

FCC/IC - TEST REPORT

Report Number : **68.950.22.0463.01** Date of Issue: **June 6, 2022**

Model / HVIN : **AP6398S2**

Product Type : **Wi-Fi and Bluetooth functionalities module**

Applicant : **Roboteam Home Technology (Shenzhen) Co., Ltd**

Address : **22F, CHANGFU JINMAO BUILDING NO.5 SHIHUA ROAD,
FUTIAN DISTRICT, 518000 SHENZHEN, PEOPLE'S REPUBLIC
OF CHINA**

Manufacturer : **Roboteam Home Technology (Shenzhen) Co., Ltd**

Address : **22F, CHANGFU JINMAO BUILDING NO.5 SHIHUA ROAD,
FUTIAN DISTRICT, 518000 SHENZHEN, PEOPLE'S REPUBLIC
OF CHINA**

Test Result : **Positive** **Negative**

Total pages including Appendices : **46**

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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, Nantou Checkpoint
Road 2, Nanshan District
Shenzhen 518052
P.R. China

Telephone: 86 755 8828 6998

Fax: 86 755 8828 5299

FCC Registration No.: 514049

FCC Designation Number: CA5009

IC Registration No.: 10320A

3 Description of the Equipment Under Test

Product:	Wi-Fi and Bluetooth functionalities module
Model no.:	AP6398S2
Brand name:	t e m i
Hardware Version Identification No. (HVIN)	AP6398S2
FCC ID:	2ASJLAP6398S2
IC:	24774-AP6398S2
Options and accessories:	N/A
Rating:	Supplied by 3.3VDC
RF Transmission Frequency:	2412MHz-2462MHz for 802.11b/g/n20 (WiFi)
No. of Operated Channel:	11 for 802.11b/g/n20 (WiFi)
Modulation:	DSSS, OFDM
Antenna Type:	Integrated antenna
Antenna 1	-0.5dBi Max for Ant0 0.5dBi Max for Ant1
Antenna 2	-5.0dBi Max for Ant0 -2.5dBi Max for Ant1
Description of the EUT:	The Equipment Under Test (EUT) is a Wi-Fi and Bluetooth functionalities module which support Bluetooth function and Wi-Fi operated at 5GHz and 2.4GHz. Only 2.4GWiFi included in this report.

NOTE 1: The above EUT's information is declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

NOTE 2: This report contains two kinds of antenna, they are identical only except antenna gain, testing only performed at the antenna support higher gain.

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 April 2018 + A1 + A2	General Requirements for Compliance of Radio Apparatus
RSS-247 Issue 2 February 2017	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE-LAN) Devices

All the test methods were according to KDB 558074 D01 15.247 Meas Guidance v05r02 Measurement Guidance and ANSI C63.10 (2013).

5 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C/ RSS-247 Issue 2/RSS-Gen Issue 5						
Test Condition	Pages	Test Site	Test Result			
			Pass	Fail	N/A	
§15.207 & RSS-GEN 8.8	Conducted emission AC power port	10	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247 (b) (1) & RSS-247 5.4(d)	Conducted peak output power	13	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
RSS-247 5.4(d)	Equivalent Isotropic Radiated Power	13	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(a)(1) & RSS-247 5.1(b)	20dB bandwidth	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1) & RSS-247 5.1(b)	Carrier frequency separation	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)(iii) & RSS-247 5.1(d)	Number of hopping frequencies	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(1)(iii) & RSS-247 5.1(d)	Dwell Time	---	---	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
§15.247(a)(2) & RSS-247 5.2(a) & RSS-GEN 6.7	6dB bandwidth and 99% Occupied Bandwidth	15	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(e) & RSS-247 5.2(b)	Power spectral density	24	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d) & RSS-247 5.5	Spurious RF conducted emissions	25	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d) & RSS-247 5.5	Band edge	36	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.247(d) & §15.209 & RSS-247 5.5 & RSS-Gen 6.13	Spurious radiated emissions for transmitter	40	Site 1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
§15.203 & RSS-Gen 6.8	Antenna requirement	See note 2		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Note 1: N/A=Not Applicable.

Note 2: The EUT uses an external antenna and manufacturer will stick it down with glue, which gain are -0.5dBi and 0.5dBi. In accordance to §15.203 & RSS-Gen 6.8, it is considered sufficiently to comply with the provisions of this section.

6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2ASJLAP6398S2, IC: 24774-AP6398S2, complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C rules and RSS-247, RSS-GEN.

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: April 25, 2022

Testing Start Date: April 27, 2022

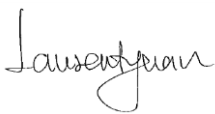
Testing End Date: June 5, 2022

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

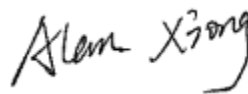
Reviewed by:

Prepared by:

Tested by:



Laurent Yuan
Section Manager



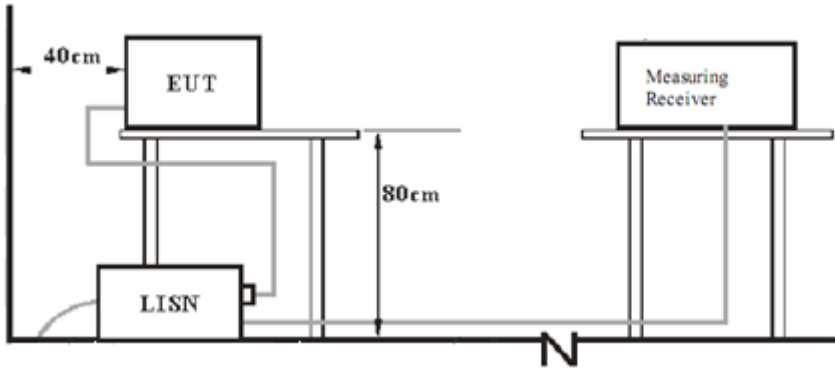
Alan Xiong
Project Engineer



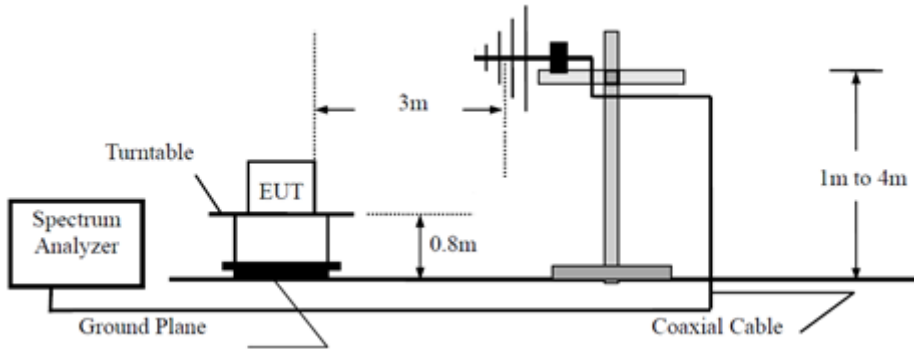
Carry Cai
Test Engineer

7 Test Setups

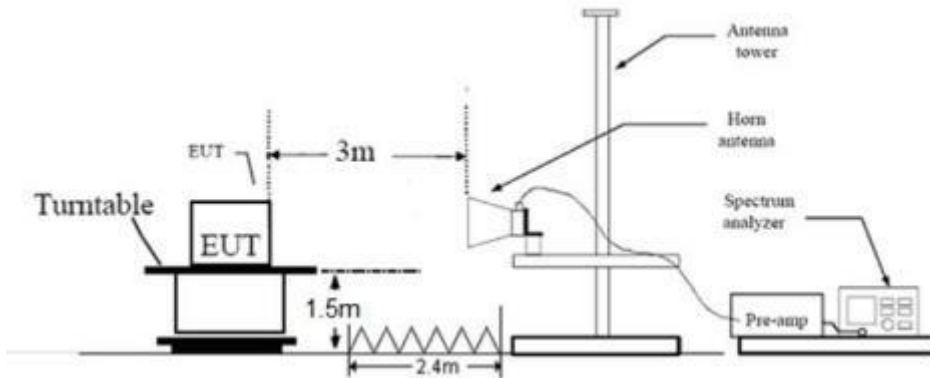
7.1 AC Power Line Conducted Emission test setups



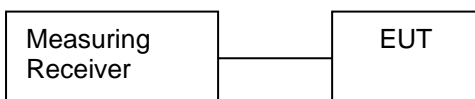
7.2 Radiated test setups Below 1GHz



Above 1GHz



7.3 Conducted RF test setups



8 Systems Test Configuration

Auxiliary Equipment Used during Test:

Description	Manufacturer	Model NO.	S/N
Laptop	Thinkpad	X230	0A72162
Adapter	HOLOTO	ADS-25FSG-12	12VDC, 2.0A

Cables Used During Test:

Cable	Length	Shielded/unshielded	With / without ferrite
USB Cable	1.0m	Shielded	Without ferrite

The system was configured to non-hopping mode.

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power.

Through pre-scan all kind of modulation and all kind of rates, find the 1Mbps of rate is the worst case of 802.11b; the 6Mbps of rate is the worst case of 802.11g; the 6.5Mbps of rate is the worst case of 802.11N20, only the worst case transmitter rate data mode in recorded in the report.

9 Technical Requirement

9.1 Conducted Emission

Test Method

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. Both sides of AC line were checked for maximum conducted interference.
6. The frequency range from 150 kHz to 30 MHz was searched.
7. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

Limit

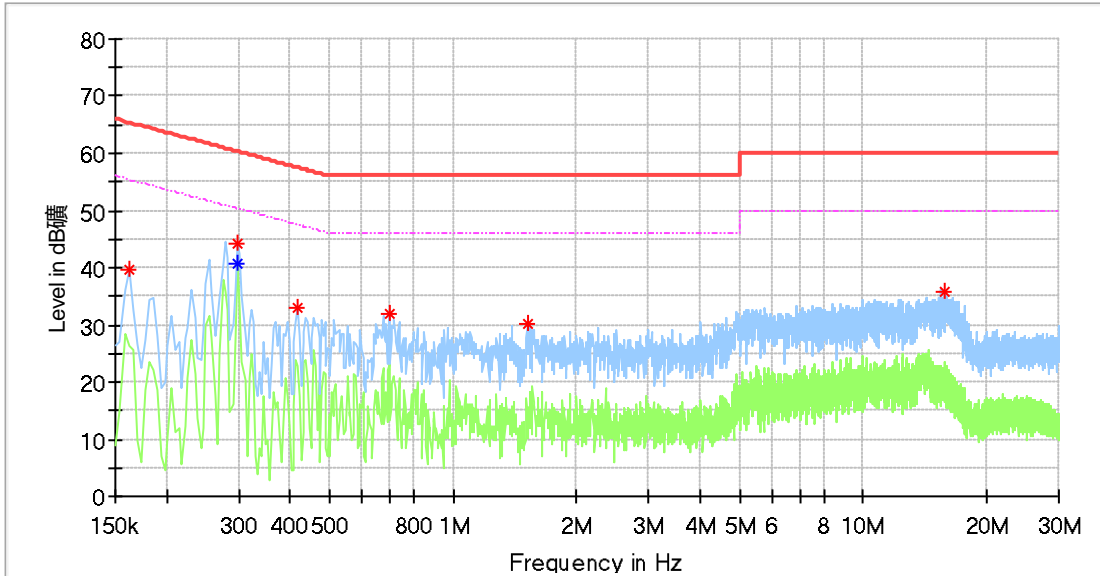
According to §15.207 & RSS-GEN 8.8, Conducted emissions limit as below:

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

Decreasing linearly with logarithm of the frequency

Conducted Emission

Product Type : Wi-Fi and Bluetooth functionalities module
 M/N : AP6398S2
 Operating Condition : Normal Working
 Test Specification : Line
 Comment : AC 120V/60Hz

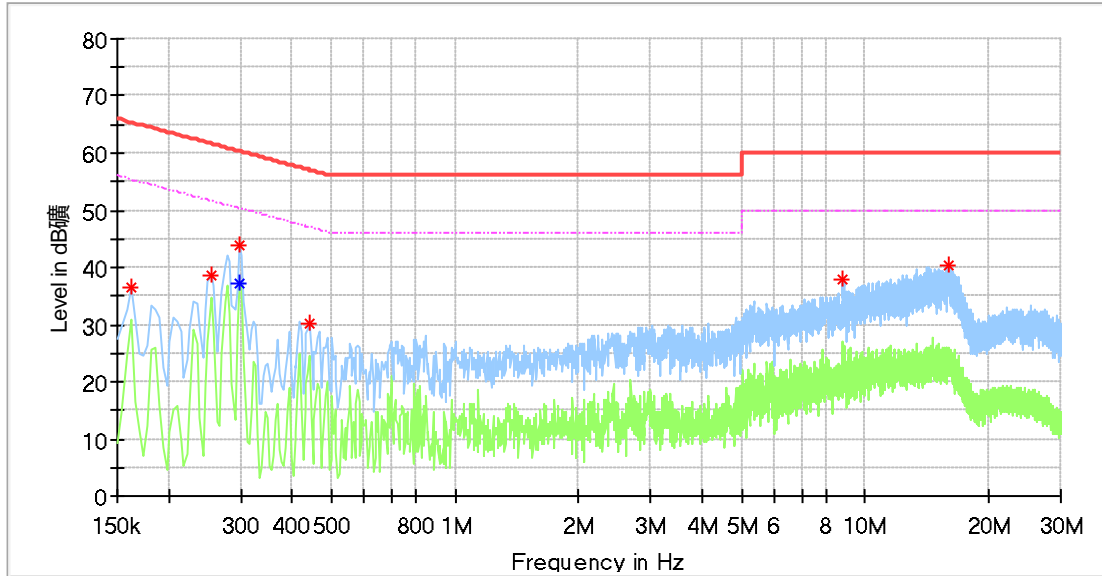


Frequency (MHz)	Max Peak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB)
0.162000	39.66	---	65.36	25.70	L1	9.73
0.298000	---	40.69	50.30	9.60	L1	9.66
0.298000	44.09	---	60.30	16.20	L1	9.66
0.418000	33.04	---	57.49	24.45	L1	9.66
0.698000	32.05	---	56.00	23.95	L1	9.65
1.514000	30.22	---	56.00	25.78	L1	9.68
15.878000	35.79	---	60.00	24.21	L1	10.24

Remark:
 Max Peak= Read level + Corrector factor
 Correct factor=cable loss + LISN factor

Conducted Emission

Product Type : Wi-Fi and Bluetooth functionalities module
 M/N : AP6398S2
 Operating Condition : Normal Working
 Test Specification : Neutral
 Comment : AC 120V/60Hz



Frequency (MHz)	Max Peak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Corr. (dB)
0.162000	36.45	---	65.36	28.91	N	9.77
0.254000	38.62	---	61.63	23.00	N	9.70
0.298000	---	37.02	50.30	13.28	N	9.70
0.298000	43.78	---	60.30	16.51	N	9.70
0.442000	30.34	---	57.02	26.68	N	9.68
8.850000	37.73	---	60.00	22.27	N	10.17
16.058000	40.40	---	60.00	19.60	N	10.37

Remark:
 Max Peak= Read level + Corrector factor
 Correct factor=cable loss + LISN factor

9.2 Conducted Peak Output Power & EIRP

Test Method

1. The RF output of EUT was connected to the test receiver by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. Use the following test receiver settings:
Span = approximately 5 times the 20dB bandwidth, centered on a hopping channel
RBW > the 20dB bandwidth of the emission being measured, VBW ≥ RBW,
Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power and record the results in the test report.
5. Repeat above procedures until all frequencies measured were complete.

Limits

According to §15.247 (b) (1) & RSS-247 5.4(d), conducted peak 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	≤1	≤30

Test result as below table

802.11b_SISO modulation Test Result

Frequency (MHz)	Conducted Peak Output Power (dBm)		Antenna Gain (dBi)		EIRP (dBm)		Result
	Ant 0	Ant 1	Ant 0	Ant 1	Ant 0	Ant 1	
Low channel 2412MHz	14.6	14.7	-0.5	0.5	14.1	15.2	Pass
Middle channel 2437MHz	14.7	14.8	-0.5	0.5	14.2	15.3	Pass
High channel 2462MHz	14.3	14.0	-0.5	0.5	13.8	14.5	Pass

802.11g_CDD modulation Test Result

Frequency (MHz)	Conducted Peak Output Power (dBm)			Antenna Gain (dBi)		EIRP (dBm)			Result
	Ant 0	Ant 1	SUM	Ant 0	Ant 1	Ant 0	Ant 1	SUM	
Low channel 2412MHz	15.1	13.6	17.4	-0.5	0.5	14.6	14.1	17.4	Pass
Middle channel 2437MHz	15.1	14.7	17.9	-0.5	0.5	14.6	15.2	17.9	Pass
High channel 2462MHz	14.8	14.0	17.4	-0.5	0.5	14.3	14.5	17.4	Pass

802.11n20_MIMO modulation Test Result

Frequency (MHz)	Conducted Peak Output Power (dBm)			Antenna Gain (dBi)		EIRP (dBm)			Result
	Ant 0	Ant 1	SUM	Ant 0	Ant 1	Ant 0	Ant 1	SUM	
Low channel 2412MHz	15.2	13.9	17.6	-0.5	0.5	14.7	14.4	17.6	Pass
Middle channel 2437MHz	15.3	14.2	17.8	-0.5	0.5	14.8	14.7	17.8	Pass
High channel 2462MHz	14.8	14.4	17.6	-0.5	0.5	14.3	14.9	17.6	Pass

$$\text{Power}^{\text{SUM}} = 10 * \text{Log}(10^{\text{Power}^{\text{Ant0}}/10} + 10^{\text{Power}^{\text{Ant1}}/10})$$

9.3 6dB Bandwidth and 99% Occupied Bandwidth

Test Method for 6 dB Bandwidth

1. Use the following spectrum analyzer settings:
RBW=100K, VBW \geq 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 \geq 6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

Test Method for 99 % Bandwidth

1. Use the following spectrum analyzer settings:
RBW=1% to 5% of the actual occupied, VBW \geq 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be \geq 6 dB.
3. Allow the trace to stabilize, record the X dB Bandwidth value.

Limit

Limit [kHz]

\geq 500

802.11b modulation Test Result

Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (MHz)	Result
Low channel 2412MHz	7.160	11.908	0.5	Pass
Middle channel 2437MHz	7.160	11.908	0.5	Pass
High channel 2462MHz	7.120	11.908	0.5	Pass

802.11g modulation Test Result

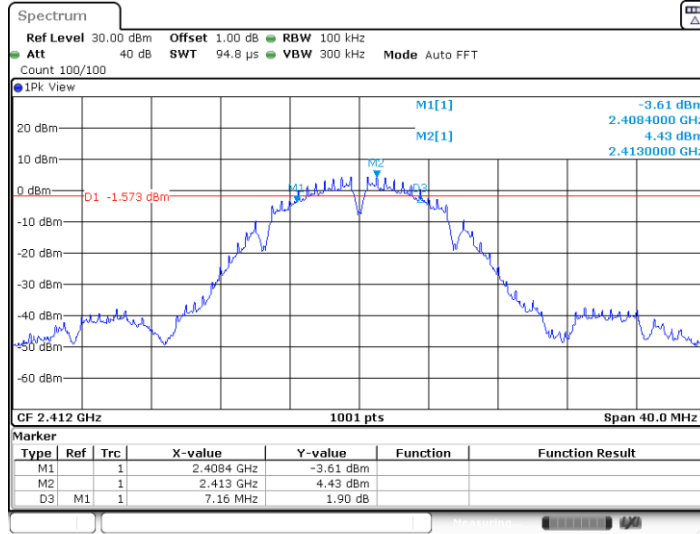
Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (MHz)	Result
Low channel 2412MHz	16.400	17.822	0.5	Pass
Middle channel 2437MHz	16.400	17.862	0.5	Pass
High channel 2462MHz	16.400	17.822	0.5	Pass

802.11n-HT20 modulation Test Result

Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	Limit (MHz)	Result
Low channel 2412MHz	17.680	18.621	0.5	Pass
Middle channel 2437MHz	17.640	18.661	0.5	Pass
High channel 2462MHz	17.680	18.661	0.5	Pass

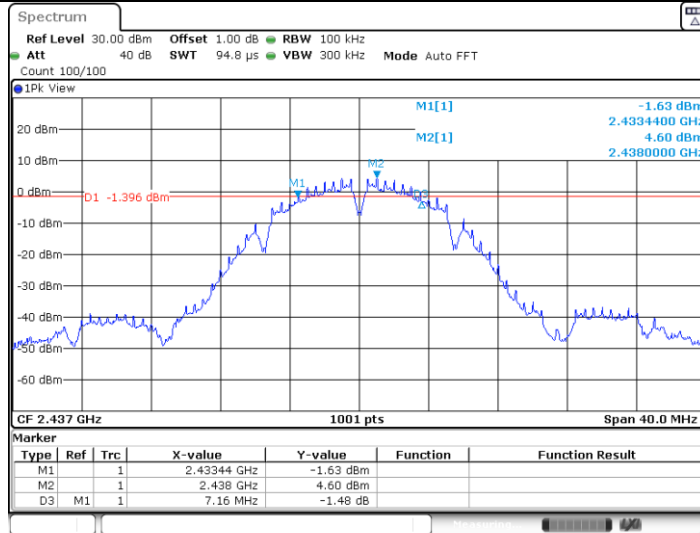
6 dB Bandwidth

11B_2412



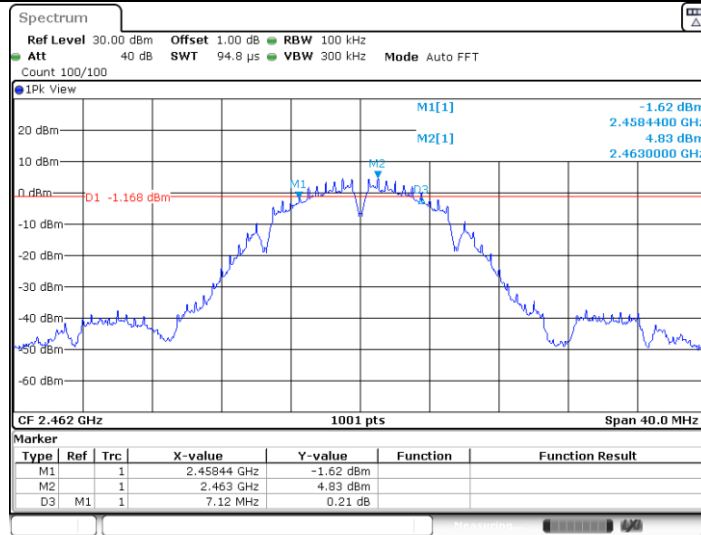
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11B_2437



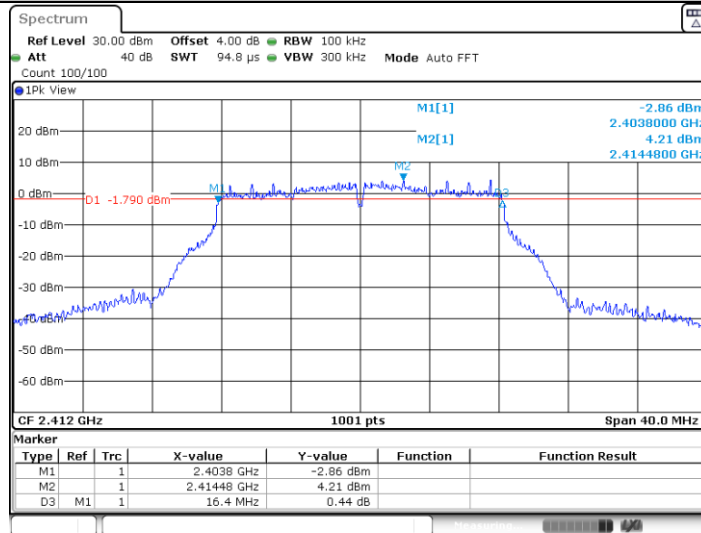
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11B_2462



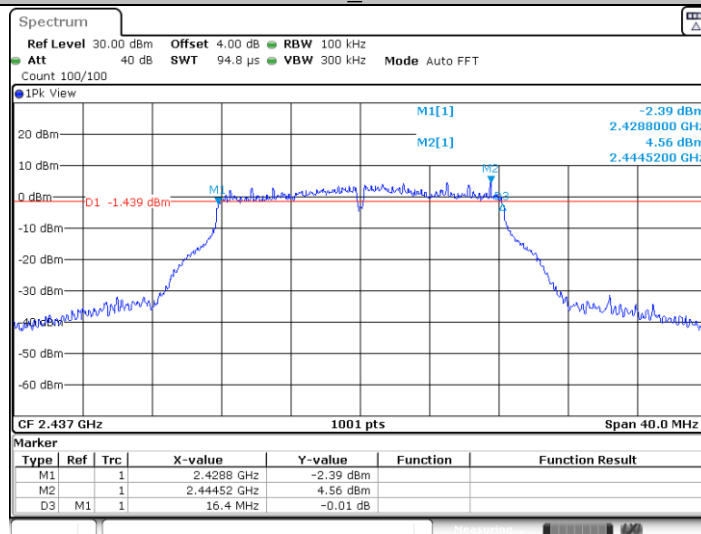
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11G_2412



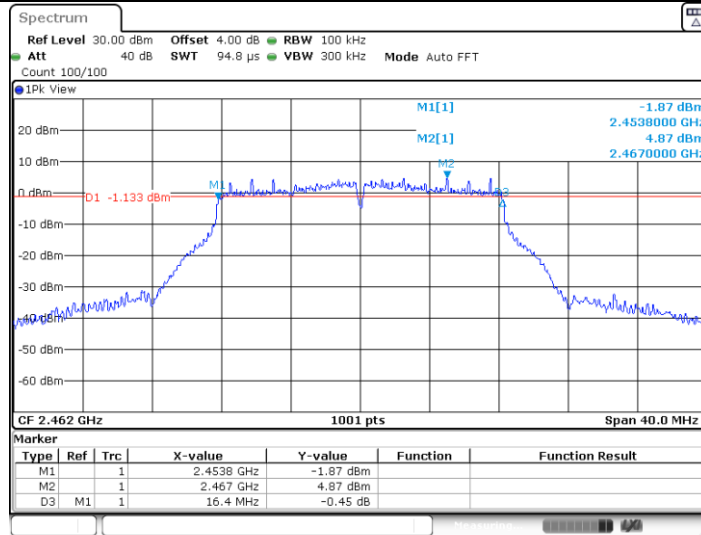
Date: 15.MAY.2022 13:29:38

11G_2437



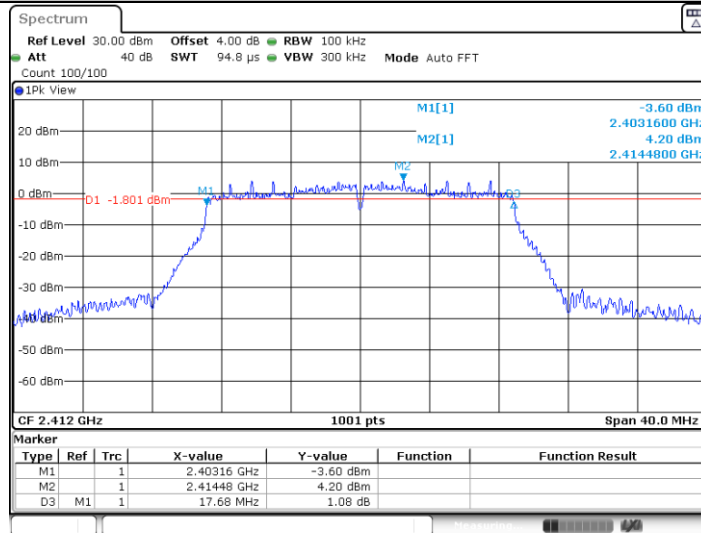
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11G_2462



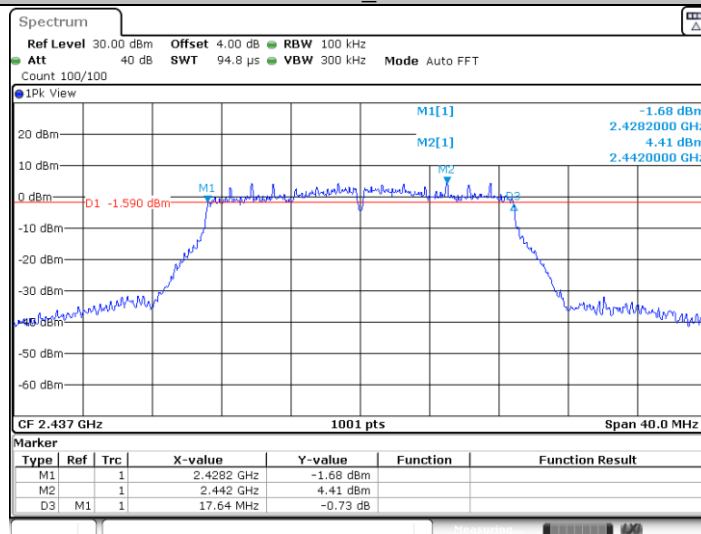
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11N20_2412



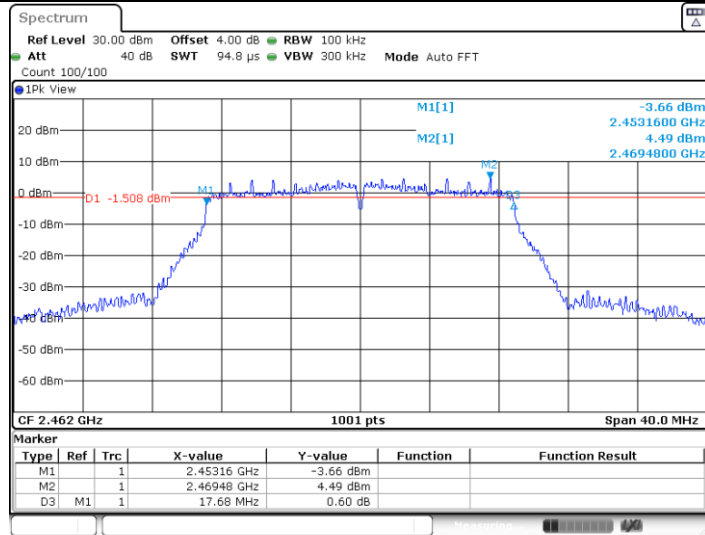
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11N20_2437



Date: 15.MAY.2022 13:40:35

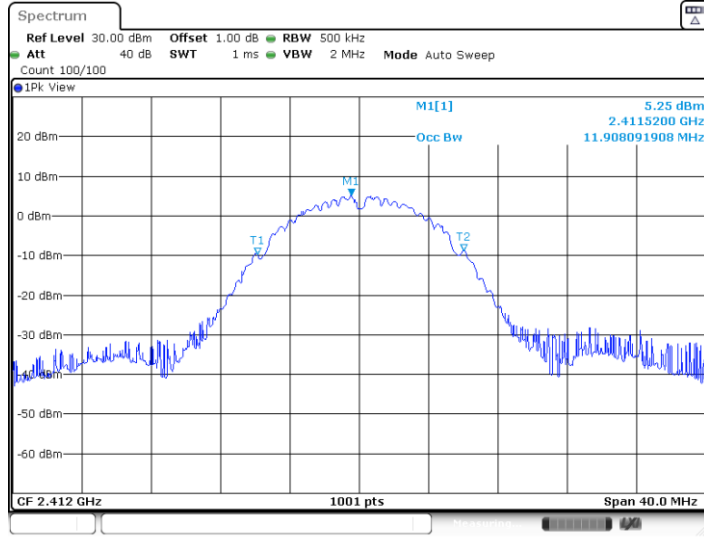
11N20_2462



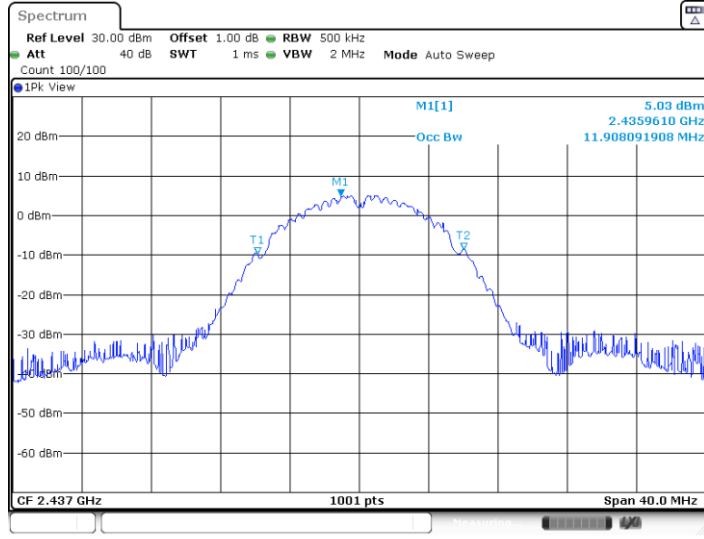
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99% Bandwidth

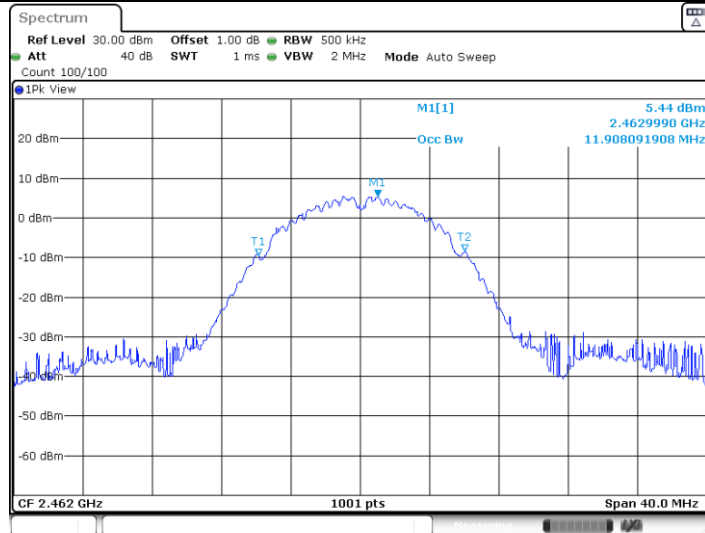
11B_2412



11B_2437

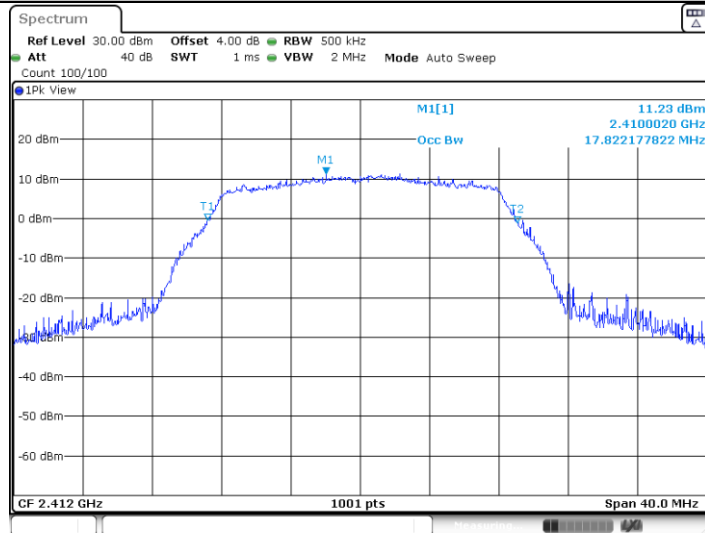


11B_2462



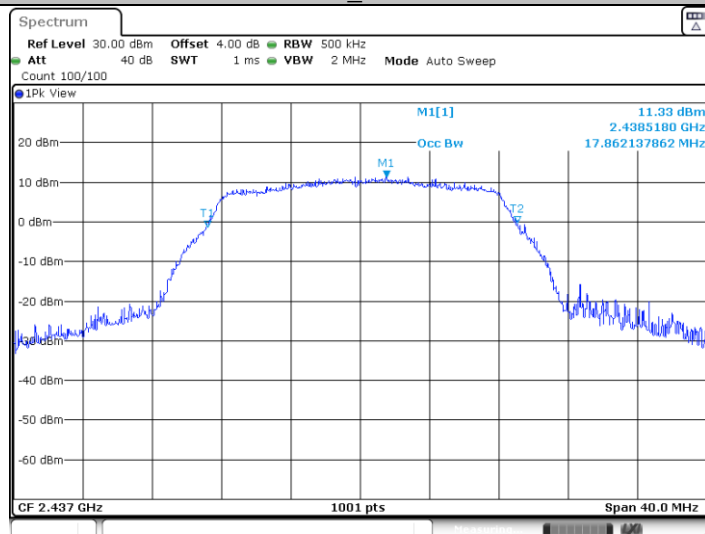
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11G_2412



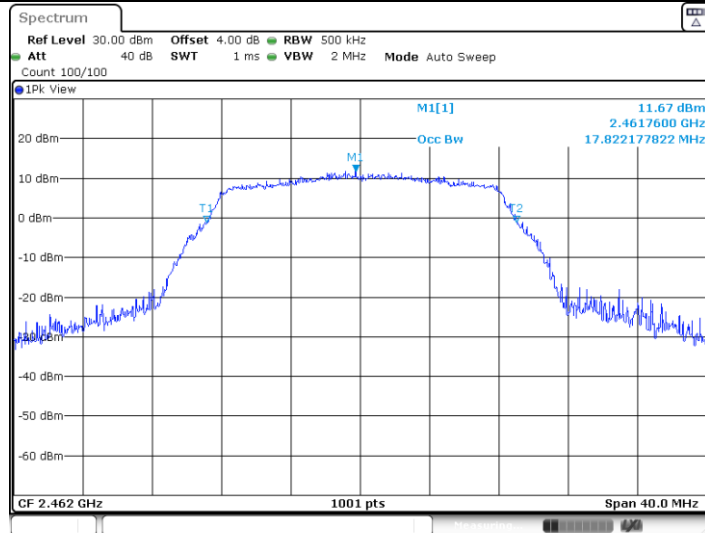
Date: 15 MAY 2022 13:29:49

11G_2437



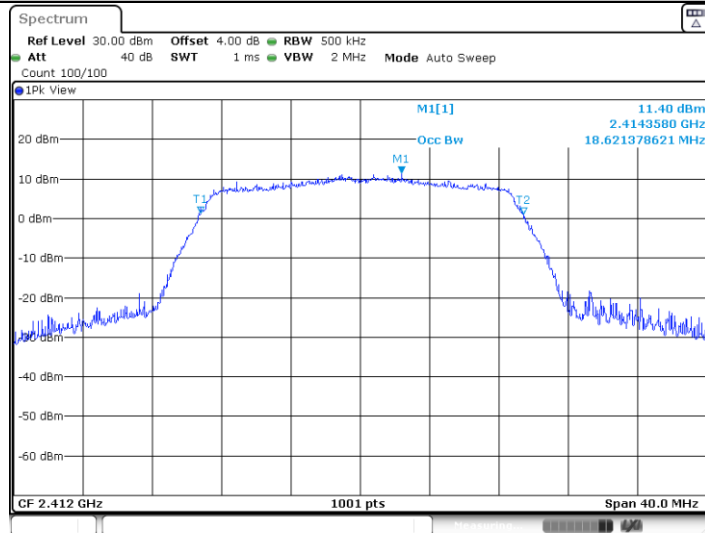
Date: 15 MAY 2022 13:31:46

11G_2462



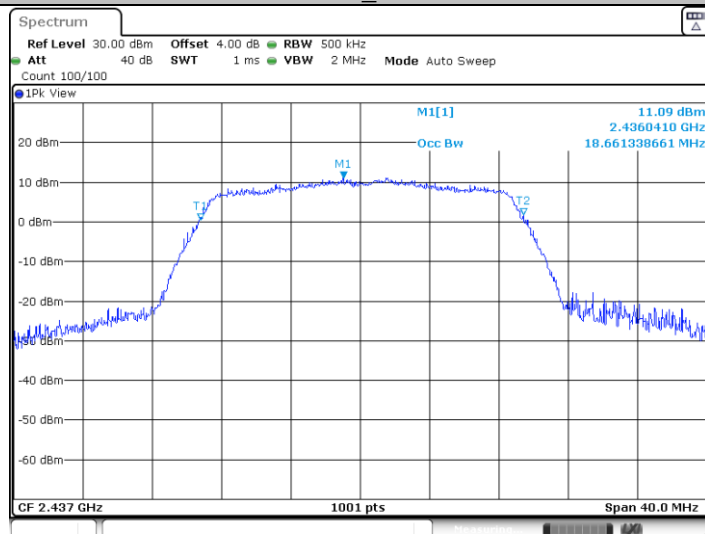
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11N20_2412



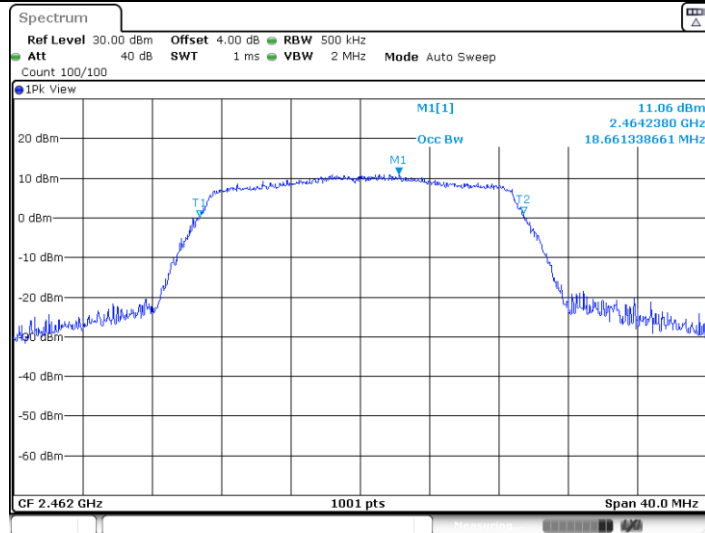
Date: 15 MAY 2022 13:38:22

11N20_2437



Date: 15 MAY 2022 13:40:46

11N20_2462



Date: 15.MAY.2022 13:43:47

9.4 Power Spectral Density

Test Method

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

1. The RF output of EUT was connected to the test receiver by RF cable. The path loss was compensated to the results for each measurement.
2. Set analyzer center frequency to DTS channel center frequency. RBW=10kHz, VBW=3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
3. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
4. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm]

≤8

802.11b modulation Test Result

Frequency (MHz)	Power spectral density (dBm)		Limit (dBm)	Result
	Ant0	Ant1		
Low channel 2412MHz	-9.00	-9.10	8	Pass
Middle channel 2437MHz	-7.59	-7.34	8	Pass
High channel 2462MHz	-8.80	-8.85	8	Pass

802.11g modulation Test Result

Frequency (MHz)	Power spectral density (dBm)			Limit (dBm)	Result
	Ant0	Ant1	SUM		
Low channel 2412MHz	-10.21	-11.33	-7.72	8	Pass
Middle channel 2437MHz	-10.19	-11.76	-7.89	8	Pass
High channel 2462MHz	-10.14	-11.89	-7.92	8	Pass

802.11n-HT20 modulation Test Result

Frequency (MHz)	Power spectral density (dBm)			Limit (dBm)	Result
	Ant0	Ant1	SUM		
Low channel 2412MHz	-10.01	-11.18	-7.55	8	Pass
Middle channel 2437MHz	-10.11	-11.26	-7.64	8	Pass
High channel 2462MHz	-10.08	-11.29	-7.63	8	Pass

$$PSD^{SUM} = 10 * \text{Log}(10^{(PSD^{Ant0}/10)} + 10^{(PSD^{Ant1}/10)})$$

9.5 Spurious RF Conducted Emissions

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100 kHz, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold
3. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
4. The level displayed must comply with the limit specified in this Section. Submit these plots.
5. Repeat above procedures until all frequencies measured were complete.

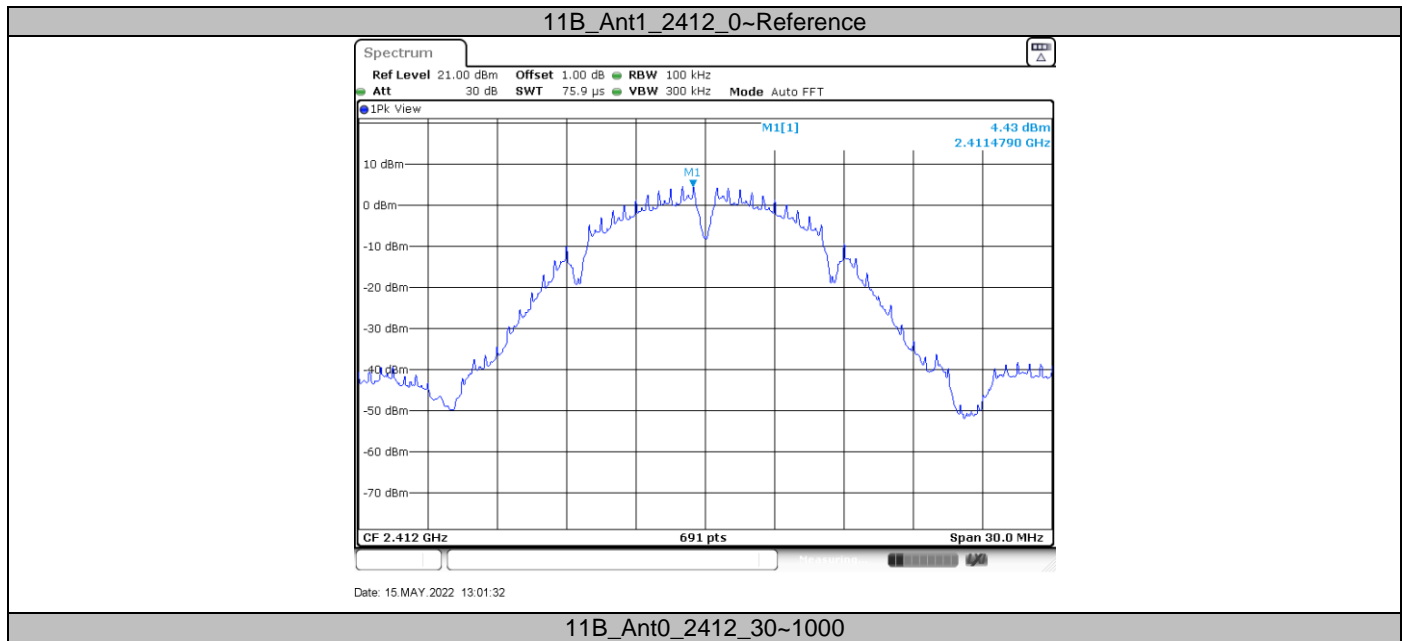
Limit

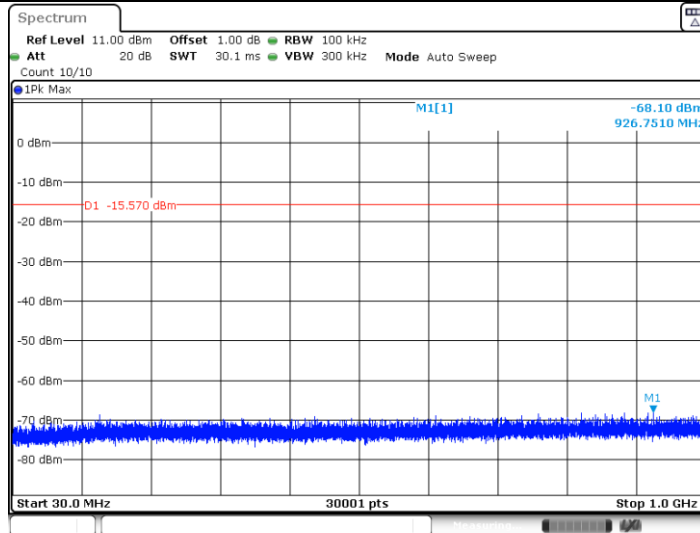
Frequency Range MHz	Limit (dBc)
30-25000	-20

Note: we test Ant0 and Ant1 respectively for 802.11b/g/n20 mode and only the worst case recorded in this report.

Spurious RF conducted emissions

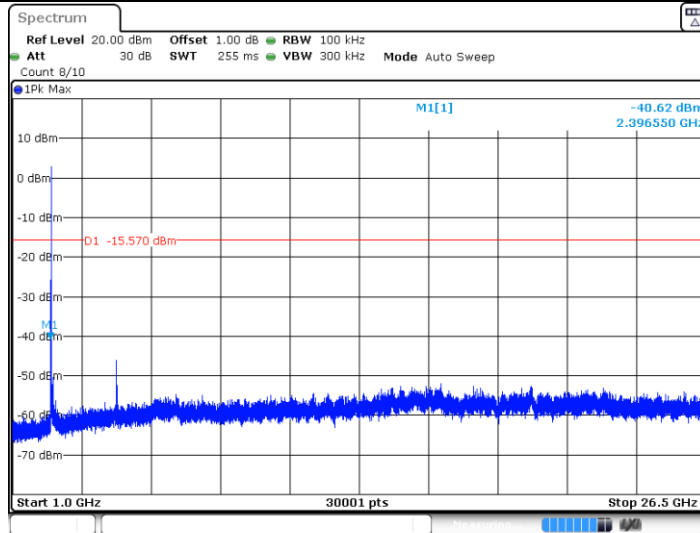
Test Mode	Antenna	Channel (MHz)	Frequency Range (MHz)	Reference Level	Result (MHz)	Limit (MHz)	Verdict
11B	Ant0	2412	Reference	4.43	4.43	---	PASS
			30~1000	30~1000	-68.1	<=-15.57	PASS
			1000~26500	1000~26500	-40.62	<=-15.57	PASS
		2437	Reference	4.66	4.66	---	PASS
			30~1000	30~1000	-68.39	<=-15.34	PASS
			1000~26500	1000~26500	-47.4	<=-15.34	PASS
		2462	Reference	4.67	4.67	---	PASS
			30~1000	30~1000	-67.79	<=-15.33	PASS
			1000~26500	1000~26500	-48.23	<=-15.33	PASS
11G	Ant0	2412	Reference	3.65	3.65	---	PASS
			30~1000	30~1000	-65.44	<=-16.35	PASS
			1000~26500	1000~26500	-32.01	<=-16.35	PASS
		2437	Reference	3.99	3.99	---	PASS
			30~1000	30~1000	-64.52	<=-16.01	PASS
			1000~26500	1000~26500	-47.94	<=-16.01	PASS
		2462	Reference	4.38	4.38	---	PASS
			30~1000	30~1000	-65.02	<=-15.62	PASS
			1000~26500	1000~26500	-49.25	<=-15.62	PASS
11N20	Ant0	2412	Reference	3.88	3.88	---	PASS
			30~1000	30~1000	-65.21	<=-16.12	PASS
			1000~26500	1000~26500	-34.61	<=-16.12	PASS
		2437	Reference	3.87	3.87	---	PASS
			30~1000	30~1000	-64.56	<=-16.13	PASS
			1000~26500	1000~26500	-49.02	<=-16.13	PASS
		2462	Reference	4.65	4.65	---	PASS
			30~1000	30~1000	-64.81	<=-15.35	PASS
			1000~26500	1000~26500	-47.14	<=-15.35	PASS





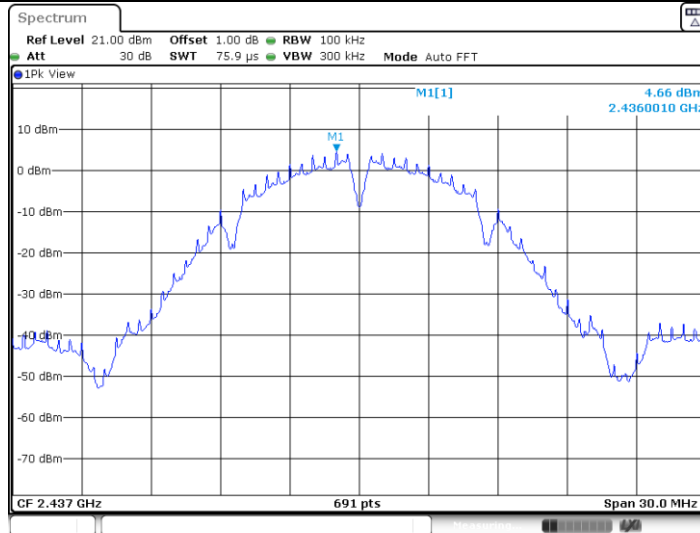
Date: 15.MAY.2022 13:01:38

11B_Ant0_2412_1000~26500



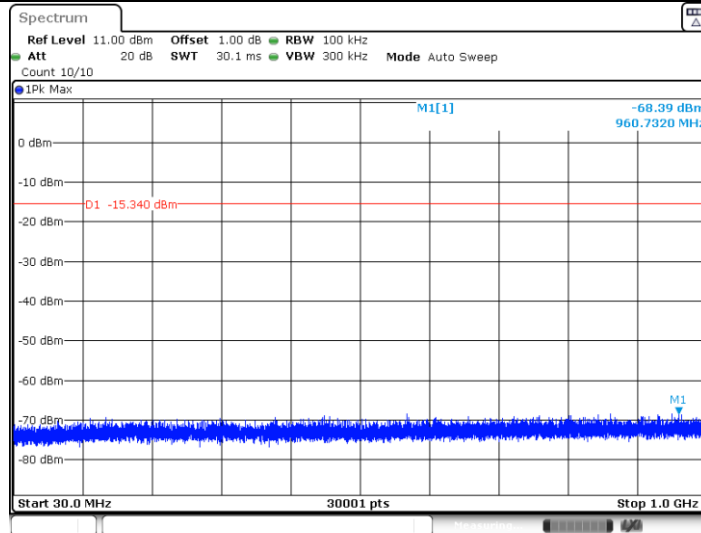
Date: 15.MAY.2022 13:01:46

11B_Ant0_2437_0~Reference



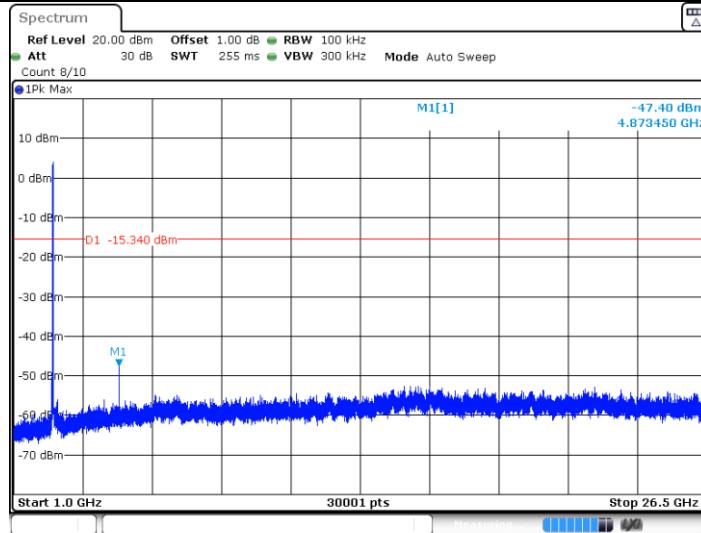
Date: 15.MAY.2022 13:03:23

11B_Ant0_2437_30~1000



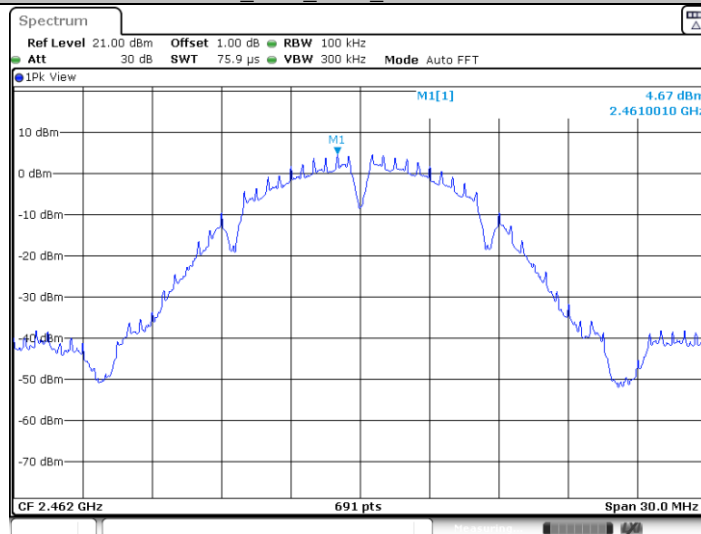
Date: 15.MAY.2022 13:03:30

11B_Ant0_2437_1000~26500



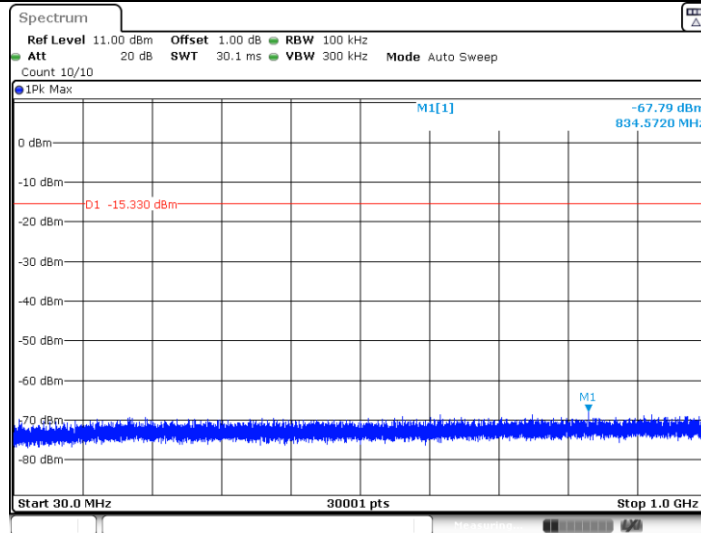
Date: 15.MAY.2022 13:03:37

11B_Ant0_2462_0~Reference



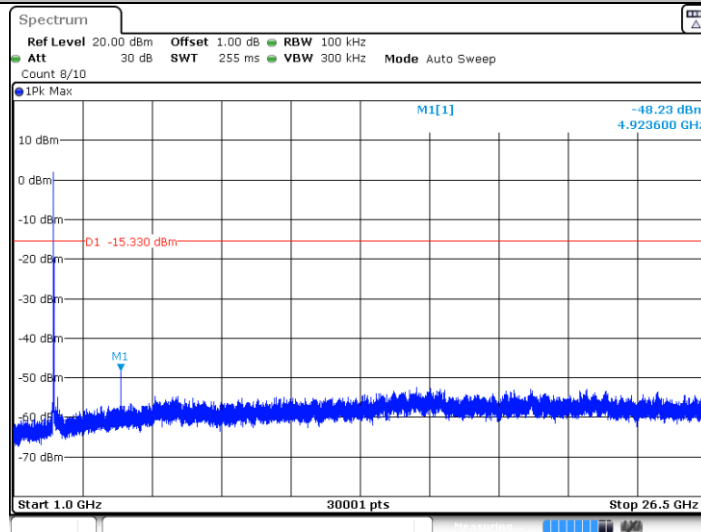
Date: 15.MAY.2022 13:05:36

11B_Ant0_2462_30~1000



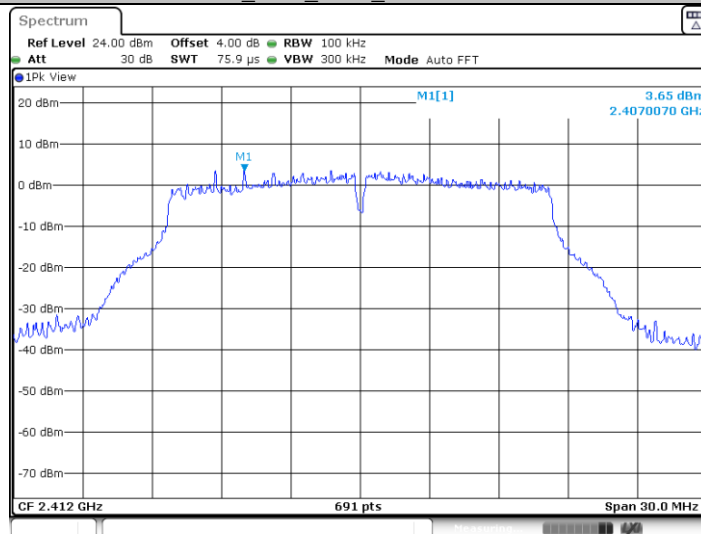
Date: 15.MAY.2022 13:05:42

11B_Ant0_2462_1000~26500



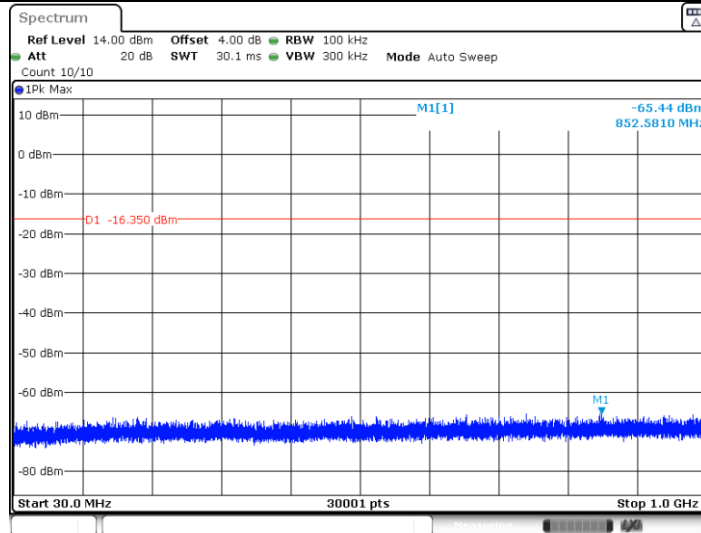
Date: 15.MAY.2022 13:05:50

11G_Ant0_2412_0~Reference



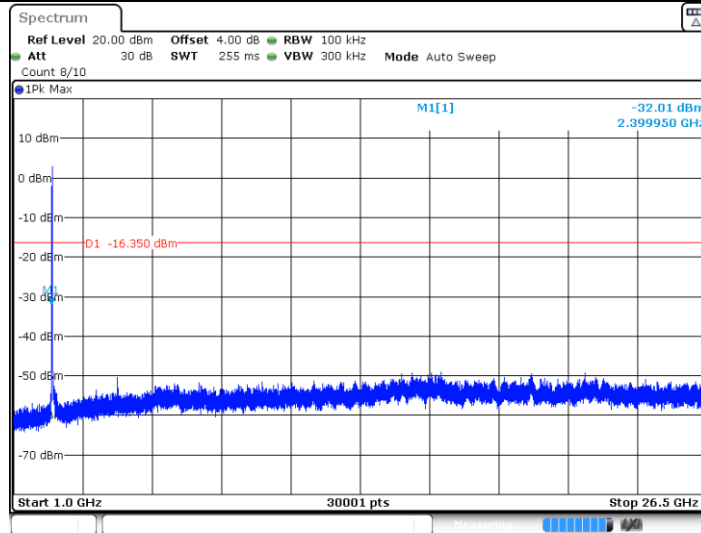
Date: 15.MAY.2022 13:30:16

11G_Ant0_2412_30~1000



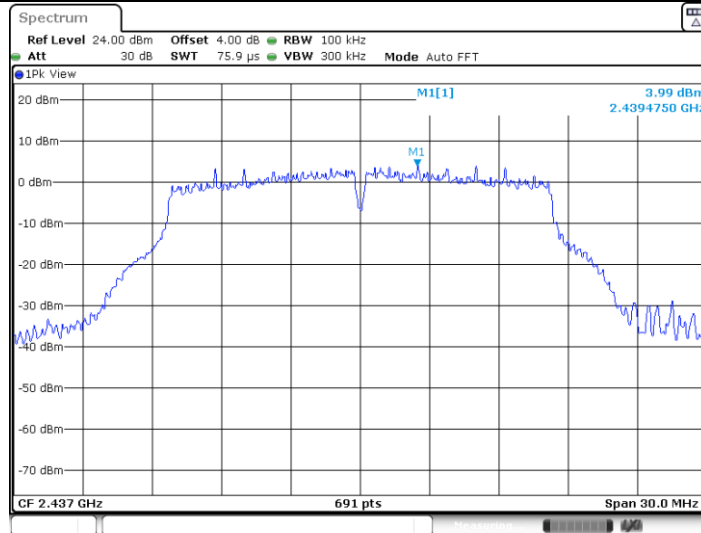
Date: 15.MAY.2022 13:30:22

11G_Ant0_2412_1000~26500



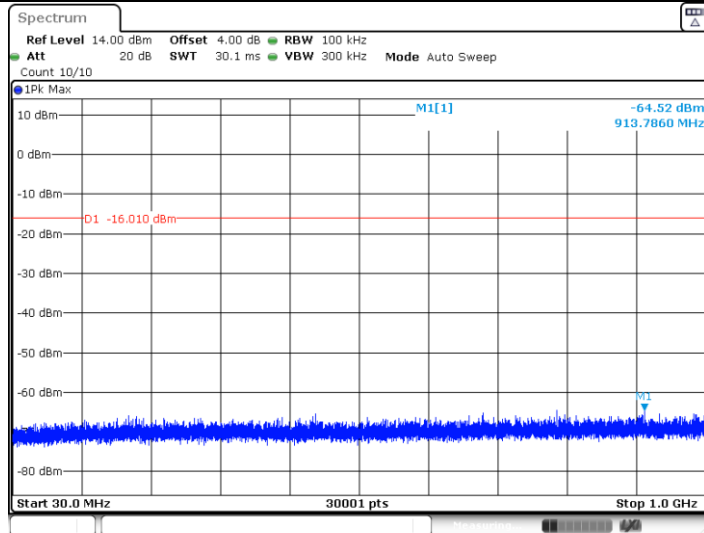
Date: 15.MAY.2022 13:30:30

11G_Ant0_2437_0~Reference



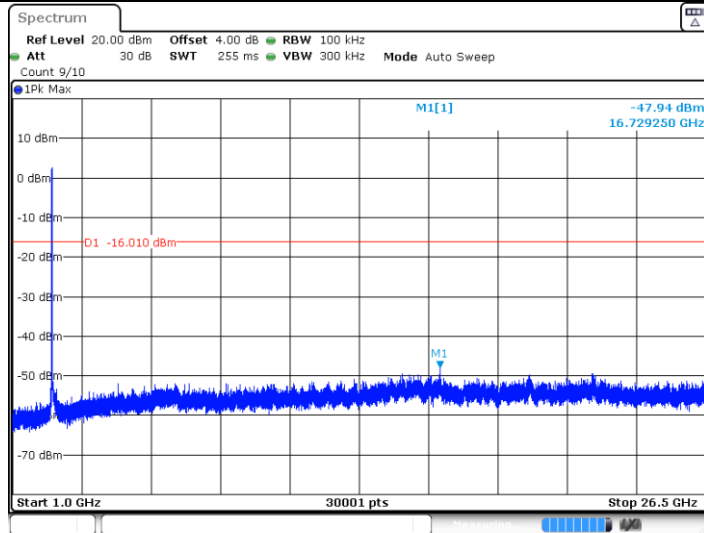
Date: 15.MAY.2022 13:32:03

11G_Ant0_2437_30~1000



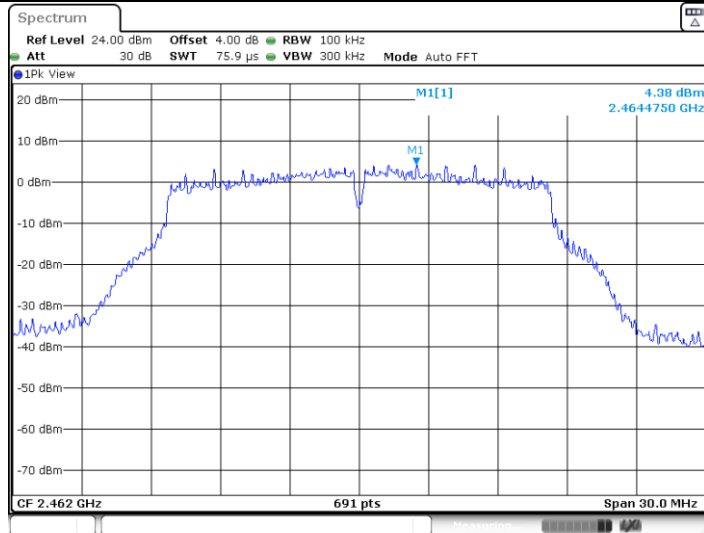
Date: 15.MAY.2022 13:32:09

11G_Ant0_2437_1000~26500



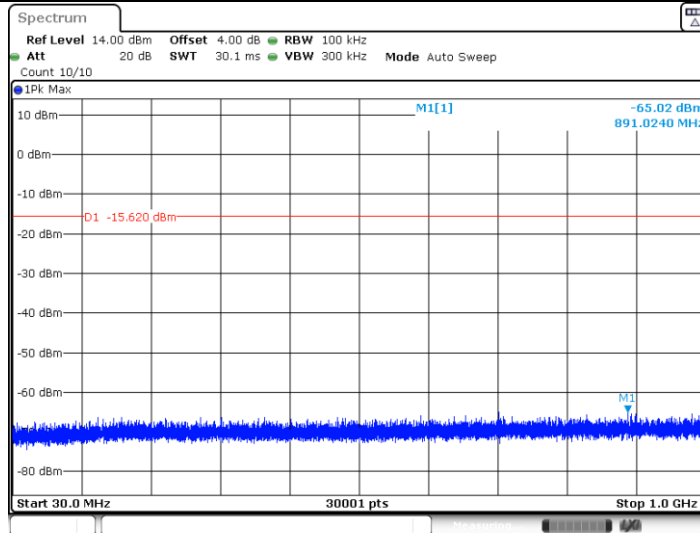
Date: 15.MAY.2022 13:32:17

11G_Ant0_2462_0~Reference



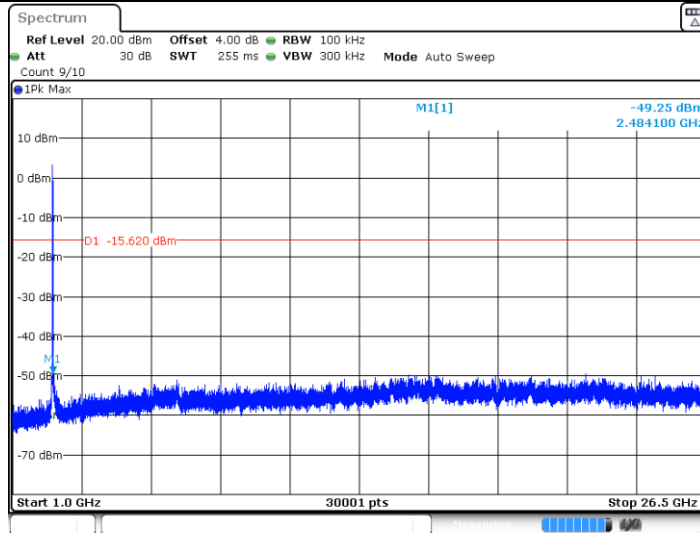
Date: 15.MAY.2022 13:33:43

11G_Ant0_2462_30~1000



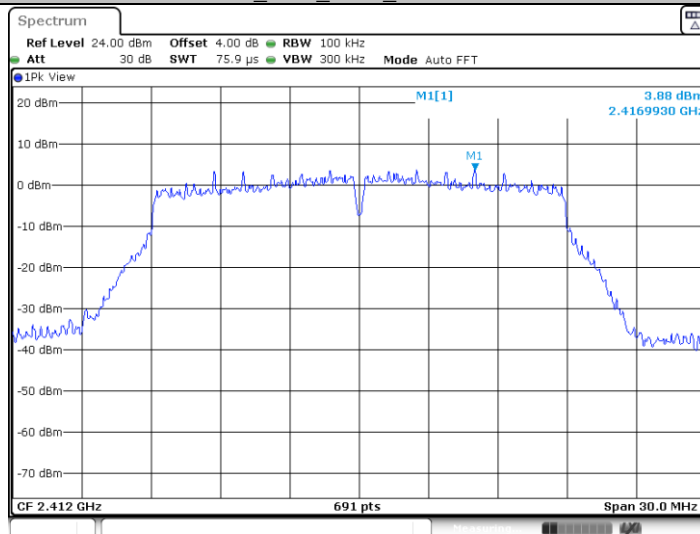
Date: 15 MAY 2022 13:33:49

11G_Ant0_2462_1000~26500



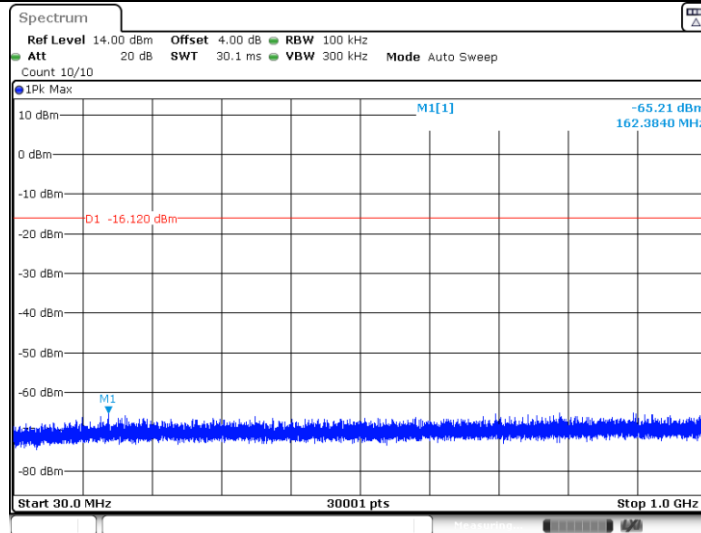
Date: 15 MAY 2022 13:33:57

11N20_Ant0_2412_0~Reference



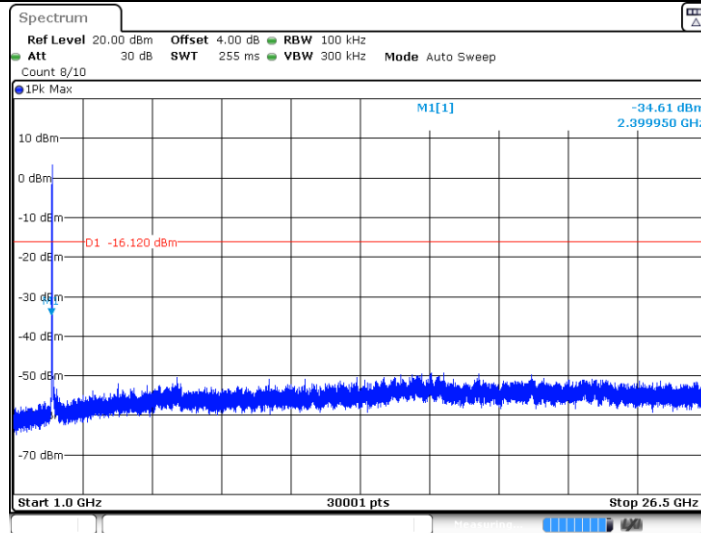
Date: 15 MAY 2022 13:38:49

11N20_Ant0_2412_30~1000



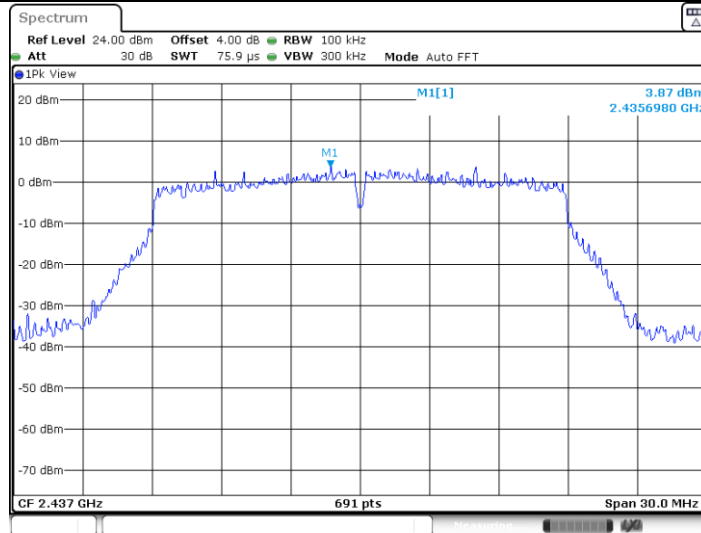
Date: 15.MAY.2022 13:38:55

11N20_Ant0_2412_1000~26500



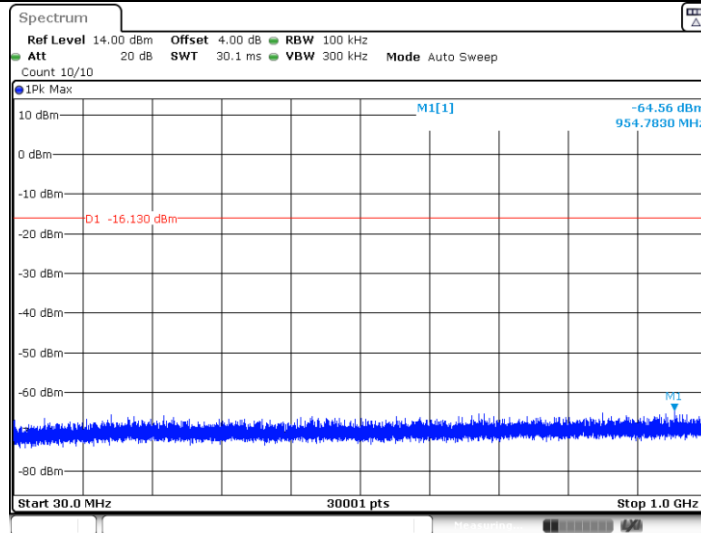
Date: 15.MAY.2022 13:39:02

11N20_Ant0_2437_0~Reference



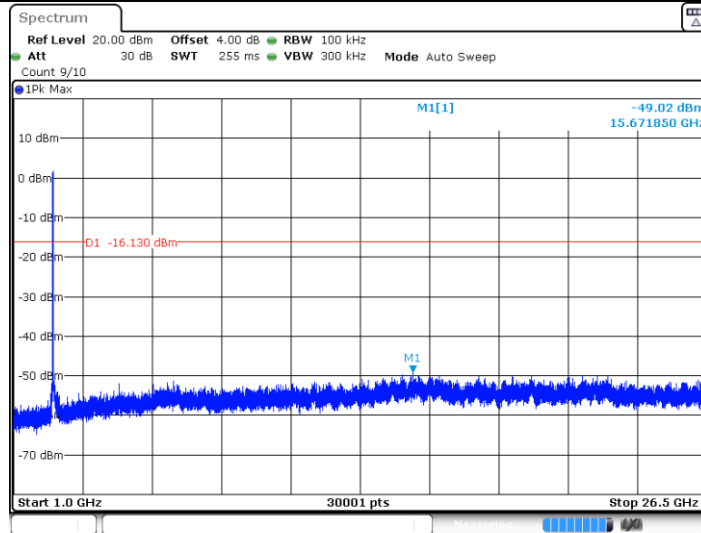
Date: 15.MAY.2022 13:41:03

11N20_Ant0_2437_30~1000



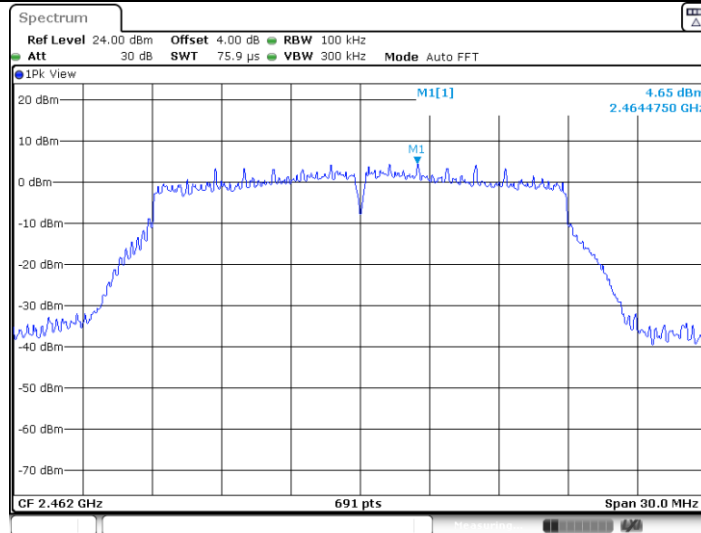
Date: 15.MAY.2022 13:41:09

11N20_Ant0_2437_1000~2650



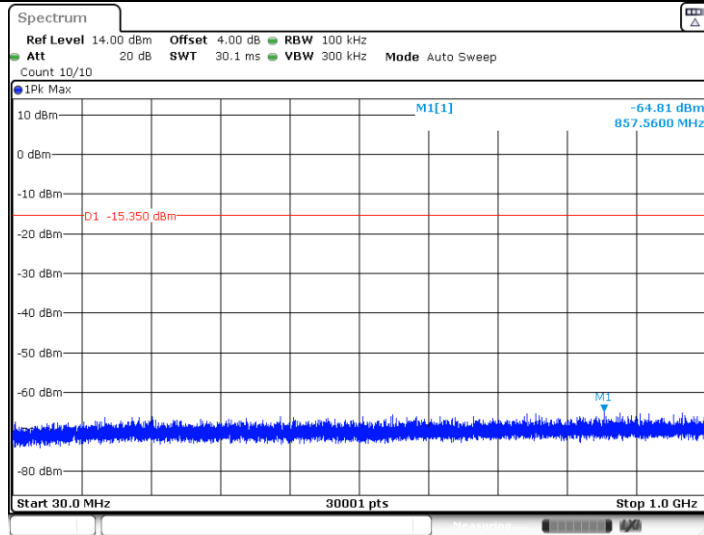
Date: 15.MAY.2022 13:41:17

11N20_Ant0_2462_0~Reference



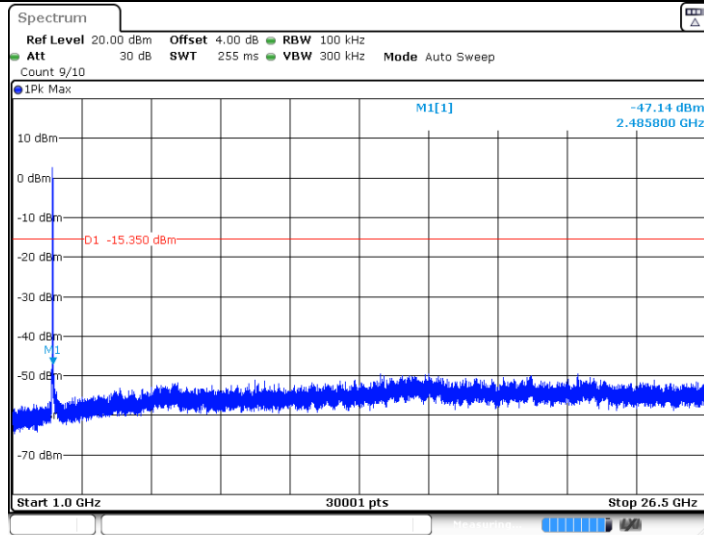
Date: 15.MAY.2022 13:44:14

11N20_Ant0_2462_30~1000



Date: 15.MAY.2022 13:44:20

11N20_Ant0_2462_1000~26500



Date: 15.MAY.2022 13:44:28

9.6 Band Edge Testing

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. 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
3. Allow the trace to stabilize, use the peak and delta measurement to record the result.
4. The level displayed must comply with the limit specified in this Section. .
5. Repeat the test at the hopping off and hopping on mode, submit all the plots.

Limit:

According to §15.247(d) and RSS-247 5.5, in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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 the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) and RSS-Gen 8.10, must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)) and RSS-Gen.

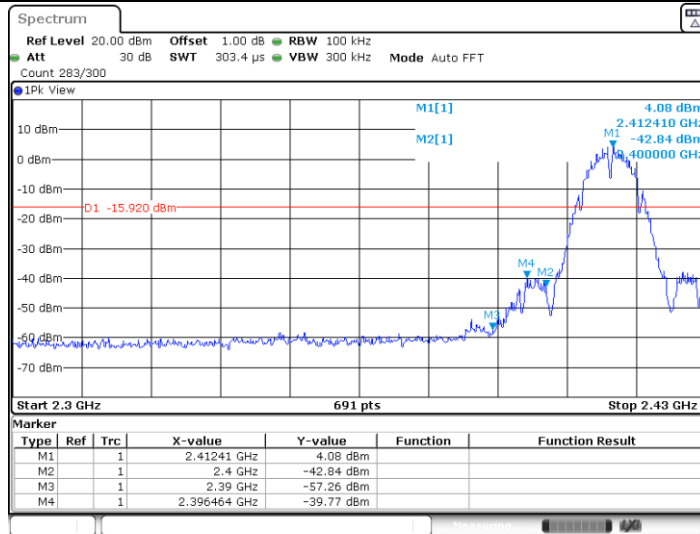
Frequency Range MHz	Limit (dBc)
30-25000	-20

Note: we test Ant0 and Ant1 respectively for 802.11b/g/n20 mode and only the worst case recorded in this report.

Band edge testing

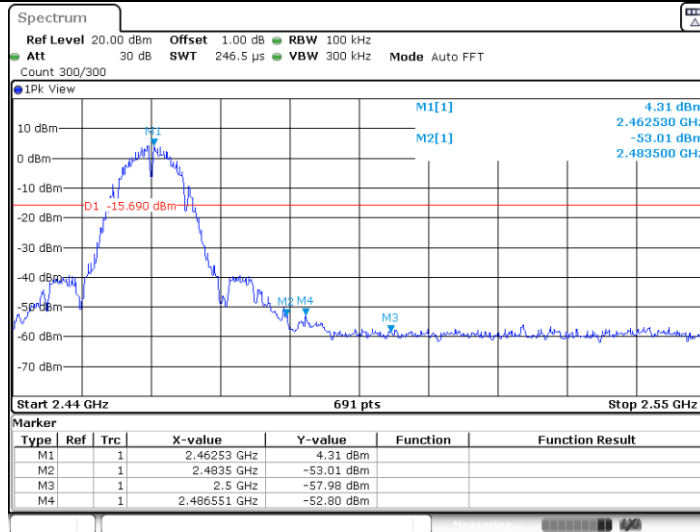
Test Mode	Antenna	Channel Name	Channel (MHz)	Reference Level (dBm)	Result (dBm)	Limit (dBm)	Verdict
11B	Ant0	Low	2412	4.08	-39.77	<=-15.92	PASS
		High	2462	4.31	-52.8	<=-15.69	PASS
11G	Ant0	Low	2412	3.21	-33.28	<=-16.79	PASS
		High	2462	4.31	-43.67	<=-15.69	PASS
11N20	Ant0	Low	2412	3.83	-33.45	<=-16.17	PASS
		High	2462	4.32	-41.79	<=-15.68	PASS

11B_Ant0_Low_2412



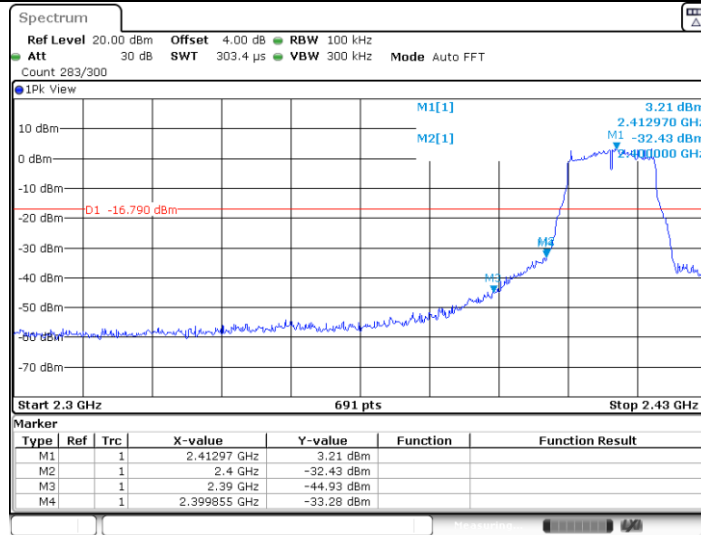
Date: 15.MAY.2022 13:01:25

11B_Ant0_High_2462



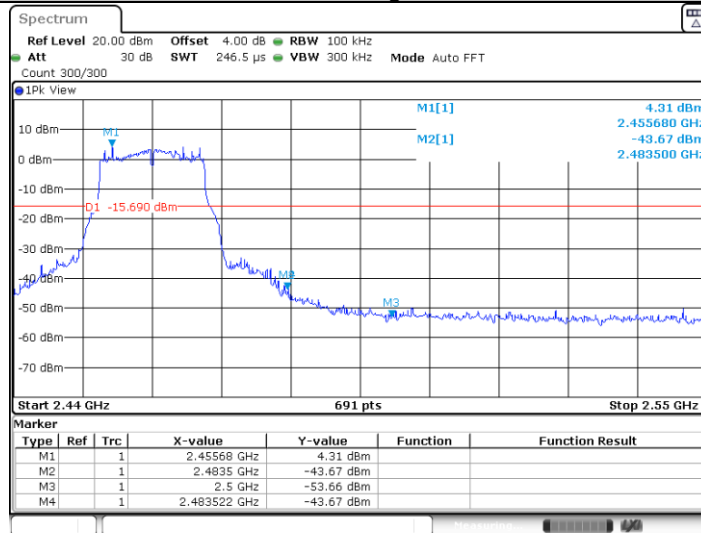
Date: 15.MAY.2022 13:05:30

11G_Ant0_Low_2412



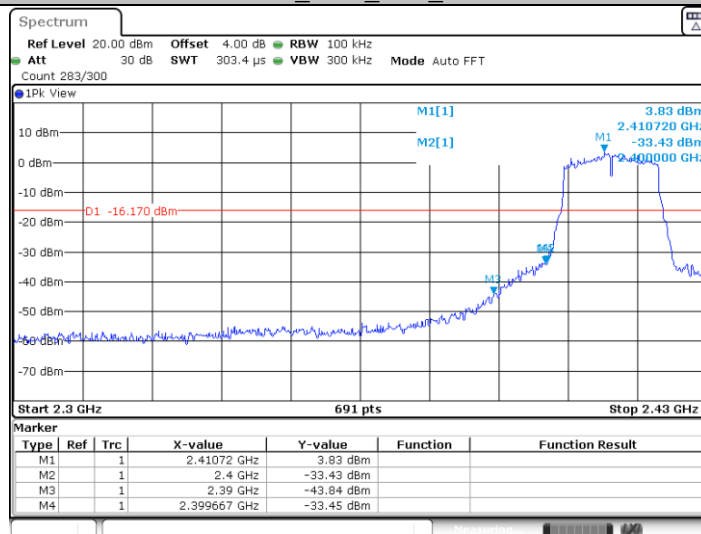
Date: 15 MAY 2022 13:30:10

11G_Ant0_High_2462



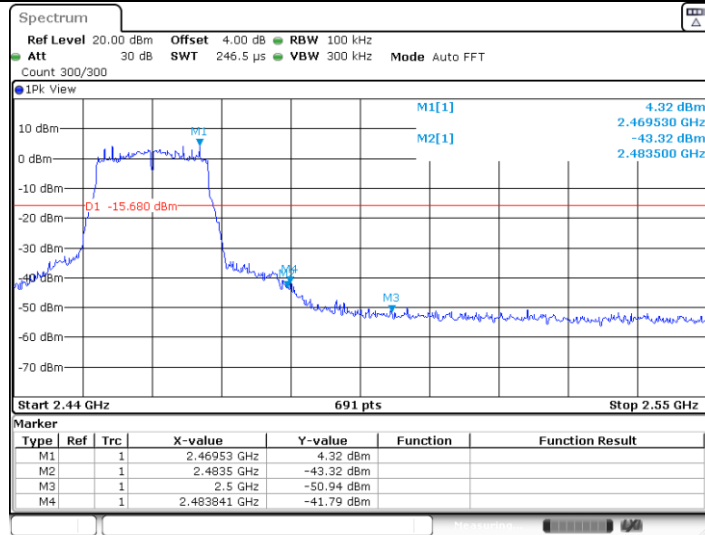
Date: 15 MAY 2022 13:33:38

11N20_Ant0_Low_2412



Date: 15 MAY 2022 13:38:43

11N20_Ant0_High_2462



Date: 15.MAY.2022 13:44:08

9.7 Spurious Radiated Emissions for Transmitter

Test Method

1. The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Set to the maximum power setting and enable the EUT transmit continuously
3. The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
4. 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.
5. 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
6. Use the following spectrum analyzer settings According to C63.10:
For Above 1GHz
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW \geq RBW for peak measurement and VBW = 10Hz for average measurement, Sweep = auto, Detector function = peak, Trace = max hold.
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, VBW \geq RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.
7. Repeat above procedures until all frequencies measured were complete.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average ((duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor ($20\log(1/\text{duty cycle})$).
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.

Spurious Radiated Emissions for Transmitter

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 section 15.205 & RSS-GEN 8.10, must comply with the radiated emission limits specified in section 15.209 & RSS-Gen 6.13.

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

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.

The only worse case (802.11n20_2472MHz mode) test result is listed in the report.

Transmitting spurious emission test result as below:

802.11n20 Modulation 2472MHz Test Result

Frequency Band	Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Correct factor (dB/m)	Result
30-1000MHz	48.430000	20.66	H	40.00	QP	19.34	20.56	Pass
	63.465000	21.48	H	40.00	QP	18.52	18.89	Pass
	124.575000	22.75	H	43.50	QP	20.75	16.04	Pass
	341.531667	27.48	H	46.00	QP	18.52	22.49	Pass
	505.838889	28.69	H	46.00	QP	17.31	25.43	Pass
	600.629444	31.00	H	46.00	QP	15.00	27.76	Pass
	Other frequency	---	H	---	QP	---	---	Pass
	30.000000	32.67	V	40.00	QP	7.33	17.38	Pass
	50.531667	26.51	V	40.00	QP	13.49	20.68	Pass
	66.967778	29.08	V	40.00	QP	10.92	18.05	Pass
	76.775556	29.06	V	40.00	QP	10.94	14.46	Pass
	86.691111	28.75	V	40.00	QP	11.25	15.33	Pass
	128.077778	28.77	V	43.50	QP	14.73	15.56	Pass
Other frequency	---	V	---	QP	---	---	Pass	
1000-2500MHz	*1593.00	40.54	H	74	PK	33.46	-9.57	Pass
	*2491.00	50.32	H	74	PK	23.68	-4.90	Pass
	3377.50	44.03	H	74	PK	29.97	-0.74	Pass
	*4307.00	48.16	H	74	PK	25.84	3.36	Pass
	6616.00	42.11	H	74	PK	31.89	9.42	Pass
	8947.00	44.79	H	74	PK	29.21	12.80	Pass
	*2483.50	64.63	H	74	PK	9.37	-5.67	Pass
	*2500.00	42.68	H	74	PK	31.32	-5.59	Pass
	2502.64	47.72	H	74	PK	26.28	-5.56	Pass
	*2483.50	52.41	H	54	AV	1.59	-5.67	Pass
	Other Frequency	---	H	74/54	---	---	---	Pass
	*1596.00	42.84	V	74	PK	31.16	-9.50	Pass
	*2493.00	45.67	V	74	PK	28.33	-4.90	Pass
	4316.50	47.19	V	74	PK	26.81	3.33	Pass
	7196.50	43.03	V	74	PK	30.97	8.76	Pass
	9239.50	44.10	V	74	PK	29.90	12.38	Pass
	13712.00	48.07	V	74	PK	25.93	15.82	Pass
	2483.50	56.89	V	74	PK	17.11	-5.67	Pass
	2500.00	40.82	V	74	PK	33.18	-5.59	Pass
	2501.32	45.48	V	74	PK	28.52	-5.58	Pass
2483.50	50.27	V	54	AV	3.73	-5.67	Pass	
Other Frequency	---	V	74/54	---	---	---	Pass	

Remark:

- (1) “*” means the emission(s) appear within the restrict bands shall follow the requirement of section 15.205 & RSS-GEN 8.10.
- (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 20dB 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

10 Test Equipment List

Conducted Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 3	68-4-74-14-001	101782	1	2022-6-4
LISN	Rohde & Schwarz	ENV432	68-4-87-16-001	101318	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	68-4-90-14-003-A10	Version9.15.00	N/A	N/A
Shielding Room	TDK	CSR #1	68-4-90-19-004	----	3	2022-11-07

Radiated Emission Test

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
EMI Test Receiver	Rohde & Schwarz	ESR 7	68-4-74-19-001	102176	1	2022-6-4
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	68-4-80-14-002	707	1	2022-7-23
Horn Antenna	Rohde & Schwarz	HF907	68-4-80-14-005	102294	1	2022-6-23
Loop Antenna	Rohde & Schwarz	HFH2-Z2	68-4-80-14-006	100398	1	2022-8-25
Pre-amplifier	Rohde & Schwarz	SCU 18	68-4-29-14-001	102230	1	2022-6-6
Attenuator	Mini-circuits	UNAT-6+	68-4-81-21-001	15542	1	2022-8-23
3m Semi-anechoic chamber	TDK	SAC-3 #1	68-4-90-14-001	----	2	2023-5-28
Test software	Rohde & Schwarz	EMC32	68-4-90-14-001-A10	Version10.35.02	N/A	N/A

Conducted RF Test System

DESCRIPTION	MANUFACTURER	MODEL NO.	EQUIPMENT ID	SERIAL NO.	CAL INTERVAL (YEAR)	CAL. DUE DATE
Vector Signal Generator	Rohde & Schwarz	SMBV100A	68-4-48-18-001	262825	1	2022-6-3
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	----	3	2022-11-07

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	
Test Items	Extended Uncertainty
Uncertainty for Conducted Emission 150kHz-30MHz (for test using AMN ENV432 or ENV4200)	3.31dB
Uncertainty for Radiated Emission 30MHz-3000MHz	Horizontal: 4.67dB; Vertical: 4.65dB;
Uncertainty for Radiated Emission 3000MHz-18000MHz	Horizontal: 4.76dB; Vertical: 4.75dB;
Uncertainty for Radiated Emission 18000MHz-40000MHz	Horizontal: 4.51dB; Vertical: 4.50dB;
Uncertainty for Conducted RF test	RF Power Conducted: 1.27dB Frequency test involved: 0.6×10^{-7} or 1%

Measurement Uncertainty Decision Rule:

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.