



# FCC TEST REPORT

**Application No:** ZR/2020/50027  
**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-X306X  
**Trade Mark:** Lenovo  
**FCC ID:** O57TBX306X  
**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:** 2020/6/26

<b>Test Result:</b>	<b>PASS *</b>
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\* 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		2020/6/26		Original

<b>Authorized for issue by:</b>			
<b>Tested By</b>		 <hr/> (Mike Hu) /Project Engineer	
<b>Checked By</b>		 <hr/> (David Chen) /Reviewer	

**Remark:**

There difference between Lenovo TB-X306F and Lenovo TB-X306X,  
They are only difference on BOM and Software:

Lenovo TB-X306F is lack some components for GSM/WCDMA/LTE, and change software to disable GSM/WCDMA/LTE function.WCDMA/LTE function.

According to the difference above, there were only spot-check for radiated emission on TB-X306X, since radiated emission below 1GHz become worse,only this data were updated on this report,other data were copied from the report of Lenovo TB-X306F( Report No.: ZR/2020/5000102).





## 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:	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

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
E-mail:	ee.shenzhen@sgs.com

#### 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 17025:2005 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::	Portable Tablet Computer
Model No.:	Lenovo TB-X306X
Trade Mark:	Lenovo
Hardware Version:	Lenovo TB-X306X
Software Version:	TB-X306X_RF01_200620
IEEE 802.11 WLAN Mode Supported	<input checked="" type="checkbox"/> 802.11B (20 MHz channel bandwidth), <input checked="" type="checkbox"/> 802.11G (20 MHz channel bandwidth) <input checked="" type="checkbox"/> 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:	<input checked="" type="checkbox"/> Portable Device, <input type="checkbox"/> Module
Antenna Type:	<input type="checkbox"/> External, <input checked="" type="checkbox"/> Integrated
Antenna Ports	<input type="checkbox"/> Ant 1, <input type="checkbox"/> Ant 2, <input type="checkbox"/> Ant 3
Smart System	<input checked="" type="checkbox"/> SISO (for 802.11B/G/N), <input type="checkbox"/> MIMO (for 802.11N): 2 Tx & 2 Rx, <input type="checkbox"/> Diversity (for 802.11B/G) : Tx & Rx
Antenna Gain:	-3.5dBi
Power Supply	<input checked="" type="checkbox"/> AC/DC Adapter; <input type="checkbox"/> Battery <input type="checkbox"/> PoE;; <input type="checkbox"/> Other:
Accessories	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:

Channel	Frequency for 802.11B/G/N (HT20)
---------	----------------------------------



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### 3.5 Test

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

<b>Standard requirement:</b>	47 CFR Part 15C Section 15.203 /247(c)
<p>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.</p> <p>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.</p>	
<p>The antenna is integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is -3.5dBi.</p>	



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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:	<ol style="list-style-type: none"> <li>1) The mains terminal disturbance voltage test was conducted in a shielded room.</li> <li>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.</li> <li>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,</li> <li>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.</li> <li>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.</li> </ol>		



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<p>Test Setup:</p>	
<p>Exploratory Test Mode:</p>	<p>Transmitting with all kind of modulations, data rates at lowest, middle and highest channel. Charge + Transmitting mode.</p>
<p>Final Test Mode:</p>	<p>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.</p>
<p>Instruments Used:</p>	<p>Refer to section 5.10 for details</p>
<p>Test Results:</p>	<p>Pass</p>

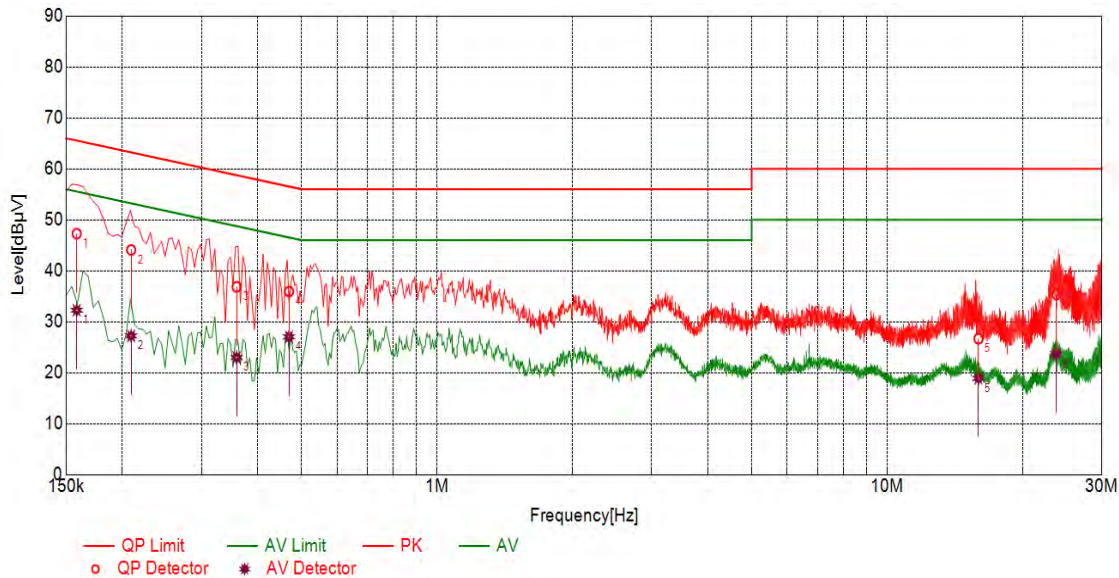


**Measurement Data**

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:



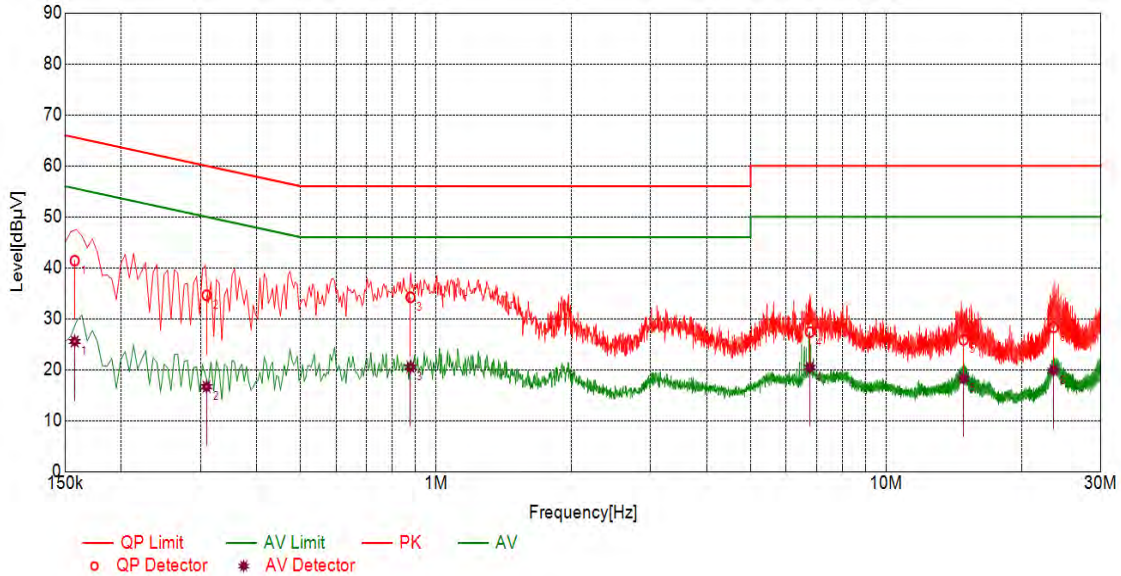
**Test Graph**

Final Data List									
NO.	Freq. [MHz]	Factor [dB]	QP Value	QP Limit	QP Margin	AV Value	AV Limit	AV Margin	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	QP Limit	QP Margin	AV Value	AV Limit	AV Margin	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.



### 4.3 Duty Cycle

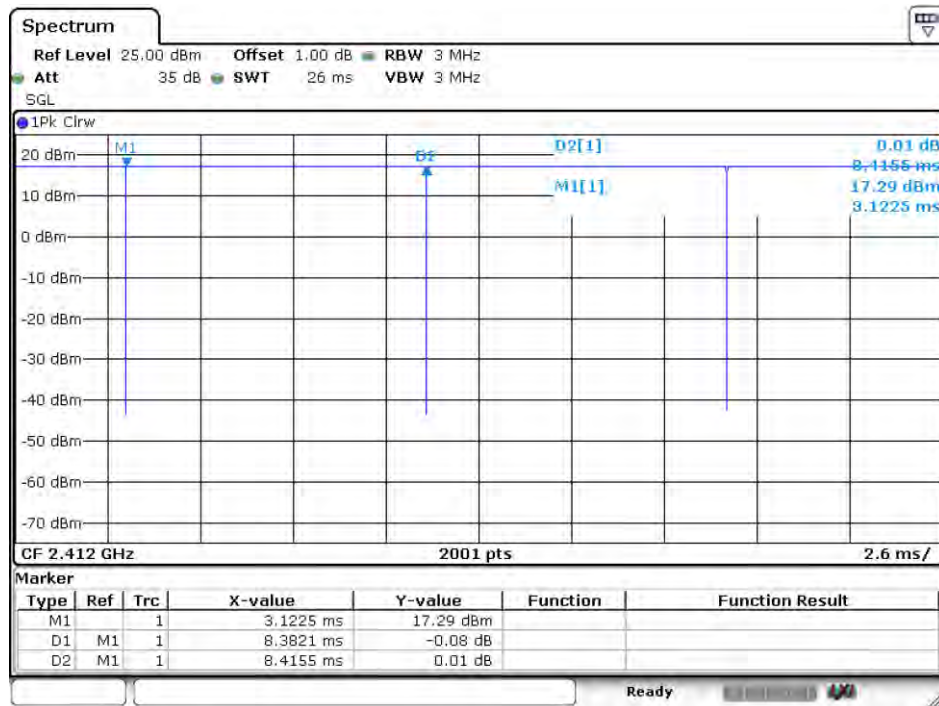
#### 4.3.1 Test Results

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

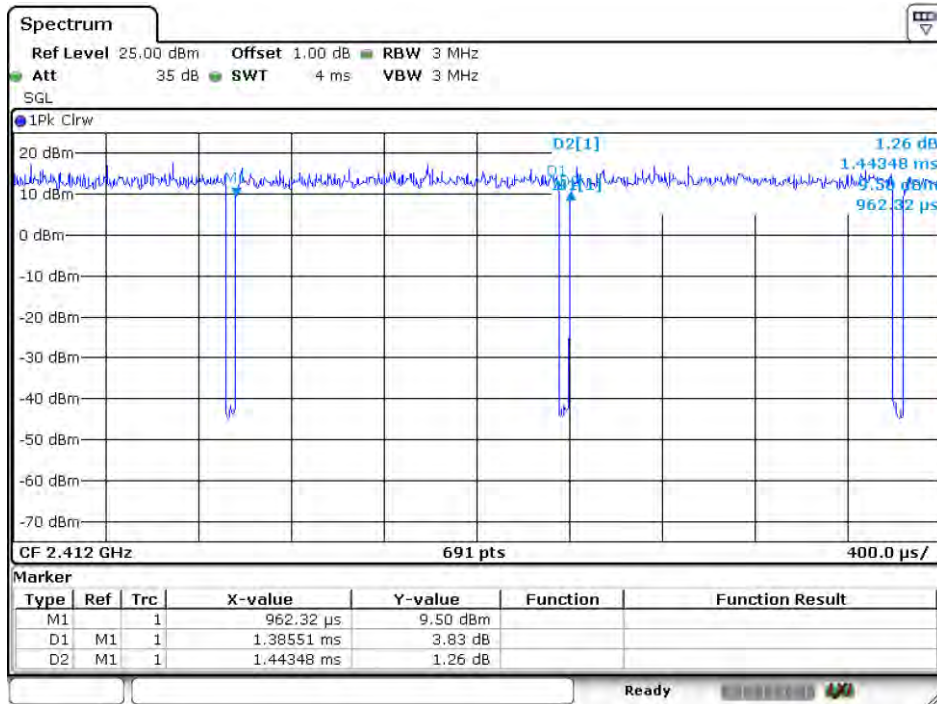
##### 4.3.1.1.1 11B



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

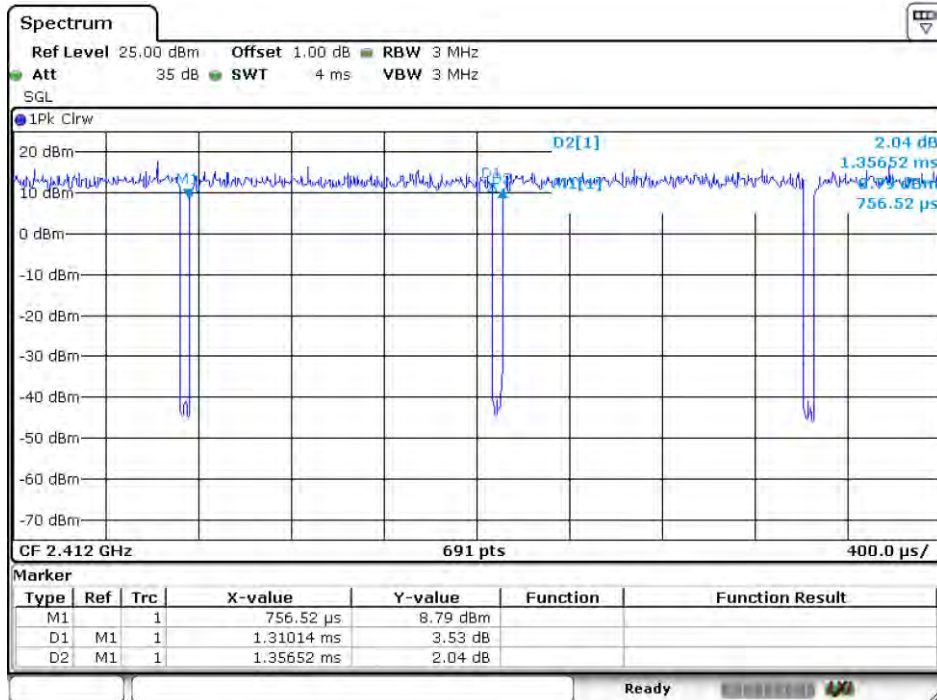


4.3.1.1.2 11G



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

4.3.1.1.3 11N20



Date: 20.MAY.2020 13:44:43



### 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:	<p>The diagram illustrates the test setup. A rectangular box labeled 'POWER METER' is connected to a smaller rectangular box labeled 'E.U.T.' (Equipment Under Test) by a red line. Both boxes are positioned on top of a 'Non-Conducted Table', which is represented by a horizontal line with two vertical legs. Below the table is a thick grey horizontal bar labeled 'Ground Reference Plane'.</p>
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



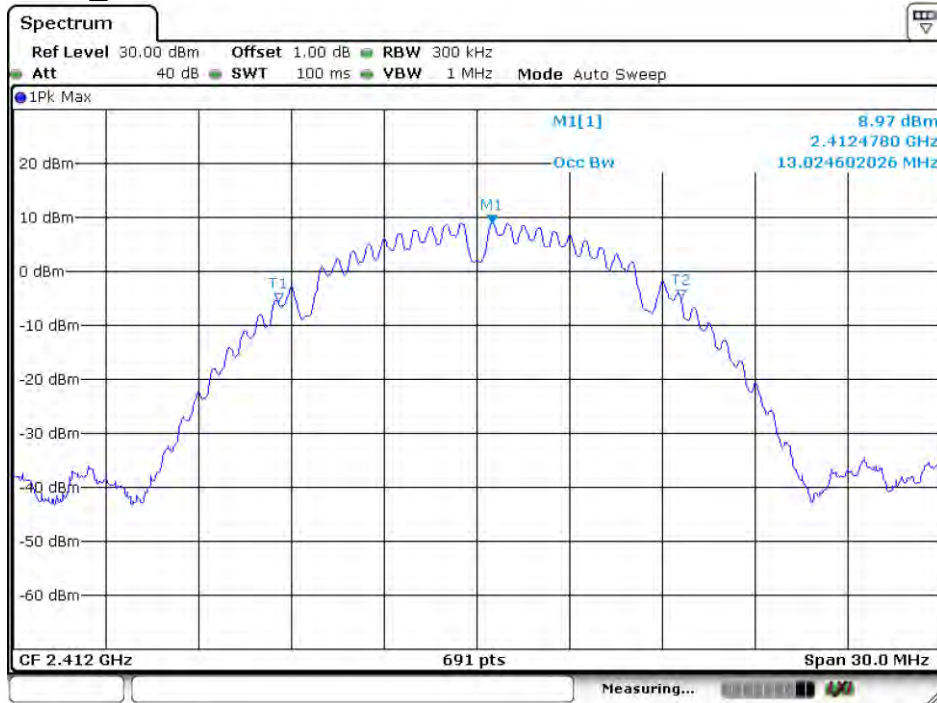
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## 4.5.2 Test plots

### 4.5.2.1 ANT1

#### 4.5.2.1.1 802.11B\_Lowest Channel

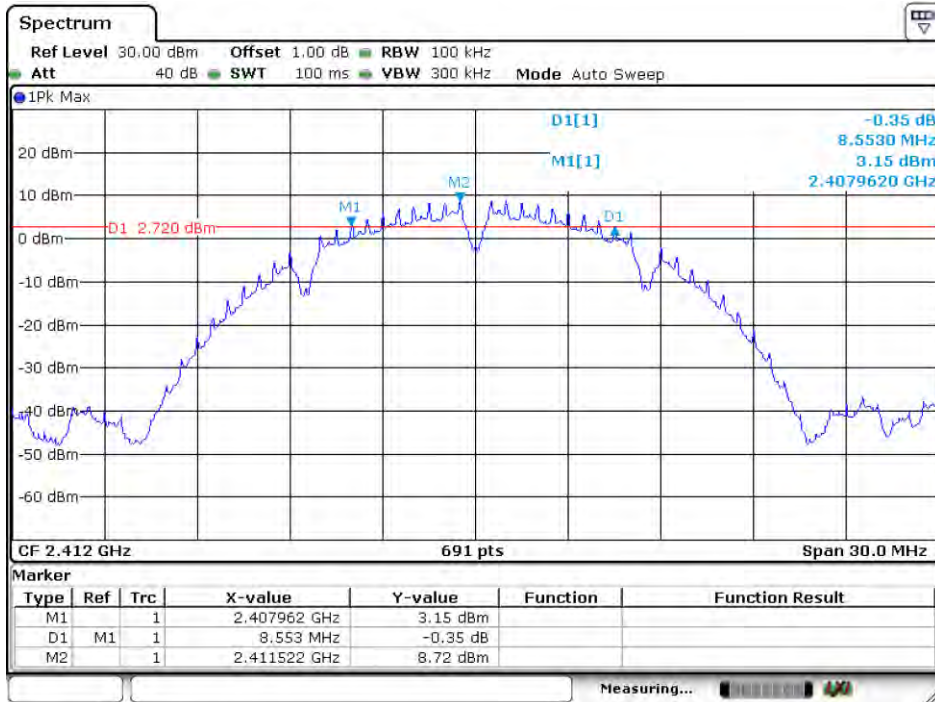


Date: 20.MAY.2020 13:01:32



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



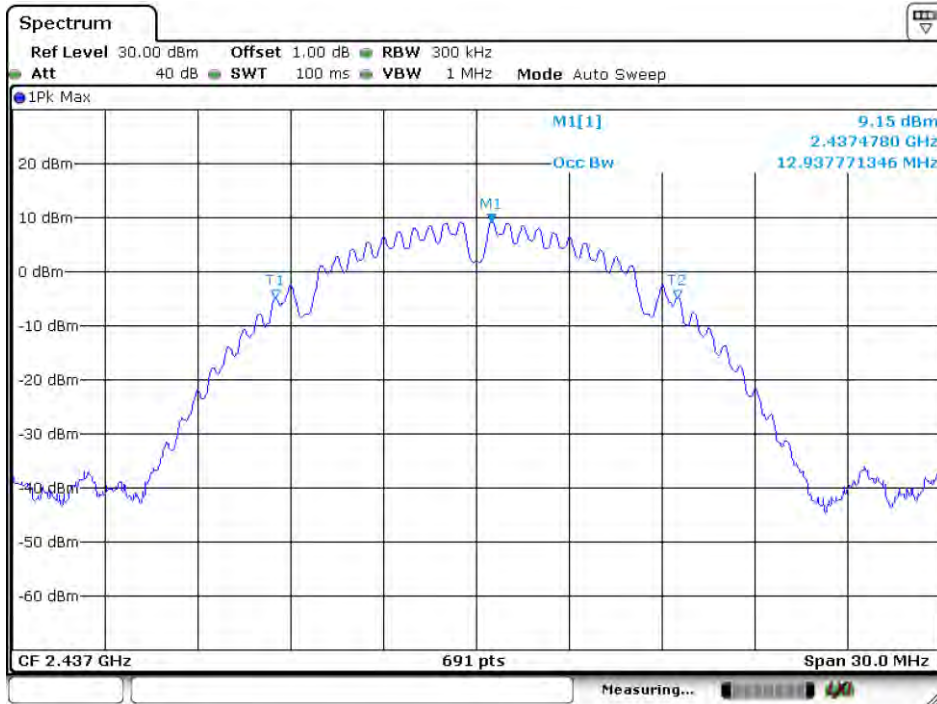
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 Shenzhen Branch Technical Services Laboratory

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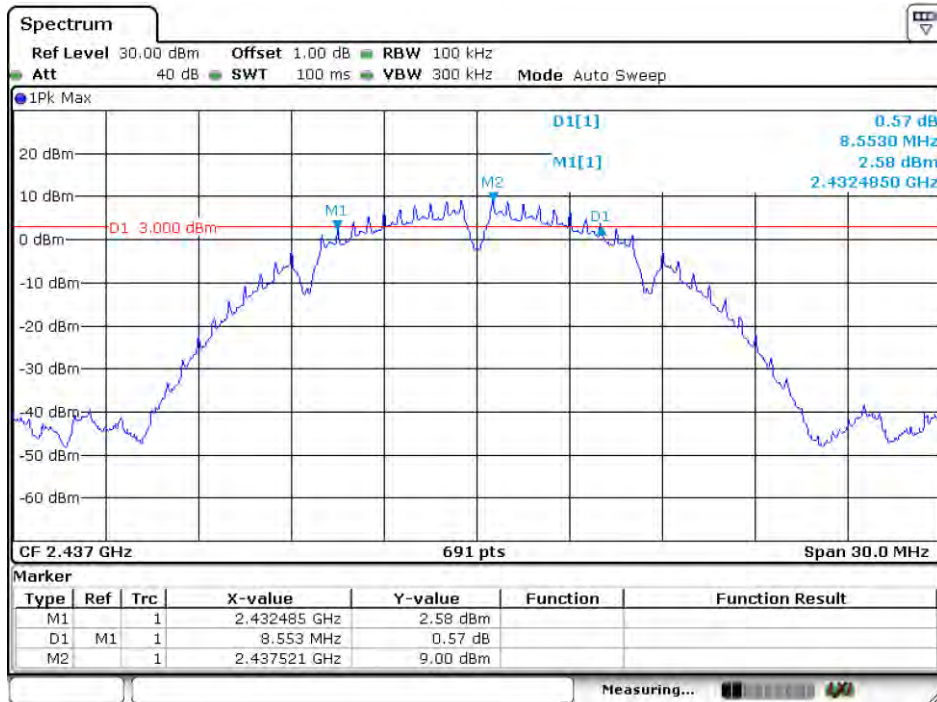
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**4.5.2.1.2 802.11B\_ Middle Channel**



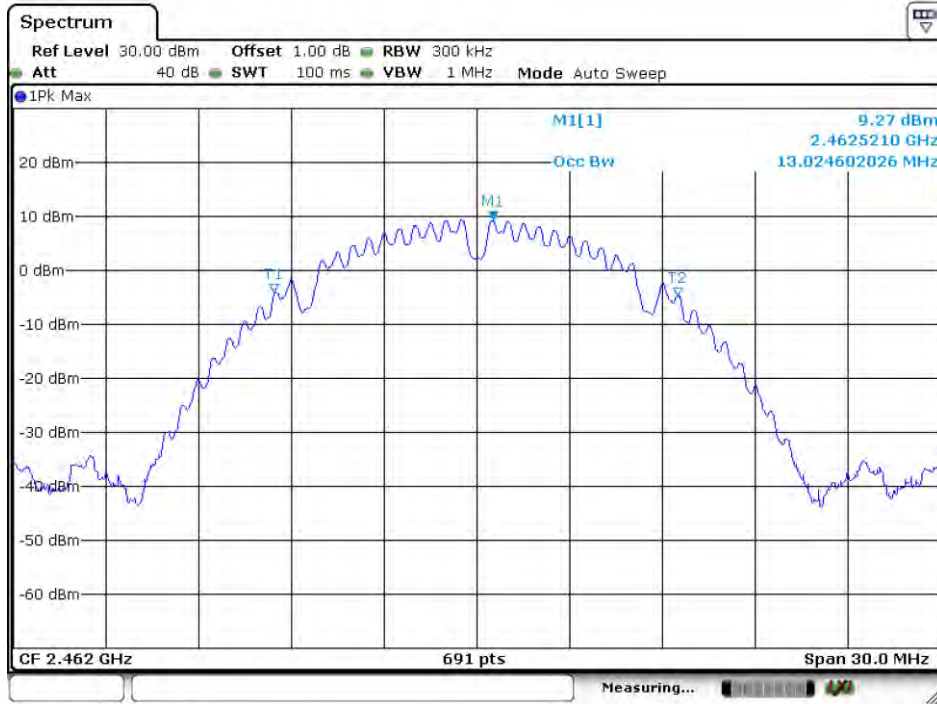
Date: 20.MAY.2020 13:01:14



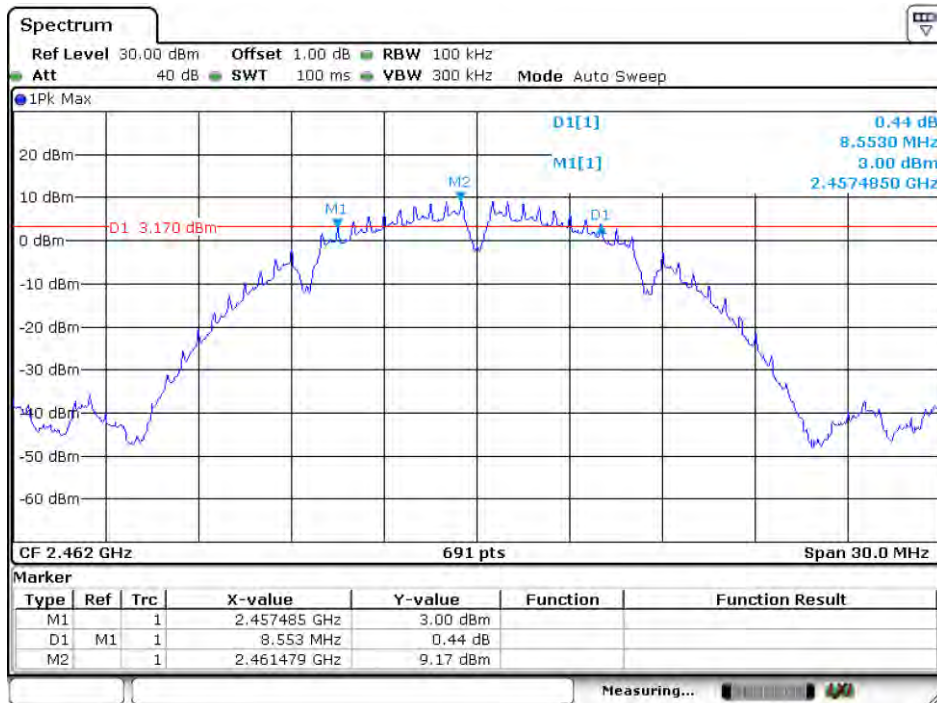
Date: 20.MAY.2020 12:53:09



**4.5.2.1.3 802.11B\_Highest Channel**



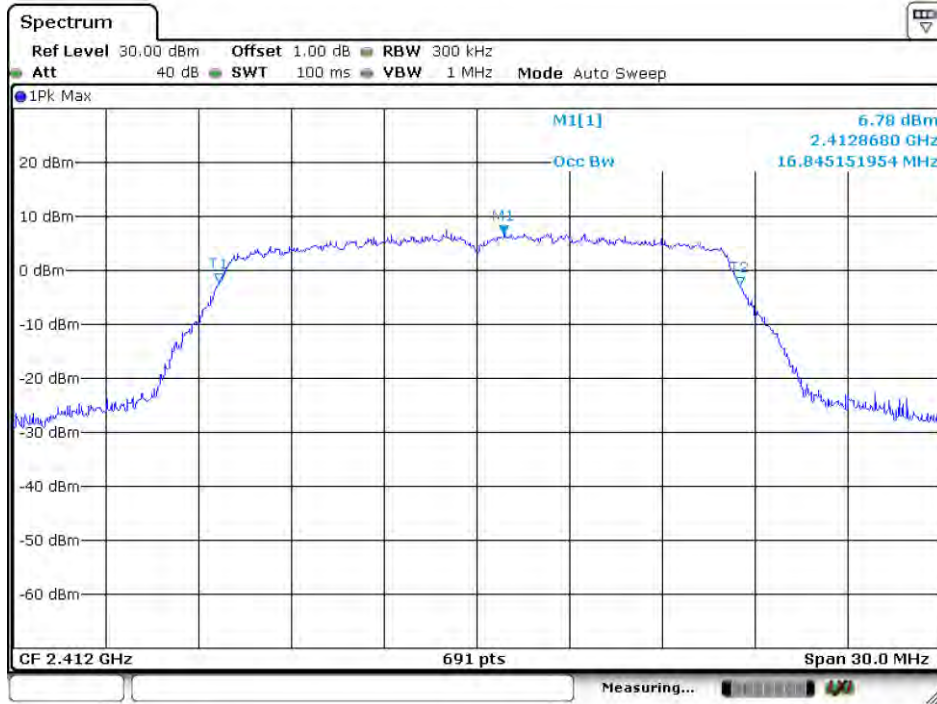
Date: 20.MAY.2020 13:00:49



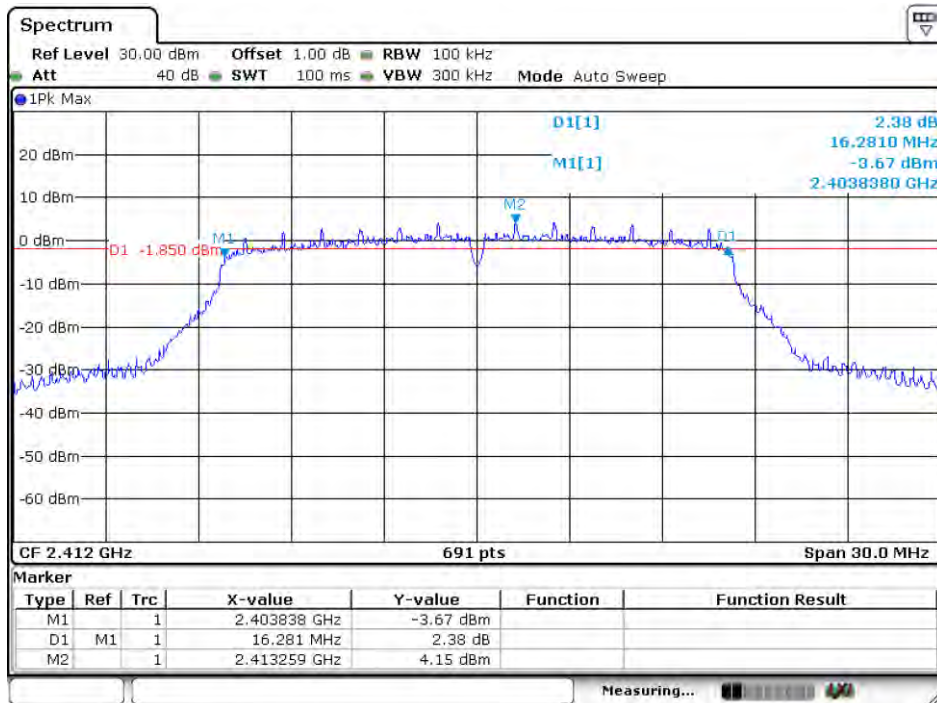
Date: 20.MAY.2020 12:53:49



**4.5.2.1.4 802.11G\_Lowest Channel**



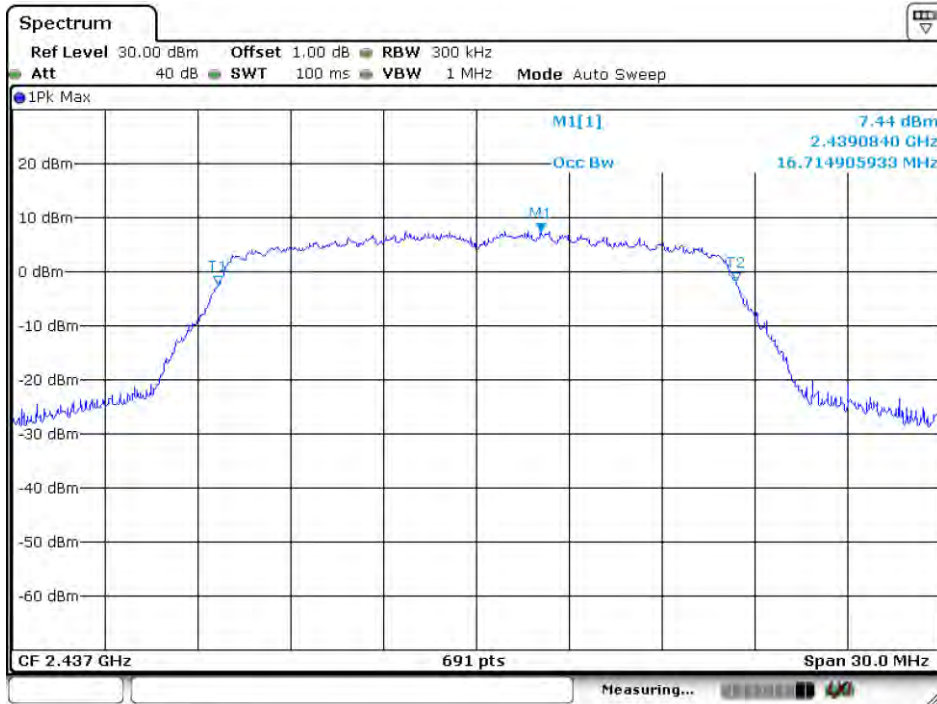
Date: 20.MAY.2020 13:01:57



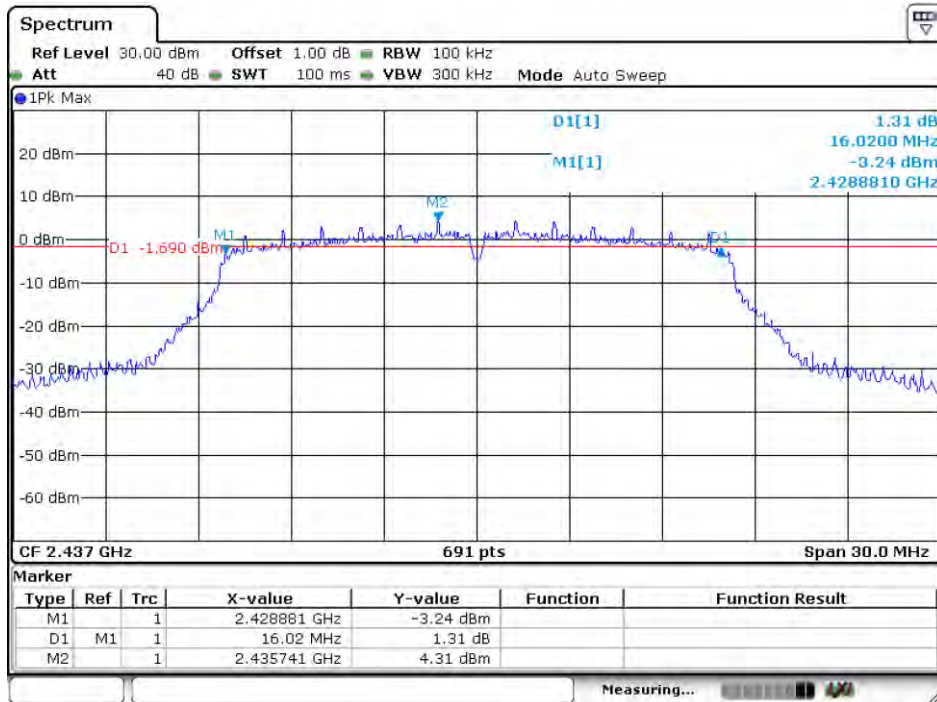
Date: 20.MAY.2020 12:55:05



**4.5.2.1.5 802.11G\_ Middle Channel**



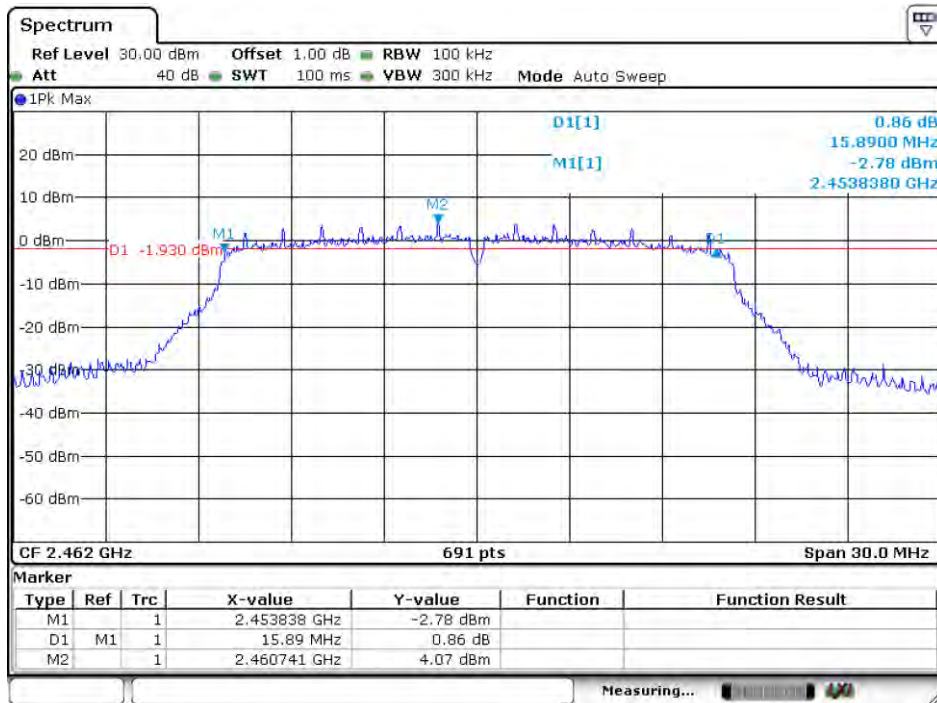
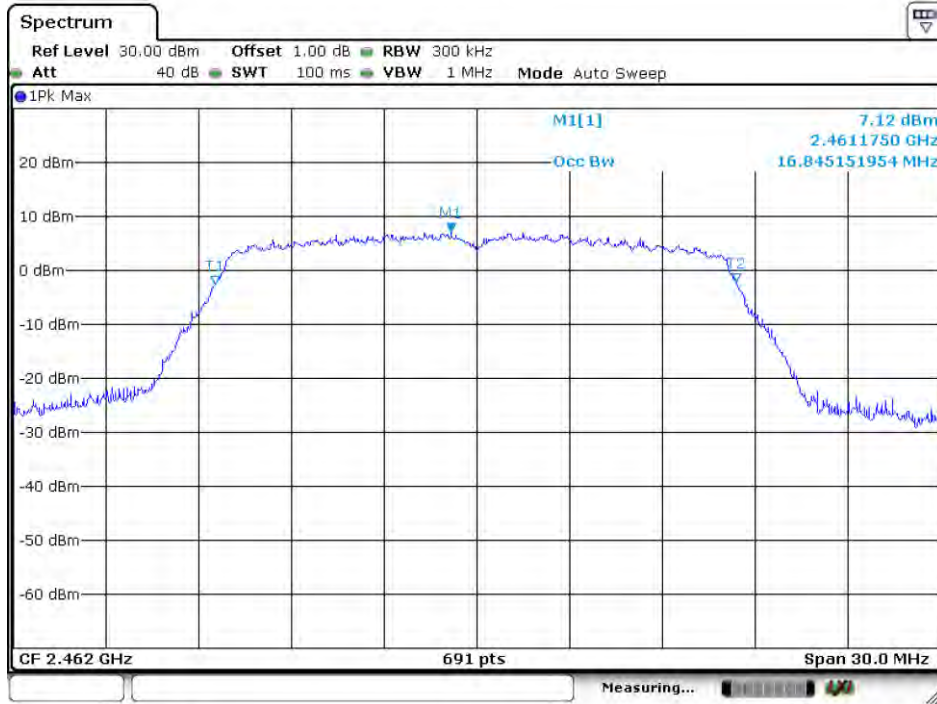
Date: 20.MAY.2020 13:02:20



Date: 20.MAY.2020 12:56:07



**4.5.2.1.6 802.11G\_Highest Channel**

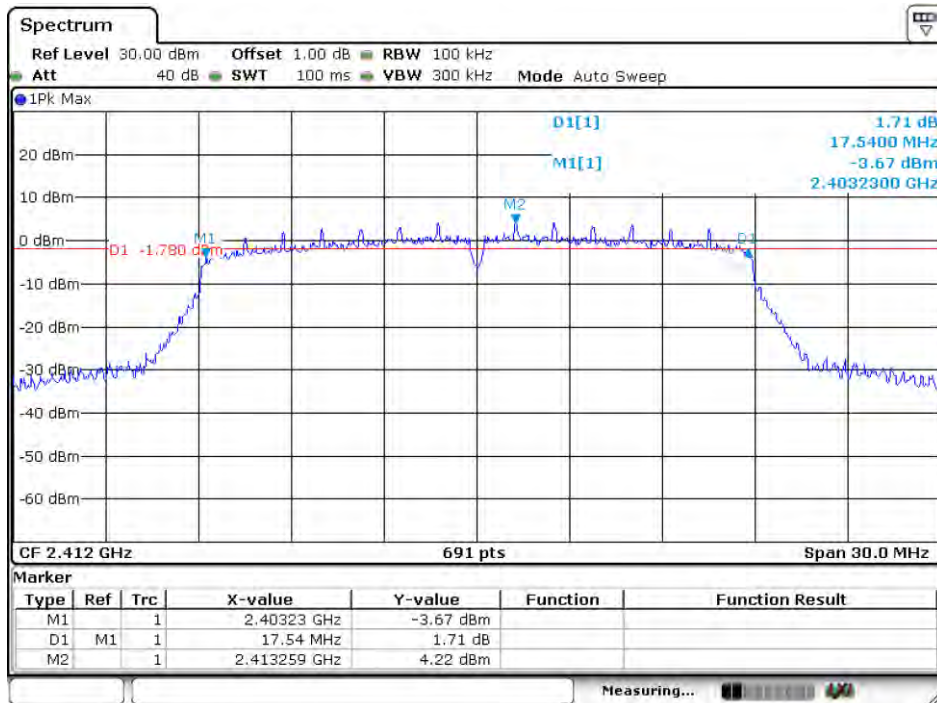




**4.5.2.1.7 802.11N20\_Lowest Channel**



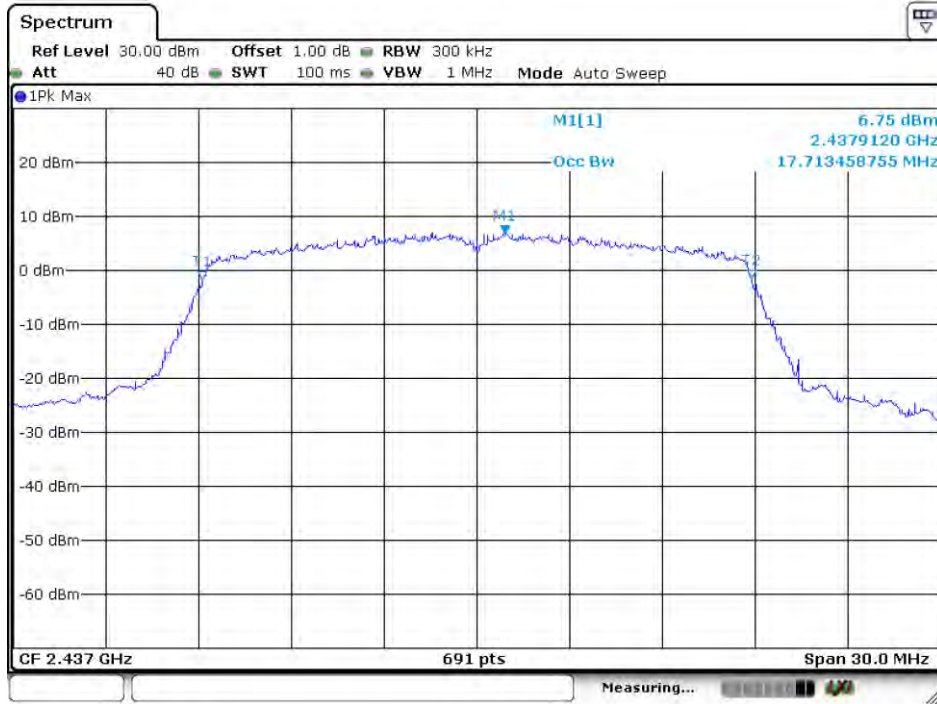
Date: 20.MAY.2020 13:03:49



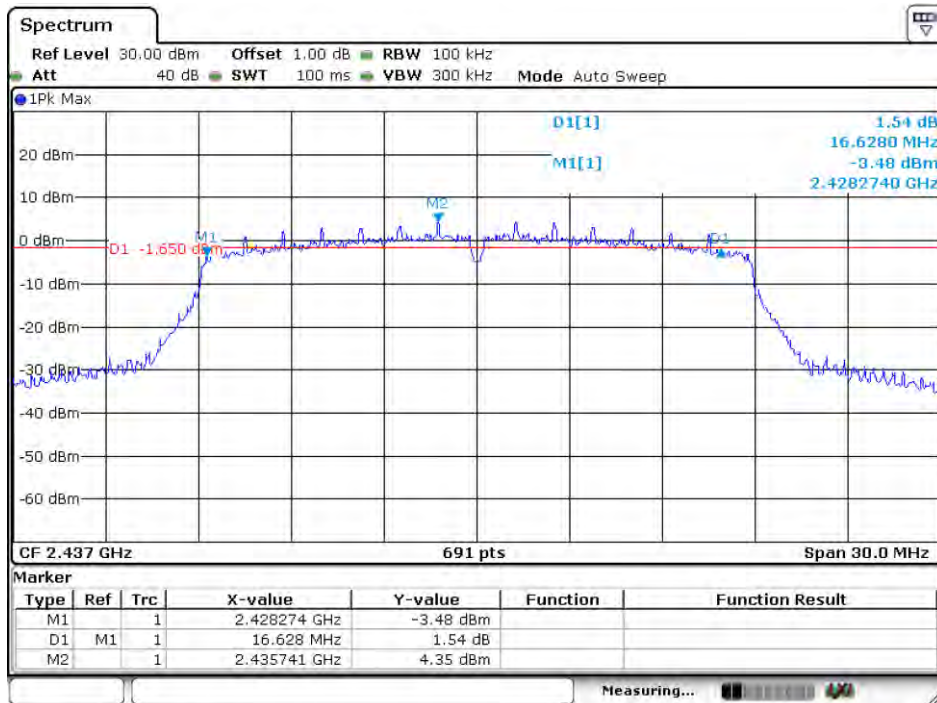
Date: 20.MAY.2020 12:51:16



**4.5.2.1.8 802.11 N20\_ Middle Channel**



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



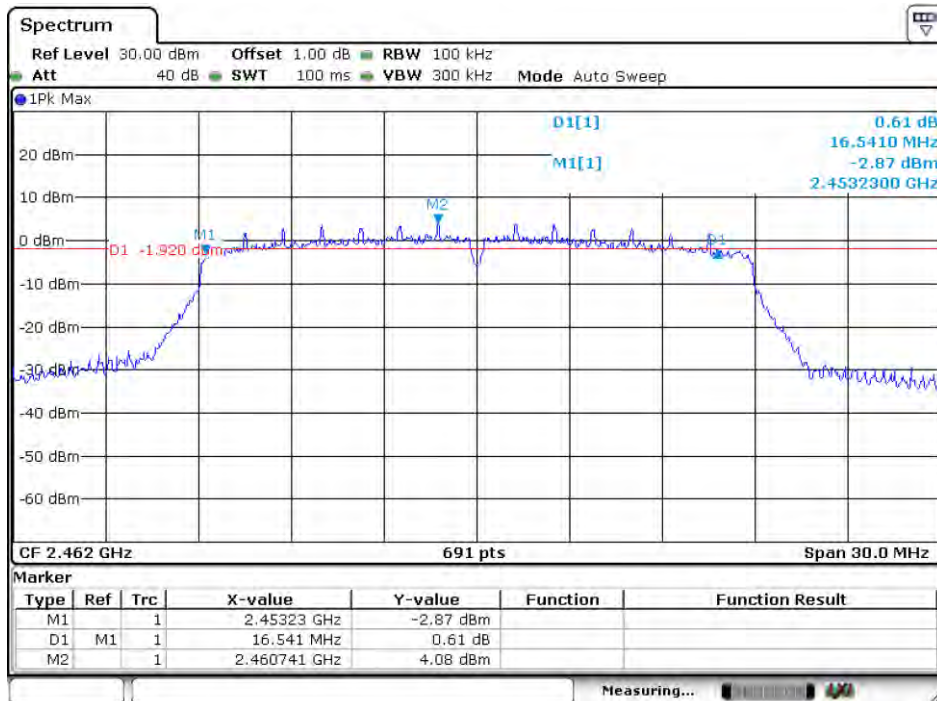
Date: 20.MAY.2020 12:49:23



**4.5.2.1.9 802.11 N20\_ Highest Channel**



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



Date: 20.MAY.2020 12:50:33



### 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



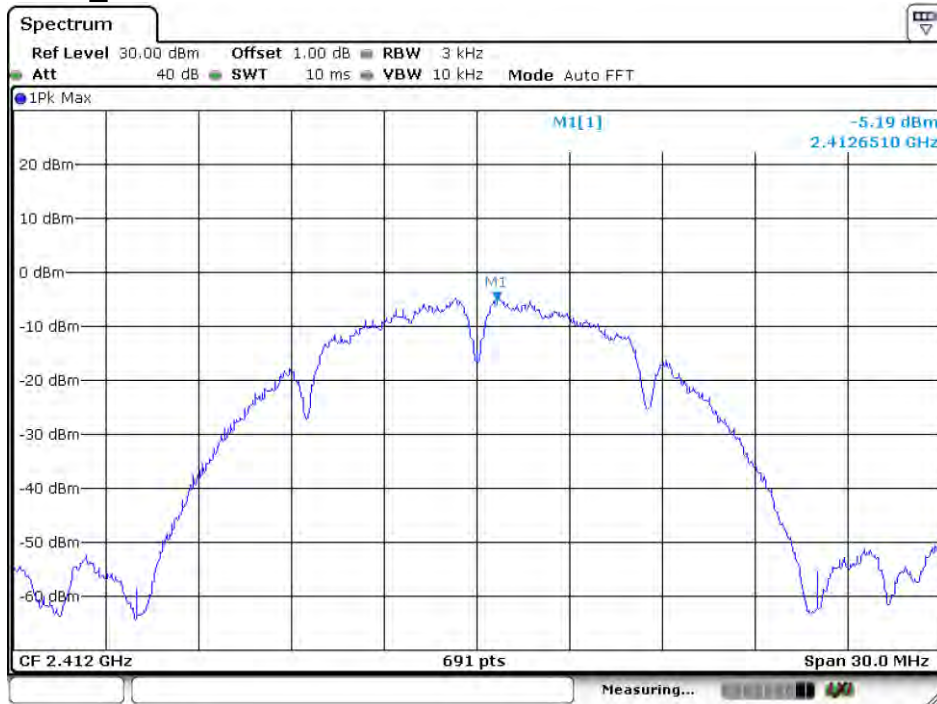
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## 4.6.2 Test plots

### 4.6.2.1 ANT1

#### 4.6.2.1.1 802.11B\_Lowest Channel



Date: 20.MAY.2020 13:10:11



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### 4.6.2.1.2 802.11B\_ Middle Channel



Date: 20.MAY.2020 13:10:28

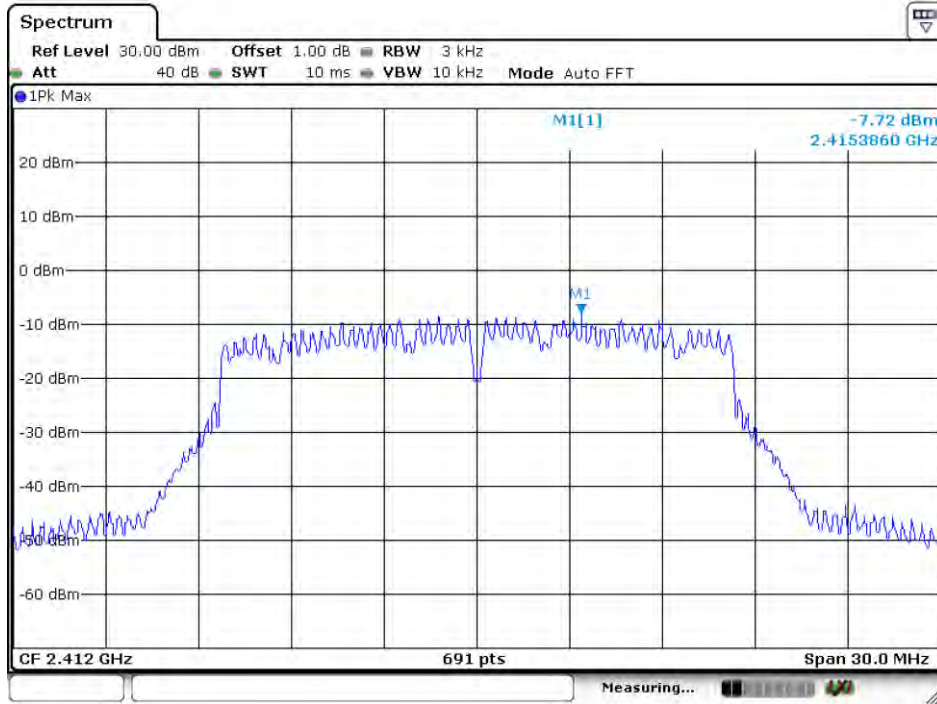
### 4.6.2.1.3 802.11B\_ Highest Channel



Date: 20.MAY.2020 13:10:59

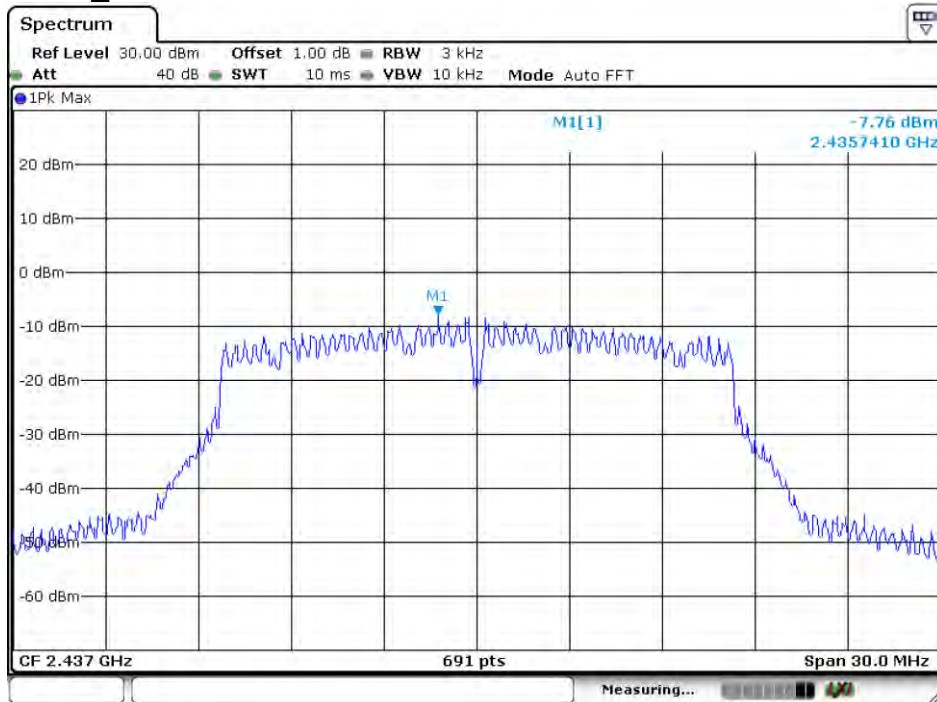


**4.6.2.1.4 802.11G\_Lowest Channel**



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

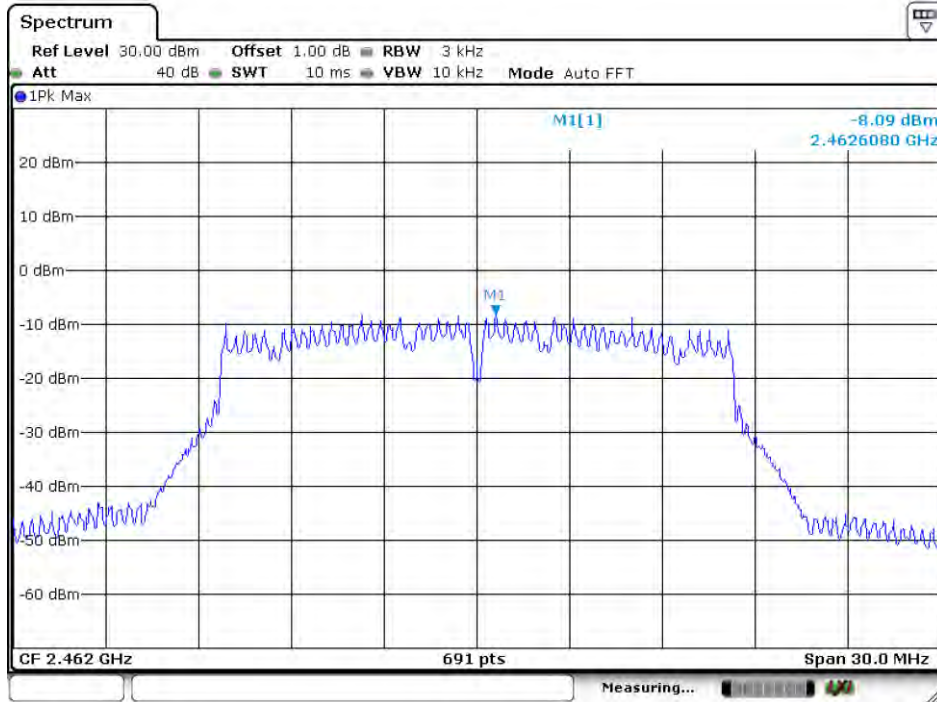
**4.6.2.1.5 802.11G\_Middle Channel**



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

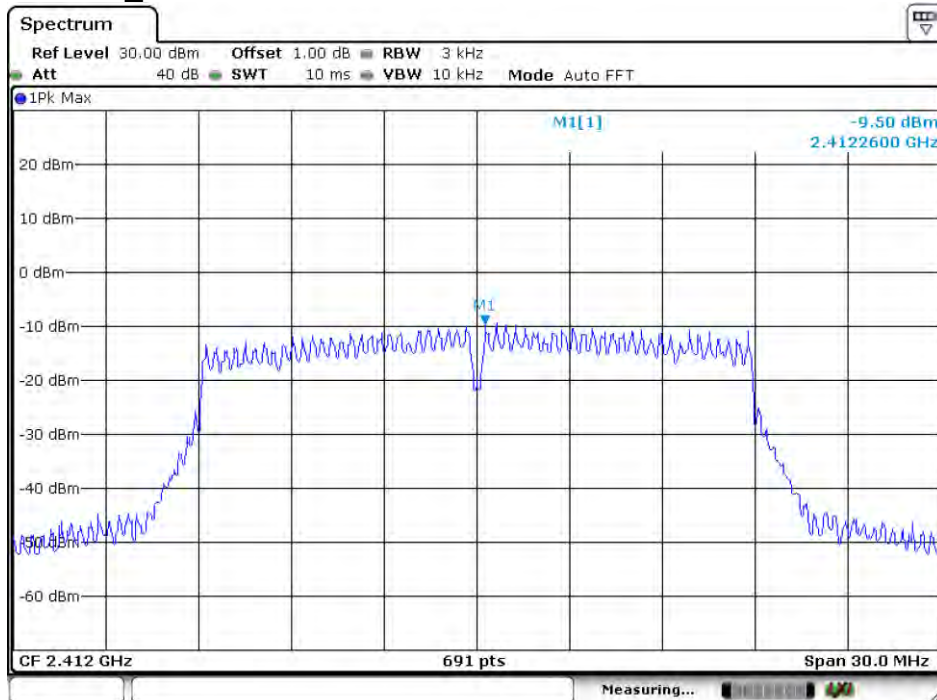


**4.6.2.1.6 802.11G\_Highest Channel**



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

**4.6.2.1.7 802.11N20\_Lowest Channel**

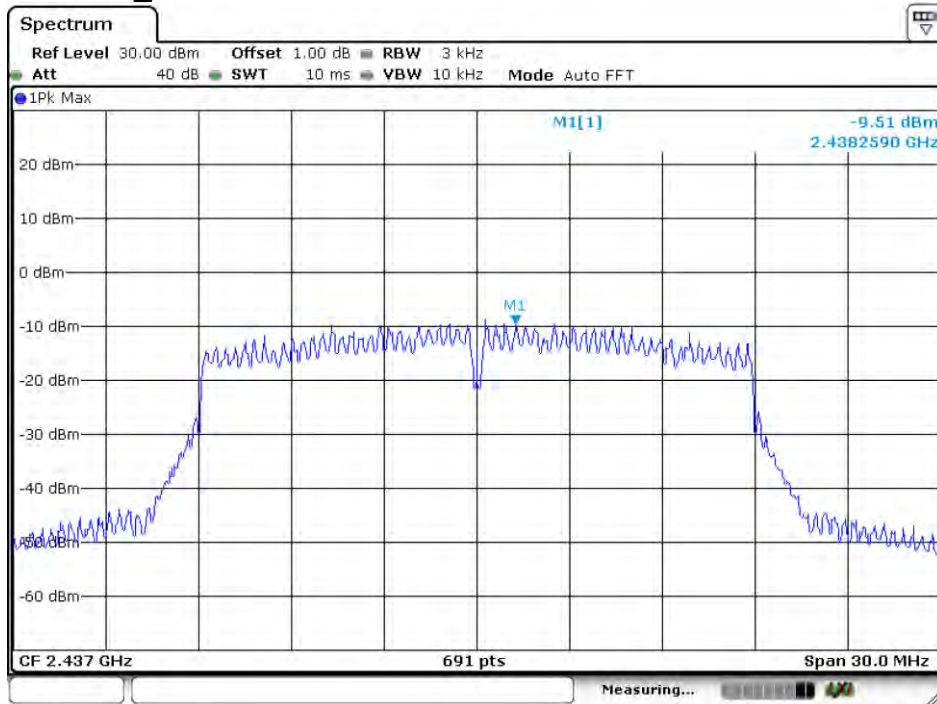


Date: 20.MAY.2020 13:06:45



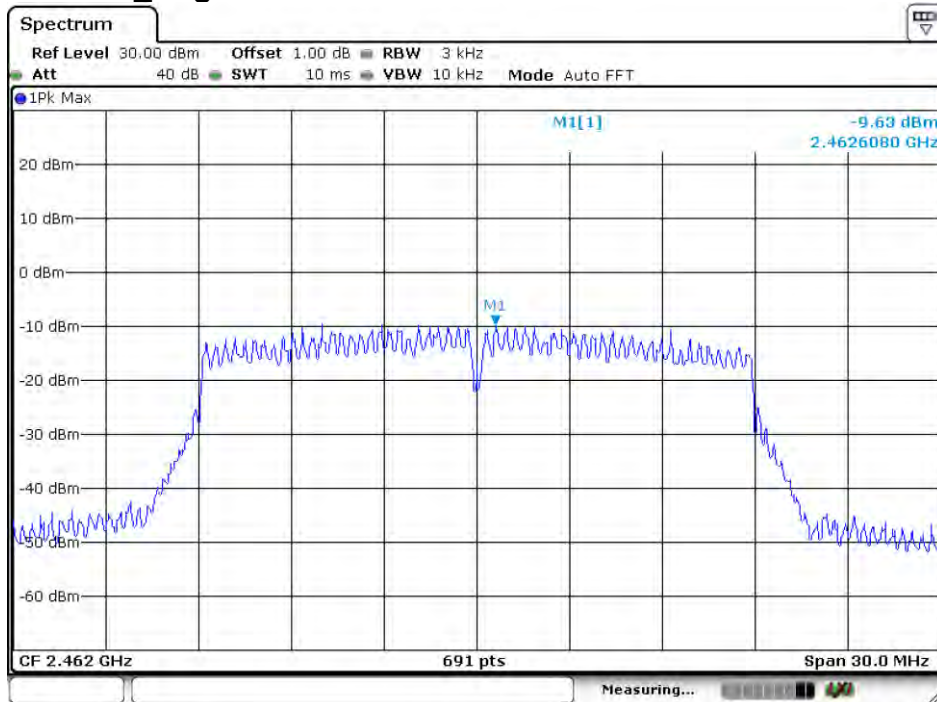


**4.6.2.1.8 802.11 N20\_ Middle Channel**



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

**4.6.2.1.9 802.11 N20\_ Highest Channel**



Date: 20.MAY.2020 13:07:25



### 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



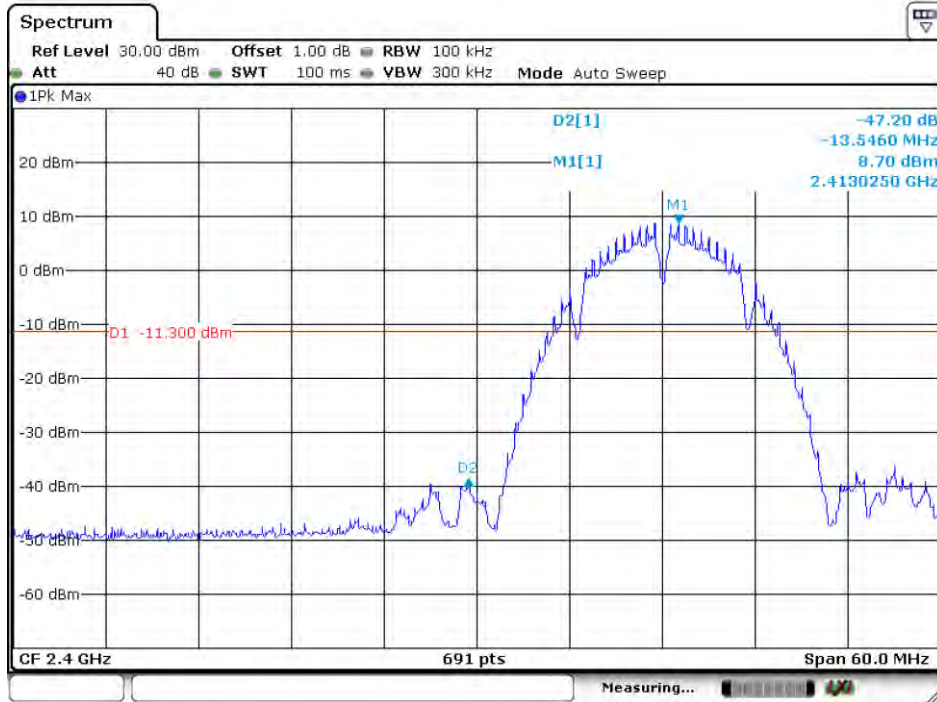
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**4.7.1 Test plots**

**4.7.1.1 ANT1**

**4.7.1.1.1 802.11B\_Lowest Channel**



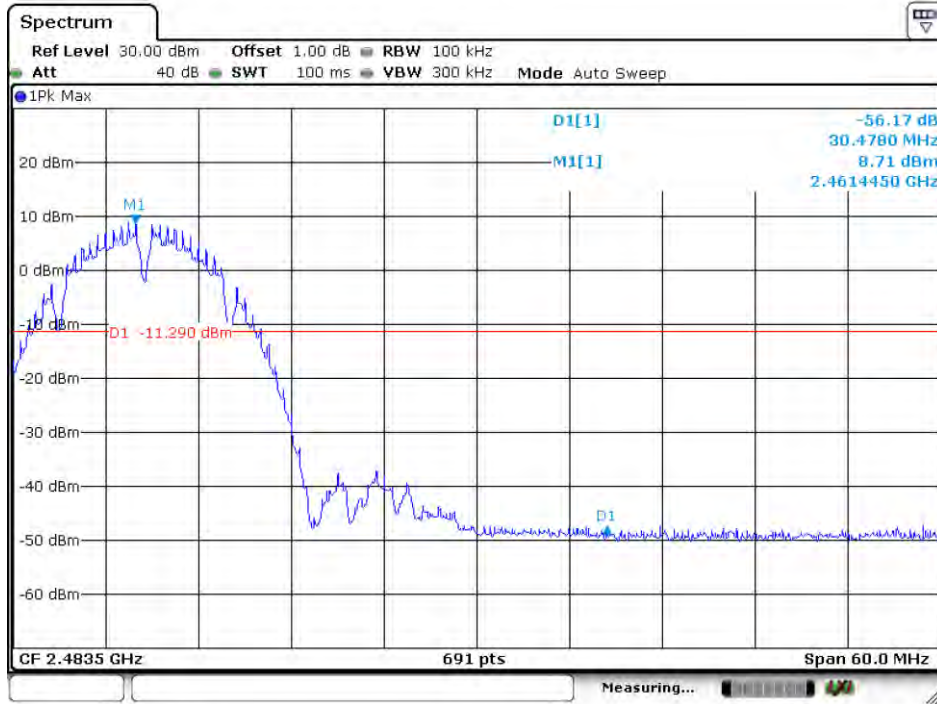
Date: 20.MAY.2020 13:12:36



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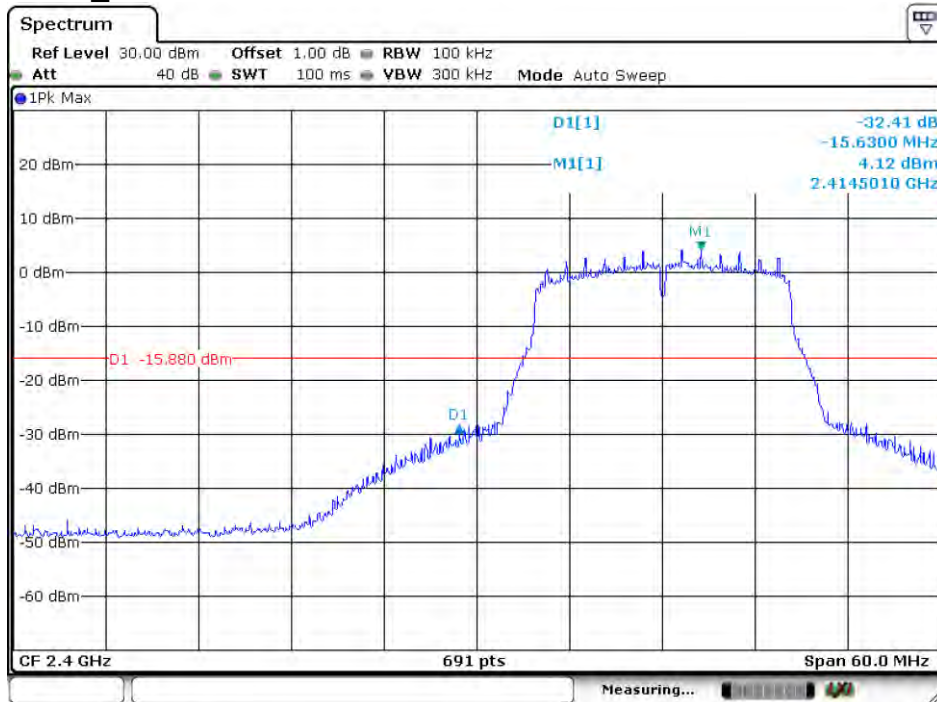
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**4.7.1.1.2 802.11B\_Highest Channel**



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

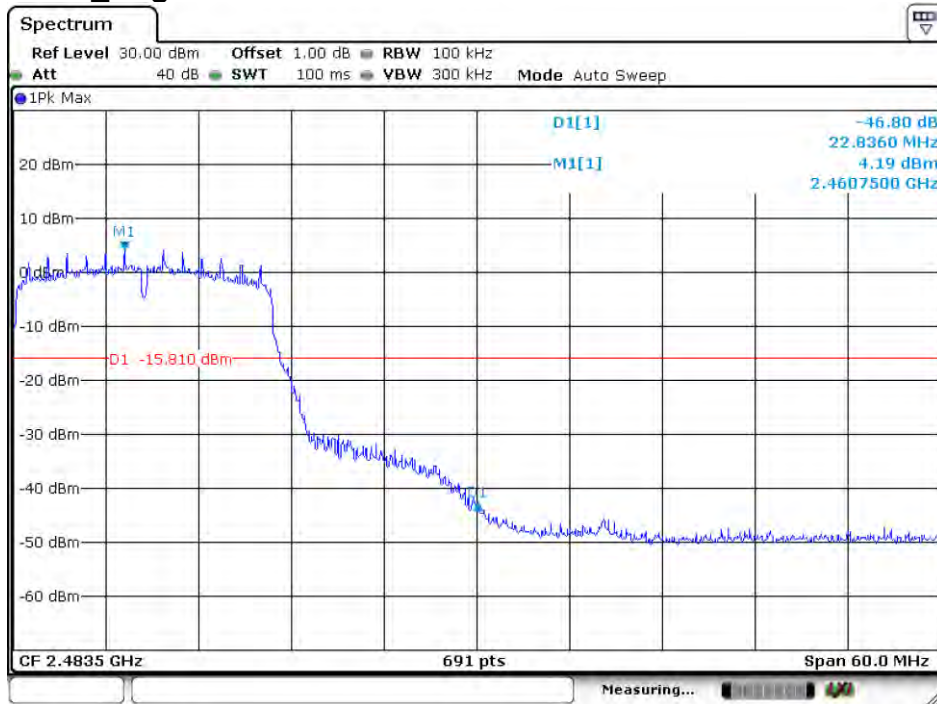
**4.7.1.1.3 802.11G\_Lowest Channel**



Date: 20.MAY.2020 13:16:49

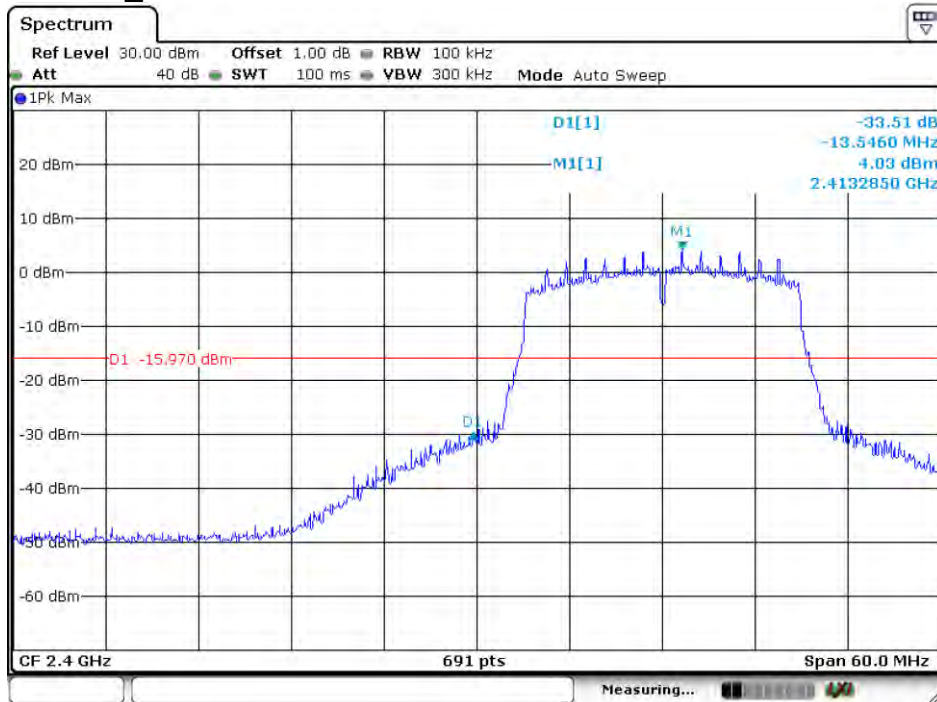


**4.7.1.1.4 802.11G\_Highest Channel**



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

**4.7.1.1.5 802.11N20\_Lowest Channel**



Date: 20.MAY.2020 13:18:54





### 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



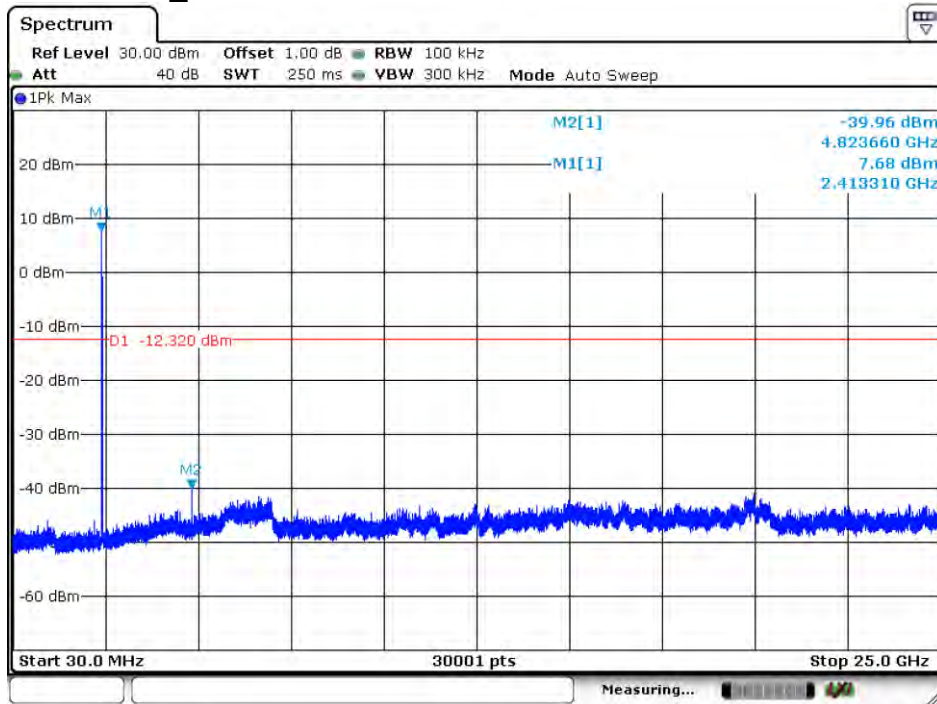
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**4.8.1 Test plots**

**4.8.1.1 ANT1**

**4.8.1.1.1 802.11B\_Lowest Channel**



Date: 20.MAY.2020 13:32:47

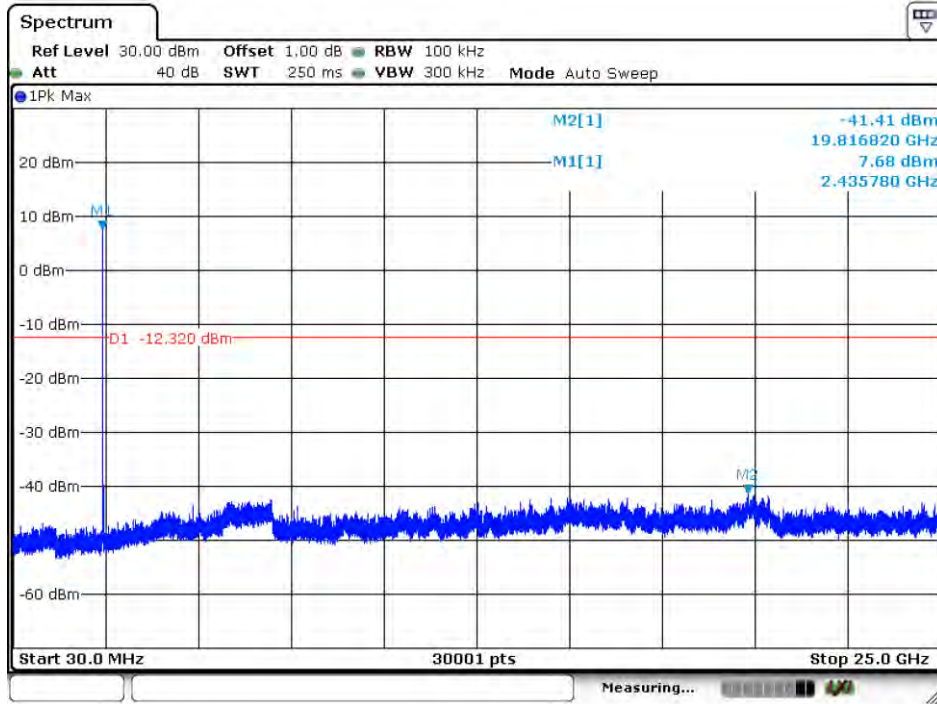


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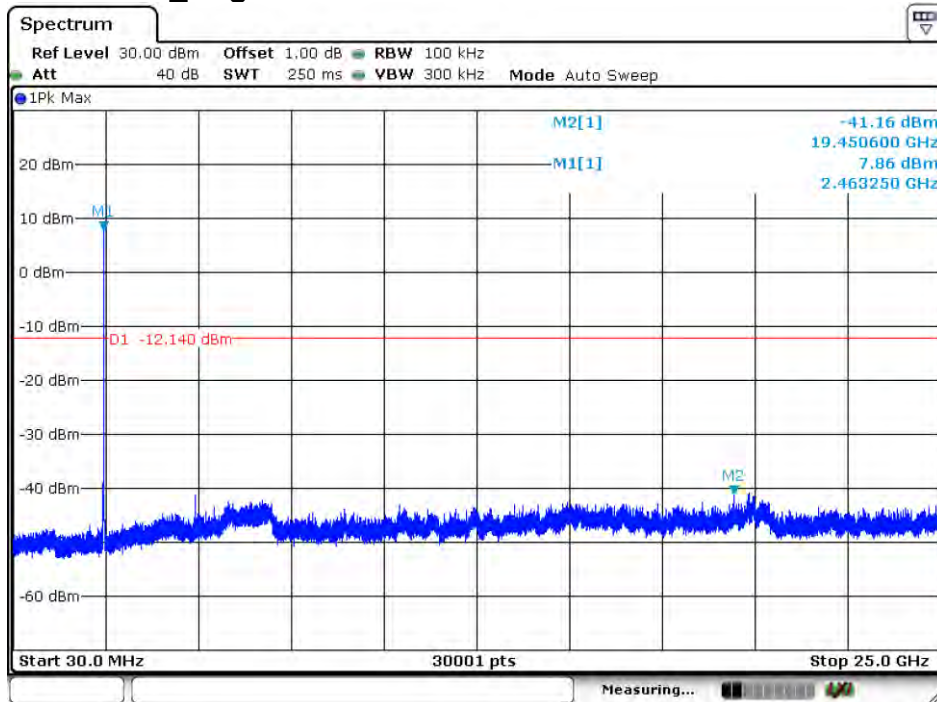


**4.8.1.1.2 802.11B\_ Middle Channel**



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

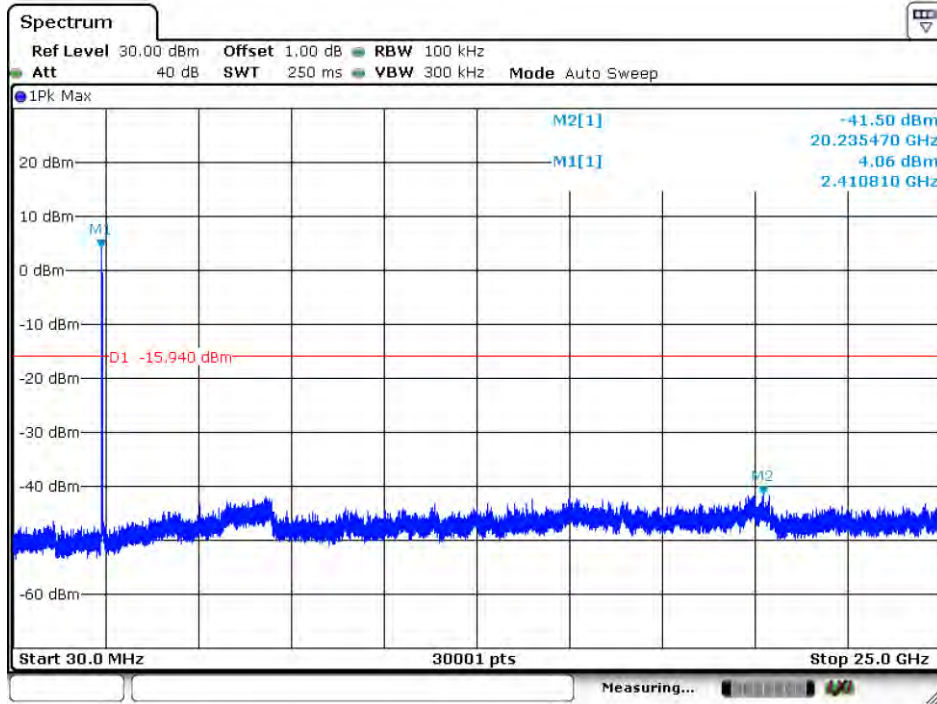
**4.8.1.1.3 802.11B\_ Highest Channel**



Date: 20.MAY.2020 13:39:39

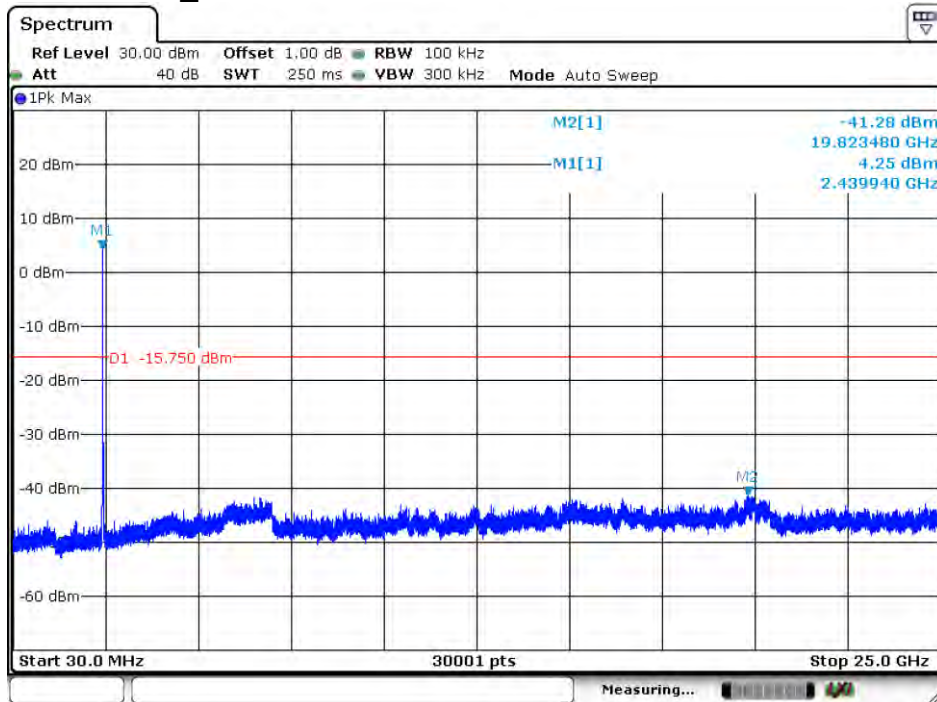


**4.8.1.1.4 802.11G\_Lowest Channel**



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

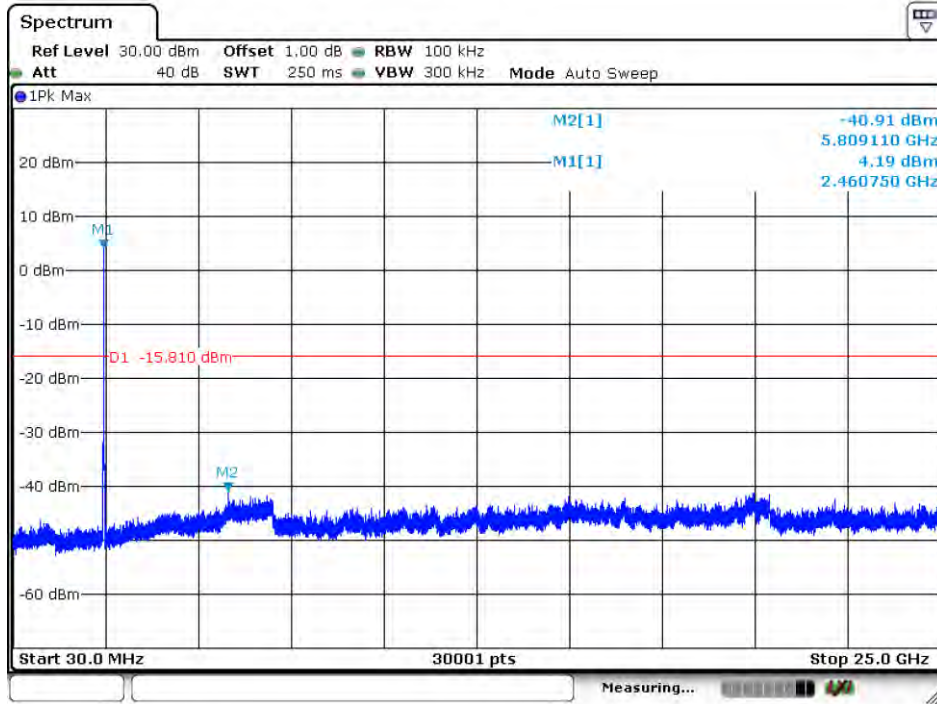
**4.8.1.1.5 802.11G\_Middle Channel**



Date: 20.MAY.2020 13:30:16

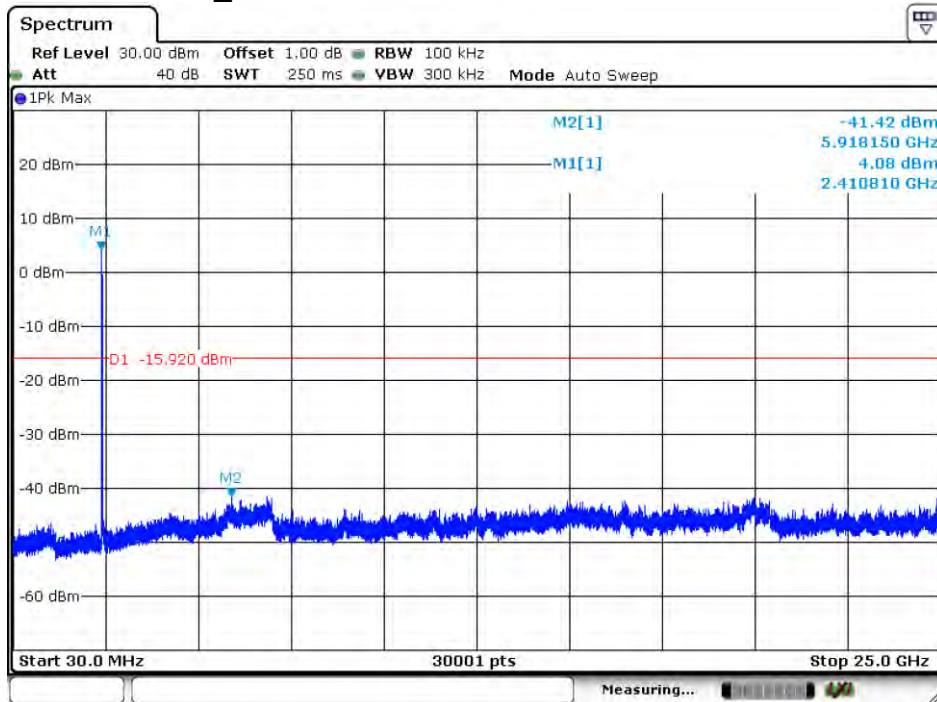


**4.8.1.1.6 802.11G\_Highest Channel**



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

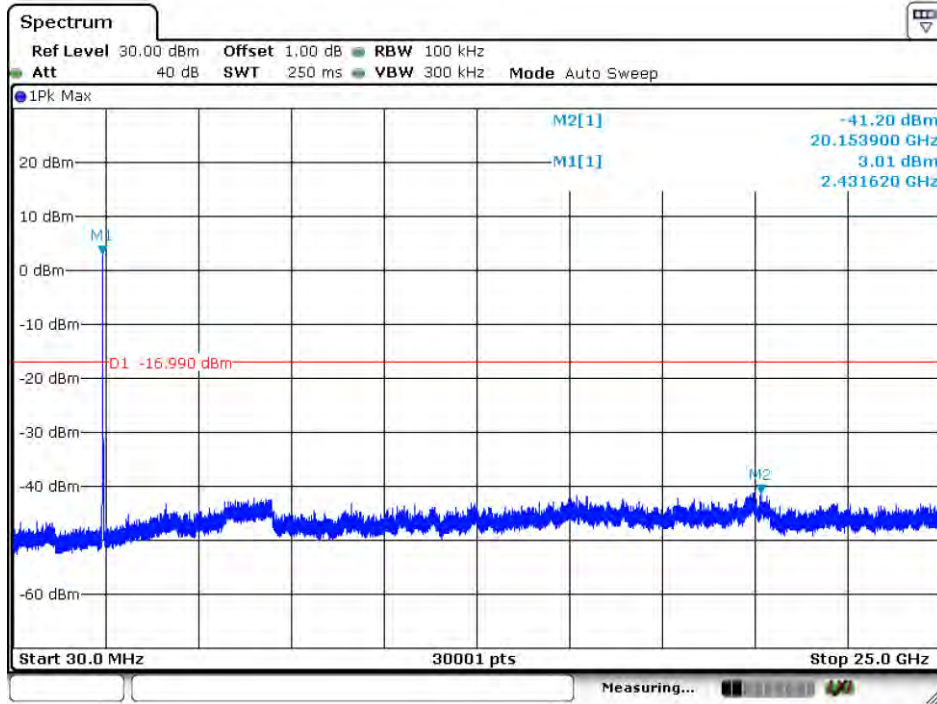
**4.8.1.1.7 802.11N20\_Lowest Channel**



Date: 20.MAY.2020 13:25:36

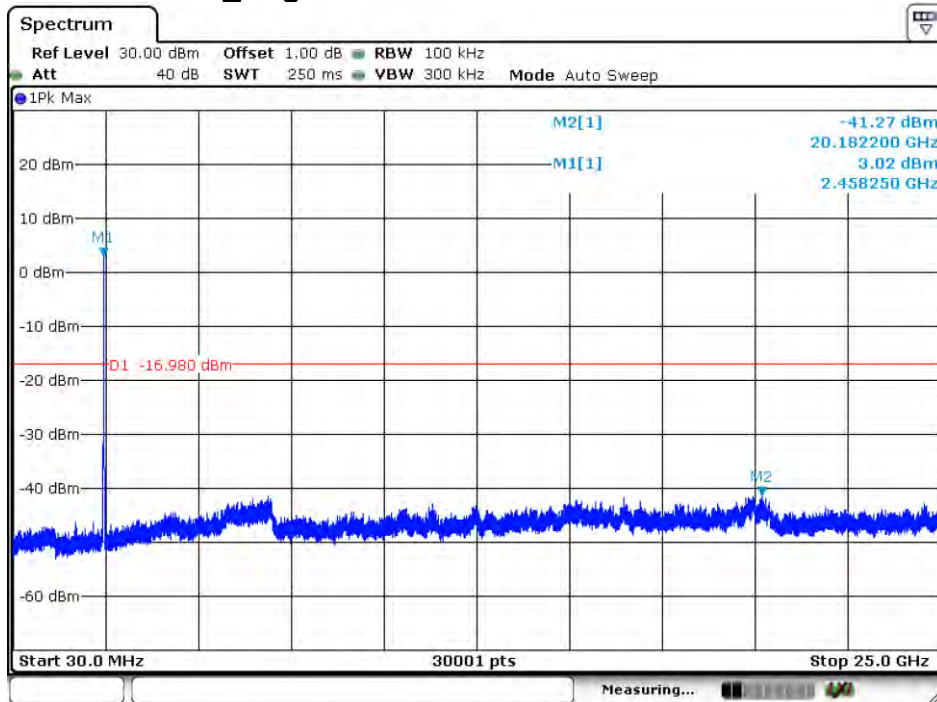


**4.8.1.1.8 802.11 N20\_ Middle Channel**



Date: 20.MAY.2020 13:27:06

**4.8.1.1.9 802.11 N20\_ Highest Channel**



Date: 20.MAY.2020 13:28:09



**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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<p><b>Test Setup:</b></p>	
<p>Figure 1. Below 30MHz</p>	<p>Figure 2. 30MHz to 1GHz</p>
<p>Figure 3. Above 1 GHz</p>	
<p><b>Test Procedure:</b></p>	<ol style="list-style-type: none"> <li>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 chamber. The table was rotated 360 degrees to determine the position of the highest radiation.</li> <li>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 chamber. The table was rotated 360 degrees to determine the position of the highest radiation</li> <li>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.</li> <li>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.</li> <li>Use the following spectrum analyzer settings:             <ol style="list-style-type: none"> <li>Span shall wide enough to fully capture the emission being measured;</li> <li>Set RBW=100 kHz for <math>f &lt; 1</math> GHz, RBW=1MHz for <math>f &gt; 1</math>GHz ; VBW <math>\geq</math> RBW; Sweep = auto; Detector function = peak; Trace = max hold for peak</li> <li>For average measurement: use duty cycle correction factor method per</li> </ol> </li> </ol>



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	<p>15.35(c).            Duty cycle = On time/100 milliseconds            On time = <math>N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{n-1} + N_n * L_n</math>            Where <math>N_1</math> is number of type 1 pulses, <math>L_1</math> is length of type 1 pulses, etc.            Average Emission Level = Peak Emission Level + <math>20 * \log(\text{Duty cycle})</math></p> <p>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.</p> <p>g. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</p> <p>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.</p> <p>i. Test the EUT in the lowest channel, the middle channel, the Highest channel</p> <p>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.</p> <p>k. Repeat above procedures until all frequencies measured was complete.</p>
<p>Exploratory Test Mode:</p>	<p>Transmitting with all kind of modulations, data rates.            Charge + Transmitting mode.</p>
<p>Final Test Mode:</p>	<p>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.</p>
<p>Instruments Used:</p>	<p>Refer to section 5.10 for details</p>
<p>Test Results:</p>	<p>Pass</p>

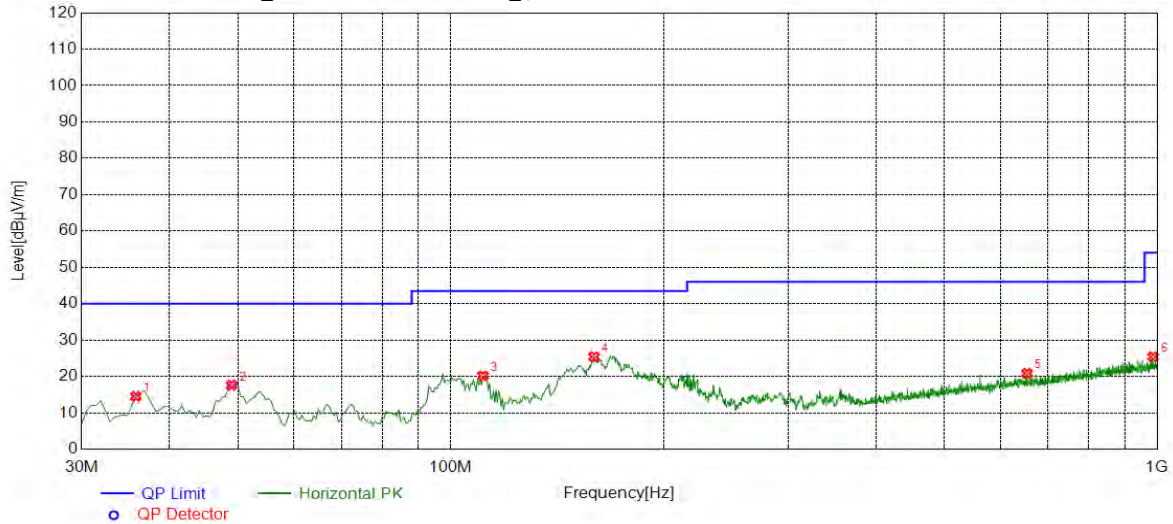


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### 4.9.1 Radiated emission below 1GHz

#### 4.9.1.1 Charge + Transmitting, Horizontal



#### Suspected List

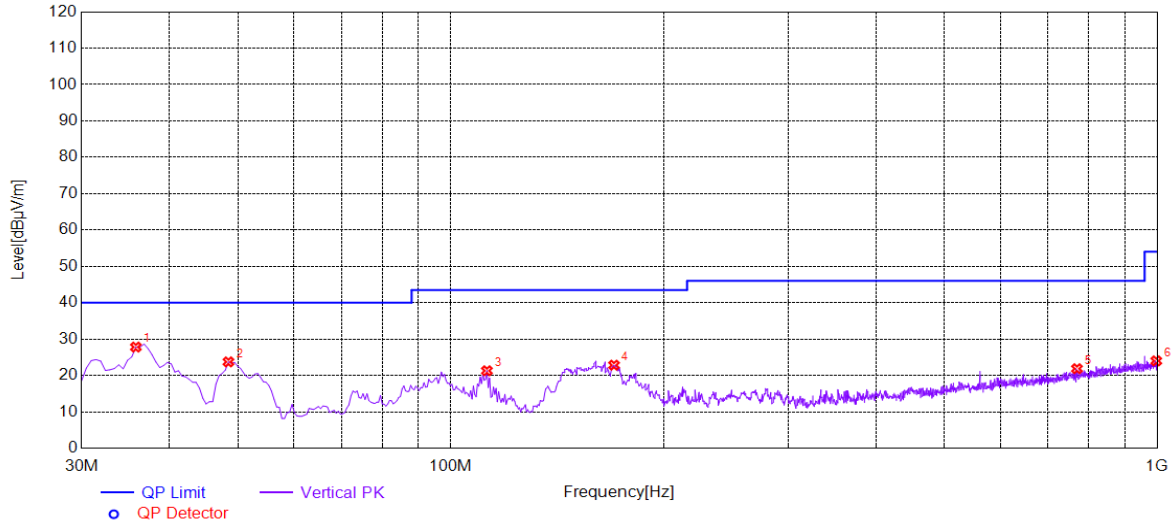
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	35.8229	14.54	-32.50	40.00	25.46	150	260	Horizontal
2	48.9245	17.61	-30.19	40.00	22.39	150	50	Horizontal
3	111.035	20.16	-31.85	43.50	23.34	150	66	Horizontal
4	159.559	25.41	-34.32	43.50	18.09	150	127	Horizontal
5	654.507	20.85	-19.33	46.00	25.15	150	66	Horizontal
6	986.413	25.40	-14.03	54.00	28.60	150	140	Horizontal



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**4.9.1.2 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	35.8229	27.81	-32.50	40.00	12.19	150	64	Vertical
2	48.4392	23.74	-30.19	40.00	16.26	150	344	Vertical
3	112.491	21.29	-32.08	43.50	22.21	150	102	Vertical
4	170.235	22.83	-33.59	43.50	20.67	150	344	Vertical
5	769.995	21.86	-17.25	46.00	24.14	150	125	Vertical
6	997.088	24.01	-13.90	54.00	29.99	150	10	Vertical



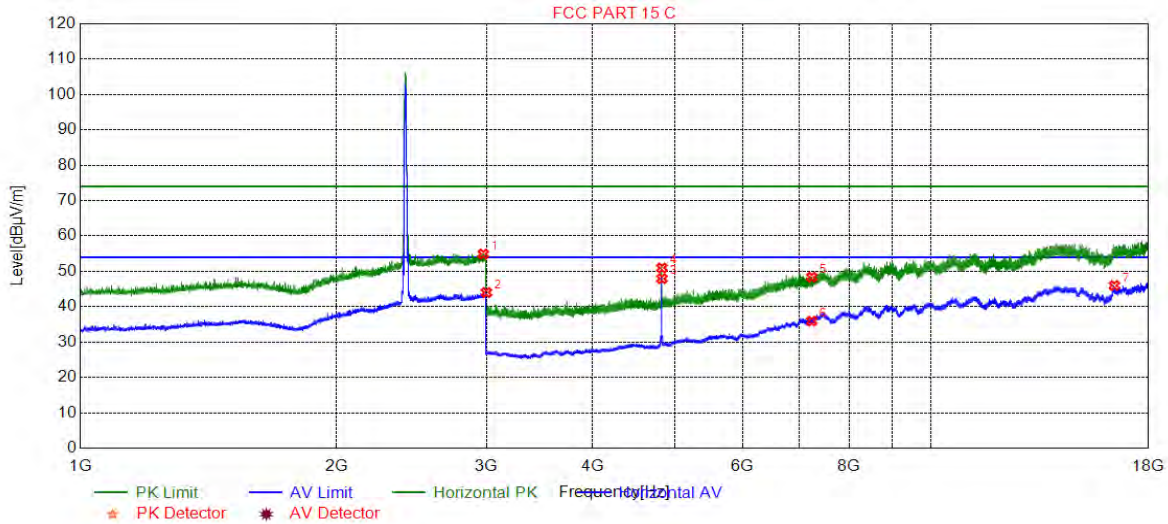
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### 4.9.2 Transmitter emission above 1GHz

#### 4.9.2.1 ANT1

#### 4.9.2.1.1 802.11B\_Lowest Channel\_Horizontal



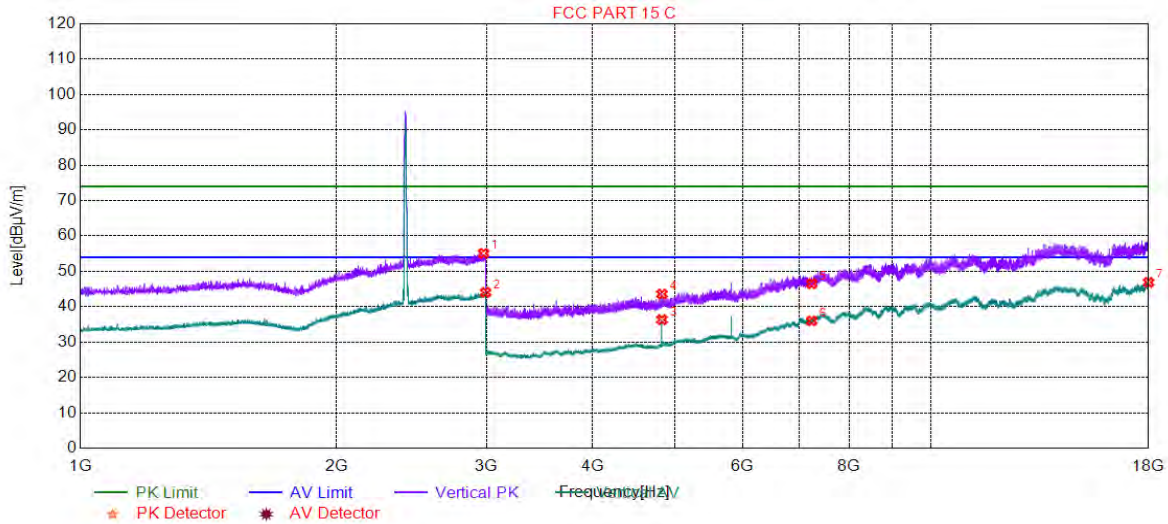
#### Suspected List

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	150	60	Horizontal
2	3000.0000	44.03	9.45	54.00	9.97	150	348	Horizontal
3	4824.0000	47.92	-18.21	54.00	6.08	150	11	Horizontal
4	4824.0000	50.96	-18.21	74.00	23.04	150	11	Horizontal
5	7236.0000	48.37	-9.99	74.00	25.63	150	320	Horizontal
6	7236.0000	35.93	-9.99	54.00	18.07	150	18	Horizontal
7	16404.370	45.98	-0.10	54.00	8.02	150	360	Horizontal



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**4.9.2.1.2 802.11B\_Lowest Channel\_Vertical**



**Suspected List**

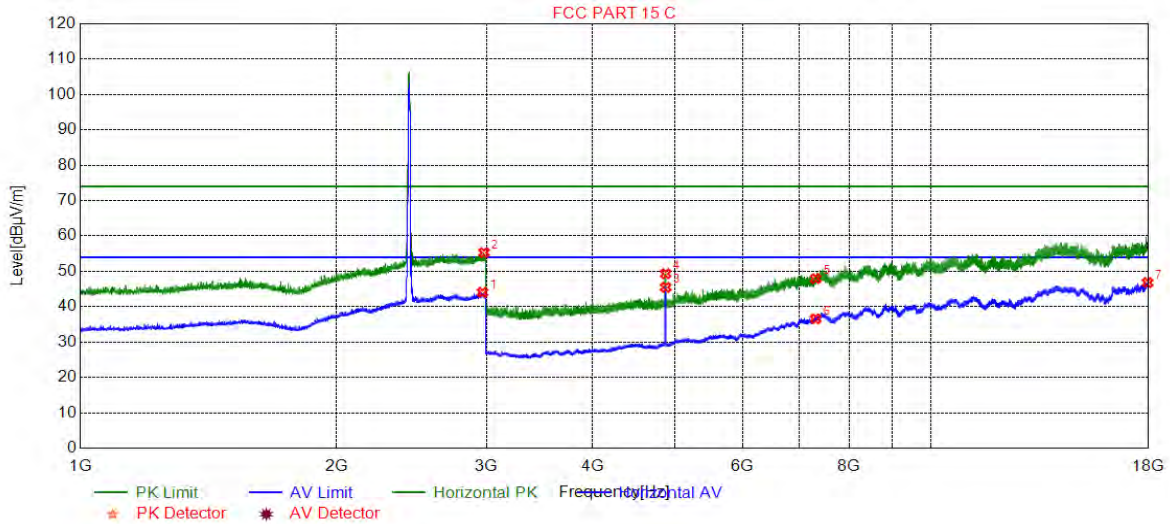
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2977.4944	55.09	9.55	74.00	18.91	150	2	Vertical
2	2993.4984	44.05	9.48	54.00	9.95	150	328	Vertical
3	4824.0000	36.34	-18.21	54.00	17.66	150	150	Vertical
4	4824.0000	43.58	-18.21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



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**4.9.2.1.3 802.11B\_ Middle Channel\_ Horizontal**



**Suspected List**

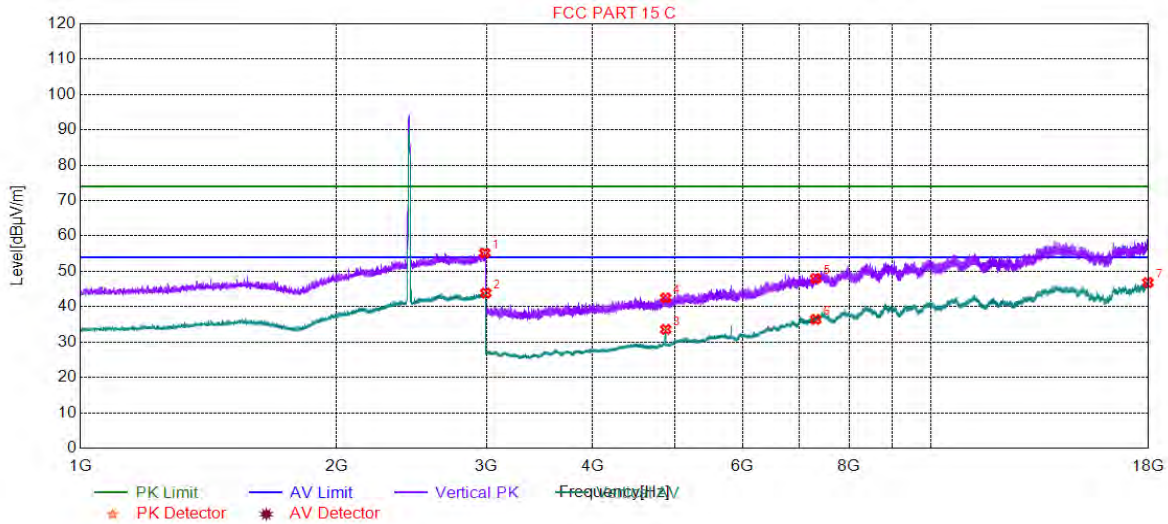
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2968.4921	44.05	9.59	54.00	9.95	150	251	Horizontal
2	2980.9952	55.31	9.54	74.00	18.69	150	333	Horizontal
3	4874.0000	45.48	-17.99	54.00	8.52	150	342	Horizontal
4	4874.0000	49.31	-17.99	74.00	24.69	150	342	Horizontal
5	7311.0000	47.95	-9.74	74.00	26.05	150	360	Horizontal
6	7311.0000	36.59	-9.74	54.00	17.41	150	169	Horizontal
7	17949.947	46.79	0.70	54.00	7.21	150	270	Horizontal



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**4.9.2.1.4 802.11B\_ Middle Channel\_ Vertical**



**Suspected List**

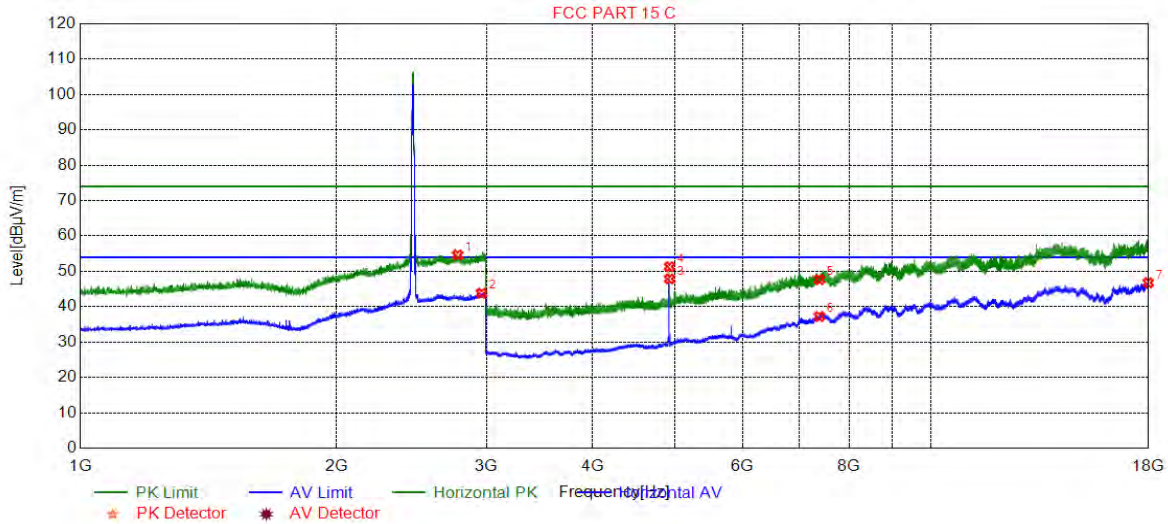
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2986.9967	55.21	9.51	74.00	18.79	150	3	Vertical
2	2995.4989	43.87	9.47	54.00	10.13	150	43	Vertical
3	4874.0000	33.60	-17.99	54.00	20.40	150	148	Vertical
4	4874.0000	42.51	-17.99	74.00	31.49	150	342	Vertical
5	7311.0000	48.00	-9.74	74.00	26.00	150	119	Vertical
6	7311.0000	36.41	-9.74	54.00	17.59	150	18	Vertical
7	17962.048	46.82	0.71	54.00	7.18	150	219	Vertical



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**4.9.2.1.5 802.11B\_ Highest Channel\_ Horizontal**



**Suspected List**

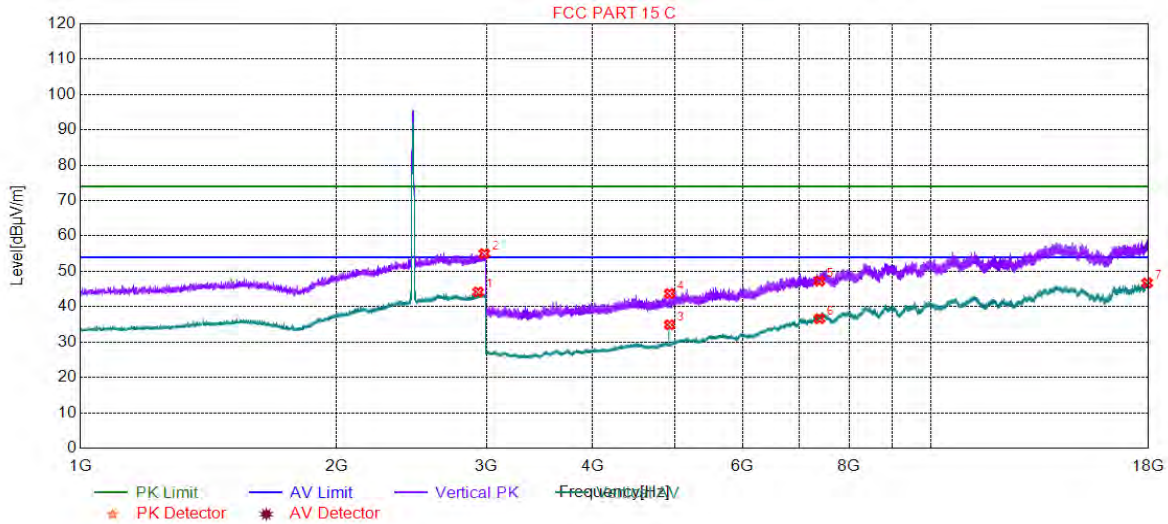
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2775.9440	54.65	9.04	74.00	19.35	150	345	Horizontal
2	2960.4901	43.81	9.63	54.00	10.19	150	71	Horizontal
3	4924.0000	47.86	-17.72	54.00	6.14	150	342	Horizontal
4	4924.0000	51.31	-17.72	74.00	22.69	150	11	Horizontal
5	7386.0000	47.68	-9.55	74.00	26.32	150	18	Horizontal
6	7386.0000	37.24	-9.55	54.00	16.76	150	272	Horizontal
7	17977.998	46.75	0.71	54.00	7.25	150	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	150	0	Vertical
2	2983.4959	55.02	9.53	74.00	18.98	150	288	Vertical
3	4924.0000	34.89	-17.72	54.00	19.11	150	119	Vertical
4	4924.0000	43.75	-17.72	74.00	30.25	150	64	Vertical
5	7386.0000	47.25	-9.55	74.00	26.75	150	322	Vertical
6	7386.0000	36.63	-9.55	54.00	17.37	150	270	Vertical
7	17925.746	46.71	0.70	54.00	7.29	150	18	Vertical

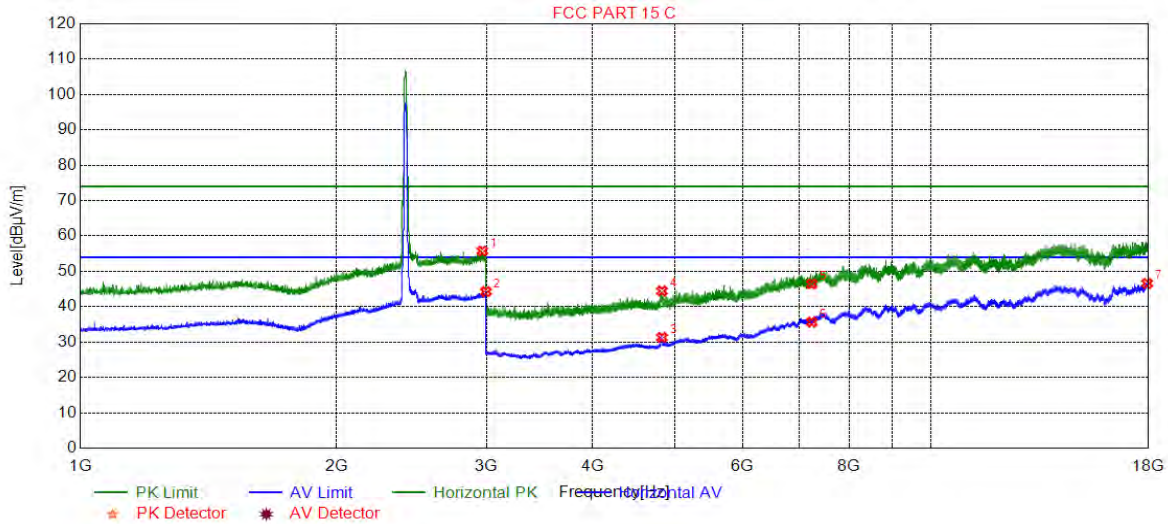


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**4.9.2.1.7 802.11G\_Lowest Channel\_Horizontal**



**Suspected List**

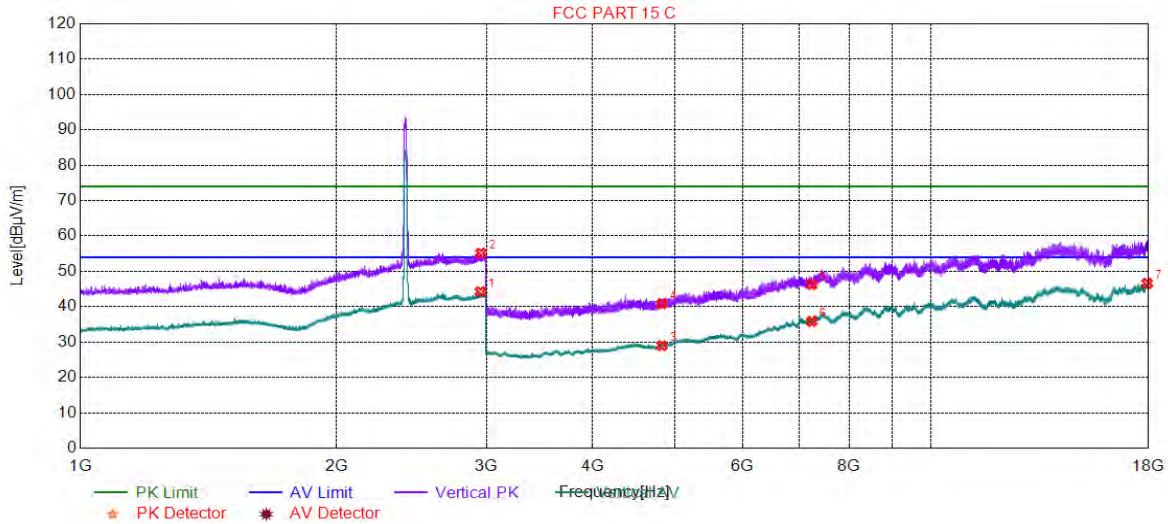
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2966.9917	55.77	9.60	74.00	18.23	150	238	Horizontal
2	2996.4991	44.28	9.47	54.00	9.72	150	18	Horizontal
3	4824.0000	31.31	-18.21	54.00	22.69	150	11	Horizontal
4	4824.0000	44.45	-18.21	74.00	29.55	150	342	Horizontal
5	7236.0000	46.40	-9.99	74.00	27.60	150	68	Horizontal
6	7236.0000	35.66	-9.99	54.00	18.34	150	119	Horizontal
7	17925.746	46.60	0.70	54.00	7.40	150	18	Horizontal



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**4.9.2.1.8 802.11G\_Lowest Channel\_Vertical**



**Suspected List**

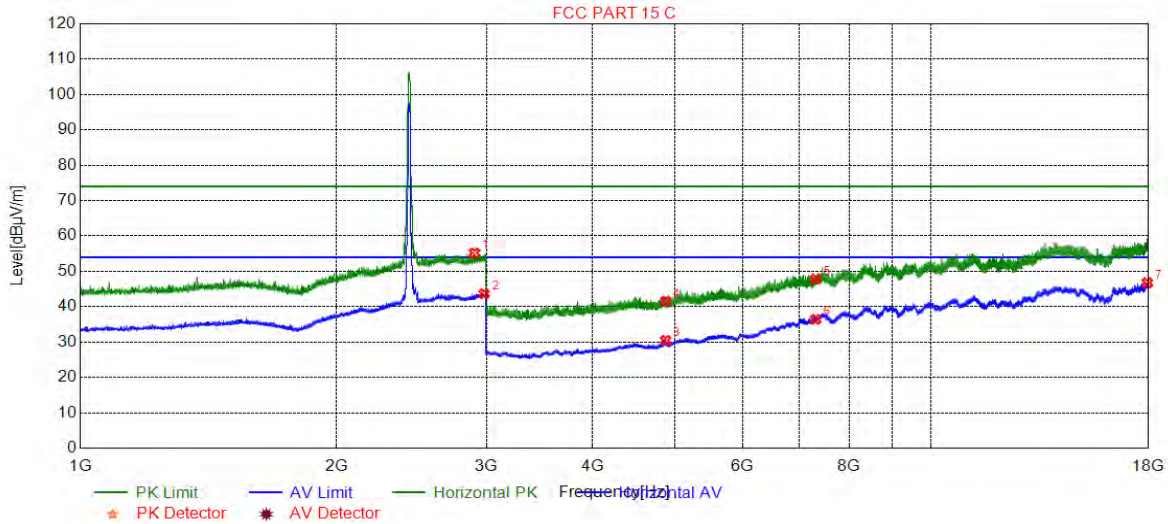
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2951.9880	44.27	9.67	54.00	9.73	150	302	Vertical
2	2956.4891	55.18	9.65	74.00	18.82	150	329	Vertical
3	4824.0000	28.98	-18.21	54.00	25.02	150	260	Vertical
4	4824.0000	40.81	-18.21	74.00	33.19	150	41	Vertical
5	7236.0000	46.26	-9.99	74.00	27.74	150	18	Vertical
6	7236.0000	35.85	-9.99	54.00	18.15	150	218	Vertical
7	17931.246	46.60	0.70	54.00	7.40	150	360	Vertical



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**4.9.2.1.9 802.11G\_ Middle Channel\_ Horizontal**



**Suspected List**

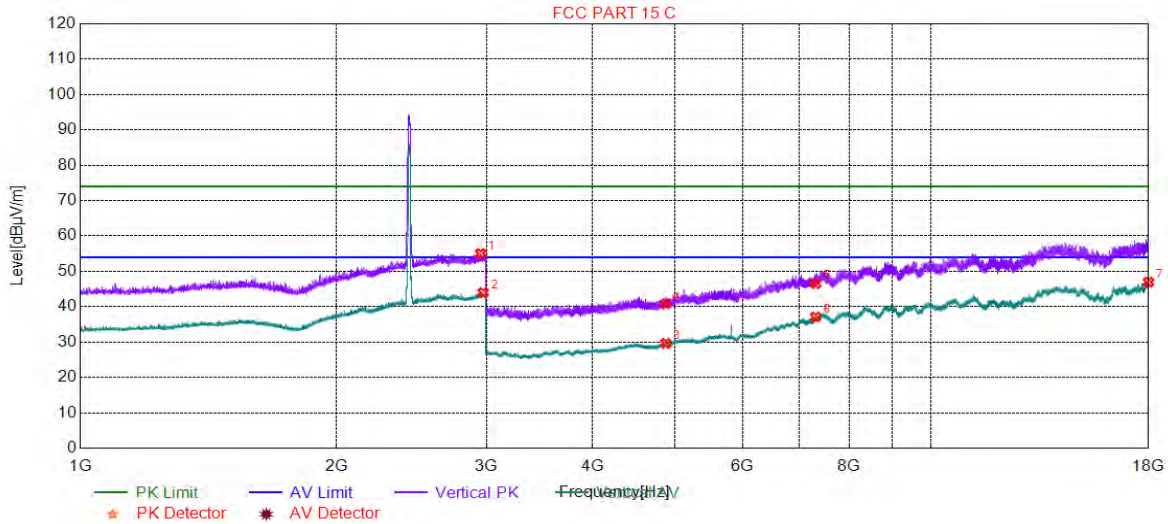
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2904.9762	55.23	9.19	74.00	18.77	150	72	Horizontal
2	2982.4956	43.69	9.53	54.00	10.31	150	292	Horizontal
3	4874.0000	30.47	-17.99	54.00	23.53	150	0	Horizontal
4	4874.0000	41.59	-17.99	74.00	32.41	150	288	Horizontal
5	7311.0000	47.81	-9.74	74.00	26.19	150	360	Horizontal
6	7311.0000	36.44	-9.74	54.00	17.56	150	18	Horizontal
7	17933.996	46.75	0.70	54.00	7.25	150	321	Horizontal



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**4.9.2.1.10 802.11G\_Middle Channel\_Vertical**



**Suspected List**

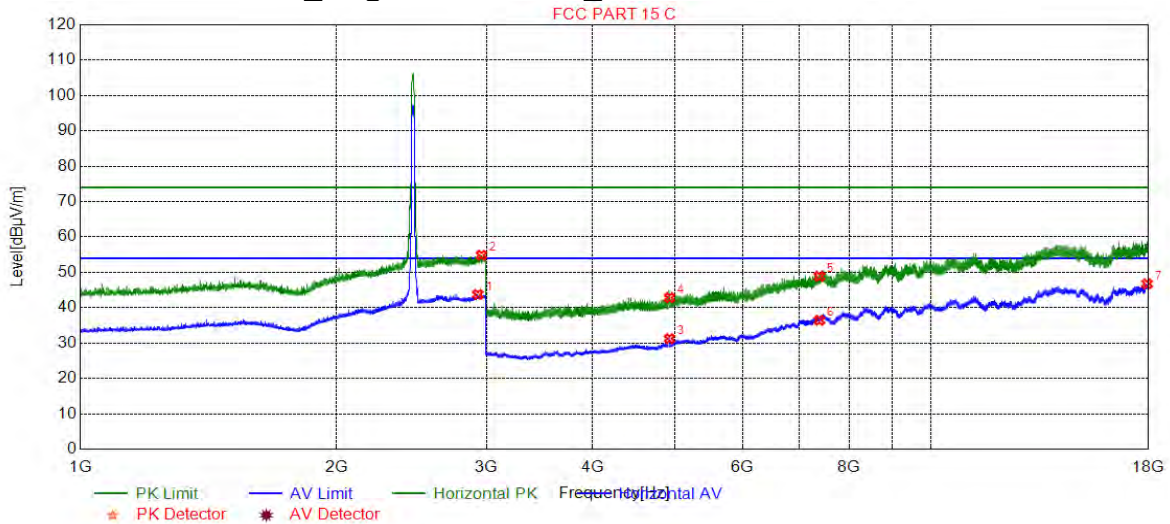
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2954.4886	55.02	9.66	74.00	18.98	150	13	Vertical
2	2973.4934	43.97	9.57	54.00	10.03	150	13	Vertical
3	4874.0000	29.62	-17.99	54.00	24.38	150	96	Vertical
4	4874.0000	40.77	-17.99	74.00	33.23	150	260	Vertical
5	7311.0000	46.54	-9.74	74.00	27.46	150	360	Vertical
6	7311.0000	37.09	-9.74	54.00	16.91	150	220	Vertical
7	17995.049	46.92	0.72	54.00	7.08	150	270	Vertical



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**4.9.2.1.11 802.11G\_Highest Channel\_Horizontal**



**Suspected List**

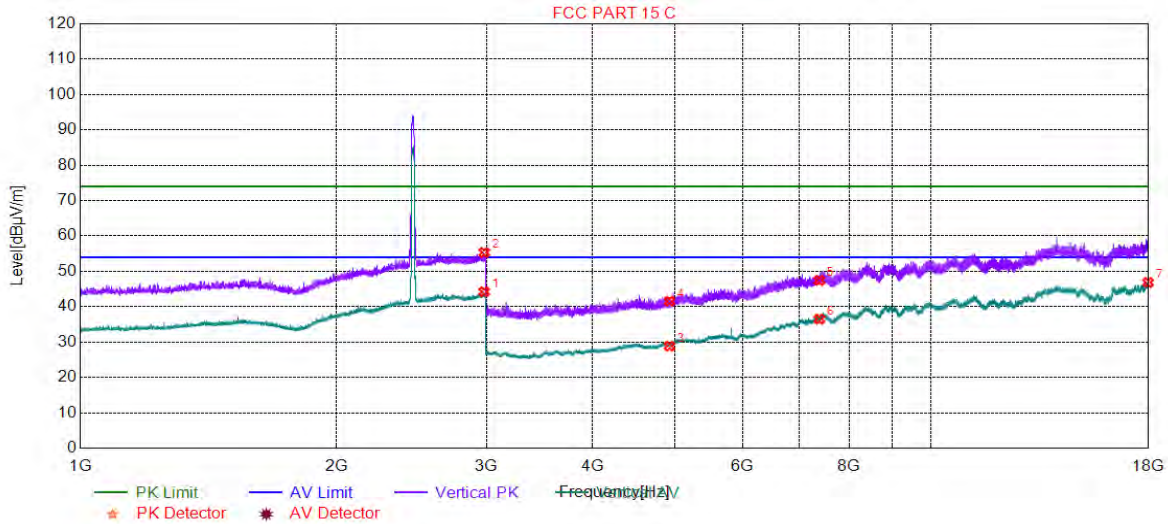
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2931.4829	43.75	9.48	54.00	10.25	150	333	Horizontal
2	2959.9900	54.86	9.63	74.00	19.14	150	360	Horizontal
3	4924.0000	31.26	-17.72	54.00	22.74	150	347	Horizontal
4	4924.0000	42.84	-17.72	74.00	31.16	150	18	Horizontal
5	7386.0000	48.86	-9.55	74.00	25.14	150	39	Horizontal
6	7386.0000	36.45	-9.55	54.00	17.55	150	0	Horizontal
7	17924.096	46.73	0.70	54.00	7.27	150	0	Horizontal



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**4.9.2.1.12 802.11G\_ Highest Channel\_ Vertical**



**Suspected List**

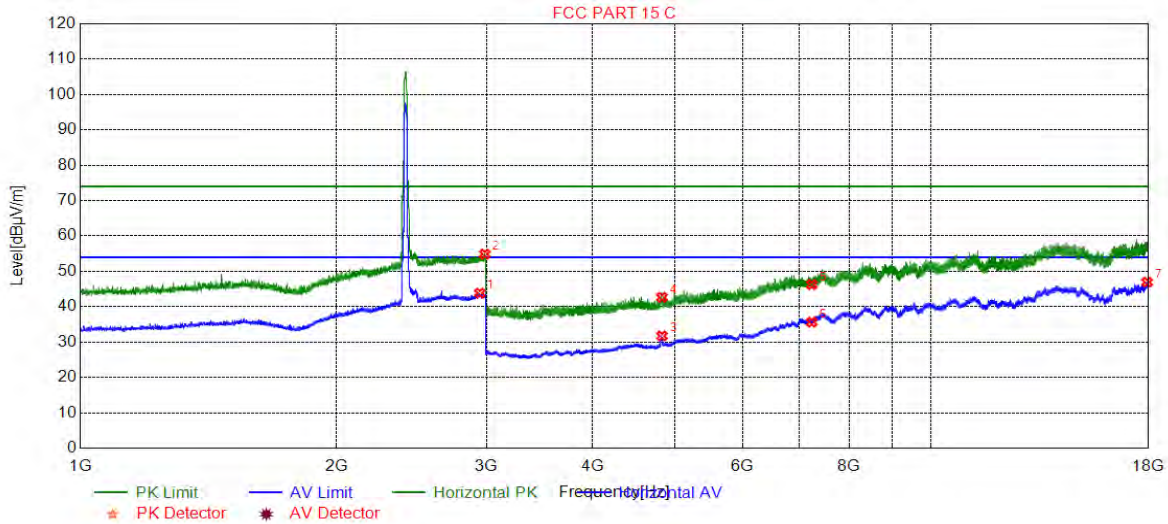
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2981.9955	44.24	9.53	54.00	9.76	150	165	Vertical
2	2982.4956	55.34	9.53	74.00	18.66	150	342	Vertical
3	4924.0000	28.86	-17.72	54.00	25.14	150	101	Vertical
4	4924.0000	41.59	-17.72	74.00	32.41	150	292	Vertical
5	7386.0000	47.43	-9.55	74.00	26.57	150	33	Vertical
6	7386.0000	36.51	-9.55	54.00	17.49	150	84	Vertical
7	17971.948	46.85	0.71	54.00	7.15	150	33	Vertical



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**4.9.2.1.13 802.11N20\_Lowest Channel\_Horizontal**



**Suspected List**

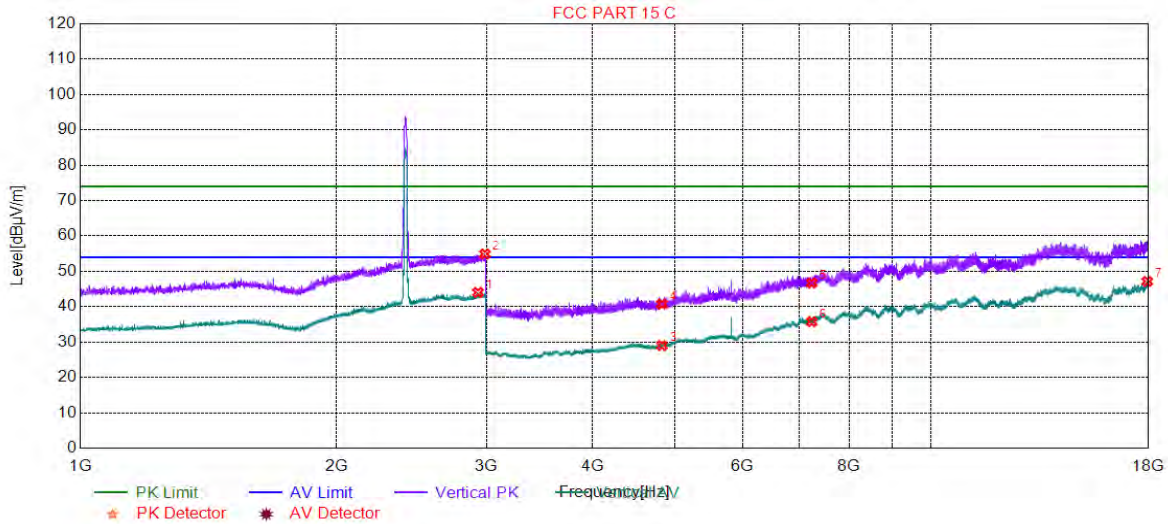
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2946.9867	43.85	9.65	54.00	10.15	150	307	Horizontal
2	2986.9967	54.89	9.51	74.00	19.11	150	348	Horizontal
3	4824.0000	31.75	-18.21	54.00	22.25	150	354	Horizontal
4	4824.0000	42.68	-18.21	74.00	31.32	150	52	Horizontal
5	7236.0000	46.26	-9.99	74.00	27.74	150	190	Horizontal
6	7236.0000	35.64	-9.99	54.00	18.36	150	140	Horizontal
7	17926.846	46.95	0.70	54.00	7.05	150	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	150	328	Vertical
2	2987.9970	54.91	9.51	74.00	19.09	150	273	Vertical
3	4824.0000	29.01	-18.21	54.00	24.99	150	352	Vertical
4	4824.0000	40.73	-18.21	74.00	33.27	150	46	Vertical
5	7236.0000	46.71	-9.99	74.00	27.29	150	342	Vertical
6	7236.0000	35.76	-9.99	54.00	18.24	150	239	Vertical
7	17934.546	47.15	0.70	54.00	6.85	150	138	Vertical

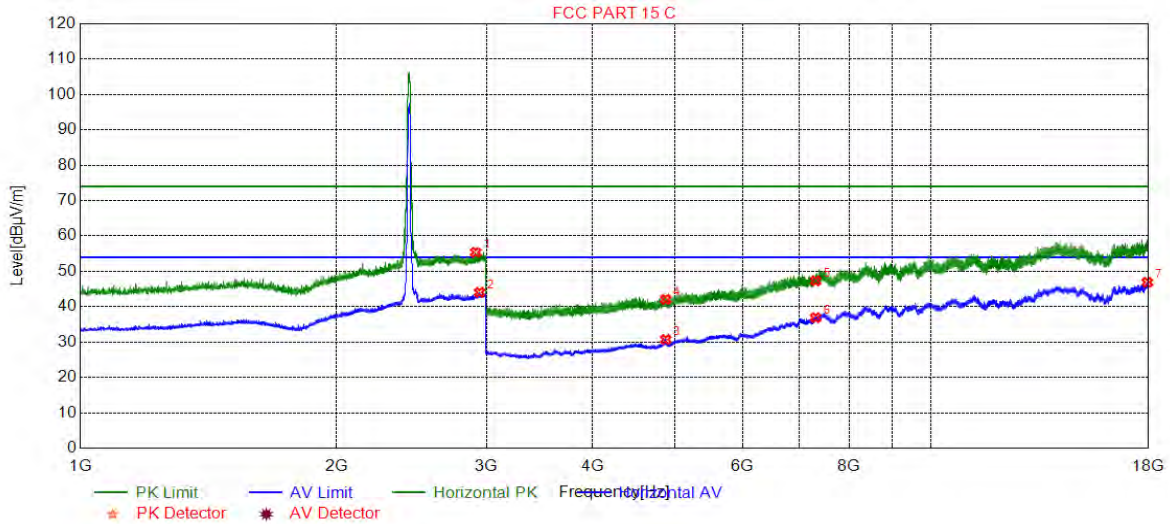


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**4.9.2.1.15 802.11N20\_ Middle Channel\_ Horizontal**



**Suspected List**

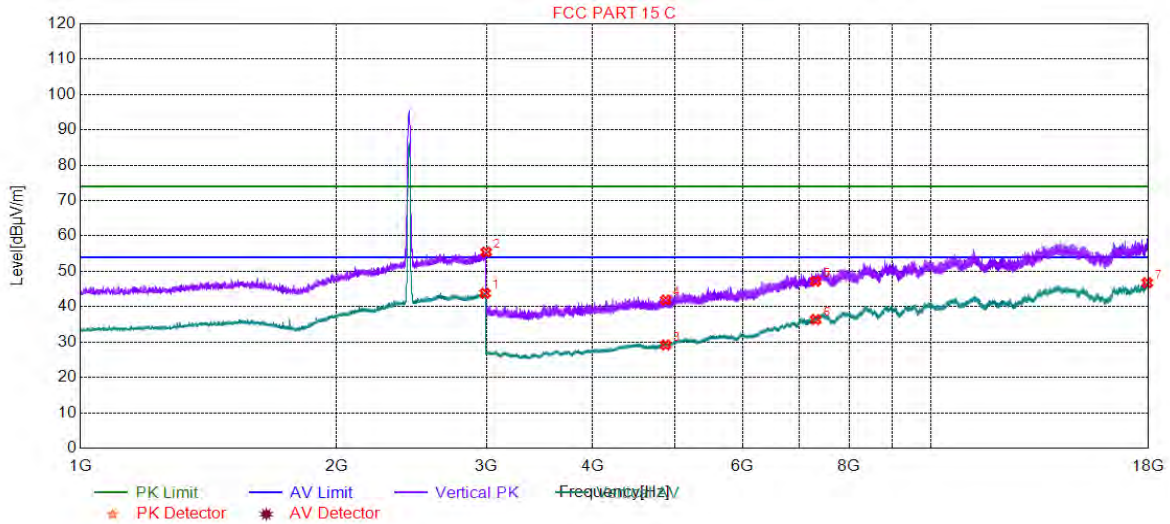
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2914.9787	55.38	9.30	74.00	18.62	150	155	Horizontal
2	2945.4864	44.05	9.63	54.00	9.95	150	113	Horizontal
3	4874.0000	30.72	-17.99	54.00	23.28	150	360	Horizontal
4	4874.0000	42.09	-17.99	74.00	31.91	150	45	Horizontal
5	7311.0000	47.31	-9.74	74.00	26.69	150	140	Horizontal
6	7311.0000	36.90	-9.74	54.00	17.10	150	140	Horizontal
7	17935.096	46.89	0.70	54.00	7.11	150	342	Horizontal



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**4.9.2.1.16 802.11N20\_Middle Channel\_Vertical**



**Suspected List**

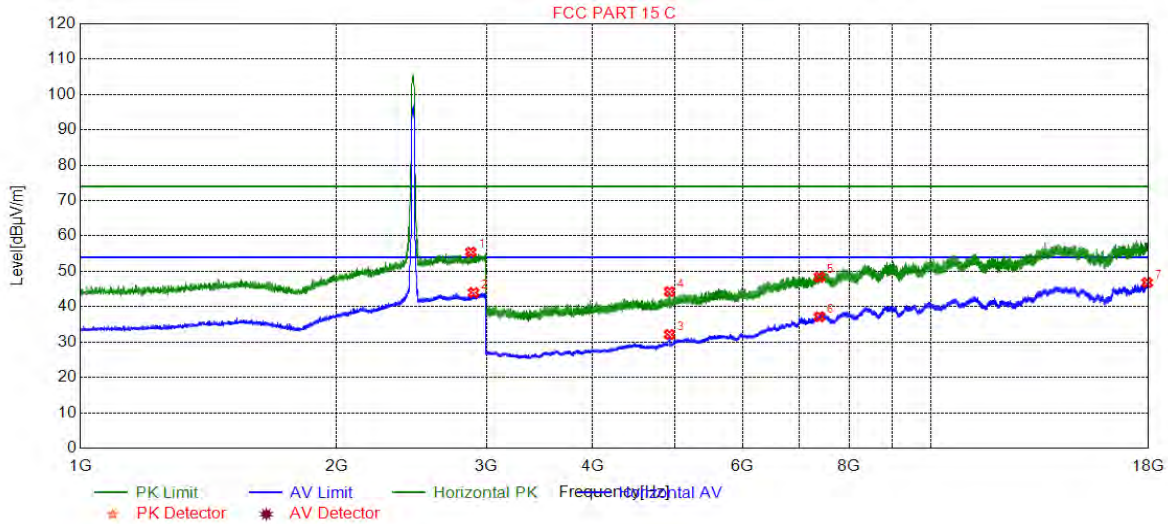
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2988.9972	43.82	9.50	54.00	10.18	150	138	Vertical
2	2997.4994	55.47	9.46	74.00	18.53	150	29	Vertical
3	4874.0000	29.20	-17.99	54.00	24.80	150	238	Vertical
4	4874.0000	41.89	-17.99	74.00	32.11	150	45	Vertical
5	7311.0000	47.22	-9.74	74.00	26.78	150	292	Vertical
6	7311.0000	36.36	-9.74	54.00	17.64	150	342	Vertical
7	17931.796	46.76	0.70	54.00	7.24	150	89	Vertical



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**4.9.2.1.17 802.11N20\_ Highest Channel\_ Horizontal**



**Suspected List**

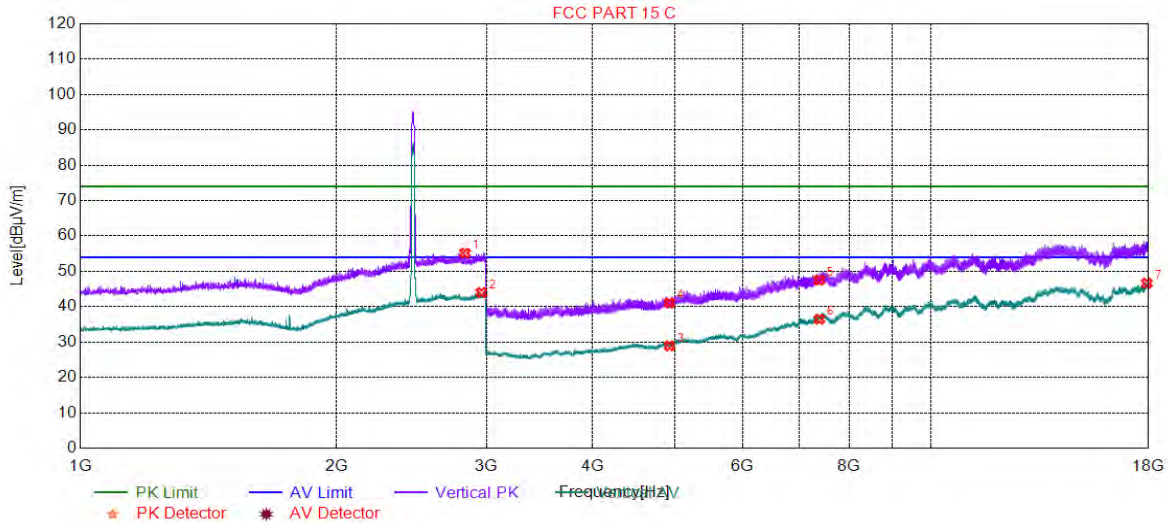
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2875.4689	55.46	9.19	74.00	18.54	150	252	Horizontal
2	2897.9745	44.00	9.14	54.00	10.00	150	358	Horizontal
3	4924.0000	32.14	-17.72	54.00	21.86	150	18	Horizontal
4	4924.0000	44.29	-17.72	74.00	29.71	150	18	Horizontal
5	7386.0000	48.37	-9.55	74.00	25.63	150	342	Horizontal
6	7386.0000	37.15	-9.55	54.00	16.85	150	0	Horizontal
7	17927.396	46.79	0.70	54.00	7.21	150	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	150	150	Vertical
2	2958.4896	44.01	9.64	54.00	9.99	150	191	Vertical
3	4924.0000	28.94	-17.72	54.00	25.06	150	182	Vertical
4	4924.0000	41.06	-17.72	74.00	32.94	150	73	Vertical
5	7386.0000	47.57	-9.55	74.00	26.43	150	240	Vertical
6	7386.0000	36.47	-9.55	54.00	17.53	150	190	Vertical
7	17912.545	46.63	0.69	54.00	7.37	150	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:			

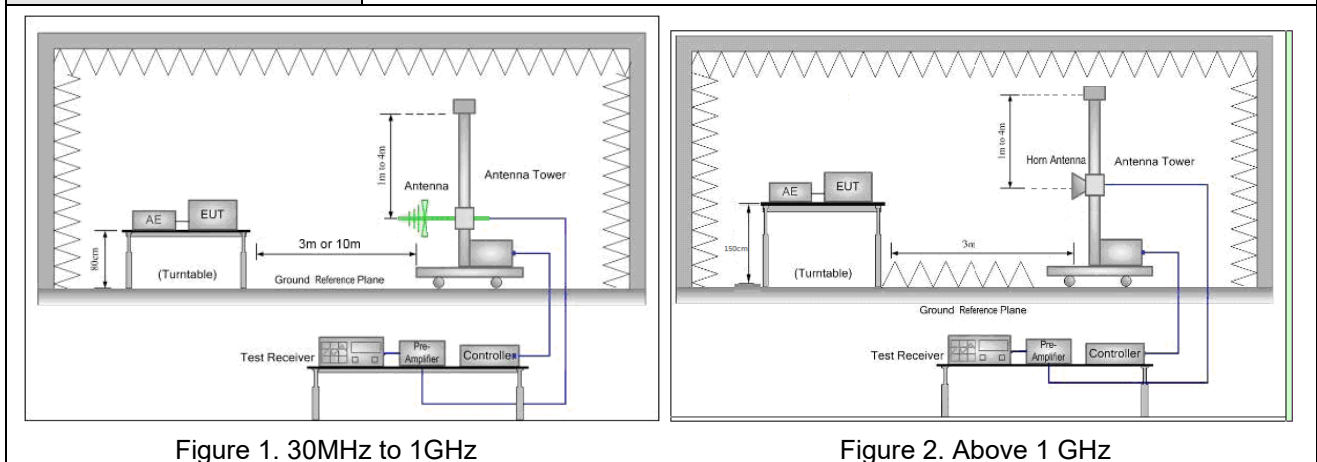


Figure 1. 30MHz to 1GHz

Figure 2. Above 1 GHz



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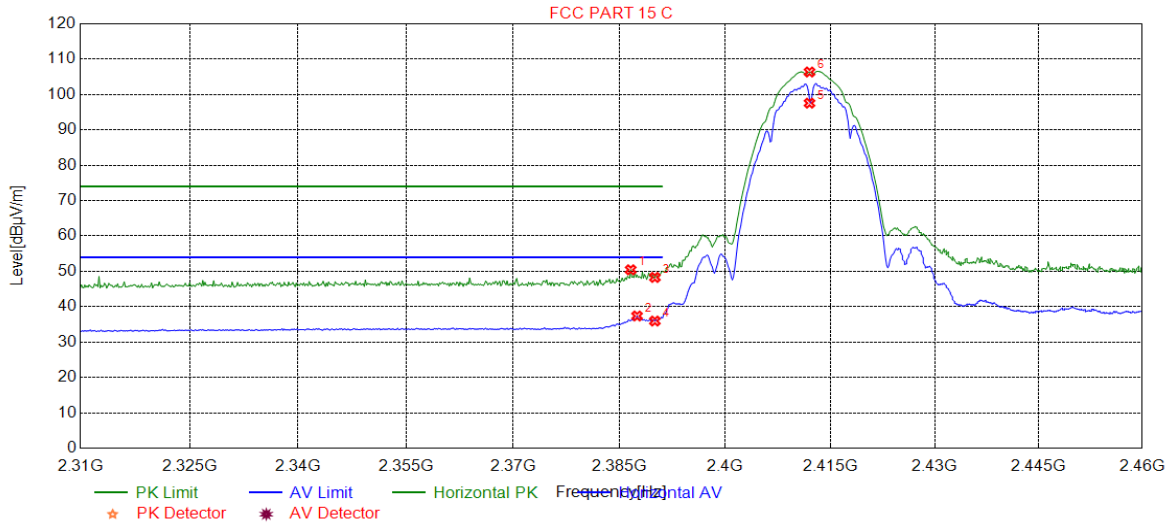
<p>Test Procedure:</p>	<ol style="list-style-type: none"> <li>a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.</li> <li>b. For 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.</li> <li>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.</li> <li>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.</li> <li>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.</li> <li>f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</li> <li>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</li> <li>h. Test the EUT in the lowest channel , the Highest channel</li> <li>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.</li> <li>j. Repeat above procedures until all frequencies measured was complete.</li> </ol>
<p>Exploratory Test Mode:</p>	<p>Transmitting with all kind of modulations, data rates. Charge + Transmitting mode.</p>
<p>Final Test Mode:</p>	<p>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.</p>
<p>Instruments Used:</p>	<p>Refer to section 5.10 for details</p>
<p>Test Results:</p>	<p>Pass</p>



Test plot as follows:

**4.10.1 ANT1**

**4.10.1.1 802.11B\_Lowest Channel\_Horizontal**



**Suspected List**

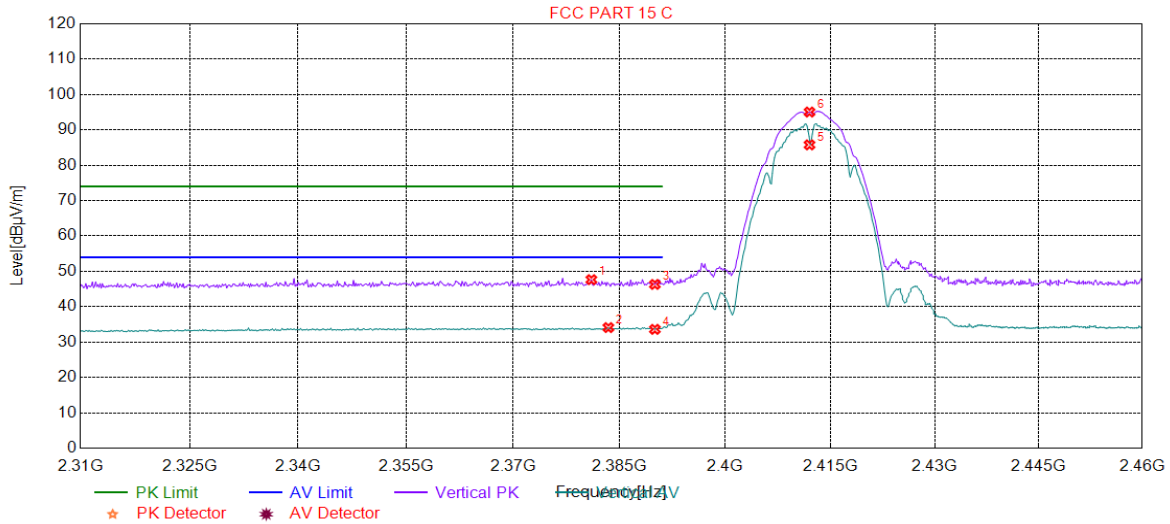
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2386.5766	50.44	7.77	74.00	23.56	150	102	Horizontal
2	2387.4775	37.38	7.77	54.00	16.62	150	238	Horizontal
3	2390.0000	48.28	7.77	74.00	25.72	150	98	Horizontal
4	2390.0000	35.95	7.77	54.00	18.05	150	98	Horizontal
5	2412.0000	97.56	7.81	0.00	-97.56	150	74	Horizontal
6	2412.0000	106.37	7.81	0.00	-106.37	150	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	150	135	Vertical
2	2383.4234	34.10	7.78	54.00	19.90	150	274	Vertical
3	2390.0000	46.31	7.77	74.00	27.69	150	156	Vertical
4	2390.0000	33.61	7.77	54.00	20.39	150	180	Vertical
5	2412.0000	85.77	7.81	0.00	-85.77	150	220	Vertical
6	2412.0000	95.05	7.81	0.00	-95.05	150	224	Vertical

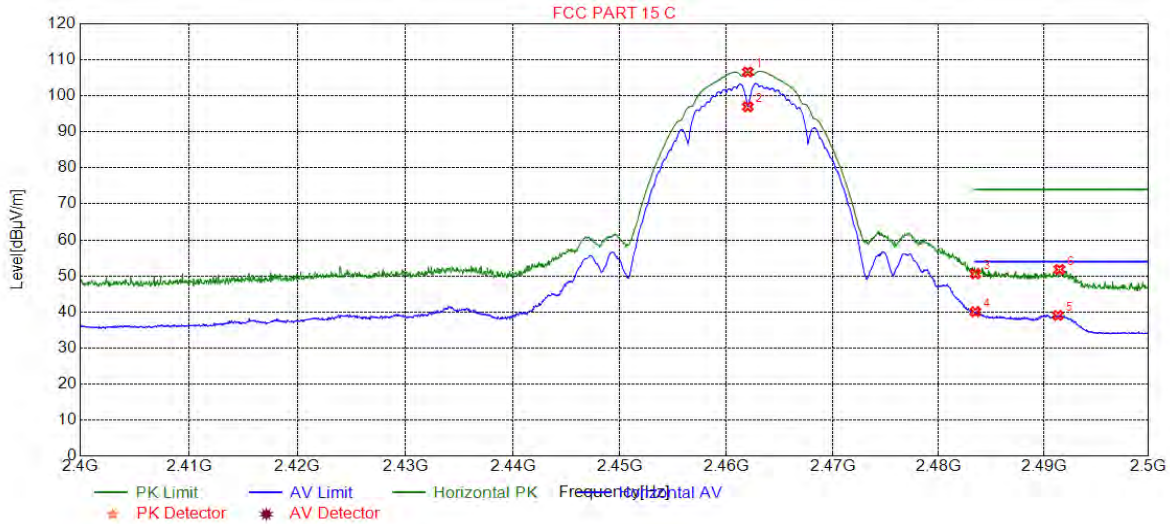


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**4.10.1.3 802.11B\_ Highest Channel\_ Horizontal**



**Suspected List**

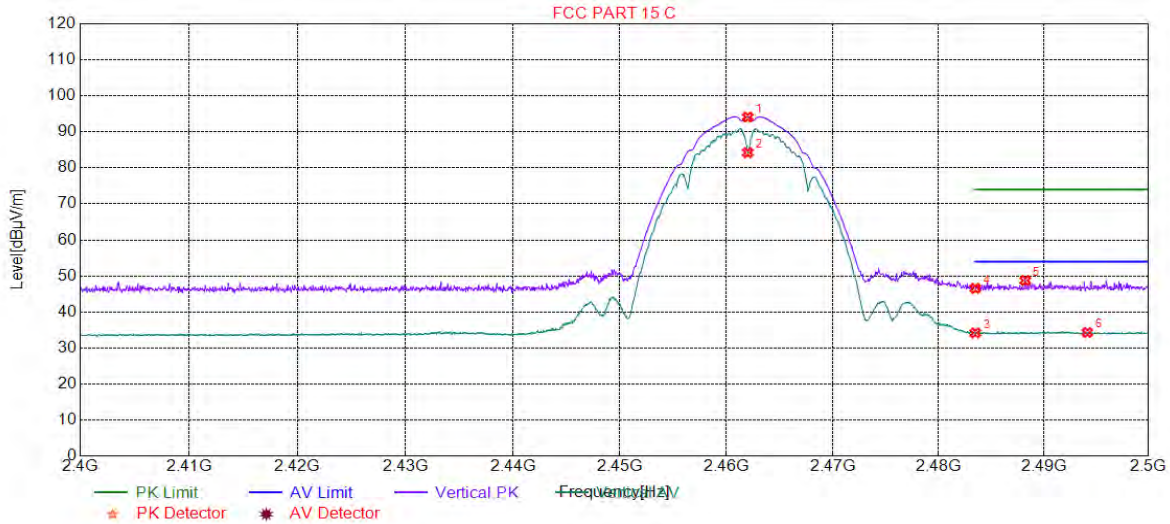
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.0000	106.63	7.98	0.00	-106.63	150	90	Horizontal
2	2462.0000	96.99	7.98	0.00	-96.99	150	90	Horizontal
3	2483.5000	50.59	8.01	74.00	23.41	150	84	Horizontal
4	2483.5000	40.07	8.01	54.00	13.93	150	68	Horizontal
5	2491.3457	39.03	8.02	54.00	14.97	150	73	Horizontal
6	2491.4957	51.82	8.02	74.00	22.18	150	62	Horizontal



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**4.10.1.4 802.11B\_ Highest Channel\_ Vertical**



**Suspected List**

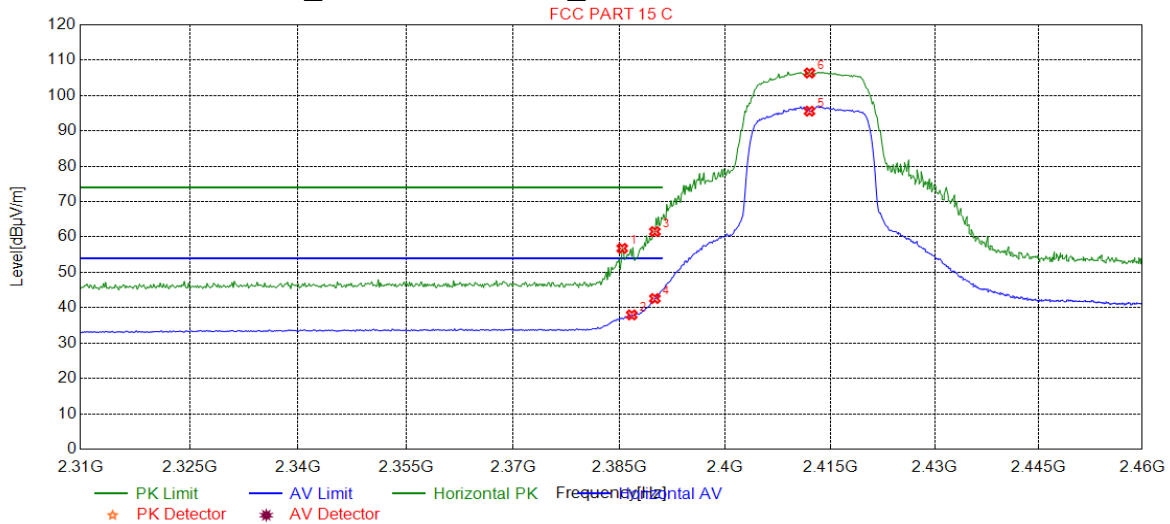
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.0000	94.12	7.98	0.00	-94.12	150	105	Vertical
2	2462.0000	84.21	7.98	0.00	-84.21	150	105	Vertical
3	2483.5000	34.20	8.01	54.00	19.80	150	208	Vertical
4	2483.5000	46.57	8.01	74.00	27.43	150	19	Vertical
5	2488.2441	48.75	8.02	74.00	25.25	150	257	Vertical
6	2494.1471	34.32	8.02	54.00	19.68	150	295	Vertical



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**4.10.1.5 802.11G\_Lowest Channel\_Horizontal**



**Suspected List**

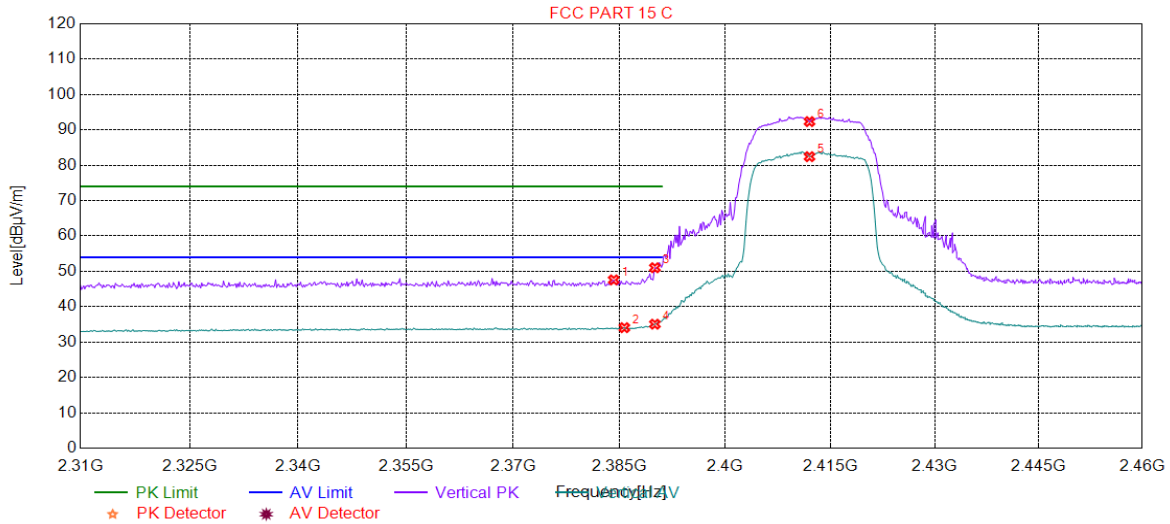
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2385.3754	56.78	7.77	74.00	17.22	150	62	Horizontal
2	2386.7267	37.97	7.77	54.00	16.03	150	73	Horizontal
3	2390.0000	61.53	7.77	74.00	12.47	150	65	Horizontal
4	2390.0000	42.60	7.77	54.00	11.40	150	81	Horizontal
5	2412.0000	95.57	7.81	0.00	-95.57	150	73	Horizontal
6	2412.0000	106.37	7.81	0.00	-106.37	150	89	Horizontal



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**4.10.1.6 802.11G\_Lowest Channel\_Vertical**



**Suspected List**

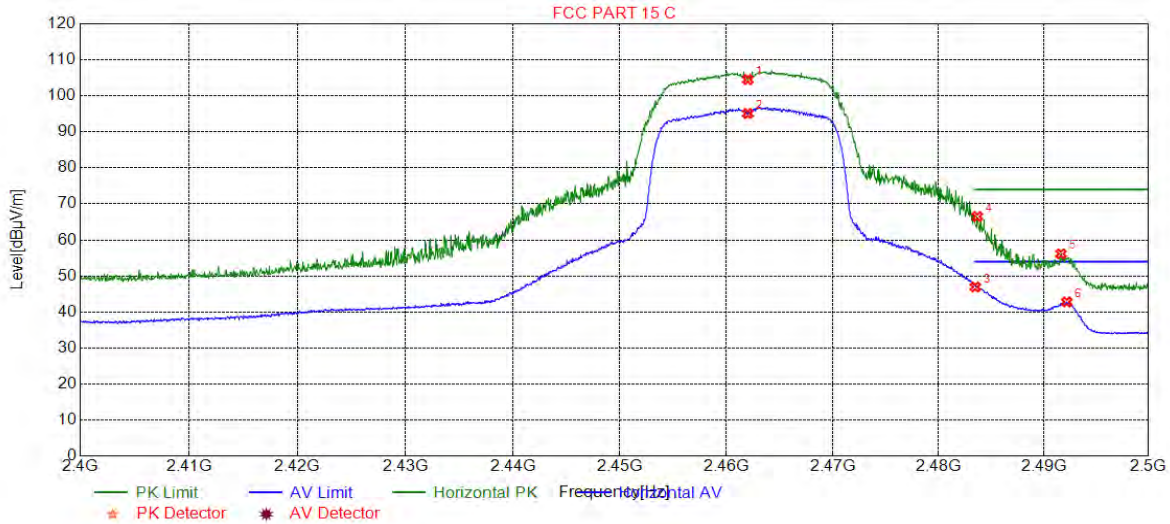
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2384.1742	47.58	7.78	74.00	26.42	150	296	Vertical
2	2385.6757	34.08	7.77	54.00	19.92	150	272	Vertical
3	2390.0000	51.02	7.77	74.00	22.98	150	25	Vertical
4	2390.0000	35.06	7.77	54.00	18.94	150	21	Vertical
5	2412.0000	82.43	7.81	0.00	-82.43	150	21	Vertical
6	2412.0000	92.35	7.81	0.00	-92.35	150	18	Vertical



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**4.10.1.7 802.11G\_ Highest Channel\_ Horizontal**



**Suspected List**

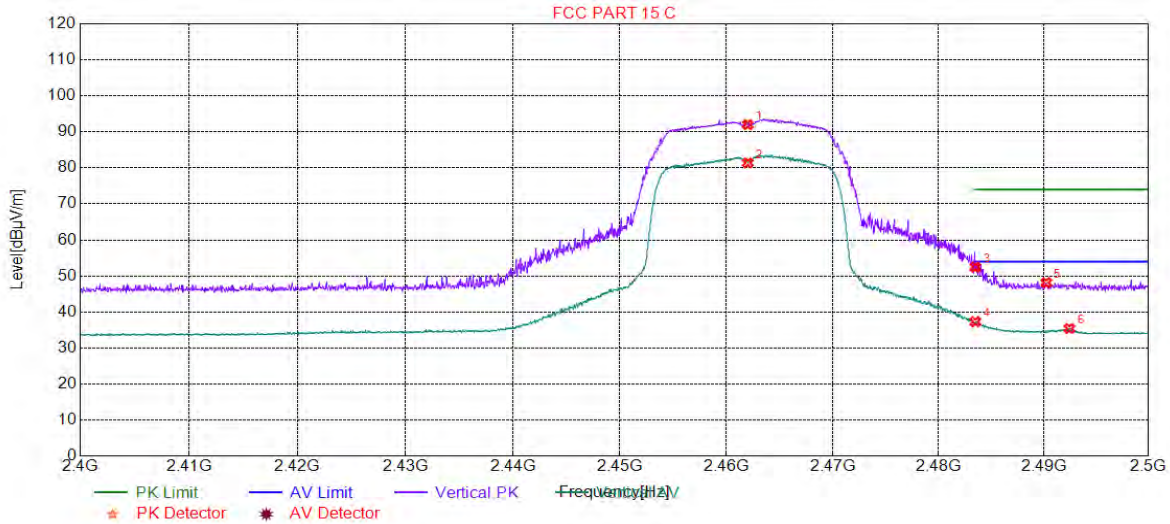
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.0000	104.53	7.98	0.00	-104.53	150	95	Horizontal
2	2462.0000	95.09	7.98	0.00	-95.09	150	95	Horizontal
3	2483.5000	46.93	8.01	54.00	7.07	150	74	Horizontal
4	2483.6918	66.49	8.01	74.00	7.51	150	101	Horizontal
5	2491.6458	56.15	8.02	74.00	17.85	150	74	Horizontal
6	2492.1961	42.79	8.02	54.00	11.21	150	84	Horizontal



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**4.10.1.8 802.11G\_ Highest Channel\_ Vertical**



**Suspected List**

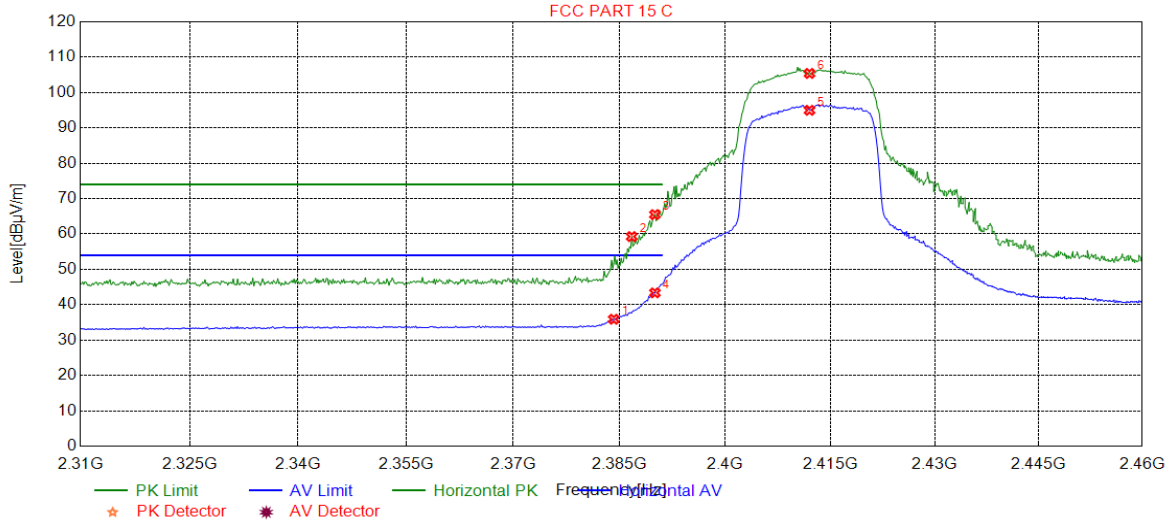
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.0000	92.02	7.98	0.00	-92.02	150	181	Vertical
2	2462.0000	81.38	7.98	0.00	-81.38	150	175	Vertical
3	2483.5000	52.44	8.01	74.00	21.56	150	224	Vertical
4	2483.5000	37.31	8.01	54.00	16.69	150	268	Vertical
5	2490.2451	48.14	8.02	74.00	25.86	150	240	Vertical
6	2492.4462	35.42	8.02	54.00	18.58	150	208	Vertical



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**4.10.1.9 802.11N20\_ Lowest Channel\_ Horizontal**



**Suspected List**

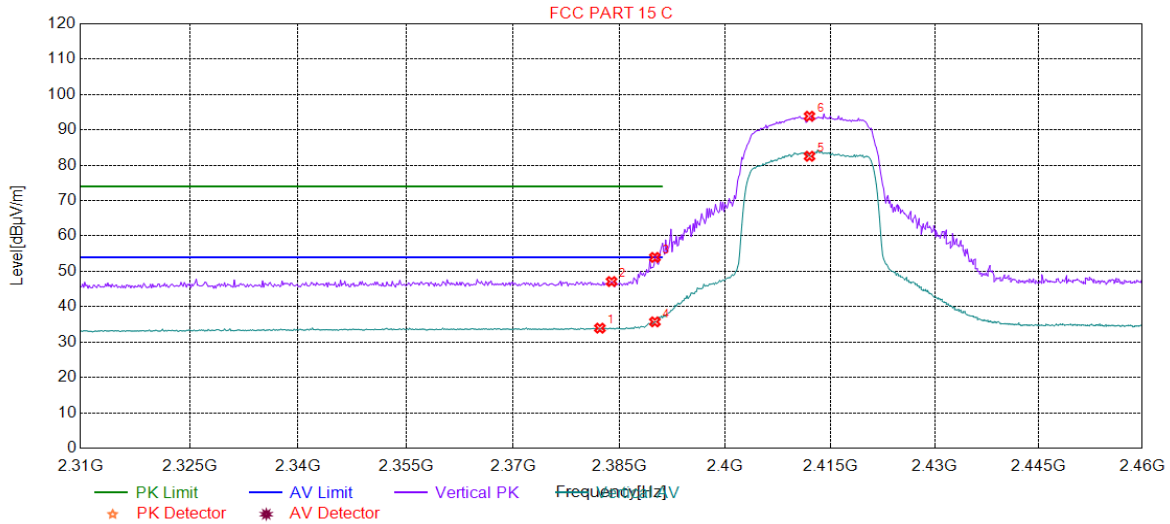
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2384.1742	35.90	7.78	54.00	18.10	150	81	Horizontal
2	2386.7267	59.26	7.77	74.00	14.74	150	101	Horizontal
3	2390.0000	65.49	7.77	74.00	8.51	150	61	Horizontal
4	2390.0000	43.36	7.77	54.00	10.64	150	77	Horizontal
5	2412.0000	94.97	7.81	0.00	-94.97	150	73	Horizontal
6	2412.0000	105.40	7.81	0.00	-105.40	150	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	150	138	Vertical
2	2383.8739	47.12	7.78	74.00	26.88	150	49	Vertical
3	2390.0000	53.94	7.77	74.00	20.06	150	306	Vertical
4	2390.0000	35.72	7.77	54.00	18.28	150	118	Vertical
5	2412.0000	82.54	7.81	0.00	-82.54	150	21	Vertical
6	2412.0000	93.86	7.81	0.00	-93.86	150	21	Vertical

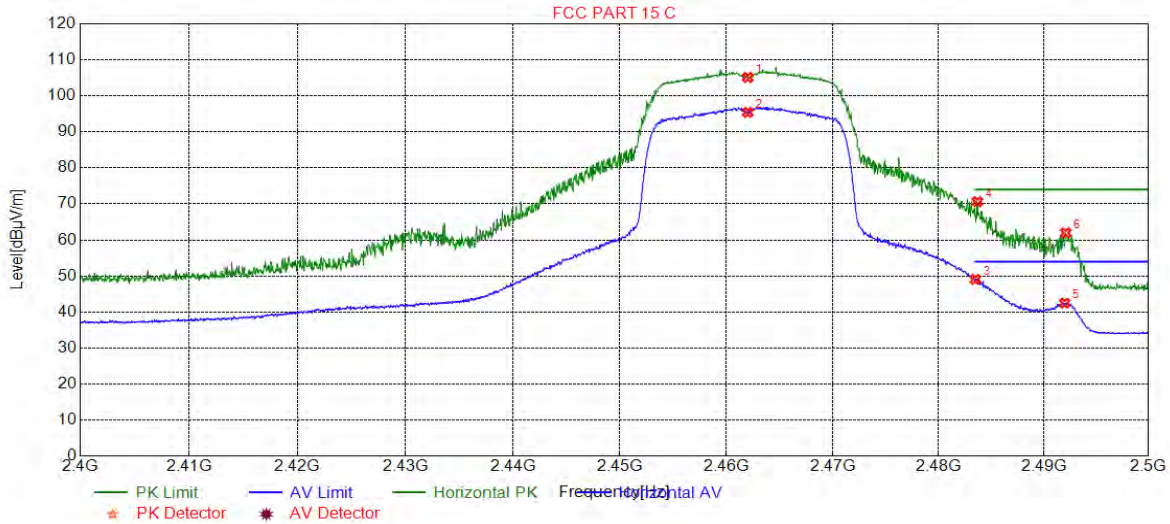


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**4.10.1.11 802.11N20\_ Highest Channel\_ Horizontal**



**Suspected List**

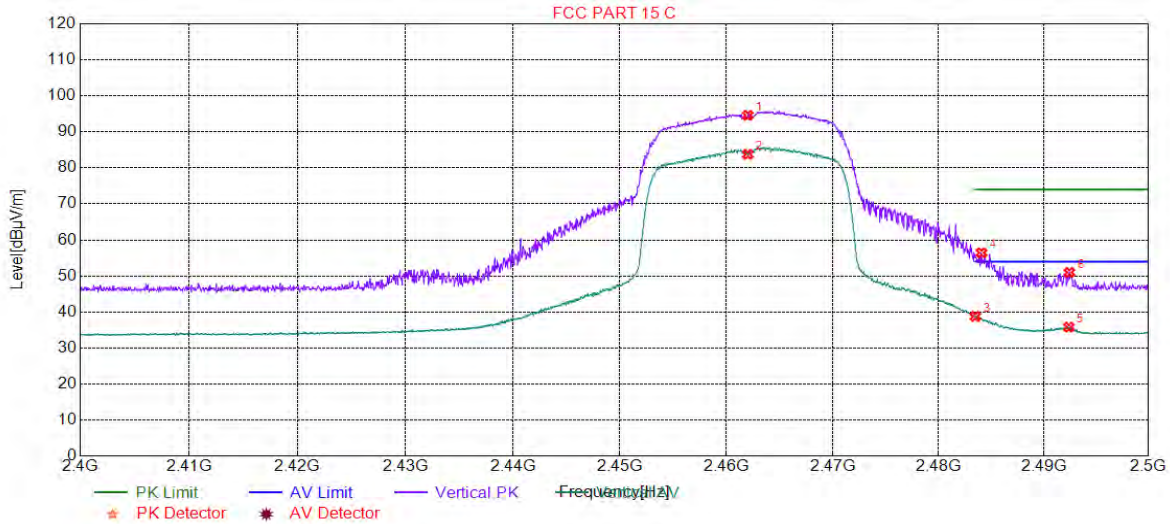
Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	2462.0000	105.11	7.98	0.00	-105.11	150	72	Horizontal
2	2462.0000	95.40	7.98	0.00	-95.40	150	72	Horizontal
3	2483.5000	49.06	8.01	54.00	4.94	150	78	Horizontal
4	2483.6918	70.63	8.01	74.00	3.37	150	61	Horizontal
5	2491.9960	42.49	8.02	54.00	11.51	150	78	Horizontal
6	2492.0960	61.96	8.02	74.00	12.04	150	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	150	258	Vertical
2	2462.0000	83.76	7.98	0.00	-83.76	150	252	Vertical
3	2483.5000	38.78	8.01	54.00	15.22	150	204	Vertical
4	2484.0920	56.45	8.01	74.00	17.55	150	165	Vertical
5	2492.3962	35.80	8.02	54.00	18.20	150	160	Vertical
6	2492.4462	50.99	8.02	74.00	23.01	150	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:

$$\text{Final Test Level} = \text{Receiver Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Preamplifier Factor}$$

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	Cal. Duedate
				(yyyy-mm-dd)	(yyyy-mm-dd)
Shielding Room	ZhongYu Electron	GB-88	SEM001-06	2020/5/10	2023/5/9
LISN	Rohde & Schwarz	ENV216	SEM007-01	2019/7/14	2020/7/14
LISN	ETS-LINDGREN	Feb-16	SEM007-02	2012/0/4/1	2021/3/31
Measurement Software	AUDIX	e3 V5.4.1221d	N/A	N/A	N/A
Coaxial Cable	SGS	N/A	SEM024-01	2019/6/12	2020/6/11
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	Cal. Duedate
				(yyyy-mm-dd)	(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



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RE in Chamber					
Test Equipment	Manufacturer	Model No.	Inventory No.	Cal. date	Cal. Due date
				(yyyy-mm-dd)	(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	2019/6/12	2020/6/11
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	2017/6/27	2020/6/26
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	2019/7/14	2020/7/14
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	Cal. Due date
				(yyyy-mm-dd)	(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	2019/6/12	2020/6/11
MXE EMI Receiver (20Hz-8.4GHz)	Agilent Technologies	N9038A	SEM004-05	2019/7/14	2020/7/14
BiConiLog Antenna (26-3000MHz)	ETS-LINDGREN	3142C	SEM003-01	2017/6/27	2020/6/26
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	2019/6/12	2020/6/11

## 7 Photographs - EUT Constructional Details

Refer to Appendix A - Photographs of Set-Up for ZR/2020/50001.

The End



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