FCC 47 CFR PART 15 SUBPART E

CERTIFICATION TEST REPORT

FOR

INTELLIGENT BACKHAUL RADIO, UNII 5.2GHz Band

MODEL NUMBERS: IBR-1300-NA and IBR-1301-NA

FCC ID: 2AAEH-107

REPORT NUMBER: 15U21741-E1V3

ISSUE DATE: February 11, 2016

Prepared for
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Revision History

Rev.	Issue Date	Revisions	Revised By
V1	2/8/16	Initial Issue	F. de Anda
V2	2/9/16	Update- section 9.1	F. de Anda
V3	2/11/16	Update- section 7	F. de Anda

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: CBF NETWORKS, INC., DBA FASTBACK NETWORKS
2460 N. FIRST STREET, SUITE 200
SAN JOSE, CA 95131, USA

EUT DESCRIPTION: INTELLIGENT BACKHAUL RADIO

MODELS: IBR-1300-NA and IBR-1301-NA

SERIAL NUMBER: Proto 1

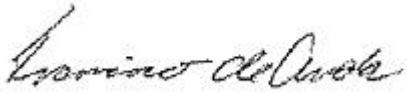
DATE TESTED: January 15, 2016 – February 5, 2016

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.

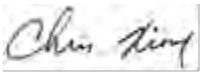
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. 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:



FRANCISCO DE ANDA
PROGRAM MANAGER
UL Verification Services Inc.

Tested By:



CHRIS XIONG
EMC ENGINEER
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, ANSI C63.10-2013, FCC KDB 789033, FCC KDB 662911 and FCC 06-96.

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	☐ Chamber D
☐ Chamber B	☐ Chamber E
☐ Chamber C	☐ Chamber F
	☐ Chamber G
	☒ Chamber H

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:

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

Fixed Point-to-Point radio in 5.2GHz unlicensed band with a proprietary communication management interface Intelligent Backhaul Radio.

The EUT uses 40, 20 and 10 MHz nominal bandwidths with QPSK, QAM16, QAM64, QAM256 modulation. The EUT can be powered by Power over Ethernet (PoE) or AC.

5.2. MANUFACTURER'S DESCRIPTION OF MODEL DIFFERENCES

There are two power options available for the EUT;

The PoE powered model is identified as:
• Model: IBR-1300-NA
• FCC ID: 2AAEH-107

The AC mains powered model is identified as:
• Model: IBR-1301-NA
• FCC ID: 2AAEH-107

5.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

5.2 GHz BAND

Bandwidth (MHz)	Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.2 GHz Band, 4TX				
10	5160 - 5240	FDD	25.26	335.74
20	5165 - 5235	FDD	25.69	370.68
40	5175 - 5225	FDD	23.46	221.82

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a dipole array antenna, with a maximum gain of 15 dBi.

5.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 1.6.8.

The test utility software used during testing was Tera Term, version 4.76.

5.6. 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.

All radiated testing was performed with the EUT in normal use orientation.

Based on the baseline scan, the worst-case data rates were:

10MHz bandwidth QAM 4
20MHz bandwidth QAM 4
40MHz bandwidth QAM 4
Data rate 38.4 Msamples/s for all bandwidths.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Dell	Latitude E5420	CN-0H5TG2-75900-162-0089 A01	N/A
AC/DC Adapter	Dell	DAP130PE1-00	CN-0JU012-48661-14C-55WB-A04	N/A
POE	Tycon	TP-POE-HP-56G-FBN	157000258ARC00	N/A

I/O CABLES

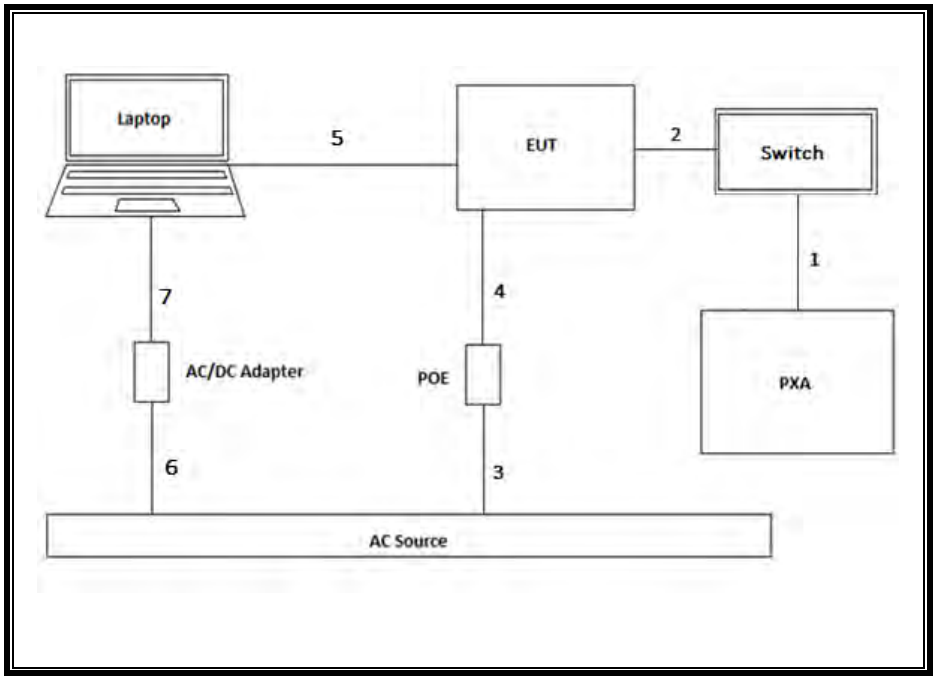
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	RF Input	1	SMA	Shielded	1	To Analyzer
2	Antenna	4	SMA	Shielded	1	EUT to switch
3	AC	1	3 Prong	Un-Shielded	1	N/A
4	POE/LAN	1	RJ45	Shielded	20	N/A
5	USB/SERIAL	1	USB/10 pins	Shielded	1.5	USB to Laptop/Serial to EUT
6	AC	1	3-Prong	Un-Shielded	0.5	N/A
7	DC	1	Barrel	Un-Shielded	1.5	N/A
8	AC	1	Barrel	Un-Shielded	1.5	To EUT

TEST SETUP

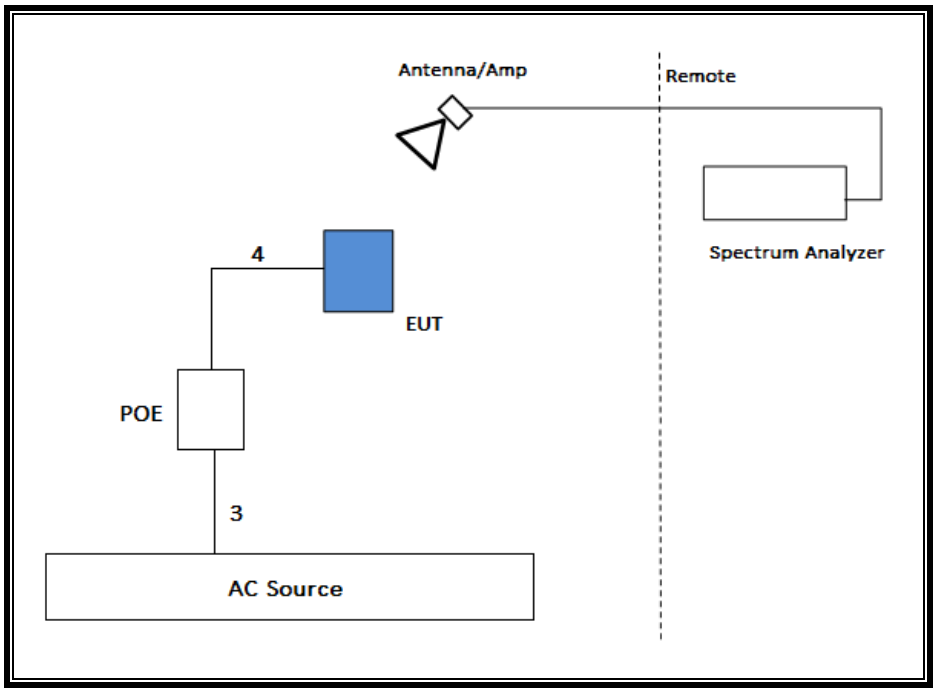
The EUT is a P-P outdoor radio used as a stand-alone device. Test software exercised the radio module.

SETUP DIAGRAM FOR TESTS

CONDUCTED

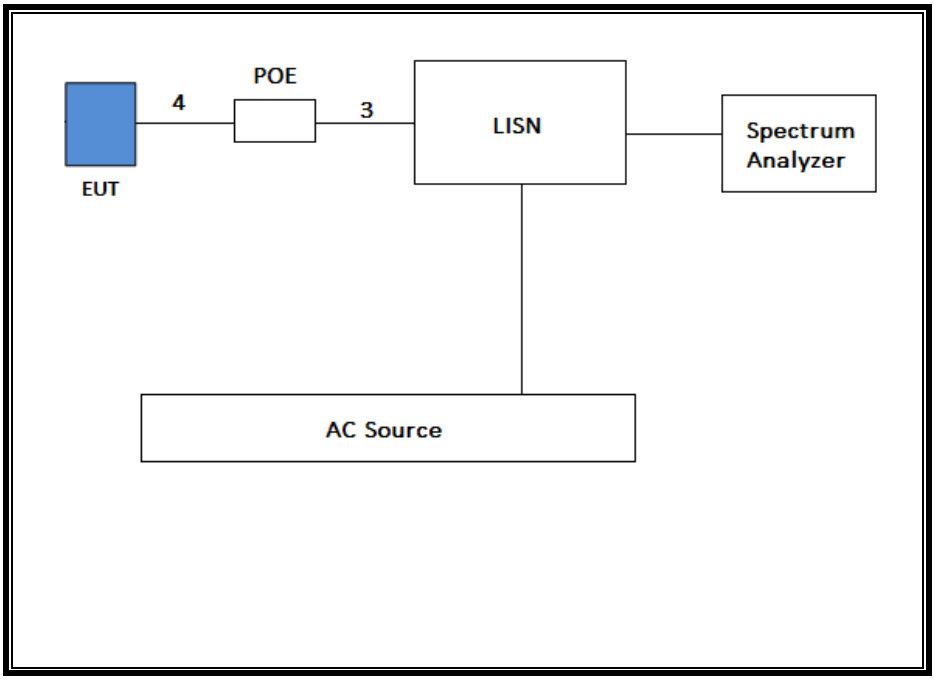


RADIATED

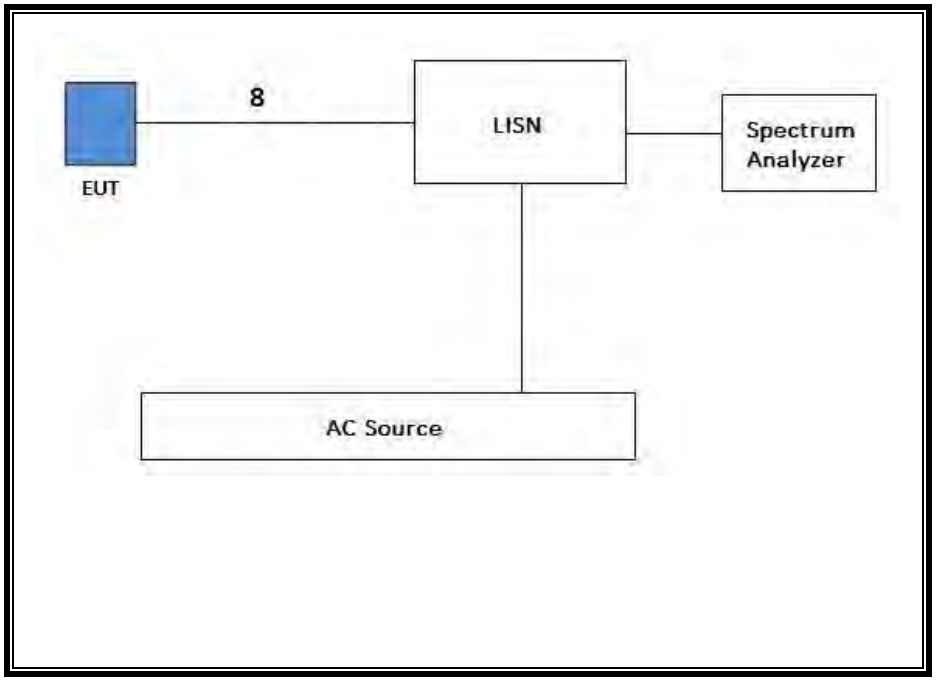


AC LINE CONDUCTED

Model IBR-1300-NA (PoE Option)



Model IBR-1301-NA (AC Option)



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 Due**
Radiated Software	UL	UL EMC	Ver 9.5, July 22, 2014	
Conducted Software	UL	UL EMC	Ver 3.9.1, December 28, 2015	
Spectrum Analyzer 9kHz - 26.5GHz	Keysight	N9030A	PRE0123763	12/09/16
Antenna, Horn 1-18GHz	ETS Lindgren	3117	863	04/10/16
Antenna, Broadband Hybrid, 30MHz - 2000MHz	Sunol Science	JB3	900	04/10/16
Amplifier, 1-18GHz	Miteq	ASF42-00101800-25-S-42	495	10/22/16
Amplifier, 10KHz-1GHz, 32dB	Sonoma	310N	835	06/06/16
Amplifier, 1-8GHz, 35dB	Miteq	AMF-4D-01000800-30-29P	782	10/22/16
Spectrum Analyzer, 40GHz	Hewlett-Packard	8564E	106	08/14/16
Antenna, Horn 18-26GHz	ARA	MWH-1826	447	05/12/16
Antenna, Horn 40GHz	ARA	MWH-2640/B	90	07/28/16
Amplifier, 1-26GHz	Keysight	8449B	404	06/29/16
Amplifier, 26-40GHz	Miteq	NSP4000-SP2	88	04/07/16
EMI Test Receiver, 10Hz-7GHz	Rohde & Schwarz	ESR7	1436	12/19/16
LISN, Conducted Emissions CISPR-16	Fischer	FCC-LISN-50/250-25-2-01-CISPR16	1310	09/16/16
Switch, SP6T Coaxial Switch	Keysight	87106C	836	06/26/16

7. MEASUREMENT METHODS

26 dB Emission BW: KDB 789033 D02 v01r01, Section C.

Conducted Output Power: KDB 789033 D02 v01r01, Section E.2.c (Method SA-1 Alternative).

Power Spectral Density: KDB 789033 D02 v01r01, Section F.

Unwanted emissions in restricted bands: KDB 789033 D02 v01r01, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v01r01, Sections G.3, G.4, and G.5.

KDB 662911 D01 Multiple Transmitter Output v02r01

KDB 662911 D02 MIMO with Cross-Polarized Antenna v01

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

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)
10MHz BW, 4TX	3.965	4.025	0.985	98.51%	0.00	0.010
20MHz BW, 4TX	3.967	4.028	0.985	98.49%	0.00	0.010
40MHz BW, 4TX	3.967	4.028	0.985	98.49%	0.00	0.010

DUTY CYCLE PLOTS

10MHz BW, 4TX MODE

20MHz BW, 4TX MODE

40MHz BW, 4TX MODE

8.2. 10MHz BW, 4TX MODE IN THE 5.2 GHz BAND

8.2.1. 26 dB BANDWIDTH

LIMITS

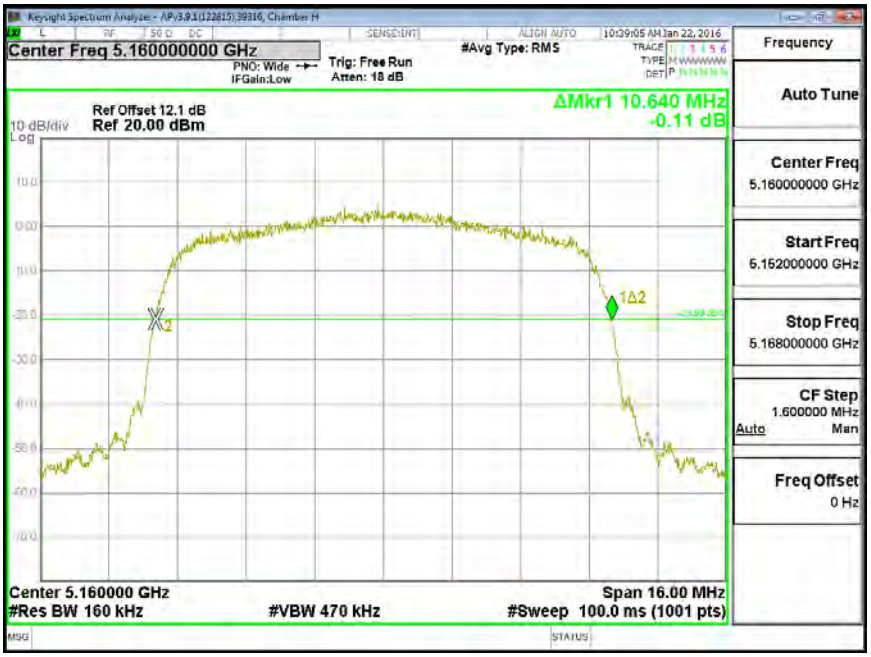
None; for reporting purposes only.

RESULTS

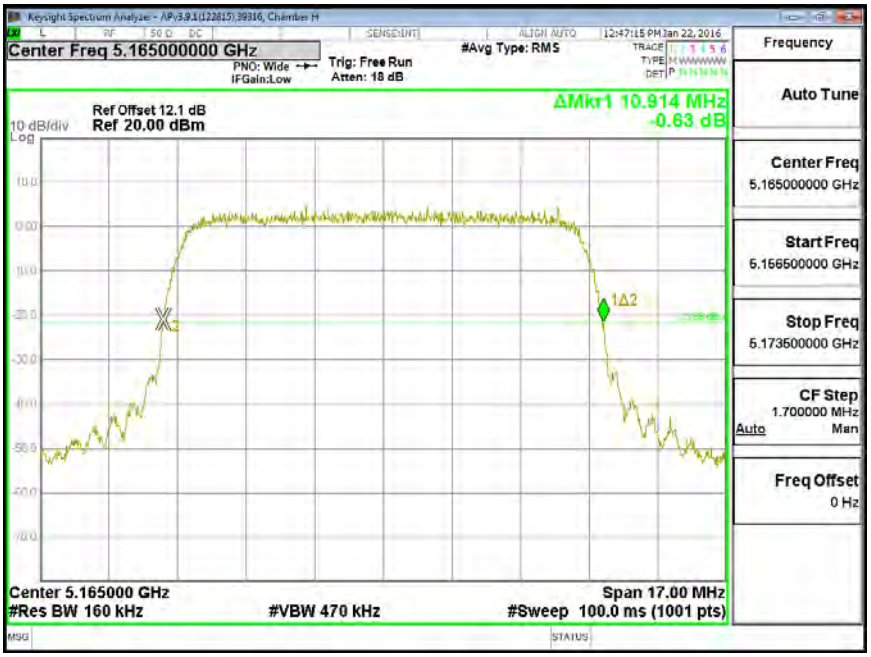
Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)	26 dB BW Chain 2 (MHz)	26 dB BW Chain 3 (MHz)
Low 1	5160	10.640	10.640	10.693	10.656
Low 2	5165	10.914	10.863	10.863	10.897
Low 3	5170	10.897	10.897	10.880	10.863
Mid	5190	10.880	10.880	10.880	10.880
High 1	5195	10.880	10.897	10.863	10.897
High 2	5240	10.914	10.880	10.880	10.880

26 dB BANDWIDTH, Chain 0

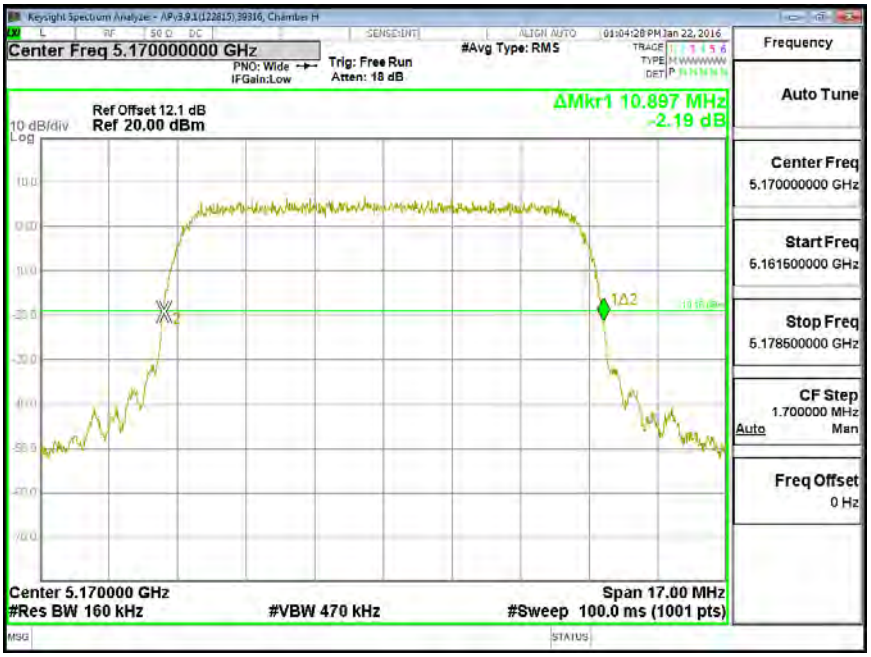
BANDWIDTH Chain 0 LOW 1 CH



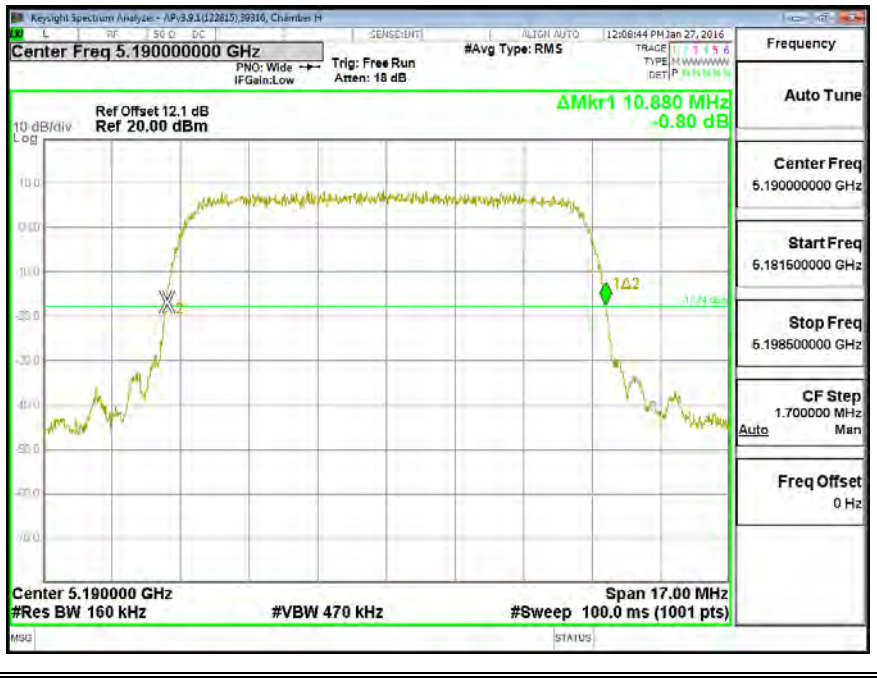
BANDWIDTH Chain 0 LOW 2 CH



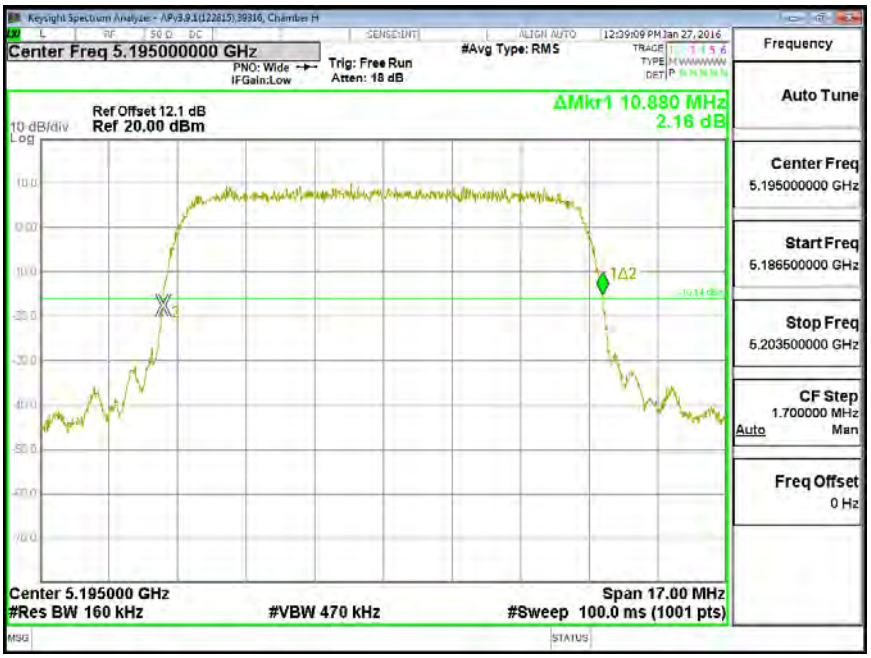
BANDWIDTH Chain 0 LOW 3 CH



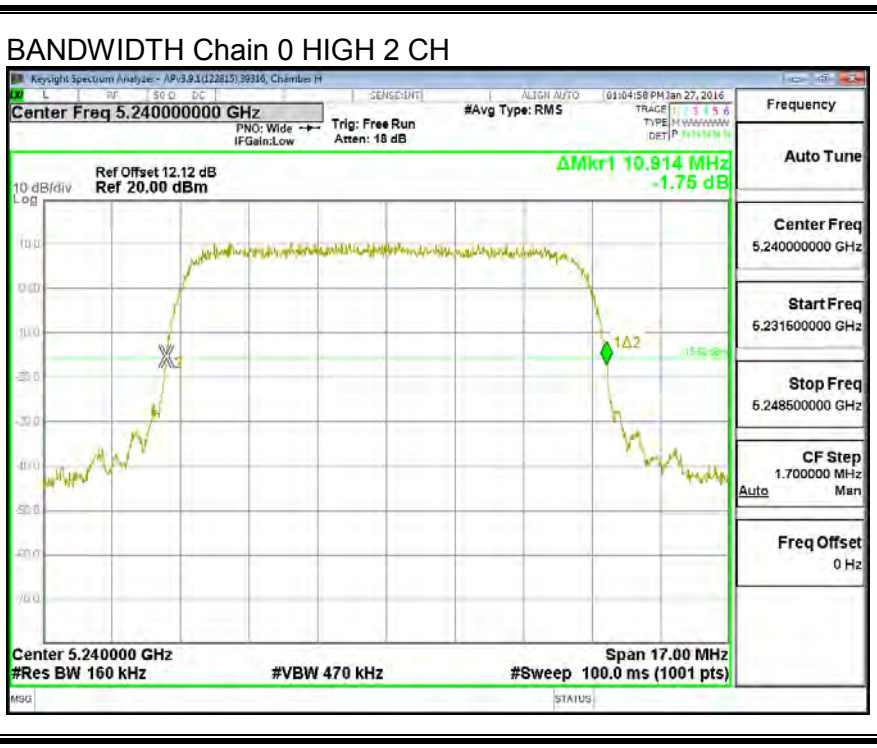
BANDWIDTH Chain 0 MID CH



BANDWIDTH Chain 0 HIGH 1 CH

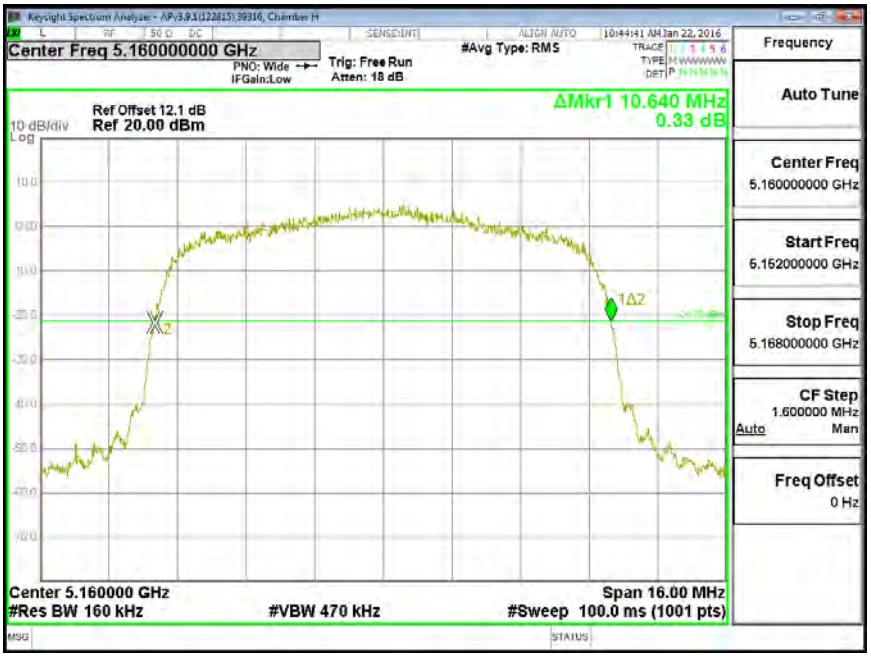


BANDWIDTH Chain 0 HIGH 2 CH



26 dB BANDWIDTH, Chain 1

BANDWIDTH Chain 1 LOW 1 CH



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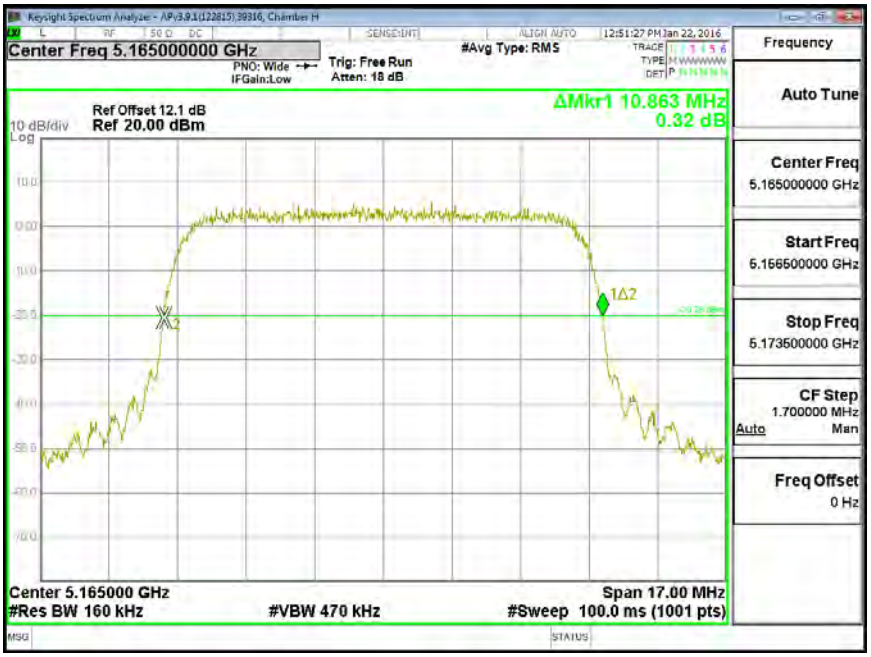

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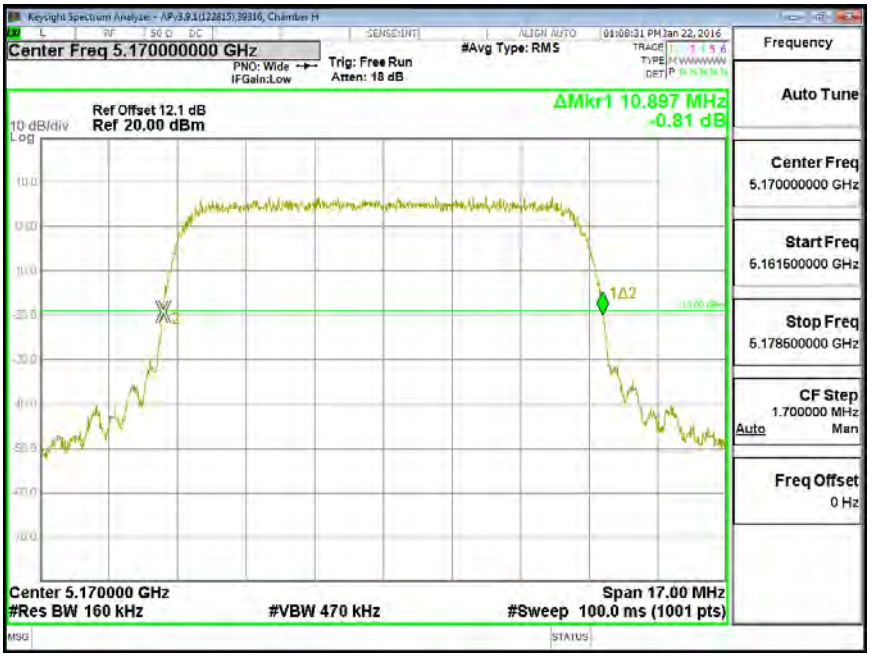
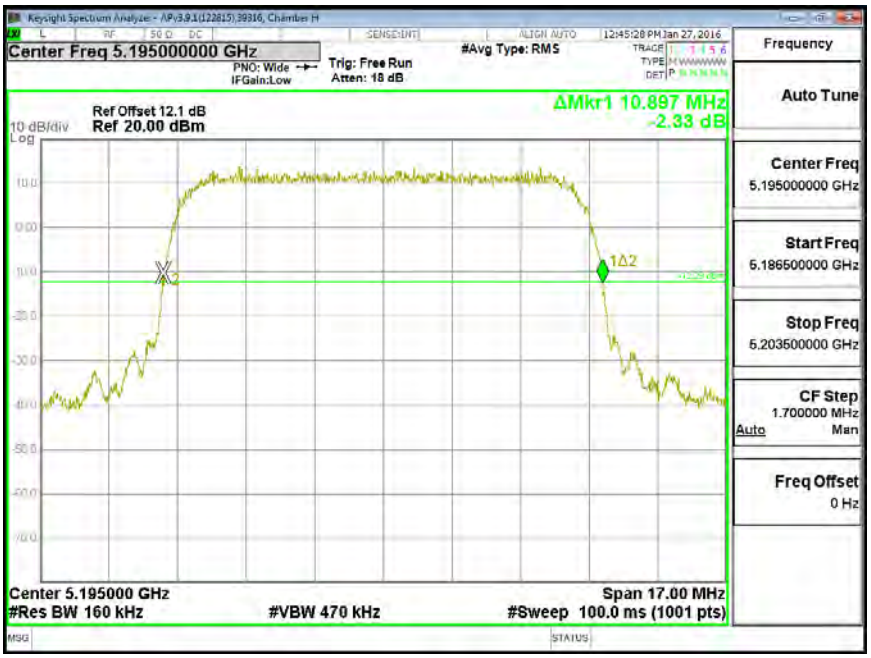


BANDWIDTH Chain 1 MID CH

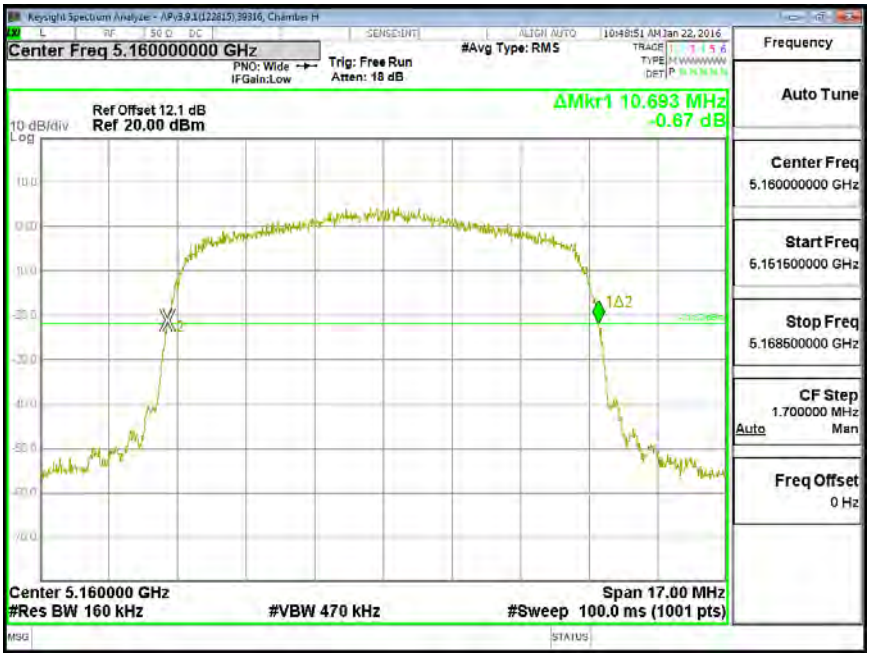
BANDWIDTH Chain 1 HIGH 1 CH



BANDWIDTH Chain 1 HIGH 2 CH

26 dB BANDWIDTH, Chain 2

BANDWIDTH Chain 2 LOW 1 CH



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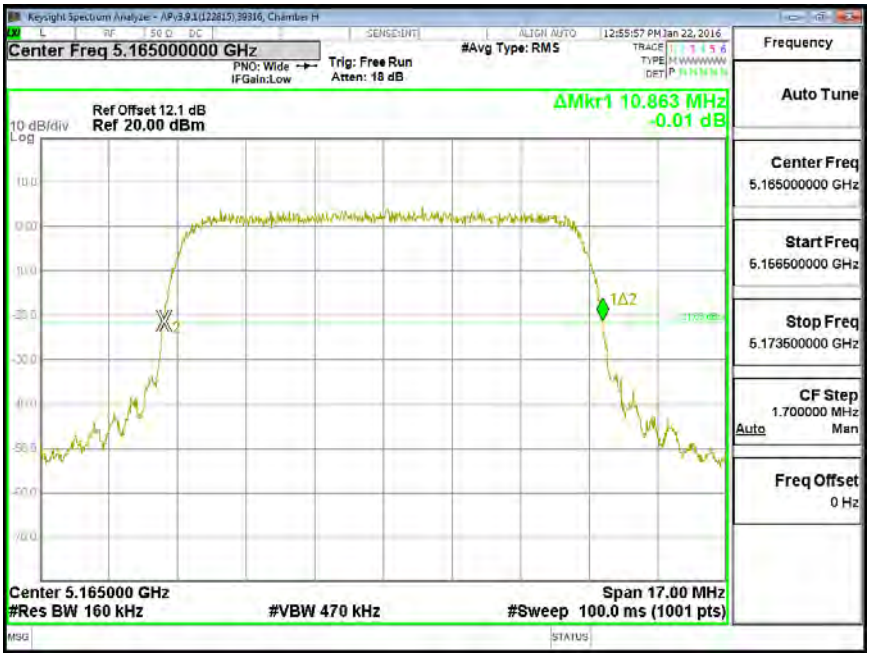
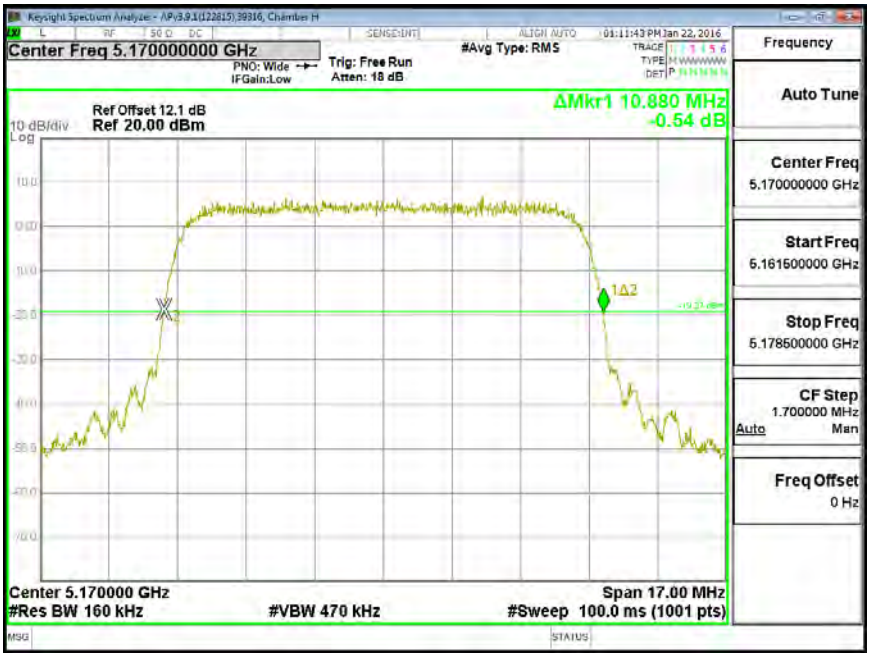


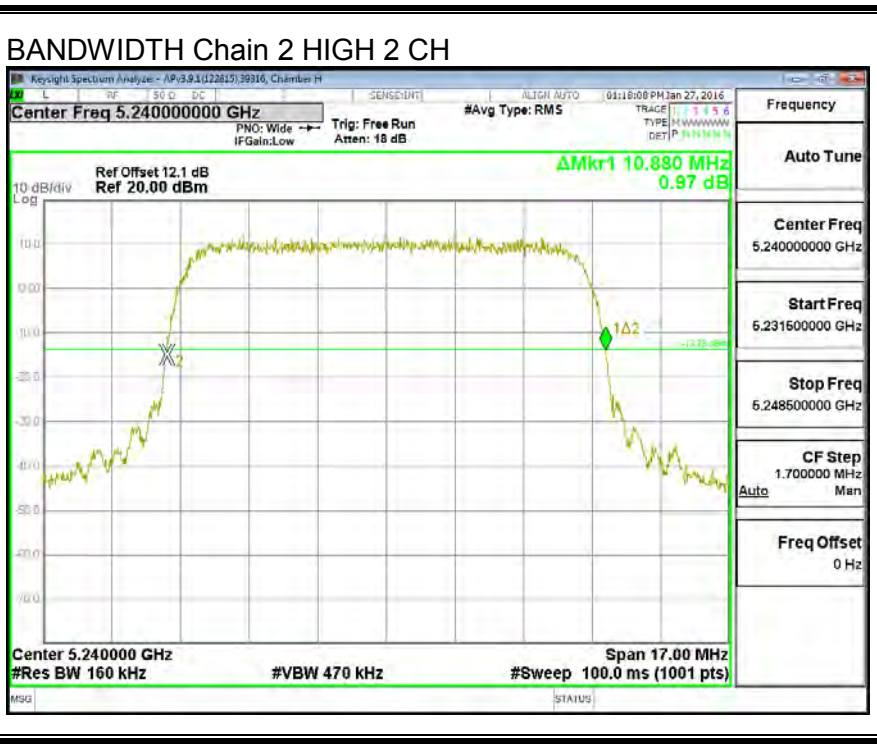
BANDWIDTH Chain 2 LOW 3 CH



BANDWIDTH Chain 2 MID CH

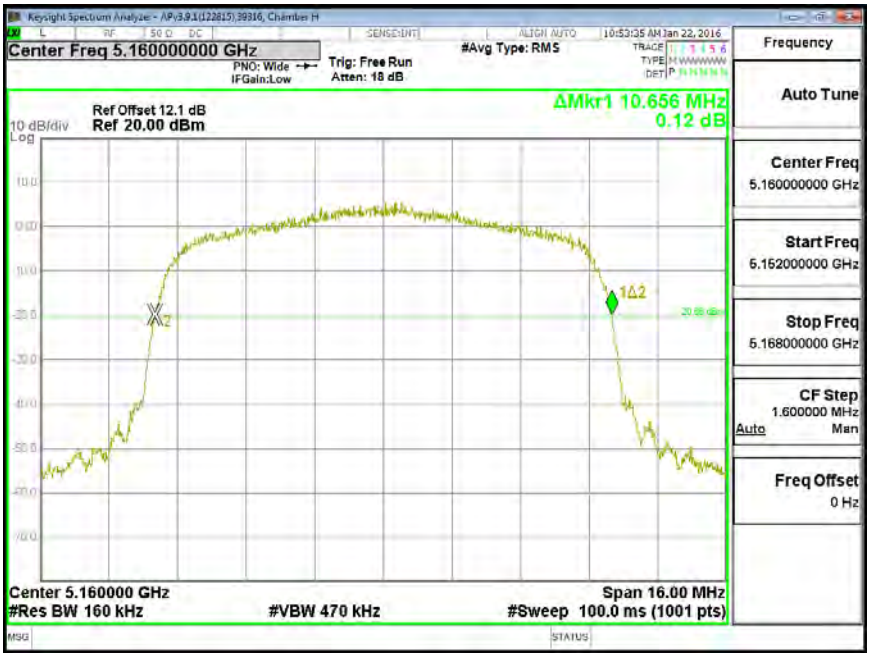
BANDWIDTH Chain 2 HIGH 1 CH

BANDWIDTH Chain 2 HIGH 2 CH

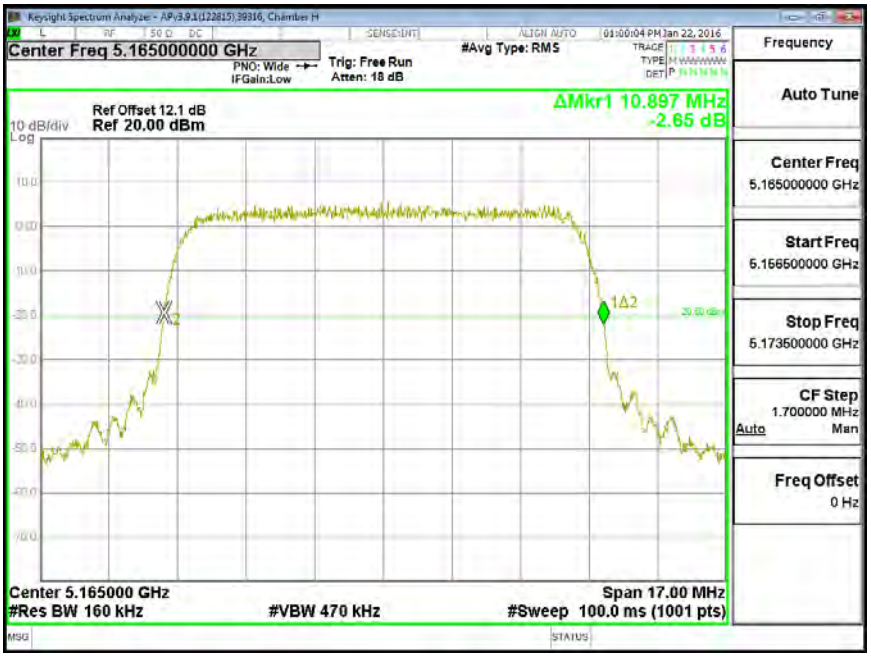


26 dB BANDWIDTH, Chain 3

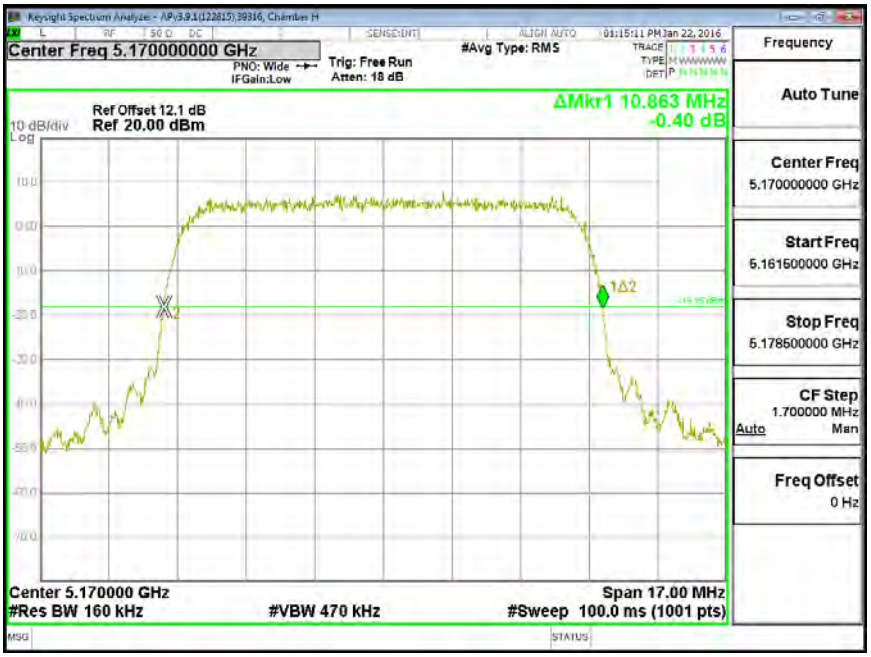
BANDWIDTH Chain 3 LOW 1 CH



BANDWIDTH Chain 3 LOW 2 CH

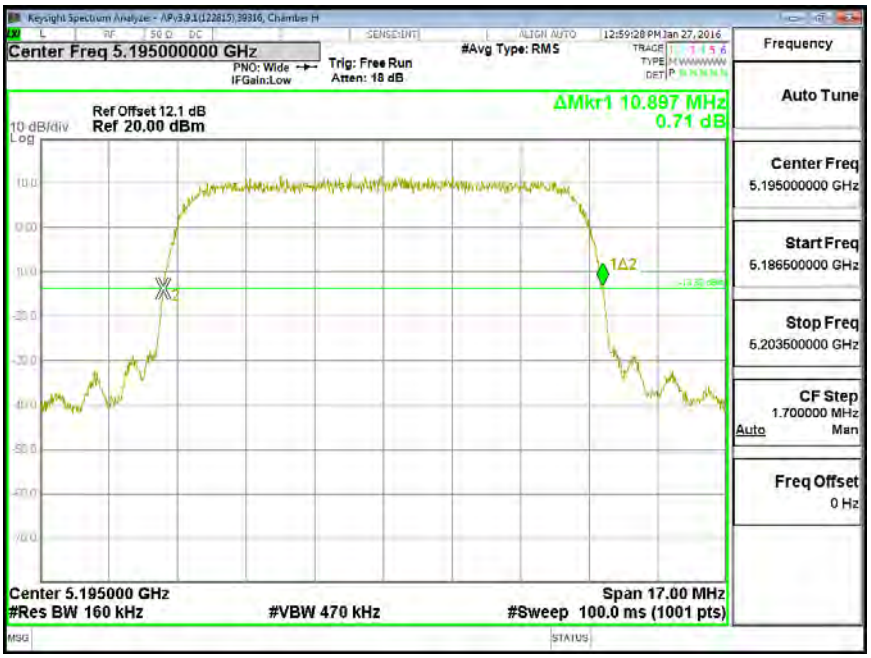


BANDWIDTH Chain 3 LOW 3 CH



BANDWIDTH Chain 3 MID CH

BANDWIDTH Chain 3 HIGH 1 CH



BANDWIDTH Chain 3 HIGH 2 CH

8.2.2. 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

There are a total of four antennas; two horizontal antennas (chains 0 and 2) and two vertical antennas (chains 1 and 3). Horizontal antennas are cross polarized with respect to vertical antennas

Two TX chains are correlated and two others are uncorrelated and the antenna gain is the same for each chain. The directional gain is;

Antenna Gain (dBi)	10 * Log (2 chains) (dB)	Correlated Chains Directional Gain (dBi)
15.00	3.01	18.01

RESULTS

Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low1	5160	18.01	18.01	30.00	17.00
Low2	5165	18.01	18.01	30.00	17.00
Low3	5170	18.01	18.01	30.00	17.00
Mid	5190	18.01	18.01	30.00	17.00
High1	5195	18.01	18.01	30.00	17.00
High2	5240	18.01	18.01	30.00	17.00

Duty Cycle CF (dB)	0.00	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)	Chain 3 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low1	5160	8.98	9.37	9.15	9.92	15.39	30.00	-14.61
Low2	5165	10.85	11.39	10.87	11.86	17.28	30.00	-12.72
Low3	5170	13.03	13.64	13.02	13.92	19.44	30.00	-10.56
Mid	5190	12.61	13.56	12.78	13.43	19.14	30.00	-10.86
High1	5195	17.71	17.67	17.63	17.55	23.66	30.00	-6.34
High2	5240	19.05	19.16	19.31	19.41	25.26	30.00	-4.74

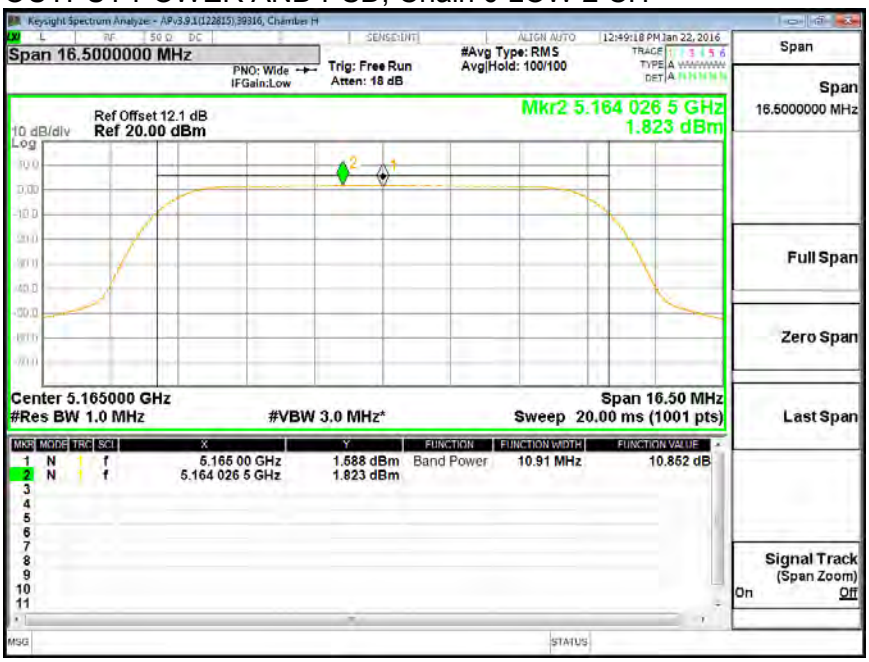
PSD Results

Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Chain 2 Meas PSD (dBm)	Chain 3 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low1	5160	2.02	2.55	2.16	3.06	8.49	17.00	-8.51
Low2	5165	1.82	2.43	1.79	2.84	8.26	17.00	-8.74
Low3	5170	3.95	4.53	3.98	4.85	10.36	17.00	-6.64
Mid	5190	3.56	4.49	3.69	4.44	10.08	17.00	-6.92
High1	5195	8.66	8.62	8.56	8.55	14.62	17.00	-2.38
High2	5240	10.04	10.10	10.28	10.40	16.23	17.00	-0.77

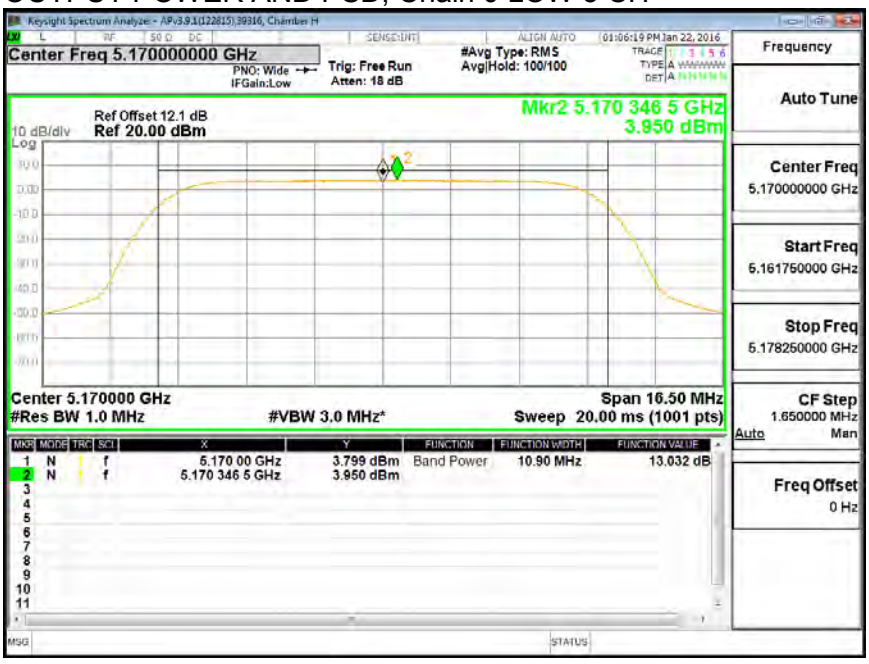
OUTPUT POWER AND PSD, Chain 0

OUTPUT POWER AND PSD, Chain 0 LOW 1 CH

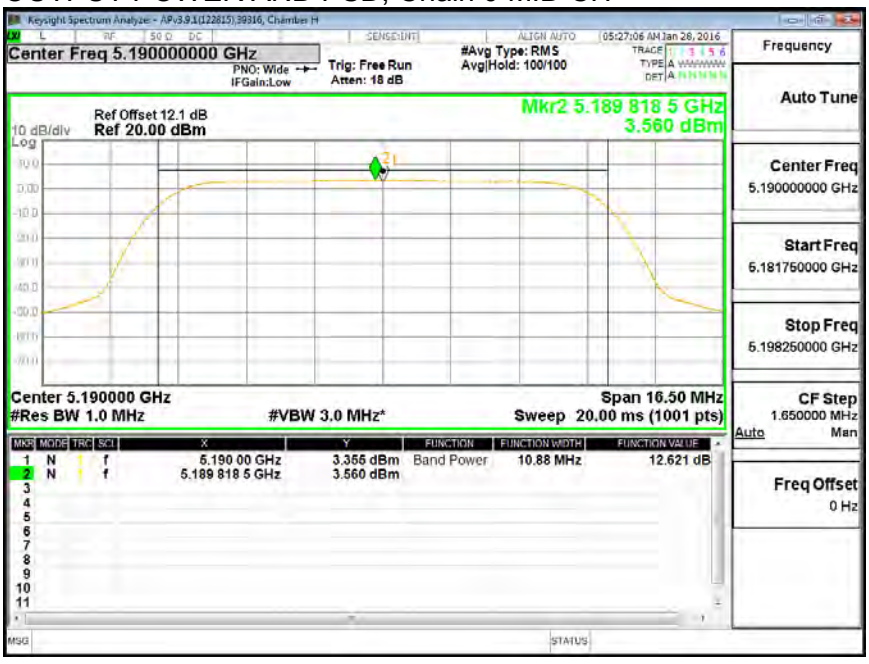
OUTPUT POWER AND PSD, Chain 0 LOW 2 CH



OUTPUT POWER AND PSD, Chain 0 LOW 3 CH



OUTPUT POWER AND PSD, Chain 0 MID CH



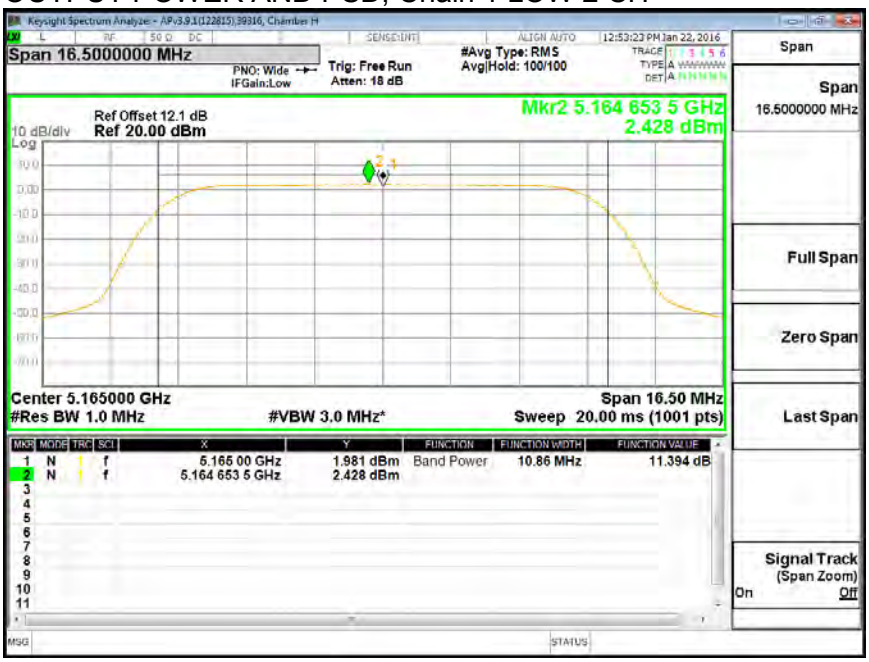
OUTPUT POWER AND PSD, Chain 0 HIGH 1 CH

OUTPUT POWER AND PSD, Chain 0 HIGH 2 CH

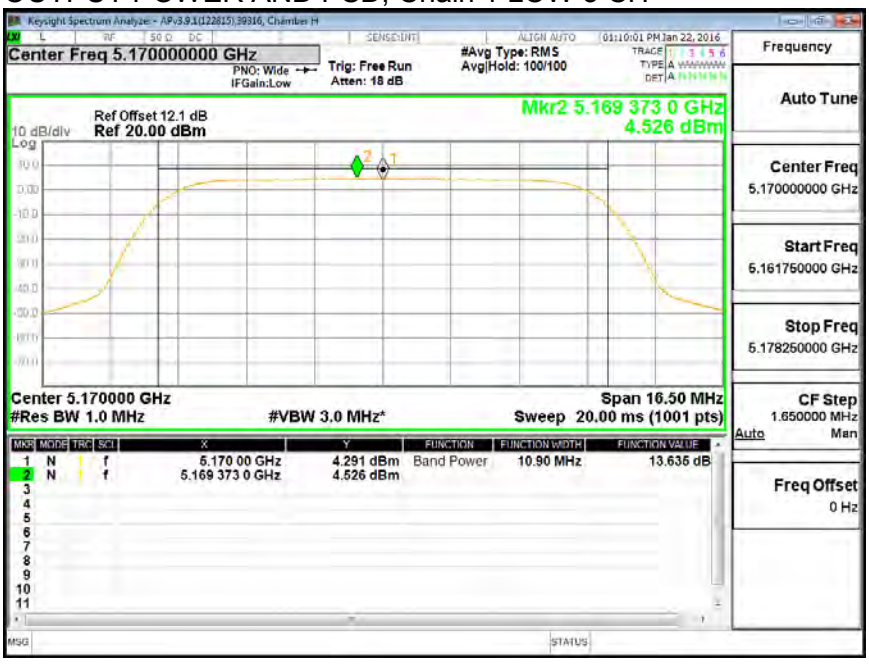
OUTPUT POWER AND PSD, Chain 1

OUTPUT POWER AND PSD, Chain 1 LOW 1 CH

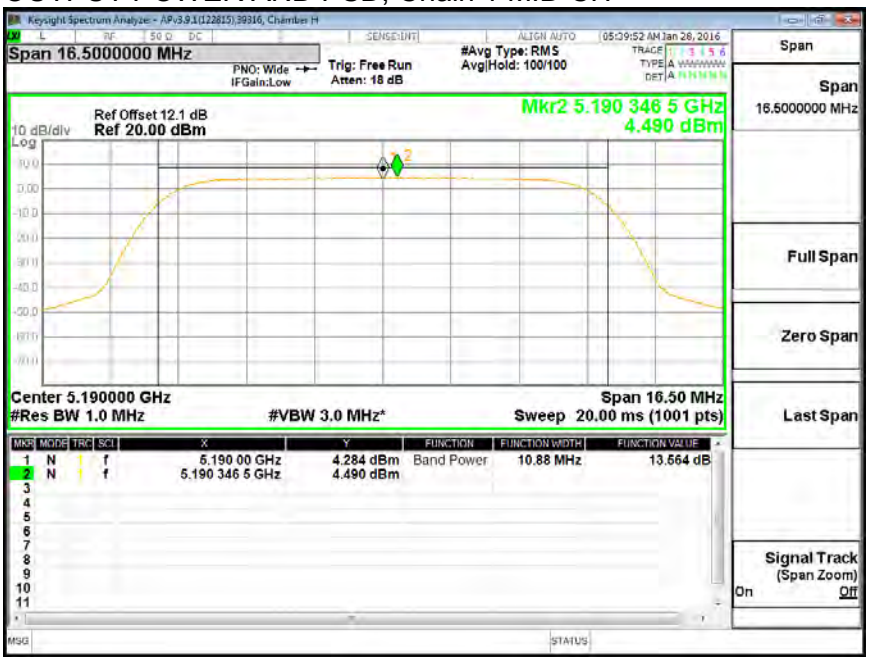
OUTPUT POWER AND PSD, Chain 1 LOW 2 CH



OUTPUT POWER AND PSD, Chain 1 LOW 3 CH

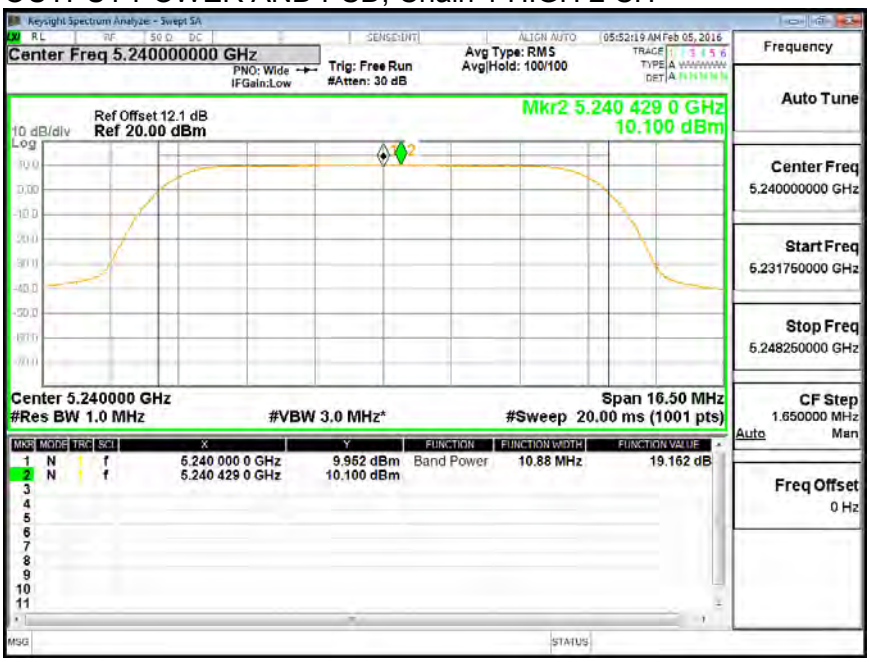


OUTPUT POWER AND PSD, Chain 1 MID CH



OUTPUT POWER AND PSD, Chain 1 HIGH 1 CH

OUTPUT POWER AND PSD, Chain 1 HIGH 2 CH

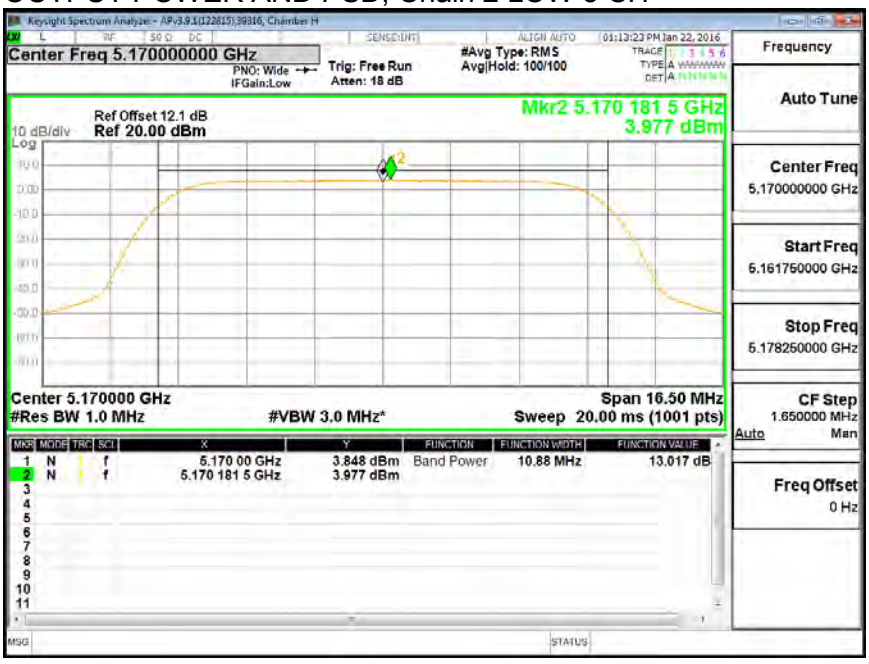


OUTPUT POWER AND PSD, Chain 2

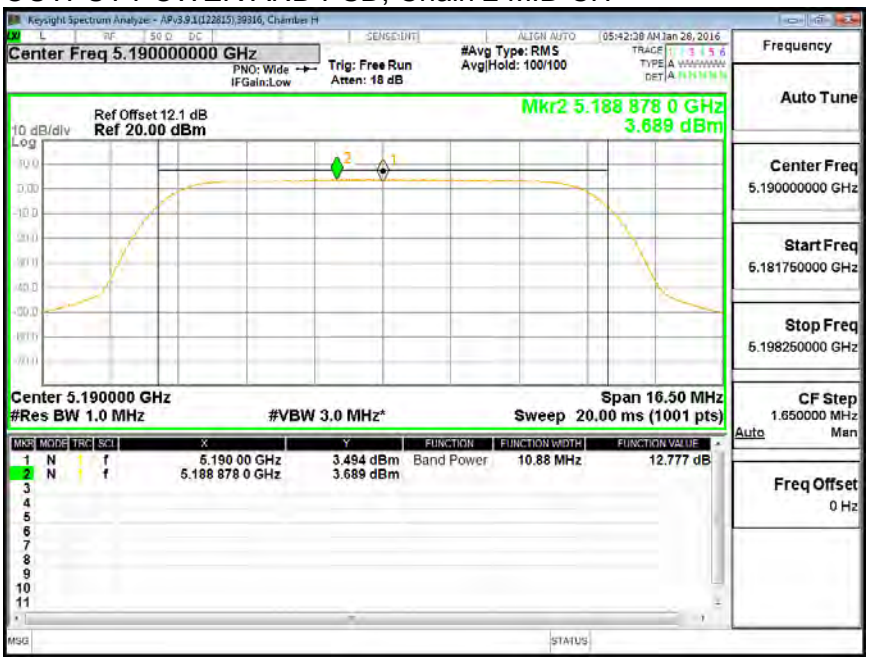
OUTPUT POWER AND PSD, Chain 2 LOW 1 CH

OUTPUT POWER AND PSD, Chain 2 LOW 2 CH

OUTPUT POWER AND PSD, Chain 2 LOW 3 CH



OUTPUT POWER AND PSD, Chain 2 MID CH



OUTPUT POWER AND PSD, Chain 2 HIGH 1 CH

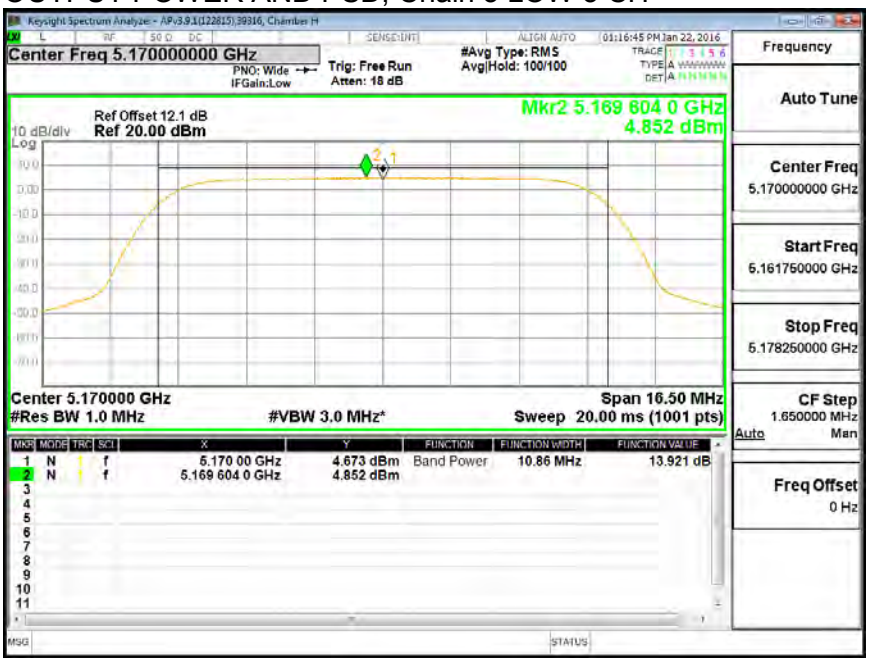
OUTPUT POWER AND PSD, Chain 2 HIGH 2 CH

OUTPUT POWER AND PSD, Chain 3

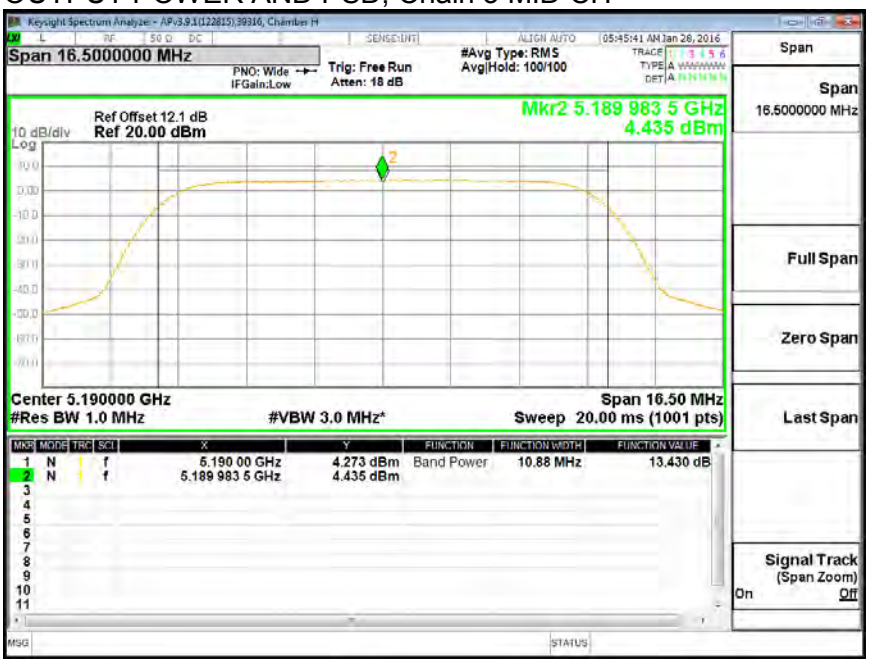
OUTPUT POWER AND PSD, Chain 3 LOW 1 CH

OUTPUT POWER AND PSD, Chain 3 LOW 2 CH

OUTPUT POWER AND PSD, Chain 3 LOW 3 CH

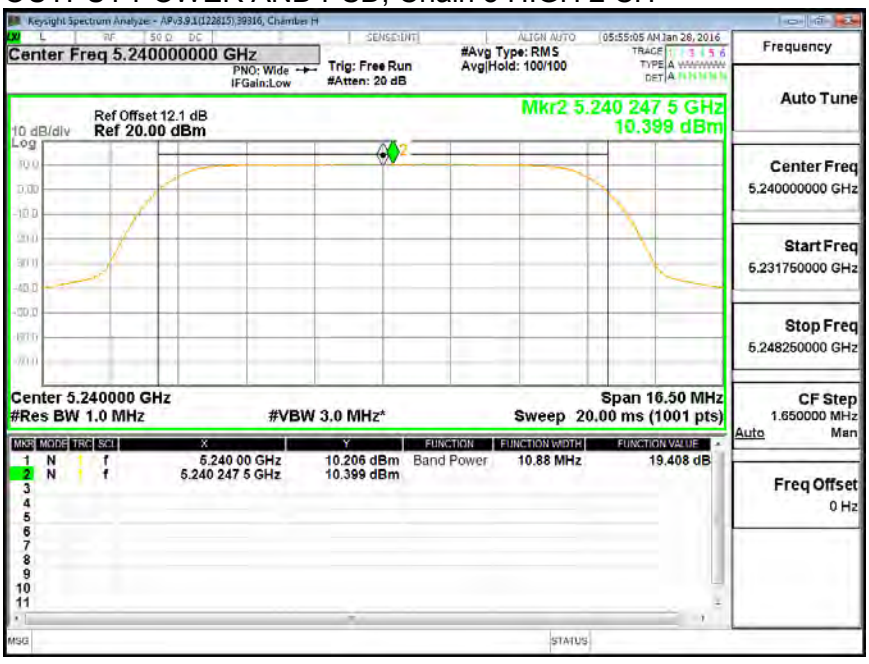


OUTPUT POWER AND PSD, Chain 3 MID CH



OUTPUT POWER AND PSD, Chain 3 HIGH 1 CH

OUTPUT POWER AND PSD, Chain 3 HIGH 2 CH



8.2.3. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.205 and §15.209

PART 15, SUBPART E

Radiated LIMIT:
(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

Procedure

KDB 789033 D02 General UNII Test Procedures New Rules v01, Section II, G5

Conducted measurements are being used to demonstrate compliance with the spurious limits in the restricted band (all other spurious emissions are measured using the radiated test method with the antennas connected). The limits are 54dBuV/m average and 74dBuV/m peak, which are equivalent to EIRP of -41.2 dBm and -21.2dBm respectively. The plots include an offset to account for the EUT antenna gain and external attenuation between EUT antenna port and spectrum analyzer.

There are a total of four antenna chains; two horizontal antennas (chains 0 and 2) and two vertical antennas (chains 1 and 3). As two antennas chains(horizontal Pol.) feed cross polarized with respect to two other antennas(vertical Pol.), the two sets of chains are treated independently, and thus the emissions do not need to be summed for all four chains. However, there is a summation for the two horizontal antennas and two vertical chains separately.

The summation is noted as below:

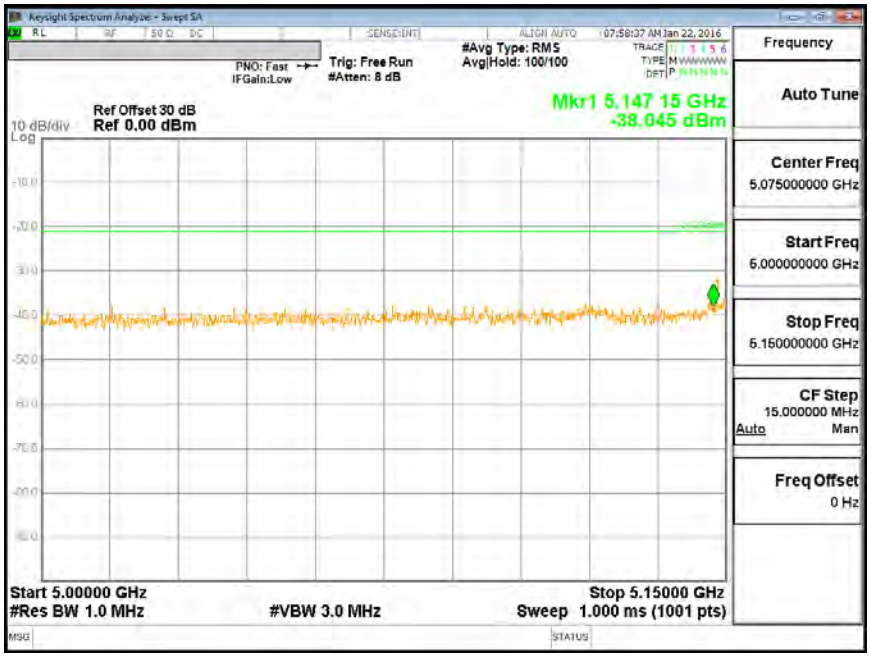
KDB 662911 D01 Multiple Transmitter Output v02r01

3(a)(i) Measure and sum the spectra across the outputs as described in section E)2)a). Note that the summation must be performed in linear power units, or the equivalent. For example, if measurement units are microvolts or microvolts/meter, the values shall be squared before summing, and then a square root shall be applied to the sum in order to achieve the equivalent of summing in power units.

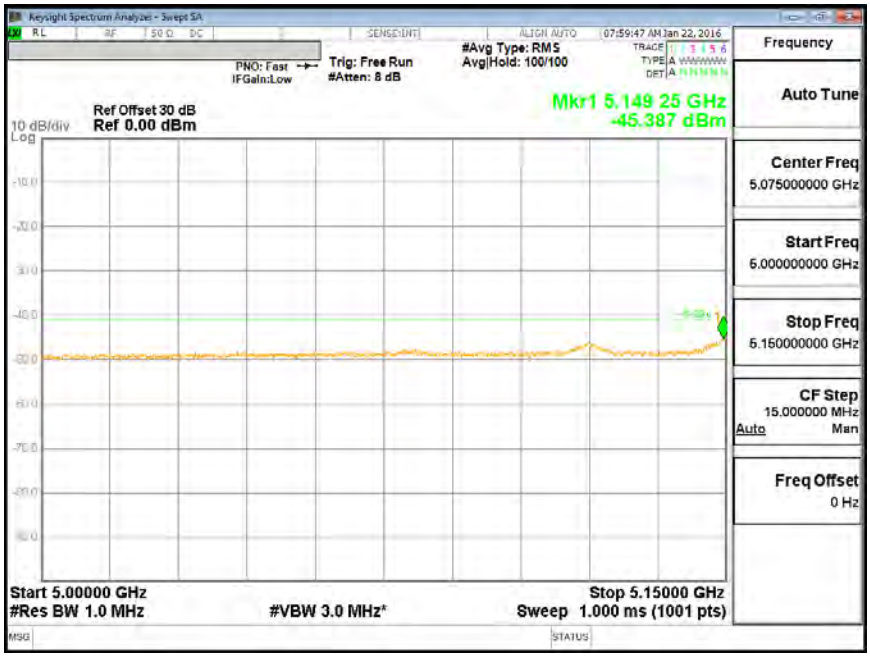
RESULTS

LOW CHANNEL BANDEDGE (5160 MHz), Chain 0

AUTHORIZED BAND EDGE Chain 0 LOW CH PEAK

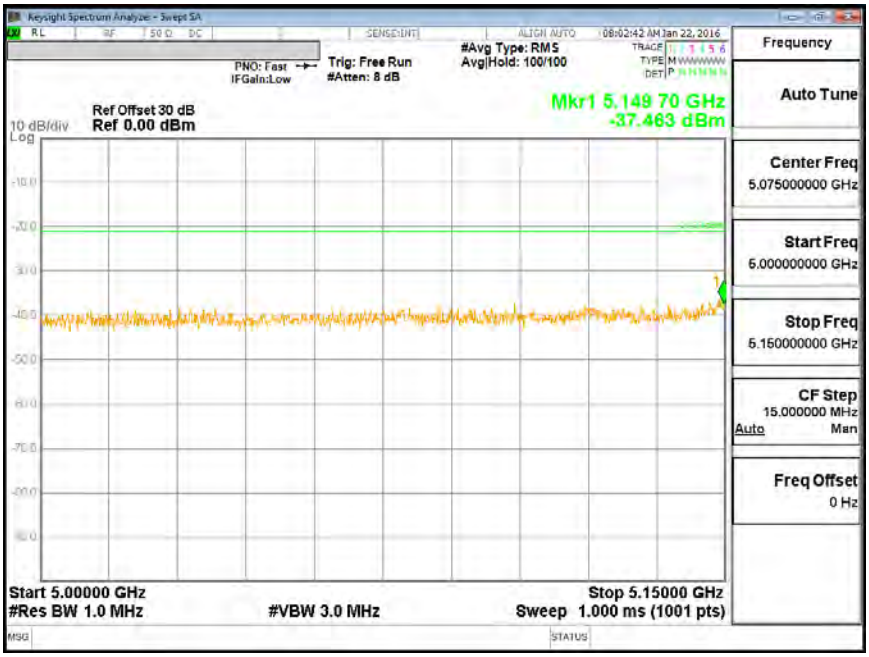


AUTHORIZED BAND EDGE Chain 0 LOW CH AVERAGE

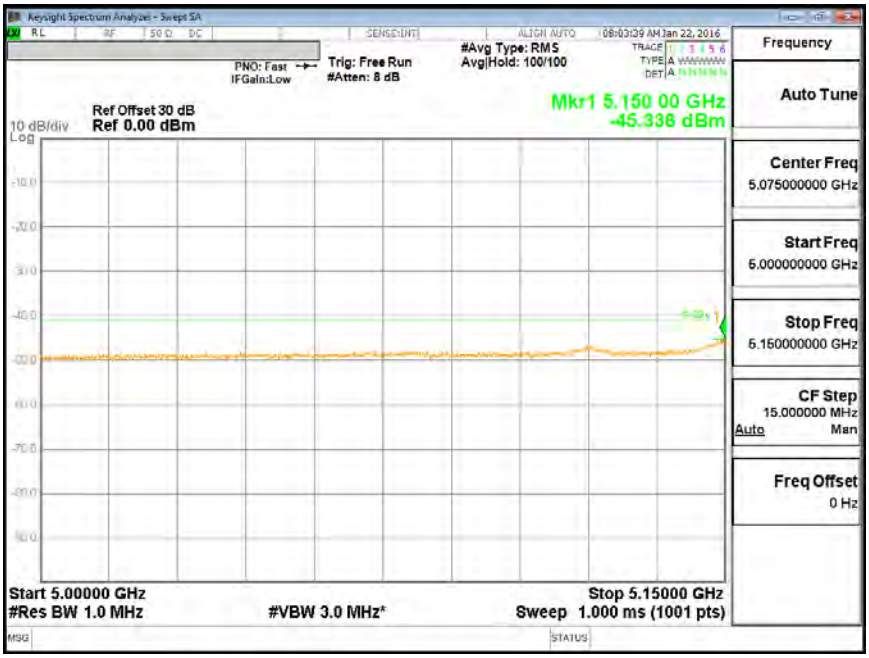


LOW CHANNEL BANDEDGE (5160 MHz), Chain 1

AUTHORIZED BAND EDGE Chain 1 LOW CH PEAK

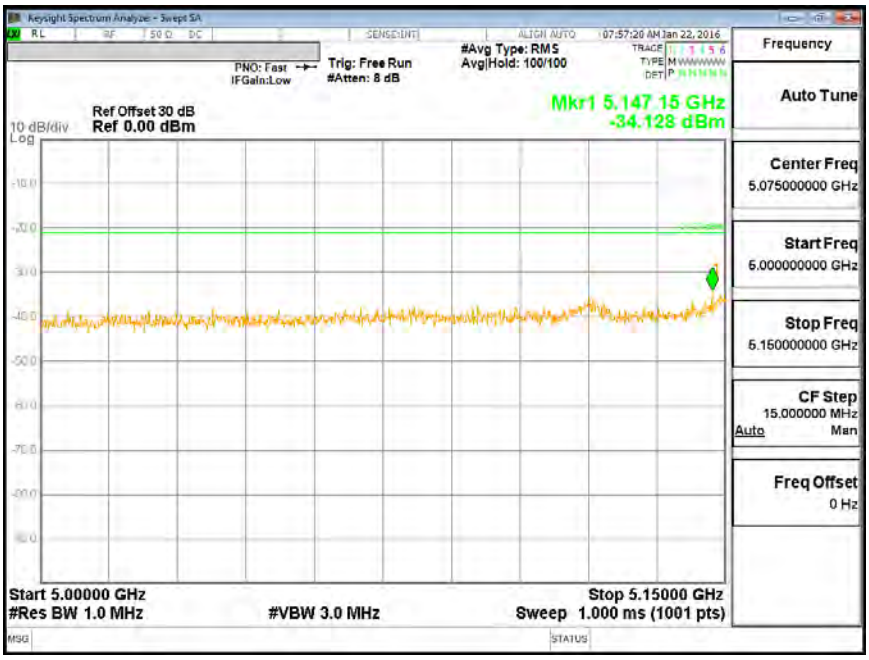


AUTHORIZED BAND EDGE Chain 1 LOW CH AVERAGE

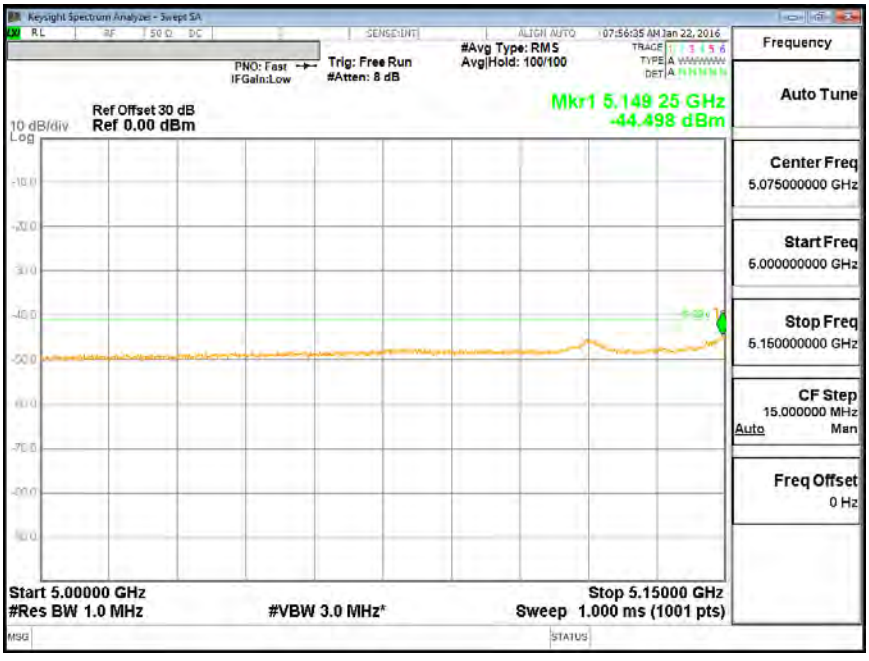


LOW CHANNEL BANDEDGE (5160 MHz), Chain 2

AUTHORIZED BAND EDGE Chain 2 LOW CH PEAK

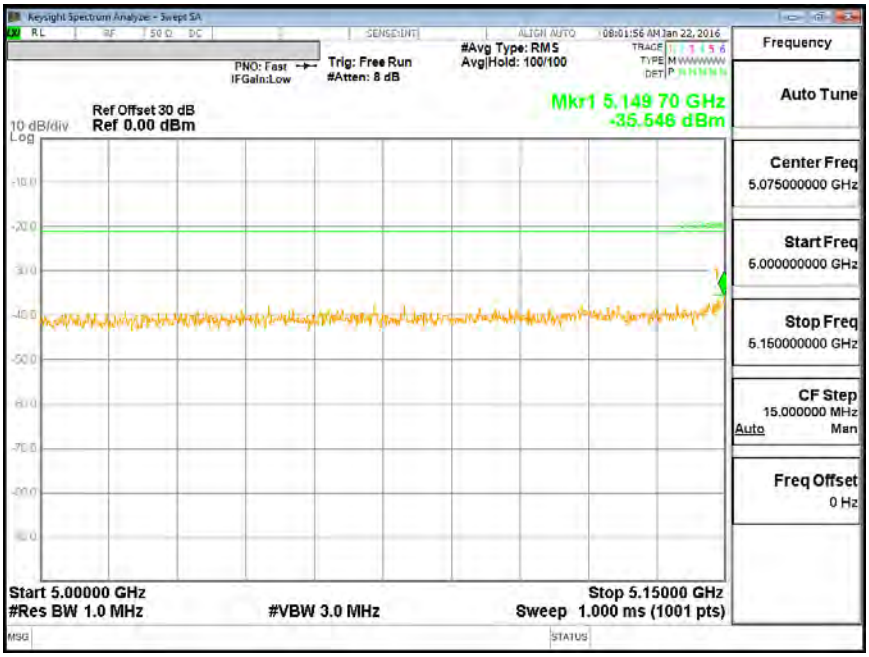


AUTHORIZED BAND EDGE Chain 2 LOW CH AVERAGE

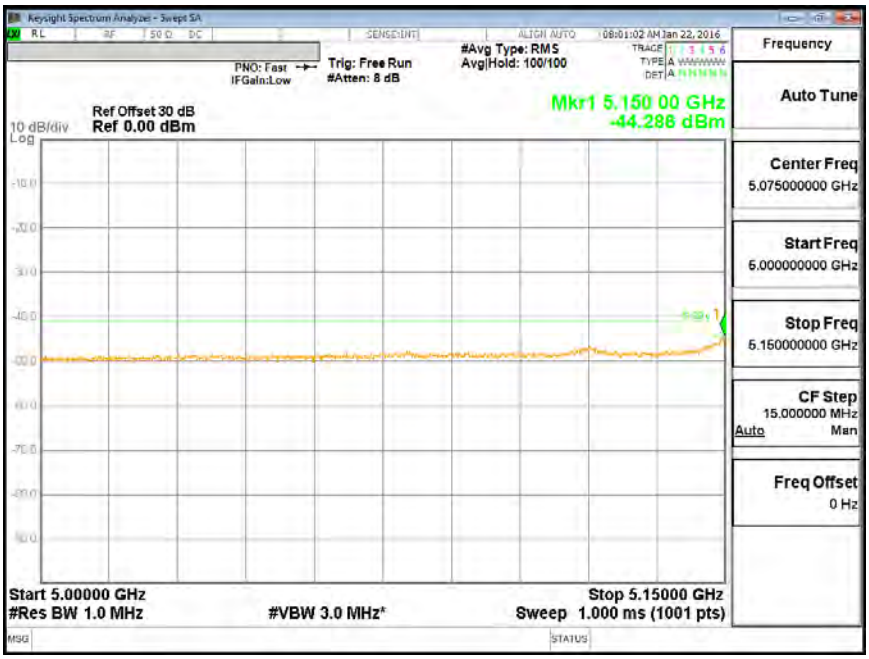


LOW CHANNEL BANDEDGE (5160 MHz), Chain 3

AUTHORIZED BAND EDGE Chain 3 LOW CH PEAK



AUTHORIZED BAND EDGE Chain 3 LOW CH AVERAGE



DATA

Peak

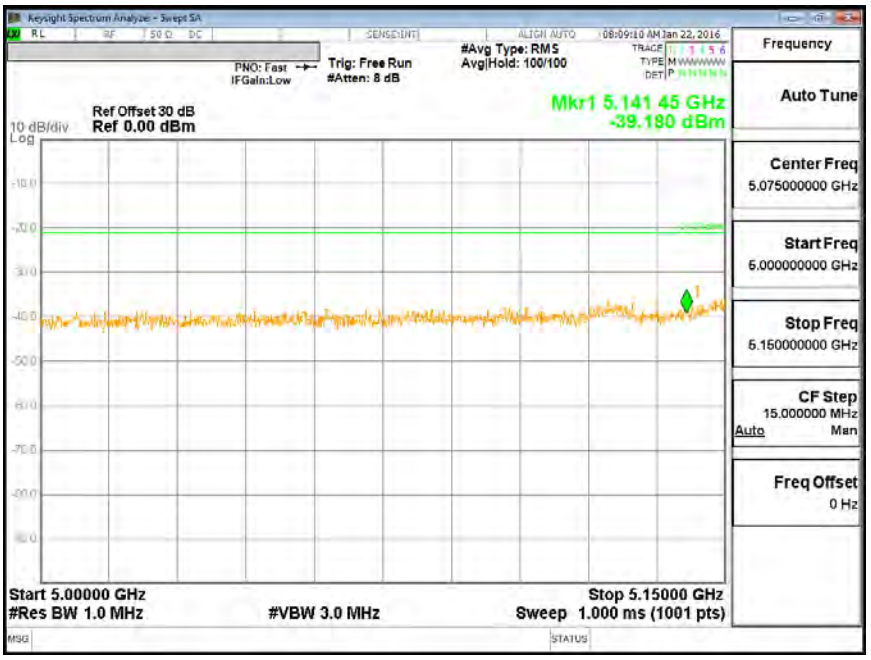
Frequency Range (MHz)	BW (MHz)	Polarity	Power, Chain 0 (dBm)	Power, Chain 2 (dBm)	Corrected (dBm)	Limit	Margin
5160	10	Horizontal	-38.05	-34.13	-33.80	-21.20	-12.60
		Polarity	**Power, Chain 1 (dBm)**	**Power, Chain 3 (dBm)**	**Corrected (dBm)**	**Limit**	**Margin**
		Vertical	-37.46	-35.55	-34.79	-21.20	-13.59

Average

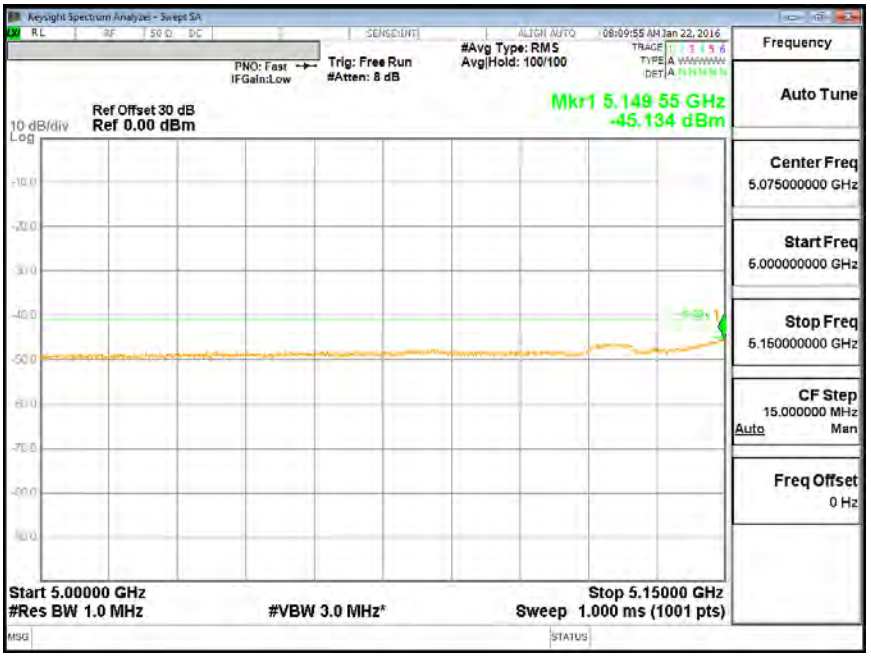
Frequency Range (MHz)	BW (MHz)	Polarity	Power, Chain 0 (dBm)	Power, Chain 2 (dBm)	Corrected (dBm)	Limit	Margin
5160	10	Horizontal	-45.39	-44.50	-43.39	-41.20	-2.19
		Polarity	**Power, Chain 1 (dBm)**	**Power, Chain 3 (dBm)**	**Corrected (dBm)**	**Limit**	**Margin**
		Vertical	-45.34	-44.29	-43.24	-41.20	-2.04

LOW CHANNEL BANDEDGE (5165 MHz), Chain 0

AUTHORIZED BAND EDGE Chain 0 LOW CH PEAK

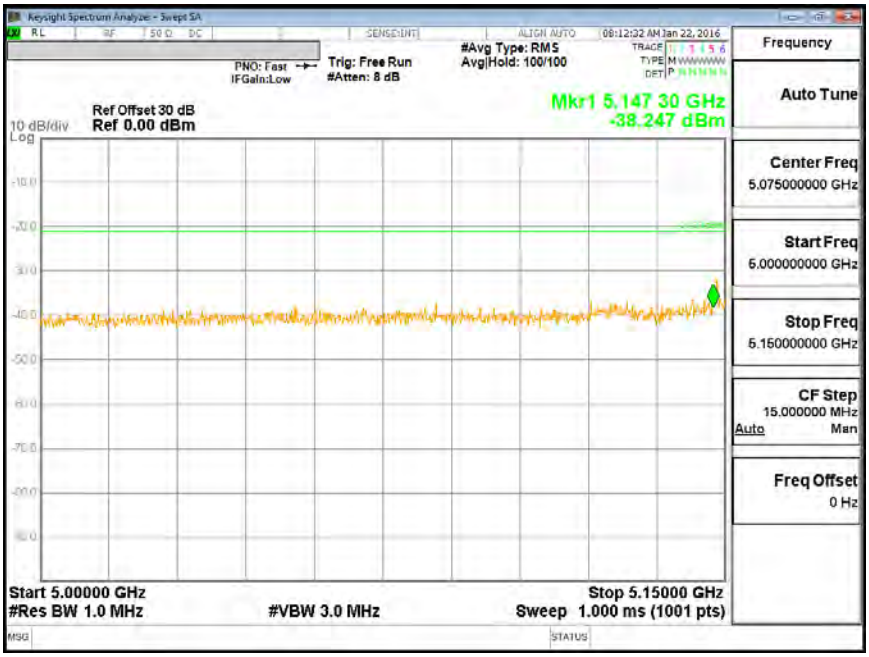


AUTHORIZED BAND EDGE Chain 0 LOW CH AVERAGE

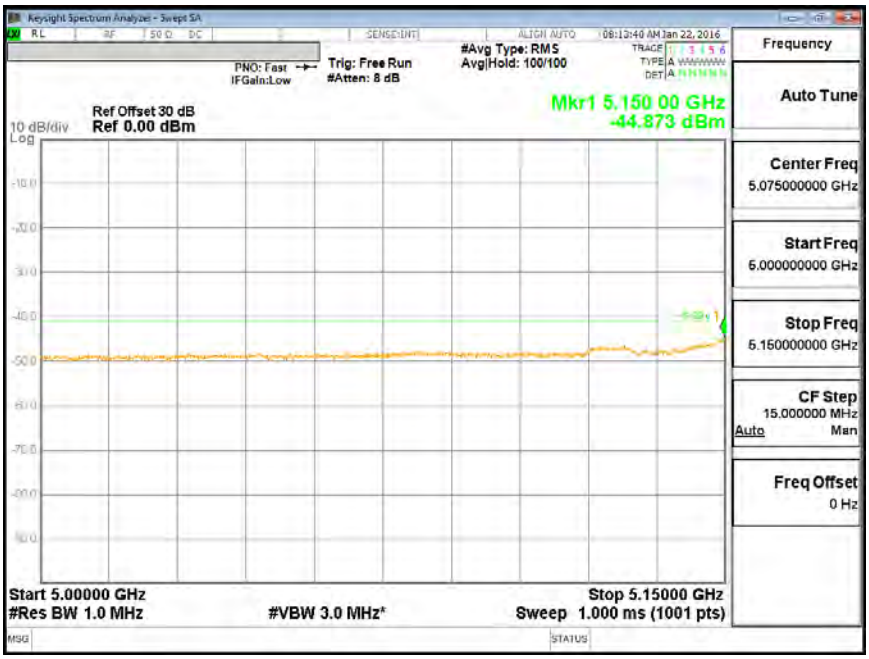


LOW CHANNEL BANDEDGE (5165 MHz), Chain 1

AUTHORIZED BAND EDGE Chain 1 LOW CH PEAK

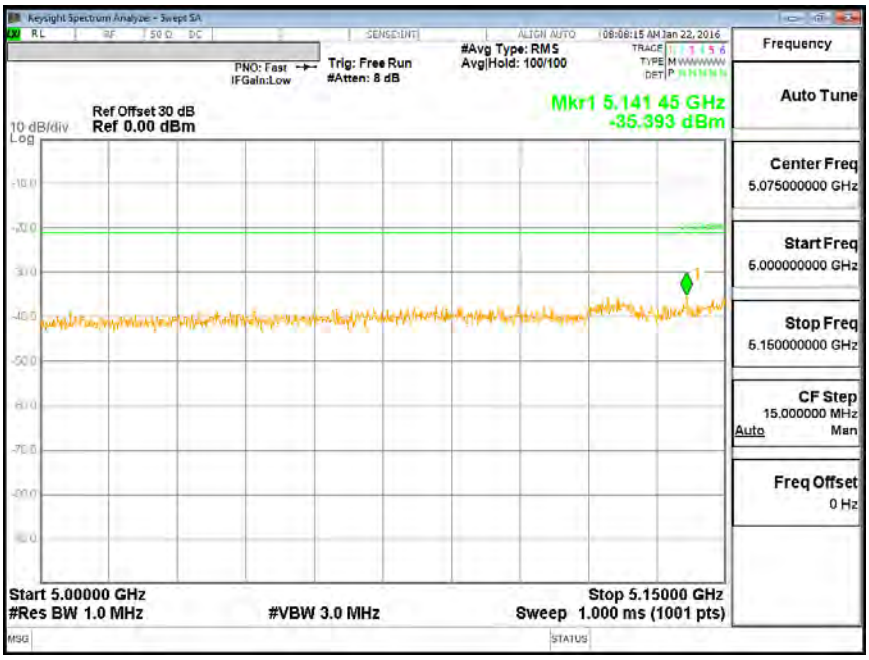


AUTHORIZED BAND EDGE Chain 1 LOW CH AVERAGE

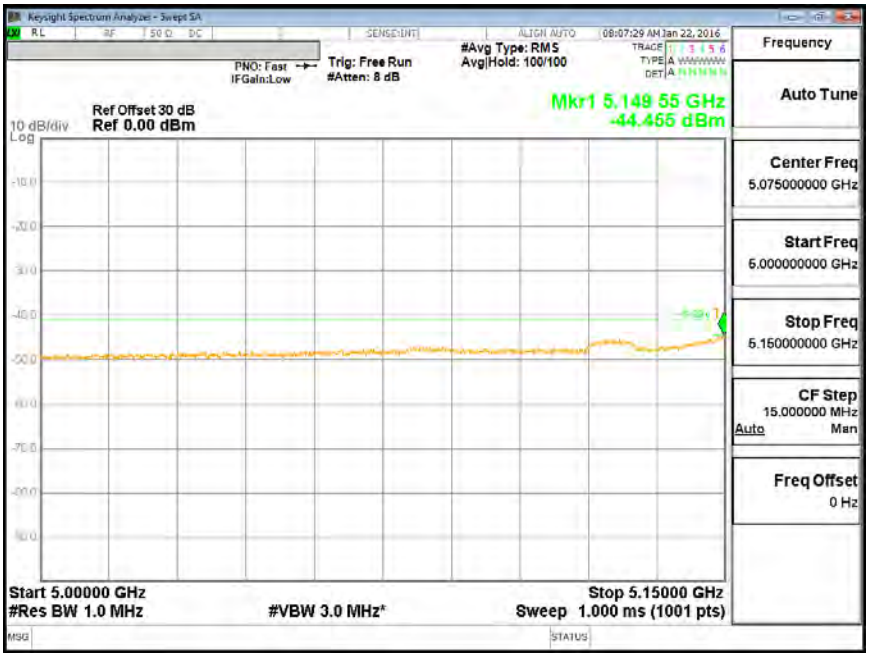


LOW CHANNEL BANDEDGE (5165 MHz), Chain 2

AUTHORIZED BAND EDGE Chain 2 LOW CH PEAK

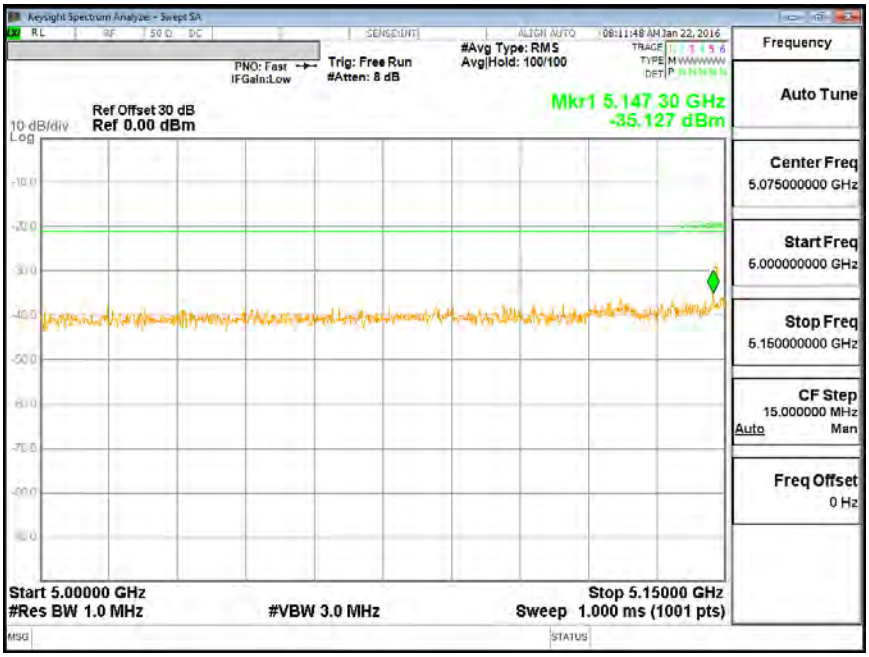


AUTHORIZED BAND EDGE Chain 2 LOW CH AVERAGE

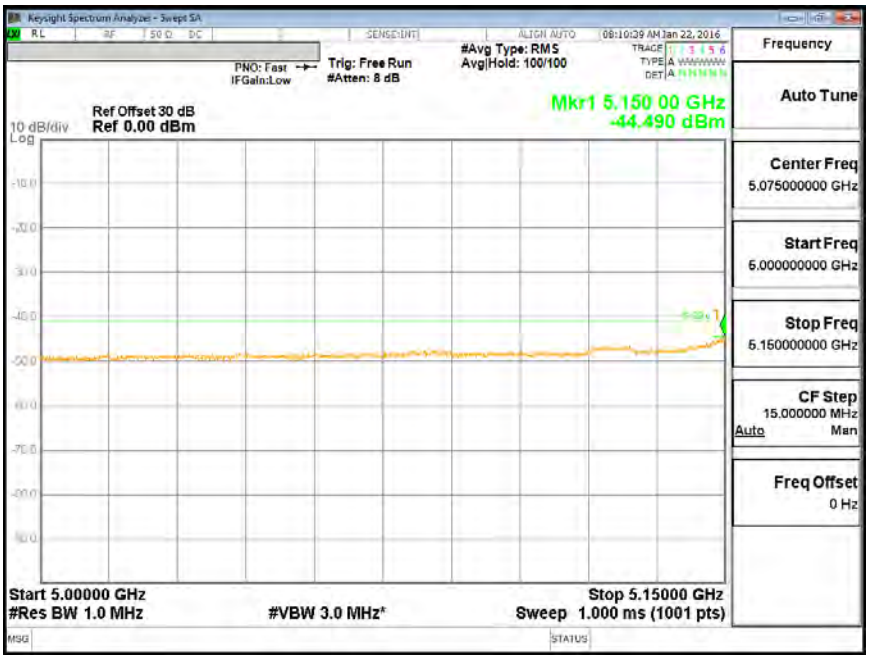


LOW CHANNEL BANDEDGE (5165 MHz), Chain 3

AUTHORIZED BAND EDGE Chain 3 LOW CH PEAK



AUTHORIZED BAND EDGE Chain 3 LOW CH AVERAGE



DATA

Peak

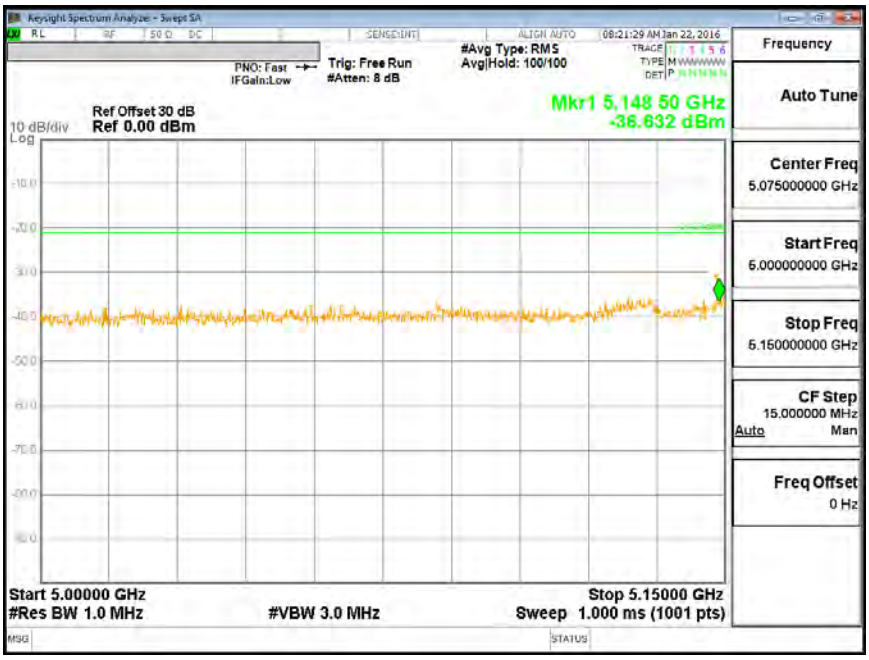
Frequency Range (MHz)	BW (MHz)	Polarity	Power, Chain 0 (dBm)	Power, Chain 2 (dBm)	Corrected (dBm)	Limit	Margin
5165	10	Horizontal	-39.18	-35.39	-35.04	-21.20	-13.84
		Polarity	**Power, Chain 1 (dBm)**	**Power, Chain 3 (dBm)**	**Corrected (dBm)**	**Limit**	**Margin**
		Vertical	-38.25	-35.13	-34.66	-21.20	-13.46

Average

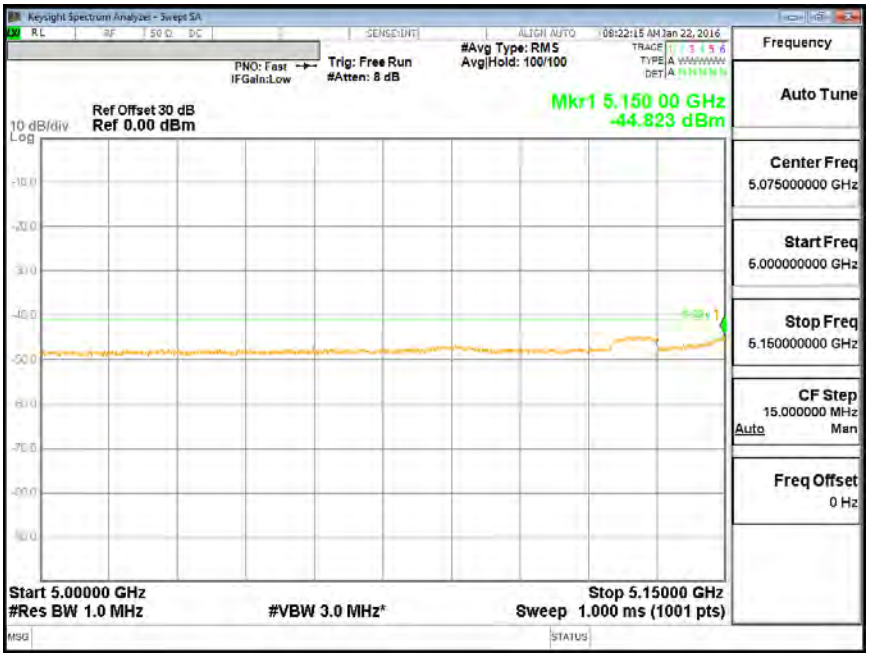
Frequency Range (MHz)	BW (MHz)	Polarity	Power, Chain 0 (dBm)	Power, Chain 2 (dBm)	Corrected (dBm)	Limit	Margin
5165	10	Horizontal	-45.13	-44.46	-43.26	-41.20	-2.06
		Polarity	**Power, Chain 1 (dBm)**	**Power, Chain 3 (dBm)**	**Corrected (dBm)**	**Limit**	**Margin**
		Vertical	-44.87	-44.49	-43.17	-41.20	-1.97

LOW CHANNEL BANDEDGE (5170 MHz), Chain 0

AUTHORIZED BAND EDGE Chain 0 LOW CH PEAK

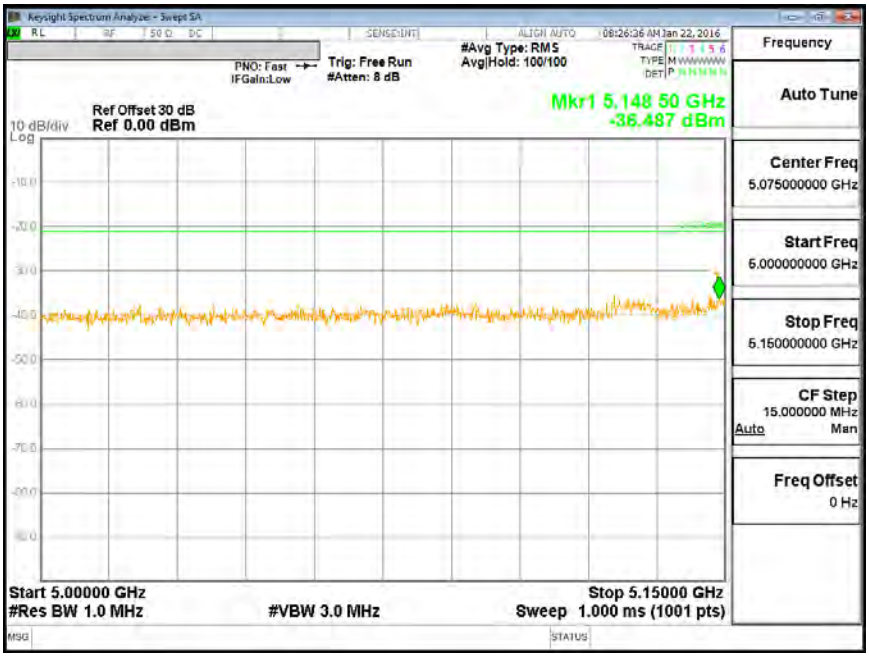


AUTHORIZED BAND EDGE Chain 0 LOW CH AVERAGE

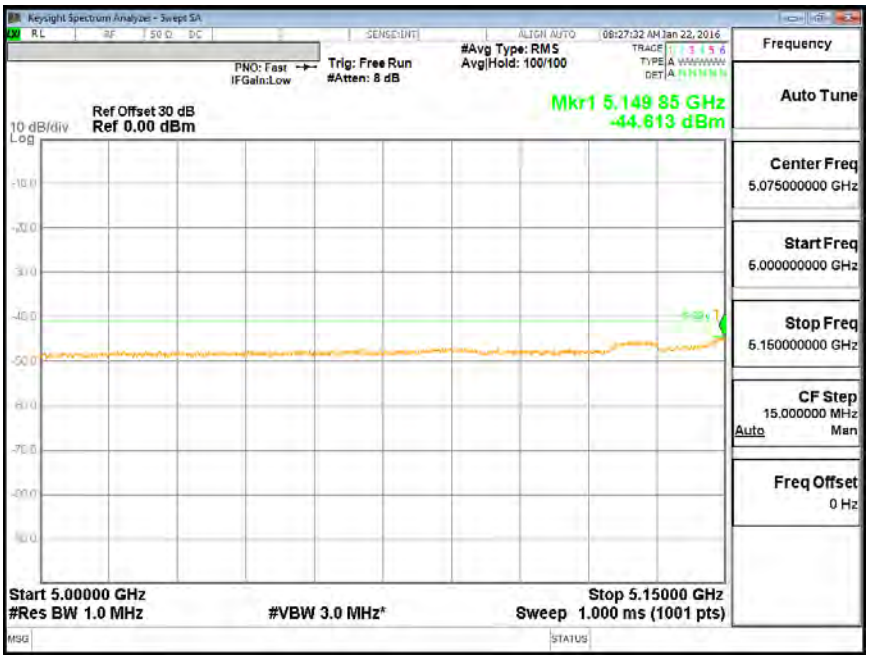


LOW CHANNEL BANDEDGE (5170 MHz), Chain 1

AUTHORIZED BAND EDGE Chain 1 LOW CH PEAK

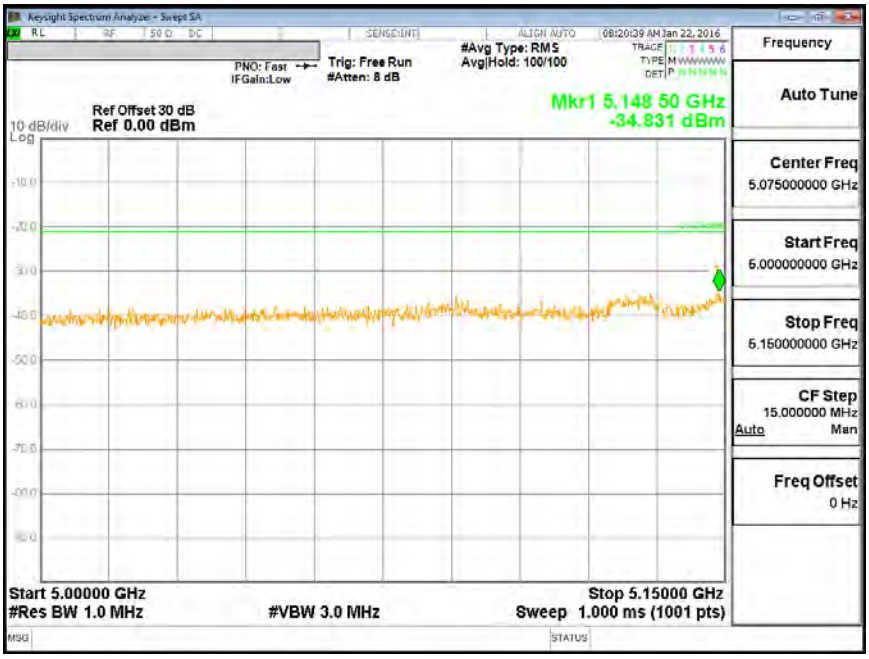


AUTHORIZED BAND EDGE Chain 1 LOW CH AVERAGE

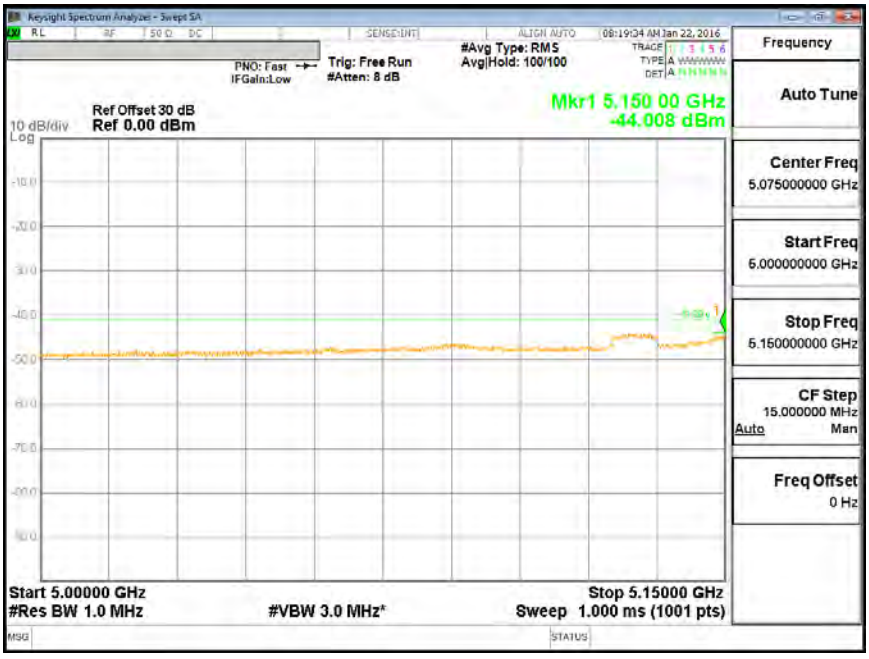


LOW CHANNEL BANDEDGE (5170 MHz), Chain 2

AUTHORIZED BAND EDGE Chain 2 LOW CH PEAK

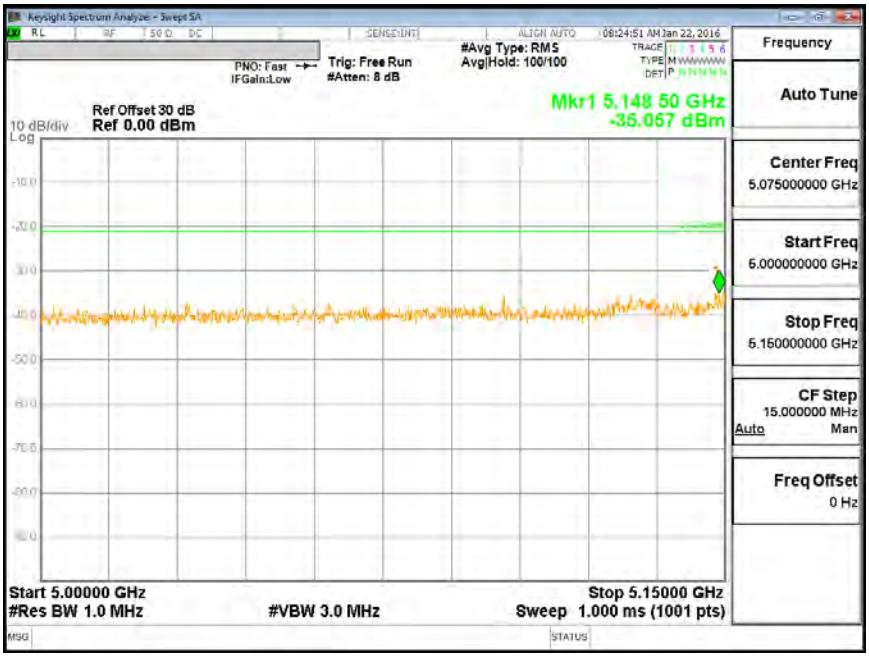


AUTHORIZED BAND EDGE Chain 2 LOW CH AVERAGE

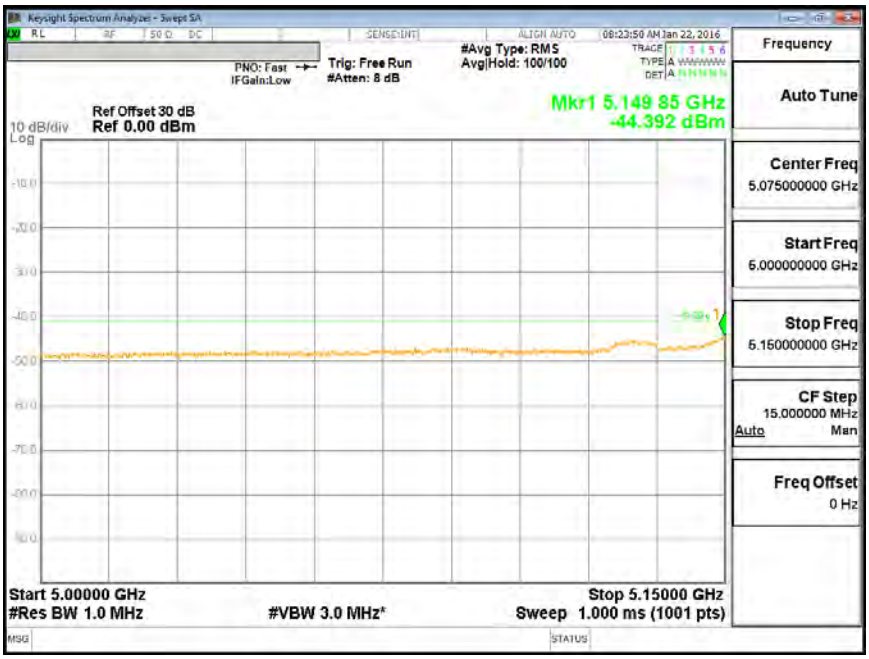


LOW CHANNEL BANDEDGE (5170 MHz), Chain 3

AUTHORIZED BAND EDGE Chain 3 LOW CH PEAK



AUTHORIZED BAND EDGE Chain 3 LOW CH AVERAGE



DATA

Peak

Frequency Range (MHz)	BW (MHz)	Polarity	Power, Chain 0 (dBm)	Power, Chain 2 (dBm)	Corrected (dBm)	Limit	Margin
5170	10	Horizontal	-36.63	-34.83	-34.04	-21.20	-12.84
		Polarity	**Power, Chain 1 (dBm)**	**Power, Chain 3 (dBm)**	**Corrected (dBm)**	**Limit**	**Margin**
		Vertical	-36.49	-35.06	-34.15	-21.20	-12.95

Average

Frequency Range (MHz)	BW (MHz)	Polarity	Power, Chain 0 (dBm)	Power, Chain 2 (dBm)	Corrected (dBm)	Limit	Margin
5170	10	Horizontal	-44.82	-44.01	-42.87	-41.20	-1.67
		Polarity	**Power, Chain 1 (dBm)**	**Power, Chain 3 (dBm)**	**Corrected (dBm)**	**Limit**	**Margin**
		Vertical	-44.61	-44.39	-42.99	-41.20	-1.79

8.3. 20MHz BW, 4TX MODE IN THE 5.2 GHz BAND

8.3.1. 26 dB BANDWIDTH

LIMITS

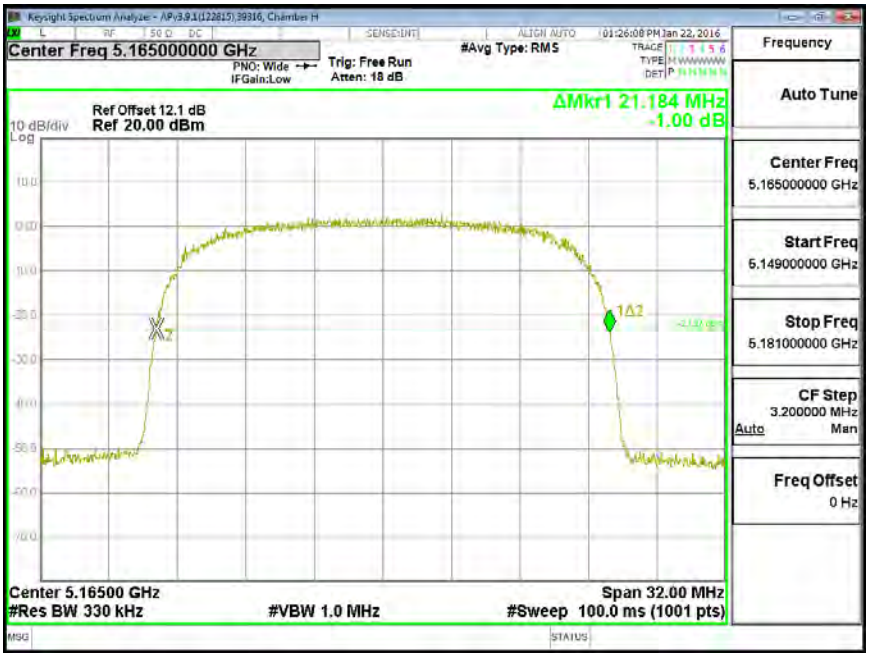
None; for reporting purposes only.

RESULTS

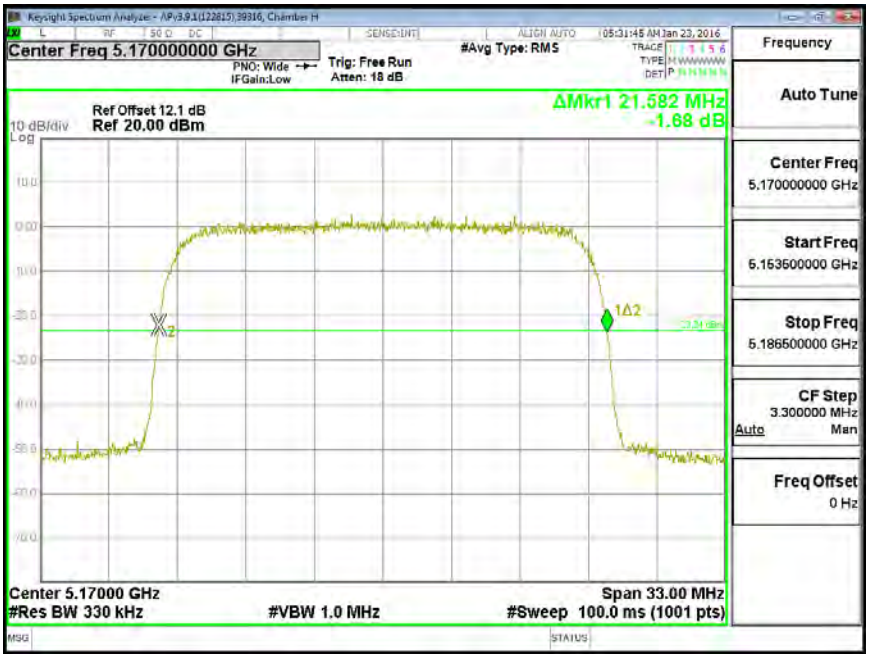
Channel	Frequency (MHz)	26 dB BW Chain 0 (MHz)	26 dB BW Chain 1 (MHz)	26 dB BW Chain 2 (MHz)	26 dB BW Chain 3 (MHz)
Low 1	5165	21.184	21.120	21.248	21.088
Low 2	5170	21.582	21.648	21.648	21.681
Low 3	5175	21.648	21.648	21.582	21.615
Mid	5180	21.648	21.615	21.615	21.648
High 1	5195	21.648	21.648	21.648	21.648
High 2	5200	21.648	21.615	21.681	21.582
High 3	5235	21.648	21.648	21.648	21.582

26 dB BANDWIDTH, Chain 0

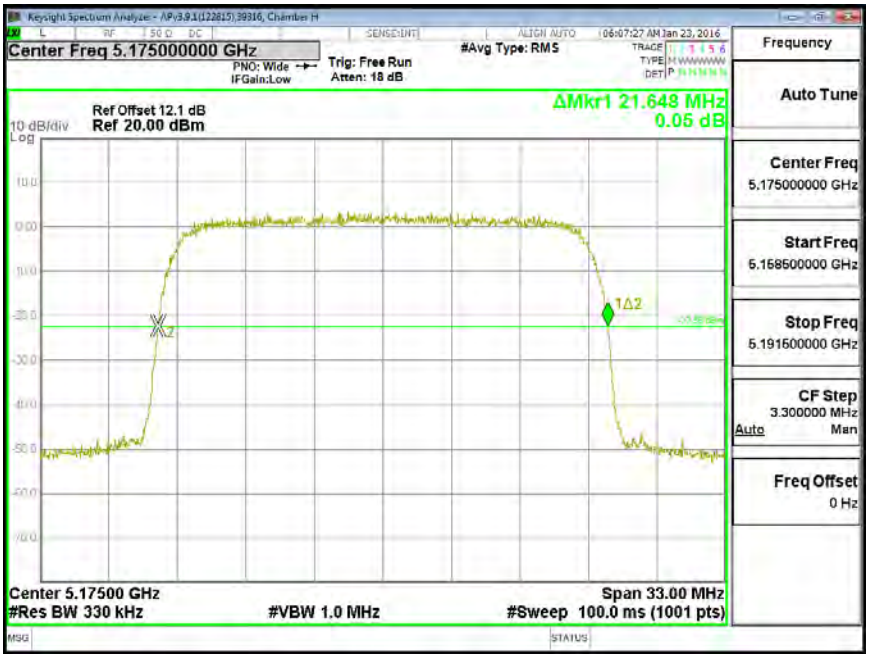
BANDWIDTH Chain 0 LOW 1 CH



BANDWIDTH Chain 0 LOW 2 CH

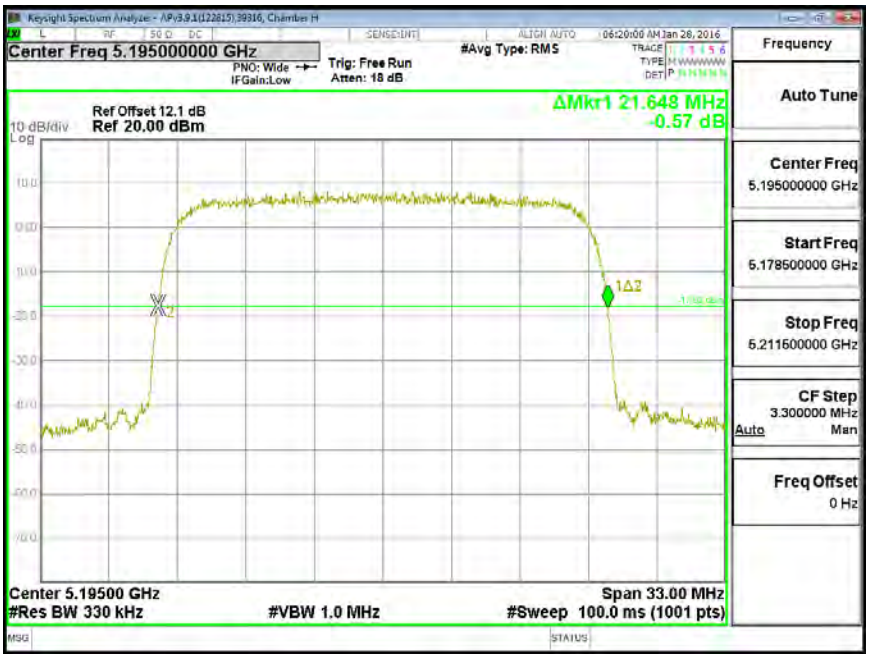


BANDWIDTH Chain 0 LOW 3 CH



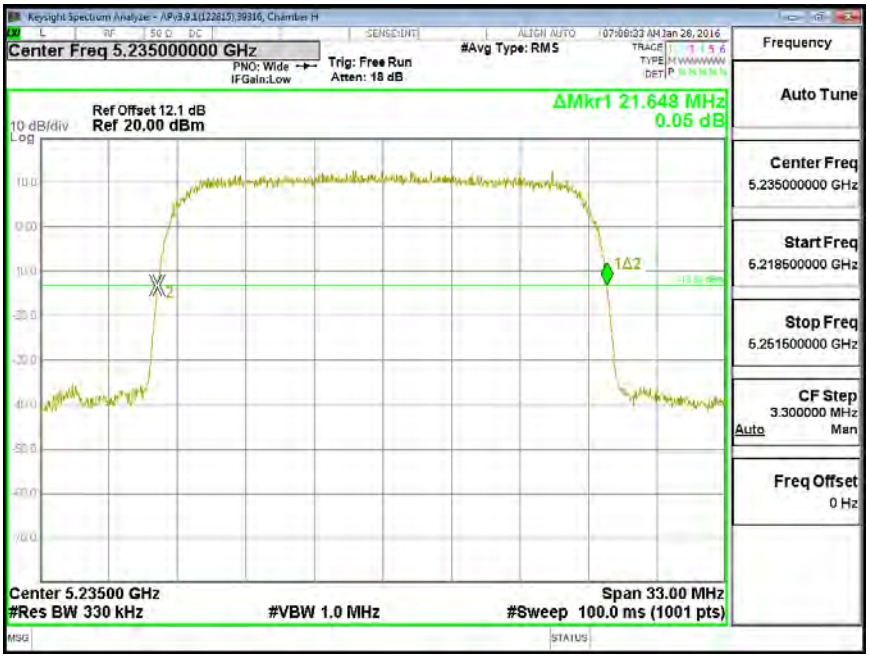
BANDWIDTH Chain 0 MID CH

BANDWIDTH Chain 0 HIGH 1 CH



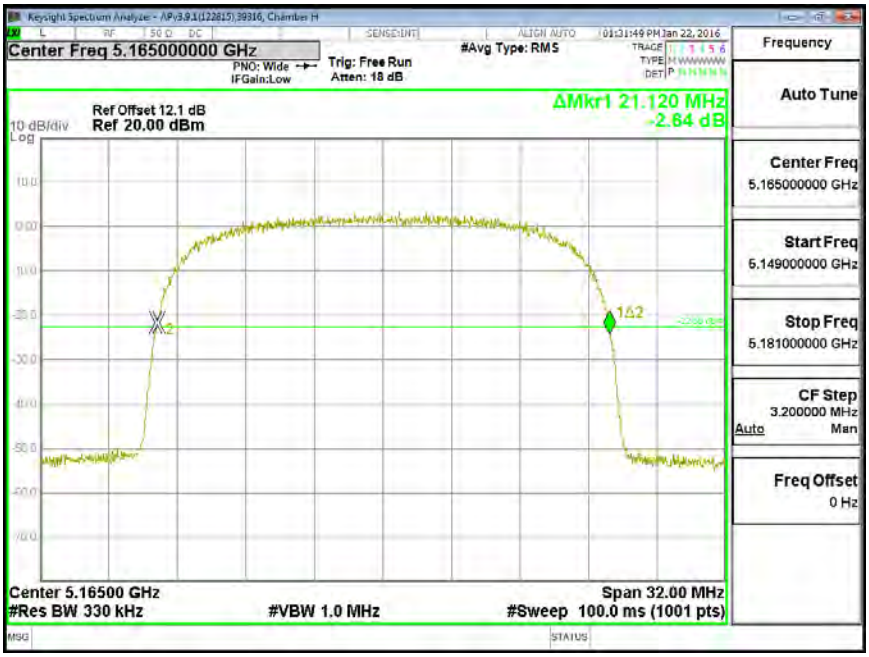
BANDWIDTH Chain 0 HIGH 2 CH

BANDWIDTH Chain 0 HIGH 3 CH

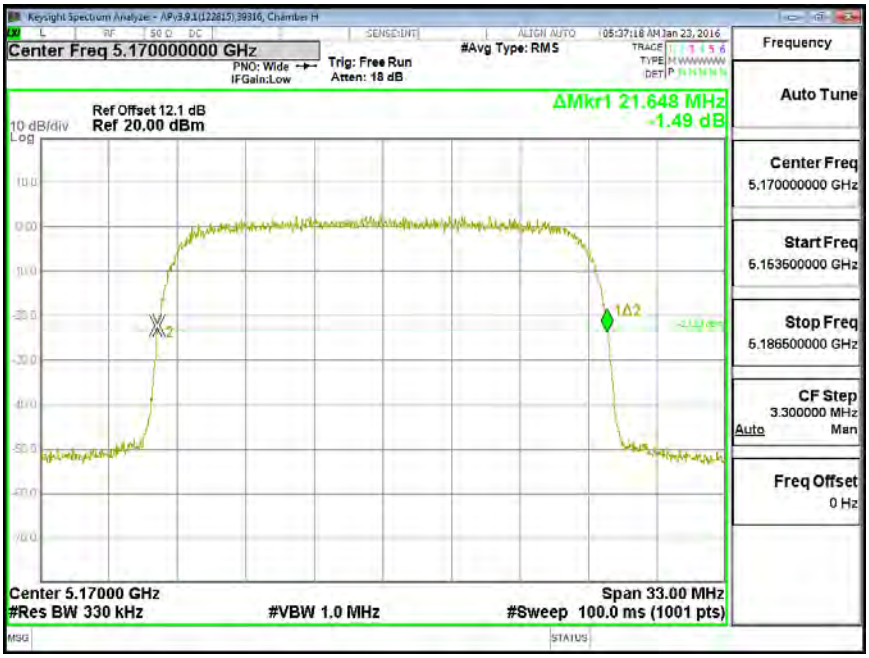


26 dB BANDWIDTH, Chain 1

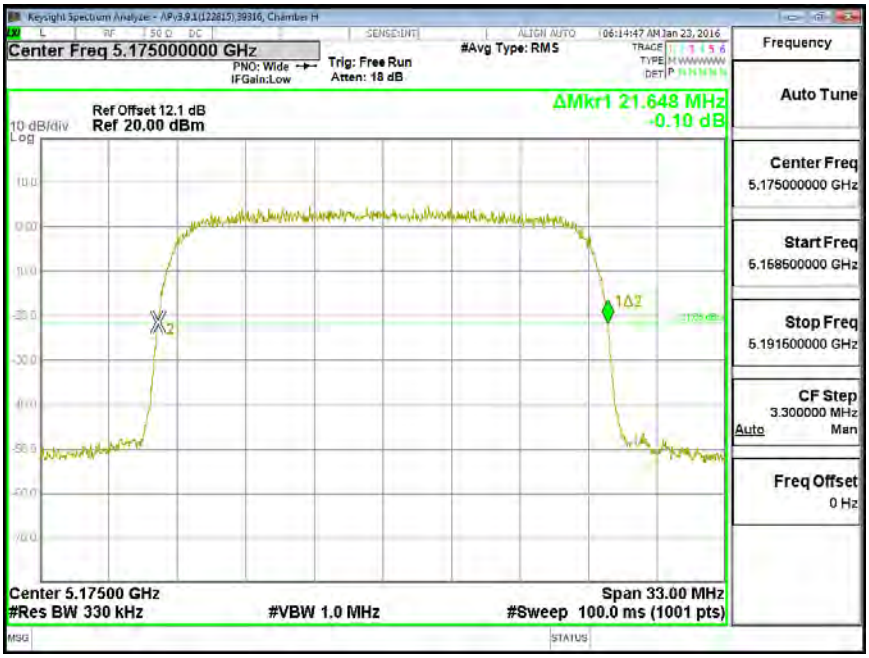
BANDWIDTH Chain 1 LOW 1 CH



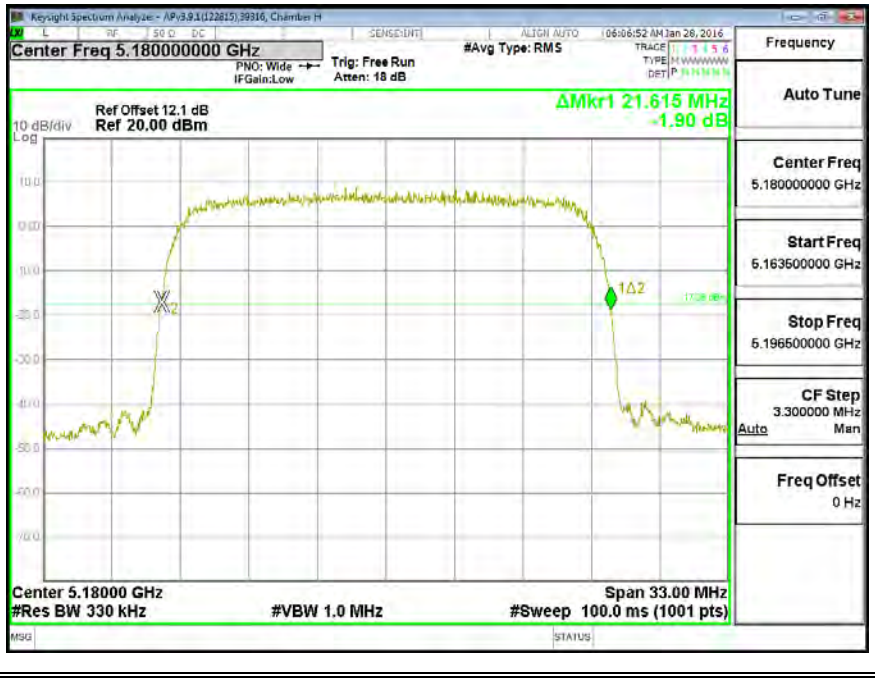
BANDWIDTH Chain 1 LOW 2 CH



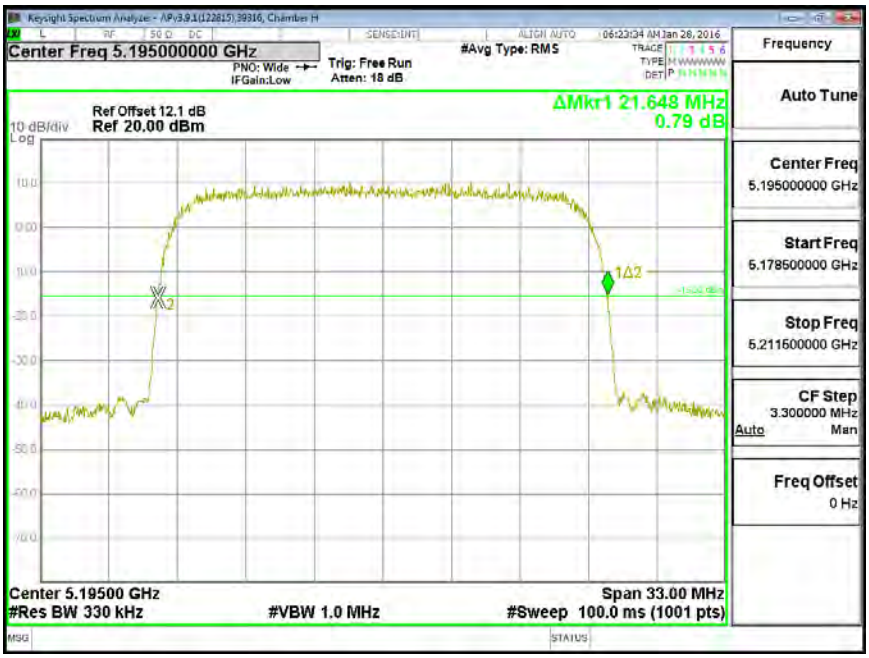
BANDWIDTH Chain 1 LOW 3 CH



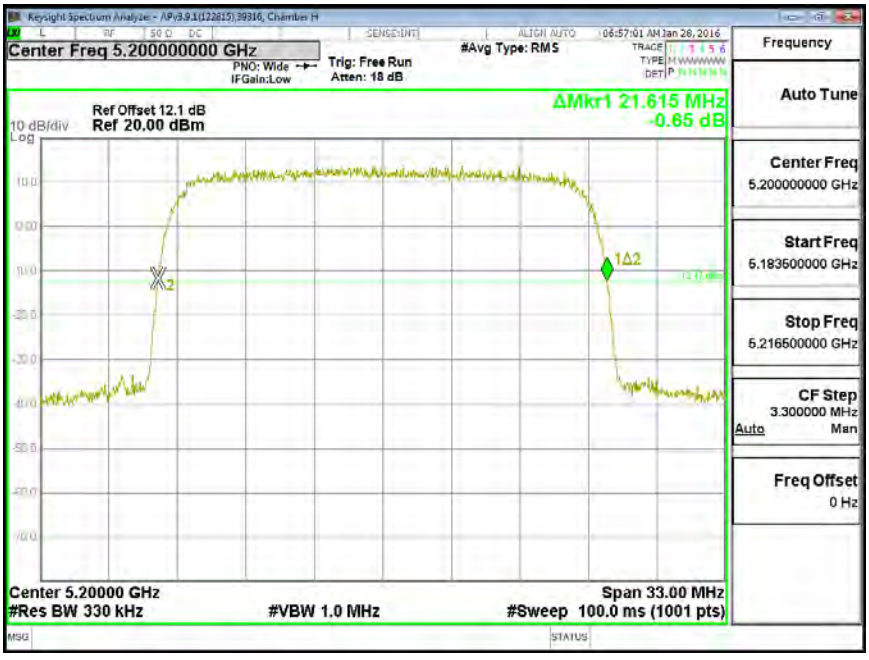
BANDWIDTH Chain 1 MID CH



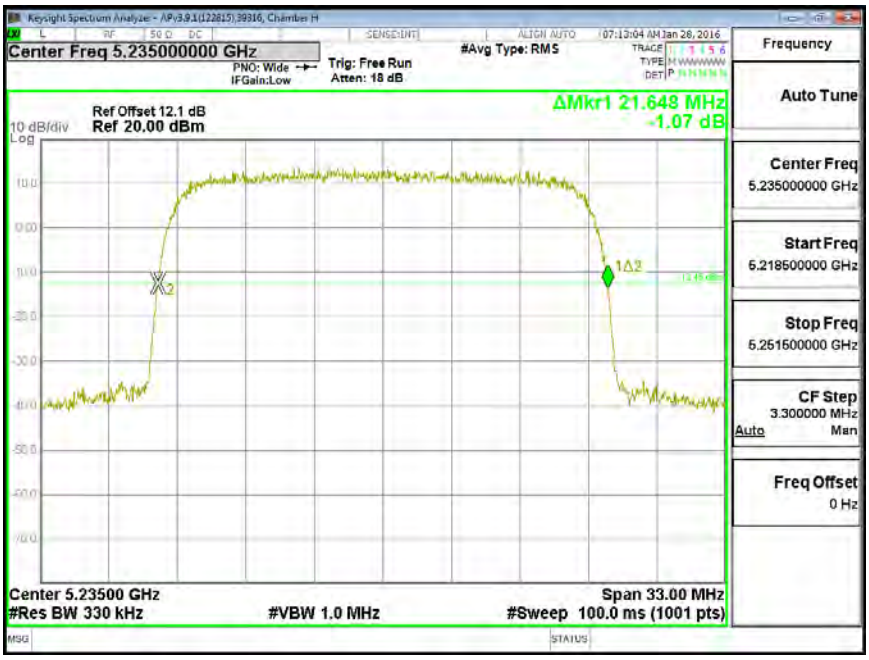
BANDWIDTH Chain 1 HIGH 1 CH



BANDWIDTH Chain 1 HIGH 2 CH

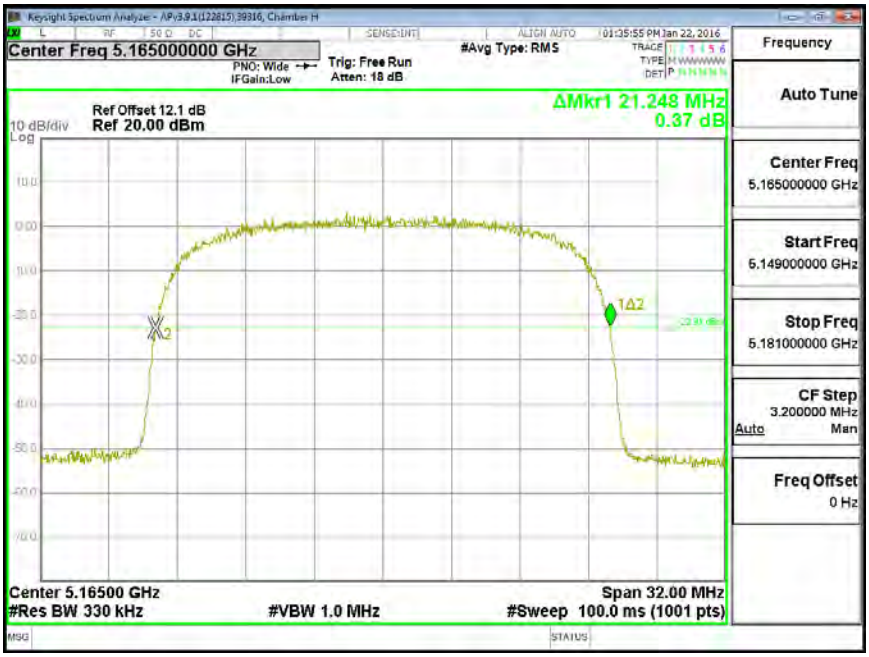


BANDWIDTH Chain 1 HIGH 3 CH

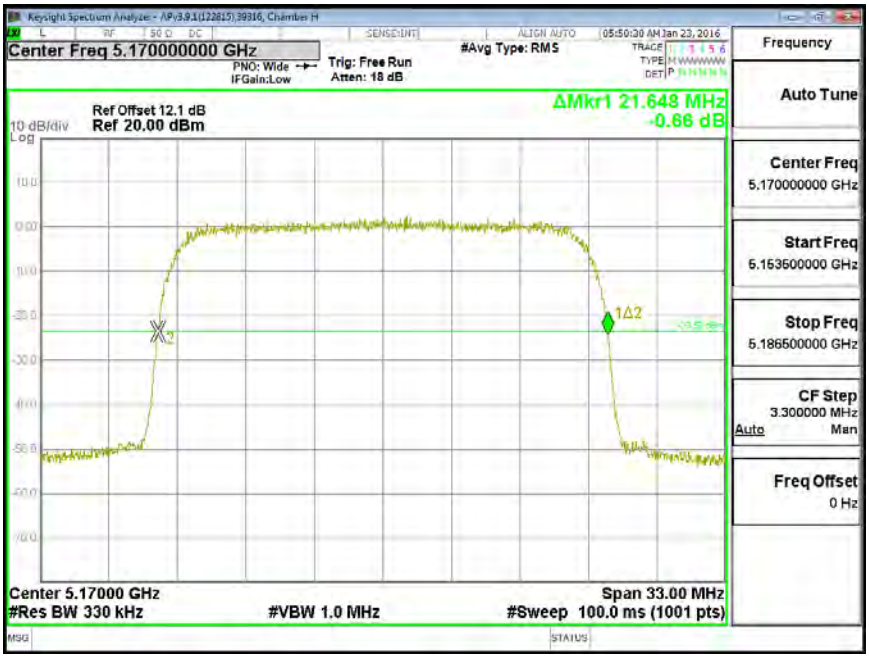


26 dB BANDWIDTH, Chain 2

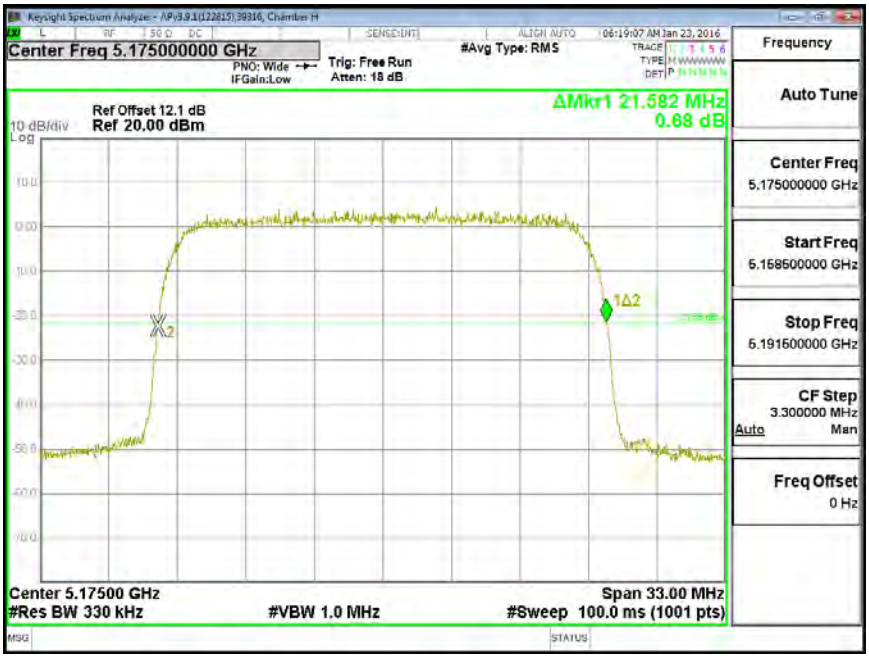
BANDWIDTH Chain 2 LOW 1 CH



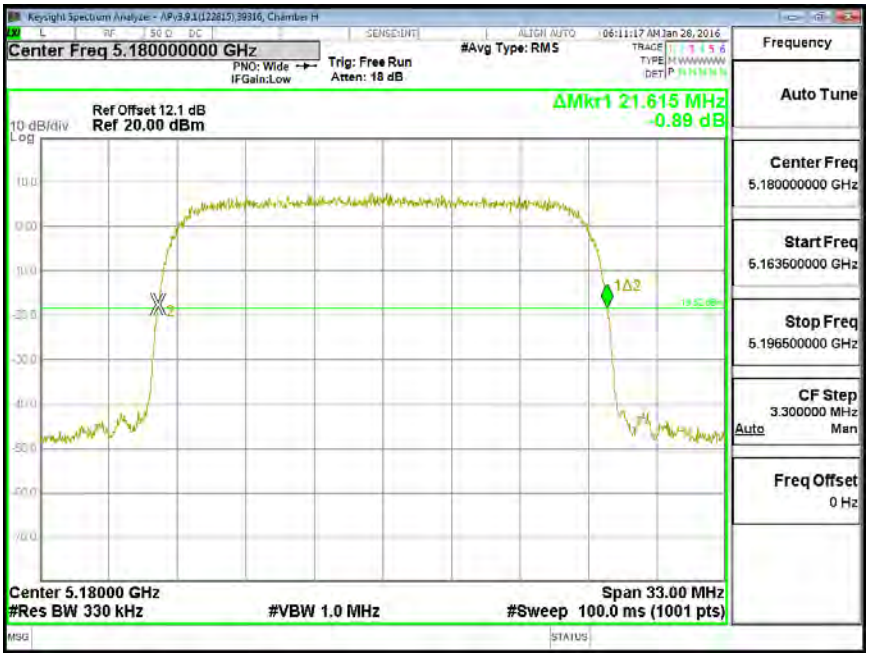
BANDWIDTH Chain 2 LOW 2 CH



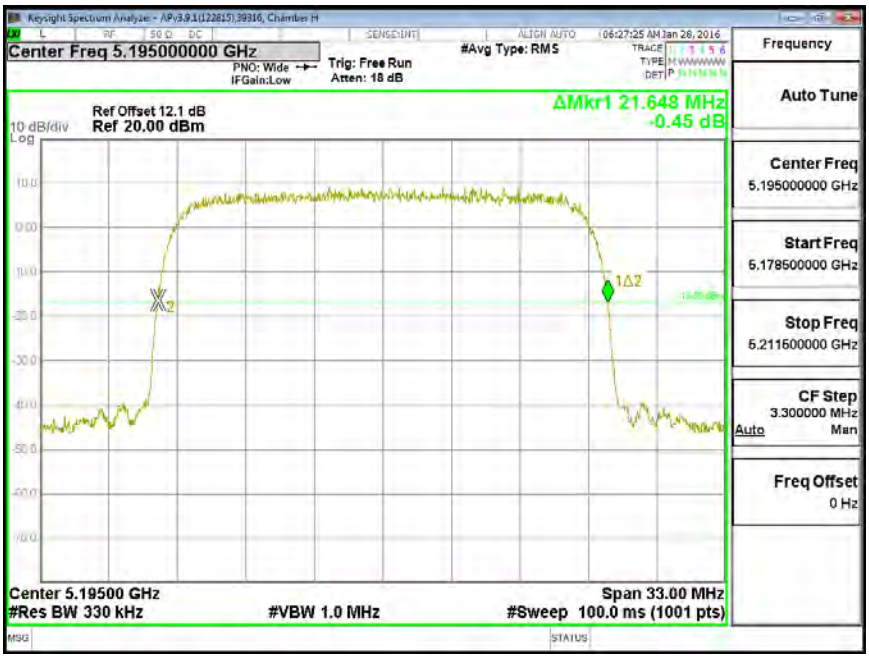
BANDWIDTH Chain 2 LOW 3 CH



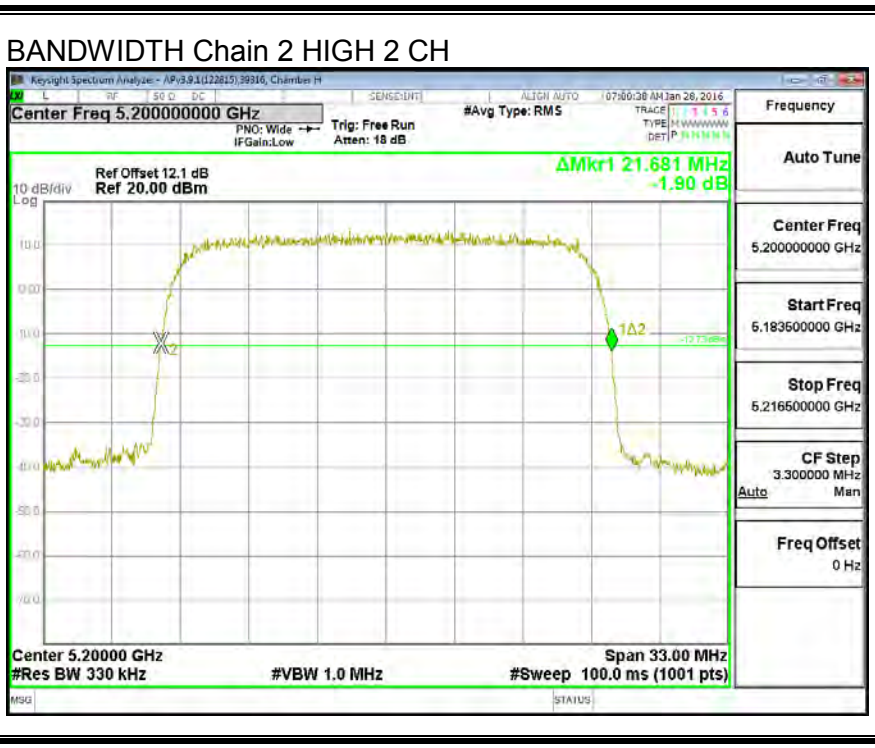
BANDWIDTH Chain 2 MID CH



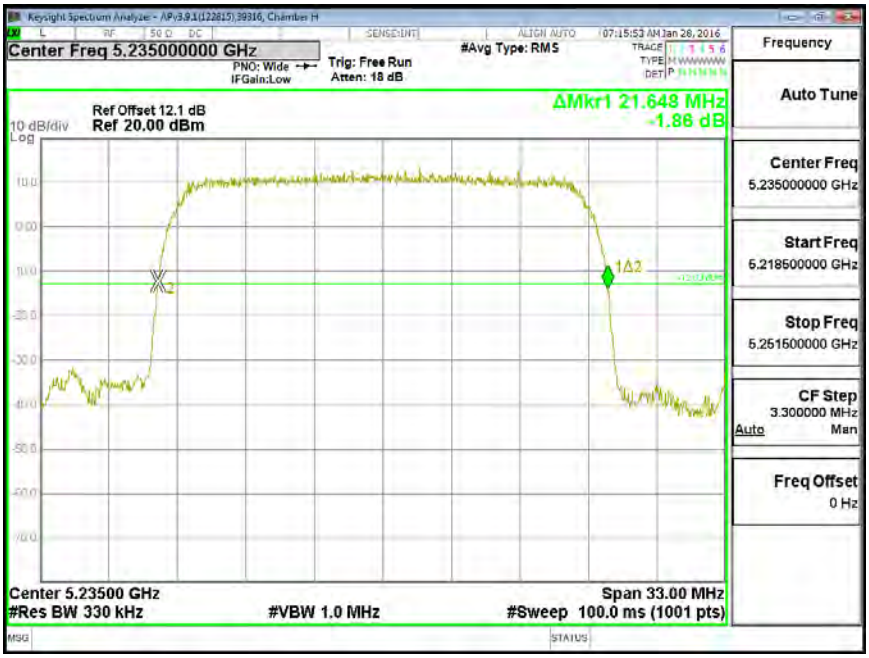
BANDWIDTH Chain 2 HIGH 1 CH



BANDWIDTH Chain 2 HIGH 2 CH

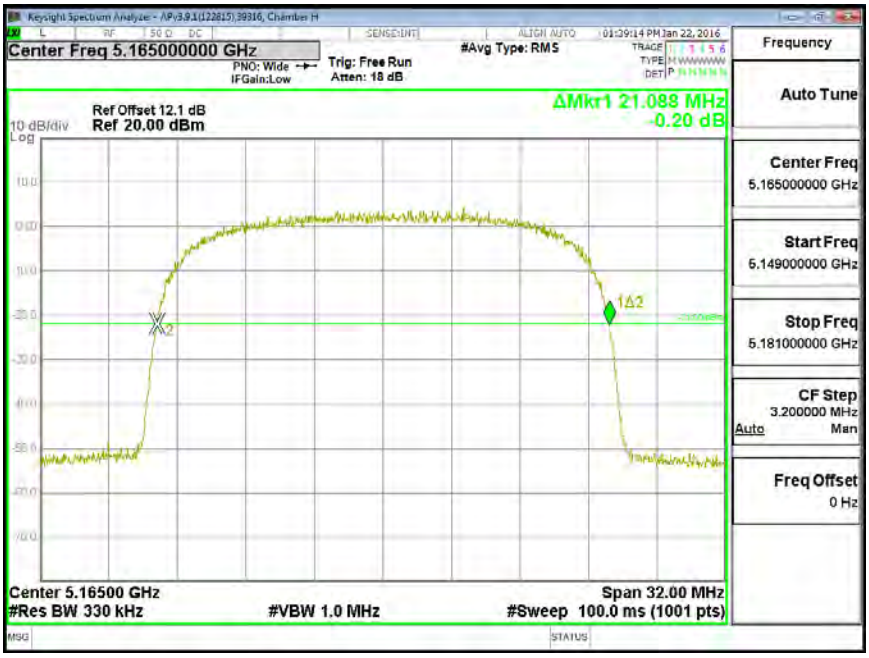


BANDWIDTH Chain 2 HIGH 3 CH

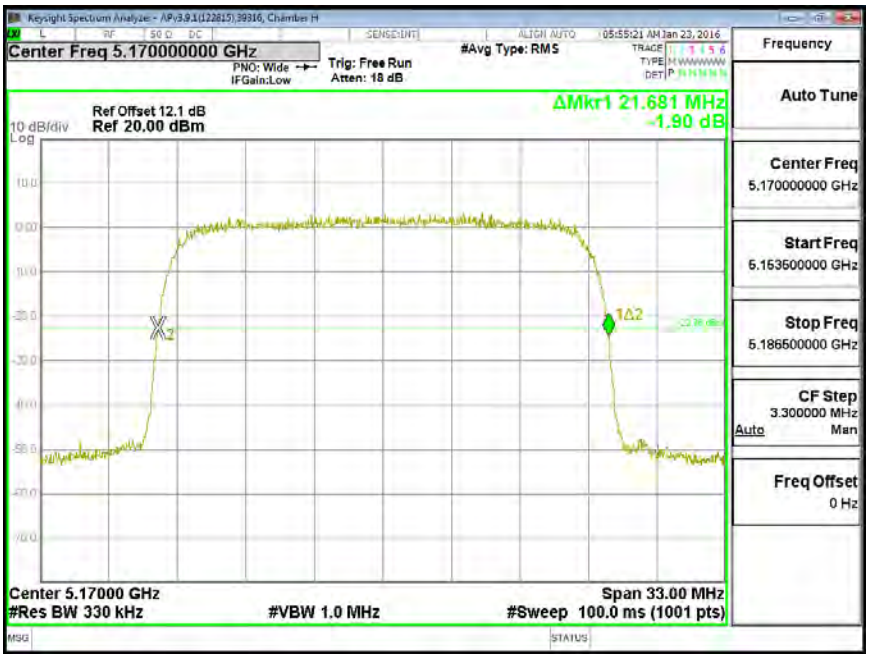


26 dB BANDWIDTH, Chain 3

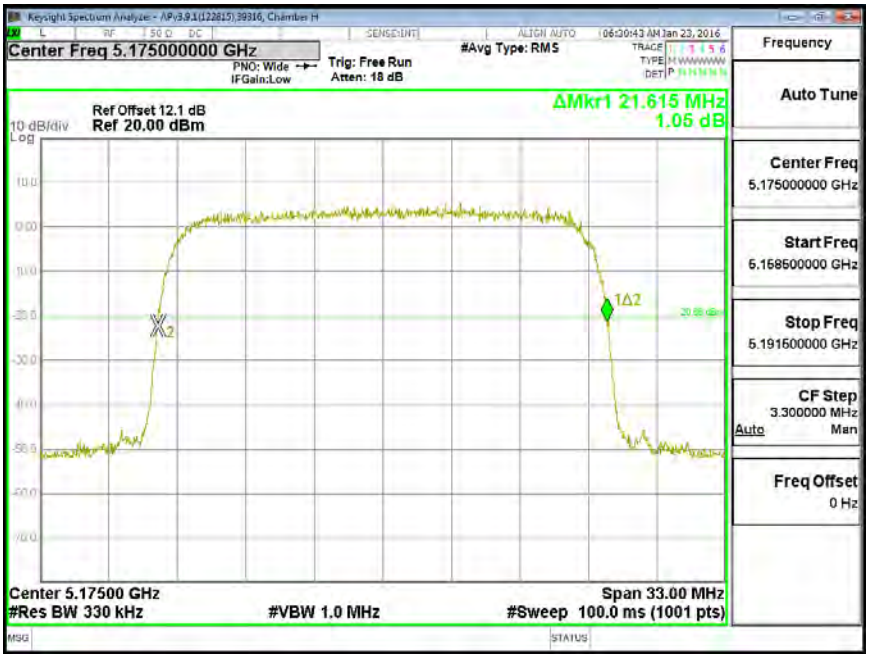
BANDWIDTH Chain 3 LOW 1 CH



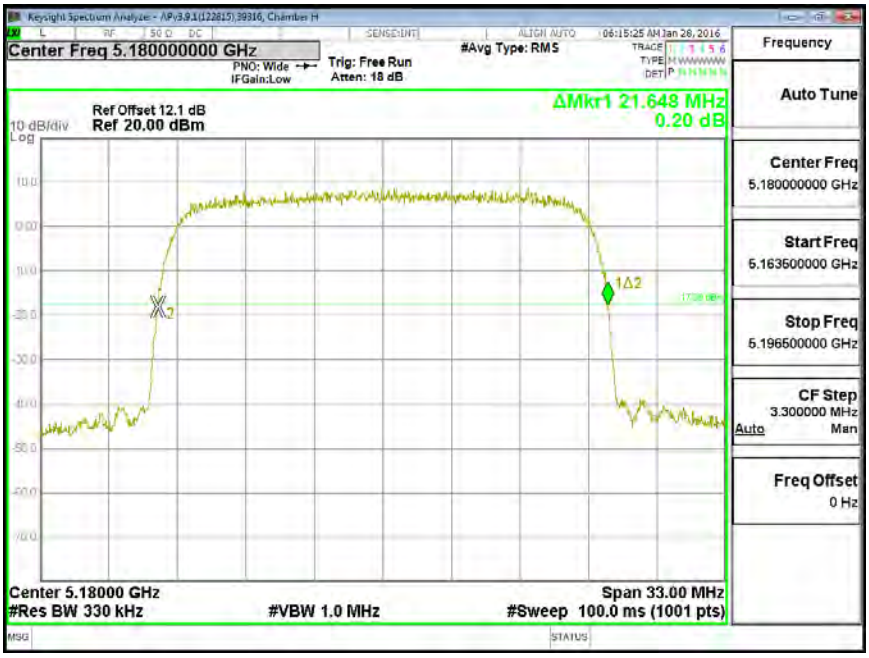
BANDWIDTH Chain 3 LOW 2 CH



BANDWIDTH Chain 3 LOW 3 CH

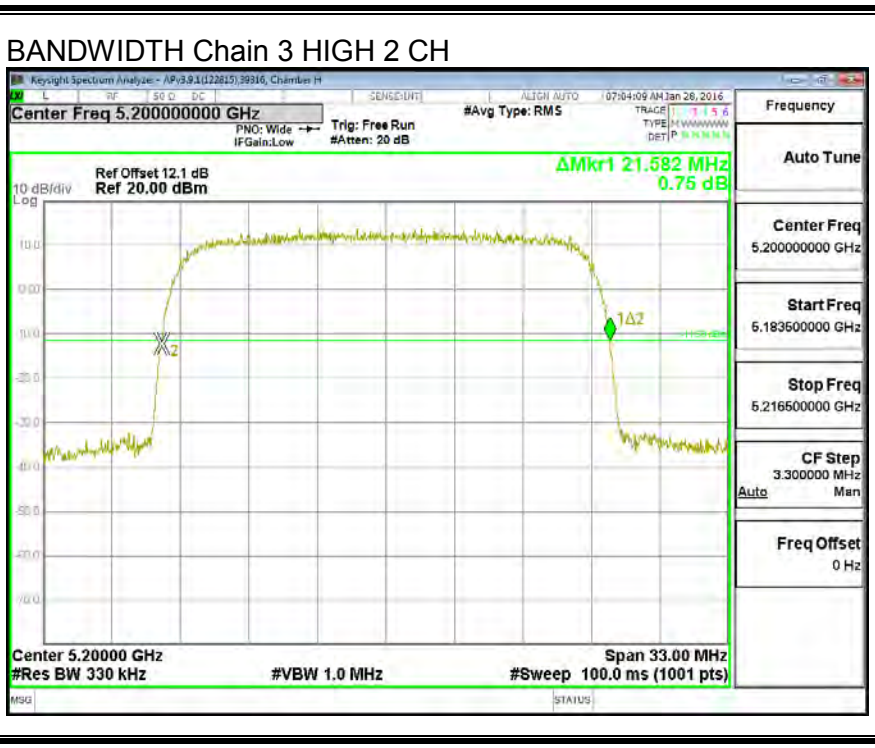


BANDWIDTH Chain 3 MID CH



BANDWIDTH Chain 3 HIGH 1 CH

BANDWIDTH Chain 3 HIGH 2 CH



BANDWIDTH Chain 3 HIGH 3 CH

8.3.2. 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

There are a total of four antennas; two horizontal antennas (chains 0 and 2) and two vertical antennas (chains 1 and 3). Horizontal antennas are cross polarized with respect to vertical antennas

Two TX chains are correlated and two others are uncorrelated and the antenna gain is the same for each chain. The directional gain is;.

Antenna Gain (dBi)	10 * Log (2 chains) (dB)	Correlated Chains Directional Gain (dBi)
15.00	3.01	18.01

RESULTS

Antenna Gain and Limits

Channel	Frequency (MHz)	Directional Gain for Power (dBi)	Directional Gain for PSD (dBi)	Power Limit (dBm)	PSD Limit (dBm)
Low1	5165	18.01	18.01	30.00	17.00
Low2	5170	18.01	18.01	30.00	17.00
Low3	5175	18.01	18.01	30.00	17.00
Mid	5180	18.01	18.01	30.00	17.00
High1	5195	18.01	18.01	30.00	17.00
High2	5200	18.01	18.01	30.00	17.00
High3	5235	18.01	18.01	30.00	17.00

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

Output Power Results

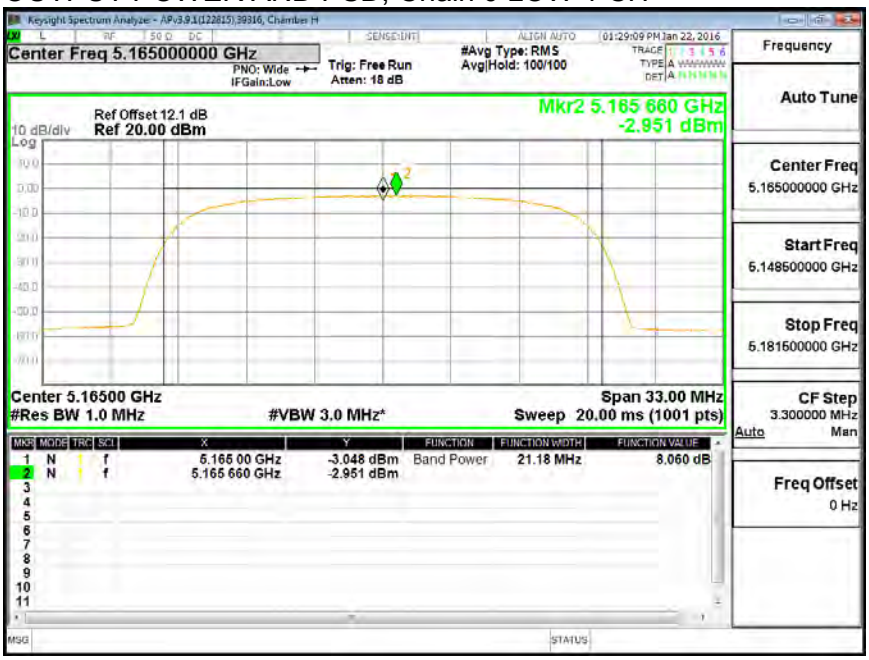
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Chain 2 Meas Power (dBm)	Chain 3 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low1	5165	8.06	8.60	8.11	9.13	14.52	30.00	-15.48
Low2	5170	8.22	8.77	8.41	9.35	14.73	30.00	-15.27
Low3	5175	9.72	10.57	10.87	11.07	16.61	30.00	-13.39
Mid	5180	13.55	14.40	13.76	14.11	19.99	30.00	-10.01
High1	5195	15.10	16.09	15.29	15.69	21.58	30.00	-8.42
High2	5200	19.10	20.10	19.46	19.94	25.69	30.00	-4.31
High3	5235	19.11	19.74	19.01	19.44	25.36	30.00	-4.64

PSD Results

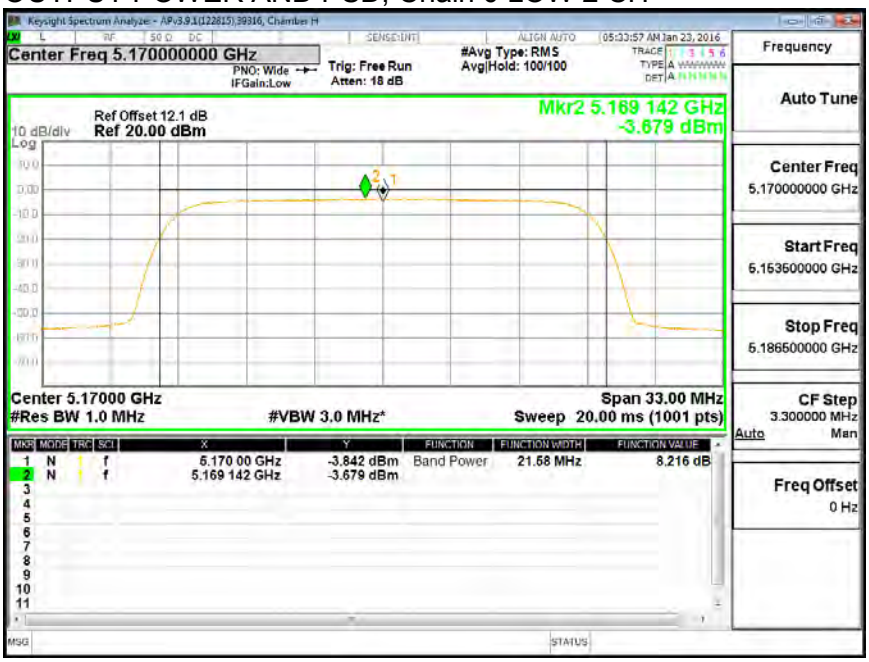
Channel	Frequency (MHz)	Chain 0 Meas PSD (dBm)	Chain 1 Meas PSD (dBm)	Chain 2 Meas PSD (dBm)	Chain 3 Meas PSD (dBm)	Total Corr'd PSD (dBm)	PSD Limit (dBm)	PSD Margin (dB)
Low1	5165	-2.95	-2.32	-2.87	-1.82	3.55	17.00	-13.45
Low2	5170	-3.68	-2.98	-3.43	-2.44	2.91	17.00	-14.09
Low3	5175	-2.15	-1.17	-1.79	-0.72	4.60	17.00	-12.40
Mid	5180	1.69	2.71	1.89	2.37	8.20	17.00	-8.80
High1	5195	3.33	4.42	3.44	3.86	9.80	17.00	-7.20
High2	5200	7.35	8.39	7.58	8.16	13.91	17.00	-3.09
High3	5235	7.33	8.04	7.14	7.69	13.58	17.00	-3.42

OUTPUT POWER AND PSD, Chain 0

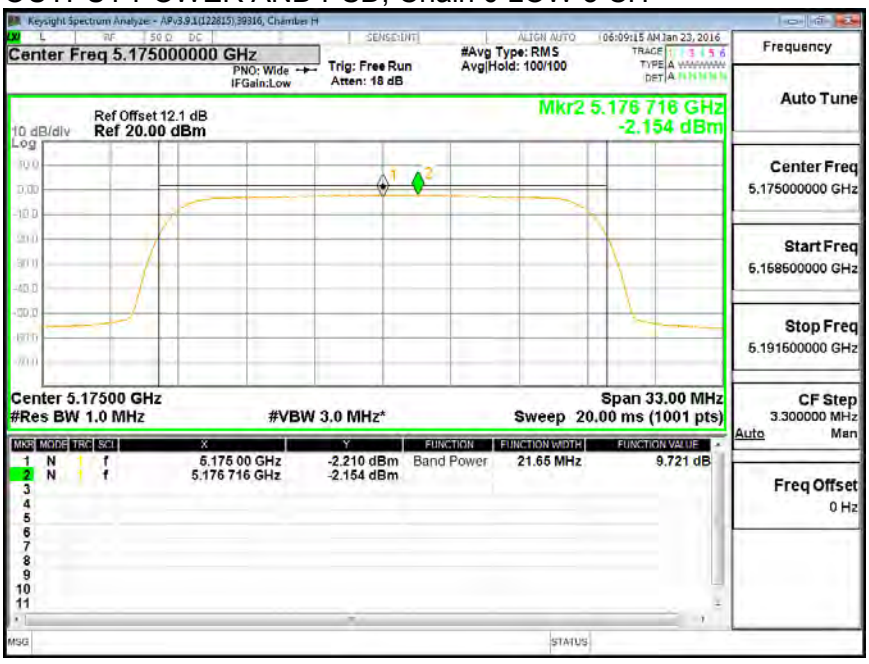
OUTPUT POWER AND PSD, Chain 0 LOW 1 CH



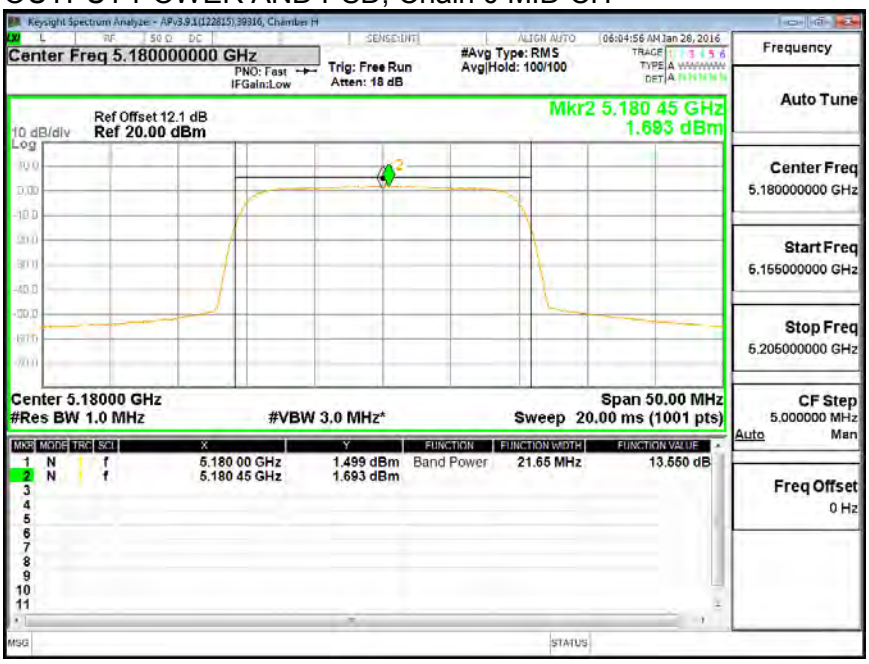
OUTPUT POWER AND PSD, Chain 0 LOW 2 CH



OUTPUT POWER AND PSD, Chain 0 LOW 3 CH



OUTPUT POWER AND PSD, Chain 0 MID CH



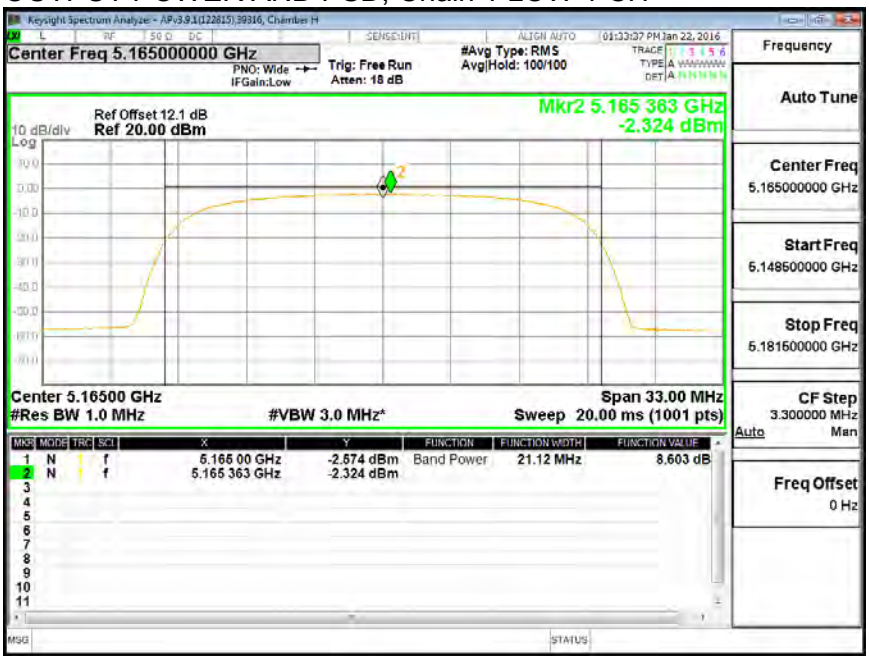
OUTPUT POWER AND PSD, Chain 0 HIGH 1 CH

OUTPUT POWER AND PSD, Chain 0 HIGH 2 CH

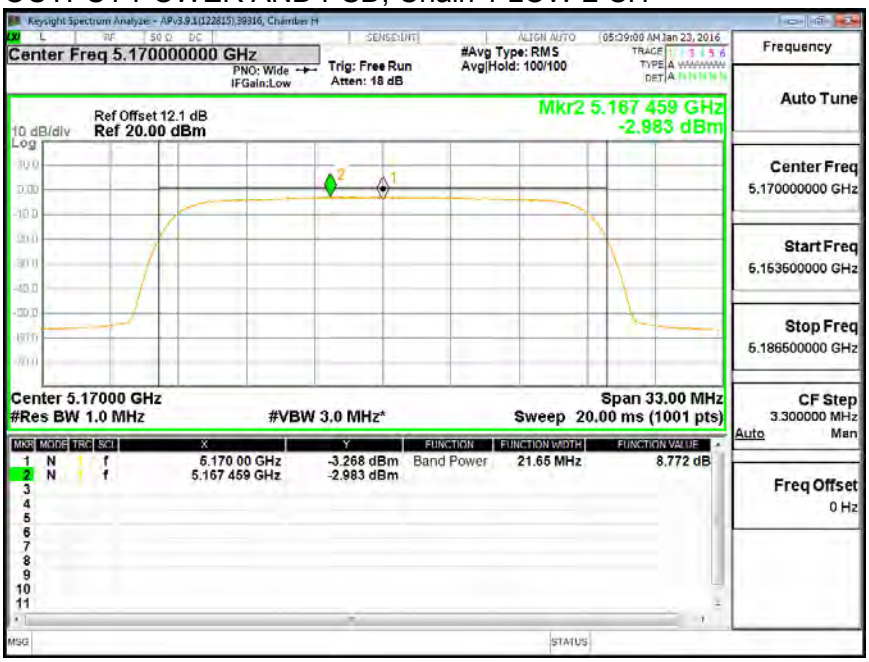
OUTPUT POWER AND PSD, Chain 0 HIGH 3 CH

OUTPUT POWER AND PSD, Chain 1

OUTPUT POWER AND PSD, Chain 1 LOW 1 CH



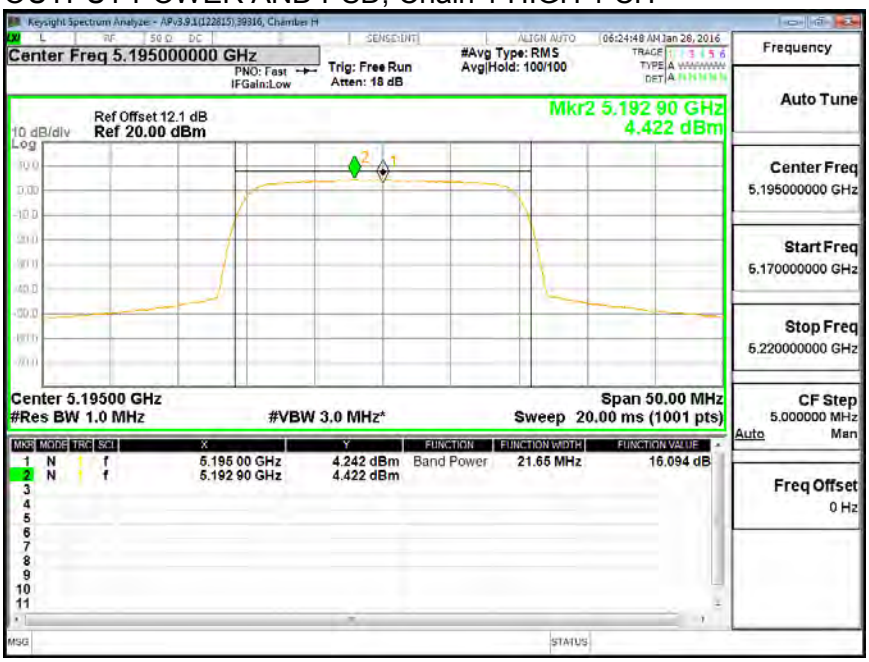
OUTPUT POWER AND PSD, Chain 1 LOW 2 CH



OUTPUT POWER AND PSD, Chain 1 LOW 3 CH

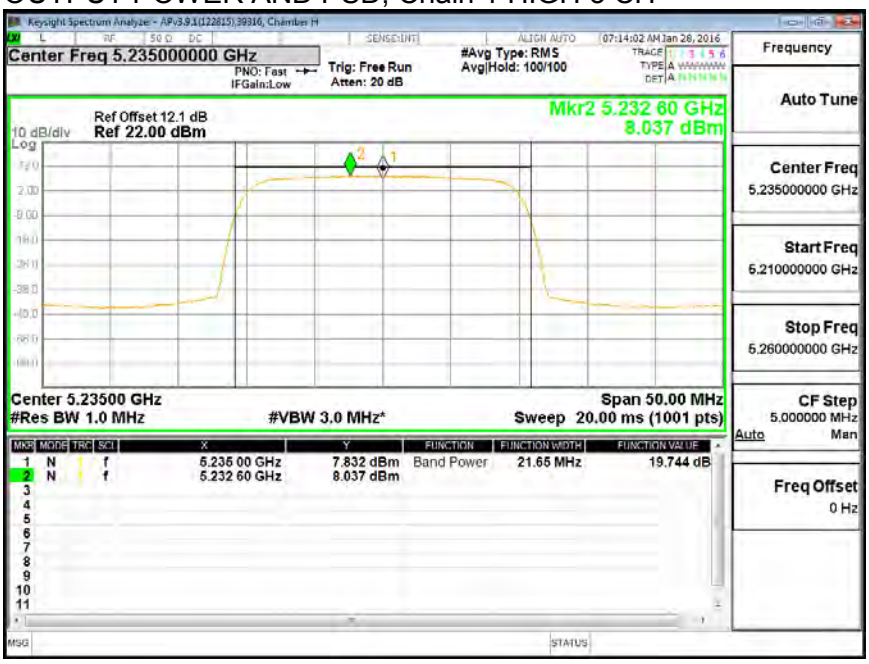
OUTPUT POWER AND PSD, Chain 1 MID CH

OUTPUT POWER AND PSD, Chain 1 HIGH 1 CH



OUTPUT POWER AND PSD, Chain 1 HIGH 2 CH

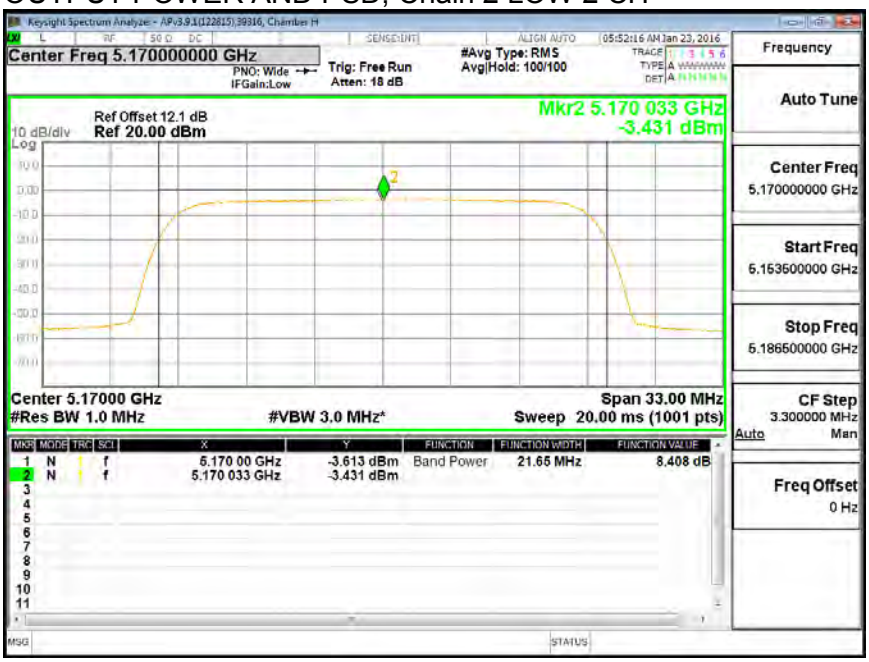
OUTPUT POWER AND PSD, Chain 1 HIGH 3 CH



OUTPUT POWER AND PSD, Chain 2

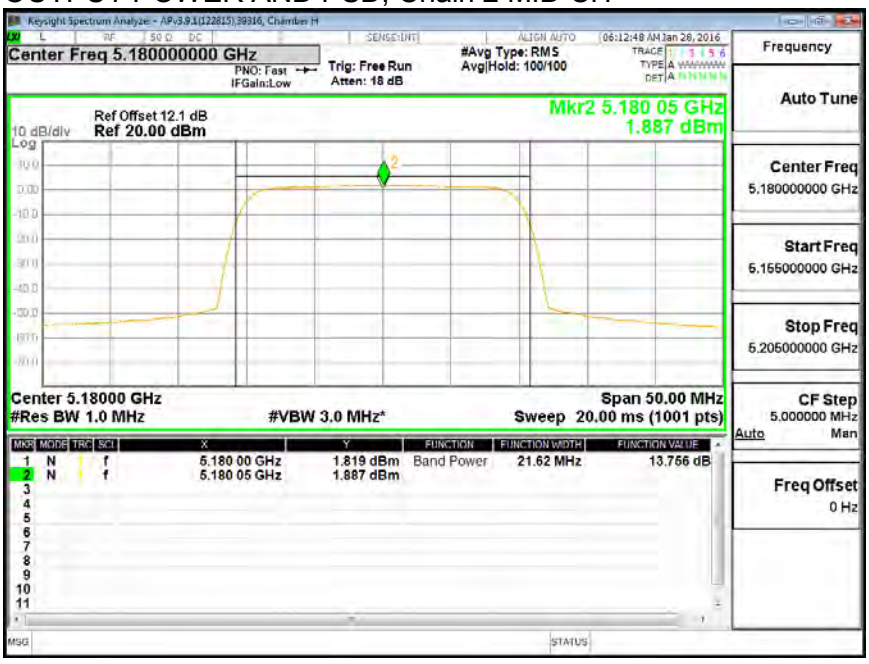
OUTPUT POWER AND PSD, Chain 2 LOW 1 CH

OUTPUT POWER AND PSD, Chain 2 LOW 2 CH



OUTPUT POWER AND PSD, Chain 2 LOW 3 CH

OUTPUT POWER AND PSD, Chain 2 MID CH



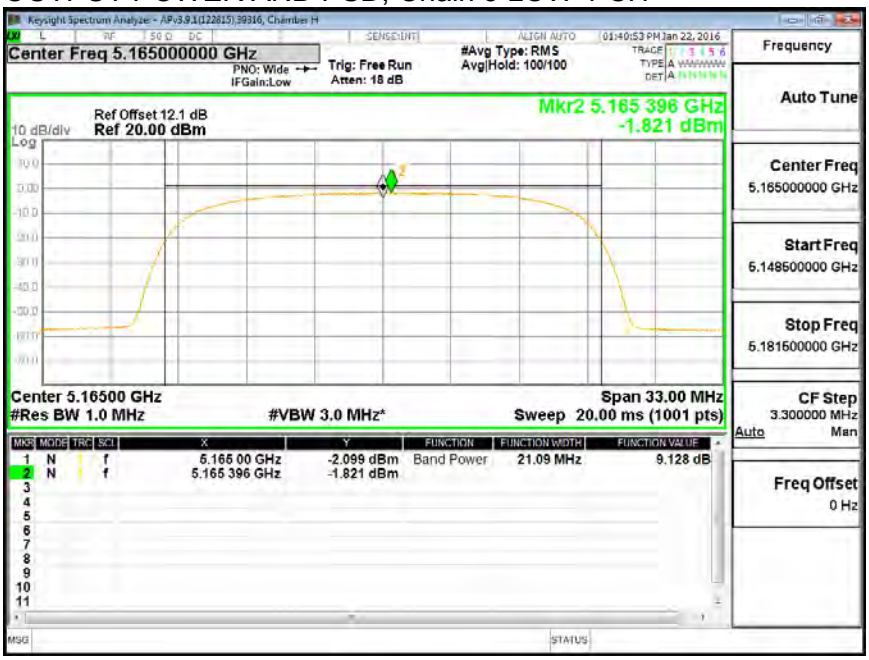
OUTPUT POWER AND PSD, Chain 2 HIGH 1 CH

OUTPUT POWER AND PSD, Chain 2 HIGH 2 CH

OUTPUT POWER AND PSD, Chain 2 HIGH 3 CH

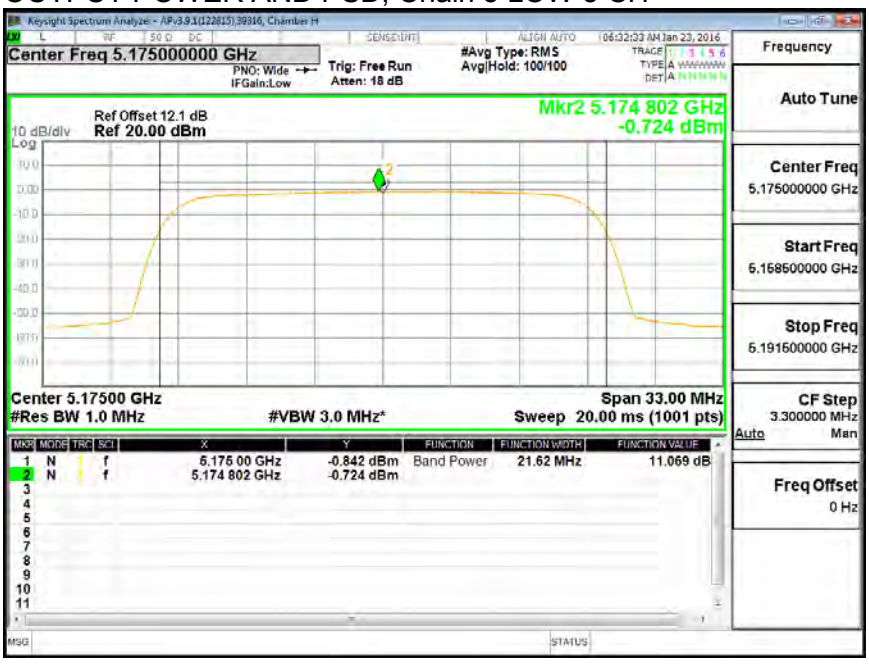
OUTPUT POWER AND PSD, Chain 3

OUTPUT POWER AND PSD, Chain 3 LOW 1 CH

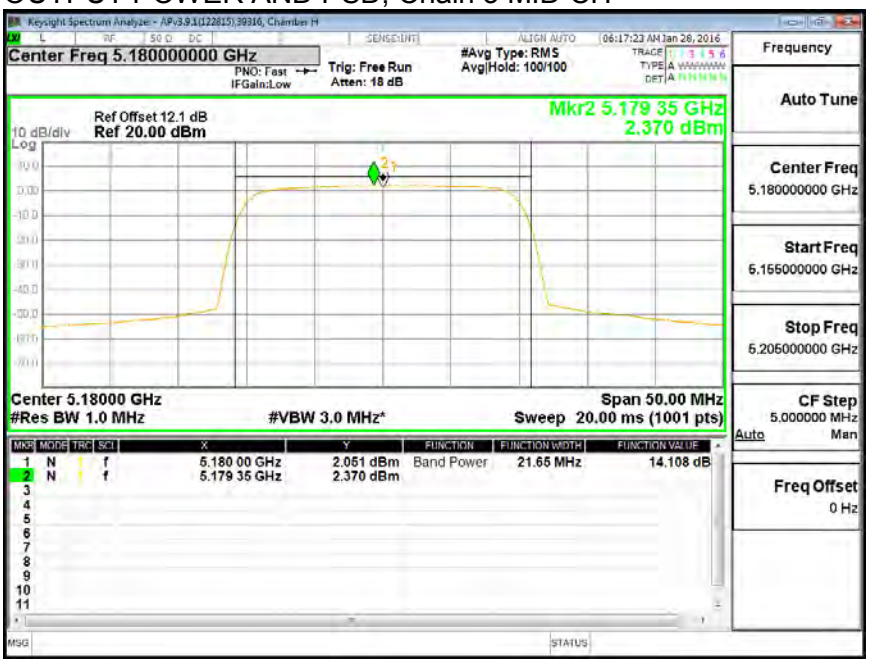


OUTPUT POWER AND PSD, Chain 3 LOW 2 CH

OUTPUT POWER AND PSD, Chain 3 LOW 3 CH



OUTPUT POWER AND PSD, Chain 3 MID CH



OUTPUT POWER AND PSD, Chain 3 HIGH 1 CH

OUTPUT POWER AND PSD, Chain 3 HIGH 2 CH

OUTPUT POWER AND PSD, Chain 3 HIGH 3 CH

8.3.3. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.205 and §15.209

PART 15, SUBPART E

Radiated LIMIT:
(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

Procedure

KDB 789033 D02 General UNII Test Procedures New Rules v01, Section II, G5

Conducted measurements are being used to demonstrate compliance with the spurious limits in the restricted band (all other spurious emissions are measured using the radiated test method with the antennas connected). The limits are 54dBuV/m average and 74dBuV/m peak, which are equivalent to EIRP of -41.2 dBm and -21.2dBm respectively. The plots include an offset to account for the EUT antenna gain and external attenuation between EUT antenna port and spectrum analyzer.

There are a total of four antenna chains; two horizontal antennas (chains 0 and 2) and two vertical antennas (chains 1 and 3). As two antennas chains(Horizontal Pol.) feed cross polarized with respect to two other antennas(Vertical Pol.), the two sets of chains are treated independently, and thus the emissions do not need to be summed for all four chains. However, there is a summation for the two horizontal antennas and two vertical chains separately.

The summation is method is noted as below:

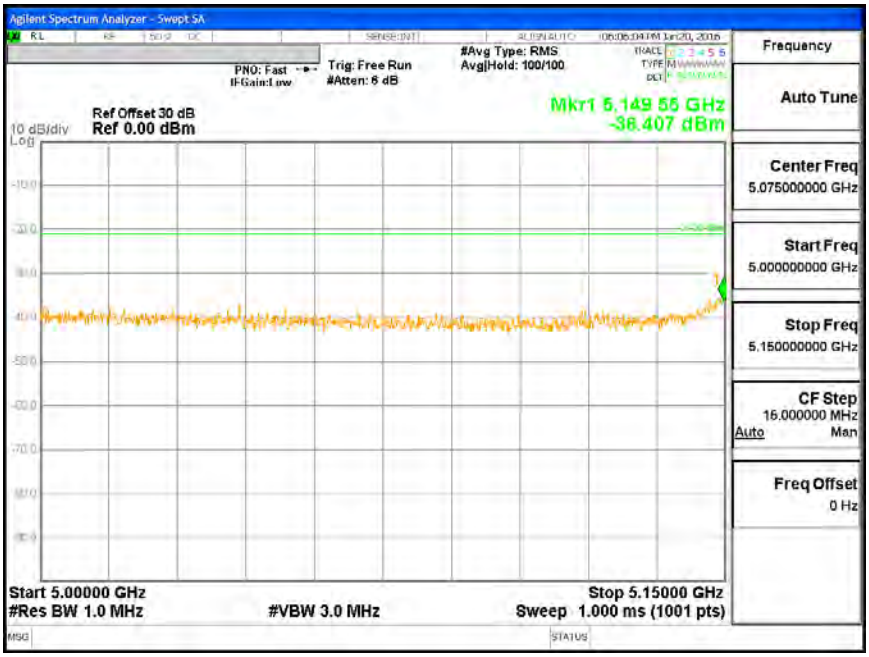
KDB 662911 D01 Multiple Transmitter Output v02r01

Section E(3)(a)(i) Measure and sum the spectra across the outputs as described in section E)2)a). Note that the summation must be performed in linear power units, or the equivalent. For example, if measurement units are microvolts or microvolts/meter, the values shall be squared before summing, and then a square root shall be applied to the sum in order to achieve the equivalent of summing in power units.

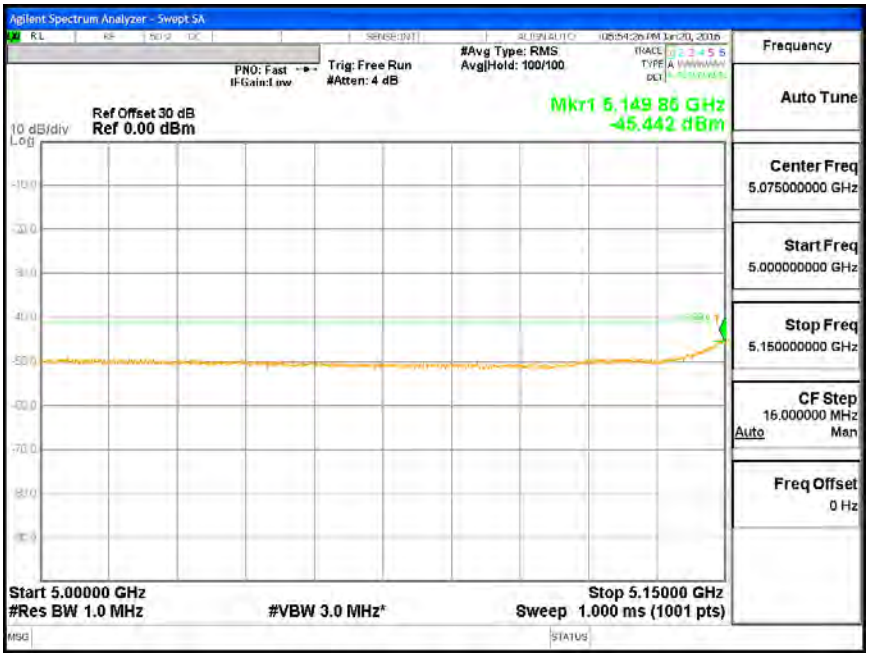
RESULTS

LOW CHANNEL BANDEDGE (5165 MHz), Chain 0

AUTHORIZED BAND EDGE Chain 0 LOW CH PEAK

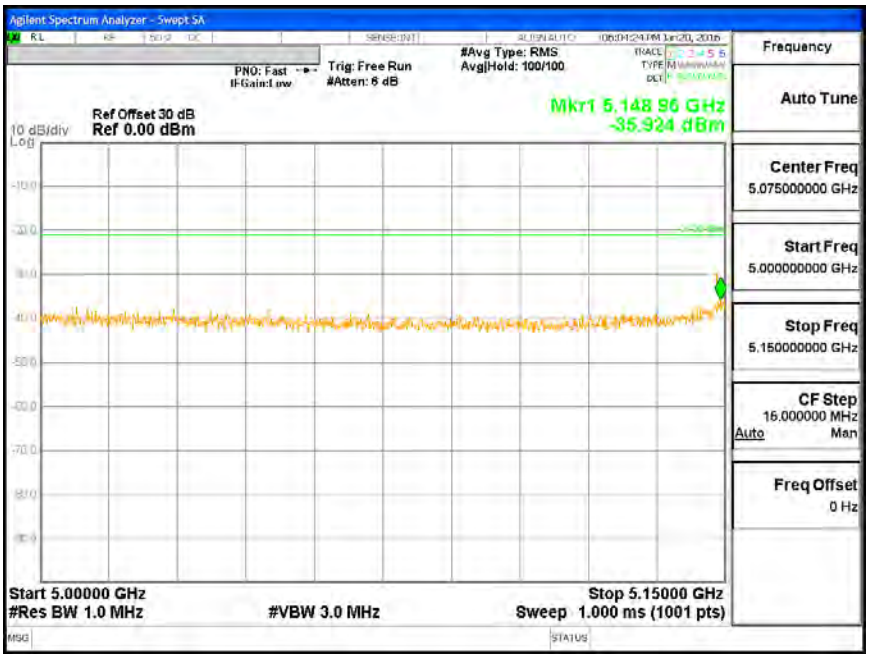


AUTHORIZED BAND EDGE Chain 0 LOW CH AVERAGE

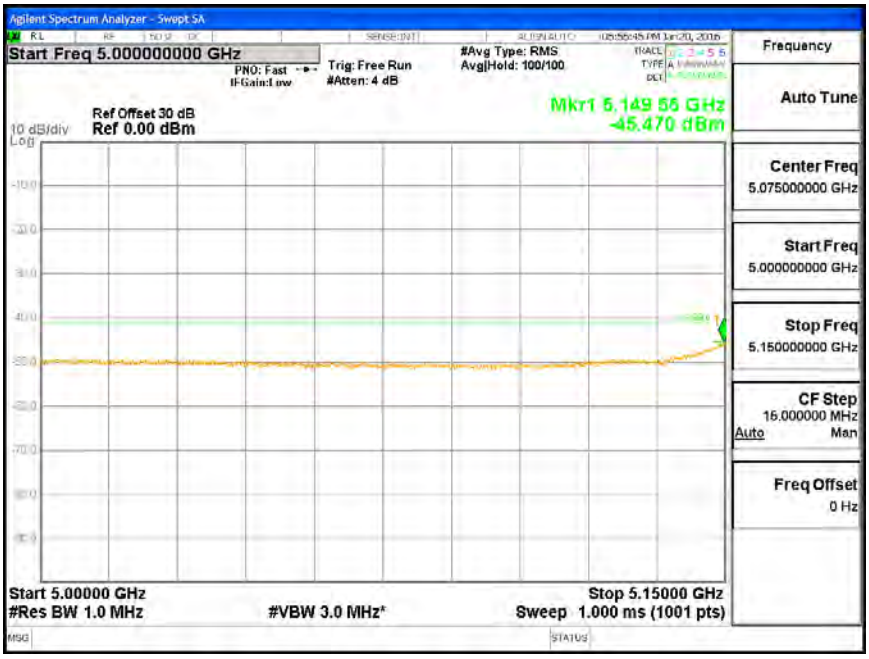


LOW CHANNEL BANDEDGE (5165 MHz), Chain 1

AUTHORIZED BAND EDGE Chain 1 LOW CH PEAK

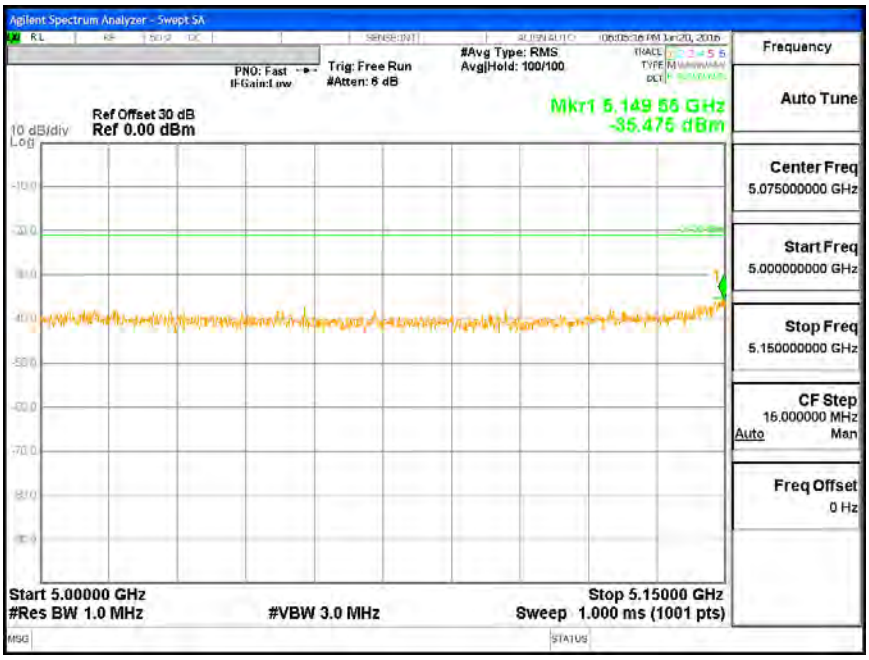


AUTHORIZED BAND EDGE Chain 1 LOW CH AVERAGE



LOW CHANNEL BANDEDGE (5165 MHz), Chain 2

AUTHORIZED BAND EDGE Chain 2 LOW CH PEAK



AUTHORIZED BAND EDGE Chain 2 LOW CH AVERAGE