CERTIFICATION TEST REPORT

Report Number. : 11526444-E2V4

Applicant	:	SONOS, INC. 614 CHAPALA STREET SANTA BARBARA, CA, 93101, U.S.A.
Model	:	S13
FCC ID	:	SBVRM012
EUT Description	:	802.11 a/b/g/n (HT20) Client Device
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART E (Except DFS)

Date Of Issue:
July 31, 2017

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	06/30/17	Initial Issue	D. Coronia
V2	07/18/17	Updated Section 6 & 9.3.3 (updated PSD limit)	D. Coronia
V3	07/24/17	Updated Section 6 & 10.2	D. Coronia
V4	07/31/17	Updated Section 9.3.3, 9.9.4, 10.1 & remove below 30MHz data	D. Coronia

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SONOS, INC.
614 CHAPALA STREET
SANTA BARBARA, CA 93101, U.S.A.

EUT DESCRIPTION: 802.11 a/b/g/n (HT20) Client Device

MODEL: S13

SERIAL NUMBER: 170378-28-CA-10-05-CC-2, 170378-28-CA-10-05-CC-0, 170378-28-CA-00-07-80-E

DATE TESTED: MARCH 27 TO MAY 16, 2017

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart E (Except DFS)	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.

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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 14-30, FCC KDB 662911 D01 v02r01, FCC KDB 905462 D02 v01r02/D03 v01r01/D06 v01, FCC KDB 789033 D02 v01r01, FCC KDB 644545 D03 v01, ANSI C63.10-2013.

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
☒ Chamber A (IC:2324B-1)	☐ Chamber D (IC:22541-1)
☐ Chamber B (IC:2324B-2)	☐ Chamber E (IC:22541-2)
☐ Chamber C (IC:2324B-3)	☐ Chamber F (IC:22541-3)
	☐ Chamber G (IC:22541-4)
	☐ Chamber H (IC:22541-5)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

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:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

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

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

Parameter	Uncertainty
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is 802.11 a/b/g/n (HT20) Client Device. Product model S13 is a high-performance all-in-one wireless smart speaker and part of Sonos' home sound system. S13 adds integrated voice control functionality with far field microphones. Moreover, the device will support multiple voice platforms and music services, allowing customers to effortlessly control their music on Sonos.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

2x2:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5180 - 5240	802.11n HT20 CDD 2TX	19.38	86.70
5260 - 5320	802.11n HT20 CDD 2TX	20.48	111.69
5500 - 5700	802.11n HT20 CDD 2TX	20.16	103.75
5745 - 5825	802.11n HT20 CDD 2TX	20.90	123.03

3x3:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5180 - 5240	802.11n HT20 CDD 3TX	21.55	142.89
5260 - 5320	802.11n HT20 CDD 3TX	20.14	103.28
5500 - 5700	802.11n HT20 CDD 3TX	19.90	97.72
5745 - 5825	802.11n HT20 CDD 3TX	21.94	156.31

NOTE: Covered modes are test reduction modes. The output powers on the covered modes are equal to or less than the mode referenced and use the same modulation.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an integrated antenna, with a maximum gain as follows:

	Peak Antenna Gain (dBi)		
Frequency (GHz)	Chain 0	Chain 1	Chain 2
5180 - 5825	3.41	2.26	4.22

5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was Atheros Radio Test 2 (ART2-GUI).

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated bandage, harmonics, and spurious emissions from 1 GHz to 18GHz were performed. The EUT was set to transmit at the Low/Middle/High channels with designed (target) output powers.

Radiated emission below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT was set to transmit at the channel with highest output power as worst-case scenario.

The EUT can only be setup in desktop orientation; therefore, all radiated testing was performed with the EUT in desktop orientation.

Worst-case data rates as provided by the client was: 802.11n HT20 mode: 26 Mbps (MCS3)

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Lenovo	X230	PK1D7EM	
AC Adapter	Lenovo	42T4418	11S42T4418Z1ZF3B048J2Z	

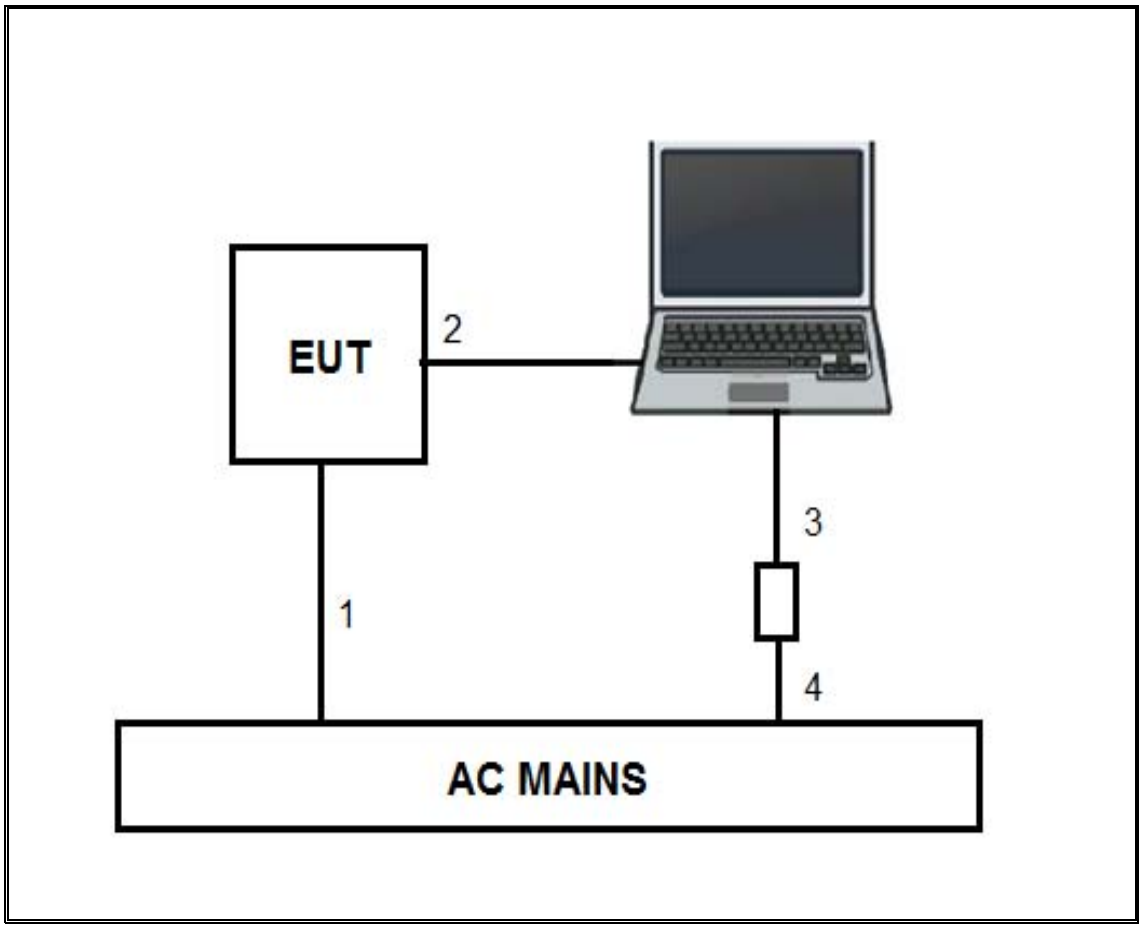
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC Power	1	AC	Unshielded	1	AC Mains to EUT
2	Ethernet	1	RJ45	Unshielded	10	EUT to Laptop
3	DC Power	1	DC	Shielded	1.2	AC/DC Adapter to Laptop
4	AC Power	1	AC	Unshielded	1	AC Mains to AC/DC Adapter

TEST SETUP

The EUT is a stand-alone unit and connected to support laptop via Ethernet cable.
The Atheros Radio Test 2 (ART2-GUI) test software is exercising the EUT during testing.

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**	**T No.**	**Cal Date**	**Cal Due**
Amplifier, 1 - 18GHz	Miteq	AFS42	1165	08/01/16	08/01/17
Amplifier, 1-26.5GHz	Agilent	8449B	404	07/05/16	07/05/17
Amplifier, 26-40GHz	Miteq	NSP 4000 SP2	88	04/29/17	04/29/18
Amplifier, 10KHz to 1GHz, 32dB	Keysight	8447D	10	02/01/17	02/01/18
Antenna, Broadband Hybrid 30MHz to 2000MHz	Sunol Science	JB1	130	09/01/16	09/01/17
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	711	01/30/17	01/30/18
Antenna, Horn 18-26.5GHz	ARA	MWH-2640/B	449	07/08/16	07/08/17
Antenna, Horn 26.5-40GHz	ARA	MWH-2640/B	446	06/12/16	06/12/17
Power Meter	Keysight	N1911A	1269	03/29/17	03/29/18
Wideband Power Sensor	Keysight	N1921A	1224	03/29/17	03/29/18
USB RF Power Sensor 10Mhz-6Ghz	ETS-LINDGREN	7002-006	1081	11/18/16	11/18/17
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	1210	06/30/16	06/30/17
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	907	01/23/17	01/23/18
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	146	07/13/16	07/13/17
LISN	FISCHER	FCC-LISN-50/250-25-2-01	T1310	06/08/16	06/08/17

Test Software List			
Description	**Manufacturer**	**Model**	**Version**
Radiated Software	UL	UL EMC	Ver 9.5, Apr 26, 2016
Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015
Antenna Port Software	UL	UL RF	Ver 6.0, Jan 19, 2017

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

NOTE: *testing is completed before equipment calibration expiration date.

7. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result
§15.407 (a)	Occupied Band width (26dB)	N/A	Conducted	Pass
§15.407	6dB Band width (5.8Ghz)	>500KHz		Pass
§15.407 (a)(1)	TX Cond. Power 5.15-5.25 GHz	<24dBm (FCC) / <23 dBm EIRP or <10+10Log(99% BW) EIRP (IC)		Pass
§15.407 (a)(2)	TX Cond. Power 5.25-5.35 & 5.47-5.725 GHz	<24dBm or <11+10log (OBW) (FCC) / <24 dBm or <11+10Log(99% BW) (IC)		Pass
§15.407 (a)(3)	TX Cond. Power 5.725-5.850 GHz	<30dBm		Pass
§15.407 (a)(1)	PSD (5.15-5.25 GHz)	<11dBm/MHz (FCC) <10 dBm/MHz EIRP (IC)		Pass
§15.407 (a)(2)	PSD (5.3,5.5GHz)	<11dBm/MHz		Pass
§15.407 (a)(3)	PSD (5.8GHz)	<30dBm per 500kHz		Pass
§15.207 (a) §15.407(b) (6)	AC Power Line conducted emissions	Section 10		Pass
§15.407 (b) & 15.209	Radiated Spurious Emission	<54dBuV/m	Radiated	Pass

8. MEASUREMENT METHODS

On Time and Duty Cycle: KDB 789033 D02 v01r03, Section B.

6 dB Emission BW: KDB 789033 D02 v01r03, Section C.2.1

26 dB Emission BW: KDB 789033 D02 v01r03, Section C.

99% Occupied BW: KDB 789033 D02 v01r03, Section D.

Conducted Output Power: KDB 789033 D02 v01r03, Section E.3.b (Method PM-G) and KDB 662911 D01 v02r01.

Power Spectral Density: KDB 789033 D02 v01r03, Section F and KDB 662911 D01 v02r01.

Unwanted emissions in restricted bands: KDB 789033 D02 v01r03, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v01r03, Sections G.3, G.4, and G.5.

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME, DUTY CYCLE

LIMITS

None; for reporting purposes only.

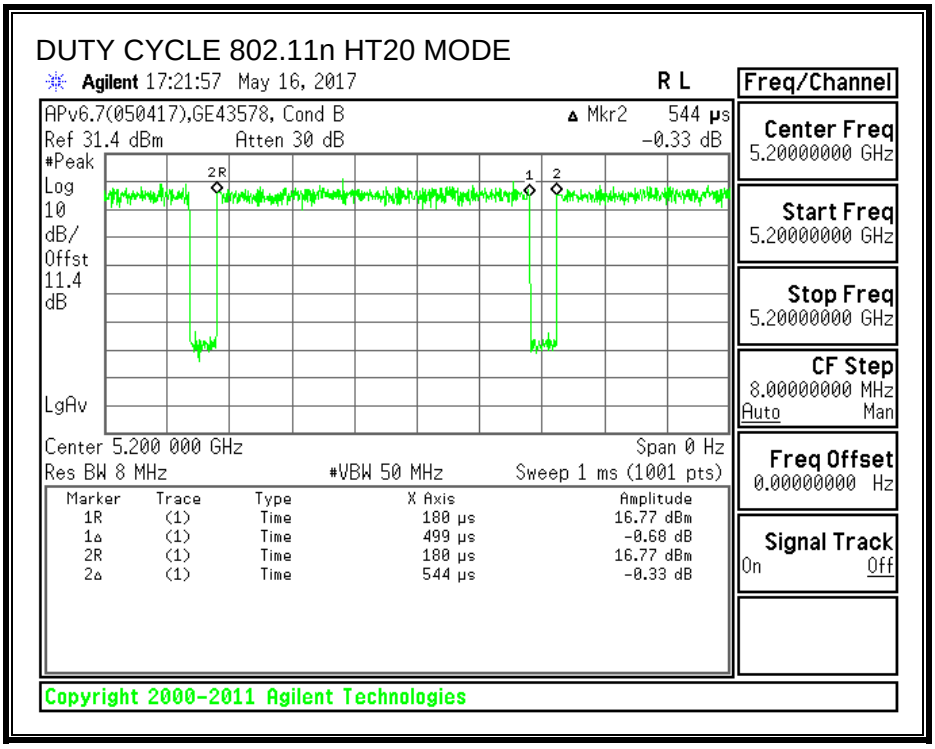
PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (kHz)
802.11n HT20	0.499	0.544	0.917	91.7%	0.37	2.004

DUTY CYCLE PLOTS



9.2. 11n HT20 2TX CDD MIMO MODE IN THE 5.2GHz BAND

9.2.1. 26 dB BANDWIDTH

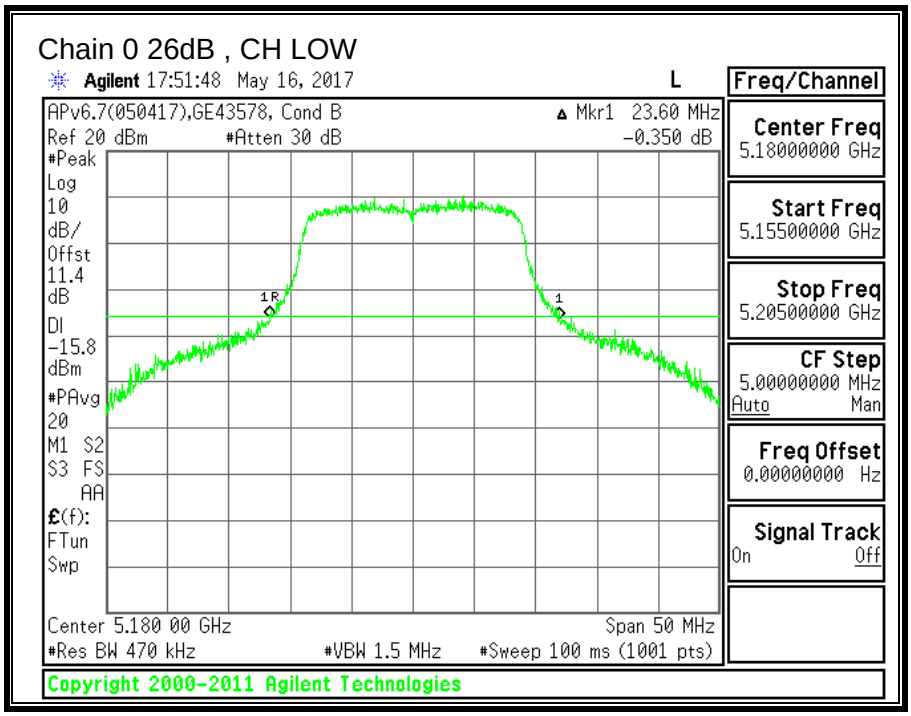
LIMITS

None; for reporting purposes only.

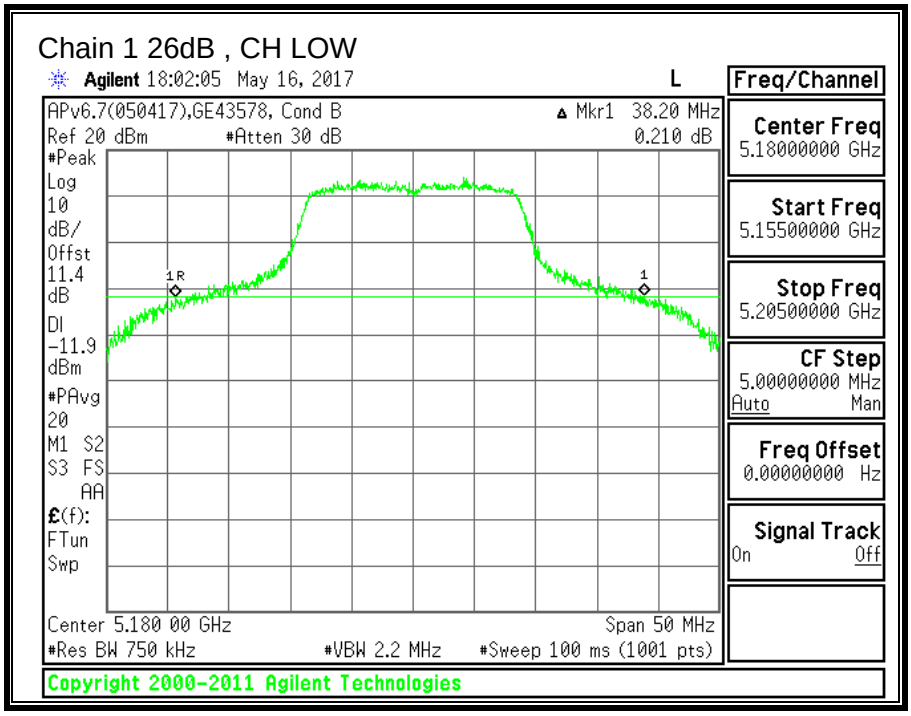
RESULTS

Channel	Frequency	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5180	23.60	38.20
Mid	5200	25.30	40.65
High	5240	25.05	32.45

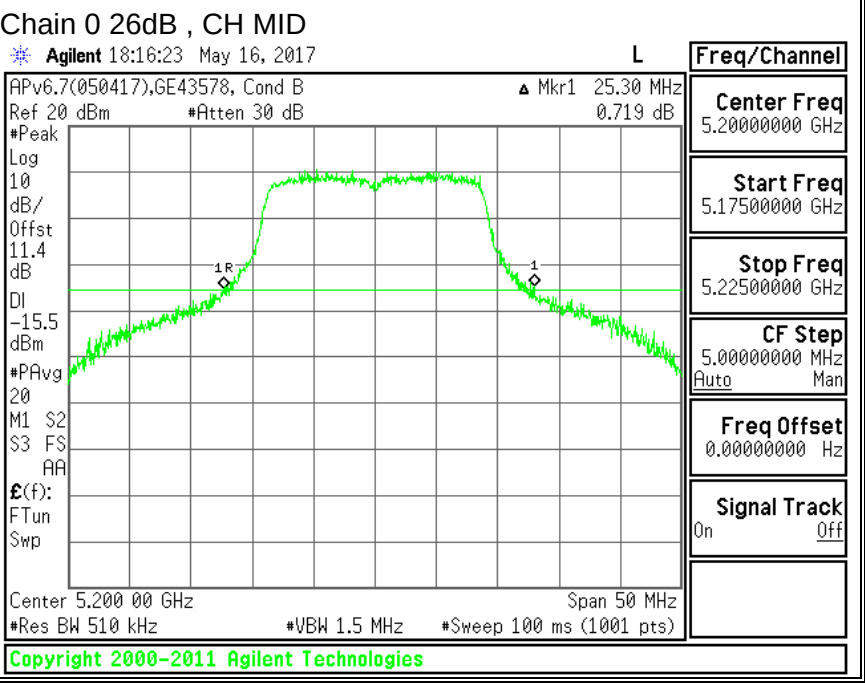
Chain 0 26dB , CH LOW



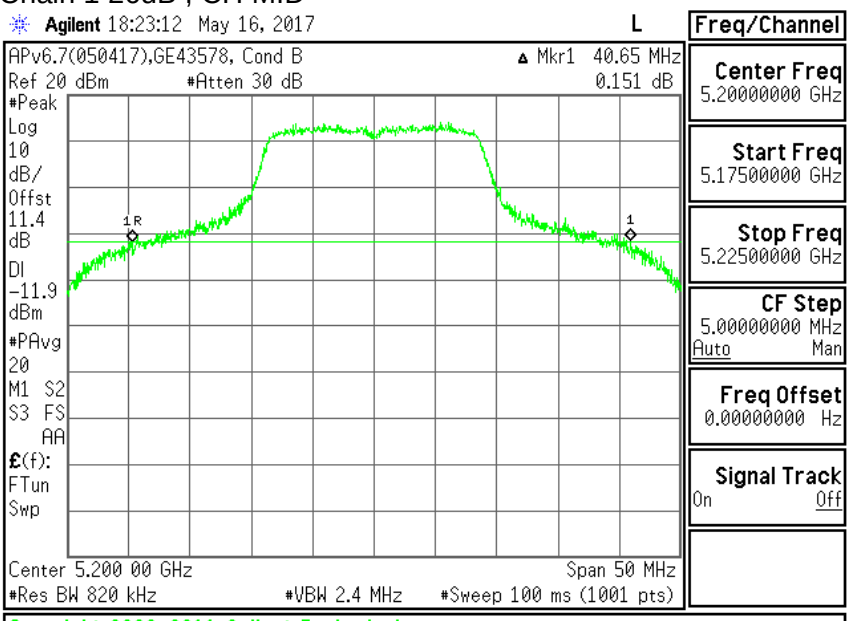
Chain 1 26dB , CH LOW



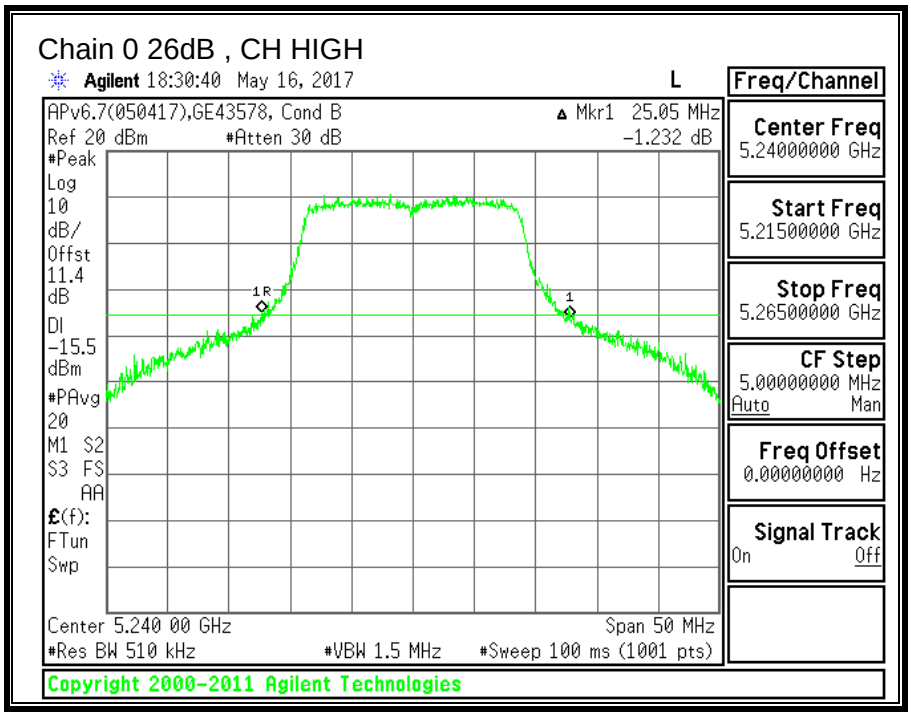
Chain 0 26dB , CH MID



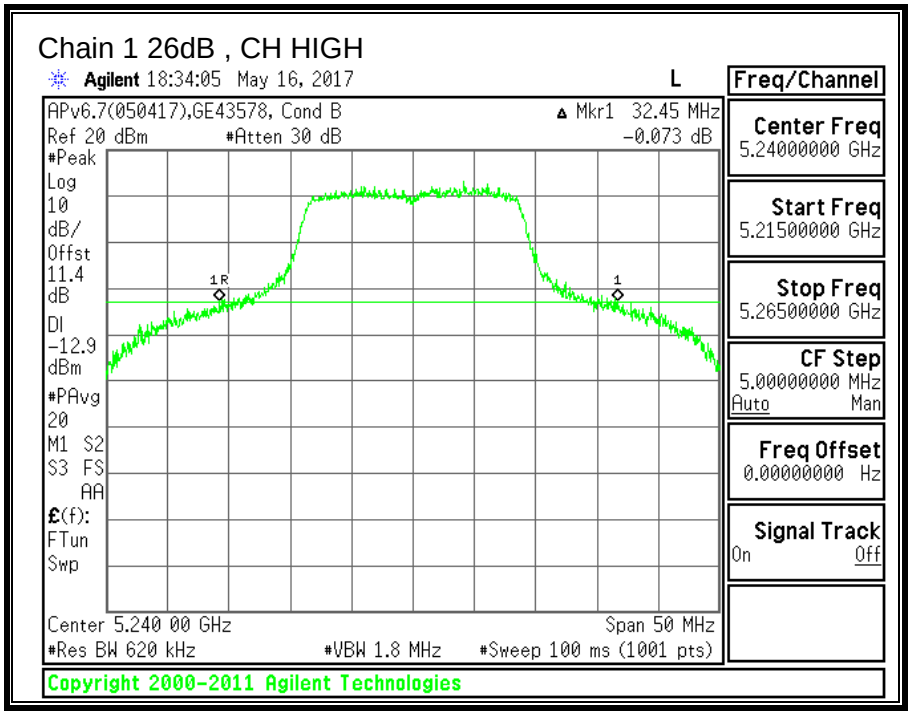
Chain 1 26dB , CH MID



Chain 0 26dB , CH HIGH



Chain 1 26dB , CH HIGH



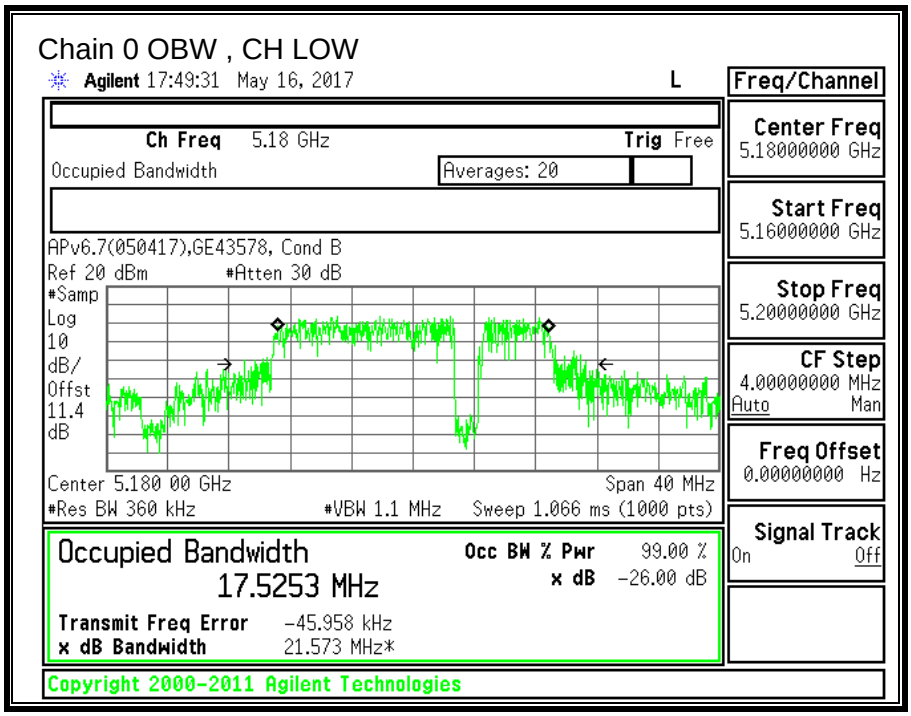
9.2.2. 99% BANDWIDTH

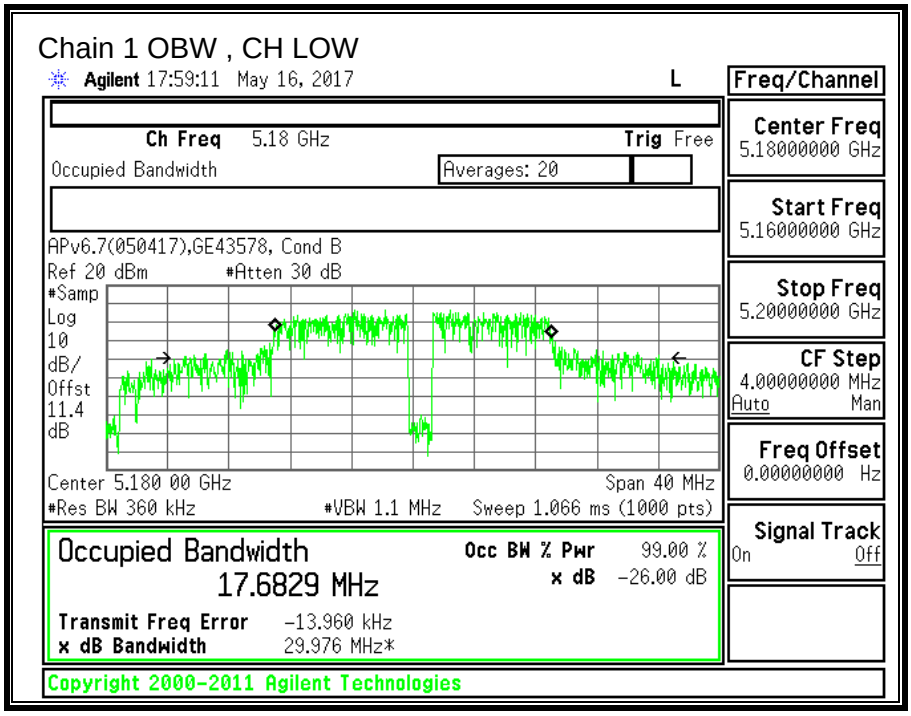
LIMITS

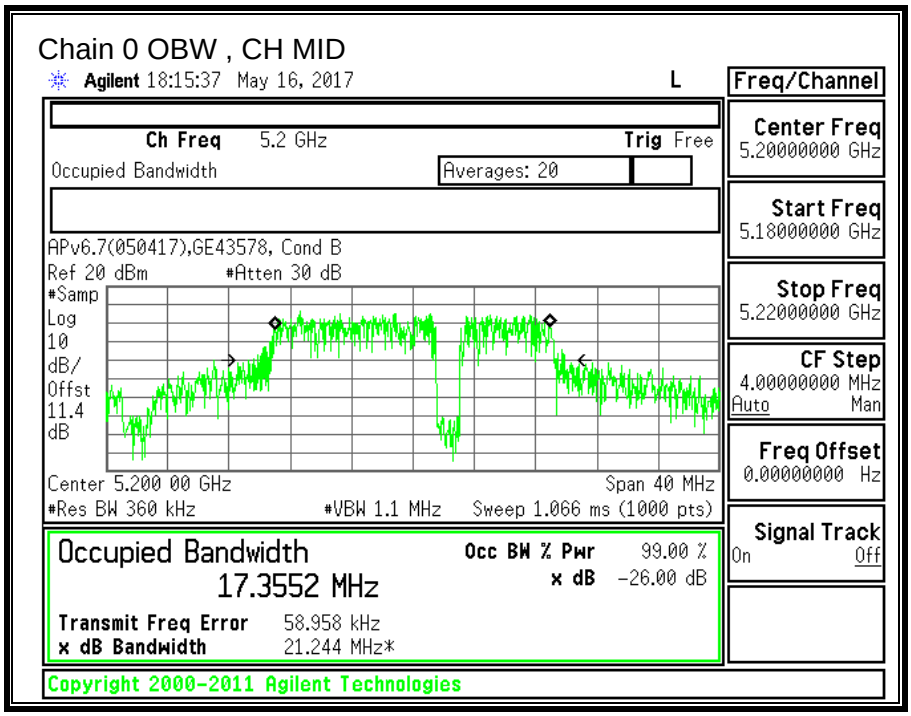
None; for reporting purposes only.

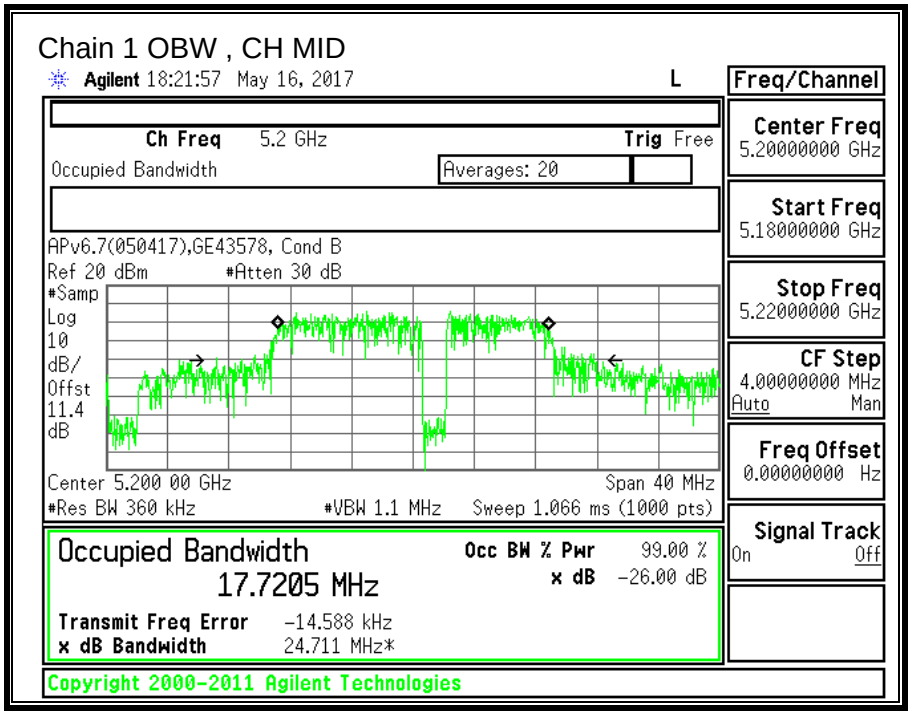
RESULTS

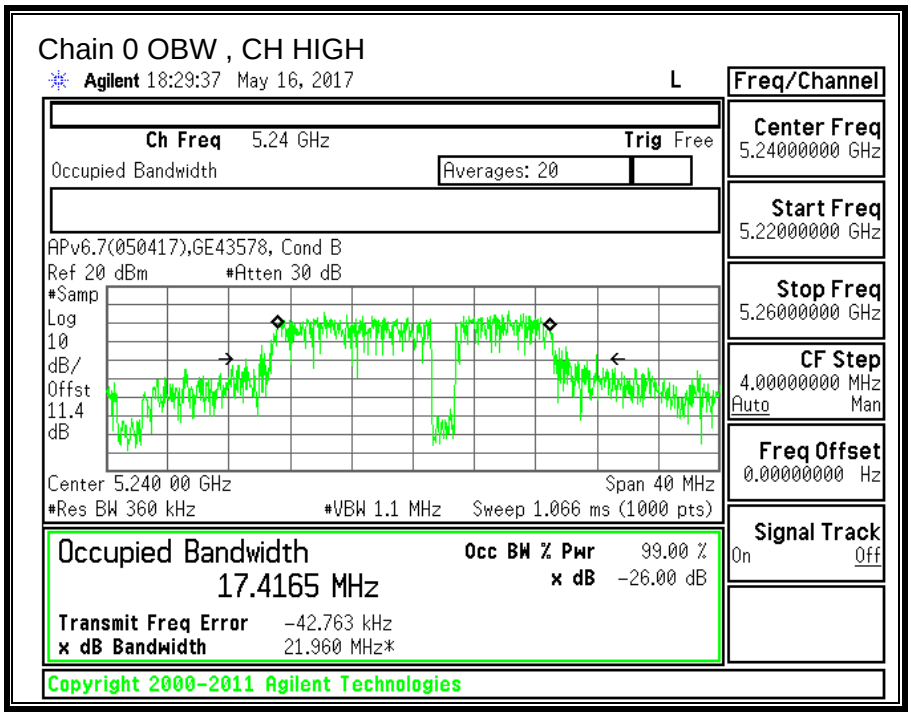
Channel	Frequency	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5180	17.5253	17.6829
Mid	5200	17.3552	17.7205
High	5240	17.4165	17.5243

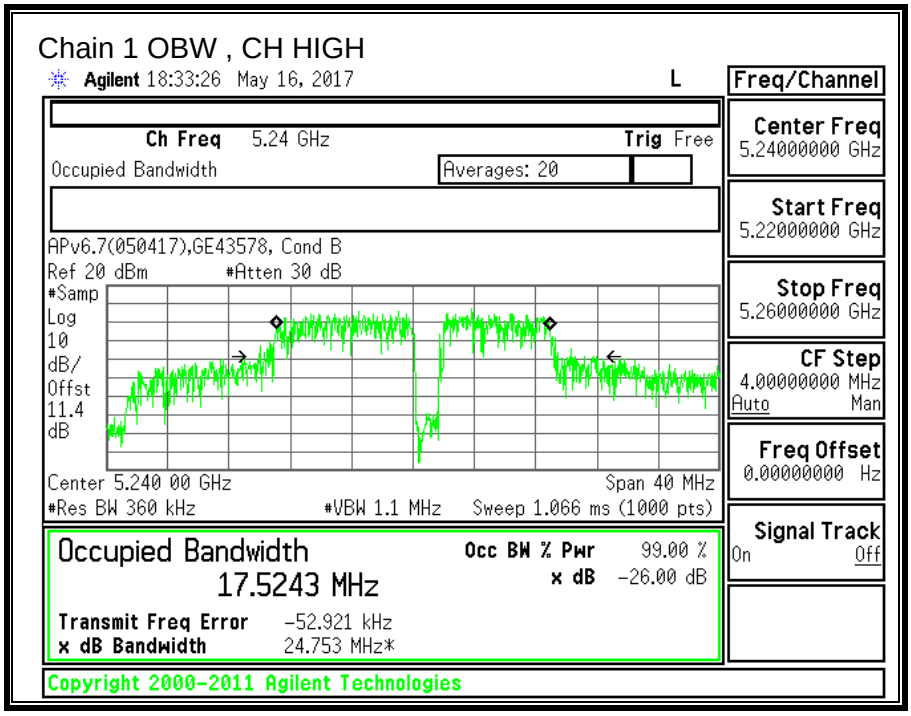












9.2.3. OUTPUT POWER AND PPSD

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.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

DIRECTIONAL ANTENNA GAIN

For Power, 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)
3.41	2.26	2.87

For PSD, The TX chains are correlated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated Chains Directional Gain (dBi)
3.41	2.26	5.86

RESULTS

ID:	GE43578	Date:	5/16/17

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	2.87	5.86	24.00	11.00
Mid	5200	2.87	5.86	24.00	11.00
High	5240	2.87	5.86	24.00	11.00

Duty Cycle CF (dB)	0.37	Included in Calculations of Corr'd PSD

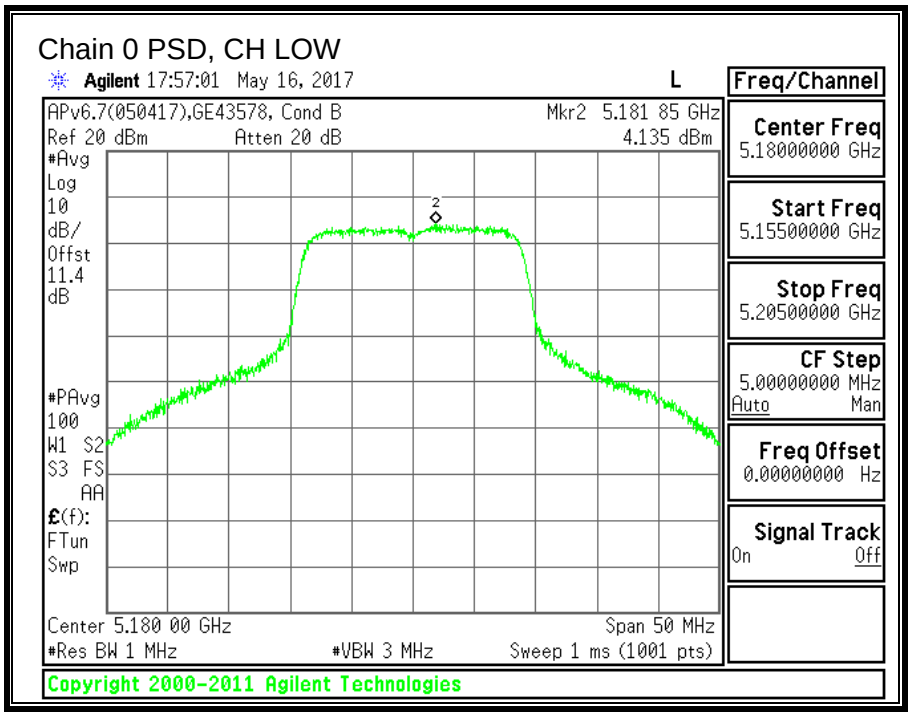
Output Power Results

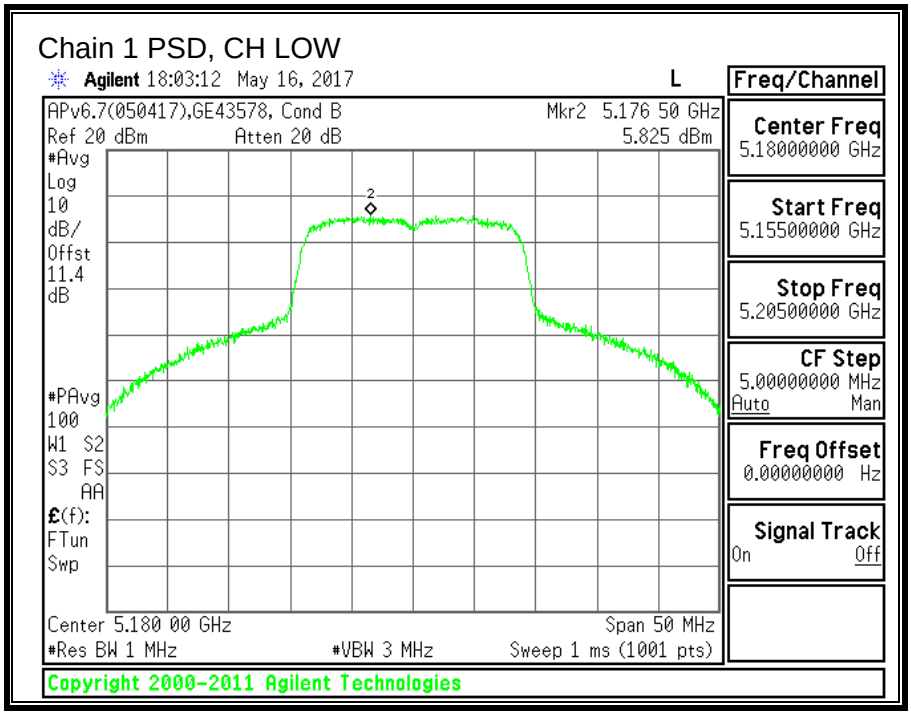
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	15.39	17.04	19.30	24.00	-4.70
Mid	5200	15.46	17.12	19.38	24.00	-4.62
High	5240	15.42	17.08	19.34	24.00	-4.66

PSD Results

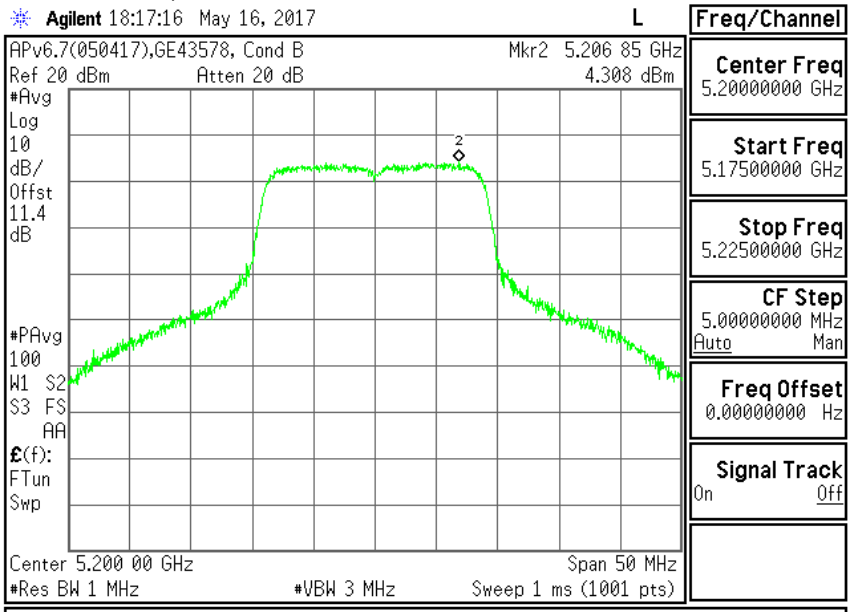
Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5180	4.135	5.825	8.44	11.00	-2.56
Mid	5200	4.308	5.990	8.61	11.00	-2.39
High	5240	4.226	5.545	8.32	11.00	-2.68

Note: the power readings above were measured with gated method, and the measurement was taken only during the ON time. No duty cycle correction was necessary.

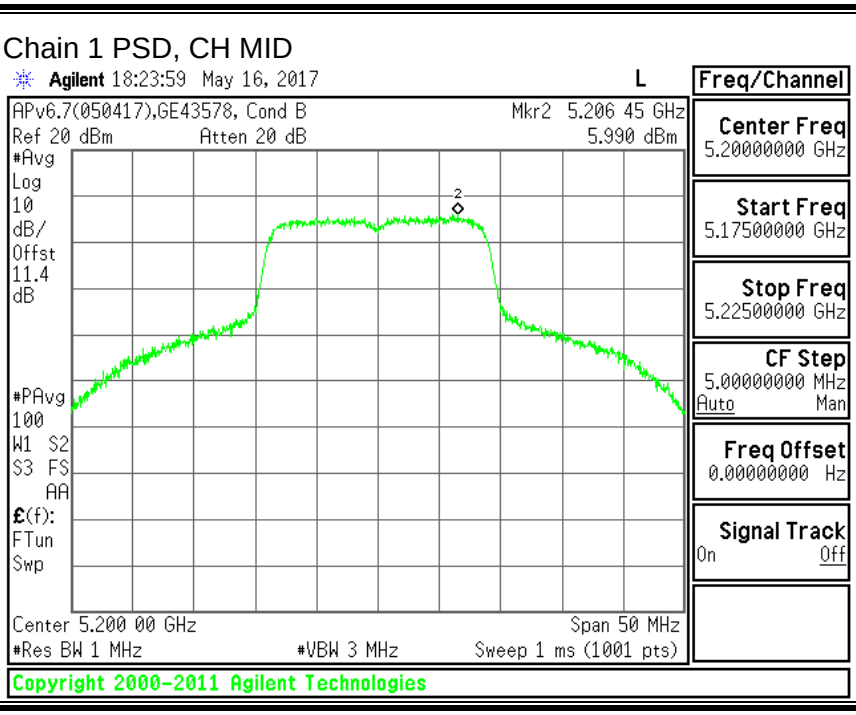




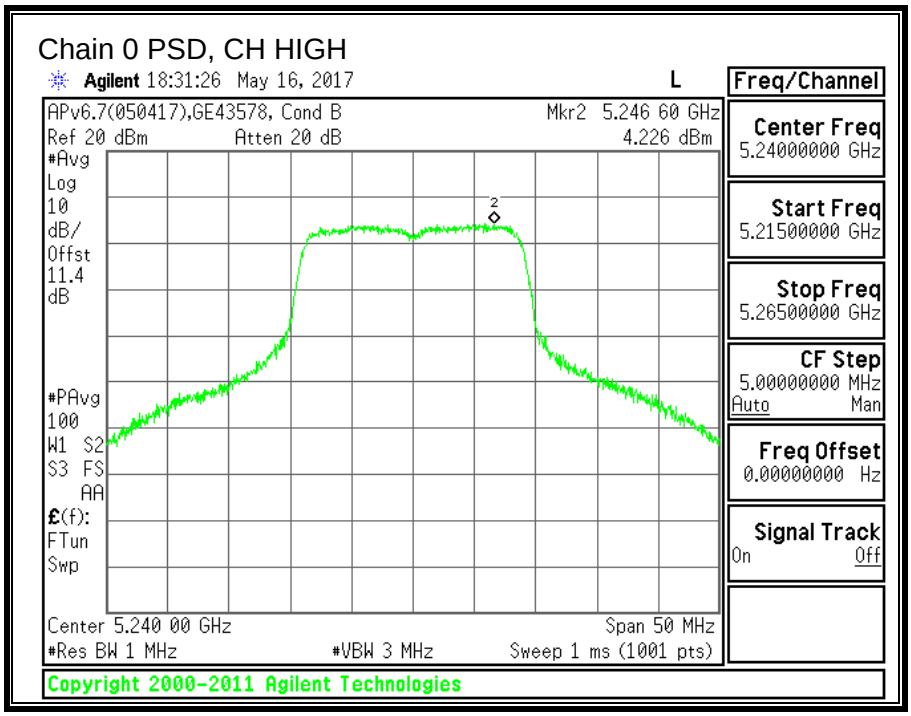
Chain 0 PSD, CH MID



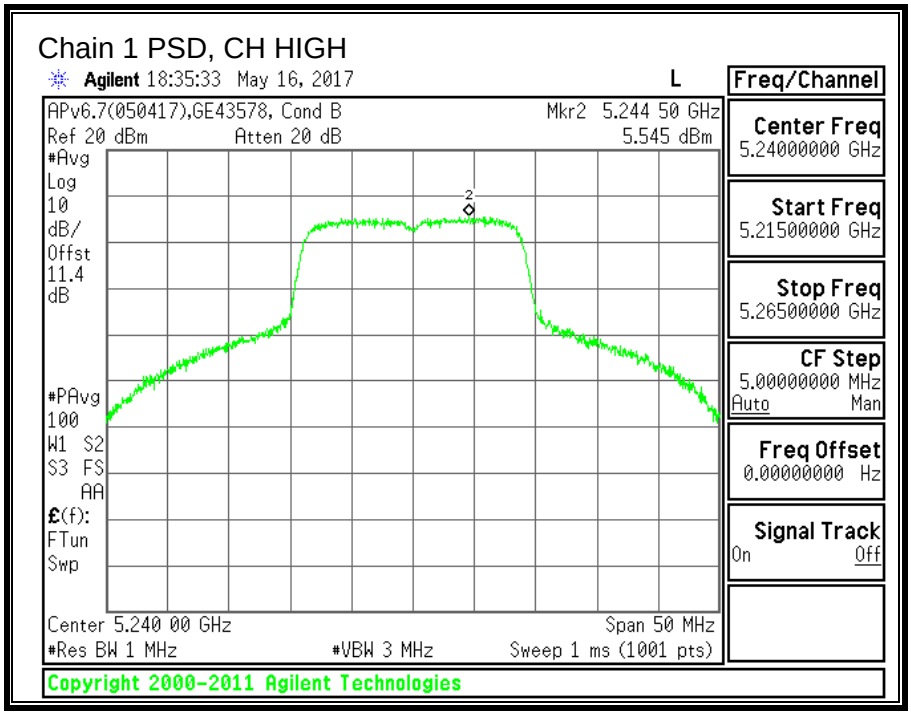
Chain 1 PSD, CH MID



Chain 0 PSD, CH HIGH



Chain 1 PSD, CH HIGH



9.3. 11n HT20 3TX CDD MIMO MODE IN THE 5.2GHz BAND

9.3.1. 26 dB BANDWIDTH

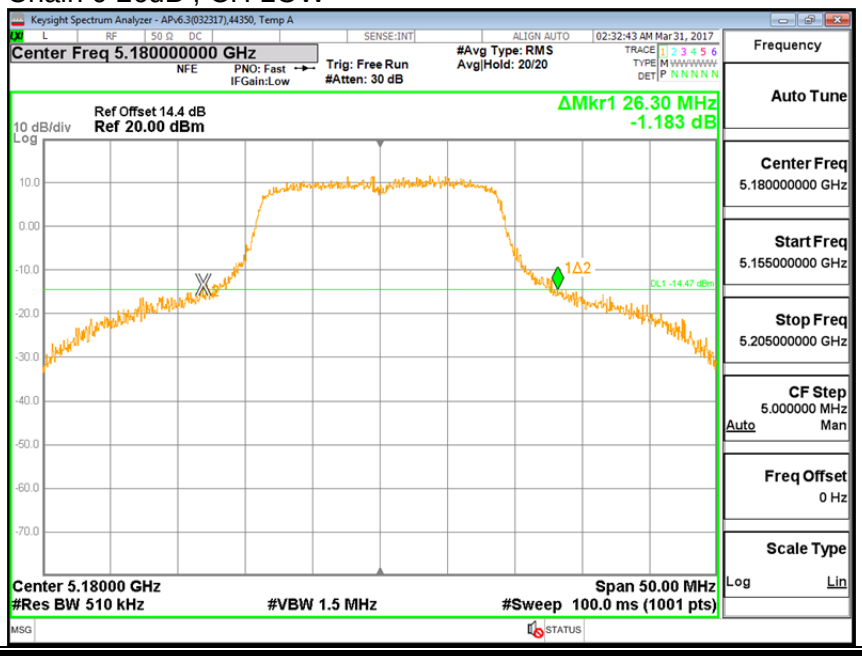
LIMITS

None; for reporting purposes only.

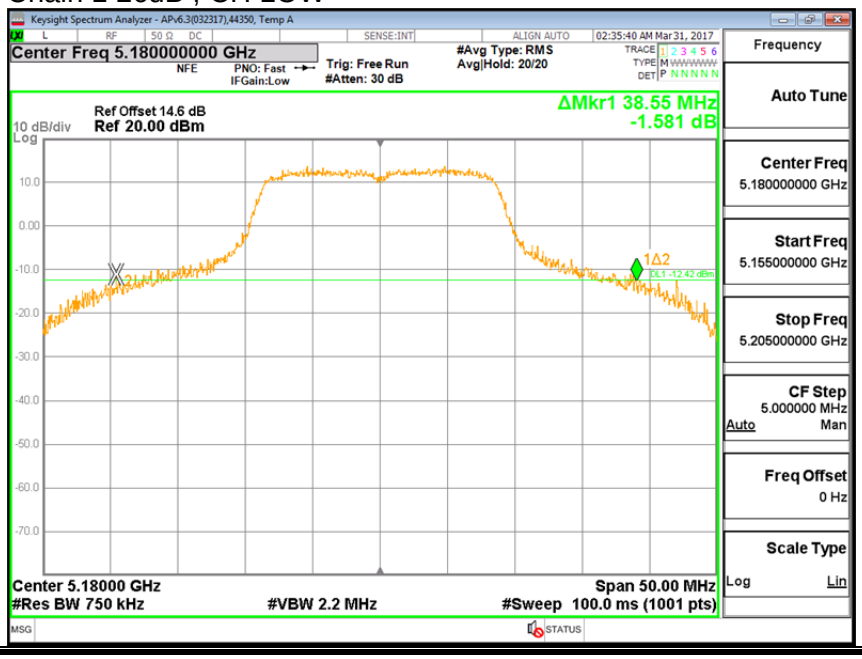
RESULTS

Channel	Frequency	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)	26 dB BW Chain 2 (MHz)
Low	5180	26.30	38.55	38.25
Mid	5200	26.85	36.55	35.05
High	5240	26.60	33.30	32.10

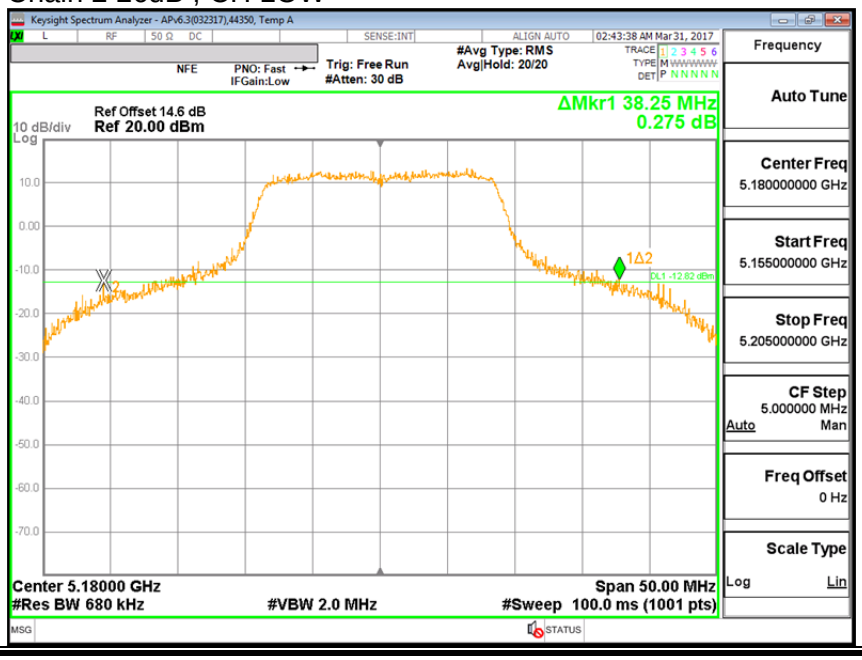
Chain 0 26dB , CH LOW



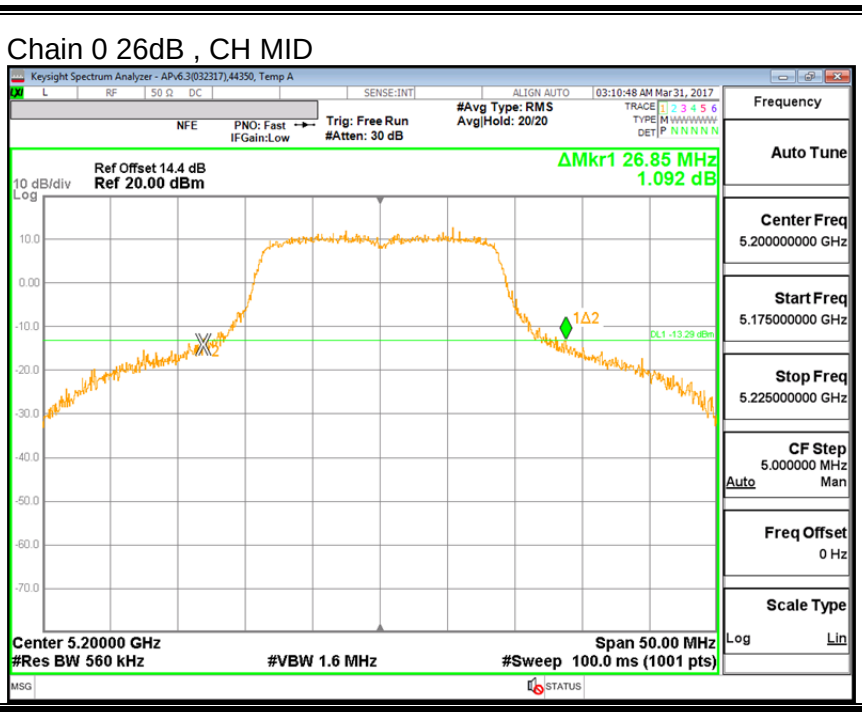
Chain 1 26dB , CH LOW



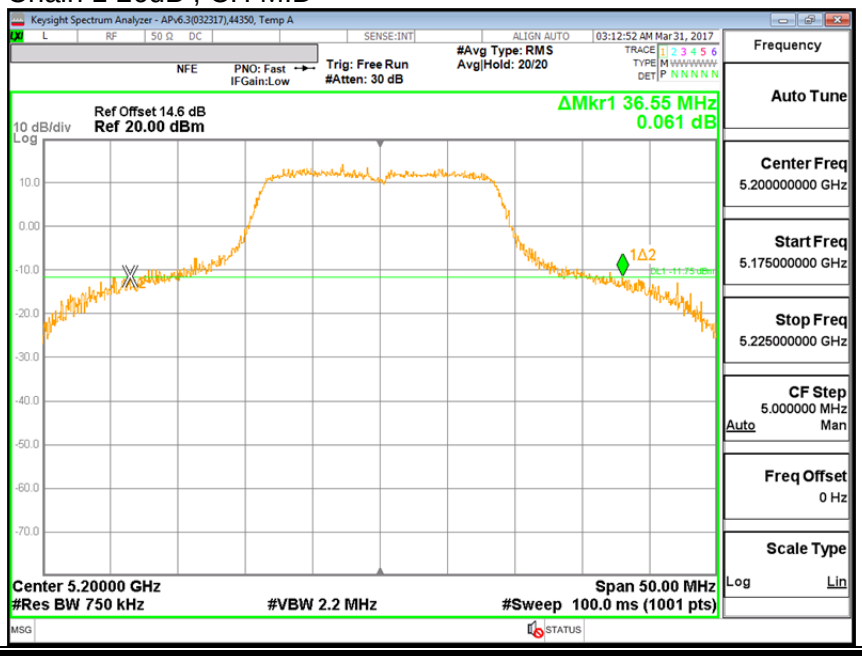
Chain 2 26dB , CH LOW



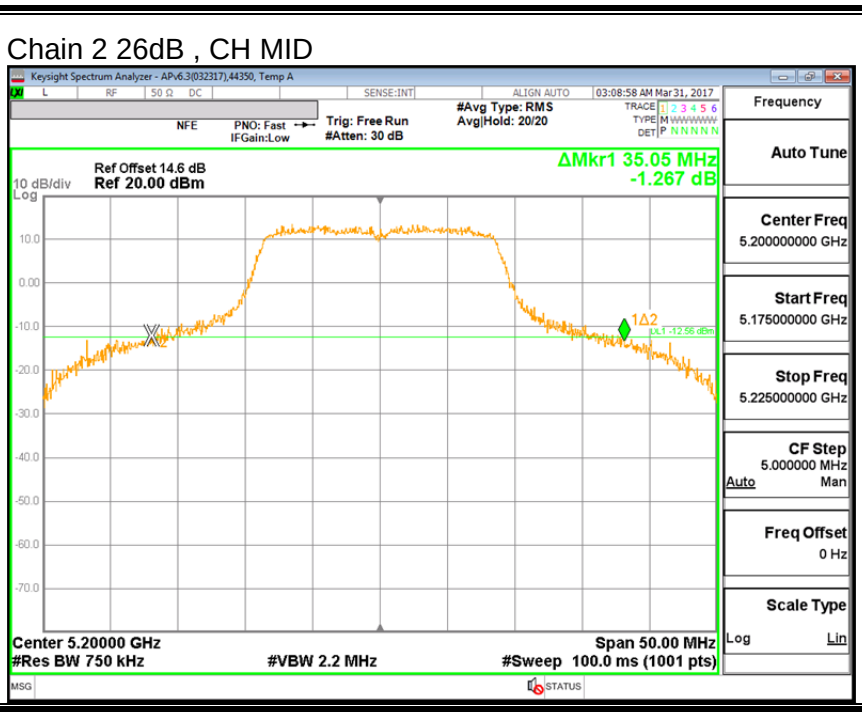
Chain 0 26dB , CH MID



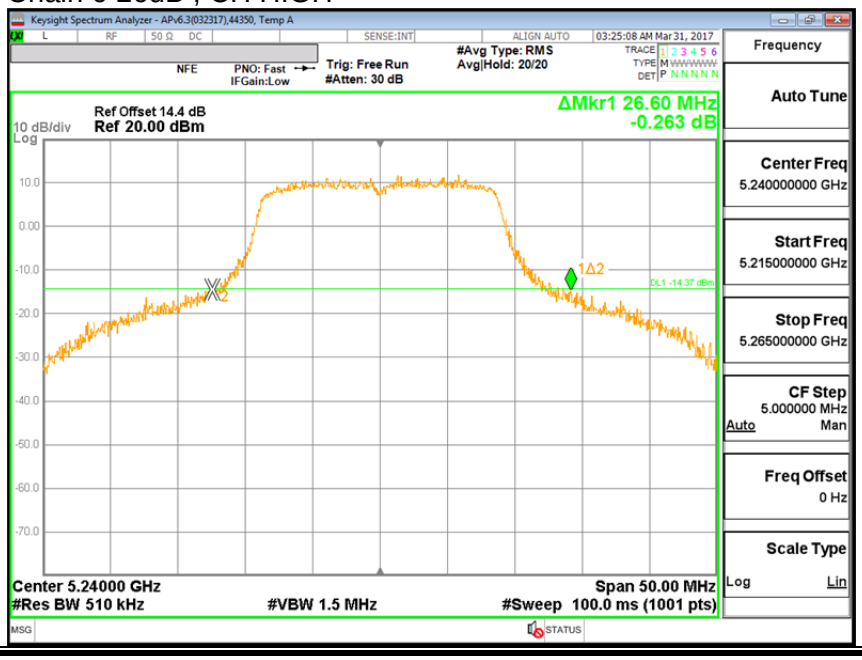
Chain 1 26dB , CH MID



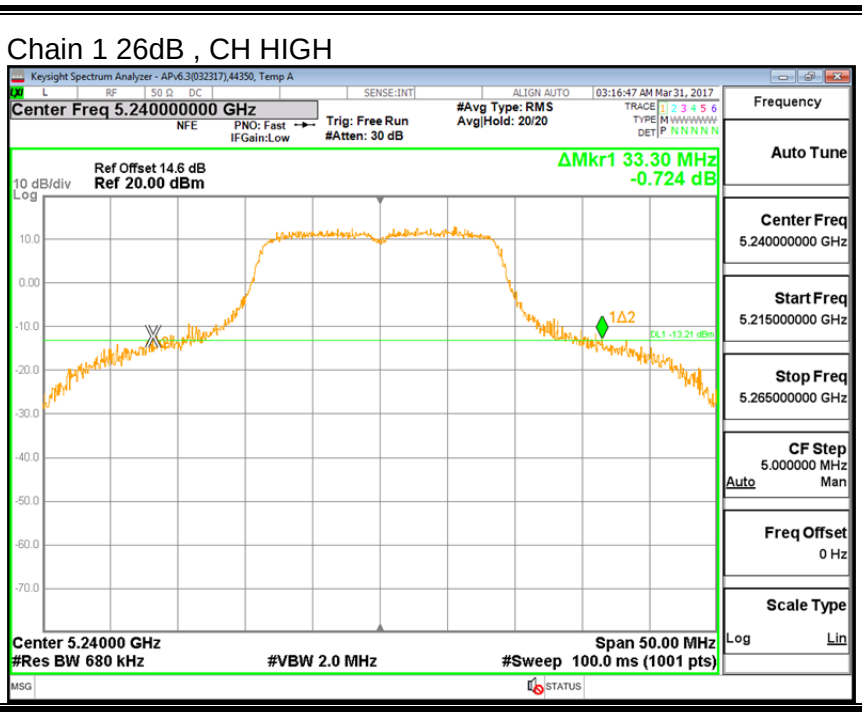
Chain 2 26dB , CH MID



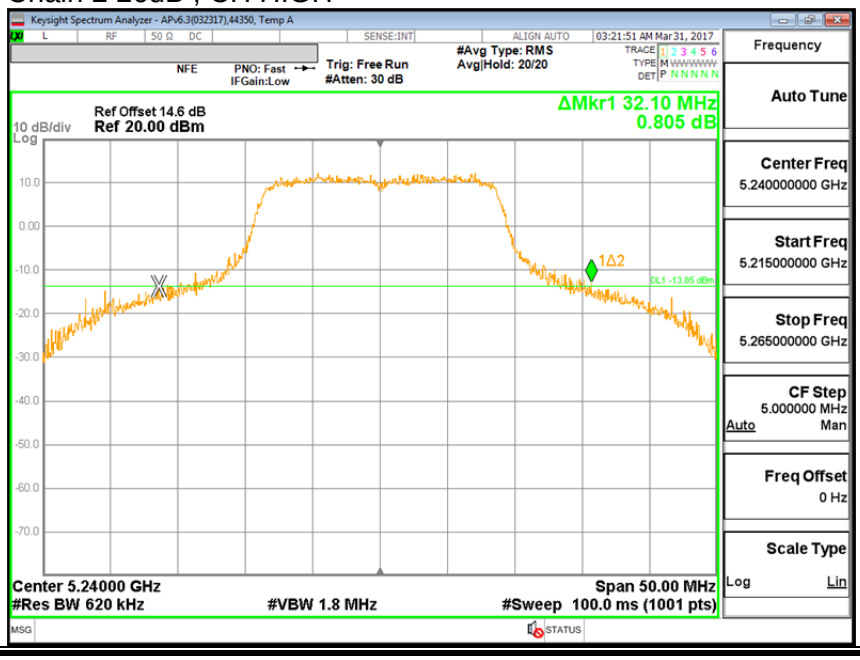
Chain 0 26dB , CH HIGH



Chain 1 26dB , CH HIGH



Chain 2 26dB , CH HIGH



9.3.2. 99% BANDWIDTH

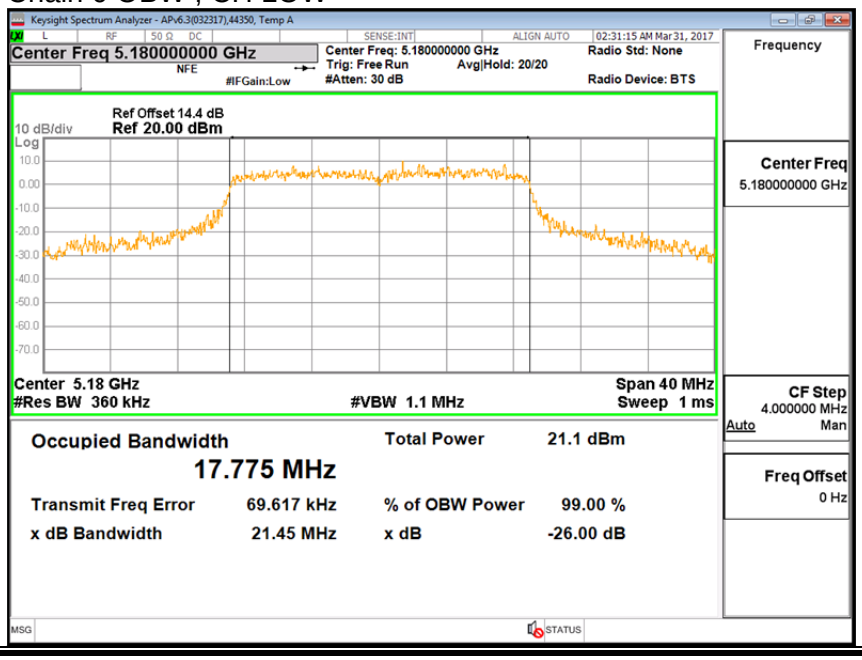
LIMITS

None; for reporting purposes only.

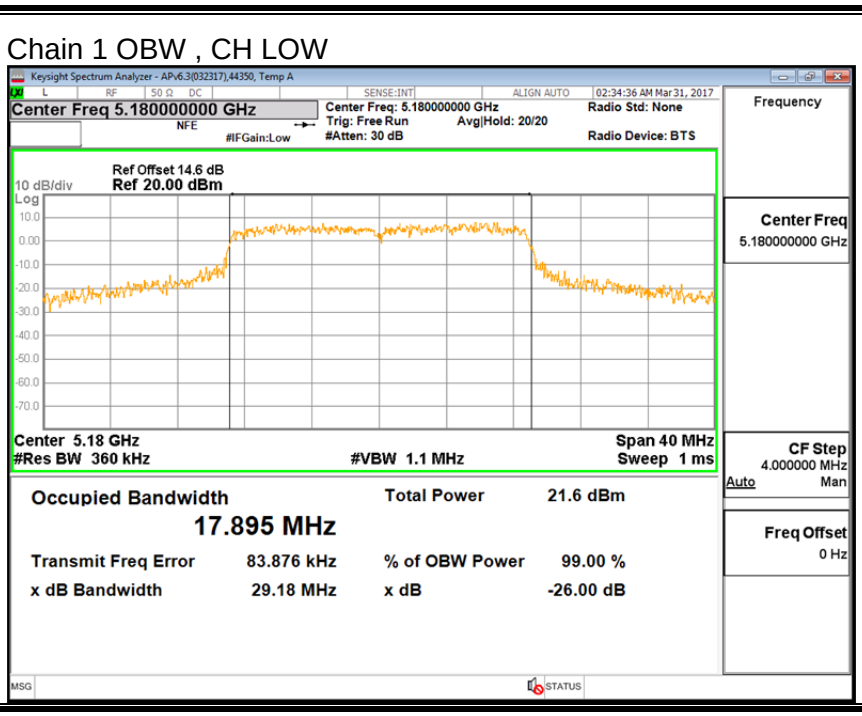
RESULTS

Channel	Frequency	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)	99% BW Chain 2 (MHz)
Low	5180	17.775	17.895	17.972
Mid	5200	17.845	17.918	17.950
High	5240	17.770	17.902	17.815

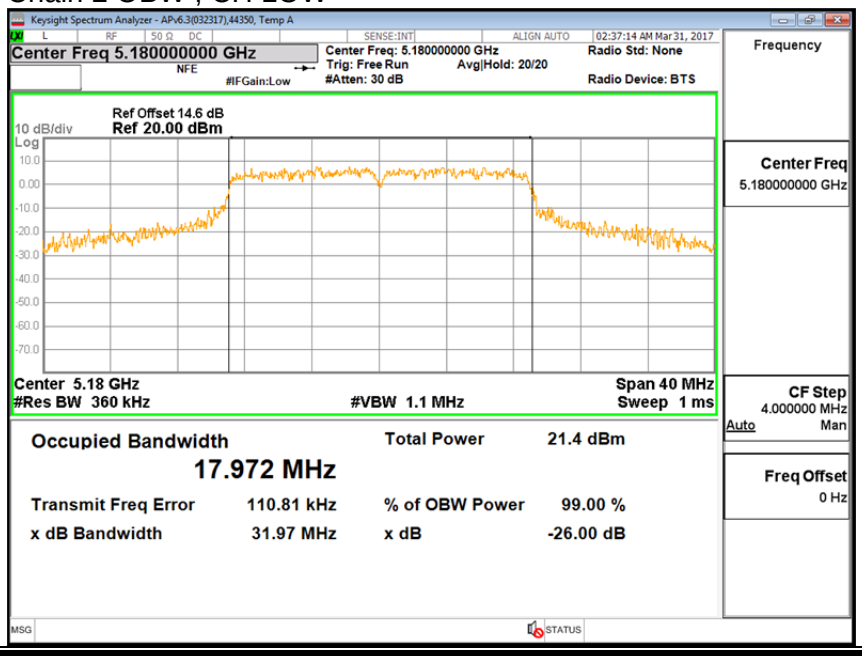
Chain 0 OBW , CH LOW



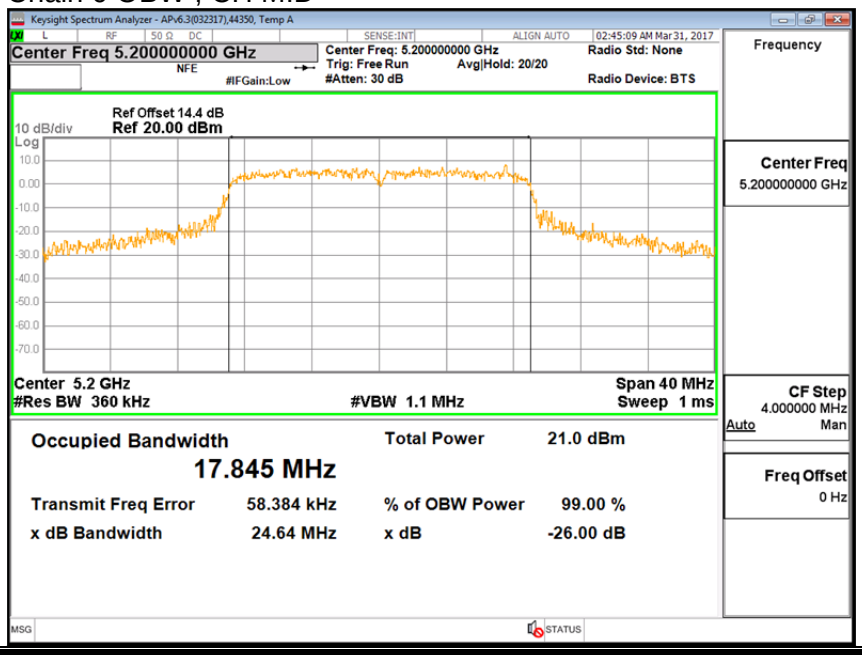
Chain 1 OBW , CH LOW



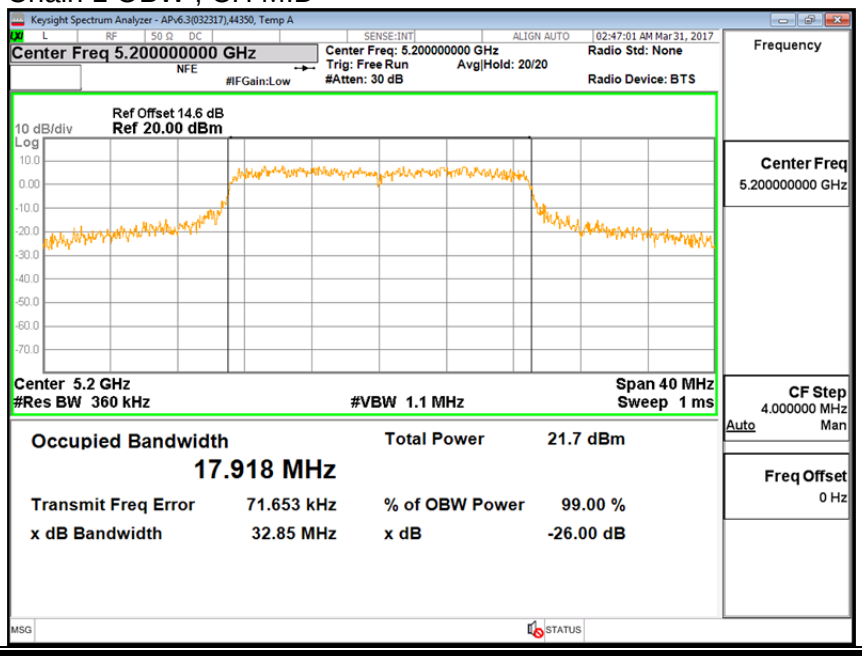
Chain 2 OBW , CH LOW



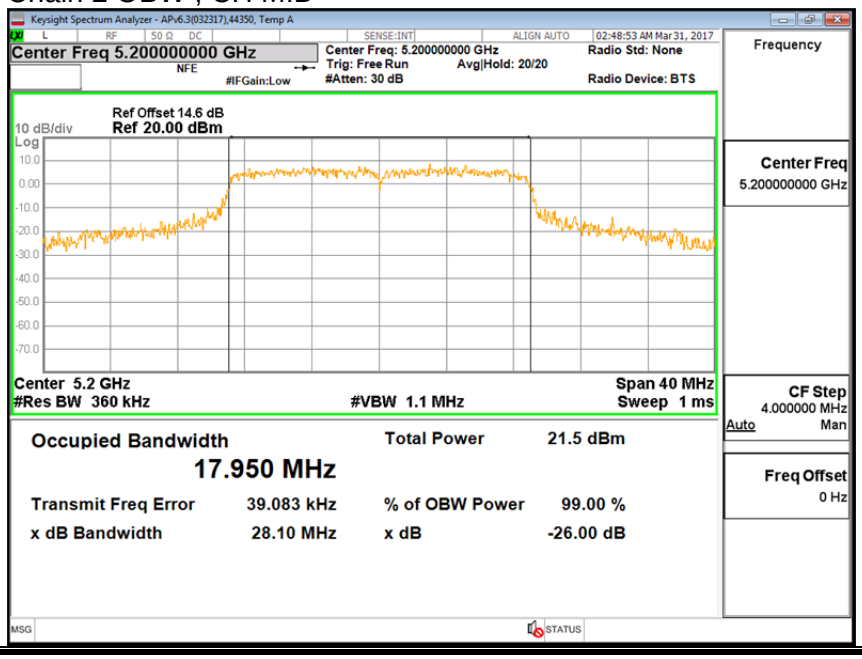
Chain 0 OBW , CH MID



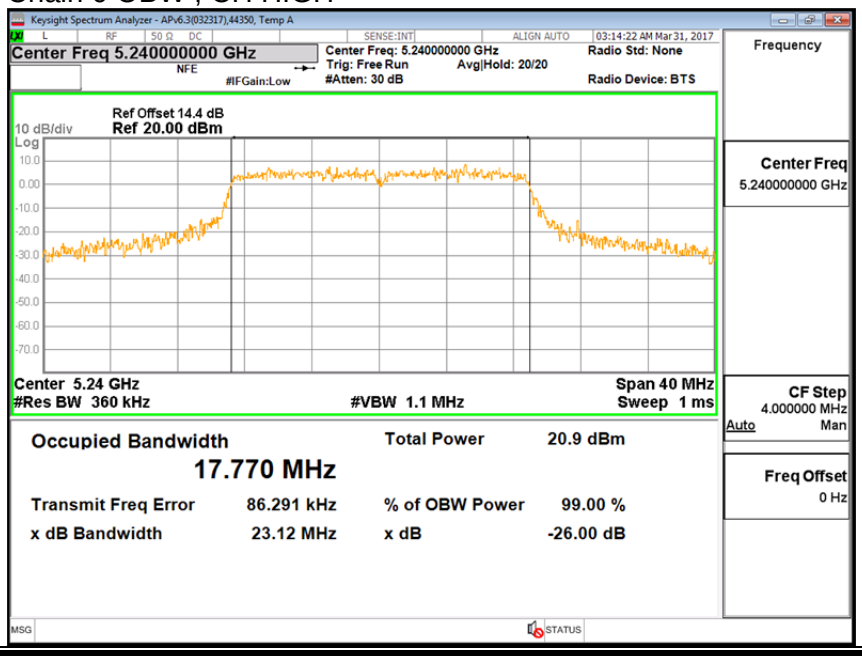
Chain 1 OBW , CH MID



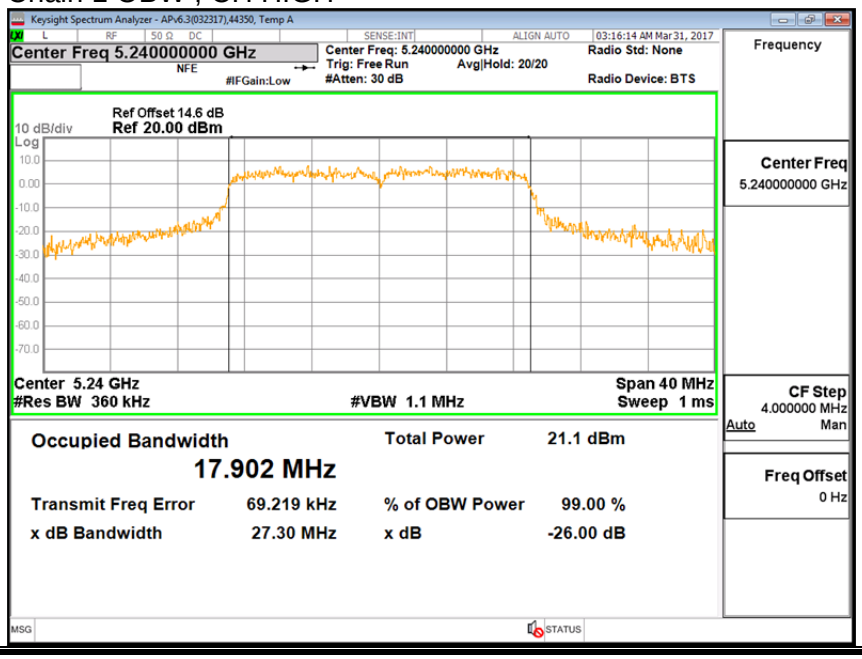
Chain 2 OBW , CH MID



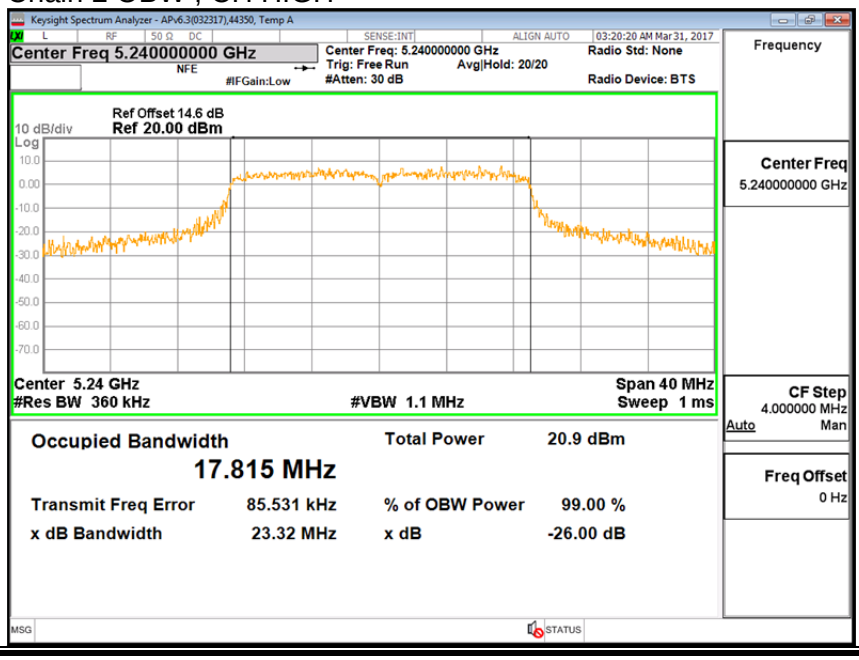
Chain 0 OBW , CH HIGH



Chain 1 OBW , CH HIGH



Chain 2 OBW , CH HIGH



9.3.3. OUTPUT POWER AND PPSD

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.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

DIRECTIONAL ANTENNA GAIN

For Power, 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)	Chain 2 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.41	2.26	4.22	3.37

For PSD, The TX chains are correlated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Correlated Chains Directional Gain (dBi)
3.41	2.26	4.22	8.10

RESULTS

ID:	GE43578	Date:	5/16/17

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	3.37	8.10	24.00	8.90
Mid	5200	3.37	8.10	24.00	8.90
High	5240	3.37	8.10	24.00	8.90

Duty Cycle CF (dB)	0.37	Included in Calculations of Corr'd Power & PSD

Output Power Results

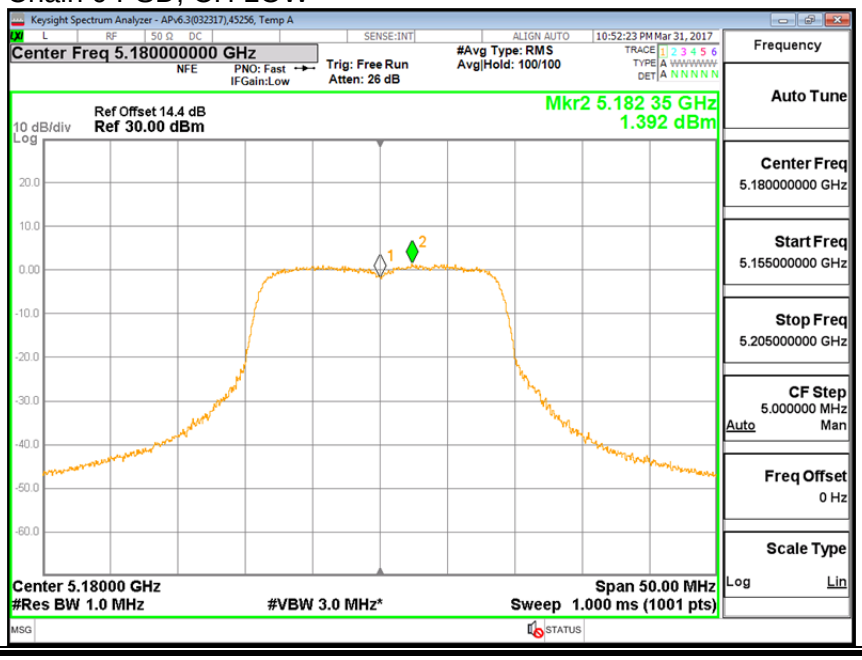
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Chain 2 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	16.41	16.52	16.30	21.55	24.00	-2.45
Mid	5200	16.31	16.49	16.22	21.48	24.00	-2.52
High	5240	15.90	15.96	15.61	20.97	24.00	-3.03

PSD Results

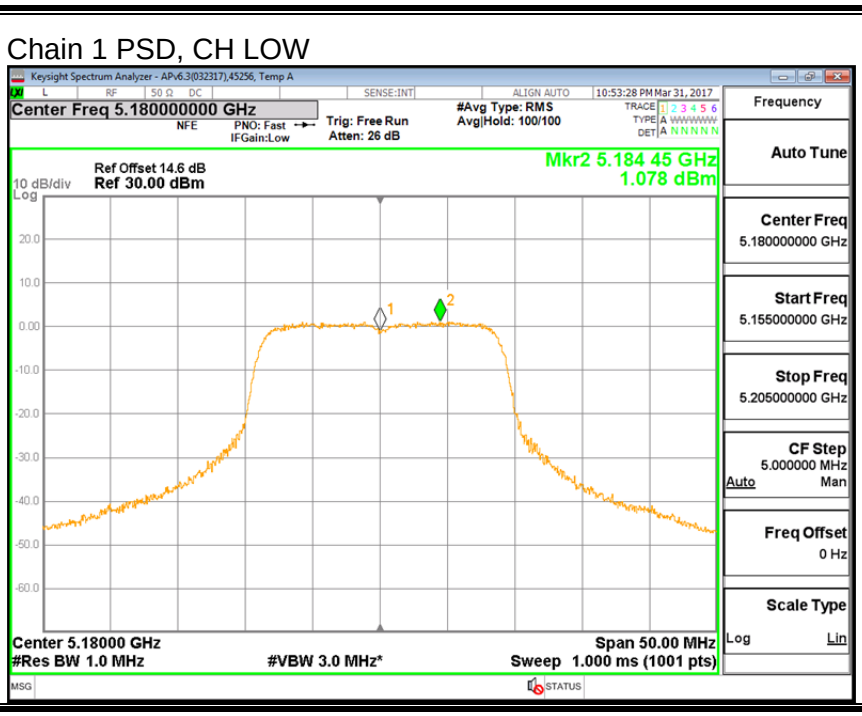
Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Chain 2 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5180	1.392	1.078	0.955	6.29	8.90	-2.61
Mid	5200	0.603	1.277	0.897	6.08	8.90	-2.82
High	5240	1.165	1.168	0.833	6.20	8.90	-2.70

Note: the power readings above were measured with gated method, and the measurement was taken only during the ON time. No duty cycle correction was necessary.

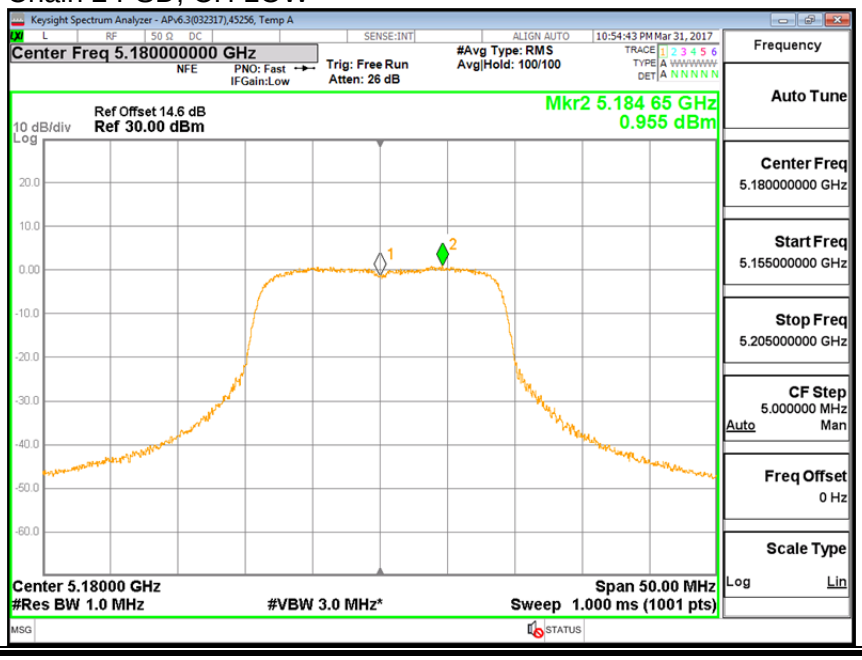
Chain 0 PSD, CH LOW



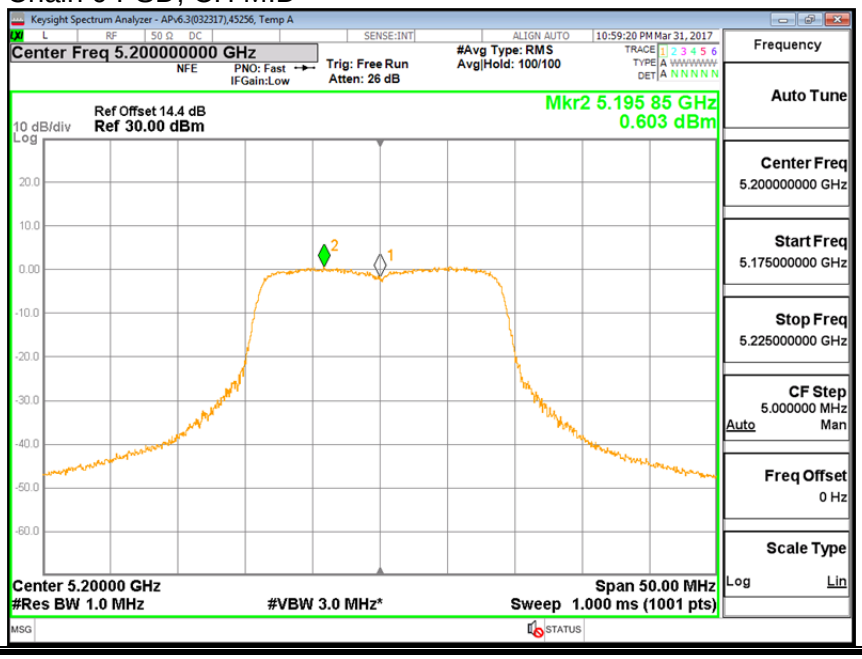
Chain 1 PSD, CH LOW



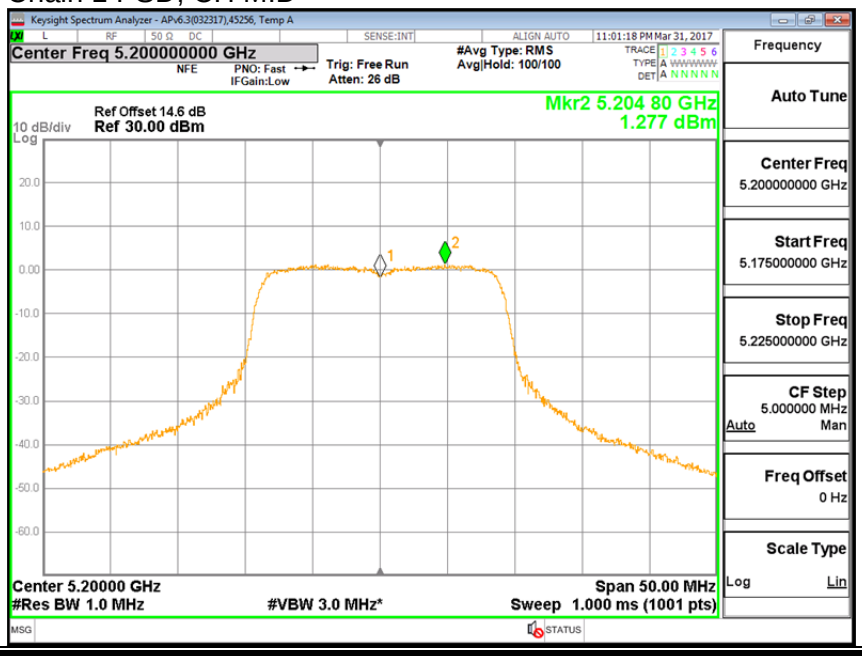
Chain 2 PSD, CH LOW



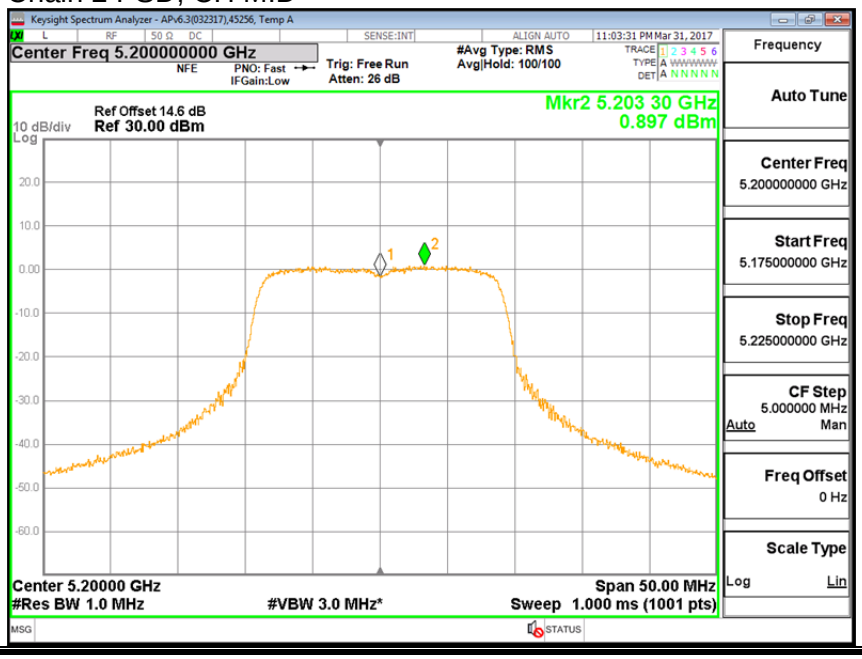
Chain 0 PSD, CH MID



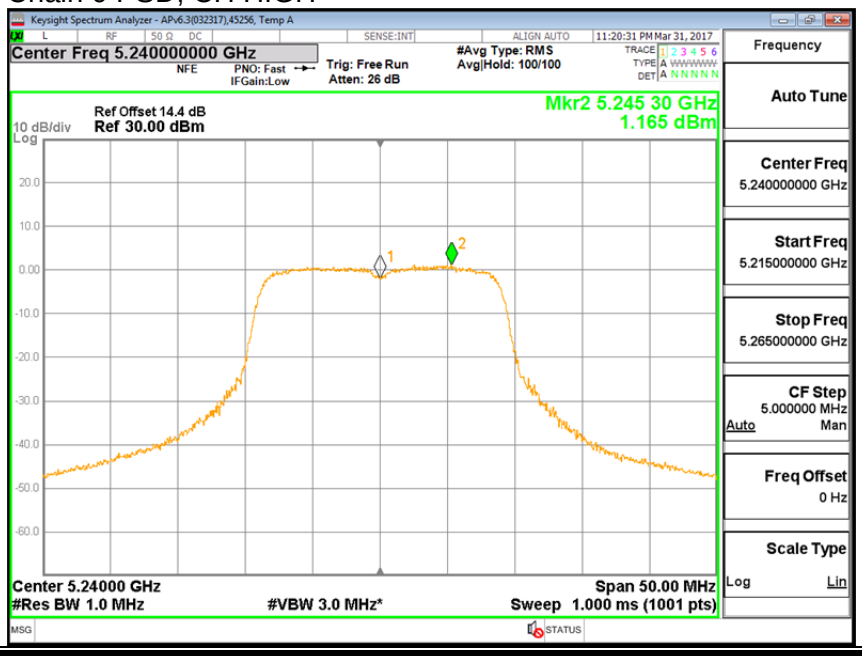
Chain 1 PSD, CH MID



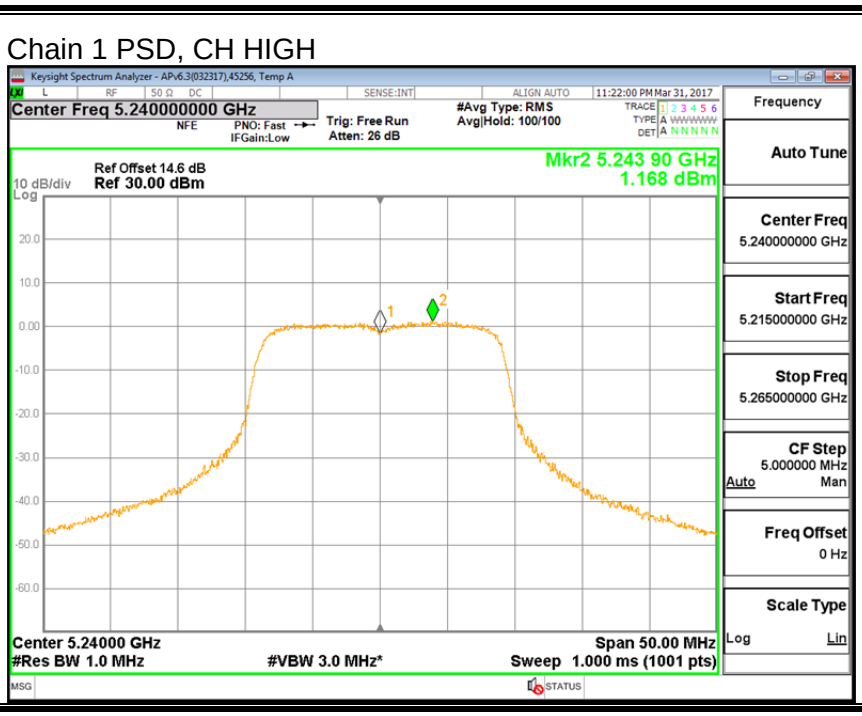
Chain 2 PSD, CH MID



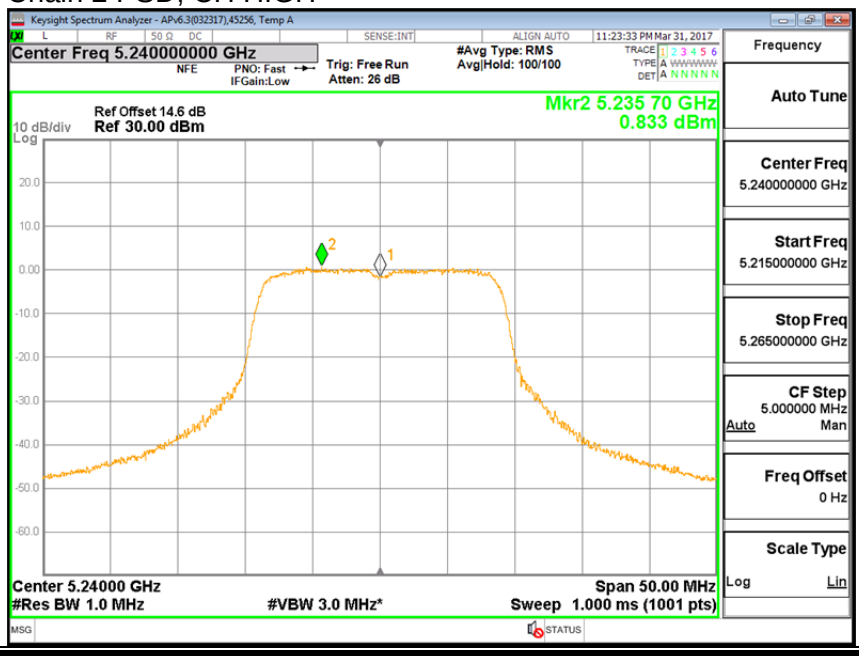
Chain 0 PSD, CH HIGH



Chain 1 PSD, CH HIGH



Chain 2 PSD, CH HIGH



9.4. 11n HT20 2TX CDD MIMO MODE IN THE 5.3GHz BAND

9.4.1. 26 dB BANDWIDTH

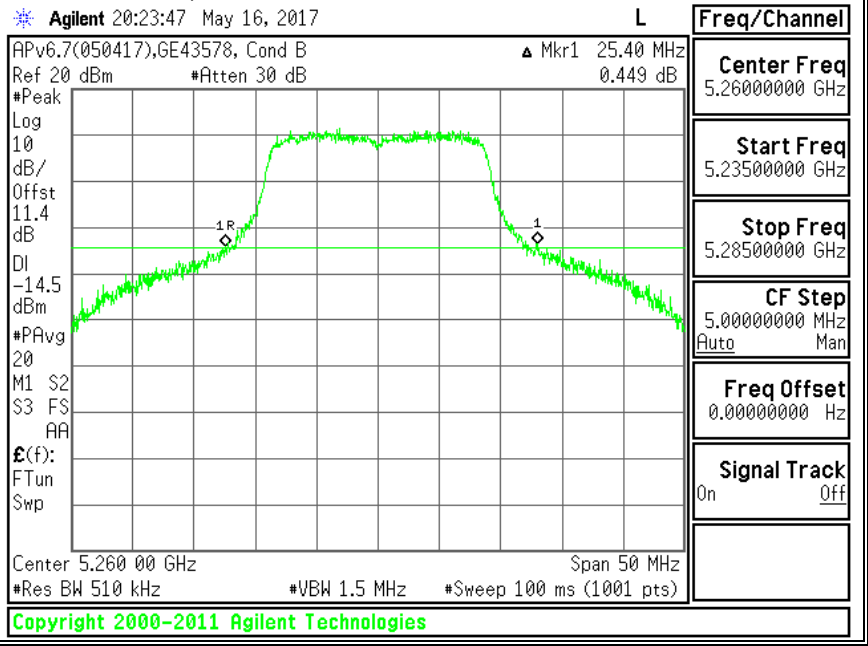
LIMITS

None; for reporting purposes only.

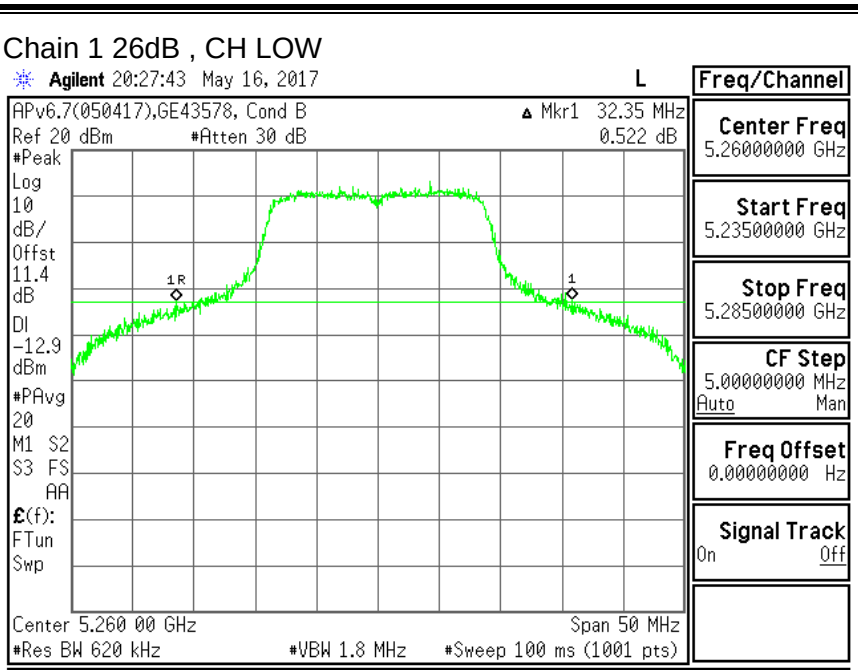
RESULTS

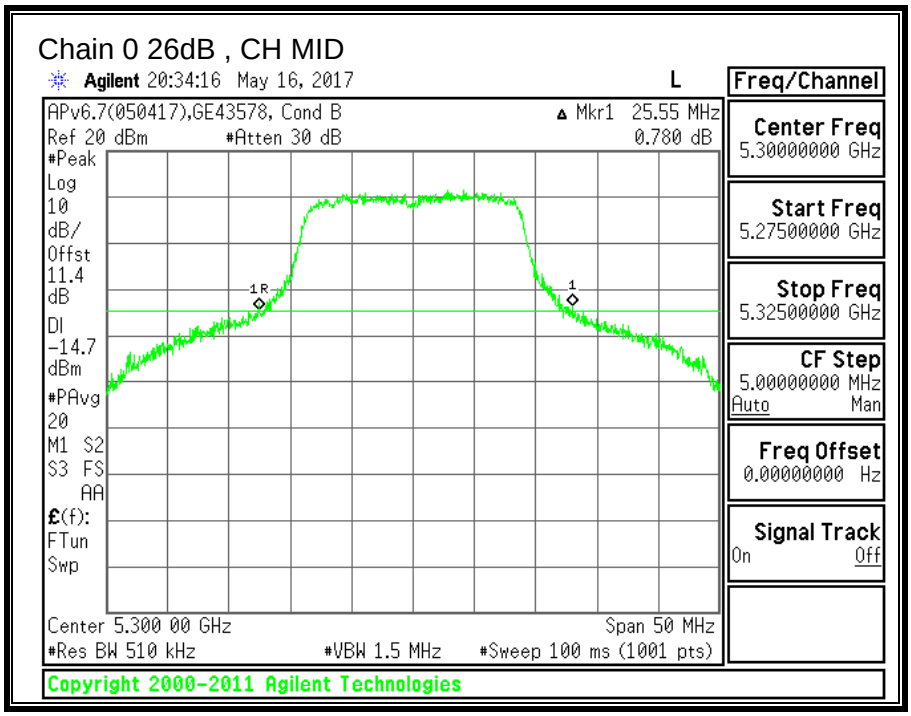
Channel	Frequency	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)
Low	5260	25.40	32.35
Mid	5300	25.55	35.00
High	5320	25.35	38.35

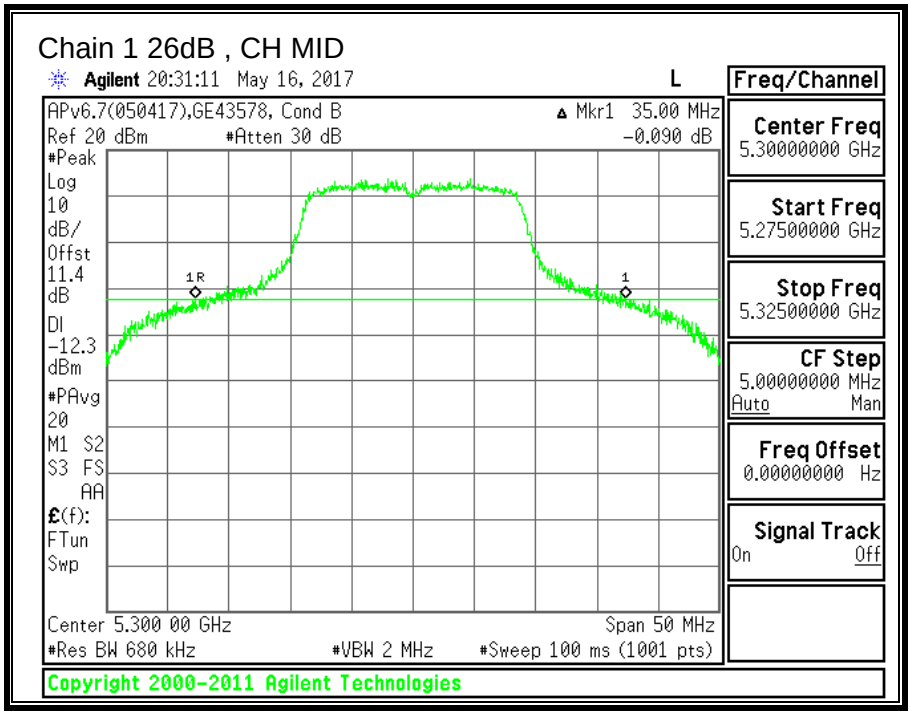
Chain 0 26dB , CH LOW



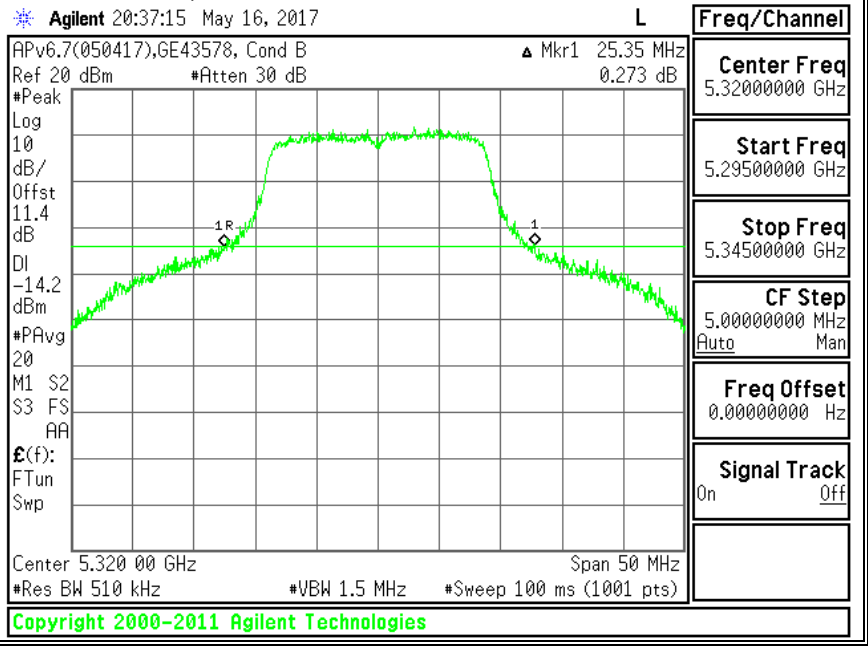
Chain 1 26dB , CH LOW



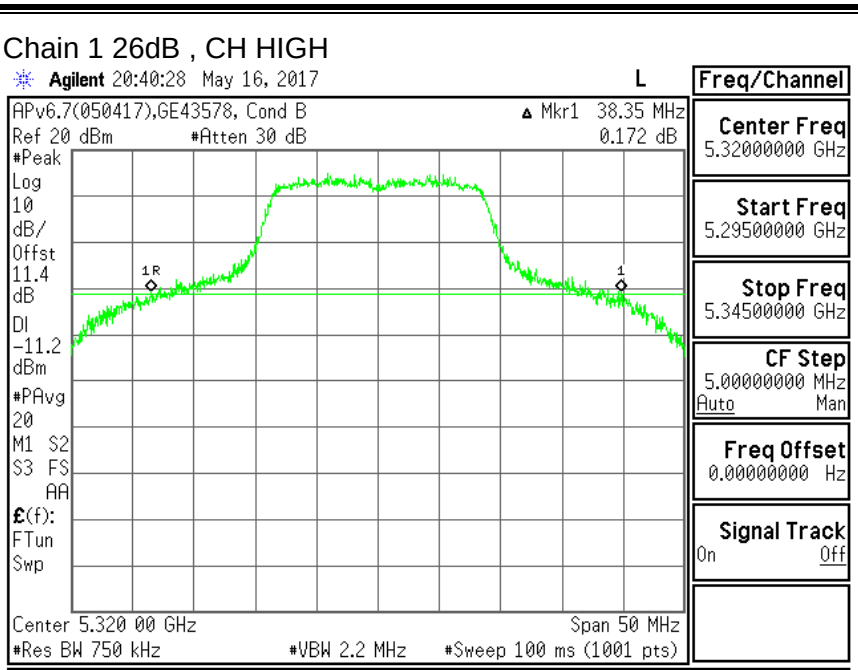




Chain 0 26dB , CH HIGH



Chain 1 26dB , CH HIGH



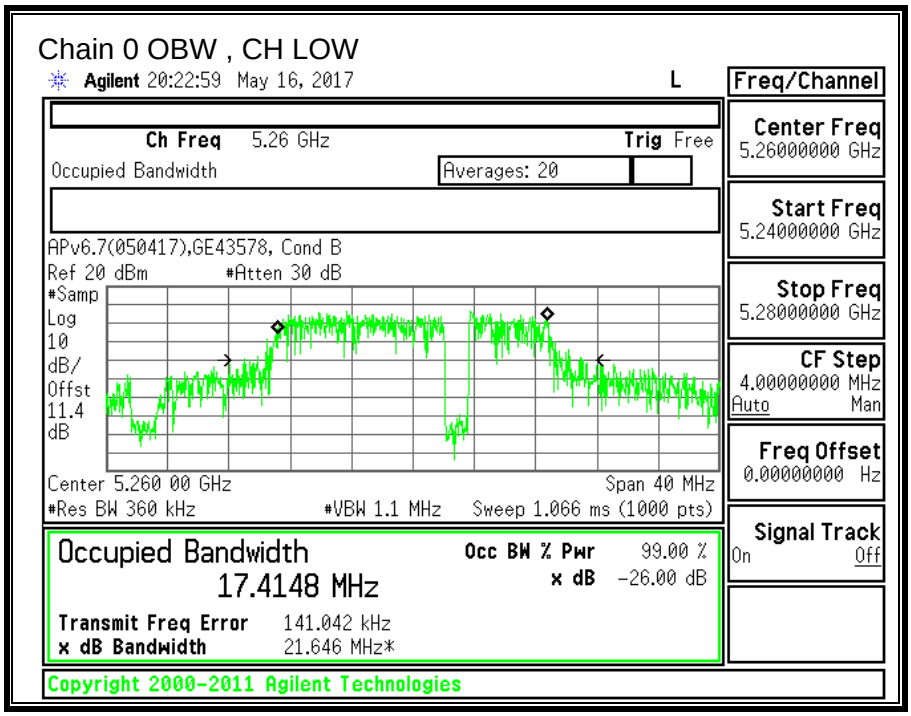
9.4.2. 99% BANDWIDTH

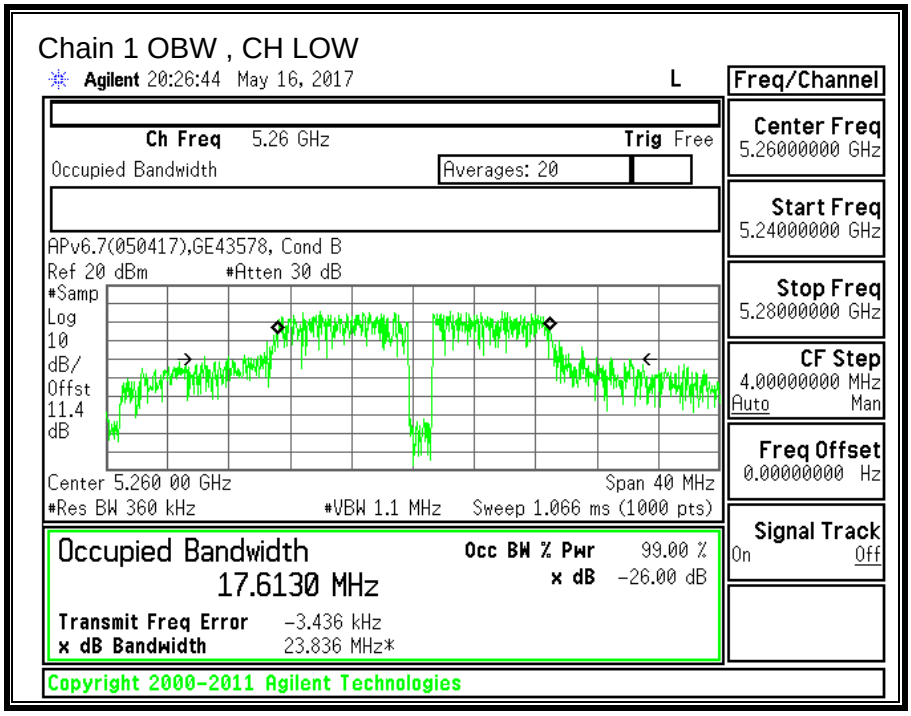
LIMITS

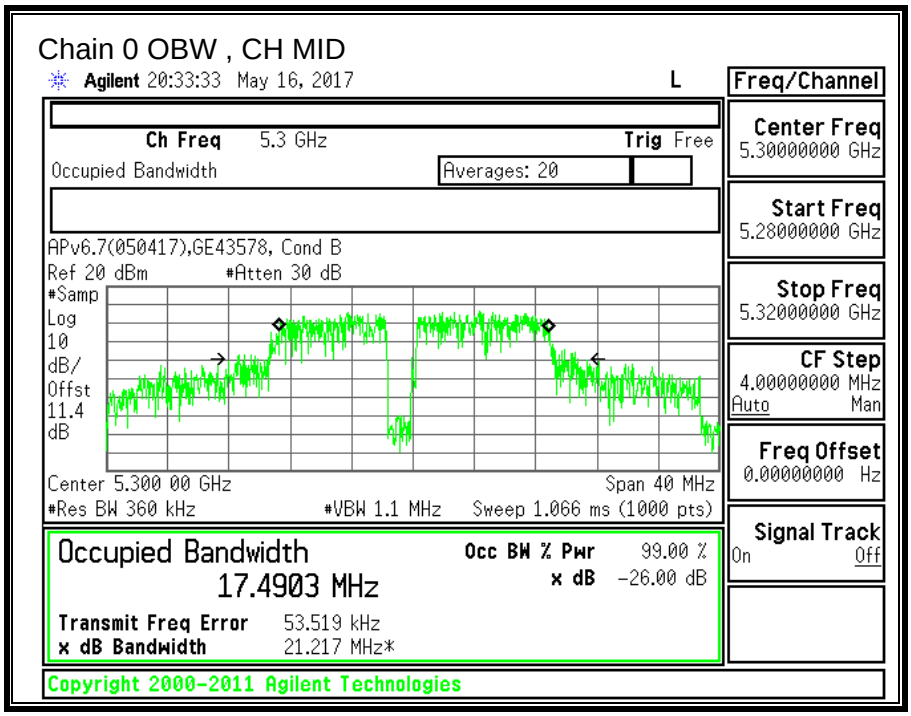
None; for reporting purposes only.

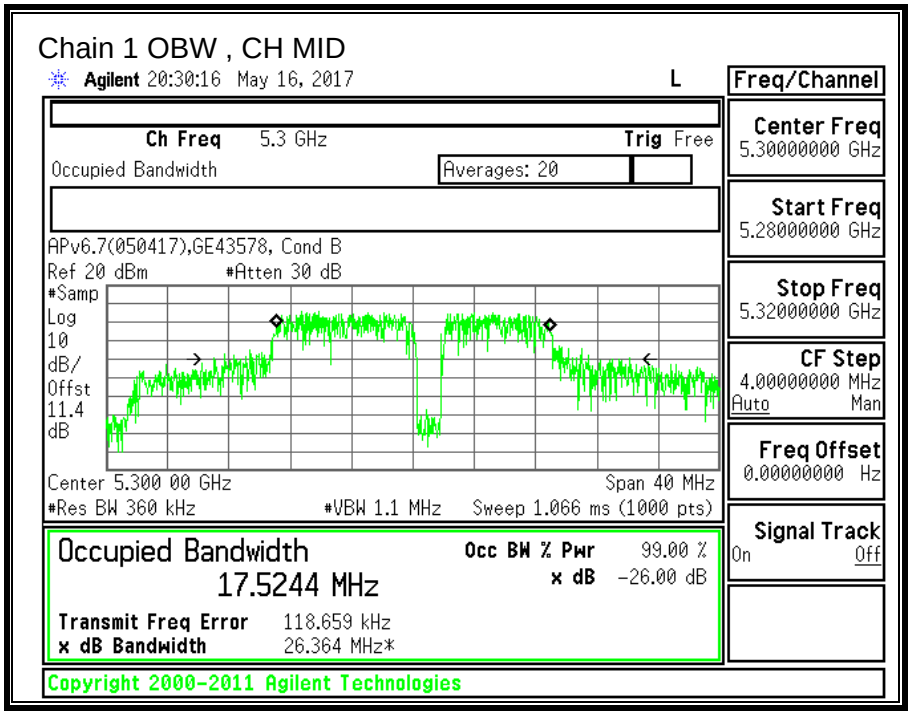
RESULTS

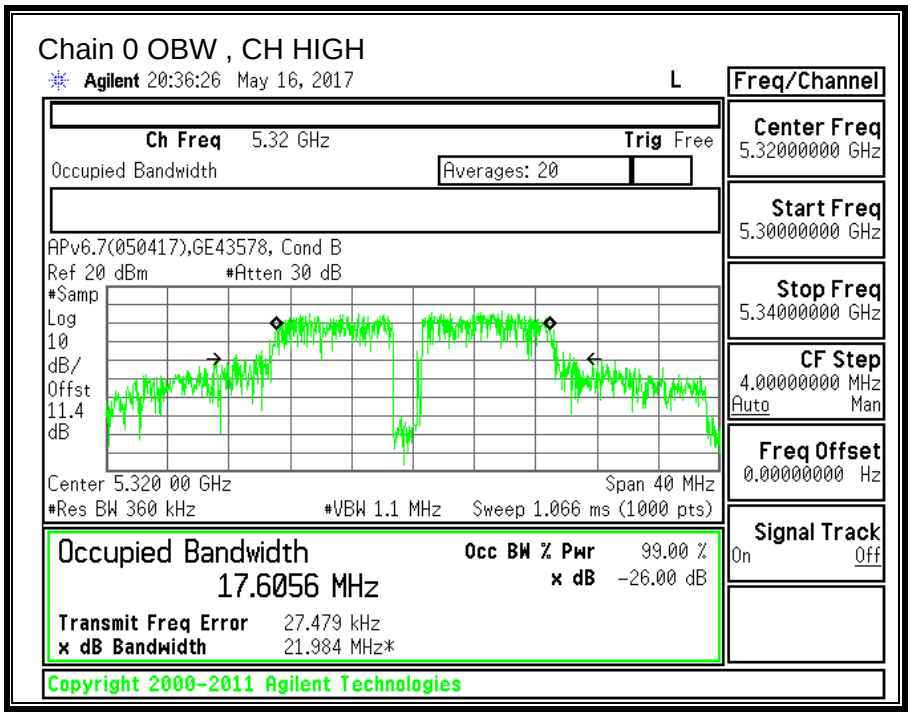
Channel	Frequency	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5260	17.4148	17.6130
Mid	5300	17.4903	17.5244
High	5320	17.6056	17.4169

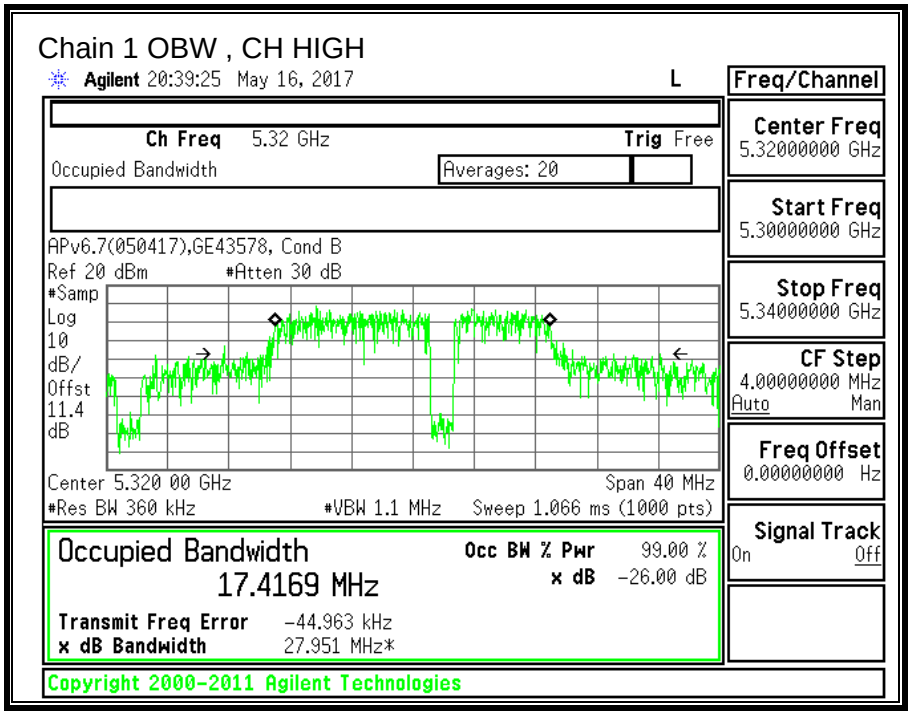












9.4.3. OUTPUT POWER AND PPSD

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.

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

DIRECTIONAL ANTENNA GAIN

For Power, 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)
3.41	2.26	2.87

For PSD, The TX chains are correlated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Correlated Chains Directional Gain (dBi)
3.41	2.26	5.86

RESULTS

ID:	GE43578	Date:	5/16/17

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	32.35	2.87	5.86	24.00	11.00
Mid	5300	35.00	2.87	5.86	24.00	11.00
High	5320	38.35	2.87	5.86	24.00	11.00

Duty Cycle CF (dB)	0.37	Included in Calculations of Corr'd PSD

Output Power Results

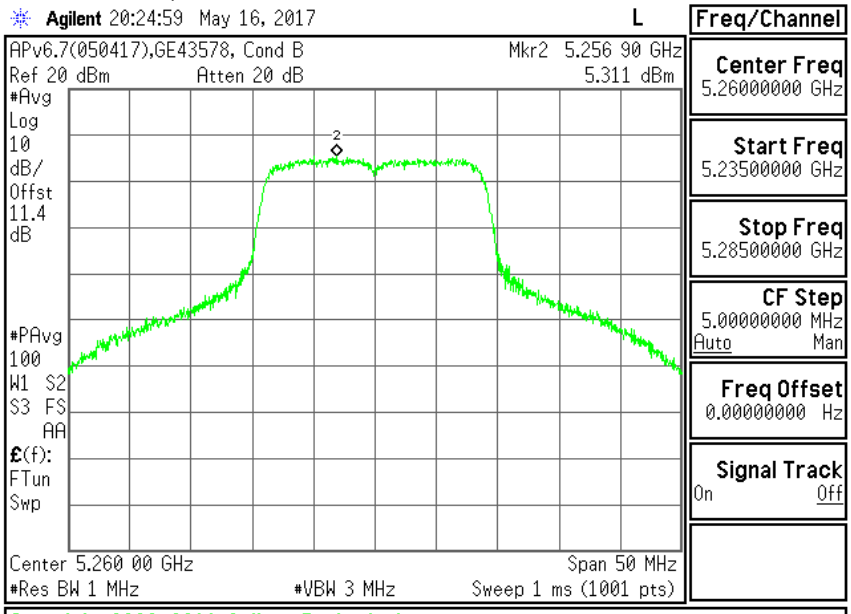
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5260	16.45	17.91	20.25	24.00	-3.75
Mid	5300	16.61	18.12	20.44	24.00	-3.56
High	5320	16.74	18.09	20.48	24.00	-3.52

PSD Results

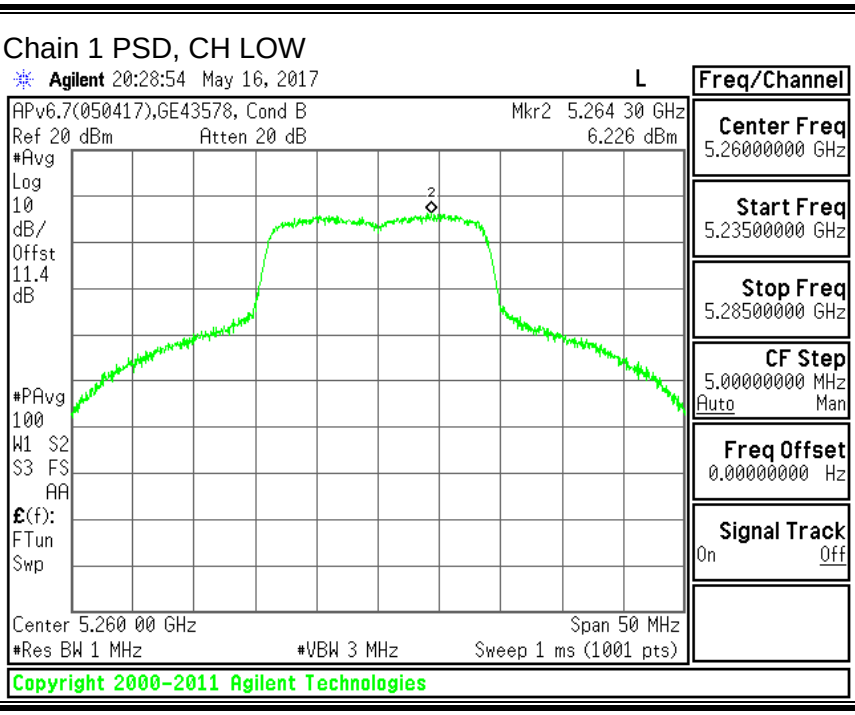
Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low	5260	5.311	6.226	9.17	11.00	-1.83
Mid	5300	5.325	6.357	9.25	11.00	-1.75
High	5320	5.384	6.518	9.37	11.00	-1.63

Note: the power readings above were measured with gated method, and the measurement was taken only during the ON time. No duty cycle correction was necessary.

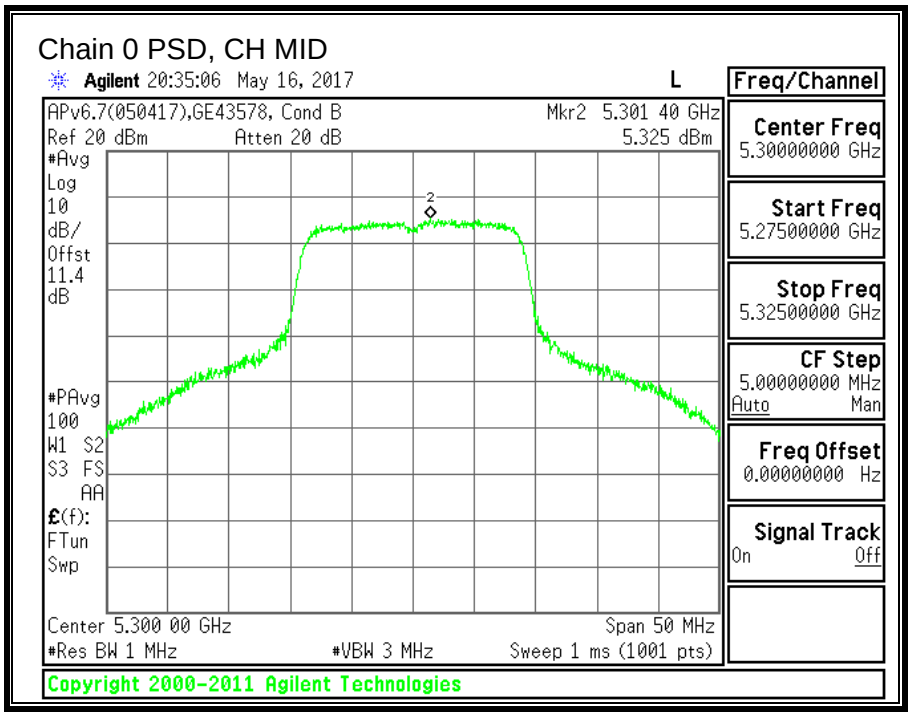
Chain 0 PSD, CH LOW



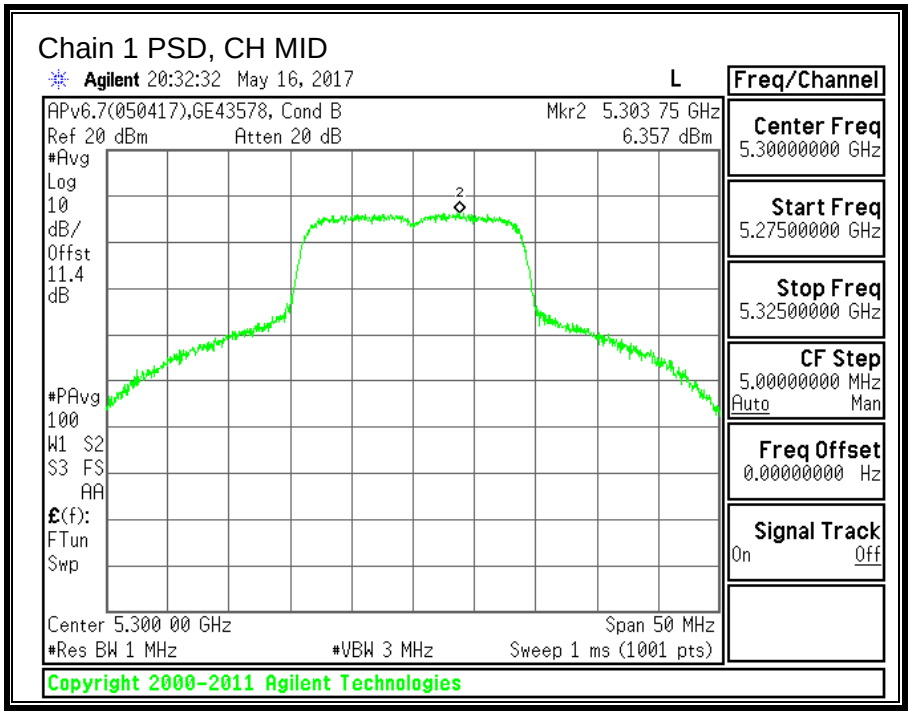
Chain 1 PSD, CH LOW



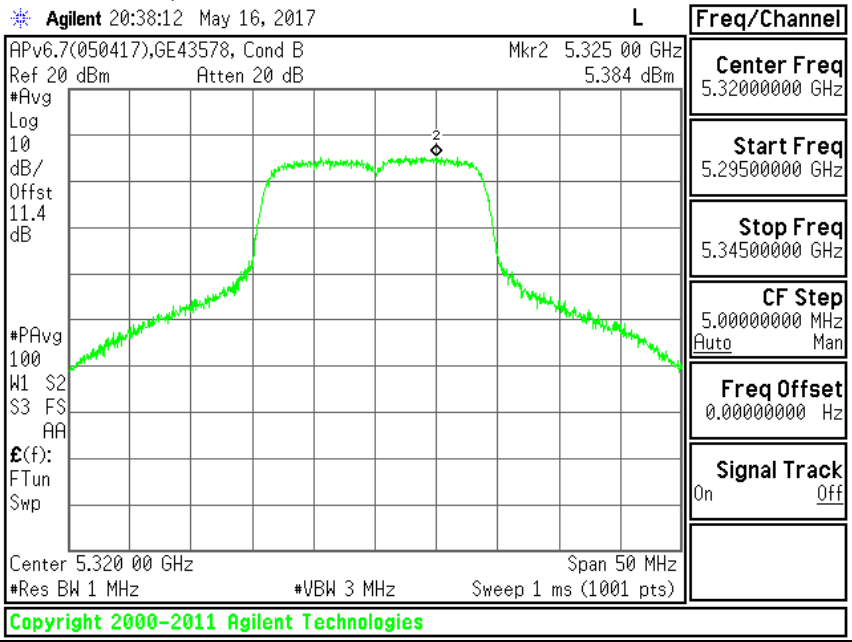
Chain 0 PSD, CH MID



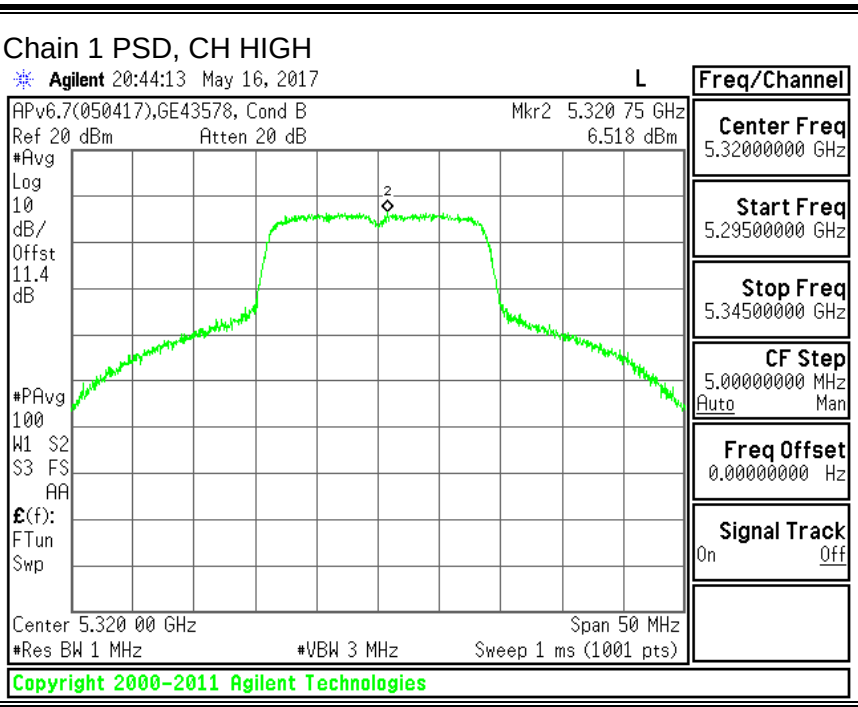
Chain 1 PSD, CH MID



Chain 0 PSD, CH HIGH



Chain 1 PSD, CH HIGH



9.5. 11n HT20 3TX CDD MIMO MODE IN THE 5.3GHz BAND

9.5.1. 26 dB BANDWIDTH

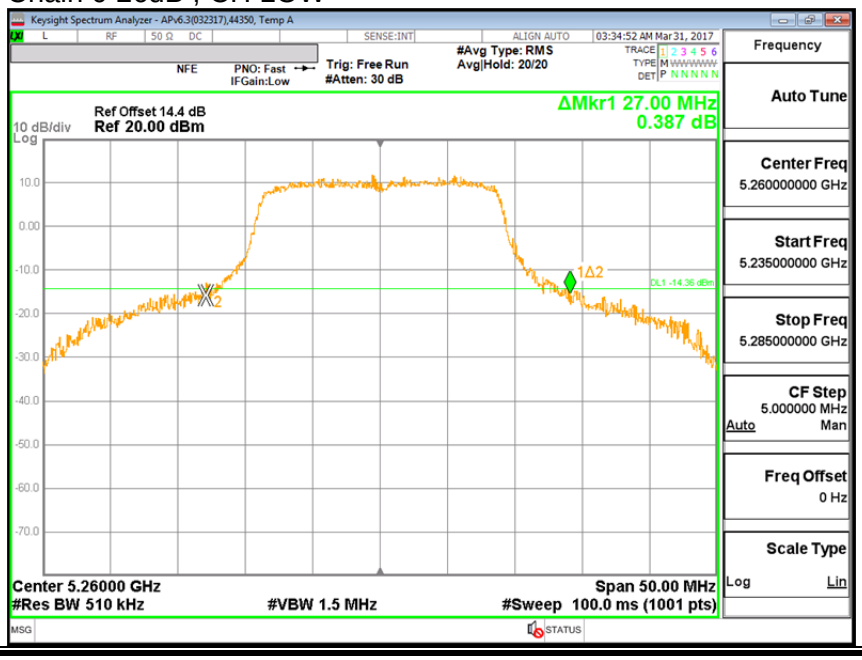
LIMITS

None; for reporting purposes only.

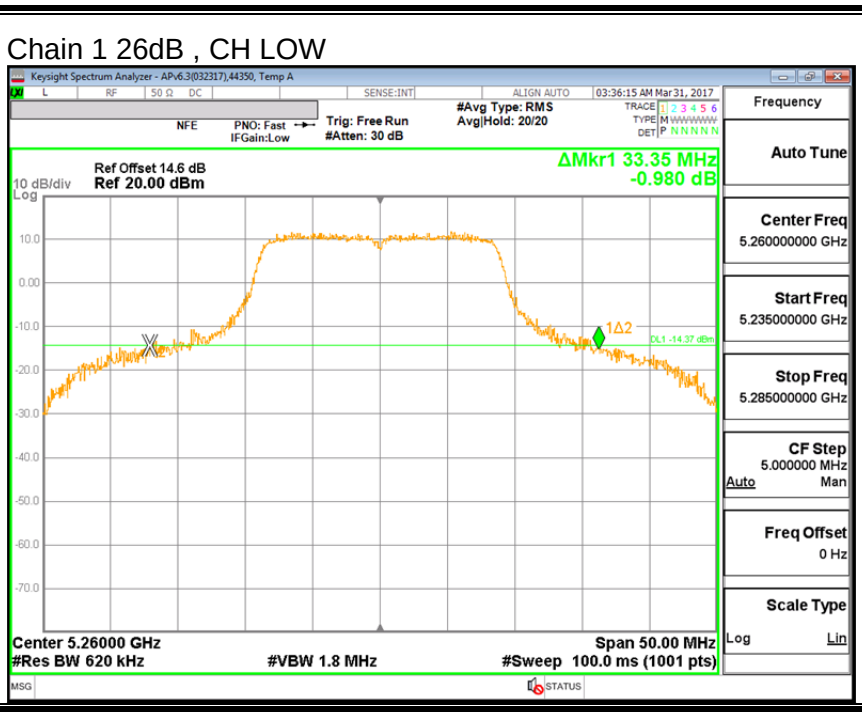
RESULTS

Channel	Frequency	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)	26 dB BW Chain 2 (MHz)
Low	5260	27.00	33.35	33.05
Mid	5300	38.25	42.75	41.90
High	5320	24.65	33.50	28.85

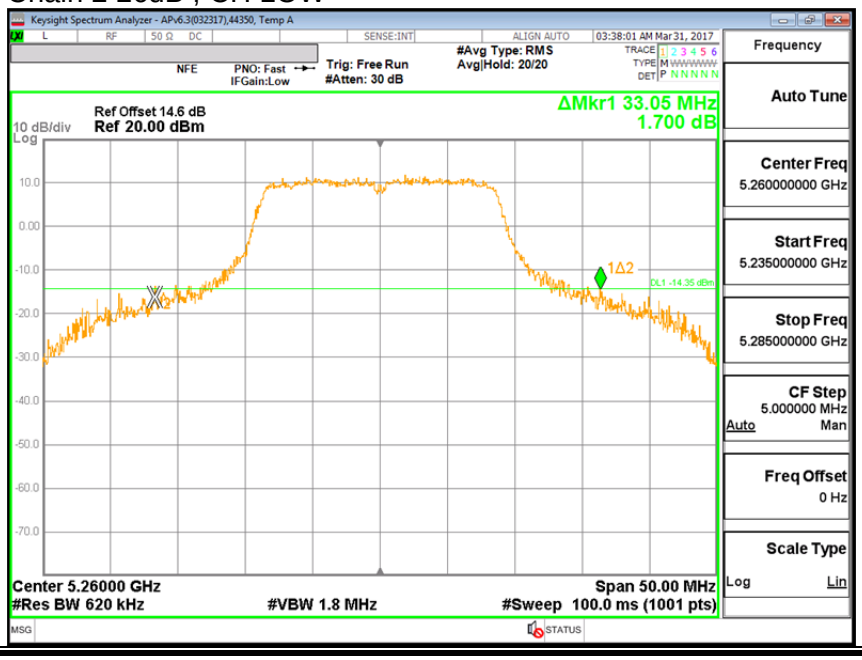
Chain 0 26dB , CH LOW



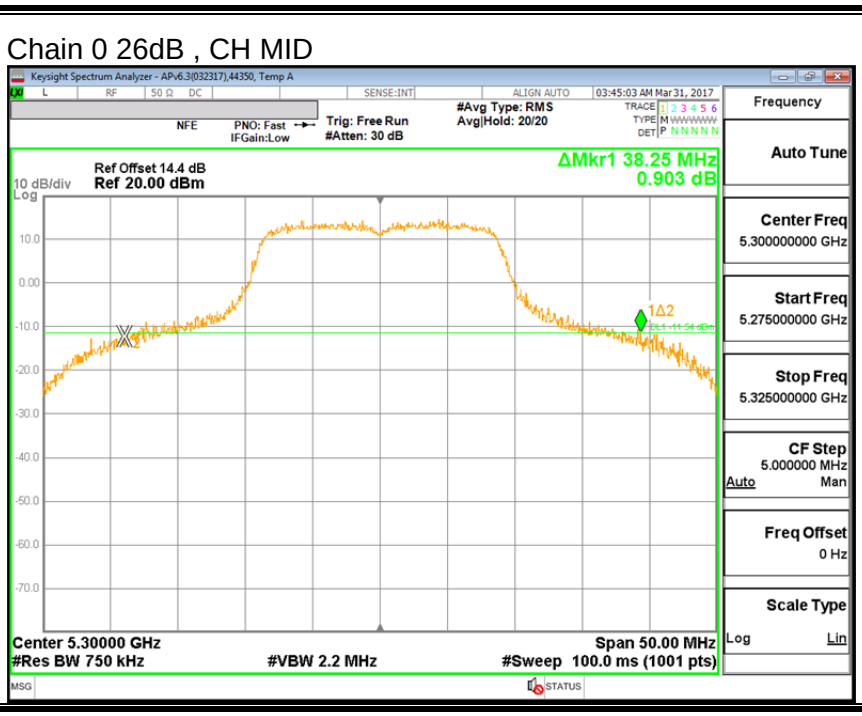
Chain 1 26dB , CH LOW



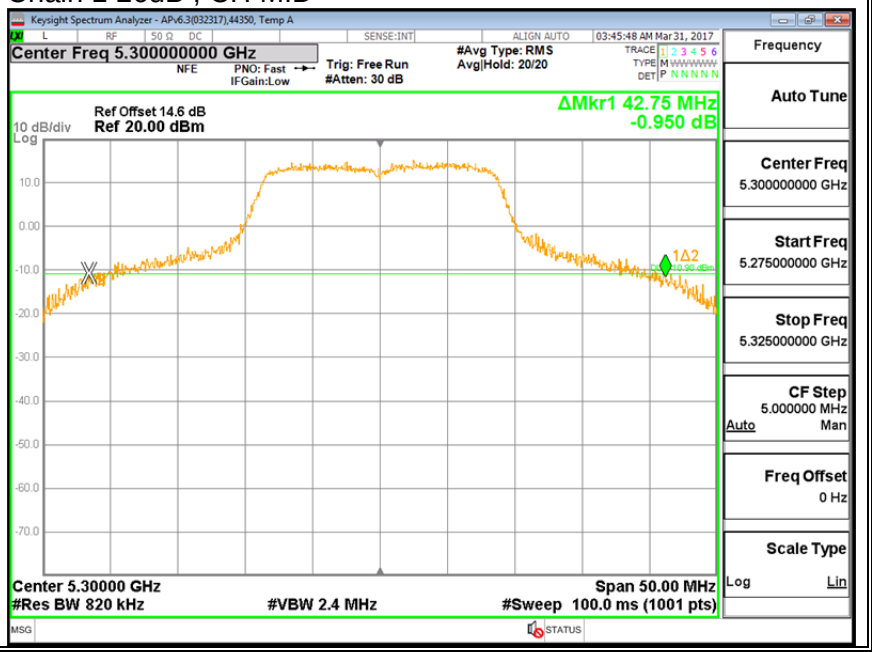
Chain 2 26dB , CH LOW



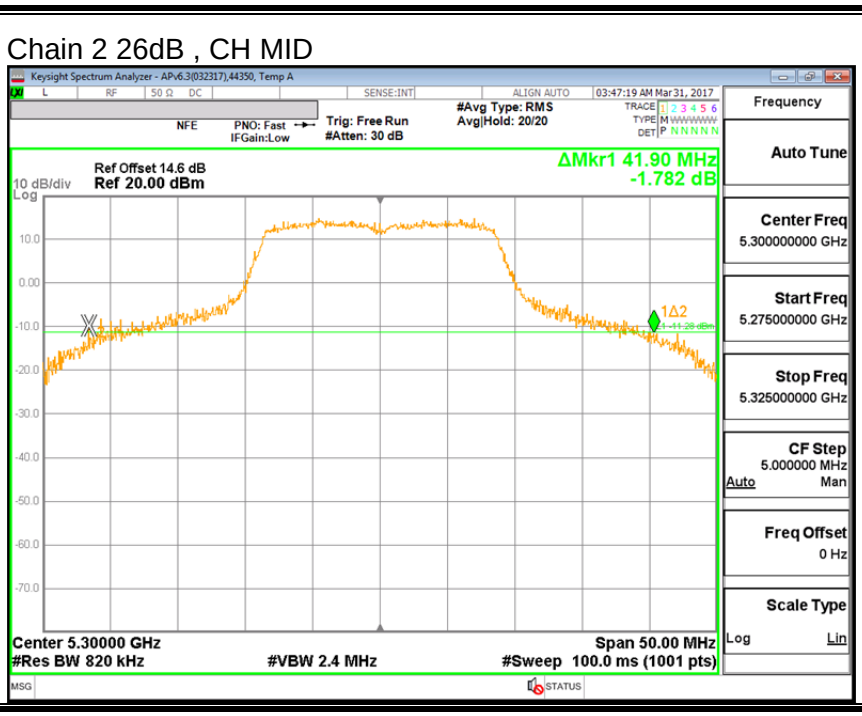
Chain 0 26dB , CH MID



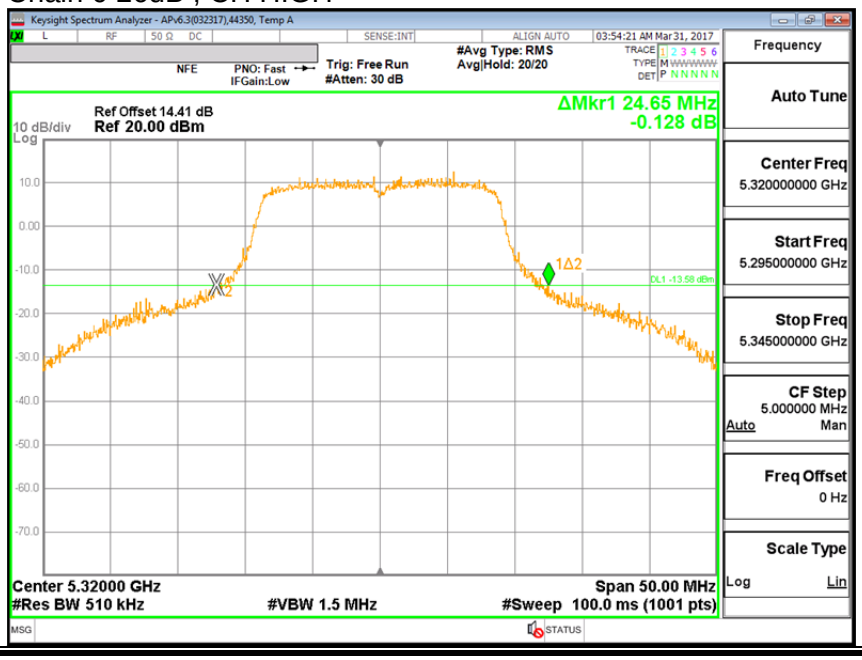
Chain 1 26dB , CH MID



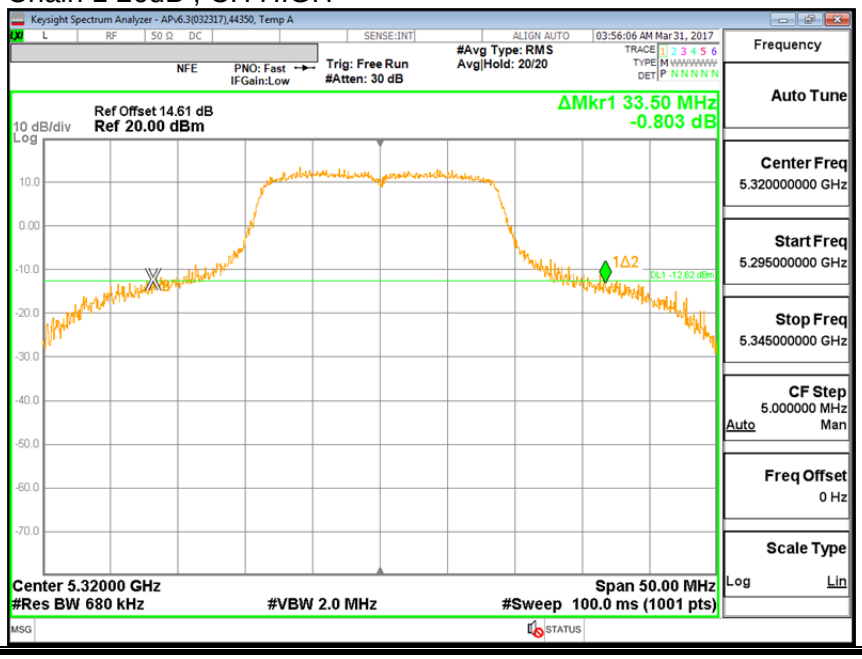
Chain 2 26dB , CH MID



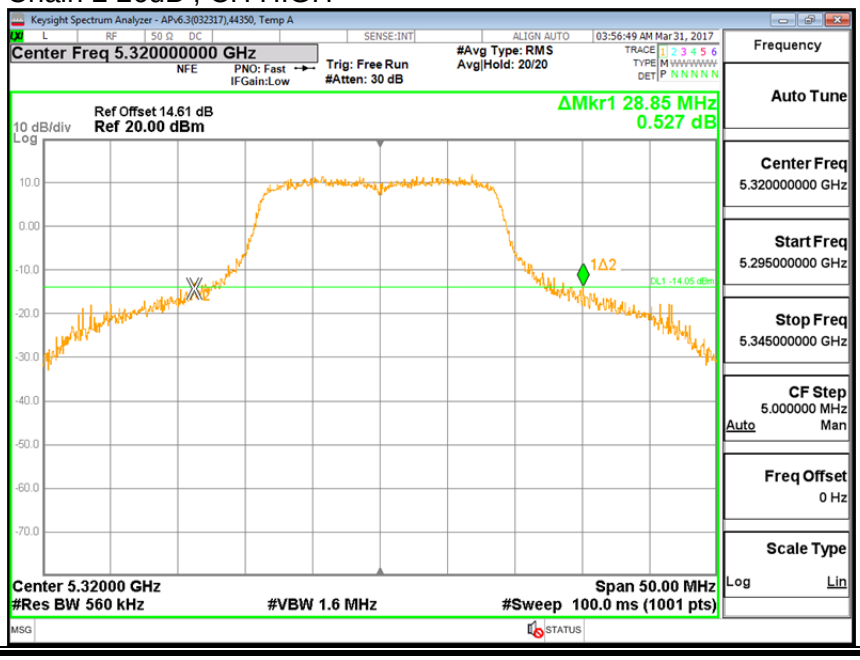
Chain 0 26dB , CH HIGH



Chain 1 26dB , CH HIGH



Chain 2 26dB , CH HIGH



9.5.2. 99% BANDWIDTH

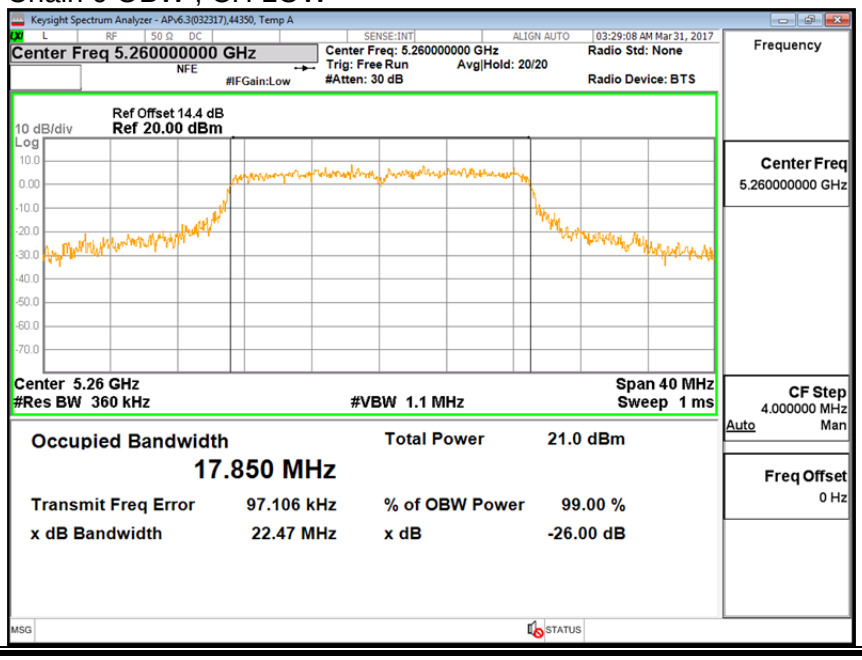
LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)	99% BW Chain 2 (MHz)
Low	5260	17.850	17.900	17.840
Mid	5300	17.989	18.360	17.990
High	5320	17.849	17.910	17.839

Chain 0 OBW , CH LOW



Chain 1 OBW , CH LOW