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Report Template Version: V05
Report Template Revision Date: 2021-11-03

TEST REPORT

Report No.:	CQASZ20220601099E-01
Applicant:	Shenzhen Shenan Yangguang Electroncis Co., Ltd
Address of Applicant:	West of 4th Floor, Building 9, No. 18, Makan Road, Xili, Nanshan District,
Equipment Under Test (EUT):	
Product:	Hub
Model No.:	Niwa Grow Hub Plus
Test Model No.:	Niwa Grow Hub Plus
Brand Name:	Niwa
FCC ID:	2AR3P-269-BMAHNP02
Standards:	47 CFR Part 15, Subpart C
Date of Receipt:	2022-07-05
Date of Test:	2022-07-05 to 2022-07-12
Date of Issue:	2022-07-26
Test Result :	**PASS***

***In the configuration tested, the EUT complied with the standards specified above**

Tested By: lewis zhou

(Lewis Zhou)

Reviewed By: K. Liao

(K Liao)

Approved By:

(Jack Ai)

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1 Version

Revision History Of Report

Report No.	Version	Description	Issue Date
CQASZ20220601099E-01	Rev.01	Initial report	2022-07-26

2 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15, Subpart C Section 15.203/15.247 (c)	ANSI C63.10 2013	PASS
AC Power Line Conducted Emission	47 CFR Part 15, Subpart C Section 15.207	ANSI C63.10 2013	PASS
Conducted Peak & Average Output Power	47 CFR Part 15, Subpart C Section 15.247 (b)(3)	ANSI C63.10 2013	PASS
6dB Occupied Bandwidth	47 CFR Part 15, Subpart C Section 15.247 (a)(2)	ANSI C63.10 2013	PASS
Power Spectral Density	47 CFR Part 15, Subpart C Section 15.247 (e)	ANSI C63.10 2013	PASS
Band-edge for RF Conducted Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	ANSI C63.10 2013	PASS
RF Conducted Spurious Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	ANSI C63.10 2013	PASS
Radiated Spurious Emissions	47 CFR Part 15, Subpart C Section 15.205/15.209	ANSI C63.10 2013	PASS
Restricted bands around fundamental frequency (Radiated Emission)	47 CFR Part 15, Subpart C Section 15.205/15.209	ANSI C63.10 2013	PASS

3 Contents

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4 General Information

4.1 Client Information

Applicant:	Shenzhen Shenan Yangguang Electroncis Co., Ltd
Address of Applicant:	West of 4th Floor, Building 9, No. 18, Makan Road, Xili, Nanshan District,
Manufacturer:	Shenzhen Shenan Yangguang Electroncis Co., Ltd
Address of Manufacturer:	West of 4th Floor, Building 9, No. 18, Makan Road, Xili, Nanshan District,
Factory:	Shenzhen Shenan Yangguang Electroncis Co., Ltd
Address of Factory:	West of 4th Floor, Building 9, No. 18, Makan Road, Xili, Nanshan District,

4.2 General Description of EUT

Product Name:	Hub
Model No.:	Niwa Grow Hub Plus
Test Model No.:	Niwa Grow Hub Plus
Trade Mark:	Niwa
Software Version:	V1.10.8
Hardware Version:	V1.4
Power Supply:	Power by AC 110V
EUT Supports Radios application:	2.4GHz: Wi-Fi: 802.11b/g/n(HT20): 2412MHz~2462MHz

4.3 Product Specification subjective to this standard

Operation Frequency:	IEEE 802.11b/g/n(HT20): 2412MHz to 2462MHz
Channel Numbers:	IEEE 802.11b/g, IEEE 802.11n HT20: 11 Channels
Channel Separation:	5MHz
Type of Modulation:	IEEE for 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE for 802.11g : OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE for 802.11n(HT20) : OFDM (64QAM, 16QAM, QPSK, BPSK)
Transfer Rate:	IEEE for 802.11b: 1Mbps/2Mbps/5.5Mbps/11Mbps IEEE for 802.11g : 6Mbps/9Mbps/12Mbps/18Mbps/24Mbps/36Mbps/48Mbps/54Mbps IEEE for 802.11n(HT20) : 6.5Mbps/13Mbps/19.5Mbps/26Mbps/39Mbps/52Mbps/58.5Mbps/65Mbps
Product Type:	☒ Mobile ☐ Portable ☐ Fix Location
Test Software of EUT:	ESP_RF_test_tool_v2.4
Antenna Type:	PCB antenna
Antenna Gain:	2dBi

Operation Frequency each of channel(802.11b/g/n HT20)							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
1	2412MHz	4	2427MHz	7	2442MHz	10	2457MHz
2	2417MHz	5	2432MHz	8	2447MHz	11	2462MHz
3	2422MHz	6	2437MHz	9	2452MHz		

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

For 802.11b/g/n (HT20):

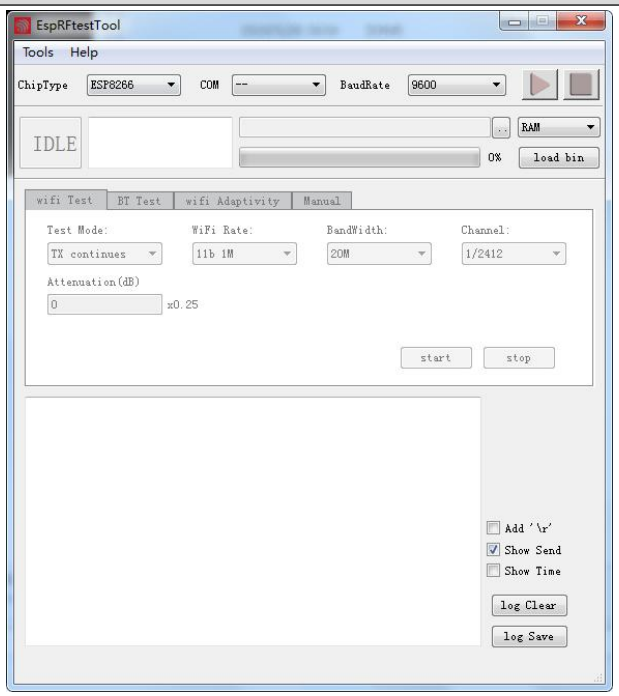
Channel	Frequency
The Lowest channel	2412MHz
The Middle channel	2437MHz
The Highest channel	2462MHz

Note:

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

4.4 Test Environment and Mode

Operating Environment:	
Radiated Emissions:	
Temperature:	25.3 °C
Humidity:	55 % RH
Atmospheric Pressure:	1009 mbar
Conducted Emissions:	
Temperature:	25.6 °C
Humidity:	60 % RH
Atmospheric Pressure:	1009 mbar
Radio conducted item test (RF Conducted test room):	
Temperature:	25.5 °C
Humidity:	52 % RH
Atmospheric Pressure:	1009 mbar
Test mode:	
Transmitting mode:	Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.
Run Software:	



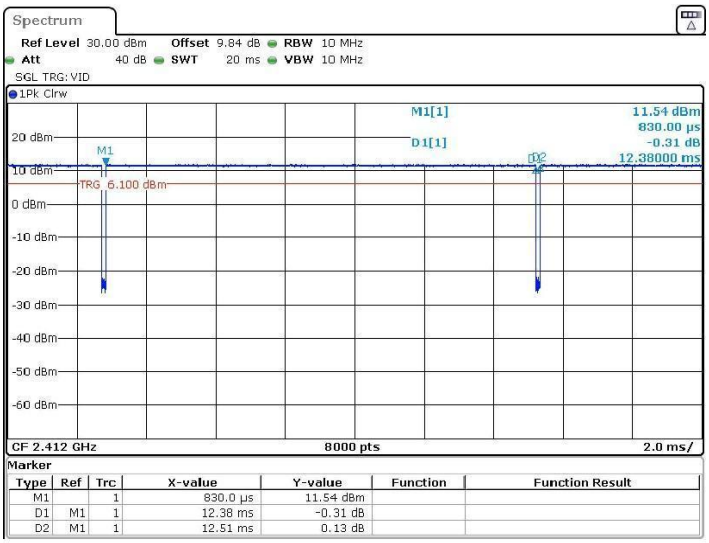
Operated Mode for Worst Duty Cycle:		
Test Mode	Duty Cycle(%)	Average correction factor(dB)
IEEE802.11b	98.96	0.05
IEEE802.11g	94.04	0.27
IEEE802.11n (HT20)	62.86	2.02

Remark:

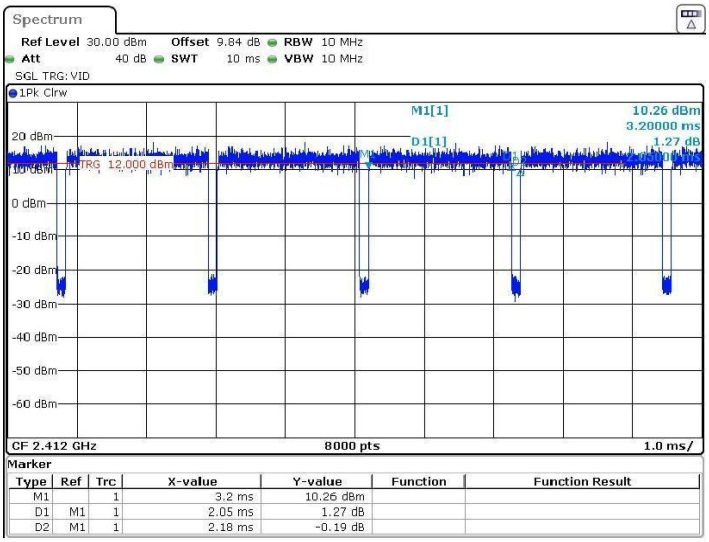
1) Duty cycle= On Time/ Period;

2) Duty Cycle factor = 10 * log(1/ Duty cycle);

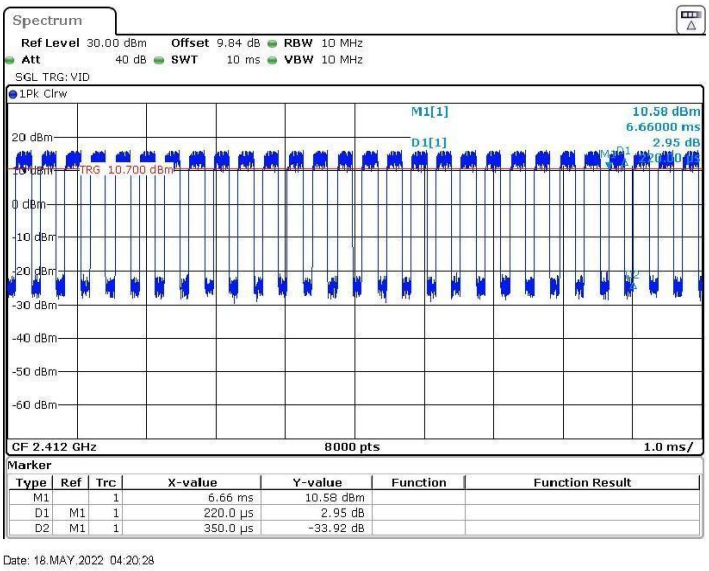
Test Graph_IEEE802.11b Duty Cycle:



Test Graph_IEEE802.11g Duty Cycle:



Test Graph_IEEE802.11 n (HT20) Duty Cycle:



4.5 Description of Support Units

The EUT has been tested with associated equipment below.

1) Support equipment

Description	Manufacturer	Model No.	Certification	Supplied by
/	/	/	/	/

2) Cable

Cable No.	Description	Manufacturer	Cable Type/Length	Supplied by
/	/	/	/	/

4.6 Test Location

All tests were performed at:

Shenzhen Huaxia Testing Technology Co., Ltd.

1F., Block A of Tongsheng Technology Building, Huahui Road, Dalang Street, Longhua New District, Shenzhen, Guangdong, China

4.7 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **A2LA (Certificate No. 4742.01)**

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 4742.01.

- **FCC Registration No.: 522263**

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No.:522263

4.8 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate.

The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities.

The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the **Shenzhen Huaxia Testing Technology Co., Ltd.** quality system acc. to DIN EN ISO/IEC 17025.

Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CQA laboratory is reported:

No.	Item	Uncertainty	Notes
1	Radiated Emission (Below 1GHz)	5.12dB	(1)
2	Radiated Emission (Above 1GHz)	4.60dB	(1)
3	Conducted Disturbance (0.15~30MHz)	3.34dB	(1)
4	Radio Frequency	3×10^{-8}	(1)
5	Duty cycle	0.6 %.	(1)
6	Occupied Bandwidth	1.1%	(1)
7	RF conducted power	0.86dB	(1)
8	RF power density	0.74	(1)
9	Conducted Spurious emissions	0.86dB	(1)
10	Temperature test	0.8℃	(1)
11	Humidity test	2.0%	(1)
12	Supply voltages	0.5 %.	(1)
13	Frequency Error	5.5 Hz	(1)

(1)This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

4.9 Deviation from Standards

None.

4.10 Abnormalities from Standard Conditions

None.

4.11 Other Information Requested by the Customer

None.

4.12 Equipment List

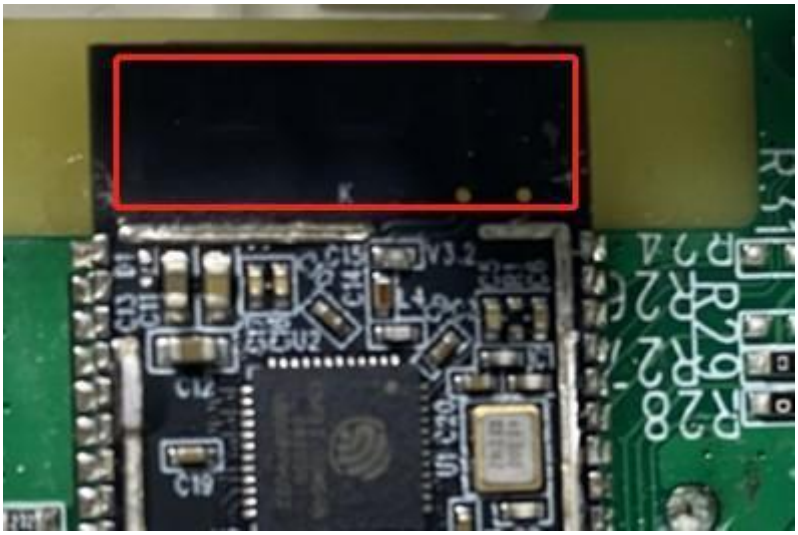
Test Equipment	Manufacturer	Model No.	Instrument No.	Calibration Date	Calibration Due Date
EMI Test Receiver	R&S	ESR7	CQA-005	2021/09/10	2022/09/09
Spectrum analyzer	R&S	FSU26	CQA-038	2021/09/10	2022/09/09
Spectrum analyzer	R&S	FSU40	CQA-075	2021/09/10	2022/09/09
Preamplifier	MITEQ	AFS4-00010300-18-10P-4	CQA-035	2021/09/10	2022/09/09
Preamplifier	MITEQ	AMF-6D-02001800-29-20P	CQA-036	2021/09/10	2022/09/09
Preamplifier	EMCI	EMC184055SE	CQA-089	2021/09/10	2022/09/09
Loop antenna	Schwarzbeck	FMZB1516	CQA-060	2021/09/16	2024/09/15
Bilog Antenna	R&S	HL562	CQA-011	2021/09/16	2024/09/15
Horn Antenna	R&S	HF906	CQA-012	2021/09/16	2024/09/15
Horn Antenna	Schwarzbeck	BBHA 9170	CQA-088	2021/09/16	2024/09/15
Coaxial Cable (Above 1GHz)	CQA	N/A	C007	2021/09/10	2022/09/09
Coaxial Cable (Below 1GHz)	CQA	N/A	C013	2021/09/10	2022/09/09
RF cable(9KHz~40GHz)	CQA	RF-01	CQA-079	2021/09/10	2022/09/09
Antenna Connector	CQA	RFC-01	CQA-080	2021/09/10	2022/09/09
Power Sensor	KEYSIGHT	U2021XA	CQA-30	2021/09/10	2022/09/09
N1918A Power Analysis Manager Power Panel	Agilent	N1918A	CQA-074	2021/09/10	2022/09/09
Power meter	R&S	NRVD	CQA-029	2021/09/10	2022/09/09
Power divider	MIDWEST	PWD-2533-02-SMA-79	CQA-067	2021/09/10	2022/09/09
EMI Test Receiver	R&S	ESR7	CQA-005	2021/09/10	2022/09/09
LISN	R&S	ENV216	CQA-003	2021/09/10	2022/09/09
Coaxial cable	CQA	N/A	CQA-C009	2021/09/10	2022/09/09
DC power	KEYSIGHT	E3631A	CQA-028	2021/09/10	2022/09/09

Test software:

	Manufacturer	Software brand
Radiated Emissions test software	Tonscend	JS1120-3
Conducted Emissions test software	Audix	e3
RF Conducted test software	Audix	e3

5 Test results and Measurement Data

5.1 Antenna Requirement

Standard requirement:	47 CFR Part 15C Section 15.203 /247(c)
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 15.247(b) (4) requirement: The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.	
EUT Antenna:	
The antenna is PCB antenna. The best case gain of the antenna is 2dBi.	

5.2 Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.207
Test Method:	ANSI C63.10: 2013
Test Frequency Range:	150kHz to 30MHz
Limit:	

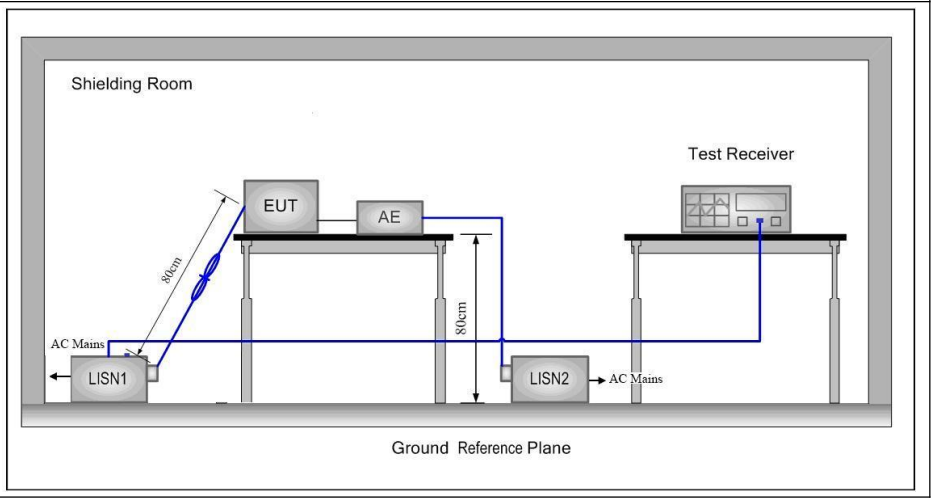
Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

Test Procedure:

1) The mains terminal disturbance voltage test was conducted in a shielded room.
2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.

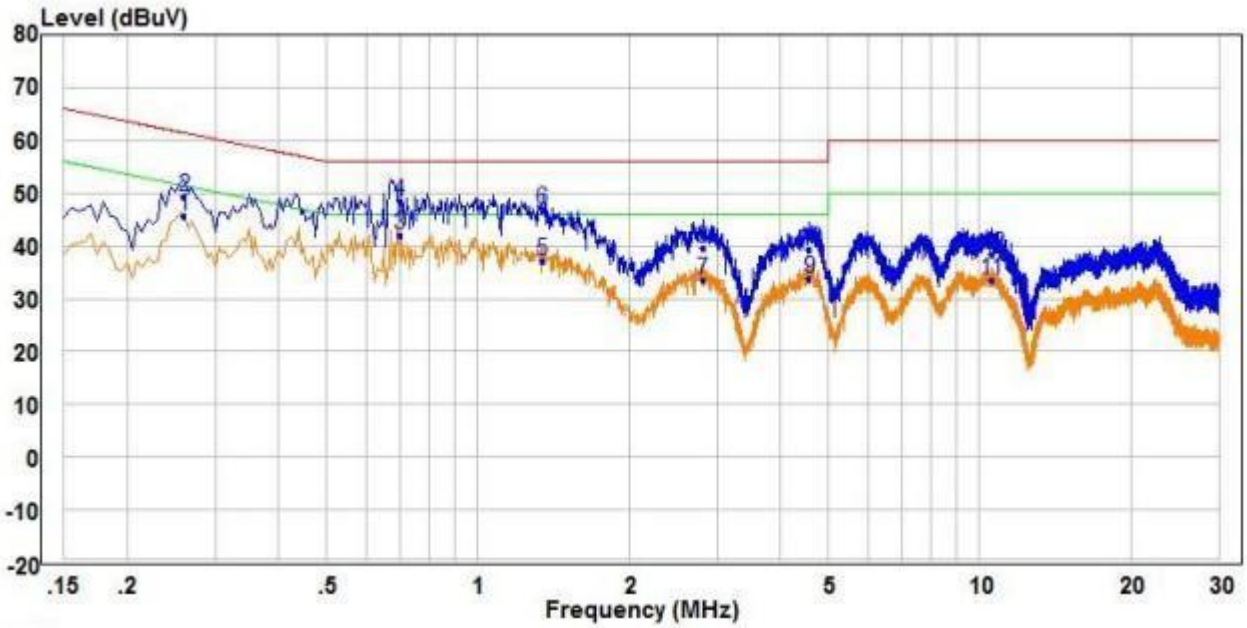
Test Setup:



Exploratory Test Mode:	Transmitting with all kind of modulations, data rates at lowest, middle and highest channel.
Final Test Mode:	Through Pre-scan, find the 1Mbps of rate of 802.11b at middle channel is the worst case. Only the worst case is recorded in the report.
Test Voltage:	AC120V/60Hz
Test Results:	Pass

Measurement Data

Live Line:



		Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
		MHz	dBuV	dB	dBuV	dBuV	dB		
1		0.260	36.03	9.49	45.52	51.43	-5.91	Average	Line
2		0.260	39.97	9.49	49.46	61.43	-11.97	QP	Line
3	PP	0.700	32.13	9.87	42.00	46.00	-4.00	Average	Line
4	QP	0.700	38.51	9.87	48.38	56.00	-7.62	QP	Line
5		1.345	27.75	9.53	37.28	46.00	-8.72	Average	Line
6		1.345	37.29	9.53	46.82	56.00	-9.18	QP	Line
7		2.805	23.85	9.59	33.44	46.00	-12.56	Average	Line
8		2.805	29.91	9.59	39.50	56.00	-16.50	QP	Line
9		4.575	24.04	9.71	33.75	46.00	-12.25	Average	Line
10		4.575	29.69	9.71	39.40	56.00	-16.60	QP	Line
11		10.575	23.72	9.82	33.54	50.00	-16.46	Average	Line
12		10.575	28.67	9.82	38.49	60.00	-21.51	QP	Line

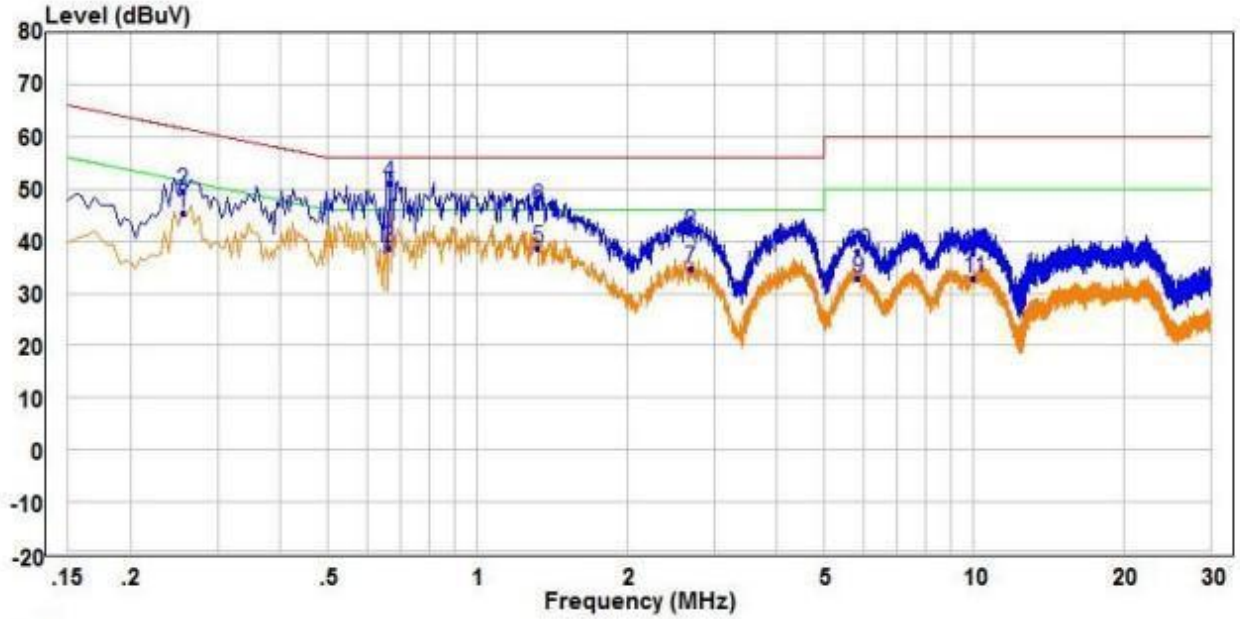
Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:

2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.

3. If the Peak value under Average limit, the Average value is not recorded in the report.

Neutral Line:

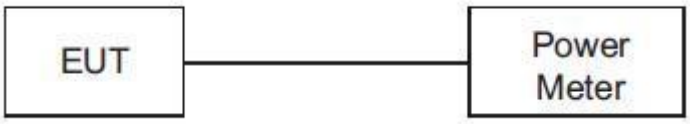


	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB		
1 AV	0.255	35.74	9.53	45.27	51.59	-6.32	Average	Neutral
2	0.255	40.02	9.53	49.55	61.59	-12.04	QP	Neutral
3	0.665	28.81	9.87	38.68	46.00	-7.32	Average	Neutral
4 PP	0.665	41.35	9.87	51.22	56.00	-4.78	QP	Neutral
5	1.320	28.86	9.72	38.58	46.00	-7.42	Average	Neutral
6	1.320	36.85	9.72	46.57	56.00	-9.43	QP	Neutral
7	2.690	24.89	9.75	34.64	46.00	-11.36	Average	Neutral
8	2.690	32.02	9.75	41.77	56.00	-14.23	QP	Neutral
9	5.850	23.21	9.82	33.03	50.00	-16.97	Average	Neutral
10	5.850	28.39	9.82	38.21	60.00	-21.79	QP	Neutral
11	10.000	22.97	9.90	32.87	50.00	-17.13	Average	Neutral
12	10.000	27.80	9.90	37.70	60.00	-22.30	QP	Neutral

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.
3. If the Peak value under Average limit, the Average value is not recorded in the report.

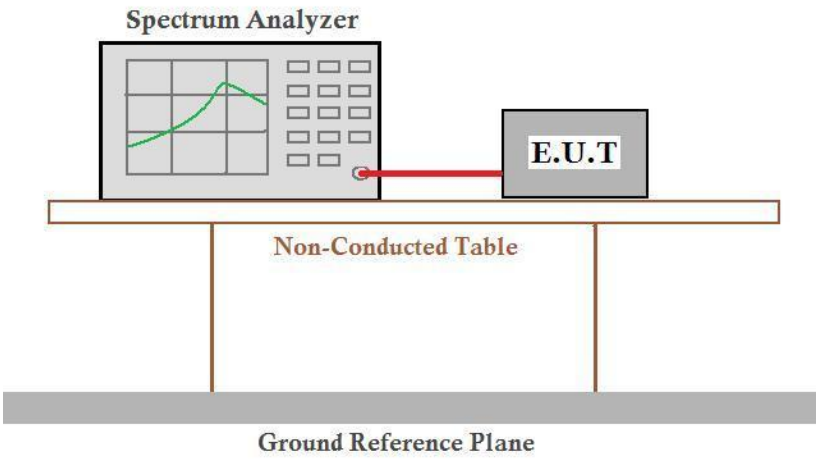
5.3 Conducted Peak & Average Output Power

Test Requirement:	47 CFR Part 15C Section 15.247 (b)(3)
Test Method:	ANSI C63.10: 2013
Test Setup:	
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Through Pre-scan, find the 1Mbps of rate is the worst case of 802.11b; 6Mbps of rate is the worst case of 802.11g; 6.5Mbps of rate is the worst case of 802.11n(HT20). Only the worst case is recorded in the report.
Limit:	30dBm
Test Results:	Pass

Test Result

TestMode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
11B	Ant1	2412	9.31	≤30	PASS
		2437	10.73	≤30	PASS
		2462	9.97	≤30	PASS
11G	Ant1	2412	9.57	≤30	PASS
		2437	10.77	≤30	PASS
		2462	10.22	≤30	PASS
11N20SISO	Ant1	2412	10.06	≤30	PASS
		2437	11.33	≤30	PASS
		2462	10.82	≤30	PASS

5.4 6dB Occupy Bandwidth

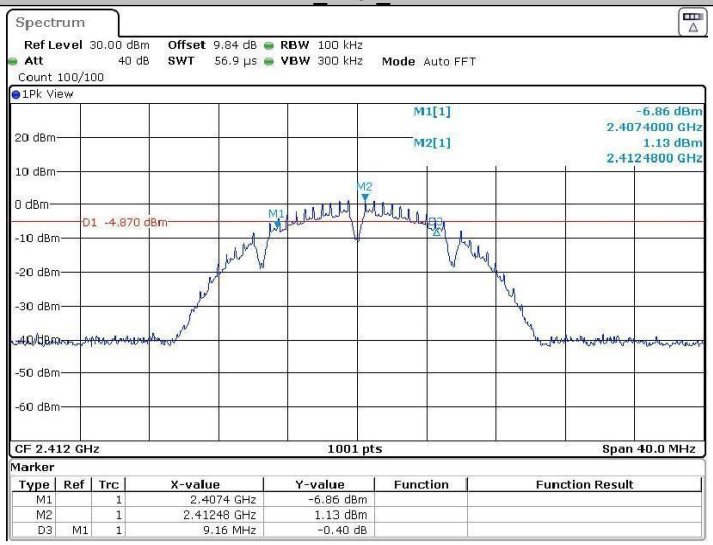
Test Requirement:	47 CFR Part 15C Section 15.247 (a)(2)
Test Method:	ANSI C63.10: 2013
Test Setup:	 Offset=cable loss+ attenuation factor
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Through Pre-scan, find the 1Mbps of rate is the worst case of 802.11b; 6Mbps of rate is the worst case of 802.11g; 6.5Mbps of rate is the worst case of 802.11n(HT20). Only the worst case is recorded in the report.
Limit:	≥ 500 kHz
Test Results:	Pass

Test Result

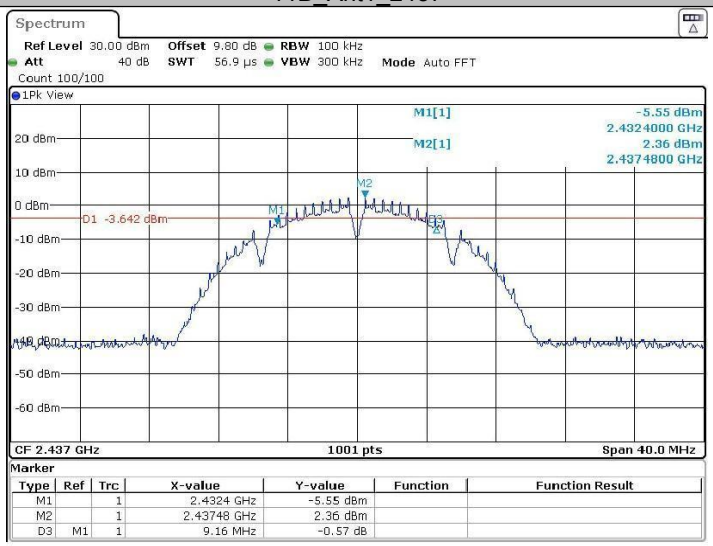
TestMode	Antenna	Channel	DTS BW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11B	Ant1	2412	9.160	2407.400	2416.560	0.5	PASS
		2437	9.160	2432.400	2441.560	0.5	PASS
		2462	9.160	2457.400	2466.560	0.5	PASS
11G	Ant1	2412	16.440	2403.760	2420.200	0.5	PASS
		2437	16.400	2428.760	2445.160	0.5	PASS
		2462	16.400	2453.800	2470.200	0.5	PASS
11N20SISO	Ant1	2412	17.720	2403.120	2420.840	0.5	PASS
		2437	17.680	2428.120	2445.800	0.5	PASS
		2462	17.720	2453.120	2470.840	0.5	PASS

Test Graphs

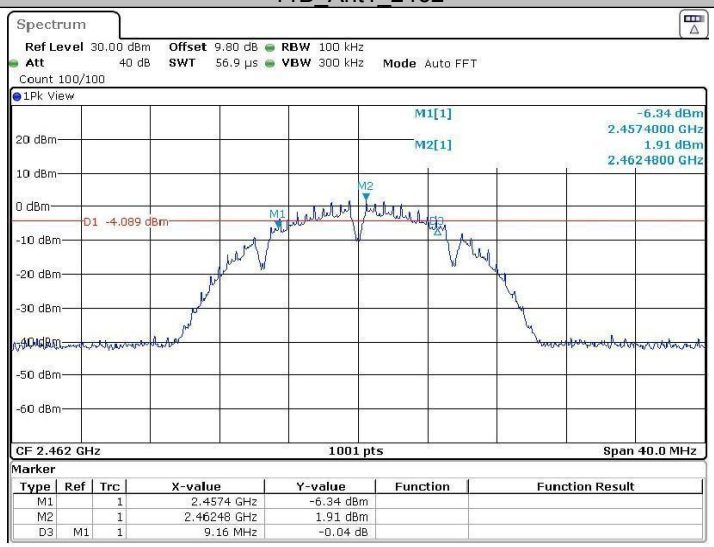
11B_Ant1_2412



11B_Ant1_2437

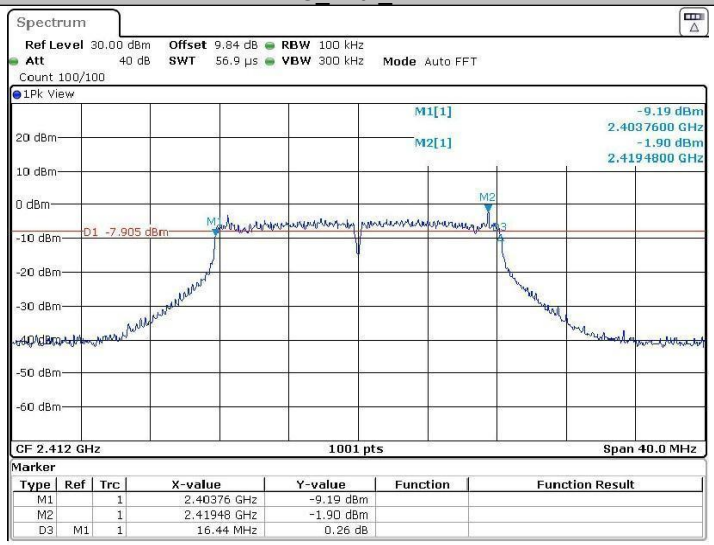


11B_Ant1_2462



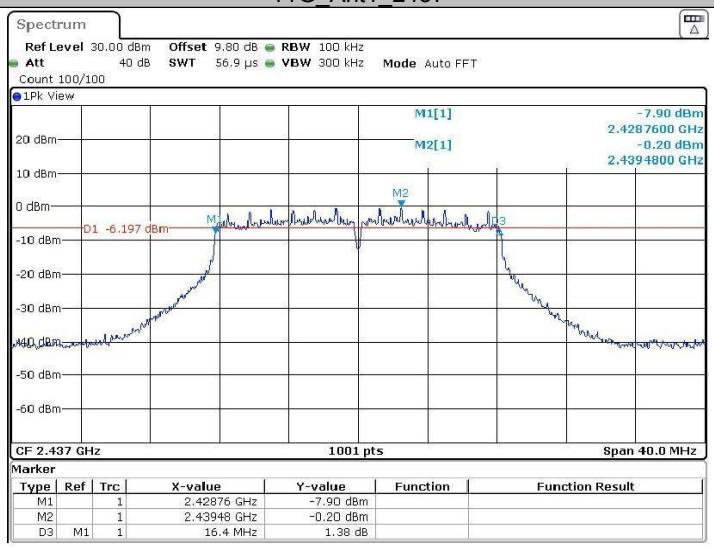
Date: 18.MAY.2022 04:02:31

11G_Ant1_2412



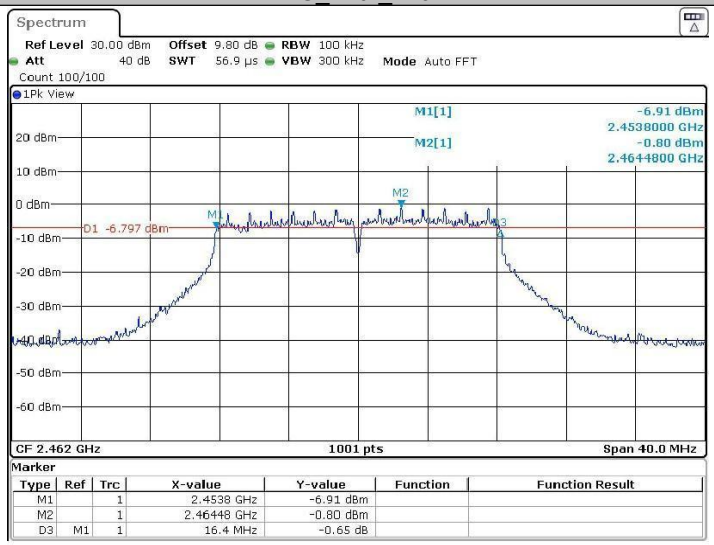
Date: 18.MAY.2022 04:12:49

11G_Ant1_2437



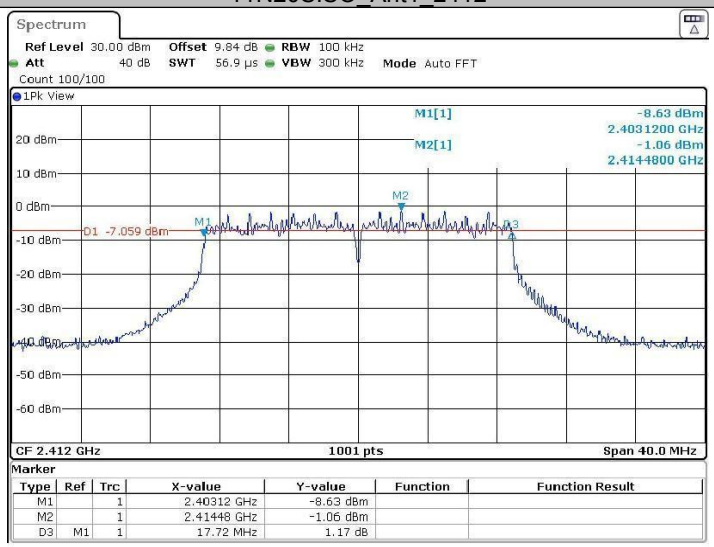
Date: 18.MAY.2022 04:15:44

11G_Ant1_2462



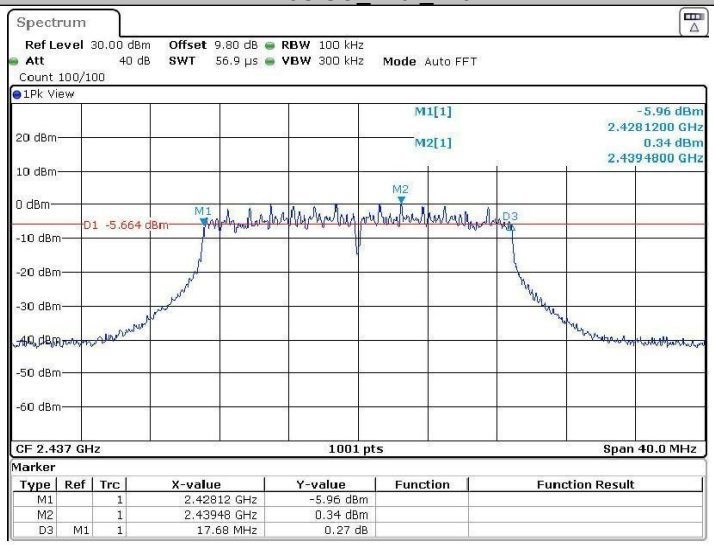
Date: 18.MAY.2022 04:17:26

11N20SISO_Ant1_2412



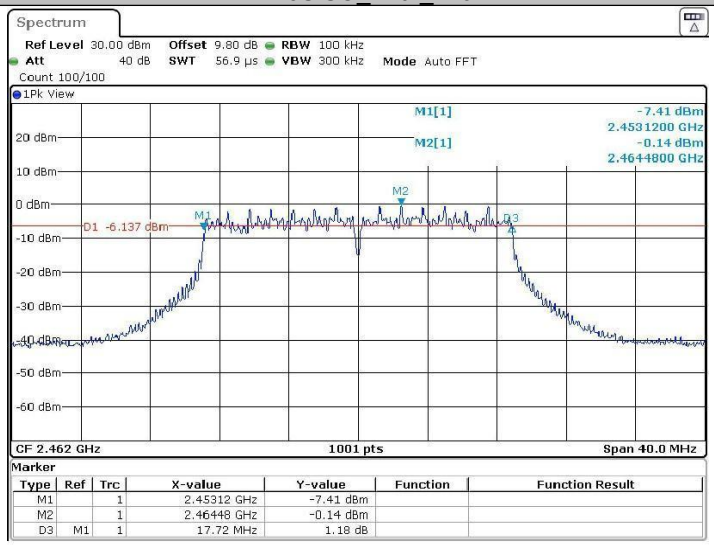
Date: 18.MAY.2022 04:20:41

11N20SISO_Ant1_2437

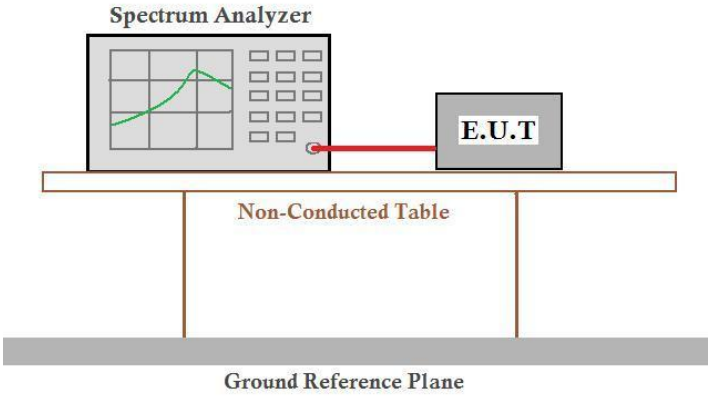


Date: 18.MAY.2022 04:23:26

11N20SISO_Ant1_2462



5.5 Power Spectral Density

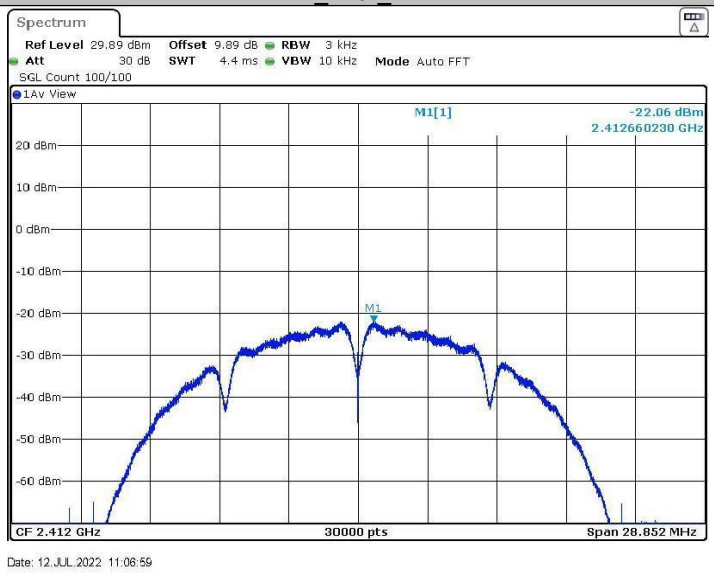
Test Requirement:	47 CFR Part 15C Section 15.247 (e)
Test Method:	ANSI C63.10: 2013
Test Setup:	 Offset=cable loss+ attenuation factor
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Through Pre-scan, find the 1Mbps of rate is the worst case of 802.11b; 6Mbps of rate is the worst case of 802.11g; 6.5Mbps of rate is the worst case of 802.11n(HT20). Only the worst case is recorded in the report.
Limit:	≤8.00dBm/3kHz
Test Results:	Pass

Test Result

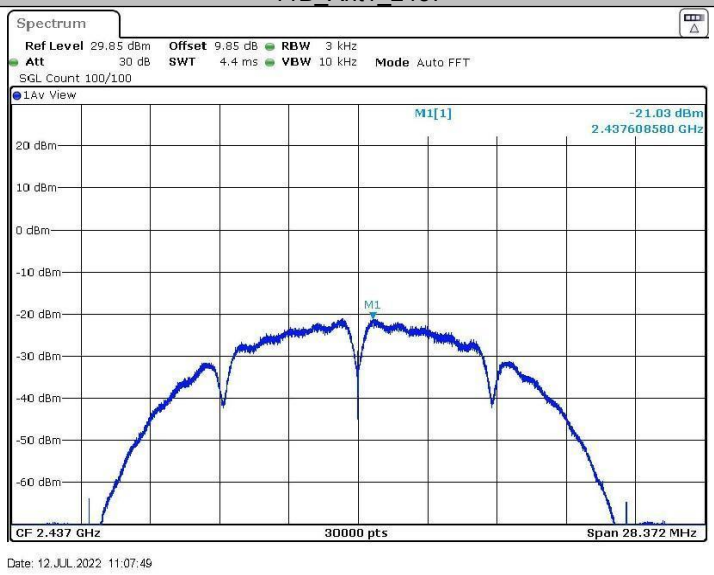
TestMode	Antenna	Channel	Result[dBm/3-100kHz]	Limit[dBm/3kHz]	Verdict
11B	Ant1	2412	-22.06	≤8	PASS
		2437	-21.03	≤8	PASS
		2462	-20.42	≤8	PASS
11G	Ant1	2412	-23.32	≤8	PASS
		2437	-22.57	≤8	PASS
		2462	-21.48	≤8	PASS
11N20SISO	Ant1	2412	-20.58	≤8	PASS
		2437	-20.52	≤8	PASS
		2462	-21.76	≤8	PASS

Test Graphs

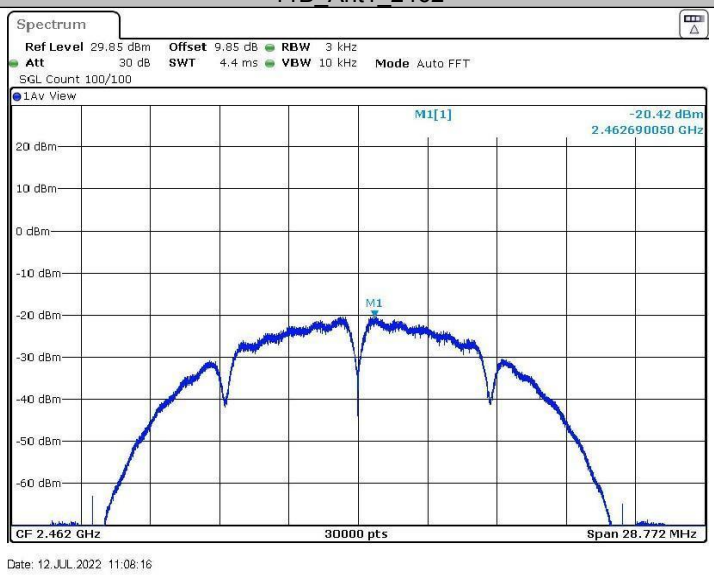
11B_Ant1_2412



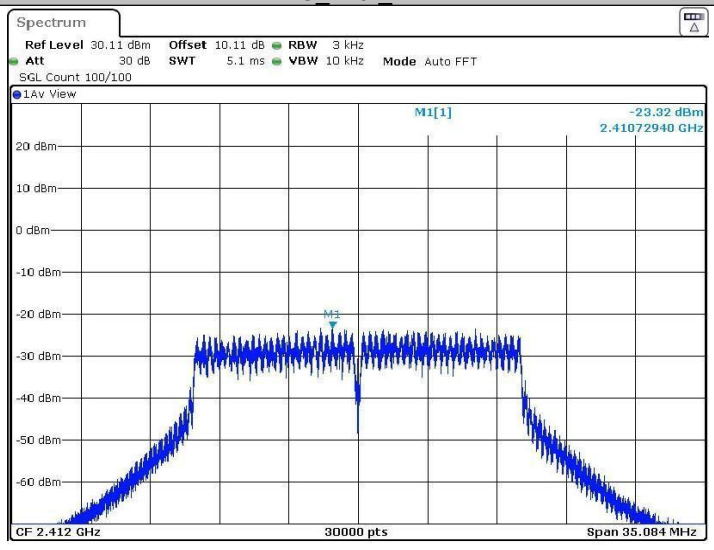
11B_Ant1_2437



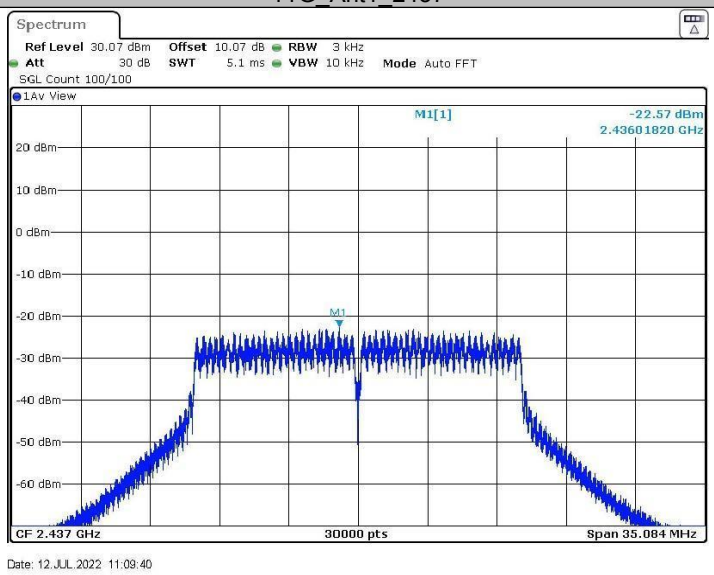
11B_Ant1_2462



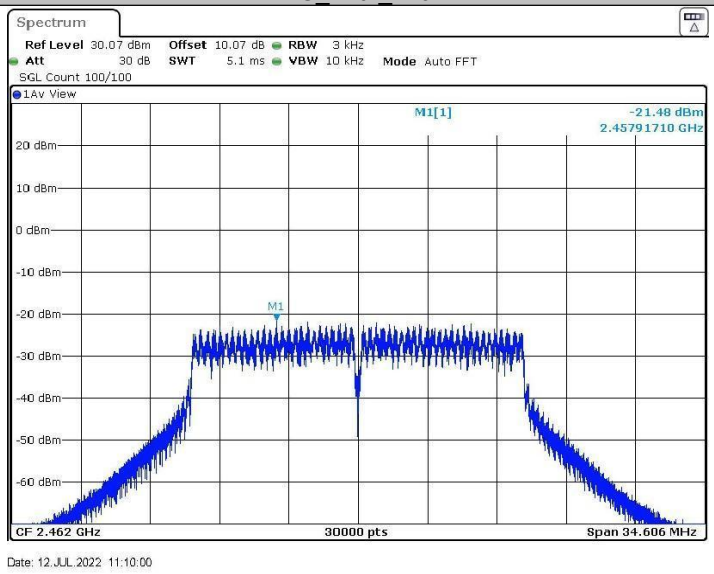
11G_Ant1_2412



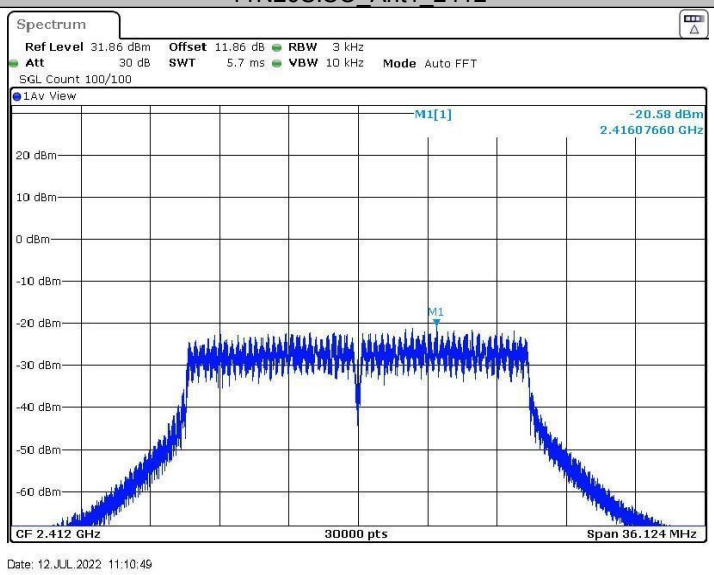
11G_Ant1_2437



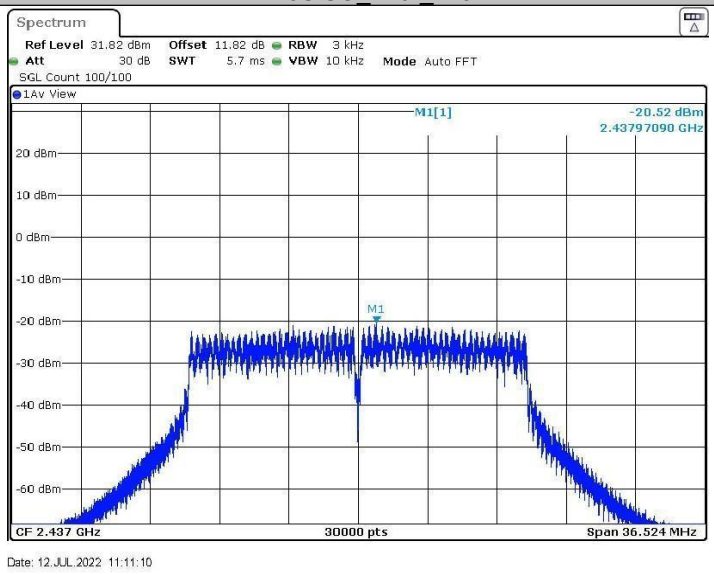
11G_Ant1_2462



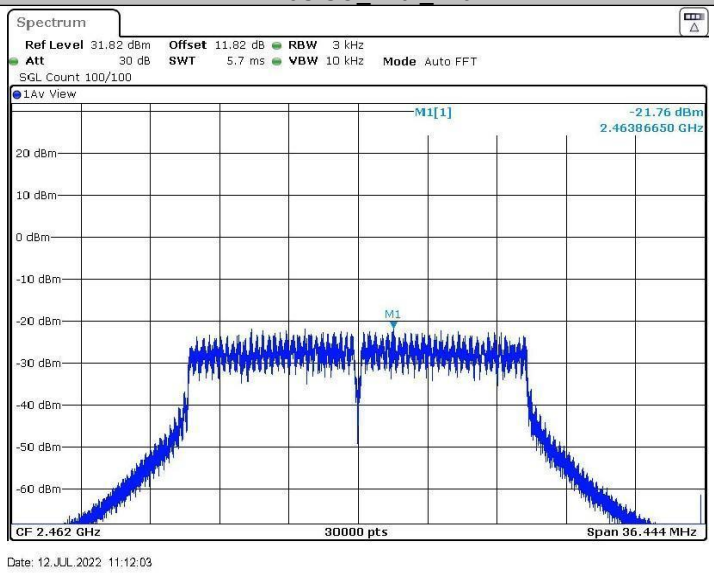
11N20SISO_Ant1_2412



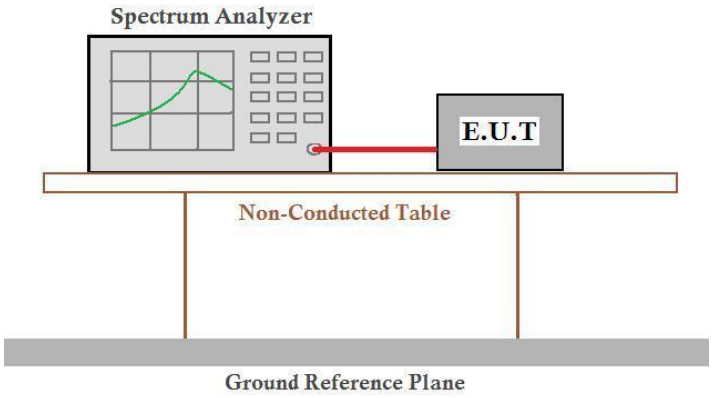
11N20SISO_Ant1_2437



11N20SISO_Ant1_2462



5.6 Band-edge for RF Conducted Emissions

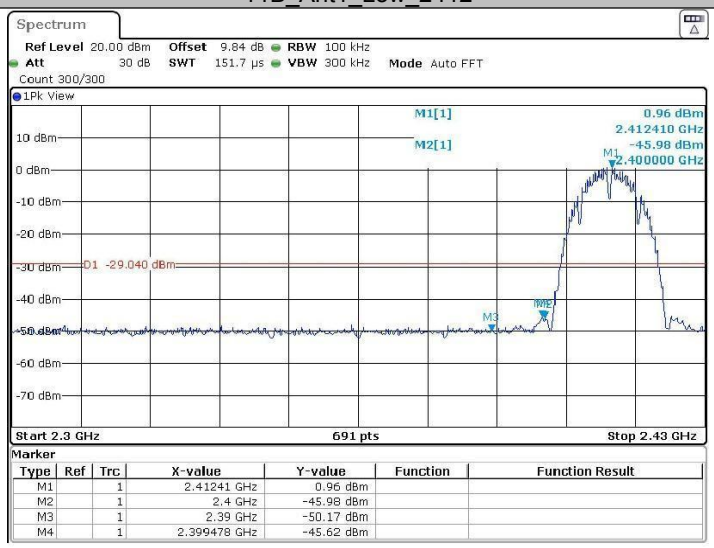
Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10: 2013
Test Setup:	 Offset=cable loss+ attenuation factor
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Through Pre-scan, find the 1Mbps of rate is the worst case of 802.11b; 6Mbps of rate is the worst case of 802.11g; 6.5Mbps of rate is the worst case of 802.11n(HT20). Only the worst case is recorded in the report.
Limit:	In any 100 kHz bandwidth outside the frequency band 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.
Test Results:	Pass

Test Result

TestMode	Antenna	ChName	Channel	RefLevel[dBm]	Result[dBm]	Limit[dBm]	Verdict
11B	Ant1	Low	2412	0.96	-45.62	≤-29.04	PASS
		High	2462	1.61	-47.82	≤-28.39	PASS
11G	Ant1	Low	2412	-2.01	-34.98	≤-32.01	PASS
		High	2462	-2.79	-47.62	≤-32.79	PASS
11N20SISO	Ant1	Low	2412	-1.17	-36.62	≤-31.17	PASS
		High	2462	-0.31	-46.89	≤-30.31	PASS

5.6.1 Test Graphs

11B_Ant1_Low_2412



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.41241 GHz	0.96 dBm		
M2		1	2.4 GHz	-45.98 dBm		
M3		1	2.39 GHz	-50.17 dBm		
M4		1	2.399478 GHz	-45.62 dBm		

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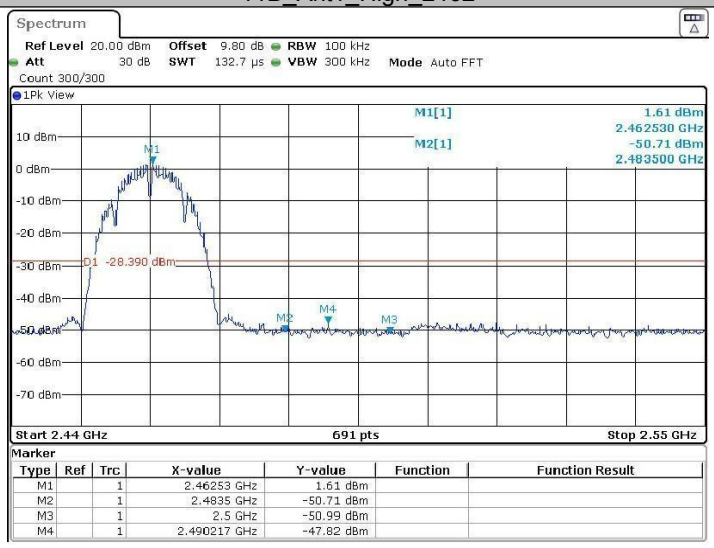
11B_Ant1_High_2462



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.46253 GHz	1.61 dBm		
M2		1	2.4835 GHz	-50.71 dBm		
M3		1	2.5 GHz	-50.99 dBm		
M4		1	2.490217 GHz	-47.82 dBm		

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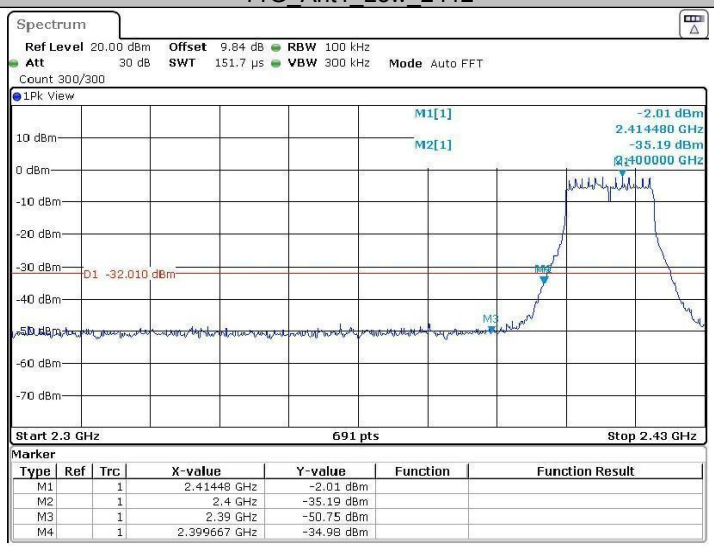
11G_Ant1_Low_2412

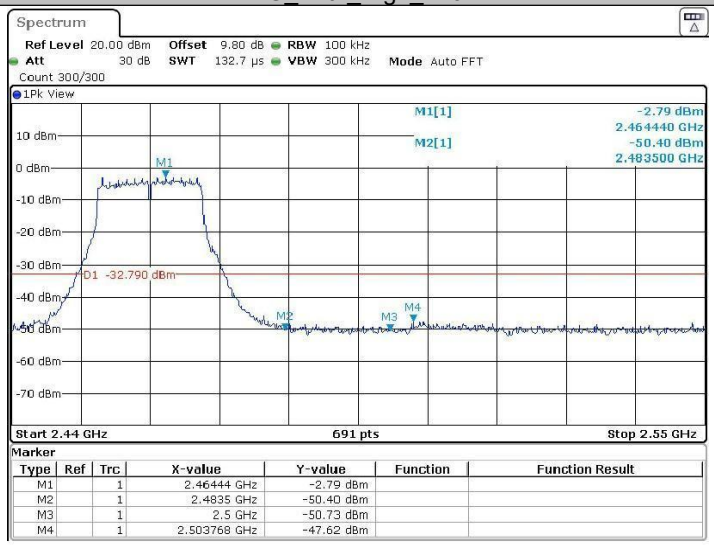


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.41448 GHz	-2.01 dBm		
M2		1	2.4 GHz	-35.19 dBm		
M3		1	2.39 GHz	-50.75 dBm		
M4		1	2.399667 GHz	-34.98 dBm		

Date: 18.MAY.2022 04:13:23

11G_Ant1_High_2462



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.46444 GHz	-2.79 dBm		
M2		1	2.4835 GHz	-50.40 dBm		
M3		1	2.5 GHz	-50.73 dBm		
M4		1	2.503768 GHz	-47.62 dBm		

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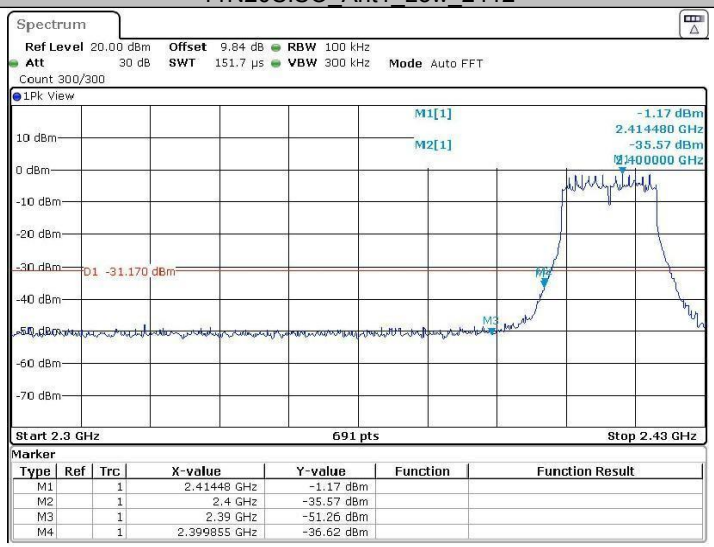
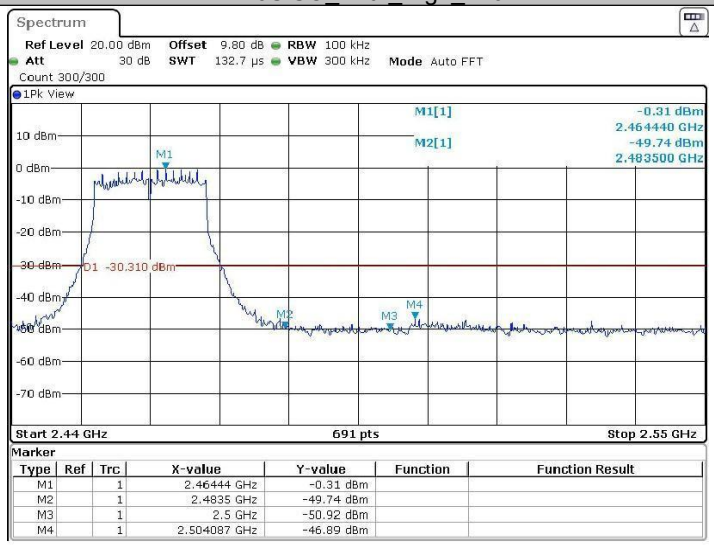
11N20SISO_Ant1_Low_2412



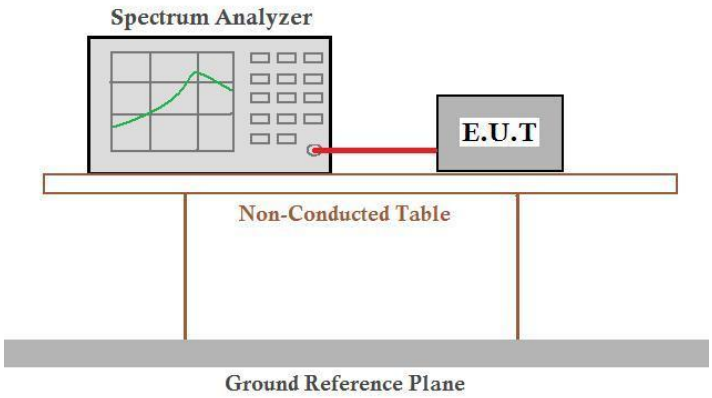
Date: 18.MAY.2022 04:21:14

11N20SISO_Ant1_High_2462



Date: 18.MAY.2022 04:38:43

5.7 RF Conducted Spurious Emissions

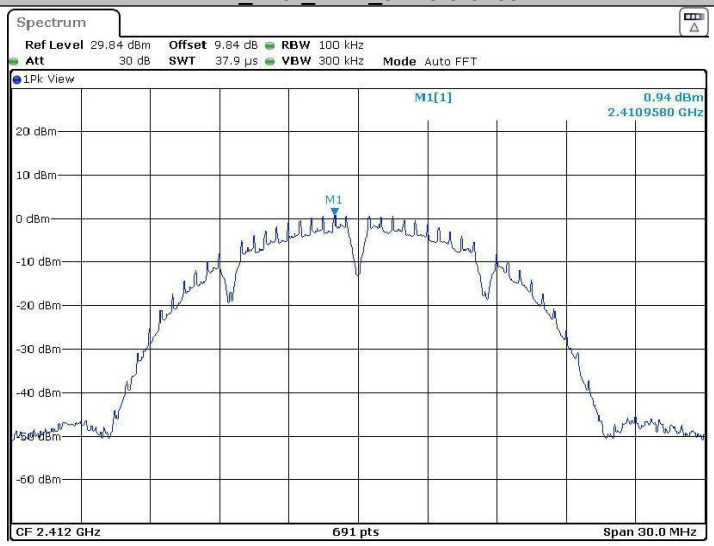
Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10: 2013
Test Setup:	 Offset=cable loss+ attenuation factor
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates
Final Test Mode:	Through Pre-scan, find the 1Mbps of rate is the worst case of 802.11b; 6Mbps of rate is the worst case of 802.11g; 6.5Mbps of rate is the worst case of 802.11n(HT20). Only the worst case is recorded in the report.
Limit:	In any 100 kHz bandwidth outside the frequency band 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.
Test Results:	Pass

Test Result

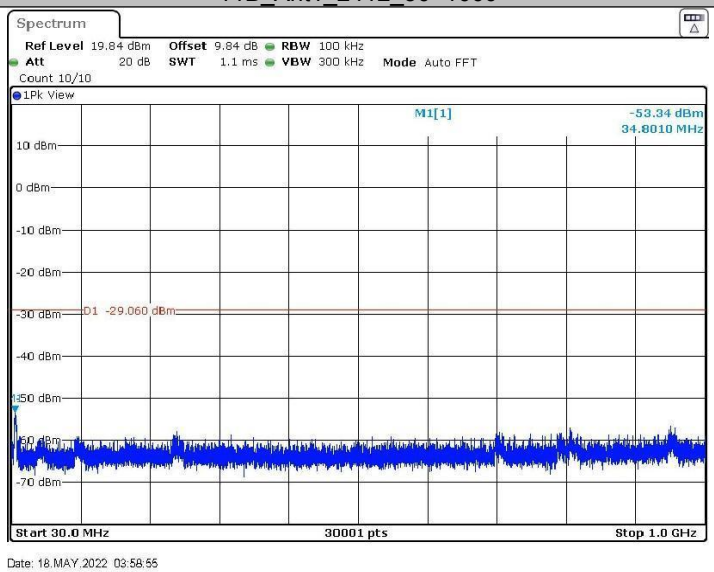
TestMode	Antenna	Channel	FreqRange [Mhz]	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
11B	Ant1	2412	Reference	0.94	0.94	---	PASS
			30~1000	0.94	-53.34	≤-29.06	PASS
			1000~26500	0.94	-52.88	≤-29.06	PASS
		2437	Reference	2.08	2.08	---	PASS
			30~1000	2.08	-53.7	≤-27.92	PASS
			1000~26500	2.08	-53.06	≤-27.92	PASS
		2462	Reference	1.36	1.36	---	PASS
			30~1000	1.36	-53.73	≤-28.64	PASS
			1000~26500	1.36	-53.54	≤-28.64	PASS
11G	Ant1	2412	Reference	-1.59	-1.59	---	PASS
			30~1000	-1.59	-52.3	≤-31.59	PASS
			1000~26500	-1.59	-53.1	≤-31.59	PASS
		2437	Reference	-0.21	-0.21	---	PASS
			30~1000	-0.21	-53.72	≤-30.21	PASS
			1000~26500	-0.21	-53.47	≤-30.21	PASS
		2462	Reference	-1.40	-1.40	---	PASS
			30~1000	-1.40	-53.83	≤-31.4	PASS
			1000~26500	-1.40	-52.88	≤-31.4	PASS
11N20SISO	Ant1	2412	Reference	-1.05	-1.05	---	PASS
			30~1000	-1.05	-52.5	≤-31.05	PASS
			1000~26500	-1.05	-53.38	≤-31.05	PASS
		2437	Reference	0.32	0.32	---	PASS
			30~1000	0.32	-53.97	≤-29.68	PASS
			1000~26500	0.32	-53.57	≤-29.68	PASS
		2462	Reference	-0.10	-0.10	---	PASS
			30~1000	-0.10	-53.55	≤-30.1	PASS
			1000~26500	-0.10	-53.39	≤-30.1	PASS

Test Graphs

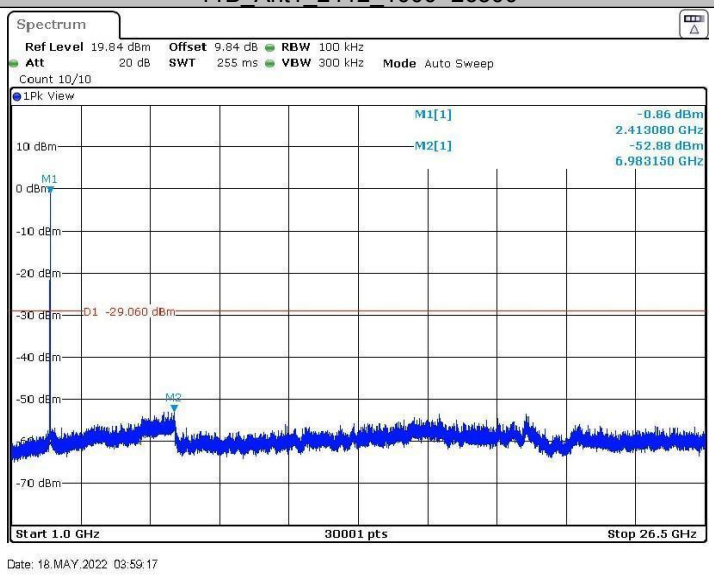
11B_Ant1_2412_0~Reference



11B_Ant1_2412_30~1000

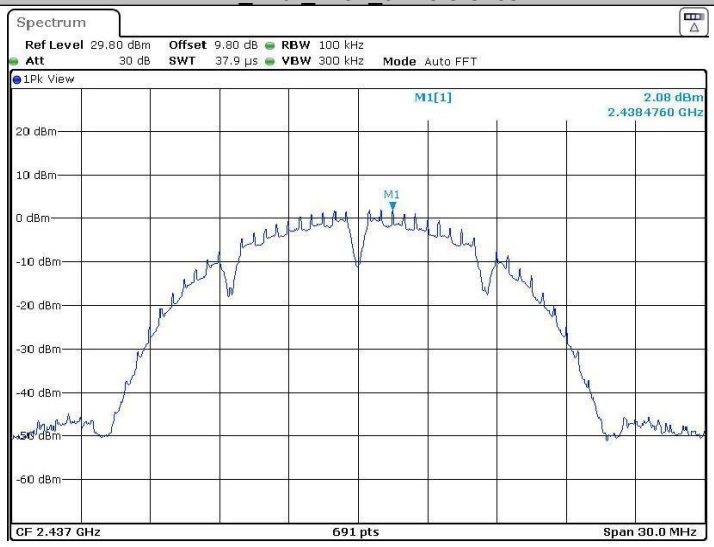


11B_Ant1_2412_1000~26500



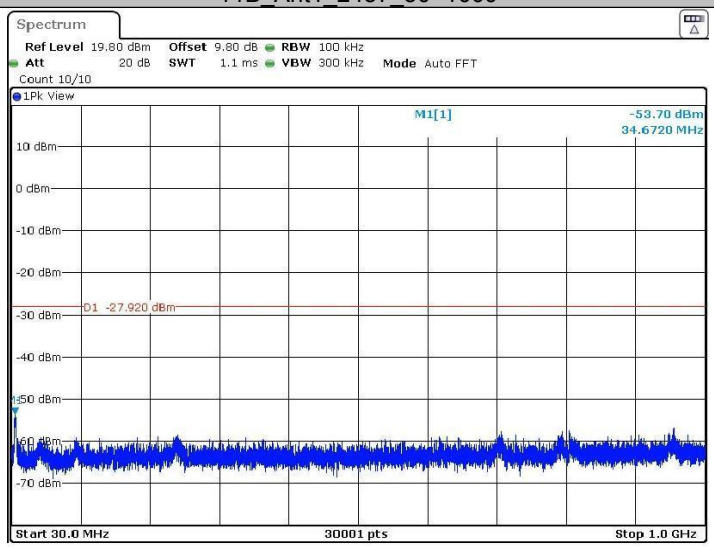
Date: 18.MAY.2022 03:59:17

11B_Ant1_2437_0~Reference

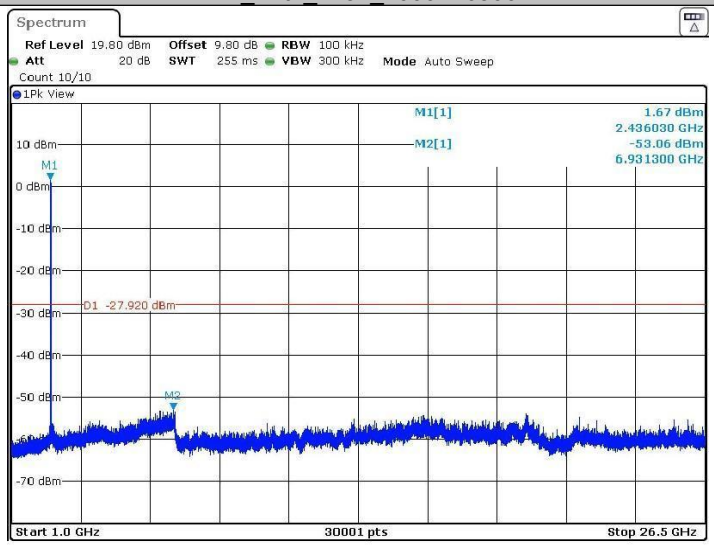


Date: 18.MAY.2022 04:01:05

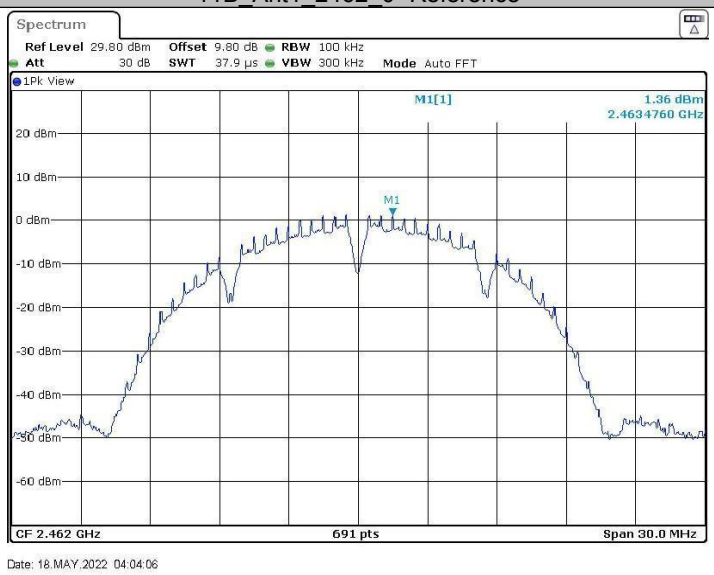
11B_Ant1_2437_30~1000



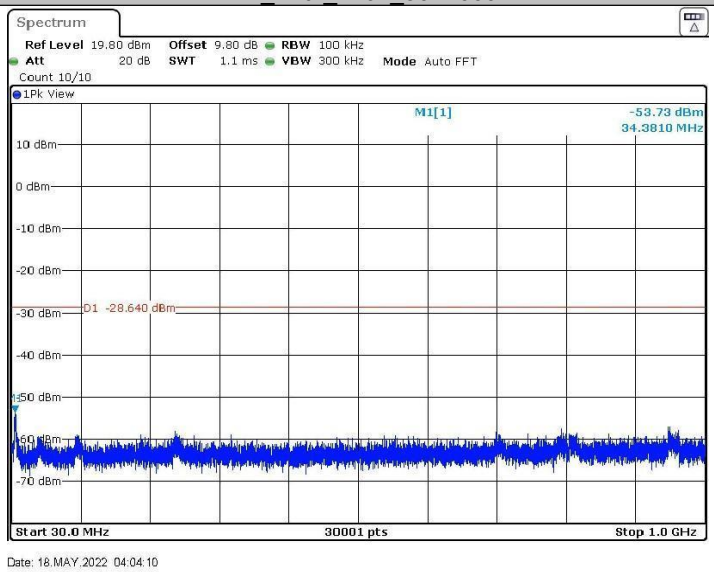
11B_Ant1_2437_1000~26500



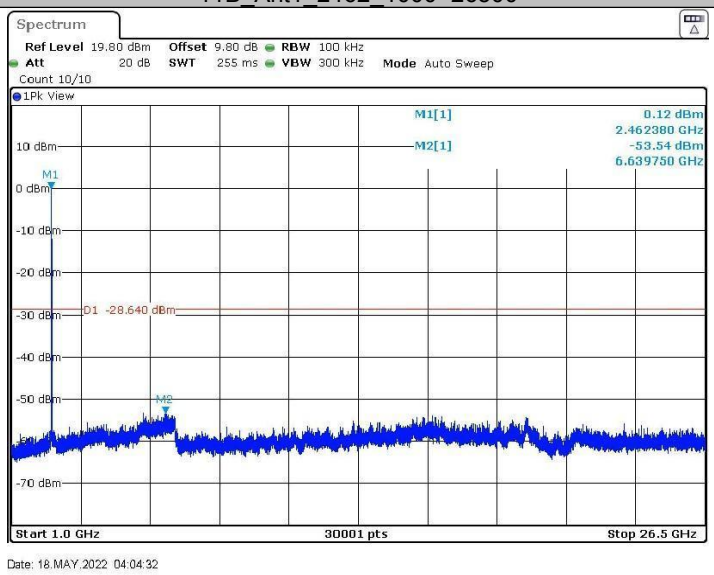
11B_Ant1_2462_0~Reference



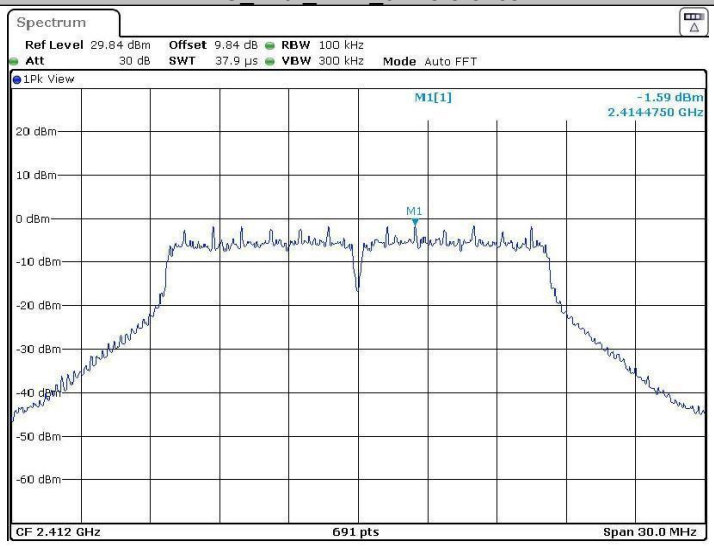
11B_Ant1_2462_30~1000



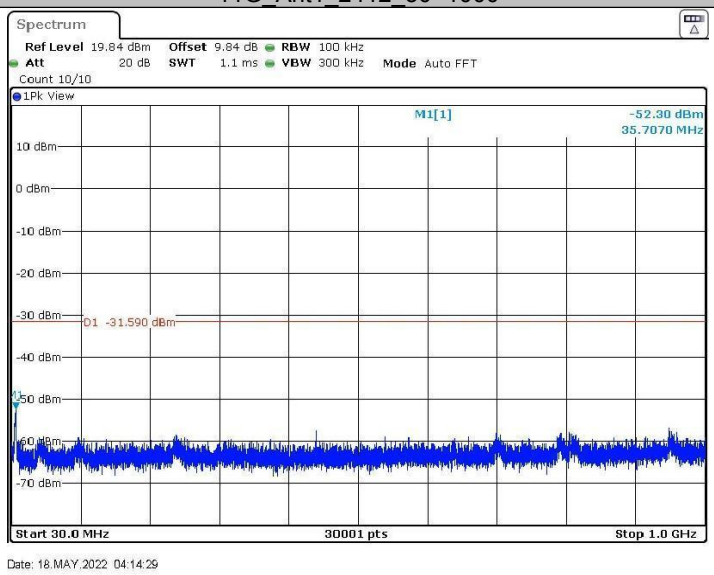
11B_Ant1_2462_1000~26500



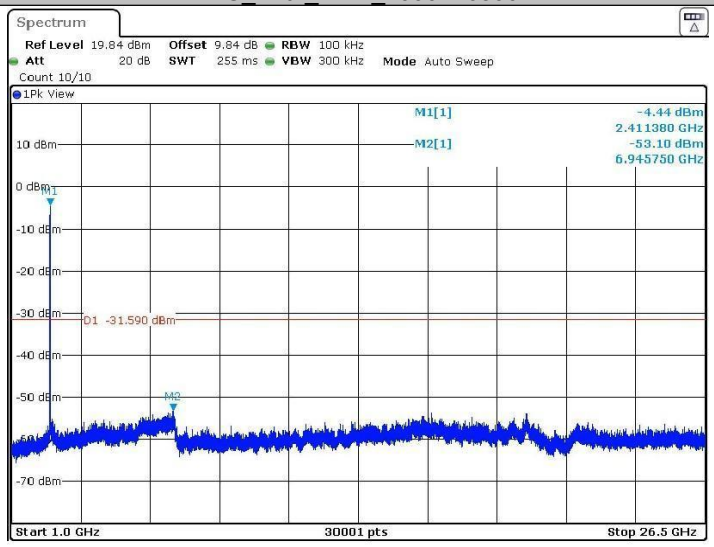
11G_Ant1_2412_0~Reference



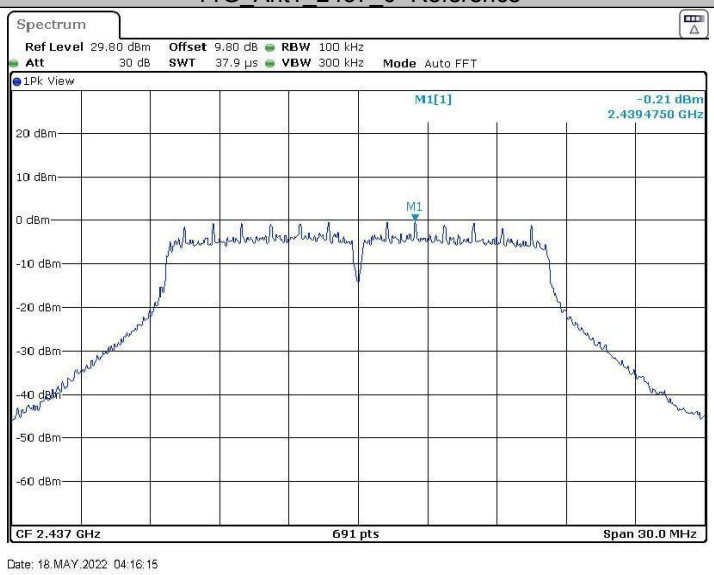
11G_Ant1_2412_30~1000



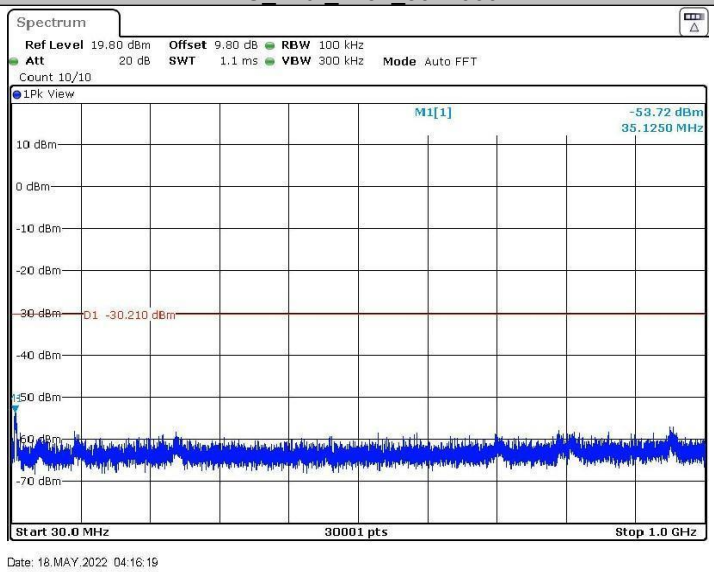
11G_Ant1_2412_1000~26500



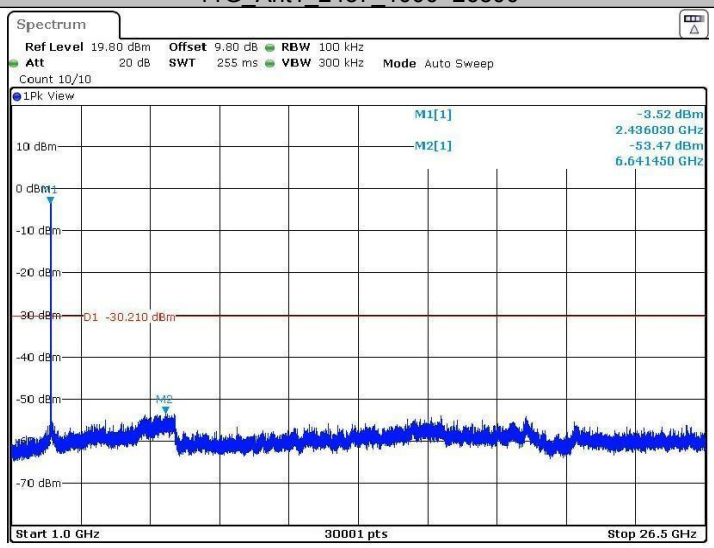
11G_Ant1_2437_0~Reference



11G_Ant1_2437_30~1000

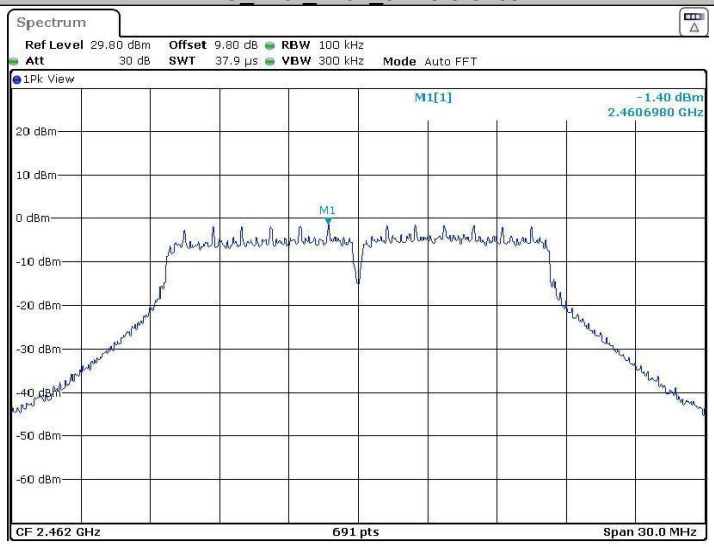


11G_Ant1_2437_1000~26500



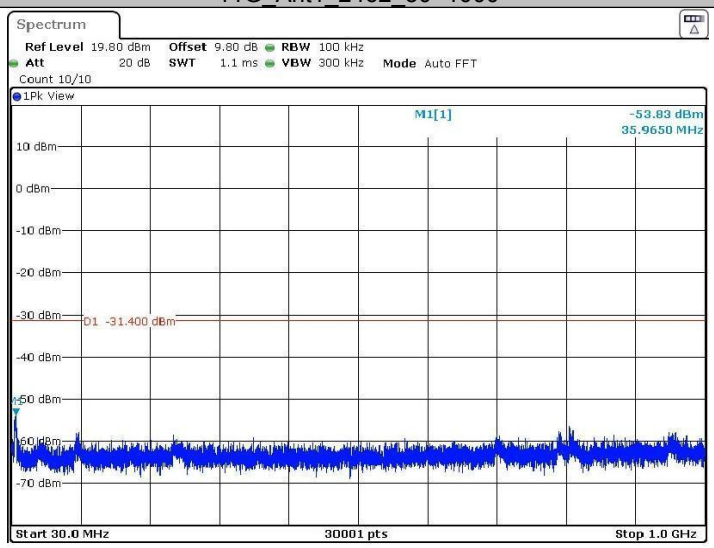
Date: 18.MAY.2022 04:16:41

11G_Ant1_2462_0~Reference



Date: 18.MAY.2022 04:19:02

11G_Ant1_2462_30~1000



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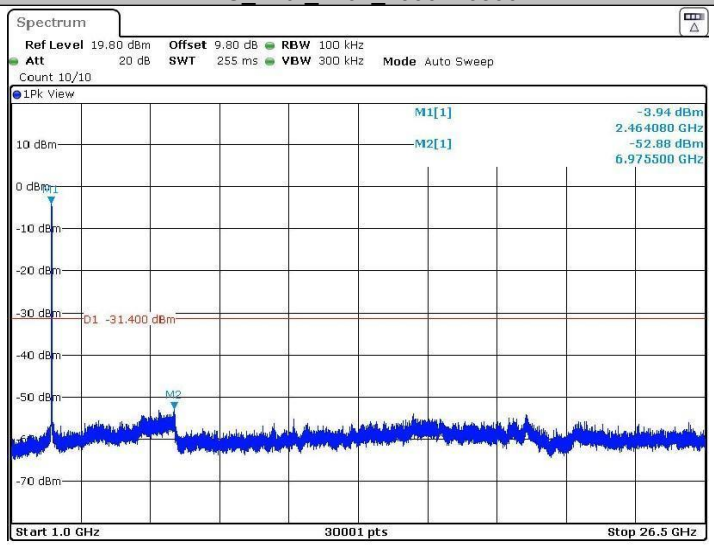
11G_Ant1_2462_1000~26500



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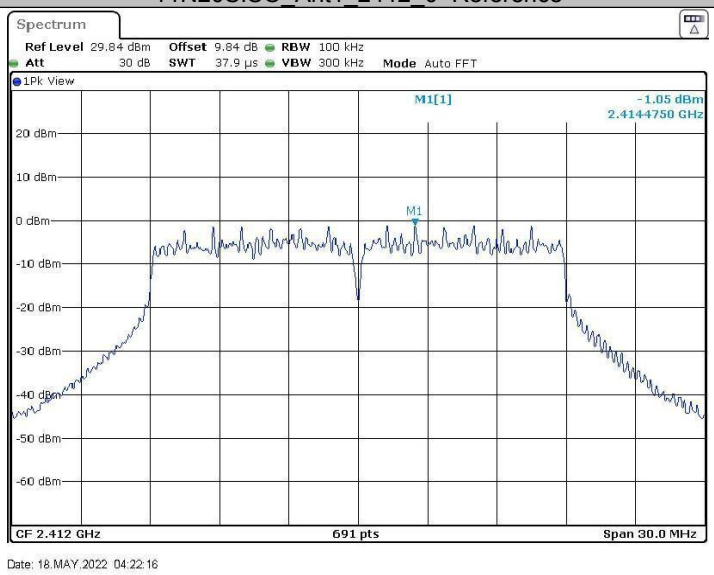

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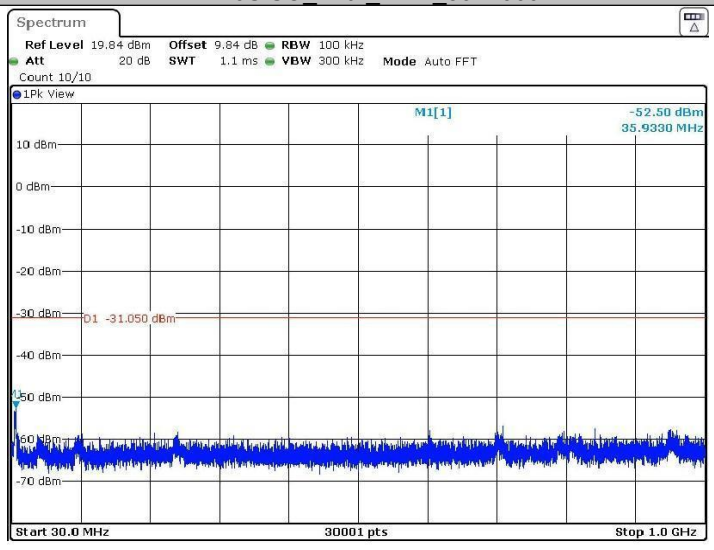

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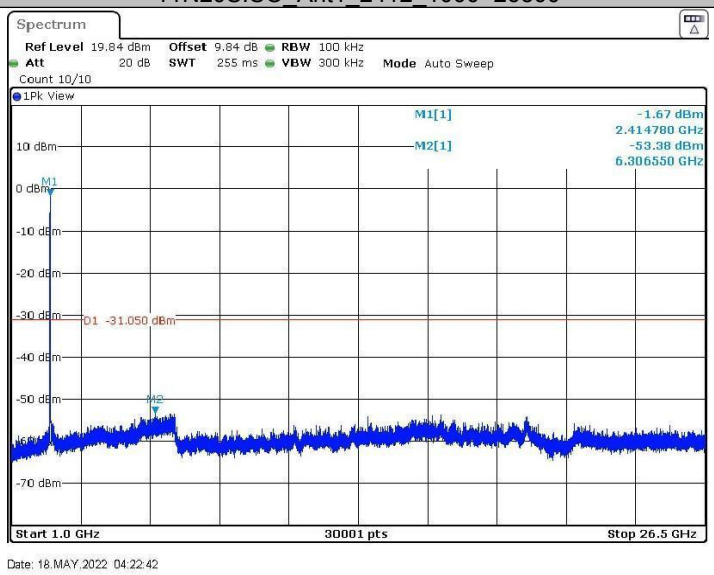

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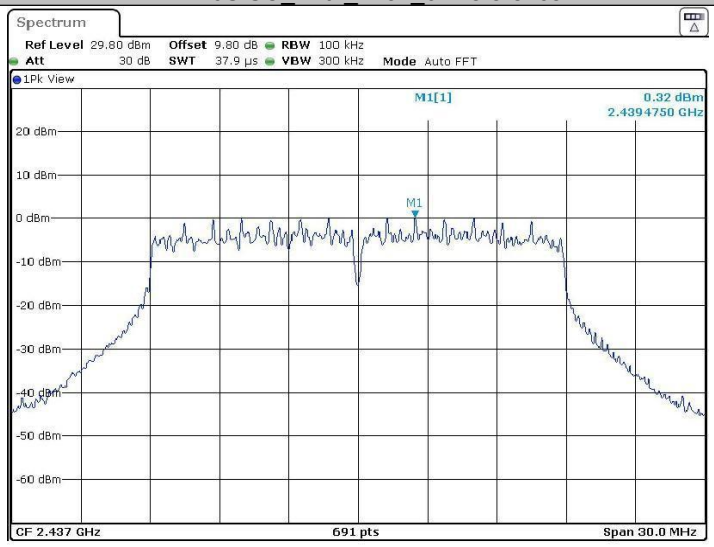

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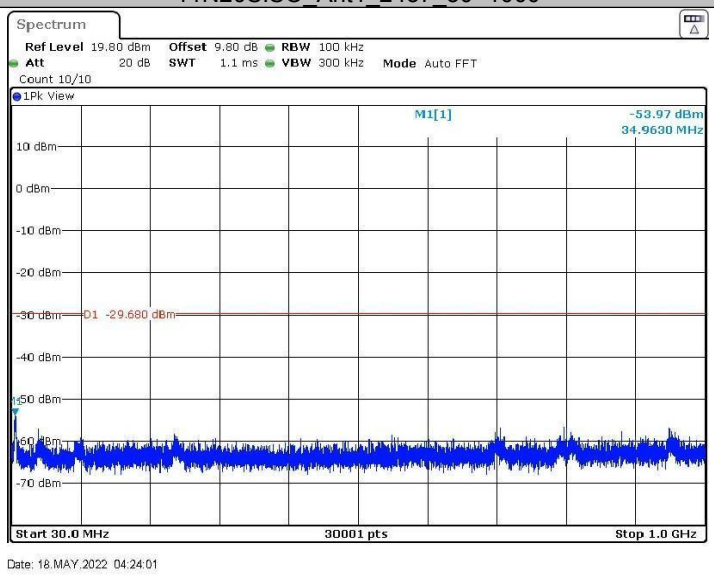

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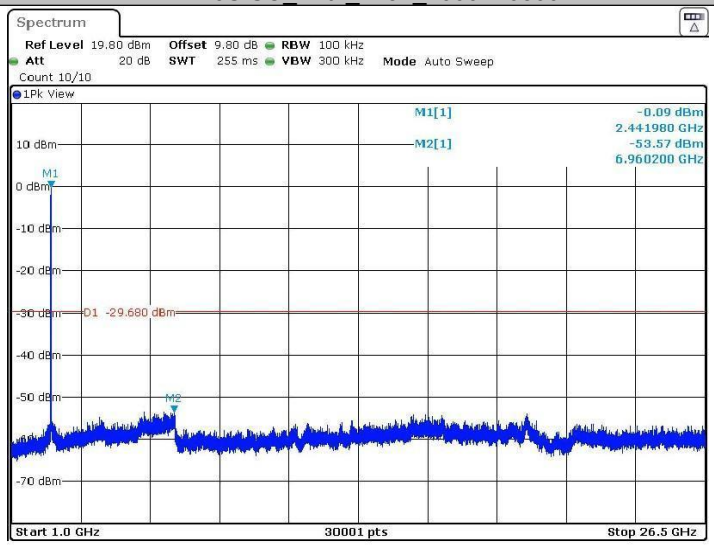

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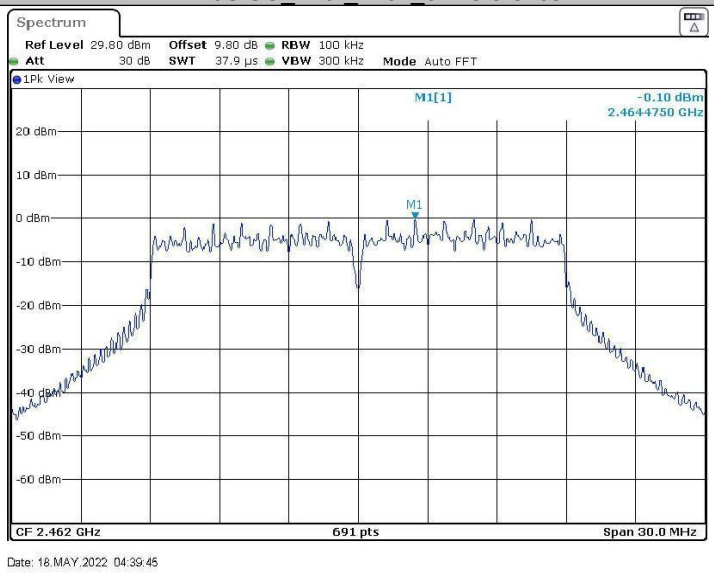

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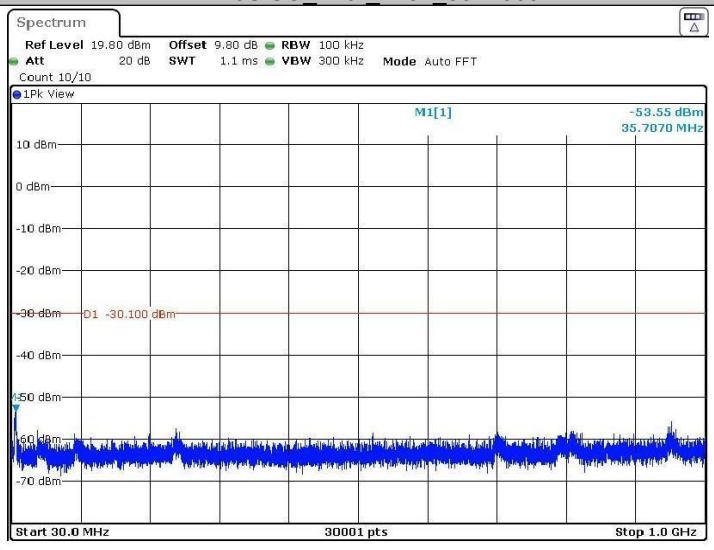

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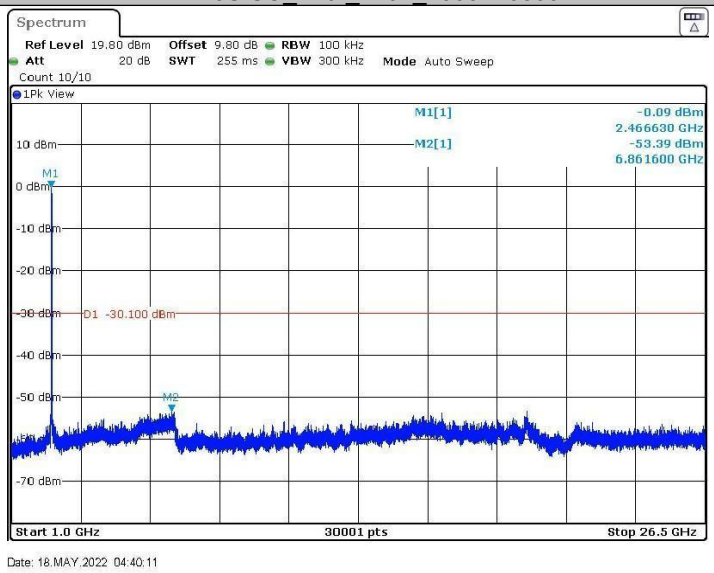


Remark:

Pretest 9kHz to 25GHz, find the highest point when testing, so only the worst data were shown in the test report. Per FCC Part 15.33 (a) and 15.31 (o) ,The amplitude of spurious emissions from intentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

5.8 Radiated Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205
Test Method:	ANSI C63.10 2013
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
30MHz-1GHz	Quasi-peak	100 kHz	300kHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Limit:

Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
1.705MHz-30MHz	30	-	-	30
30MHz-88MHz	100	40.0	Quasi-peak	3
88MHz-216MHz	150	43.5	Quasi-peak	3
216MHz-960MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	54.0	Average	3

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

Test Setup:	

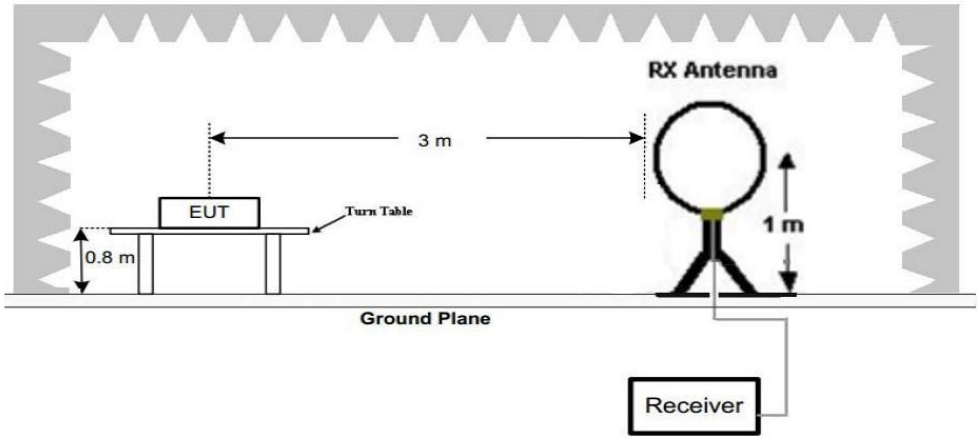


Figure 1. Below 30MHz

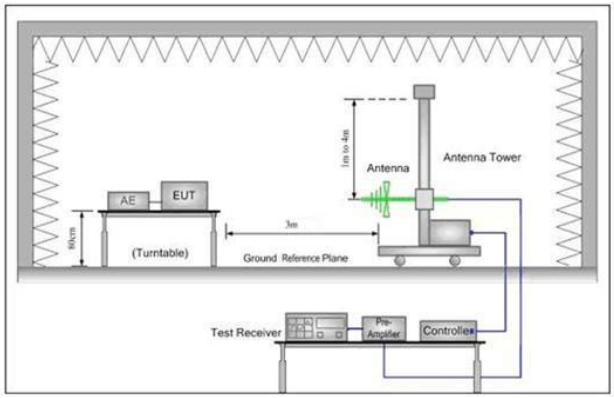


Figure 2. 30MHz to 1GHz

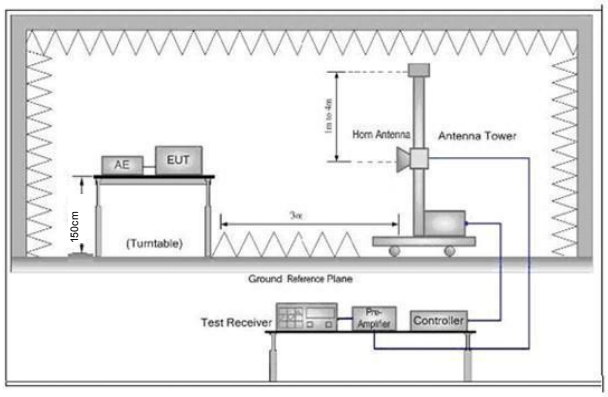


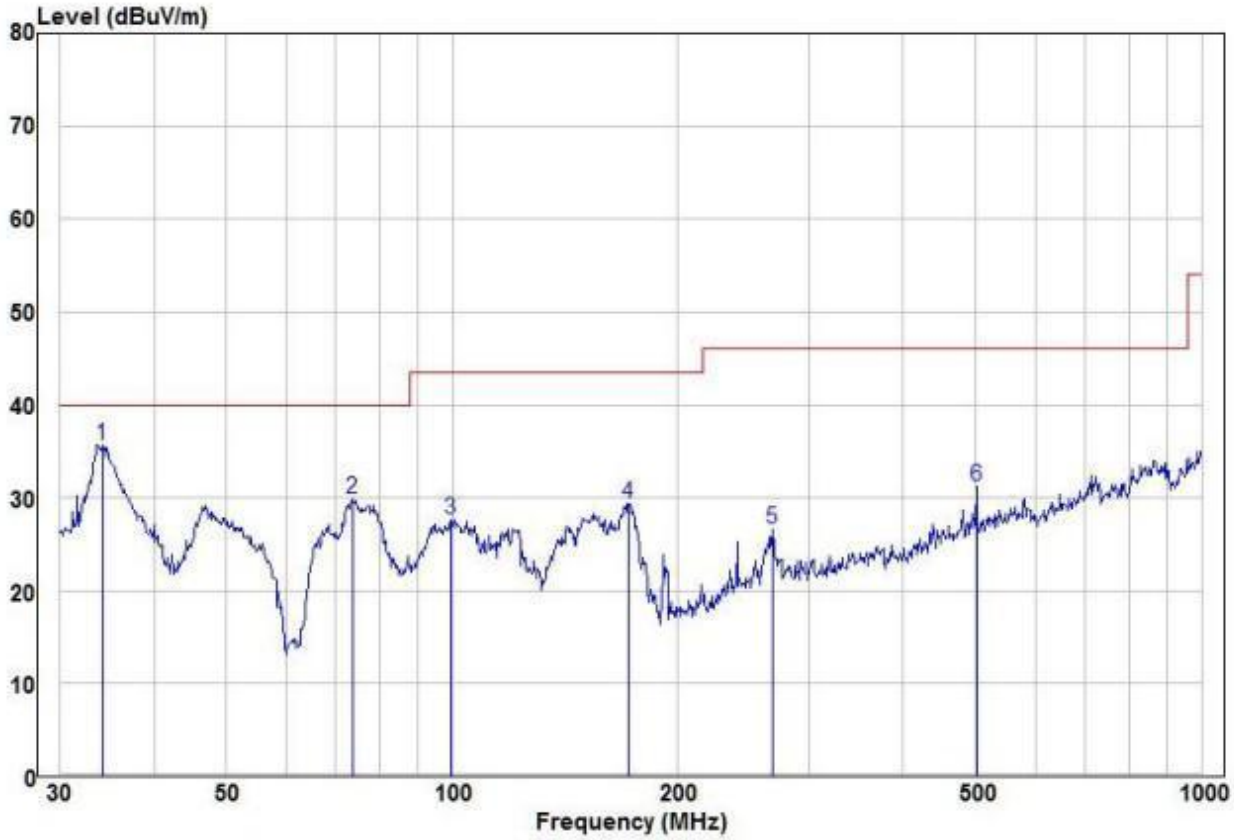
Figure 3. Above 1 GHz

Test Procedure:	a. 1) Below 1G: The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2) Above 1G: The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. Note: For the radiated emission test above 1GHz: Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane. b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. c. The antenna height 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.

	d. 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(for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. g. Test the EUT in the lowest channel, the middle channel, the Highest channel. h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode,And found the X axis positioning which it is worse case . i. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates at lowest, middle and highest channel.
Final Test Mode:	Pretest the EUT at Transmitting mode and Charge +Transmitting mode, found the Charge +Transmitting mode which it is worse case. Through Pre-scan, find the 1Mbps of rate is the worst case of 802.11b; 6Mbps of rate is the worst case of 802.11g; 6.5Mbps of rate is the worst case of 802.11n(HT20). For below 1GHz, through Pre-scan, find the 1Mbps of rate of 802.11b at middle channel is the worst case. Only the worst case is recorded in the report.
Test Results:	Pass

5.8.1 Radiated emission below 1GHz

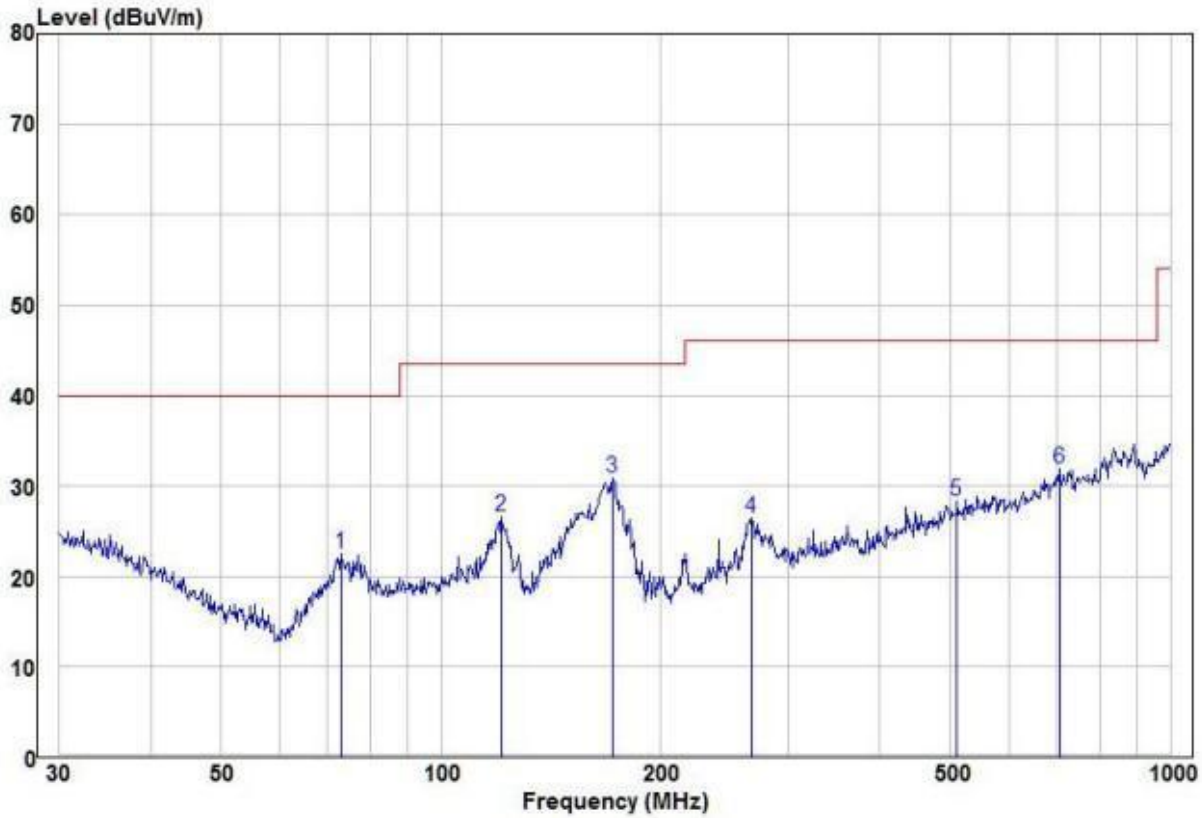
30MHz~1GHz
Vertical



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1 pp	34.16	20.88	14.83	35.71	40.00	-4.29	Peak	VERTICAL
2	73.62	21.09	8.75	29.84	40.00	-10.16	Peak	VERTICAL
3	99.53	17.05	10.62	27.67	43.50	-15.83	Peak	VERTICAL
4	171.99	21.66	7.76	29.42	43.50	-14.08	Peak	VERTICAL
5	267.55	13.94	12.66	26.60	46.00	-19.40	Peak	VERTICAL
6	501.18	12.93	18.29	31.22	46.00	-14.78	Peak	VERTICAL

Remark:
The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Factor= Antenna Factor + Cable Factor – Preamplifier Factor,
Level = Read Level + Factor,
Over Limit=Level-Limit Line.

Horizontal



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	72.85	13.91	8.62	22.53	40.00	-17.47	Peak	HORIZONTAL
2	121.12	15.89	10.66	26.55	43.50	-16.95	Peak	HORIZONTAL
3 pp	171.99	23.11	7.76	30.87	43.50	-12.63	Peak	HORIZONTAL
4	266.61	13.85	12.62	26.47	46.00	-19.53	Peak	HORIZONTAL
5	510.04	10.01	18.38	28.39	46.00	-17.61	Peak	HORIZONTAL
6	704.23	10.74	21.12	31.86	46.00	-14.14	Peak	HORIZONTAL

Remark:
The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Factor= Antenna Factor + Cable Factor – Preamplifier Factor,
Level = Read Level + Factor,
Over Limit=Level-Limit Line.