FCC 47 CFR PART 15 SUBPART E

for

802.11ac Gigabit Router

Model: SR905acv, SR905ac

Brand: SmartRG

Test Report Number:
C171214Z01-RP1-2

Issued Date: August 13, 2018

Issued for

SmartRG Inc.
501 SE Columbia Shores Boulevard, Suite 500 Vancouver, Washington 98661

Issued by:

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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	August 13, 2018	Initial Issue	ALL	Sinphy Xie

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1. TEST CERTIFICATION

Product	802.11ac Gigabit Router
Model	SR905acv, SR905ac
Brand	SmartRG
Tested	December 14, 2017~ August 13, 2018
Applicant	**SmartRG Inc.** 501 SE Columbia Shores Boulevard, Suite 500 Vancouver, Washington 98661
Manufacturer	**SmartRG Inc.** 501 SE Columbia Shores Boulevard, Suite 500 Vancouver, Washington 98661
Factory	**Taicang T&W Electronics Co., Ltd.** Jiangnan Road 89, Ludu Town, Taicang SUZHOU Jiangsu

APPLICABLE STANDARDS	
STANDARD	**TEST RESULT**
FCC 47 CFR Part 15 Subpart E	No non-compliance noted

We hereby certify that:

Compliance Certification Services (Shenzhen) Inc. tested the above equipment. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in **ANSI C63.10: 2013** and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.407、FCC 14-30.

The TEST RESULTS of this report relate only to the tested sample identified in this report.

Approved by:

Eve. Wang

Eve Wang
Supervisor of EMC Dept.
Compliance Certification Services (Shenzhen) Inc.

Reviewed by:

Nancy Fu

Nancy Fu
Supervisor of Report Dept.
Compliance Certification Services (Shenzhen) Inc.

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2. EUT DESCRIPTION

Product	802.11ac Gigabit Router
Model Number	SR905acv, SR905ac
Brand	SmartRG
Model Discrepancy	The model SR905acv of product name is “802.11ac Gigabit VoIP Router”, the model SR905ac of product name is “802.11ac Gigabit Router”, “SR905ac” is less VOIP ports than mode “SR905acv”.
Serial Number	C171214Z01-RP1-2
Received Date	December 14, 2017
Power Supply	DC 12V supply by the adapter
Adapter Specification	Shenzhen Gongjin Electronics Co., Ltd. S36B52-120A300-04 INPUT:100-240V,50/60Hz Max 1.0A OUTPUT: 12V,3A DC Cable: Unshielded, 1.50m
RJ45 Cable	Unshielded, 2.00m
RJ11 Cable	Unshielded, 2.00m
Frequency Range	UNII Band I: IEEE 802.11a, 802.11n HT20 : 5180MHz ~ 5240MHz; IEEE 802.11n HT40: 5190MHz ~ 5230MHz IEEE 802.11ac 80: 5210MHz UNII Band IV IEEE 802.11a, 802.11n HT20 : 5745MHz ~ 5825MHz IEEE 802.11n HT40: 5755MHz ~ 5795MHz IEEE 802.11ac 80: 5775MHz
Transmit Power	UNII Band I: IEEE 802.11a: 17.56dBm (Antenna 0) 17.70dBm (Antenna 1) 17.59dBm (Antenna 2) 18.23dBm (Antenna 3) IEEE 802.11n HT 20 MHz mode: 19.25dBm(Combine with antenna 0, antenna 1, antenna 2 and antenna 3) IEEE 802.11n HT 40 MHz mode: 19.59dBm(Combine with antenna 0, antenna 1, antenna 2 and antenna 3) IEEE 802.11ac 80: 19.77dBm(Combine with antenna 0, antenna 1, antenna 2 and antenna 3) UNII Band IV IEEE 802.11a: 20.93dBm (Antenna 0) 21.93dBm (Antenna 1) 20.92dBm (Antenna 2) 21.04dBm (Antenna 3) IEEE 802.11n HT 20 MHz mode: 24.87dBm (Combine with antenna 0, antenna 1, antenna 2 and antenna 3) IEEE 802.11n HT 40 MHz mode: 25.32dBm (Combine with antenna 0, antenna 1, antenna 2 and antenna 3) IEEE 802.11ac 80: 26.35dBm (Combine with antenna 0, antenna 1, antenna 2 and antenna 3)
Modulation Technique	OFDM (QPSK, BPSK, 16-QAM, 64-QAM, 256-QAM)

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Transmit Data Rate	IEEE 802.11a mode: 48, 36, 24, 18, 12, 9, 6Mbps IEEE802.11n HT20MHz mode(400ns GI): 28.8,57.6,86.8,115.6,173.2,231.2,260, 288.8Mbps IEEE802.11n HT40MHz mode(400ns GI): 60,120,180,240,360,480,540,600Mbps IEEE802.11ac 80 mode(400ns GI): 130,260,390,520,780,1040,1170,1300,1560, 1733.2Mbps
Number of Channels	UNII Band I: IEEE 802.11a, 802.11n HT20 : 4 Channels IEEE 802.11n HT40 : 2 Channels IEEE 802.11ac 80: 1 Channel UNII Band IV IEEE 802.11a, 802.11n HT20 : 5 Channels IEEE 802.11n HT 40 MHz mode: 2 Channels IEEE 802.11ac 80: 1 Channel
Antenna Specification	Internal antenna with 4.52dBi gain (Max)
Channels Spacing	IEEE 802.11a, 802.11n HT20 : 20MHz IEEE 802.11n HT40: 40MHz IEEE 802.11ac 80: 80MHz
Temperature Range	0°C ~ +45°C
Hardware Version	B3
Software Version	v10.5.2.1

Note: *1. The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.*

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Operation Frequency:

UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE (U-NII)	
CHANNEL	**MHz**
36	5180
38	5190
40	5200
42	5210
44	5220
46	5230
48	5240
149	5745
151	5755
153	5765
155	5775
157	5785
159	5795
161	5805
165	5825

Remark:

1. The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: VW7SR900 filing to comply with Section 15.407 of the FCC Part 15, Subpart E Rules and FCC 14-30.

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3. TEST METHODOLOGY

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10 Radiated testing was performed at an antenna to EUT distance 3 meters.
The tests documented in this report were performed in accordance with ANSI C63.10: 2013 and FCC CFR 47 Part 15.207, 15.209, 15.407 and FCC 14-30.
Radio testing was performed according to KDB DA 02-2138、KDB 789033 D02、KDB 905462 D06；

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed for RF field strength measurement to meet the Commissions requirement, and is operated in a manner intended to generate the maximum emission in a continuous normal application.

3.2 EUT EXERCISE

The EUT is operated in the engineering mode to fix the TX frequency for the purposes of measurement.
According to its specifications, the EUT must comply with the requirements of Section 15.407 under the FCC Rules Part 15 Subpart E.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is positioned at 0.8 m above the ground plane. According to the requirements in Section 6.2 of ANSI C63.10, the conducted emission from the EUT is measured in the frequency range between 0.15 MHz and 30MHz, using the CISPR Quasi-Peak detector mode.

Radiated Emissions

The EUT is placed on the turntable, which is 0.8 m (below 1GHz) /1.5m (Above 1GHz) above the ground plane. The turntable is then rotated for 360 degrees to determine the proper orientation for the maximum emission level. The EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission level. And, each emission is to be maximized by changing the horizontal and vertical polarization of the receiving antenna. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.4 to Section 6.6 of ANSI C63.10.

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3.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	([2])
13.36 - 13.41	322 - 335.4		

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2] Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

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3.5 DESCRIPTION OF TEST MODES

The EUT is a 4x4 configuration spatial MIMO (4TX & 4RX) without beam forming function. Use "Lantiq DUT" to control the EUT for staying in continuous transmitting mode was programmed.

Test Item	Test mode	Worse mode
Conducted Emission	**Mode 1:** Full system (AC120V/60Hz)	☒
	Mode 2: Full system (AC240V/50Hz)	☒
Radiated Emission	**Mode 4:** Continuously Transmitting	☒

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz, which worst case was in normal link mode only.

UNII Band I:

IEEE 802.11a for 5180 ~ 5240MHz:
Channel Low (5180MHz), Channel Mid (5200MHz) and Channel High (5240MHz) with 6Mbps data rate were chosen for full testing.

IEEE 802.11n HT 20 MHz for 5180 ~ 5240MHz:
Channel Low (5180MHz), Channel Mid (5200MHz) and Channel High (5240MHz) with 28.8Mbps data rate were chosen for full testing.

IEEE 802.11n HT 40 MHz Channel for 5190 ~ 5230MHz:
Channel Low (5190MHz) and Channel High (5230MHz) with 60Mbps data rate were chosen for full testing.

IEEE 802.11ac 80 Channel for 5210MHz:
Channel Low (5210MHz) with 130Mbps data rate were chosen for full testing.

UNII Band IV:

IEEE 802.11a for 5745 ~ 5825MHz:
Channel Low (5745MHz), Channel Mid (5785MHz) and Channel High (5825MHz) with 6Mbps data rate were chosen for full testing.

IEEE 802.11n HT 20 MHz for 5745 ~ 5825MHz:
Channel Low (5745MHz), Channel Mid (5785MHz) and Channel High (5825MHz) with 28.8Mbps data rate were chosen for full testing.

IEEE 802.11n HT 40 MHz Channel for 5755~ 5795MHz:
Channel Low (5755MHz) and Channel High (5795MHz) with 60Mbps data rate were chosen for full testing.

IEEE 802.11ac 80 Channel for 5775MHz:
Channel Low (5775MHz) with 130Mbps data rate were chosen for full testing.

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4. SETUP OF EQUIPMENT UNDER TEST

4.1 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

No.	Equipment	Model No.	Serial No.	FCC ID	Brand	Data Cable	Power Cord
1	Notebook	TianYi 310-14ISK	MP18DLC6	DoC	LENOVO	N/A	N/A
2	Adapter	ADLX65NCC3A	N/A	N/A	LENOVO	Unshielded 2.00m	Unshielded 1.00m (AC Cable) Shielded 1.80m (DC Cable)

Note:

Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

4.2 CONFIGURATION OF SYSTEM UNDER TEST

See test photographs attached in Appendix II for the actual connections between EUT and support equipment.

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4.3 TEST INSTRUMENTS

Conducted Emission Test Site					
Name of Equipment	**Manufacturer**	**Model Number**	**Serial Number**	**Last Calibration**	**Due Calibration**
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100783	01/27/2018	01/26/2019
LISN(EUT)	ROHDE&SCHWARZ	ENV216	101543-WX	01/27/2018	01/26/2019
LISN	EMCO	3825/2	8901-1459	01/27/2018	01/26/2019
Temp. / Humidity Meter	VICTOR	HTC-1	N/A	01/29/2018	01/28/2019
Test S/W	FARAD	EZ-EMC/ CCS-3A1-CE			

Radiated Emission Test Site 966 (2)					
Name of Equipment	**Manufacturer**	**Model Number**	**Serial Number**	**Last Calibration**	**Due Calibration**
Spectrum Analyzer	Agilent	N9010A	MY52221469	01/27/2018	01/26/2019
EMI TEST RECEIVER	ROHDE&SCHWARZ	ESCI	100783	01/27/2018	01/26/2019
Amplifier	EMEC	EM330	060661	01/27/2018	01/26/2019
High Noise Amplifier	Agilent	8449B	3008A01838	01/27/2018	01/26/2019
Loop Antenna	COM-POWER	AL-130	121044	01/30/2018	01/29/2019
Bilog Antenna	SCHAFFNER	CBL6143	5082	02/21/2018	02/20/2019
Horn Antenna	SCHWARZBECK	BBHA9120	D286	01/27/2018	01/26/2019
Board-Band Horn Antenna	Schwarzbeck	BBHA 9170	9170-497	01/24/2018	01/23/2019
Turn Table	N/A	N/A	N/A	N.C.R	N.C.R
Antenna Tower	SUNOL	TLT2	N/A	N.C.R	N.C.R
Controller	Sunol Sciences	SC104V	022310-1	N.C.R	N.C.R
Controller	CT	N/A	N/A	N.C.R	N.C.R
Temp. / Humidity Meter	Anymetre	JR913	N/A	01/29/2018	01/28/2019
Test S/W	FARAD	LZ-RF / CCS-SZ-3A2			

26dB Bandwidth					
Name of Equipment	**Manufacturer**	**Model Number**	**Serial Number**	**Last Calibration**	**Due Calibration**
Spectrum Analyzer	Agilent	N9010A	MY52221469	01/27/2018	01/26/2019

6dB Bandwidth					
Name of Equipment	**Manufacturer**	**Model Number**	**Serial Number**	**Last Calibration**	**Due Calibration**
Spectrum Analyzer	Agilent	N9010A	MY52221469	01/27/2018	01/26/2019

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Antenna Gain					
Name of Equipment	**Manufacturer**	**Model Number**	**Serial Number**	**Last Calibration**	**Due Calibration**
Spectrum Analyzer	Agilent	N9010A	MY52221469	01/27/2018	01/26/2019

Peak Output Power					
Name of Equipment	**Manufacturer**	**Model Number**	**Serial Number**	**Last Calibration**	**Due Calibration**
Power Meter	Anritsu	ML2495A	1204003	01/27/2018	01/26/2019
Power Sensor	Anritsu	MA2411B	1126150	01/27/2018	01/26/2019

Band edges					
Name of Equipment	**Manufacturer**	**Model Number**	**Serial Number**	**Last Calibration**	**Due Calibration**
Spectrum Analyzer	Agilent	N9010A	MY52221469	01/27/2018	01/26/2019

Peak Power Spectral Density					
Name of Equipment	**Manufacturer**	**Model Number**	**Serial Number**	**Last Calibration**	**Due Calibration**
Spectrum Analyzer	Agilent	N9010A	MY52221469	01/27/2018	01/26/2019

Antenna Conducted Spurious Emission					
Name of Equipment	**Manufacturer**	**Model Number**	**Serial Number**	**Last Calibration**	**Due Calibration**
Spectrum Analyzer	Agilent	N9010A	MY52221469	01/27/2018	01/26/2019

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

2. N.C.R = No Calibration Request.

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5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

All measurement facilities used to collect the measurement data are located at
No.10-1 Mingkeda Logistics park, No.18, Huanguan South Rd., Guan Lan Town, Baoan District, Shenzhen, China

The sites are constructed in conformance with the requirements of ANSI C63.10, ANSI C63.7 and CISPR Publication 22.

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.
Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.
Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

5.3 ACCREDITATIONS

Our laboratories are accredited and approved by the following accreditation body according to ISO/IEC 17025.

USA	**A2LA**
China	**CNAS**

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

USA	**FCC**
Japan	**VCCI(C-3478, R-3135, T-652, G-10624)**
Canada	**INDUSTRY CANADA**

Copies of granted accreditation certificates are available for downloading from our web site, http://www.ccssz.com

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5.4 MEASUREMENT UNCERTAINTY

Parameter	Uncertainty
RF frequency	+/-1 * 10-5
RF power conducted	+/- 1,5 dB
RF power radiated	+/- 6 dB
Spurious emissions, conducted	+/- 3 dB
Spurious emissions, radiated	+/- 6 dB
Humidity	+/- 5 %
Temperature	+/- 1°C
Time	+/-10 %

Remark: *This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.*

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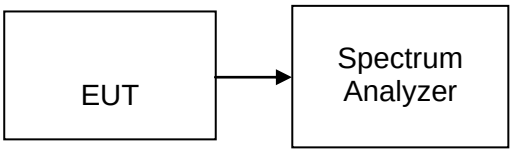
6. FCC PART 15 REQUIREMENTS

6.1 26dB EMISSION BANDWIDTH

6.1.1 LIMIT

According to §15.403(c), for purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Compliance with the emissions limits is based on the use of measurement instrumentation employing a peak detector function with an instrument resolutions bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

6.1.2 TEST CONFIGURATION



6.1.3TEST PROCEDURE

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low-loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW > 1%EBW, VBW > RBW, Span >26dB bandwidth, Detector = Peak, and Sweep = auto.
4. Mark the peak frequency and –26dB (upper and lower) frequency.
5. Repeat until all the rest channels were investigated.

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6.1.4 TEST RESULTS

No non-compliance noted

Test Data

Test mode: IEEE 802.11a mode / 5180 ~ 5240MHz

Channel	Frequency (MHz)	26dB Bandwidth(B) (MHz)			
		Antenna 0	Antenna 1	Antenna 2	Antenna 3
Low	5180	22.87	21.85	22.34	22.40
Mid	5200	22.96	22.61	22.51	23.02
High	5240	22.32	22.51	22.81	22.51

Test mode: IEEE 802.11n HT 20 MHz mode / 5180 ~ 5240MHz

Channel	Frequency (MHz)	26dB Bandwidth(B) (MHz)			
		Antenna 0	Antenna 1	Antenna 2	Antenna 3
Low	5180	23.89	23.80	23.42	23.28
Mid	5200	23.95	23.45	22.90	23.41
High	5240	23.80	24.08	23.15	23.66

Test mode: IEEE 802.11n HT 40 MHz mode / 5190 ~ 5230MHz

Channel	Frequency (MHz)	26dB Bandwidth(B) (MHz)			
		Antenna 0	Antenna 1	Antenna 2	Antenna 3
Low	5190	43.05	41.98	43.13	42.57
High	5230	43.39	42.87	43.68	42.70

Test mode: IEEE 802.11ac 80 mode / 5210MHz

Channel	Frequency (MHz)	26dB Bandwidth(B) (MHz)			
		Antenna 0	Antenna 1	Antenna 2	Antenna 3
	5210	83.56	81.87	83.57	82.24

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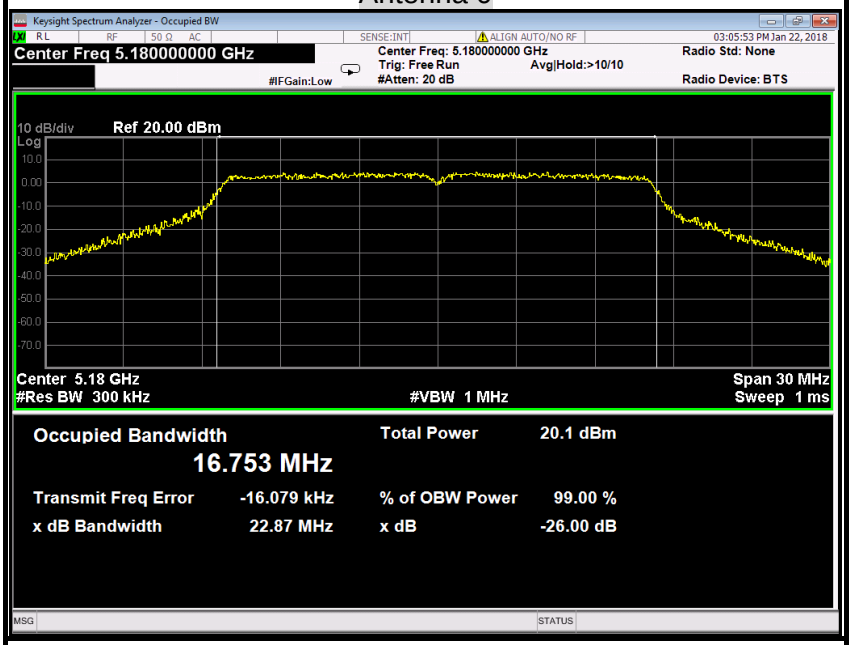
Test Plot

IEEE 802.11a mode / 5180 ~ 5240MHz

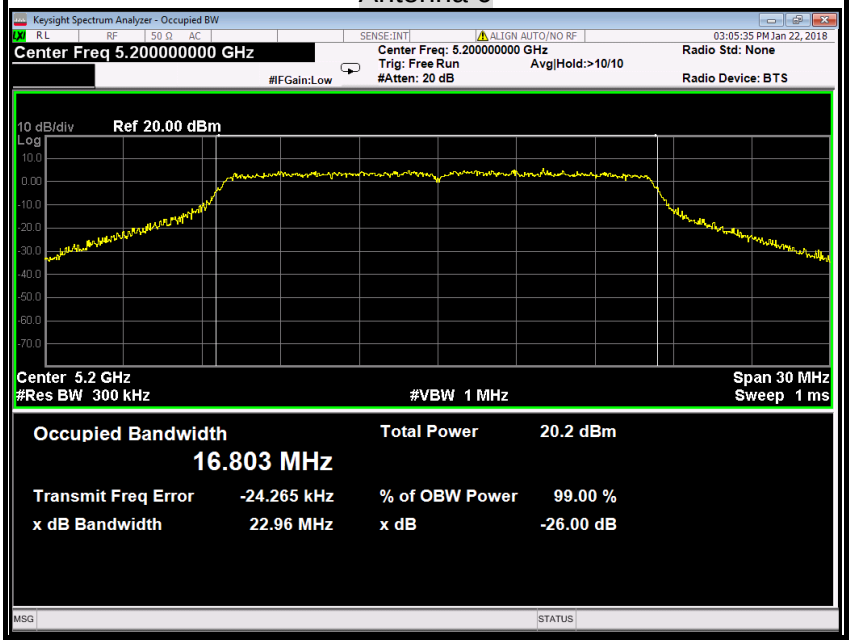
26dB Bandwidth (CH Low)

Antenna 0



26dB Bandwidth (CH Mid)

Antenna 0



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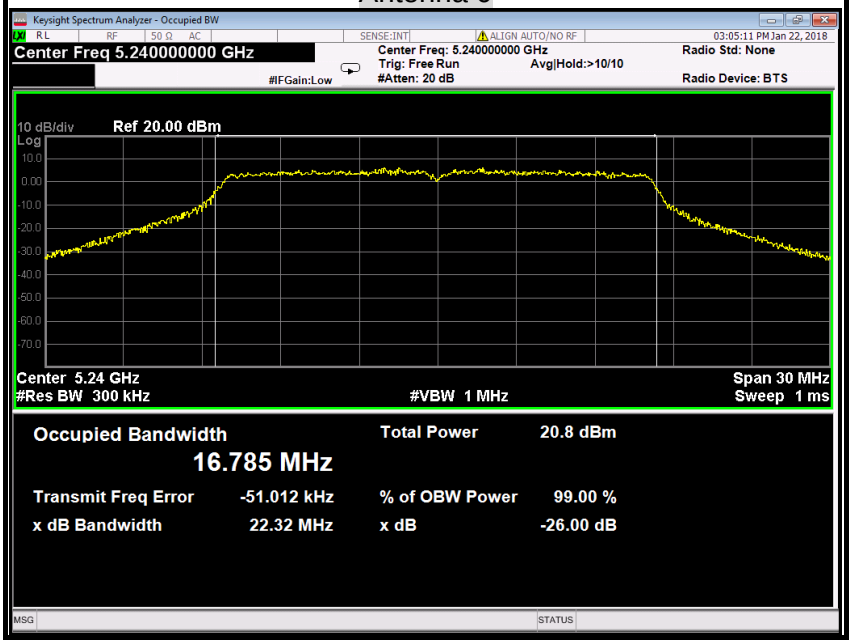
26dB Bandwidth (CH High)

Antenna 0



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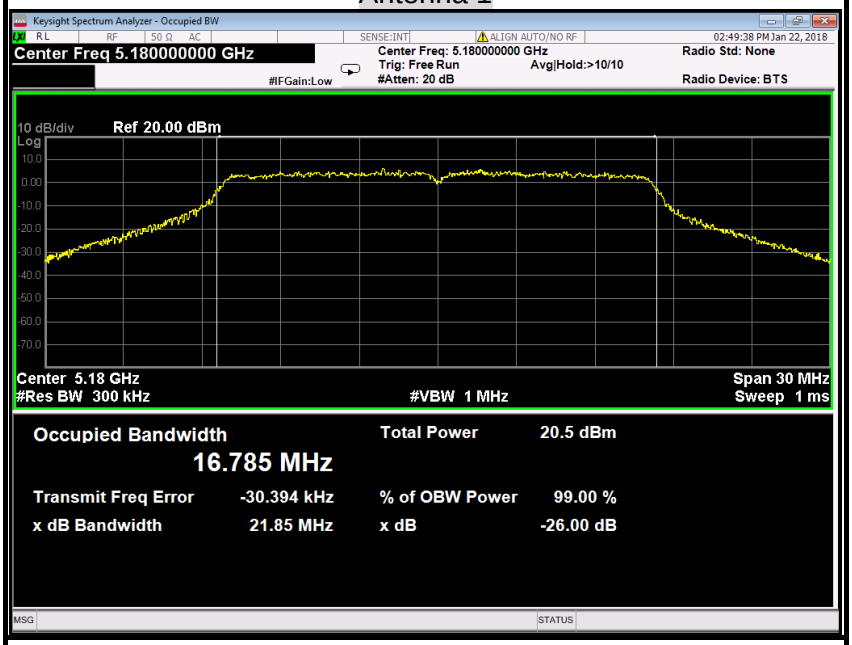
IEEE 802.11a mode / 5180 ~ 5240MHz

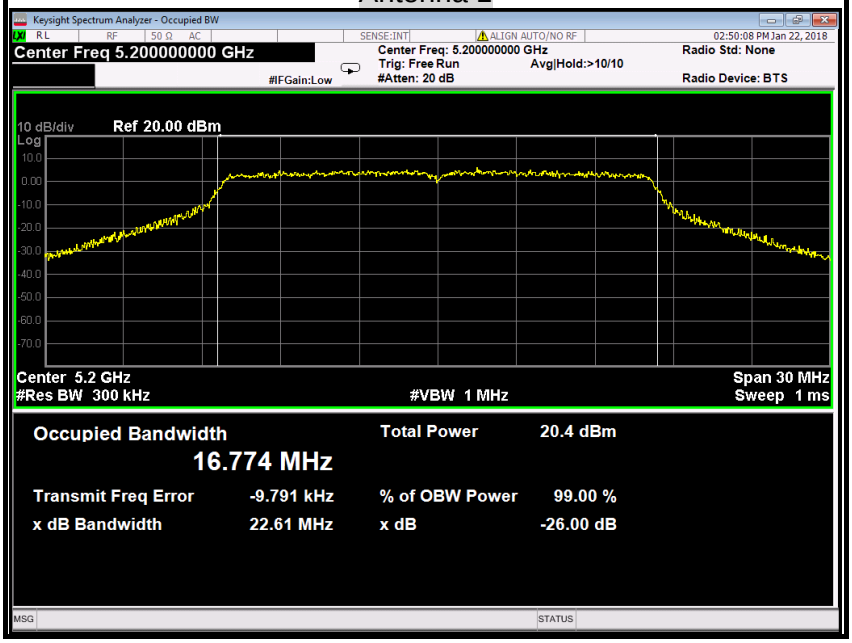
26dB Bandwidth (CH Low)

Antenna 1



26dB Bandwidth (CH Mid)

Antenna 1



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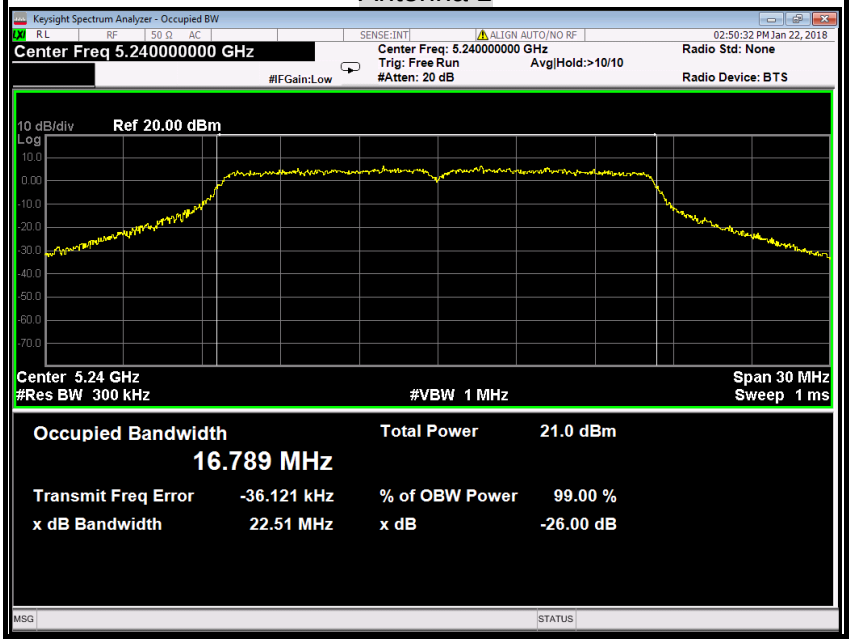
26dB Bandwidth (CH High)

Antenna 1



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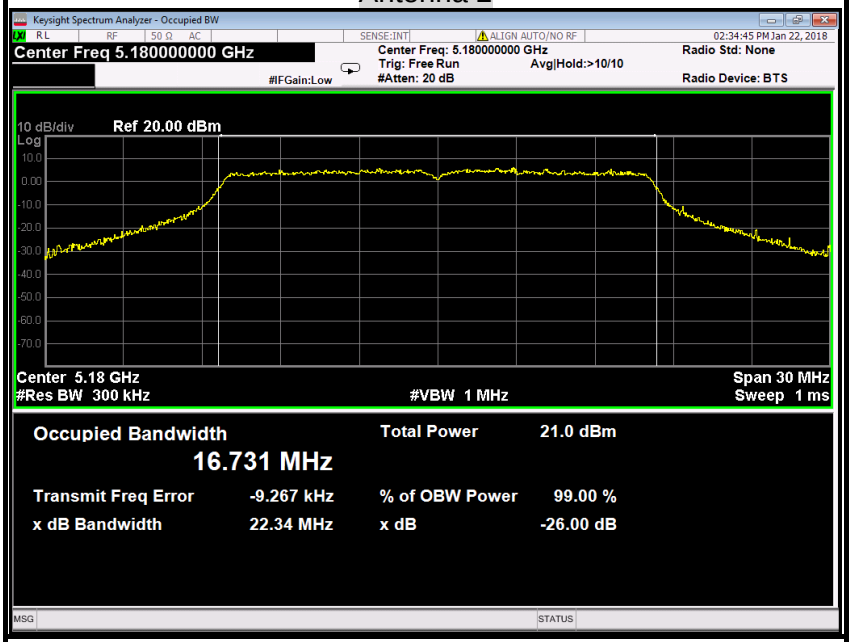
IEEE 802.11a mode / 5180 ~ 5240MHz

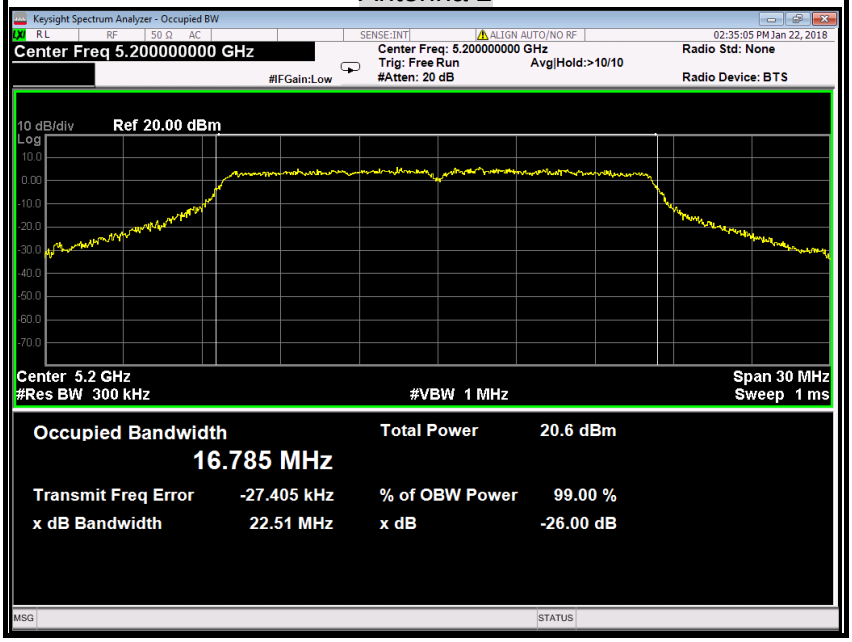
26dB Bandwidth (CH Low)

Antenna 2



26dB Bandwidth (CH Mid)

Antenna 2



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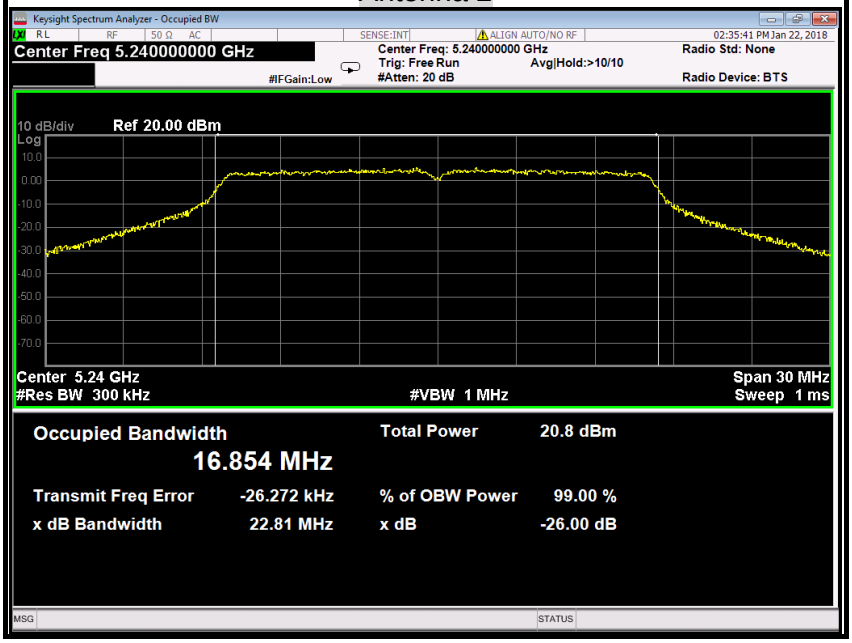
26dB Bandwidth (CH High)

Antenna 2



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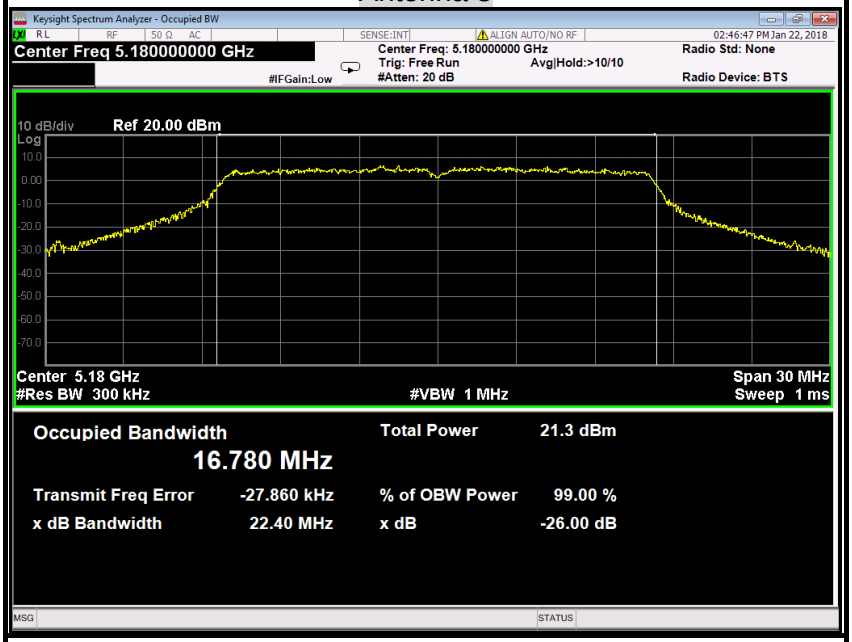
IEEE 802.11a mode / 5180 ~ 5240MHz

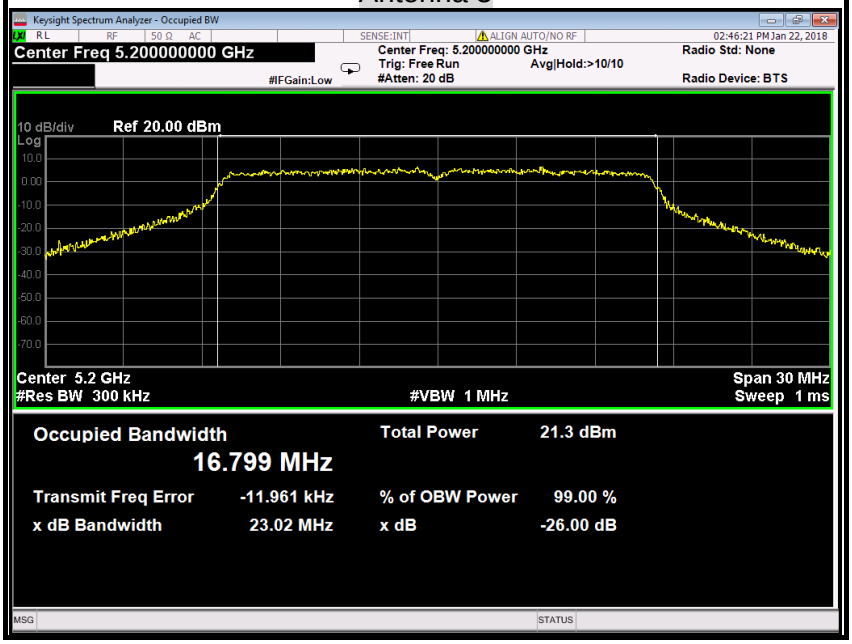
26dB Bandwidth (CH Low)

Antenna 3



26dB Bandwidth (CH Mid)

Antenna 3



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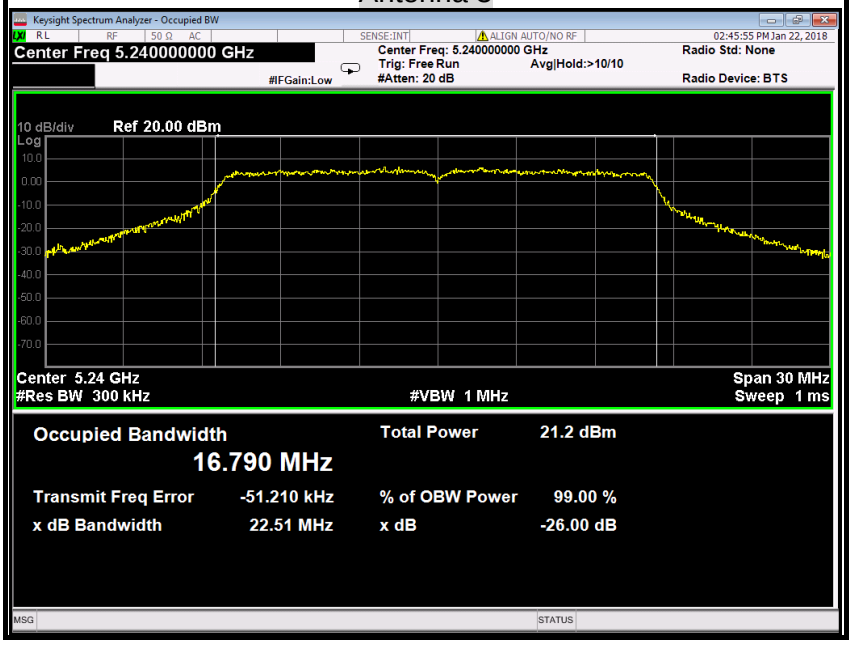
26dB Bandwidth (CH High)

Antenna 3



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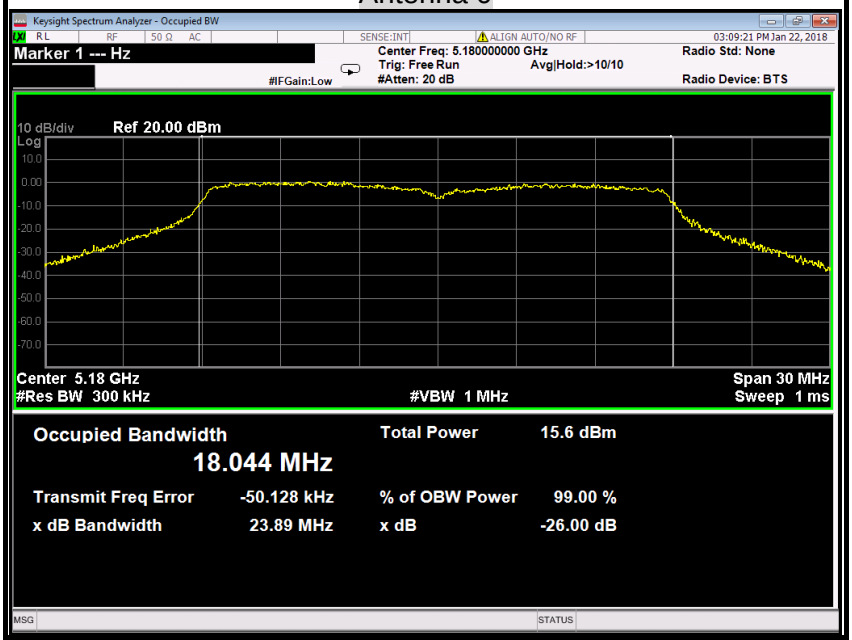
IEEE 802.11n HT 20 MHz mode / 5180 ~ 5240MHz

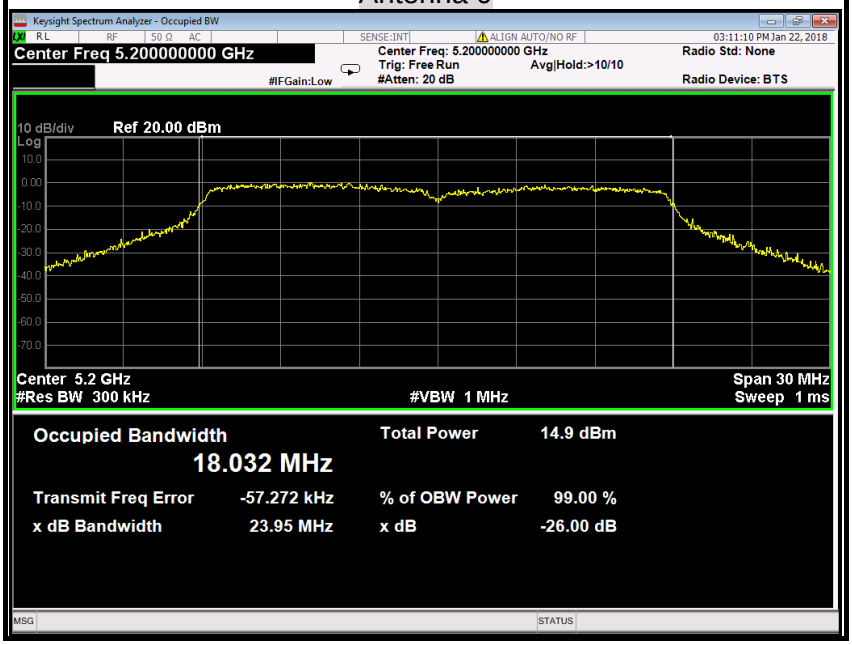
26dB Bandwidth (CH Low)

Antenna 0



26dB Bandwidth (CH Mid)

Antenna 0



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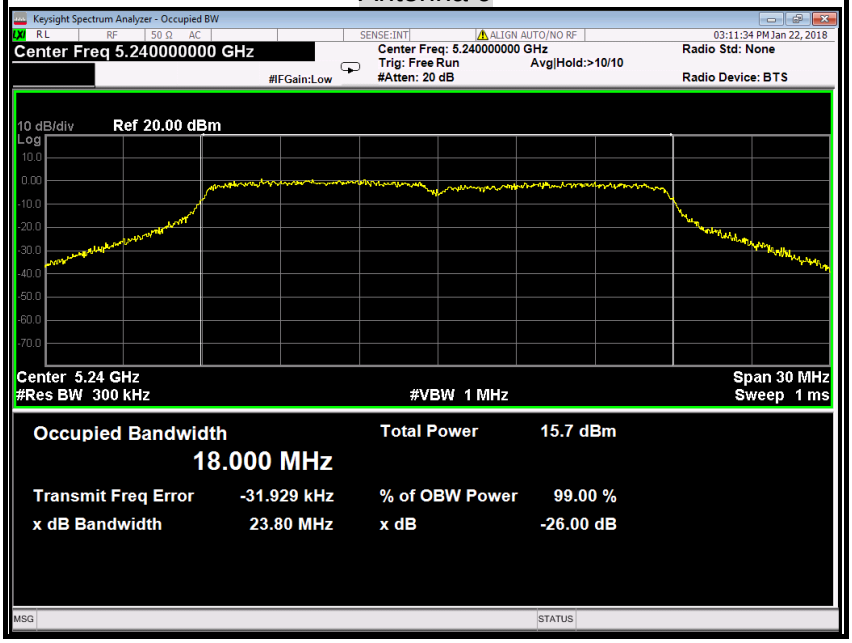
26dB Bandwidth (CH High)

Antenna 0



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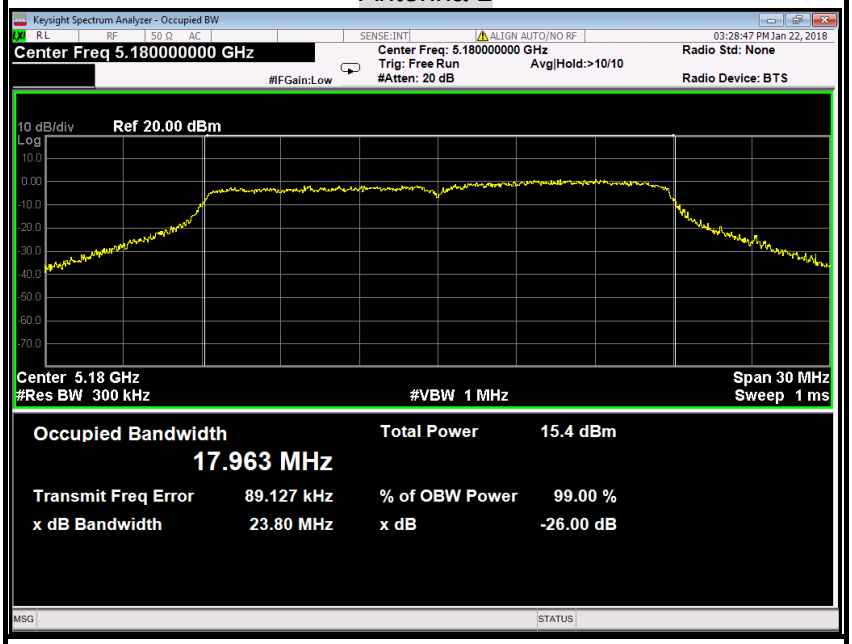
IEEE 802.11n HT 20 MHz mode / 5180 ~ 5240MHz

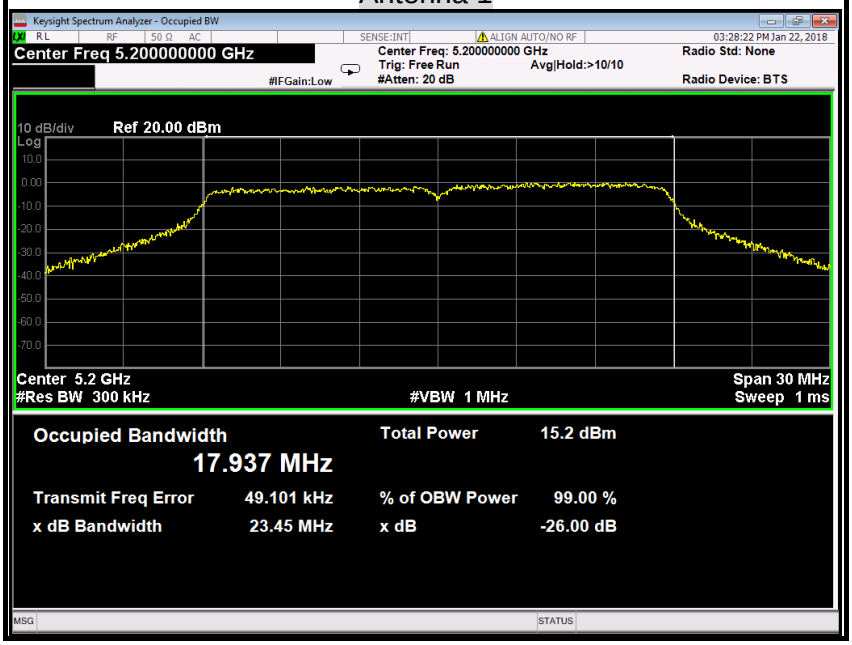
26dB Bandwidth (CH Low)

Antenna 1



26dB Bandwidth (CH Mid)

Antenna 1



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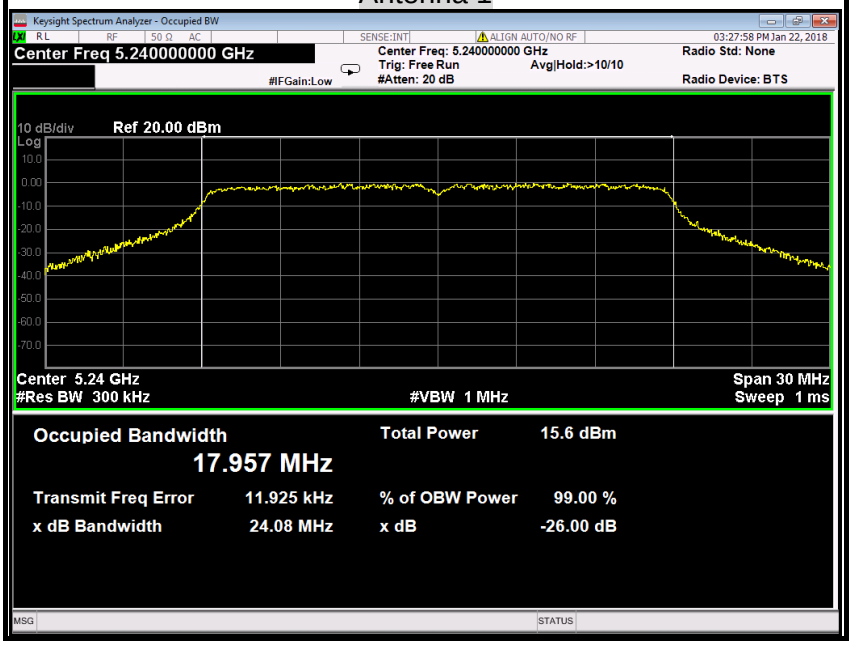
26dB Bandwidth (CH High)

Antenna 1



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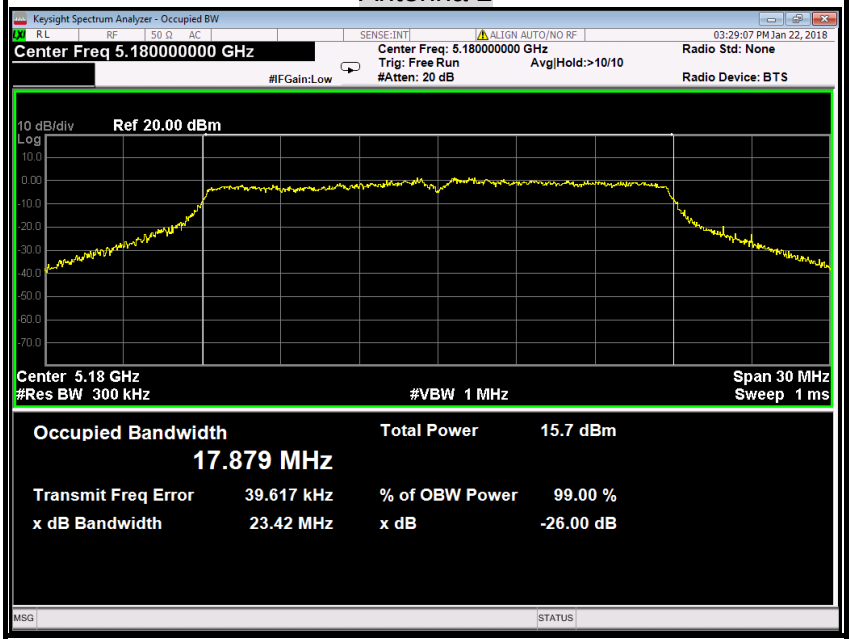
IEEE 802.11n HT 20 MHz mode / 5180 ~ 5240MHz

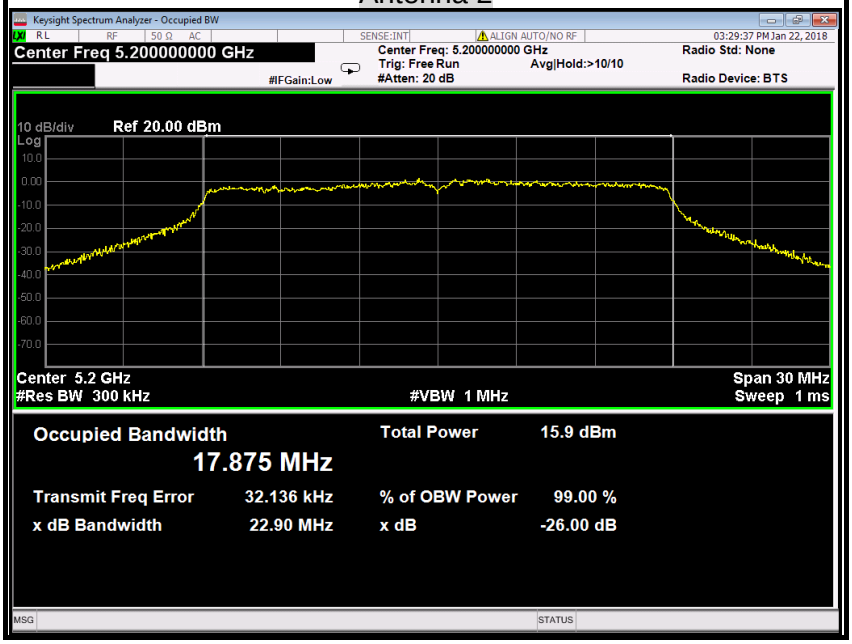
26dB Bandwidth (CH Low)

Antenna 2



26dB Bandwidth (CH Mid)

Antenna 2



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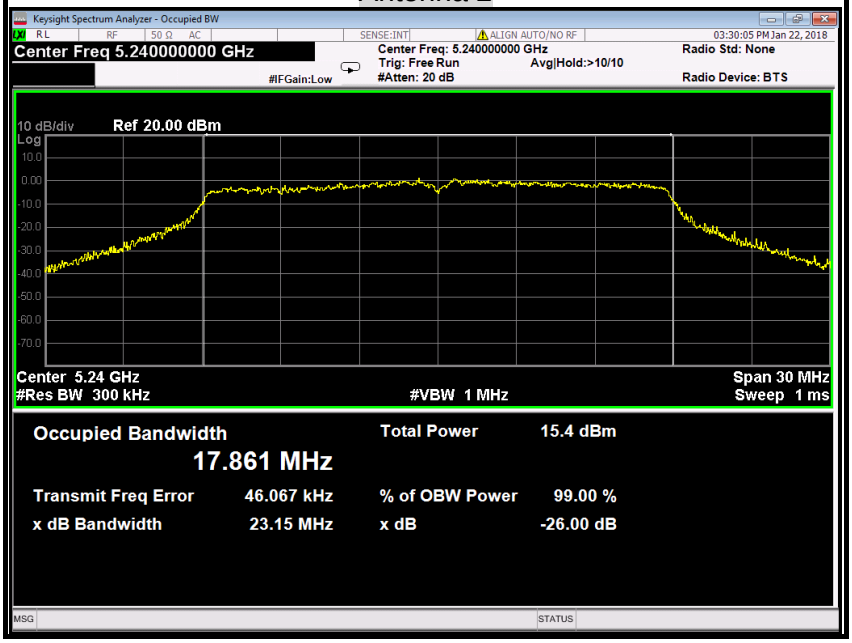
26dB Bandwidth (CH High)

Antenna 2



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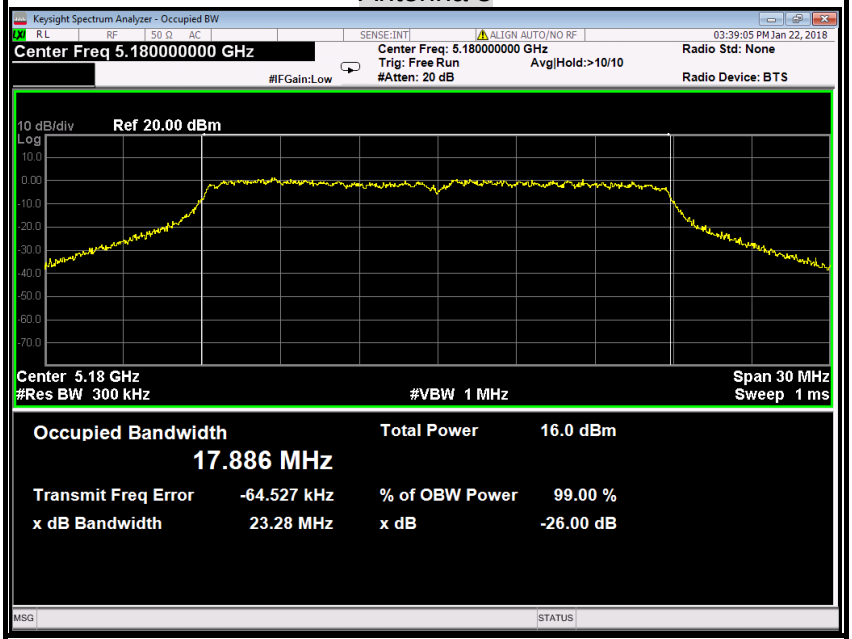
IEEE 802.11n HT 20 MHz mode / 5180 ~ 5240MHz

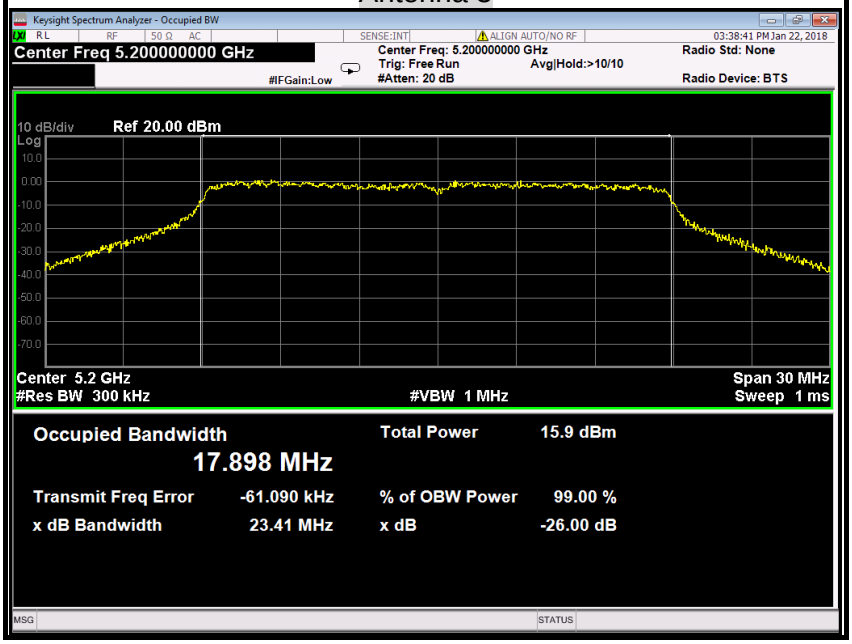
26dB Bandwidth (CH Low)

Antenna 3



26dB Bandwidth (CH Mid)

Antenna 3



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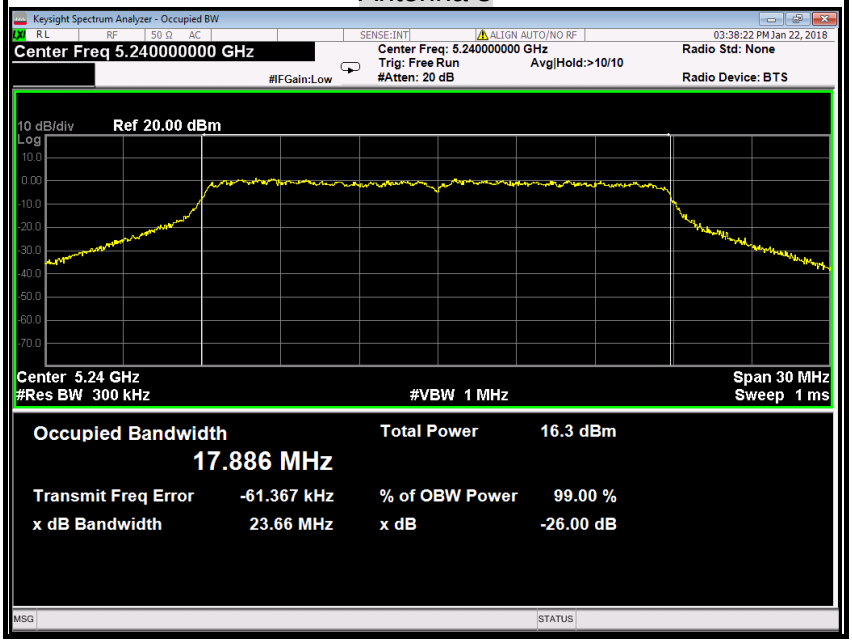
26dB Bandwidth (CH High)

Antenna 3



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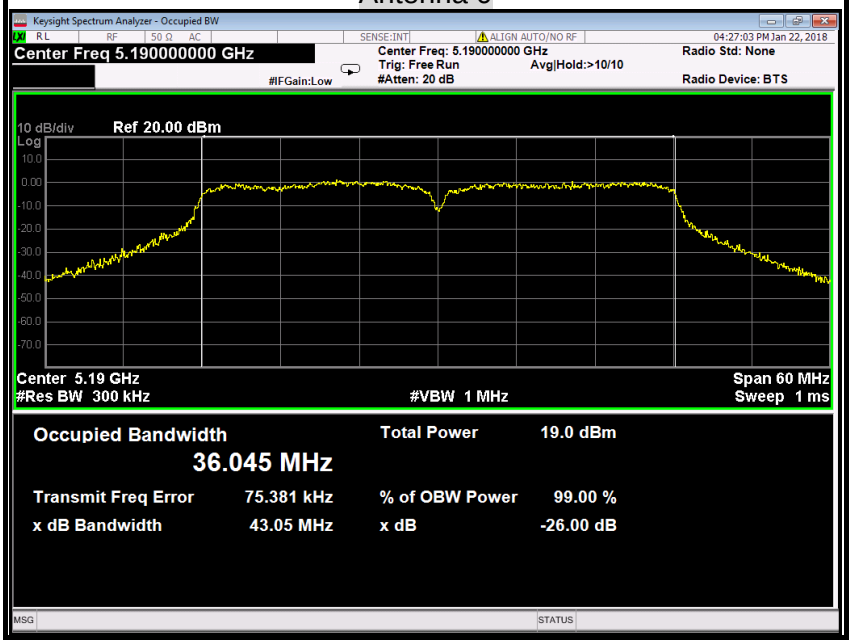
IEEE 802.11n HT 40 MHz mode / 5190 ~ 5230MHz

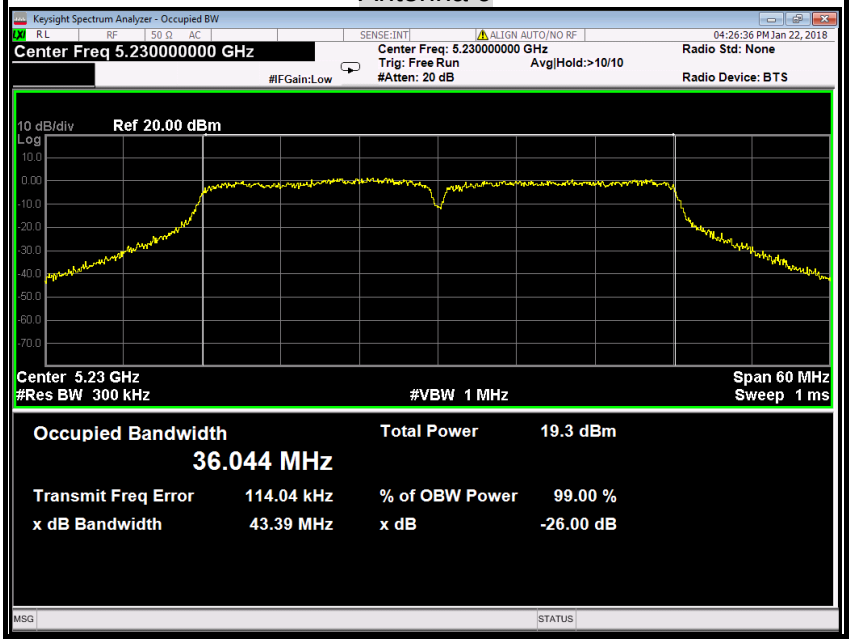
26dB Bandwidth (CH Low)

Antenna 0



26dB Bandwidth (CH High)

Antenna 0



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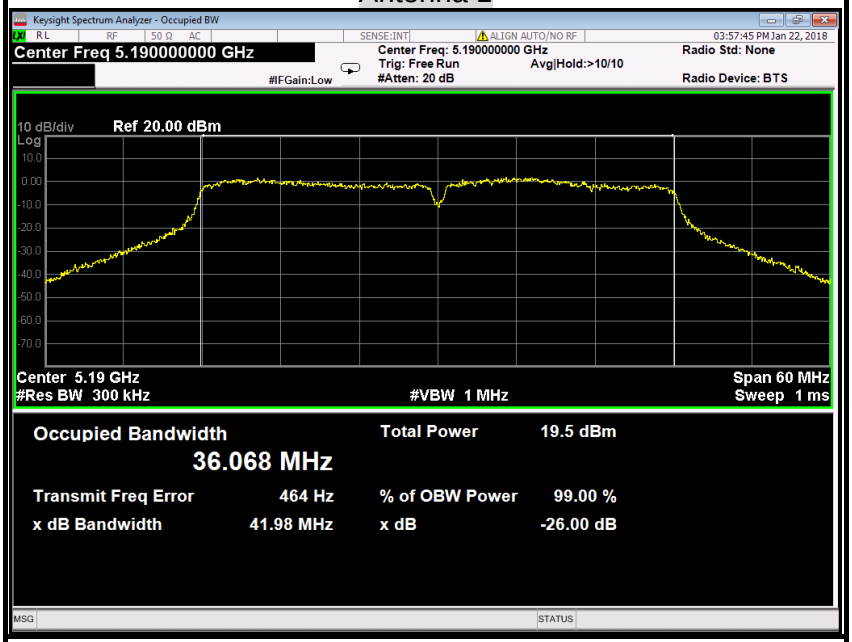
IEEE 802.11n HT 40 MHz mode / 5190 ~ 5230MHz

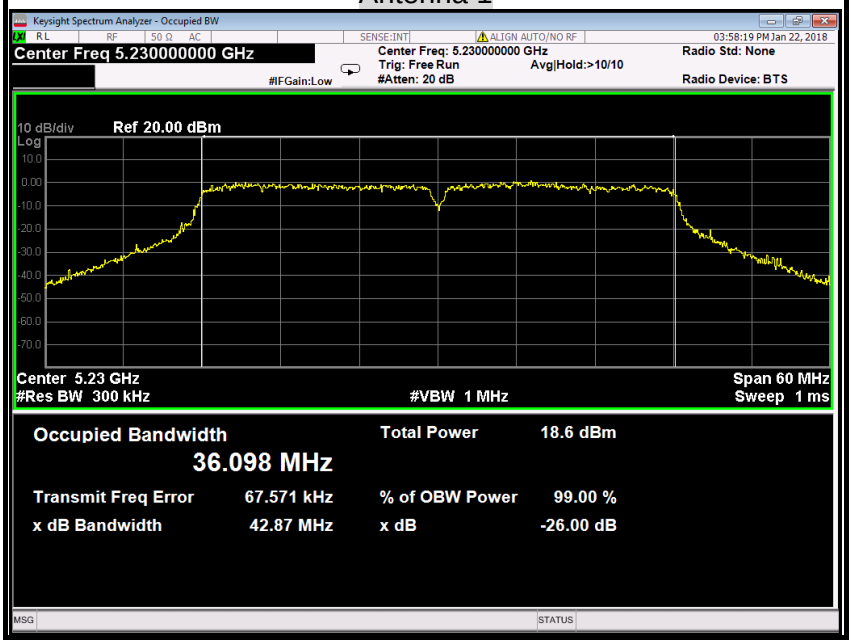
26dB Bandwidth (CH Low)

Antenna 1



26dB Bandwidth (CH High)

Antenna 1



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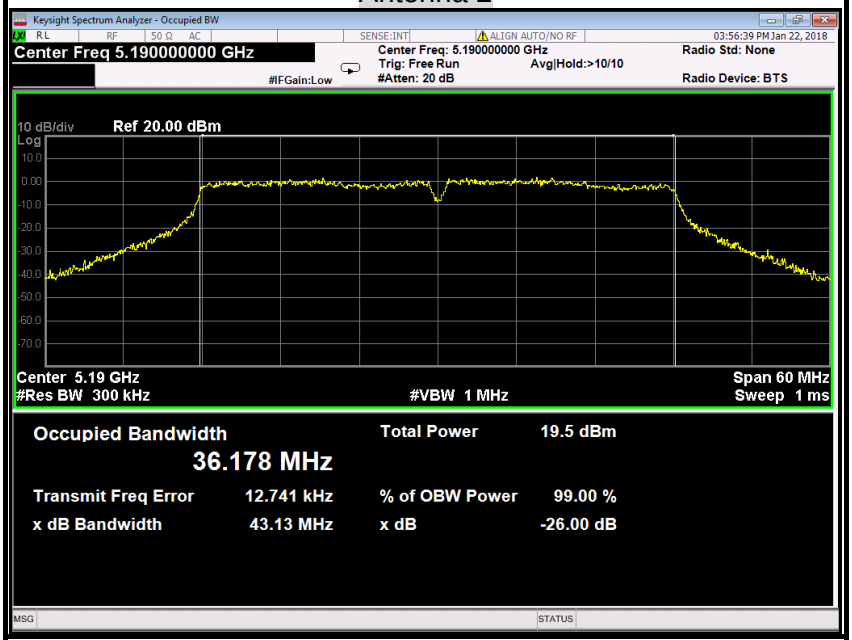
IEEE 802.11n HT 40 MHz mode / 5190 ~ 5230MHz

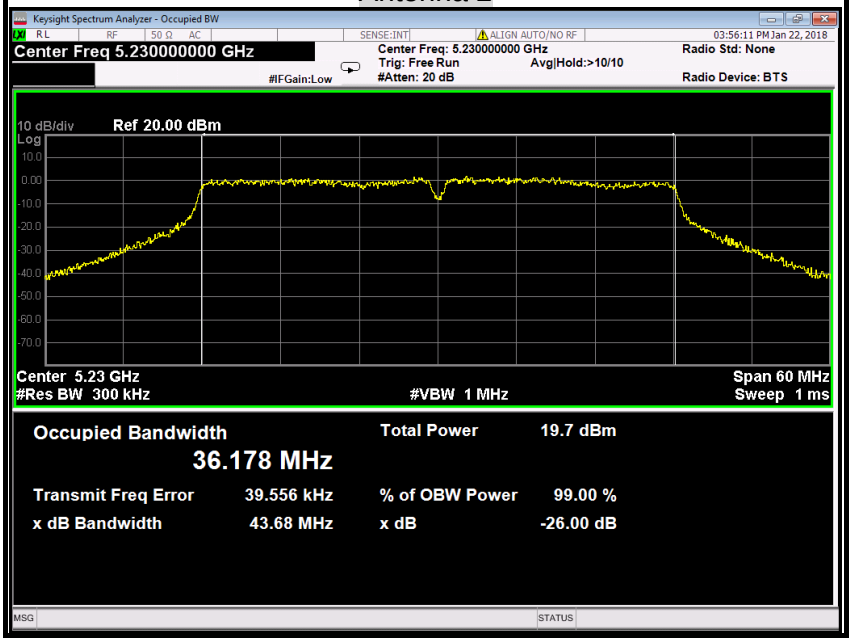
26dB Bandwidth (CH Low)

Antenna 2



26dB Bandwidth (CH High)

Antenna 2



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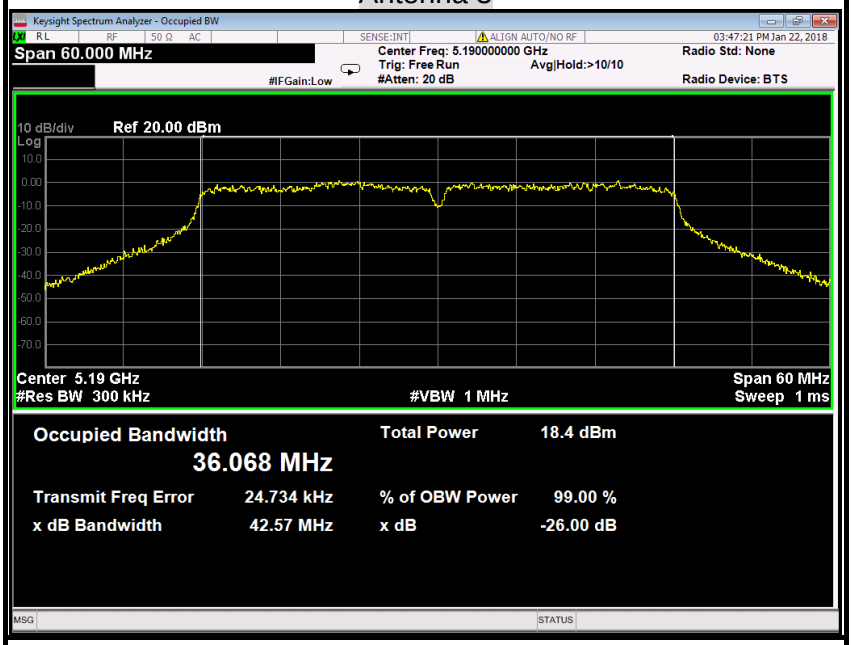
IEEE 802.11n HT 40 MHz mode / 5190 ~ 5230MHz

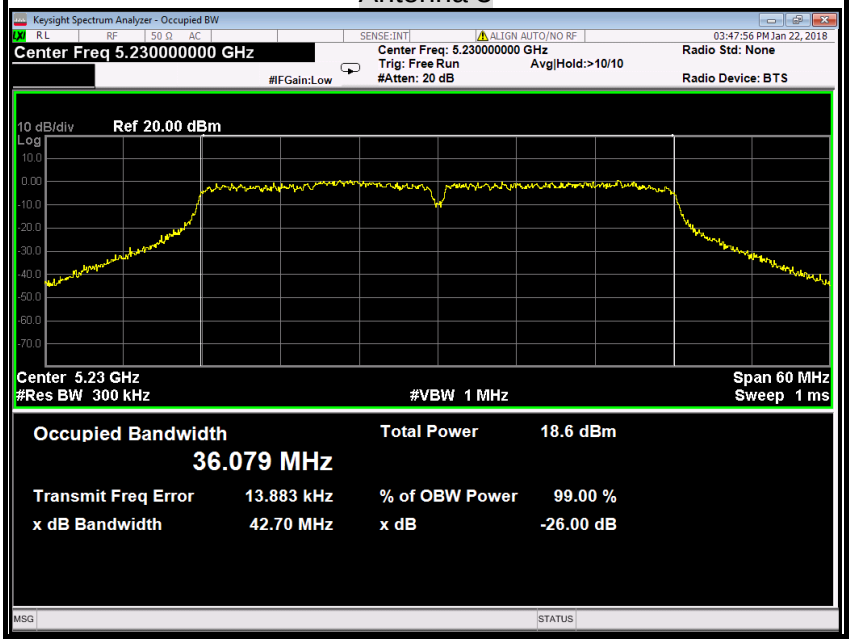
26dB Bandwidth (CH Low)

Antenna 3



26dB Bandwidth (CH High)

Antenna 3



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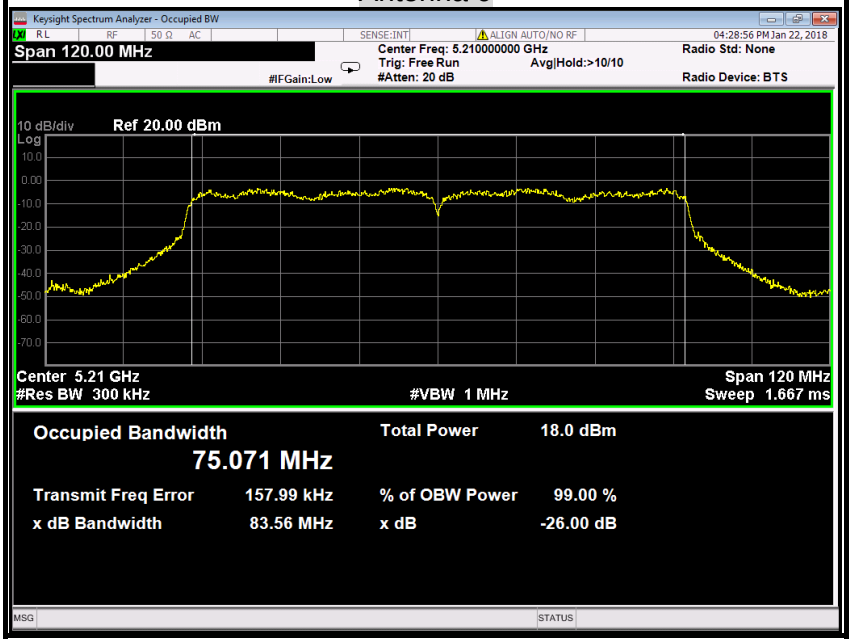
IEEE 802.11ac 80 mode / 5210MHz

26dB Bandwidth

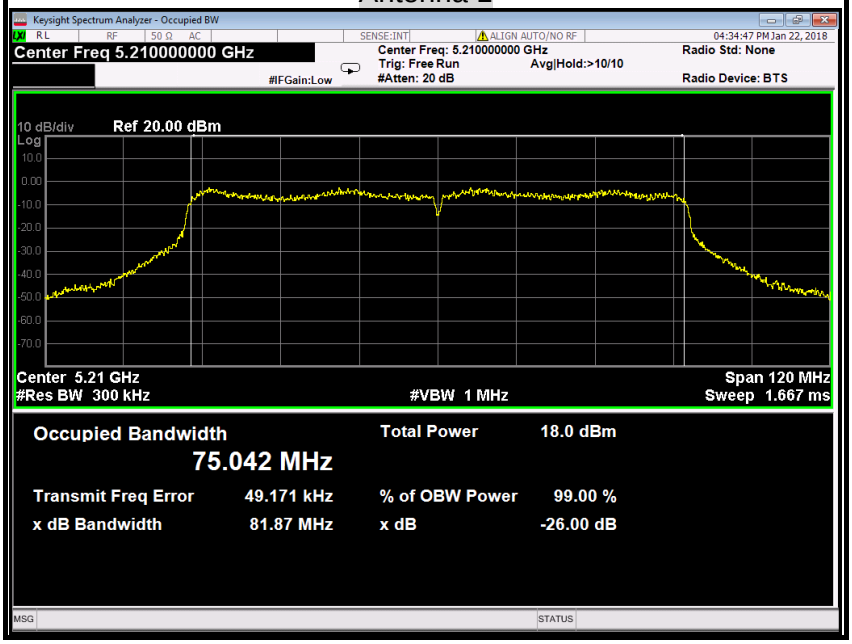
Antenna 0



IEEE 802.11ac 80 mode / 5210MHz

26dB Bandwidth

Antenna 1



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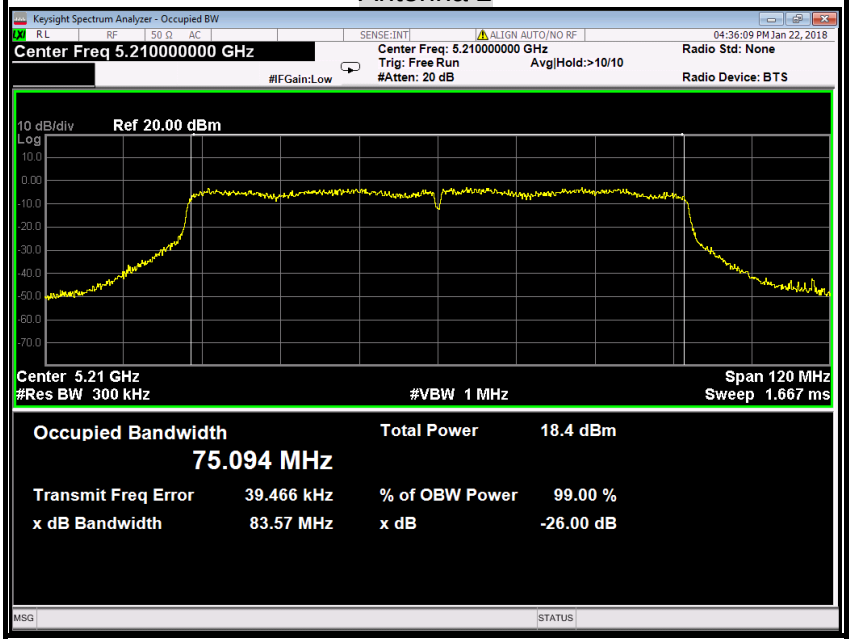
IEEE 802.11ac 80 mode / 5210MHz

26dB Bandwidth

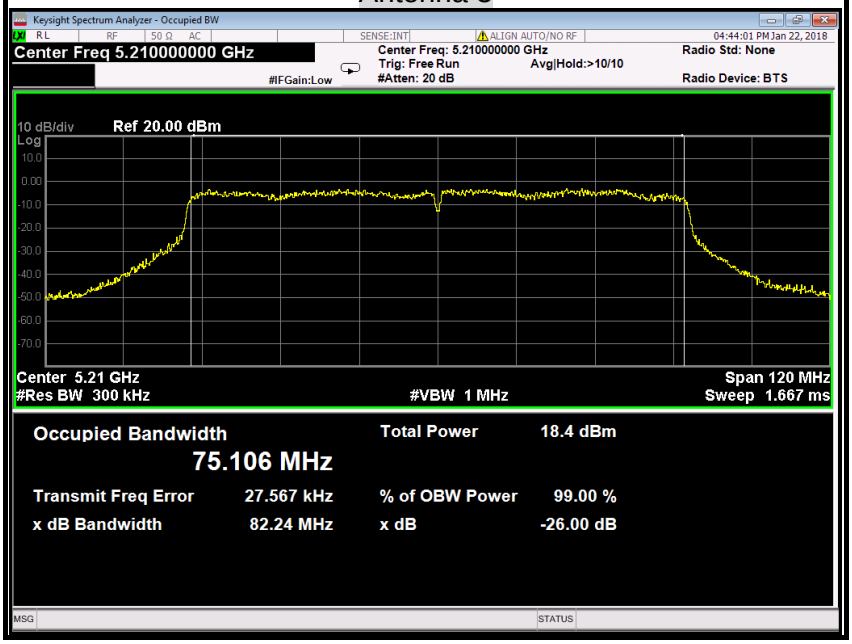
Antenna 2



IEEE 802.11ac 80 mode / 5210MHz

26dB Bandwidth

Antenna 3



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6.2 6dB BANDWIDTH MEASUREMENT

6.2.1 LIMITS

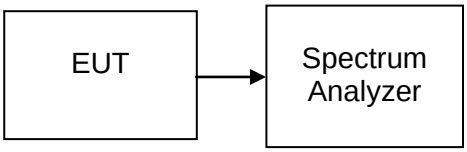
According to §15.407(e), Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

6.2.2 TEST PROCEDURES (please refer to measurement standard)

8.1 Option 2:

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

6.2.3 TEST SETUP



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6.2.4 TEST RESULTS

No non-compliance noted

Test Data

Test mode: IEEE 802.11a mode / 5745 ~ 5825MHz

Channel	Frequency (MHz)	6dB Bandwidth(B) (MHz)				Limit (kHz)	Test Result
		Antenna 0	Antenna 1	Antenna 2	Antenna 3		
Low	5745	16.33	16.32	16.32	16.33	>500	PASS
Mid	5785	16.31	16.32	16.32	16.33		PASS
High	5825	16.31	16.31	16.32	16.33		PASS

Test mode: IEEE 802.11n HT 20 MHz mode / 5745 ~ 5825MHz

Channel	Frequency (MHz)	6dB Bandwidth(B) (MHz)				Limit (kHz)	Test Result
		Antenna 0	Antenna 1	Antenna 2	Antenna 3		
Low	5745	15.13	16.31	15.11	17.62	>500	PASS
Mid	5785	15.11	16.06	17.57	17.59		PASS
High	5825	15.11	16.29	16.07	17.58		PASS

Test mode: IEEE 802.11n HT 40 MHz mode / 5755 ~ 5795MHz

Channel	Frequency (MHz)	6dB Bandwidth(B) (MHz)				Limit (kHz)	Test Result
		Antenna 0	Antenna 1	Antenna 2	Antenna 3		
Low	5755	35.14	35.13	35.34	35.36	>500	PASS
High	5795	35.17	35.08	35.91	35.45		PASS

Test mode: IEEE 802.11ac 80 mode / 5775MHz

Channel	Frequency (MHz)	6dB Bandwidth(B) (MHz)				Limit (kHz)	Test Result
		Antenna 0	Antenna 1	Antenna 2	Antenna 3		
	5775	75.13	73.91	75.08	75.12	>500	PASS

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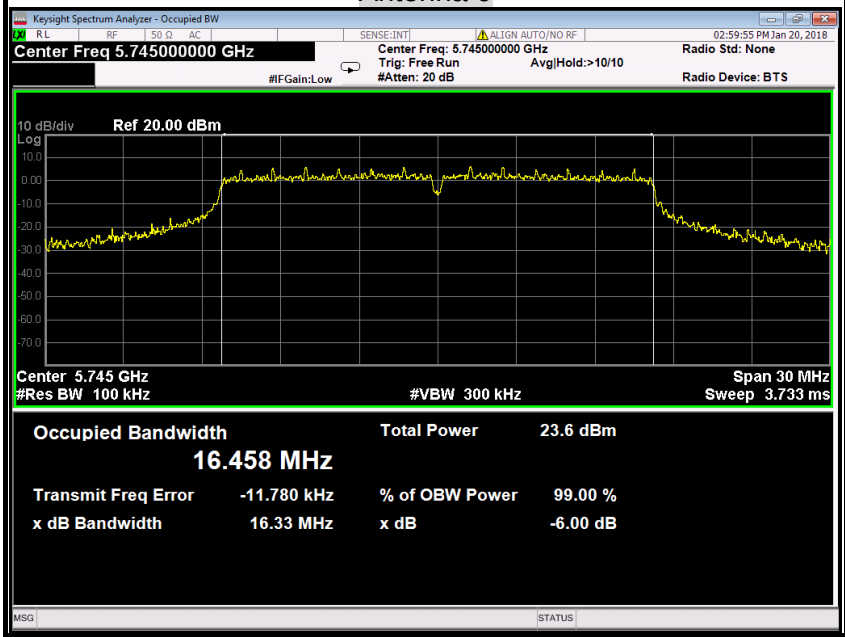
Test Plot

IEEE 802.11a mode / 5745 ~ 5825MHz

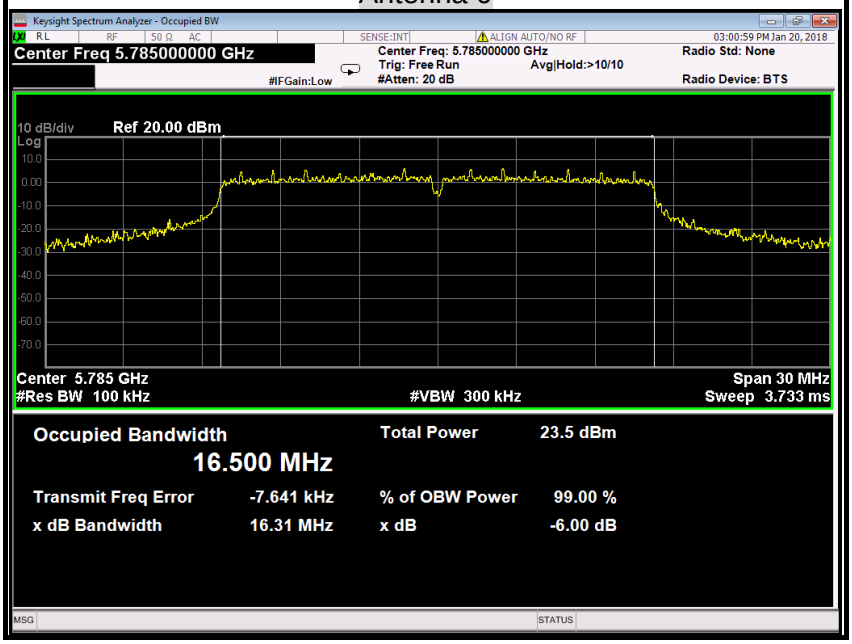
6dB Bandwidth (CH Low)

Antenna 0



6dB Bandwidth (CH Mid)

Antenna 0



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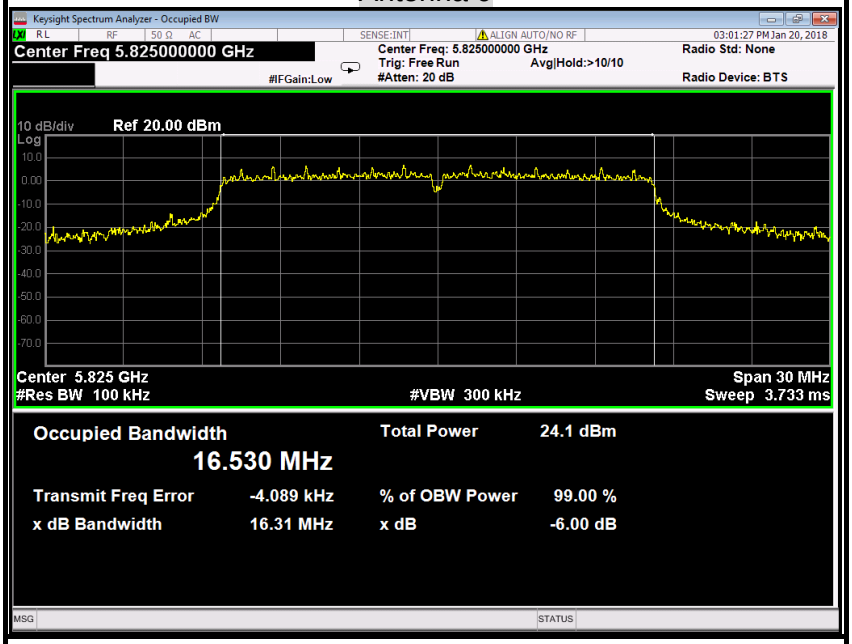
6dB Bandwidth (CH High)

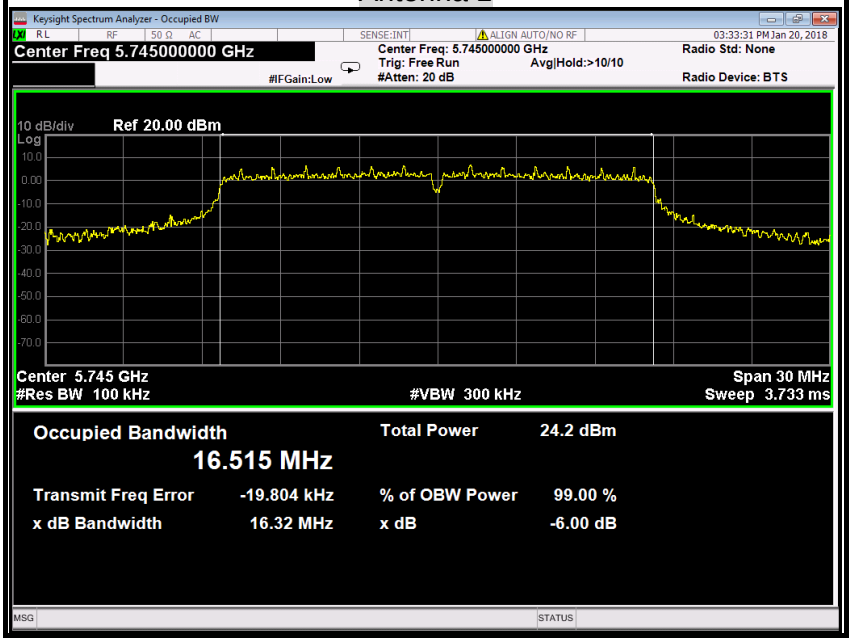
Antenna 0



IEEE 802.11a mode / 5745 ~ 5825MHz

6dB Bandwidth (CH Low)

Antenna 1



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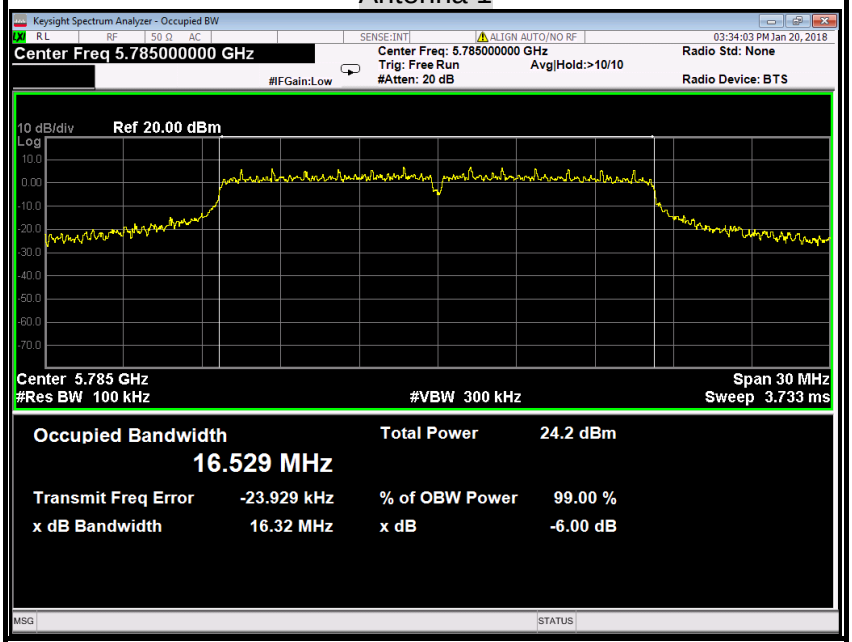
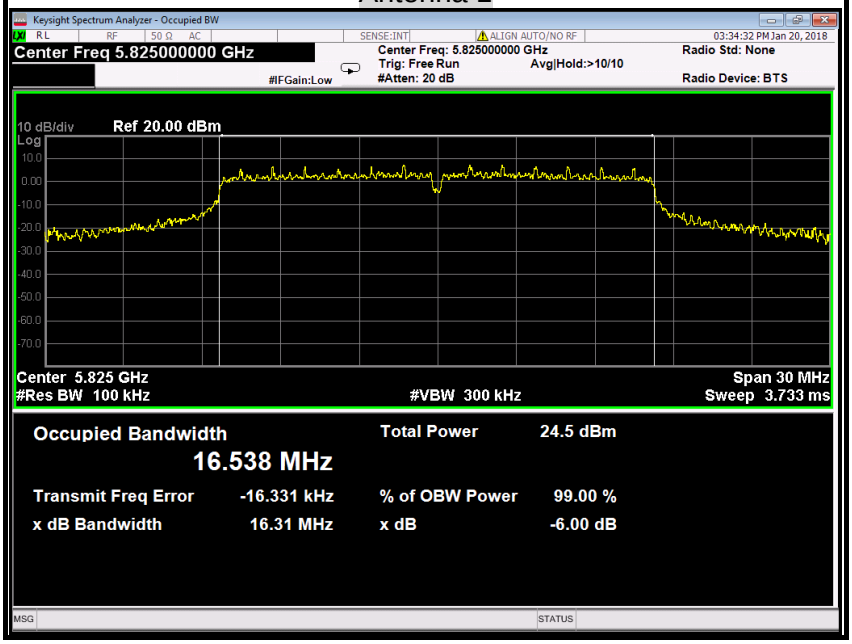
6dB Bandwidth (CH Mid)

Antenna 1



6dB Bandwidth (CH High)

Antenna 1



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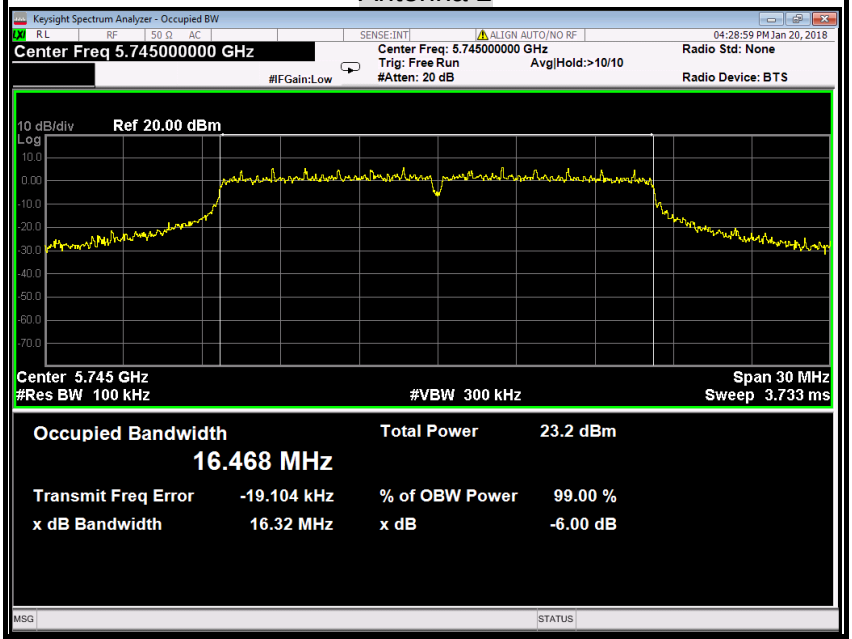
IEEE 802.11a mode / 5745 ~ 5825MHz

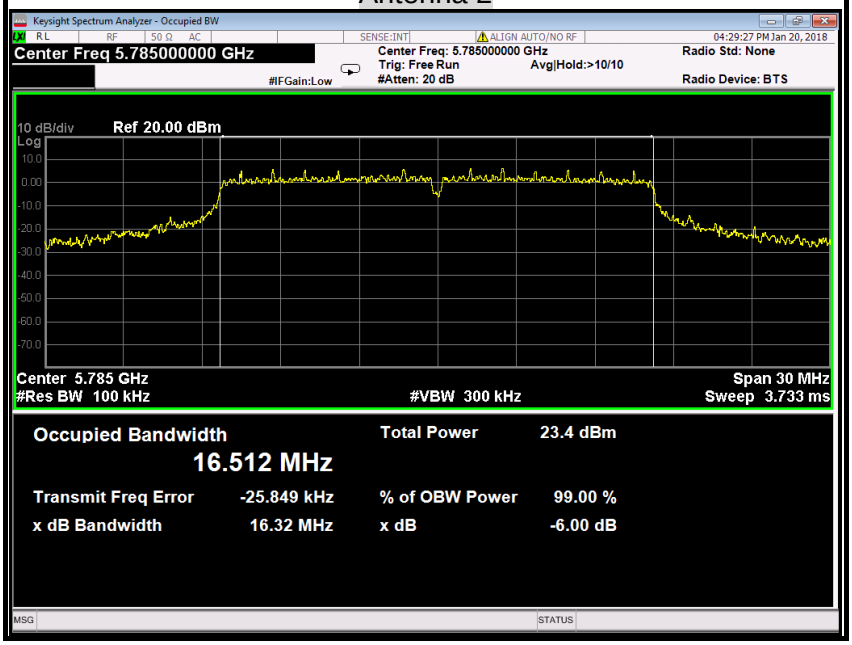
6dB Bandwidth (CH Low)

Antenna 2



6dB Bandwidth (CH Mid)

Antenna 2



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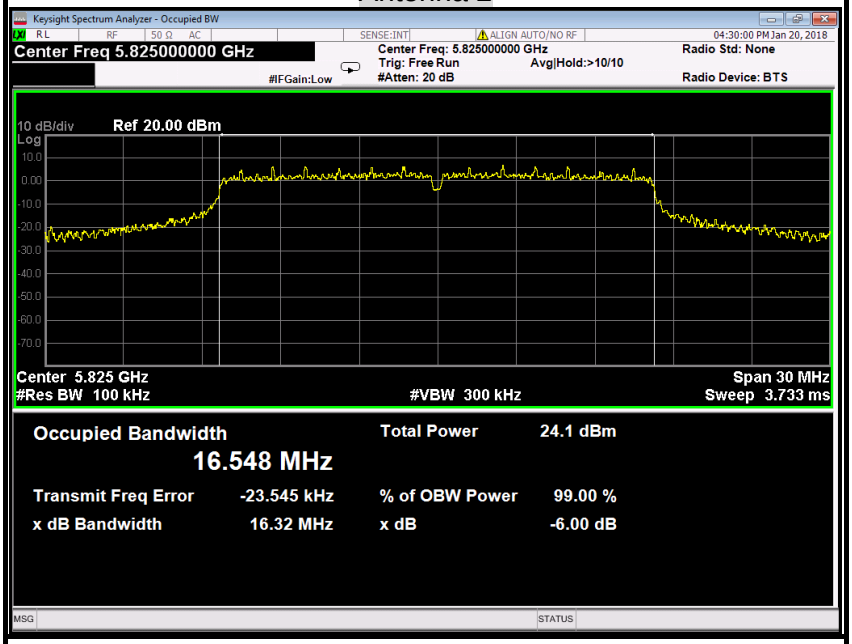
6dB Bandwidth (CH High)

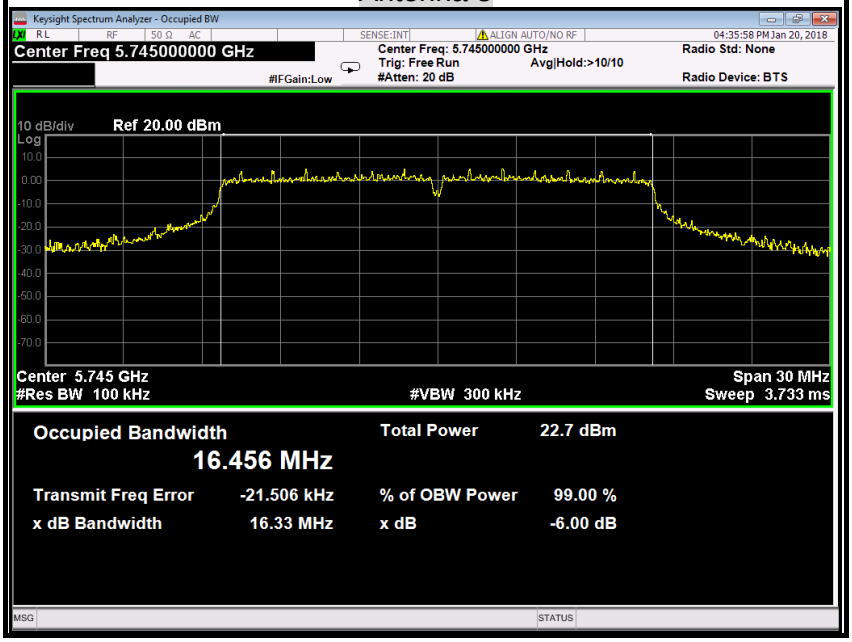
Antenna 2



IEEE 802.11a mode / 5745 ~ 5825MHz

6dB Bandwidth (CH Low)

Antenna 3



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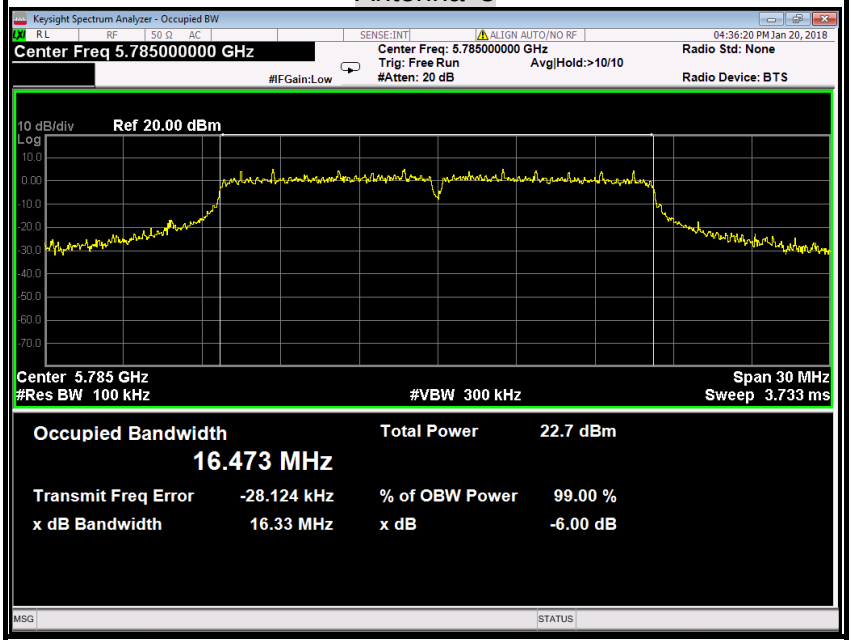
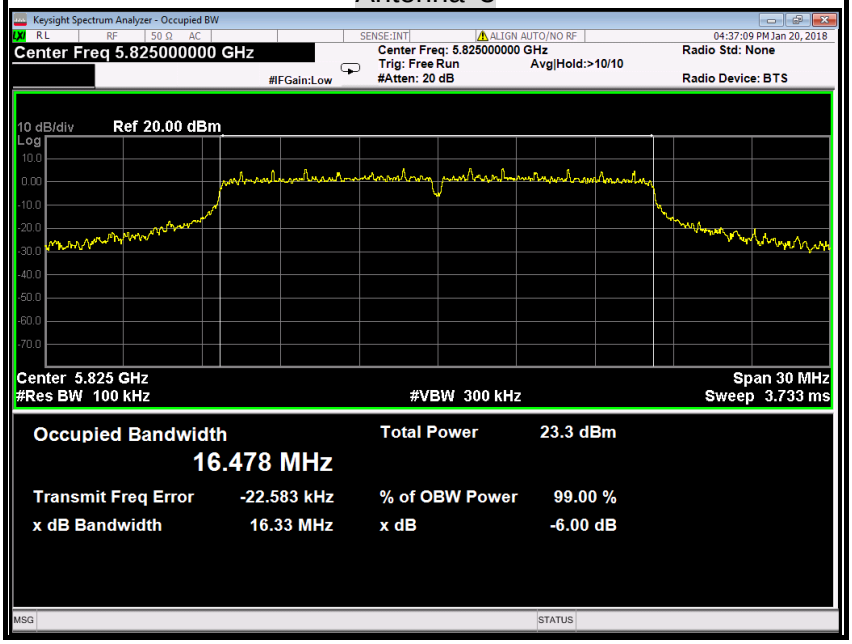
6dB Bandwidth (CH Mid)

Antenna 3



6dB Bandwidth (CH High)

Antenna 3



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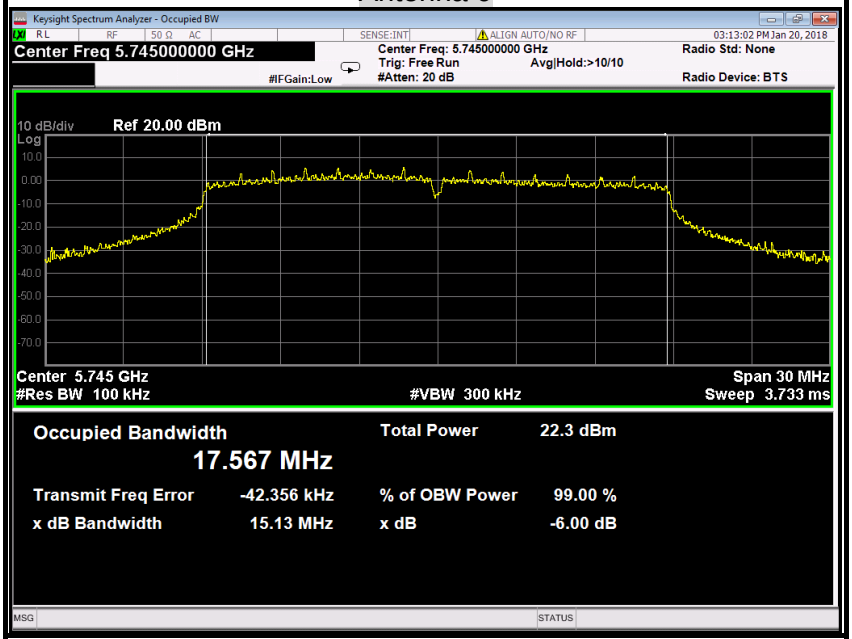
IEEE 802.11n HT 20 MHz mode / 5745 ~ 5825MHz

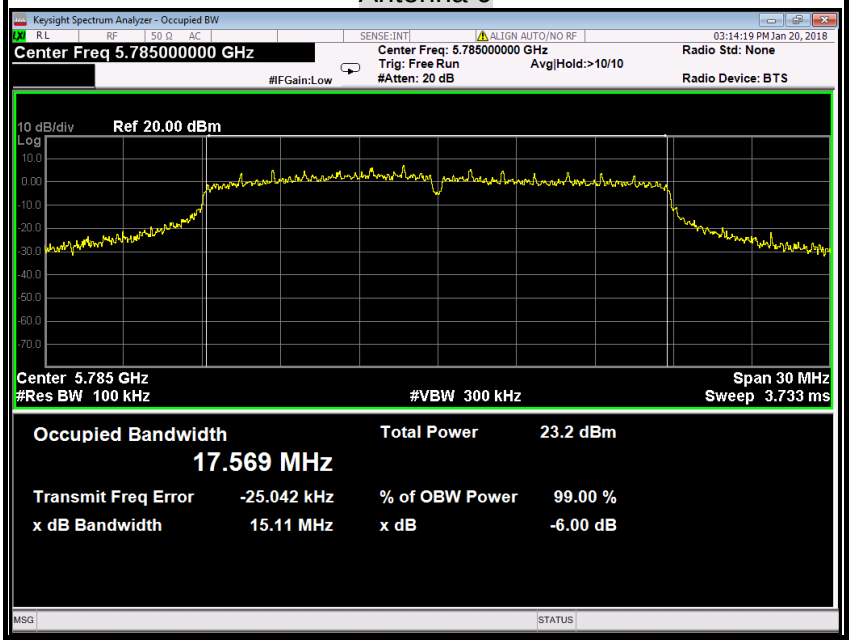
6dB Bandwidth (CH Low)

Antenna 0



6dB Bandwidth (CH Mid)

Antenna 0



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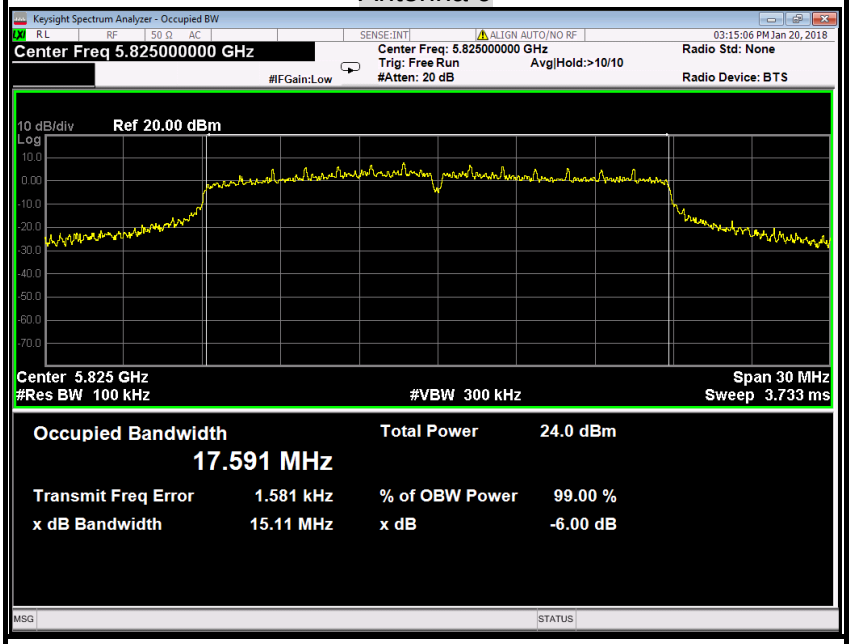
6dB Bandwidth (CH High)

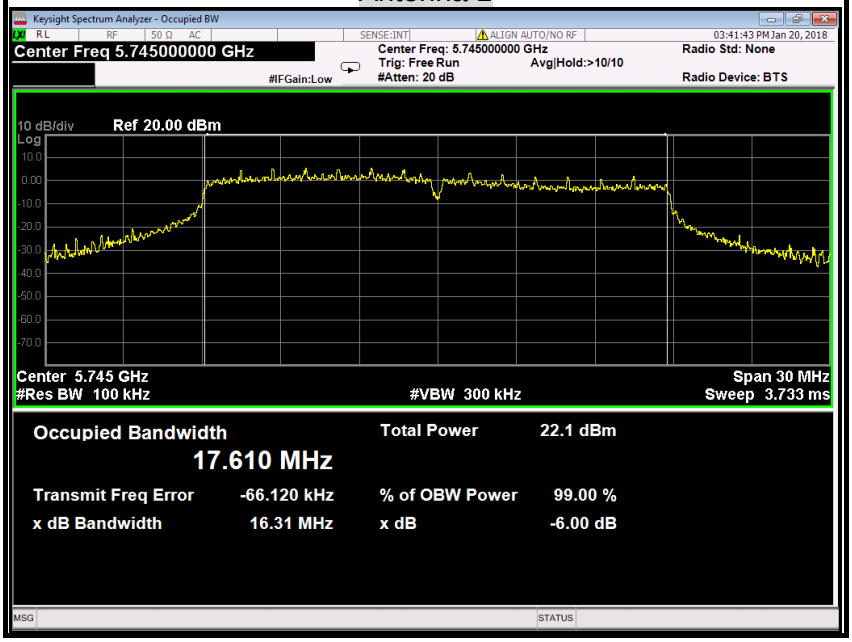
Antenna 0



IEEE 802.11n HT 20 MHz mode / 5745 ~ 5825MHz

6dB Bandwidth (CH Low)

Antenna 1



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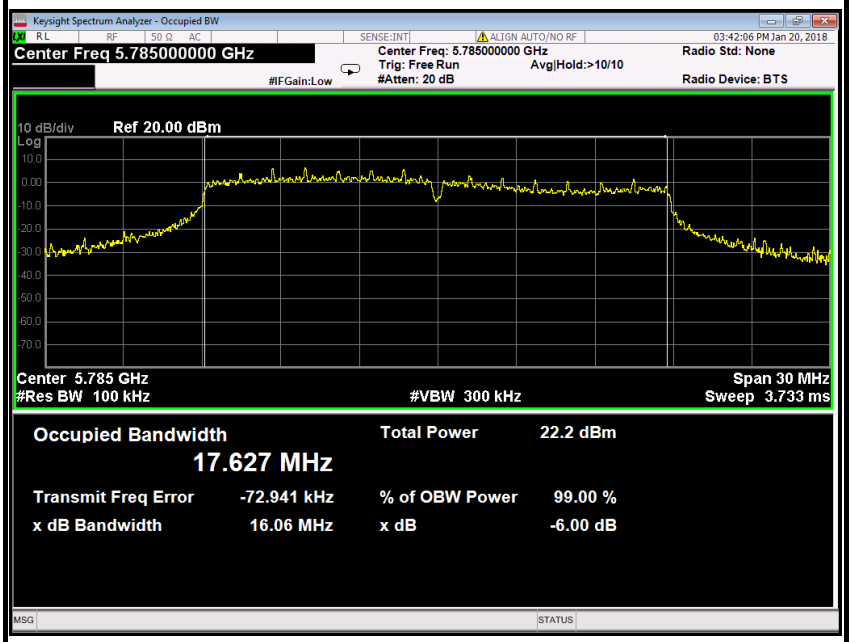
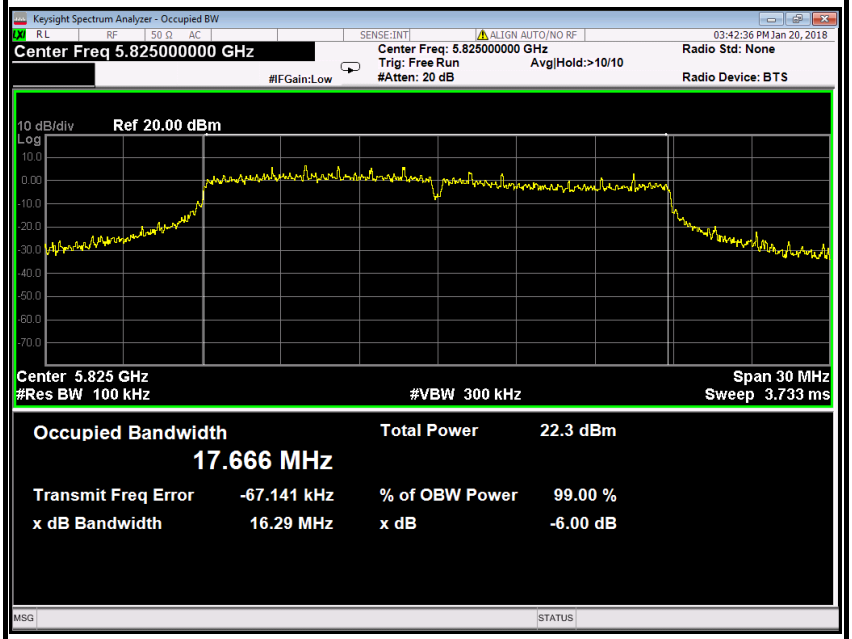
6dB Bandwidth (CH Mid)

Antenna 1



6dB Bandwidth (CH High)

Antenna 1



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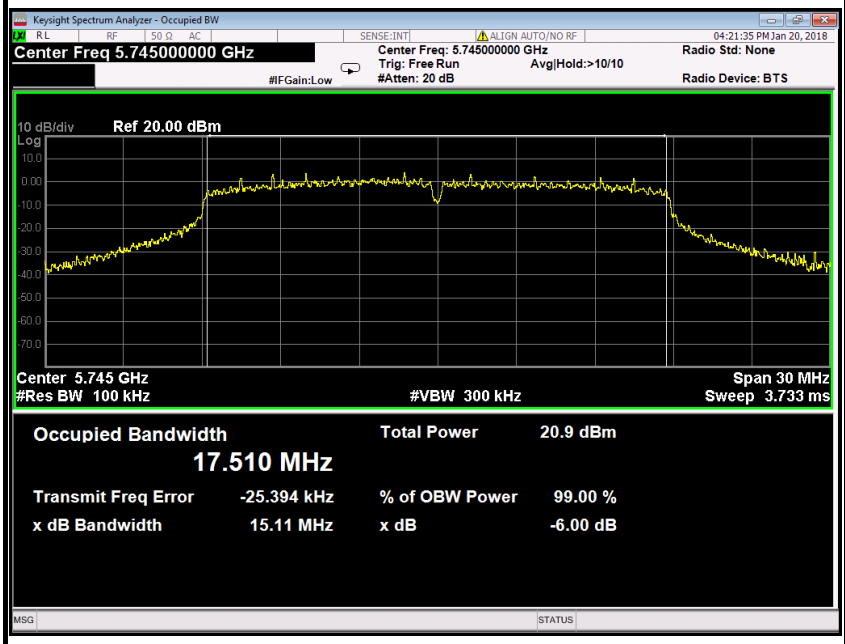
IEEE 802.11n HT 20 MHz mode / 5745 ~ 5825MHz

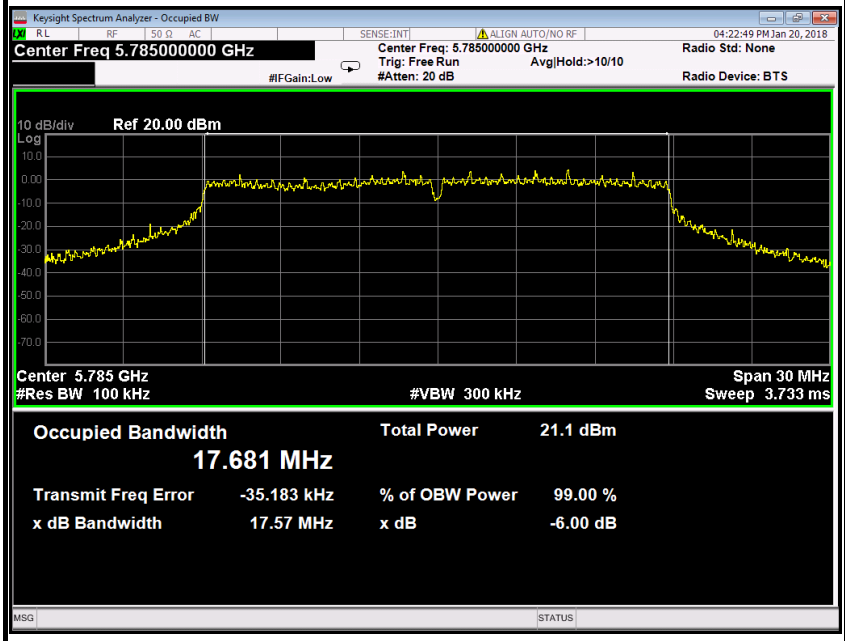
6dB Bandwidth (CH Low)

Antenna 2



6dB Bandwidth (CH Mid)

Antenna 2



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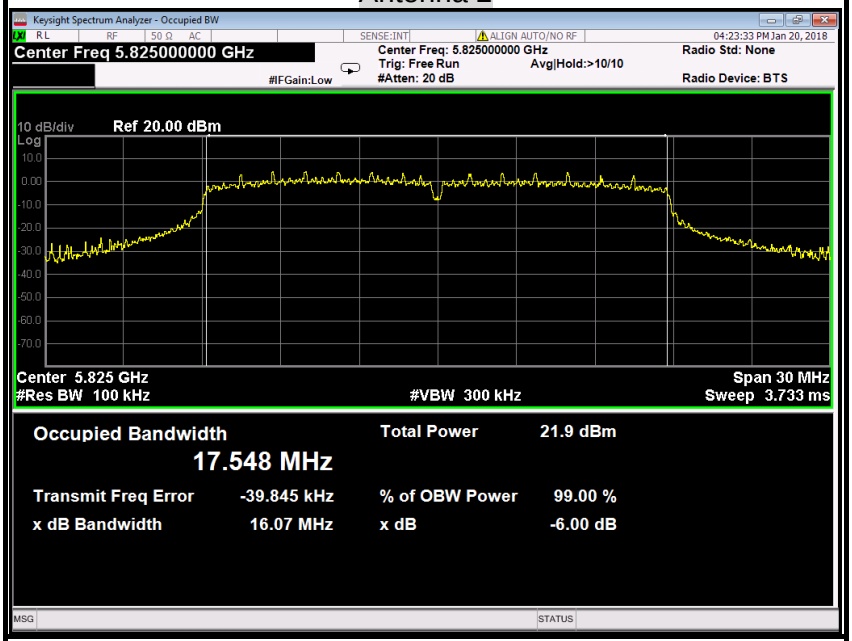
6dB Bandwidth (CH High)

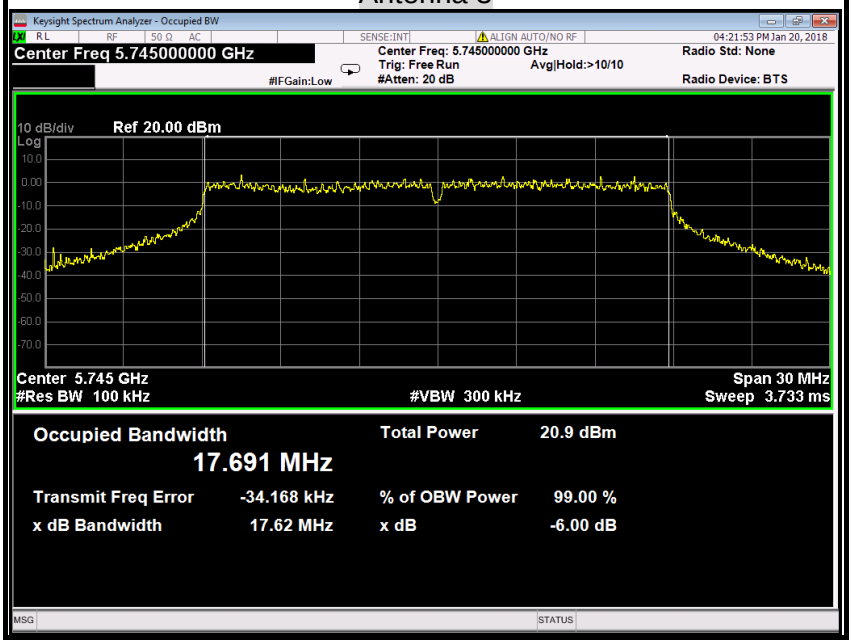
Antenna 2



IEEE 802.11n HT 20 MHz mode / 5745 ~ 5825MHz

6dB Bandwidth (CH Low)

Antenna 3



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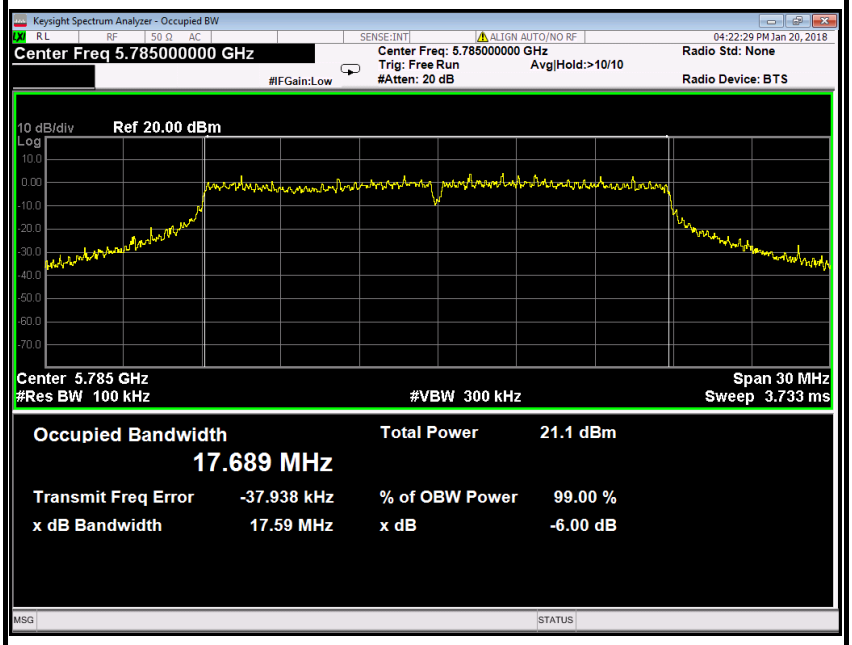
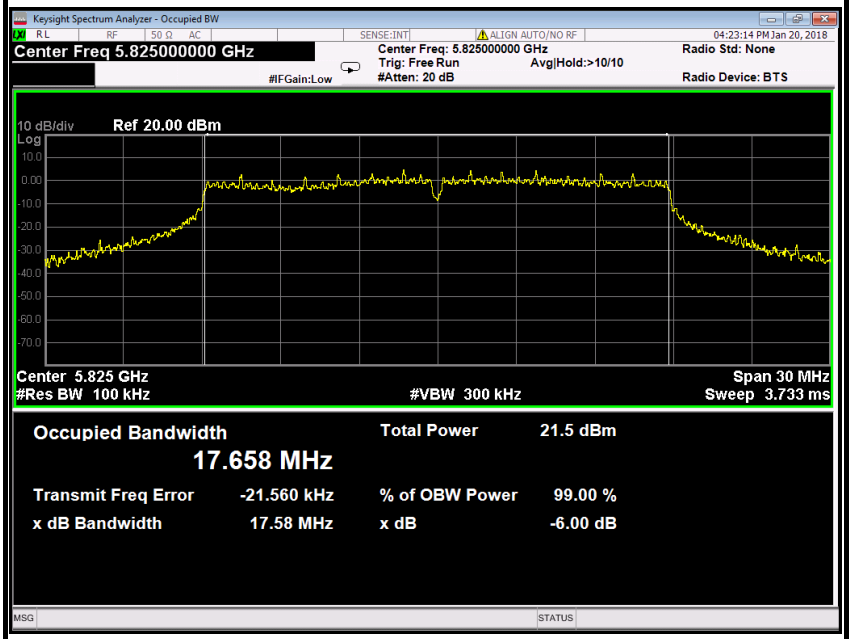
6dB Bandwidth (CH Mid)

Antenna 3



6dB Bandwidth (CH High)

Antenna 3



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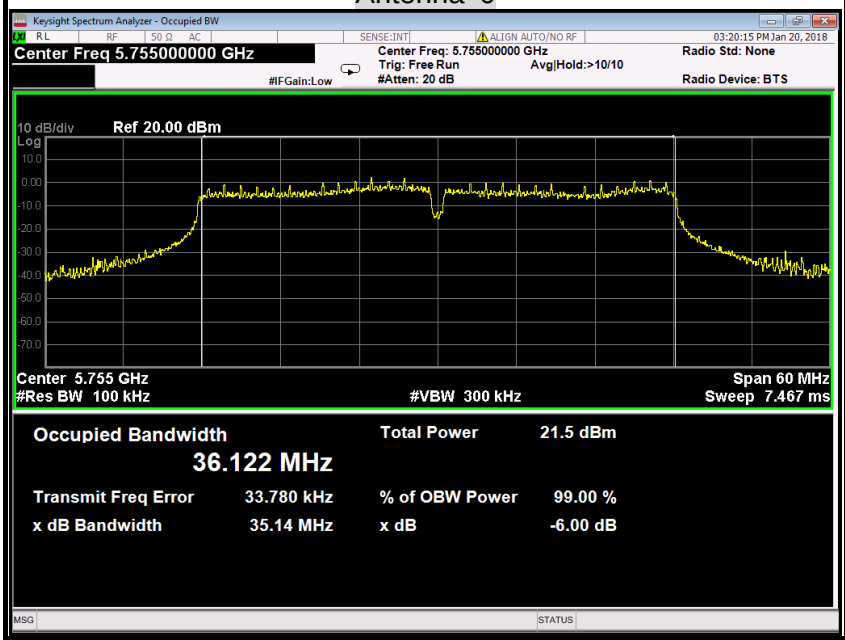
IEEE 802.11n HT 40 MHz mode / 5755 ~ 5795MHz

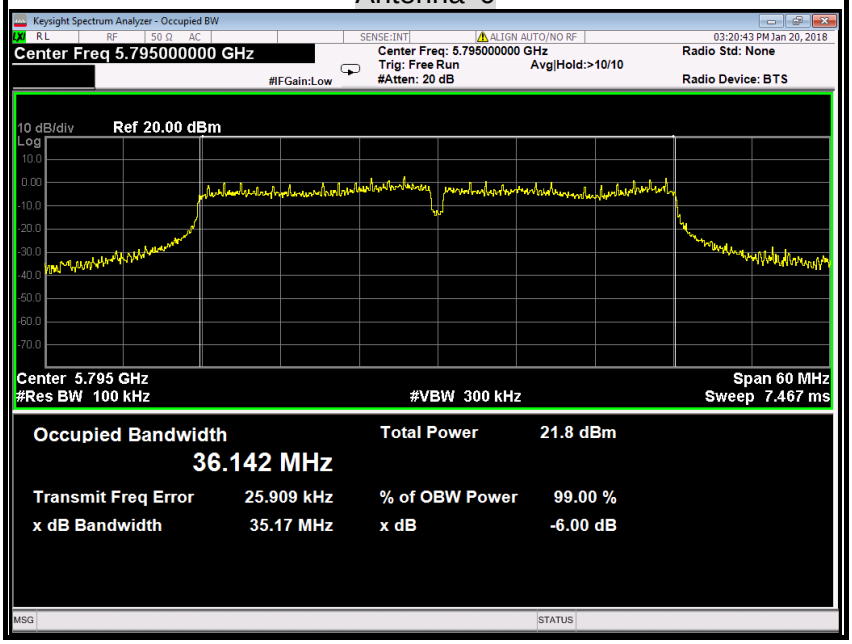
6dB Bandwidth (CH Low)

Antenna 0



6dB Bandwidth (CH High)

Antenna 0



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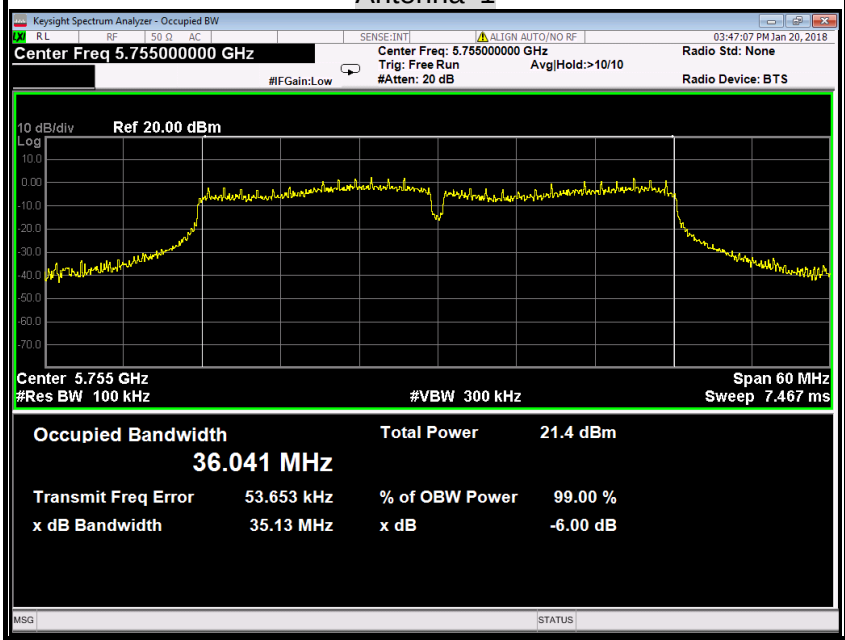
IEEE 802.11n HT 40 MHz mode / 5755 ~ 5795MHz

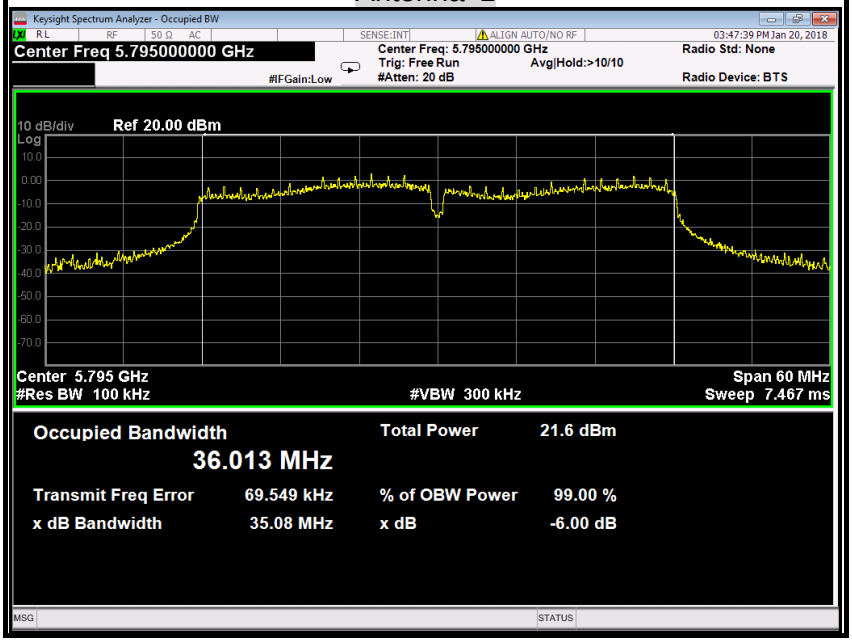
6dB Bandwidth (CH Low)

Antenna 1



6dB Bandwidth (CH High)

Antenna 1



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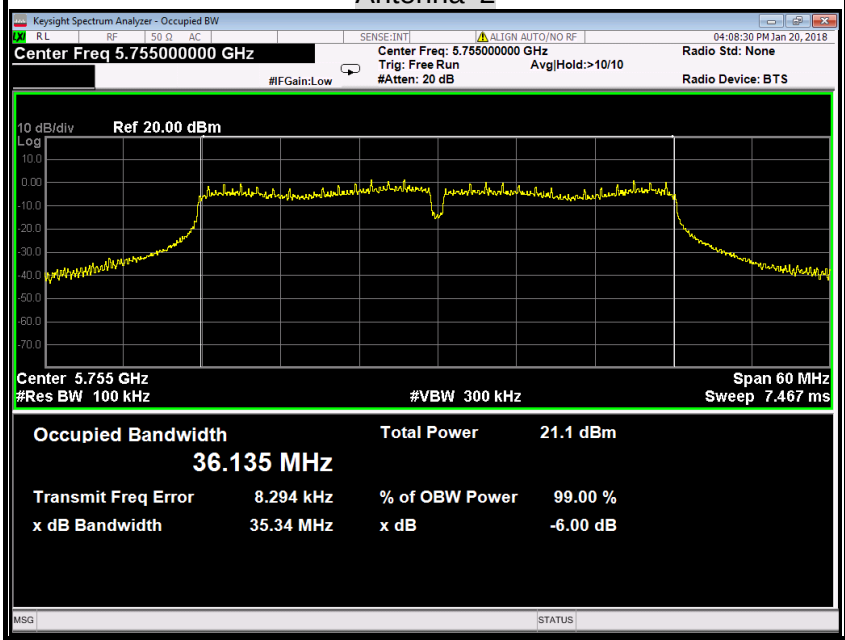
IEEE 802.11n HT 40 MHz mode / 5755 ~ 5795MHz

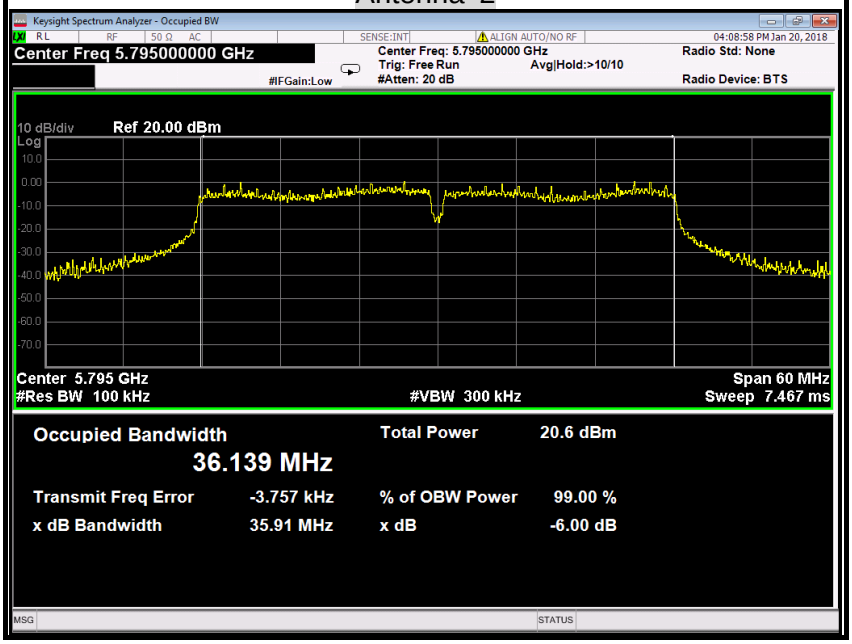
6dB Bandwidth (CH Low)

Antenna 2



6dB Bandwidth (CH High)

Antenna 2



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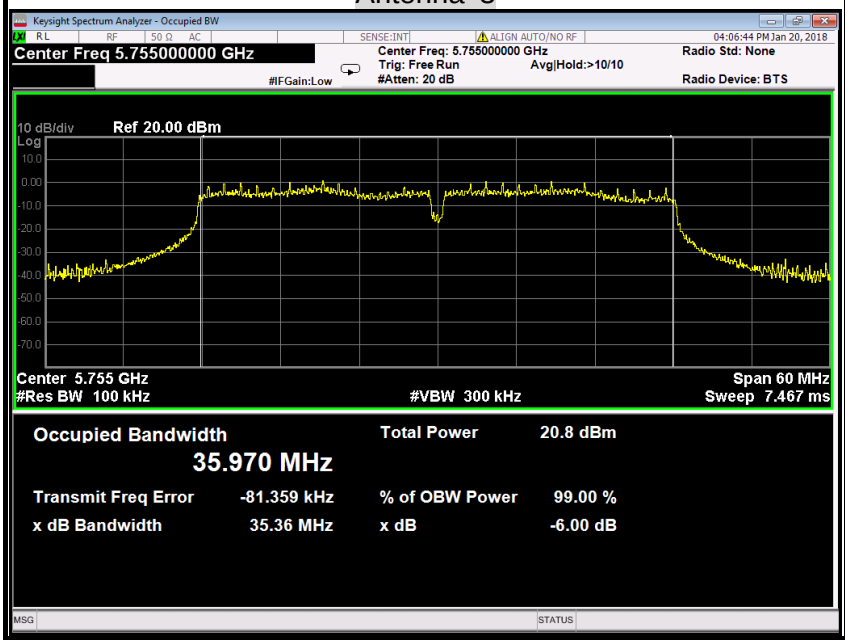
IEEE 802.11n HT 40 MHz mode / 5755 ~ 5795MHz

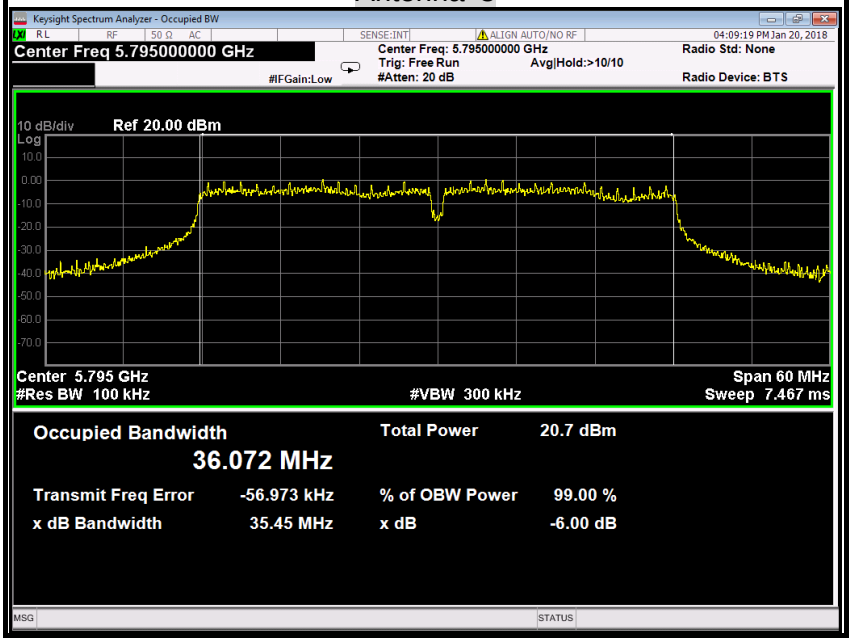
6dB Bandwidth (CH Low)

Antenna 3



6dB Bandwidth (CH High)

Antenna 3



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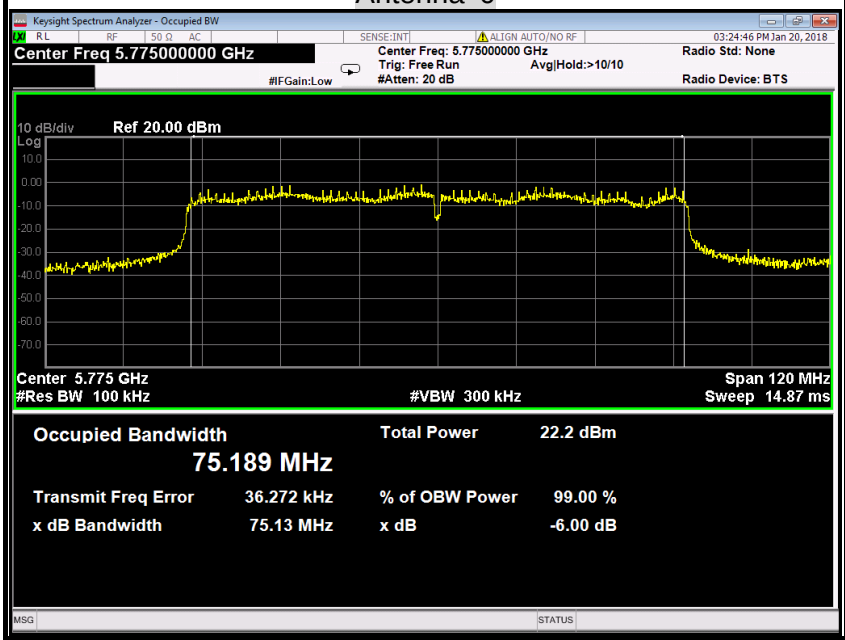
IEEE 802.11ac 80 MHz mode / 5775MHz

6dB Bandwidth

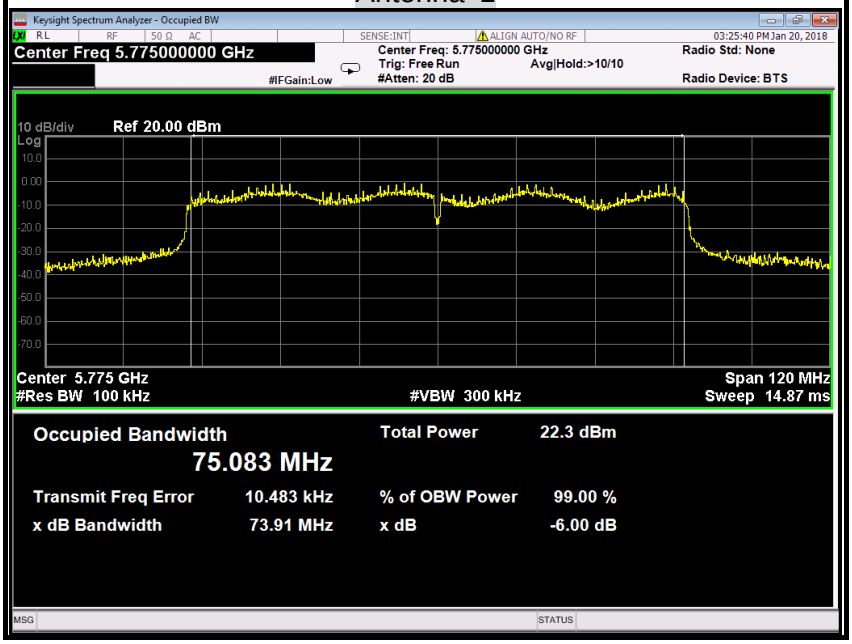
Antenna 0



IEEE 802.11ac 80 MHz mode / 5775MHz

6dB Bandwidth

Antenna 1



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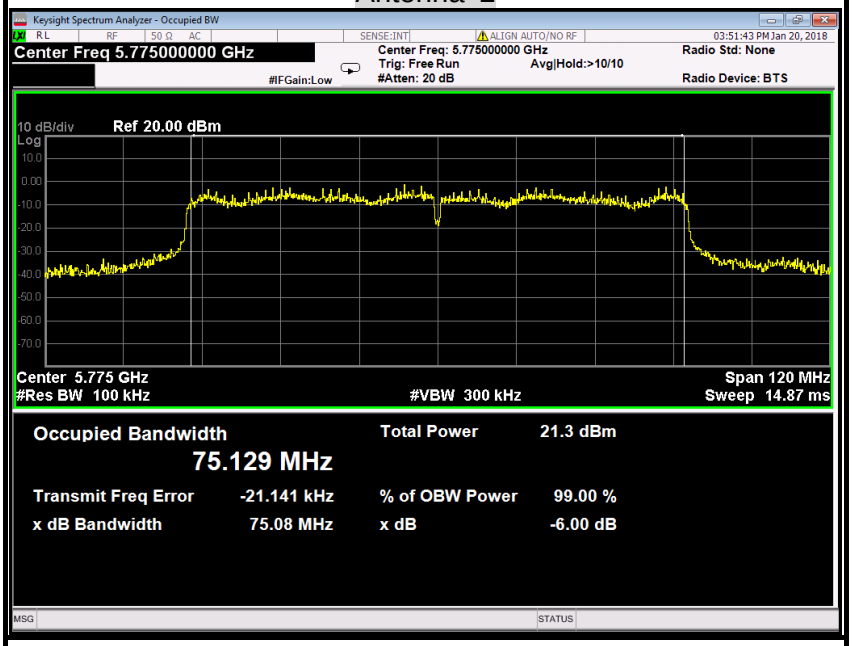
IEEE 802.11ac 80 MHz mode / 5775MHz

6dB Bandwidth

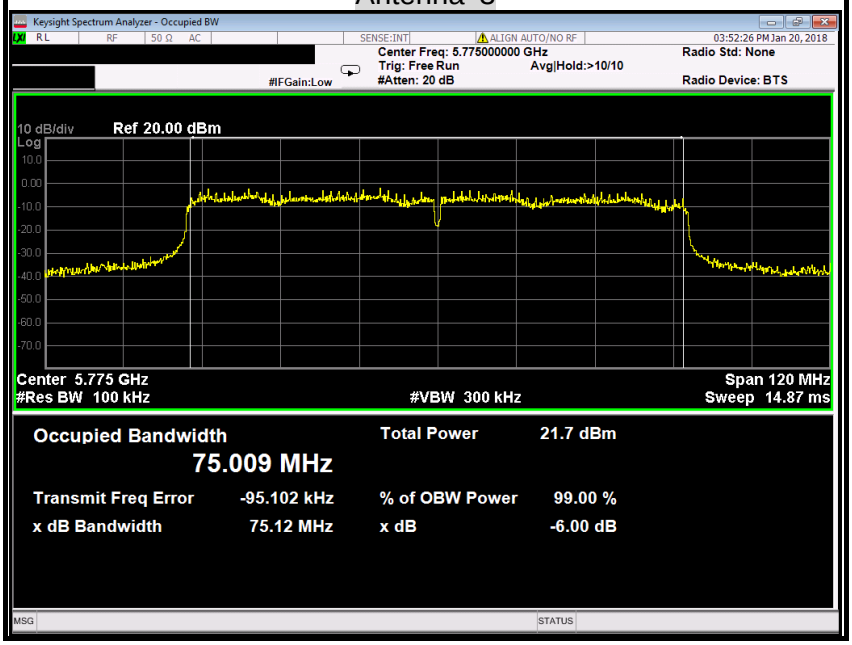
Antenna 2



IEEE 802.11ac 80 MHz mode / 5775MHz

6dB Bandwidth

Antenna 3



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6.3 ANTENNA GAIN

MEASUREMENT

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module. For UNII devices, the IEEE 802.11a mode is used.

MEASUREMENT PARAMETERS

Measurement parameter	
Detector	Peak
Sweep time	Auto
Resolution bandwidth	3 MHz
Video bandwidth	3 MHz
Trace-Mode	Max hold

LIMITS

FCC	IC
Antenna Gain	
6 dBi	

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TEST RESULTS

IEEE 802.11a mode

Antenna 0

IEEE 802.11a mode / 5180 ~ 5240MHz

T_{nom}	V_{nom}	Lowest channel 5180MHz	Highest channel 5240MHz
Conducted power [dBm] Measured with OFDM modulation		5.52	5.20
Radiated power [dBm] Measured with OFDM modulation		7.31	6.75
Gain [dBi] Calculated		1.79	1.55
Measurement uncertainty		± 1.5 dB (cond.) / ± 3 dB (rad.)	

IEEE 802.11a mode / 5745 ~ 5825MHz

T_{nom}	V_{nom}	Lowest channel 5745MHz	Highest channel 5825MHz
Conducted power [dBm] Measured with OFDM modulation		8.63	8.74
Radiated power [dBm] Measured with OFDM modulation		11.33	11.95
Gain [dBi] Calculated		2.70	3.21
Measurement uncertainty		± 1.5 dB (cond.) / ± 3 dB (rad.)	

Antenna 1

IEEE 802.11a mode / 5180 ~ 5240MHz

T_{nom}	V_{nom}	Lowest channel 5180MHz	Highest channel 5240MHz
Conducted power [dBm] Measured with OFDM modulation		5.22	7.11
Radiated power [dBm] Measured with OFDM modulation		7.10	8.85
Gain [dBi] Calculated		1.88	1.74
Measurement uncertainty		± 1.5 dB (cond.) / ± 3 dB (rad.)	

IEEE 802.11a mode / 5745 ~ 5825MHz

T_{nom}	V_{nom}	Lowest channel 5745MHz	Highest channel 5825MHz
Conducted power [dBm] Measured with OFDM modulation		9.75	9.23
Radiated power [dBm] Measured with OFDM modulation		12.93	12.42
Gain [dBi] Calculated		3.18	3.19
Measurement uncertainty		± 1.5 dB (cond.) / ± 3 dB (rad.)	

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Antenna 2

IEEE 802.11a mode / 5180 ~ 5240MHz

T_{nom}	V_{nom}	Lowest channel 5180MHz	Highest channel 5240MHz
Conducted power [dBm] Measured with OFDM modulation		5.21	6.76
Radiated power [dBm] Measured with OFDM modulation		7.60	8.42
Gain [dBi] Calculated		1.39	1.66
Measurement uncertainty		± 1.5 dB (cond.) / ± 3 dB (rad.)	

IEEE 802.11a mode / 5745 ~ 5825MHz

T_{nom}	V_{nom}	Lowest channel 5745MHz	Highest channel 5825MHz
Conducted power [dBm] Measured with OFDM modulation		8.75	8.72
Radiated power [dBm] Measured with OFDM modulation		12.26	11.93
Gain [dBi] Calculated		3.51	3.21
Measurement uncertainty		± 1.5 dB (cond.) / ± 3 dB (rad.)	

Antenna 3

IEEE 802.11a mode / 5180 ~ 5240MHz

T_{nom}	V_{nom}	Lowest channel 5180MHz	Highest channel 5240MHz
Conducted power [dBm] Measured with OFDM modulation		5.67	7.24
Radiated power [dBm] Measured with OFDM modulation		7.47	8.95
Gain [dBi] Calculated		1.80	1.61
Measurement uncertainty		± 1.5 dB (cond.) / ± 3 dB (rad.)	

IEEE 802.11a mode / 5745 ~ 5825MHz

T_{nom}	V_{nom}	Lowest channel 5745MHz	Highest channel 5825MHz
Conducted power [dBm] Measured with OFDM modulation		8.88	8.85
Radiated power [dBm] Measured with OFDM modulation		12.16	12.67
Gain [dBi] Calculated		3.28	3.82
Measurement uncertainty		± 1.5 dB (cond.) / ± 3 dB (rad.)	

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6.4 OUTPUT POWER

6.4.1 LIMIT

According to §15.407(a)& FCC R&O FCC 14 - 30,

(1) For the band 5.15-5.25 GHz.

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 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. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 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.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 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 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. 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.

(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 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.

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(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.

Note to paragraph (a)(3): The Commission strongly recommends that parties employing U-NII devices to provide critical communications services should determine if there are any nearby Government radar systems that could affect their operation.

Specified Limit of the Output Power

The EUT only has band I, band IV.

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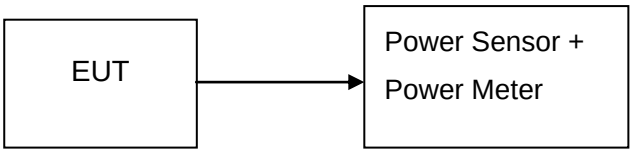
6.4.2 TEST CONFIGURATIONS



6.4.3 TEST PROCEDURE

The EUT was connected to a Power Meter through a 50Ω RF cable.

6.4.4 TEST RESULTS

No non-compliance noted

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6.4.5 TEST DATA

IEEE 802.11a mode / 5180 ~ 5240MHz

Channel	Frequency (MHz)	AVG Output Power (dBm)				AVG Output Power (W)				Limit (dBm)	Result
		Antenna 0	Antenna 1	Antenna 2	Antenna 3	Antenna 0	Antenna 1	Antenna 2	Antenna 3		
Low	5180	17.27	16.67	16.63	17.34	0.05333	0.04645	0.04603	0.05420	30.00	PASS
Mid	5200	17.17	16.73	17.59	17.38	0.05212	0.04710	0.05741	0.05470		PASS
High	5240	17.56	17.70	17.27	18.23	0.05702	0.05888	0.05333	0.06653		PASS

IEEE 802.11a mode / 5745 ~ 5825MHz

Channel	Frequency (MHz)	AVG Output Power (dBm)				AVG Output Power (W)				Limit (dBm)	Result
		Antenna 0	Antenna 1	Antenna 2	Antenna 3	Antenna 0	Antenna 1	Antenna 2	Antenna 3		
Low	5745	20.80	21.93	20.92	21.04	0.12023	0.15596	0.12359	0.12706	30.00	PASS
Mid	5785	20.62	21.50	20.78	20.45	0.11535	0.14125	0.11967	0.11092		PASS
High	5825	20.93	21.41	20.91	21.02	0.12388	0.13836	0.12331	0.12647		PASS

IEEE 802.11n HT 20 MHz mode / 5180 ~ 5240MHz

Channel	Frequency (MHz)	AVG Output Power (dBm)					AVG Output Power (W)	Limit (dBm)	Result
		Antenna 0	Antenna 1	Antenna 2	Antenna 3	Total			
Low	5180	11.48	13.12	13.63	13.12	18.93	0.07815	30.00	PASS
Mid	5200	13.13	13.18	12.34	12.97	18.94	0.07831		PASS
High	5240	13.04	13.55	13.30	13.02	19.25	0.08421		PASS

IEEE 802.11n HT 20 MHz mode / 5745 ~ 5825MHz

Channel	Frequency (MHz)	AVG Output Power (dBm)					AVG Output Power (W)	Limit (dBm)	Result
		Antenna 0	Antenna 1	Antenna 2	Antenna 3	Total			
Low	5745	18.26	18.35	17.73	17.94	24.10	0.25690	30.00	PASS
Mid	5785	19.49	18.61	19.16	17.97	24.87	0.30661		PASS
High	5825	18.17	17.96	18.61	18.52	24.34	0.27186		PASS

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IEEE 802.11n HT 40 MHz mode / 5190 ~ 5230MHz

Channel	Frequency (MHz)	AVG Output Power (dBm)					AVG Output Power (W)	Limit (dBm)	Result
		Antenna 0	Antenna 1	Antenna 2	Antenna 3	Total			
Low	5190	13.85	13.20	13.28	13.90	19.59	0.09099	30.00	PASS
High	5230	13.85	13.17	13.39	12.60	19.30	0.08504		PASS

IEEE 802.11n HT 40 MHz mode / 5755 ~ 5795MHz

Channel	Frequency (MHz)	AVG Output Power (dBm)					AVG Output Power (W)	Limit (dBm)	Result
		Antenna 0	Antenna 1	Antenna 2	Antenna 3	Total			
Low	5755	19.70	19.02	18.74	18.83	25.11	0.32433	30.00	PASS
High	5795	19.28	19.20	19.82	18.84	25.32	0.34040		PASS

IEEE 802.11ac 80 mode / 5210MHz

Channel	Frequency (MHz)	AVG Output Power (dBm)					AVG Output Power (W)	Limit (dBm)	Result
		Antenna 0	Antenna 1	Antenna 2	Antenna 3	Total			
	5210	13.52	14.01	13.44	13.98	19.77	0.09475	30.00	PASS

IEEE 802.11ac 80 mode / 5775MHz

Channel	Frequency (MHz)	AVG Output Power (dBm)					AVG Output Power (W)	Limit (dBm)	Result
		Antenna 0	Antenna 1	Antenna 2	Antenna 3	Total			
	5775	18.35	18.26	17.87	17.99	24.14	0.25957	30.00	PASS

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6.5 BAND EDGES MEASUREMENT

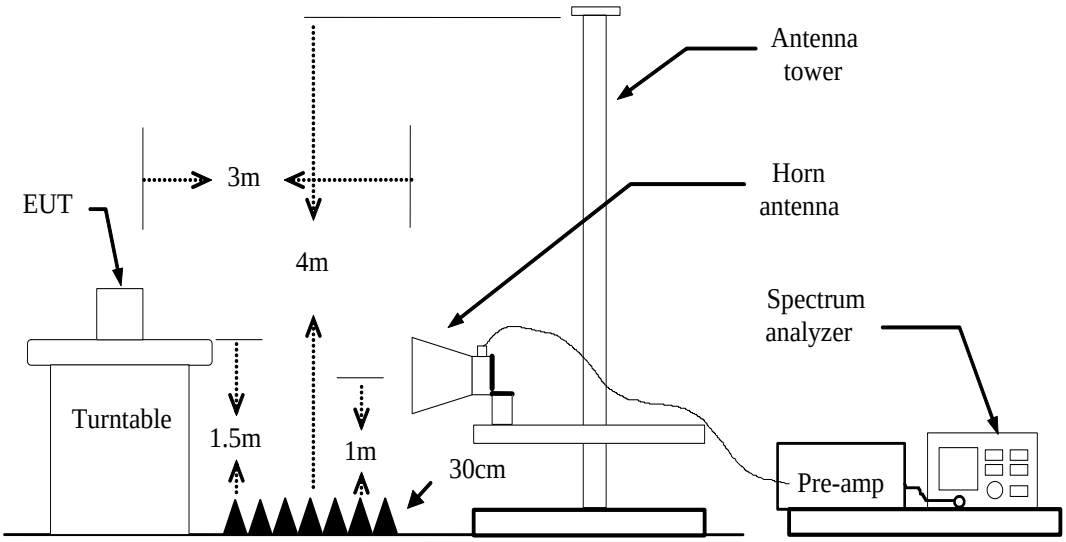
6.5.1 LIMIT

According to §15.407(b)

(1) The provisions of Section 15.205 of this part apply to intentional radiators operating under this section.

(2) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency block edges as the design of the equipment permits.

6.5.2 TEST CONFIGURATION



6.5.3 TEST PROCEDURE

1. The EUT is placed on a turntable, which is 1.5m above the ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4. Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
   (a) PEAK: RBW=1 / VBW=3MHz / Sweep=AUTO
   (b) AVERAGE: RBW=1MHz / VBW=1/T / Sweep=AUTO / Detector=Peak
5. Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

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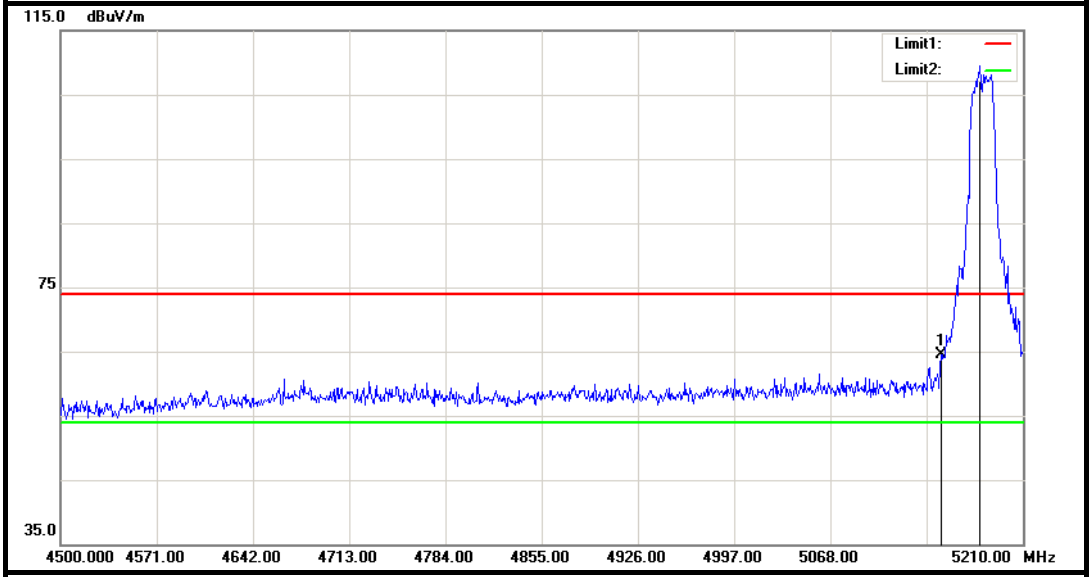
6.5.4 TEST RESULT

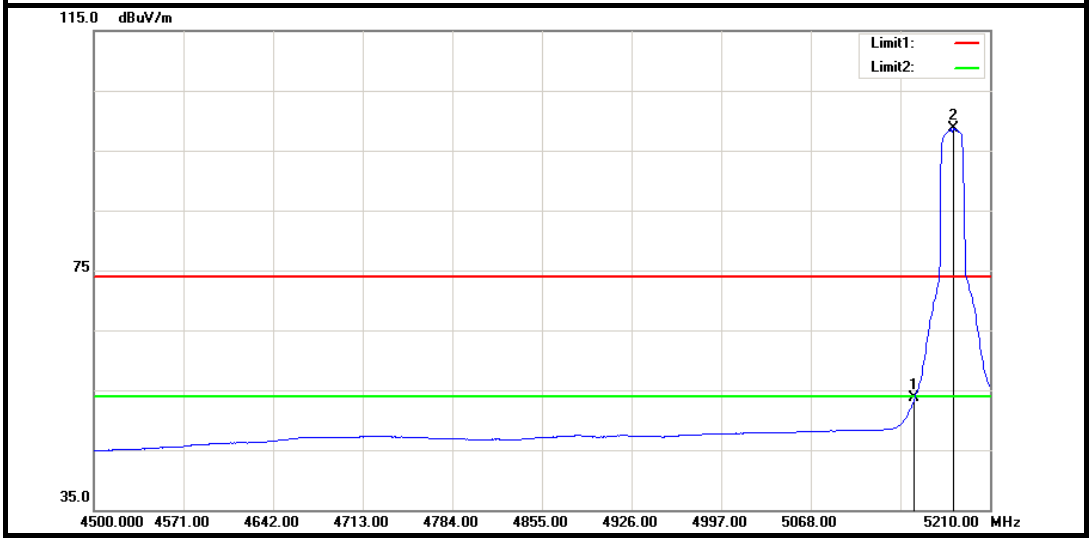
Test Plot

IEEE 802.11a mode / 5180MHz (Antenna 0)

Detector mode: Peak **Polarity: Vertical**



Detector mode: Average **Polarity: Vertical**



No.	Frequency (MHz)	Reading (dB)	Factor (dB/m)	Result (dB/m)	Limit (dB/m)	Margin (dB)	Remark	Antenna Polar
1	5150.000	59.29	5.25	64.54	74.00	-9.46	Peak	Vertical
2	5178.050	104.15	5.30	109.45	---	---	Peak	Vertical
1	5150.000	48.37	5.25	53.62	54.00	-0.38	Average	Vertical
2	5180.890	93.32	5.30	98.62	---	---	Average	Vertical

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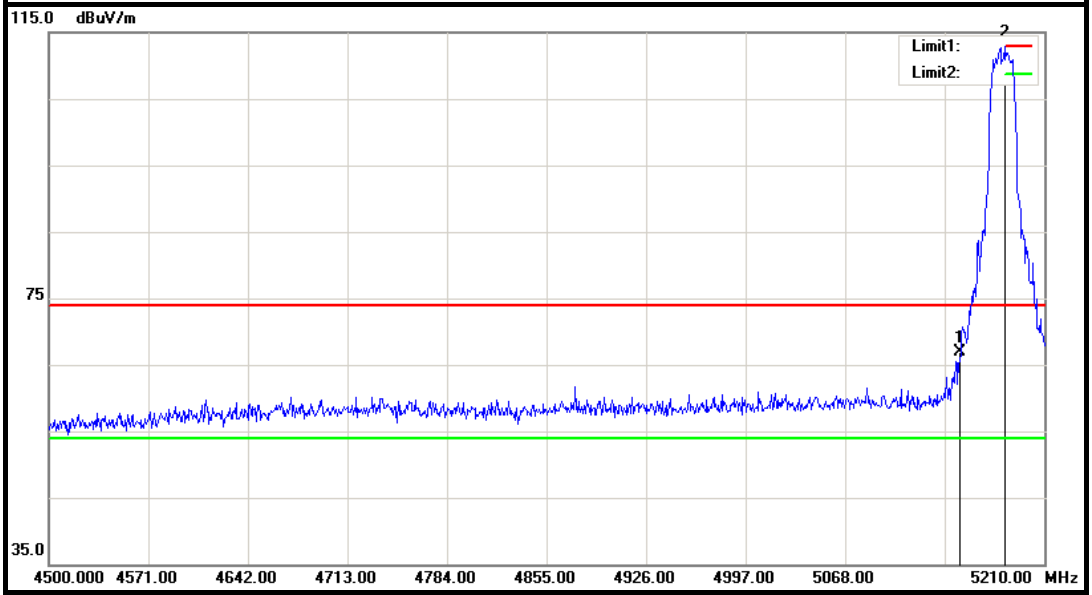
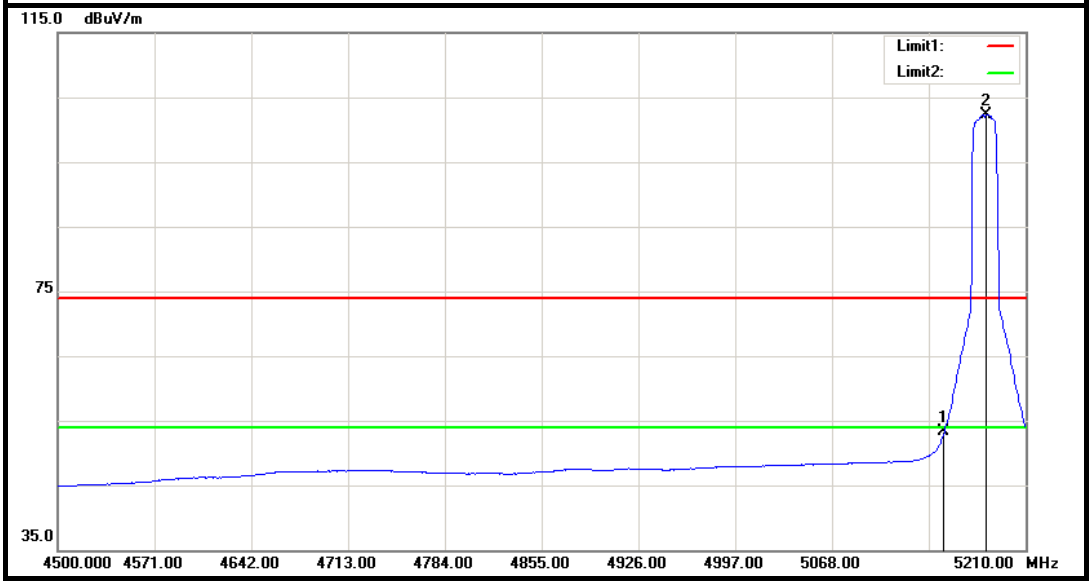
Detector mode: Peak **Polarity: Horizontal**



Detector mode: Average **Polarity: Horizontal**



No.	Frequency (MHz)	Reading (dB)	Factor (dB/m)	Result (dB/m)	Limit (dB/m)	Margin (dB)	Remark	Antenna Polar
1	5150.000	61.65	5.25	66.90	74.00	-7.10	Peak	Horizontal
2	5181.600	107.56	5.30	112.86	---	---	Peak	Horizontal
1	5150.000	48.07	5.25	53.32	54.00	-0.68	Average	Horizontal
2	5180.890	97.07	5.30	102.37	---	---	Average	Horizontal

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