

FCC TEST REPORT

Product : In-wall Smart Dimmer Switch
Trade mark : iDevices In-wall Dimmer Switch
Model/Type reference : IDEV0009
Report Number : 1612300603RFC-2
Date of Issue : February 9, 2017
FCC ID : 2ABDJ-DIMMER
Test Standards : 47 CFR Part 15 Subpart C
Test result : PASS

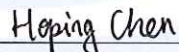
Prepared for:

iDevices, LLC
136 Simsbury Rd Building 12, Avon, Connecticut 06001, United States

Prepared by:

Shenzhen UnionTrust Quality and Technology Co., Ltd.
**16/F, Block A, Building 6, Baoneng Science and Technology Park,
 Qingxiang Road No.1, Longhua New District, Shenzhen, China**
TEL: +86-755-2823 0888
FAX: +86-755-2823 0886

Tested by:



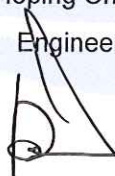
Hoping Chen
Engineer

Reviewed by:



Leo Lai
Senior Supervisor

Approved by:



Billy Li
Technical Director

Date:

February 9, 2017


Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China
Tel: +86-755-28230888 Fax: +86-755-28230886 E-mail: info@uttlab.com [Http://www.uttlab.com](http://www.uttlab.com)

Version

Version No.	Date	Description
V1.0	February 9, 2017	Original



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1 General Information

1.1 Client Information

Applicant:	iDevices, LLC
Address of Applicant:	136 Simsbury Rd Building 12, Avon, Connecticut 06001, United States
Manufacturer:	EWIG INDUSTRIES MACAO COMMERCIAL OFFSHORE LTD
Address of Manufacturer:	11/F, Houtex Industrial Building E16 Hung To Road, Kwun Tung Kowloon, Hong Kong

1.2 General Description of EUT

Product Name:	In-wall Smart Dimmer Switch
Model No.(EUT):	IDEV0009
Add Mode No.:	N/A
Trade Mark:	iDevices In-wall Dimmer Switch
EUT Supports Radios application:	Bluetooth V4.0 BLE only Wlan 2.4GHz 802.11b/g/n(HT20)
Power Supply:	120Vac/60Hz
USB Micro-B Plug cable:	N/A
Sample Received Date:	January 25, 2017
Sample tested Date:	January 25, 2017 to February 9, 2017

1.3 Product Specification subjective to this standard

Operation Frequency:	2400MHz-2483.5MHz
Channel Numbers:	802.11b/g/n(HT20): 11 Channels
Channel Separation:	5MHz step for WiFi
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): up to MCS7(65Mbps)
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:	Mobile production
Antenna Type:	Chain 1: PCB antenna for WiFi
Antenna Gain:	Chain 1: 3.3 dBi gain
Normal Test voltage:	5Vdc from USB-to-Serial Adapter
Software Version:	-
Hardware Version:	iDev 036 Rev E

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	Brand	Model No.	Certification	Supplied by
Laptop	Lenovo	E450	FCC ID and DOC	UnionTrust
USB Isolator	TITAN	USB-ISO-M	FCC DOC	Applicant
iDevices Tag Connect Programmer	-	iDev 046 Rev B	-	Applicant

2) Cable

Cable No.	Description	Connector Type	Cable Type/Length	Supplied by
1	Antenna cable	SMA	0.2m(Shielded)	UnionTrust
2	USB Cable	USB	1.2m(shielded)	Applicant

1.5 Test Location

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China 518109

Telephone: +86 (0) 755 2823 0888 Fax: +86 (0) 755 2823 0886

Tests were sub-contracted. (FCC 47 CFR Part 15 Subpart C Section 15.205/15.207/15.209)
Compliance Certification Services (Shenzhen) Inc.

No.10-1 Mingkeda Logistics Park, No.18 Huanguan South RD. Guan lan Town, Baoan Distr, Shenzhen, Guangdong, China.

Tel: 86 0755 28055000 Fax: 86 0755 29055221

1.6 Test Facility

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

Shenzhen UnionTrust Quality and Technology Co., Ltd.

CNAS-Lab Code: L9069

The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC/EN 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

Compliance Certification Services (Shenzhen) Inc.

FCC Registration Number is **441872**.

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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=2)

No.	Item	Measurement Uncertainty
1	Conducted emission 9KHz-150KHz	3.8 dB
2	Conducted emission 150KHz-30MHz	3.4 dB
3	Radiated emission 9KHz-30MHz	4.9 dB
4	Radiated emission 30MHz-1GHz	4.7 dB
5	Radiated emission 1GHz-18GHz	5.1 dB
6	Radiated emission 18GHz-26GHz	5.2 dB
7	Radiated emission 26GHz-40GHz	5.2 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	See remark 1
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	ANSI C63.10-2013	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.

N/A: Not application,

1. There is a separate report for the AC Power Line Conducted Emission test.

3 Equipment List

3M Semi/full-anechoic Chamber						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm-dd-yyyy)	Cal. Due date (mm-dd-yyyy)
☒	PSA Series Spectrum Analyzer	Agilent	E4446A	US44300399	02-21-2016	02-20-2017
☒	Turn Table	N/A	N/A	N/A	N.C.R	N.C.R
☒	Controller	Sunol Sciences	SC104V	022310-1	N.C.R	N.C.R
☒	Controller	CT	N/A	N/A	N.C.R	N.C.R
☒	Bilog Antenna	SCHAFFNER	CBL6143	5063	02-22-2016	02-21-2017
☒	Horn Antenna	SCHWARZBECK	BBHA9120	D286	02-21-2016	02-20-2017
☒	Loop Antenna	COM-POWER	AL-130	121044	02-21-2016	02-20-2017
☒	High Noise Amplifier	Agilent	8449B	3008A01838	02-22-2016	02-21-2017
☒	Horn Antenna	Schwarzbeck	BBHA9120	D286	02-22-2016	02-21-2017
☒	Temp. / Humidity Meter	Anymetre	JR913	N/A	02-22-2016	02-21-2017
☒	Antenna Tower	SUNOL	TLT2	N/A	N.C.R	N.C.R
☒	Test S/W	FARAO	LZ-RF / CCS-SZ-3A2			

RF test system						
Used	Equipment	Manufacturer	Model No.	Serial Number	Cal. date (mm-dd-yyyy)	Cal. Due date (mm-dd-yyyy)
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	12-22-2016	12-22-2017
☐	Receiver	R&S	ESR7	1316.3003K07-101181-K3	12-22-2016	12-22-2017
☐	Receiver	R&S	ESIB26	100114	12-22-2016	12-22-2017
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	12-22-2016	12-22-2017
☐	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	12-22-2016	12-22-2017
☐	EXG-B RF Analog Signal Generator	KEYSIGHT	N5171B	MY53051777	01-09-2016	01-08-2018
☐	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	01-08-2016	01-07-2018
☐	4ch. Simultaneous Sampling 14 Bits 2MS/s	KEYSIGHT	U2531A	TW55193502	11-09-2015	11-08-2017
☐	Universal Radio Communication Tester	R&S	CMU200	114713	12-22-2016	12-22-2017
☐	Band rejection filter (5150MHz~5880MHz)	micro-tronics	BRM50716	G1868	06-15-2016	06-14-2017

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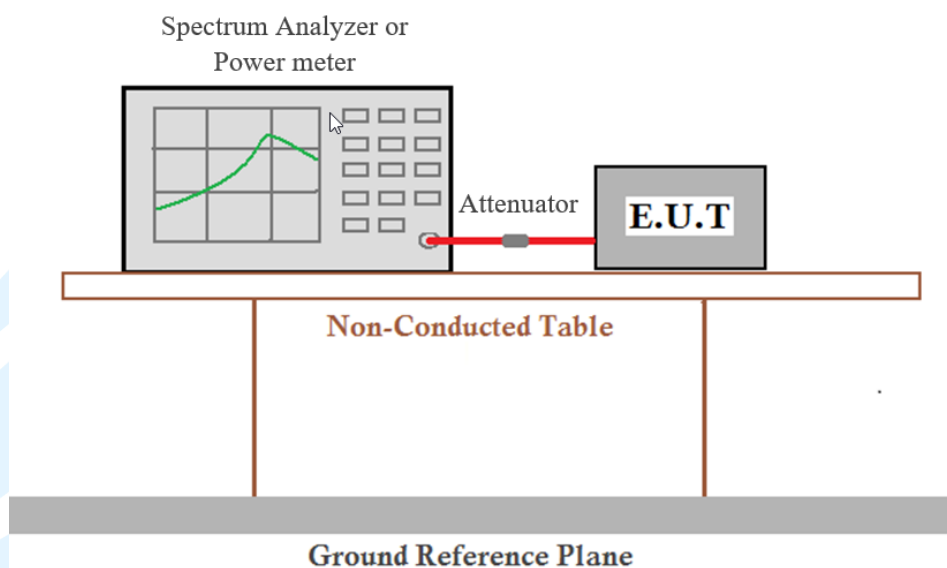
☐	Band rejection filter (2400MHz~2500MHz)	micro-tronics	BRM5070 2	G248	06-21-2016	06-20-2017
☐	DC Source	KIKUSUI	PWR400L	LK003024	09-21-2016	09-20-2017
☐	Temp & Humidity chamber	Ispec	GL(U)04K A(W)	1692H201P3	09-21-2016	09-20-2017



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:

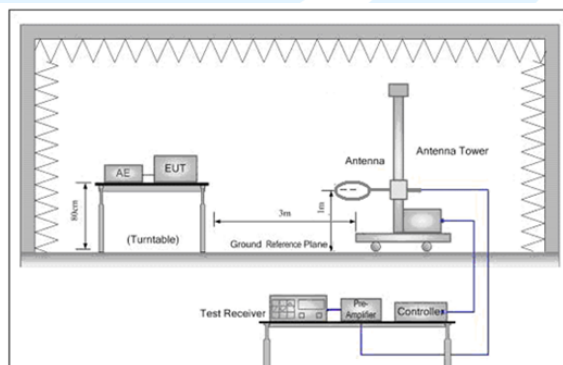


Figure 1. Below 30MHz

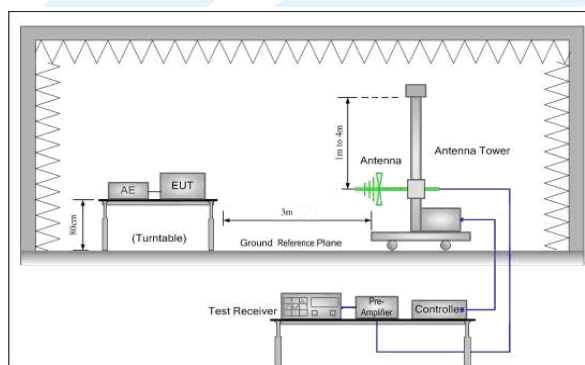


Figure 2. 30MHz to 1GHz

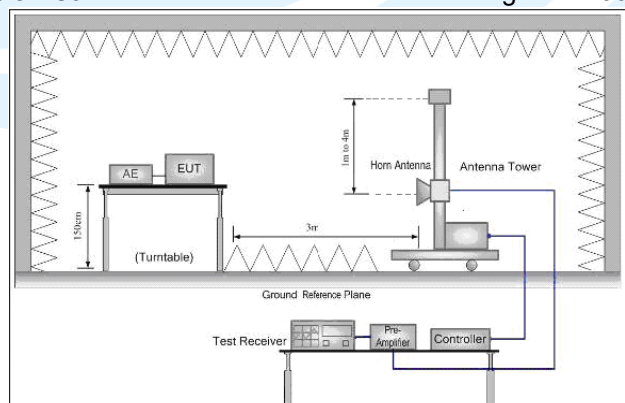
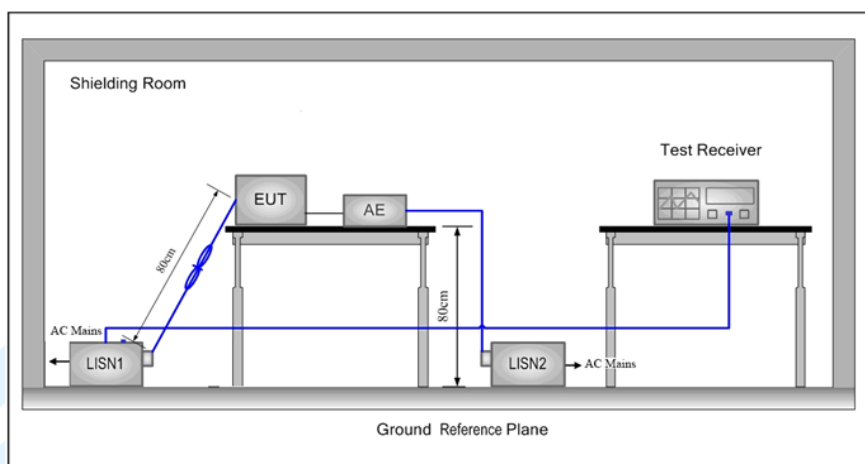


Figure 3. Above 1GHz

4.1.3 For Conducted Emissions test setup

Conducted Emissions setup



4.2 Test Environment

Operating Environment:	
Temperature:	24.6 °C
Humidity:	47 % RH
Atmospheric Pressure:	100.25 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 DC5V from a USB-to-Serial Adapter. 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
Below 1GHz	1TX	Chain 1	X-Portrait
Above 1GHz	1TX	Chain 1	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.

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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	RF Channel		
	Low(L)	Middle(M)	High(H)
802.11b/g/n(HT20)	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 1 802.11b								
Data Rate (Mbps)	1	2		5.5			11	
1(2412)	14.36	14.32		14.33			14.29	
Chain 1 802.11g								
Data Rate (Mbps)	6	9	12	18	24	36	48	54
1(2412)	13.45	13.41	13.37	13.36	13.33	13.29	13.41	13.43
Chain 1 802.11n(HT20)								
Data Rate (Mbps)	MCS 0	MCS 1	MCS 2	MCS 3	MCS 4	MCS 5	MCS 6	MCS 7
1(2412)	13.35	13.31	13.28	13.29	13.24	13.16	13.31	13.27

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

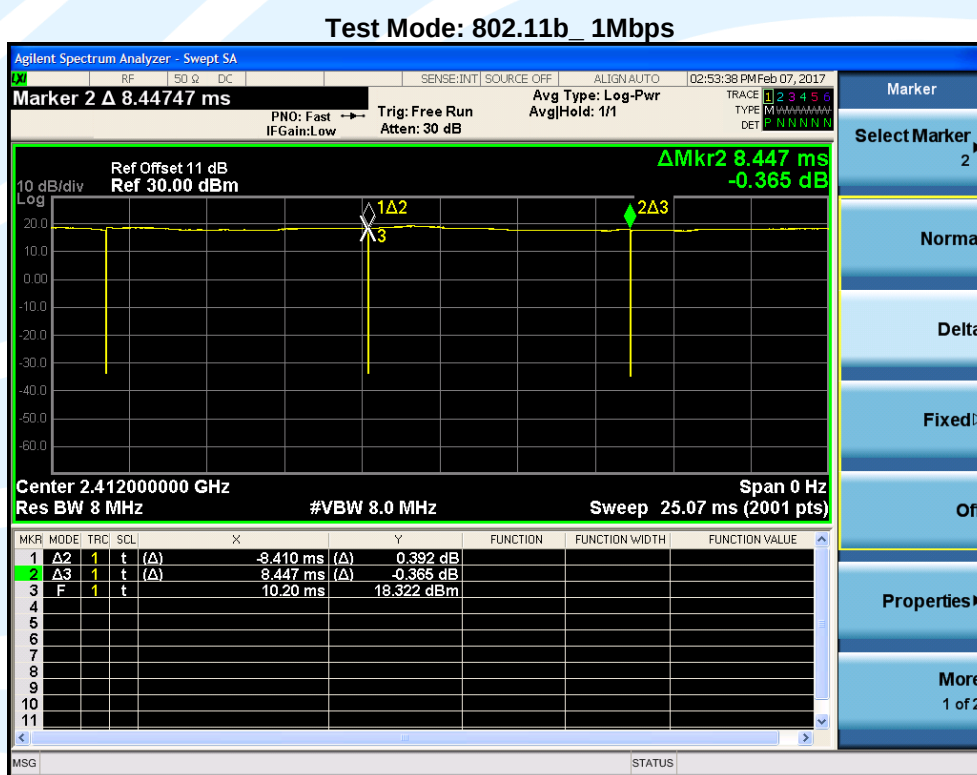
Mode	Worst-case data rates
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS 0(6.5Mbps)

4.4.3 Duty Cycle

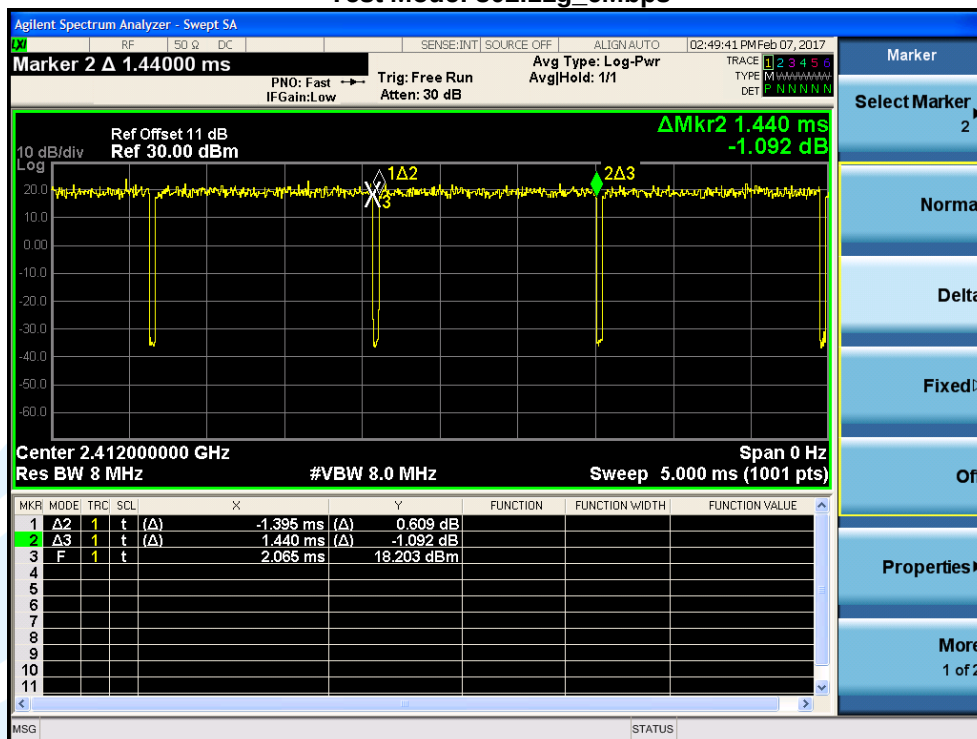
Mode	Data rates (Mbps)	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)
802.11b	1	8.410	8.447	0.9956	99.56	0.019	0.12
802.11g	6	1.395	1.440	0.9688	96.88	0.138	0.72
802.11n(HT20)	6.5	1.310	1.350	0.9704	97.04	0.131	0.76

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

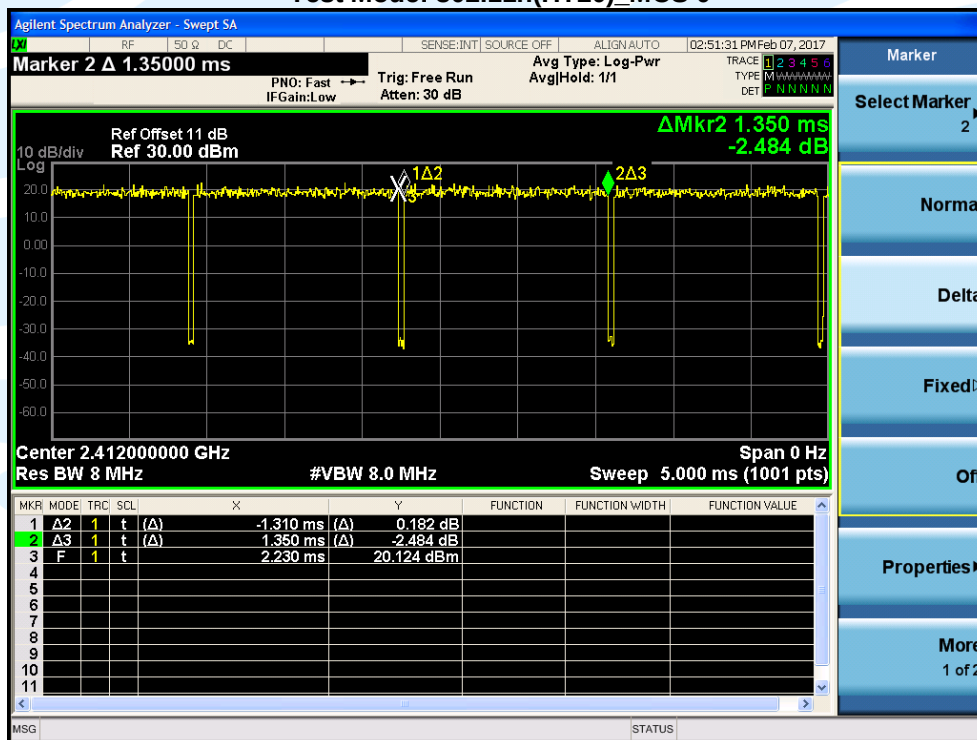
The test plot as follows:



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 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
4	KDB 558074 D01 DTS Meas Guidance v03r05	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

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 3.3 dBi.

5.2 Conducted Peak Output Power

Test Requirement:	47 CFR Part 15 Subpart C Section 15.247 (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:	- The output from the transmitter was connected to an attenuator and then to the input of the power meter. - 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	17.57	14.36	14.379
	6(2437)		17.98	14.81	14.829
	11(2462)		17.91	14.76	14.779
802.11g	1(2412)	6	23.32	13.45	13.588
	6(2437)		23.54	13.67	13.808
	11(2462)		23.73	13.74	13.878
802.11n (HT20)	1(2412)	MCS0	23.21	13.35	13.481
	6(2437)		23.34	13.52	13.651
	11(2462)		23.39	13.58	13.711

Remark:

- 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:

- Set RBW = 100 kHz.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- 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

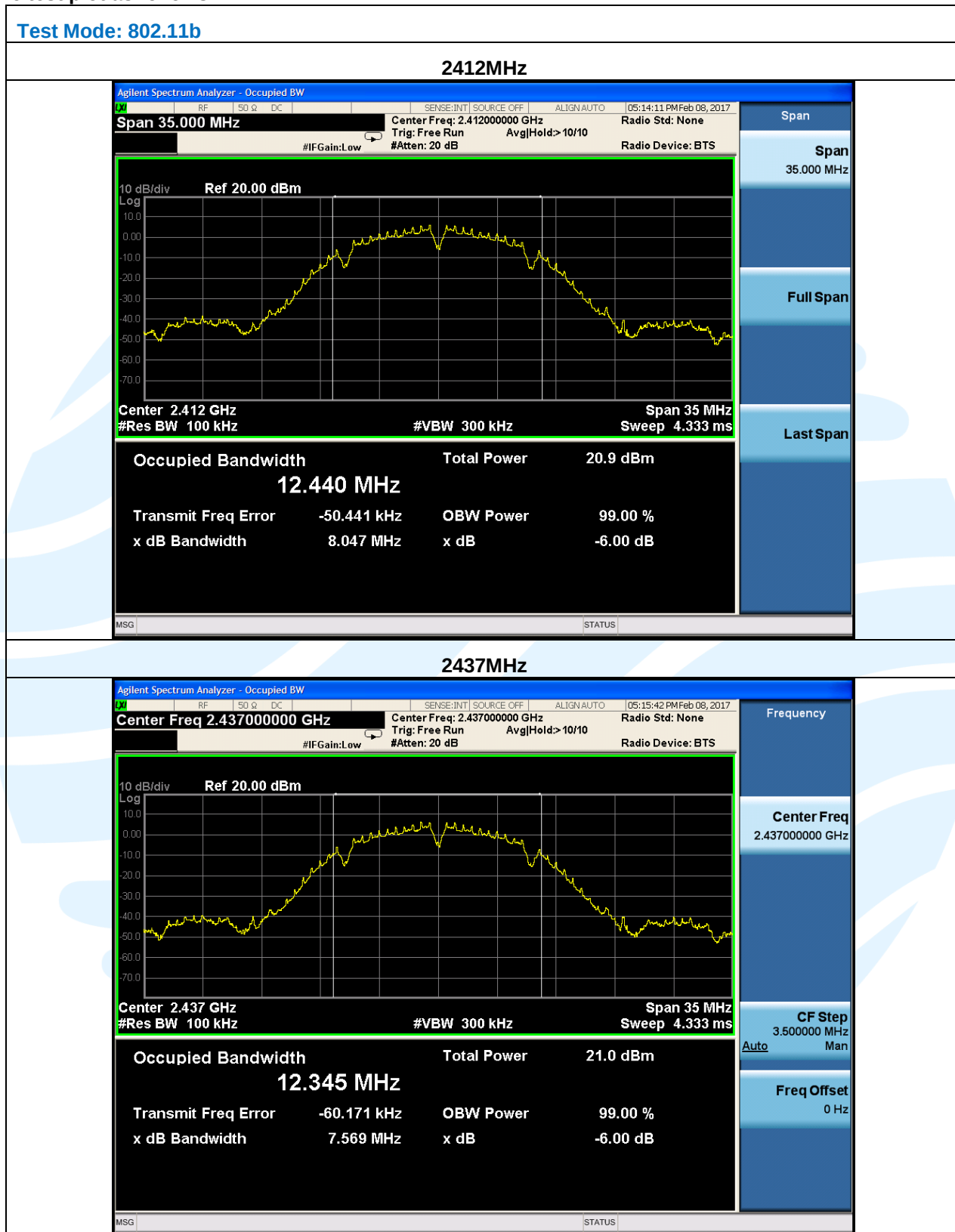
Test Data:

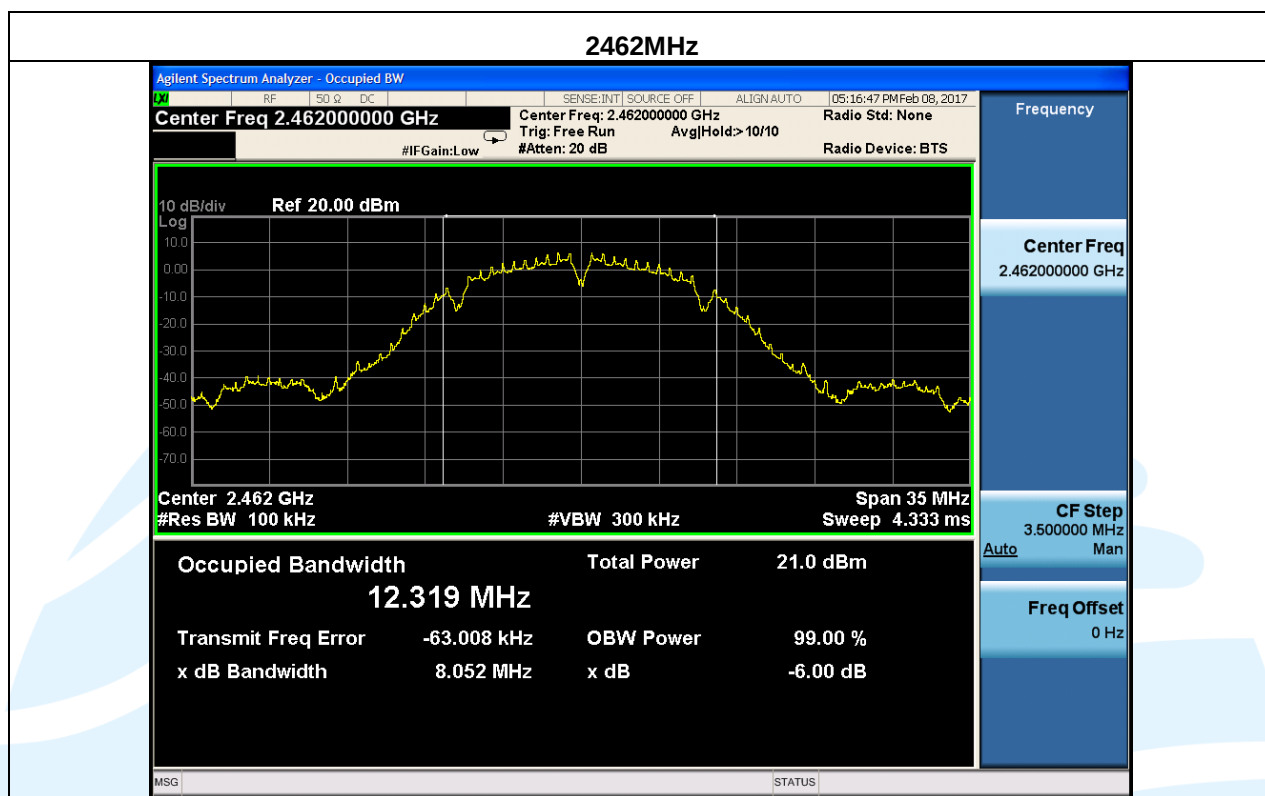
Occupied Bandwidth:

Mode	Channel Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	6 dB Bandwidth Limit	Result (Pass / Fail)
802.11b	1 (2412)	8.047	12.440	> 500 kHz	Pass
	6 (2437)	7.569	12.345	> 500 kHz	Pass
	11 (2462)	8.052	12.319	> 500 kHz	Pass
802.11g	1 (2412)	15.11	16.299	> 500 kHz	Pass
	6 (2437)	15.11	16.294	> 500 kHz	Pass
	11 (2462)	15.11	16.297	> 500 kHz	Pass
802.11n (HT20)	1 (2412)	15.98	17.461	> 500 kHz	Pass
	6 (2437)	15.99	17.473	> 500 kHz	Pass
	11 (2462)	15.96	17.471	> 500 kHz	Pass

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

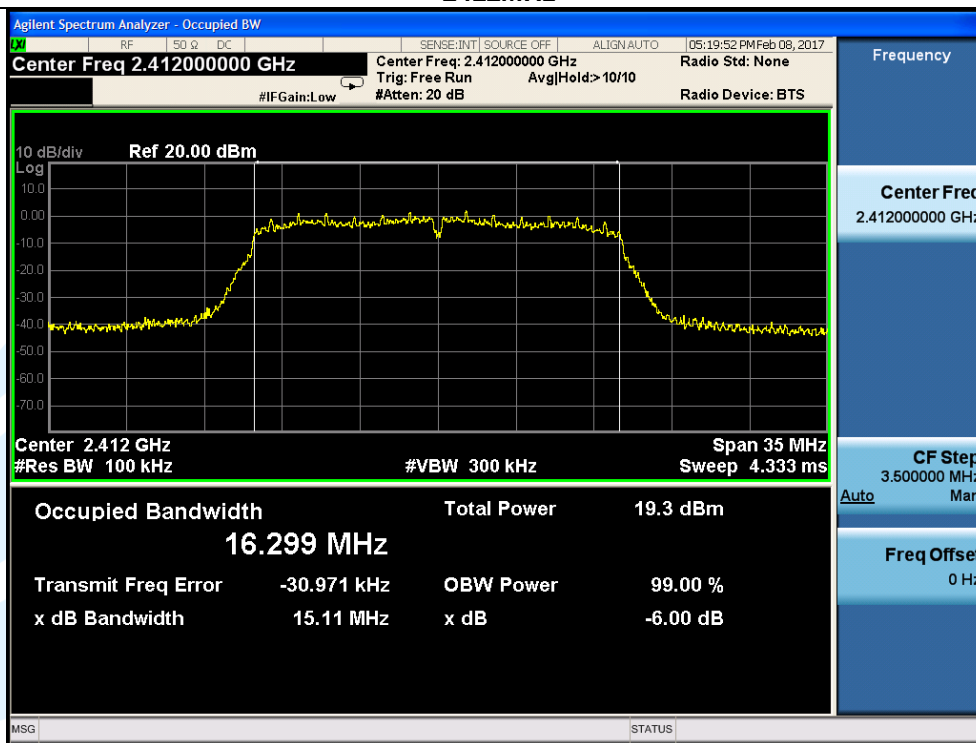
The test plot as follows:



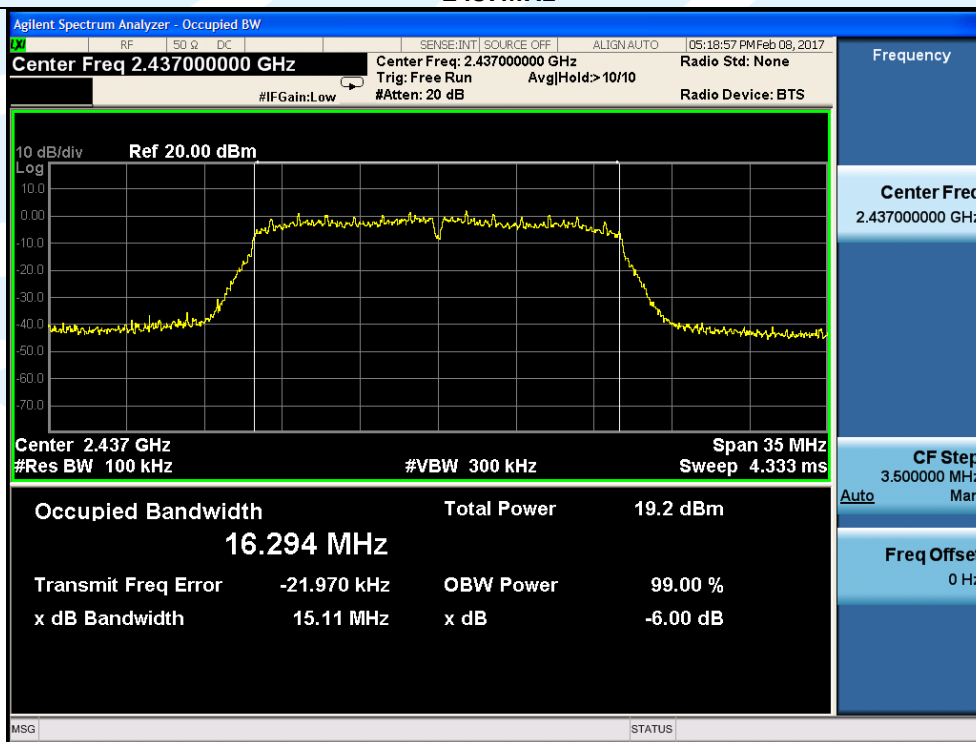


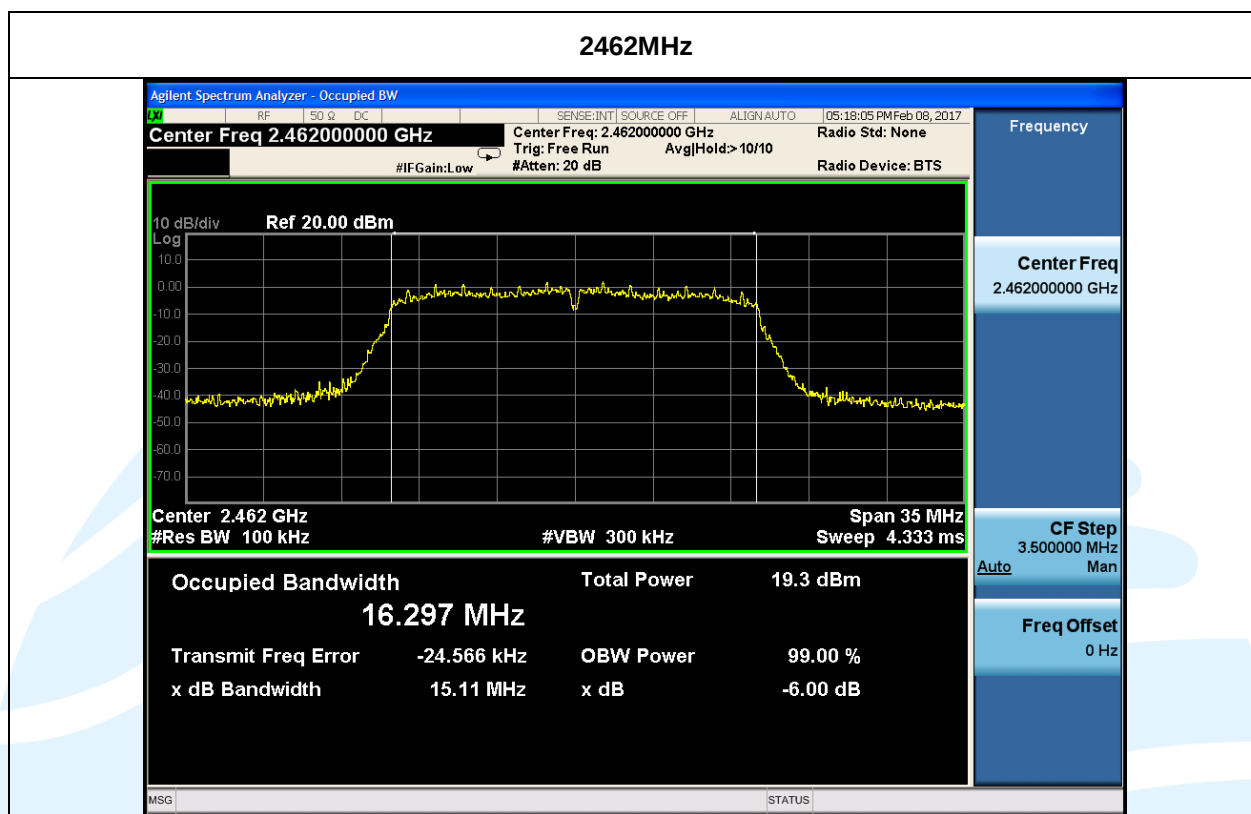
Test Mode: 802.11g

2412MHz



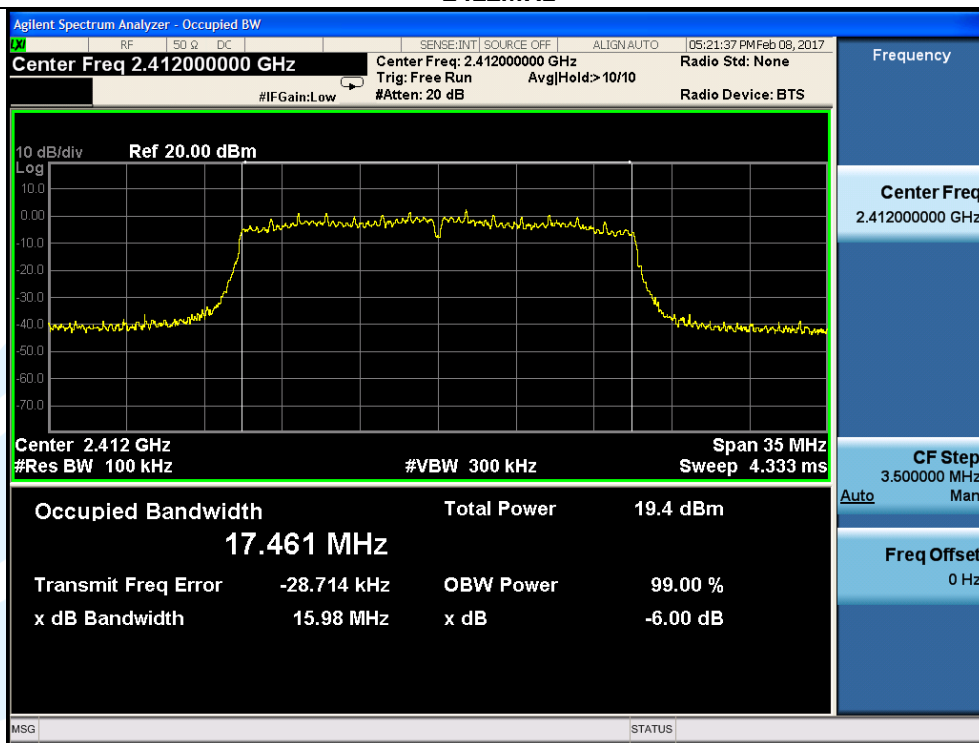
2437MHz



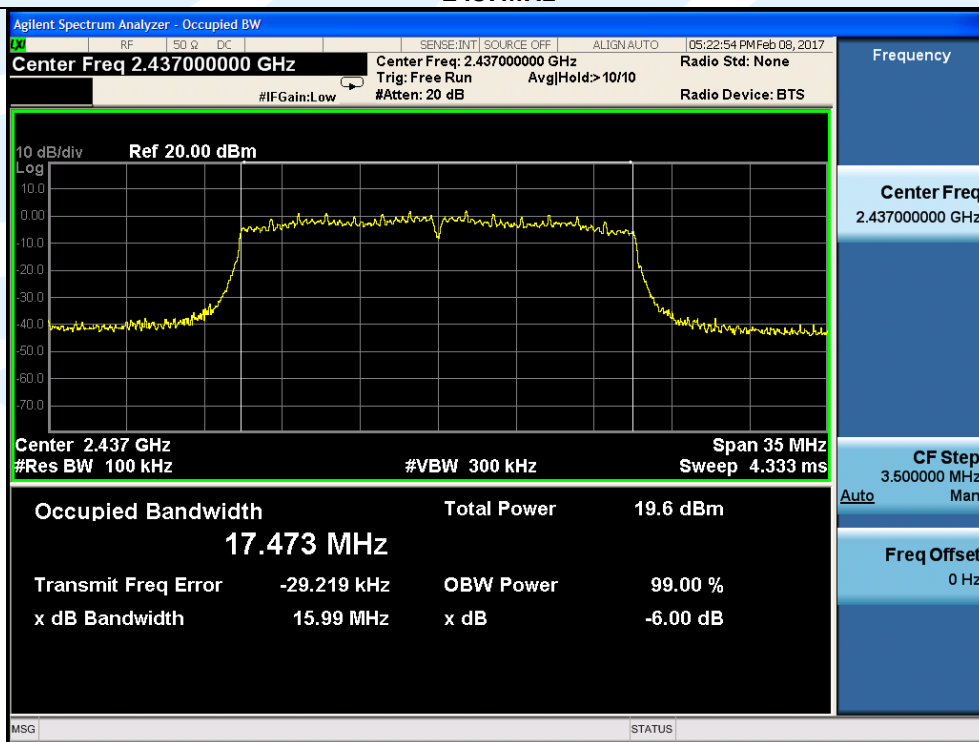


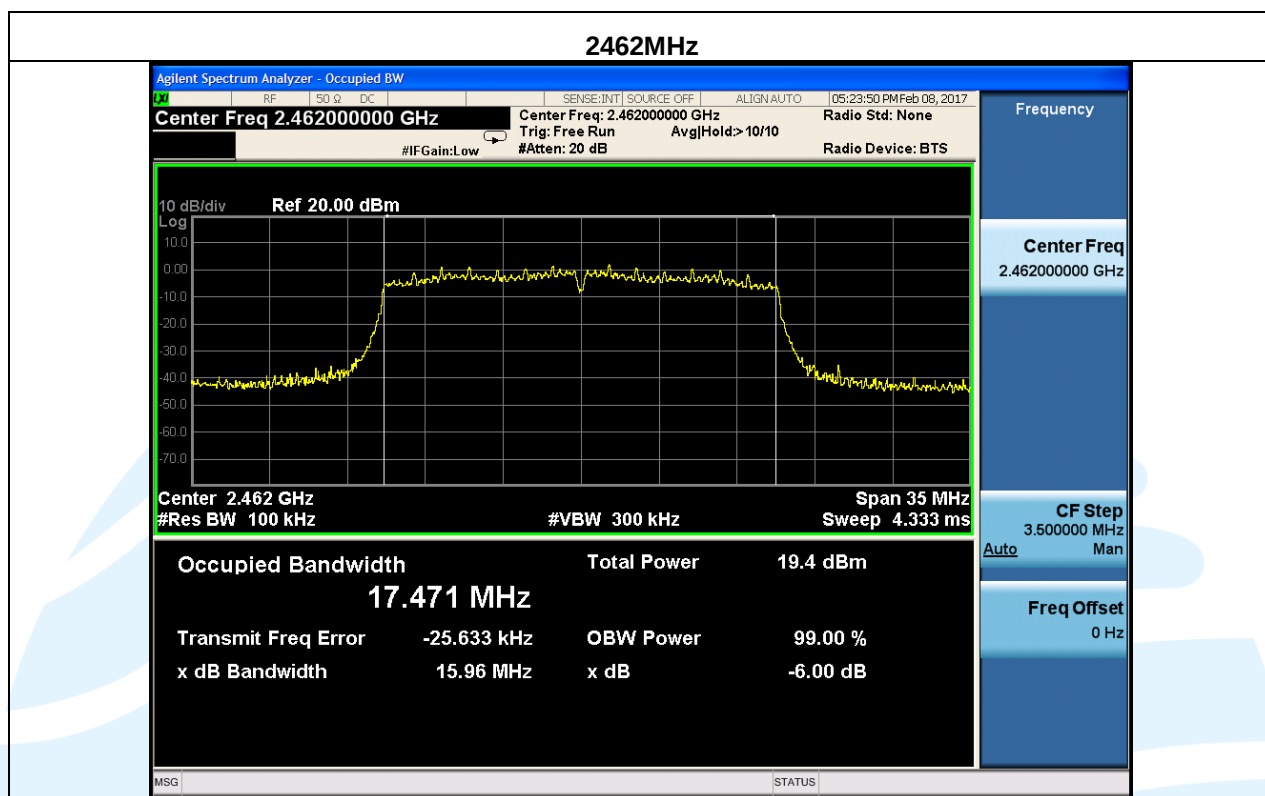
Test Mode: 802.11n(HT20)

2412MHz



2437MHz





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:

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq 3 \times \text{RBW}$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- 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:

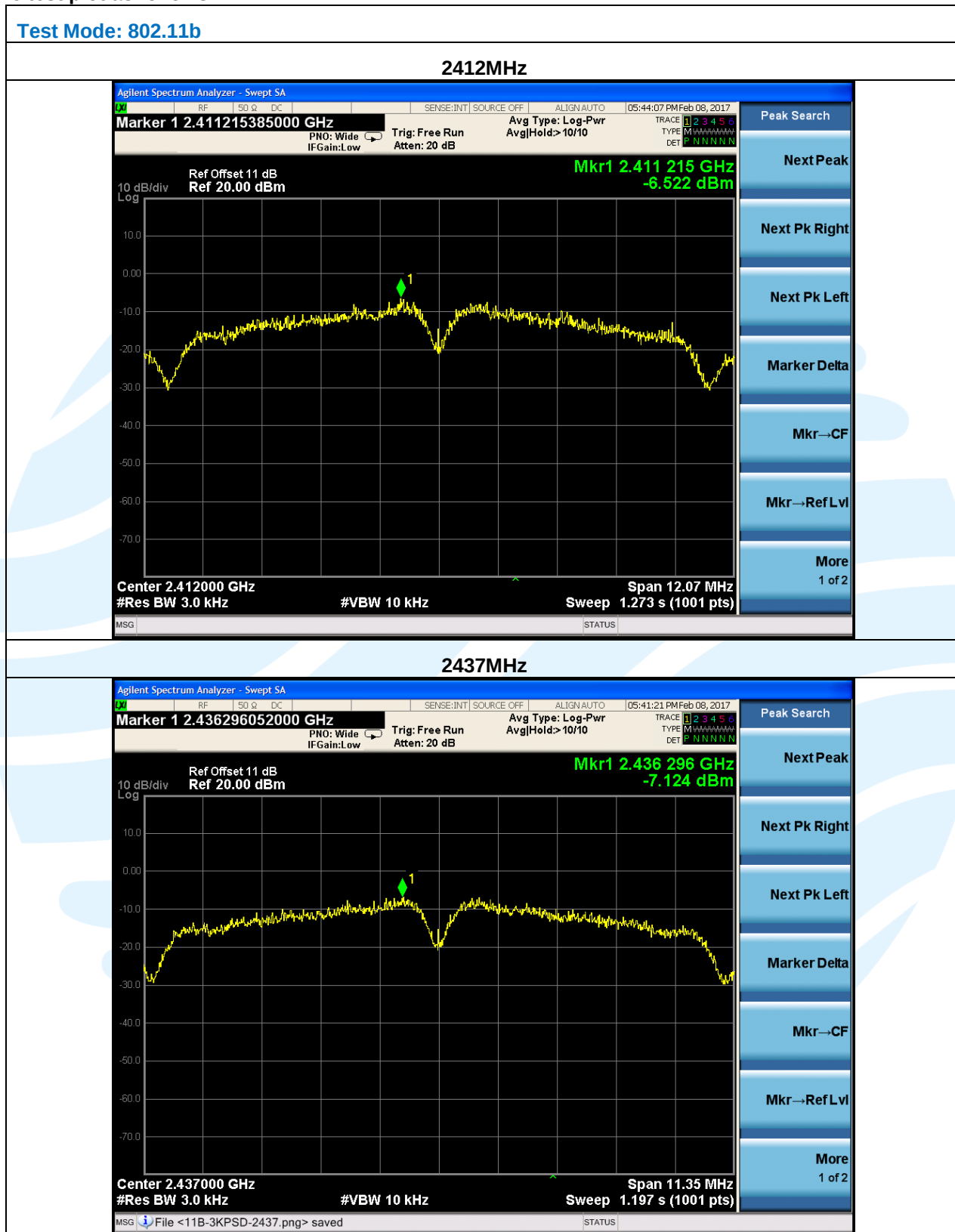
Test Data:

Mode	Channel/ Frequency (MHz)	PSD (dBm)	PSD Limit (dBm)	Result (Pass / Fail)
802.11b	1 (2412)	-6.522	8	Pass
	6 (2437)	-7.124	8	Pass
	11 (2462)	-6.545	8	Pass
802.11g	1 (2412)	-11.014	8	Pass
	6 (2437)	-11.040	8	Pass
	11 (2462)	-10.687	8	Pass
802.11n (HT20)	1 (2412)	-11.146	8	Pass
	6 (2437)	-11.113	8	Pass
	11 (2462)	-10.337	8	Pass

Remark:

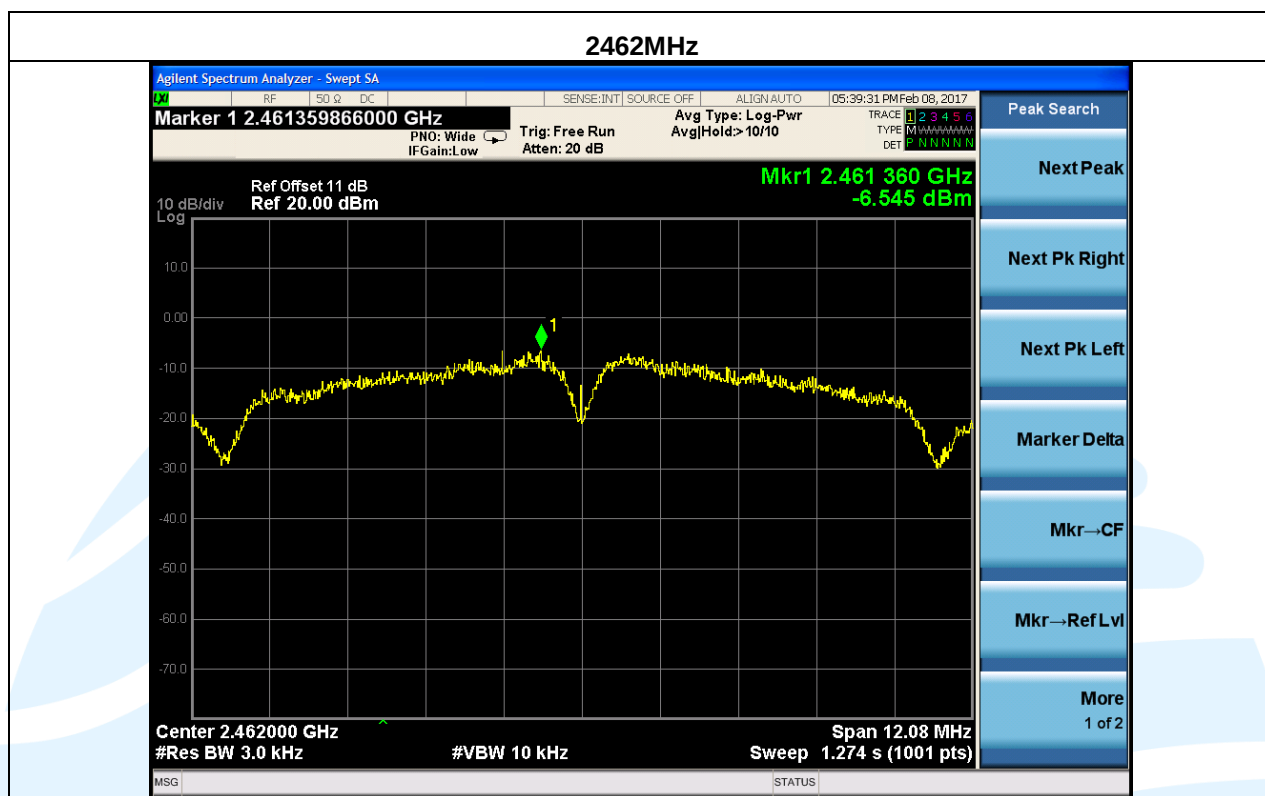
- All the data attached was use the worst case data rate.

The test plot as follows:



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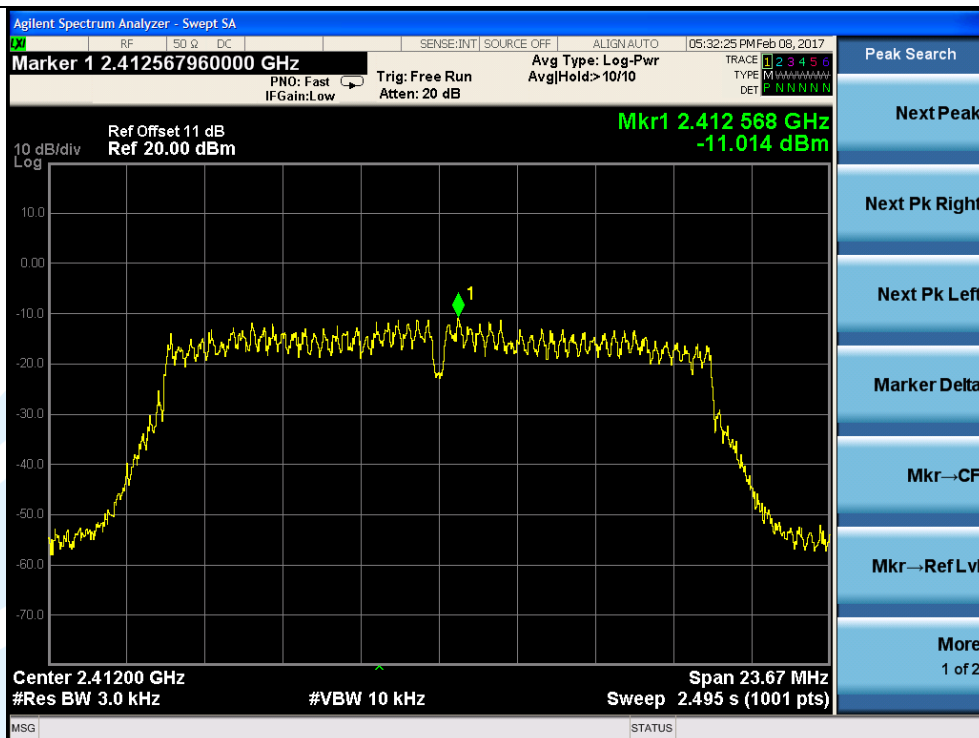


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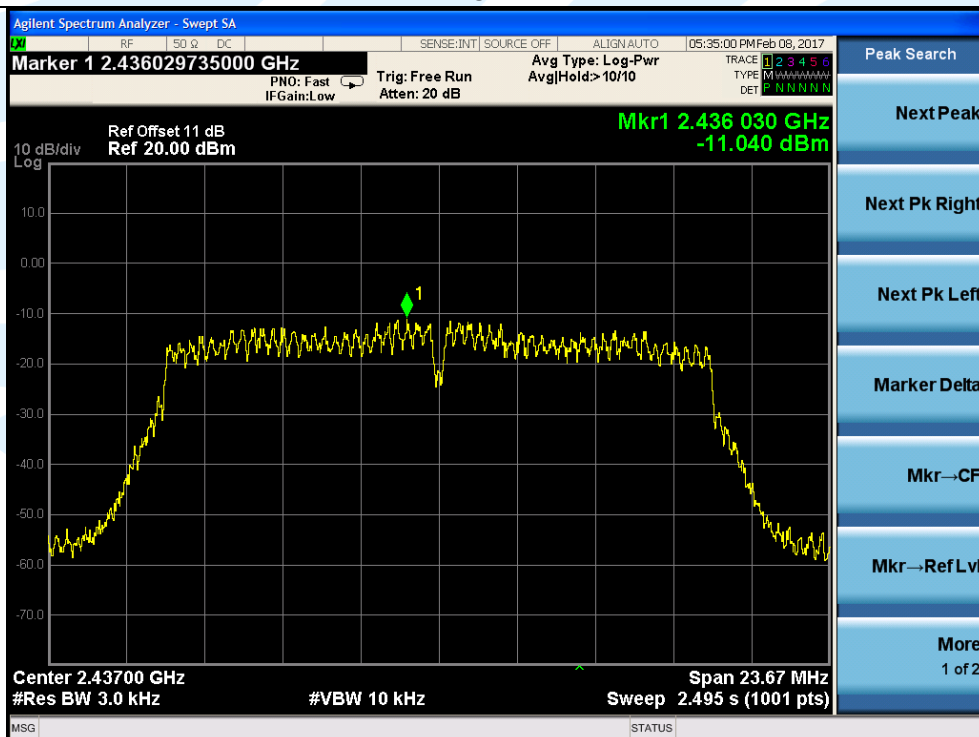
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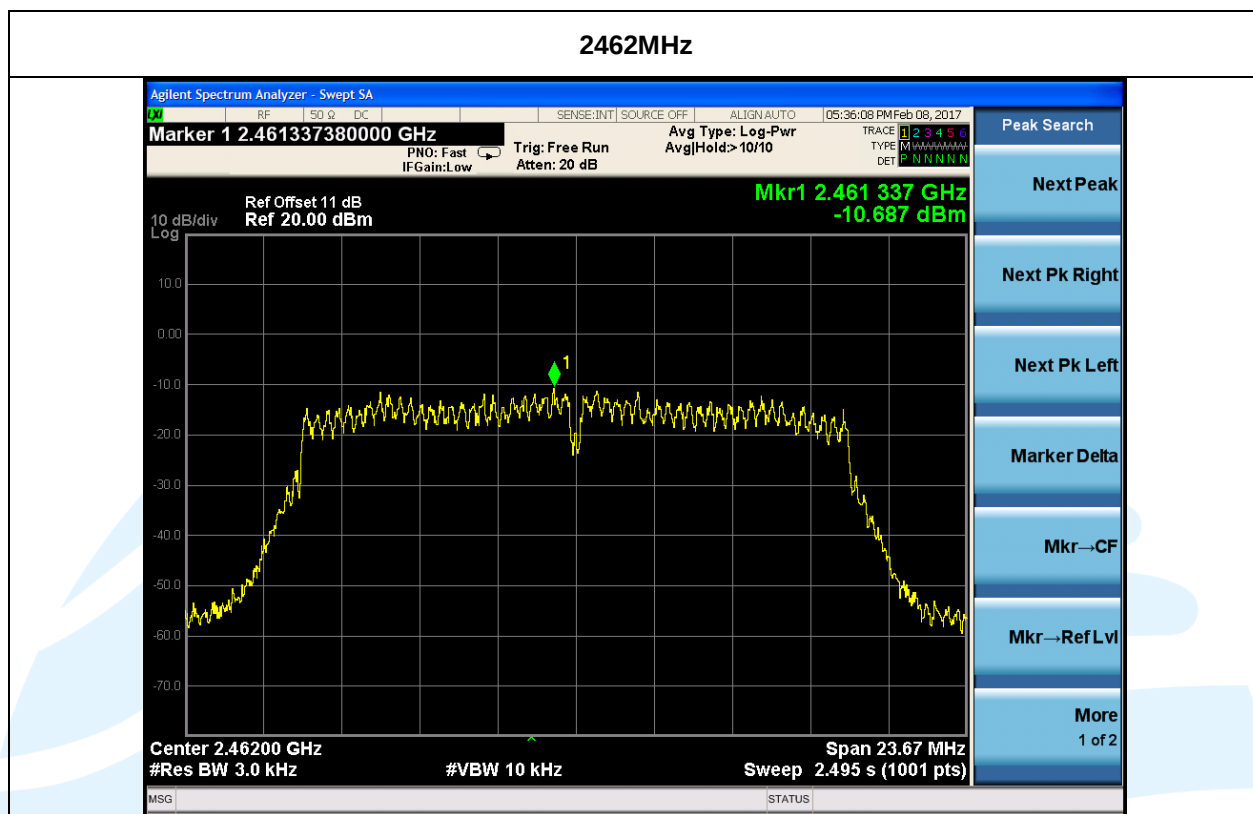
Test Mode: 802.11g

2412MHz



2437MHz



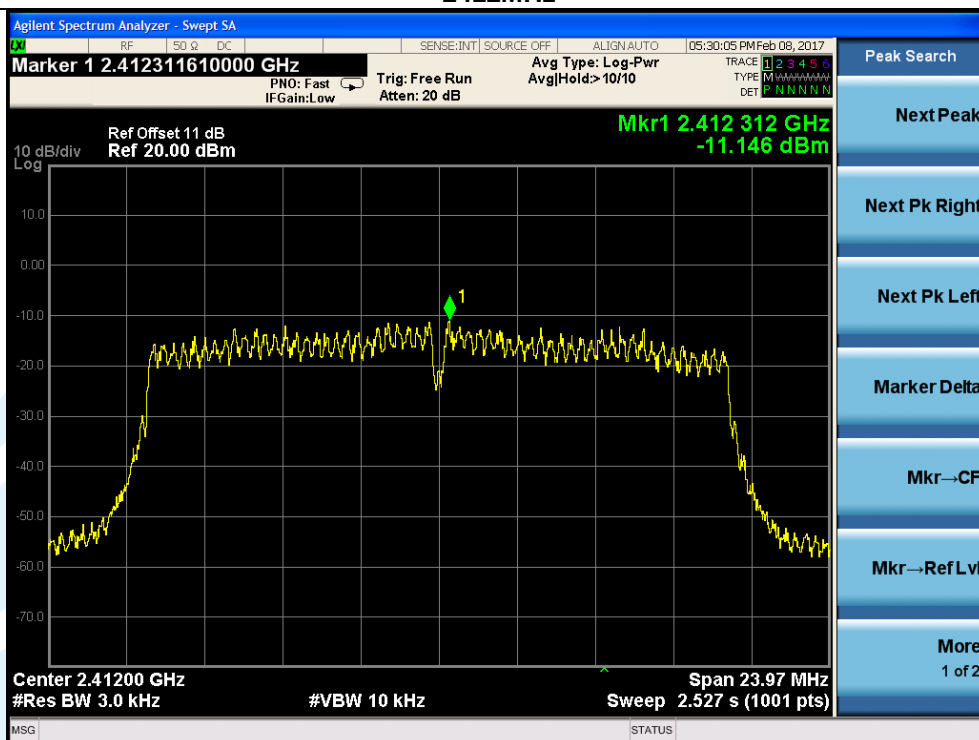


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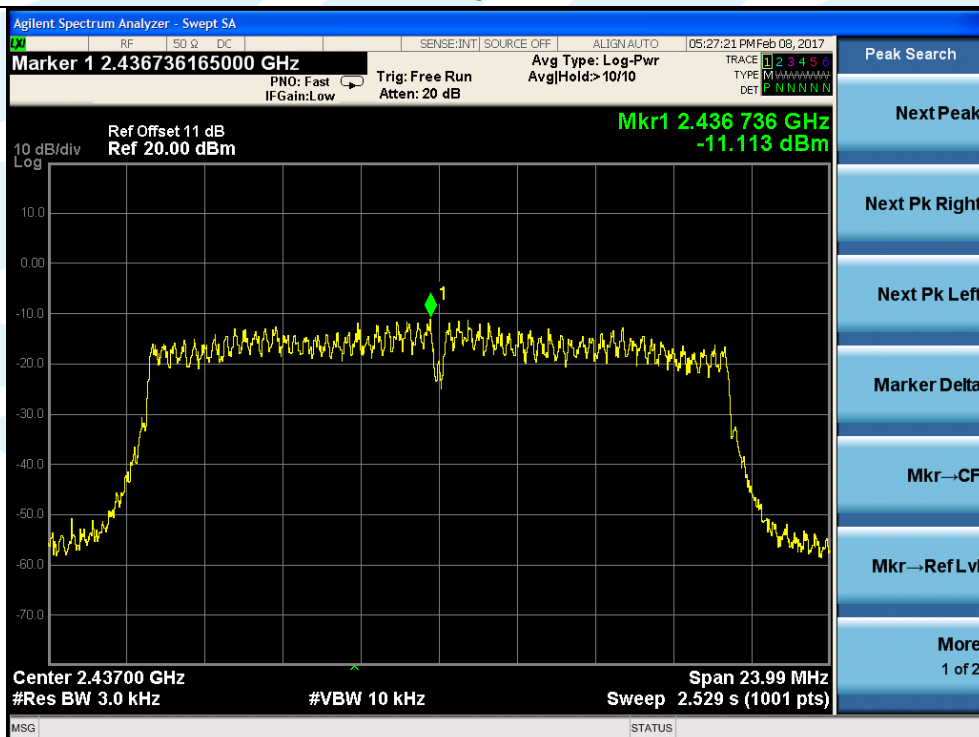
Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China
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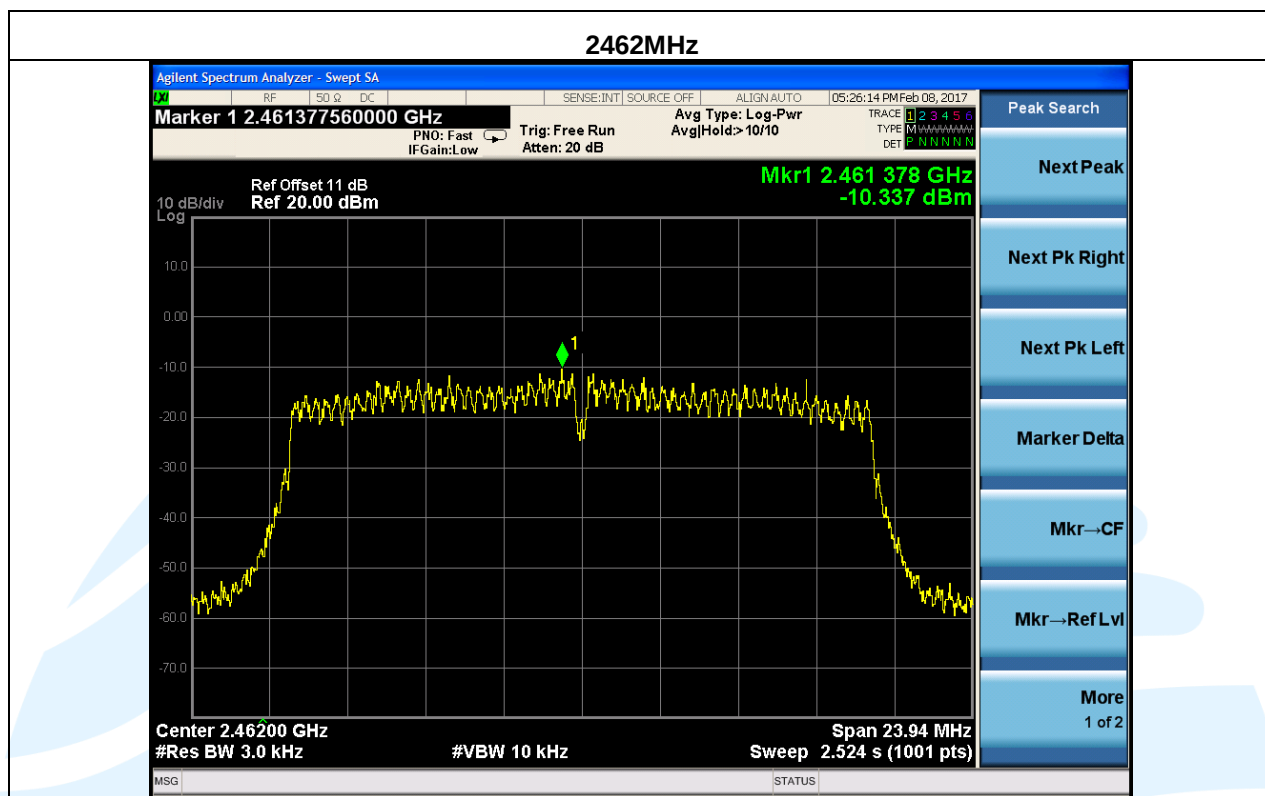
Test Mode: 802.11n(HT20)

2412MHz



2437MHz





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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 is 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

- Set instrument center frequency to DTS channel center frequency.
- Set the span to ≥ 1.5 times the DTS bandwidth.
- Set the RBW = 100 kHz.
- Set the VBW $\geq 3 \times$ RBW.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum PSD level.
- Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Step 2: Measurement Procedure OOB

- Set RBW = 100 kHz.
- Set VBW ≥ 300 kHz.
- Detector = peak.
- Sweep = auto couple.
- Trace Mode = max hold.
- Allow trace to fully stabilize.
- 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

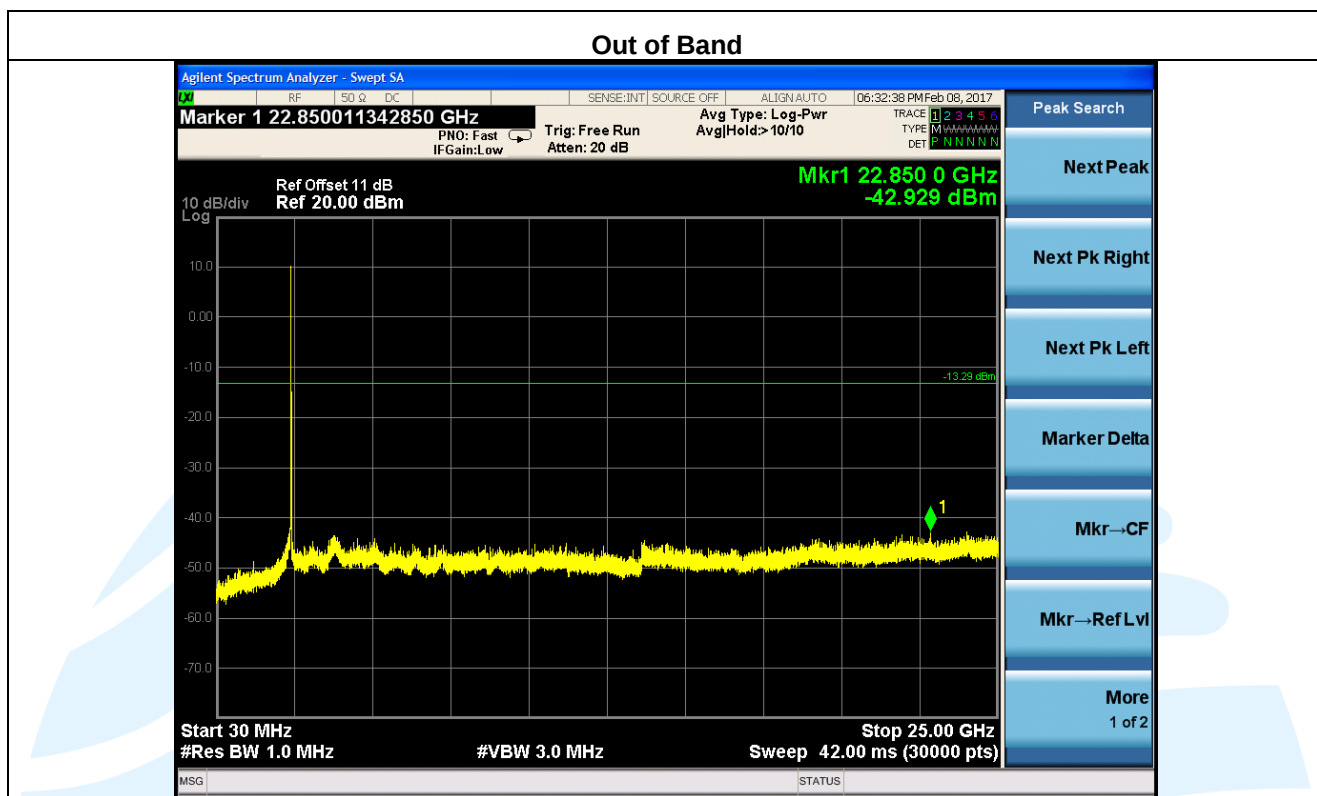
2412MHz

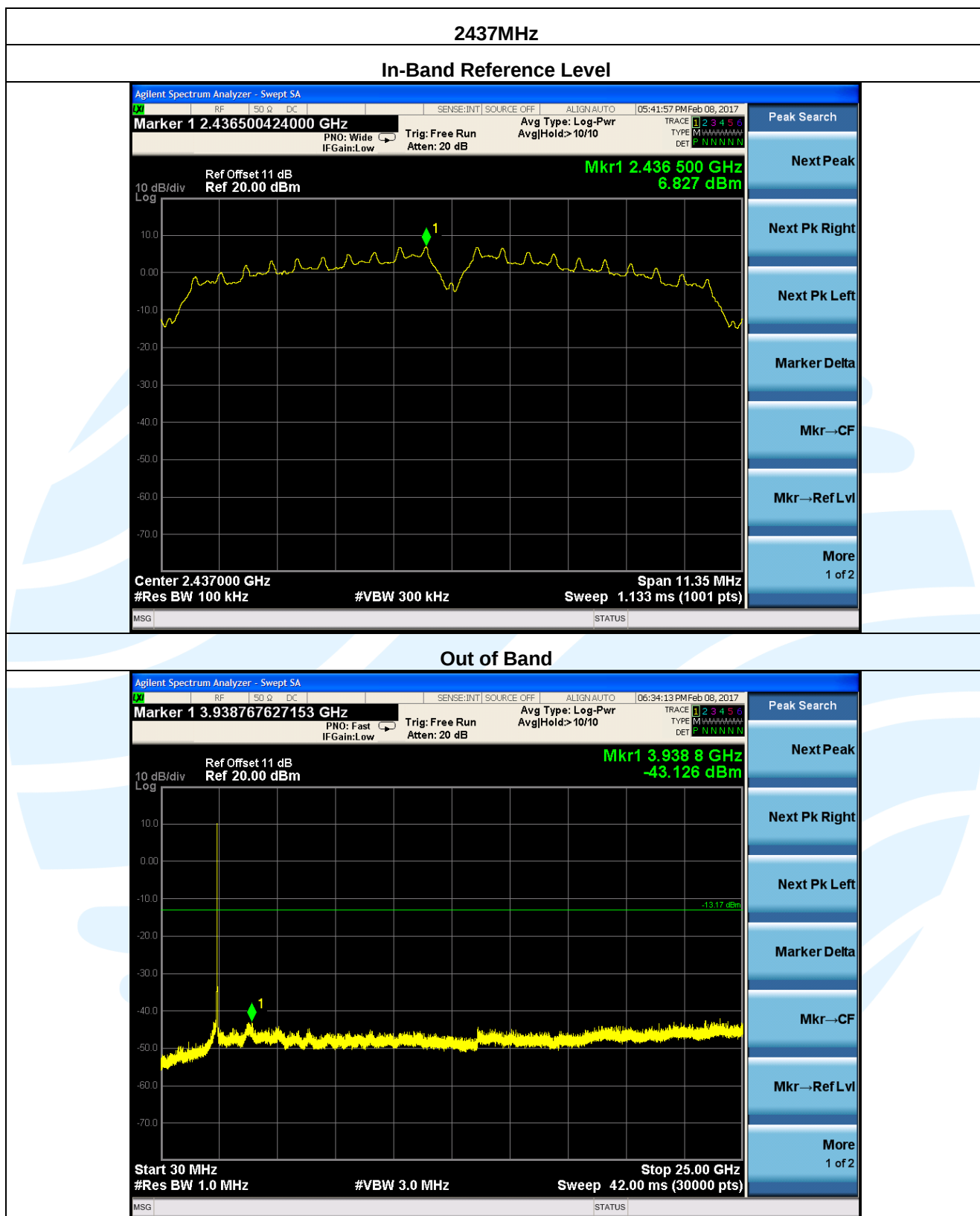
In-Band Reference Level

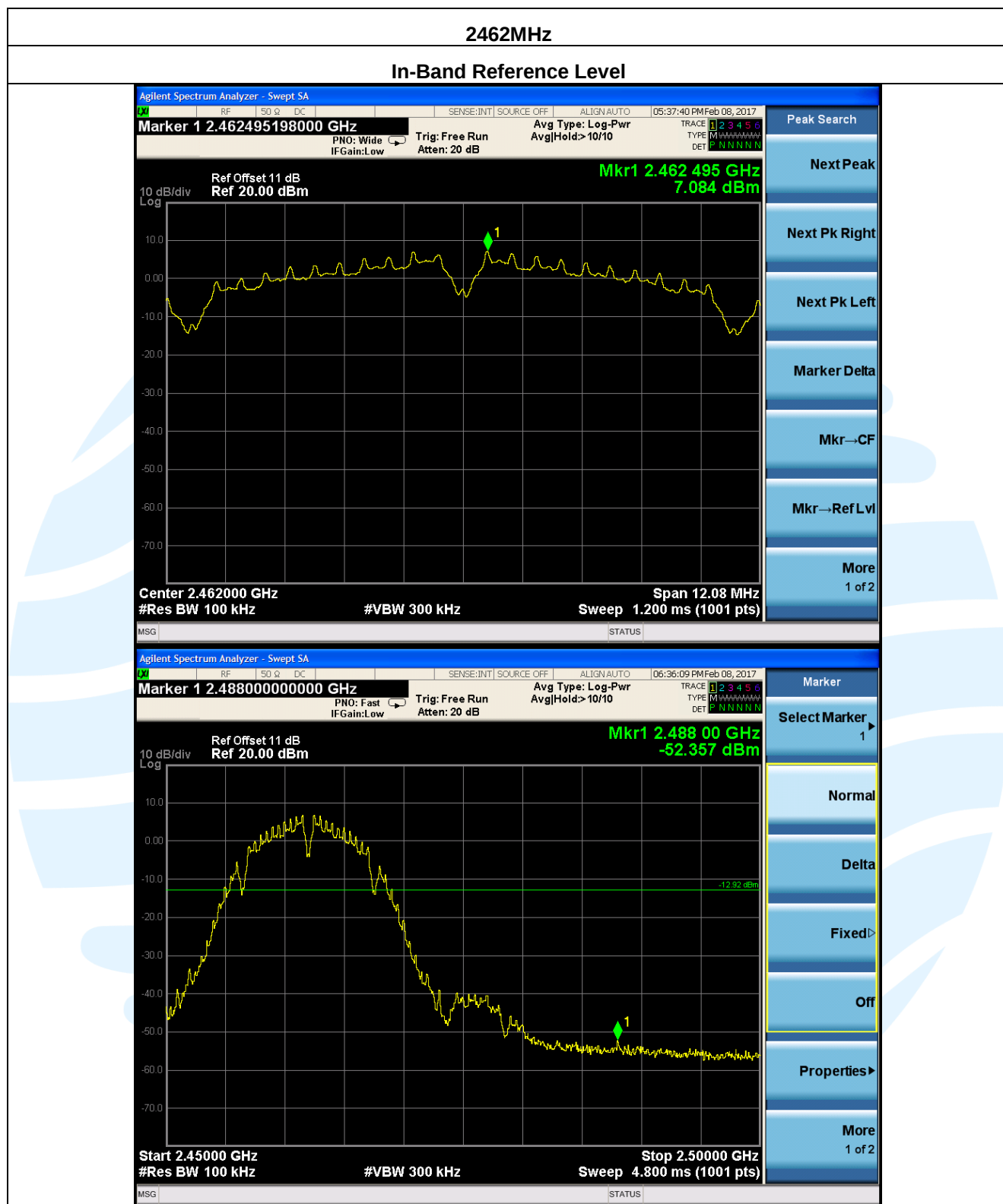


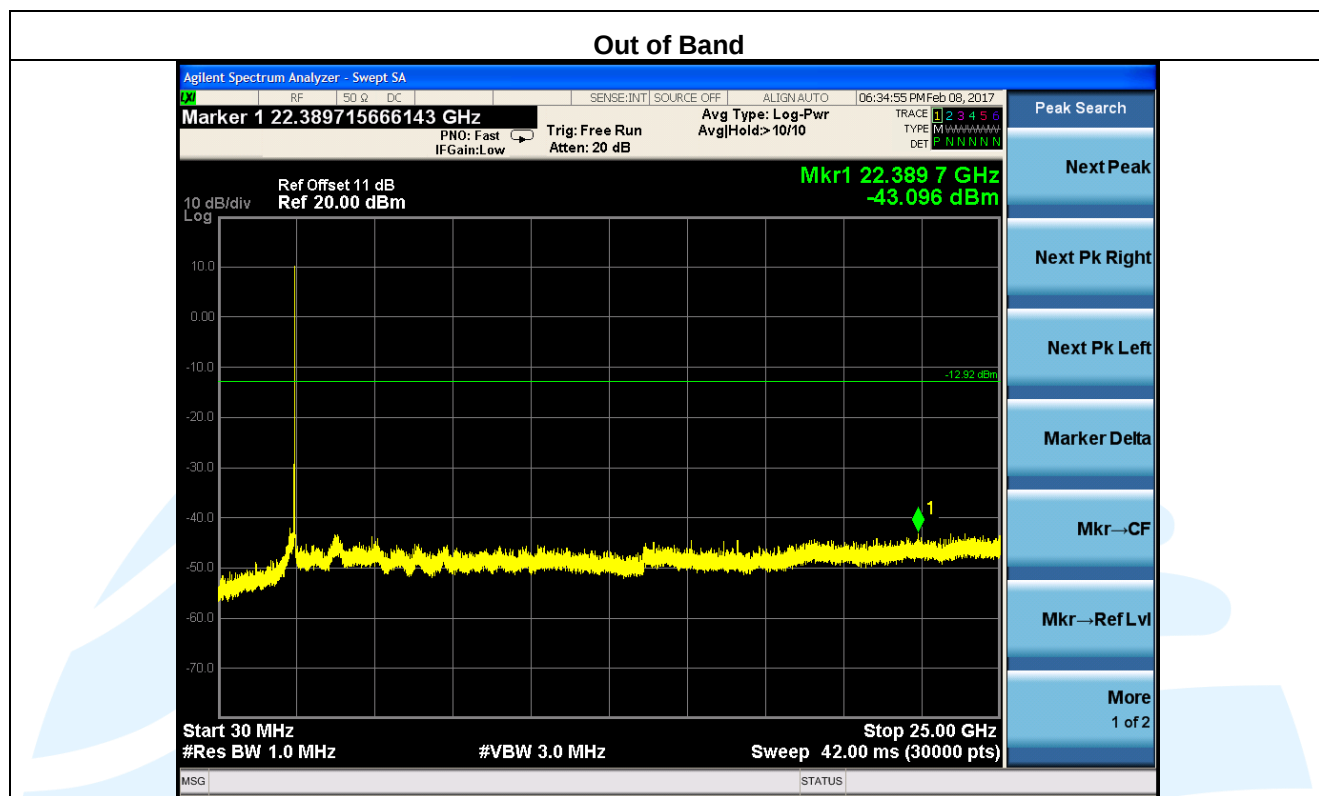
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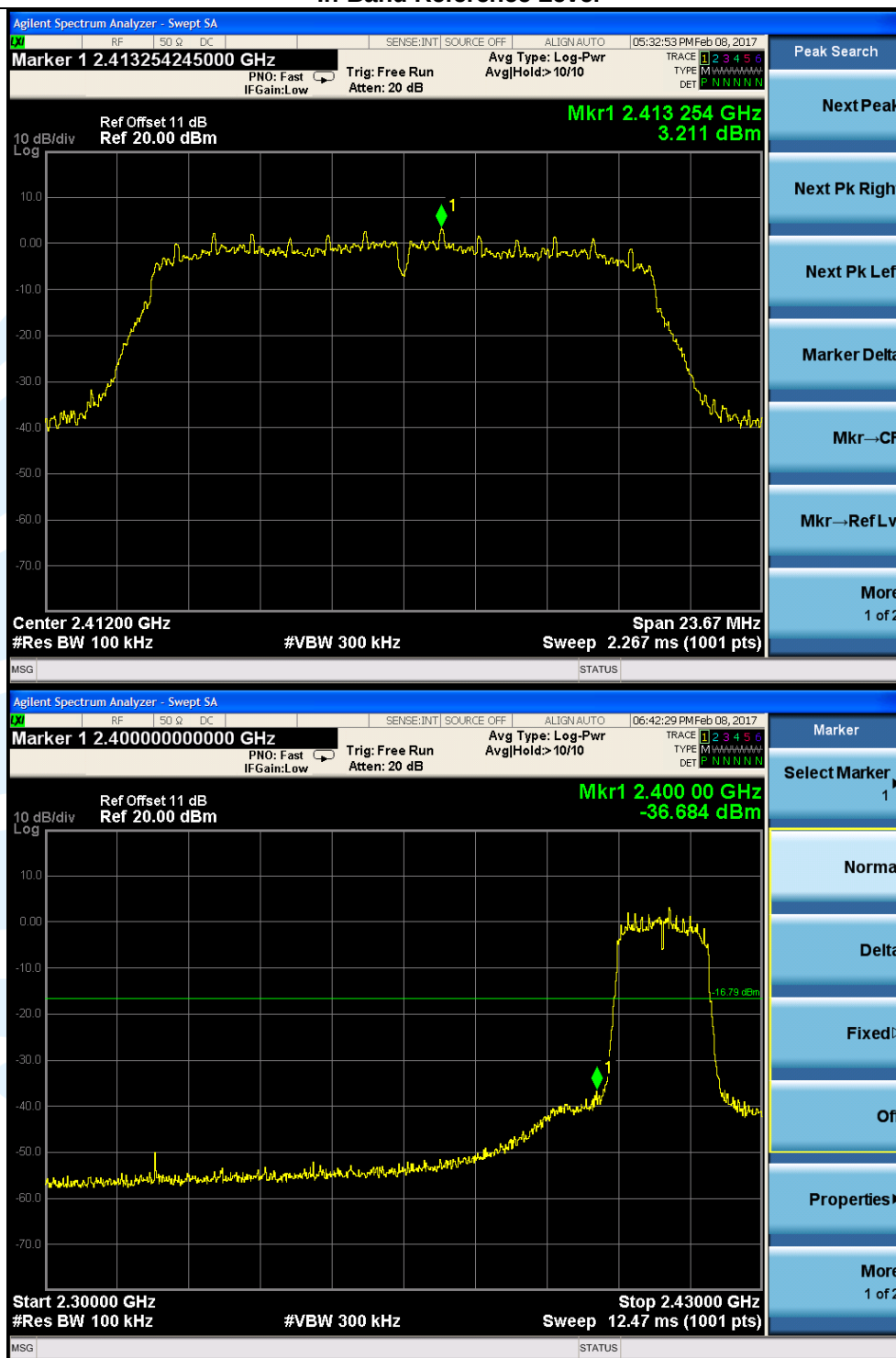




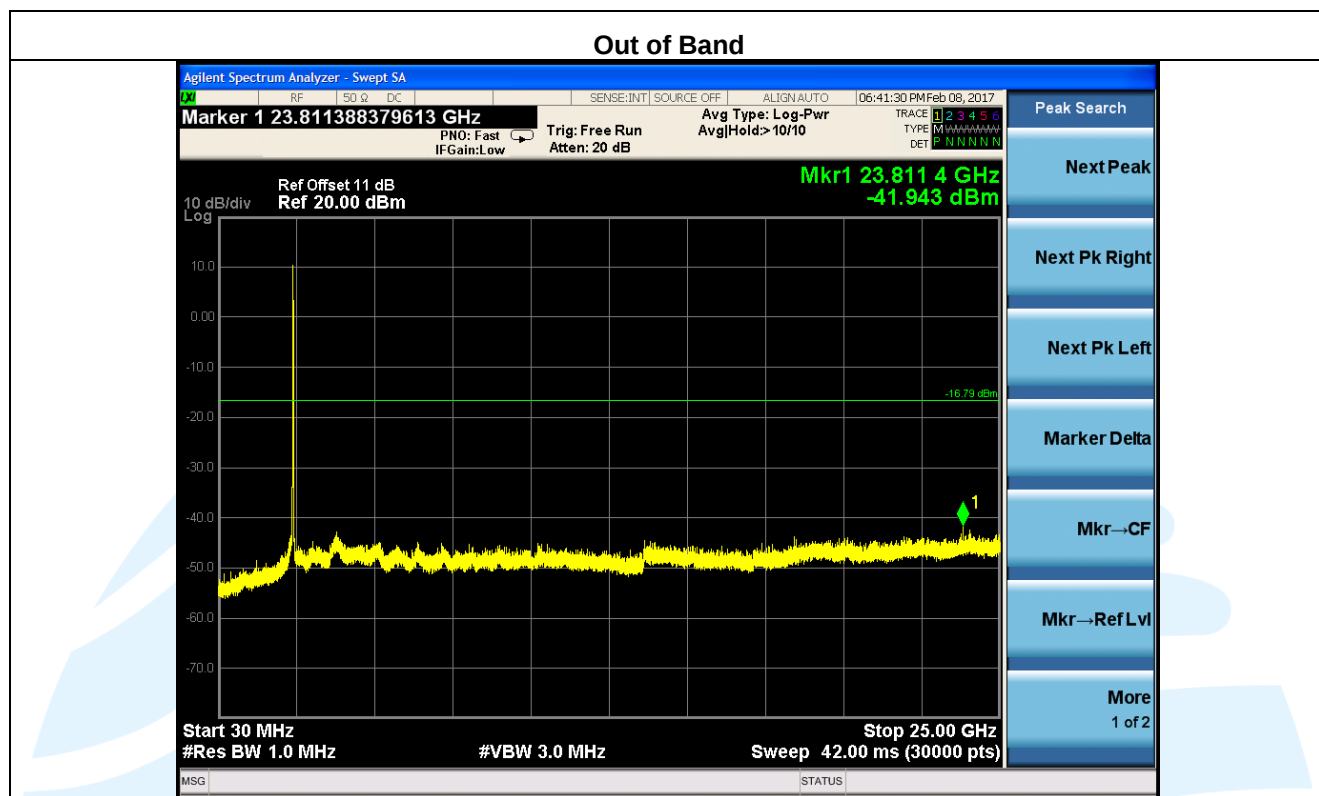
Test Mode: 802.11g

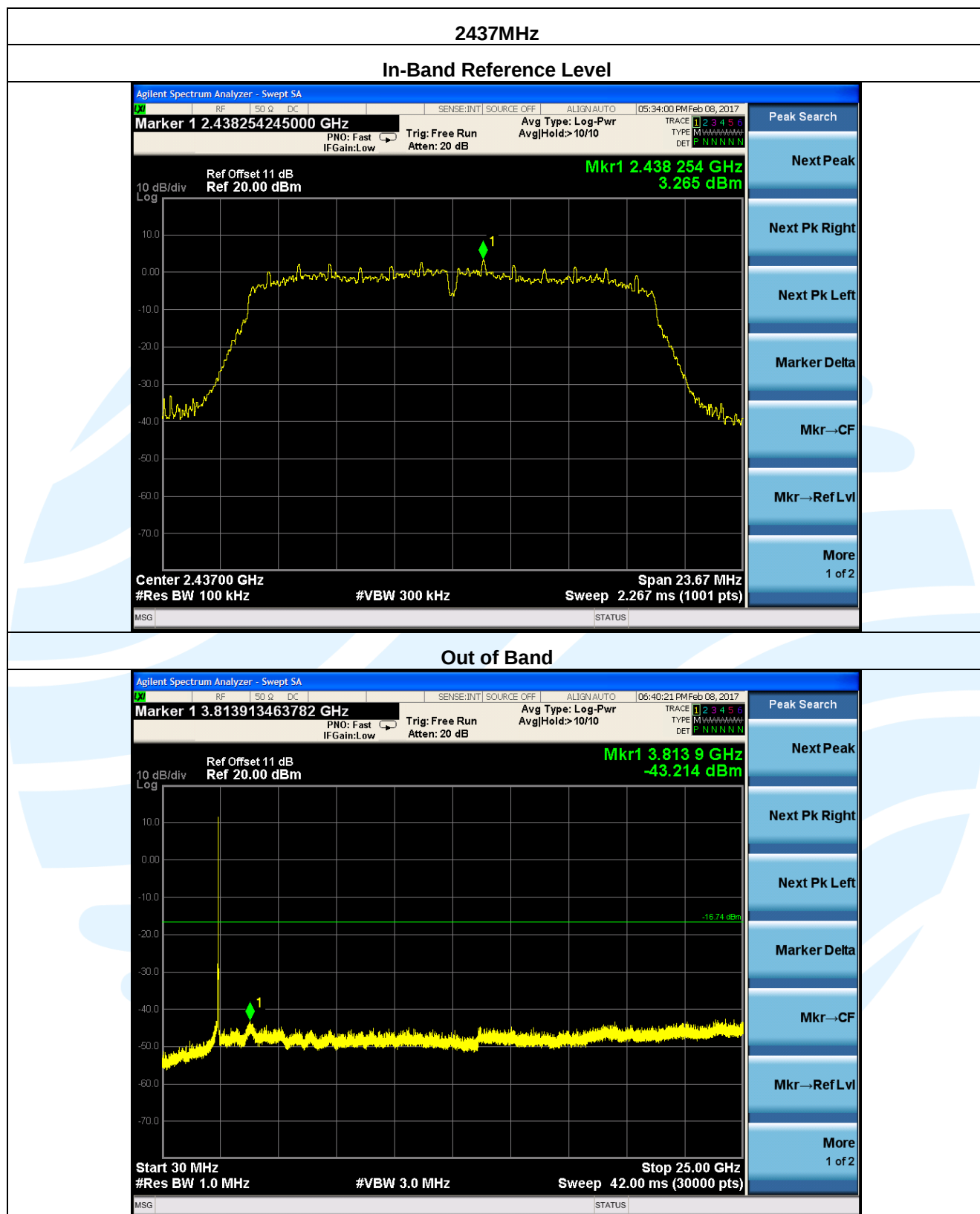
2412MHz

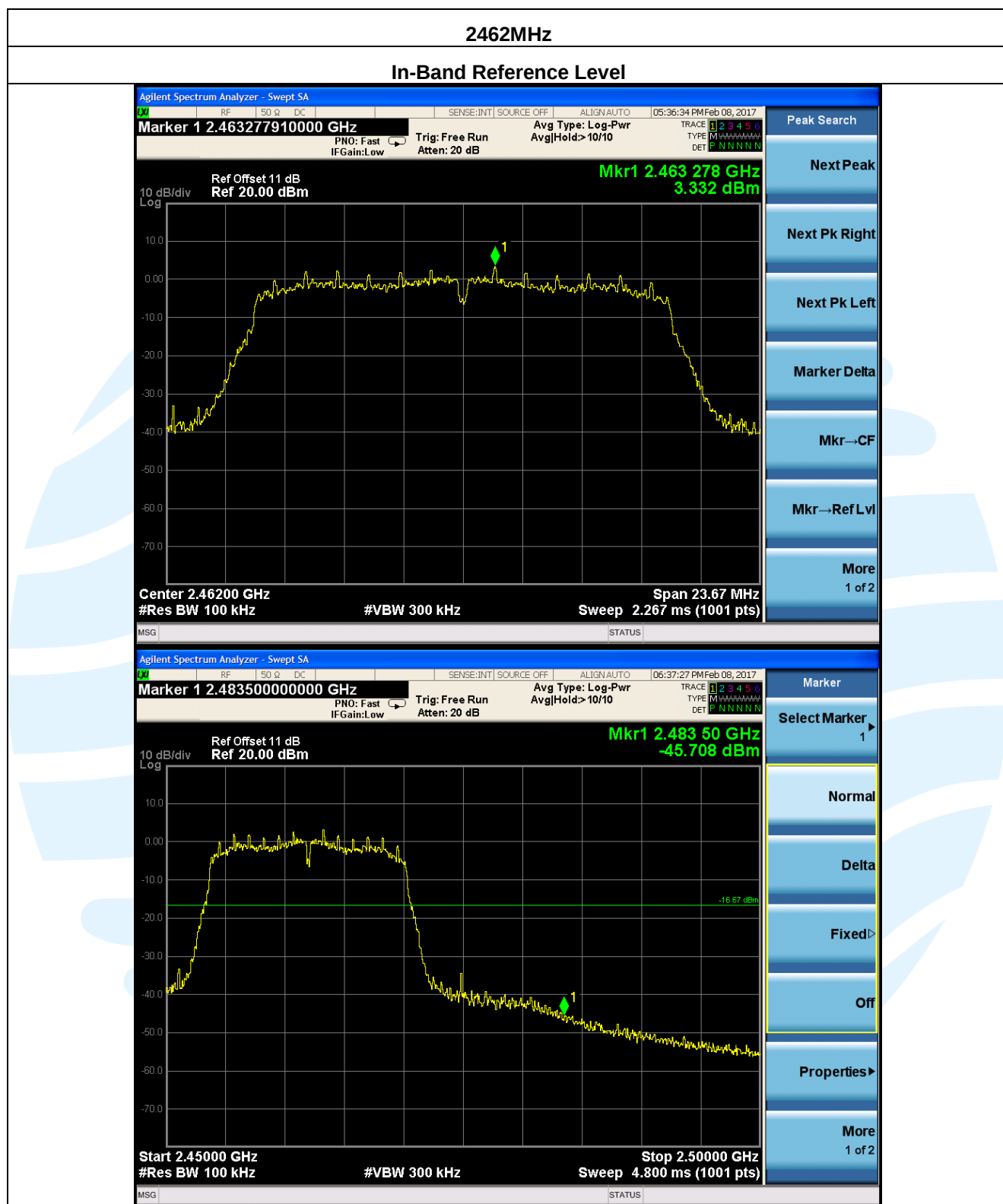
In-Band Reference Level

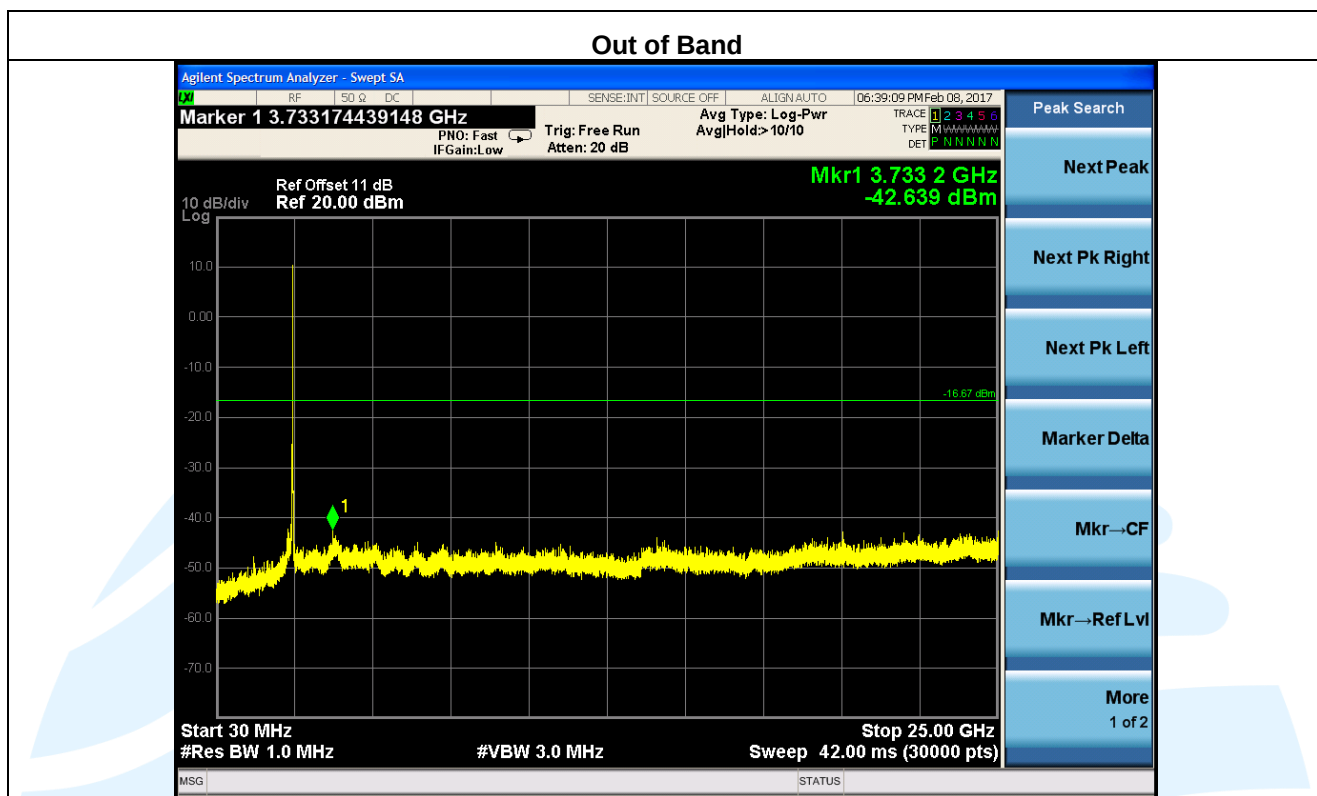

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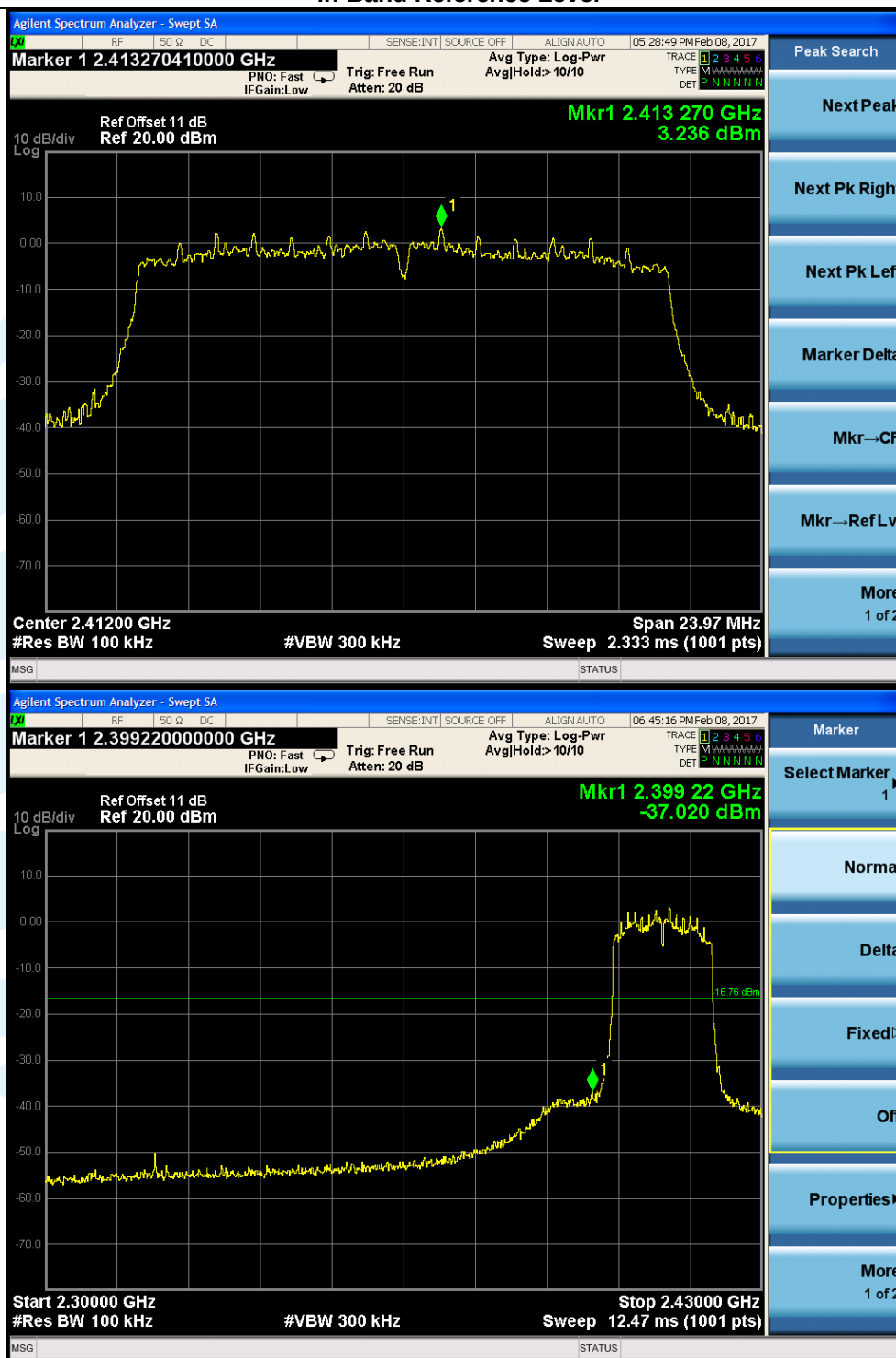




Test Mode: 802.11 n(HT20)

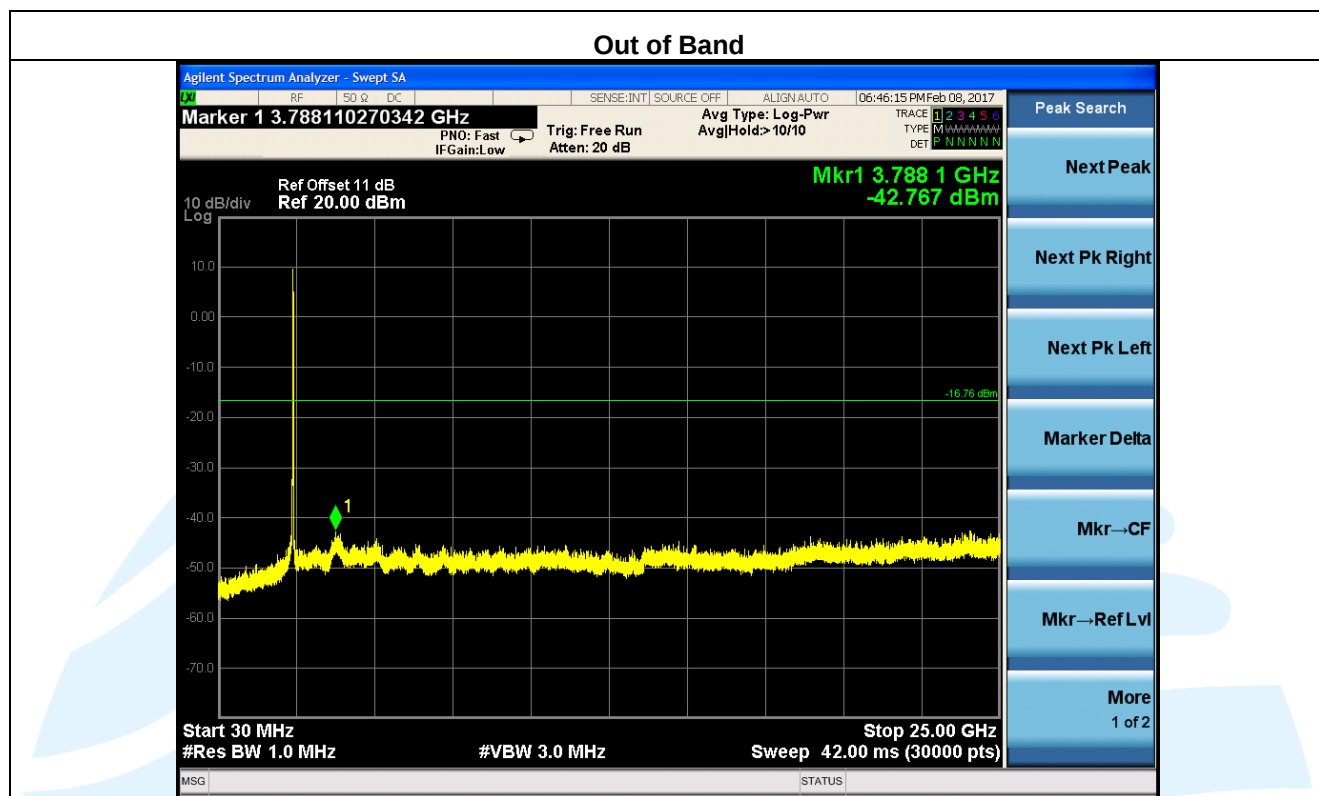
2412MHz

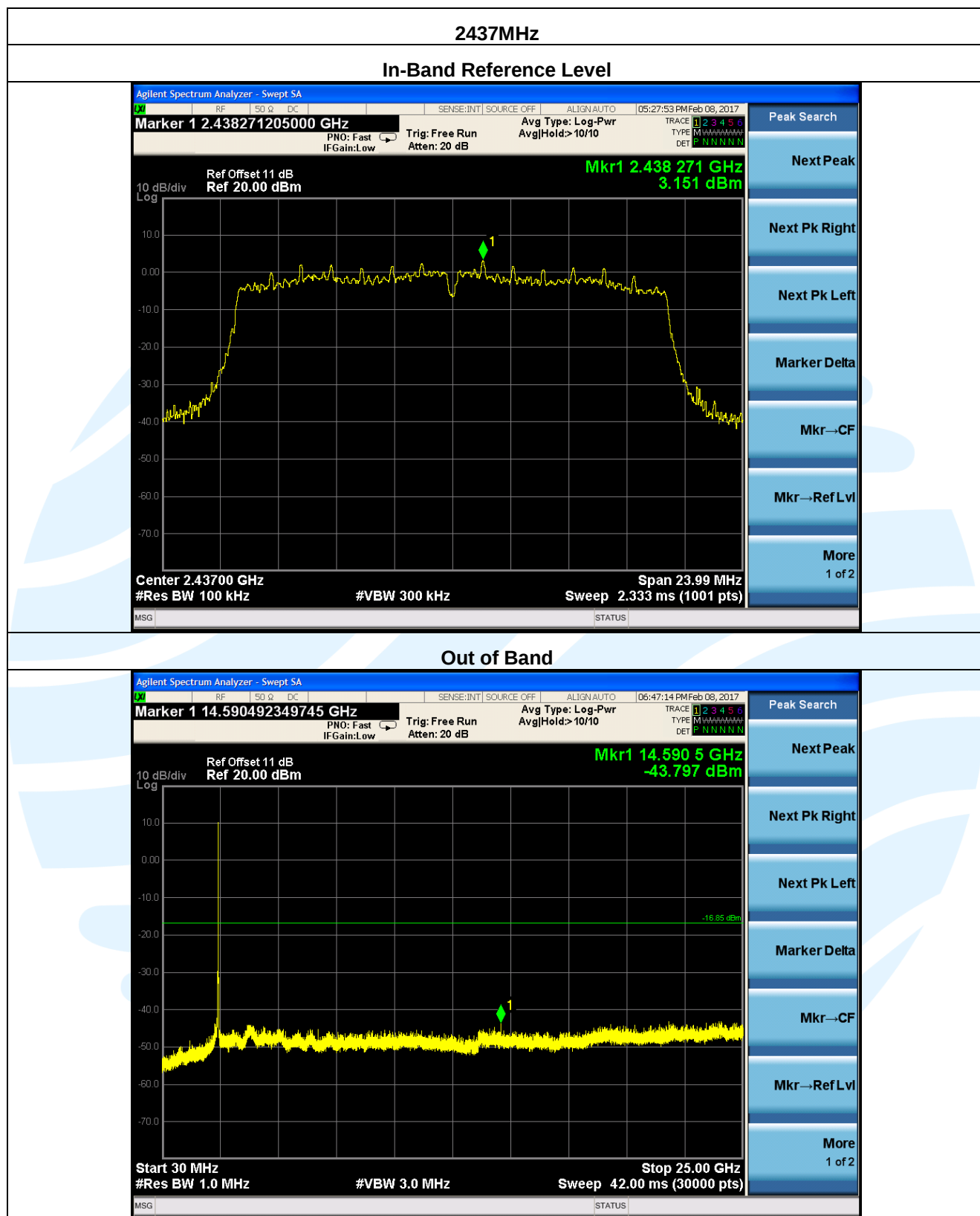
In-Band Reference Level

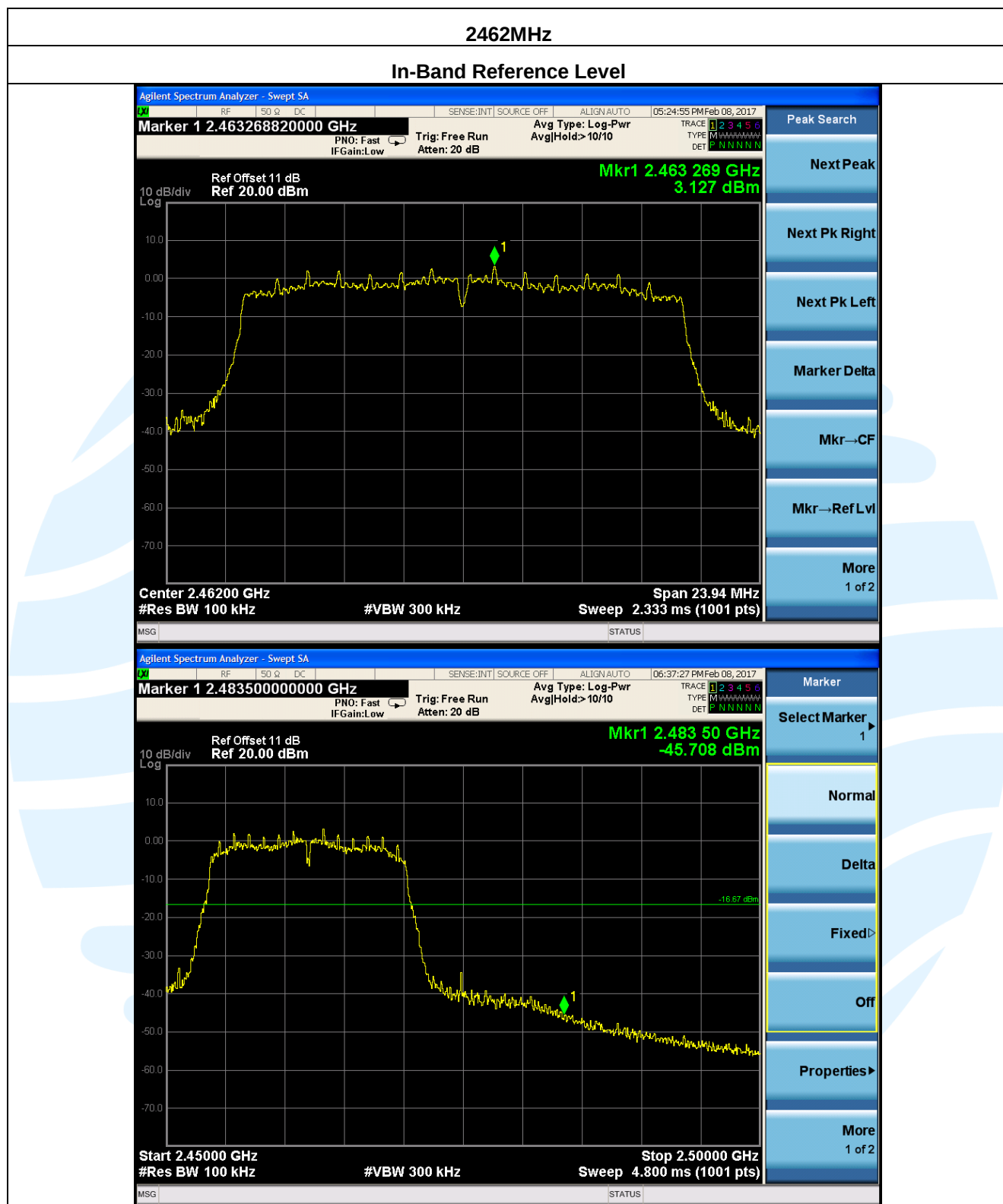


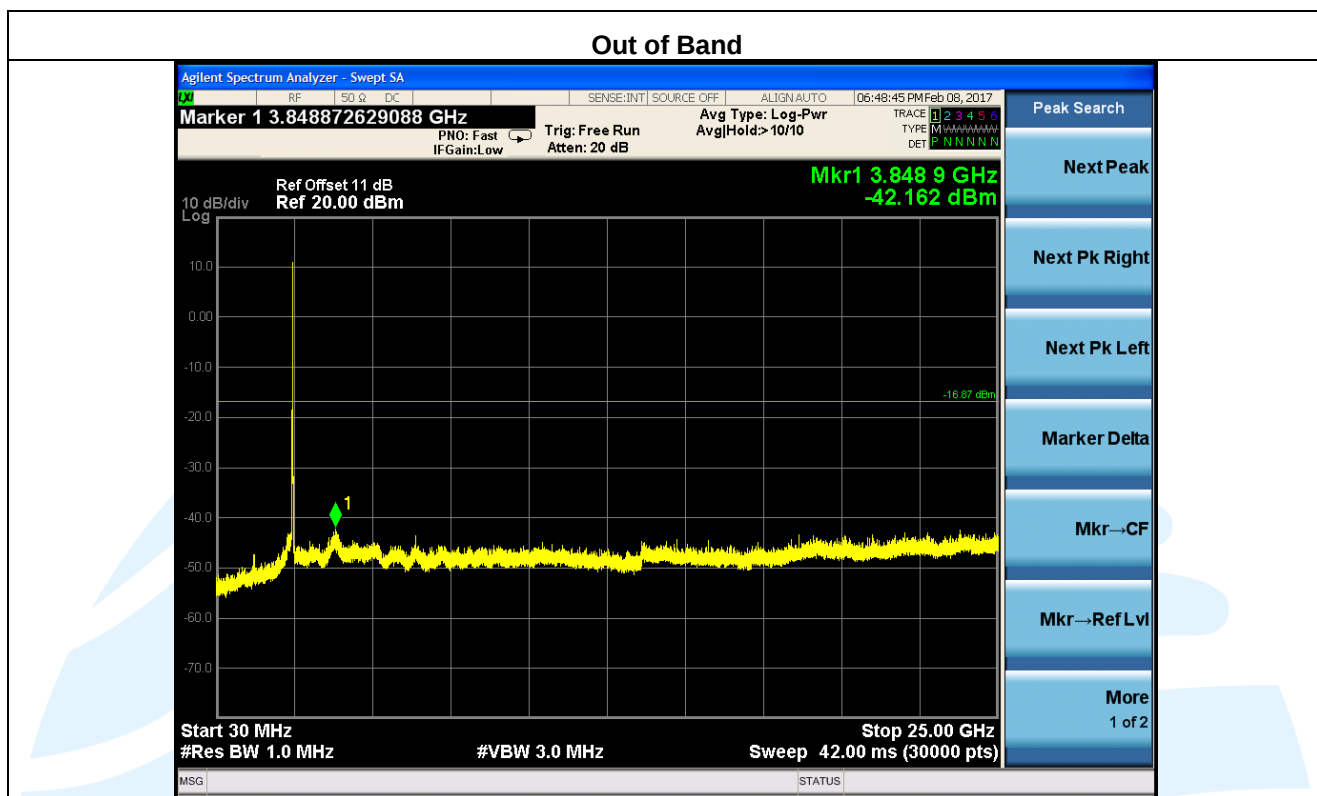
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5.6 Radiated Spurious Emissions

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

Test Method: ANSI C63.10

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 chamber. 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:

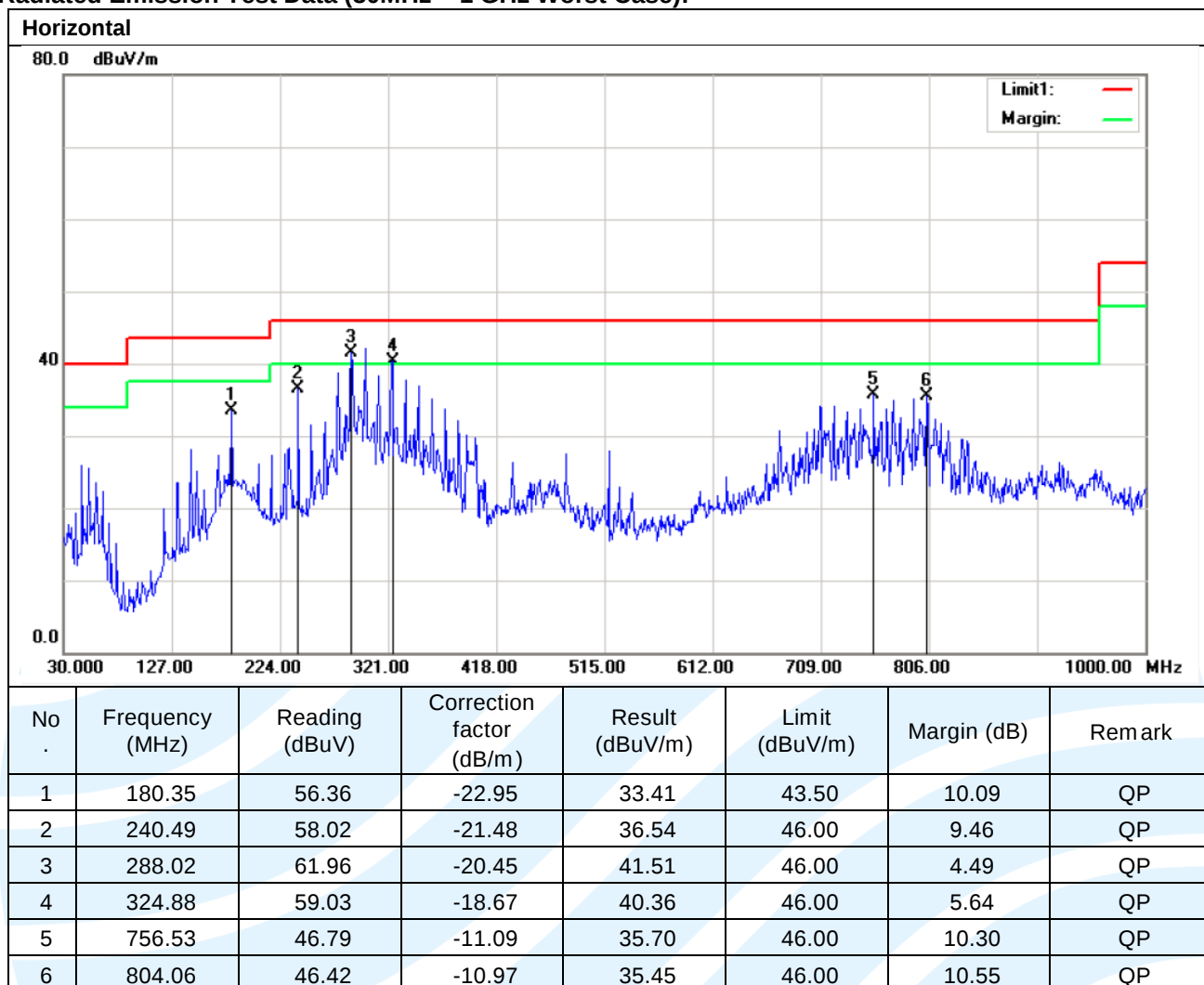
Pass

Test Data:**Radiated Emission Test Data (9 KHz ~ 30MHz)**

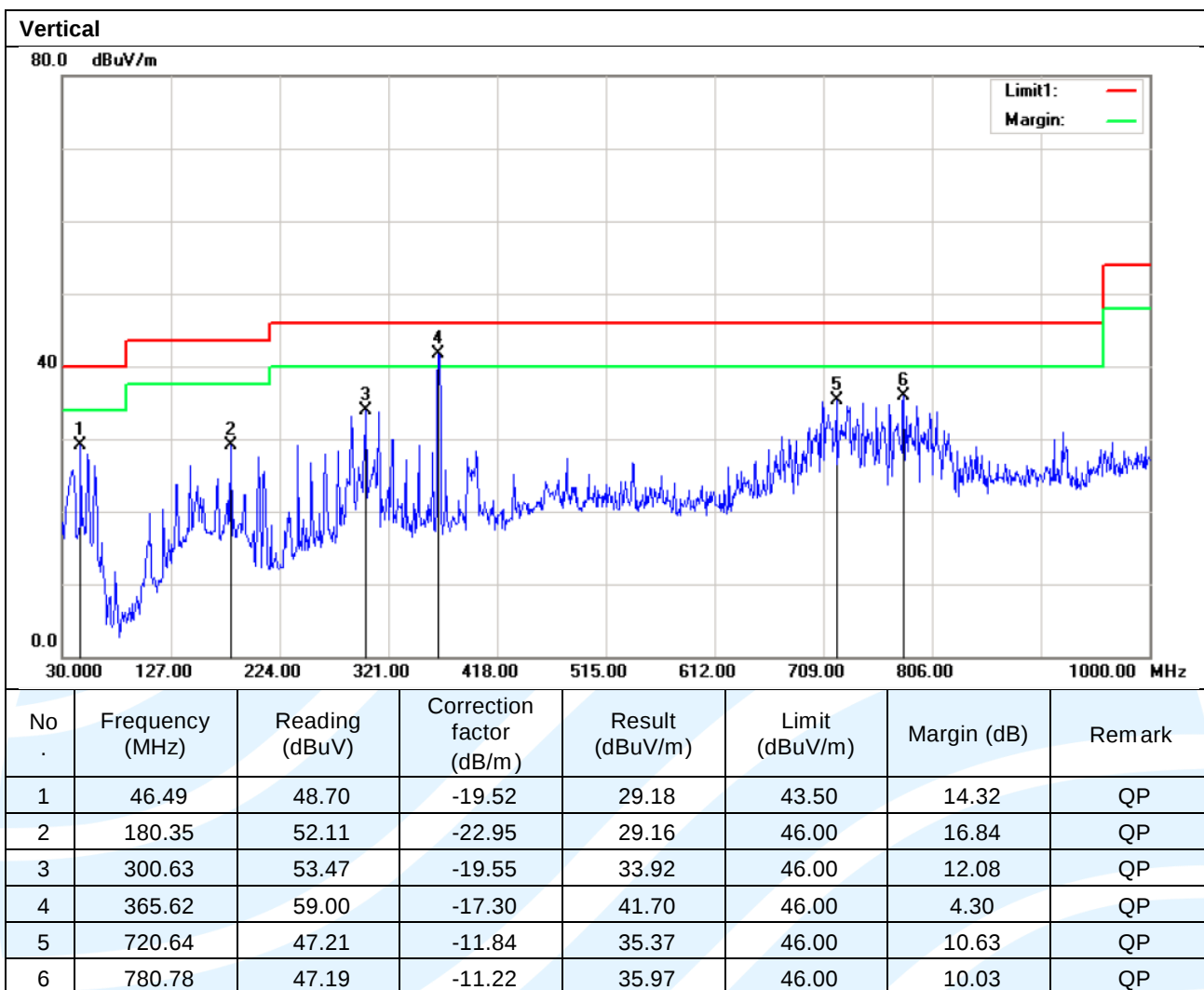
The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Radiated Emission Test Data (Above 18 GHz)

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

Radiated Emission Test Data (30MHz ~ 1 GHz Worst Case):

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

802.11b						
Tx_ Lowest						
No.	Frequency (MHz)	Result (dBuV)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Polar.
1	1321.0000	41.38	74.00	32.62	Peak	Horizontal
2	1726.0000	42.82	74.00	31.18	Peak	Horizontal
3	2581.0000	43.26	74.00	30.74	Peak	Horizontal
4	2844.0000	41.82	74.00	32.18	Peak	Horizontal
5	3617.0000	41.75	74.00	32.25	Peak	Horizontal
6	4398.0000	42.82	74.00	31.18	Peak	Horizontal
7	1591.0000	45.11	74.00	28.89	Peak	Vertical
8	1896.0000	43.10	74.00	30.90	Peak	Vertical
9	2546.0000	41.90	74.00	32.10	Peak	Vertical
10	3615.0000	42.25	74.00	31.75	Peak	Vertical
11	4824.0000	48.53	74.00	25.47	Peak	Vertical
12	5241.0000	45.19	74.00	28.81	Peak	Vertical
Tx_ Middle						
No.	Frequency (MHz)	Result (dBuV)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Polar.
1	1286.0000	40.74	74.00	33.26	Peak	Horizontal
2	1591.0000	40.22	74.00	33.78	Peak	Horizontal
3	2128.0000	39.83	74.00	34.17	Peak	Horizontal
4	2524.0000	41.79	74.00	32.21	Peak	Horizontal
5	3237.0000	43.15	74.00	30.85	Peak	Horizontal
6	4351.0000	42.74	74.00	31.26	Peak	Horizontal
7	1597.0000	46.14	74.00	27.86	Peak	Vertical
8	1903.0000	42.99	74.00	31.01	Peak	Vertical
9	2559.0000	42.72	74.00	31.28	Peak	Vertical
10	3238.0000	41.96	74.00	32.04	Peak	Vertical
11	3586.0000	42.04	74.00	31.96	Peak	Vertical
12	4874.0000	46.09	74.00	27.91	Peak	Vertical
Tx_ Highest						
No.	Frequency (MHz)	Result (dBuV)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Polar.
1	1291.0000	40.89	74.00	33.11	Peak	Horizontal
2	1607.0000	40.48	74.00	33.52	Peak	Horizontal
3	1893.0000	40.55	74.00	33.45	Peak	Horizontal
4	2525.0000	41.84	74.00	32.16	Peak	Horizontal
5	3341.0000	41.81	74.00	32.19	Peak	Horizontal
6	3829.0000	42.77	74.00	31.23	Peak	Horizontal
7	1597.0000	46.43	74.00	27.57	Peak	Vertical
8	1769.0000	44.47	74.00	29.53	Peak	Vertical
9	2532.0000	42.94	74.00	31.06	Peak	Vertical
10	2838.0000	41.26	74.00	32.74	Peak	Vertical
11	3144.0000	41.59	74.00	32.41	Peak	Vertical
12	4924.0000	48.43	74.00	25.57	Peak	Vertical

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802.11g						
Tx_ Lowest						
No.	Frequency (MHz)	Result (dBuV)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Polar.
1	1346.0000	43.58	74.00	30.42	Peak	Horizontal
2	1759.0000	47.00	74.00	27.00	Peak	Horizontal
3	2542.0000	42.45	74.00	31.55	Peak	Horizontal
4	2841.0000	42.71	74.00	31.29	Peak	Horizontal
5	3626.0000	43.03	74.00	30.97	Peak	Horizontal
6	3839.0000	43.87	74.00	30.13	Peak	Horizontal
7	1597.0000	44.80	74.00	29.20	Peak	Vertical
8	2254.0000	40.99	74.00	33.01	Peak	Vertical
9	2497.0000	42.63	74.00	31.37	Peak	Vertical
10	3626.0000	43.39	74.00	30.61	Peak	Vertical
11	4824.0000	46.40	74.00	27.60	Peak	Vertical
12	5483.0000	45.26	74.00	28.74	Peak	Vertical
Tx_ Middle						
No.	Frequency (MHz)	Result (dBuV)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Polar.
1	1385.0000	39.71	74.00	34.29	Peak	Horizontal
2	2182.0000	41.02	74.00	32.98	Peak	Horizontal
3	2568.0000	42.67	74.00	31.33	Peak	Horizontal
4	2817.0000	41.81	74.00	32.19	Peak	Horizontal
5	3312.0000	41.59	74.00	32.41	Peak	Horizontal
6	3826.0000	41.95	74.00	32.05	Peak	Horizontal
7	1603.0000	46.74	74.00	27.26	Peak	Vertical
8	2517.0000	41.97	74.00	32.03	Peak	Vertical
9	3253.0000	41.91	74.00	32.09	Peak	Vertical
10	3576.0000	43.17	74.00	30.83	Peak	Vertical
11	4874.0000	46.09	74.00	27.91	Peak	Vertical
12	5596.0000	45.70	74.00	28.30	Peak	Vertical
Tx_ Highest						
No.	Frequency (MHz)	Result (dBuV)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Polar.
1	1263.0000	41.34	74.00	32.66	Peak	Horizontal
2	1607.0000	41.24	74.00	32.76	Peak	Horizontal
3	2562.0000	42.97	74.00	31.03	Peak	Horizontal
4	2803.0000	42.66	74.00	31.34	Peak	Horizontal
5	3297.0000	42.53	74.00	31.47	Peak	Horizontal
6	3693.0000	42.46	74.00	31.54	Peak	Horizontal
7	1597.0000	46.13	74.00	27.87	Peak	Vertical
8	2156.0000	40.98	74.00	33.02	Peak	Vertical
9	2561.0000	42.00	74.00	32.00	Peak	Vertical
10	3199.0000	41.94	74.00	32.06	Peak	Vertical
11	4094.0000	41.99	74.00	32.01	Peak	Vertical
12	4924.0000	47.03	74.00	26.97	Peak	Vertical

802.11n-HT20						
Tx_ Lowest						
No.	Frequency (MHz)	Result (dBuV)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Polar.
1	1597.0000	42.04	74.00	31.96	Peak	Horizontal
2	1786.0000	41.31	74.00	32.69	Peak	Horizontal
3	2523.0000	42.43	74.00	31.57	Peak	Horizontal
4	2832.0000	41.62	74.00	32.38	Peak	Horizontal
5	3621.0000	42.65	74.00	31.35	Peak	Horizontal
6	4824.0000	46.78	74.00	27.22	Peak	Horizontal
7	1596.0000	47.45	74.00	26.55	Peak	Vertical
8	2183.0000	40.69	74.00	33.31	Peak	Vertical
9	2527.0000	41.81	74.00	32.19	Peak	Vertical
10	2811.0000	41.86	74.00	32.14	Peak	Vertical
11	3623.0000	43.09	74.00	30.91	Peak	Vertical
12	4824.0000	48.50	74.00	25.50	Peak	Vertical
Tx_ Middle						
No.	Frequency (MHz)	Result (dBuV)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Polar.
1	1273.0000	39.79	74.00	34.21	Peak	Horizontal
2	1789.0000	40.43	74.00	33.57	Peak	Horizontal
3	2542.0000	43.53	74.00	30.47	Peak	Horizontal
4	2803.0000	41.87	74.00	32.13	Peak	Horizontal
5	3654.0000	41.77	74.00	32.23	Peak	Horizontal
6	4874.0000	46.90	74.00	27.10	Peak	Horizontal
7	1596.0000	46.02	74.00	27.98	Peak	Vertical
8	2532.0000	41.92	74.00	32.08	Peak	Vertical
9	3257.0000	42.93	74.00	31.07	Peak	Vertical
10	4373.0000	43.45	74.00	30.55	Peak	Vertical
11	4874.0000	46.82	74.00	27.18	Peak	Vertical
12	5181.0000	46.46	74.00	27.54	Peak	Vertical
Tx_ Highest						
No.	Frequency (MHz)	Result (dBuV)	Limit (dBuV/m)	Margin (dB)	Remark	Ant. Polar.
1	1859.0000	40.18	74.00	33.82	Peak	Horizontal
2	2568.0000	42.38	74.00	31.62	Peak	Horizontal
3	2811.0000	42.17	74.00	31.83	Peak	Horizontal
4	3397.0000	41.83	74.00	32.17	Peak	Horizontal
5	4125.0000	42.89	74.00	31.11	Peak	Horizontal
6	4799.0000	43.92	74.00	30.08	Peak	Horizontal
7	1593.0000	45.53	74.00	28.47	Peak	Vertical
8	1787.0000	41.24	74.00	32.76	Peak	Vertical
9	2571.0000	43.42	74.00	30.58	Peak	Vertical
10	3388.0000	41.86	74.00	32.14	Peak	Vertical
11	4659.0000	43.50	74.00	30.50	Peak	Vertical
12	4924.0000	46.46	74.00	27.54	Peak	Vertical

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 9 KHz to 25 GHz, the disturbance above 10 GHz and below 30 MHz was very low, the amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.*
- 3) *Since peak data above 1 GHz are lower the average limit, so the average data are pass, no need for testing.*



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.

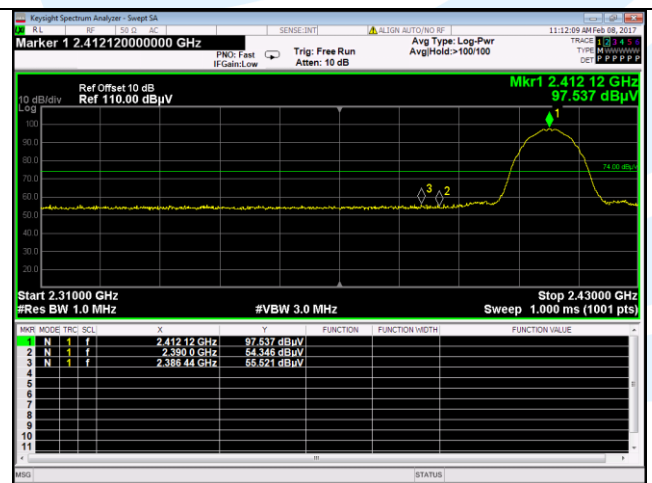
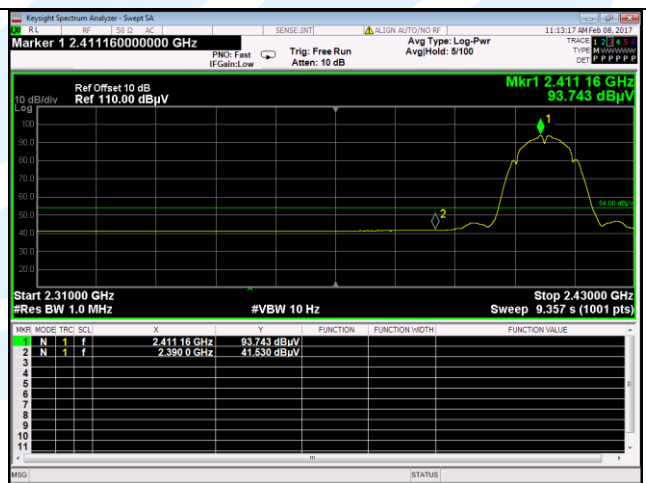
Instruments Used: Refer to section 3 for details

Test Mode: Transmitter mode

Test Results: Pass

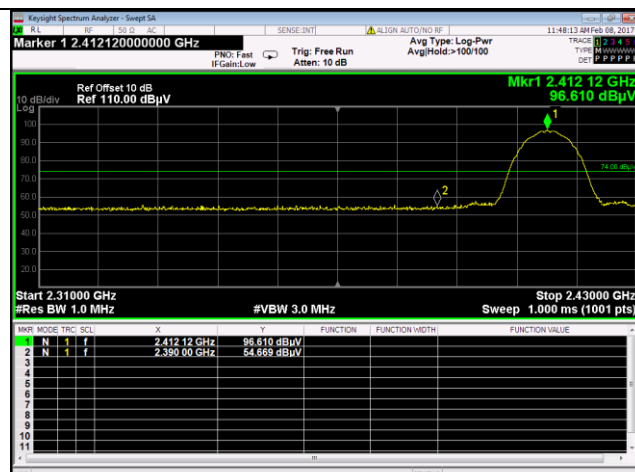
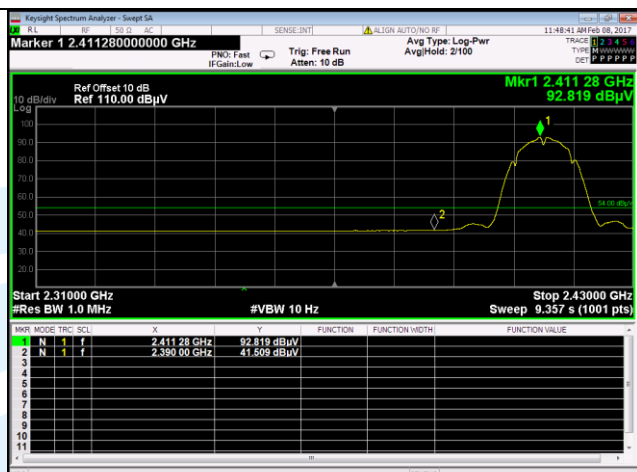
Test Data:

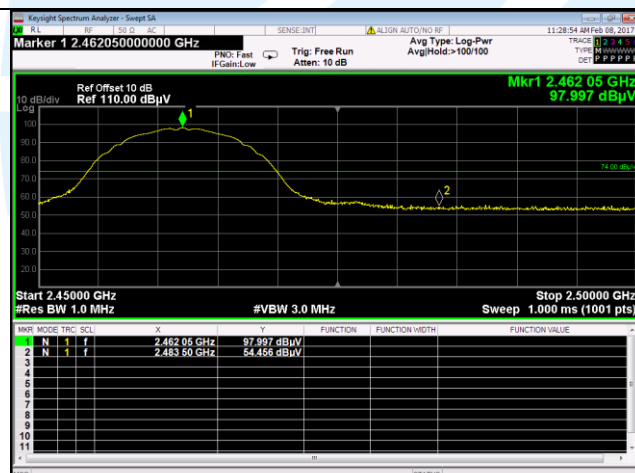
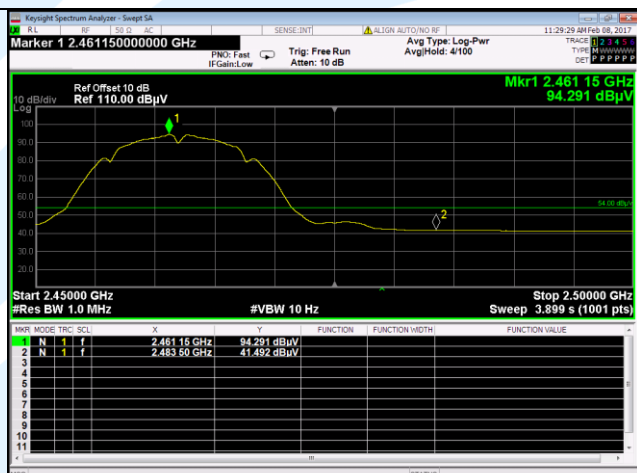
802.11b

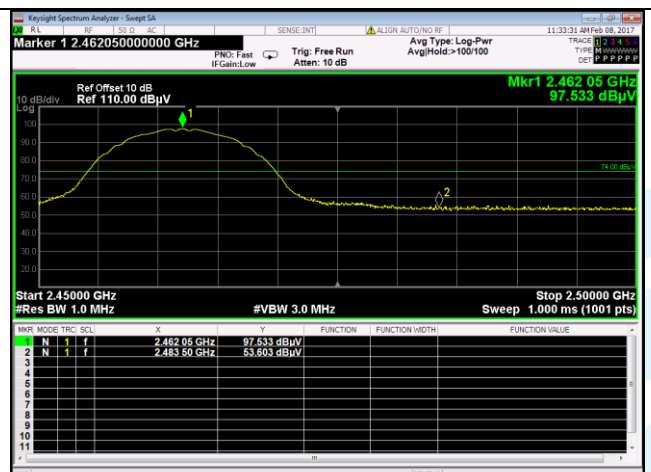
Frequency (MHz)		2412		Ant. Polar.		Horizontal	
Detector: Peak				Detector: AV			
							
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion		
2390.000	54.346	74	41.530	54	Pass		
2386.44	55.521	74	-	-	Pass		

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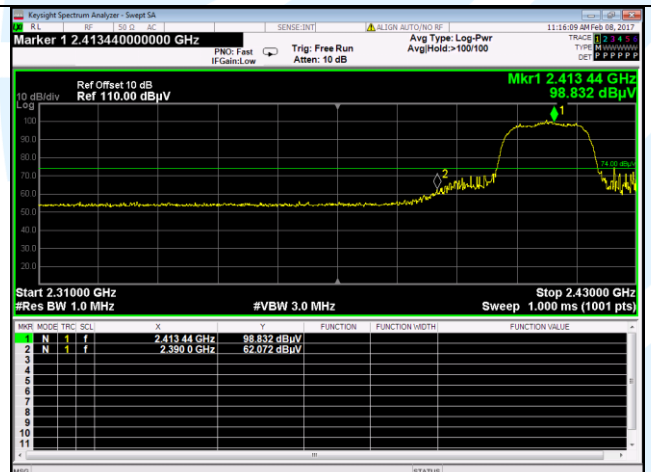
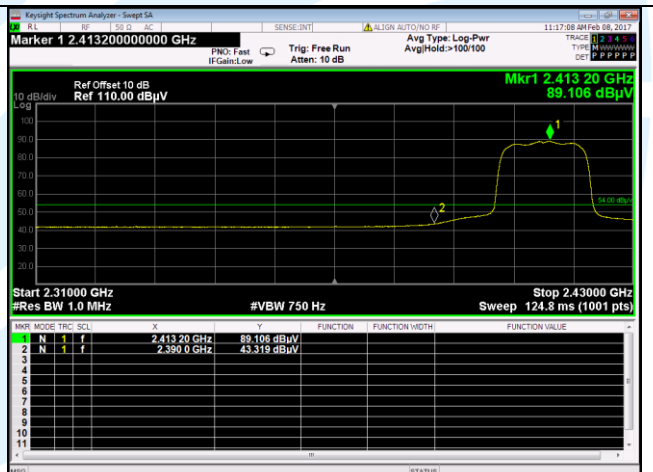
Address: 16/F, Block A, Building 6, Baoneng Science and Technology Park, Qingxiang Road No.1, Longhua New District, Shenzhen, China
Tel: +86-755-28230888 Fax: +86-755-28230886 E-mail: info@uttlab.com <http://www.uttlab.com>

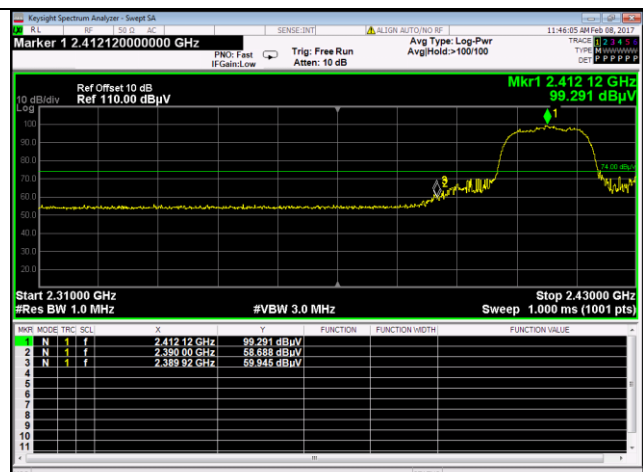
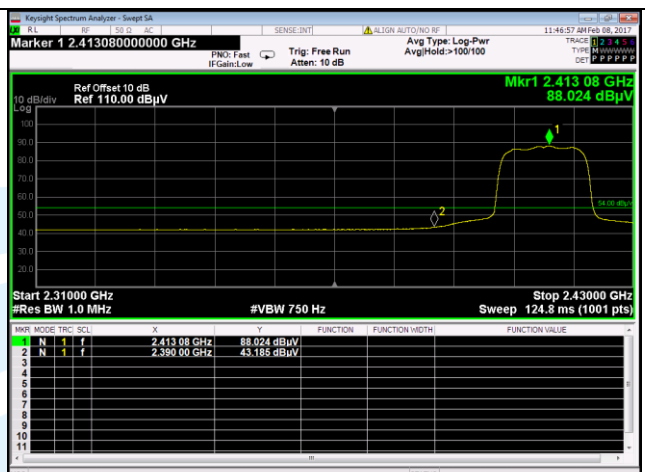
Frequency (MHz)			Ant. Polar.		
2412			Vertical		
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2390.000	54.669	74	41.509	54	Pass

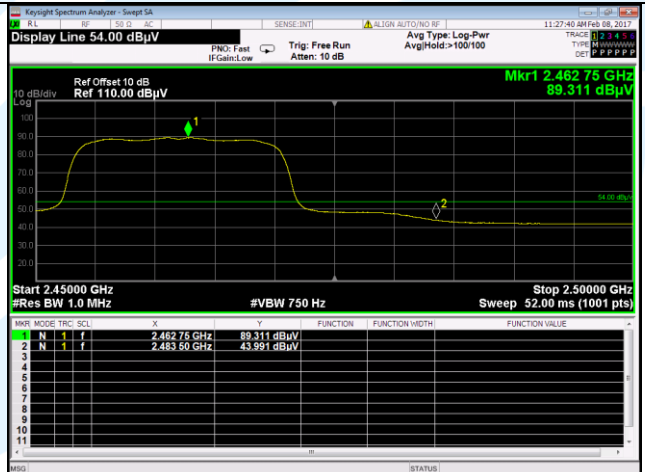
Frequency (MHz)			Ant. Polar.		
2462			Horizontal		
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2483.500	54.456	74	41.492	54	Pass

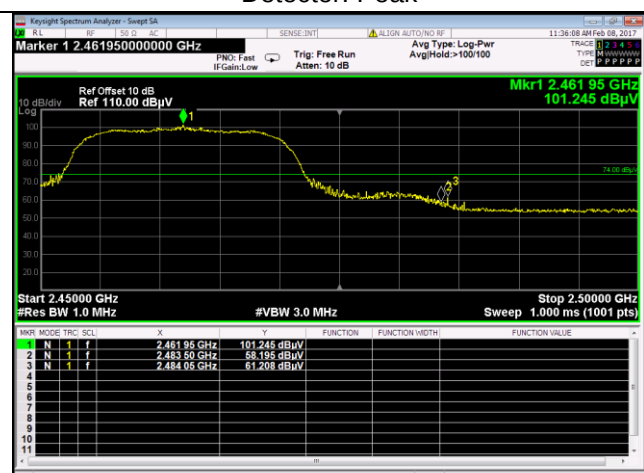
Frequency (MHz)			Ant. Polar.		Vertical
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2483.500	53.603	74	41.419	54	Pass

802.11g

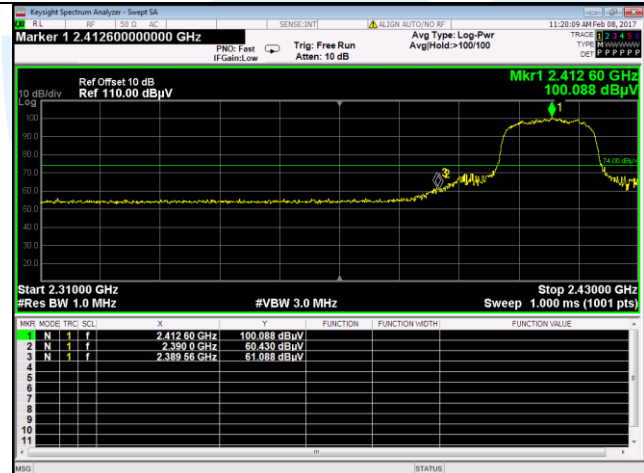
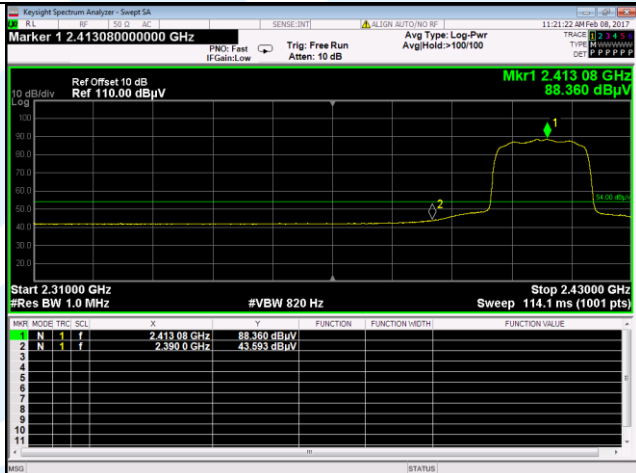
Frequency (MHz)			Ant. Polar.		Horizontal
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2390.000	62.072	74	43.319	54	Pass

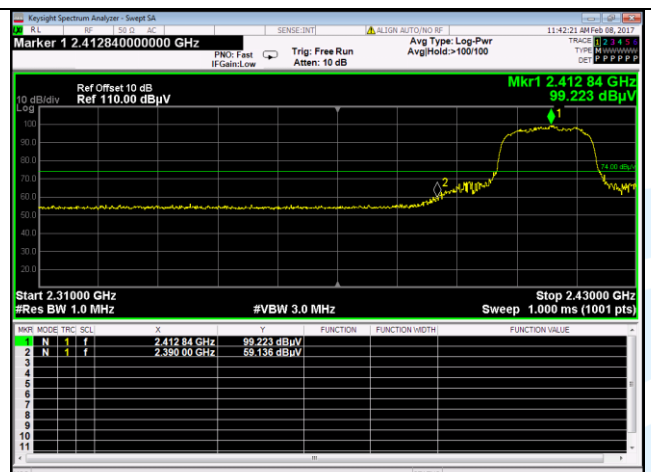
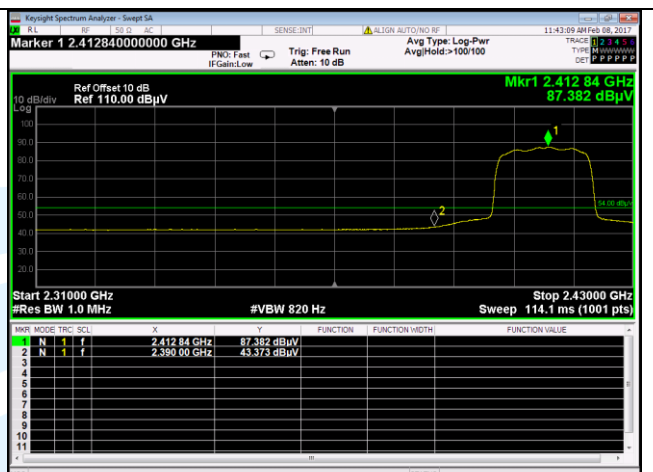
Frequency (MHz)			Ant. Polar.		
2412			Vertical		
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2390.000	58.688	74	43.185	54	Pass
2389.920	59.945	74	-	-	Pass

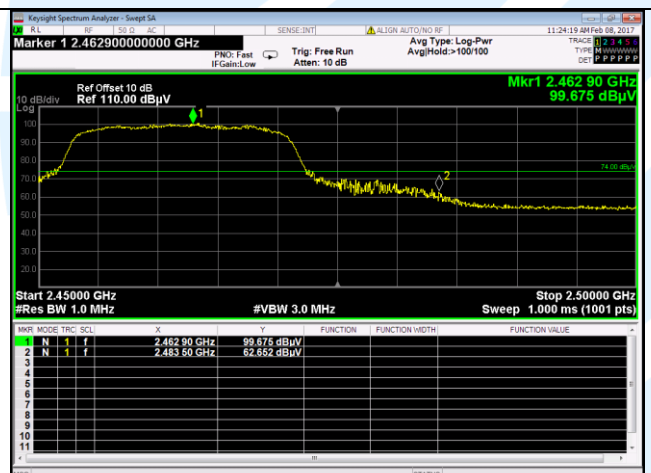
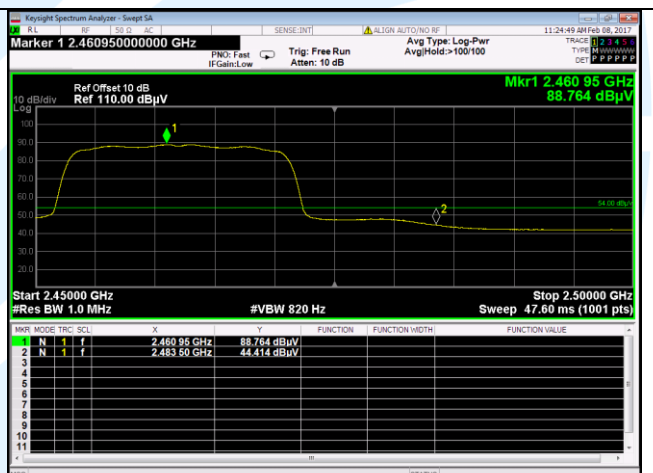
Frequency (MHz)			Ant. Polar.		
2462			Horizontal		
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2483.500	56.744	74	43.991	54	Pass
2486.100	59.834	74	-	-	Pass

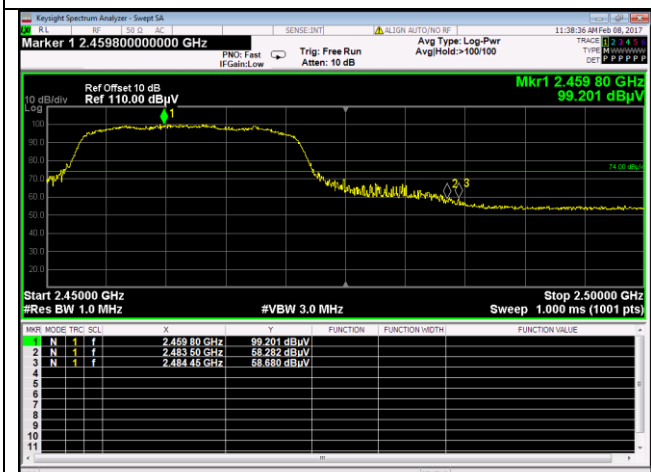
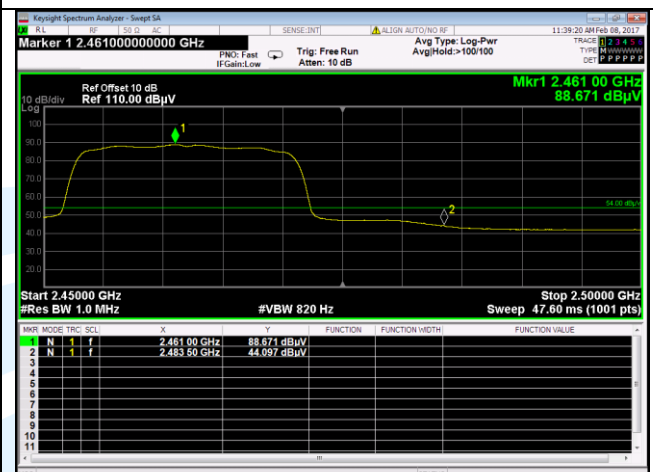
Frequency (MHz)		2462	Ant. Polar.		Vertical
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2483.500	58.195	74	43.229	54	Pass
2484.05	61.208	74	-	-	Pass

802.11n(HT20)

Frequency (MHz)		2412		Ant. Polar.		Horizontal	
Detector: Peak				Detector: AV			
							
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion		
2390.000	60.430	74	43.593	54	Pass		
2389.560	61.088	74	-	-	Pass		

Frequency (MHz)			Ant. Polar.		
2412			Vertical		
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2390.000	59.136	74	43.373	54	Pass

Frequency (MHz)			Ant. Polar.		
2462			Horizontal		
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2483.500	62.652	74	44.414	54	Pass

Frequency (MHz)			Ant. Polar.		Vertical
Detector: Peak			Detector: AV		
					
Frequency (MHz)	Peak level (dBuV/m)	Peak Limit (dBuV/m)	AV level (dBuV/m)	AV Limit (dBuV/m)	Conclusion
2483.500	58.282	74	44.097	54	Pass
2484.450	58.680	74	-	-	Pass

Note:

- 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.
- 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 - Correct Factor
 Correct Factor = Preamplifier Factor - Antenna Factor - Cable Factor

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 $50\Omega/50\mu\text{H} + 5\Omega$ 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: See note 1.

Note: 1. There is a separate report for the AC Power Line Conducted Emission test.

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 ***

The test report is effective only with both signature and specialized stamp. The result(s) shown in this report refer only to the sample(s) tested. Without written approval of UnionTrust, this report can't be reproduced except in full.