MRT Technology (Taiwan) Co., Ltd
Phone: +886-3-3288388
Fax: +886-3-3288918
Web: www.mrt-cert.com

Report No.: 1612TW0106-U2
Report Version: V01
Issue Date: 01-05-2017

# MEASUREMENT REPORT

## FCC PART 15.247 WLAN 802.11b/g/n

**FCC ID:** TE7C2300

**APPLICANT:** TP-Link Technologies Co., Ltd.

| | |
|---|---|
| **Application Type:** | Certification |
| **Product:** | AC2300 Wireless MU-MIMO Gigabit Router |
| **Model No.:** | Archer C2300, Archer A2300 |
| **Brand Name:** | TP-Link |
| **FCC Classification:** | Digital Transmission System (DTS) |
| **FCC Rule Part(s):** | Part 15.247 |
| **Test Procedure(s):** | ANSI C63.10-2013, KDB 558074 D01v03r05, KDB 662911 D01v02r01 |
| **Test Date:** | November 28, 2016 ~ January 04, 2017 |

Reviewed By : Paddy Chen
( Paddy Chen )

Approved By : Chenz Ker
( Chenz Ker )

Testing Laboratory
3261

The test results relate only to the samples tested.

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 558074 D01v03r05. Test results reported herein relate only to the item(s) tested.

# Revision History

| Report No. | Version | Description | Issue Date | Note |
|---|---|---|---|---|
| 1612TW0106-U2 | Rev. 01 | Initial report | 01-05-2017 | Valid |
| | | | | |

# CONTENTS

## §2.1033 General Information

| | |
|---|---|
| **Applicant:** | TP-Link Technologies Co., Ltd. |
| **Applicant Address:** | Building 24 (floors 1,3,4,5) and 28 (floors1-4) Central Science and Technology Park, Shennan Rd, Nanshan, Shenzhen, China |
| **Manufacturer:** | TP-Link Technologies Co., Ltd. |
| **Manufacturer Address:** | Building 24 (floors 1,3,4,5) and 28 (floors1-4) Central Science and Technology Park, Shennan Rd, Nanshan, Shenzhen, China |
| **Test Site:** | MRT Technology (Taiwan) Co., Ltd |
| **Test Site Address:** | No. 38, Fuxing Second Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C) |
| **MRT Registration No.:** | 153292 |
| **FCC Rule Part(s):** | Part 15.247 |
| **Model No.:** | Archer C2300, Archer A2300 |
| **Test Device Serial No.:** | N/A ☐ Production ☒ Pre-Production ☐ Engineering |

**Test Facility / Accreditations**

**Measurements were performed at MRT Laboratory located in Fuxing Rd., Taoyuan, Taiwan ( R.O.C )**

- **MRT facility is a FCC registered (MRT Reg. No. 153292) test facility with the site description report on file and is designated by the FCC as an Accredited Test Film.**
- **MRT facility is an IC registered (MRT Reg. No. 21723-1) test laboratory with the site description on file at Industry Canada.**
- **MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (TAF) under the American Association for Laboratory Accreditation Program (TAF Cert. No. 3261) in EMC, Telecommunications and Radio testing for FCC, Industry Canada, Taiwan, EU and TELEC Rules.**

**TAF certificate here**

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Testing Laboratory
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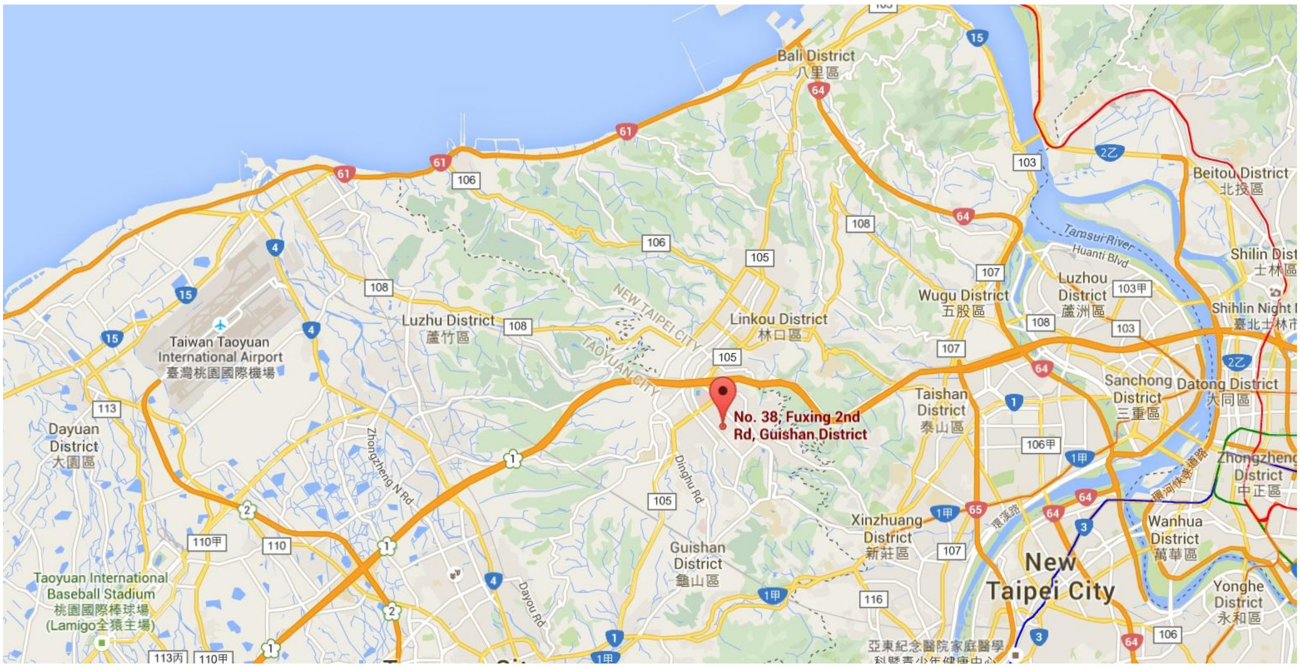
# 1. INTRODUCTION

## 1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

## 1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taoyuan City. These measurement tests were conducted at the MRT Technology (Taiwan) Co., Ltd. Facility located at No.38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 33377, Taiwan (R.O.C).



# 2. PRODUCT INFORMATION

## 2.1. Equipment Description

| | |
|---|---|
| Product Name: | AC2300 Wireless MU-MIMO Gigabit Router |
| Model No.: | Archer C2300, Archer A2300 |
| Brand Name: | TP-Link |
| Wi-Fi Specification: | 802.11a/b/g/n/ac |
| **Components** | |
| Adapter | Model No.: S048CU1200330<br>Input Power: 100 - 240V ~ 50/60Hz 1.5A Max<br>Output Power: 12VDC 3300mA |

Note: Differences between all models are for different marketing requirement.

## 2.2. Product Specification Subjective to this Report

| | |
|---|---|
| Frequency Range: | 802.11b/g/n-HT20: 2412 ~ 2462MHz<br>802.11n-HT40: 2422 ~ 2452MHz |
| Channel Number: | 802.11b/g/n-HT20: 11<br>802.11b/g/n-HT20: 7 |
| Type of Modulation: | 802.11b: DSSS<br>802.11g/n: OFDM |
| Data Rate: | 802.11b: 1/2/5.5/11Mbps<br>802.11g: 6/9/12/18/24/36/48/54Mbps<br>802.11n: up to 600Mbps |
| Maximum Average Output Power: | 802.11b: 28.90dBm<br>802.11g: 28.23dBm<br>802.11n-HT20: 28.24dBm<br>802.11n-HT40: 23.75dBm |

Note: For other features of this EUT, test report will be issued separately.

## 2.3. Operating Frequency and Channel List

802.11b/g/n-HT20

| Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|
| 01 | 2412 MHz | 02 | 2417 MHz | 03 | 2422 MHz |
| 04 | 2427 MHz | 05 | 2432 MHz | 06 | 2437 MHz |
| 07 | 2442 MHz | 08 | 2447 MHz | 09 | 2452 MHz |
| 10 | 2457 MHz | 11 | 2462 MHz | -- | -- |

802.11n-HT40

| Channel | Frequency | Channel | Frequency | Channel | Frequency |
|---|---|---|---|---|---|
| 03 | 2422 MHz | 04 | 2427 MHz | 05 | 2432 MHz |
| 06 | 2437 MHz | 07 | 2442 MHz | 08 | 2447 MHz |
| 09 | 2452 MHz | -- | -- | -- | -- |

## 2.4. Description of Available Antennas

| Antenna Type | Frequency Band (MHz) | TX Paths | Max Antenna Gain (dBi) | Beam-forming Gain (dBi) | CDD Directional Gain (dBi) | |
|---|---|---|---|---|---|---|
| | | | | | For Power | For PSD |
| Dipole Antenna | 2412 ~ 2462 | 3 | 2 | N/A | 2 | 6.77 |
| | 5150 ~ 5250 | 3 | 3 | 7.77 | 3 | 7.77 |
| | 5725 ~ 5850 | 3 | 3 | 7.77 | 3 | 7.77 |

Note 1: The EUT supports Cyclic Delay Diversity (CDD) technology for 802.11a/b/g/n/ac mode, and the transmitter output signal is correlated.

For CDD transmissions, directional gain is calculated as follows, $N_{ANT} = 3$, $N_{SS} = 1$.

Three antennas have the same gain, $G_{ANT}$, Directional gain = $G_{ANT}$ + Array Gain, where Array Gain is as follows.

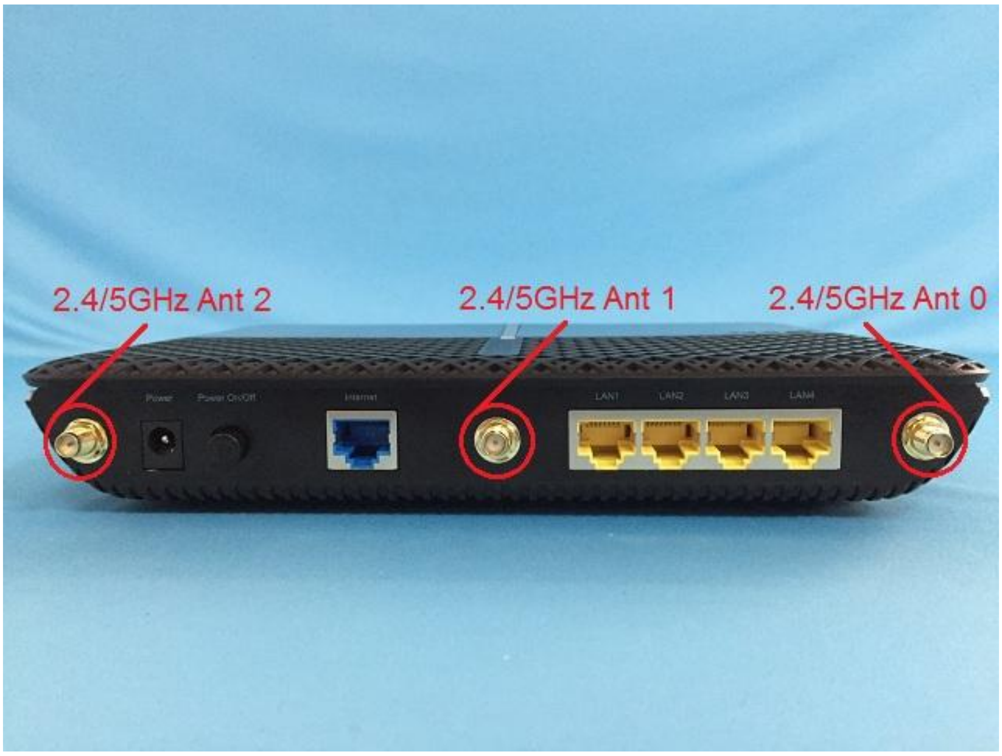
- For power spectral density (PSD) measurements on all devices,
  Array Gain = 10 log ($N_{ANT}$/ $N_{SS}$) dB = 4.77;
- For power measurements on IEEE 802.11 devices,
  Array Gain = 0 dB for $N_{ANT} \leq 4$;

Note 2: The EUT also supports Beam Forming technology, and the Beam Forming only support 802.11ac mode. Three antennas have the same gain, $G_{ANT}$:

Directional gain = $G_{ANT}$ + 10 log ($N_{ANT}$/$N_{SS}$) dBi, where $N_{SS}$ = the number of independent spatial streams of data and $G_{ANT}$ is the antenna gain in dBi.

## 2.5. Description of Antenna RF Port

| Antenna RF Port | | | | | | |
|---|---|---|---|---|---|---|
| -- | 2.4GHz RF Port | | | 5GHz RF Port | | |
| Software Control Port | Ant 0 | Ant 1 | Ant 2 | Ant 0 | Ant 1 | Ant 2 |




## 2.6. Test Mode

| | |
|---|---|
| Test Mode | Mode 1: Transmit by 802.11b |
| | Mode 2: Transmit by 802.11g |
| | Mode 3: Transmit by 802.11n-HT20 |
| | Mode 4: Transmit by 802.11n-HT40 |

## 2.7. Description of Test Software

The test utility software used during testing was “MTool_2.0.2.7”.

Power Parameter Value

| Test Mode | Test Channel No. | Test Frequency (MHz) | Power Parameter Value |
|---|---|---|---|
| 802.11b | 1 | 2412 | 94 |
| | 6 | 2437 | 100 |
| | 11 | 2462 | 90 |
| 802.11g | 1 | 2412 | 74 |
| | 6 | 2437 | 100 |
| | 11 | 2462 | 72 |
| 802.11n-HT20 | 1 | 2412 | 74 |
| | 6 | 2437 | 100 |
| | 11 | 2462 | 72 |
| 802.11n-HT40 | 3 | 2422 | 60 |
| | 6 | 2437 | 82 |
| | 9 | 2452 | 62 |

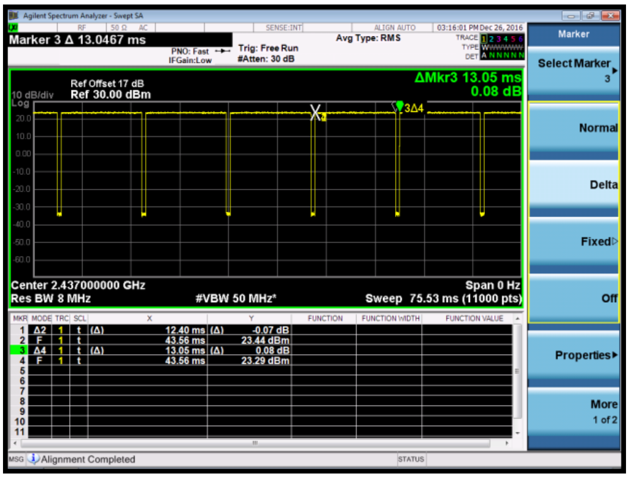
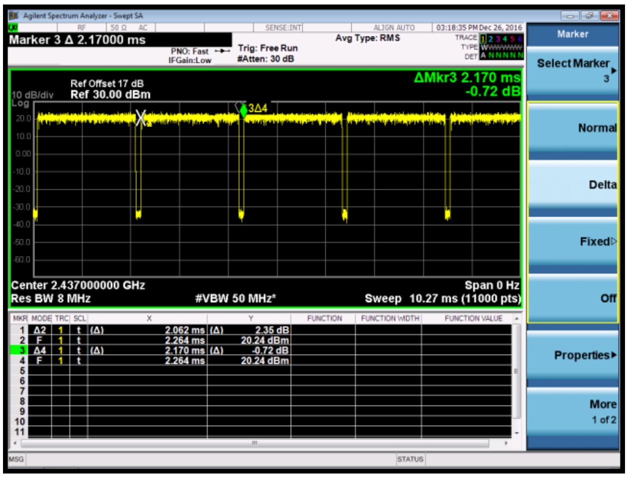
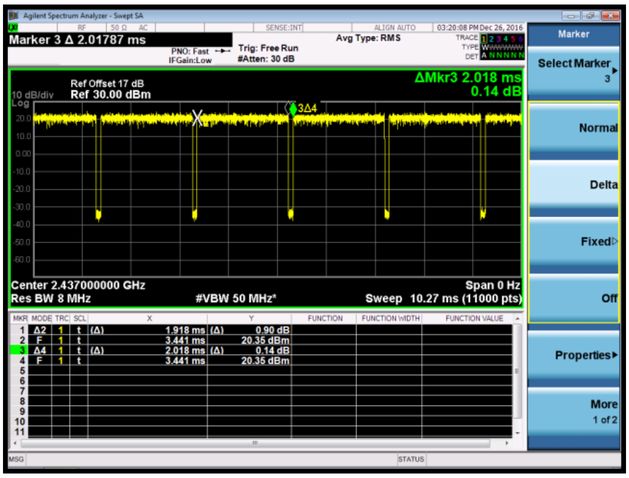
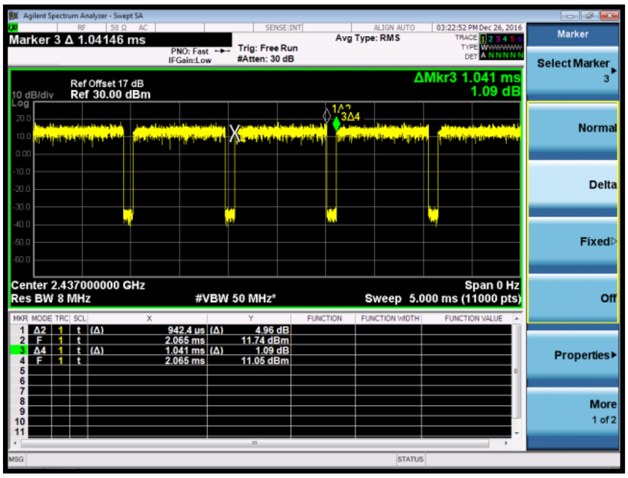
## 2.8. Device Capabilities

This device contains the following capabilities:

2.4GHz WLAN (DTS) and 5GHz WLAN (UNII).

**Note:** 2.4GHz WLAN (DTS) operation is possible in 20MHz, and 40MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

| Test Mode | Duty Cycle |
|---|---|
| 802.11b | 95.02% |
| 802.11g | 95.02% |
| 802.11n-HT20 | 95.04% |
| 802.11n-HT40 | 90.53% |

| 802.11b - Duty Cycle | 802.11g - Duty Cycle |
|---|---|
|  |  |
| **802.11n-HT20 - Duty Cycle** | **802.11n-HT40 - Duty Cycle** |
|  |  |

## 2.9. Test Configuration

The **AC2300 Wireless MU-MIMO Gigabit Router** was tested per the guidance of KDB 558074 D01v03r05. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

## 2.10. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

## 2.11. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

# 3. DESCRIPTION of TEST

## 3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013), and the guidance provided in KDB 558074 D01v03r05 were used in the measurement of the **AC2300 Wireless MU-MIMO Gigabit Router.**

**Deviation from measurement procedure…………………………....................................None**

## 3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment which determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

Line conducted emissions test results are shown in Section 7.8.

## 3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-40GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, which produced the worst-case emissions.

According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

# 4. ANTENNA REQUIREMENTS

**Excerpt from §15.203 of the FCC Rules/Regulations:**

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 shall be considered sufficient to comply with the provisions of this section."

- The antennas of **AC2300 Wireless MU-MIMO Gigabit Router** use a unique reversed SMA connector.

**Conclusion:**

The **AC2300 Wireless MU-MIMO Gigabit Router** unit complies with the requirement of §15.203.

# 5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions - SR2

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Due Date |
|---|---|---|---|---|
| Two-Line V-Network | R&S | ENV216 | MRTTWA00019 | 2017.03.23 |
| Two-Line V-Network | R&S | ENV216 | MRTTWA00020 | 2017.03.23 |
| Absorbing Clamp | R&S | MDS21 | MRTTWA00016 | 2017.03.02 |
| EMI Test Receiver | R&S | ESR3 | MRTTWA00009 | 2017.03.16 |
| Conducted Cable | Rosnol | N1C50-RG400-B1 C50-500CM | MRTTWE00013 | 2017.05.20 |
| TFA | DIVA PLUS Funk-Wetterstation | 35.1078.10.IT | MRTTWA00033 | 2017.06.09 |

Radiated Spurious Emission and Radiated Restricted Band Edge - AC1

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Due Date |
|---|---|---|---|---|
| Acitve Loop Antenna | SCHWARZBECK | FMZB 1519B | MRTTWA00002 | 2017.04.06 |
| Broadband TRILOG Antenna | SCHWARZBECK | VULB 9162 | MRTTWA00001 | 2017.04.06 |
| Broadband Hornantenna | SCHWARZBECK | BBHA 9120D | MRTTWA00003 | 2017.04.06 |
| BreitbandHornantenna | SCHWARZBECK | BBHA 9170 | MRTTWA00004 | 2017.04.06 |
| Broadband Preamplifier | SCHWARZBECK | BBV 9718 | MRTTWA00005 | 2017.04.06 |
| Broadband Amplifier | SCHWARZBECK | BBV 9721 | MRTTWA00006 | 2017.04.06 |
| Signal Analyzer | R&S | FSV40 | MRTTWA00007 | 2017.03.02 |
| EXA Signal Analyzer | KEYSIGHT | N9010A | MRTTWA00012 | 2017.05.08 |
| Antenna Cable | HUBERSUHNER | SF106 | MRTTWE00010 | 2017.05.20 |

Conducted Test Equipment - SR1

| Instrument | Manufacturer | Type No. | Asset No. | Cali. Due Date |
|---|---|---|---|---|
| Signal Analyzer | R&S | FSV40 | MRTTWA00007 | 2017.03.02 |
| EXA Signal Analyzer | KEYSIGHT | N9010A | MRTTWA00012 | 2017.05.08 |
| USB wideband power sensor | Boonton | 55006 | MRTTWA00050 | 2017/05/08 |
| X-Series USB Peak and Average Power Sensor | KEYSIGHT | U2021XA | MRTTWA00014 | 2017.03.18 |

| **Software** | **Version** | **Function** |
|---|---|---|
| e3 | V 8.3.5 | EMI Test Software |

# 6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

| |
|---|
| AC Conducted Emission Measurement - SR2 |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>150kHz~30MHz: 3.46dB |
| Radiated Emission Measurement - AC1 |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>9kHz ~ 1GHz: 4.18dB<br>1GHz ~ 25GHz: 4.76dB |
| Spurious Emissions, Conducted - SR1 |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>0.78dB |
| Output Power - SR1 |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>1.13dB |
| Power Spectrum Density - SR1 |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>1.15dB |
| Occupied Bandwidth - SR1 |
| Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):<br>0.28% |

# 7. TEST RESULT

## 7.1. Summary

**Product Name:** **AC2300 Wireless MU-MIMO Gigabit Router**

**FCC ID:** **TE7C2300**

**FCC Classification:** **Digital Transmission System (DTS)**

**Data Rate / MCS Tested:** **1Mbps for 802.11b;**
**6Mbps for 802.11g;**
**MCS0 for 802.11n-HT20;**
**MCS0 for 802.11n-HT40**

| FCC Part Section(s) | Test Description | Test Limit | Test Condition | Test Result | Reference |
|---|---|---|---|---|---|
| 15.247(a)(2) | 6dB Bandwidth | ≥ 500kHz | Conducted | Pass | Section 7.2 |
| 15.247(b)(3) | Output Power | ≤ 30.00dBm | | Pass | Section 7.3 |
| 15.247(e) | Power Spectral Density | ≤ 7.23dBm/3kHz | | Pass | Section 7.4 |
| 15.247(d) | Band Edge / Out-of-Band Emissions | ≥ 30dBc(Average) | | Pass | Section 7.5 |
| 15.205, 15.209 | General Field Strength Limits (Restricted Bands and Radiated Emission Limits) | Emissions in restricted bands must meet the radiated limits detailed in 15.209 | Radiated | Pass | Section 7.6 & 7.7 |
| 15.207 | AC Conducted Emissions 150kHz - 30MHz | < FCC 15.207 limits | Line Conducted | Pass | Section 7.8 |

**Notes:**

1) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
2) Test Items “6dB Bandwidth” and “Band Edge / Out-of-Band Emissions” have been assessed the MIMO transmission, and showed the worst single test data in this report.

## 7.2. 6dB Bandwidth Measurement

### 7.2.1. Test Limit

The minimum 6dB bandwidth shall be at least 500 kHz.

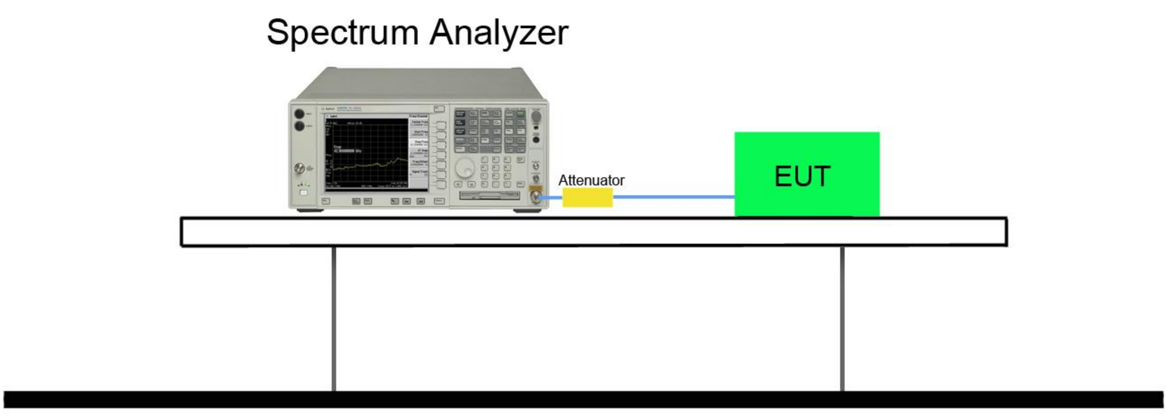
### 7.2.2. Test Procedure used

KDB 558074 D01v03r05 - Section 8.2 Option 2

### 7.2.3. Test Setting

1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set RBW = 100 kHz
3. VBW ≥ 3 × RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace was allowed to stabilize

### 7.2.4. Test Setup

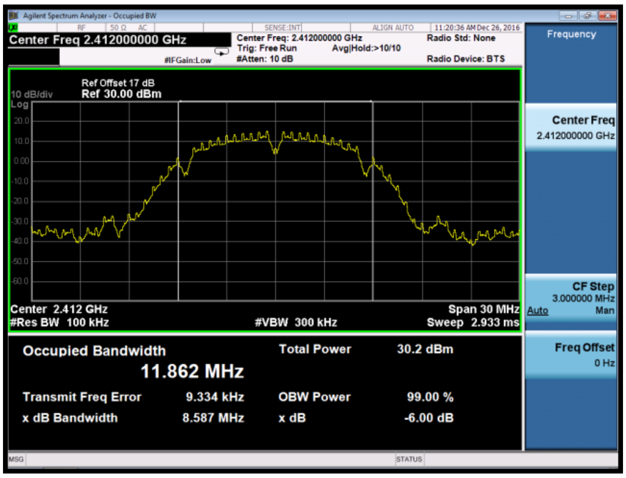


### 7.2.5. Test Result

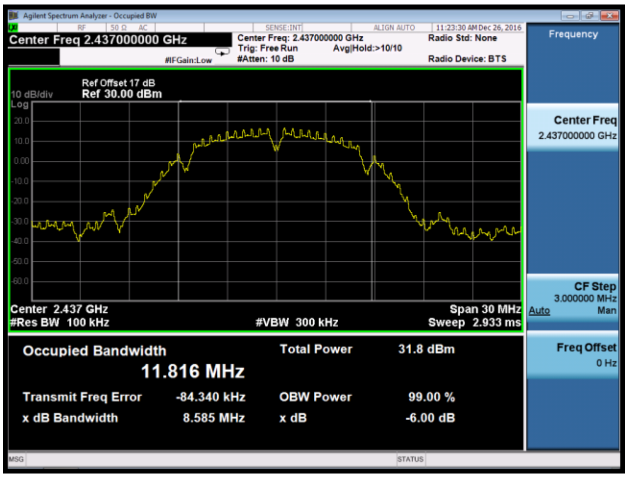
| Test Mode | Data Rate/ MCS | Channel No. | Frequency (MHz) | 6dB Bandwidth (MHz) | Limit (MHz) | Result |
|---|---|---|---|---|---|---|
| Ant 1 / Ant 0 + 1 + 2 | | | | | | |
| 802.11b | 1Mbps | 01 | 2412 | 8.59 | ≥ 0.5 | Pass |
| 802.11b | 1Mbps | 06 | 2437 | 8.59 | ≥ 0.5 | Pass |
| 802.11b | 1Mbps | 11 | 2462 | 9.07 | ≥ 0.5 | Pass |
| 802.11g | 6Mbps | 01 | 2412 | 16.38 | ≥ 0.5 | Pass |
| 802.11g | 6Mbps | 06 | 2437 | 16.37 | ≥ 0.5 | Pass |
| 802.11g | 6Mbps | 11 | 2462 | 16.39 | ≥ 0.5 | Pass |
| 802.11n-HT20 | MCS0 | 01 | 2412 | 17.62 | ≥ 0.5 | Pass |
| 802.11n-HT20 | MCS0 | 06 | 2437 | 17.59 | ≥ 0.5 | Pass |
| 802.11n-HT20 | MCS0 | 11 | 2462 | 17.63 | ≥ 0.5 | Pass |
| 802.11n-HT40 | MCS0 | 03 | 2422 | 36.33 | ≥ 0.5 | Pass |
| 802.11n-HT40 | MCS0 | 06 | 2437 | 35.75 | ≥ 0.5 | Pass |
| 802.11n-HT40 | MCS0 | 09 | 2452 | 36.37 | ≥ 0.5 | Pass |

## 802.11b 6dB Bandwidth - Ant 1 / Ant 0 + 1 + 2

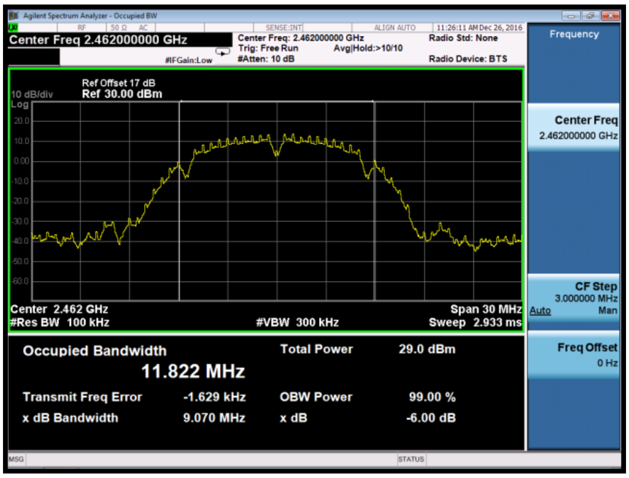
### Channel 01 (2412MHz)



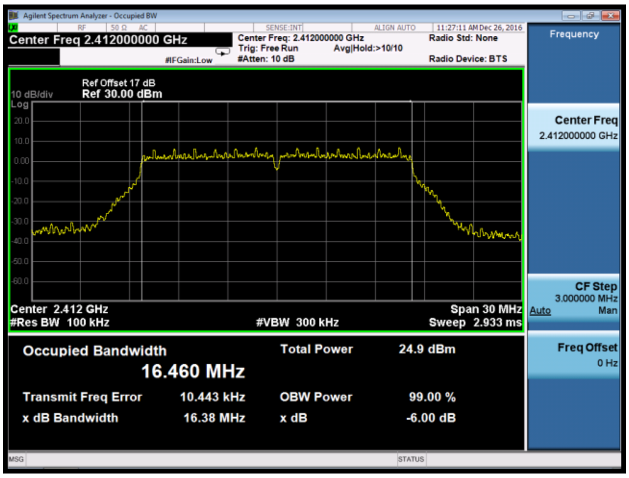

### Channel 06 (2437MHz)




### Channel 11 (2462MHz)



<table>
<tr><th colspan="2">802.11g 6dB Bandwidth - Ant 1 / Ant 0 + 1 + 2</th></tr>
<tr><th>Channel 01 (2412MHz)</th><th>Channel 06 (2437MHz)</th></tr>
<tr><td>

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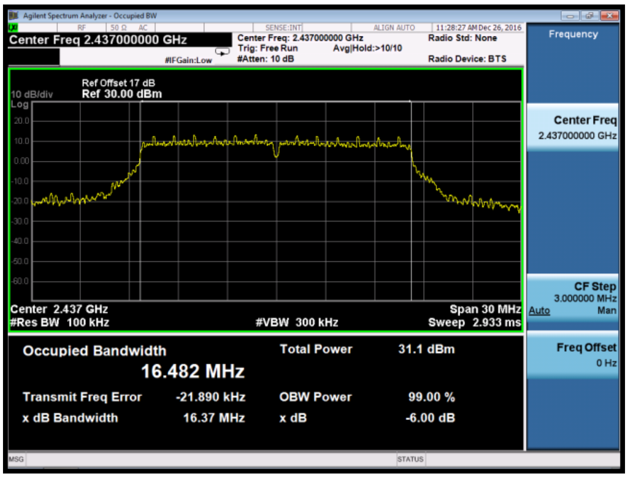


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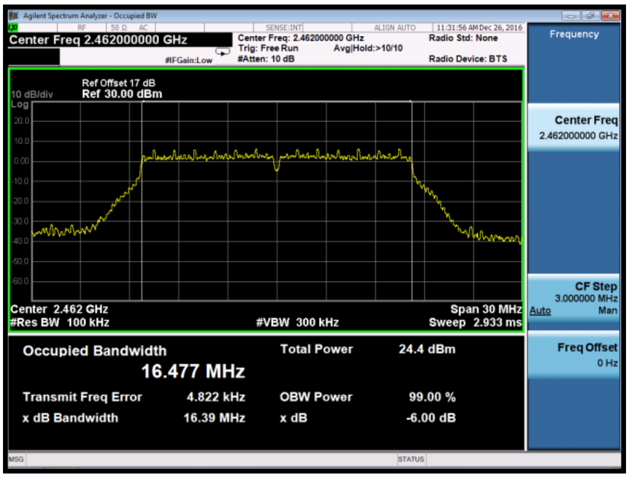


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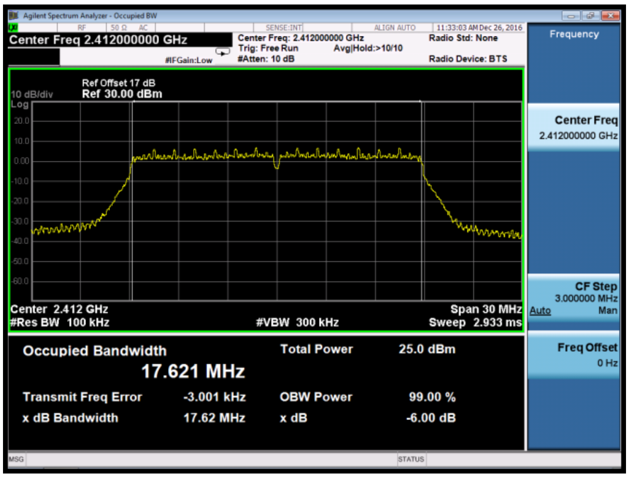
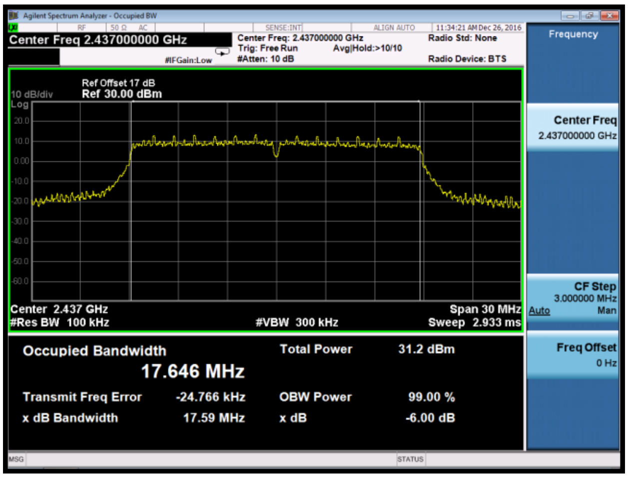
## 802.11n-HT20 6dB Bandwidth - Ant 1 / Ant 0 + 1 + 2

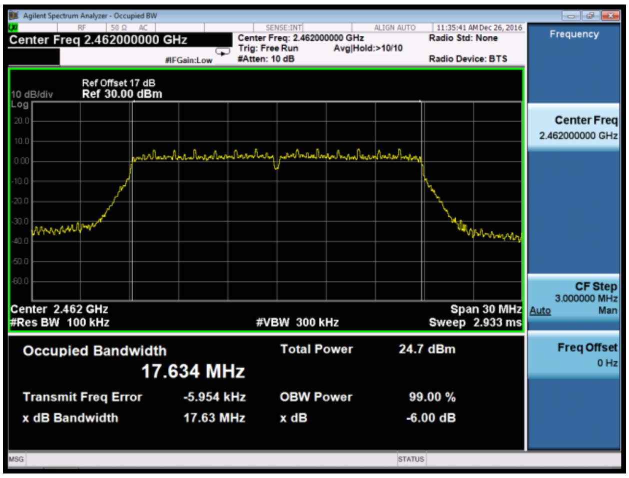
### Channel 01 (2412MHz)




### Channel 06 (2437MHz)

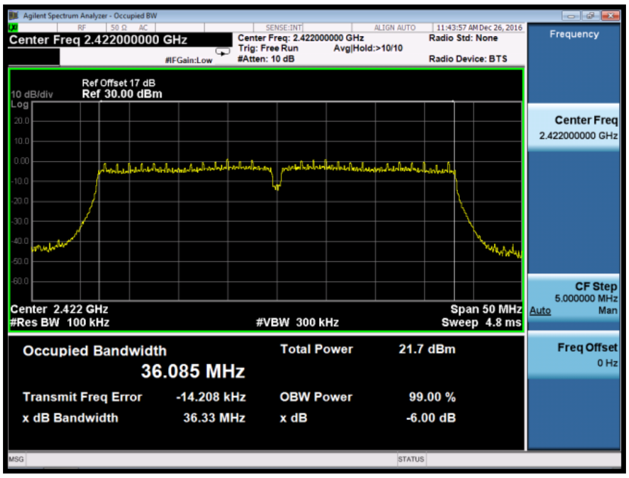



### Channel 11 (2462MHz)

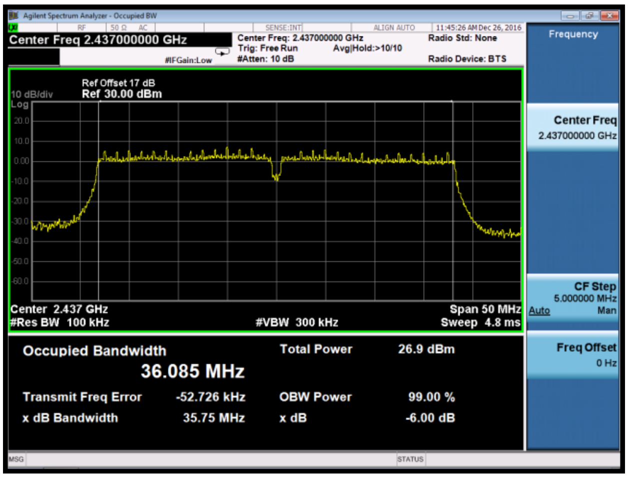


## 802.11n-HT40 6dB Bandwidth - Ant 1 / Ant 0 + 1 + 2

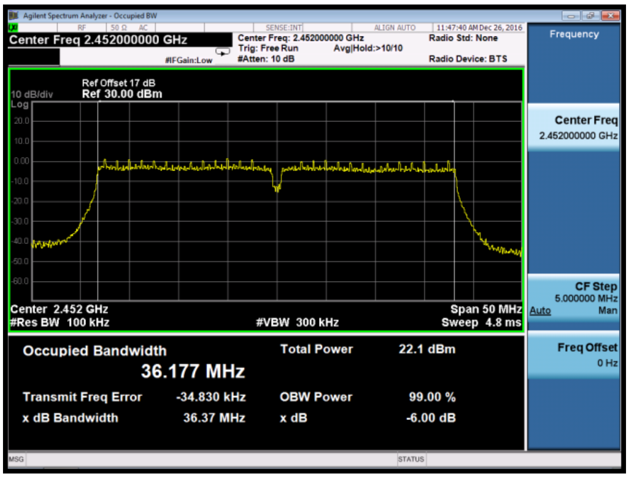
### Channel 03 (2422MHz)




### Channel 06 (2437MHz)




### Channel 09 (2452MHz)



## 7.3. Output Power Measurement

### 7.3.1. Test Limit

The maximum out power shall be less 1 Watt (30dBm).

### 7.3.2. Test Procedure Used

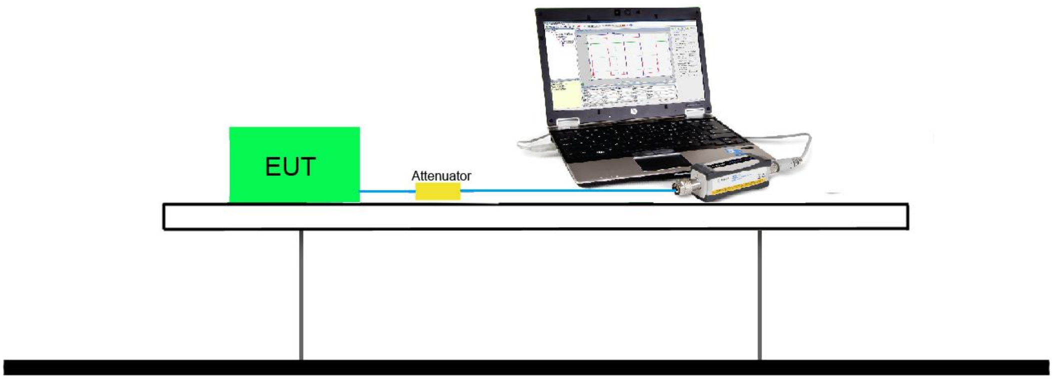
KDB 558074 D01v03r05 - Section 9.2.3.2 AVGPM-G Average Power Method

### 7.3.3. Test Setting

**Average Power Measurement**

Average power measurements were perform only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

### 7.3.4. Test Setup



### 7.3.5. Test Result of Output Power

Power output test was verified over all data rates of each mode shown as below table.

For Ant 0 / Ant 0 + 1 +2 port:

| Test Mode | Bandwidth (MHz) | Channel No. | Frequency (MHz) | Data Rate/ MCS | Average Power (dBm) |
|---|---|---|---|---|---|
| 802.11b | 20 | 6 | 2437 | 1Mbps | 24.09 |
| | | | | 5.5Mbps | 23.86 |
| | | | | 11Mbps | 23.63 |
| 802.11g | 20 | 6 | 2437 | 6Mbps | 23.11 |
| | | | | 24Mbps | 22.74 |
| | | | | 54Mbps | 22.26 |
| 802.11n | 20 | 6 | 2437 | MCS0 | 23.29 |
| | | | | MCS3 | 22.56 |
| | | | | MCS7 | 22.07 |
| 802.11n | 40 | 6 | 2437 | MCS0 | 18.85 |
| | | | | MCS3 | 18.35 |
| | | | | MCS7 | 18.02 |

**Test Result of Average Output Power**

| Test Mode | Data Rate/ MCS | Channel No. | Freq. (MHz) | Ant 0 Average Power (dBm) | Ant 1 Average Power (dBm) | Ant 2 Average Power (dBm) | Total Average Power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|---|---|
| 11b | 1Mbps | 01 | 2412 | 22.67 | 22.30 | 22.66 | 27.32 | ≤ 30.00 | Pass |
| 11b | 1Mbps | 06 | 2437 | 24.09 | 24.02 | 24.27 | 28.90 | ≤ 30.00 | Pass |
| 11b | 1Mbps | 11 | 2462 | 21.20 | 21.52 | 21.71 | 26.25 | ≤ 30.00 | Pass |
| 11g | 6Mbps | 01 | 2412 | 17.35 | 17.23 | 17.52 | 22.14 | ≤ 30.00 | Pass |
| 11g | 6Mbps | 06 | 2437 | 23.11 | 23.43 | 23.80 | 28.23 | ≤ 30.00 | Pass |
| 11g | 6Mbps | 11 | 2462 | 16.77 | 16.79 | 17.42 | 21.78 | ≤ 30.00 | Pass |
| 11n-HT20 | MCS0 | 01 | 2412 | 17.25 | 17.24 | 17.54 | 22.12 | ≤ 30.00 | Pass |
| 11n-HT20 | MCS0 | 06 | 2437 | 23.29 | 23.44 | 23.68 | 28.24 | ≤ 30.00 | Pass |
| 11n-HT20 | MCS0 | 11 | 2462 | 16.80 | 16.78 | 17.31 | 21.74 | ≤ 30.00 | Pass |
| 11n-HT40 | MCS0 | 03 | 2422 | 14.03 | 13.71 | 14.06 | 18.71 | ≤ 30.00 | Pass |
| 11n-HT40 | MCS0 | 06 | 2437 | 18.85 | 18.82 | 19.26 | 23.75 | ≤ 30.00 | Pass |
| 11n-HT40 | MCS0 | 09 | 2452 | 14.69 | 14.10 | 14.24 | 19.12 | ≤ 30.00 | Pass |

Note: Total Average Power (dBm) = $10 \cdot \text{Log}\{10^{(\text{Ant 0 Average Power}/10)} + 10^{(\text{Ant 1 Average Power}/10)} + 10^{(\text{Ant 2 Average Power}/10)}\}$ (dBm).

## 7.4. Power Spectral Density Measurement

### 7.4.1. Test Limit

The maximum permissible power spectral density is 8dBm in any 3 kHz band.

2.412~2.462GHz: 8dBm/3kHz - (6.77dBi - 6dBi) = 7.23dBm/3kHz

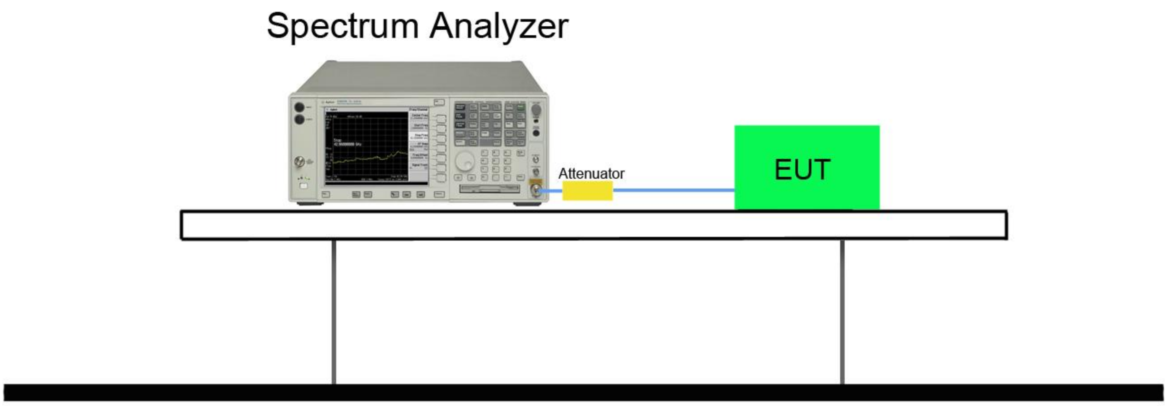
### 7.4.2. Test Procedure Used

KDB 558074 D01v03r05 - Section 10.5 Method AVGPSD

### 7.4.3. Test Setting

1. Measure the duty cycle (x) of the transmitter output signal
2. Set instrument center frequency to DTS channel center frequency.
3. Set span to at least 1.5 times the OBW.
4. RBW = 10kHz
5. VBW = 30kHz
6. Detector = RMS
7. Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW.
8. Sweep time = auto couple
9. Don’t use sweep triggering. Allow sweep to “free run”.
10. Employ trace averaging (RMS) mode over a minimum of 100 traces.
11. Use the peak marker function to determine the maximum amplitude level.
12. Add 10 log (1/x), where x is the duty cycle measured in step (a, to the measured PSD to compute the average PSD during the actual transmission time.
13. Add Constant Factor = 10*log(3kHz / 10kHz) = -5.23

### 7.4.4. Test Setup

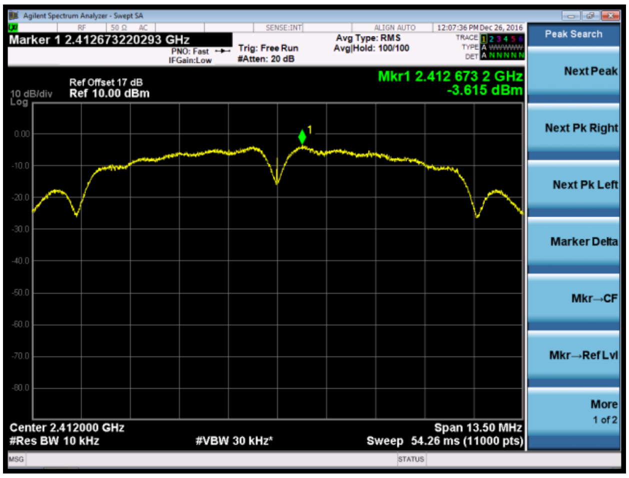
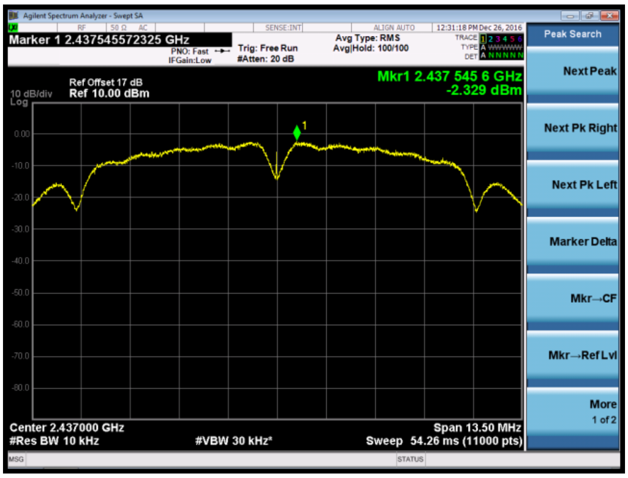


### 7.4.5. Test Result

| Test Mode | Data Rate/ MCS | Channel No. | Freq. (MHz) | Ant 0 AVGPSD (dBm / 10kHz) | Ant 1 AVGPSD (dBm / 10kHz) | Ant 2 AVGPSD (dBm / 10kHz) | Duty Cycle (%) | Constant Factor | Total AVGPSD (dBm / 3kHz) | Limit (dBm / 3kHz) | Result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11b | 1Mbps | 01 | 2412 | -3.62 | -3.34 | -3.60 | 95.02 | -5.23 | -3.76 | ≤ 7.23 | Pass |
| 11b | 1Mbps | 06 | 2437 | -2.33 | -1.97 | -2.23 | 95.02 | -5.23 | -2.41 | ≤ 7.23 | Pass |
| 11b | 1Mbps | 11 | 2462 | -4.19 | -4.87 | -4.47 | 95.02 | -5.23 | -4.74 | ≤ 7.23 | Pass |
| 11g | 6Mbps | 01 | 2412 | -10.37 | -9.62 | -9.94 | 95.02 | -5.23 | -10.20 | ≤ 7.23 | Pass |
| 11g | 6Mbps | 06 | 2437 | -3.95 | -3.60 | -3.75 | 95.02 | -5.23 | -4.00 | ≤ 7.23 | Pass |
| 11g | 6Mbps | 11 | 2462 | -10.44 | -10.72 | -10.36 | 95.02 | -5.23 | -10.74 | ≤ 7.23 | Pass |
| 11n-HT20 | MCS0 | 01 | 2412 | -11.45 | -8.77 | -11.51 | 95.04 | -5.23 | -10.62 | ≤ 7.23 | Pass |
| 11n-HT20 | MCS0 | 06 | 2437 | -5.11 | -4.73 | -5.42 | 95.04 | -5.23 | -5.32 | ≤ 7.23 | Pass |
| 11n-HT20 | MCS0 | 11 | 2462 | -11.28 | -12.13 | -11.38 | 95.04 | -5.23 | -11.82 | ≤ 7.23 | Pass |
| 11n-HT40 | MCS0 | 03 | 2422 | -17.62 | -17.41 | -17.65 | 90.53 | -5.23 | -17.59 | ≤ 7.23 | Pass |
| 11n-HT40 | MCS0 | 06 | 2437 | -12.67 | -11.24 | -11.90 | 90.53 | -5.23 | -11.92 | ≤ 7.23 | Pass |
| 11n-HT40 | MCS0 | 09 | 2452 | -16.94 | -17.58 | -17.02 | 90.53 | -5.23 | -17.20 | ≤ 7.23 | Pass |

Note 1: When EUT duty cycle < 98%, the total AVGPSD = 10*log{$10^{(\text{Ant 0 AVGPSD}/10)}$ + $10^{(\text{Ant 1 AVGPSD}/10)}$ + $10^{(\text{Ant 2 AVGPSD}/10)}$} + 10*log(1/duty cycle) + Constant Factor.

Note 2: PSD Limit = 8 (dBm/3kHz) - [Directional Gain (dBi) - 6 (dBi)] = 7.23 (dBm/3kHz).

<table>
<tr><th colspan="2">802.11b AVGPSD - Ant 0 / Ant 0 + 1 + 2</th></tr>
<tr><th>Channel 01 (2412MHz)</th><th>Channel 06 (2437MHz)</th></tr>
<tr><td></td><td></td></tr>
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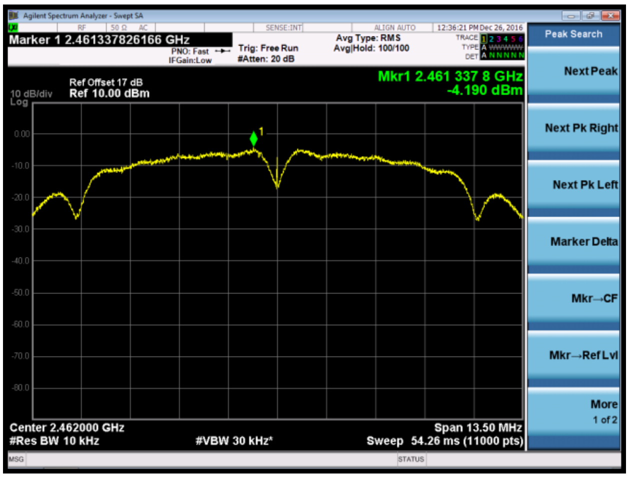
<tr><td></td><td></td></tr>
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| 802.11g AVGPSD - Ant 0 / Ant 0 + 1 + 2 | |
|---|---|
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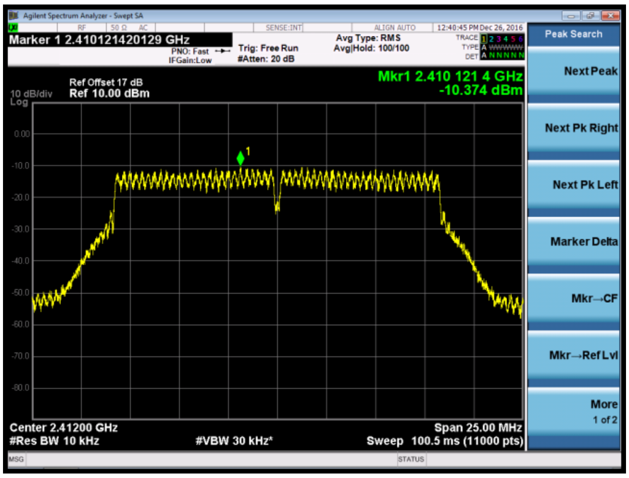
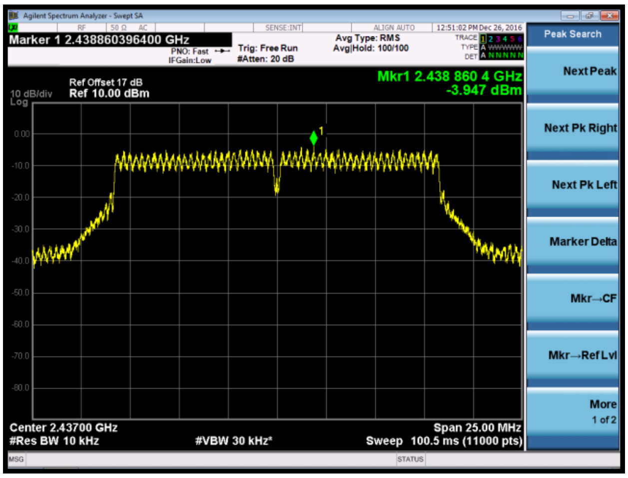
|  |  |
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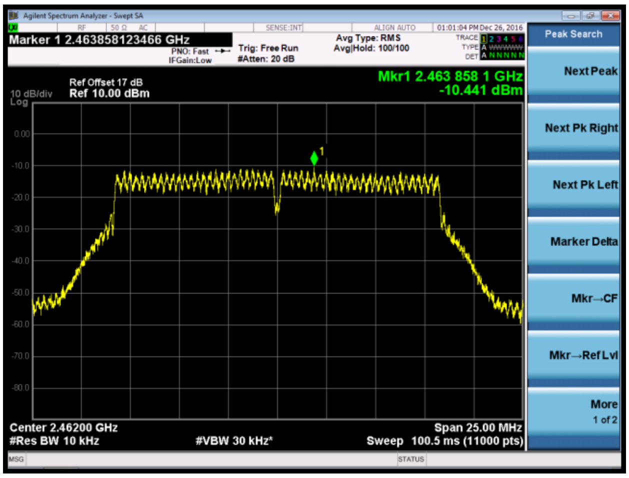
|  | |

## 802.11n-HT20 AVGPSD - Ant 0 / Ant 0 + 1 + 2

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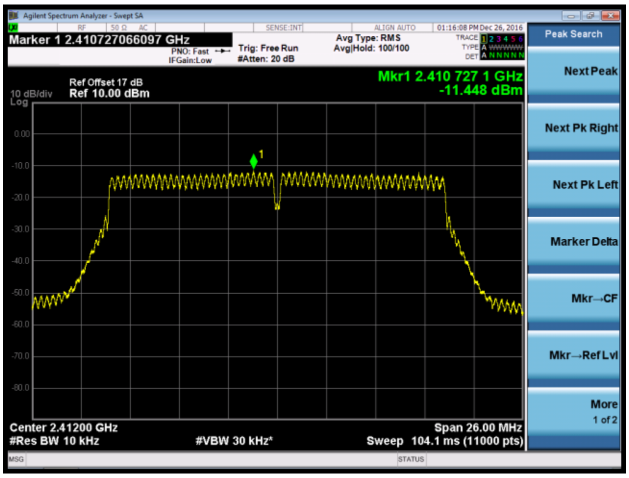


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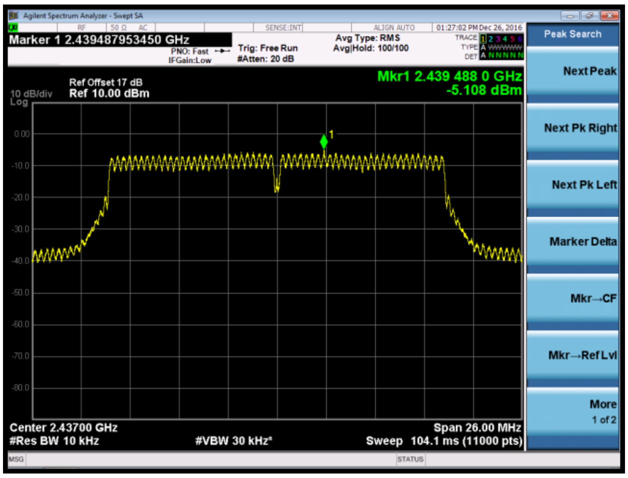


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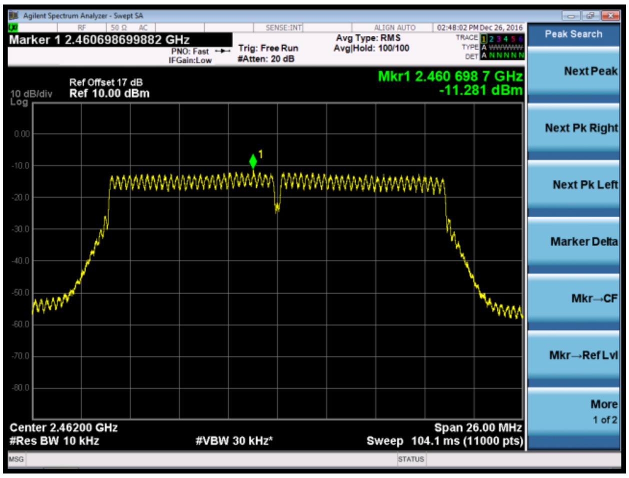

| 802.11n-HT40 AVGPSD - Ant 0 / Ant 0 + 1 + 2 | |
|---|---|
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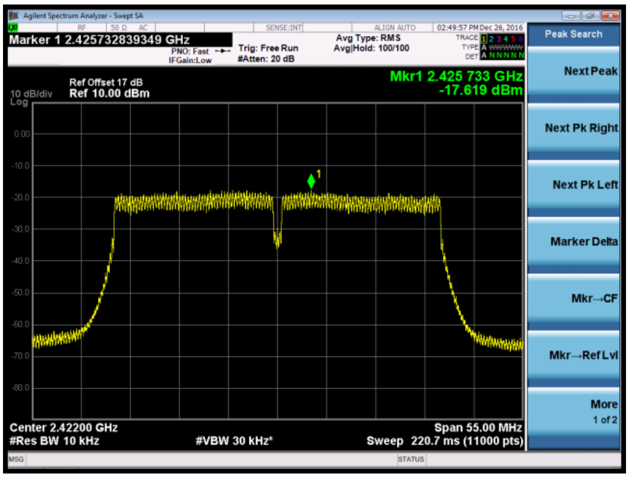
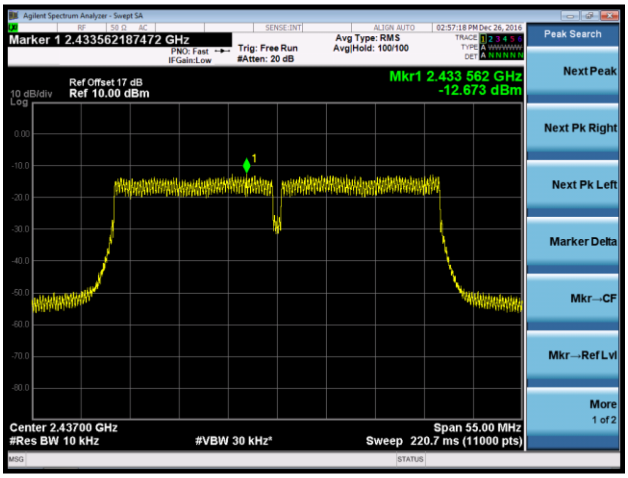
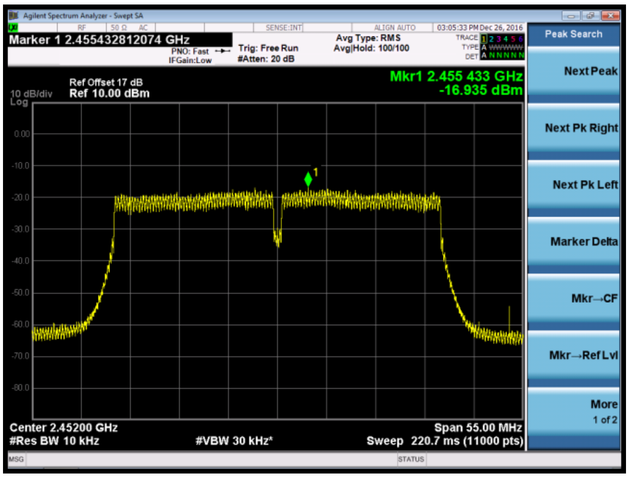
|   |   |
| **Channel 09 (2452MHz)** | |
|   | |

| 802.11b AVGPSD - Ant 1 / Ant 0 + 1 + 2 | |
|---|---|
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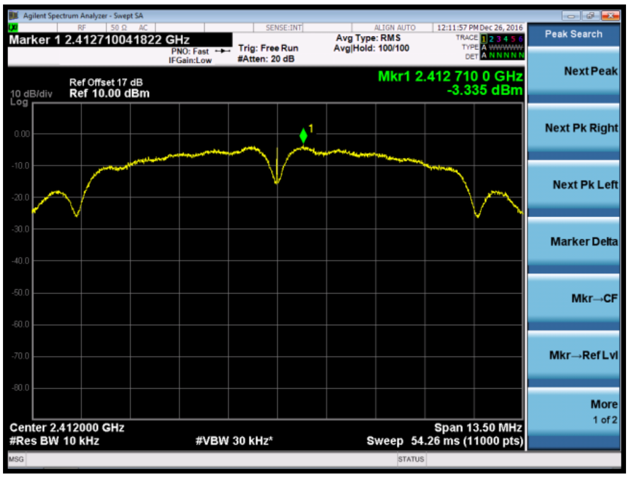
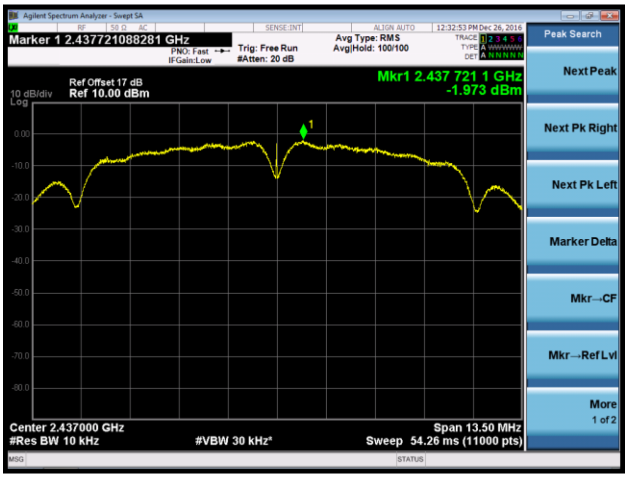
|  |  |
| Channel 11 (2462MHz) | |
|  | |

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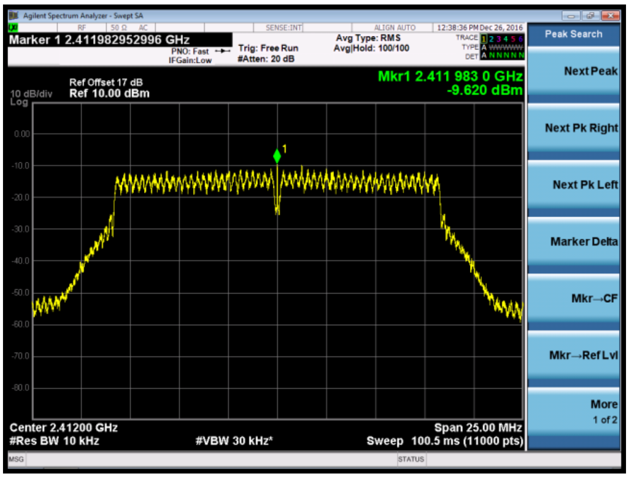

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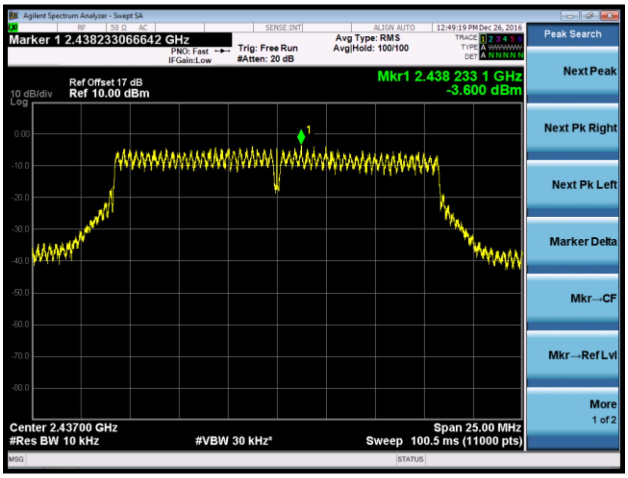

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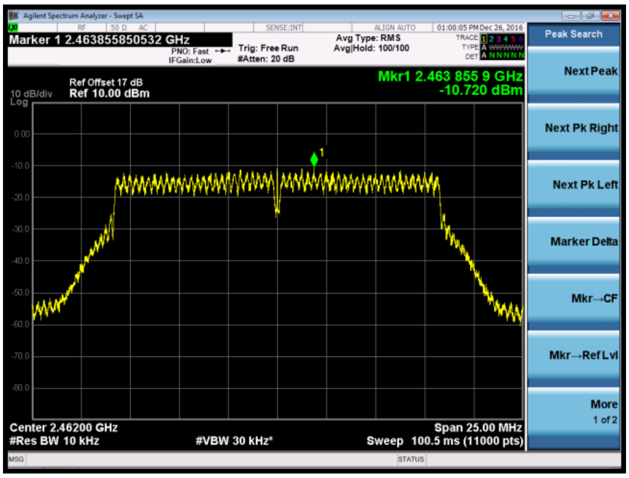

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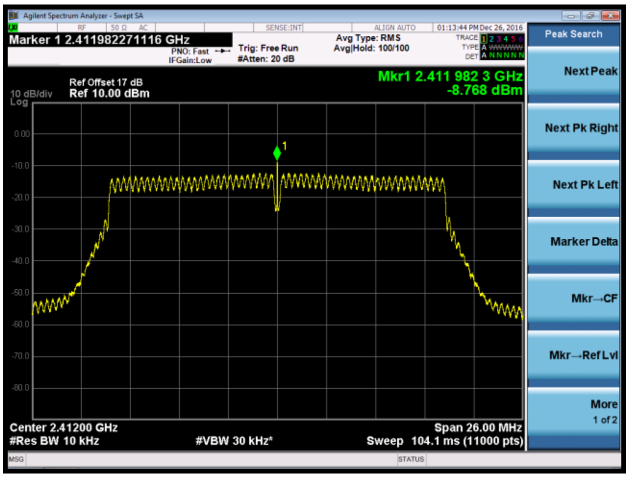
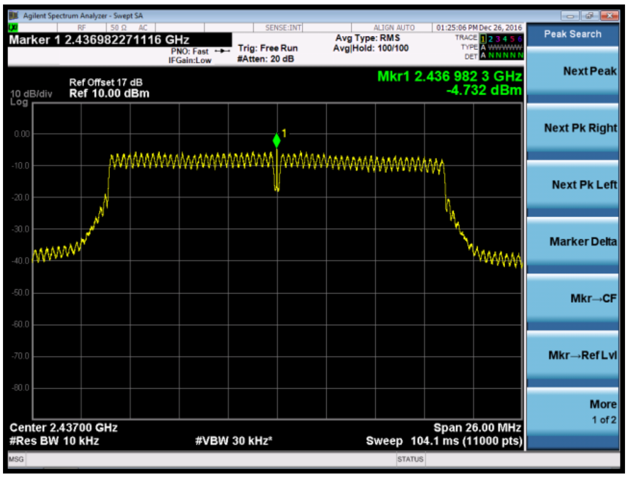
<tr><td></td><td></td></tr>
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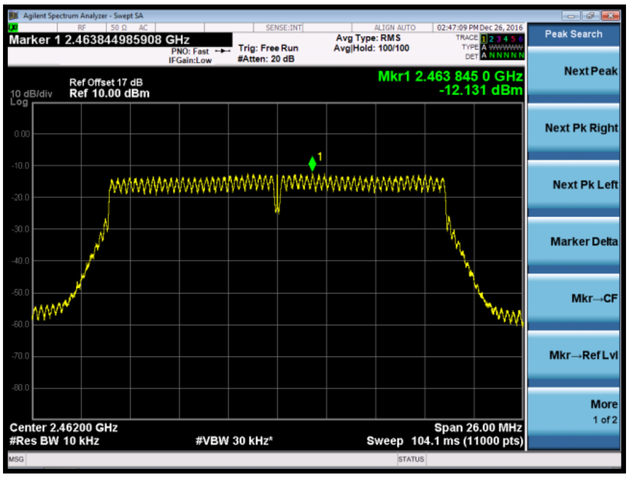
<tr><td></td><td></td></tr>
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| 802.11n-HT40 AVGPSD - Ant 1 / Ant 0 + 1 + 2 | |
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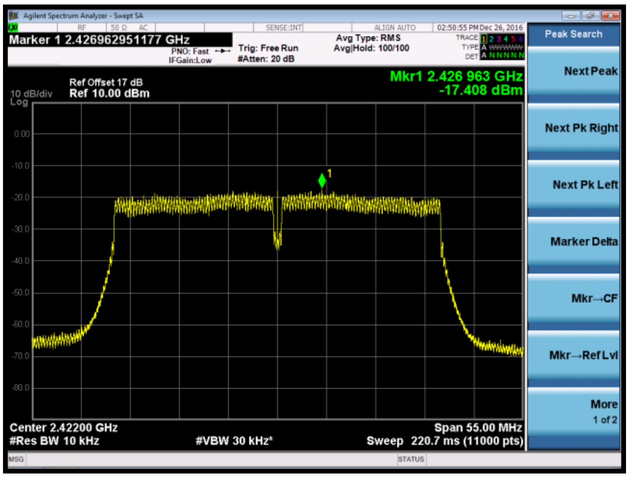
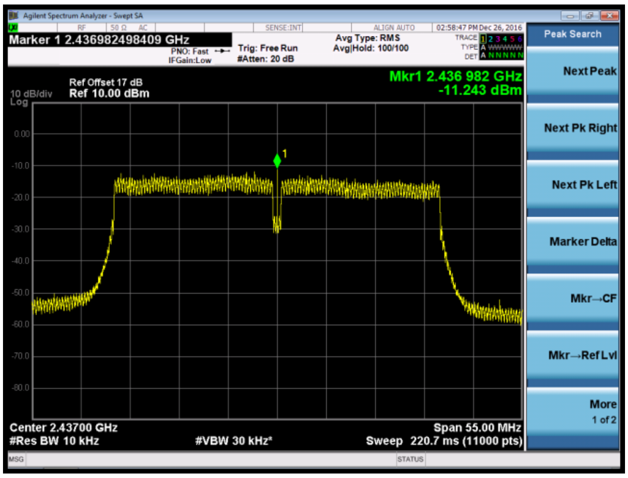
|  |  |
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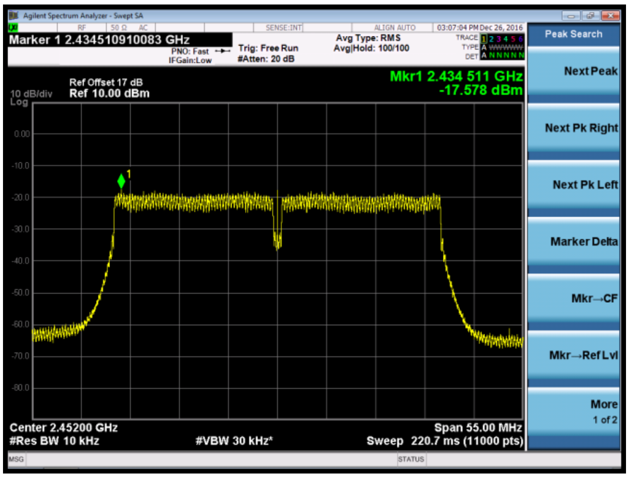
|  | |

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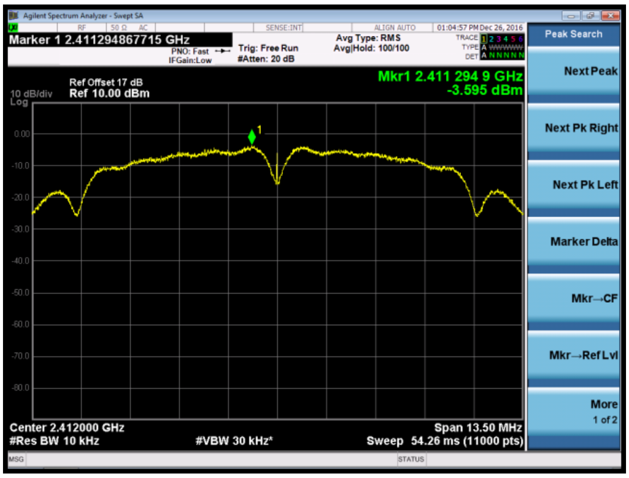
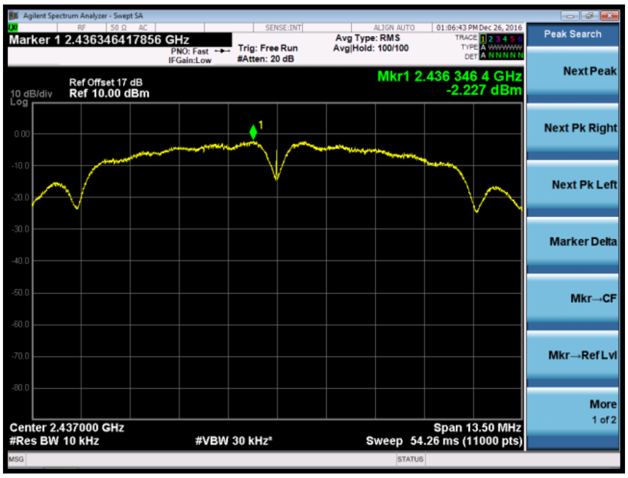
<tr><td>
</td><td>
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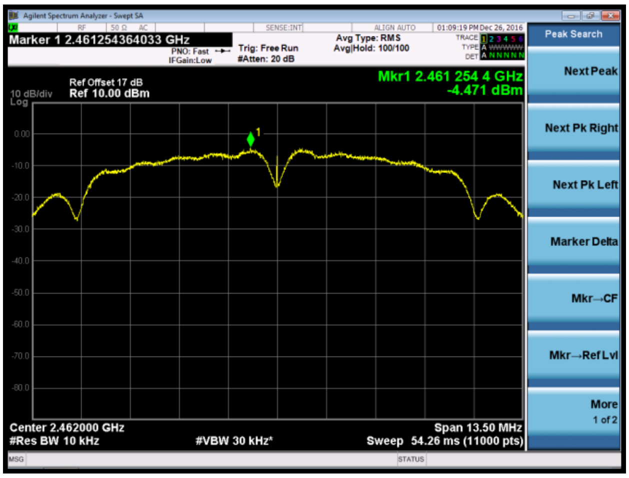
<tr><td>
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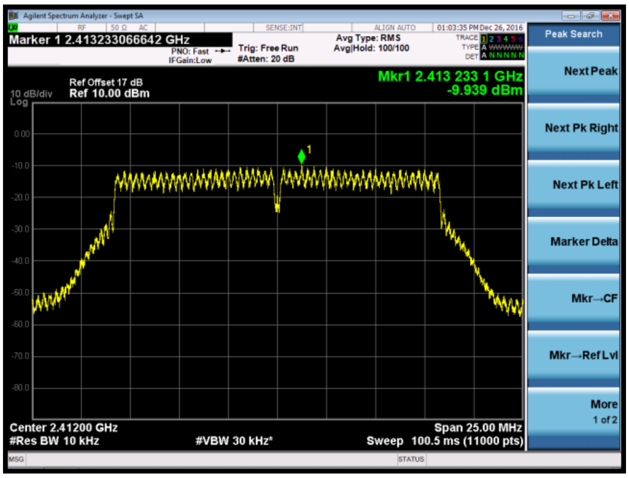
<tr><td>
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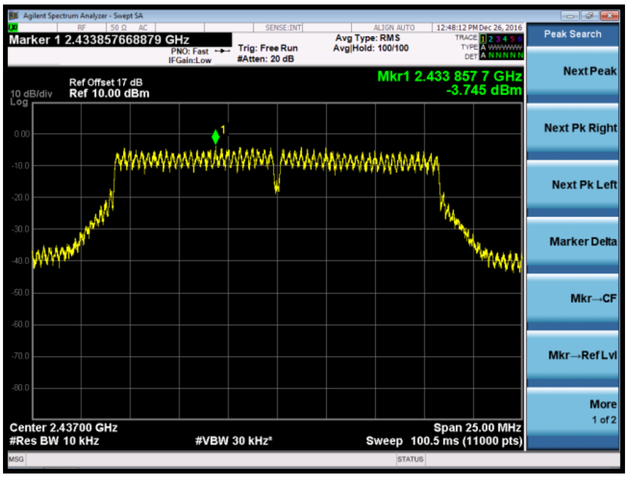
<td>
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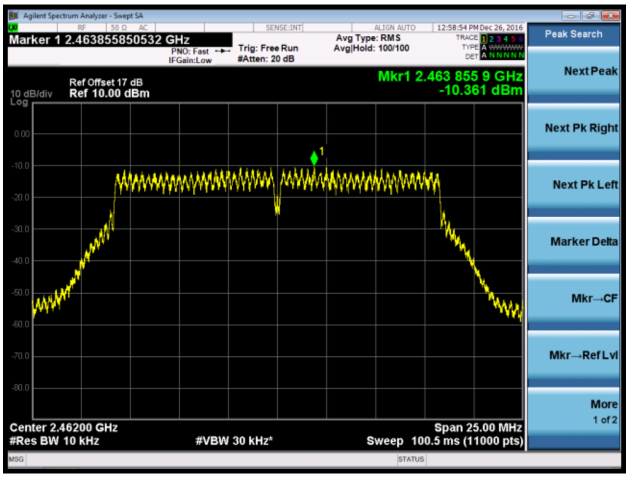
<tr><td>
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| 802.11n-HT20 AVGPSD - Ant 2 / Ant 0 + 1 + 2 | |
|---|---|
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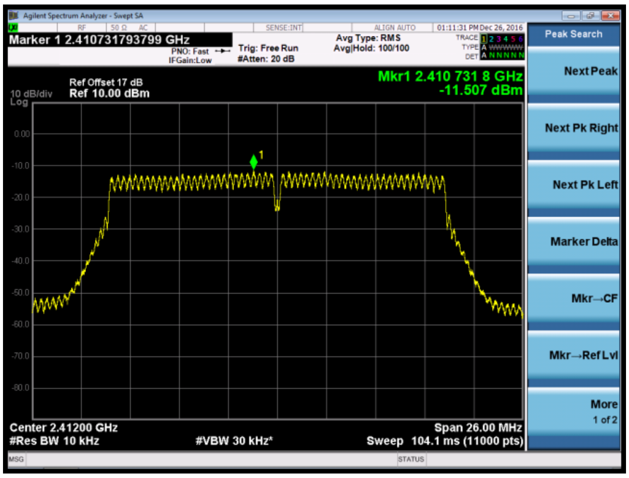
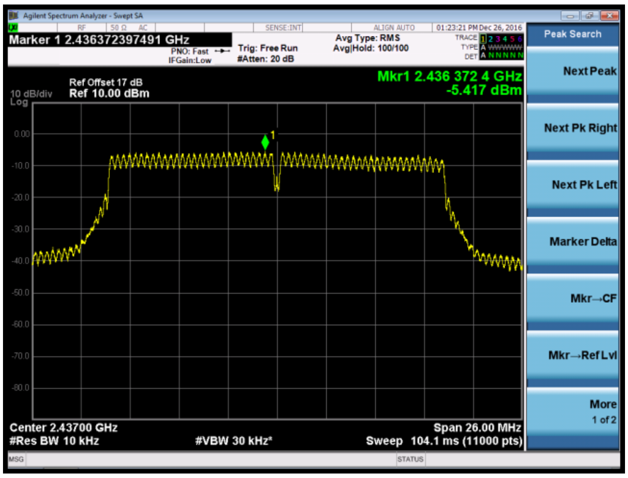
|  |  |
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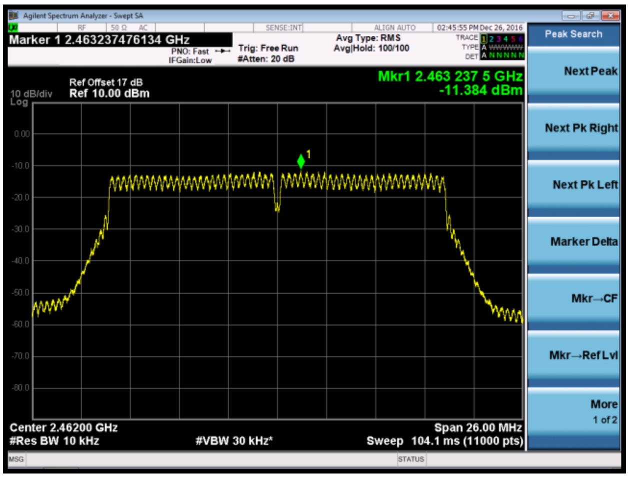
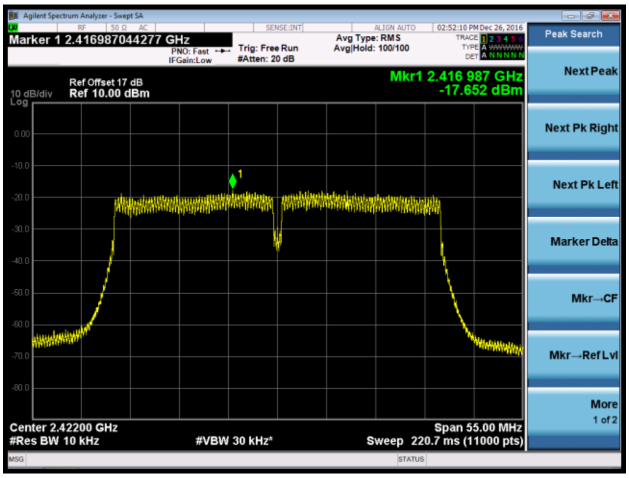
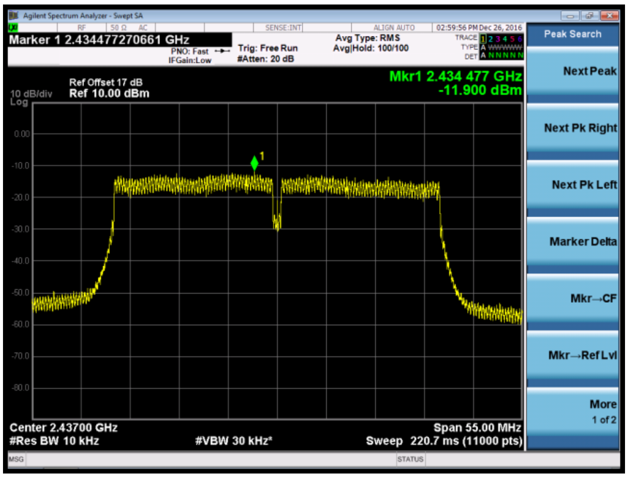
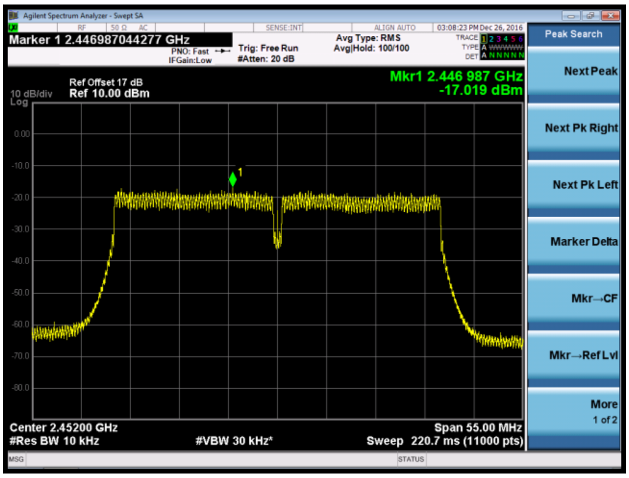
|  | |

| 802.11n-HT40 AVGPSD - Ant 2 / Ant 0 + 1 + 2 | |
|---|---|
| **Channel 03 (2422MHz)** | **Channel 06 (2437MHz)** |
|   |   |
| **Channel 09 (2452MHz)** | |
|   | |

## 7.5. Conducted Band Edge and Out-of-Band Emissions

### 7.5.1. Test Limit

The limit for out-of-band spurious emissions at the band edge is 30dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth per the PSD procedure.

### 7.5.2. Test Procedure Used

KDB 558074 D01v03r05 - Section 11.2 & Section 11.3

### 7.5.3. Test Settitng

**1. Reference level measurement**

(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

**2. Emission level measurement**

(a) Set the center frequency and span to encompass frequency range to be measured

(b) RBW = 100kHz

(c) VBW = 300kHz

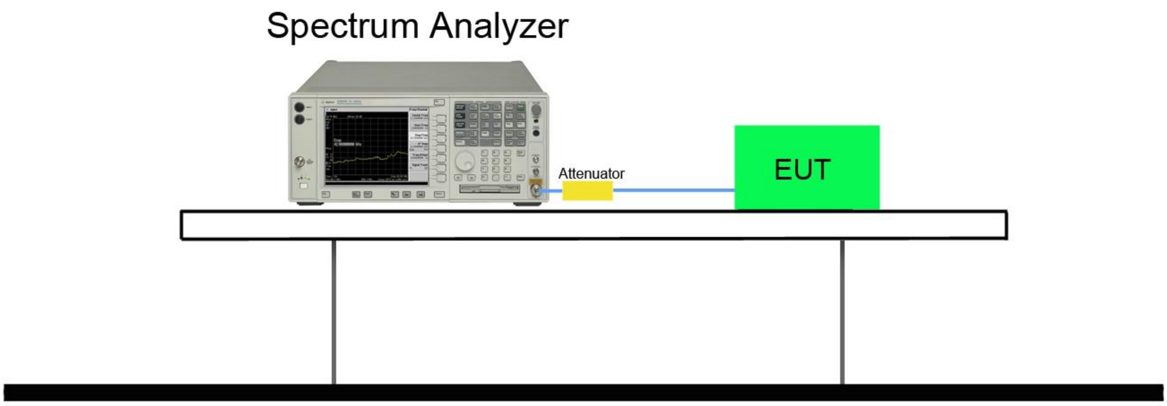
(d) Detector = Peak

(e) Trace mode = max hold

(f) Sweep time = auto couple

(g) The trace was allowed to stabilize

### 7.5.4. Test Setup



### 7.5.5. Test Result

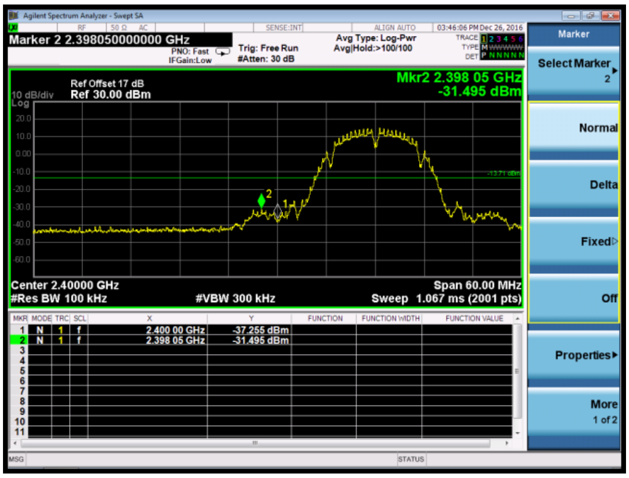
| Test Mode | Data Rate / MCS | Channel No. | Frequency (MHz) | Limit | Result |
|---|---|---|---|---|---|
| Ant 1 / Ant 0 + 1 + 2 | | | | | |
| 802.11b | 1Mbps | 01 | 2412 | 30dBc | Pass |
| 802.11b | 1Mbps | 06 | 2437 | 30dBc | Pass |
| 802.11b | 1Mbps | 11 | 2462 | 30dBc | Pass |
| 802.11g | 6Mbps | 01 | 2412 | 30dBc | Pass |
| 802.11g | 6Mbps | 06 | 2437 | 30dBc | Pass |
| 802.11g | 6Mbps | 11 | 2462 | 30dBc | Pass |
| 802.11n-HT20 | MCS0 | 01 | 2412 | 30dBc | Pass |
| 802.11n-HT20 | MCS0 | 06 | 2437 | 30dBc | Pass |
| 802.11n-HT20 | MCS0 | 11 | 2462 | 30dBc | Pass |
| 802.11n-HT40 | MCS0 | 03 | 2422 | 30dBc | Pass |
| 802.11n-HT40 | MCS0 | 06 | 2437 | 30dBc | Pass |
| 802.11n-HT40 | MCS0 | 09 | 2452 | 30dBc | Pass |

## 802.11b Out-of-Band Emissions - Ant 1 / Ant 0 + 1 + 2

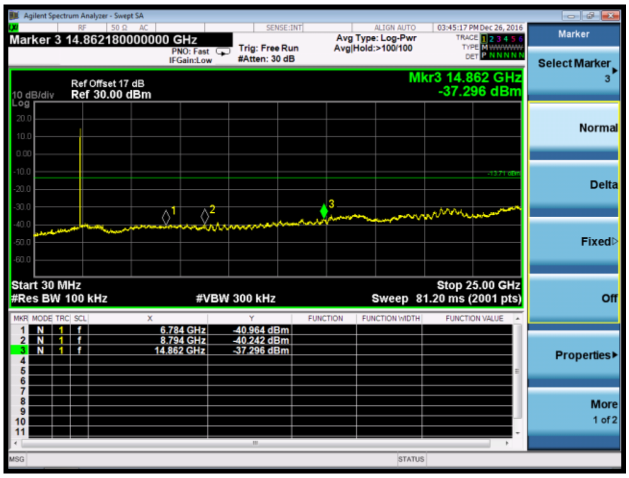
### 100kHz PSD Reference Level


### Channel 01 (2412MHz)

#### Low Band Edge




#### Spurious Emission




### Channel 06 (2437MHz)

#### Spurious Emission