

FCC Part 15E

Measurement and Test Report

For

ShenZhen Nater Electronics Co., Ltd

**Room 1B25, Block 1, XianJi Building, West of BaoMin Road,
Xixiang, Ban' an, ShenZhen, China**

FCC ID: 2AGKCNT-5572M

FCC Rule(s):	<u>FCC Part 15E</u>
Product Description:	<u>WiFi Module</u>
Tested Model:	<u>WL-UM01EBS-5572-V1.0</u>
Report No.:	<u>STR15108261I-2</u>
Tested Date:	<u>2015-11-02 to 2015-11-21</u>
Issued Date:	<u>2015-11-21</u>
Tested By:	<u>Silin Chen / EMC Manager</u> <i>Silin chen</i>
Reviewed By:	<u>Suan Su / Engineer</u> <i>Susan Su</i>
Approved & Authorized By:	<u>Jandy So / PSQ Manager</u> <i>Jandyso</i>
Prepared By:	Shenzhen SEM.Test Technology Co., Ltd. 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, P.R.C. (518101) Tel.: +86-755-33663308 Fax.: +86-755-33663309 Website: www.semtest.com.cn

Note: This test report is limited to the above client company and the product model only. It may not be duplicated without prior permission by Shenzhen SEM.Test Technology Co., Ltd.

TABLE OF CONTENTS

1. GENERAL INFORMATION	3
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	3
1.2 TEST STANDARDS.....	4
1.3 TEST METHODOLOGY.....	4
1.4 TEST FACILITY	4
1.5 EUT SETUP AND TEST MODE	5
1.6 TEST EQUIPMENT LIST AND DETAILS	5
2. SUMMARY OF TEST RESULTS	6
3. RF EXPOSURE	7
3.1 STANDARD APPLICABLE.....	7
3.2 TEST RESULT.....	7
4. ANTENNA REQUIREMENT	8
4.1 STANDARD APPLICABLE.....	8
4.2 EVALUATION INFORMATION	8
5. POWER SPECTRAL DENSITY	9
5.1 STANDARD APPLICABLE.....	9
5.2 TEST PROCEDURE.....	9
5.3 ENVIRONMENTAL CONDITIONS	10
5.4 SUMMARY OF TEST RESULTS/PLOTS	10
6. EMISSION BANDWIDTH AND OCCUPIED BANDWIDTH.....	24
6.1 STANDARD APPLICABLE.....	24
6.2 TEST PROCEDURE.....	24
6.3 ENVIRONMENTAL CONDITIONS	26
6.4 SUMMARY OF TEST RESULTS/PLOTS	26
7. MAXIMUM CONDUCTED OUTPUT POWER.....	46
7.1 STANDARD APPLICABLE.....	46
7.2 TEST PROCEDURE.....	46
7.3 ENVIRONMENTAL CONDITIONS	47
7.4 SUMMARY OF TEST RESULTS/PLOTS	47
8. CONDUCTED SPURIOUS EMISSIONS	61
8.1 STANDARD APPLICABLE.....	61
8.2 TEST PROCEDURE.....	61
8.3 ENVIRONMENTAL CONDITIONS	61
8.4 SUMMARY OF TEST RESULTS/PLOTS	61
9. RADIATED SPURIOUS EMISSIONS.....	86
9.1 MEASUREMENT UNCERTAINTY	86
9.2 STANDARD APPLICABLE.....	86
9.3 TEST PROCEDURE.....	86
9.4 TEST RECEIVER SETUP	87
9.5 CORRECTED AMPLITUDE & MARGIN CALCULATION.....	87
9.6 ENVIRONMENTAL CONDITIONS	87
9.7 SUMMARY OF TEST RESULTS/PLOTS	87
10. FREQUENCY STABILITY	148
10.1 STANDARD APPLICABLE.....	148
10.2 TEST PROCEDURE.....	148
10.3 ENVIRONMENTAL CONDITIONS	149
10.4 SUMMARY OF TEST RESULTS/PLOTS	149

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: Shenzhen Nater Electronics Co., Ltd
Address of applicant: Room 1B25, Block 1, XianJi Building, West of BaoMin Road, Xixiang, Ban'an, ShenZhen, China

Manufacturer: Shenzhen Nater Electronics Co., Ltd
Address of manufacturer: Room 1B25, Block 1, XianJi Building, West of BaoMin Road, Xixiang, Ban'an, ShenZhen, China

General Description of EUT	
Product Name:	WiFi Module
Trade Name:	Nater
Model No.:	WL-UM01EBS-5572-V1.0
Adding Model(s):	/
Rated Voltage:	DC 3.3V
<i>Note: The test data is gathered from a production sample provided by the manufacturer.</i>	

Technical Characteristics of EUT	
Wi-Fi(5G/5.8G)	
Support Standards:	802.11n(HT20,HT40)
Frequency Range:	5180-5240MHz, 5745-5825MHz
RF Output Power:	8.13dBm (Conducted)
Type of Modulation:	OFDM, 64-QAM, 16-QAM, QPSK, BPSK, 256-QAM
Data Rate:	6-54Mbps, up to 300Mbps
Quantity of Channels:	4 for 5180-5240MHz; 5 for 5745-5825MHz
Channel Separation:	20MHz/40MHz
Type of Antenna:	Integral Antenna
Antenna Gain:	Antenna 1:2.4dBi, Antenna 2:2.4dBi

1.2 Test Standards

The following report is prepared on behalf of the ShenZhen Nater Electronics Co., Ltd in accordance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.407 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.407 of the Federal Communication Commissions rules.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. The measurement guide KDB 789033 D02 v01 for Unlicensed National Information Infrastructure (U-NII) Devices and KDB 662911 D01 Multiple Transmitter Output v02r01 shall be performed also.

1.4 Test Facility

FCC – Registration No.: 934118

Shenzhen SEM.Test Technology 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 and the Registration is 934118.

Industry Canada (IC) Registration No.: 11464A

The 3m Semi-anechoic chamber of Shenzhen SEM.Test Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

CNAS Registration No.: L4062

Shenzhen SEM.Test Technology Co., Ltd. is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L4062. All measurement facilities used to collect the measurement data are located at 1/F, Building A, Hongwei Industrial Park, Liuxian 2nd Road, Bao'an District, Shenzhen, P.R.C (518101).

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List			
Test Mode	Description	Remark	
TM1	802.11n-HT20	5180MHz, 5200MHz, 5240MHz, 5745MHz, 5785MHz, 5825MHz	
TM2	802.11n-HT40	5180MHz, 5200MHz, 5220MHz, 5745MHz, 5785MHz, 5825MHz	

EUT Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Core
/	/	/	/

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
DC Cable	1.0	Unshielded	Without Core

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
/	/	/	/

1.6 Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Cal Date	Due Date
Spectrum Analyzer	Agilent	E4407B	MY41440400	2015-06-17	2016-06-16
Spectrum Analyzer	Rohde & Schwarz	FSP	836079/035	2015-06-17	2016-06-16
EMI Test Receiver	Rohde & Schwarz	ESVB	825471/005	2015-06-17	2016-06-16
Amplifier	Agilent	8447F	3113A06717	2015-06-17	2016-06-16
Amplifier	C&D	PAP-1G18	2002	2015-06-17	2016-06-16
Broadband Antenna	Schwarz beck	VULB9163	9163-333	2015-06-17	2016-06-16
Horn Antenna	ETS	3117	00086197	2015-06-17	2016-06-16
Horn Antenna	ETS	3116B	00088203	2015-06-17	2016-06-16
Loop Antenna	Schwarz beck	FMZB 1516	9773	2015-06-17	2016-06-16
EMI Test Receiver	Rohde & Schwarz	ESPI	101611	2015-06-17	2016-06-16
L.I.S.N	Schwarz beck	NSLK8126	8126-224	2015-06-17	2016-06-16
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100911	2015-06-17	2016-06-16

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 15.203; § 15.405	Antenna Requirement	Compliant
§ 15.207; § 15.407(b)(6)	Conducted Emission	Compliant
§ 15.407(a)(1),(2)	Power Spectral Density	Compliant
§ 15.407(e)	Emission Bandwidth and Occupied Bandwidth	Compliant
§ 15.407(a)(1),(2)	Maximum Conducted Output Power	Compliant
§ 15.407(b)(1),(2),(3)	Conducted Spurious Emission	Compliant
§ 15.205; § 15.407(b)(1),(2),(3)	Radiated Emission	Compliant
§ 15.407(g)	Frequency Stability	Compliant
§ 15.407(h)	Dynamic Frequency Selection (DFS)	N/A

N/A: not applicable

3. RF Exposure

3.1 Standard Applicable

According to § 1.1307 and § 2.1093, the portable transmitter must comply the RF exposure requirements.

3.2 Test Result

This product complied with the requirement of the RF exposure, please see the RF Exposure Report.

4. Antenna Requirement

4.1 Standard Applicable

According to FCC Part 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.

4.2 Evaluation Information

This product has two integral antennas, fulfill the requirement of this section.

5. Power Spectral Density

5.1 Standard Applicable

Section 15.407(a) Power limits:

(1) For the band 5.15-5.25 GHz.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

5.2 Test Procedure

According to 789033 D02 v01 section F, the following is the measurement procedure.

For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 KHz bandwidth, the following adjustments to the procedures apply:

- a) Set RBW $\geq 1/T$, where T is defined in section II.B.1.a).
- b) Set VBW ≥ 3 RBW.
- c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10\log(500\text{kHz}/\text{RBW})$ to the measured result, whereas RBW (< 500 KHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
- d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add $10\log(1\text{MHz}/\text{RBW})$ to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.
- e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Note: As a practical matter, it is recommended to use reduced RBW of 100 KHz for the sections 5.c) and 5.d) above, since RBW=100 KHZ is available on nearly all spectrum analyzers.

5.3 Environmental Conditions

Temperature:	20° C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

5.4 Summary of Test Results/Plots

5150-5250MHz

Operating mode	Test Channel	Chain 1 dBm/MHz	Chain 2 dBm/MHz	Total dBm/MHz	Limit (dBm/MHz)
802.11n-HT20	5180	1.677	-0.733	3.65	11
	5200	0.116	-1.747	2.29	11
	5240	-0.725	-2.829	1.36	11
802.11n-HT40	5180	-2.459	-4.986	-0.53	11
	5200	-3.606	-5.502	-1.44	11
	5220	-3.806	-5.592	-1.60	11

5725-5850MHz

Operating mode	Test Channel	Chain 1 dBm/500kHz	Chain 2 dBm/500kHz	Total dBm/500kHz	Limit (dBm/500kHz)
802.11n-HT20	5745	-0.407	-2.895	1.54	30
	5785	0.000	-3.481	1.61	30
	5825	-2.088	-5.137	-0.34	30
802.11n-HT40	5745	-2.605	-4.306	-0.36	30
	5785	-4.210	-7.002	-2.38	30
	5825	-4.011	-5.710	-1.77	30

Note: If measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10\log(500\text{kHz}/\text{RBW})$ to the measured result, whereas RBW (< 500 KHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.

Antenna 1

Test Mode: 802.11n-HT20

5180MHz



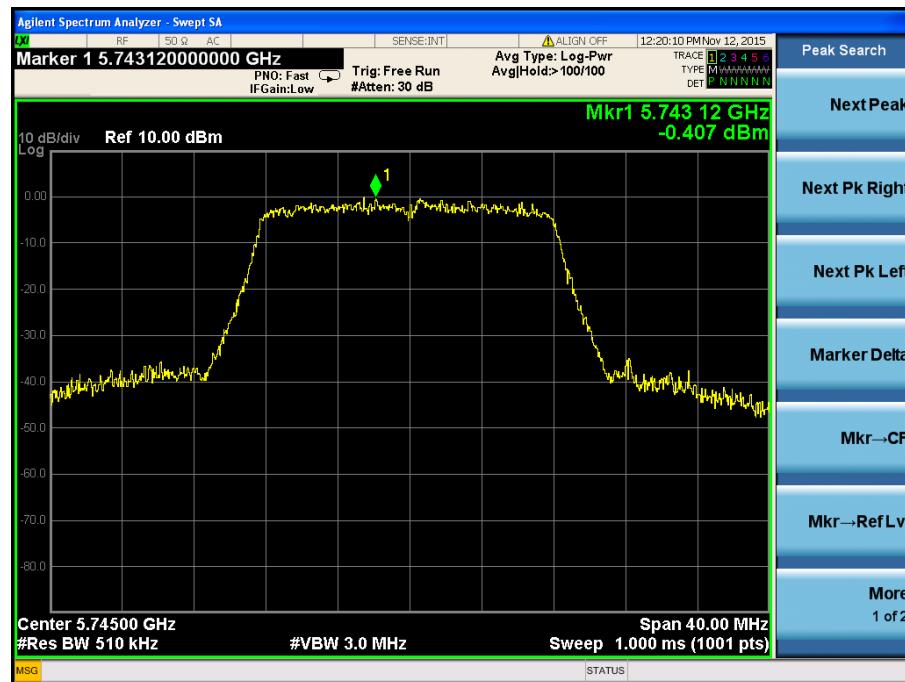
5200MHz



5240MHz



5745MHz



5785MHz



5825MHz

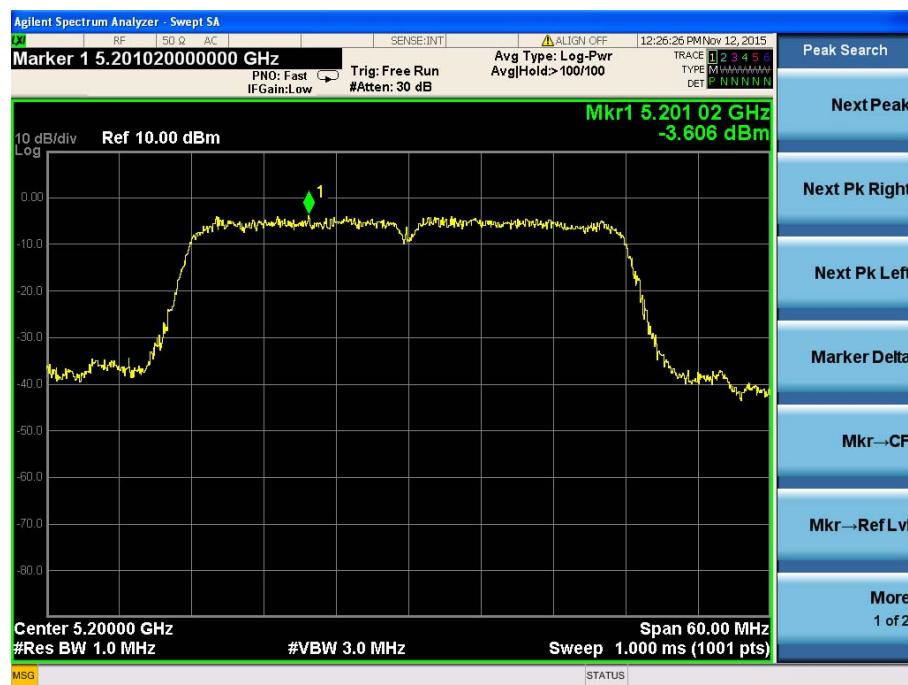


Test Mode: 802.11n-HT40

5180MHz



5200MHz



5220MHz



5745MHz



5785MHz



5825MHz



Antenna 2

Test Mode: 802.11n-HT20

5180MHz



5200MHz



5240MHz



5745MHz



5785MHz



5825MHz



Test Mode: 802.11n-HT40

5180MHz



5200MHz



5220MHz



5745MHz



5785MHz



5825MHz



6. Emission Bandwidth and Occupied Bandwidth

6.1 Standard Applicable

According to 15.407 (a) and (e)

(1) For the band 5.15-5.25 GHz.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(e) Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

6.2 Test Procedure

According to 789033 D02 v01 section C&D, the following is the measurement procedure.

1. Emission Bandwidth (EBW)

- a) Set RBW = approximately 1% of the emission bandwidth.
- b) Set the VBW > RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare

this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

2. Minimum Emission Bandwidth for the band 5.725-5.85 GHz

Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for the band 5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:

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

g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

D. 99 Percent Occupied Bandwidth

The 99-percent occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5 % of the total mean power of the given emission.

Measurement of the 99-percent occupied bandwidth is required only as a condition for using the optional band-edge measurement techniques described in section II.G.3.d). Measurements of 99-percent occupied bandwidth may also optionally be used in lieu of the EBW to 789033 D02 General UNII Test Procedures New Rules v01 define the minimum frequency range over which the spectrum is integrated when measuring maximum conducted output power as described in section II.E. However, the EBW must be measured to determine bandwidth dependent limits on maximum conducted output power in accordance with 15.407(a).

The following procedure shall be used for measuring (99 %) power bandwidth:

1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1 % to 5 % of the OBW
4. Set VBW $\geq 3 \cdot$ RBW
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6. Use the 99 % power bandwidth function of the instrument (if available).
7. If the instrument does not have a 99 % power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5 % of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

6.3 Environmental Conditions

Temperature:	24° C
Relative Humidity:	53%
ATM Pressure:	1018 mbar

6.4 Summary of Test Results/Plots

Antenna 1

5150-5250MHz

Test Mode	Test Channel MHz	26 dB Bandwidth MHz	99% Bandwidth MHz	Limit MHz
802.11n-HT20	5180	18.78	16.405	--
	5200	18.80	16.392	--
	5240	18.84	16.407	--
802.11n-HT40	5180	39.46	36.032	--
	5200	39.60	35.838	--
	5220	39.24	35.998	--

5725-5850MHz

Test Mode	Test Channel MHz	26 dB Bandwidth MHz	6 dB Bandwidth MHz	99% Bandwidth MHz	Limit kHz
802.11n-HT20	5745	18.73	16.39	16.361	≥500
	5785	19.14	16.38	16.387	≥500
	5825	18.70	16.40	16.383	≥500
802.11n-HT40	5745	39.31	35.45	36.010	≥500
	5785	38.68	35.91	35.972	≥500
	5825	39.21	36.25	36.100	≥500

Antenna 2
5150-5250MHz

Test Mode	Test Channel MHz	26 dB Bandwidth MHz	99% Bandwidth MHz	Limit MHz
802.11n-HT20	5180	19.02	16.387	--
	5200	18.80	16.366	--
	5240	18.96	16.385	--
802.11n-HT40	5180	38.96	35.958	--
	5200	39.51	35.282	--
	5220	39.35	35.982	--

5725-5850MHz

Test Mode	Test Channel MHz	26 dB Bandwidth MHz	6 dB Bandwidth MHz	99% Bandwidth MHz	Limit kHz
802.11n-HT20	5745	19.06	16.48	16.381	≥500
	5785	18.78	16.43	16.378	≥500
	5825	18.86	16.38	16.381	≥500
802.11n-HT40	5745	39.26	35.45	35.925	≥500
	5785	39.31	35.42	35.984	≥500
	5825	39.01	35.28	35.864	≥500

Antenna 1

Test mode: 802.11n-HT20

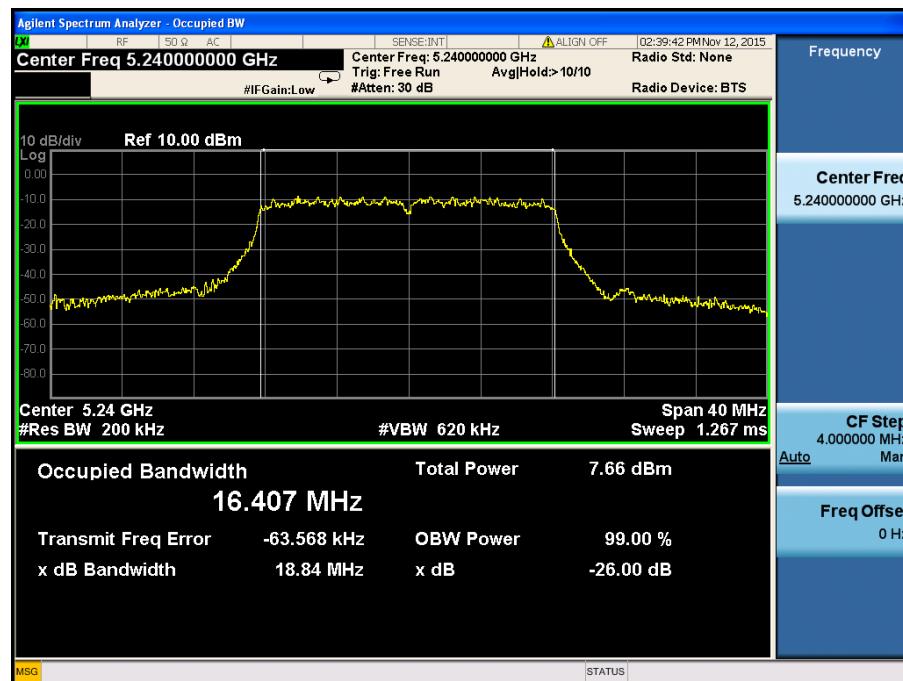
5180MHz



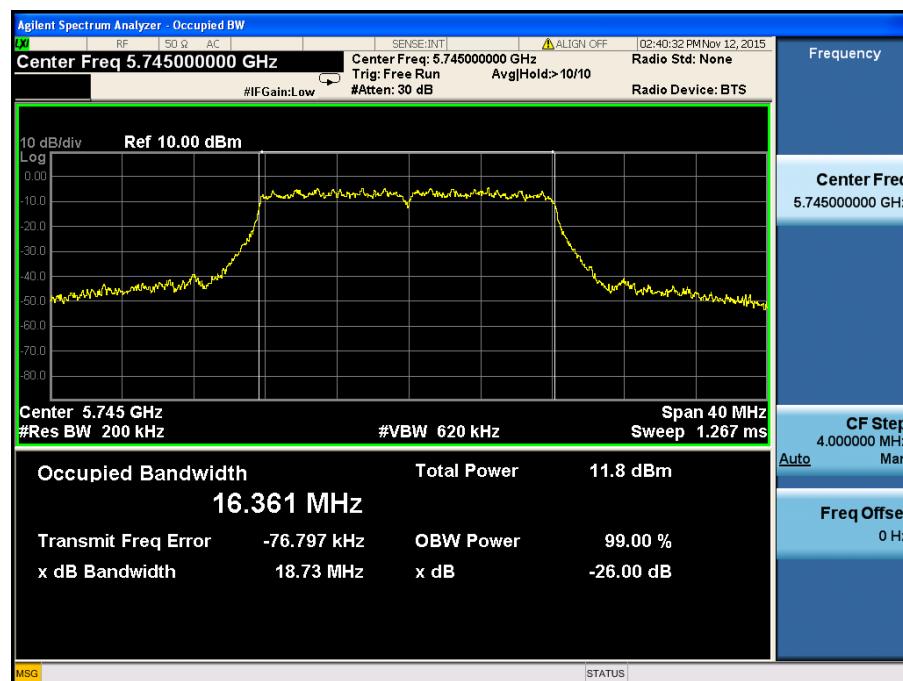
5200MHz



5240MHz

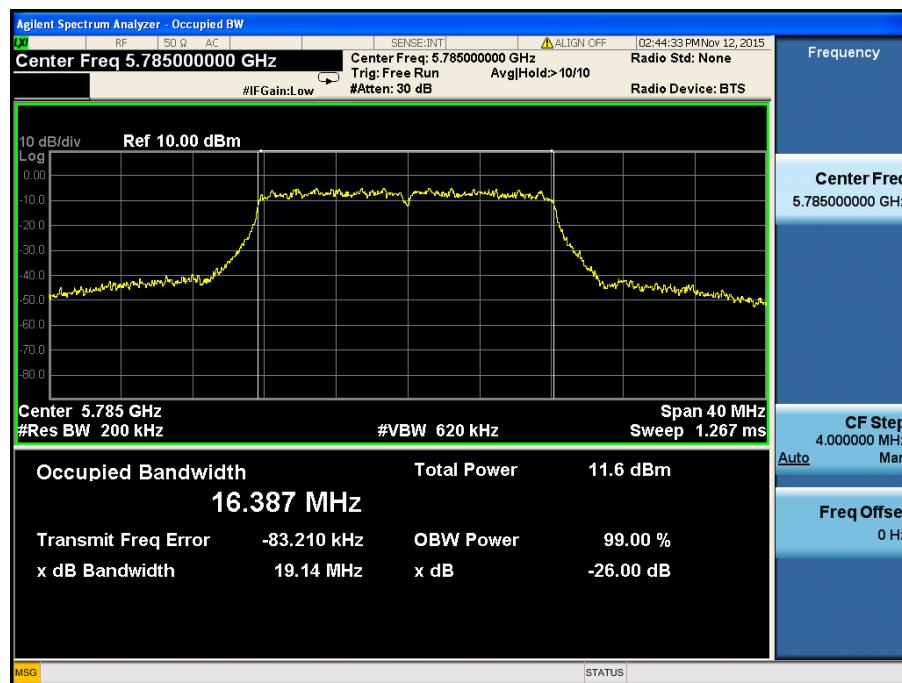


5745MHz



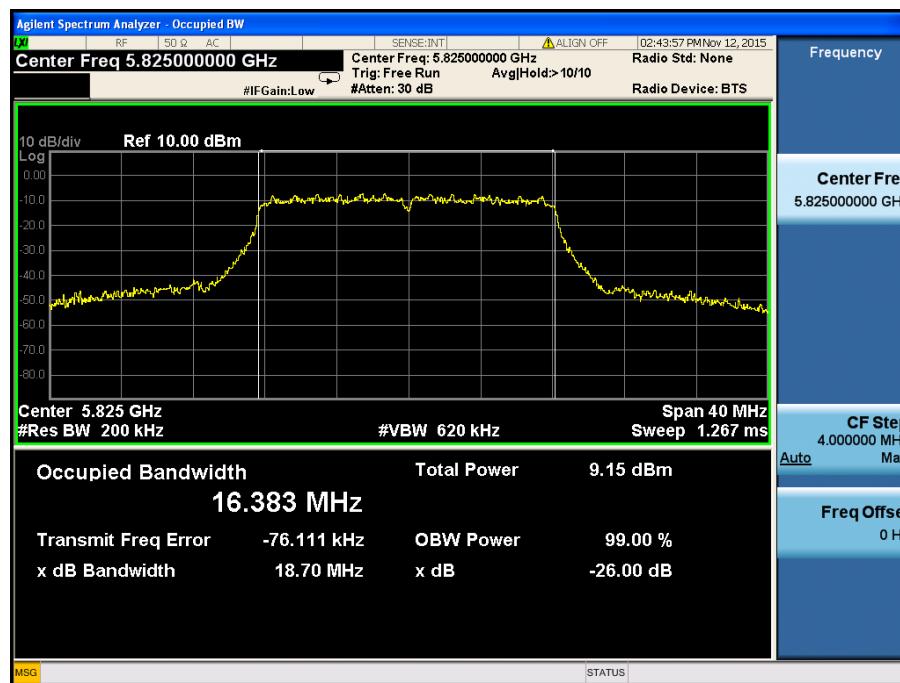


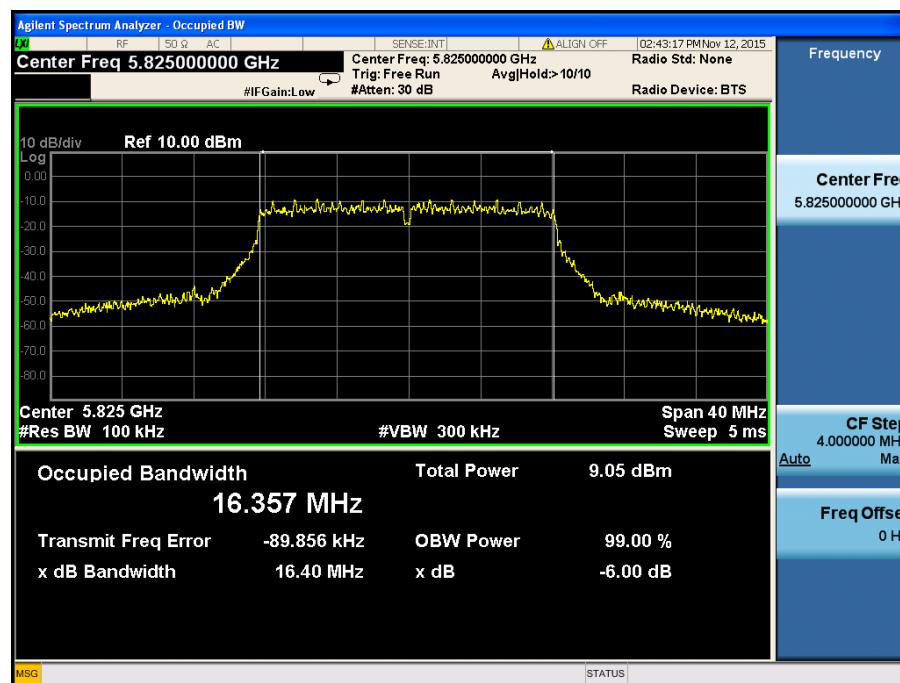
5785MHz





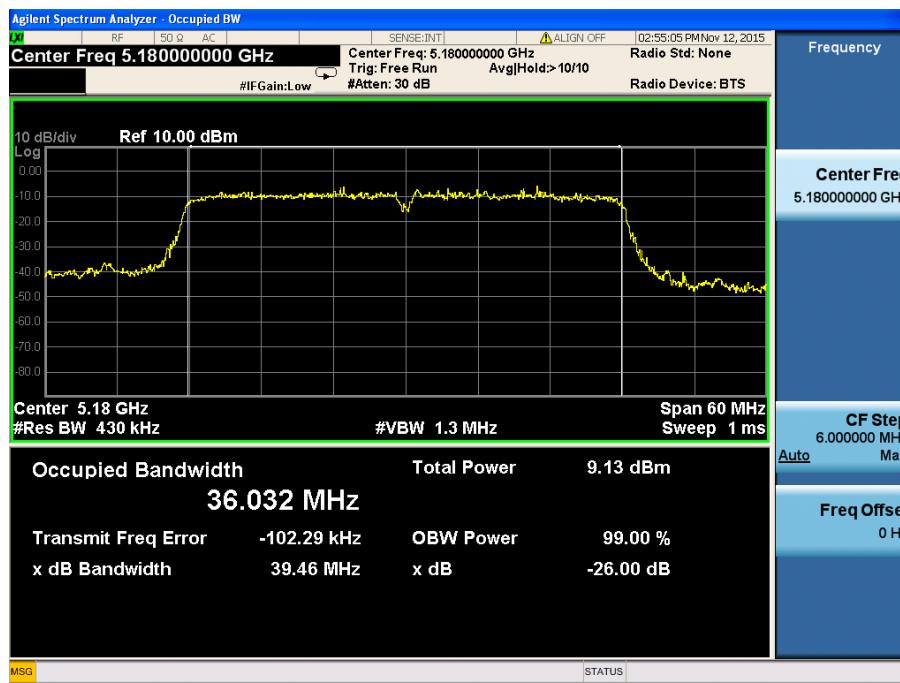
5825MHz



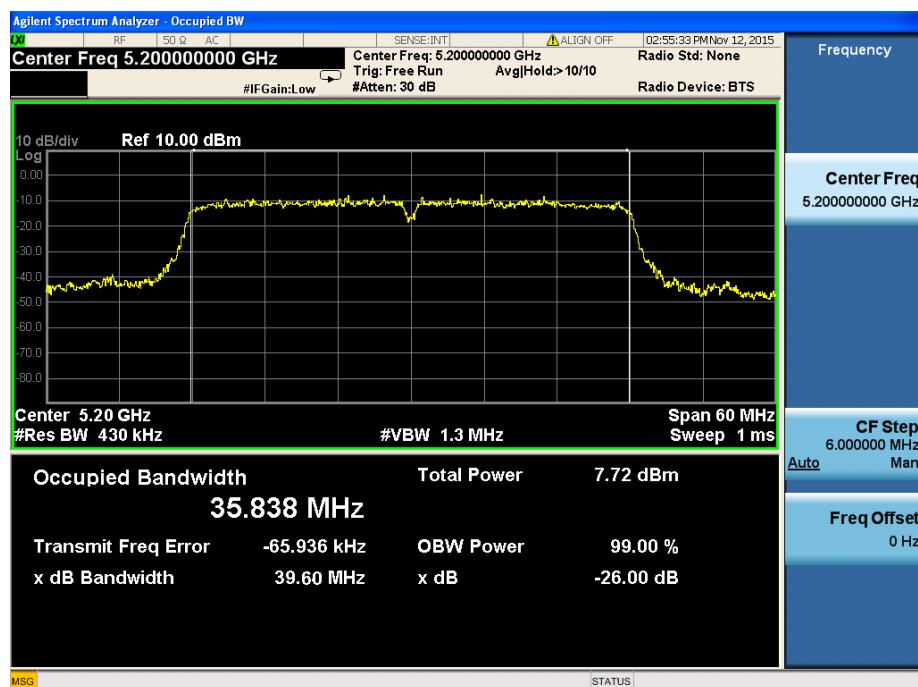


Test mode: 802.11n-HT40

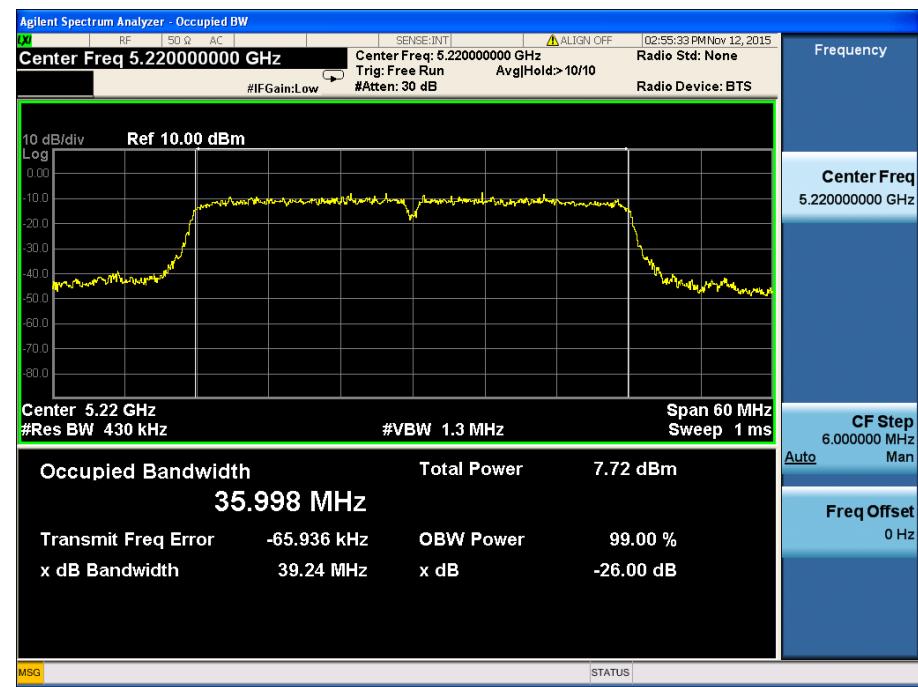
5180MHz



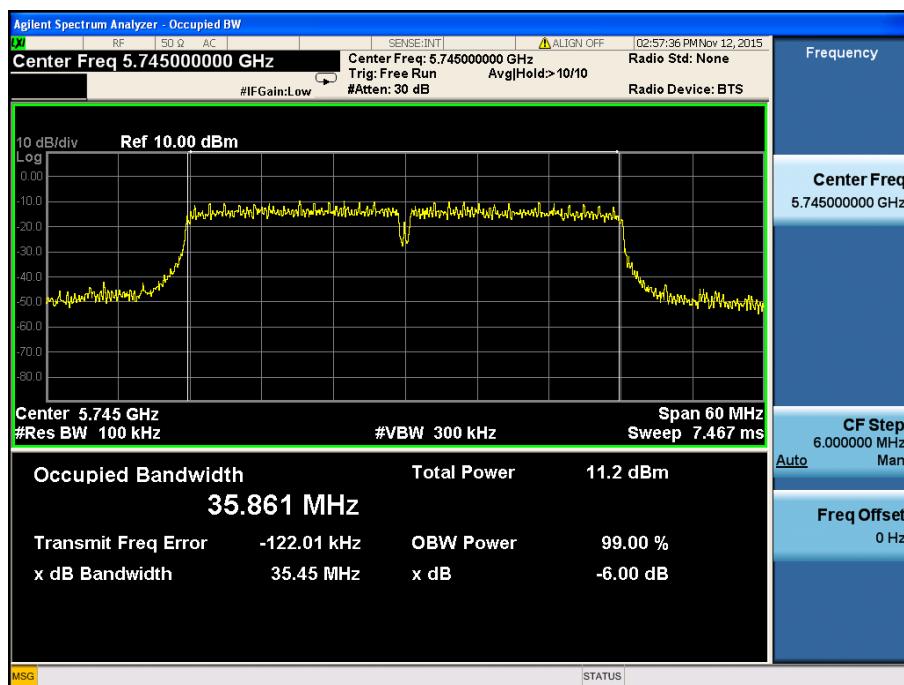
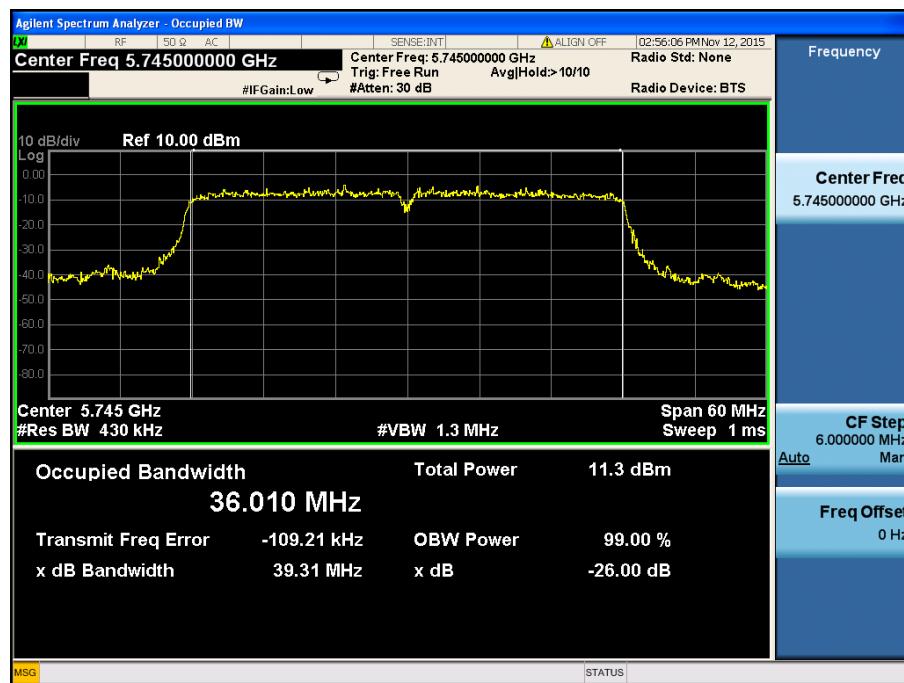
5200MHz



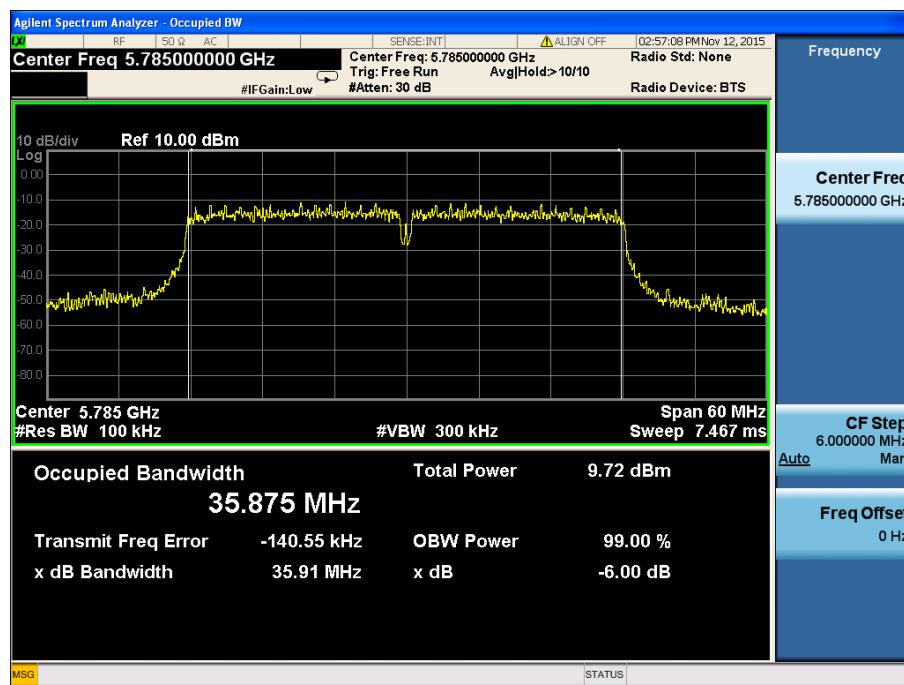
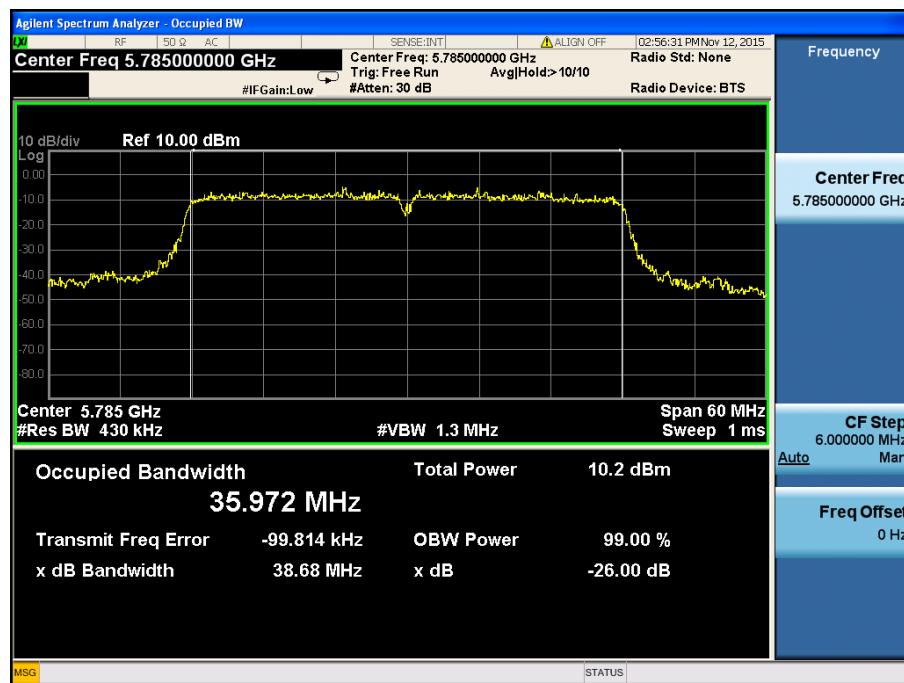
5220MHz



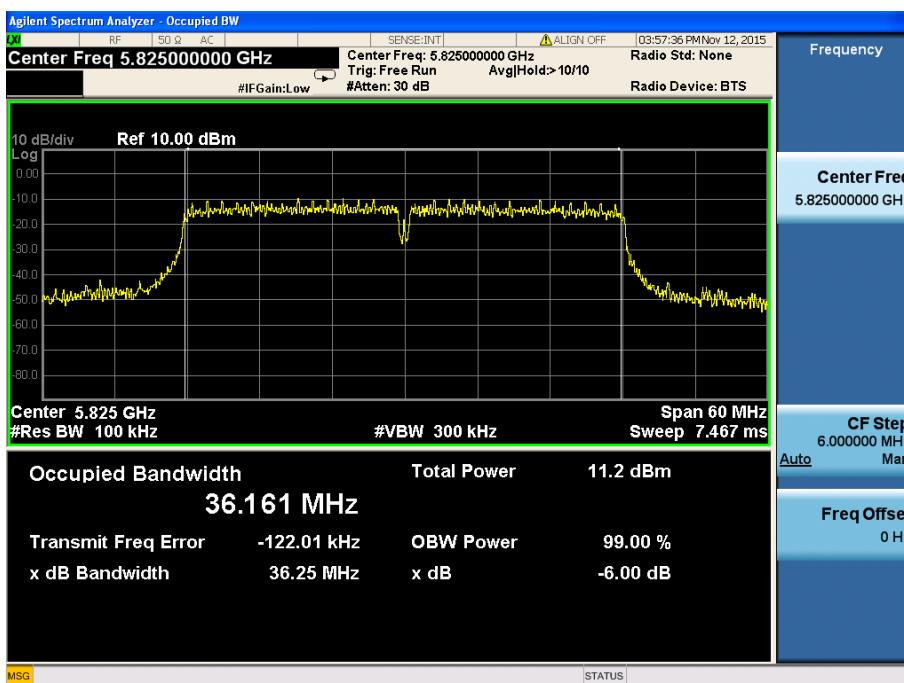
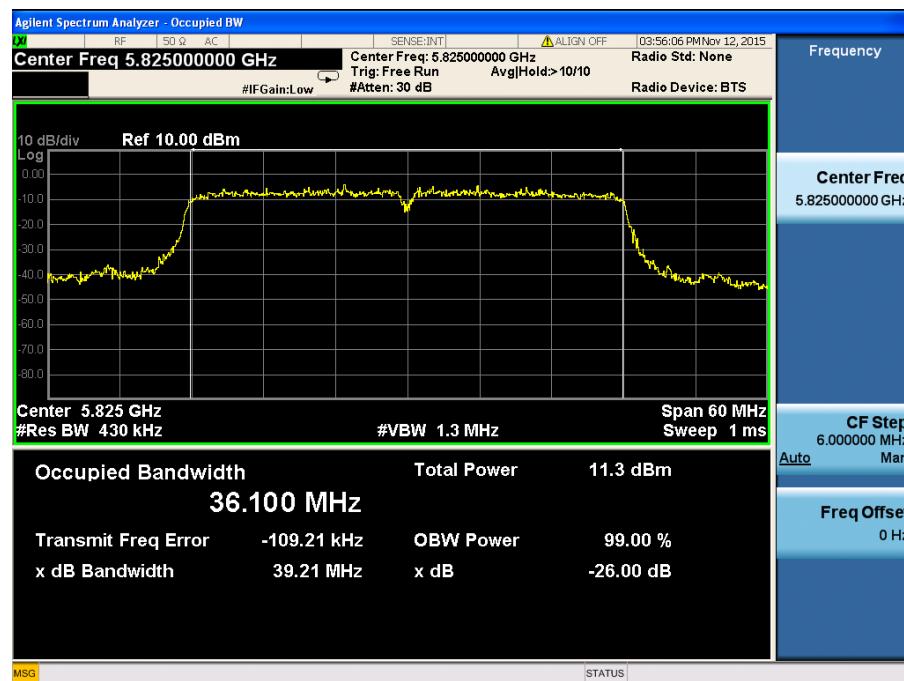
5745MHz



5785MHz



5825MHz



Antenna 2

Test mode: 802.11n-HT20

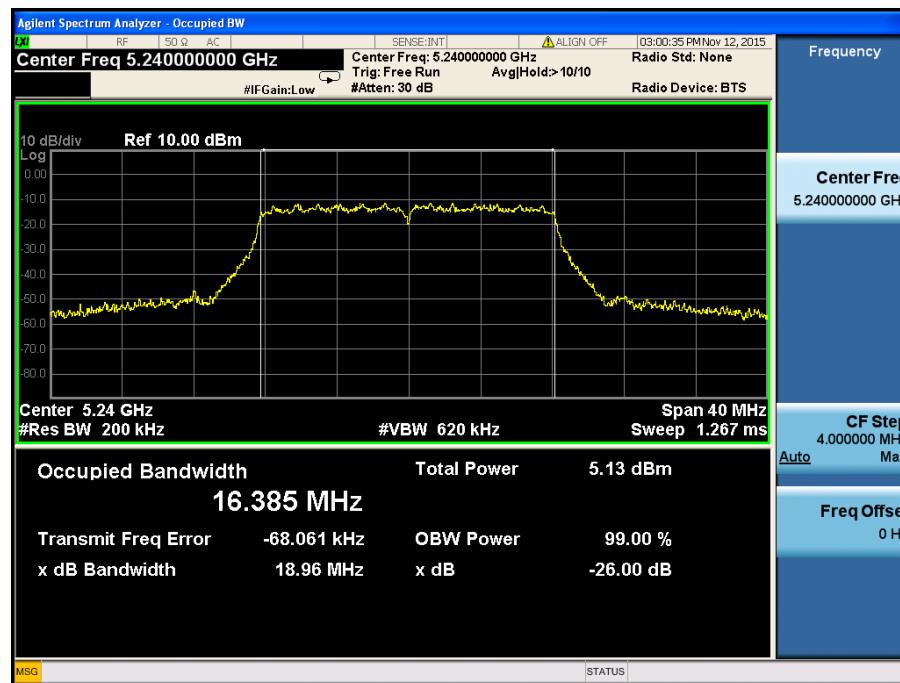
5180MHz



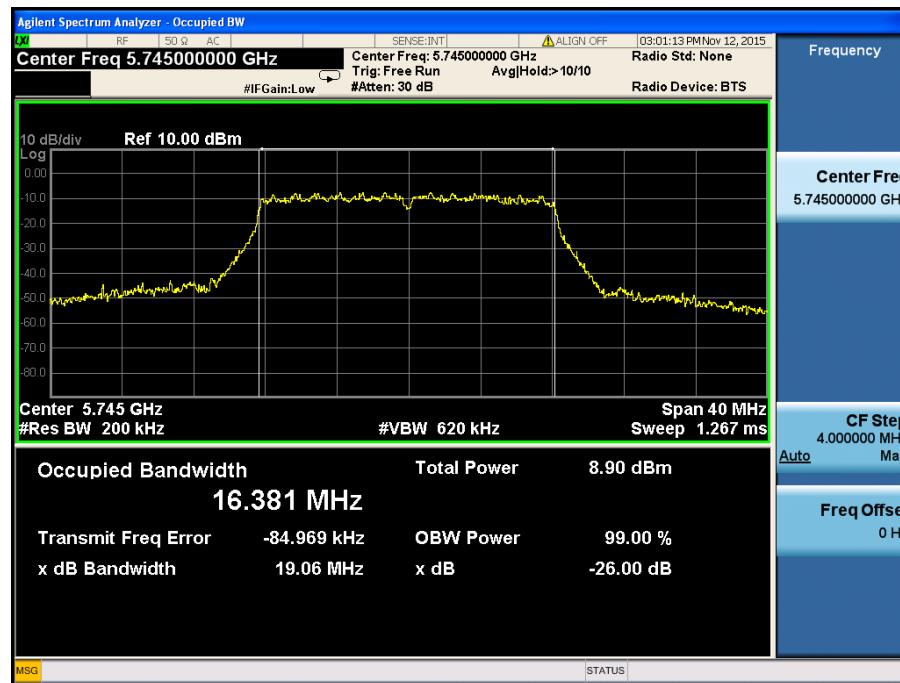
5200MHz

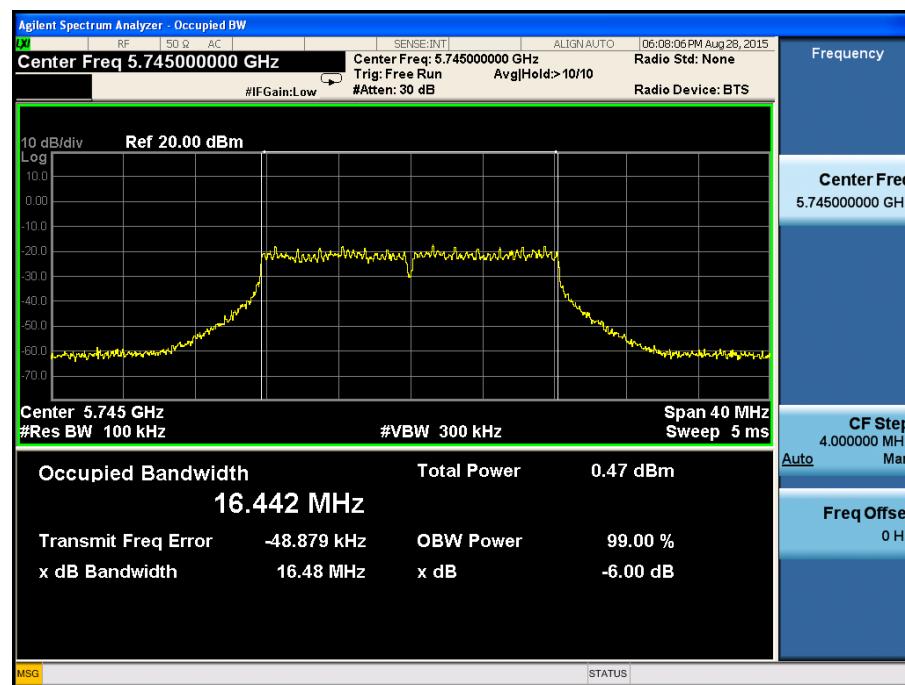


5240MHz

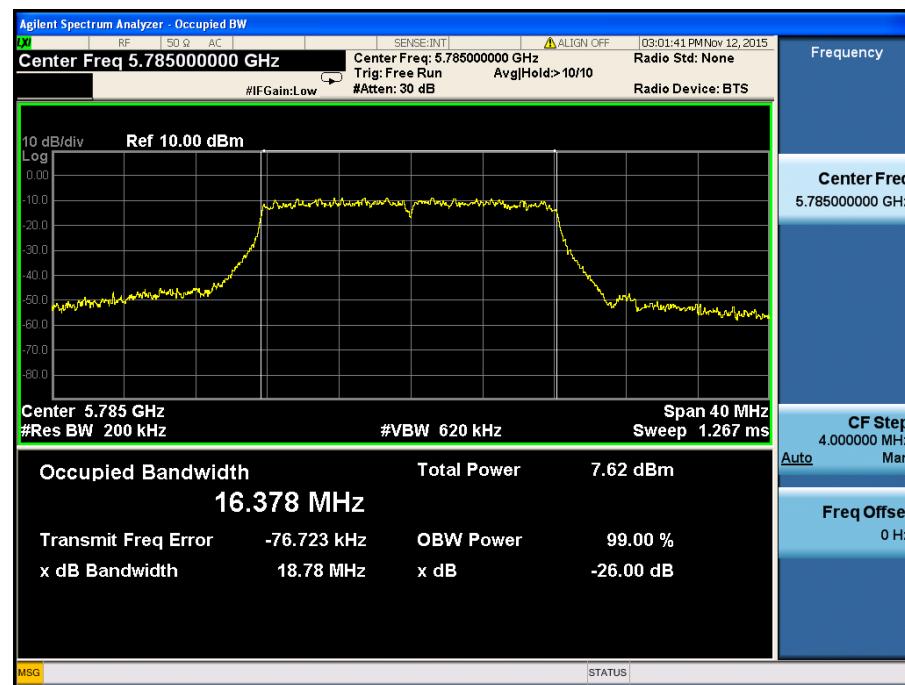


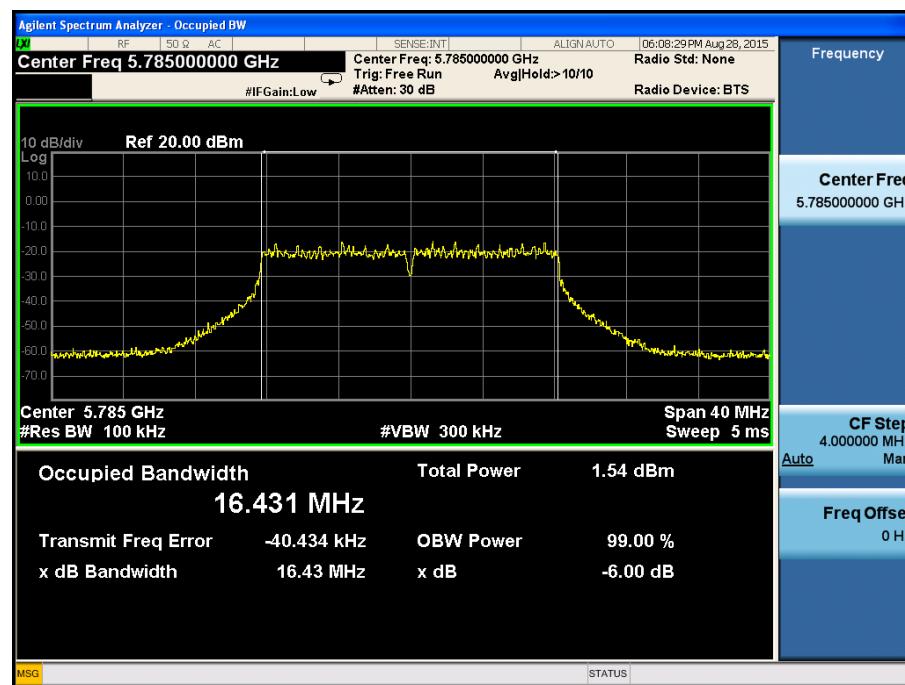
5745MHz



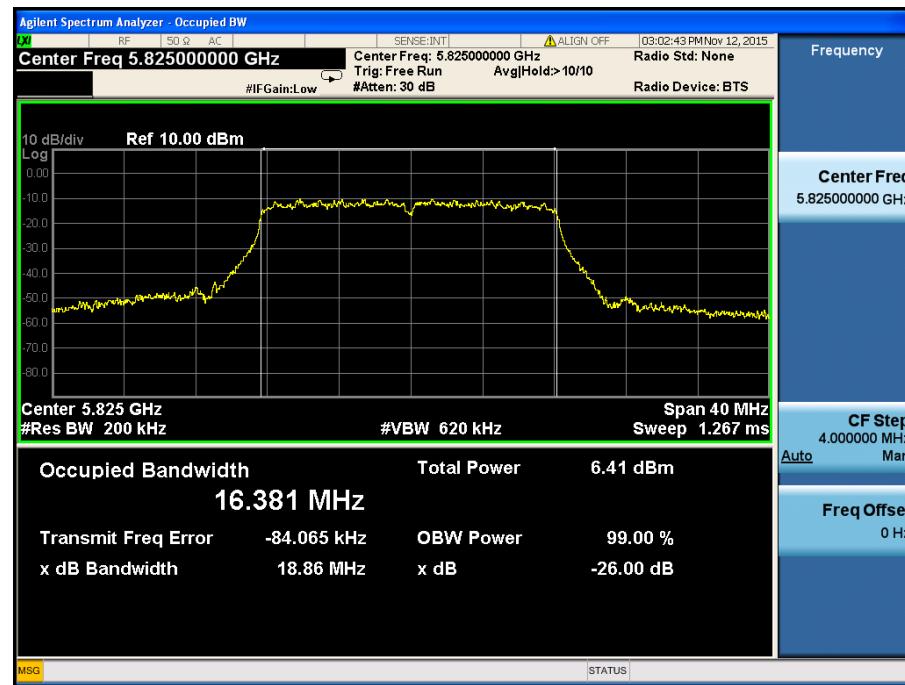


5785MHz





5825MHz





Test mode: 802.11n-HT40

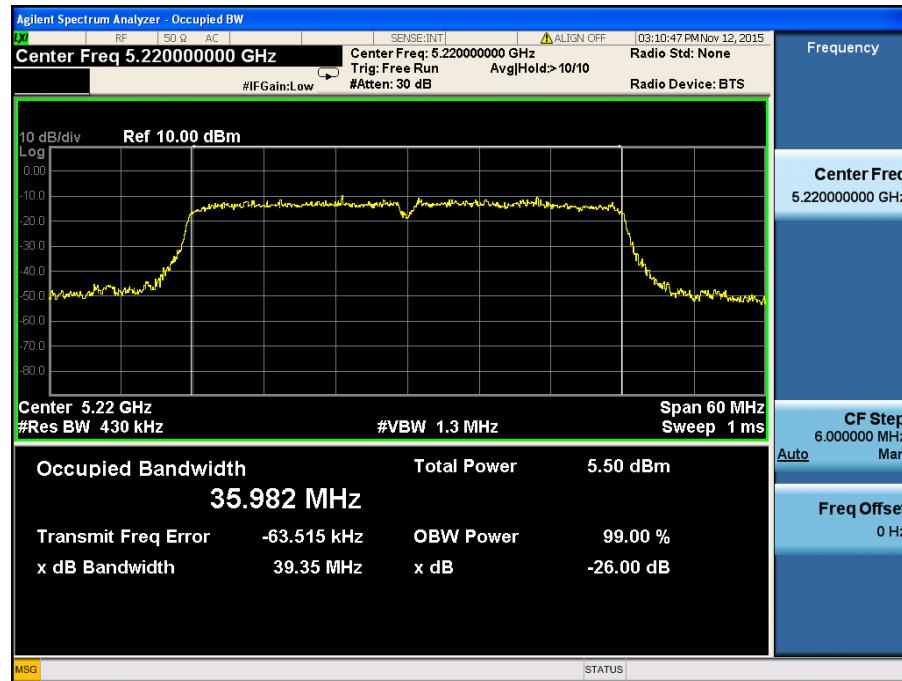
5180MHz



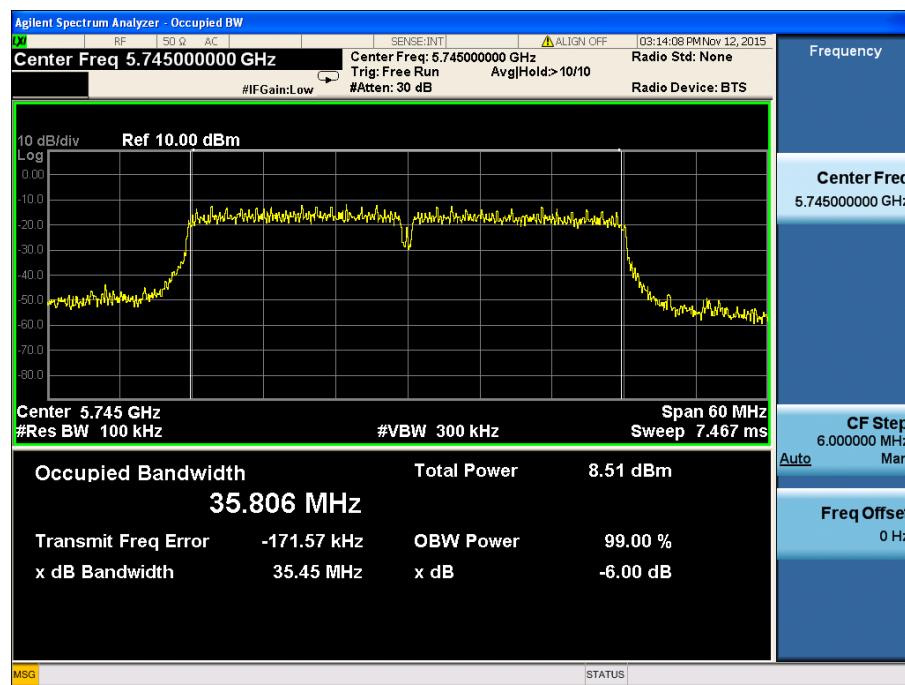
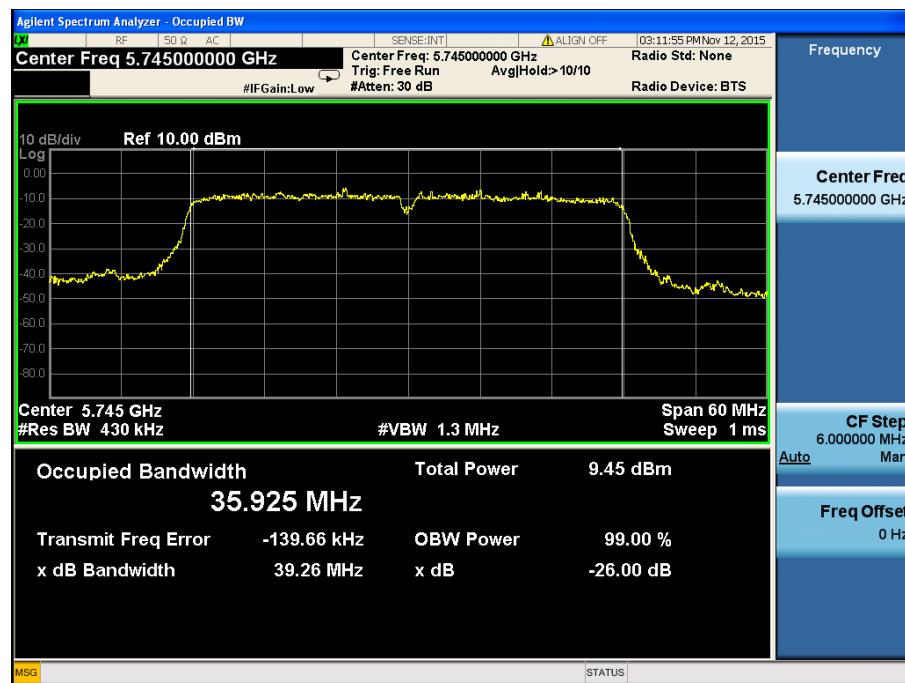
5200MHz



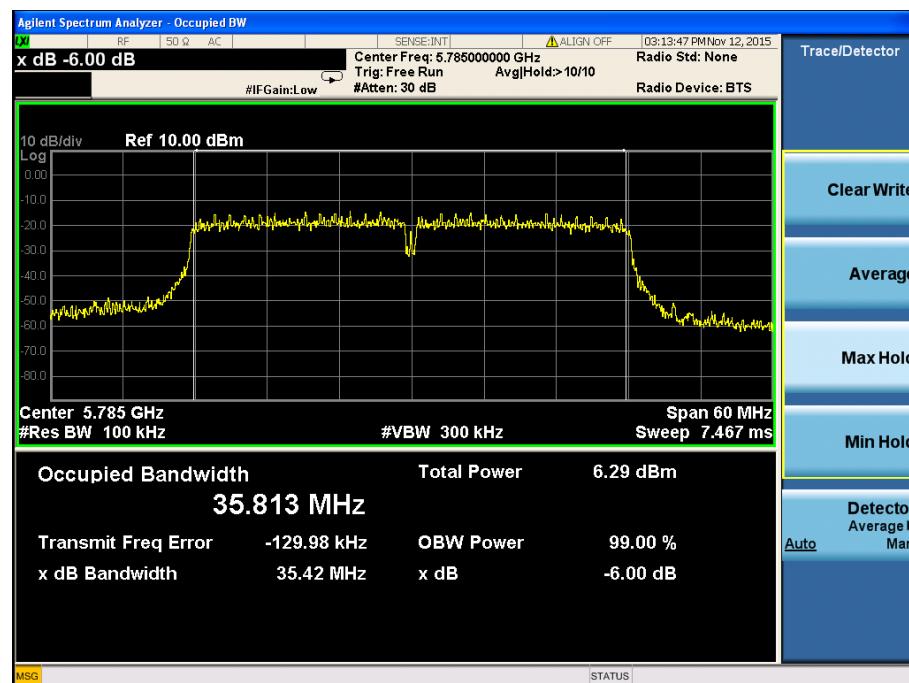
5220MHz



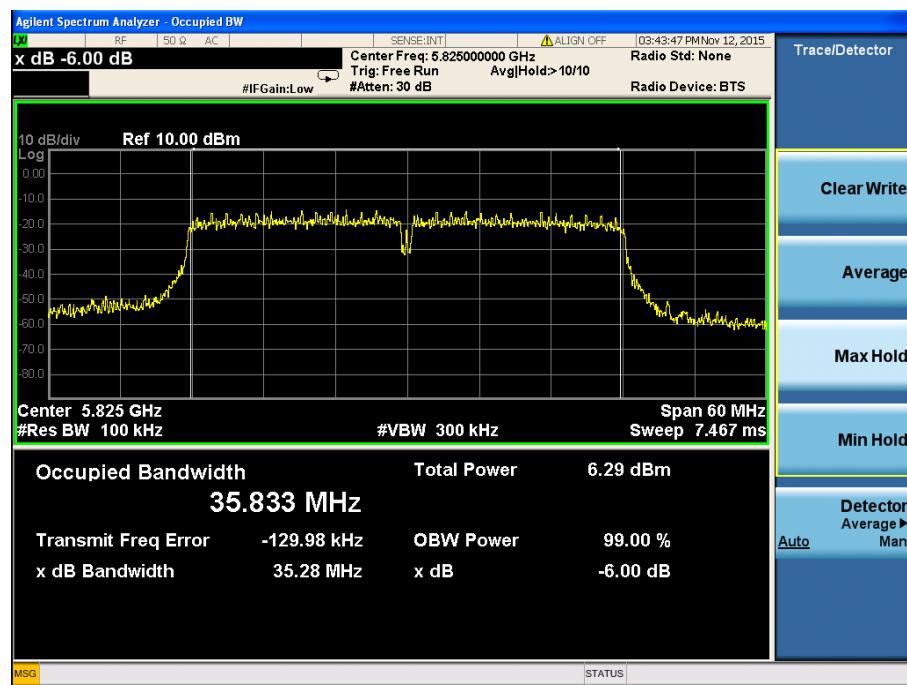
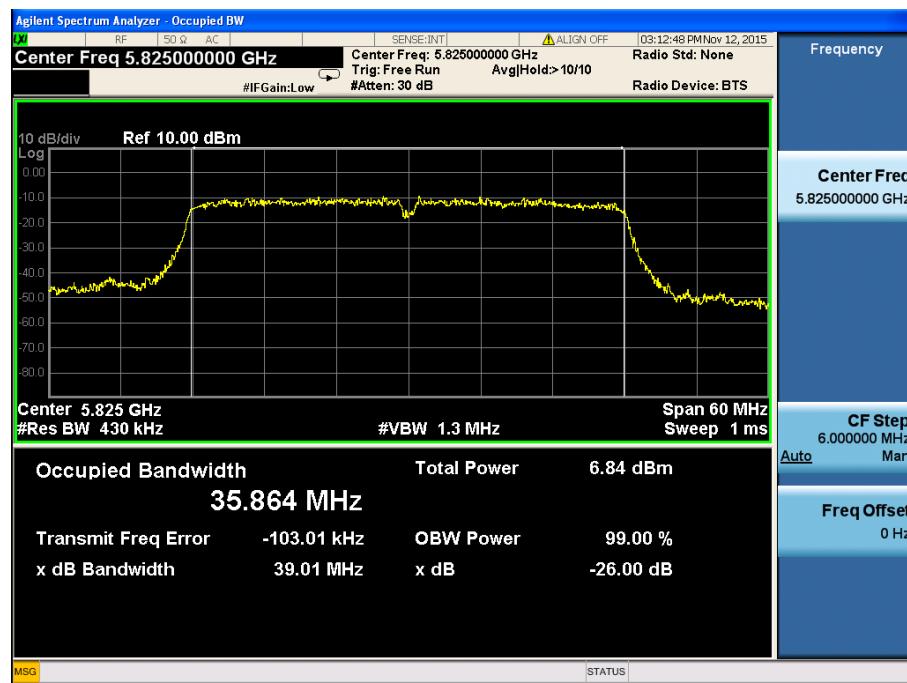
5745MHz



5785MHz



5825MHz



7. Maximum Conducted Output Power

7.1 Standard Applicable

According to 15.407(a) Power limits:

(1) For the band 5.15-5.25 GHz.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

7.2 Test Procedure

According to KDB789033 D02 v01 section E, the following is the measurement procedure.

(i) Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal.

(ii) Set RBW = 1 MHz.

(iii) Set VBW \geq 3 MHz.

(iv) Number of points in sweep \geq 2 Span / RBW. (This ensures that bin-to-bin spacing is \leq RBW/2, so that narrowband signals are not lost between frequency bins.)

(v) Sweep time = auto.

- (vi) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- (vii) If transmit duty cycle < 98 percent, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle \geq 98 percent, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run”.
- (viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
- (ix) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument’s band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the spectrum.

7.3 Environmental Conditions

Temperature:	26° C
Relative Humidity:	65%
ATM Pressure:	1011 mbar

7.4 Summary of Test Results/Plots

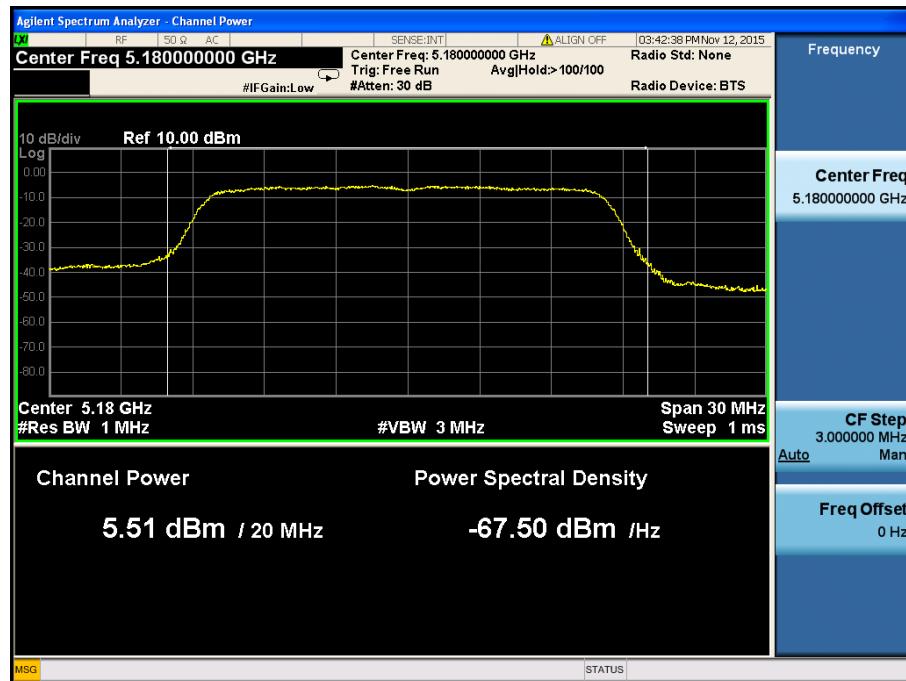
For the frequency band 5.15-5.25GHz, 5.275-5.850GHz

Test mode	Frequency MHz	Power 1 dBm	Power 2 dBm	Total Power dBm	Total Power mW	Limit mW
802.11n-HT20	5180	5.51	4.69	8.13	6.50	250
	5200	6.04	3.92	8.12	6.48	250
	5240	5.10	3.48	7.38	5.46	250
	5745	4.06	2.10	6.20	4.17	1000
	5785	3.65	1.66	5.78	3.78	1000
	5825	2.82	1.84	5.37	3.44	1000
802.11n-HT40	5180	3.74	2.44	6.15	4.12	250
	5200	3.66	2.27	6.03	4.01	250
	5220	3.22	2.19	5.75	3.75	250
	5745	3.15	2.46	5.83	3.83	1000
	5785	2.29	1.50	4.92	3.11	1000
	5825	2.23	1.44	4.86	3.06	1000

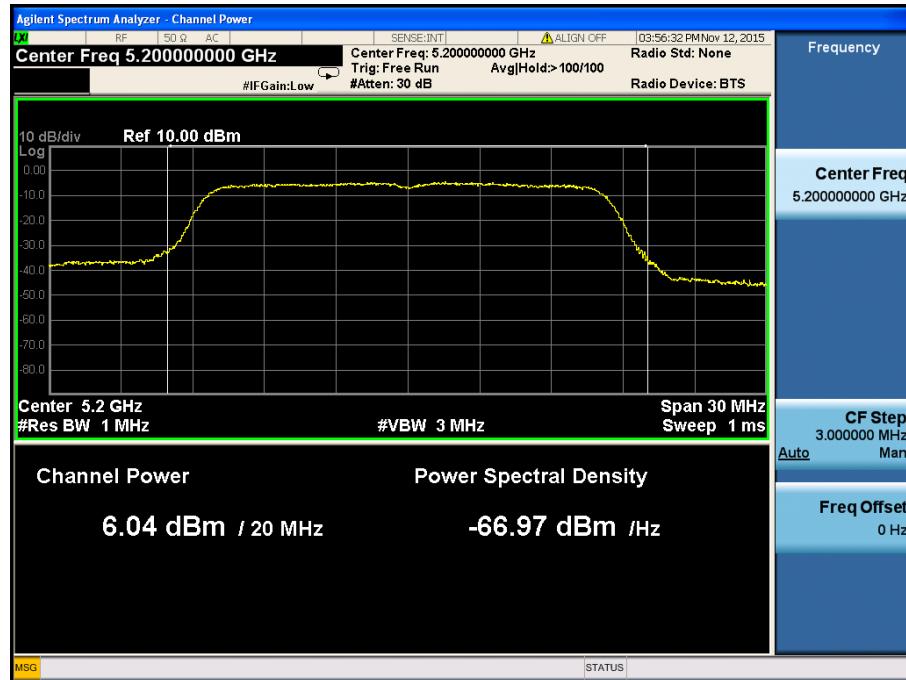
Antenna 1

Test Mode: 802.11n-HT20

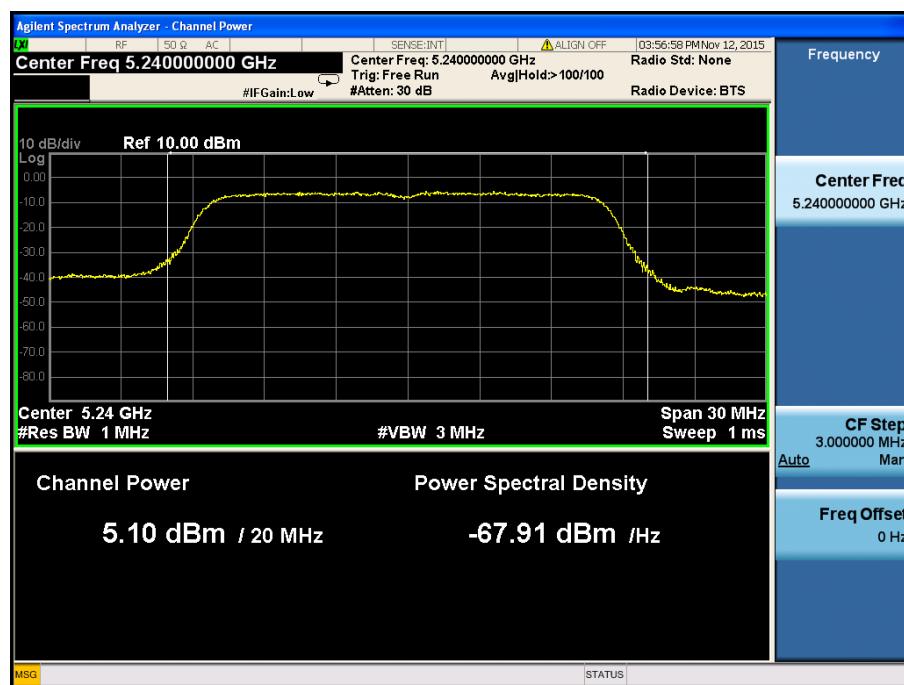
5180MHz



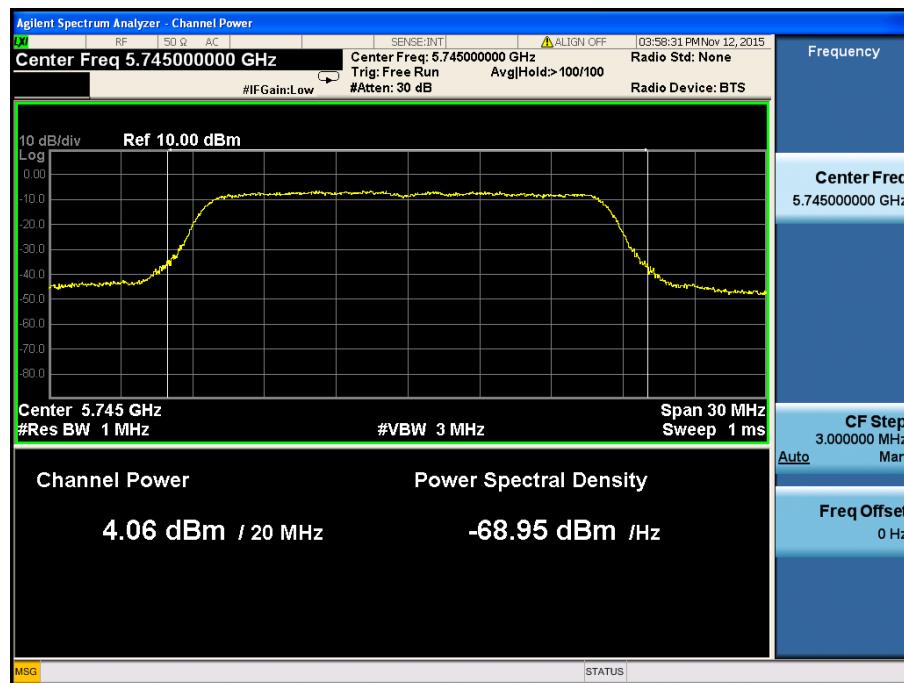
5200MHz



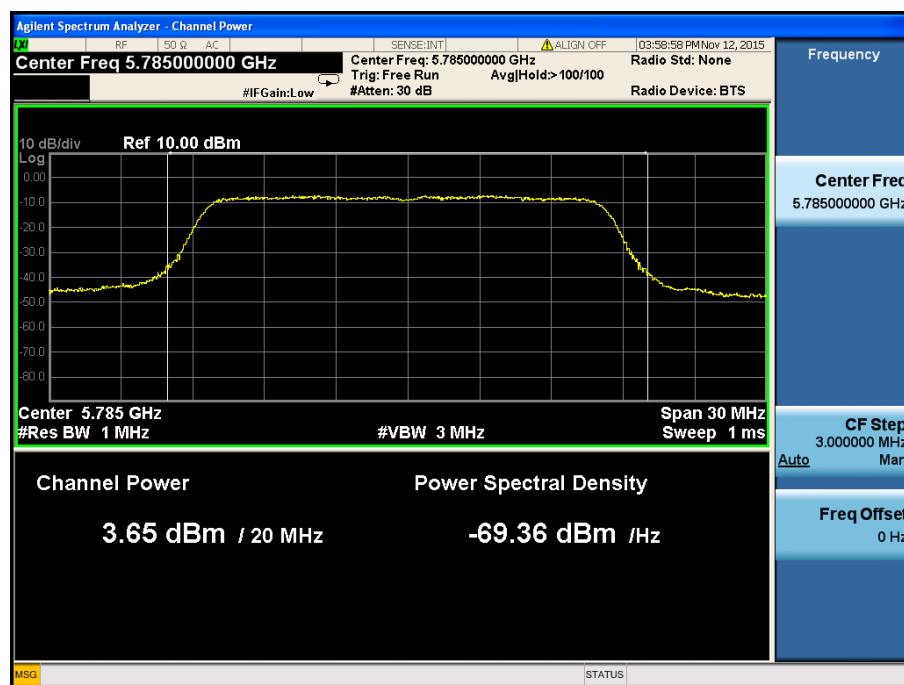
5240MHz



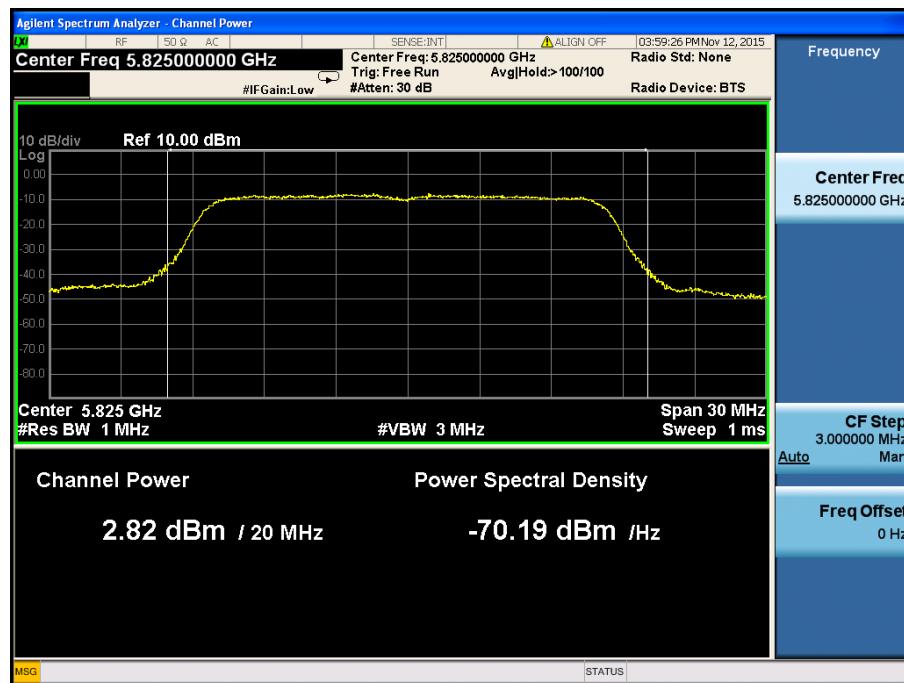
5745MHz



5785MHz

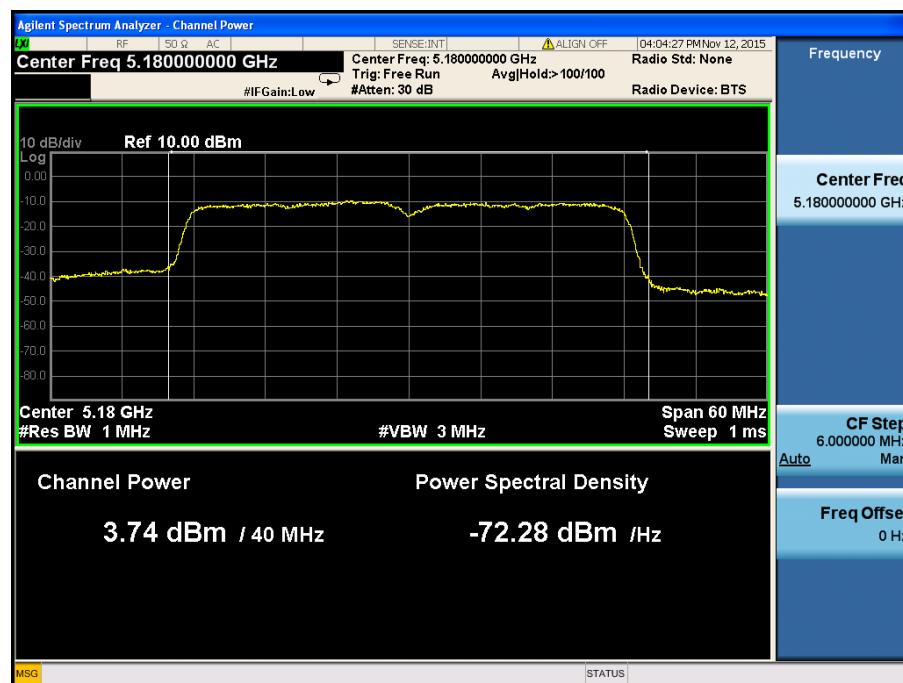


5825MHz

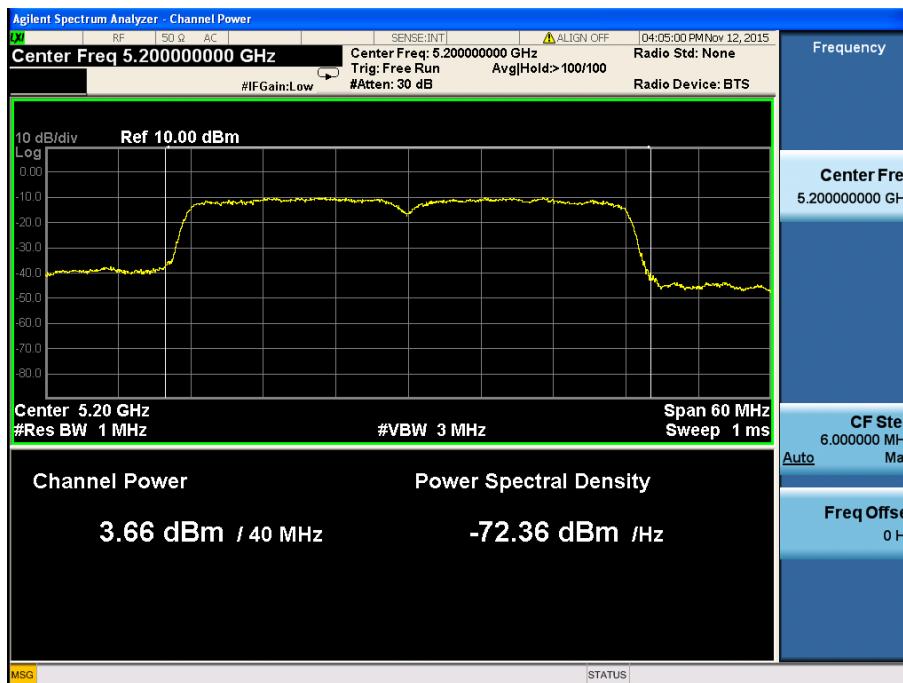


Test Mode: 802.11n-HT40

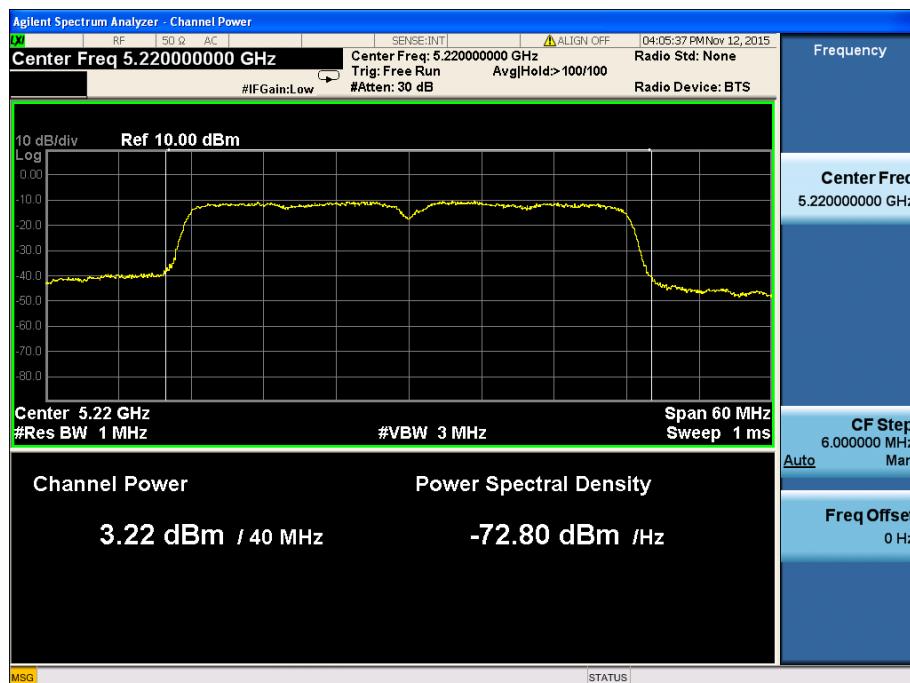
5180MHz



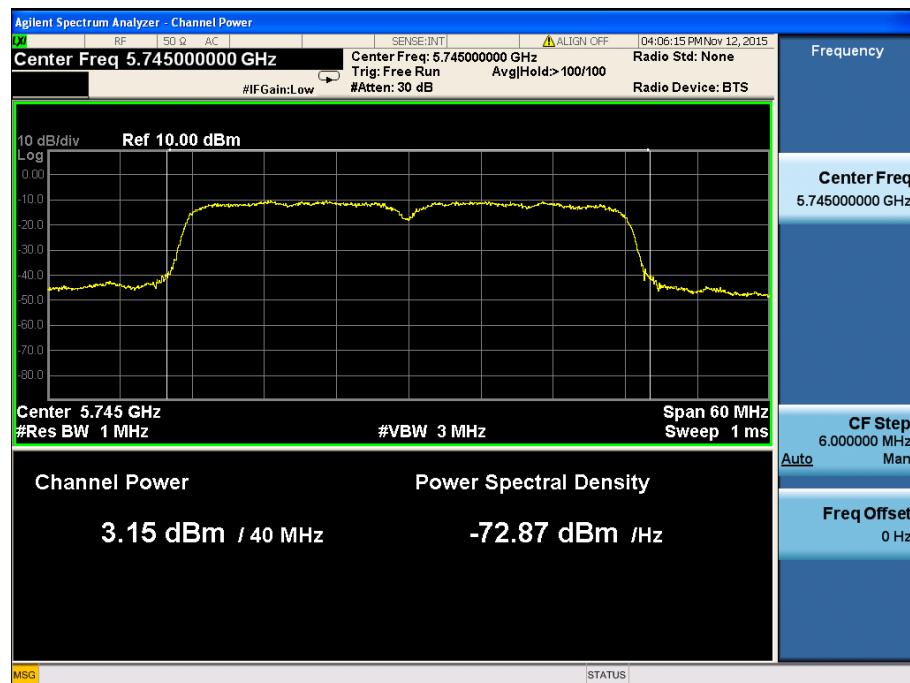
5200MHz



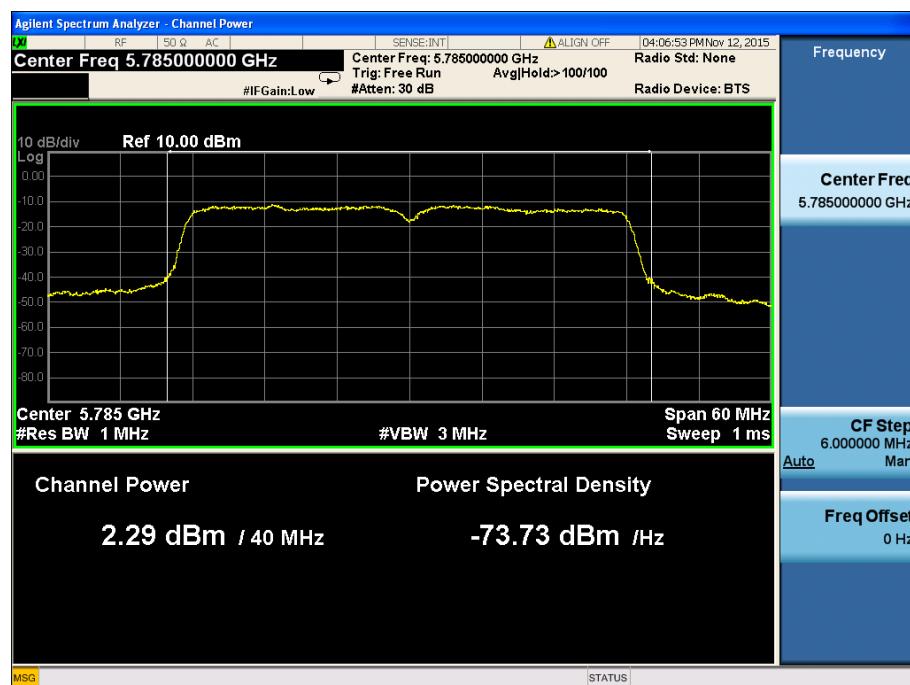
5220MHz



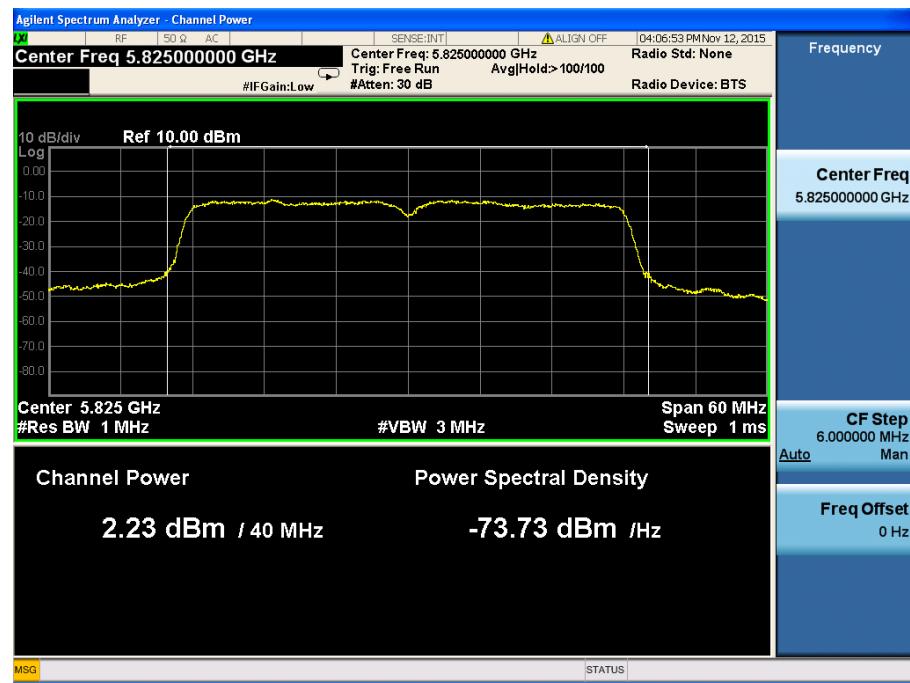
5745MHz



5785MHz



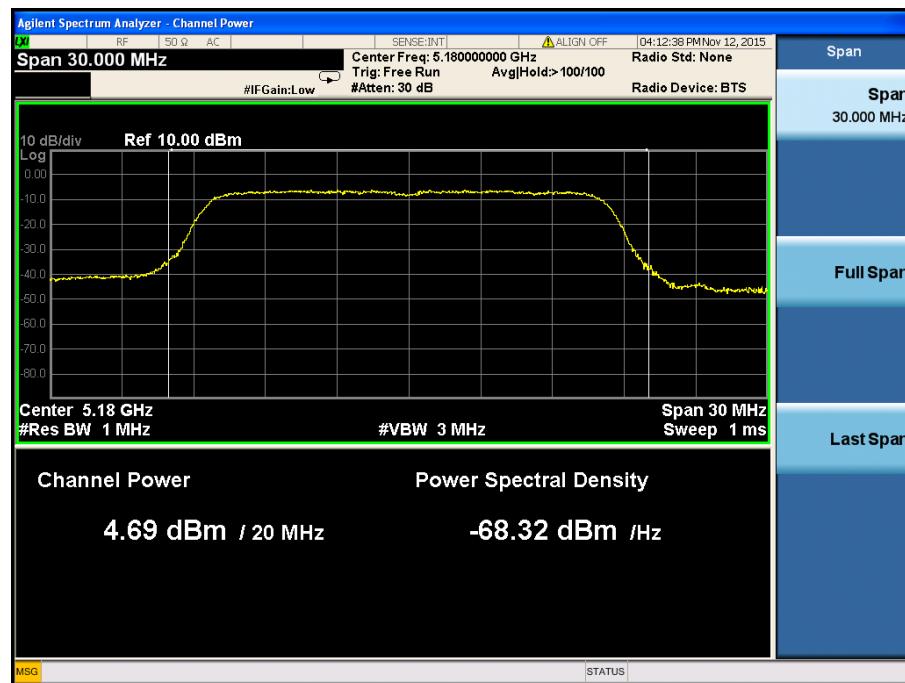
5825MHz



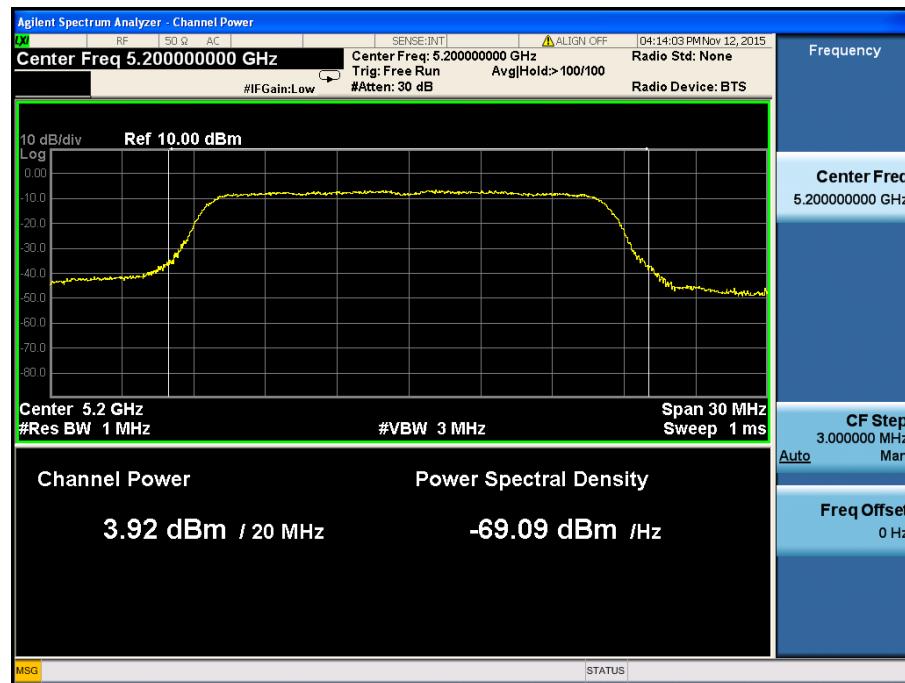
Antenna 2

Test Mode: 802.11n-HT20

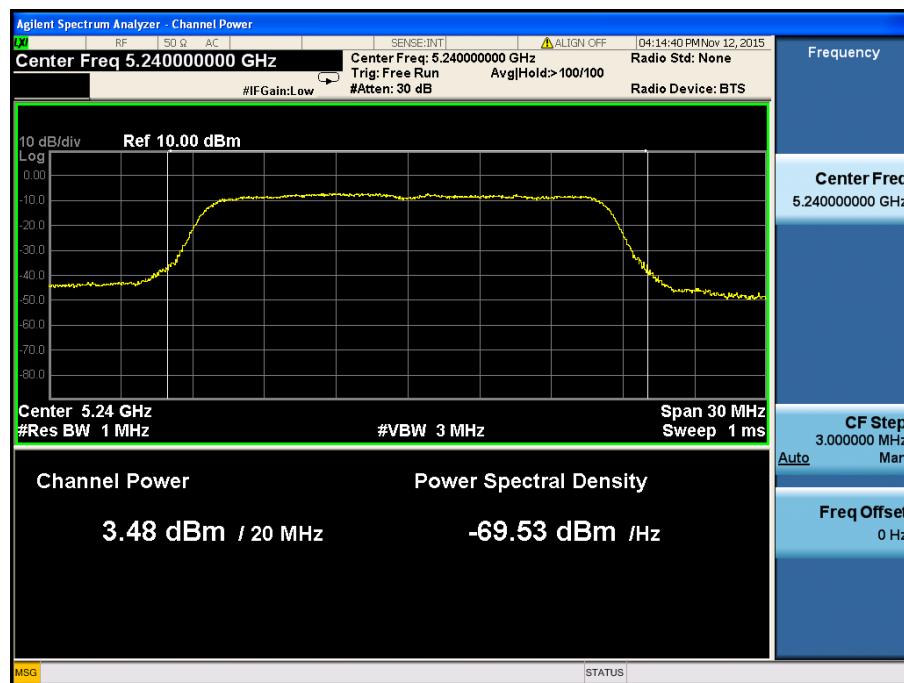
5180MHz



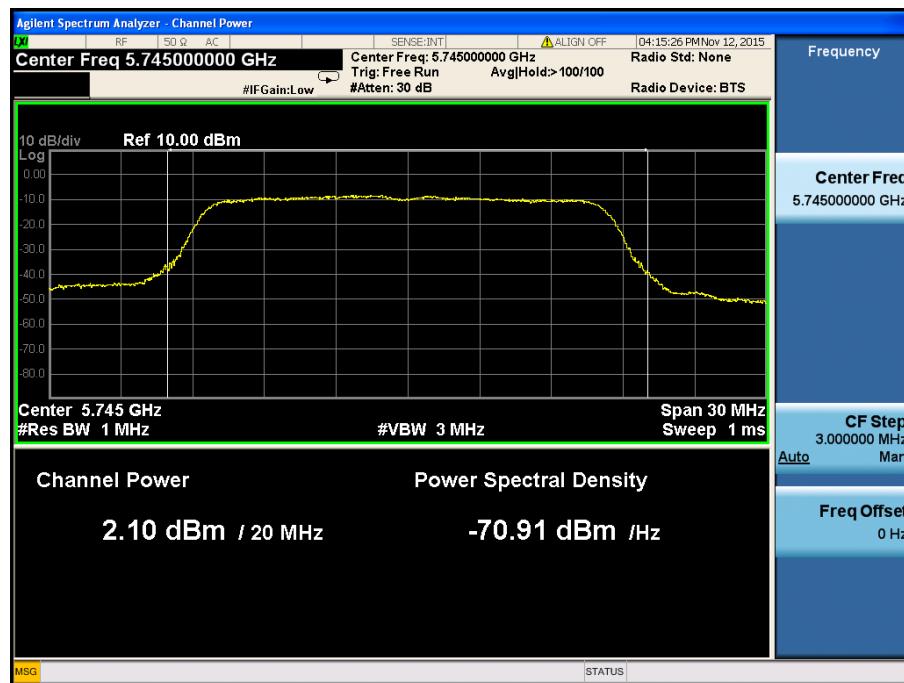
5200MHz



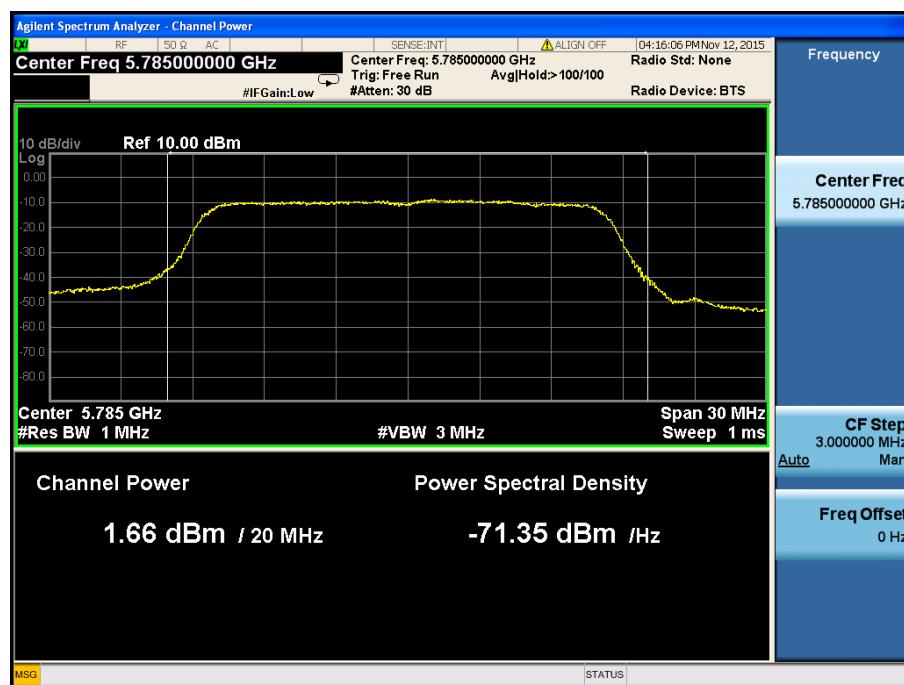
5240MHz



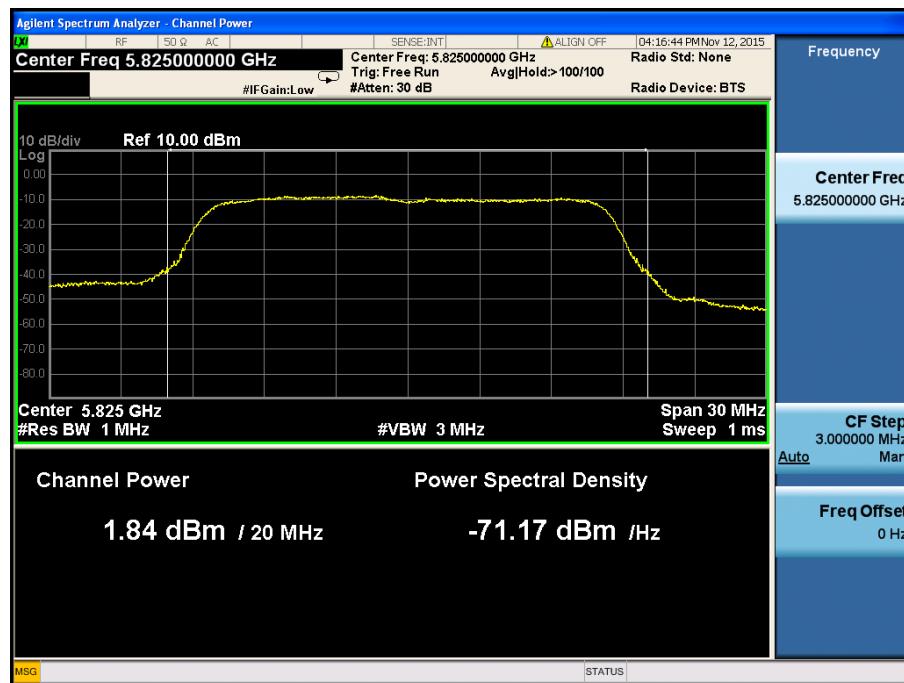
5745MHz



5785MHz

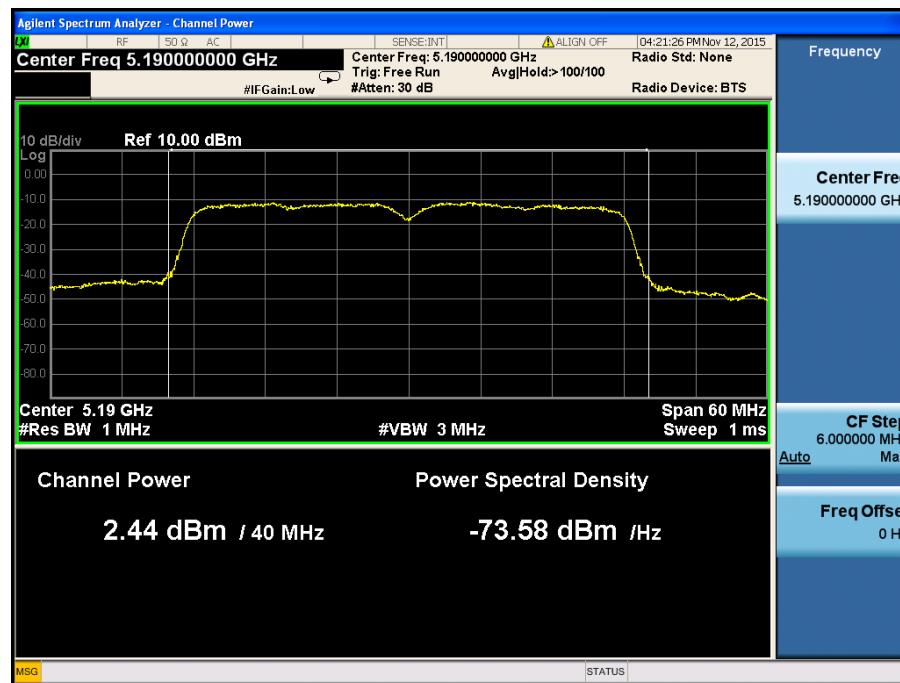


5825MHz

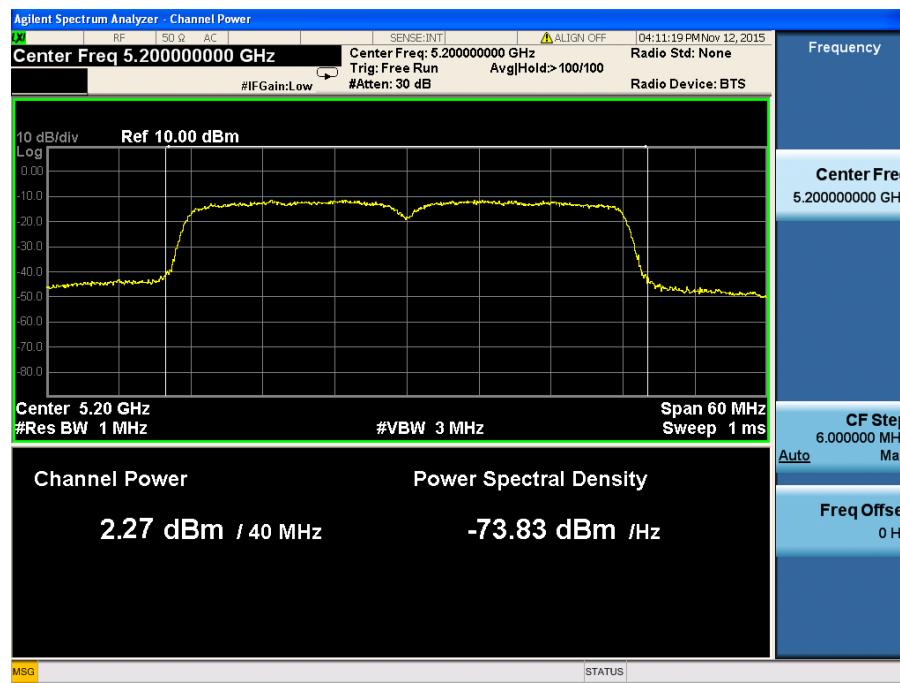


Test Mode: 802.11n-HT40

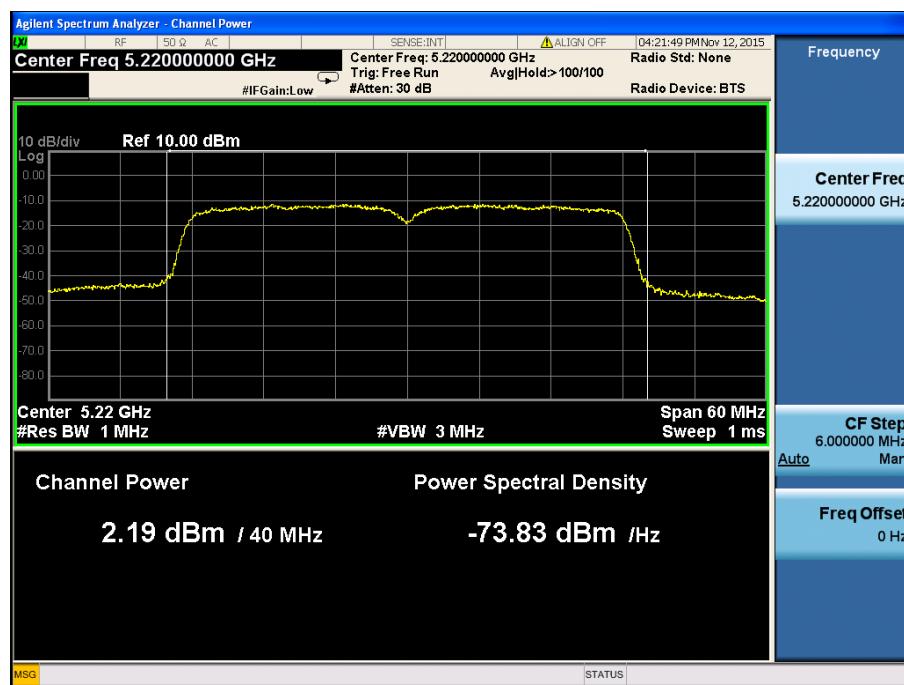
5180MHz



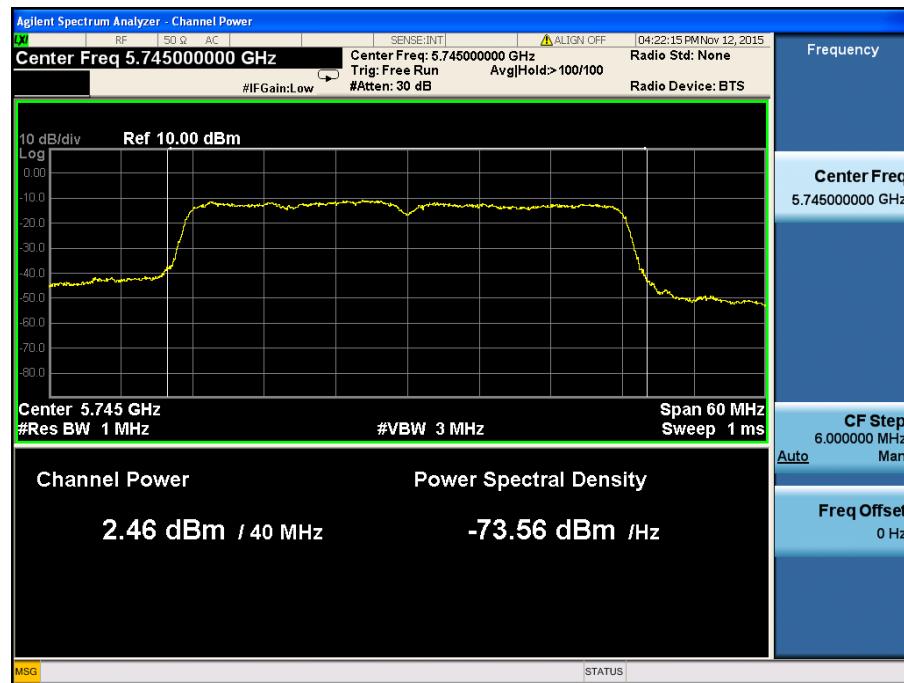
5200MHz



5220MHz



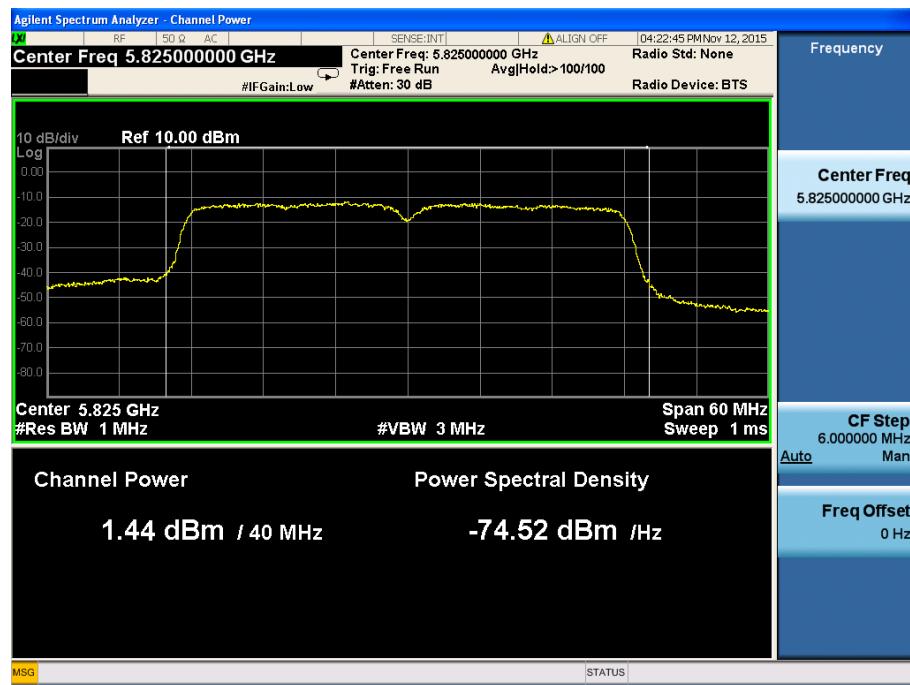
5745MHz



5785MHz



5825MHz



8. Conducted Spurious Emissions

8.1 Standard Applicable

According to §15.407 (b) (b) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

- (1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (4) For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz.

8.2 Test Procedure

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer via a RF combiner.
2. Set the spectrum analyzer as RBW = 100kHz/1MHz, VBW=300kHz/3MHz, Sweep = auto
3. Set the Lowest, Middle and Highest Transmitting Channel, observed the outside band of 30MHz to 40GHz, then mark the higher-level emission for comparing with the FCC rules.

8.3 Environmental Conditions

Temperature:	21° C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

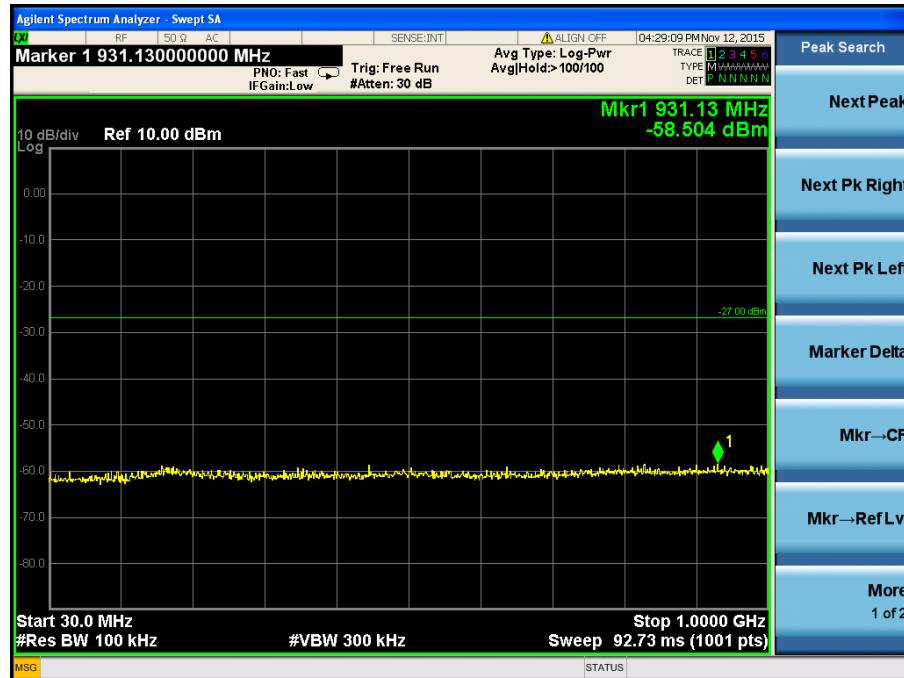
8.4 Summary of Test Results/Plots

Emissions above 26.5GHz are attenuated more than 20dB below the permissible limits and test data are not reported.

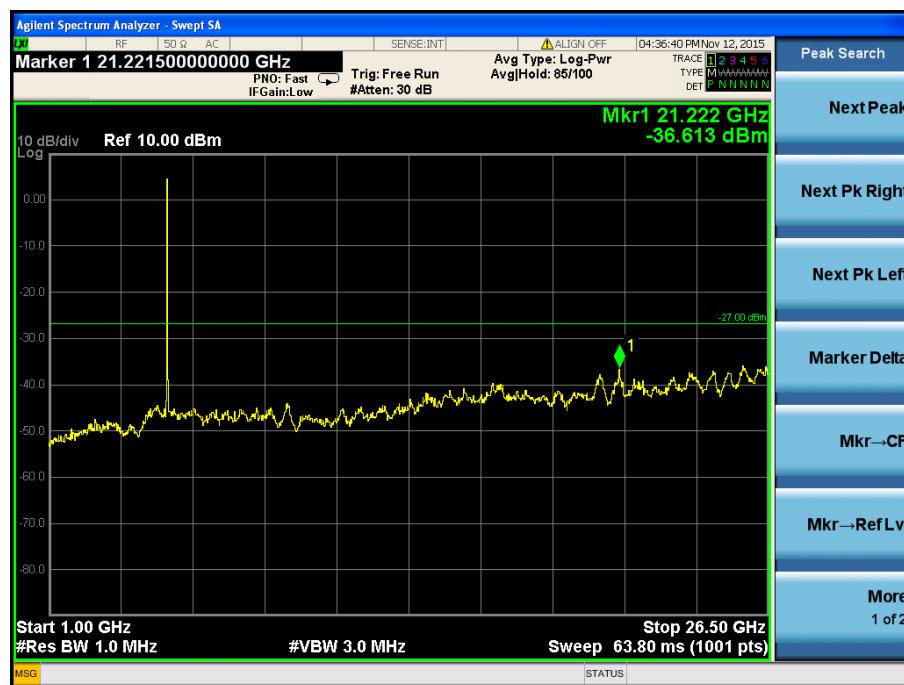
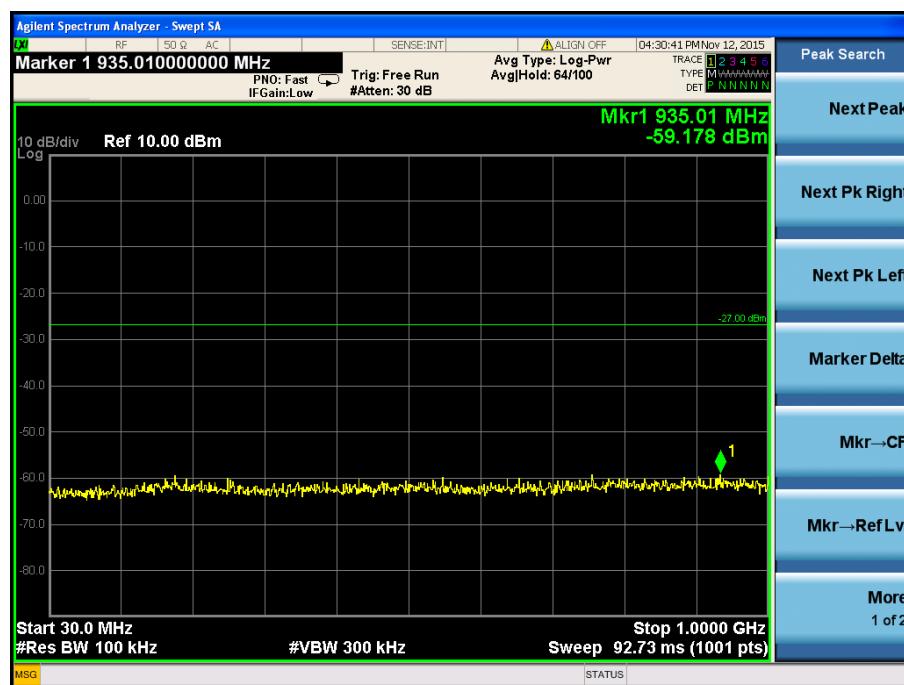
Antenna 1

802.11n-HT20

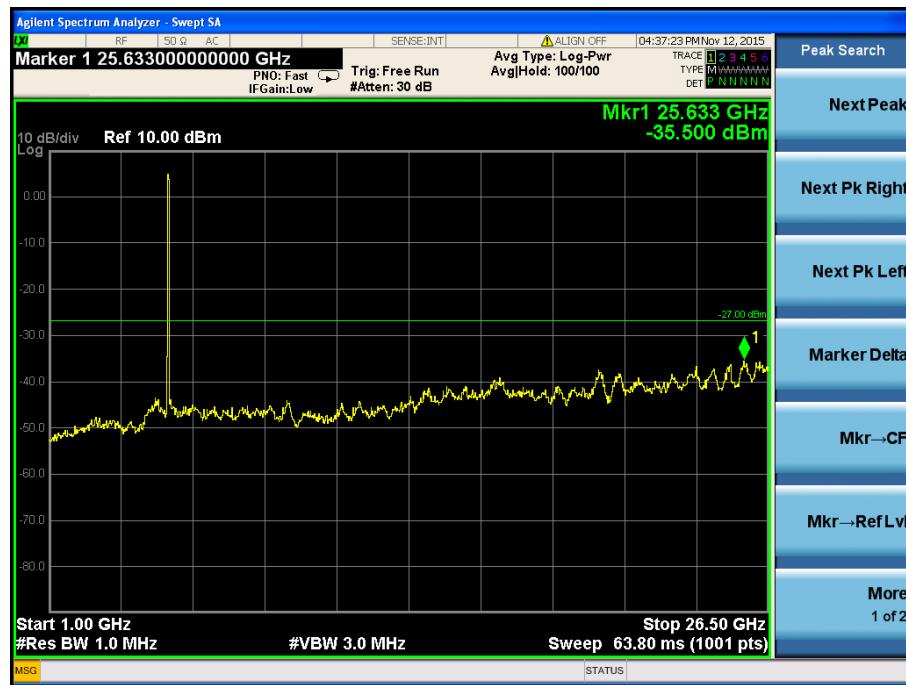
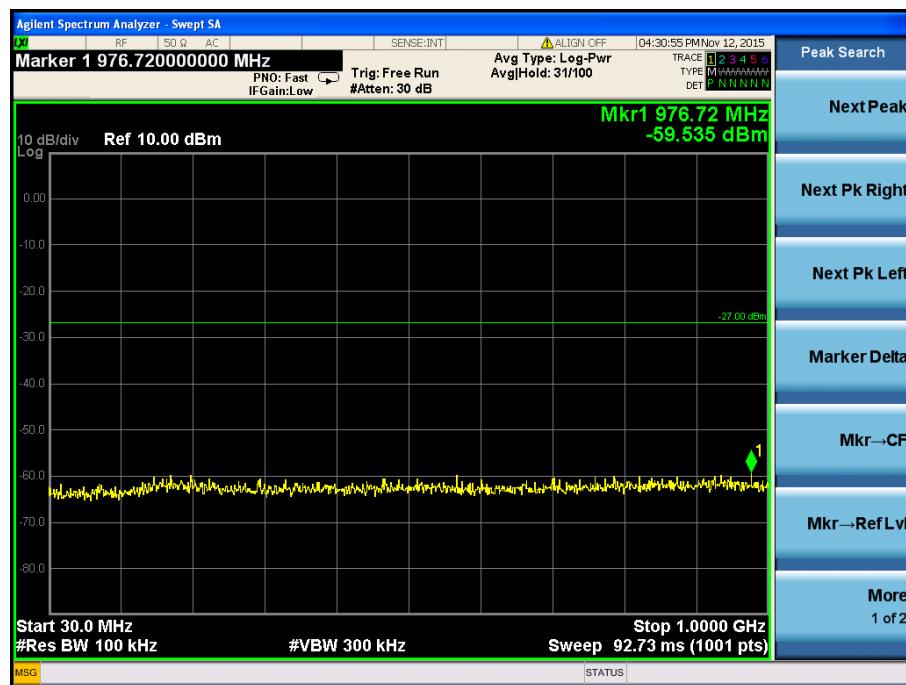
5180MHz



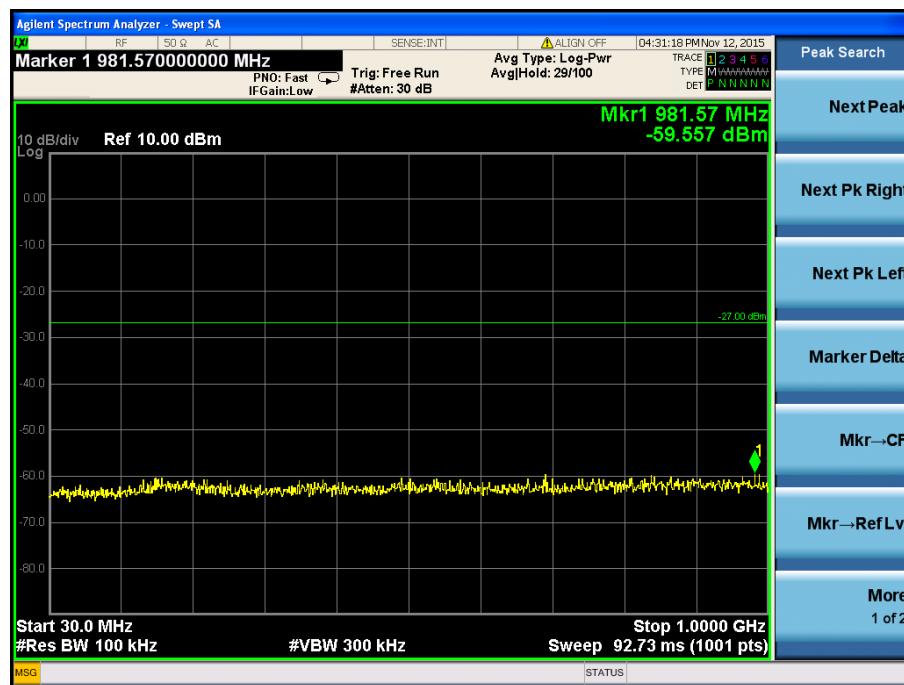
5200MHz



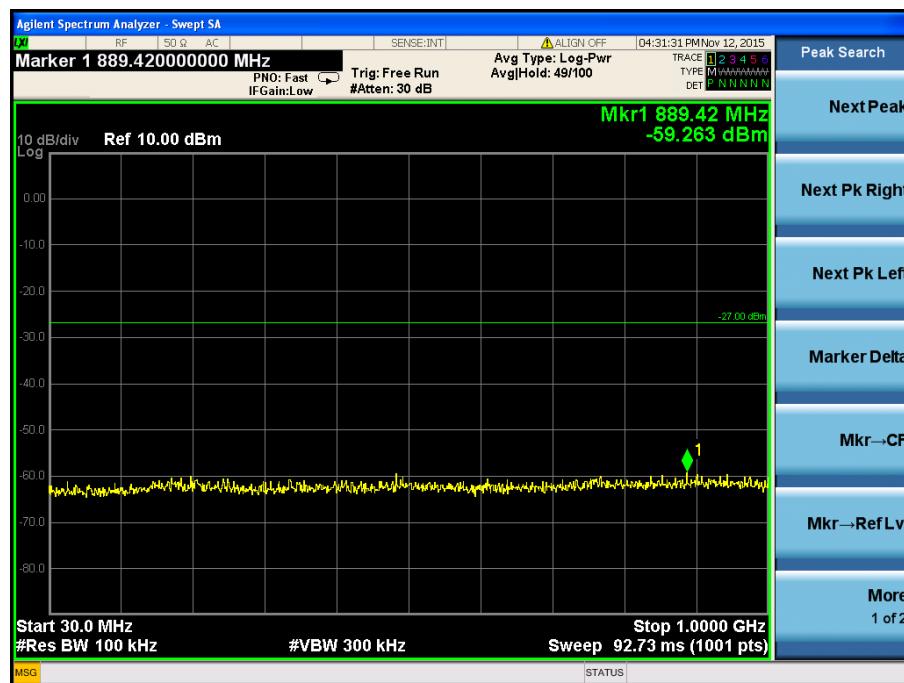
5240MHz



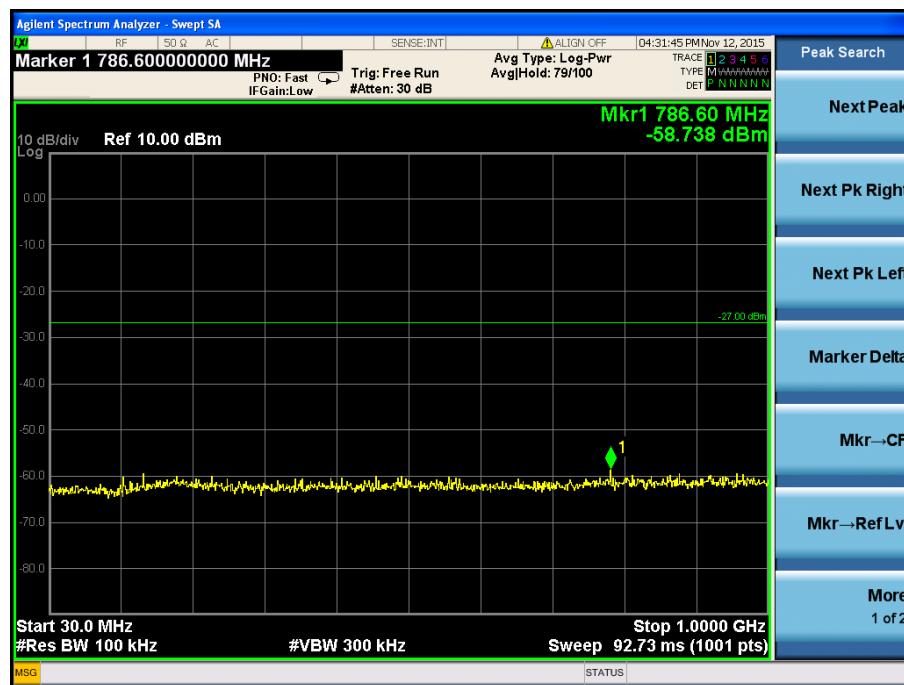
5745MHz



5785MHz

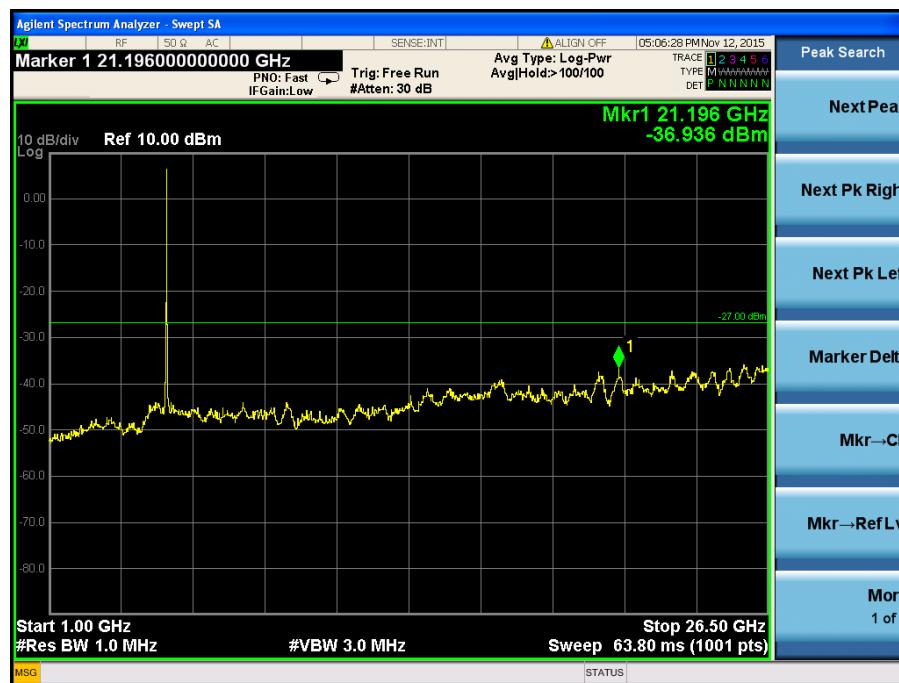


5825MHz

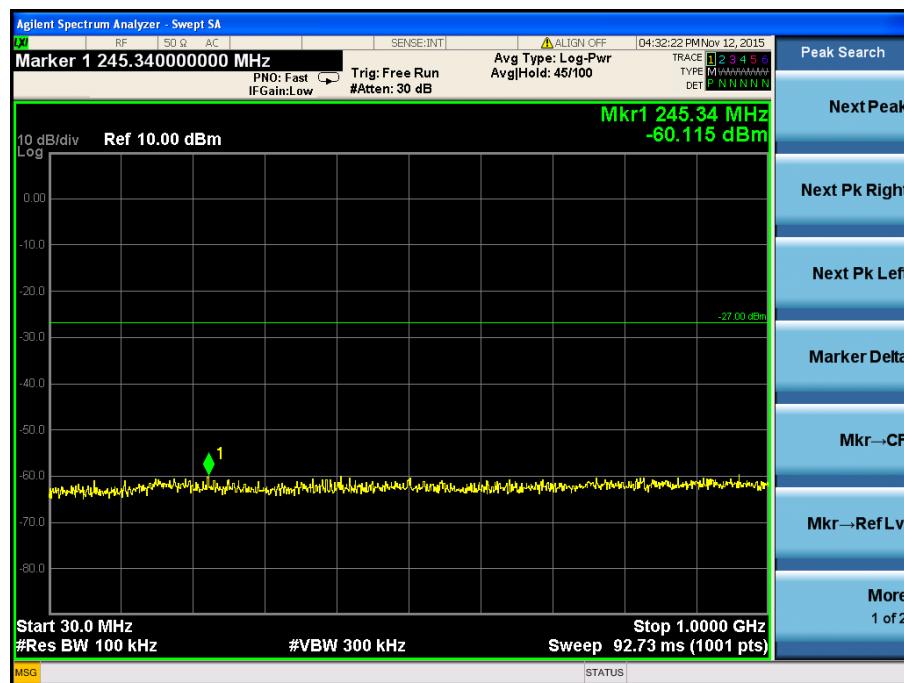


802.11n-HT40

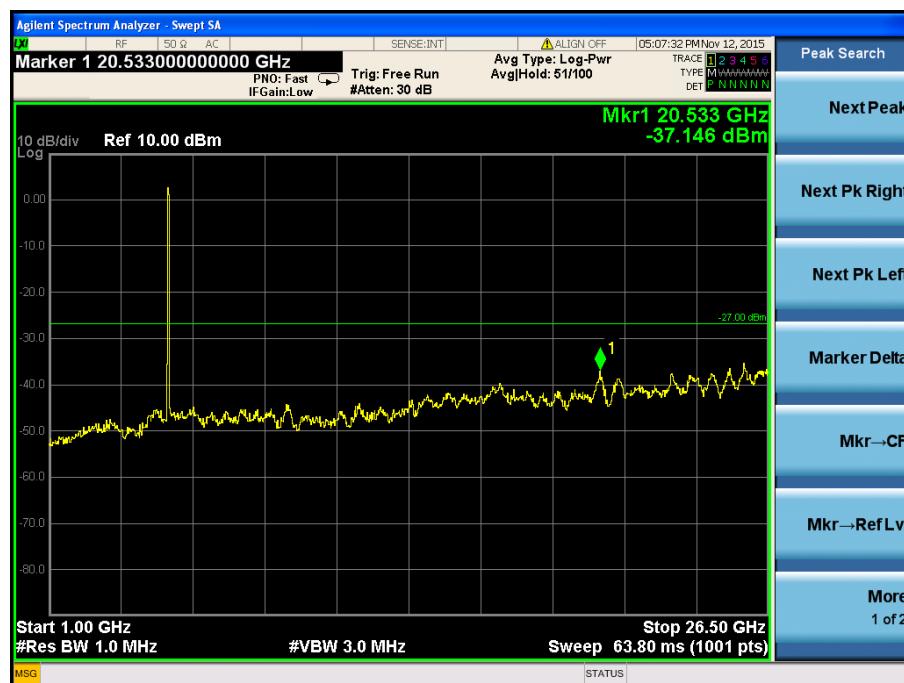
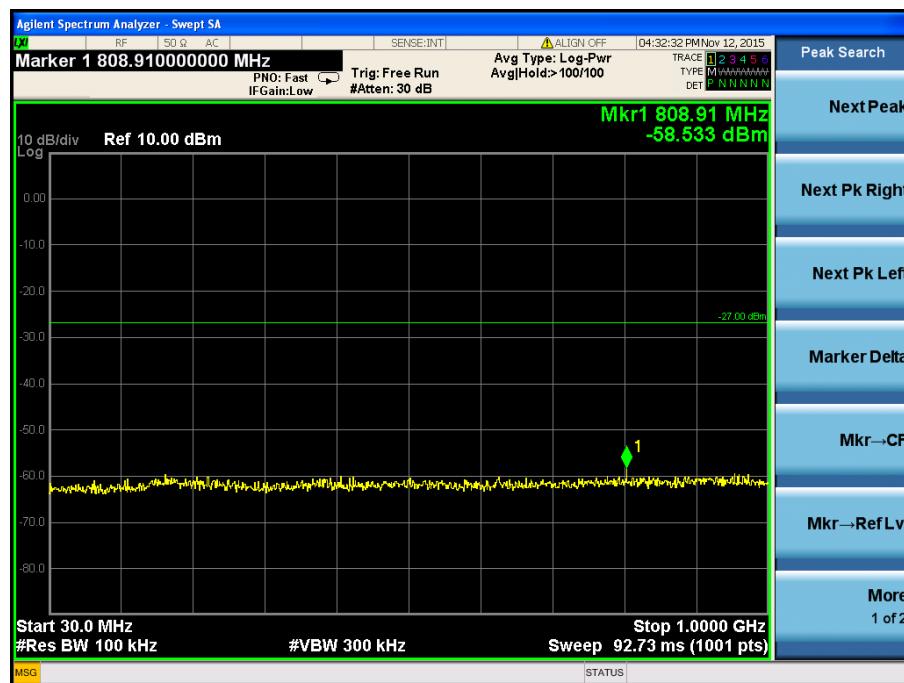
5180MHz



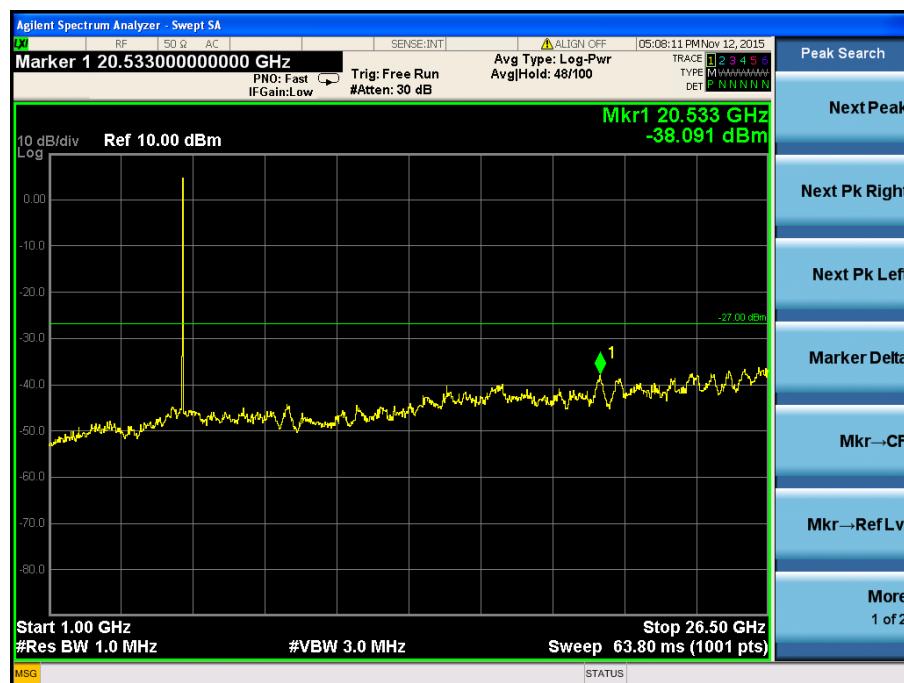
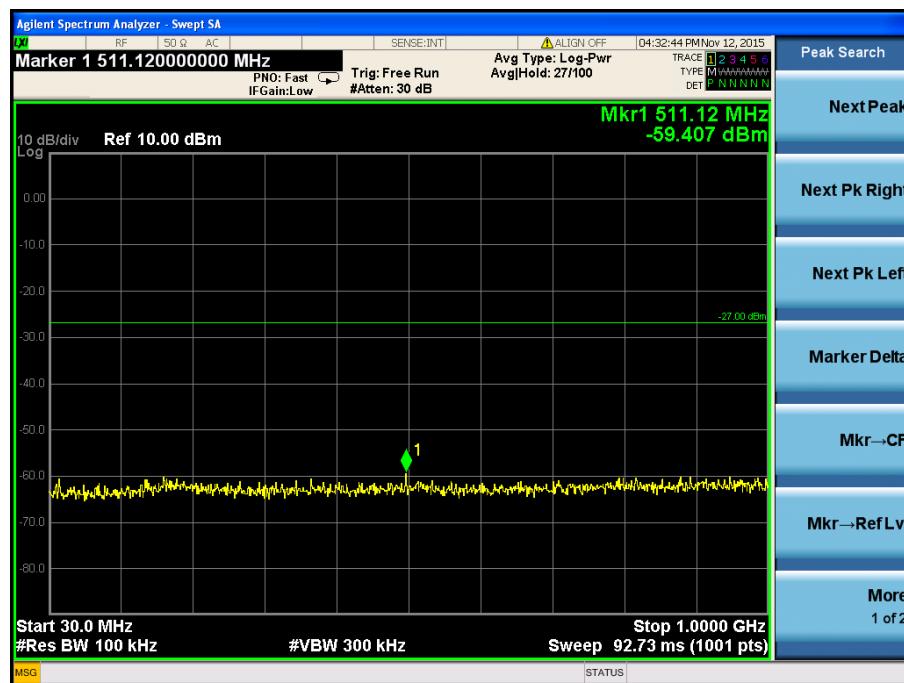
5200MHz



5220MHz



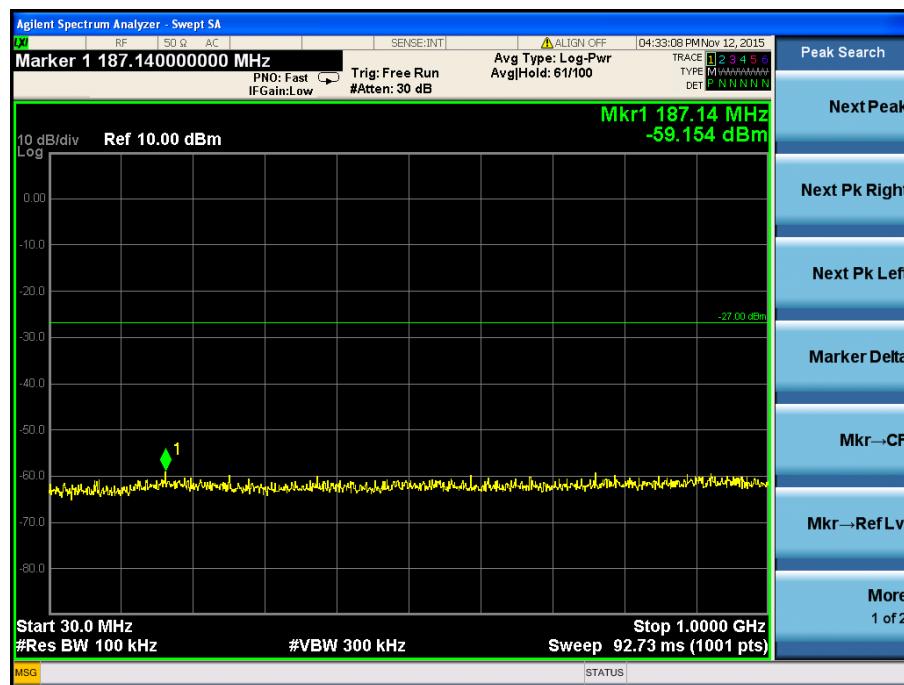
5745MHz



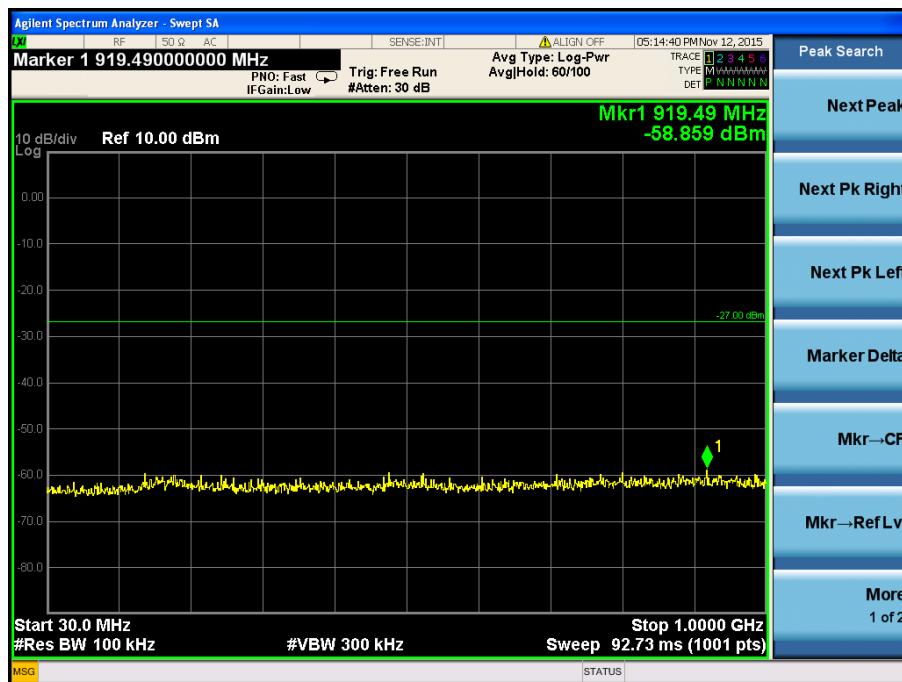
5785MHz



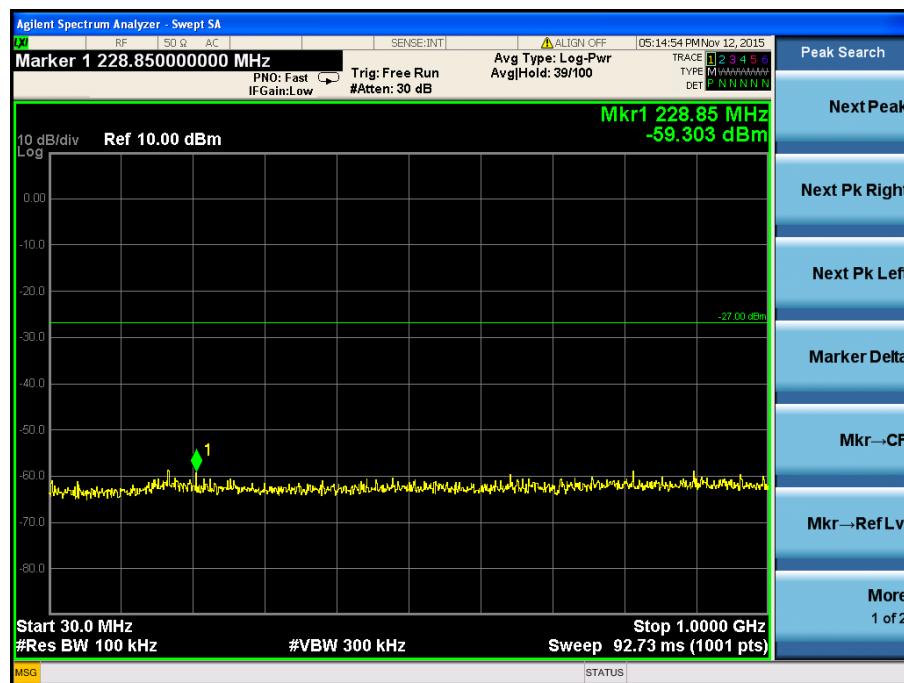
5825MHz



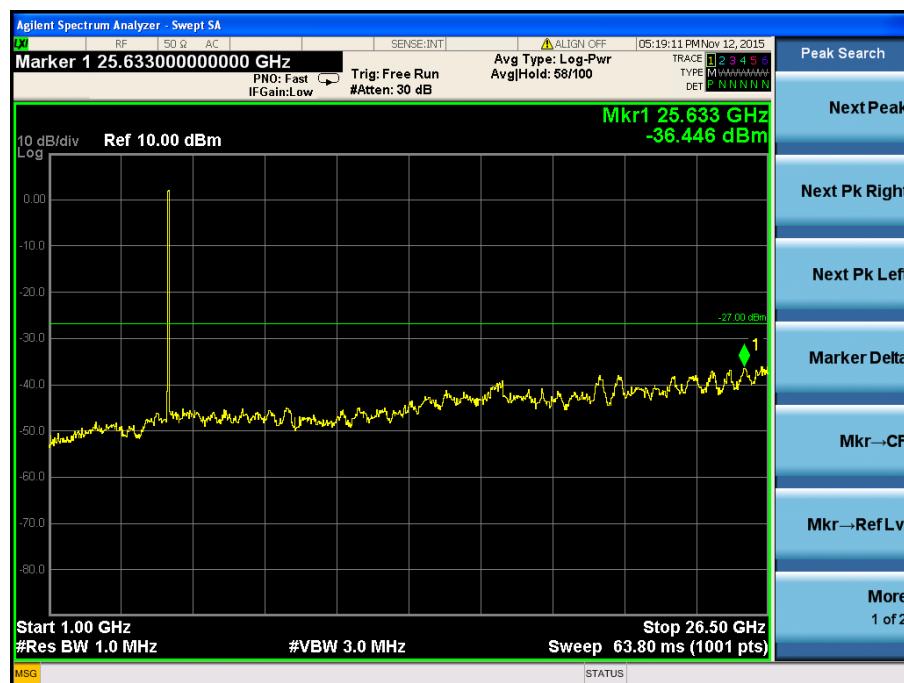
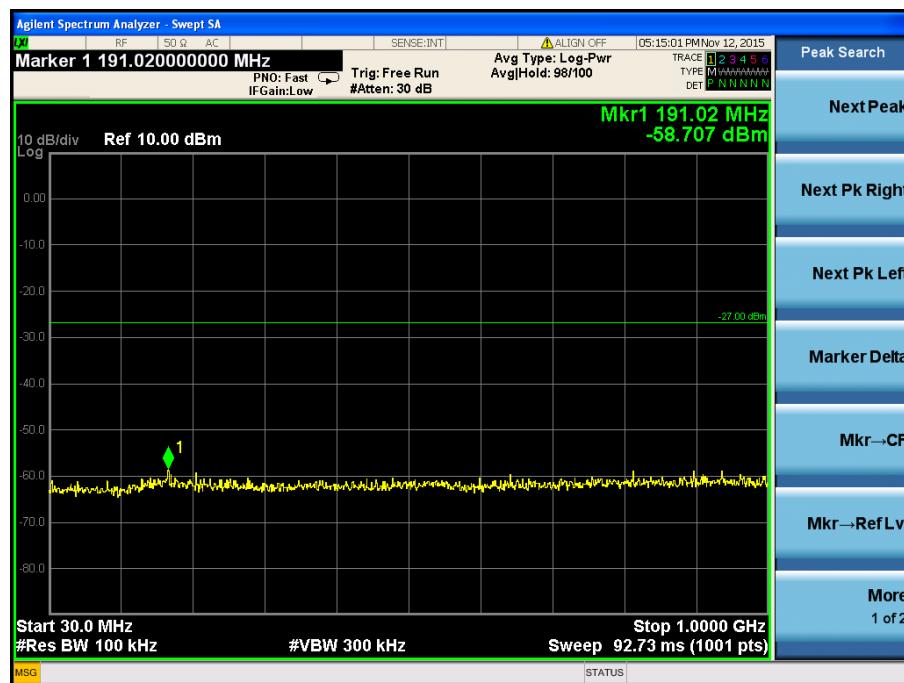
Antenna 2
802.11n-HT20
 5180MHz



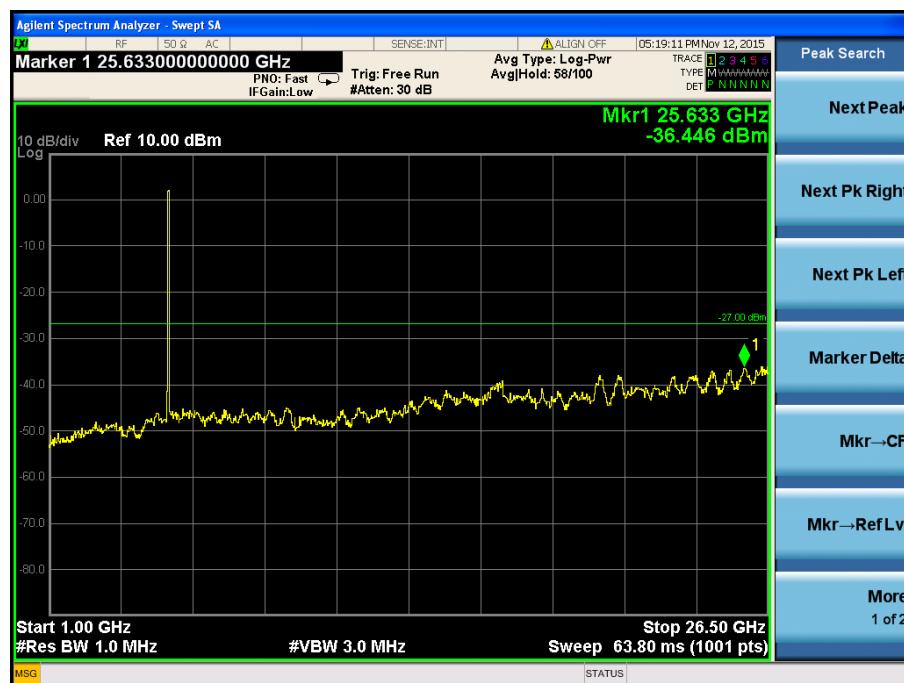
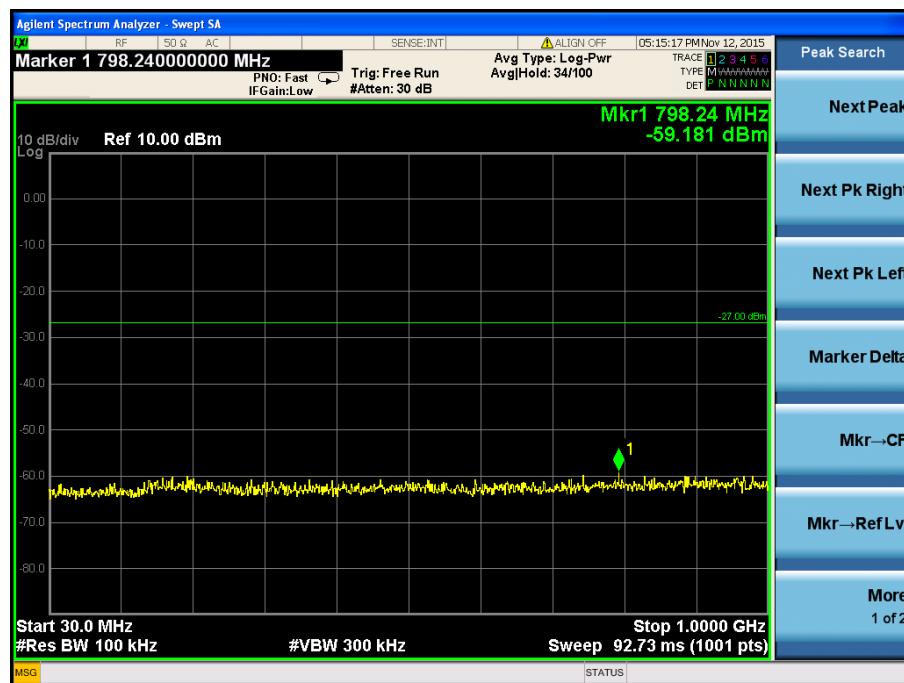
5200MHz



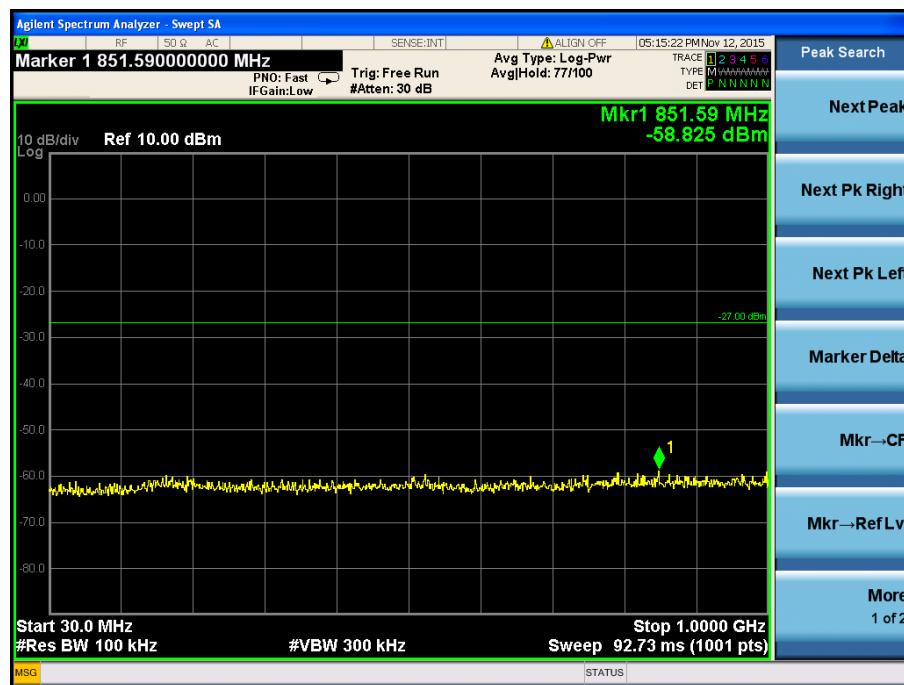
5240MHz



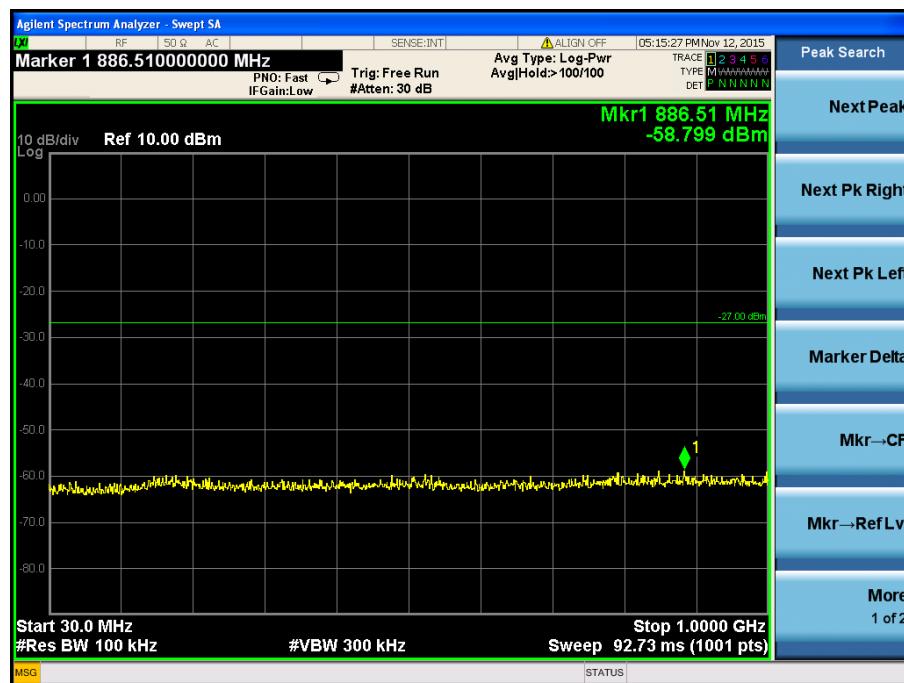
5745MHz



5785MHz

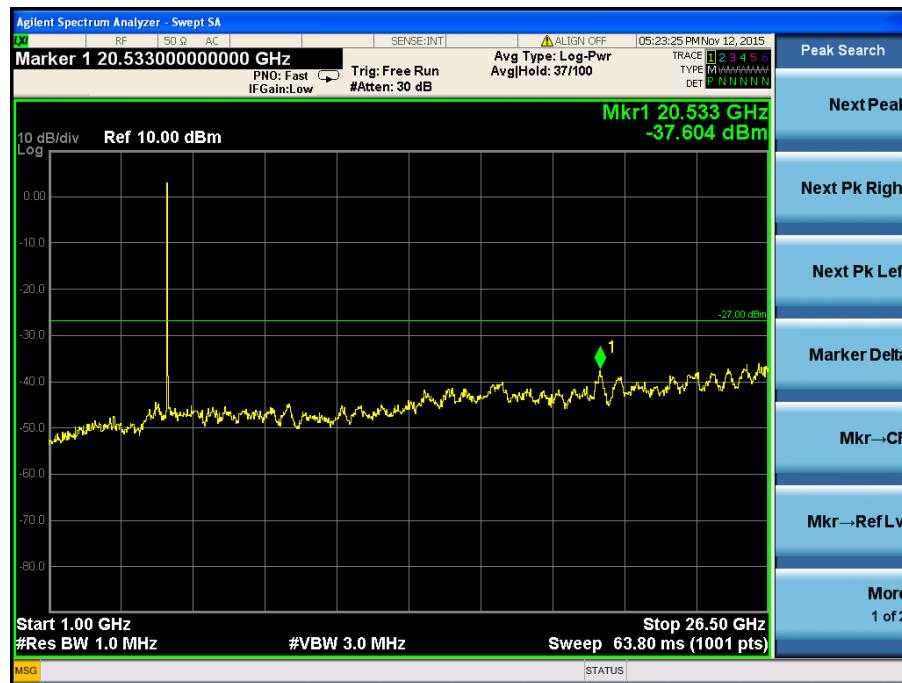
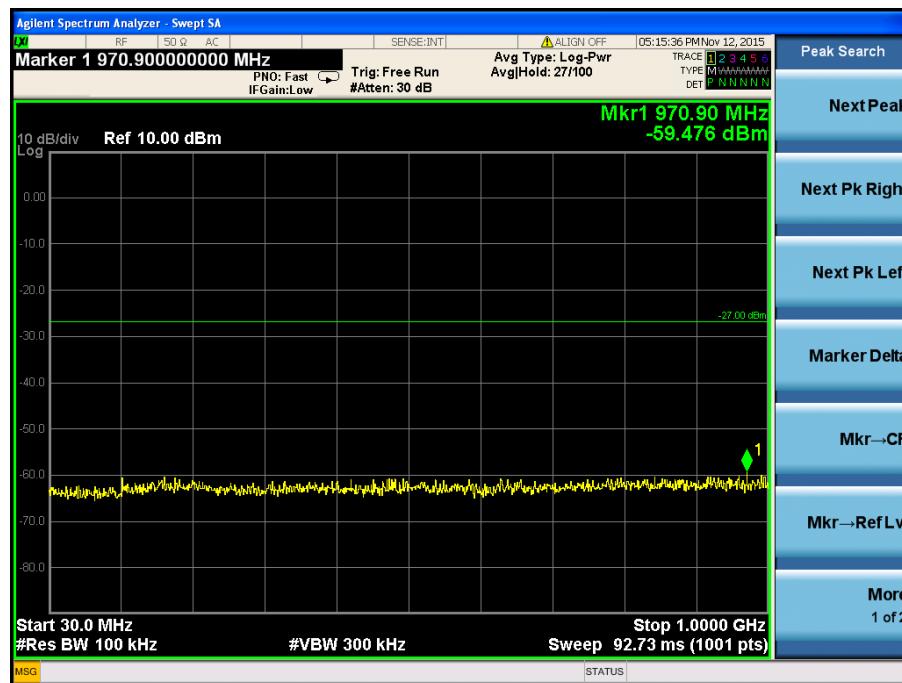


5825MHz

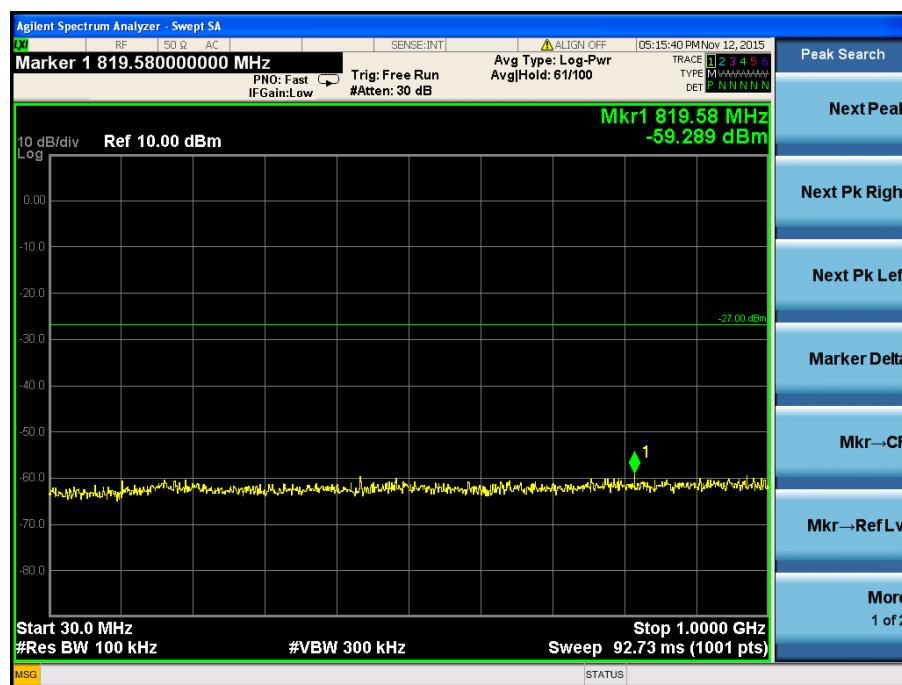


802.11n-HT40

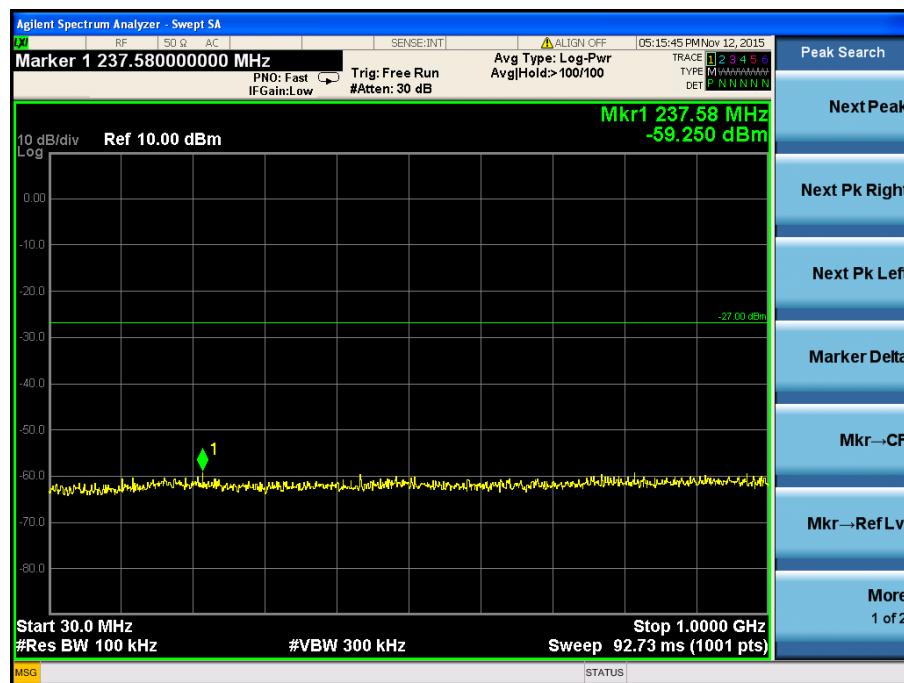
5180MHz



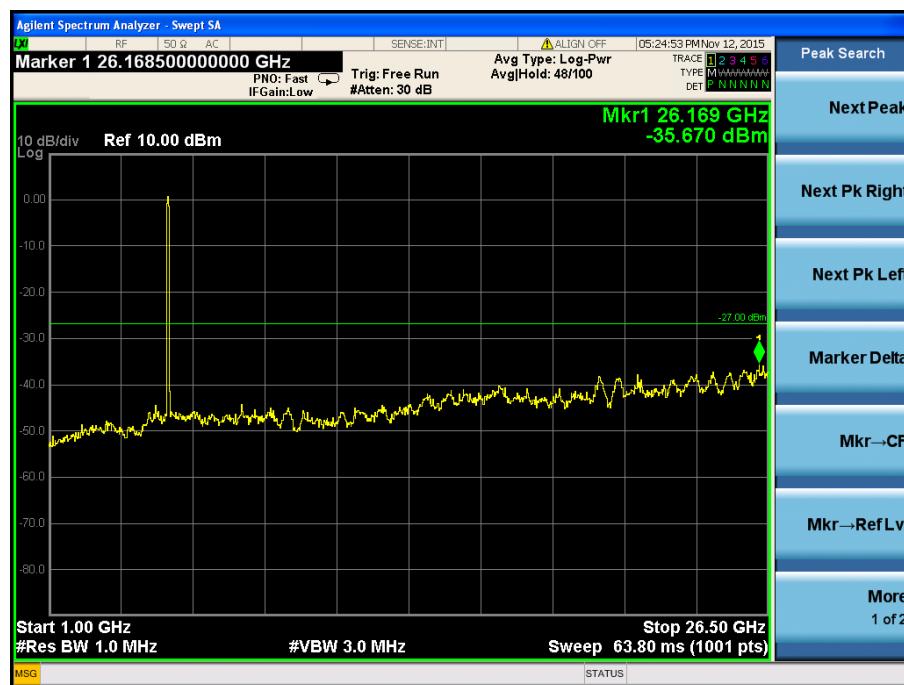
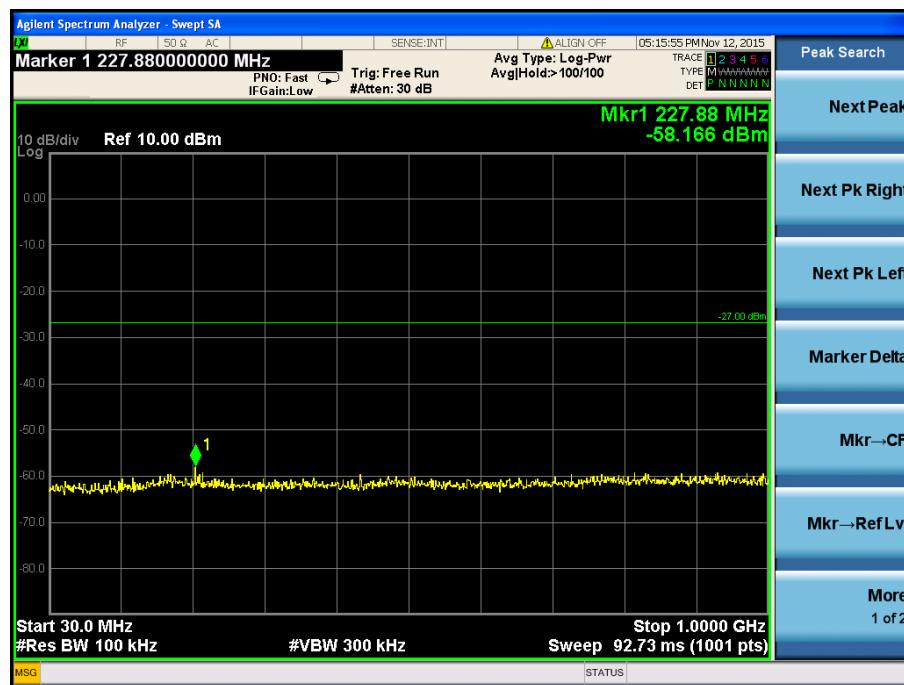
5200MHz



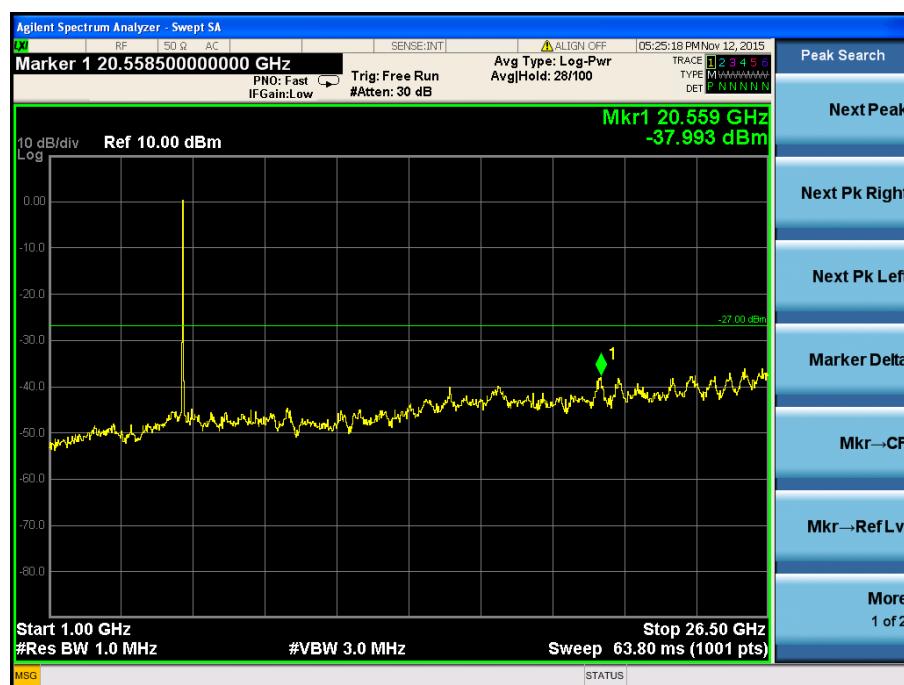
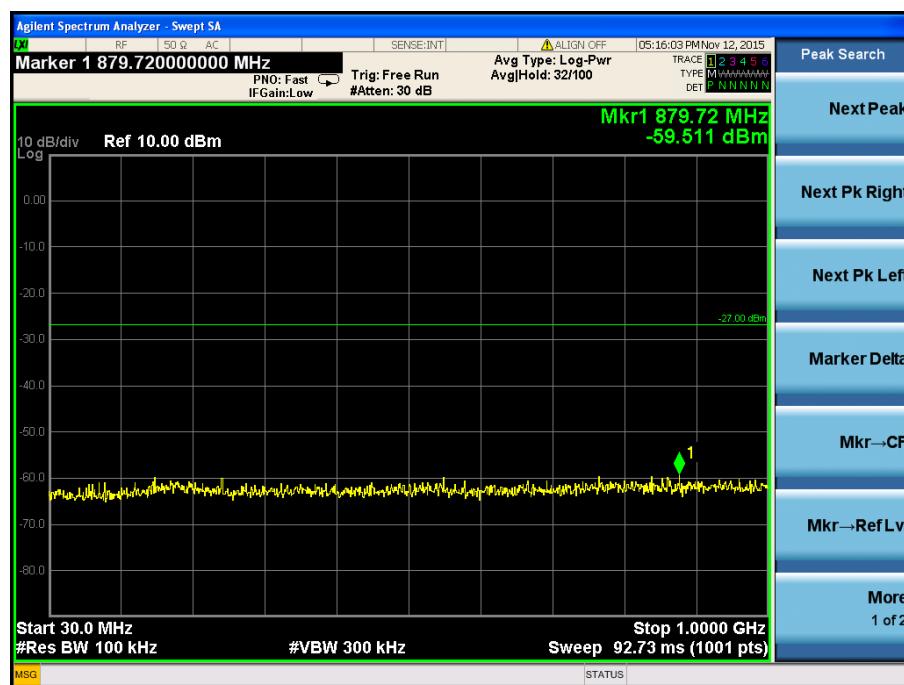
5220MHz



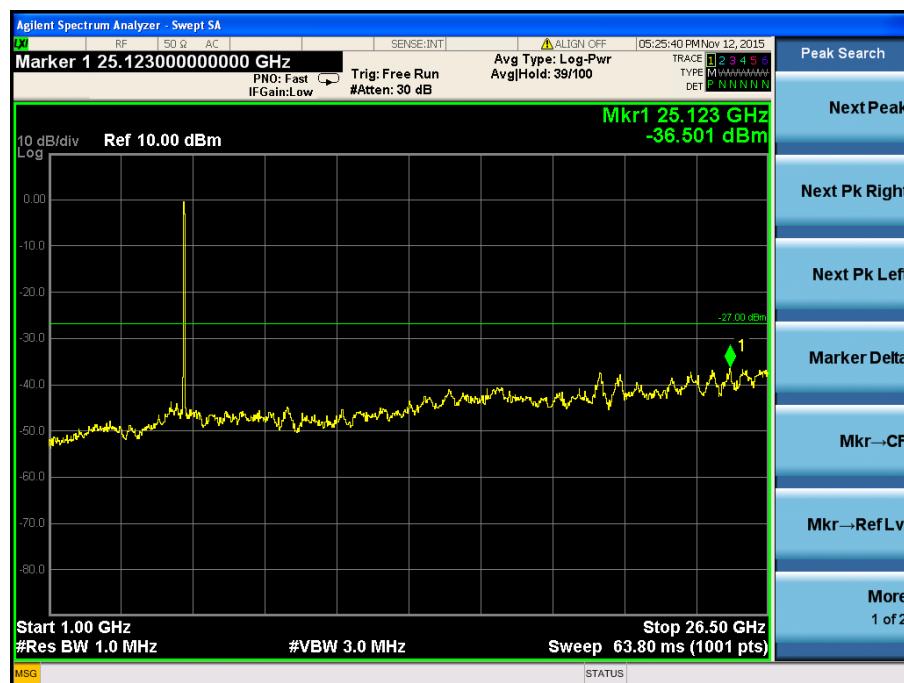
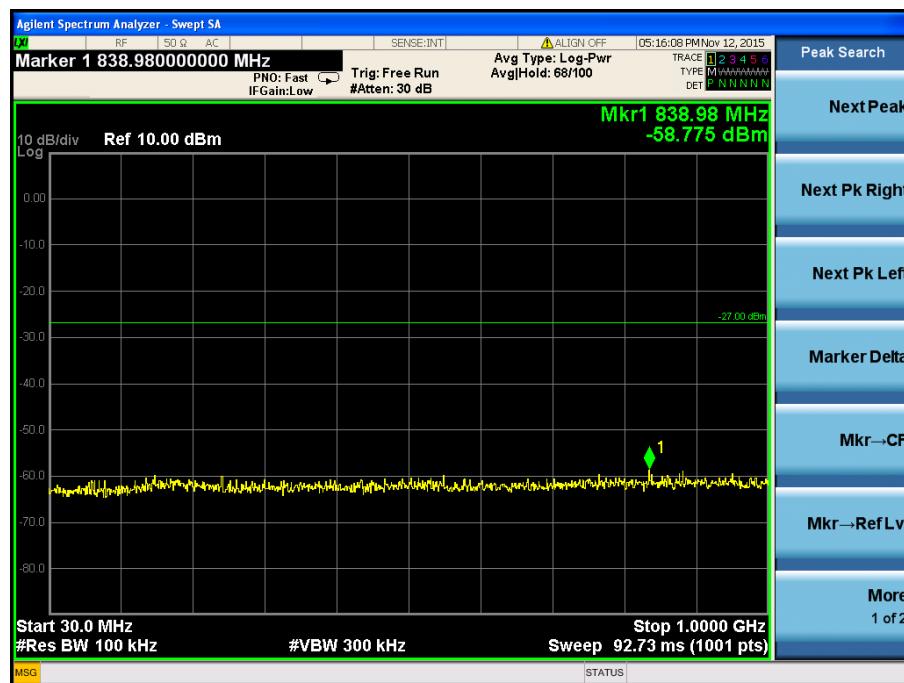
5745MHz



5785MHz



5825MHz



9. Radiated Spurious Emissions

9.1 Measurement Uncertainty

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement is ± 5.10 dB.

9.2 Standard Applicable

According to §15.407(b)(6), Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

According to §15.407(b)(7), The provisions of §15.205 apply to intentional radiators operating under this section.
789033 D02 General UNII Test Procedures New Rules v01

If radiated measurements are performed, field strength is then converted to EIRP as follows:

$$\text{EIRP} = ((E^*d)^2) / 30$$

where:

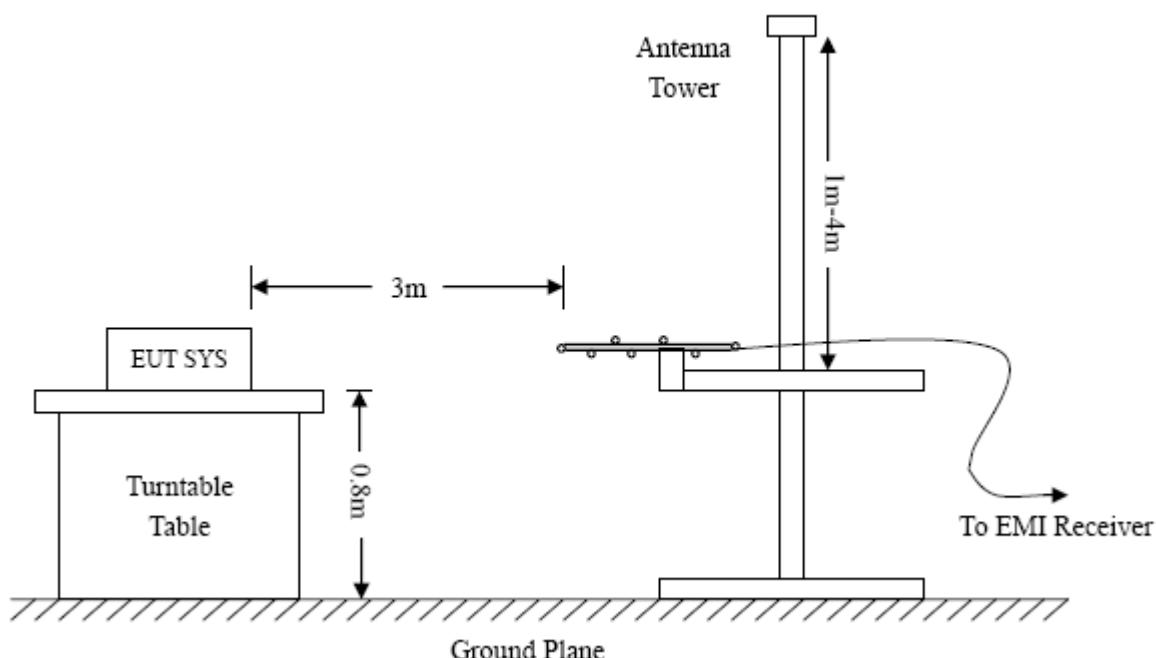
- E is the field strength in V/m;
- d is the measurement distance in meters;
- EIRP is the equivalent isotropically radiated power in watts.

9.3 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 measurement procedure. The specification used was with the FCC Part 15.205 15.407(b)(6) and FCC Part 15.209 Limit..

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.



9.4 Test Receiver Setup

During the radiated emission test for above 1GHz, the test receiver was set with the following configurations:

For peak detector:

RBW = 1000kHz, VBW = 3000kHz, Sweep Time = Auto

For average detector:

RBW = 1000kHz, VBW = 10Hz, Sweep Time = Auto

9.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}$$

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dB μ V means the emission is 6dB μ V below the maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

9.6 Environmental Conditions

Temperature:	22° C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

9.7 Summary of Test Results/Plots

According to the data below, the FCC Part 15.205, 15.209 and 15.407(b)(6) standards, and had the worst margin of:

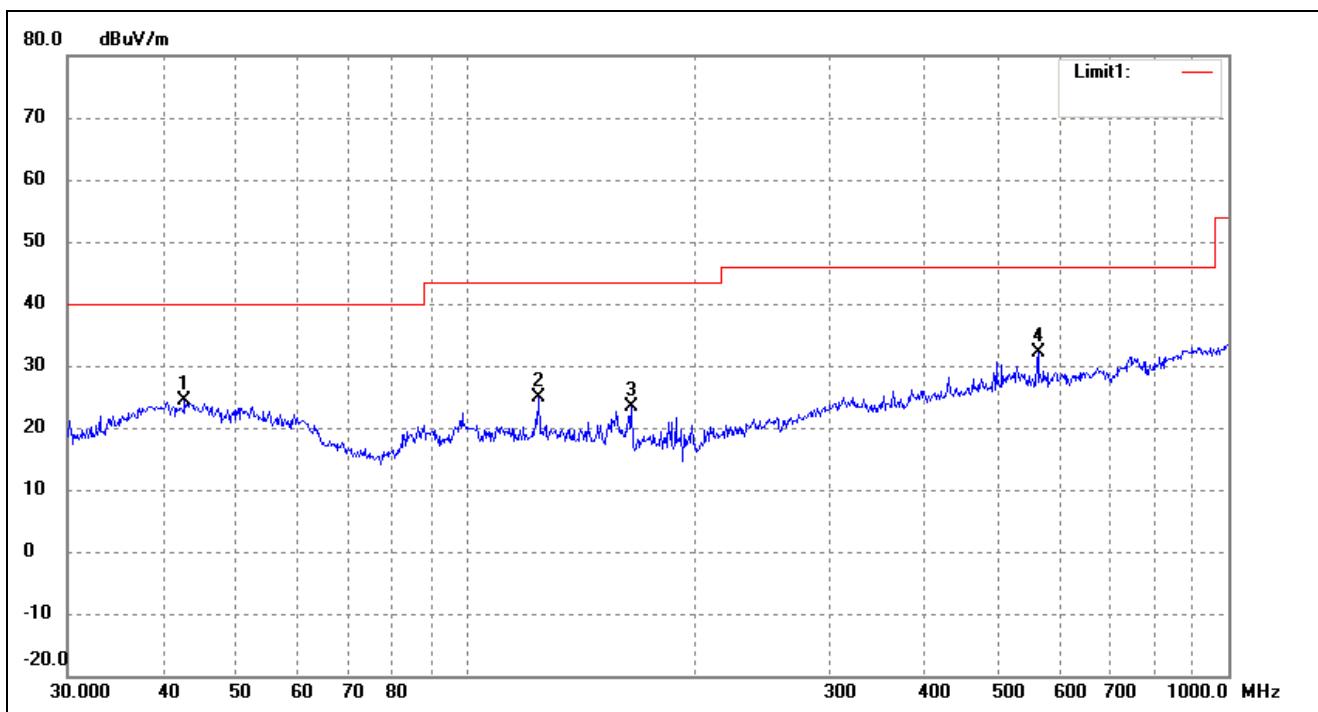
Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

For 802.11n-HT20

Spurious Emission From 30 MHz to 1 GHz

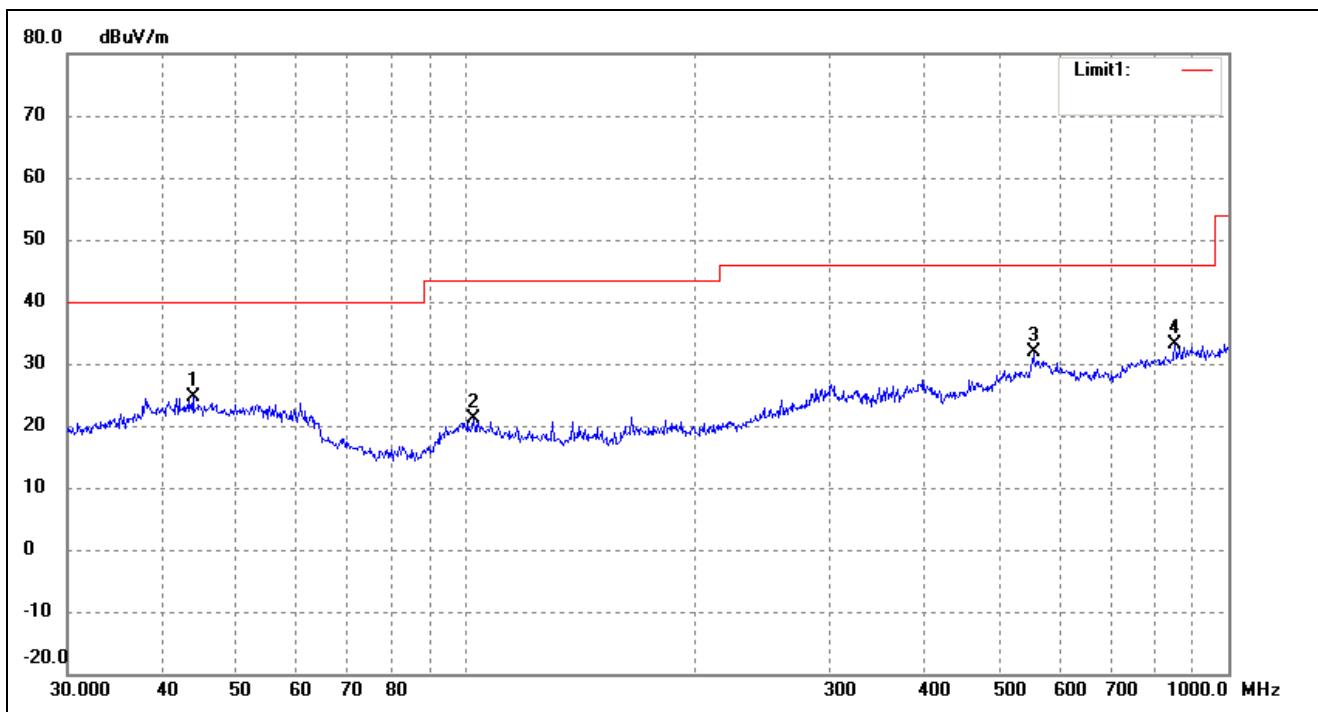
Test mode: Transmitting Channel 5180MHz

Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (•)	Height (cm)	Remark
1	42.7496	17.30	6.98	24.28	40.00	-15.72	35	100	peak
2	124.5690	21.12	3.65	24.77	43.50	-18.73	68	100	peak
3	164.9071	20.76	2.65	23.41	43.50	-20.09	105	100	peak
4	562.6624	20.52	11.67	32.19	46.00	-13.81	138	100	peak

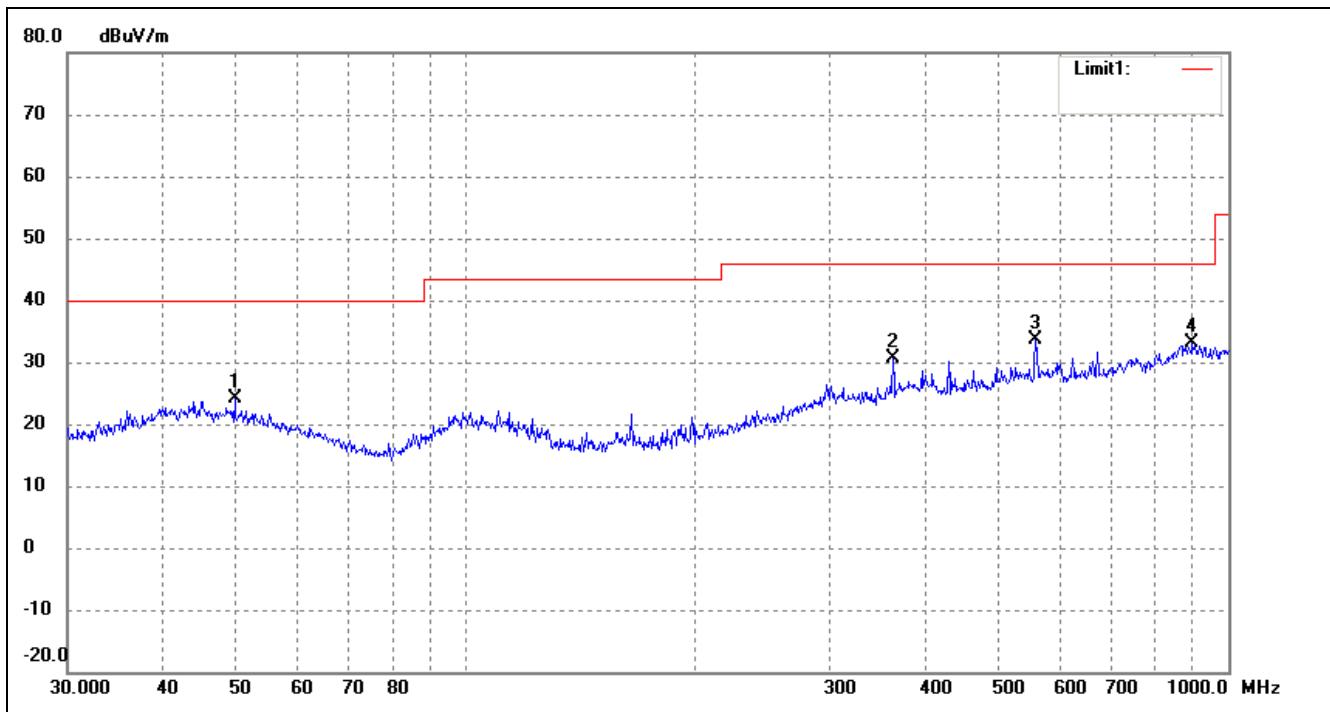
Test Specification: Vertical



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (•)	Height (cm)	Remark
1	43.8119	16.42	8.12	24.54	40.00	-15.46	41	100	peak
2	102.3597	15.15	5.88	21.03	43.50	-22.47	77	100	peak
3	554.8252	20.44	11.46	31.90	46.00	-14.10	114	100	peak
4	851.0353	17.11	15.97	33.08	46.00	-12.92	172	100	peak

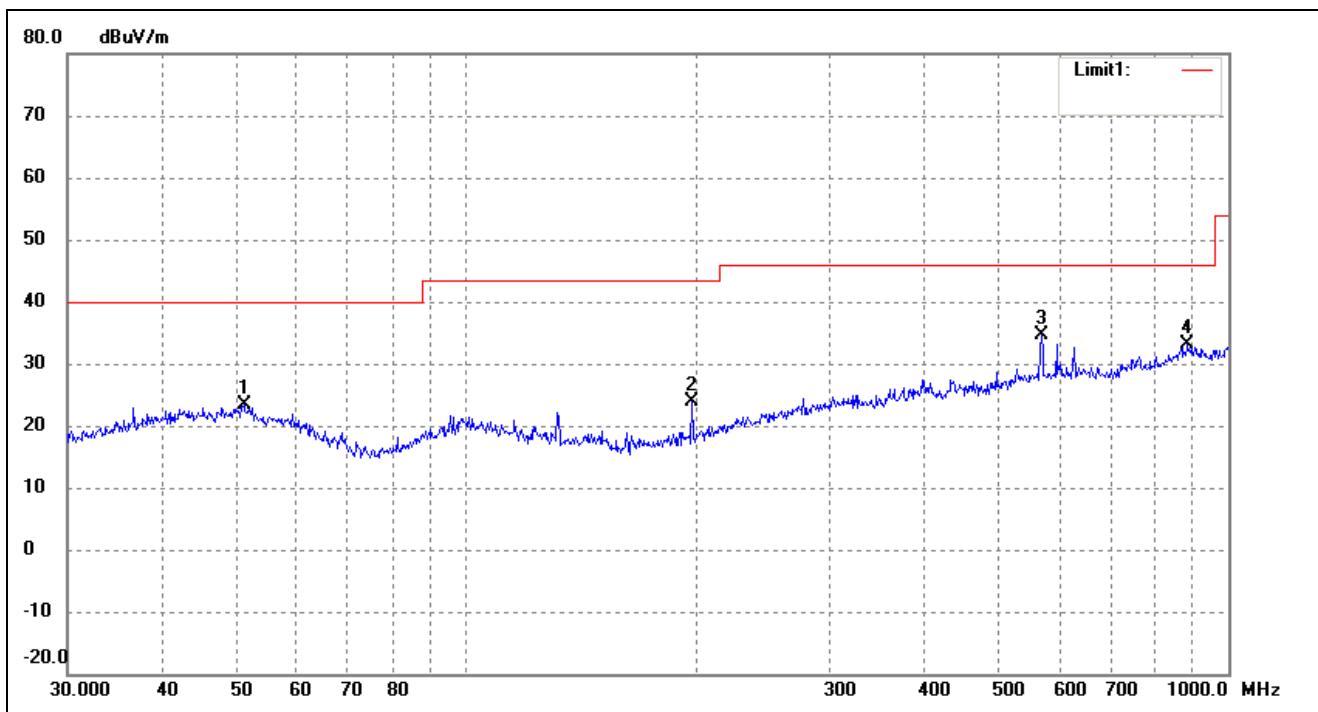
Test mode: Transmitting Channel 5200MHz

Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (•)	Height (cm)	Remark
1	49.7068	17.83	6.29	24.12	40.00	-15.88	39	100	peak
2	362.9845	21.39	9.24	30.63	46.00	-15.37	164	100	peak
3	558.7301	22.04	11.52	33.56	46.00	-12.44	204	100	peak
4	896.9964	16.18	16.85	33.03	46.00	-12.97	255	100	peak

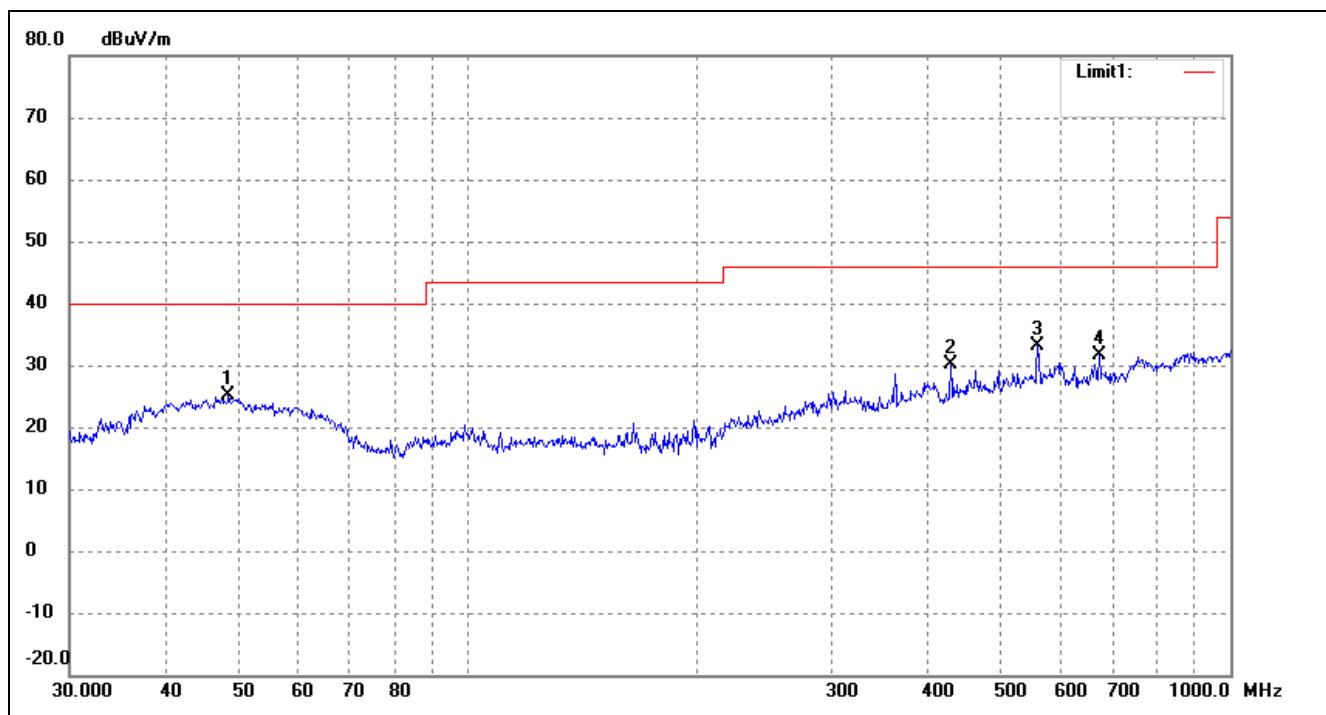
Test Specification: Vertical



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (•)	Height (cm)	Remark
1	51.1208	17.10	6.16	23.26	40.00	-16.74	50	100	peak
2	197.8927	20.40	3.58	23.98	43.50	-19.52	89	100	peak
3	568.6127	22.66	11.98	34.64	46.00	-11.36	135	100	peak
4	884.5028	16.19	16.83	33.02	46.00	-12.98	169	100	peak

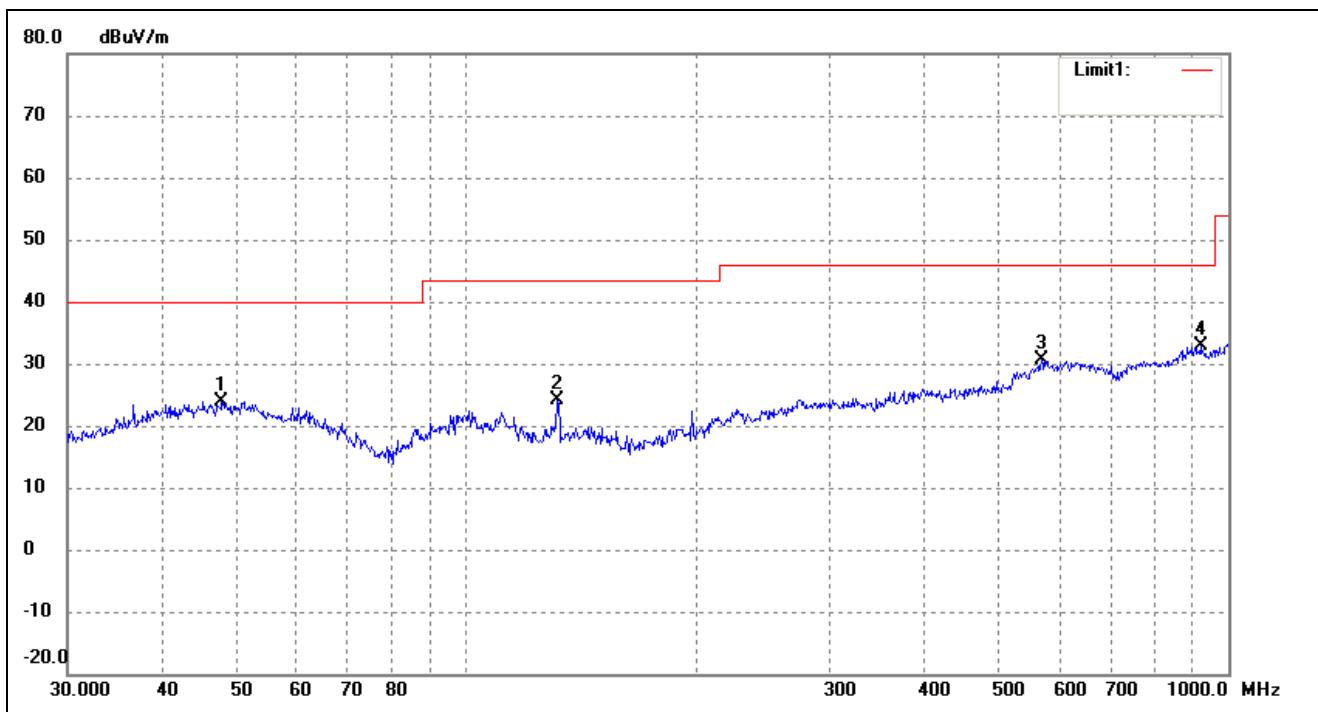
Test mode: Transmitting Channel 5240MHz

Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (•)	Height (cm)	Remark
1	48.5016	18.61	6.41	25.02	40.00	-14.98	44	100	peak
2	429.5228	20.36	9.68	30.04	46.00	-15.96	149	100	peak
3	558.7300	21.54	11.52	33.06	46.00	-12.94	183	100	peak
4	672.8445	19.38	12.22	31.60	46.00	-14.40	226	100	peak

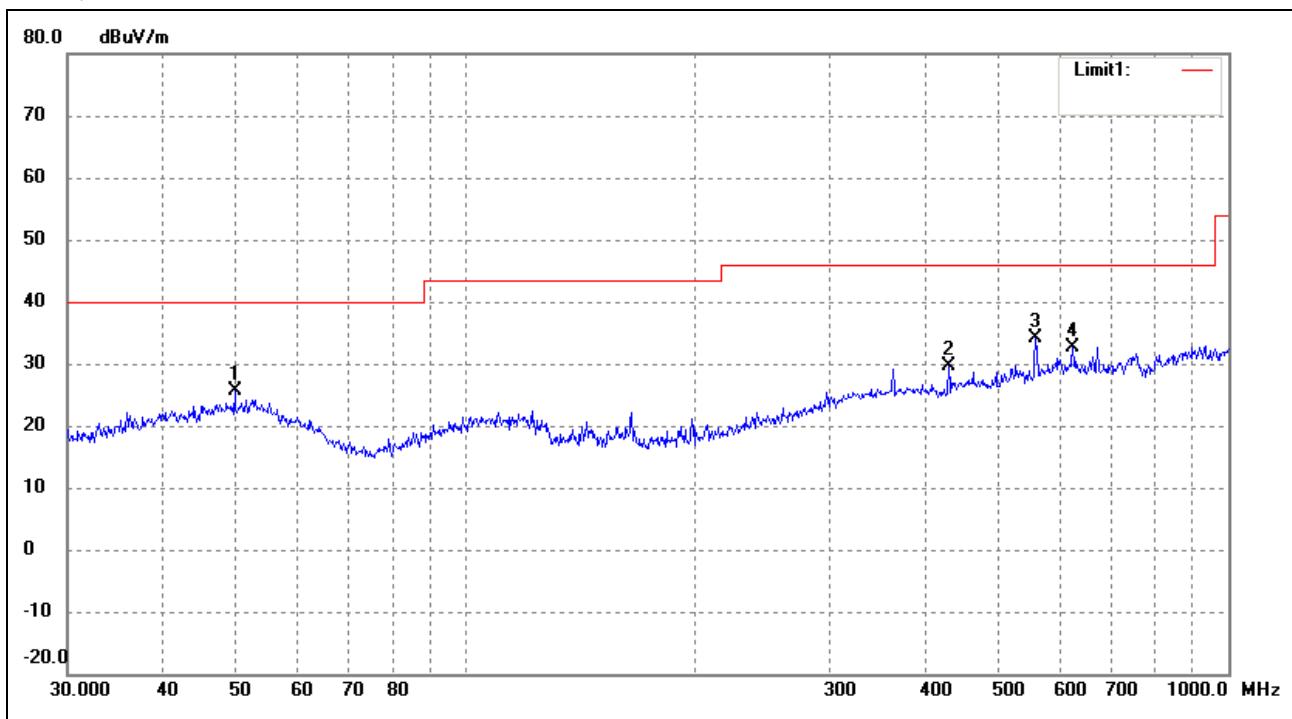
Test Specification: Vertical



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (•)	Height (cm)	Remark
1	47.8260	16.91	6.91	23.82	40.00	-16.18	42	100	peak
2	131.7574	21.00	3.07	24.07	43.50	-19.43	79	100	peak
3	568.6127	18.66	11.98	30.64	46.00	-15.36	176	100	peak
4	919.2866	16.36	16.50	32.86	46.00	-13.14	255	100	peak

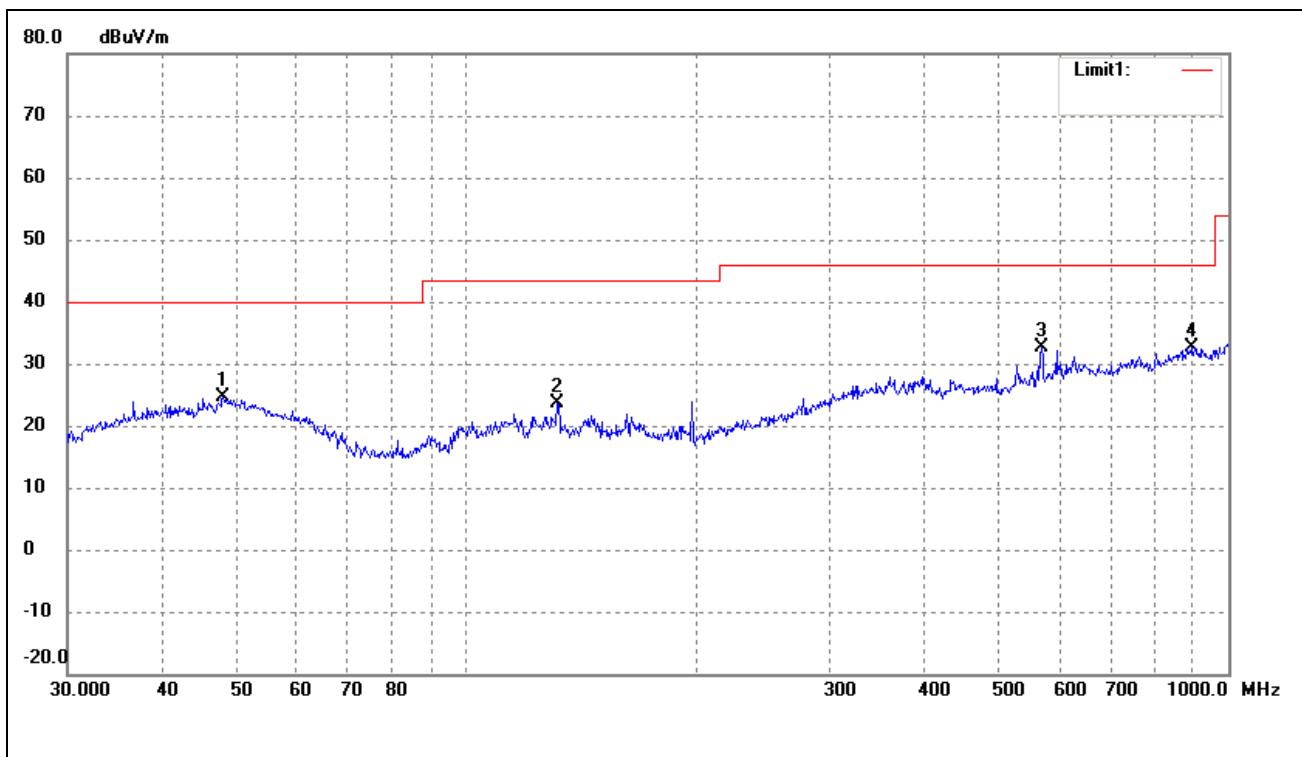
Test mode: Transmitting Channel 5745MHz

Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (°)	Height (cm)	Remark
1	49.7068	19.33	6.29	25.62	40.00	-14.38	46	100	peak
2	429.5228	19.86	9.68	29.54	46.00	-16.46	149	100	peak
3	558.7300	22.54	11.52	34.06	46.00	-11.94	169	100	peak
4	625.0778	20.58	12.11	32.69	46.00	-13.31	212	100	peak

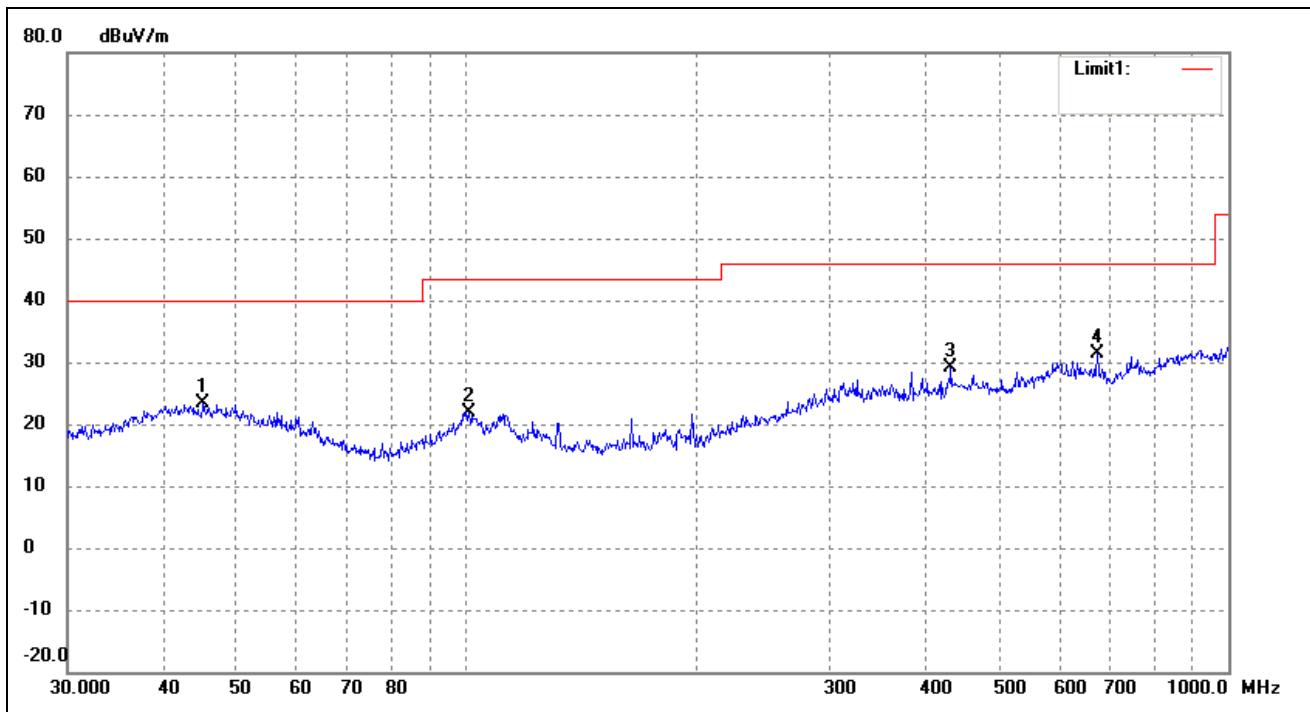
Test Specification: Vertical



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (•)	Height (cm)	Remark
1	47.9938	17.73	6.86	24.59	40.00	-15.41	39	100	peak
2	131.7574	20.50	3.07	23.57	43.50	-19.93	97	100	peak
3	568.6127	20.66	11.98	32.64	46.00	-13.36	156	100	peak
4	893.8567	15.68	16.85	32.53	46.00	-13.47	221	100	peak

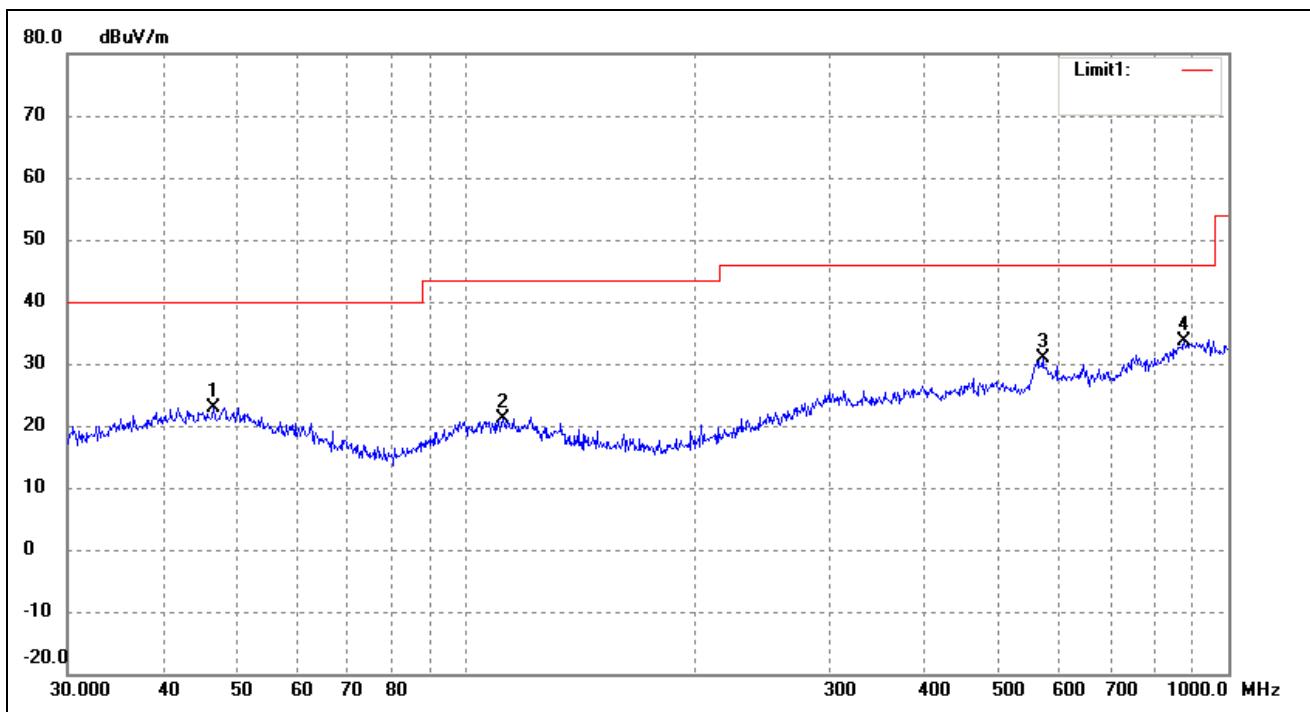
Test mode: Transmitting Channel 5785MHz

Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (•)	Height (cm)	Remark
1	45.2165	16.53	6.74	23.27	40.00	-16.73	45	100	peak
2	100.9338	15.83	6.03	21.86	43.50	-21.64	66	100	peak
3	432.5457	19.28	9.77	29.05	46.00	-16.95	157	100	peak
4	672.8445	19.24	12.22	31.46	46.00	-14.54	232	100	peak

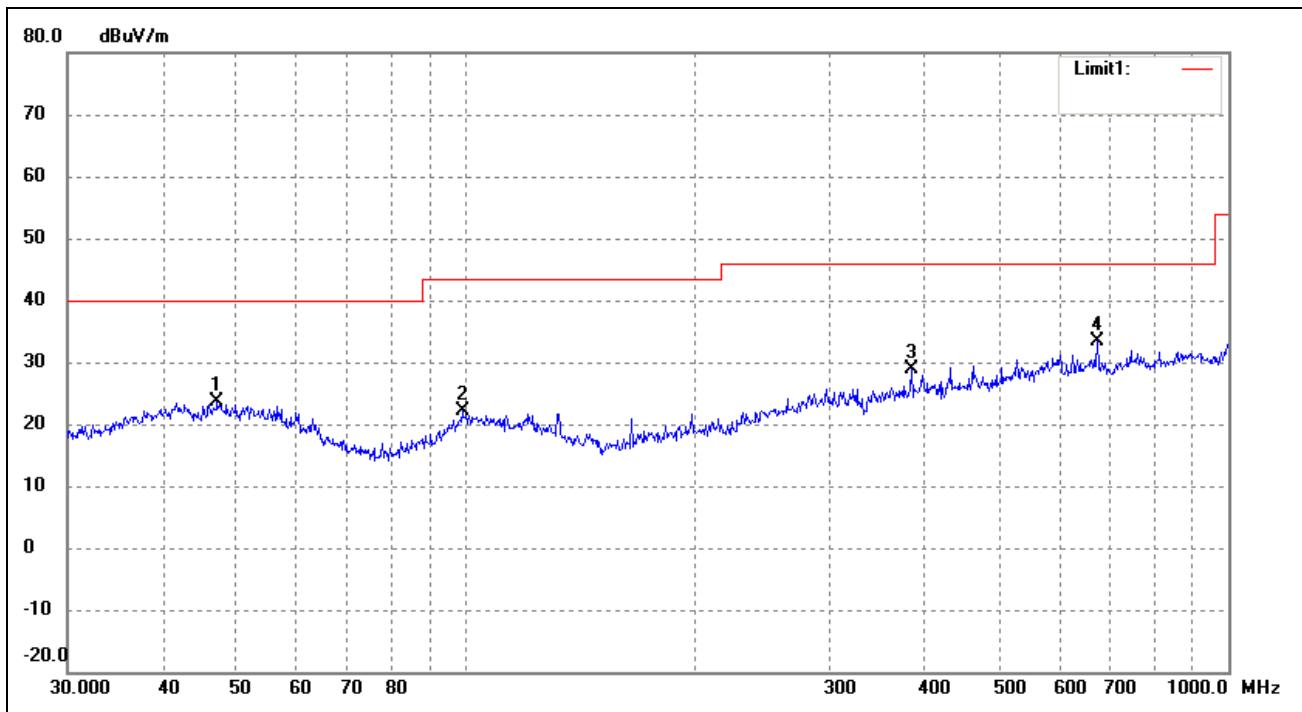
Test Specification: Vertical



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (•)	Height (cm)	Remark
1	46.6664	15.71	7.26	22.97	40.00	-17.03	51	100	peak
2	111.7378	16.15	4.89	21.04	43.50	-22.46	93	100	peak
3	570.6100	18.68	12.08	30.76	46.00	-15.24	164	100	peak
4	875.2468	16.84	16.70	33.54	46.00	-12.46	199	100	peak

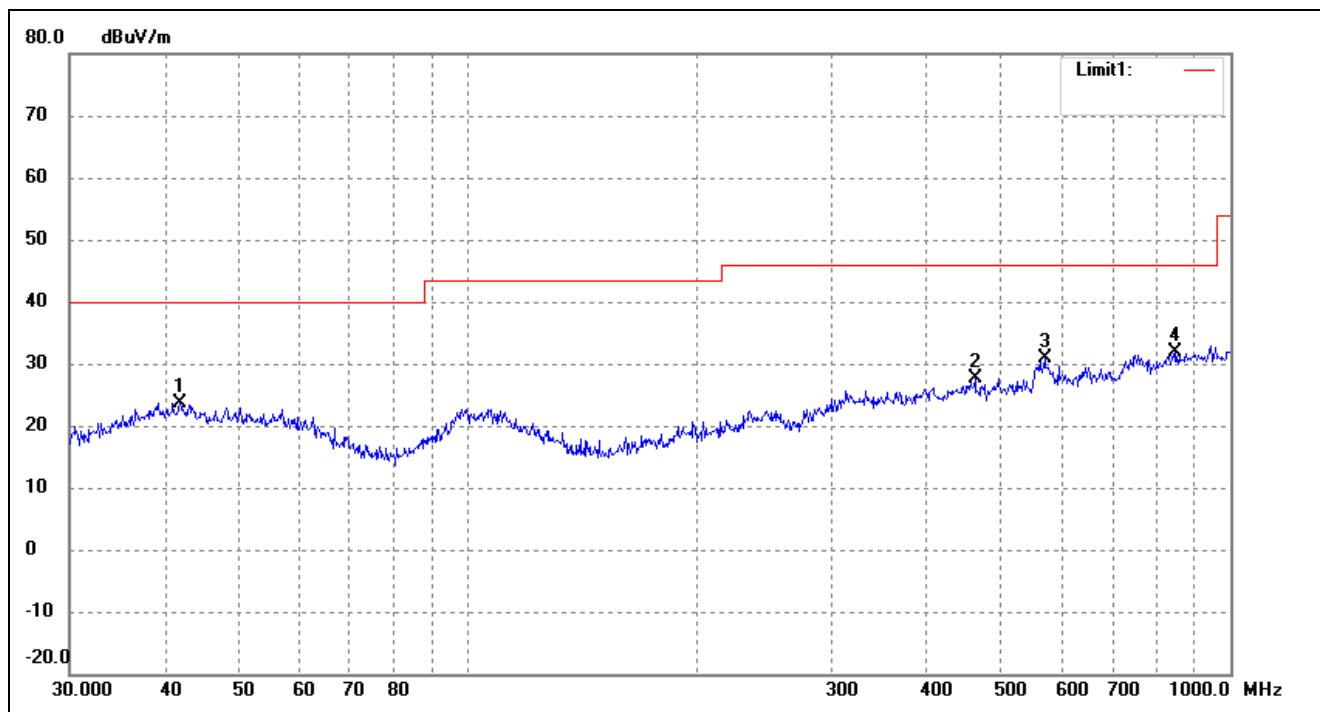
Test mode: Transmitting Channel 5825MHz

Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (•)	Height (cm)	Remark
1	47.1599	17.01	6.54	23.55	40.00	-16.45	36	100	peak
2	98.8324	16.40	5.84	22.24	43.50	-21.26	82	100	peak
3	383.9318	19.57	9.38	28.95	46.00	-17.05	164	100	peak
4	672.8445	21.24	12.22	33.46	46.00	-12.54	241	100	peak

Test Specification: Vertical

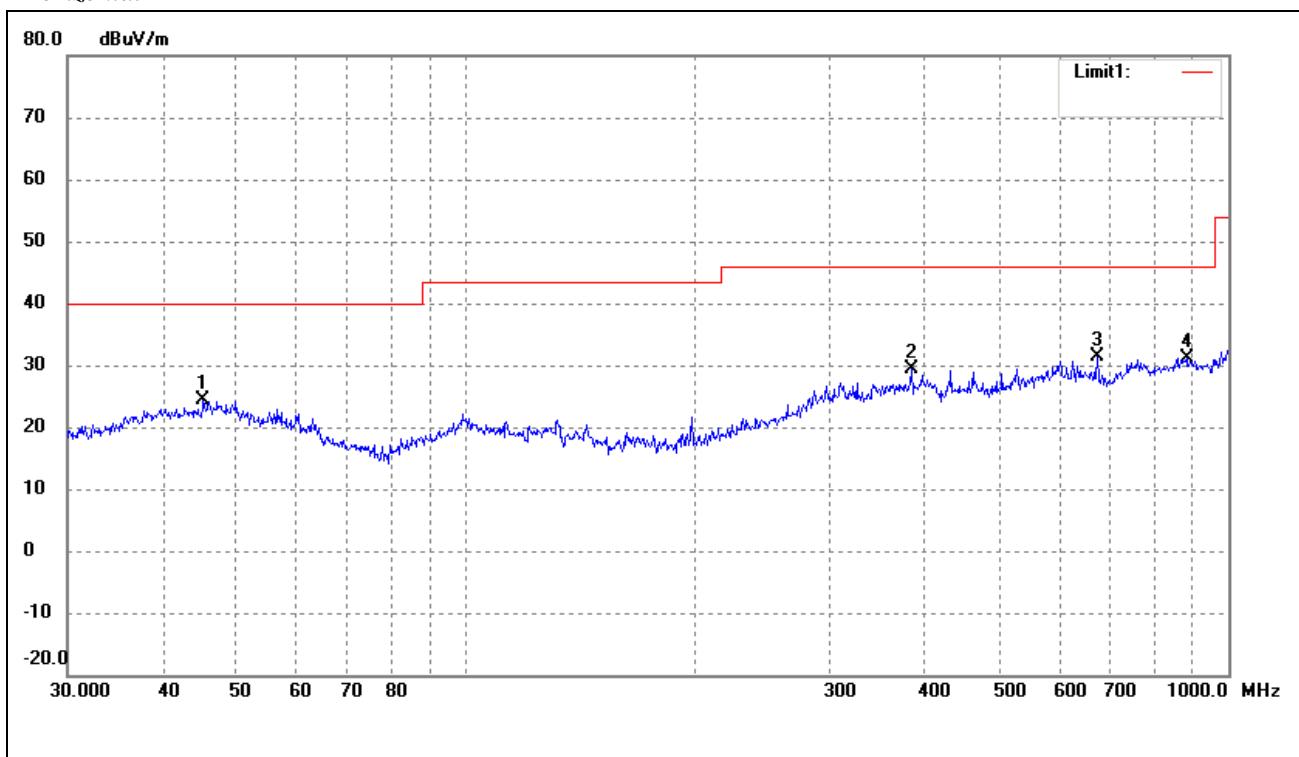


No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (•)	Height (cm)	Remark
1	41.8596	15.06	8.69	23.75	40.00	-16.25	46	100	peak
2	462.3455	17.11	10.50	27.61	46.00	-18.39	138	100	peak
3	570.6100	18.68	12.08	30.76	46.00	-15.24	175	100	peak
4	848.0561	15.92	15.86	31.78	46.00	-14.22	235	100	peak

For 802.11n-HT40

Test mode: Transmitting Channel 5180MHz

Horizontal



No.	Frequency (MHz)	Reading (dBuV/m)	Correct dB/m	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Degree (•)	Height (cm)	Remark
1	45.2165	17.53	6.74	24.27	40.00	-15.73	54	100	peak
2	383.9318	20.07	9.38	29.45	46.00	-16.55	125	100	peak
3	672.8445	19.24	12.22	31.46	46.00	-14.54	167	100	peak
4	881.4067	14.27	16.82	31.09	46.00	-14.91	241	100	peak