic Vacuum Cleaner with 2.4GHz Wi-Fi function.

Model differences are as below:

1. The Robotic vacuum cleaner of all models have the same technical construction including circuit diagram, PCB Layout, components and component layout, all electrical construction and mechanical construction.
2. Different charging accessories used:
   T2193 and T2194 using charging base and adapter
   T2181 and T2182 using dust collector(T2999)
3. The appearance is different.

Unless otherwise specified, the model T2193 was chosen as the representative model to perform all the tests, and T2181 was chosen to perform the conducted emission test to verify the difference.

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2020 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators
RSS-Gen Issue 5 Amendment 2 (February 2021)	RSS-Gen — General Requirements for Compliance of Radio Apparatus
RSS-247 Issue 2 February 2017	Digital Transmission Systems (DTS), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices

All the test methods were according to KDB558074 D01 DTS Meas Guidance v05r02 and ANSI C63.10 (2013).

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5 Summary of Test Results

Technical Requirements					
FCC Part 15 Subpart C/RSS-247 Issue 2/RSS-Gen Issue 5					
Test Condition			Pages	Test Result	Test Site
§15.207	RSS-GEN 8.8	Conducted emission AC power port	10	Pass	Site 1
§15.247(b)(1)	RSS-247 Clause 5.4(b)	Conducted AV output power for FHSS	--	N/A	--
§15.247(b)(3)	RSS-247 Clause 5.4(d)	Conducted peak output power for DTS	13	Pass	Site 1
§15.247(e)	RSS-247 Clause 5.2(b)	Power spectral density	31	Pass	Site 1
§15.247(a)(2)	RSS-247 Clause 5.2(a)	6dB bandwidth	15	Pass	Site 1
§15.247(a)(1)	RSS-247 Clause 5.1(a)	20dB Occupied bandwidth	--	N/A	--
--	RSS-GEN 6.7	99% Occupied Bandwidth	24	Pass	Site 1
§15.247(a)(1)	RSS-247 Clause 5.1(b)	Carrier frequency separation	--	N/A	--
§15.247(a)(1)(iii)	RSS-247 Clause 5.1(d)	Number of hopping frequencies	--	N/A	--
§15.247(a)(1)(iii)	RSS-247 Clause 5.1(d)	Dwell Time	--	N/A	--
§15.247(d)	RSS-247 Clause 5.5	Spurious RF conducted emissions	36	Pass	Site 1
§15.247(d)	RSS-247 Clause 5.5	Band edge	49	Pass	Site 1
§15.247(d) & §15.209 & §15.205	RSS-247 Clause 5.5 & RSS-GEN 6.13 RSS-GEN 8.9 RSS-GEN 8.10	Spurious radiated emissions for transmitter	36	Pass	Site 1
§15.203	RSS-GEN 6.8	Antenna requirement	See note 2	Pass	--

Remark 1: N/A – Not Applicable.
Note 1: The EUT uses an Integrated Metal Antenna 2.0 dBi max. According to §15.203, it is considered sufficiently to comply with the provisions of this section.

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6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2AOKB-T2182 and IC: 23451-T2182 complies with Section 15.207, 15.205, 15.209, 15.247 of the FCC Part 15, Subpart C Rules; RSS-Gen Issue 5 and RSS-247 issue 2.

SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

☐ - **Not** Performed

The Equipment under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date: May 27, 2022

Testing Start Date: April 11, 2022

Testing End Date: May 13, 2022

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch -

Reviewed by:	Prepared by:	Tested by:
Jessie He	Myron Yu	Louise Liu
EMC Project Manager	EMC Project Engineer	EMC Test Engineer

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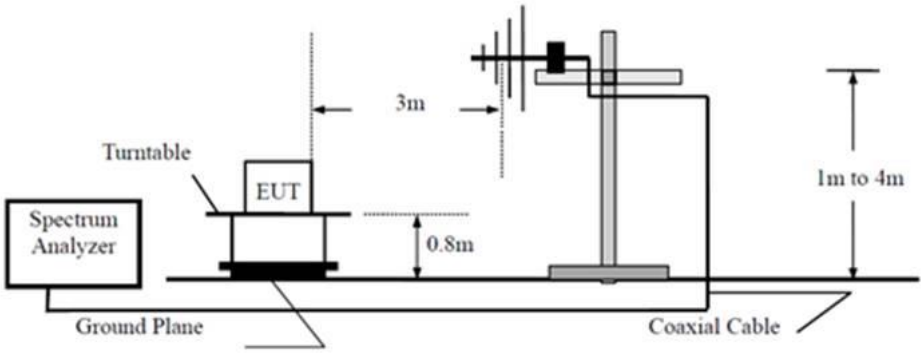
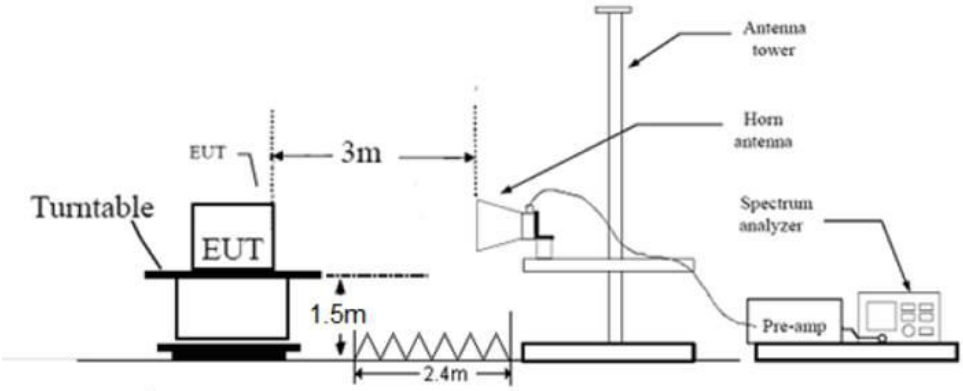
7 Test Setups

7.1 Radiated test setups

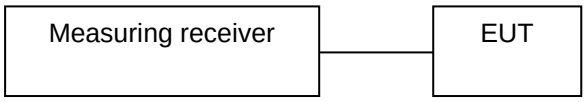
Below 1GHz



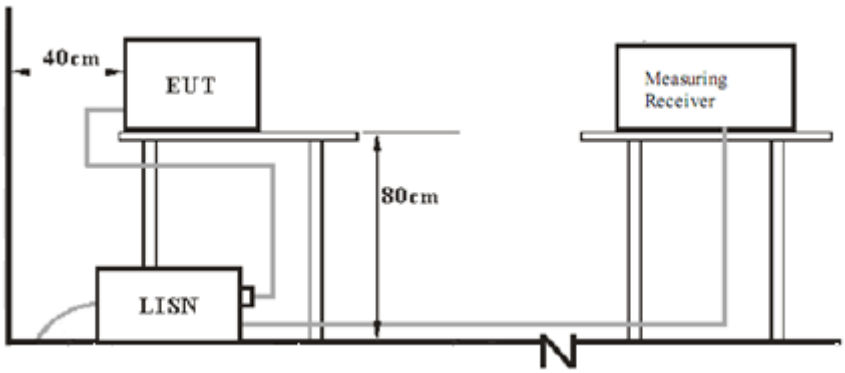
Above 1GHz



7.2 Conducted RF test setups



7.3 AC Power Line Conducted Emission test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.	S/N
Laptop	X220	Thinkpad	---

Test software information:

Test Software Version	QA tool	
Modulation	Setting TX Power	Packet Type
802.11b	15	---
802.11g	15	---
802.11nHT20	12	---
802.11Nht40	12	---

The system was configured to channel 1, 6 and 11 for the test.

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9 Technical Requirement

9.1 Conducted Emission

Test Method

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through an Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

Limit

Frequency MHz	QP Limit dBµV	AV Limit dBµV
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Note: "*" means Decreasing line;

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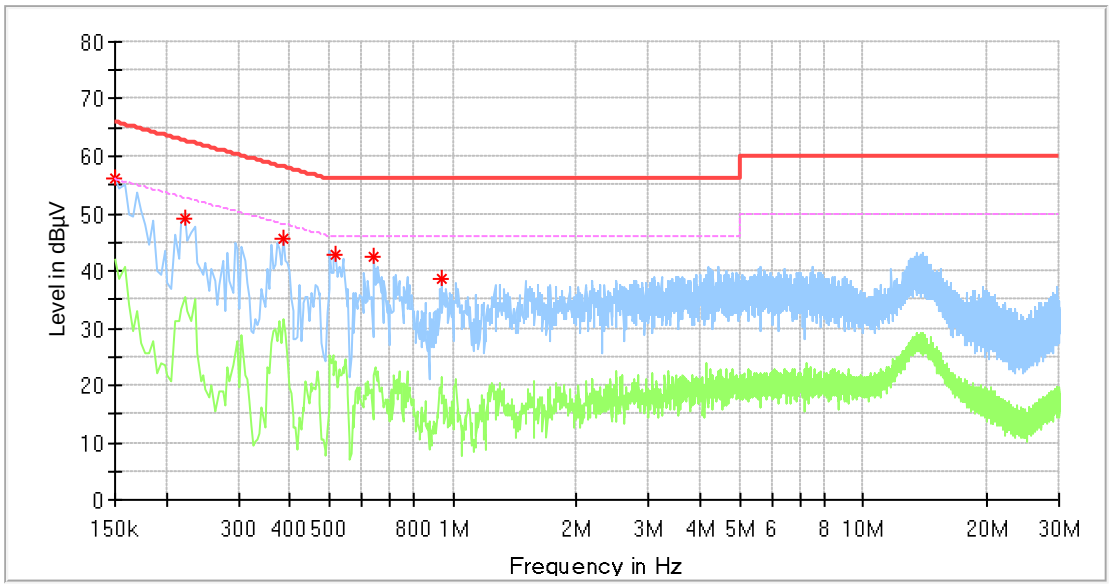
Conducted Emission

Product Type	:	RoboVac LR30 Hybrid+
M/N	:	T2193
Operating Condition	:	Charging with transmitting
Test Specification	:	Power Line, Live
Comment	:	AC 120V/60Hz (tested with charging base + adapter)



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.150000	56.18	---	66.00	9.82	L1	9.74
0.222000	49.16	---	62.74	13.58	L1	9.69
0.386000	45.78	---	58.15	12.37	L1	9.66
0.518000	42.83	---	56.00	13.17	L1	9.65
0.642000	42.56	---	56.00	13.44	L1	9.65
0.938000	38.61	---	56.00	17.39	L1	9.66

Remark:
Level=Reading Level + Correction Factor
Correction Factor=Cable Loss + LISN Factor
(The Reading Level is recorded by software which is not shown in the sheet)

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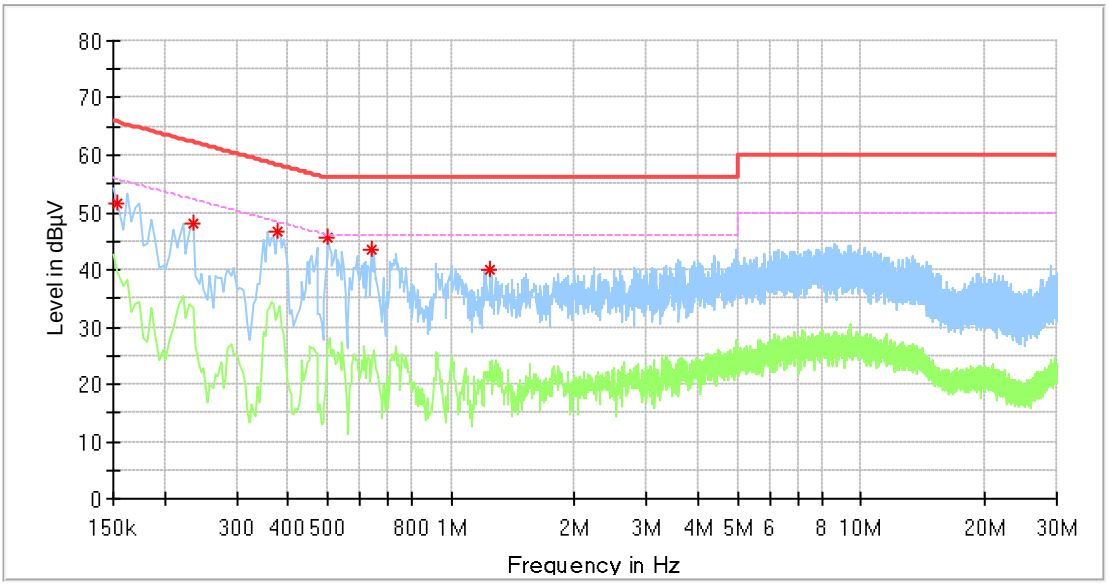
Conducted Emission

Product Type	:	RoboVac LR30 Hybrid+
M/N	:	T2181
Operating Condition	:	Charging with transmitting
Test Specification	:	Power Line, Neutral
Comment	:	AC 120V/60Hz (tested with charging base + adapter)



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.154000	51.59	---	65.78	14.19	N	9.78
0.234000	48.04	---	62.31	14.27	N	9.71
0.378000	46.78	---	58.32	11.55	N	9.69
0.502000	45.62	---	56.00	10.38	N	9.68
0.638000	43.65	---	56.00	12.35	N	9.68
1.242000	39.96	---	56.00	16.04	N	9.70

Remark:
Level=Reading Level + Correction Factor
Correction Factor=Cable Loss + LISN Factor
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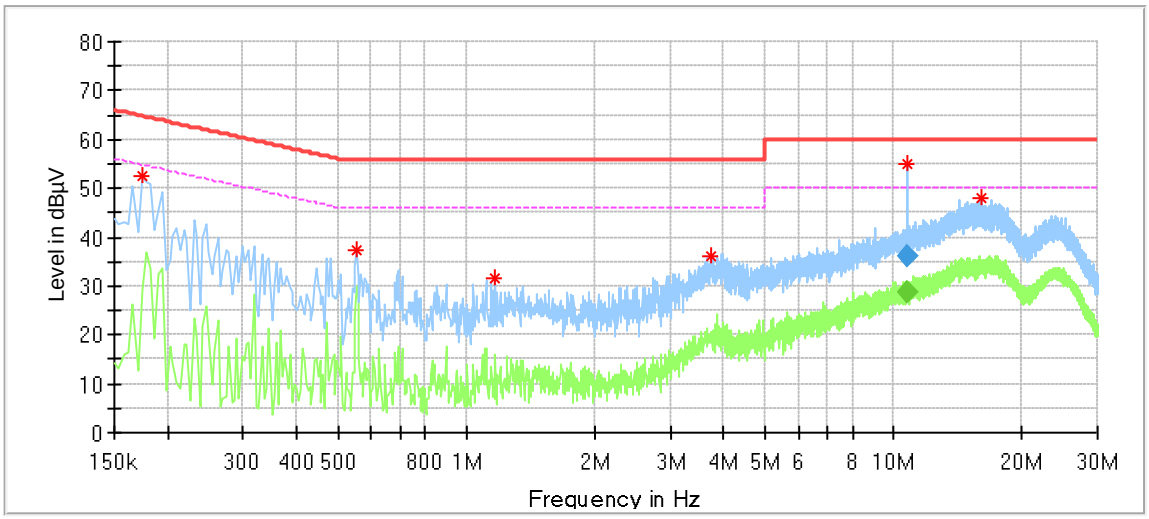
Conducted Emission

Product Type	:	RoboVac LR30 Hybrid+
M/N	:	T2181
Operating Condition	:	Charging with transmitting
Test Specification	:	Power Line, Live
Comment	:	AC 120V/60Hz (tested with dust collector)



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.174000	52.36	---	64.77	12.41	L1	9.25
0.554000	37.15	---	56.00	18.85	L1	9.20
1.170000	31.78	---	56.00	24.22	L1	9.20
3.738000	36.07	---	56.00	19.93	L1	9.27
10.777500	55.02	---	60.00	4.98	L1	9.39
15.966000	47.87	---	60.00	12.13	L1	9.40

Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
10.777500	---	28.88	50.00	21.12	L1	9.39
10.777500	36.28	---	60.00	23.72	L1	9.39

Remark:
Level=Reading Level + Correction Factor
Correction Factor=Cable Loss + LISN Factor
(The Reading Level is recorded by software which is not shown in the sheet)

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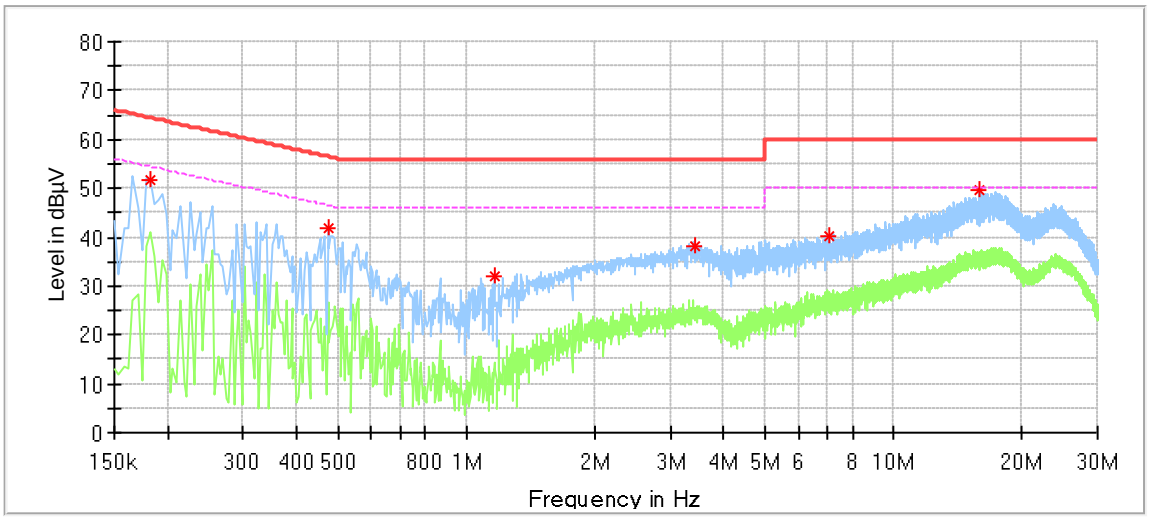
Conducted Emission

Product Type	:	RoboVac LR30 Hybrid+
M/N	:	T2181
Operating Condition	:	Charging with transmitting
Test Specification	:	Power Line, Neutral
Comment	:	AC 120V/60Hz (tested with dust collector)



Critical_Freqs

Frequency (MHz)	MaxPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.182000	51.76	---	64.39	12.63	N	9.40
0.474000	41.90	---	56.44	14.54	N	9.39
1.162000	32.06	---	56.00	23.94	N	9.40
3.426000	37.95	---	56.00	18.05	N	9.45
7.038000	40.38	---	60.00	19.62	N	9.56
15.890000	49.64	---	60.00	10.36	N	9.65

Remark:
Level=Reading Level + Correction Factor
Correction Factor=Cable Loss + LISN Factor
(The Reading Level is recorded by software which is not shown in the sheet)

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9.2 Conducted peak output power

Test Method

1. Connect the power meter to the EUT
   a) The EUT is configured to transmit continuously, or to transmit with a constant duty factor.
   b) At all times the EUT is transmitting at its maximum power control level.
   c) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
3. Adjust the measurement in dBm by adding 10log (1/x), where x is the duty cycle to the measurement result.

Limits

According to §15.247 (b) (3) & RSS-247 5.4(d), conducted output power limit as below:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

According to & RSS-247 5.4(d), EIRP limit as below:

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤4	≤36.2

Test result

802.11b

Frequency MHz	Conducted Peak Output Power dBm	Antenna Gain dBi	EIRP dBm	Result
Top channel 2412MHz	14.2	2.0	16.2	Pass
Middle channel 2437MHz	14.5	2.0	16.5	Pass
Bottom channel 2462MHz	15.6	2.0	17.6	Pass

802.11g

Frequency MHz	Conducted Peak Output Power dBm	Antenna Gain dBi	EIRP dBm	Result
Top channel 2412MHz	14.9	2.0	16.9	Pass
Middle channel 2437MHz	14.0	2.0	16.0	Pass
Bottom channel 2462MHz	13.9	2.0	15.9	Pass

802.11nHT20

Frequency MHz	Conducted Peak Output Power dBm	Antenna Gain dBi	EIRP dBm	Result
Top channel 2412MHz	12.7	2.0	14.7	Pass
Middle channel 2437MHz	12.3	2.0	14.3	Pass
Bottom channel 2462MHz	11.9	2.0	13.9	Pass

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802.11nHT40

Frequency	Conducted Peak Output Power	Antenna Gain	EIRP	Result
MHz	**dBm**	**dBi**	**dBm**	
Top channel 2422MHz	11.8	2.0	13.8	Pass
Middle channel 2437MHz	11.6	2.0	13.6	Pass
Bottom channel 2452MHz	12.2	2.0	14.2	Pass

Note:
EIRP [dBm] = A [dBm] + G[dBi]. Where, A = Average Power, G = Antenna Gain

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9.3 6dB bandwidth

Test Method

1. Use the following spectrum analyzer settings:
   RBW=100K, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]
⩾500

Test result

802.11b

Frequency MHz	6dB bandwidth MHz	Result
Bottom channel 2412MHz	8.160	Pass
Middle channel 2437MHz	9.120	Pass
Top channel 2462MHz	9.080	Pass

802.11g

Frequency MHz	6dB bandwidth MHz	Result
Bottom channel 2412MHz	16.400	Pass
Middle channel 2437MHz	16.400	Pass
Top channel 2462MHz	16.400	Pass

802.11nHT20

Frequency MHz	6dB bandwidth MHz	Result
Bottom channel 2412MHz	17.000	Pass
Middle channel 2437MHz	17.440	Pass
Top channel 2462MHz	17.360	Pass

802.11nHT40

Frequency MHz	6dB bandwidth MHz	Result
Bottom channel 2422MHz	35.440	Pass
Middle channel 2437MHz	35.840	Pass
Top channel 2452MHz	35.680	Pass

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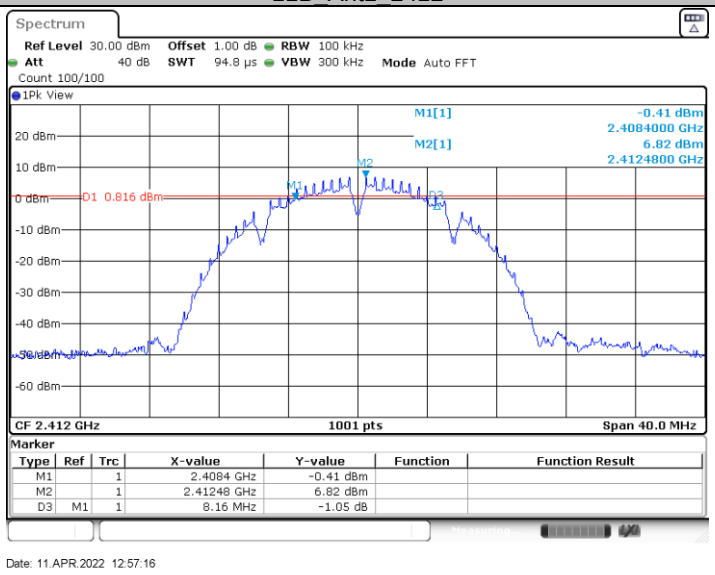
Test Graphs

11B_Ant1_2412



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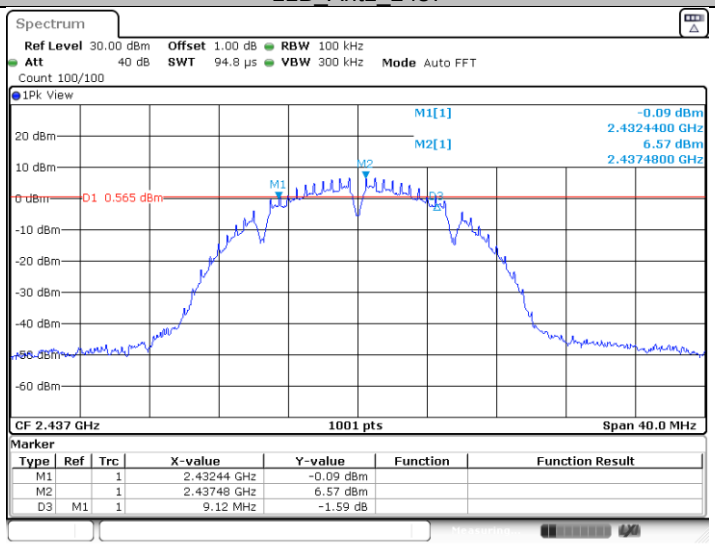

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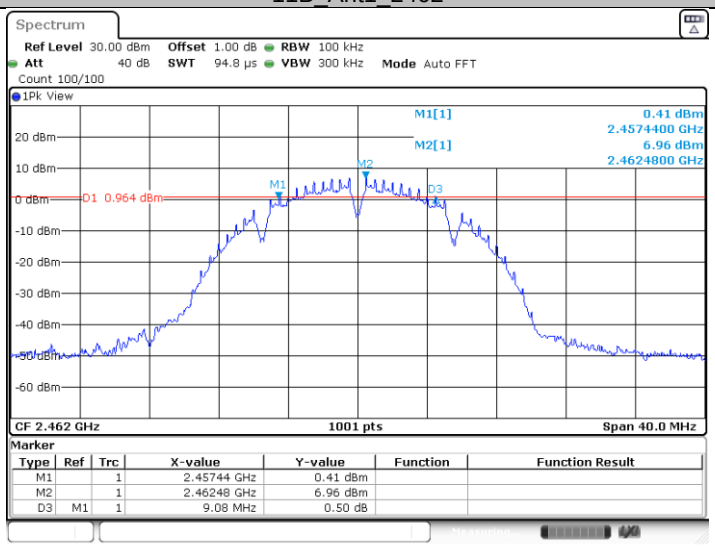

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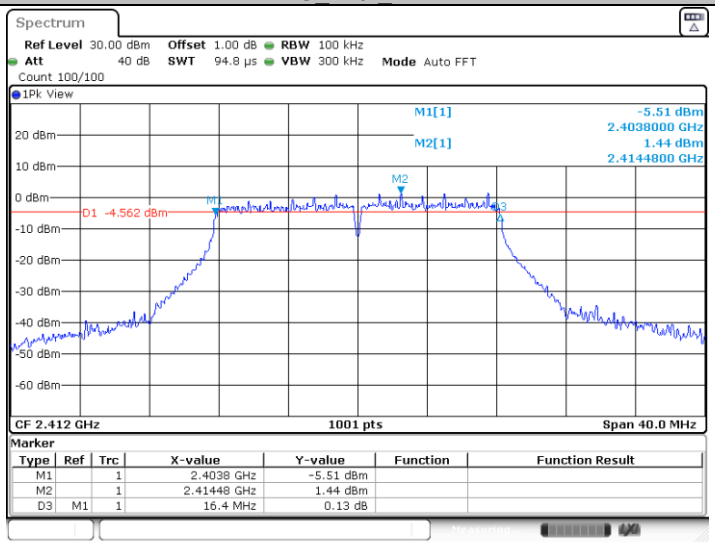
11G_Ant1_2412



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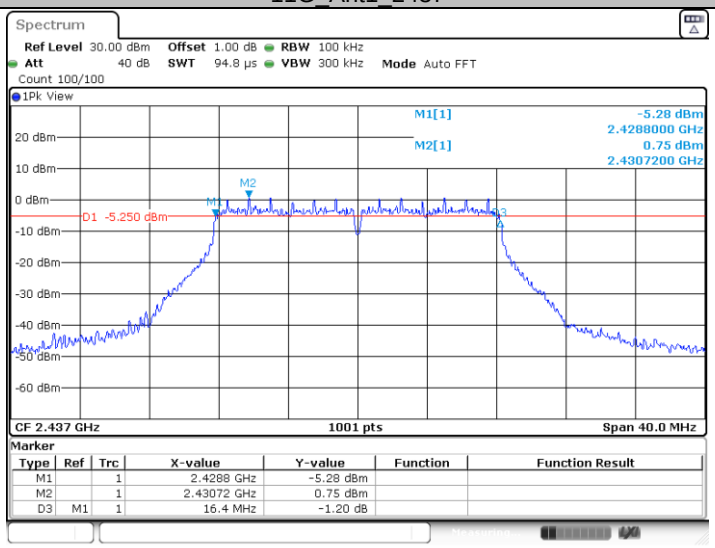
11G_Ant1_2437



Date: 11.APR.2022 13:33:06

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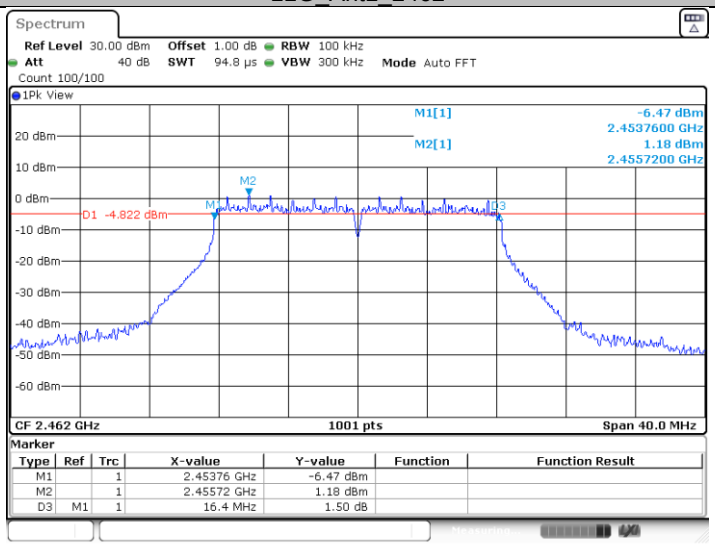

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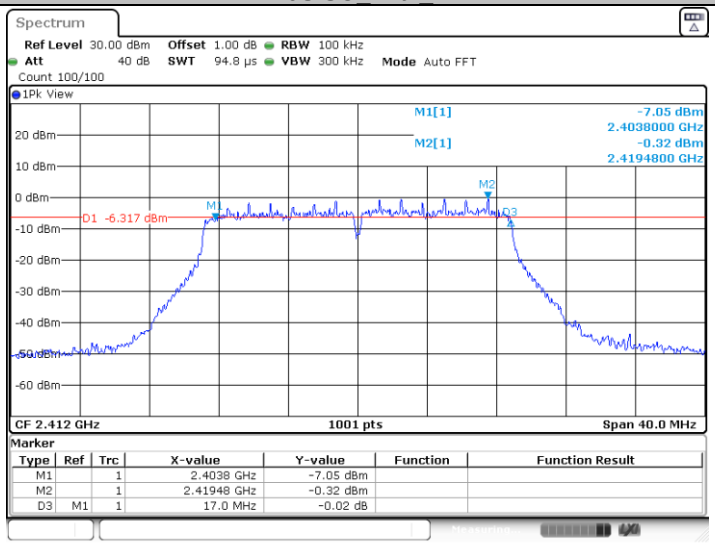
11N20SISO_Ant1_2412



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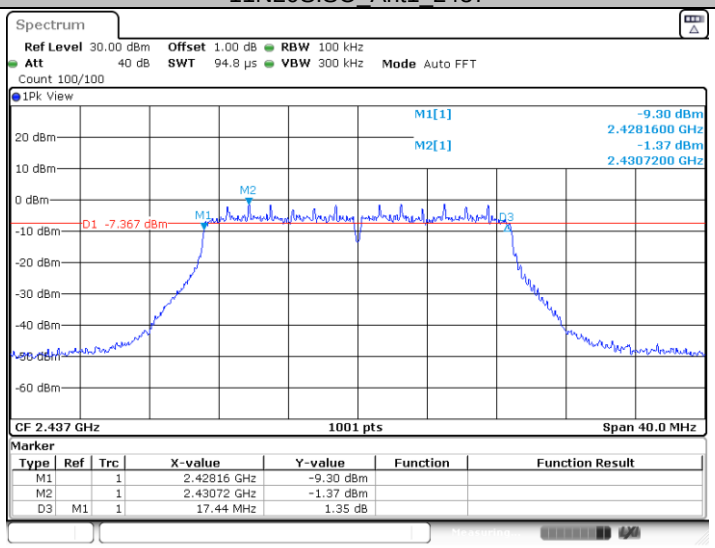

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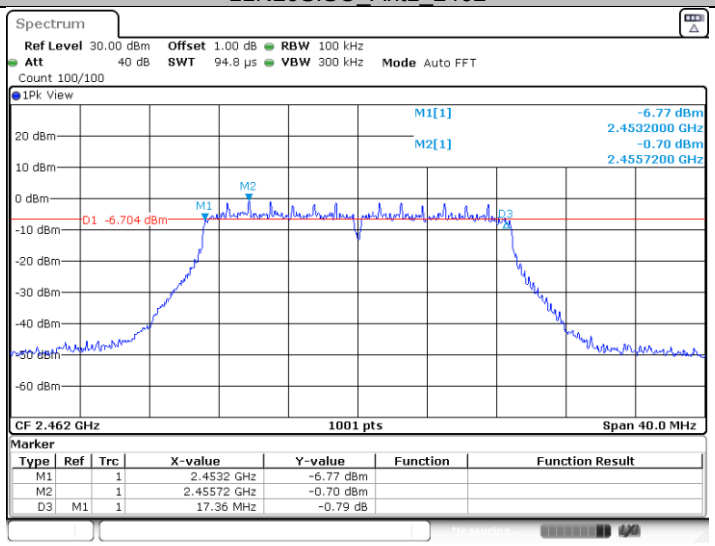

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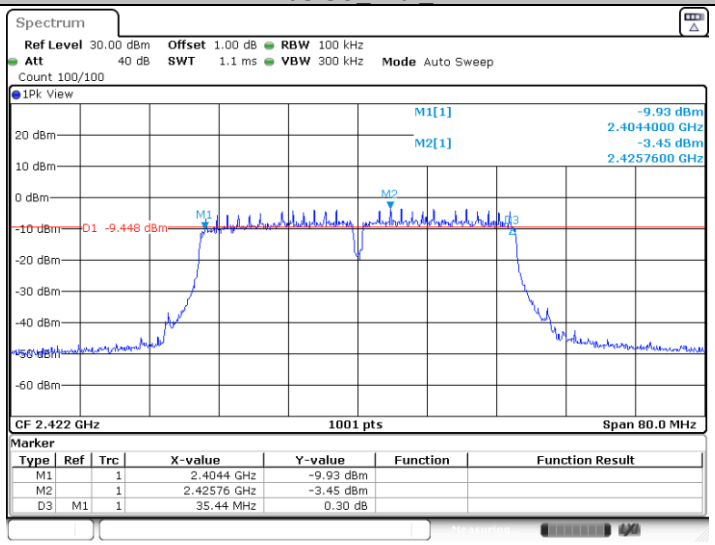

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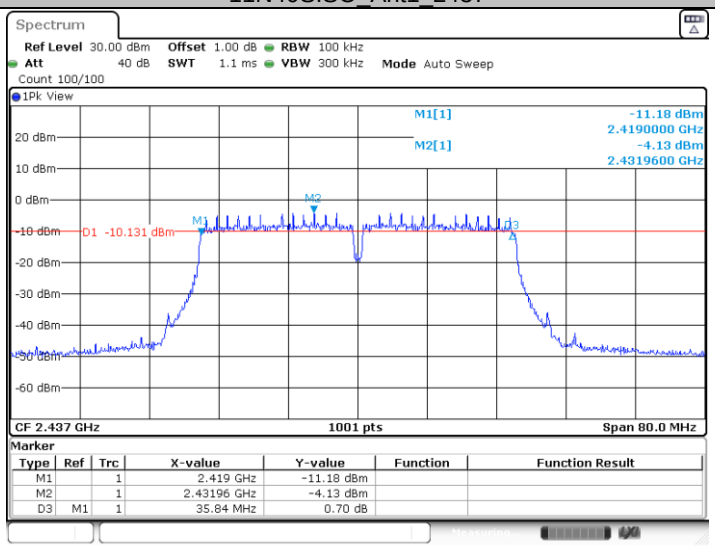

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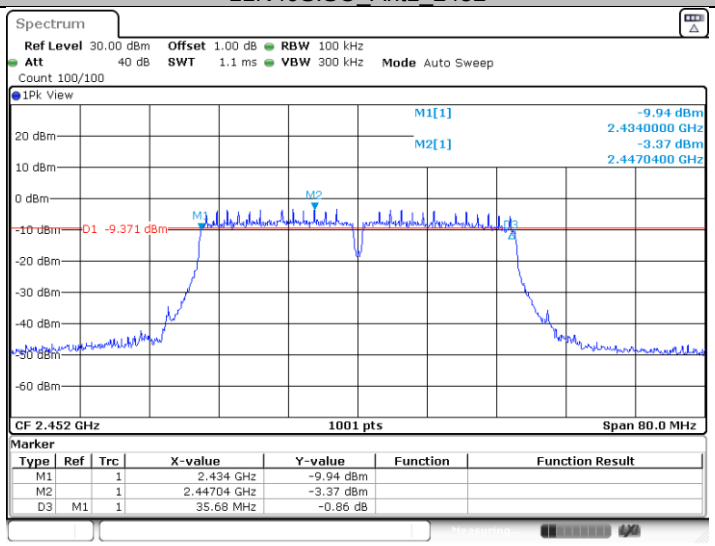

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9.4 99% bandwidth

Test Method

4. Use the following spectrum analyzer settings:
   RBW=100K, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
5. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
6. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]

Test result

802.11b

Frequency MHz	99% bandwidth MHz	Result
Bottom channel 2412MHz	13.387	Pass
Middle channel 2437MHz	13.546	Pass
Top channel 2462MHz	13.586	Pass

802.11g

Frequency MHz	99% bandwidth MHz	Result
Bottom channel 2412MHz	17.542	Pass
Middle channel 2437MHz	17.622	Pass
Top channel 2462MHz	17.303	Pass

802.11nHT20

Frequency MHz	99% bandwidth MHz	Result
Bottom channel 2412MHz	18.342	Pass
Middle channel 2437MHz	18.182	Pass
Top channel 2462MHz	18.222	Pass

802.11nHT40

Frequency MHz	99% bandwidth MHz	Result
Bottom channel 2422MHz	36.284	Pass
Middle channel 2437MHz	36.444	Pass
Top channel 2452MHz	36.603	Pass

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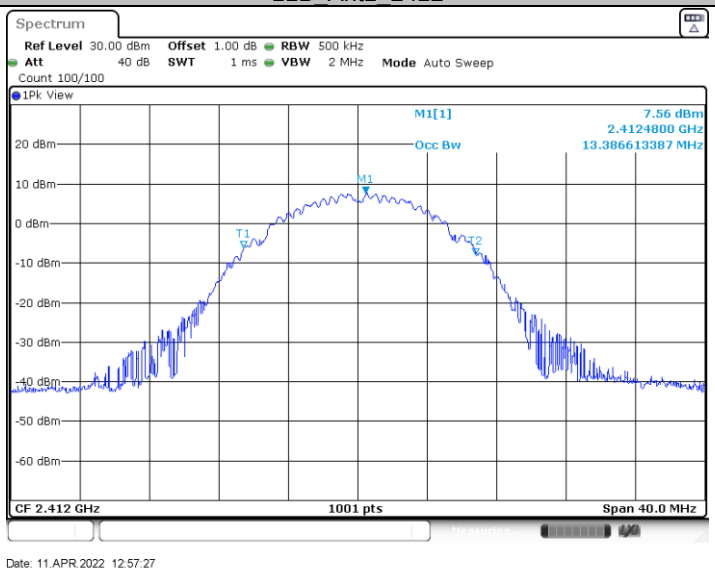
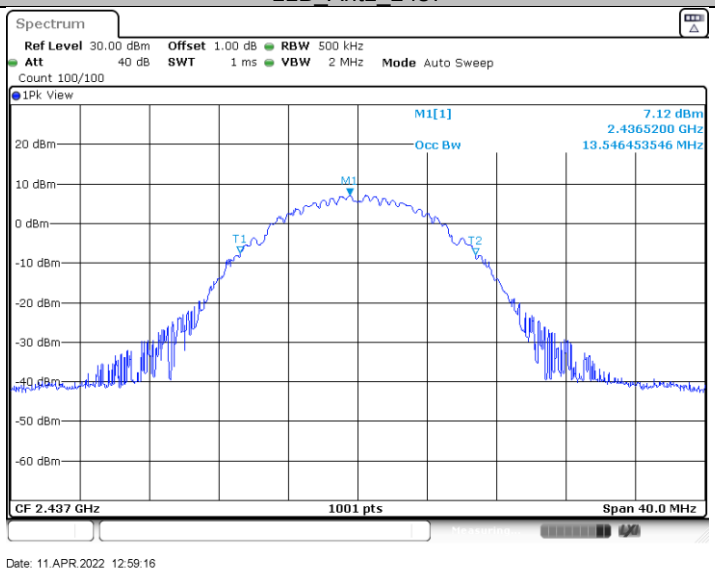
Test Graphs

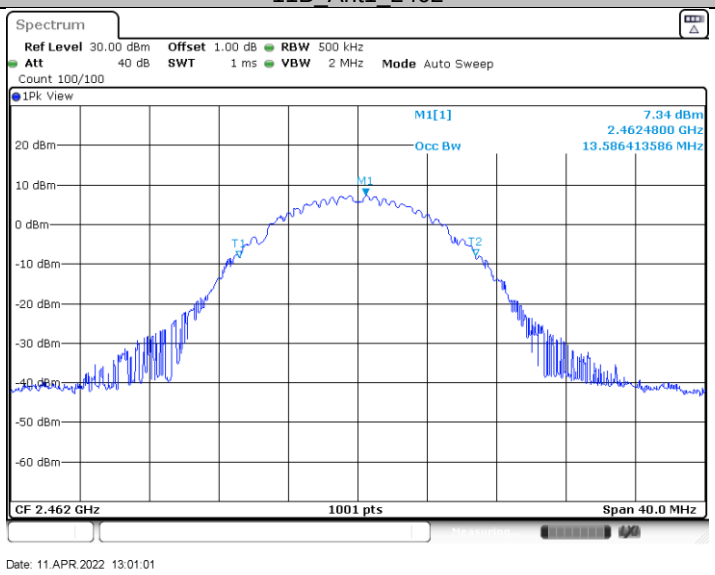
11B_Ant1_2412



11B_Ant1_2437



11B_Ant1_2462



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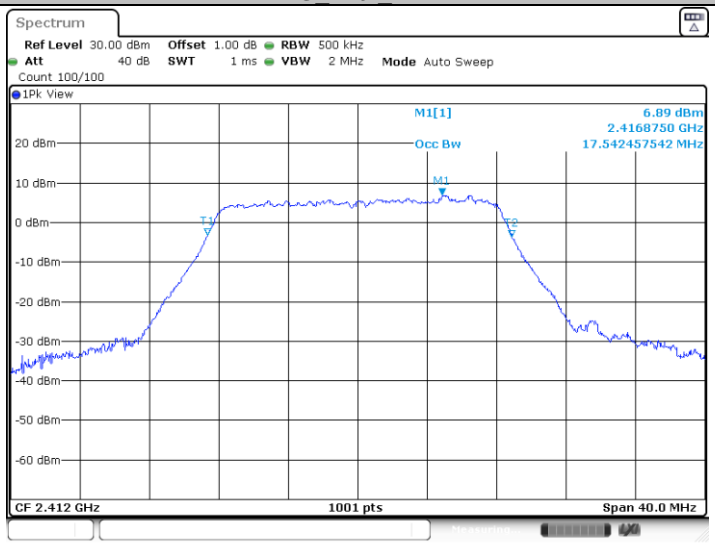
11G_Ant1_2412



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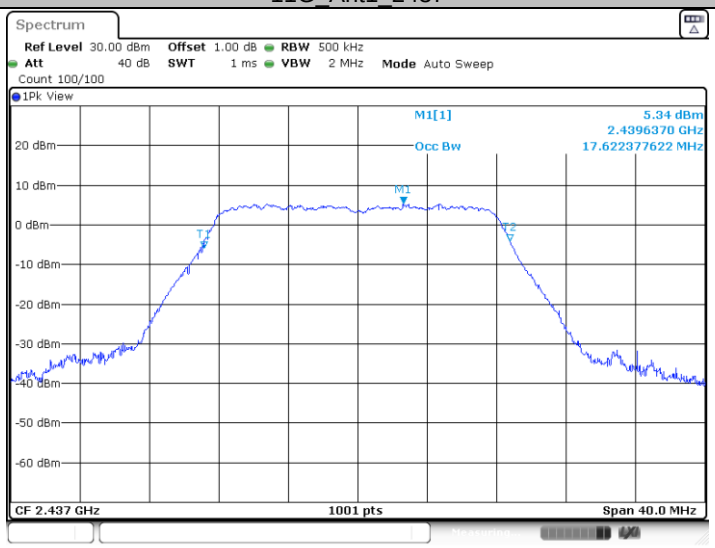

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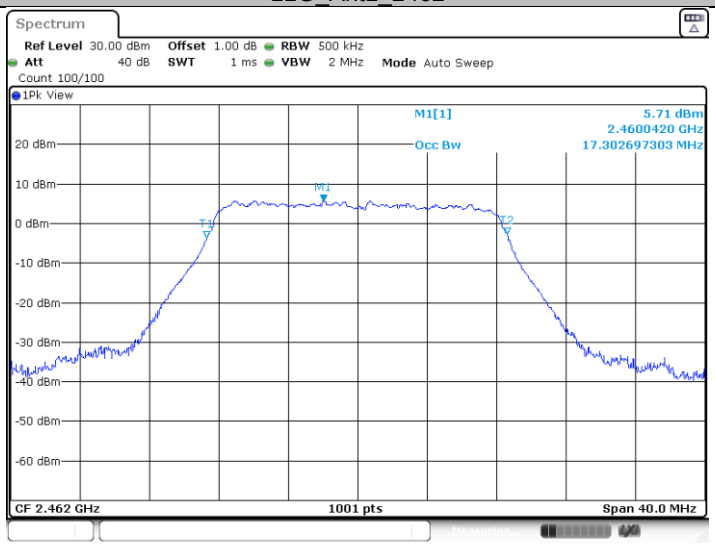

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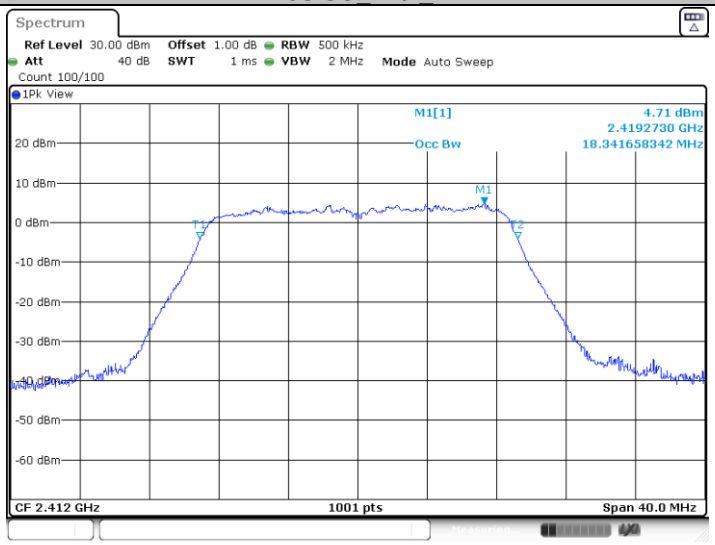
11N20SISO_Ant1_2412



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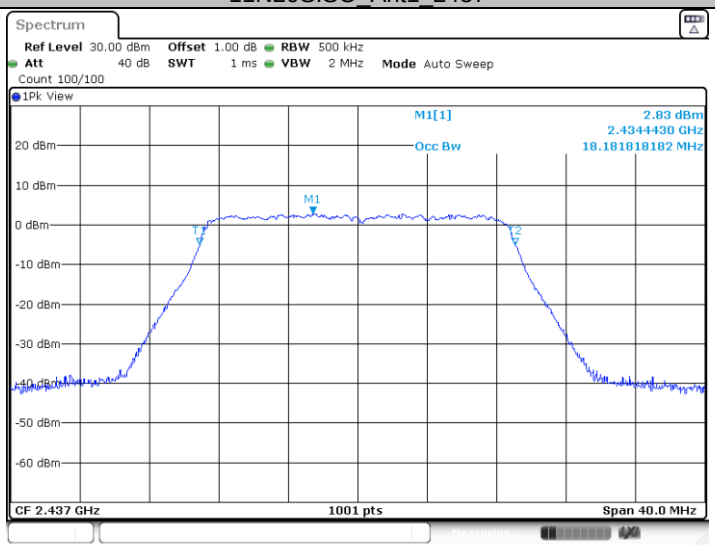

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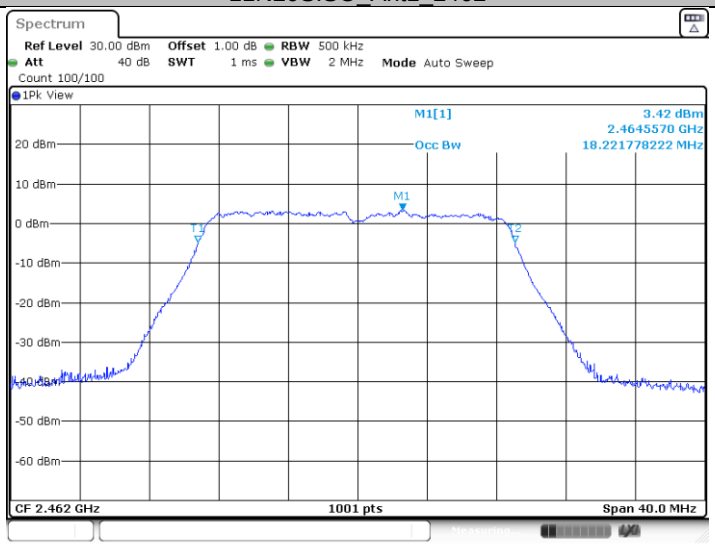

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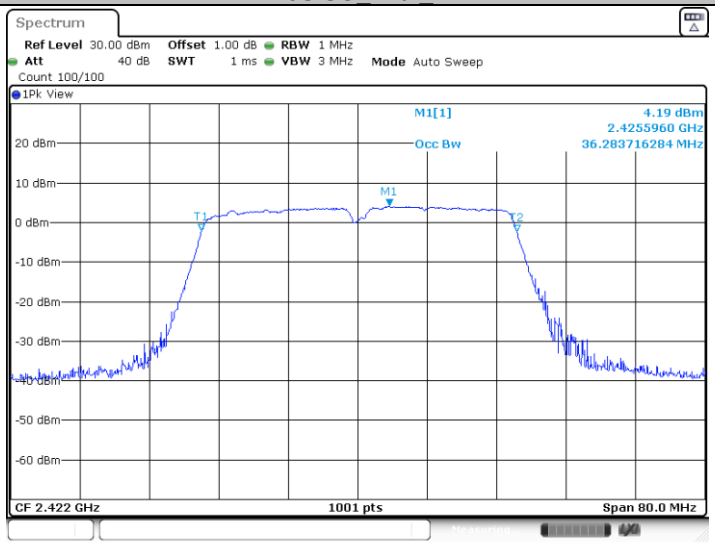
11N40SISO_Ant1_2422



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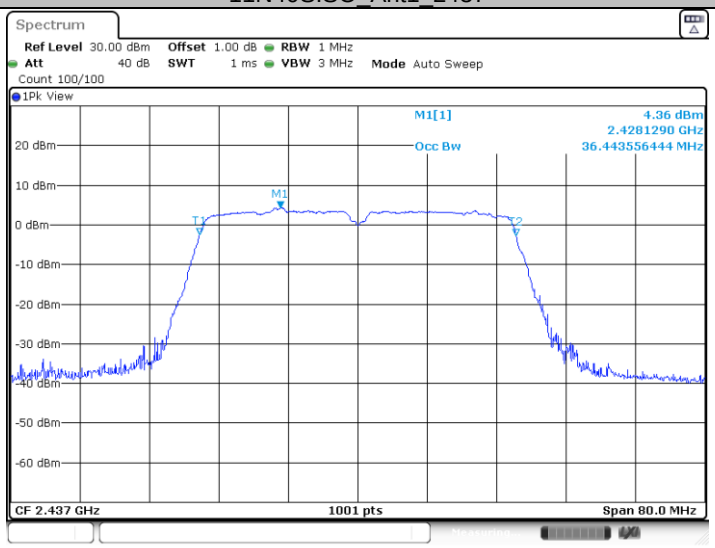

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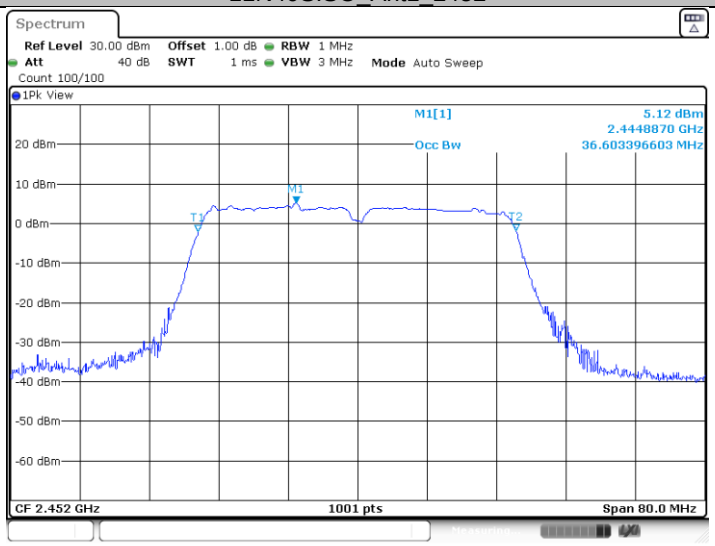

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9.5 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW≥3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
2. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
3. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm/3KHz]
⩽8

Test result

802.11b

Frequency	Power spectral density	Result
MHz	**dBm/3KHz**	
Top channel 2412MHz	-7.25	Pass
Middle channel 2437MHz	-6.15	Pass
Bottom channel 2462MHz	-7.54	Pass

802.11g

Frequency	Power spectral density	Result
MHz	**dBm/3KHz**	
Top channel 2412MHz	-12.55	Pass
Middle channel 2437MHz	-12.84	Pass
Bottom channel 2462MHz	-12.44	Pass

802.11nHT20

Frequency	Power spectral density	Result
MHz	**dBm/3KHz**	
Top channel 2412MHz	-14.3	Pass
Middle channel 2437MHz	-16.11	Pass
Bottom channel 2462MHz	-15.85	Pass

802.11nHT40

Frequency	Power spectral density	Result
MHz	**dBm/3KHz**	
Top channel 2422MHz	-18.52	Pass
Middle channel 2437MHz	-18.82	Pass
Bottom channel 2452MHz	-17.28	Pass

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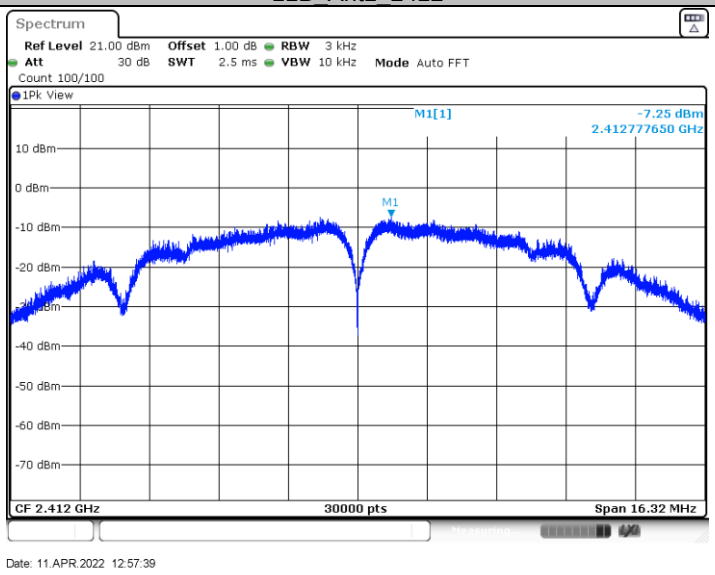
Test Graphs

11B_Ant1_2412



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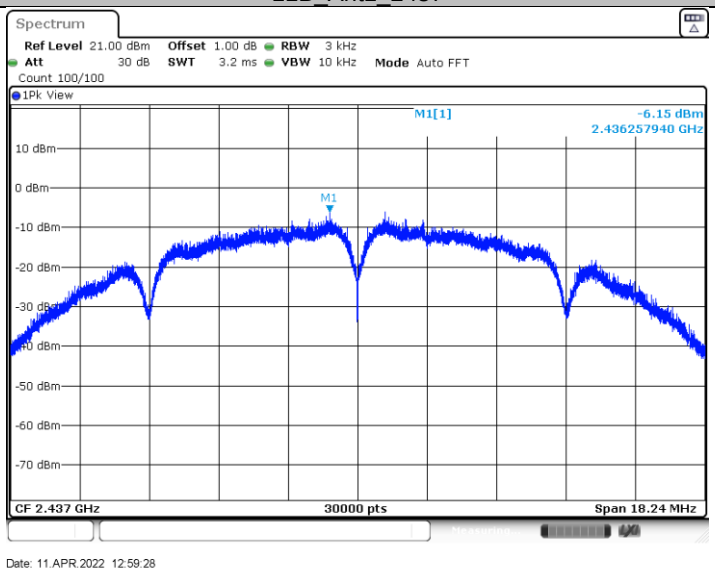

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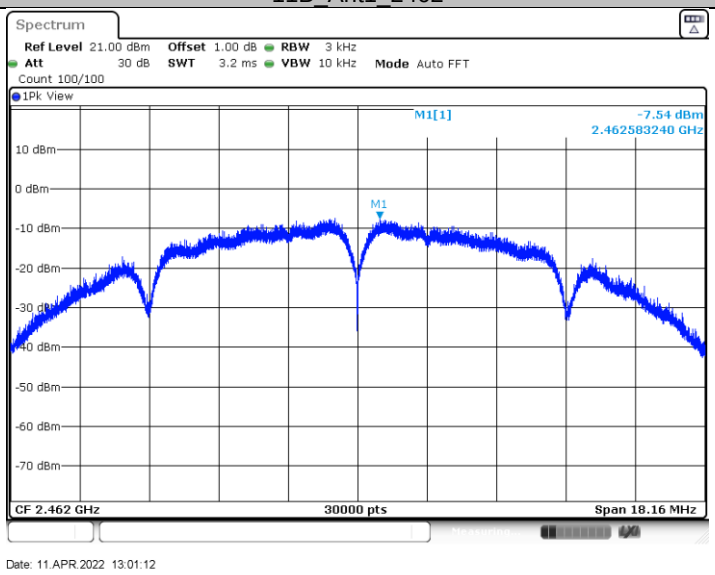

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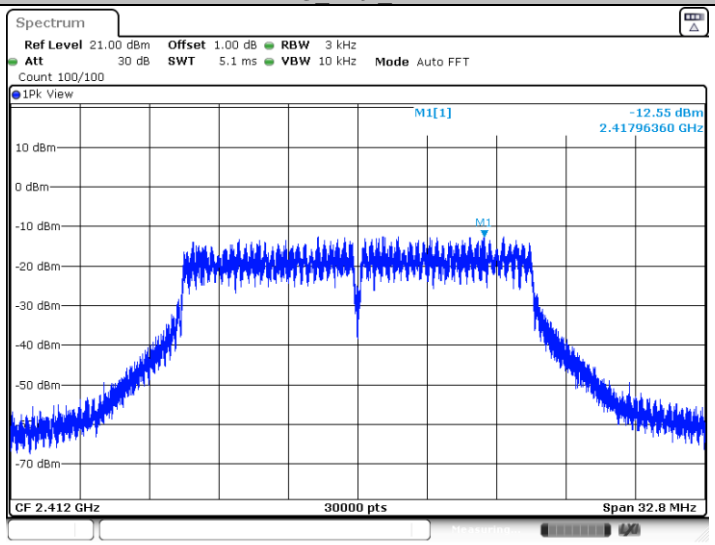
11G_Ant1_2412



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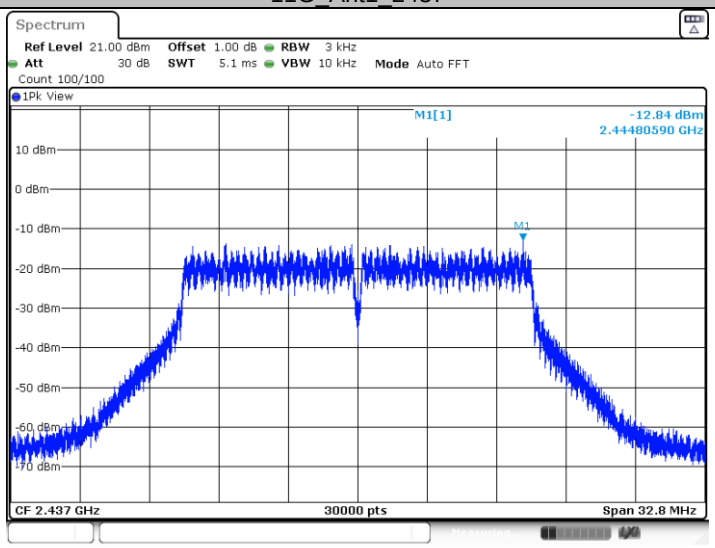

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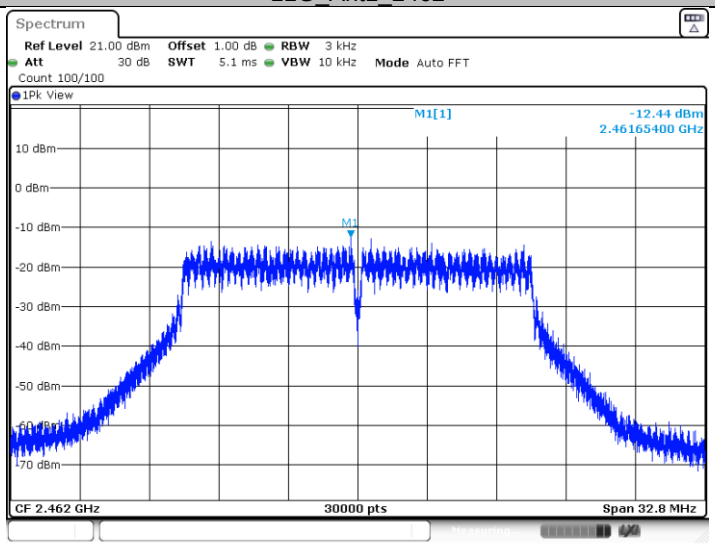

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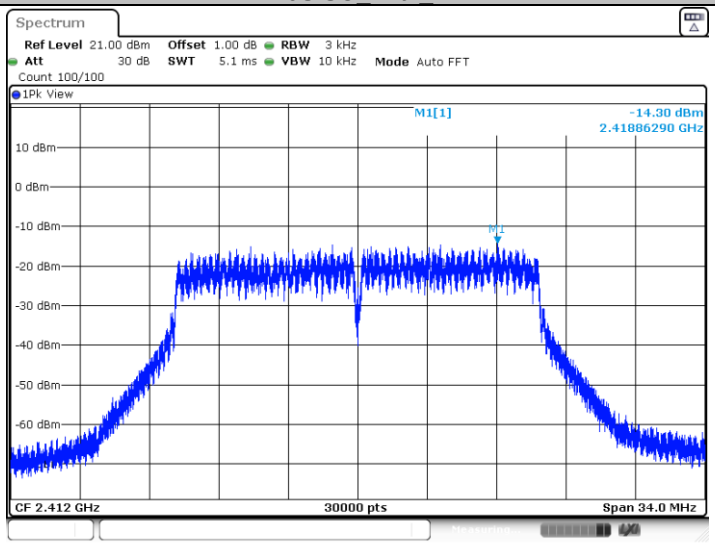

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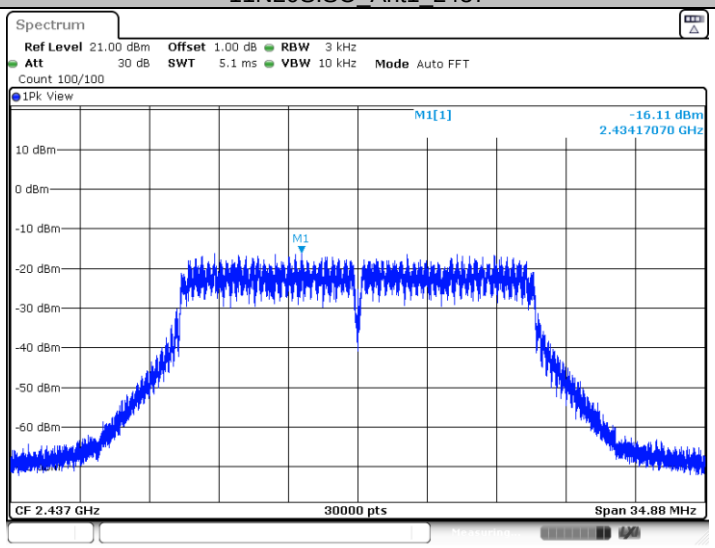

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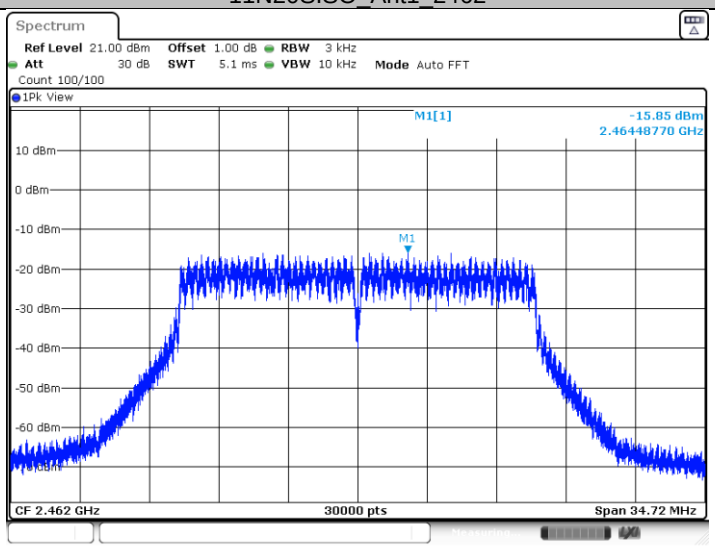

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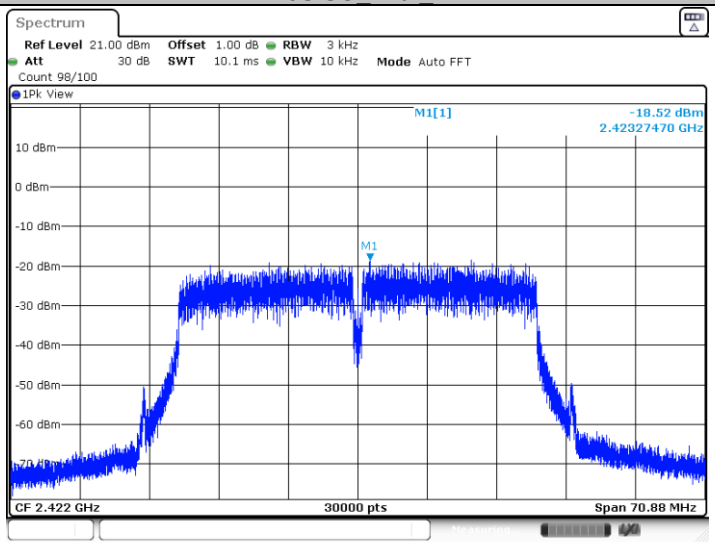

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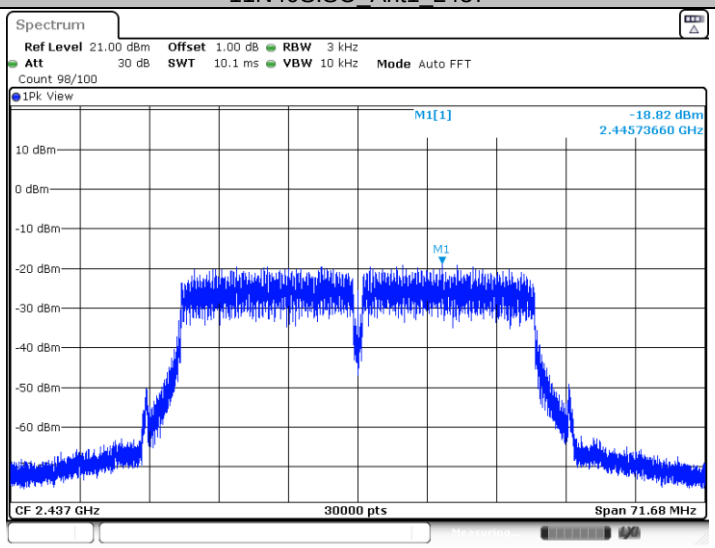

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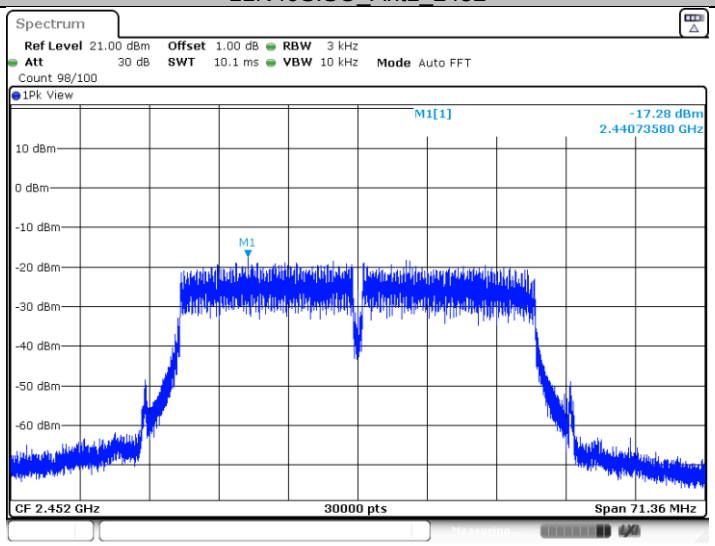

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9.6 Spurious RF conducted emissions

Test Method

1. Establish a reference level by using the following procedure:
   a. Set RBW=100 kHz. VBW≥3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
   b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level to establish the reference level.
   a. Set the center frequency and span to encompass frequency range to be measured.
   b. 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.
3. Repeat above procedures until other frequencies measured were completed.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

Test result

Test Mode	Antenna	Channel (MHz)	Freq Range (MHz)	Ref Level (dBm)	Result (dBm)	Limit (dBm)	Verdict
11B	Ant1	2412	Reference	5.94	5.94	---	PASS
			30~1000	---	-67.69	<=-14.06	PASS
			1000~26500	---	-41.85	<=-14.06	PASS
		2437	Reference	6.11	6.11	---	PASS
			30~1000	---	-68.21	<=-13.89	PASS
			1000~26500	---	-40.78	<=-13.89	PASS
		2462	Reference	7.12	7.12	---	PASS
			30~1000	---	-68.2	<=-12.88	PASS
			1000~26500	---	-40.78	<=-12.88	PASS
11G	Ant1	2412	Reference	2.13	2.13	---	PASS
			30~1000	---	-68.09	<=-17.87	PASS
			1000~26500	---	-39.15	<=-17.87	PASS
		2437	Reference	-0.22	-0.22	---	PASS
			30~1000	---	-68.45	<=-20.22	PASS
			1000~26500	---	-52.17	<=-20.22	PASS
		2462	Reference	0.97	0.97	---	PASS
			30~1000	---	-68.22	<=-19.03	PASS
			1000~26500	---	-52.41	<=-19.03	PASS
11N20SISO	Ant1	2412	Reference	-0.33	-0.33	---	PASS
			30~1000	---	-68.3	<=-20.33	PASS
			1000~26500	---	-41.63	<=-20.33	PASS
		2437	Reference	-3.10	-3.10	---	PASS
			30~1000	---	-67.67	<=-23.1	PASS
			1000~26500	---	-52.2	<=-23.1	PASS
		2462	Reference	-1.08	-1.08	---	PASS
			30~1000	---	-67.49	<=-21.08	PASS
			1000~26500	---	-51.64	<=-21.08	PASS
11N40SISO	Ant1	2422	Reference	-4.64	-4.64	---	PASS
			30~1000	---	-68.1	<=-24.64	PASS
			1000~26500	---	-39.86	<=-24.64	PASS
		2437	Reference	-4.41	-4.41	---	PASS
			30~1000	---	-67.36	<=-24.41	PASS

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			1000~26500	---	-52.63	<=-24.41	PASS
		2452	Reference	-3.55	-3.55	---	PASS
			30~1000	---	-68	<=-23.55	PASS
			1000~26500	---	-52.92	<=-23.55	PASS

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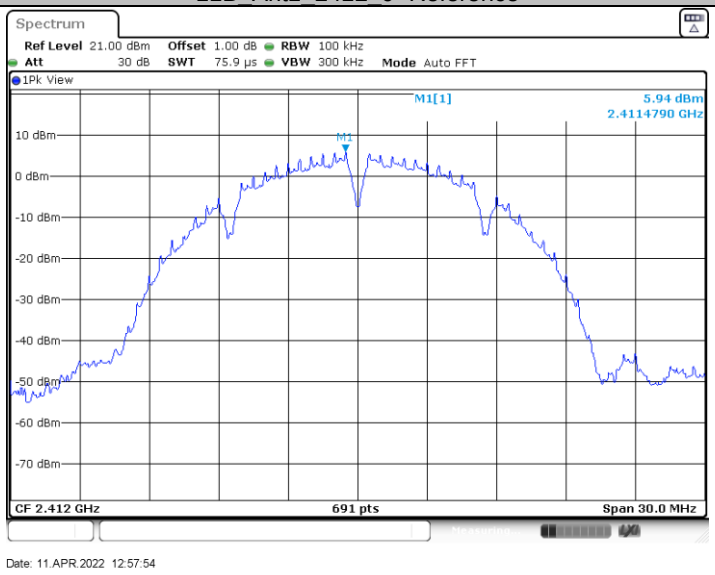
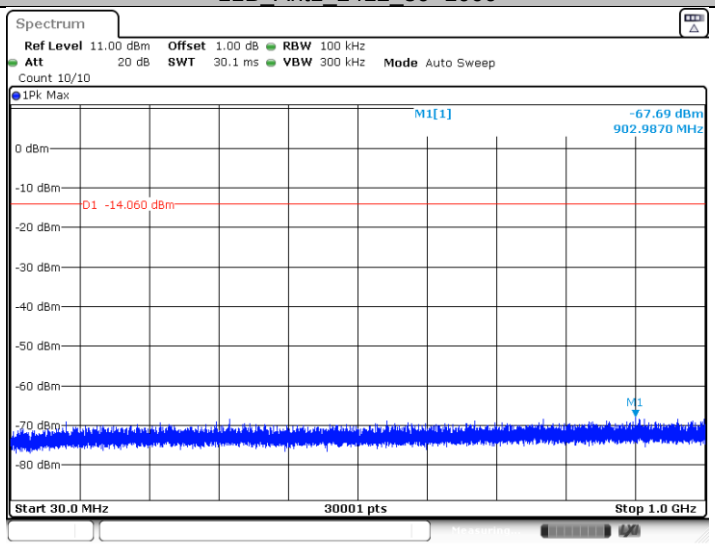
Test Graphs

11B_Ant1_2412_0~Reference



Date: 11.APR.2022 12:57:54

11B_Ant1_2412_30~1000



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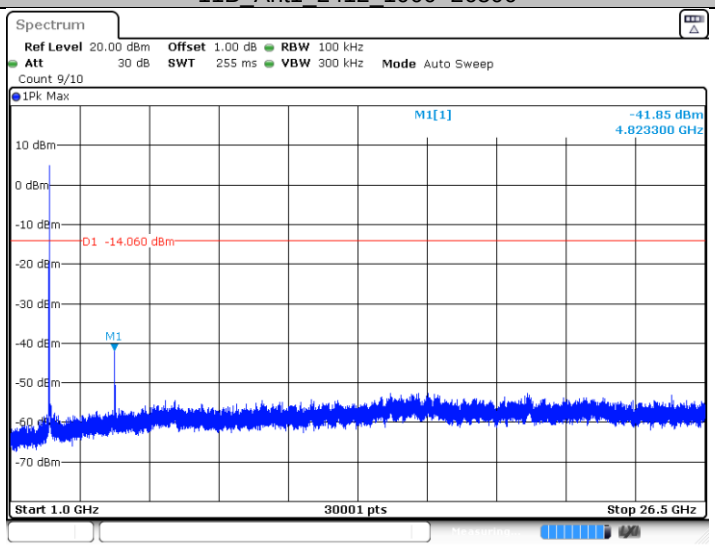

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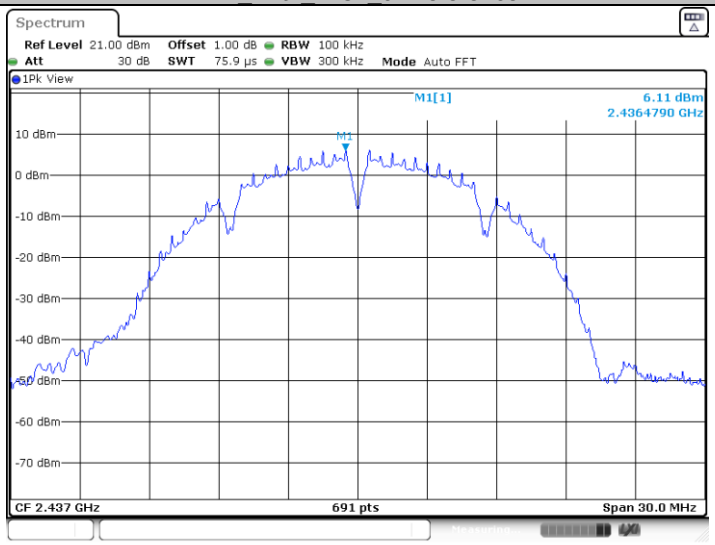

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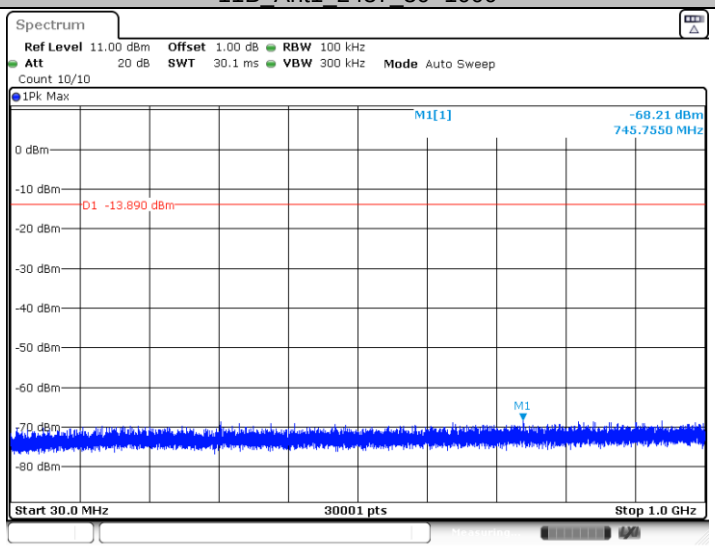

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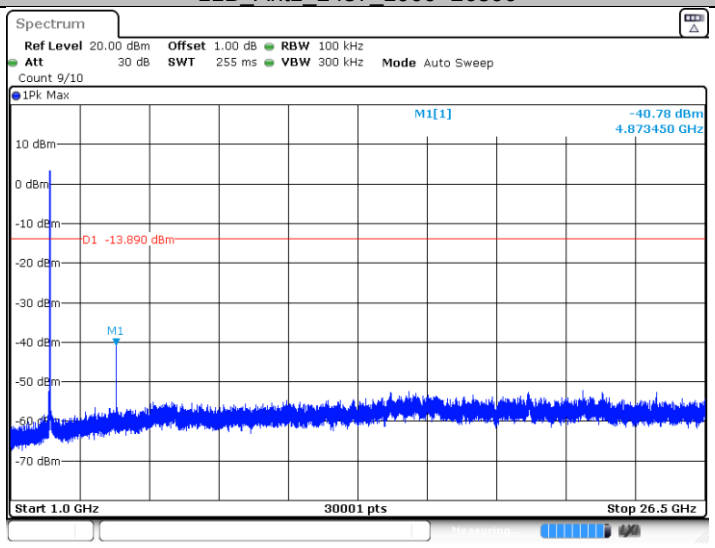

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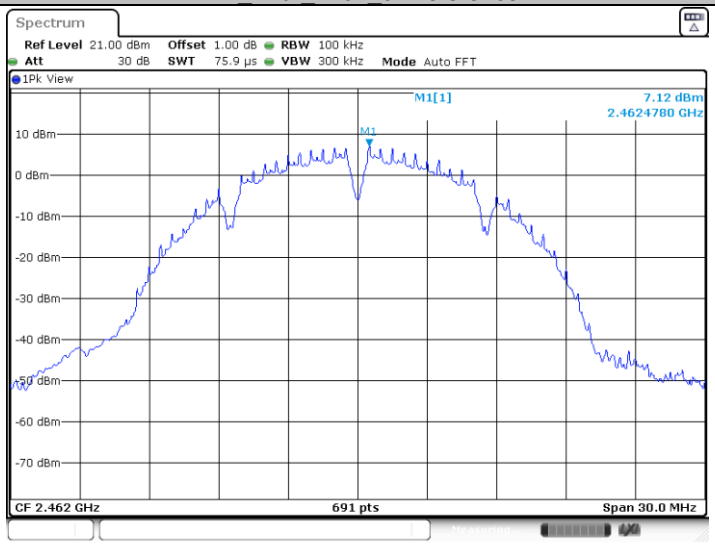

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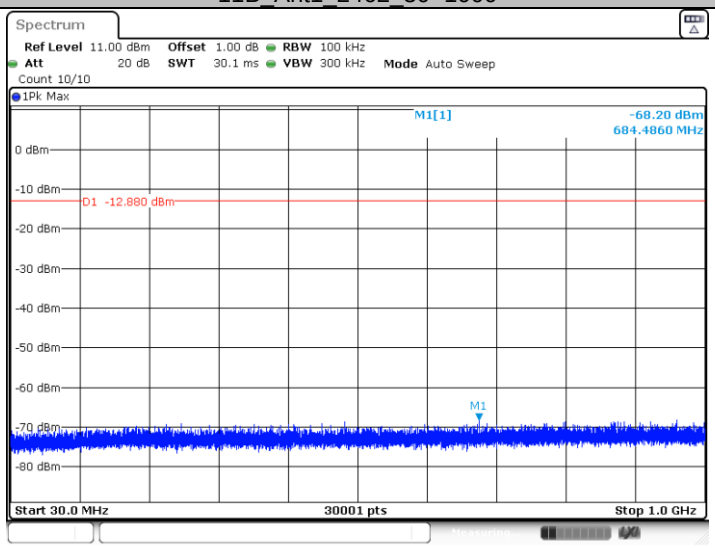

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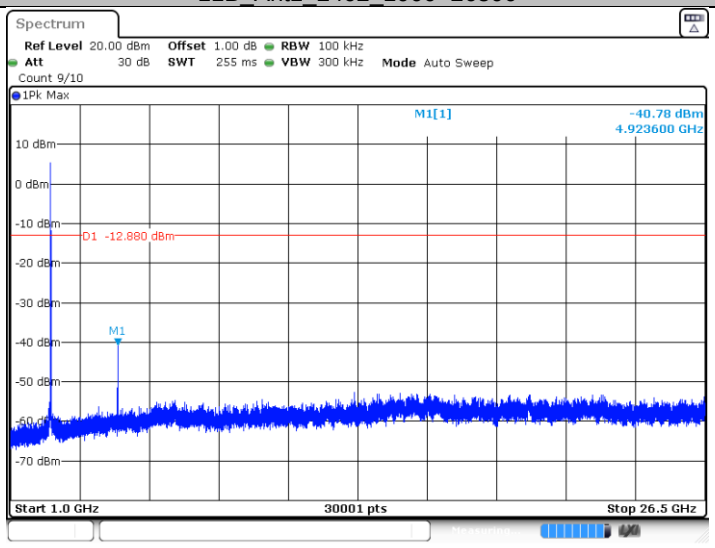

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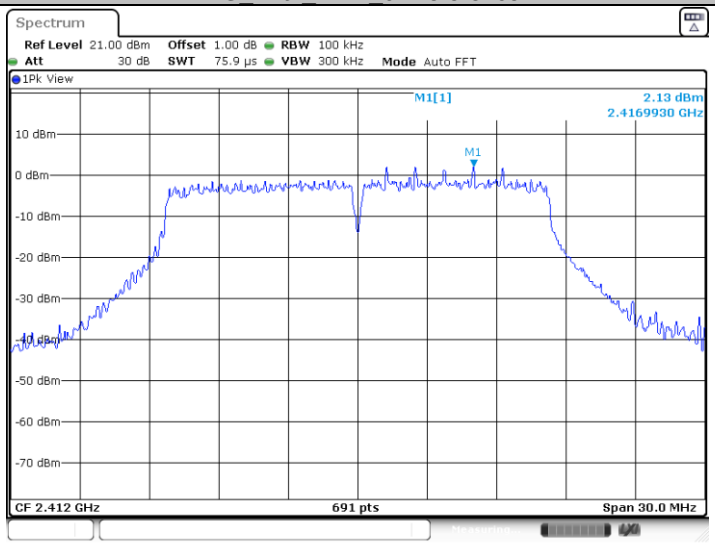

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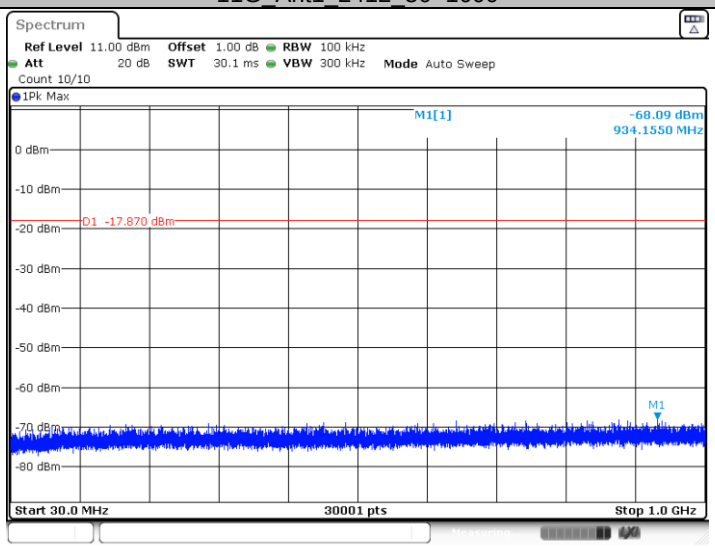

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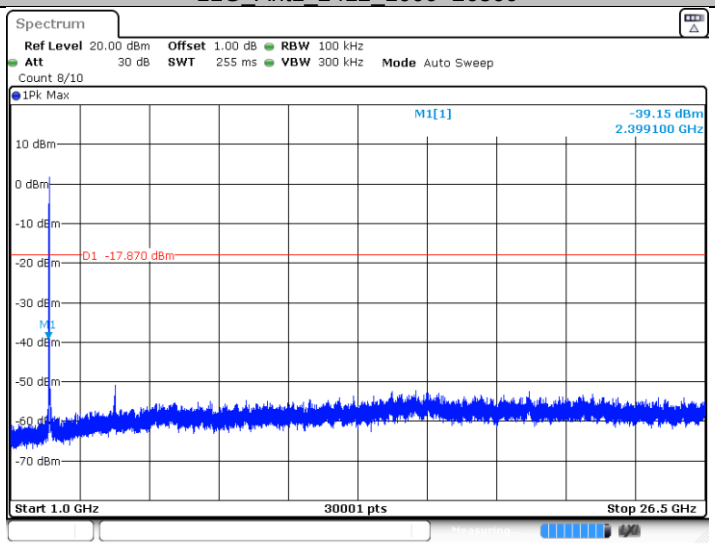

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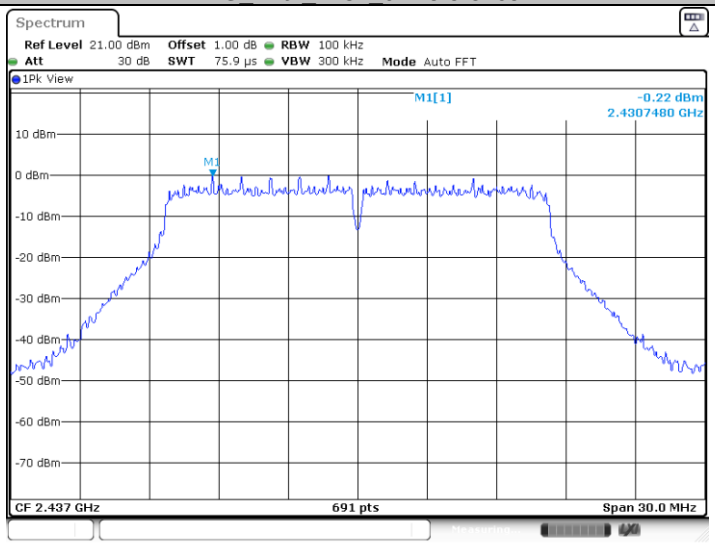

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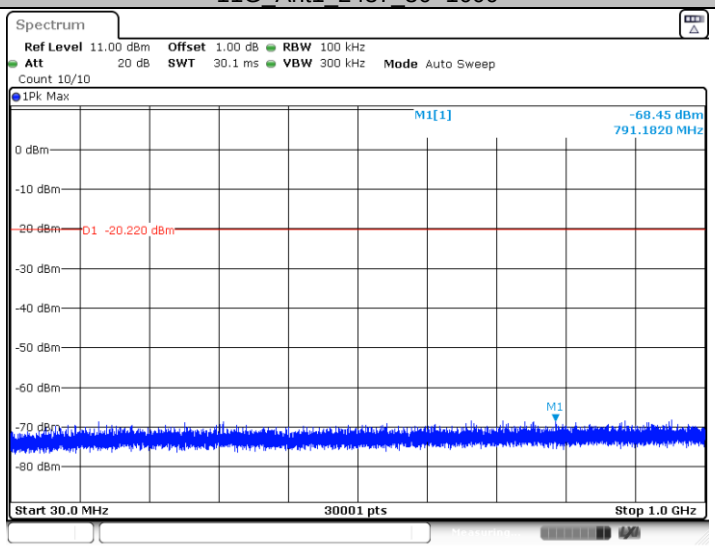

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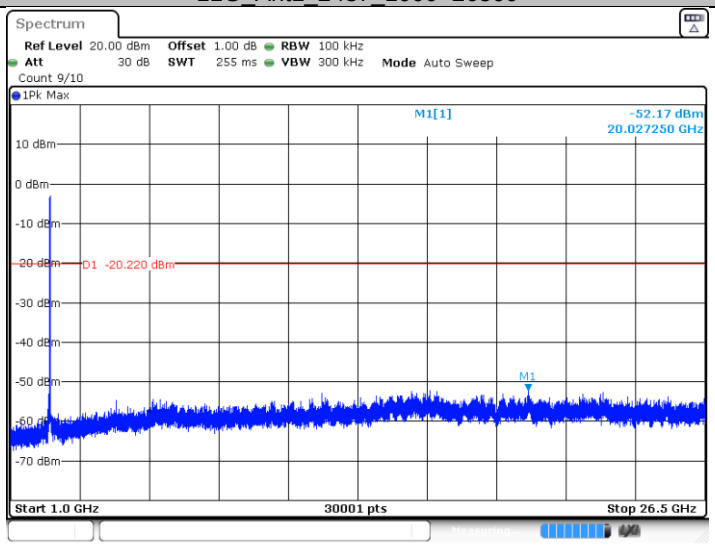

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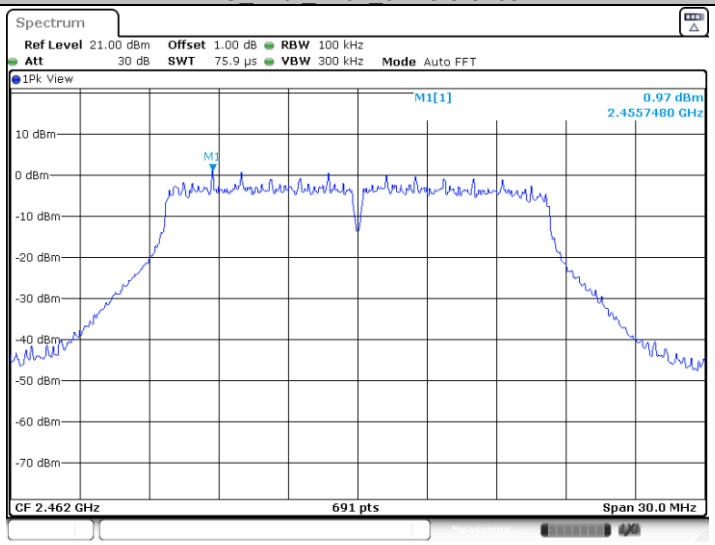

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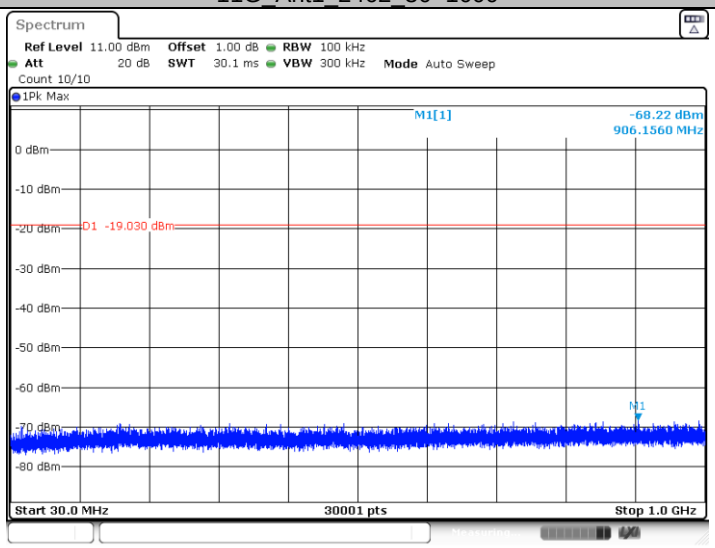

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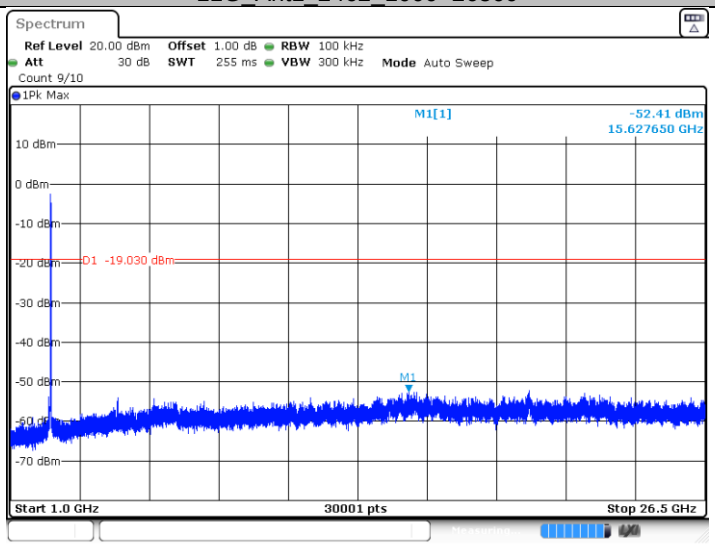

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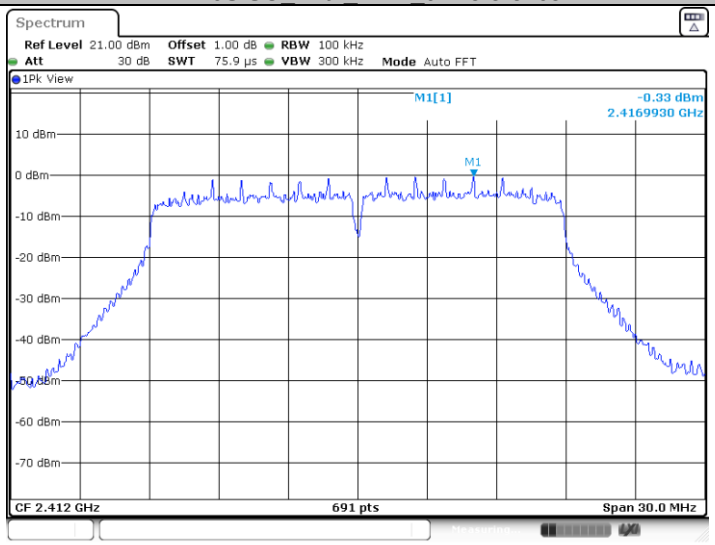

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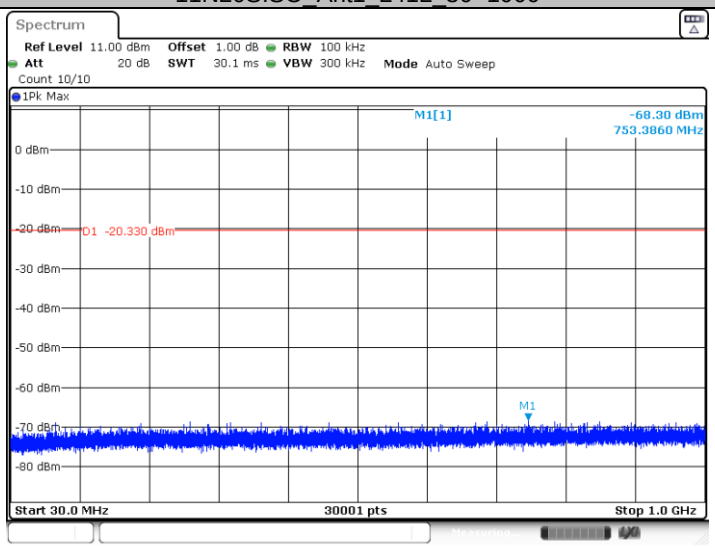

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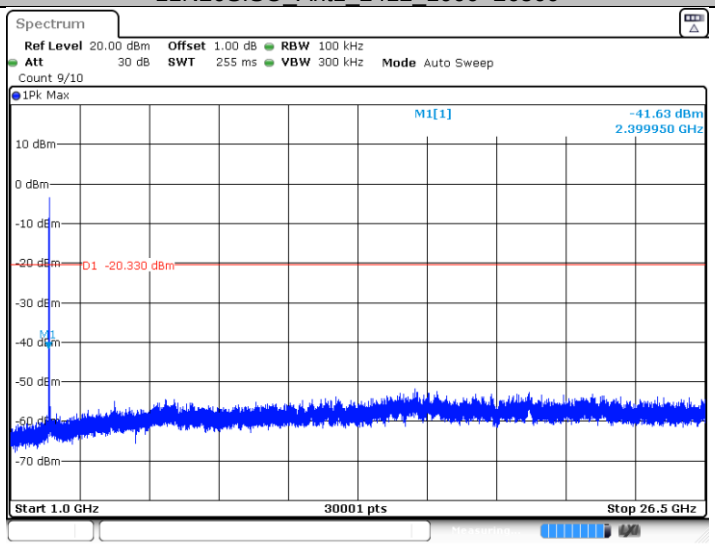

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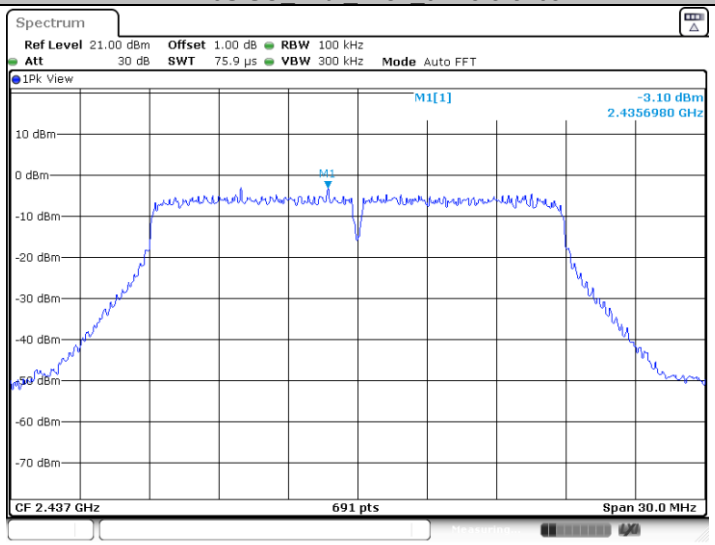

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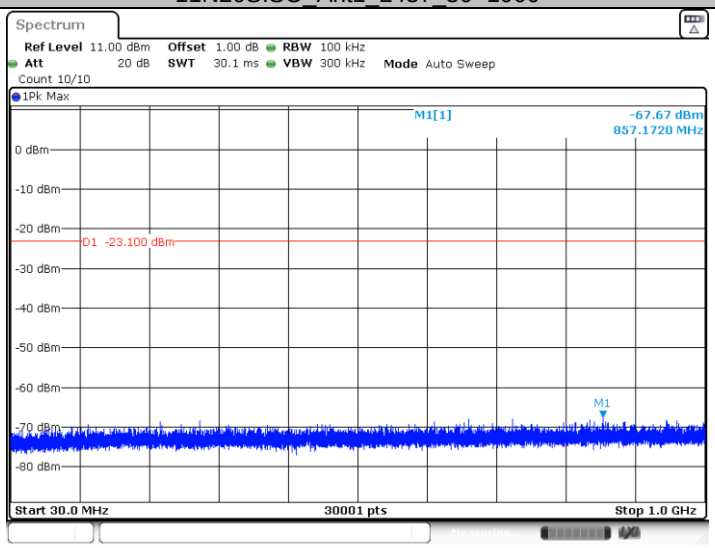

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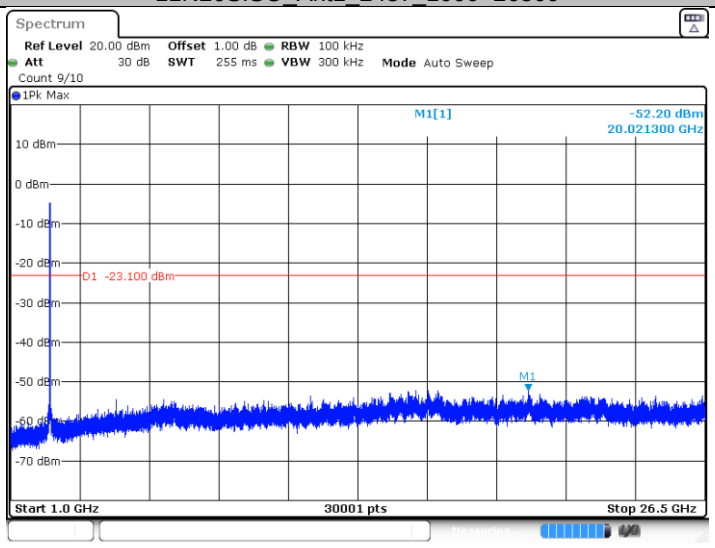

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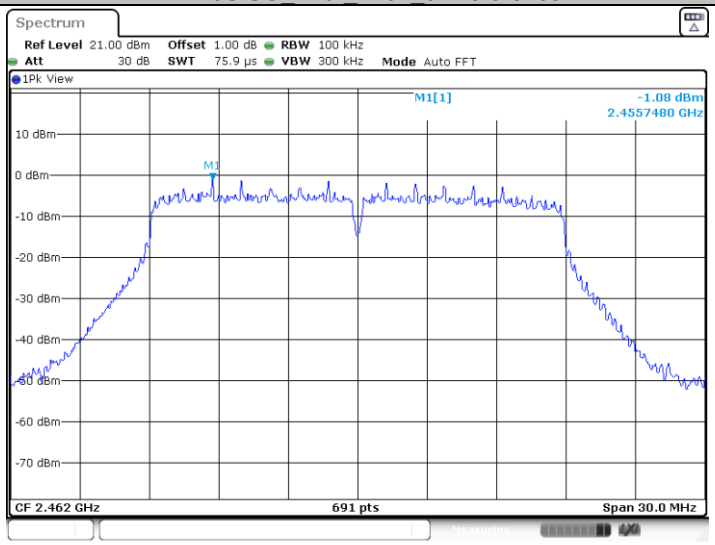

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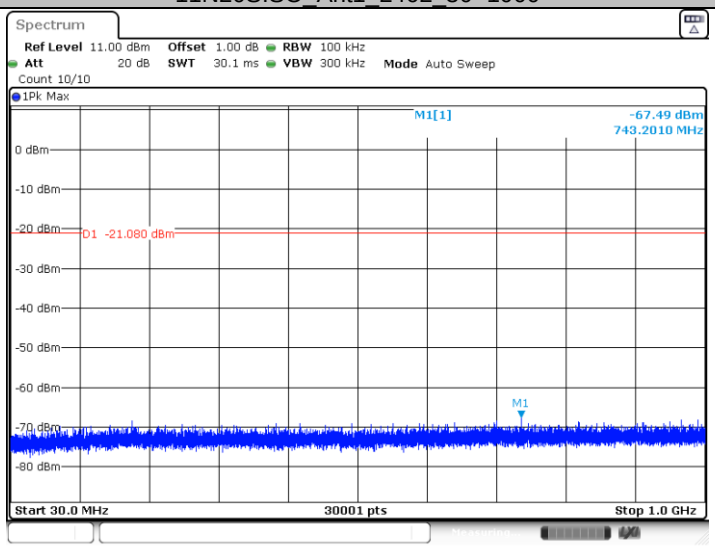

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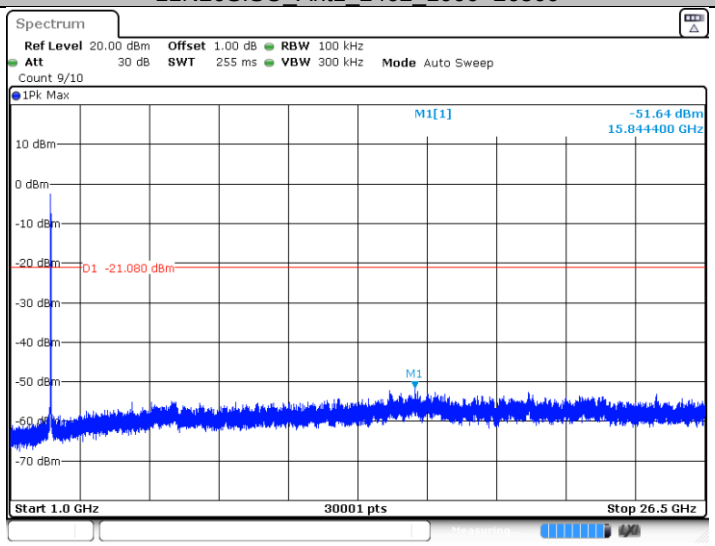

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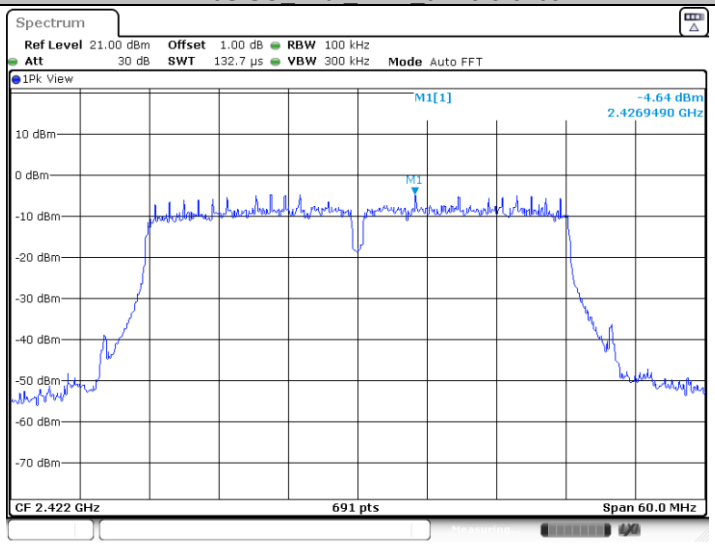

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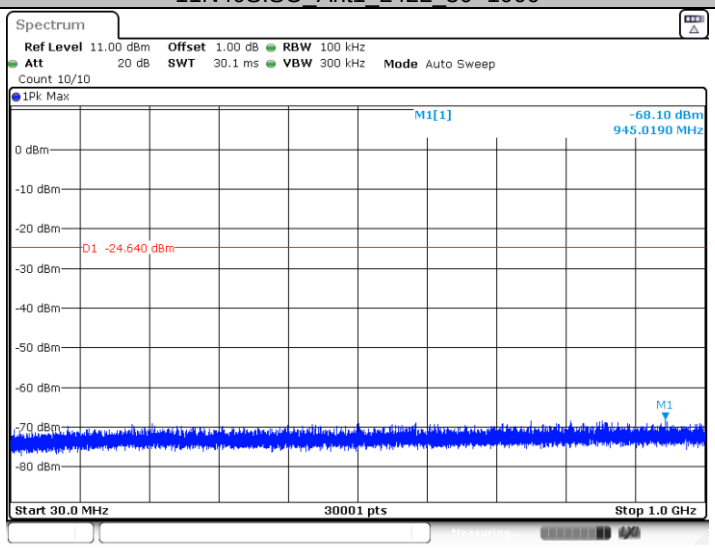

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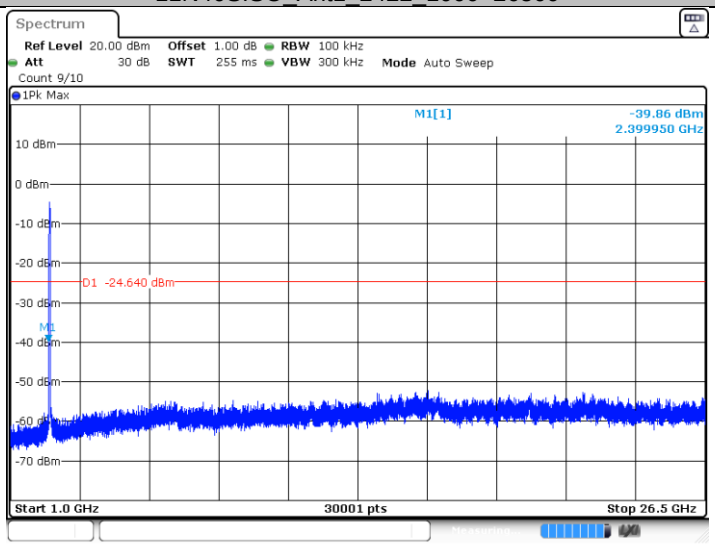

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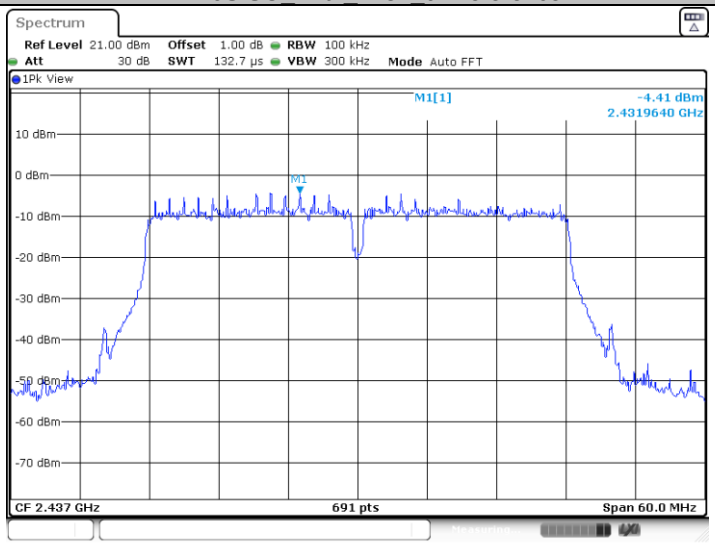

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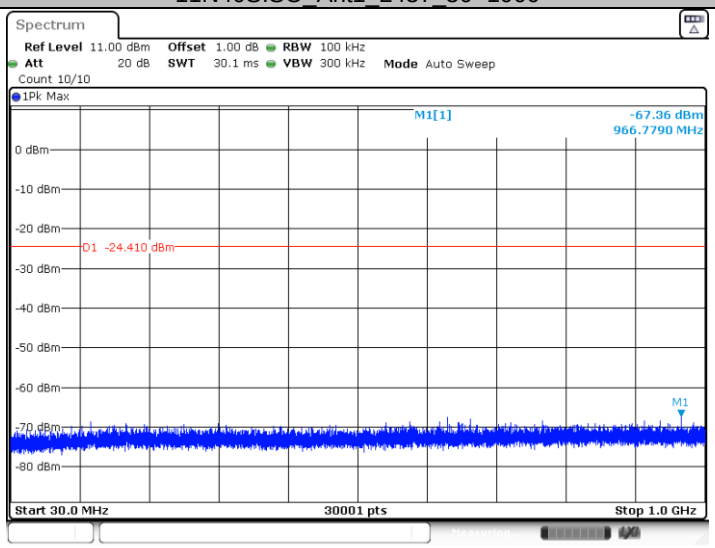

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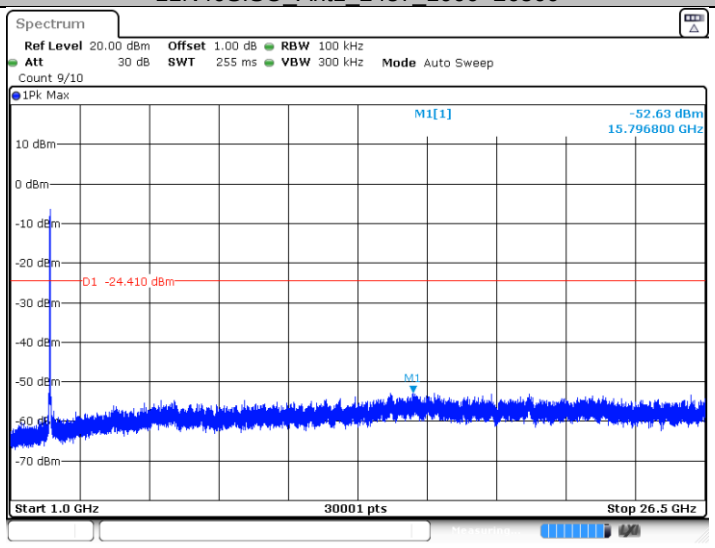

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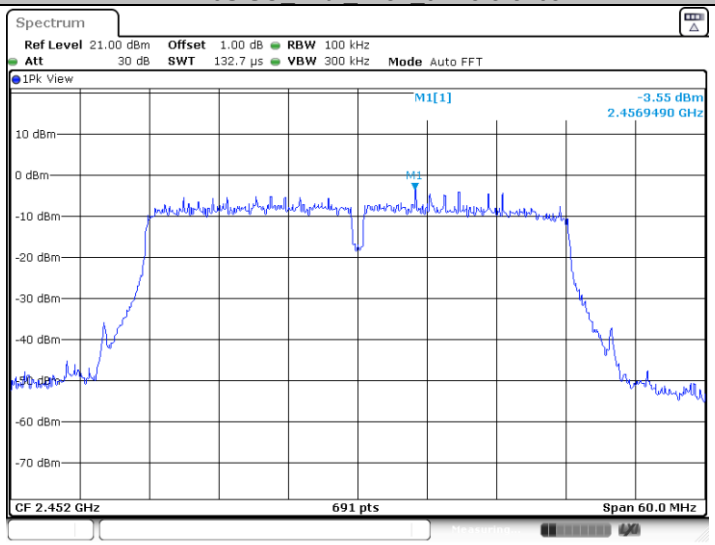

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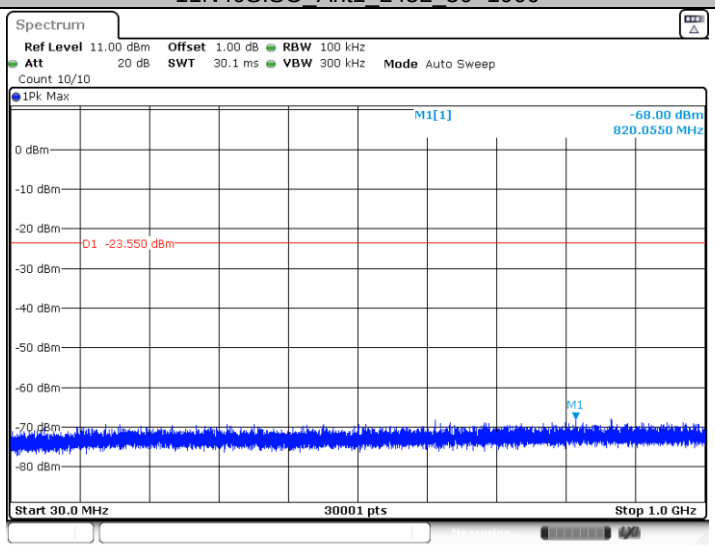

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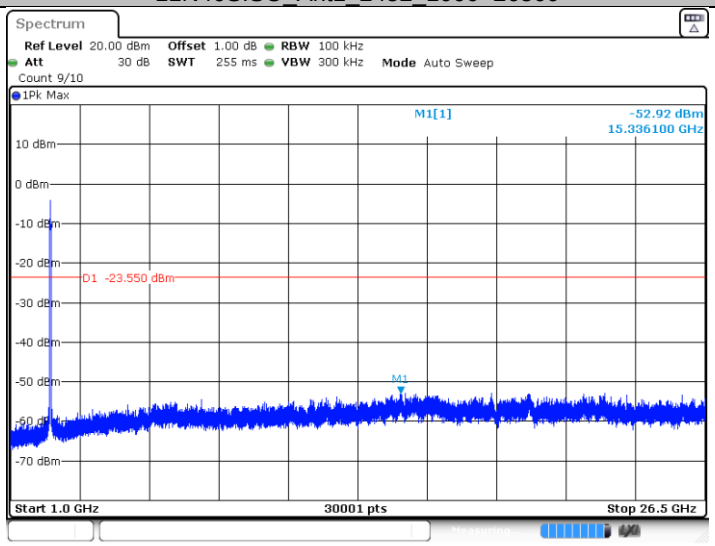

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9.7 Band edge

Test Method

1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW≥RBW, Sweep = auto, Detector function = peak, Trace = max hold.
2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
3 The level displayed must comply with the limit specified in this Section.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

Test result

Test Mode	Antenna	Ch Name	Channel (MHz)	Ref Level (dBm)	Result (dBm)	Limit (dBm)	Verdict
11B	Ant1	Low	2412	5.78	-44.34	<=-14.22	PASS
		High	2462	6.67	-56.01	<=-13.33	PASS
11G	Ant1	Low	2412	0.72	-35.76	<=-19.28	PASS
		High	2462	-1.22	-53.45	<=-21.22	PASS
11N20SISO	Ant1	Low	2412	-0.67	-41.18	<=-20.67	PASS
		High	2462	-2.58	-54.78	<=-22.58	PASS
11N40SISO	Ant1	Low	2422	-4.26	-43.09	<=-24.26	PASS
		High	2452	-3.99	-53.55	<=-23.99	PASS

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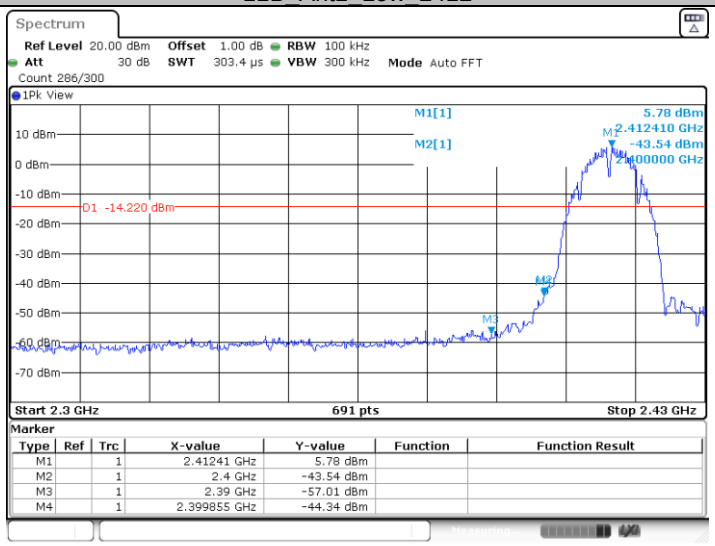
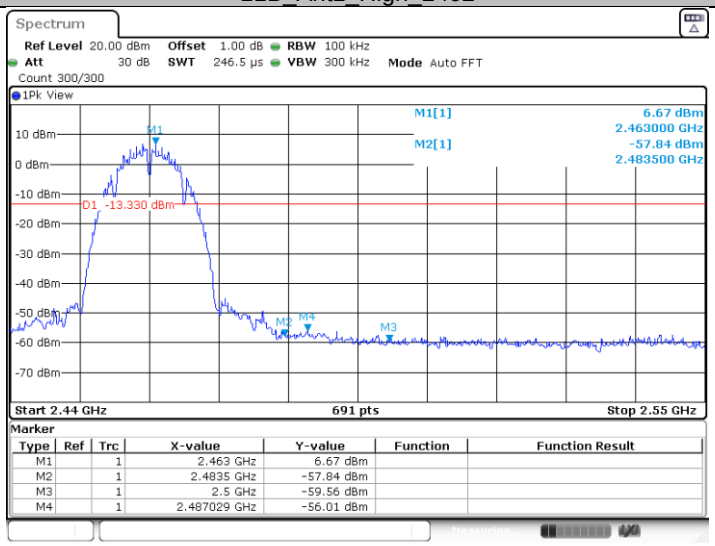
Test Graphs

11B_Ant1_Low_2412



Date: 11.APR.2022 12:57:48

11B_Ant1_High_2462



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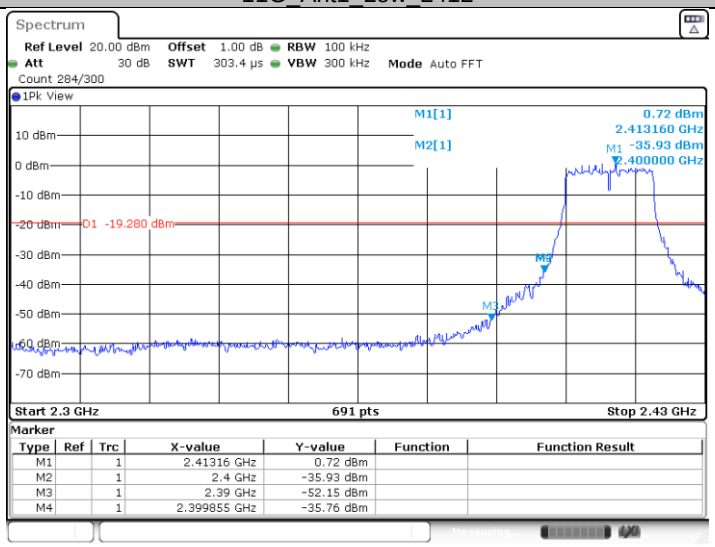

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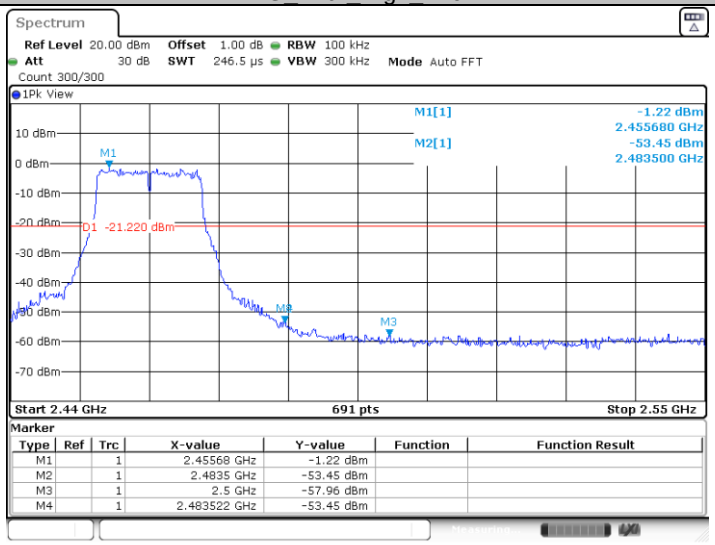

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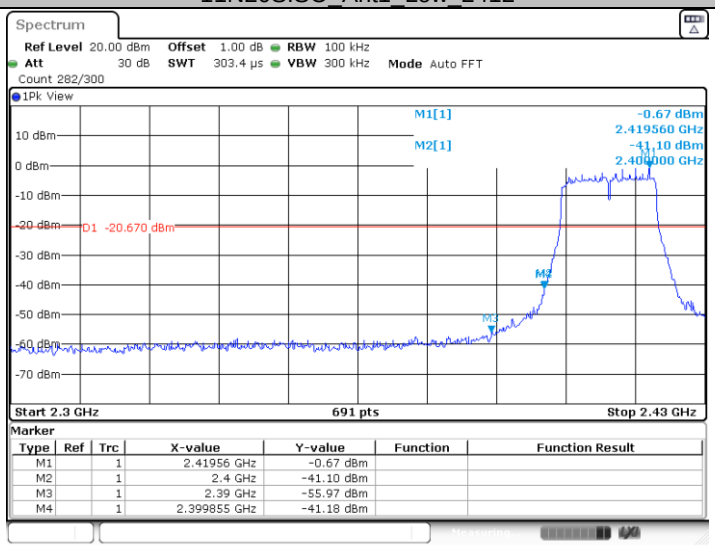

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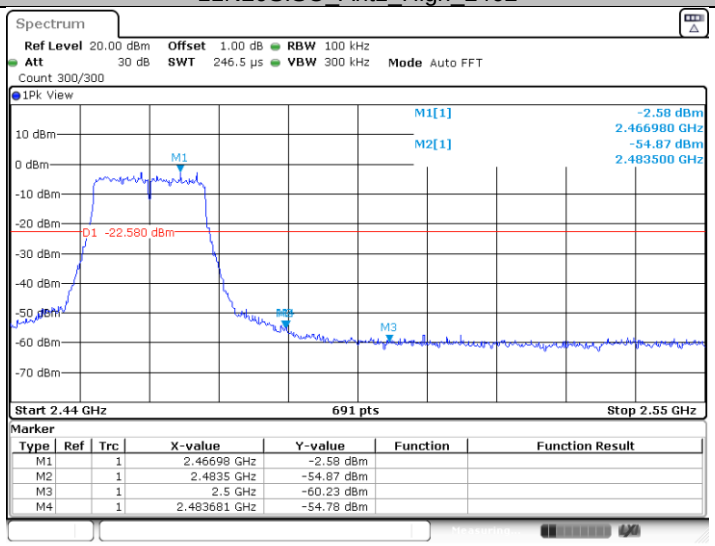

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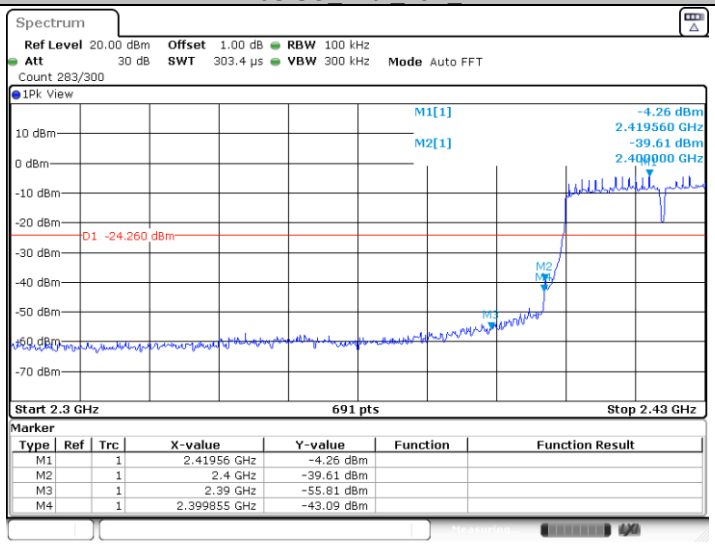
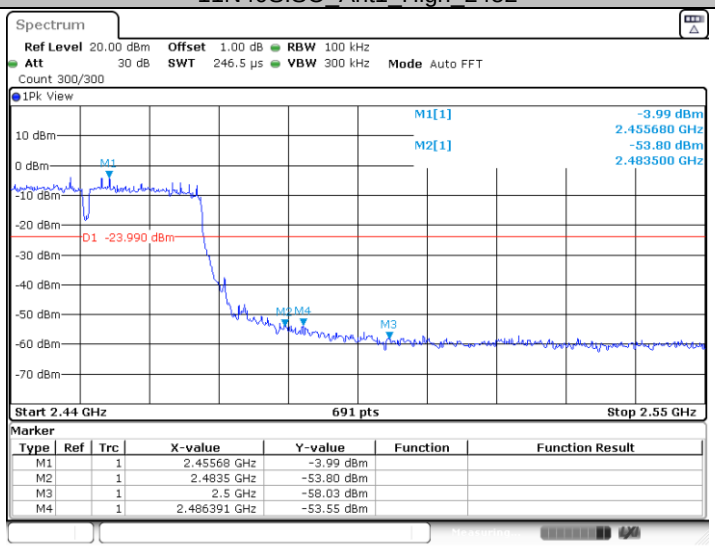
11N40SISO_Ant1_Low_2422


11N40SISO_Ant1_High_2452


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9.8 Spurious radiated emissions for transmitter

Test Method

1: The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
3: The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4: For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5: Use the following spectrum analyzer settings According to C63.10:
For Below 1GHz
Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 KHz to 120KHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Peak unwanted emissions Above 1GHz:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW≥RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.
Procedures for average unwanted emissions measurements above 1000 MHz
a) RBW = 1MHz.
b) VBW \ [3 × RBW].
c) Detector = RMS (power averaging), if [span / (# of points in sweep)] \ RBW / 2. Satisfying this condition can require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, then the detector mode shall be set to peak.
d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
e) Sweep time = auto.
f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)
g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:
1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is [10 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.

2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is [20 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.
3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

Limit

The radio emission outside the operating frequency band 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. Radiated emissions which fall in the restricted bands, as defined in section15.205 and RSS-GEN 8.10, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

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Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Transmitting spurious emission test result as below:

802.11b

2412MHz (30MHz – 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
792.042778	37.05	Horizontal	46.00	8.95	QP	30.06	Pass
786.438333	33.25	Vertical	46.00	12.75	QP	30.01	Pass

2412MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB/m	
4824.500000*	49.99	Horizontal	74.00	24.01	PK	3.97	Pass
4824.500000*	50.62	Vertical	74.00	23.38	PK	3.97	Pass

2437MHz (30MHz – 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
--	--	Horizontal	--	--	QP	--	Pass
--	--	Vertical	--	--	QP	--	Pass

2437MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
5343.000000	49.68	Horizontal	74.00	24.32	Peak	5.18	Pass
5014.500000*	47.97	Vertical	74.00	26.03	Peak	4.83	Pass

2462MHz (30MHz – 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
--	--	Horizontal	--	--	QP	--	Pass
--	--	Vertical	--	--	QP	--	Pass

2462MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
4963.000000*	49.17	Horizontal	74.00	24.83	Peak	4.63	Pass
4283.500000*	49.30	Vertical	74.00	24.70	Peak	3.34	Pass

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802.11g

2412MHz (30MHz – 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
--	--	Horizontal	--	--	QP	--	Pass
--	--	Vertical	--	--	QP	--	Pass

2412MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
4825.500000*	50.31	Horizontal	74.00	23.69	Peak	4.42	Pass
15307.000000	50.70	Vertical	74.00	23.30	Peak	18.82	Pass

2437MHz (30MHz – 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
--	--	Horizontal	--	--	QP	--	Pass
--	--	Vertical	--	--	QP	--	Pass

2437MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
4861.000000*	49.24	Horizontal	74.00	24.76	Peak	4.63	Pass
7308.000000*	47.99	Vertical	74.00	26.01	Peak	8.86	Pass

2462MHz (30MHz – 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
--	--	Horizontal	--	--	QP	--	Pass
--	--	Vertical	--	--	QP	--	Pass

2462MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
14961.500000	49.25	Horizontal	74.00	24.75	Peak	17.35	Pass
4895.500000*	50.20	Vertical	74.00	23.80	Peak	4.57	Pass

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802.11nHT20

2412MHz (30MHz – 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
--	--	Horizontal	--	--	QP	--	Pass
--	--	Vertical	--	--	QP	--	Pass

2412MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
12628.500000*	49.52	Horizontal	74.00	24.48	Peak	16.57	Pass
4900.000000*	49.37	Vertical	74.00	24.63	Peak	4.55	Pass

2437MHz (30MHz – 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
--	--	Horizontal	--	--	QP	--	Pass
--	--	Vertical	--	--	QP	--	Pass

2437MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
4756.000000*	49.18	Horizontal	74.00	24.82	Peak	4.36	Pass
1766.000000	49.36	Vertical	74.00	24.64	Peak	-5.75	Pass

2462MHz (30MHz – 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
--	--	Horizontal	--	--	QP	--	Pass
--	--	Vertical	--	--	QP	--	Pass

2462MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
8025.000000*	43.24	Horizontal	74.00	30.76	Peak	10.10	Pass
9768.000000	48.69	Vertical	74.00	25.31	Peak	12.53	Pass

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802.11nHT40

2422MHz (30MHz – 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
--	--	Horizontal	--	--	QP	--	Pass
--	--	Vertical	--	--	QP	--	Pass

2422MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
9768.000000	47.88	Horizontal	74.00	26.12	Peak	12.53	Pass
8920.500000	46.38	Vertical	74.00	27.62	Peak	11.80	Pass

2437MHz (30MHz – 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
--	--	Horizontal	--	--	QP	--	Pass
--	--	Vertical	--	--	QP	--	Pass

2437MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
11317.500000*	46.67	Horizontal	74.00	27.33	Peak	13.46	Pass
9748.000000	47.42	Vertical	74.00	26.58	Peak	12.50	Pass

2452MHz (30MHz – 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
--	--	Horizontal	--	--	QP	--	Pass
--	--	Vertical	--	--	QP	--	Pass

2452MHz (Above 1GHz)

Frequency	Emission Level	Polarization	Limit	Margin	Detector	Corr.	Result
MHz	dBuV/m		dBµV/m	dB		dB	
4904.500000*	45.63	Horizontal	74.00	28.37	Peak	4.96	Pass
1994.761905	47.30	Vertical	74.00	26.70	Peak	-3.71	Pass

Remark:

(1) "*" means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205.
(2) Data of measurement within this frequency range shown "--" in the table above means the reading of emissions are the noise floor or attenuated more than 10dB below the permissible limits or the field strength is too small to be measured.
(3) Corrected Amplitude = Read level + Corrector factor
Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain.
Below 1GHz: Corrector factor = Antenna Factor + Cable Loss.
(The Reading Level is recorded by software which is not shown in the sheet)

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10 Test Equipment List

Radiated Emission 2# Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 26	68-4-74-14-002	101269	1	2022-6-4
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9162	68-4-80-19-003	284	1	2022-2-2
Wave Guide Antenna	ETS	3117	68-4-80-19-001	00218954	1	2022-5-24
Pre-amplifier	Rohde & Schwarz	SCU 18F	68-4-29-19-001	100745	1	2022-10-10
Pre-amplifier	Rohde & Schwarz	SCU 08F2	68-4-29-19-004	08400018	1	2022-10-10
Sideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	68-4-80-14-008	12827	1	2022-7-21
Pre-amplifier	Rohde & Schwarz	SCU 40A	68-4-29-14-002	100432	1	2022-7-27
3m Semi-anechoic chamber	TDK	SAC-3 #2	68-4-90-19-006	----	2	2023-5-28
Test software	Rohde & Schwarz	EMC32	68-4-90-19-006-A01	Version10.35.02	N/A	N/A

Conducted Emission 2# Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	68-4-74-19-002	102590	1	2022-6-4
LISN	Rohde & Schwarz	ENV216	68-4-87-19-001	102472	1	2022-6-5
ISN	Rohde & Schwarz	ENY81	68-4-87-14-003	100177	1	2022-6-5
ISN	Rohde & Schwarz	ENY81-CA6	68-4-87-14-004	101664	1	2022-6-5
High Voltage Probe	Schwarzbeck	TK9420(VT9420)	68-4-27-14-001	9420-584	1	2022-6-5
RF Current Probe	Rohde & Schwarz	EZ-17	68-4-27-14-002	100816	1	2022-6-5
Attenuator	Shanghai Huaxiang	TS2-26-3	68-4-81-16-003	080928189	1	2022-6-3
Test software	Rohde & Schwarz	EMC32	68-4-90-19-005-A01	Version10.35.02	N/A	N/A
Shielding Room	TDK	CSR #2	68-4-90-19-005	----	1	2022-11-07

RF Conducted Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Signal Analyzer	Rohde & Schwarz	FSV40	68-4-74-14-004	101030	1	2022-6-3
RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	68-4-93-14-003	101226/100851	1	2022-6-3
Power Splitter	Weinschel	1580	68-4-85-14-001	SC319	1	2022-6-3
10dB Attenuator	Weinschel	4M-10	68-4-81-14-003	43152	1	2022-6-3
10dB Attenuator	R&S	DNF	68-4-81-14-004	DNF-001	1	2022-6-3
10dB Attenuator	R&S	DNF	68-4-81-14-005	DNF-002	1	2022-6-3
10dB Attenuator	R&S	DNF	68-4-81-14-006	DNF-003	1	2022-6-3
10dB Attenuator	R&S	DNF	68-4-81-14-007	DNF-004	1	2022-6-3
Test software	Tonscend	System for BT/WIFI	68-4-74-14-006-A13	Version 2.6.77.0518	N/A	N/A
Shielding Room	TDK	TS8997	68-4-90-19-003	----	1	2022-11-07

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11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty

System Measurement Uncertainty	
Items	**Extended Uncertainty**
Uncertainty for Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.35dB; Vertical: 4.44dB;
Uncertainty for Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.30dB; Vertical: 4.29dB;
Uncertainty for Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 4.51dB; Vertical: 4.50dB;
Uncertainty for Conducted RF test with TS 8997	RF Power Conducted: 1.31dB Frequency test involved: 0.6×10^{-7} or 1%
Uncertainty for Conducted Emission in new shielding room (68-4-90-19-005) 150kHz-30MHz (for test using AMN ENV216)	3.20dB

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