FCC TEST REPORT

Application No:	ZR/2020/60019
Applicant:	Lenovo(Shanghai) Electronics Technology Co., Ltd.
Address of Applicant:	Section 304-305, Building No. 4, # 222, Meiyue Road, China (Shanghai) Pilot Free Trade Zone
Manufacturer:	Lenovo PC HK Limited
Address of Manufacturer	23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong P.R.China
EUT Description:	Portable Tablet Computer
Model No.:	Lenovo TB-X306FA
Trade Mark:	Lenovo
FCC ID:	O57TBX306FA
Standards:	47 CFR FCC Part 2, Subpart J 47 CFR Part 15, Subpart C
Test Method:	KDB558074 D01 15.247 Meas Guidance v05r02 ANSI C63.10 (2013)
Date of Receipt:	2020/5/7
Date of Test:	2020/5/10 to 2020/5/20
Date of Issue:	2021/4/30
Test Result:	**PASS ***

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

Authorized Signature:

Derek Yang
Wireless Laboratory Manager

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1 Version

Revision Record				
Version	**Chapter**	**Date**	**Modifier**	**Remark**
00		2020/7/21		Original
01		2021/4/30	Flora Wang	1.Add test site Information 2.Modify data conversion error of antenna height 3.Update equipment list

This report supersedes our previous report ZR/2020/6001902, issued on 2020-07-21, which is hereby deemed null and void.

Authorized for issue by:				
Prepared By		Flora Wang **(Flora Wang) /Project Engineer**		
Checked By		David Chen **(David Chen) /Reviewer**		

Remark:

There difference between Lenovo TB-X306F and Lenovo TB-X306FA,

They are only difference on BOM and Software:
They have different model and different software version for different market, But the hardware circuitry is same. It will not change the radio frequency conformance of original model, all other data copy from the original report (Report No: ZR/2020/5000102-01).

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2 Test Summary

Test Item	Test Requirement	Test method	Test Result	Result	Test Lab*
AC Power Line Conducted Emission	15.207	ANSI C63.10 2013	Clause 4.2	PASS	B
Duty Cycle	--	--	Clause 4.3	PASS	A
Conducted Output Power	15.247 (b)(3)	ANSI C63.10 2013	Clause 4.4	PASS	A
DTS (6 dB) Bandwidth & 99% Occupied Bandwidth	15.247 (a)(2)	ANSI C63.10 2013	Clause 4.5	PASS	A
Power Spectral Density	15.247 (e)	ANSI C63.10 2013	Clause 4.6	PASS	A
Band-edge for RF Conducted Emissions	15.247(d)	ANSI C63.10 2013	Clause 4.7	PASS	A
RF Conducted Spurious Emissions	15.247(d)	ANSI C63.10 2013	Clause 4.8	PASS	A
Radiated Spurious Emissions	15.247(d);15.205/15.209	ANSI C63.10 2013	Clause 4.9	PASS	B
Restricted bands around fundamental frequency (Radiated Emission)	15.247(d);15.205/15.209	ANSI C63.10 2013	Clause 4.10	PASS	B

Remark：All test were performed by Lab A and B.
Parts of test items above were subcontracted to Lab B.
Lab A SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

Lab B SGS-CSTC STANDARDS TECHNICAL SERVICES (XI 'AN) CO., LTD.

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3 General Information

3.1 Client Information

Applicant:	Lenovo(Shanghai) Electronics Technology Co., Ltd.
Address of Applicant:	Section 304-305, Building No. 4, # 222, Meiyue Road, China (Shanghai) Pilot Free Trade Zone
Manufacturer:	Lenovo PC HK Limited
Address of Manufacturer:	23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong P.R.China

3.2 Test Location

Lab A:

Company:	SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch
Address:	No. 1 Workshop, M-10, Middle section, Science & Technology Park, Shenzhen, Guangdong, China
Post code:	518057
Test engineer:	Dee Zheng, Mike Hu

Lab B:

Company:	SGS-CSTC STANDARDS TECHNICAL SERVICES (XI 'AN) CO., LTD.
Address:	1/F, Unit D, Building 1, Kanghong Orange Technology Park, No.137, Keyuan 3rd Road, Fengdong New City, Xi'an, Shaanxi China
Post code:	710086
Test engineer:	Ben Huang, Leah Chen

3.3 Test Facility

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

Lab A:

• A2LA (Certificate No. 3816.01)

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• VCCI

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

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• FCC –Designation Number: CN1178

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

• Innovation, Science and Economic Development Canada

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

Lab B:

A2LA (Certificate No. 4854.01)

SGS-CSTC STANDARDS TECHNICAL SERVICES (XI 'AN) CO., LTD. is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 4854.01.

FCC-Designation Number: CN1271.

3.4 General Description of EUT

EUT Description::	Portable Tablet Computer
Model No.:	Lenovo TB-X306FA
Trade Mark:	Lenovo
Hardware Version:	Lenovo TB-X306FA
Software Version:	TB-X306FA_RF01_200714
IEEE 802.11 WLAN Mode Supported	☒ 802.11B (20 MHz channel bandwidth), ☒ 802.11G (20 MHz channel bandwidth) ☒ 802.11N (20 MHz channel bandwidth),
Operation Frequency:	2400 MHz -2483.5MHz fc = 2407 MHz + N * 5 MHz, where: -fc = “Operating Frequency” in MHz, -N = “Channel Number” with the range from 1 to 11 for the 20 MHz channel bandwidth, or 3 to 9 for the 40 MHz channel bandwidth.
Type of Modulation:	IEEE for 802.11B: DSSS IEEE for 802.11G : OFDM IEEE for 802.11N(HT20) : OFDM
Sample Type:	☒ Portable Device, ☐Module
Antenna Type:	☐ External, ☒ Integrated
Antenna Ports	☒ Ant 1, ☐ Ant 2, ☐ Ant 3
Smart System	☒ SISO (for 802.11B/G/N), MIMO (for 802.11N): 2 Tx & 2 Rx, ☐ Diversity (for 802.11B/G) : Tx & Rx
Antenna Gain:	-3.5dBi

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Power Supply	☒ AC/DC Adapter; ☐ Battery ☐ PoE:; ☐ Other:
Accsessories	Adaptor Model No.: SC-41 AC Input: 100-240V 50/60Hz 0.3A DC Output: DC 5V 2A

Operation Frequency of each 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		

Remark:

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:

3.5 Test

Channel	Frequency for 802.11B/G/N (HT20)
The Lowest channel	2412MHz
The Middle channel	2437MHz
The Highest channel	2462MHz

Environment and Mode

Operating Environment:	
Temperature:	25.0 °C
Humidity:	50 % RH
Atmospheric Pressure:	101.30 KPa
Test mode:	
Transmitting mode:	Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.

3.6 Description of Support Units

The EUT has been tested independent unit.

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4 Test results and Measurement Data

4.1 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.	
The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is -3.5dBi.	

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4.2 AC Power Line 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.		

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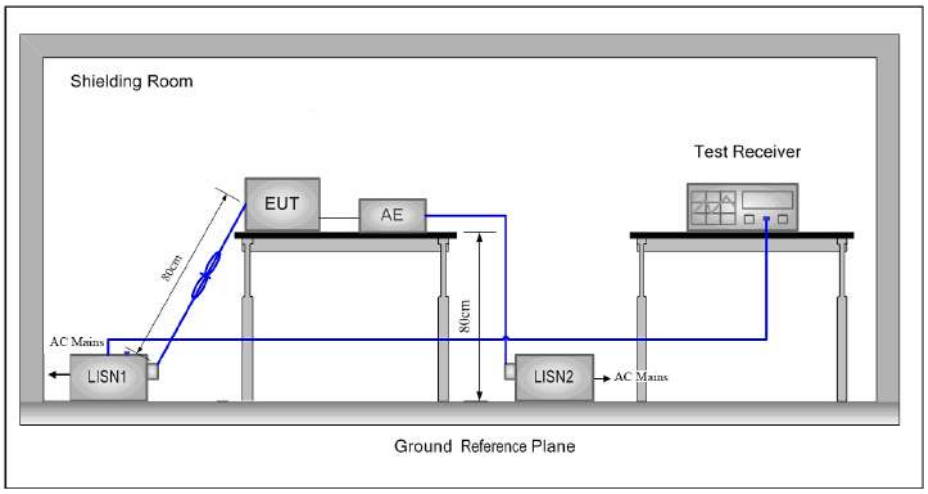
Test Setup:	
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates at lowest, middle and highest channel. Charge + Transmitting mode.
Final Test Mode:	Through Pre-scan, find the 1Mbps of rate of 802.11B at lowest channel is the worst case. Charge + Transmitting mode. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

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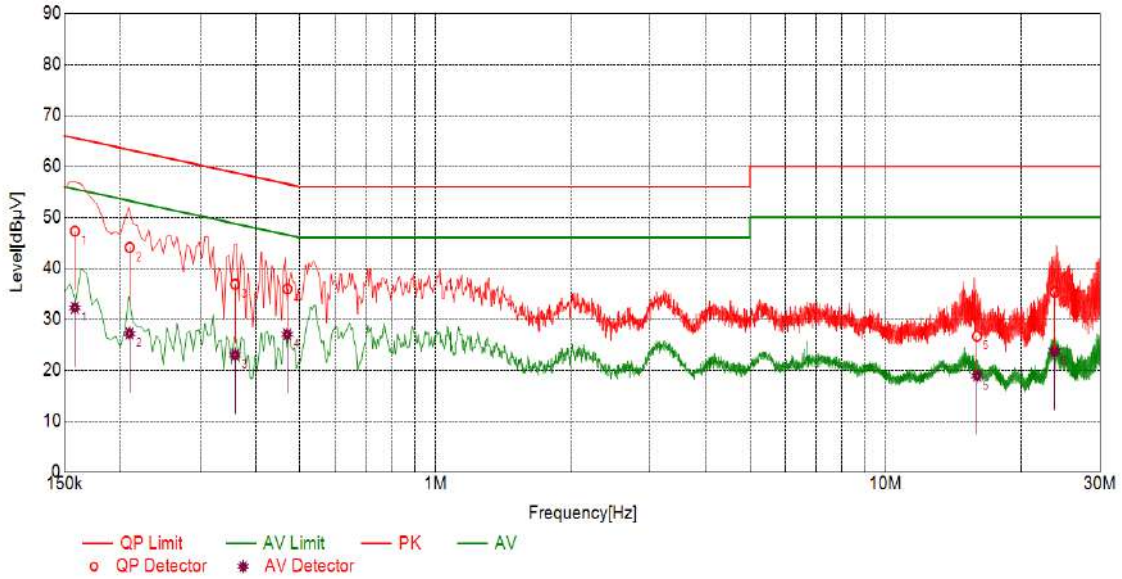
Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Live Line:



Test Graph

Final Data List									
NO.	Freq. [MHz]	Factor [dB]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Type
1	0.1584	10.10	47.28	65.55	18.27	32.26	55.55	23.29	L
2	0.2093	10.10	44.09	63.23	19.14	27.22	53.23	26.01	L
3	0.3590	10.10	36.86	58.75	21.89	22.98	48.75	25.77	L
4	0.4694	10.10	35.92	56.52	20.60	27.03	46.52	19.49	L
5	15.9577	10.11	26.67	60.00	33.33	18.89	50.00	31.11	L
6	23.7684	10.11	35.36	60.00	24.64	23.71	50.00	26.29	L

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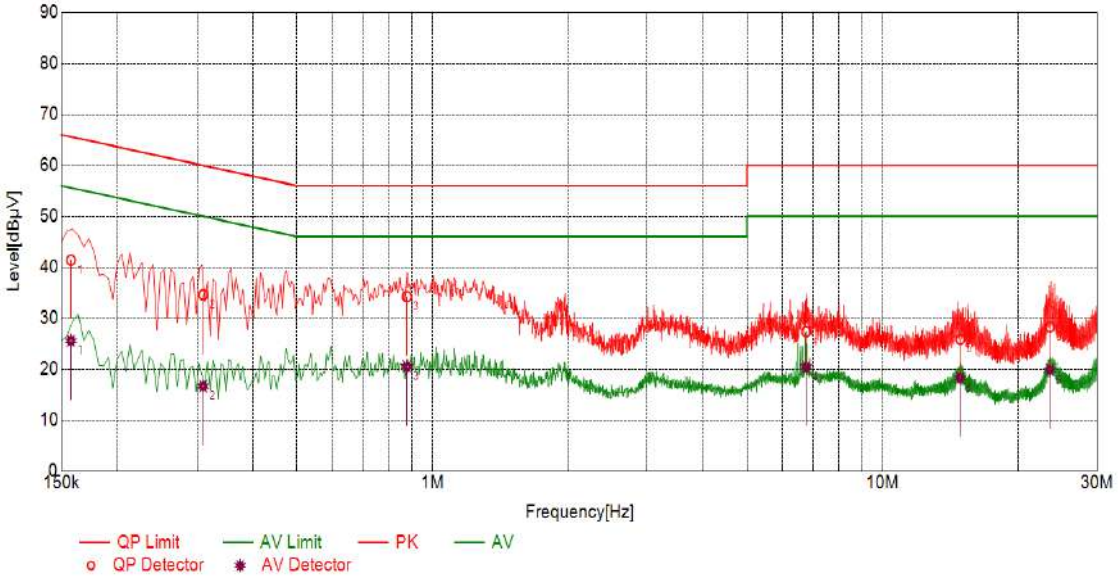
Neutral Line:



Test Graph

Final Data List									
NO.	Freq. [MHz]	Factor [dB]	QP Value [dBµV]	QP Limit [dBµV]	QP Margin [dB]	AV Value [dBµV]	AV Limit [dBµV]	AV Margin [dB]	Type
1	0.1576	10.10	41.39	65.59	24.20	25.53	55.59	30.06	N
2	0.3094	10.10	34.60	59.99	25.39	16.66	49.99	33.33	N
3	0.8780	10.10	34.22	56.00	21.78	20.52	46.00	25.48	N
4	6.7697	10.10	27.37	60.00	32.63	20.45	50.00	29.55	N
5	14.8626	10.11	25.85	60.00	34.15	18.29	50.00	31.71	N
6	23.5569	10.11	28.31	60.00	31.69	19.87	50.00	30.13	N

Remarks:

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

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

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4.3 Duty Cycle

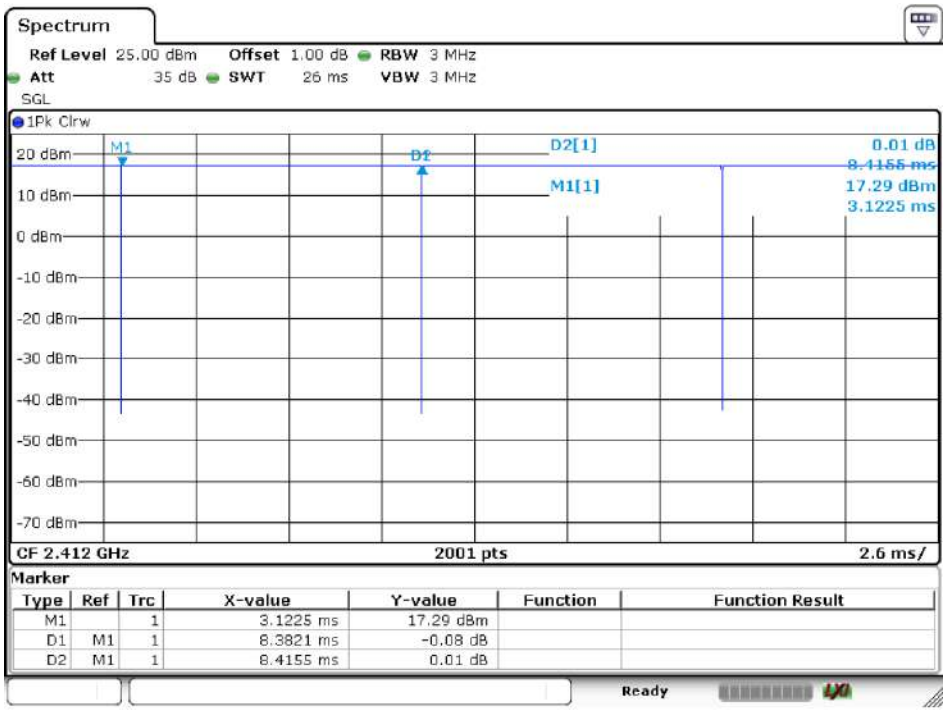
4.3.1 Test Results

Test Mode	TX Freq. [MHz]	Duty cycle [%]
11B	Ant 1: CH1,CH6,CH11	99.52
11G	Ant 1: CH1,CH6,CH11	95.98
11N20	Ant 1: CH1,CH6,CH11	95.94

4.3.1 Test Plots

4.3.1.1 ANT1

4.3.1.1.1 11B



Date: 20.MAY.2020 13:46:05

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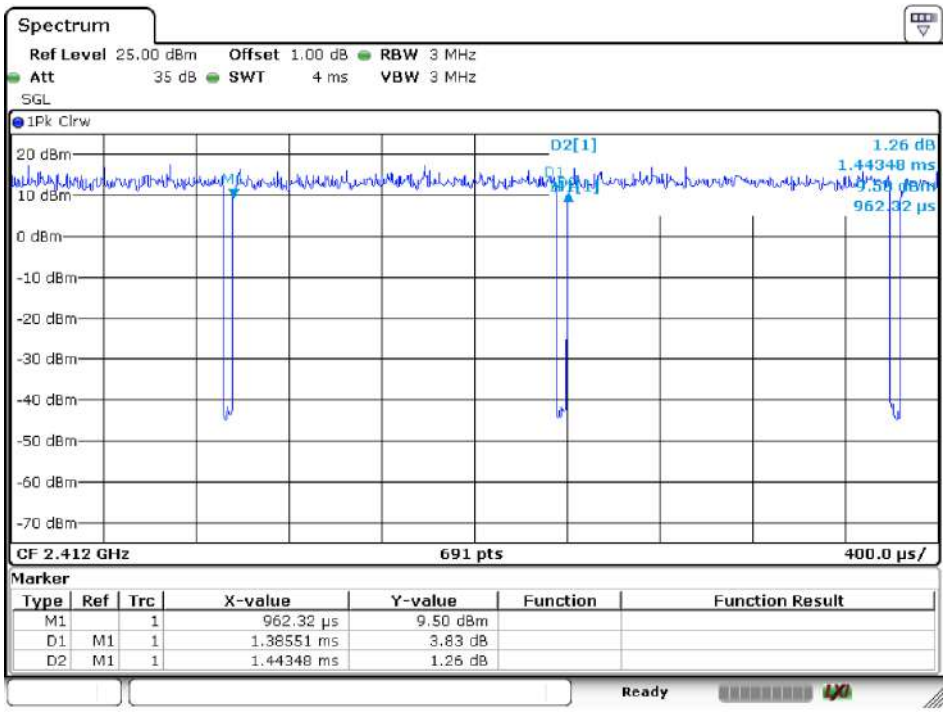
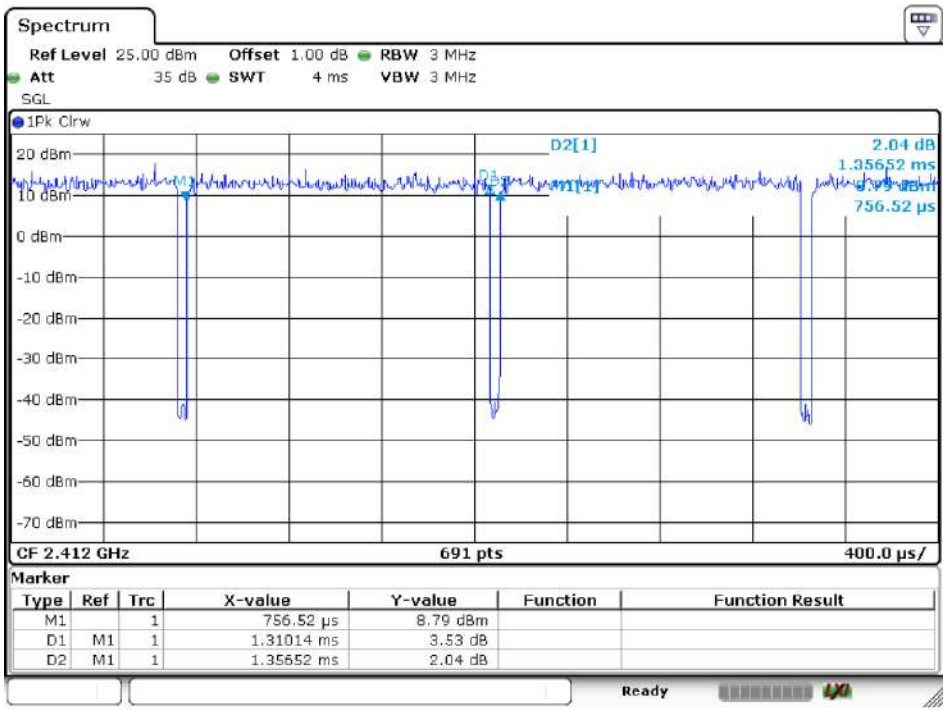
4.3.1.1.2 11G



Date: 20.MAY.2020 13:47:10

4.3.1.1.3 11N20



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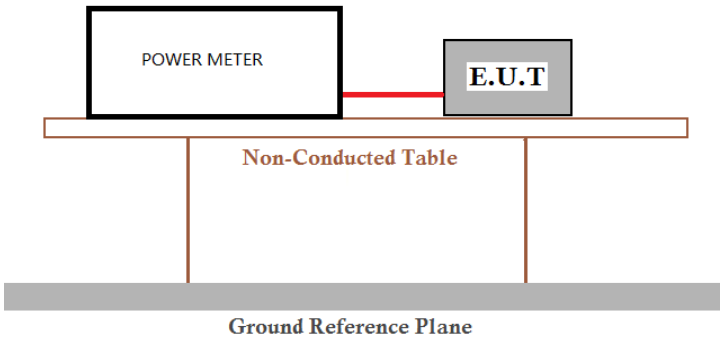
4.4 Conducted Output Power

Test Requirement:	47 CFR Part 15C Section 15.247 (b)(3)
Test Method:	ANSI C63.10 :2013 Section 11.9.1.3
Test Setup:	
Test Instruments:	Refer to section 5.10 for details
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); 13.5Mbps of rate is the worst case of 802.11N(HT40).
Limit:	30dBm
Test Results:	Pass

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4.4.1 Test Results

Measurement Data of Average Power:

Mode	Test Channel	Average Output Power (dBm) [Duty Cycle Considered]	Result
802.11B	Lowest	16.61	Report purpose only
	Middle	16.70	Report purpose only
	Highest	16.30	Report purpose only
802.11G	Lowest	14.44	Report purpose only
	Middle	14.55	Report purpose only
	Highest	14.02	Report purpose only
802.11N20	Lowest	14.22	Report purpose only
	Middle	14.15	Report purpose only
	Highest	14.02	Report purpose only

Measurement Data of Peak Power:

Mode	Test Channel	Peak Output Power (dBm)	Limit (dBm)	Result
802.11B	Lowest	16.94	30.00	Pass
	Middle	16.89	30.00	Pass
	Highest	17.30	30.00	Pass
802.11G	Lowest	14.95	30.00	Pass
	Middle	15.12	30.00	Pass
	Highest	15.04	30.00	Pass
802.11N20	Lowest	14.83	30.00	Pass
	Middle	14.93	30.00	Pass
	Highest	14.90	30.00	Pass

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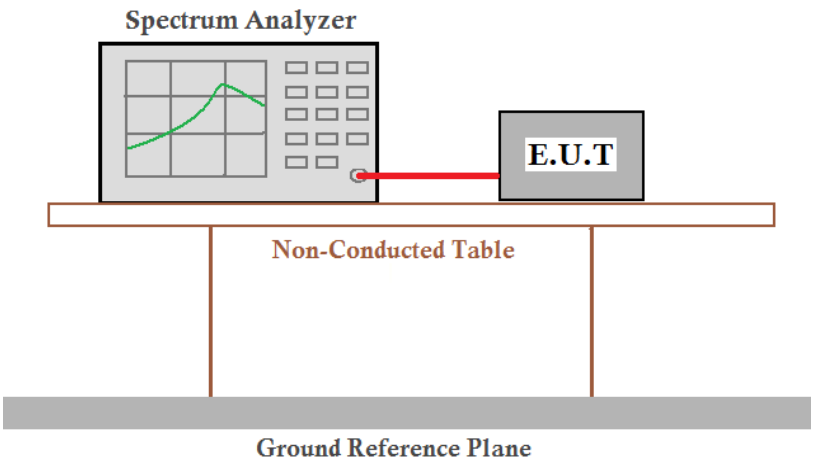
4.5 DTS (6 dB) Bandwidth & 99% Occupied Bandwidth

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(2)
Test Method:	ANSI C63.10: 2013 Section 11.8.1 Option 1
Test Setup:	
Instruments Used:	Refer to section 5.10 for details
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); 13.5Mbps of rate is the worst case of 802.11N(HT40).
Limit:	≥ 500 kHz
Test Results:	Pass

4.5.1 Test Results

Mode	Test Channel	Occupied Bandwidth (MHz)	6dB Emission Bandwidth (MHz)	Limit (kHz)	Result
802.11B	Lowest	13.02	8.55	≥500	Pass
	Middle	12.94	8.55	≥500	Pass
	Highest	13.02	8.55	≥500	Pass
802.11G	Lowest	16.85	16.28	≥500	Pass
	Middle	16.71	16.02	≥500	Pass
	Highest	16.85	15.89	≥500	Pass
802.11N20	Lowest	17.84	17.54	≥500	Pass
	Middle	17.71	16.62	≥500	Pass
	Highest	17.84	16.54	≥500	Pass

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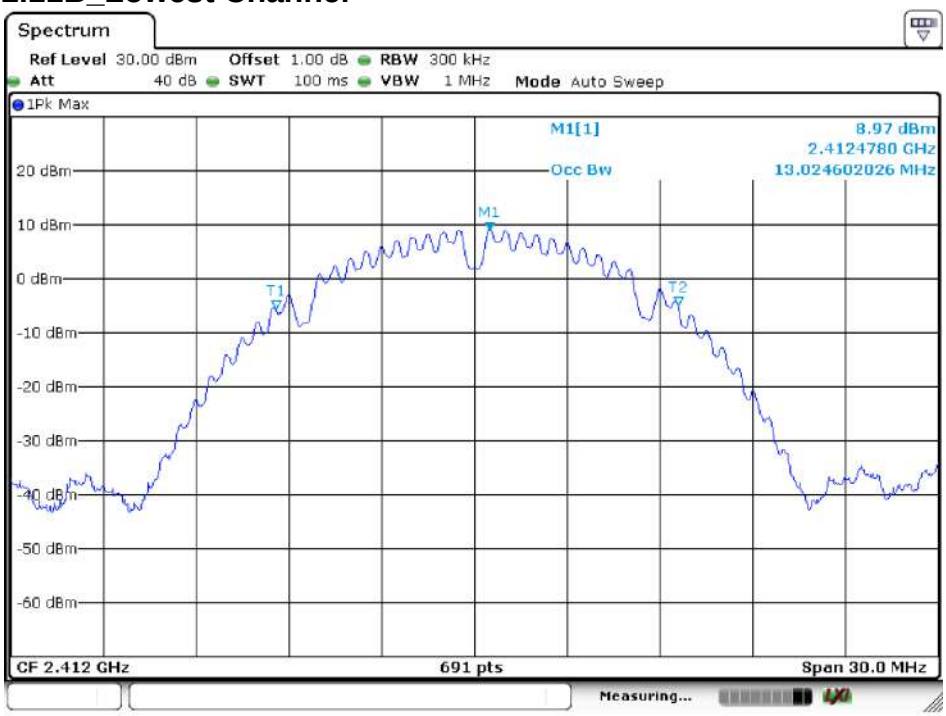
4.5.2 Test plots

4.5.2.1 ANT1

4.5.2.1.1 802.11B_Lowest Channel



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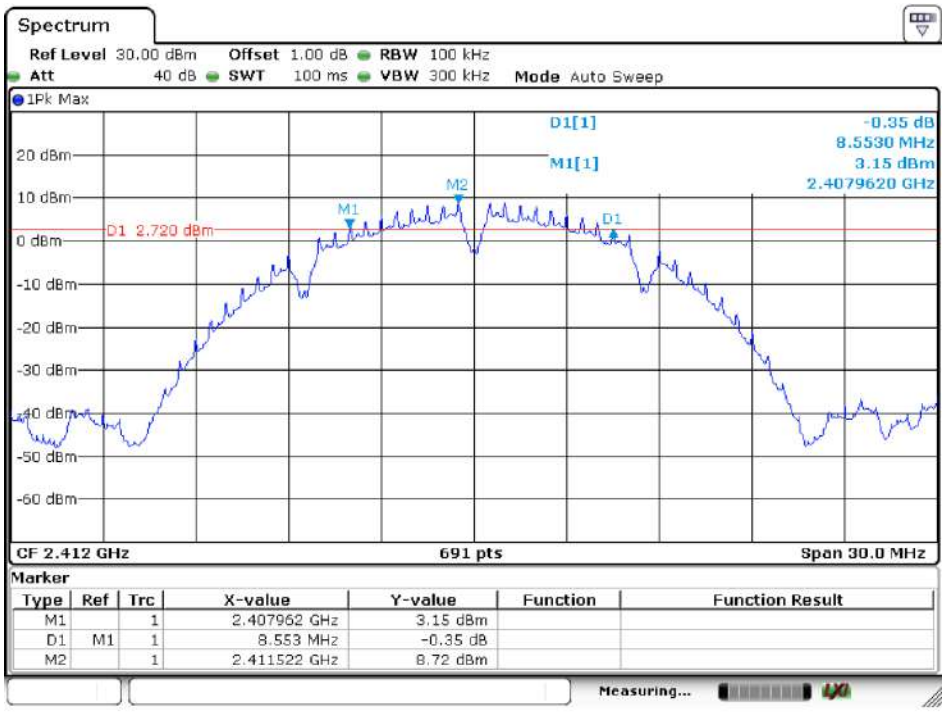

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.407962 GHz	3.15 dBm		
D1	M1	1	8.553 MHz	-0.35 dB		
M2		1	2.411522 GHz	8.72 dBm		

Date: 20.MAY.2020 12:52:14

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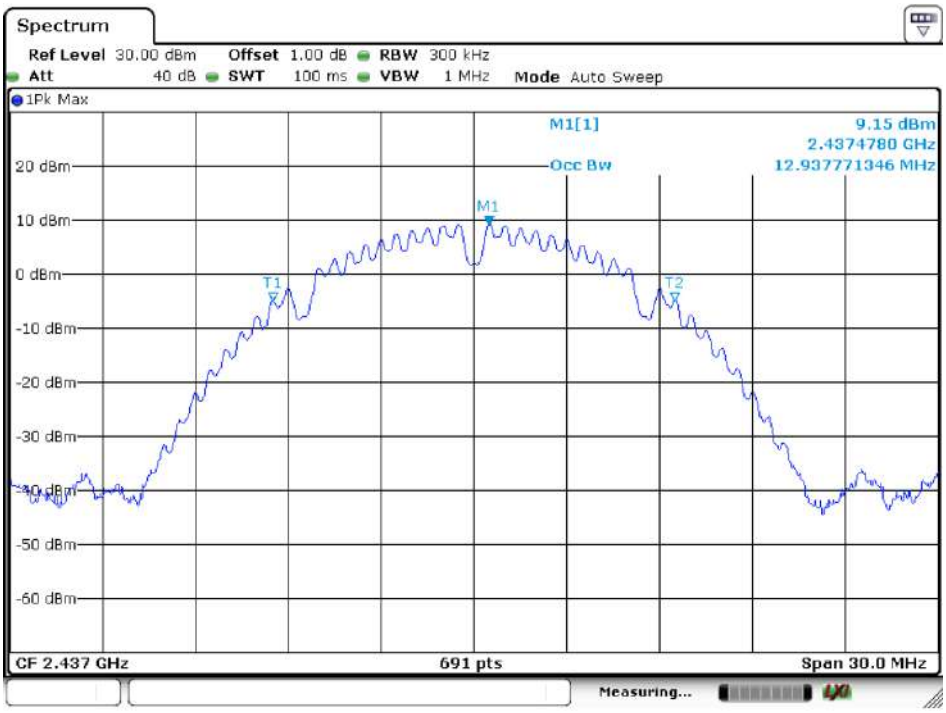
4.5.2.1.2 802.11B_ Middle Channel



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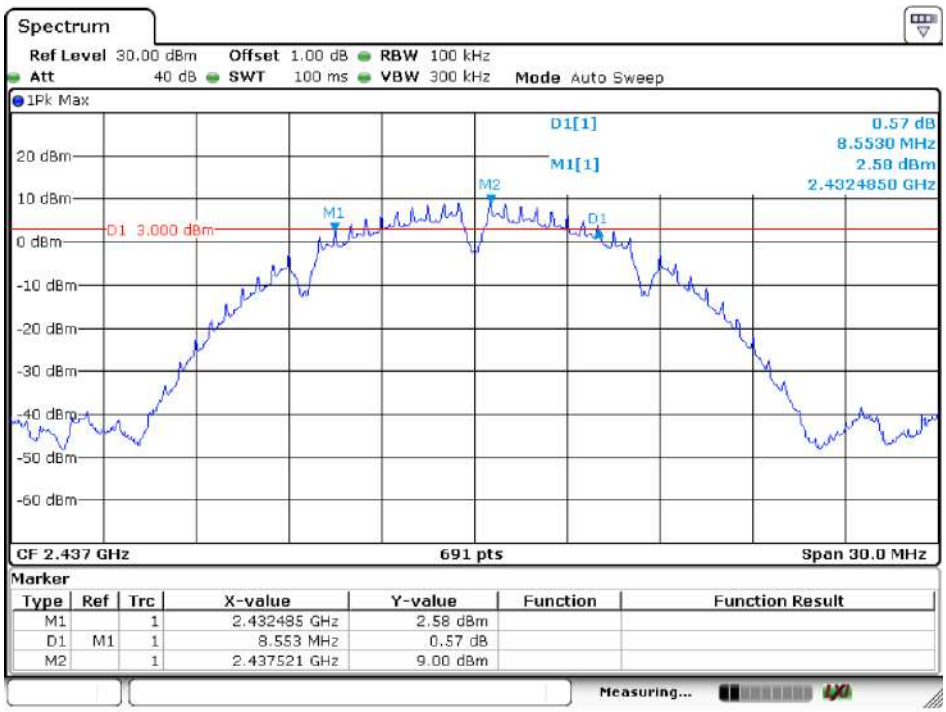

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.432485 GHz	2.58 dBm		
D1	M1	1	8.553 MHz	0.57 dB		
M2		1	2.437521 GHz	9.00 dBm		

Date: 20.MAY.2020 12:53:09

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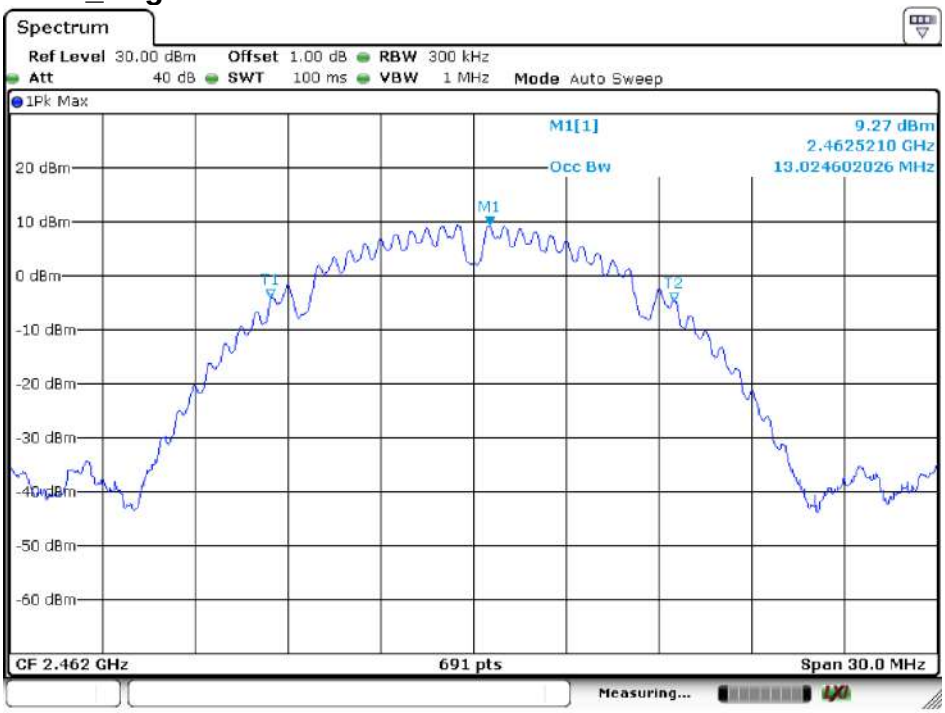
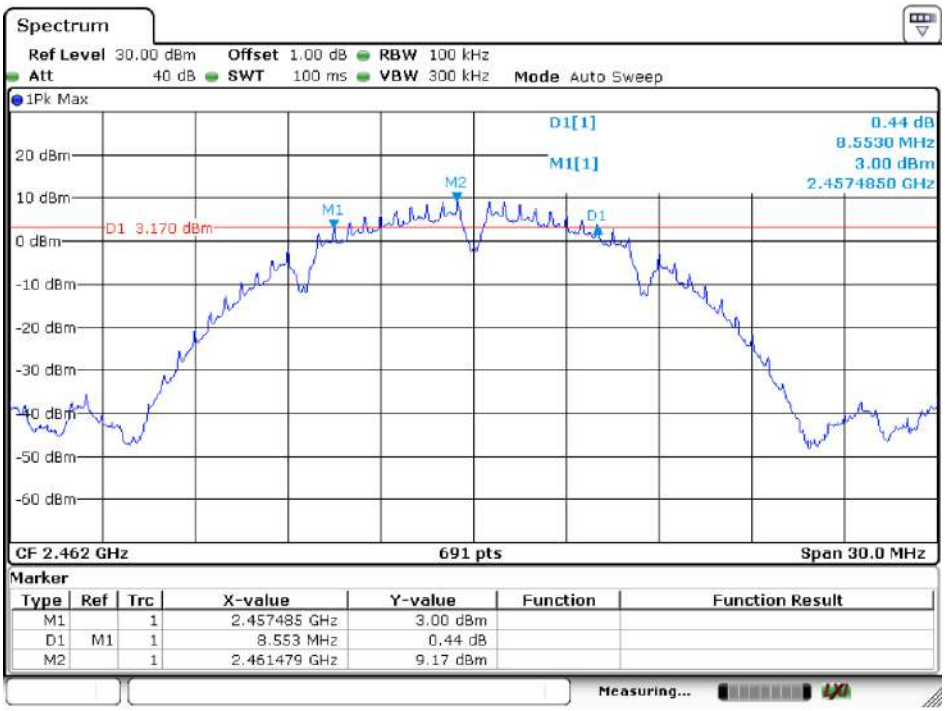
4.5.2.1.3 802.11B_ Highest Channel



Date: 20.MAY.2020 13:00:49



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.457485 GHz	3.00 dBm		
D1	M1	1	8.553 MHz	0.44 dB		
M2		1	2.461479 GHz	9.17 dBm		

Date: 20.MAY.2020 12:53:49

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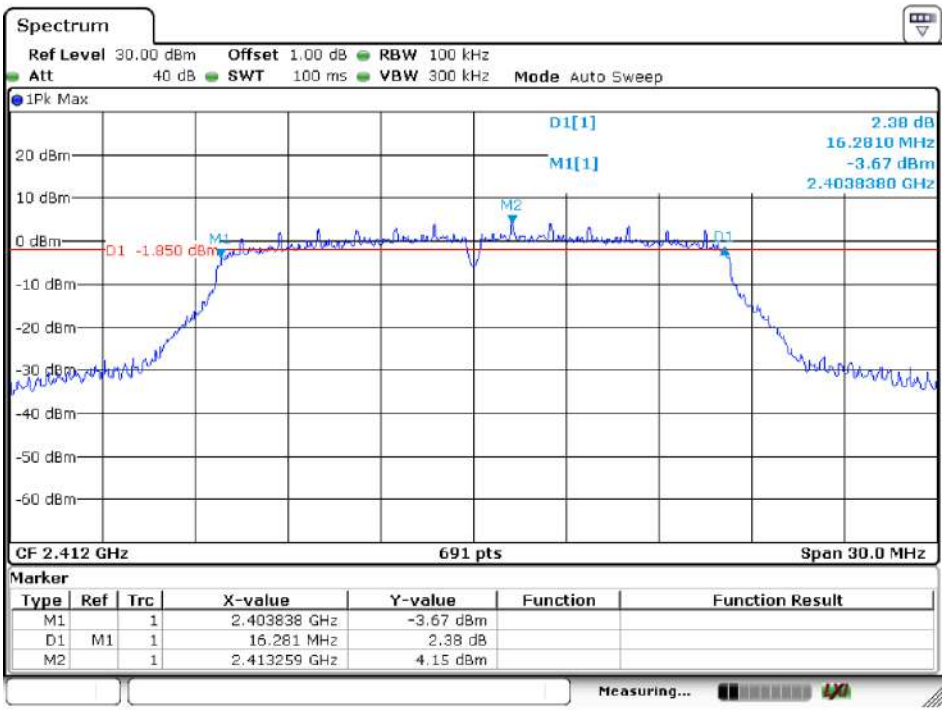
4.5.2.1.4 802.11G_Lowest Channel

Date: 20.MAY.2020 13:01:57



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.403838 GHz	-3.67 dBm		
D1	M1	1	16.281 MHz	2.38 dB		
M2		1	2.413259 GHz	4.15 dBm		

Date: 20.MAY.2020 12:55:05

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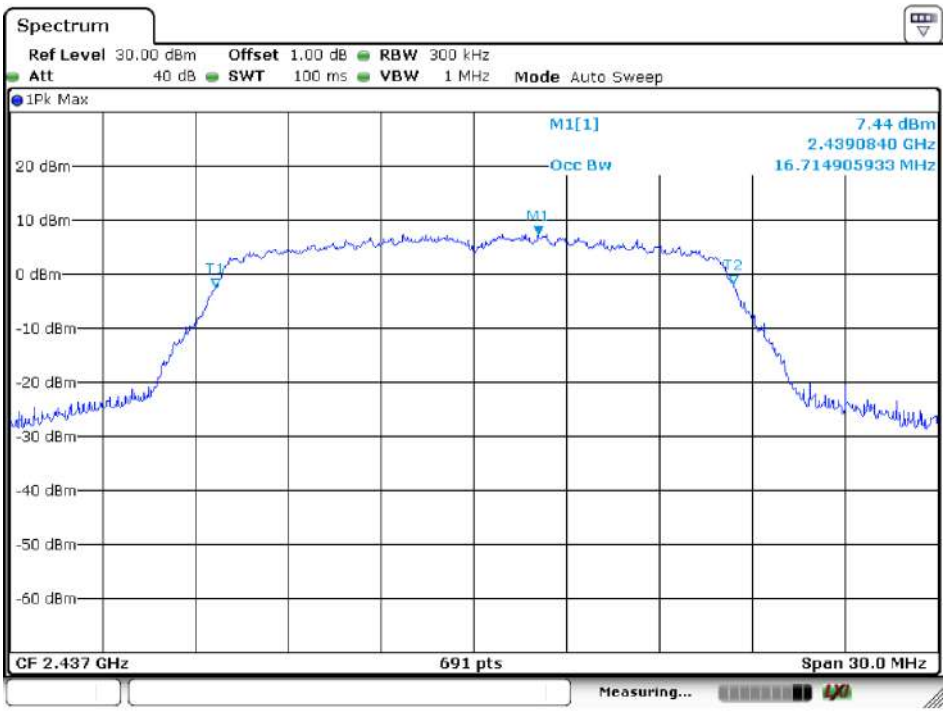
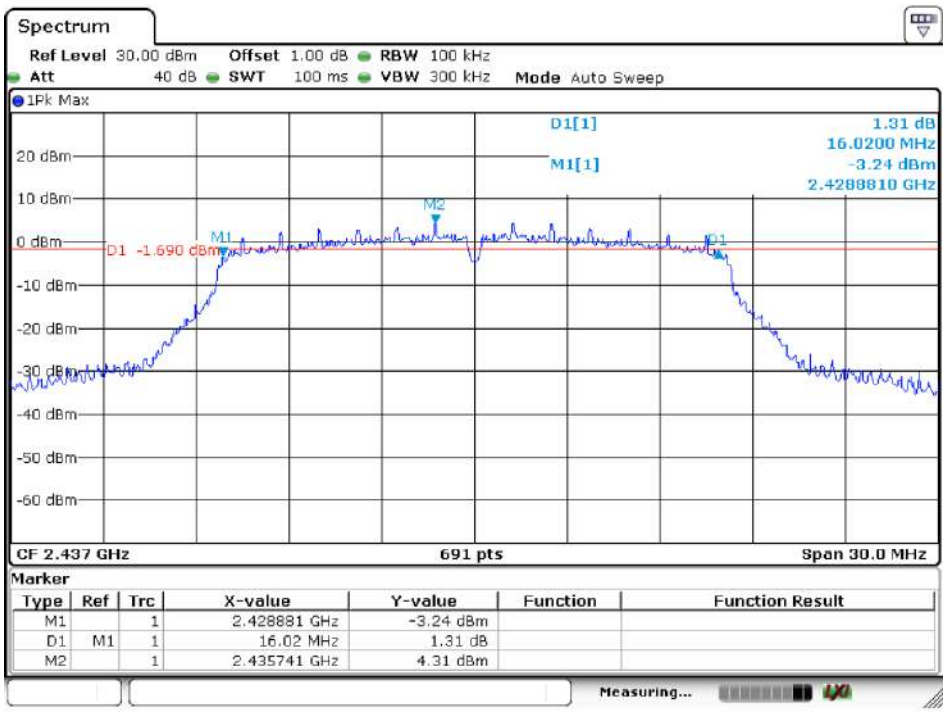
4.5.2.1.5 802.11G_ Middle Channel



Date: 20.MAY.2020 13:02:20



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.428881 GHz	-3.24 dBm		
D1	M1	1	16.02 MHz	1.31 dB		
M2		1	2.435741 GHz	4.31 dBm		

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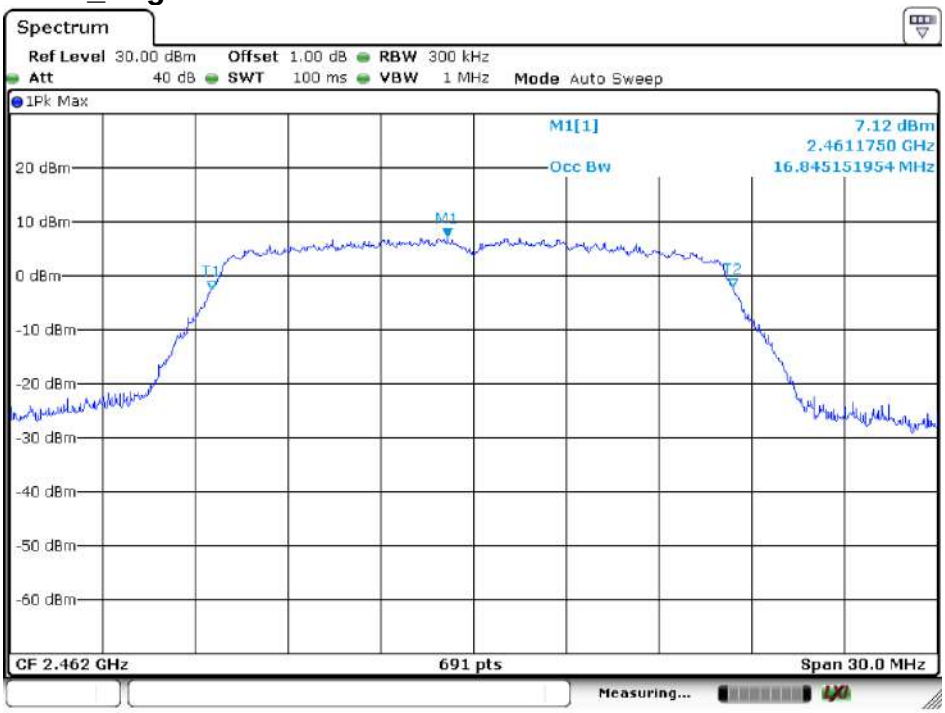
4.5.2.1.6 802.11G_ Highest Channel



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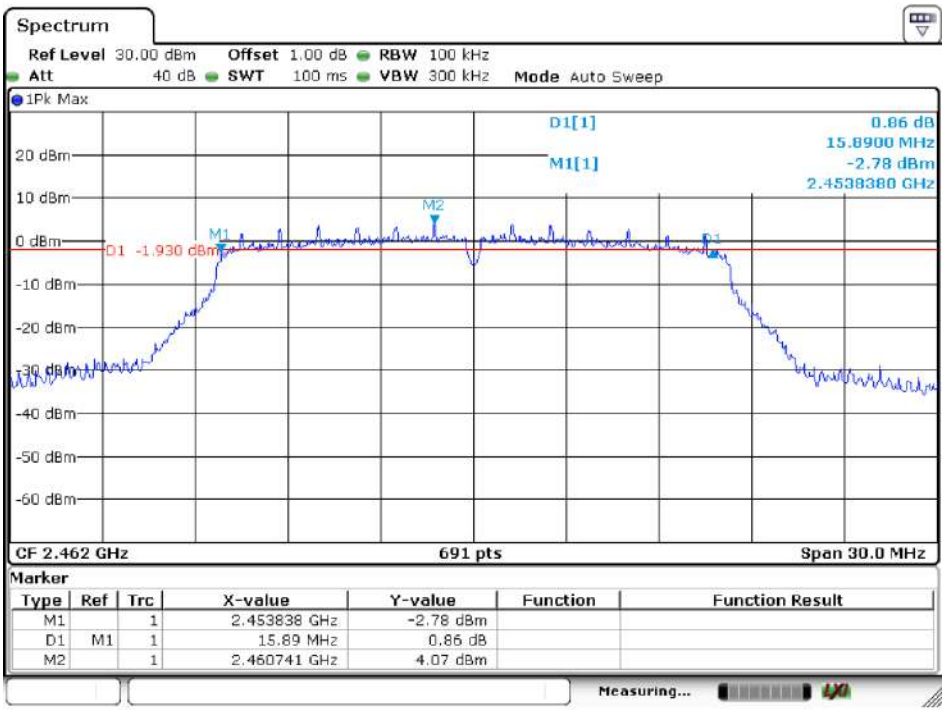

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.453838 GHz	-2.78 dBm		
D1	M1	1	15.89 MHz	0.86 dB		
M2		1	2.460741 GHz	4.07 dBm		

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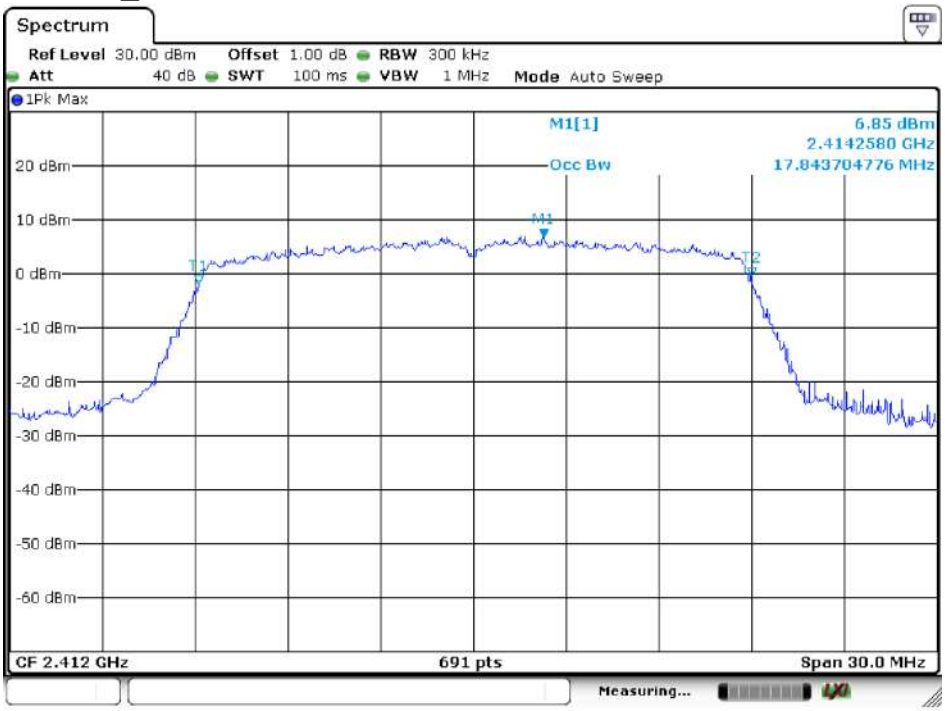
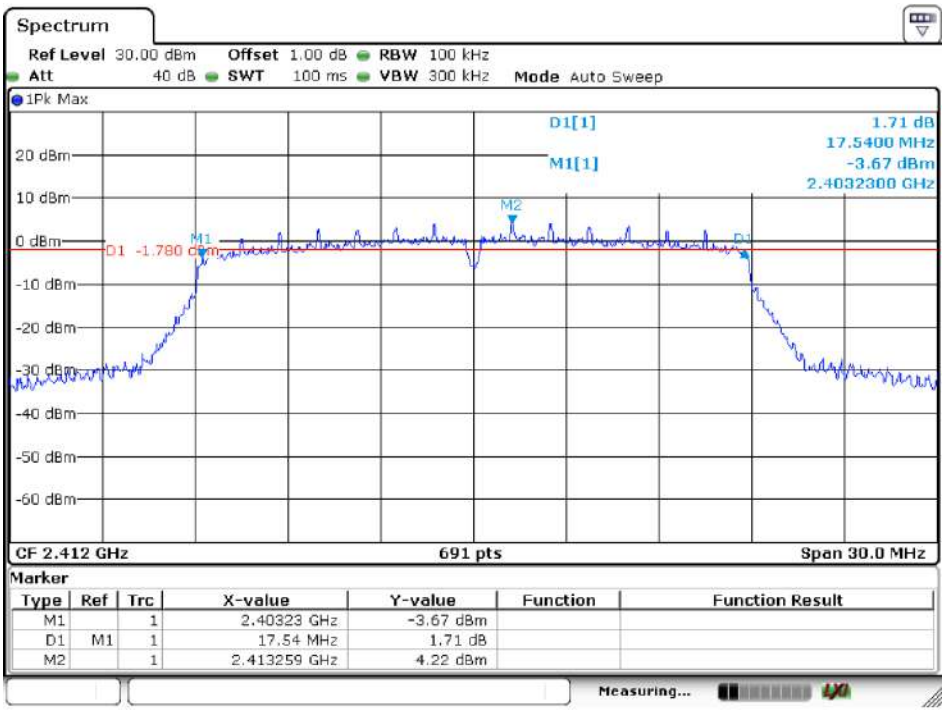
4.5.2.1.7 802.11N20_Lowest Channel



Date: 20.MAY.2020 13:03:49



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40323 GHz	-3.67 dBm		
D1	M1	1	17.54 MHz	1.71 dB		
M2		1	2.413259 GHz	4.22 dBm		

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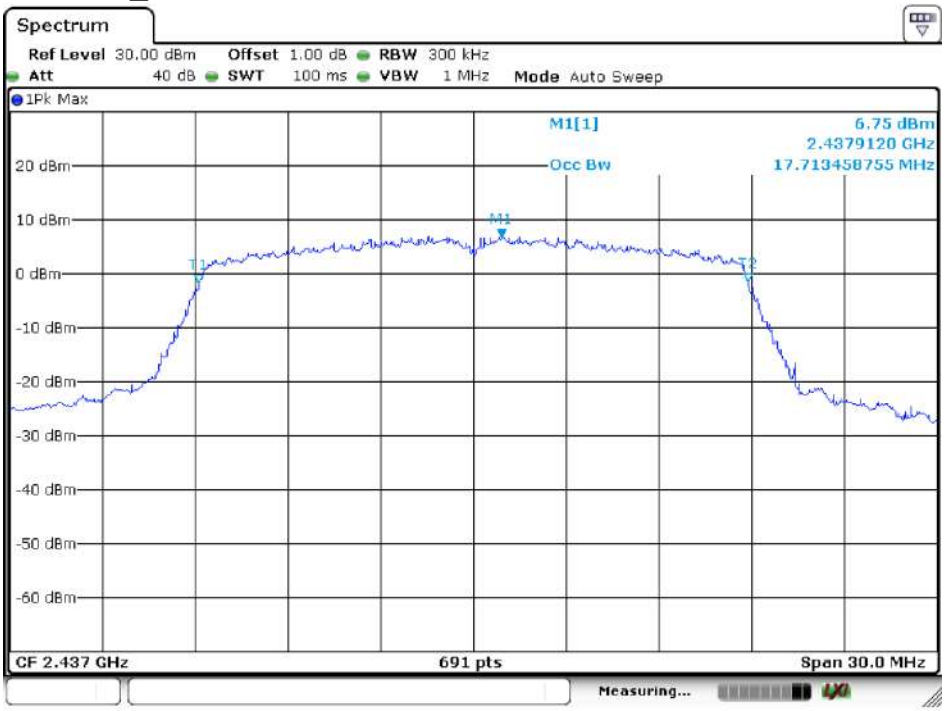
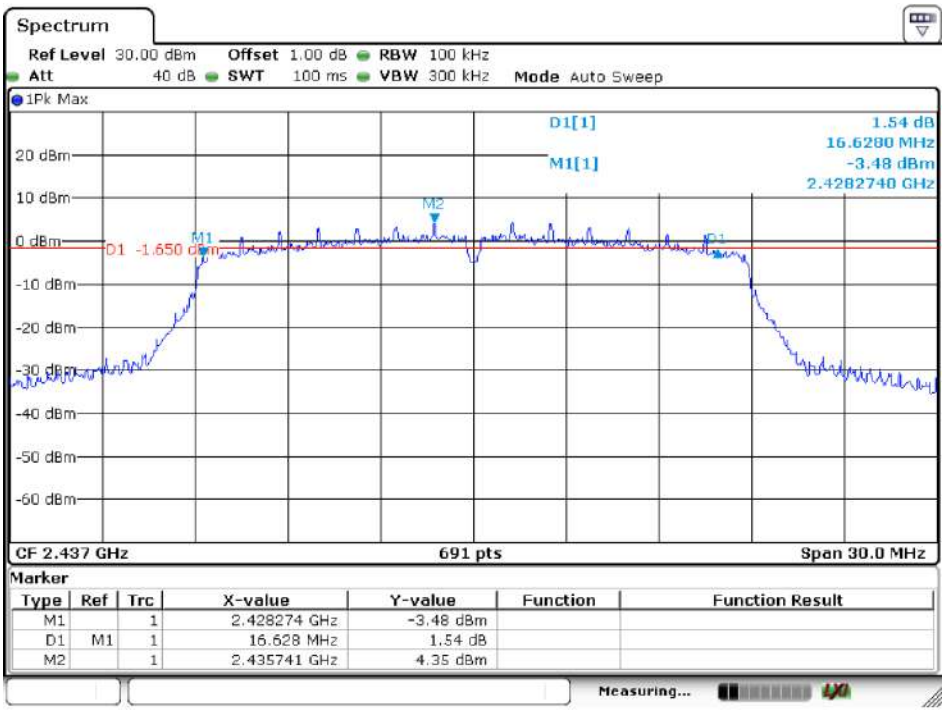
4.5.2.1.8 802.11 N20_ Middle Channel



Date: 20.MAY.2020 13:03:24



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.428274 GHz	-3.48 dBm		
D1	M1	1	16.628 MHz	1.54 dB		
M2		1	2.435741 GHz	4.35 dBm		

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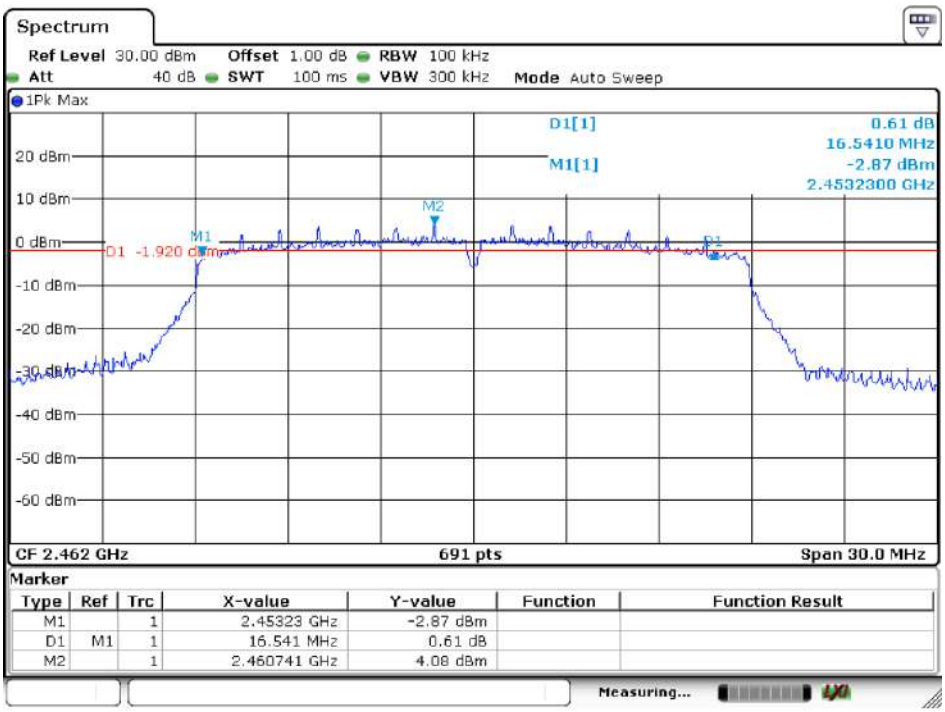
4.5.2.1.9 802.11 N20_ Highest Channel

Date: 20.MAY.2020 13:03:03



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.45323 GHz	-2.87 dBm		
D1	M1	1	16.541 MHz	0.61 dB		
M2		1	2.460741 GHz	4.08 dBm		

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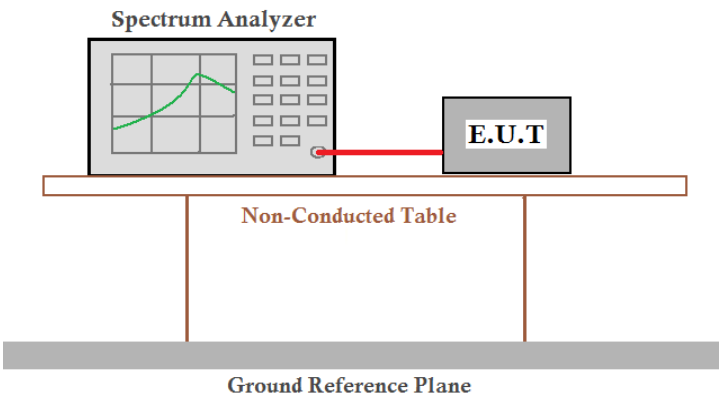
4.6 Power Spectral Density

Test Requirement:	47 CFR Part 15C Section 15.247 (e)
Test Method:	ANSI C63.10 :2013 Section 11.10.2
Test Setup:	
Test Instruments:	Refer to section 5.10 for details
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); 13.5Mbps of rate is the worst case of 802.11N(HT40).
Limit:	≤8.00dBm/3kHz
Test Results:	Pass

4.6.1 Test Results

Mode	Test Channel	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
802.11B	Lowest	-5.19	≤8.00	Pass
	Middle	-5.72	≤8.00	Pass
	Highest	-4.10	≤8.00	Pass
802.11G	Lowest	-7.72	≤8.00	Pass
	Middle	-7.76	≤8.00	Pass
	Highest	-8.09	≤8.00	Pass
802.11N20	Lowest	-9.50	≤8.00	Pass
	Middle	-9.51	≤8.00	Pass
	Highest	-9.63	≤8.00	Pass

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4.6.2 Test plots

4.6.2.1 ANT1

4.6.2.1.1 802.11B_Lowest Channel

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4.6.2.1.2 802.11B_ Middle Channel

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4.6.2.1.3 802.11B_ Highest Channel

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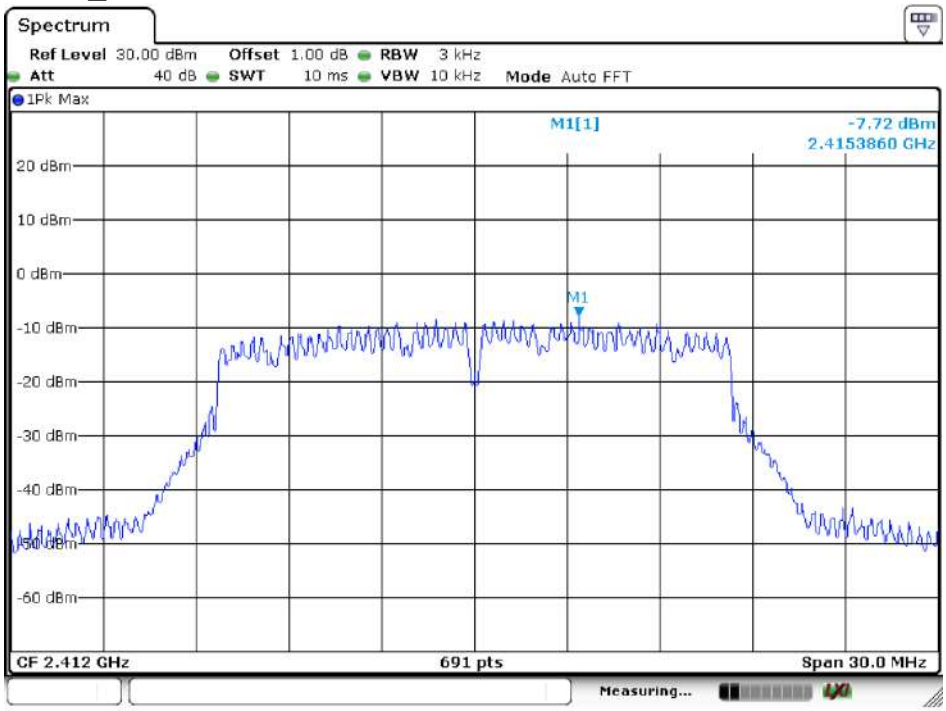
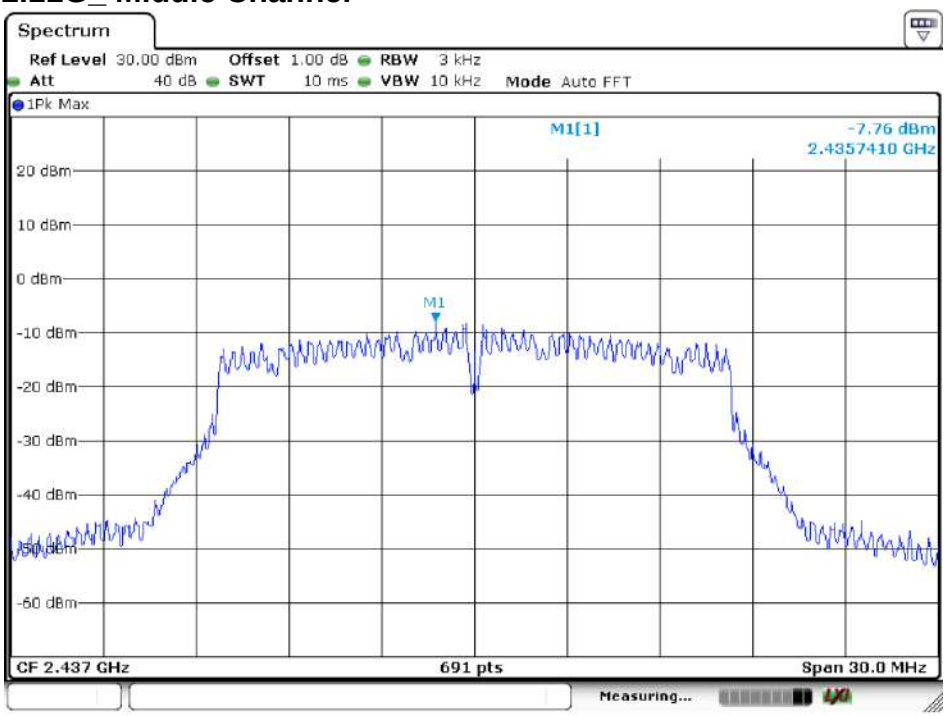
4.6.2.1.4 802.11G_Lowest Channel



Date: 20.MAY.2020 13:08:51

4.6.2.1.5 802.11G_ Middle Channel



Date: 20.MAY.2020 13:09:20

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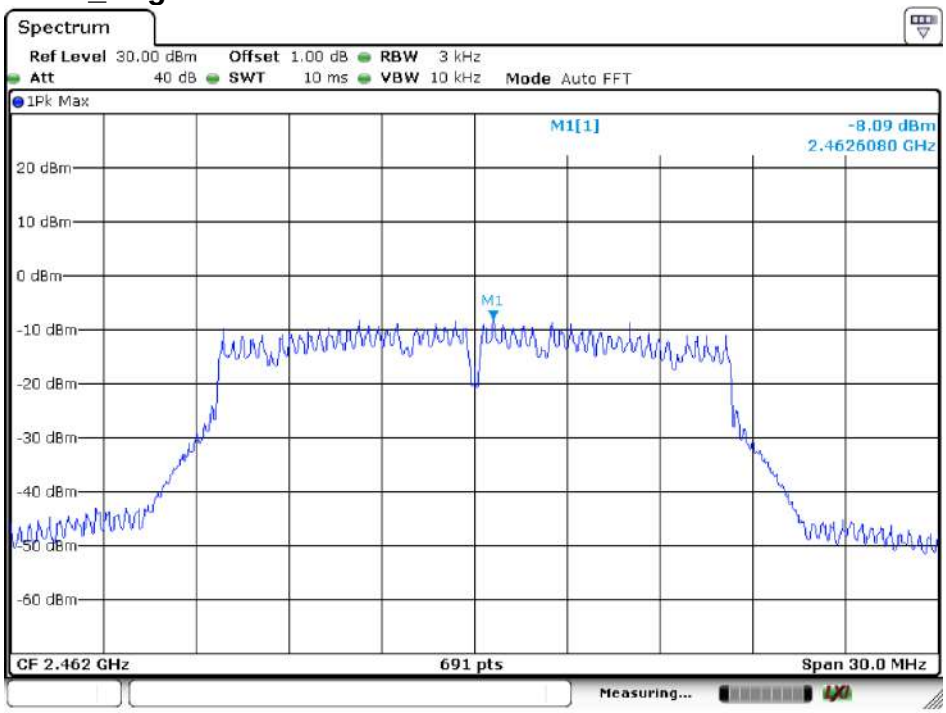
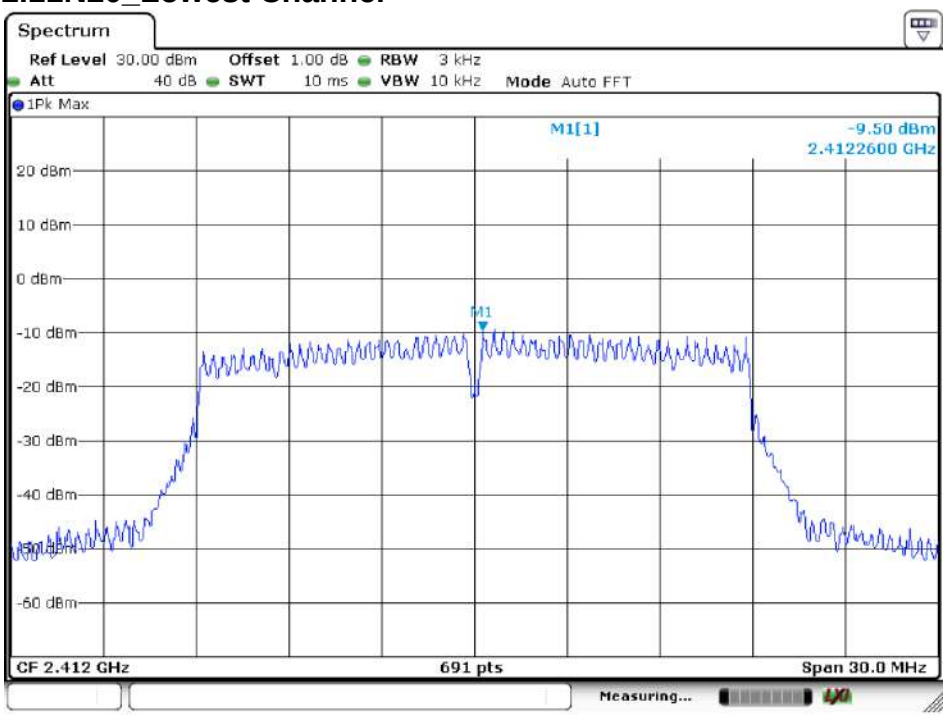
4.6.2.1.6 802.11G_ Highest Channel



Date: 20.MAY.2020 13:09:51

4.6.2.1.7 802.11N20_Lowest Channel



Date: 20.MAY.2020 13:06:45

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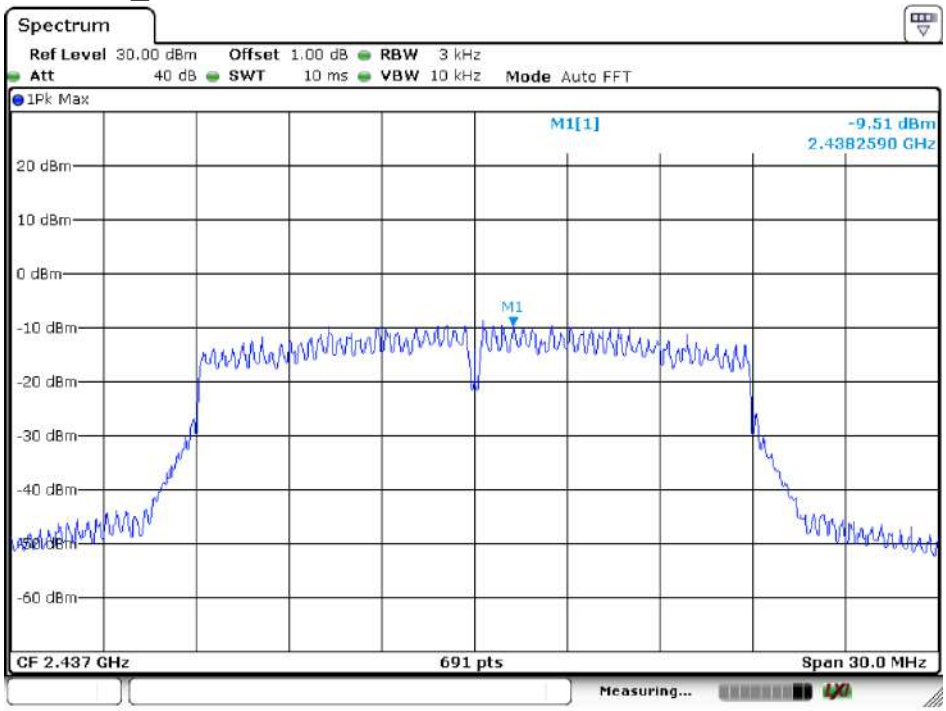
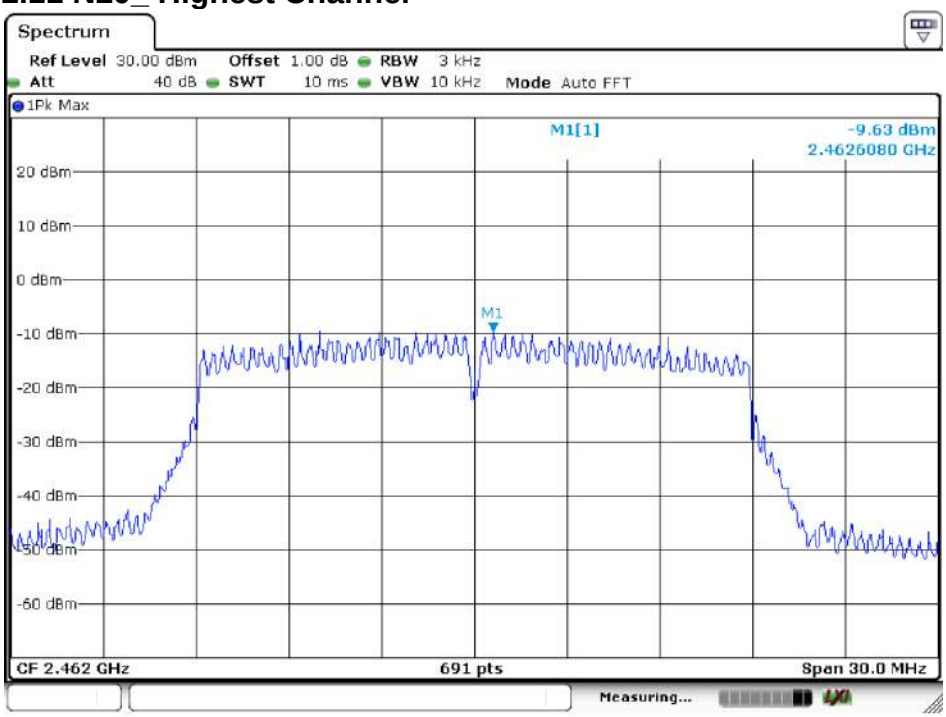
4.6.2.1.8 802.11 N20_ Middle Channel



Date: 20.MAY.2020 13:07:07

4.6.2.1.9 802.11 N20_ Highest Channel



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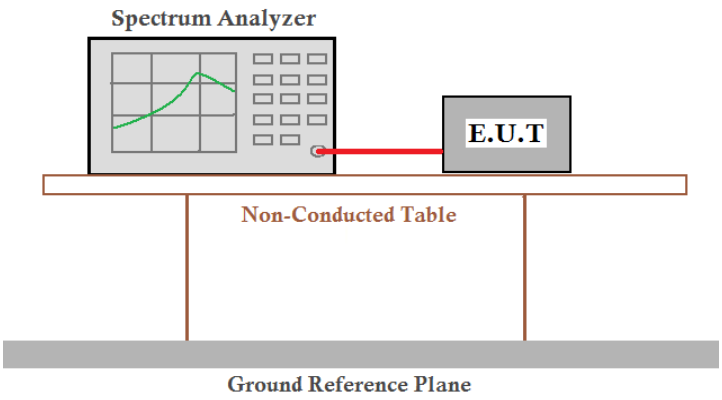
4.7 Band-edge for RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10: 2013 Section 11.13
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) ; 13.5Mbps of rate is the worst case of 802.11N(HT40).
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.
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

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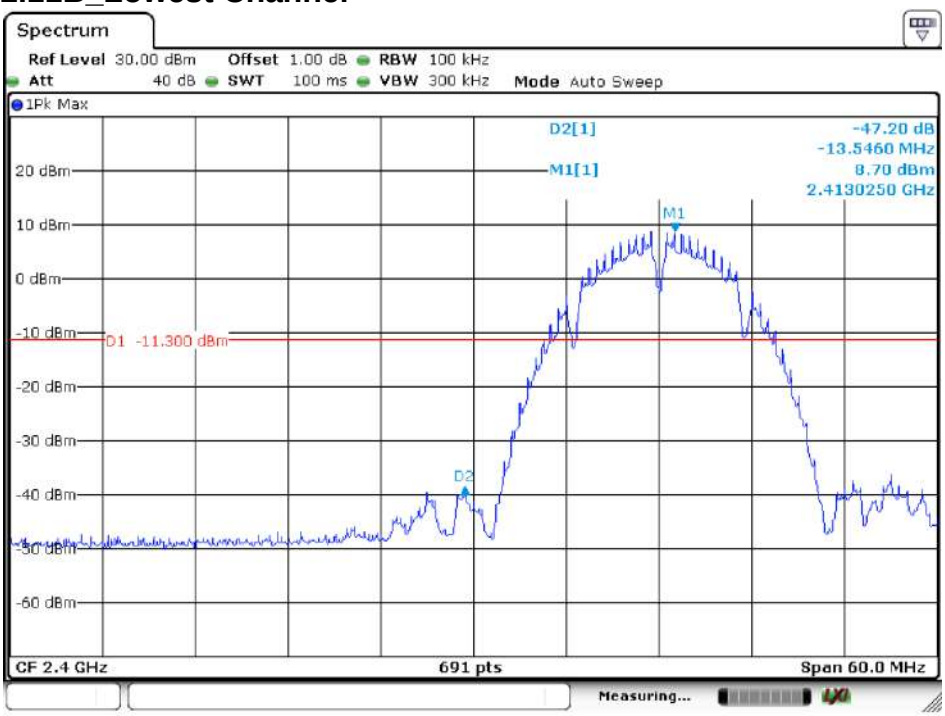
4.7.1 Test plots

4.7.1.1 ANT1

4.7.1.1.1 802.11B_Lowest Channel



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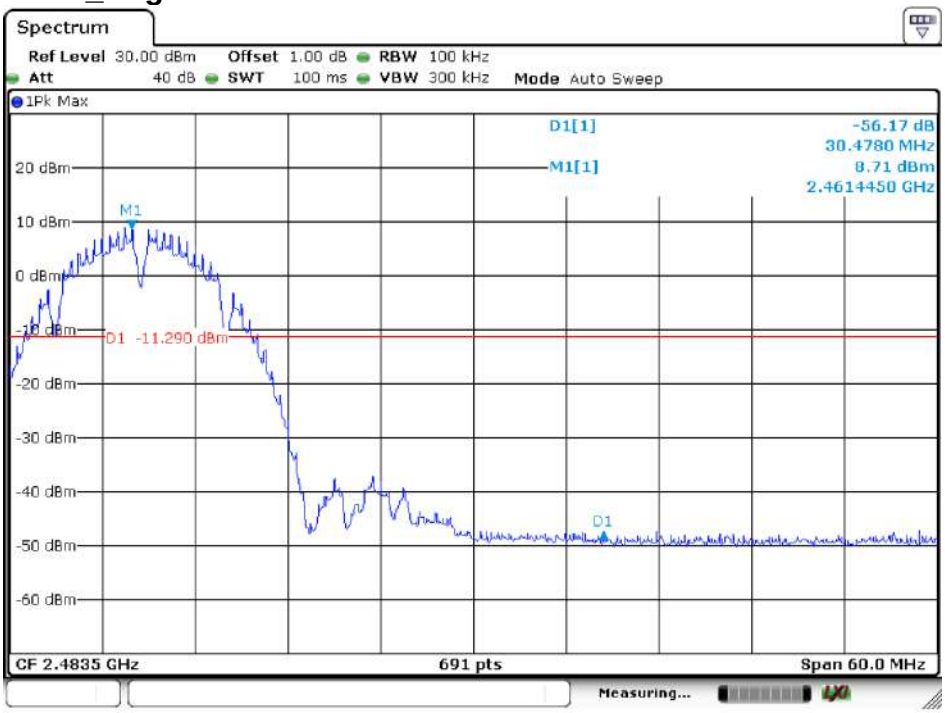
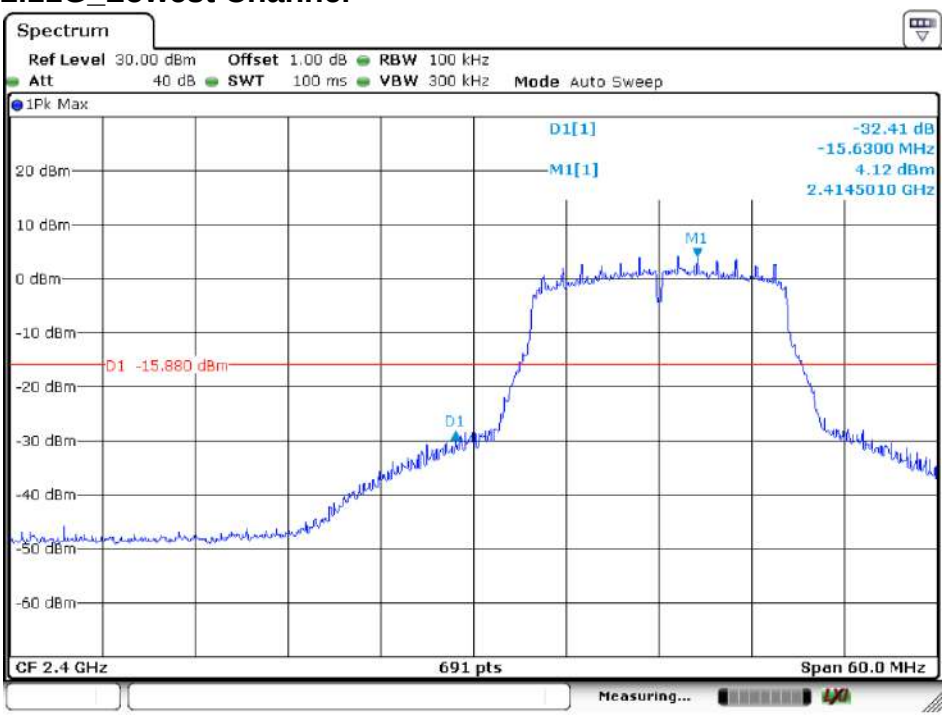
4.7.1.1.2 802.11B_ Highest Channel



Date: 20.MAY.2020 13:13:29

4.7.1.1.3 802.11G_Lowest Channel



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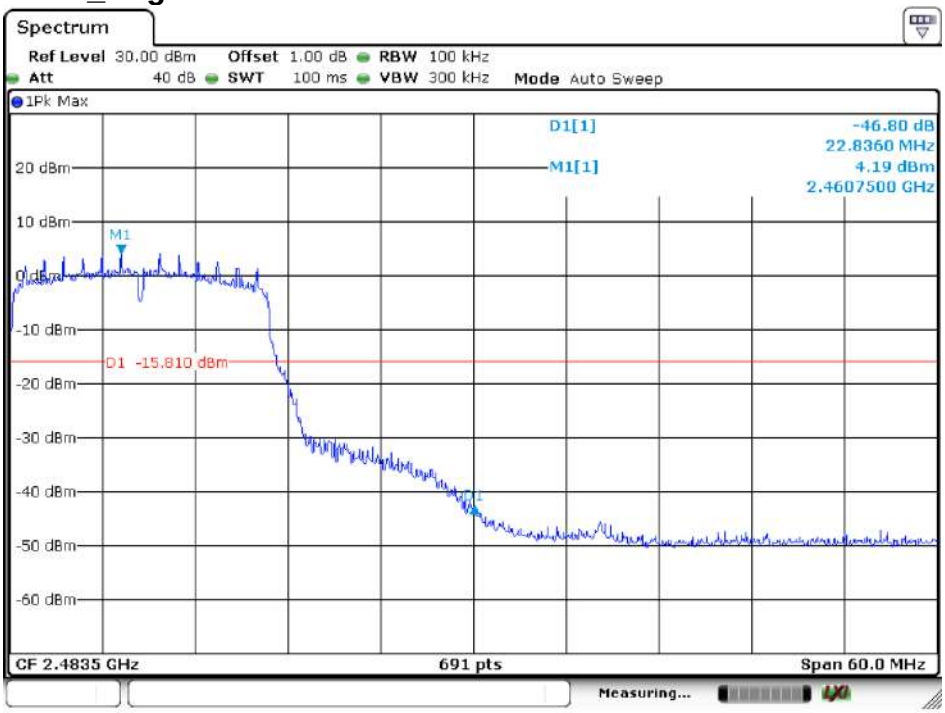
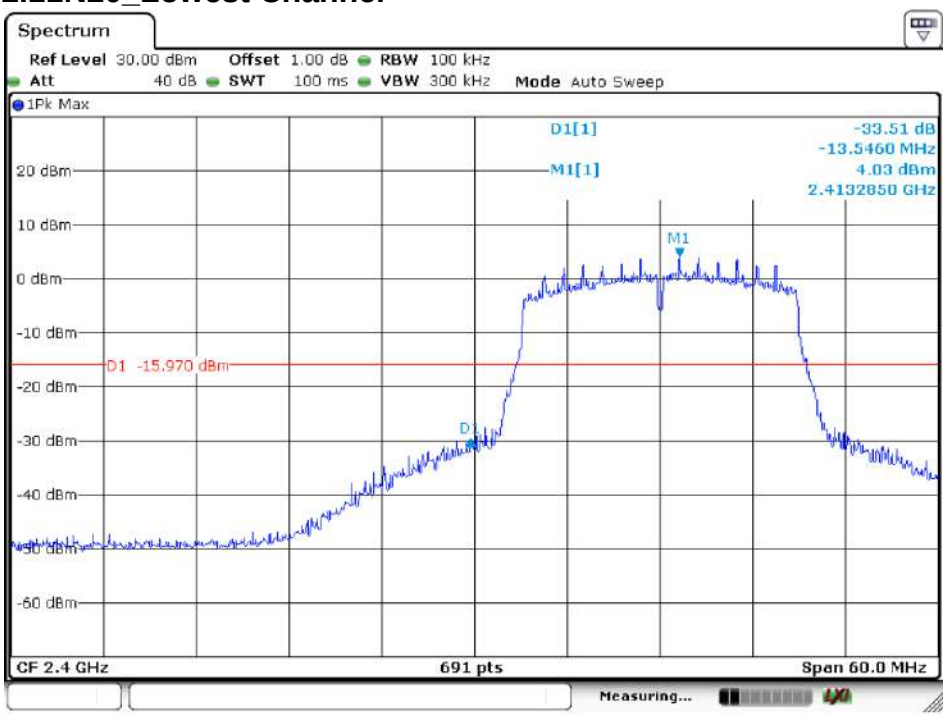
4.7.1.1.4 802.11G_ Highest Channel



Date: 20.MAY.2020 13:17:27

4.7.1.1.5 802.11N20_Lowest Channel



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4.7.1.1.6 802.11 N20_ Highest Channel

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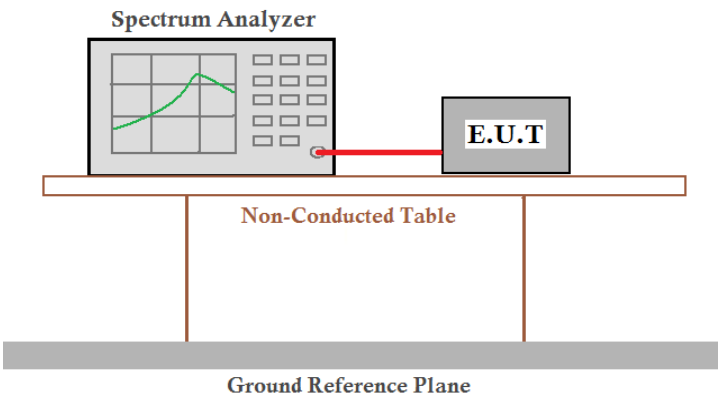
4.8 RF Conducted Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10: 2013 Section 11.11
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); 13.5Mbps of rate is the worst case of 802.11N(HT40).
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.
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

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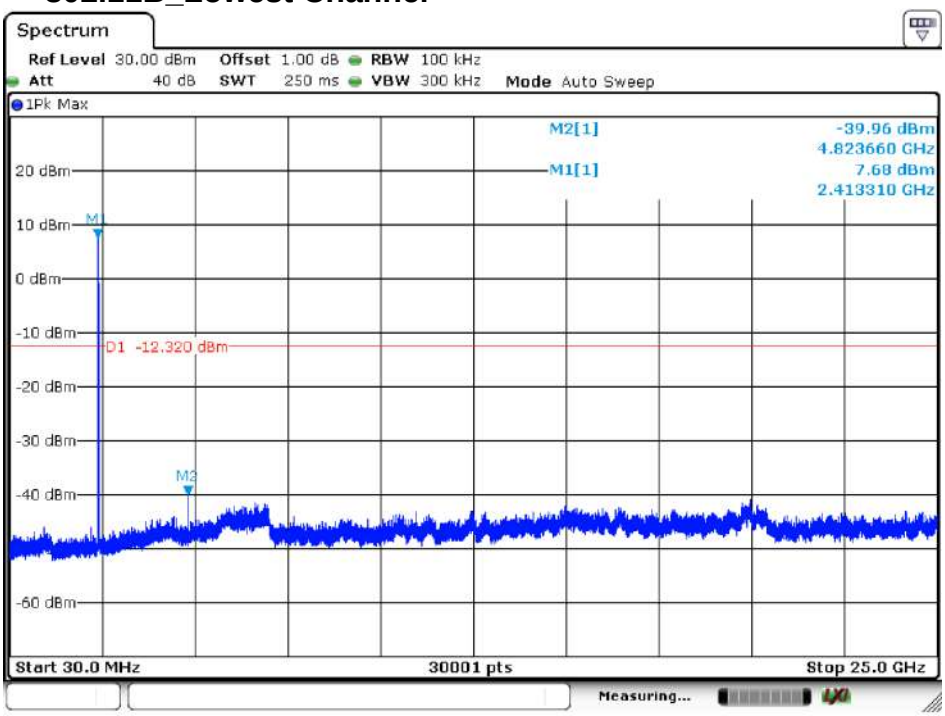
4.8.1 Test plots

4.8.1.1 ANT1

4.8.1.1.1 802.11B_Lowest Channel



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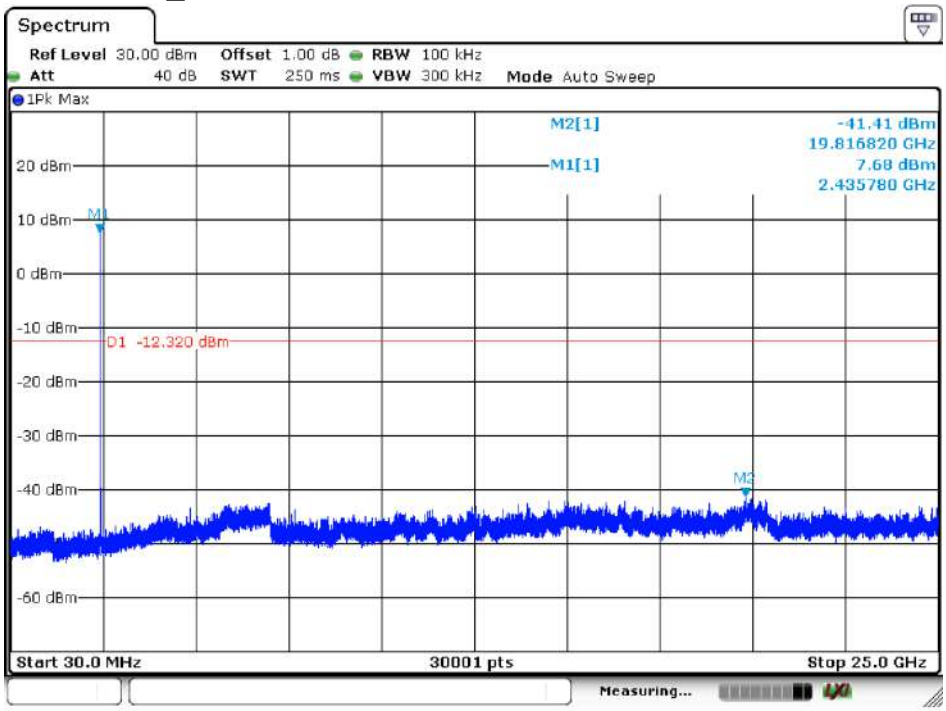
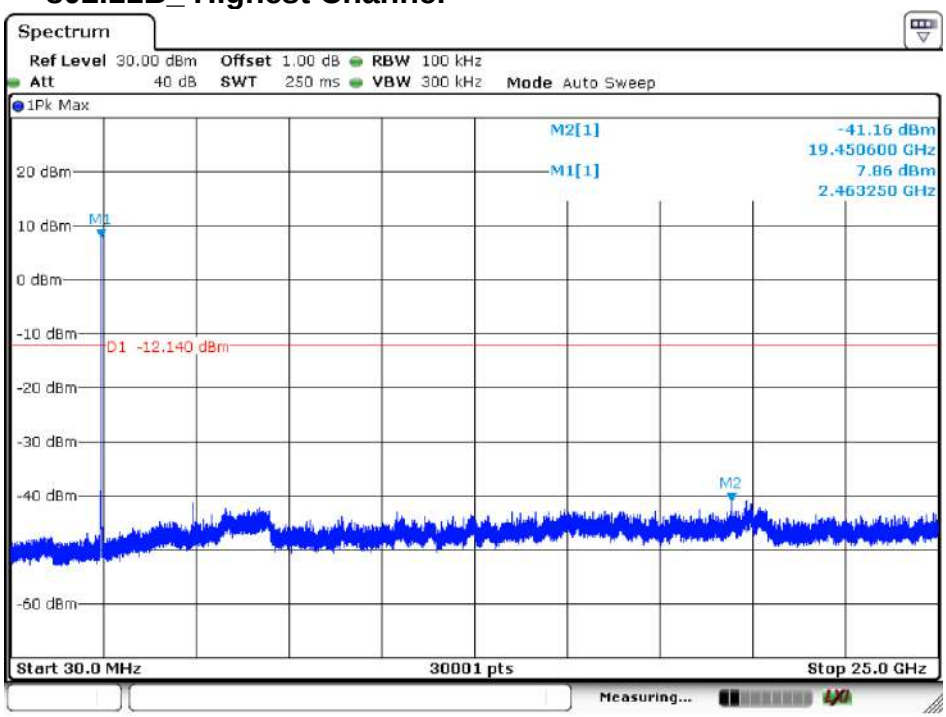
4.8.1.1.2 802.11B_ Middle Channel



Date: 20.MAY.2020 13:38:51

4.8.1.1.3 802.11B_ Highest Channel



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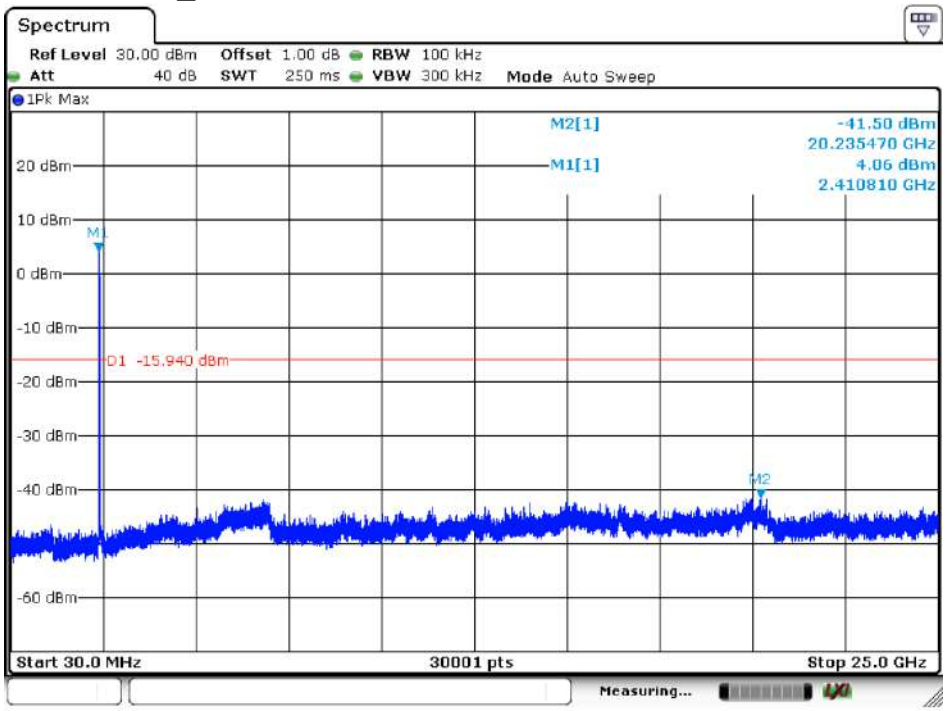
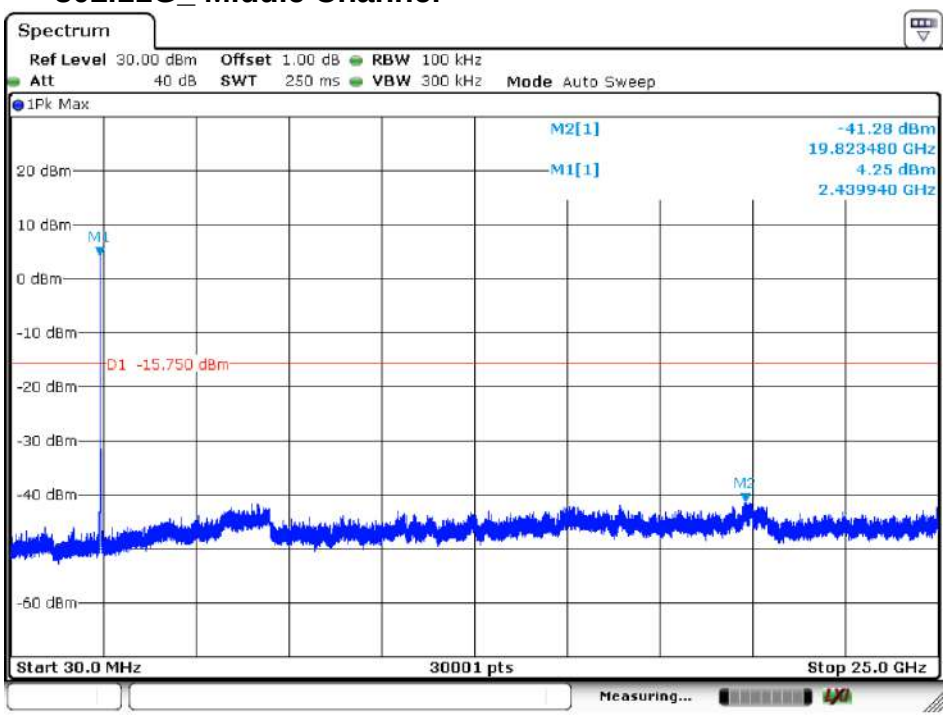
4.8.1.1.4 802.11G_Lowest Channel



Date: 20.MAY.2020 13:28:56

4.8.1.1.5 802.11G_ Middle Channel



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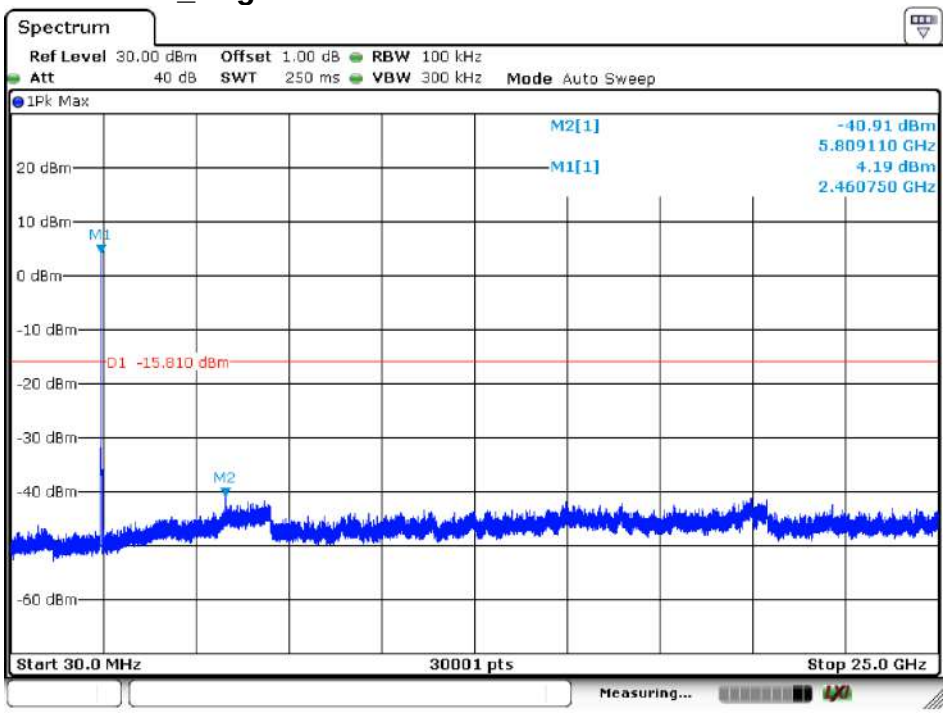
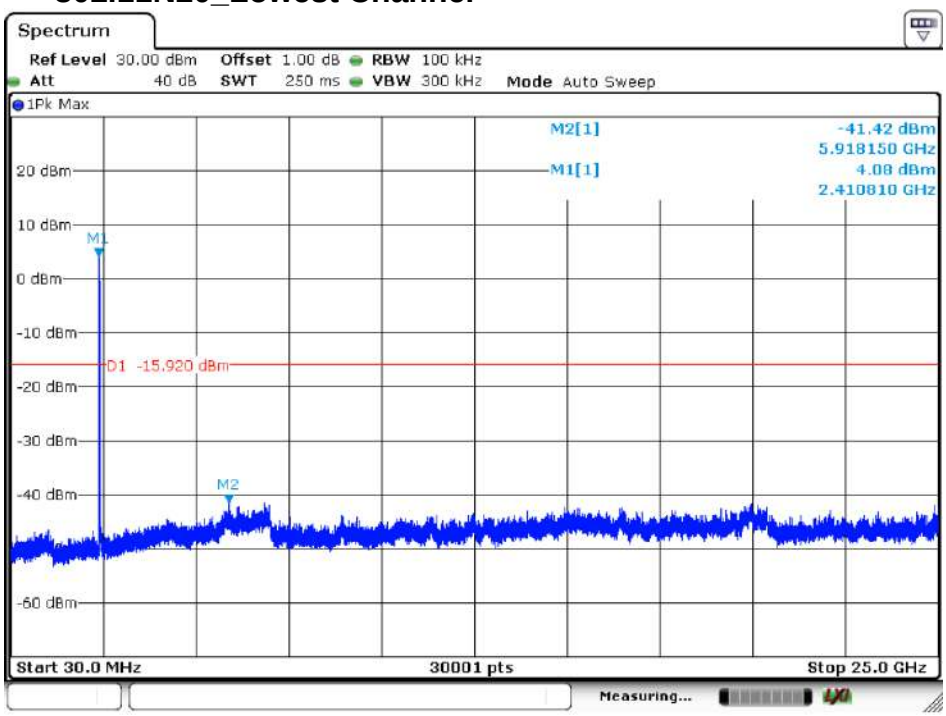
4.8.1.1.6 802.11G_ Highest Channel



Date: 20.MAY.2020 13:31:31

4.8.1.1.7 802.11N20_Lowest Channel



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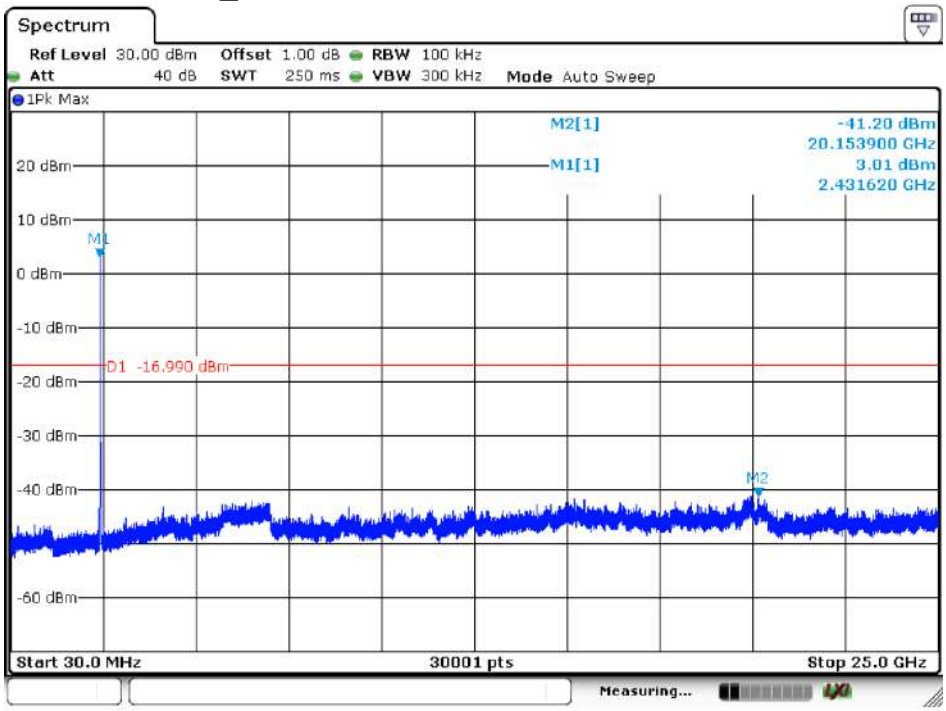
4.8.1.1.8 802.11 N20_ Middle Channel



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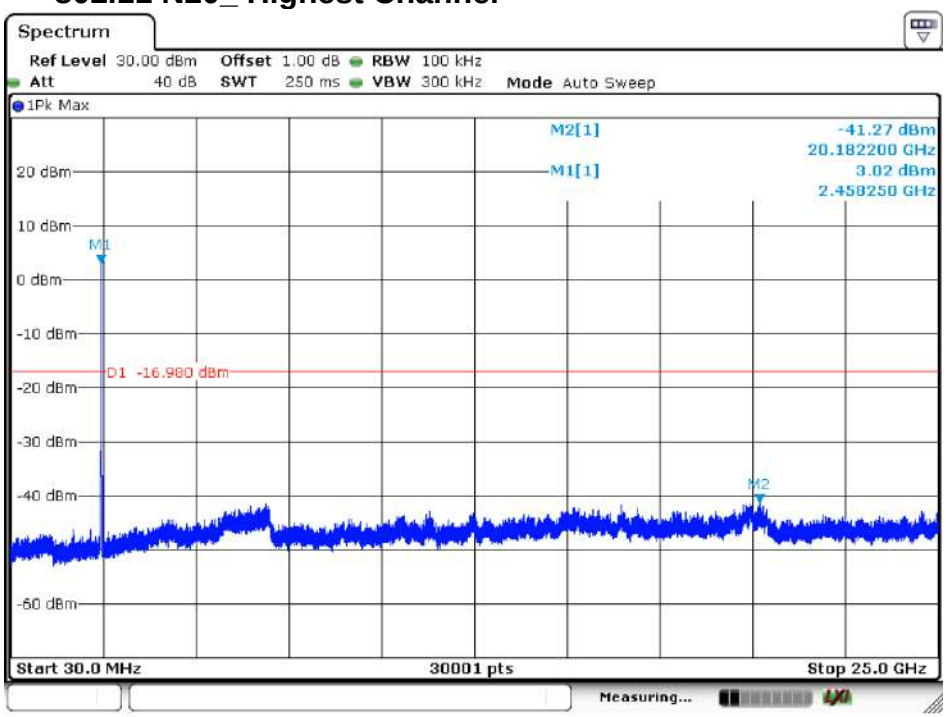
4.8.1.1.9 802.11 N20_ Highest Channel



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Remark:

Scan from 9kHz to 25GHz, the disturbance between 9KHz to 30MHz was very low, and the above harmonics were the highest point could be found when testing, The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

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4.9 Radiated Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205				
Test Method:	ANSI C63.10 :2013 Section 11.12				
Test Site:	Measurement Distance: 3m or 10m (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
	Remark: 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.				

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Test Setup:

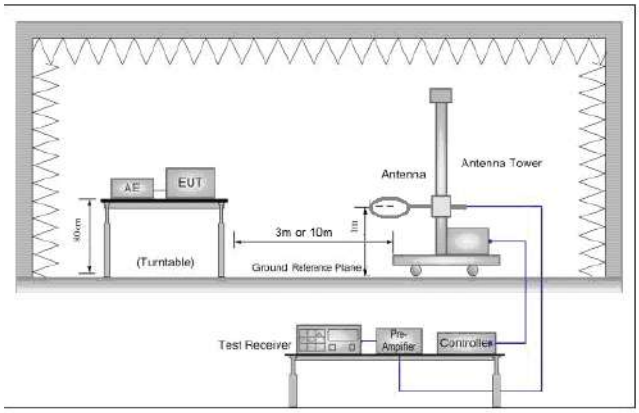

Figure 1. Below 30MHz

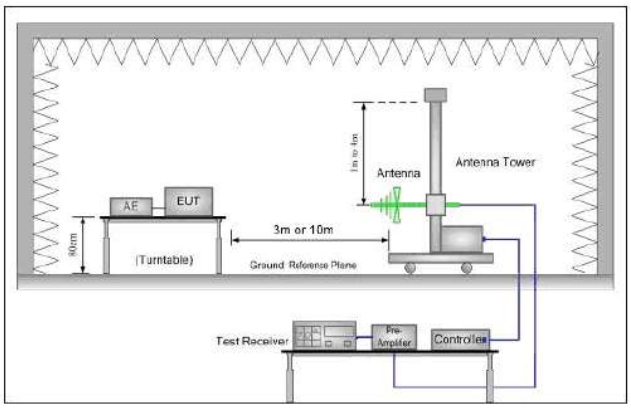

Figure 2. 30MHz to 1GHz

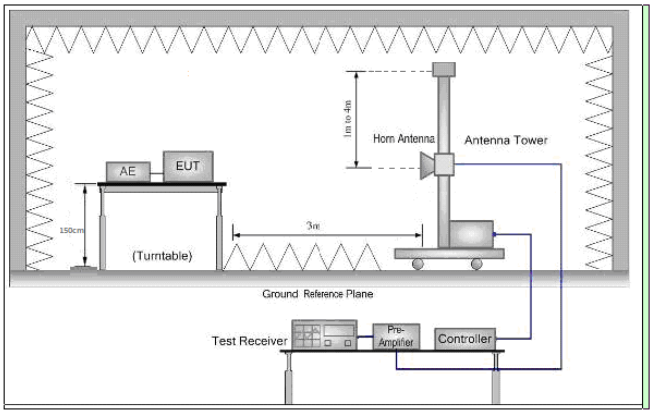

Figure 3. Above 1 GHz

Test Procedure:

a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. For above 1GHz, 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

c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

d. 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.

e. Use the following spectrum analyzer settings:

(1) Span shall wide enough to fully capture the emission being measured;

(2) Set RBW=100 kHz for f < 1 GHz, RBW=1MHz for f>1GHz ; VBW ⩾ RBW; Sweep = auto;

Detector function = peak; Trace = max hold for peak

(3) For average measurement: use duty cycle correction factor method per

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	15.35(c). Duty cycle = On time/100 milliseconds On time = N 1 *L 1 +N 2 *L 2 +...+N n-1 *LN n-1 +N n *L n Where N 1 is number of type 1 pulses, L 1 is length of type 1 pulses, etc. Average Emission Level = Peak Emission Level + 20*log(Duty cycl f. 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. g. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. h. 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. i. Test the EUT in the lowest channel, the middle channel ,the Highest channel j. 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. k. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates. Charge + Transmitting mode.
Final Test Mode:	Pretest the EUT at Charge + Transmitting 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); 13.5Mbps of rate is the worst case of 802.11N(HT40) For below 1GHz, through Pre-scan, find the 1Mbps of rate of 802.11B at lowest channel is the worst case. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

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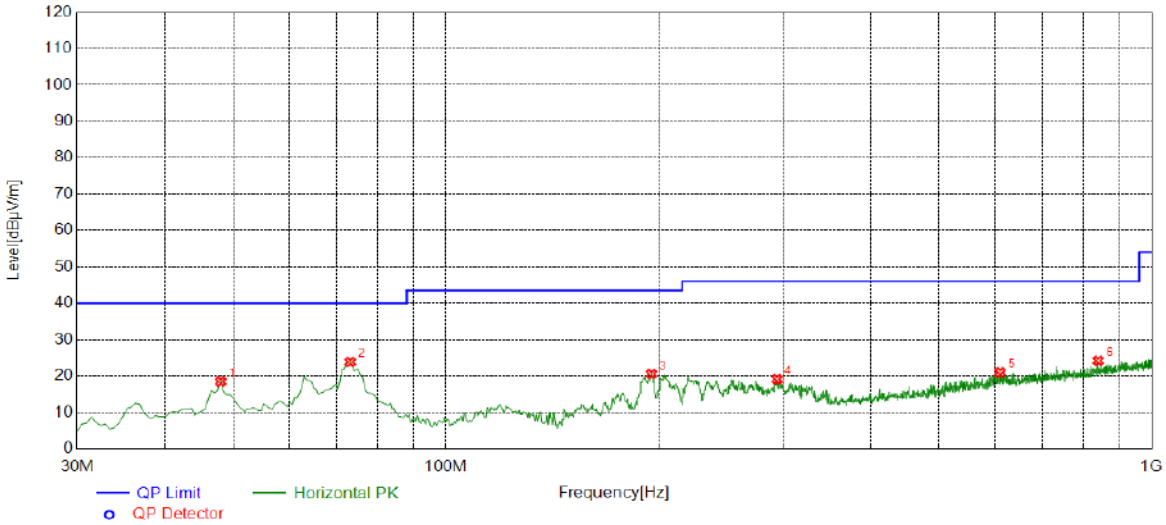
4.9.1 Radiated emission below 1GHz

4.9.1.1 Charge + Transmitting, Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	47.9540	18.41	-30.19	40.00	21.59	169	100	Horizontal
2	73.1866	23.88	-34.71	40.00	16.12	206	16	Horizontal
3	195.467	20.55	-31.29	43.50	22.95	242	233	Horizontal
4	294.457	19.06	-28.02	46.00	26.94	162	108	Horizontal
5	609.864	20.92	-19.94	46.00	25.08	231	84	Horizontal
6	839.869	24.21	-16.23	46.00	21.79	123	153	Horizontal

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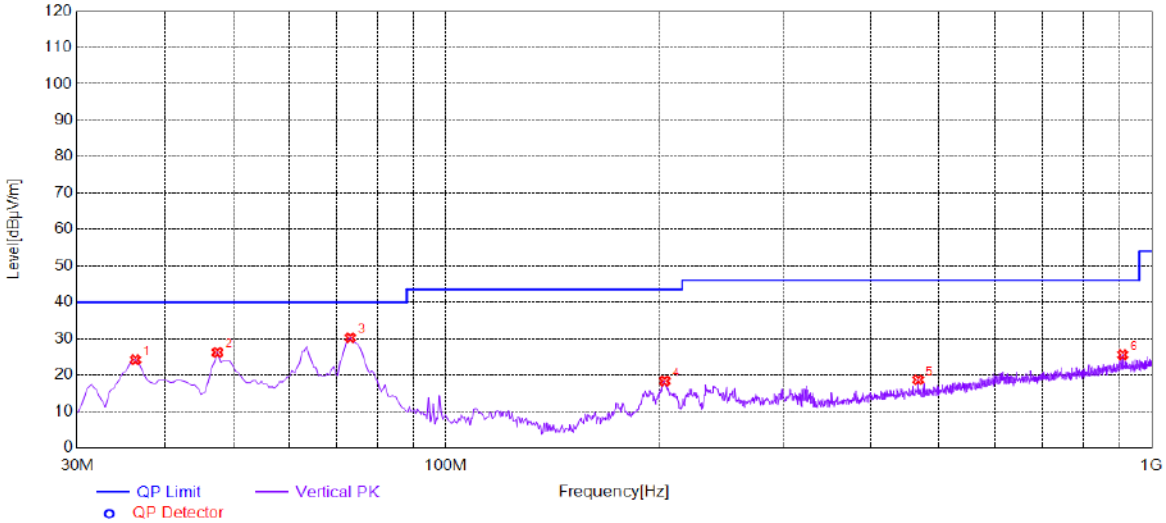
4.9.1.2 Charge + Transmitting, Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	36.3082	24.21	-32.34	40.00	15.79	291	28	Vertical
2	47.4687	26.20	-30.20	40.00	13.80	287	282	Vertical
3	73.1866	30.23	-34.71	40.00	9.77	273	320	Vertical
4	204.202	18.29	-30.73	43.50	25.21	254	310	Vertical
5	466.718	18.64	-23.49	46.00	27.36	228	56	Vertical
6	909.259	25.56	-15.09	46.00	20.44	208	65	Vertical

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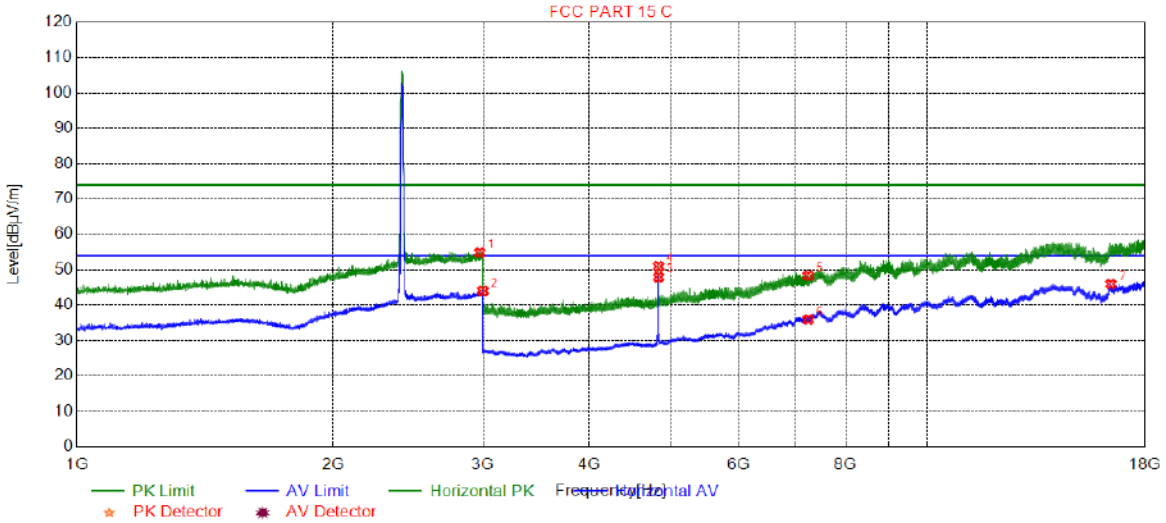
4.9.2 Transmitter emission above 1GHz

4.9.2.1 ANT1

4.9.2.1.1 802.11B_Lowest Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2974.9937	54.88	9.57	74.00	19.12	116	60	Horizontal
2	3000.0000	44.03	9.45	54.00	9.97	166	348	Horizontal
3	4824.0000	47.92	-18.21	54.00	6.08	127	11	Horizontal
4	4824.0000	50.96	-18.21	74.00	23.04	213	11	Horizontal
5	7236.0000	48.37	-9.99	74.00	25.63	184	320	Horizontal
6	7236.0000	35.93	-9.99	54.00	18.07	176	18	Horizontal
7	16404.370	45.98	-0.10	54.00	8.02	209	360	Horizontal

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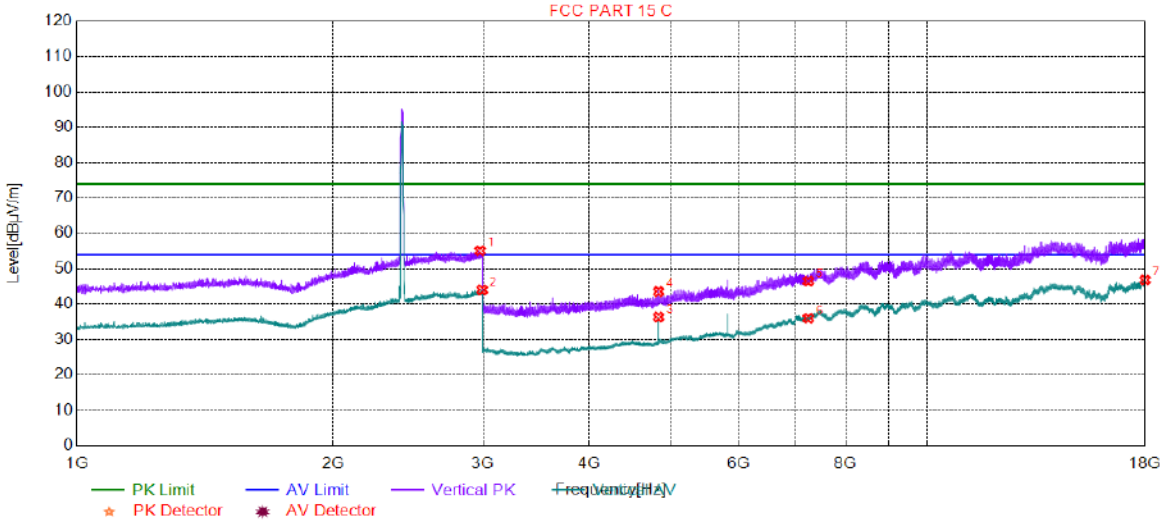
4.9.2.1.2 802.11B_Lowest Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2977.4944	55.09	9.55	74.00	18.91	166	2	Vertical
2	2993.4984	44.05	9.48	54.00	9.95	242	328	Vertical
3	4824.0000	36.34	-18.21	54.00	17.66	200	150	Vertical
4	4824.0000	43.58	-18.21	74.00	30.42	260	232	Vertical
5	7236.0000	46.52	-9.99	74.00	27.48	166	360	Vertical
6	7236.0000	36.00	-9.99	54.00	18.00	166	270	Vertical
7	17996.149	46.84	0.72	54.00	7.16	158	69	Vertical

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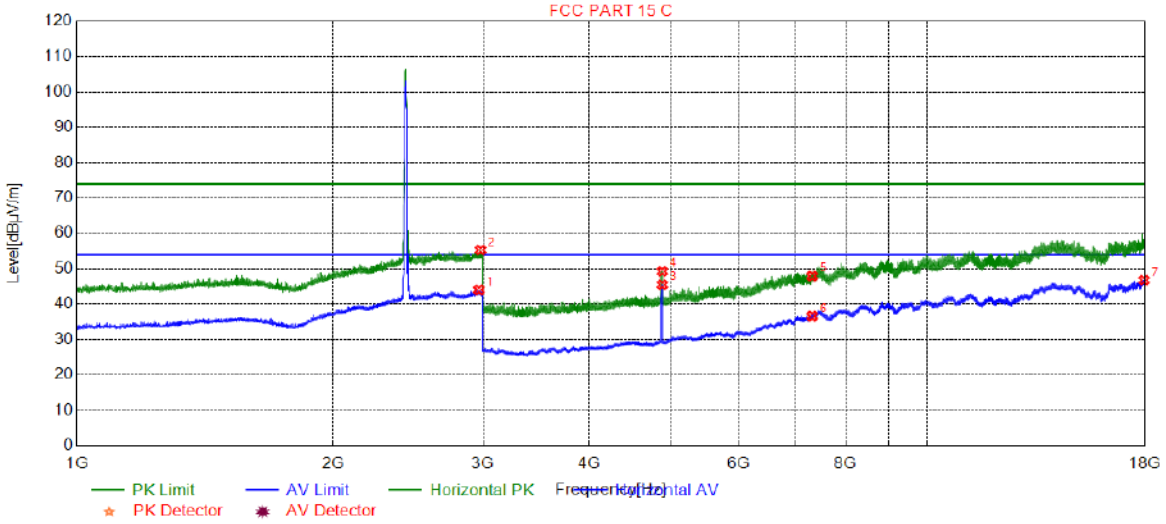
4.9.2.1.3 802.11B_ Middle Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2968.4921	44.05	9.59	54.00	9.95	201	251	Horizontal
2	2980.9952	55.31	9.54	74.00	18.69	238	333	Horizontal
3	4874.0000	45.48	-17.99	54.00	8.52	146	342	Horizontal
4	4874.0000	49.31	-17.99	74.00	24.69	202	342	Horizontal
5	7311.0000	47.95	-9.74	74.00	26.05	248	360	Horizontal
6	7311.0000	36.59	-9.74	54.00	17.41	177	169	Horizontal
7	17949.947	46.79	0.70	54.00	7.21	220	270	Horizontal

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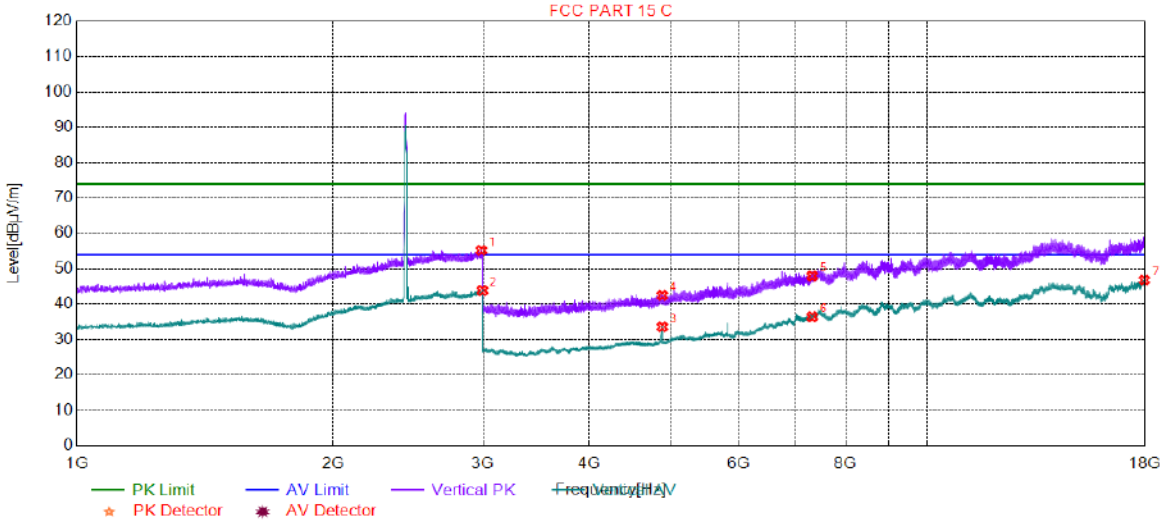
4.9.2.1.4 802.11B_ Middle Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2986.9967	55.21	9.51	74.00	18.79	153	3	Vertical
2	2995.4989	43.87	9.47	54.00	10.13	179	43	Vertical
3	4874.0000	33.60	-17.99	54.00	20.40	156	148	Vertical
4	4874.0000	42.51	-17.99	74.00	31.49	249	342	Vertical
5	7311.0000	48.00	-9.74	74.00	26.00	224	119	Vertical
6	7311.0000	36.41	-9.74	54.00	17.59	221	18	Vertical
7	17962.048	46.82	0.71	54.00	7.18	251	219	Vertical

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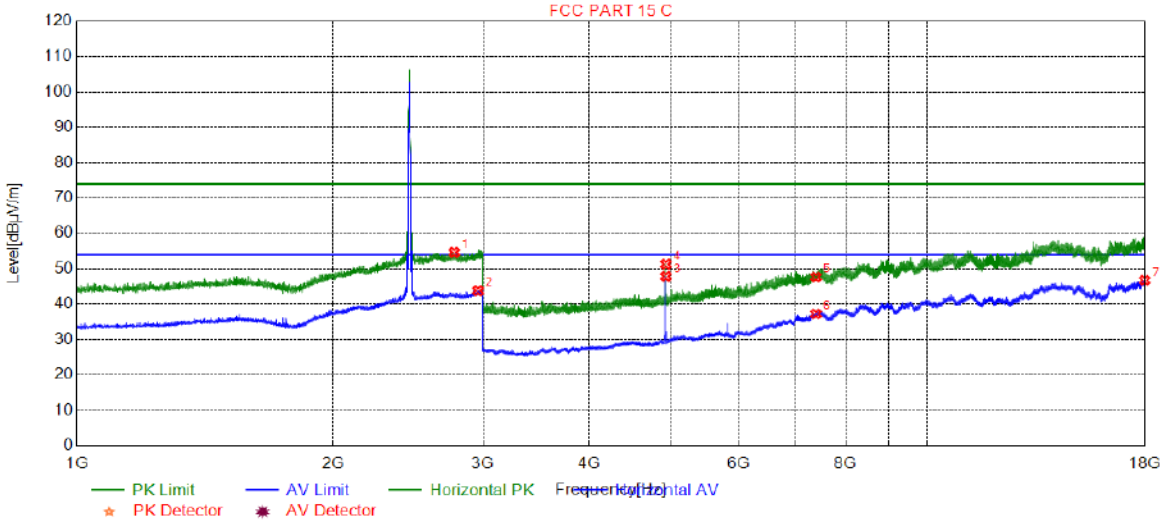
4.9.2.1.5 802.11B_ Highest Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2775.9440	54.65	9.04	74.00	19.35	230	345	Horizontal
2	2960.4901	43.81	9.63	54.00	10.19	137	71	Horizontal
3	4924.0000	47.86	-17.72	54.00	6.14	220	342	Horizontal
4	4924.0000	51.31	-17.72	74.00	22.69	214	11	Horizontal
5	7386.0000	47.68	-9.55	74.00	26.32	197	18	Horizontal
6	7386.0000	37.24	-9.55	54.00	16.76	152	272	Horizontal
7	17977.998	46.75	0.71	54.00	7.25	177	221	Horizontal

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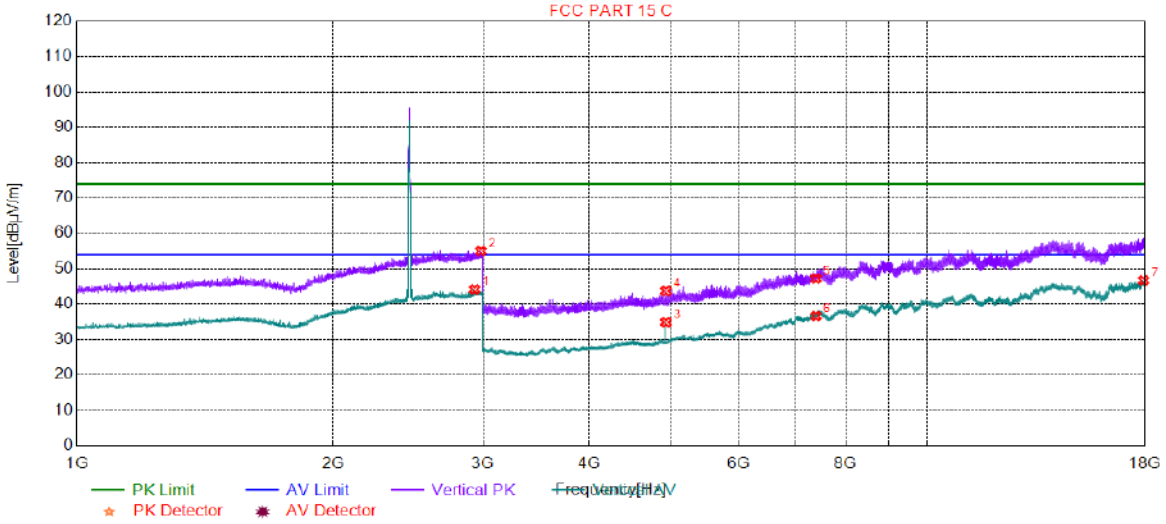
4.9.2.1.6 802.11B_ Highest Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2933.4834	44.17	9.50	54.00	9.83	207	0	Vertical
2	2983.4959	55.02	9.53	74.00	18.98	269	288	Vertical
3	4924.0000	34.89	-17.72	54.00	19.11	228	119	Vertical
4	4924.0000	43.75	-17.72	74.00	30.25	284	64	Vertical
5	7386.0000	47.25	-9.55	74.00	26.75	163	322	Vertical
6	7386.0000	36.63	-9.55	54.00	17.37	276	270	Vertical
7	17925.746	46.71	0.70	54.00	7.29	169	18	Vertical

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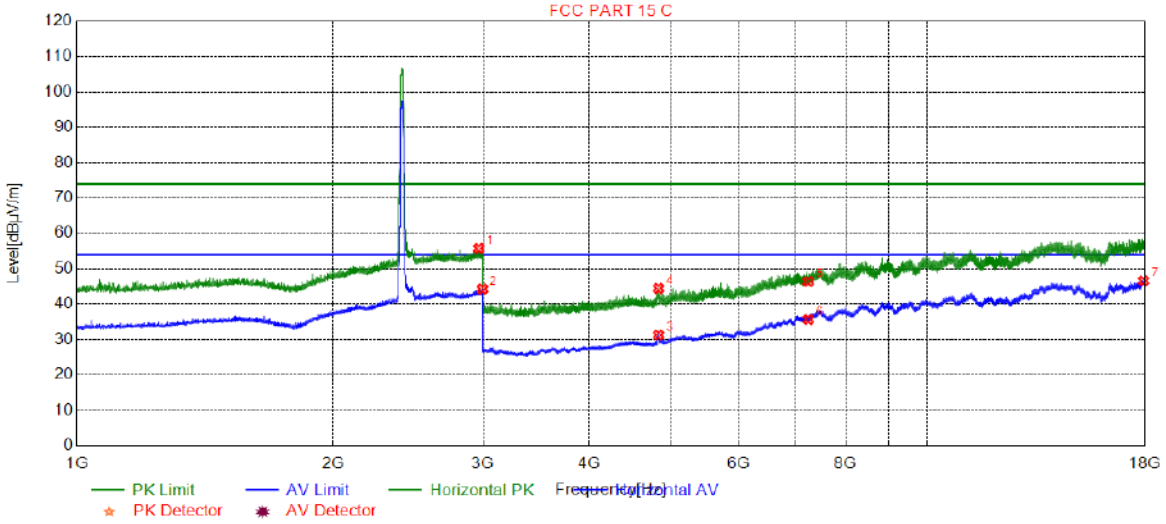
4.9.2.1.7 802.11G_Lowest Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2966.9917	55.77	9.60	74.00	18.23	164	238	Horizontal
2	2996.4991	44.28	9.47	54.00	9.72	233	18	Horizontal
3	4824.0000	31.31	-18.21	54.00	22.69	168	11	Horizontal
4	4824.0000	44.45	-18.21	74.00	29.55	218	342	Horizontal
5	7236.0000	46.40	-9.99	74.00	27.60	238	68	Horizontal
6	7236.0000	35.66	-9.99	54.00	18.34	228	119	Horizontal
7	17925.746	46.60	0.70	54.00	7.40	235	18	Horizontal

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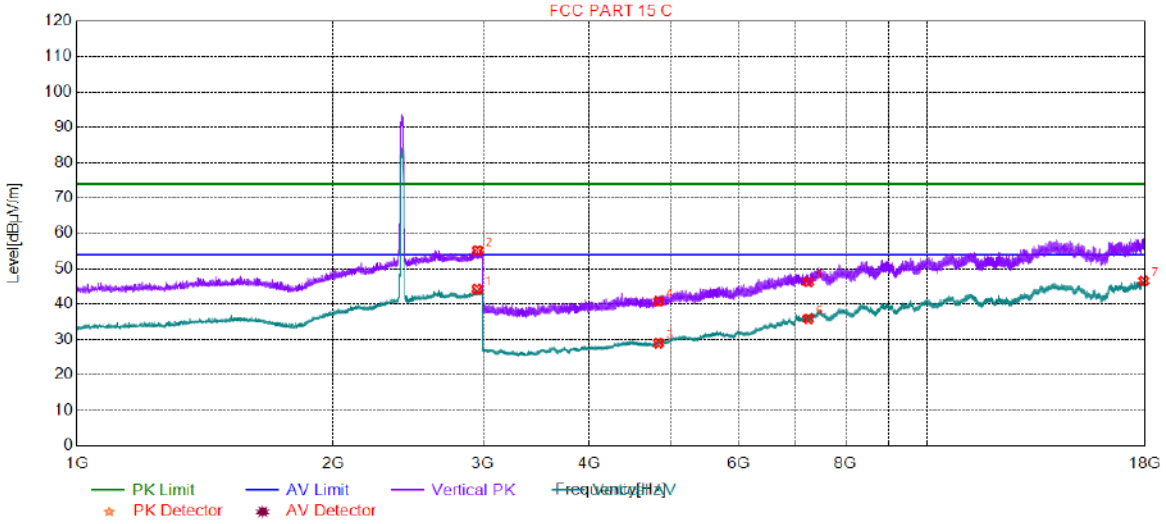
4.9.2.1.8 802.11G_Lowest Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2951.9880	44.27	9.67	54.00	9.73	174	302	Vertical
2	2956.4891	55.18	9.65	74.00	18.82	260	329	Vertical
3	4824.0000	28.98	-18.21	54.00	25.02	264	260	Vertical
4	4824.0000	40.81	-18.21	74.00	33.19	203	41	Vertical
5	7236.0000	46.26	-9.99	74.00	27.74	267	18	Vertical
6	7236.0000	35.85	-9.99	54.00	18.15	222	218	Vertical
7	17931.246	46.60	0.70	54.00	7.40	298	360	Vertical

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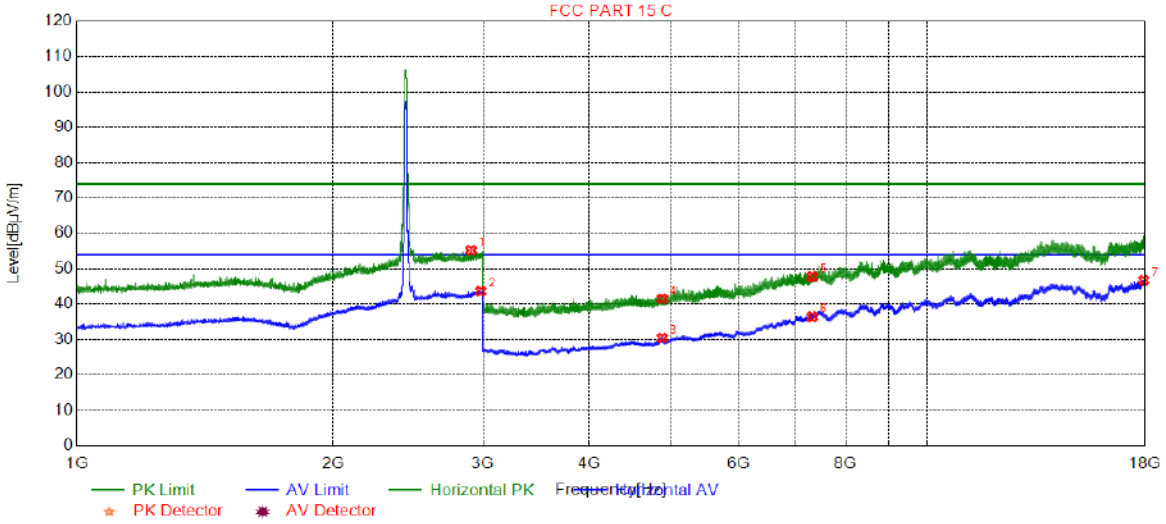
4.9.2.1.9 802.11G_ Middle Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2904.9762	55.23	9.19	74.00	18.77	186	72	Horizontal
2	2982.4956	43.69	9.53	54.00	10.31	169	292	Horizontal
3	4874.0000	30.47	-17.99	54.00	23.53	165	0	Horizontal
4	4874.0000	41.59	-17.99	74.00	32.41	172	288	Horizontal
5	7311.0000	47.81	-9.74	74.00	26.19	127	360	Horizontal
6	7311.0000	36.44	-9.74	54.00	17.56	239	18	Horizontal
7	17933.996	46.75	0.70	54.00	7.25	116	321	Horizontal

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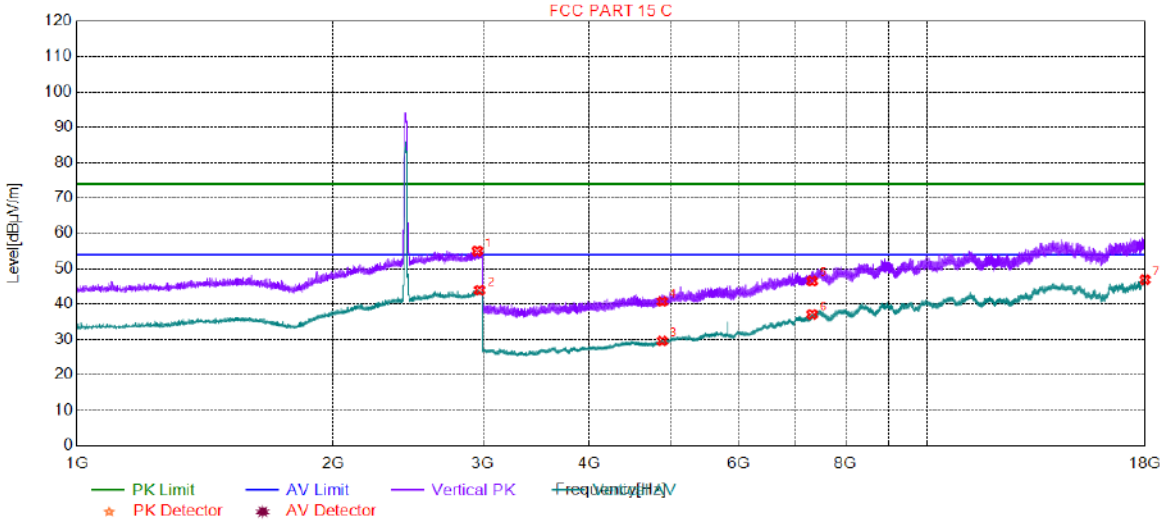
4.9.2.1.10 802.11G_ Middle Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2954.4886	55.02	9.66	74.00	18.98	168	13	Vertical
2	2973.4934	43.97	9.57	54.00	10.03	178	13	Vertical
3	4874.0000	29.62	-17.99	54.00	24.38	164	96	Vertical
4	4874.0000	40.77	-17.99	74.00	33.23	241	260	Vertical
5	7311.0000	46.54	-9.74	74.00	27.46	231	360	Vertical
6	7311.0000	37.09	-9.74	54.00	16.91	228	220	Vertical
7	17995.049	46.92	0.72	54.00	7.08	293	270	Vertical

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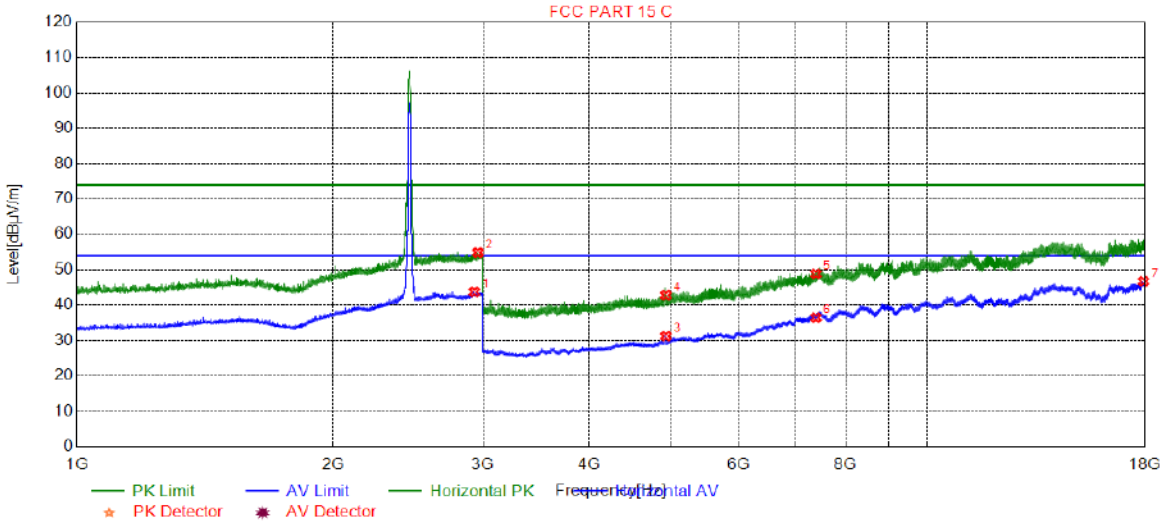
4.9.2.1.11 802.11G_ Highest Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2931.4829	43.75	9.48	54.00	10.25	204	333	Horizontal
2	2959.9900	54.86	9.63	74.00	19.14	198	360	Horizontal
3	4924.0000	31.26	-17.72	54.00	22.74	107	347	Horizontal
4	4924.0000	42.84	-17.72	74.00	31.16	125	18	Horizontal
5	7386.0000	48.86	-9.55	74.00	25.14	166	39	Horizontal
6	7386.0000	36.45	-9.55	54.00	17.55	219	0	Horizontal
7	17924.096	46.73	0.70	54.00	7.27	174	0	Horizontal

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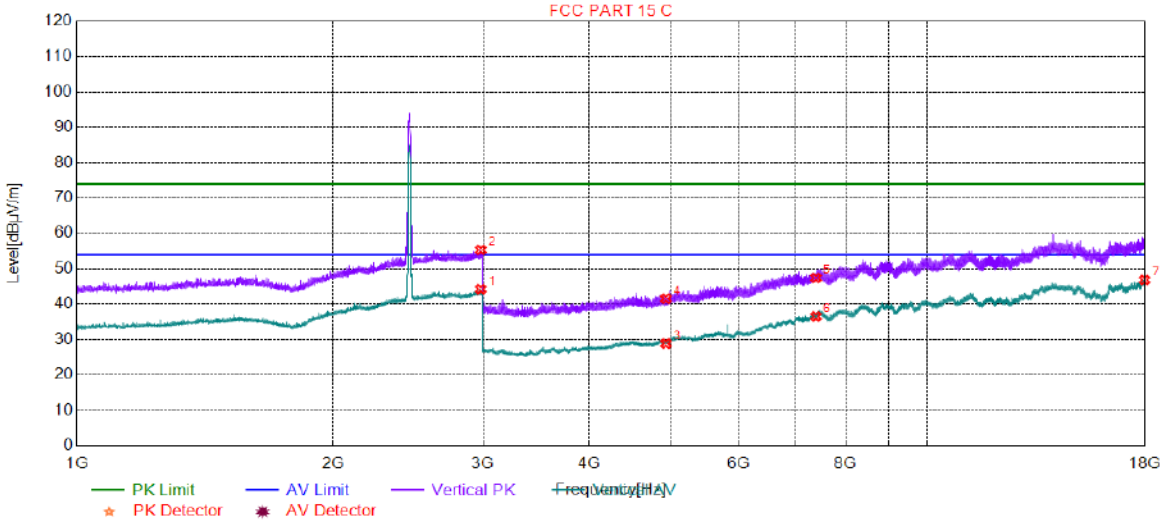
4.9.2.1.12 802.11G_ Highest Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2981.9955	44.24	9.53	54.00	9.76	294	165	Vertical
2	2982.4956	55.34	9.53	74.00	18.66	248	342	Vertical
3	4924.0000	28.86	-17.72	54.00	25.14	298	101	Vertical
4	4924.0000	41.59	-17.72	74.00	32.41	164	292	Vertical
5	7386.0000	47.43	-9.55	74.00	26.57	193	33	Vertical
6	7386.0000	36.51	-9.55	54.00	17.49	248	84	Vertical
7	17971.948	46.85	0.71	54.00	7.15	212	33	Vertical

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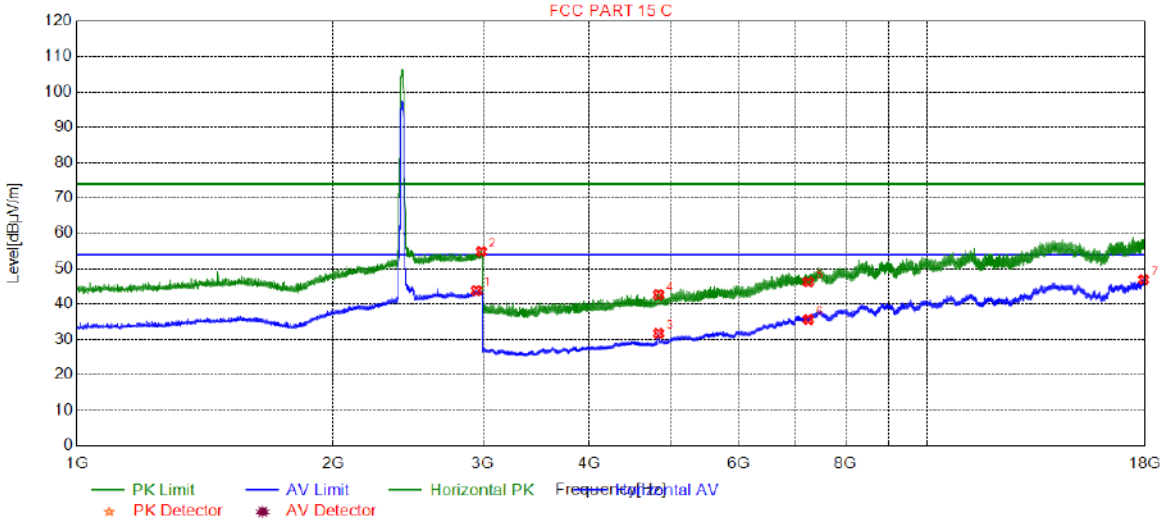
4.9.2.1.13 802.11N20_Lowest Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2946.9867	43.85	9.65	54.00	10.15	127	307	Horizontal
2	2986.9967	54.89	9.51	74.00	19.11	189	348	Horizontal
3	4824.0000	31.75	-18.21	54.00	22.25	133	354	Horizontal
4	4824.0000	42.68	-18.21	74.00	31.32	209	52	Horizontal
5	7236.0000	46.26	-9.99	74.00	27.74	178	190	Horizontal
6	7236.0000	35.64	-9.99	54.00	18.36	228	140	Horizontal
7	17926.846	46.95	0.70	54.00	7.05	246	140	Horizontal

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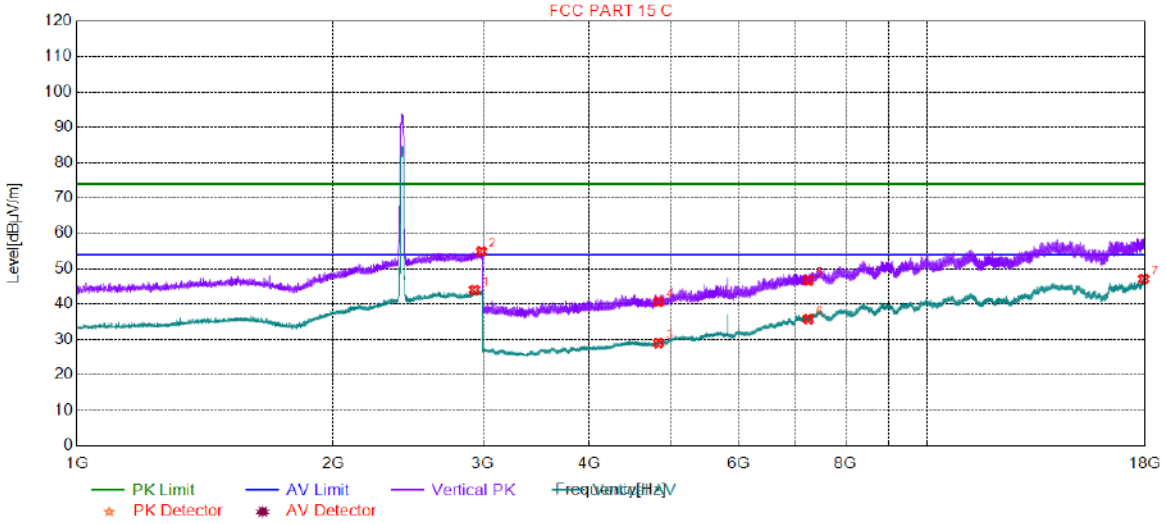
4.9.2.1.14 802.11N20_Lowest Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2932.4831	44.04	9.49	54.00	9.96	151	328	Vertical
2	2987.9970	54.91	9.51	74.00	19.09	151	273	Vertical
3	4824.0000	29.01	-18.21	54.00	24.99	225	352	Vertical
4	4824.0000	40.73	-18.21	74.00	33.27	200	46	Vertical
5	7236.0000	46.71	-9.99	74.00	27.29	263	342	Vertical
6	7236.0000	35.76	-9.99	54.00	18.24	246	239	Vertical
7	17934.546	47.15	0.70	54.00	6.85	299	138	Vertical

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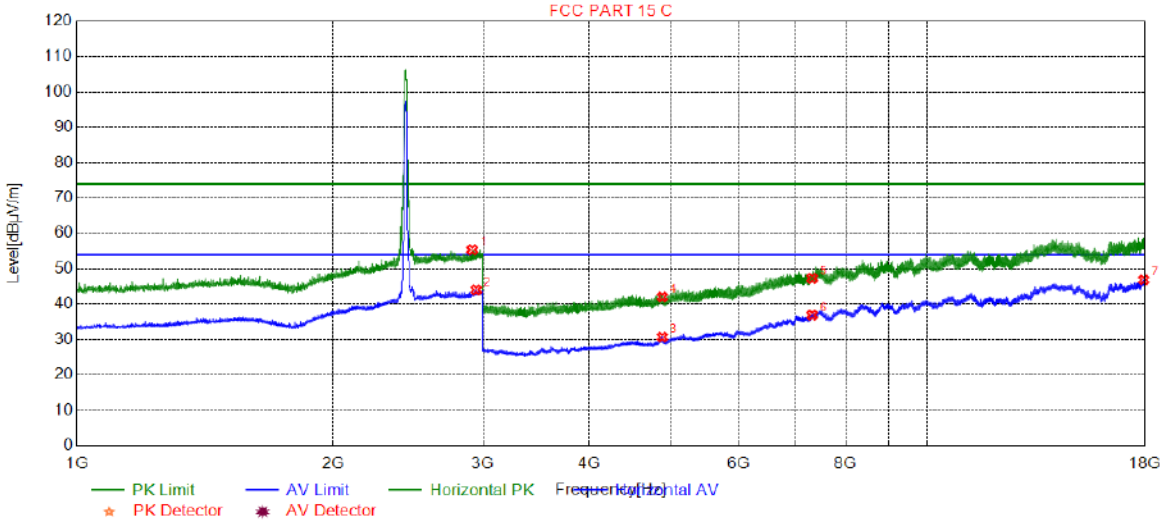
4.9.2.1.15 802.11N20_ Middle Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2914.9787	55.38	9.30	74.00	18.62	173	155	Horizontal
2	2945.4864	44.05	9.63	54.00	9.95	221	113	Horizontal
3	4874.0000	30.72	-17.99	54.00	23.28	145	360	Horizontal
4	4874.0000	42.09	-17.99	74.00	31.91	181	45	Horizontal
5	7311.0000	47.31	-9.74	74.00	26.69	209	140	Horizontal
6	7311.0000	36.90	-9.74	54.00	17.10	232	140	Horizontal
7	17935.096	46.89	0.70	54.00	7.11	120	342	Horizontal

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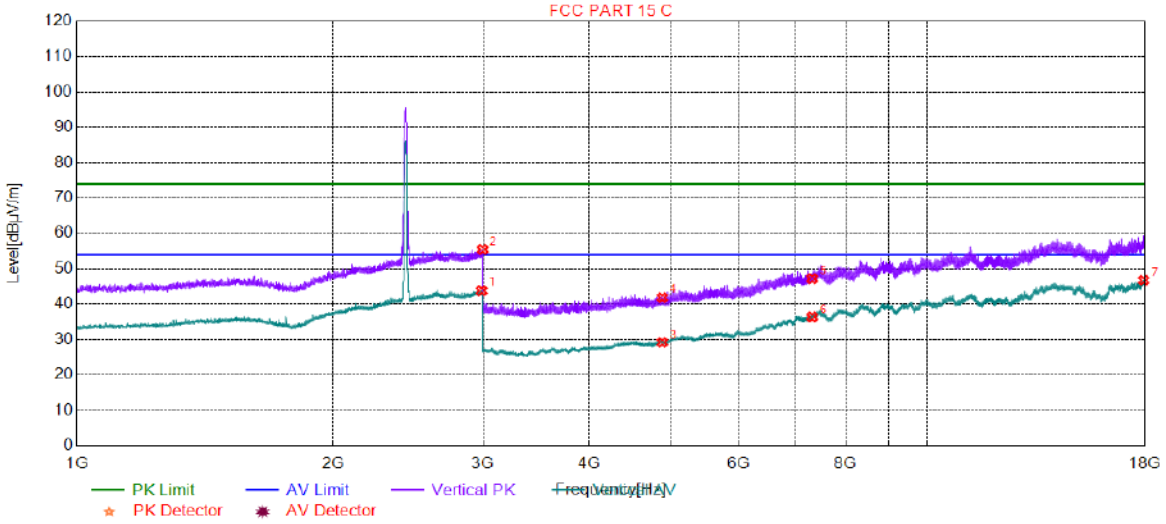
4.9.2.1.16 802.11N20_ Middle Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2988.9972	43.82	9.50	54.00	10.18	210	138	Vertical
2	2997.4994	55.47	9.46	74.00	18.53	287	29	Vertical
3	4874.0000	29.20	-17.99	54.00	24.80	217	238	Vertical
4	4874.0000	41.89	-17.99	74.00	32.11	168	45	Vertical
5	7311.0000	47.22	-9.74	74.00	26.78	242	292	Vertical
6	7311.0000	36.36	-9.74	54.00	17.64	223	342	Vertical
7	17931.796	46.76	0.70	54.00	7.24	233	89	Vertical

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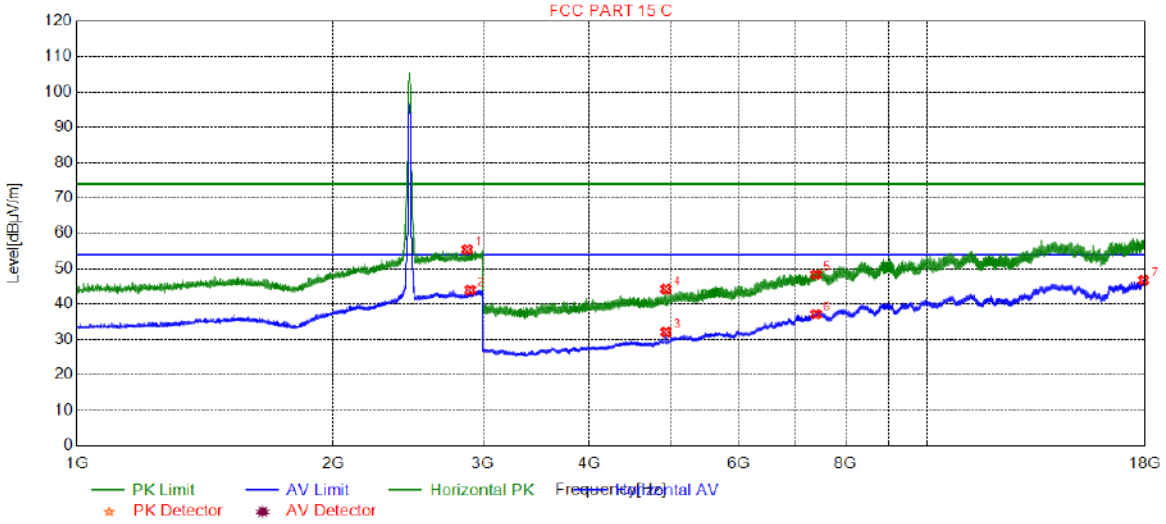
4.9.2.1.17 802.11N20_ Highest Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2875.4689	55.46	9.19	74.00	18.54	220	252	Horizontal
2	2897.9745	44.00	9.14	54.00	10.00	188	358	Horizontal
3	4924.0000	32.14	-17.72	54.00	21.86	127	18	Horizontal
4	4924.0000	44.29	-17.72	74.00	29.71	186	18	Horizontal
5	7386.0000	48.37	-9.55	74.00	25.63	230	342	Horizontal
6	7386.0000	37.15	-9.55	54.00	16.85	211	0	Horizontal
7	17927.396	46.79	0.70	54.00	7.21	177	292	Horizontal

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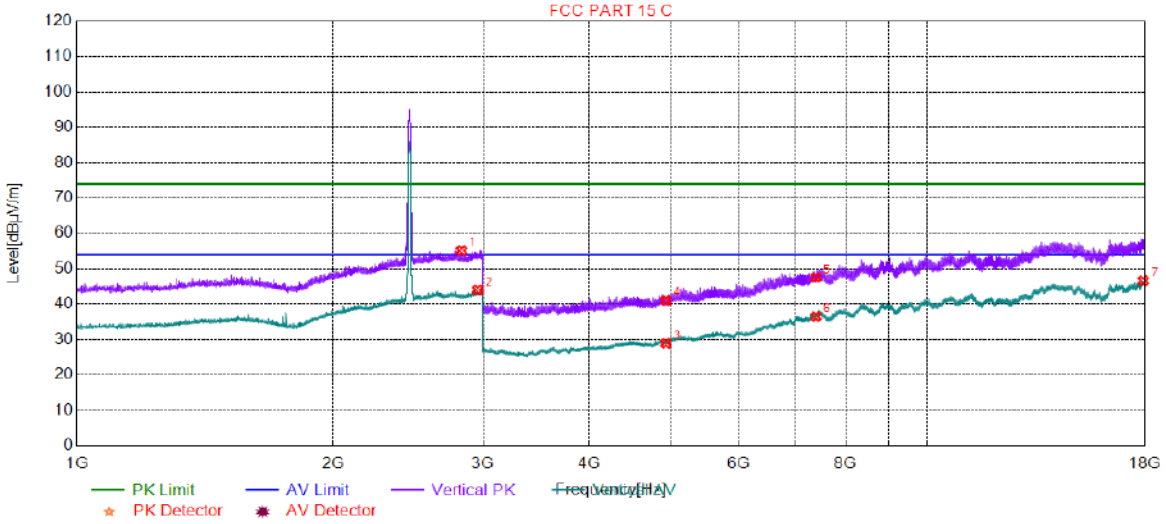
4.9.2.1.18 802.11N20_ Highest Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2831.9580	55.16	9.15	74.00	18.84	197	150	Vertical
2	2958.4896	44.01	9.64	54.00	9.99	197	191	Vertical
3	4924.0000	28.94	-17.72	54.00	25.06	186	182	Vertical
4	4924.0000	41.06	-17.72	74.00	32.94	189	73	Vertical
5	7386.0000	47.57	-9.55	74.00	26.43	254	240	Vertical
6	7386.0000	36.47	-9.55	54.00	17.53	261	190	Vertical
7	17912.545	46.63	0.69	54.00	7.37	186	88	Vertical

Remark:

1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

   Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

2) Scan from 9kHz to 25GHz, the disturbance between 9KHz to 30MHz and 18GHz to 25GHz was very low, and the above harmonics were the highest point could be found when testing, The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

3）As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the peak measurements were shown in the report.

4）All Modes have been tested, but only the worst case data displayed in this report.

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4.10 Restricted bands around fundamental frequency

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205		
Test Method:	ANSI C63.10: 2013 Section 11.12		
Test Site:	Measurement Distance: 3m or 10m (Semi-Anechoic Chamber)		
Limit:	Frequency	Limit (dBuV/m @3m)	Remark
	30MHz-88MHz	40.0	Quasi-peak Value
	88MHz-216MHz	43.5	Quasi-peak Value
	216MHz-960MHz	46.0	Quasi-peak Value
	960MHz-1GHz	54.0	Quasi-peak Value
	Above 1GHz	54.0	Average Value
		74.0	Peak Value
Test Setup:			

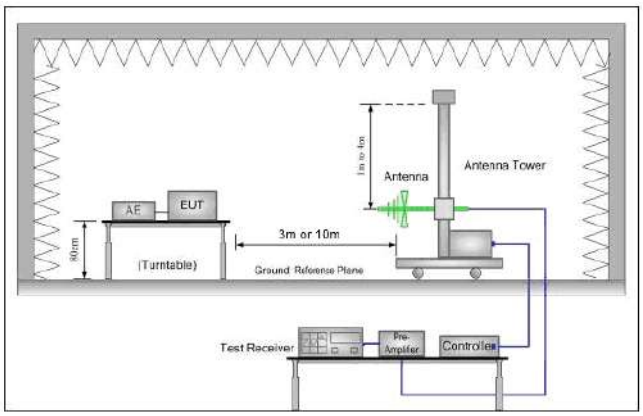

Figure 1. 30MHz to 1GHz

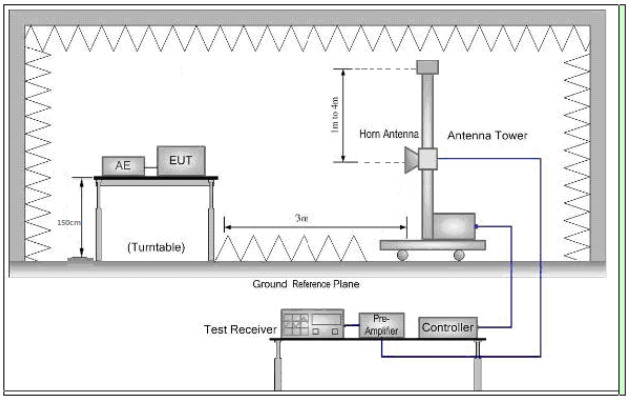

Figure 2. Above 1 GHz

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Test Procedure:	a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. b. For above 1GHz, 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. c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. d. 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. e. 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. f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. g. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel h. Test the EUT in the lowest channel , the Highest channel i. 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. j. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates. Charge + Transmitting mode.
Final Test Mode:	Pretest the EUT at Charge +Transmitting 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); 13.5Mbps of rate is the worst case of 802.11N(HT40). Only the worst case is recorded in the report.
Instruments Used:	Refer to section 5.10 for details
Test Results:	Pass

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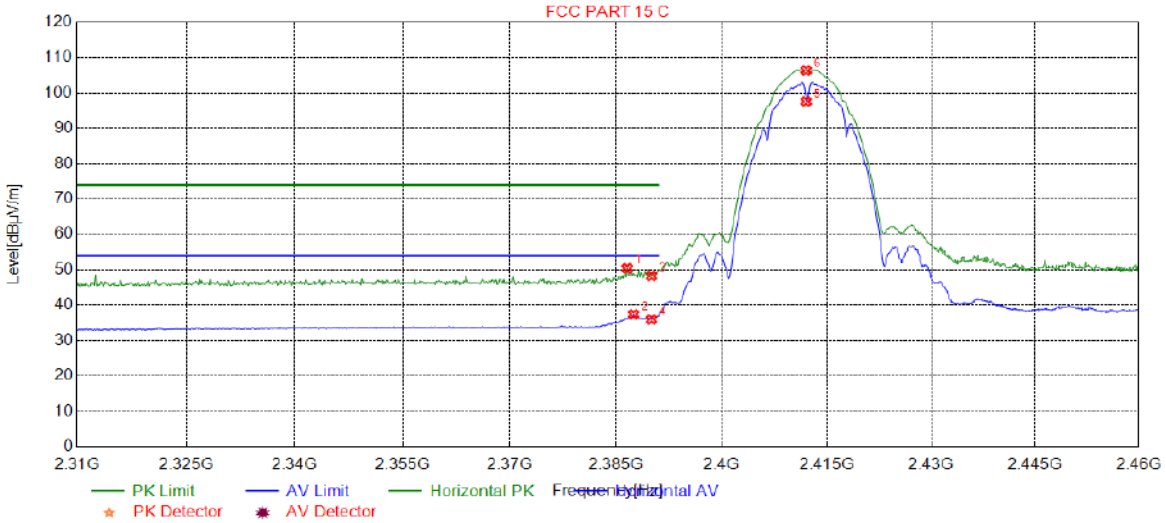
Test plot as follows:

4.10.1 ANT1

4.10.1.1 802.11B_Lowest Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2386.5766	50.44	7.77	74.00	23.56	206	102	Horizontal
2	2387.4775	37.38	7.77	54.00	16.62	241	238	Horizontal
3	2390.0000	48.28	7.77	74.00	25.72	101	98	Horizontal
4	2390.0000	35.95	7.77	54.00	18.05	208	98	Horizontal
5	2412.0000	97.56	7.81	0.00	-97.56	108	74	Horizontal
6	2412.0000	106.37	7.81	0.00	-106.37	108	74	Horizontal

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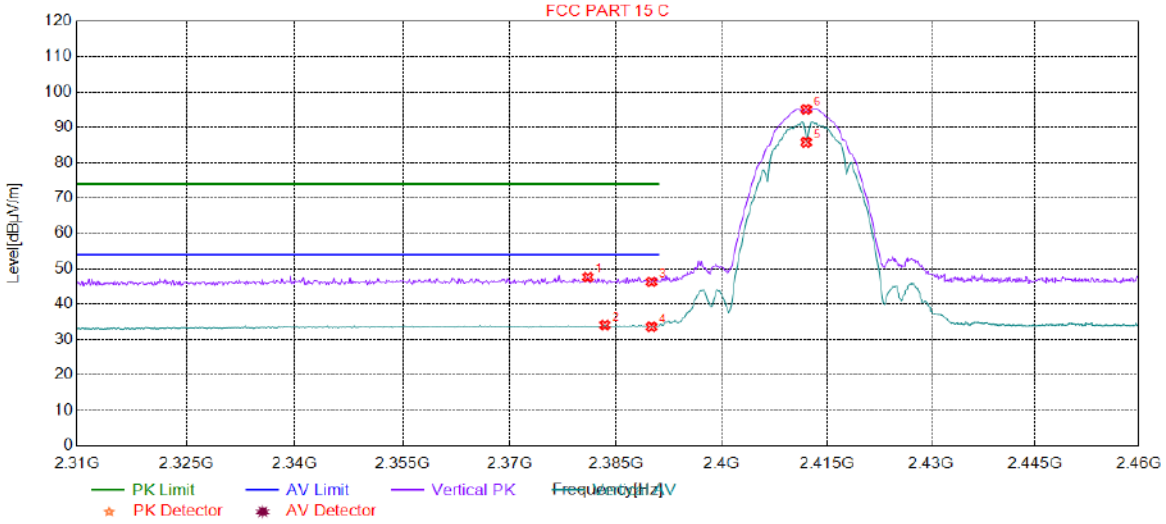
4.10.1.2 802.11B_Lowest Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2381.0210	47.65	7.78	74.00	26.35	216	135	Vertical
2	2383.4234	34.10	7.78	54.00	19.90	225	274	Vertical
3	2390.0000	46.31	7.77	74.00	27.69	180	156	Vertical
4	2390.0000	33.61	7.77	54.00	20.39	278	180	Vertical
5	2412.0000	85.77	7.81	0.00	-85.77	262	220	Vertical
6	2412.0000	95.05	7.81	0.00	-95.05	263	224	Vertical

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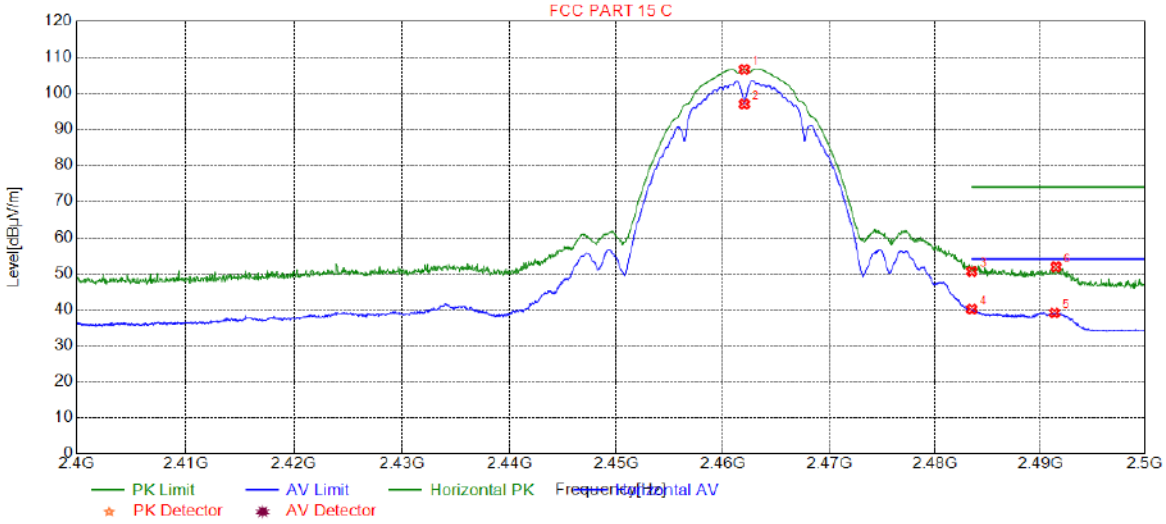
4.10.1.3 802.11B_ Highest Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.0000	106.63	7.98	0.00	-106.63	144	90	Horizontal
2	2462.0000	96.99	7.98	0.00	-96.99	120	90	Horizontal
3	2483.5000	50.59	8.01	74.00	23.41	219	84	Horizontal
4	2483.5000	40.07	8.01	54.00	13.93	200	68	Horizontal
5	2491.3457	39.03	8.02	54.00	14.97	154	73	Horizontal
6	2491.4957	51.82	8.02	74.00	22.18	106	62	Horizontal

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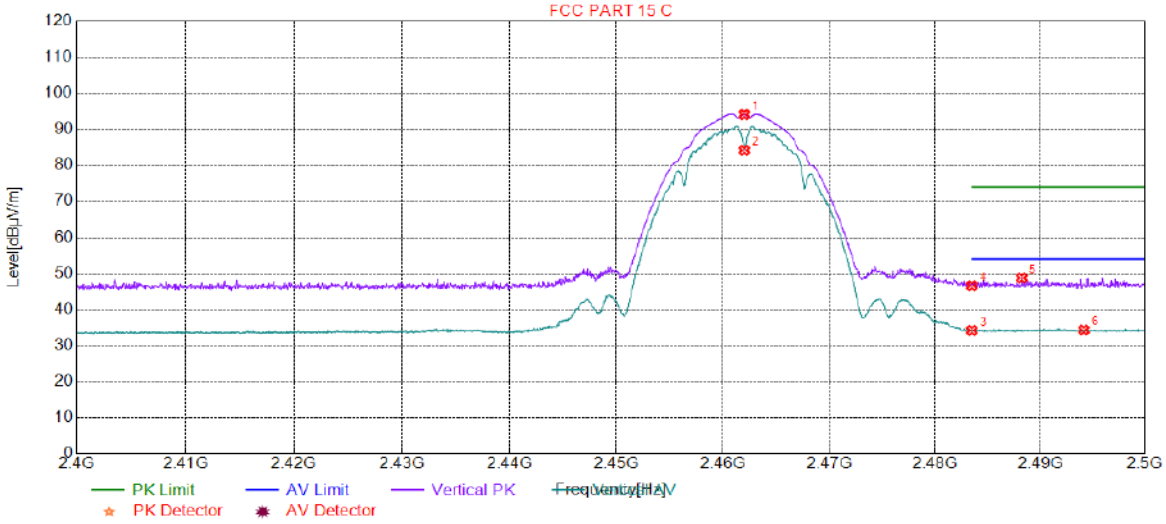
4.10.1.4 802.11B_ Highest Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.0000	94.12	7.98	0.00	-94.12	171	105	Vertical
2	2462.0000	84.21	7.98	0.00	-84.21	190	105	Vertical
3	2483.5000	34.20	8.01	54.00	19.80	190	208	Vertical
4	2483.5000	46.57	8.01	74.00	27.43	274	19	Vertical
5	2488.2441	48.75	8.02	74.00	25.25	177	257	Vertical
6	2494.1471	34.32	8.02	54.00	19.68	242	295	Vertical

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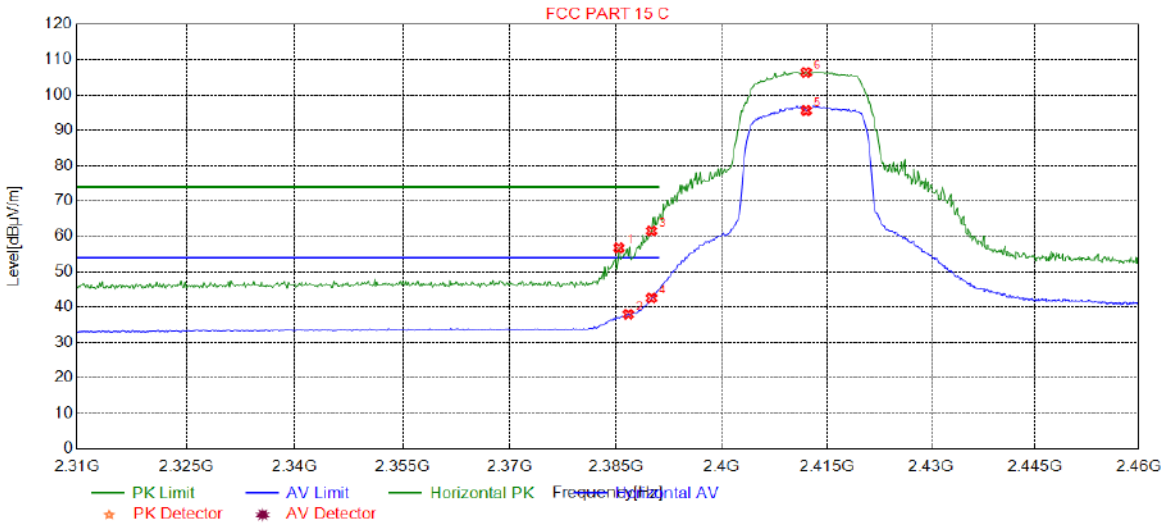
4.10.1.5 802.11G_Lowest Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2385.3754	56.78	7.77	74.00	17.22	203	62	Horizontal
2	2386.7267	37.97	7.77	54.00	16.03	115	73	Horizontal
3	2390.0000	61.53	7.77	74.00	12.47	204	65	Horizontal
4	2390.0000	42.60	7.77	54.00	11.40	195	81	Horizontal
5	2412.0000	95.57	7.81	0.00	-95.57	117	73	Horizontal
6	2412.0000	106.37	7.81	0.00	-106.37	104	89	Horizontal

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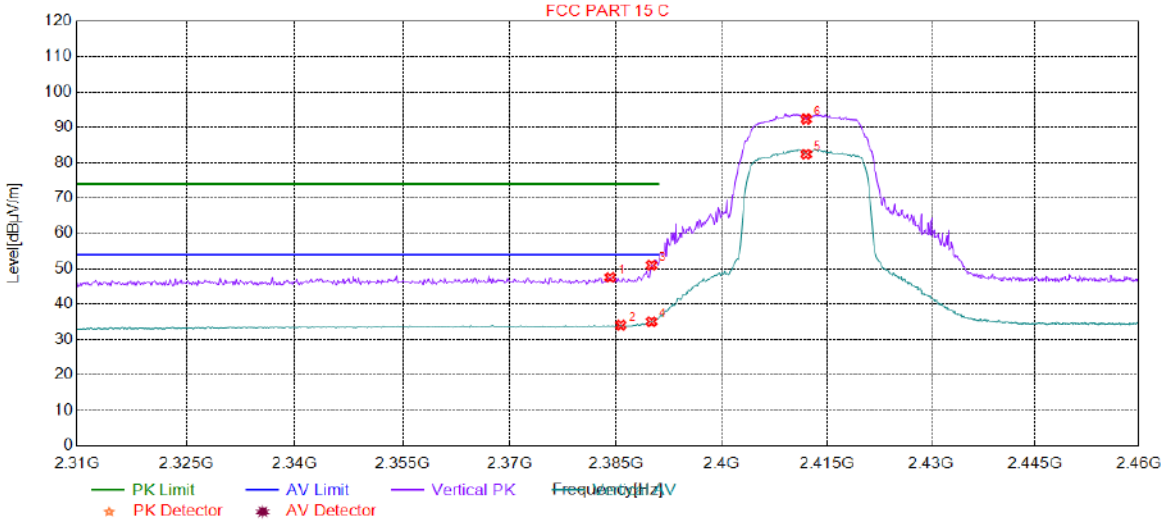
4.10.1.6 802.11G_Lowest Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2384.1742	47.58	7.78	74.00	26.42	267	296	Vertical
2	2385.6757	34.08	7.77	54.00	19.92	298	272	Vertical
3	2390.0000	51.02	7.77	74.00	22.98	167	25	Vertical
4	2390.0000	35.06	7.77	54.00	18.94	284	21	Vertical
5	2412.0000	82.43	7.81	0.00	-82.43	172	21	Vertical
6	2412.0000	92.35	7.81	0.00	-92.35	278	18	Vertical

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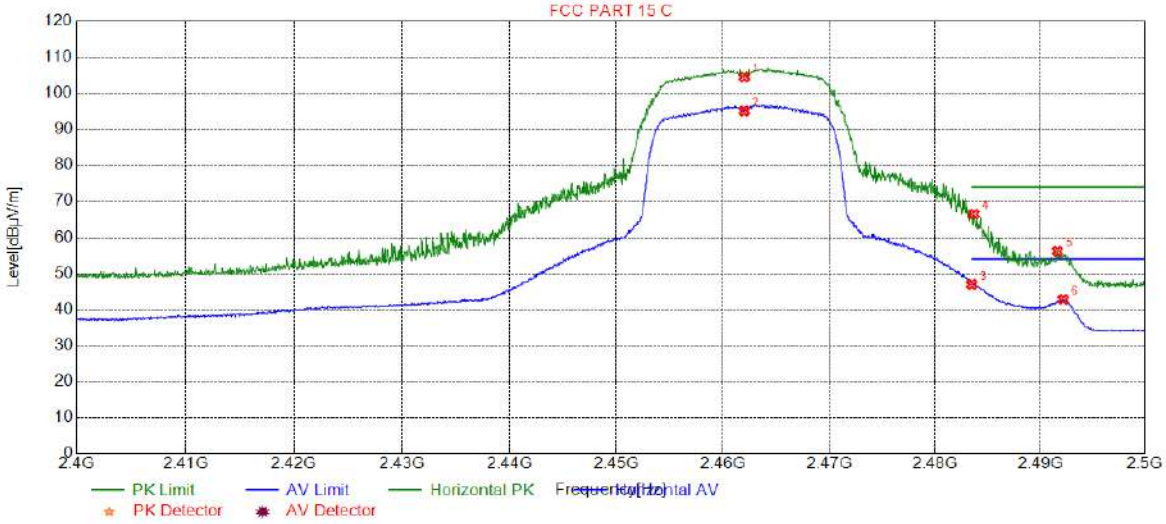
4.10.1.7 802.11G_ Highest Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.0000	104.53	7.98	0.00	-104.53	183	95	Horizontal
2	2462.0000	95.09	7.98	0.00	-95.09	210	95	Horizontal
3	2483.5000	46.93	8.01	54.00	7.07	230	74	Horizontal
4	2483.6918	66.49	8.01	74.00	7.51	231	101	Horizontal
5	2491.6458	56.15	8.02	74.00	17.85	158	74	Horizontal
6	2492.1961	42.79	8.02	54.00	11.21	115	84	Horizontal

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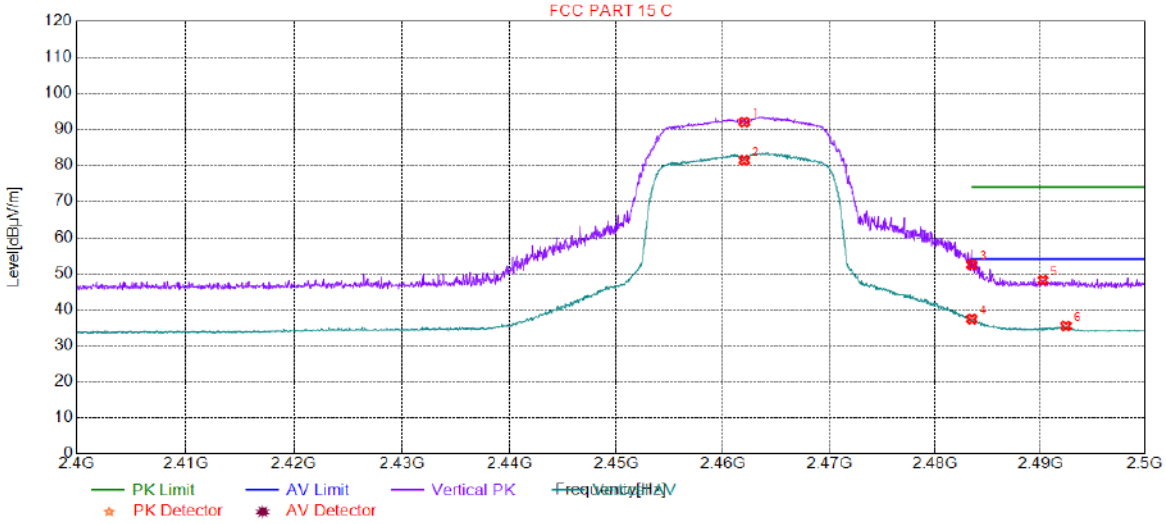
4.10.1.8 802.11G_ Highest Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.0000	92.02	7.98	0.00	-92.02	295	181	Vertical
2	2462.0000	81.38	7.98	0.00	-81.38	299	175	Vertical
3	2483.5000	52.44	8.01	74.00	21.56	218	224	Vertical
4	2483.5000	37.31	8.01	54.00	16.69	295	268	Vertical
5	2490.2451	48.14	8.02	74.00	25.86	245	240	Vertical
6	2492.4462	35.42	8.02	54.00	18.58	276	208	Vertical

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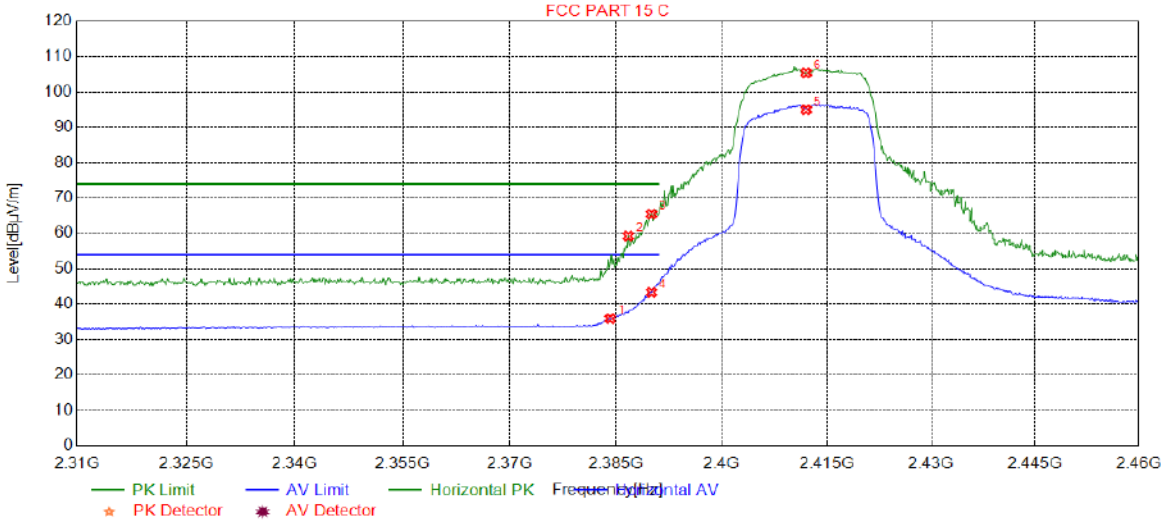
4.10.1.9 802.11N20_ Lowest Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2384.1742	35.90	7.78	54.00	18.10	184	81	Horizontal
2	2386.7267	59.26	7.77	74.00	14.74	135	101	Horizontal
3	2390.0000	65.49	7.77	74.00	8.51	233	61	Horizontal
4	2390.0000	43.36	7.77	54.00	10.64	244	77	Horizontal
5	2412.0000	94.97	7.81	0.00	-94.97	133	73	Horizontal
6	2412.0000	105.40	7.81	0.00	-105.40	154	81	Horizontal

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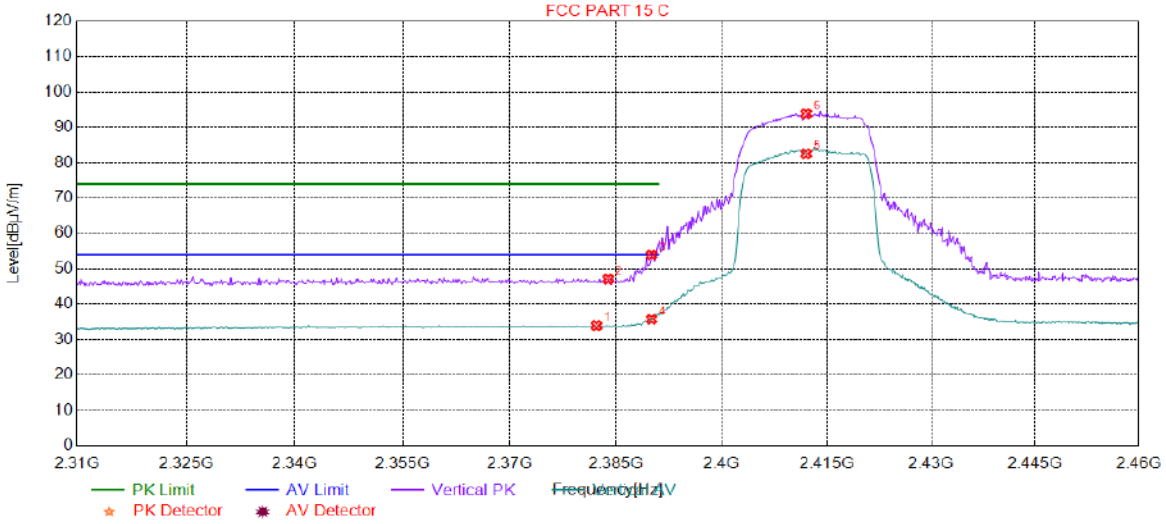
4.10.1.10 802.11N20_Lowest Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2382.2222	33.94	7.78	54.00	20.06	243	138	Vertical
2	2383.8739	47.12	7.78	74.00	26.88	270	49	Vertical
3	2390.0000	53.94	7.77	74.00	20.06	211	306	Vertical
4	2390.0000	35.72	7.77	54.00	18.28	222	118	Vertical
5	2412.0000	82.54	7.81	0.00	-82.54	153	21	Vertical
6	2412.0000	93.86	7.81	0.00	-93.86	191	21	Vertical

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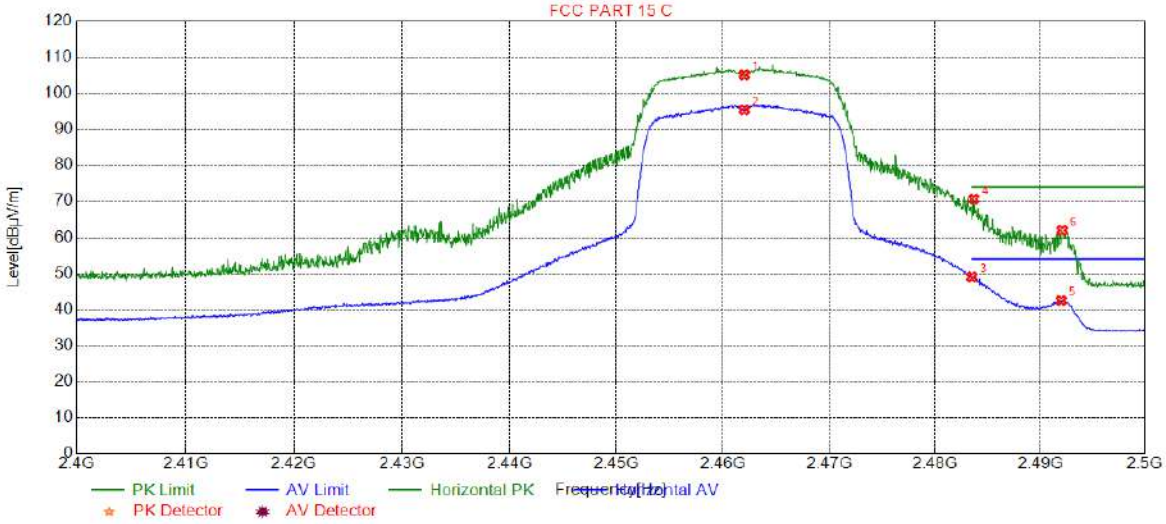
4.10.1.11 802.11N20_ Highest Channel_ Horizontal



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.0000	105.11	7.98	0.00	-105.11	114	72	Horizontal
2	2462.0000	95.40	7.98	0.00	-95.40	108	72	Horizontal
3	2483.5000	49.06	8.01	54.00	4.94	187	78	Horizontal
4	2483.6918	70.63	8.01	74.00	3.37	247	61	Horizontal
5	2491.9960	42.49	8.02	54.00	11.51	215	78	Horizontal
6	2492.0960	61.96	8.02	74.00	12.04	180	72	Horizontal

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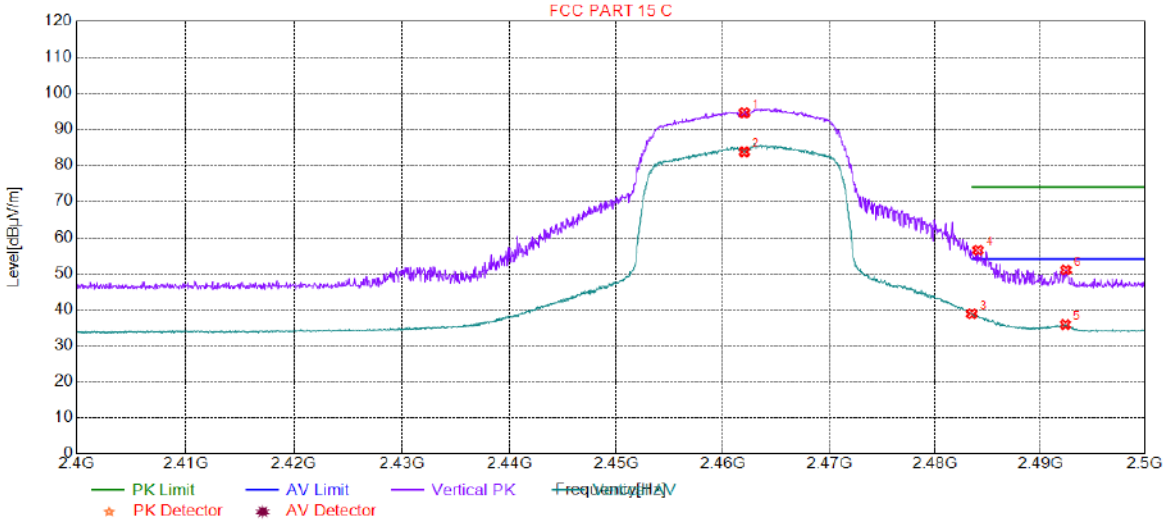
4.10.1.12 802.11N20_ Highest Channel_ Vertical



Suspected List

Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.0000	94.60	7.98	0.00	-94.60	162	258	Vertical
2	2462.0000	83.76	7.98	0.00	-83.76	254	252	Vertical
3	2483.5000	38.78	8.01	54.00	15.22	214	204	Vertical
4	2484.0920	56.45	8.01	74.00	17.55	263	165	Vertical
5	2492.3962	35.80	8.02	54.00	18.20	204	160	Vertical
6	2492.4462	50.99	8.02	74.00	23.01	186	171	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:
Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

All Modes have been tested, but only the worst case data displayed in this report.

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5 Measurement Uncertainty (95% confidence levels, k=2)

Lab A:

No.	Item	Measurement Uncertainty
1	Total RF power, conducted	±0.75dB
2	RF power density, conducted	±2.84dB
3	Spurious emissions, conducted	±0.75dB
4	Temperature test	±1°C
5	Humidity test	±3%
6	DC and low frequency voltages	±0.5%

Lab B:

No.	Item	Measurement Uncertainty
1	Conduct emission test	± 3.0dB (150kHz to 30MHz)
2	Radiated Spurious emission test	± 4.8dB (Below 1GHz)
		± 4.8dB (1GHz to 6GHz)
		± 4.5dB (6GHz to 18GHz)
		± 5.02dB (Above 18GHz)

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6 Equipment List

RF conducted test					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date (yyyy-mm-dd)	Cal.Duedate (yyyy-mm-dd)
DC Power Supply	Agilent Technologies Inc	66311B	W009-09	2019/7/15	2020/7/15
Signal Analyzer	Rohde & Schwarz	FSV	W025-05	2020/1/3	2021/1/2
Coaxial Cable	SGS	N/A	SEM031-01	2019/6/12	2020/6/11
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2019/7/14	2020/7/14
Temperature Chamber	GIANT FORCE	ICT-150-40-CP-AR	W027-03	2019/10/27	2020/10/27
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2019/7/14	2020/7/14

CE Test System					
Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
Shielding Room	Brilliant-emc	N/A	XAW03-35-01	2019-09-11	2022-09-10
Test receiver	ROHDE&SCHWARZ	ESR	XAW01-08-01	2019-09-07	2020-09-06
Artificial network	ROHDE&SCHWARZ	ENV216	XAW01-04-01	2019-07-16	2020-07-15
Temperature and humidity meter	MingGao	TH101B	XAW01-01-01	2019-11-28	2020-11-28
Measurement Software	Tonscend	TS+ CE V2.5	XAW02-05-02	NCR	NCR

RSE Test System					
Equipment	Manufacturer	Model No.	Inventory No.	Cal Date	Cal Due Date
Semi-Anechoic Chamber	Brilliant-emc	N/A	XAW03-35-01	2019-09-11	2022-09-10
MXA signal analyzer	Keysight	N9020A	XAW01-06-01	2020-04-02	2021-04-01
Test receiver	ROHDE&SCHWARZ	ESR	XAW01-08-01	2019-09-07	2020-09-06
Receiving antenna (30MHz-3GHz)	Schwarzbeck	VULB 9163	XAW01-09-01	2019-10-13	2021-10-12
Receiving antenna (1GHz~18GHz)	Schwarzbeck	BBHA 9120D	XAW01-09-02	2019-10-13	2021-10-12
Receiving antenna (15GHz~40GHz)	Schwarzbeck	BBHA 9170	XAW01-09-03	2019-10-13	2021-10-12
Directional antenna rack controller	Max-Full	MF-7802BS	XAW03-03-01	NCR	NCR
High-speed antenna rack controller	Max-Full	MF-7802	XAW03-04-01	NCR	NCR
Filter bank	Tonscend	JS0806-F	XAW03-05-01	NCR	NCR

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Filter bank	Tonscend	JS0806s	XAW03-05-02	NCR	NCR
Amplifier	Tonscend	TAP00903040	XAW01-41-01	2019-11-18	2020-11-17
Amplifier	Tonscend	TAP01018048	XAW01-41-02	2019-11-18	2020-11-17
Amplifier	Tonscend	TAP18040048	XAW01-41-03	2019-12-03	2020-12-02
Amplifier	Shanghai Steed	YX28980930	XAW01-41-06	2019-11-18	2020-11-17
Temperature and humidity meter	MingGao	TH101B	XAW01-01-01	2019-11-18	2020-11-17
Measurement Software	Tonscend	TS+ RSE V3.0.0.2	XAW02-05-01	NCR	NCR

7 Photographs - EUT Constructional Details

Refer to Appendix A - Photographs of Set-Up for ZR/2020/60019.

The End

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