FCC TEST REPORT

Application No:	ZR/202070004
Applicant:	LG Electronics USA, Inc.
Address of Applicant	111 Sylvan Avenue, North Building Englewood Cliffs, NJ 07632
Manufacturer:	Huaqin Telecom Technology Co.,Ltd.
Address of Manufacturer:	No.1 Building, No.9 Building, No.399,Keyuan Road,Zhangjiang Hi-tech Park,Shanghai,P.R.China
EUT Description:	Mobile handset
Model No.:	LM-K520EMW
Trade Mark:	LG
FCC ID:	ZNFK520EMW
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:	2020/7/2
Date of Test:	2020/7/3 to 2020/7/23
Date of Issue:	2020/7/31
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**
01		2020/7/31		Original

Authorized for issue by:				
Tested By		Mike Hu **(Mike Hu) /Project Engineer**		
Checked By		David Chen **(David Chen) /Reviewer**		

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2 Test Summary

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

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3 General Information

3.1 Client Information

Applicant:	LG Electronics USA, Inc.
Address of Applicant	111 Sylvan Avenue, North Building Englewood Cliffs, NJ 07632
Manufacturer:	Huaqin Telecom Technology Co.,Ltd.
Address of Manufacturer:	No.1 Building, No.9 Building, No.399,Keyuan Road,Zhangjiang Hi-tech Park,Shanghai,P.R.China

3.2 Test Location

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
Telephone:	+86 (0) 755 2601 2053
Fax:	+86 (0) 755 2671 0594
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3.3 Test Facility

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

• CNAS (No. CNAS L2929)

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

• 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.

• 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.

• Industry Canada (IC)

Two 3m Semi-anechoic chambers and the 10m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1, 4620C-2, 4620C-3.

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3.4 General Description of EUT

EUT Description::	Mobile handset
Model No.:	LM-K520EMW
Trade Mark:	LG
IEEE 802.11 WLAN Mode Supported	☒ 802.11B (20 MHz channel bandwidth), ☒ 802.11G (20 MHz channel bandwidth) ☒ 802.11N (20 MHz channel bandwidth), ☐ 802.11N (40 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:	-5.56dBi
Power Supply	☒ AC/DC Adapter; ☒ Battery ☐ PoE:; ☐ Other:

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	12	2467MHz
13	2472MHz						

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:

Channel	Frequency for 802.11B/G/N (HT20)
CH 1	2412MHz
CH 6	2437MHz
CH 11	2462MHz

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CH 12	2467MHz
CH 13	2472MHz

3.5 Test 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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3.7 MCC Country code detection mechanism specification

Network mode	Description
No country code received	The device only operates with the default country code. (12 /13 channels enable)
Invalid country code received	The device can't get invalid country code. If the network is connected, the country code is set in US. (12/13 channels in low power mode) Otherwise, if the network is not connected, the device oper ates with the default country code. (12/13 channels enable)
US country code	If the network is connected, the country code is set in US. (12/13 channels in low power mode) Otherwise, if the network is not connected, the device oper ates with the default country code. (12/13 channels enable)
US territories country code (Guam, Puerto Rico)	If the network is connected, the country code is set accordi ng to the network service. Otherwise, if the network is not connected, the device oper ates with the default country code. (12/13 channels enable)
Airplane mode	The device only operates with the default county code. (12/ 13 channels enable)
On loss of non- US country code (drop the link any verify device returns to default state)	The device only operates with the default county code. (12/ 13 channels enable)

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Remark:

1.Channel 12 and 13 are enable in default mode for this device.Channel 12 and 13 use lower target power.

2.The device always use country code as geo-location information and it is determined only when the device is attached to 2G/3G/LTE network.Additionally,in case of the invalid country code, Wi-Fi driver will revert to the NV Binary code in which channels 1-13 are enabled.Therefore there will be no problem with those scenarios.

3.The device always use the country code as location information and it periodically checks the information in a few seconds until the device is attached to 2G/3G/LTE network.For the multiple cell network environment with different MCC codes, there will be network roam search with intervals below and the device will get the updated country code when the device is attached to the different network.

-2G/3G/LTE network:Every 2 seconds

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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 -5.56dBi.	

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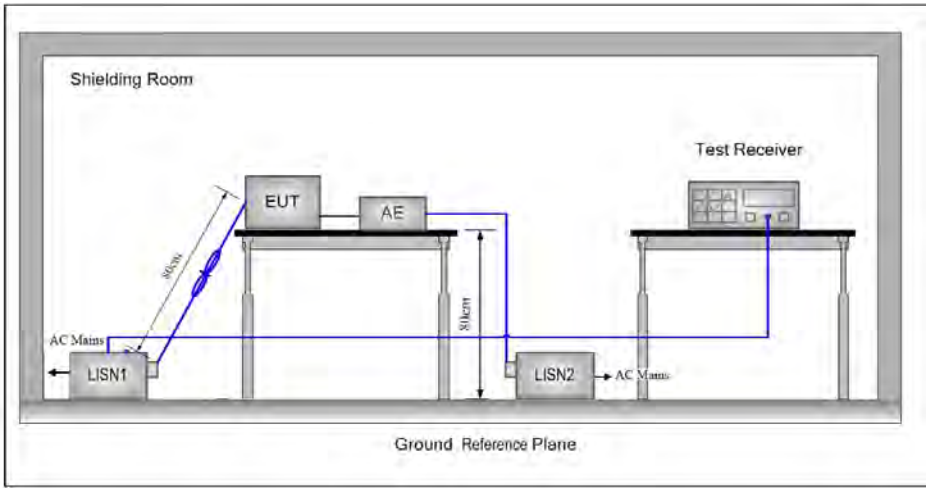
Test Setup:	
Exploratory Test Mode:	Transmitting with all kind of modulations, data rates at lowest, middle and highest channel. Charge + Transmitting mode.
Final Test Mode:	Through Pre-scan, find the 1Mbps of rate of 802.11B at lowest channel is the worst case. Charge + Transmitting mode. Only the worst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

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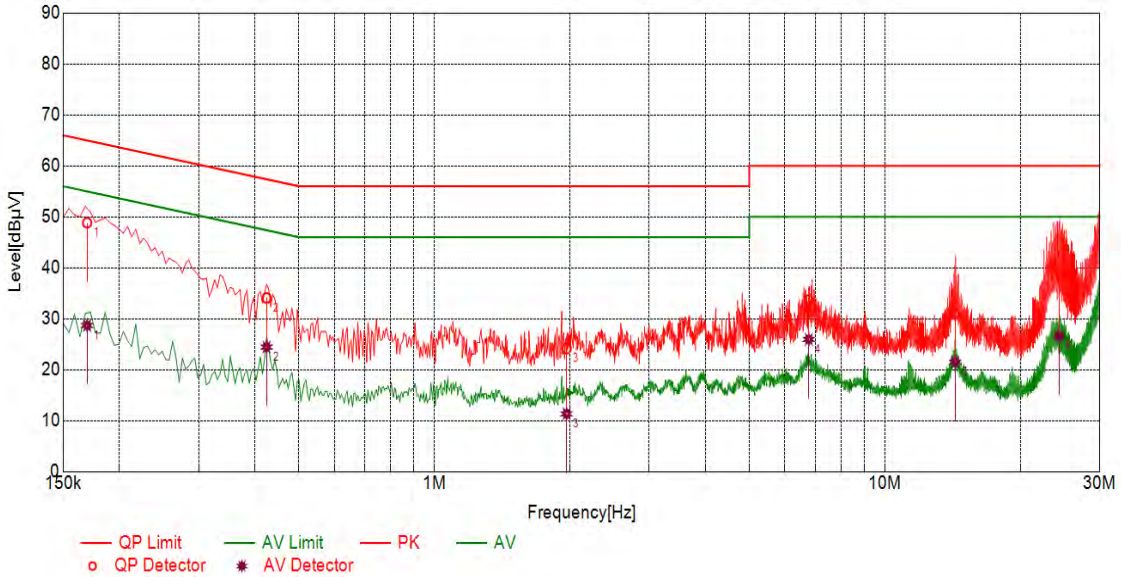
Measurement Data

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	0.1696	10.10	48.83	64.98	16.15	28.68	54.98	26.30	L
2	0.4244	10.10	34.08	57.36	23.28	24.44	47.36	22.92	L
3	1.9660	10.10	24.14	56.00	31.86	11.34	46.00	34.66	L
4	6.7800	10.10	33.68	60.00	26.32	25.95	50.00	24.05	L
5	14.3251	10.11	30.89	60.00	29.11	21.48	50.00	28.52	L
6	24.3634	10.11	39.33	60.00	20.67	26.63	50.00	23.37	L

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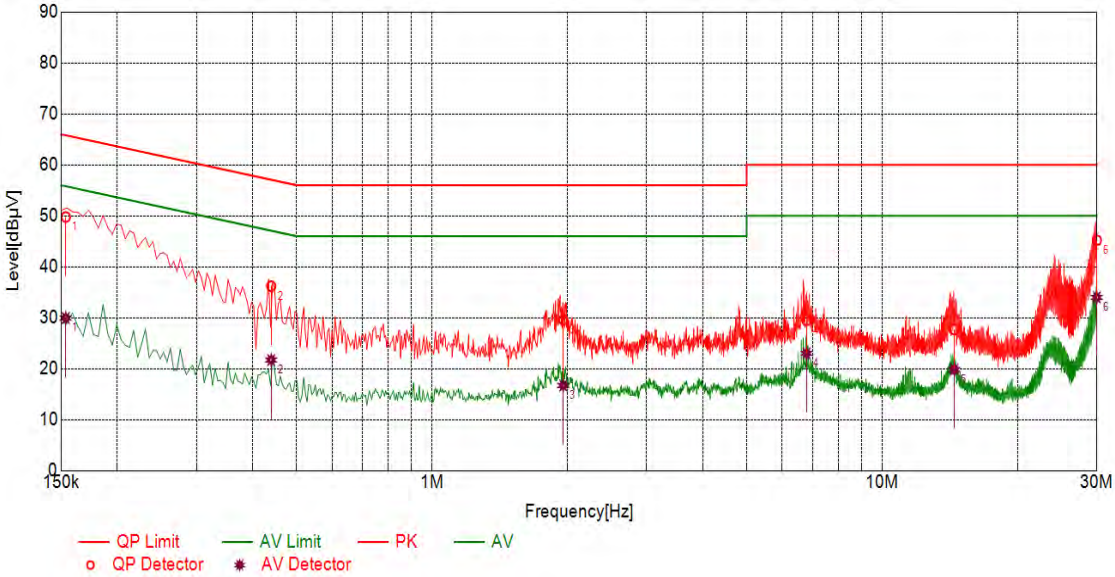
Neutral Line:



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	0.1537	10.10	49.77	65.80	16.03	29.94	55.80	25.86	N
2	0.4395	10.10	36.20	57.07	20.87	21.70	47.07	25.37	N
3	1.9573	10.10	29.61	56.00	26.39	16.71	46.00	29.29	N
4	6.7943	10.10	29.48	60.00	30.52	23.00	50.00	27.00	N
5	14.4754	10.11	27.69	60.00	32.31	19.83	50.00	30.17	N
6	29.9946	10.11	45.22	60.00	14.78	33.99	50.00	16.01	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

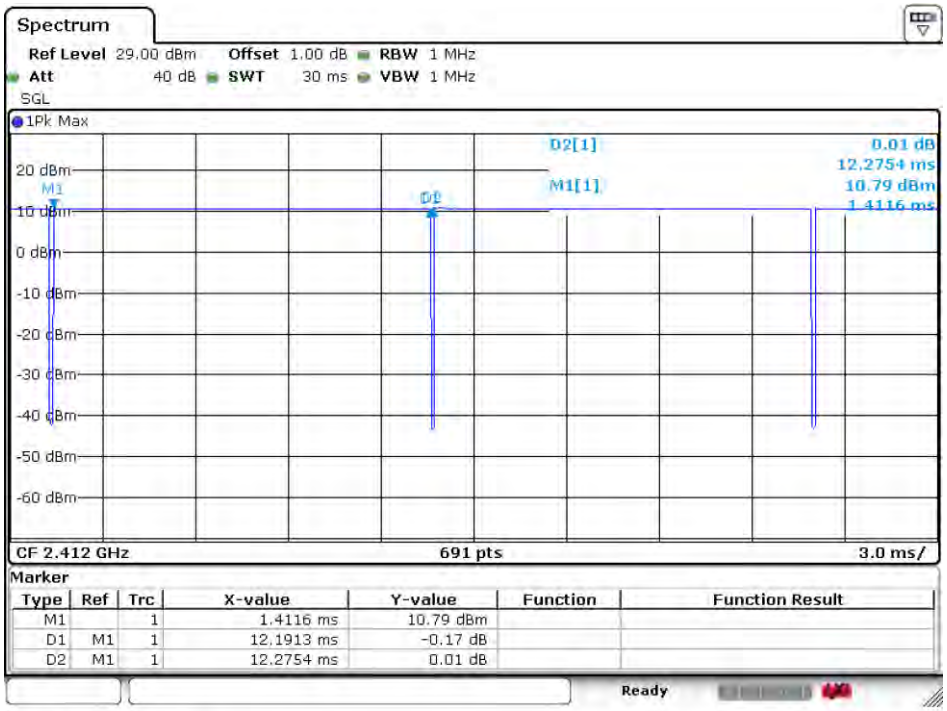
4.3.1 Test Results

Test Mode	TX Freq. [MHz]	Duty cycle [%]
11B	Ant 1: CH1,CH6,CH11	99.31
11G	Ant 1: CH1,CH6,CH11	95.53
11N20	Ant 1: CH1,CH6,CH11	95.22

4.3.1 Test Plots

4.3.1.1 ANT1

4.3.1.1.1 11B



Date: 7.JUL.2020 03:29:00

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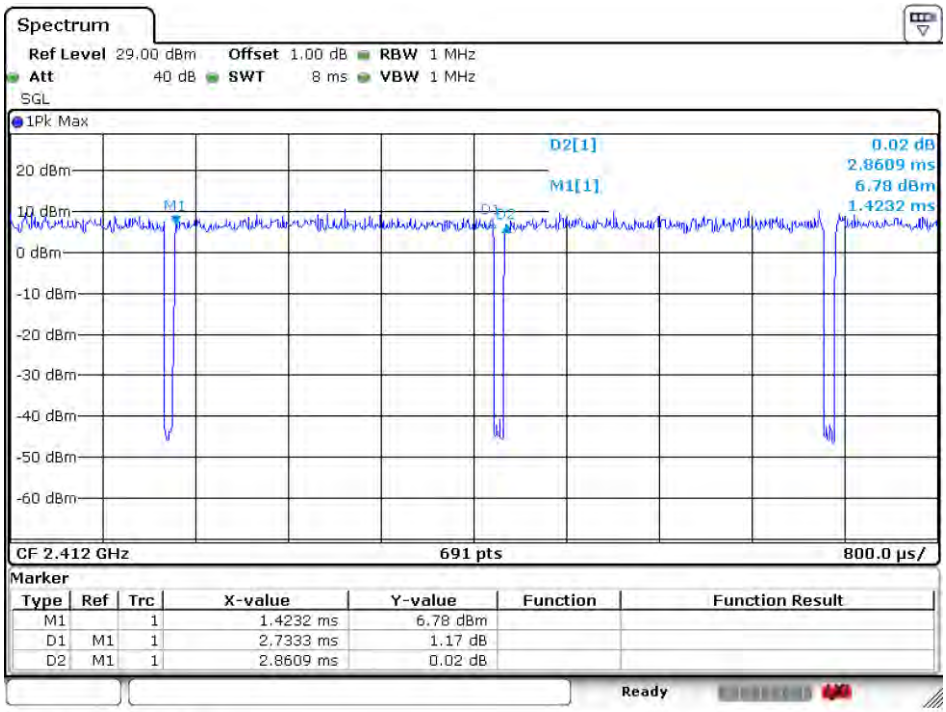
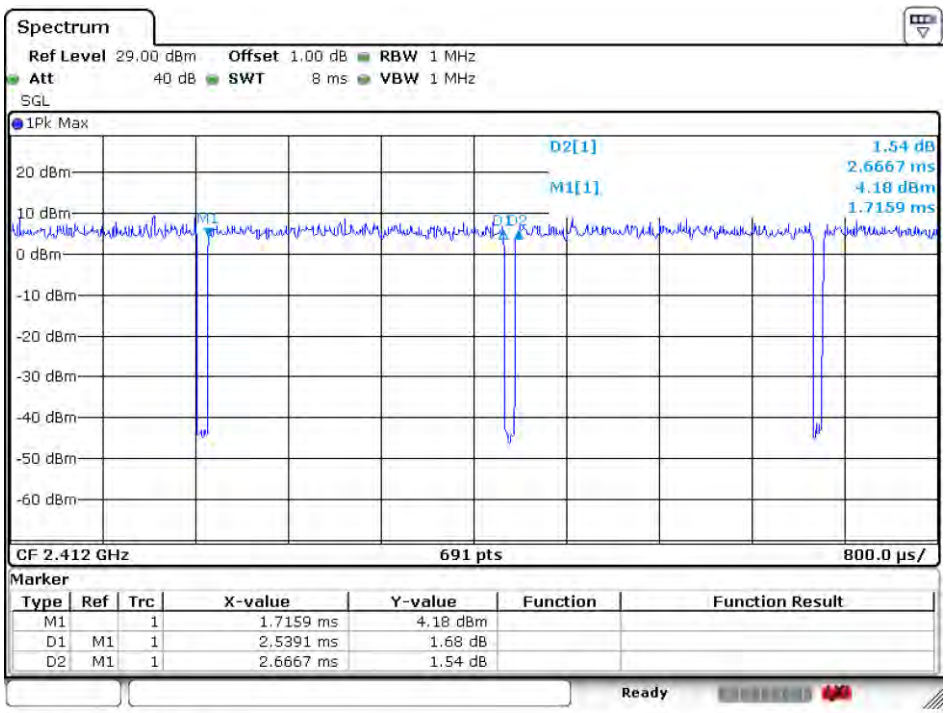
4.3.1.1.2 11G



Date: 7.JUL.2020 03:29:45

4.3.1.1.3 11N20



Date: 7.JUL.2020 03:27:56

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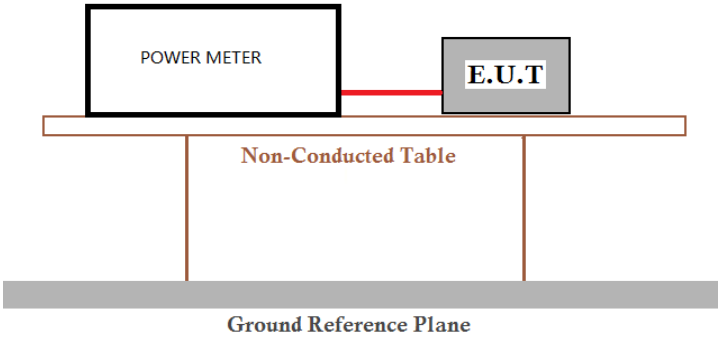
4.4 Conducted Output Power

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);
Limit:	30dBm
Test Results:	Pass

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4.4.1 Test Results

Measurement Data of Peak Power:

Mode	Test Channel	Peak Output Power (dBm)	Limit (dBm)	Result
802.11B	CH1	16.96	30.00	Pass
	CH6	17.90	30.00	Pass
	CH11	17.16	30.00	Pass
	CH12	6.34	30.00	Pass
	CH13	6.00	30.00	Pass
802.11G	CH1	14.69	30.00	Pass
	CH6	15.74	30.00	Pass
	CH11	15.06	30.00	Pass
	CH12	5.90	30.00	Pass
	CH13	5.56	30.00	Pass
802.11N20	CH1	13.77	30.00	Pass
	CH6	14.75	30.00	Pass
	CH11	14.02	30.00	Pass
	CH12	5.83	30.00	Pass
	CH13	5.74	30.00	Pass

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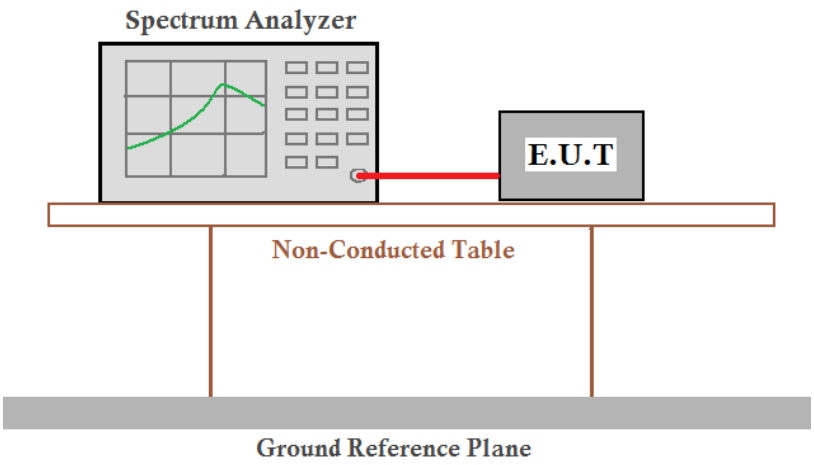
4.5 DTS (6 dB) Bandwidth & 99% Occupied Bandwidth

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);
Limit:	≥ 500 kHz
Test Results:	Pass

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4.5.1 Test Results

Mode	Test Channel	Occupied Bandwidth (MHz)	6dB Emission Bandwidth (MHz)	Limit (kHz)	Result
802.11B	CH1	12.81	9.03	≥500	Pass
	CH6	12.85	9.03	≥500	Pass
	CH11	12.85	8.99	≥500	Pass
	CH12	12.68	8.55	≥500	Pass
	CH13	13.20	8.59	≥500	Pass
802.11G	CH1	16.80	16.06	≥500	Pass
	CH6	16.93	15.72	≥500	Pass
	CH11	16.67	16.06	≥500	Pass
	CH12	17.06	16.41	≥500	Pass
	CH13	17.37	16.45	≥500	Pass
802.11N20	CH1	17.80	16.32	≥500	Pass
	CH6	17.93	16.37	≥500	Pass
	CH11	17.76	16.63	≥500	Pass
	CH12	18.06	17.63	≥500	Pass
	CH13	18.28	17.67	≥500	Pass

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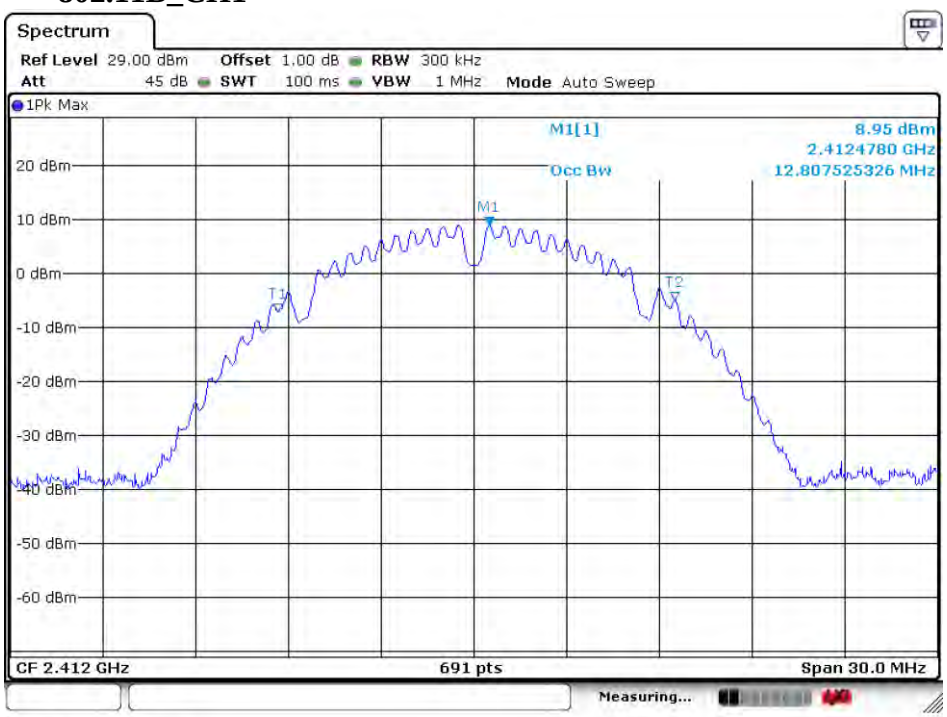
4.5.2 Test plots

4.5.2.1 802.11B_CH1



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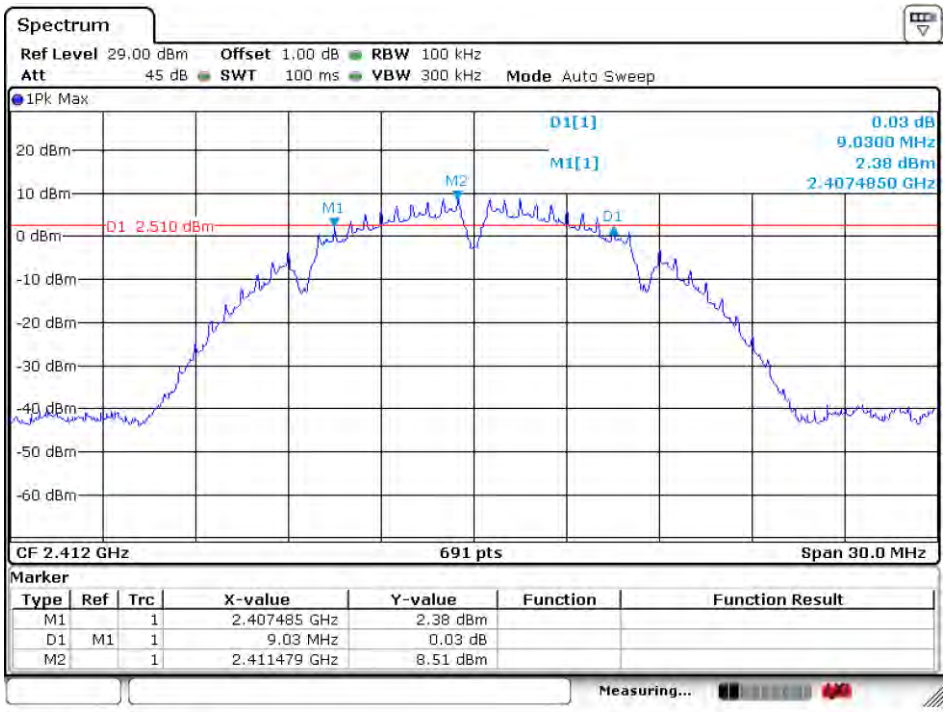

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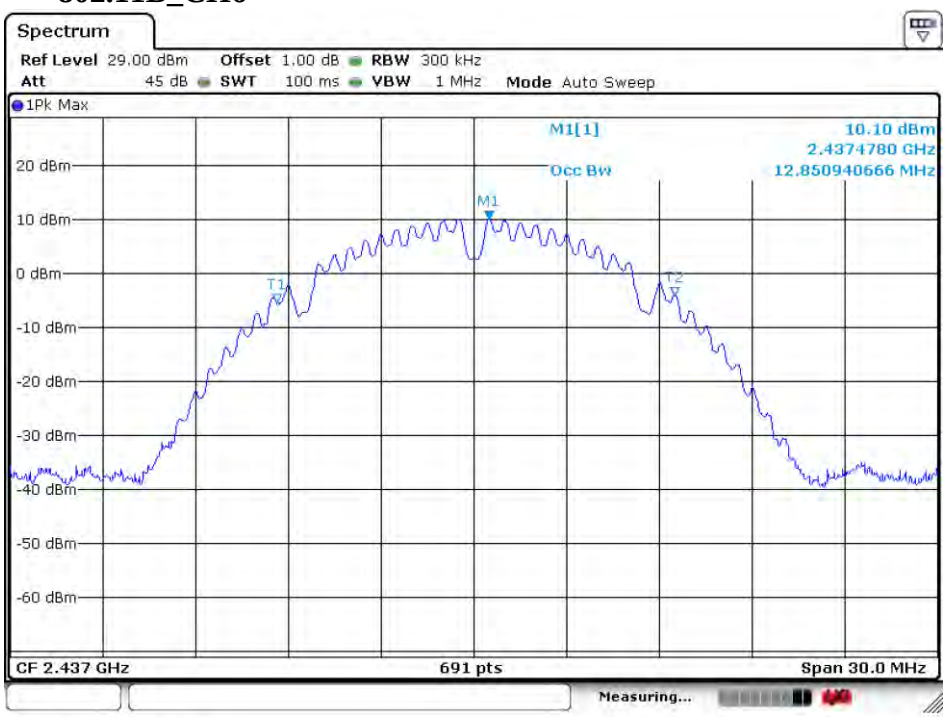
4.5.2.2 802.11B_CH6



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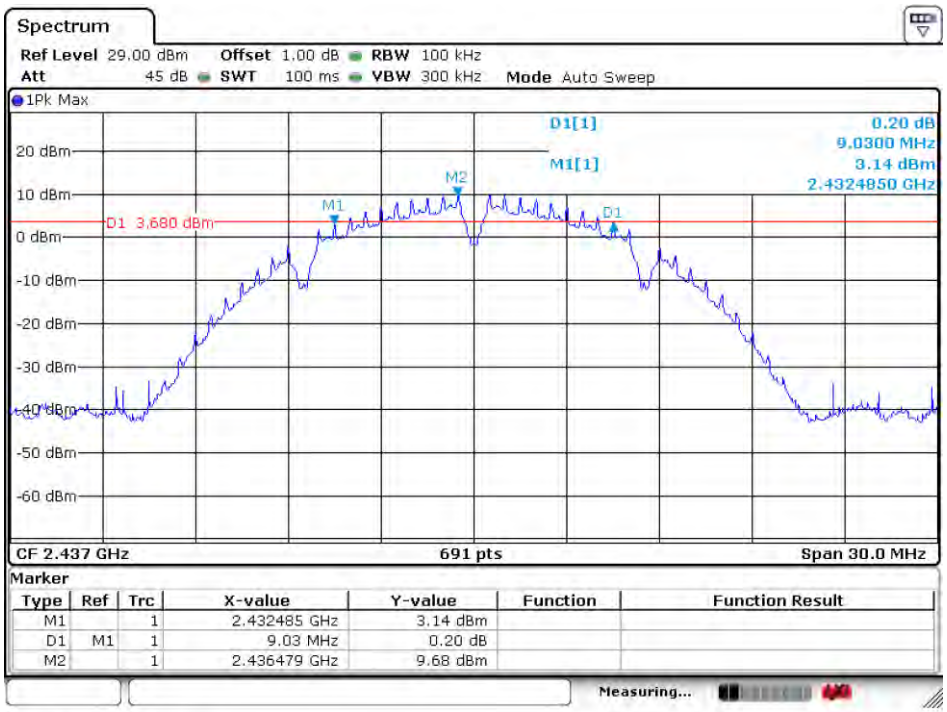

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.432485 GHz	3.14 dBm		
D1	M1	1	9.03 MHz	0.20 dB		
M2		1	2.436479 GHz	9.68 dBm		

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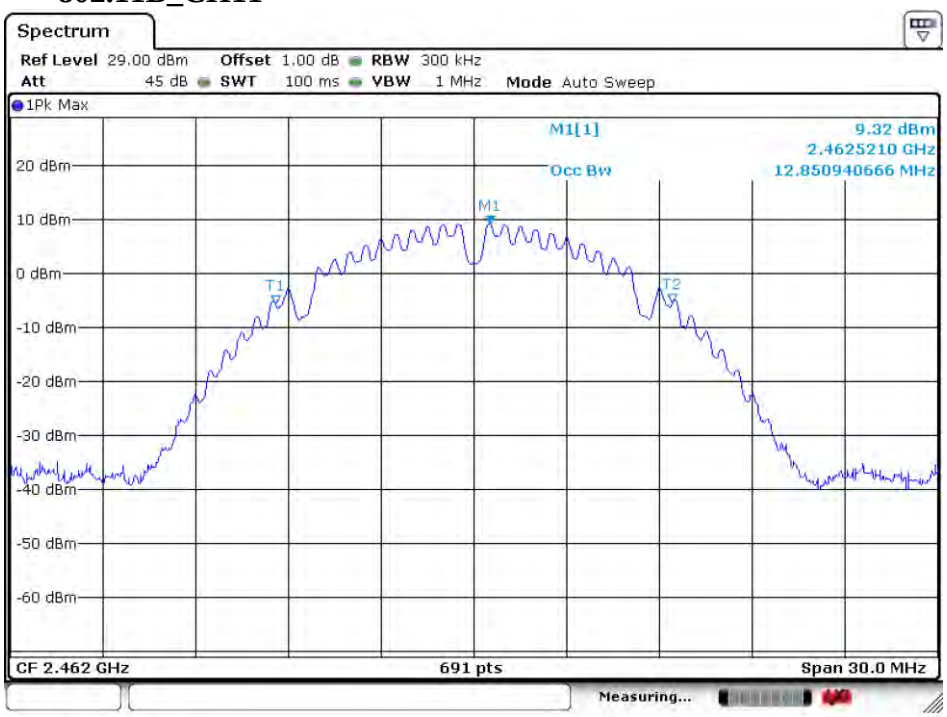
4.5.2.3 802.11B_CH11



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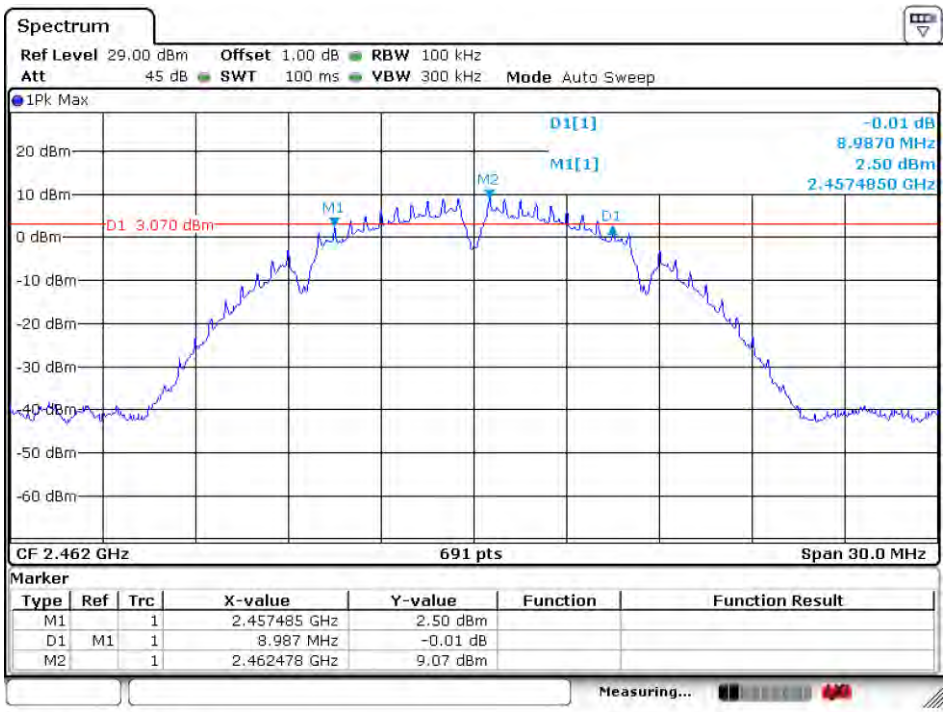

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.457485 GHz	2.50 dBm		
D1	M1	1	8.987 MHz	-0.01 dB		
M2		1	2.462478 GHz	9.07 dBm		

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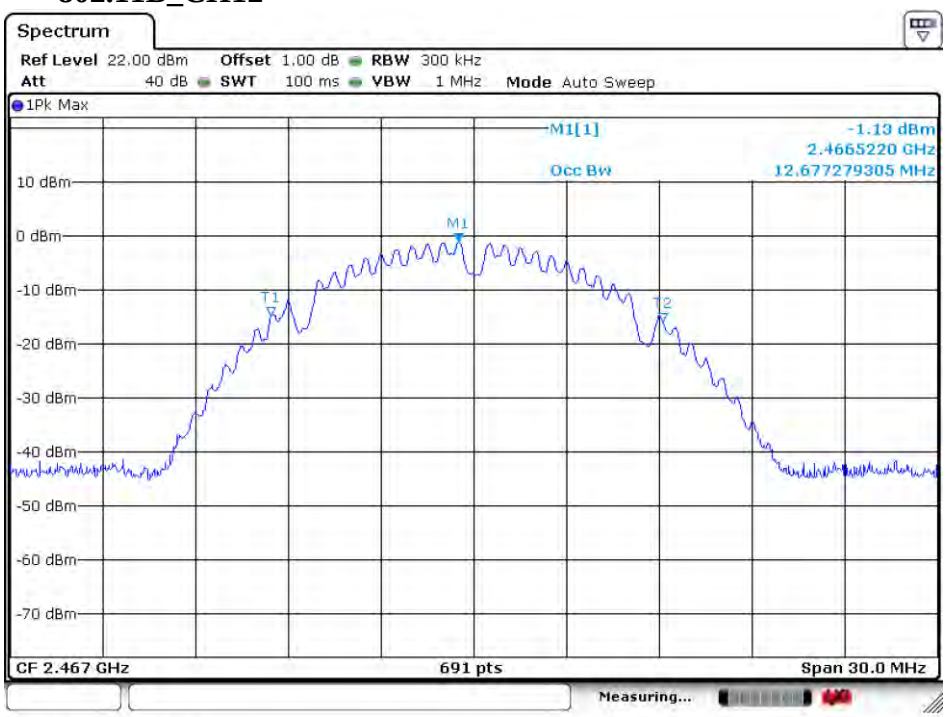
4.5.2.4 802.11B_CH12



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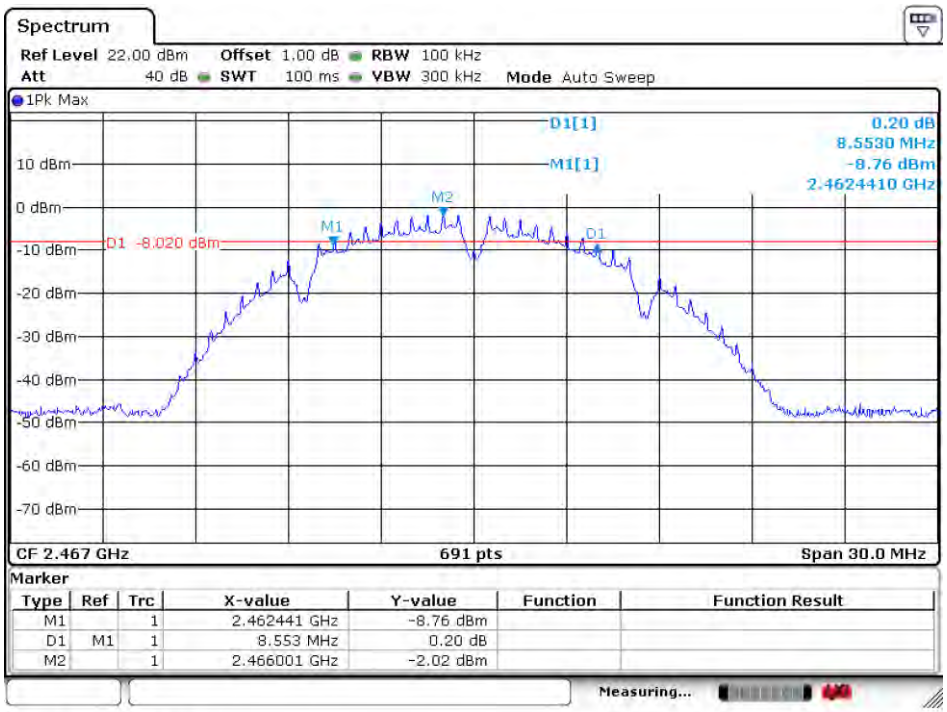

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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.462441 GHz	-8.76 dBm		
D1	M1	1	8.553 MHz	0.20 dB		
M2		1	2.466001 GHz	-2.02 dBm		

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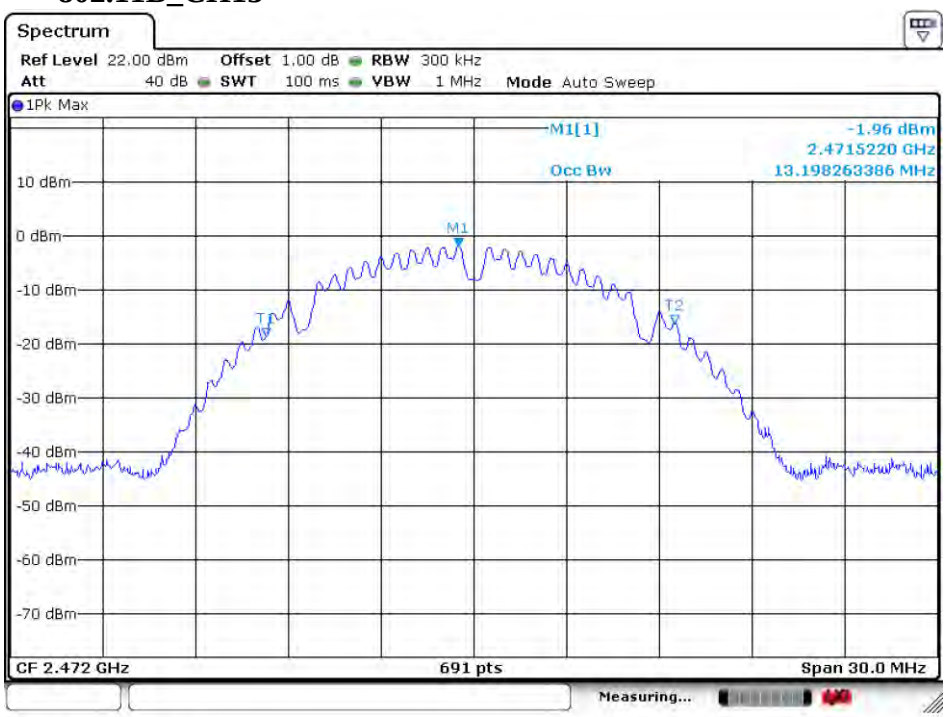
4.5.2.5 802.11B_CH13



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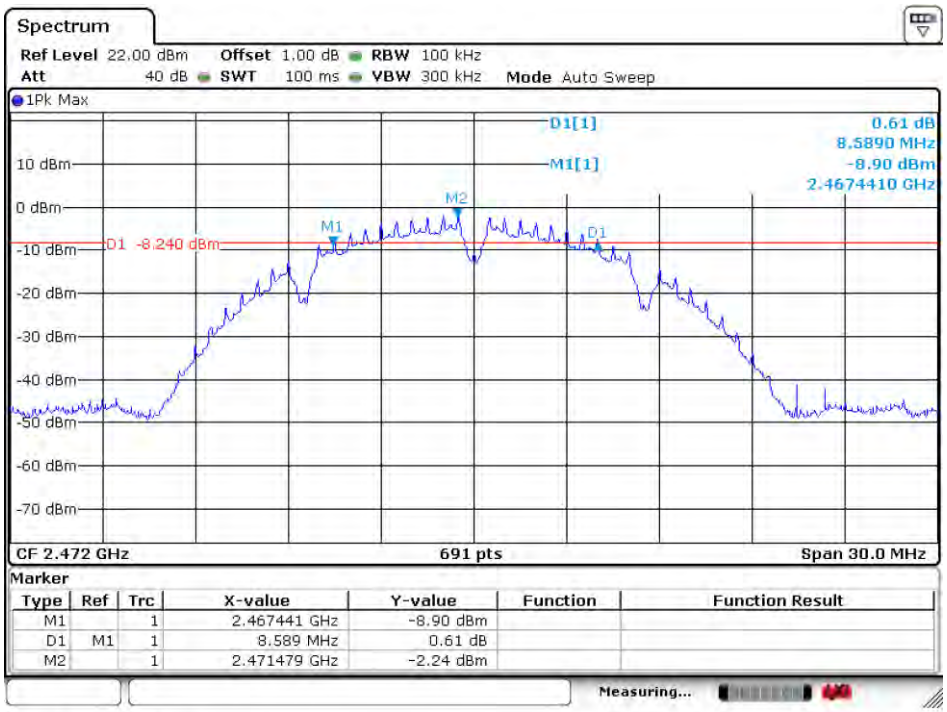

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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.467441 GHz	-8.90 dBm		
D1	M1	1	8.589 MHz	0.61 dB		
M2		1	2.471479 GHz	-2.24 dBm		

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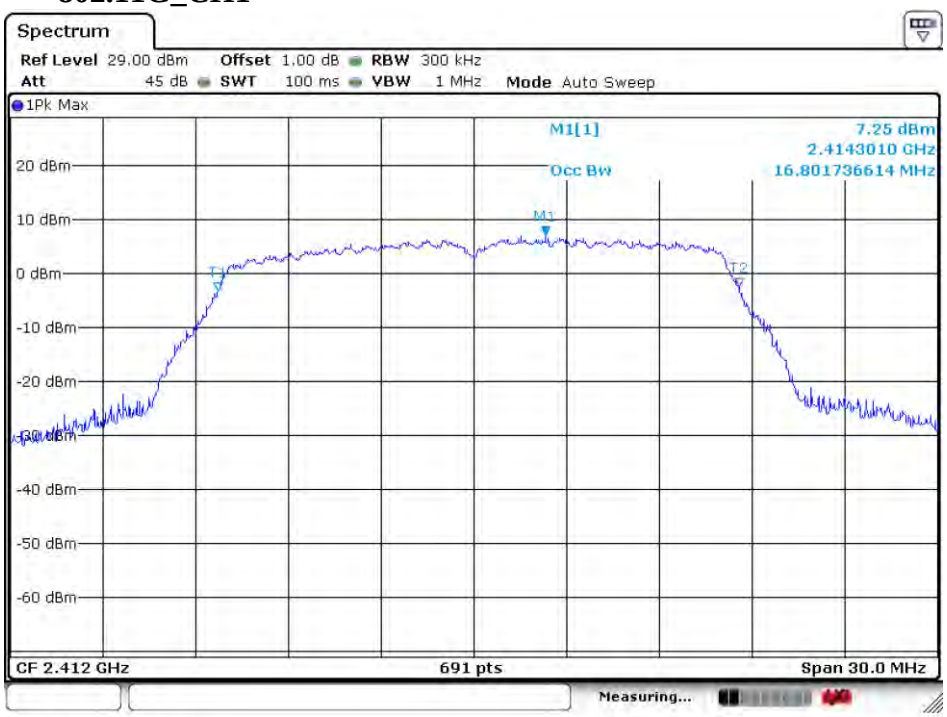
4.5.2.6 802.11G_CH1



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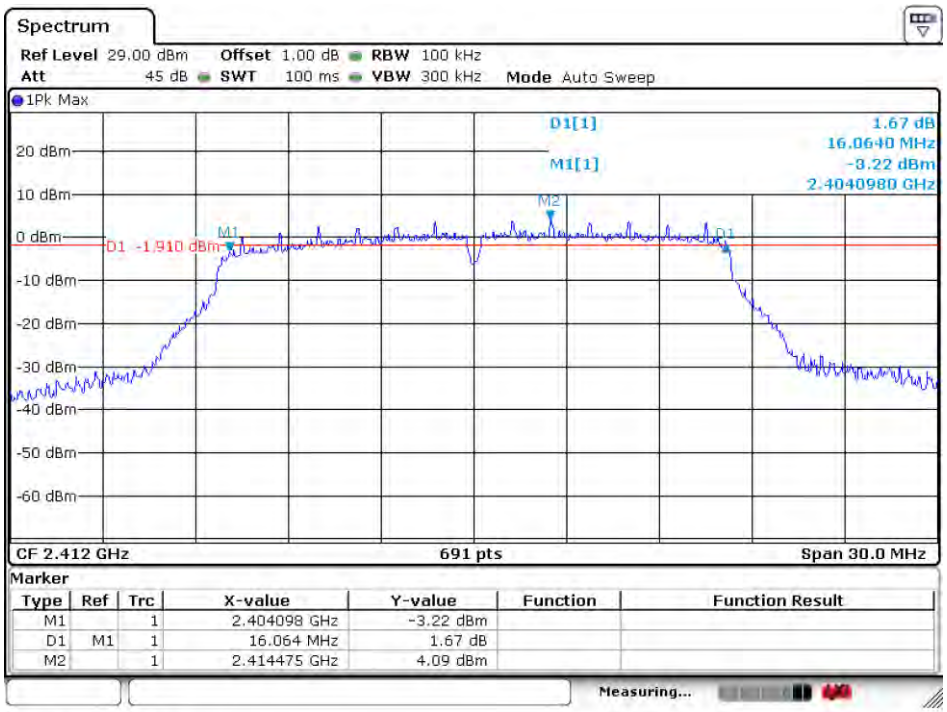

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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.404098 GHz	-3.22 dBm		
D1	M1	1	16.064 MHz	1.67 dB		
M2		1	2.414475 GHz	4.09 dBm		

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4.5.2.7 802.11G_CH6

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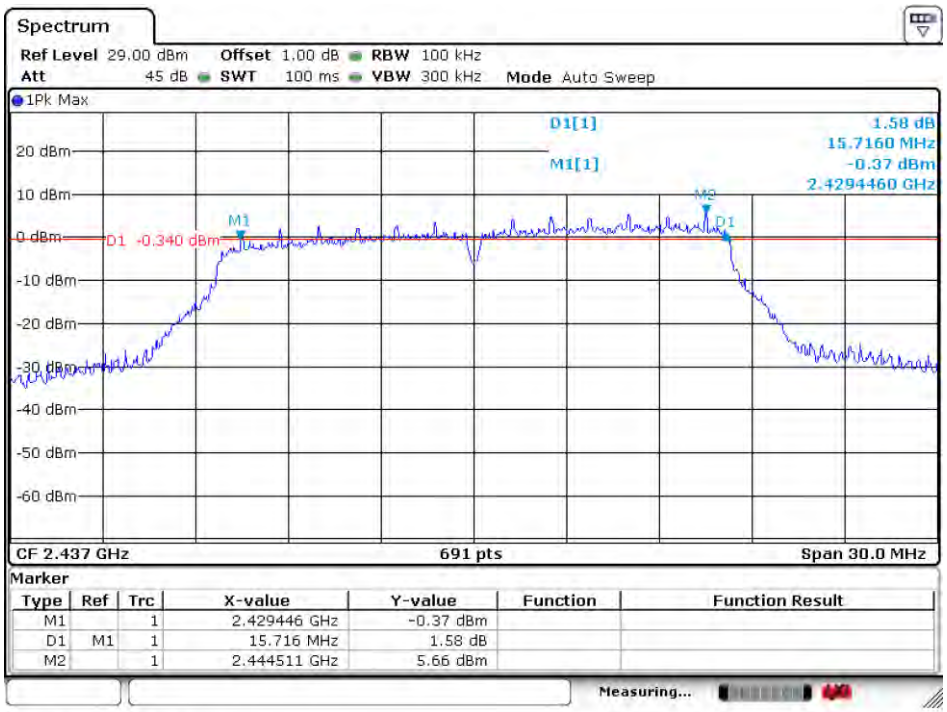

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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.429446 GHz	-0.37 dBm		
D1	M1	1	15.716 MHz	1.58 dB		
M2		1	2.444511 GHz	5.66 dBm		

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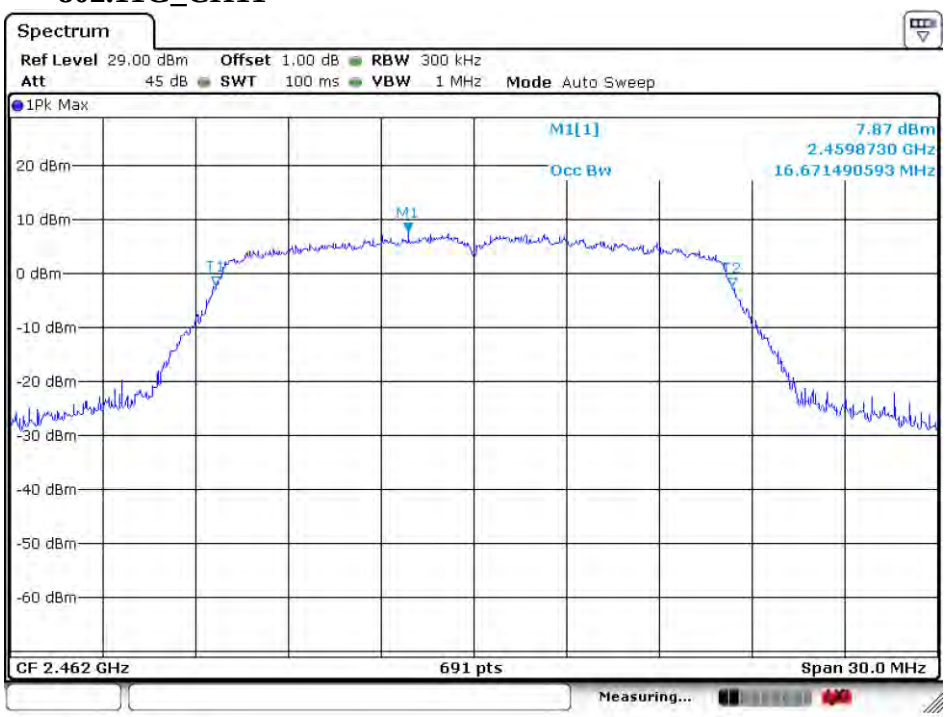
4.5.2.8 802.11G_CH11



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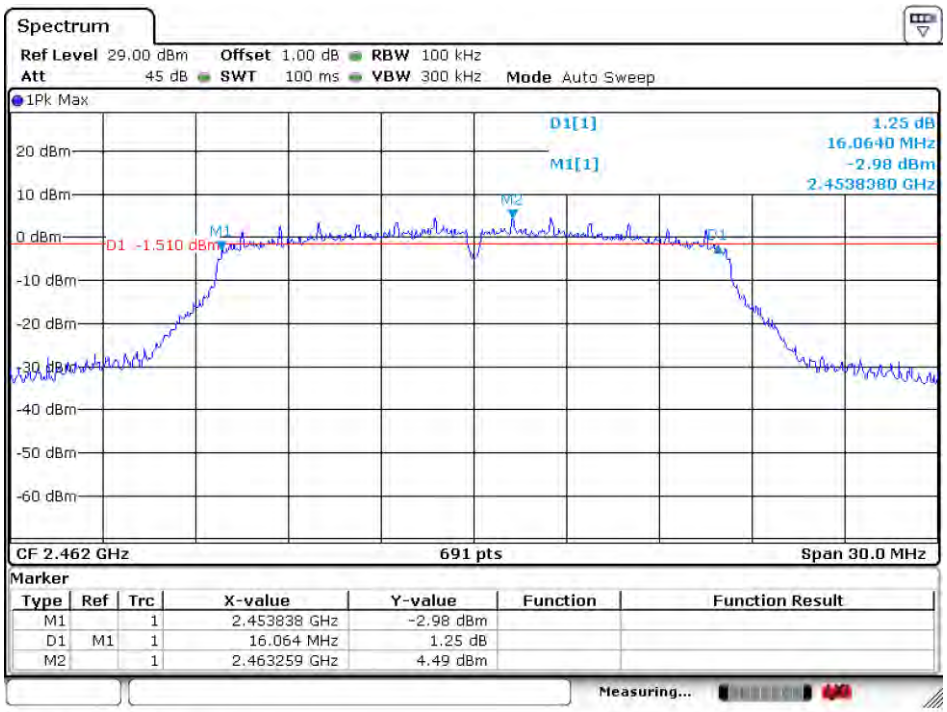

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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.453838 GHz	-2.98 dBm		
D1	M1	1	16.064 MHz	1.25 dB		
M2		1	2.463259 GHz	4.49 dBm		

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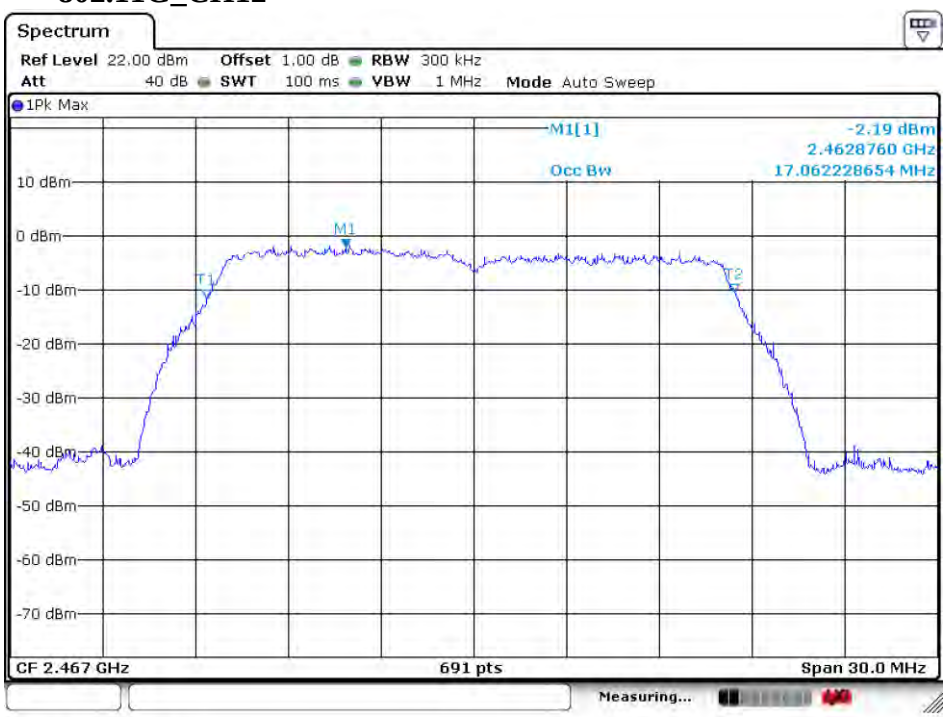
4.5.2.9 802.11G_CH12



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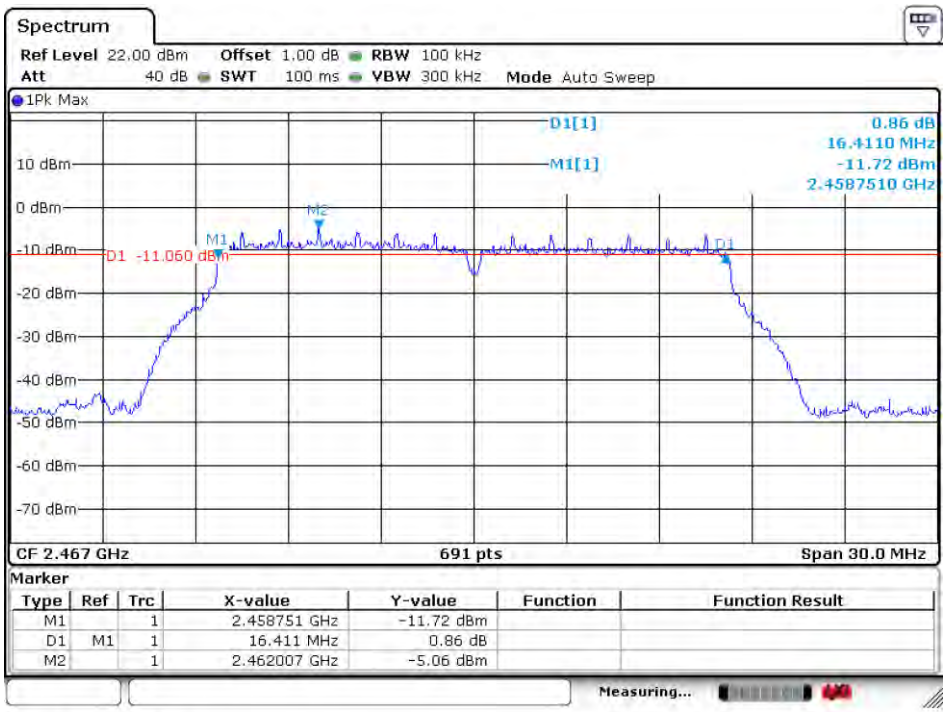

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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.458751 GHz	-11.72 dBm		
D1	M1	1	16.411 MHz	0.86 dB		
M2		1	2.462007 GHz	-5.06 dBm		

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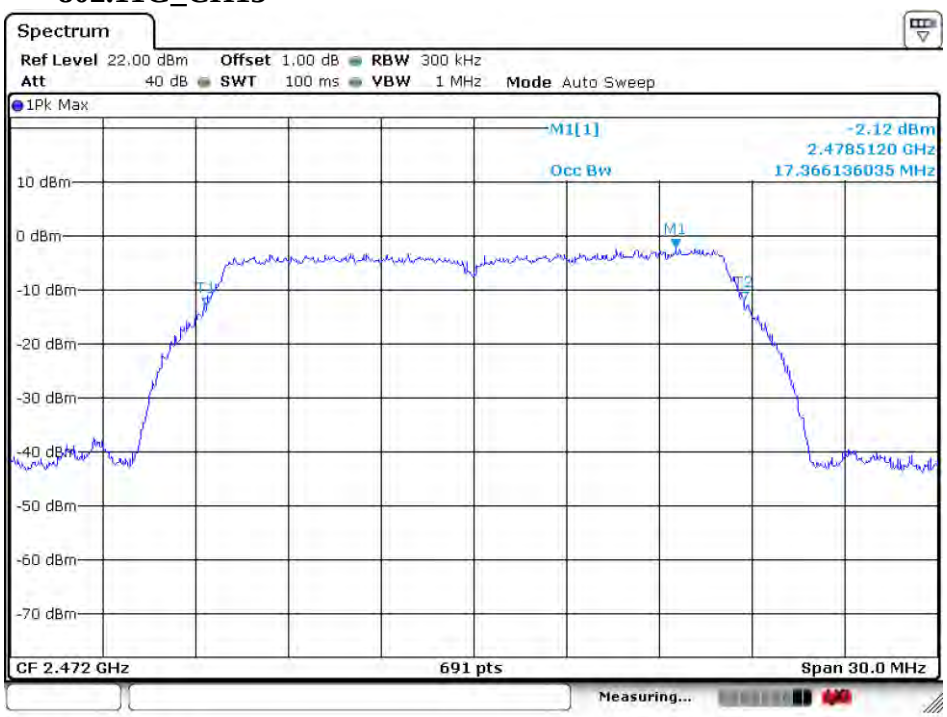
4.5.2.10 802.11G_CH13



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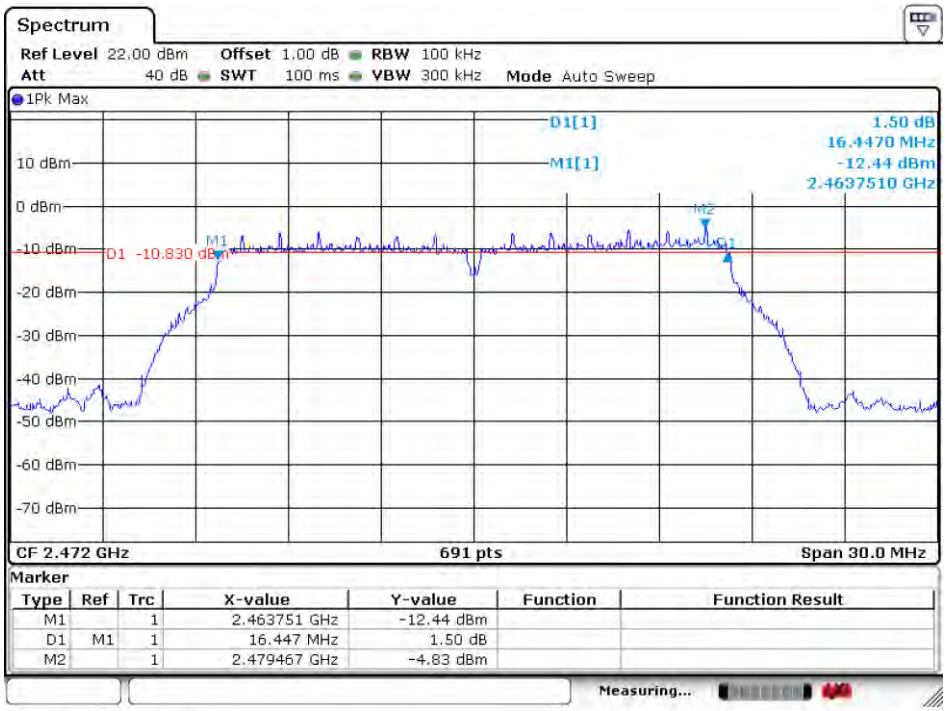

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.463751 GHz	-12.44 dBm		
D1	M1	1	16.447 MHz	1.50 dB		
M2		1	2.479467 GHz	-4.83 dBm		

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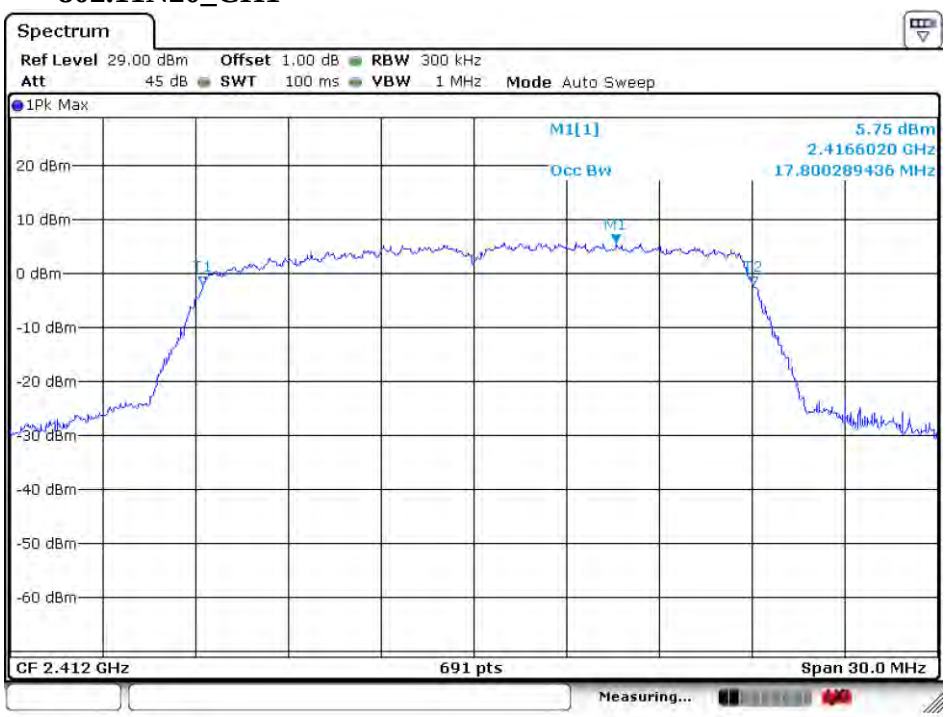
4.5.2.11 802.11N20_CH1



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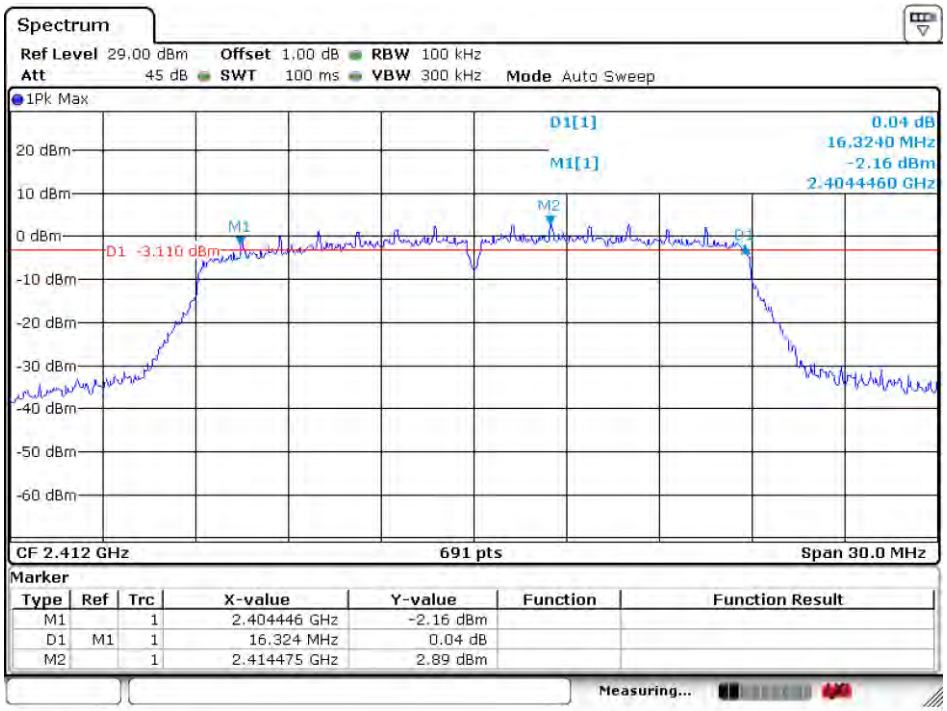

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.404446 GHz	-2.16 dBm		
D1	M1	1	16.324 MHz	0.04 dB		
M2		1	2.414475 GHz	2.89 dBm		

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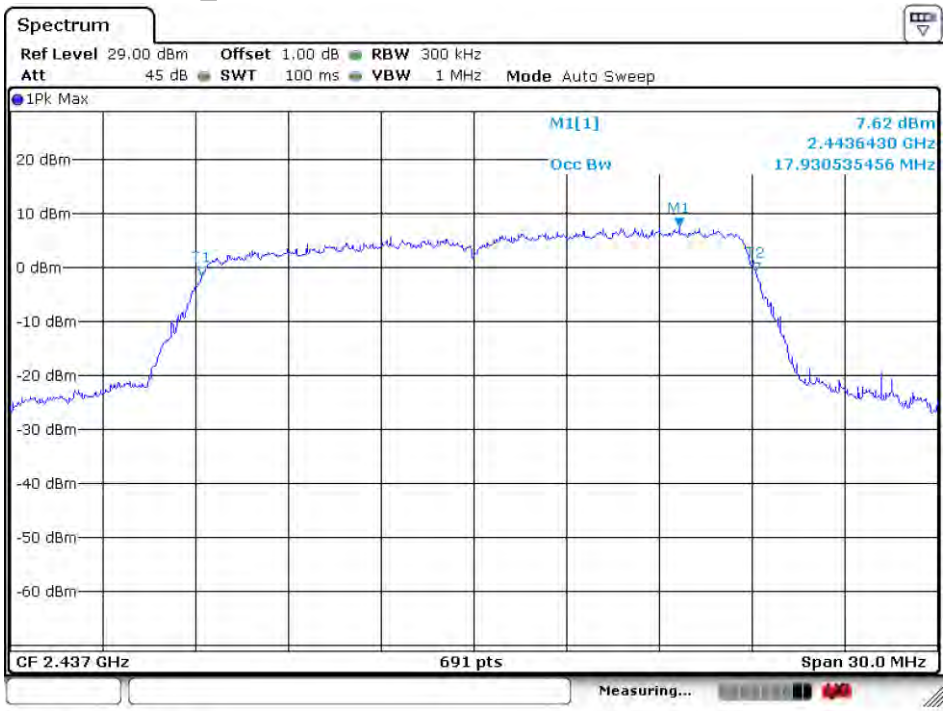
4.5.2.12 802.11N20_CH6



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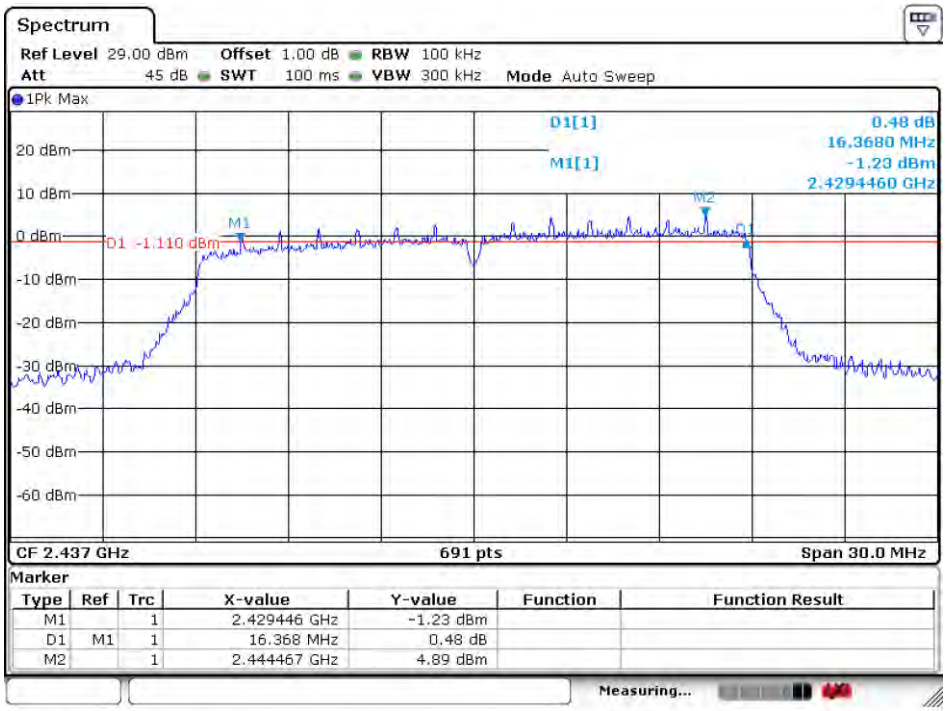

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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.429446 GHz	-1.23 dBm		
D1	M1	1	16.368 MHz	0.48 dB		
M2		1	2.444467 GHz	4.89 dBm		

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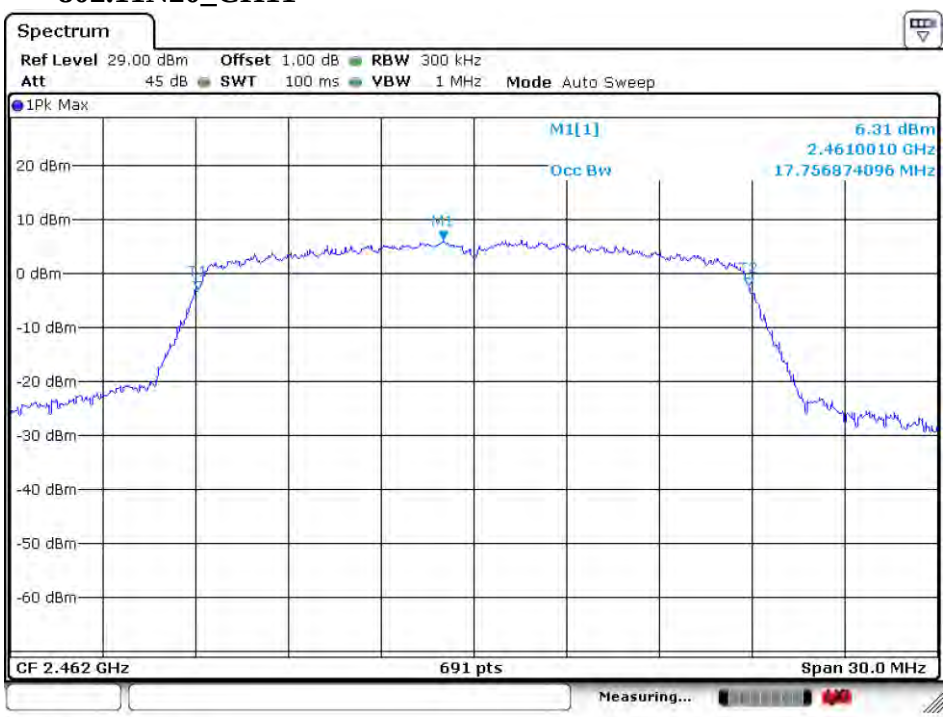
4.5.2.13 802.11N20_CH11



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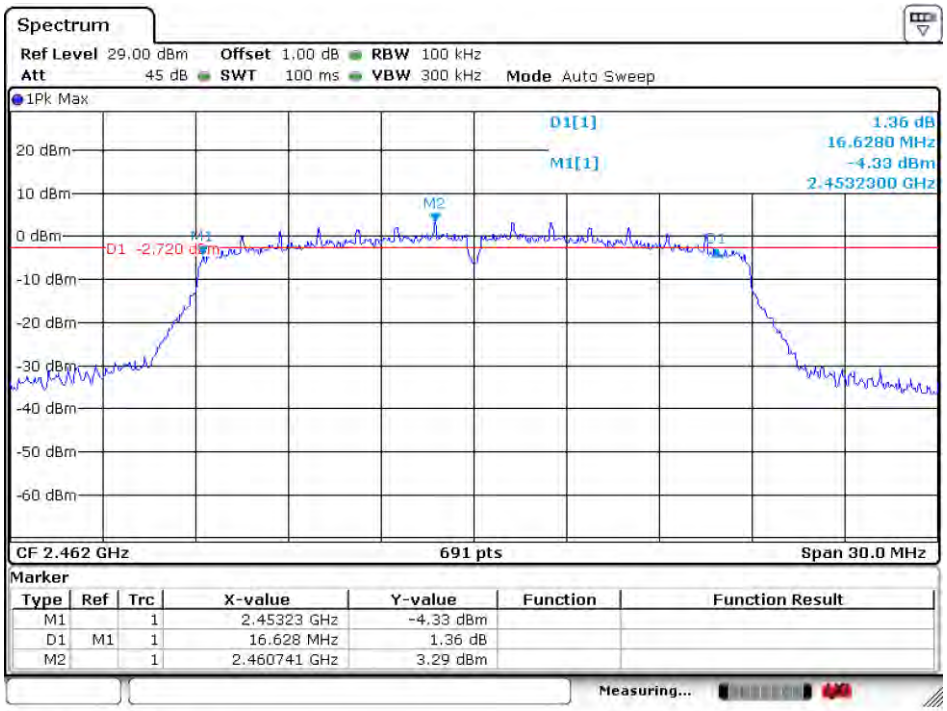

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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.45323 GHz	-4.33 dBm		
D1	M1	1	16.628 MHz	1.36 dB		
M2		1	2.460741 GHz	3.29 dBm		

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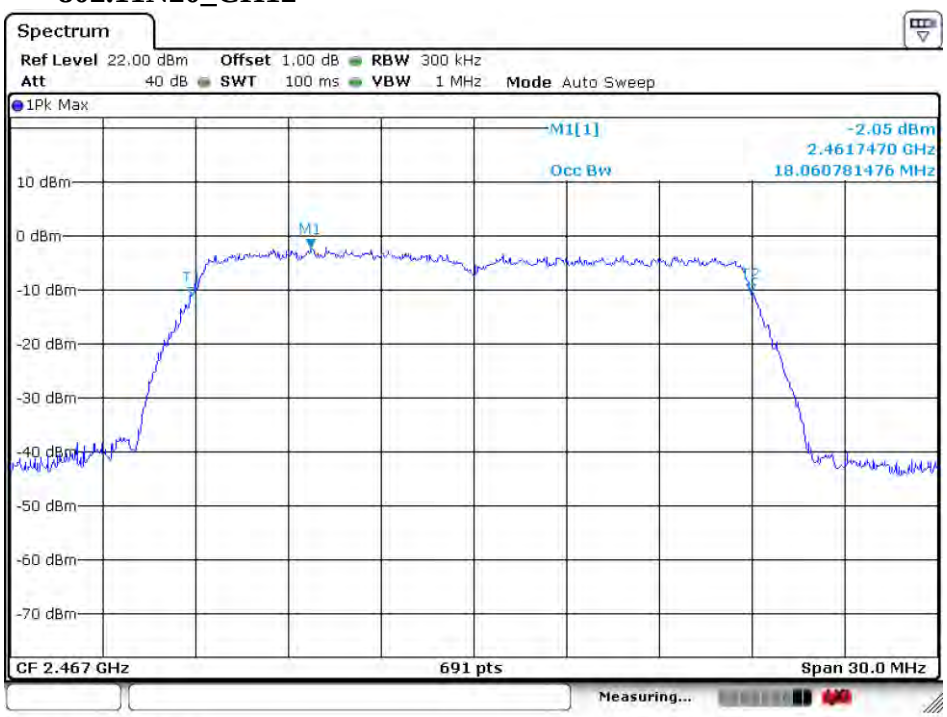
4.5.2.14 802.11N20_CH12



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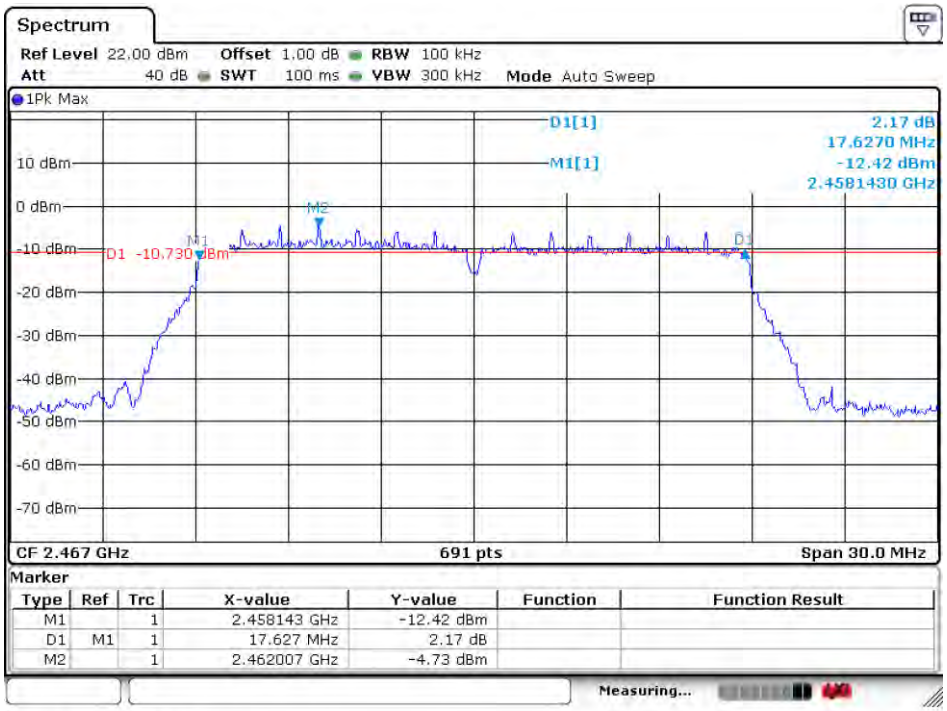

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Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.458143 GHz	-12.42 dBm		
D1	M1	1	17.627 MHz	2.17 dB		
M2		1	2.462007 GHz	-4.73 dBm		

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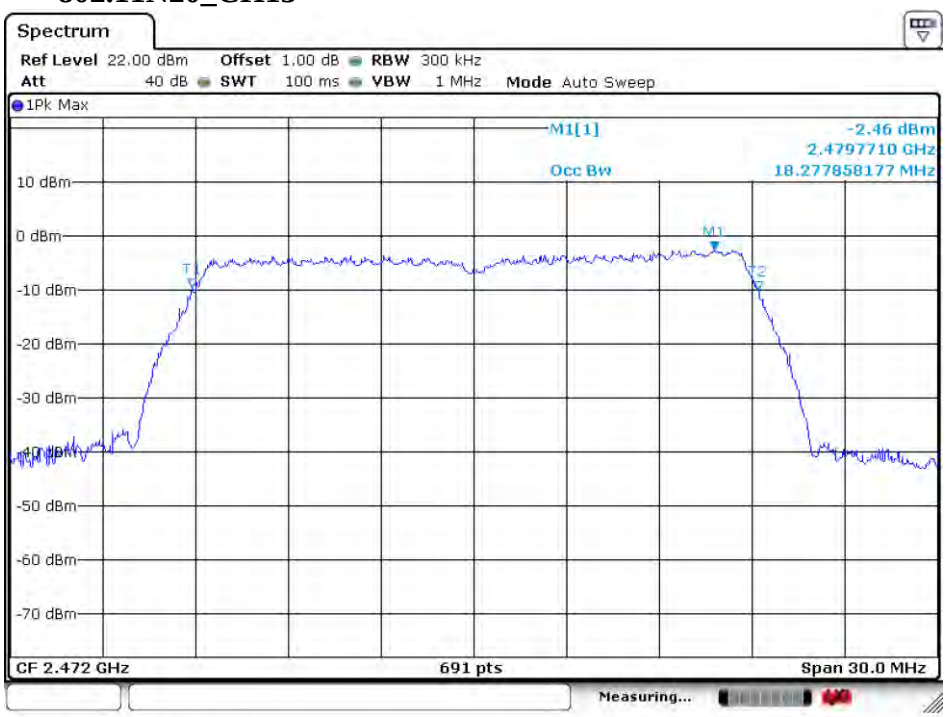
4.5.2.15 802.11N20_CH13



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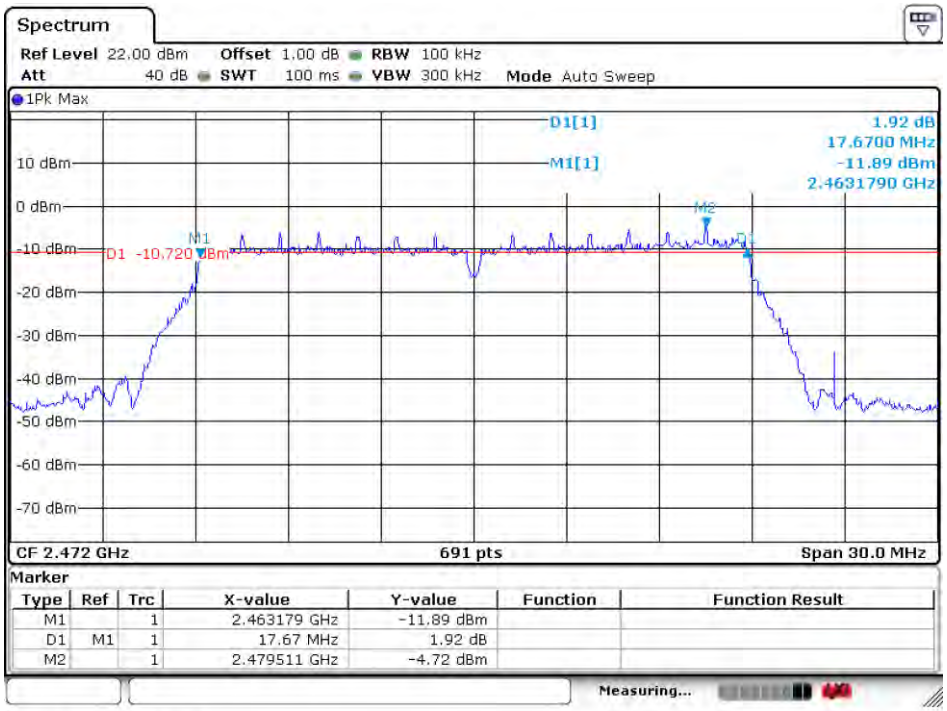

Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.463179 GHz	-11.89 dBm		
D1	M1	1	17.67 MHz	1.92 dB		
M2		1	2.479511 GHz	-4.72 dBm		

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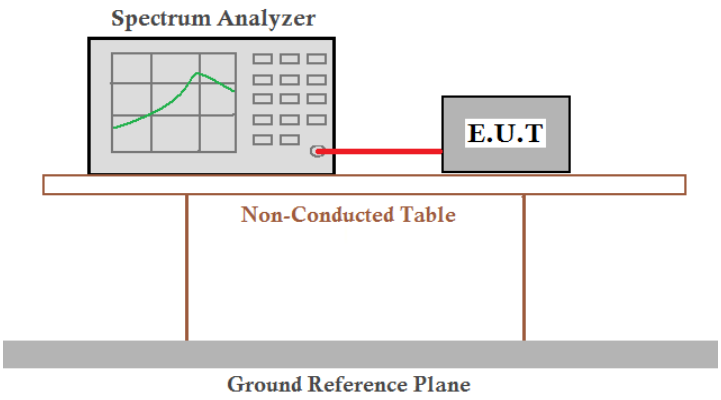
4.6 Power Spectral Density

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);
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	CH1	-4.43	≤8.00	Pass
	CH6	-3.18	≤8.00	Pass
	CH11	-3.80	≤8.00	Pass
	CH12	-14.49	≤8.00	Pass
	CH13	-14.75	≤8.00	Pass
802.11G	CH1	-8.36	≤8.00	Pass
	CH6	-7.50	≤8.00	Pass
	CH11	-7.59	≤8.00	Pass
	CH12	-17.51	≤8.00	Pass
	CH13	-17.28	≤8.00	Pass
802.11N20	CH1	-8.78	≤8.00	Pass
	CH6	-8.31	≤8.00	Pass
	CH11	-8.59	≤8.00	Pass
	CH12	-18.09	≤8.00	Pass
	CH13	-16.94	≤8.00	Pass

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4.6.2 Test plots

4.6.2.1 802.11B_CH1

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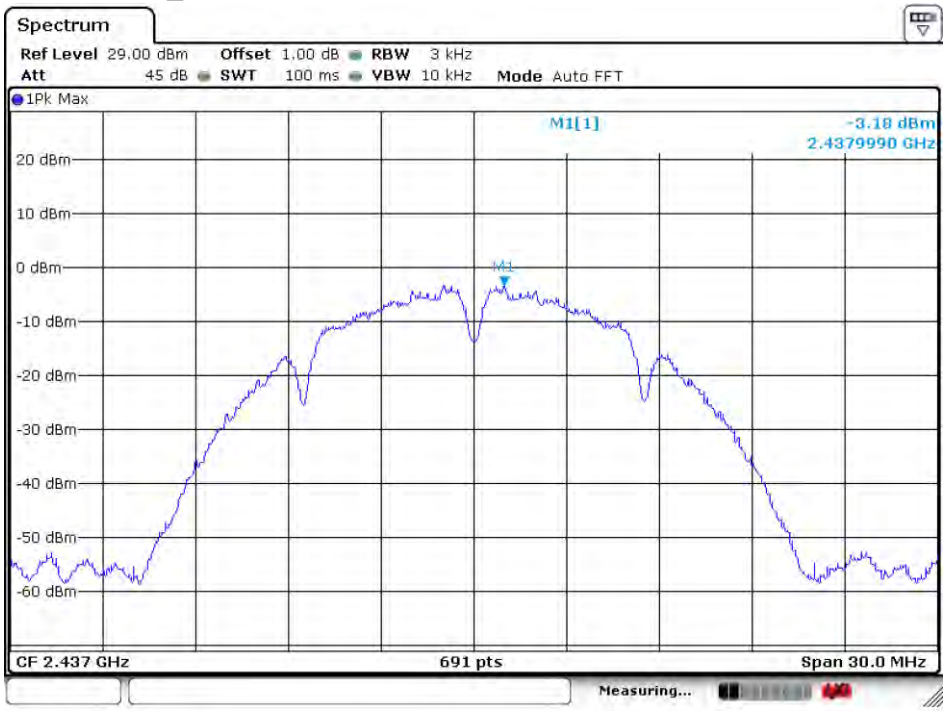
4.6.2.2 802.11B_CH6



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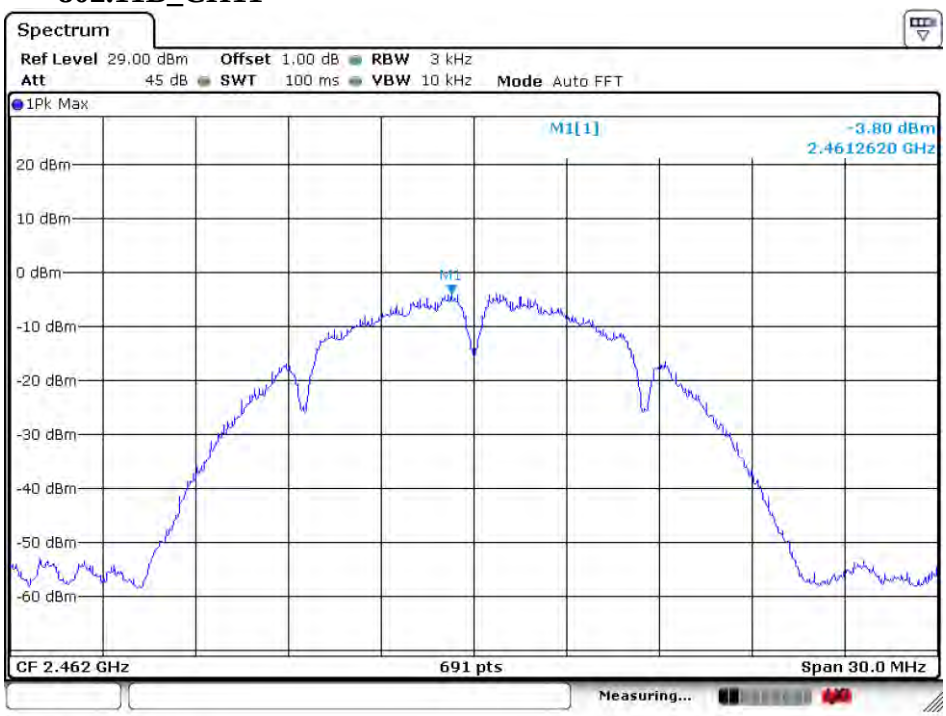
4.6.2.3 802.11B_CH11



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4.6.2.4 802.11B_CH12

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4.6.2.5 802.11B_CH13

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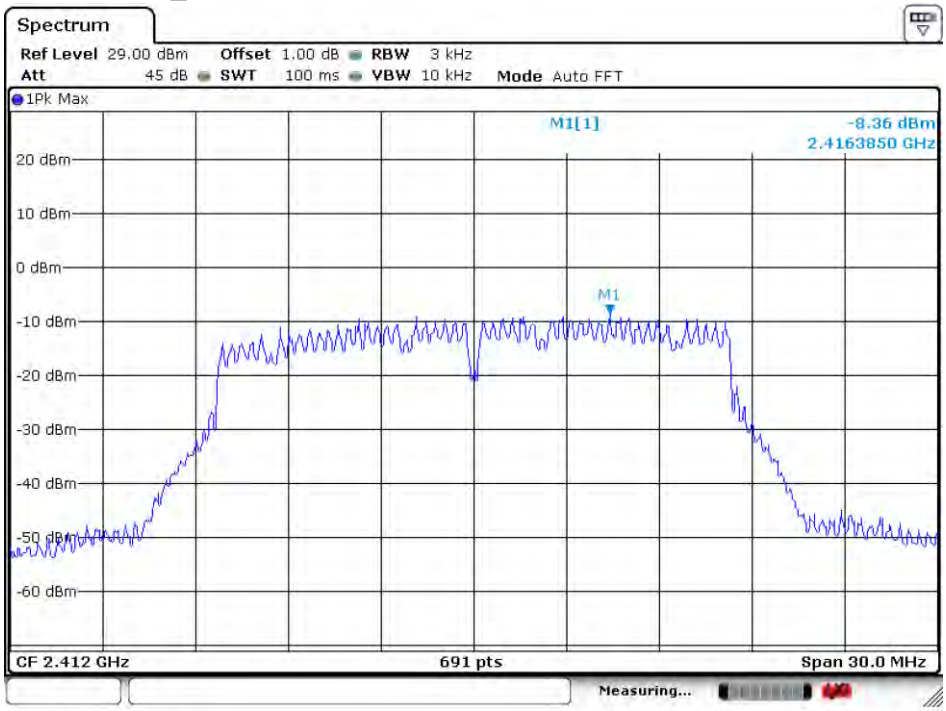
4.6.2.6 802.11G_CH1



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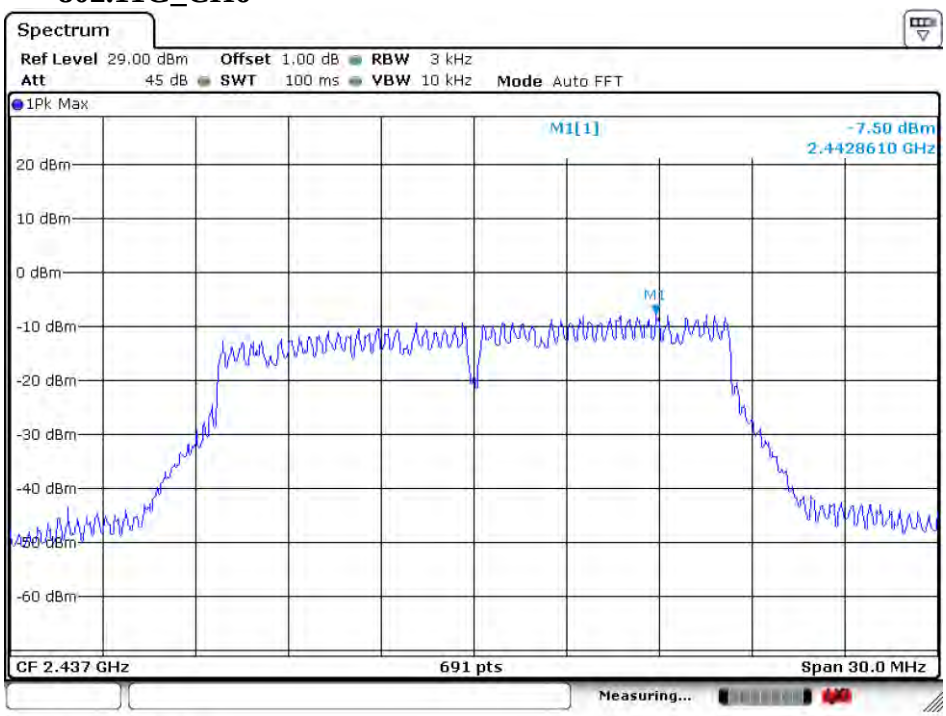
4.6.2.7 802.11G_CH6



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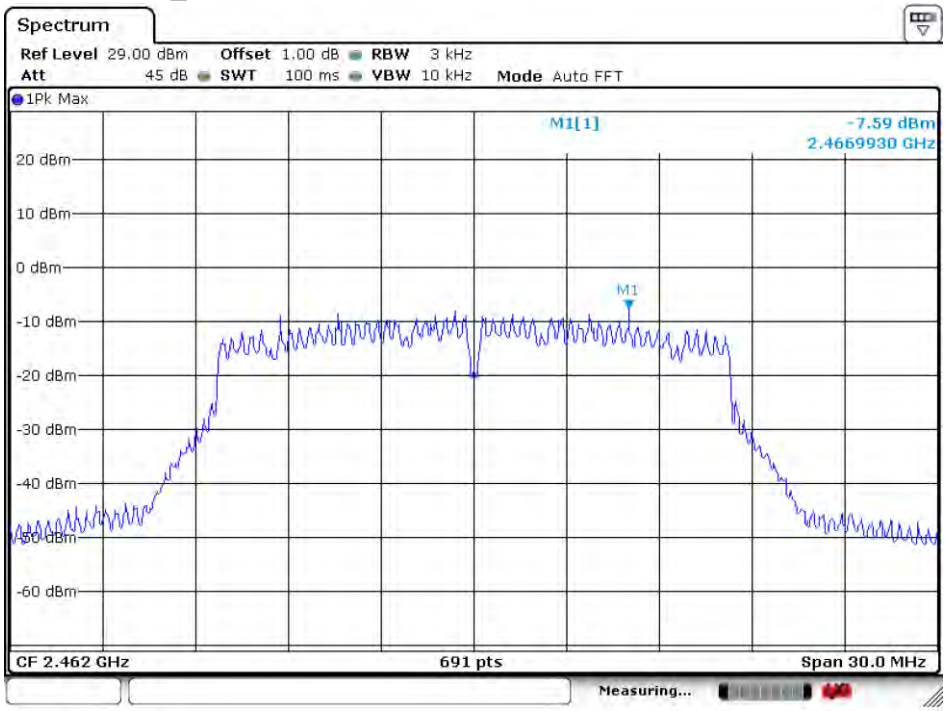
4.6.2.8 802.11G_CH11



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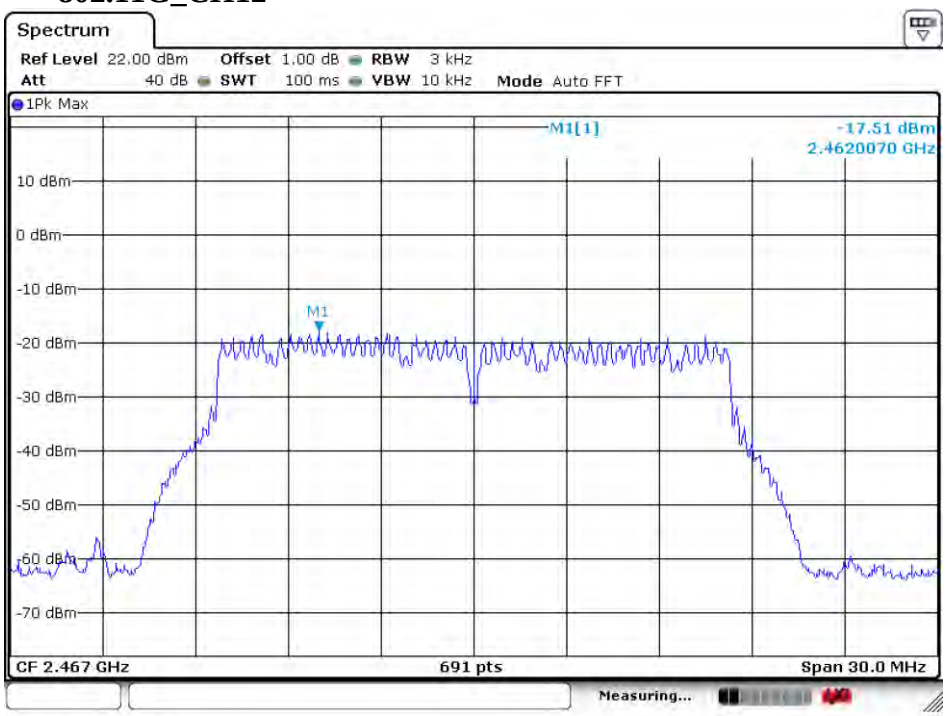
4.6.2.9 802.11G_CH12



Date: 17.AUG.2020 15:47:31

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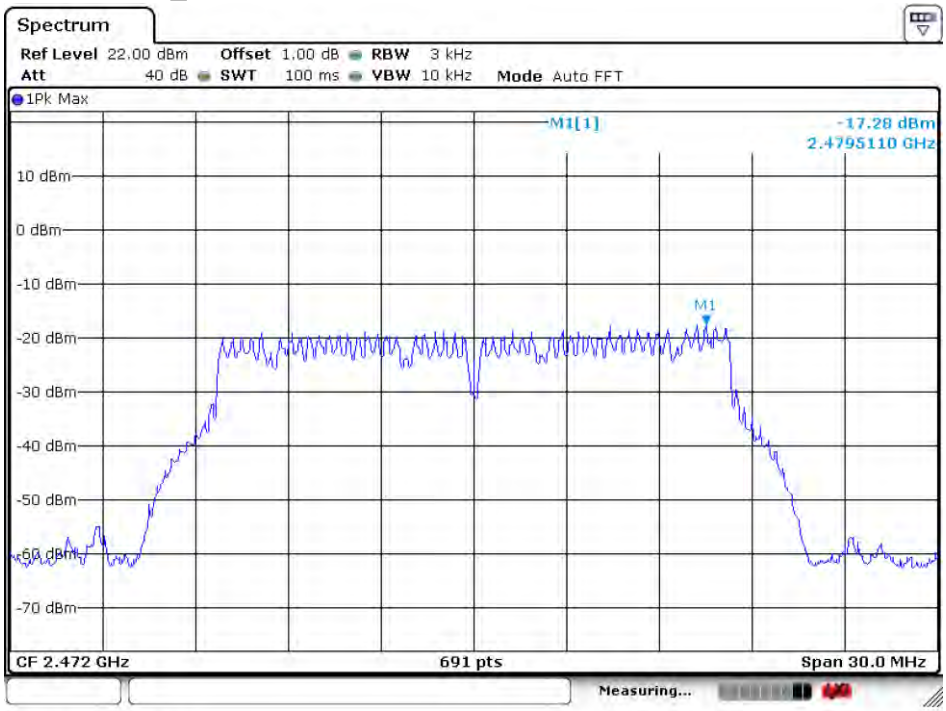
4.6.2.10 802.11G_CH13



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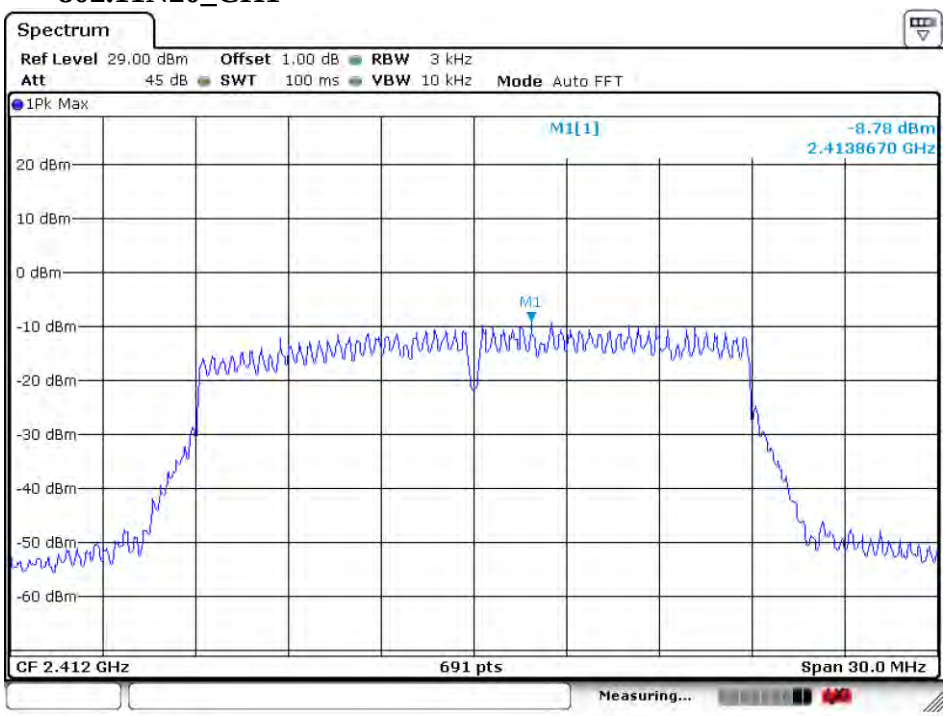
4.6.2.11 802.11N20_CH1



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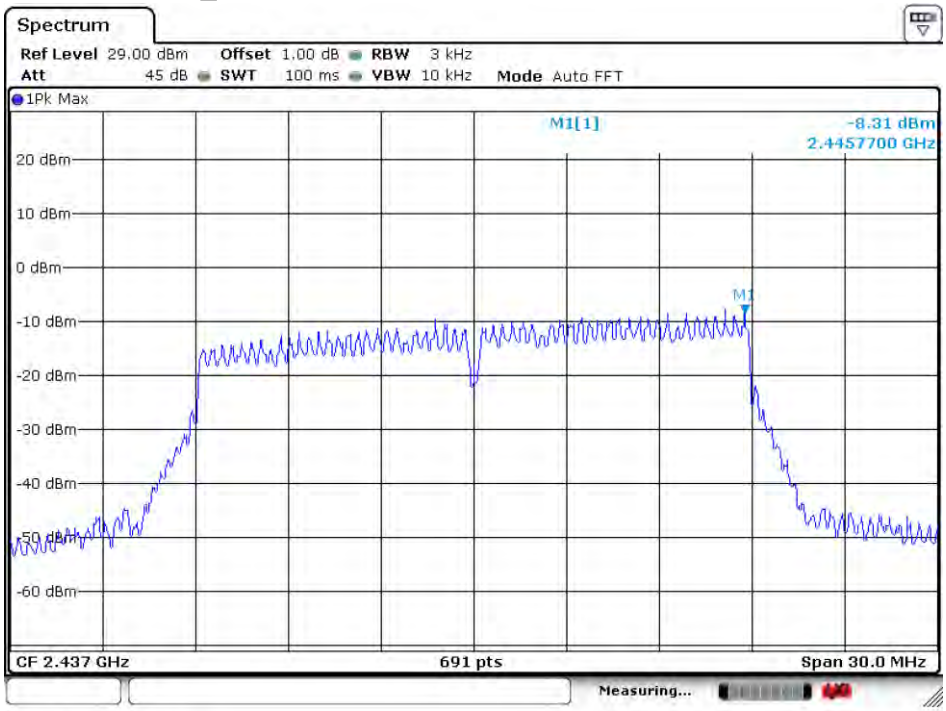
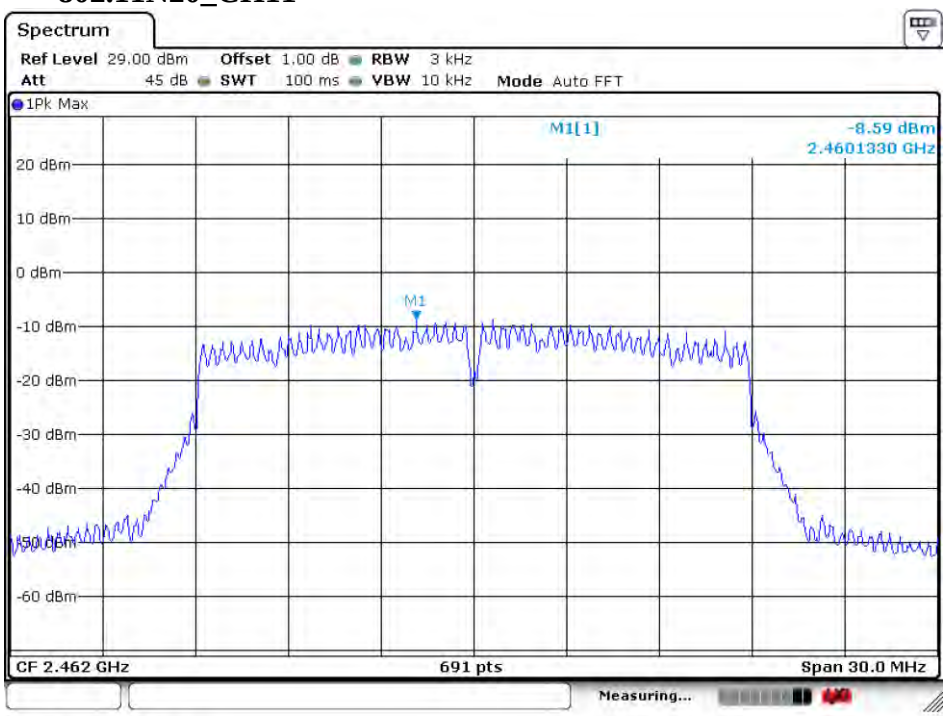
4.6.2.12 802.11N20_CH6



Date: 7.JUL.2020 02:48:39

4.6.2.13 802.11N20_CH11



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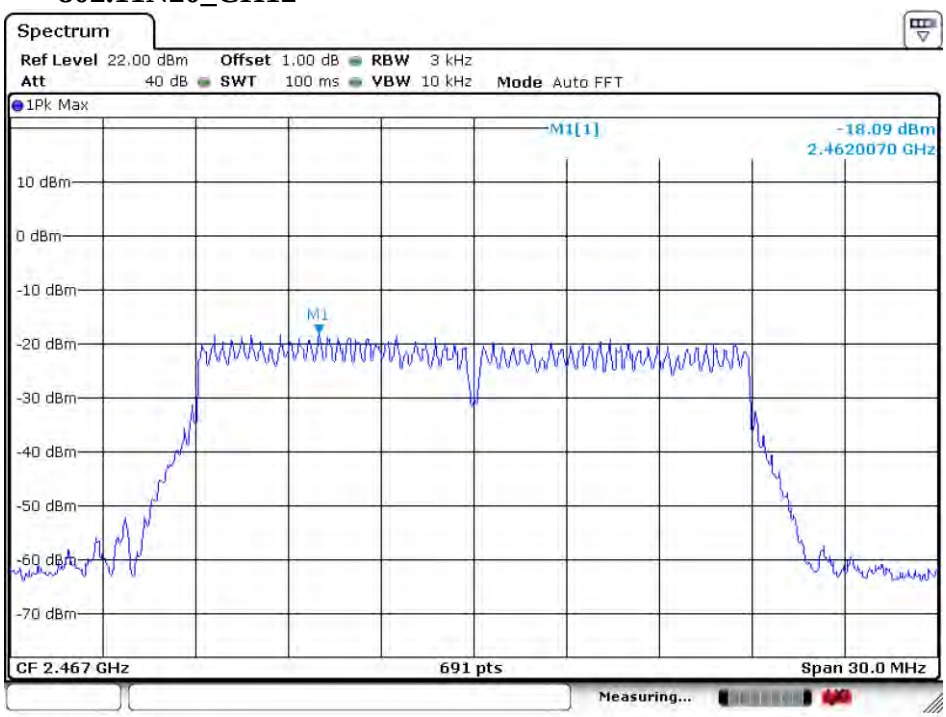
4.6.2.14 802.11N20_CH12



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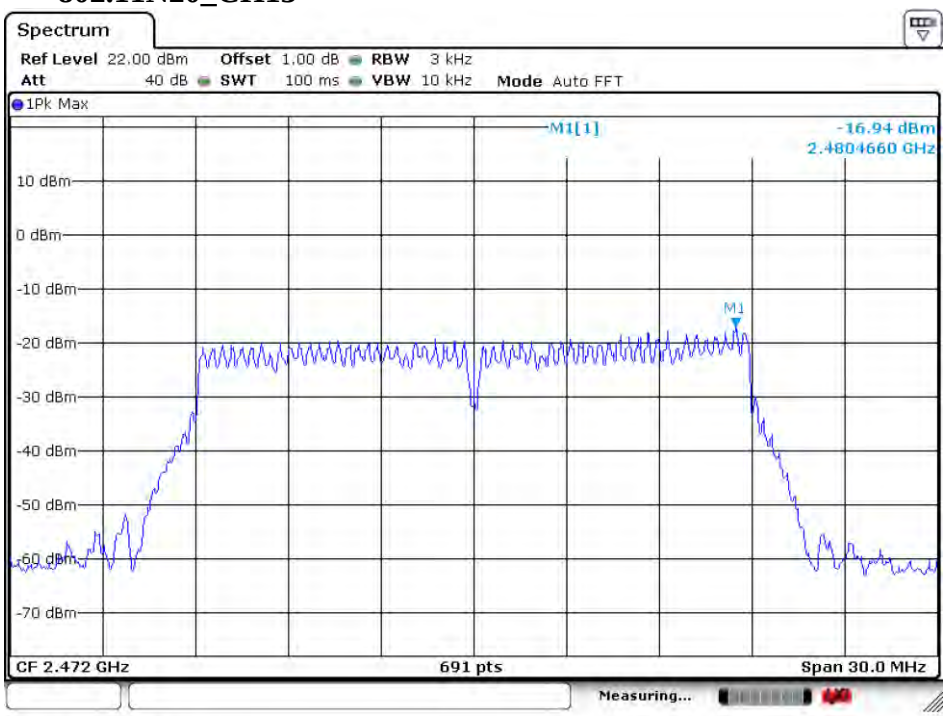
4.6.2.15 802.11N20_CH13



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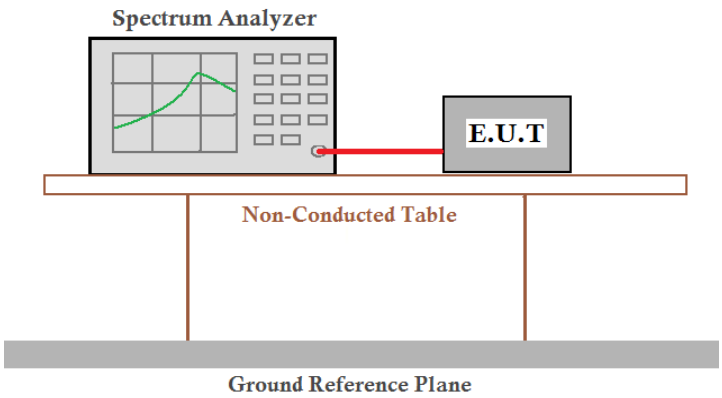
4.7 Band-edge for RF Conducted Emissions

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) ;
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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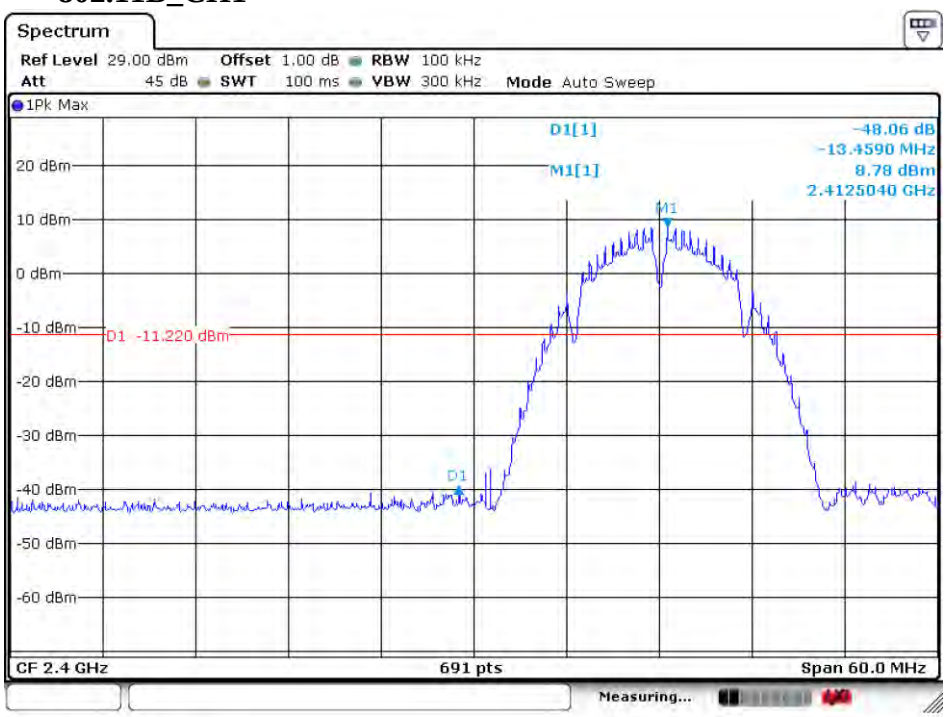
4.7.1 Test plots

4.7.1.1 802.11B_CH1



Date: 7.JUL.2020 03:11:23

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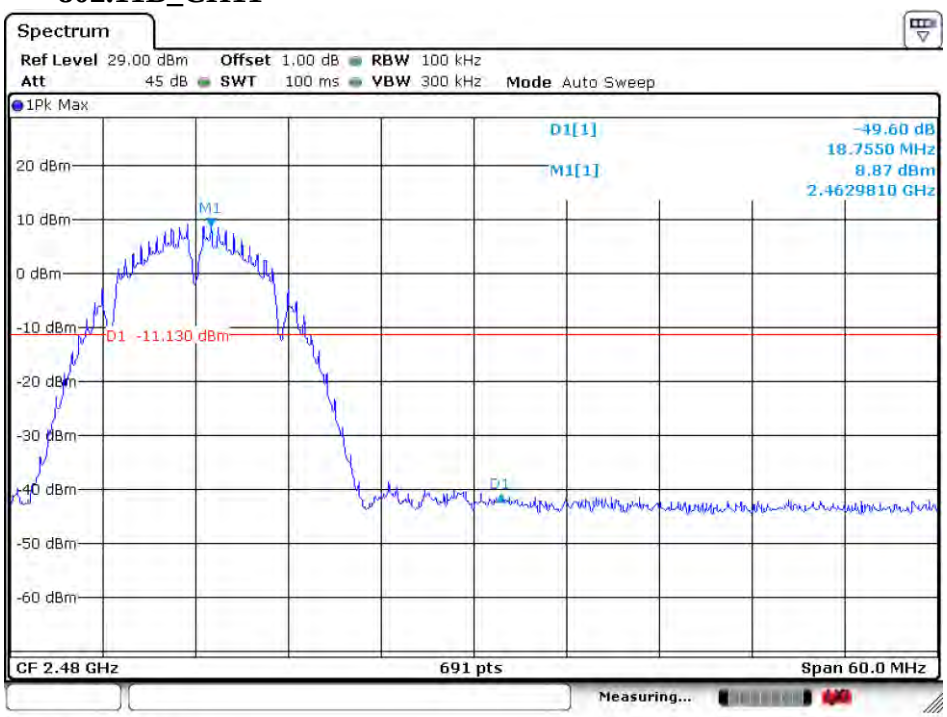
4.7.1.2 802.11B_CH11



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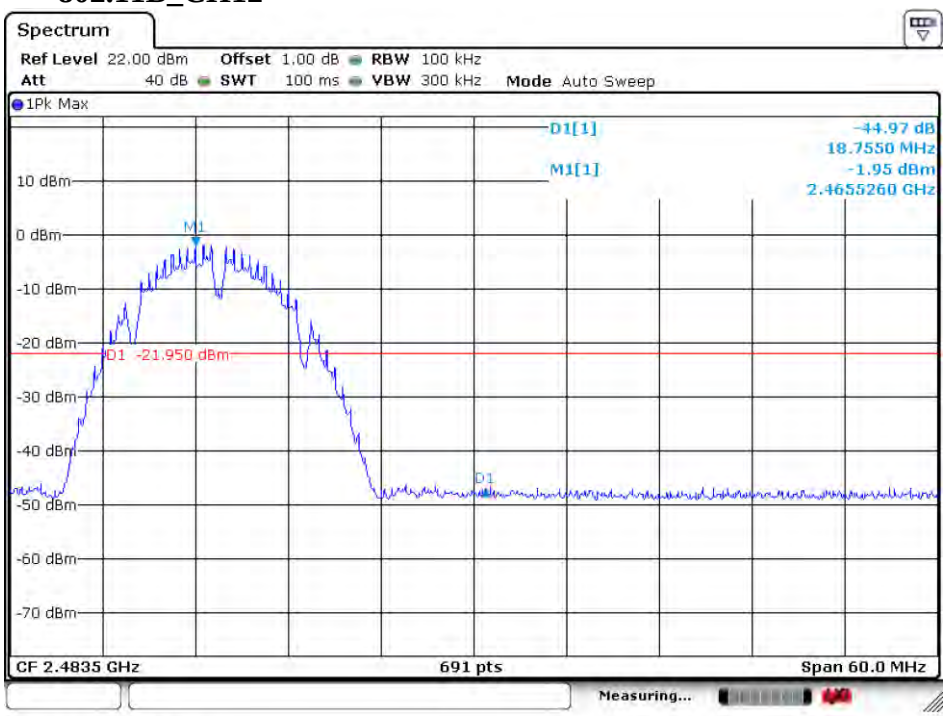
4.7.1.3 802.11B_CH12



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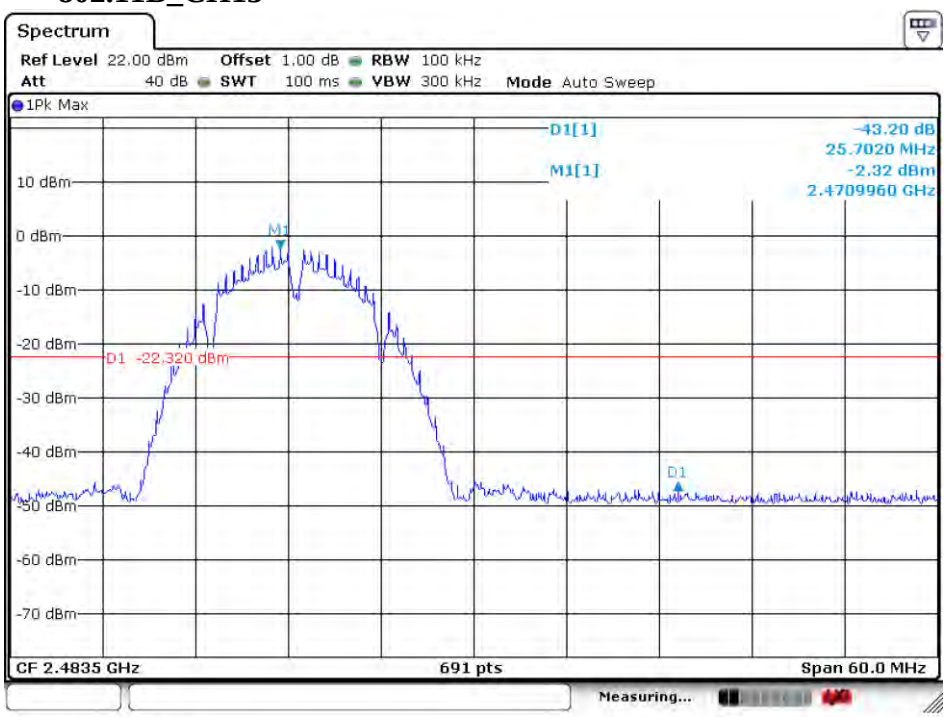
4.7.1.4 802.11B_CH13



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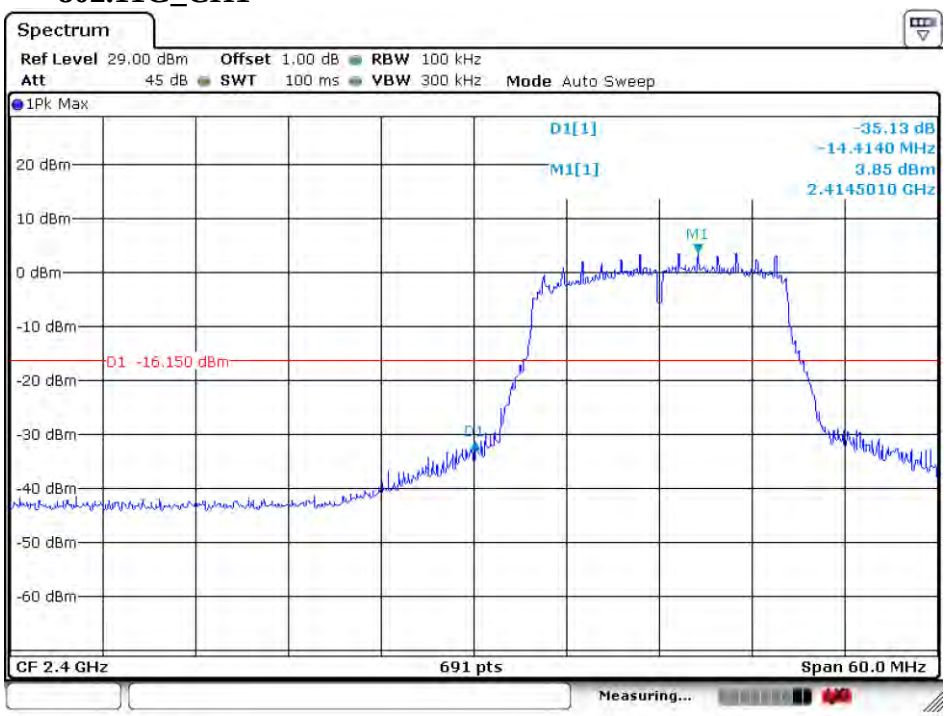
4.7.1.5 802.11G_CH1



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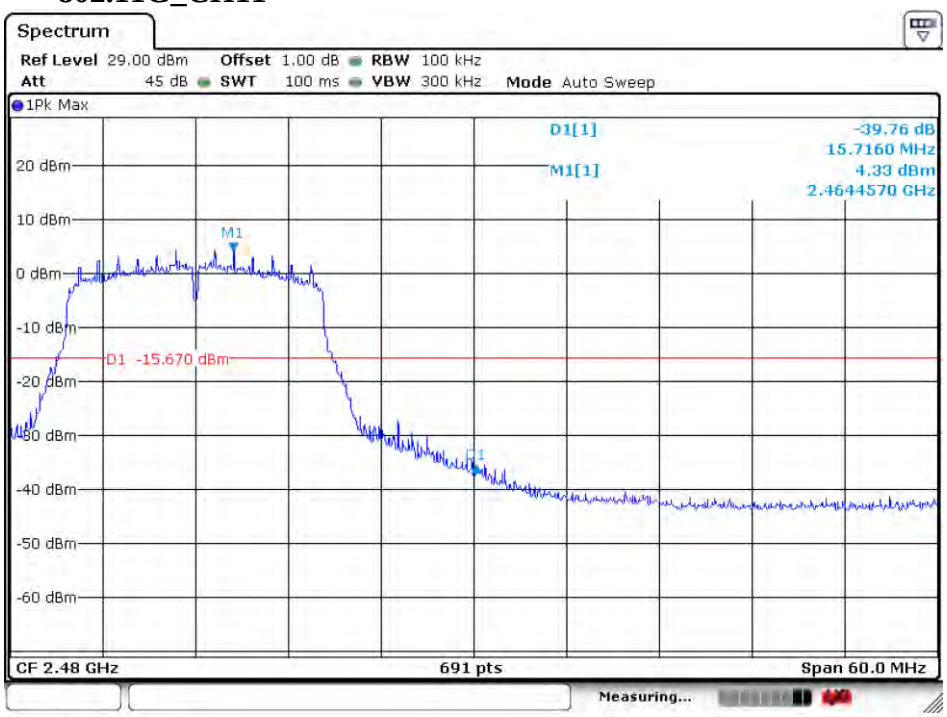
4.7.1.6 802.11G_CH11



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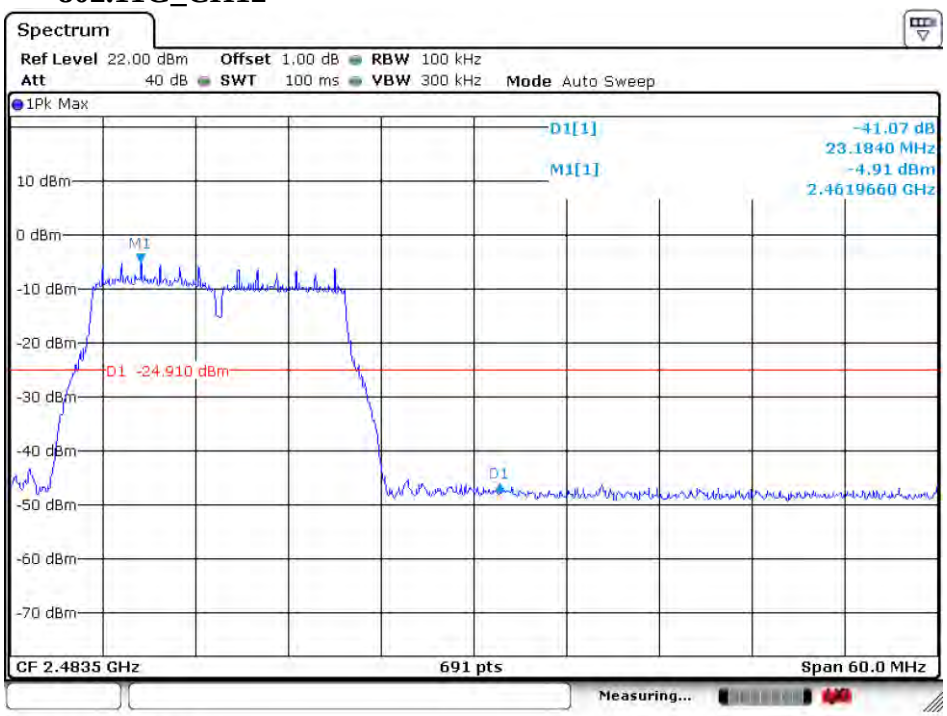
4.7.1.7 802.11G_CH12



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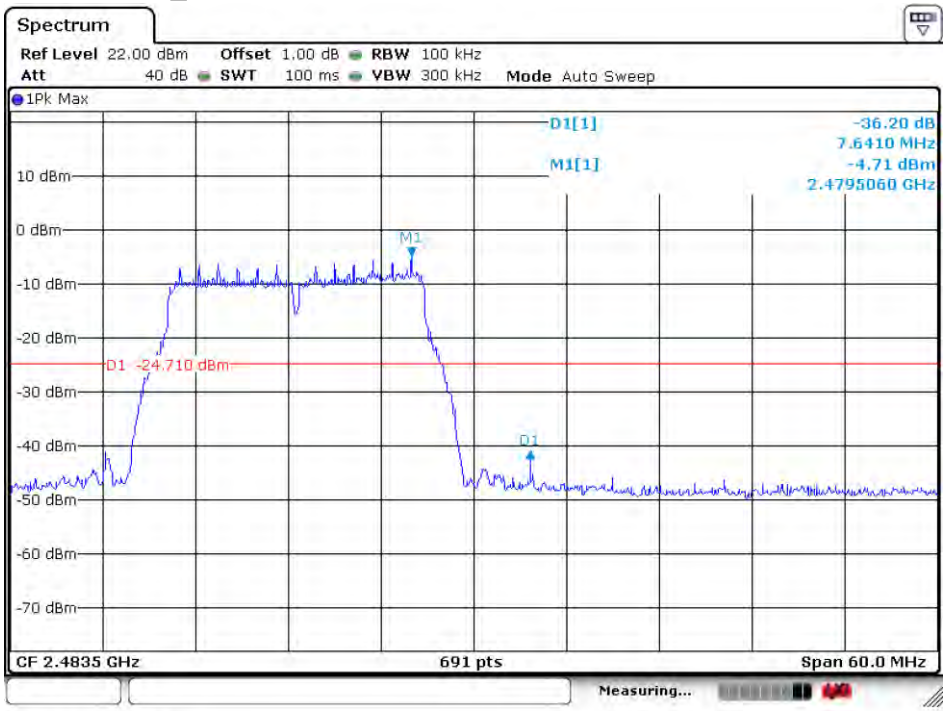
4.7.1.8 802.11G_CH13



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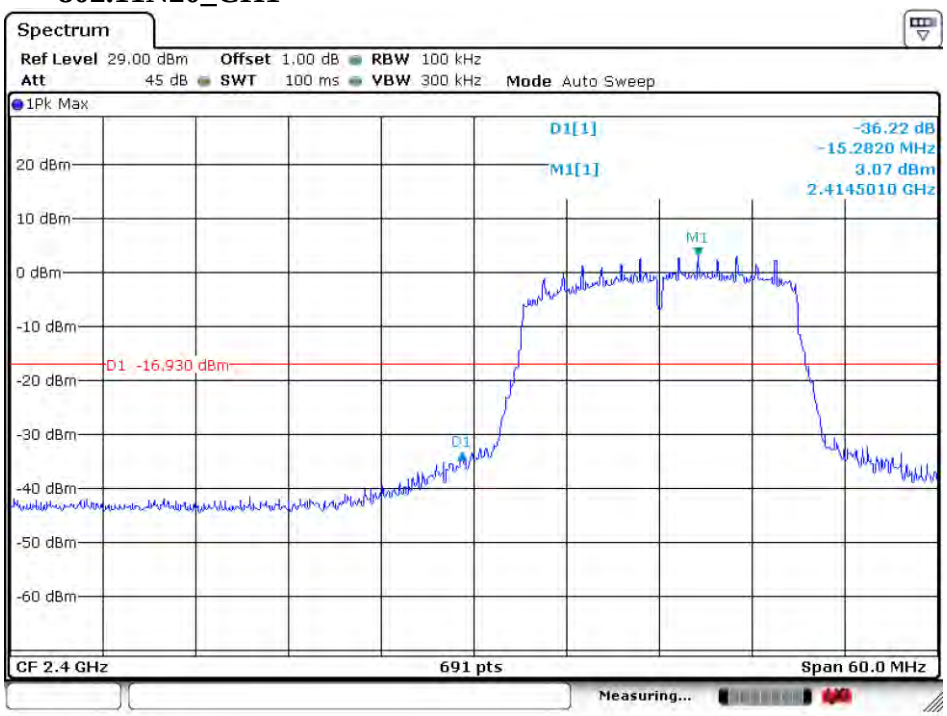
4.7.1.9 802.11N20_CH1



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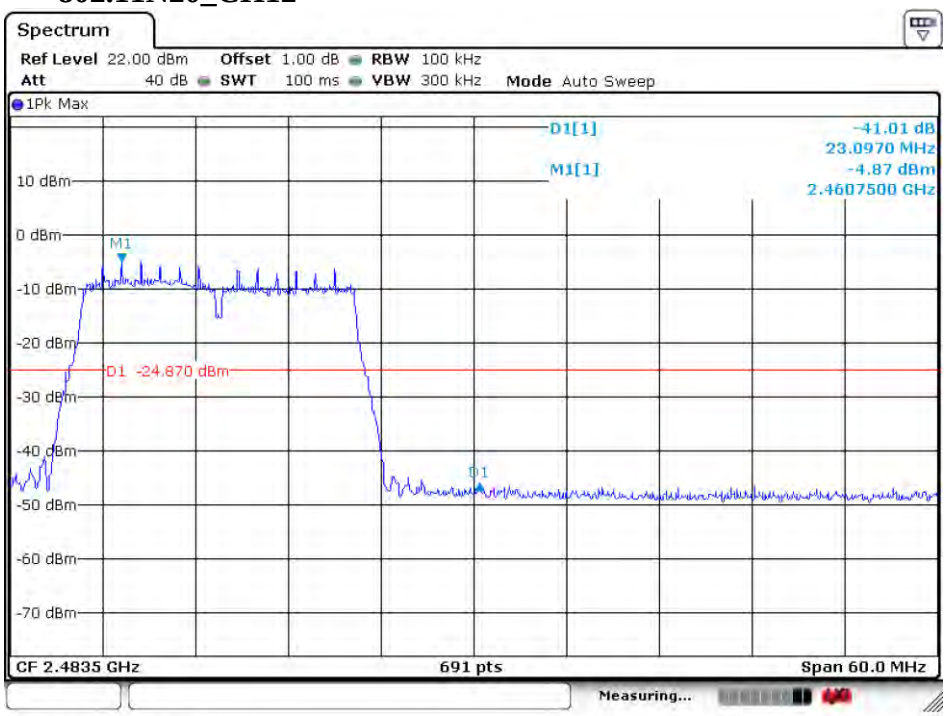
4.7.1.10 802.11N20_CH11

Date: 7.JUL.2020 03:13:17

4.7.1.11 802.11N20_CH12



Date: 17.AUG.2020 15:59:47

4.7.1.12 802.11N20_CH13

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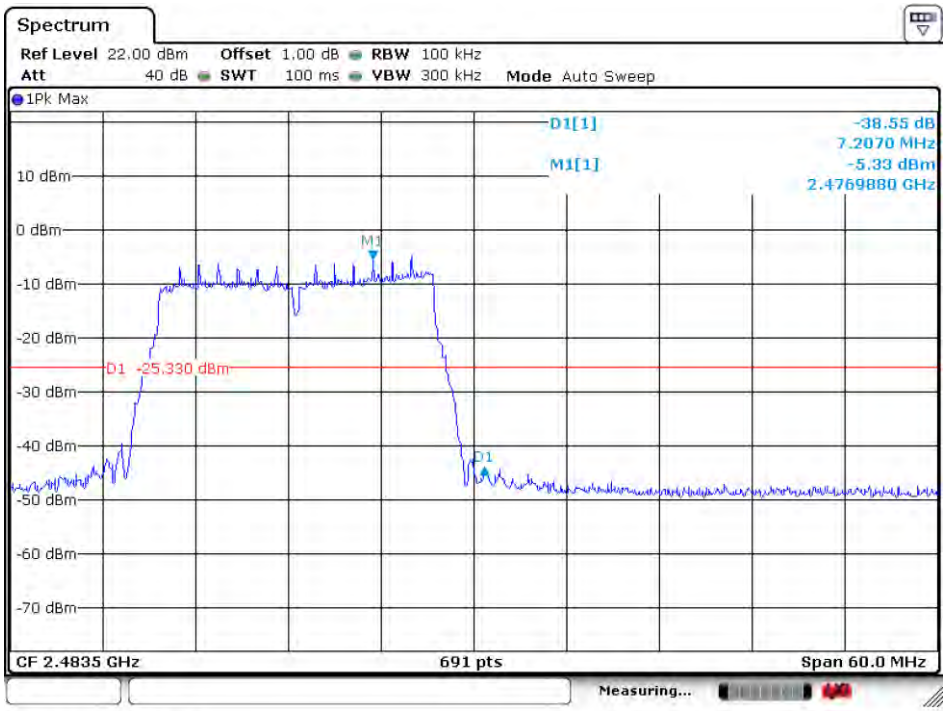

Date: 17.AUG.2020 16:00:25

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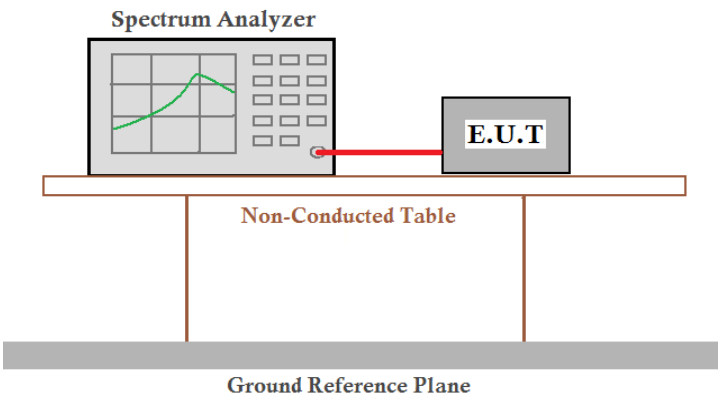
4.8 RF Conducted Spurious Emissions

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);
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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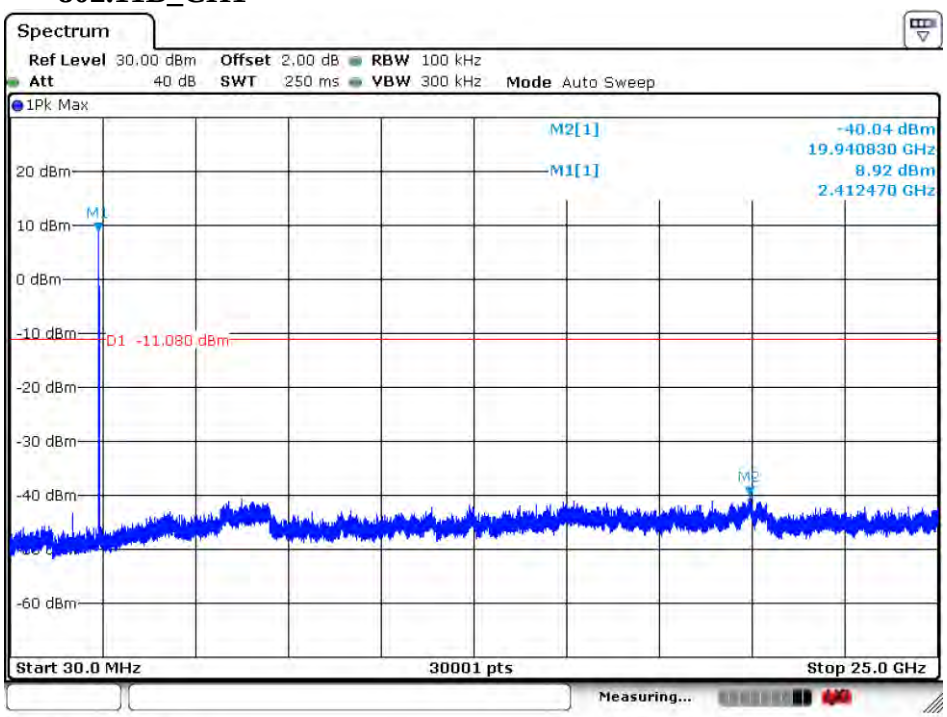
4.8.1 Test plots

4.8.1.1 802.11B_CH1



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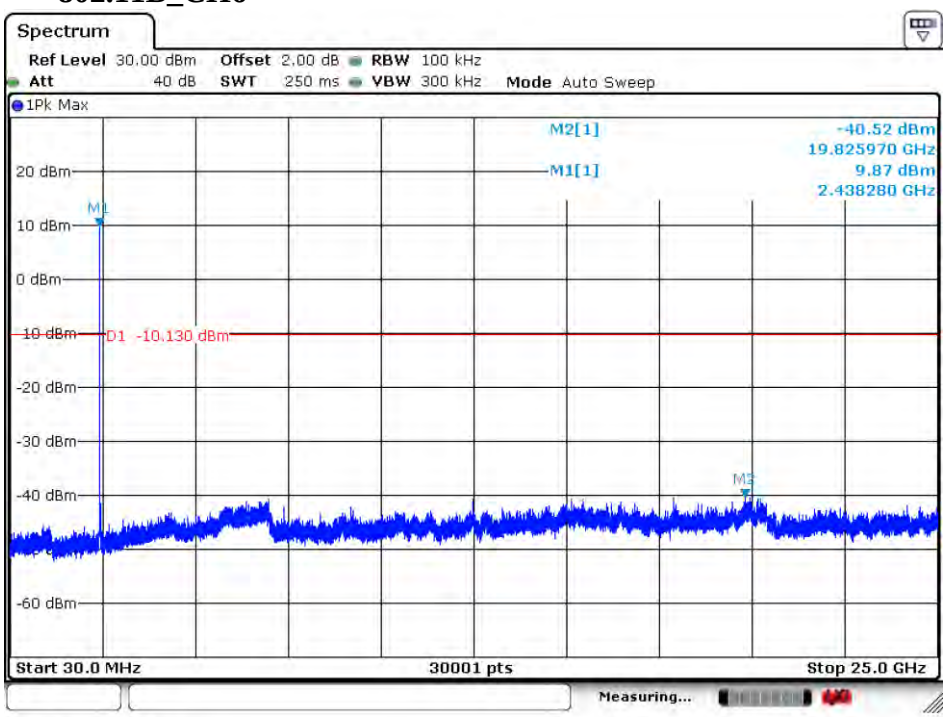
4.8.1.2 802.11B_CH6



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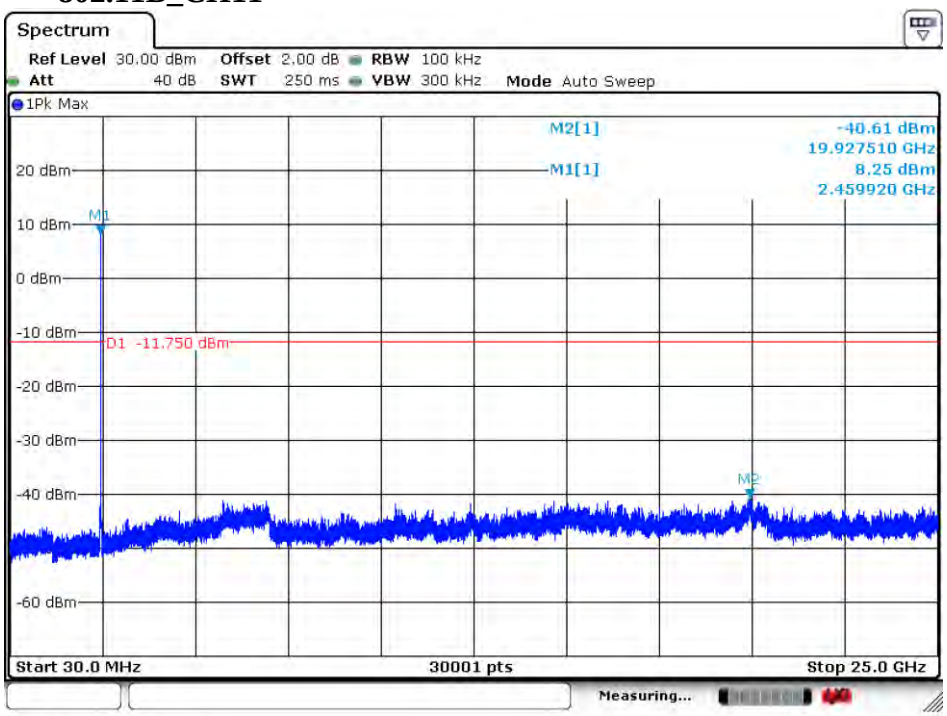
4.8.1.3 802.11B_CH11



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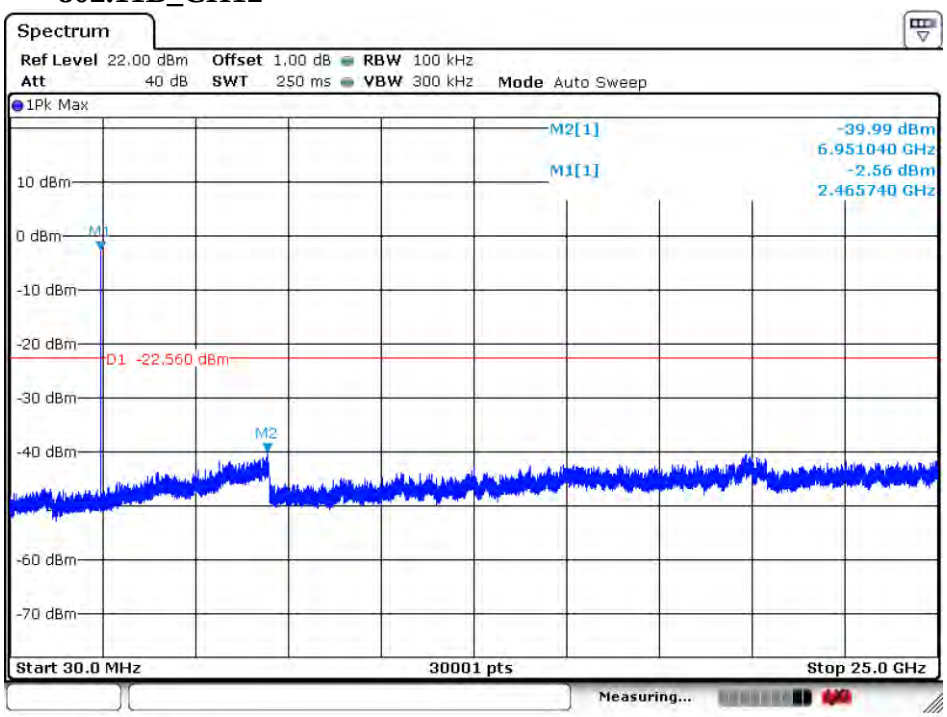
4.8.1.4 802.11B_CH12



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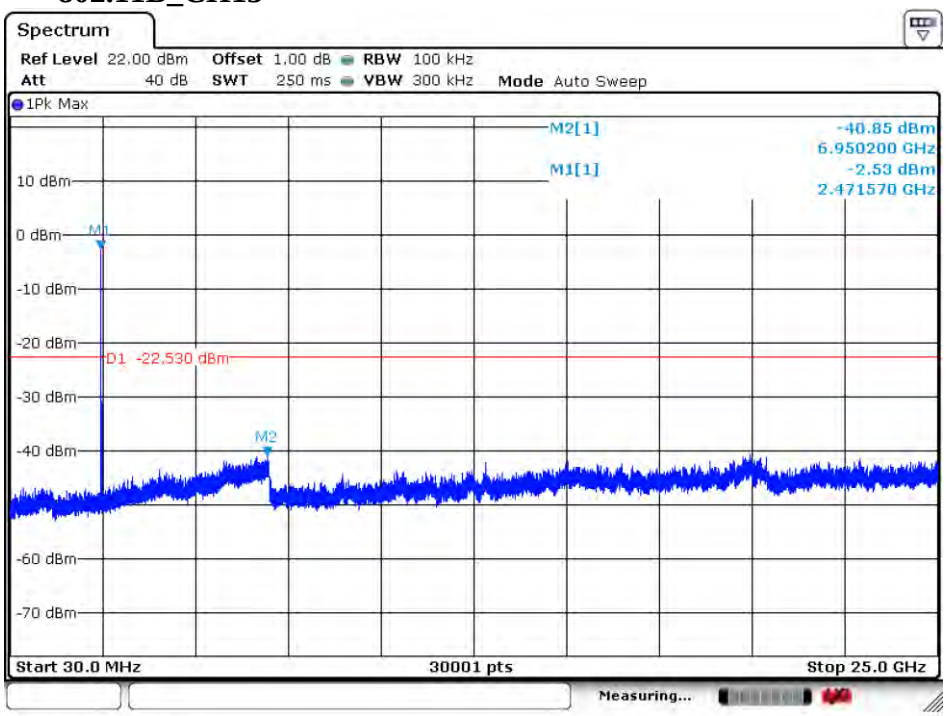
4.8.1.5 802.11B_CH13



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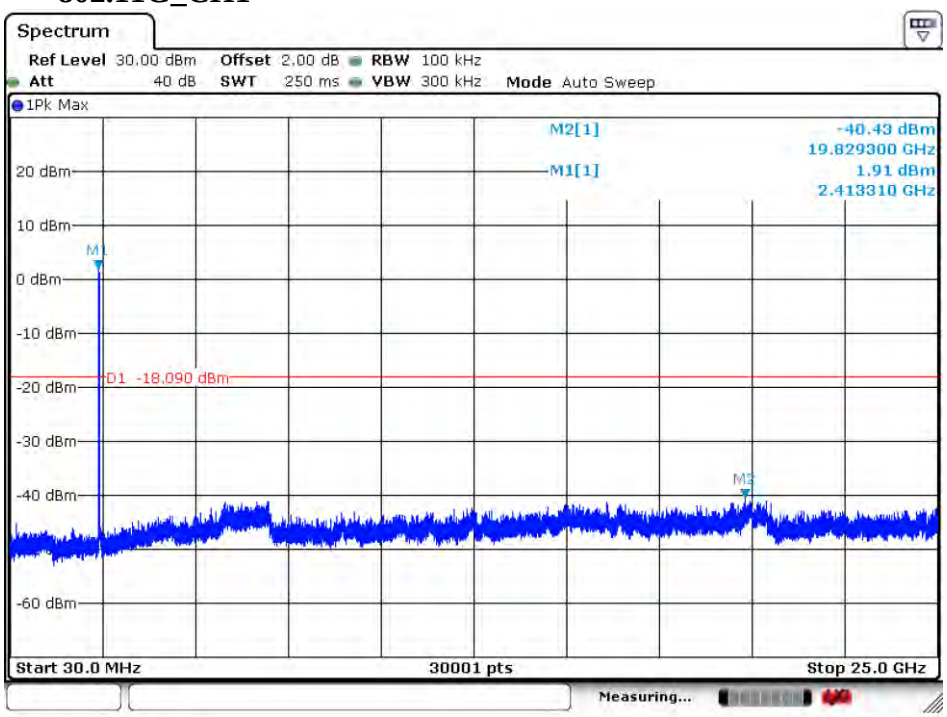
4.8.1.6 802.11G_CH1



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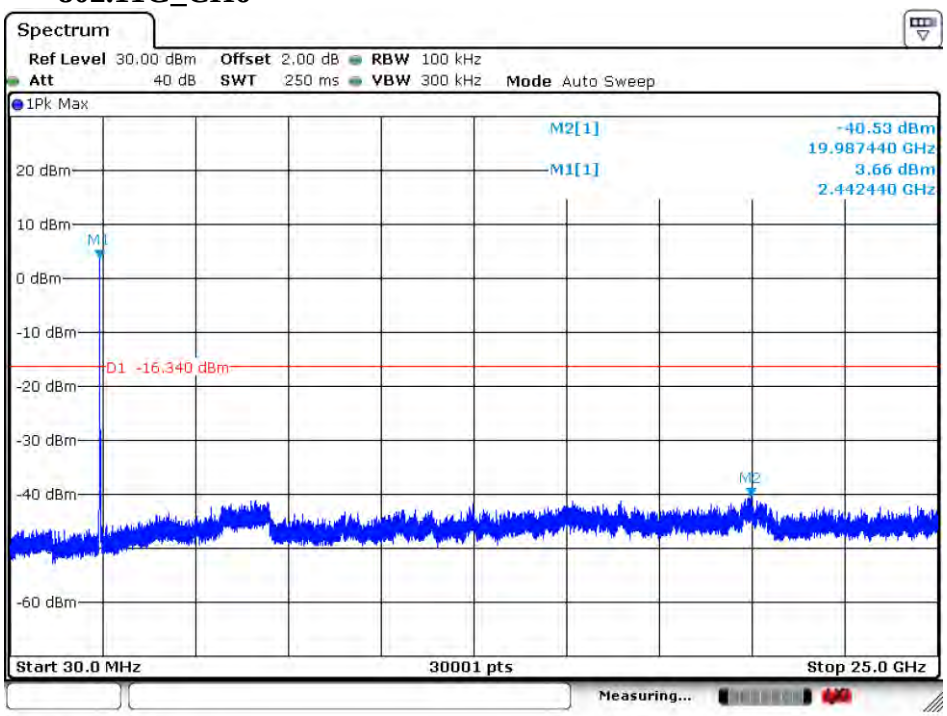
4.8.1.7 802.11G_CH6



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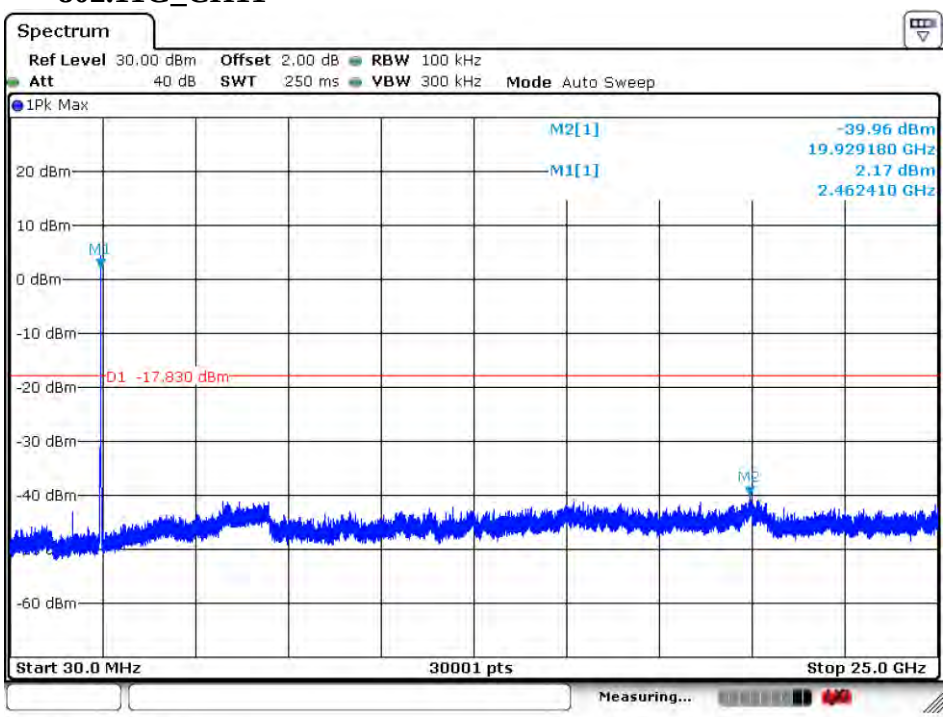
4.8.1.8 802.11G_CH11



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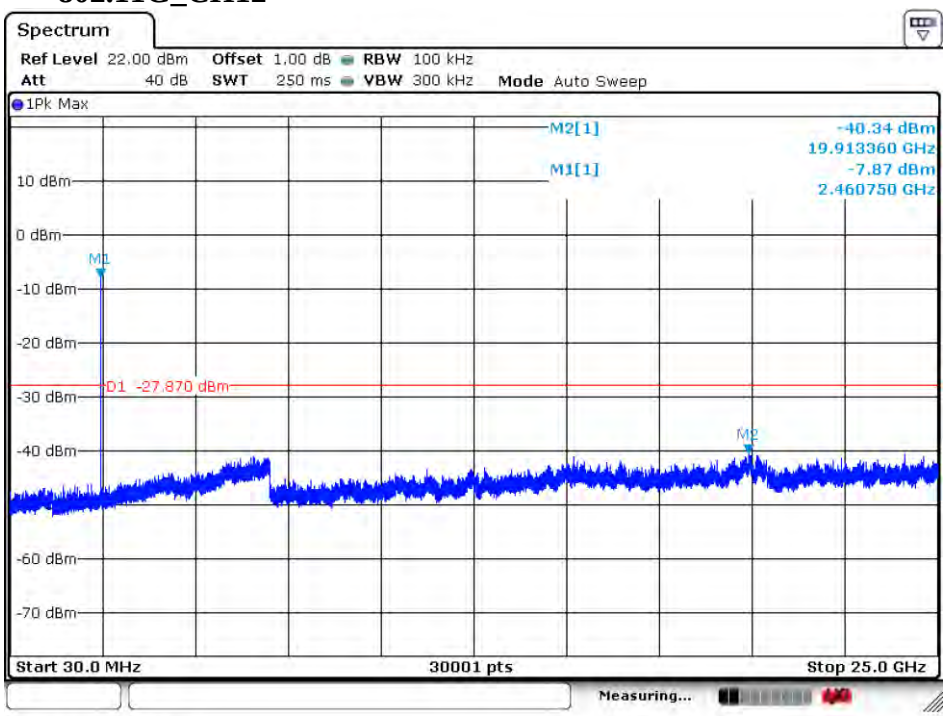
4.8.1.9 802.11G_CH12



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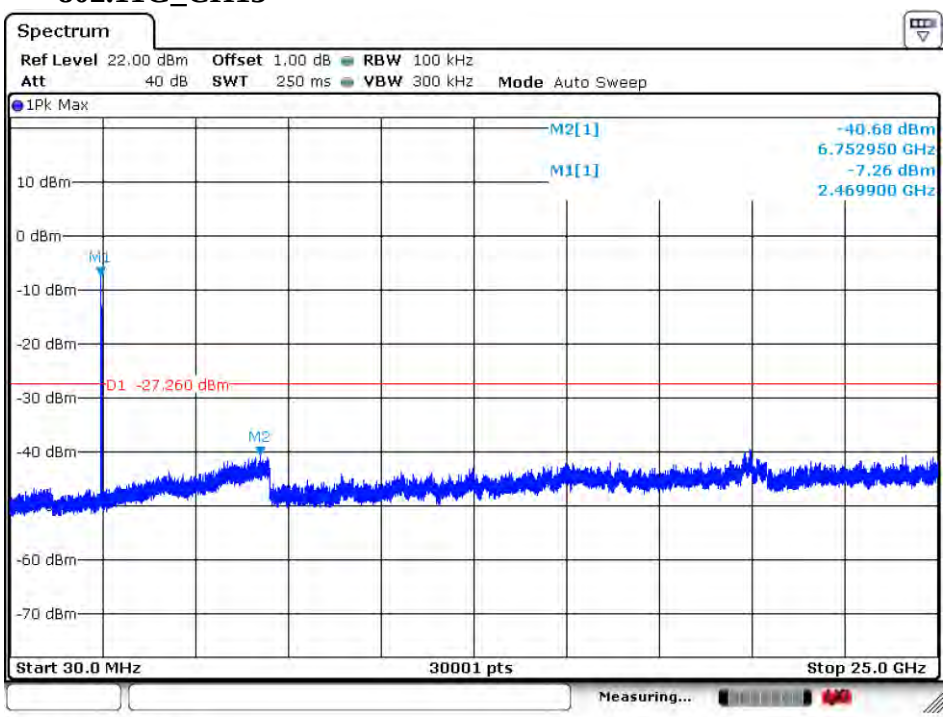
4.8.1.10 802.11G_CH13



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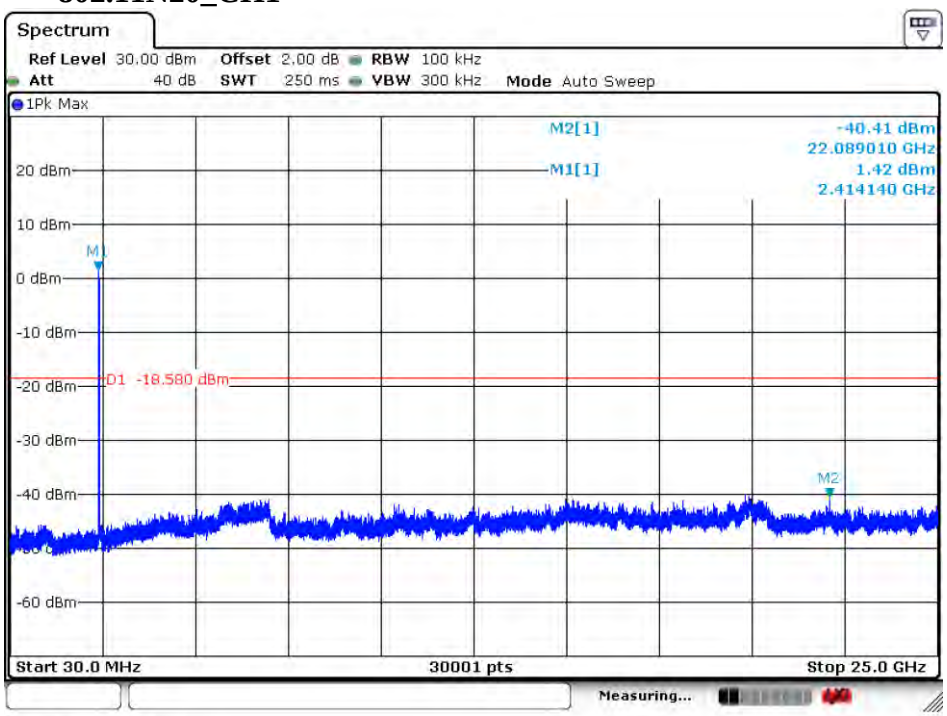
4.8.1.11 802.11N20_CH1



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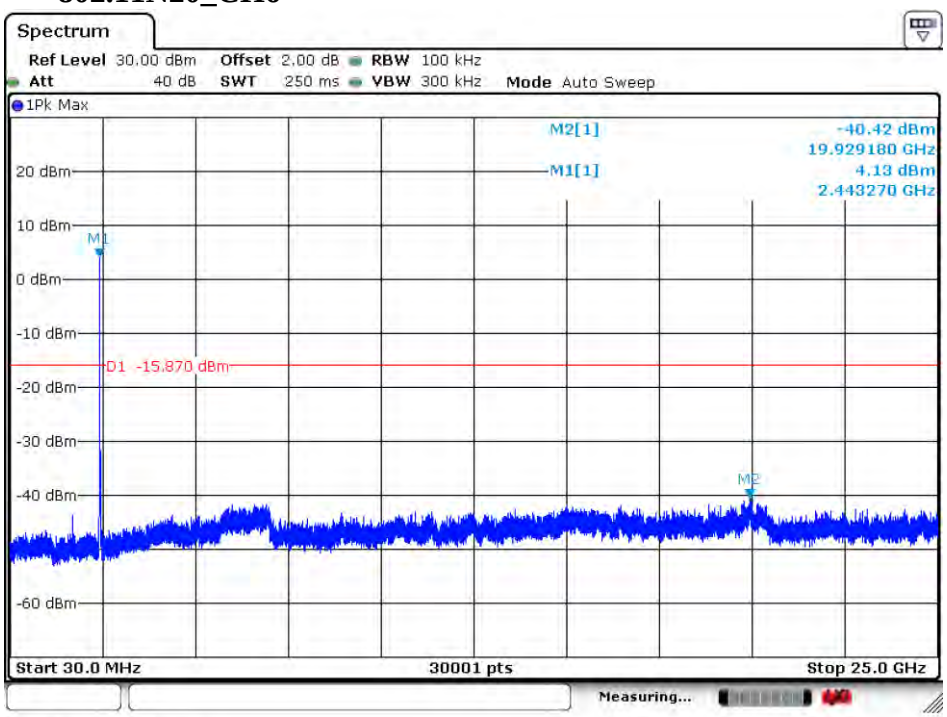
4.8.1.12 802.11N20_CH6



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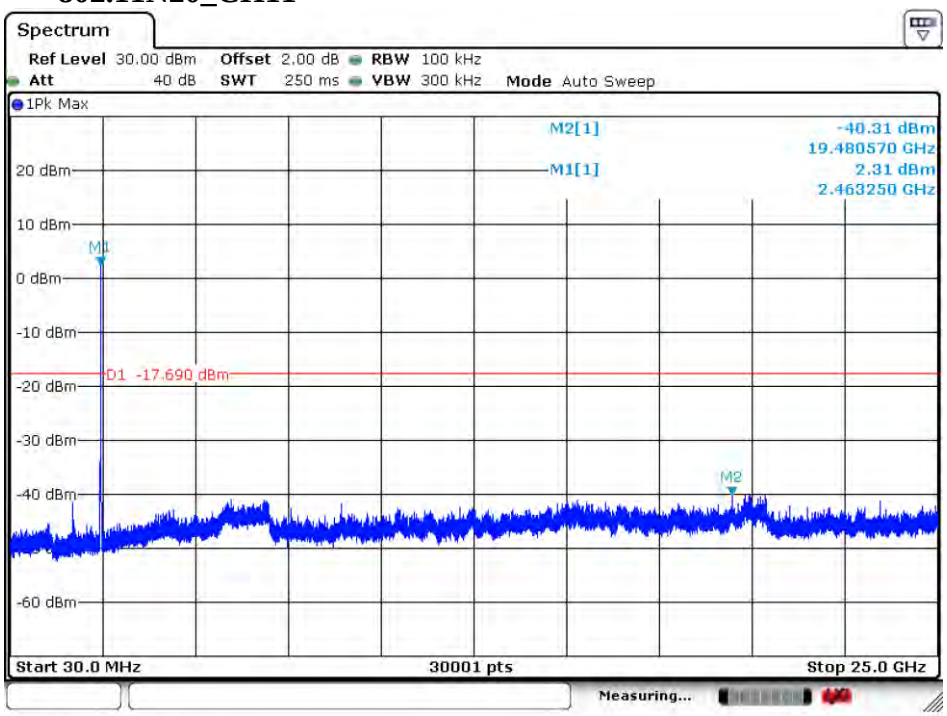
4.8.1.13 802.11N20_CH11



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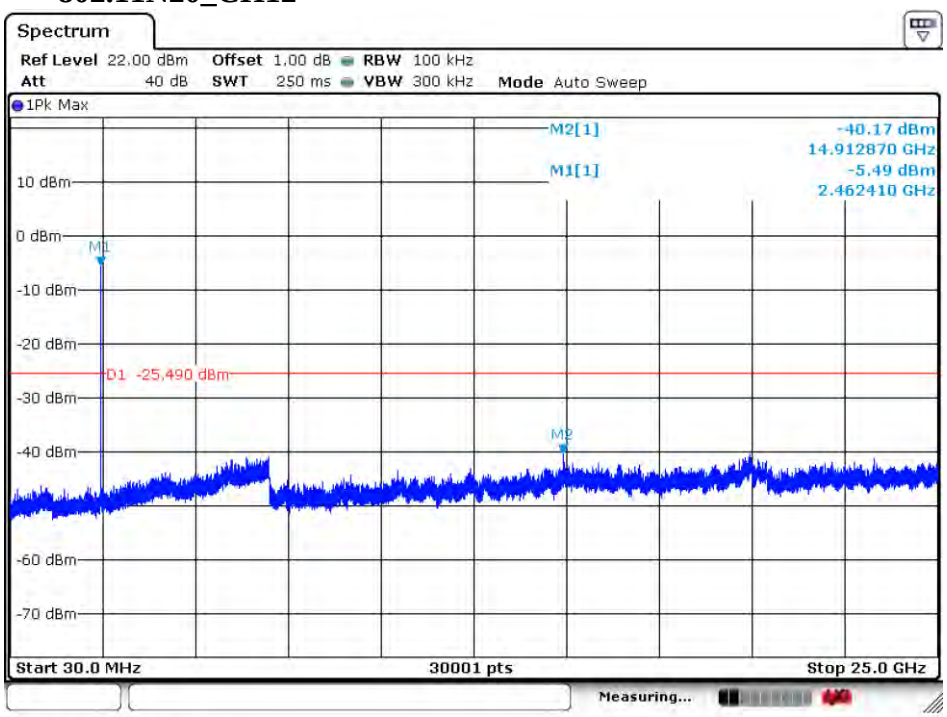
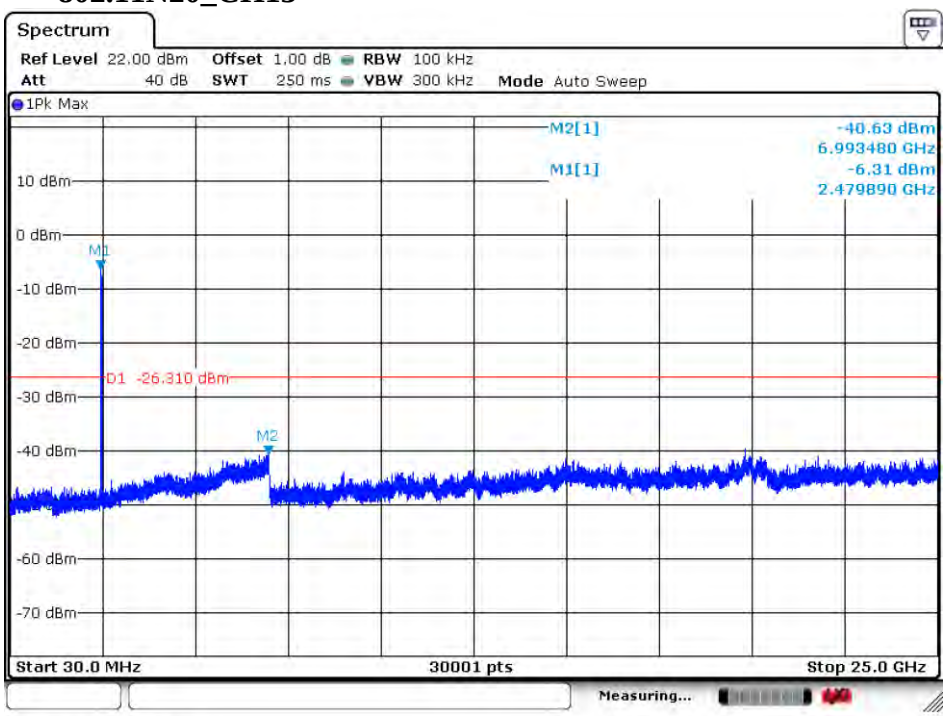
4.8.1.14 802.11N20_CH12



Date: 17.AUG.2020 16:03:09

4.8.1.15 802.11N20_CH13



Date: 17.AUG.2020 16:02:17

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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 (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.				

Test Setup:	

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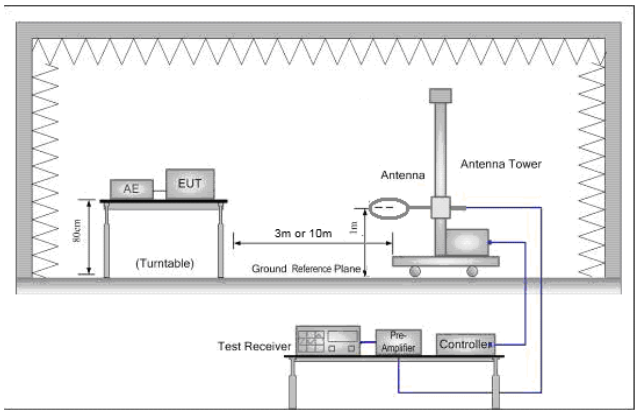

Figure 1. Below 30MHz

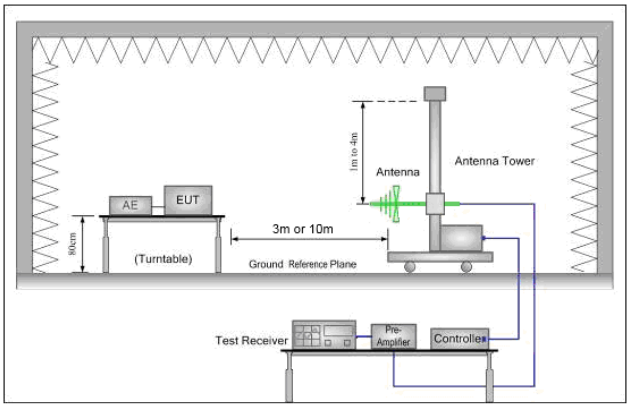

Figure 2. 30MHz to 1GHz

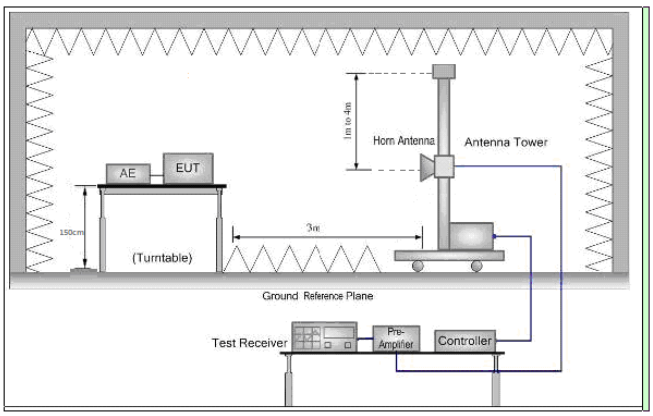

Figure 3. Above 1 GHz

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 15.35(c). Duty cycle = On time/100 milliseconds

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	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); 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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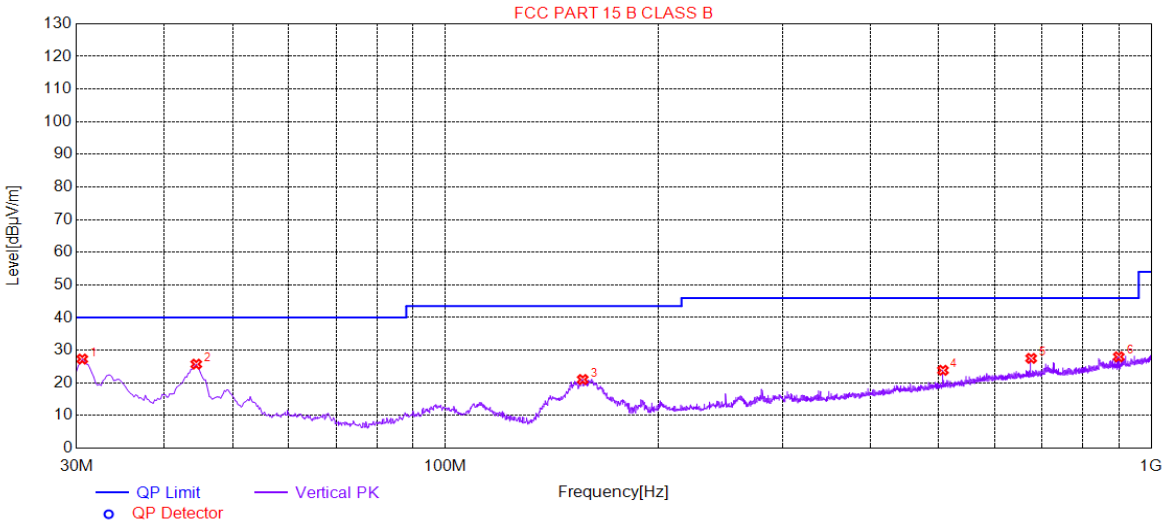
4.9.1 Radiated emission below 1GHz

4.9.1.1 Charge + Transmitting, Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	30.5821	27.30	-30.07	40.00	12.70	100	277	Vertical
2	44.3589	25.74	-30.16	40.00	14.26	100	248	Vertical
3	156.513	21.04	-34.79	43.50	22.46	100	14	Vertical
4	506.947	23.86	-23.14	46.00	22.14	100	298	Vertical
5	675.955	27.52	-19.76	46.00	18.48	100	280	Vertical
6	899.487	27.99	-16.04	46.00	18.01	200	60	Vertical

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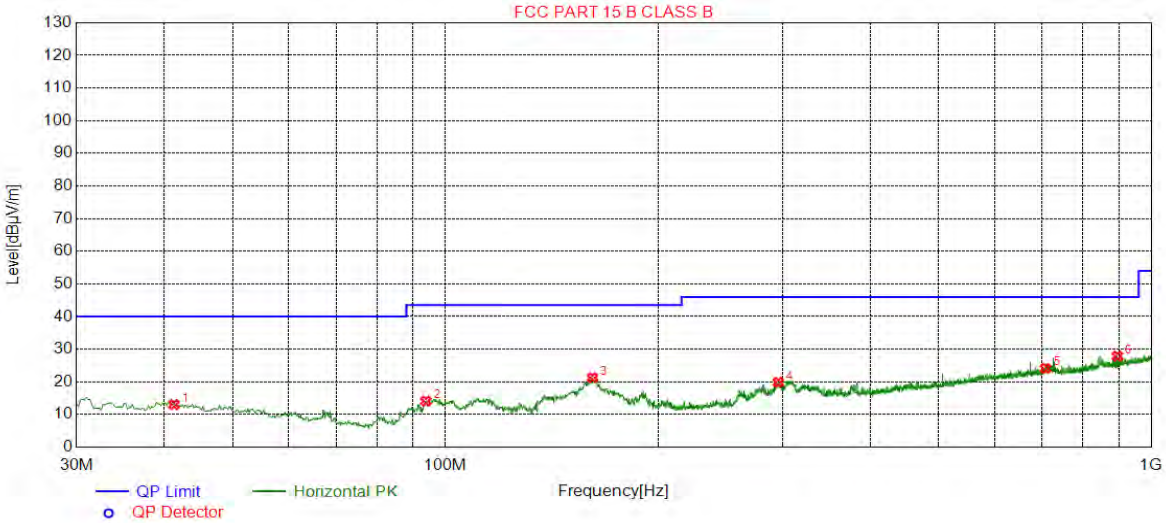
4.9.1.2 Charge + Transmitting, Horizontal



Suspected List								
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1	41.2543	13.06	-28.86	40.00	26.94	100	22	Horizontal
2	93.8388	14.14	-33.08	43.50	29.36	200	264	Horizontal
3	161.558	21.31	-34.54	43.50	22.19	200	101	Horizontal
4	296.221	19.86	-28.41	46.00	26.14	100	252	Horizontal
5	708.359	24.10	-19.31	46.00	21.90	200	10	Horizontal
6	895.801	27.89	-16.10	46.00	18.11	100	308	Horizontal

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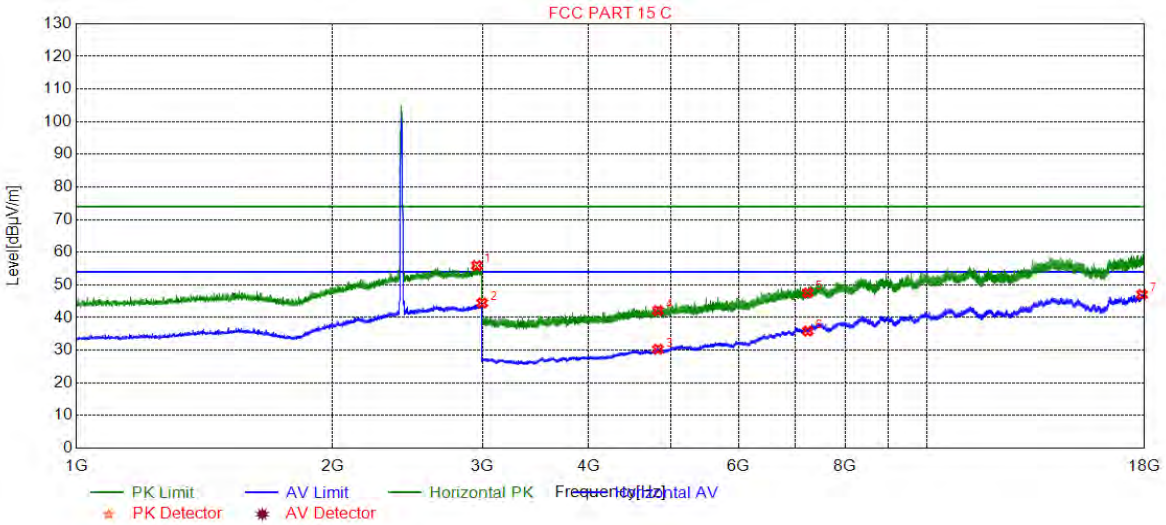
4.9.2 Transmitter emission above 1GHz

4.9.2.1 ANT1

4.9.2.1.1 802.11B_Lowest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2954.98	55.92	9.66	74.00	18.08	150	261	Horizontal
2	2998.49	44.48	9.46	54.00	9.52	150	39	Horizontal
3	4824.00	30.31	-18.21	54.00	23.69	150	342	Horizontal
4	4824.00	42.14	-18.21	74.00	31.86	150	233	Horizontal
5	7236.00	47.56	-9.99	74.00	26.44	150	218	Horizontal
6	7236.00	35.87	-9.99	54.00	18.13	150	18	Horizontal
7	17870.7	47.08	0.30	54.00	6.92	150	360	Horizontal

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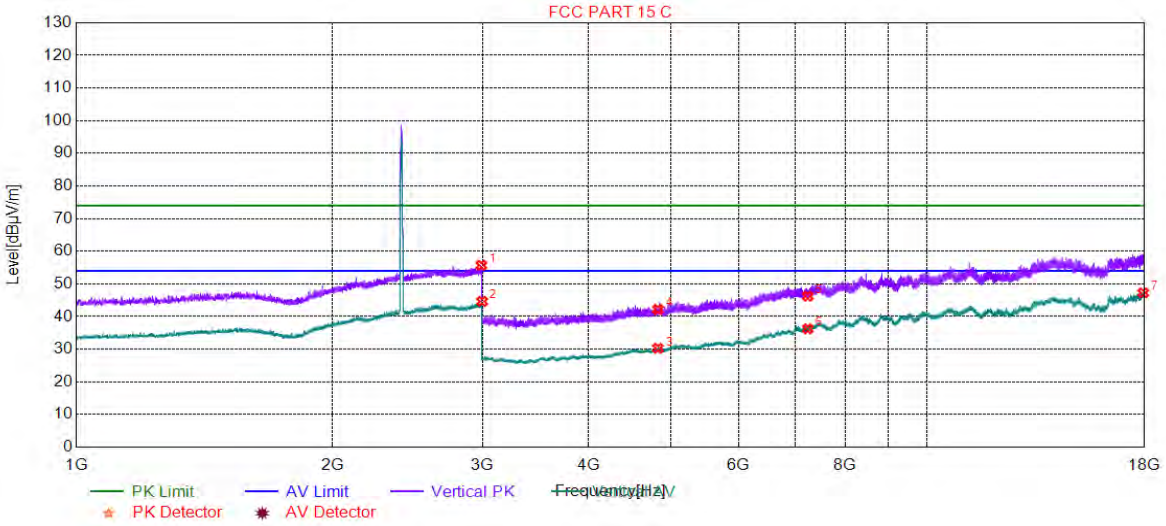
4.9.2.1.2 802.11B_Lowest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2991.49	55.74	9.49	74.00	18.26	150	358	Vertical
2	2997.99	44.66	9.46	54.00	9.34	150	18	Vertical
3	4824.00	30.30	-18.21	54.00	23.70	150	287	Vertical
4	4824.00	42.21	-18.21	74.00	31.79	150	260	Vertical
5	7236.00	46.26	-9.99	74.00	27.74	150	219	Vertical
6	7236.00	36.26	-9.99	54.00	17.74	150	360	Vertical
7	17933.9	47.28	0.70	54.00	6.72	150	169	Vertical

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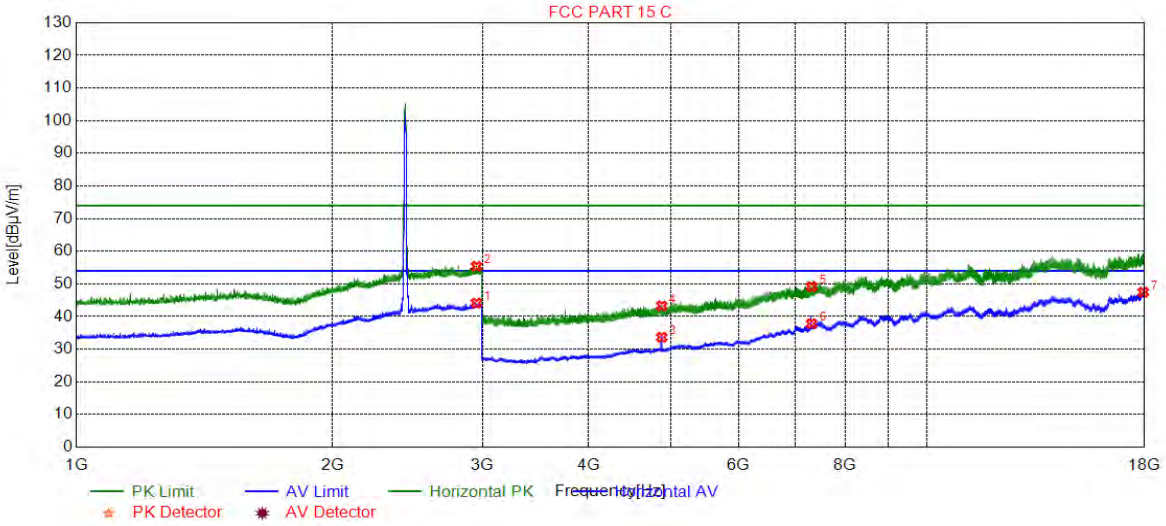
4.9.2.1.3 802.11B_ Middle Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2952.48	44.14	9.67	54.00	9.86	150	124	Horizontal
2	2952.98	55.41	9.67	74.00	18.59	150	83	Horizontal
3	4874.00	33.68	-17.99	54.00	20.32	150	41	Horizontal
4	4874.00	43.29	-17.99	74.00	30.71	150	96	Horizontal
5	7311.00	49.20	-9.74	74.00	24.80	150	229	Horizontal
6	7311.00	37.85	-9.74	54.00	16.15	150	178	Horizontal
7	17934.5	47.48	0.70	54.00	6.52	150	78	Horizontal

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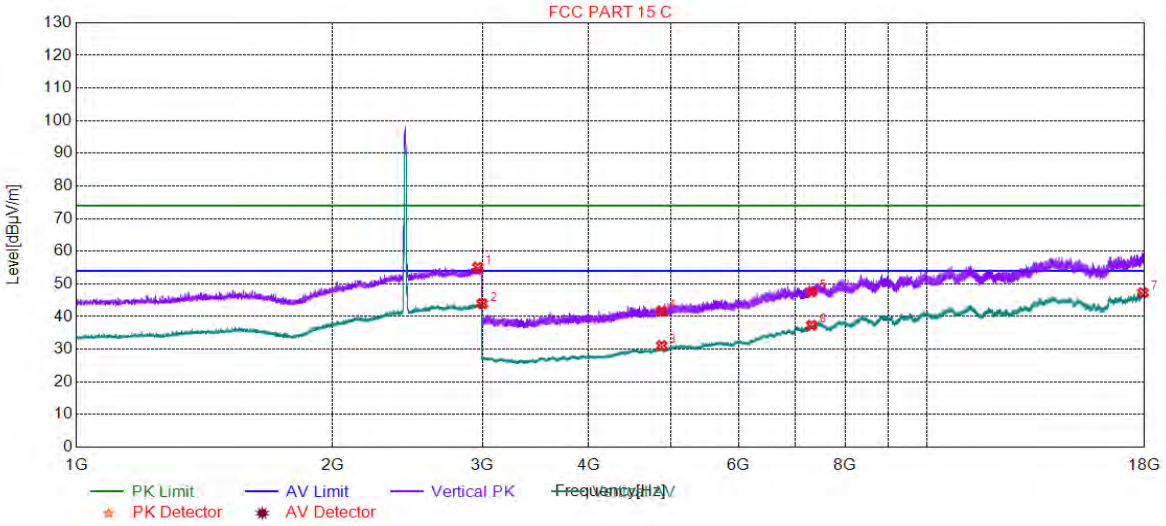
4.9.2.1.4 802.11B_ Middle Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2963.49	55.15	9.62	74.00	18.85	150	18	Vertical
2	2998.49	43.99	9.46	54.00	10.01	150	332	Vertical
3	4874.00	31.12	-17.99	54.00	22.88	150	342	Vertical
4	4874.00	41.71	-17.99	74.00	32.29	150	315	Vertical
5	7311.00	47.58	-9.74	74.00	26.42	150	68	Vertical
6	7311.00	37.35	-9.74	54.00	16.65	150	270	Vertical
7	17923.5	47.37	0.70	54.00	6.63	150	360	Vertical

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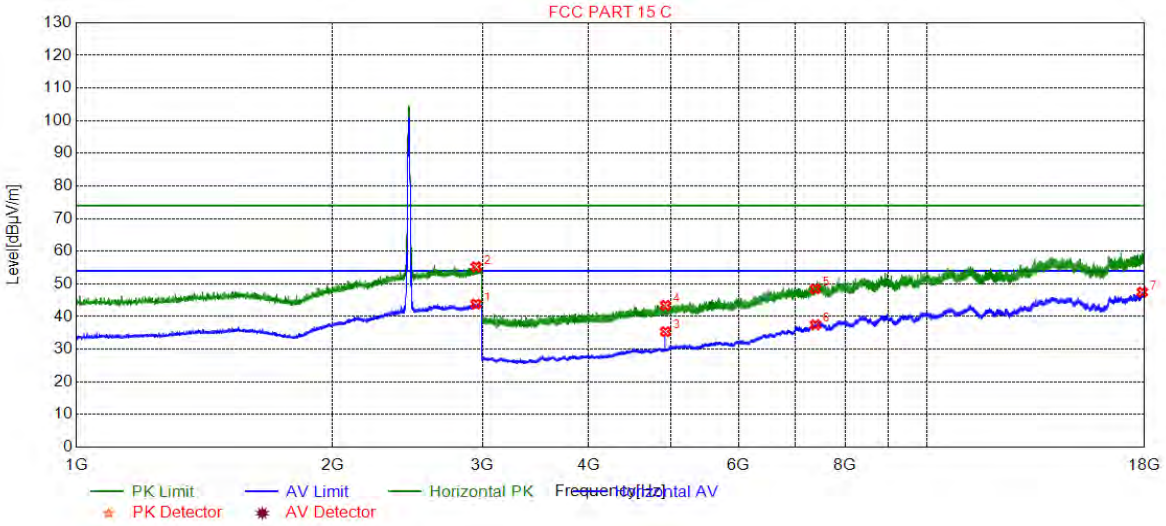
4.9.2.1.5 802.11B_ Highest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2948.98	43.84	9.67	54.00	10.16	150	274	Horizontal
2	2950.48	55.24	9.68	74.00	18.76	150	68	Horizontal
3	4924.00	35.39	-17.72	54.00	18.61	150	94	Horizontal
4	4924.00	43.43	-17.72	74.00	30.57	150	67	Horizontal
5	7386.00	48.48	-9.55	74.00	25.52	150	68	Horizontal
6	7386.00	37.49	-9.55	54.00	16.51	150	169	Horizontal
7	17885.0	47.50	0.49	54.00	6.50	150	18	Horizontal

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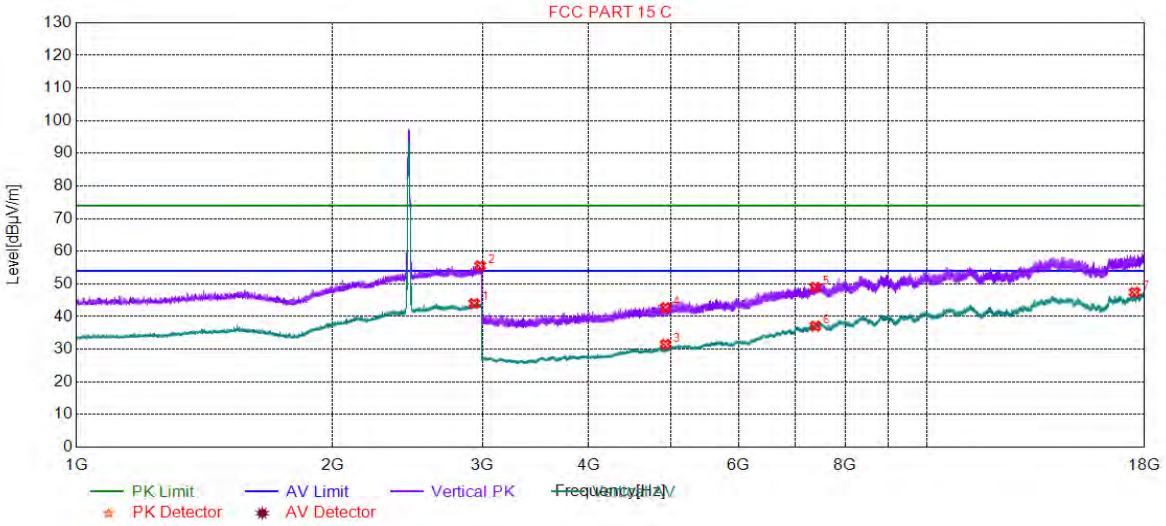
4.9.2.1.6 802.11B_ Highest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2934.48	44.02	9.51	54.00	9.98	150	303	Vertical
2	2981.99	55.57	9.53	74.00	18.43	150	58	Vertical
3	4924.00	31.50	-17.72	54.00	22.50	150	259	Vertical
4	4924.00	42.75	-17.72	74.00	31.25	150	12	Vertical
5	7386.00	48.96	-9.55	74.00	25.04	150	18	Vertical
6	7386.00	37.07	-9.55	54.00	16.93	150	18	Vertical
7	17518.7	47.44	0.99	54.00	6.56	150	119	Vertical

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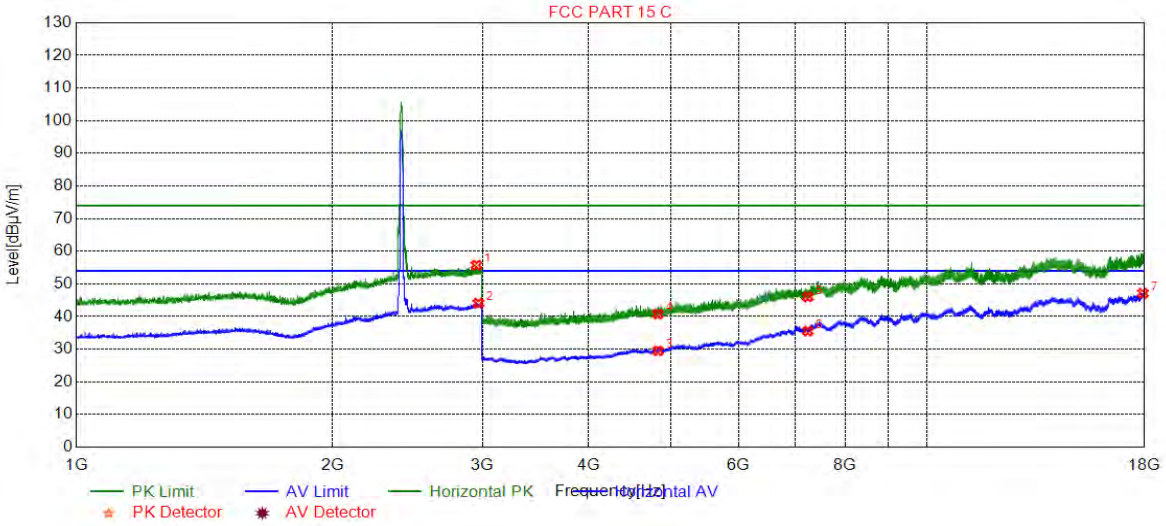
4.9.2.1.7 802.11G_Lowest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2952.48	55.76	9.67	74.00	18.24	150	40	Horizontal
2	2967.49	44.08	9.60	54.00	9.92	150	342	Horizontal
3	4824.00	29.52	-18.21	54.00	24.48	150	205	Horizontal
4	4824.00	40.78	-18.21	74.00	33.22	150	151	Horizontal
5	7236.00	46.04	-9.99	74.00	27.96	150	319	Horizontal
6	7236.00	35.57	-9.99	54.00	18.43	150	319	Horizontal
7	17916.3	47.13	0.69	54.00	6.87	150	168	Horizontal

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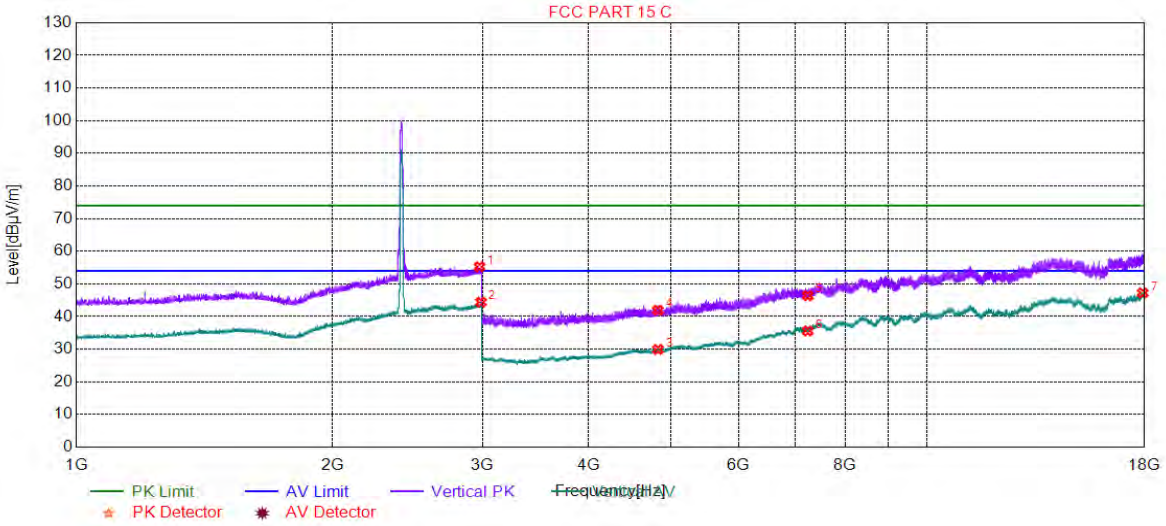
4.9.2.1.8 802.11G_Lowest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2976.99	55.27	9.56	74.00	18.73	150	87	Vertical
2	2988.49	44.42	9.50	54.00	9.58	150	18	Vertical
3	4824.00	29.93	-18.21	54.00	24.07	150	151	Vertical
4	4824.00	41.97	-18.21	74.00	32.03	150	13	Vertical
5	7236.00	46.42	-9.99	74.00	27.58	150	319	Vertical
6	7236.00	35.61	-9.99	54.00	18.39	150	360	Vertical
7	17907.5	47.26	0.69	54.00	6.74	150	219	Vertical

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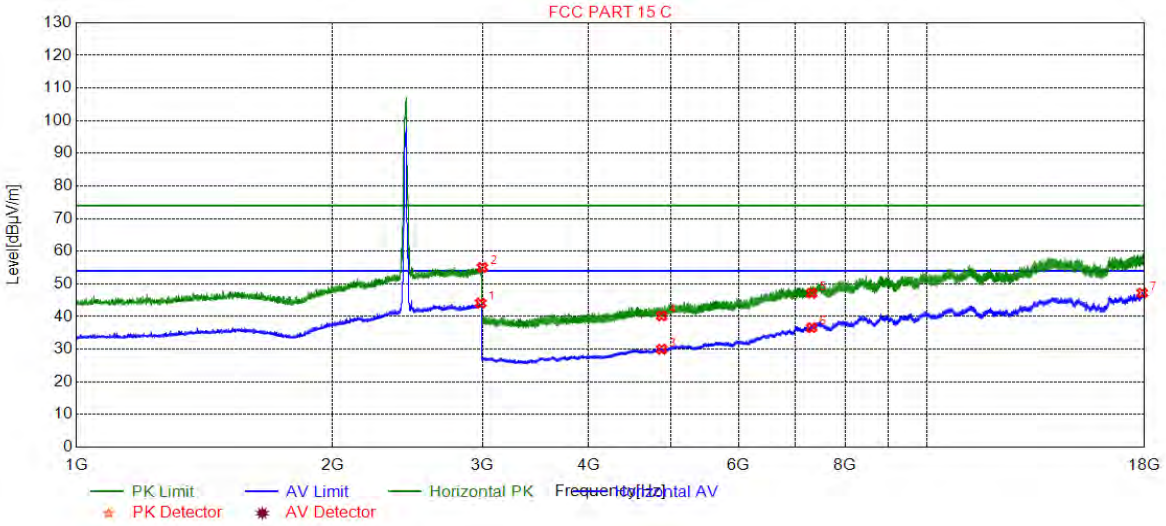
4.9.2.1.9 802.11G_ Middle Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2985.99	44.11	9.51	54.00	9.89	150	53	Horizontal
2	3000.00	55.04	9.45	74.00	18.96	150	25	Horizontal
3	4874.00	30.01	-17.99	54.00	23.99	150	12	Horizontal
4	4874.00	40.19	-17.99	74.00	33.81	150	204	Horizontal
5	7311.00	47.16	-9.74	74.00	26.84	150	360	Horizontal
6	7311.00	36.61	-9.74	54.00	17.39	150	269	Horizontal
7	17883.3	47.22	0.47	54.00	6.78	150	68	Horizontal

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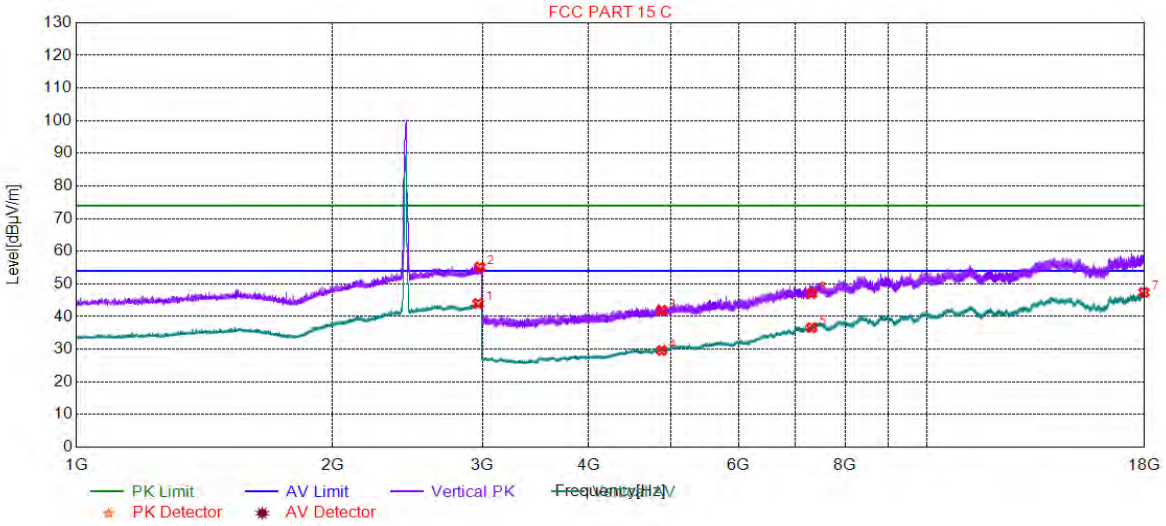
4.9.2.1.10 802.11G_ Middle Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2965.49	44.00	9.61	54.00	10.00	150	84	Vertical
2	2979.49	55.15	9.54	74.00	18.85	150	249	Vertical
3	4874.00	41.90	-17.99	74.00	32.10	150	314	Vertical
4	4874.00	29.61	-17.99	54.00	24.39	150	94	Vertical
5	7311.00	36.59	-9.74	54.00	17.41	150	119	Vertical
6	7311.00	47.10	-9.74	74.00	26.90	150	219	Vertical
7	17968.6	47.42	0.71	54.00	6.58	150	219	Vertical

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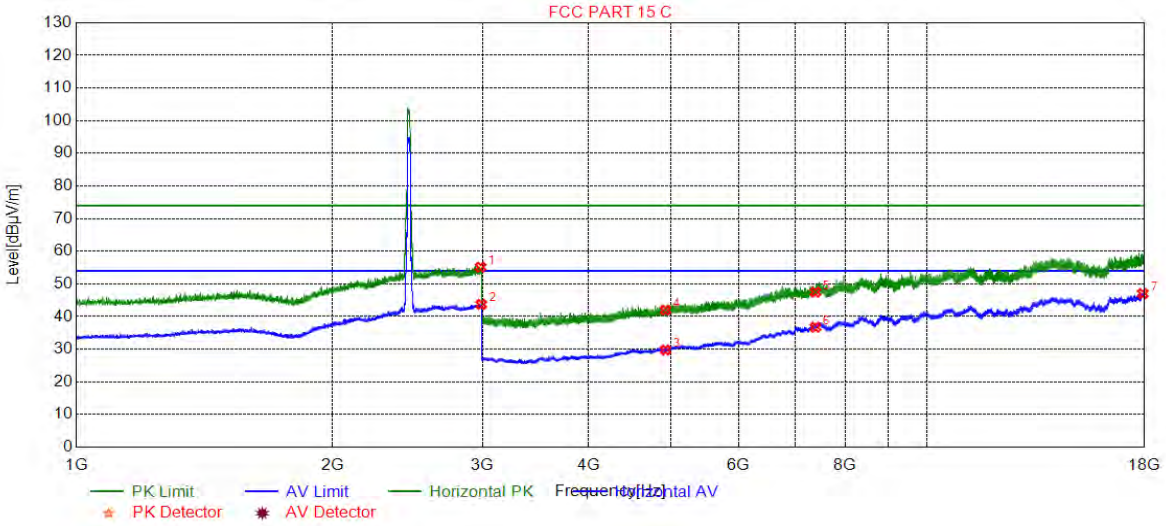
4.9.2.1.11 802.11G_ Highest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2985.49	55.16	9.52	74.00	18.84	150	232	Horizontal
2	2990.99	43.73	9.49	54.00	10.27	150	288	Horizontal
3	4924.00	29.77	-17.72	54.00	24.23	150	12	Horizontal
4	4924.00	42.00	-17.72	74.00	32.00	150	232	Horizontal
5	7386.00	47.50	-9.55	74.00	26.50	150	270	Horizontal
6	7386.00	36.76	-9.55	54.00	17.24	150	69	Horizontal
7	17915.2	47.03	0.69	54.00	6.97	150	270	Horizontal

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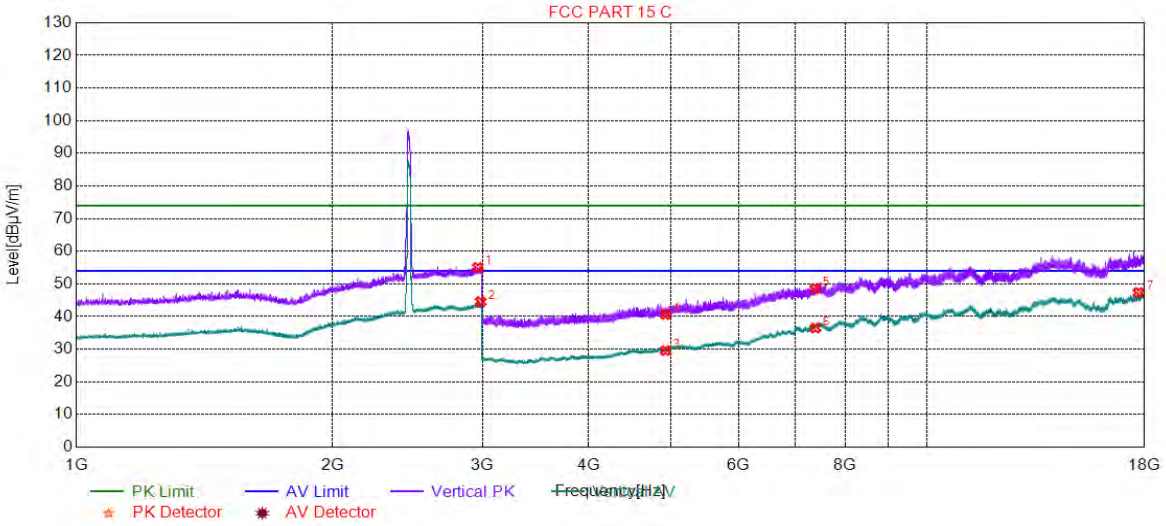
4.9.2.1.12 802.11G_ Highest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2963.99	55.08	9.62	74.00	18.92	150	45	Vertical
2	2985.99	44.57	9.51	54.00	9.43	150	58	Vertical
3	4924.00	29.57	-17.72	54.00	24.43	150	287	Vertical
4	4924.00	40.66	-17.72	74.00	33.34	150	12	Vertical
5	7386.00	48.59	-9.55	74.00	25.41	150	220	Vertical
6	7386.00	36.48	-9.55	54.00	17.52	150	270	Vertical
7	17704.6	47.37	1.27	54.00	6.63	150	320	Vertical

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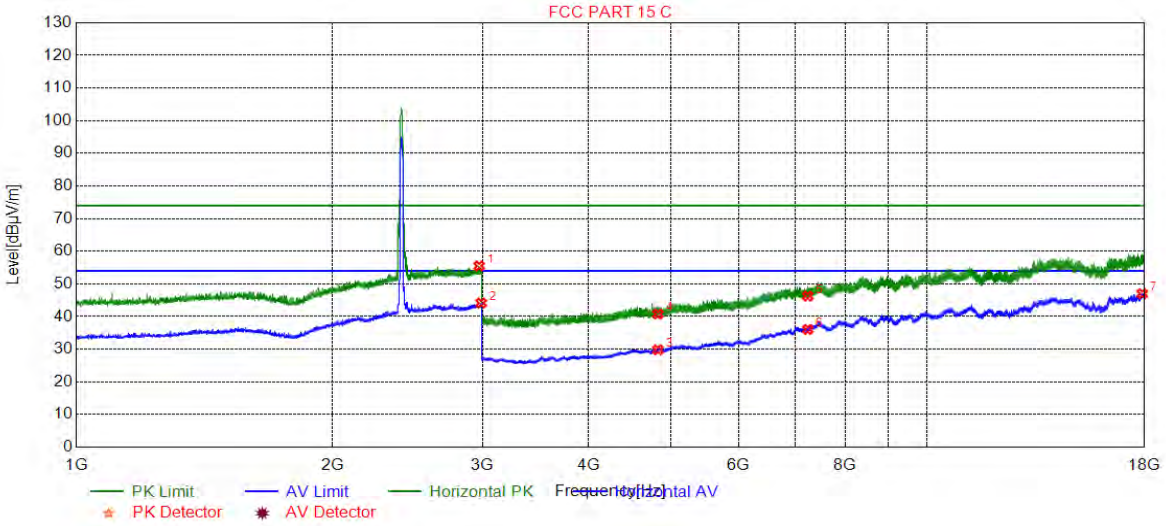
4.9.2.1.13 802.11N20_Lowest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2973.49	55.51	9.57	74.00	18.49	150	110	Horizontal
2	2989.99	44.16	9.50	54.00	9.84	150	219	Horizontal
3	4824.00	29.83	-18.21	54.00	24.17	150	96	Horizontal
4	4824.00	40.77	-18.21	74.00	33.23	150	260	Horizontal
5	7236.00	46.30	-9.99	74.00	27.70	150	220	Horizontal
6	7236.00	36.08	-9.99	54.00	17.92	150	220	Horizontal
7	17884.4	47.00	0.49	54.00	7.00	150	220	Horizontal

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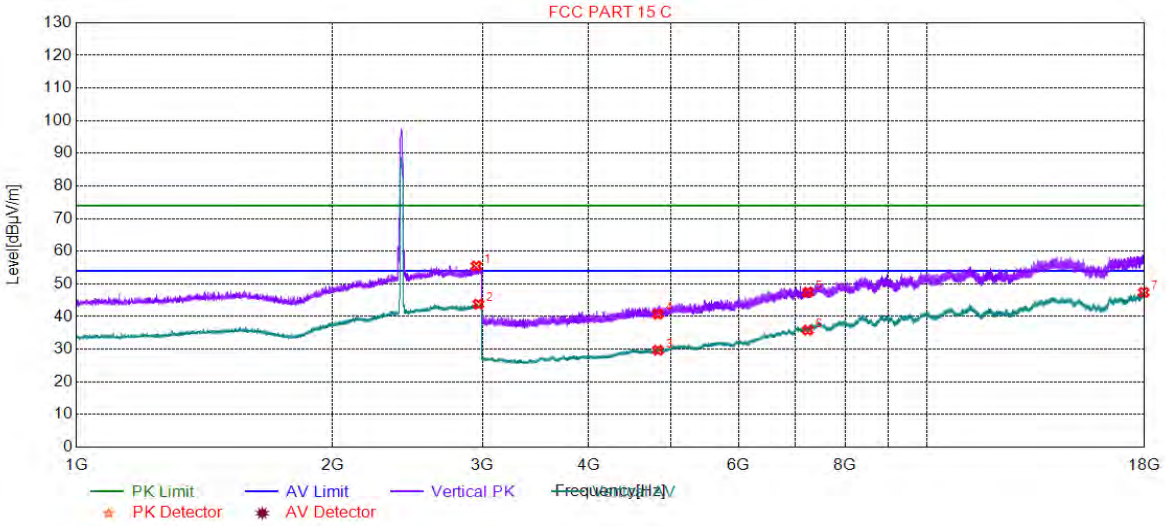
4.9.2.1.14 802.11N20_Lowest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2950.98	55.49	9.68	74.00	18.51	150	72	Vertical
2	2967.49	43.82	9.60	54.00	10.18	150	72	Vertical
3	4824.00	29.71	-18.21	54.00	24.29	150	151	Vertical
4	4824.00	40.72	-18.21	74.00	33.28	150	288	Vertical
5	7236.00	47.45	-9.99	74.00	26.55	150	360	Vertical
6	7236.00	35.85	-9.99	54.00	18.15	150	119	Vertical
7	17953.7	47.45	0.71	54.00	6.55	150	18	Vertical

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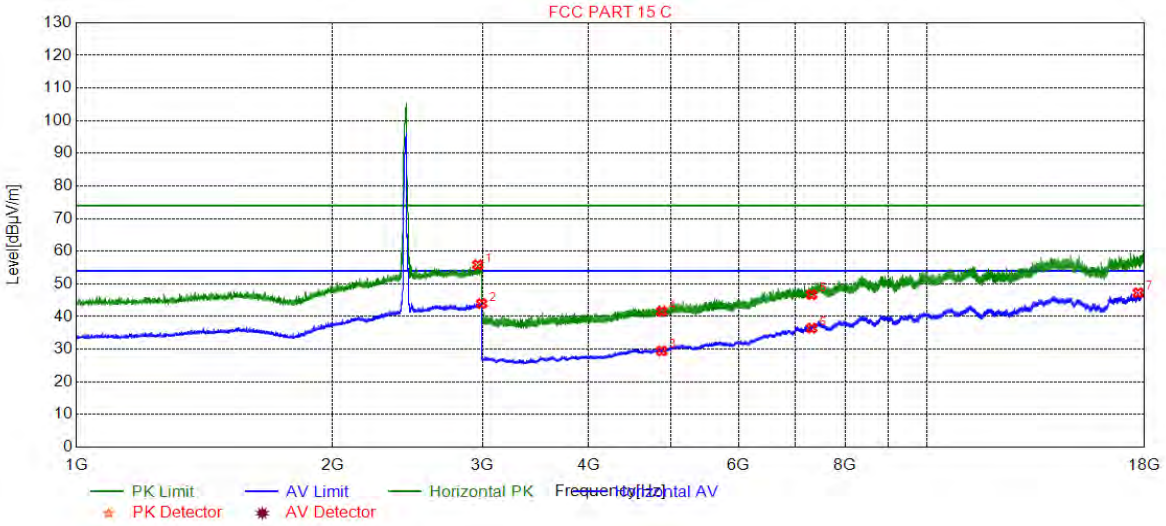
4.9.2.1.15 802.11N20_ Middle Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2962.99	55.85	9.62	74.00	18.15	150	110	Horizontal
2	2994.99	43.99	9.47	54.00	10.01	150	151	Horizontal
3	4874.00	29.48	-17.99	54.00	24.52	150	95	Horizontal
4	4874.00	41.61	-17.99	74.00	32.39	150	40	Horizontal
5	7311.00	46.70	-9.74	74.00	27.30	150	168	Horizontal
6	7311.00	36.46	-9.74	54.00	17.54	150	68	Horizontal
7	17689.7	47.31	1.35	54.00	6.69	150	18	Horizontal

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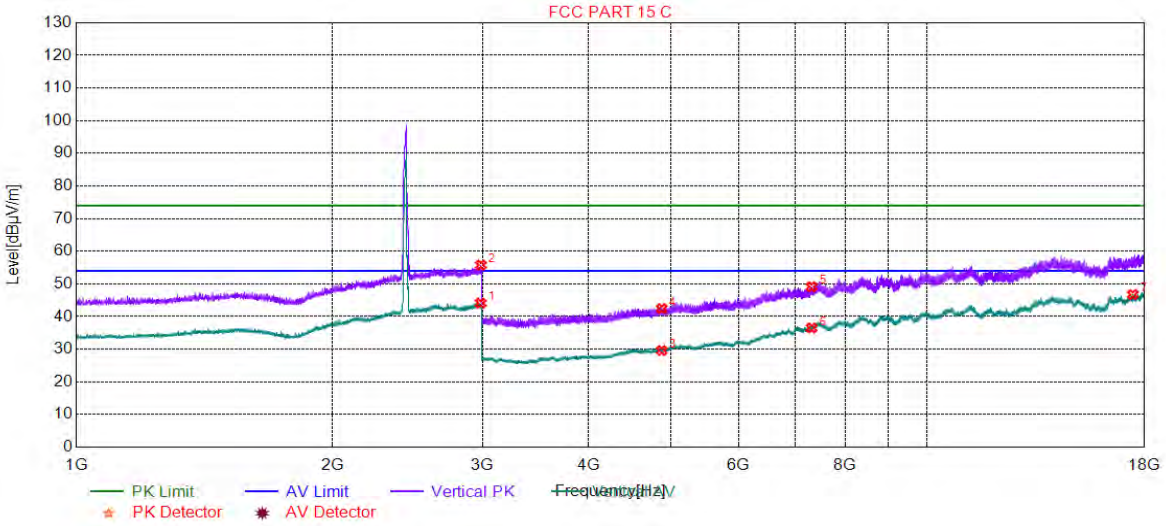
4.9.2.1.16 802.11N20_ Middle Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2985.99	44.11	9.51	54.00	9.89	150	87	Vertical
2	2987.99	55.78	9.51	74.00	18.22	150	197	Vertical
3	4874.00	29.61	-17.99	54.00	24.39	150	14	Vertical
4	4874.00	42.45	-17.99	74.00	31.55	150	288	Vertical
5	7311.00	49.16	-9.74	74.00	24.84	150	319	Vertical
6	7311.00	36.51	-9.74	54.00	17.49	150	220	Vertical
7	17431.8	46.78	0.48	54.00	7.22	150	69	Vertical

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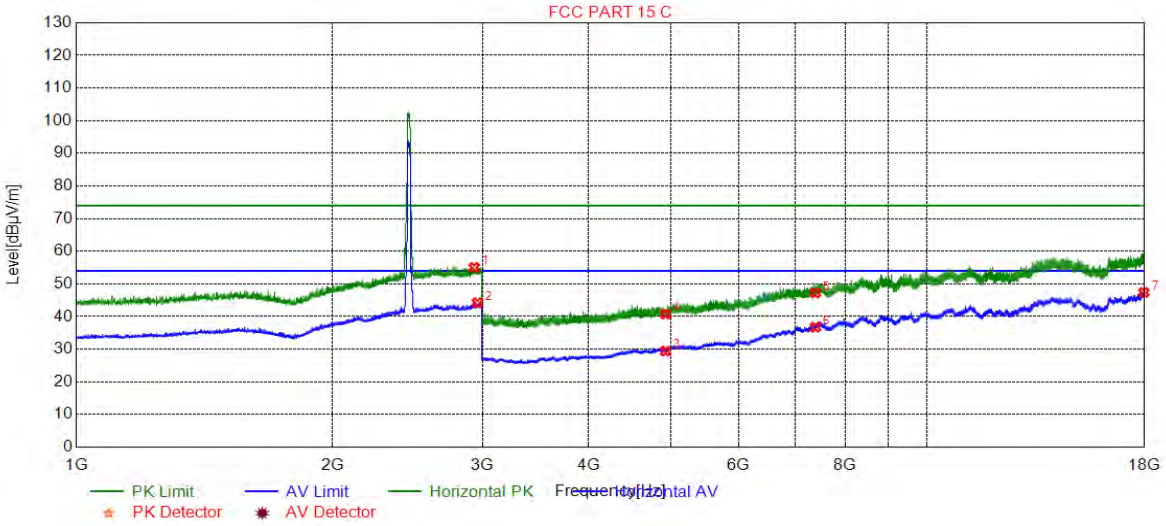
4.9.2.1.17 802.11N20_ Highest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2933.98	55.06	9.51	74.00	18.94	150	137	Horizontal
2	2959.48	44.23	9.64	54.00	9.77	150	137	Horizontal
3	4924.00	29.43	-17.72	54.00	24.57	150	205	Horizontal
4	4924.00	40.76	-17.72	74.00	33.24	150	260	Horizontal
5	7386.00	47.24	-9.55	74.00	26.76	150	69	Horizontal
6	7386.00	36.77	-9.55	54.00	17.23	150	69	Horizontal
7	17960.9	47.40	0.71	54.00	6.60	150	169	Horizontal

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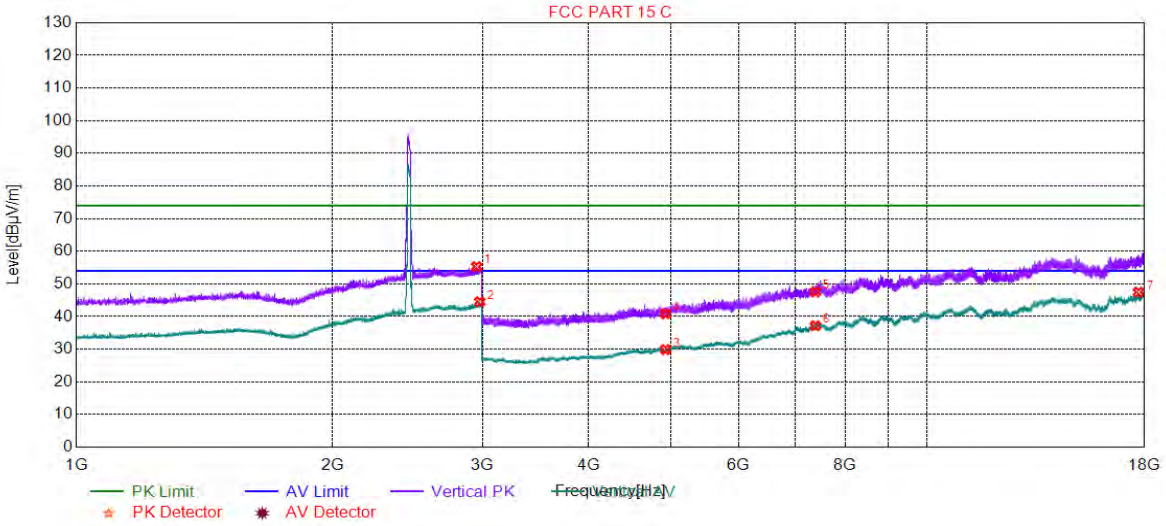
4.9.2.1.18 802.11N20_ Highest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2953.98	55.30	9.66	74.00	18.70	150	127	Vertical
2	2979.49	44.54	9.54	54.00	9.46	150	210	Vertical
3	4924.00	29.90	-17.72	54.00	24.10	150	122	Vertical
4	4924.00	40.87	-17.72	74.00	33.13	150	314	Vertical
5	7386.00	47.56	-9.55	74.00	26.44	150	320	Vertical
6	7386.00	37.19	-9.55	54.00	16.81	150	360	Vertical
7	17702.9	47.49	1.30	54.00	6.51	150	169	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:			

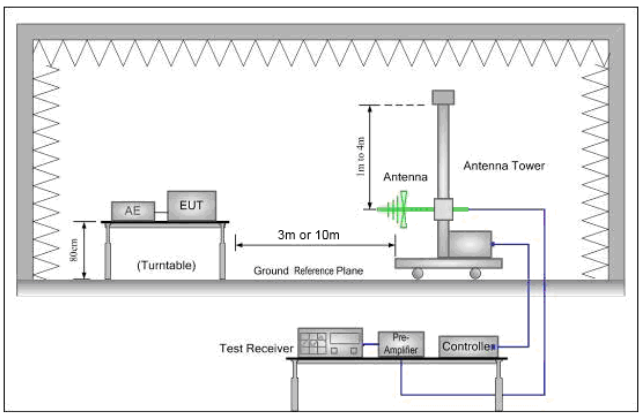

Figure 1. 30MHz to 1GHz

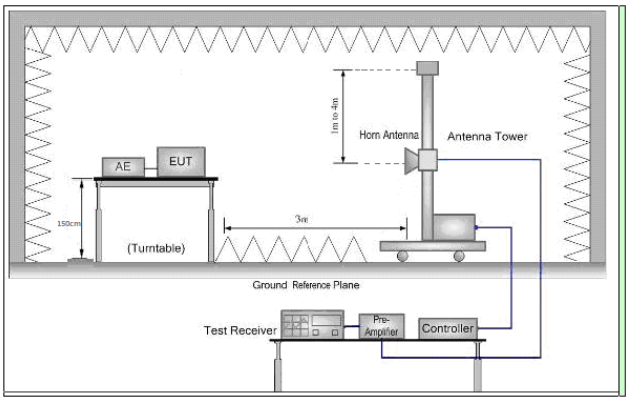

Figure 2. Above 1 GHz

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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); 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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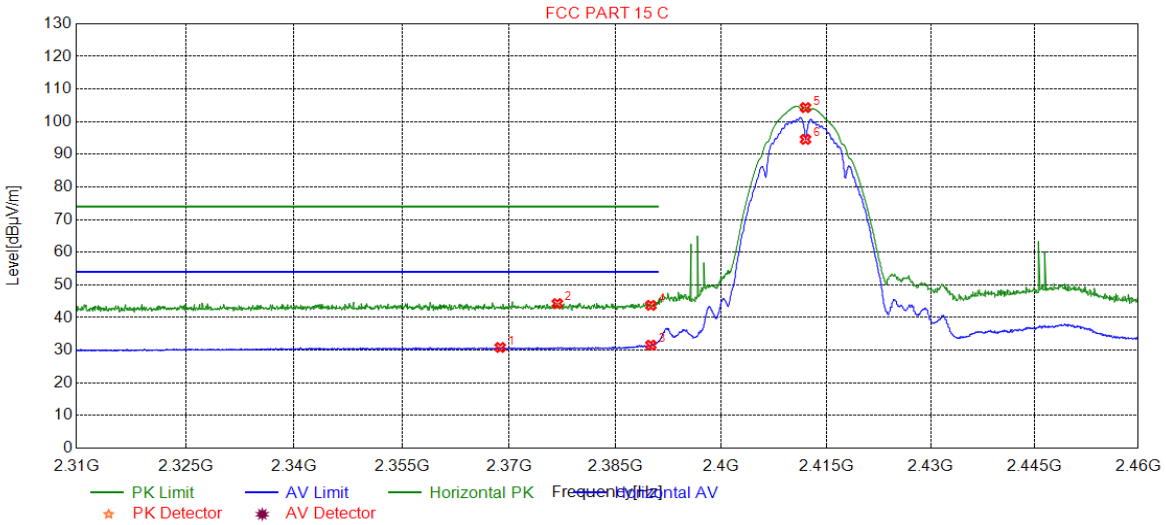
Test plot as follows:

4.10.1 ANT1

4.10.1.1 802.11B_Lowest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2368.75	30.86	7.79	54.00	23.14	150	138	Horizontal
2	2376.78	44.31	7.78	74.00	29.69	150	188	Horizontal
3	2390.00	31.57	7.77	54.00	22.43	150	210	Horizontal
4	2390.00	43.75	7.77	74.00	30.25	150	2	Horizontal
5	2412.00	104.33	7.81	0.00	-104.33	150	248	Horizontal
6	2412.00	94.59	7.81	0.00	-94.59	150	205	Horizontal

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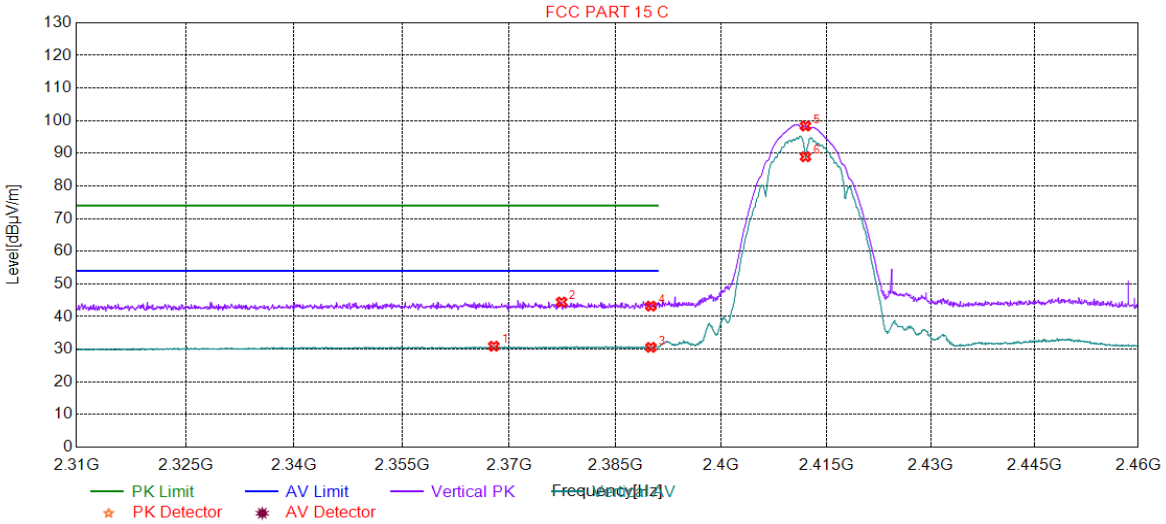
4.10.1.2 802.11B_Lowest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2367.85	30.93	7.79	54.00	23.07	150	208	Vertical
2	2377.38	44.46	7.78	74.00	29.54	150	254	Vertical
3	2390.00	30.58	7.77	54.00	23.42	150	181	Vertical
4	2390.00	43.21	7.77	74.00	30.79	150	297	Vertical
5	2412.00	98.37	7.81	0.00	-98.37	150	220	Vertical
6	2412.00	88.96	7.81	0.00	-88.96	150	213	Vertical

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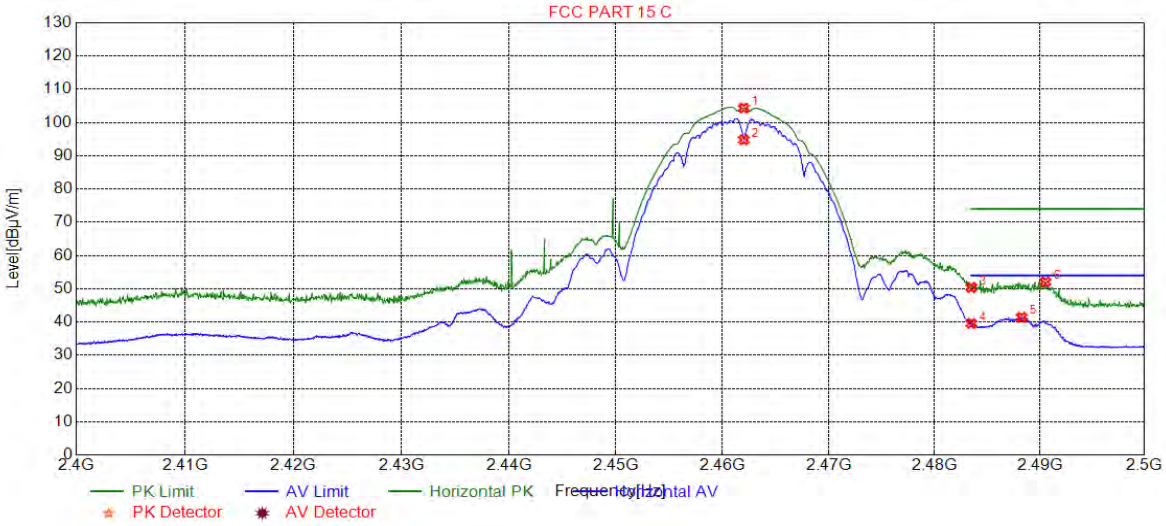
4.10.1.3 802.11B_ Highest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.00	104.36	7.98	0.00	-104.36	150	204	Horizontal
2	2462.00	94.81	7.98	0.00	-94.81	150	204	Horizontal
3	2483.50	50.40	8.01	74.00	23.60	150	204	Horizontal
4	2483.50	39.59	8.01	54.00	14.41	150	204	Horizontal
5	2488.29	41.41	8.02	54.00	12.59	150	204	Horizontal
6	2490.54	52.09	8.02	74.00	21.91	150	209	Horizontal

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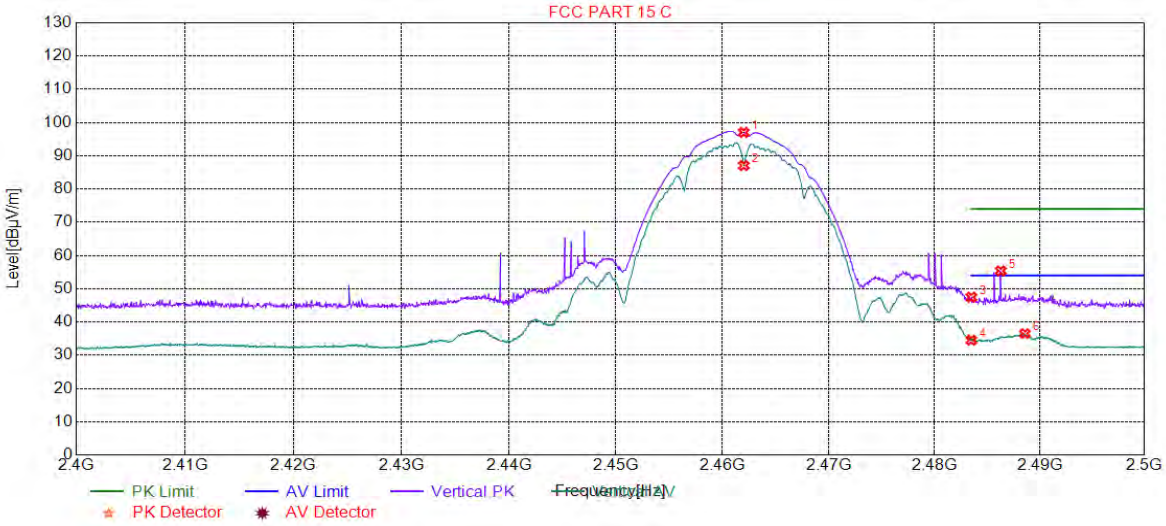
4.10.1.4 802.11B_ Highest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.00	97.03	7.98	0.00	-97.03	150	220	Vertical
2	2462.00	87.06	7.98	0.00	-87.06	150	350	Vertical
3	2483.50	47.48	8.01	74.00	26.52	150	323	Vertical
4	2483.50	34.55	8.01	54.00	19.45	150	214	Vertical
5	2486.29	55.39	8.01	74.00	18.61	150	159	Vertical
6	2488.59	36.54	8.02	54.00	17.46	150	220	Vertical

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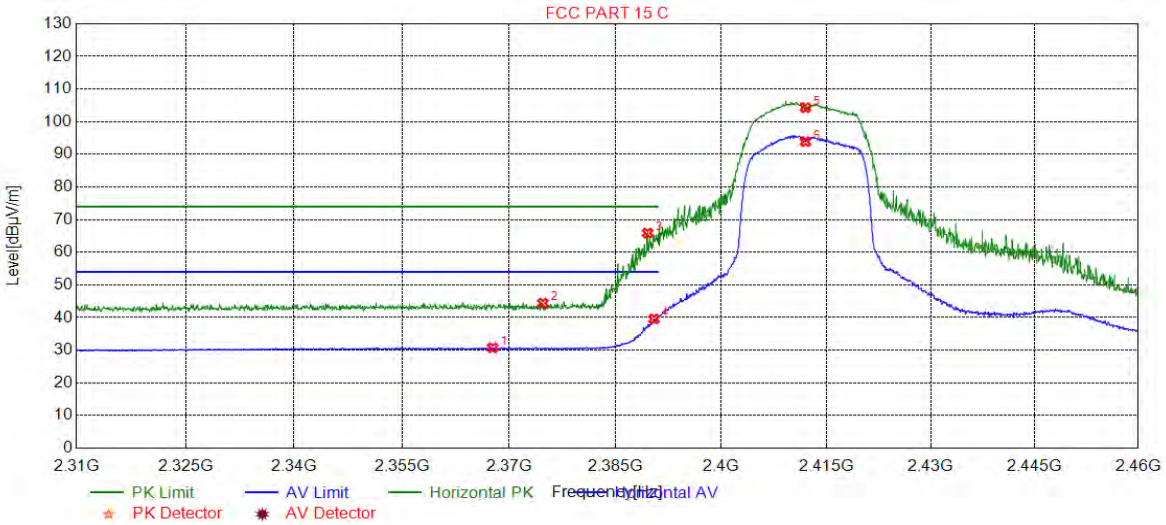
4.10.1.5 802.11G_Lowest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2367.70	30.74	7.79	54.00	23.26	150	156	Horizontal
2	2374.75	44.44	7.79	74.00	29.56	150	117	Horizontal
3	2389.53	65.90	7.77	74.00	8.10	150	209	Horizontal
4	2390.44	39.57	7.77	54.00	14.43	150	215	Horizontal
5	2412.00	104.30	7.81	0.00	-104.30	150	209	Horizontal
6	2412.00	93.91	7.81	0.00	-93.91	150	215	Horizontal

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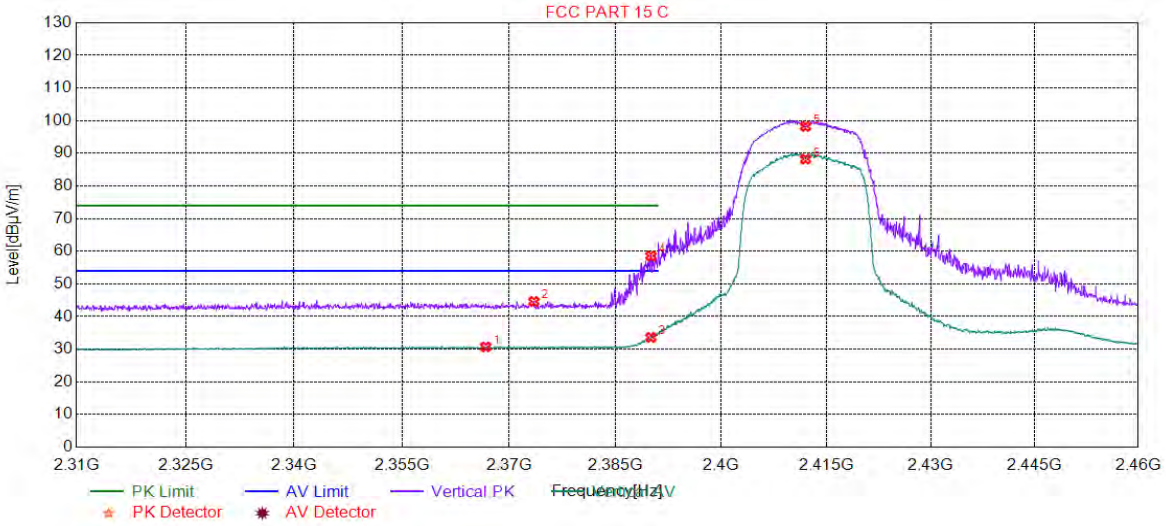
4.10.1.6 802.11G_Lowest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2366.72	30.73	7.79	54.00	23.27	150	14	Vertical
2	2373.48	44.62	7.79	74.00	29.38	150	145	Vertical
3	2390.00	33.61	7.77	54.00	20.39	150	167	Vertical
4	2390.00	58.57	7.77	74.00	15.43	150	222	Vertical
5	2412.00	98.25	7.81	0.00	-98.25	150	329	Vertical
6	2412.00	88.24	7.81	0.00	-88.24	150	173	Vertical

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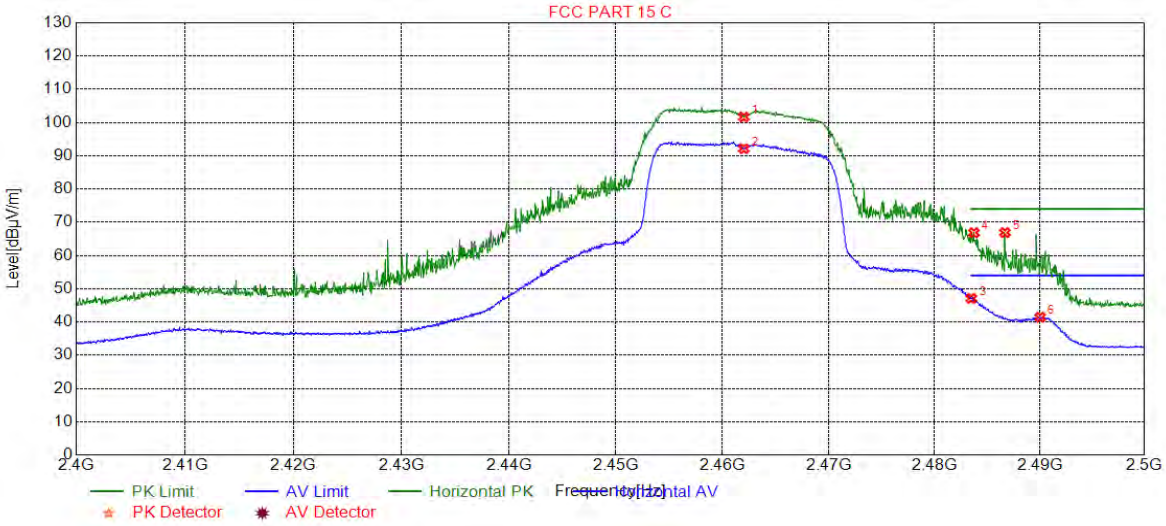
4.10.1.7 802.11G_ Highest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.00	101.67	7.98	0.00	-101.67	150	205	Horizontal
2	2462.00	92.14	7.98	0.00	-92.14	150	210	Horizontal
3	2483.50	47.08	8.01	54.00	6.92	150	205	Horizontal
4	2483.74	66.86	8.01	74.00	7.14	150	205	Horizontal
5	2486.69	66.91	8.01	74.00	7.09	150	210	Horizontal
6	2490.04	41.46	8.02	54.00	12.54	150	210	Horizontal

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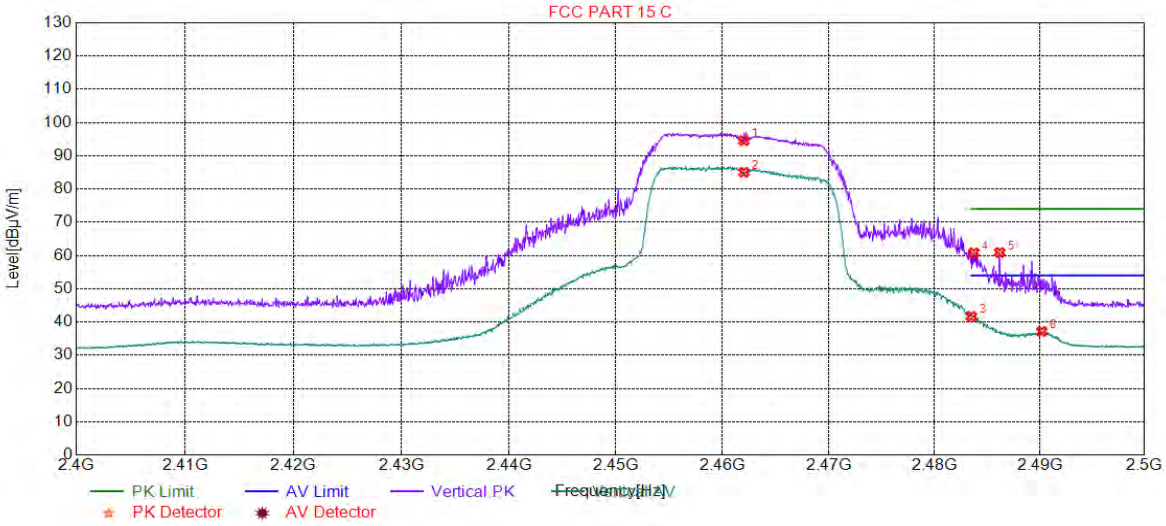
4.10.1.8 802.11G_ Highest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.00	94.60	7.98	0.00	-94.60	150	226	Vertical
2	2462.00	85.05	7.98	0.00	-85.05	150	221	Vertical
3	2483.50	41.70	8.01	54.00	12.30	150	330	Vertical
4	2483.74	60.83	8.01	74.00	13.17	150	347	Vertical
5	2486.19	60.94	8.01	74.00	13.06	150	324	Vertical
6	2490.19	37.18	8.02	54.00	16.82	150	324	Vertical

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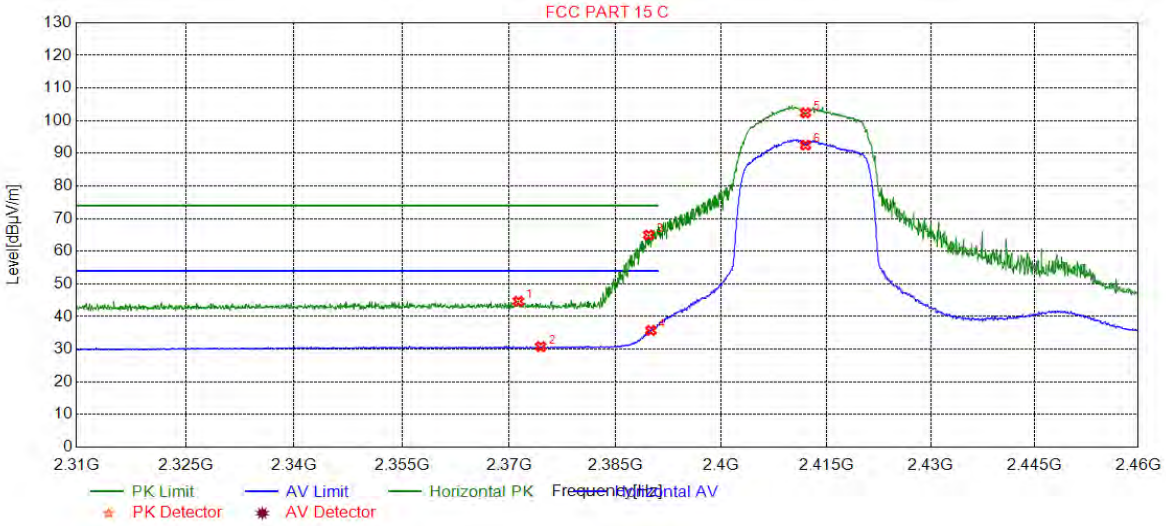
4.10.1.9 802.11N20_ Lowest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2371.30	44.68	7.79	74.00	29.32	150	266	Horizontal
2	2374.45	30.81	7.79	54.00	23.19	150	155	Horizontal
3	2389.68	64.99	7.77	74.00	9.01	150	211	Horizontal
4	2390.00	35.76	7.77	54.00	18.24	150	216	Horizontal
5	2412.00	102.42	7.81	0.00	-102.42	150	200	Horizontal
6	2412.00	92.51	7.81	0.00	-92.51	150	211	Horizontal

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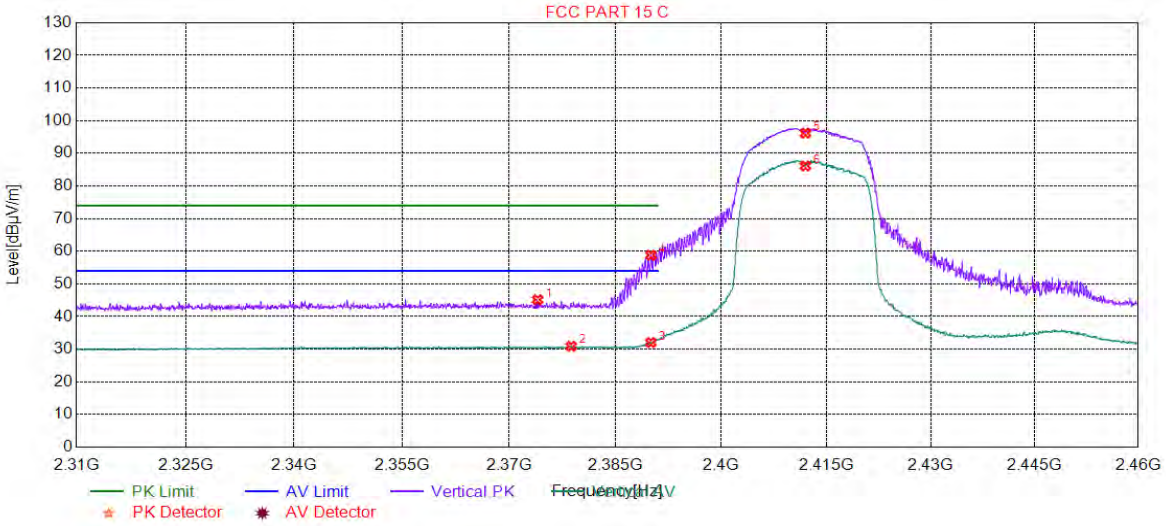
4.10.1.10 802.11N20_Lowest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2374.00	45.17	7.79	74.00	28.83	150	249	Vertical
2	2378.73	30.92	7.78	54.00	23.08	150	316	Vertical
3	2390.00	32.07	7.77	54.00	21.93	150	227	Vertical
4	2390.00	58.80	7.77	74.00	15.20	150	227	Vertical
5	2412.00	96.21	7.81	0.00	-96.21	150	353	Vertical
6	2412.00	86.14	7.81	0.00	-86.14	150	326	Vertical

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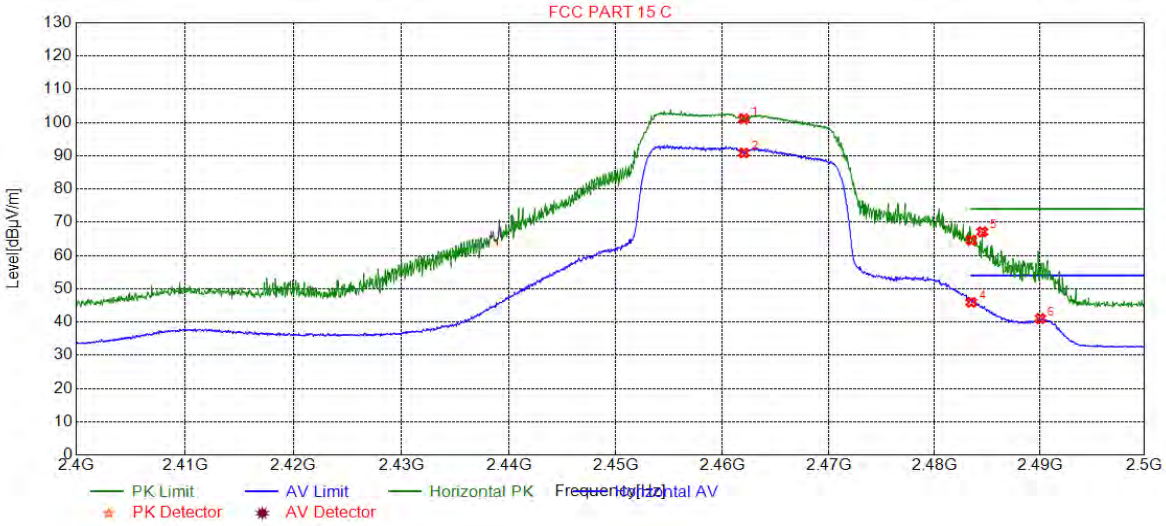
4.10.1.11 802.11N20_ Highest Channel_ Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.00	101.14	7.98	0.00	-101.14	150	204	Horizontal
2	2462.00	90.87	7.98	0.00	-90.87	150	209	Horizontal
3	2483.50	64.60	8.01	74.00	9.40	150	198	Horizontal
4	2483.50	45.95	8.01	54.00	8.05	150	209	Horizontal
5	2484.54	67.14	8.01	74.00	6.86	150	204	Horizontal
6	2490.04	41.06	8.02	54.00	12.94	150	209	Horizontal

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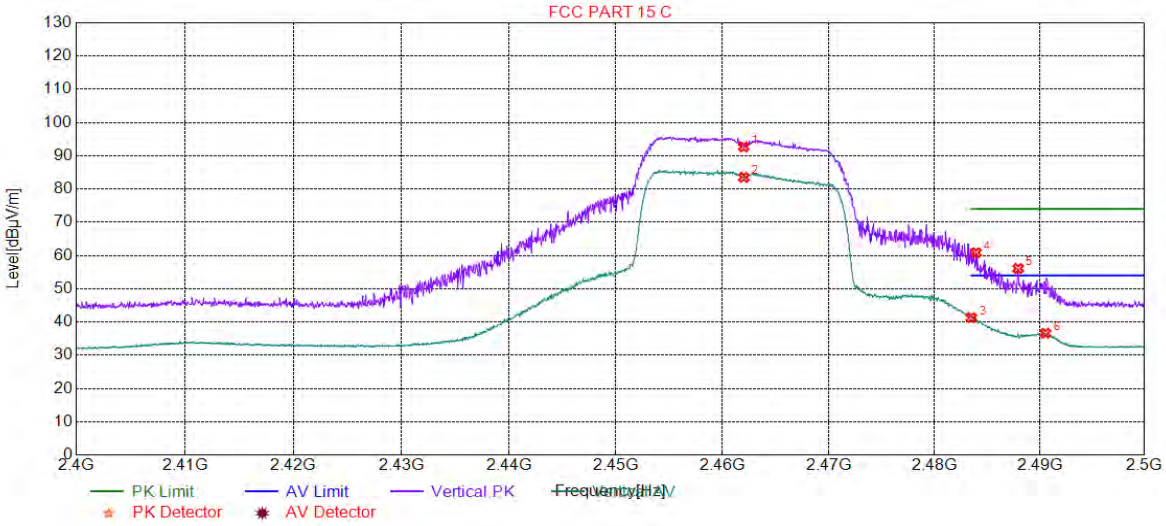
4.10.1.12 802.11N20_ Highest Channel_ Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.00	92.66	7.98	0.00	-92.66	150	222	Vertical
2	2462.00	83.52	7.98	0.00	-83.52	150	222	Vertical
3	2483.50	41.32	8.01	54.00	12.68	150	325	Vertical
4	2483.94	60.90	8.01	74.00	13.10	150	330	Vertical
5	2487.94	56.11	8.02	74.00	17.89	150	347	Vertical
6	2490.54	36.65	8.02	54.00	17.35	150	325	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)

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	Radiated Spurious emission test	±4.5dB (30MHz-1GHz)
		±4.8dB (1GHz-25GHz)
5	Conduct emission test	±3.12 dB (9KHz- 30MHz)
6	Temperature test	±1°C
7	Humidity test	±3%
8	DC and low frequency voltages	±0.5%

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6 Equipment List

Conducted Emission					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date (yyyy-mm-dd)	Cal.Duedate (yyyy-mm-dd)
Shielding Room	ZhongYu Electron	GB-88	SEM001-06	2020/5/10	2023/5/9
LISN	Rohde & Schwarz	ENV216	SEM007-01	2020/7/14	2023/7/13
				2017/7/15	2020/7/14
LISN	ETS-LINDGREN	Feb-16	SEM007-02	2020/4/1	2021/3/31
Measurement Software	AUDIX	e3 V5.4.1221d	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM024-01	2020/6/12	2021/6/11
2 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T2-02	EMC0122	2020/2/11	2021/2/10
EMI Test Receiver	Rohde & Schwarz	ESCI	SEM004-02	2020/3/2	2021/3/1

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	2020/7/15	2021/7/14
				2019/7/16	2020/7/15
Signal Analyzer	Rohde & Schwarz	FSV	W025-05	2020/1/3	2021/1/2
Coaxial Cable	SGS	N/A	SEM031-01	2020/6/12	2021/6/11
Attenuator	Weinschel Associates	WA41	SEM021-09	N/A	N/A
Signal Generator	KEYSIGHT	N5173B	SEM006-05	2020/7/15	2021/7/14
				2019/7/16	2020/7/15
Temperature Chamber	GIANT FORCE	ICT-150-40-CP-AR	W027-03	2019/10/27	2020/10/27
Power Meter	Rohde & Schwarz	NRVS	SEM014-02	2020/7/15	2021/7/14
				2019/7/16	2020/7/15

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RE in Chamber					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date (yyyy-mm-dd)	Cal.Due date (yyyy-mm-dd)
3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2018/3/13	2021/3/12
Measurement Software	AUDIX	e3V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM026-01	2020/6/12	2021/6/11
EXA Signal Analyzer (10Hz-26.5GHz)	Agilent Technologies Inc	N9010A	SEM004-09	2020/3/12	2021/3/11
BiConiLog Antenna (26-3000MHz)	ETS-Lindgren	3142C	SEM003-01	2020/6/27	2023/6/26
Horn Antenna (0.8-18GHz)	Rohde & Schwarz	HF907	SEM003-07	2018/4/13	2021/4/12
Pre-amplifier(0.1-1.3GHz)	HP	8447D	SEM005-02	2020/7/15	2021/7/14
				2019/7/16	2020/7/15
Low Noise Amplifier(100MHz-18GHz)	Black Diamond Series	BDLNA-0118-352810	SEM005-05	2019/9/3	2020/9/2
Horn Antenna (15-40GHz)	Schwarzbeck	BBHA 9170	SEM003-15	2017/10/17	2020/10/16
Pre-amplifier(18-26GHz)	Rohde & Schwarz	CH14-H052	SEM005-17	2020/3/2	2021/3/1
Band filter	N/A	N/A	SEM023-01	N/A	N/A

RE in Chamber					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date (yyyy-mm-dd)	Cal.Due date (yyyy-mm-dd)
3m Semi-Anechoic Chamber	ETS-LINDGREN	N/A	SEM001-01	2017/8/5	2020/8/4
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM025-01	2020/6/12	2021/6/11
MXE EMI Receiver (20Hz-8.4GHz)	Agilent Technologies	N9038A	SEM004-05	2020/7/15	2021/7/14
				2019/7/16	2020/7/15
BiConiLog Antenna (26-3000MHz)	ETS-LINDGREN	3142C	SEM003-01	2020/6/27	2023/6/26
Pre-amplifier (0.1-1.3GHz)	Agilent Technologies	8447D	SEM005-01	2020/3/2	2021/3/1

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RE in Chamber					
Test Equipment	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal. Date (yyyy-mm-dd)**	**Cal. Due date (yyyy-mm-dd)**
10m Semi-Anechoic Chamber	SAEMC	FSAC1018	SEM001-03	2018/3/31	2021/3/30
EMI Test Receiver (9k-7GHz)	Rohde & Schwarz	ESR	SEM004-03	2020/3/2	2021/3/1
Trilog-Broadband Antenna(25M-2GHz)	Schwarzbeck	VULB9168	SEM003-18	2020/3/15	2022/3/14
Pre-amplifier (9k-1GHz)	Sonoma	310N	SEM005-03	2020/3/12	2021/3/11
Loop Antenna (9kHz-30MHz)	ETS-Lindgren	6502	SEM003-08	2017/8/22	2020/8/21
Measurement Software	AUDIX	e3 V8.2014-6-27	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM029-01	2020/6/12	2021/6/11

7 Photographs - EUT Constructional Details

Refer to Appendix A - Photographs of Set-Up for ZR/2020/70004.

The End

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