RF TEST REPORT

Report No.: SET2016-17302

Product Name: WiFi Module

FCC ID: 2AGM4-WUS14

IC: 20960-WUS14

Model No. : WUS-AC14

Applicant: Dongguan Digital AV Technology Corp., Ltd.

Address: 4th,5th&6th floor, building A, No. 39 Haibin Road, Wusha, Chang'an Dongguan China

Test Date: 08/26/2016 — 10/20/2016

Issued by: CCIC-SET

Lab Location: Building 28/29, East of Shigu, Xili Industrial Zone, Xili Road, Nanshan District, Shenzhen, Guangdong, China

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Test Report

Product Name ..... :	WiFi Module
Brand Name ..... :	OPPO
Trade Name ..... :	OPPO
Applicant ..... :	Dongguan Digital AV Technology Corp., Ltd.
Applicant Address ..... :	4th,5th&6th floor, building A, No. 39 Haibin Road, Wusha, Chang'an Dongguan China
Manufacturer..... :	Dongguan Digital AV Technology Corp., Ltd.
Manufacturer Address ..... :	4th,5th&6th floor, building A, No. 39 Haibin Road, Wusha, Chang'an Dongguan China
Test Standards ..... :	47 CFR Part 15 Subpart C：Radio Frequency Devices IC RSS-Gen(Issue 4, November 2014) IC RSS-247(Issue 1, May 2015)
Test Result ..... :	PASS
Tested by ..... :	Candy Liu 2016.10.20 Candy Liu, Test Engineer
Reviewed by..... :	Zhu Qi 2016.10.20 Zhu Qi, Senior Egineer
Approved by ..... :	Wu Lian 2016.10.20 Wu Li'an, Manager

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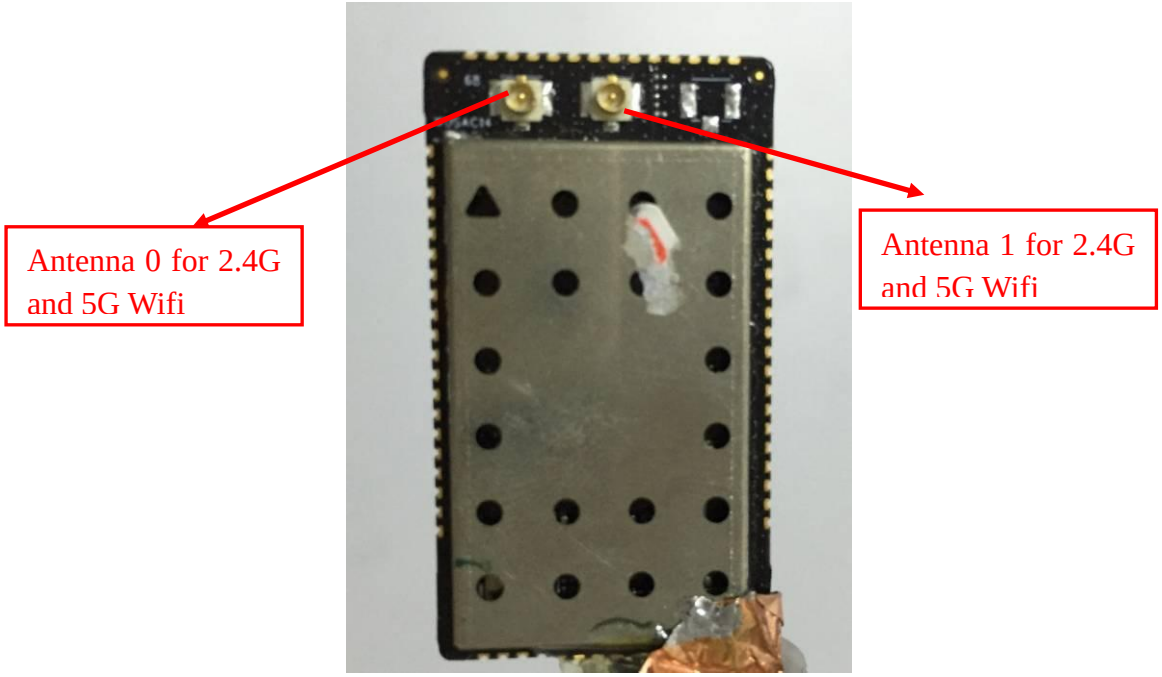
Change History		
Issue	Date	Reason for change
1.0	2016.10.20	First edition

1. General Information

1.1. EUT Description

EUT Type	WiFi Module
Hardware Version	2UDP1603-0
Software Version	UDP20X-02-0729
EUT supports Radios application	WLAN2.4GHz 802.11b/g/n (HT20/HT40) WLAN5.0GHz 802.11a/n (HT20/40)/ac(VHT20/40/80)
Modulation technology	DSSS, OFDM
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM,16QAM, QPSK, BPSK for OFDM
Transfer Rate	2.4GHz: 802.11b: 11/5.5/2/1 Mbps 802.11g: 54/48/36/24/18/12/9/6 Mbps 802.11n: up to 300 Mbps
Frequency Range	2.4GHz: 802.11b, 802.11g, 802.11n(20MHz): 2412~2462MHz 802.11n(40MHz): 2422~2452MHz
Channel Number	2.4GHz: 802.11b/g/n-20MHz: 11 802.11n-40MHz: 7
Antenna Type	PCB Antenna
Antenna Gain	Antenna 0: 3.0dBi Antenna 1: 3.0dBi ;
Product Type	Refer to note
Output Power (Max.)	802.11b: 23.62dBm 802.11g: 23.12dBm 802.11n(20MHz): 24.55dBm 802.11n(40MHz): 24.93dBm

Frequency	Modulation Mode	TX / RX Function
2.4GHz	802.11b	1TX / 1RX
	802.11g	1TX / 1RX
	802.11n (HT20)	1TX / 1RX or 2TX / 2RX
	802.11n (HT40)	1TX / 1RX or 2TX / 2RX
2.4GHz+5GHz	/	Not support


Antenna 0 for 2.4G and 5G Wifi
Antenna 1 for 2.4G and 5G Wifi

1.2. Test Standards and Results

No.	Identity	Document Title
1	47 CFR Part 15 Subpart C (10-1-14 Edition)	Miscellaneous Wireless Communications Services
2	ANSI C63.10 2013	American National Standard for Testing Unlicensed Wireless Devices
3	KDB Publication 6629911 D01 v02r01	Emission Testing of Transmitters with Multiple Outputs in the same Band(e.g., MIMO, Smart Antenna, etc)
4	RSS-Gen (Issue 4, Nov. 2014)	General Requirements for Compliance of Radio Apparatus
5	RSS-247 (Issue 1, May 2015)	Digital Transmission Systems (DTSs), Frequency Hopping Systems(FHSs) and Licence-Exemp Local Area Network (LE-LAN) Devices

Test detailed items/section required by FCC rules and results are as below:

No.	FCC Rules	IC Rules	Description	Result
1	15.203	RSS-247, 5.4	Antenna Requirement	PASS
2	15.247(b)	RSS-247, 5.4	Output Power	PASS
3	15.247(a)	RSS-GEN, 6.6 RSS-247, 5.2	Bandwidth	PASS
4	15.247(d)	RSS-247, 5.5	Conducted Band Edges and Spurious Emission	PASS
5	15.247(e)	RSS-247, 5.2	Power spectral density (PSD)	PASS
6	15.207	RSS-GEN, 8.8	Conducted Emission	N/A
7	15.209 15.247(d)	RSS-247, 5.5	Radiated Band Edges and Spurious Emission	PASS

1.3. Channel list

WLAN 2.4GHz

11 channels are provided for 802.11b, 802.11g, and 802.11n (20MHz)

Channel	Frequency(MHz)	Channel	Frequency(MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		
7	2442		

7 channels are provided for 802.11n (40MHz)

Channel	Frequency(MHz)	Channel	Frequency(MHz)
3	2422	7	2442
4	2427	8	2447
5	2432	9	2452
6	2437		

1.4. Test environment and mode

Operating Environment	
Temperature	24℃
Humidity	57 % RH
Atmospheric Pressure	1010 mbar
Test mode:	
Continuously transmitting mode	Keeps the EUT in 100% duty cycle transmitting with modulation in SISO and MIMO mode, duty cycle factor is not required.

We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:

Test Items	Mode	Data Rate	Channel
Peak Conducted Output Power Power Spectral Density Bandwidth Conducted and Spurious Emission Radiated and Spurious Emission	11b/DSSS	1 Mbps	1/6/11
	11g/OFDM	6 Mbps	1/6/11
	11n(20MHz)/OFDM	MCS 0	1/6/11
	11n(40MHz)/OFDM	MCS 0	3/6/9
Band Edge	11b/DSSS	1 Mbps	1/11
	11g/OFDM	6 Mbps	1/11
	11n(20MHz)/OFDM	MCS 0	1/11
	11n(40MHz)/OFDM	MCS 0	3/9

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation modes or test configuration modes mentioned above was evaluated respectively.

Pretest Test Mode	Description
Mode 1	TX B Mode / CH1, CH6, CH11
Mode 2	TX G Mode / CH1, CH6, CH11
Mode 3	TX N20 Mode / CH1, CH6, CH11
Mode 4	TX N40 Mode / CH3, CH6, CH9
Mode 5	TX Mode

The EUT system operated these modes were found to be the worst case during the pre-scanning test as following:

For Conducted Test	
Final Test Mode	Description
Mode 5	TX Mode

For Radiated Test	
Final Test Mode	Description
Mode 1	TX B Mode / CH1, CH6, CH11
Mode 2	TX G Mode / CH1, CH6, CH11
Mode 3	TX N20 Mode / CH1, CH6, CH11
Mode 4	TX N40 Mode / CH3, CH6, CH9

1.5. Power level setup in software

Power level setup in software for 2.4G wifi		
Mode	Software setup	
	Antenna 0	Antenna 1
802.11b	26	28
802.11g	26	28
802.11n20	24	26
802.11n40	24	26

1.6. Laboratory Facilities

CNAS-Lab Code: L1225

Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories

(identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: February 28, 2015. Valid time is until February 27, 2018.

FCC-Registration No.: 317478

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

IC-Registration No.: 5377B

Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 5377B on Dec.03, 2014, valid time is until Dec.03, 2017.

2. 47 CFR Part 15C Requirements

2.1. Antenna requirement

2.1.1. Applicable Standard

According to FCC 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

And according to FCC 47 CFR Section 15.247(c), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

2.1.2. Antenna Information

Antenna System	Cyclic Delay Diversity(CDD)
	2 antennas are correlated with each other
Antenna Type	PCB

A PCB antenna was soldered to the antenna port of EUT via an adaptor cable can't be removed.

2.1.3. Antenna Gain

Antenna	Gain(dBi)
0	3
1	3
0+1	6.01

Note: 1. for 802.11n20/n40 mode, antenna 0, 1 can transmit/receive simultaneously (MIMO mode), for 802.11b/g, both antennas 0, 1 can transmit/receive at single mode (SISO mode)

2. Directional gain = $G_{ANT} + 10 \log(N_{ANT})$ dBi

2.1.4. Result: comply

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.

2.2. Output Power

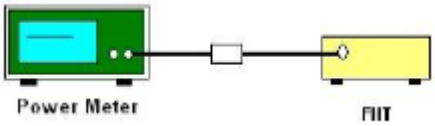
2.2.1. Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.2.3. Test Setup



2.2.4. Test Procedures

1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 v03r05.

2. The RF output of EUT was connected to the broadband average RF power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.

3. Set to the maximum power setting and enable the EUT transmit continuously.

4. Measure the conducted output power and record the results in the test report.

2.2.5. Test Result

802.11b mode

Channel	Frequency (MHz)	Output Power(dBm)		Limits (dBm)	Result
		Ant. 0	Ant. 1		
1	2412	23.62	23.07	30	PASS
6	2437	23.30	22.72	30	PASS
11	2462	23.55	22.07	30	PASS

802.11g Test mode

Channel	Frequency (MHz)	Output Power(dBm)		Limits (dBm)	Result
		Ant. 0	Ant. 1		
1	2412	23.03	22.98	30	PASS
6	2437	23.01	22.56	30	PASS
11	2462	23.12	22.05	30	PASS

802.11n-20MHz Test mode

Channel	Frequency (MHz)	Output Power(dBm)			Limits (dBm)	Result
		Ant. 0	Ant. 1	Ant. 0+1		
1	2412	21.59	21.49	24.55	29.99	PASS
6	2437	21.56	21.23	24.41	29.99	PASS
11	2462	21.64	21.29	24.48	29.99	PASS

802.11n-40MHz Test mode

Channel	Frequency (MHz)	Output Power(dBm)			Limits (dBm)	Result
		Ant. 0	Ant. 1	Ant. 0+1		
3	2422	22.12	21.70	24.93	29.99	PASS
6	2437	21.85	21.68	24.78	29.99	PASS
9	2452	21.89	21.59	24.75	29.99	PASS

Note: All data rates are testing, but the worse case data rate was record in the report.

2.3. Bandwidth

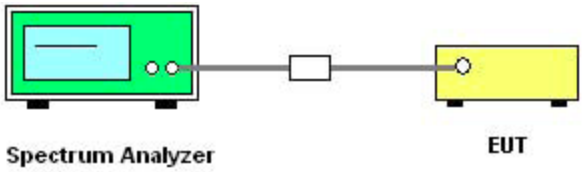
2.3.1. Limit of 6dB Bandwidth

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

2.3.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.3.3. Test Setup



2.3.4. Test Procedures

1. The testing follows FCC KDB558074 D01 v03r05.

2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

3. Set to the maximum power setting and enable the EUT transmit continuously.

4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6dB bandwidth must be greater than 500 kHz.

5. For 99% Bandwidth Measurement, the RBW shall be set to 1% to 5% of OBW.

6. Measure and record the results in the test report.

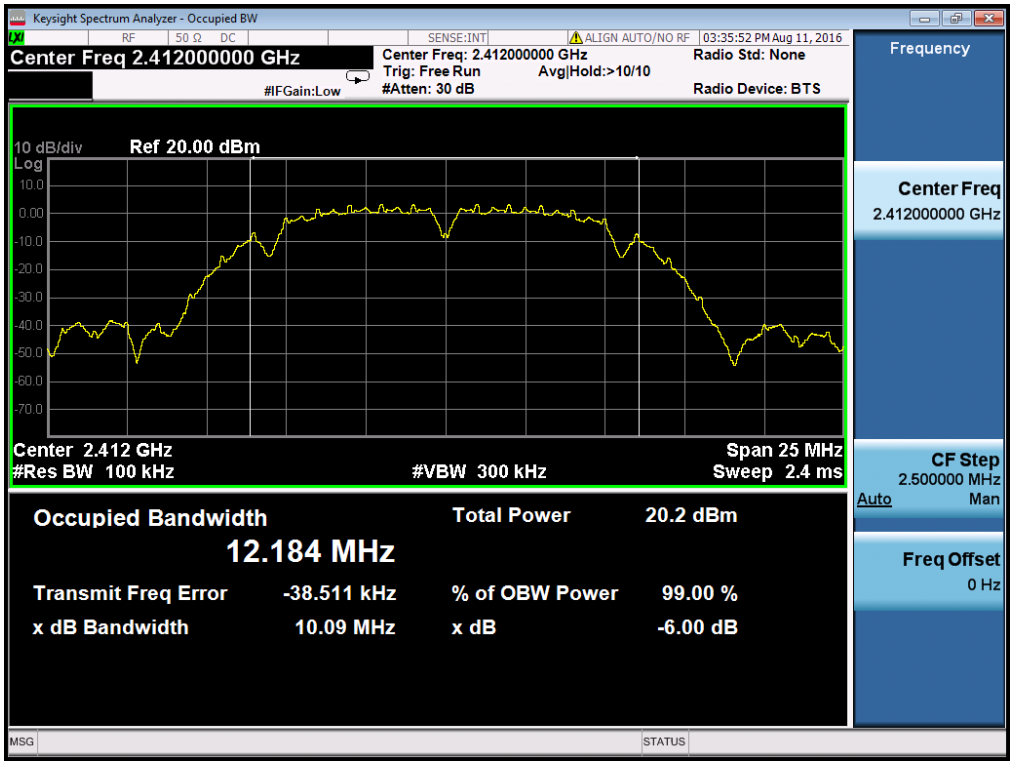
2.3.5. Test Results of 6dB Bandwidth

Antenna	Test mode	Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limits (MHz)
Antenna 0	802.11b	1	2412	10.09	12.29	≥0.5
		6	2437	10.09	12.44	
		11	2462	10.09	12.40	
	802.11g	1	2412	16.50	17.16	
		6	2437	16.51	17.20	
		11	2462	16.51	17.13	
	802.11n20	1	2412	17.62	17.77	
		6	2437	17.62	17.84	
		11	2462	17.62	17.83	
	802.11n40	3	2422	36.39	36.52	
		6	2437	36.39	36.59	
		9	2452	36.36	36.54	

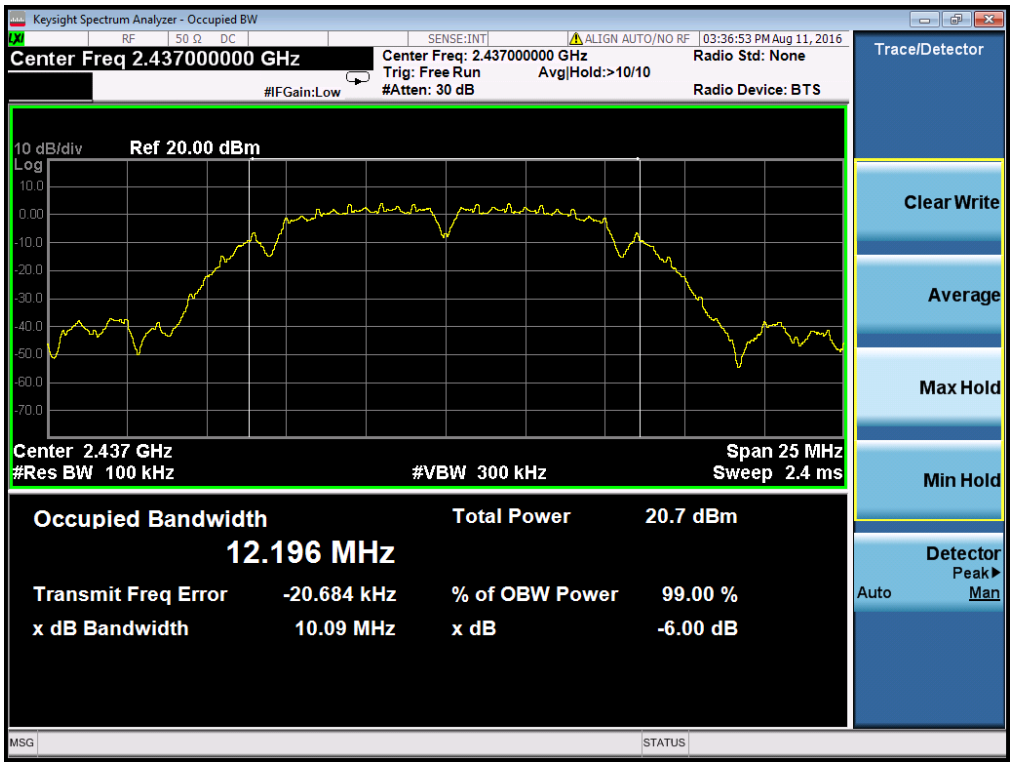
Antenna	Test mode	Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Limits (MHz)
Antenna 1	802.11b	1	2412	10.09	12.45	≥0.5
		6	2437	10.09	12.66	
		11	2462	10.09	12.37	
	802.11g	1	2412	16.53	17.12	
		6	2437	16.49	17.01	
		11	2462	16.51	17.33	
	802.11n20	1	2412	17.62	17.97	
		6	2437	17.63	17.91	
		11	2462	17.63	17.94	
	802.11n40	3	2422	36.39	36.71	
		6	2437	36.40	36.83	
		9	2452	36.38	36.98	

2.3.6. Test Results (plots) of Bandwidth

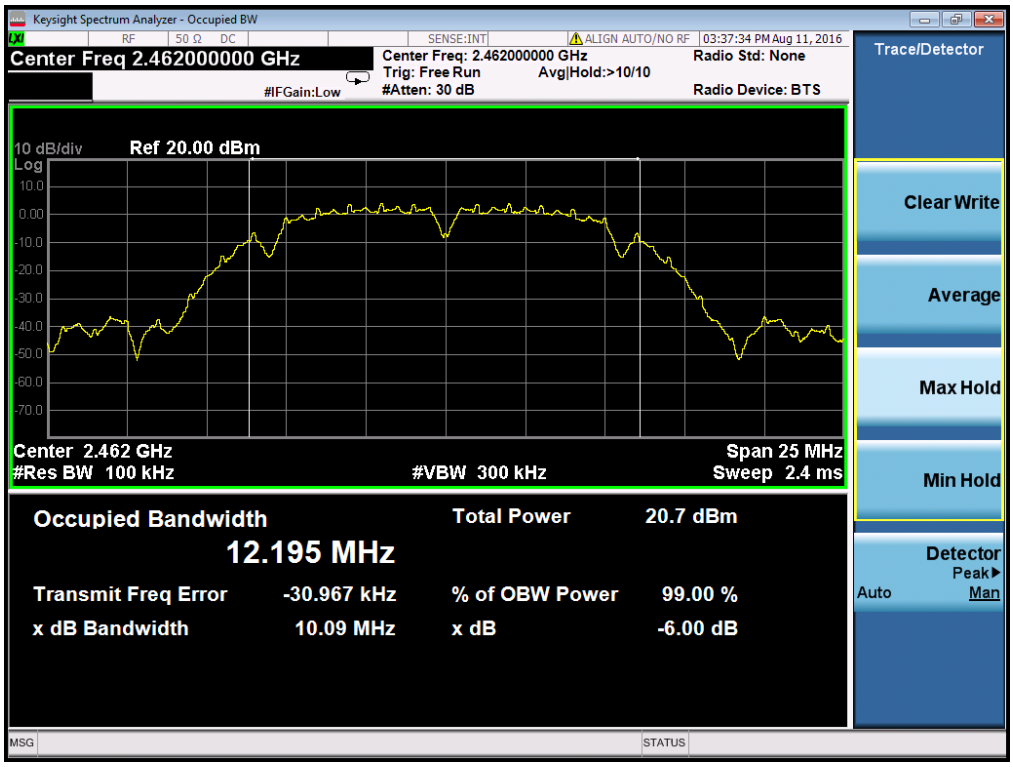
Antenna 0 - 802.11b – 6dB Bandwidth – L channel



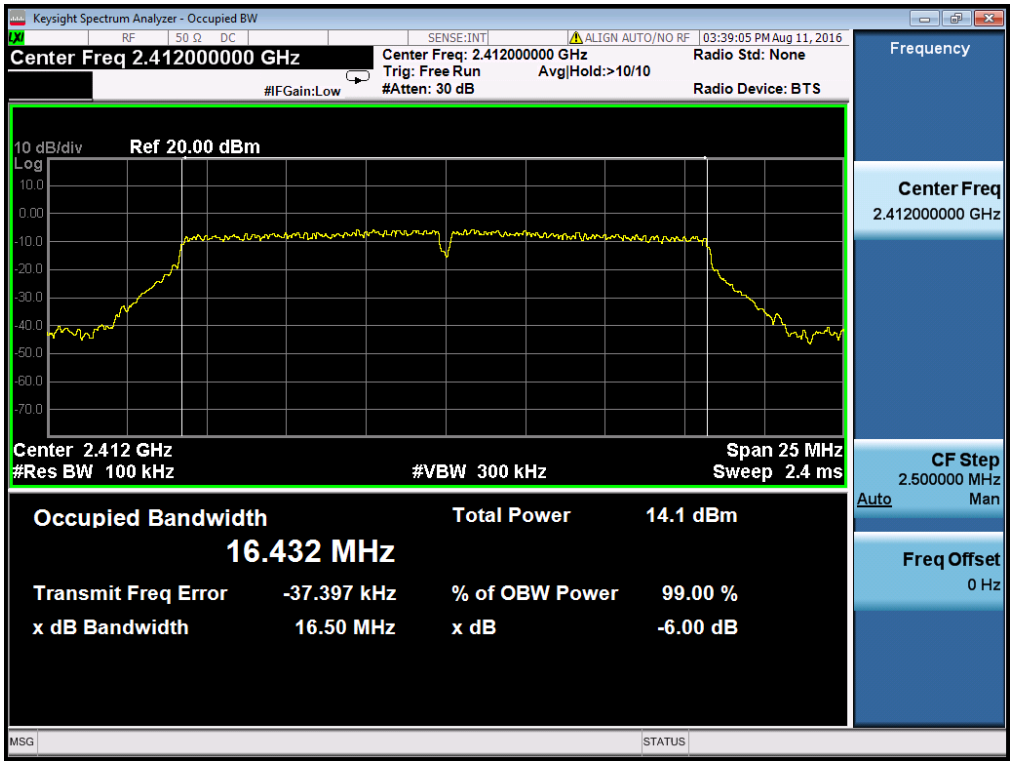
Antenna 0 - 802.11b - 6dB Bandwidth – M channel



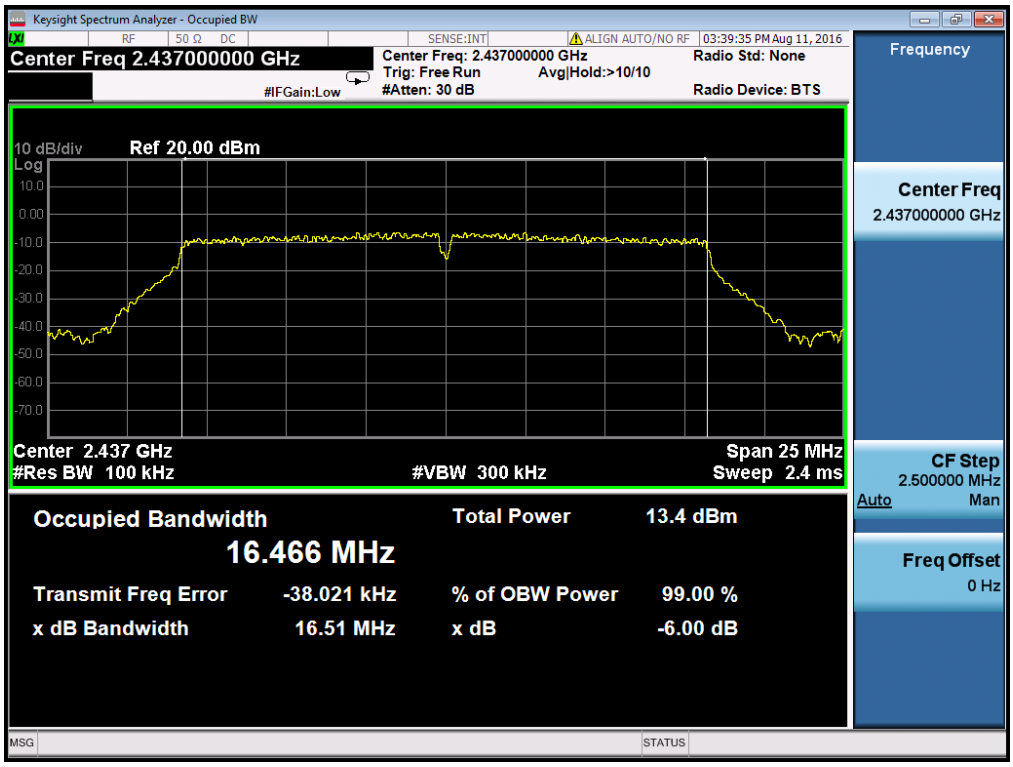
Antenna 0 - 802.11b - 6dB Bandwidth – H channel



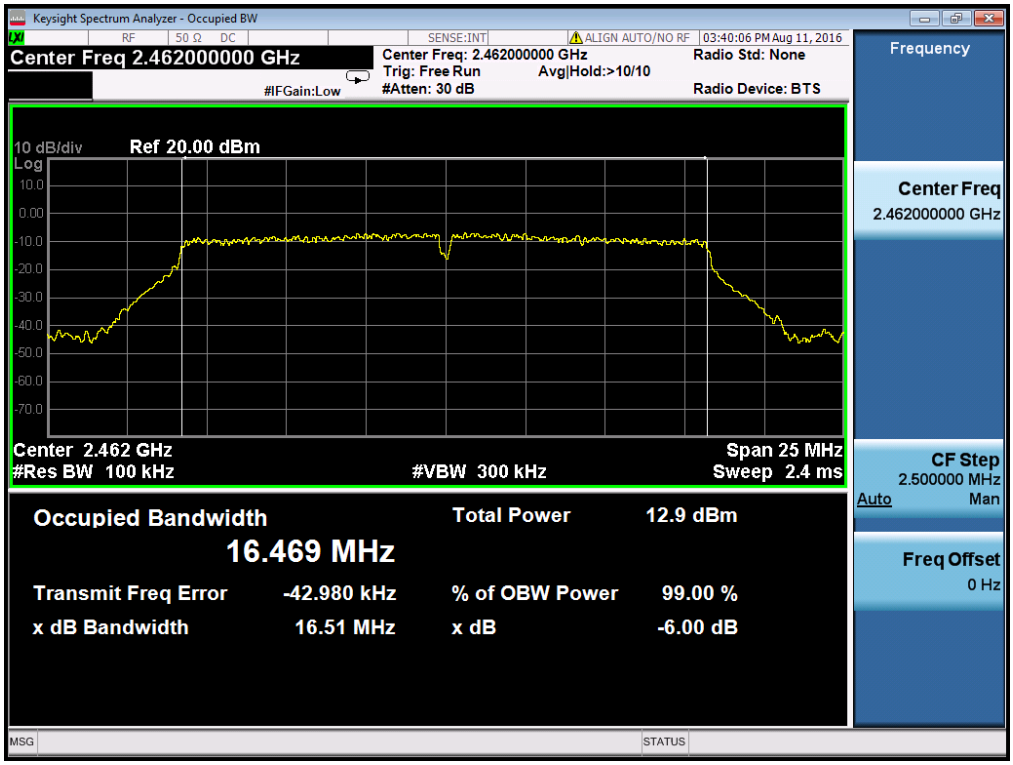
Antenna 0 - 802.11g - 6dB Bandwidth – L channel



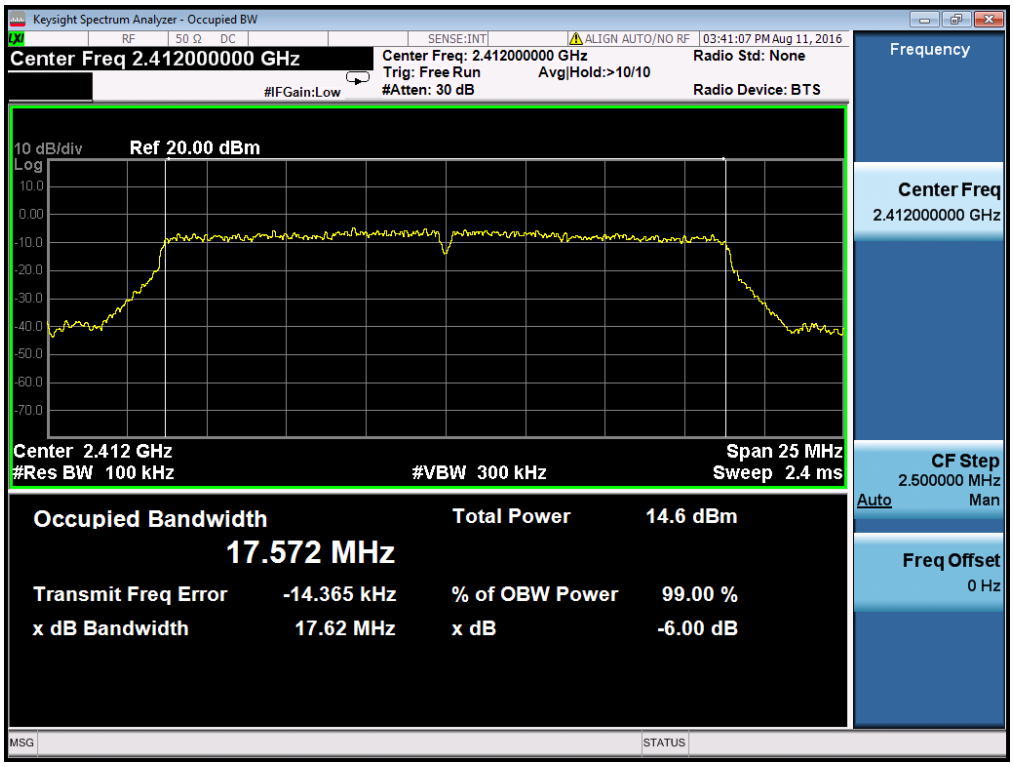
Antenna 0 - 802.11g - 6dB Bandwidth – M channel



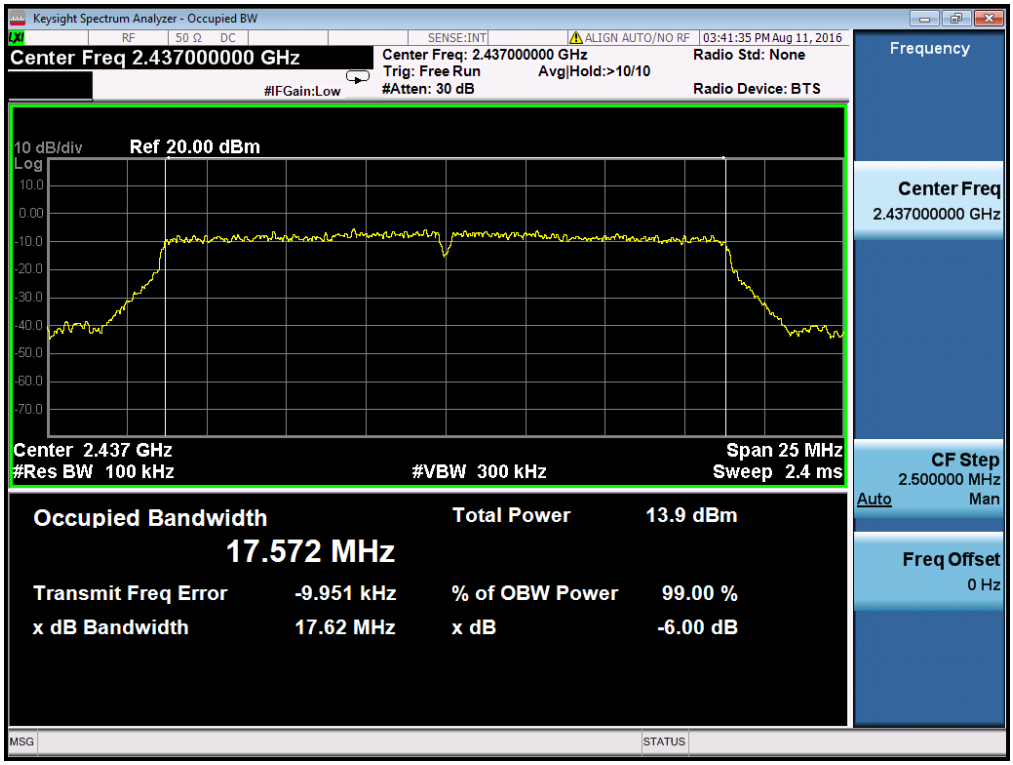
Antenna 0 - 802.11g - 6dB Bandwidth – H channel



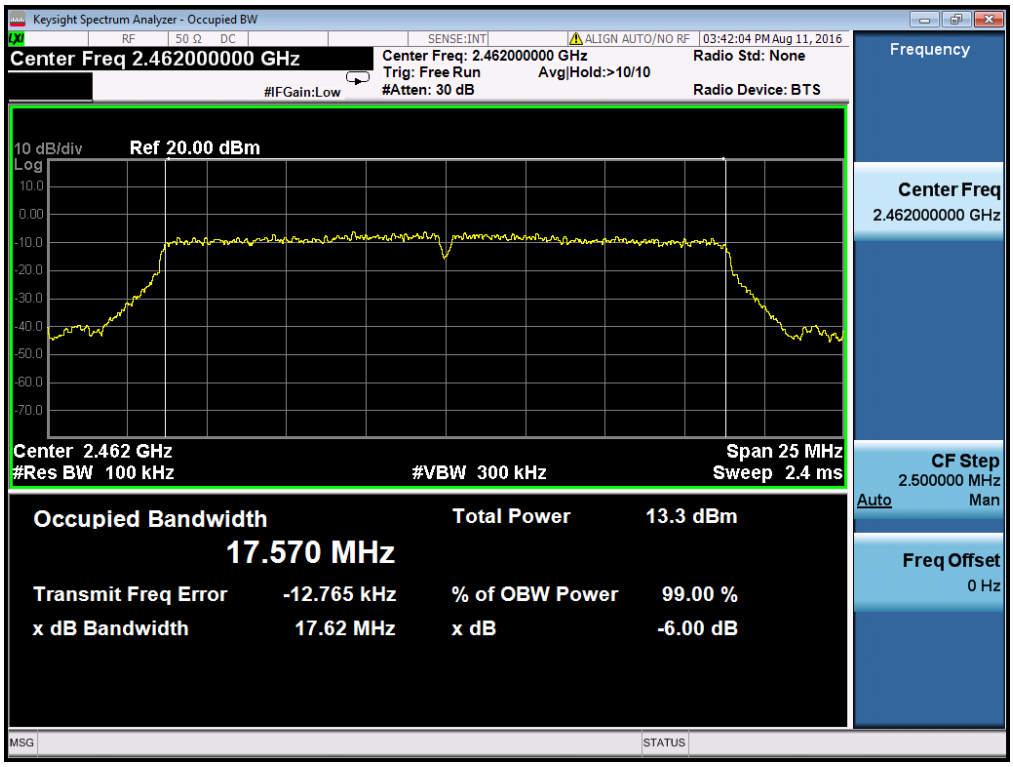
Antenna 0 - 802.11n20 - 6dB Bandwidth – L channel



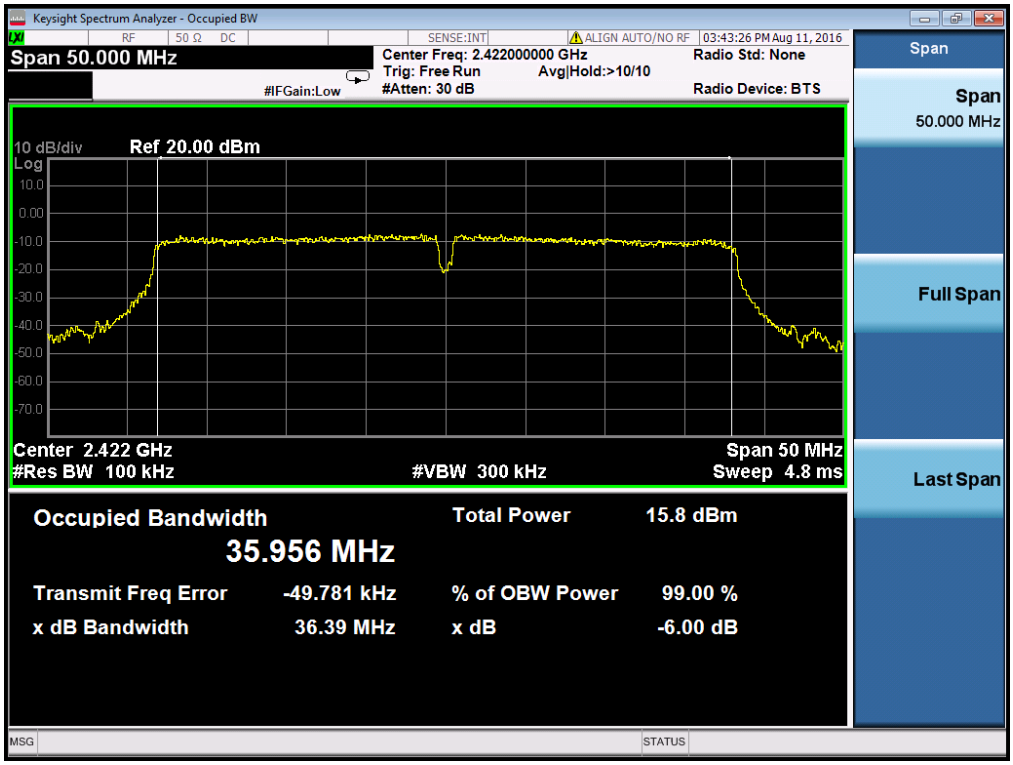
Antenna 0 - 802.11n20 - 6dB Bandwidth – M channel



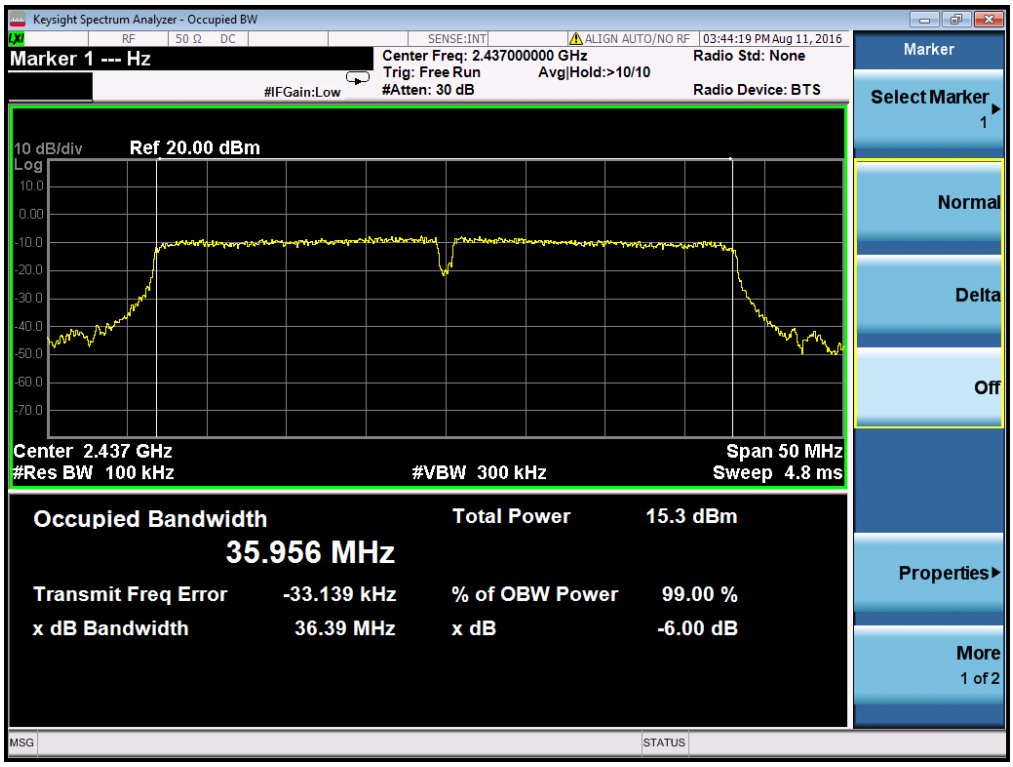
Antenna 0 - 802.11n20 - 6dB Bandwidth – H channel



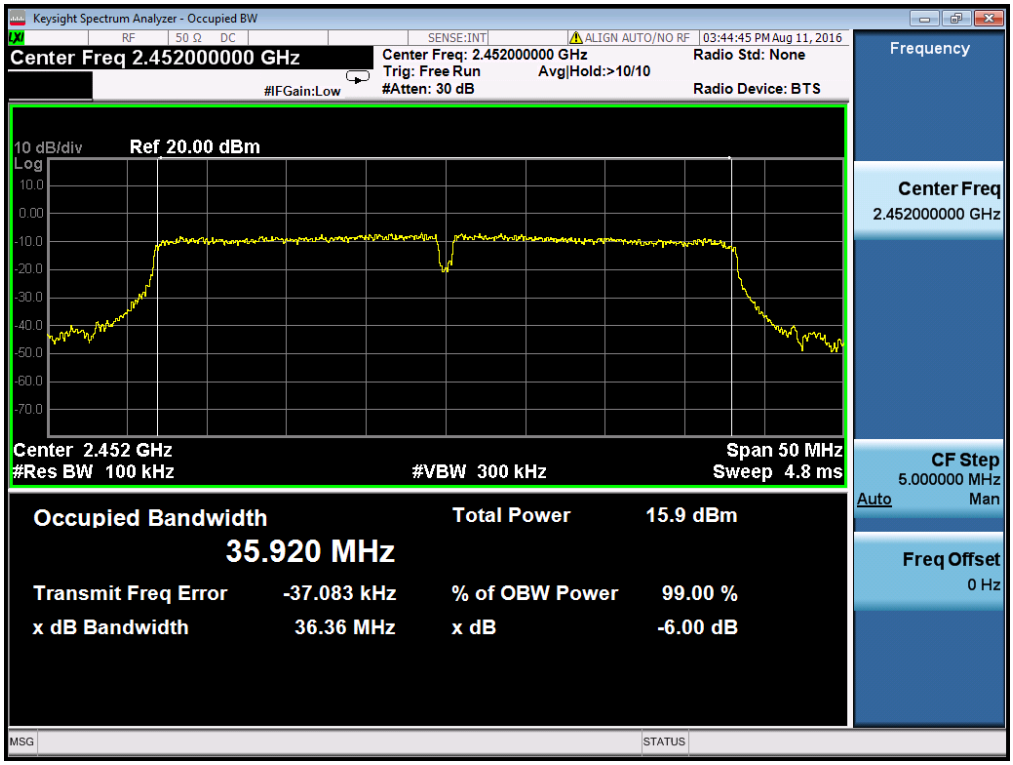
Antenna 0 - 802.11n40 - 6dB Bandwidth – L channel



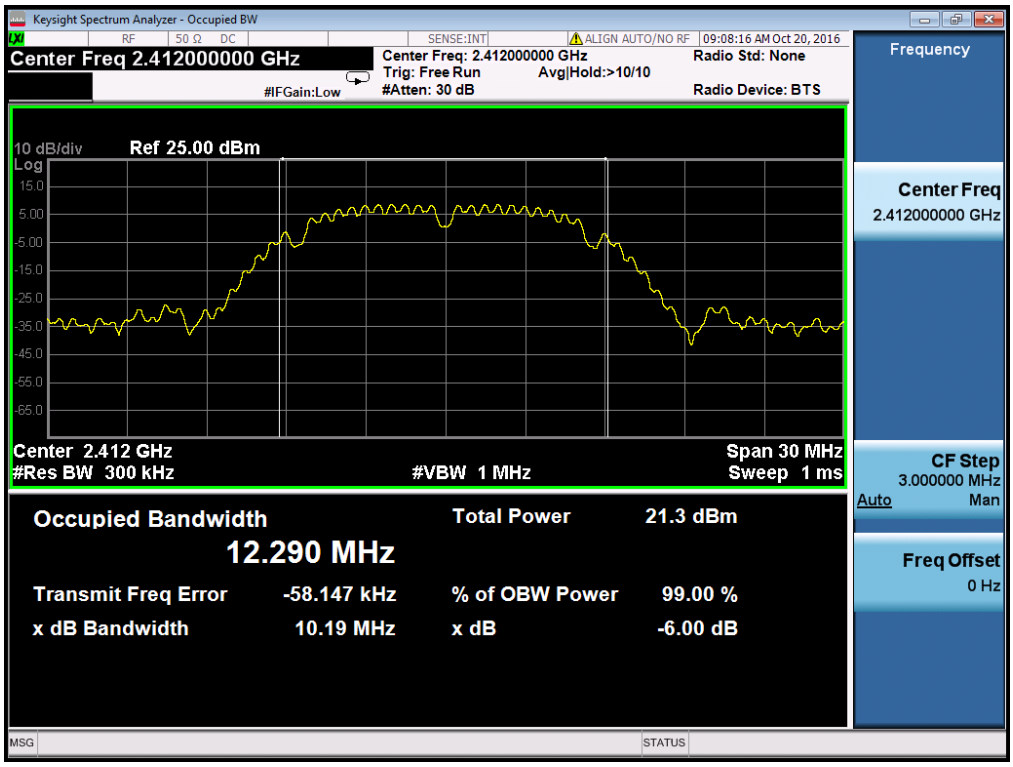
Antenna 0 - 802.11n40 - 6dB Bandwidth – M channel



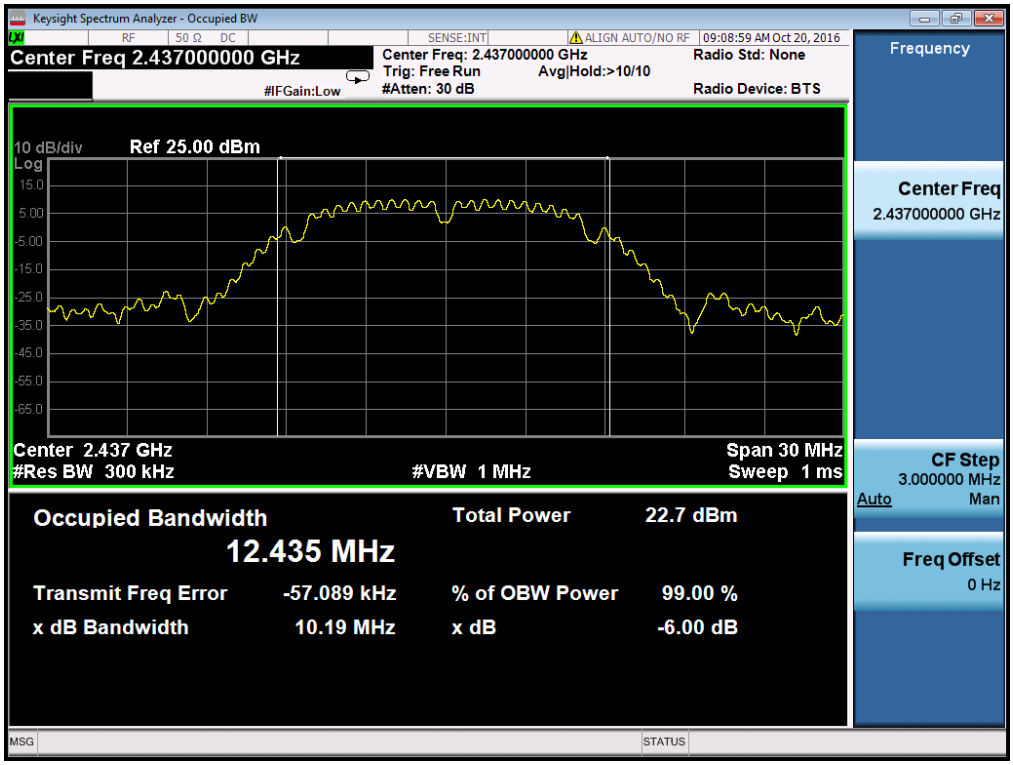
Antenna 0 - 802.11n40 - 6dB Bandwidth – H channel



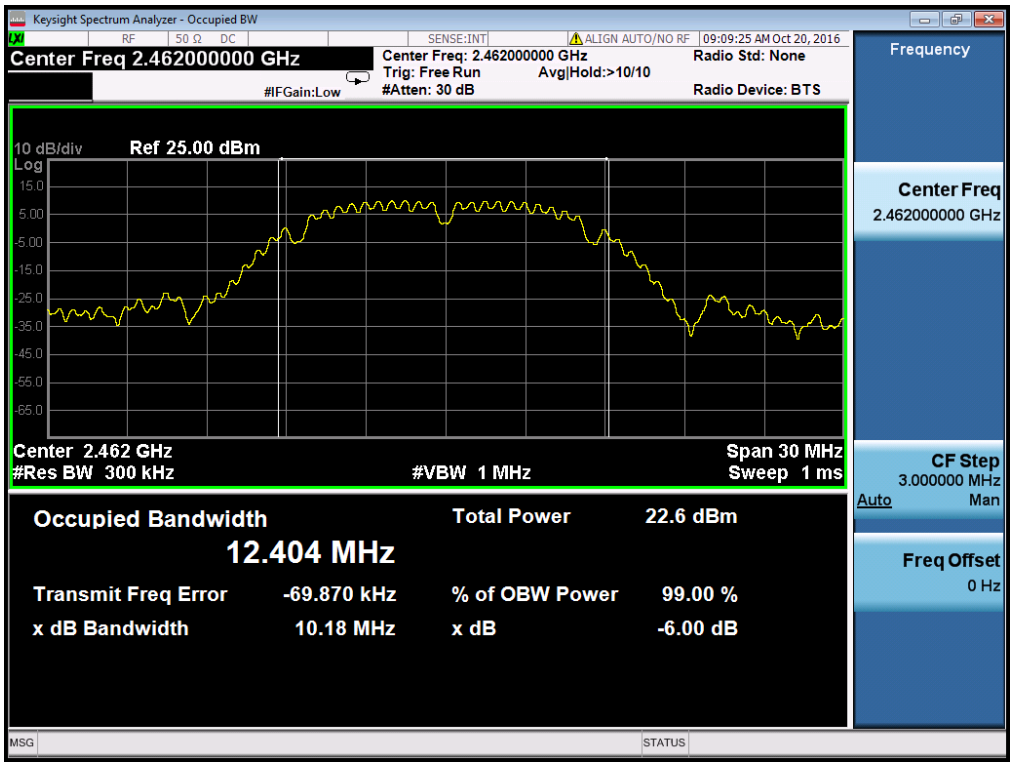
Antenna 0 - 802.11b – 99% Bandwidth – L channel



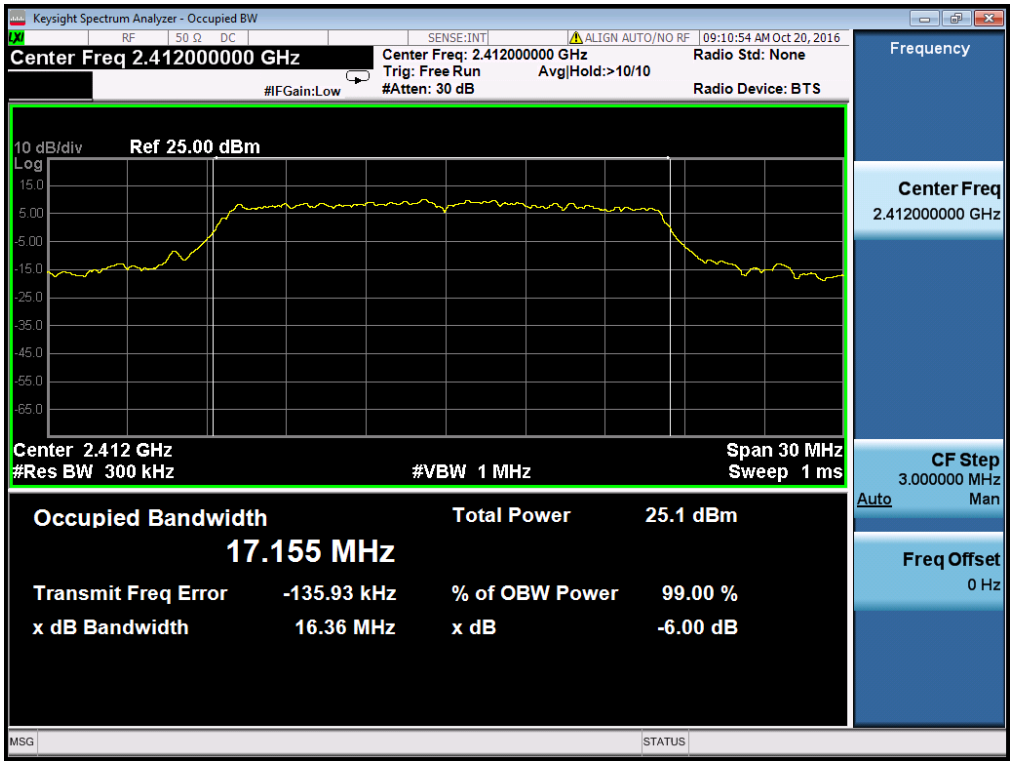
Antenna 0 - 802.11b – 99% Bandwidth – M channel



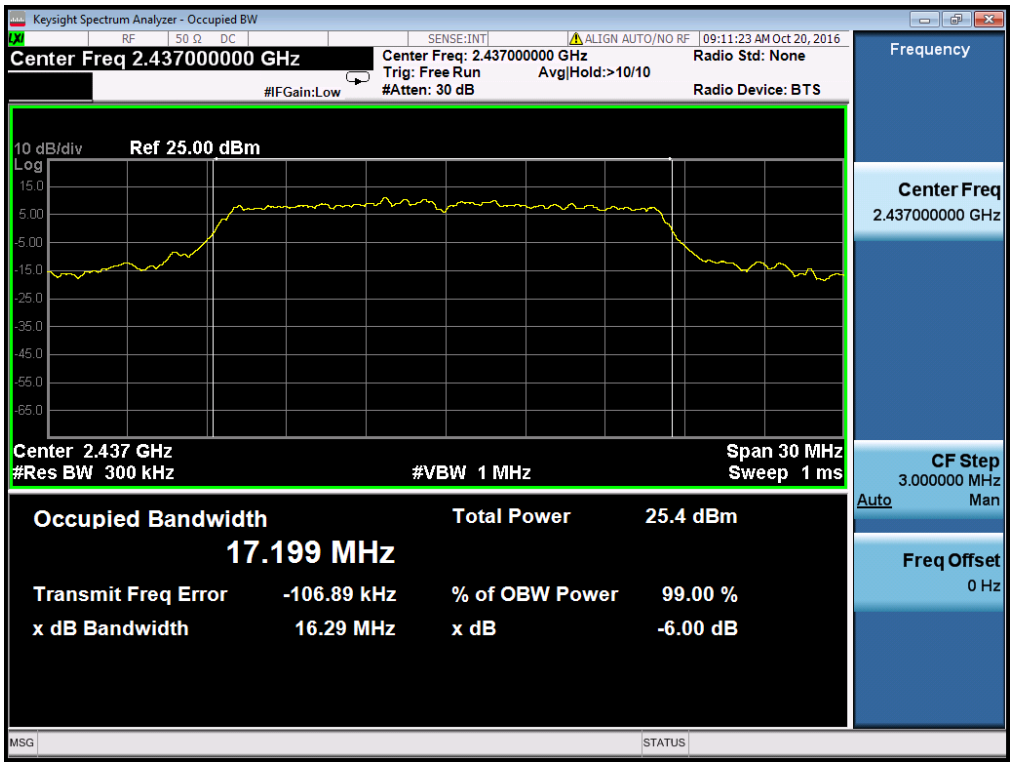
Antenna 0 - 802.11b – 99% Bandwidth – H channel



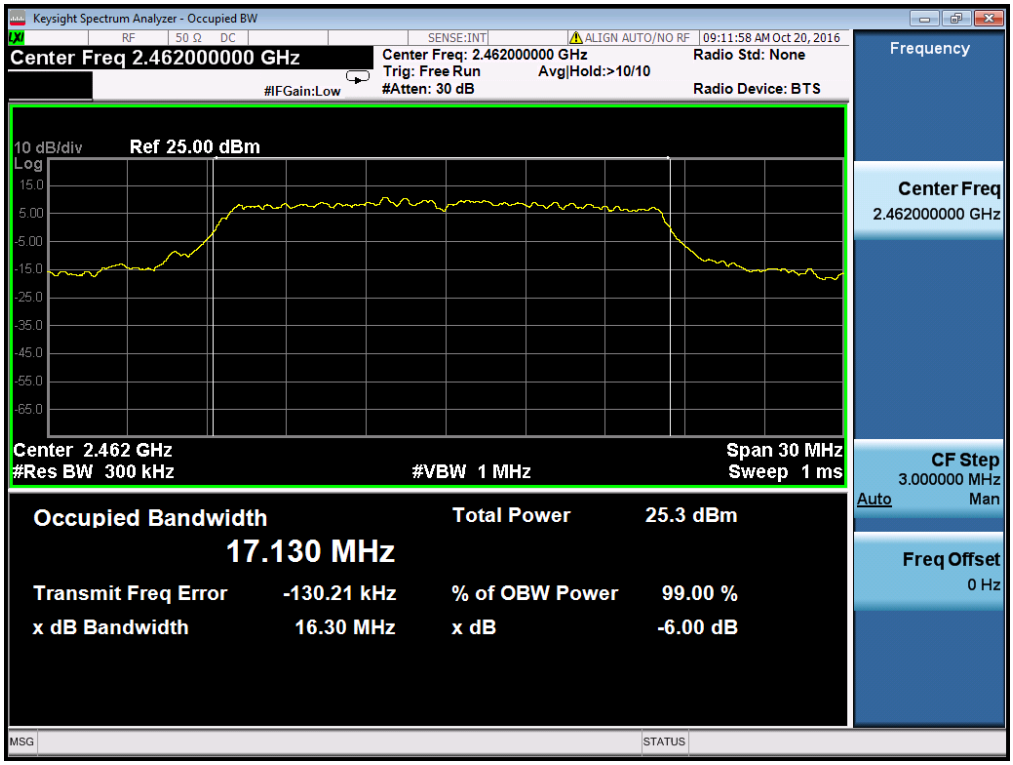
Antenna 0 - 802.11g – 99% Bandwidth – L channel



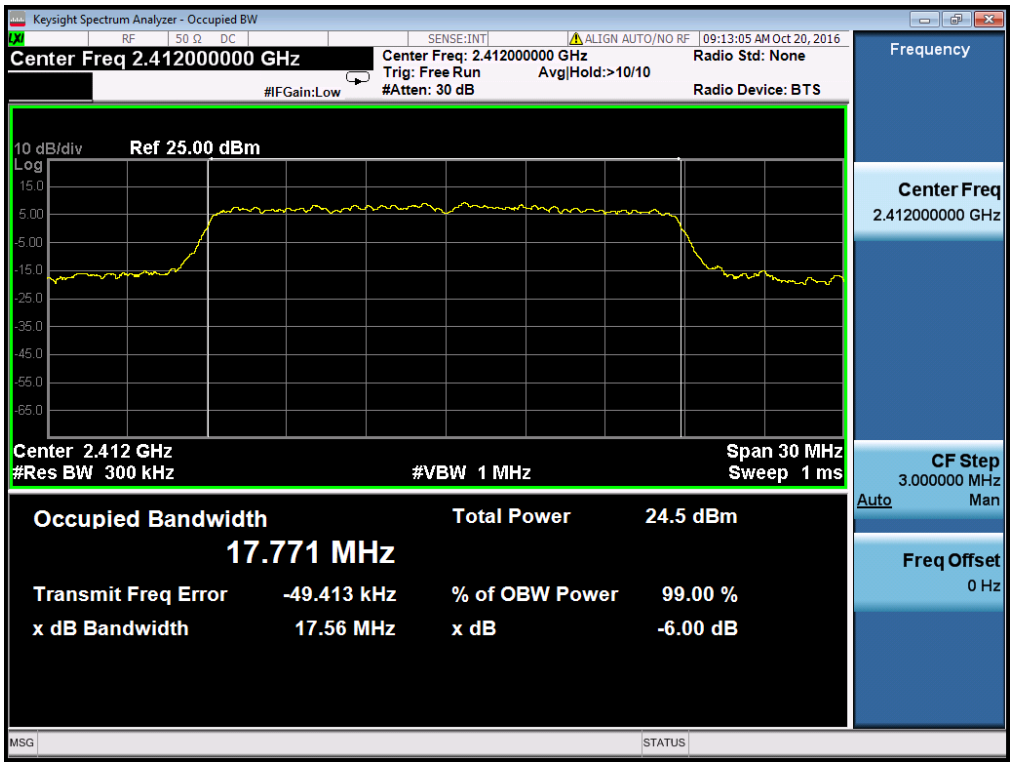
Antenna 0 - 802.11g – 99% Bandwidth – M channel



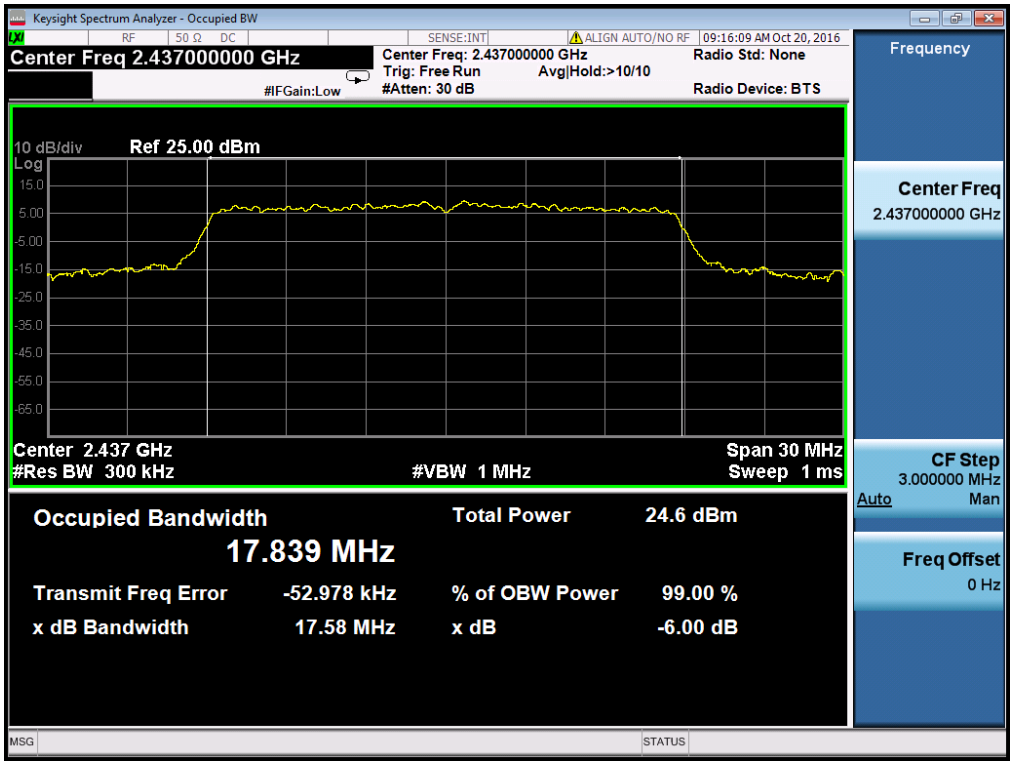
Antenna 0 - 802.11g – 99% Bandwidth – H channel



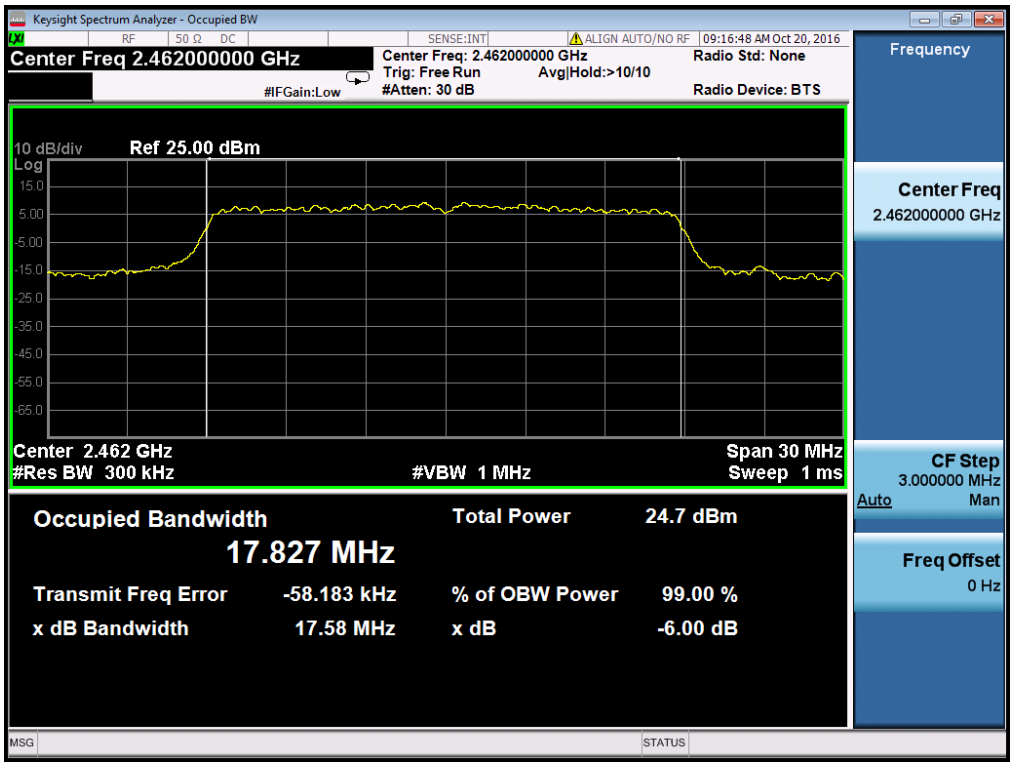
Antenna 0 - 802.11n20 – 99% Bandwidth – L channel



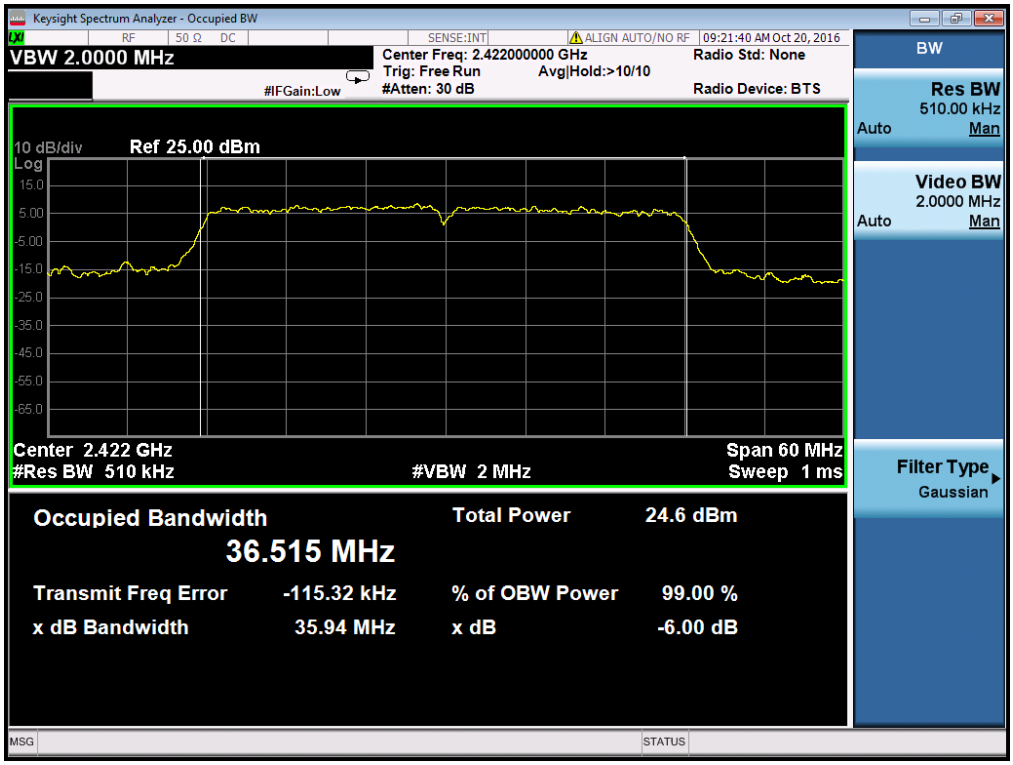
Antenna 0 - 802.11n20 – 99% Bandwidth – M channel



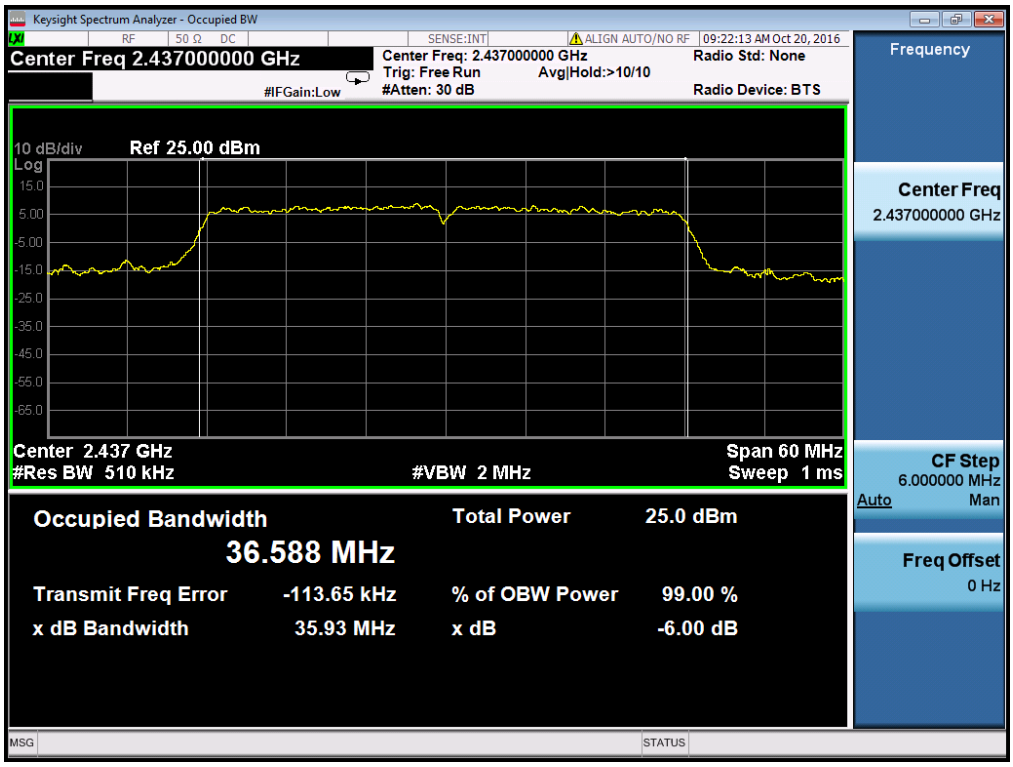
Antenna 0 - 802.11n20 – 99% Bandwidth – H channel



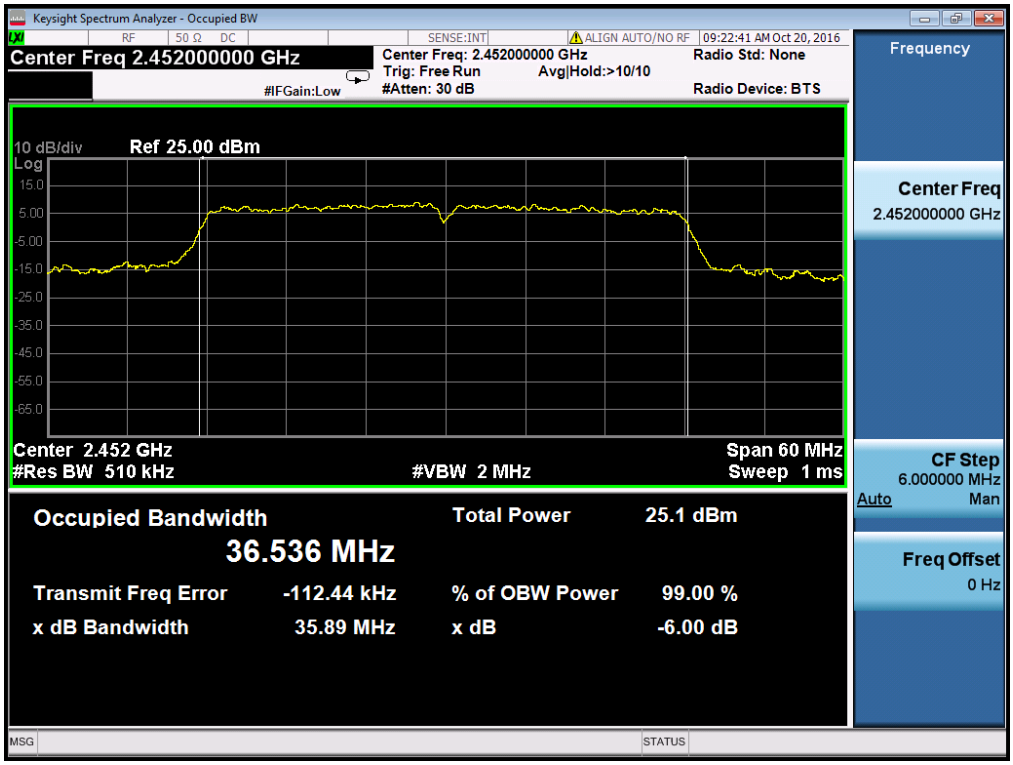
Antenna 0 - 802.11n40 – 99% Bandwidth – L channel



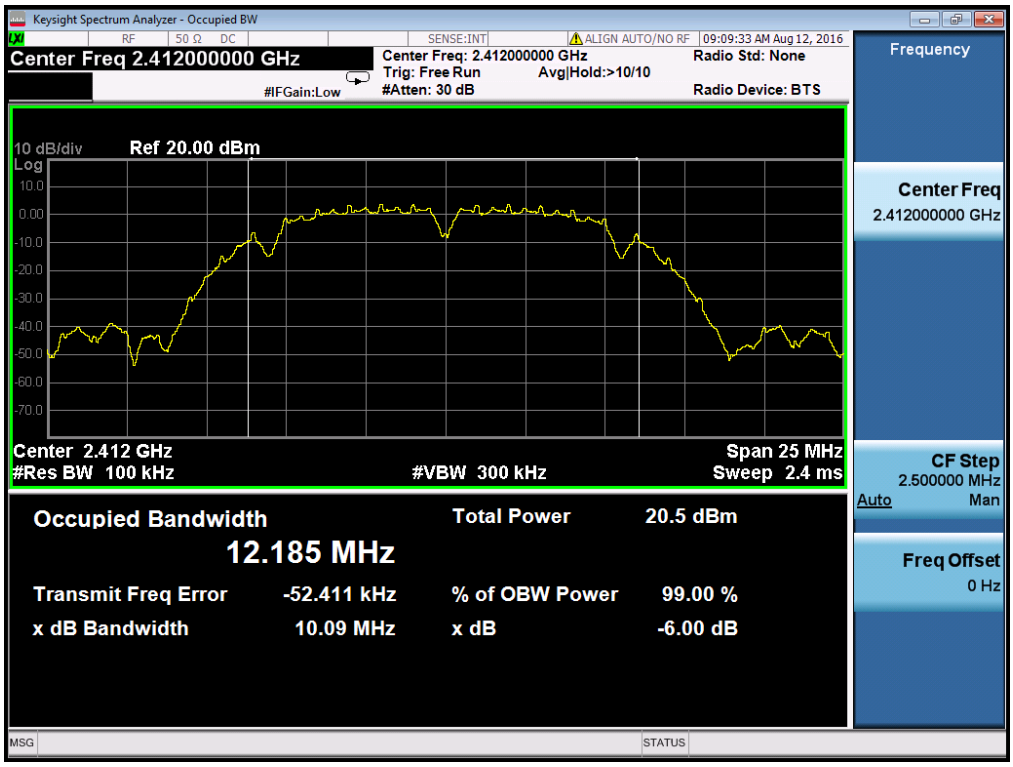
Antenna 0 - 802.11n40 – 99% Bandwidth – M channel



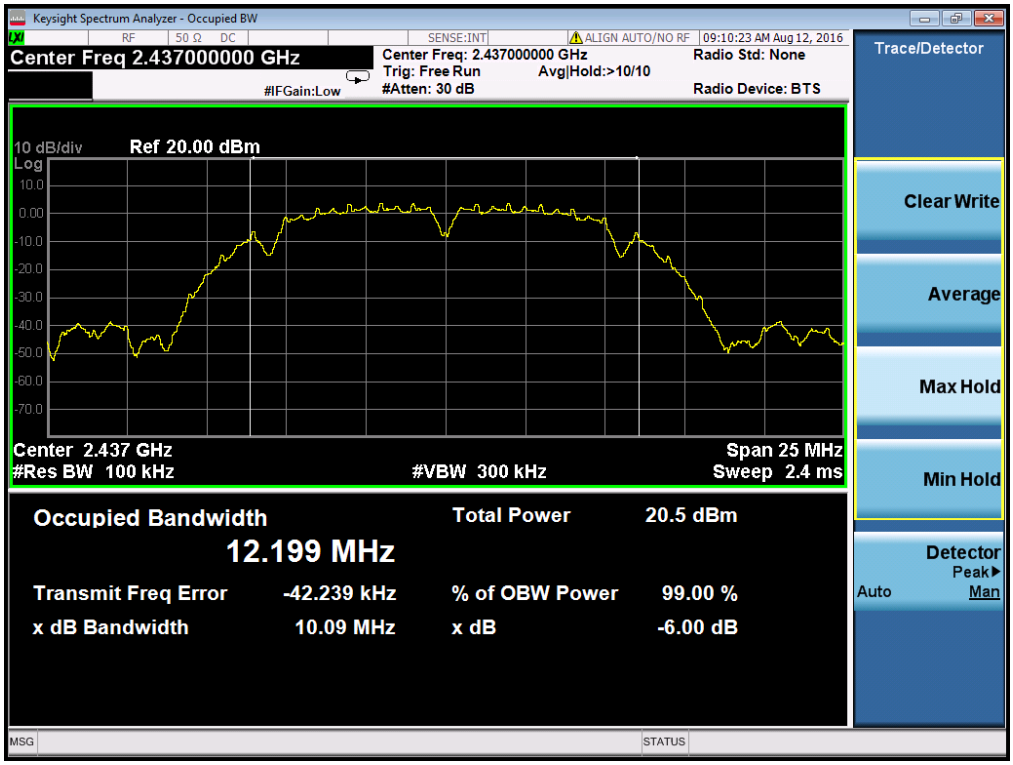
Antenna 0 - 802.11n40 – 99% Bandwidth – H channel



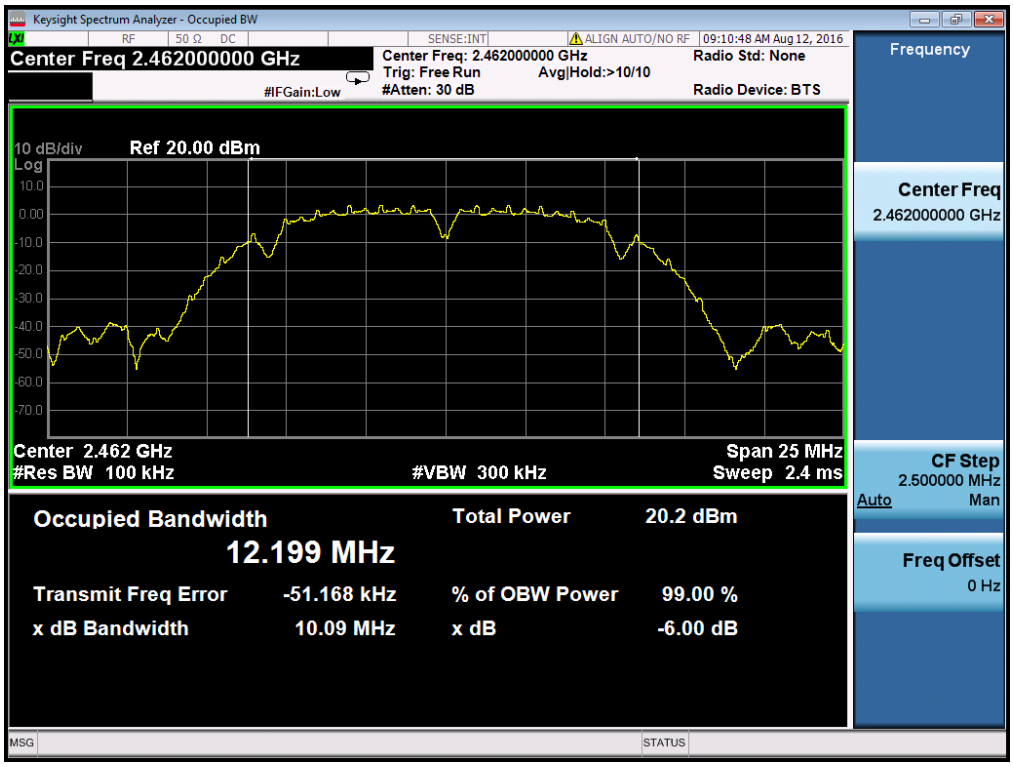
Antenna 1 - 802.11b –6dB Bandwidth – L channel



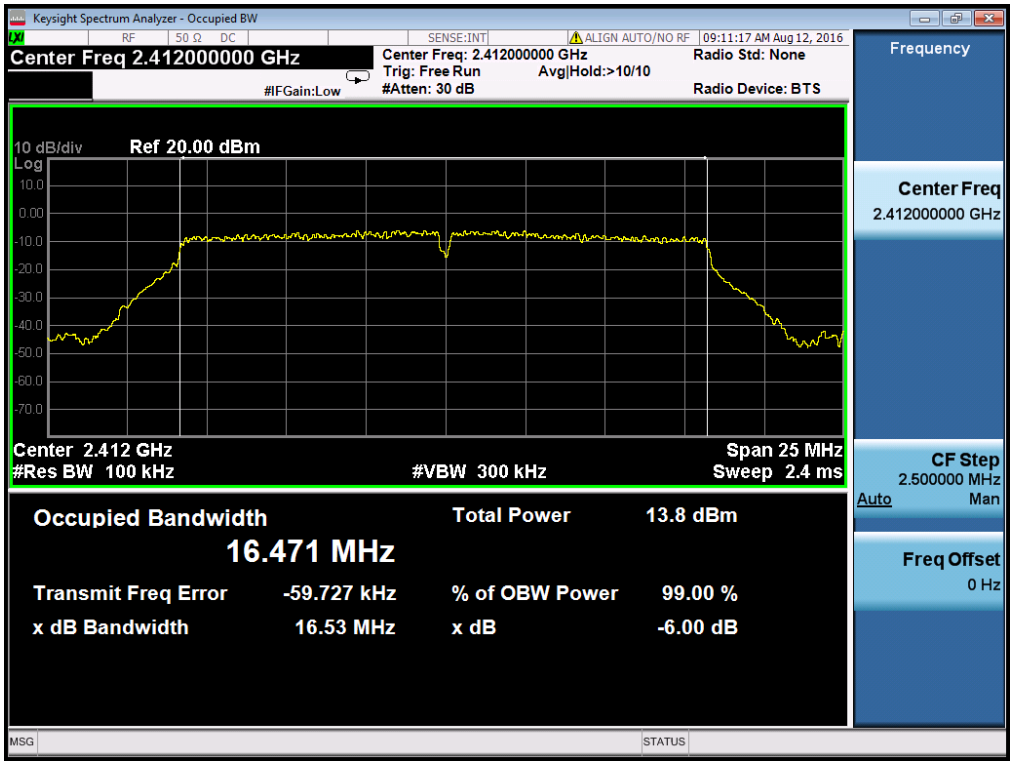
Antenna 1 - 802.11b - 6dB Bandwidth – M channel



Antenna 1 - 802.11b - 6dB Bandwidth – H channel

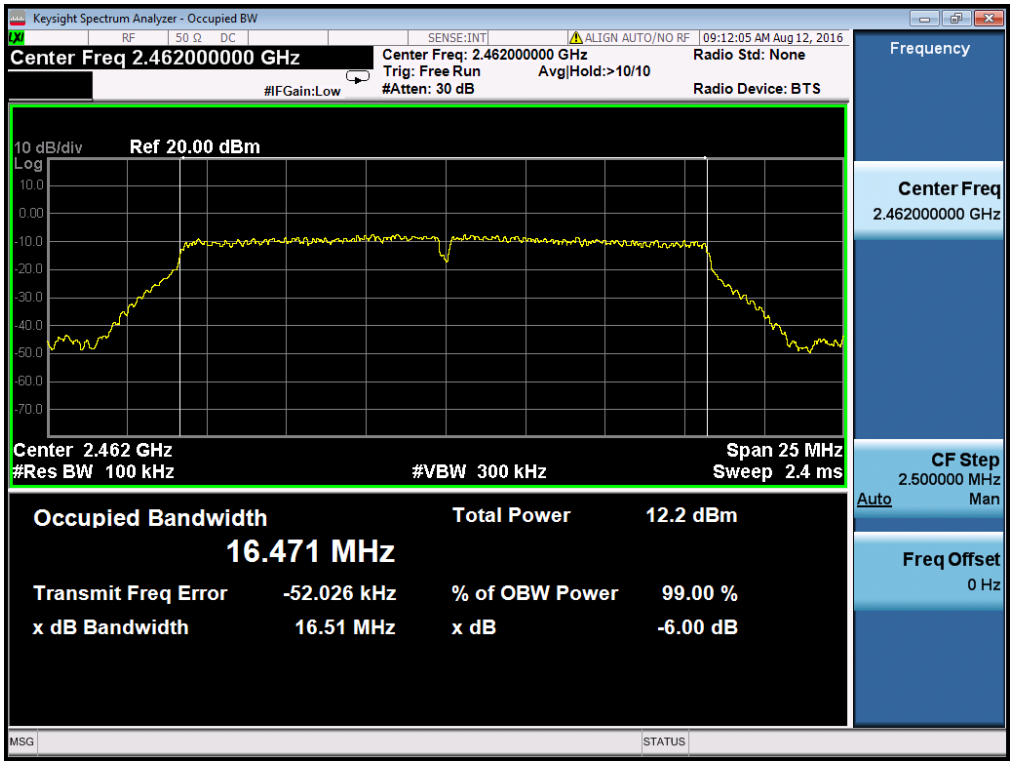


Antenna 1 - 802.11g - 6dB Bandwidth – L channel

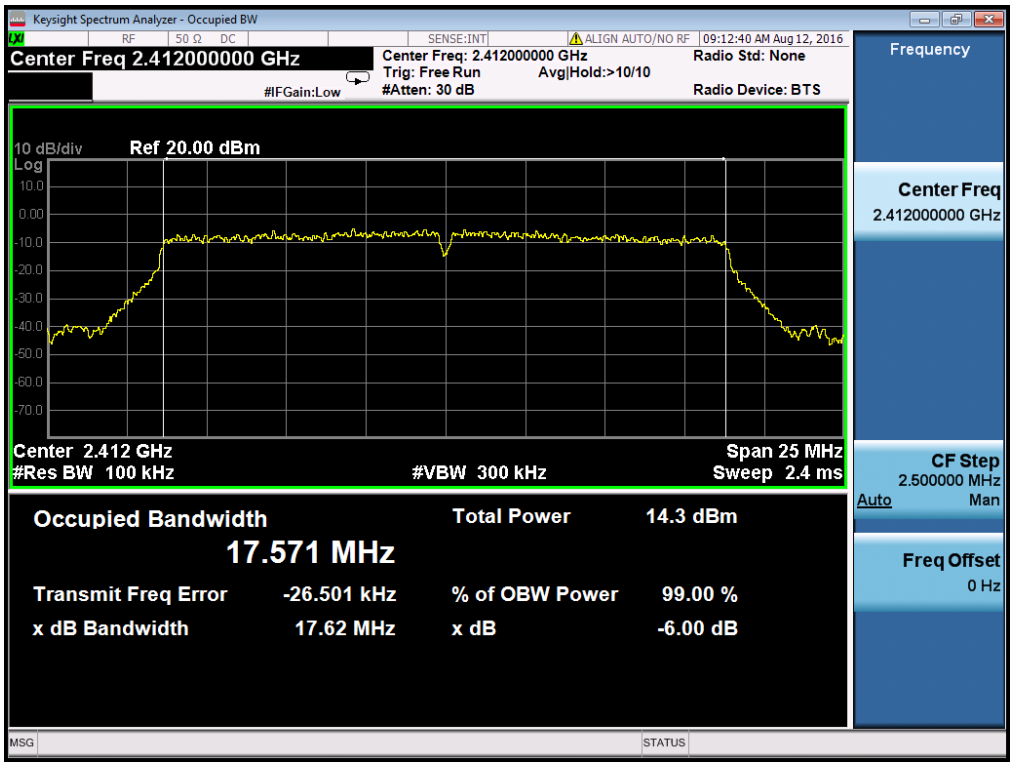


Antenna 1 - 802.11g - 6dB Bandwidth – M channel

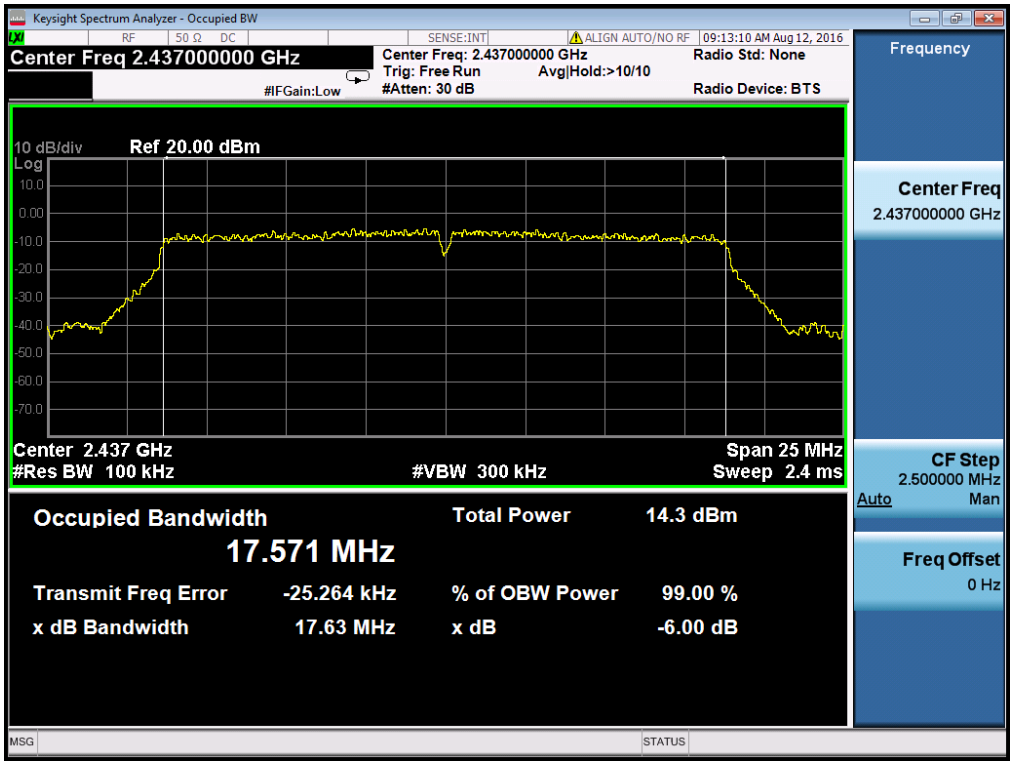
Antenna 1 - 802.11g - 6dB Bandwidth – H channel



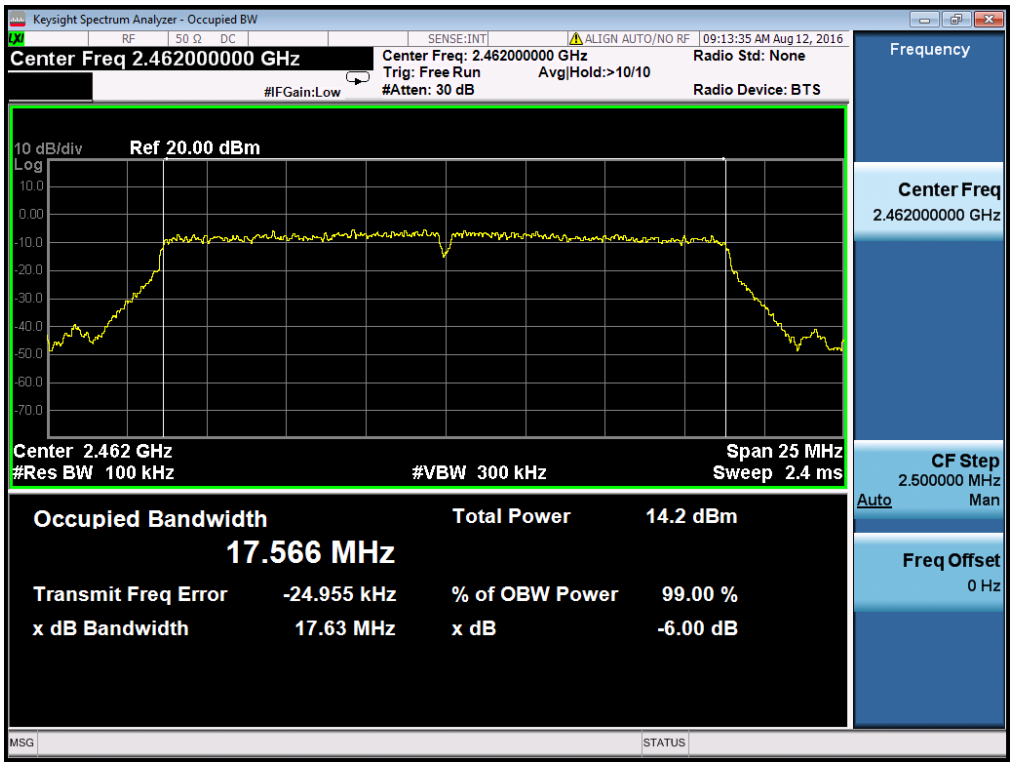
Antenna 1 - 802.11n20 - 6dB Bandwidth – L channel



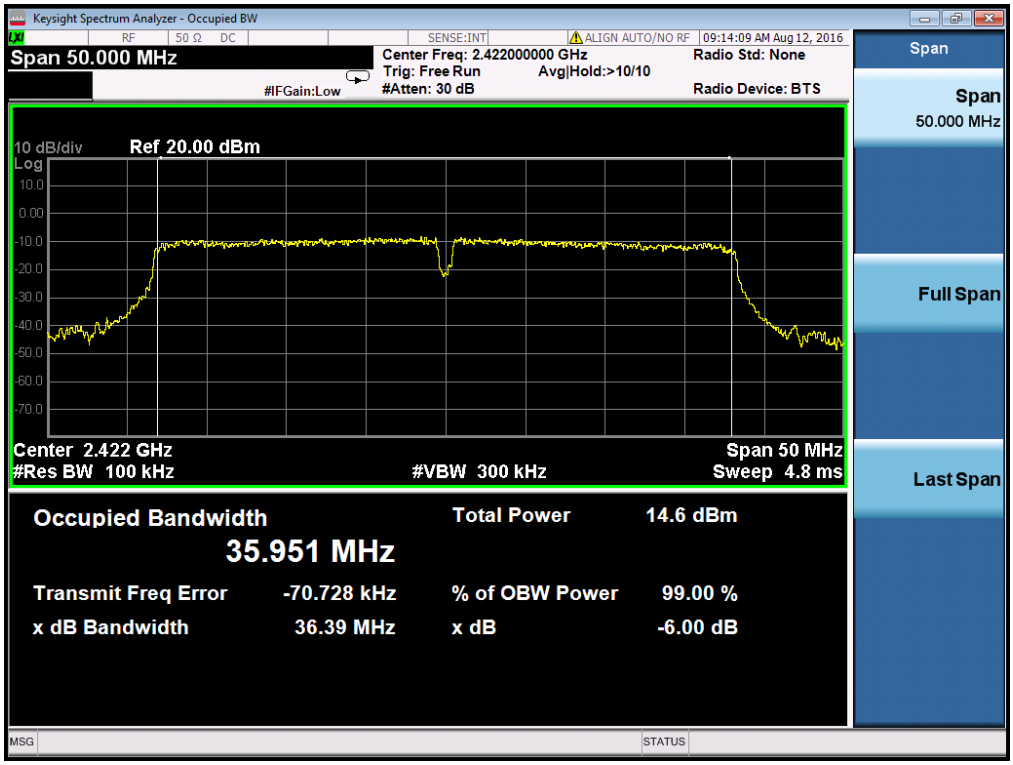
Antenna 1 - 802.11n20 - 6 dB Bandwidth – M channel



Antenna 1 - 802.11n20 - 6 dB Bandwidth – H channel

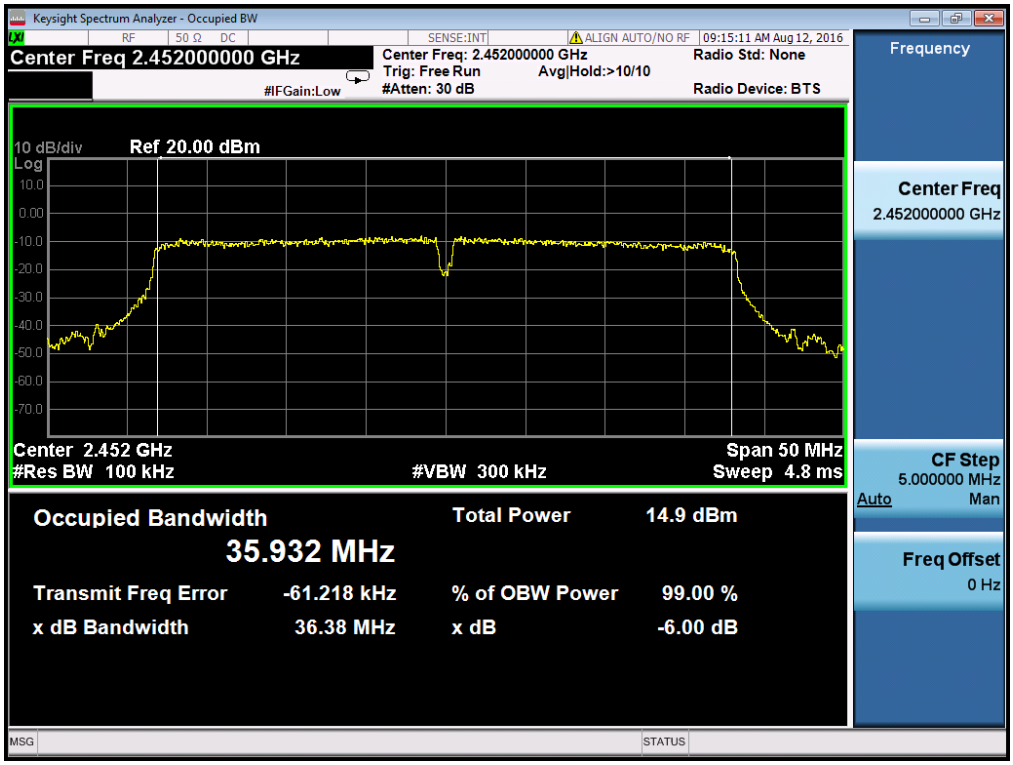


Antenna 1 - 802.11n40 - 6 dB Bandwidth – L channel



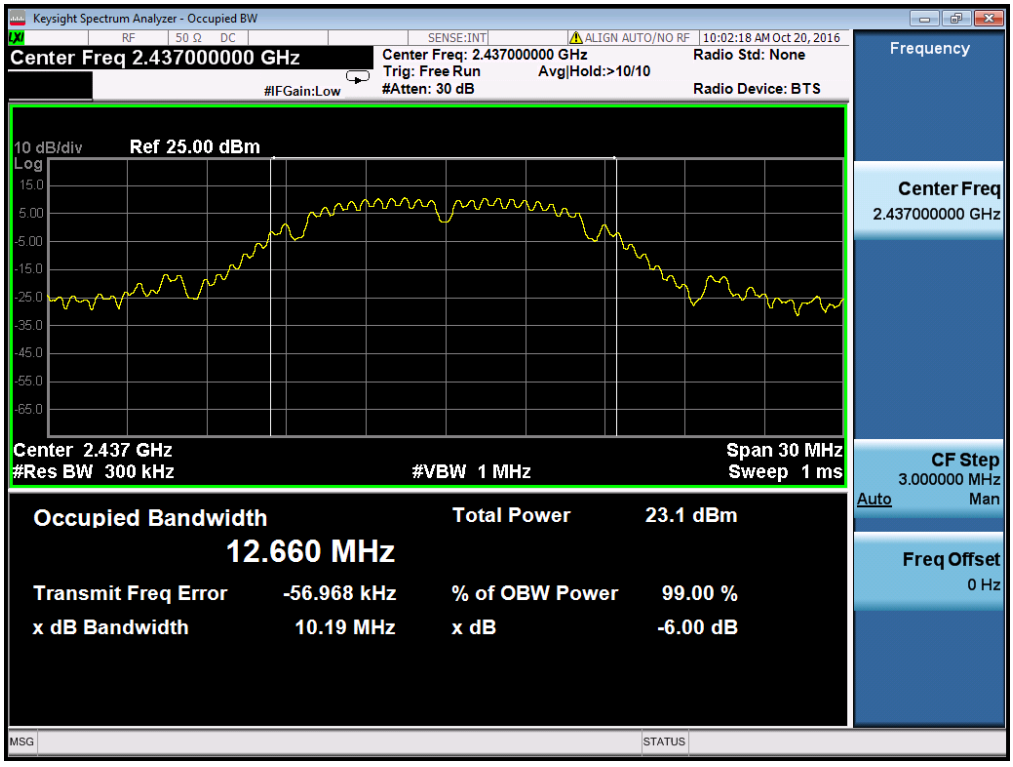
Antenna 1 - 802.11n40 - 6 dB Bandwidth – M channel

Antenna 1 - 802.11n40 - 6 dB Bandwidth – H channel

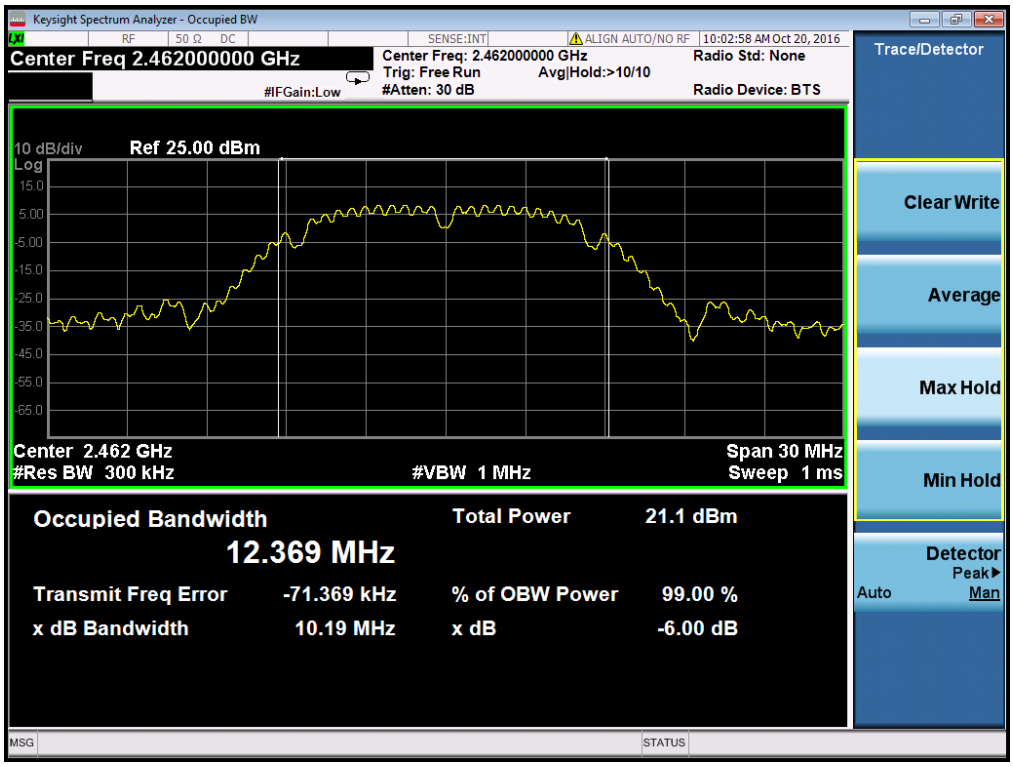


Antenna 1 - 802.11b – 99% Bandwidth – L channel

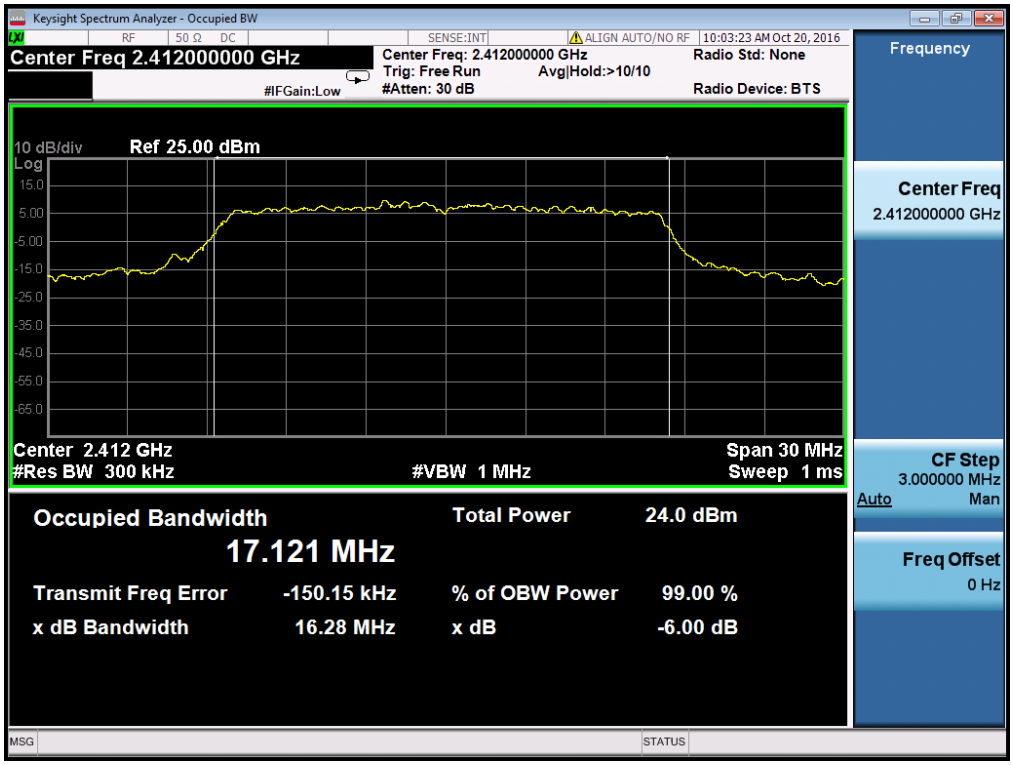
Antenna 1 - 802.11b – 99% Bandwidth – M channel



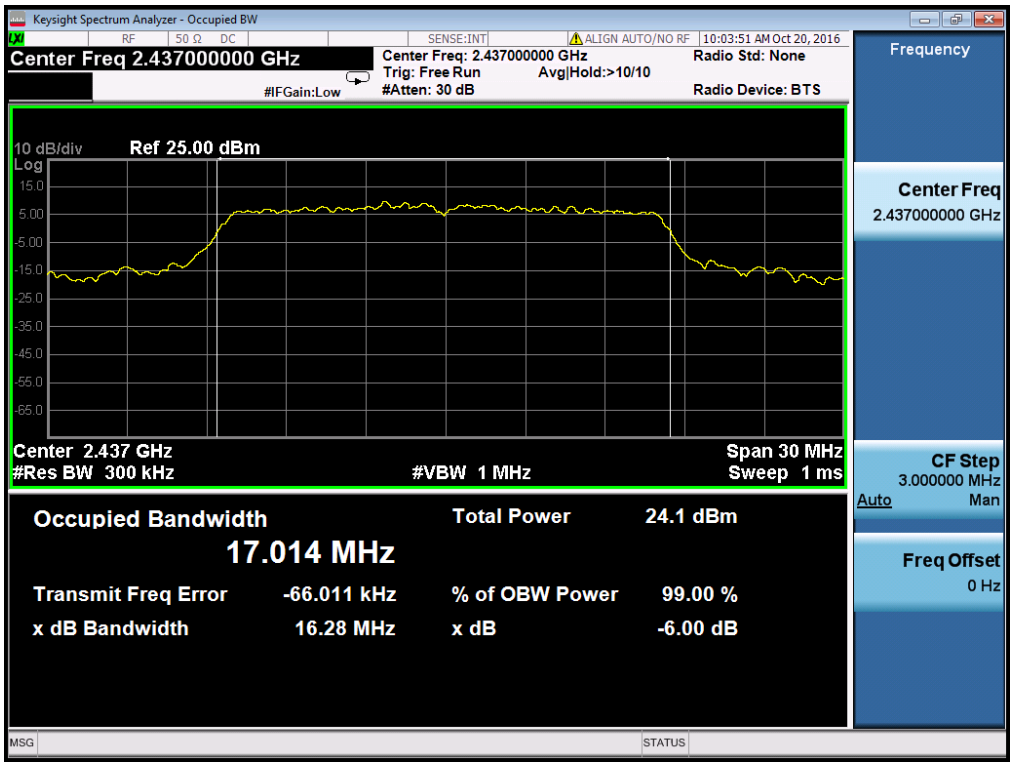
Antenna 1 - 802.11b – 99% Bandwidth – H channel



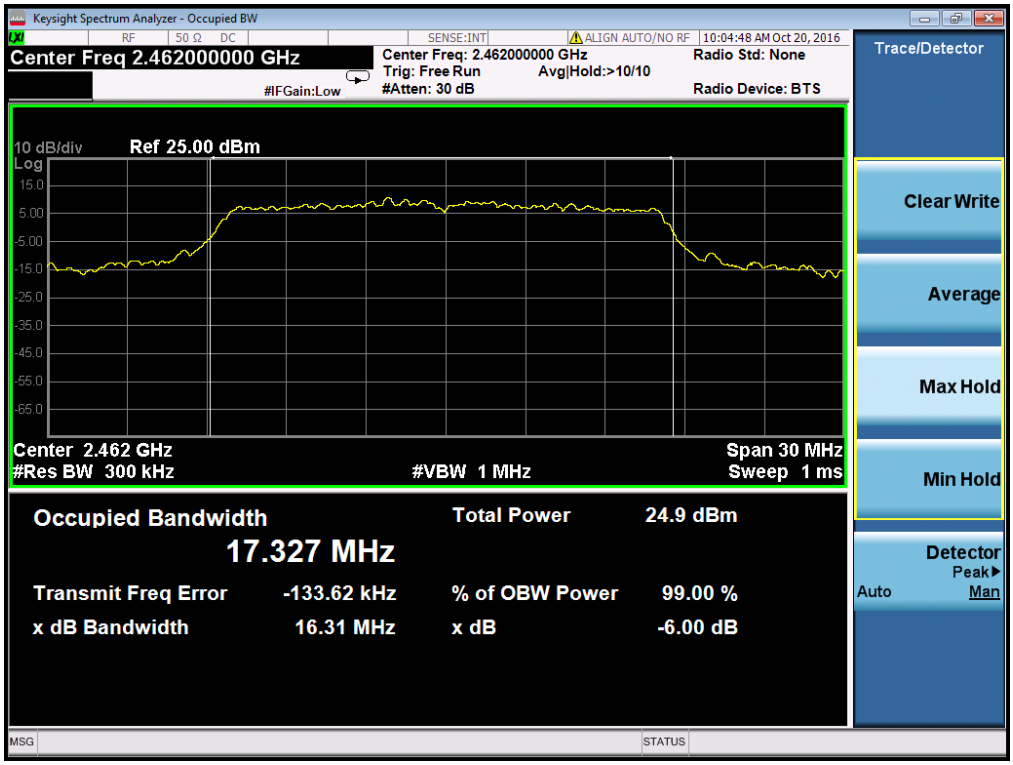
Antenna 1 - 802.11g – 99% Bandwidth – L channel



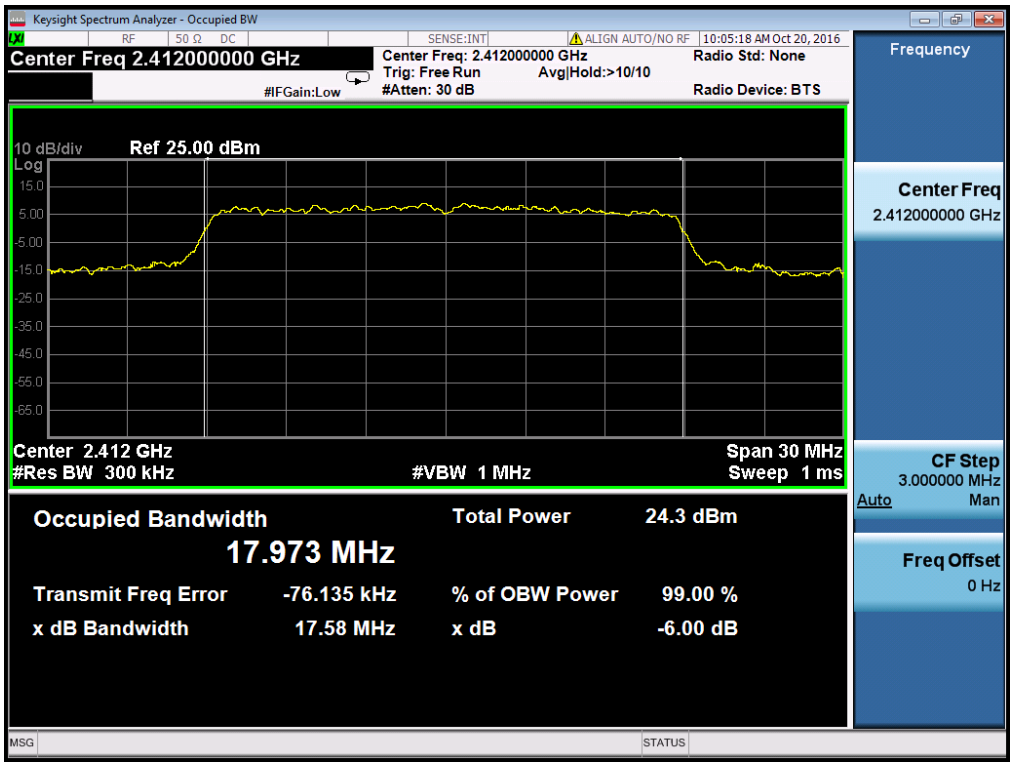
Antenna 1 - 802.11g – 99% Bandwidth – M channel



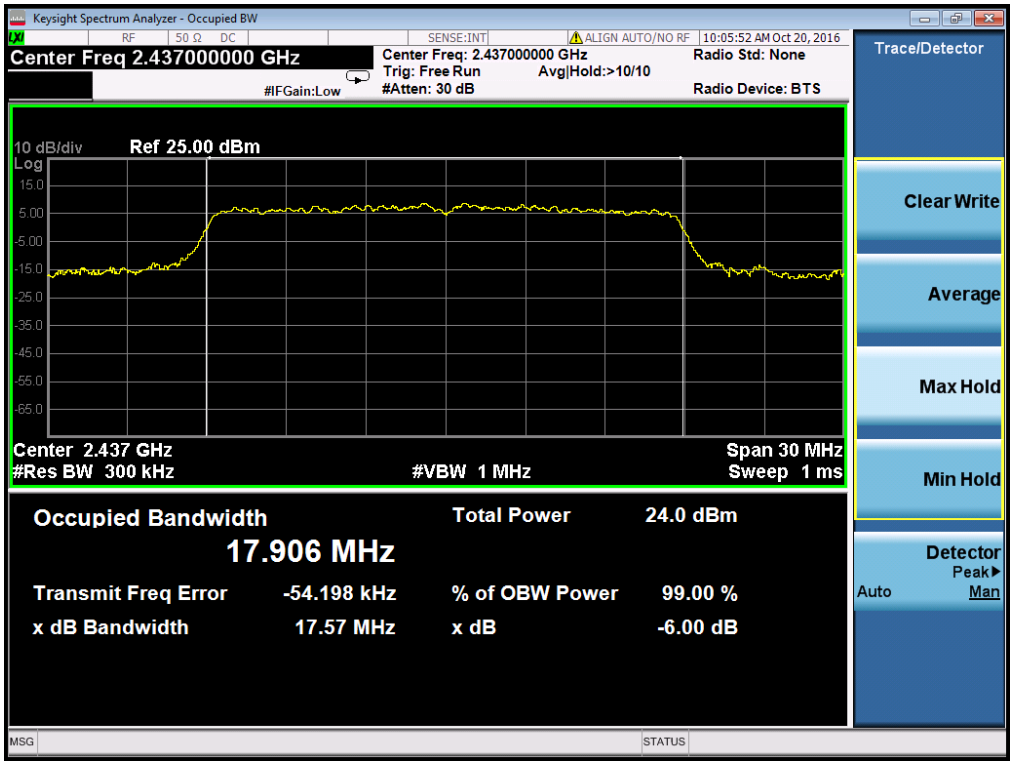
Antenna 1 - 802.11g – 99% Bandwidth – H channel



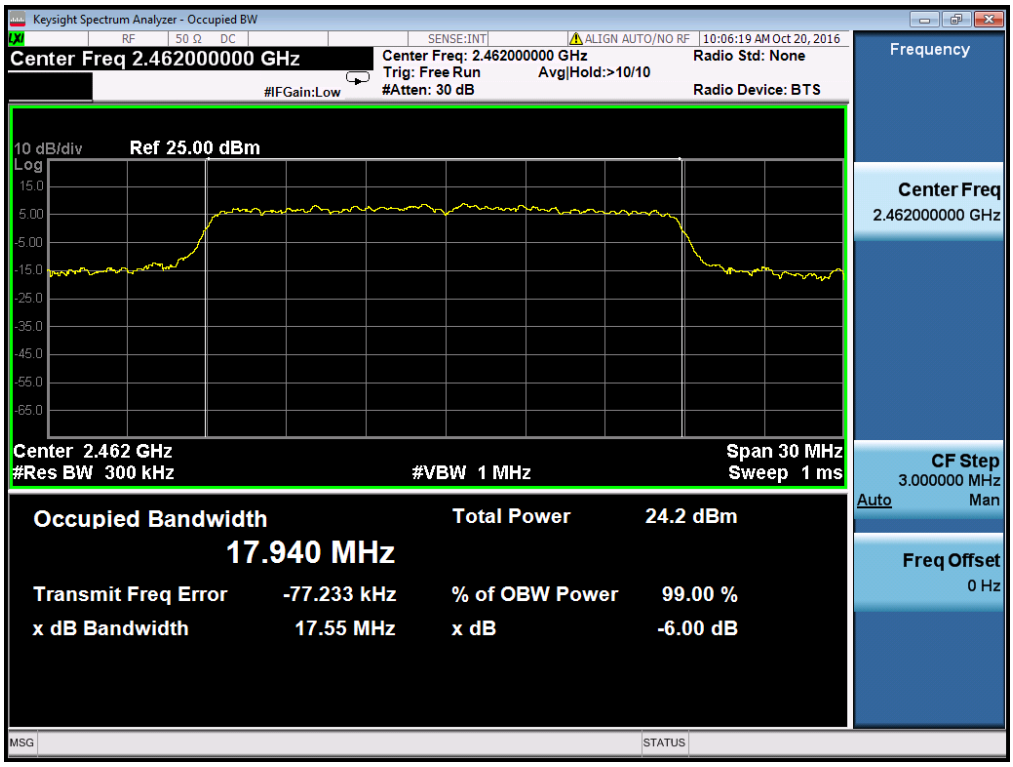
Antenna 1 - 802.11n20 – 99% Bandwidth – L channel



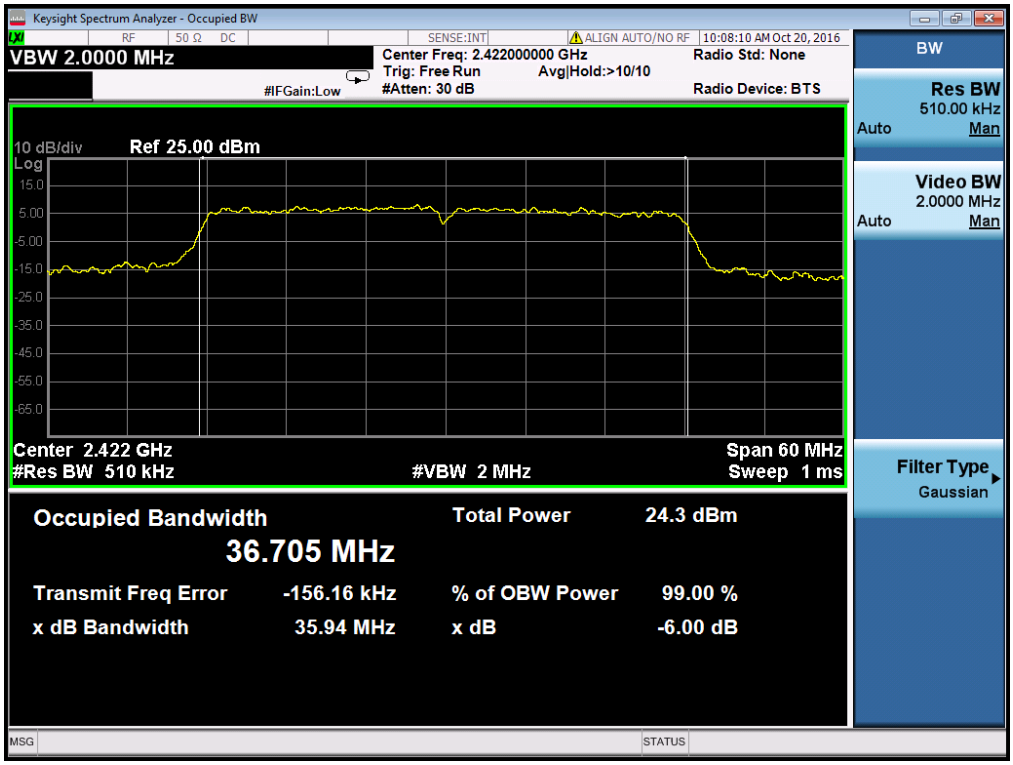
Antenna 1 - 802.11n20 – 99% Bandwidth – M channel



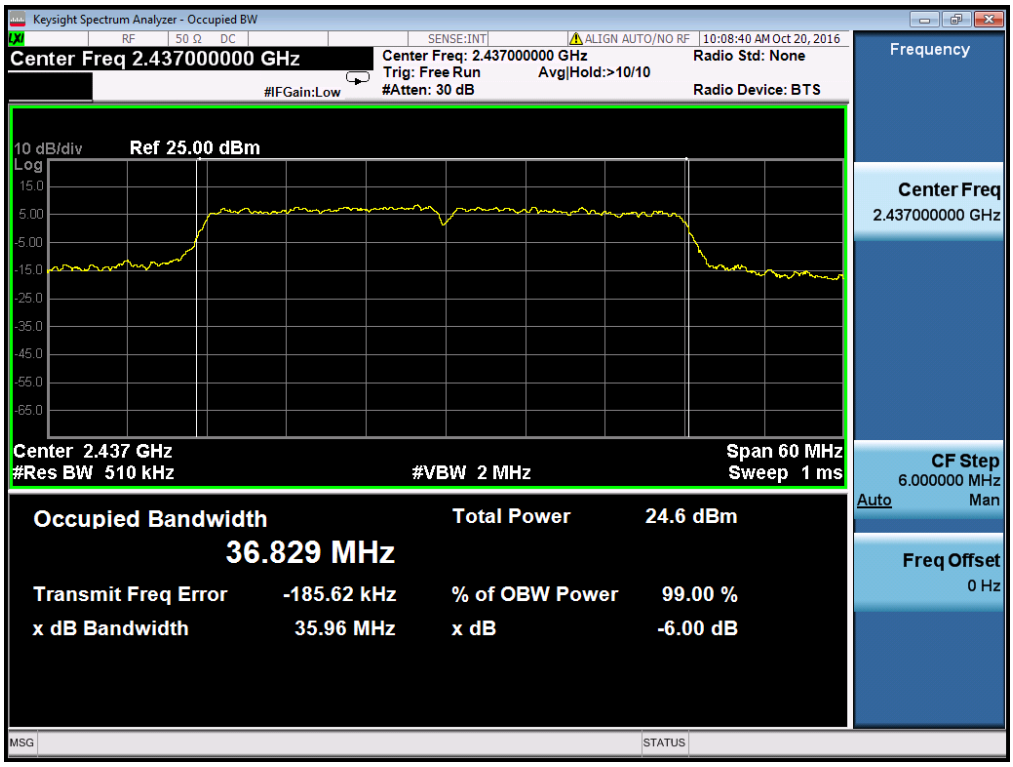
Antenna 1 - 802.11n20 – 99% Bandwidth – H channel



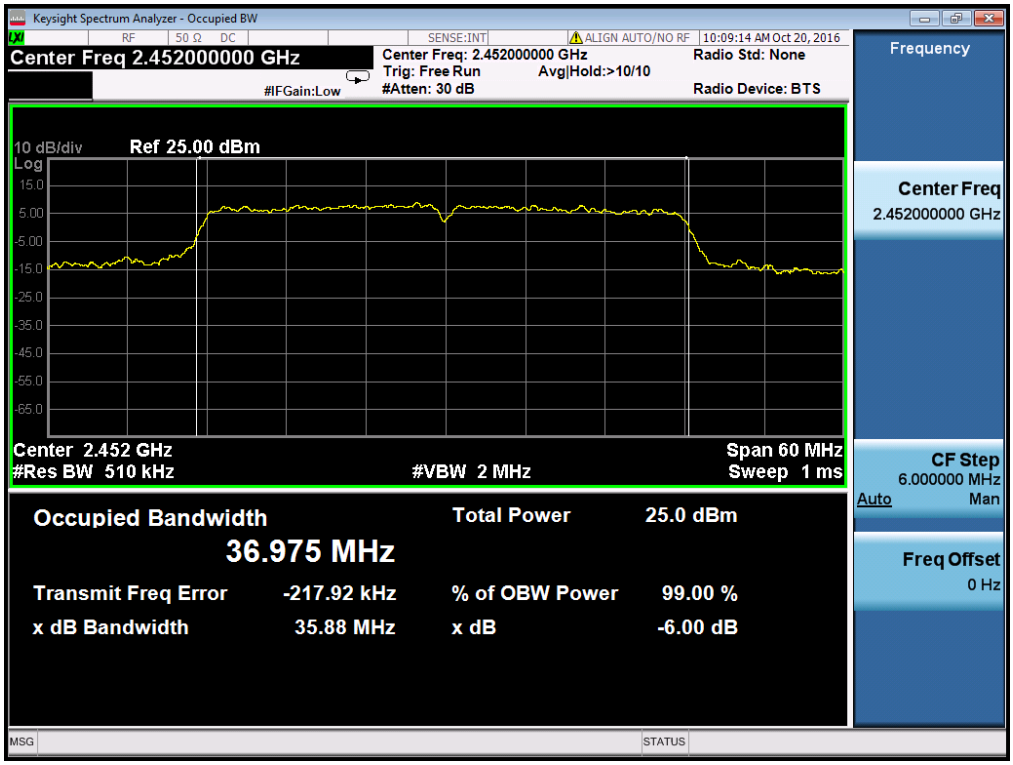
Antenna 1 - 802.11n40 – 99% Bandwidth – L channel



Antenna 1 - 802.11n40 – 99% Bandwidth – M channel



Antenna 1 - 802.11n40 – 99% Bandwidth – H channel



2.4. Conducted Band Edges and Spurious Emissions

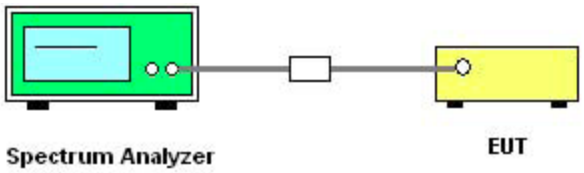
2.4.1. Limit of Conducted Band Edges and Spurious Emissions

All harmonics/spurious must be at least 20 dB down from the highest emission level within the authorized band.

2.4.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

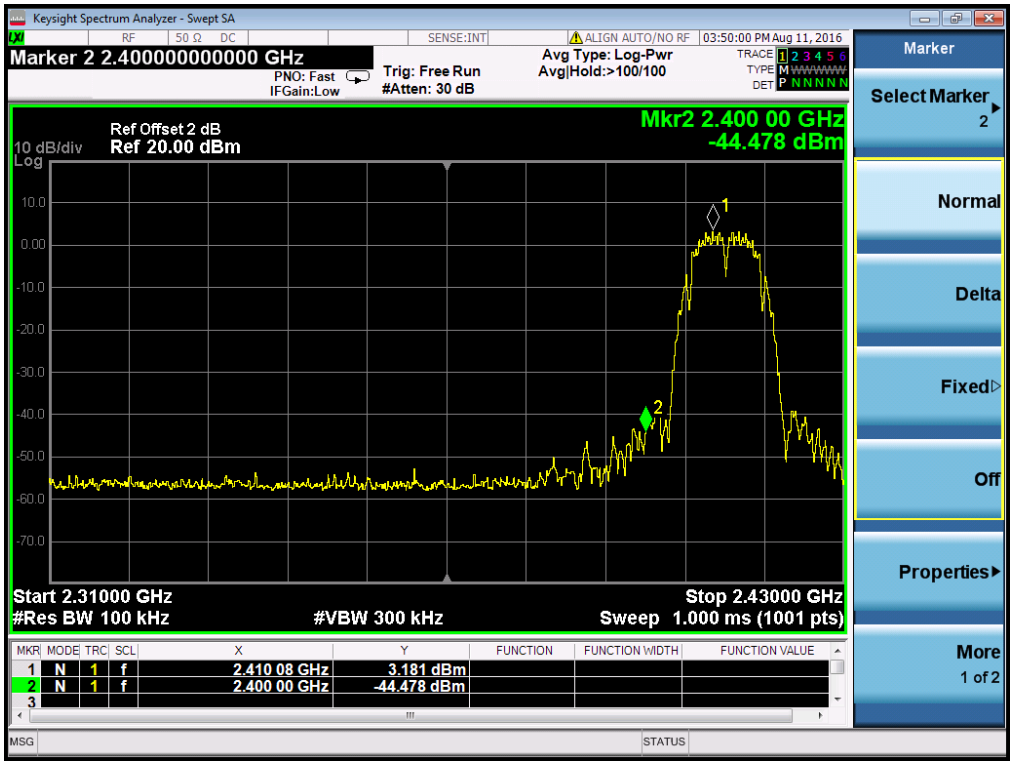
2.4.3. Test Setup



2.4.4. Test Procedure

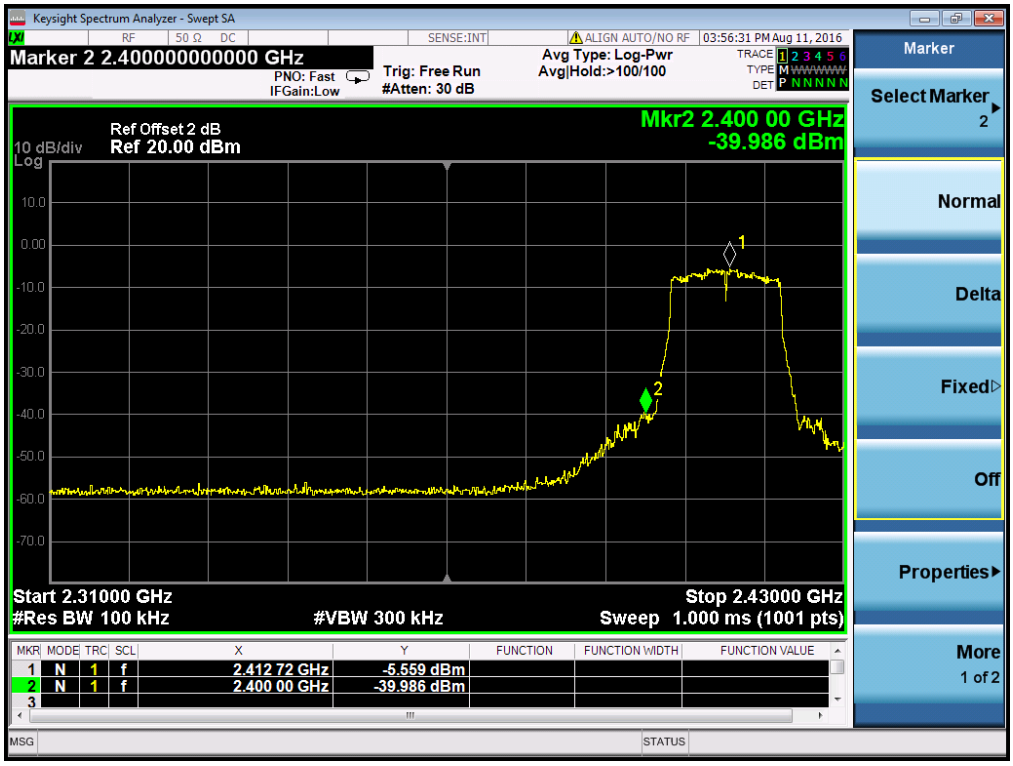
1. The testing follows FCC KDB558074 D01 v03r05.
2. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

2.4.5. Test Results of Conducted Band Edges

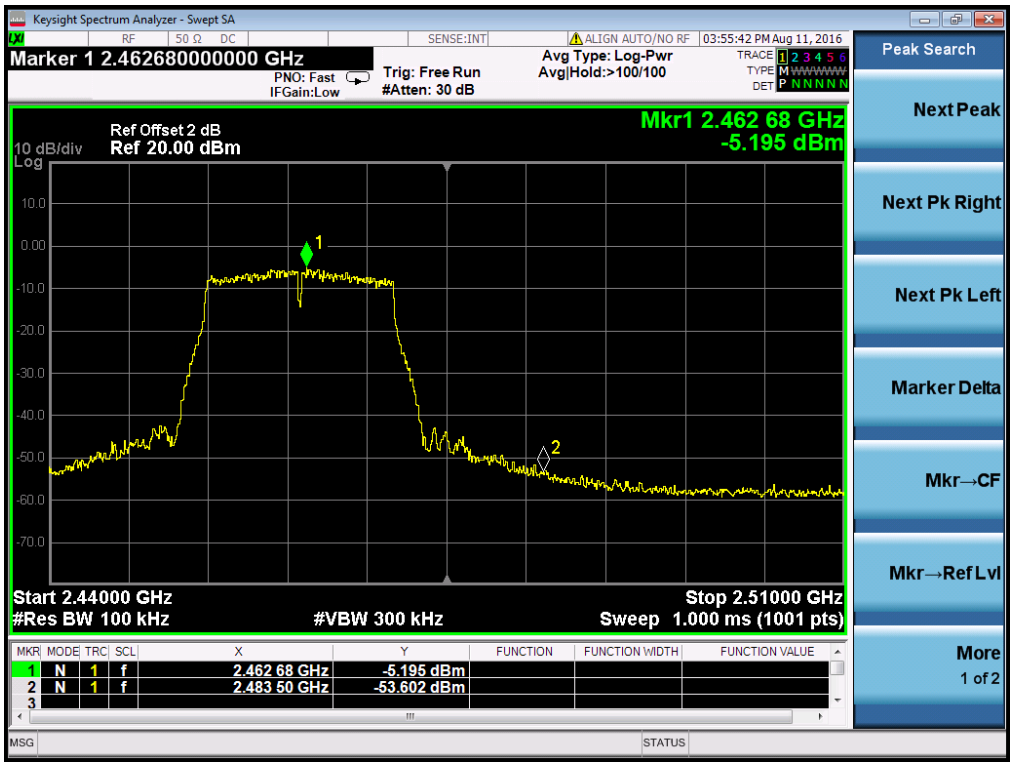


Antenna 0 - 802.11b - Low Band Edge Plot on Channel 1

Antenna 0 - 802.11b - High Band Edge Plot on Channel 11



Antenna 0 - 802.11g - Low Band Edge Plot on Channel 1



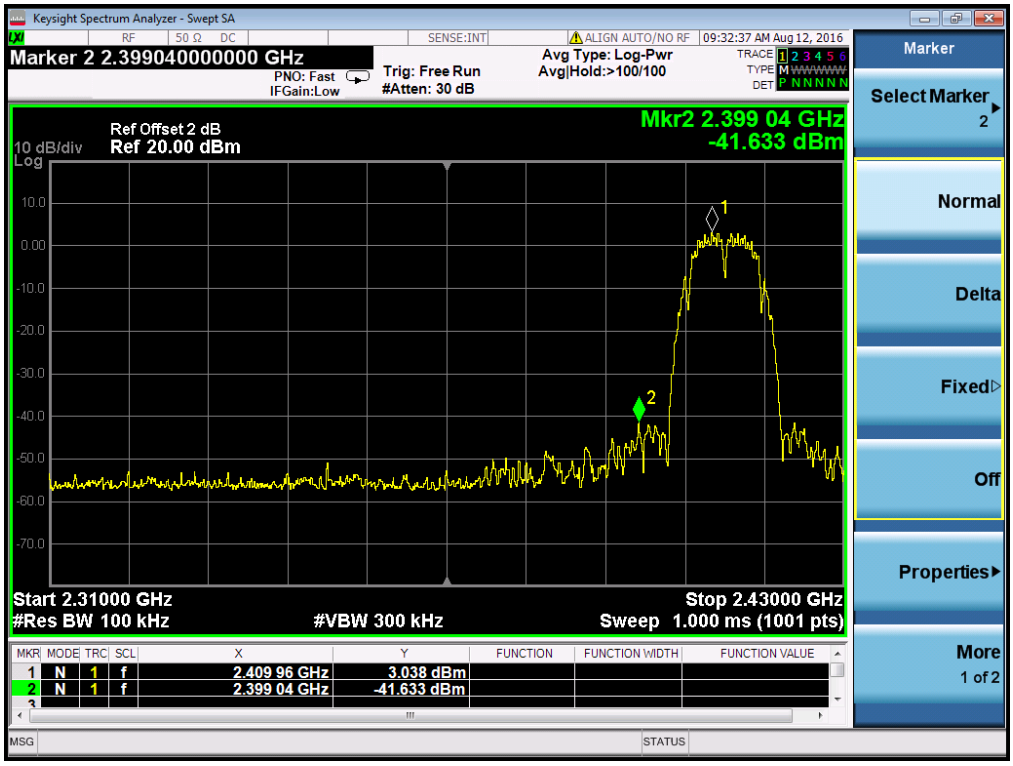
Antenna 0 - 802.11g - High Band Edge Plot on Channel 11

Antenna 0 - 802.11n20 - Low Band Edge Plot on Channel 1

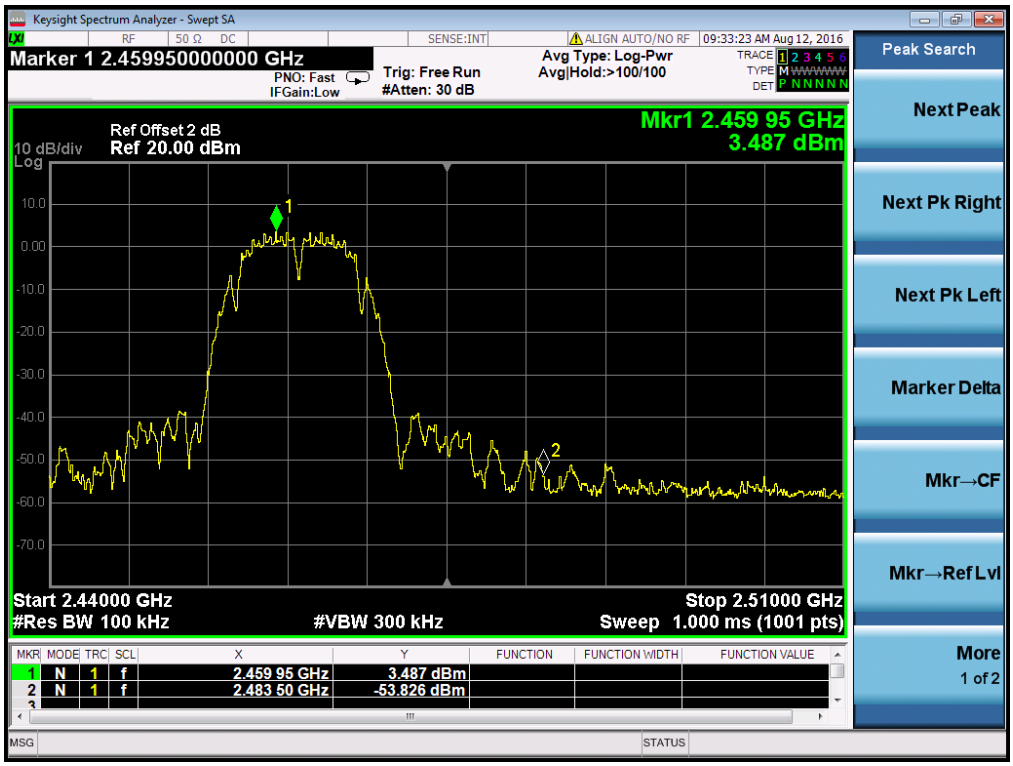
Antenna 0 - 802.11n20 - High Band Edge Plot on Channel 11

Antenna 0 - 802.11n40 - Low Band Edge Plot on Channel 3

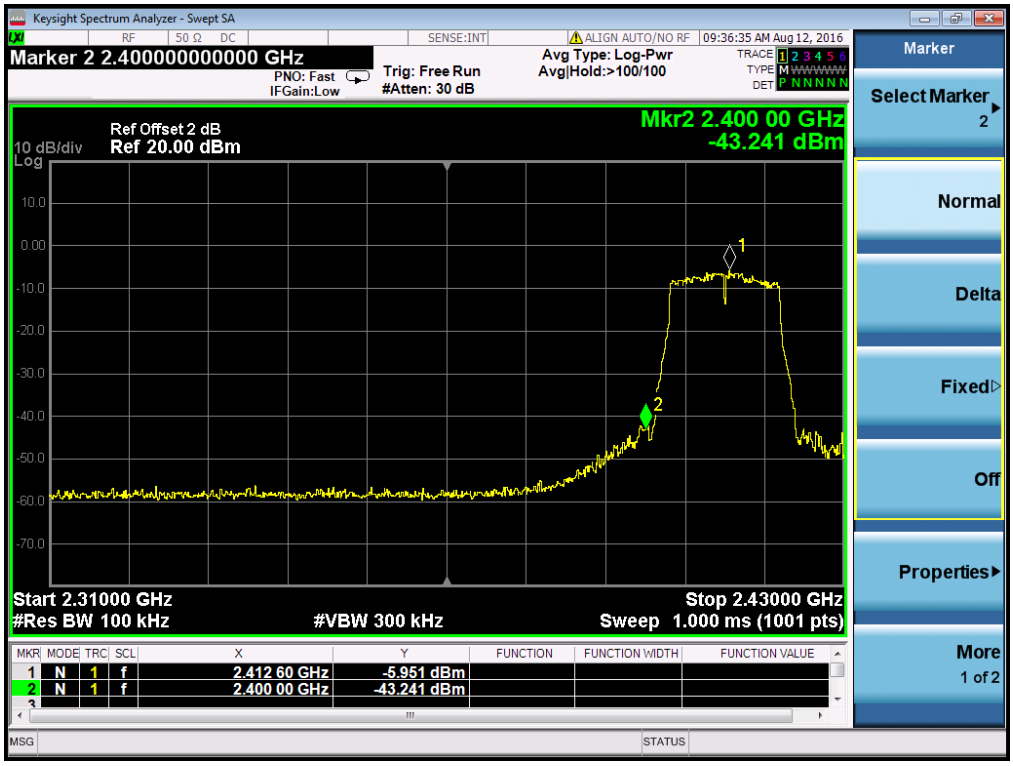
Antenna 0 - 802.11n40 - High Band Edge Plot on Channel 9



Antenna 1 - 802.11b - Low Band Edge Plot on Channel 1

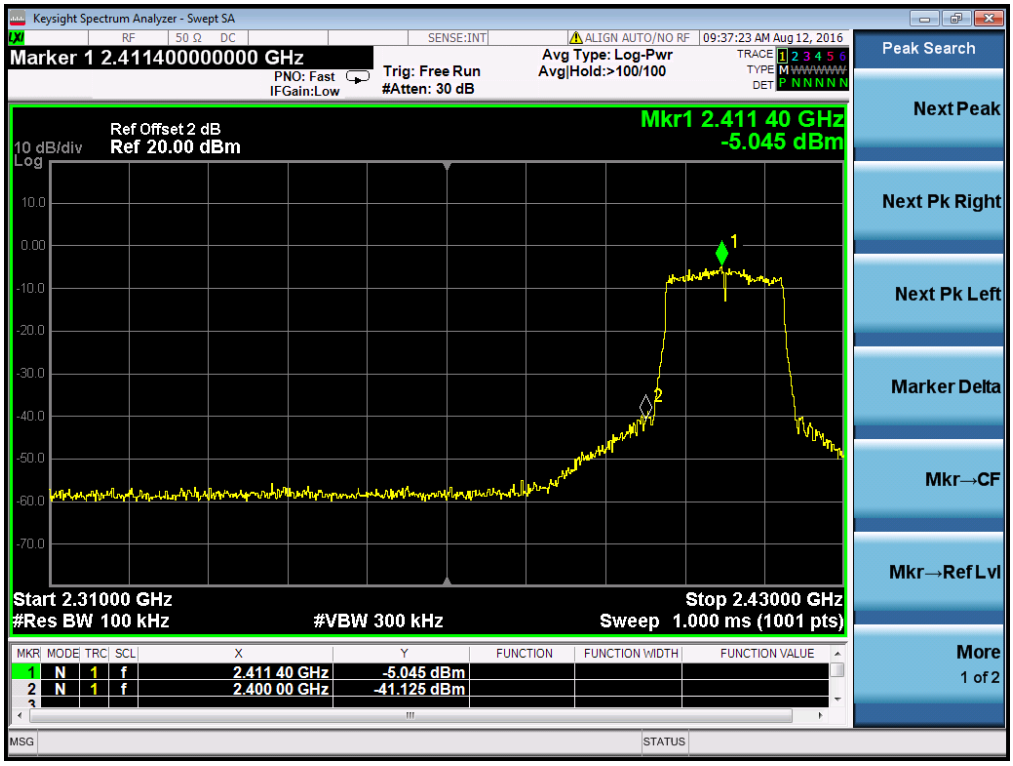


Antenna 1 - 802.11b - High Band Edge Plot on Channel 11



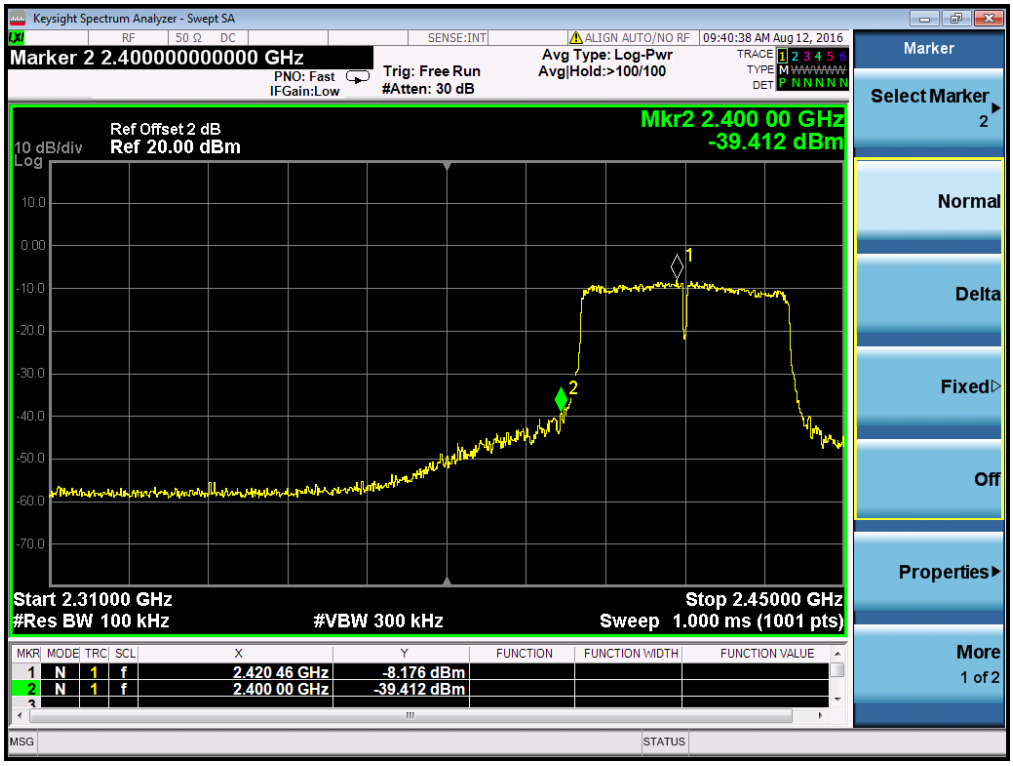
Antenna 1 - 802.11g - Low Band Edge Plot on Channel 1

Antenna 1 - 802.11g - High Band Edge Plot on Channel 11



Antenna 1 - 802.11n20 - Low Band Edge Plot on Channel 1

Antenna 1 - 802.11n20 - High Band Edge Plot on Channel 11



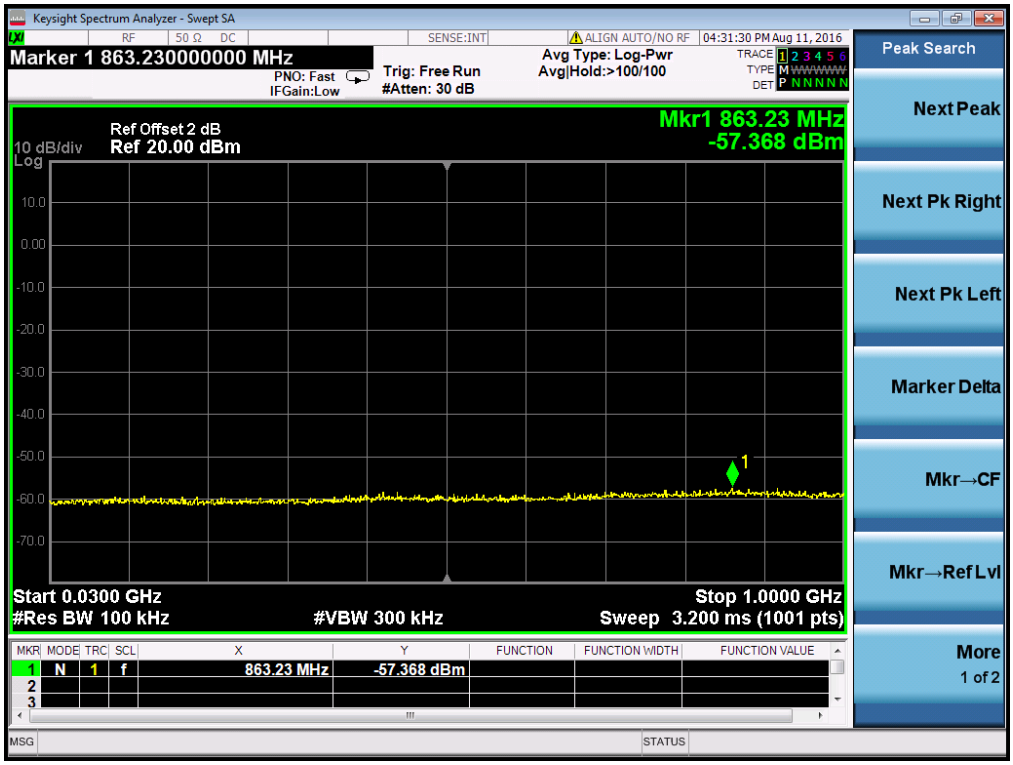
Antenna 1 - 802.11n40 - Low Band Edge Plot on Channel 3

Antenna 1 - 802.11n40 - High Band Edge Plot on Channel 9

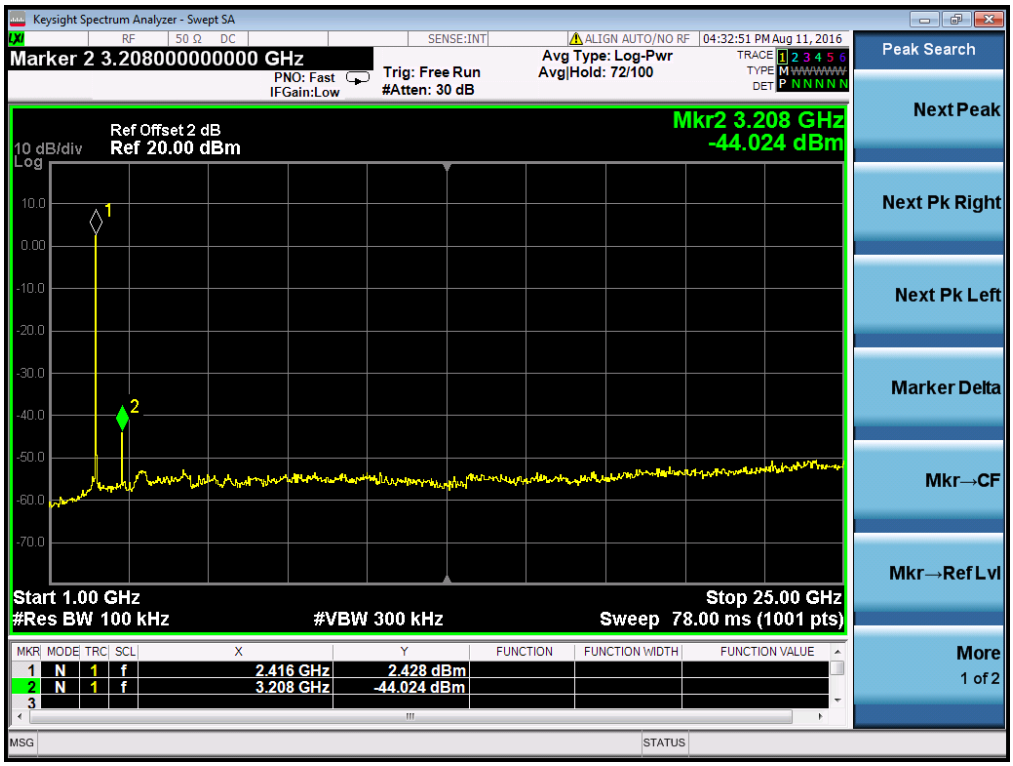
2.4.6. Test Result of Conducted Spurious Emission

NOTE1: Two antenna were tested and found antenna 0 for 802.11b/g/n is the worst mode， the worst results were recorded in this report.

802.11b - Conducted Spurious Emission Plot on channel 1

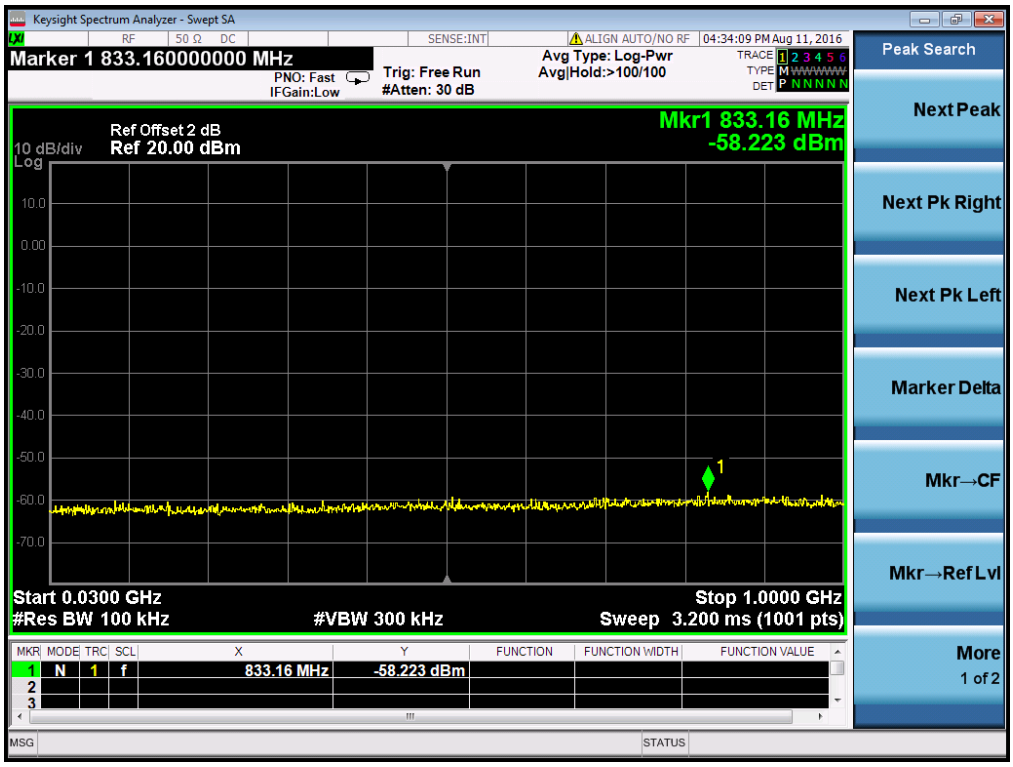


Channel = 1, 30MHz to 1GHz

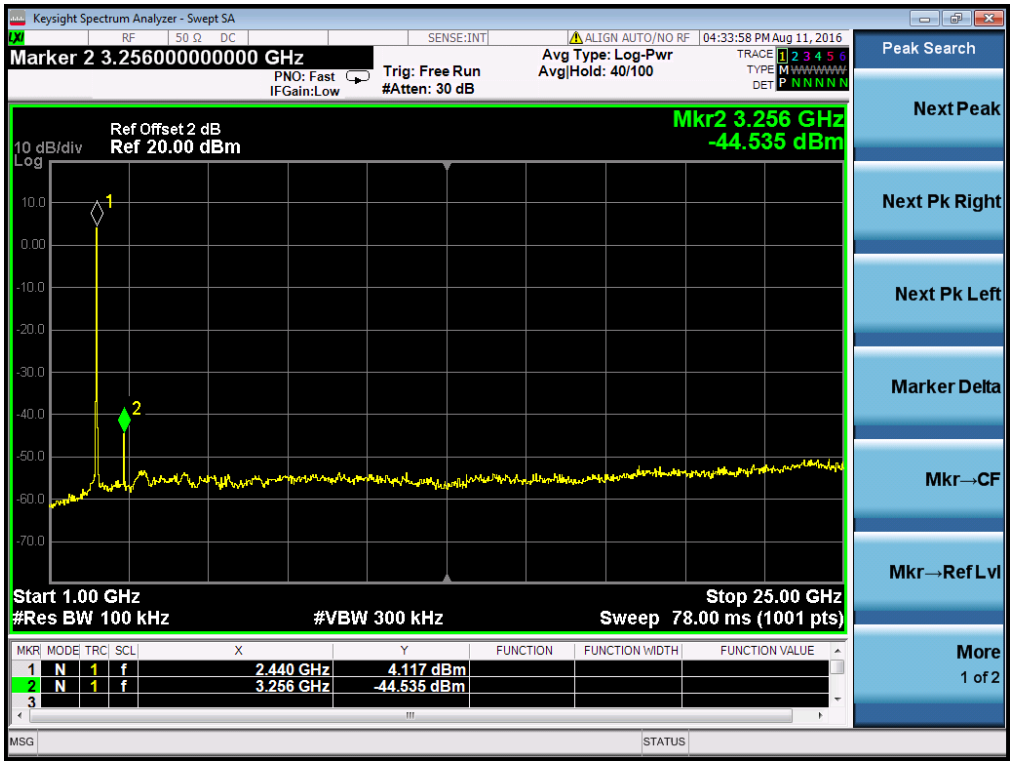


Channel = 1, 1GHz to 25GHz

802.11b - Conducted Spurious Emission Plot on channel 6

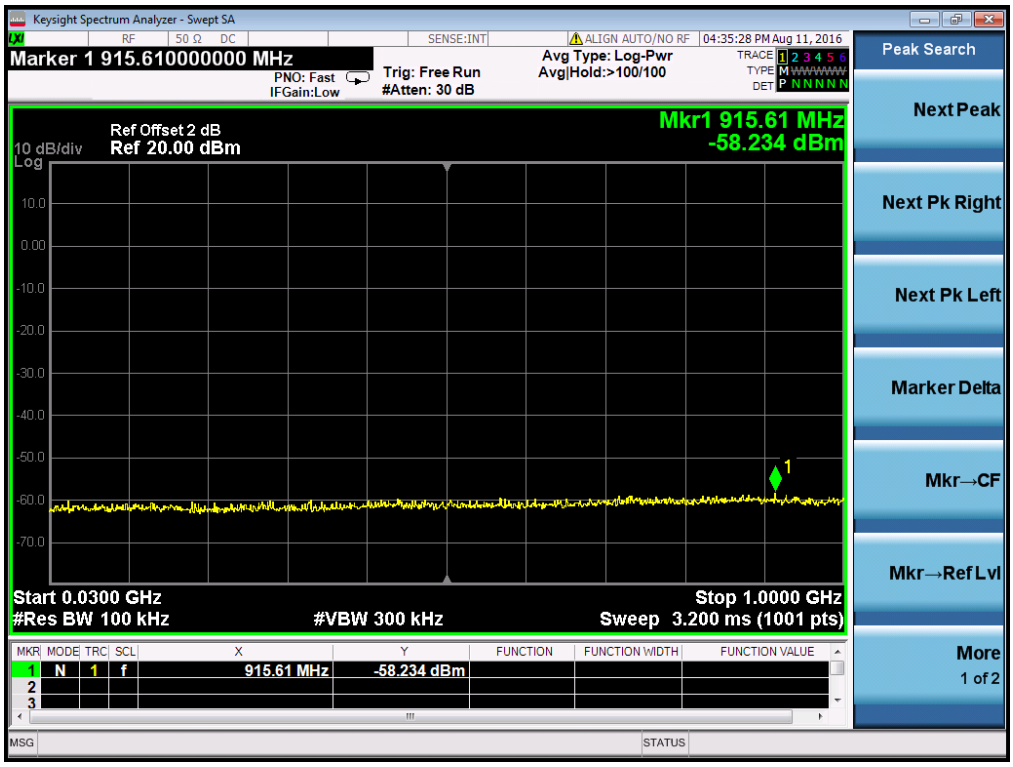


Channel = 6, 30MHz to 1GHz

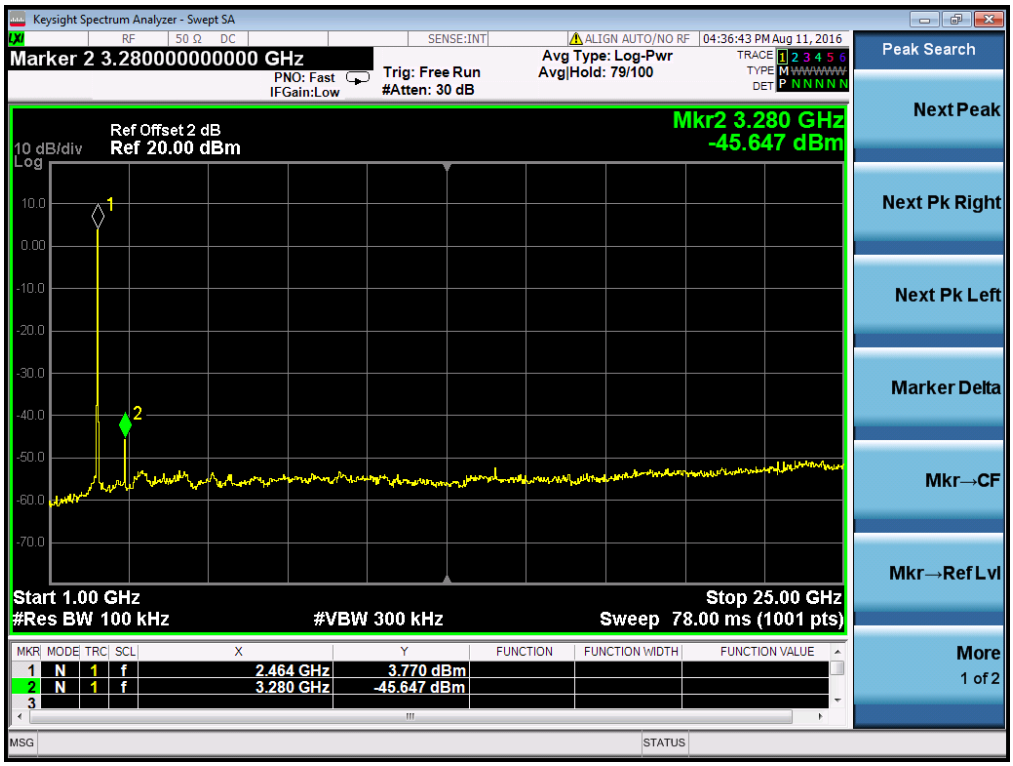


Channel = 6, 1GHz to 25GHz

802.11b - Conducted Spurious Emission Plot on channel 11



Channel = 11, 30MHz to 25GHz



Channel = 11, 30MHz to 25GHz