# FCC TEST REPORT

| | | |
|---|---|---|
| **Product** | : | WiFi & Bluetooth Enabled Leak Detector |
| **Trade mark** | : | Delta Faucet Co. |
| **Model/Type reference** | : | Leak Detector model LEAKX1 |
| **Report Number** | : | 170111001RFC-2 |
| **Date of Issue** | : | January 19, 2017 |
| **FCC ID** | : | 2AA4X-LEAKX1 |
| **Test Standards** | : | 47 CFR Part 15 Subpart C (2015) |
| **Test result** | : | PASS |

Prepared for:

**Delta Faucet Company**

**55 East 111th Street Indianapolis, Indiana, 46280, USA**

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 — Hoping Chen, Engineer

Reviewed by: Leo Lai — Leo Lai, Senior Supervisor

Approved by: Billy Li — Billy Li, Technical Director

Date: January 19, 2017

UnionTrust Laboratories UnionTrust * Certified *

# Version

| Version No. | Date | Description |
|---|---|---|
| V1.0 | January 19, 2017 | Original |

# Content

# 1 General Information

## 1.1 Client Information

| | |
|---|---|
| Applicant: | Delta Faucet Company |
| Address of Applicant: | 55 East 111th Street Indianapolis, Indiana, 46280, USA |
| Manufacturer: | Defond |
| Address of Manufacturer: | DEL Industrial LTD, 23/F, Chai Wan Industrial Centre, 20 Lee Chung Street, Chai Wan, Hong Kong |

## 1.2 General Description of EUT

| | | |
|---|---|---|
| Product Name: | WiFi & Bluetooth Enabled Leak Detector | |
| Model No.(EUT): | Leak Detector model LEAKX1 | |
| Add Mode No.: | N/A | |
| Trade Mark: | Delta Faucet Co. | |
| EUT Supports Radios application: | Bluetooth V4.0 BLE only<br>Wlan 2.4GHz 802.11b/g/n(HT20) | |
| Power Supply: | AC adapter | N/A |
| | Battery: | 3*AAA batteries |
| USB Micro-B Plug cable: | N/A | |
| Sample Received Date: | January 11, 2017 | |
| Sample tested Date: | January 11, 2017 to January 17, 2017 | |

## 1.3 Product Specification subjective to this standard

| | |
|---|---|
| Operation Frequency: | 2400MHz-2483.5MHz |
| Channel Numbers: | BLE: 40 Channels<br>802.11b/g/n(HT20): 11 Channels |
| Channel Separation: | 2MHz step for BLE<br>5MHz step for WiFi |
| Transmit Data Rate: | BLE: 1MHz<br>802.11b:1M/ 2M/ 5.5M/ 11M bps<br>802.11g:6M/ 9M/ 12M/ 18M/ 24M/ 36M/ 48M/ 54M bps<br>802.11n(HT20): up to MCS7(65Mbps) |
| Type of Modulation: | BLE: GFSK<br>802.11b:DSSS(CCK, DQPSK, DBPSK)<br>802.11g:OFDM(64QAM, 16QAM, QPSK, BPSK)<br>802.11n(HT20): OFDM (64QAM, 16QAM, QPSK, BPSK) |
| Sample Type: | Mobile production |
| Sample Type: | Mobile production |
| Antenna Type: | Chain 0: PCB antenna for BLE<br>Chain 1: PCB antenna for WiFi |
| Antenna Gain: | Chain 0: 3.3 dBi gain<br>Chain 1: 3.3 dBi gain |
| Normal Test voltage: | DC 4.5V |
| Extreme Test voltage: | DC4V, DC5V (declared by the manufacturer) |
| Operating Temperature: | -20℃ to +50℃ (declared by the manufacturer) |

| 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

Tested by: Darry Wu

## 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**.

## 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 | Radio Frequency | ±6.3 x $10^{-8}$ |
| 2 | RF power, conducted | ±1.31 dB |
| 3 | Spurious emissions, radiated (Below 1GHz) | ±4.5 dB |
| | Spurious emissions, radiated (Above 1GHz) | ±4.4 dB |
| 4 | Conduction emission (9KHz~150KHz) | ±3.8 dB |
| | Conduction emission (150KHz~30MHz) | ±3.4 dB |
| 5 | Temperature | ±0.64 °C |
| 6 | Humidity | ±5.6 % |
| 7 | Supply voltages | ±1.9 % |

# 2 Test Summary

Tests for radiated 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 | N/A |
| **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. This EUT is powered by batteries.

# 3 Equipment List

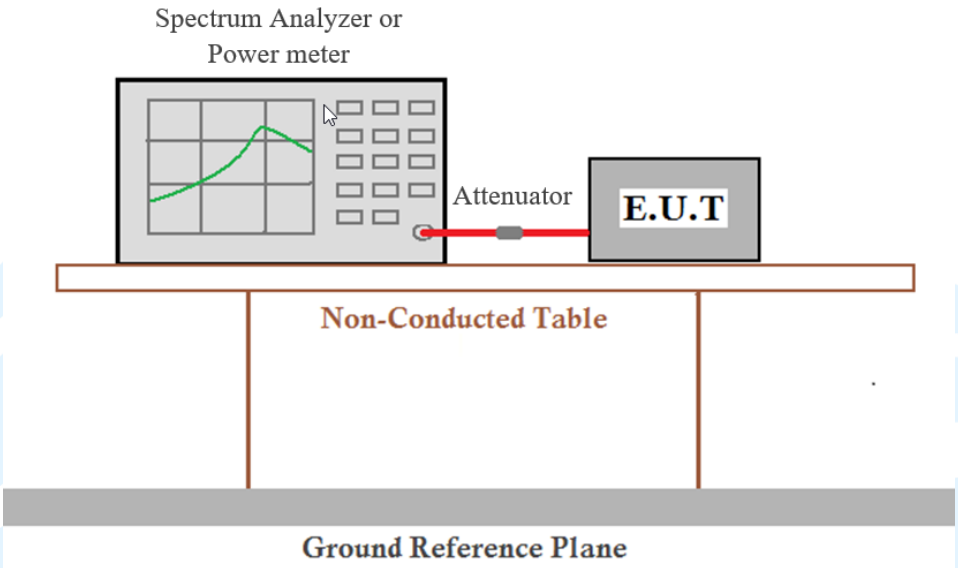
| 3m (Semi-Anechoic Chamber) | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Mode No.** | **Serial Number** | **Cal. Due date (mm-dd-yyyy)** | **Cal. Interval** |
| PSA Series Spectrum Analyzer | Agilent | E4446A | US44300399 | 02-20-2017 | 1 Year |
| Turn Table | N/A | N/A | 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 | 02-21-2017 | 1 Year |
| Horn Antenna | SCHWARZBECK | BBHA9120 | D286 | 02-20-2017 | 1 Year |
| High Noise Amplifier | Agilent | 8449B | 3008A01838 | 02-21-2017 | 1 Year |
| Horn Antenna | Schwarzbeck | BBHA9120 | D286 | 02-21-2017 | 1 Year |
| Temp. / Humidity Meter | Anymetre | JR913 | N/A | 02-21-2017 | N.C.R |
| Antenna Tower | SUNOL | TLT2 | N/A | N.C.R | N.C.R |
| Test S/W | FARAO | LZ-RF / CCS-SZ-3A2 | | | |

| Conducted RF test | | | | | |
|---|---|---|---|---|---|
| **Equipment** | **Manufacturer** | **Mode No.** | **Serial Number** | **Cal. Due date (mm-dd-yyyy)** | **Cal. Interval** |
| Spectrum Analyzer | Agilent | N9010A | MY52221469 | 02-21-2017 | 1 Year |
| Power Meter | Agilent | ML2495A | 1204003 | 02-21-2017 | 1 Year |

# 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:**

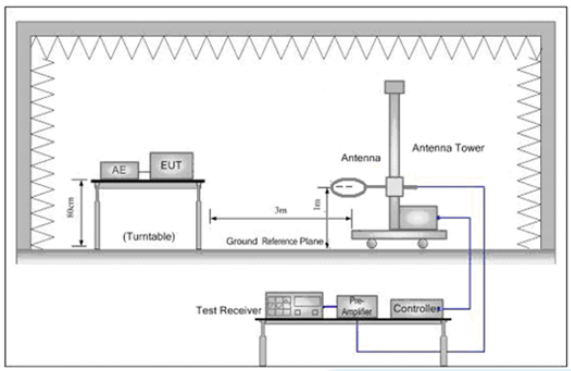



Figure 1. Below 30MHz

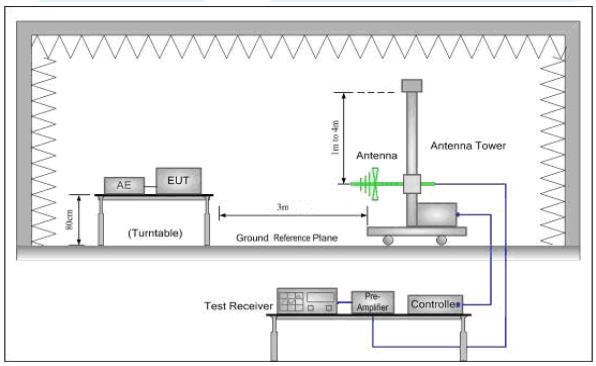



Figure 2. 30MHz to 1GHz

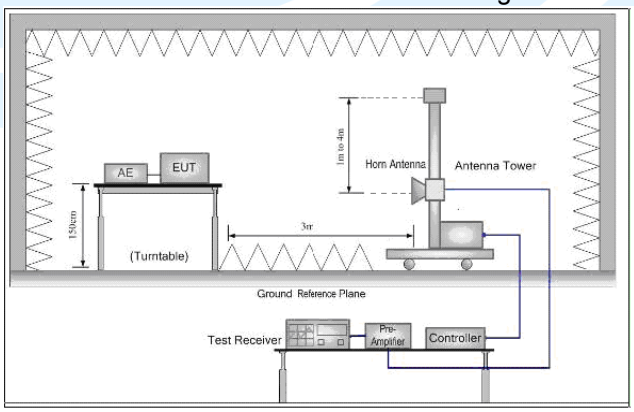
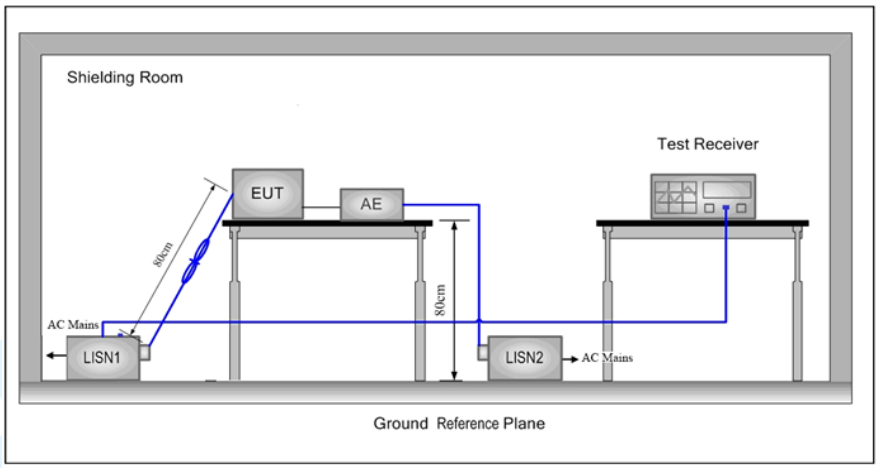



Figure 3. Above 1GHz

### 4.1.3 For Conducted Emissions test setup

**Conducted Emissions setup**




## 4.2 Test Environment

| Operating Environment: | |
|---|---|
| Temperature: | 24.6 °C |
| Humidity: | 52 % RH |
| Atmospheric Pressure: | 101.13 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 DC4.5V from 3*AAA batteries. 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 0 | X-Portrait |
| Above 1GHz | 1TX | 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 | RF Channel | | |
|---|---|---|---|
| | Low(L) | Middle(M) | High(H) |
| 802.11b/g/n(HT20) | Channel 1 | Channel 6 | Channel 11 |
| | 2412MHz | 2437MHz | 2462MHz |
| Transmitting mode:<br>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) | **15.94** | 15.93 | 15.91 | 15.90 | | | | |
| Chain 0_802.11g | | | | | | | | |
| Data Rate (Mbps) | **6** | 9 | 12 | 18 | 24 | 36 | 48 | 54 |
| 1(2412) | **10.09** | 9.98 | 10.00 | 9.97 | 9.96 | 9.94 | 9.98 | 9.99 |
| 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) | **7.93** | 7.92 | 7.90 | 7.89 | 7.87 | 7.76 | 7.78 | 7.87 |

**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) |

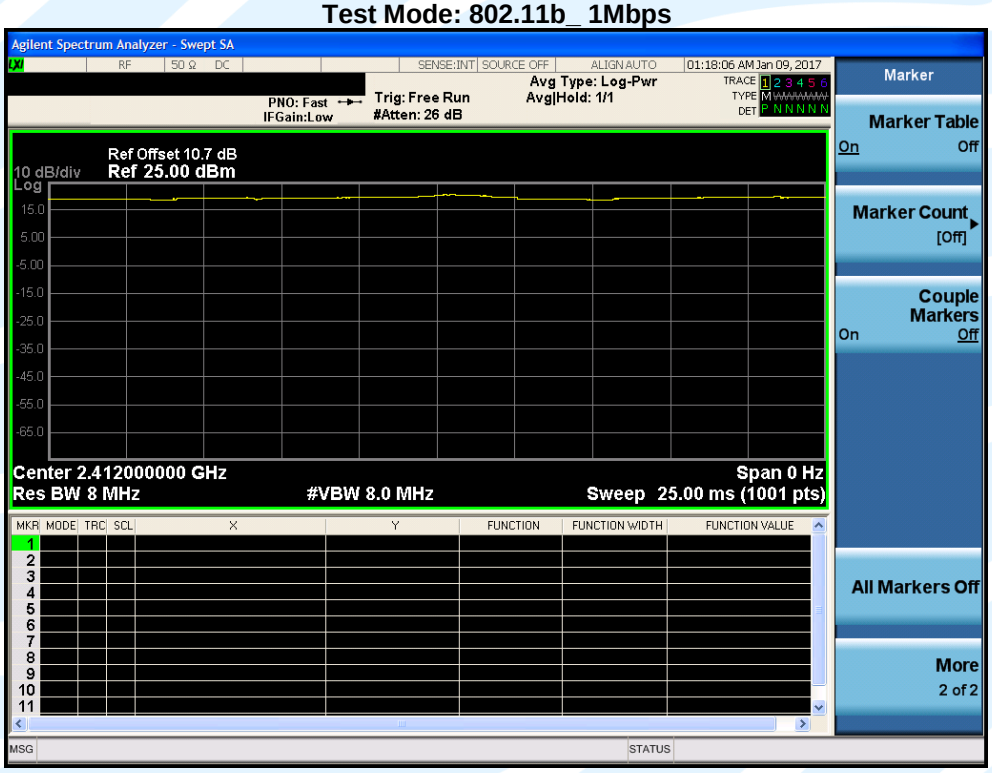
### 4.4.3 Duty Cycle

| 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 | - | - | - | 100 | 0 | 0.010 |
| 802.11g | 6 | 1.393 | 1.438 | 0.969 | 96.9 | 0.137 | 0.718 |
| 802.11n(HT20) | 6.5 | 1.303 | 1.343 | 0.970 | 97.0 | 0.132 | 0.767 |

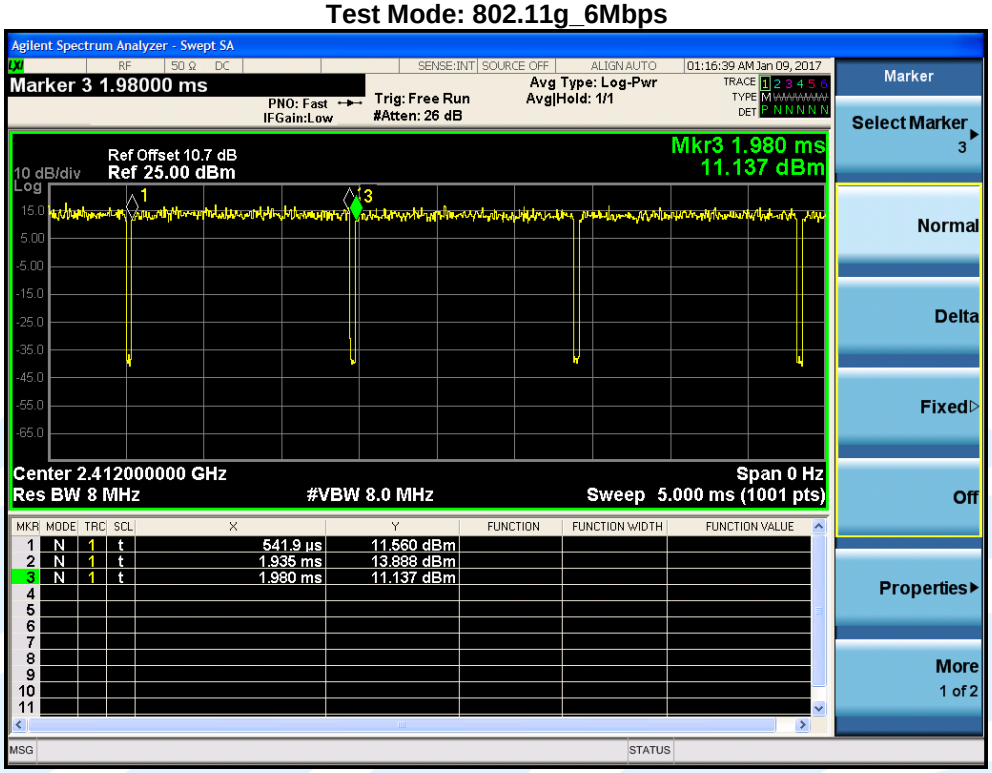
Remark:
1) Duty cycle= On Time/ Period
2) Duty Cycle factor = 10 * log(1/ Duty cycle)

**The test plot as follows:**

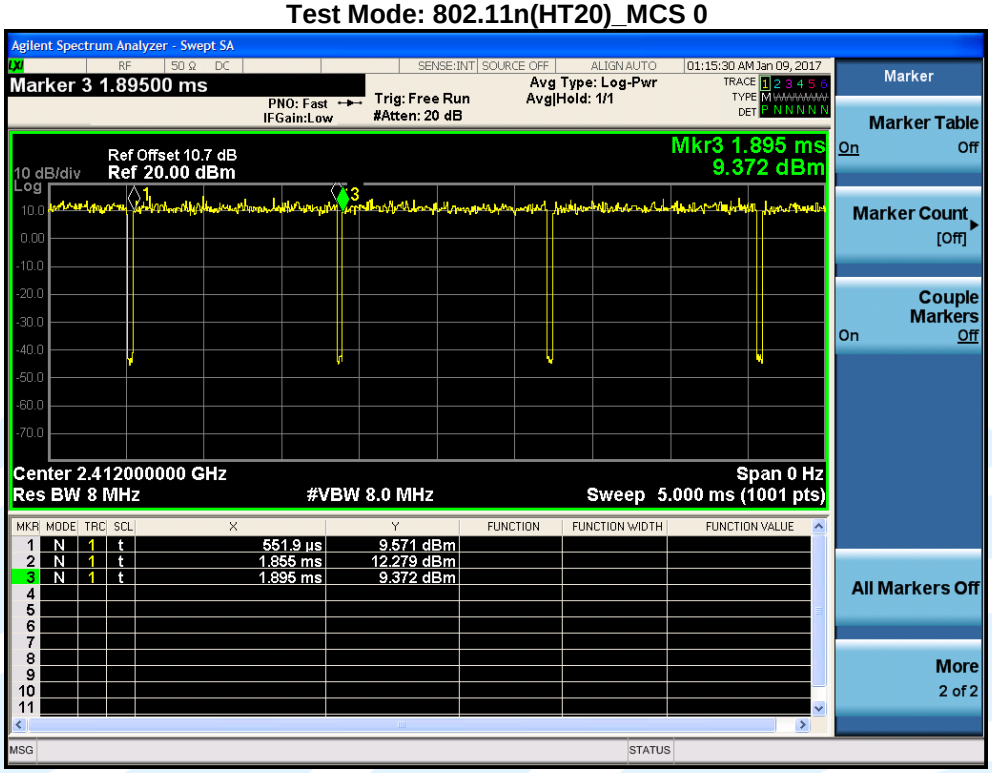
**Test Mode: 802.11b_ 1Mbps**



**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 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 Unlicesed 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 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 | 18.67 | 15.94 | 15.94 |
| | 6(2437) | | 18.58 | 15.72 | 15.72 |
| | 11(2462) | | 18.46 | 15.68 | 15.68 |
| 802.11g | 1(2412) | 6 | 19.85 | 10.09 | 10.227 |
| | 6(2437) | | 19.83 | 10.06 | 10.197 |
| | 11(2462) | | 19.72 | 10.02 | 10.157 |
| 802.11n (HT20) | 1(2412) | MCS0 | 17.26 | 7.93 | 8.062 |
| | 6(2437) | | 17.24 | 7.91 | 8.042 |
| | 11(2462) | | 17.35 | 7.92 | 8.052 |

Remark:
1. 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:**

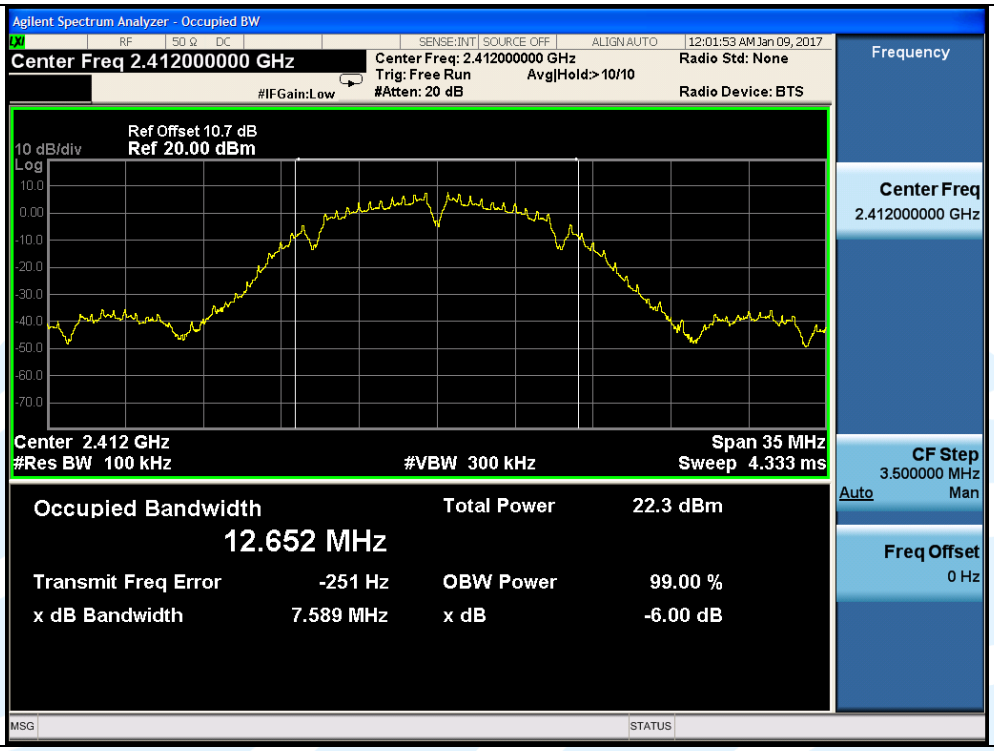
| Mode | Channel Frequency (MHz) | 6 dB Bandwidth (MHz) | 99% Bandwidth (MHz) | 6 dB Bandwidth Limit | Result (Pass / Fail) |
|---|---|---|---|---|---|
| 802.11b | 1 (2412) | 7.589 | 12.652 | > 500 kHz | Pass |
| | 6 (2437) | 8.061 | 12.638 | > 500 kHz | Pass |
| | 11 (2462) | 8.538 | 12.577 | > 500 kHz | Pass |
| 802.11g | 1 (2412) | 15.110 | 16.314 | > 500 kHz | Pass |
| | 6 (2437) | 15.440 | 16.311 | > 500 kHz | Pass |
| | 11 (2462) | 15.110 | 16.311 | > 500 kHz | Pass |
| 802.11n (HT20) | 1 (2412) | 16.000 | 17.491 | > 500 kHz | Pass |
| | 6 (2437) | 16.020 | 17.492 | > 500 kHz | Pass |
| | 11 (2462) | 16.010 | 17.494 | > 500 kHz | Pass |

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

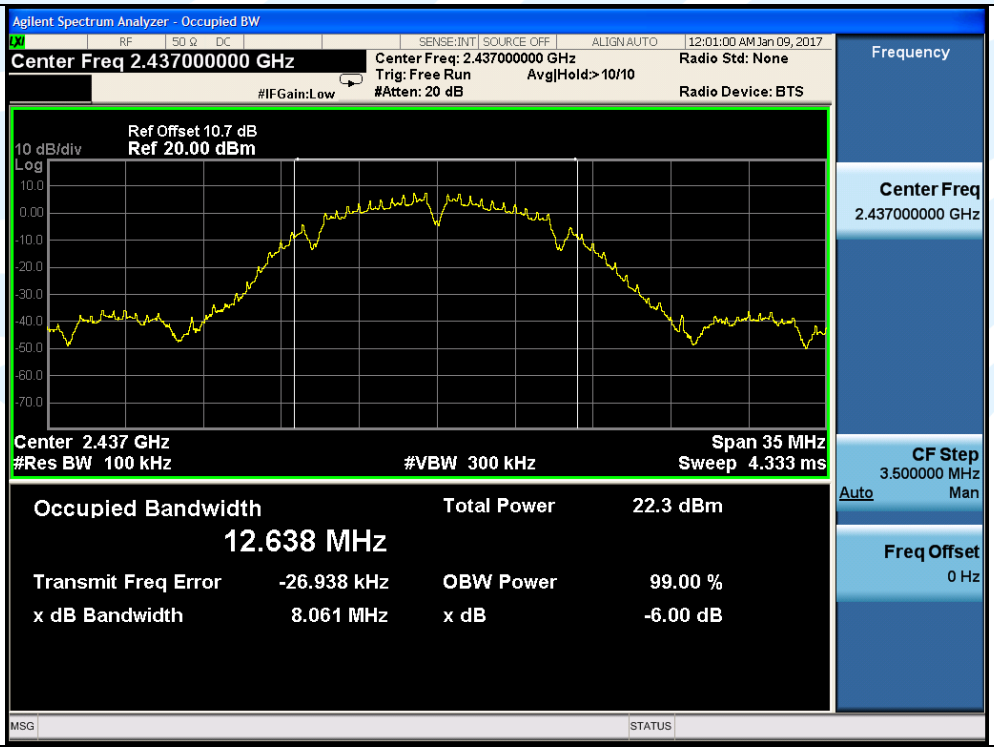
**The test plot as follows:**

**Test Mode: 802.11b**

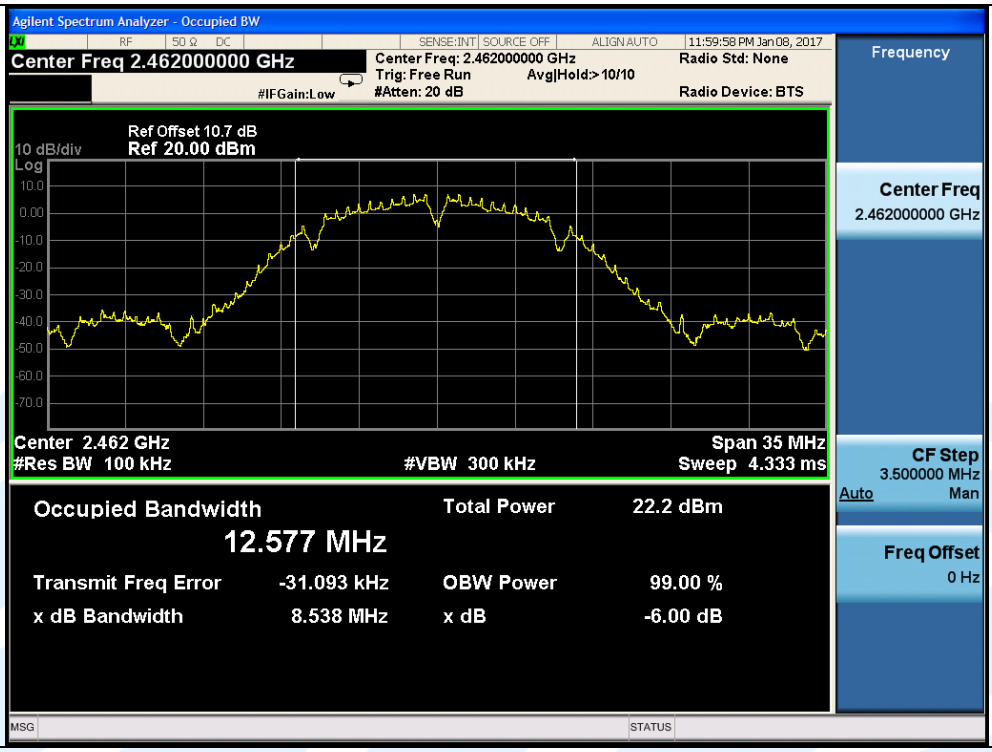
**2412MHz**




**2437MHz**

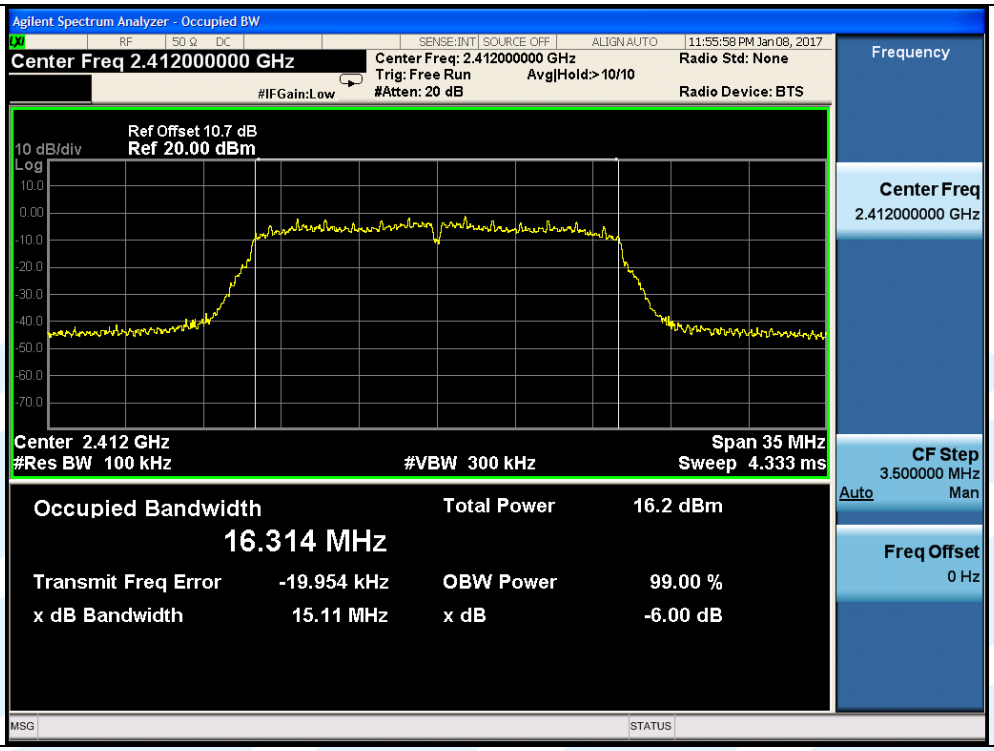


**2462MHz**

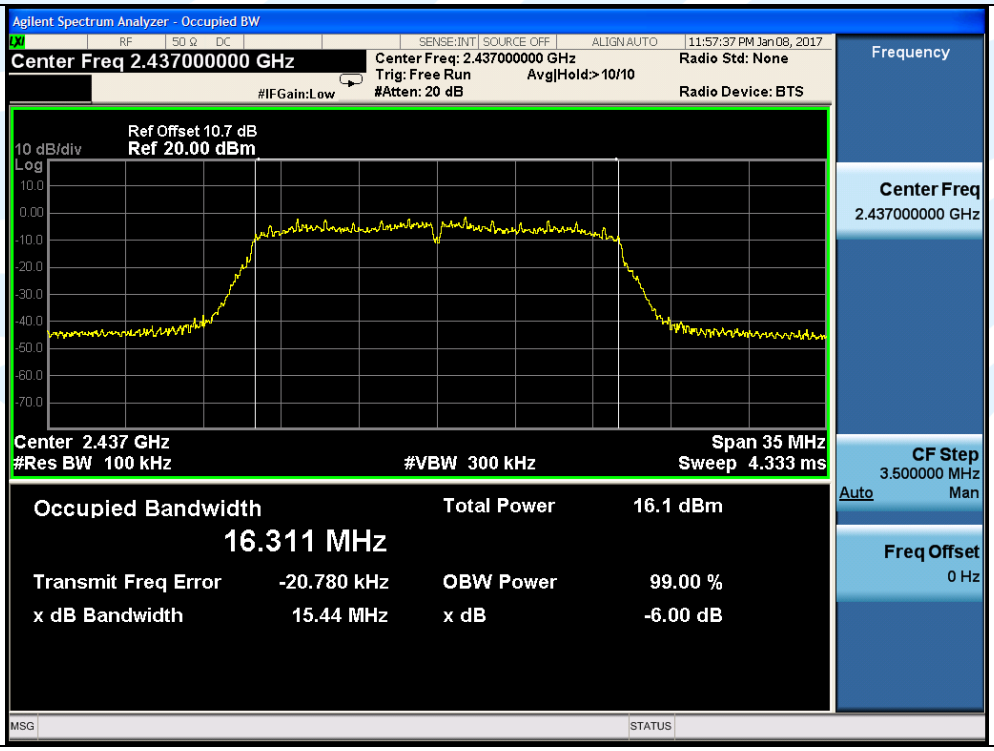

Agilent Spectrum Analyzer - Occupied BW
RF 50 Ω DC
SENSE:INT SOURCE OFF ALIGN AUTO 11:59:58 PM Jan 08, 2017
Center Freq 2.462000000 GHz
Center Freq: 2.462000000 GHz
Trig: Free Run Avg|Hold:>10/10
#IFGain:Low #Atten: 20 dB
Radio Std: None
Radio Device: BTS
Frequency
Ref Offset 10.7 dB
10 dB/div Ref 20.00 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 35 MHz
Sweep 4.333 ms
Occupied Bandwidth
12.577 MHz
Total Power 22.2 dBm
Transmit Freq Error -31.093 kHz
OBW Power 99.00 %
x dB Bandwidth 8.538 MHz
x dB -6.00 dB
Center Freq
2.462000000 GHz
CF Step
3.500000 MHz
Auto Man
Freq Offset
0 Hz
MSG
STATUS

**Test Mode: 802.11g**

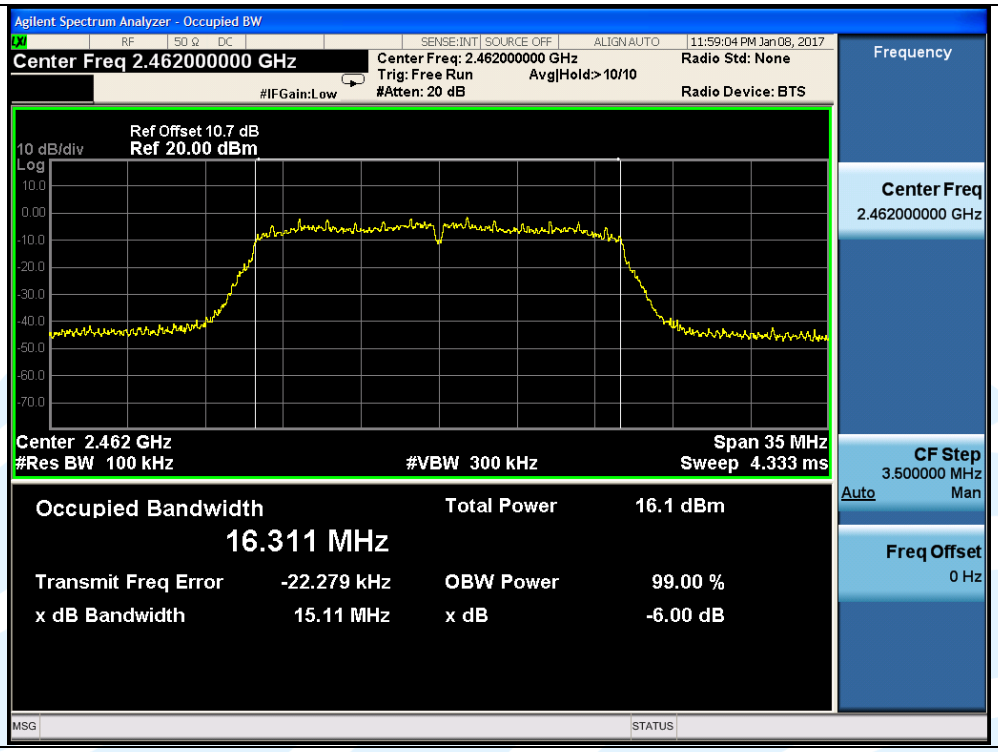
**2412MHz**




**2437MHz**

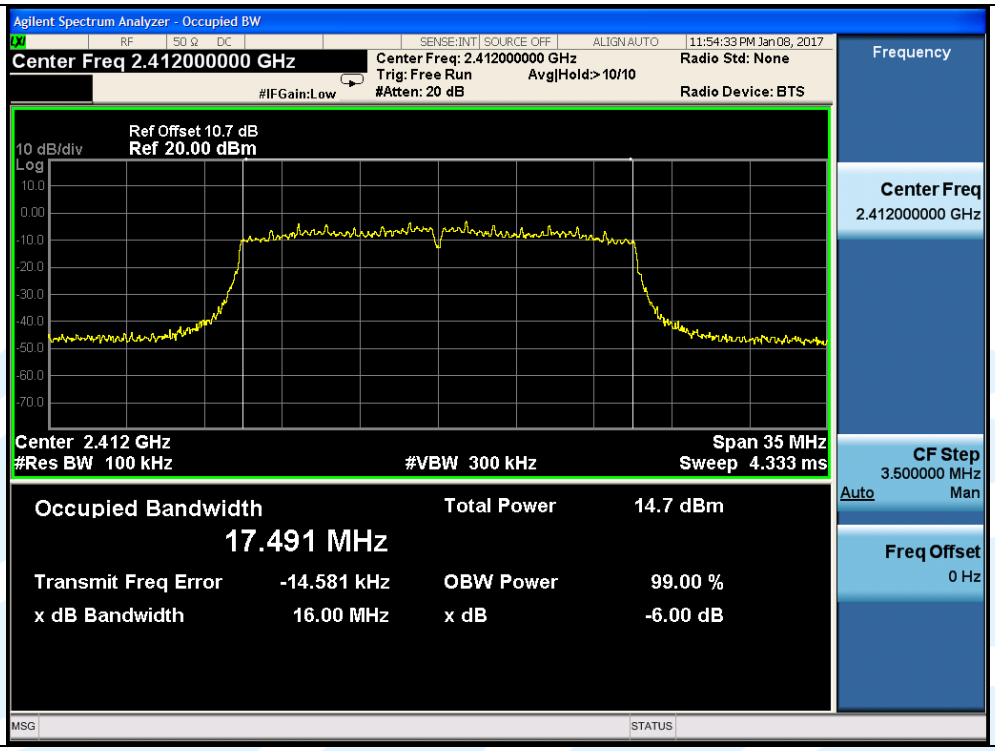


**2462MHz**

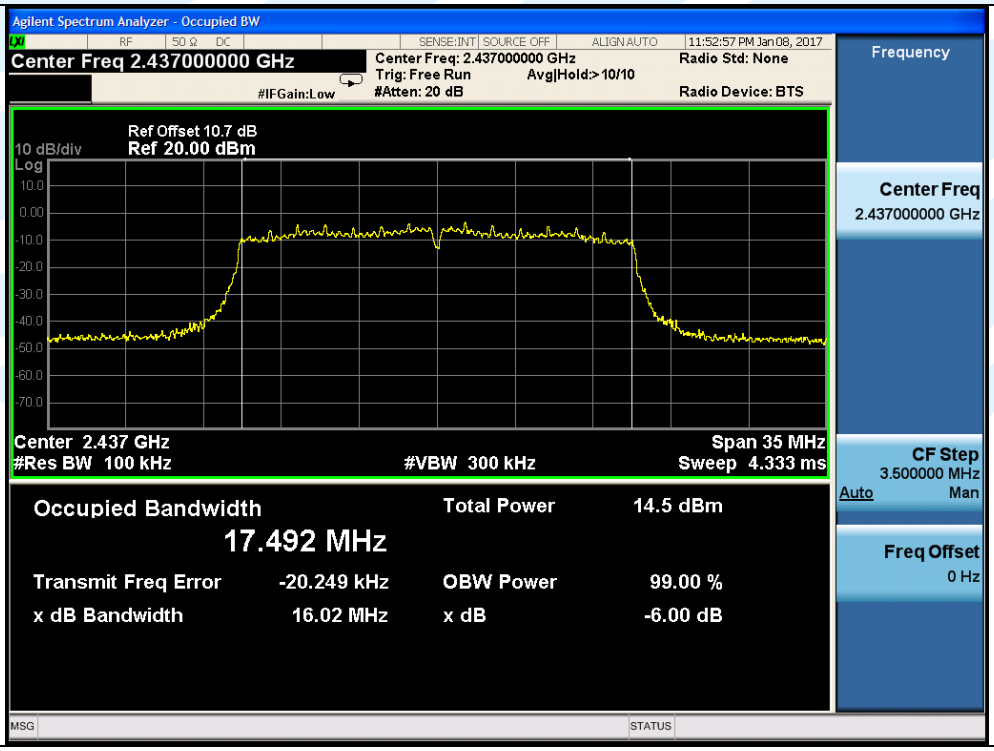

Agilent Spectrum Analyzer - Occupied BW
RF 50 Ω DC
SENSE:INT SOURCE OFF ALIGN AUTO 11:59:04 PM Jan 08, 2017
Center Freq 2.462000000 GHz
Center Freq: 2.462000000 GHz
Trig: Free Run Avg|Hold:>10/10
#Atten: 20 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
Frequency
Ref Offset 10.7 dB
10 dB/div Ref 20.00 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 35 MHz
Sweep 4.333 ms
Occupied Bandwidth
16.311 MHz
Total Power 16.1 dBm
Transmit Freq Error -22.279 kHz
OBW Power 99.00 %
x dB Bandwidth 15.11 MHz
x dB -6.00 dB
Center Freq
2.462000000 GHz
CF Step
3.500000 MHz
Auto Man
Freq Offset
0 Hz
MSG
STATUS

**Test Mode: 802.11n(HT20)**

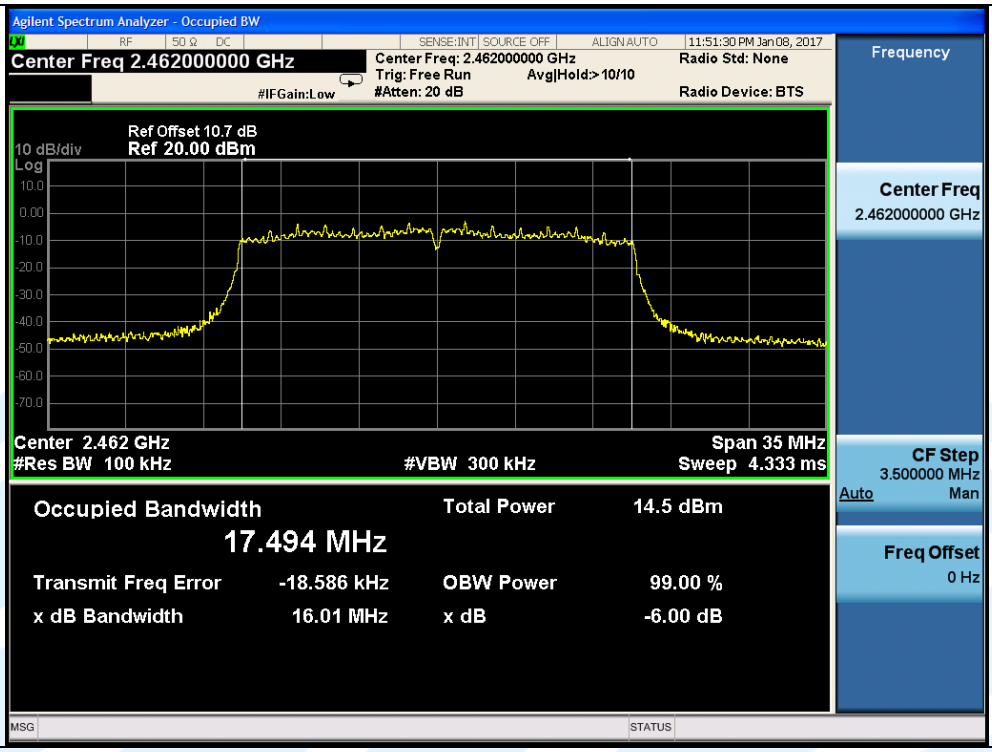
**2412MHz**




**2437MHz**



**2462MHz**


Agilent Spectrum Analyzer - Occupied BW
RF 50 Ω DC
SENSE:INT SOURCE OFF ALIGN AUTO 11:51:30 PM Jan 08, 2017
Center Freq 2.462000000 GHz
Center Freq: 2.462000000 GHz
Trig: Free Run Avg|Hold:>10/10
#Atten: 20 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
Frequency
Ref Offset 10.7 dB
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 35 MHz
Sweep 4.333 ms
Occupied Bandwidth
17.494 MHz
Total Power 14.5 dBm
Transmit Freq Error -18.586 kHz
OBW Power 99.00 %
x dB Bandwidth 16.01 MHz
x dB -6.00 dB
Center Freq
2.462000000 GHz
CF Step
3.500000 MHz
Auto Man
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:**

**Test Data:**

| Mode | Channel/ Frequency (MHz) | PSD (dBm) | PSD Limit (dBm) | Result (Pass / Fail) |
|---|---|---|---|---|
| 802.11b | 1 (2412) | -5.479 | 8 | Pass |
| | 6 (2437) | -5.510 | 8 | Pass |
| | 11 (2462) | -5.275 | 8 | Pass |
| 802.11g | 1 (2412) | -14.123 | 8 | Pass |
| | 6 (2437) | -13.478 | 8 | Pass |
| | 11 (2462) | -14.301 | 8 | Pass |
| 802.11n (HT20) | 1 (2412) | -15.559 | 8 | Pass |
| | 6 (2437) | -16.590 | 8 | Pass |
| | 11 (2462) | -16.120 | 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**

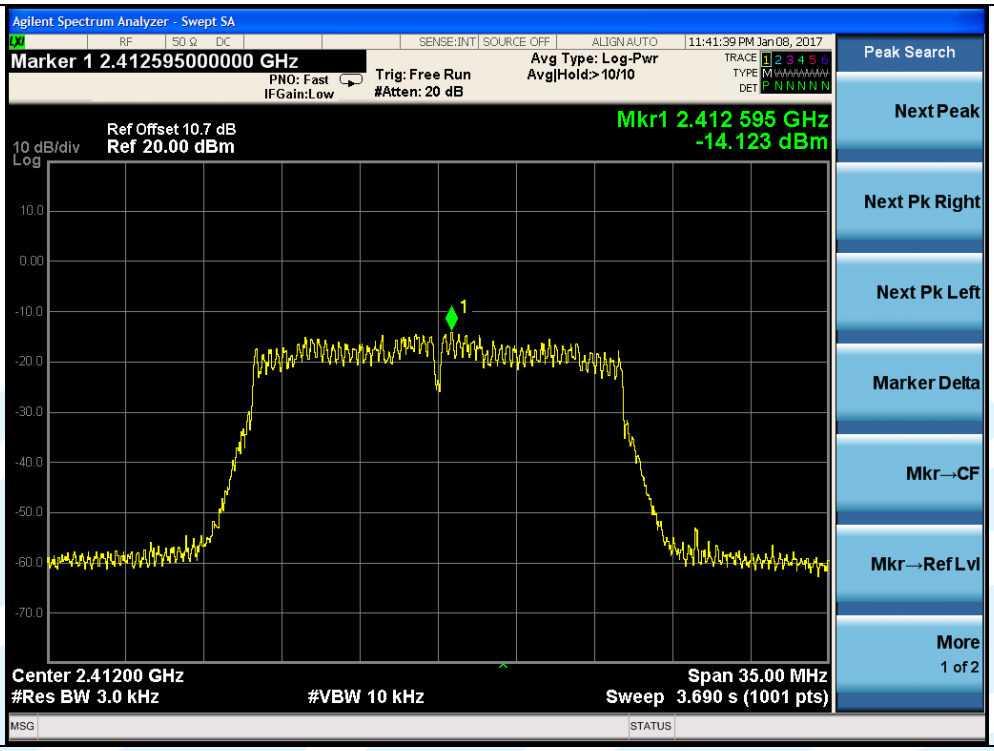

**2437MHz**

**2462MHz**

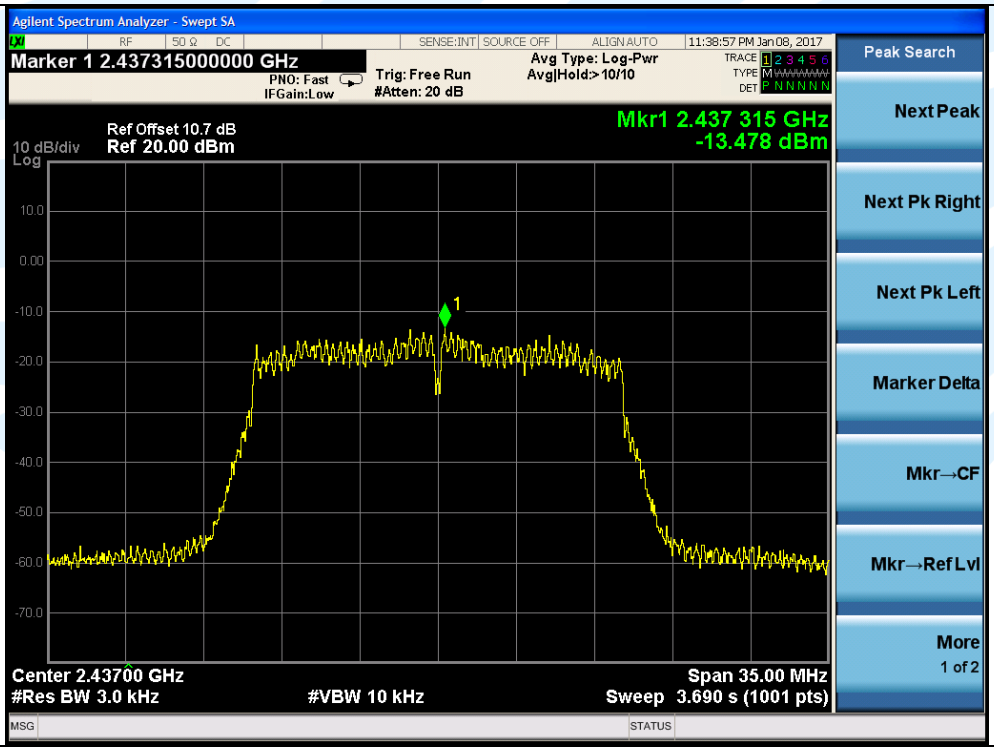

Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT SOURCE OFF ALIGN AUTO 11:32:15 PM Jan 08, 2017
Marker 1 2.462770000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 10.7 dB
10 dB/div Ref 20.00 dBm
Log
Mkr1 2.462 770 GHz
-5.275 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 2.46200 GHz
#Res BW 3.0 kHz
#VBW 10 kHz
Span 35.00 MHz
Sweep 3.690 s (1001 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

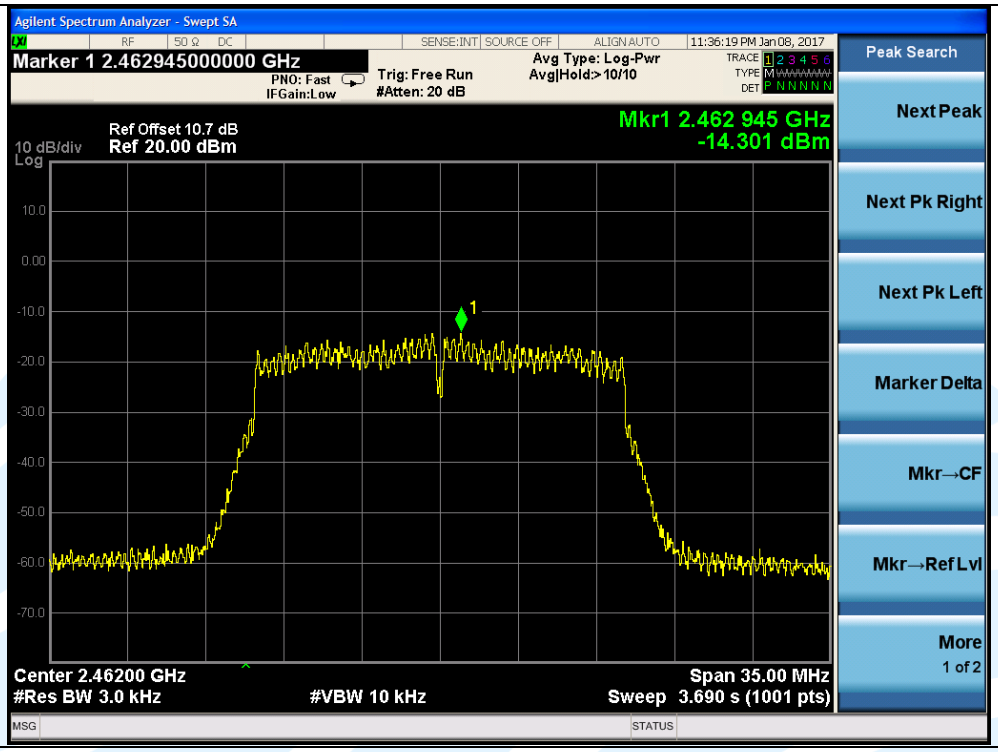
**Test Mode: 802.11g**

**2412MHz**




**2437MHz**

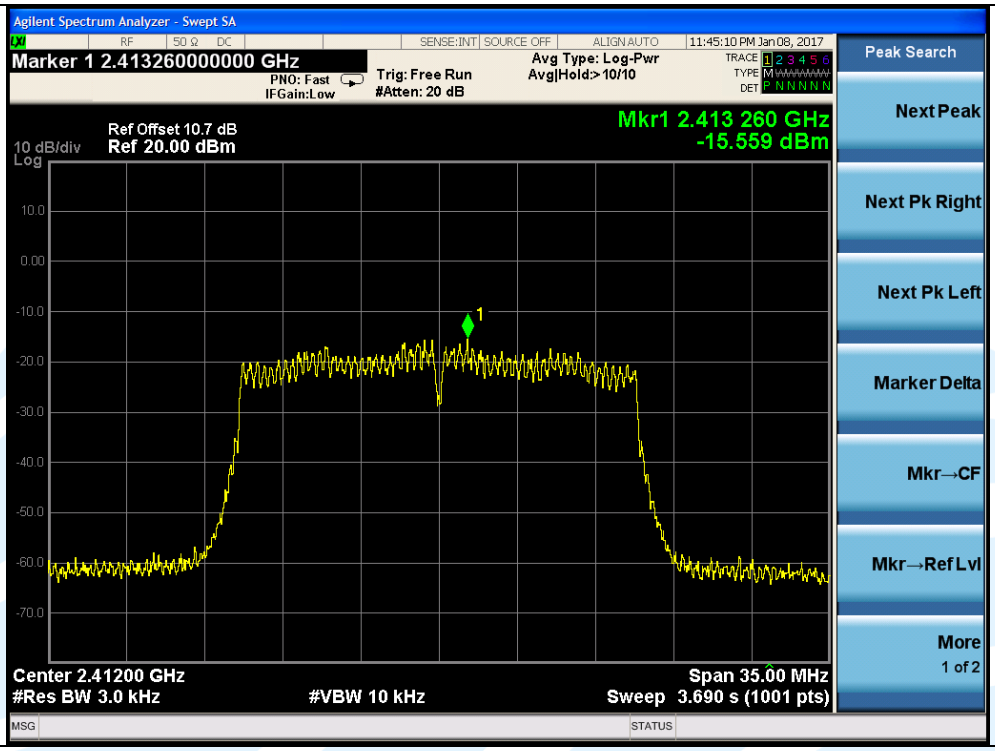


| 2462MHz |
| --- |
|  |

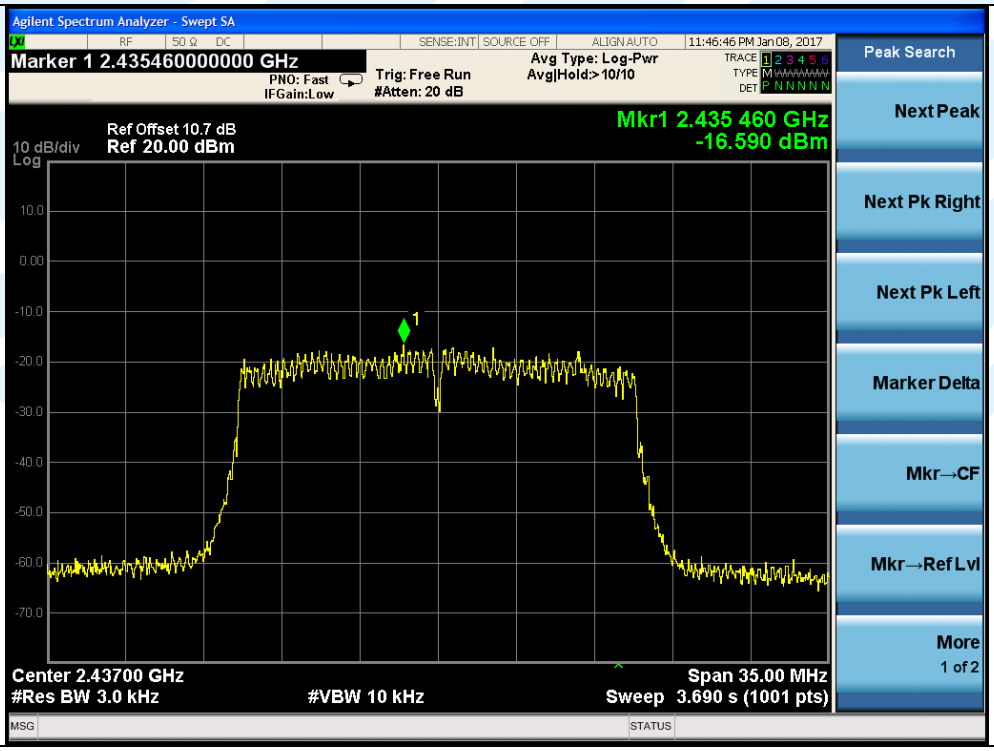
Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT SOURCE OFF ALIGN AUTO 11:36:19 PM Jan 08, 2017
Marker 1 2.462945000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 10.7 dB
10 dB/div Ref 20.00 dBm
Log
Mkr1 2.462 945 GHz
-14.301 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 2.46200 GHz
#Res BW 3.0 kHz
#VBW 10 kHz
Span 35.00 MHz
Sweep 3.690 s (1001 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

**Test Mode: 802.11n(HT20)**

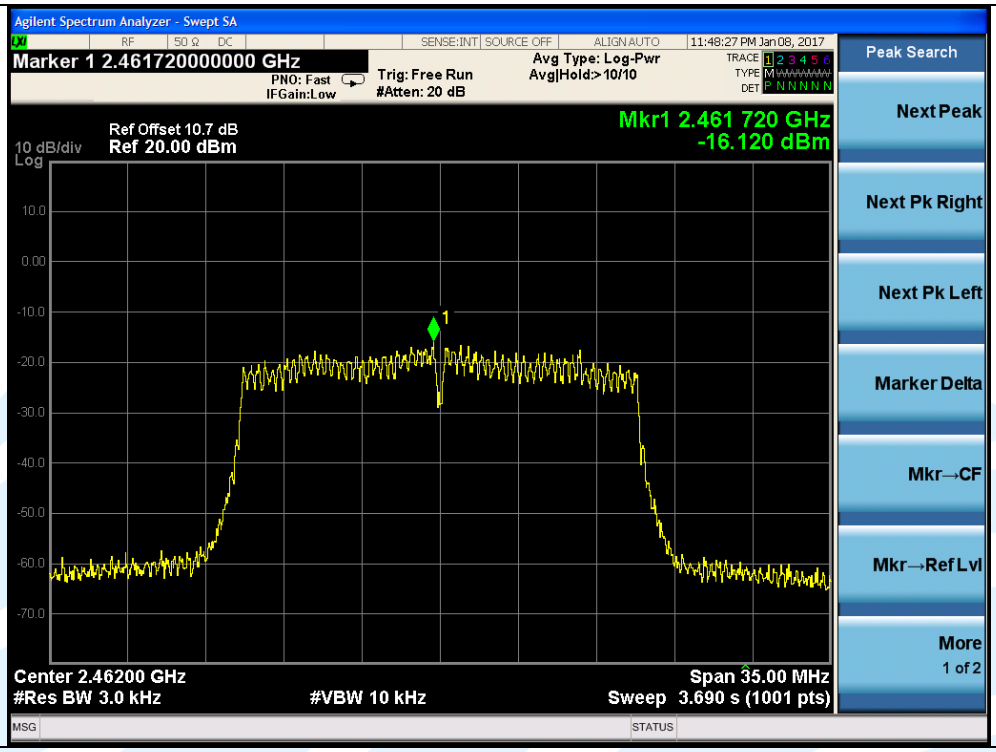
**2412MHz**




**2437MHz**



**2462MHz**


Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT SOURCE OFF ALIGN AUTO 11:48:27 PM Jan 08, 2017
Marker 1 2.461720000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 10.7 dB
10 dB/div Ref 20.00 dBm
Log
Mkr1 2.461 720 GHz
-16.120 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
1
Center 2.46200 GHz
#Res BW 3.0 kHz
#VBW 10 kHz
Span 35.00 MHz
Sweep 3.690 s (1001 pts)
MSG
STATUS
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

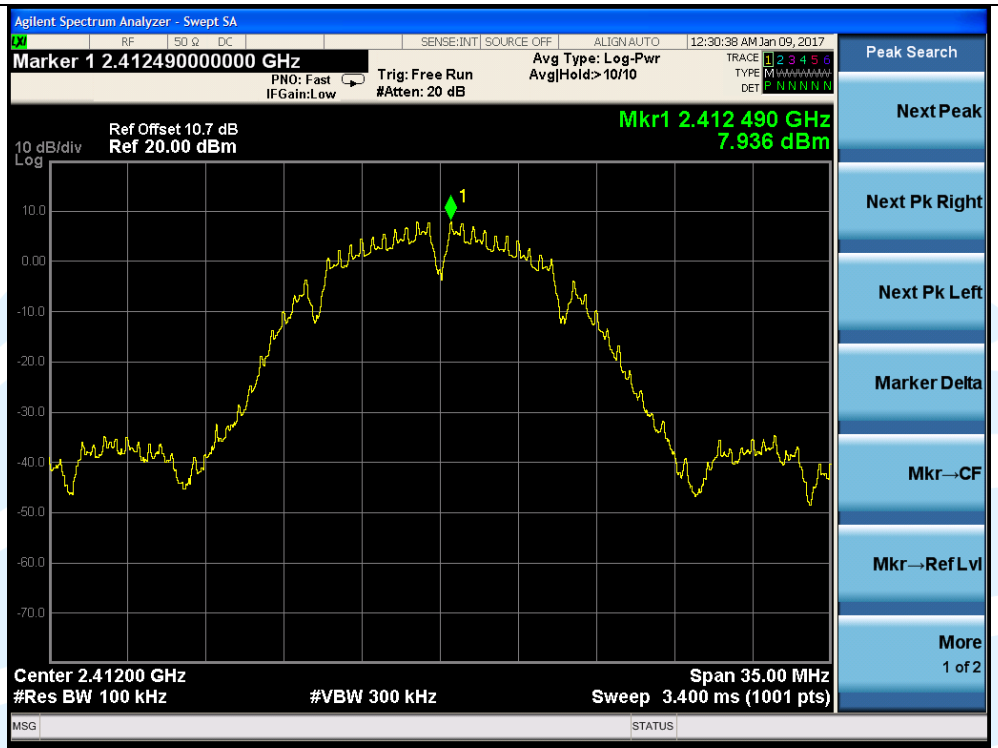
**Test Results:** Pass

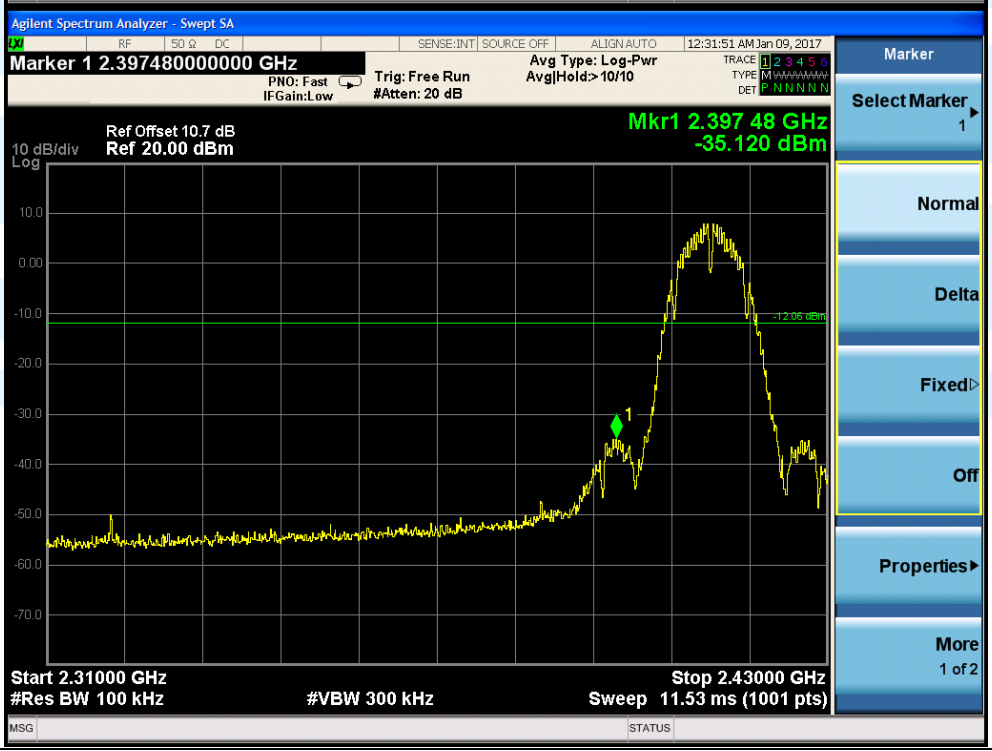
**The test plot as follows:**

**Test Mode: 802.11b**

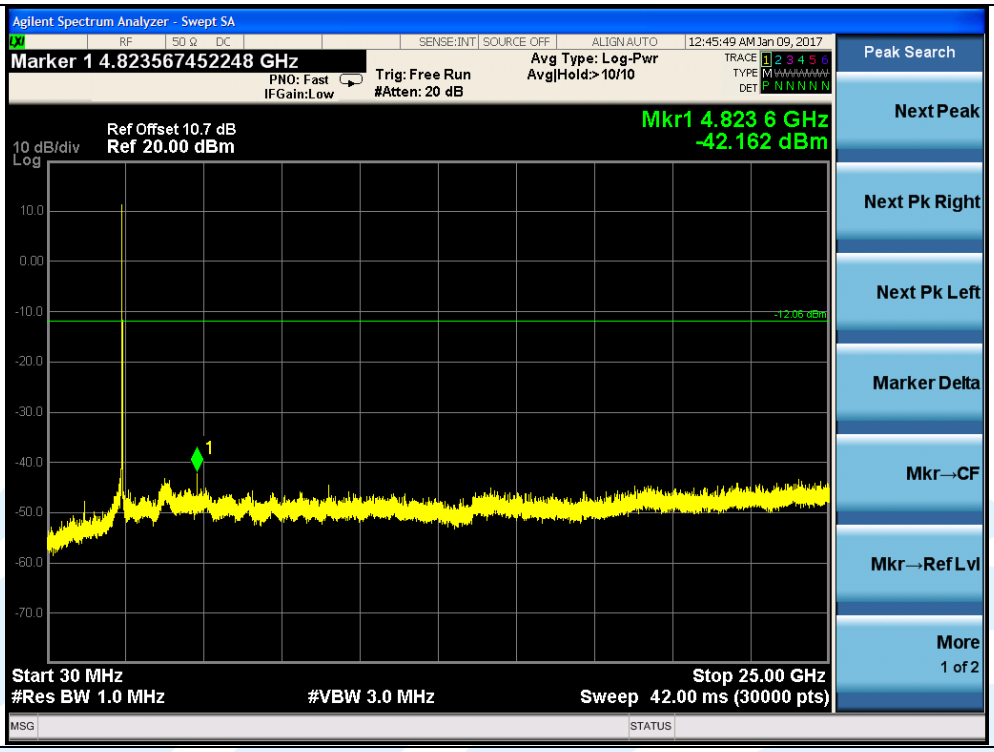
**2412MHz**

**In-Band Reference Level**



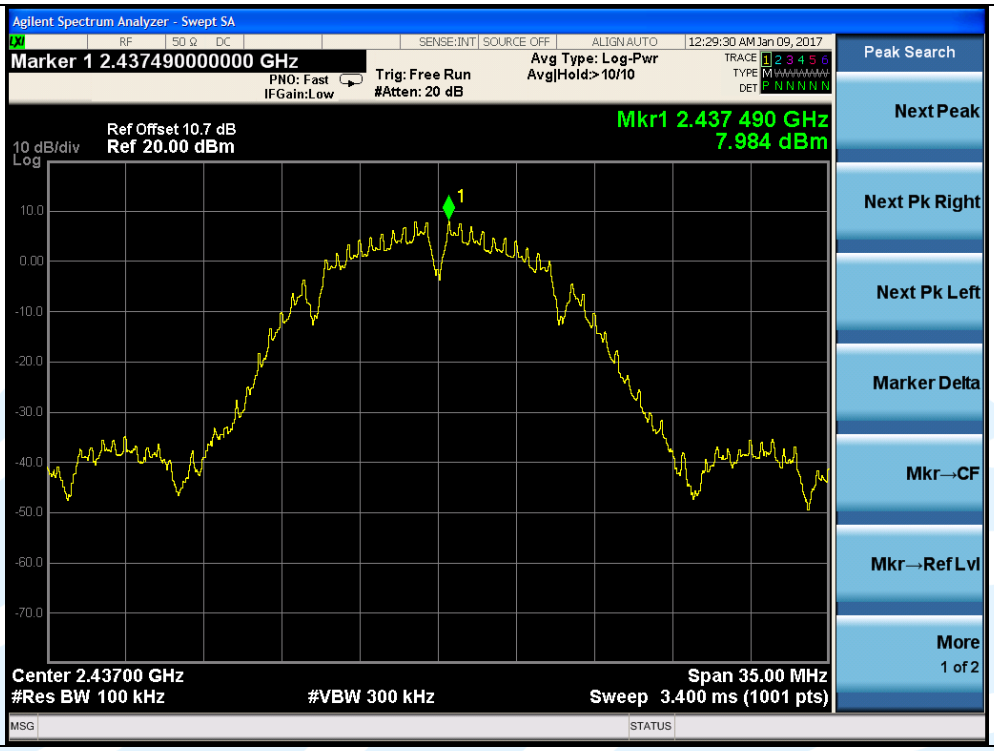




**Out of Band**

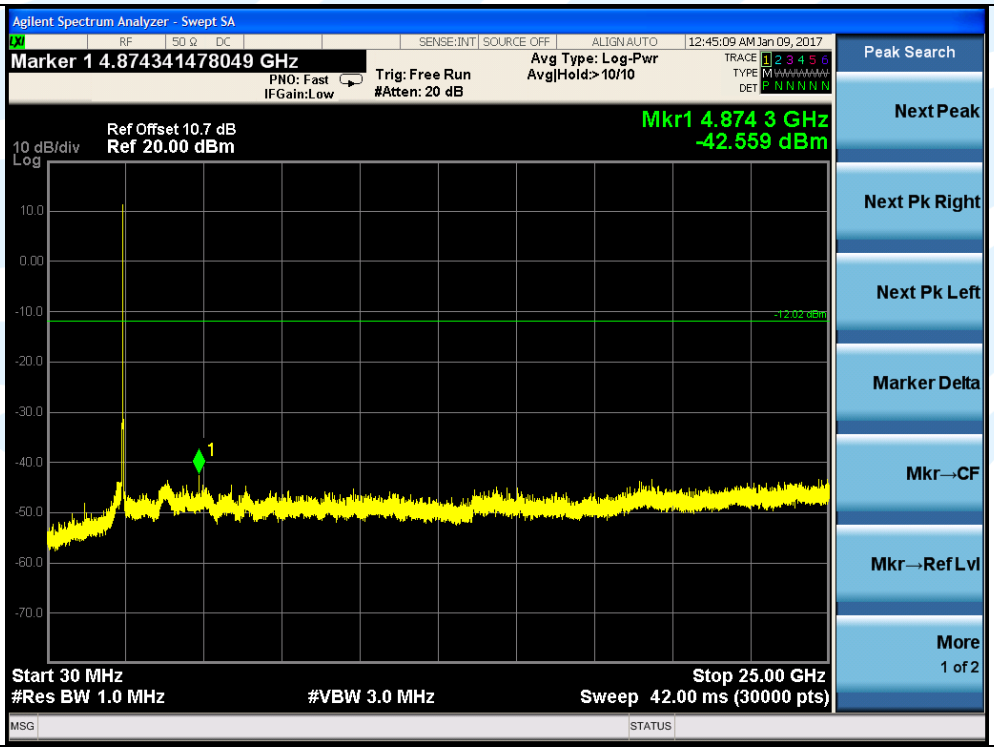

Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT SOURCE OFF ALIGN AUTO 12:45:49 AM Jan 09, 2017
Marker 1 4.823567452248 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 10.7 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 4.823 6 GHz
-42.162 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-12.06 dBm
1
Start 30 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 42.00 ms (30000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

**2437MHz**

**In-Band Reference Level**

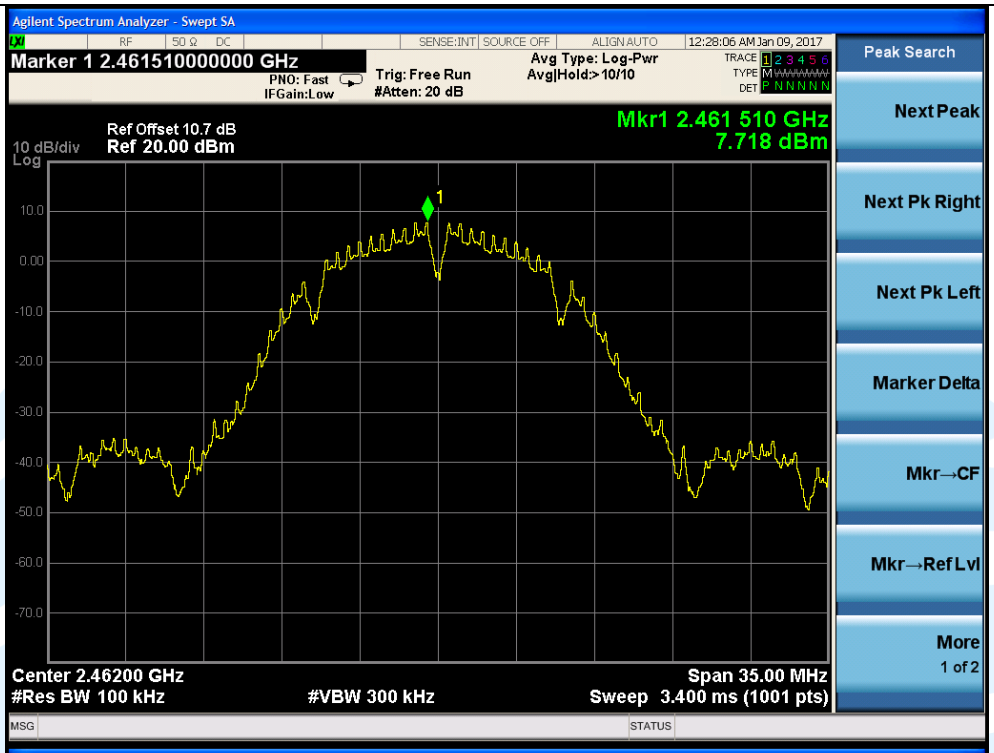



**Out of Band**



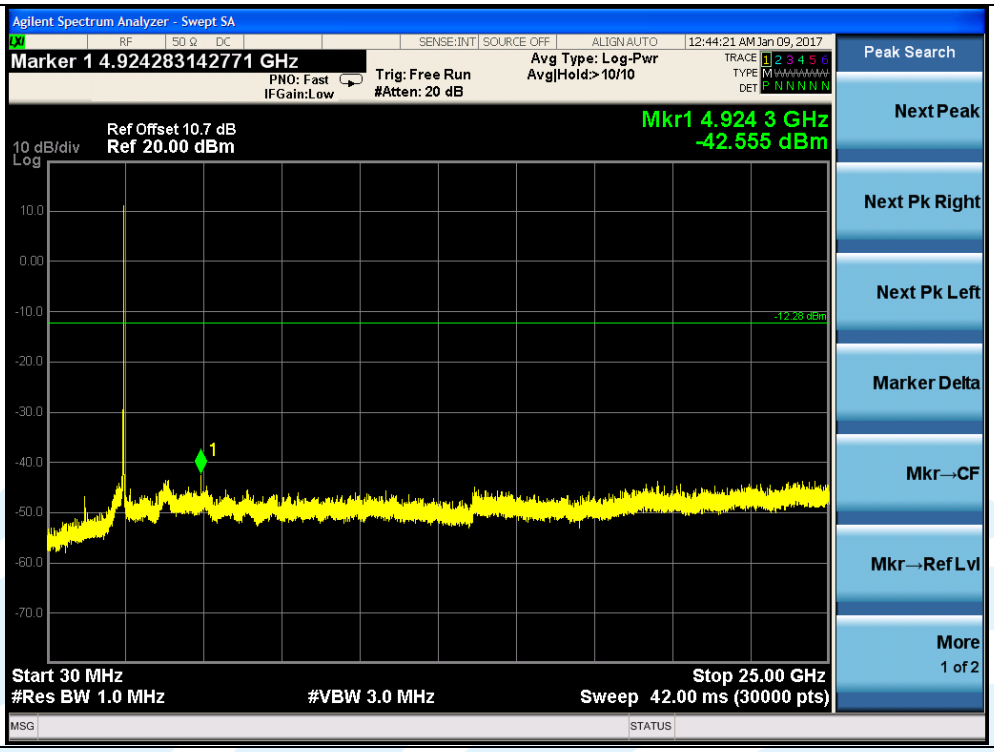
**2462MHz**

**In-Band Reference Level**





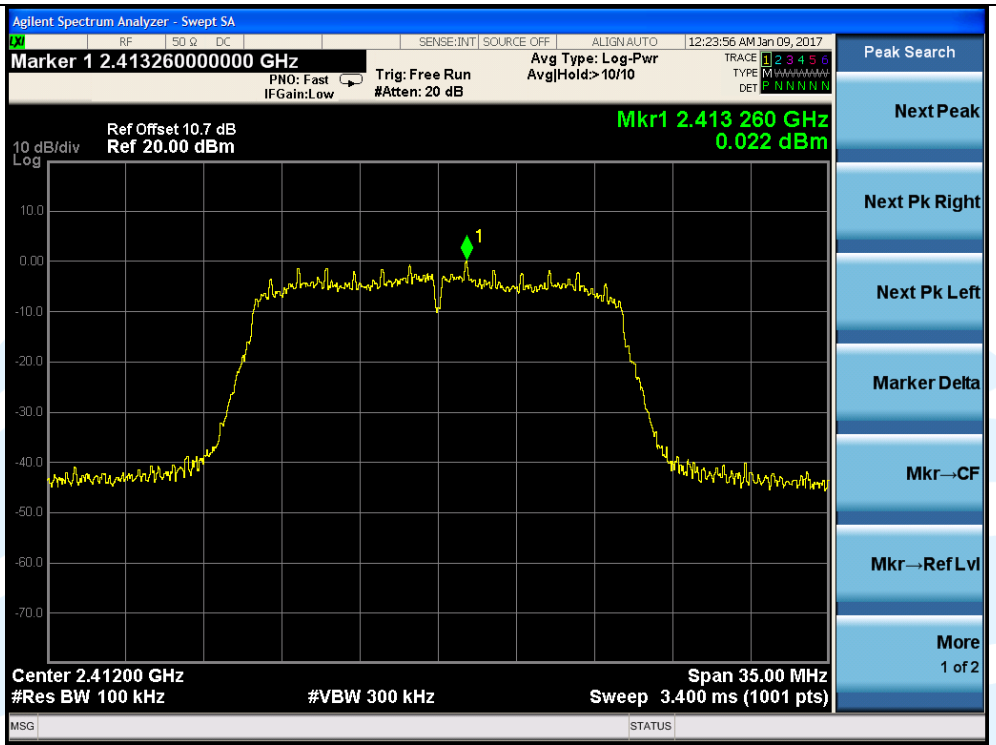
**Out of Band**

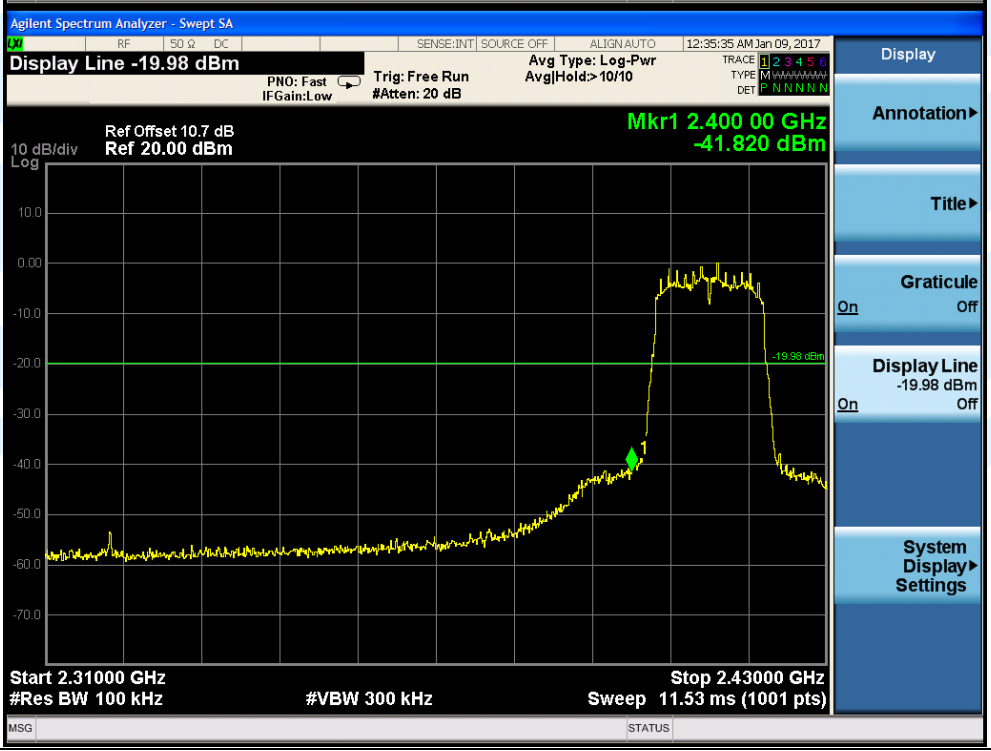

Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT SOURCE OFF ALIGN AUTO 12:44:21 AM Jan 09, 2017
Marker 1 4.924283142771 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 10.7 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 4.924 3 GHz
-42.555 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-12.28 dBm
1
Start 30 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 42.00 ms (30000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

**Test Mode: 802.11g**

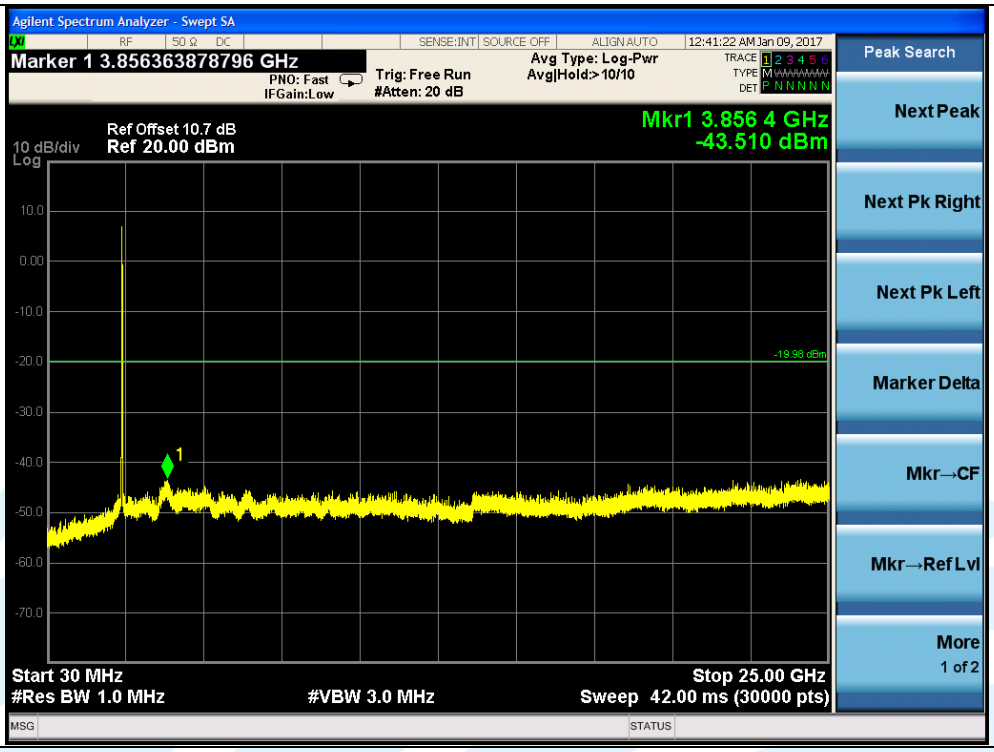
**2412MHz**

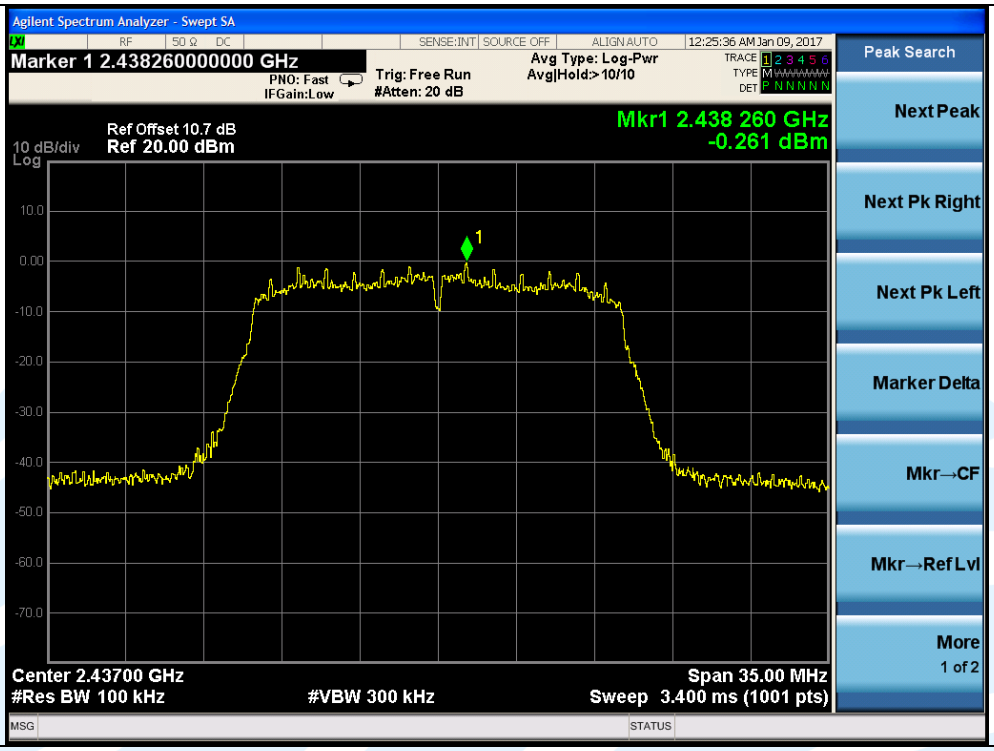
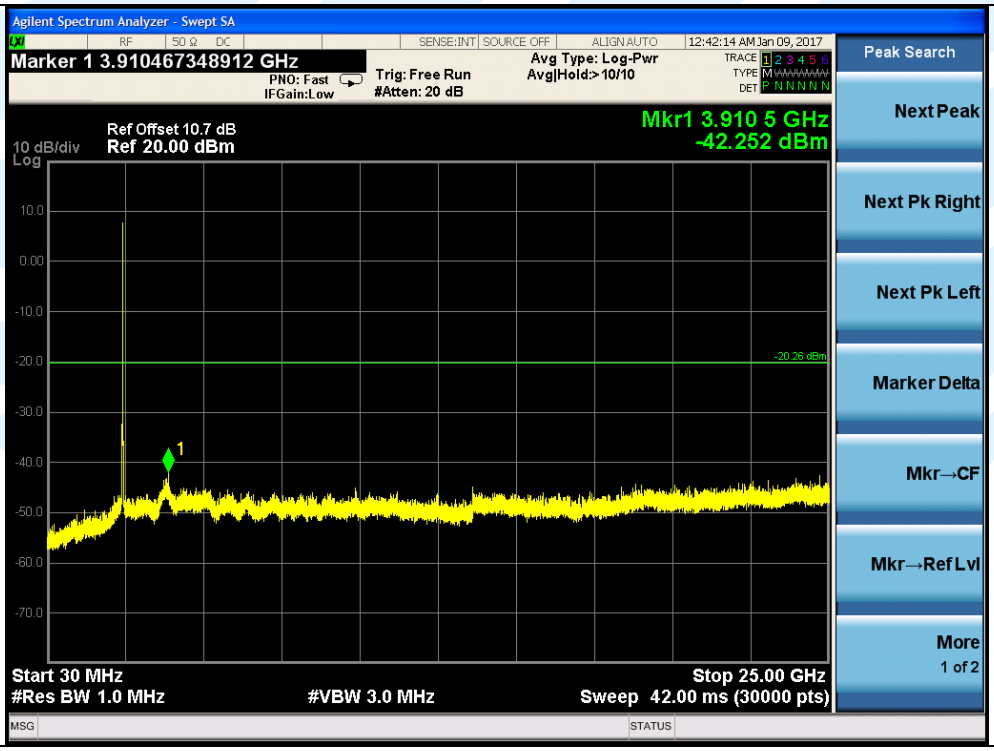
**In-Band Reference Level**



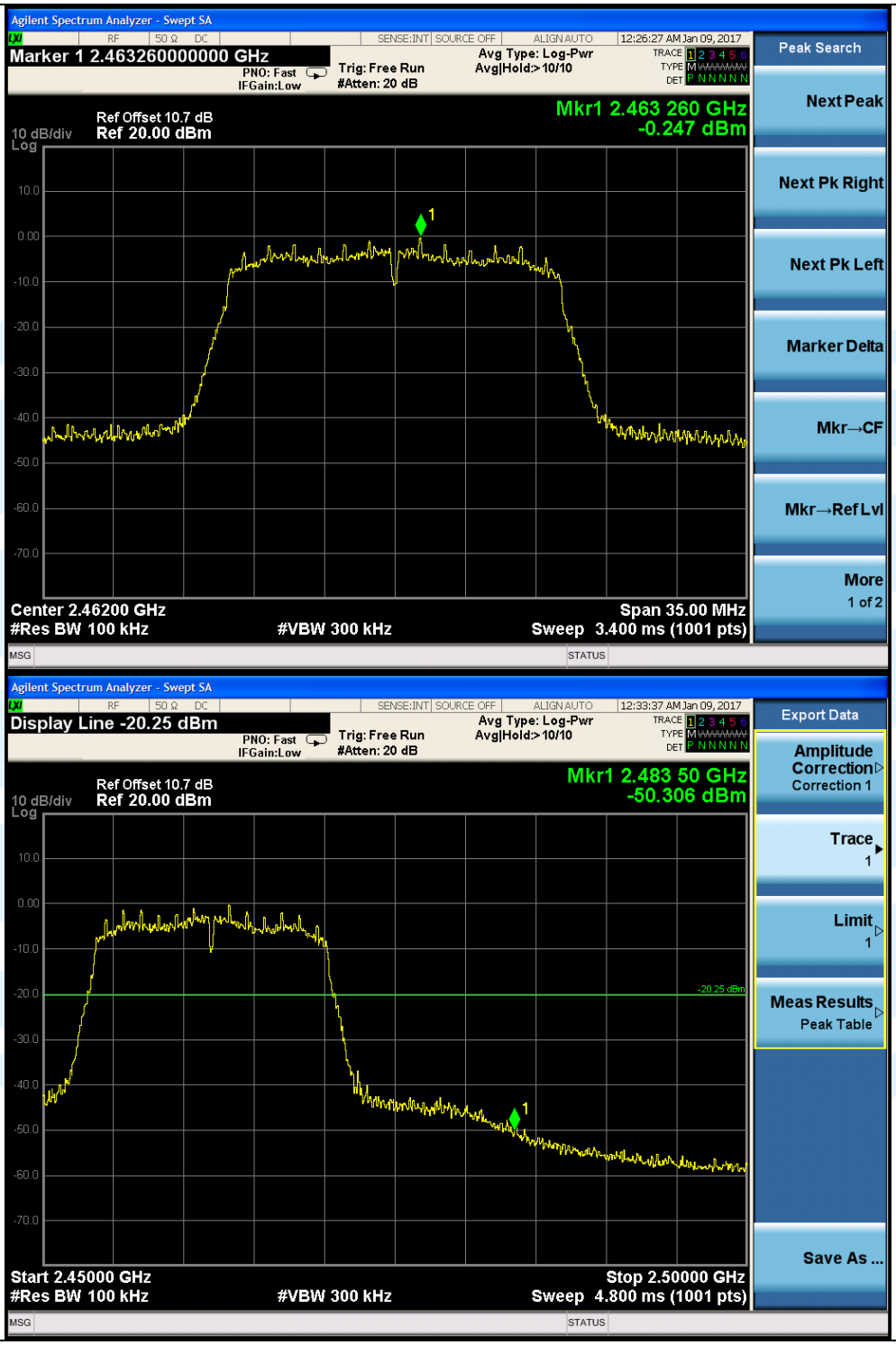

**Out of Band**


Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT SOURCE OFF ALIGN AUTO 12:41:22 AM Jan 09, 2017
Marker 1 3.856363878796 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 10.7 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 3.856 4 GHz
-43.510 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-19.98 dBm
1
Start 30 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 42.00 ms (30000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

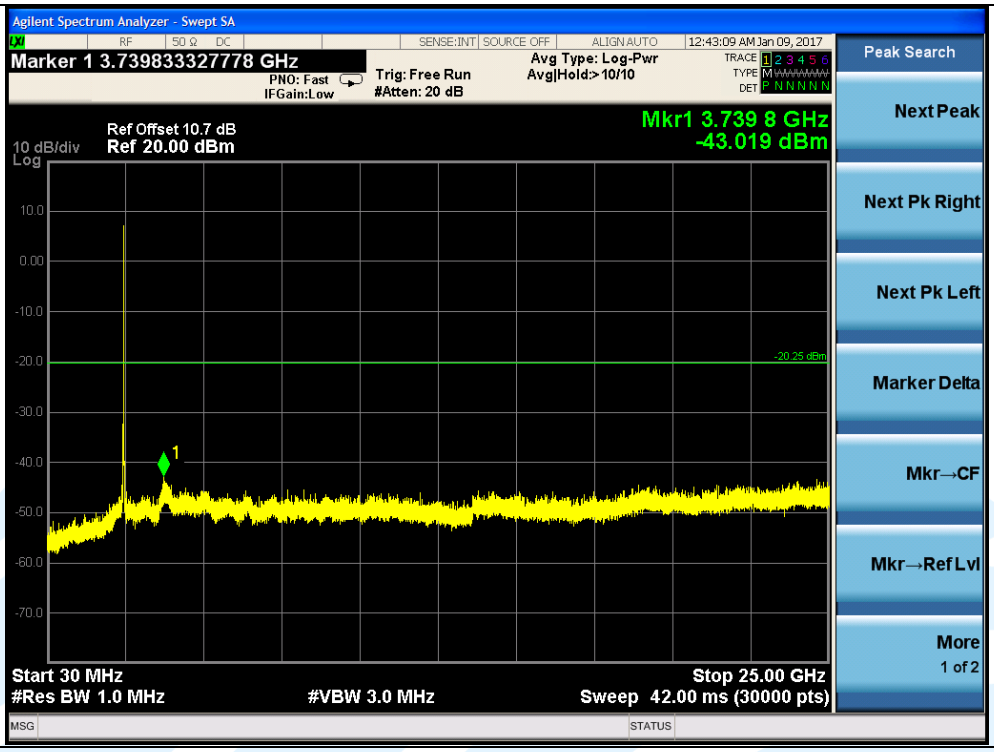
| 2437MHz |
| --- |
| In-Band Reference Level |
|  |
| Out of Band |
|  |

**2462MHz**

**In-Band Reference Level**



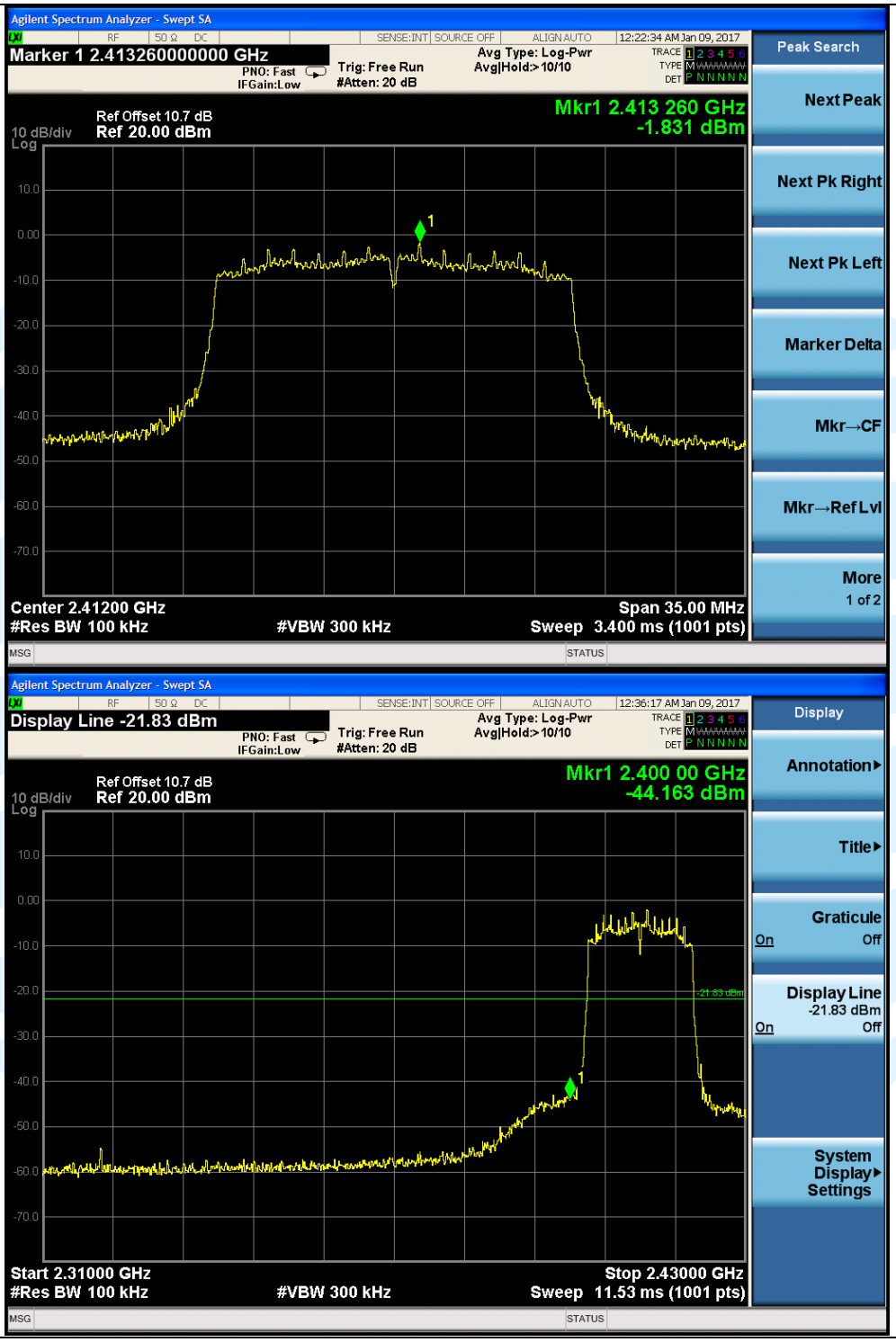

**Out of Band**


Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT SOURCE OFF ALIGN AUTO 12:43:09 AM Jan 09, 2017
Marker 1 3.739833327778 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 10.7 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 3.739 8 GHz
-43.019 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-20.25 dBm
1
Start 30 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 42.00 ms (30000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

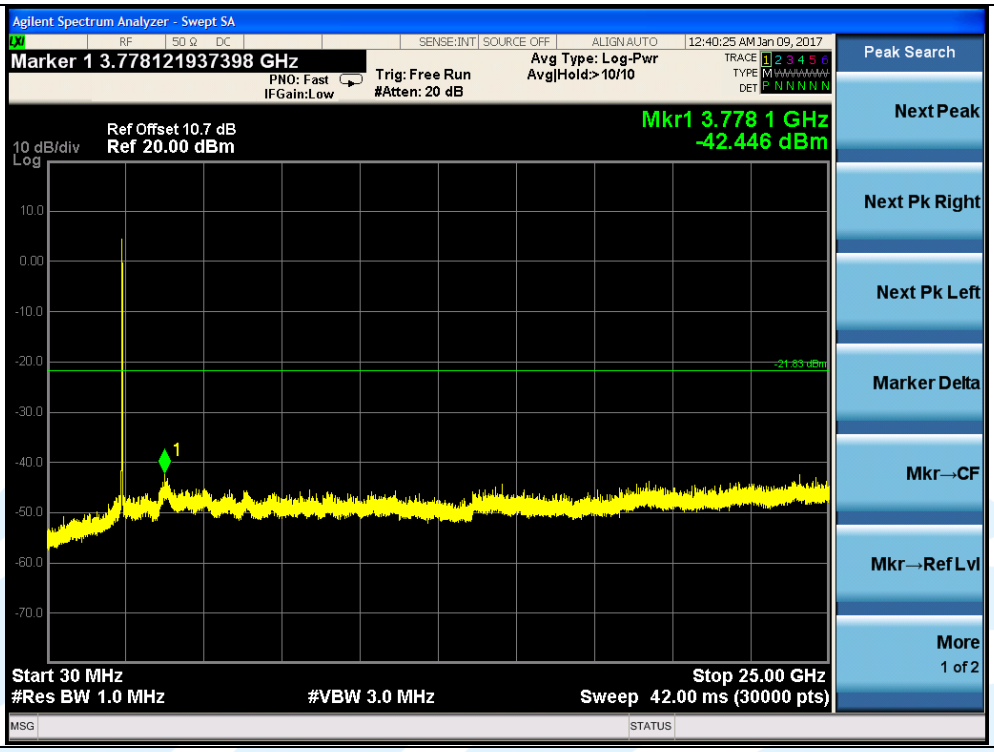
**Test Mode: 802.11 n(HT20)**

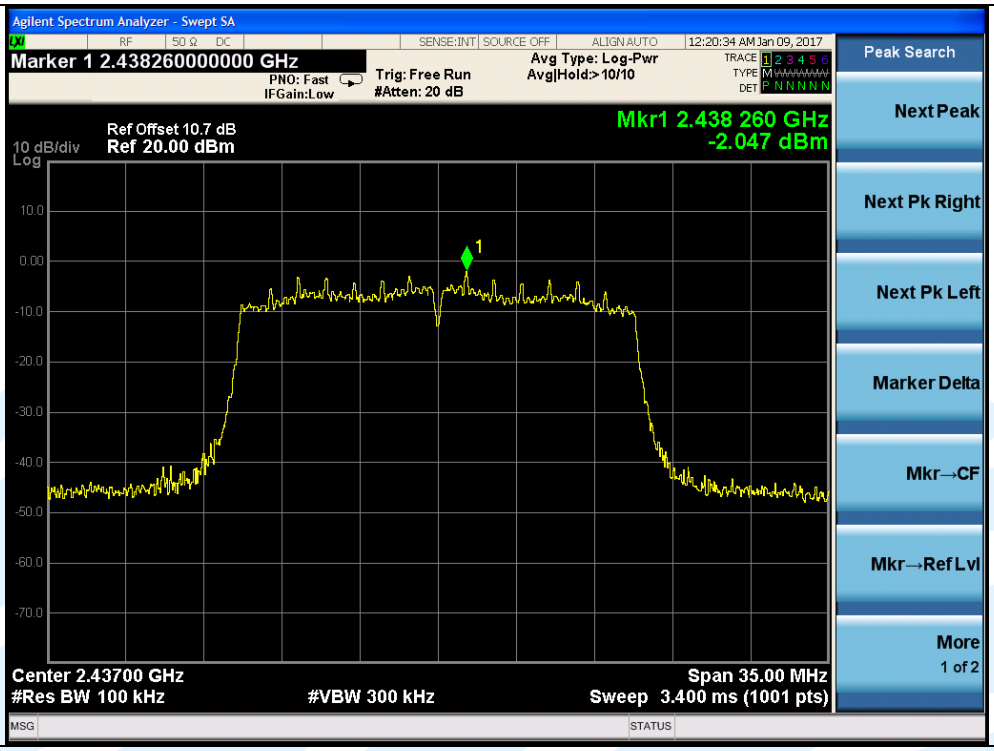
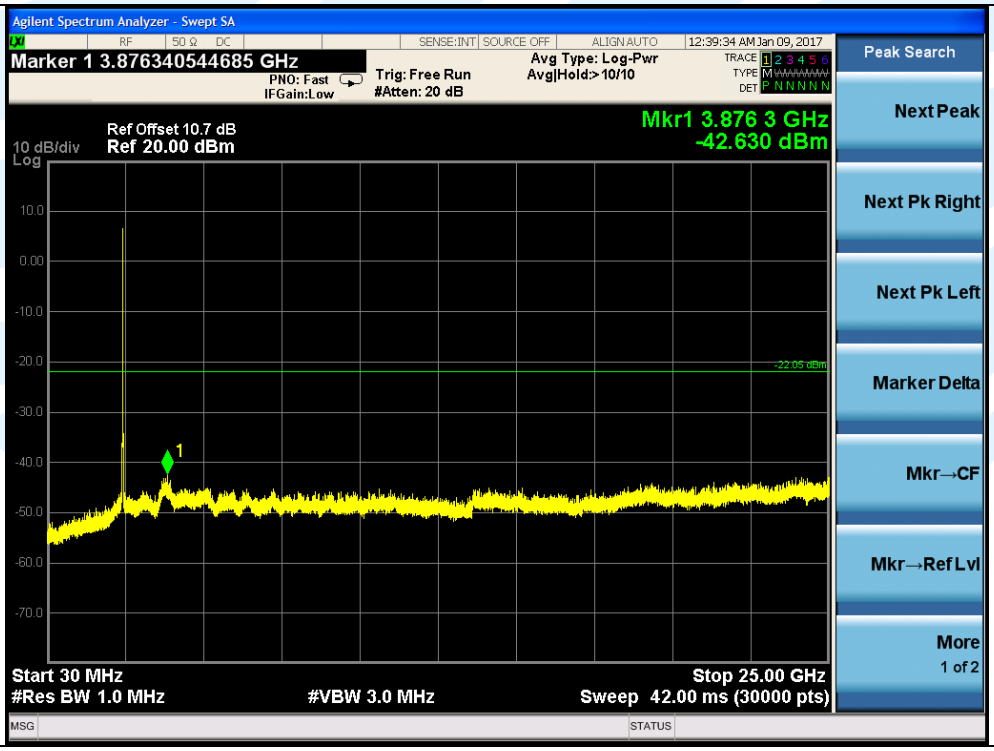
**2412MHz**

**In-Band Reference Level**



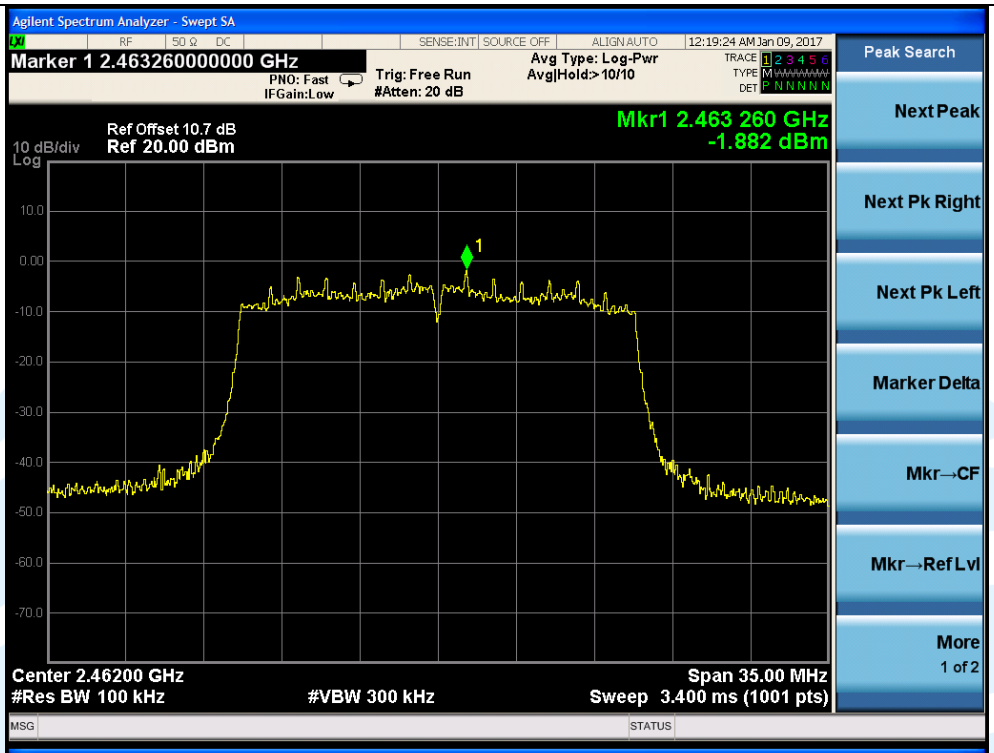

**Out of Band**


Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT SOURCE OFF ALIGN AUTO 12:40:25 AM Jan 09, 2017
Marker 1 3.778121937398 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 10.7 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 3.778 1 GHz
-42.446 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-21.83 dBm
1
Start 30 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 42.00 ms (30000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

| 2437MHz |
| --- |
| In-Band Reference Level |
|  |
| Out of Band |
|  |

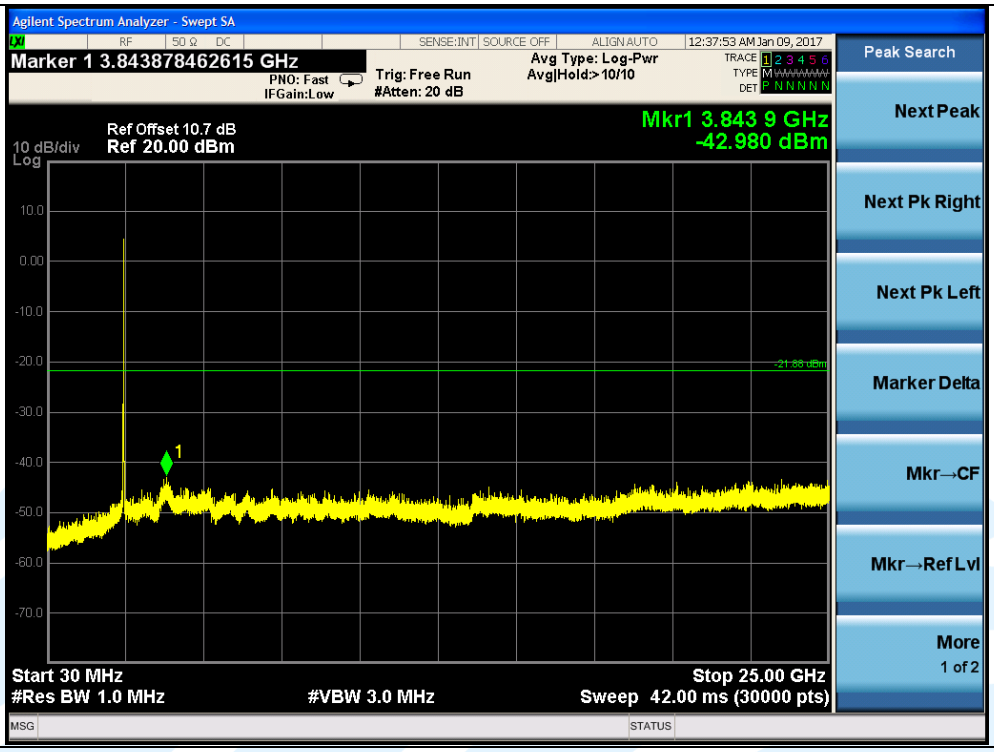
**2462MHz**

**In-Band Reference Level**





**Out of Band**


Agilent Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT SOURCE OFF ALIGN AUTO 12:37:53 AM Jan 09, 2017
Marker 1 3.843878462615 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M
DET P N N N N N
Ref Offset 10.7 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 3.843 9 GHz
-42.980 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-21.86 dBm
1
Start 30 MHz
#Res BW 1.0 MHz
#VBW 3.0 MHz
Stop 25.00 GHz
Sweep 42.00 ms (30000 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

## 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 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 (9 KHz ~ 30MHz)**

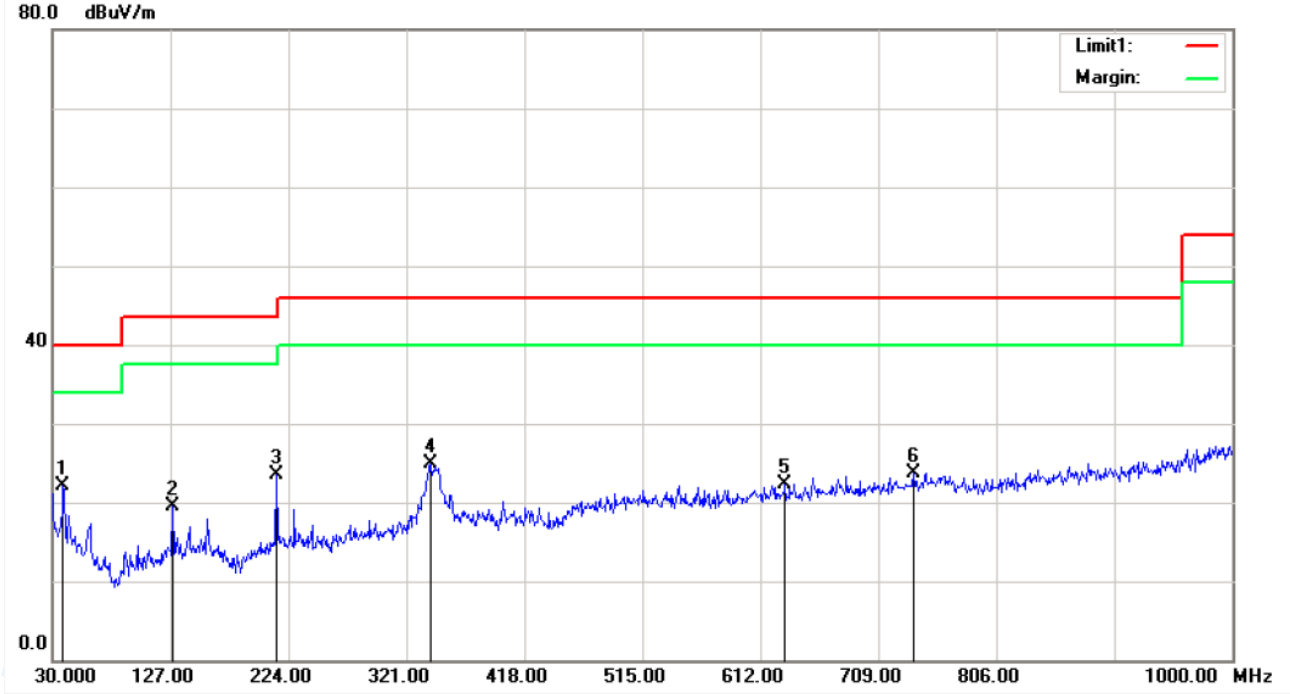
The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

**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.

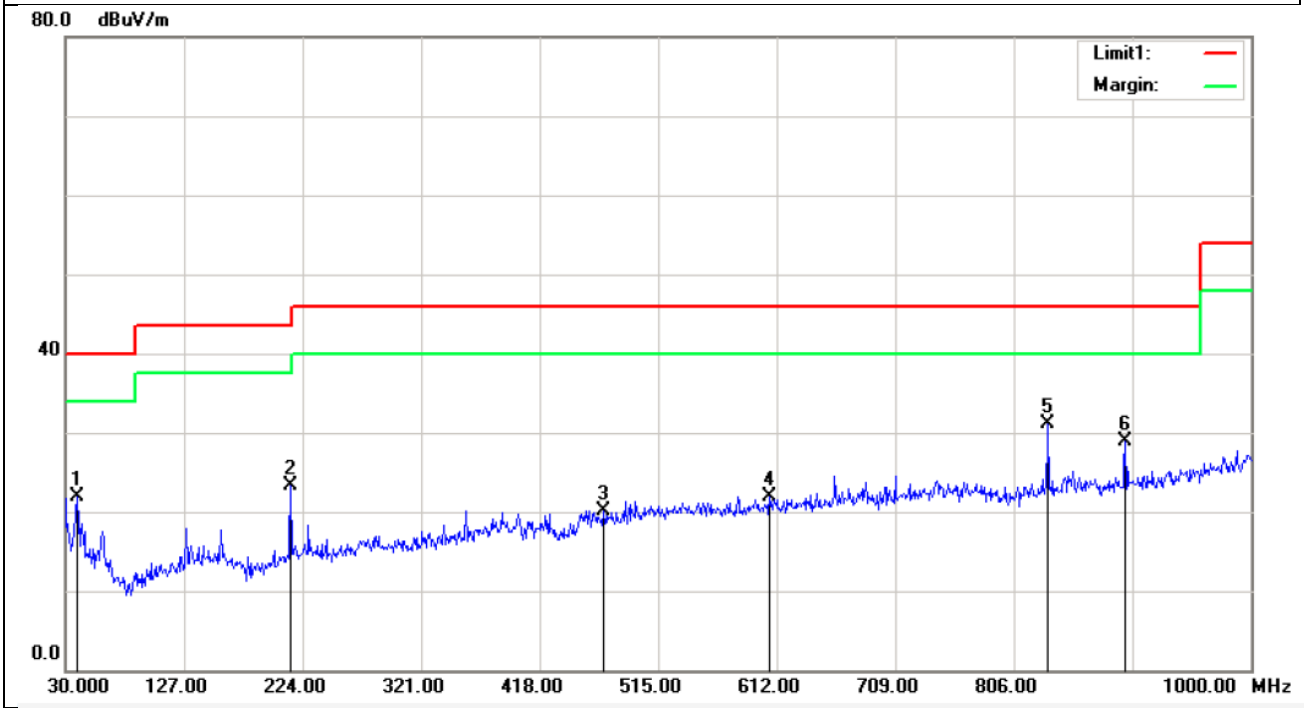
**Radiated Emission Test Data (30MHz ~ 1 GHz Worst Case):**

**Horizontal**




| No. | Frequency (MHz) | Reading (dBuV) | Correction factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 38.7300 | 33.33 | -11.27 | 22.06 | 40.00 | 17.94 | QP |
| 2 | 128.9400 | 32.04 | -12.54 | 19.50 | 43.50 | 24.00 | QP |
| 3 | 214.3000 | 34.61 | -11.20 | 23.41 | 43.50 | 20.09 | QP |
| 4 | 340.4000 | 34.51 | -9.56 | 24.95 | 46.00 | 21.05 | QP |
| 5 | 632.3700 | 27.72 | -5.44 | 22.28 | 46.00 | 23.72 | QP |
| 6 | 738.1000 | 27.28 | -3.64 | 23.64 | 46.00 | 22.36 | QP |

**Vertical**




| No. | Frequency (MHz) | Reading (dBuV) | Correction factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 39.7000 | 33.13 | -11.25 | 21.88 | 40.00 | 18.12 | QP |
| 2 | 214.3000 | 34.56 | -11.20 | 23.36 | 43.50 | 20.14 | QP |
| 3 | 470.3800 | 27.52 | -7.40 | 20.12 | 43.50 | 23.38 | QP |
| 4 | 606.1800 | 27.54 | -5.73 | 21.81 | 46.00 | 24.19 | QP |
| 5 | 834.1300 | 34.26 | -3.07 | 31.19 | 46.00 | 14.81 | QP |
| 6 | 897.1800 | 31.19 | -2.34 | 28.85 | 46.00 | 17.15 | QP |

**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 | 1207.0000 | 43.82 | 74.00 | 30.18 | Peak | Horizontal |
| 2 | 1765.0000 | 43.88 | 74.00 | 30.12 | Peak | Horizontal |
| 3 | 2179.0000 | 45.16 | 74.00 | 28.84 | Peak | Horizontal |
| 4 | 3619.0000 | 43.43 | 74.00 | 30.57 | Peak | Horizontal |
| 5 | 4231.0000 | 44.77 | 74.00 | 29.23 | Peak | Horizontal |
| 6 | 4825.0000 | 55.38 | 74.00 | 18.62 | Peak | Horizontal |
| 7 | 1207.0000 | 40.30 | 74.00 | 33.70 | Peak | Vertical |
| 8 | 2206.0000 | 43.34 | 74.00 | 30.66 | Peak | Vertical |
| 9 | 2638.0000 | 43.02 | 74.00 | 30.98 | Peak | Vertical |
| 10 | 3214.0000 | 42.38 | 74.00 | 31.62 | Peak | Vertical |
| 11 | 4438.0000 | 45.34 | 74.00 | 28.66 | Peak | Vertical |
| 12 | 4825.0000 | 51.46 | 74.00 | 22.54 | Peak | Vertical |
| **Tx_ Middle** | | | | | | |
| No. | Frequency (MHz) | Result (dBuV) | Limit (dBuV/m) | Margin (dB) | Remark | Ant. Polar. |
| 1 | 2233.0000 | 43.73 | 74.00 | 30.27 | Peak | Horizontal |
| 2 | 2539.0000 | 43.81 | 74.00 | 30.19 | Peak | Horizontal |
| 3 | 3880.0000 | 44.87 | 74.00 | 29.13 | Peak | Horizontal |
| 4 | 4870.0000 | 53.06 | 74.00 | 20.94 | Peak | Horizontal |
| 5 | 6391.0000 | 48.57 | 74.00 | 25.43 | Peak | Horizontal |
| 6 | 7651.0000 | 51.46 | 74.00 | 22.54 | Peak | Horizontal |
| 7 | 1198.0000 | 40.74 | 74.00 | 33.26 | Peak | Vertical |
| 8 | 2233.0000 | 43.44 | 74.00 | 30.56 | Peak | Vertical |
| 9 | 2512.0000 | 43.36 | 74.00 | 30.64 | Peak | Vertical |
| 10 | 3088.0000 | 43.17 | 74.00 | 30.83 | Peak | Vertical |
| 11 | 3925.0000 | 43.28 | 74.00 | 30.72 | Peak | Vertical |
| 12 | 4870.0000 | 53.04 | 74.00 | 20.96 | Peak | Vertical |
| **Tx_ Highest** | | | | | | |
| No. | Frequency (MHz) | Result (dBuV) | Limit (dBuV/m) | Margin (dB) | Remark | Ant. Polar. |
| 1 | 2242.0000 | 43.33 | 74.00 | 30.67 | Peak | Horizontal |
| 2 | 2512.0000 | 43.77 | 74.00 | 30.23 | Peak | Horizontal |
| 3 | 4123.0000 | 44.09 | 74.00 | 29.91 | Peak | Horizontal |
| 4 | 4924.0000 | 53.09 | 74.00 | 20.91 | Peak | Horizontal |
| 5 | 5626.0000 | 46.94 | 74.00 | 27.06 | Peak | Horizontal |
| 6 | 6580.0000 | 47.48 | 74.00 | 26.52 | Peak | Horizontal |
| 7 | 2242.0000 | 42.96 | 74.00 | 31.04 | Peak | Vertical |
| 8 | 2503.0000 | 43.49 | 74.00 | 30.51 | Peak | Vertical |
| 9 | 3214.0000 | 42.99 | 74.00 | 31.01 | Peak | Vertical |
| 10 | 4096.0000 | 44.24 | 74.00 | 29.76 | Peak | Vertical |
| 11 | 4924.0000 | 50.74 | 74.00 | 23.26 | Peak | Vertical |
| 12 | 5410.0000 | 47.49 | 74.00 | 26.51 | Peak | Vertical |

| 802.11g | | | | | | |
|---|---|---|---|---|---|---|
| **Tx_ Lowest** | | | | | | |
| No. | Frequency (MHz) | Result (dBuV) | Limit (dBuV/m) | Margin (dB) | Remark | Ant. Polar. |
| 1 | 1279.0000 | 44.25 | 74.00 | 29.75 | Peak | Horizontal |
| 2 | 2530.0000 | 43.69 | 74.00 | 30.31 | Peak | Horizontal |
| 3 | 3088.0000 | 41.98 | 74.00 | 32.02 | Peak | Horizontal |
| 4 | 3970.0000 | 43.73 | 74.00 | 30.27 | Peak | Horizontal |
| 5 | 4888.0000 | 47.47 | 74.00 | 26.53 | Peak | Horizontal |
| 6 | 5563.0000 | 47.28 | 74.00 | 26.72 | Peak | Horizontal |
| 7 | 1603.0000 | 40.60 | 74.00 | 33.40 | Peak | Vertical |
| 8 | 2062.0000 | 42.58 | 74.00 | 31.42 | Peak | Vertical |
| 9 | 2503.0000 | 43.46 | 74.00 | 30.54 | Peak | Vertical |
| 10 | 3619.0000 | 43.58 | 74.00 | 30.42 | Peak | Vertical |
| 11 | 4834.0000 | 46.30 | 74.00 | 27.70 | Peak | Vertical |
| 12 | 5977.0000 | 46.86 | 74.00 | 27.14 | Peak | Vertical |
| **Tx_ Middle** | | | | | | |
| No. | Frequency (MHz) | Result (dBuV) | Limit (dBuV/m) | Margin (dB) | Remark | Ant. Polar. |
| 1 | 1288.0000 | 43.44 | 74.00 | 30.56 | Peak | Horizontal |
| 2 | 2134.0000 | 42.22 | 74.00 | 31.78 | Peak | Horizontal |
| 3 | 2521.0000 | 42.96 | 74.00 | 31.04 | Peak | Horizontal |
| 4 | 3088.0000 | 42.41 | 74.00 | 31.59 | Peak | Horizontal |
| 5 | 4870.0000 | 47.41 | 74.00 | 26.59 | Peak | Horizontal |
| 6 | 6031.0000 | 47.44 | 74.00 | 26.56 | Peak | Horizontal |
| 7 | 1180.0000 | 41.53 | 74.00 | 32.47 | Peak | Vertical |
| 8 | 1594.0000 | 46.56 | 74.00 | 27.44 | Peak | Vertical |
| 9 | 1900.0000 | 42.45 | 74.00 | 31.55 | Peak | Vertical |
| 10 | 2521.0000 | 43.29 | 74.00 | 30.71 | Peak | Vertical |
| 11 | 3727.0000 | 43.35 | 74.00 | 30.65 | Peak | Vertical |
| 12 | 4879.0000 | 47.58 | 74.00 | 26.42 | Peak | Vertical |
| **Tx_ Highest** | | | | | | |
| No. | Frequency (MHz) | Result (dBuV) | Limit (dBuV/m) | Margin (dB) | Remark | Ant. Polar. |
| 1 | 1207.0000 | 43.94 | 74.00 | 30.06 | Peak | Horizontal |
| 2 | 1594.0000 | 42.10 | 74.00 | 31.90 | Peak | Horizontal |
| 3 | 2233.0000 | 41.89 | 74.00 | 32.11 | Peak | Horizontal |
| 4 | 2521.0000 | 43.20 | 74.00 | 30.80 | Peak | Horizontal |
| 5 | 3835.0000 | 44.95 | 74.00 | 29.05 | Peak | Horizontal |
| 6 | 4915.0000 | 46.82 | 74.00 | 27.18 | Peak | Horizontal |
| 7 | 1603.0000 | 41.33 | 74.00 | 32.67 | Peak | Vertical |
| 8 | 1900.0000 | 45.26 | 74.00 | 28.74 | Peak | Vertical |
| 9 | 2494.0000 | 43.88 | 74.00 | 30.12 | Peak | Vertical |
| 10 | 2827.0000 | 42.85 | 74.00 | 31.15 | Peak | Vertical |
| 11 | 3970.0000 | 43.05 | 74.00 | 30.95 | Peak | Vertical |
| 12 | 6094.0000 | 47.08 | 74.00 | 26.92 | Peak | Vertical |

| 802.11n-HT20 | | | | | | |
|---|---|---|---|---|---|---|
| **Tx_ Lowest** | | | | | | |
| No. | Frequency (MHz) | Result (dBuV) | Limit (dBuV/m) | Margin (dB) | Remark | Ant. Polar. |
| 1 | 1270.0000 | 44.38 | 74.00 | 29.62 | Peak | Horizontal |
| 2 | 2242.0000 | 42.53 | 74.00 | 31.47 | Peak | Horizontal |
| 3 | 2566.0000 | 43.57 | 74.00 | 30.43 | Peak | Horizontal |
| 4 | 2818.0000 | 43.05 | 74.00 | 30.95 | Peak | Horizontal |
| 5 | 3646.0000 | 43.79 | 74.00 | 30.21 | Peak | Horizontal |
| 6 | 5167.0000 | 46.28 | 74.00 | 27.72 | Peak | Horizontal |
| 7 | 1198.0000 | 42.52 | 74.00 | 31.48 | Peak | Vertical |
| 8 | 2512.0000 | 42.64 | 74.00 | 31.36 | Peak | Vertical |
| 9 | 3349.0000 | 42.63 | 74.00 | 31.37 | Peak | Vertical |
| 10 | 4375.0000 | 45.48 | 74.00 | 28.52 | Peak | Vertical |
| 11 | 5086.0000 | 46.77 | 74.00 | 27.23 | Peak | Vertical |
| 12 | 5635.0000 | 46.35 | 74.00 | 27.65 | Peak | Vertical |
| **Tx_ Middle** | | | | | | |
| No. | Frequency (MHz) | Result (dBuV) | Limit (dBuV/m) | Margin (dB) | Remark | Ant. Polar. |
| 1 | 1324.0000 | 42.10 | 74.00 | 31.90 | Peak | Horizontal |
| 2 | 2242.0000 | 42.55 | 74.00 | 31.45 | Peak | Horizontal |
| 3 | 2530.0000 | 43.20 | 74.00 | 30.80 | Peak | Horizontal |
| 4 | 3079.0000 | 42.01 | 74.00 | 31.99 | Peak | Horizontal |
| 5 | 4888.0000 | 46.83 | 74.00 | 27.17 | Peak | Horizontal |
| 6 | 5779.0000 | 46.13 | 74.00 | 27.87 | Peak | Horizontal |
| 7 | 1216.0000 | 39.93 | 74.00 | 34.07 | Peak | Vertical |
| 8 | 2233.0000 | 41.51 | 74.00 | 32.49 | Peak | Vertical |
| 9 | 3214.0000 | 42.75 | 74.00 | 31.25 | Peak | Vertical |
| 10 | 4618.0000 | 46.41 | 74.00 | 27.59 | Peak | Vertical |
| 11 | 5599.0000 | 47.07 | 74.00 | 26.93 | Peak | Vertical |
| 12 | 6166.0000 | 46.89 | 74.00 | 27.11 | Peak | Vertical |
| **Tx_ Highest** | | | | | | |
| No. | Frequency (MHz) | Result (dBuV) | Limit (dBuV/m) | Margin (dB) | Remark | Ant. Polar. |
| 1 | 1324.0000 | 42.81 | 74.00 | 31.19 | Peak | Horizontal |
| 2 | 2242.0000 | 41.62 | 74.00 | 32.38 | Peak | Horizontal |
| 3 | 2494.0000 | 43.73 | 74.00 | 30.27 | Peak | Horizontal |
| 4 | 3889.0000 | 43.23 | 74.00 | 30.77 | Peak | Horizontal |
| 5 | 4879.0000 | 46.41 | 74.00 | 27.59 | Peak | Horizontal |
| 6 | 6337.0000 | 47.03 | 74.00 | 26.97 | Peak | Horizontal |
| 7 | 1603.0000 | 43.03 | 74.00 | 30.97 | Peak | Vertical |
| 8 | 2521.0000 | 43.35 | 74.00 | 30.65 | Peak | Vertical |
| 9 | 3187.0000 | 41.83 | 74.00 | 32.17 | Peak | Vertical |
| 10 | 4258.0000 | 44.85 | 74.00 | 29.15 | Peak | Vertical |
| 11 | 4708.0000 | 45.94 | 74.00 | 28.06 | Peak | Vertical |
| 12 | 5374.0000 | 46.73 | 74.00 | 27.27 | 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; 6Mbpsof 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

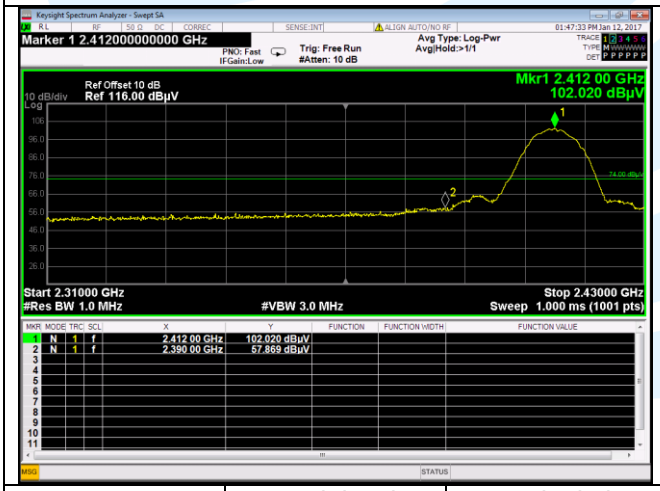
**Test Results:** Pass

**Test Data:**

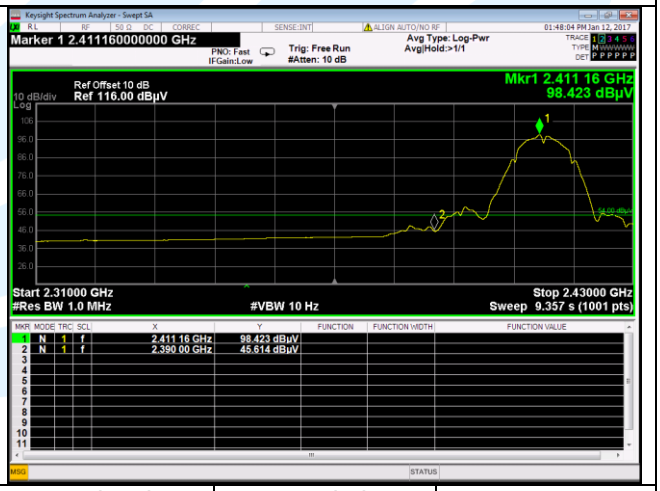
**802.11b**

| Frequency (MHz) | 2412 | Ant. Polar. | Horizontal |
|---|---|---|---|

Detector: Peak



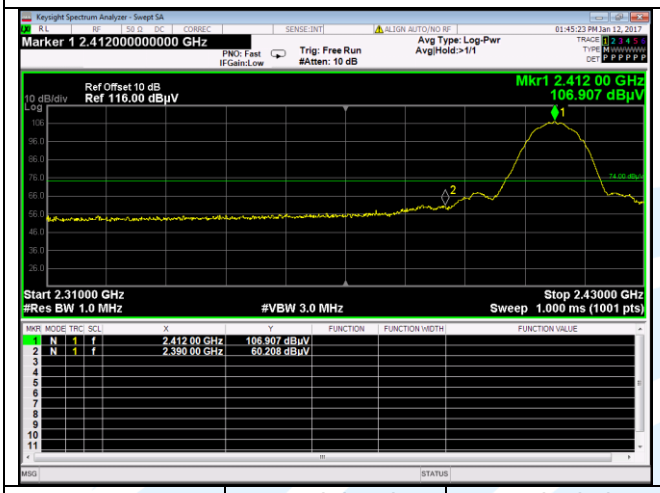

Detector: AV



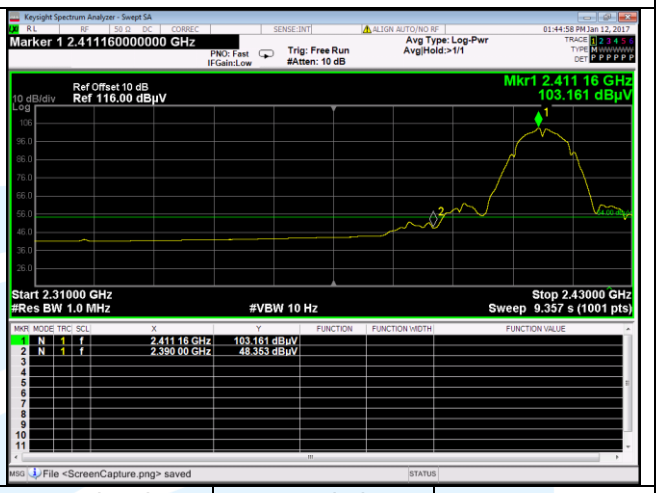

| Frequency (MHz) | Peak level (dBuv/m) | Peak Limit (dBuv/m) | AV level (dBuv/m) | AV Limit (dBuv/m) | Conclusion |
|---|---|---|---|---|---|
| 2390 | 57.869 | 74 | 45.614 | 54 | Pass |

| Frequency (MHz) | 2412 | Ant. Polar. | Vertical |
|---|---|---|---|

Detector: Peak



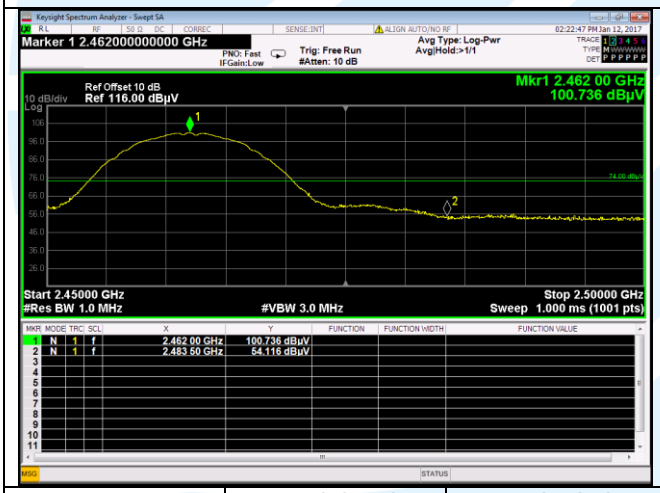

Detector: AV



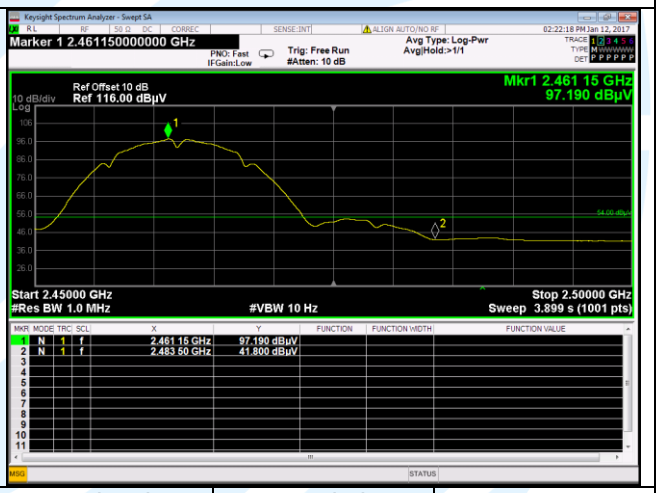

| Frequency (MHz) | Peak level (dBuv/m) | Peak Limit (dBuv/m) | AV level (dBuv/m) | AV Limit (dBuv/m) | Conclusion |
|---|---|---|---|---|---|
| 2390 | 60.208 | 74 | 48.353 | 54 | Pass |

| Frequency (MHz) | 2462 | Ant. Polar. | Horizontal |
|---|---|---|---|

Detector: Peak

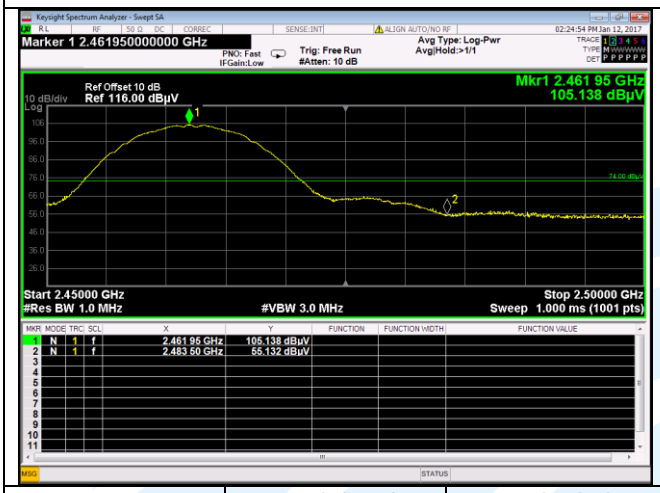


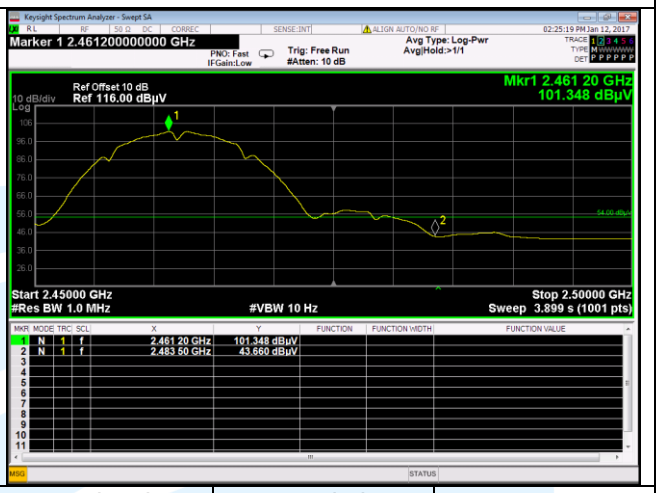

Detector: AV




| Frequency (MHz) | Peak level (dBuv/m) | Peak Limit (dBuv/m) | AV level (dBuv/m) | AV Limit (dBuv/m) | Conclusion |
|---|---|---|---|---|---|
| 2483.5 | 54.116 | 74 | 41.800 | 54 | Pass |

| Frequency (MHz) | 2462 | Ant. Polar. | Vertical |
|---|---|---|---|
| Detector: Peak | | Detector: AV | |

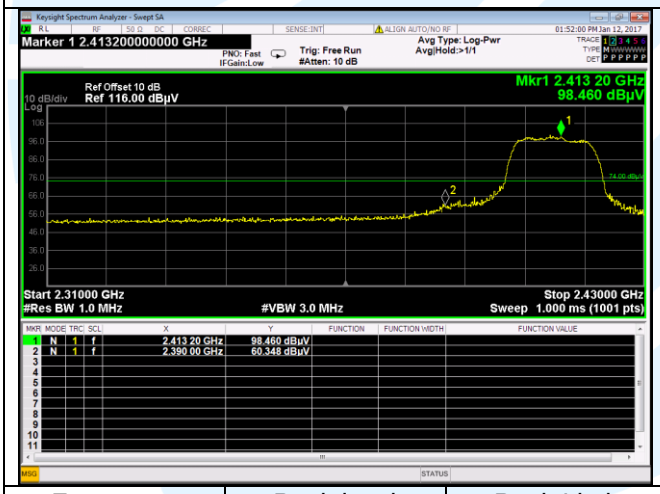


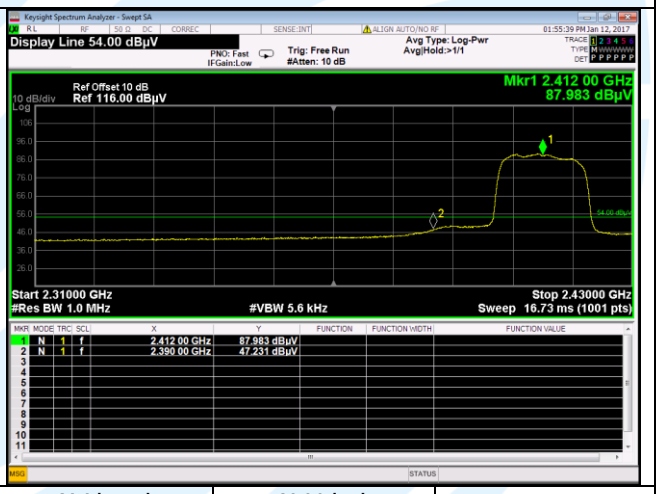




| Frequency (MHz) | Peak level (dBuv/m) | Peak Limit (dBuv/m) | AV level (dBuv/m) | AV Limit (dBuv/m) | Conclusion |
|---|---|---|---|---|---|
| 2483.5 | 55.132 | 74 | 43.660 | 54 | Pass |

802.11g

| Frequency (MHz) | 2412 | Ant. Polar. | Horizontal |
|---|---|---|---|
| Detector: Peak | | Detector: AV | |

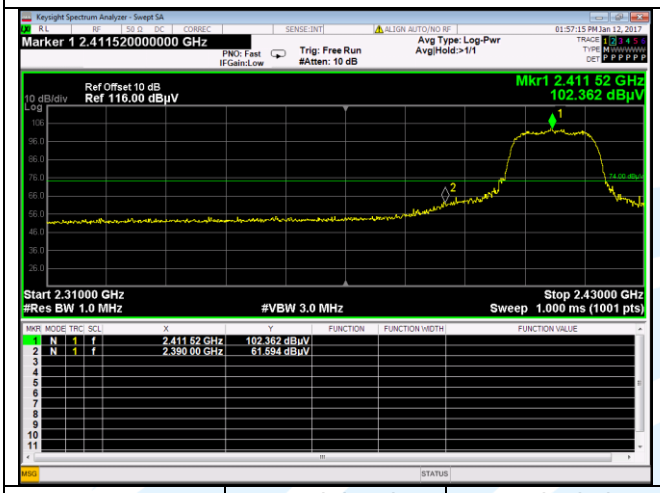


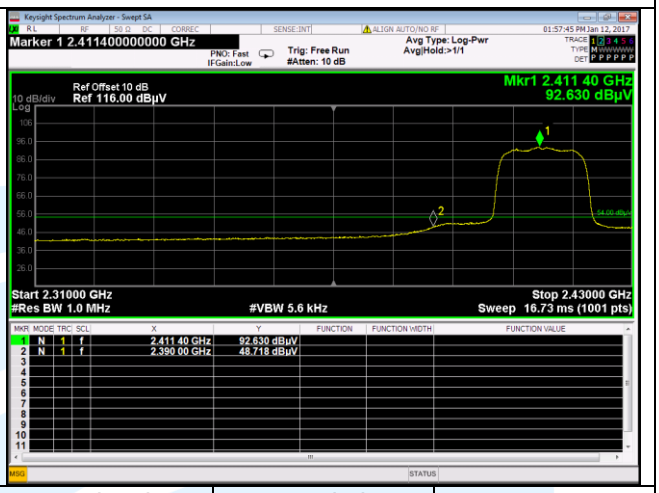

| Frequency (MHz) | Peak level (dBuv/m) | Peak Limit (dBuv/m) | AV level (dBuv/m) | AV Limit (dBuv/m) | Conclusion |
|---|---|---|---|---|---|
| 2390 | 60.348 | 74 | 47.231 | 54 | Pass |

| Frequency (MHz) | 2412 | Ant. Polar. | Vertical |
|---|---|---|---|

Detector: Peak



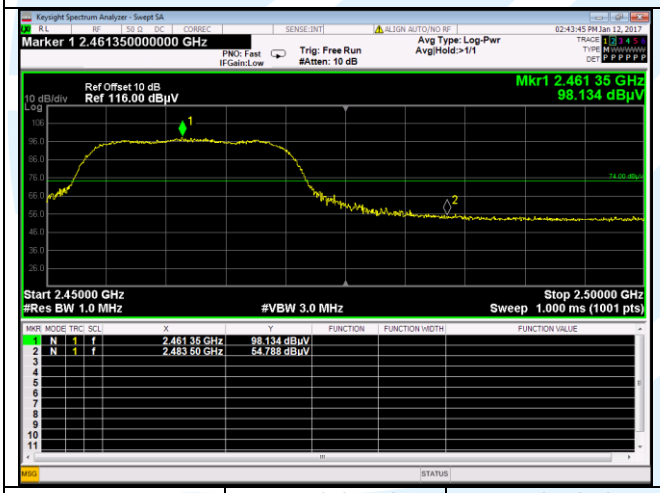

Detector: AV



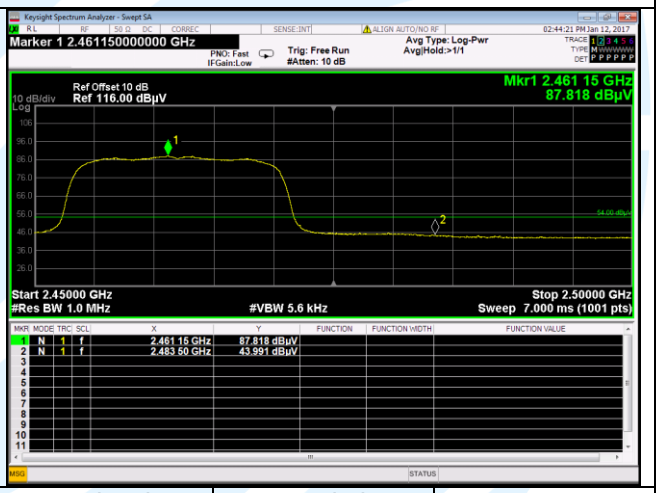

| Frequency (MHz) | Peak level (dBuv/m) | Peak Limit (dBuv/m) | AV level (dBuv/m) | AV Limit (dBuv/m) | Conclusion |
|---|---|---|---|---|---|
| 2390 | 61.594 | 74 | 48.718 | 54 | Pass |

| Frequency (MHz) | 2462 | Ant. Polar. | Horizontal |
|---|---|---|---|

Detector: Peak

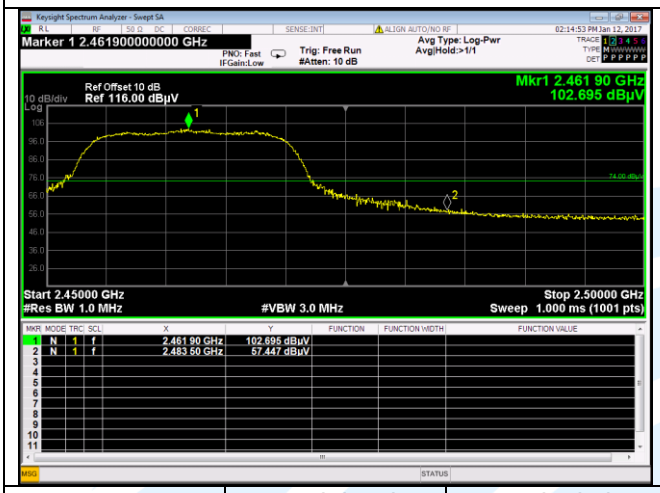


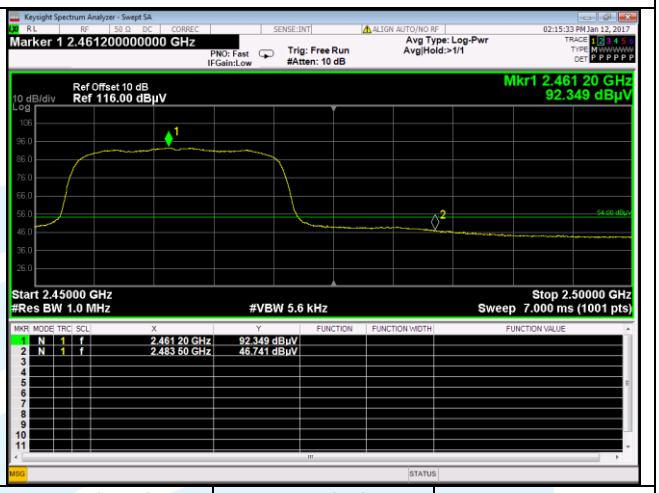

Detector: AV




| Frequency (MHz) | Peak level (dBuv/m) | Peak Limit (dBuv/m) | AV level (dBuv/m) | AV Limit (dBuv/m) | Conclusion |
|---|---|---|---|---|---|
| 2483.5 | 54.788 | 74 | 43.991 | 54 | Pass |

| Frequency (MHz) | 2462 | Ant. Polar. | Vertical |
|---|---|---|---|
| Detector: Peak | | Detector: AV | |

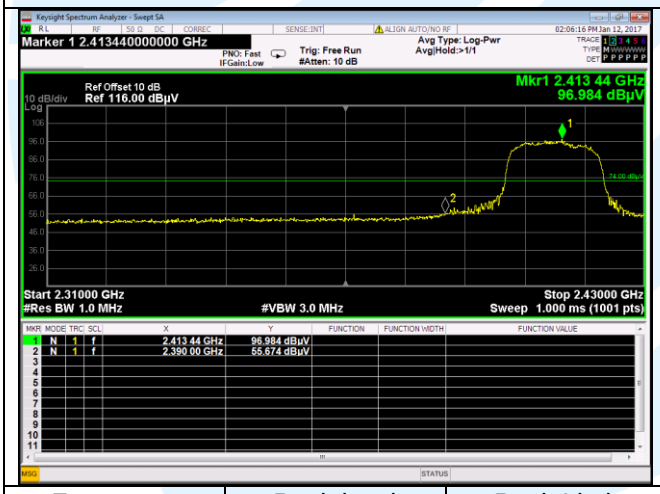


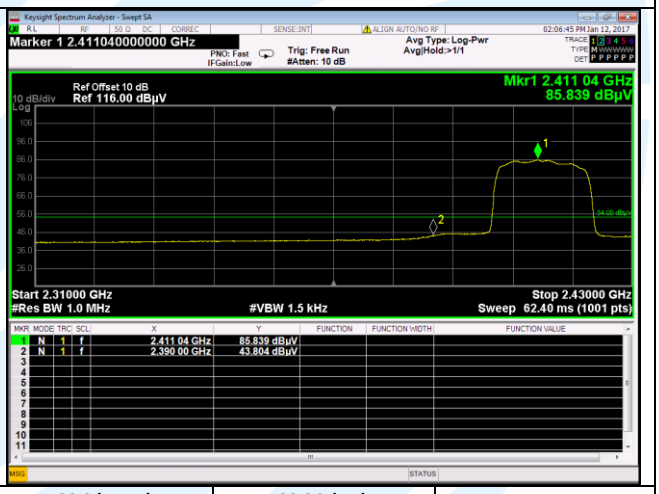




| Frequency (MHz) | Peak level (dBuv/m) | Peak Limit (dBuv/m) | AV level (dBuv/m) | AV Limit (dBuv/m) | Conclusion |
|---|---|---|---|---|---|
| 2483.5 | 57.447 | 74 | 46.741 | 54 | Pass |

## 802.11n(HT20)

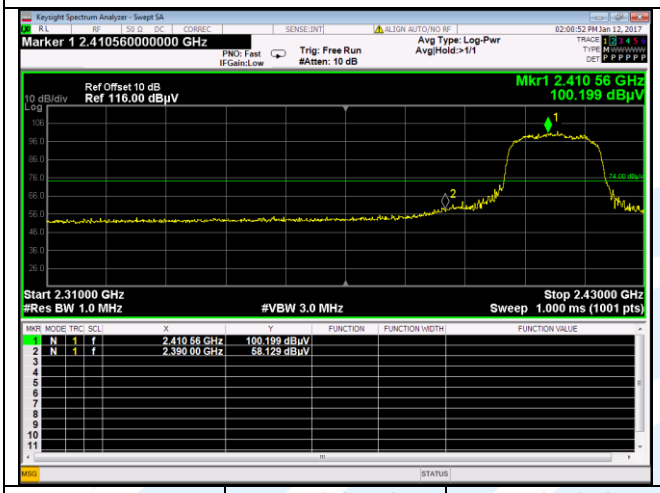
| Frequency (MHz) | 2412 | Ant. Polar. | Horizontal |
|---|---|---|---|
| Detector: Peak | | Detector: AV | |

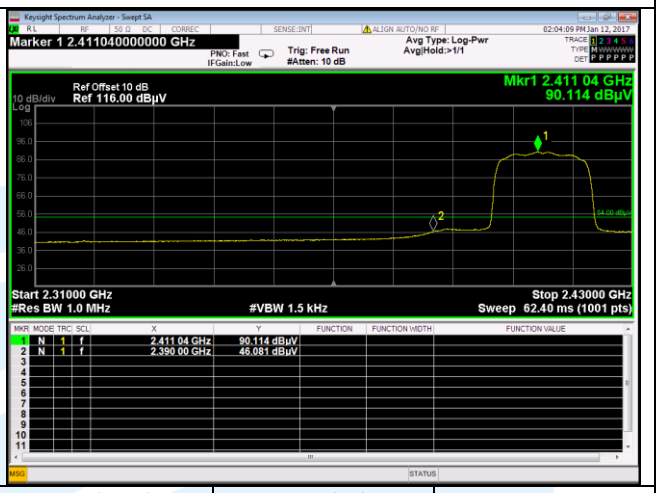



| Frequency (MHz) | Peak level (dBuv/m) | Peak Limit (dBuv/m) | AV level (dBuv/m) | AV Limit (dBuv/m) | Conclusion |
|---|---|---|---|---|---|
| 2390 | 55.674 | 74 | 43.804 | 54 | Pass |

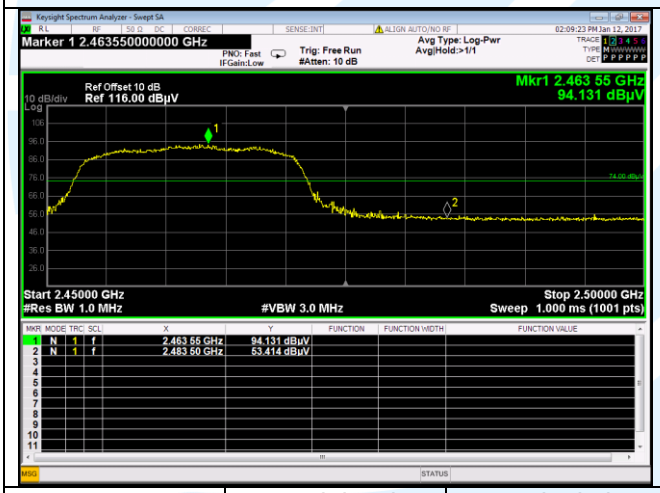
| Frequency (MHz) | 2412 | Ant. Polar. | Vertical |
|---|---|---|---|
| Detector: Peak | | Detector: AV | |

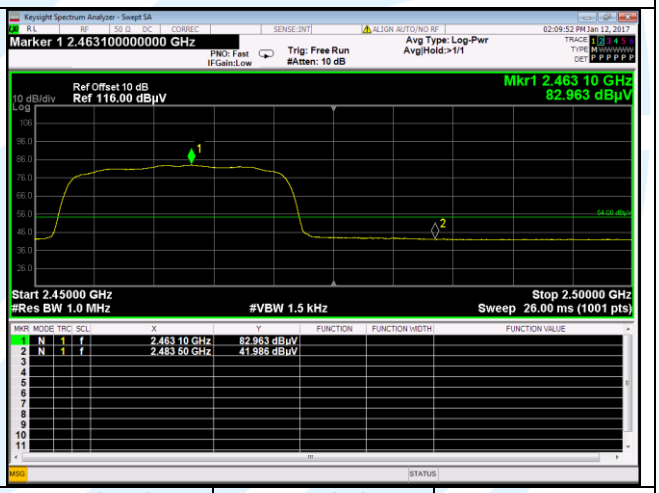



| Frequency (MHz) | Peak level (dBuv/m) | Peak Limit (dBuv/m) | AV level (dBuv/m) | AV Limit (dBuv/m) | Conclusion |
|---|---|---|---|---|---|
| 2390 | 58.129 | 74 | 46.081 | 54 | Pass |

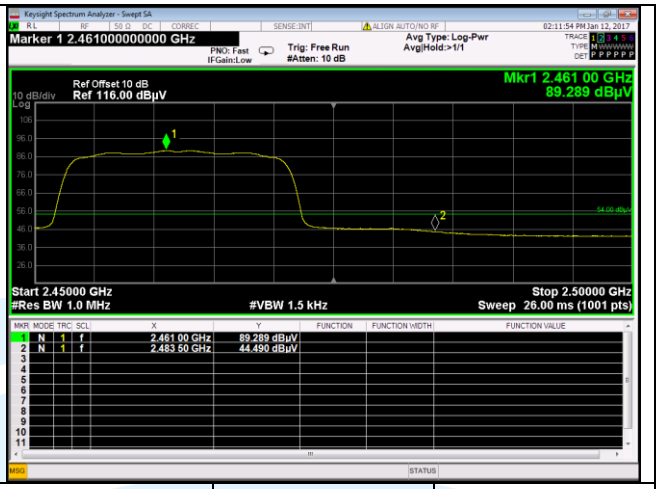
| Frequency (MHz) | 2462 | Ant. Polar. | Horizontal |
|---|---|---|---|
| Detector: Peak | | Detector: AV | |




| Frequency (MHz) | Peak level (dBuv/m) | Peak Limit (dBuv/m) | AV level (dBuv/m) | AV Limit (dBuv/m) | Conclusion |
|---|---|---|---|---|---|
| 2483.5 | 53.414 | 74 | 41.986 | 54 | 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 |
|---|---|---|---|---|---|
| 2483.5 | 55.632 | 74 | 44.490 | 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; 6Mbpsof 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) *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 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:** Not applicable.

# 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 ***