MEASUREMENT REPORT
FCC PART 15.247 802.11b/g/n

FCC ID:	I88C424G
APPLICANT:	Zyxel Communications Corporation
Application Type:	Certification
Product:	Indoor GPON HGU
Model No.:	PMG5717-B10A, C424G
Brand Name:	ZYXEL, ADTRAN
Part Number:	1287781F1C
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 25 ~ December 18, 2016

Reviewed By : Robin Wu
(Robin Wu)

Approved By : Marlinchen
(Marlin Chen)

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

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.

The test report shall not be reproduced except in full without the written approval of MRT Technology (Suzhou) Co., Ltd.

Revision History

Report No.	Version	Description	Issue Date	Note
1611RSU04001	Rev. 01	Initial report	02-08-2017	Valid

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§2.1033 General Information

Applicant:	Zyxel Communications Corporation
Applicant Address:	No.2 Industry East RD. IX, Hsinchu Science Park, Hsinchu, Taiwan, R.O.C
Manufacturer:	Zyxel Communications Corporation
Manufacturer Address:	No.2 Industry East RD. IX, Hsinchu Science Park, Hsinchu, Taiwan, R.O.C
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
MRT Registration No.:	809388
FCC Rule Part(s):	Part 15.247
FCC ID:	I88C424G
Test Device Serial No.:	N/A ☐ Production ☒ Pre-Production ☐ Engineering
FCC Classification:	Digital Transmission System (DTS)

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.

- **MRT facility is a FCC registered (MRT Reg. No. 809388) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules.**
- **MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.**
- **MRT facility is a VCCI registered (R-4179, G-814, C-4664, T-2206) test laboratory with the site description on file at VCCI Council.**
- **MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications and Radio testing for FCC, Industry Canada, EU and TELEC Rules.**

Accredited Laboratory

A2LA has accredited

MRT TECHNOLOGY (SUZHOU) CO., LTD.

Suzhou, Jiangsu, People's Republic of China

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 6th day of September 2016.

Senior Director of Quality and Communications
For the Accreditation Council
Certificate Number 3628.01
Valid to August 31, 2018

For the tests to which the accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

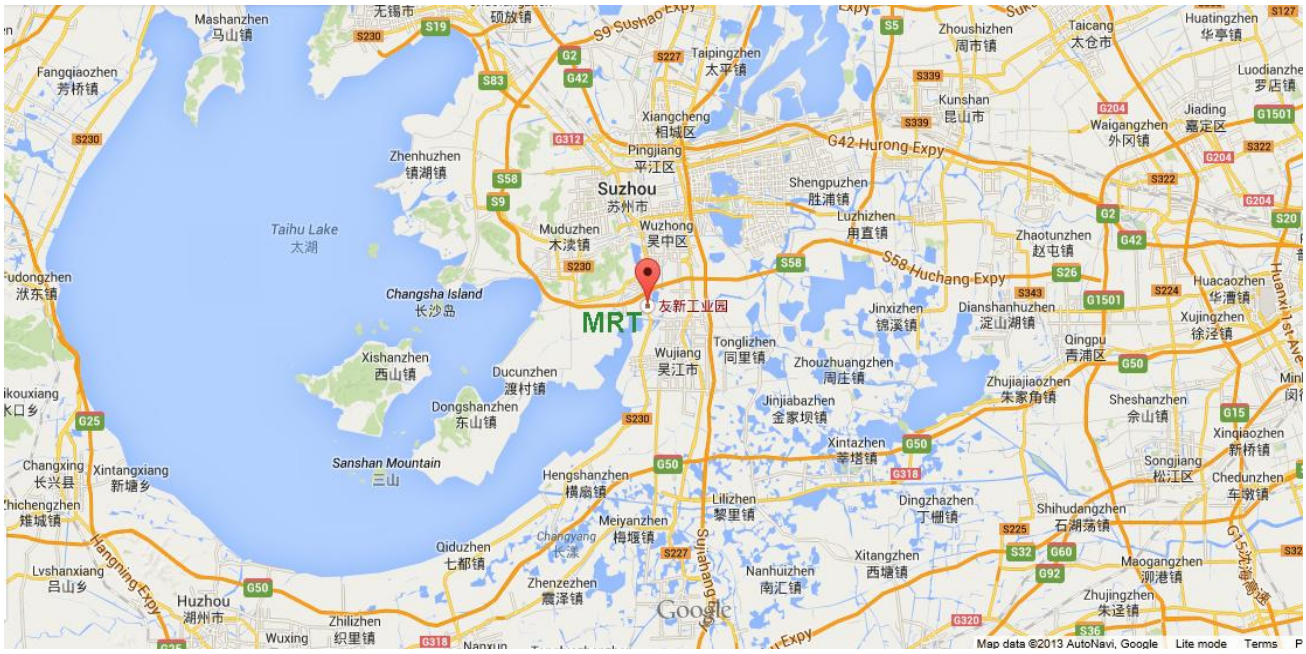
1. INTRODUCTION

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 Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2009 on September 30, 2013.



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	Indoor GPON HGU
Model No.	PMG5717-B10A, C424G
Brand Name	ZYXEL, ADTRAN
Wi-Fi Specification	802.11a/b/g/n/ac
Frequency Range	**2.4GHz:** For 802.11b/g/n-HT20: 2412 ~ 2462 MHz For 802.11n-HT40: 2422 ~ 2452 MHz **5GHz:** For 802.11a/n-HT20/ac-VHT20: 5180~5240MHz, 5745~5825MHz For 802.11n-HT40/ac-VHT40: 5190~5230MHz, 5755~5795MHz For 802.11ac-VHT80: 5210MHz, 5775MHz
2.4GHz Maximum Average Output Power	802.11b: 23.65dBm 802.11g: 23.75dBm 802.11n-HT20: 26.10dBm 802.11n-HT40: 26.09dBm
Type of Modulation	802.11b: DSSS 802.11a/g/n/ac: OFDM

2.2. Operation Frequency / 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	N/A	N/A	N/A	N/A

2.3. Description of Available Antennas

For SISO Mode

Antenna Type	Mode	Frequency Band (GHz)	T_X Paths	Antenna Gain (dBi)	
				Ant 0	Ant 1
PCB Antenna	802.11b	2.4	1	3.4	--
	802.11g/n		2	3.4	2.7

For MIMO mode

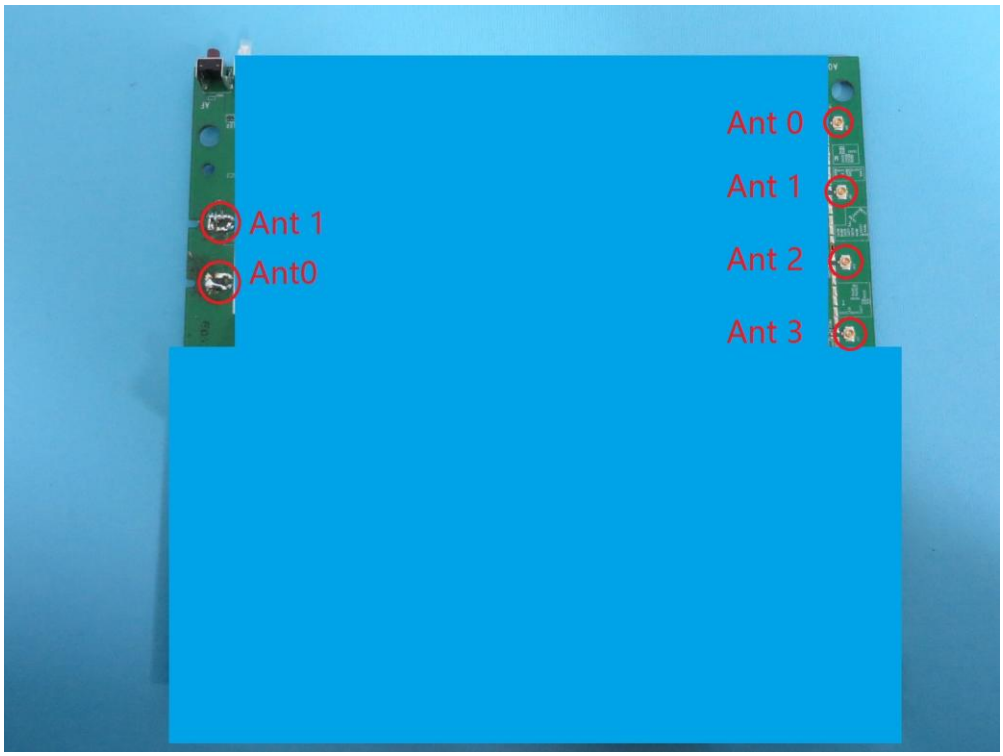
Antenna Type	Mode	Frequency Band (GHz)	T_X Paths	Directional Gain (dBi)	
				Non Beam Forming	Beam Forming
PCB Antenna	802.11n	2.4	2	2.92	--

Note:

1. The EUT doesn't support Beam Forming technology at 2.4GHz mode.
2. Completely uncorrelated signals include those transmitted in the following modes, if they are not combined with any correlated modes, such as beamforming:
   - Space Time Block Codes (STBC) or Space Time Codes (STC) for which different digital data is carried by each transmit antenna during any symbol period (e.g., WiMAX Matrix A [Alamouti coding]).
   - Spatial Multiplexing MIMO (SM-MIMO), for which independent data streams are sent to each transmit antenna (e.g., WiMAX Matrix B). WiMAX Matrix C, which adds diversity, also produces uncorrelated transmit signals.
3. Unequal antenna gains, with equal transmit powers. For antenna gains given by G_1, G_2, …, G_N dBi
   - transmit signals are uncorrelated, then
   - Directional gain = 10 log[$(10^{G1/10} + 10^{G2/10} + \ldots + 10^{GN/10})/N_{ANT}$] dBi [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

2.4. Description of Antenna RF Port

Antenna RF Port						
---	2.4GHz RF Port		5GHz RF Port			
Software Control Port	Ant 0	Ant 1	Ant 0	Ant 1	Ant 2	Ant 3



2.5. 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

2.6. Test Software

The test utility software used during testing was “MTool_2.0.07”, this software can be used to control the test mode, data rate, and power level of the device.

2.7. Device Capabilities

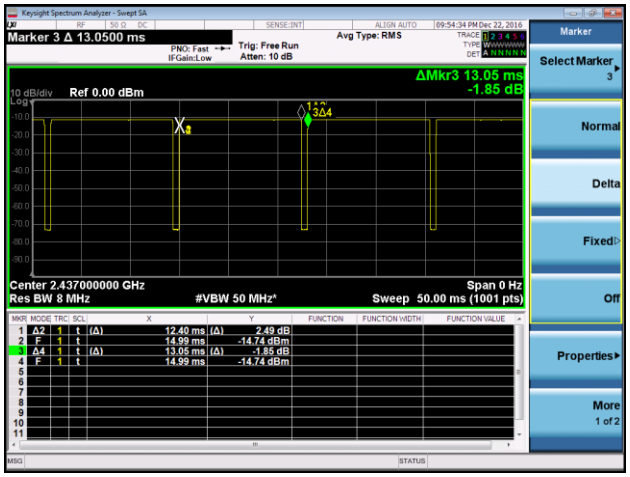
This device contains the following capabilities:

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

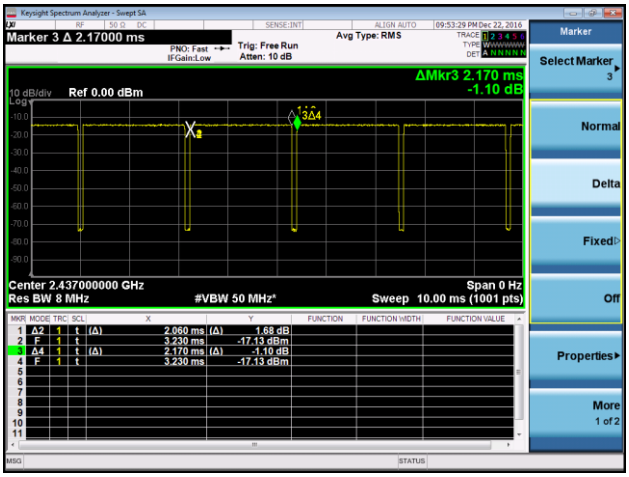
Note: 2.4GHz WLAN (DTS) operation is possible in 20MHz, and 40MHz channel bandwidths. The maximum achievable duty cycle was determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz. The RBW and VBW were both greater than 50/T, where T is the minimum 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	95.0%
802.11g	94.9%
802.11n-HT20	94.7%
802.11n-HT40	89.5%

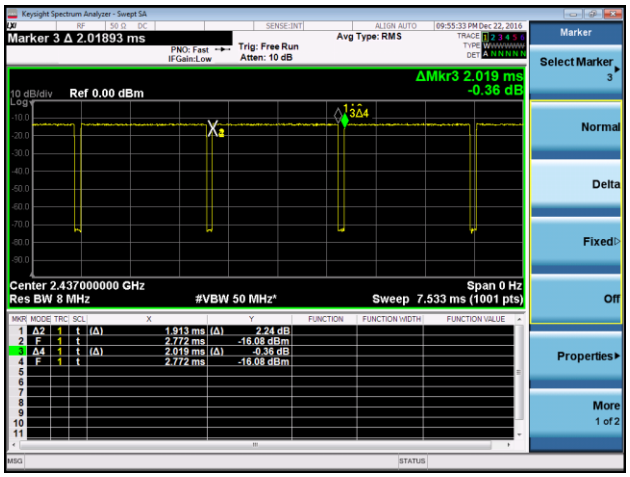
802.11b - Duty Cycle



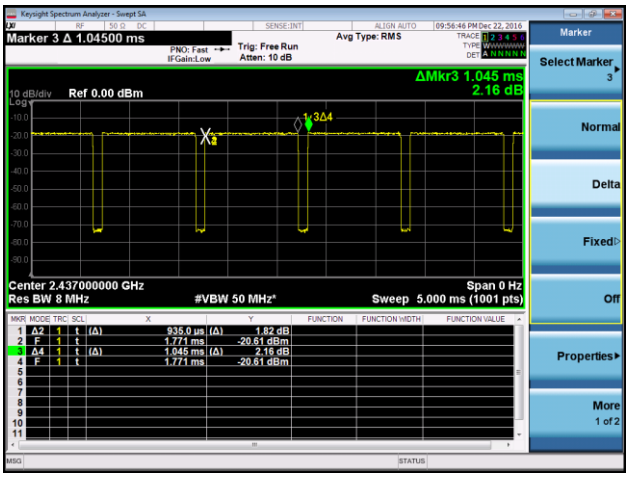
802.11g - Duty Cycle



802.11n-HT20 - Duty Cycle



802.11n-HT40 - Duty Cycle



2.8. Test Configuration

The **Indoor GPON HGU** 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.

2.9. EMI Suppression Device(s)/Modifications

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

2.10. 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 **Indoor GPON HGU.**

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 whichever 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 1-25GHz 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, whichever 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 antenna of the **Indoor GPON HGU** is **permanently attached.**
- There are no provisions for connection to an external antenna.

Conclusion:

The **Indoor GPON HGU** unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions - SR2

Instrument	Manufacturer	Type No.	Serial No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	101209	1 year	2017/06/20
Two-Line V-Network	R&S	ENV216	101683	1 year	2017/06/20
Two-Line V-Network	R&S	ENV216	101684	1 year	2017/06/20
Temperature/Humidity Meter	Yuhuaze	N/A	N/A	1 year	2017/12/20
Shielding Anechoic Chamber	MIX-BEP	Chamber-SR2	N/A	1 year	2017/05/10

Radiated Emission - AC1

Instrument	Manufacturer	Type No.	Serial No.	Cali. Interval	Cali. Due Date
MXE EMI Receiver	Agilent	N9038A	MY51210182	1 year	2017/08/03
Preamplifier	Agilent	83017A	MY52090106	1 year	2017/03/28
Loop Antenna	Schwarzbeck	FMZB1519	1519-041	1 year	2017/11/20
TRILOG Antenna	Schwarzbeck	VULB9162	9162-047	1 year	2017/10/22
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1167	1 year	2017/10/22
Digital Thermometer & Hygrometer	Yuhuaze	HTC-2	N/A	1 year	2017/12/20
RF Cable	HUBER+ SUHNER	Cable 01	N/A	1 year	2017/03/29
RF Cable	HUBER+ SUHNER	Cable 02	N/A	1 year	2017/03/29
Anechoic Chamber	TDK	Chamber-AC1	N/A	1 year	2017/05/10

Conducted Test Equipment - TR3

Instrument	Manufacturer	Type No.	Serial No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	MY52090106	1 year	2017/05/08
USB Wideband Power Sensor	Boonton	55006	MRTSUE06109	1 year	2017/05/08
RF Cable	HUBER+ SUHNER	Cable 03	N/A	1 year	2017/03/29
Attenuator	Woken	WATT-218FS-15	N/A	1 year	2017/03/29
DC Block	Woken	00900A1A2A101A	N/A	1 year	2017/03/29
Temperature/Humidity Meter	Yuhuaze	HTC-2	N/A	1 year	2017/12/20

Software	Version	Function
e3	V8.3.5	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)): 150kHz~30MHz: 3.46dB
Radiated Emission Measurement – AC1
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 9kHz ~ 1GHz: 4.18dB 1GHz ~ 25GHz: 4.76dB
Output Power - TR3
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 1.13dB
Power Spectrum Density - TR3
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 1.15dB
Occupied Bandwidth - TR3
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 0.28%

7. TEST RESULT

7.1. Summary

Company Name: **Zyxel Communications Corporation**

FCC ID: **I88C424G**

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

Data Rate(s) Tested: **1Mbps ~ 11Mbps (b); 6Mbps ~ 54Mbps (g);**
6.5/7.2Mbps ~ 130.0/144.0Mbps (n-HT20);
13.5/15Mbps ~ 270/300Mbps (n-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	≤ 30dBm		Pass	Section 7.3
15.247(e)	Power Spectral Density	≤ 8dBm/3kHz		Pass	Section 7.4
15.247(d)	Band Edge / Out-of-Band Emissions	< 30dBc		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) All modes of operation and data rates were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.
2) 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.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.
4) For 6dB Bandwidth Measurment, we have showed the worst test data in the report.

7.2. 6dB Bandwidth Measurement

7.2.1. Test Limit

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

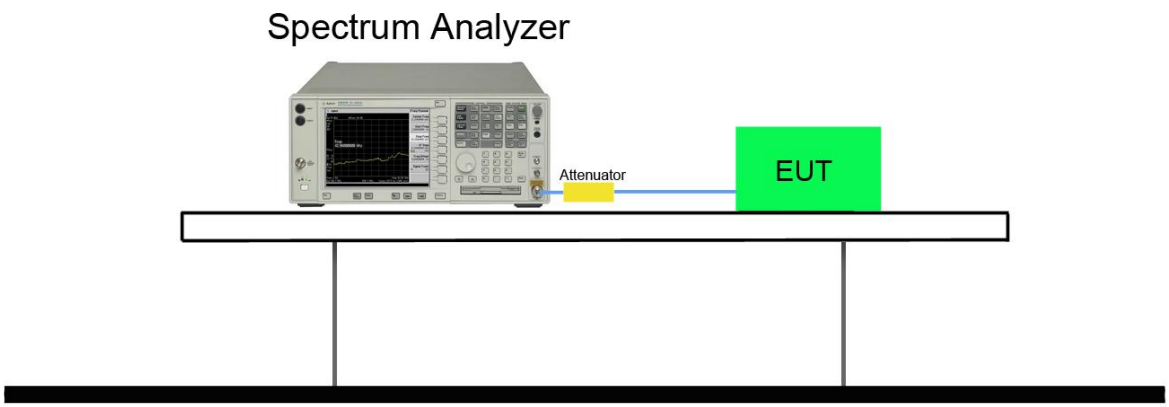
7.2.2. Test Procedure used

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

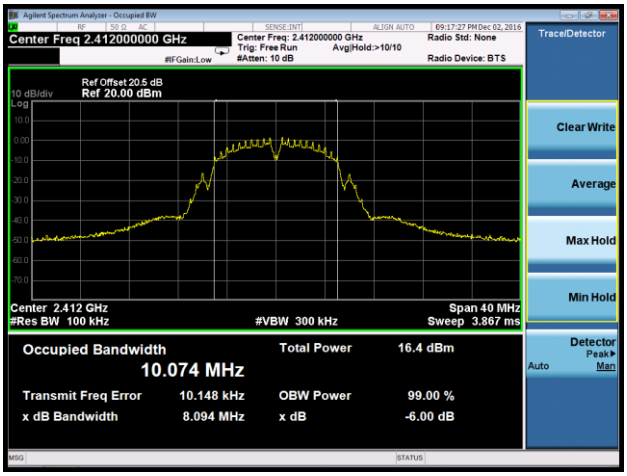


7.2.5. Test Result

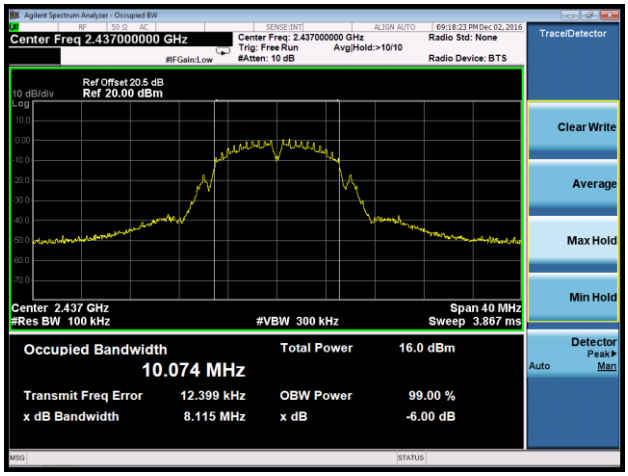
Test Mode	Data Rate (Mbps)	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
Ant 0						
802.11b	1	01	2412	8.09	≥0.5	Pass
802.11b	1	06	2437	8.12	≥0.5	Pass
802.11b	1	11	2462	8.10	≥0.5	Pass
802.11g	6	01	2412	16.40	≥0.5	Pass
802.11g	6	06	2437	16.40	≥0.5	Pass
802.11g	6	11	2462	16.43	≥0.5	Pass
802.11n-HT20	6.5	01	2412	17.61	≥0.5	Pass
802.11n-HT20	6.5	06	2437	17.61	≥0.5	Pass
802.11n-HT20	6.5	11	2462	17.62	≥0.5	Pass
802.11n-HT40	13.5	03	2422	35.60	≥0.5	Pass
802.11n-HT40	13.5	06	2437	35.73	≥0.5	Pass
802.11n-HT40	13.5	09	2452	35.61	≥0.5	Pass
Ant 1						
802.11g	6	01	2412	16.43	≥0.5	Pass
802.11g	6	06	2437	16.40	≥0.5	Pass
802.11g	6	11	2462	16.40	≥0.5	Pass
802.11n-HT20	6.5	01	2412	17.62	≥0.5	Pass
802.11n-HT20	6.5	06	2437	17.59	≥0.5	Pass
802.11n-HT20	6.5	11	2462	17.62	≥0.5	Pass
802.11n-HT40	13.5	03	2422	35.44	≥0.5	Pass
802.11n-HT40	13.5	06	2437	35.52	≥0.5	Pass
802.11n-HT40	13.5	09	2452	35.54	≥0.5	Pass

802.11b 6dB Bandwidth - Ant 0

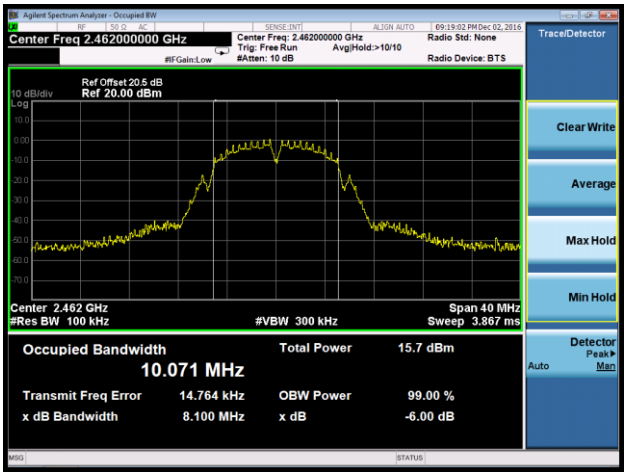
Channel 01 (2412MHz)



Channel 06 (2437MHz)

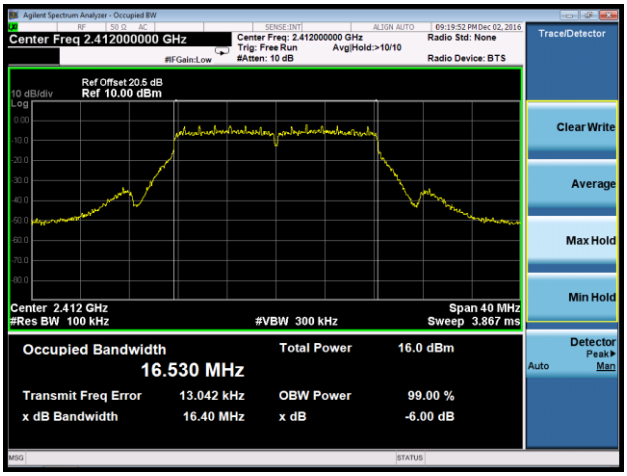


Channel 11 (2462MHz)

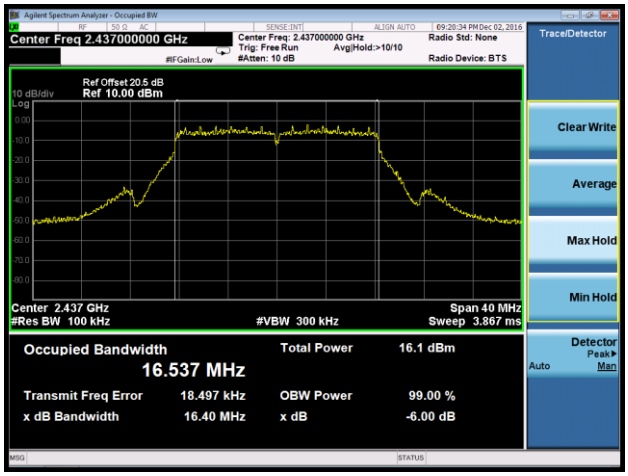


802.11g 6dB Bandwidth - Ant 0

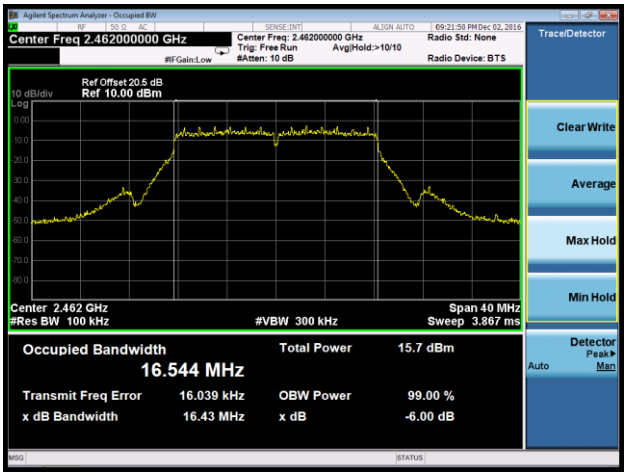
Channel 01 (2412MHz)



Channel 06 (2437MHz)

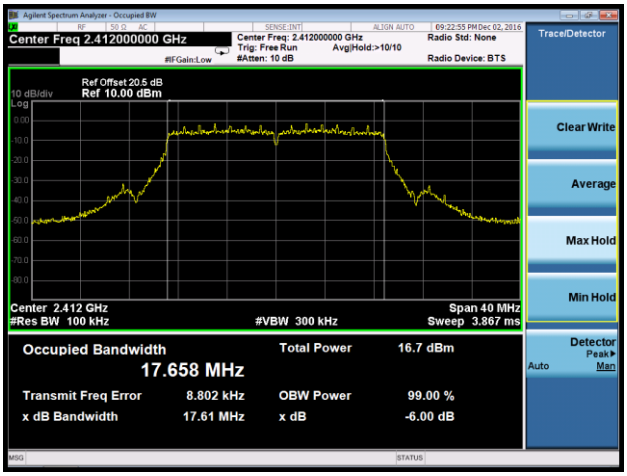


Channel 11 (2462MHz)

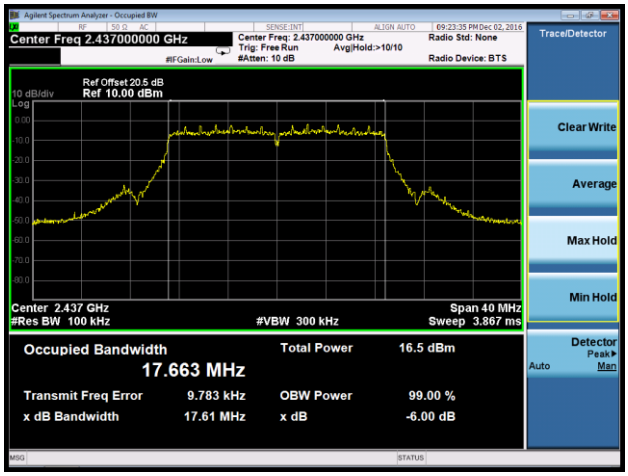


802.11n-HT20 6dB Bandwidth - Ant 0

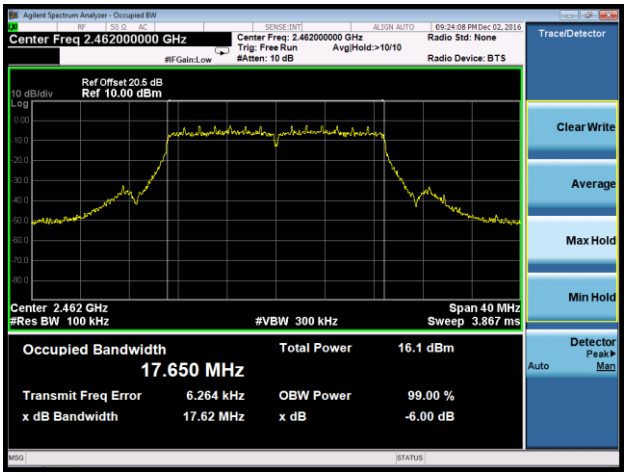
Channel 01 (2412MHz)



Channel 06 (2437MHz)

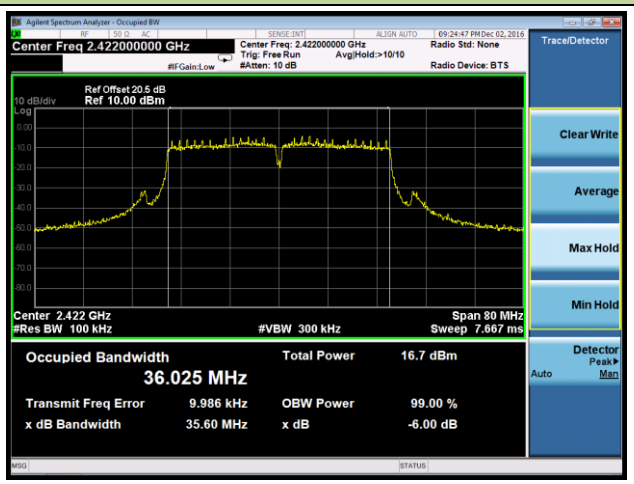


Channel 11 (2462MHz)

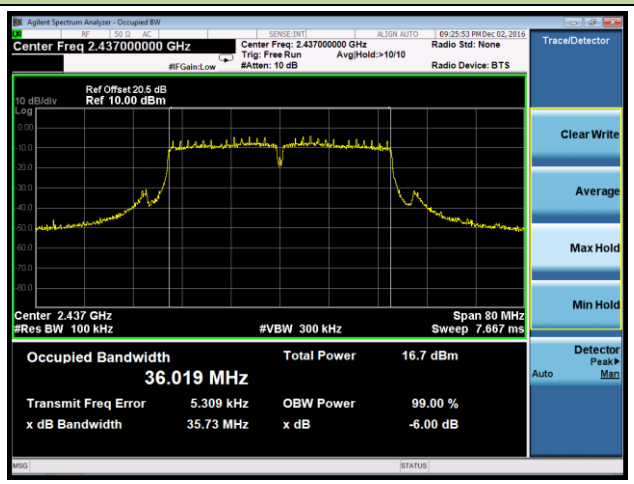


802.11n-HT40 6dB Bandwidth - Ant 0

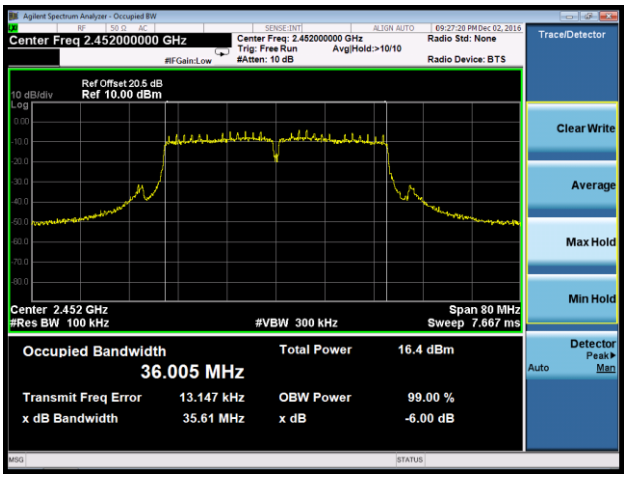
Channel 03 (2422MHz)



Channel 06 (2437MHz)

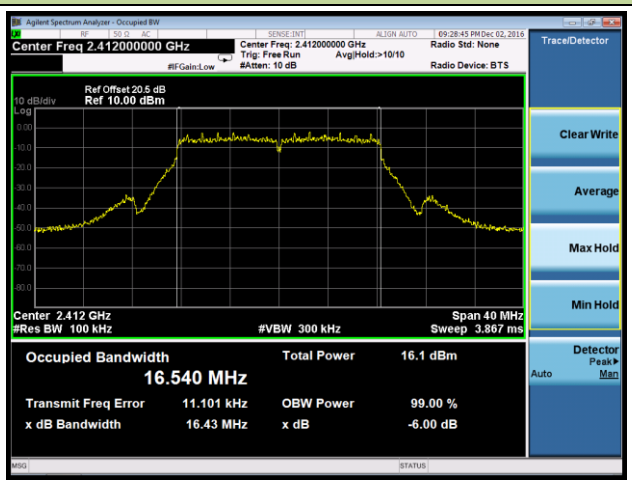


Channel 09 (2452MHz)

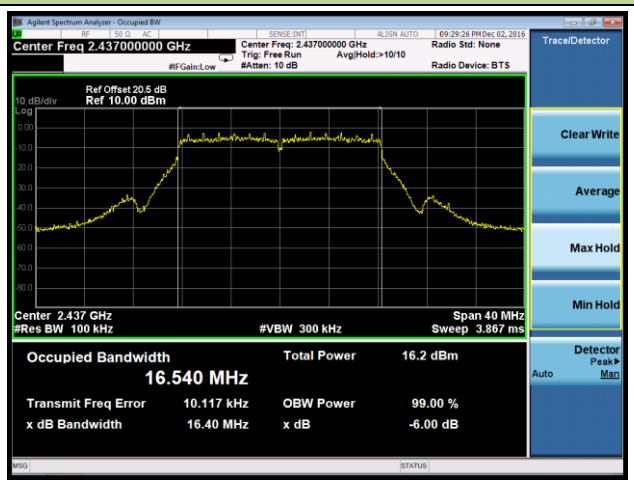


802.11g 6dB Bandwidth - Ant 1

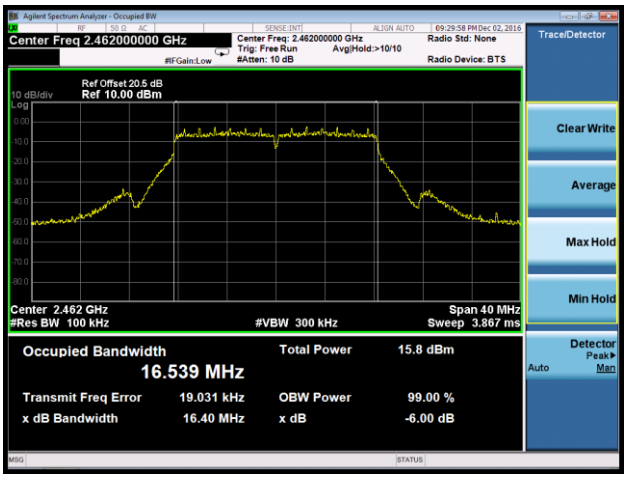
Channel 01 (2412MHz)



Channel 06 (2437MHz)

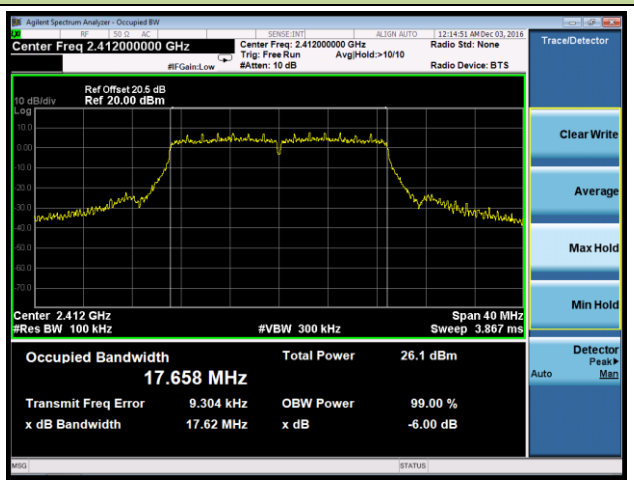


Channel 11 (2462MHz)

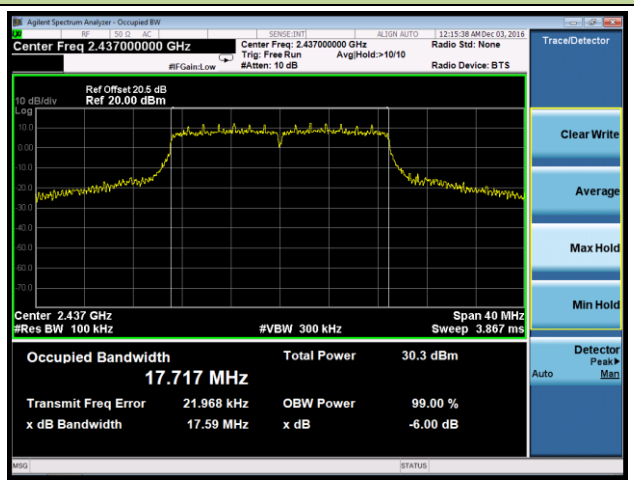


802.11n-HT20 6dB Bandwidth - Ant 1

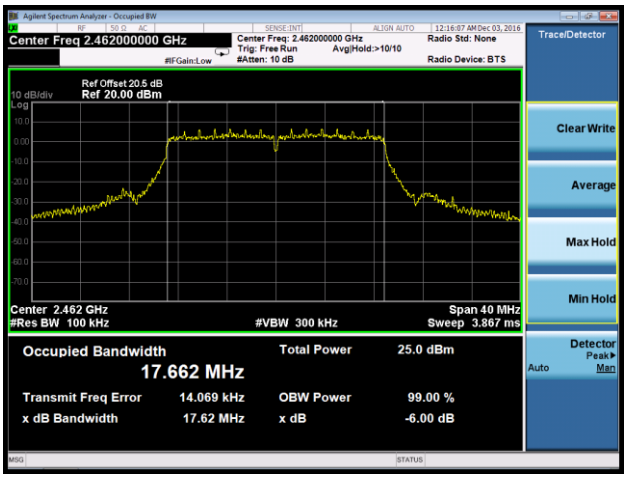
Channel 01 (2412MHz)



Channel 06 (2437MHz)

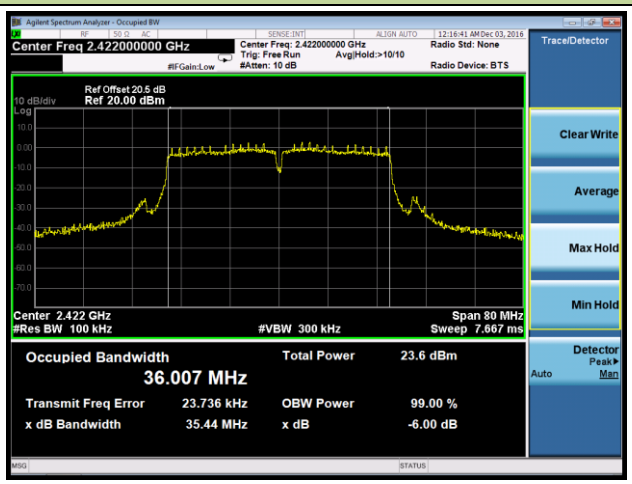


Channel 11 (2462MHz)

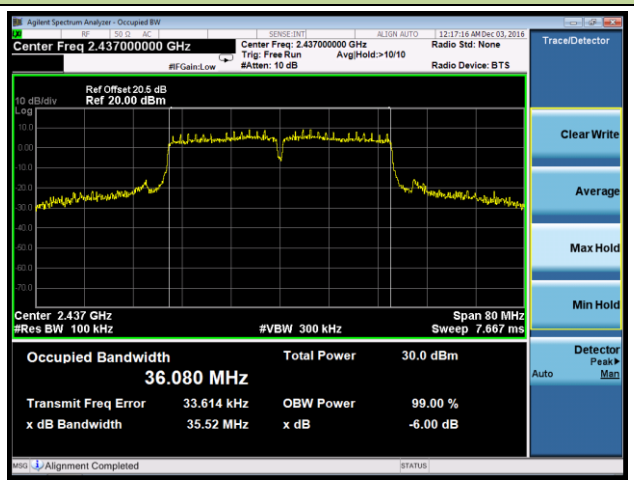


802.11n-HT40 6dB Bandwidth - Ant 1

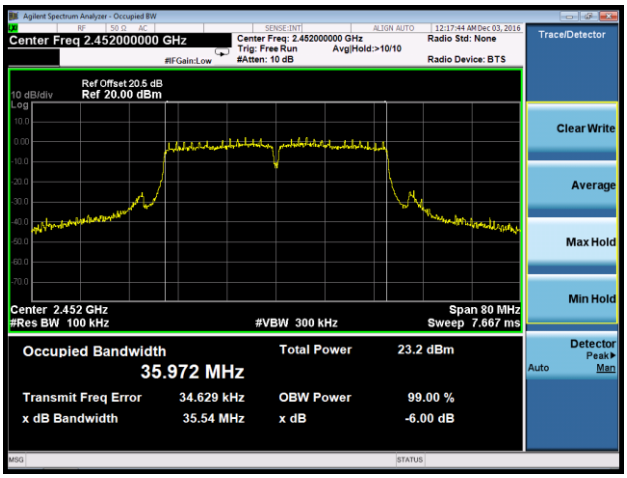
Channel 03 (2422MHz)



Channel 06 (2437MHz)



Channel 09 (2452MHz)



7.3. Output Power Measurement

7.3.1. Test Limit

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

7.3.2. Test Procedure Used

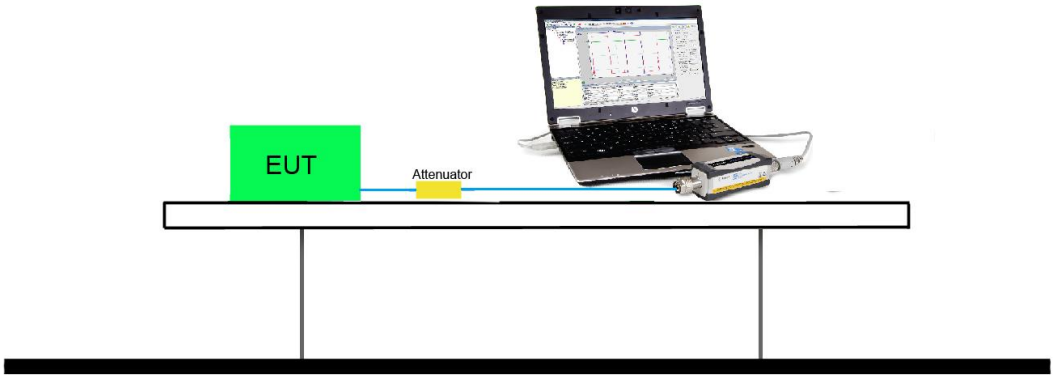
KDB 558074 D01v03r05 - Section 9.2.3.2 AVGPM-G Average Power Method

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, and then choose the maximum power output (yellow marker) for final test of each channel.

MCS Index for 802.11n	N_{TX}	Data Rate (Mbps)					
		802.11b	802.11g	20MHz Bandwidth		40MHz Bandwidth	
				800ns GI	400ns GI	800ns GI	400ns GI
0	1	1	6	6.5	7.2	13.5	15.0
1	1	2	9	13.0	14.4	27.0	30.0
2	1	5.5	12	19.5	21.7	40.5	45.0
3	1	11	18	26.0	28.9	54.0	60.0
4	1	--	24	39.0	43.3	81.0	90.0
5	1	--	36	52.0	57.8	108.0	120.0
6	1	--	48	58.5	65.0	121.5	135.0
7	1	--	54	65.0	72.2	135.0	150.0
8	2	--	--	13.0	14.4	27.0	30.0
9	2	--	--	26.0	28.9	54.0	60.0
10	2	--	--	39.0	43.3	81.0	90.0
11	2	--	--	52.0	57.8	108.0	120.0
12	2	--	--	78.0	86.7	162.0	180.0
13	2	--	--	104.0	115.6	216.0	240.0
14	2	--	--	117.0	130.0	243.0	270.0
15	2	--	--	130.0	144.0	270.0	300.0

Output power at various data rates for Ant 0:

Test Mode	Bandwidth (MHz)	Channel No.	Frequency (MHz)	Data Rate (Mbps)	Peak Power (dBm)
802.11b	20	6	2437	1	23.59
				5.5	23.24
				11	23.03
802.11g	20	6	2437	6	23.75
				24	23.49
				54	23.19
802.11n	20	6	2437	6.5	23.73
				39.0	23.51
				65.0	23.34
802.11n	40	6	2437	13.5	23.15
				81.0	22.92
				135.0	22.75

Test Result of Average Output Power

Test Mode	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Ant 0 Average Power (dBm)	Ant 1 Average Power (dBm)	Total Average Power (dBm)	Limit (dBm)	Result
Ant 0								
802.11b	1	01	2412	23.65	--	23.65	≤30	Pass
802.11b	1	06	2437	23.59	--	23.59	≤30	Pass
802.11b	1	11	2462	23.48	--	23.48	≤30	Pass
802.11g	6	01	2412	17.95	--	17.95	≤30	Pass
802.11g	6	06	2437	23.75	--	23.75	≤30	Pass
802.11g	6	11	2462	18.55	--	18.55	≤30	Pass
802.11n-HT20	6.5	01	2412	17.87	--	17.87	≤30	Pass
802.11n-HT20	6.5	06	2437	23.73	--	23.73	≤30	Pass
802.11n-HT20	6.5	11	2462	18.16	--	18.16	≤30	Pass
802.11n-HT40	13.5	03	2422	15.38	--	15.38	≤30	Pass
802.11n-HT40	13.5	06	2437	23.15	--	23.15	≤30	Pass
802.11n-HT40	13.5	09	2452	16.51	--	16.51	≤30	Pass
Ant 1								
802.11g	6	01	2412	--	20.27	20.27	≤30	Pass
802.11g	6	06	2437	--	23.42	23.42	≤30	Pass
802.11g	6	11	2462	--	18.55	18.55	≤30	Pass
802.11n-HT20	6.5	01	2412	--	19.04	19.04	≤30	Pass
802.11n-HT20	6.5	06	2437	--	23.37	23.37	≤30	Pass
802.11n-HT20	6.5	11	2462	--	18.28	18.28	≤30	Pass
802.11n-HT40	13.5	03	2422	--	16.65	16.65	≤30	Pass
802.11n-HT40	13.5	06	2437	--	22.66	22.66	≤30	Pass
802.11n-HT40	13.5	09	2452	--	15.97	15.97	≤30	Pass
Ant 0 + 1								
802.11n-HT20	13	01	2412	17.35	16.45	19.93	≤30	Pass
802.11n-HT20	13	06	2437	23.44	22.71	26.10	≤30	Pass
802.11n-HT20	13	11	2462	17.67	16.97	20.34	≤30	Pass
802.11n-HT40	27	03	2422	14.54	14.25	17.41	≤30	Pass
802.11n-HT40	27	06	2437	23.02	23.13	26.09	≤30	Pass
802.11n-HT40	27	09	2452	15.11	14.88	18.01	≤30	Pass

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

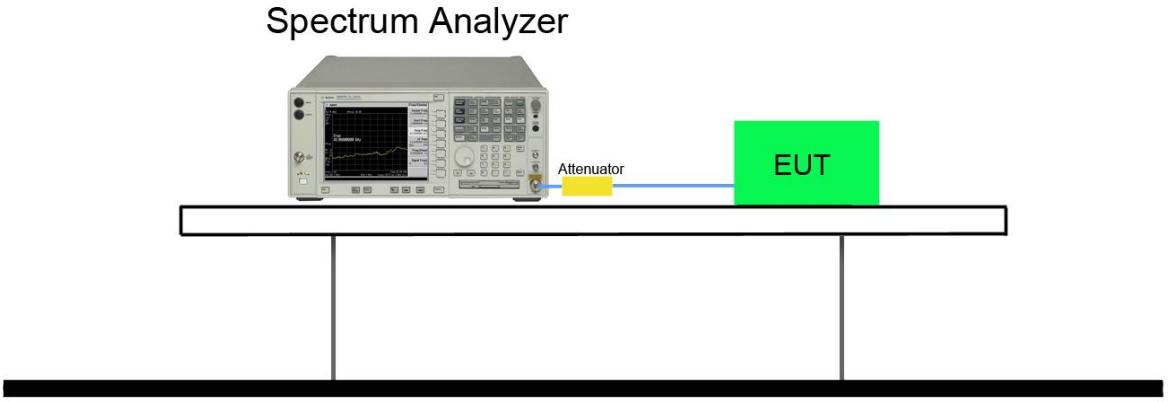
7.4.2. Test Procedure Used

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



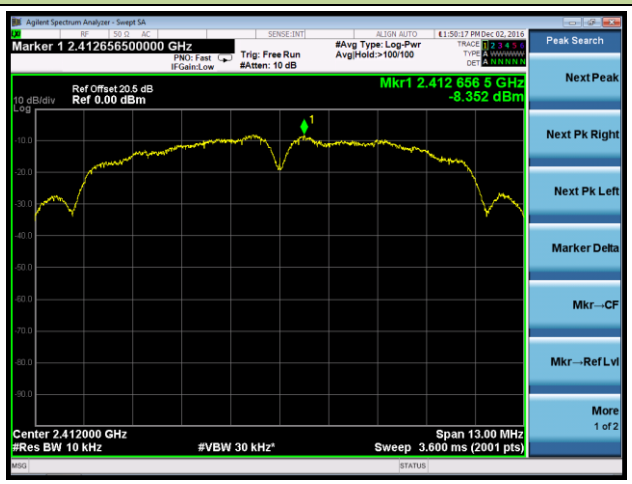
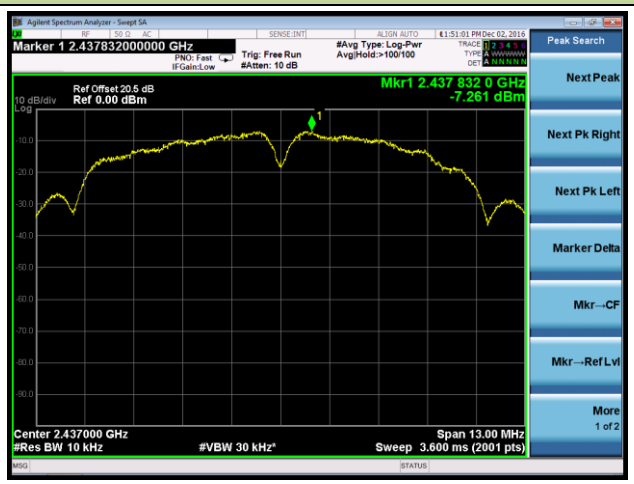
7.4.5. Test Result

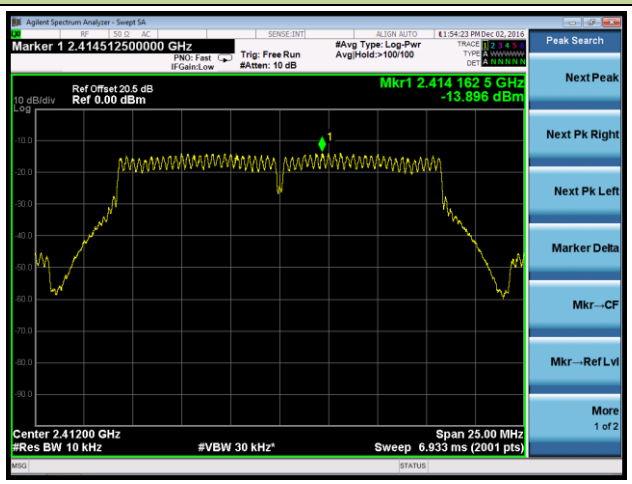
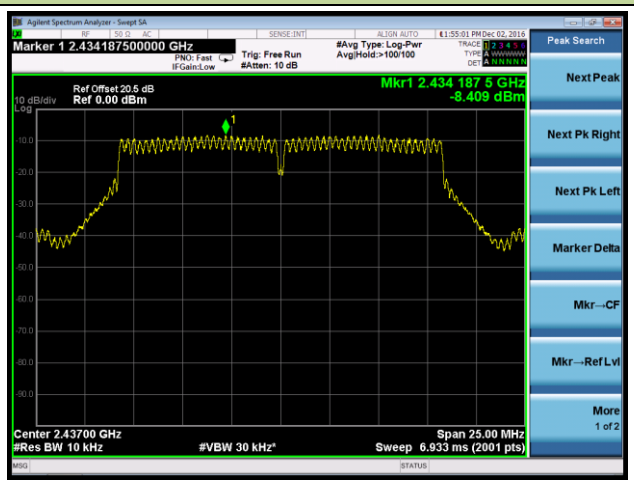
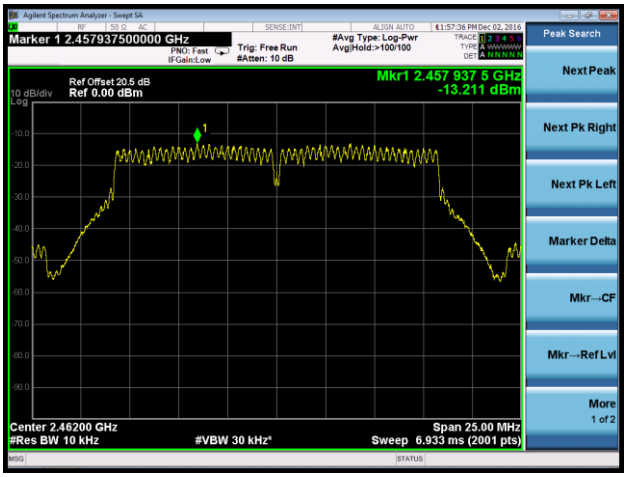
Test Mode	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Ant 0 AVGPSD (dBm / 10kHz)	Ant 1 AVGPSD (dBm / 10kHz)	Duty Cycle (%)	Constant Factor	Total AVGPSD (dBm / 3kHz)	Limit (dBm / 3kHz)	Result
Ant 0										
11b	1	1	2412	-8.35	--	95.0	-5.23	-13.36	≤ 8.0	Pass
11b	1	6	2437	-7.26	--	95.0	-5.23	-12.27	≤ 8.0	Pass
11b	1	11	2462	-6.80	--	95.0	-5.23	-11.81	≤ 8.0	Pass
11g	6	1	2412	-13.90	--	94.9	-5.23	-18.90	≤ 8.0	Pass
11g	6	6	2437	-8.41	--	94.9	-5.23	-13.41	≤ 8.0	Pass
11g	6	11	2462	-13.21	--	94.9	-5.23	-18.21	≤ 8.0	Pass
11n-HT20	6.5	1	2412	-14.36	--	94.7	-5.23	-19.35	≤ 8.0	Pass
11n-HT20	6.5	6	2437	-8.75	--	94.7	-5.23	-13.74	≤ 8.0	Pass
11n-HT20	6.5	11	2462	-14.79	--	94.7	-5.23	-19.78	≤ 8.0	Pass
11n-HT40	13.5	3	2422	-19.57	--	89.5	-5.23	-24.32	≤ 8.0	Pass
11n-HT40	13.5	6	2437	-11.98	--	89.5	-5.23	-16.73	≤ 8.0	Pass
11n-HT40	13.5	9	2452	-18.94	--	89.5	-5.23	-23.69	≤ 8.0	Pass
Ant 1										
11g	6	1	2412	--	-11.98	94.9	-5.23	-16.98	≤ 8.0	Pass
11g	6	6	2437	--	-8.80	94.9	-5.23	-13.80	≤ 8.0	Pass
11g	6	11	2462	--	-13.37	94.9	-5.23	-18.37	≤ 8.0	Pass
11n-HT20	6.5	1	2412	--	-13.30	94.7	-5.23	-18.29	≤ 8.0	Pass
11n-HT20	6.5	6	2437	--	-9.02	94.7	-5.23	-14.01	≤ 8.0	Pass
11n-HT20	6.5	11	2462	--	-14.25	94.7	-5.23	-19.24	≤ 8.0	Pass
11n-HT40	13.5	3	2422	--	-18.69	89.5	-5.23	-23.44	≤ 8.0	Pass
11n-HT40	13.5	6	2437	--	-12.10	89.5	-5.23	-16.85	≤ 8.0	Pass
11n-HT40	13.5	9	2452	--	-19.30	89.5	-5.23	-24.05	≤ 8.0	Pass

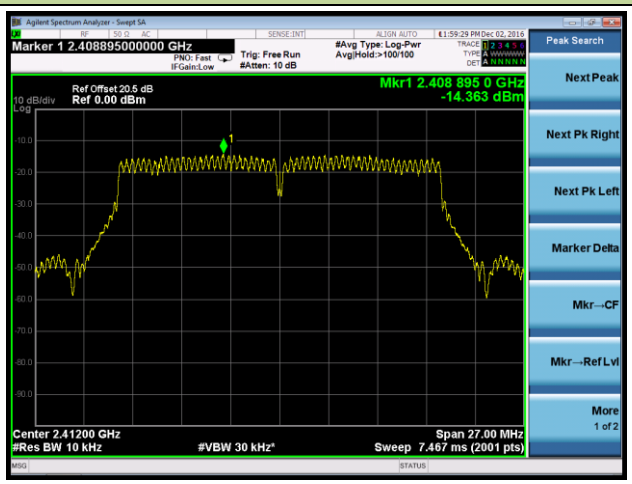
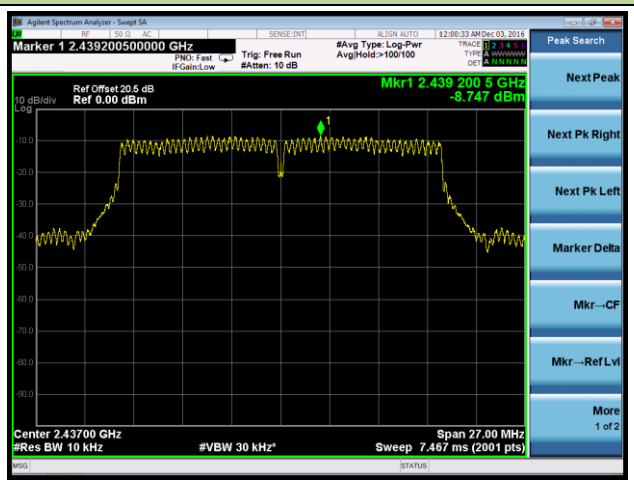
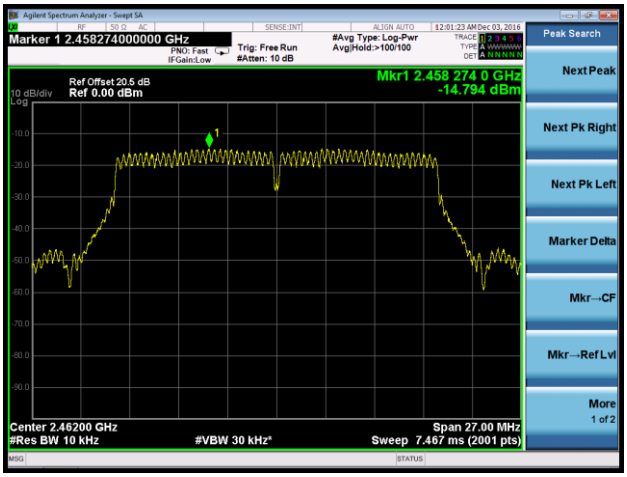
Test Mode	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Ant 0 AVGPSD (dBm / 10kHz)	Ant 1 AVGPSD (dBm / 10kHz)	Duty Cycle (%)	Constant Factor	Total AVGPSD (dBm / 3kHz)	Limit (dBm / 3kHz)	Result
Ant 0 + 1										
11n-HT20	13	1	2412	-15.24	-16.15	94.7	-5.23	-17.65	≤ 8.0	Pass
11n-HT20	13	6	2437	-8.83	-9.27	94.7	-5.23	-11.03	≤ 8.0	Pass
11n-HT20	13	11	2462	-14.87	-15.19	94.7	-5.23	-17.01	≤ 8.0	Pass
11n-HT40	27	3	2422	-20.60	-21.42	89.5	-5.23	-22.73	≤ 8.0	Pass
11n-HT40	27	6	2437	-12.57	-12.29	89.5	-5.23	-14.17	≤ 8.0	Pass
11n-HT40	27	9	2452	-19.61	-20.09	89.5	-5.23	-21.58	≤ 8.0	Pass

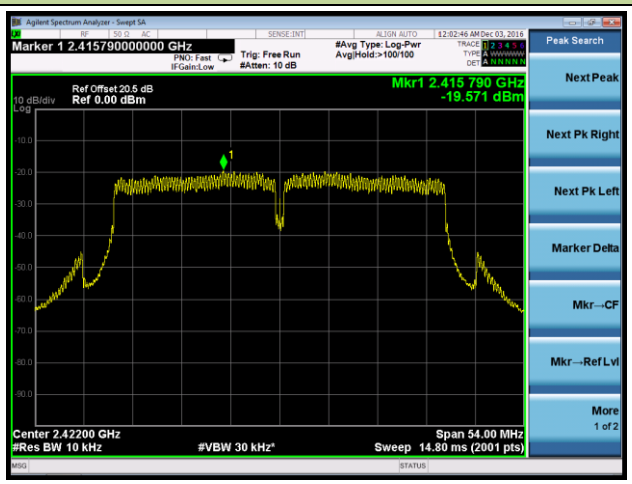
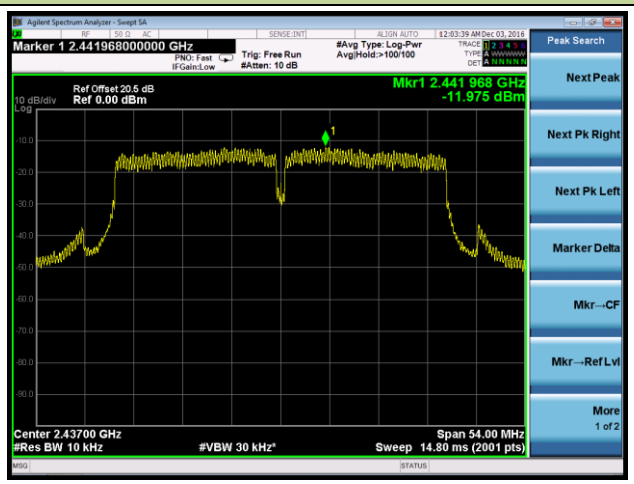
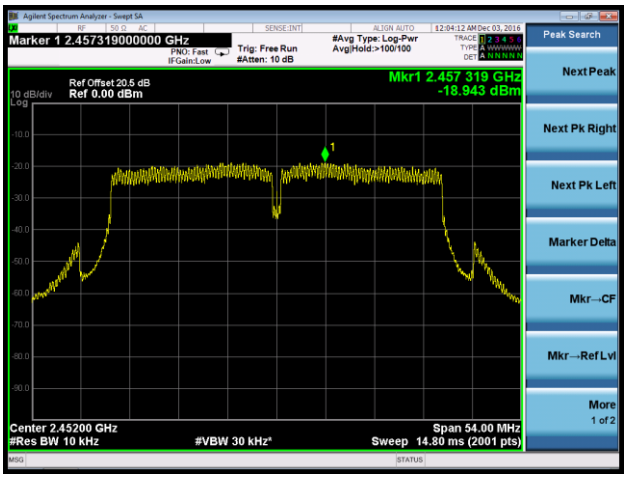
Note 1: When EUT duty cycle < 98%, the total AVGPSD = $10*\log\{10^{(\text{Ant 0 AVGPSD}/10)}+10^{(\text{Ant 1 AVGPSD}/10)}\}$ + 10*log(1/duty cycle) + Constant Factor.

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

802.11b AVGPSD - Ant 0	
Channel 01 (2412MHz)	**Channel 06 (2437MHz)**
	
Channel 11 (2462MHz)	

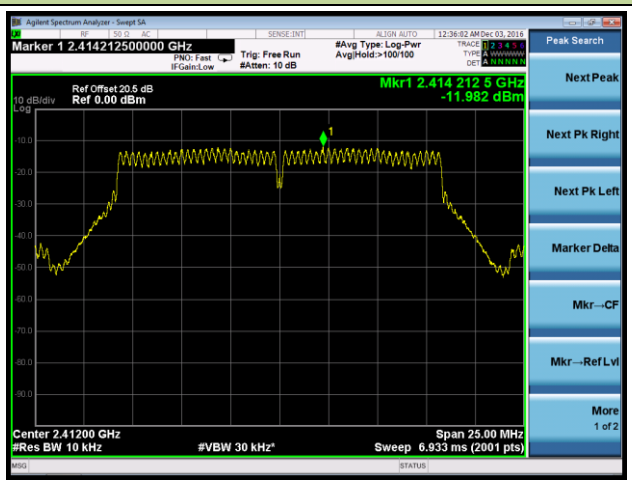
802.11g AVGPSD - Ant 0	
Channel 01 (2412MHz)	**Channel 06 (2437MHz)**
	
Channel 11 (2462MHz)	
	

802.11n-HT20 AVGPSD - Ant 0	
Channel 01 (2412MHz)	**Channel 06 (2437MHz)**
	
Channel 11 (2462MHz)	
	

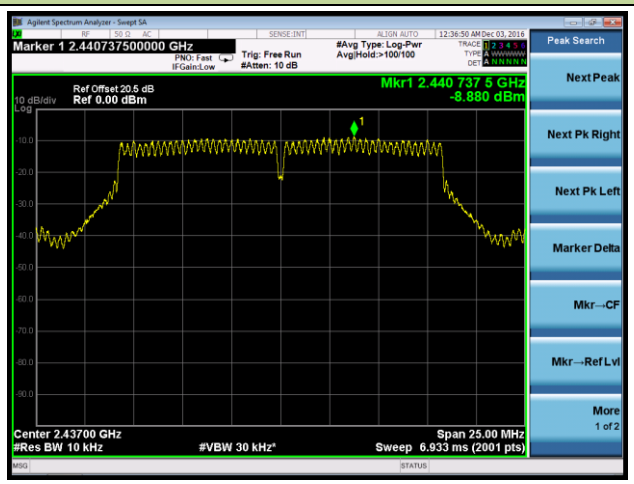
802.11n-HT40 AVGPSD - Ant 0	
Channel 03 (2422MHz)	**Channel 06 (2437MHz)**
	
Channel 09 (2452MHz)	
	

802.11g AVGPSD - Ant 1

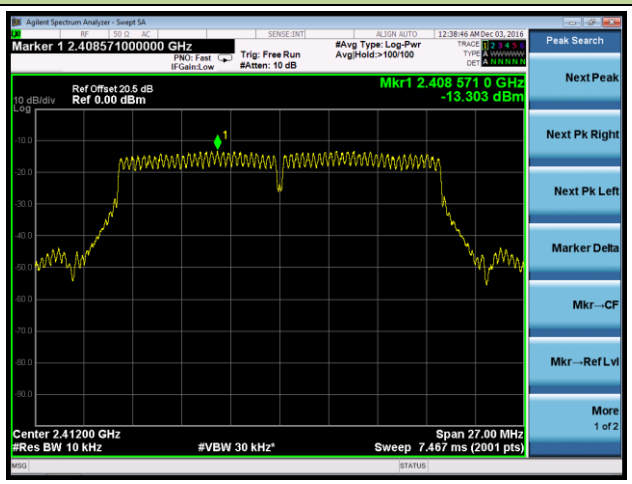
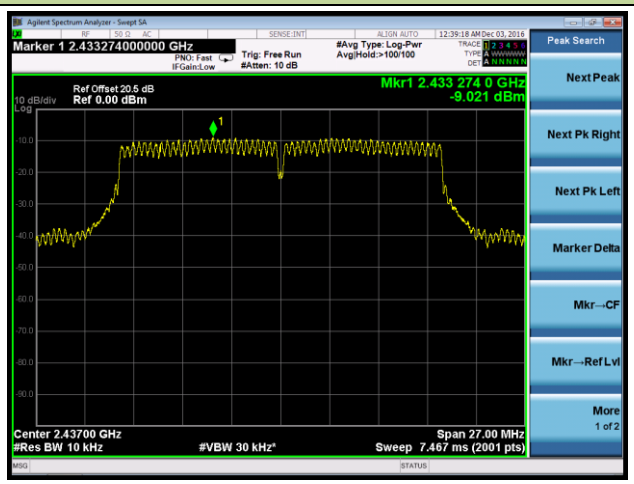
Channel 01 (2412MHz)

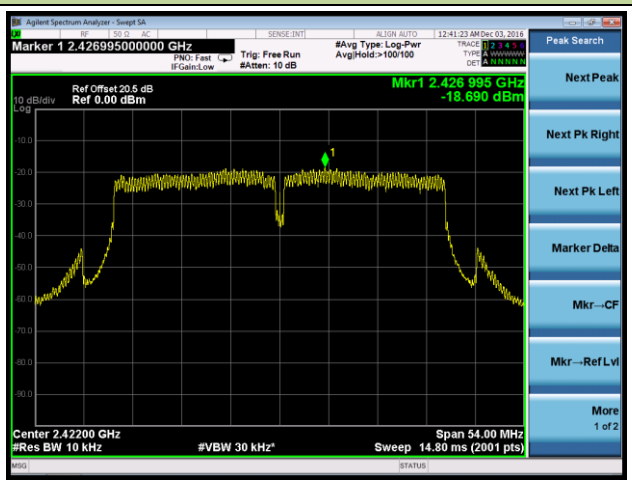
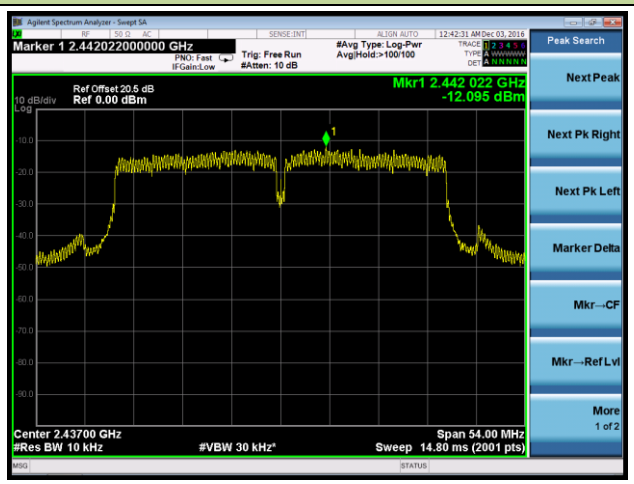
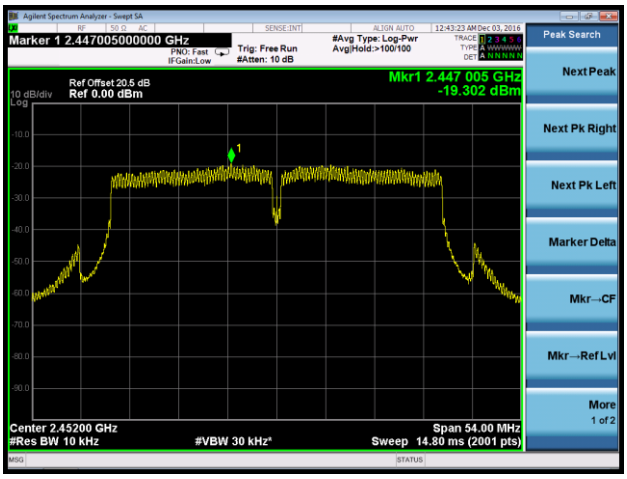


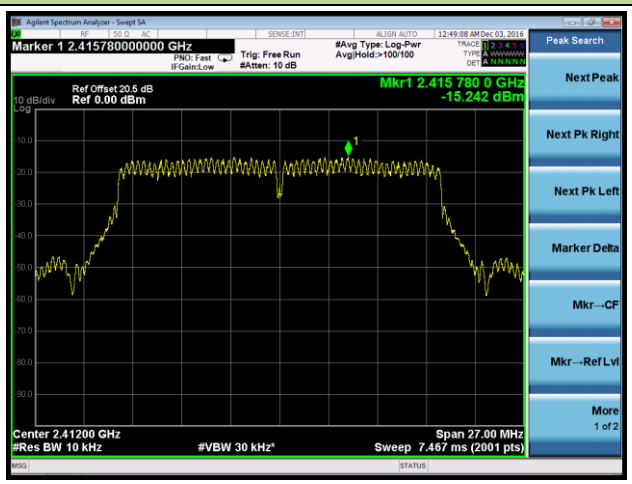
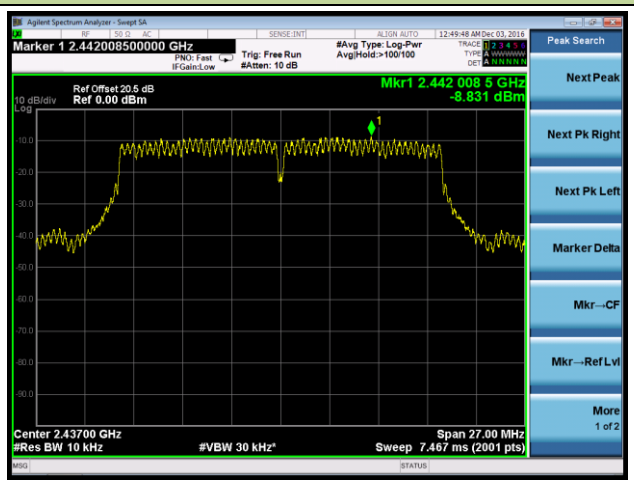
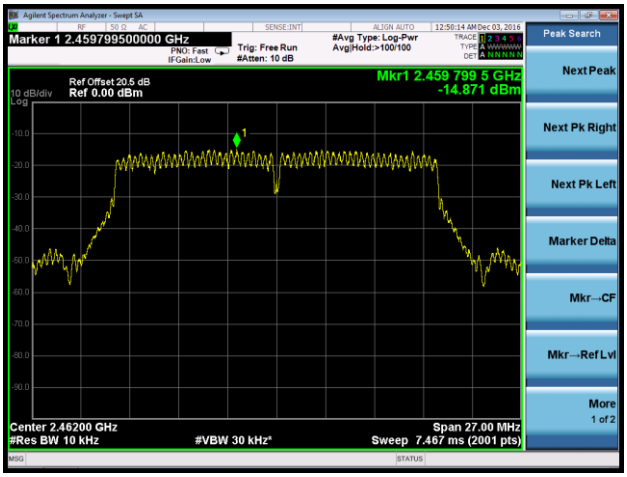
Channel 06 (2437MHz)

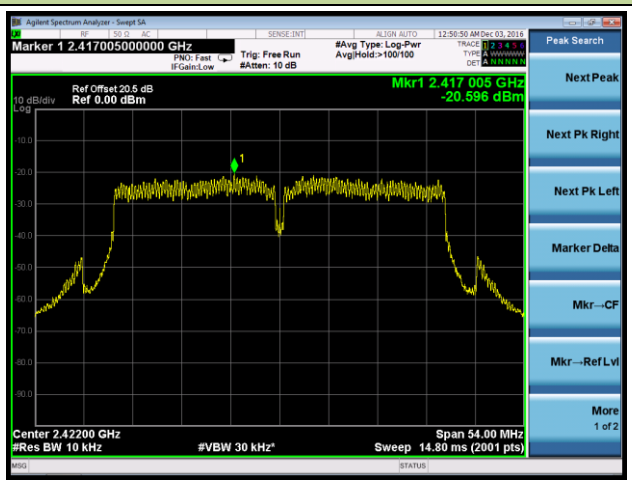
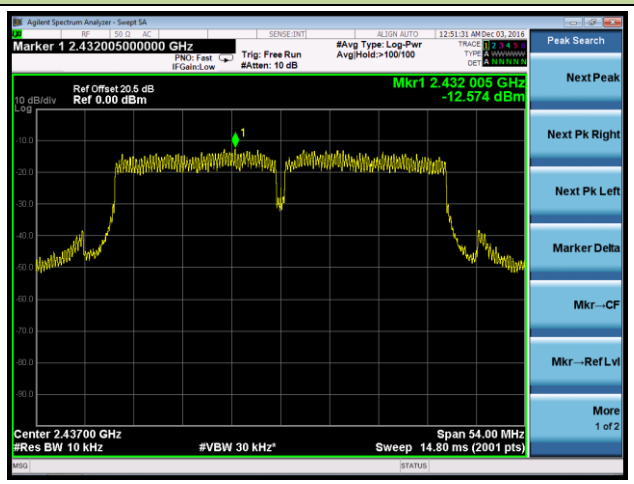
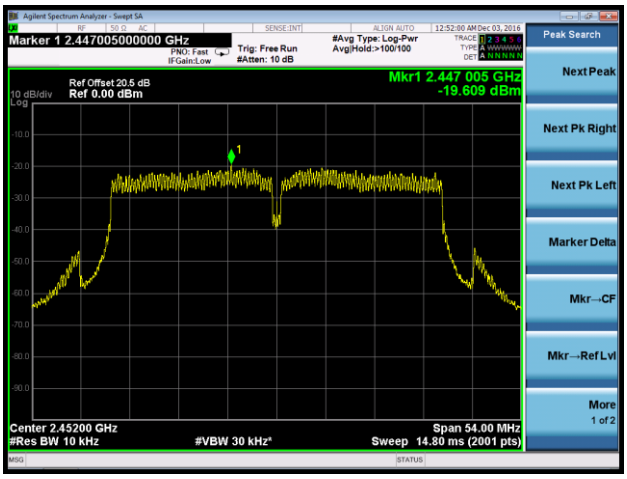


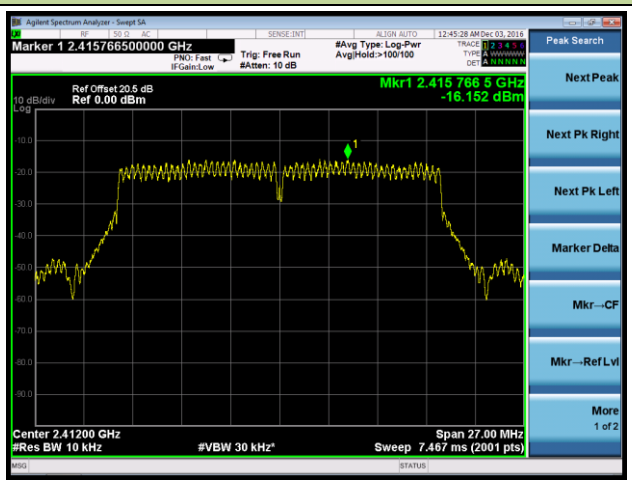
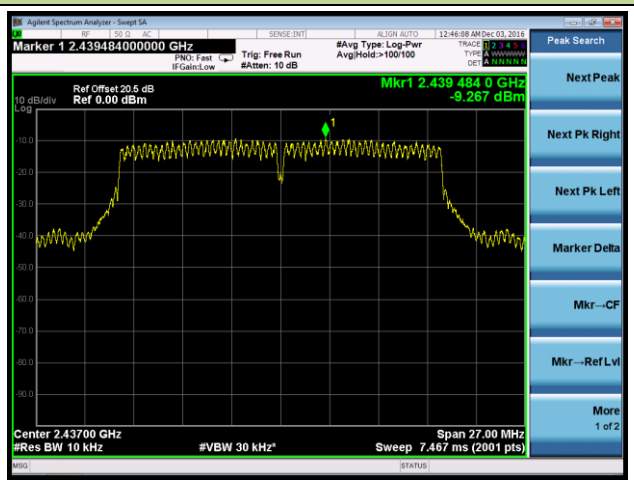
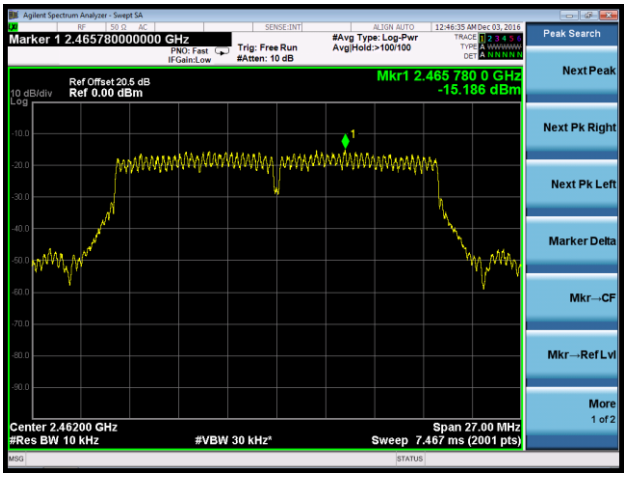
Channel 11 (2462MHz)

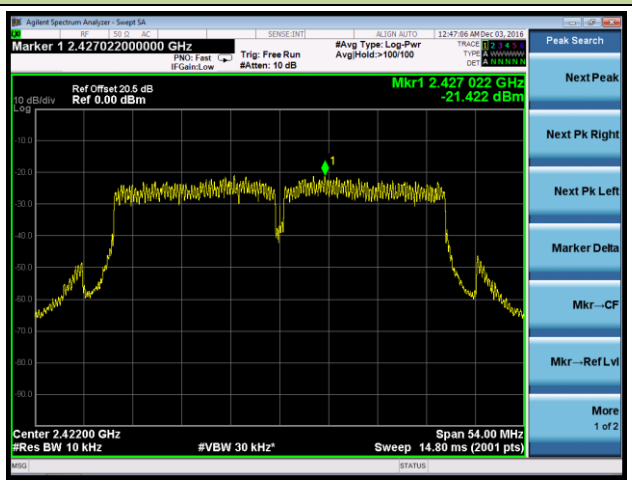
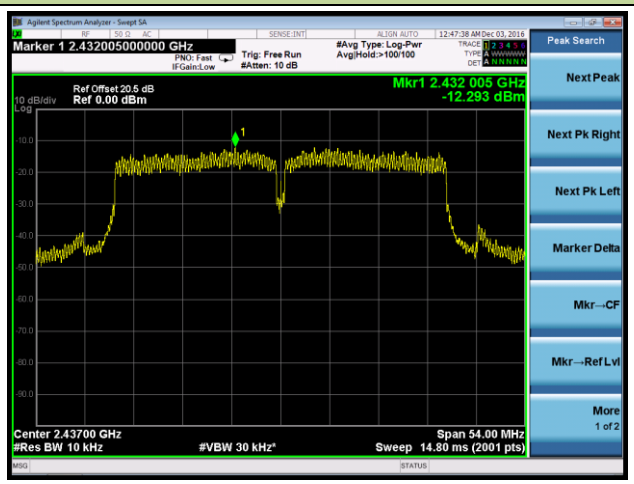
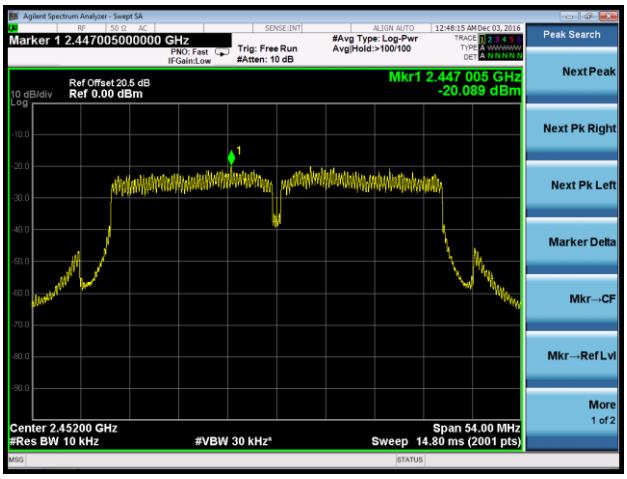
802.11n-HT20 AVGPSD - Ant 1	
Channel 01 (2412MHz)	**Channel 06 (2437MHz)**
	
Channel 11 (2462MHz)	

802.11n-HT40 AVGPSD - Ant 1	
Channel 03 (2422MHz)	**Channel 06 (2437MHz)**
	
Channel 09 (2452MHz)	
	

802.11n-HT20 AVGPSD - Ant 0 / Ant 0 + 1	
Channel 01 (2412MHz)	**Channel 06 (2437MHz)**
	
Channel 11 (2462MHz)	
	

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

802.11n-HT20 AVGPSD - Ant 1 / Ant 0 + 1	
Channel 01 (2412MHz)	**Channel 06 (2437MHz)**
	
Channel 11 (2462MHz)	
	

802.11n-HT40 AVGPSD - Ant 1 / Ant 0 + 1	
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

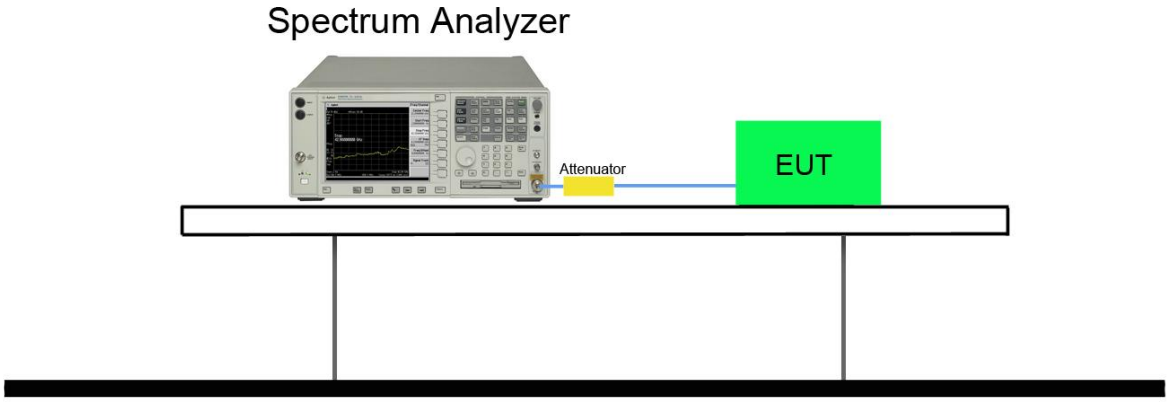
(d) Detector = Peak

(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 (Mbps)	Channel No.	Frequency (MHz)	Limit	Result
Ant 0					
802.11b	1	01	2412	< 30dBc	Pass
802.11b	1	06	2437	< 30dBc	Pass
802.11b	1	11	2462	< 30dBc	Pass
802.11g	6	01	2412	< 30dBc	Pass
802.11g	6	06	2437	< 30dBc	Pass
802.11g	6	11	2462	< 30dBc	Pass
802.11n-HT20	6.5	01	2412	< 30dBc	Pass
802.11n-HT20	6.5	06	2437	< 30dBc	Pass
802.11n-HT20	6.5	11	2462	< 30dBc	Pass
802.11n-HT40	13.5	03	2422	< 30dBc	Pass
802.11n-HT40	13.5	06	2437	< 30dBc	Pass
802.11n-HT40	13.5	09	2452	< 30dBc	Pass
Ant 1					
802.11g	6	01	2412	< 30dBc	Pass
802.11g	6	06	2437	< 30dBc	Pass
802.11g	6	11	2462	< 30dBc	Pass
802.11n-HT20	6.5	01	2412	< 30dBc	Pass
802.11n-HT20	6.5	06	2437	< 30dBc	Pass
802.11n-HT20	6.5	11	2462	< 30dBc	Pass
802.11n-HT40	13.5	03	2422	< 30dBc	Pass
802.11n-HT40	13.5	06	2437	< 30dBc	Pass
802.11n-HT40	13.5	09	2452	< 30dBc	Pass
Ant 0 / Ant 0 + 1					
802.11n-HT20	13	01	2412	< 30dBc	Pass
802.11n-HT20	13	06	2437	< 30dBc	Pass
802.11n-HT20	13	11	2462	< 30dBc	Pass
802.11n-HT40	27	03	2422	< 30dBc	Pass
802.11n-HT40	27	06	2437	< 30dBc	Pass
802.11n-HT40	27	09	2452	< 30dBc	Pass