FCC TEST REPORT

Product	:	Mobile Phone
Trade mark	:	MI
Model/Type reference	:	2016117
Report Number	:	1608310293RFC-1
Date of Issue	:	Oct.15, 2016
FCC ID	:	2AFZZ-RM6117
Test Standards	:	47 CFR Part 15 Subpart C (2015)
Test result	:	PASS

Prepared for:

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The Rainbow City of China Resources, NO.68, Qinghe Middle Street, Haidian District, Beijing, China

Prepared by:

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Approved by:	Billy Li Technical Director	Date:	Oct.15, 2016

Version

Version No.	Date	Description
V1.0	Oct.15, 2016	Original

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1 General Information

1.1 Client Information

Applicant:	Xiaomi Communications Co., Ltd.
Address of Applicant:	The Rainbow City of China Resources, NO.68, Qinghe Middle Street, Haidian District, Beijing, China
Manufacturer:	Xiaomi Communications Co., Ltd.
Address of Manufacturer:	The Rainbow City of China Resources, NO.68, Qinghe Middle Street, Haidian District, Beijing, China

1.2 General Description of EUT

Product Name:	Mobile Phone	
Model No.(EUT):	2016117	
Add. Mode No.:	N/A	
Trade Mark:	MI	
EUT Supports Radios application:	GSM850/900/1800/1900 WCDMA Band I/Band II/Band V/Band VIII LTE FDD Band 1/Band 3/ Band 4/ Band 5/Band 7/Band 8/Band 20 LTE TDD Band 40/Band 41 Wlan 2.4GHz 802.11b/g/n(HT20) Bluetooth V3.0+EDR&Bluetooth V4.0 BLE GPS, Glonass	
Power Supply:	AC adapter	Model:MDY-08-EF Input:100-240V~50/60Hz, 0.35A; Output: 5V ⎓ 2A
	Battery1	Model: BN30 Brand: Sunwoda Rated voltage: 3.84Vdc Battery capacity: 3030mAh(Li-on Rechargeable)
	Battery2	Model: BN30 Brand: SCUD Rated voltage: 3.84Vdc Battery capacity: 3030mAh(Li-on Rechargeable)
USB Micro-B Plug cable:	117cm(Shielded)	
Sample Received Date:	Sep. 09, 2016	
Sample tested Date:	Sep. 11, 2016 to Sep. 29, 2016	

1.3 Product Specification subjective to this standard

Operation Frequency:	802.11b/g/n(HT20): 2412MHz to 2462MHz
Channel Numbers:	802.11b/g/n(HT20): 11 Channels
Channel Separation:	Channels with 5MHz step
Transmit Data Rate:	802.11b:1M/ 2M/ 5.5M/ 11M bps 802.11g:6M/ 9M/ 12M/ 18M/ 24M/ 36M/ 48M/ 54M bps 802.11n(HT20):6.5M/13M/19.5M/26M/39M/52M/58.5M/64M bps
Type of Modulation:	802.11b:DSSS(CCK,DQPSK,DBPSK) 802.11g:OFDM(64QAM, 16QAM, QPSK, BPSK) 802.11n(HT20): OFDM (64QAM, 16QAM,QPSK,BPSK)
Sample Type:	Portable production
Test Software of EUT:	Provided by the manufacturer
Antenna Type	LDS Antenna

Antenna Gain:	-3 dBi
Normal Test voltage:	3.84Vdc
Extreme Test voltage:	3.6~4.35Vdc (declared by the manufacturer)
Operating Temperature:	0℃ to +40℃ (declared by the manufacturer)
Software Version:	MIUI8
Hardware Version:	P3

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

1.4 Description of Support Units

The EUT has been tested with associated equipment below.

1) Support equipment

Description	Manufacturer	Model No.	Serial Number	Supplied by
Notebook	Lenovo	E450	SL10G10780	UnionTrust

2) Cable

Cable No.	Description	Connector Type	Cable Type/Length	Supplied by
N/A	N/A	N/A	N/A	N/A

1.5 Test Location

All tests were performed at:

Shenzhen Huatongwei International Inspection Co., Ltd.

Address: 1/F, Bldg 3,Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

Telephone: +86 (0) 755 26748019 Fax:+86 (0) 755 26748089

1.6 Test Facility

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

FCC-Registration No.: 317478

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 317478, Renewal date Jul.18, 2014, valid time is until Jul.18, 2017.

1.7 Deviation from Standards

None.

1.8 Abnormalities from Standard Conditions

None.

1.9 Other Information Requested by the Customer

None.

1.10 Measurement Uncertainty (95% confidence levels, k=1.96)

No.	Item	Measurement Uncertainty
1	Transmitter power conducted	0.57 dB
2	Transmitter power Radiated	2.20 dB
3	Conducted spurious emission 9KHz-40GHz	1.60 dB
	Radiated spurious emission 9KHz-40GHz	2.20 dB
4	Conducted emission 9KHz-30MHz	3.39 dB
	Radiated emission 30MHz-1000MHz	4.24 dB
5	Radiated emission 1GHz-18GHz	5.16 dB
6	Radiated emission 18GHz-40GHz	5.54 dB

2 Test Summary

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2013 version of ANSI C63.10

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15 Subpart C Section 15.203/15.247 (c)	ANSI C63.10-2013	PASS
AC Power Line Conducted Emission	47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013	PASS
Conducted Peak Output Power	47 CFR Part 15 Subpart C Section 15.247 (b)(3)	KDB 558074 D01 v03r05 Section 9.1.2	PASS
6dB Bandwidth	47 CFR Part 15 Subpart C Section 15.247 (a)(2)	KDB 558074 D01 v03r05 Section 8.1	PASS
Power Spectral Density	47 CFR Part 15 Subpart C Section 15.247 (e)	KDB 558074 D01 v03r05 Section 10.2	PASS
Conducted Out of Band Emission	47 CFR Part 15 Subpart C Section 15.247(d)	KDB 558074 D01 v03r05 Section 11	PASS
Radiated Spurious Emissions	47 CFR Part 15 Subpart C Section 15.205/15.209	KDB 558074 D01 v03r05 Section 12.1	PASS
Band Edge Measurements (Radiated)	47 CFR Part 15 Subpart C Section 15.205/15.209	KDB 558074 D01 v03r05 Section 12.1	PASS

Remark:
Tx: In this whole report Tx (or tx) means Transmitter.
Rx: In this whole report Rx (or rx) means Receiver.
RF: In this whole report RF means Radiated Frequency.
CH: In this whole report CH means channel.

3 Equipment List

Conducted Emission Test					
Equipment	**Manufacturer**	**Mode No.**	**Serial Number**	**Cal date (mm-dd-yyyy)**	**Due date (mm-dd-yyyy)**
EMI Test Receiver	R&S	ESCI	101247	11/1/2015	10/31/2016
Artificial Mains	SCHWARZBECK	NNLK 8121	573	11/1/2015	10/31/2016
Pulse Limiter	R&S	ESH3-Z2	101488	11/1/2015	10/31/2016
EMI Test Receiver	R&S	ESCI	101247	11/1/2015	10/31/2016

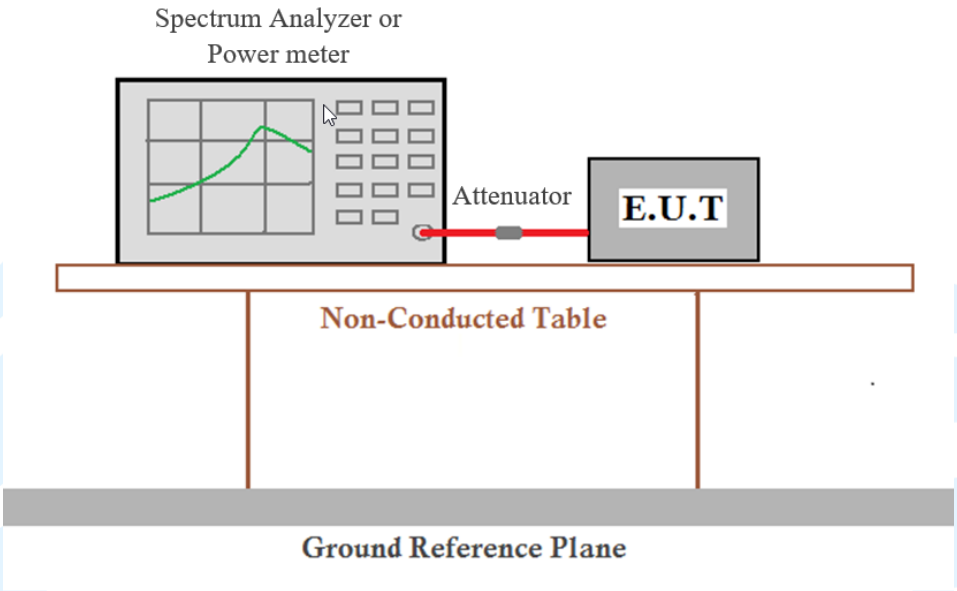
3m (Semi-Anechoic Chamber)					
Equipment	**Manufacturer**	**Mode No.**	**Serial Number**	**Cal date (mm-dd-yyyy)**	**Cal. Due date (mm-dd-yyyy)**
Ultra-Broadband Antenna	SCHWARZBECK	VULB9163	538	11/8/2015	11/7/2017
Double-Ridged-Waveguide Horn Antenna	SCHWARZBECK	9120D	1011	11/8/2015	11/7/2017
Emi Test Receiver	R&S	ESCI	101247	11/1/2015	10/31/2016
Spectrum Analyzer	R&S	FSP40	100597	11/1/2015	10/31/2016
Pre-amplifer	SCHWARZBECK	BBV 9743	9743-0022	11/1/2015	10/31/2016
Broadband Preamplifer	SCHWARZBECK	BBV 9718	9718-248	11/1/2015	10/31/2016
Turntable	Maturo Germany	TT2.0-1T	N/A	N/A	N/A
Antenna Mast	Maturo Germany	CAM-4.0-P-12	N/A	N/A	N/A
Test Software	R&S	ES-K1	N/A	N/A	N/A

Conducted RF test					
Equipment	**Manufacturer**	**Mode No.**	**Serial Number**	**Cal date (mm-dd-yyyy)**	**Due date (mm-dd-yyyy)**
Spectrum Analyzer	Keysight	N9030A	ATO-67098	07/19/2016	07/18/2017
Power Sensor	KEYSIGHT	U2021XA	MY55430035	01-09-2016	01-08-2017

4 Test Requirement

4.1 Test setup

4.1.1 For Conducted test setup



4.1.2 For Radiated Emissions test setup

Radiated Emissions setup:

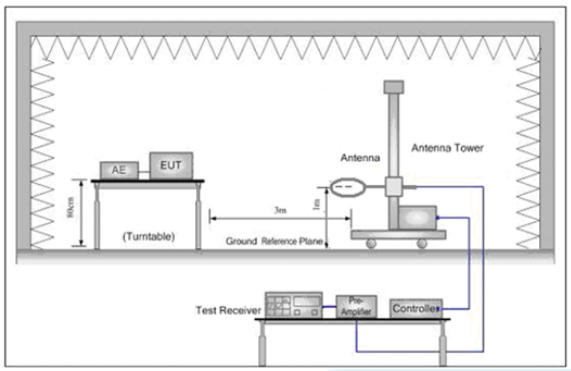


Figure 1. Below 30MHz

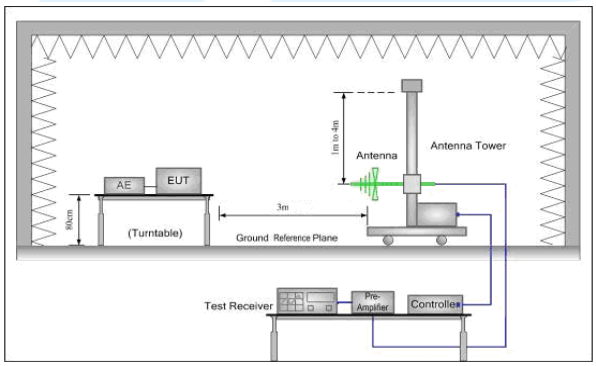


Figure 2. 30MHz to 1GHz

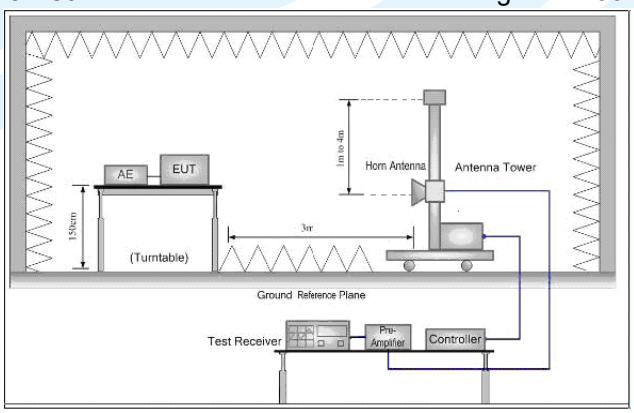
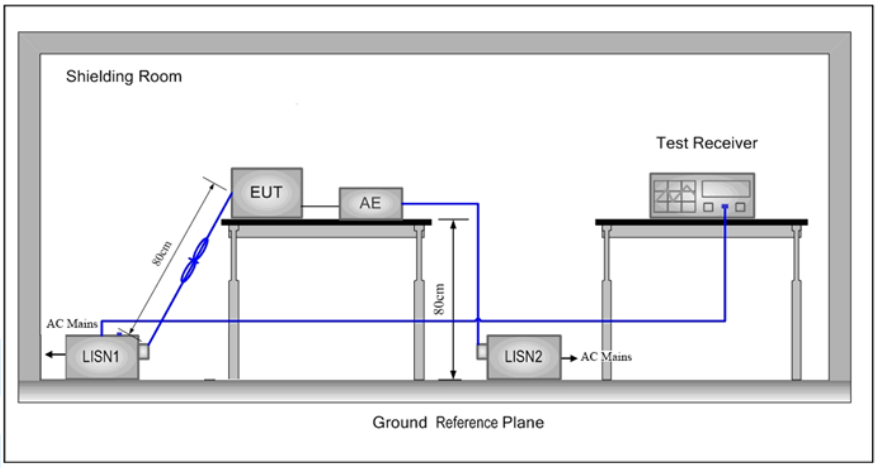


Figure 3. Above 1GHz

4.1.3 For Conducted Emissions test setup

Conducted Emissions setup



4.2 Test Environment

Operating Environment:	
Temperature:	25.6 °C
Humidity:	54 % RH
Atmospheric Pressure:	99.98 Kpa

4.3 System Test Configuration

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. It was powered by a 3.84Vdc rechargeable Li-on battery. Only the worst case data were recorded in this test report.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

Frequency Band	Mode	Antenna Port	Worst-case Orientation
2.4 **GHz**	1Tx SISO	Chain 0	X-Portrait

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000MHz. The resolution is 1 MHz or greater for frequencies above 1000MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

4.4 Test Condition

4.4.1 Test channel

Test Mode	Tx/Rx	RF Channel		
		Low(L)	Middle(M)	High(H)
802.11b/g/n(HT20)	2412MHz ~2462 MHz	Channel 1	Channel 6	Channel 11
		2412MHz	2437MHz	2462MHz
Transmitting mode: Keep the EUT in transmitting mode with all kind of modulation and all kind of data rate.				

4.4.2 Test mode

Pre-scan under all rate at lowest channel

Channel/ Frequency (MHz)	Maximum Conducted Average Power (Measured Value) (dBm)							
Chain 0_802.11b								
Data Rate (Mbps)	**1**	2	5.5	11				
1(2412)	**14.98**	14.86	14.92	14.95				
Chain 0_802.11g								
Data Rate (Mbps)	**6**	9	12	18	24	36	48	54
1(2412)	**13.52**	13.5	13.48	13.41	13.36	13.49	13.37	13.42
Chain 0_802.11n(HT20)								
Data Rate (Mbps)	**MCS 0**	MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
1(2412)	**12.48**	12.4	12.45	12.36	12.46	12.39	12.37	12.42

So, the worst-case data rates see table below:

Mode	Worst-case data rates
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS 0(6.5MHz)

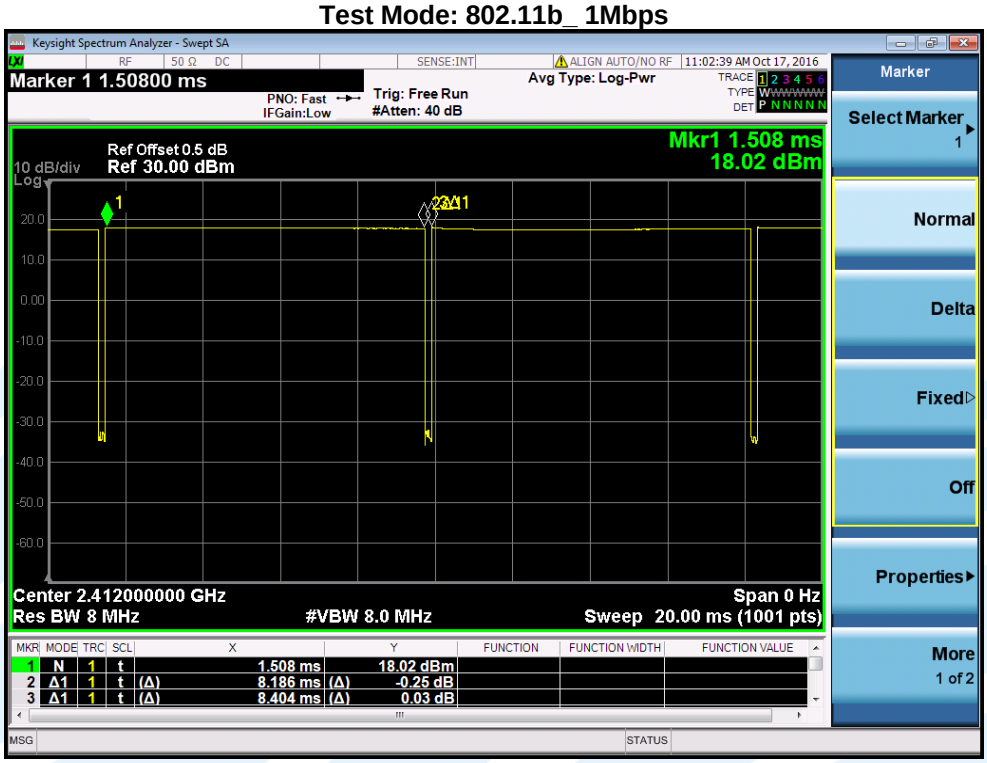
4.4.3 Duty Cycle

Mode	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)
802.11b	1	8.186	8.404	0.97	97	0.11	0.12
802.11g	6	1.366	1.564	0.87	87	0.59	0.73
802.11n(HT20)	6.5	1.276	1.474	0.87	87	0.63	0.78

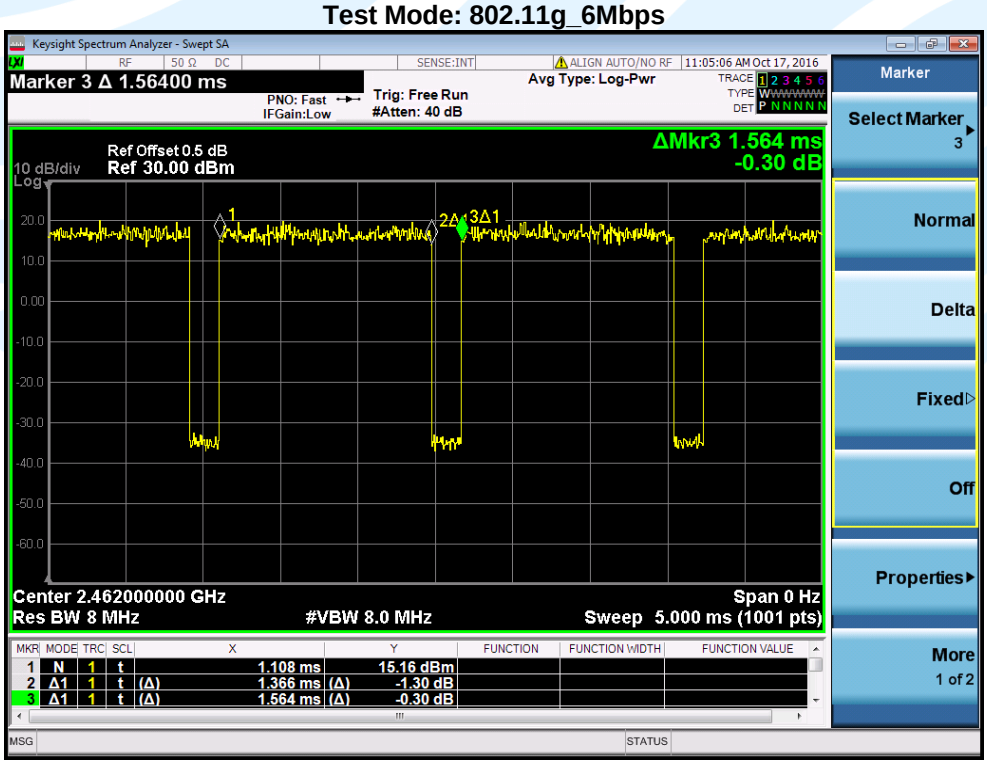
Remark:
1) Duty cycle= On Time/ Period
2) Duty Cycle factor = 10 * log(1/ Duty cycle)

The test plot as follows:

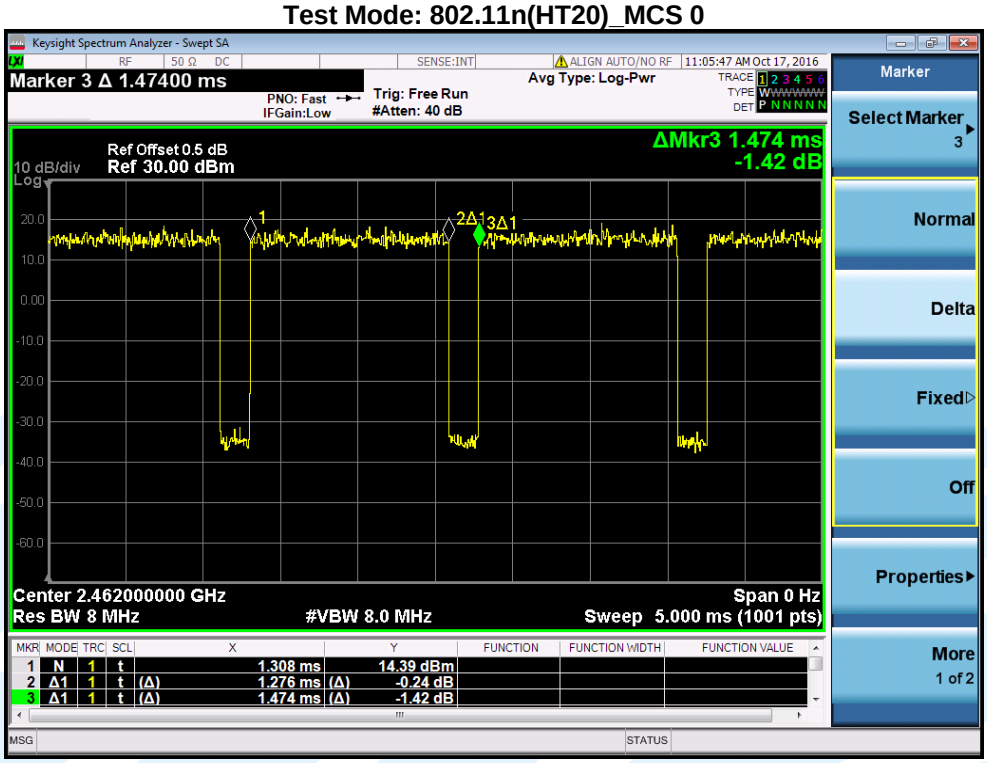
Test Mode: 802.11b_ 1Mbps



Test Mode: 802.11g_6Mbps



Test Mode: 802.11n(HT20)_MCS 0



5 Radio Technical Requirements Specification

Reference documents for testing:

No.	Identity	Document Title
1	FCC Part15C (2015)	Subpart C-Intentional Radiators
2	ANSI C63.10-2013	American National Standard for Testing Unlicesed Wireless Devices
3	KDB 558074 D01 DTS Meas Guidance v03r05	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
4	KDB 662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

5.1 Antenna Requirement

15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:	
Both antenna in the interior of the equipment and no consideration of replacement. The gain of the antenna is -3dBi.	

5.2 Conducted Peak Output Power

Test Requirement: 47 CFR Part 15 Subpart C Section15.247 (b)(3)

Test Method: KDB 558074 D01 v03r05 Section 9.1.2 & Section 9.2.3

Limit: For systems using digital modulation in the 2400-2483.5 MHz bands: 1 Watt.

Test Procedure:

1. The output from the transmitter was connected to an attenuator and then to the input of the the power meter.
2. Measure out each test modes' peak or average output power, record the power level.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.1.1 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

Test Data:

Maximum Conducted Power:

Mode	Channel/ Frequency (MHz)	Data Rate (Mbps)	Maximum Conducted Power (dBm)		
			Peak Power	Average Power	
				Measured Power	Power with Duty Factor
802.11b	1(2412)	1	17.53	14.98	15.09
	6(2437)		16.96	14.17	14.28
	11(2462)		17.14	14.40	14.51
802.11g	1(2412)	6	21.48	13.52	14.11
	6(2437)		21.61	13.43	14.02
	11(2462)		21.92	13.95	14.54
802.11n (HT20)	1(2412)	MCS0	20.28	12.48	13.11
	6(2437)		20.35	12.42	13.05
	11(2462)		20.87	12.97	13.60

Remark:

1. All the data attached was use the worst case data rate.
2. Power with Duty Factor = Measured Power + Duty Cycle Factor

5.3 6dB Bandwidth

Test Requirement: 47 CFR Part 15 Subpart C Section 15.247 (a)(2)

Test Method: KDB 558074 D01 v03r05 Section 8.1

Limit: For direct sequence systems, the minimum 6dB bandwidth shall be at least 500kHz

Test Procedure: The output from the transmitter was connected to an attenuator and then to the input of the spectrum analyzer.

Use the following spectrum analyzer settings:
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 x RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.1.1 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

Test Data:

Occupied Bandwidth:

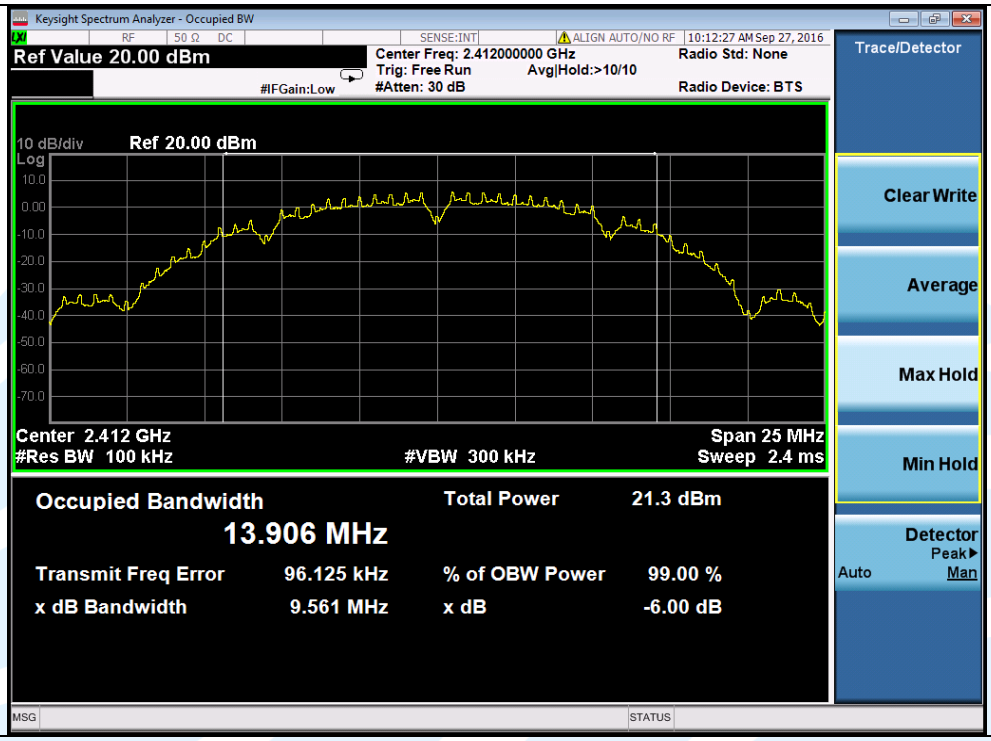
Mode	Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	6 dB Bandwidth Limit	Result (Pass / Fail)
802.11b	1	2412	9.561	13.906	> 500 kHz	Pass
	6	2437	10.060	14.122	> 500 kHz	Pass
	11	2462	10.070	14.117	> 500 kHz	Pass
802.11b	1	2412	16.340	16.495	> 500 kHz	Pass
	6	2437	16.370	16.593	> 500 kHz	Pass
	11	2462	16.380	16.582	> 500 kHz	Pass
802.11n (HT20)	1	2412	17.300	17.651	> 500 kHz	Pass
	6	2437	17.600	17.740	> 500 kHz	Pass
	11	2462	17.600	17.725	> 500 kHz	Pass

Remark:
All the data attached was use the worst case data rate.

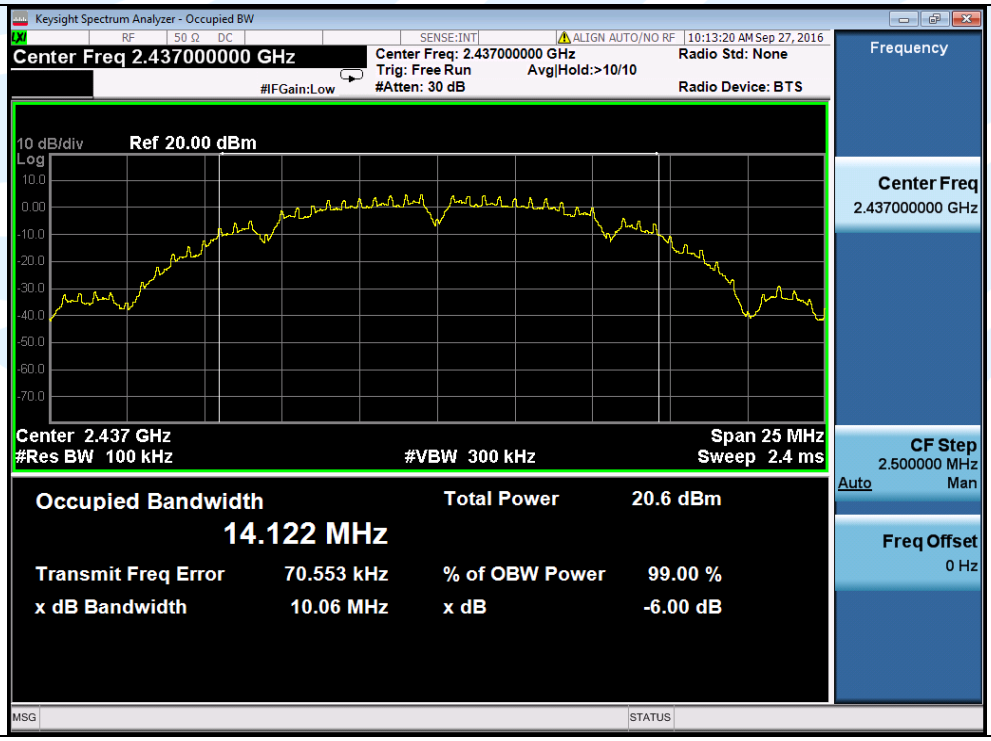
The test plot as follows:

Test Mode: 802.11b

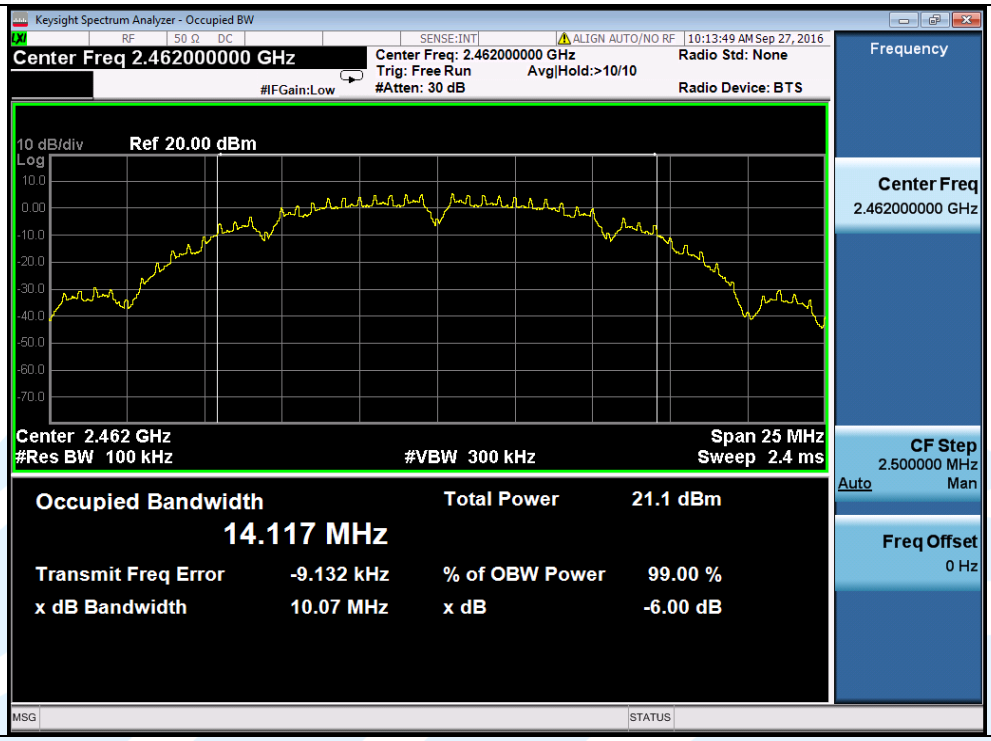
2412MHz



2437MHz

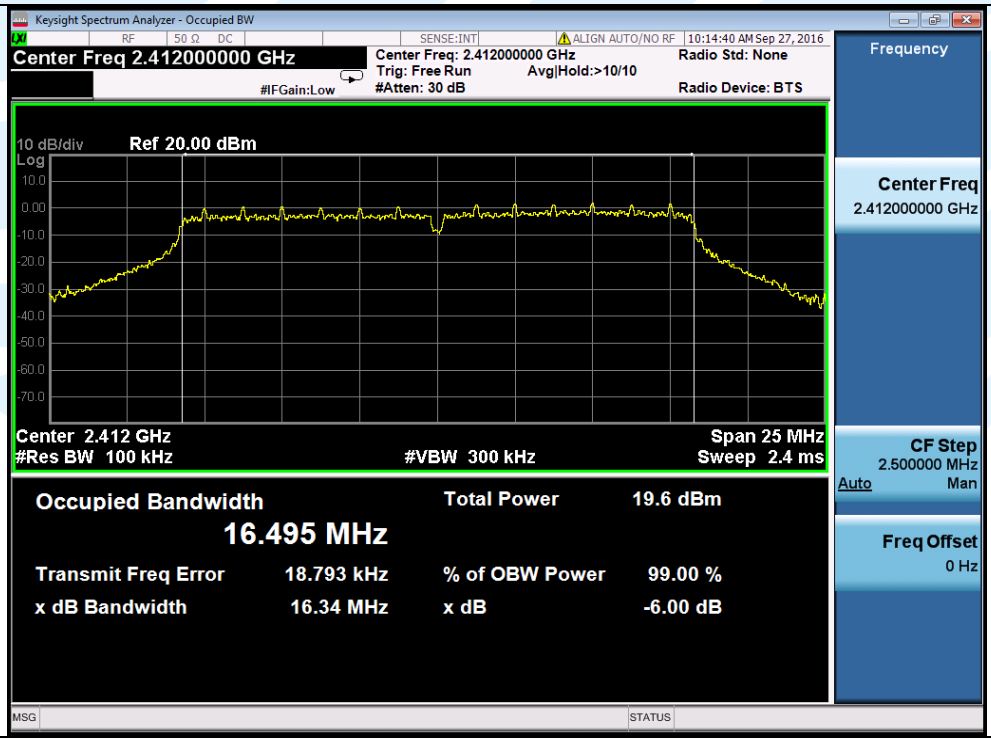


2462MHz

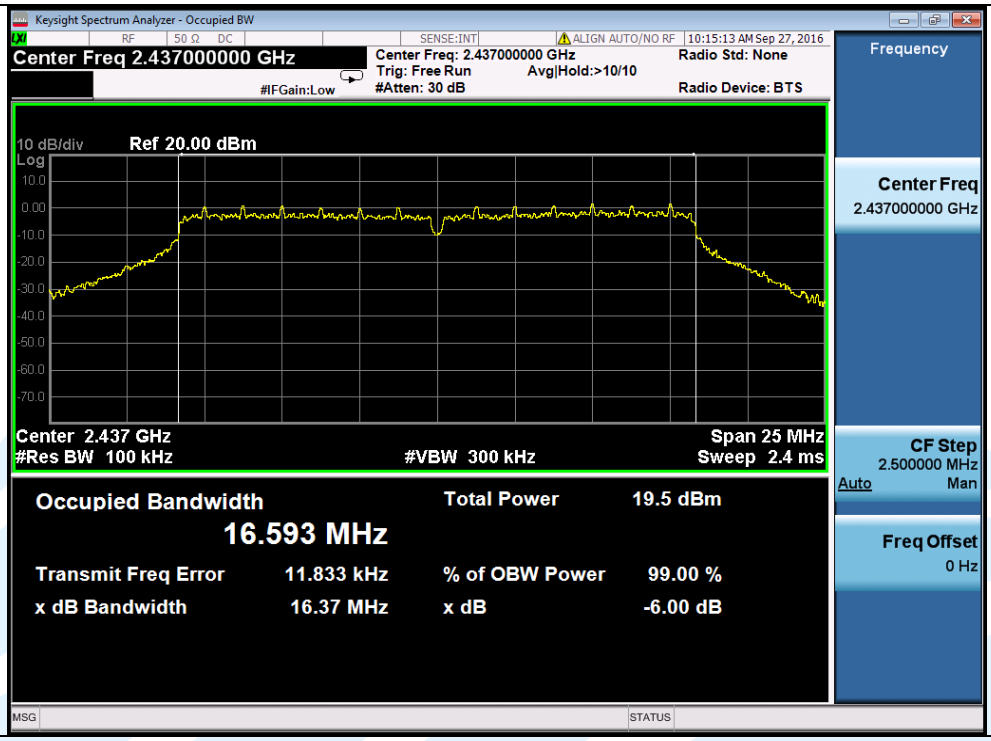


Test Mode: 802.11g

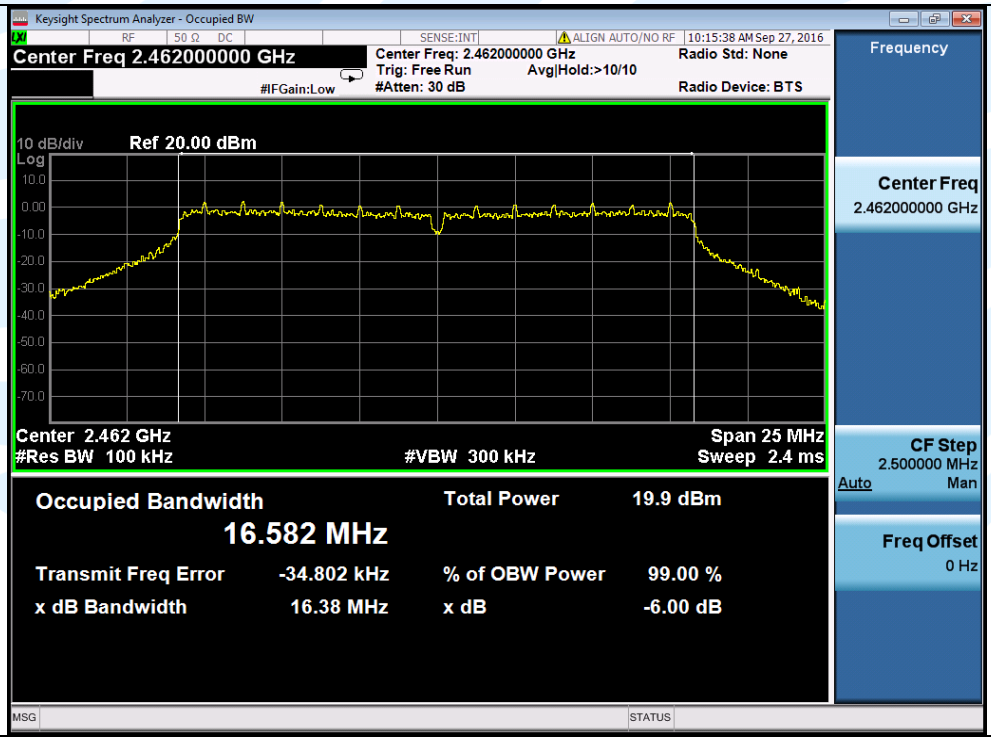
2412MHz



2437MHz

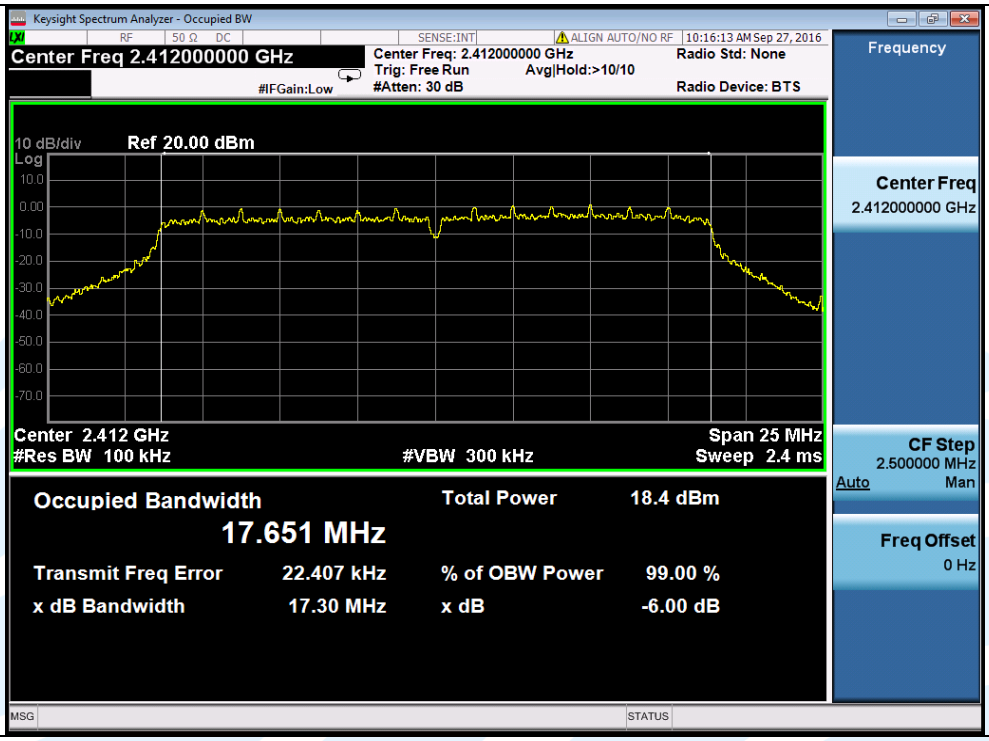


2462MHz

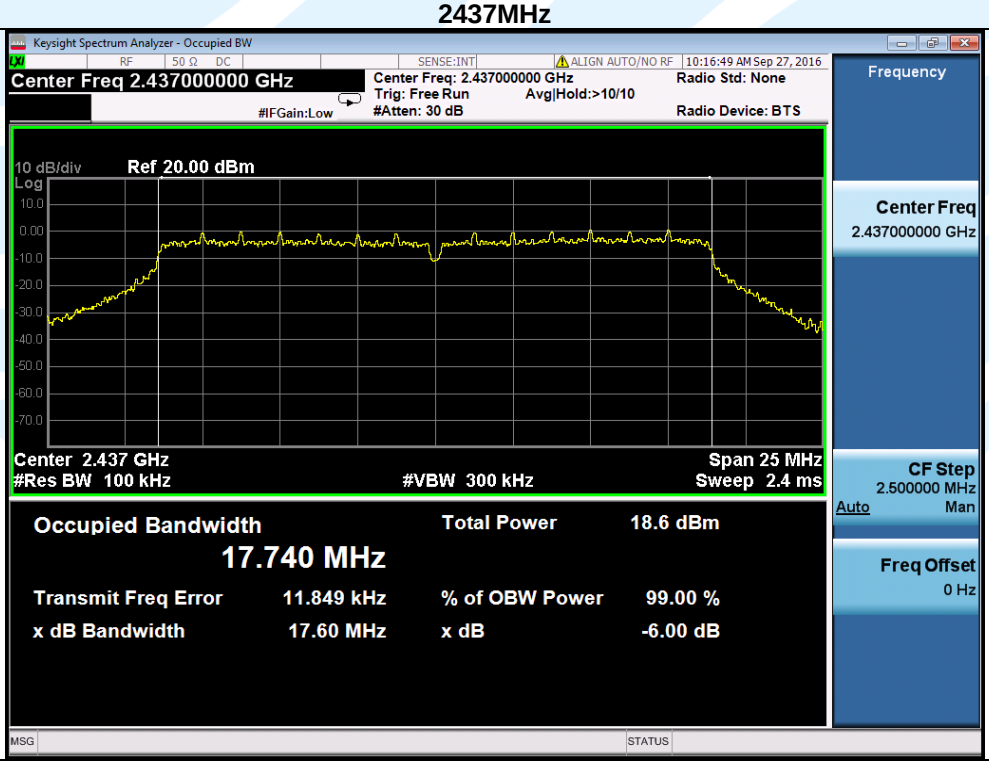


Test Mode: 802.11n(HT20)

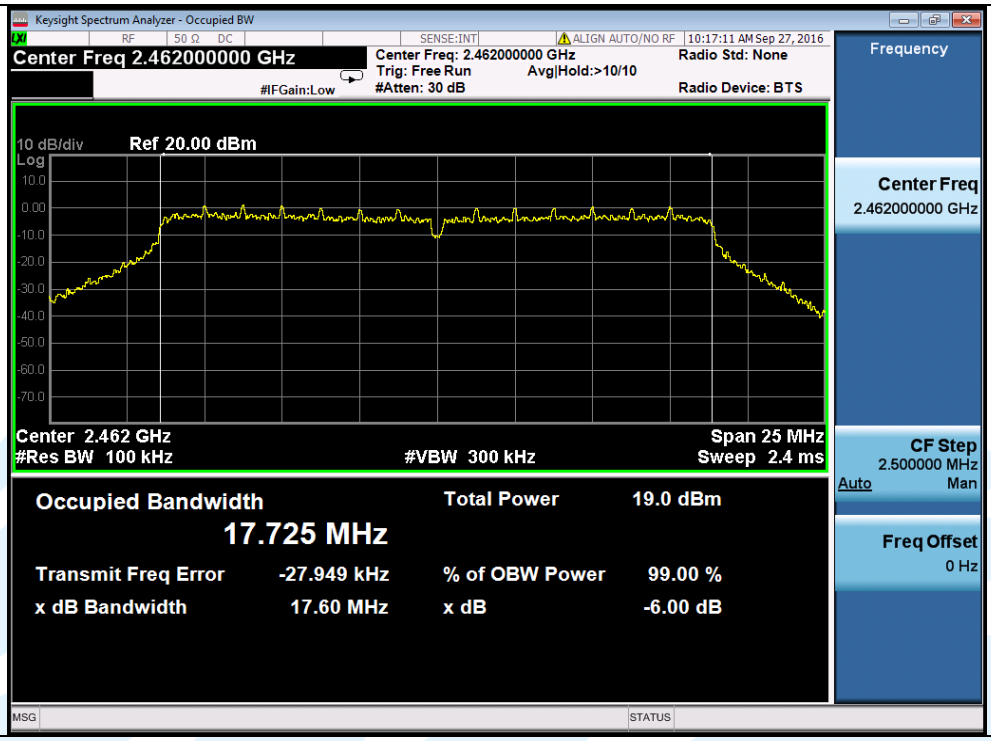
2412MHz



2437MHz



2462MHz


Keysight Spectrum Analyzer - Occupied BW
RF 50 Ω DC
SENSE:INT
ALIGN AUTO/NO RF
10:17:11 AM Sep 27, 2016
Center Freq 2.462000000 GHz
#IFGain:Low
Center Freq: 2.462000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Frequency
10 dB/div
Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 2.462 GHz
#Res BW 100 kHz
#VBW 300 kHz
Span 25 MHz
Sweep 2.4 ms
Center Freq
2.462000000 GHz
CF Step
2.500000 MHz
Auto
Man
Occupied Bandwidth
17.725 MHz
Total Power 19.0 dBm
Transmit Freq Error -27.949 kHz
% of OBW Power 99.00 %
x dB Bandwidth 17.60 MHz
x dB -6.00 dB
Freq Offset
0 Hz
MSG
STATUS

5.4 Power Spectral Density

Test Requirement: 47 CFR Part 15 Subpart C Section 15.247 (e)

Test Method: KDB 558074 D01 v03r05 Section 10.2

Limit: For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

Test Procedure: The output from the transmitter was connected to an attenuator and then to the input of the spectrum analyzer.

Use the following spectrum analyzer settings:

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ⩾ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.1.1 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

Test Data:

Mode	Channel	Frequency (MHz)	PSD (dBm)	PSD Limit (dBm)	Result (Pass / Fail)
802.11b	1	2412	-7.493	8	Pass
	6	2437	-8.334	8	Pass
	11	2462	-6.788	8	Pass
802.11g	1	2412	-11.474	8	Pass
	6	2437	-11.651	8	Pass
	11	2462	-10.758	8	Pass
802.11n (HT20)	1	2412	-13.050	8	Pass
	6	2437	-12.407	8	Pass
	11	2462	-12.702	8	Pass

Remark:

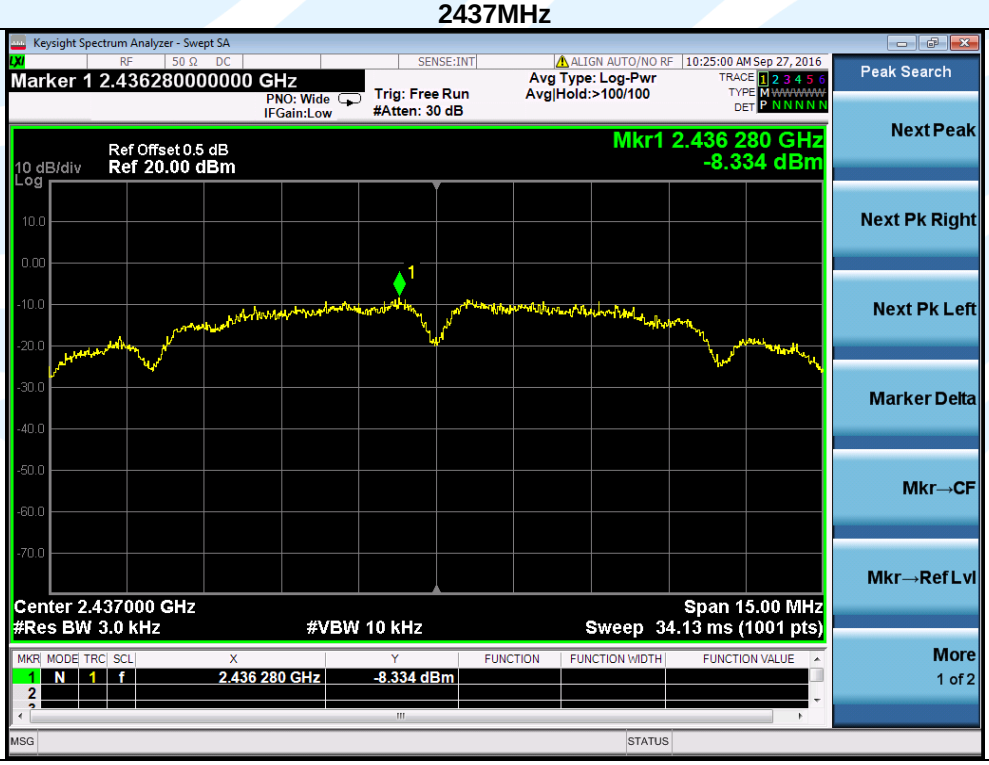
1. All the data attached was use the worst case data rate.

The test plot as follows:

Test Mode: 802.11b

2412MHz

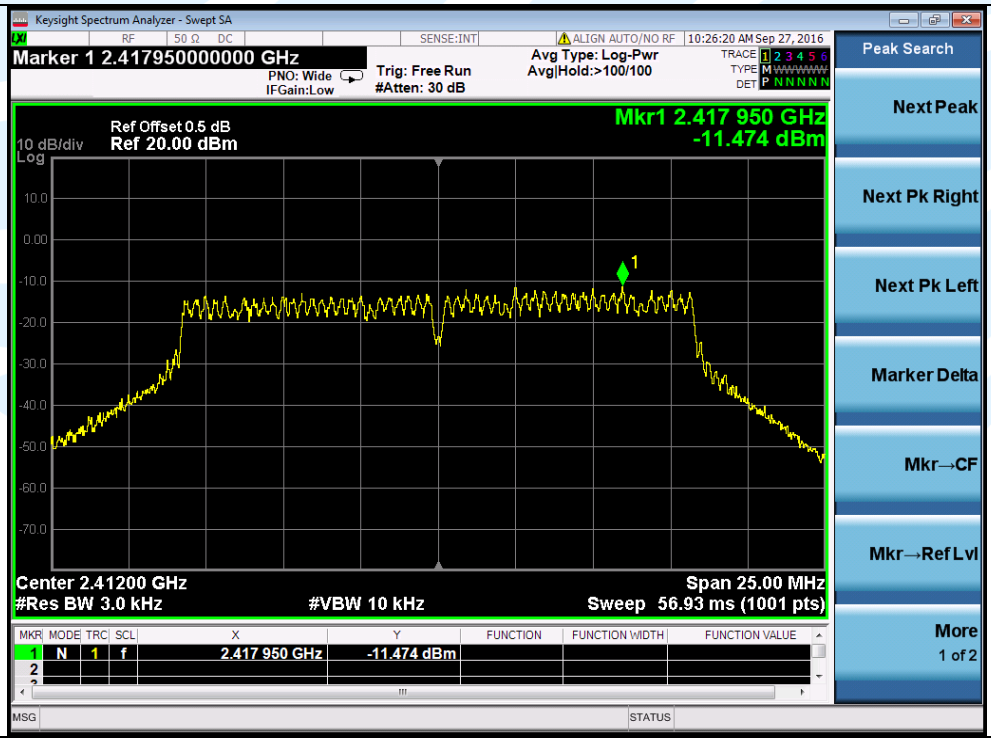
2437MHz



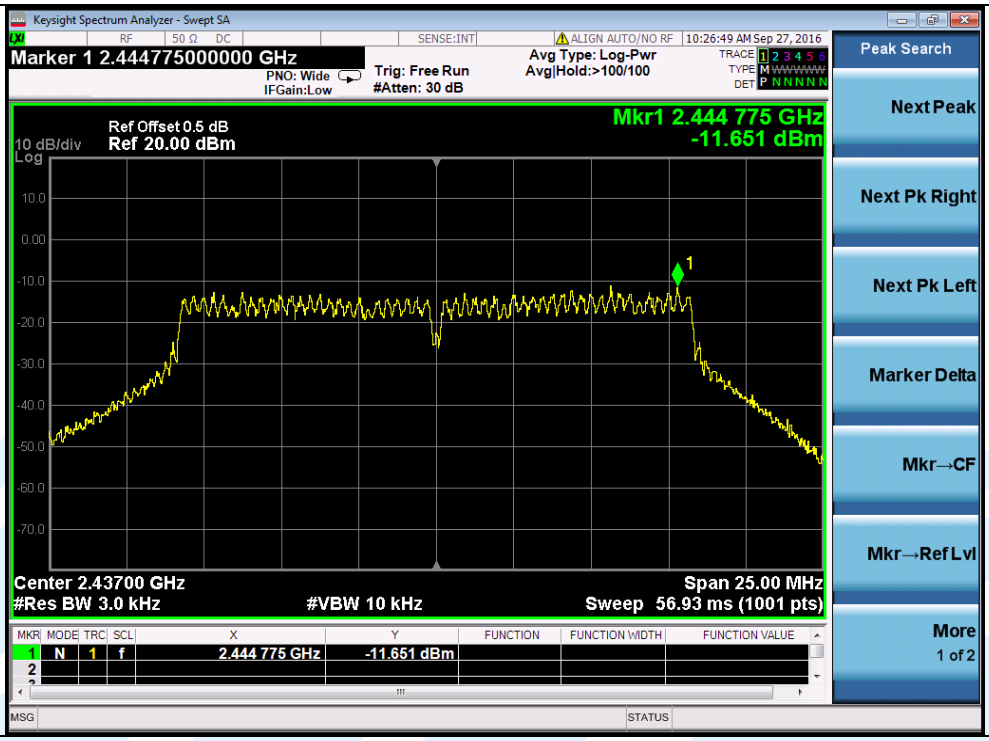
2462MHz

Test Mode: 802.11g

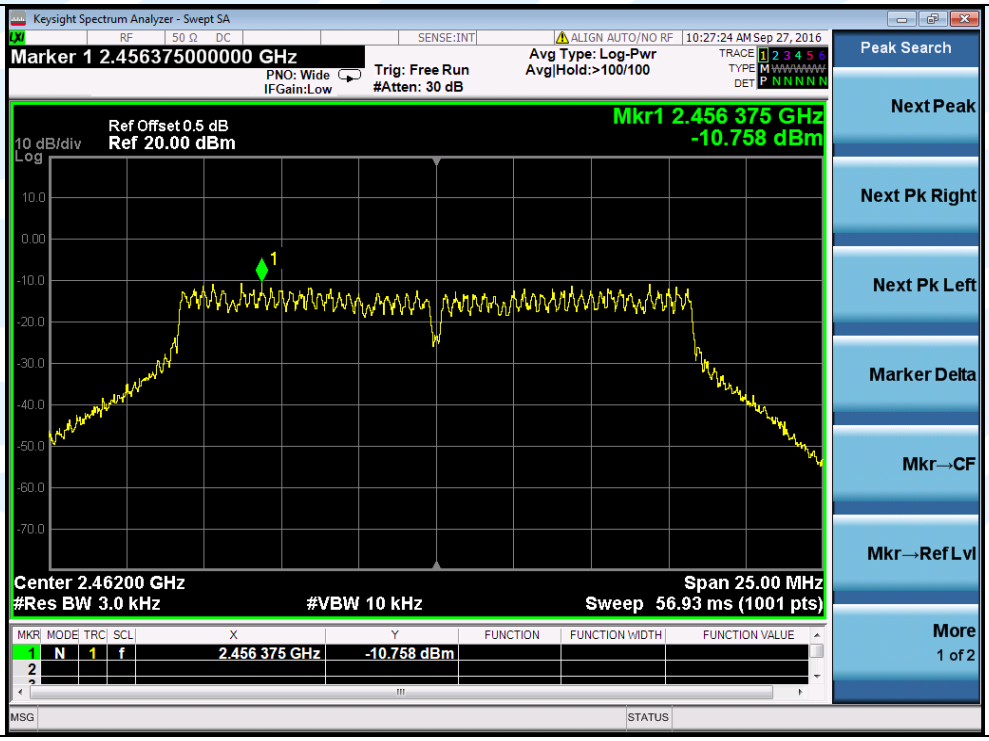
2412MHz



2437MHz

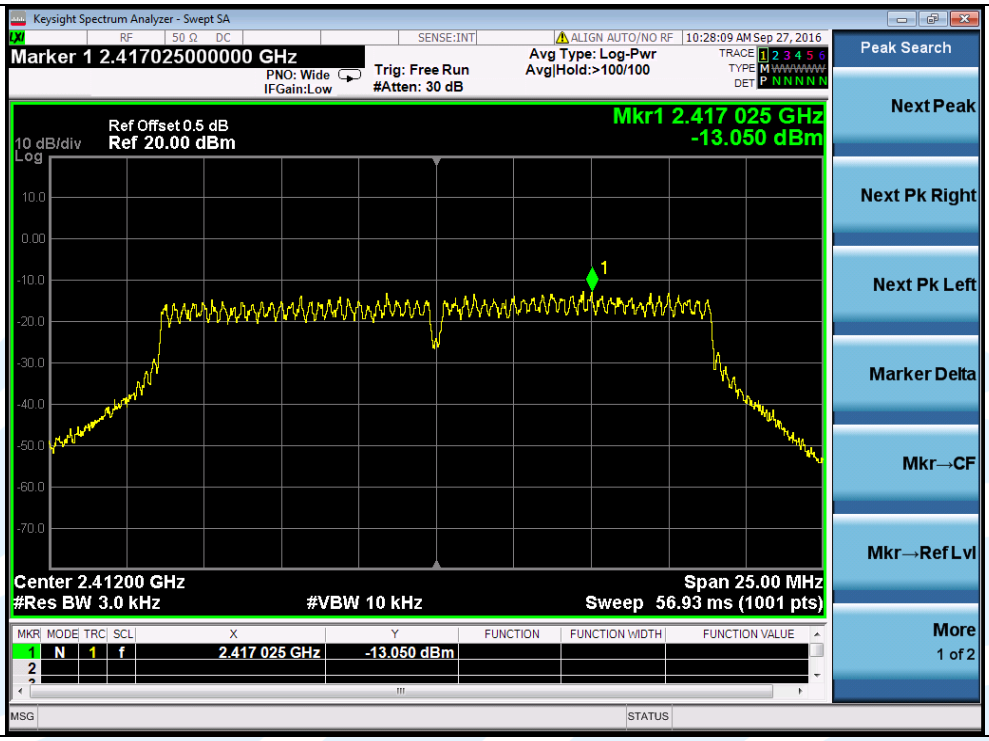


2462MHz

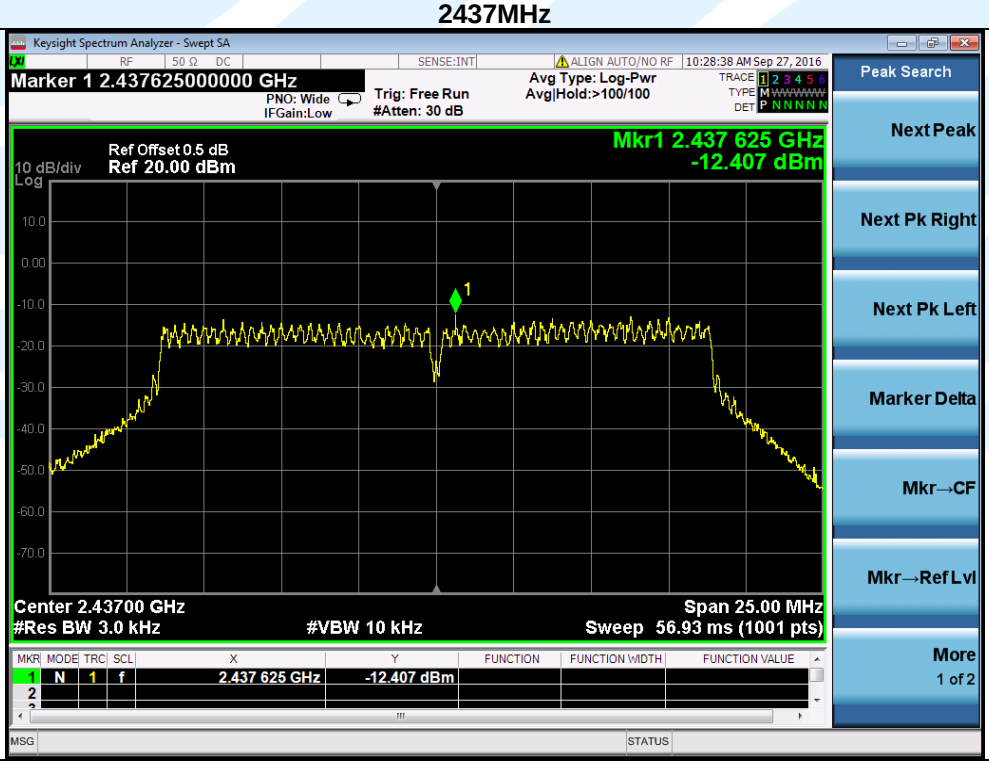


Test Mode: 802.11n(HT20)

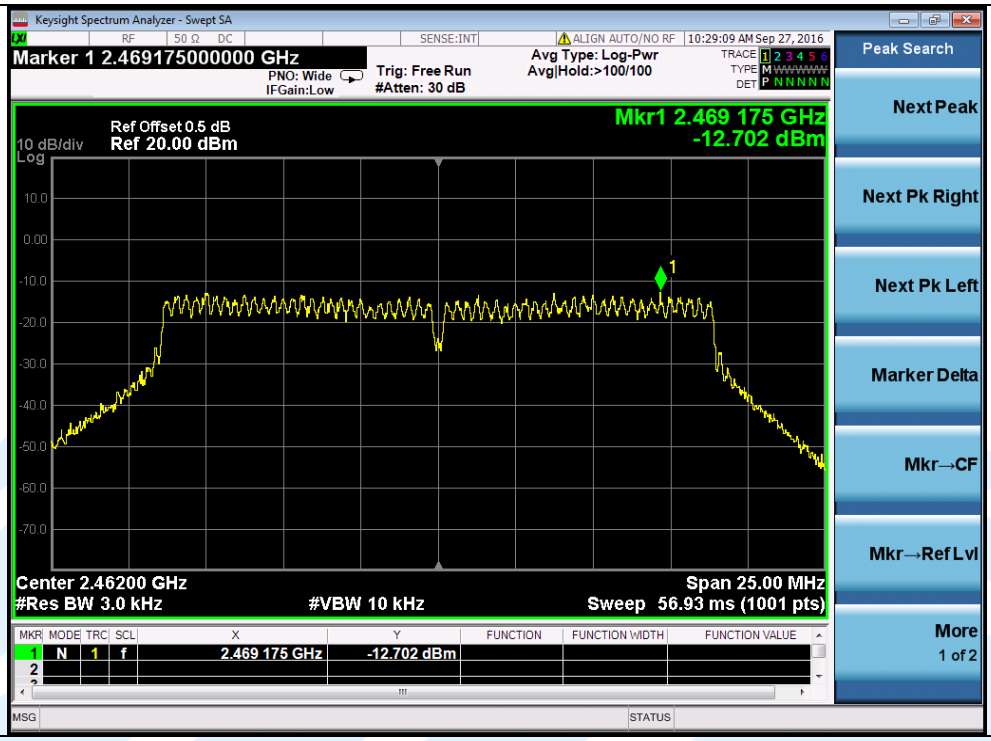
2412MHz



2437MHz



2462MHz


Keysight Spectrum Analyzer - Swept SA
Marker 1 2.469175000000 GHz
PNO: Wide
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
10:29:09 AM Sep 27, 2016
Ref Offset 0.5 dB
10 dB/div
Ref 20.00 dBm
Log
Mkr1 2.469 175 GHz
-12.702 dBm
Center 2.46200 GHz
#Res BW 3.0 kHz
#VBW 10 kHz
Span 25.00 MHz
Sweep 56.93 ms (1001 pts)
1 N 1 f 2.469 175 GHz -12.702 dBm
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

5.5 Conducted Out of Band Emission

Test Requirement: 47 CFR Part 15 Subpart C Section 15.247(d)

Test Method: KDB 558074 D01 v03r05 Section 11

Limit: In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

Test Procedure: The output from the transmitter was connected to an attenuator and then to the input of the spectrum analyzer.

Use the following spectrum analyzer settings:

Step 1:Measurement Procedure REF

a) Set instrument center frequency to DTS channel center frequency.
b) Set the span to ≥ 1.5 times the DTS bandwidth.
c) Set the RBW = 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum PSD level.
j) Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Step 2:Measurement Procedure OOBE

a) Set RBW = 100 kHz.
b) Set VBW ≥ 300 kHz.
c) Detector = peak.
d) Sweep = auto couple.
e) Trace Mode = max hold.
f) Allow trace to fully stabilize.
g) Use the peak marker function to determine the maximum amplitude level.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.1.1 for details.

Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

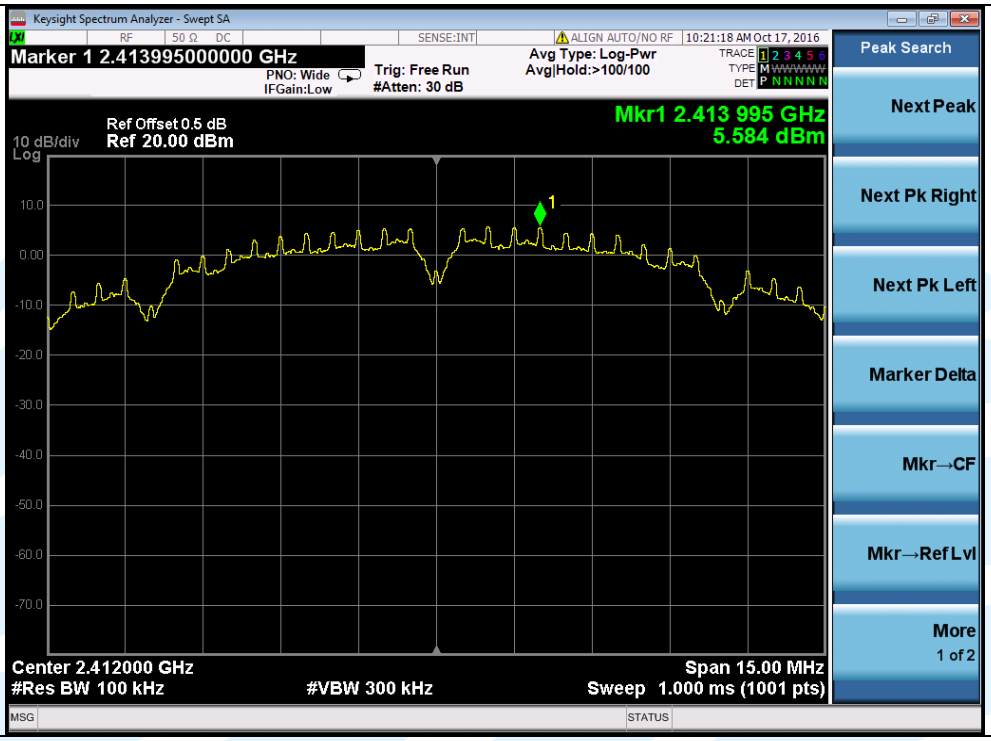
Test Results: Pass

The test plot as follows:

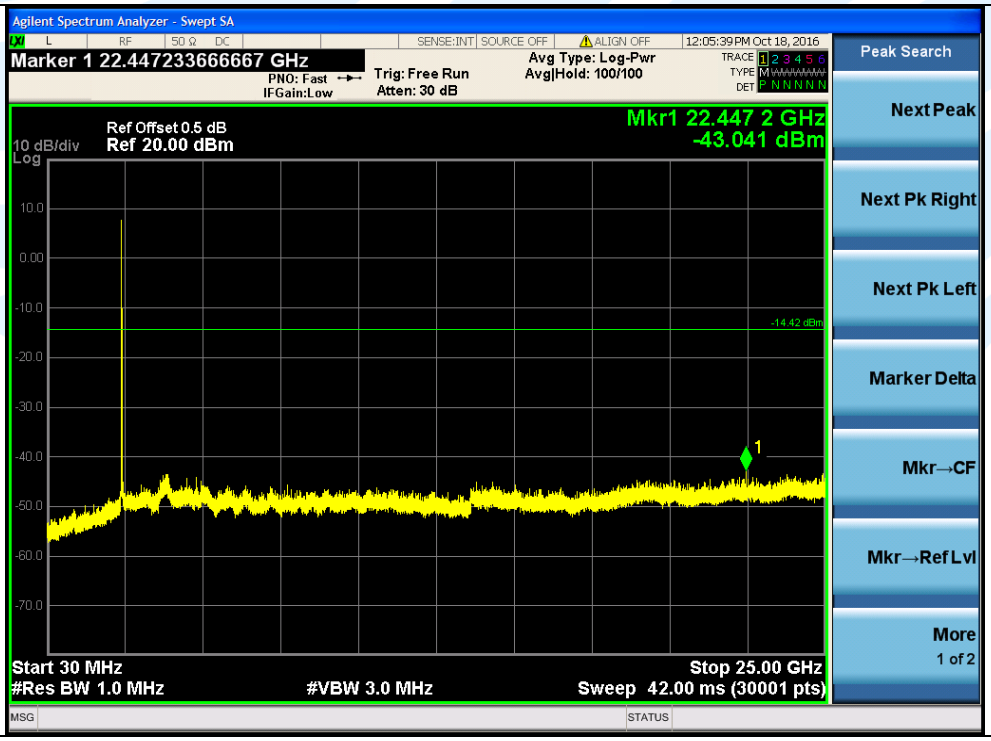
Test Mode: 802.11b

2412MHz

Reference Level

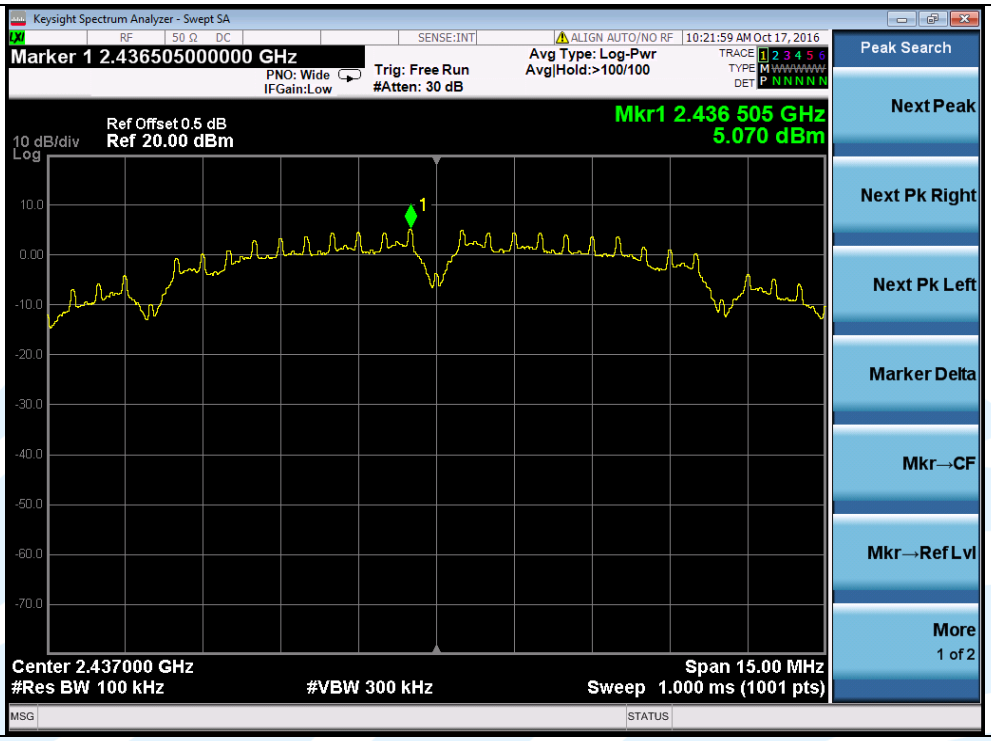


Out of Band

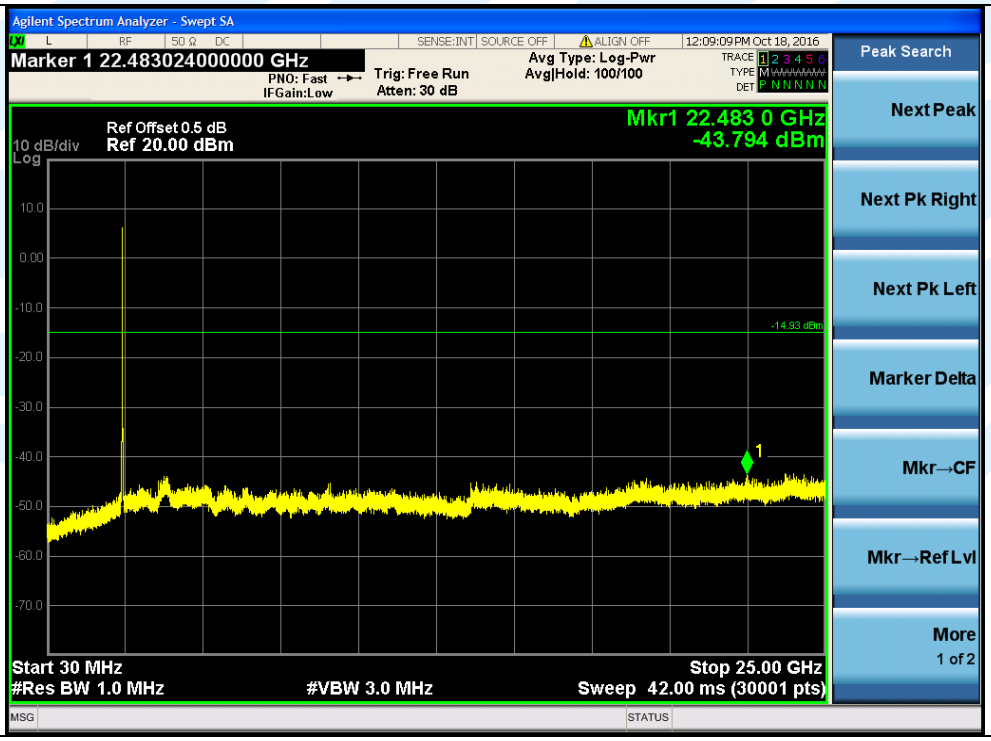


2437MHz

Reference Level

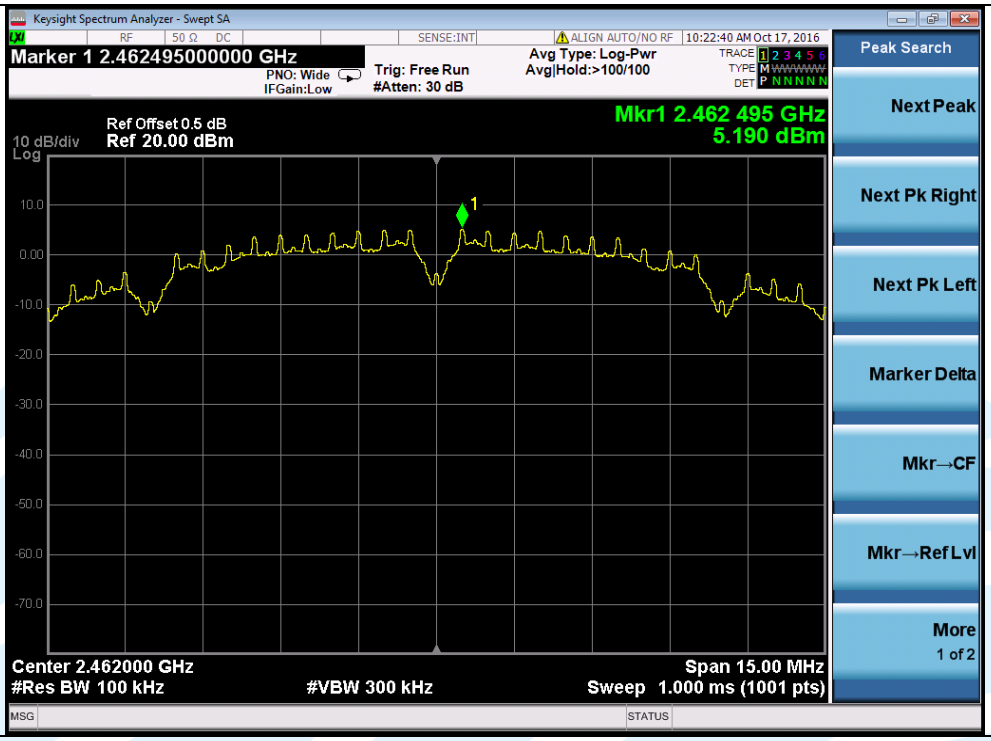


Out of Band

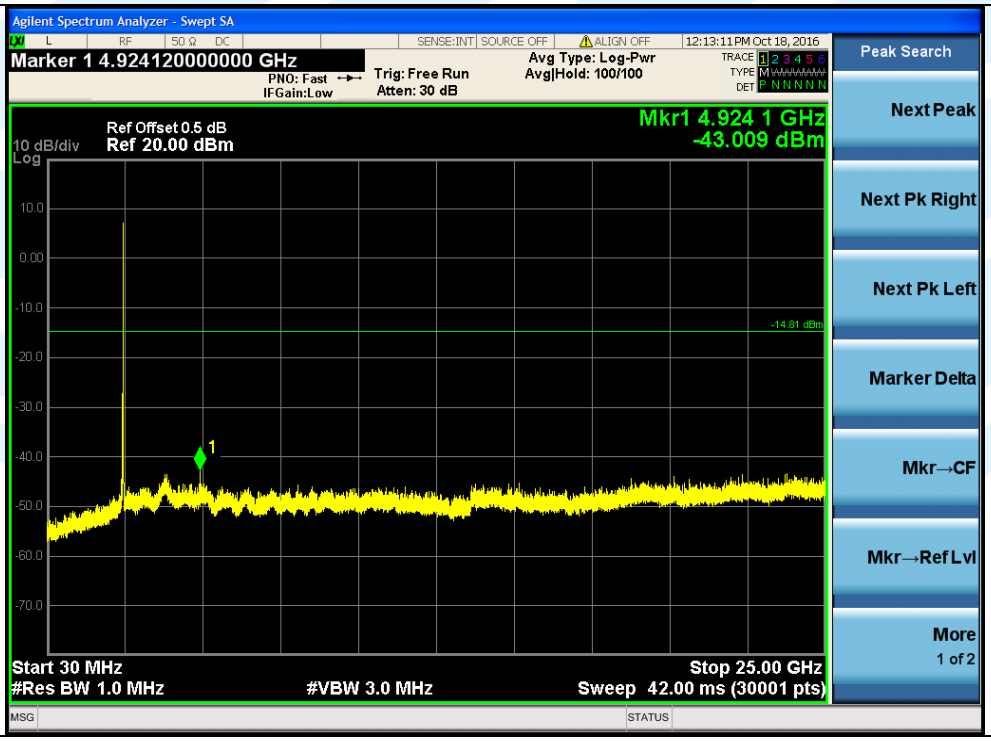


2462MHz

Reference Level



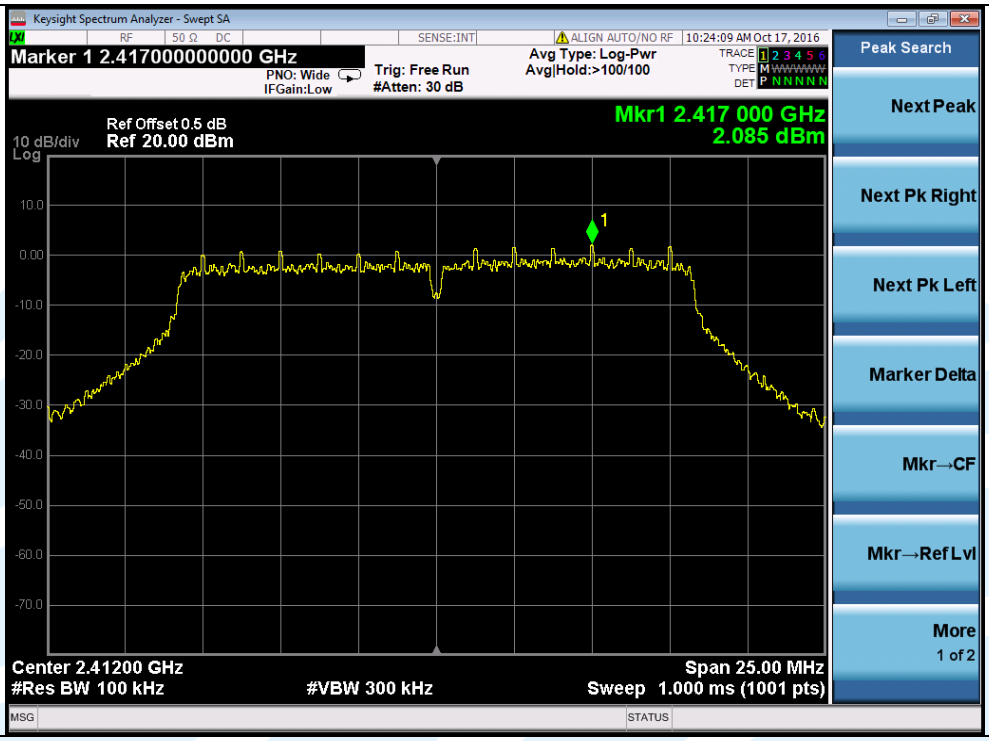
Out of Band



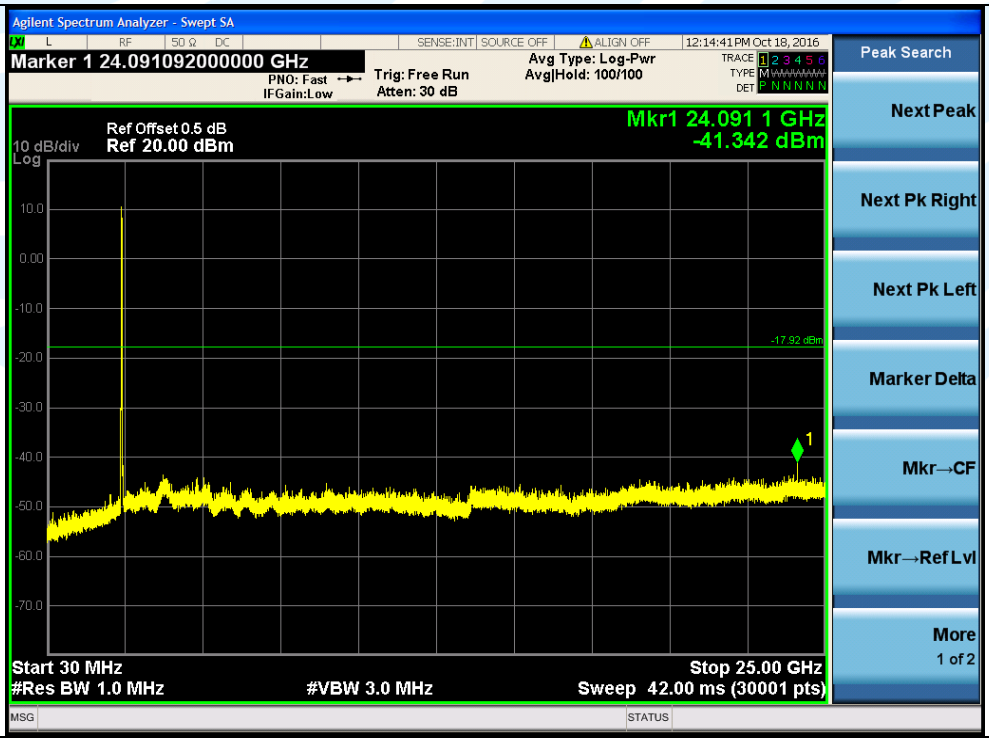
Test Mode: 802.11g

2412MHz

Reference Level

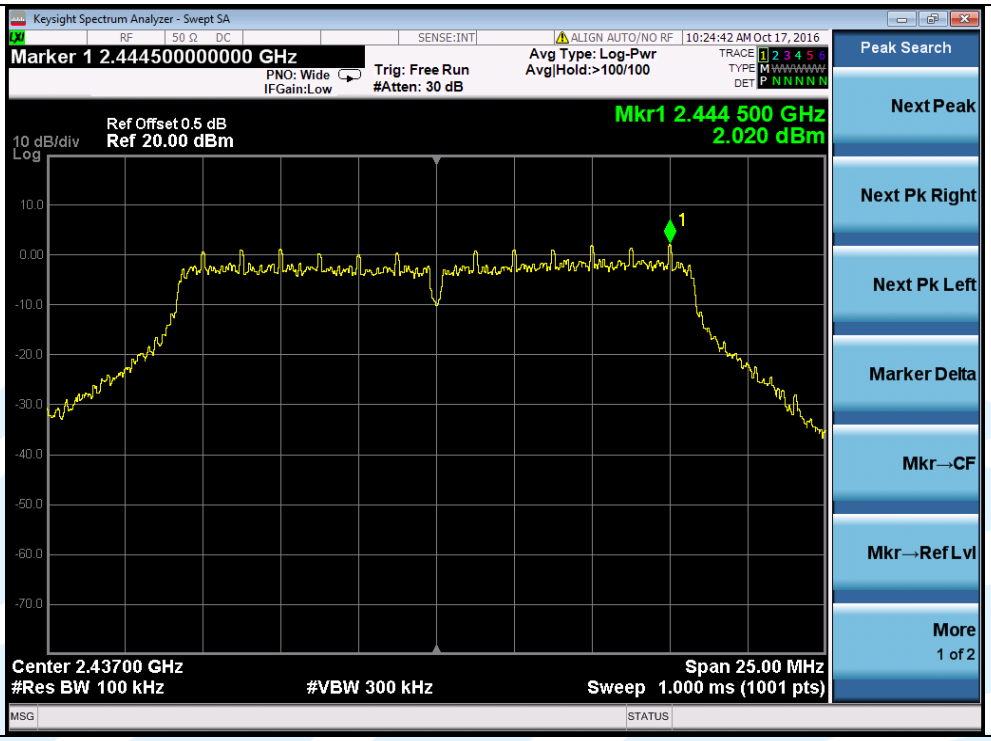


Out of Band

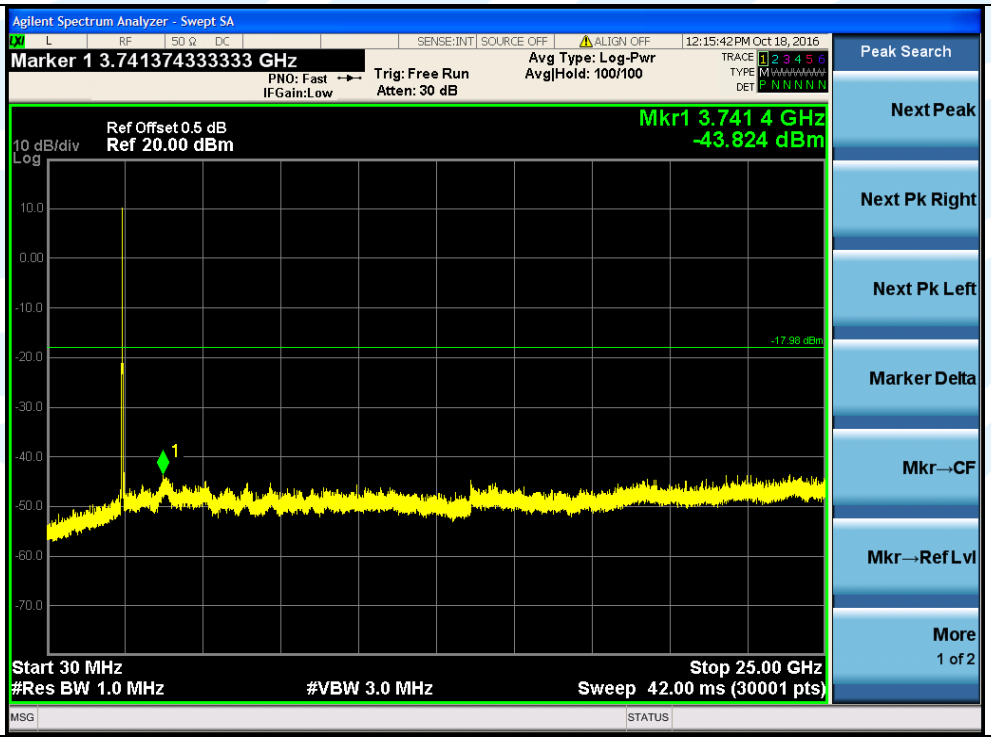


2437MHz

Reference Level

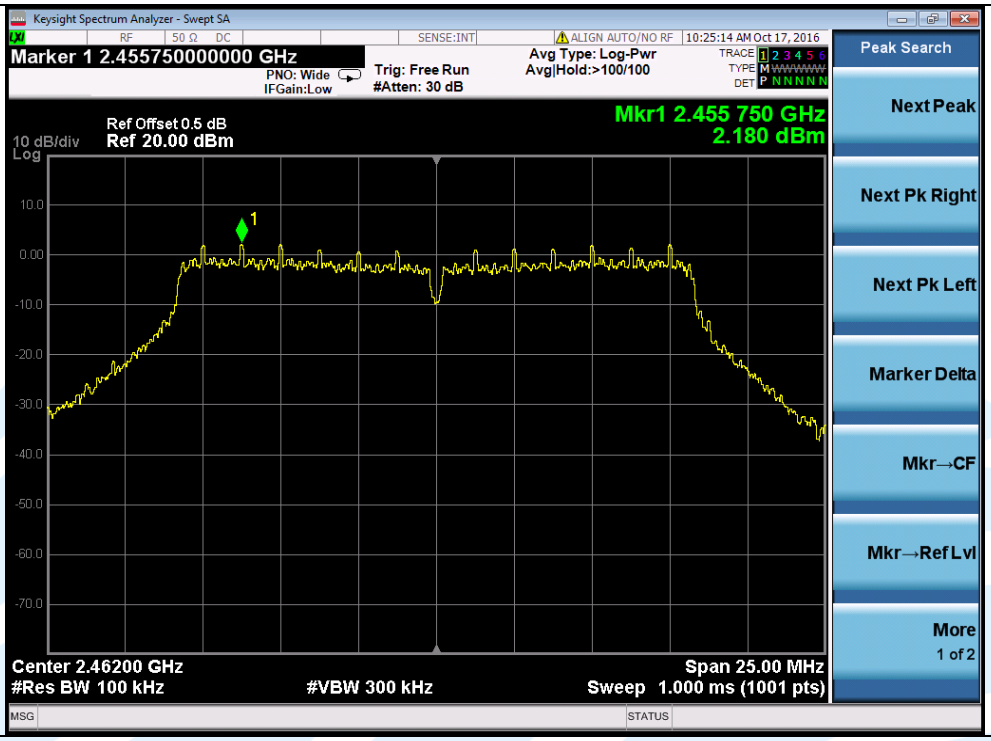


Out of Band

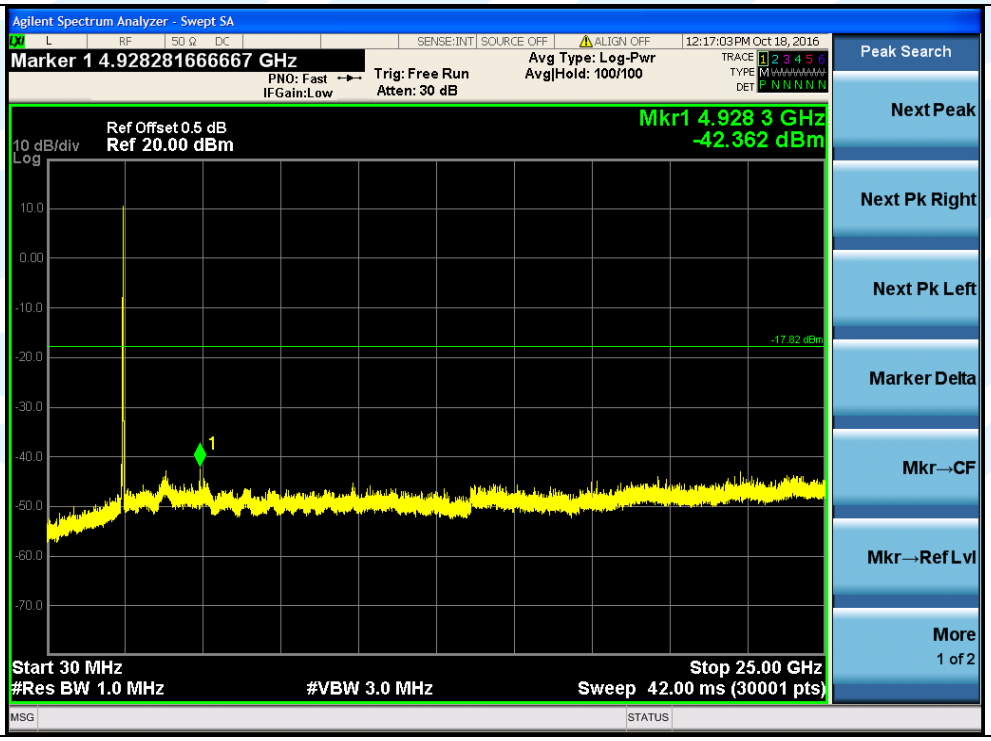


2462MHz

Reference Level



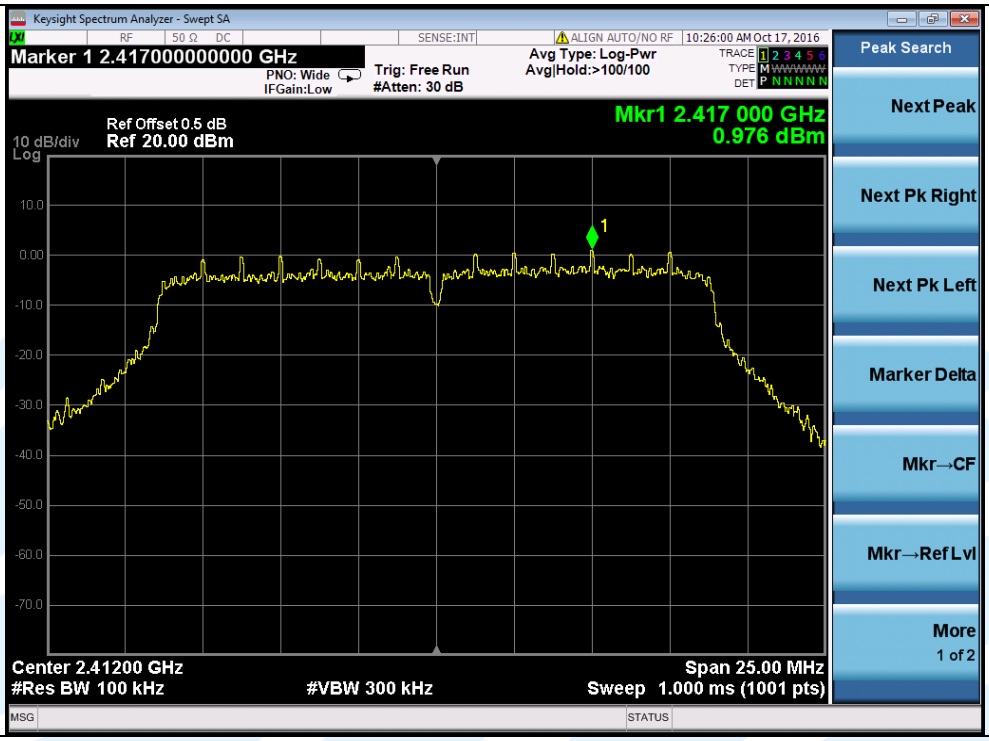
Out of Band



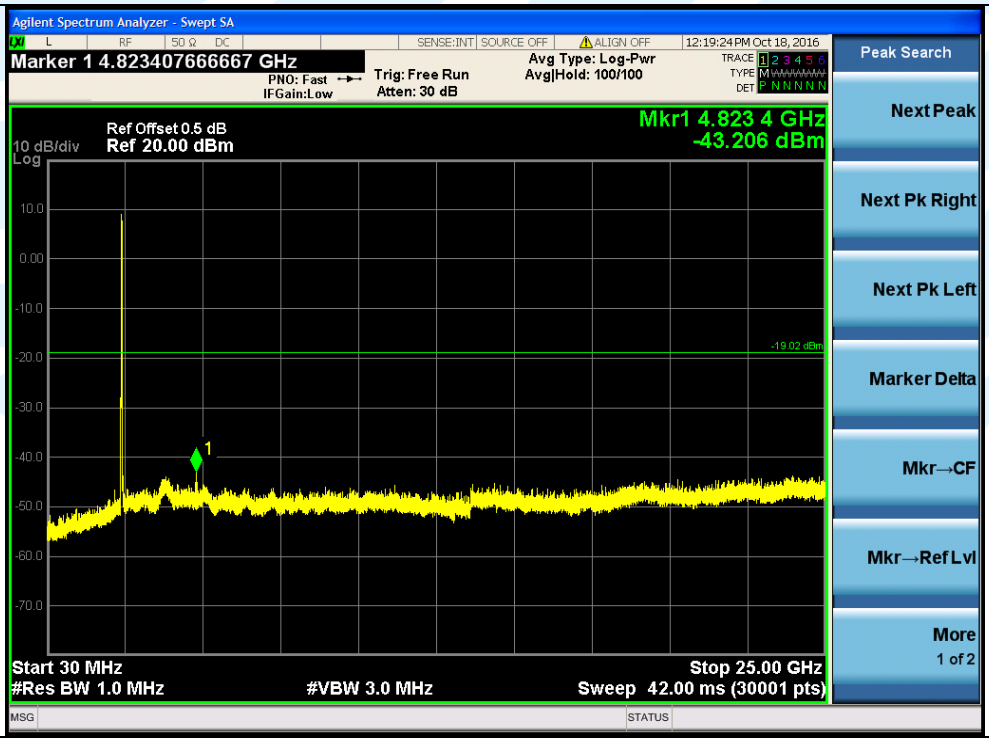
Test Mode: 802.11 n(HT20)

2412MHz

Reference Level

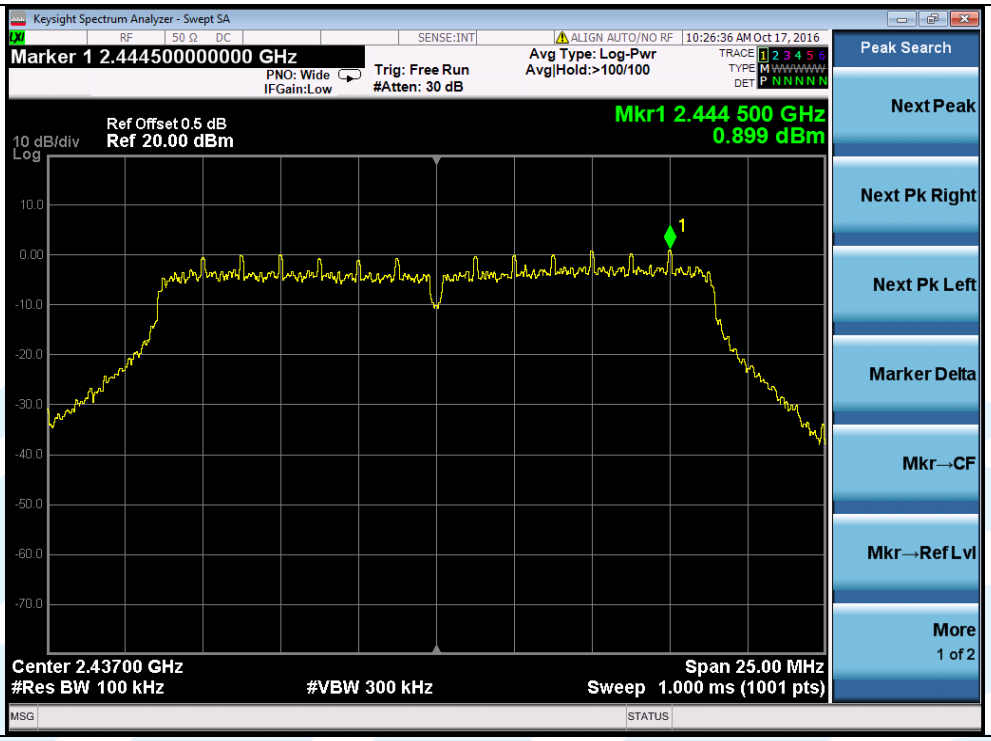


Out of Band

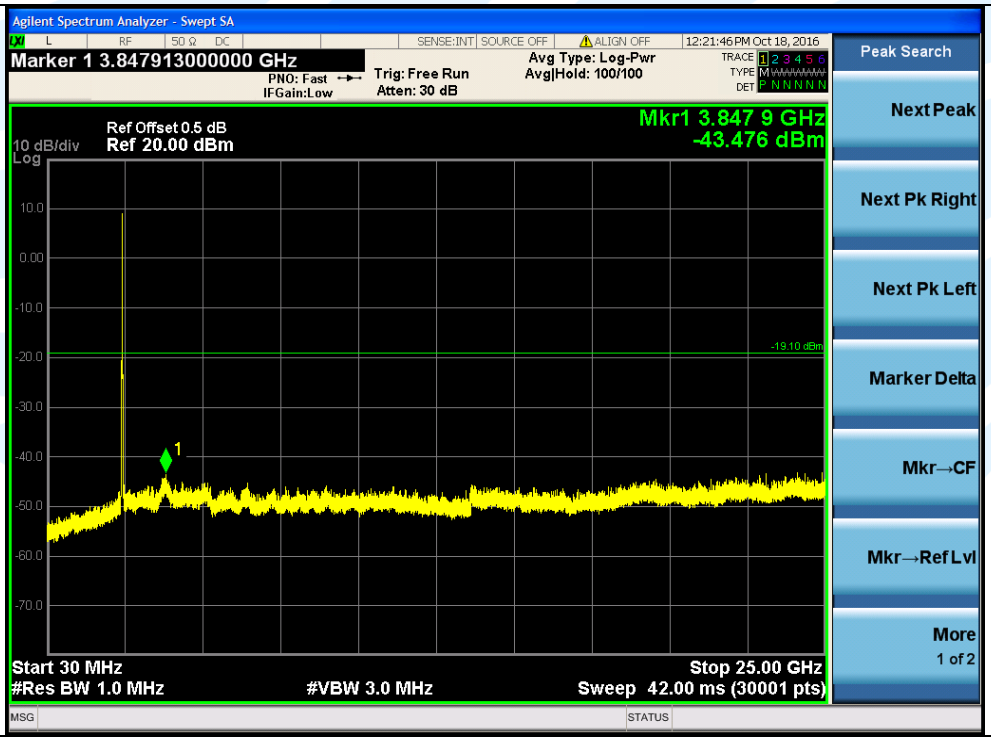


2437MHz

Reference Level



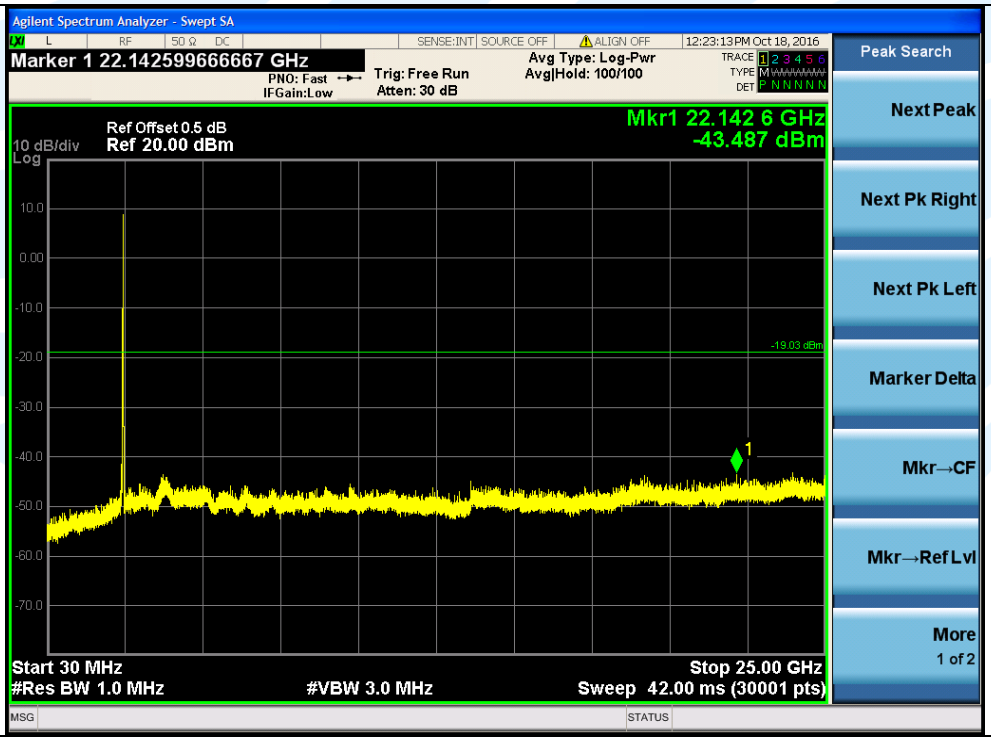
Out of Band



2462MHz

Reference Level

Out of Band



5.6 Radiated Spurious Emissions

Test Requirement: 47 CFR Part 15 Subpart C Section 15.205/15.209

Test Method: KDB 558074 D01 v03r05 Section 12.1

Limit:

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

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

Remark:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, 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.

The emissions were measured using the following resolution bandwidths:

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

Harmonic and Spurious emissions that were identified as coming from the EUT were checked in Peak and in Average Mode. The high frequency, which started from 10 to26.5GHz, which above 10GHz are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured was not reported.

Peak measurements and average measurements are made. All emissions were determined to have a peak-to-average ratio of less than 20dB.

Test Procedure:

Below 1GHz test procedure as below:

a) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.

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

c) The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable was turned from 0 degrees to 360 degrees to find the maximum reading.

e) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f) 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

Above 1GHz test procedure as below:

g) Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber change form table 0.8 meter to 1.5 meter(Above 18GHz the distance is 1 meter and table is 1.5 meter).

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.

Test Setup: Refer to section 4.1.2 for details.

Instruments Used: Refer to section 3 for details

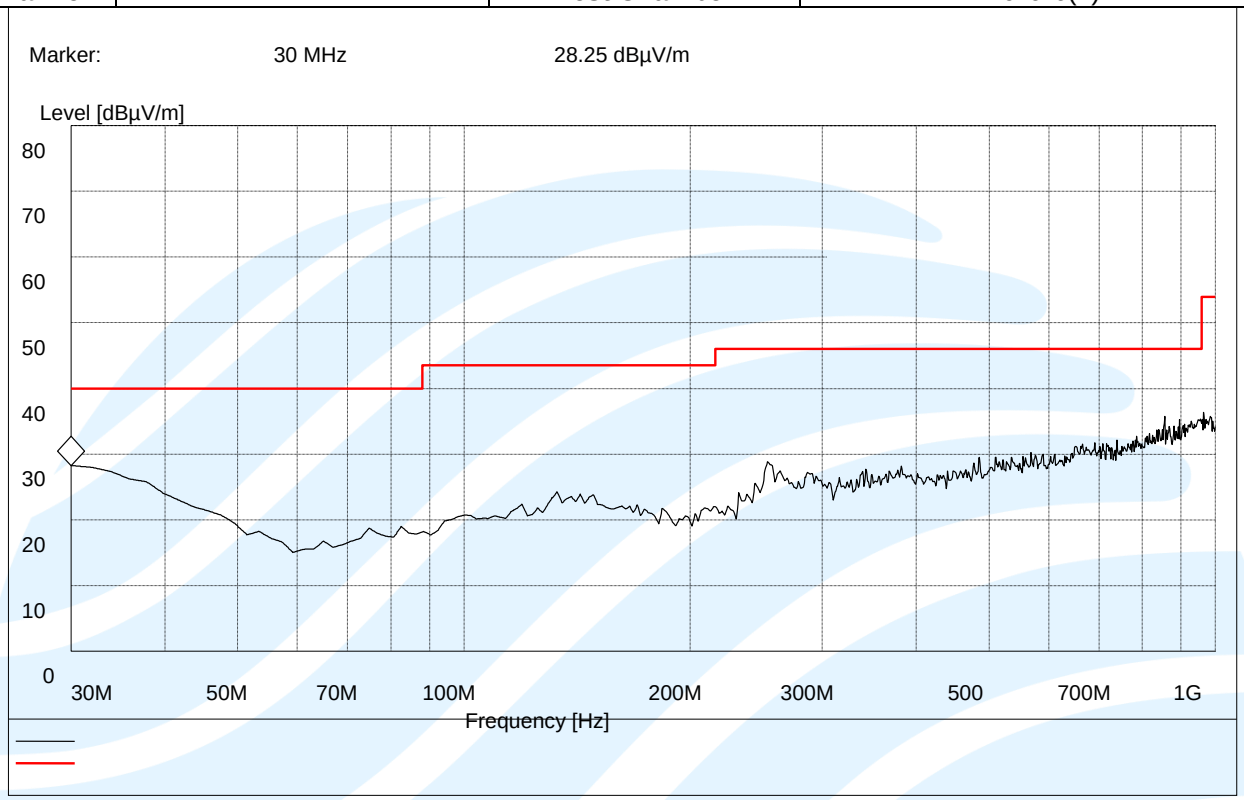
Test Mode: Transmitter mode

Test Results: Pass

Test Data:

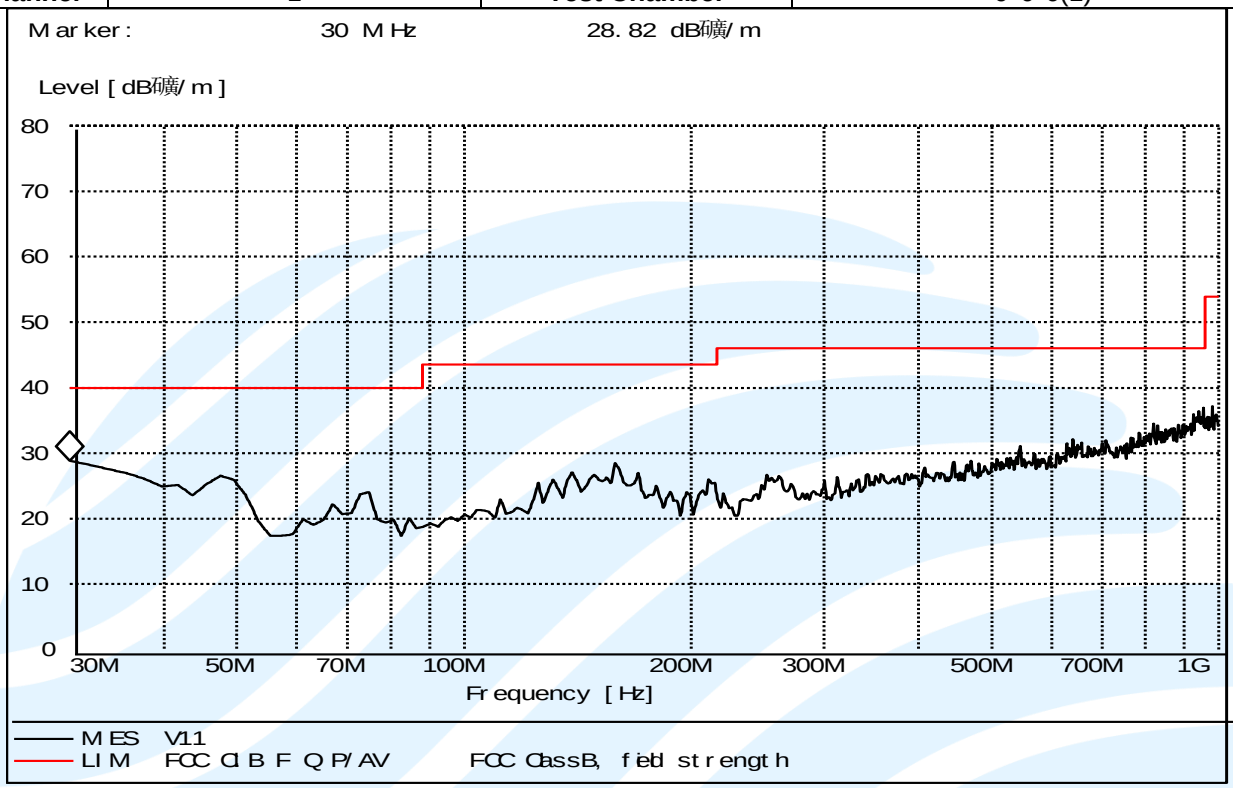
Radiated Emission Test Data (Below 1 GHz Worst Case):

Mode	802.11b	**Ant. Polar.**	Horizontal
Channel	1	**Test Chamber**	9*6*6(1)



.No.	Frequency (MHz)	Measurement Level (dBuV/m)	Limit (dBuV/m)	Result
1	30.000	27.11	40.0	PASS
2	146.850	22.63	43.5	PASS
3	263.330	28.81	46.0	PASS

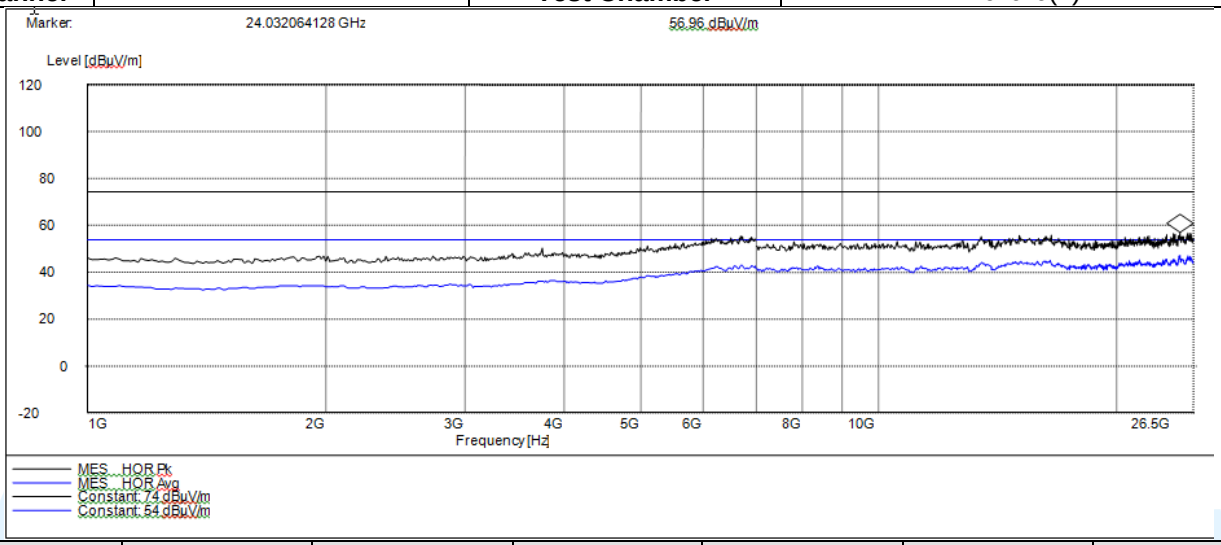
Mode	802.11b	Ant. Polar.	Vertical
Channel	1	Test Chamber	9*6*6(1)



.No.	Frequency	Measurement Level	Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	
1	30.000	28.01	40	PASS
2	48.880	25.72	43.5	PASS
3	172.280	28.18	46	PASS

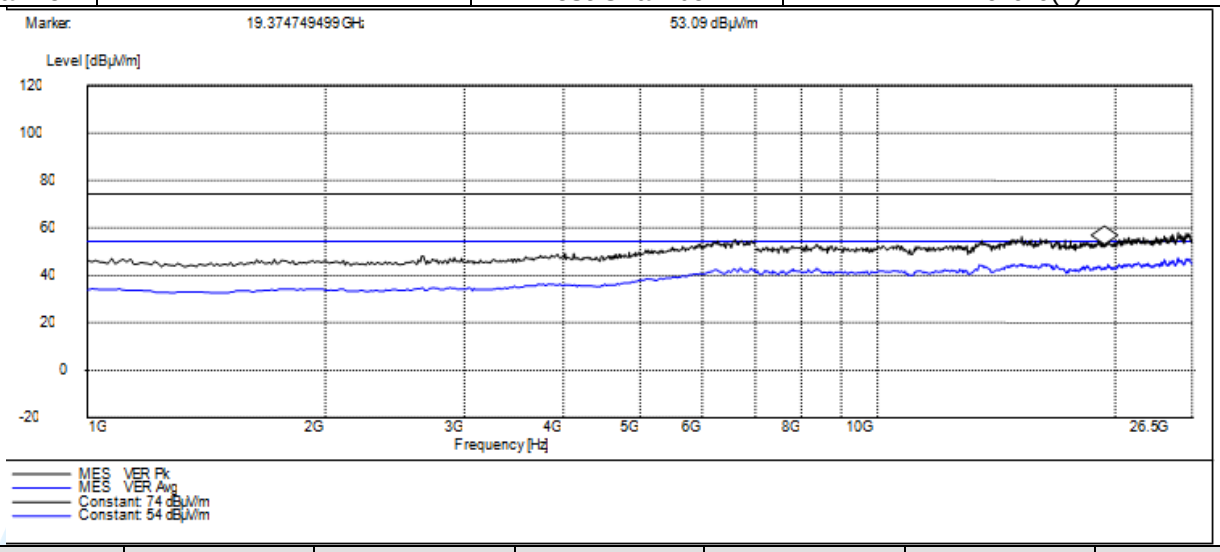
Radiated Emission Test Data (Above 1GHz):

Mode	802.11b	**Ant. Polar.**	Horizontal
Channel	1	**Test Chamber**	9*6*6(2)



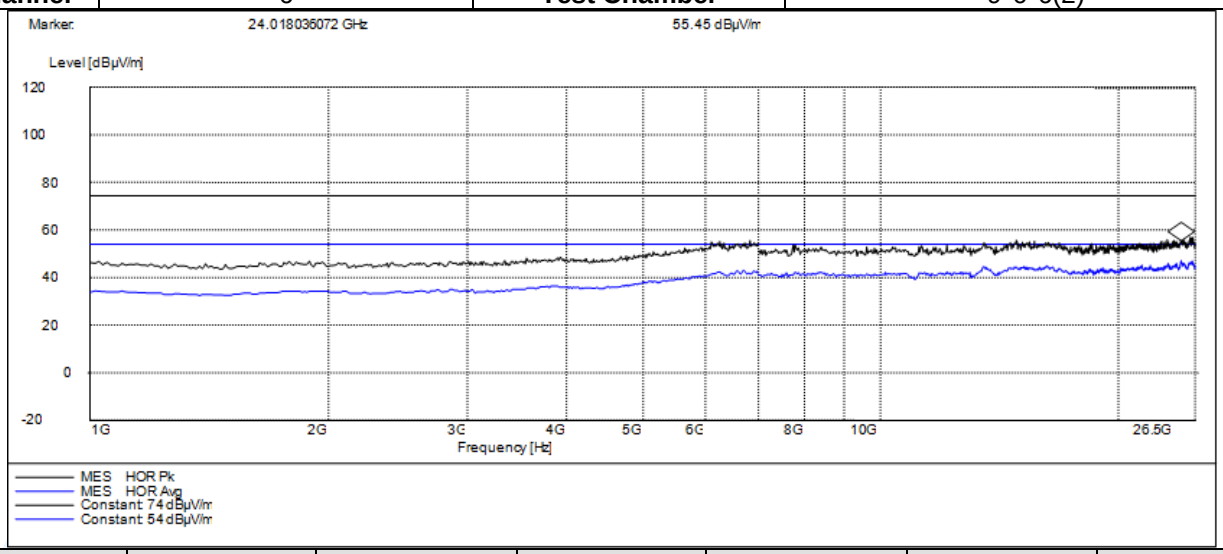
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6182.300	52.63	74	41.86	54	PASS
2	134809.000	55.22	74	43.91	54	PASS
3	24018.000	54.46	74	46.92	54	PASS

Mode	802.11b	Ant. Polar.	Vertical
Channel	1	Test Chamber	9*6*6(2)



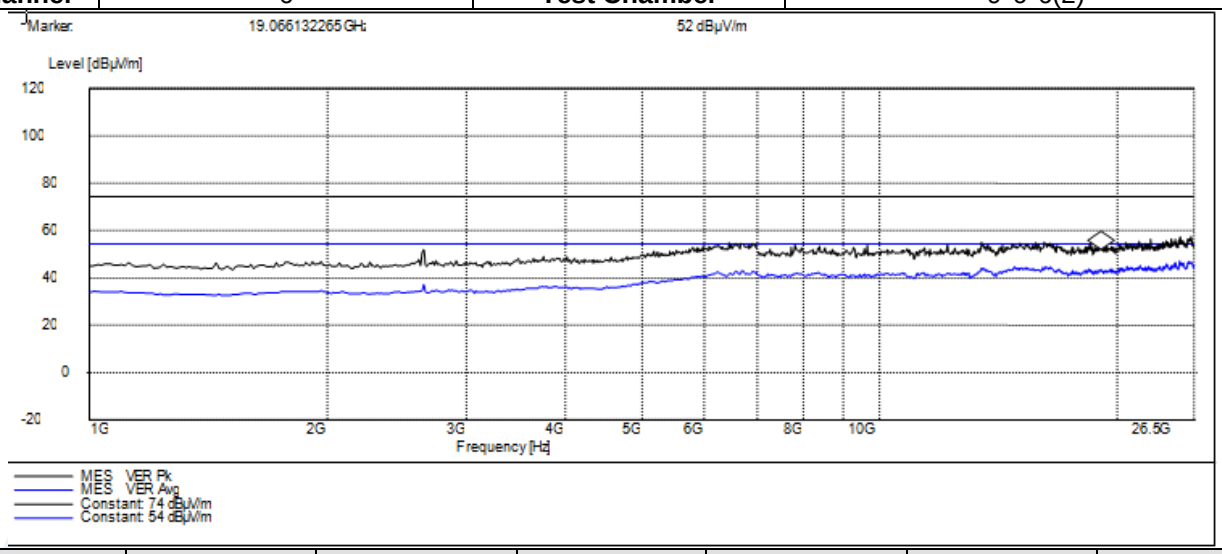
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6218.400	53.6	74	42.35	54	PASS
2	13436.900	52.78	74	43.87	54	PASS
3	23106.200	55.88	74	45.75	54	PASS

Mode	802.11b	Ant. Polar.	Horizontal
Channel	6	Test Chamber	9*6*6(2)



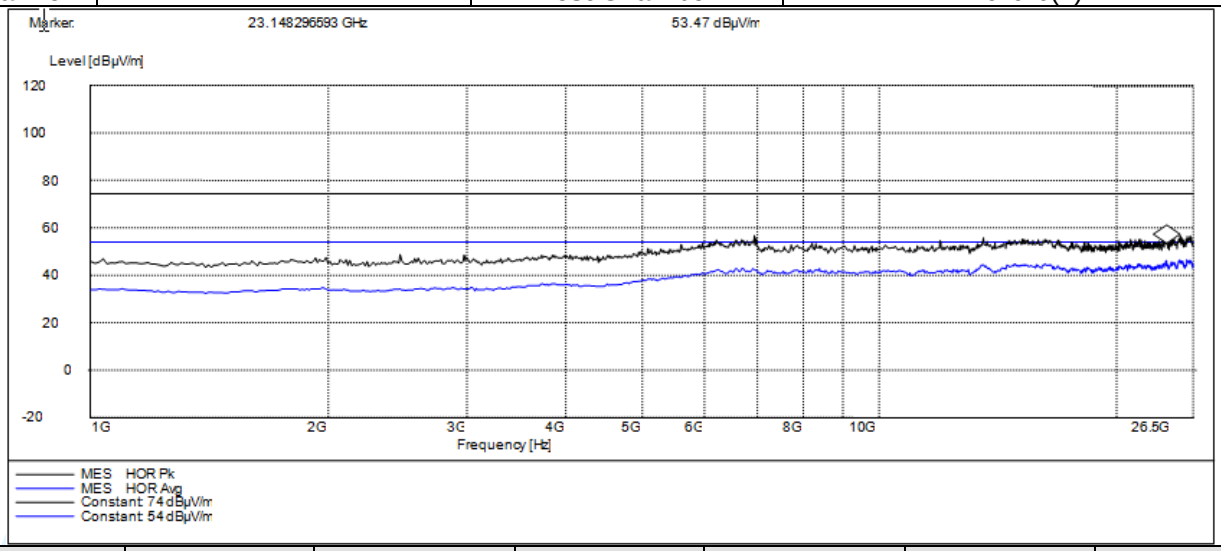
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6230.400	53.63	74	42.32	54	PASS
2	13547.100	54.34	74	44.3	54	PASS
3	24004.000	55.73	74	46.55	54	PASS

Mode	802.11b	Ant. Polar.	Vertical
Channel	6	Test Chamber	9*6*6(2)



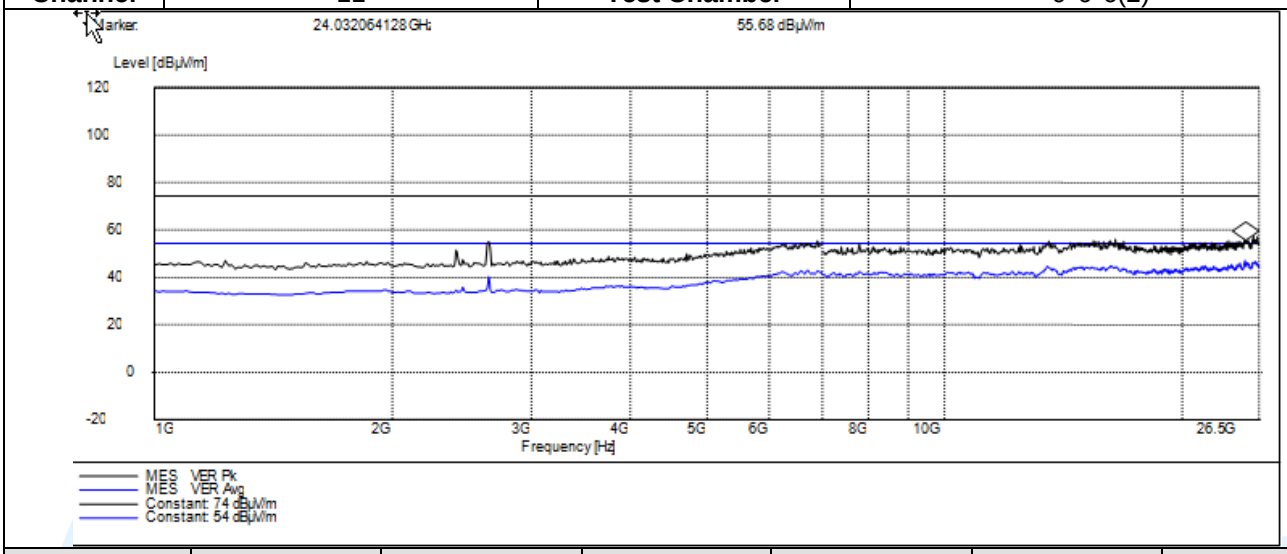
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6218.400	53.18	74	42.34	54	PASS
2	13480.900	53.24	74	43.39	54	PASS
3	22110.200	52.64	74	43.06	54	PASS

Mode	802.11b	Ant. Polar.	Horizontal
Channel	11	Test Chamber	9*6*6(2)



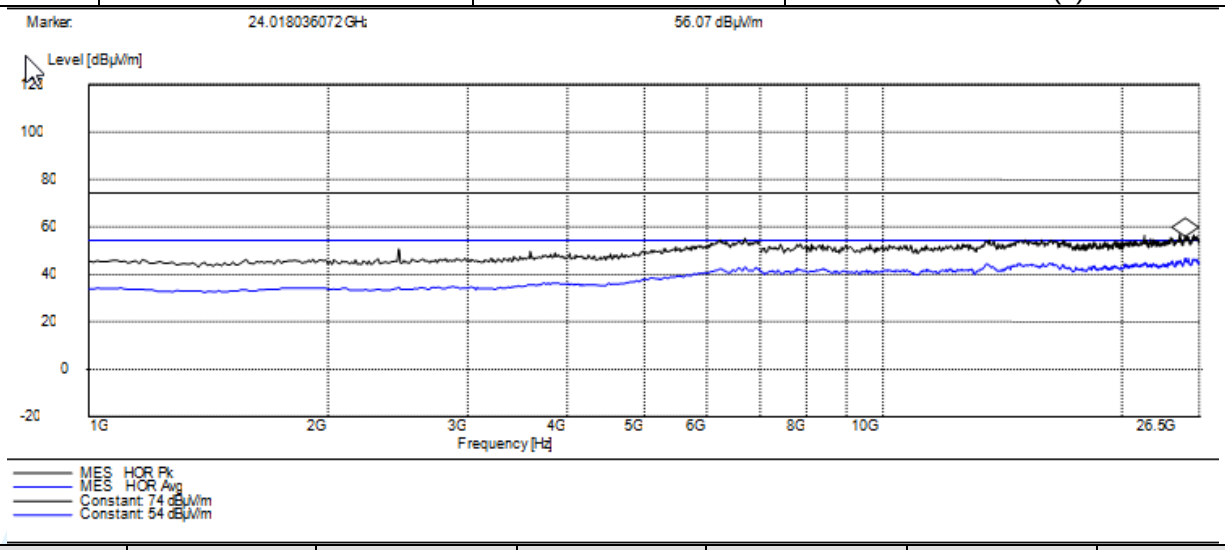
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6230.400	53.59	74	42.32	54	PASS
2	13547.100	55.79	74	44.30	54	PASS
3	23130.400	53.89	74	44.96	54	PASS

Mode	802.11b	Ant. Polar.	Vertical
Channel	11	Test Chamber	9*6*6(2)



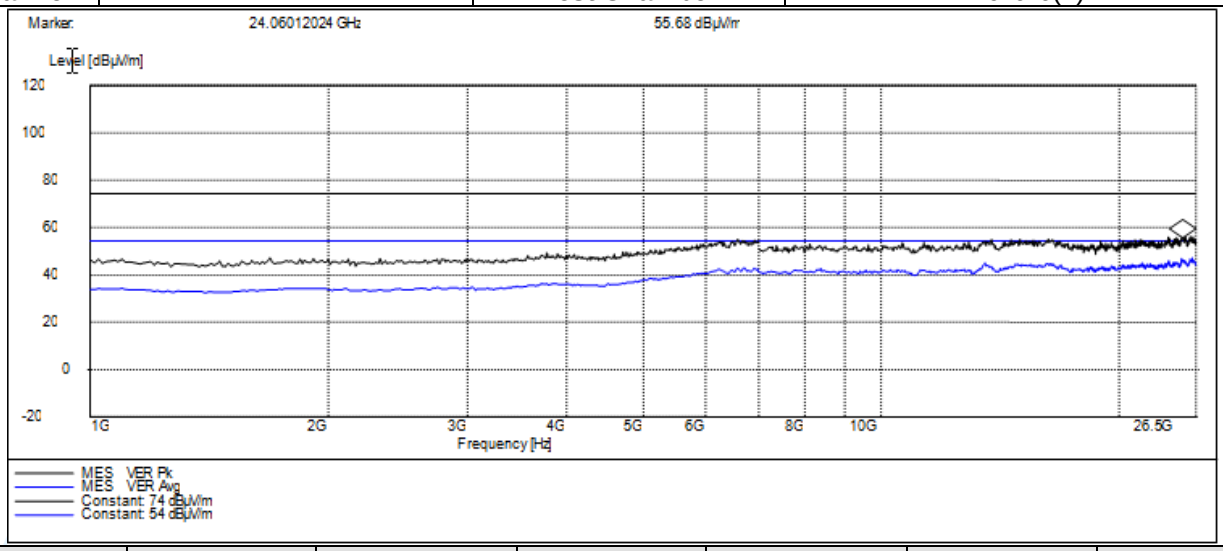
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6194.400	52.77	74	41.85	54	PASS
2	13480.900	53.45	74	44.74	54	PASS
3	24046.000	55.33	74	45.00	54	PASS

Mode	802.11g	Ant. Polar.	Horizontal
Channel	1	Test Chamber	9*6*6(2)



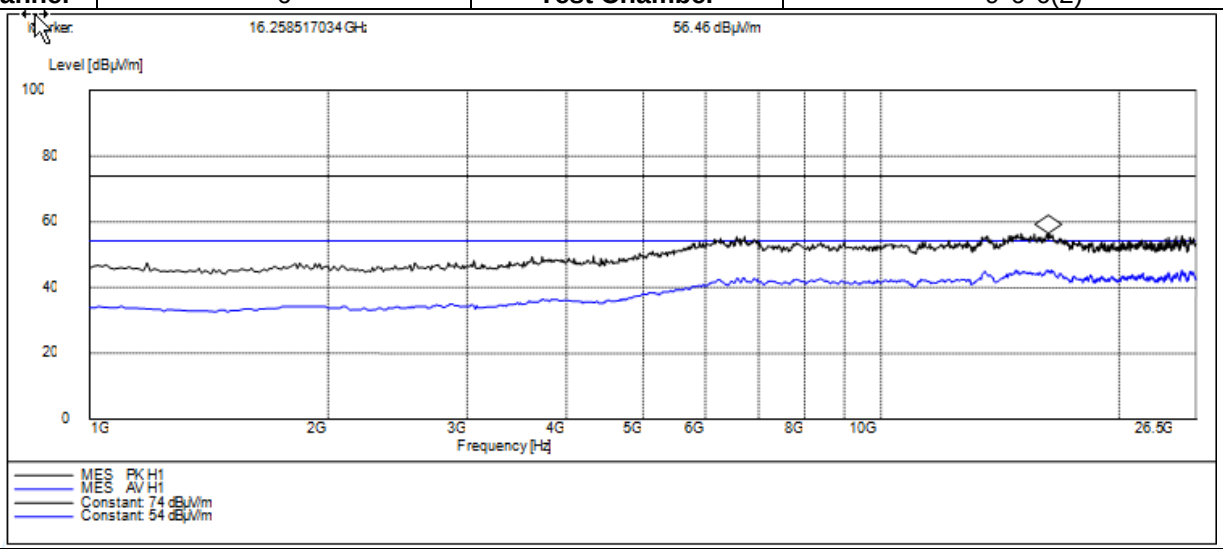
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6290.500	52.83	74	41.57	54	PASS
2	13547.100	54.07	74	44.30	54	PASS
3	24004.000	57.95	74	46.91	54	PASS

Mode	802.11g	Ant. Polar.	Vertical
Channel	1	Test Chamber	9*6*6(2)



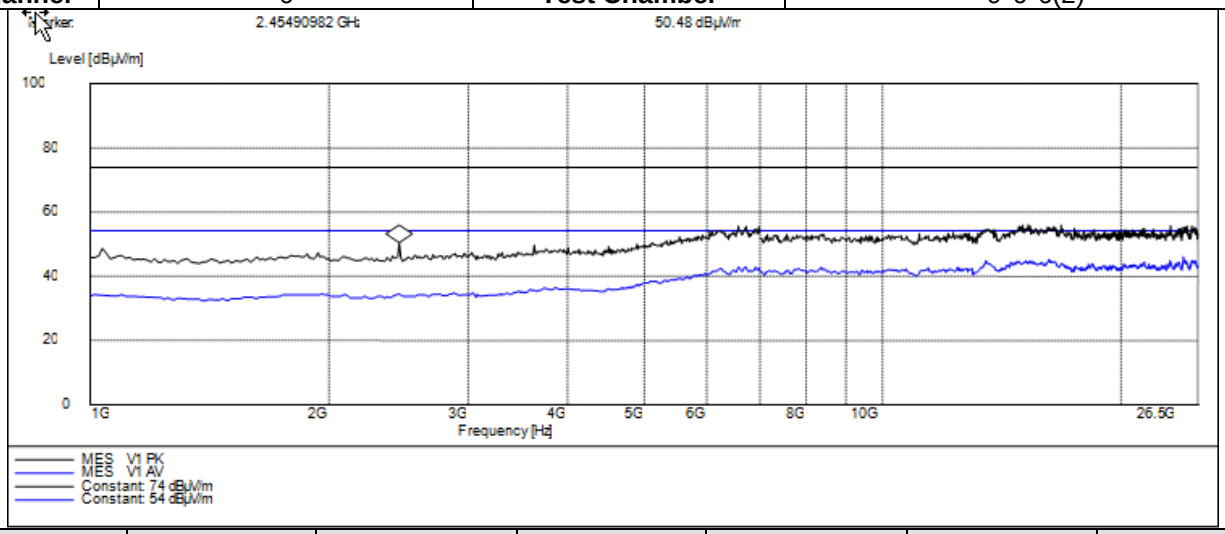
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6254.500	53.70	74	42.37	54	PASS
2	13525.100	54.25	74	45.09	54	PASS
3	24046.100	57.23	74	46.48	54	PASS

Mode	802.11g	Ant. Polar.	Horizontal
Channel	6	Test Chamber	9*6*6(2)



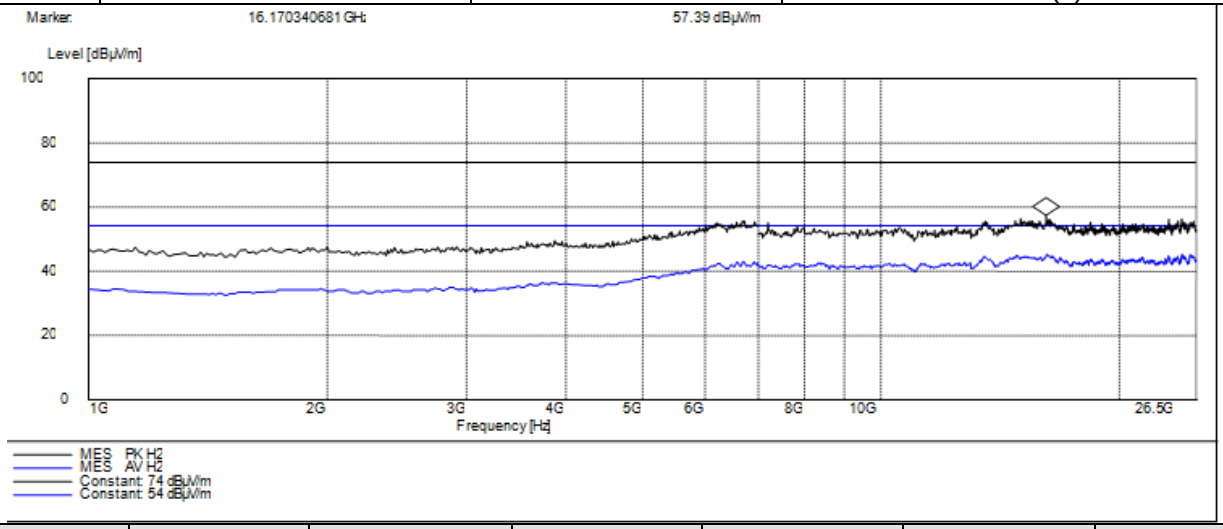
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6699．400	54.83	74	42.97	54	PASS
2	15046.100	56.38	74	44.42	54	PASS
3	21352.700	53.94	74	44.02	54	PASS

Mode	802.11g	Ant. Polar.	Vertical
Channel	6	Test Chamber	9*6*6(2)



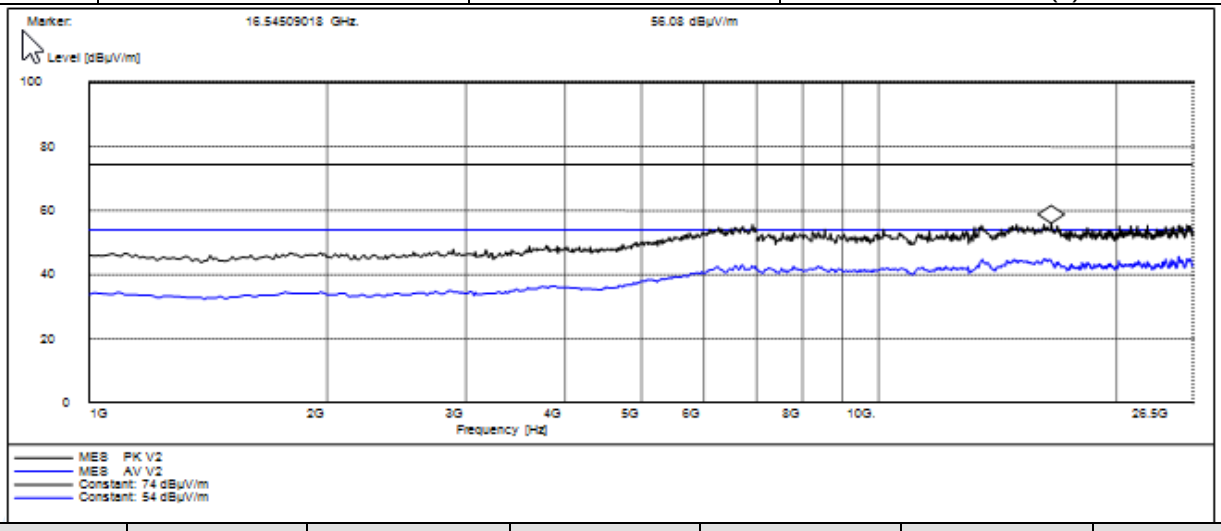
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	1937.8	47.36	74	34.20	54	PASS
2	6723.4	55.60	74	42.73	54	PASS
3	16809.6	56.03	74	43.93	54	PASS

Mode	802.11g	Ant. Polar.	Horizontal
Channel	11	Test Chamber	9*6*6(2)



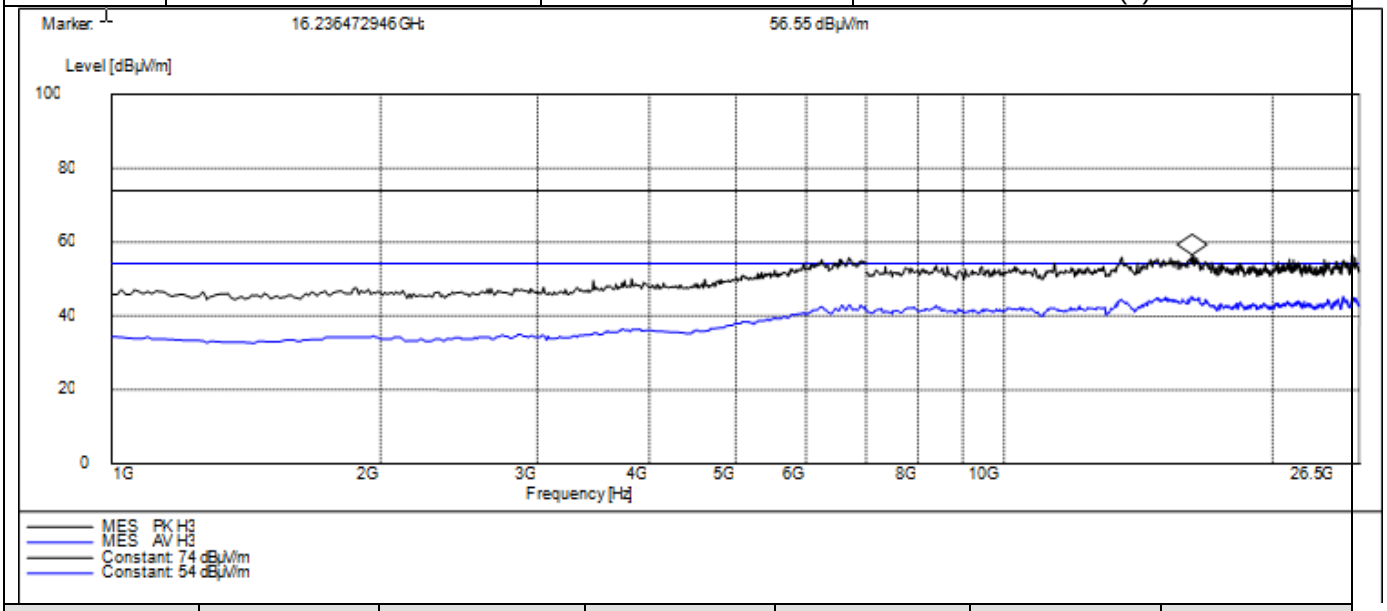
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6699.400	54.83	74	42.97	54	PASS
2	13613.200	55.15	74	43.81	54	PASS
3	20959.900	54.79	74	42.89	54	PASS

Mode	802.11g	Ant. Polar.	Vertical
Channel	11	Test Chamber	9*6*6(2)



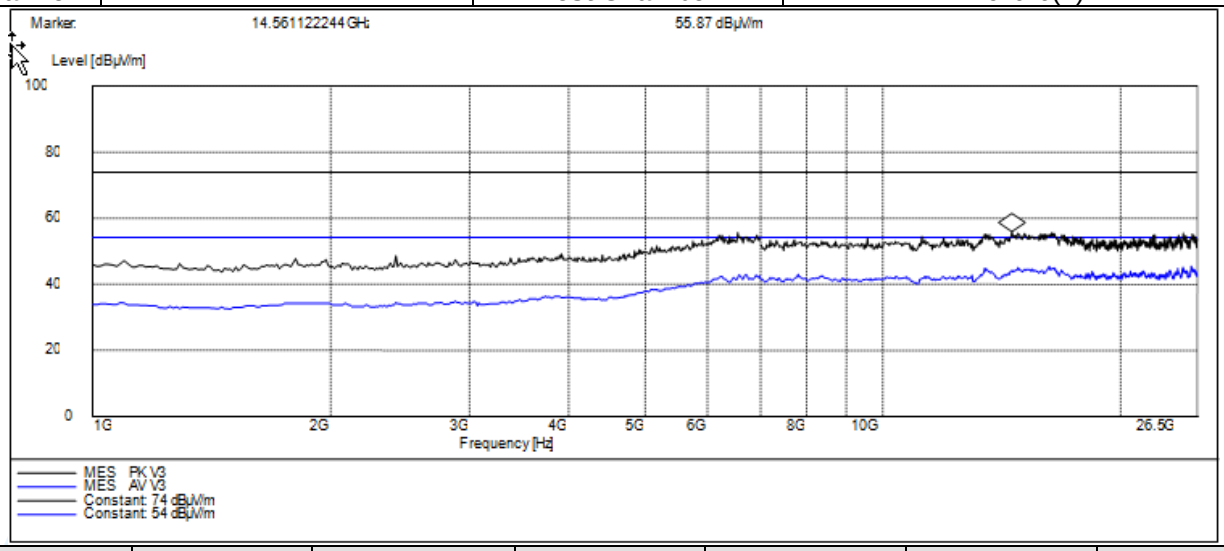
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6278.5	54.22	74	41.85	54	PASS
2	13503.00	55.45	74	44.86	54	PASS
3	20861.700	55.20	74	43.21	54	PASS

Mode	802.11n(HT20)	Ant. Polar.	Horizontal
Channel	1	Test Chamber	9*6*6(2)



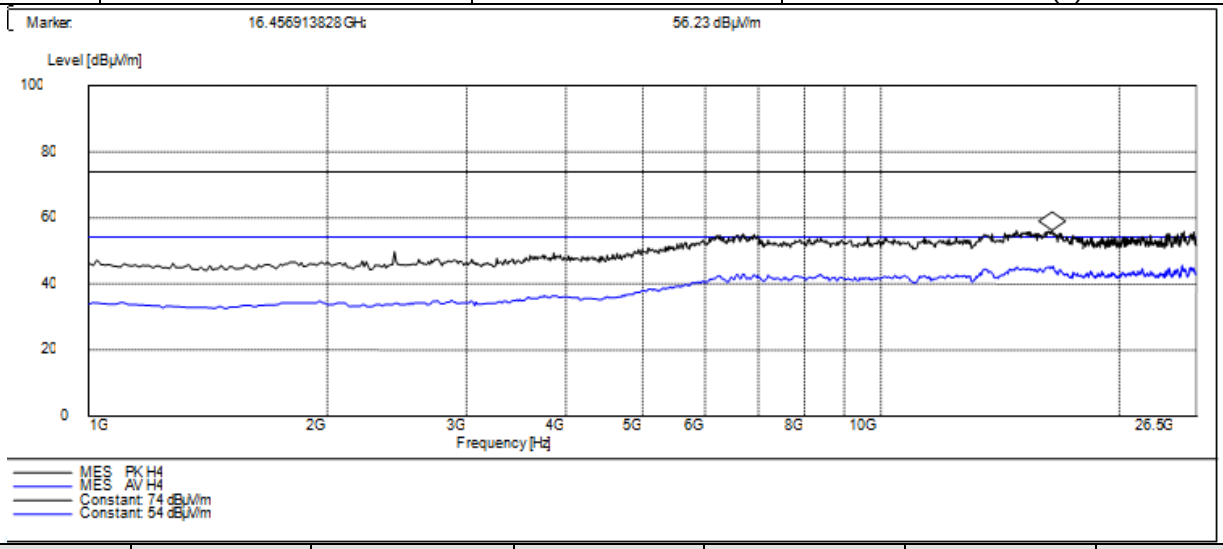
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6230.500	54.05	74	42.32	54	PASS
2	13386.800	54.30	74	42.13	54	PASS
3	20875.700	55.38	74	43.21	54	PASS

Mode	802.11n(HT20)	Ant. Polar.	Vertical
Channel	1	Test Chamber	9*6*6(2)



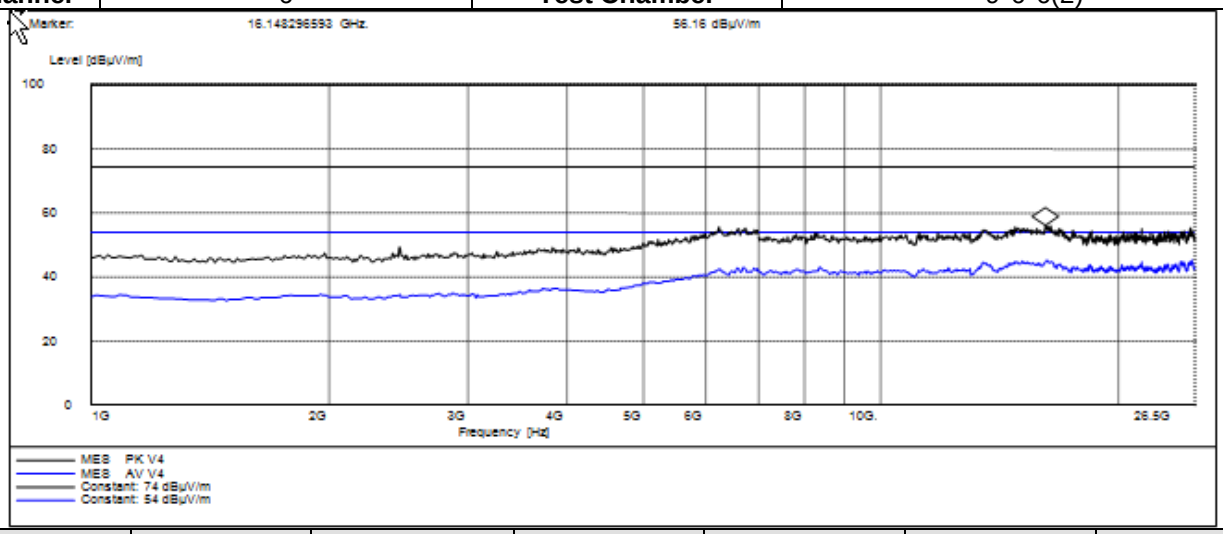
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6555.100	55.62	74	41.96	54	PASS
2	11210.400	54.46	74	41.74	54	PASS
3	21913.800	53.91	74	43.62	54	PASS

Mode	802.11n(HT20)	Ant. Polar.	Horizontal
Channel	6	Test Chamber	9*6*6(2)



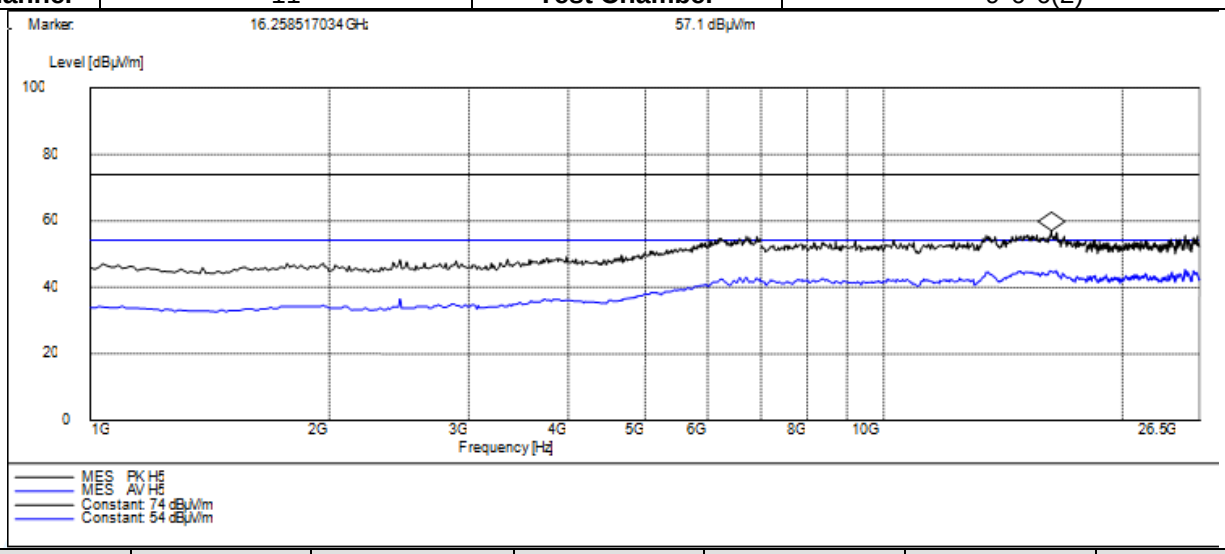
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6699.300	55.19	74	42.73	54	PASS
2	13547.100	54.67	74	44.42	54	PASS
3	21380.7	54.39	74	44.02	54	PASS

Mode	802.11n(HT20)	Ant. Polar.	Vertical
Channel	6	Test Chamber	9*6*6(2)



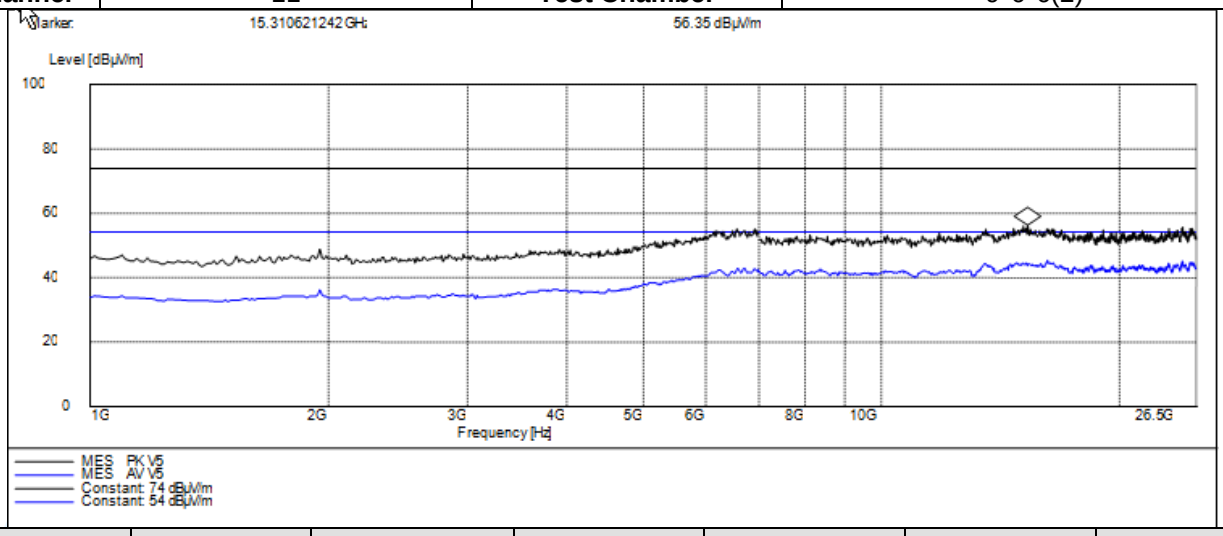
.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6230.400	55.69	74	42.32	54	PASS
2	11210.400	53.35	74	41.74	54	PASS
3	21422.800	53.59	74	44.76	54	PASS

Mode	802.11n(HT20)	Ant. Polar.	Horizontal
Channel	11	Test Chamber	9*6*6(2)



.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6254.500	54.23	74	42.37	54	PASS
2	13547.00	55.33	74	44.65	54	PASS
3	21352.700	52.72	74	43.82	54	PASS

Mode	802.11n(HT20)	Ant. Polar.	Vertical
Channel	11	Test Chamber	9*6*6(2)



.No.	Frequency	Measurement Peak Level	Peak Limit	Measurement Avg Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	6579.100	55.11	74	42.83	54	PASS
2	13547.00	55.06	74	44.30	54	PASS
3	21296.500	53.94	74	43.42	54	PASS

Note:

1) Through Pre-scan transmitting mode with all kind of modulation and data rate, find the 1Mbps of rate is the worst case of 802.11b; 6Mbps of rate is the worst case of 802.11g; MCS 0 of rate is the worst case of 802.11n(HT20), and then Only the worst case is recorded in the report.
2) Scan from 9kHz to 26.5GHz, the amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

5.7 Band Edge Measurements (Radiated)

Test Requirement: 47 CFR Part 15 Subpart C Section 15.205/15.209

Test Method: KDB 558074 D01 v03r05 Section 12.1

Limit:

Frequency	Limit (dBµV/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 Procedure: Radiated band edge measurements at 2390MHz and 2483MHz were made with the unit transmitting in the low end of the channel range and the high end closest to the restricted bands respectively. The emissions were made on the 966 Semi-Chamber. Use (resolution bandwidth (RBW) = 1 MHz, video bandwidth (VBW) = 3 MHz for peak levels and RBW = 1 MHz and VBW = 10 Hz or 1/T for average levels).

1. Use radiated spurious emission test procedure described in 5.6 clause. The transmitter output (antenna port) was connected to the test receiver.
2. Set the PK and AV limit line.
3. Record the fundamental emission and emissions out of the band-edge.
4. Determine band-edge compliance as required.

Test Setup: Refer to section 4.1.2 for details.

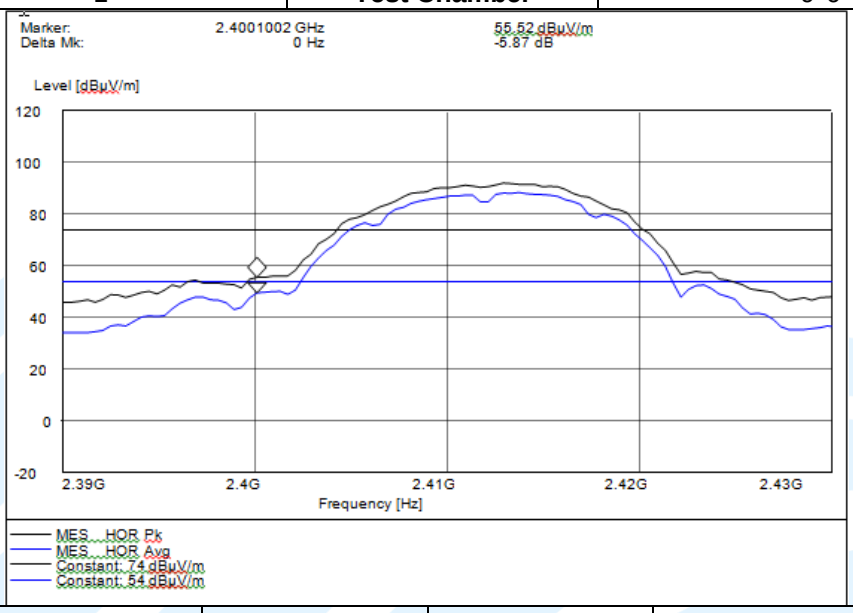
Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

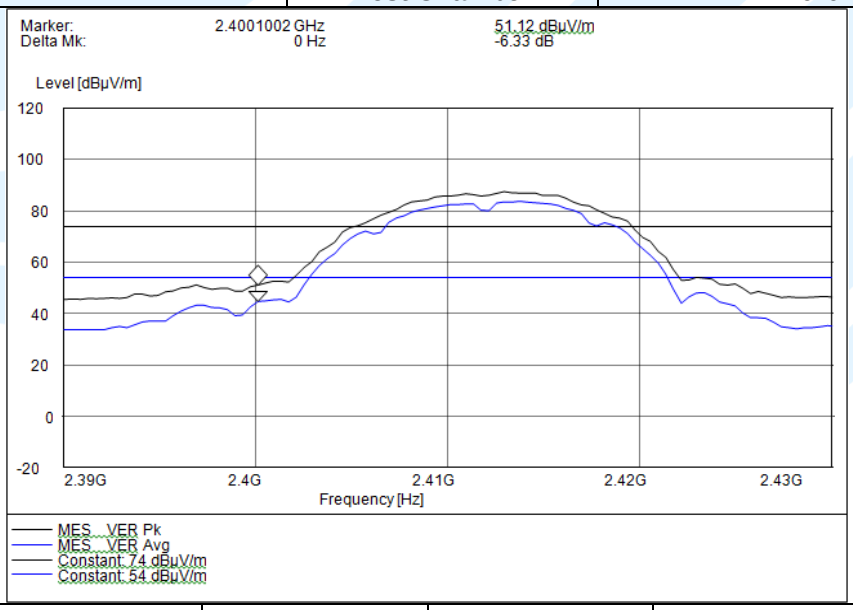
Test Data:

Mode	802.11b	Ant. Polar.	Horizontal
Channel	1	Test Chamber	9*6*6(2)



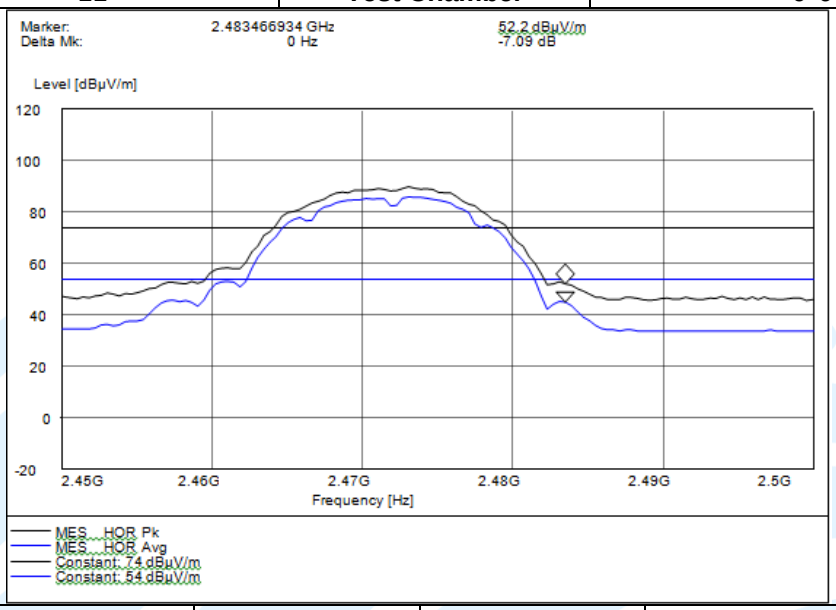
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2400	55.52	74	49.65	54	Pass

Mode	802.11b	Ant. Polar.	Vertical
Channel	1	Test Chamber	9*6*6(2)



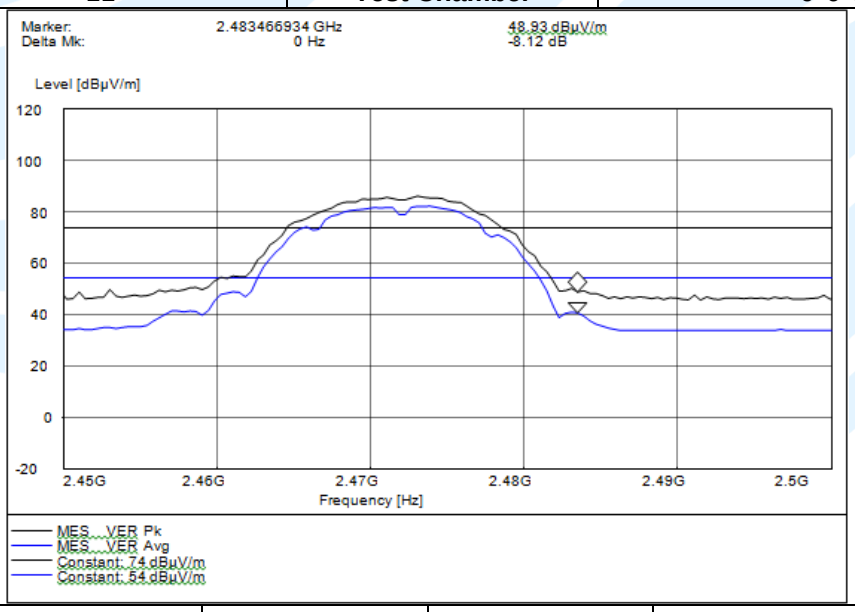
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2400	51.12	74	44.79	54	Pass

Mode	802.11b	Ant. Polar.	Horizontal
Channel	11	Test Chamber	9*6*6(2)



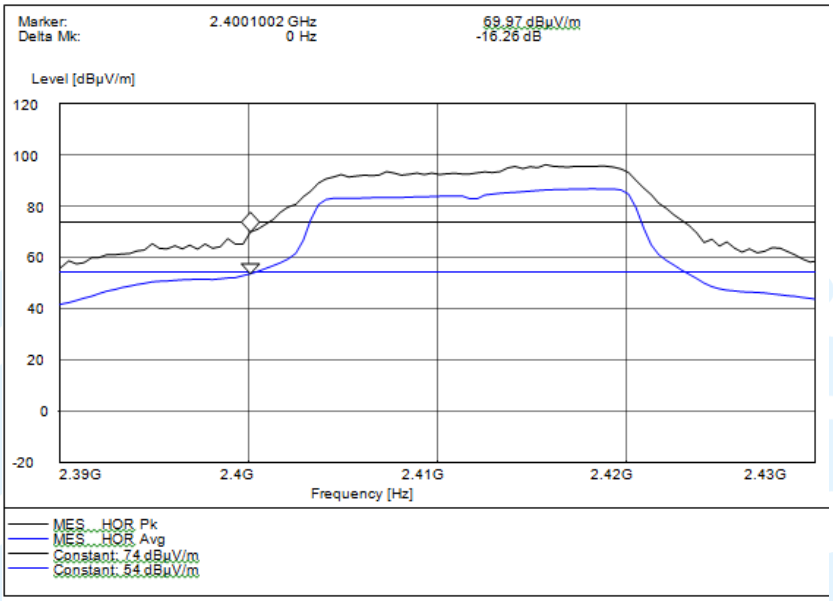
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5	52.20	74	45.11	54	Pass

Mode	802.11b	Ant. Polar.	Vertical
Channel	11	Test Chamber	9*6*6(2)



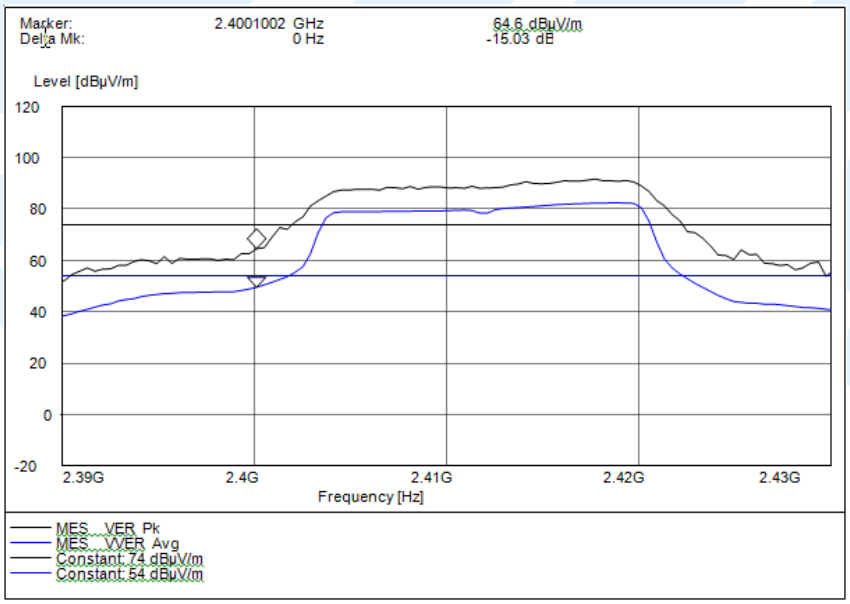
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5	48.93	74	40.81	54	Pass

Mode	802.11g	Ant. Polar.	Horizontal
Channel	1	Test Chamber	9*6*6(2)



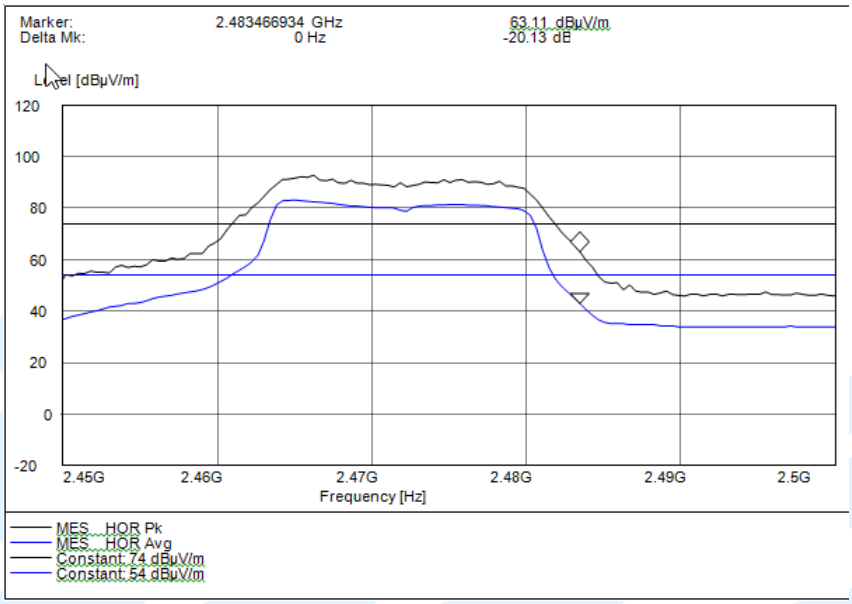
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2400	69.97	74	53.71	54	Pass

Mode	802.11g	Ant. Polar.	Vertical
Channel	1	Test Chamber	9*6*6(2)



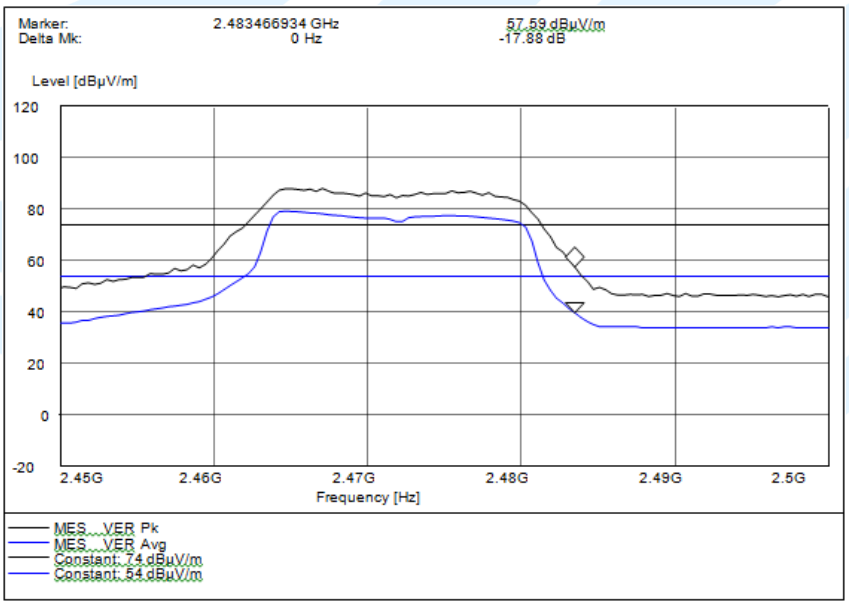
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2400	64.60	74	49.57	54	Pass

Mode	802.11g	Ant. Polar.	Horizontal
Channel	11	Test Chamber	9*6*6(2)



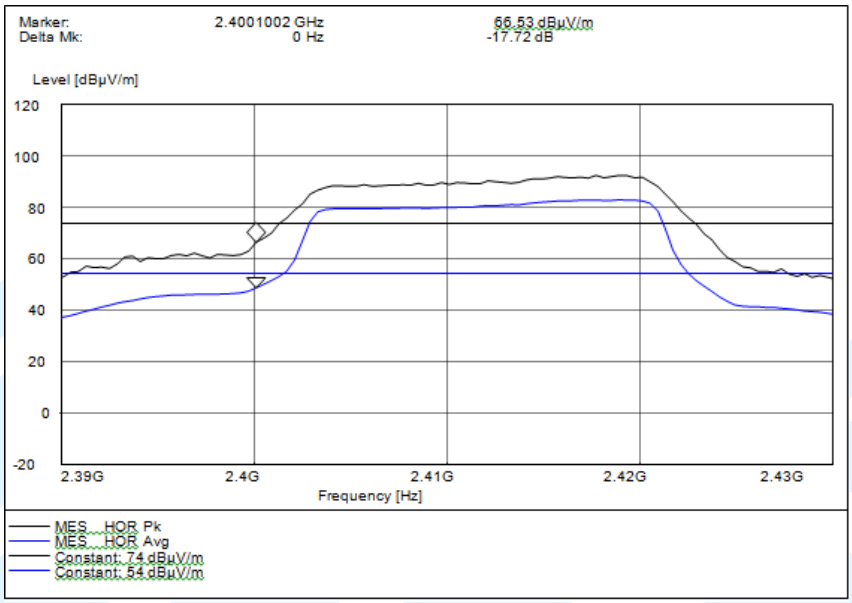
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5	63.11	74	42.98	54	Pass

Mode	802.11g	Ant. Polar.	Vertical
Channel	11	Test Chamber	9*6*6(2)



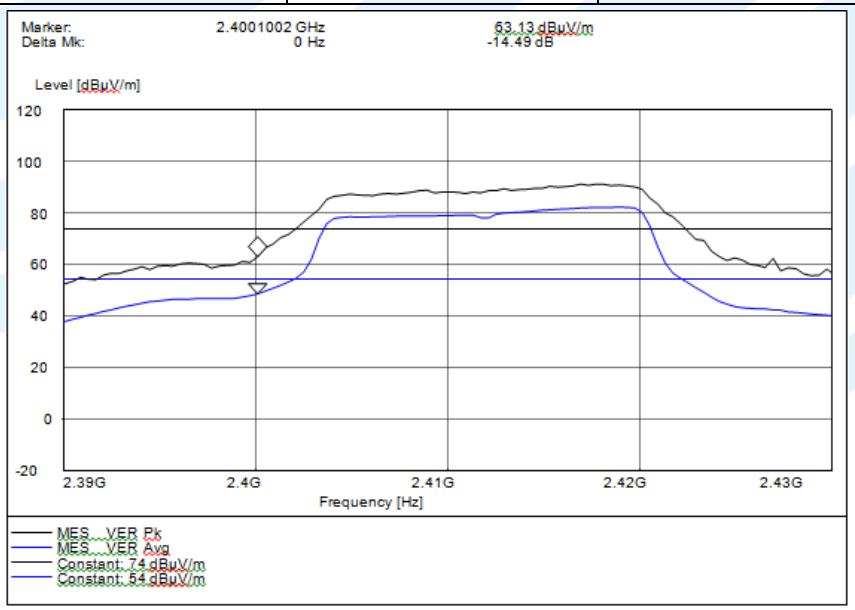
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5	57.59	74	39.71	54	Pass

Mode	802.11n(HT20)	Ant. Polar.	Horizontal
Channel	1	Test Chamber	9*6*6(2)



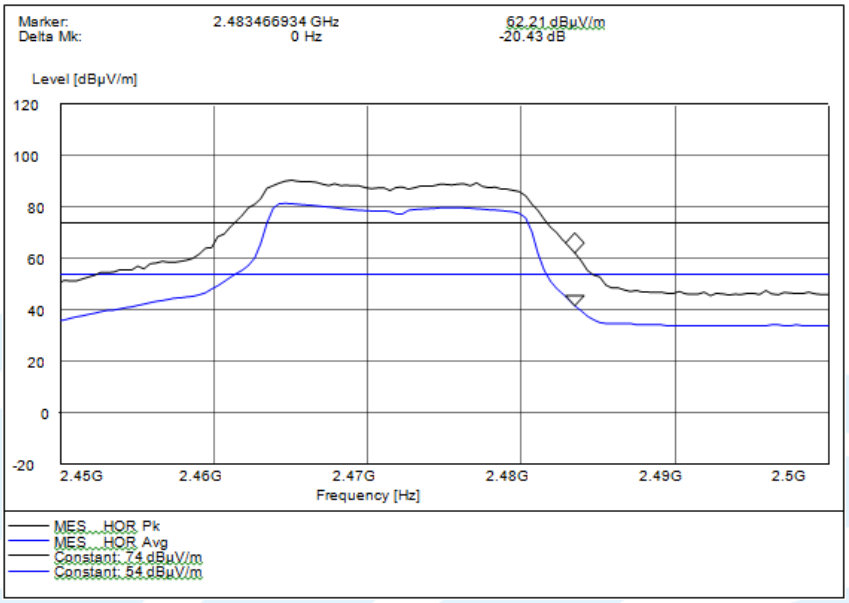
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2400	66.53	74	48.81	54	Pass

Mode	802.11n(HT20)	Ant. Polar.	Vertical
Channel	1	Test Chamber	9*6*6(2)



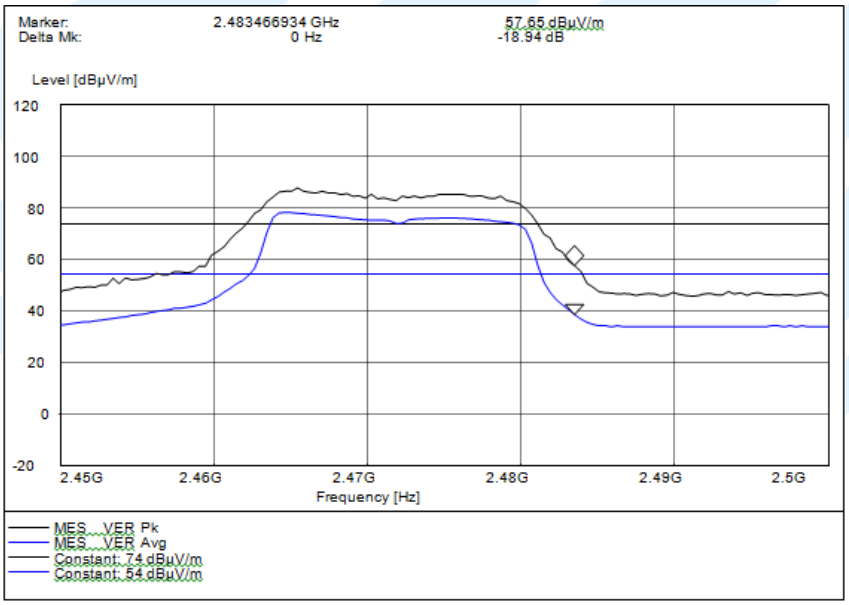
Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2400	63.13	74	48.61	54	Pass

Mode	802.11n(HT20)	Ant. Polar.	Horizontal
Channel	11	Test Chamber	9*6*6(2)



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5	62.21	74	41.78	54	Pass

Mode	802.11n(HT20)	Ant. Polar.	Vertical
Channel	11	Test Chamber	9*6*6(2)



Frequency (MHz)	Peak level (dBuv/m)	Peak Limit (dBuv/m)	AV level (dBuv/m)	AV Limit (dBuv/m)	Conclusion
2483.5	57.65	74	38.71	54	Pass

Note:

1) Through Pre-scan transmitting mode with all kind of modulation and data rate, find the 1Mbps of rate is the worst case of 802.11b; 6Mbps of rate is the worst case of 802.11g; MCS0 of rate is the worst case of 802.11n(HT20), and then Only the worst case is recorded in the report.
2) Through testing, the point of 2400 MHz test result is highest in 2310-2400 MHz band.

5.8 Conducted Emissions

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

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

* The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

NOTE : The lower limit is applicable at the transition frequency

Test Procedure: Test frequency range :150KHz-30MHz

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 on conducted measurement.

Test Setup: Refer to section 4.1.3 for details.

Instruments Used: Refer to section 3 for details

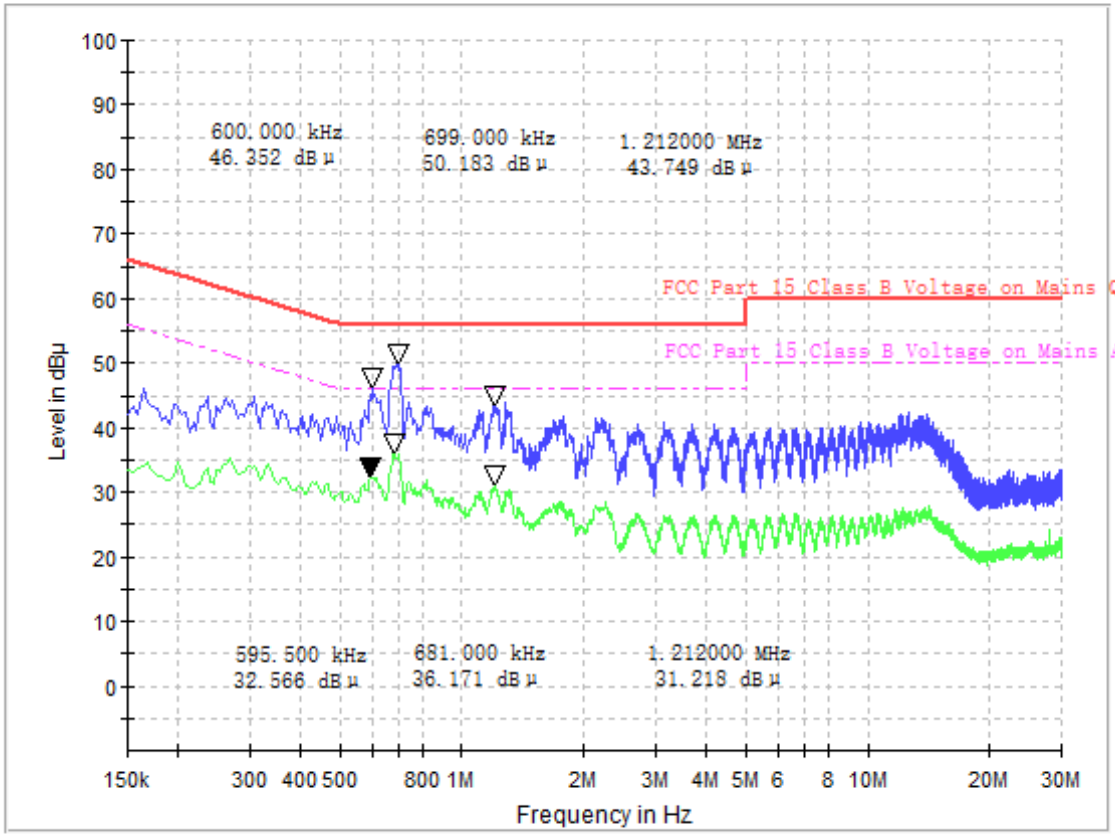
Test Mode: Transmitter mode

Test Results: Pass

Measurement Data

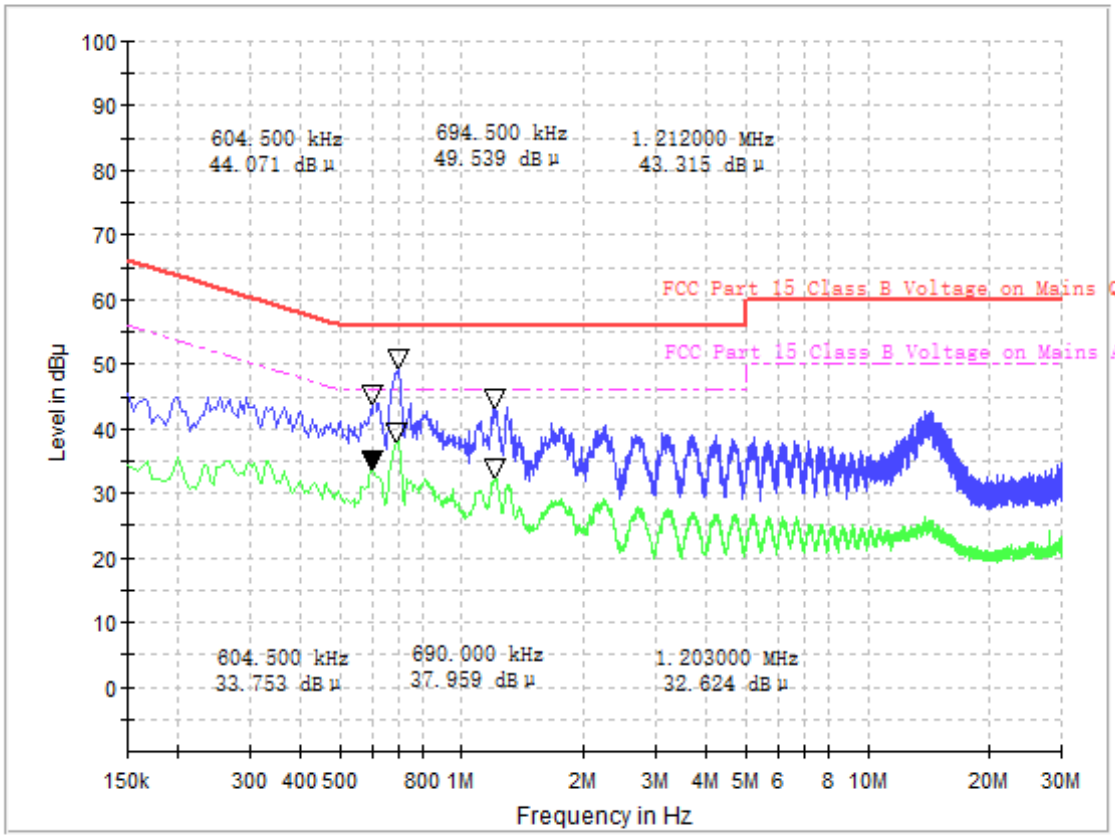
An initial pre-scan was performed on the live and neutral lines with peak detector.
Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Test plot as follows:
Live Line:



.No.	Frequency	Measurement QP Level	QP Limit	Measurement AVG Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	0.600	44.36	56	32.42	46	PASS
2	0.699	48.12	56	36.27	46	PASS
3	1.212	41.21	56	31.46	46	PASS

Neutral Line:



.No.	Frequency	Measurement QP Level	QP Limit	Measurement AVG Level	Avg Limit	Result
	(MHz)	(dBuV)	(dBuV/m)	(dBuV/m)	(dB)	
1	0.605	42.13	56	32.72	46	PASS
2	0.695	47.88	56	37.87	46	PASS
3	1.212	41.54	56	32.27	46	PASS

Notes:

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

APPENDIX 1 PHOTOGRAPHS OF TEST SETUP

See test photographs attached in Appendix 1 for the actual connections between Product and support equipment.

APPENDIX 2 PHOTOGRAPHS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photographs.

*** End of Report ***

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