



FCC 47 CFR PART 15 SUBPART E

CERTIFICATION TEST REPORT

FOR

MODEL NUMBER: 1645

FCC ID: C3K1645

REPORT NUMBER: 14U19051-E2 REVISION. B

ISSUE DATE: MARCH 25, 2015

Prepared for
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NVLAP LAB CODE 200065-0

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	01/26/15	Initial Issue	C. Pang
A	02/09/15	Removed heading in page 1. Changed EUT description to Handheld Computing Device. Fixed orientation typo, and added 11a and 11ac data rates.	H. Lau
B	3/25/2015	Address TCB's Questions on Section 6,	C. Pang

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: MICROSOFT CORPORATION
ONE MICROSOFT WAY
REDMOND, WA 98052, U.S.A.

EUT DESCRIPTION: HANDHELD COMPUTING DEVICE

MODEL: 1645

SERIAL NUMBER: 000200544952 (CONDUCTED); 000207544952 (RADIATED)

DATE TESTED: DECEMBER 17, 2014 – JANUARY 26, 2015

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

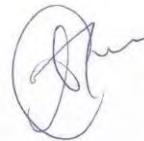
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:



Chin Pang
Senior Engineer
UL Verification Services Inc.

Tested By:



Tina Chu
Lab Technician
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, FCC KDB 789033, ANSI C63.10-2009.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
<input type="checkbox"/> Chamber A	<input type="checkbox"/> Chamber D
<input type="checkbox"/> Chamber B	<input checked="" type="checkbox"/> Chamber E
<input type="checkbox"/> Chamber C	<input checked="" type="checkbox"/> Chamber F
	<input checked="" type="checkbox"/> Chamber G
	<input checked="" type="checkbox"/> Chamber H

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-8, respectively.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	± 3.52 dB
Radiated Disturbance, 30 to 1000 MHz	± 4.94 dB
Radiated Disturbance, 1 to 6 GHz	± 3.86 dB
Radiated Disturbance, 6 to 18 GHz	± 4.23 dB
Radiated Disturbance, 18 to 26 GHz	± 5.30 dB
Radiated Disturbance, 26 to 40 GHz	± 5.23 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a handheld computing device with 802.11 2x2, a/b/g/n/ac WLAN and Bluetooth radios.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range (MHz)	Mode 2TX	Output Power (dBm)	Output Power (mW)
5180 - 5240	802.11a	10.17	10.40
5180 - 5240	802.11n HT20	10.00	10.00
5190 - 5230	802.11n HT40	10.27	10.64
5210	802.11ac VHT80	9.53	8.97
5260 - 5320	802.11a	10.17	10.40
5260 - 5320	802.11n HT20	10.16	10.38
5270 - 5310	802.11n HT40	10.15	10.35
5290	802.11ac VHT80	9.61	9.14
5500 - 5700	802.11a	10.35	10.84
5500 - 5700	802.11n HT20	10.24	10.57
5510 - 5670	802.11n HT40	10.40	10.96
5530 - 5610	802.11ac VHT80	9.59	9.10
5745 - 5825	802.11a	10.40	10.96
5745 - 5825	802.11n HT20	10.11	10.26
5755 - 5795	802.11n HT40	10.44	11.07
5775	802.11ac VHT80	9.29	8.49

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an integrated antenna with maximum gains as follows:

Frequency Band (GHz)	Antenna Gain (dBi)	
	Chain 0	Chain 1
5.15 - 5.25	3.1	3.6
5.25 - 5.35	2.9	3.5
5.47 - 5.725	3.3	2.5
5.725 -5.85	3.5	1.9

5.4. SOFTWARE

The test software used during testing was WIFI Tool v2.3.2

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The fundamental of the EUT was investigated in three orthogonal orientations X, Y, Z, it was determined that Y orientation was worst-case orientation for 2.4GHz band and Z orientation was worst-case orientation for 5GHz band; therefore, all final radiated testing was performed with the EUT in Y (Landscape) orientation for 2.4GHz band and Z (Portrait) orientation for 5.GHz band.

Worst-case data rates as provided by the client were:

802.11b mode: 1 Mbps
802.11g mode: 6 Mbps
802.11a mode: 6 Mbps
802.11n HT20mode: MCS0
802.11n HT40 mode: MCS0
802.11ac mode: MCS0

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Lenovo	E545	5399926	DoC
Laptop AC/DC adapter	Lenovo	ADLX65NCT2A	11S36200293ZZ10049556A	DoC
Headset	N/A	N/A	N/A	N/A

I/O CABLES (CONDUCTED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	SMA	Un-Shielded	0.3	To spectrum Analyzer
2	Ether cable	1	RJ45- USB	Shielded	3	To EUT
3	DC	1	DC	Un-shielded	0.8	N/A

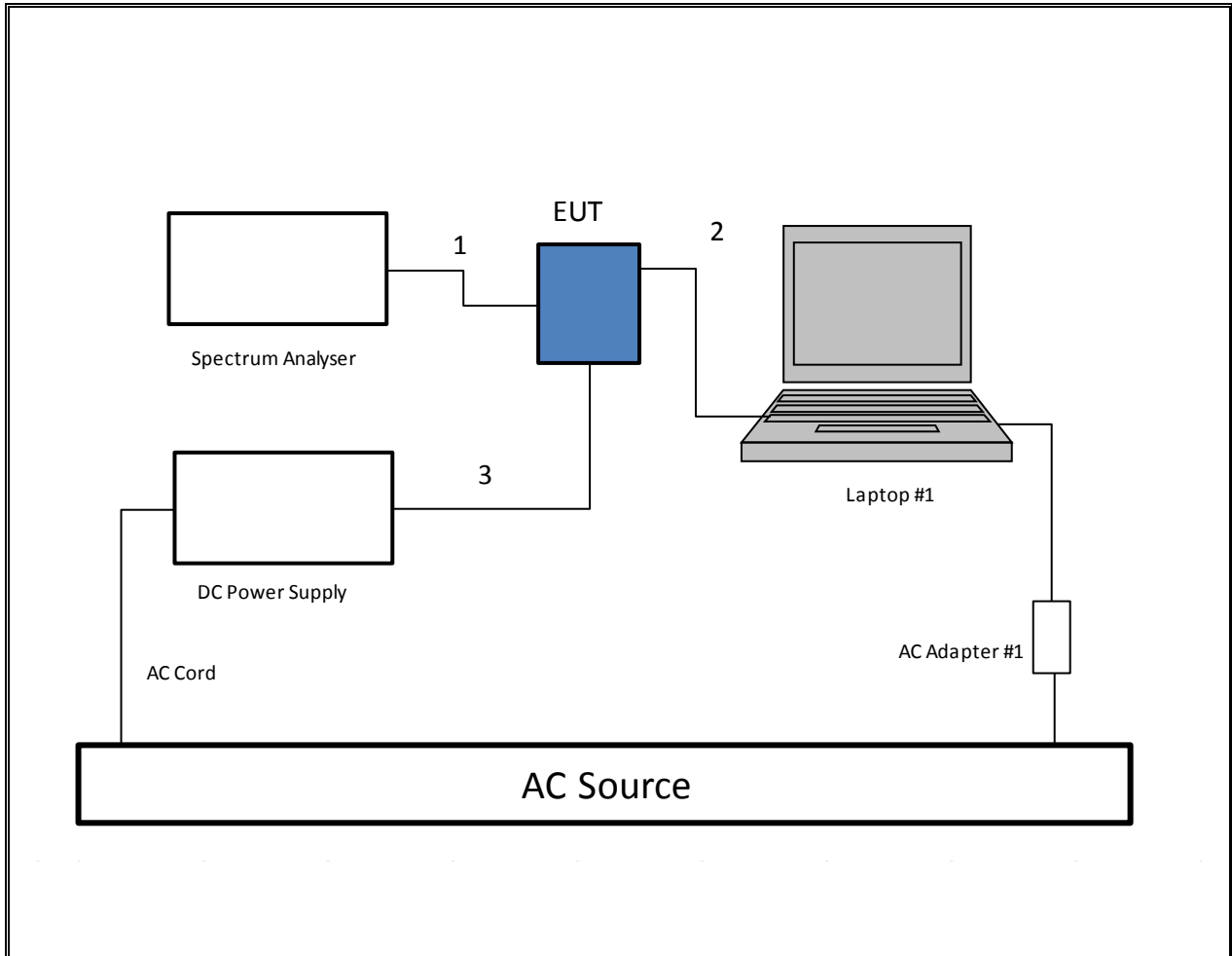
I/O CABLES (BELOW 1GHZ & AC LINE CONDUCTED TESTS)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC Main	1	115VAC	Un-Shielded	1.2	NA
2	DC	1	DC	Un-Shielded	0.8	NA
3	Audio Jack	1	Headset	Un-shielded	1	N/A

TEST SETUP- CONDUCTED PORT

The EUT was tested connected to a host Laptop via RJ45/USB cable and spectrum analyzer to antenna port. Test software exercised the EUT.

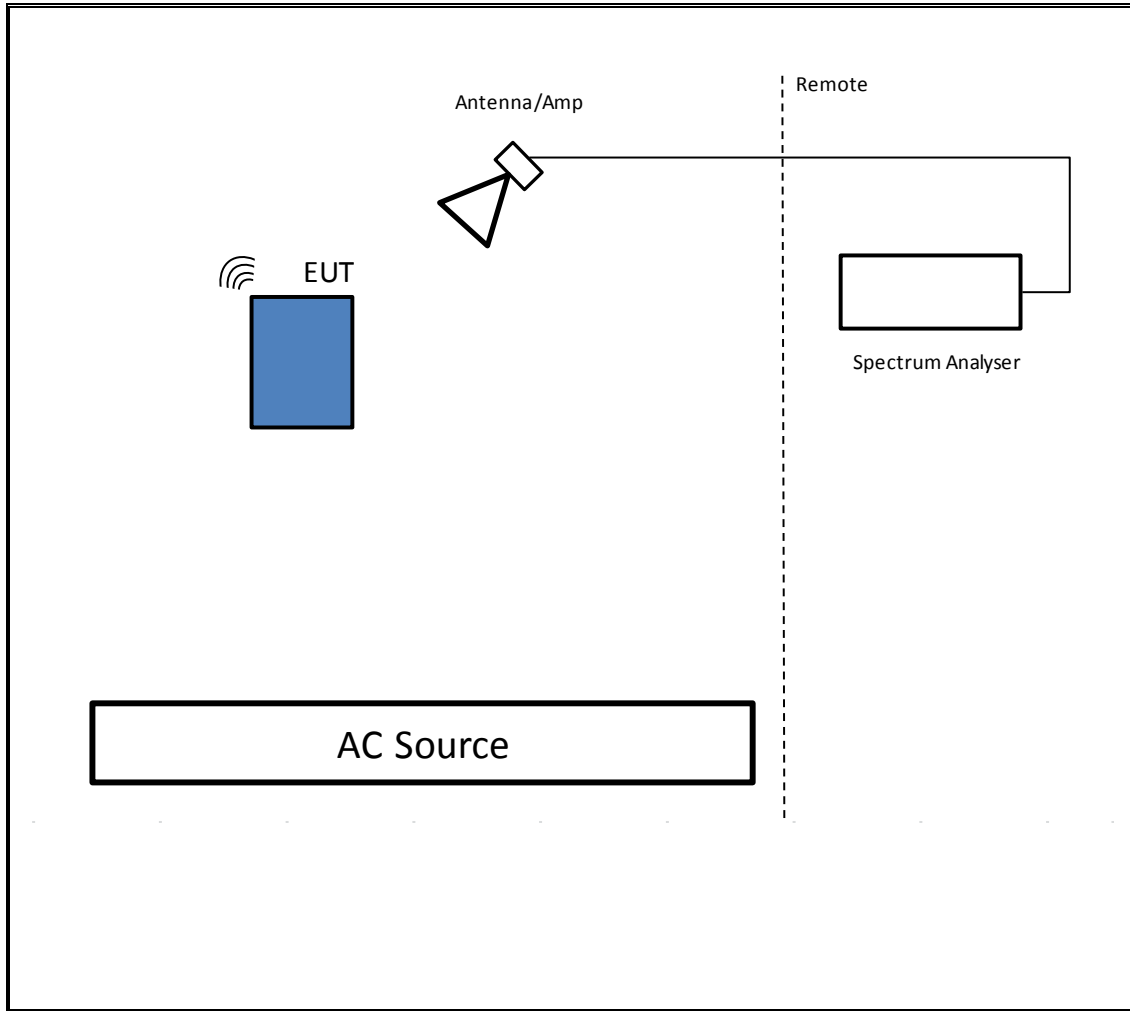
SETUP DIAGRAM



TEST SETUP- RADIATED-ABOVE 1 GHZ

The EUT was tested battery powered. Test software exercised the EUT.

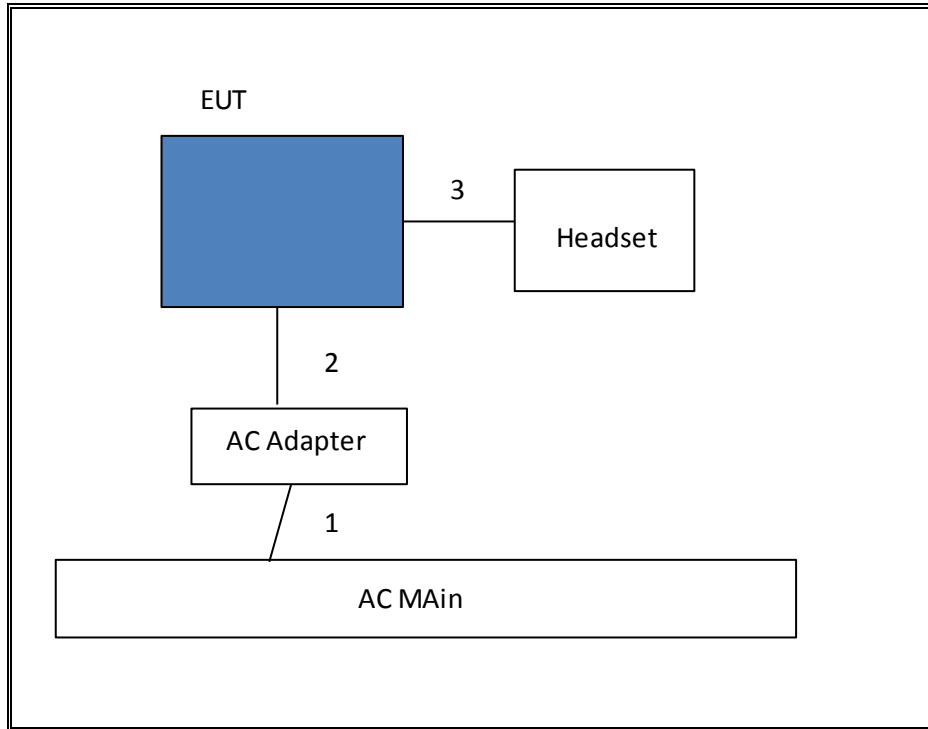
SETUP DIAGRAM



TEST SETUP - BELOW 1GHZ & AC LINE CONDUCTED TESTS

The EUT was tested with AC/DC power supply. Test software exercised the EUT.

SETUP DIAGRAM



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List				
Description	Manufacturer	Model	Serial Number	Cal Due
Antenna, Horn 1-18GHz	ETS Lindgren	3117	143448	2/18/2015
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	A022813-2	2/26/2015
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826	1049	12/17/15
Horn Antenna, 40GHz	ARA	MWH-2640/B	1029	7/15/2015
Amplifier, 1 - 18GHz	Miteq	AFS42-00101800-25-S-42	1782158	1/11/2016
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	323562	4/23/2015
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	MY52350675	3/11/2015
Antenna, Horn 1-18GHz	ETS Lindgren	3117	00029310	3/20/2015
Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum	Agilent	8449B	3008A04710	3/25/2015
EMI Test Receiver 9KHz-7GHz	Rohde & Schwarz	ECSI7	N/A	9/16/2015
LISN for Conducted Emissions CISPR-16	FCC	50/250-25-2	N/A	1/16/2016
Power Cable, Line Conducted Emissions ANSI 63.4	UL	PG1	N/A	7/28/2015
Amplifier, 26 - 40GHz	Miteq	NSP4000-SP2	924343	9/3/2015
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Agilent	N1921A	MY53260010	7/12/2015
Amplifier, 1 - 18GHz	Miteq	AFS42-00101800-25-S-42	N/A	1/20/2016
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	185623	6/7/2015
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	MY53310972	05/08/15
Power Meter, P-series single channel	Agilent	N1911A	MY53060011	4/9/2015

7. MEASUREMENT METHODS

26 dB Emission BW: KDB 789033 D02 v01r, Section C.

99% Occupied BW: KDB 789033 D02 v01, Section D.

Conducted Output Power: KDB 789033 D02 v01, Section E.2.b (Method SA-1).

Conducted Output Power: KDB 789033 D02 v01, Section E.2.d (Method SA-2).

Power Spectral Density: KDB 789033 D02 v01, Section F.

Unwanted emissions in restricted bands: KDB 789033 D02 v01, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v01, Sections G.3, G.4, and G.5.

8. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

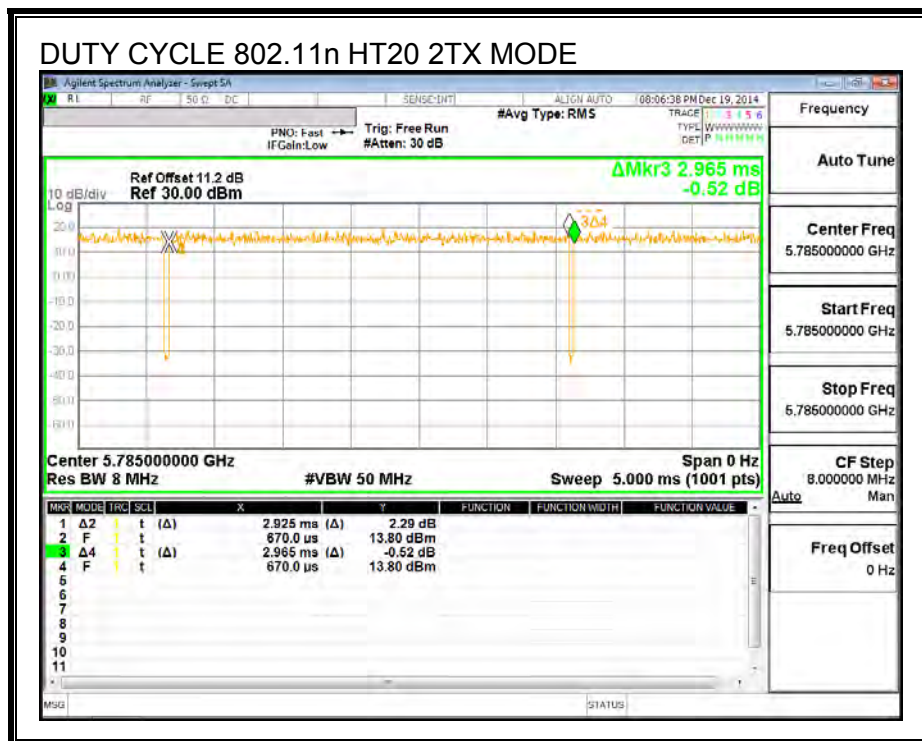
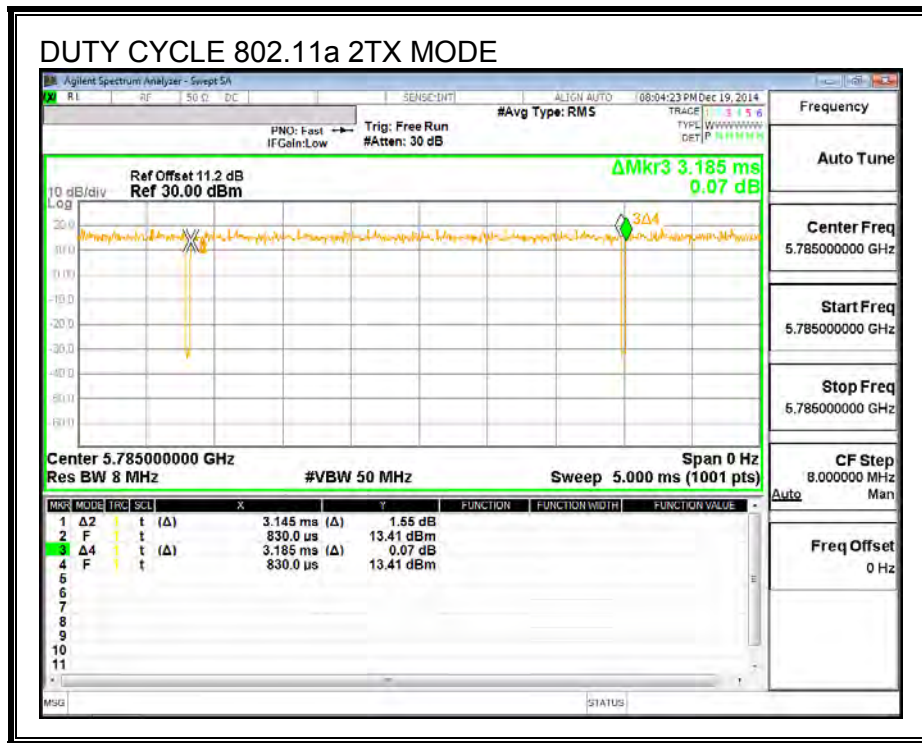
PROCEDURE

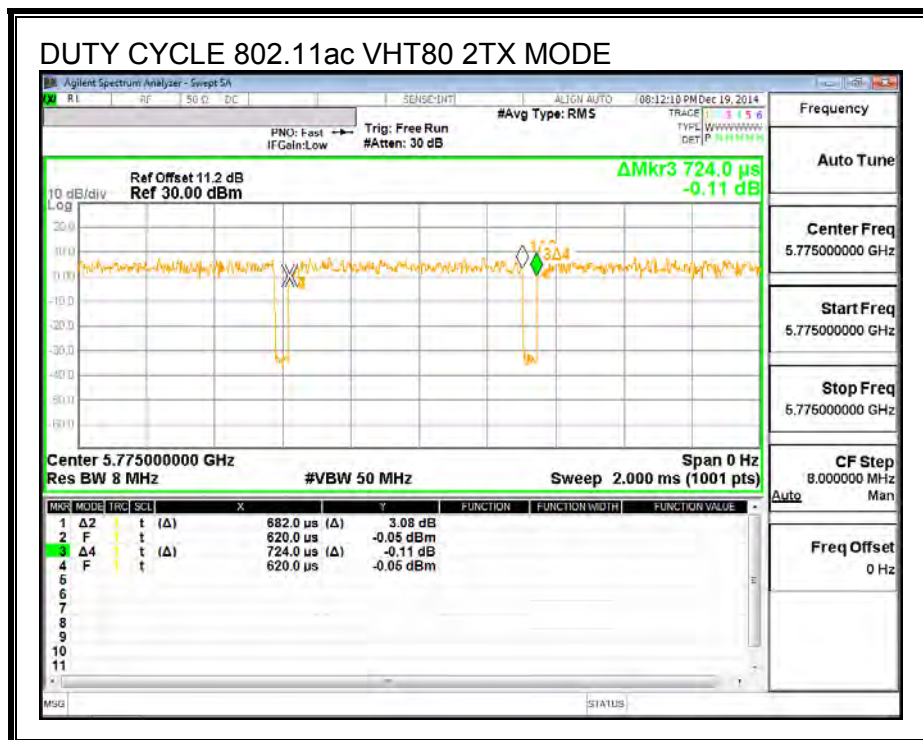
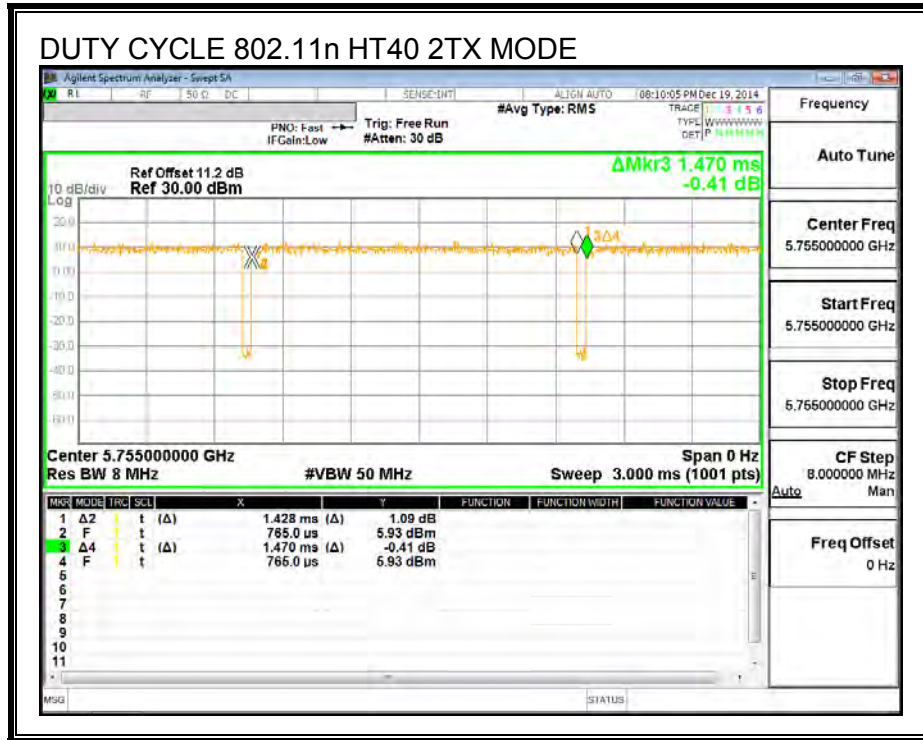
KDB 789033 Zero-Span Spectrum Analyzer Method.

8.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
802.11a 2TX	3.145	3.185	0.987	98.74%	0.00	0.010
802.11n HT20 2TX	2.925	2.965	0.987	98.65%	0.00	0.010
802.11n HT40 2TX	1.428	1.470	0.971	97.14%	0.13	0.700
802.11ac VHT80 2TX	0.682	0.724	0.942	94.20%	0.26	1.466

8.2. DUTY CYCLE PLOTS





9. ANTENNA PORT TEST RESULTS

9.1. 802.11a MODE IN THE 5.2 GHZ BAND

9.1.1. 26 dB BANDWIDTH

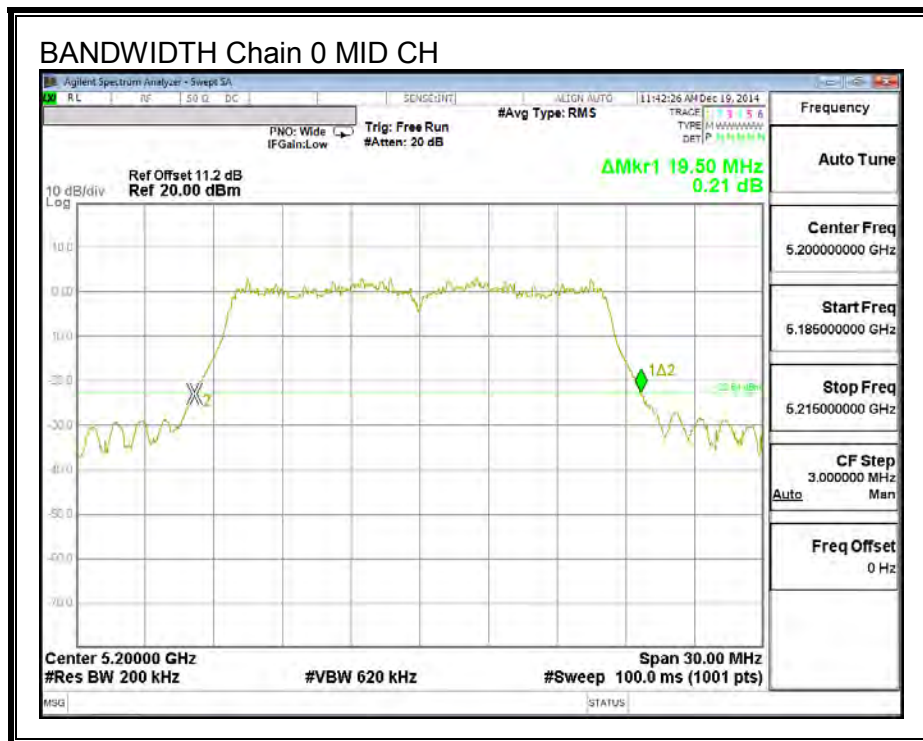
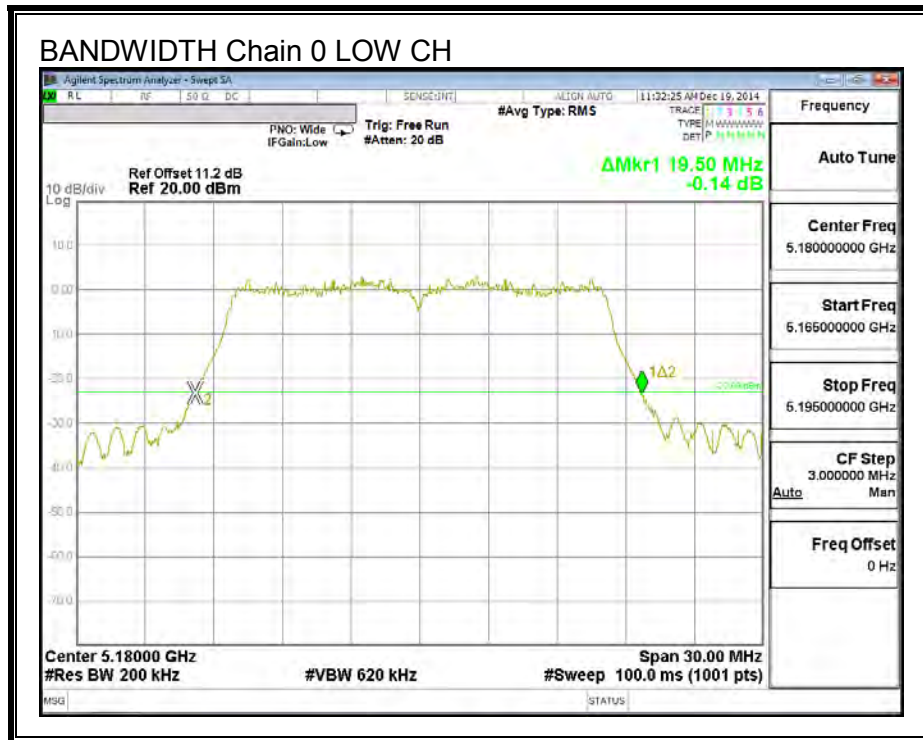
LIMITS

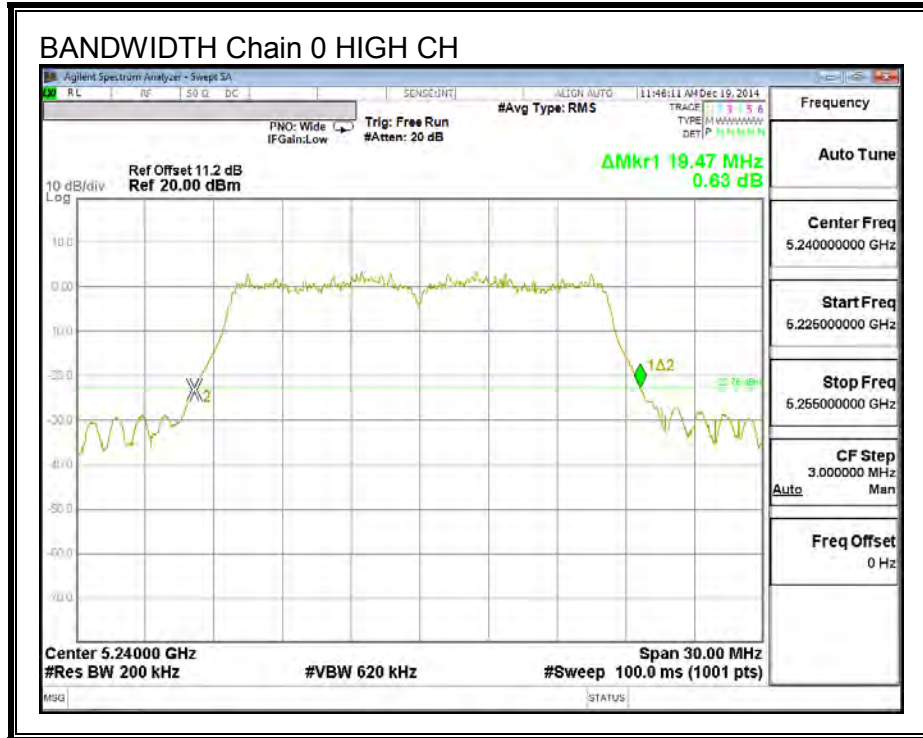
None; for reporting purposes only.

RESULTS

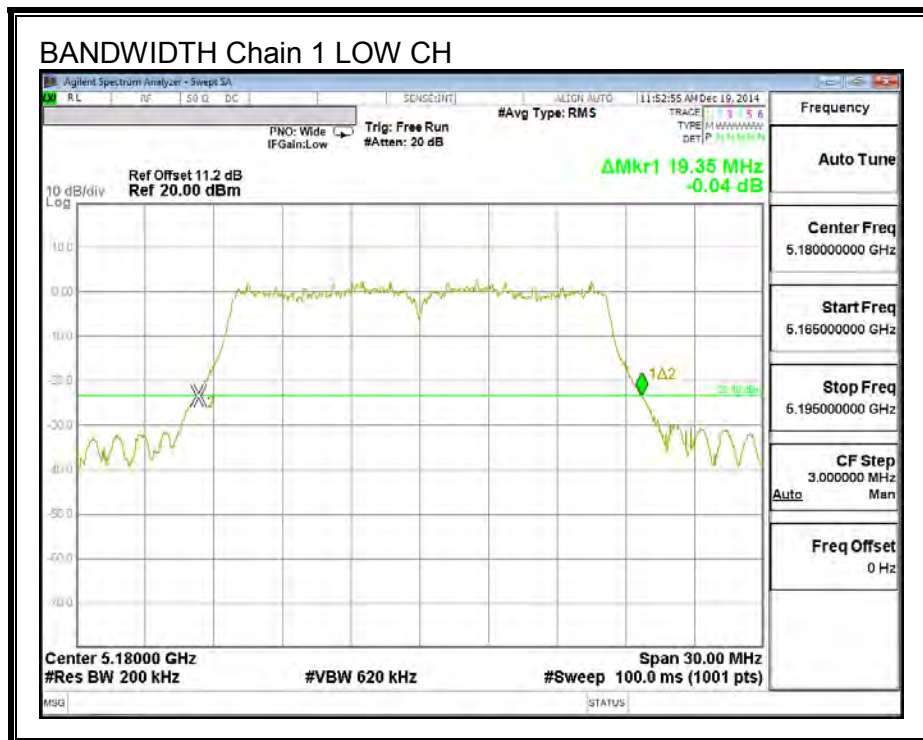
Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5180	19.50	19.35
Mid	5200	19.50	19.38
High	5240	19.47	19.38

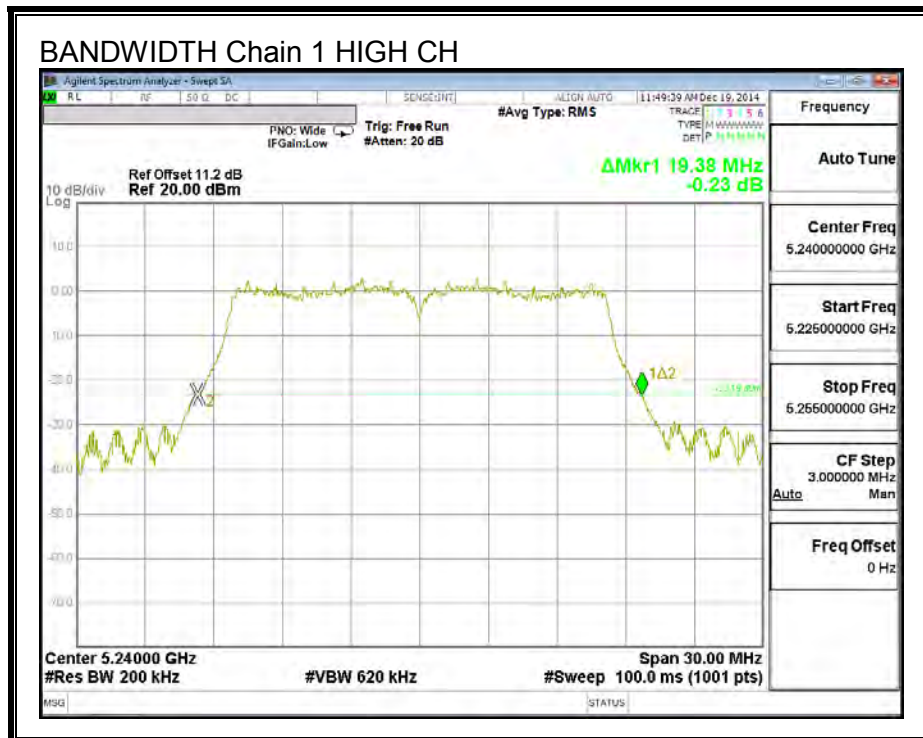
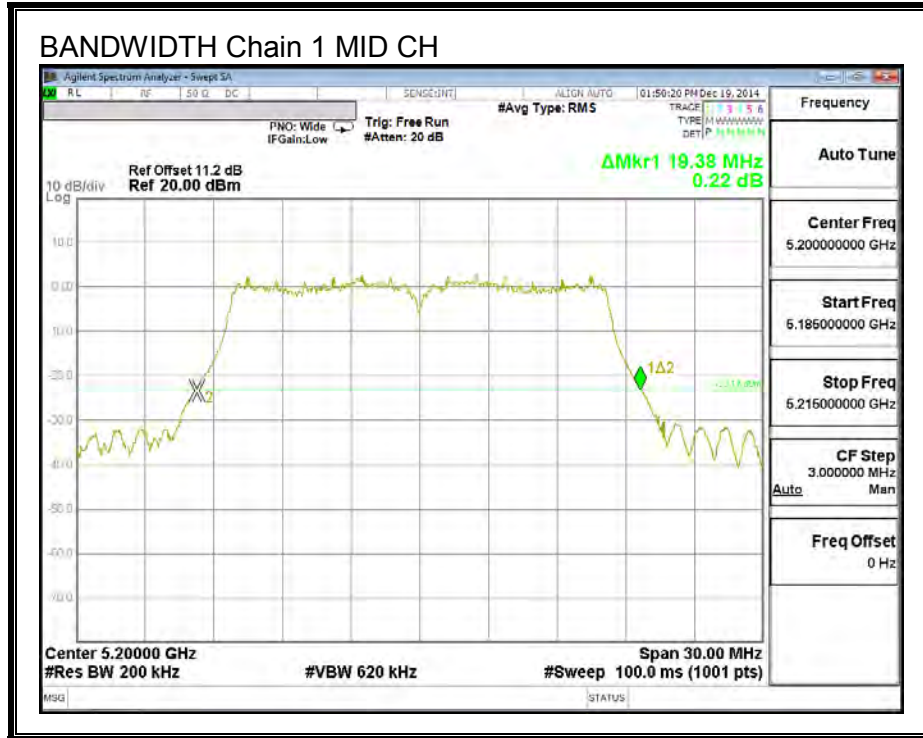
26 dB BANDWIDTH, Chain 0





26 dB BANDWIDTH, Chain 1





9.1.2. 99% BANDWIDTH

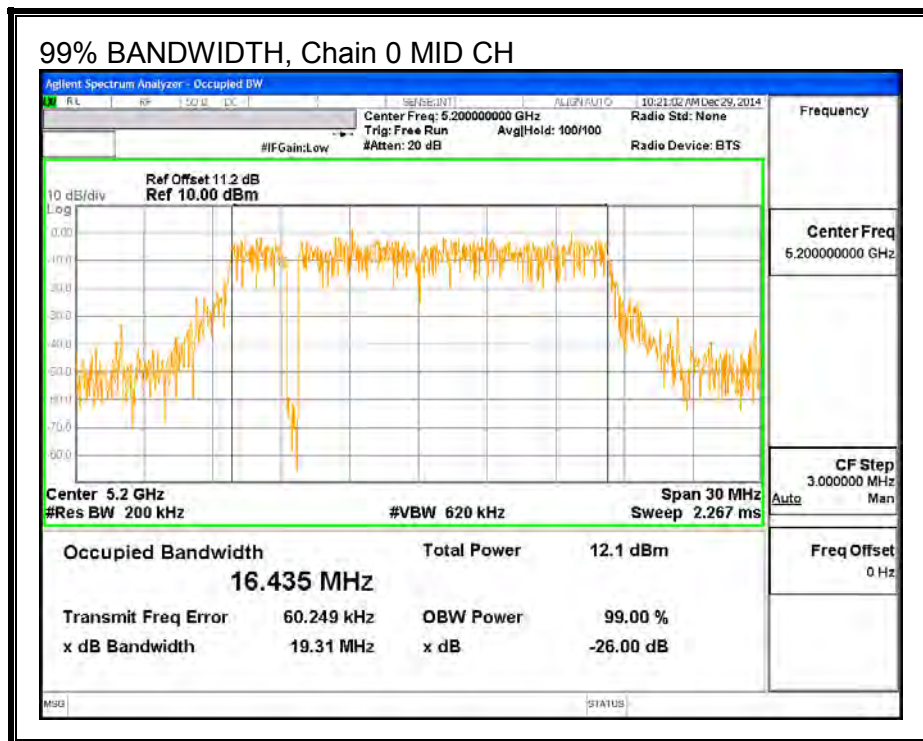
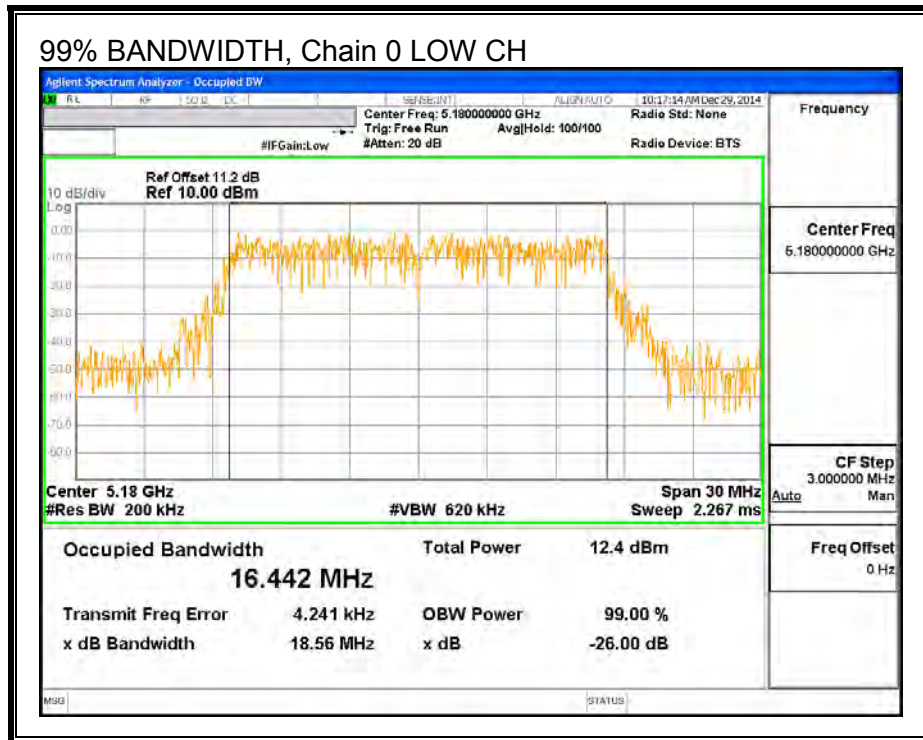
LIMITS

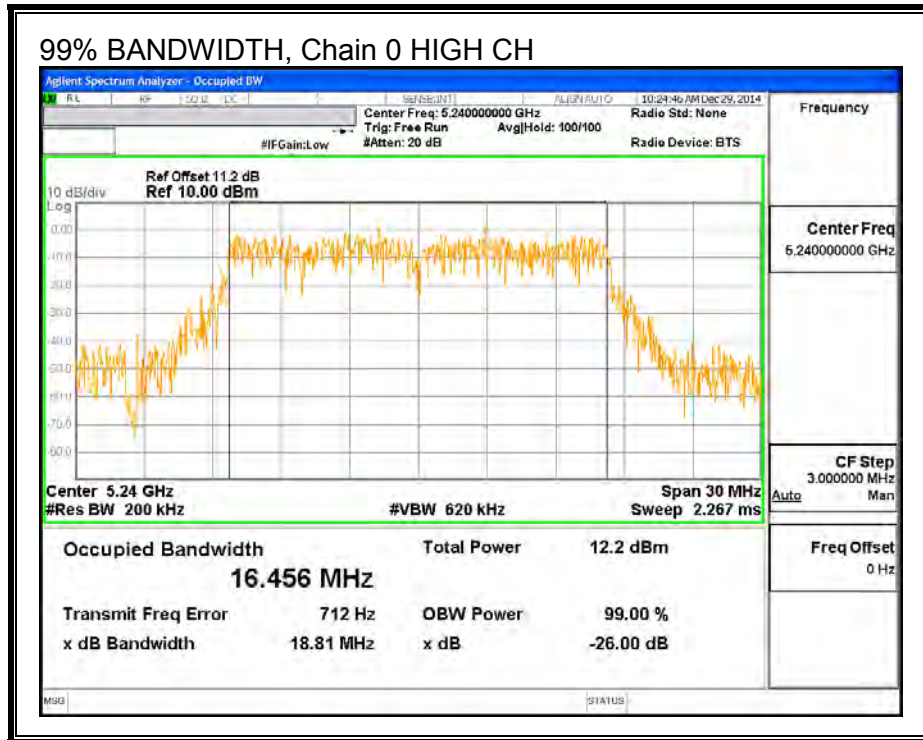
None; for reporting purposes only.

RESULTS

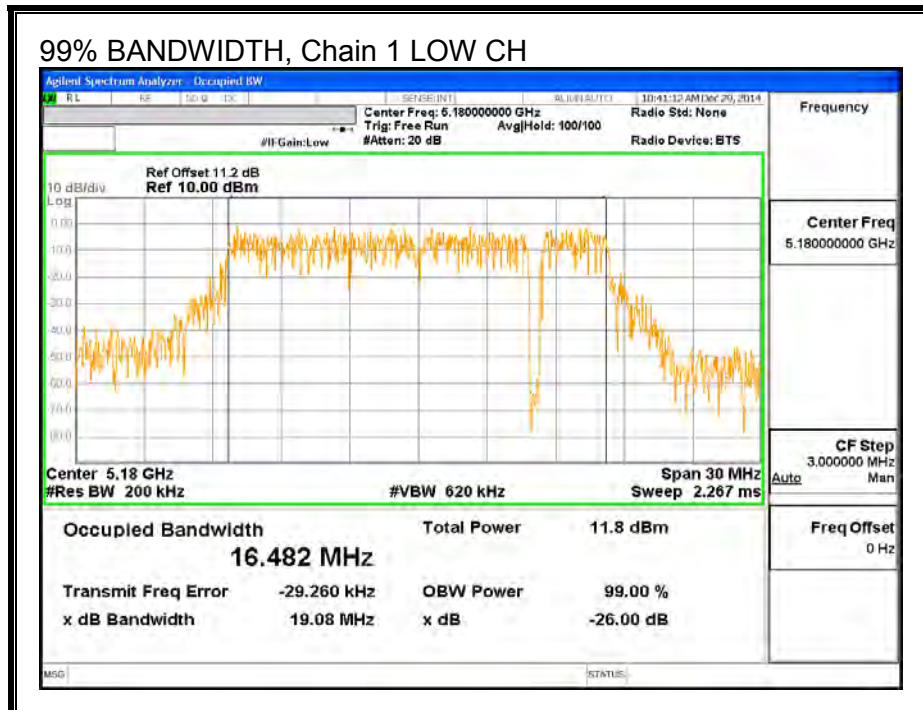
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5180	16.442	16.482
Mid	5200	16.435	16.337
High	5240	16.456	16.502

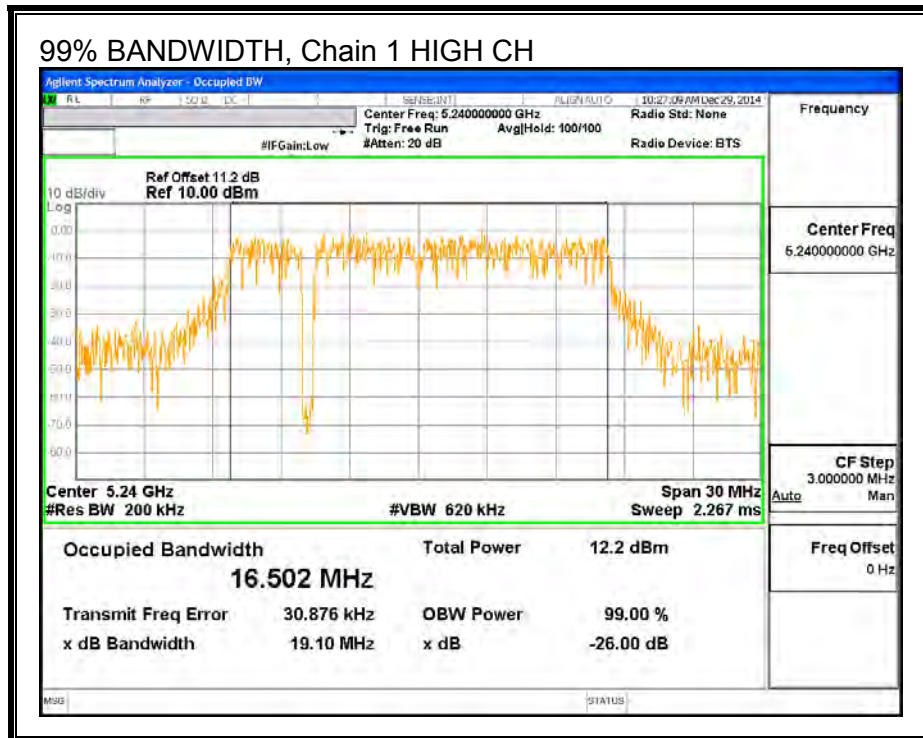
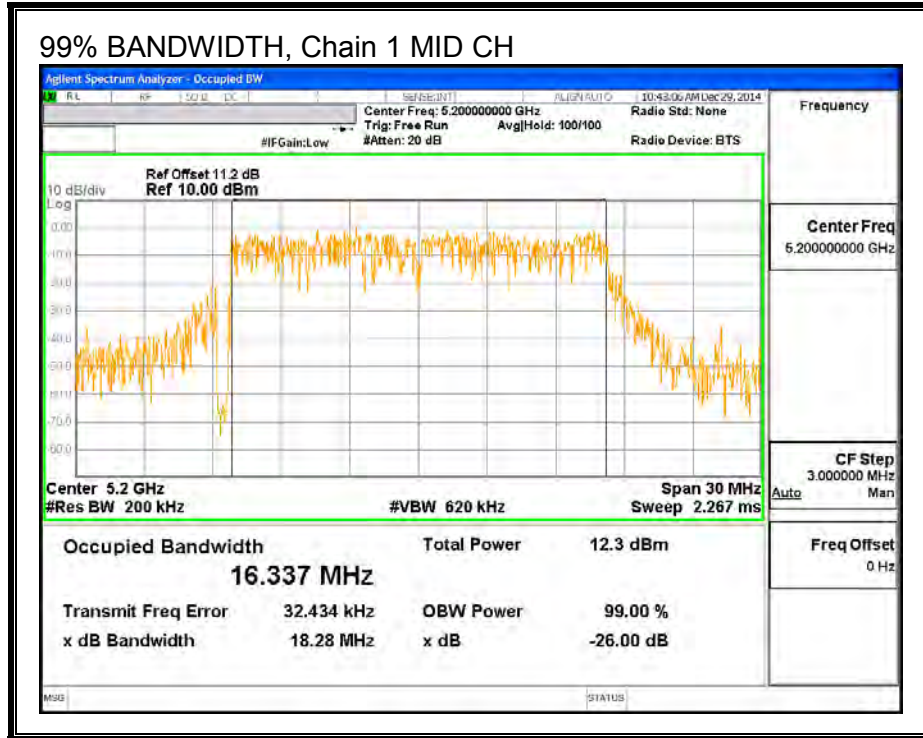
99% BANDWIDTH, Chain 0





99% BANDWIDTH, Chain 1





9.1.3. OUTPUT POWER AND PSD

LIMITS

FCC §15.407 (a) (1)

(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. 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.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.1	3.6	3.36

RESULTS

Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5180	3.36	3.36	24.00	11.00
Mid	5200	3.36	3.36	24.00	11.00
High	5240	3.36	3.36	24.00	11.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd Power & PSD
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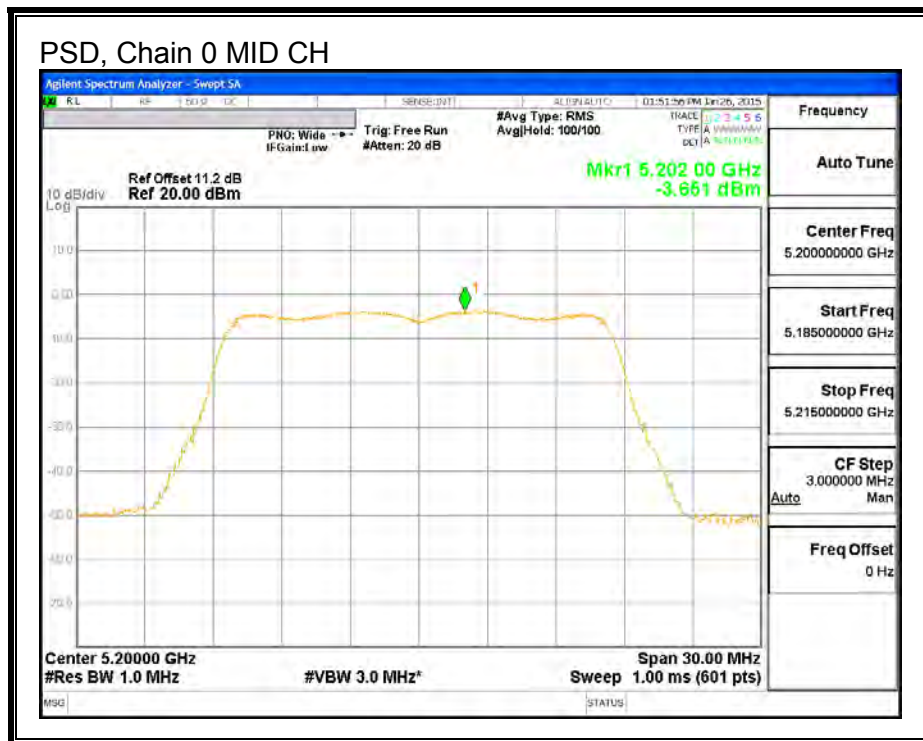
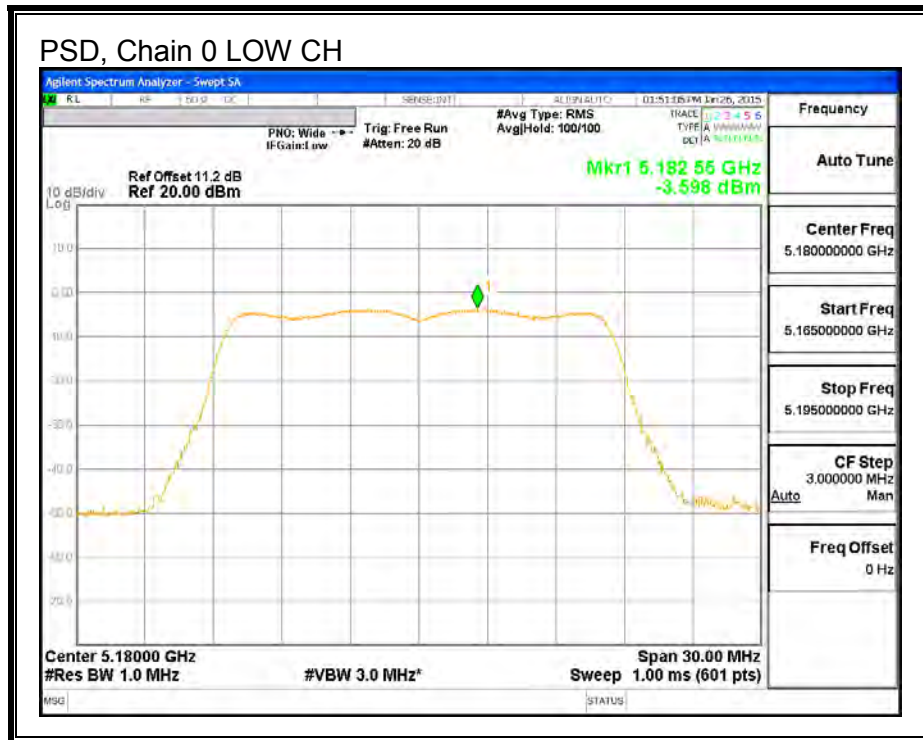
Output Power Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	6.93	7.16	10.06	24.00	-13.94
Mid	5200	7.01	6.95	9.99	24.00	-14.01
High	5240	7.20	7.12	10.17	24.00	-13.83

PSD Results

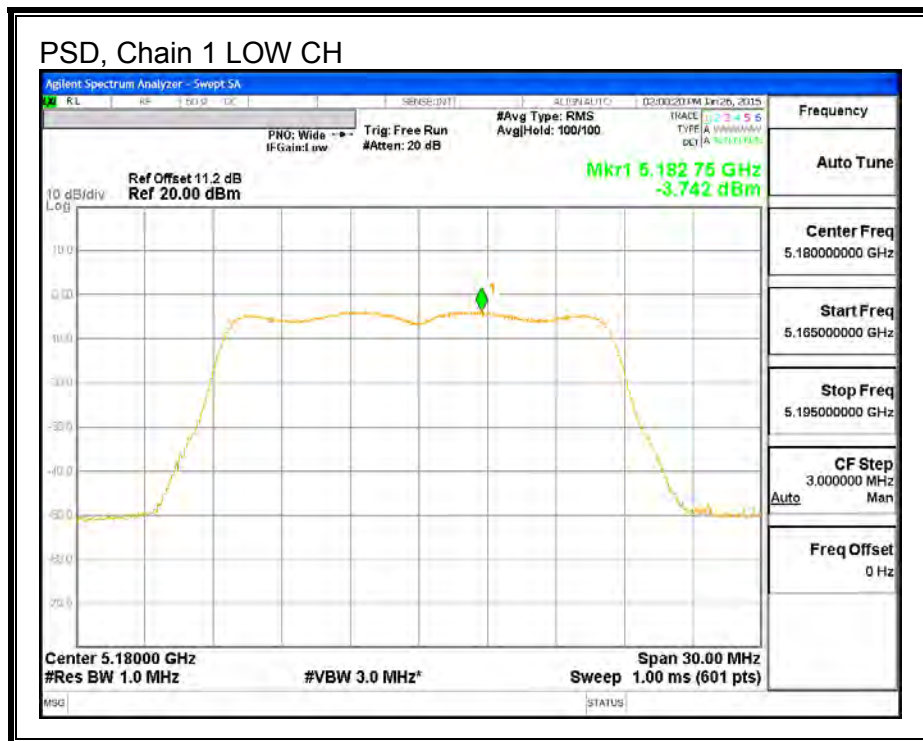
Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5180	-3.598	-3.742	-0.66	11.00	-11.66
Mid	5200	-3.651	-4.103	-0.86	11.00	-11.86
High	5240	-3.577	-4.351	-0.94	11.00	-11.94

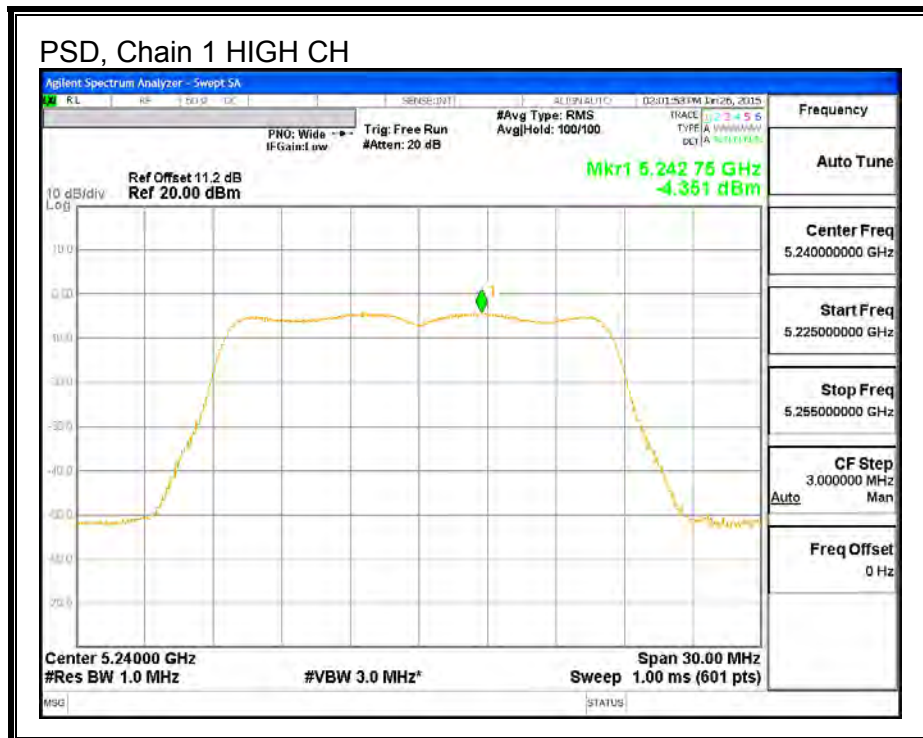
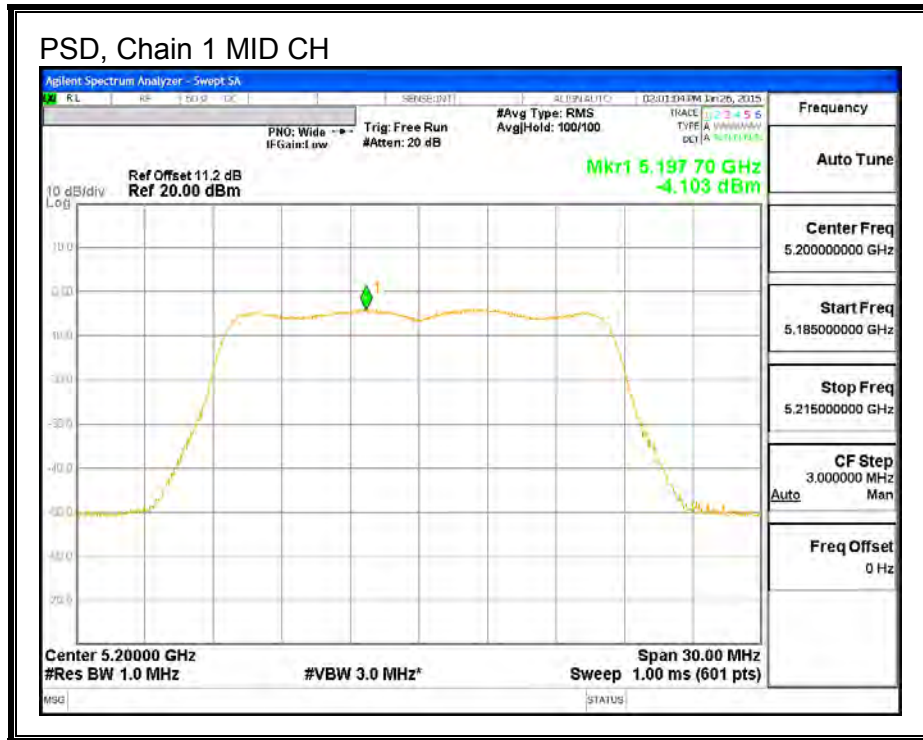
PSD, Chain 0





PSD, Chain 1





9.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND

9.2.1. 26 dB BANDWIDTH

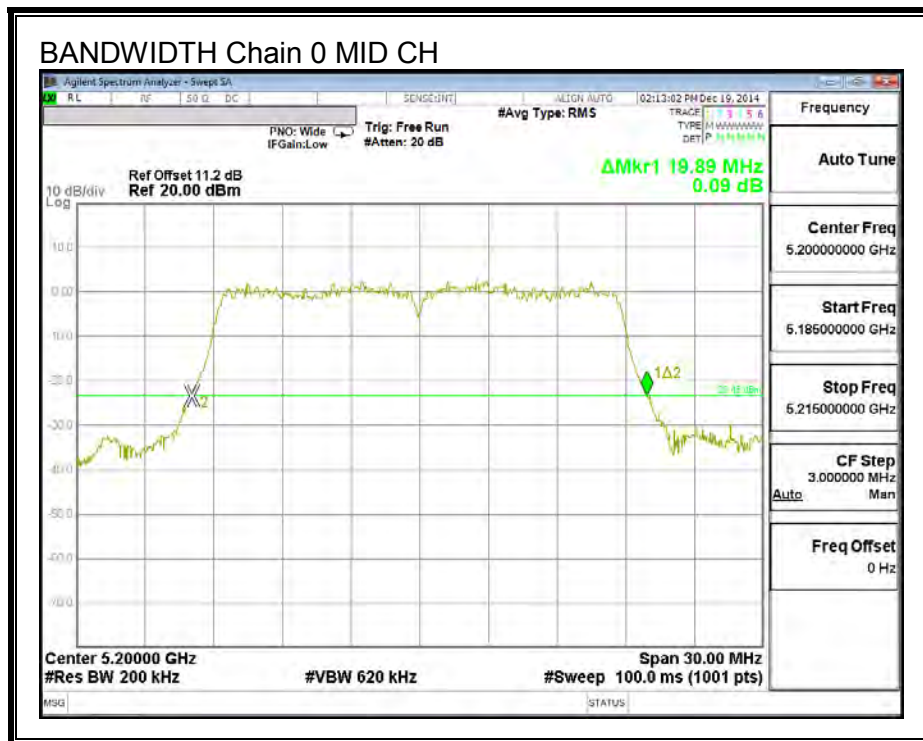
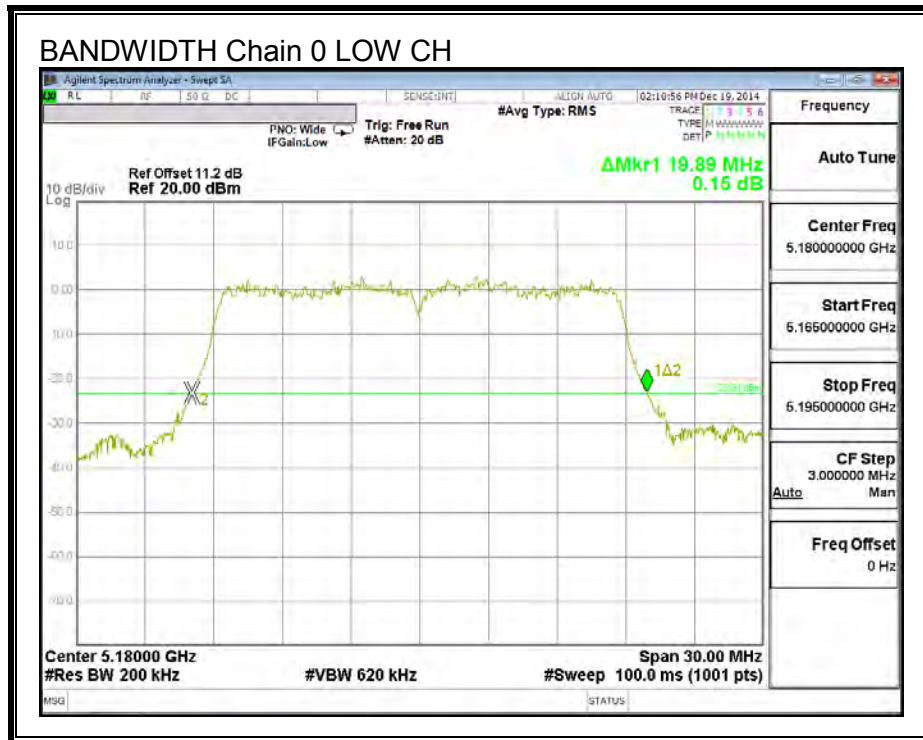
LIMITS

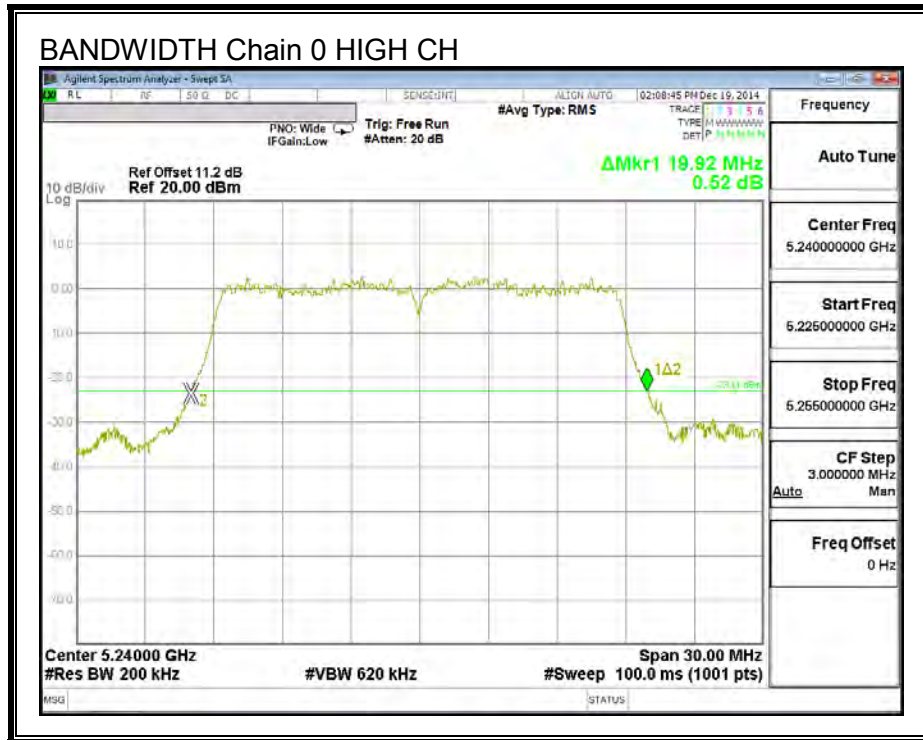
None; for reporting purposes only.

RESULTS

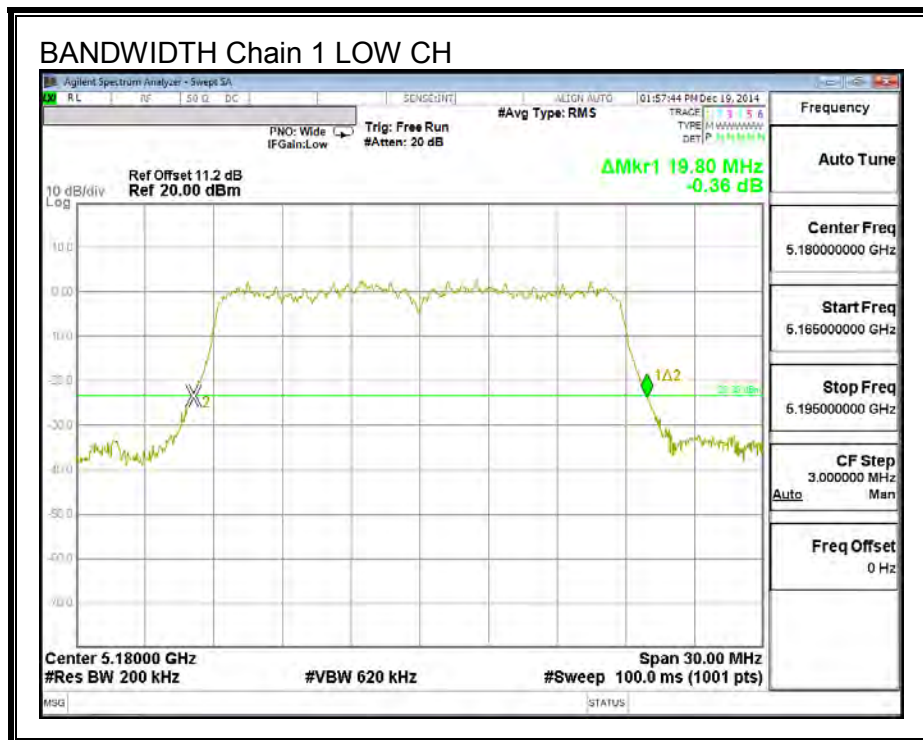
Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5180	19.89	19.80
Mid	5200	19.89	19.80
High	5240	19.92	19.80

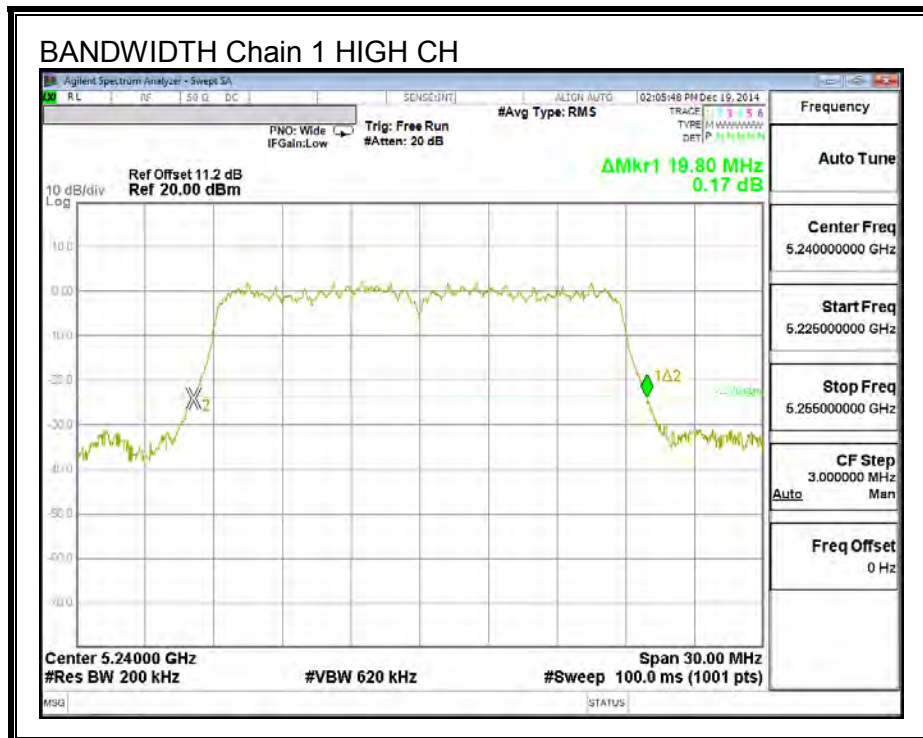
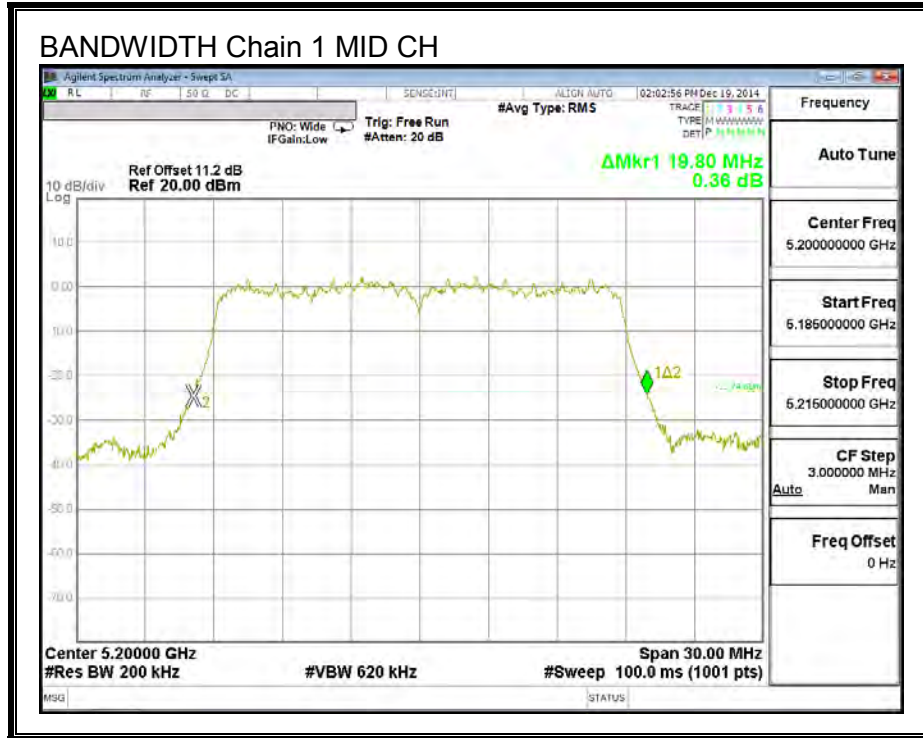
26 dB BANDWIDTH, Chain 0





26 dB BANDWIDTH, Chain 1





9.2.2. 99% BANDWIDTH

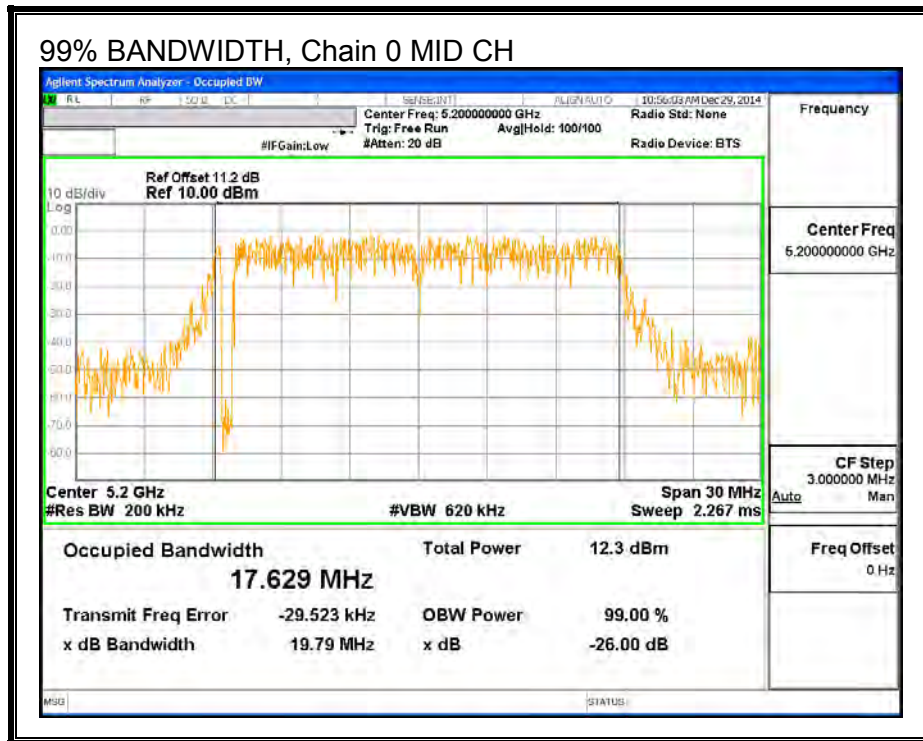
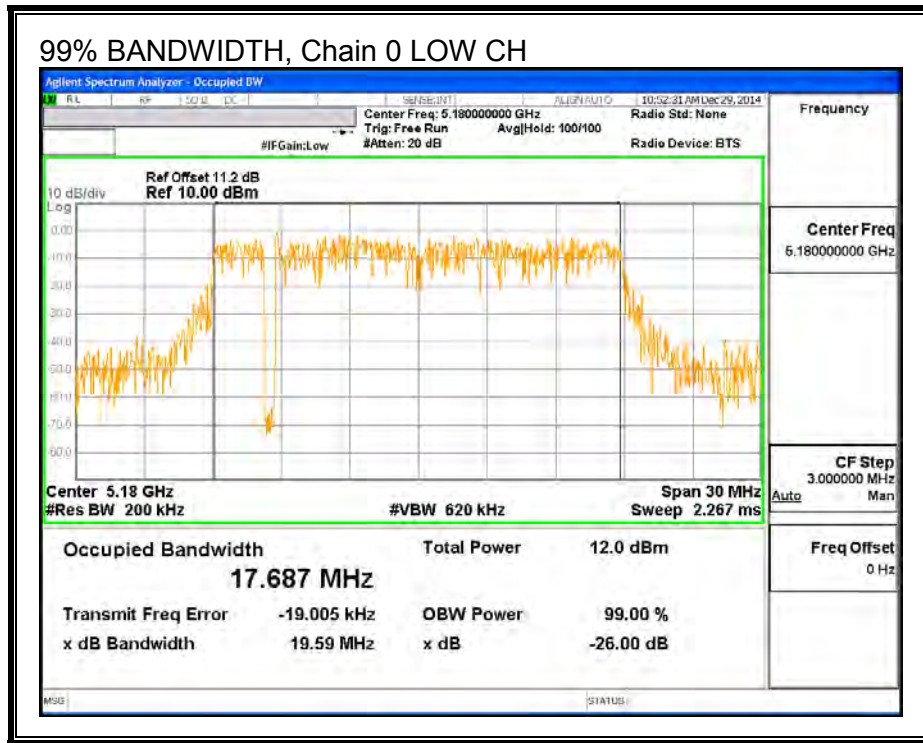
LIMITS

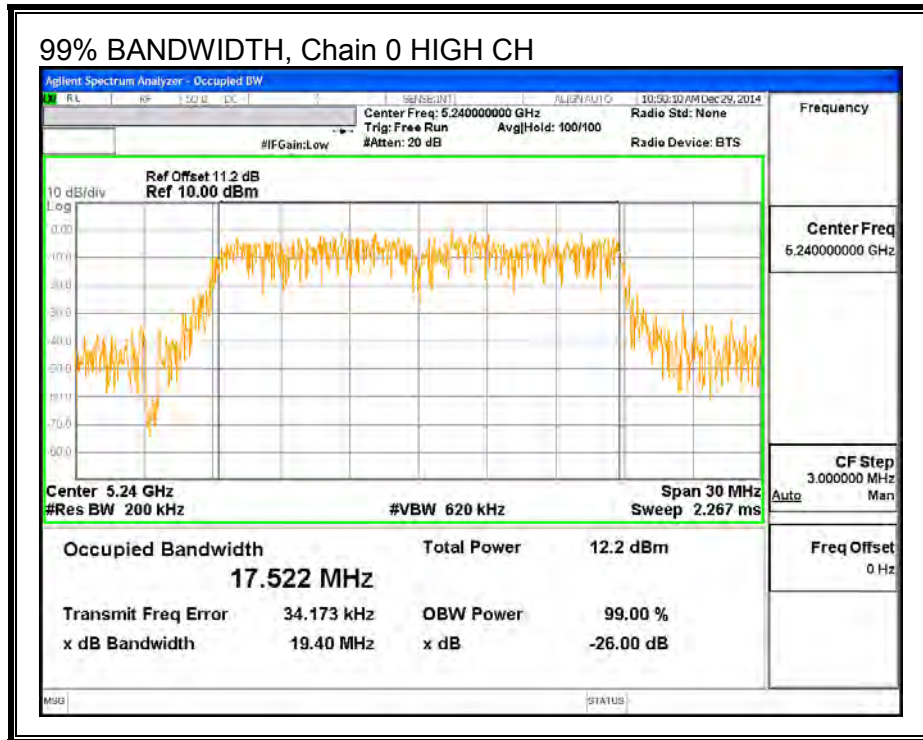
None; for reporting purposes only.

RESULTS

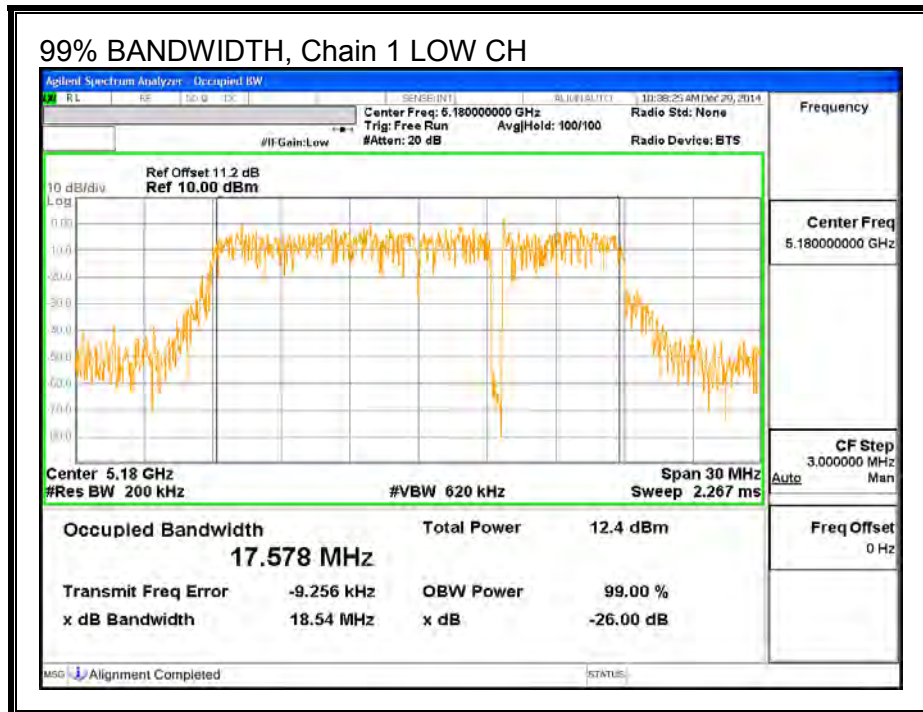
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5180	17.687	17.578
Mid	5200	17.629	17.501
High	5240	17.522	17.517

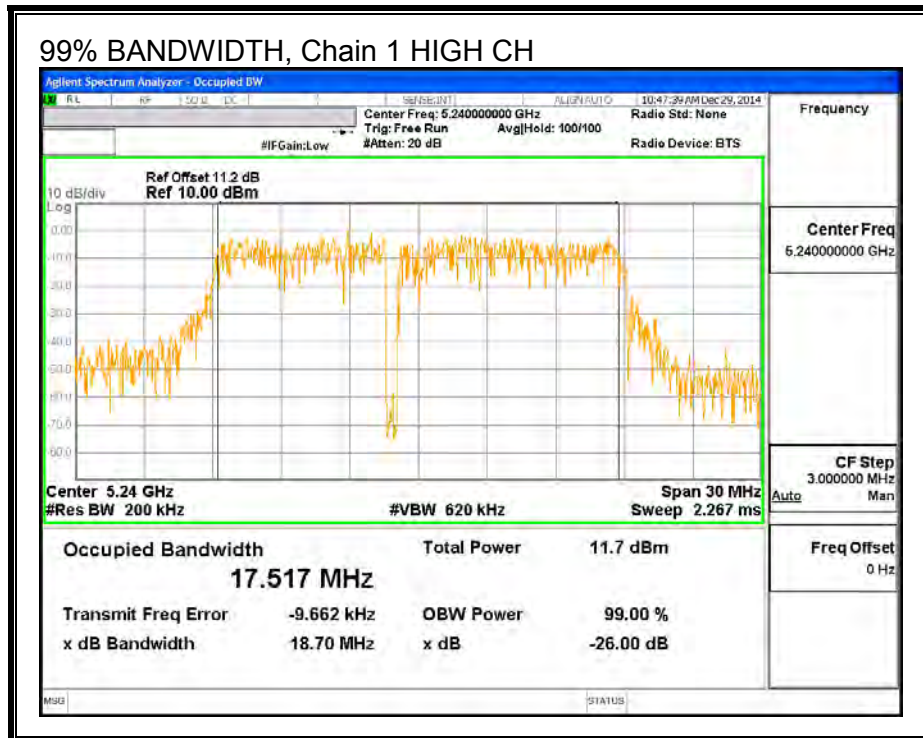
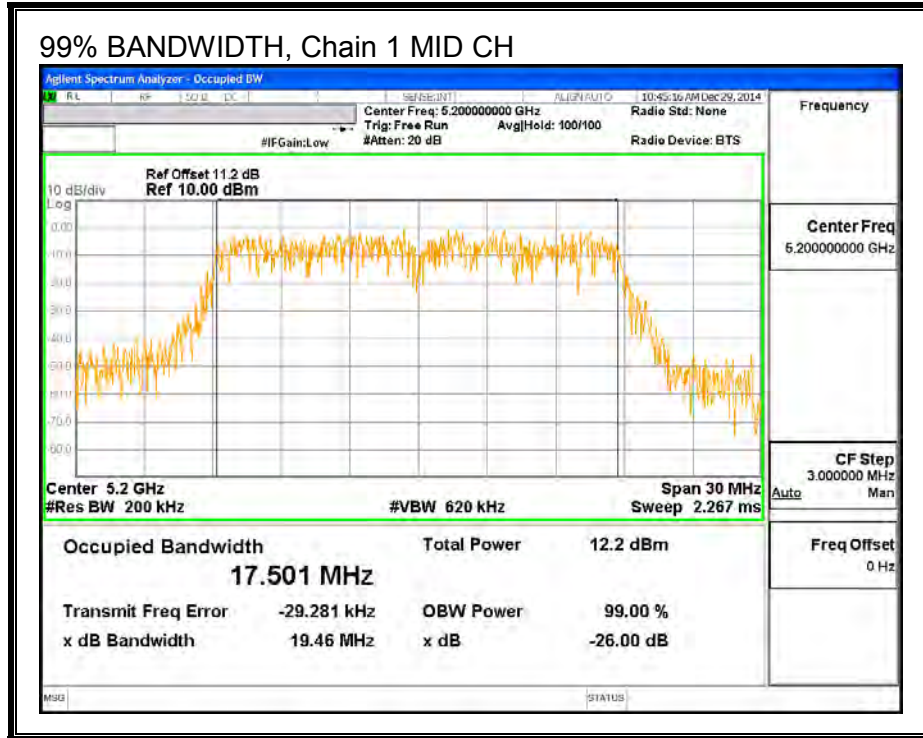
99% BANDWIDTH, Chain 0





99% BANDWIDTH, Chain 1





9.2.3. OUTPUT POWER AND PSD

LIMITS

FCC §15.407 (a) (1)

(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. 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.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.1	3.6	3.36

RESULTS

Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5180	3.36	3.36	24.00	11.00
Mid	5200	3.36	3.36	24.00	11.00
High	5240	3.36	3.36	24.00	11.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd Power & PSD
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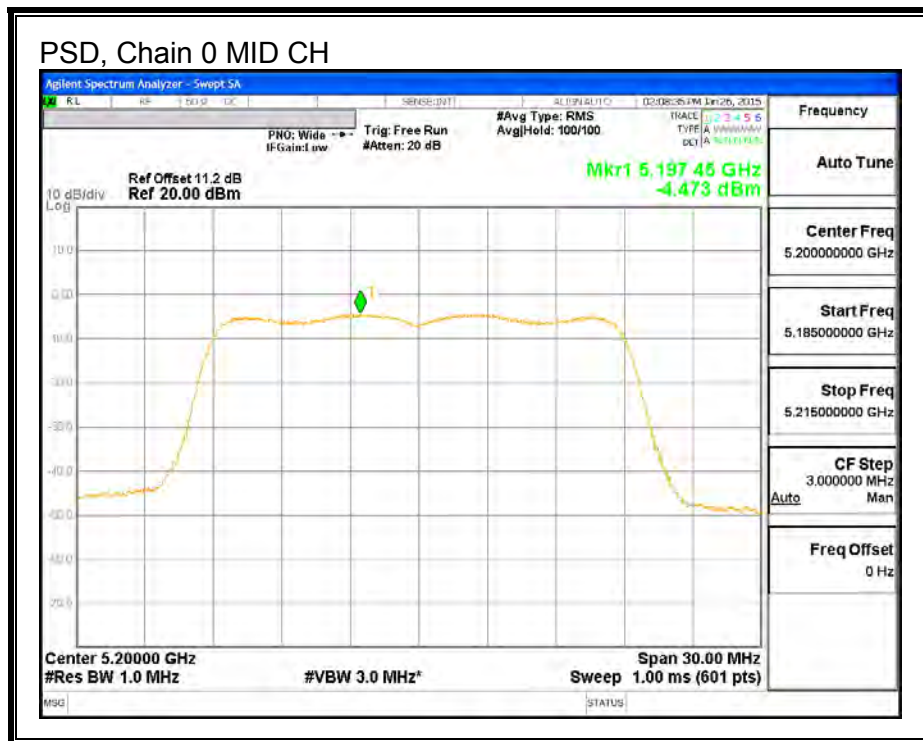
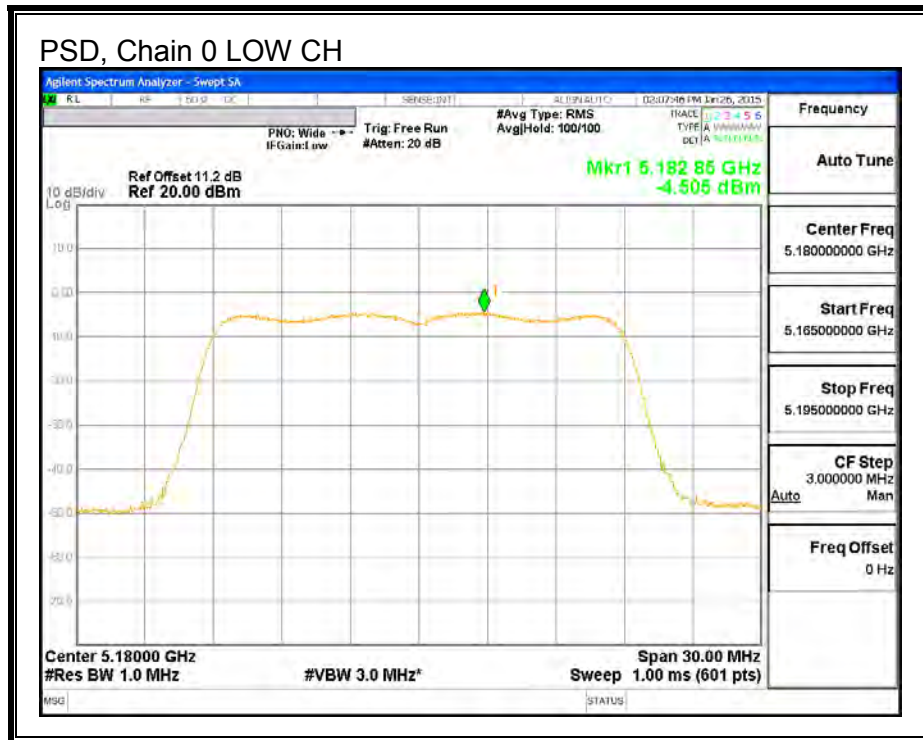
Output Power Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	6.90	6.98	9.95	24.00	-14.05
Mid	5200	6.83	7.08	9.97	24.00	-14.03
High	5240	6.90	7.07	10.00	24.00	-14.00

PSD Results

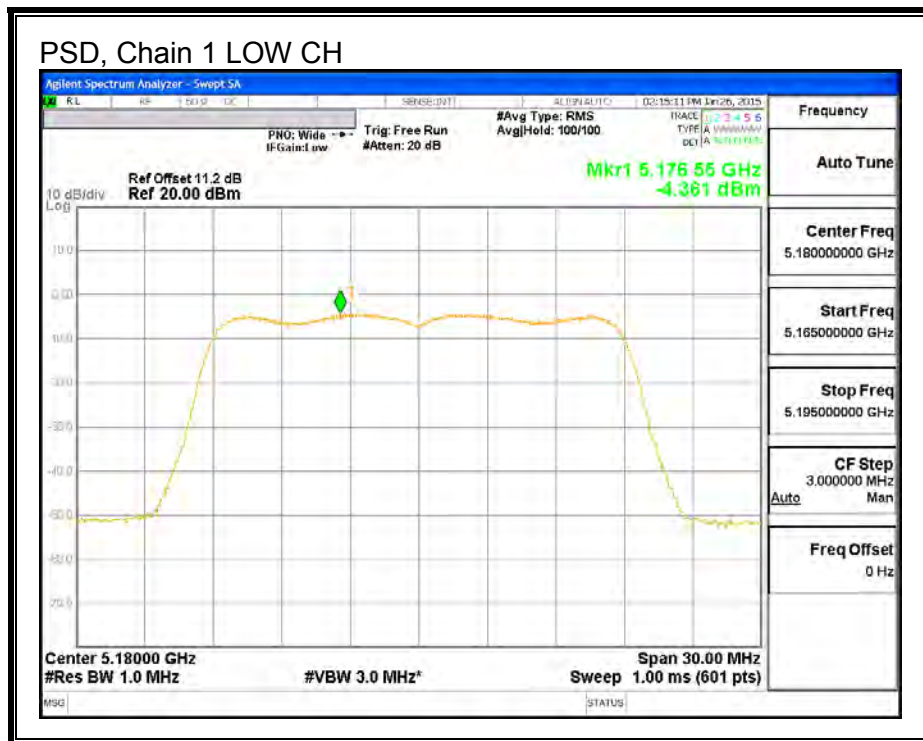
Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5180	-4.505	-4.361	-1.42	11.00	-12.42
Mid	5200	-4.473	-4.082	-1.26	11.00	-12.26
High	5240	-4.487	-4.551	-1.51	11.00	-12.51

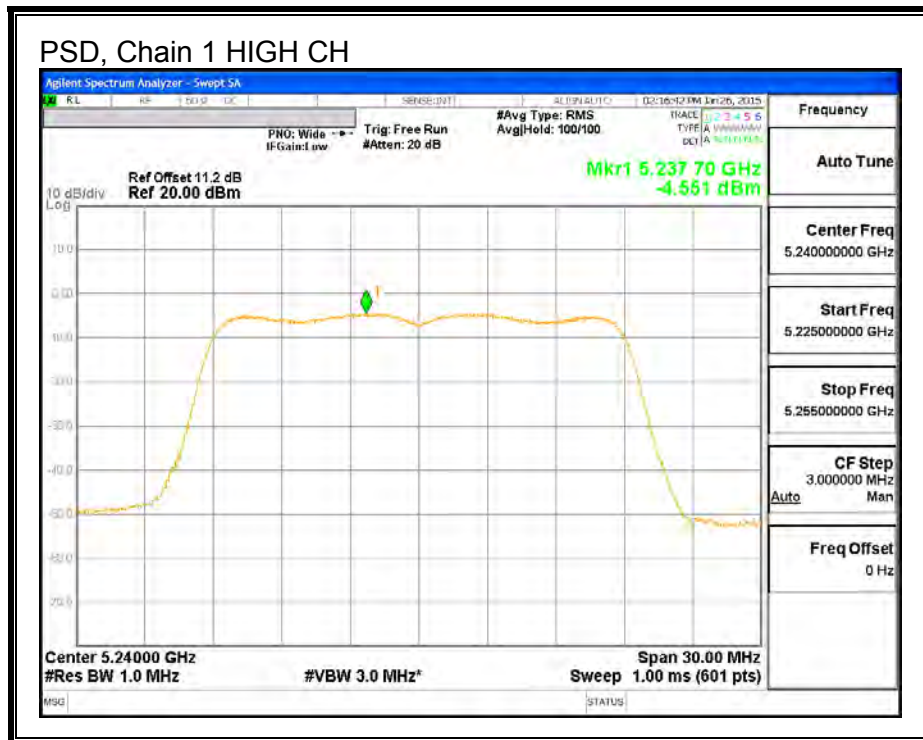
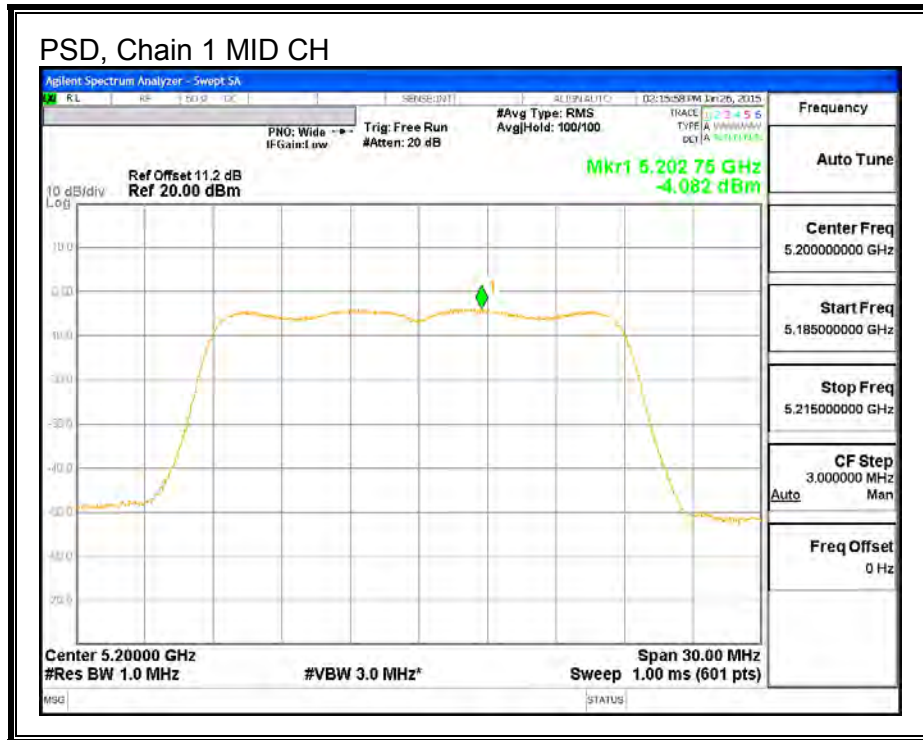
PSD, Chain 0





PSD, Chain 1





9.3. 802.11n HT40 MODE IN THE 5.2 GHz BAND

9.3.1. 26 dB BANDWIDTH

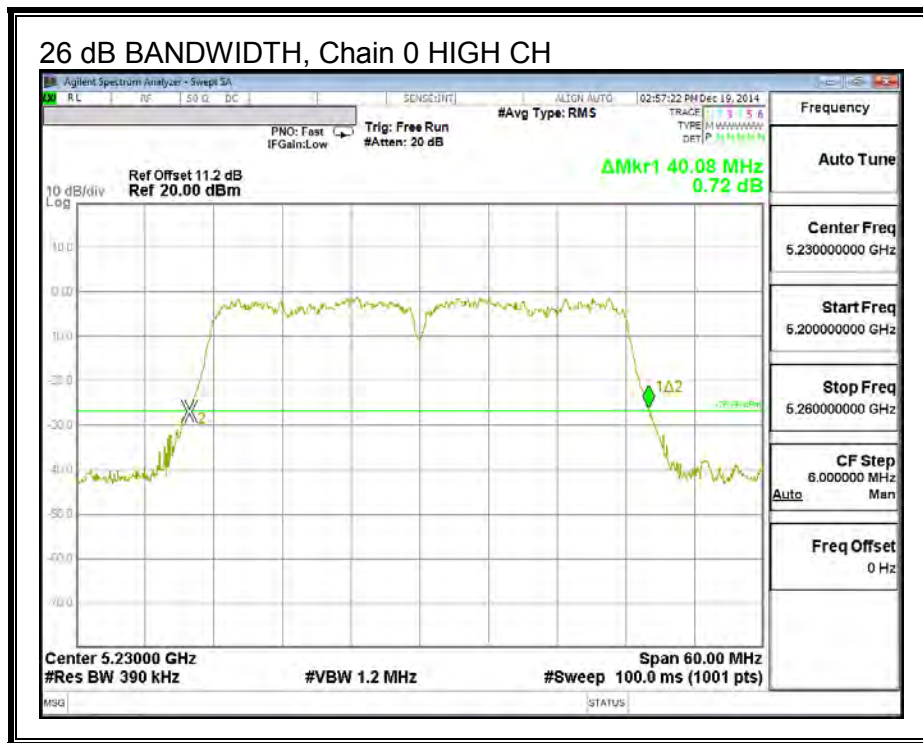
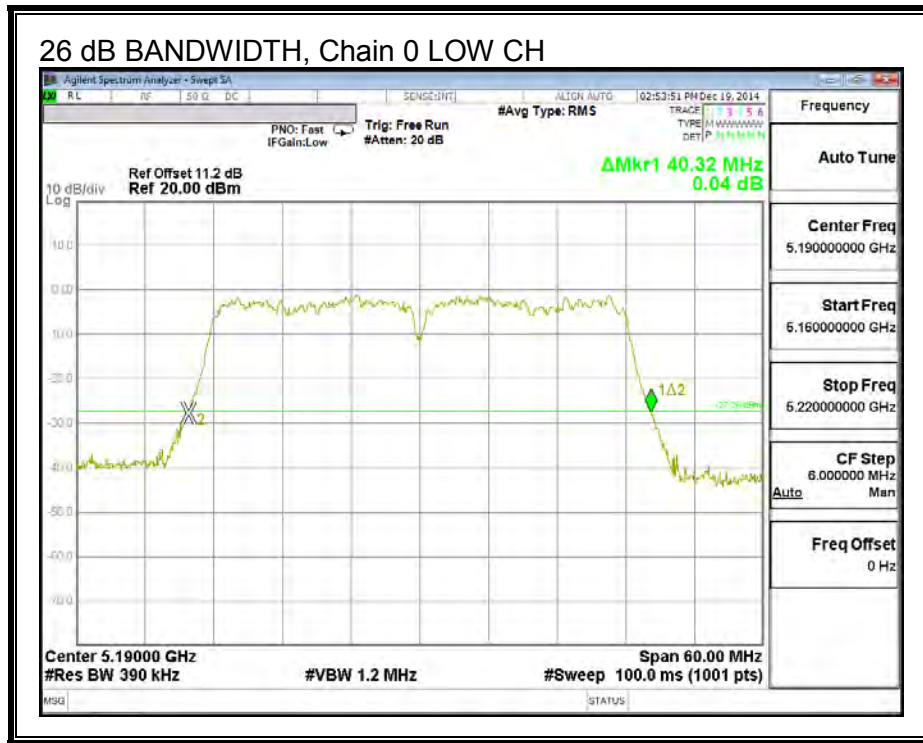
LIMITS

None; for reporting purposes only.

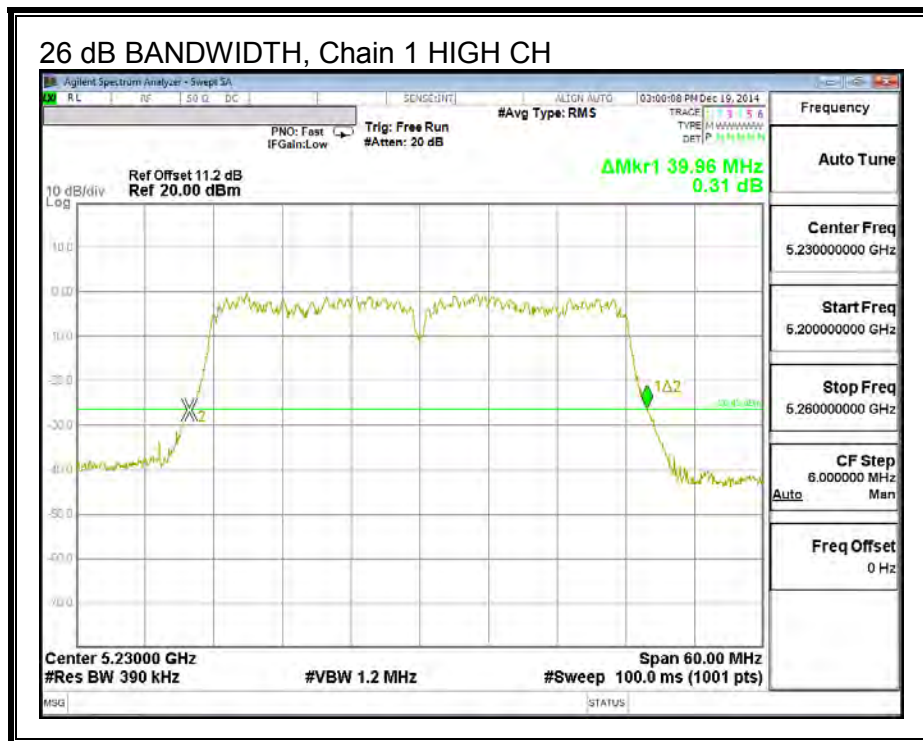
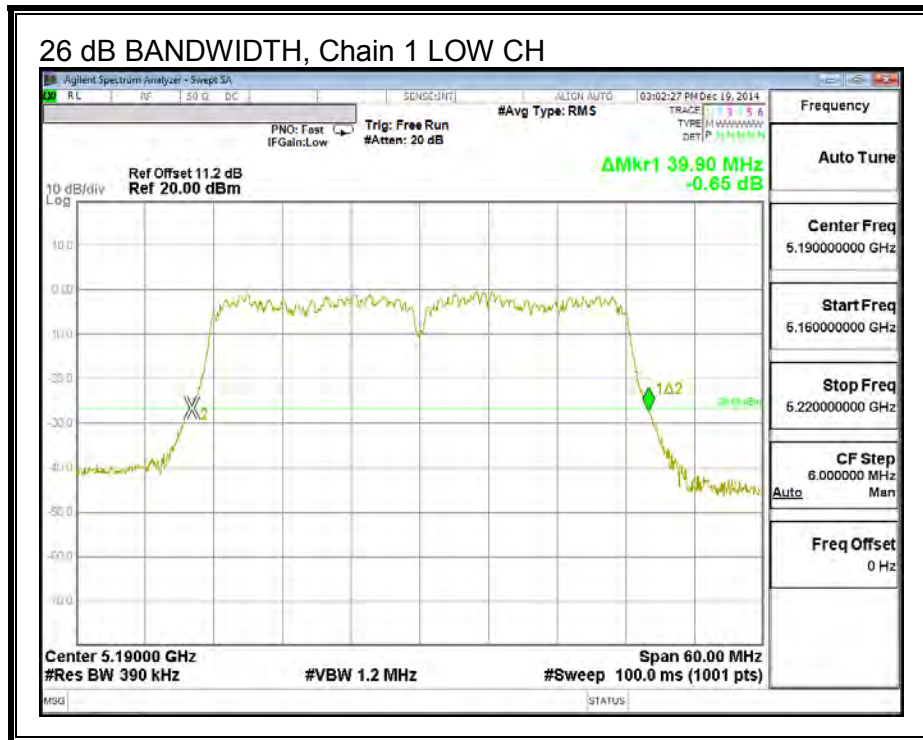
RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5190	40.32	39.90
High	5230	40.08	39.96

26 dB BANDWIDTH, Chain 0



26 dB BANDWIDTH, Chain 1



9.3.2. 99% BANDWIDTH

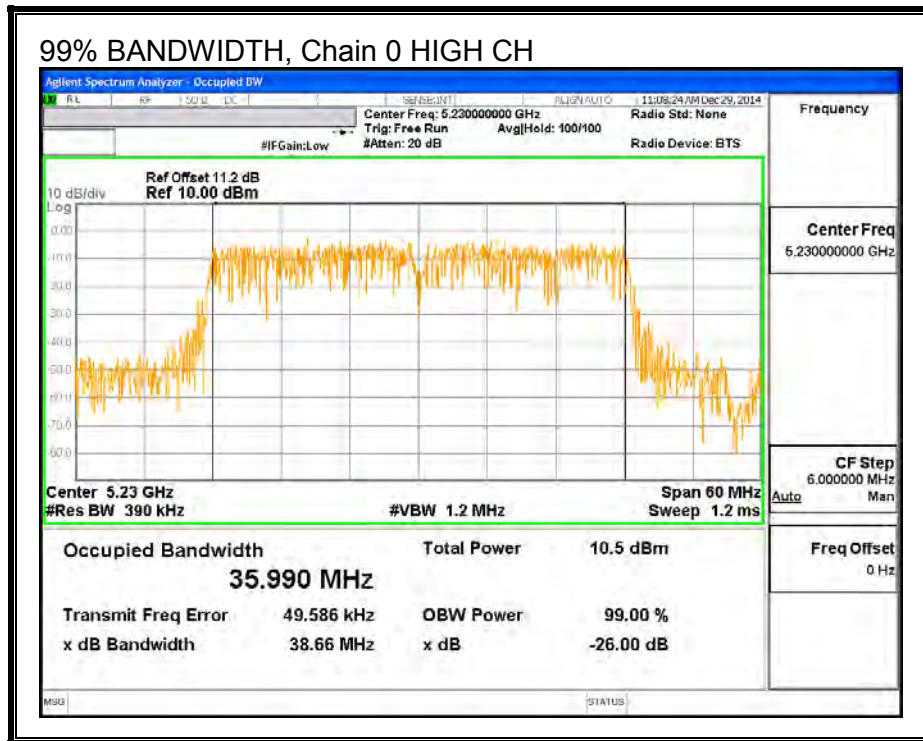
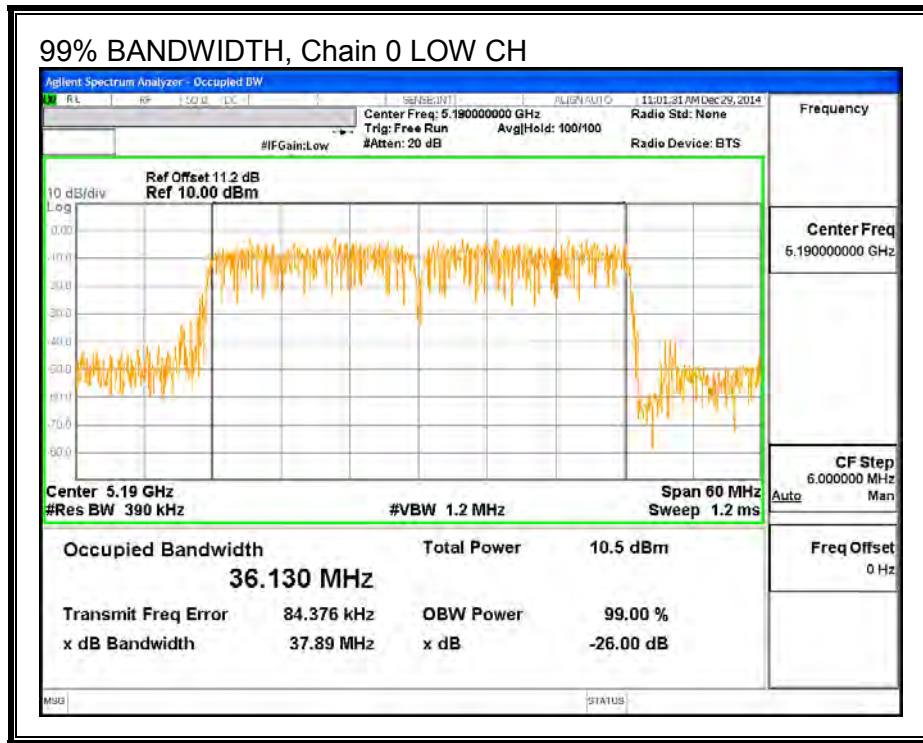
LIMITS

None; for reporting purposes only.

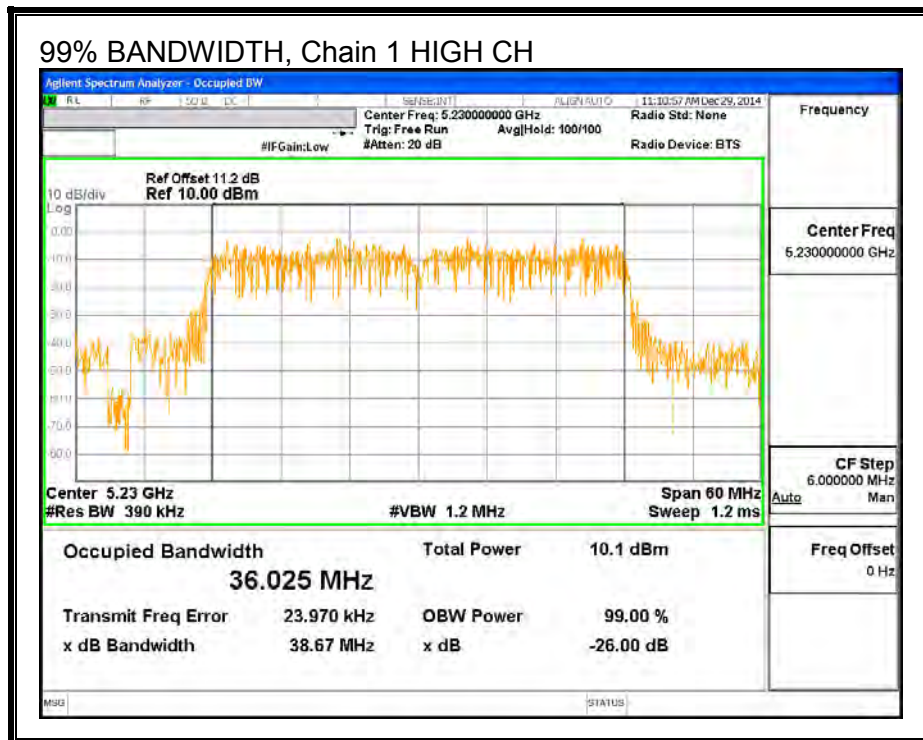
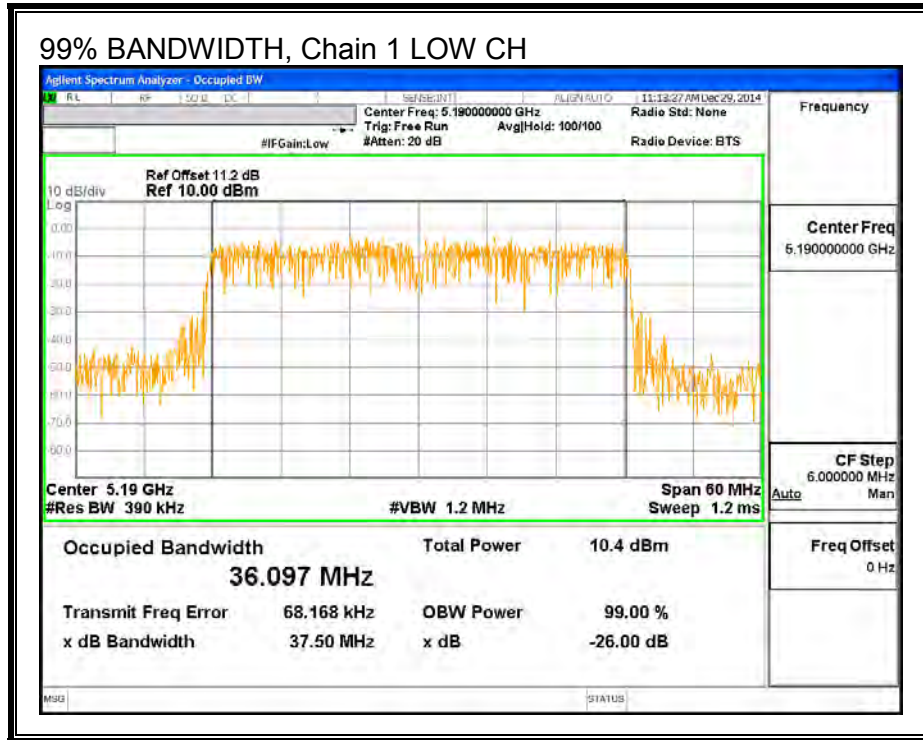
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5190	36.130	36.097
High	5230	35.990	36.025

99% BANDWIDTH, Chain 0



99% BANDWIDTH, Chain 1



9.3.3. OUTPUT POWER AND PSD

LIMITS

FCC §15.407 (a) (1)

(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. 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.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.1	3.6	3.36

RESULTS

Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5190	3.36	3.36	24.00	11.00
High	5230	3.36	3.36	24.00	11.00

Duty Cycle CF (dB)	0.13	Included in Calculations of Corr'd Power & PSD
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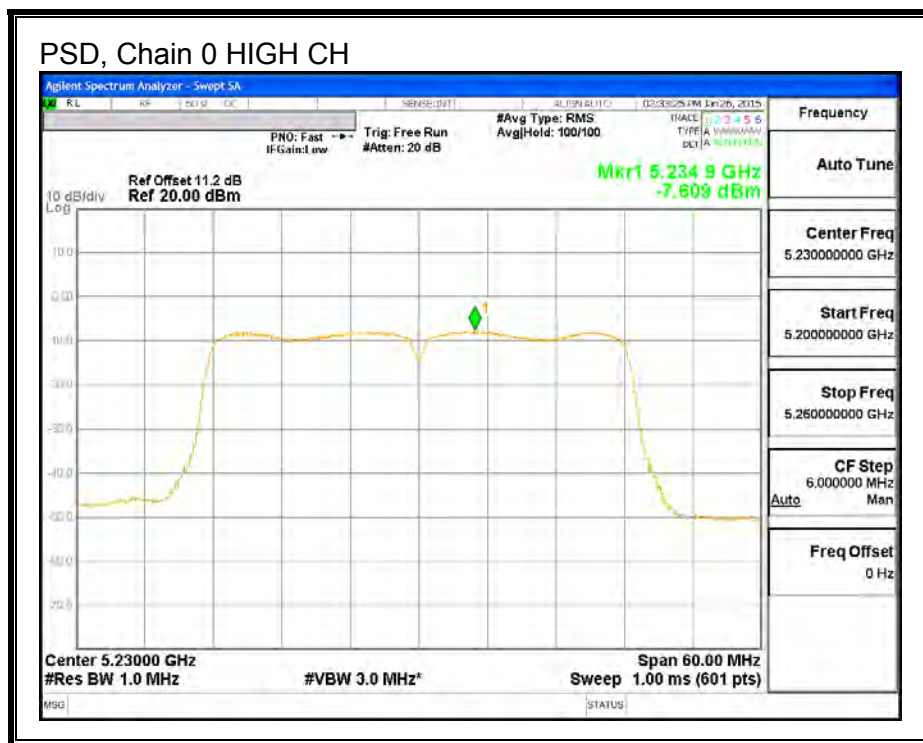
Output Power Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5190	7.060	7.200	10.27	24.00	-13.73
High	5230	7.280	6.920	10.24	24.00	-13.76

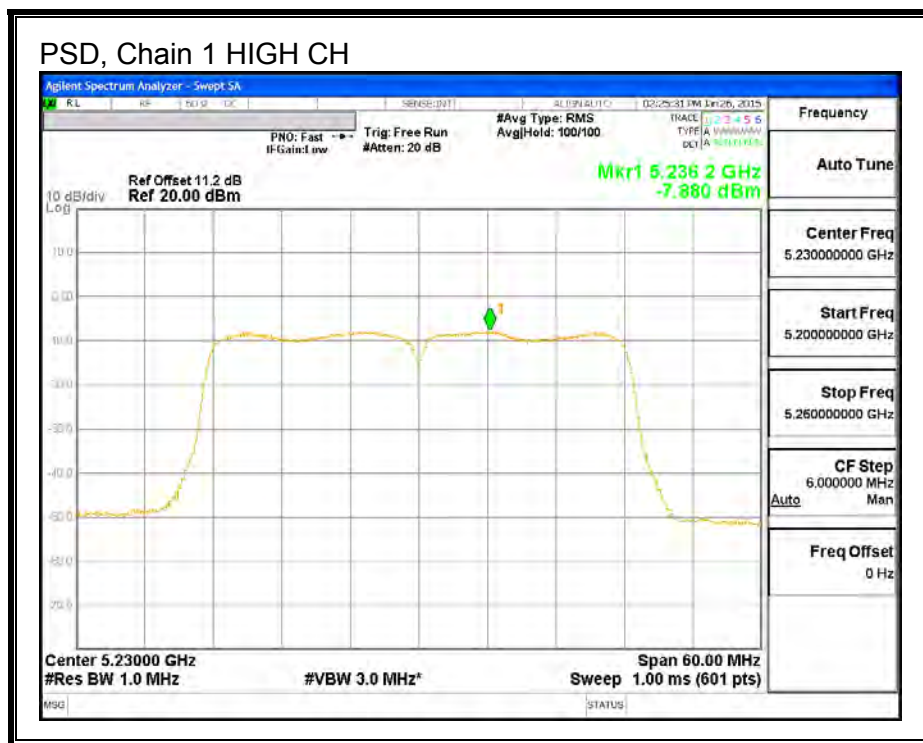
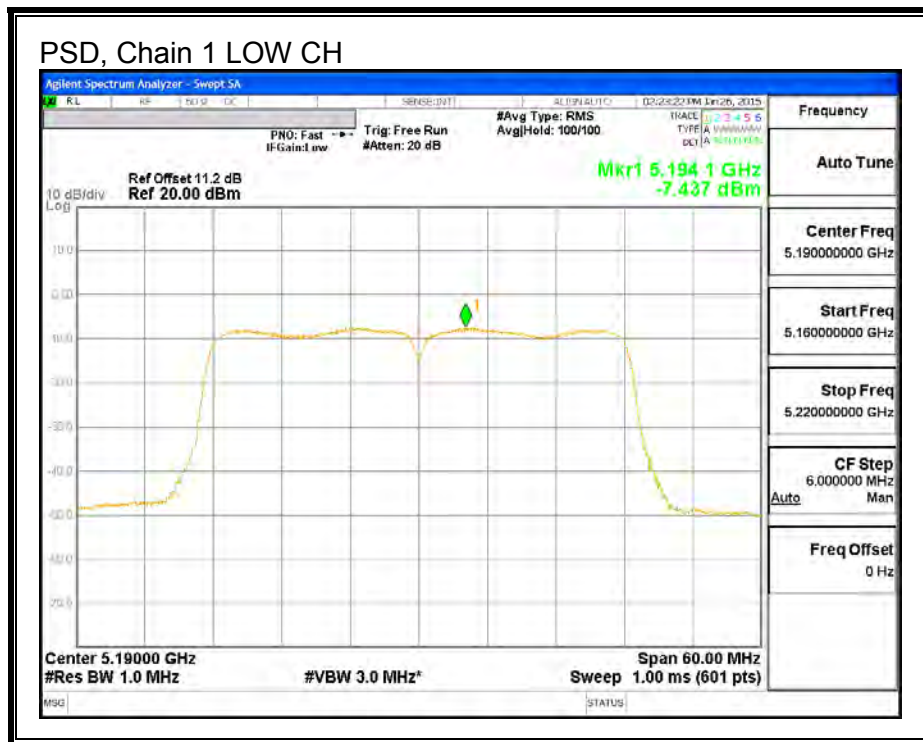
PSD Results

Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5190	-8.001	-7.437	-4.57	11.00	-15.57
High	5230	-7.609	-7.880	-4.60	11.00	-15.60

PSD, Chain 0



PSD, Chain 1



9.4. 802.11ac VHT80MHz MODE IN THE 5.2 GHz BAND

9.4.1. 26 dB BANDWIDTH

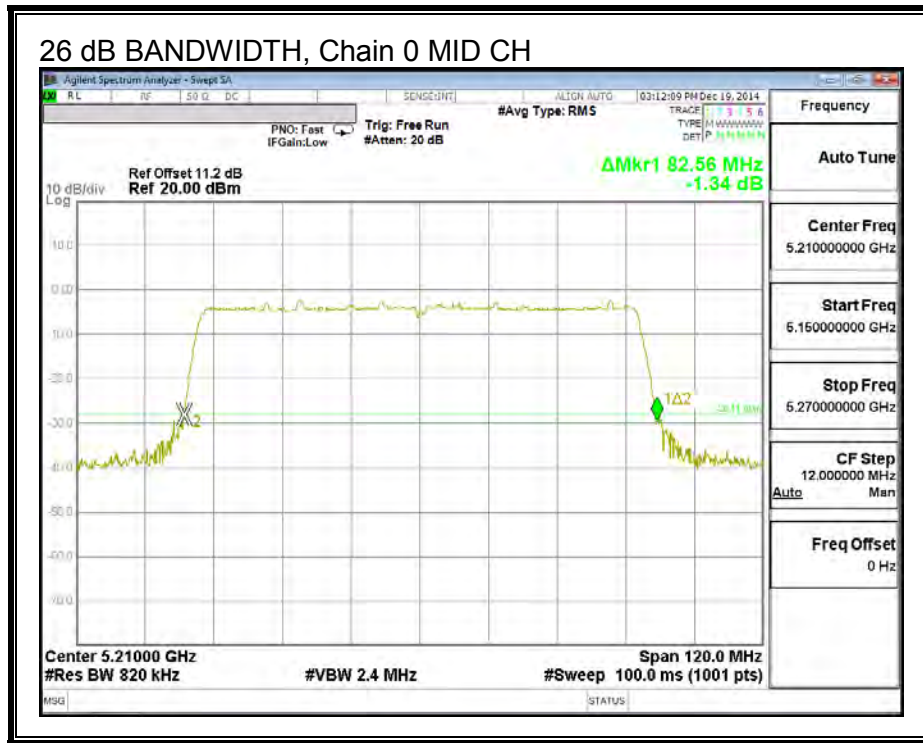
LIMITS

None; for reporting purposes only.

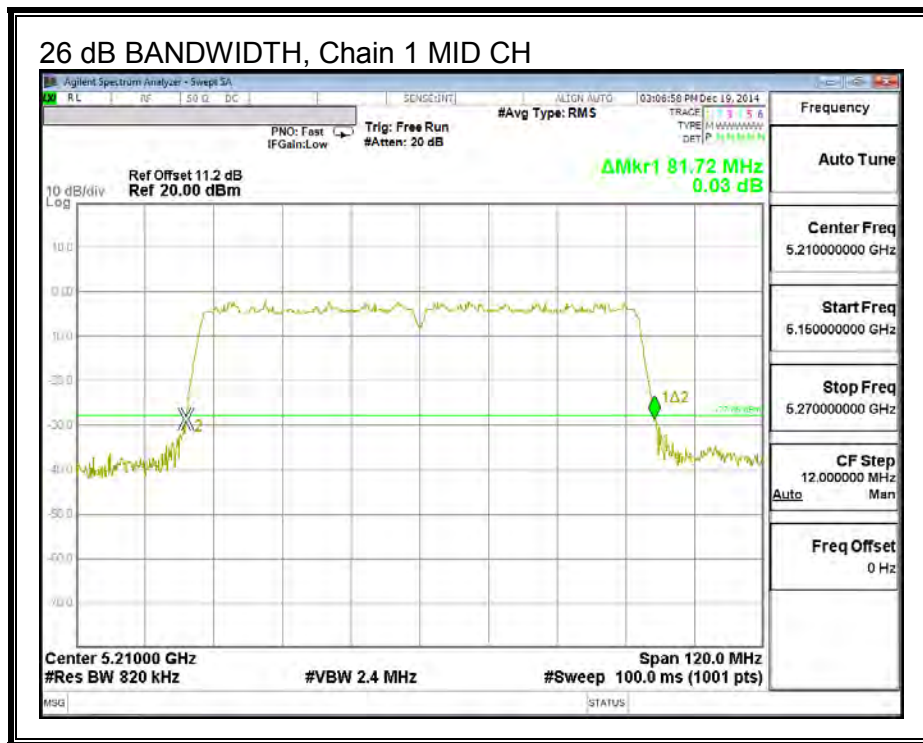
RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Mid	5210	82.56	81.72

26 dB BANDWIDTH, Chain 0



26 dB BANDWIDTH, Chain 1



9.4.2. 99% BANDWIDTH

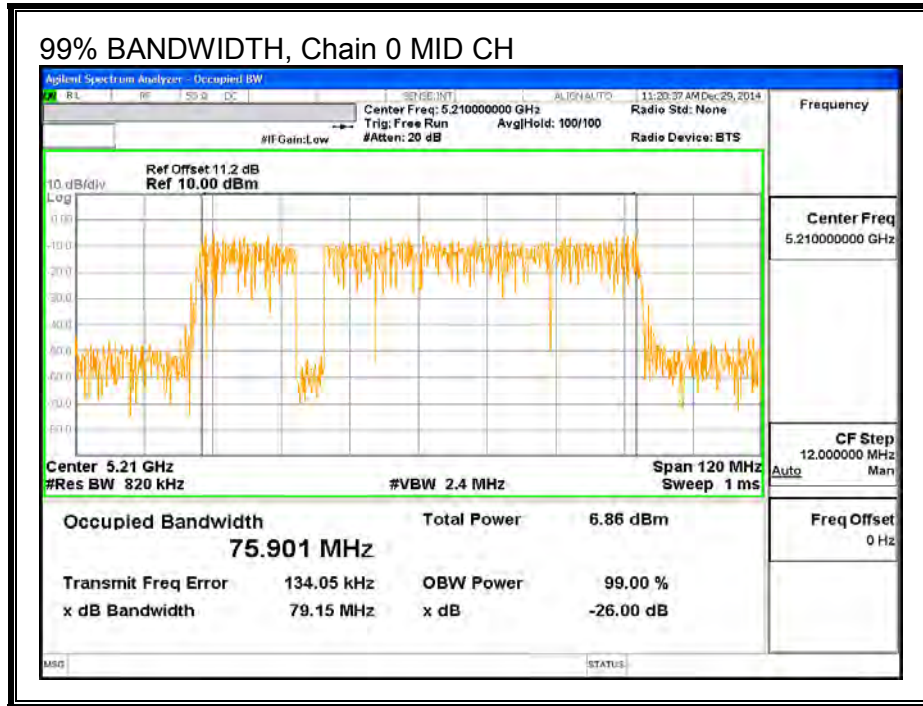
LIMITS

None; for reporting purposes only.

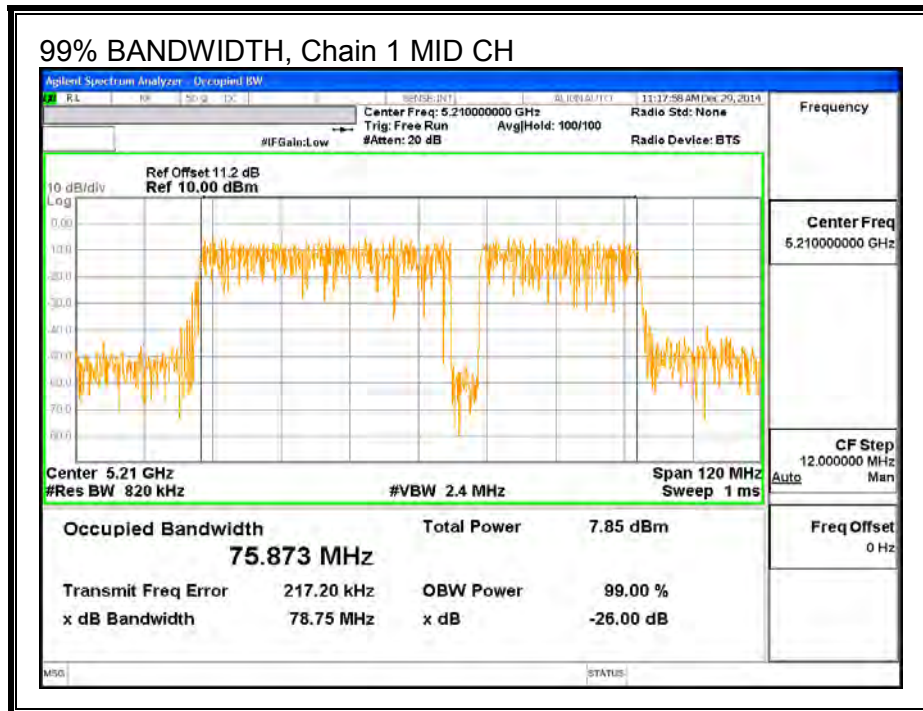
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Mid	5210	75.901	75.873

99% BANDWIDTH, Chain 0



99% BANDWIDTH, Chain 1



9.4.3. OUTPUT POWER AND PSD

LIMITS

FCC §15.407 (a) (1)

(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. 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.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.1	3.6	3.36

RESULTS

Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Mid	5210	3.36	3.36	24.00	11.00

Duty Cycle CF (dB)	0.26	Included in Calculations of Corr'd Power & PSD
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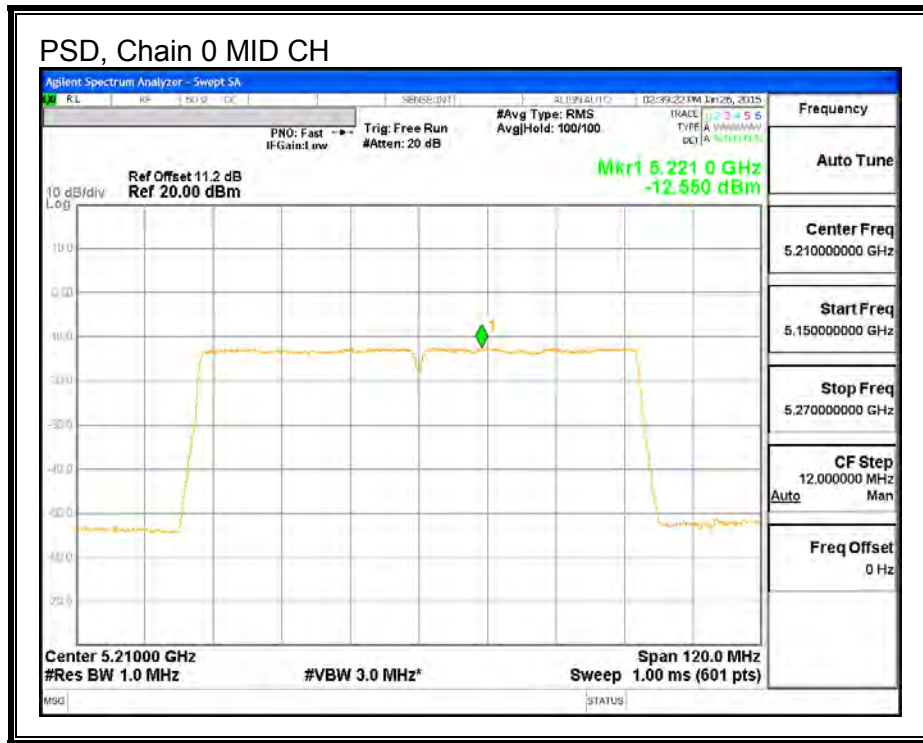
Output Power Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Mid	5210	6.40	6.12	9.53	24.00	-14.47

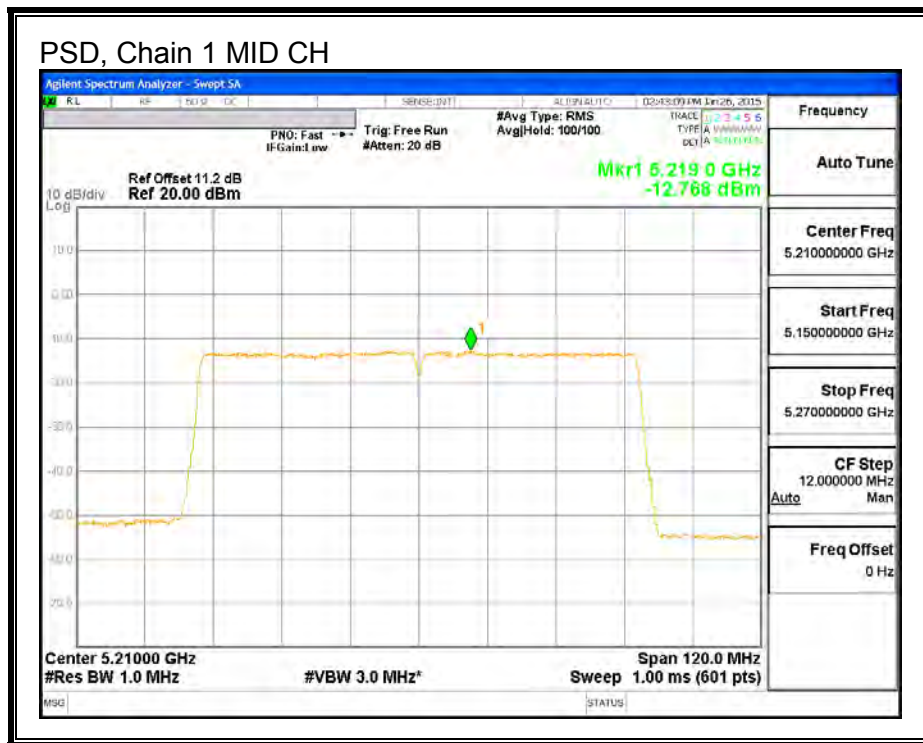
PSD Results

Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Mid	5210	-12.550	-12.768	-9.39	11.00	-20.39

PSD, Chain 0



PSD, Chain 1



9.5. 802.11a MODE IN THE 5.3 GHz BAND

9.5.1. 26 dB BANDWIDTH

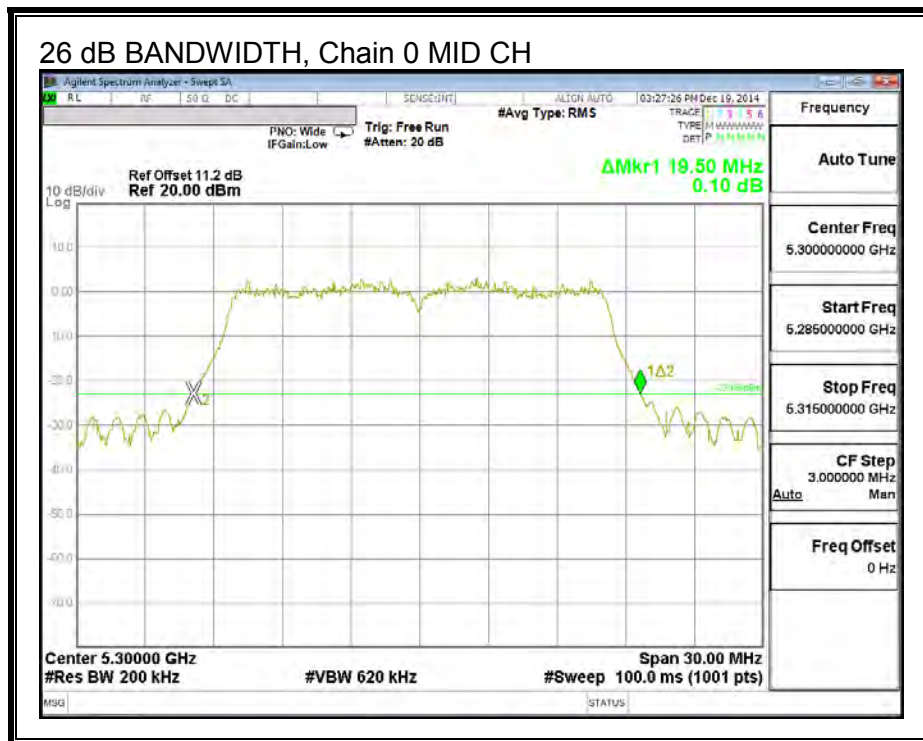
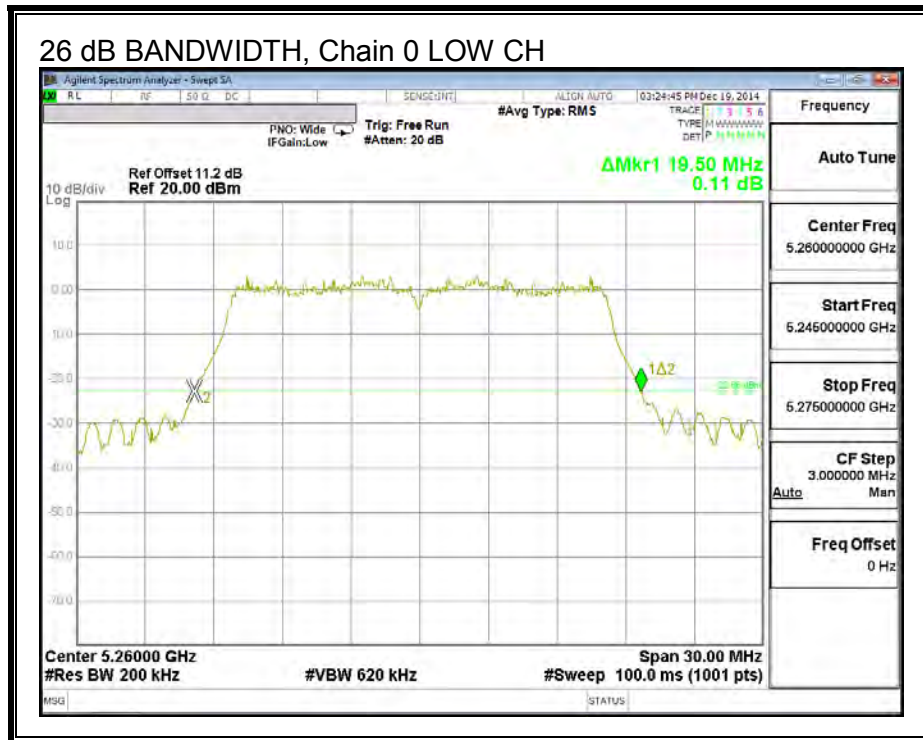
LIMITS

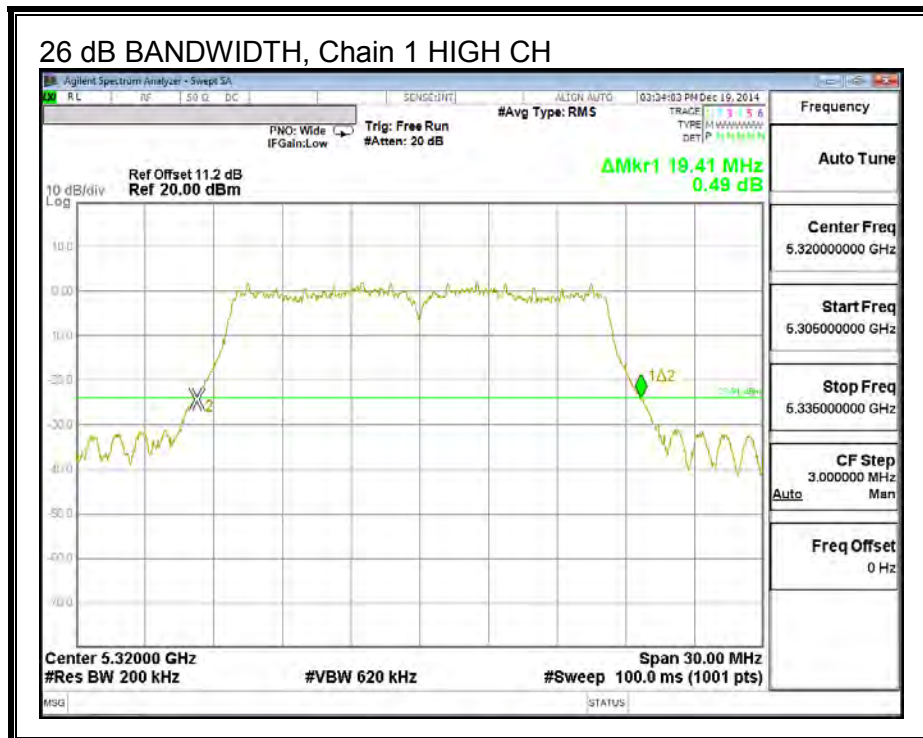
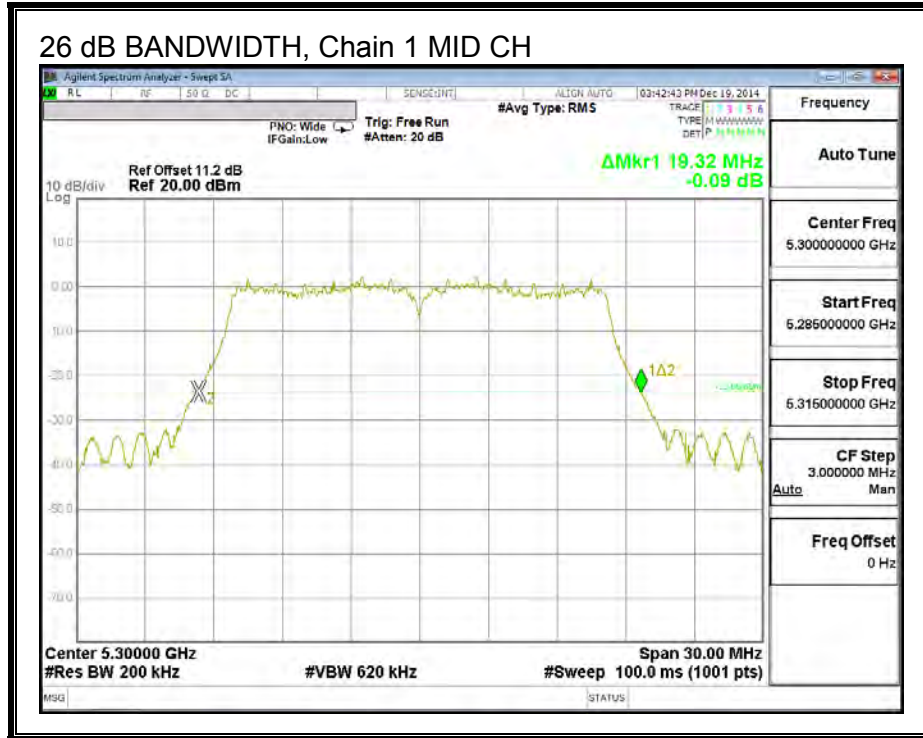
None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5260	19.50	19.38
Mid	5300	19.50	19.32
High	5320	19.59	19.41

26 dB BANDWIDTH, Chain 0





9.5.2. 99% BANDWIDTH

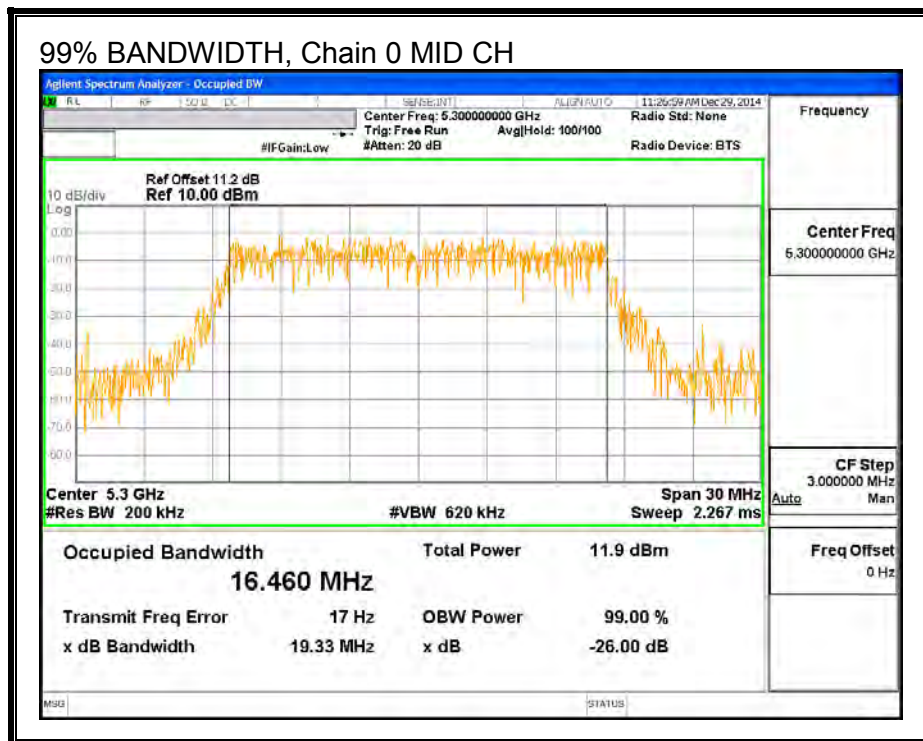
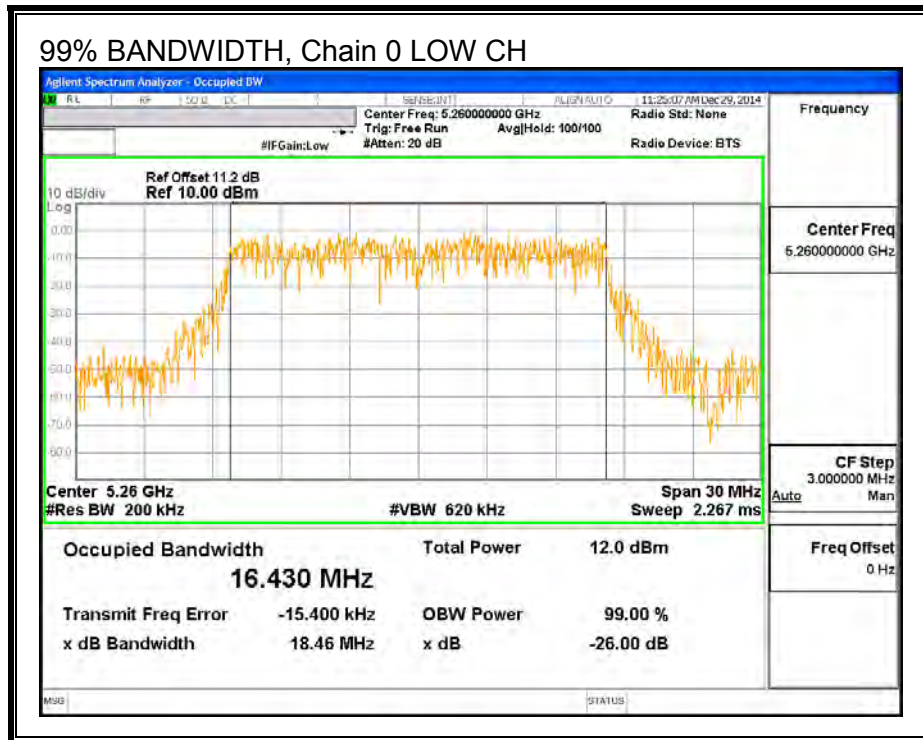
LIMITS

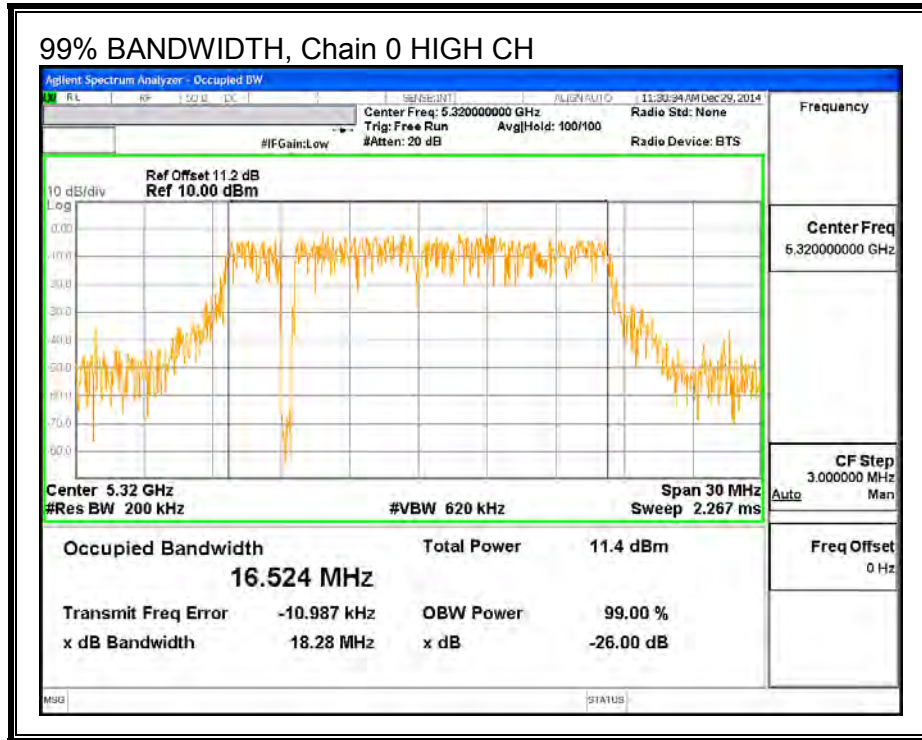
None; for reporting purposes only.

RESULTS

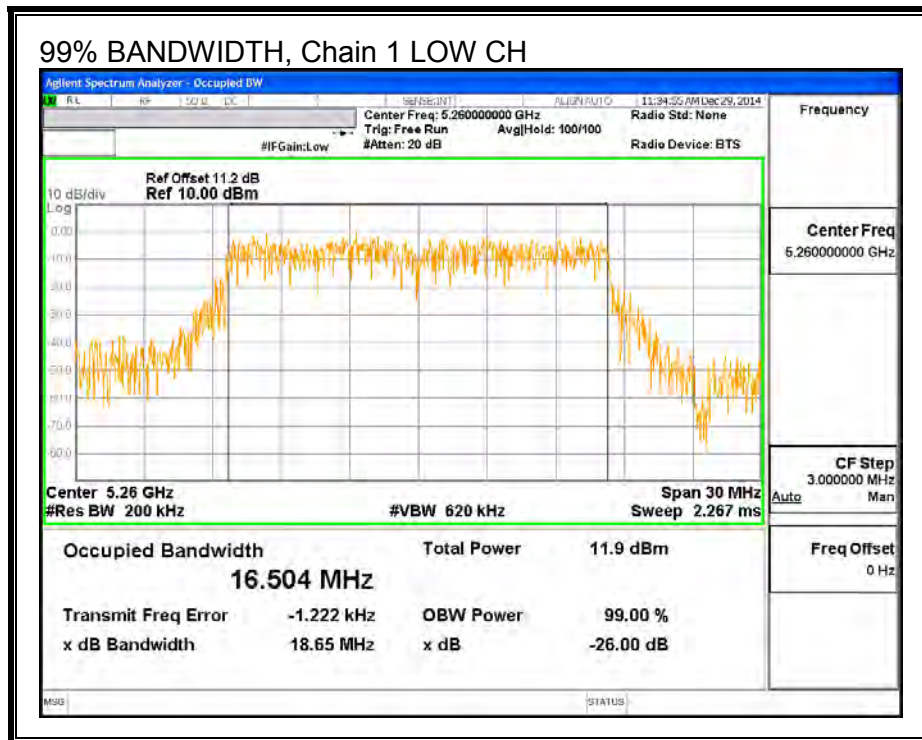
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5260	16.430	16.504
Mid	5300	16.460	16.522
High	5320	16.524	16.370

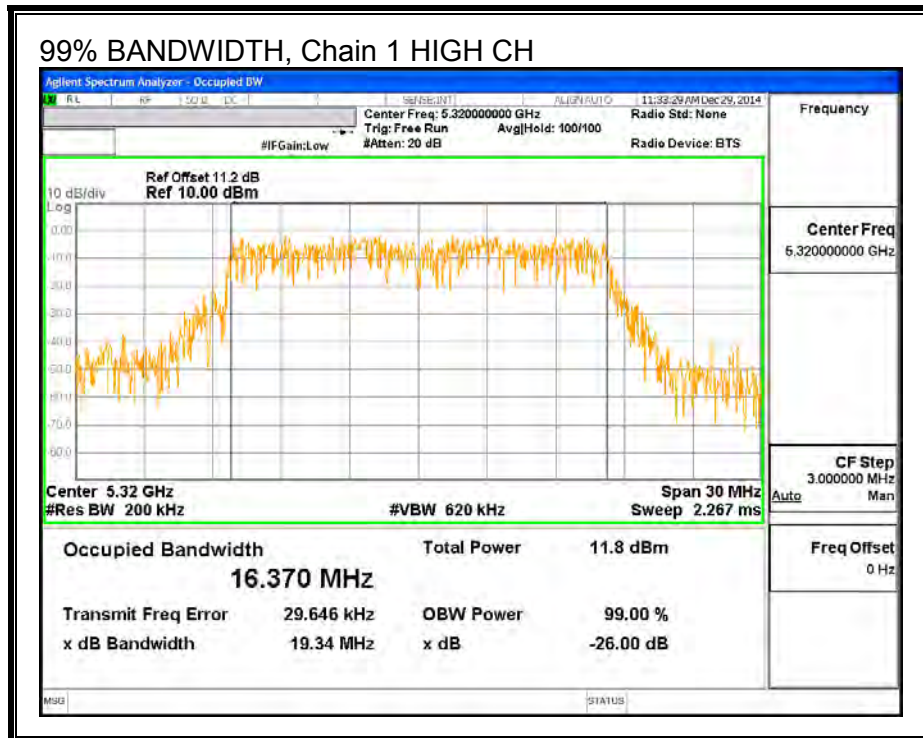
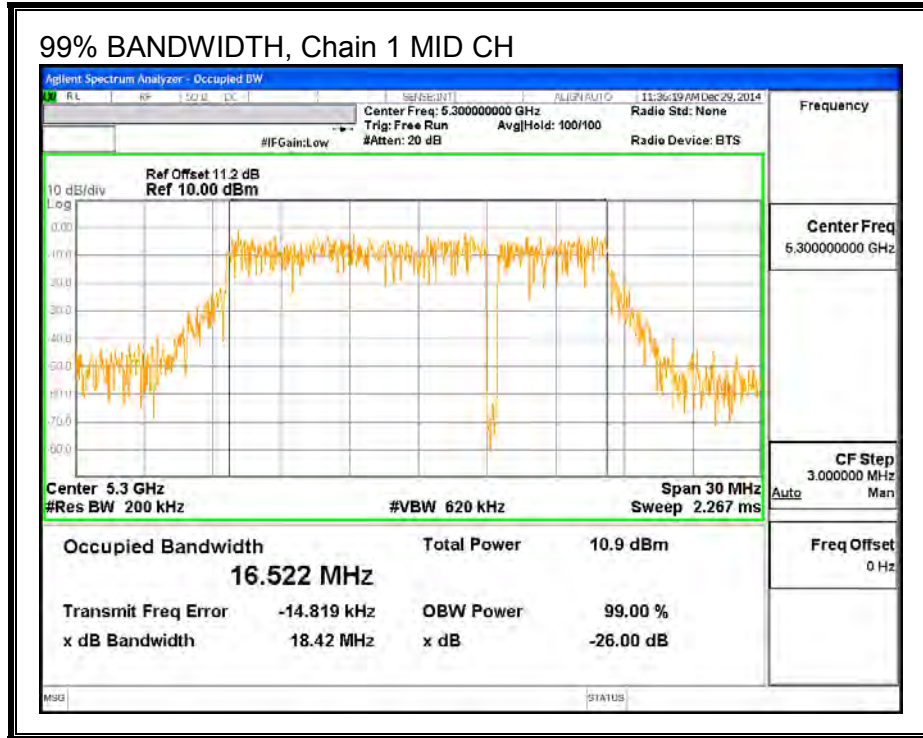
99% BANDWIDTH, Chain 0





99% BANDWIDTH, Chain 1





9.5.3. OUTPUT POWER AND PSD

LIMITS

FCC §15.407 (a) (2)

For the band 5.25–5.35 GHz, the maximum conducted output power over the frequency band 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 MHz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
2.9	3.5	3.21

RESULTS

Bandwidth, Antenna Gain and Limits

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5260	19.38	3.21	3.21	23.87	11.00
Mid	5300	19.32	3.21	3.21	23.86	11.00
High	5320	19.41	3.21	3.21	23.88	11.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd Power & PSD
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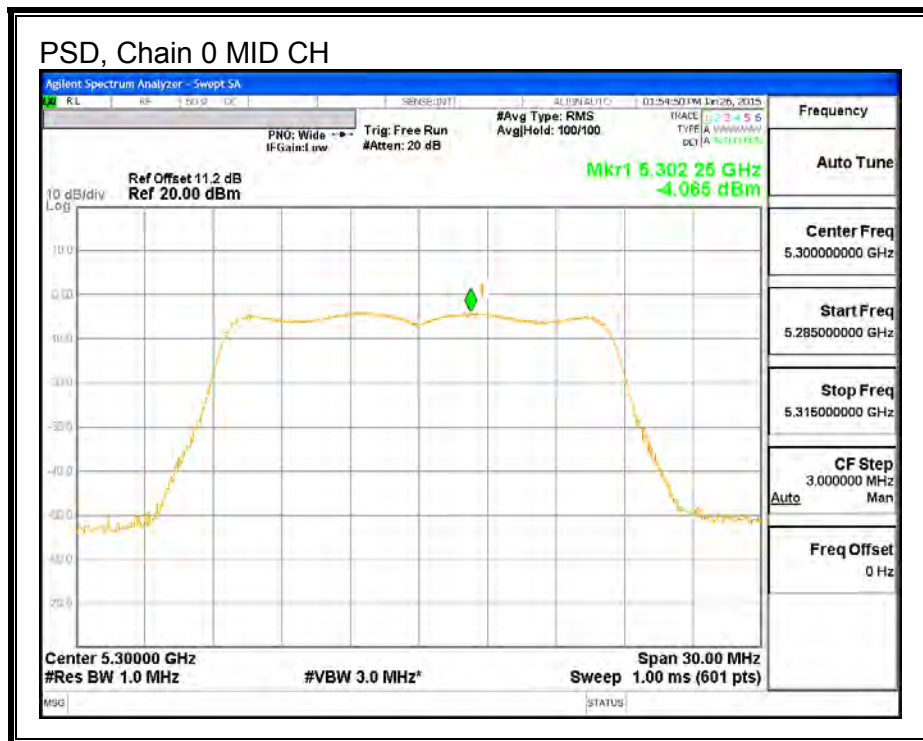
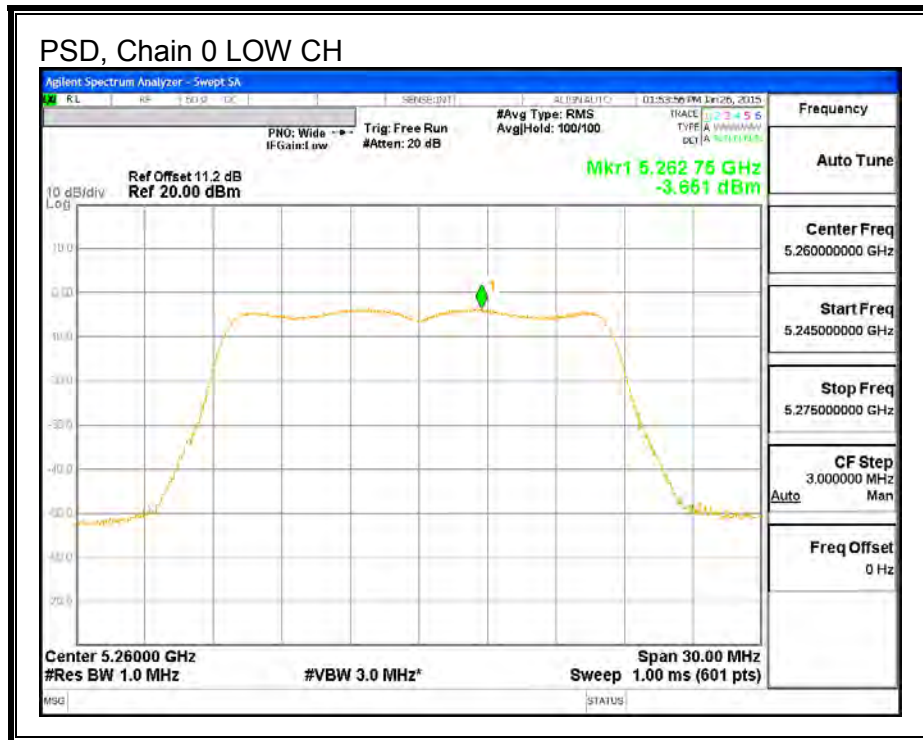
Output Power Results

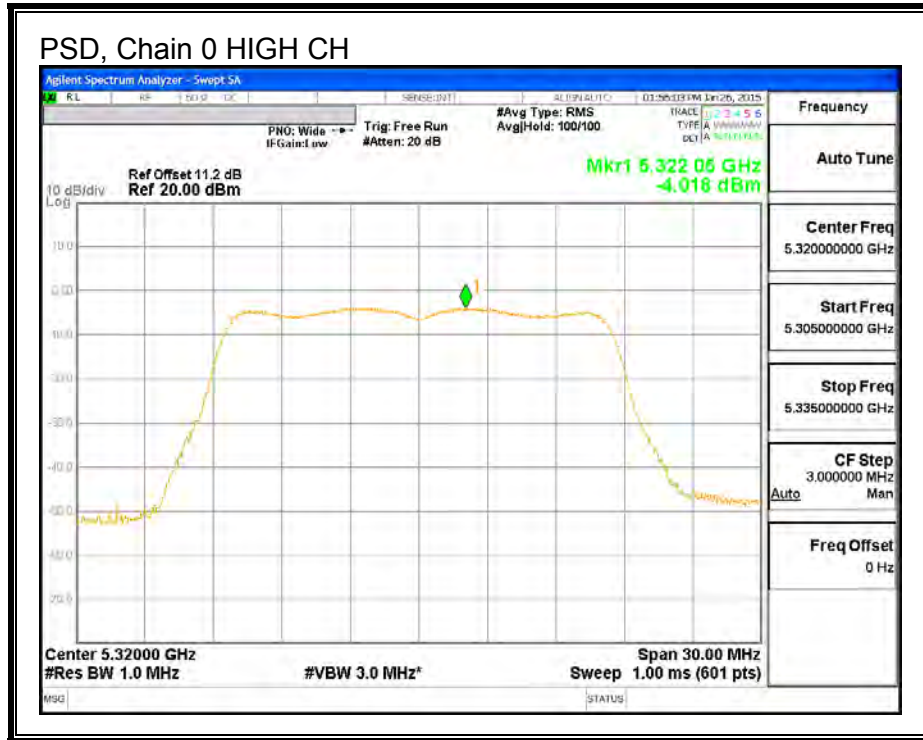
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5260	7.24	7.08	10.17	23.87	-13.70
Mid	5300	7.16	6.96	10.07	23.86	-13.79
High	5320	7.35	6.91	10.15	23.88	-13.73

PSD Results

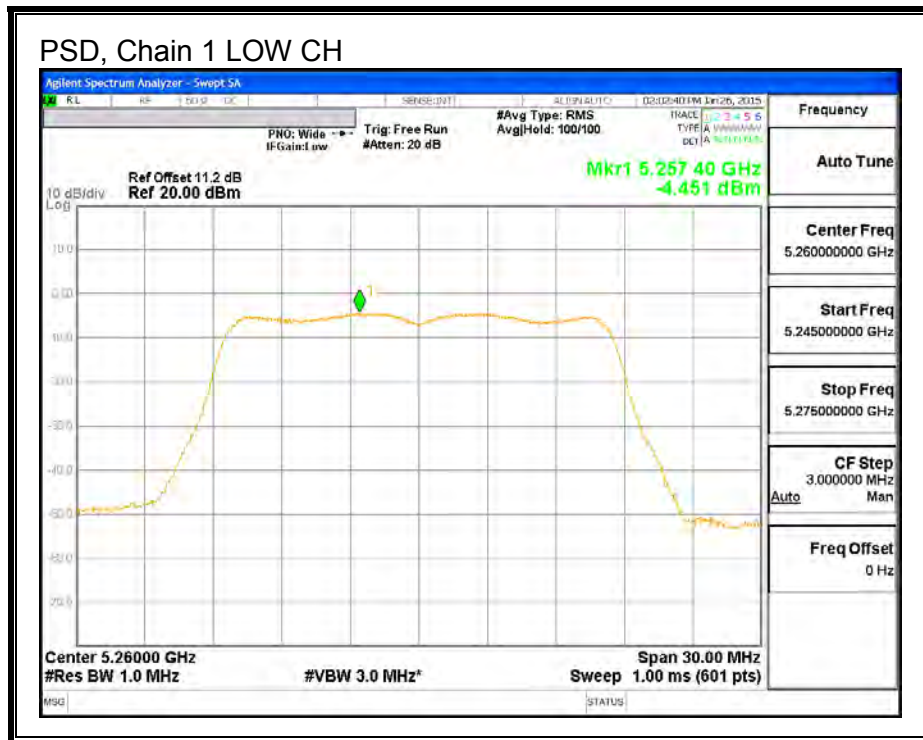
Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5260	-3.651	-4.451	-1.02	11.00	-12.02
Mid	5300	-4.065	-4.502	-1.27	11.00	-12.27
High	5320	-4.018	-4.644	-1.31	11.00	-12.31

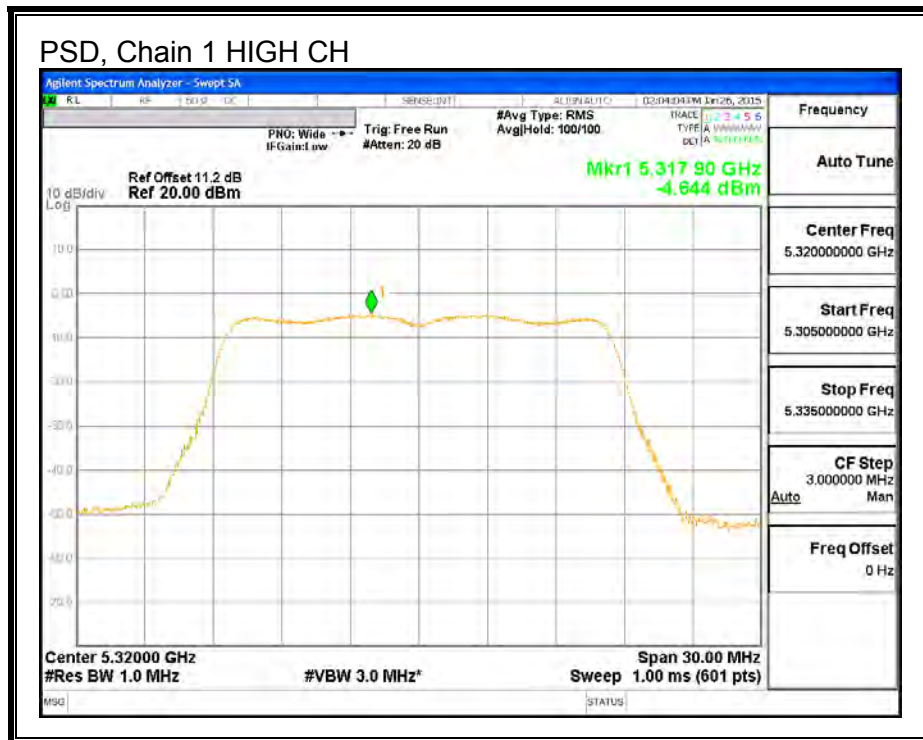
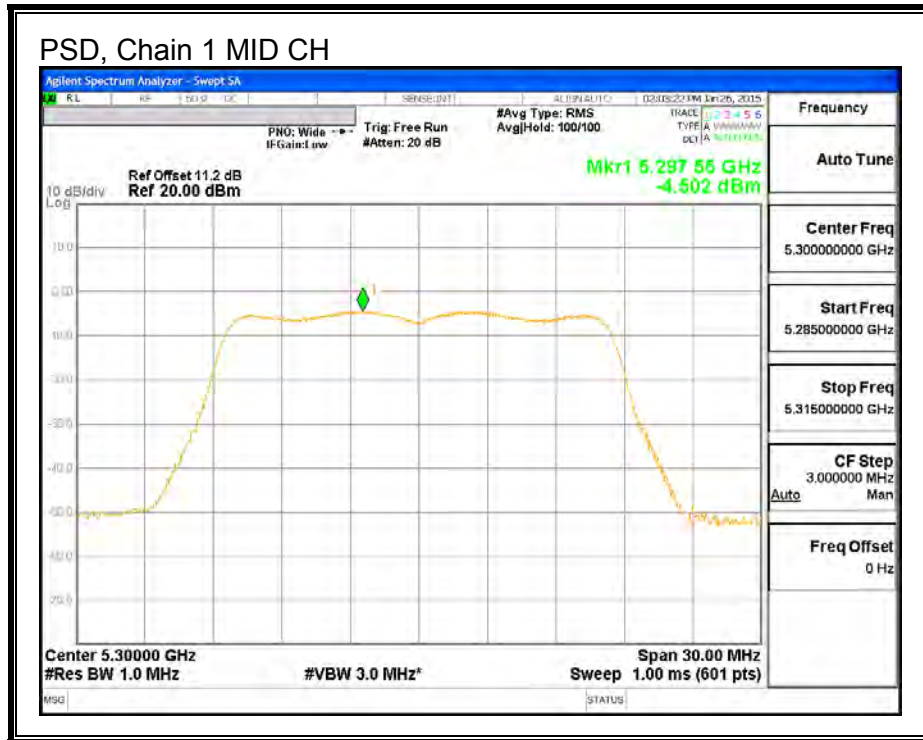
PSD, Chain 0





PSD, Chain 1





9.6. 802.11n HT20 MODE IN THE 5.2 GHz BAND

9.6.1. 26 dB BANDWIDTH

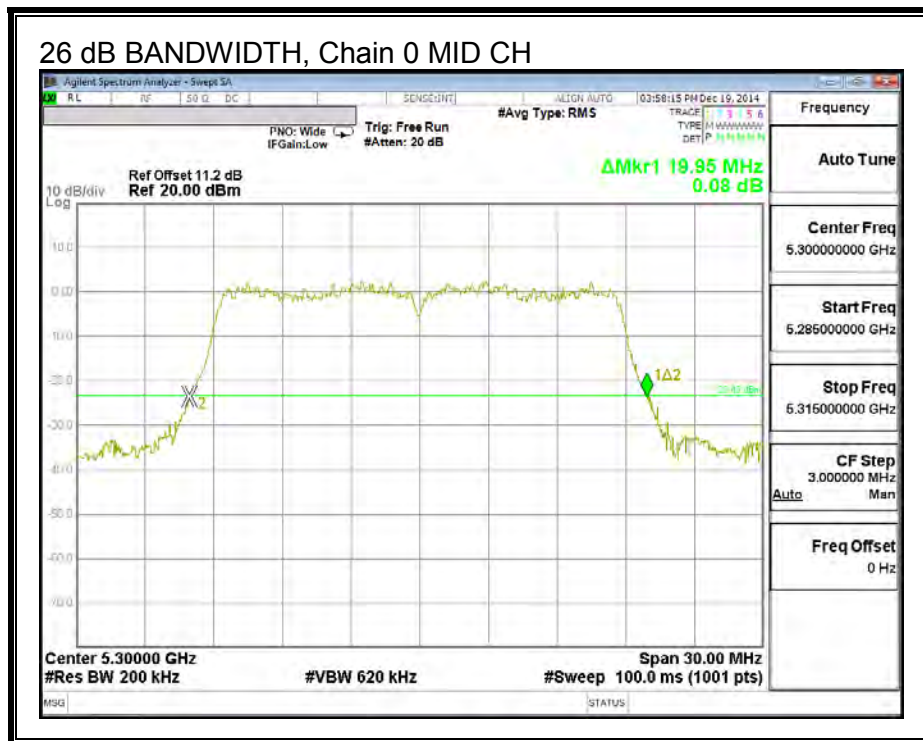
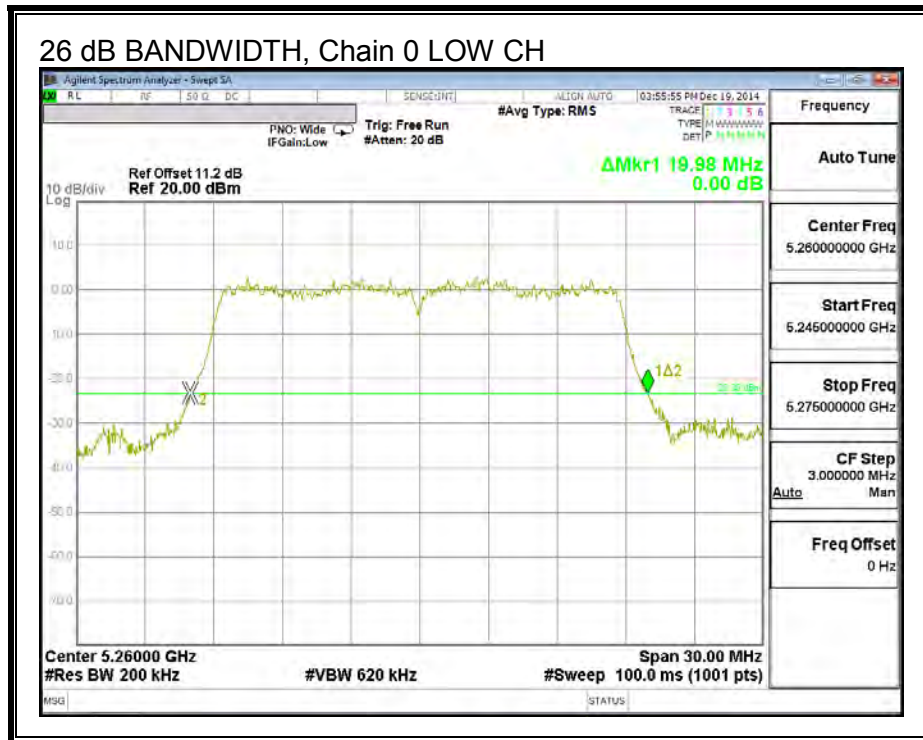
LIMITS

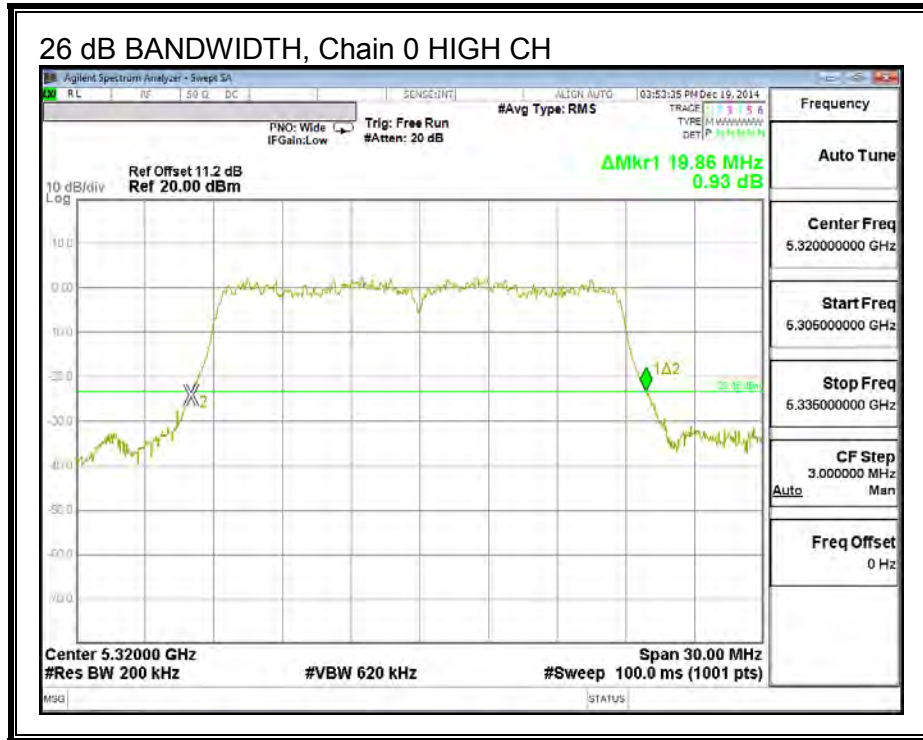
None; for reporting purposes only.

RESULTS

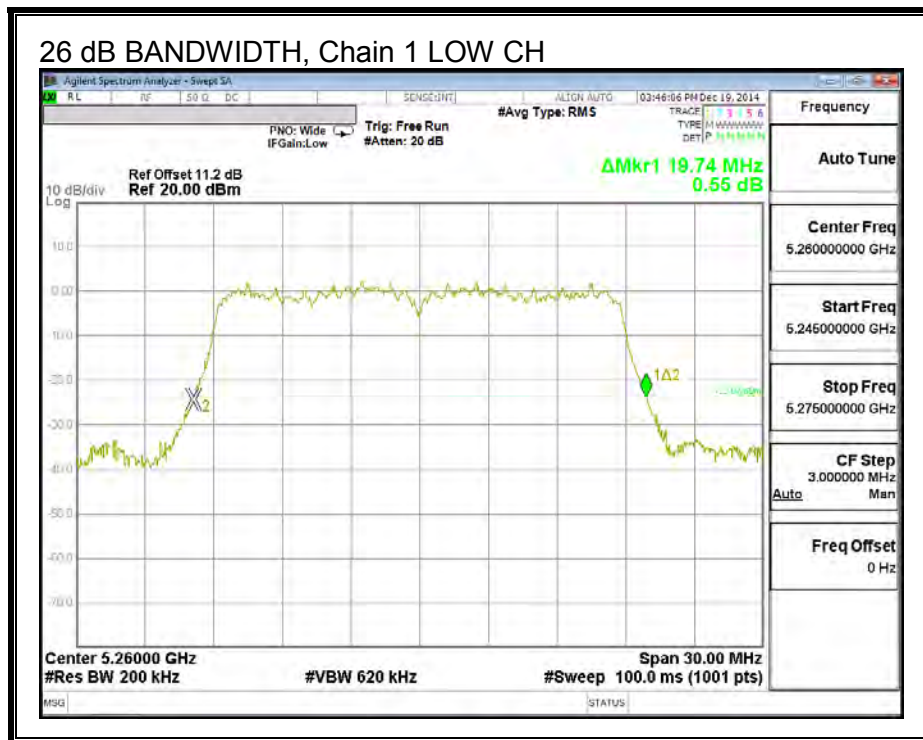
Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5260	19.98	19.74
Mid	5300	19.95	19.86
High	5320	19.86	19.80

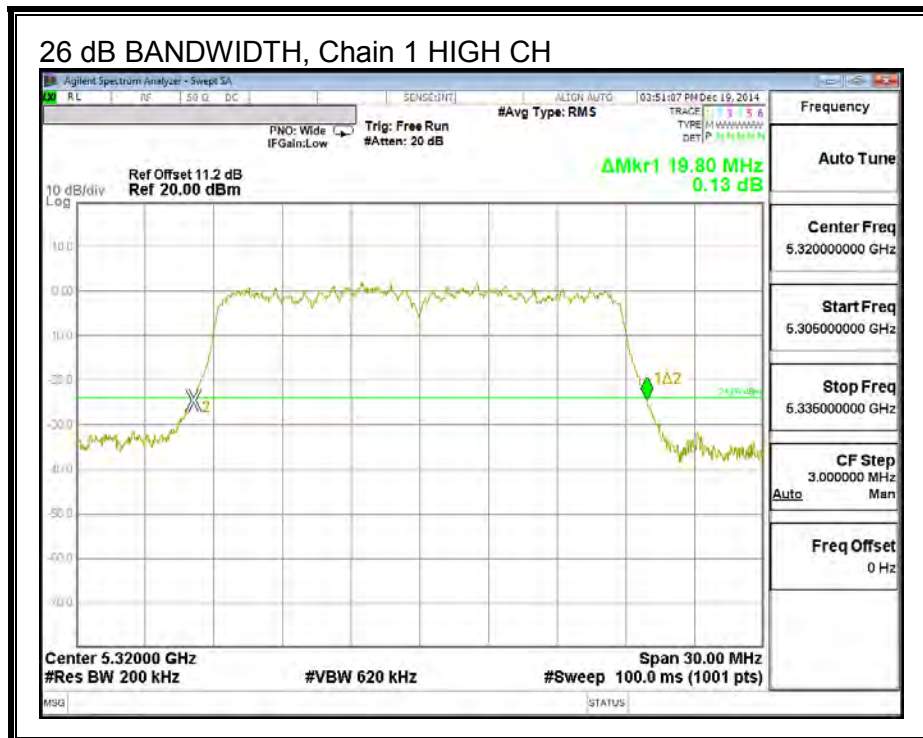
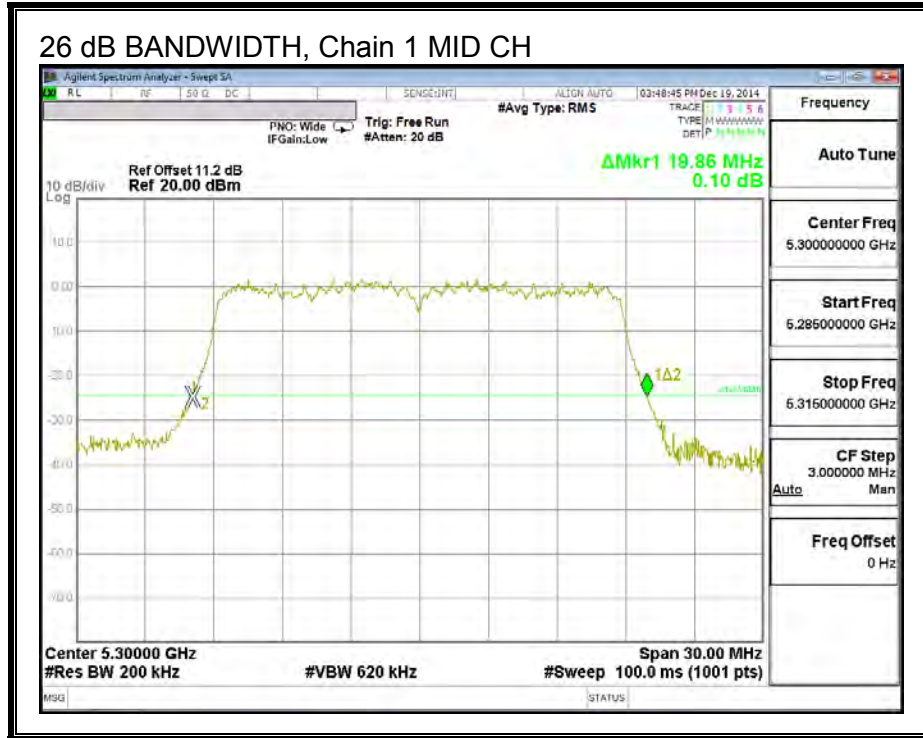
26 dB BANDWIDTH, Chain 0





26 dB BANDWIDTH, Chain 1





9.6.2. 99% BANDWIDTH

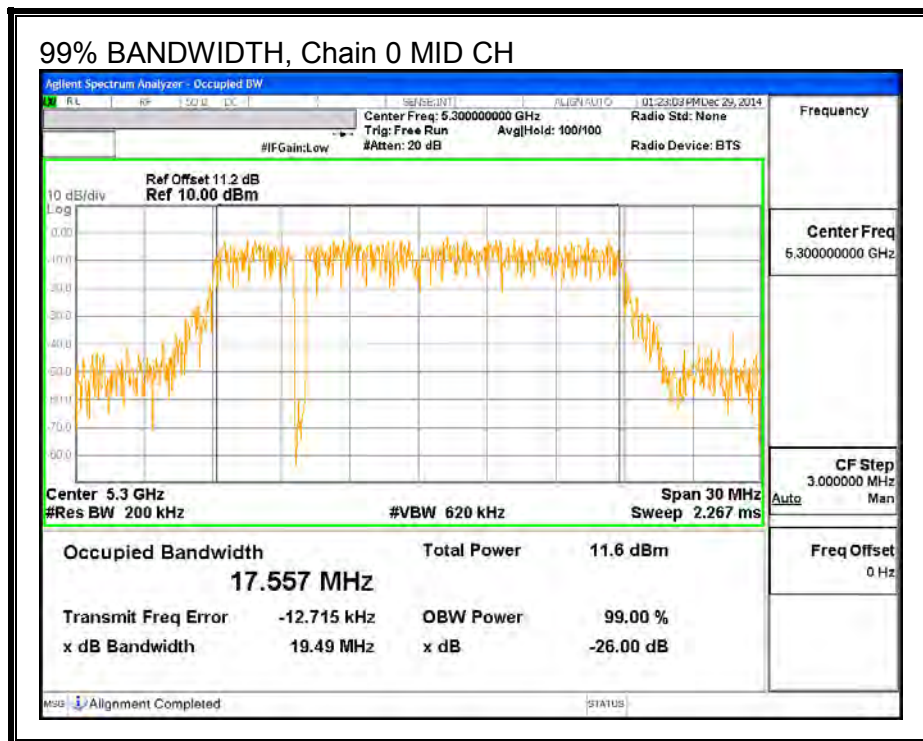
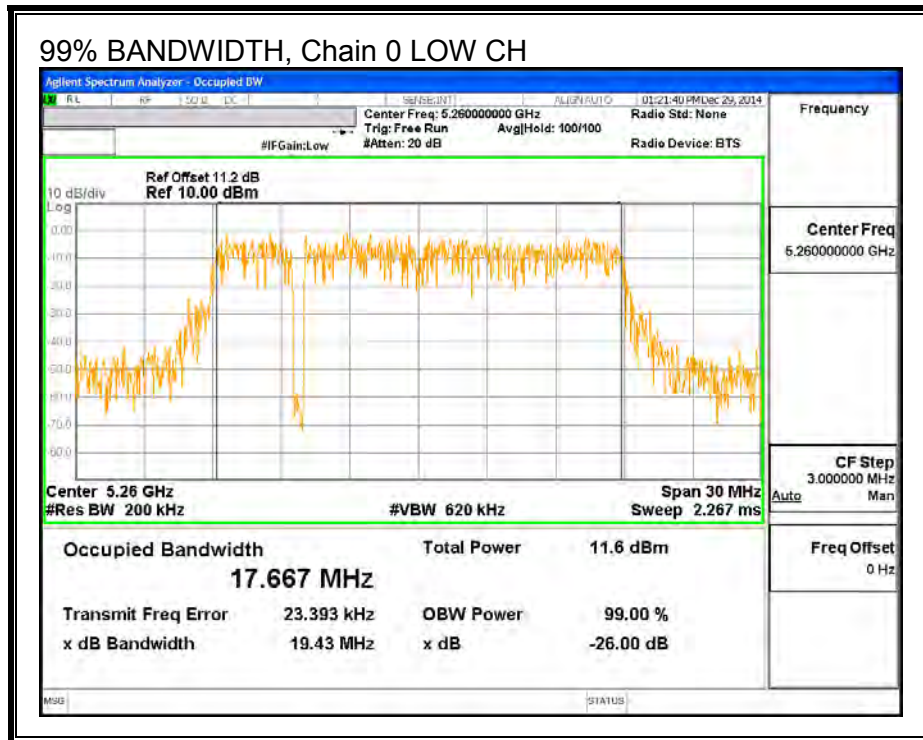
LIMITS

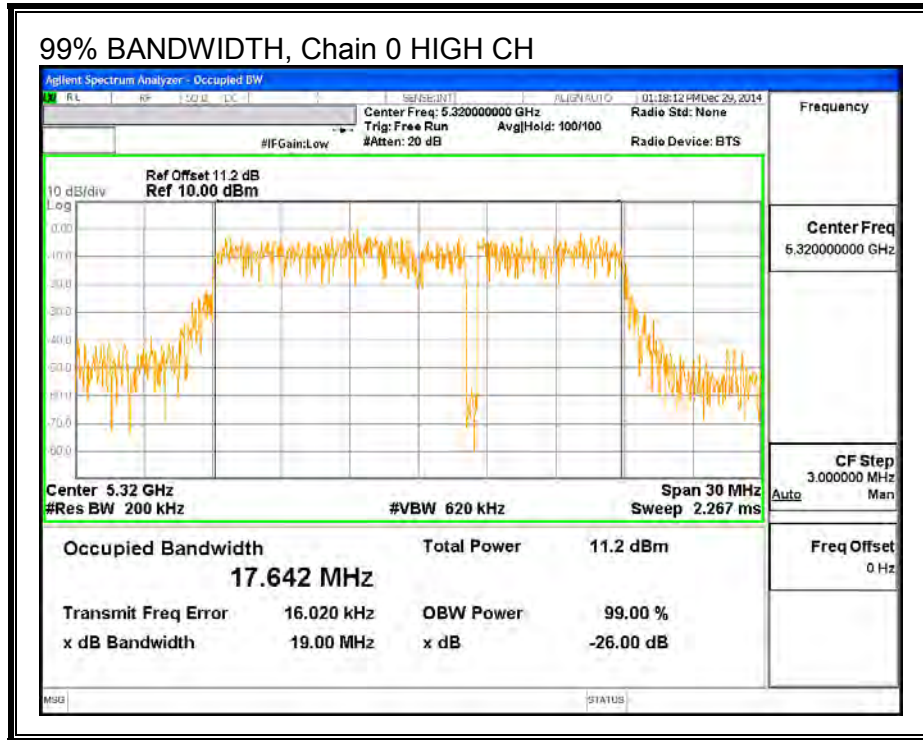
None; for reporting purposes only.

RESULTS

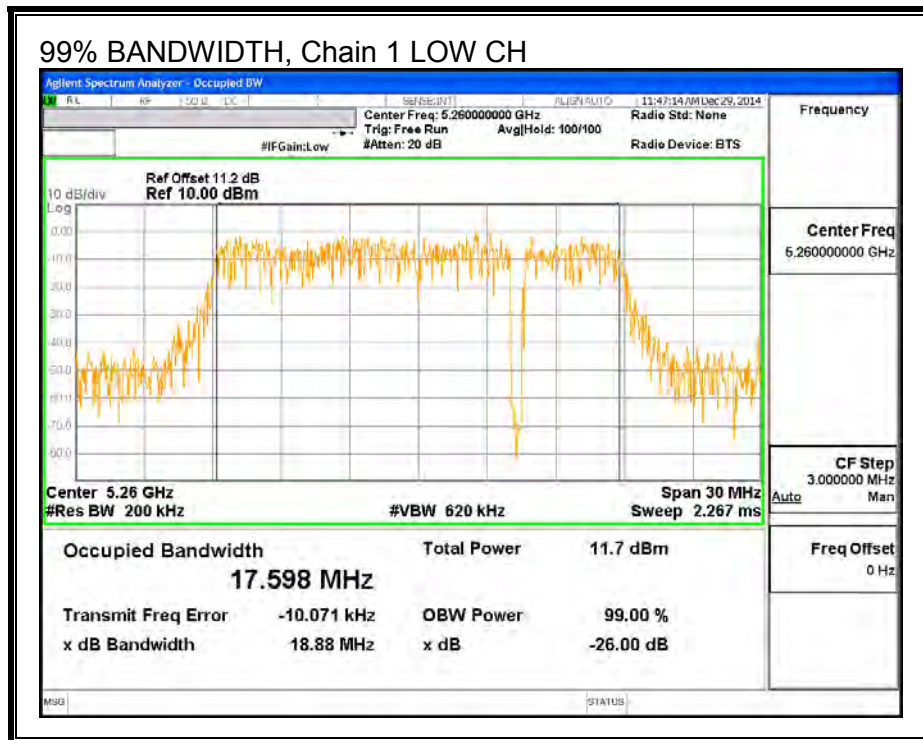
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5260	17.667	17.598
Mid	5300	17.557	17.588
High	5320	17.642	17.565

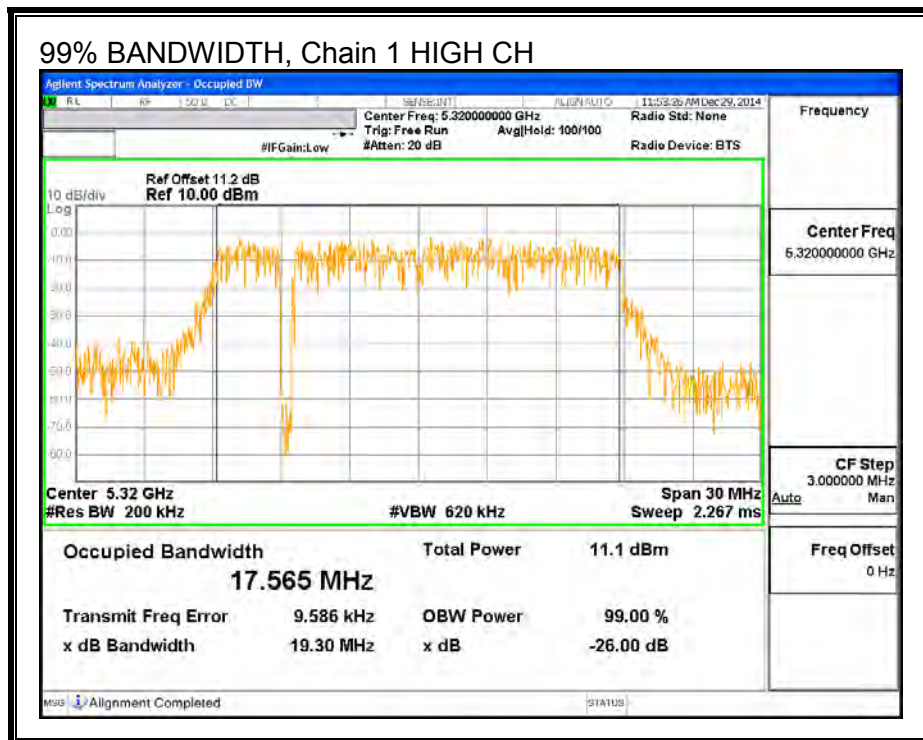
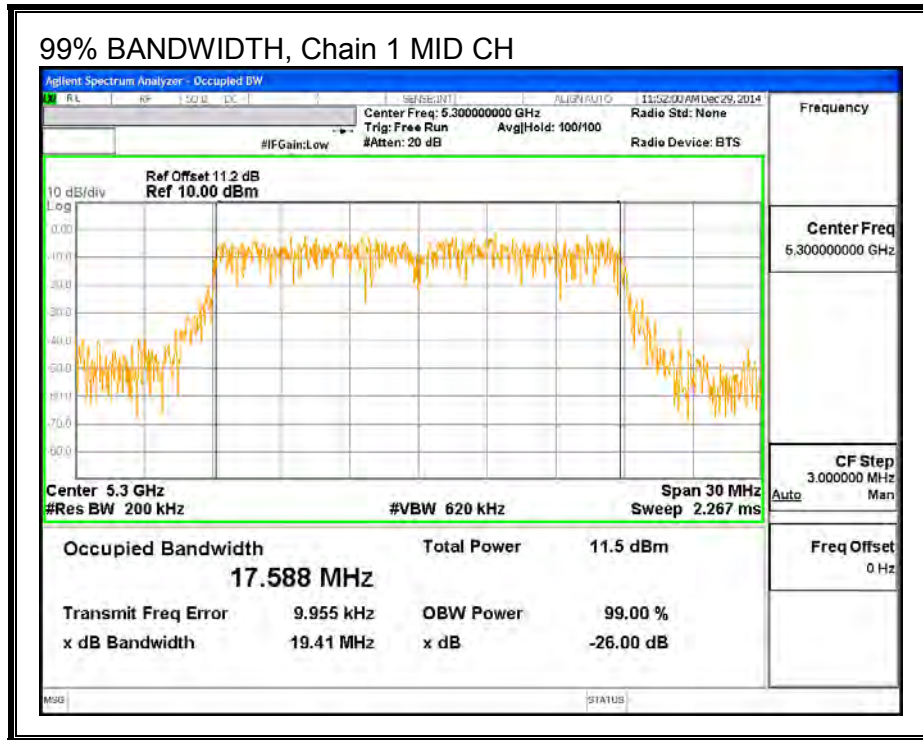
99% BANDWIDTH, Chain 0





99% BANDWIDTH, Chain 1





9.6.3. OUTPUT POWER AND PSD

LIMITS

FCC §15.407 (a) (2)

For the band 5.25–5.35 GHz, the maximum conducted output power over the frequency band 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 MHz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1–MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
2.9	3.5	3.21

RESULTS

Bandwidth, Antenna Gain and Limits

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5260	19.74	3.21	3.21	23.95	11.00
Mid	5300	19.86	3.21	3.21	23.98	11.00
High	5320	19.80	3.21	3.21	23.97	11.00

Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd Power & PSD
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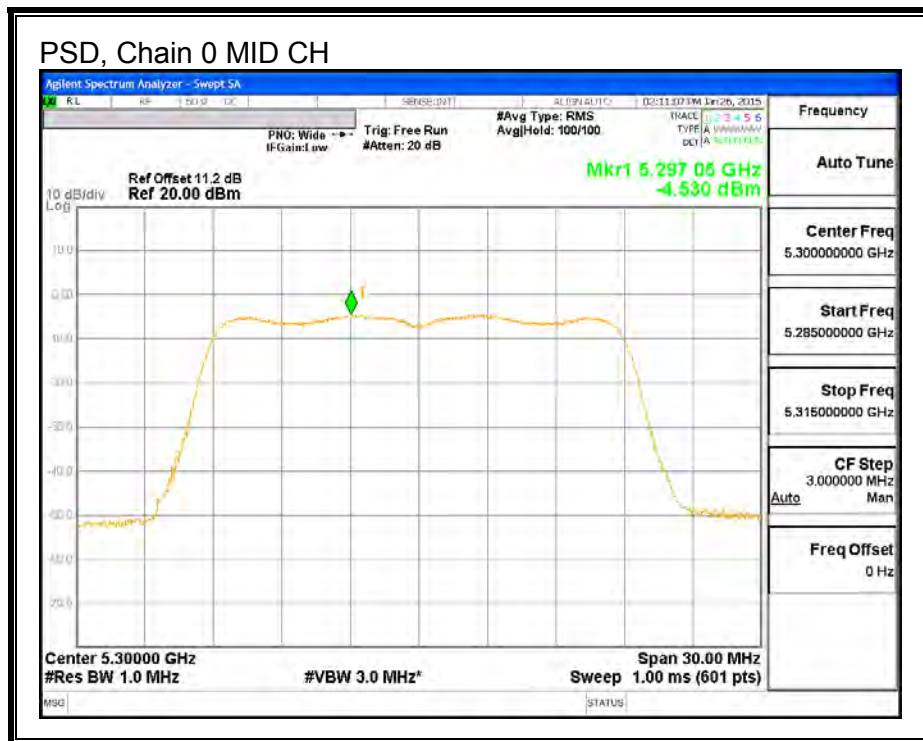
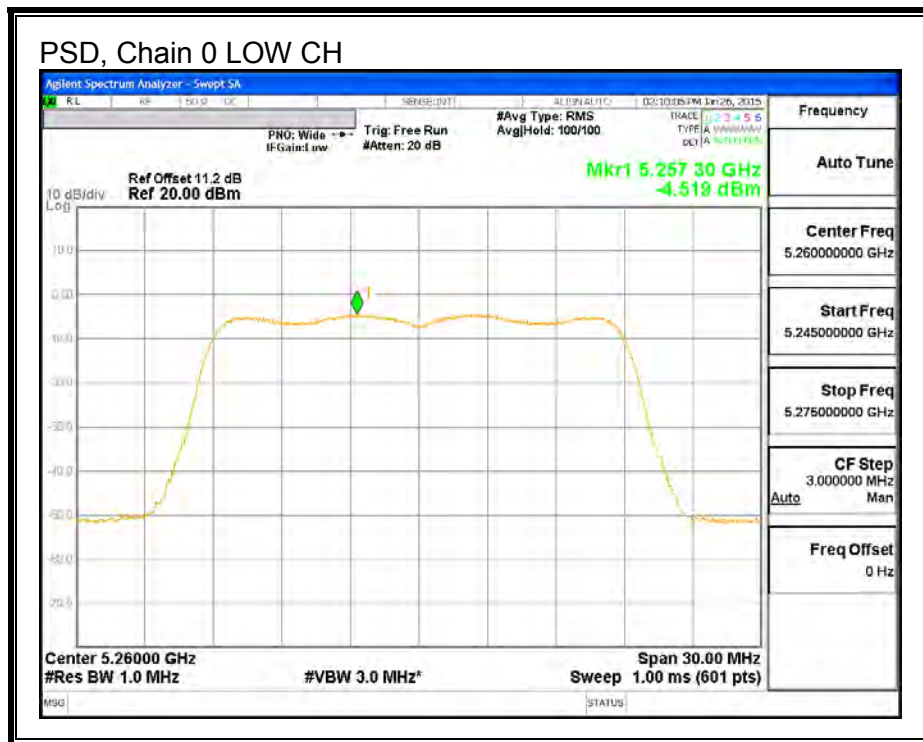
Output Power Results

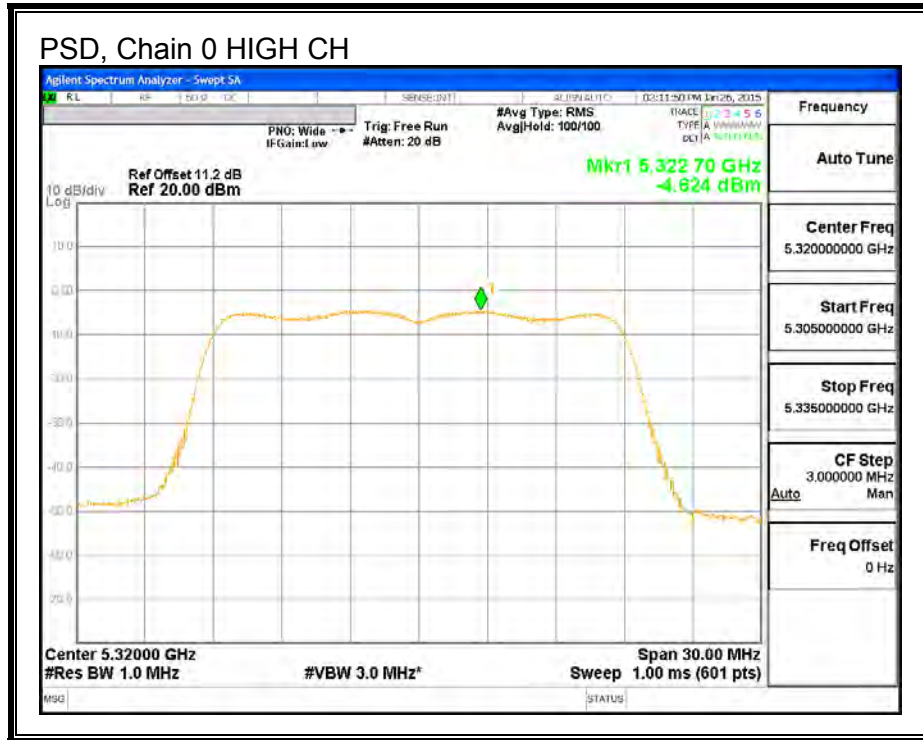
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5260	7.00	7.03	10.03	23.95	-13.93
Mid	5300	7.35	6.94	10.16	23.98	-13.82
High	5320	7.04	6.68	9.87	23.97	-14.09

PSD Results

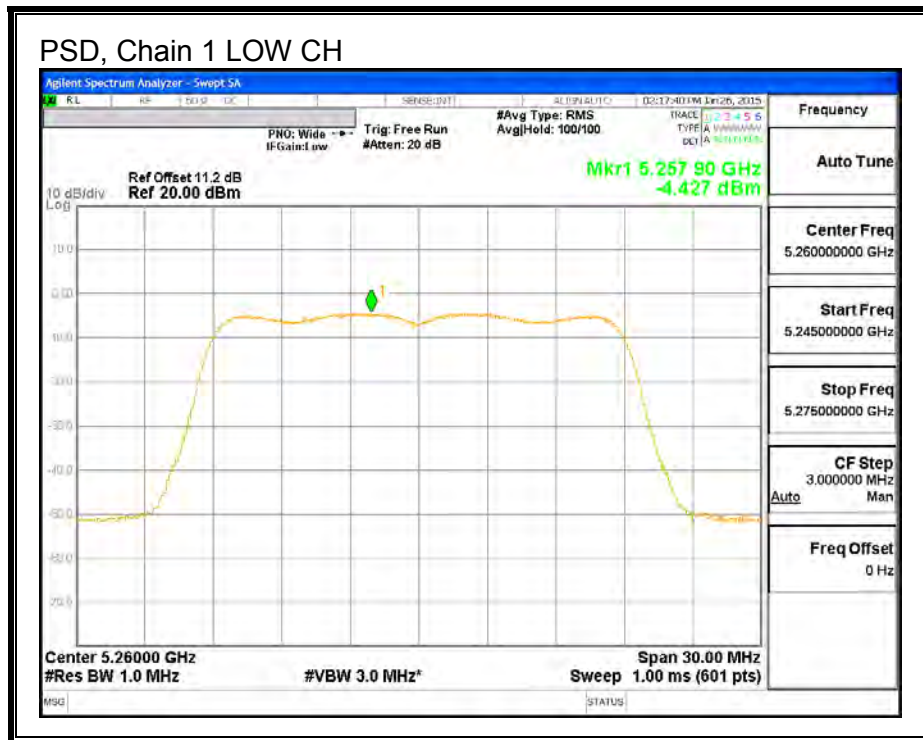
Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5260	-4.519	-4.427	-1.46	11.00	-12.46
Mid	5300	-4.530	-4.761	-1.63	11.00	-12.63
High	5320	-4.624	-4.943	-1.77	11.00	-12.77

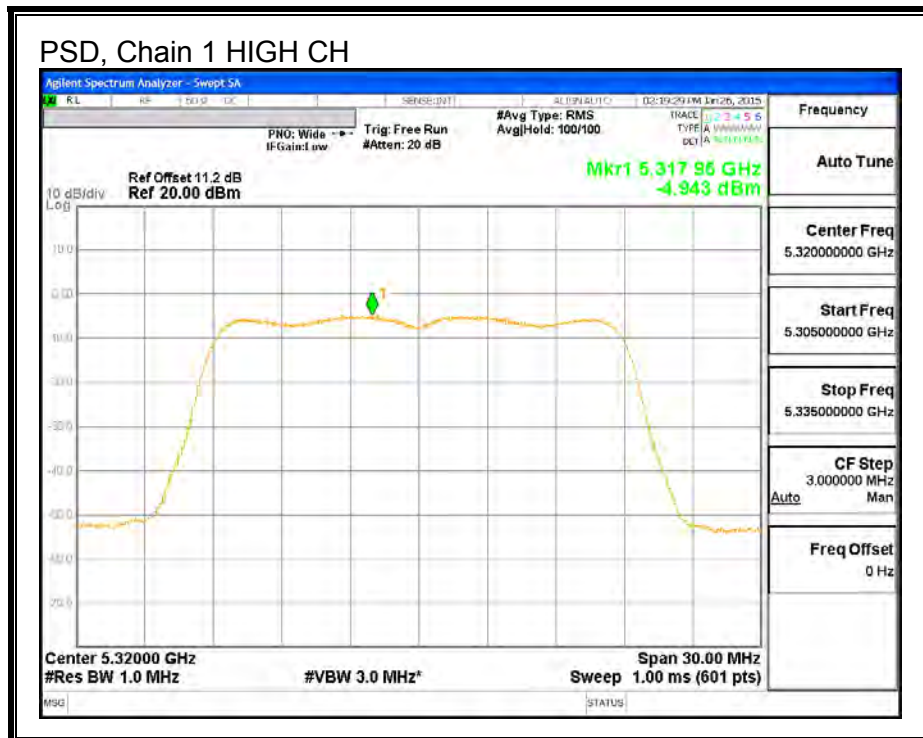
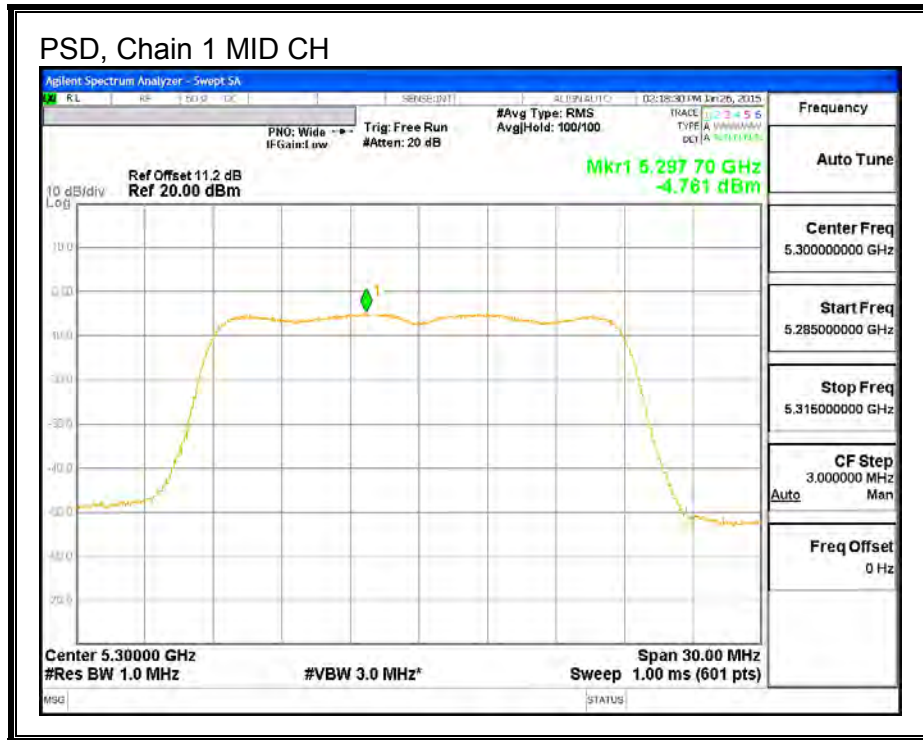
PSD, Chain 0





PSD, Chain 1





9.7. 802.11n HT40 MODE IN THE 5.3 GHz BAND

9.7.1. 26 dB BANDWIDTH

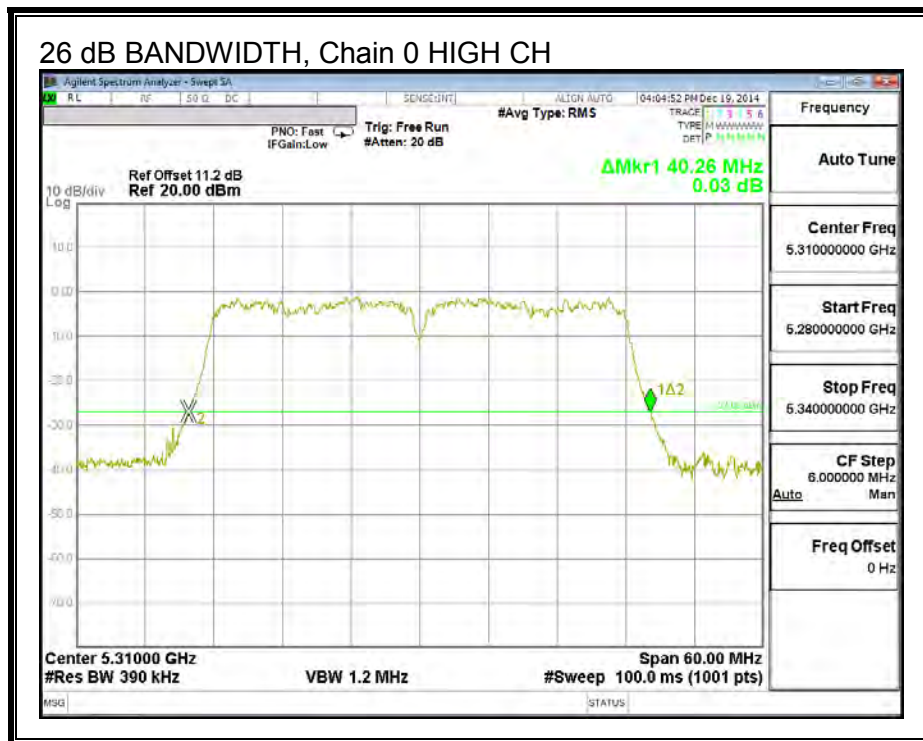
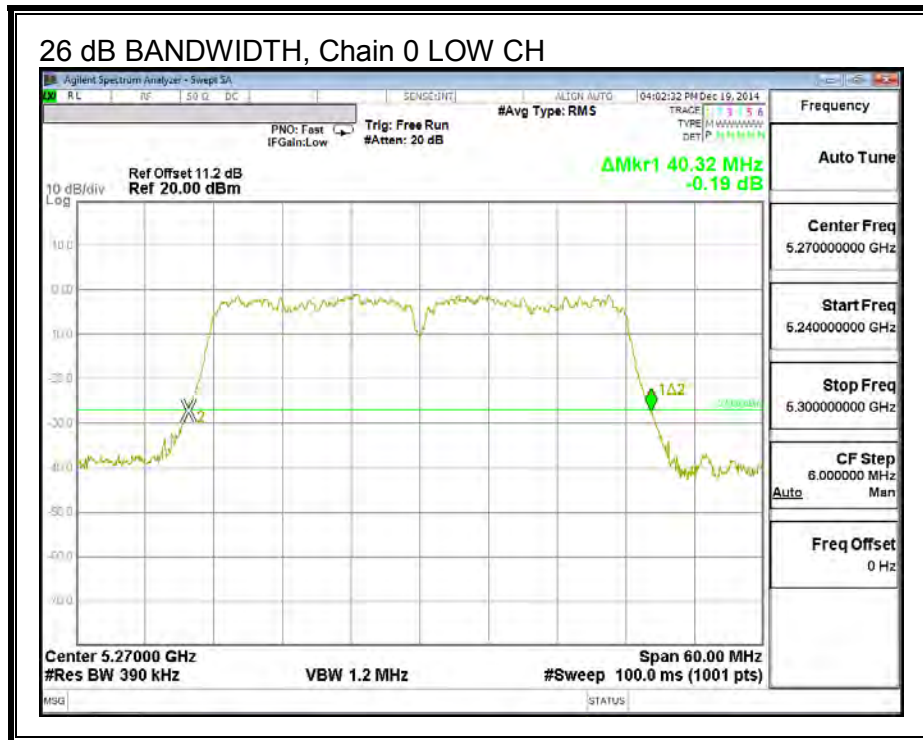
LIMITS

None; for reporting purposes only.

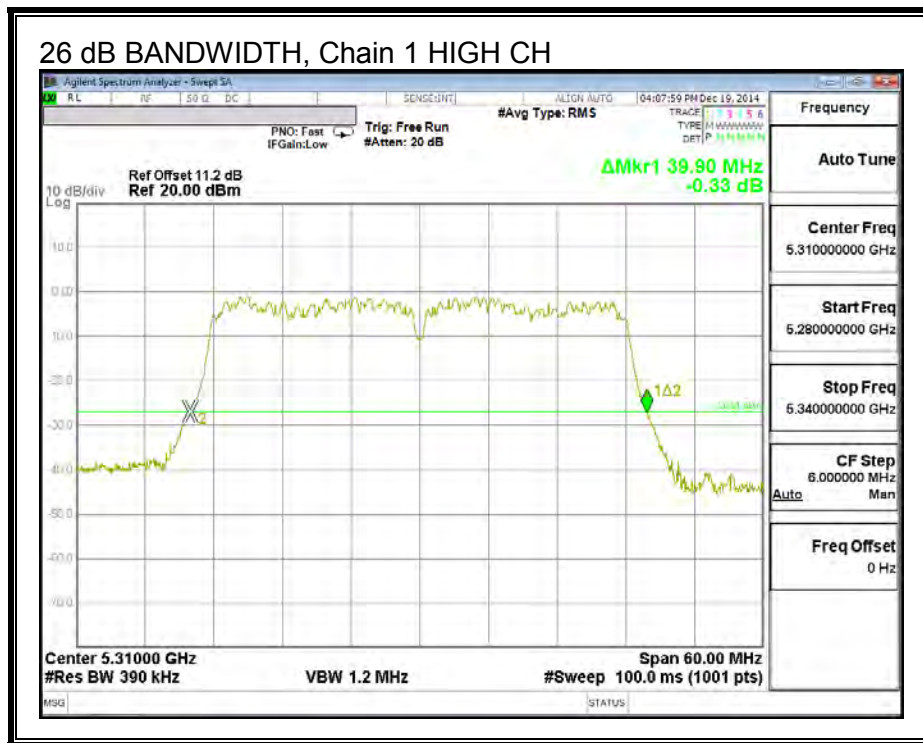
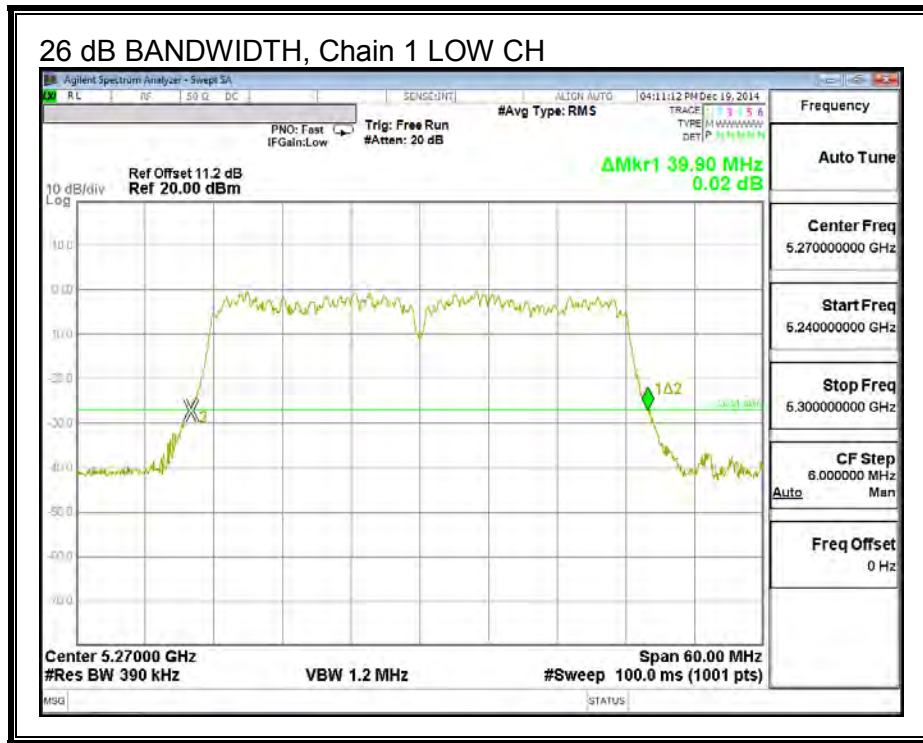
RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5270	40.32	39.90
High	5310	40.26	39.90

26 dB BANDWIDTH, Chain 0



26 dB BANDWIDTH, Chain 1



9.7.2. 99% BANDWIDTH

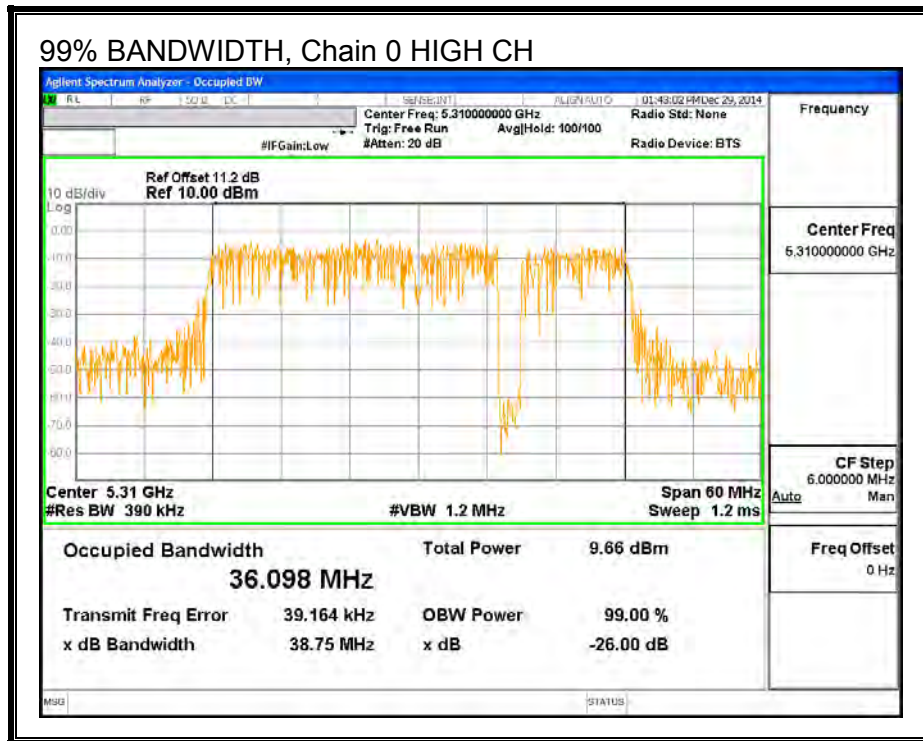
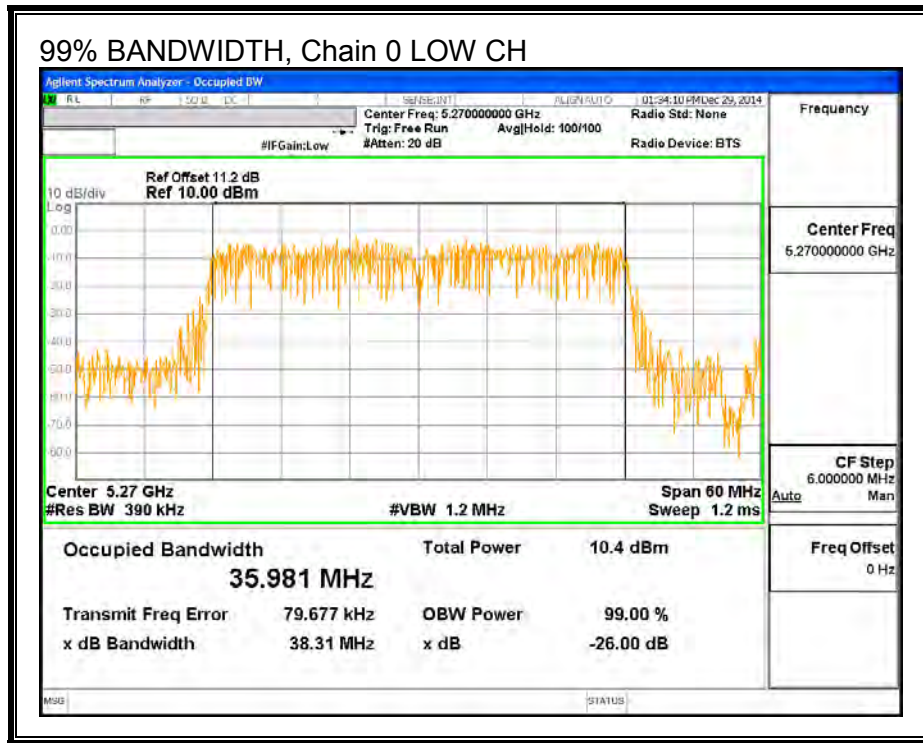
LIMITS

None; for reporting purposes only.

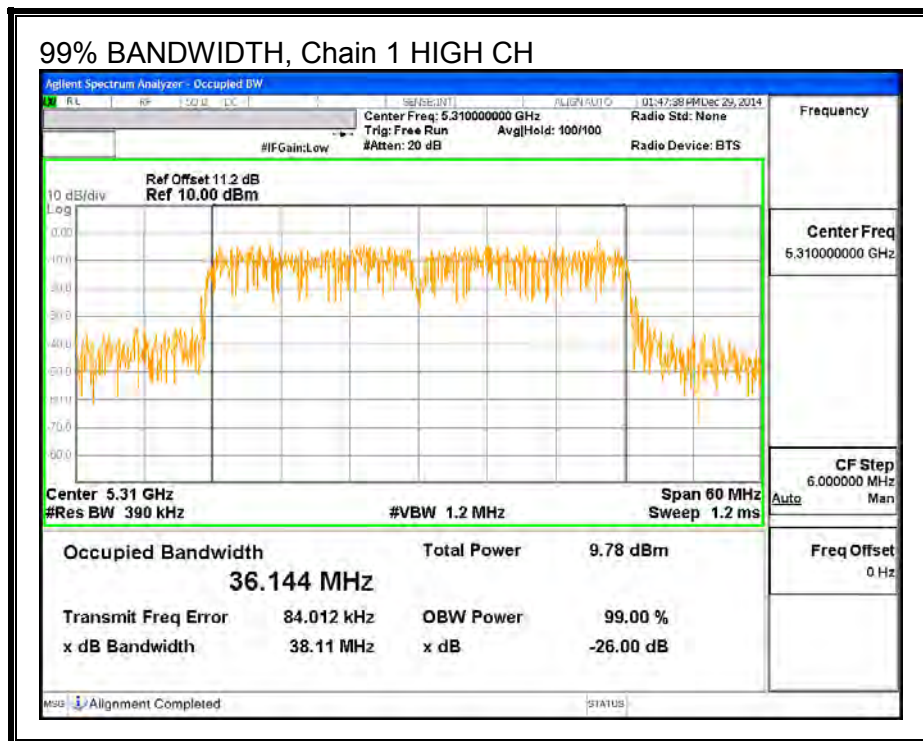
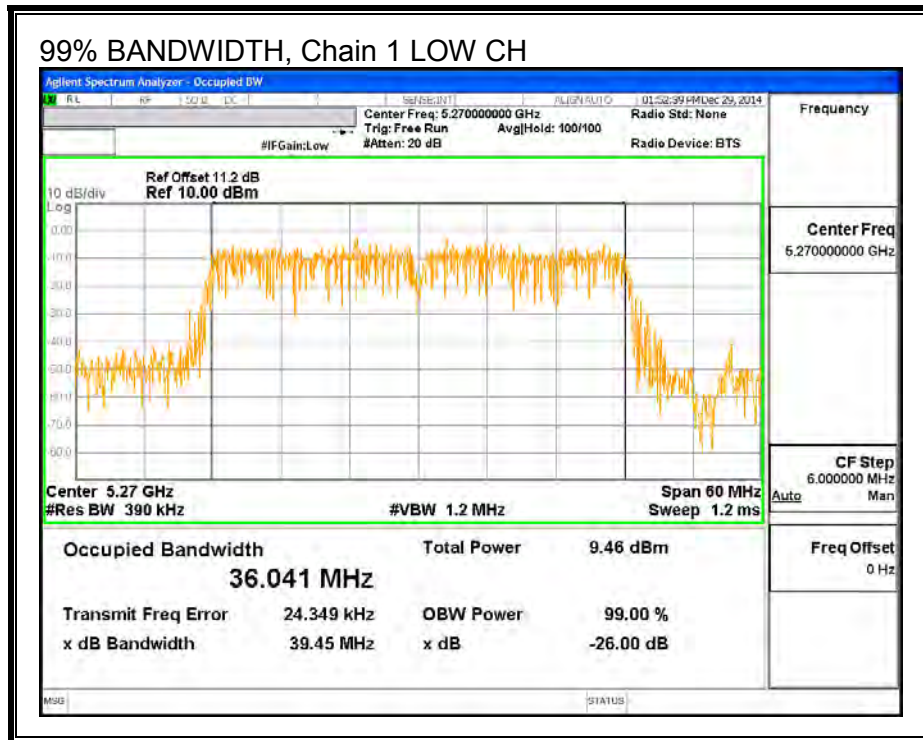
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5270	35.981	36.041
High	5310	36.098	36.144

99% BANDWIDTH, Chain 0



99% BANDWIDTH, Chain 1



9.7.3. OUTPUT POWER AND PSD

LIMITS

FCC §15.407 (a) (2)

For the band 5.25–5.35 GHz, the maximum conducted output power over the frequency band 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 MHz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1–MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
2.9	3.5	3.21

RESULTS

Bandwidth, Antenna Gain and Limits

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low	5270	39.90	3.21	3.21	24.00	11.00
High	5310	39.90	3.21	3.21	24.00	11.00

Duty Cycle CF (dB)	0.13	Included in Calculations of Corr'd Power & PSD
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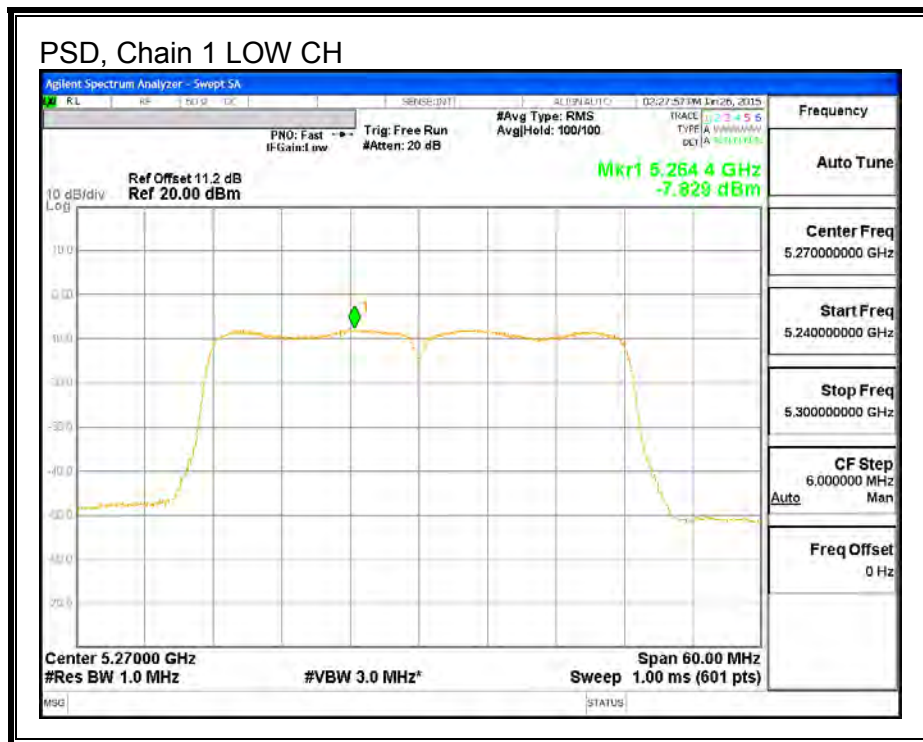
Output Power Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5270	7.220	6.780	10.15	24.00	-13.85
High	5310	7.010	6.880	10.09	24.00	-13.91

PSD Results

Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5270	-7.813	-7.829	-4.68	11.00	-15.68
High	5310	-7.612	-8.319	-4.81	11.00	-15.81

PSD, Chain 1



9.8. 802.11ac VHT80 MODE IN THE 5.3 GHz BAND

9.8.1. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Mid	5290	82.20	81.72