FCC 47 CFR PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

802.11ac 3x3 Set Top Box Client with RF4CE for remote operation

MODEL NUMBER: ID:072

FCC ID: DKNCR90

REPORT NUMBER: 13U16571-1

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Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	01/28/14	Initial Issue	F. de Anda

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ATTESTATION OF TEST RESULTS

COMPANY NAME:	ECHOSTAR 90 INVERNESS CIRCLE EAST ENGLEWOOD, CO 80112, U.S.A.
EUT DESCRIPTION:	802.11ac 3x3 Set Top Box Client with RF4CE for remote operation
MODEL:	ID: 072
SERIAL NUMBER:	P2-224 (Conducted), P2-230 (Radiated)
DATE TESTED:	DECEMBER 14, 2013 - JANUARY 07, 2014

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	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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UL Verification Services Inc.

Tested By:

FRANCISCO GUARNERO
EMC ENGINEER
UL Verification Services Inc.

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1. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2009, RSS-GEN Issue 3, and RSS-210 Issue 8.

2. 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

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3. CALIBRATION AND UNCERTAINTY

3.1. 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.

3.2. 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

3.3. 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

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

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4. EQUIPMENT UNDER TEST

4.1. DESCRIPTION OF EUT

The EUT is an 802.11ac 3x3 Set Top Box Client with RF4CE for remote operation.

The set-top box is intended to be connected to any secondary television in a consumer's home. Using an 802.11ac link to an 802.11ac AP it will decode and output high-definition TV2 programming from an Echostar host STB.

4.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5745 - 5825	802.11a SISO	29.80	954.99
5745 - 5825	802.11n HT20 SISO	29.40	870.96
5745 - 5825	802.11n HT20 3TX CDD	27.60	575.44
5745 - 5825	802.11n HT20 3TX SDM	29.60	912.01
5755 - 5795	802.11n HT40 SISO	29.46	883.08
5755 - 5795	802.11n HT40 3TX CDD	27.84	608.14
5756 - 5795	802.11n HT40 3TX SDM	29.67	926.83
5735 - 5815	802.11ac 80MHz SISO	29.70	933.25
5735 - 5815	802.11ac 80MHz 3TX CDD	27.73	592.93
5735 - 5815	802.11ac 80MHz 3TX SDM	29.57	905.73

Testing performed was done on 1TX and 3TX modes only. All 2TX mode testing was waived because the power settings for these modes will leverage on the power setting for 3TX. 3TX modes are worst case representation of 2 TX modes.

The manufacturer will use 3TX power settings on 2TX modes.

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4.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an N5x20B Embedded antenna, with a maximum is,

Freq. Band (GHz)	Antenna Gain (dBi)
5.8	3.16

4.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was FCC2 ZDAH.

The test utility software used during testing was MTool version 2.0.1.1

4.5. WORST-CASE CONFIGURATION AND MODE

The EUT supports only one orientation; therefore, X orientation (Up Right) was investigated and is considered the worst case.

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

802.11a SISO mode: 6 Mbps
802.11n HT20 SISO mode: MCS0
802.11n HT20 3TX CDD mode: MCS0
802.11n HT20 3TX SDM mode: MCS0
802.11n HT40 SISO mode: MCS0
802.11n HT40 3TX CDD mode: MCS0
802.11n HT40 3TX SDM mode: MCS0
802.11ac 80 SISO mode: MCS0
802.11ac 80 3TX CDD mode: MCS0
802.11ac 80 3TX SDM mode: MCS0

The worst-case mode and channel used for 30-1000 MHz radiated and power line conducted emissions was in the mode and channel with the highest output power.

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4.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
EUT AC adapter	Delta Elect.	ADP-25AW B	125	N/A
Laptop	HP	8470p	Compliance 2-HP	DOC
AC adapter	HP	PA-1650-32HJ	76103	DoC
Access Point	Netgear	MBRN3000	80007F7	PY309200112
AC adapter	Netgear	T012LF1209	603LR	N/A

I/O CABLES

I/O Cable List						
Cable No.	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	3	2-Prong	Un-Shielded	1.8m	NA
2	DC	1	Barrel	Un-Shielded	1.8	NA
3	DC	1	Barrel	Un-Shielded	1.8	To Spectrum Analyzer
4	DC	1	Locking 2-Pin	Un-Shielded	1.8	NA
5	LAN	1	RJ45	Un-Shielded	2	NA
6	LAN	1	RJ45	Un-Shielded	2	To Spectrum Analyzer
7	Antenna	1	SMA	Coax	0.1	NA
8	LAN	1	RJ45	Un-Shielded	7.5	NA

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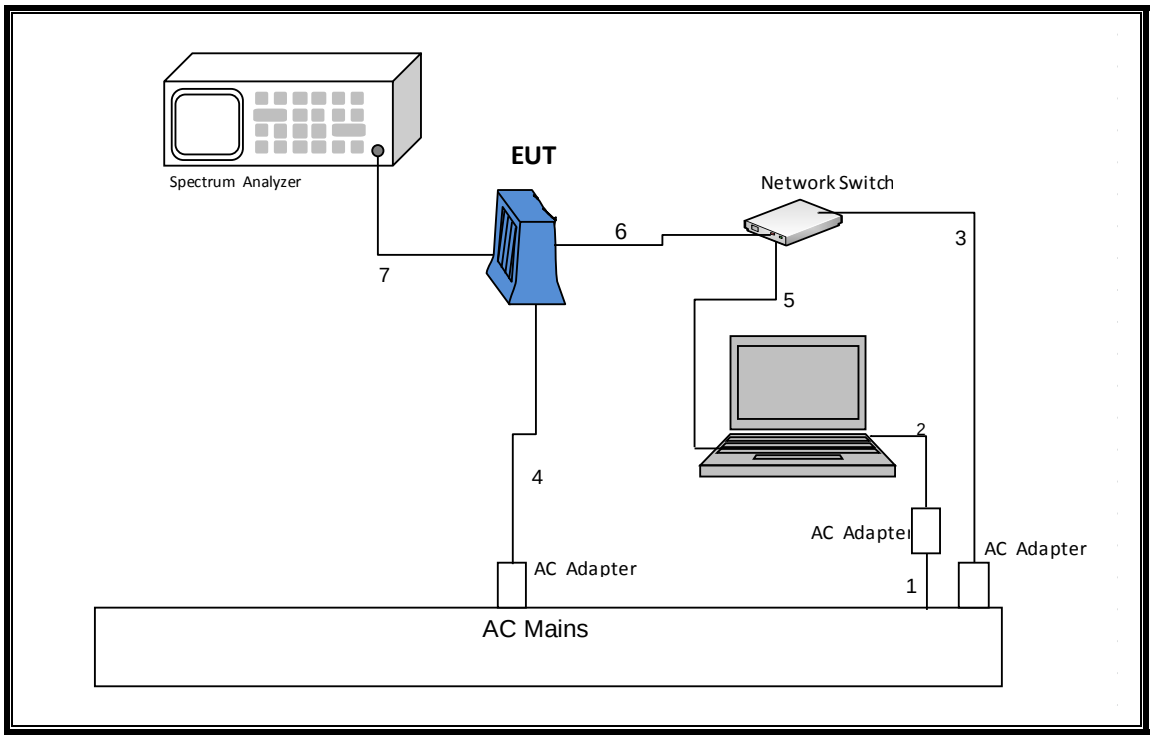
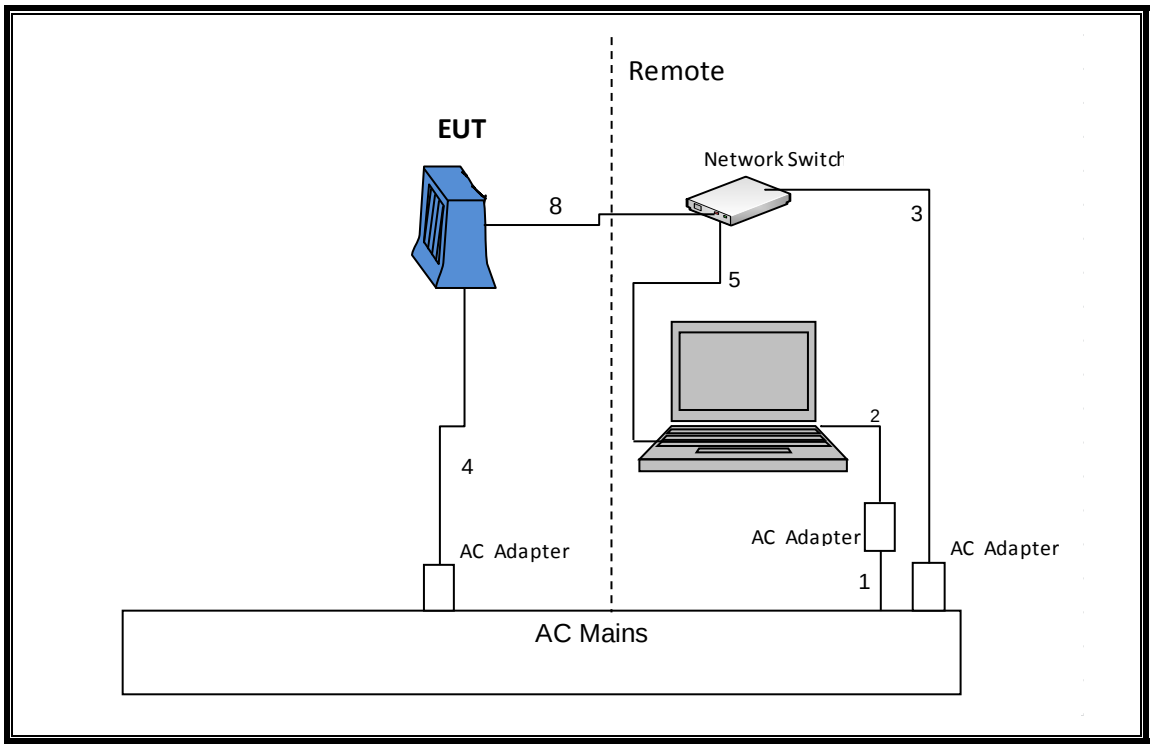
SETUP DIAGRAM FOR CONDUCTED TESTS



SETUP DIAGRAM FOR RADIATED TESTS



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5. 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**	**Asset**	**Cal Due**
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	F00027	03/07/14
Antenna, Horn 1-18GHz	ETS Lindgren	3117	F00131	02/19/14
Antenna, Horn, 26.5 GHz	ARA	SWH-28	C01015	05/06/14
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	F00194	05/14/14
Spectrum Analyzer, 40 GHz	Agilent / HP	8564E	C00951	07/29/14
Spectrum Analyzer, 3Hz-44GHz	Agilent	N9030A	F00127	02/22/14
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	01/28/14
PreApmplifier, 1-26.5GHz	Agilent	8449B	C01052	06/26/14
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	08/20/14
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/15/14
LISN, 30 MHz	FCC	50/250-25-2	C00626	01/14/14
Peak / Average Power Sensor	Agilent / HP	E9323A	F00163	04/03/14
P-Series single channel Power Meter	Agilent / HP	N1911A	F00164	04/03/14

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6. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

6.1. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01.

Output Power: KDB 558074 D01.

Power Spectral Density: KDB 558074 D01.

Out-of-band emissions in non-restricted bands: KDB 558074 D01.

Out-of-band emissions in restricted bands: KDB 558074 D01.

6.2. ON TIME AND DUTY CYCLE RESULTS

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
802.11a SISO	2.064	2.169	0.952	95.16%	0.22	0.484
802.11a 3TX CDD	2.064	2.172	0.950	95.03%	0.22	0.484
802.11n HT20 SISO	1.920	2.019	0.951	95.10%	0.22	0.521
802.11n HT20 3TX CDD	1.917	2.016	0.951	95.09%	0.22	0.522
802.11n HT20 3TX SDM	0.684	0.712	0.961	96.12%	0.17	1.462
802.11n HT40 SISO	0.940	1.042	0.902	90.21%	0.45	1.064
802.11n HT40 3TX CDD	0.950	0.982	0.967	96.74%	0.14	1.053
802.11n HT40 3TX SDM	0.355	0.384	0.924	92.45%	0.34	2.817
802.11ac 80MHz SISO	0.459	0.488	0.941	94.06%	0.27	2.179
802.11ac 80MHz CDD	0.459	0.488	0.941	94.06%	0.27	2.179
802.11ac 80MHz SDM	0.192	0.220	0.870	87.05%	0.60	5.222

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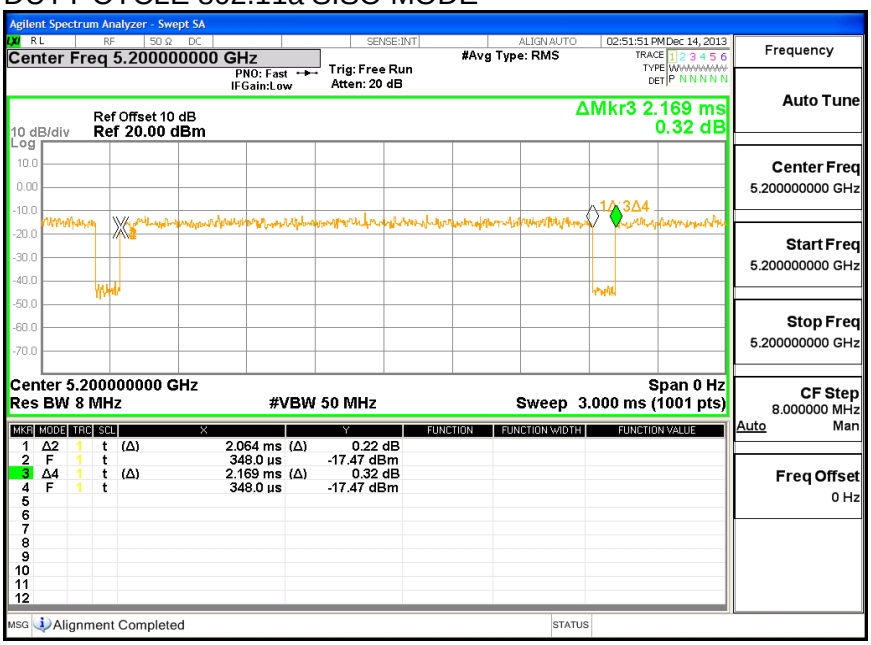
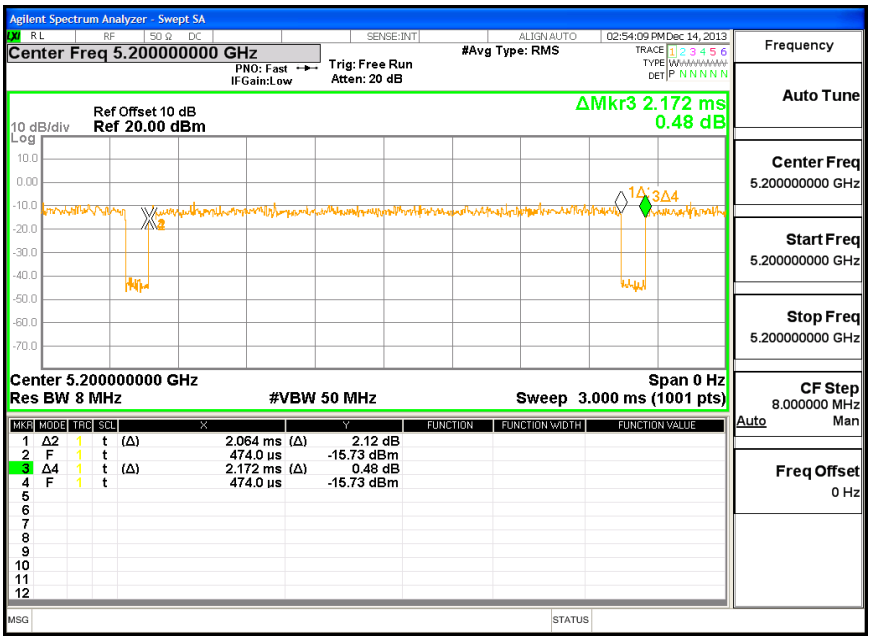
6.3. DUTY CYCLE PLOTS

5 GHz BANDS

DUTY CYCLE 802.11a SISO MODE



DUTY CYCLE 802.11a 3TX CDD MODE



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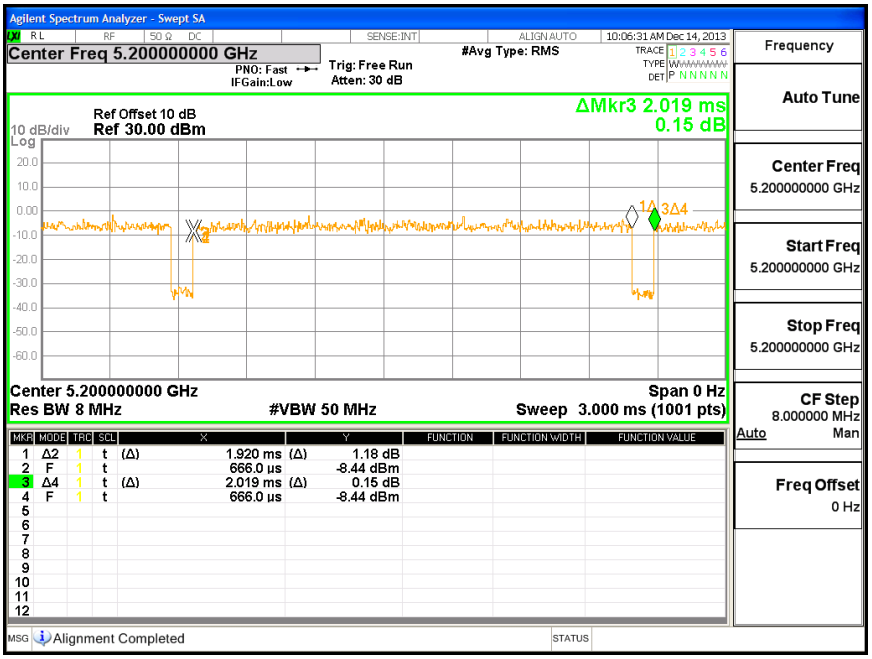
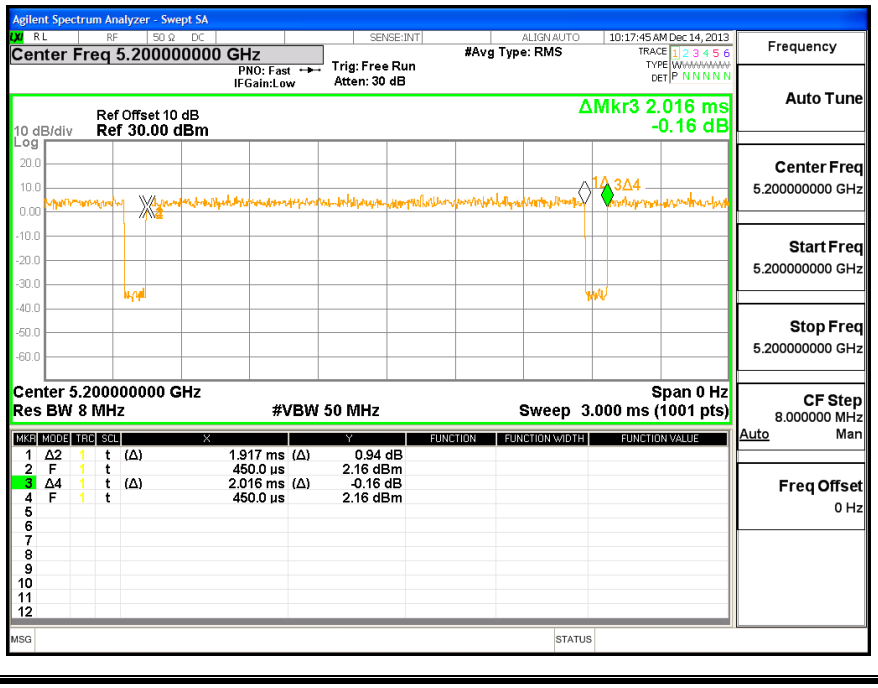
DUTY CYCLE 802.11n HT20 SISO MODE



DUTY CYCLE 802.11n HT20 3TX CDD MODE



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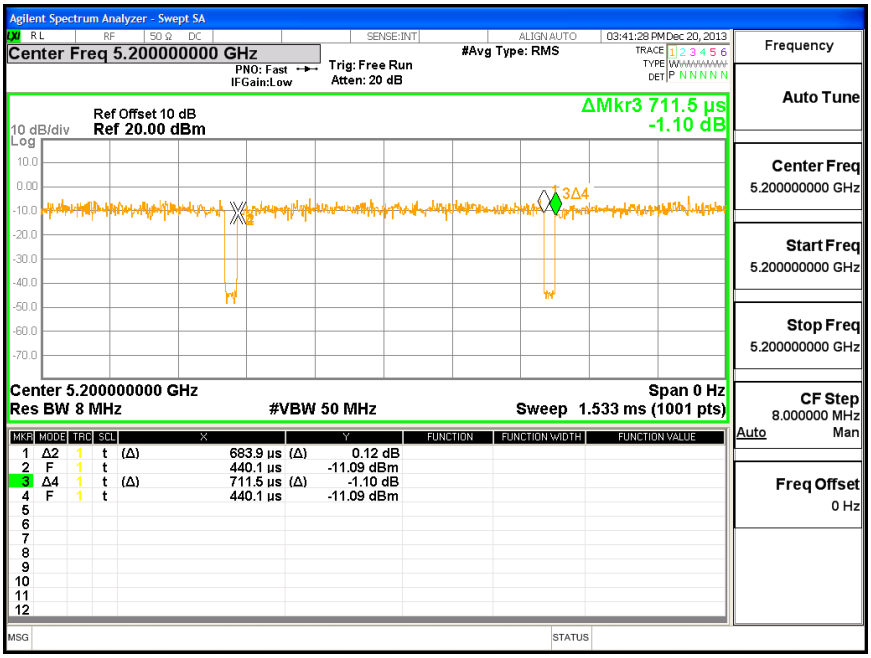
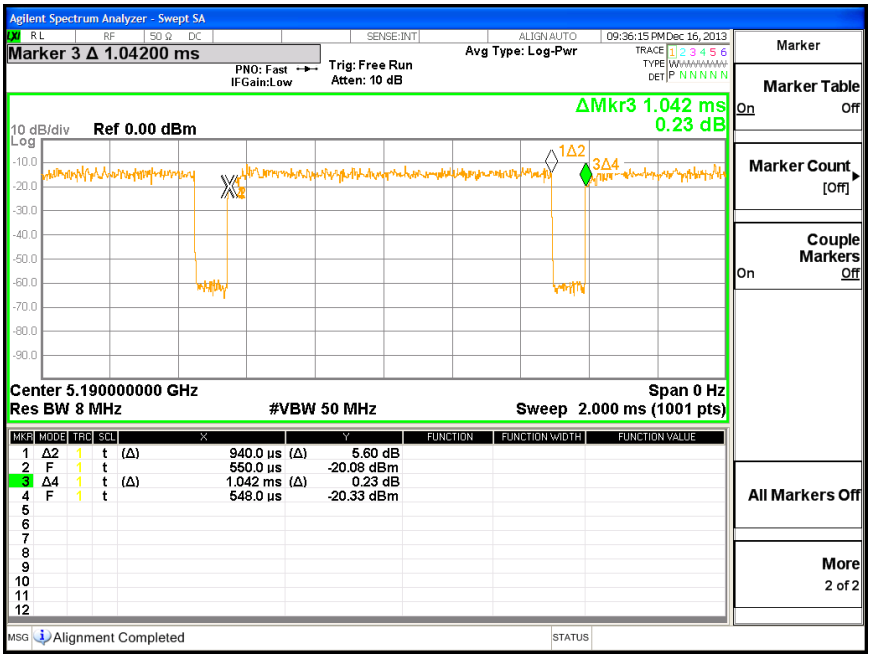
DUTY CYCLE 802.11n HT20 3TX SDM MODE



DUTY CYCLE 802.11n HT40 SISO MODE



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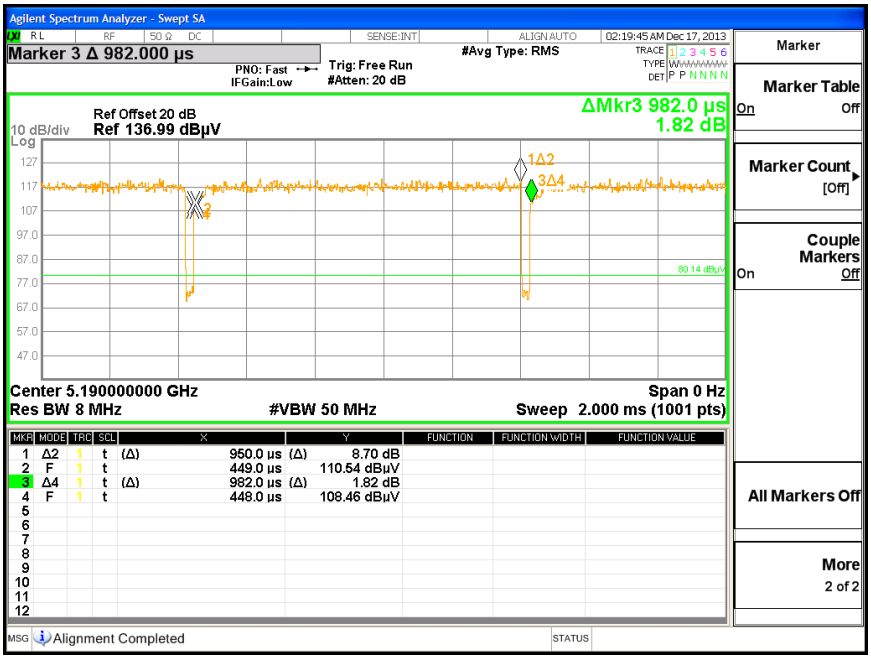
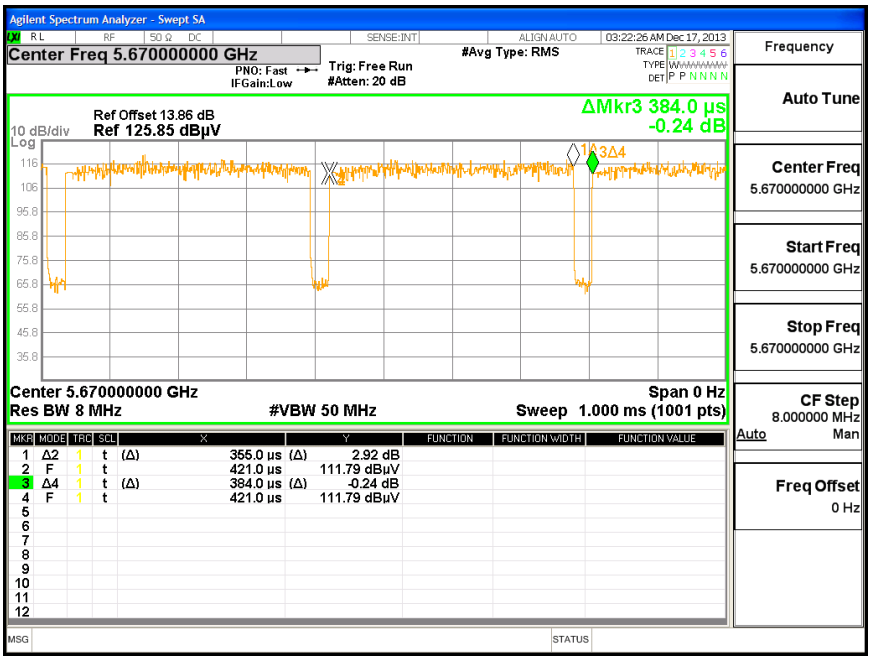
DUTY CYCLE 802.11n HT40 3TX CDD MODE



DUTY CYCLE 802.11n HT40 3TX SDM MODE



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DUTY CYCLE 802.11ac 80HMz SISO MODE

DUTY CYCLE 802.11ac 80MHz 3TX CDD MODE

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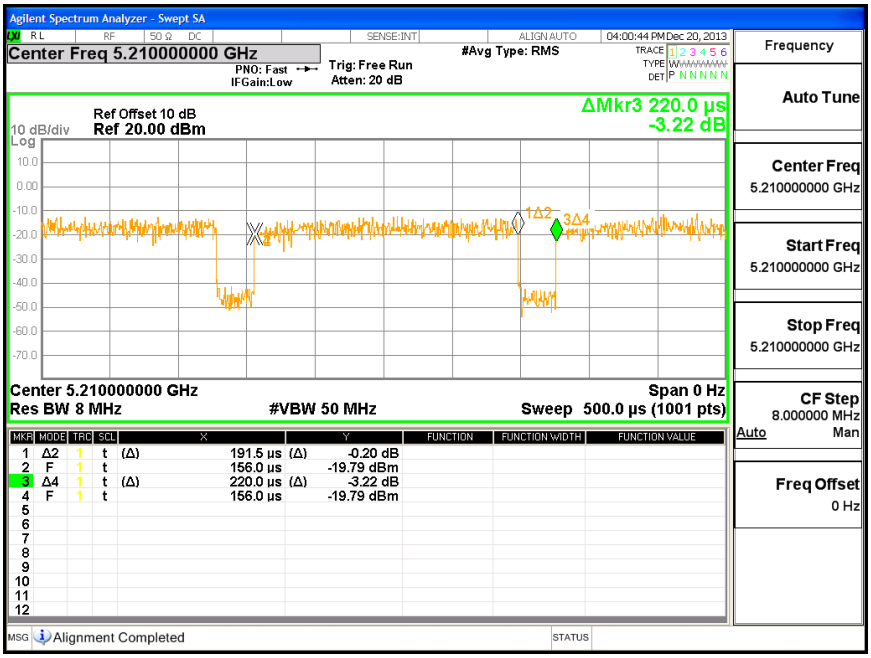
DUTY CYCLE 802.11ac 80MHz 3TX SDM MODE



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7. ANTENNA PORT TEST RESULTS

7.1. 802.11a SISO MODE IN THE 5.8 GHz BAND

7.1.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
149	5745	16.400	0.5
157	5785	16.475	0.5
165	5825	16.350	0.5

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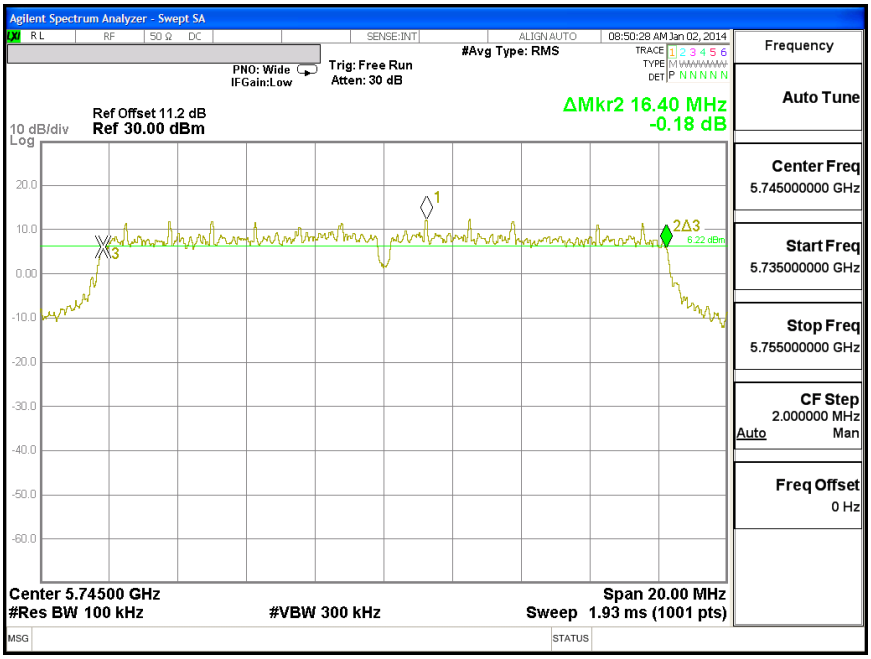
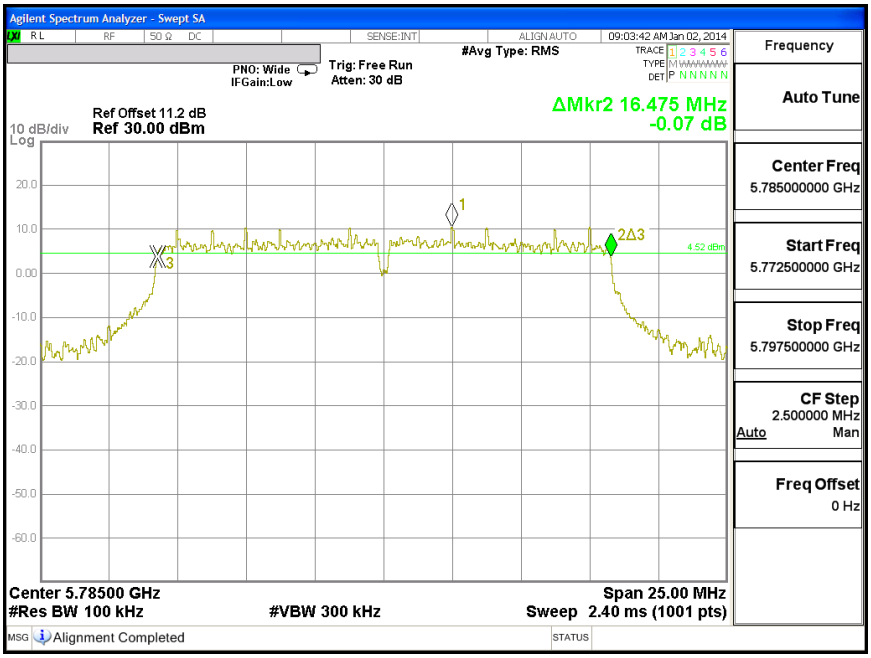
6 dB BANDWIDTH

6 dB BANDWIDTH CH 149



6 dB BANDWIDTH CH 157



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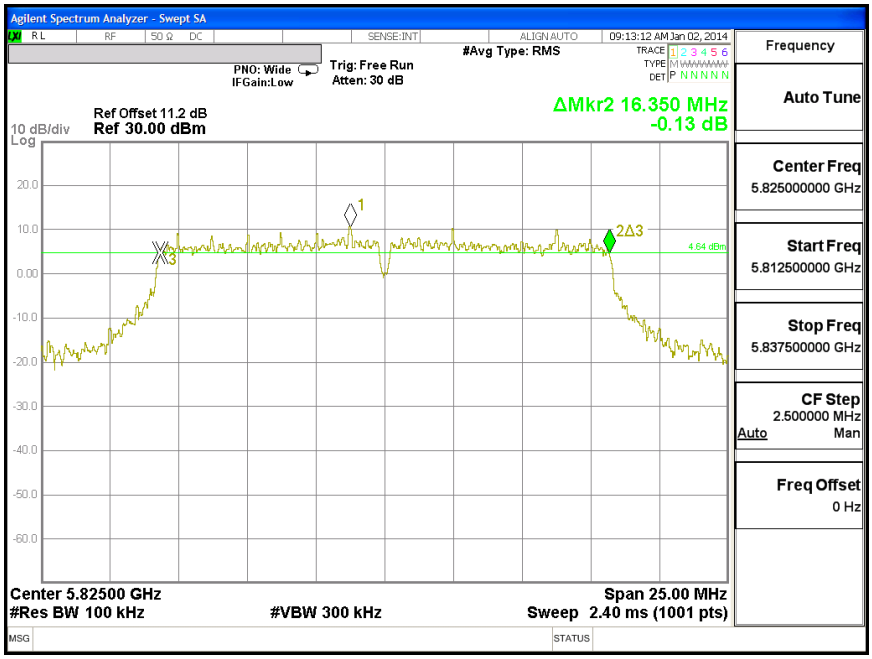
6 dB BANDWIDTH CH 165



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7.1.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
149	5745	16.8130
157	5785	16.8370
165	5825	16.9750

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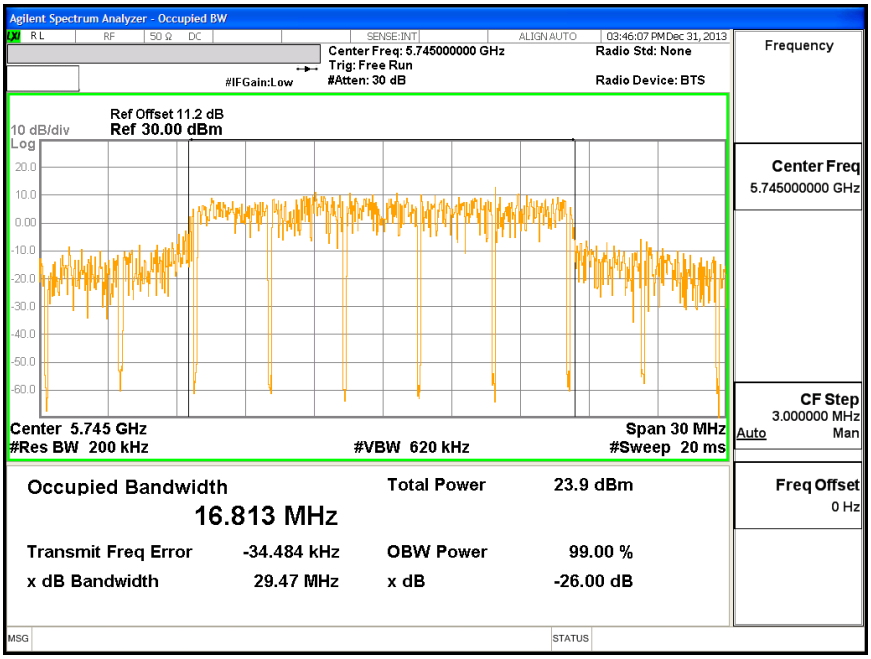
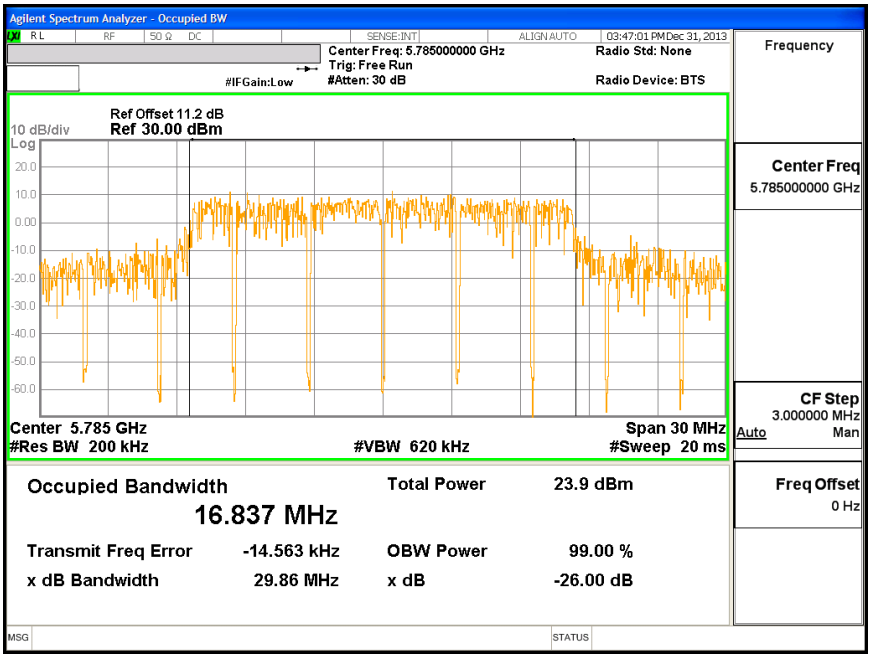
99% BANDWIDTH

99% BANDWIDTH CH 149



99% BANDWIDTH CH 157



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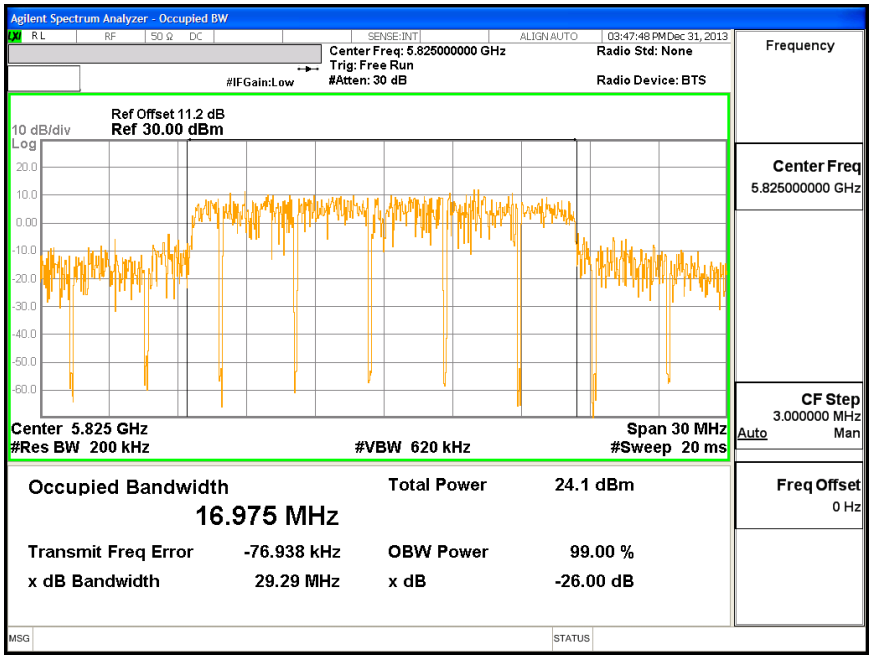
99% BANDWIDTH CH 165



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7.1.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
149	5745	21.80
157	5785	21.87
165	5825	21.39

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7.1.4. OUTPUT POWER

LIMITS

FCC §15.247

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

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RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
149	5745	3.16	30.00	30	36	30.00
157	5785	3.16	30.00	30	36	30.00
165	5825	3.16	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
149	5745	29.80	29.80	30.00	-0.20
157	5785	29.70	29.70	30.00	-0.30
165	5825	29.19	29.19	30.00	-0.81

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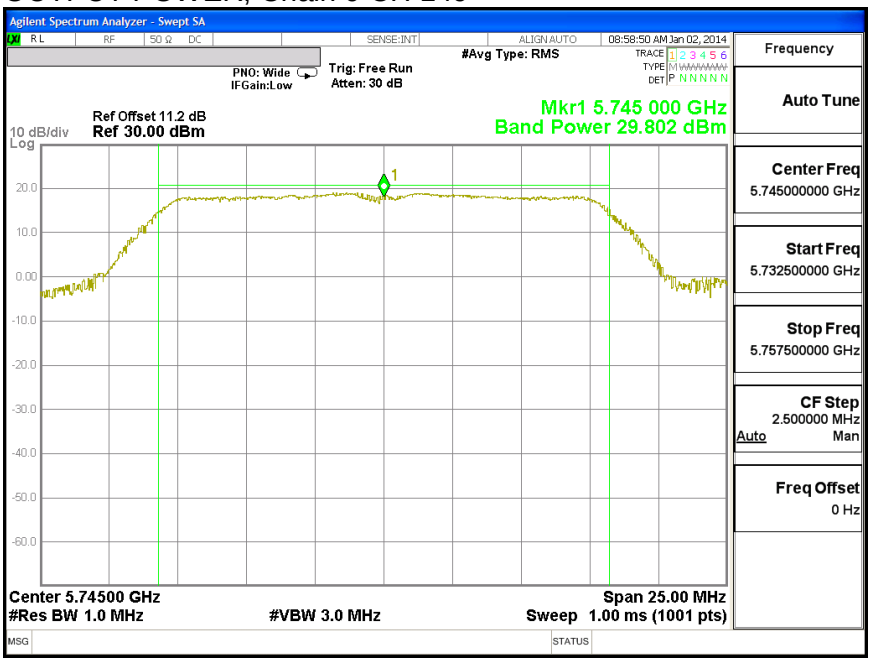
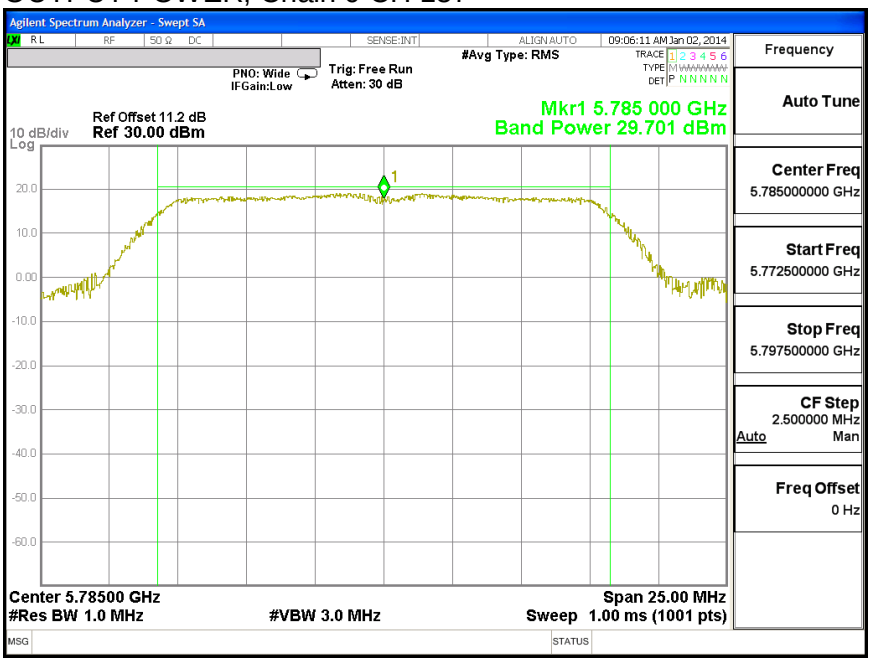
OUTPUT POWER, Chain 0

OUTPUT POWER, Chain 0 CH 149



OUTPUT POWER, Chain 0 CH 157



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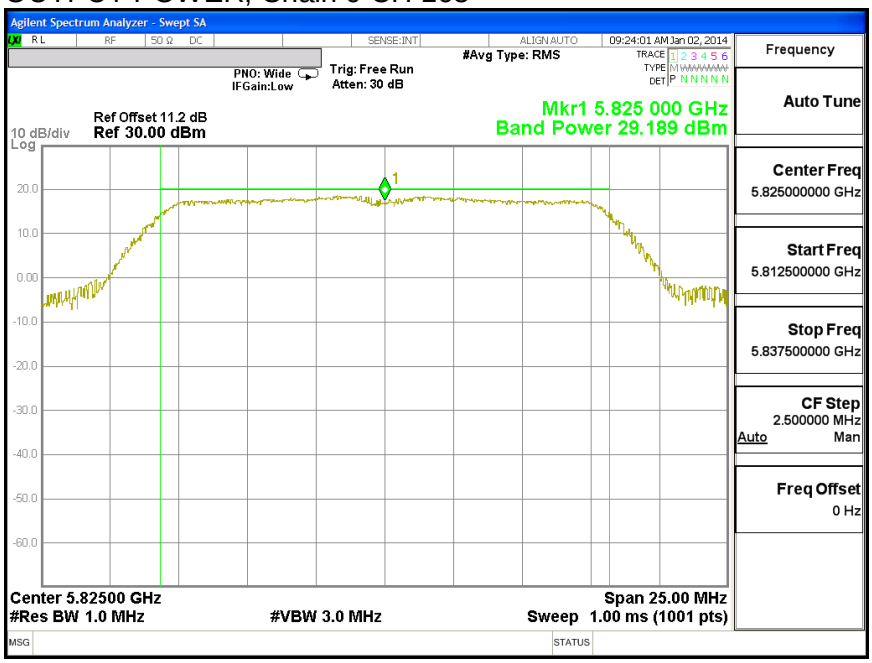
OUTPUT POWER, Chain 0 CH 165



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7.1.5. PSD

LIMITS

FCC §15.247

RESULTS

PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Limit (dBm)	Margin (dB)
149	5745	-0.296	8.0	-8.3
157	5785	-0.382	8.0	-8.4
165	5825	-0.496	8.0	-8.5

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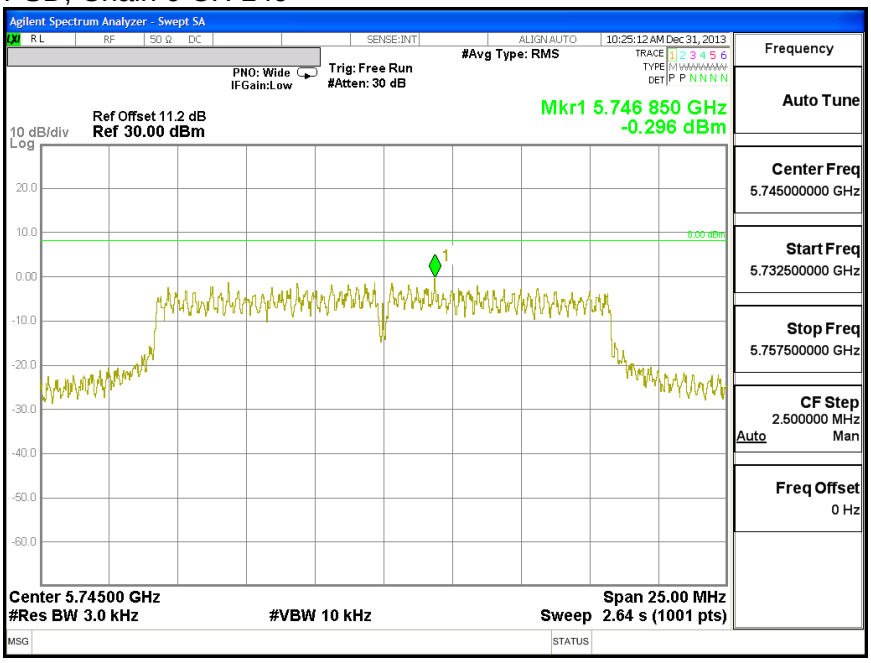
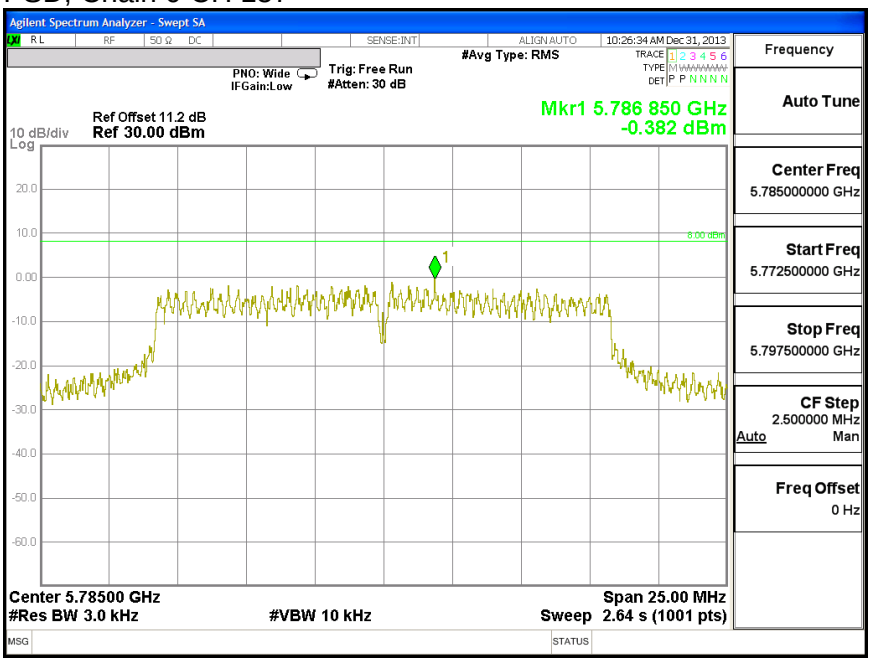
PSD, Chain 0

PSD, Chain 0 CH 149



PSD, Chain 0 CH 157



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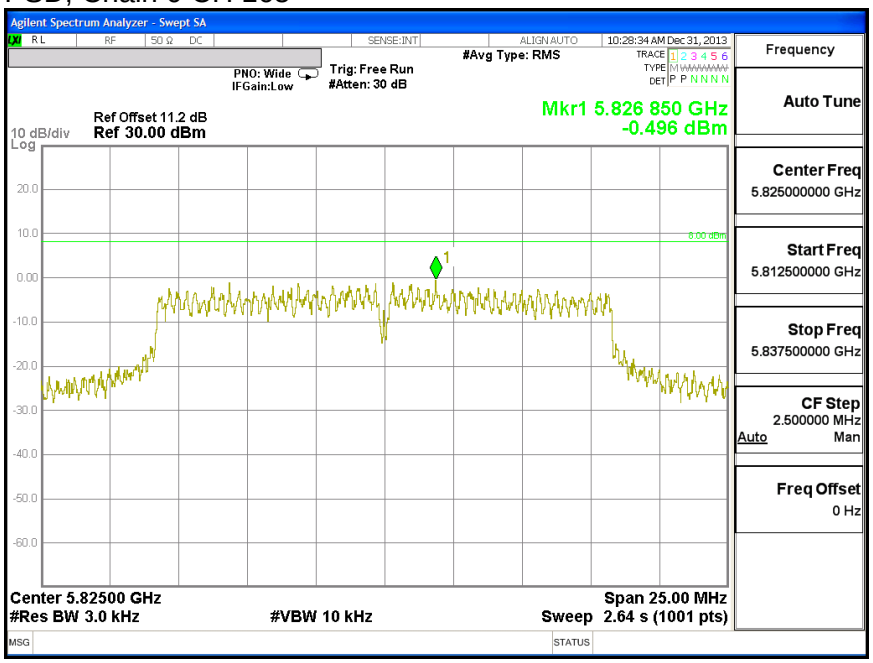
PSD, Chain 0 CH 165



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7.1.6. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

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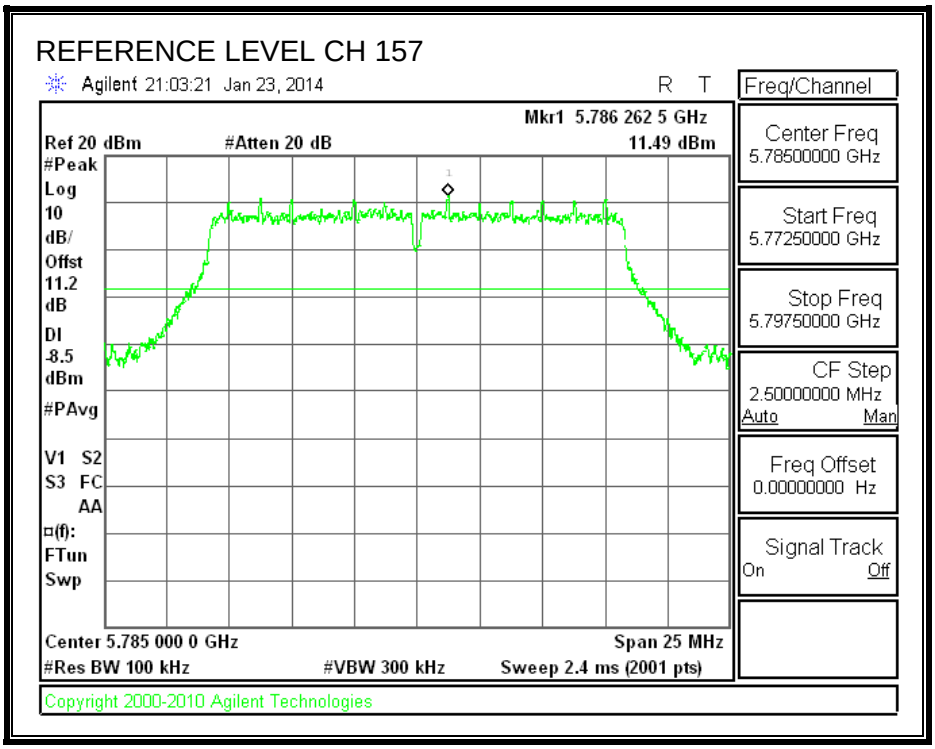
RESULTS

IN-BAND REFERENCE LEVEL



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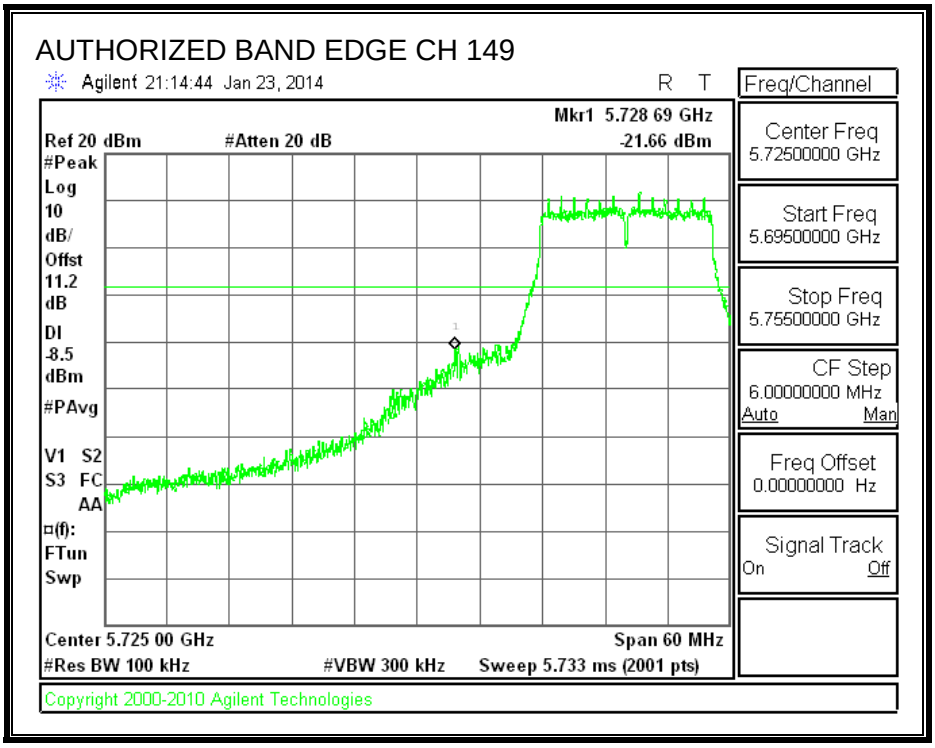
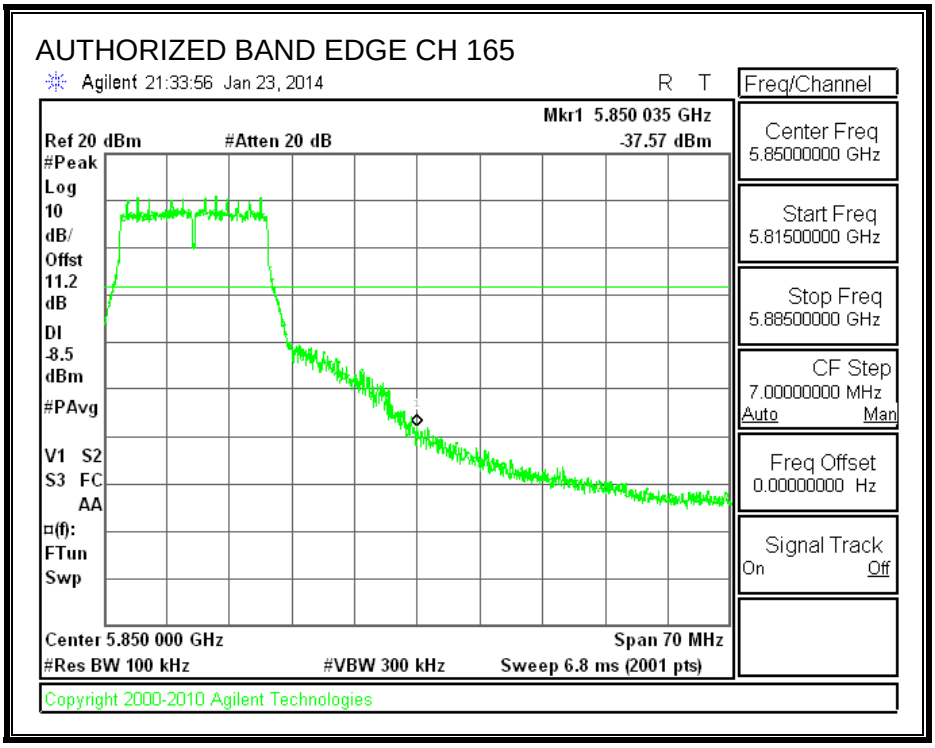
LOW CHANNEL BANDEDGE



HIGH CHANNEL BANDEDGE



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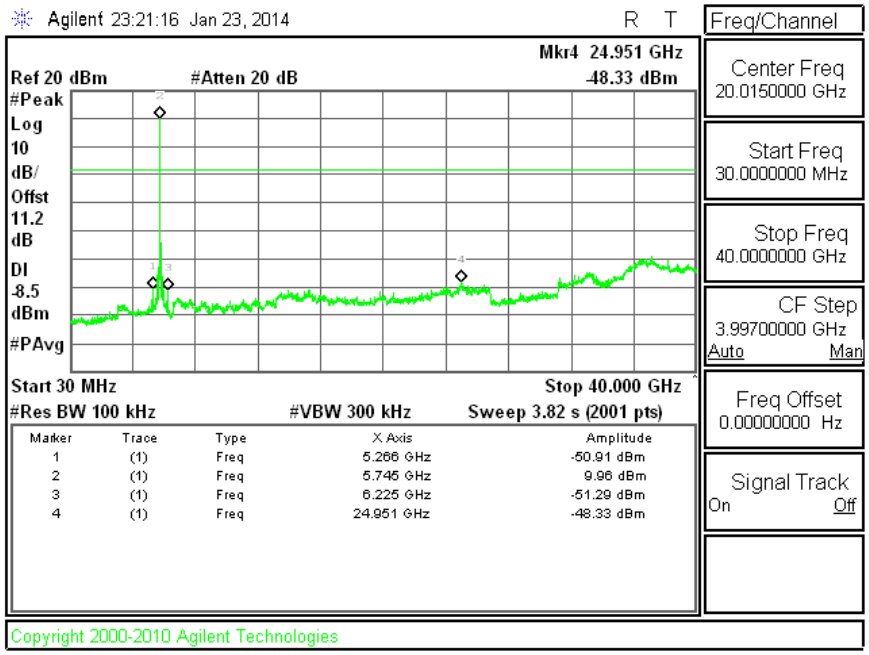
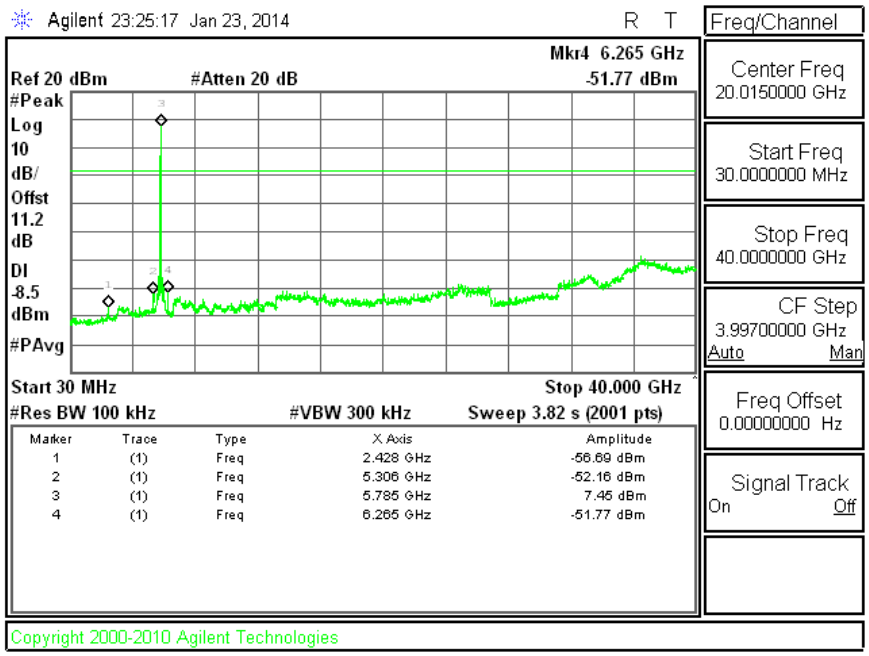
OUT-OF-BAND EMISSIONS

OUT OF BAND CH 149



OUT OF BAND CH 157



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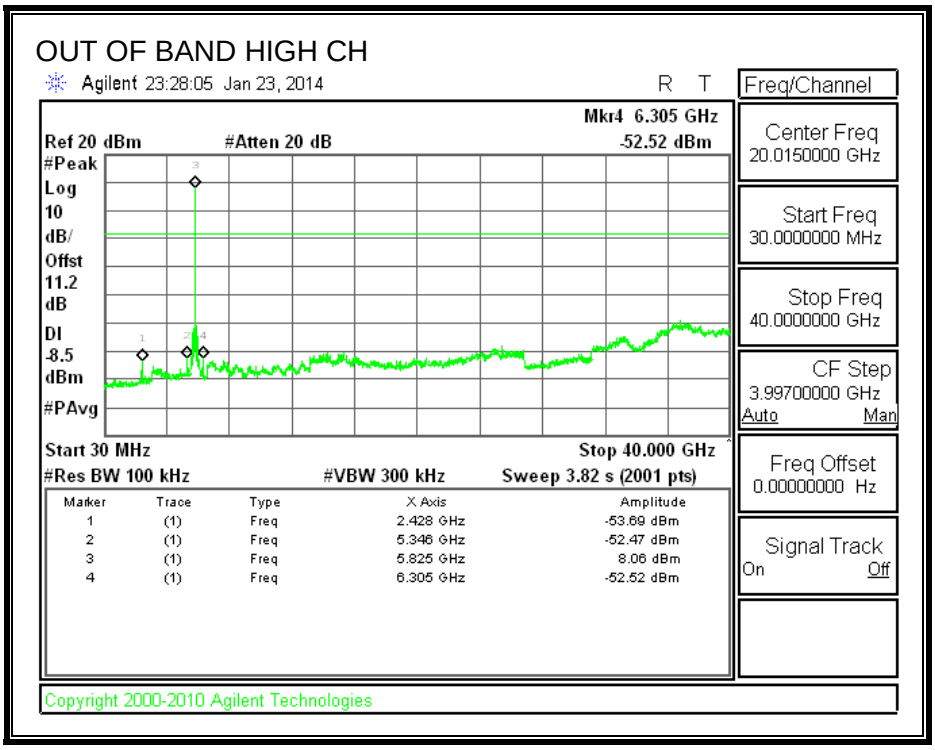

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7.2. 802.11n HT20 SISO MODE IN THE 5.8 GHz BAND

7.2.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
149	5745	17.600	0.5
157	5785	17.525	0.5
165	5825	17.575	0.5

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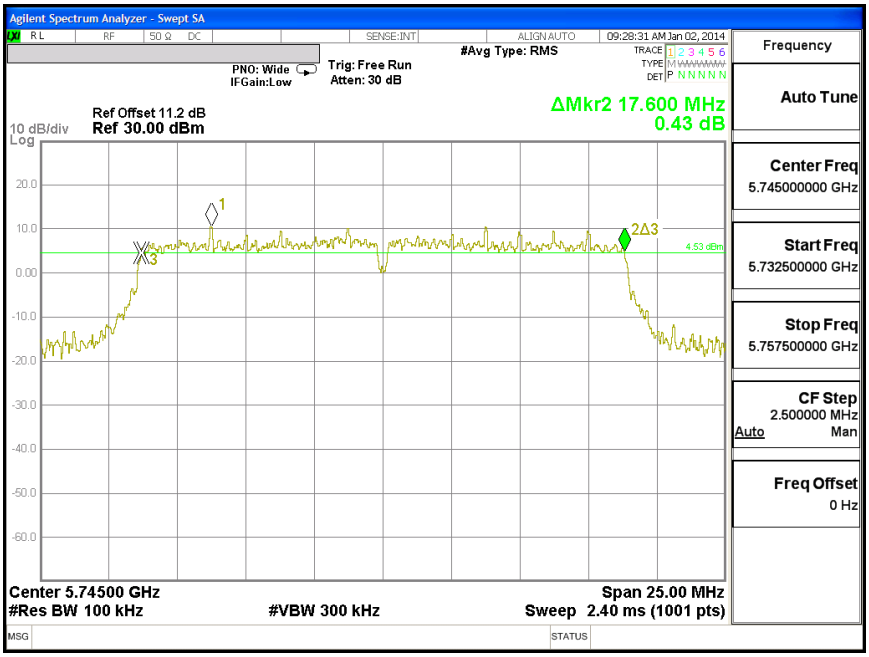
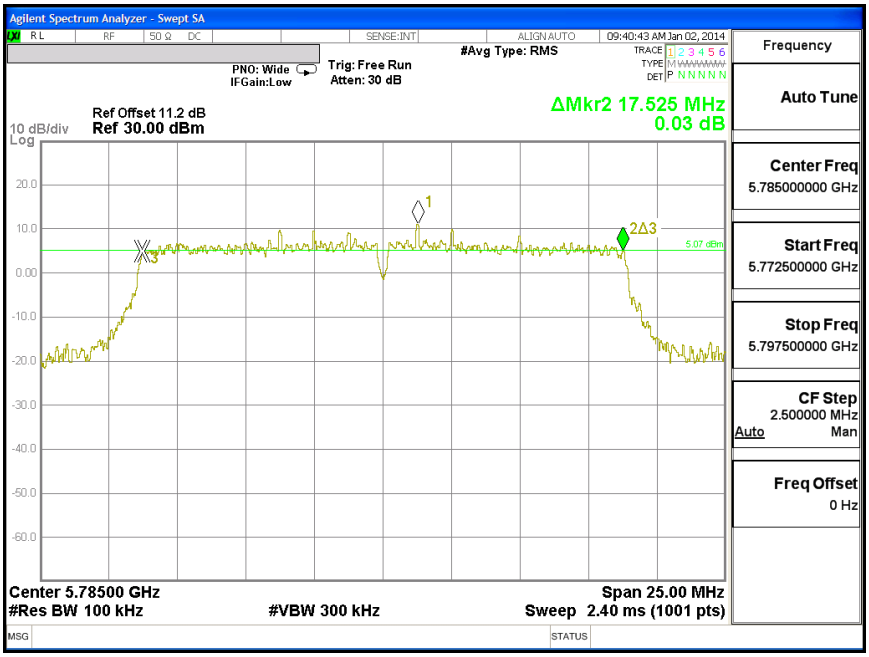
6 dB BANDWIDTH

6 dB BANDWIDTH CH 149



6 dB BANDWIDTH CH 157



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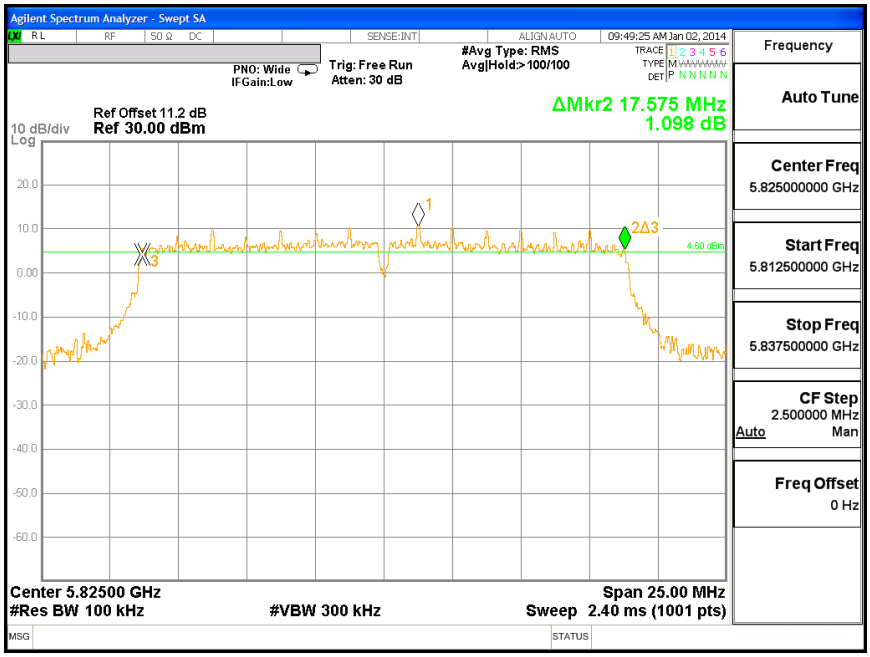
6 dB BANDWIDTH CH 165



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7.2.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
149	5745	17.954
157	5785	17.978
165	5825	17.950

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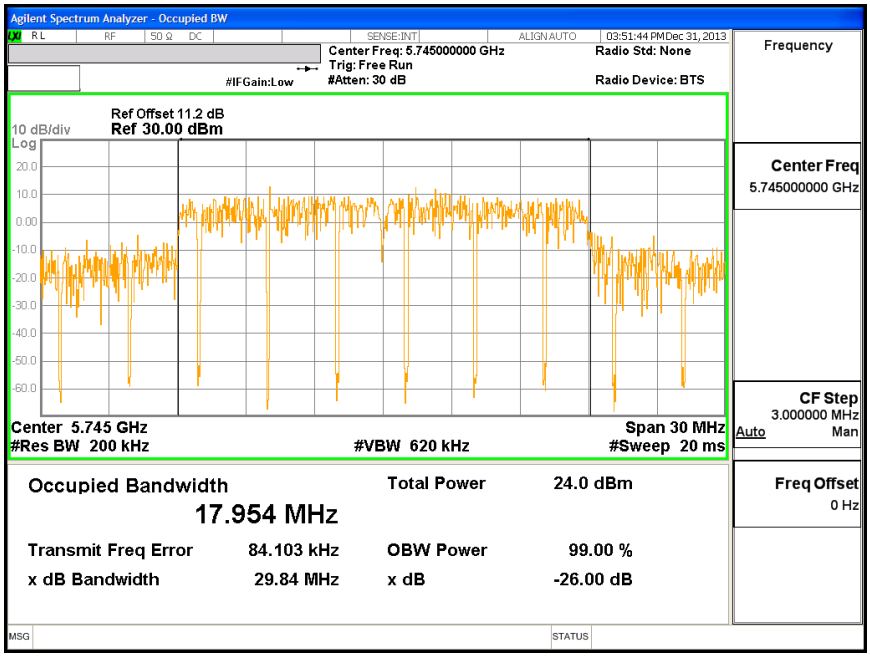
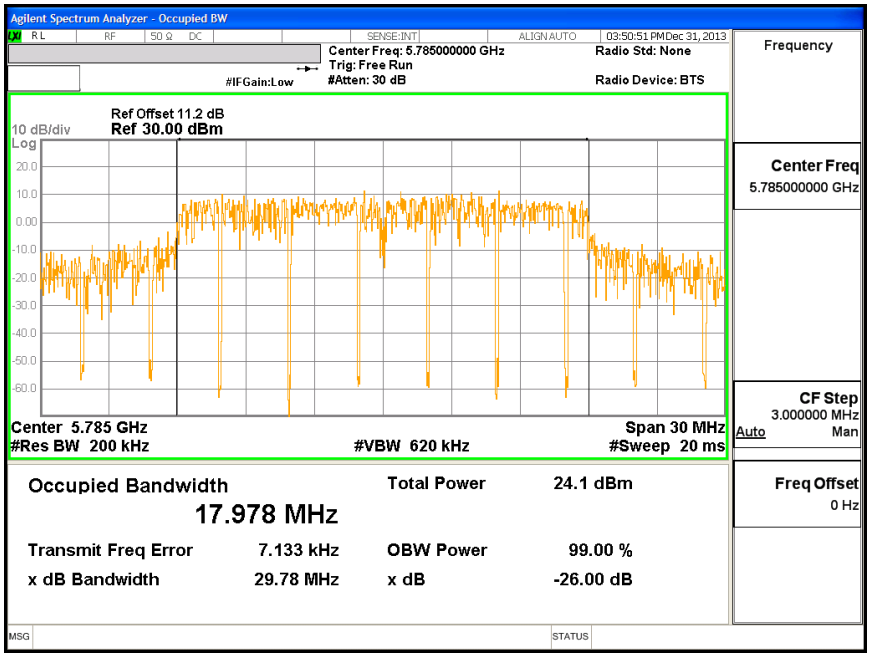
99% BANDWIDTH

99% BANDWIDTH CH 149



99% BANDWIDTH CH 157



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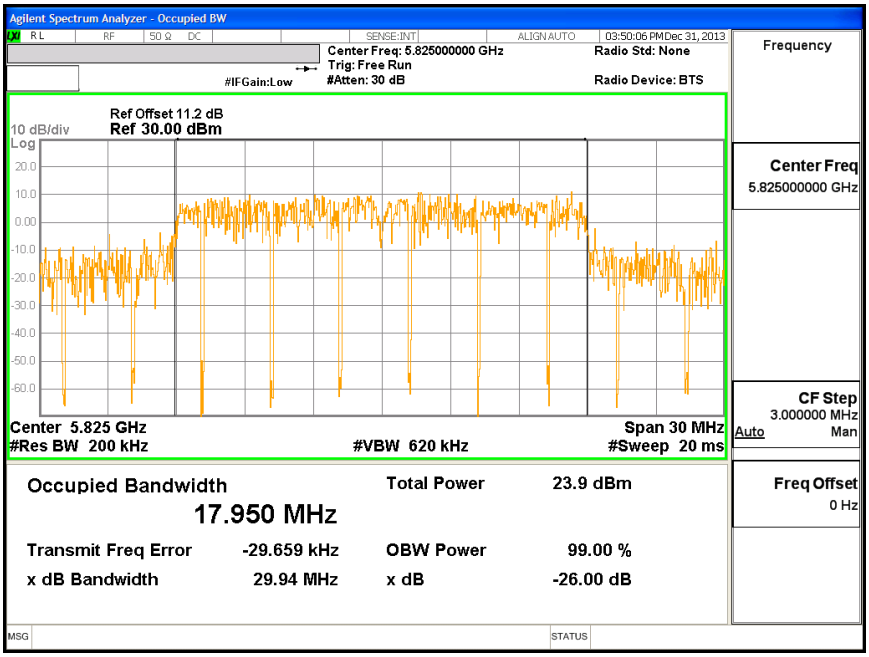
99% BANDWIDTH CH 165



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7.2.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
149	5745	21.48
157	5785	21.42
165	5825	21.40

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7.2.4. OUTPUT POWER

LIMITS

FCC §15.247

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

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RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
149	5745	3.16	30.00	30	36	30.00
157	5785	3.16	30.00	30	36	30.00
165	5825	3.16	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
149	5745	29.35	29.35	30.00	-0.65
157	5785	29.40	29.40	30.00	-0.60
165	5825	29.20	29.20	30.00	-0.80

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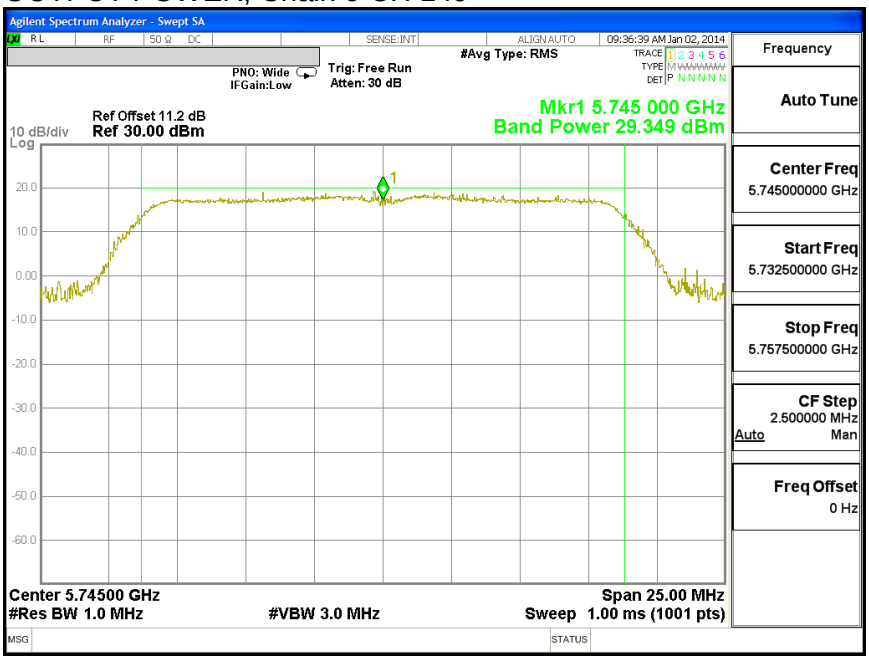
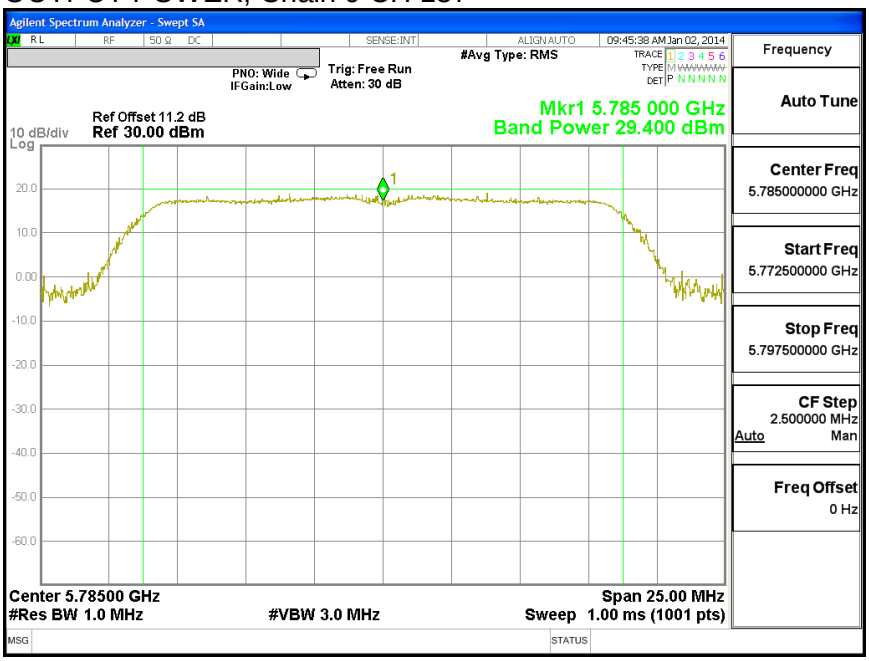
OUTPUT POWER, Chain 0

OUTPUT POWER, Chain 0 CH 149



OUTPUT POWER, Chain 0 CH 157



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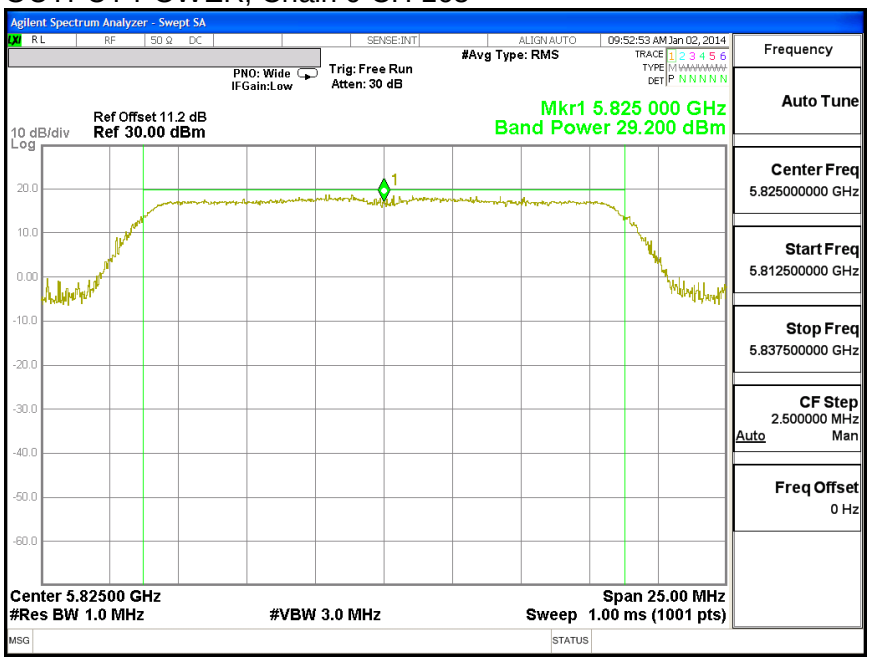
OUTPUT POWER, Chain 0 CH 165



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7.2.5. PSD

LIMITS

FCC §15.247

RESULTS

PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Limit (dBm)	Margin (dB)
149	5745	-1.68	8.0	-9.7
157	5785	-0.84	8.0	-8.8
165	5825	-1.55	8.0	-9.6

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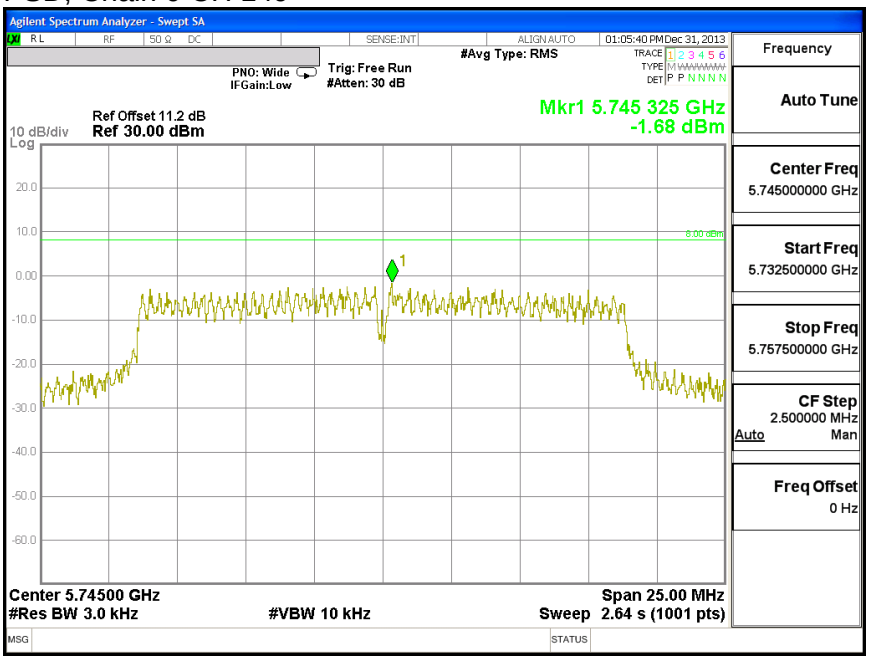
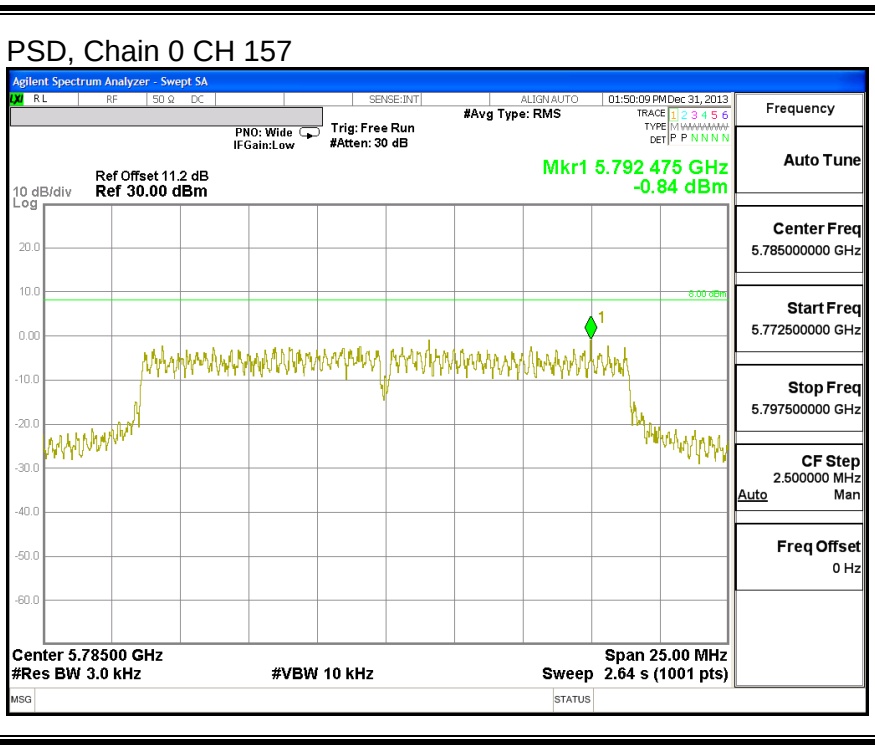
PSD, Chain 0

PSD, Chain 0 CH 149



PSD, Chain 0 CH 157



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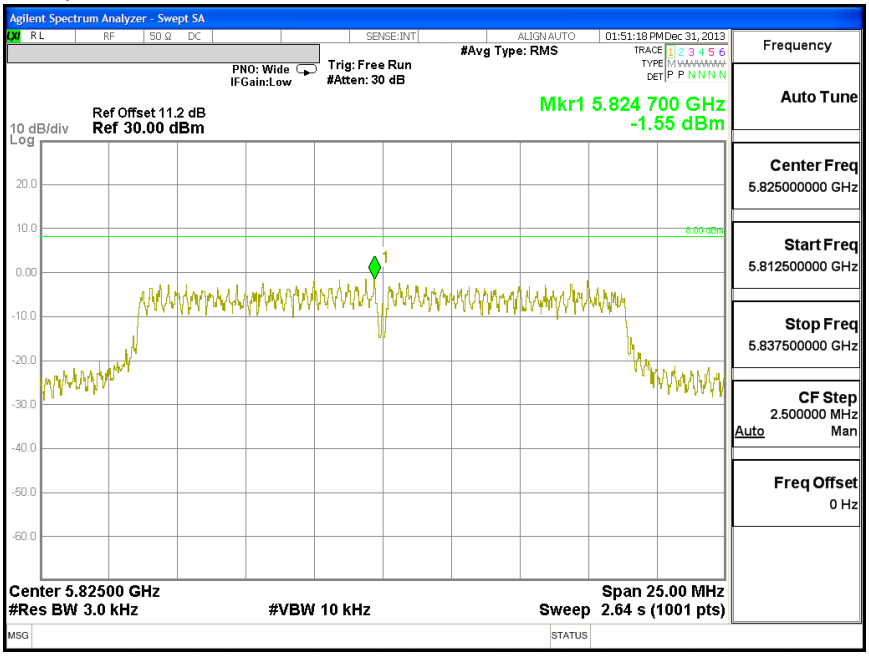
PSD, Chain 0 CH 165



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7.2.6. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

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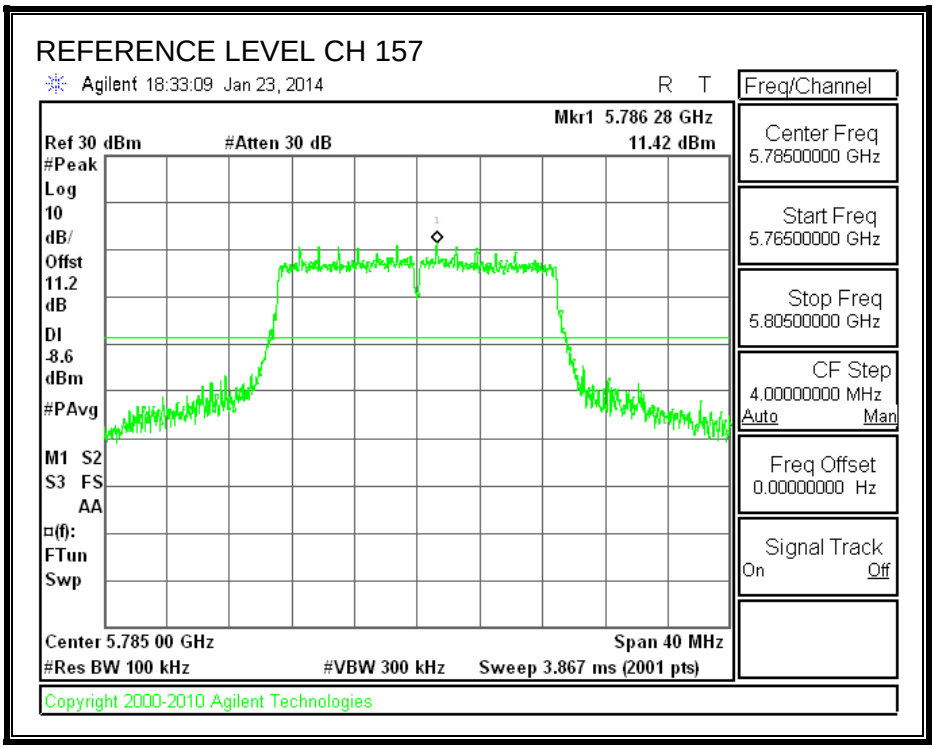
RESULTS

IN-BAND REFERENCE LEVEL



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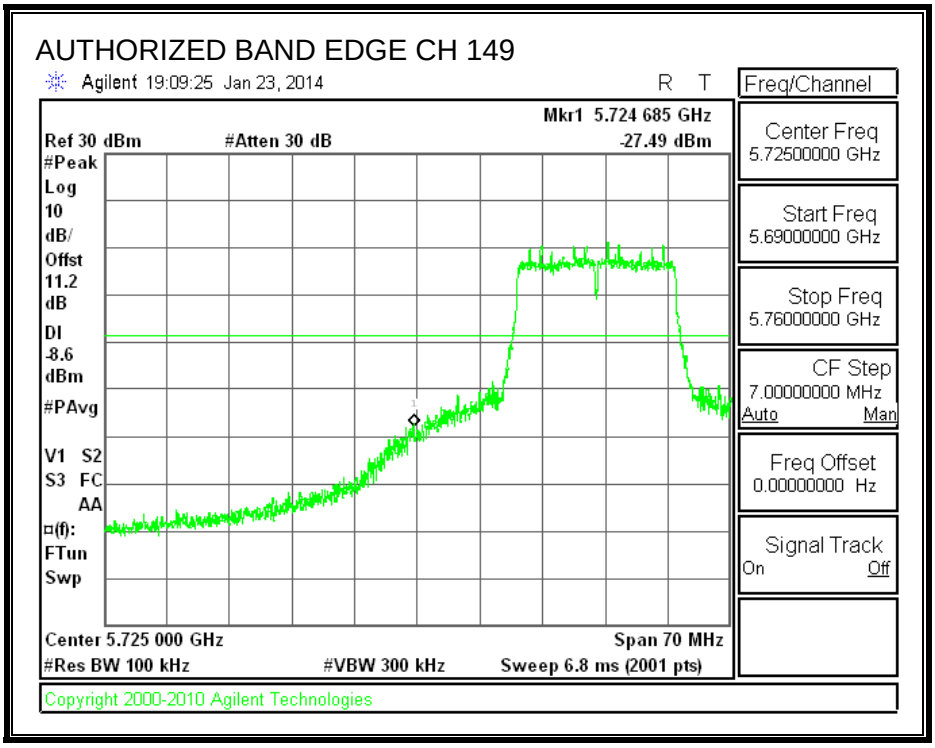
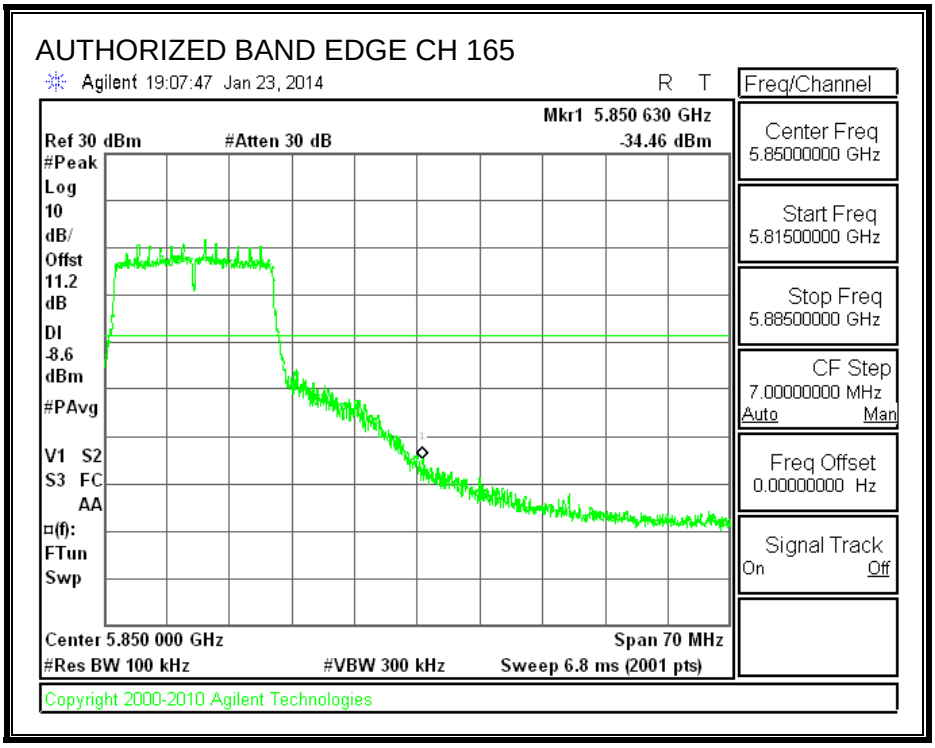
LOW CHANNEL BANDEDGE



HIGH CHANNEL BANDEDGE



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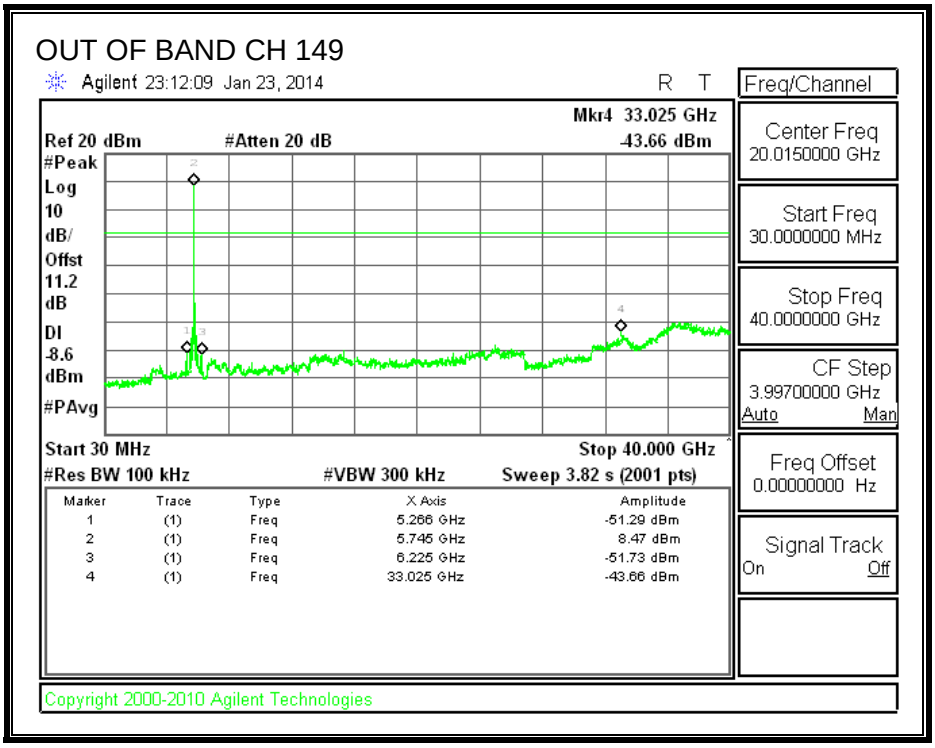
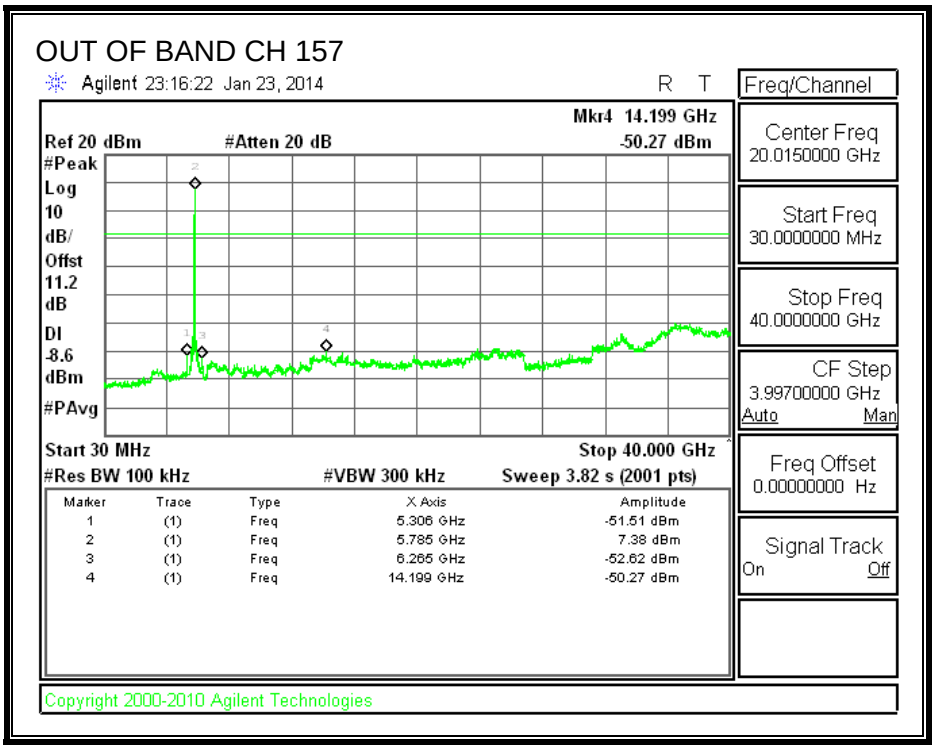
OUT-OF-BAND EMISSIONS

OUT OF BAND CH 149



OUT OF BAND CH 157



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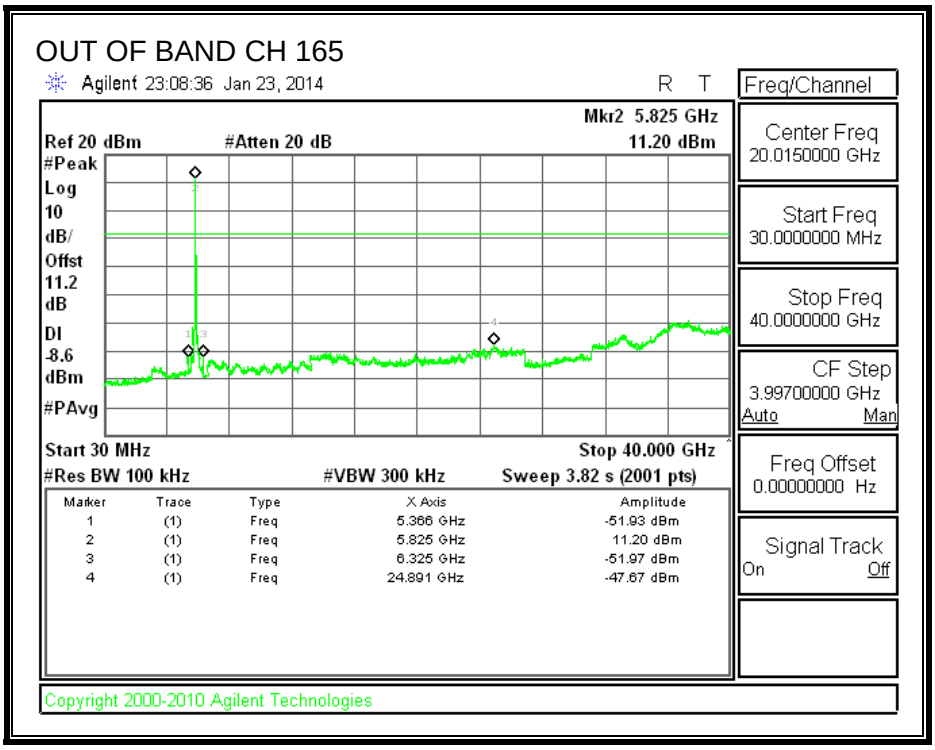

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7.3. 802.11n HT20 3TX CDD MODE IN THE 5.8 GHz BAND

7.3.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	6 dB BW Chain 2 (MHz)	Minimum Limit (MHz)
149	5745	17.550	17.600	17.625	0.5
157	5785	17.600	17.600	17.625	0.5
165	5825	17.625	17.625	17.600	0.5

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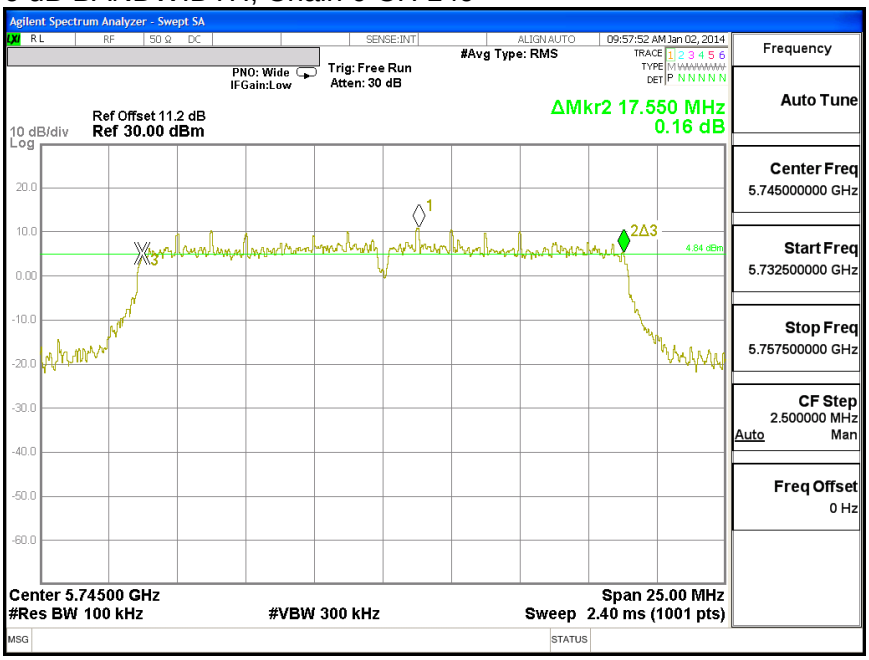
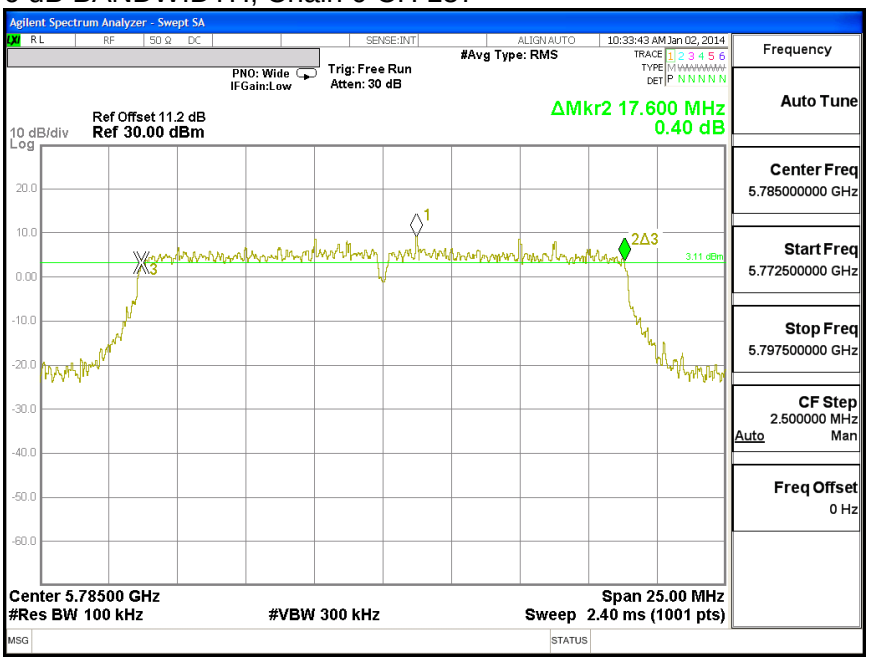
6 dB BANDWIDTH, Chain 0

6 dB BANDWIDTH, Chain 0 CH 149



6 dB BANDWIDTH, Chain 0 CH 157



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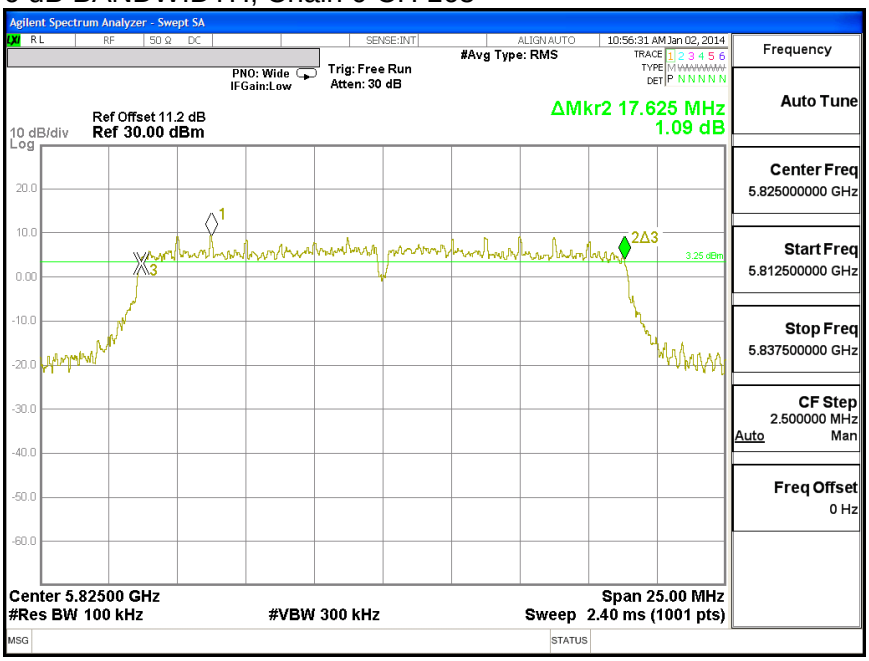
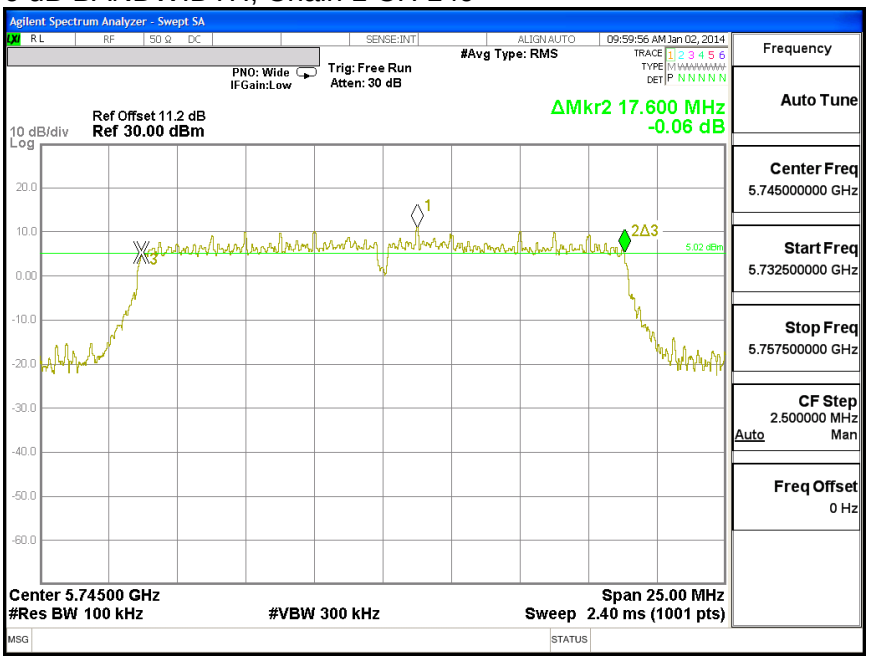
6 dB BANDWIDTH, Chain 0 CH 165



6 dB BANDWIDTH, Chain 1

6 dB BANDWIDTH, Chain 1 CH 149



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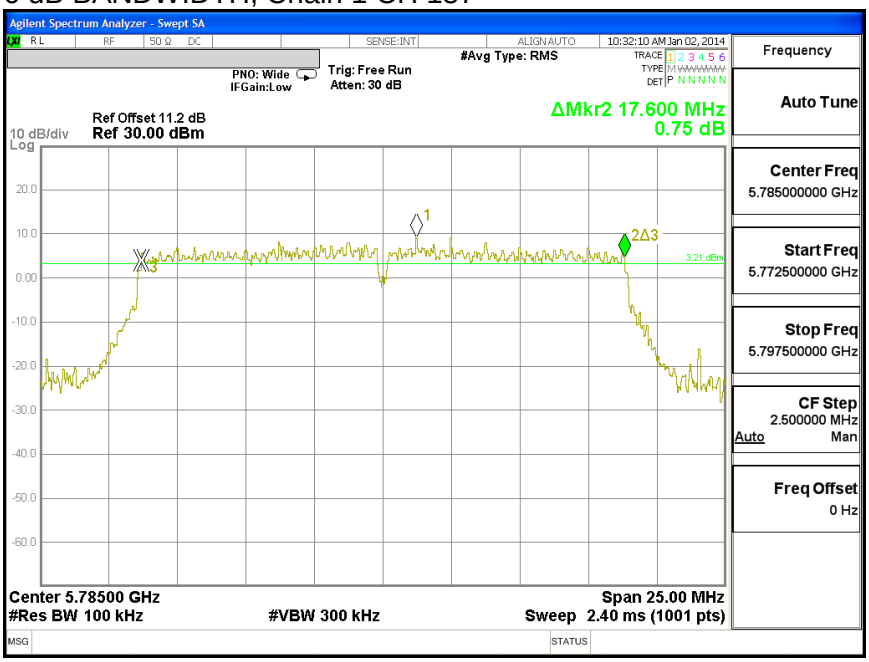
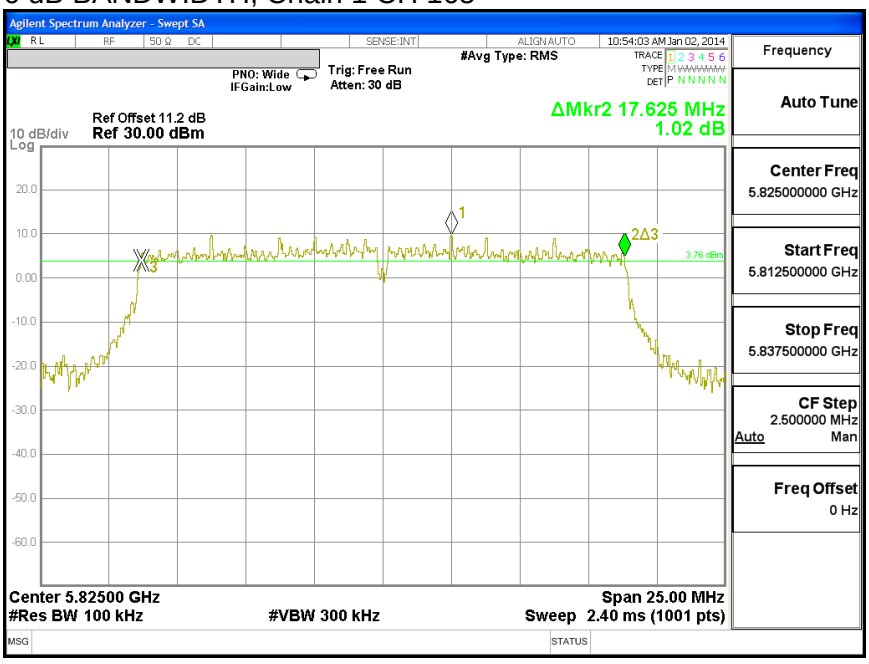
6 dB BANDWIDTH, Chain 1 CH 157



6 dB BANDWIDTH, Chain 1 CH 165



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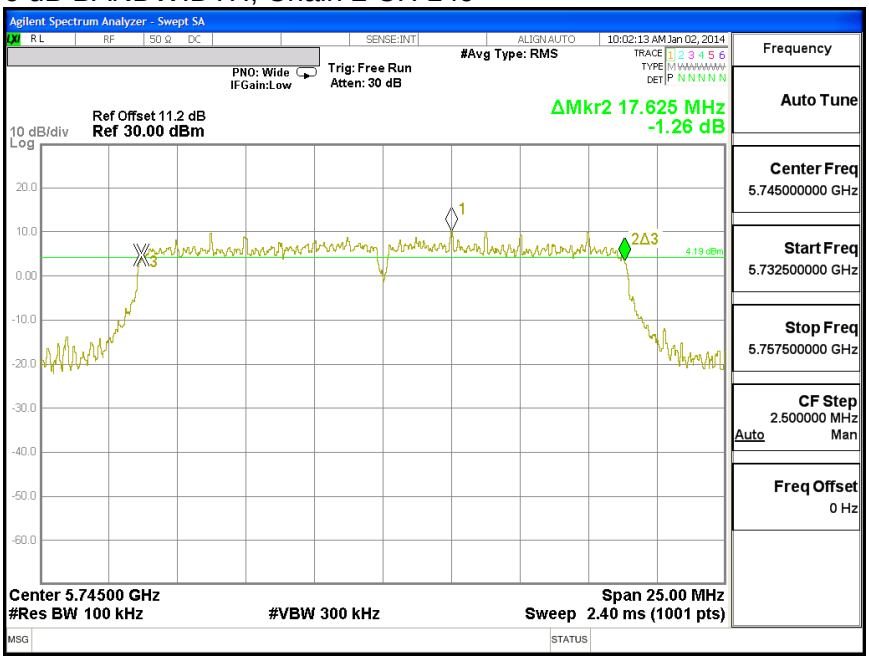
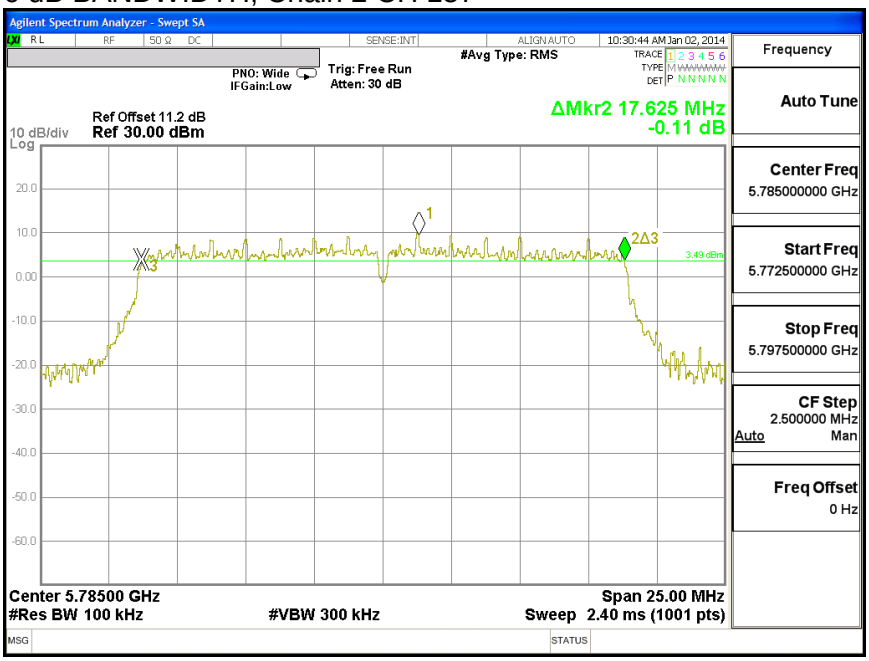
6 dB BANDWIDTH, Chain 2

6 dB BANDWIDTH, Chain 2 CH 149



6 dB BANDWIDTH, Chain 2 CH 157



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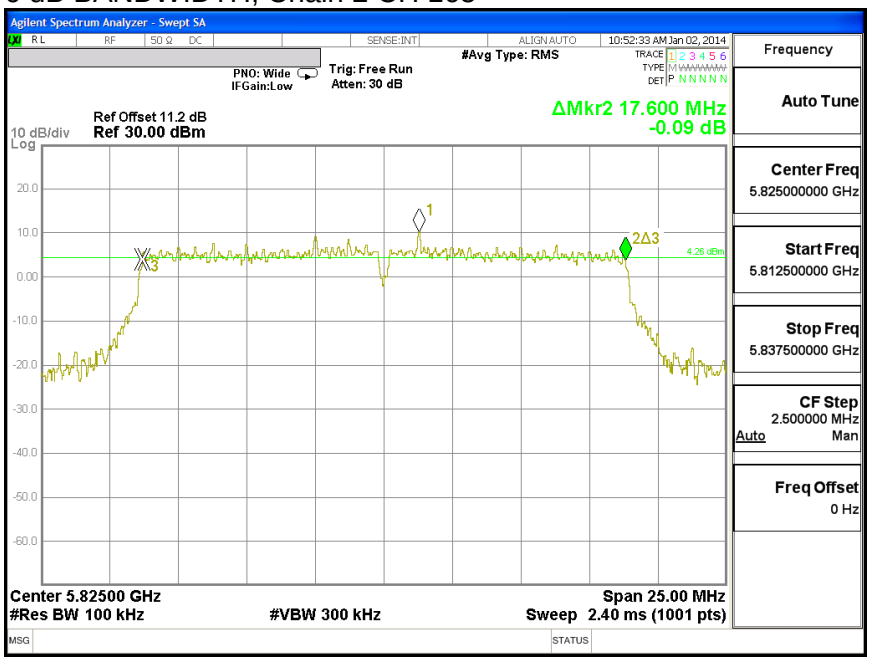
6 dB BANDWIDTH, Chain 2 CH 165



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7.3.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)	99% BW Chain 2 (MHz)
149	5745	17.6690	17.6540	17.6440
157	5785	17.7740	17.6450	17.6950
165	5825	17.6850	17.6790	17.7050

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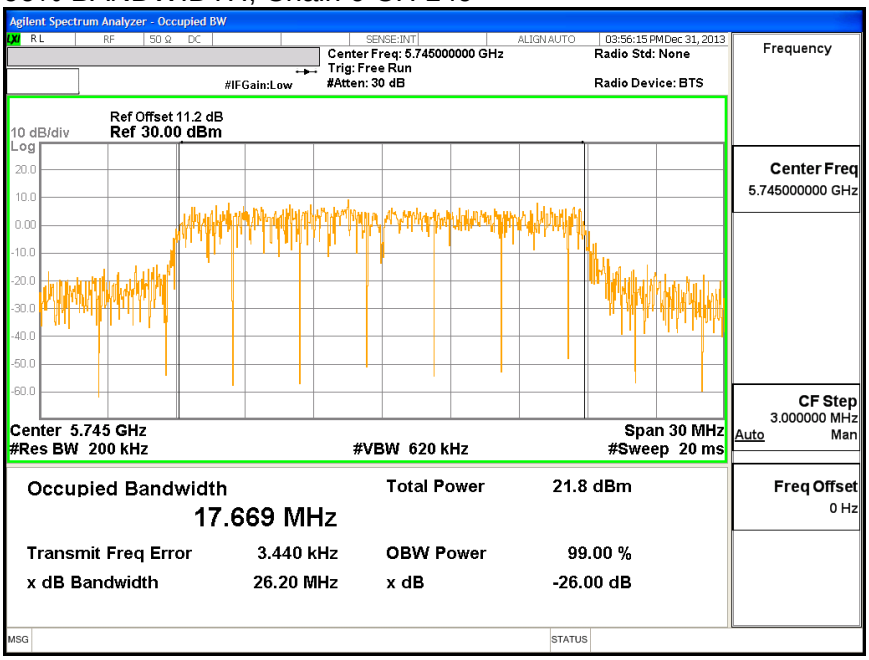
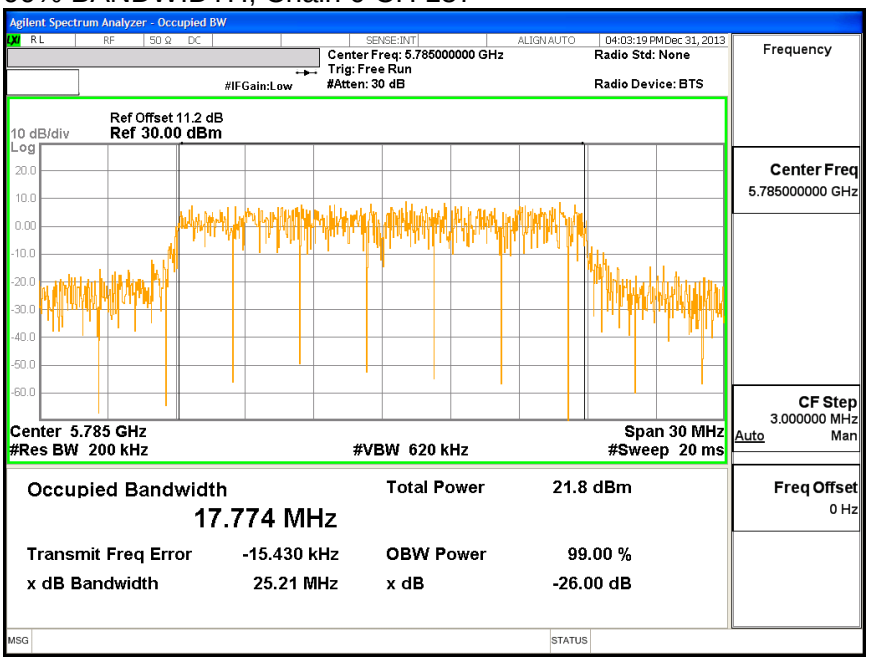
99% BANDWIDTH, Chain 0

99% BANDWIDTH, Chain 0 CH 149



99% BANDWIDTH, Chain 0 CH 157



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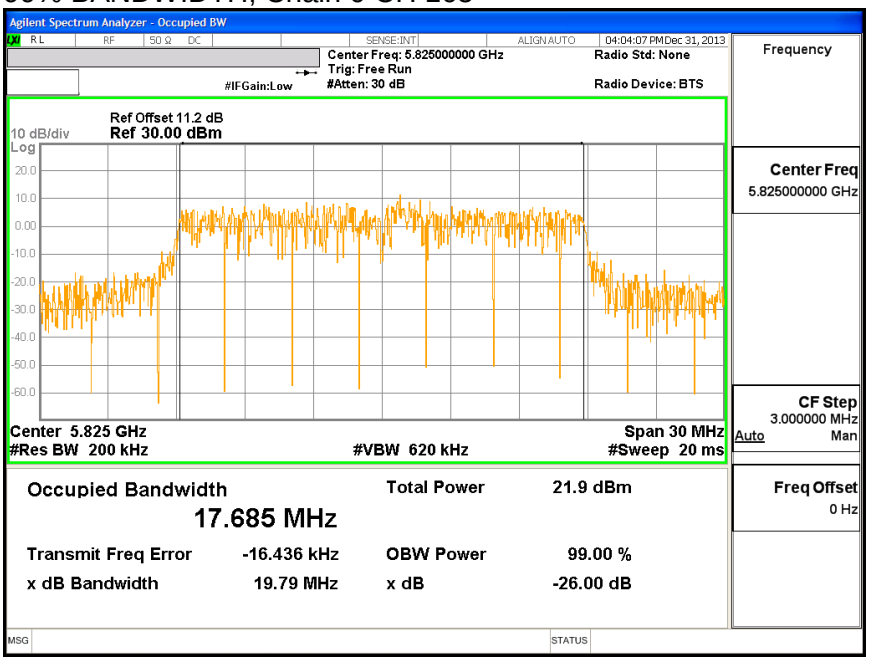
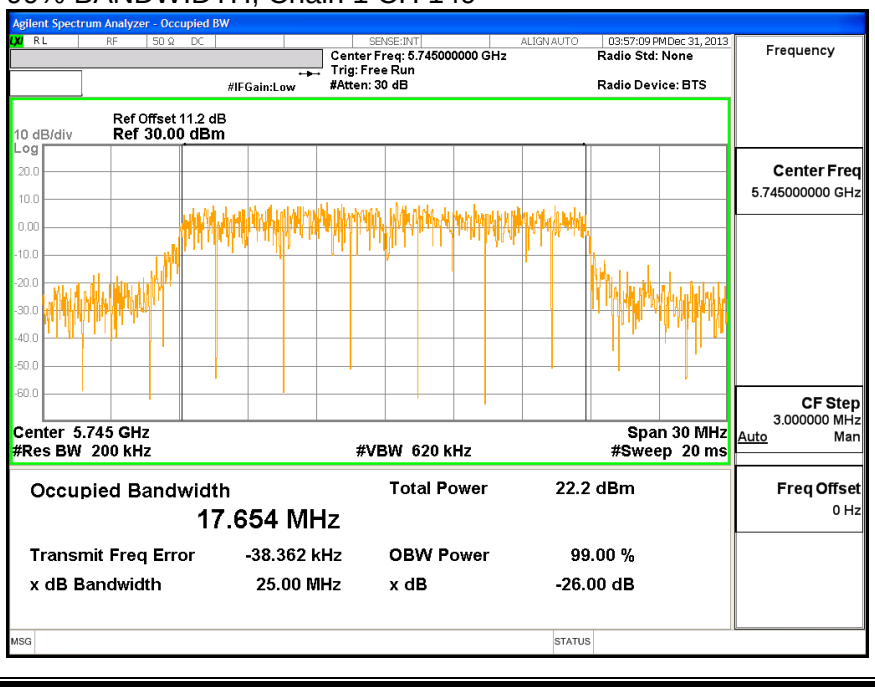
99% BANDWIDTH, Chain 0 CH 165



99% BANDWIDTH, Chain 1

99% BANDWIDTH, Chain 1 CH 149



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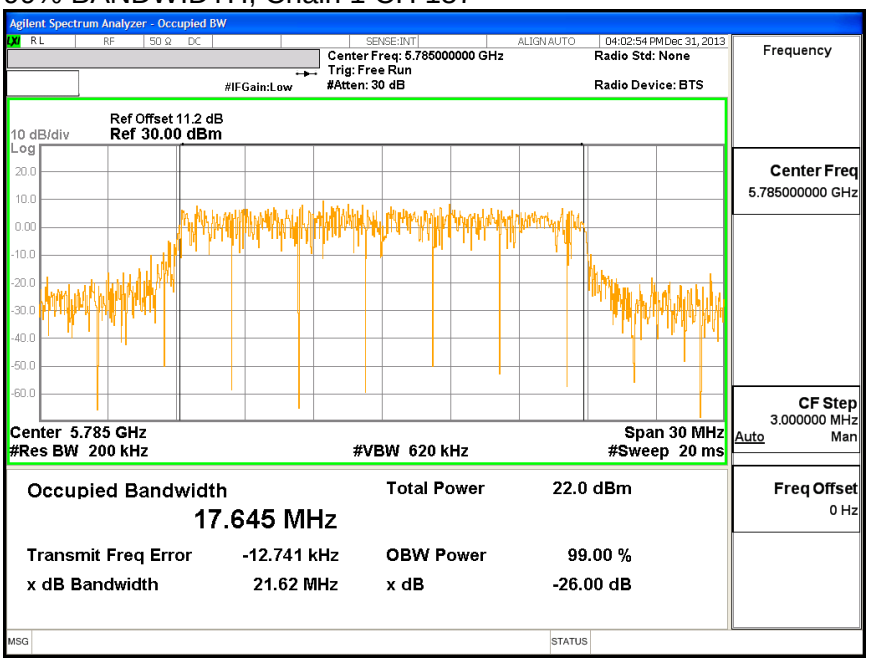
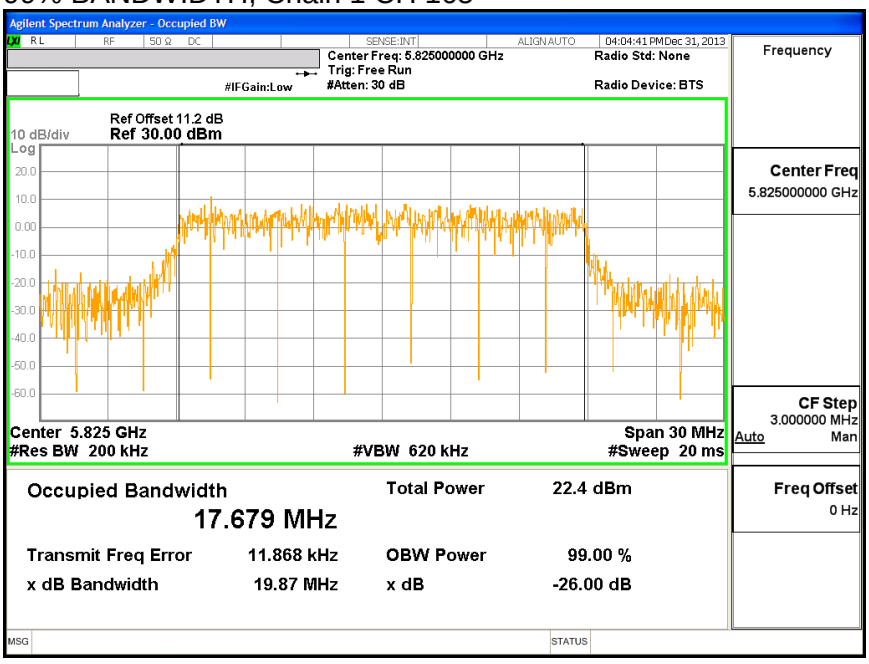
99% BANDWIDTH, Chain 1 CH 157



99% BANDWIDTH, Chain 1 CH 165



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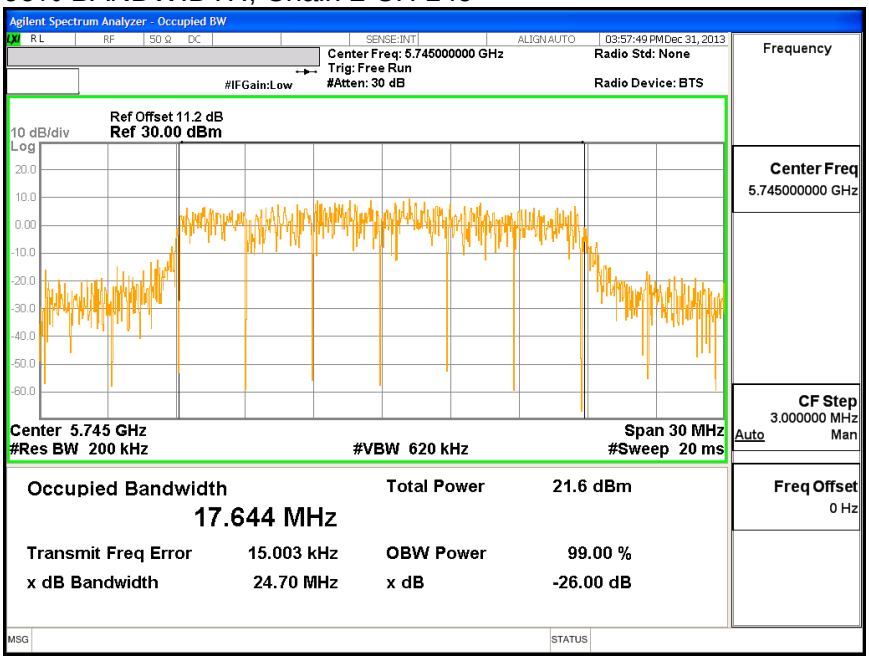
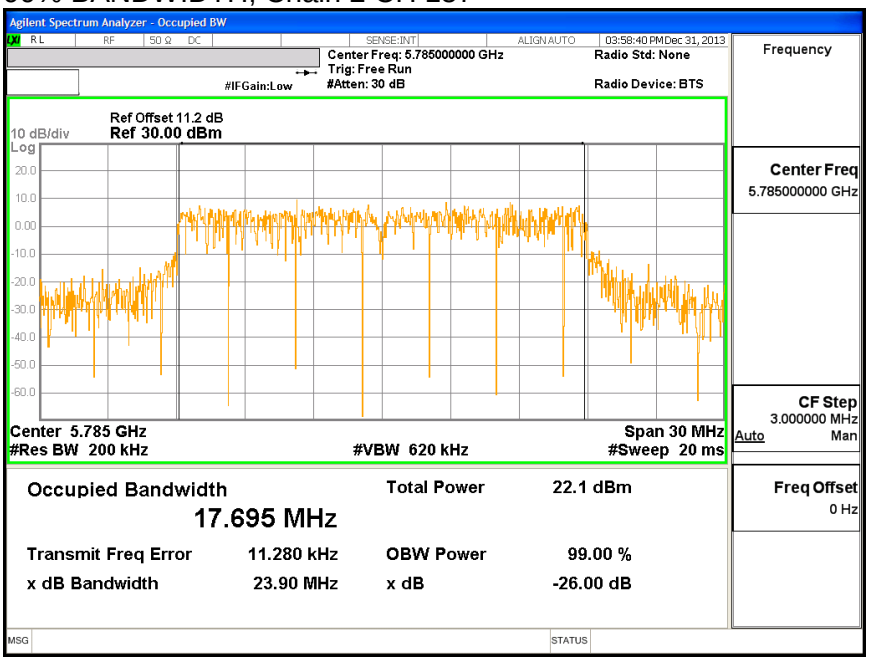
99% BANDWIDTH, Chain 2

99% BANDWIDTH, Chain 2 CH 149



99% BANDWIDTH, Chain 2 CH 157



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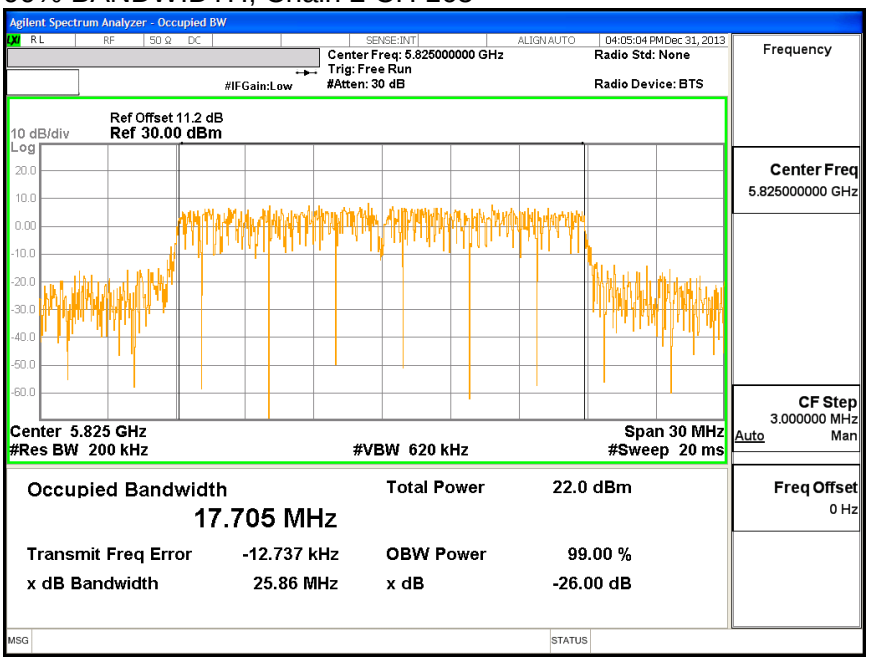
99% BANDWIDTH, Chain 2 CH 165



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7.3.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
149	5745	20.83	21.07	20.92	25.71
157	5785	20.75	20.91	20.77	25.58
165	5825	21.02	21.20	20.97	25.84

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7.3.4. OUTPUT POWER

LIMITS

FCC §15.247

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are correlated and the antenna gain is the same for each chain. The directional gain is:

Antenna Gain (dBi)	10 * Log (3 chains) (dB)	Correlated Chains Directional Gain (dBi)
3.16	4.77	7.93

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RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
149	5745	7.93	28.07	30	36	28.07
157	5785	7.93	28.07	30	36	28.07
165	5825	7.93	28.07	30	36	28.07

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)	Margin (dB)
149	5745	22.77	23.00	22.71	27.60	28.07	-0.47
157	5785	22.71	23.04	22.73	27.60	28.07	-0.47
165	5825	22.73	23.01	22.67	27.57	28.07	-0.50

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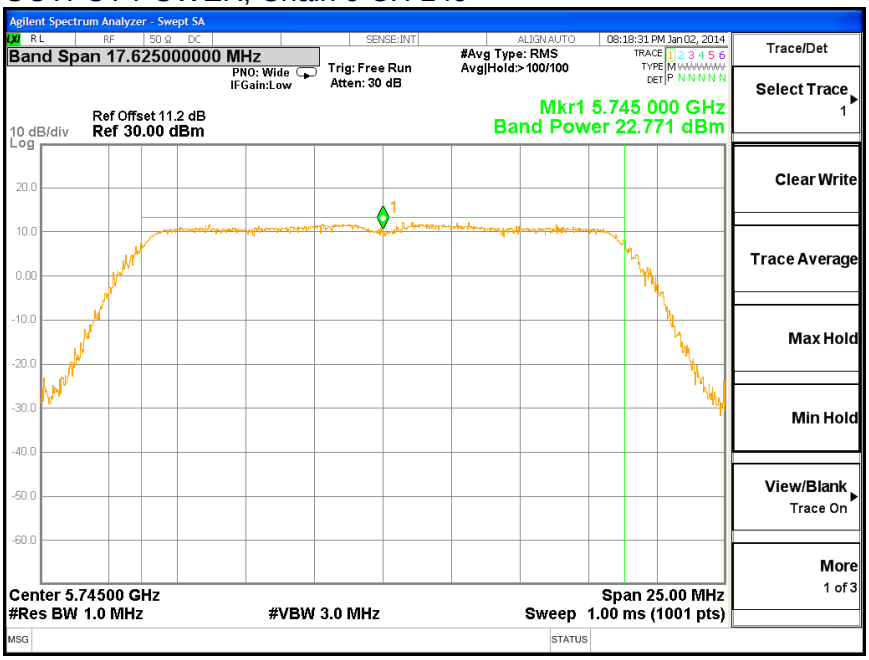
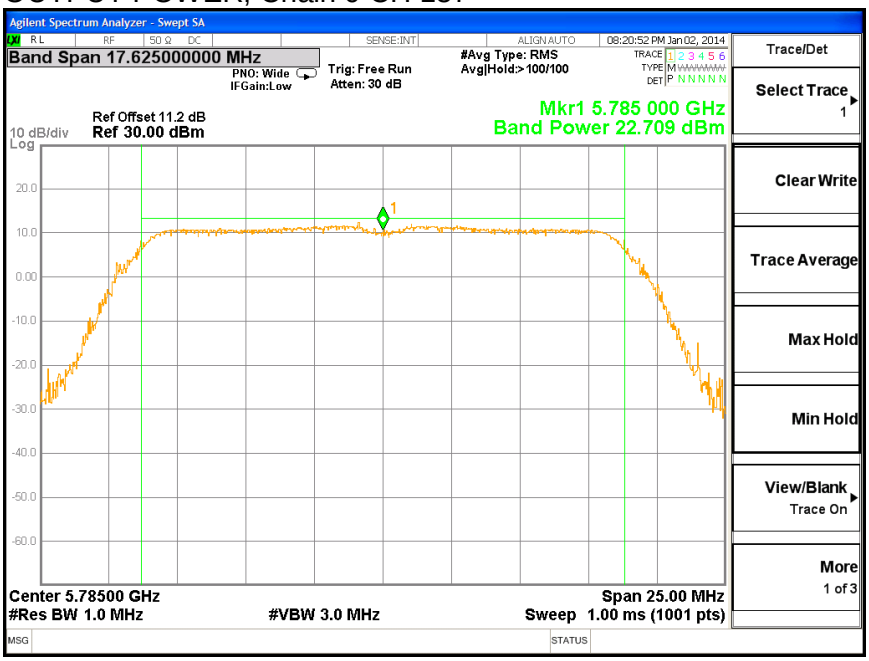
OUTPUT POWER, Chain 0

OUTPUT POWER, Chain 0 CH 149



OUTPUT POWER, Chain 0 CH 157



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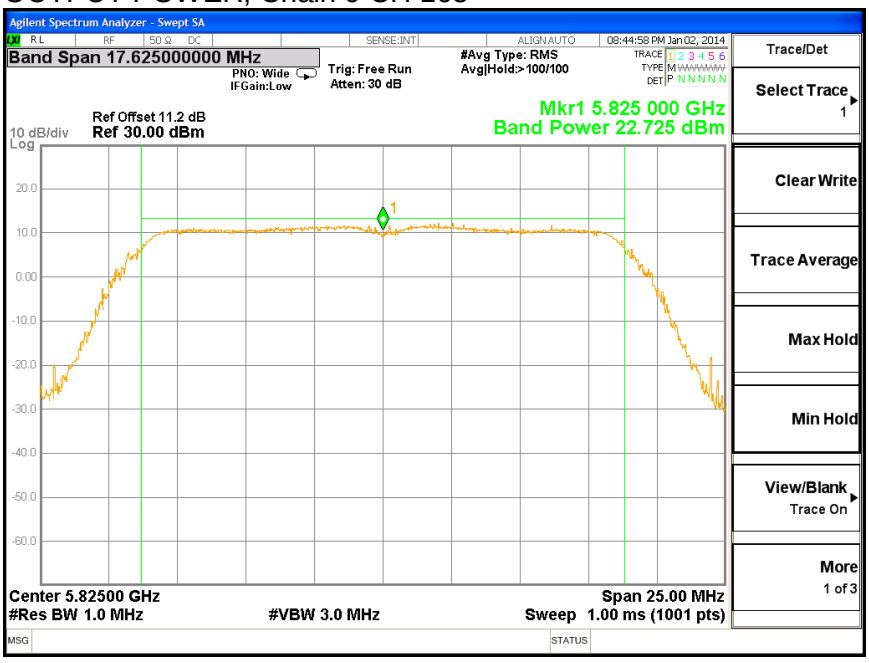
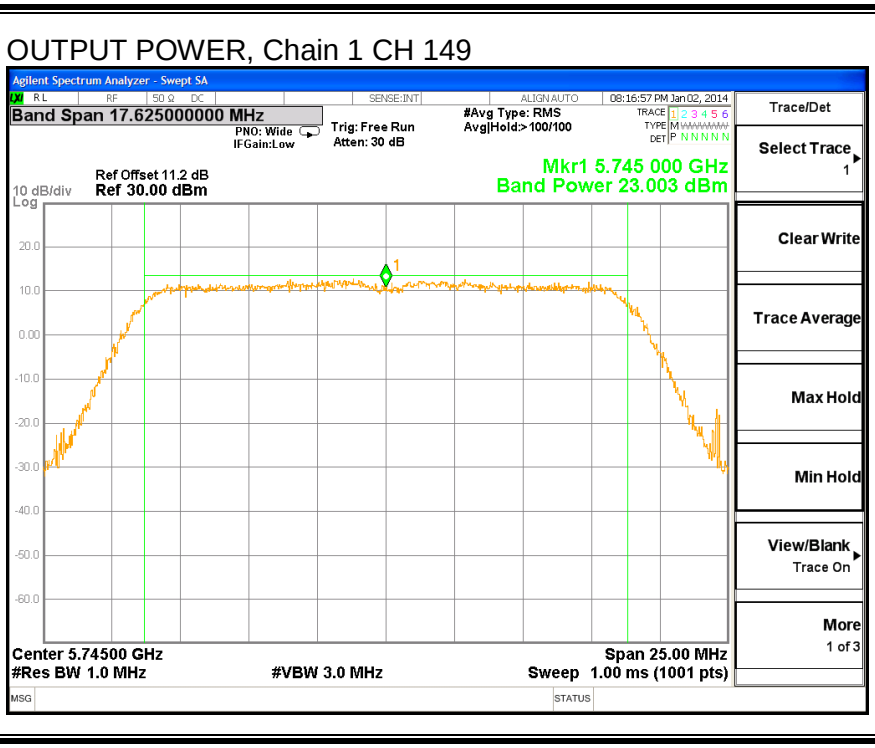
OUTPUT POWER, Chain 0 CH 165



OUTPUT POWER, Chain 1

OUTPUT POWER, Chain 1 CH 149



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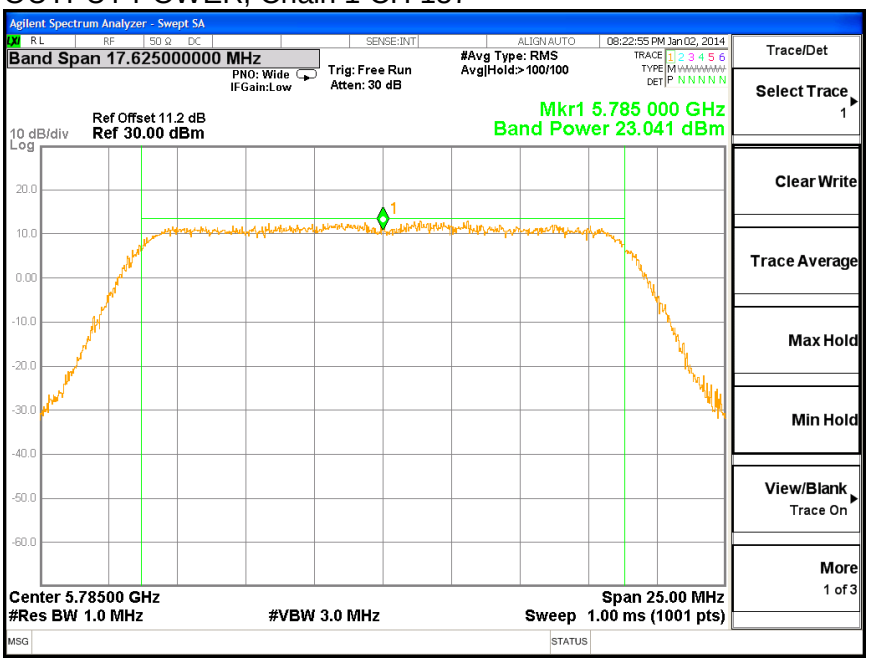
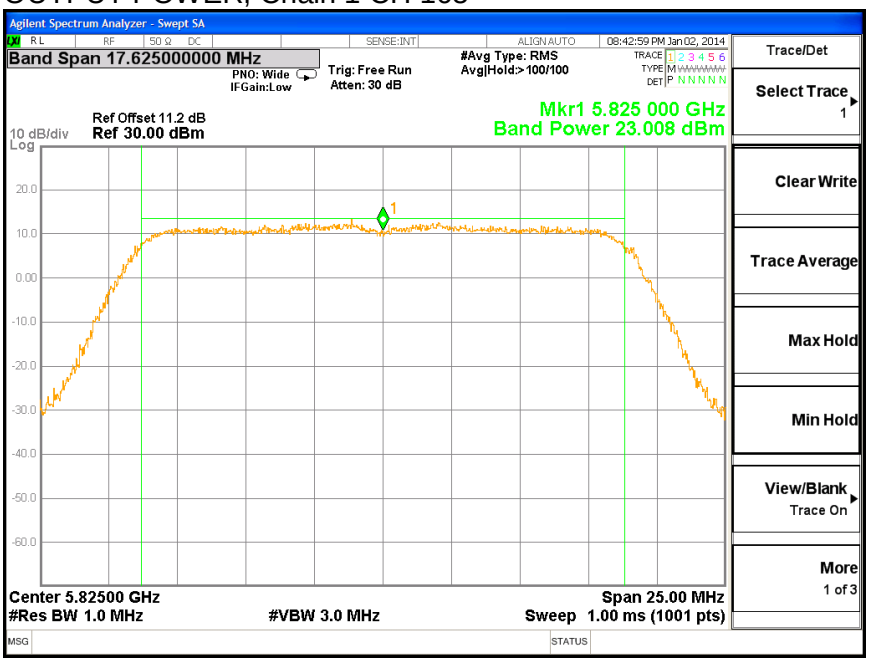
OUTPUT POWER, Chain 1 CH 157



OUTPUT POWER, Chain 1 CH 165



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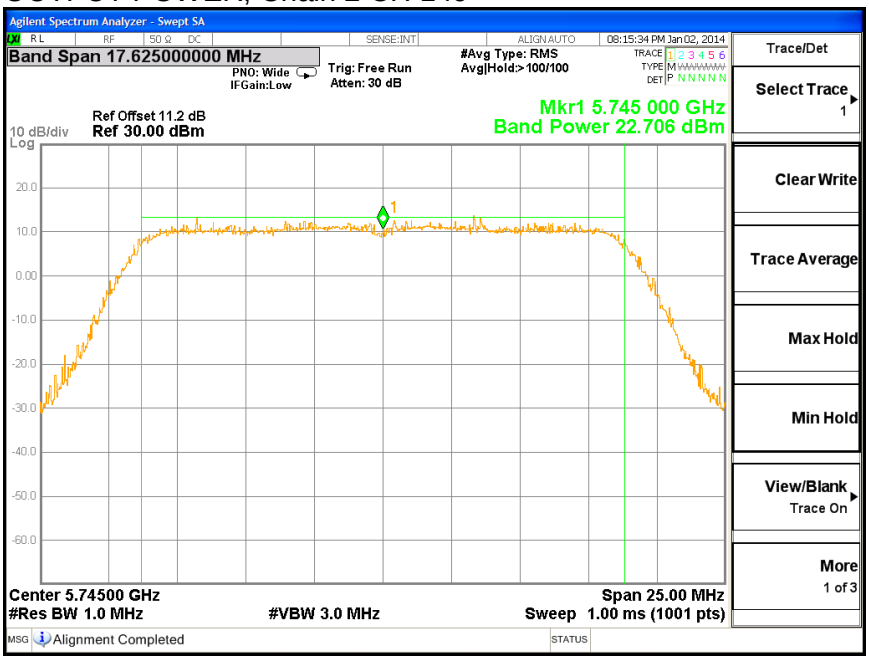
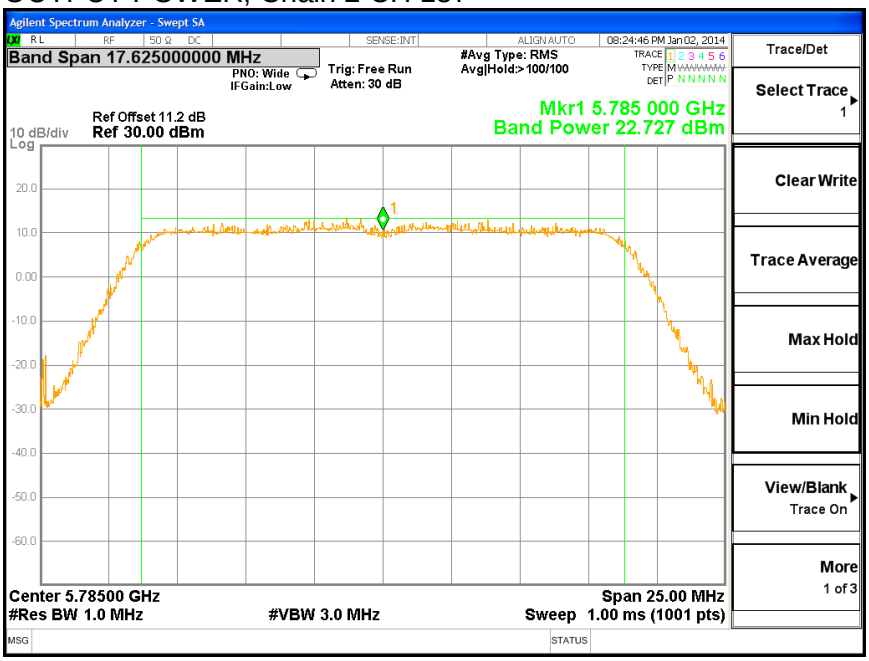
OUTPUT POWER, Chain 2

OUTPUT POWER, Chain 2 CH 149



OUTPUT POWER, Chain 2 CH 157



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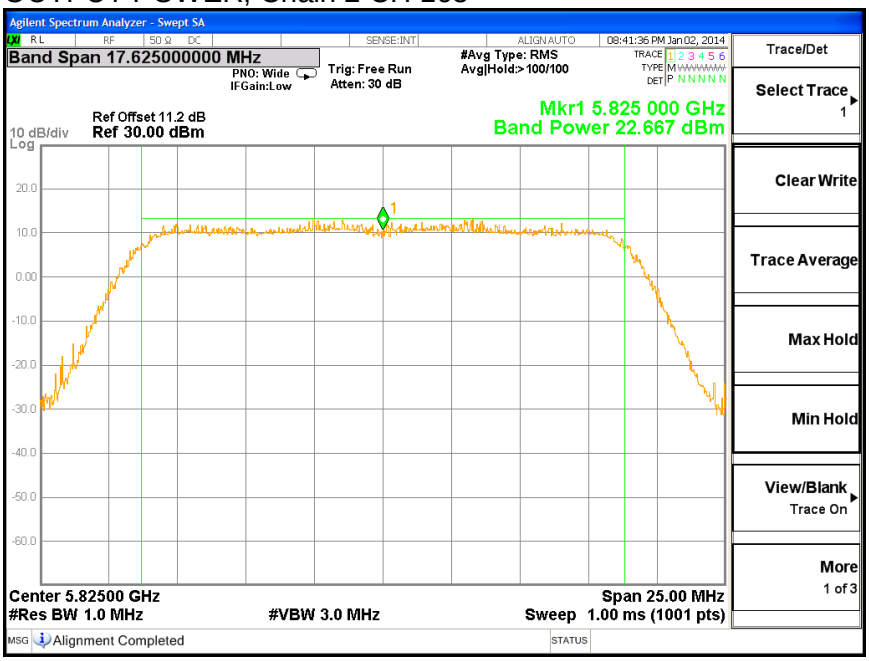
OUTPUT POWER, Chain 2 CH 165



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7.3.5. PSD

LIMITS

FCC §15.247

RESULTS

PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Chain 1 Meas (dBm)	Chain 2 Meas (dBm)	Total PSD (dBm)	Limit (dBm)	Margin (dB)
149	5745	-3.46	-3.07	-3.24	1.52	8.0	-6.5
157	5785	-3.09	-2.74	-2.72	1.92	8.0	-6.1
165	5825	-3.54	-2.23	-2.42	2.08	8.0	-5.9

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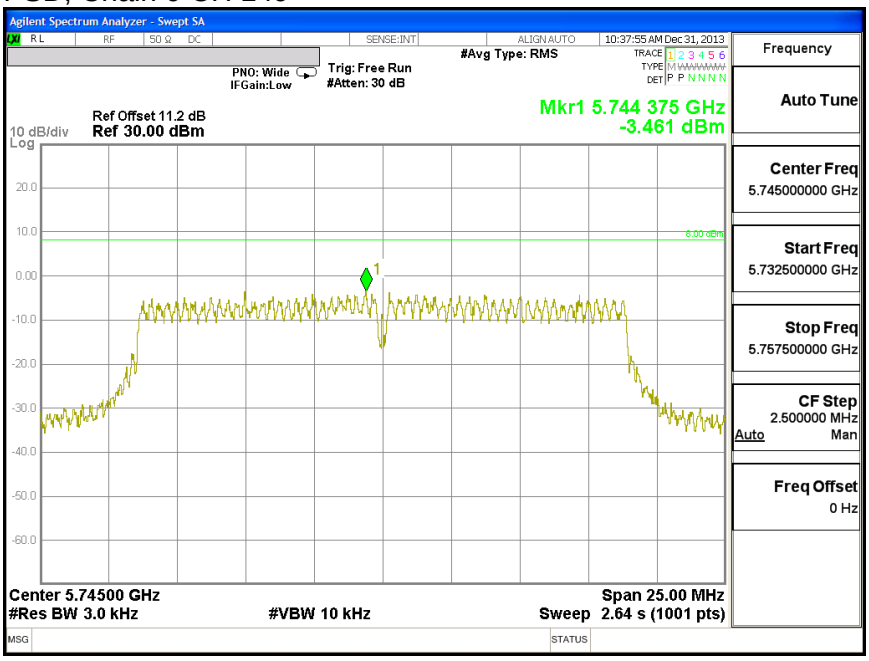
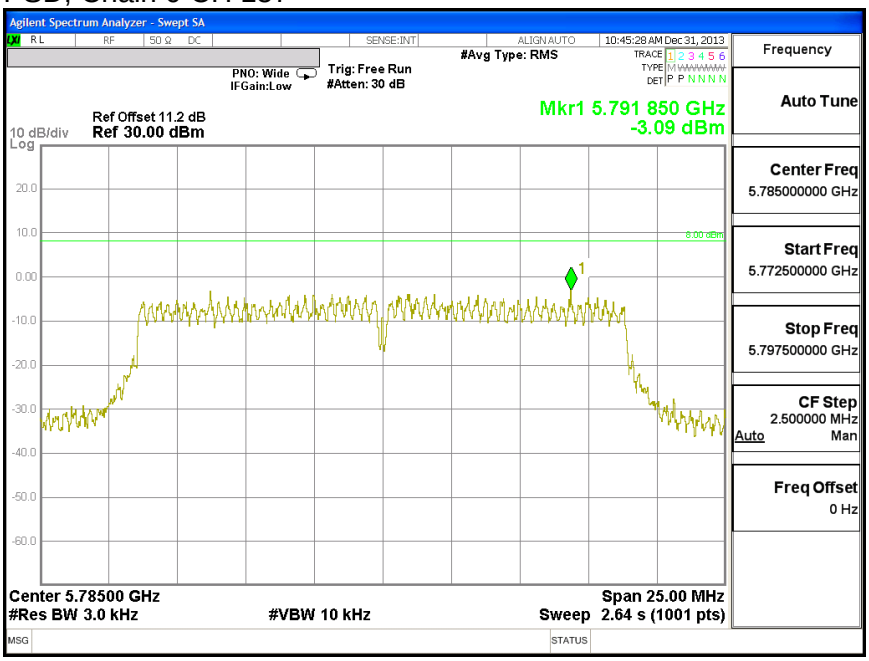
PSD, Chain 0

PSD, Chain 0 CH 149



PSD, Chain 0 CH 157



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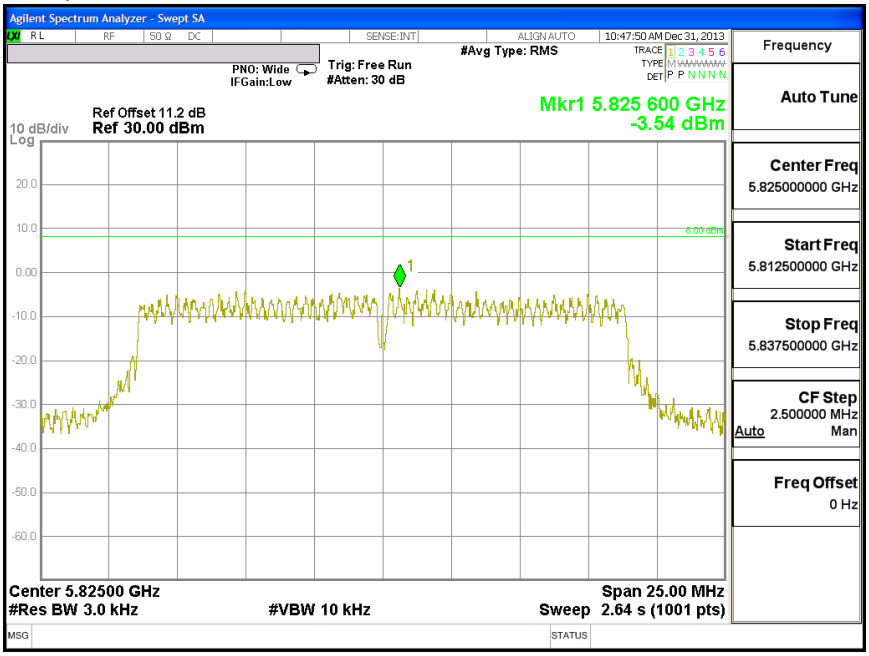
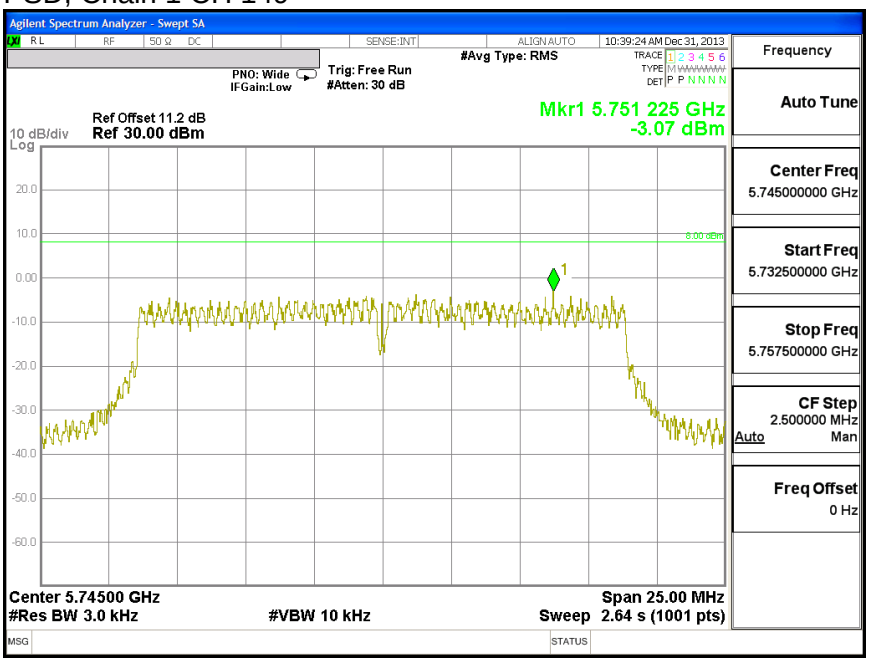
PSD, Chain 0 CH 165



PSD, Chain 1

PSD, Chain 1 CH 149



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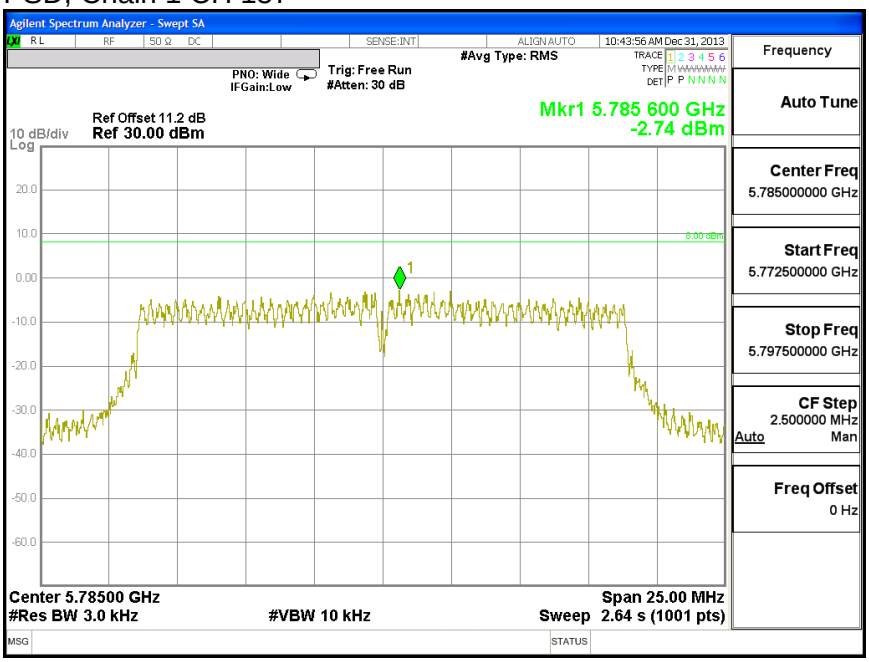
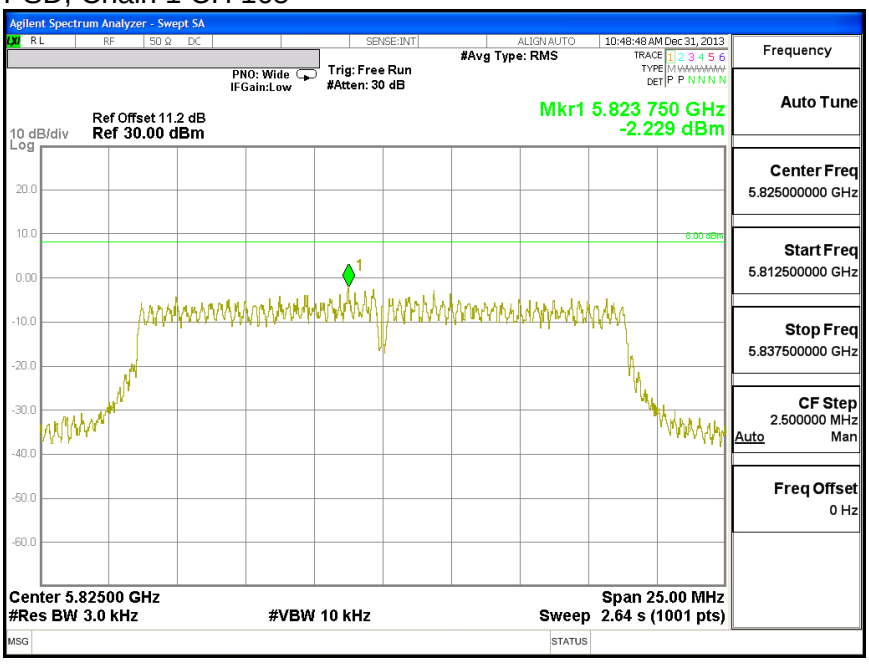
PSD, Chain 1 CH 157



PSD, Chain 1 CH 165



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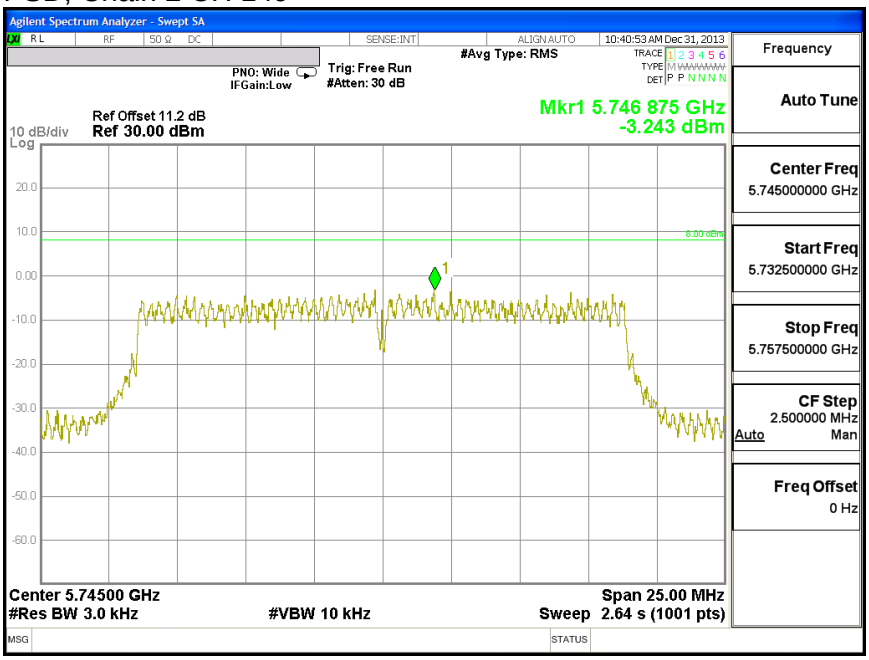
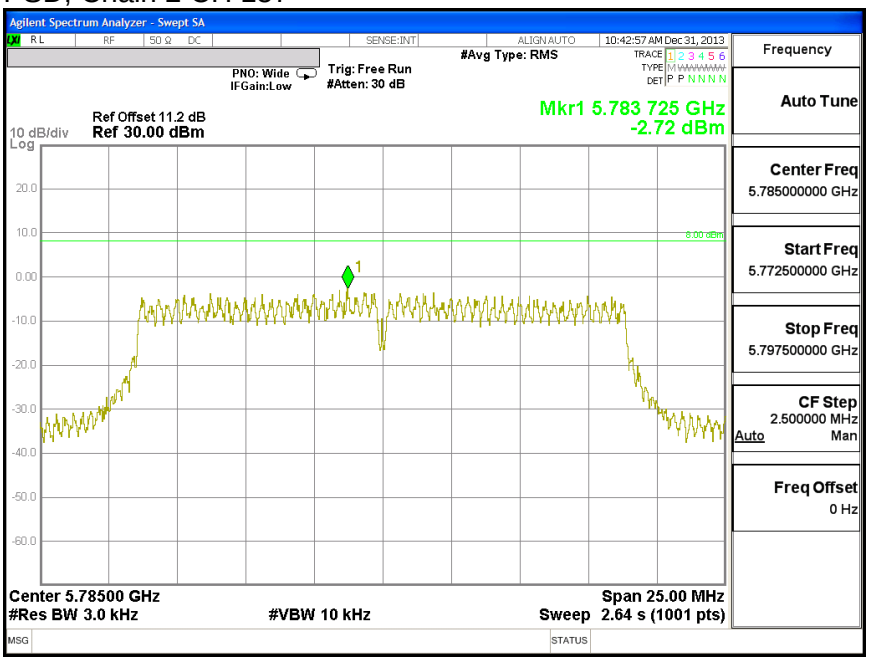
PSD, Chain 2

PSD, Chain 2 CH 149



PSD, Chain 2 CH 157



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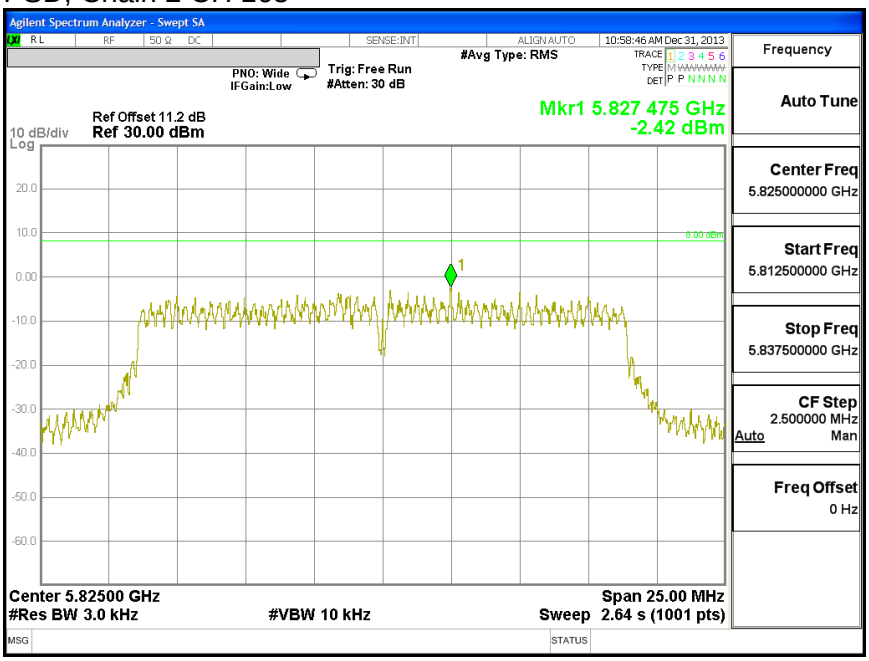
PSD, Chain 2 CH 165



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7.3.6. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

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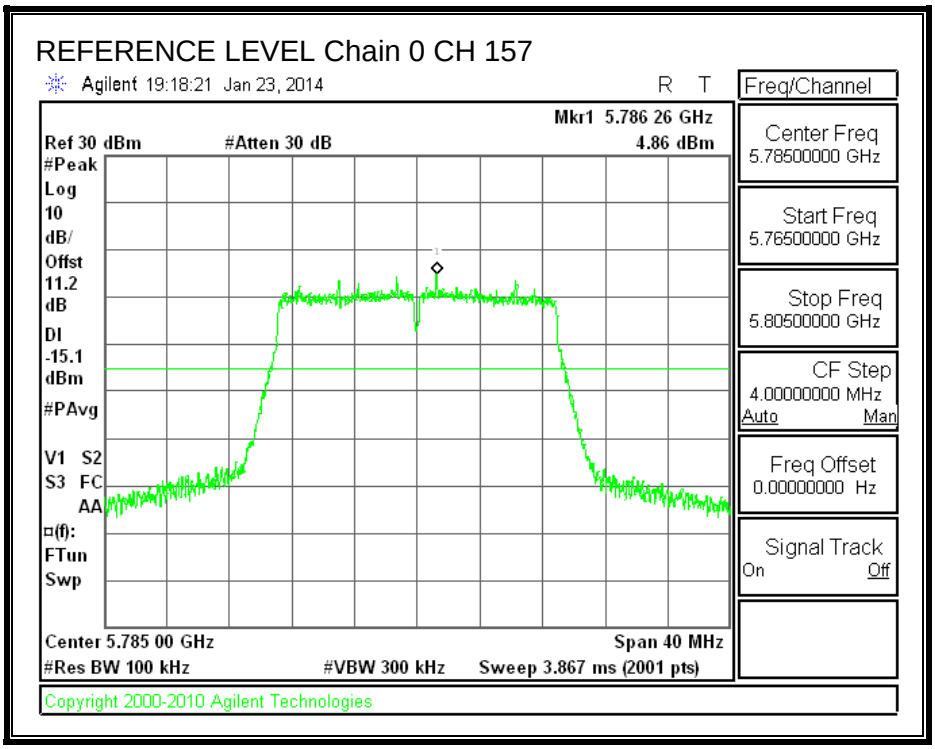
RESULTS

IN-BAND REFERENCE LEVEL, Chain 0



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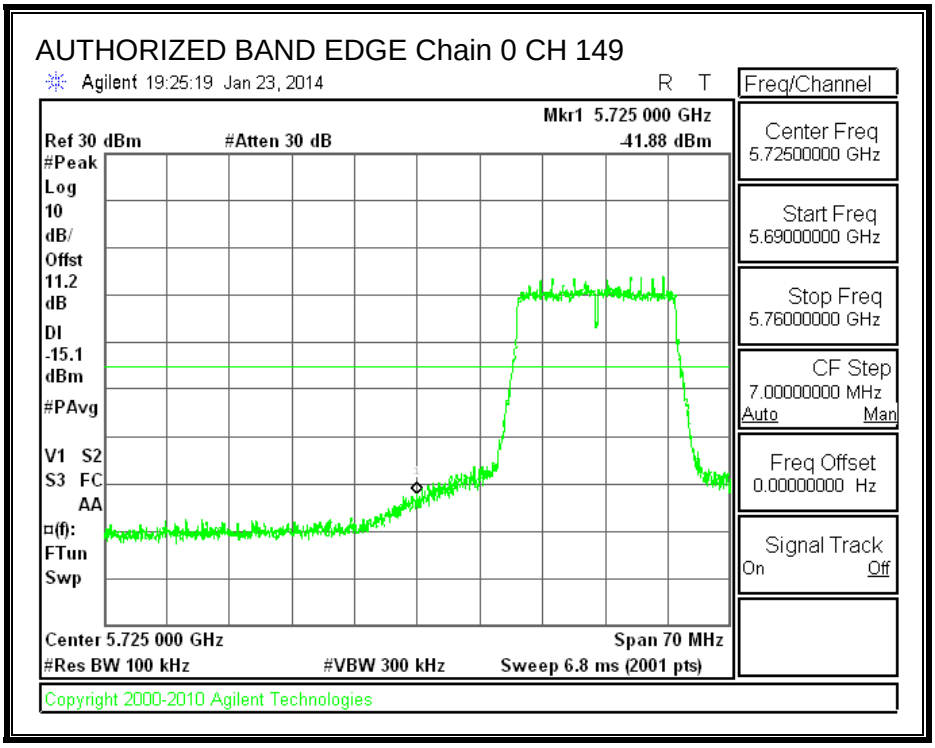
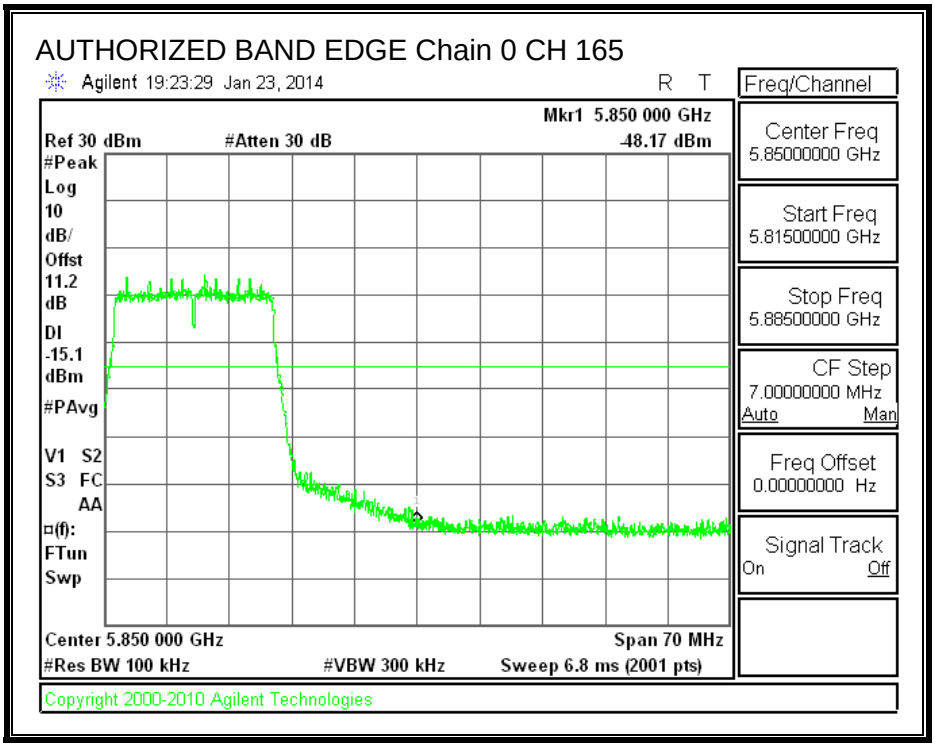
LOW CHANNEL BANDEDGE, Chain 0



HIGH CHANNEL BANDEDGE, Chain 0



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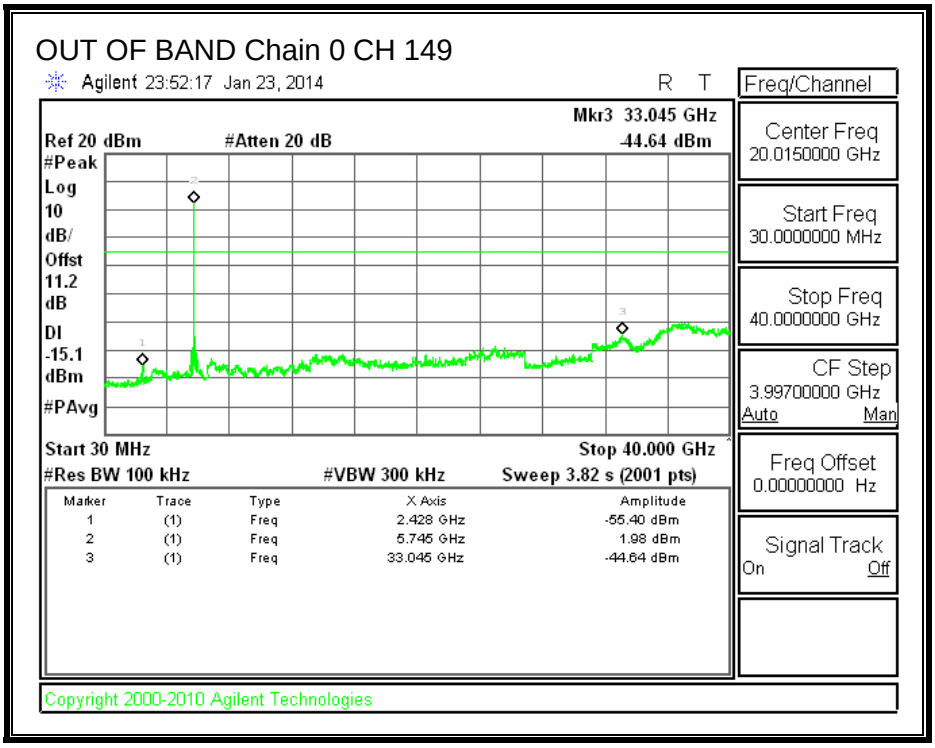
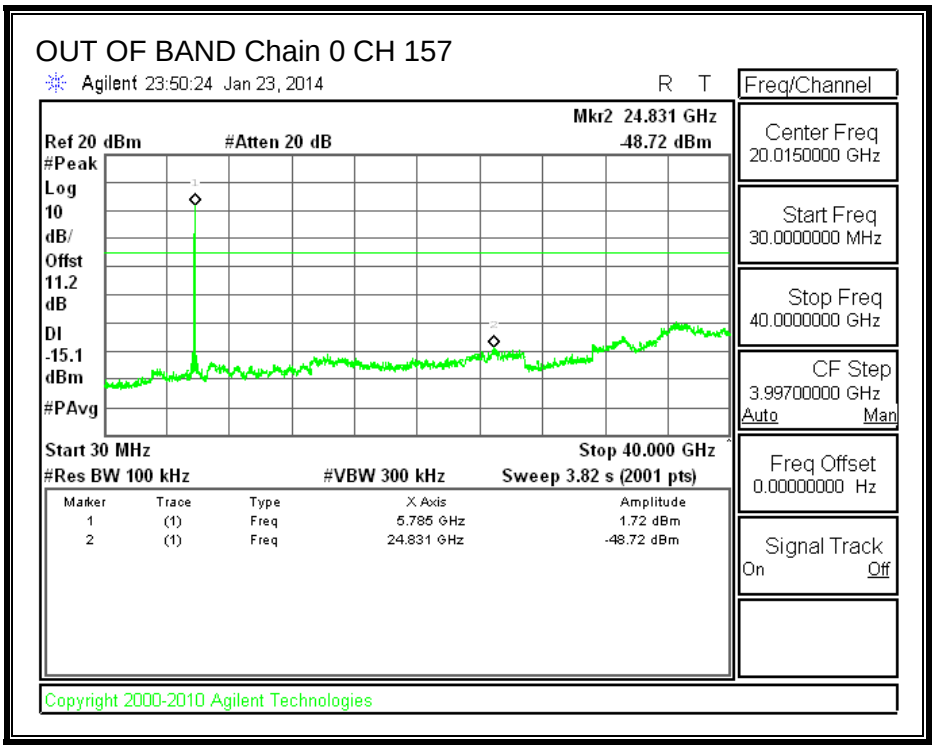
OUT-OF-BAND EMISSIONS, Chain 0





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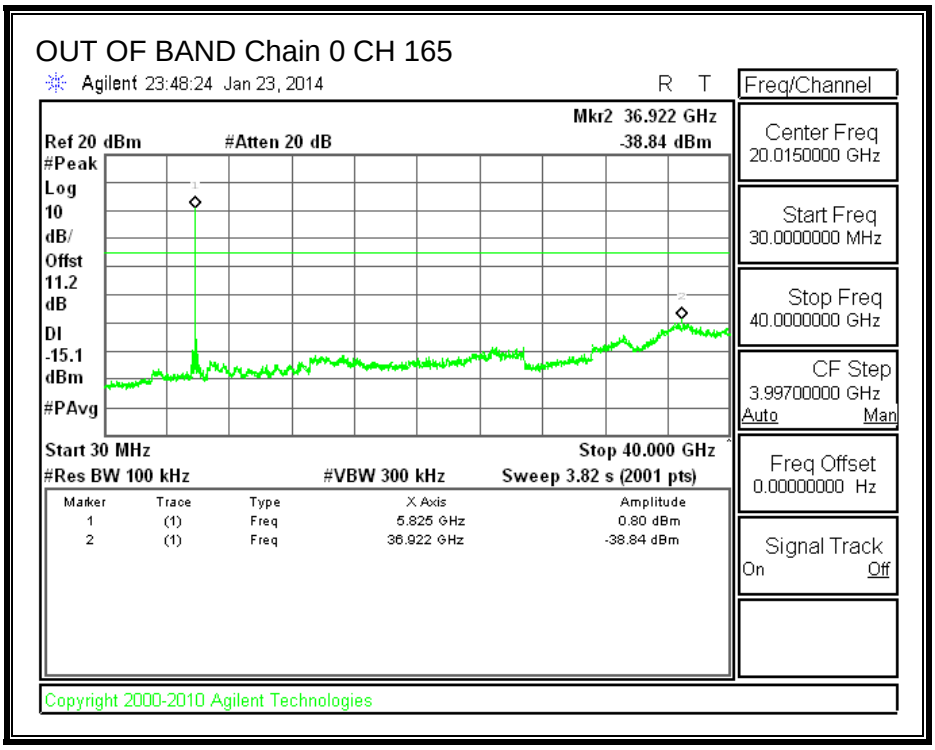

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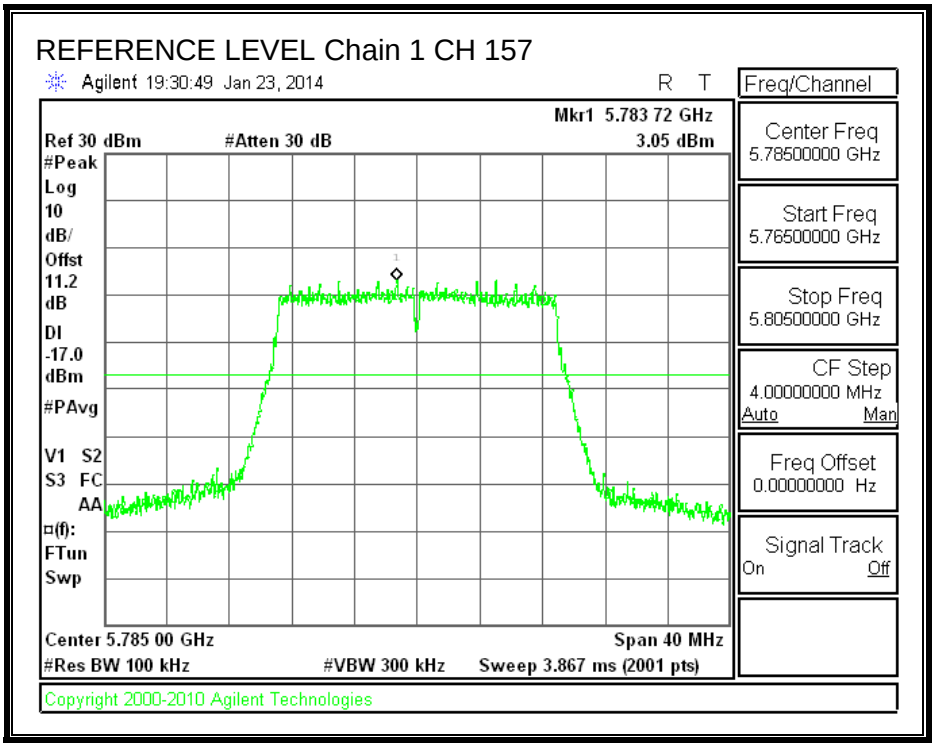
IN-BAND REFERENCE LEVEL, Chain 1



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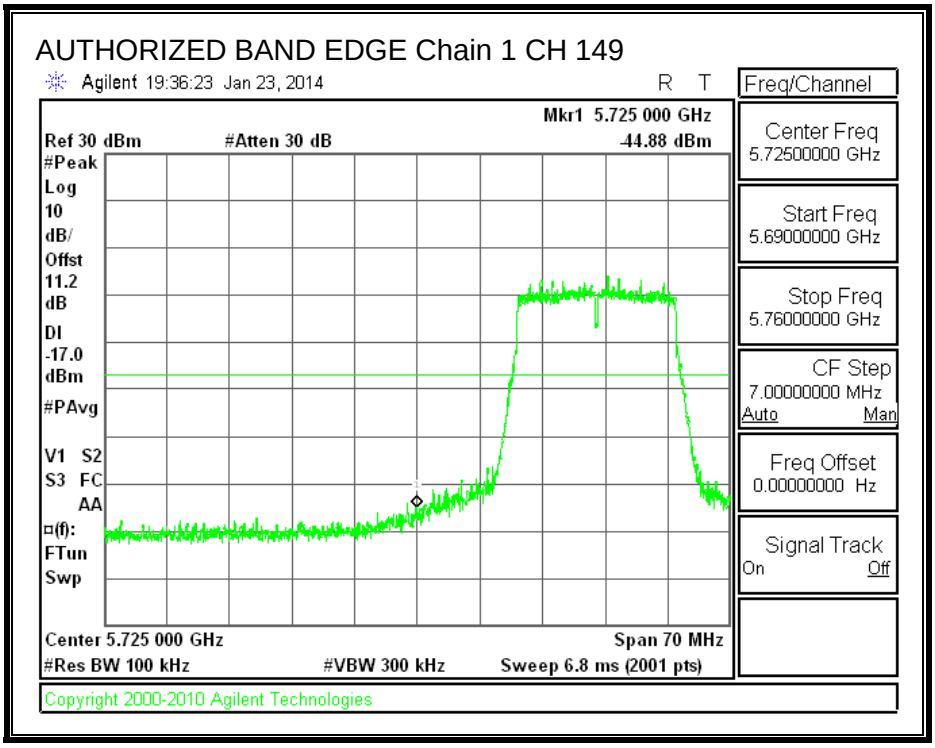
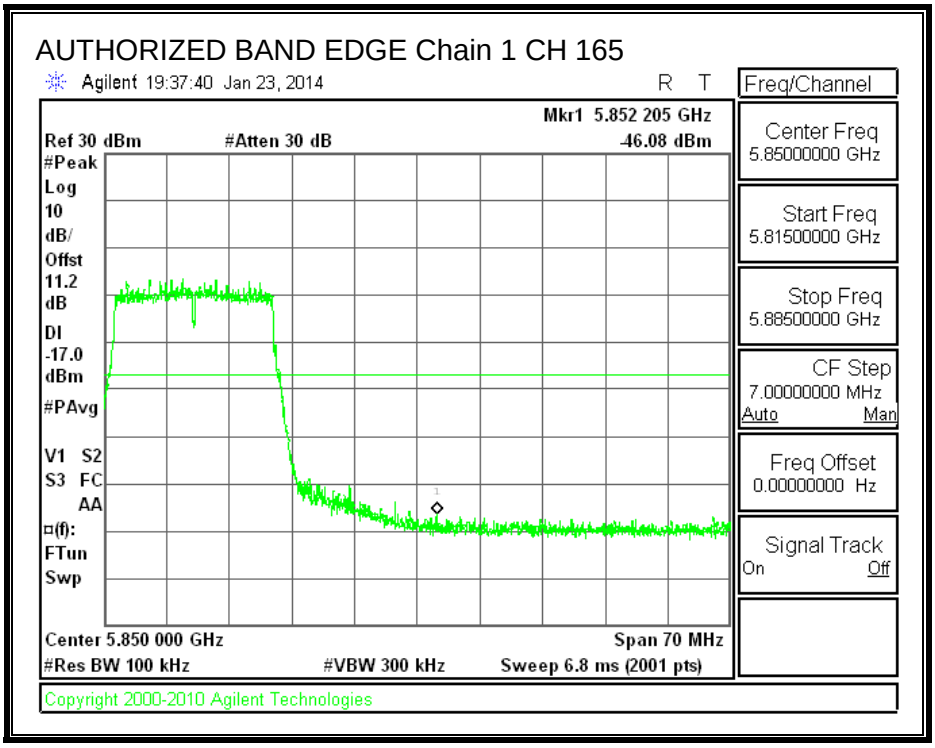
LOW CHANNEL BANDEDGE, Chain 1



HIGH CHANNEL BANDEDGE, Chain 1



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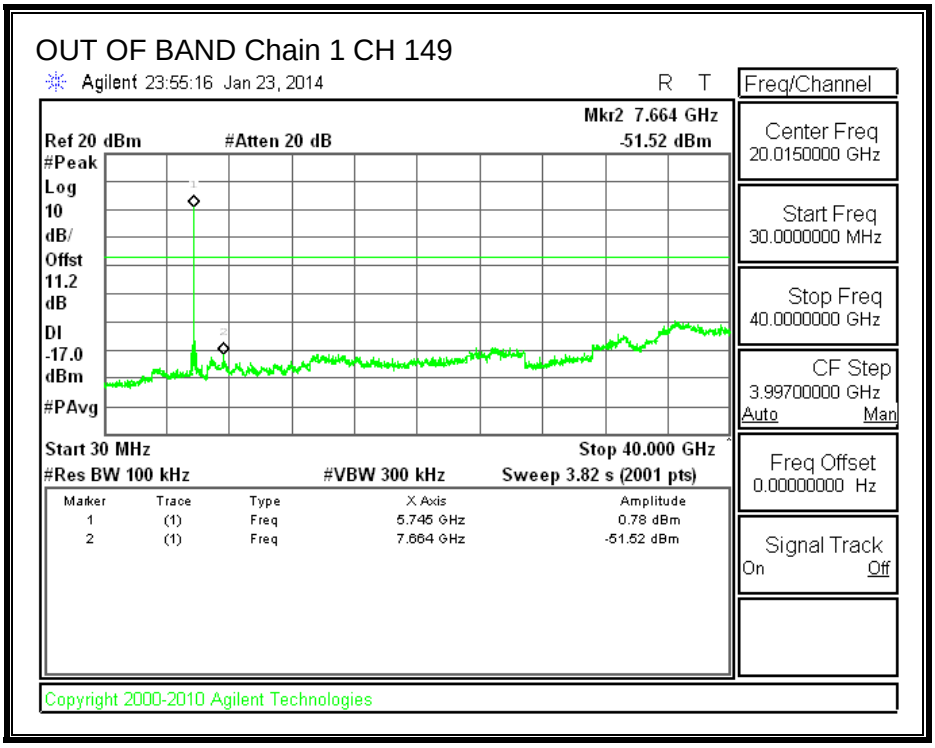
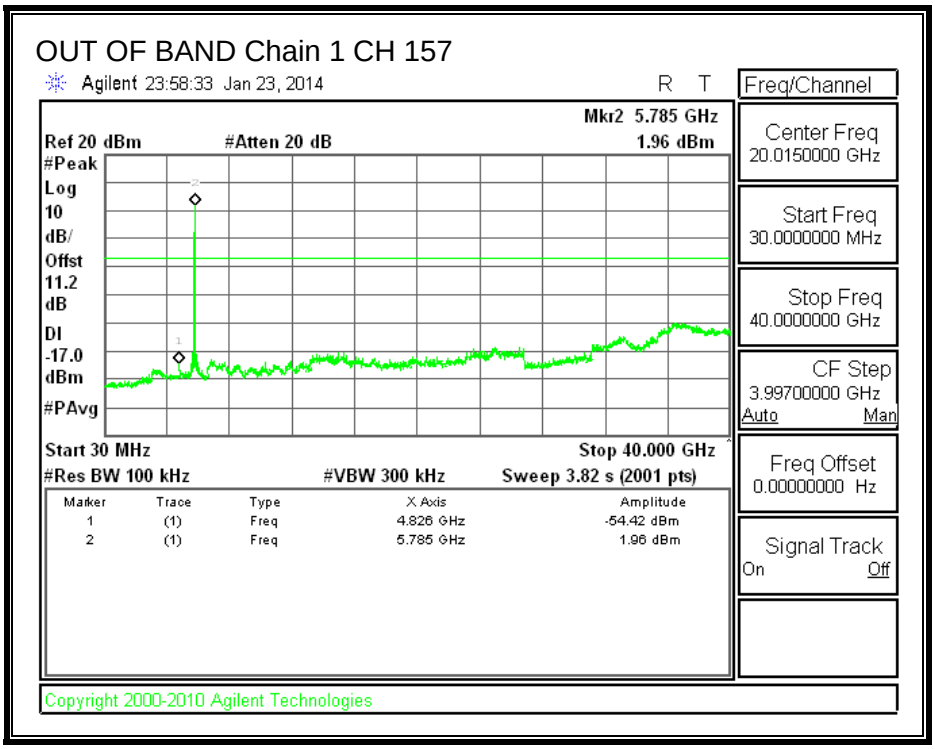
OUT-OF-BAND EMISSIONS, Chain 1





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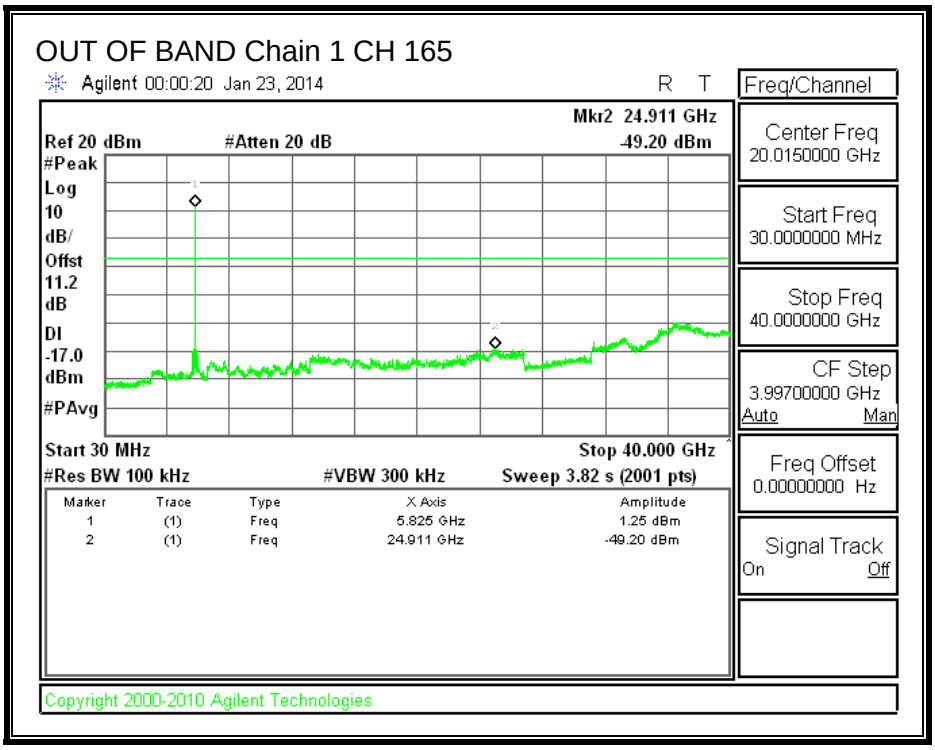

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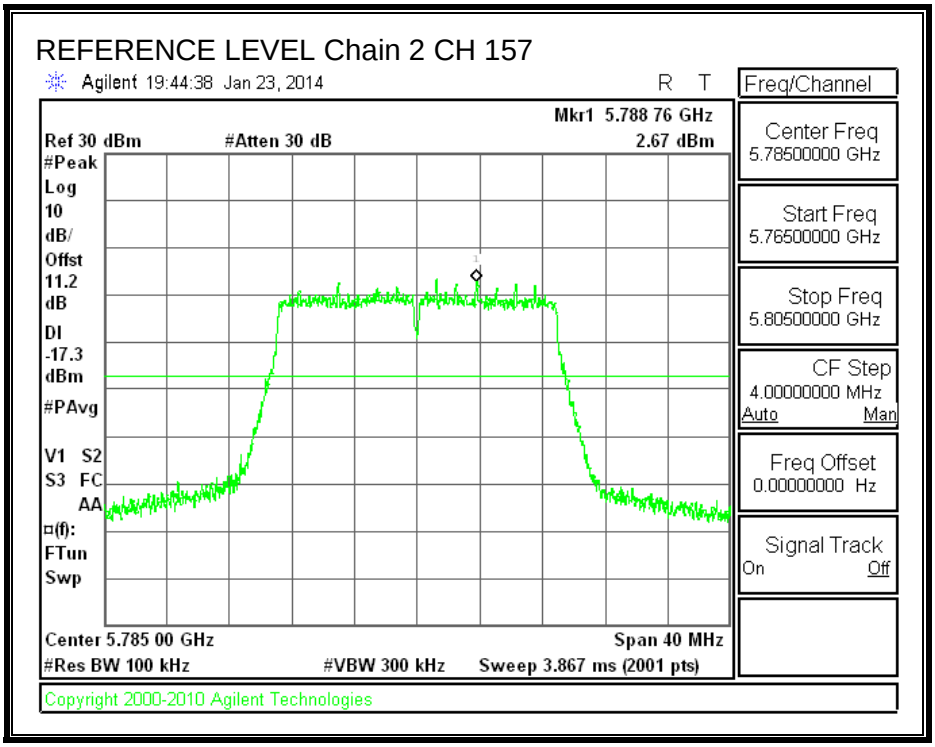
IN-BAND REFERENCE LEVEL, Chain 2



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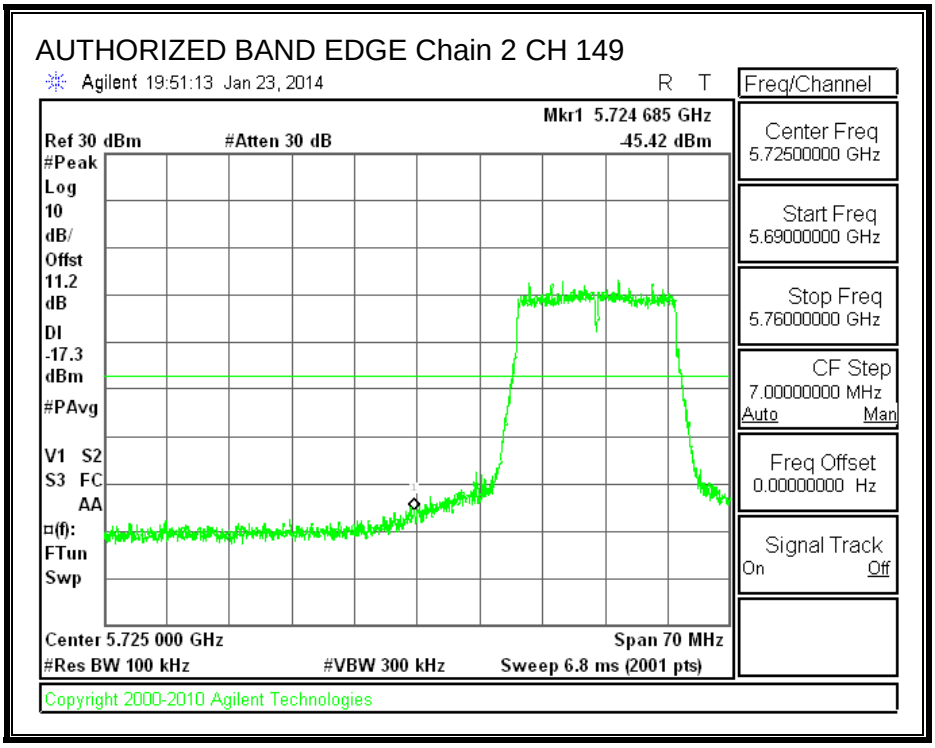
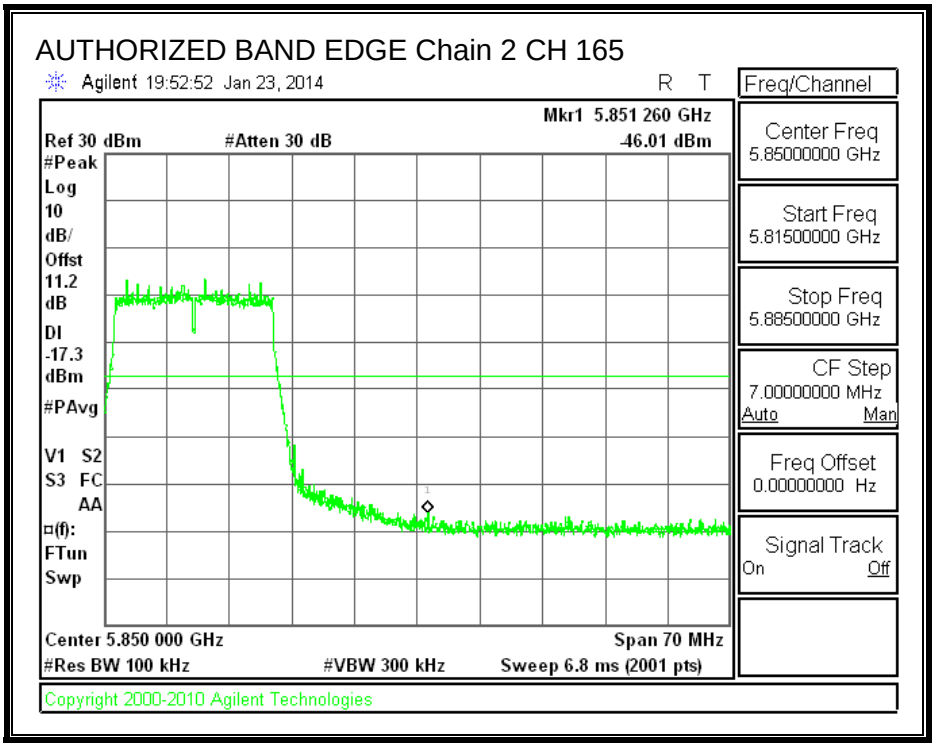
LOW CHANNEL BANDEDGE, Chain 2



HIGH CHANNEL BANDEDGE, Chain 2



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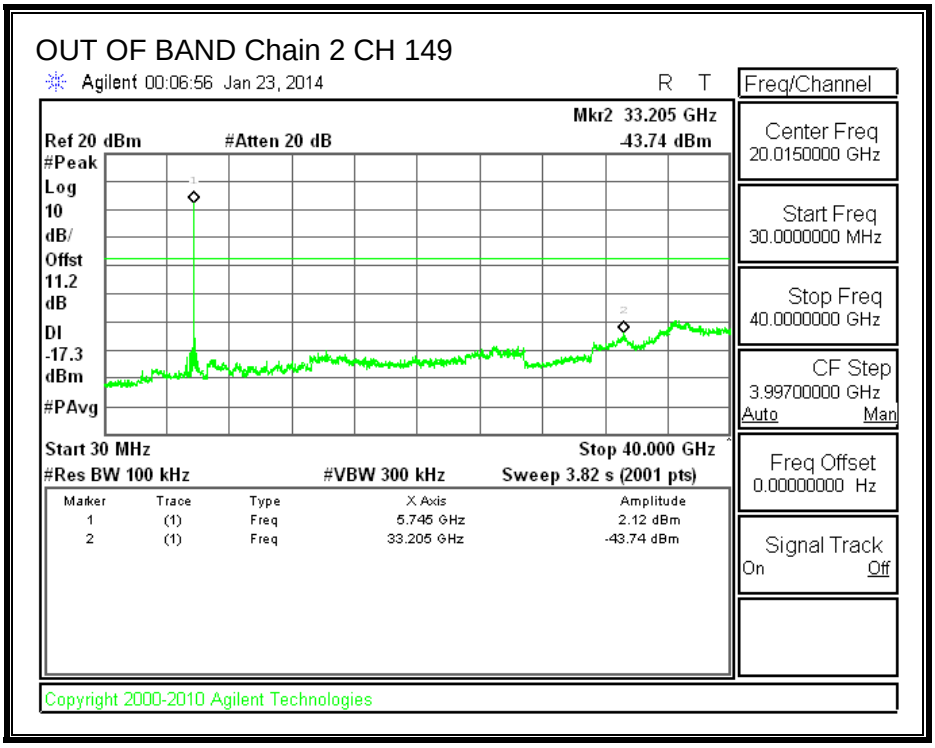
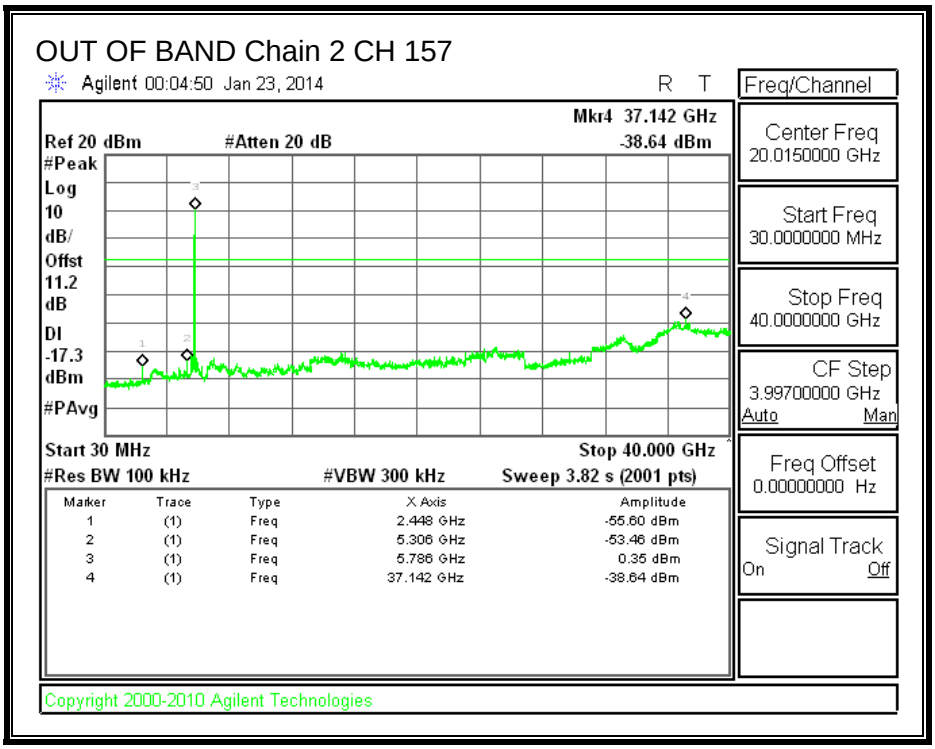
OUT-OF-BAND EMISSIONS, Chain 2





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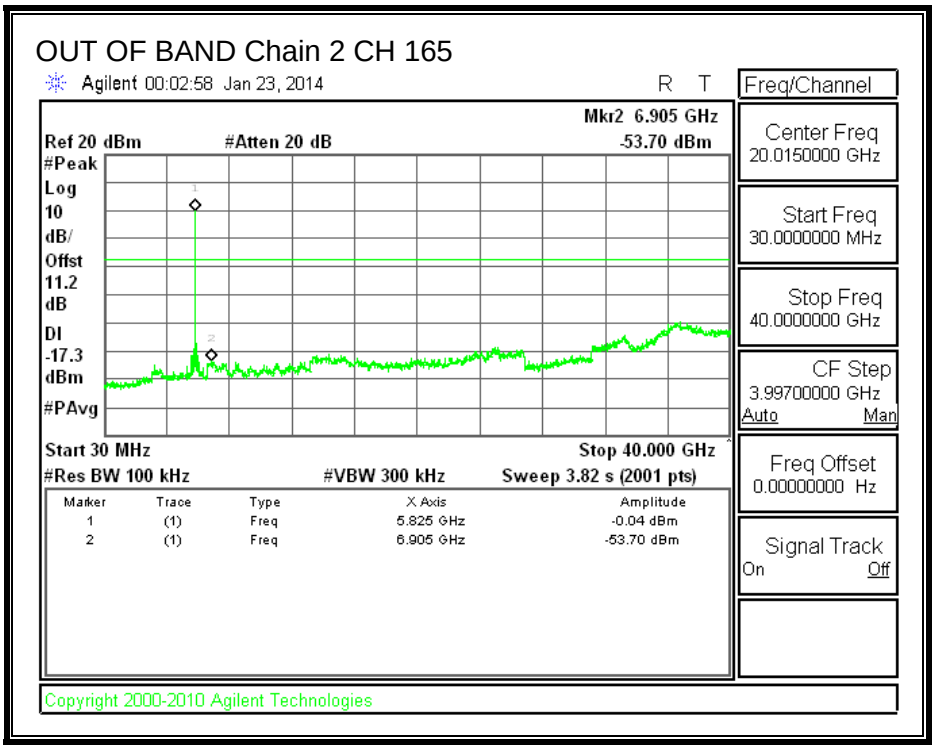

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7.4. 802.11n HT20 3TX SDM MODE IN THE 5.8 GHz BAND

7.4.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	6 dB BW Chain 2 (MHz)	Minimum Limit (MHz)
149	5745	17.550	17.600	17.600	0.5
157	5785	17.600	17.600	17.600	0.5
165	5825	17.575	17.575	17.575	0.5

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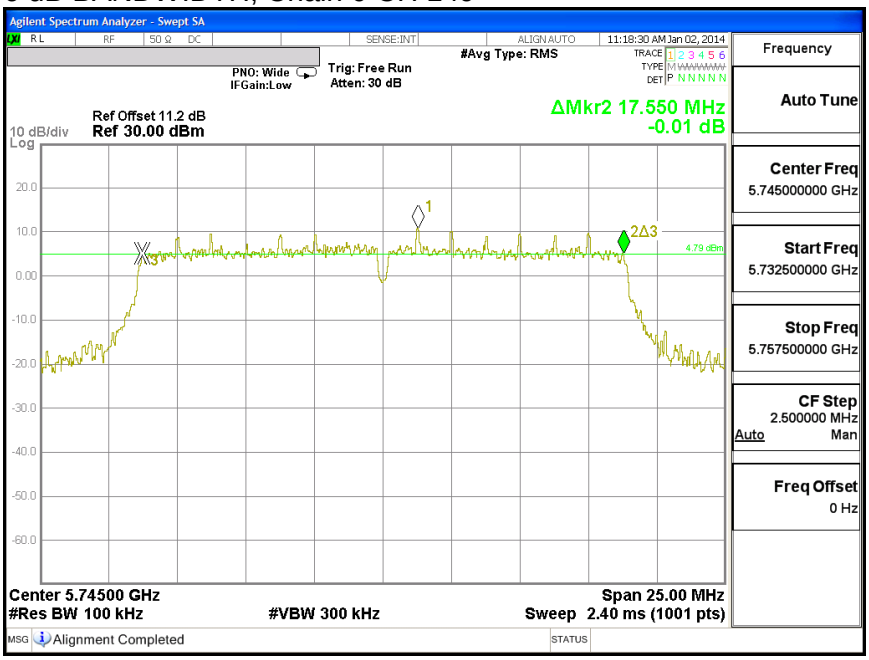
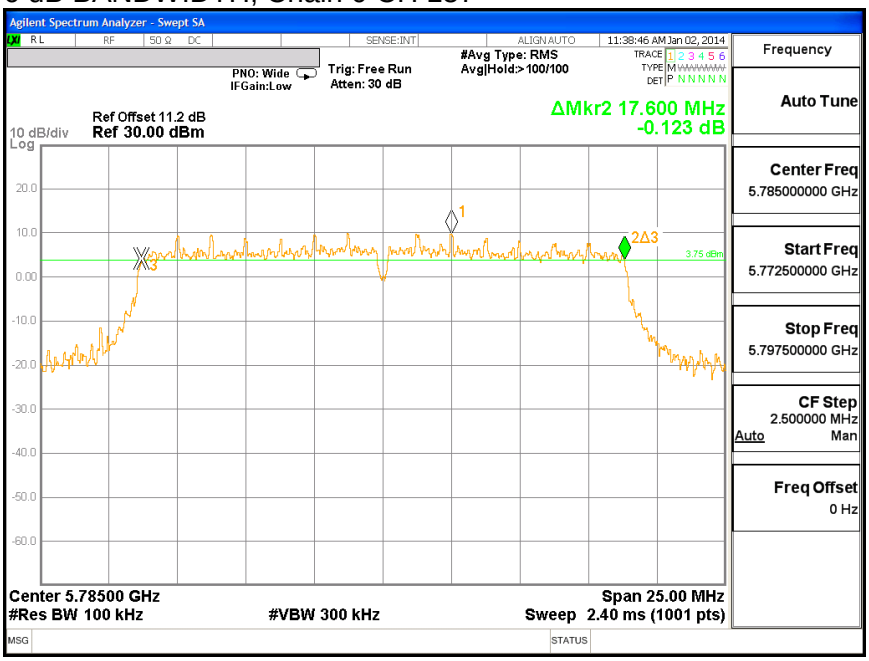
6 dB BANDWIDTH, Chain 0

6 dB BANDWIDTH, Chain 0 CH 149



6 dB BANDWIDTH, Chain 0 CH 157



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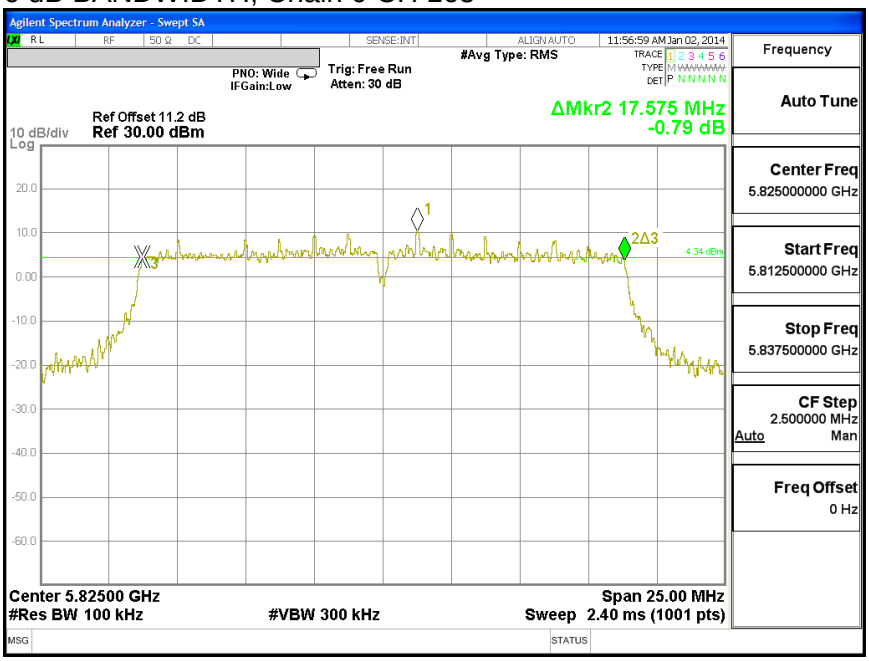
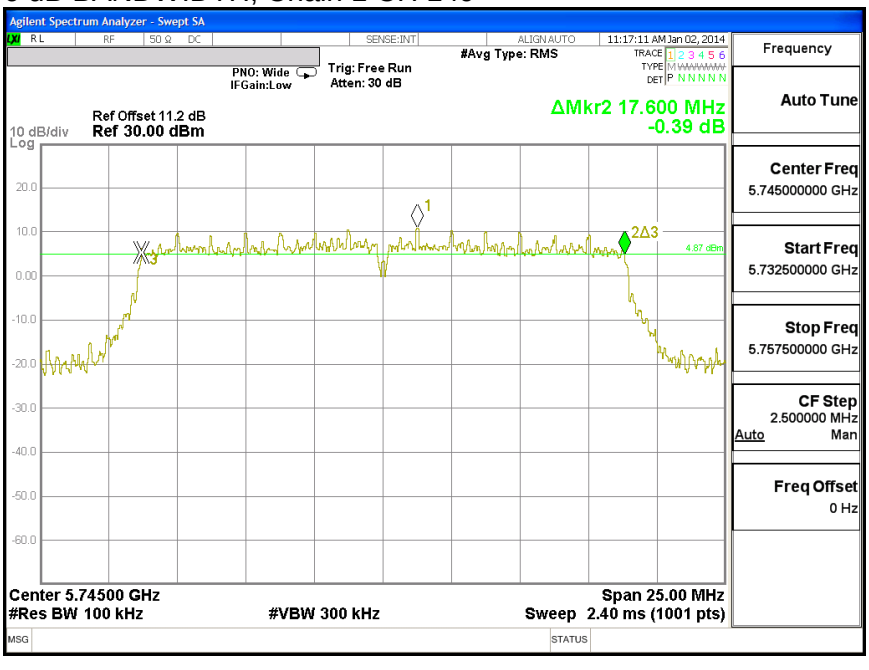
6 dB BANDWIDTH, Chain 0 CH 165



6 dB BANDWIDTH, Chain 1

6 dB BANDWIDTH, Chain 1 CH 149



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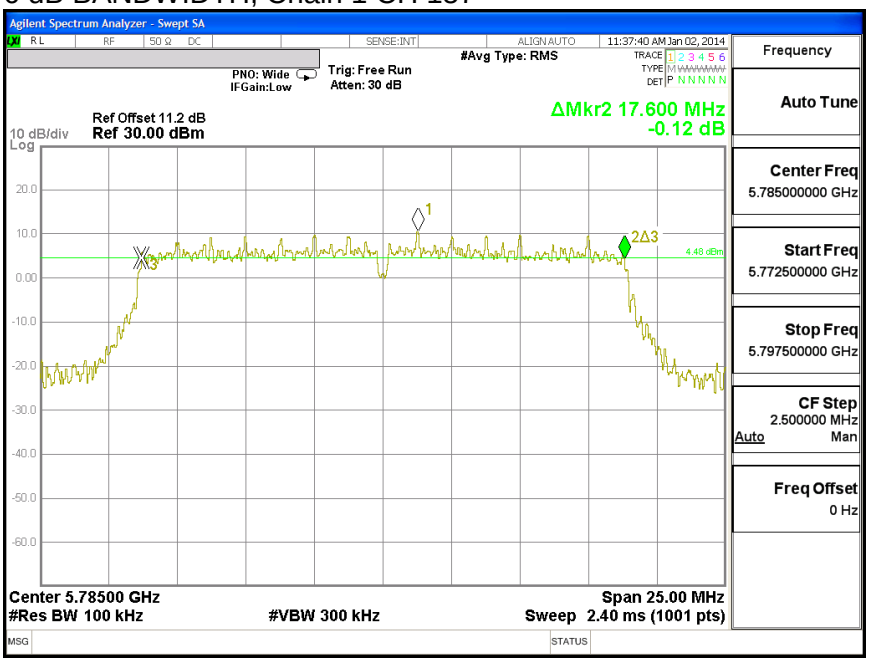
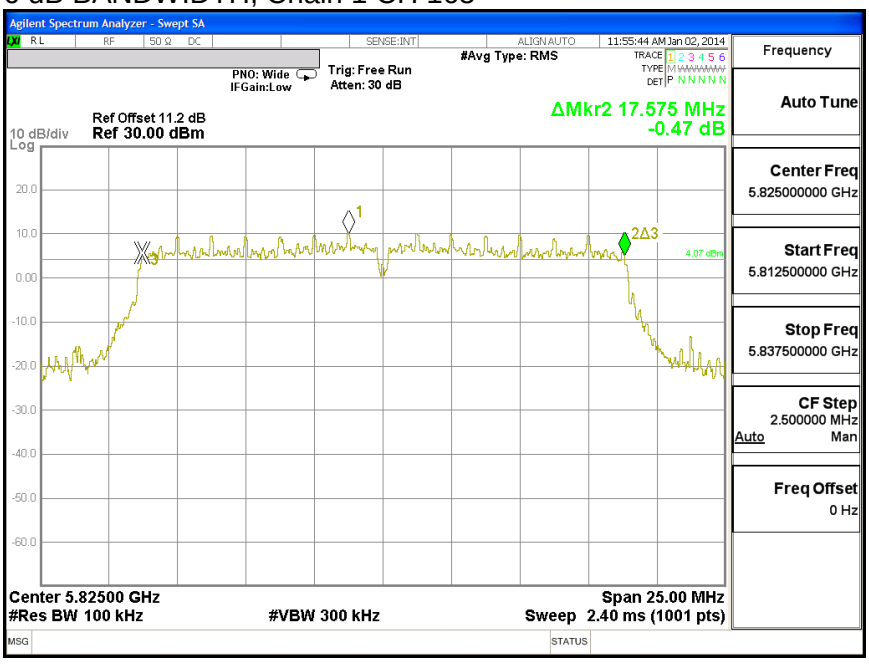
6 dB BANDWIDTH, Chain 1 CH 157



6 dB BANDWIDTH, Chain 1 CH 165



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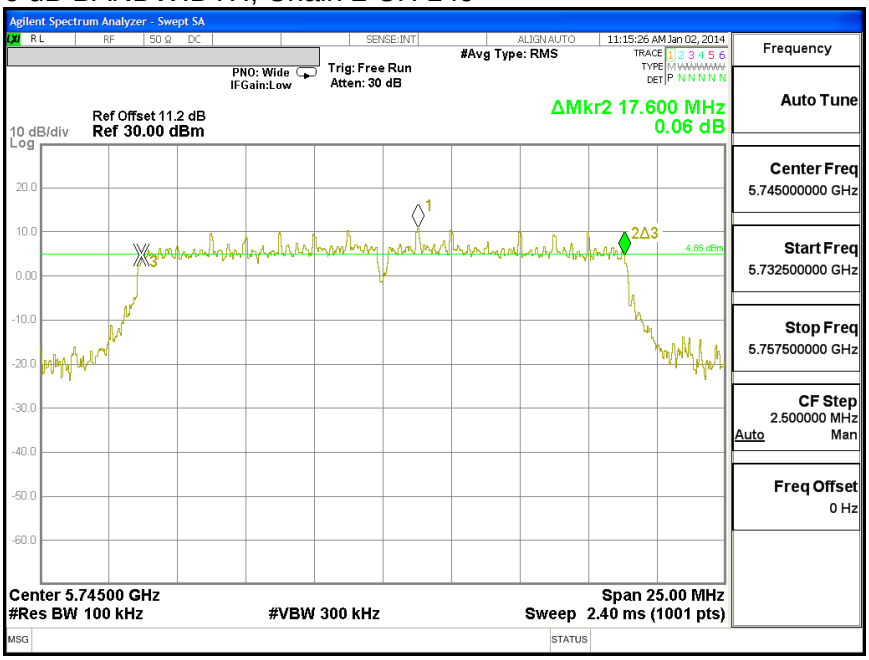
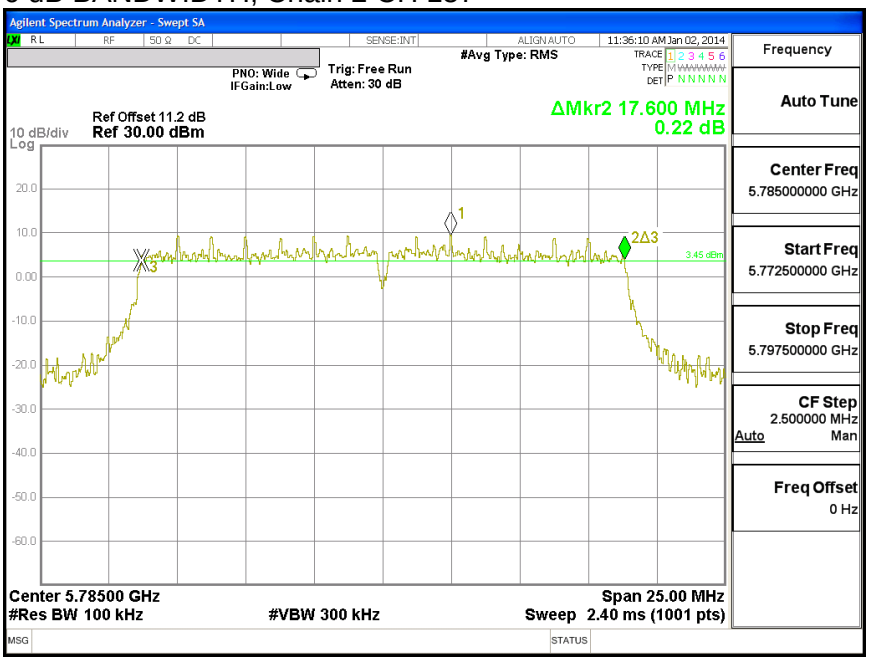
6 dB BANDWIDTH, Chain 2

6 dB BANDWIDTH, Chain 2 CH 149



6 dB BANDWIDTH, Chain 2 CH 157



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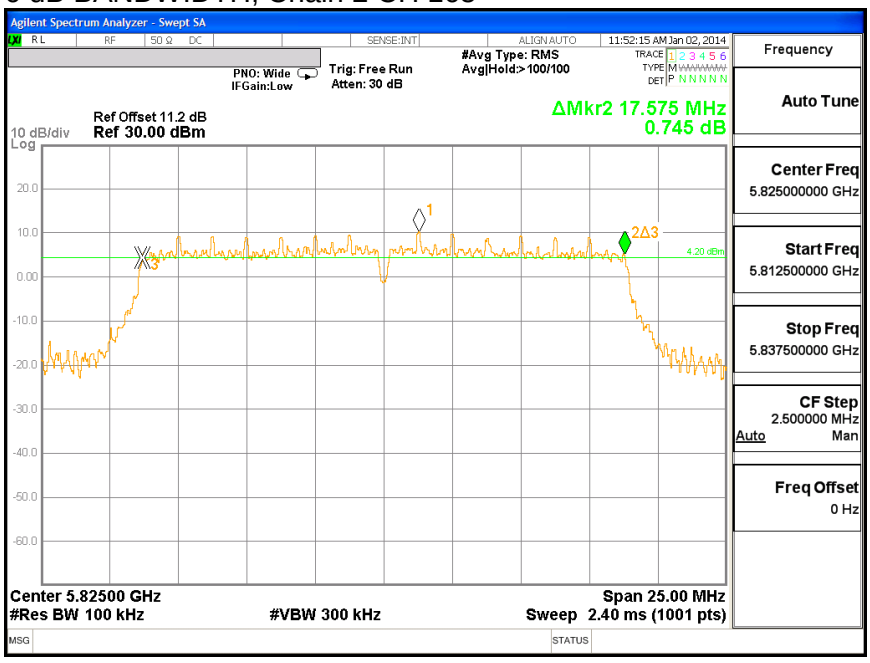
6 dB BANDWIDTH, Chain 2 CH 165



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7.4.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)	99% BW Chain 2 (MHz)
149	5745	17.8850	17.9240	17.9380
157	5785	17.8920	17.8920	17.9520
165	5825	18.2210	18.3180	18.3180

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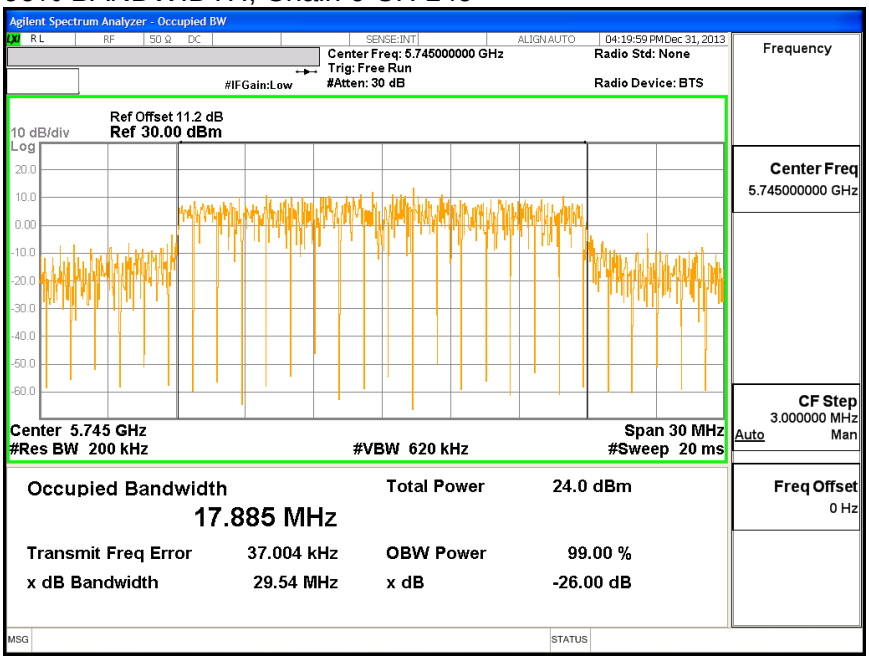
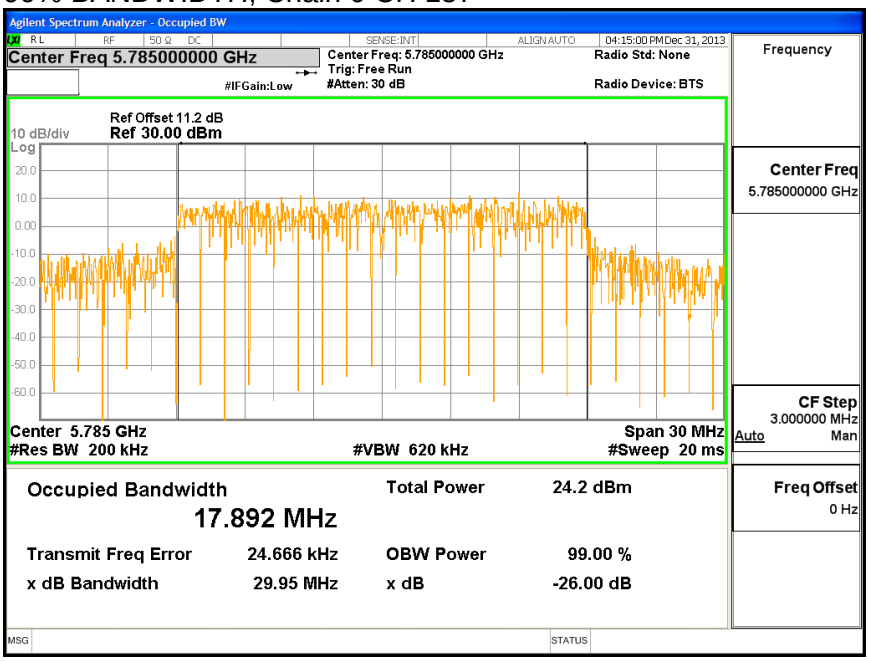
99% BANDWIDTH, Chain 0

99% BANDWIDTH, Chain 0 CH 149



99% BANDWIDTH, Chain 0 CH 157



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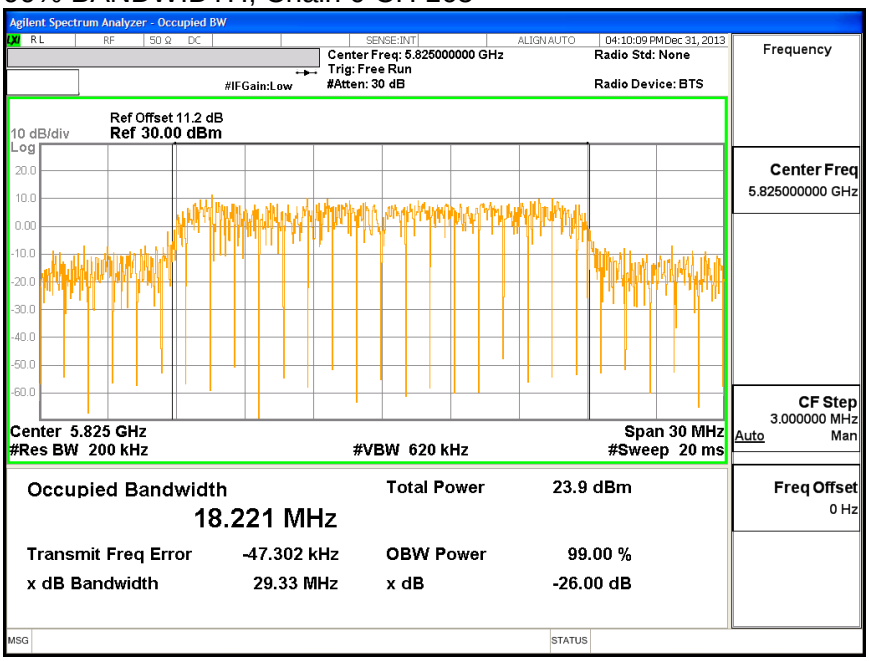
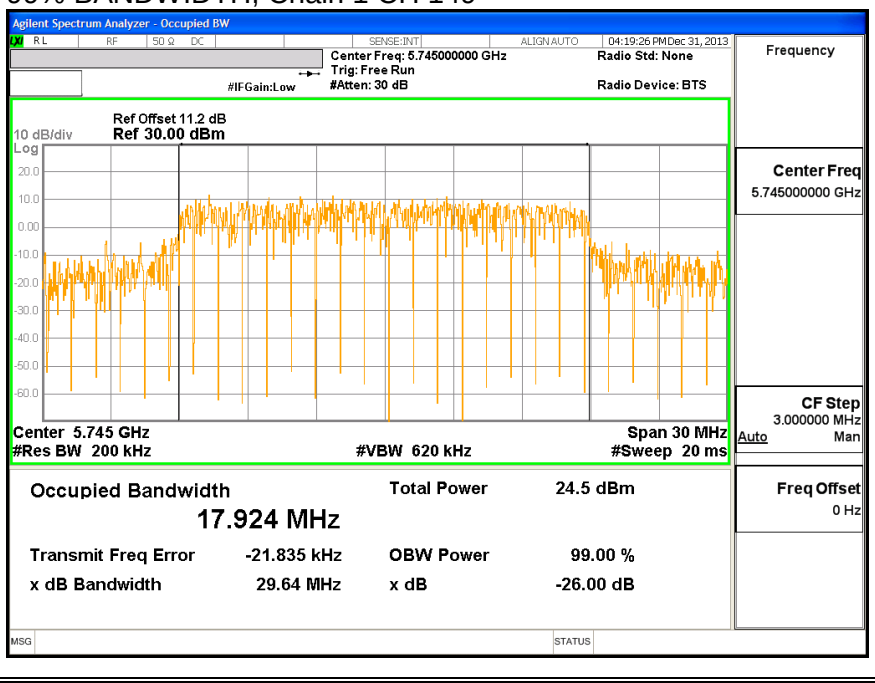
99% BANDWIDTH, Chain 0 CH 165



99% BANDWIDTH, Chain 1

99% BANDWIDTH, Chain 1 CH 149



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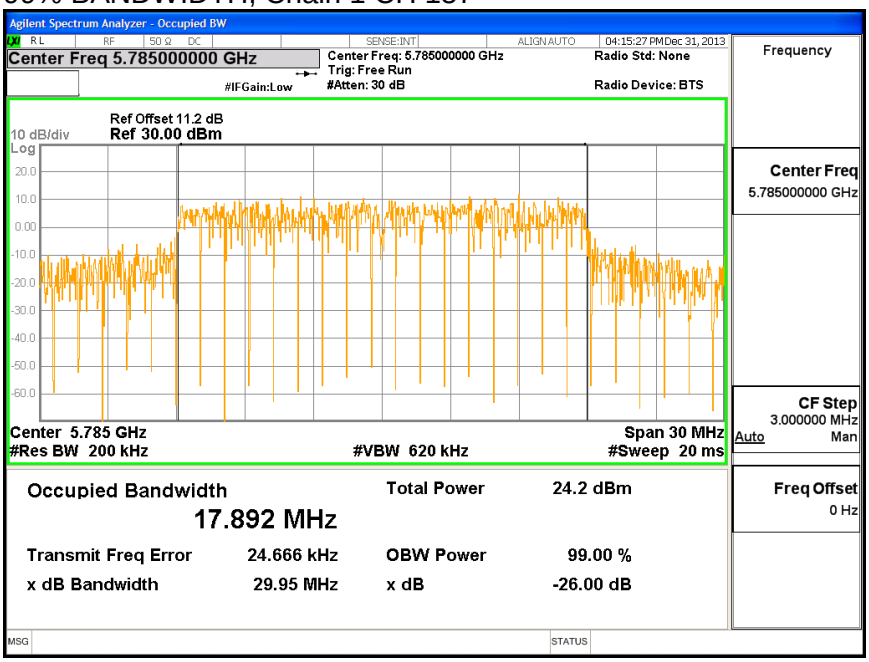
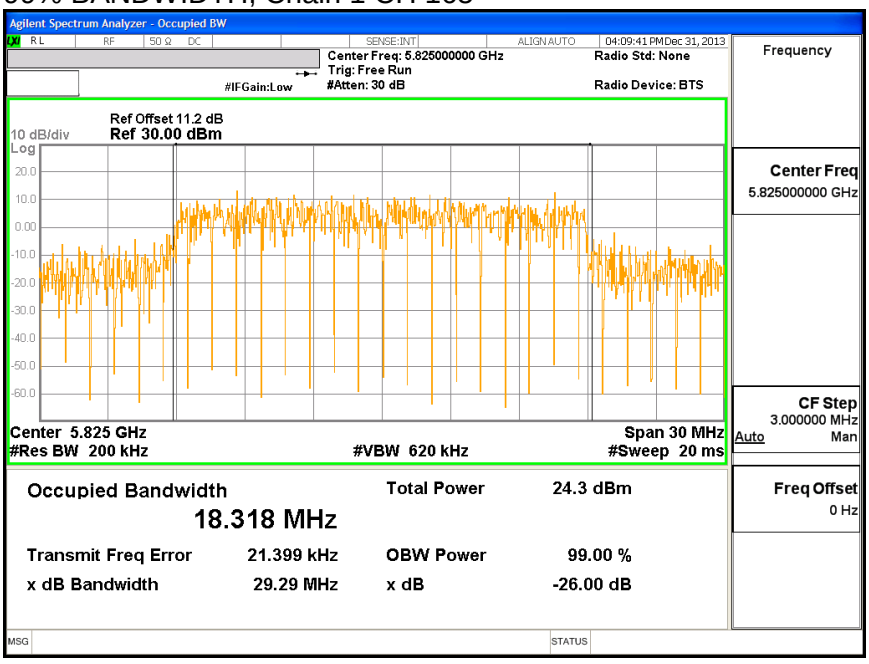
99% BANDWIDTH, Chain 1 CH 157



99% BANDWIDTH, Chain 1 CH 165



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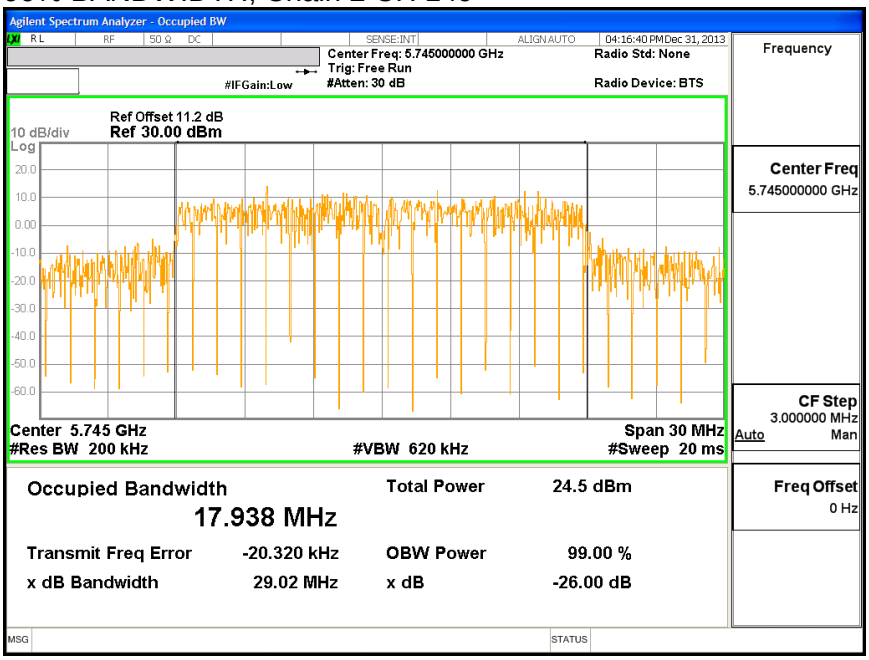
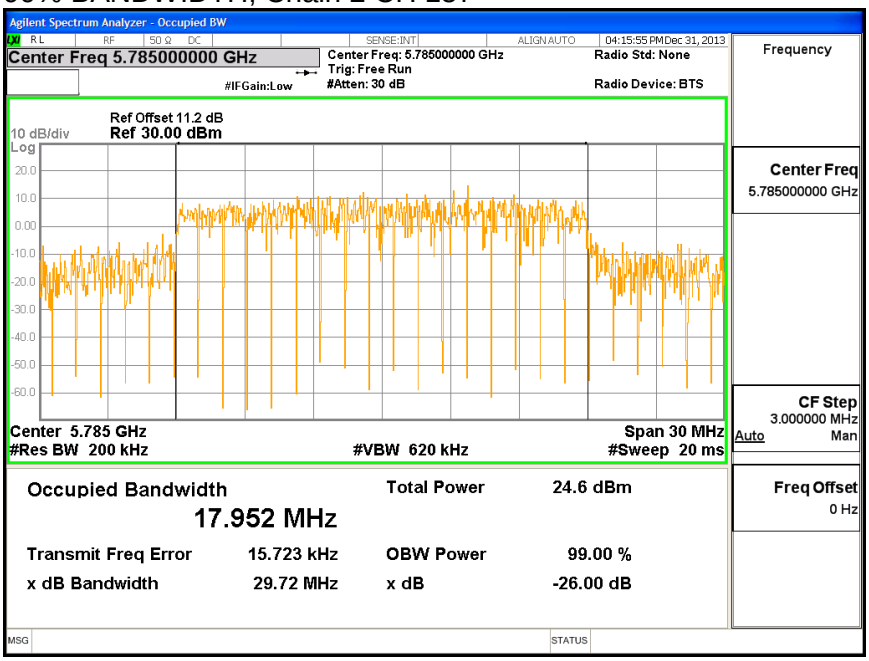
99% BANDWIDTH, Chain 2

99% BANDWIDTH, Chain 2 CH 149



99% BANDWIDTH, Chain 2 CH 157



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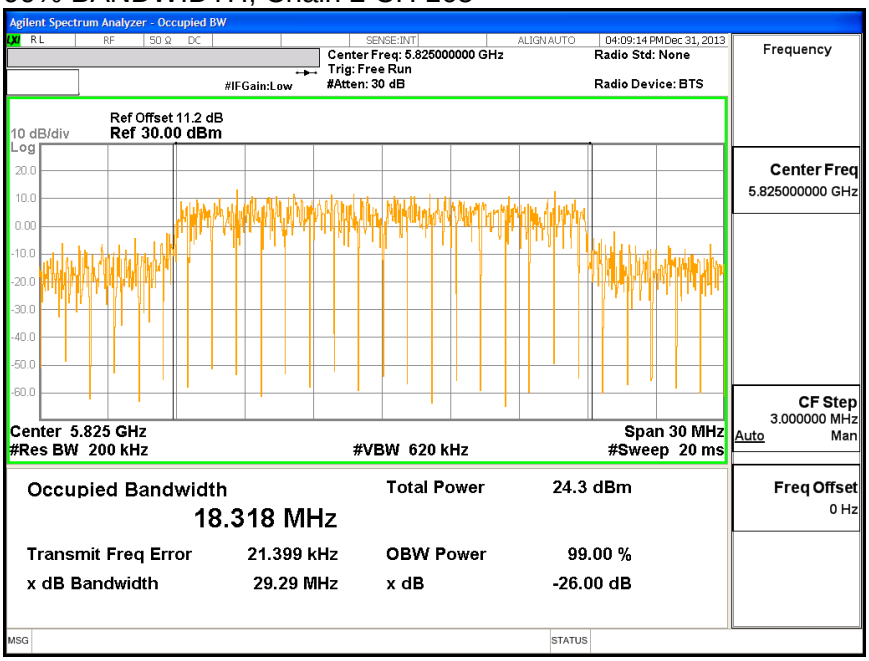
99% BANDWIDTH, Chain 2 CH 165



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7.4.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
149	5745	20.90	21.15	20.95	25.77
157	5785	21.05	21.27	20.91	25.85
165	5825	20.92	21.08	21.03	25.78

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7.4.4. OUTPUT POWER

LIMITS

FCC §15.247

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

The TX chains are uncorrelated and the antenna gain is the same for each chain. The directional gain is equal to the antenna gain.

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RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
149	5745	3.16	30.00	30	36	30.00
157	5785	3.16	30.00	30	36	30.00
165	5825	3.16	30.00	30	36	30.00

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)	Margin (dB)
149	5745	24.83	25.03	24.62	29.60	30.00	-0.40
157	5785	24.58	24.93	24.57	29.47	30.00	-0.53
165	5825	24.56	24.98	24.53	29.46	30.00	-0.54

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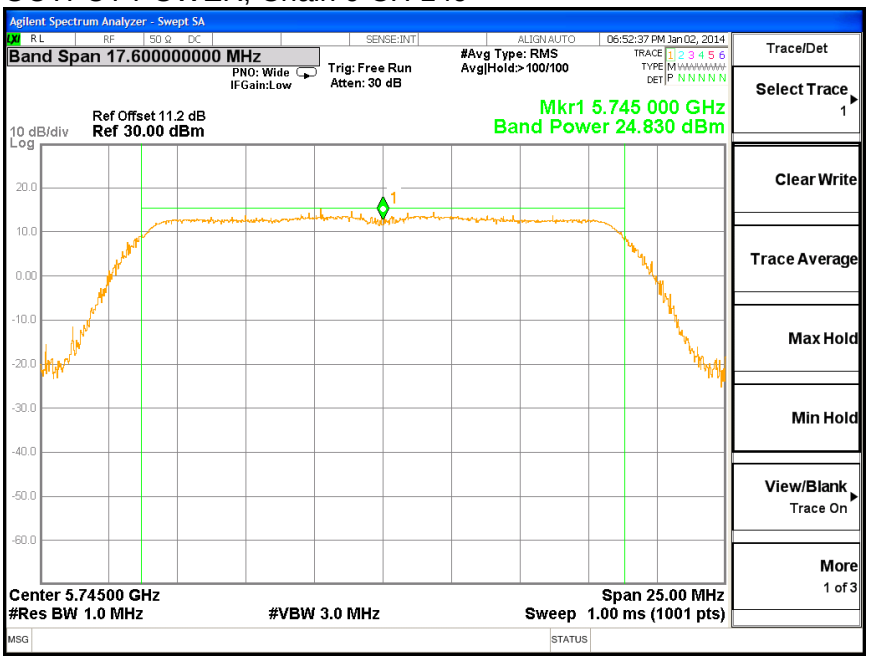
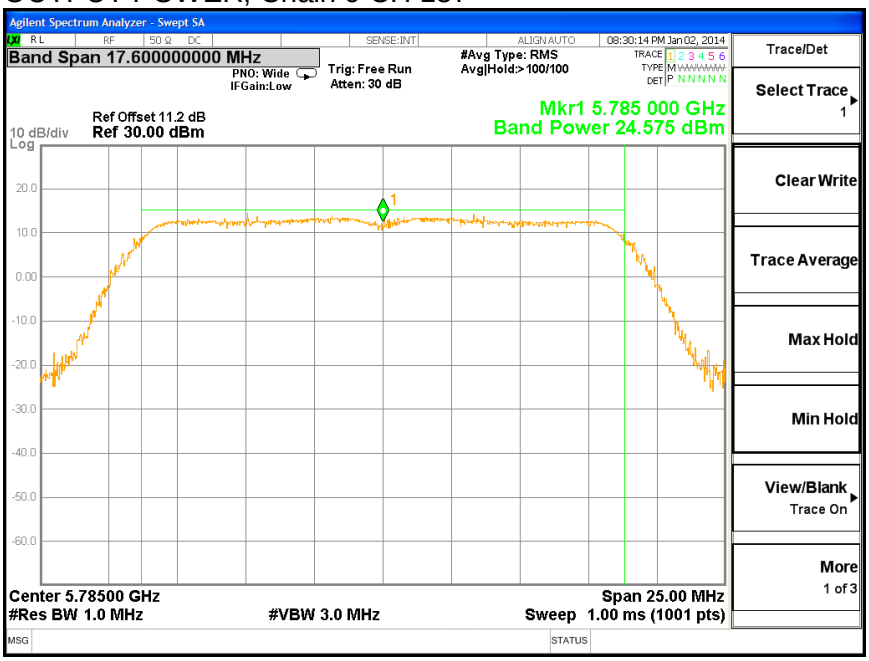
OUTPUT POWER, Chain 0

OUTPUT POWER, Chain 0 CH 149



OUTPUT POWER, Chain 0 CH 157



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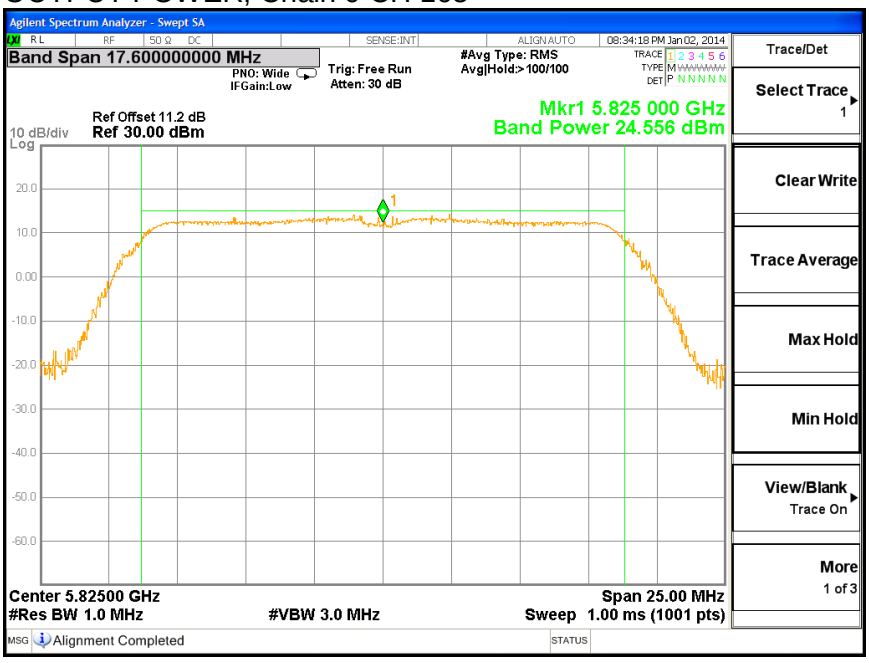
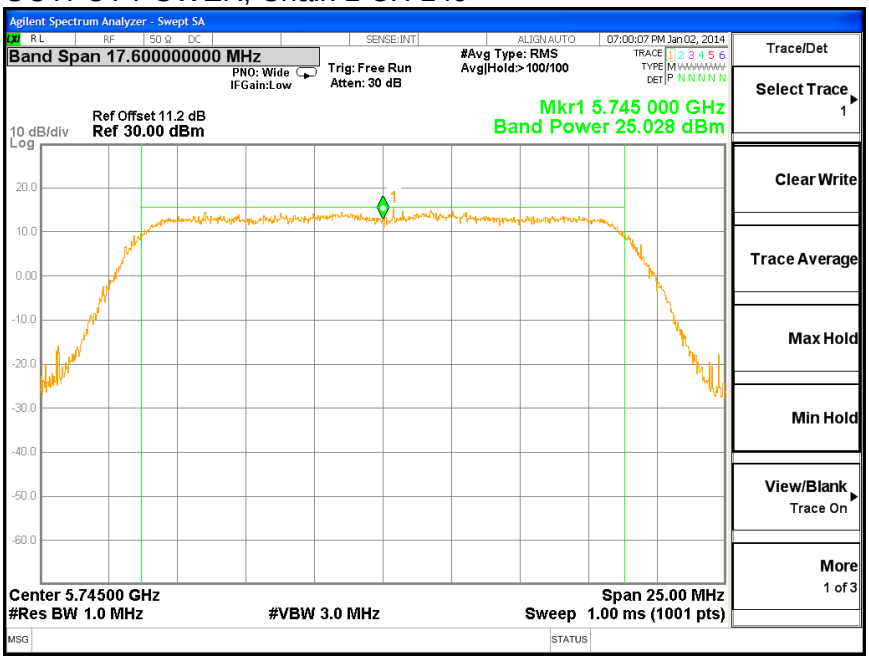
OUTPUT POWER, Chain 0 CH 165



OUTPUT POWER, Chain 1

OUTPUT POWER, Chain 1 CH 149



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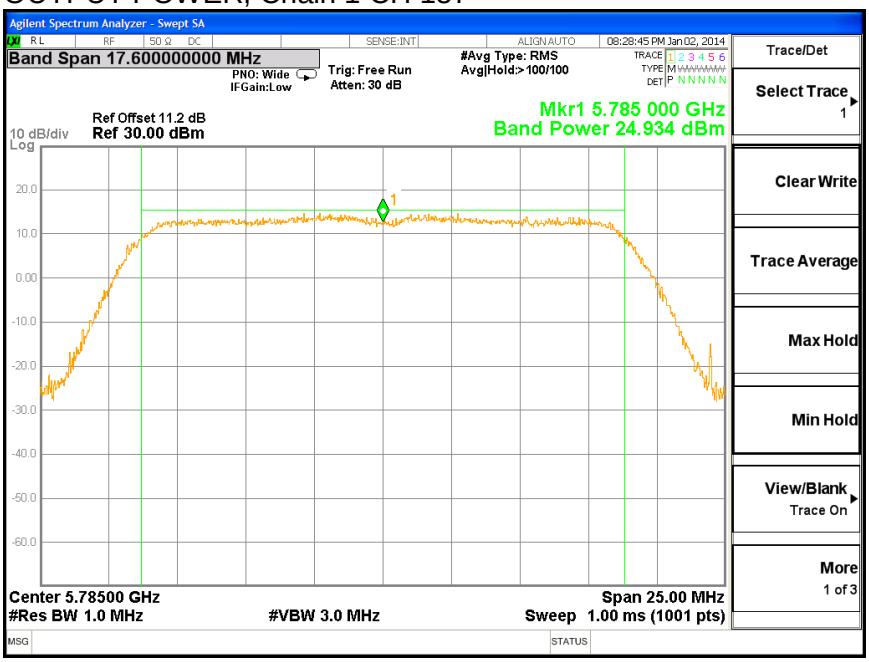
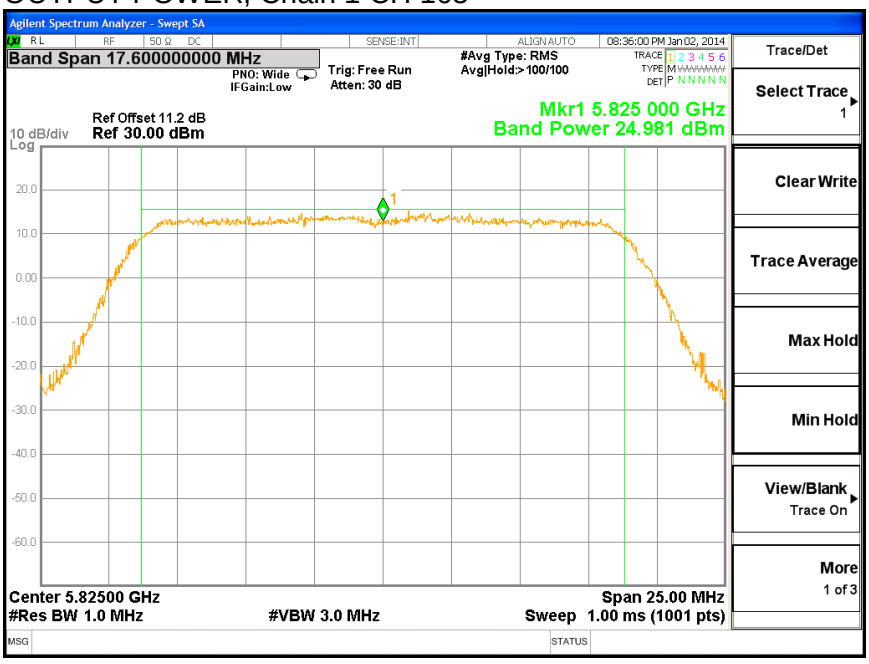
OUTPUT POWER, Chain 1 CH 157



OUTPUT POWER, Chain 1 CH 165



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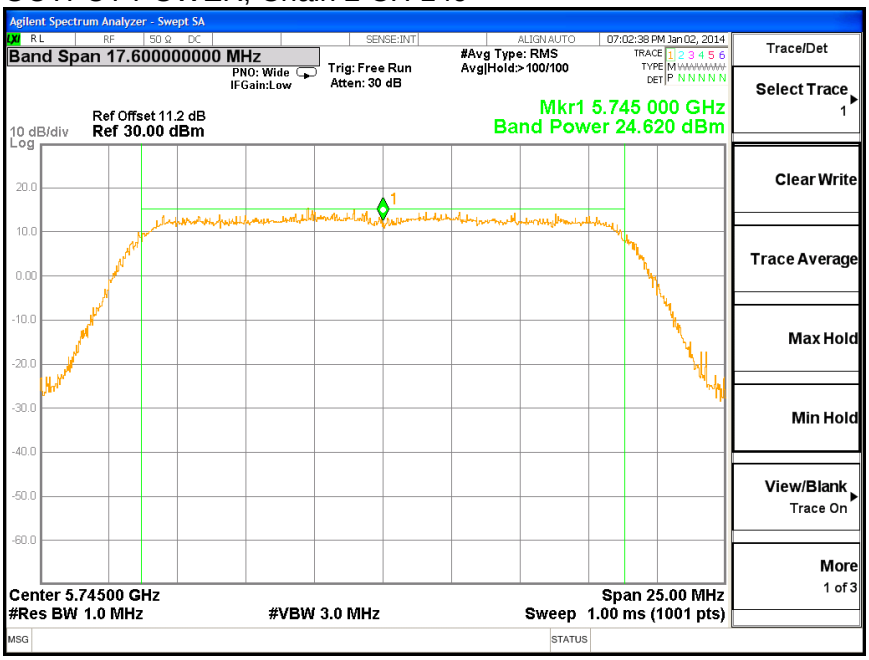
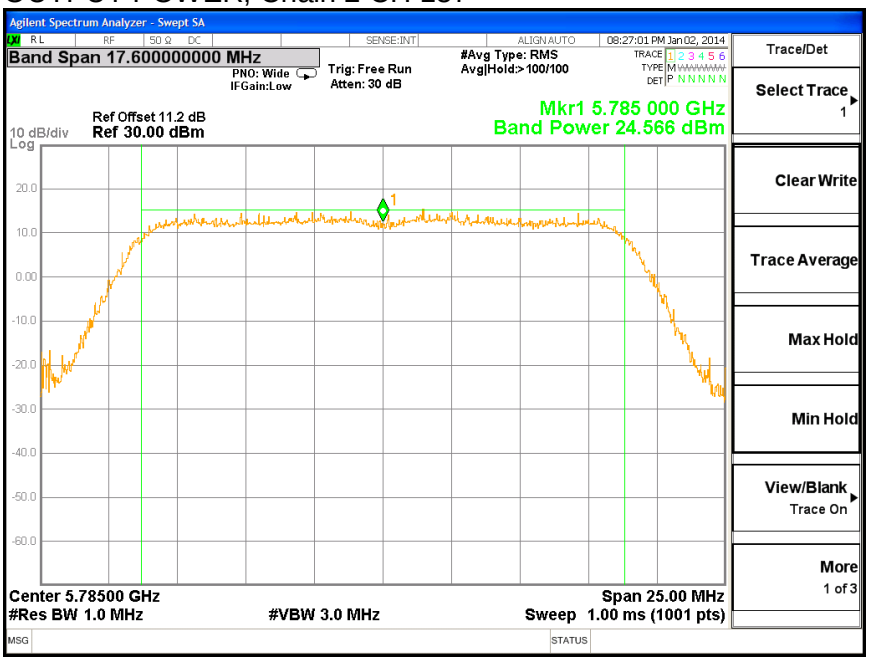
OUTPUT POWER, Chain 2

OUTPUT POWER, Chain 2 CH 149



OUTPUT POWER, Chain 2 CH 157



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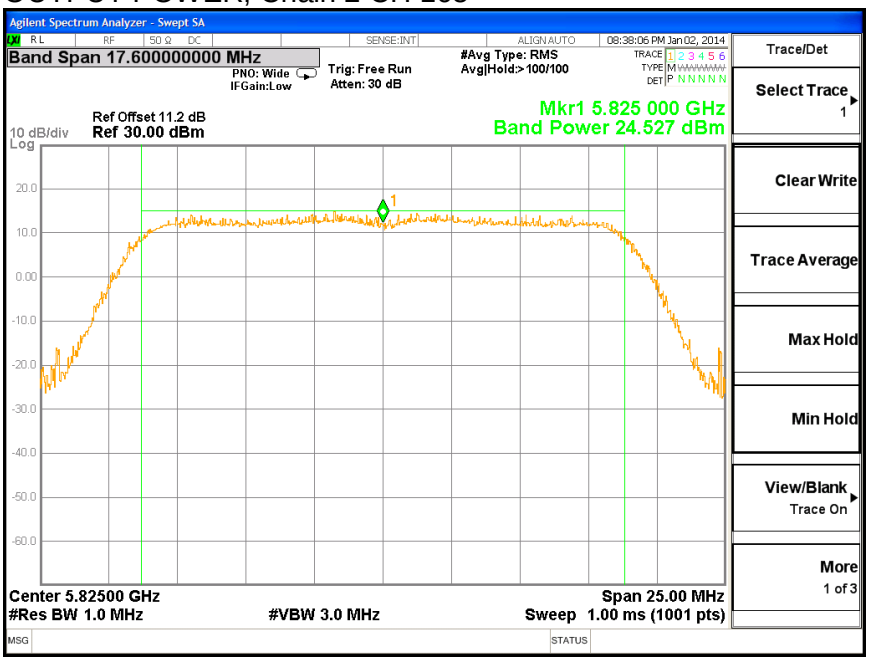
OUTPUT POWER, Chain 2 CH 165



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7.4.5. PSD

LIMITS

FCC §15.247

RESULTS

PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Chain 1 Meas (dBm)	Chain 2 Meas (dBm)	Total PSD (dBm)	Limit (dBm)	Margin (dB)
149	5745	-0.17	-0.33	-0.84	4.33	8.0	-3.7
157	5785	-0.94	-0.55	-1.14	3.90	8.0	-4.1
165	5825	-1.58	0.04	0.65	4.57	8.0	-3.4

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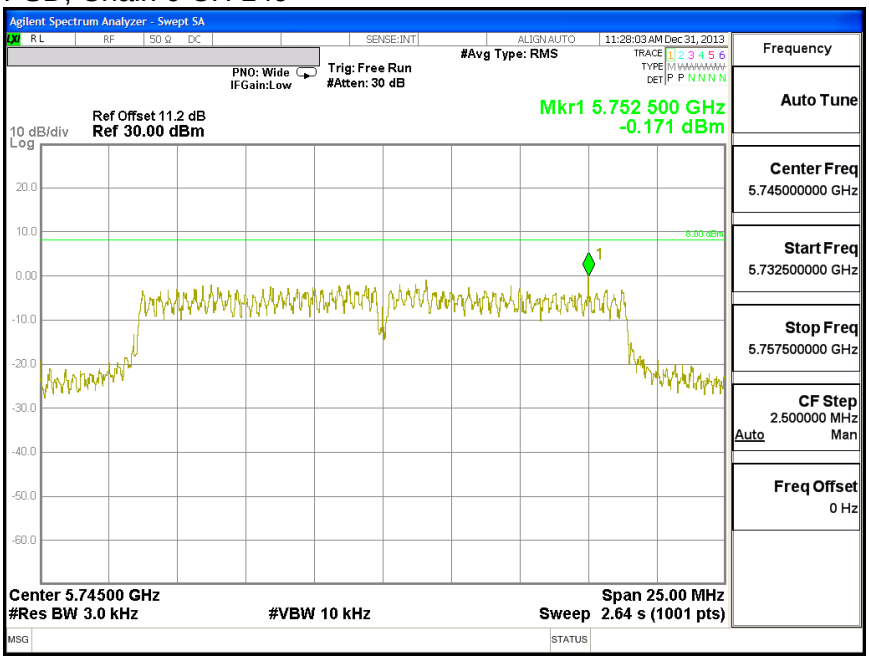
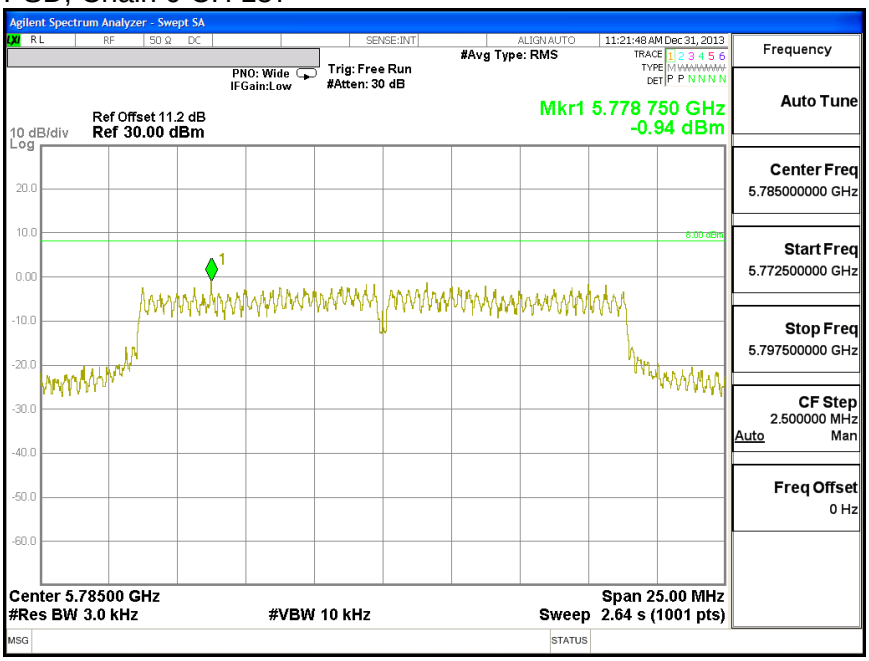
PSD, Chain 0

PSD, Chain 0 CH 149



PSD, Chain 0 CH 157



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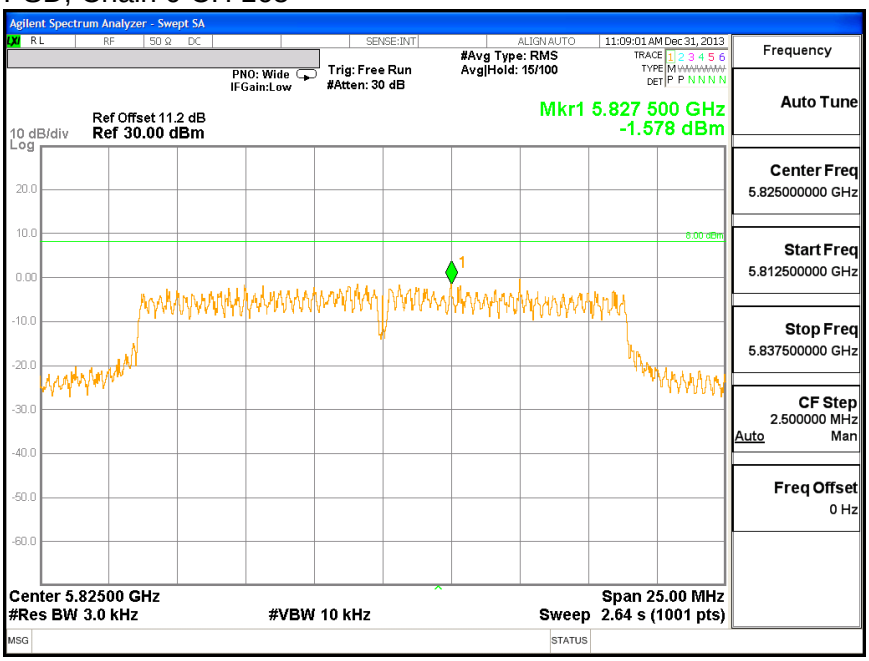
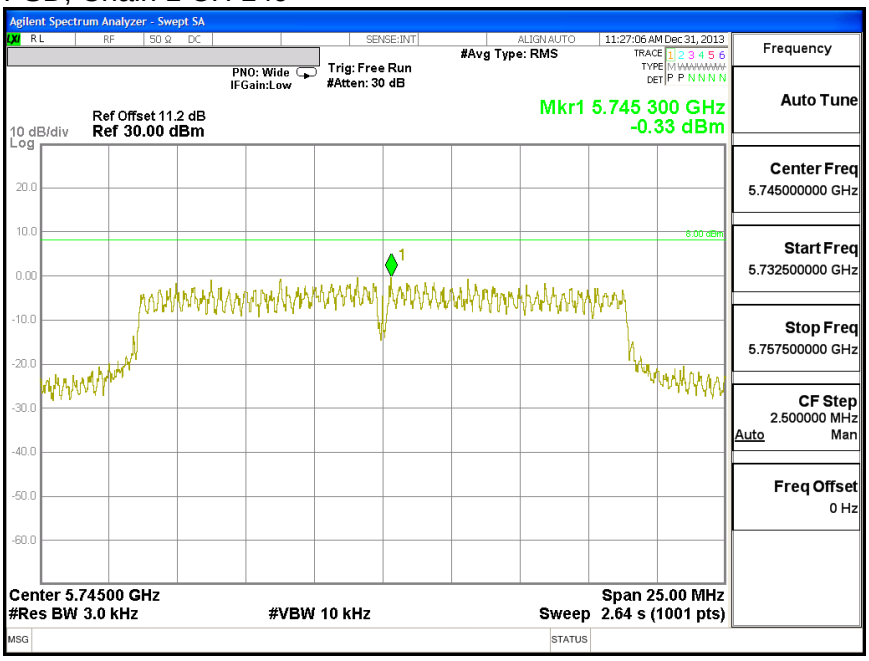
PSD, Chain 0 CH 165



PSD, Chain 1

PSD, Chain 1 CH 149



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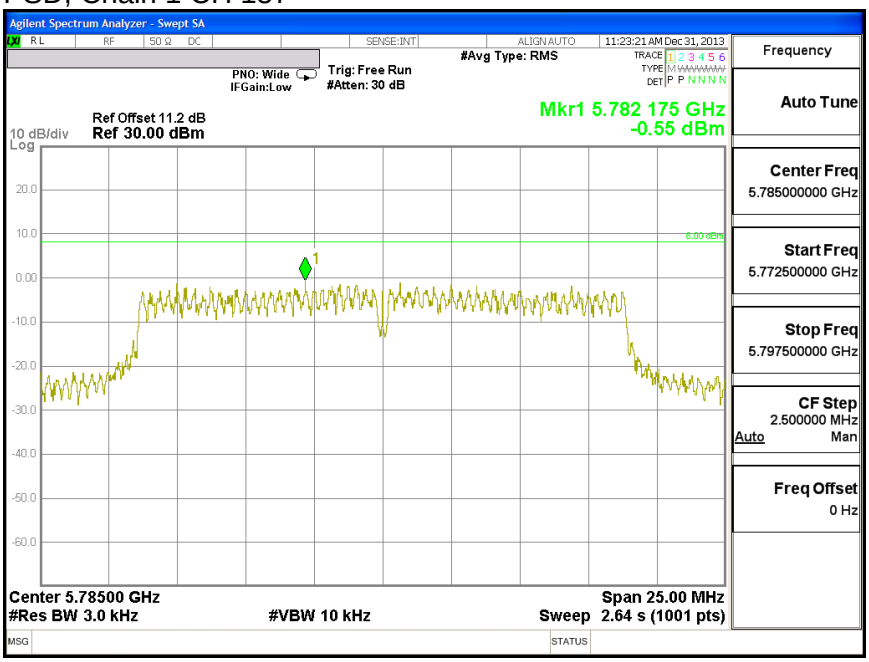
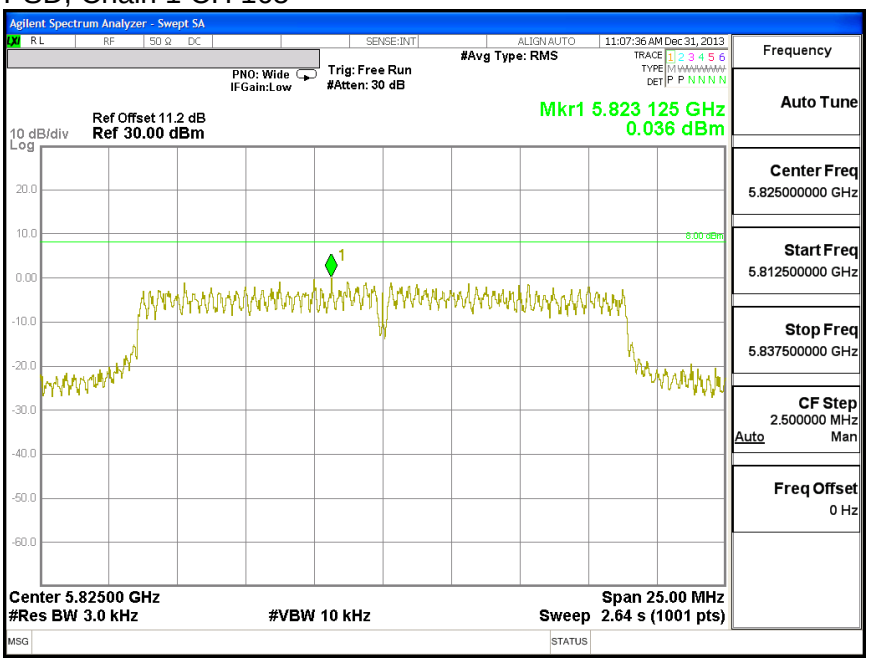
PSD, Chain 1 CH 157



PSD, Chain 1 CH 165



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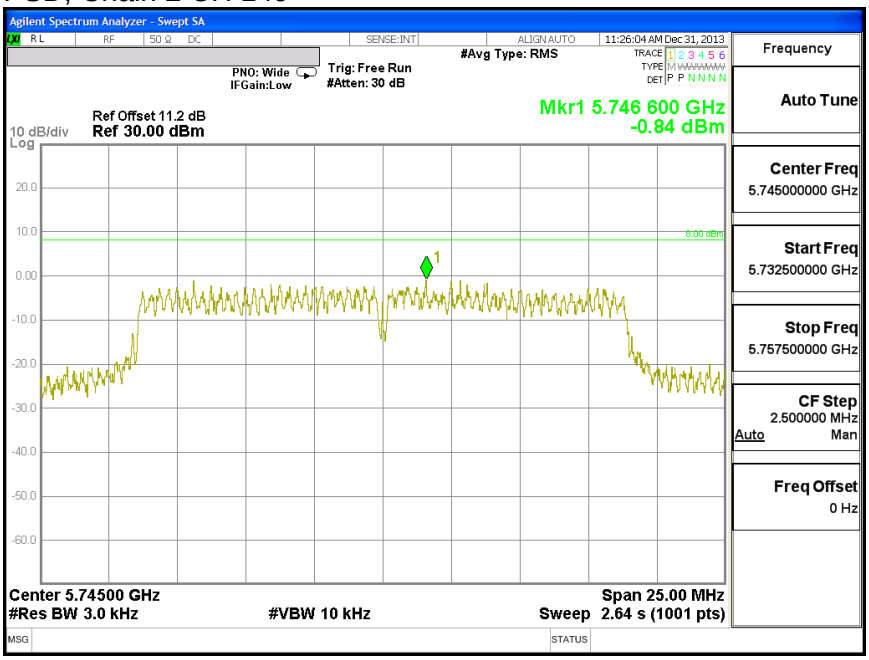
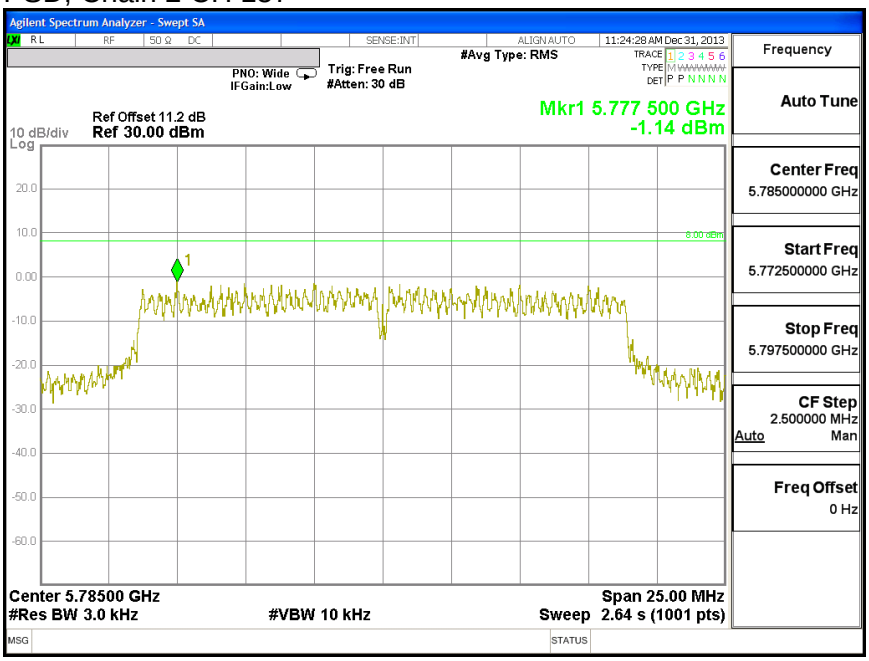
PSD, Chain 2

PSD, Chain 2 CH 149



PSD, Chain 2 CH 157



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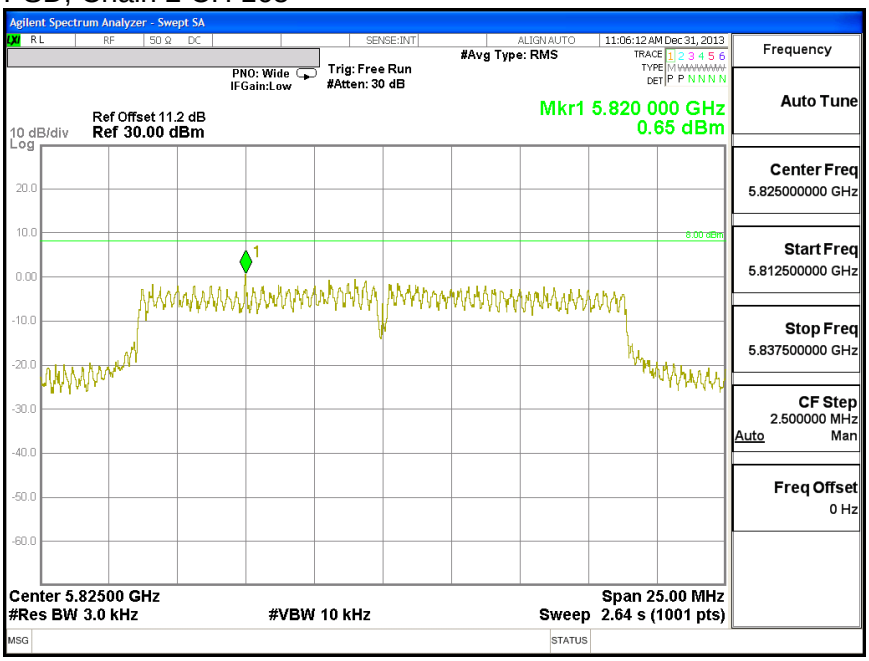
PSD, Chain 2 CH 165



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7.4.6. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

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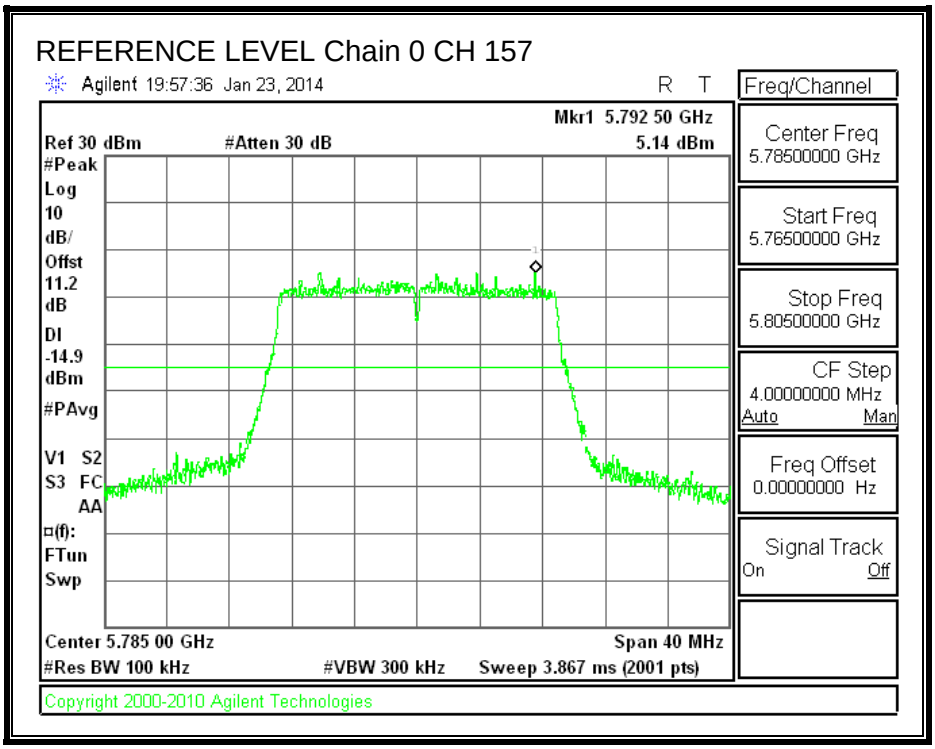
RESULTS

IN-BAND REFERENCE LEVEL, Chain 0



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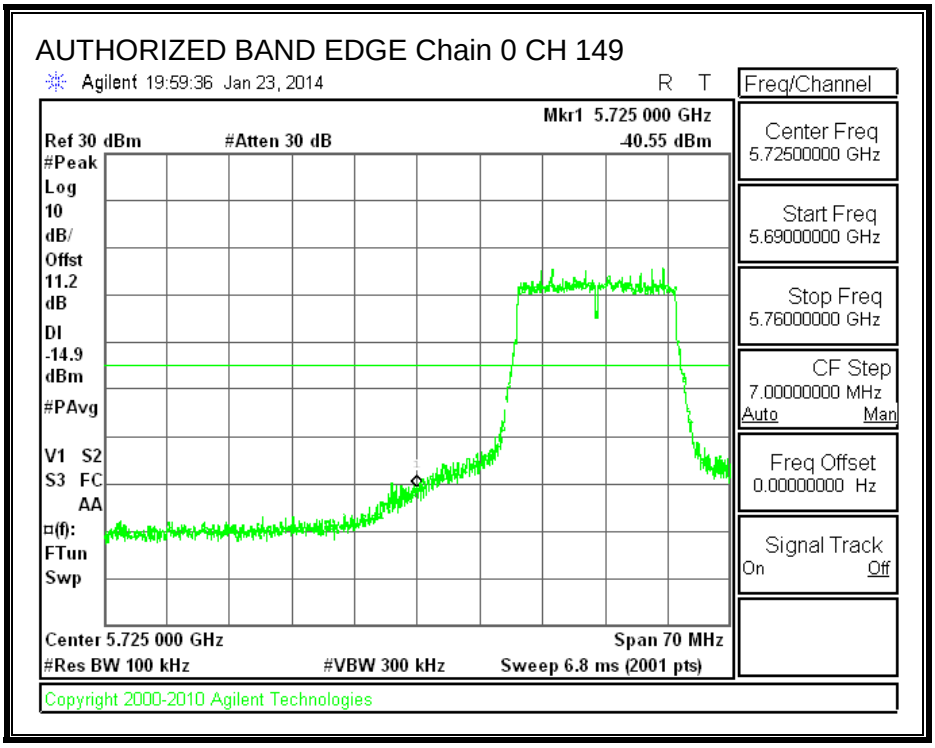
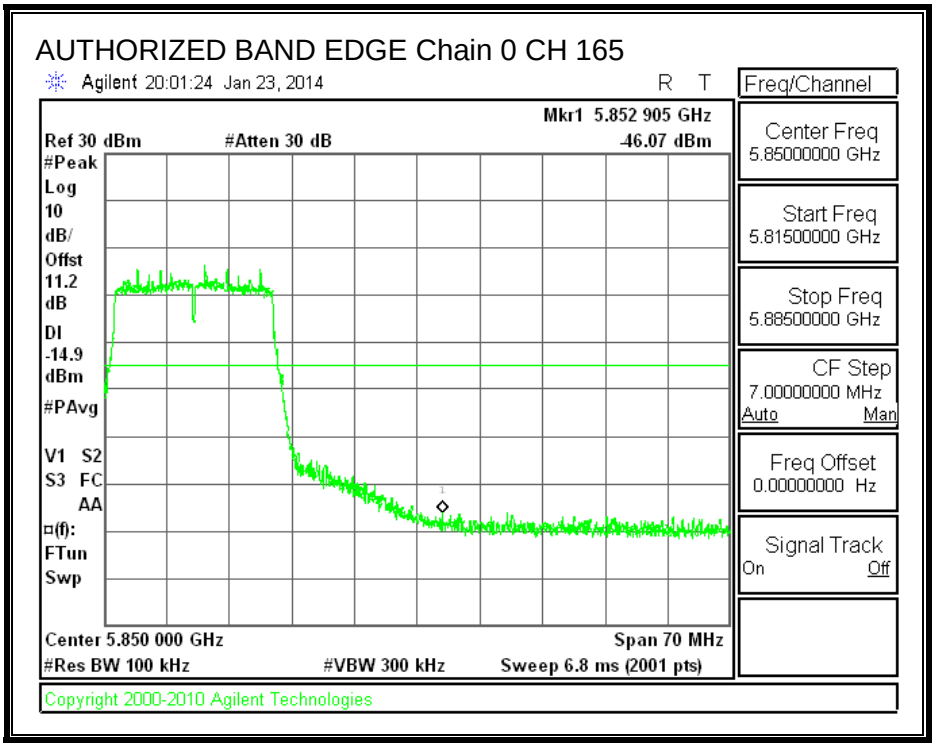
LOW CHANNEL BANDEDGE, Chain 0



HIGH CHANNEL BANDEDGE, Chain 0



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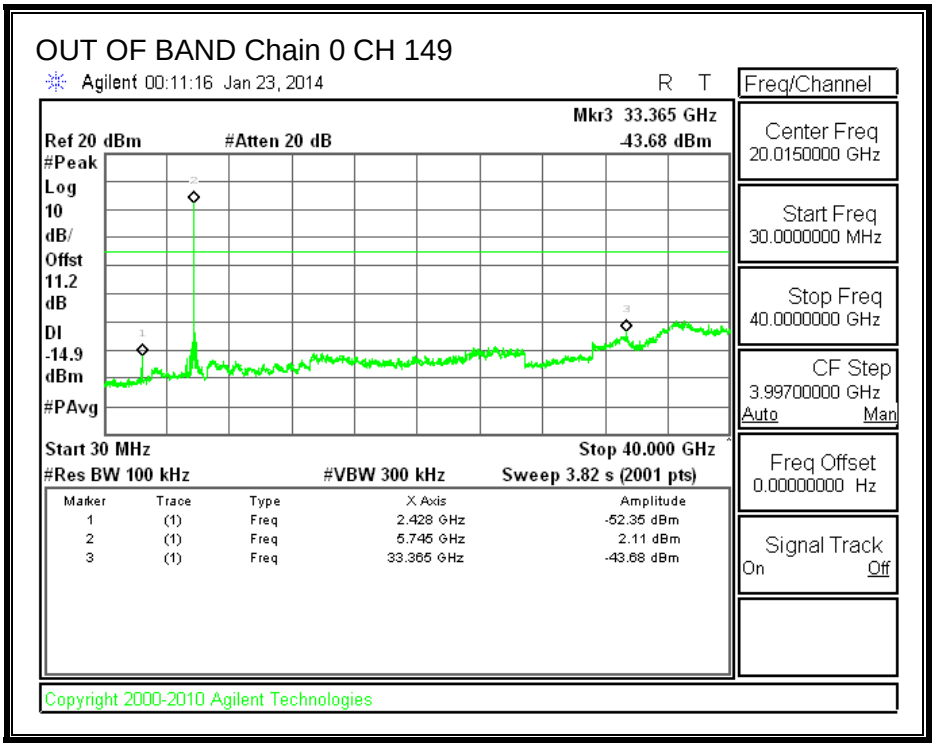
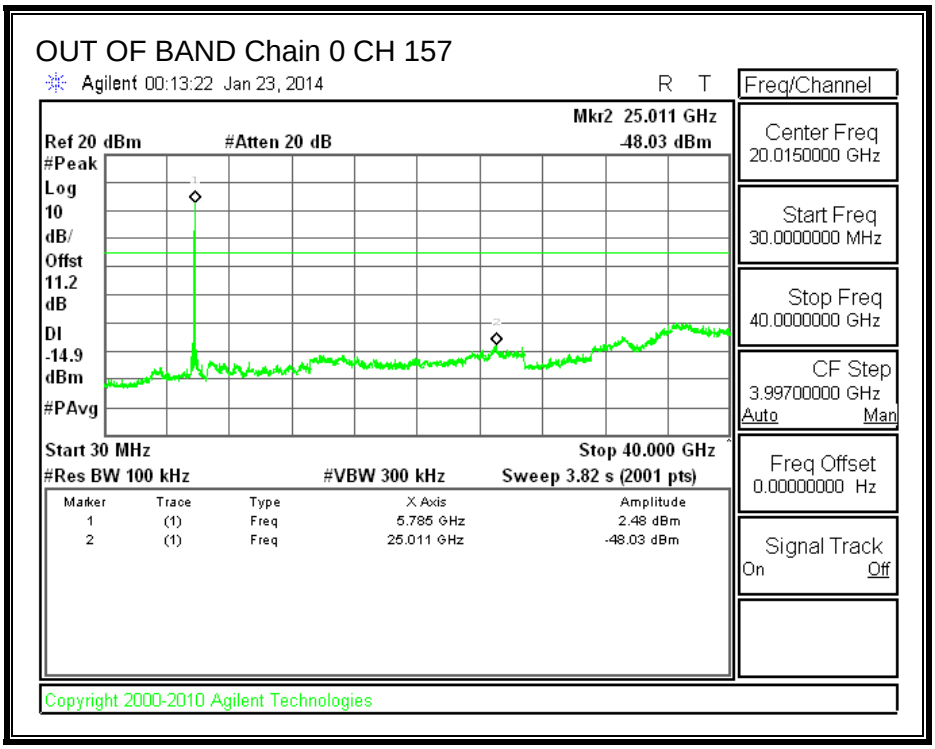
OUT-OF-BAND EMISSIONS, Chain 0





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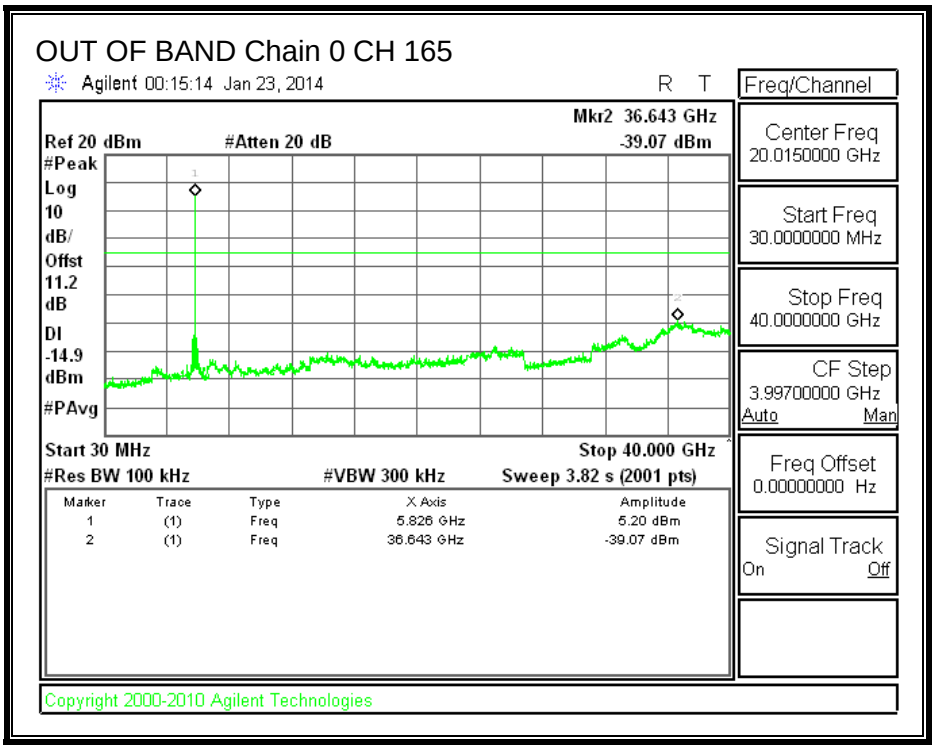

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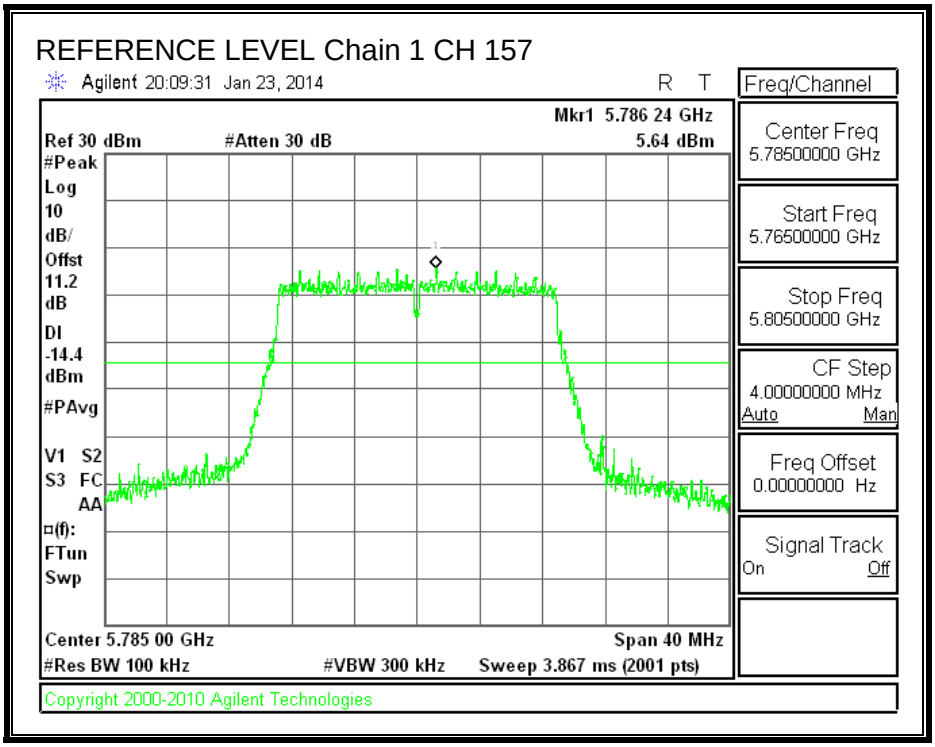
IN-BAND REFERENCE LEVEL, Chain 1



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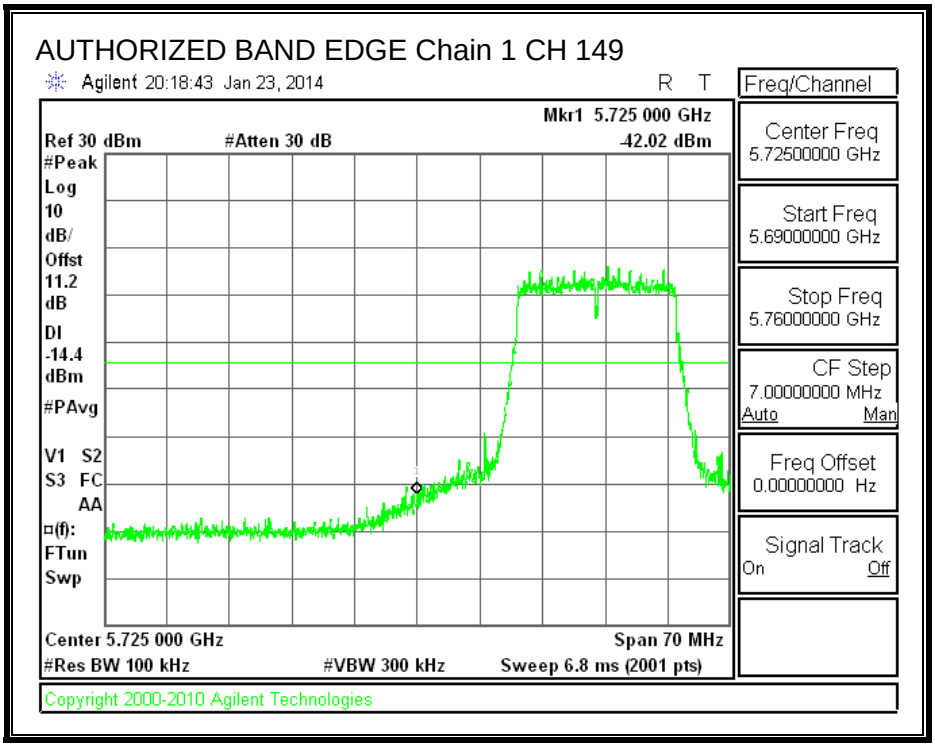
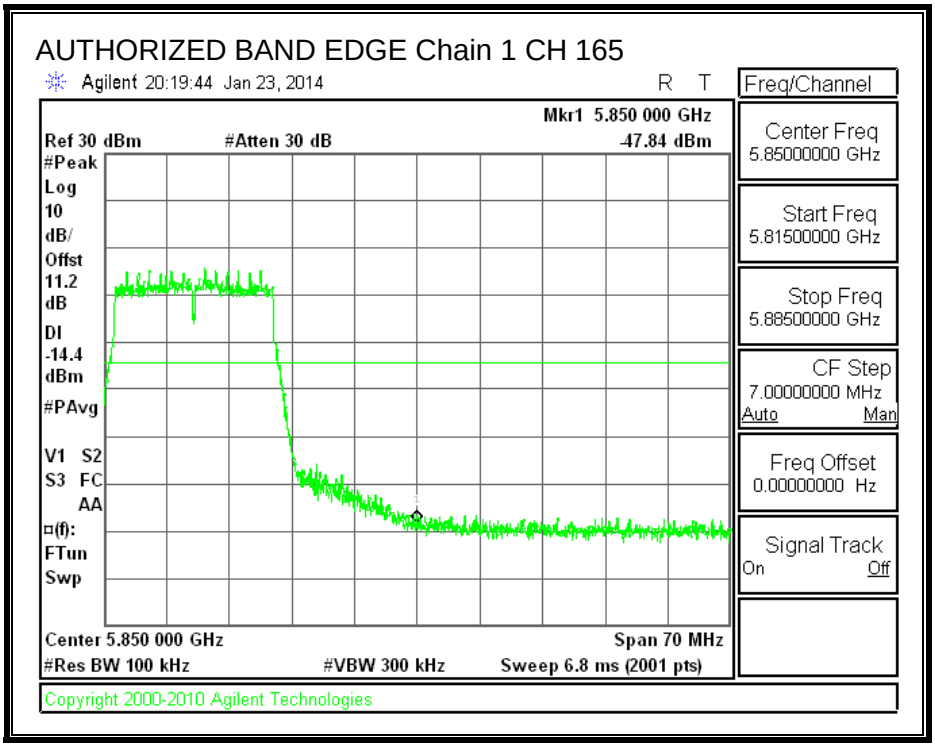
LOW CHANNEL BANDEDGE, Chain 1



HIGH CHANNEL BANDEDGE, Chain 1



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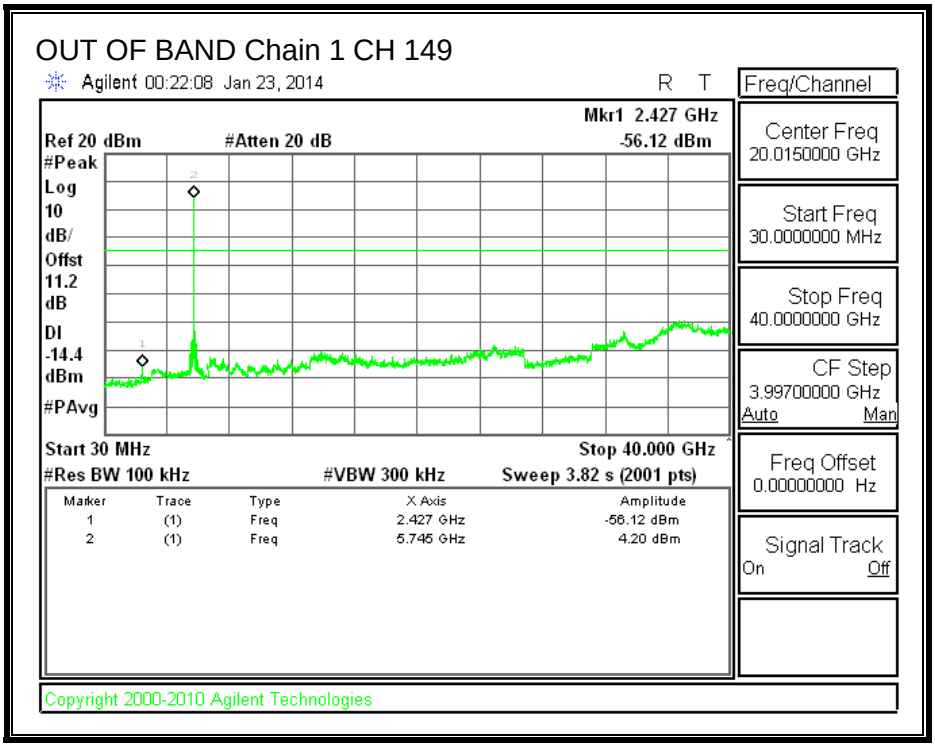
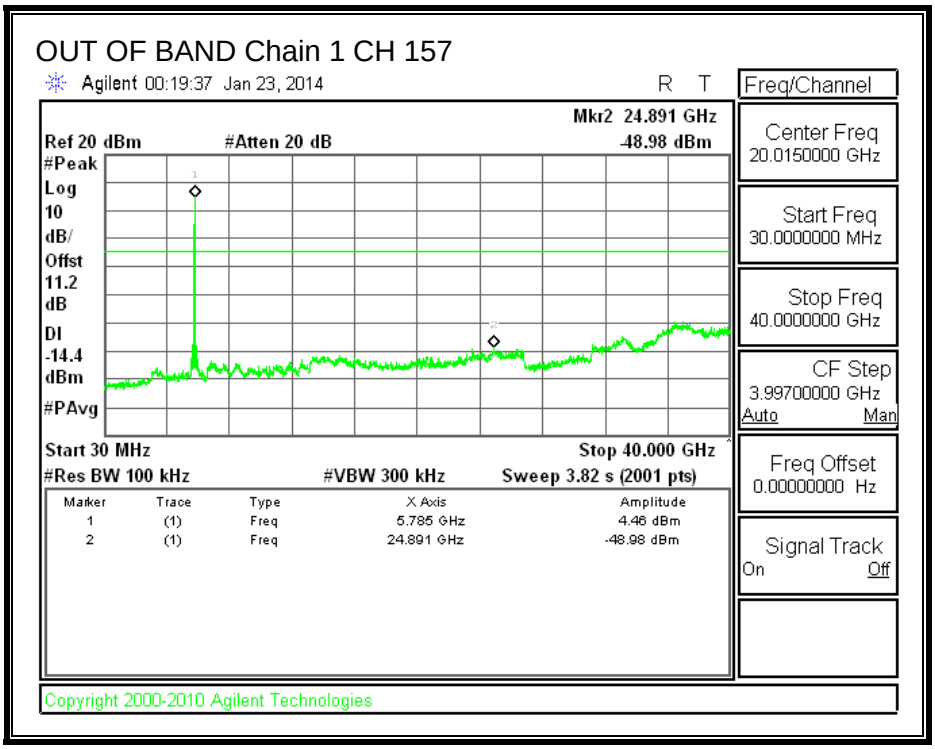
OUT-OF-BAND EMISSIONS, Chain 1





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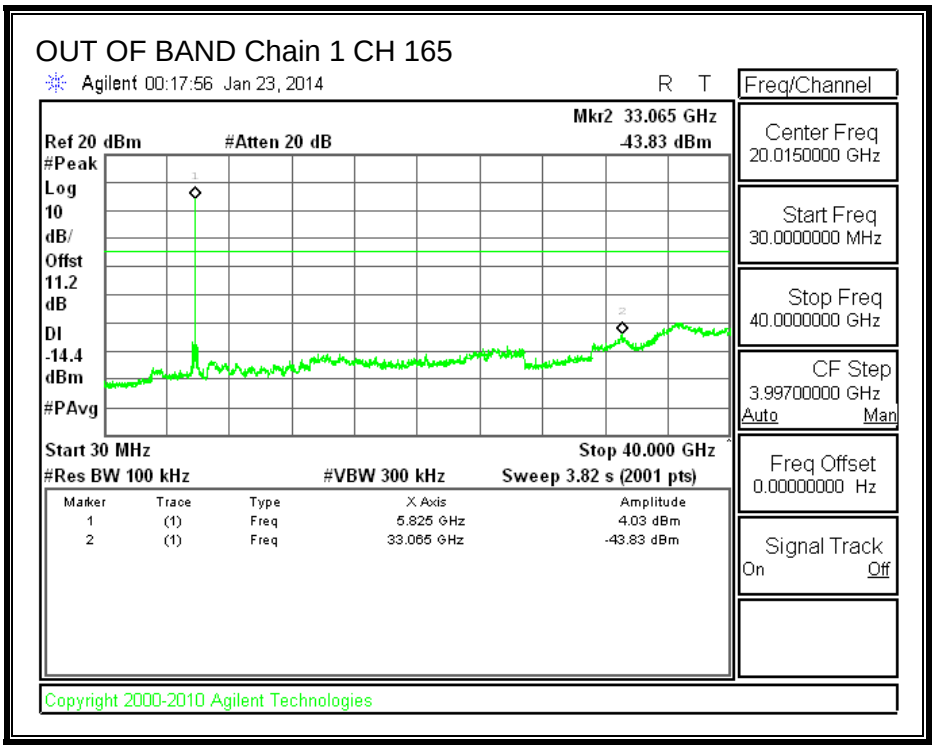

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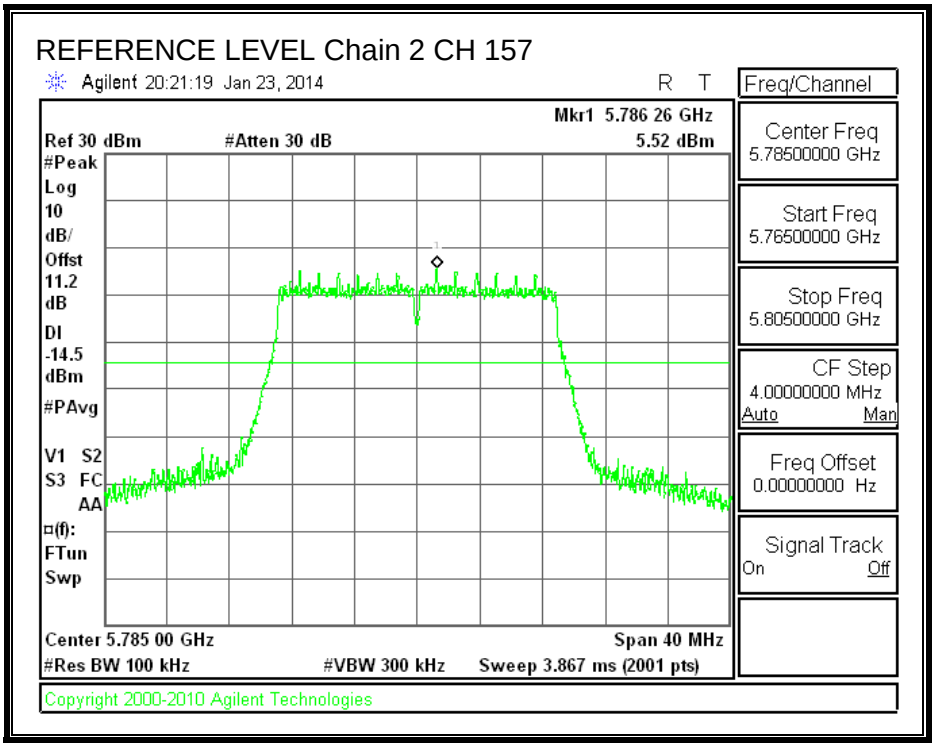
IN-BAND REFERENCE LEVEL, Chain 2



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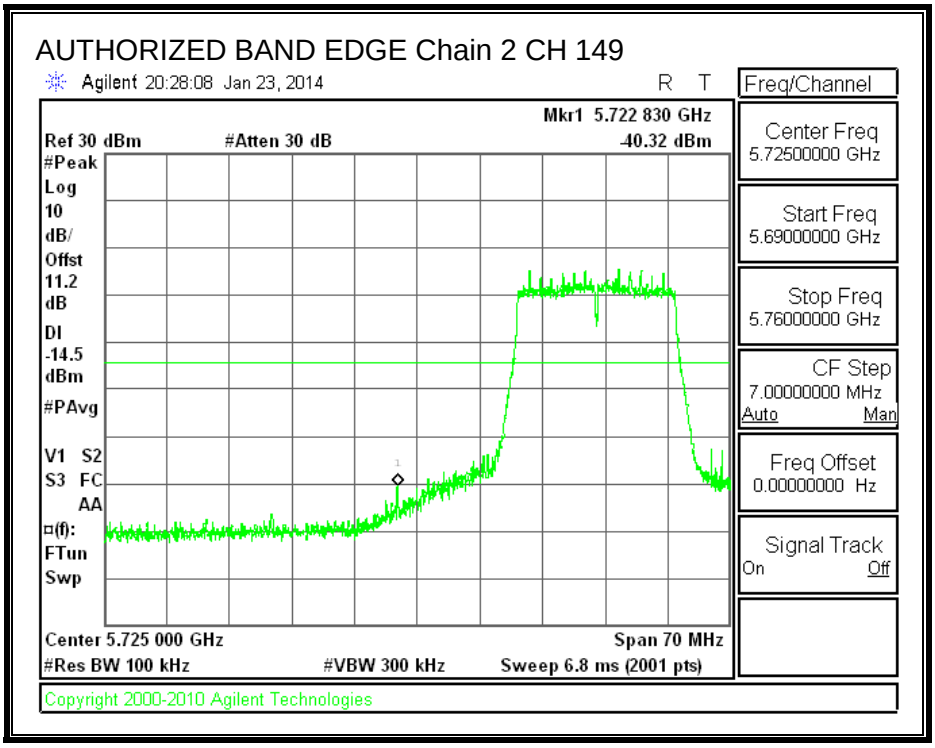
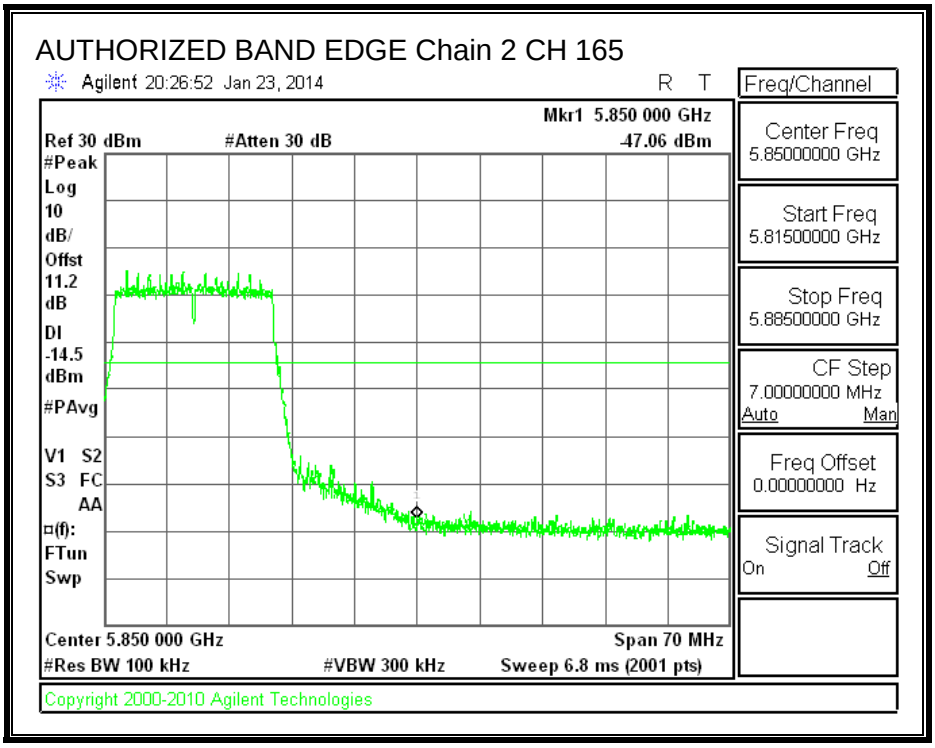
LOW CHANNEL BANDEDGE, Chain 2



HIGH CHANNEL BANDEDGE, Chain 2



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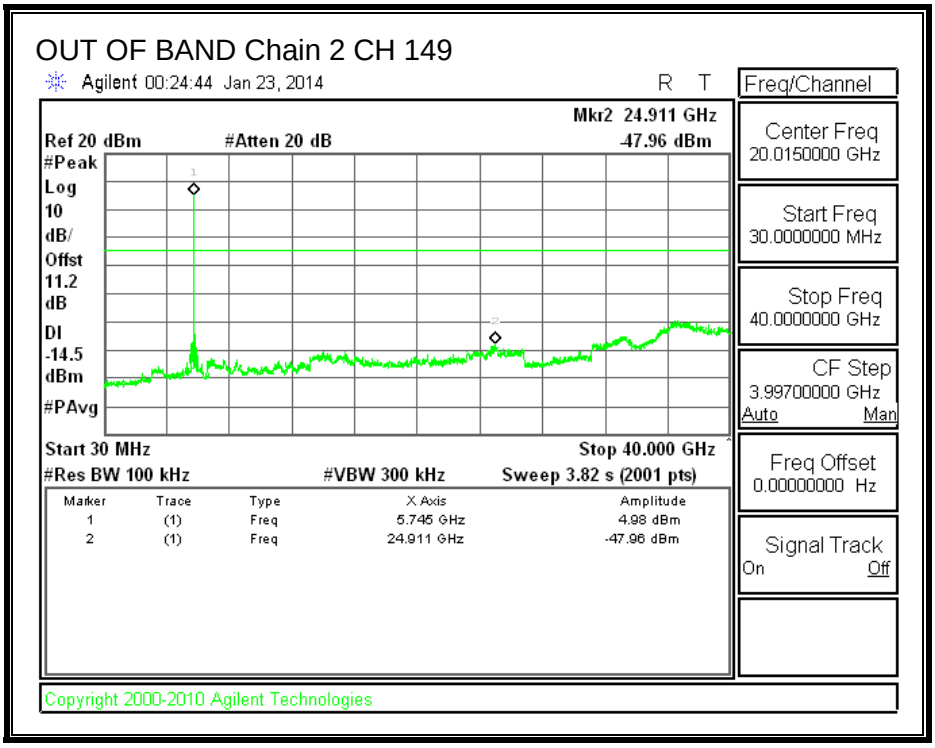
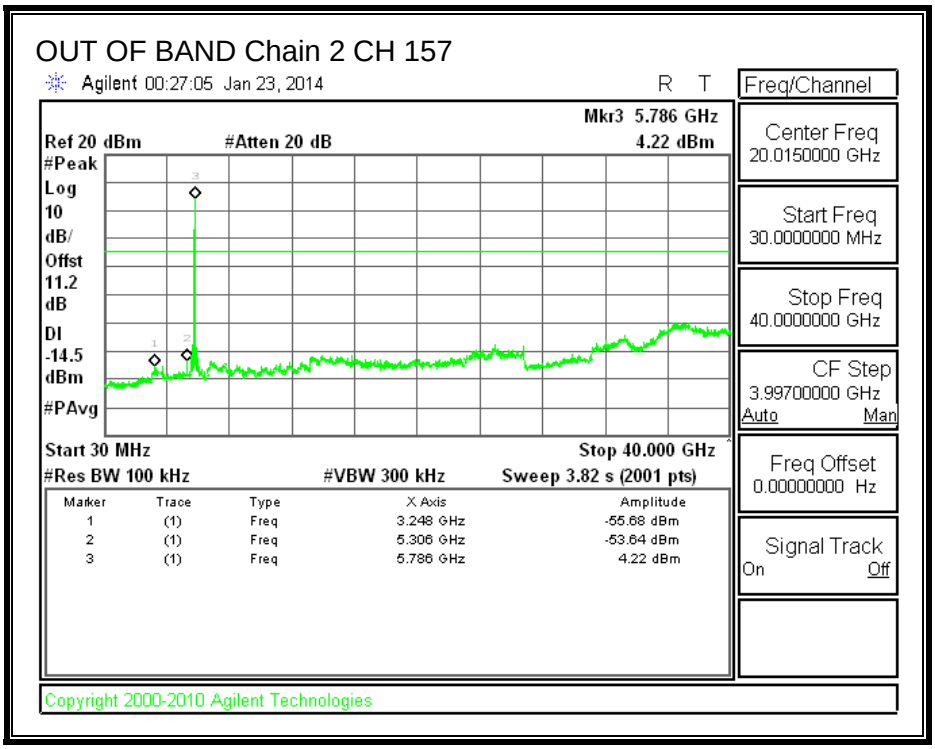
OUT-OF-BAND EMISSIONS, Chain 2





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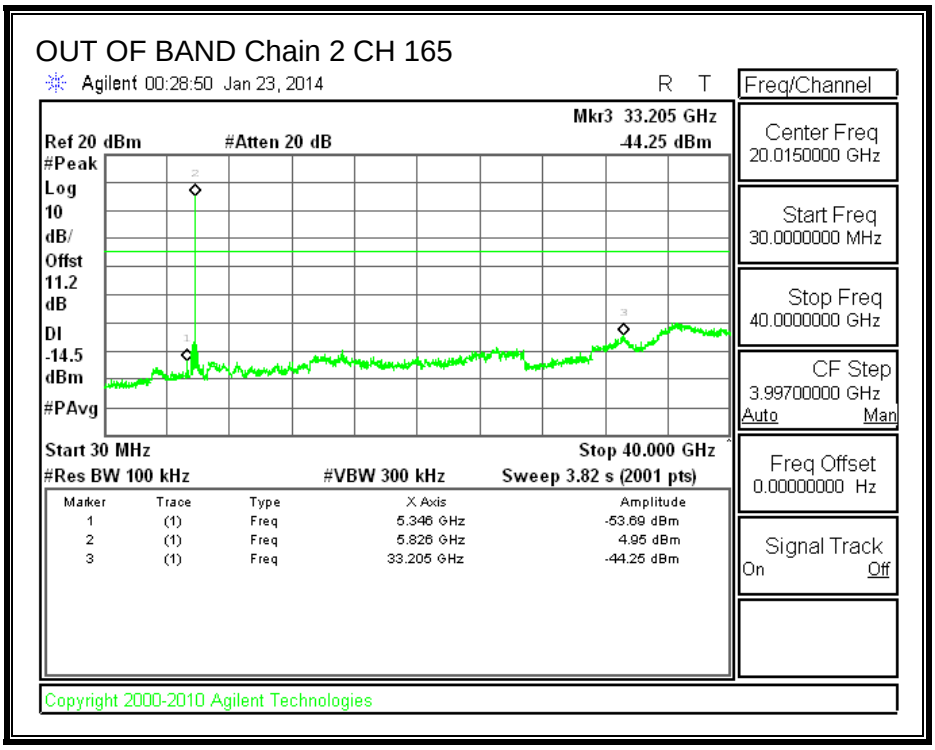

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7.5. 802.11n HT40 SISO MODE IN THE 5.8 GHz BAND

7.5.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
151	5755	36.355	0.5
159	5795	36.300	0.5

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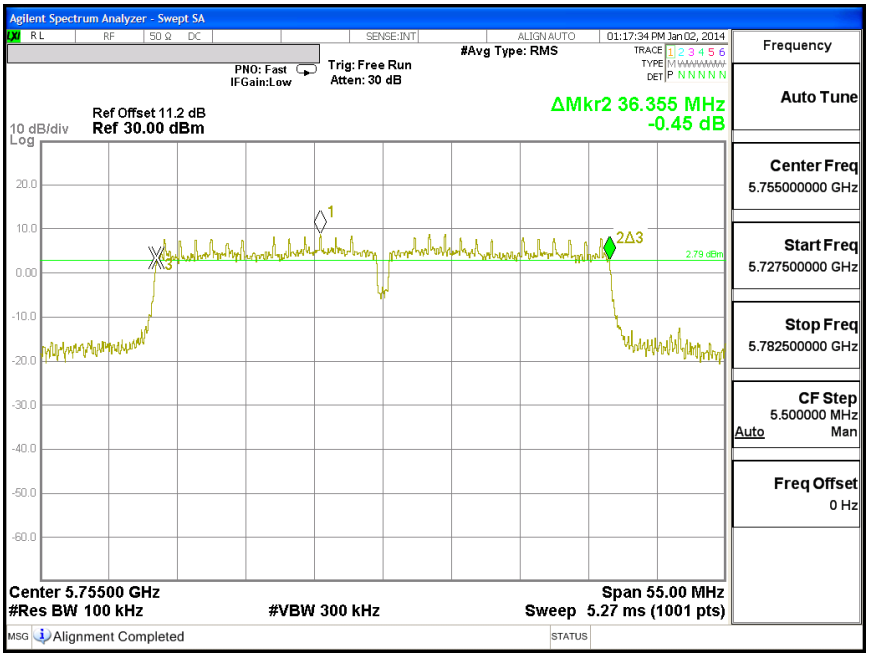
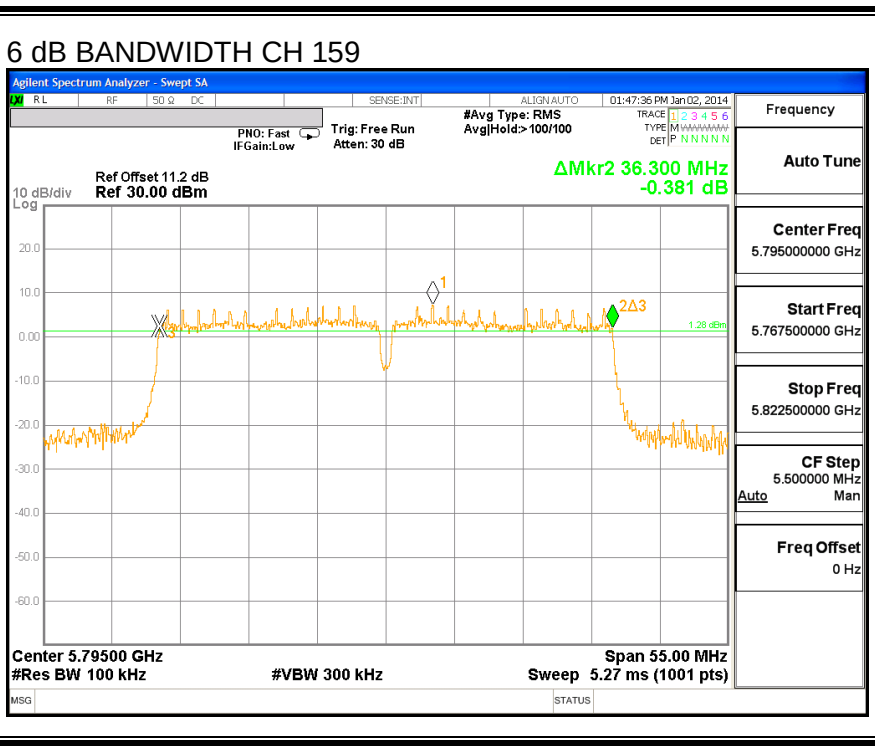
6 dB BANDWIDTH

6 dB BANDWIDTH CH 151



6 dB BANDWIDTH CH 159



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7.5.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
151	5755	36.5600
159	5795	36.6590

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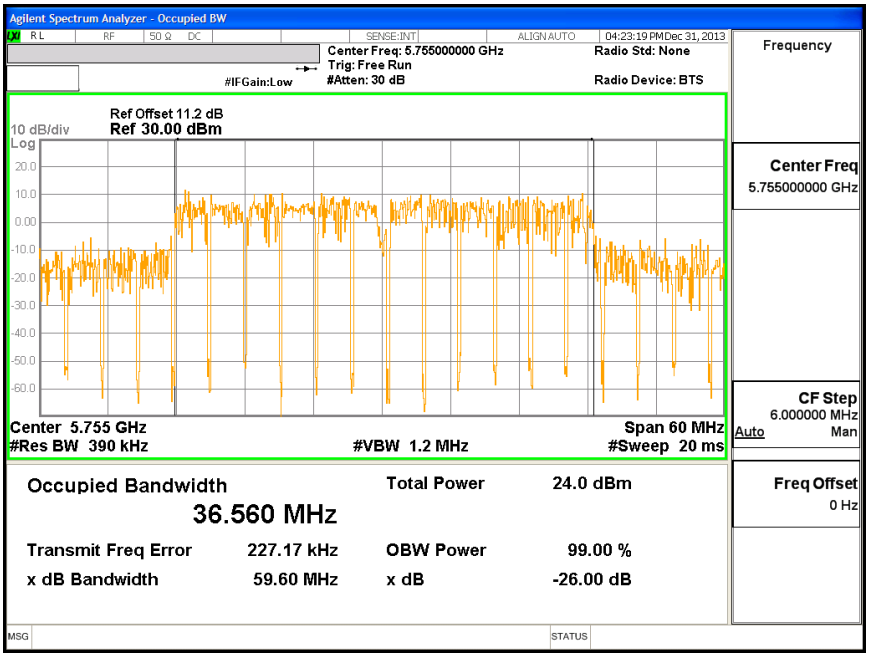
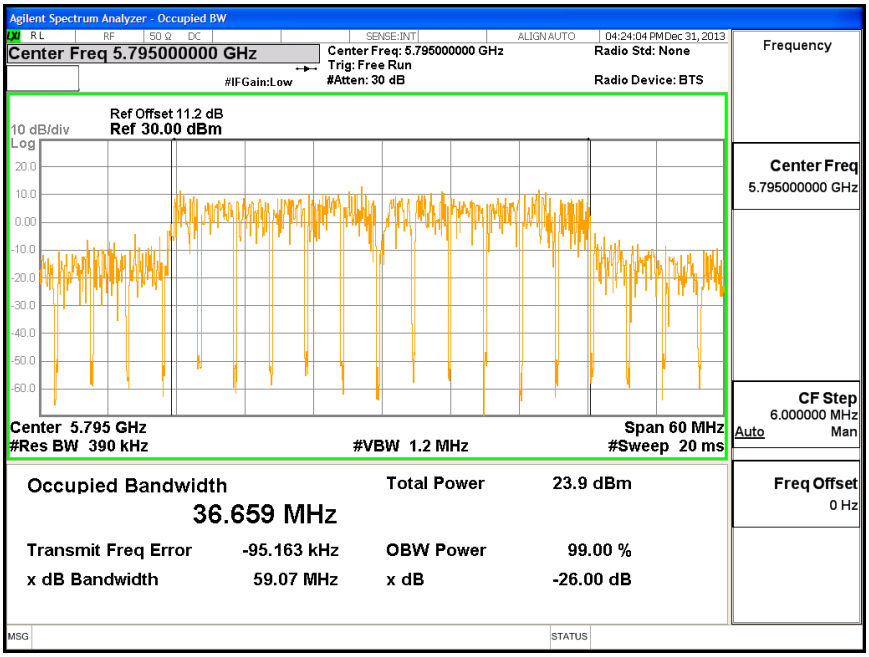
99% BANDWIDTH

99% BANDWIDTH CH 151



99% BANDWIDTH CH 159



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7.5.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
151	5755	20.98
159	5795	20.93

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7.5.4. OUTPUT POWER

LIMITS

FCC §15.247

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

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RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
151	5755	3.16	30.00	30	36	30.00
159	5795	3.16	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
151	5755	29.40	29.40	30.00	-0.60
159	5795	29.46	29.46	30.00	-0.54

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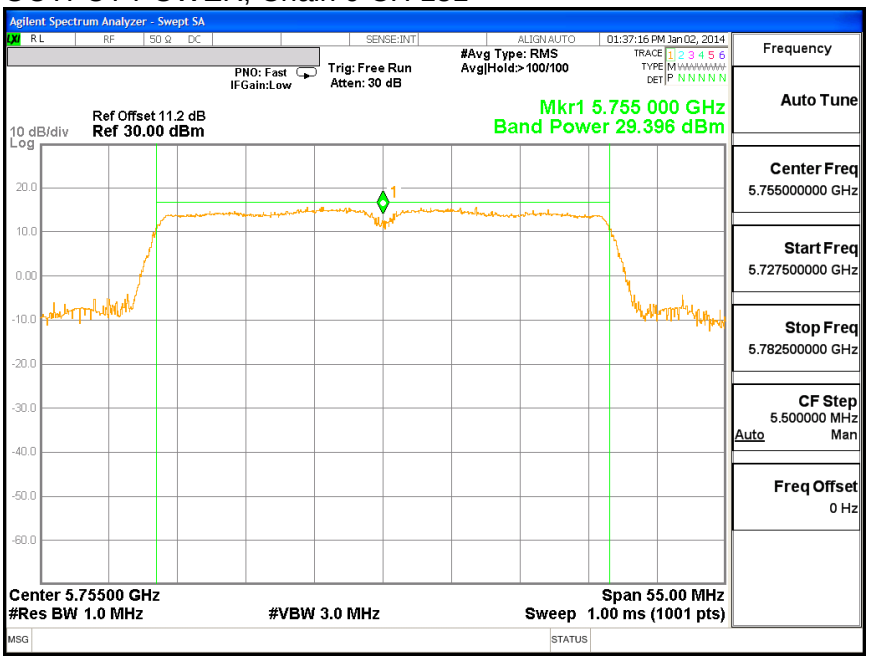
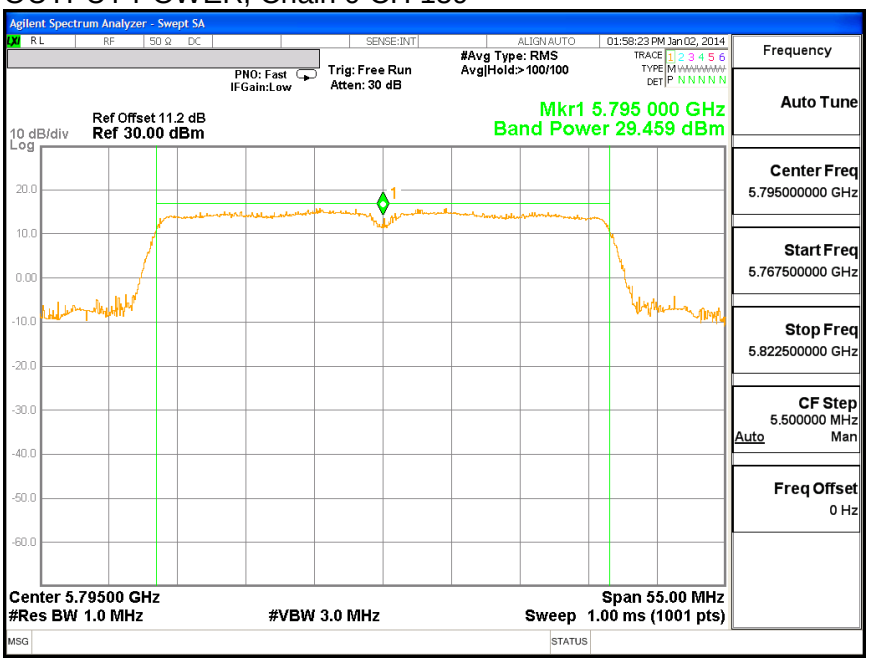
OUTPUT POWER, Chain 0

OUTPUT POWER, Chain 0 CH 151



OUTPUT POWER, Chain 0 CH 159



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7.5.5. PSD

LIMITS

FCC §15.247

RESULTS

PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Limit (dBm)	Margin (dB)
151	5755	-3.72	8.0	-11.7
159	5795	-4.87	8.0	-12.9

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