FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8

CERTIFICATION TEST REPORT

FOR

802.11a/b/g/n 2x2 Client Device

MODEL NUMBER: PLAY:1

FCC ID: SBVRM007
IC: 5373A-RM007

REPORT NUMBER: 13U14836-1, Revision B

ISSUE DATE: AUGUST 14, 2013

Prepared for
Sonos, Inc.
223 E. De La Guerra Street
Santa Barbara, CA, 93101, U.S.A.

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	05/15/13	Initial Issue	F. Ibrahim
A	08/06/13	Revised sections 7.1 and 7.2	F. Ibrahim
B	08/14/13	Revised section 9.1 by adding notes (1) and (2). Removed KDB reference from all tabular data sheets for above 1 GHz.	F. Ibrahim

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Sonos, Inc.
223 E. De La Guerra Street
Santa Barbara, CA, 93101, U.S.A.

EUT DESCRIPTION: 802.11a/b/g/n 2x2 Client Device

MODEL: PLAY:1

SERIAL NUMBER: 00-0E-58-C0-00-CA-6, 00-0E-58-C0-00-E2-D

DATE TESTED: March 26 – April 17, 2013

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	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:

FRANK IBRAHIM
WiSE PROGRAM MANAGER
UL Verification Services Inc.

Tested By:

TONY WAGONER
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 C63.10-2003, RSS-GEN Issue 3, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

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

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

EUT is an 802.11a/b/g/n (2x2, 20 MHz channel bandwidth only) DFS client device.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2462	802.11b	29.48	887.16
2412 - 2462	802.11g	29.24	839.46
2412 - 2462	802.11n HT20	29.61	914.11
5745 - 5825	802.11n HT20	29.31	853.10

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes the following antennas:

Dipole, PCB antenna, with the following gains:

2.4 GHz band:
Right Antenna (Red) = 2.85 dBi
Left Antenna (Yellow) = 3.09 dBi

5 GHz bands:
Right Antenna (Red) = 3.59 dBi
Left Antenna (Yellow) = 3.29 dBi

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was V4.2

The EUT driver software installed in the support laptop during testing was Busy box, rev. V1.14.1.

The test utility software used during testing was Note Pad script.

5.5. WORST-CASE CONFIGURATION AND MODE

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

The EUT is for desktop applications; all radiated testing was performed with EUT laid out in desktop configuration.

Per the manufacturer, only the following data rates are used for the EUT, and these are the data rates used for the testing:

802.11b mode: 11 Mbps
802.11g mode: 24 Mbps (16 QAM)
802.11n HT20 mode in the 2.4 GHz band: 26 Mbps (QPSK, MCS9)
802.11n HT20 mode in the 5.8 GHz band: 26 Mbps (QPSK, MCS9)

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Router	LINKSYS	BEFSR81 ver. 3	C2220E202195	n/a
Laptop	DELL	LATITUDE E4310	CN0928G47243807F16F1A00	n/a

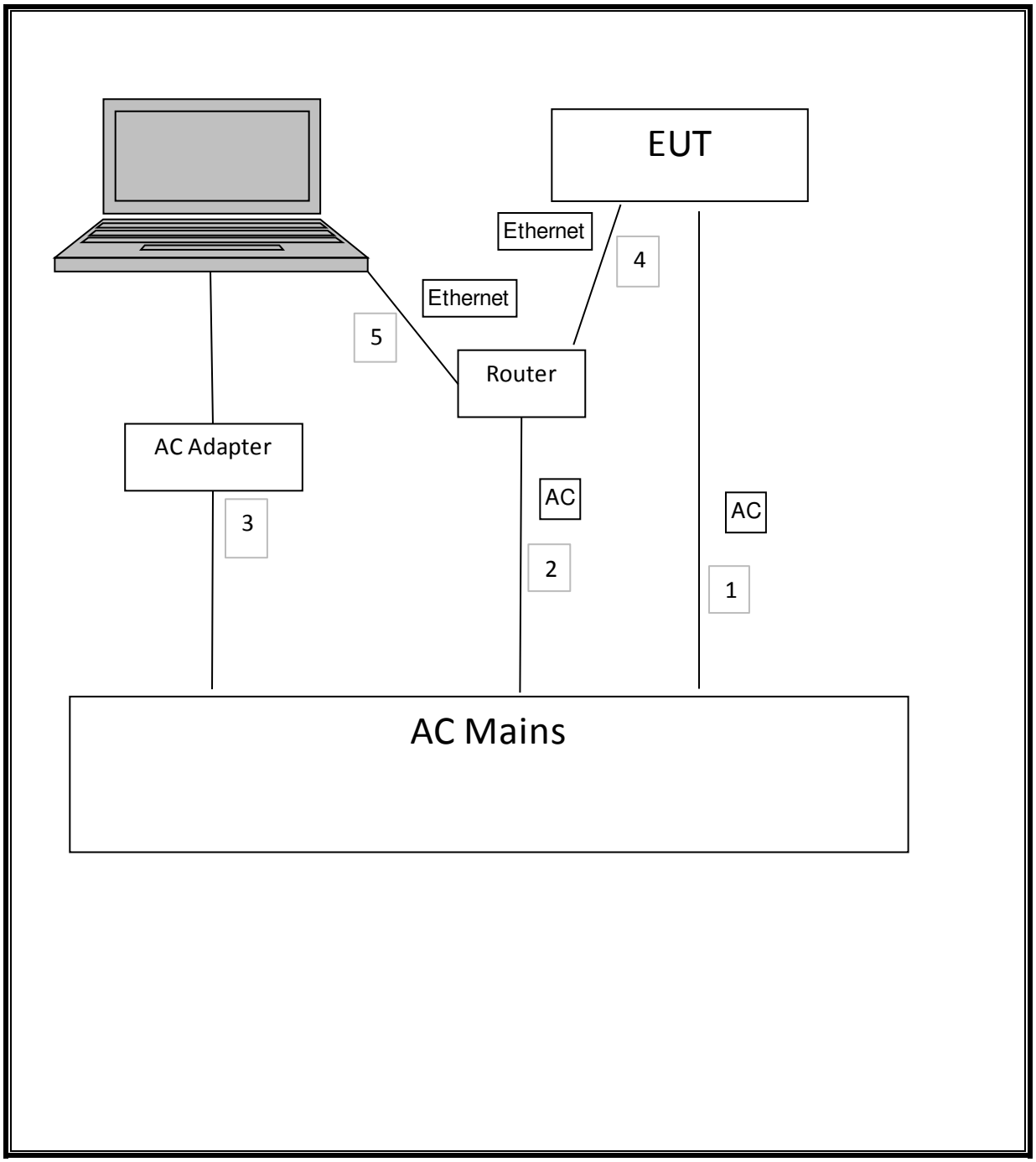
I/O CABLES

Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	ac	none	ac	Unshielded	1	n/a
2	ac	none	ac	Unshielded	1.5	n/a
3	ac	none	ac adapter	Unshielded	1.5	n/a
4	ethernet	none	RJ45	Unshielded	1	n/a
5	ethernet	none	RJ45	Unshielded	2	n/a

TEST SETUP

The EUT and the support laptop were connected to the Access Point during the tests. A command prompt was used to select channels and power settings from a list of commands to exercise the radio card.

SETUP DIAGRAM FOR TESTS



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**	**Asset**	**Cal Date**	**Cal Due**
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00986	04/01/13	04/01/14
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	12/20/12	12/20/13
Peak Power Meter	Agilent / HP	E4416A	C00963	12/13/12	12/13/13
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/13/12	12/13/13
Antenna, Horn, 40GHz	ARA	MWH-2640/B	C00981	06/14/13	06/14/13
Antenna, Horn, 18 GHz	ETS	3117	C01022	02/21/13	02/21/14
Antenna, Bilog, 30MHz-1 GHz	Sunol Sciences	JB1	C01171	02/13/13	02/13/14
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	08/02/11	08/02/13
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	10/22/12	10/22/13
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	01/16/13	01/16/14
Reject Filter, 5.15-5.35 GHz	Micro-Tronics	BRC13190	N02679	CNR	CNR
Band Reject Filter, 5150-5350MHz	Micro-Tronics	BRC13190	N/A	03/23/13	03/23/14
Reject Filter, 5.725-5.825 GHz	Micro-Tronics	BRC13192	N02677	CNR	CNR
LISN, 30 MHz	FCC	50/250-25-2	C00626	01/14/13	01/14/14
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/08/12	08/08/13

7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

7.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	8.383	8.550	0.980	98.0%	0.00
802.11g	0.3648	0.4352	0.838	83.8%	0.77
802.11n HT20	0.355	0.525	0.676	67.6%	1.70

7.2. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01 v03r01, Section 8.1.

Output Power: KDB 558074 D01 v03r01, Section 9.1.2.

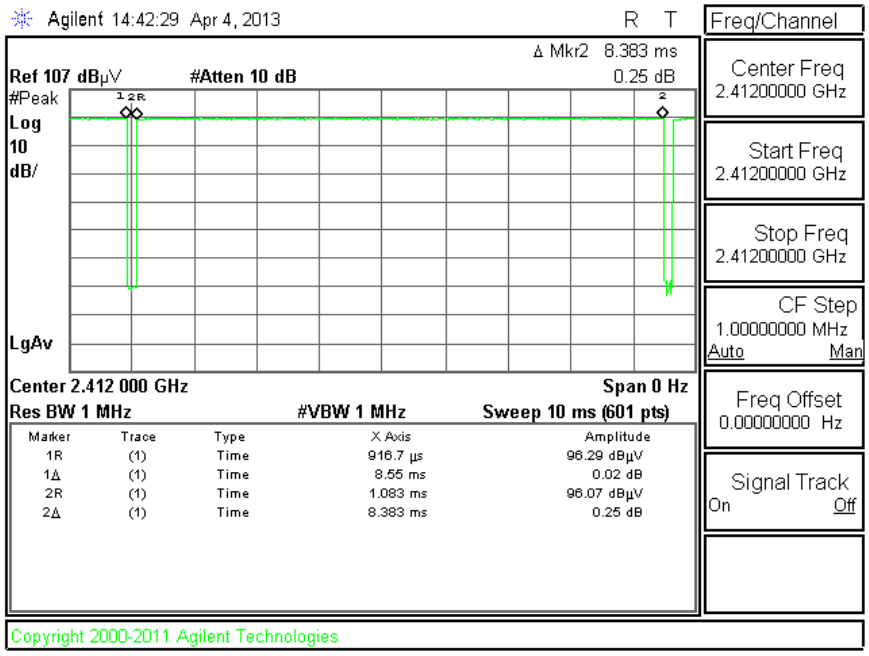
Power Spectral Density: KDB 558074 D01 v03r01, Section 10.2.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v03r01, Section 11.

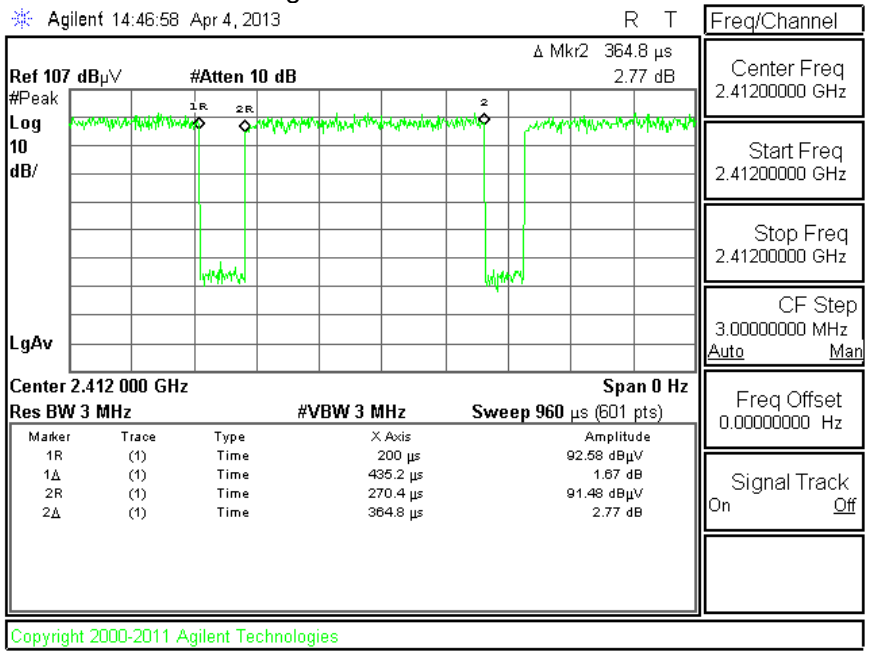
Out-of-band emissions in restricted bands: KDB 558074 D01 v03r01, Section 12.1.

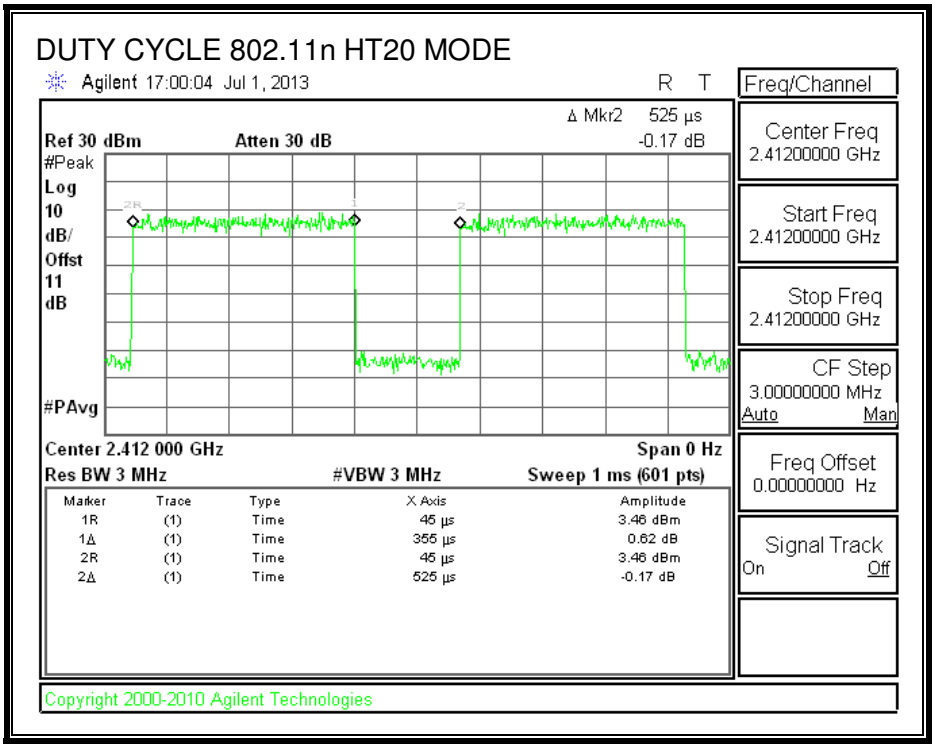
7.3. DUTY CYCLE PLOTS

DUTY CYCLE 802.11b MODE



DUTY CYCLE 802.11g HT20 MODE





8. ANTENNA PORT TEST RESULTS

8.1. 802.11b MODE IN THE 2.4 GHz BAND

8.1.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

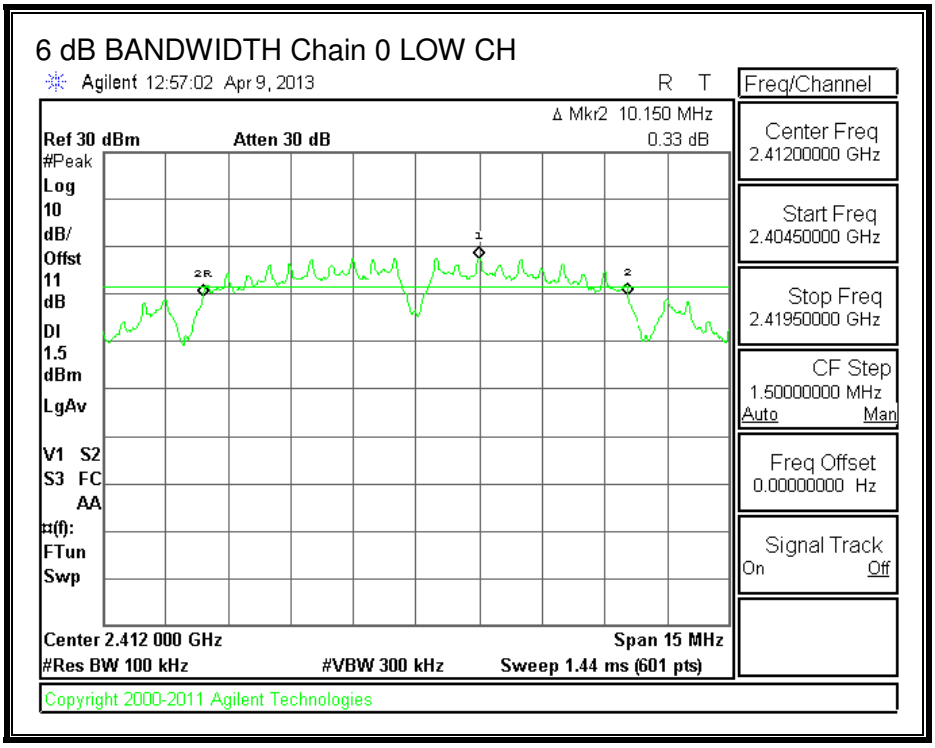
IC RSS-210 A8.2 (a)

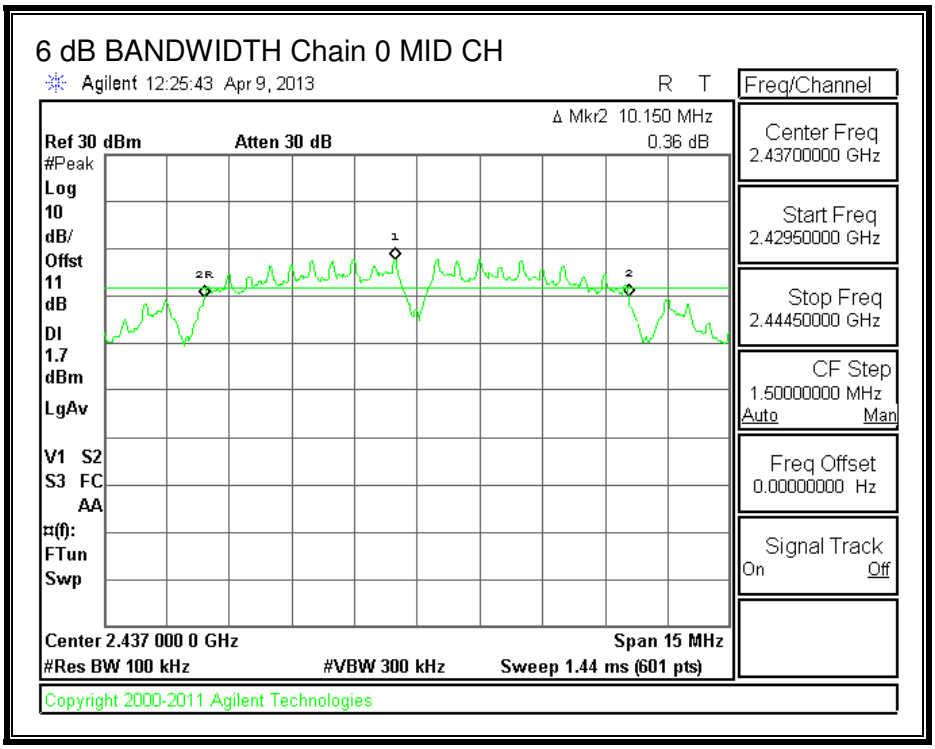
The minimum 6 dB bandwidth shall be at least 500 kHz.

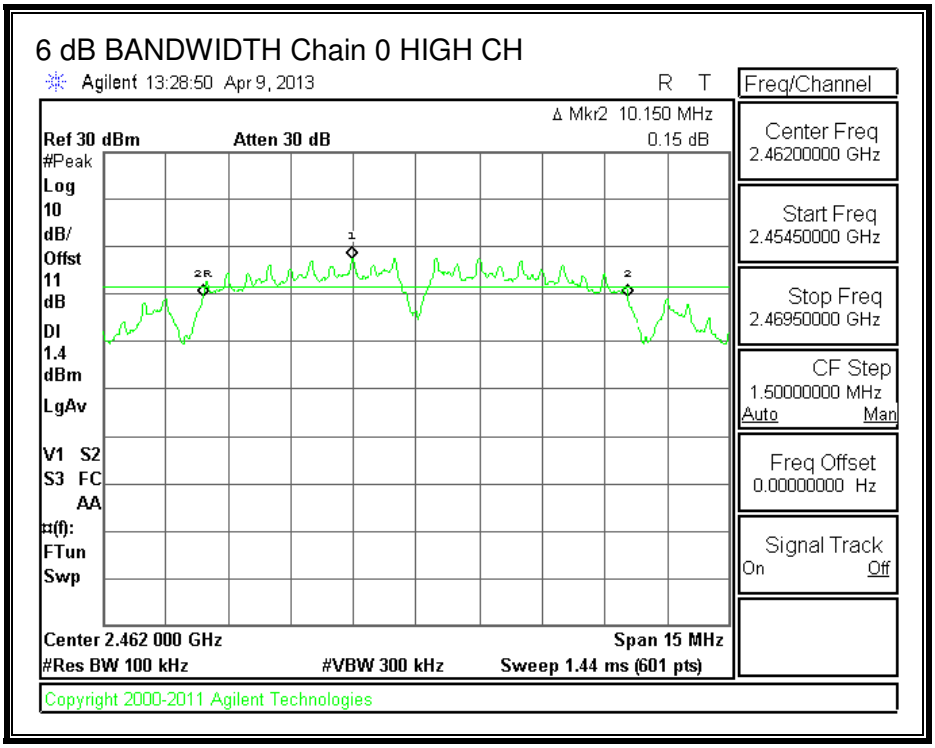
RESULTS

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low	2412	10.150	10.150	0.5
Mid	2437	10.150	10.150	0.5
High	2462	10.150	10.150	0.5

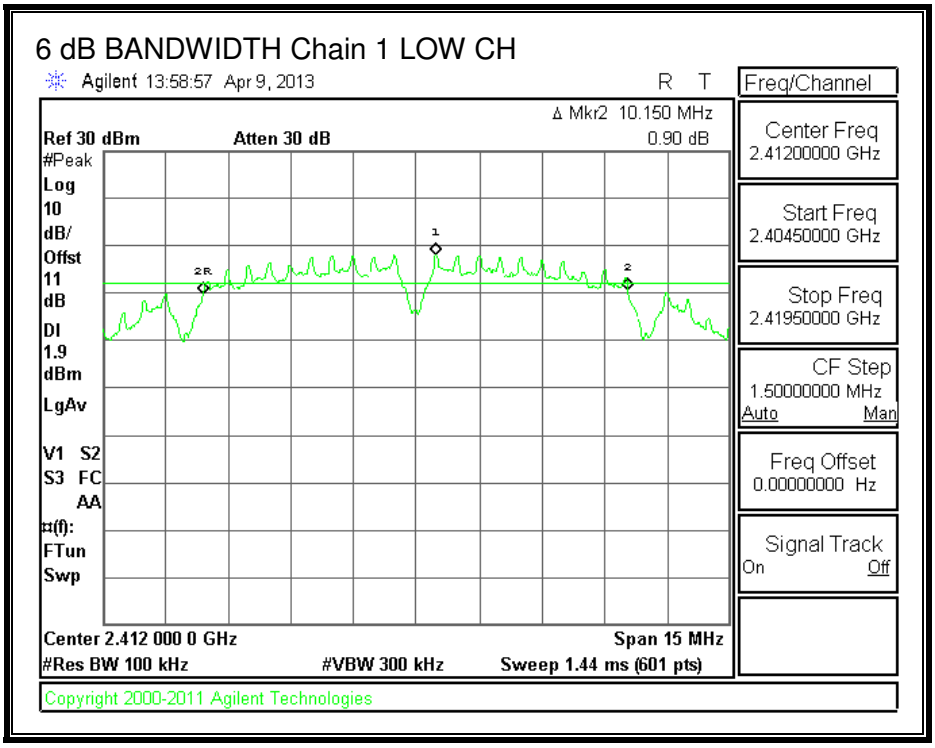
6 dB BANDWIDTH, Chain 0

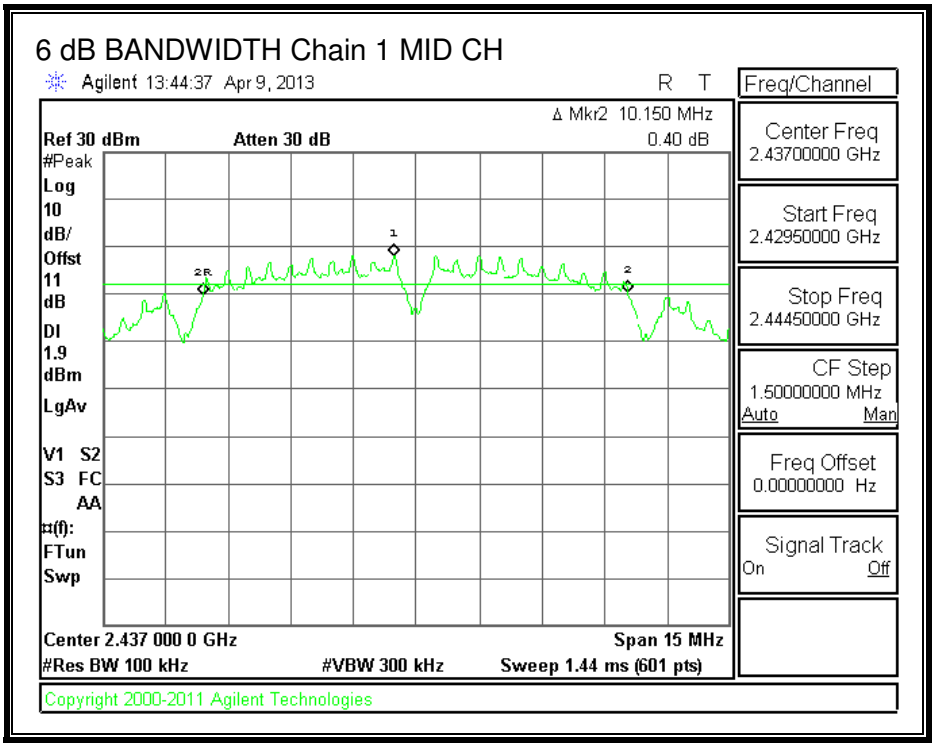


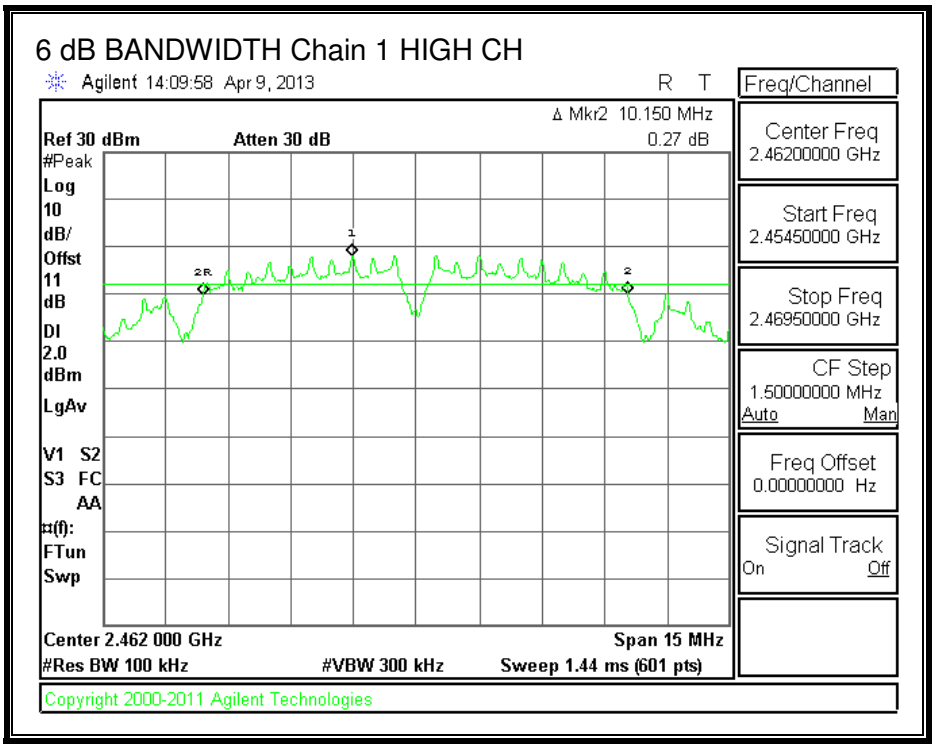




6 dB BANDWIDTH, Chain 1







8.1.2. 99% BANDWIDTH

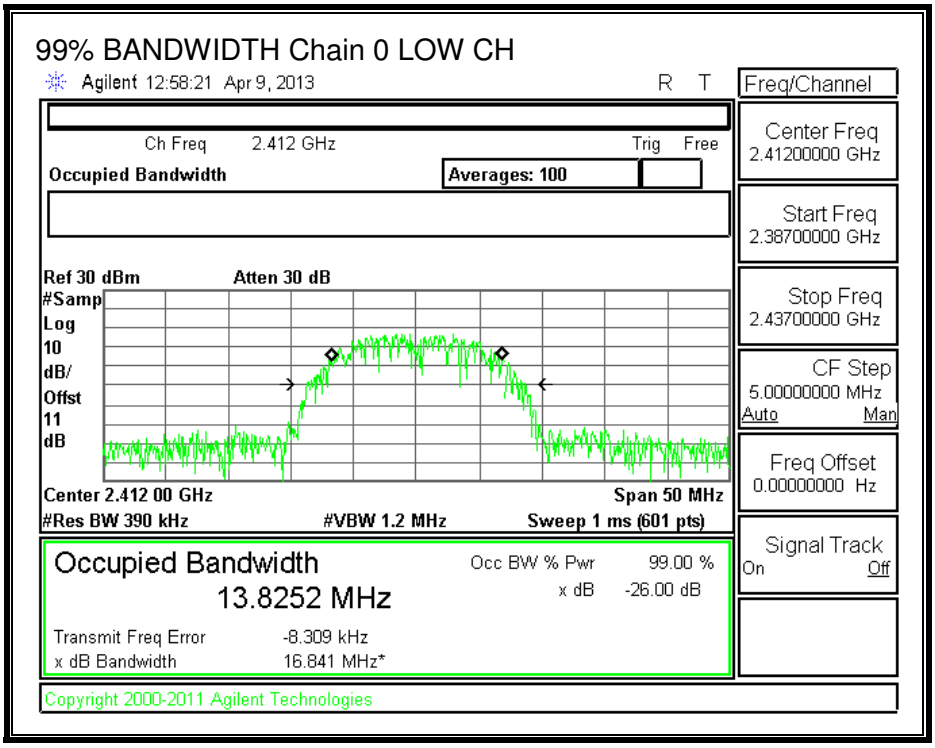
LIMITS

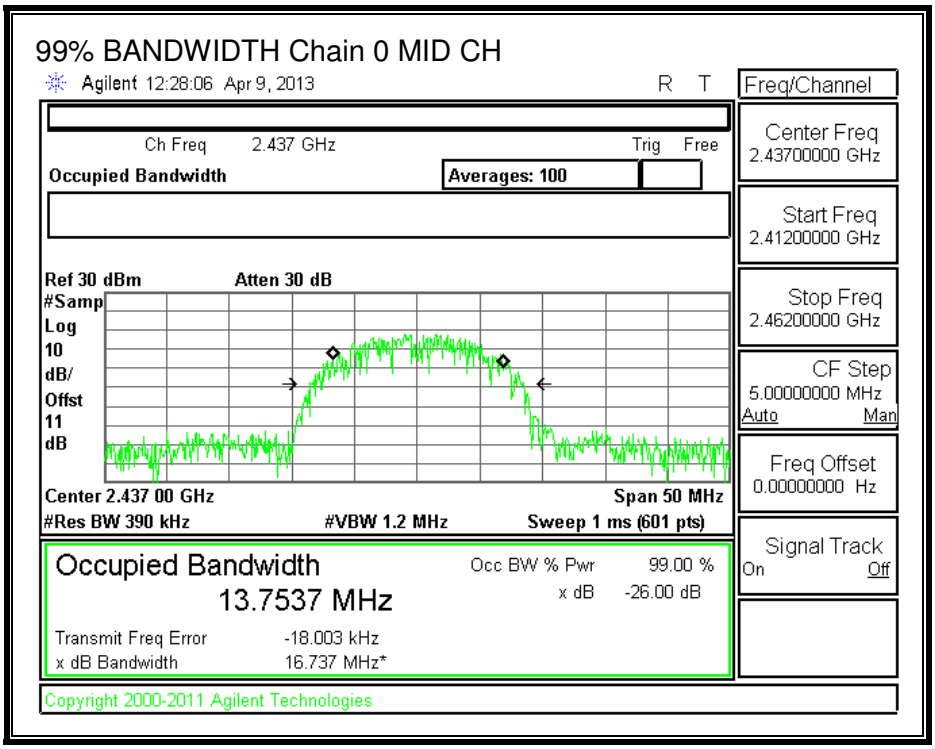
None; for reporting purposes only.

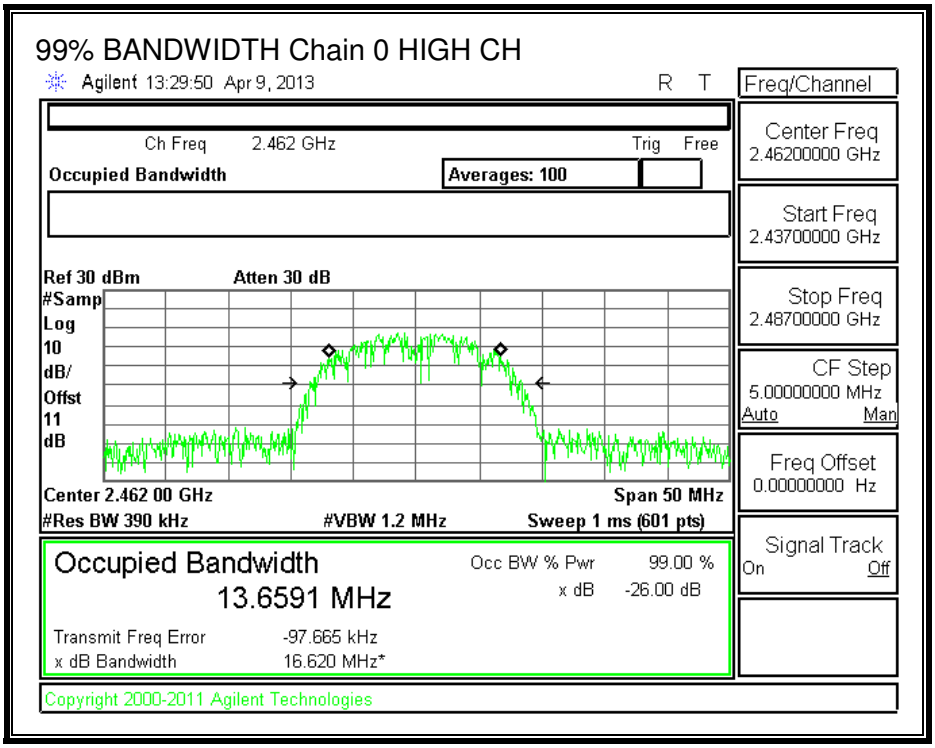
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	2412	13.8252	13.7595
Mid	2437	13.7537	13.5904
High	2462	13.6591	13.4590

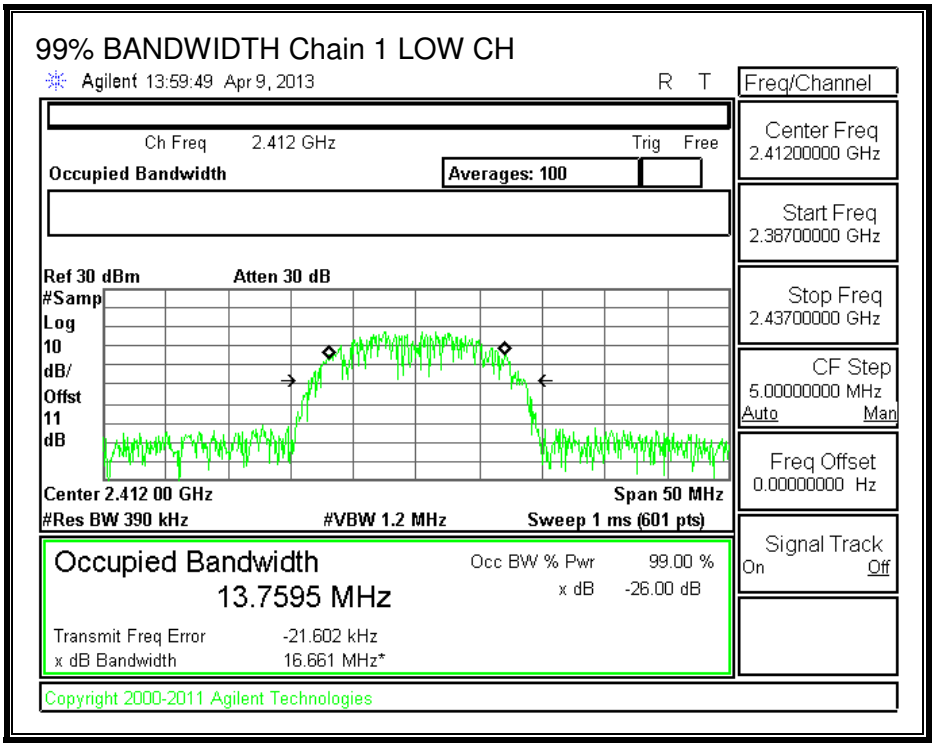
99% BANDWIDTH, Chain 0

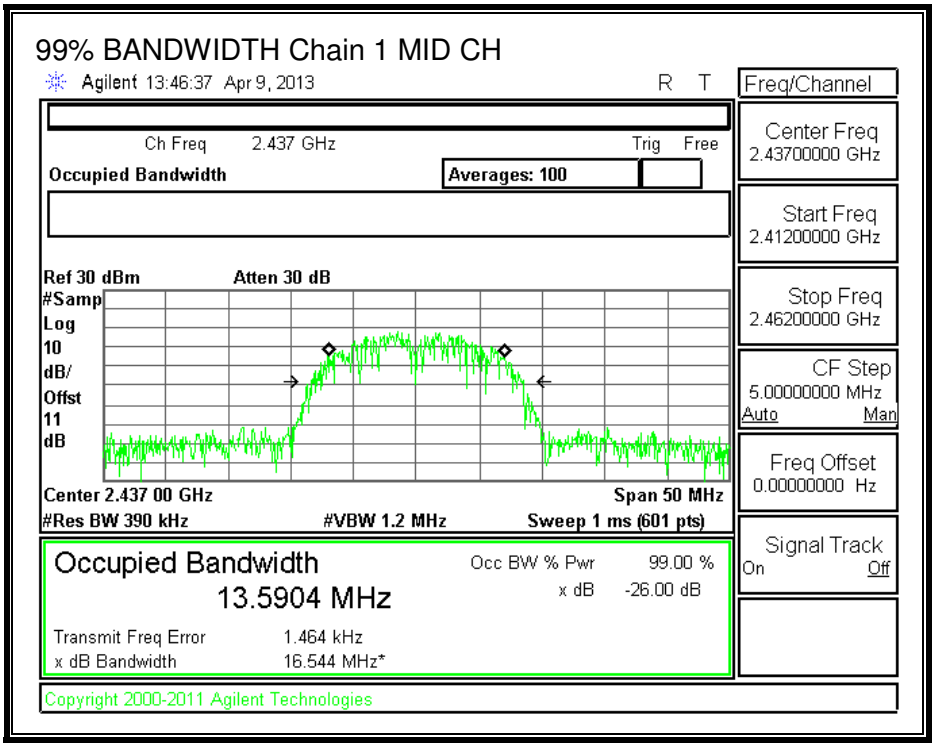


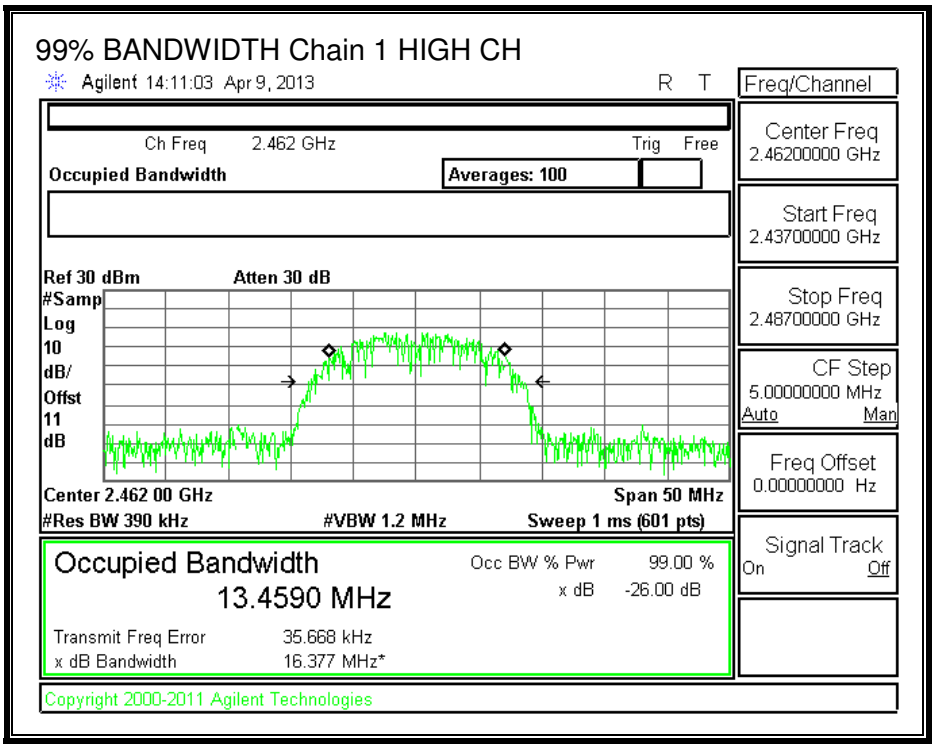




99% BANDWIDTH, Chain 1







8.1.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1.0 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	2412	16.41	16.31	19.37
Mid	2437	16.27	16.00	19.15
High	2462	16.62	16.65	19.65

8.1.4. OUTPUT POWER

LIMITS

FCC §15.247

IC RSS-210 A8.4

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 unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
2.85	3.09	2.97

RESULTS

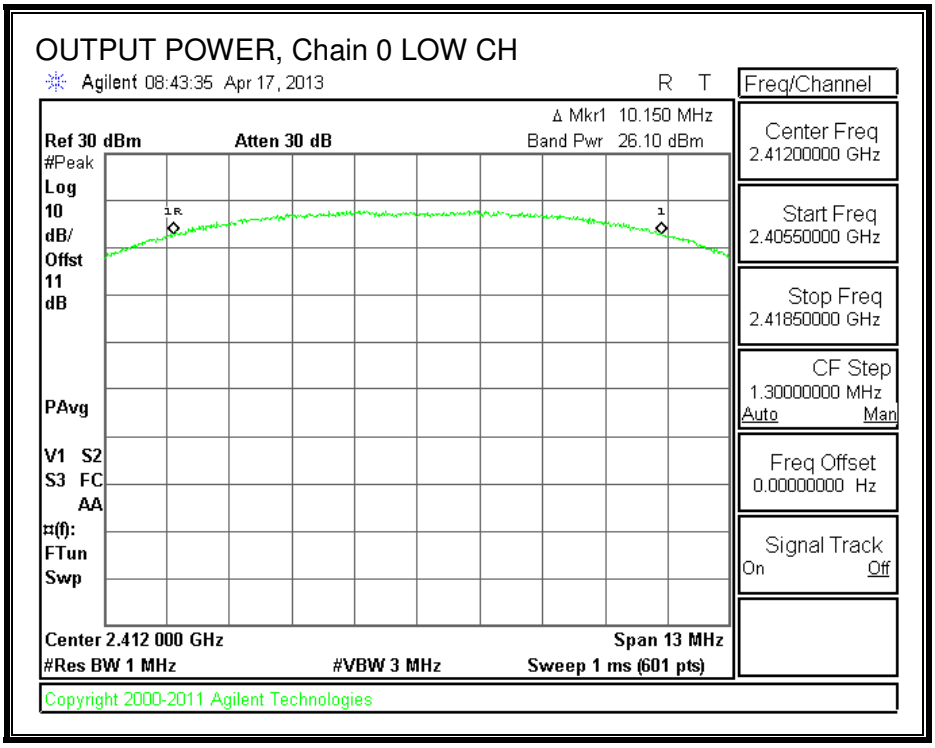
Limits

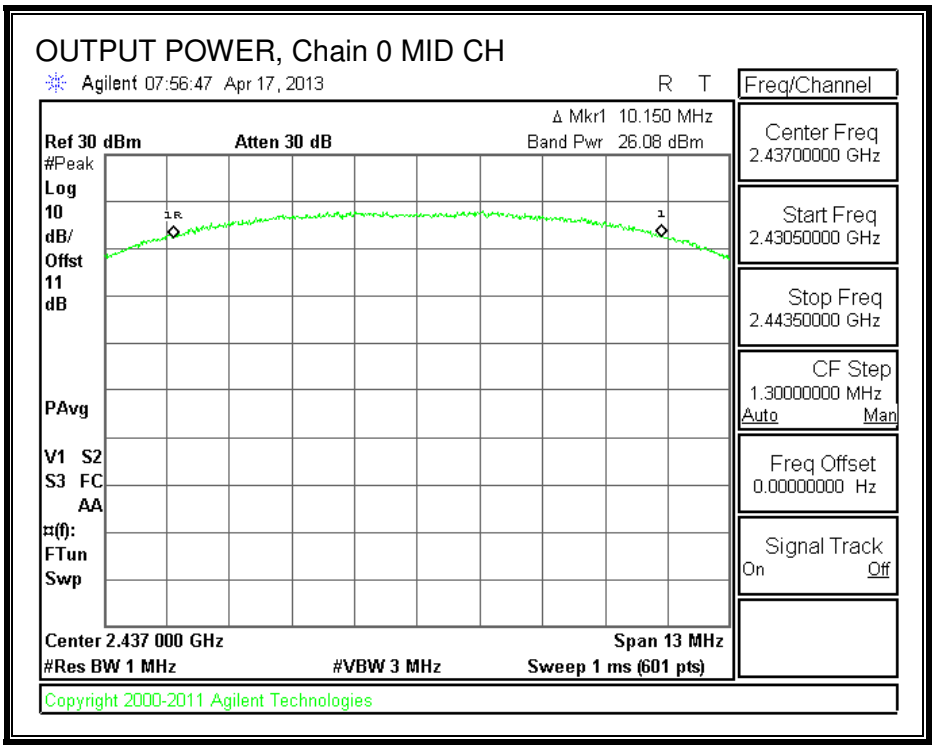
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	2412	2.97	30.00	30	36	30.00
Mid	2437	2.97	30.00	30	36	30.00
High	2462	2.97	30.00	30	36	30.00

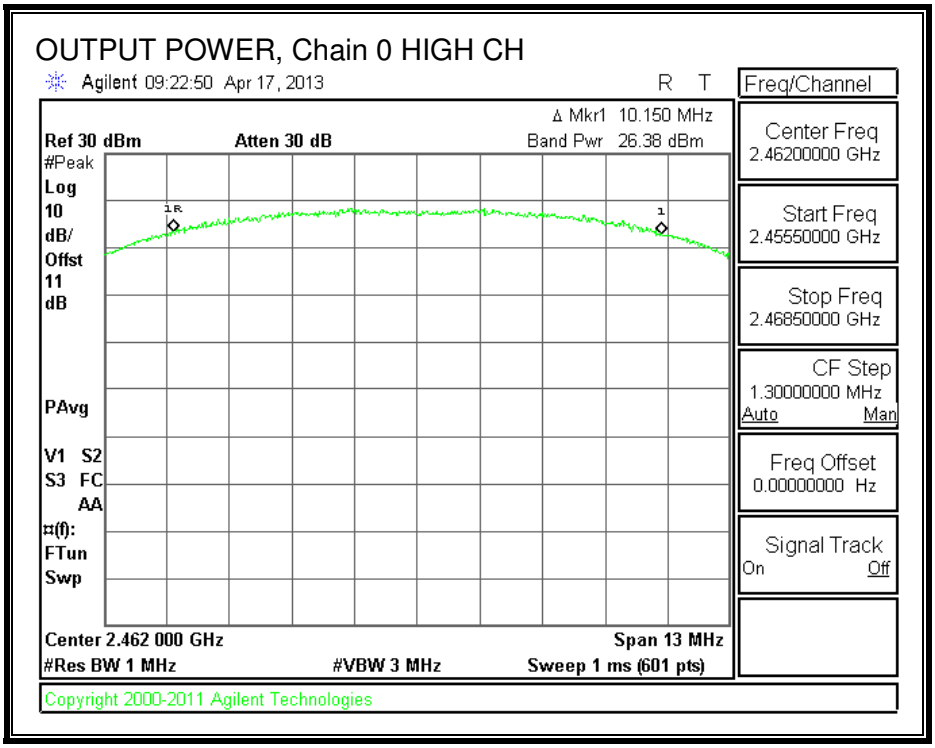
Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margi (dB)
Low	2412	26.10	26.07	29.10	30.00	-0.90
Mid	2437	26.08	25.65	28.88	30.00	-1.12
High	2462	26.38	26.55	29.48	30.00	-0.52

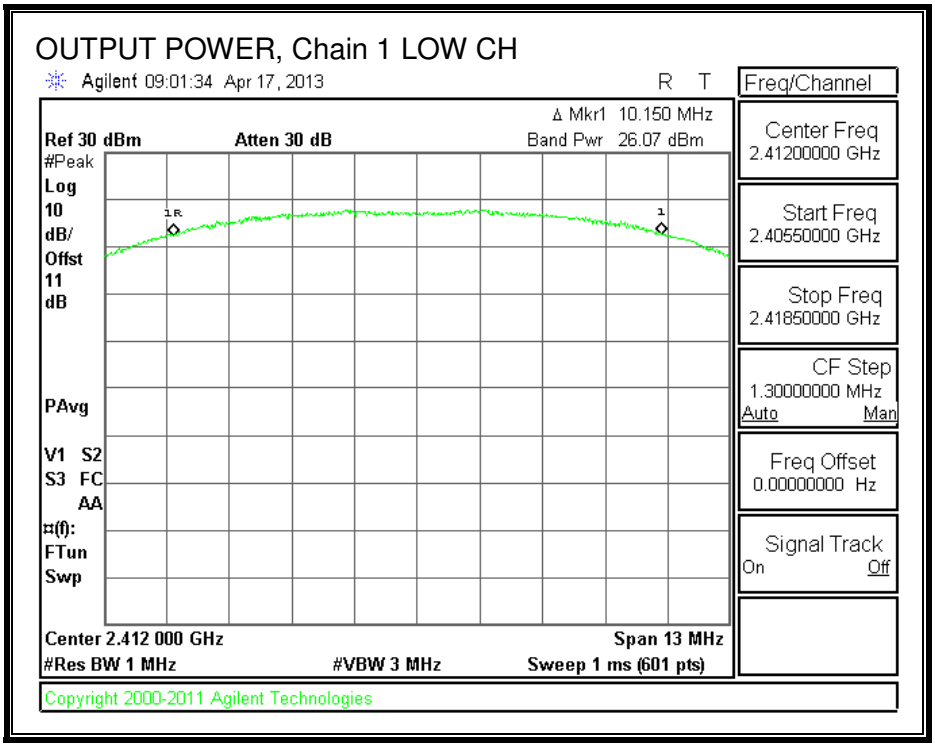
OUTPUT POWER, Chain 0



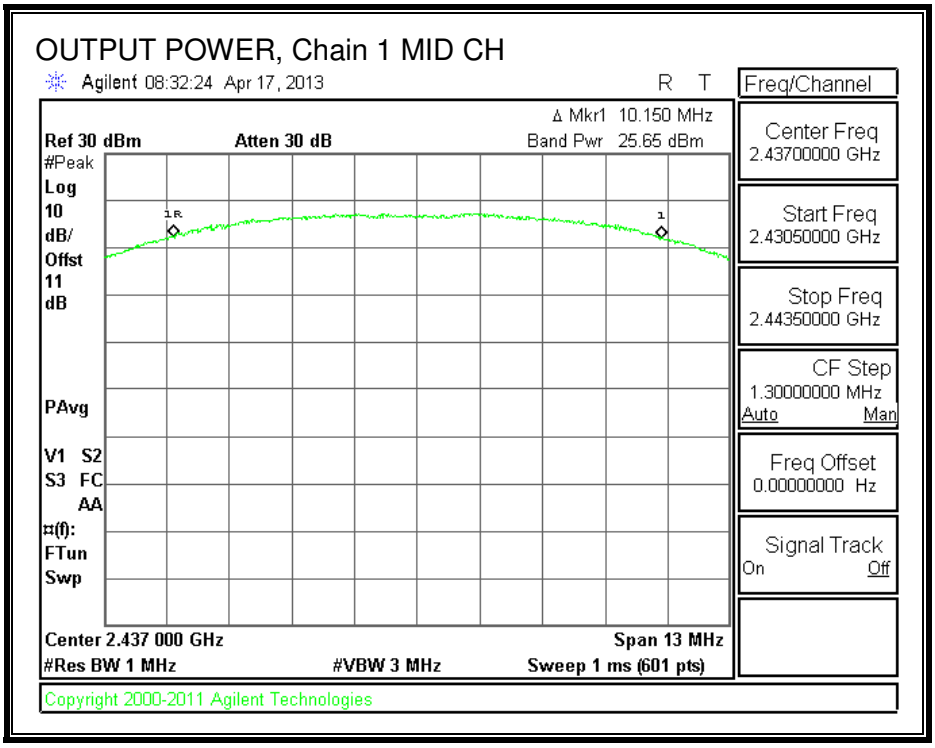




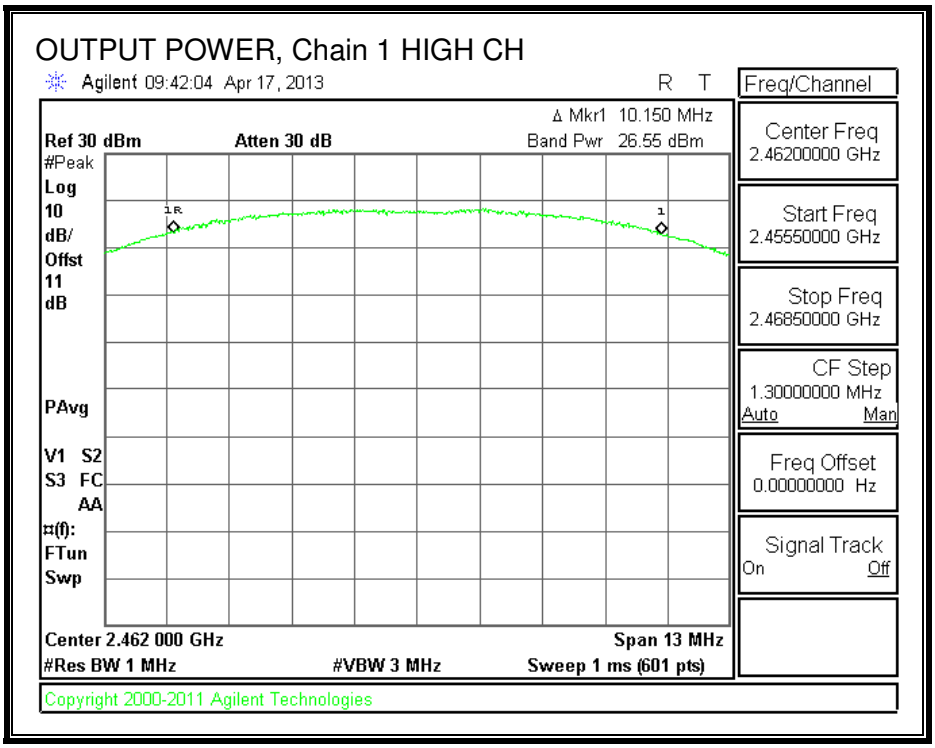
OUTPUT POWER, Chain 1



OUTPUT POWER, Chain 1 MID CH



OUTPUT POWER, Chain 1 HIGH CH



8.1.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247

IC RSS-210 A8.2

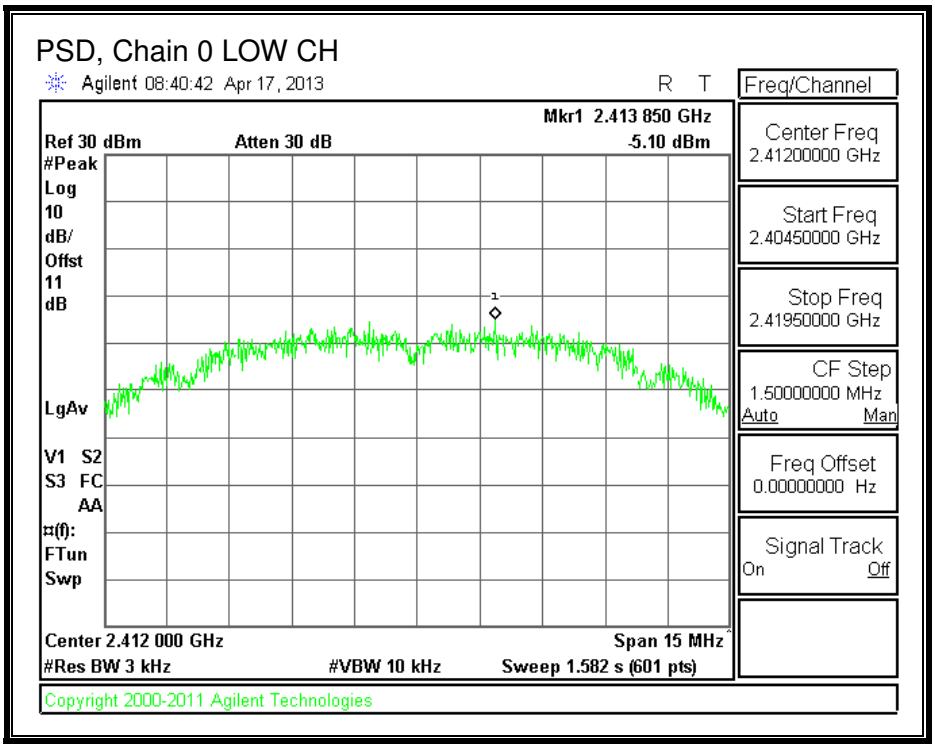
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

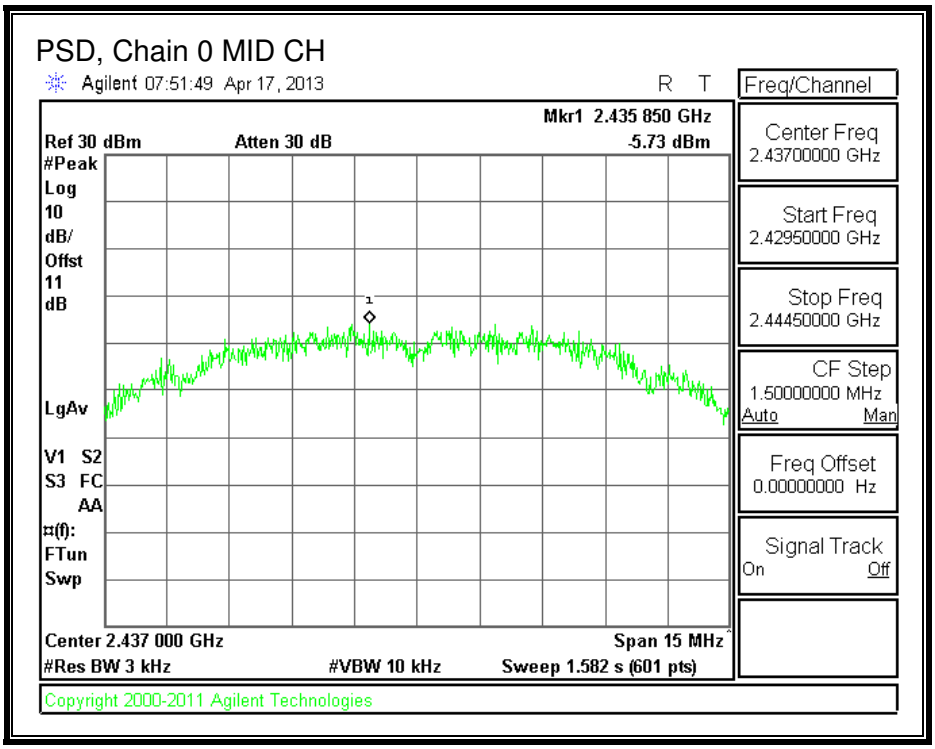
RESULTS

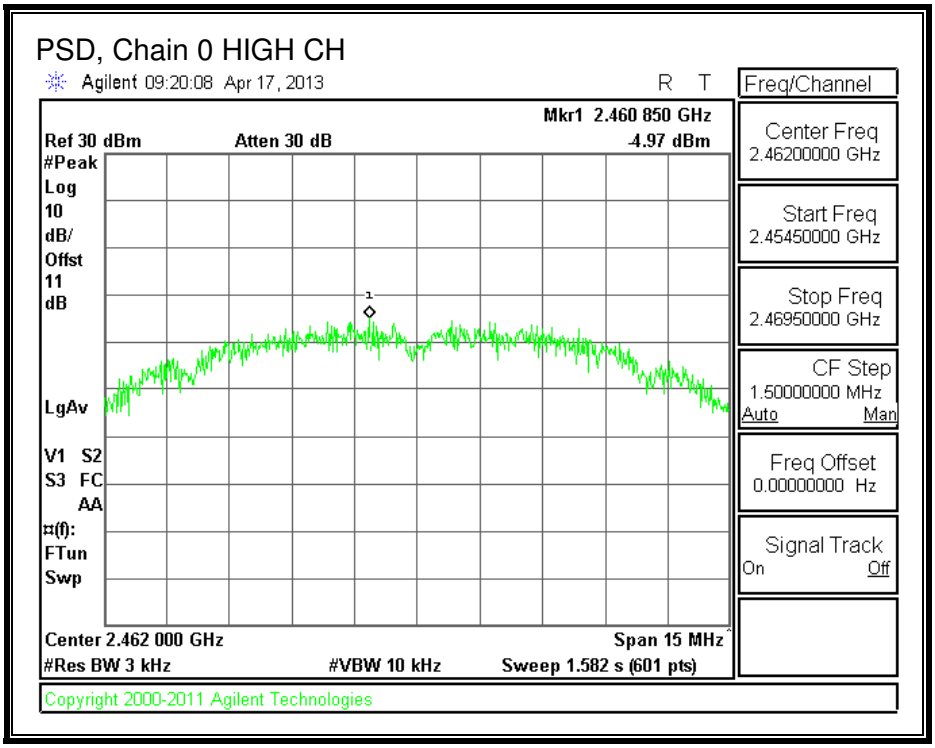
PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Chain 1 Meas (dBm)	Total PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-5.10	-4.81	-1.94	8.0	-9.9
Mid	2437	-5.73	-5.31	-2.50	8.0	-10.5
High	2462	-4.97	-5.66	-2.29	8.0	-10.3

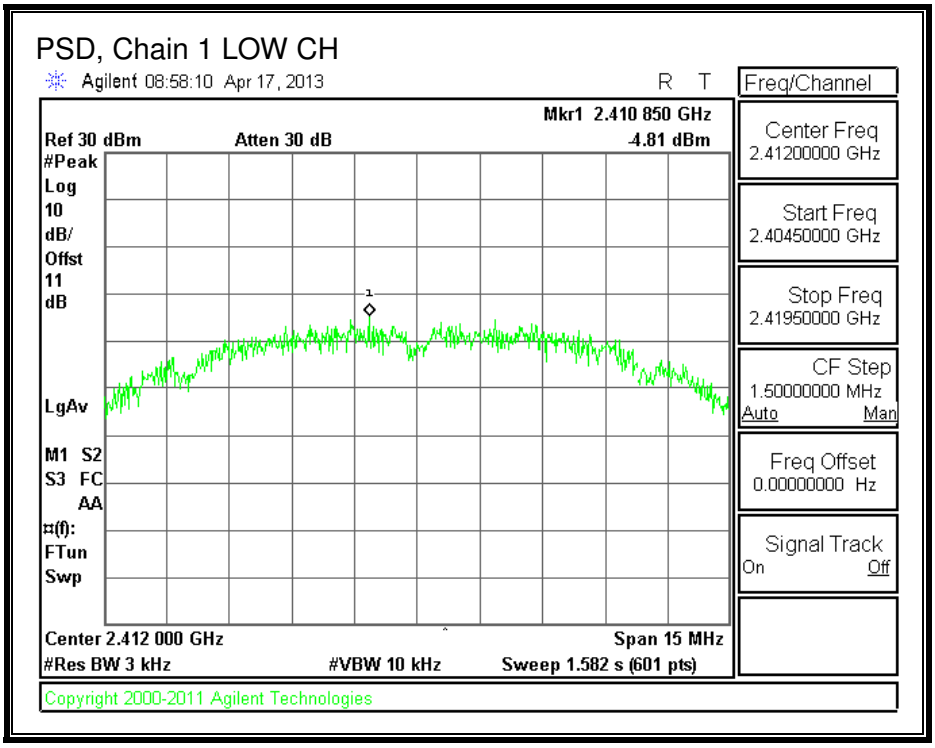
PSD, Chain 0

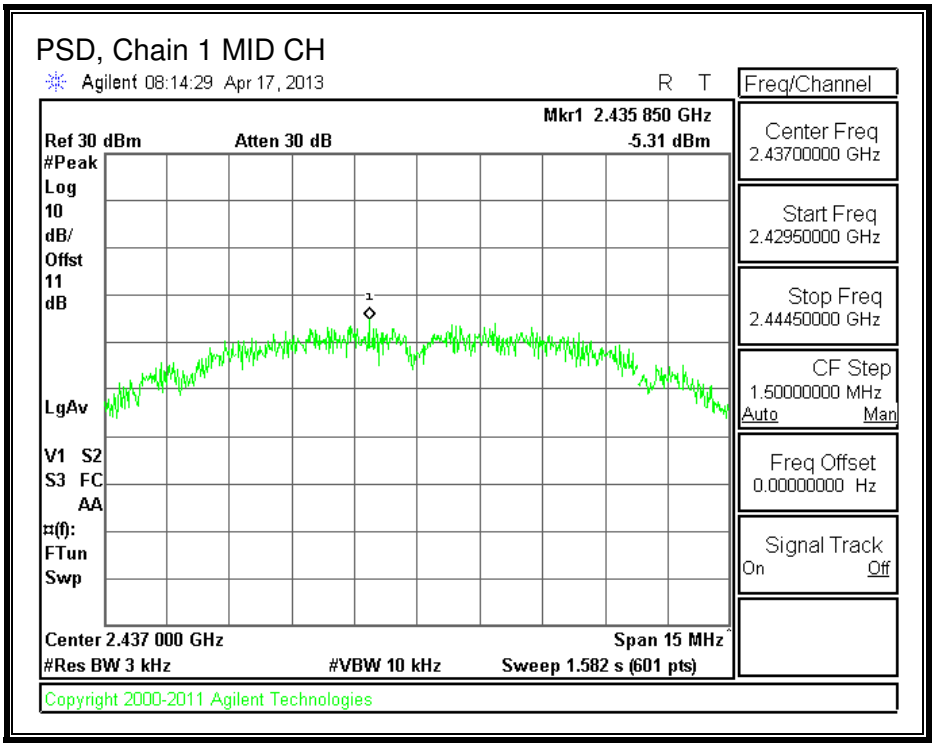


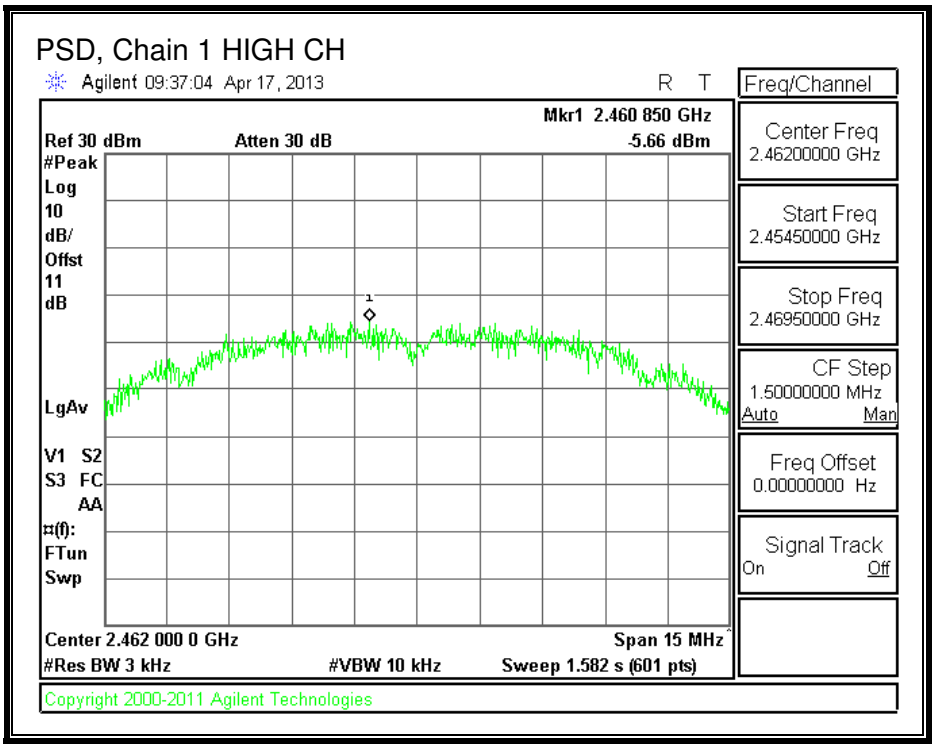




PSD, Chain 1







8.1.6. OUT-OF-BAND EMISSIONS

LIMITS

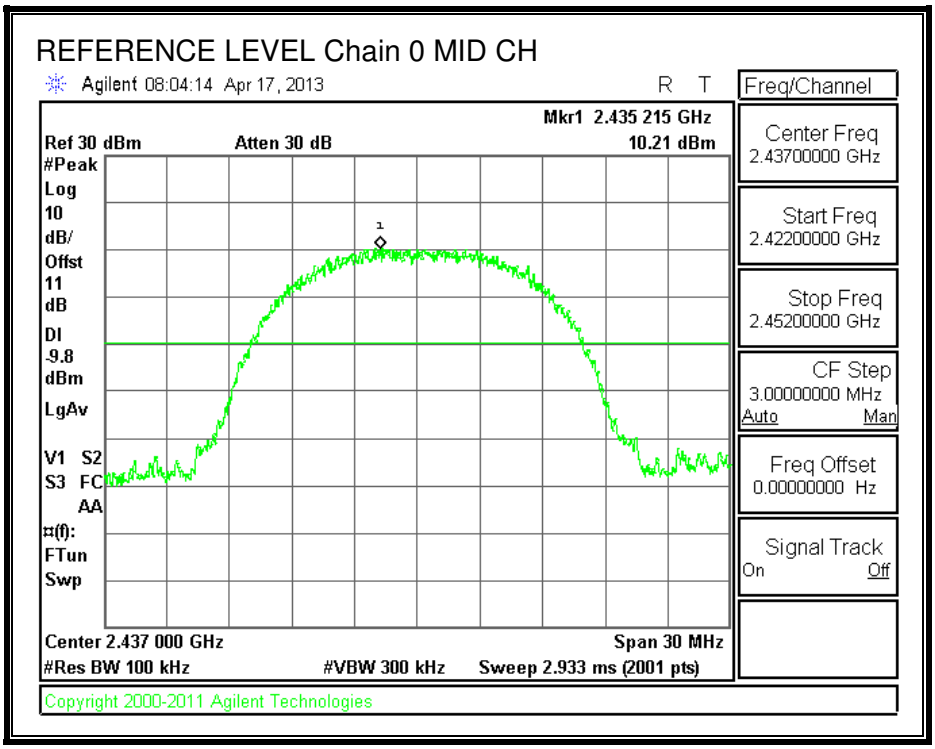
FCC §15.247 (d)

IC RSS-210 A8.5

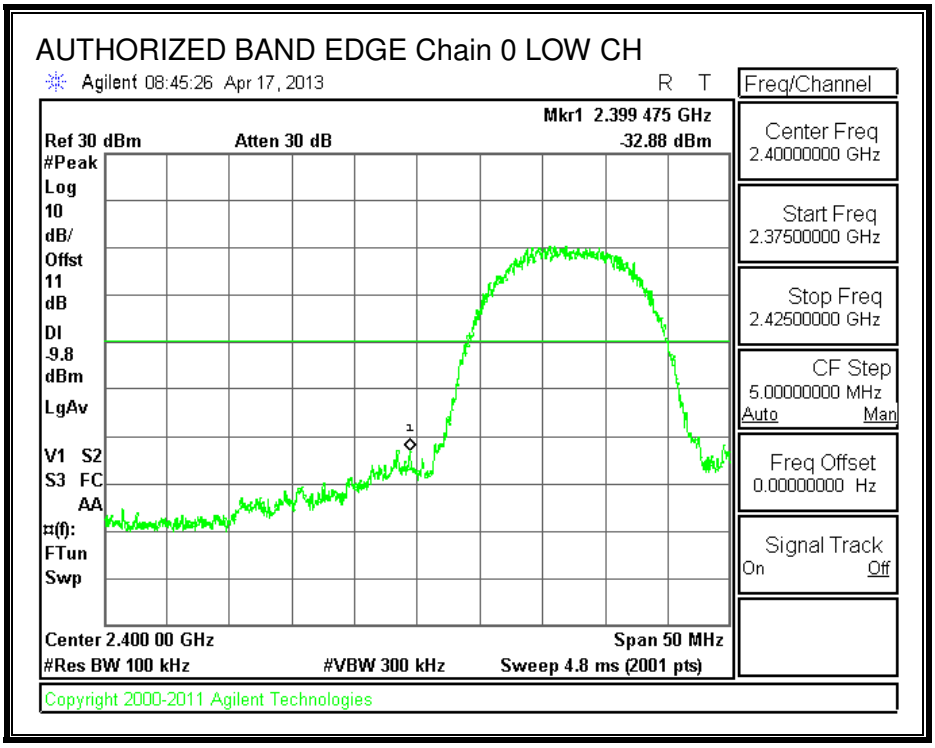
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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.

RESULTS

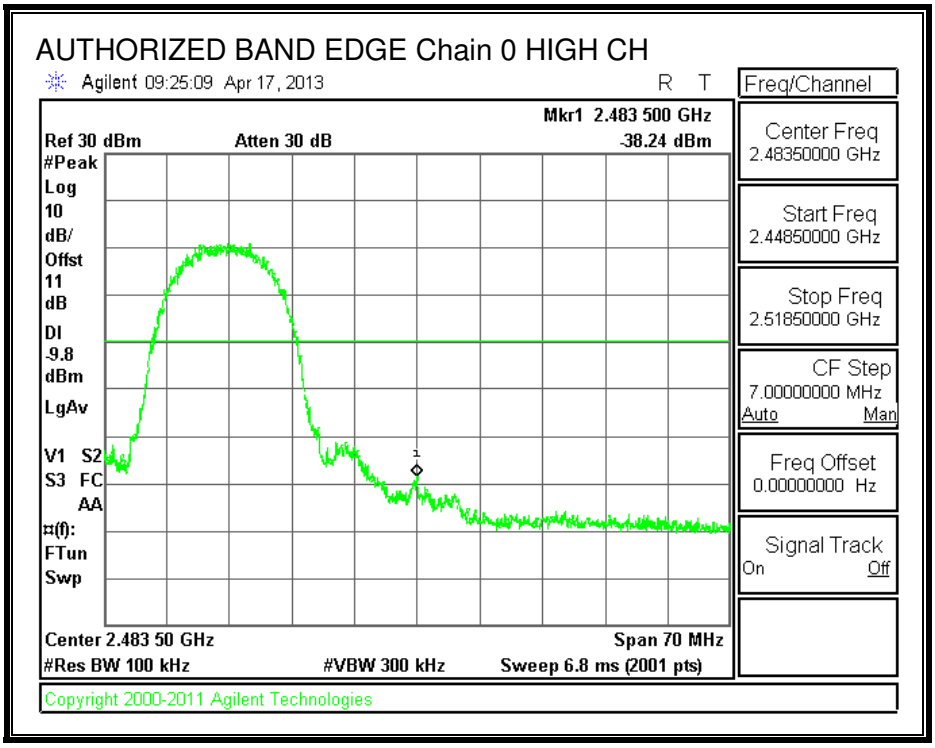
IN-BAND REFERENCE LEVEL, Chain 0



LOW CHANNEL BANDEDGE, Chain 0

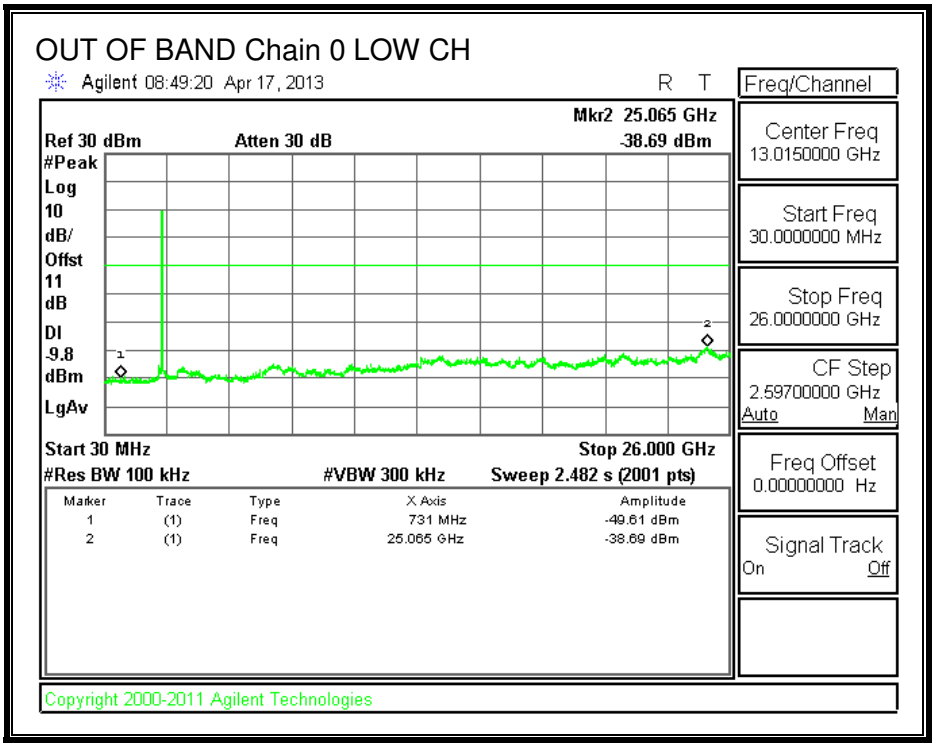


HIGH CHANNEL BANDEDGE, Chain 0

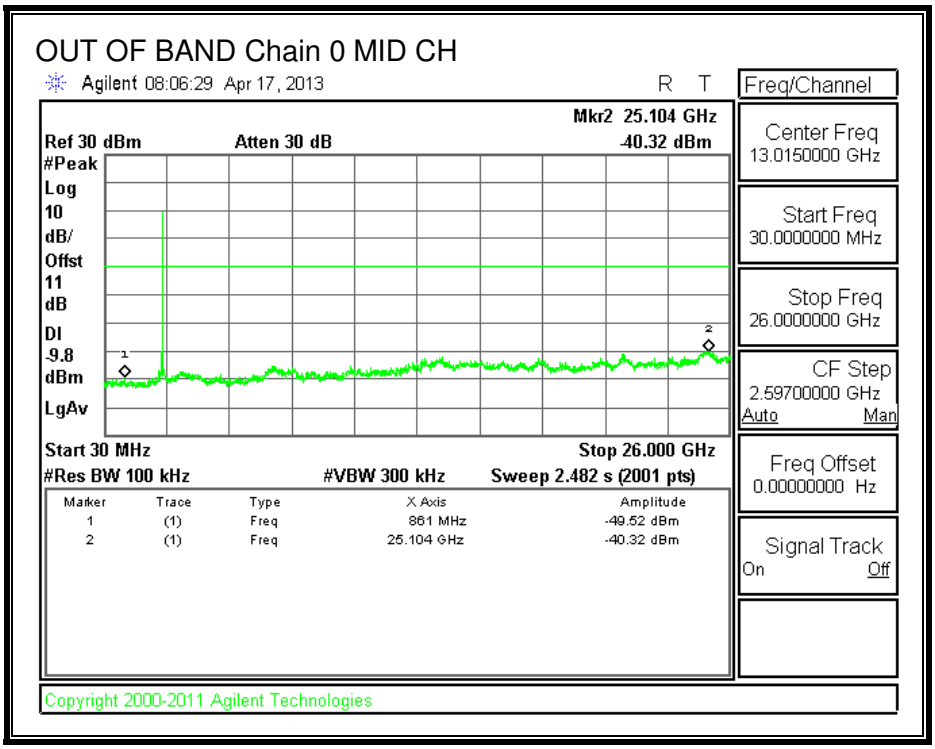


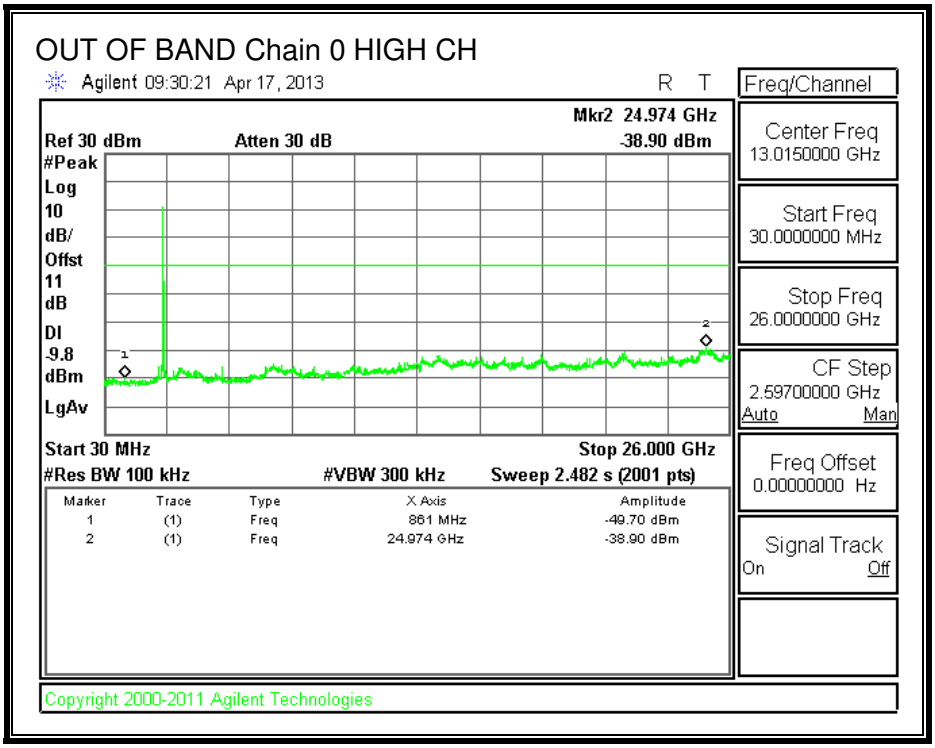
OUT-OF-BAND EMISSIONS, Chain 0

OUT OF BAND Chain 0 LOW CH

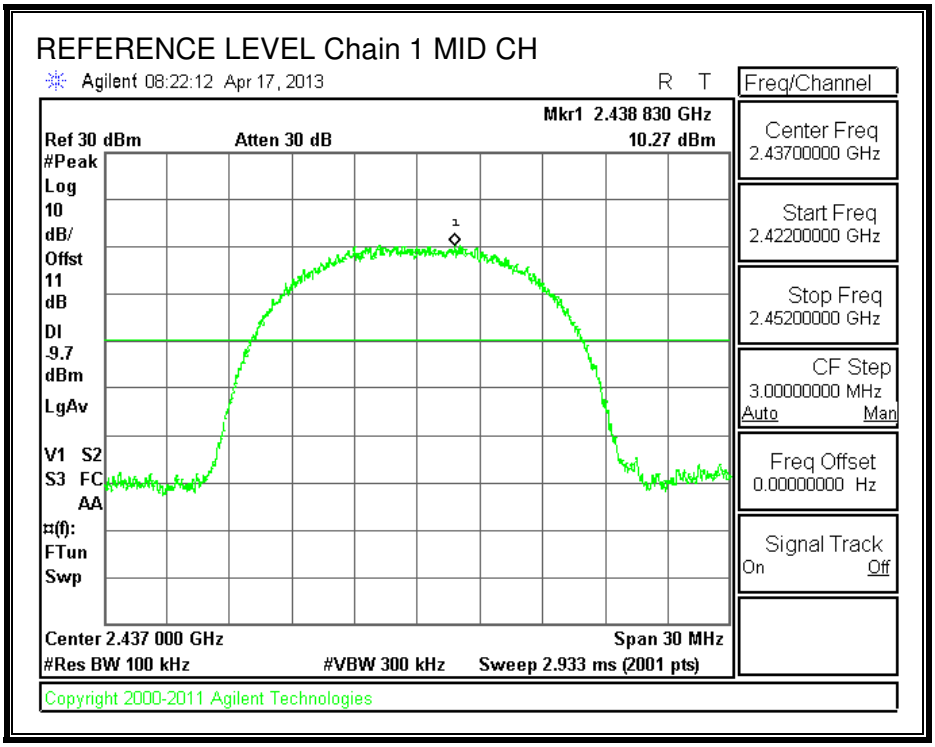


OUT OF BAND Chain 0 MID CH

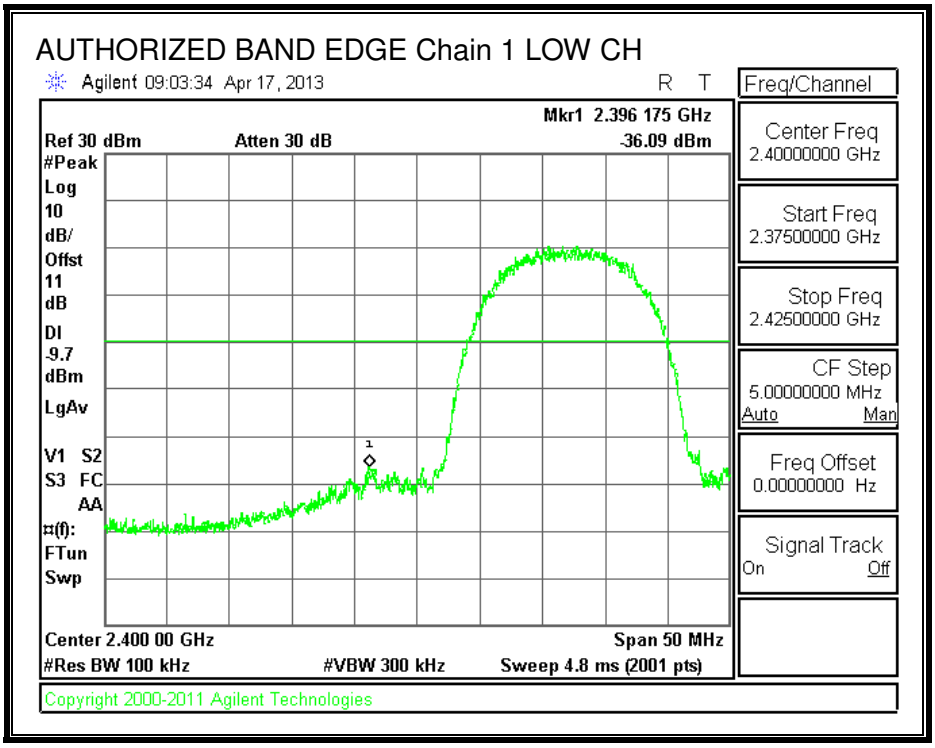




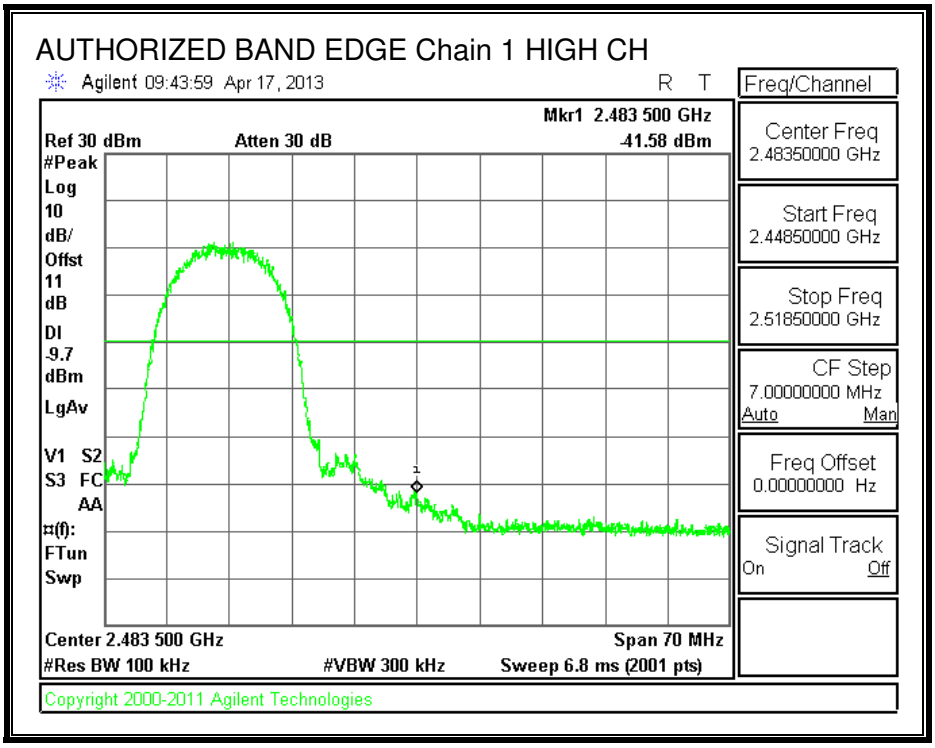
IN-BAND REFERENCE LEVEL, Chain 1

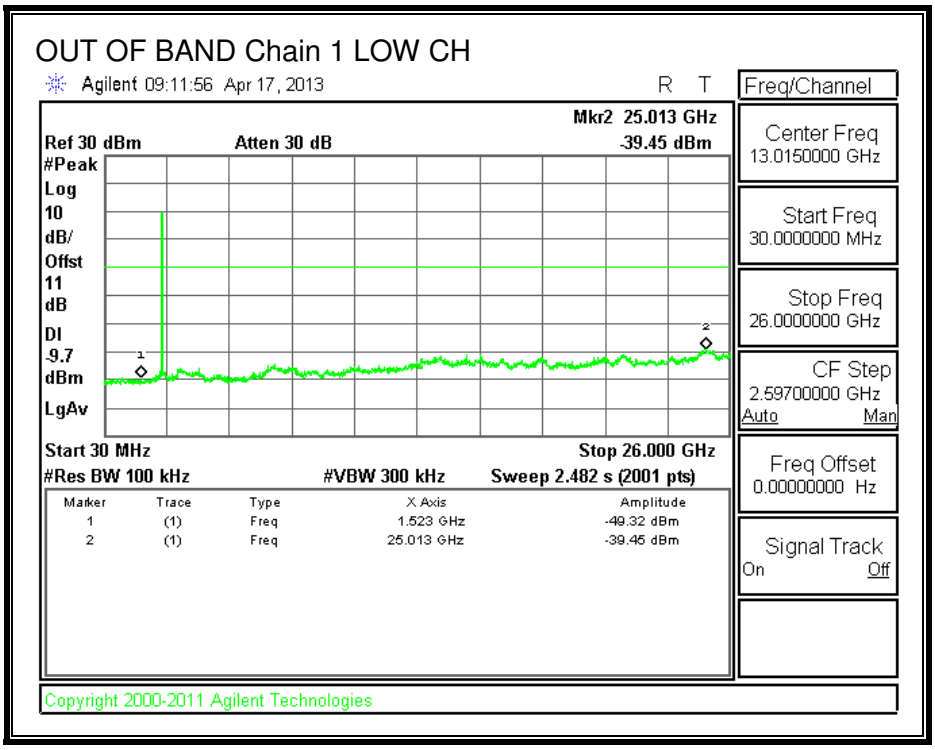


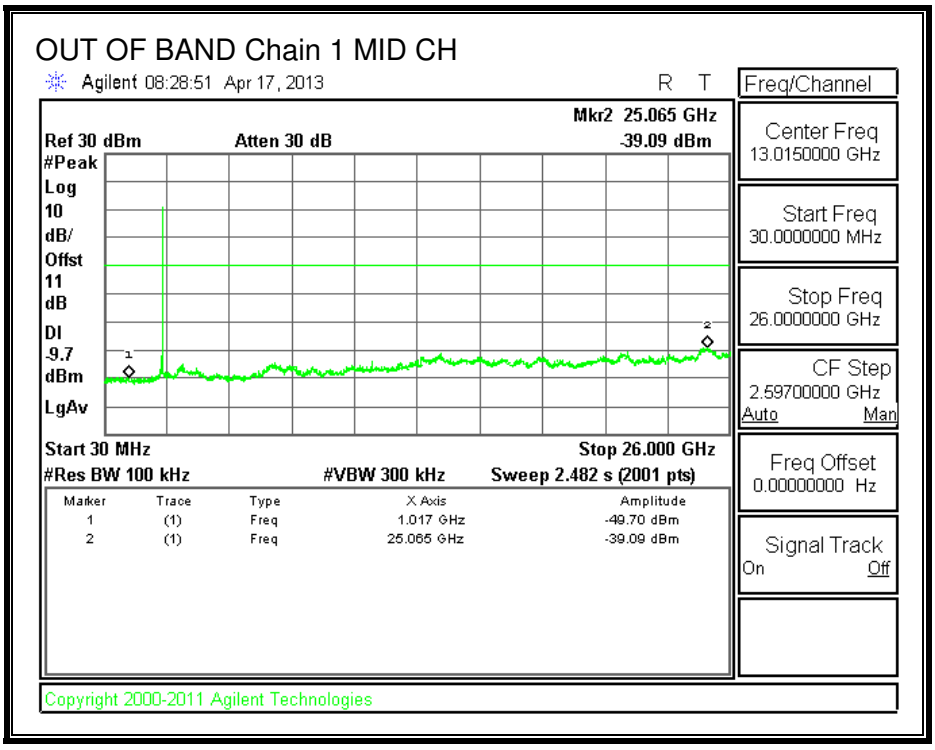
LOW CHANNEL BANDEDGE, Chain 1

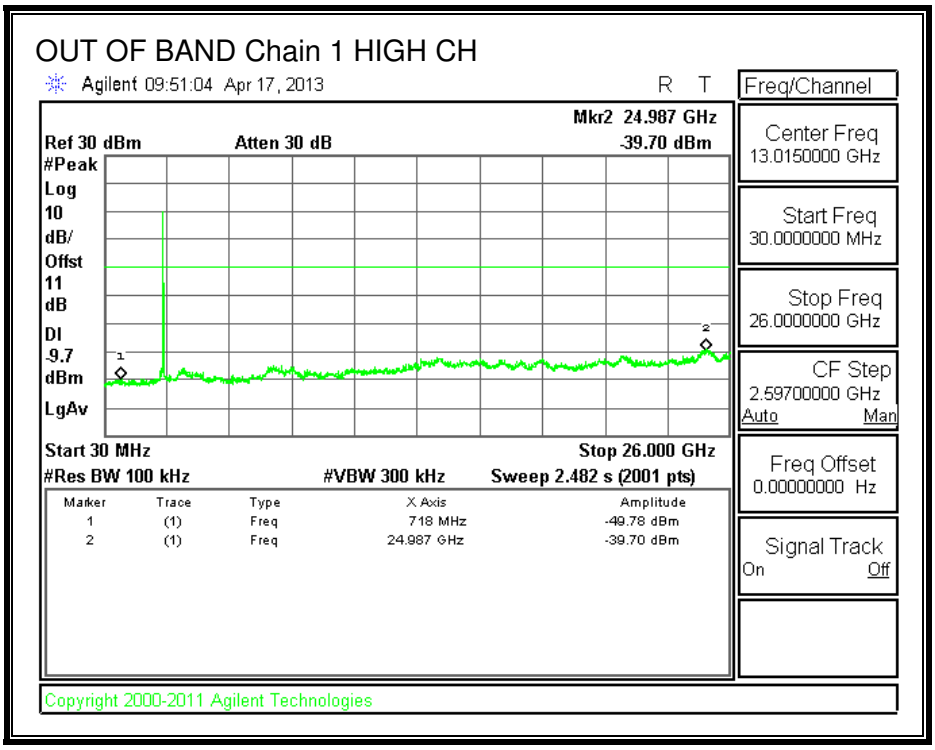


HIGH CHANNEL BANDEDGE, Chain 1









8.2. 802.11g MODE IN THE 2.4 GHz BAND

8.2.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

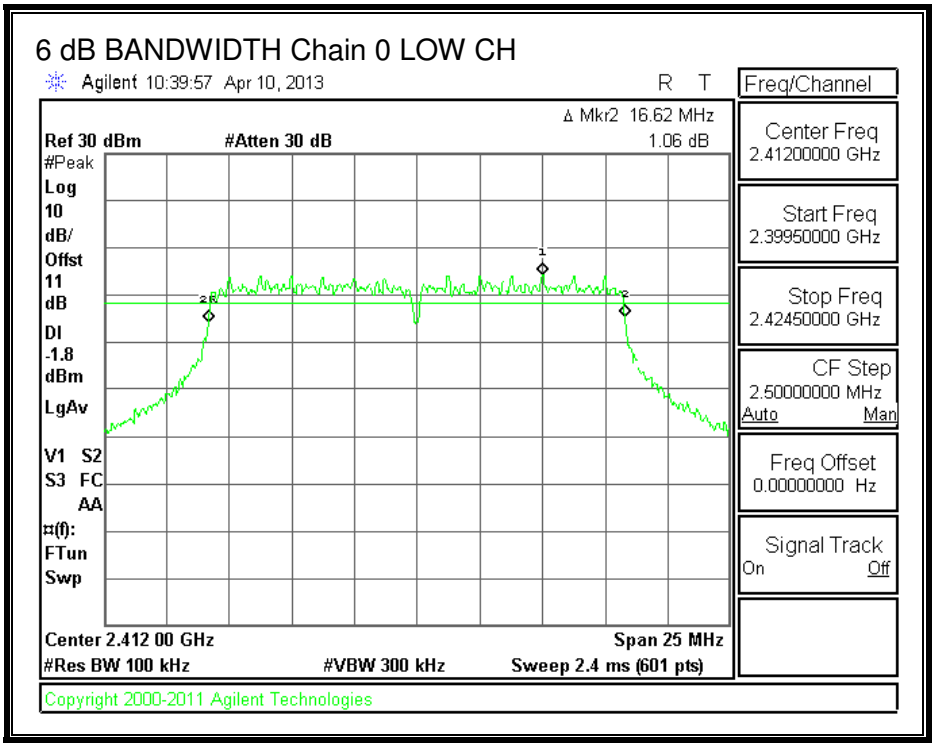
IC RSS-210 A8.2 (a)

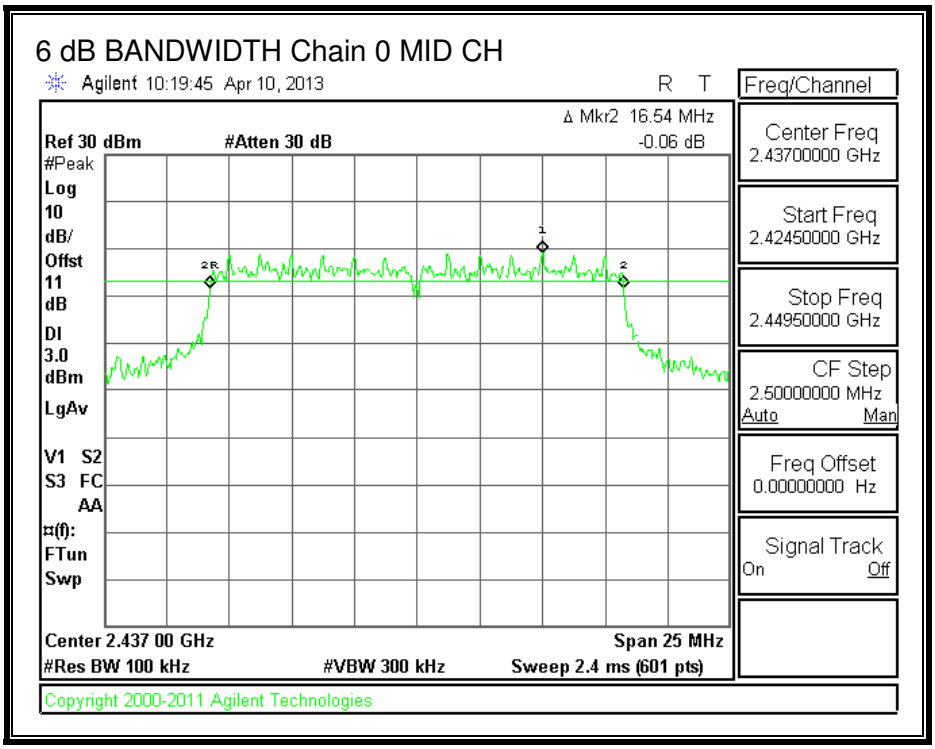
The minimum 6 dB bandwidth shall be at least 500 kHz.

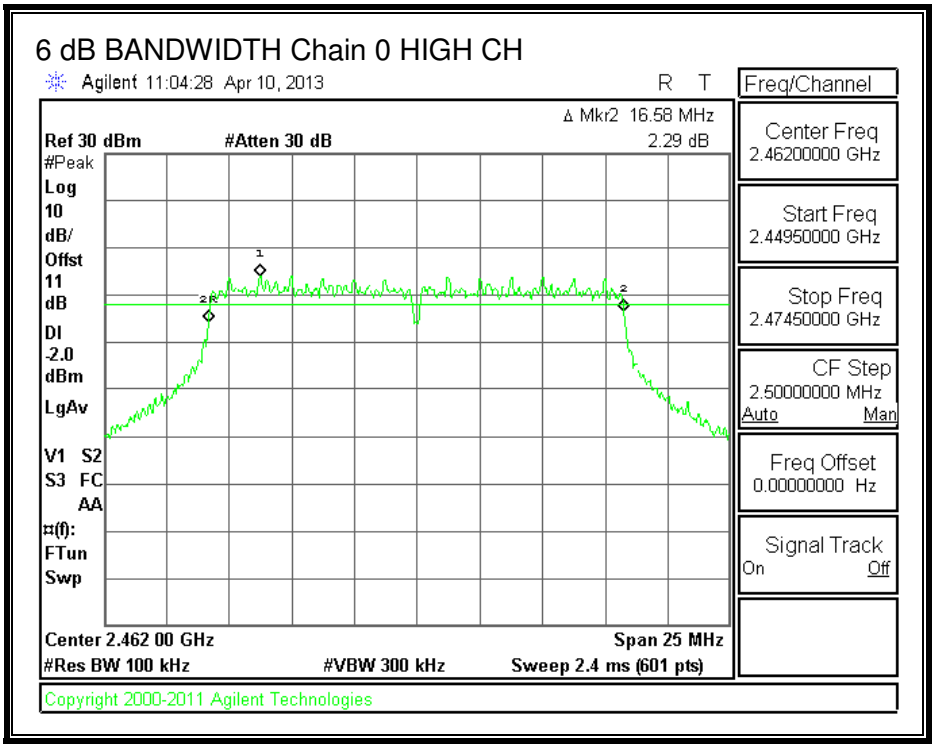
RESULTS

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low	2412	16.62	16.62	0.5
Mid	2437	16.54	16.54	0.5
High	2462	16.58	16.62	0.5

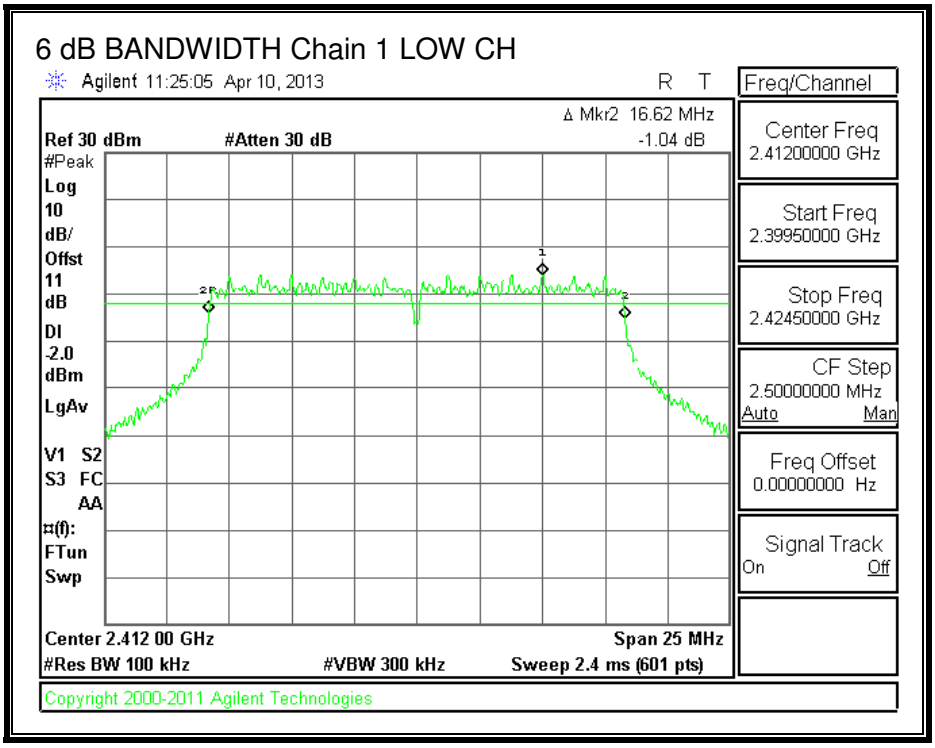
6 dB BANDWIDTH, Chain 0

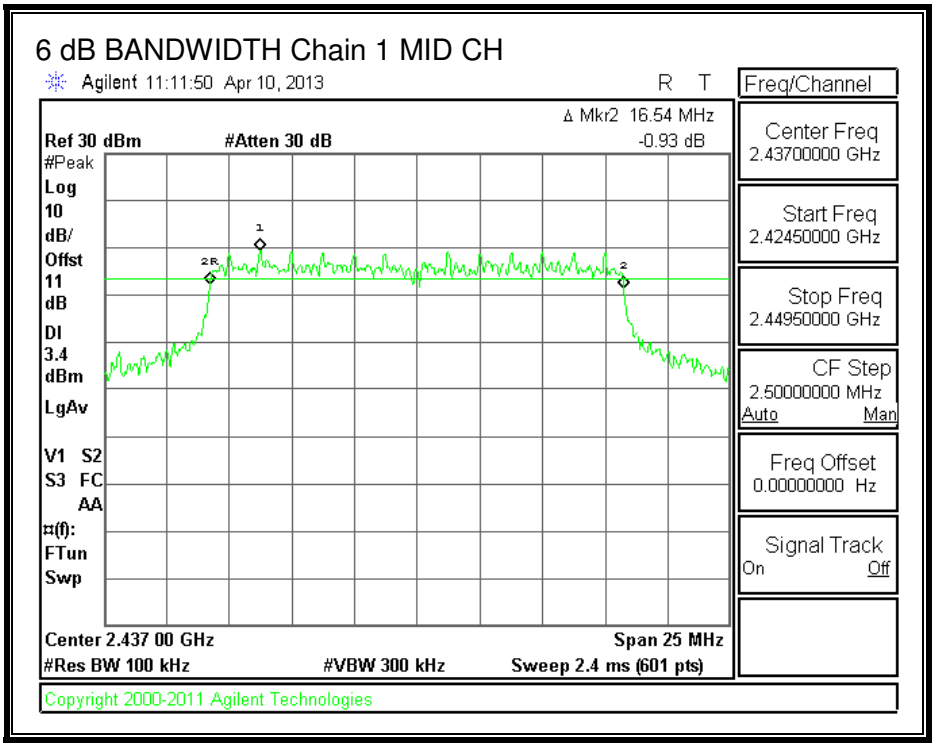


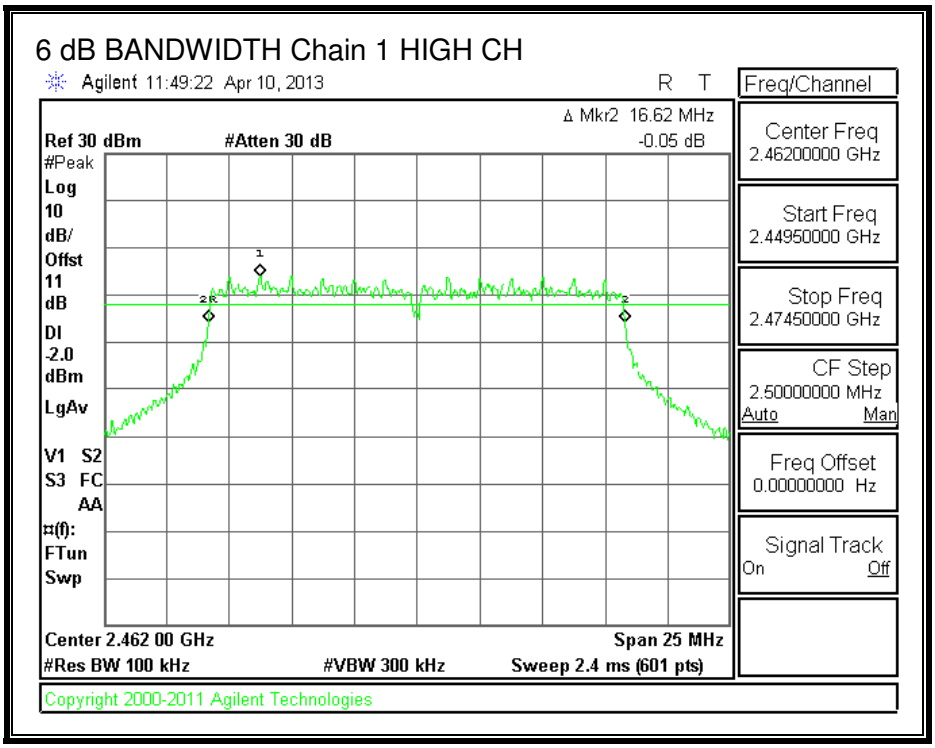




6 dB BANDWIDTH, Chain 1







8.2.2. 99% BANDWIDTH

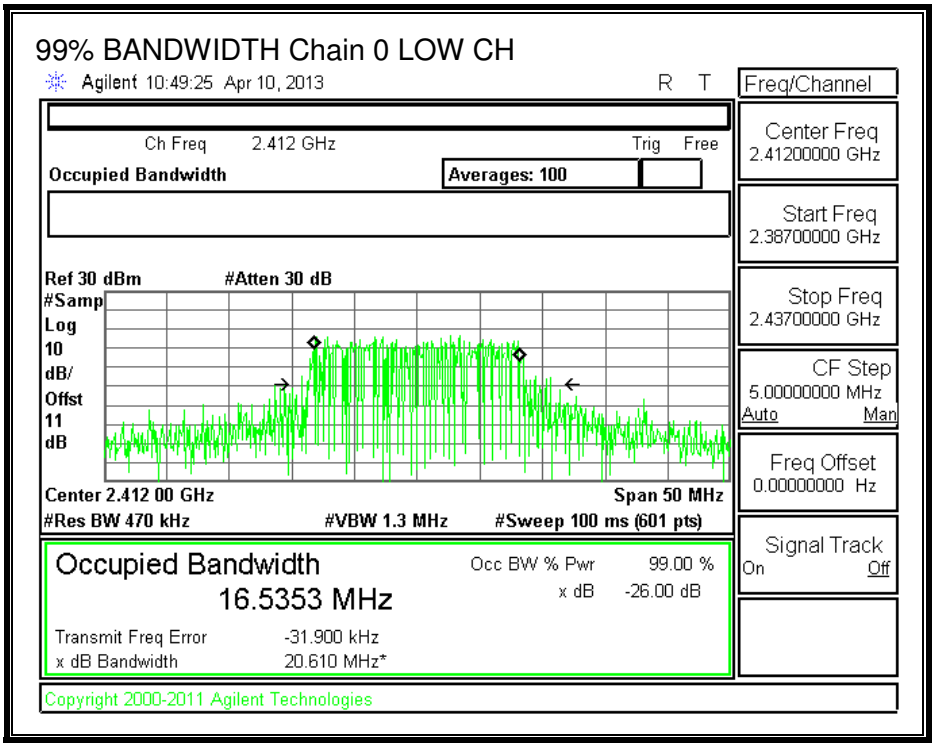
LIMITS

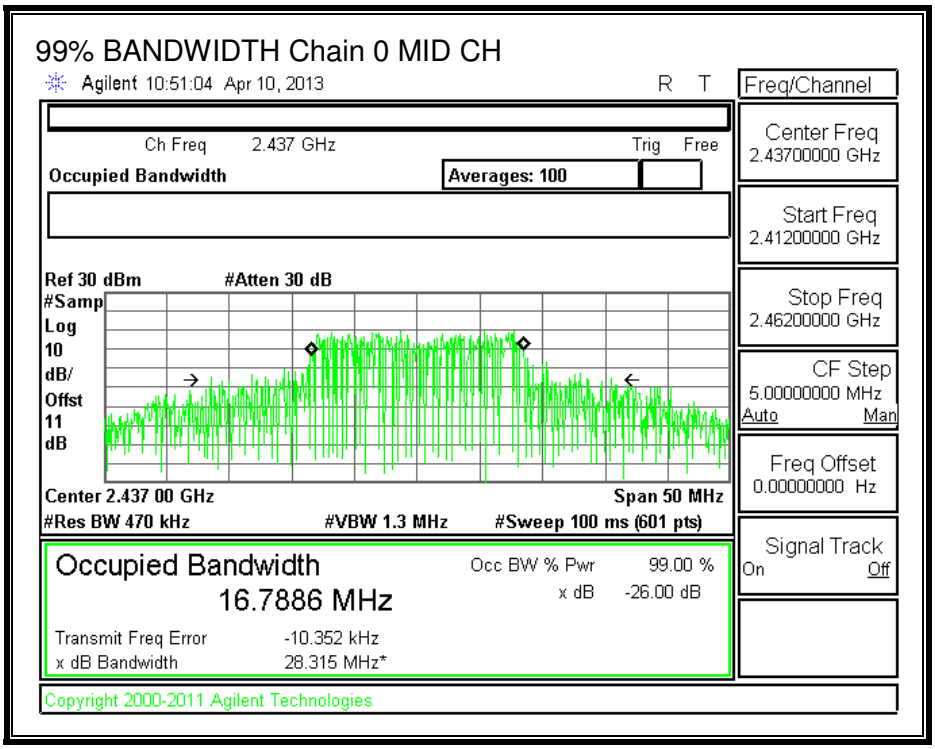
None; for reporting purposes only.

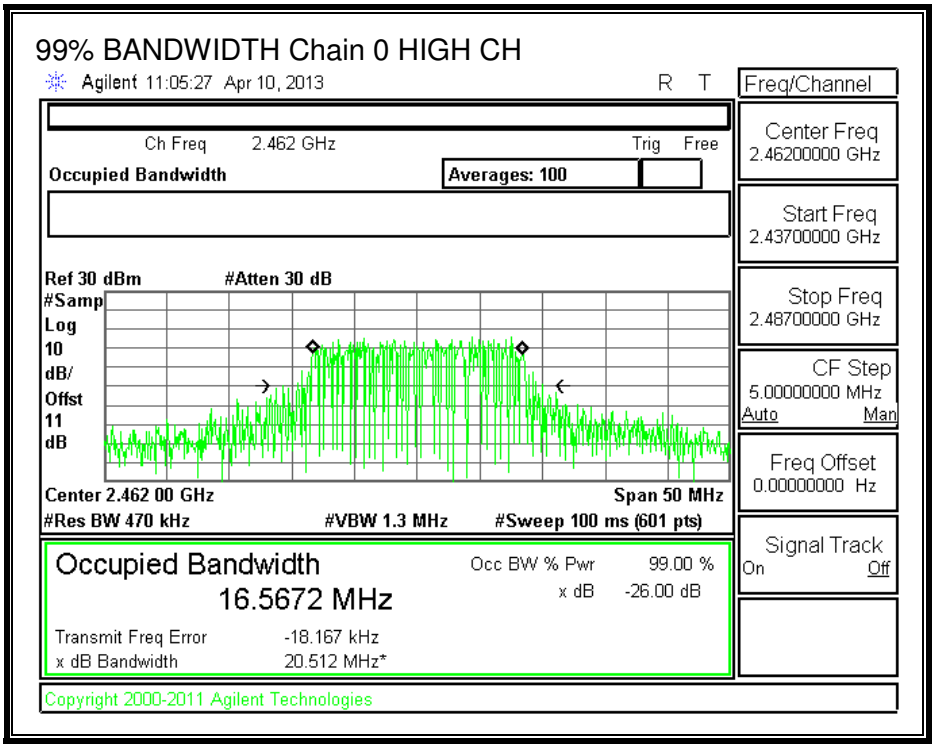
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	2412	16.5353	16.6057
Mid	2437	16.7886	16.8259
High	2462	16.5672	16.5907

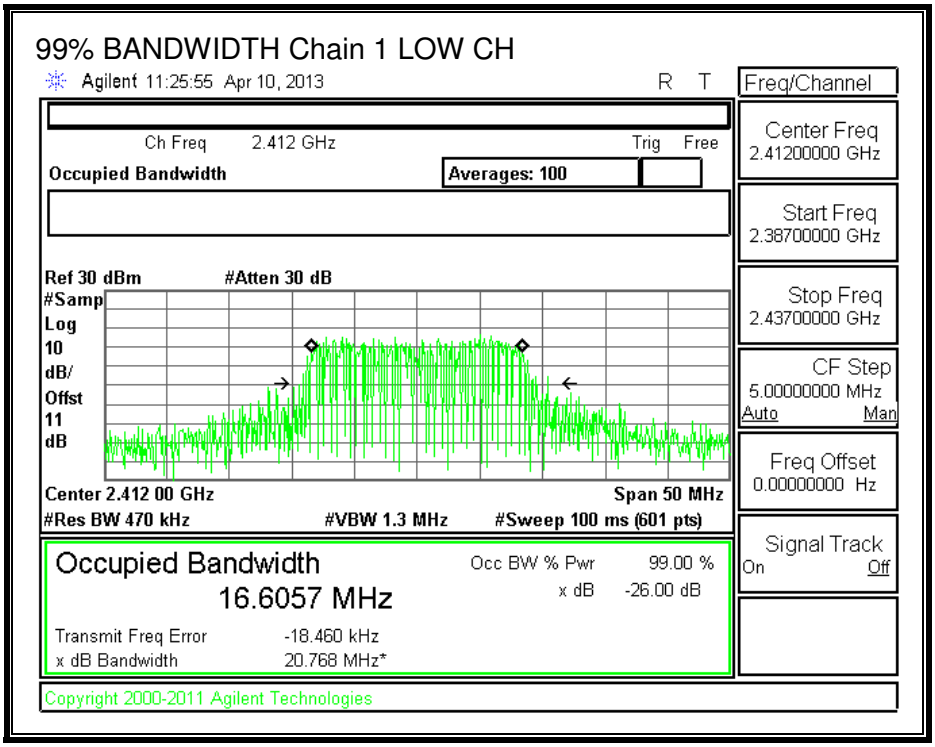
99% BANDWIDTH, Chain 0

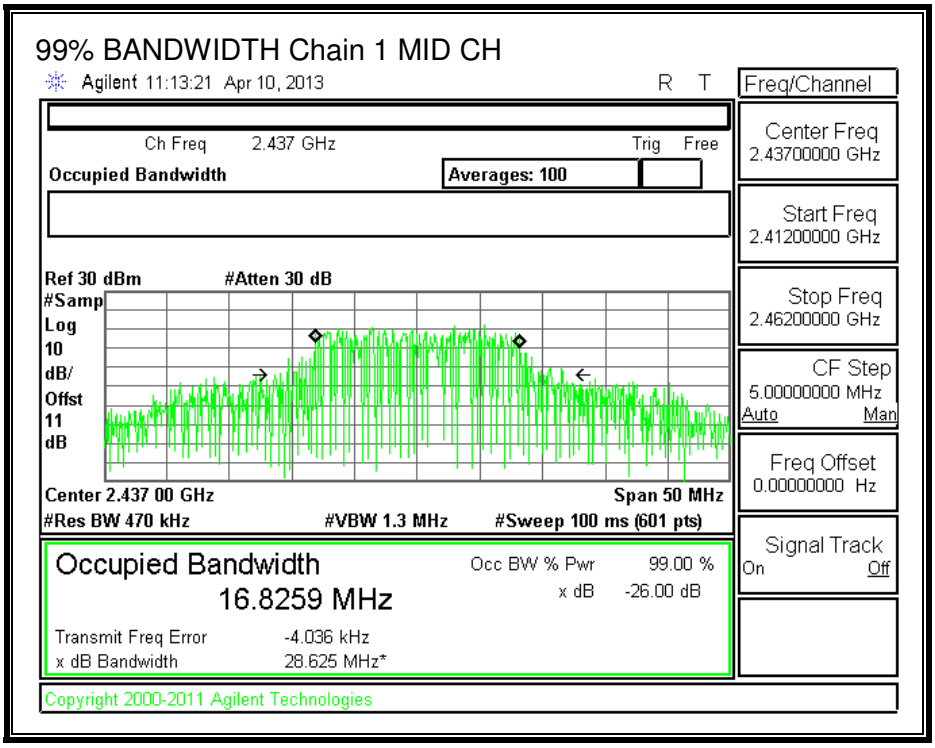


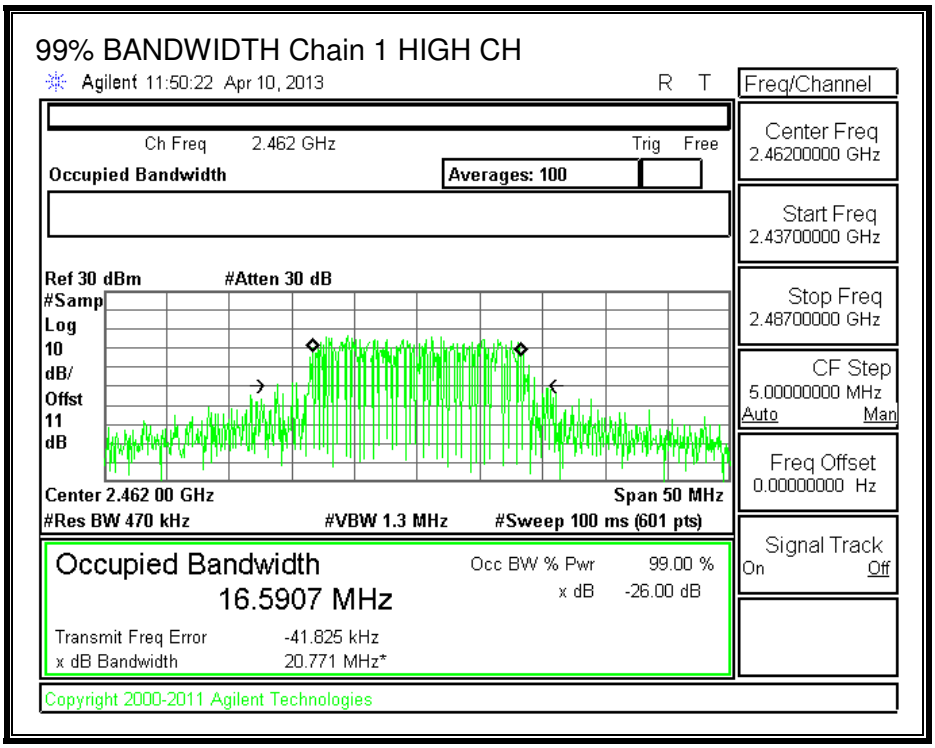




99% BANDWIDTH, Chain 1







8.2.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1.0 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	2412	13.60	14.45	17.06
Mid	2437	16.91	16.62	19.78
High	2462	13.54	14.00	16.79

8.2.4. OUTPUT POWER

LIMITS

FCC §15.247

IC RSS-210 A8.4

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 unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
2.85	3.09	2.97

RESULTS

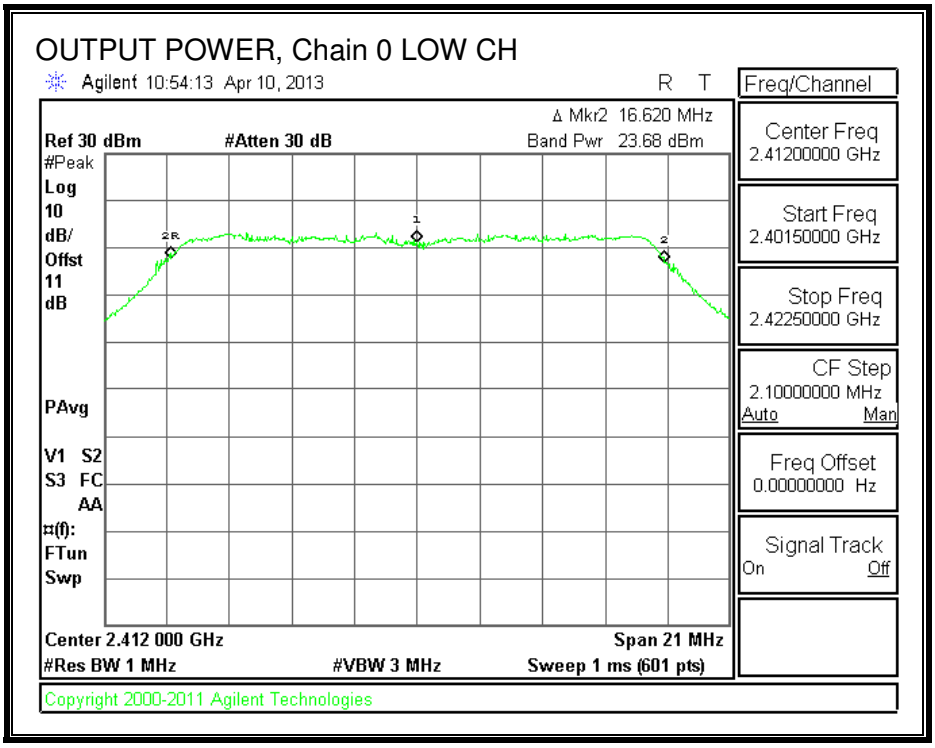
Limits

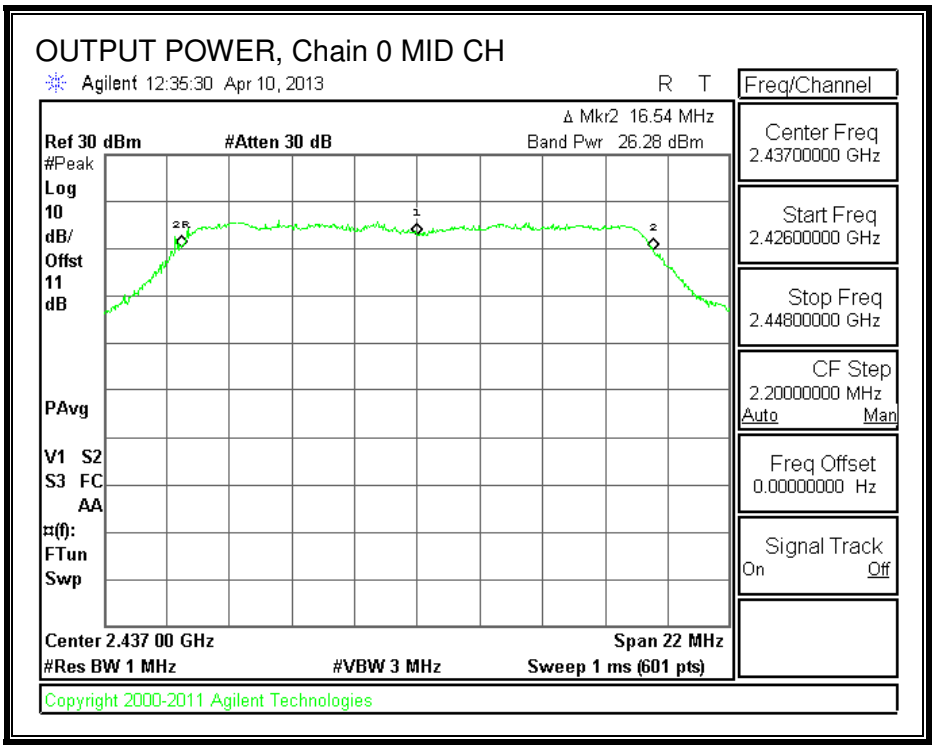
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	2412	2.97	30.00	30	36	30.00
Mid	2437	2.97	30.00	30	36	30.00
High	2462	2.97	30.00	30	36	30.00

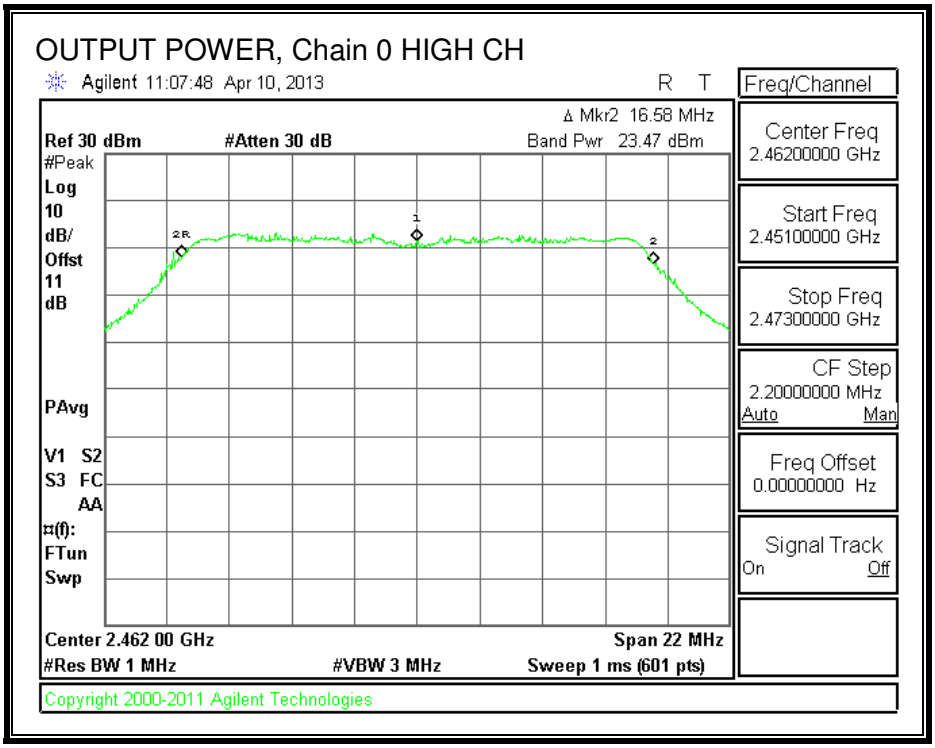
Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margi (dB)
Low	2412	23.68	23.68	26.69	30.00	-3.31
Mid	2437	26.28	26.18	29.24	30.00	-0.76
High	2462	23.47	23.44	26.47	30.00	-3.53

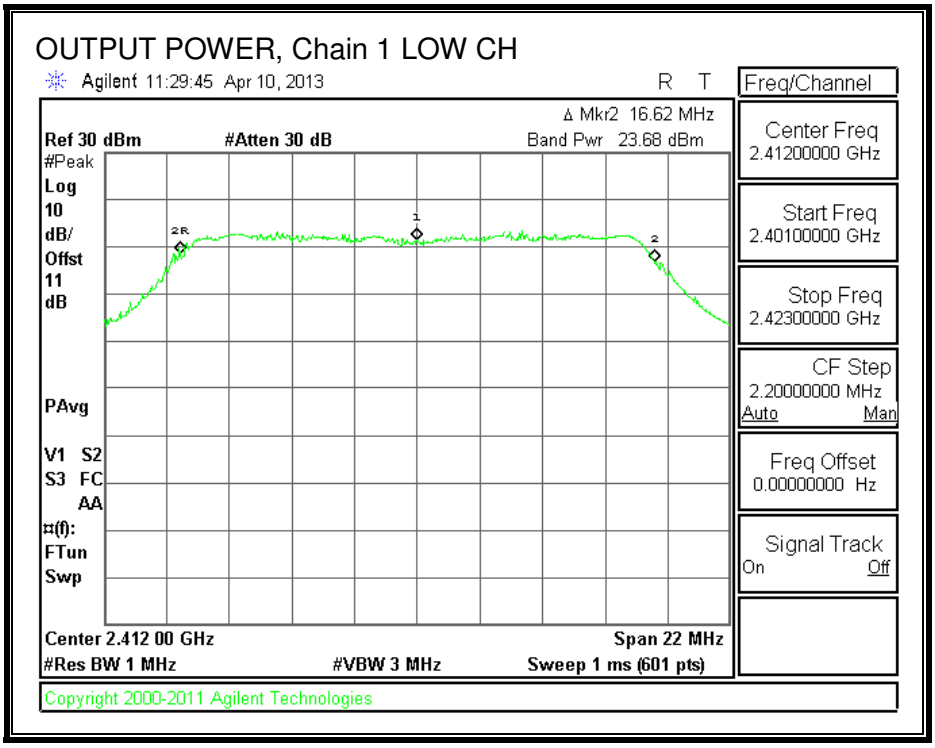
OUTPUT POWER, Chain 0

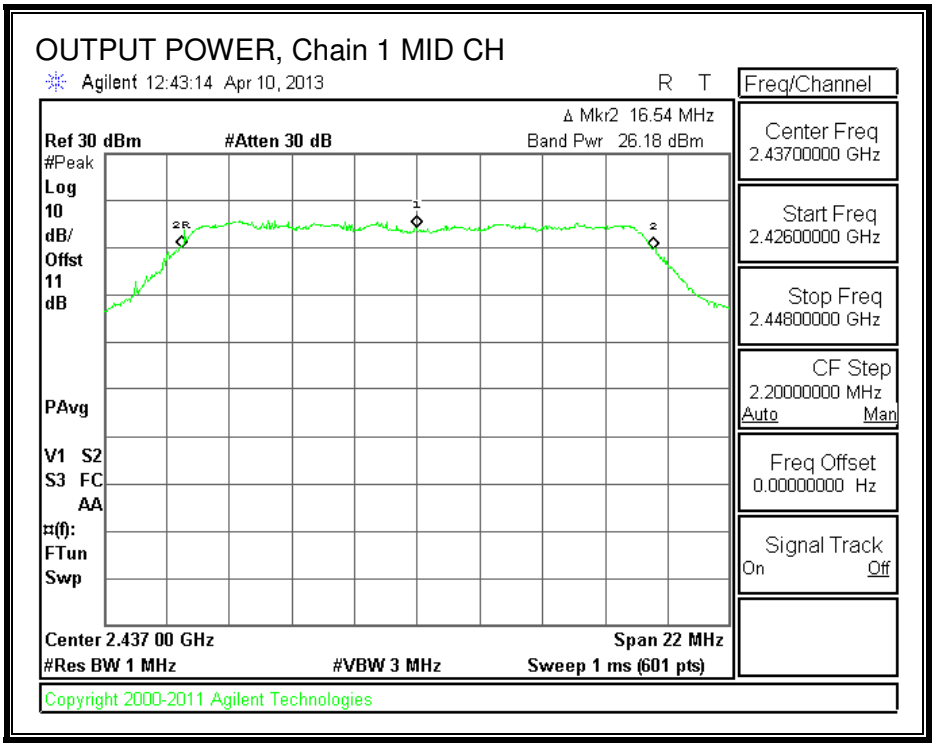


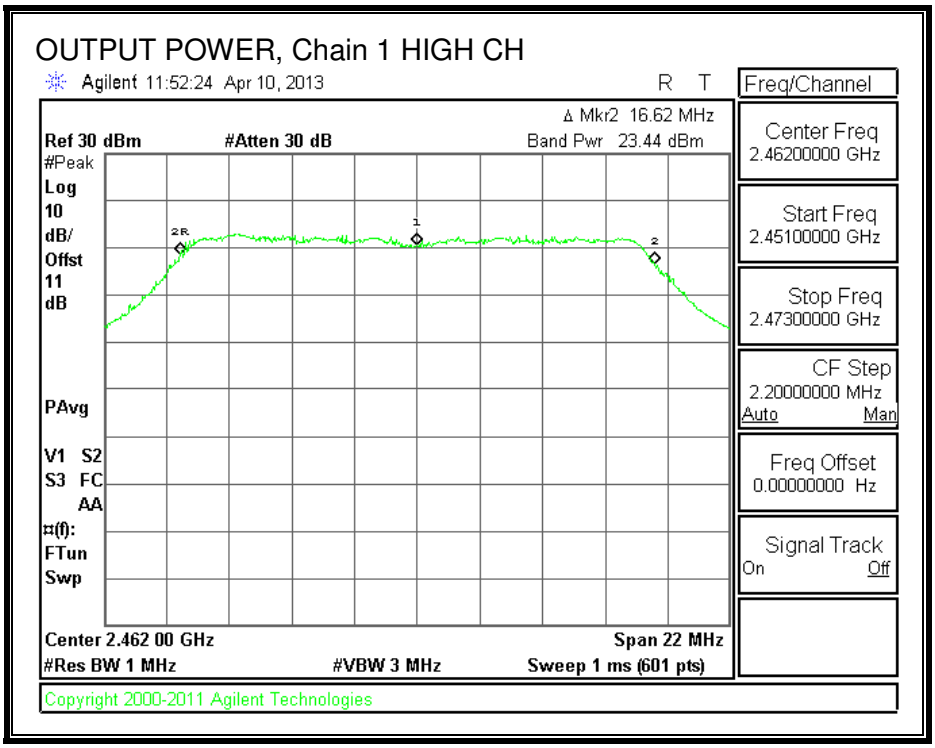




OUTPUT POWER, Chain 1







8.2.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247

IC RSS-210 A8.2

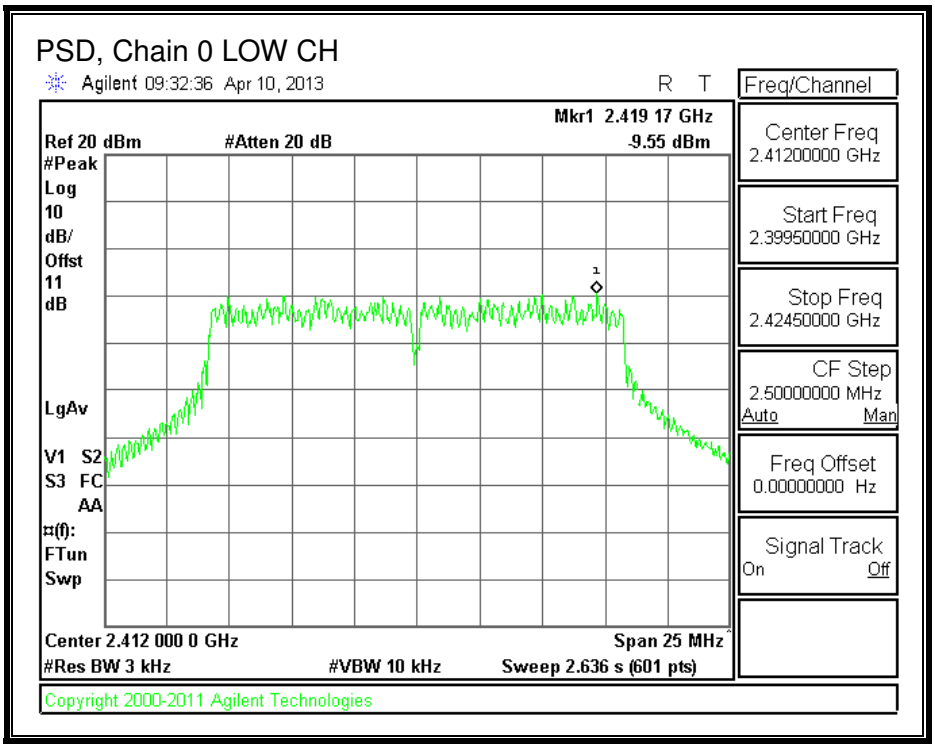
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

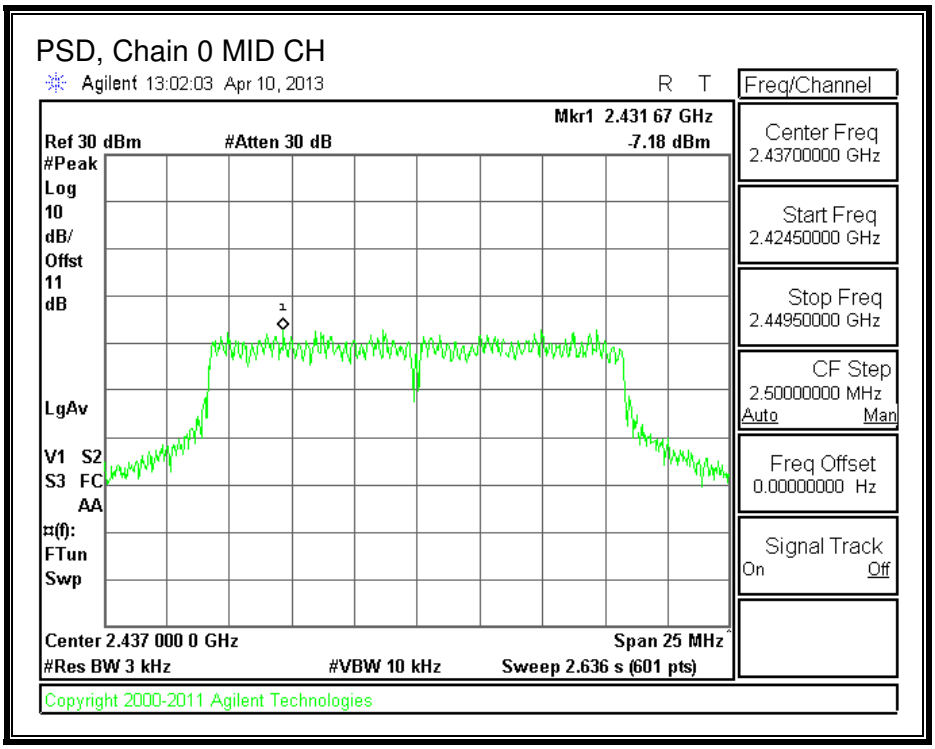
RESULTS

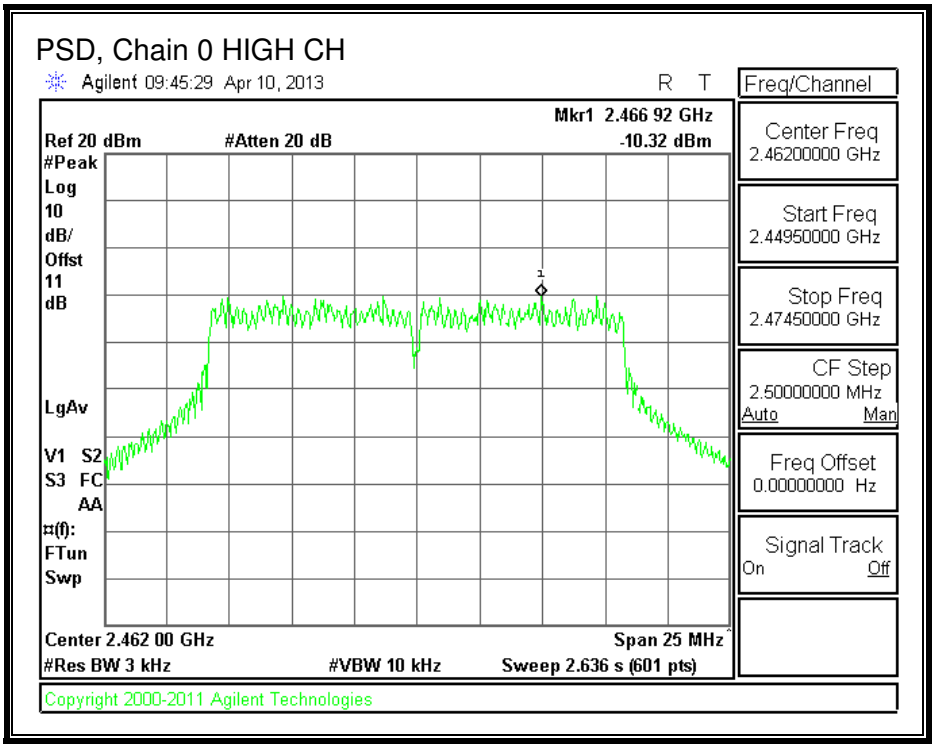
PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Chain 1 Meas (dBm)	Total PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-9.55	-9.74	-6.63	8.0	-14.6
Mid	2437	-7.18	-4.59	-2.68	8.0	-10.7
High	2462	-10.32	-9.88	-7.08	8.0	-15.1

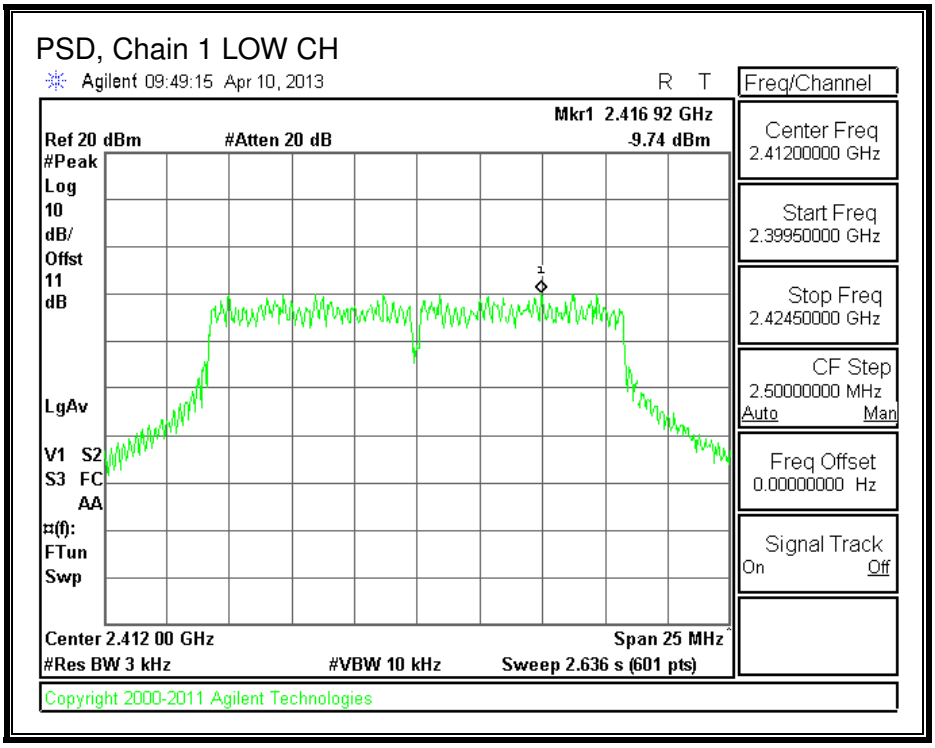
PSD, Chain 0



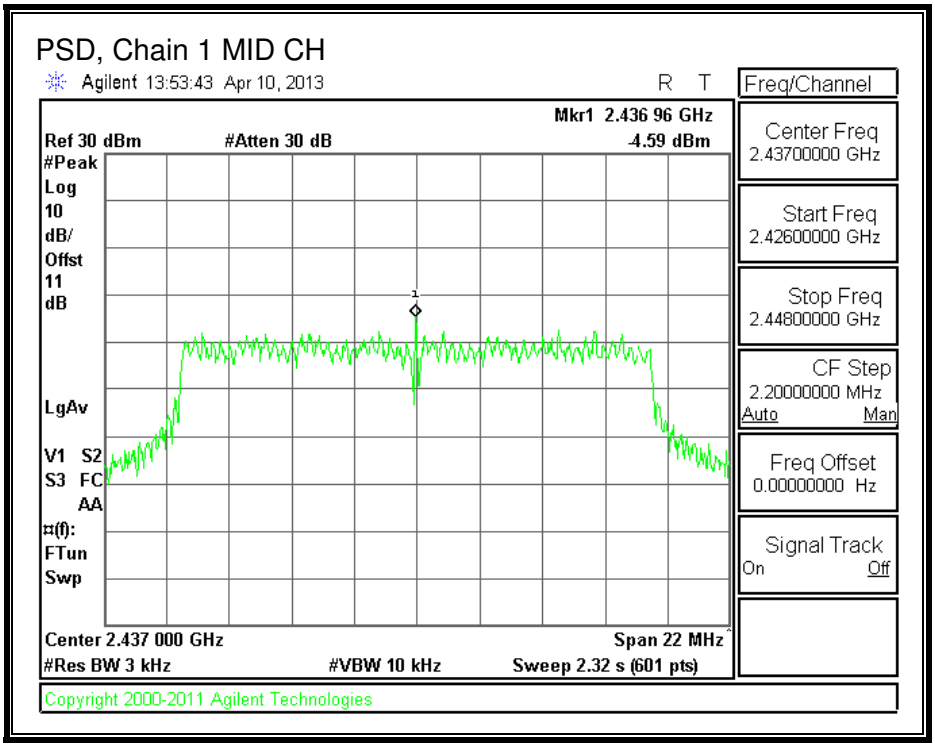




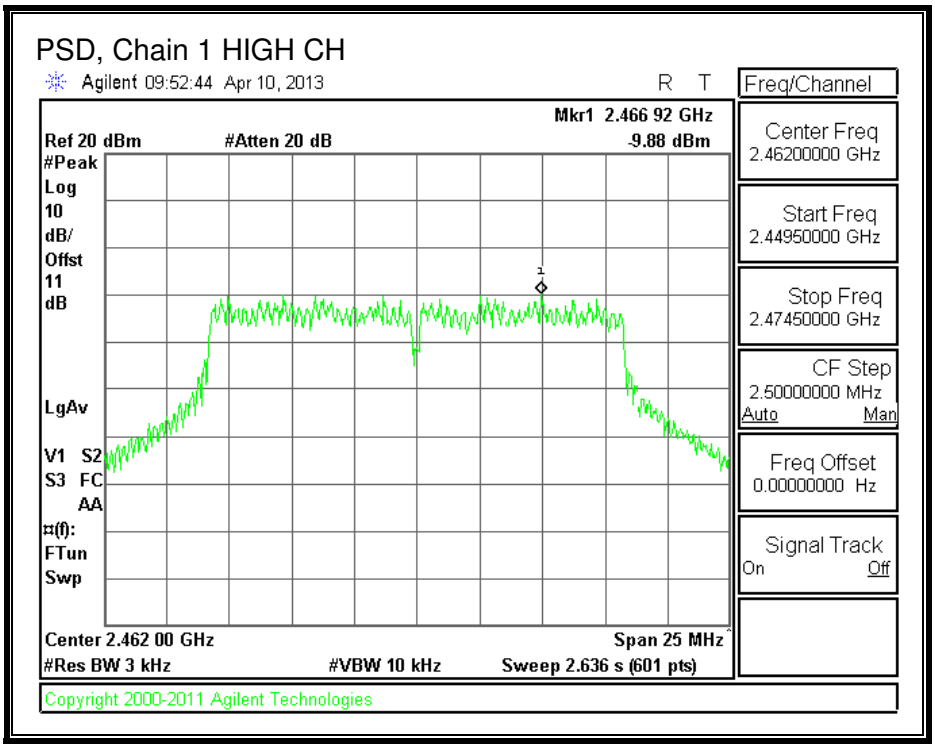
PSD, Chain 1



PSD, Chain 1 MID CH



PSD, Chain 1 HIGH CH



8.2.6. OUT-OF-BAND EMISSIONS

LIMITS

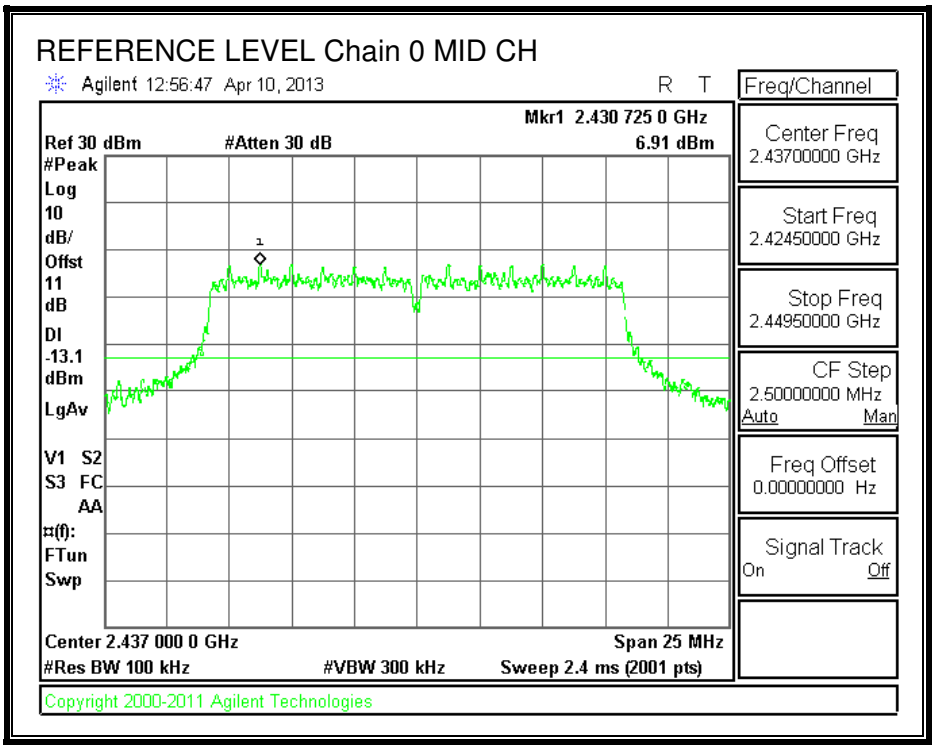
FCC §15.247 (d)

IC RSS-210 A8.5

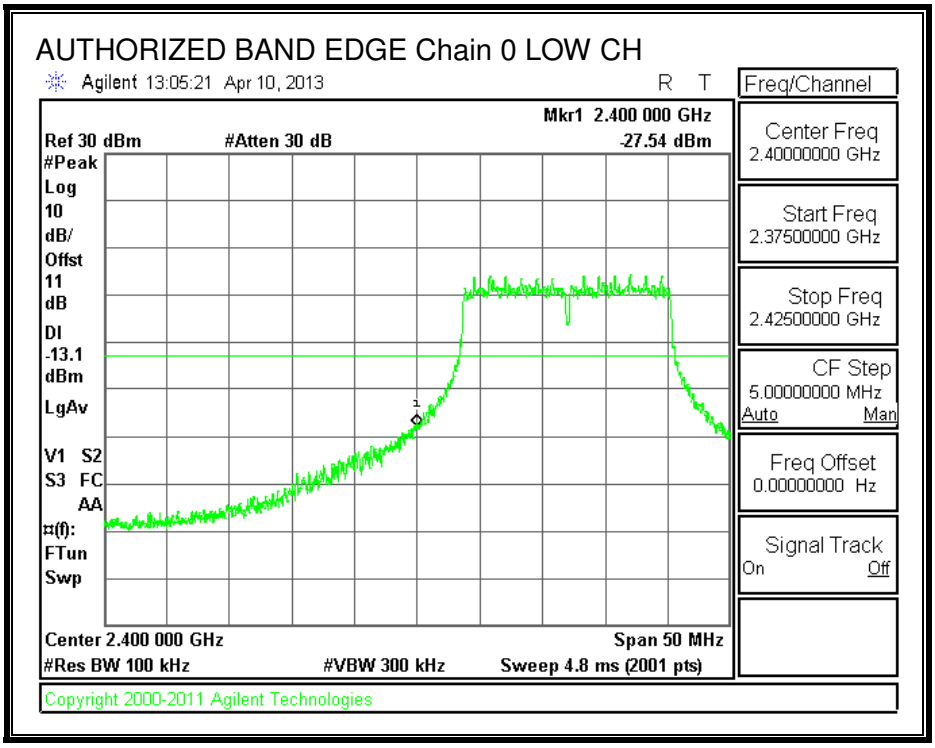
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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.

RESULTS

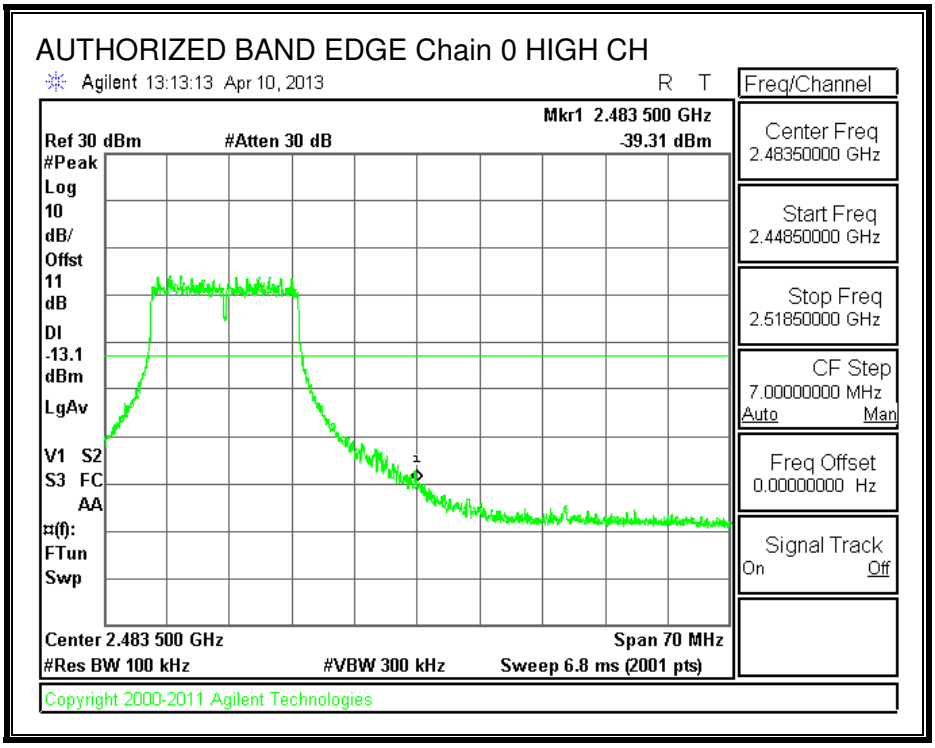
IN-BAND REFERENCE LEVEL, Chain 0



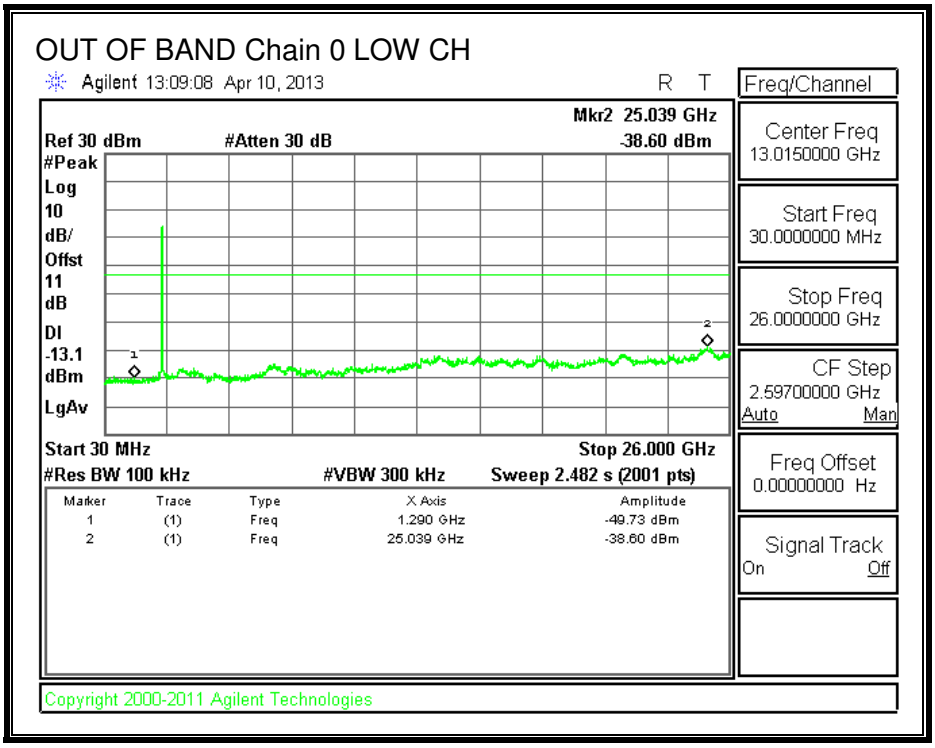
LOW CHANNEL BANDEDGE, Chain 0

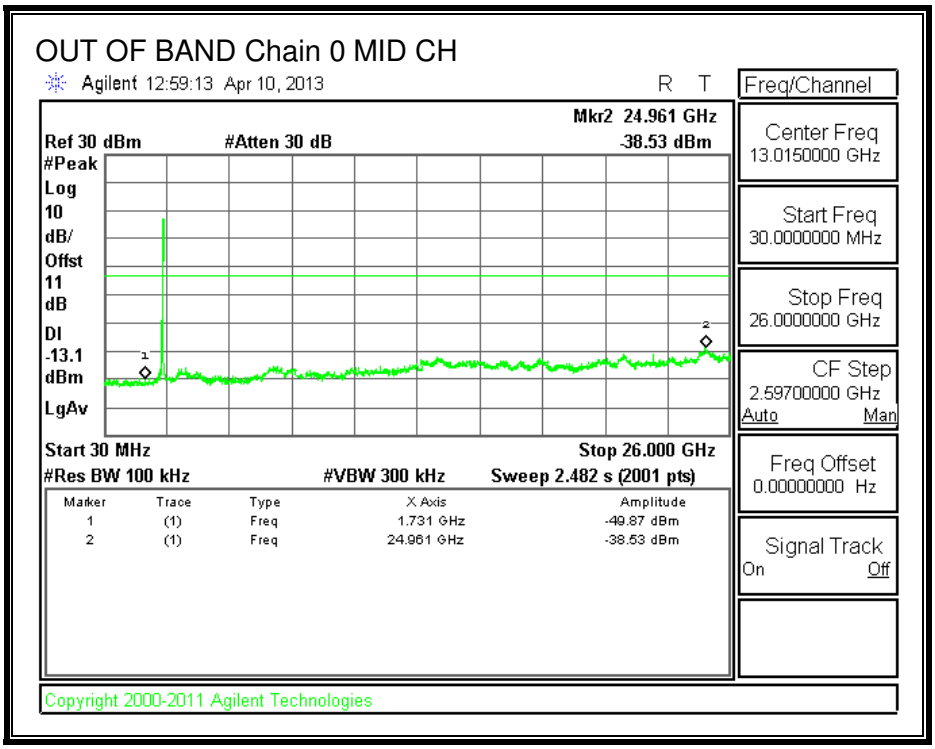


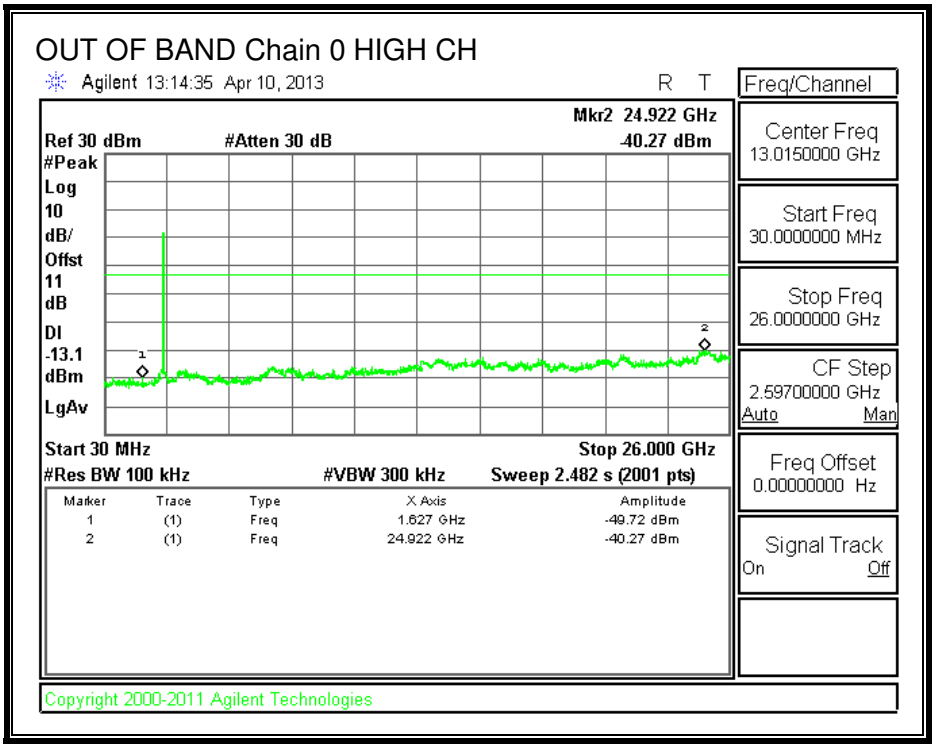
HIGH CHANNEL BANDEDGE, Chain 0



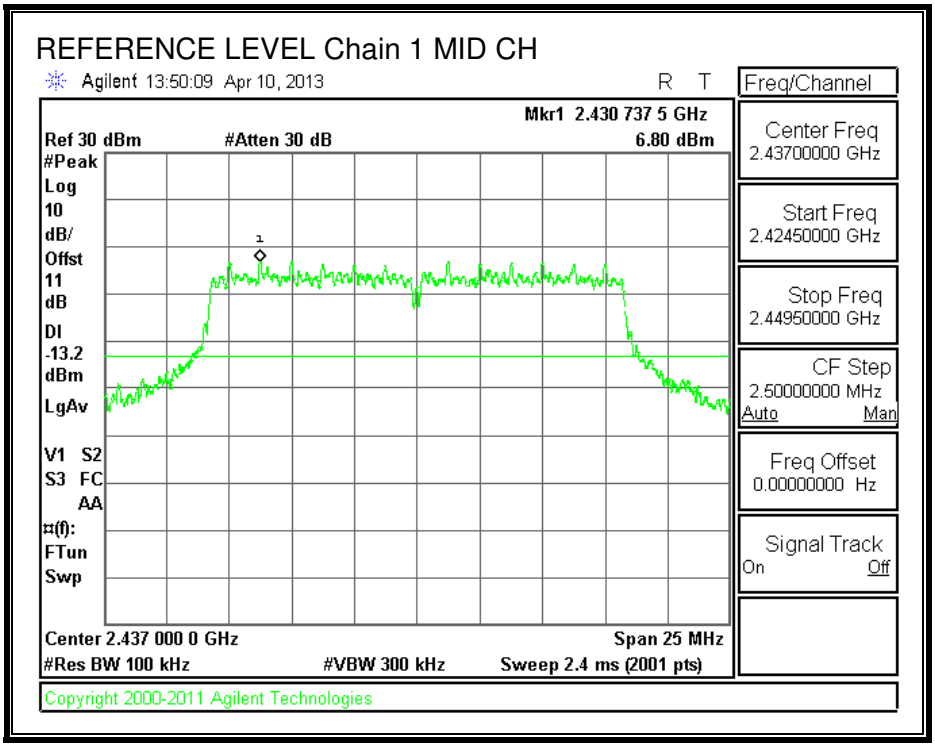
OUT-OF-BAND EMISSIONS, Chain 0



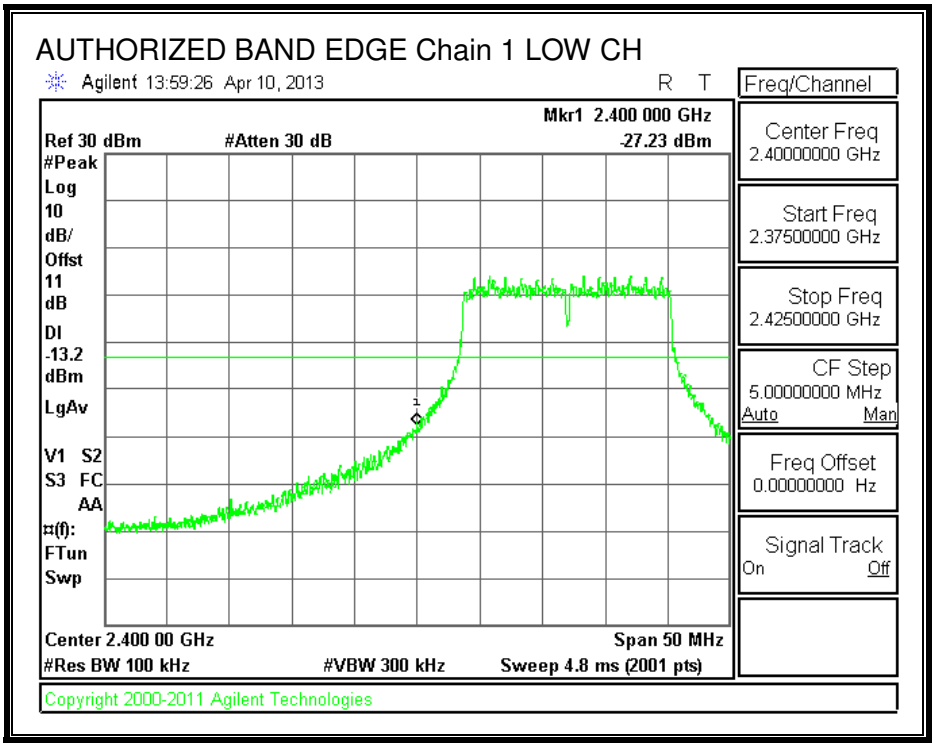




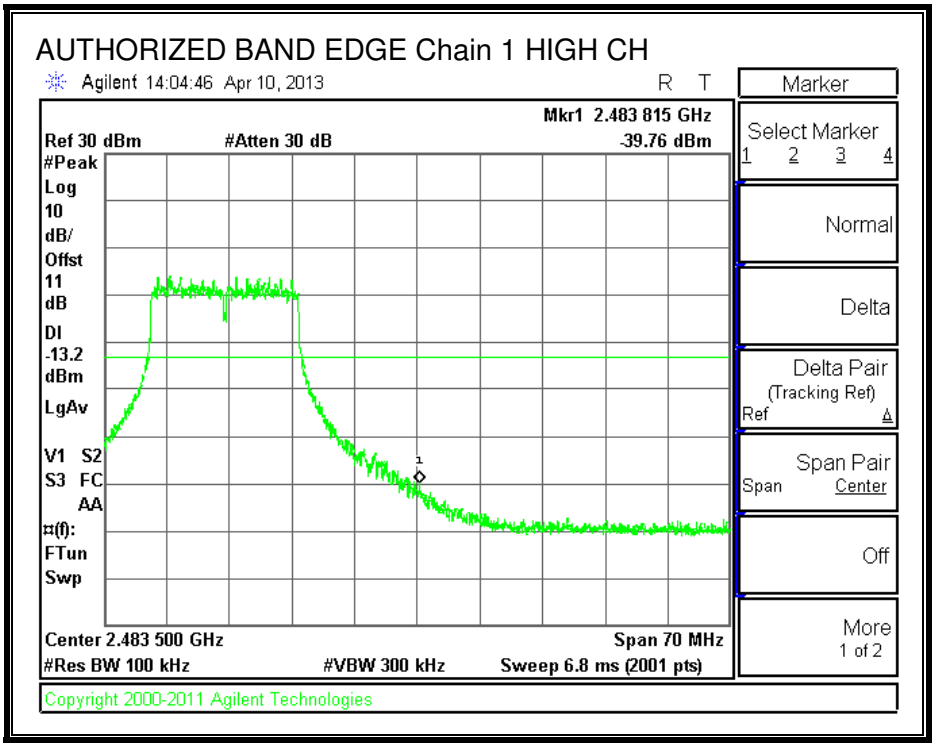
IN-BAND REFERENCE LEVEL, Chain 1

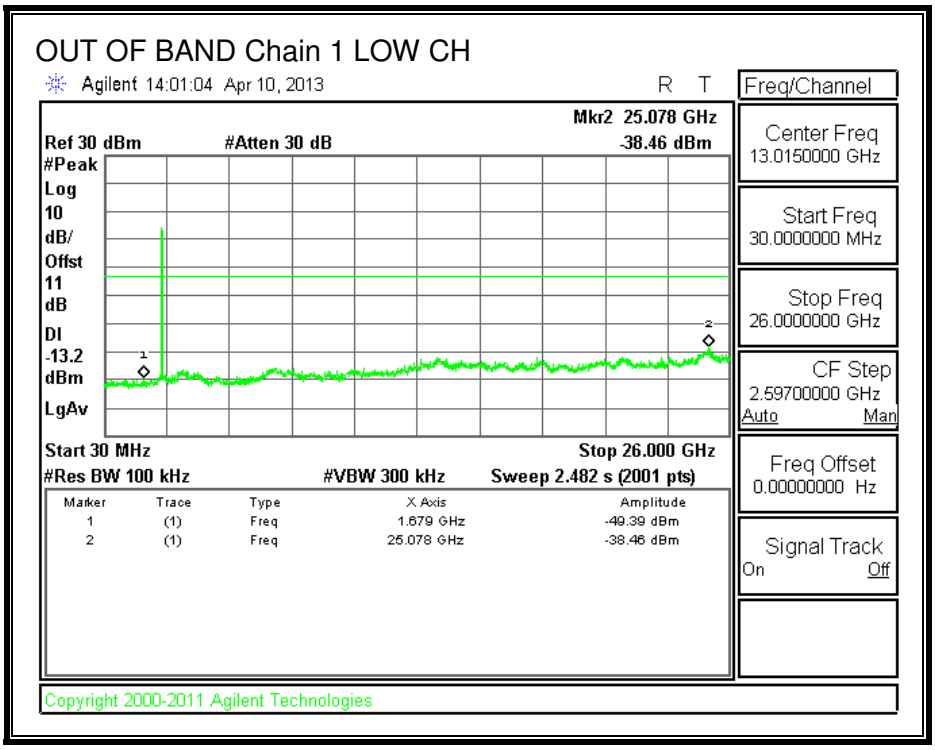


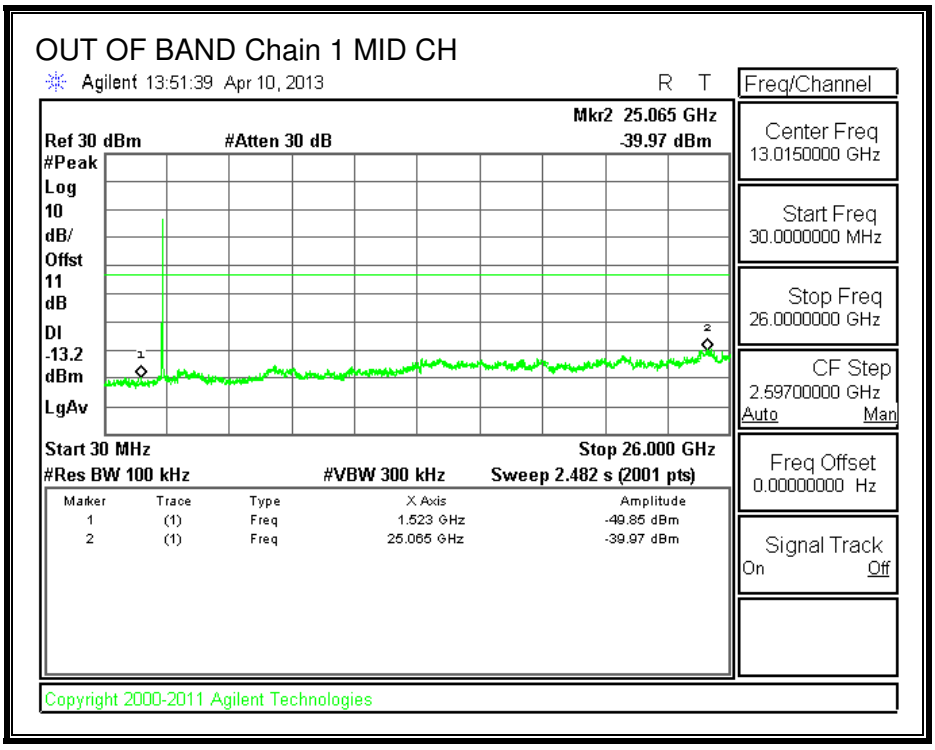
LOW CHANNEL BANDEDGE, Chain 1

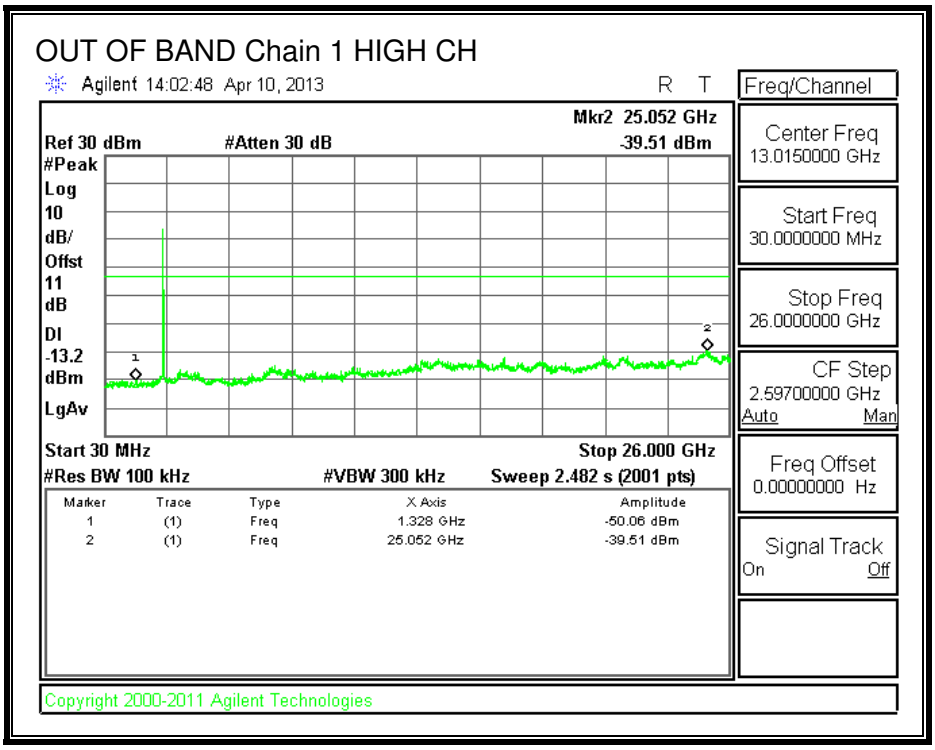


HIGH CHANNEL BANDEDGE, Chain 1









8.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

8.3.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

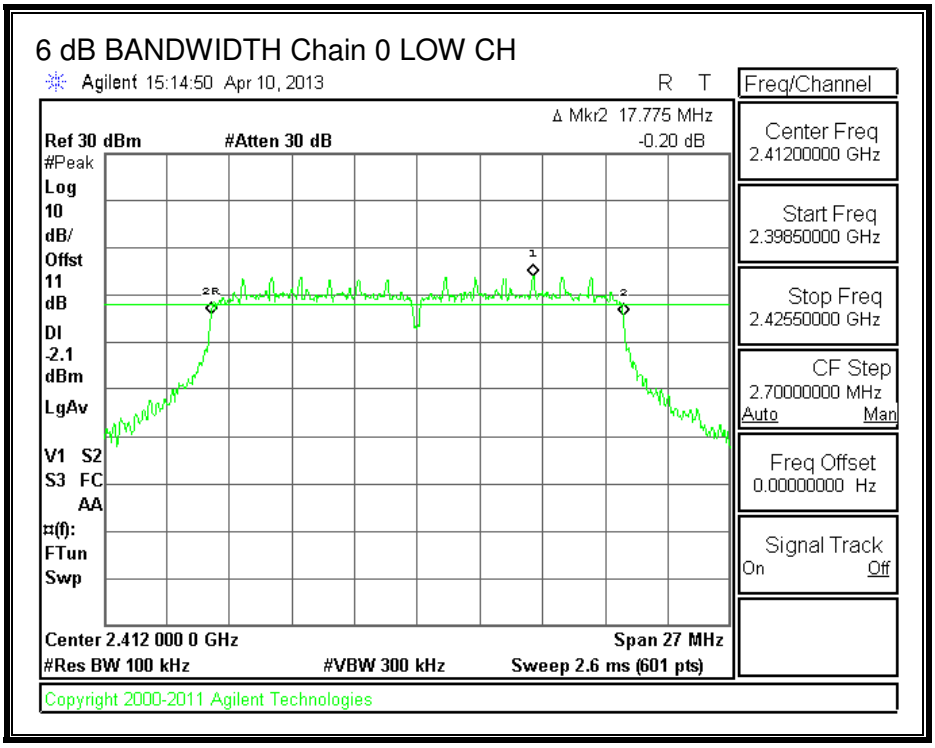
IC RSS-210 A8.2 (a)

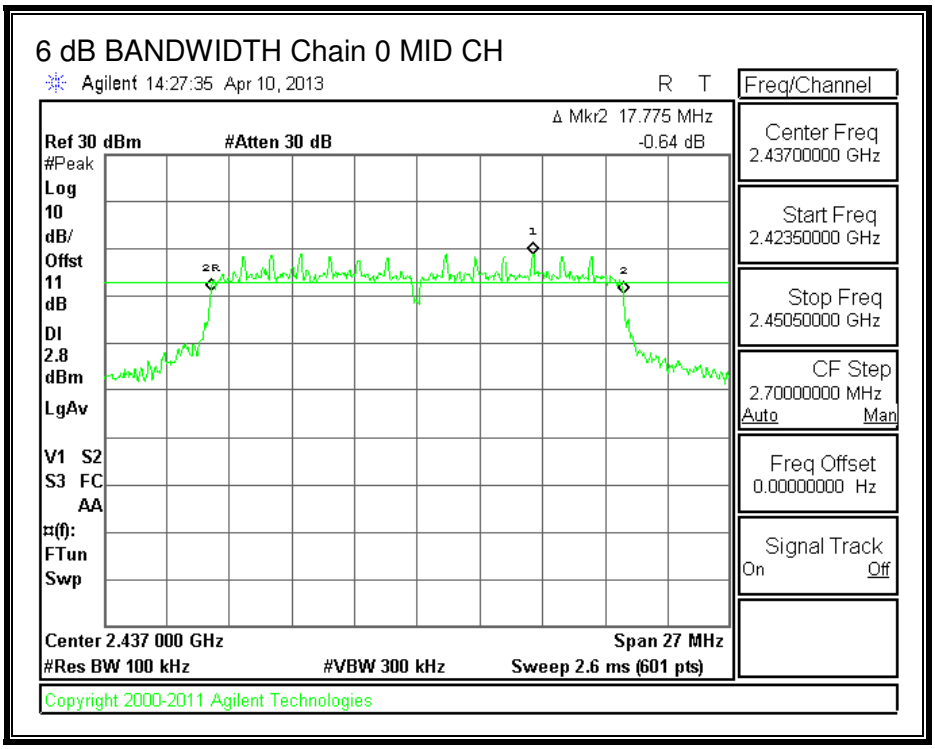
The minimum 6 dB bandwidth shall be at least 500 kHz.

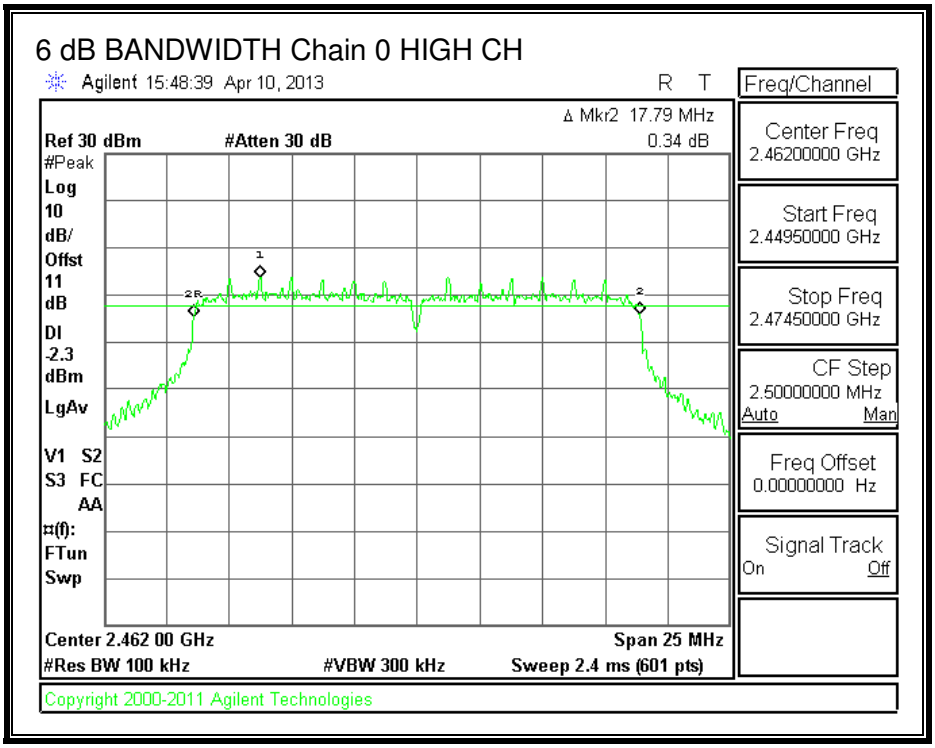
RESULTS

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low	2412	17.775	17.730	0.5
Mid	2437	17.775	17.775	0.5
High	2462	17.790	17.775	0.5

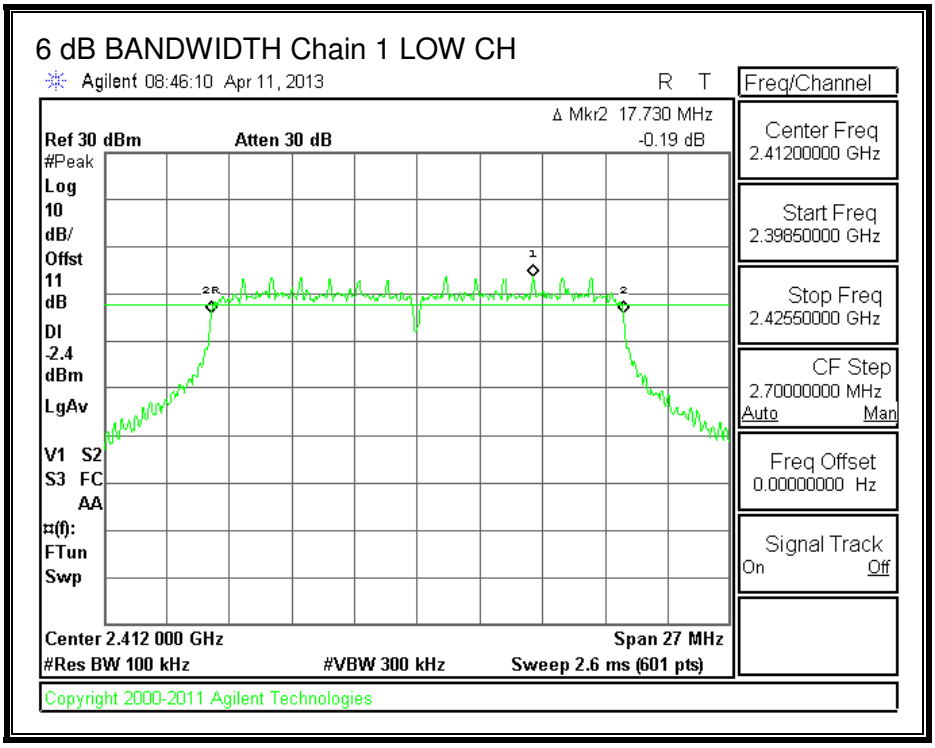
6 dB BANDWIDTH, Chain 0

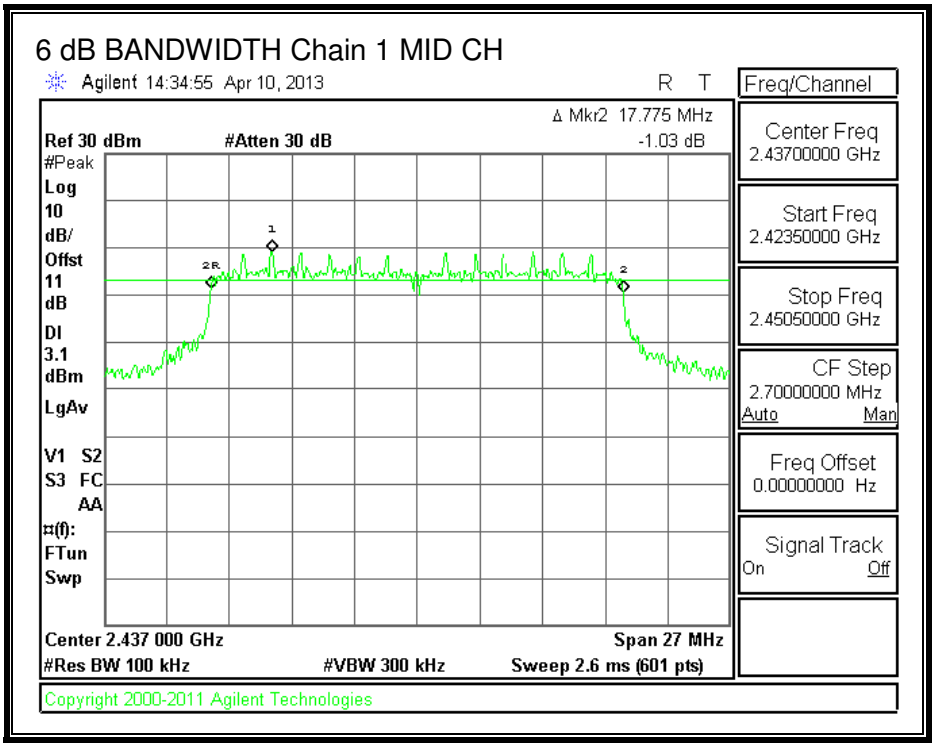


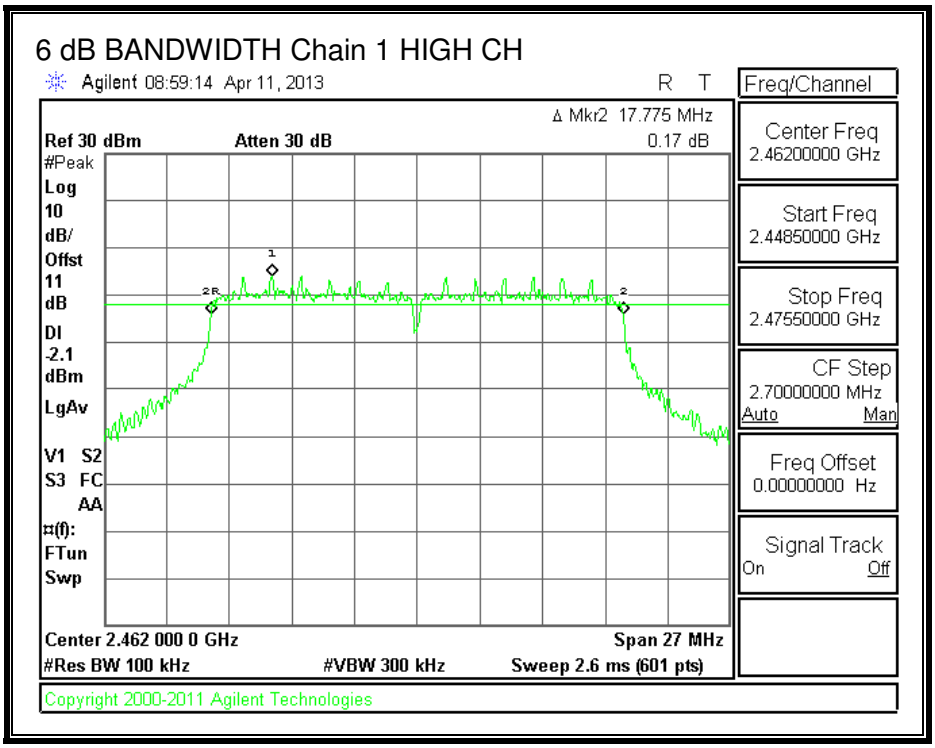




6 dB BANDWIDTH, Chain 1







8.3.2. 99% BANDWIDTH

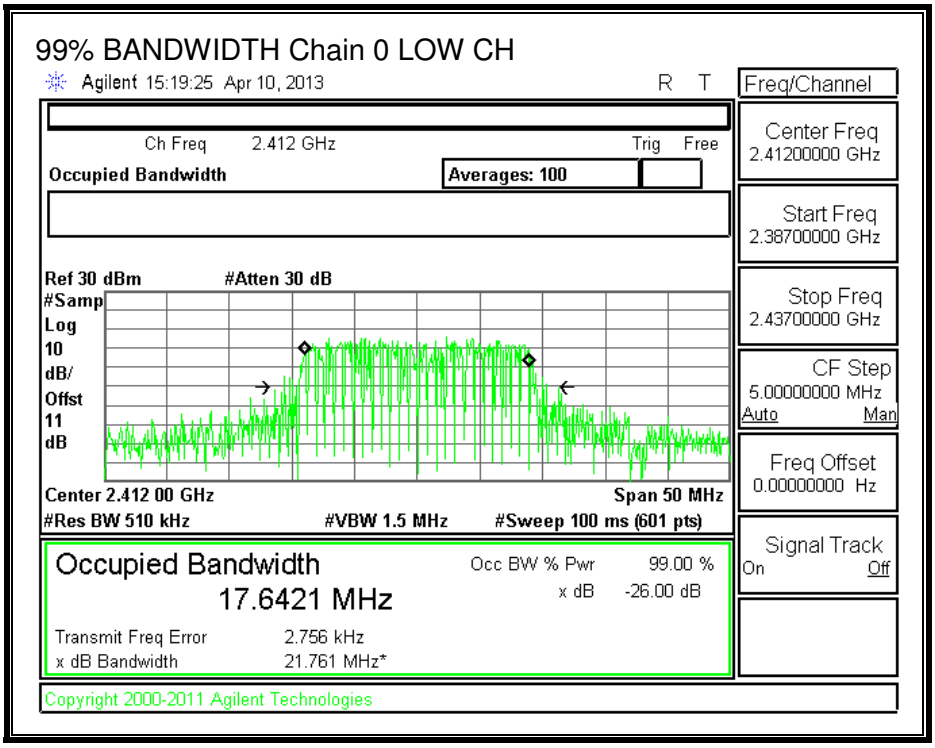
LIMITS

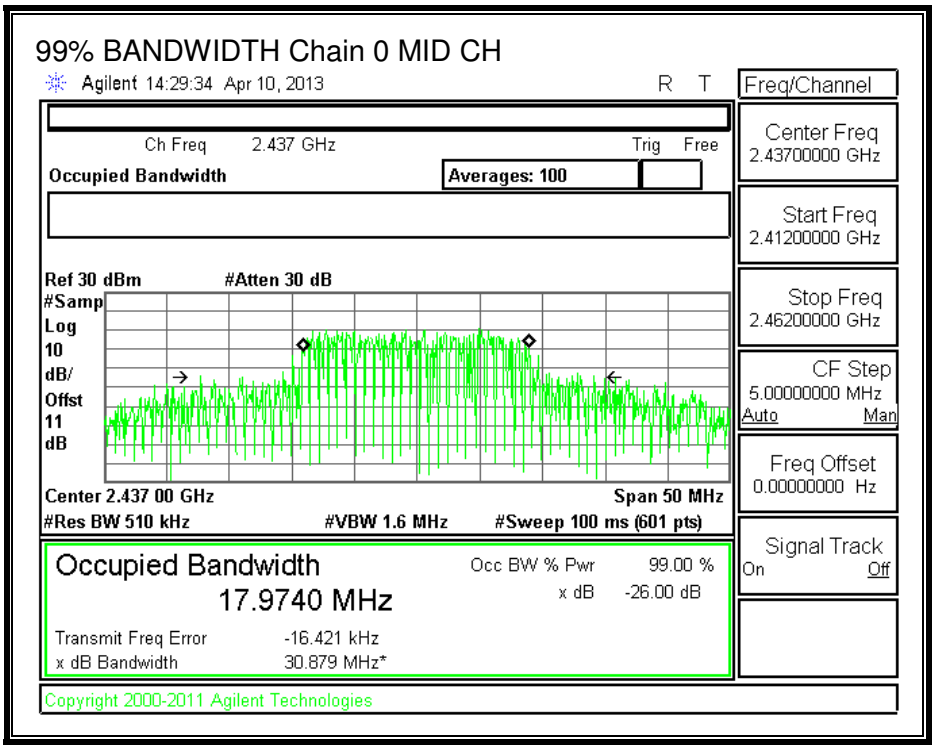
None; for reporting purposes only.

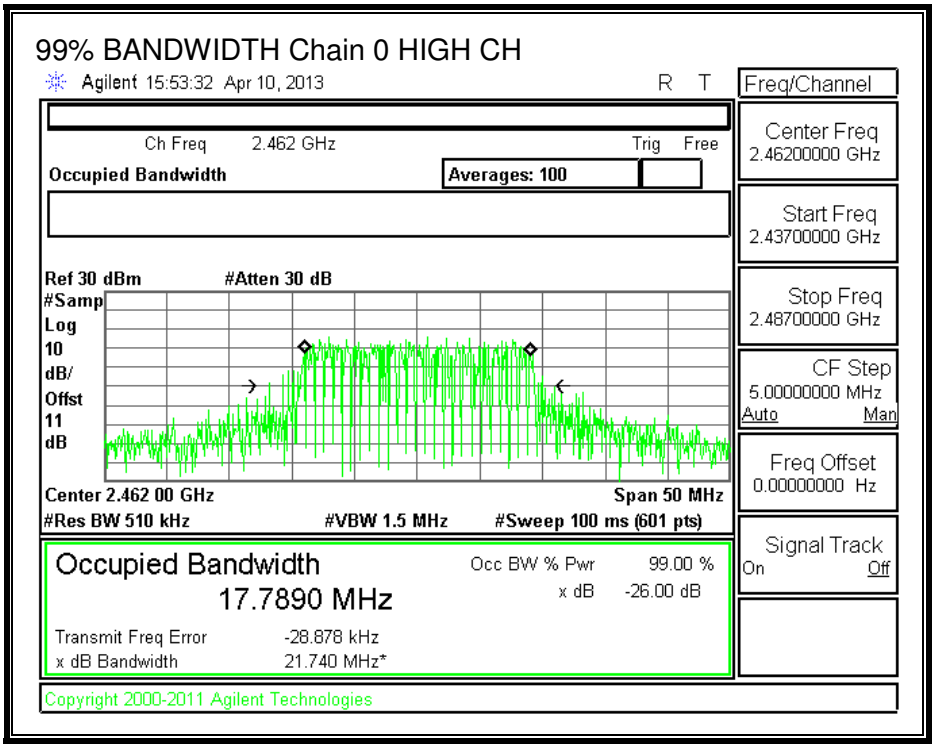
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	2412	17.6421	17.7580
Mid	2437	17.9740	17.9664
High	2462	17.7890	17.8050

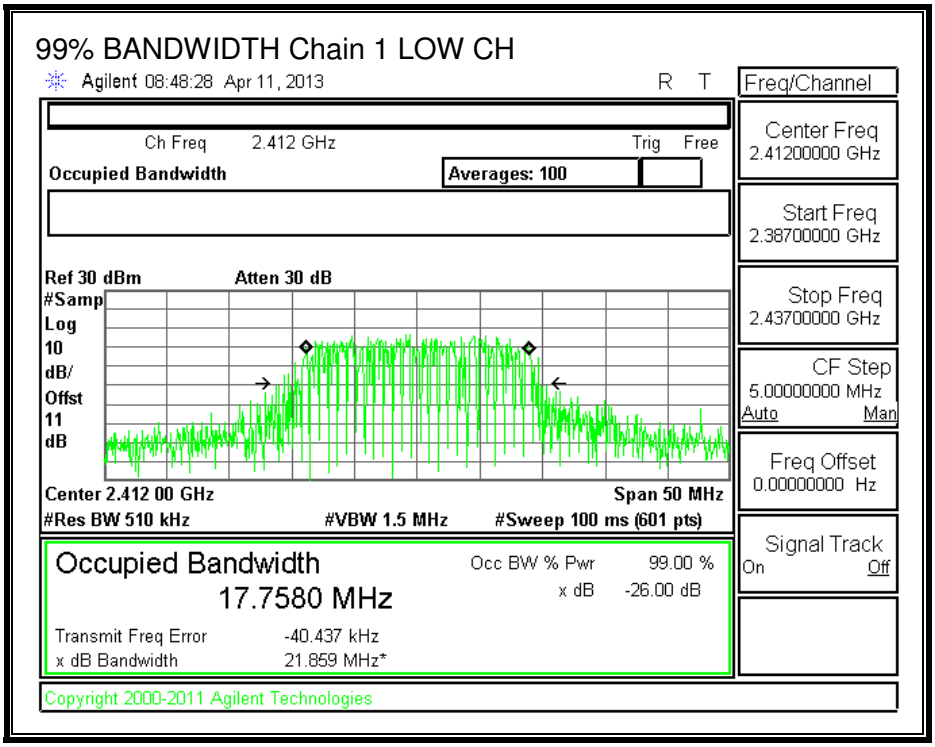
99% BANDWIDTH, Chain 0

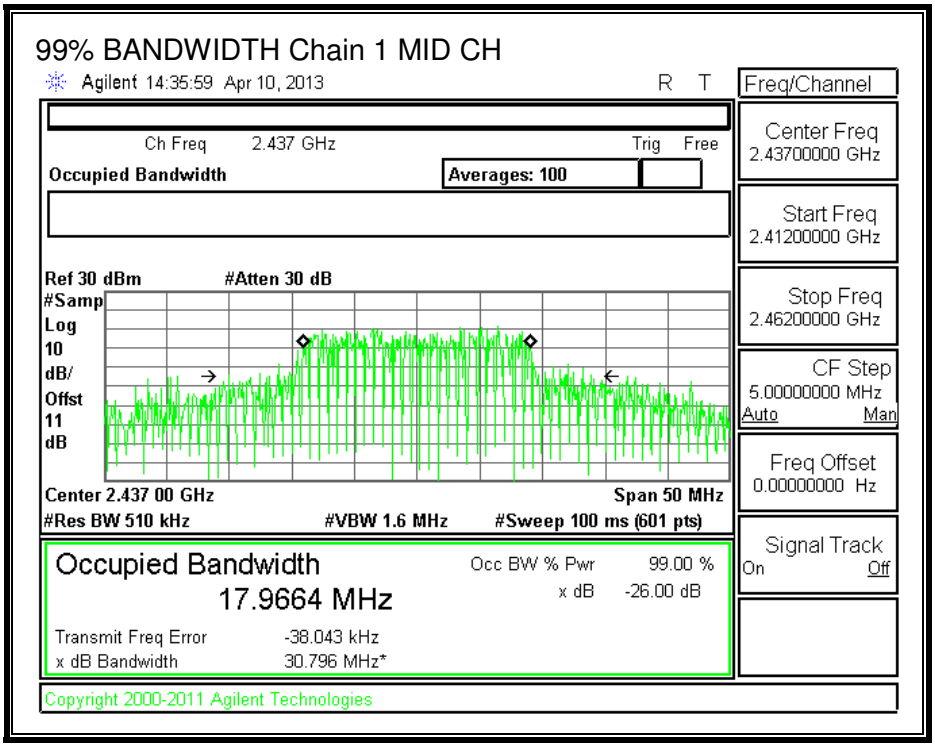


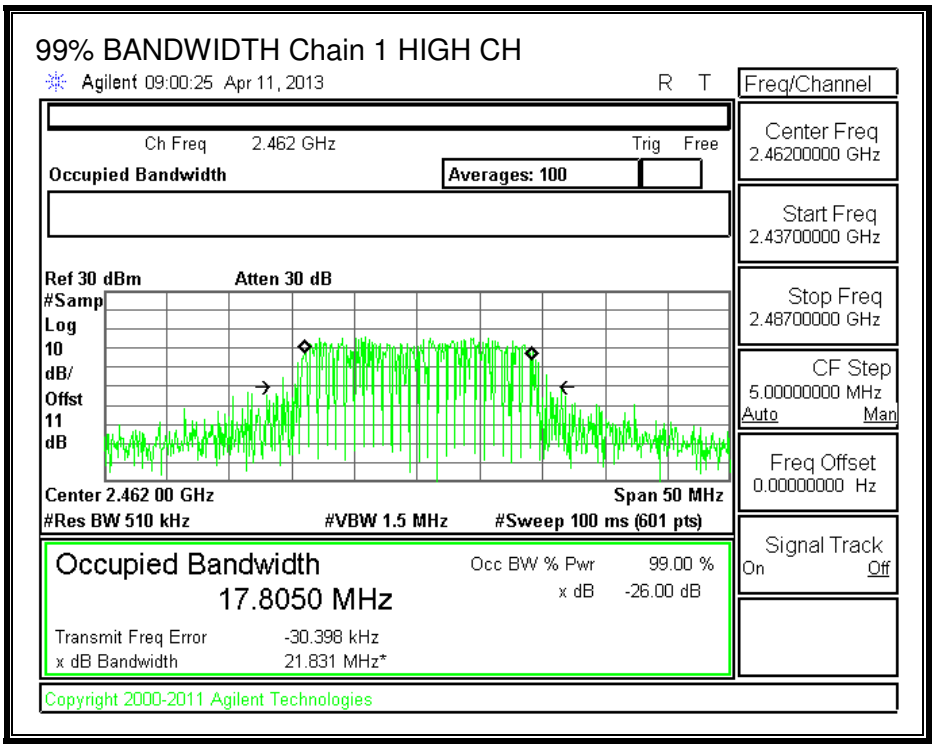




99% BANDWIDTH, Chain 1







8.3.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1.0 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	2412	15.56	16.62	19.13
Mid	2437	16.03	16.59	19.33
High	2462	15.55	16.42	19.02

8.3.4. OUTPUT POWER

LIMITS

FCC §15.247

IC RSS-210 A8.4

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 unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
2.85	3.09	2.97

RESULTS

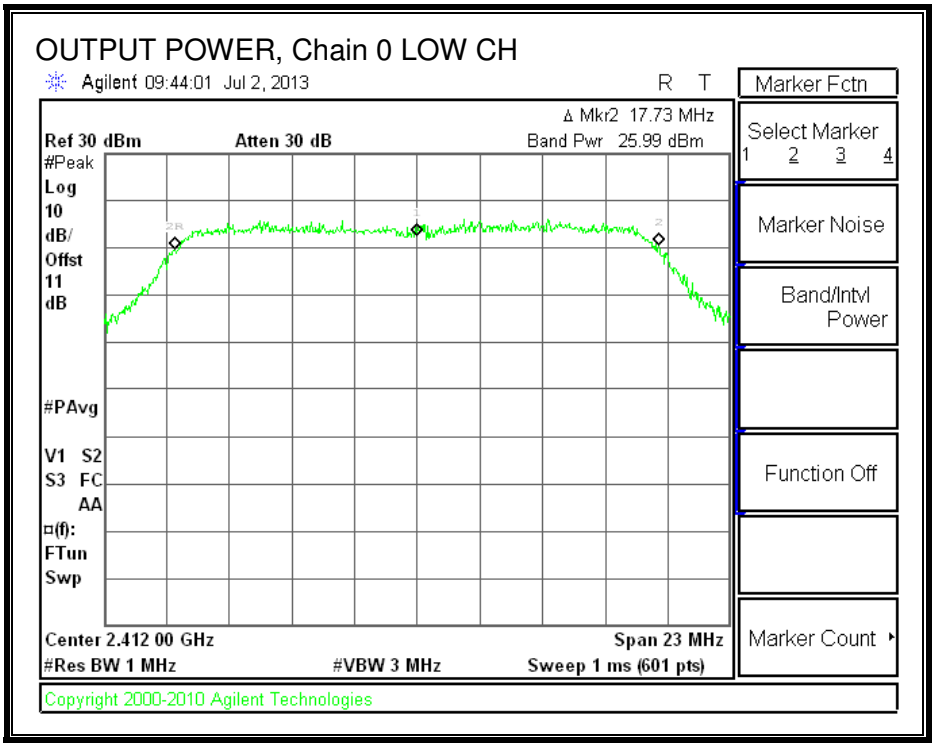
Limits

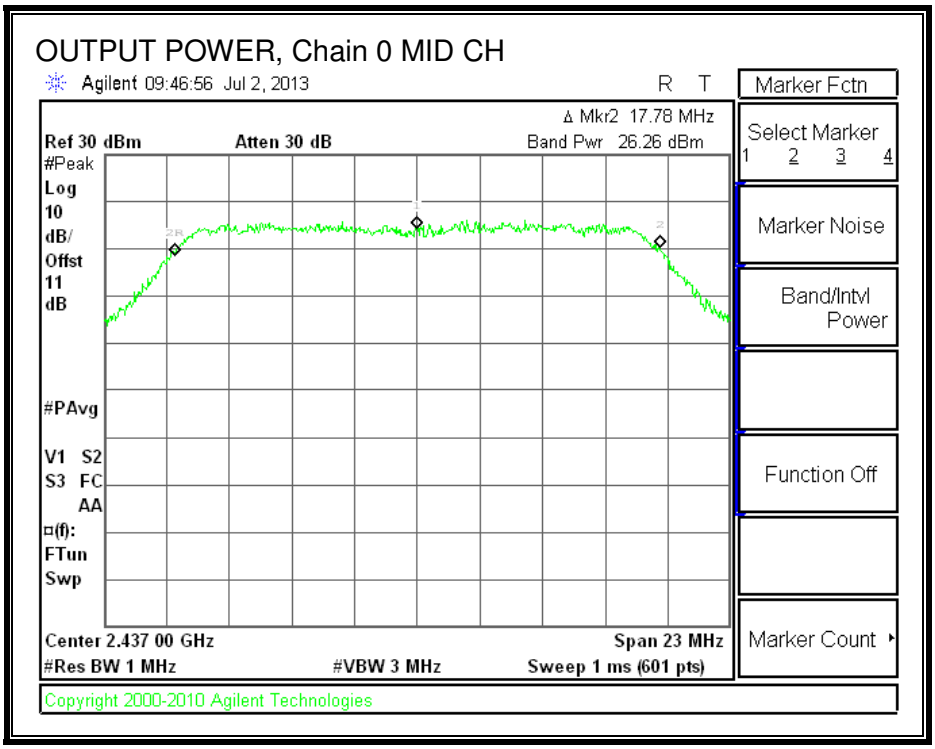
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	2412	2.97	30.00	30	36	30.00
Mid	2437	2.97	30.00	30	36	30.00
High	2462	2.97	30.00	30	36	30.00

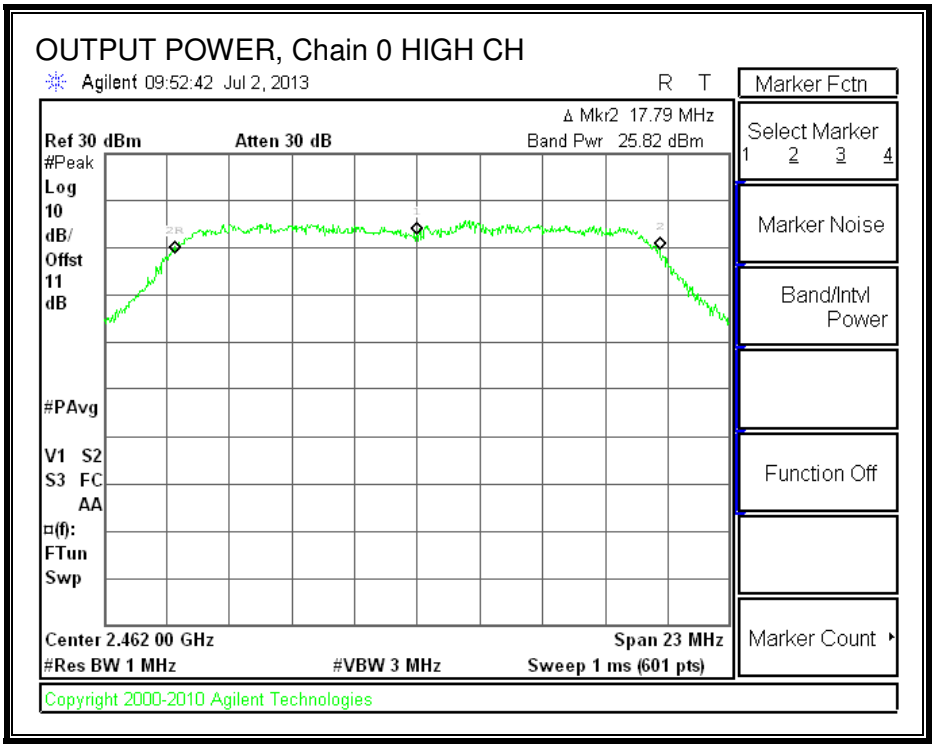
Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margi (dB)
Low	2412	25.99	25.97	28.99	30.00	-1.01
Mid	2437	26.26	25.87	29.08	30.00	-0.92
High	2462	25.82	26.15	29.00	30.00	-1.00

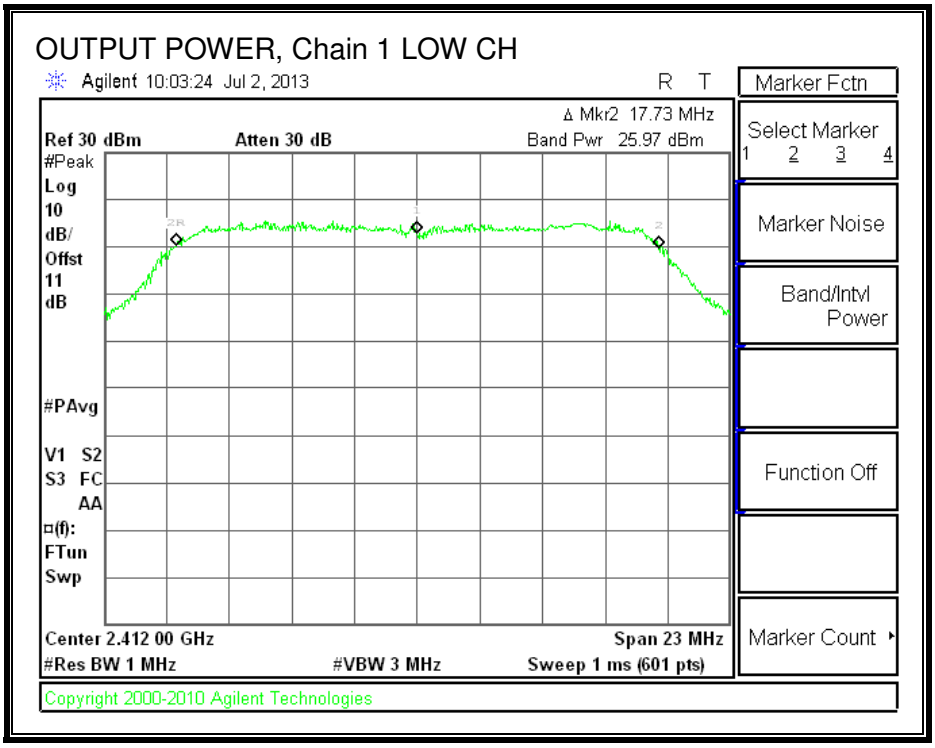
OUTPUT POWER, Chain 0

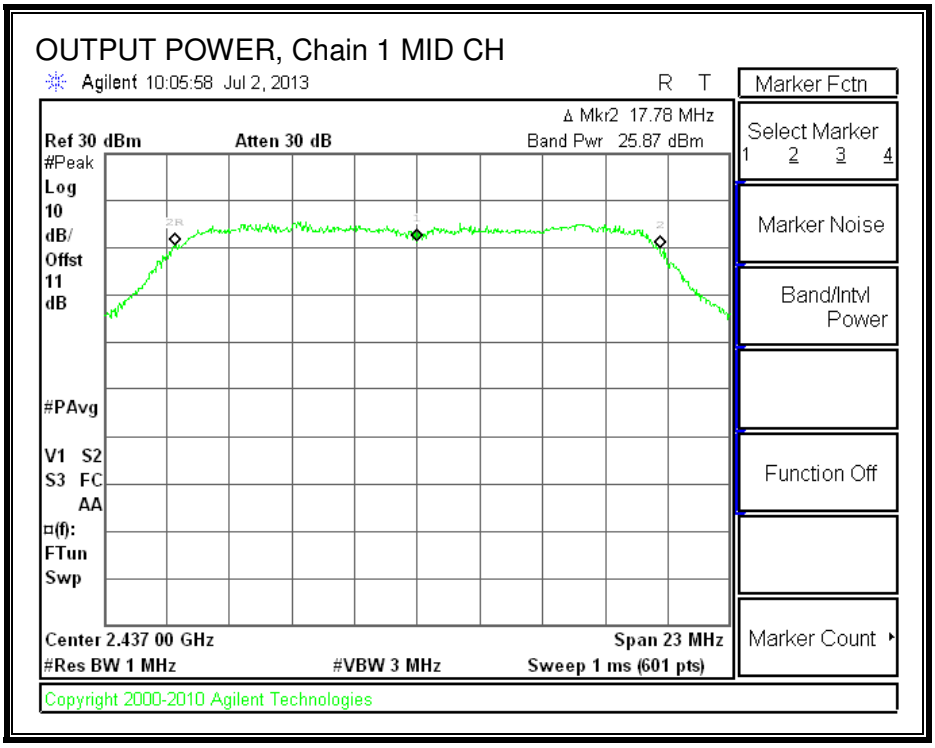


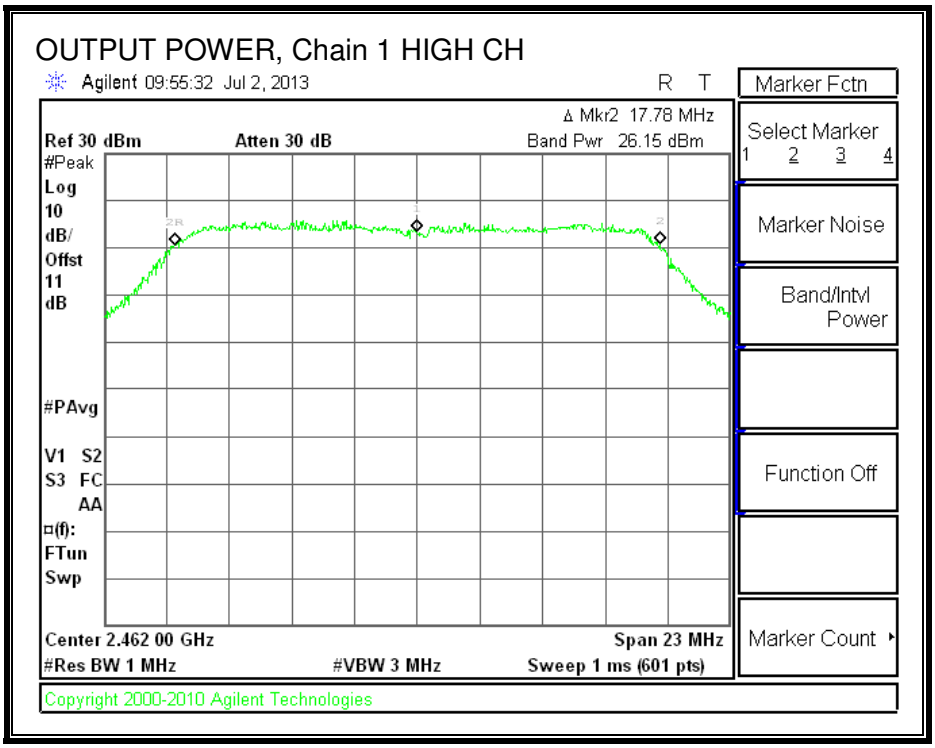




OUTPUT POWER, Chain 1







8.3.5. PSD

LIMITS

FCC §15.247

IC RSS-210 A8.2

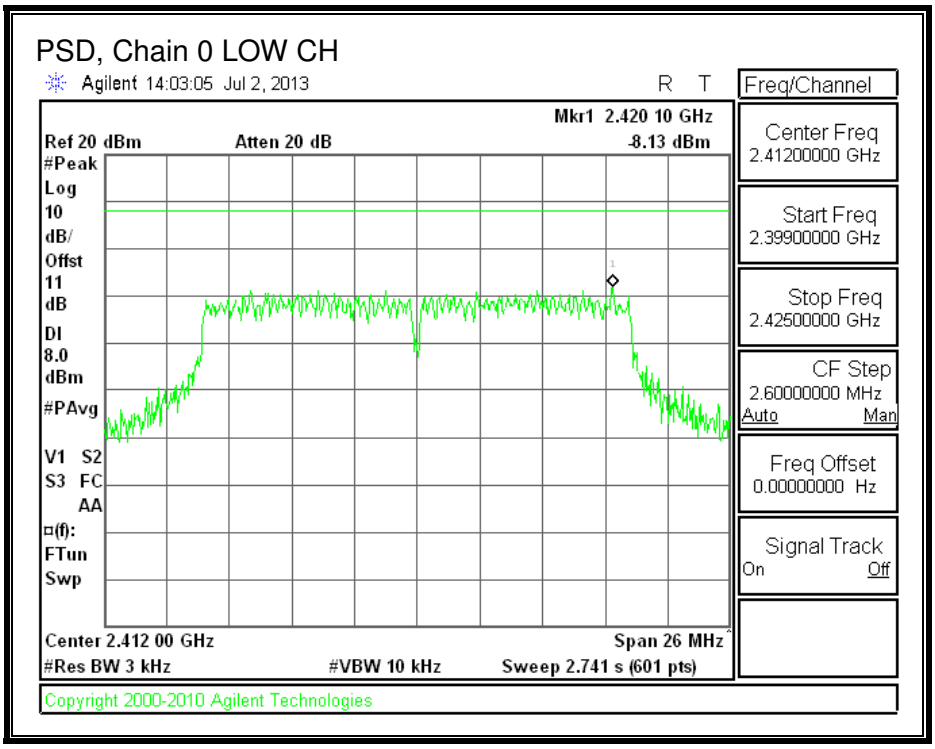
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

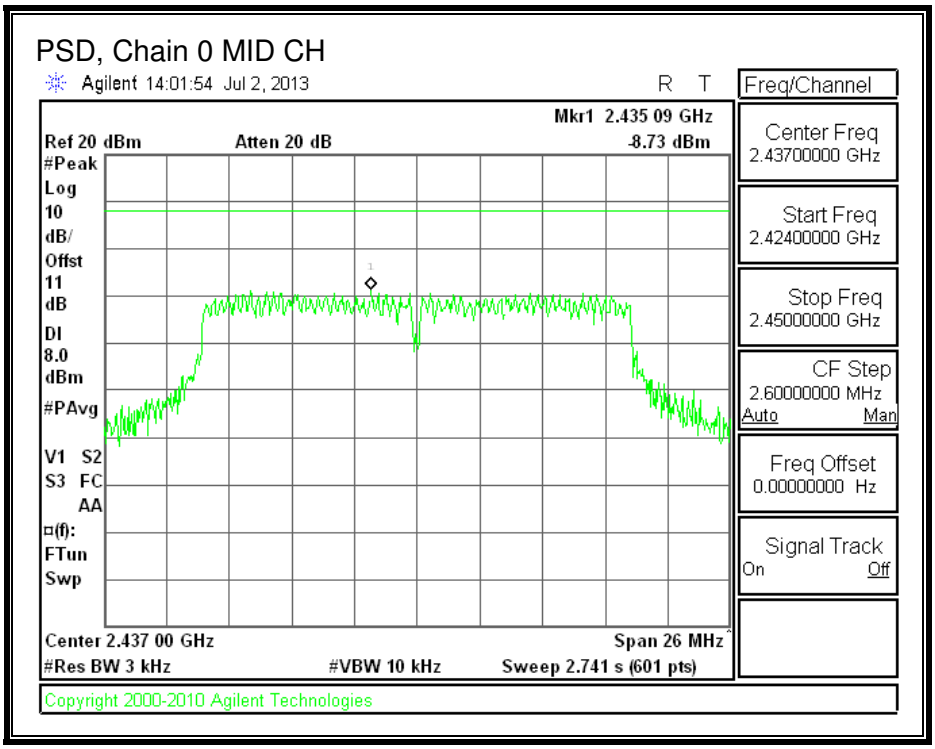
RESULTS

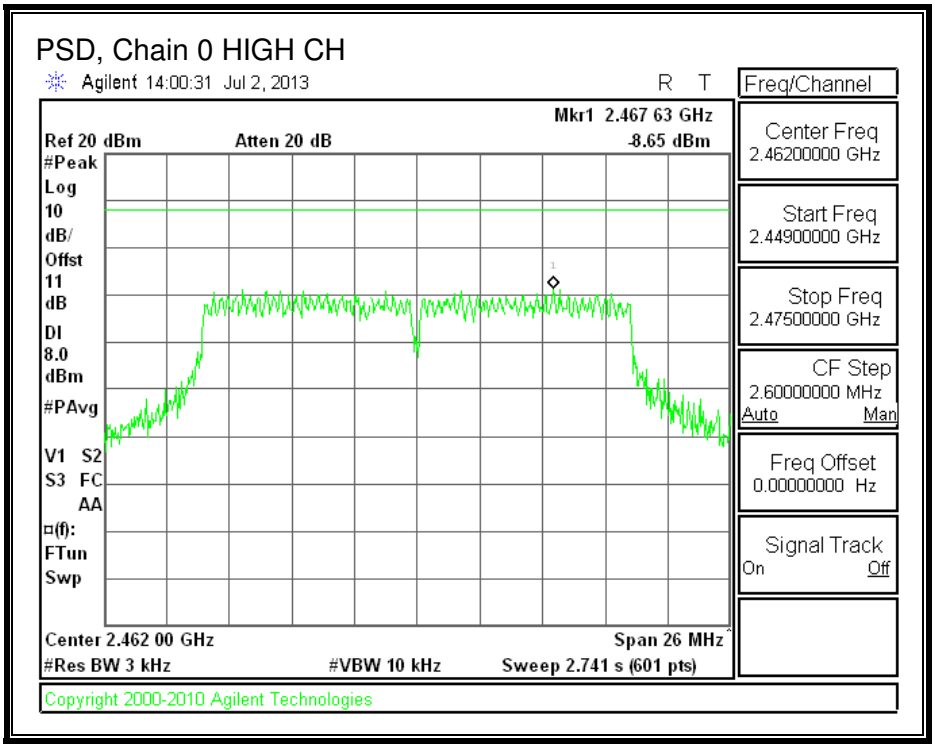
PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Chain 1 Meas (dBm)	Total PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-8.13	-8.10	-5.10	8.0	-13.1
Mid	2437	-8.73	-7.40	-5.00	8.0	-13.0
High	2462	-8.65	-7.82	-5.20	8.0	-13.2

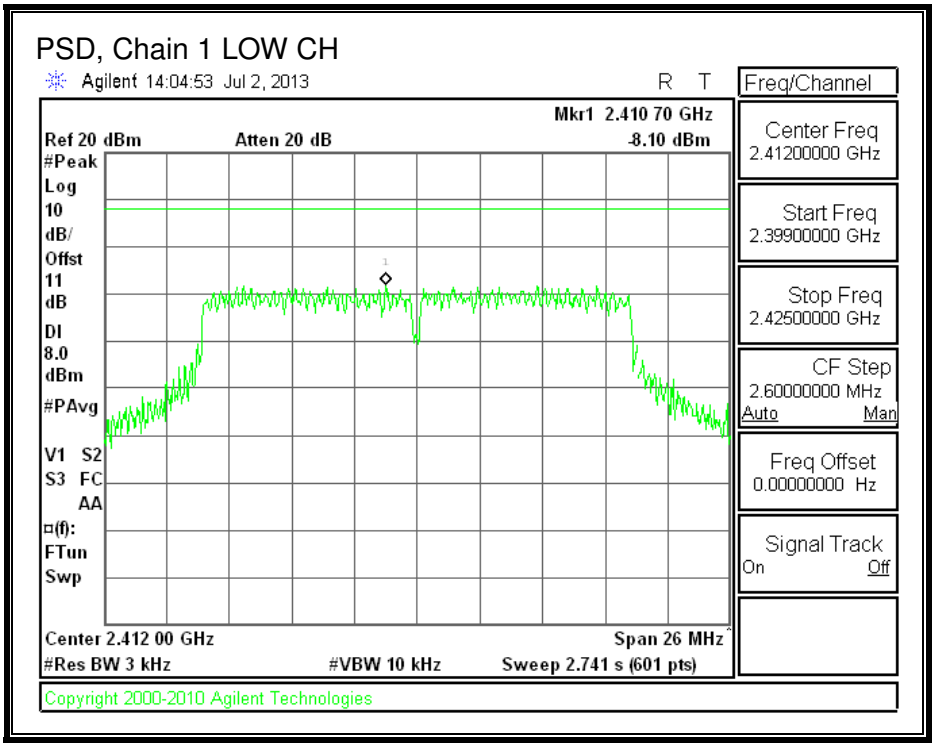
PSD, Chain 0



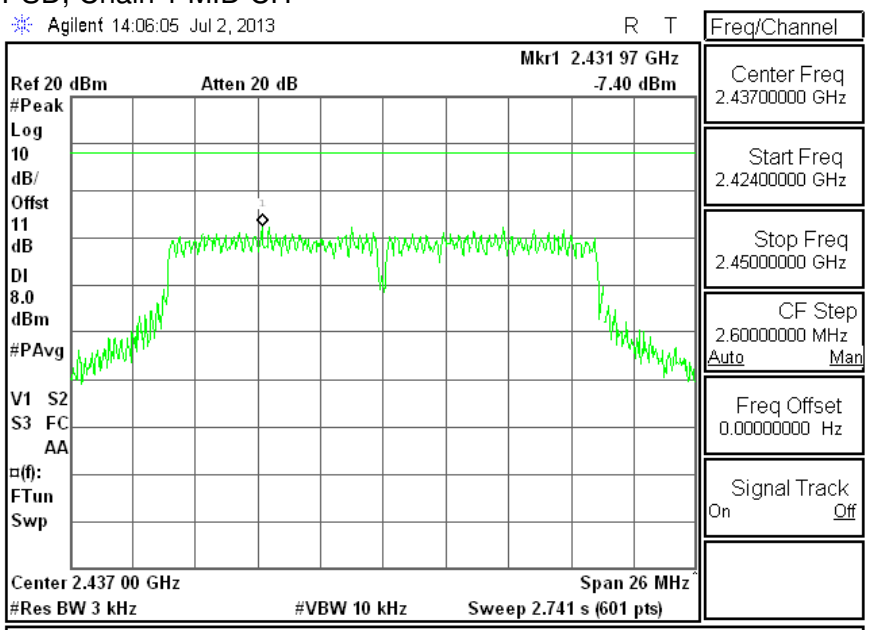




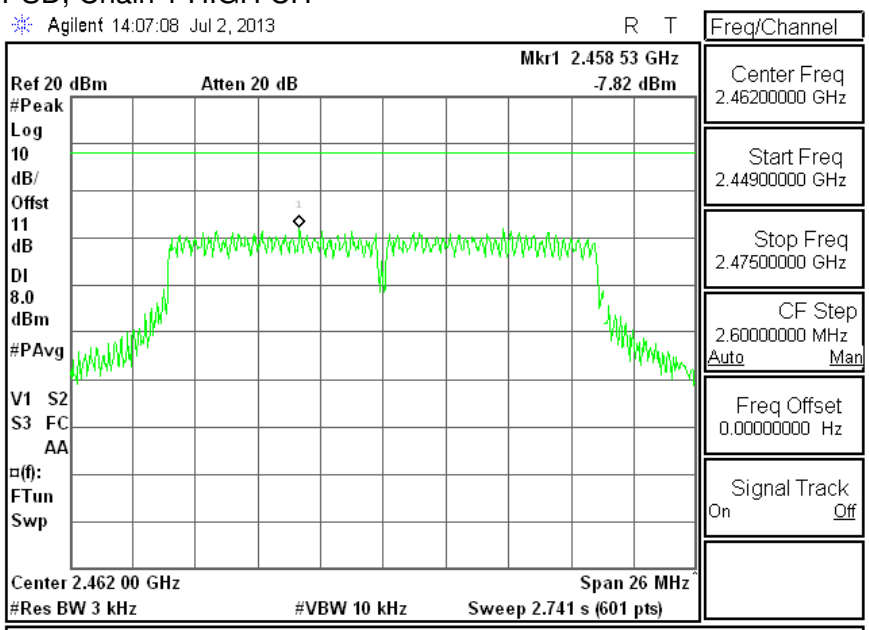
PSD, Chain 1



PSD, Chain 1 MID CH



PSD, Chain 1 HIGH CH



8.3.6. OUT-OF-BAND EMISSIONS

LIMITS

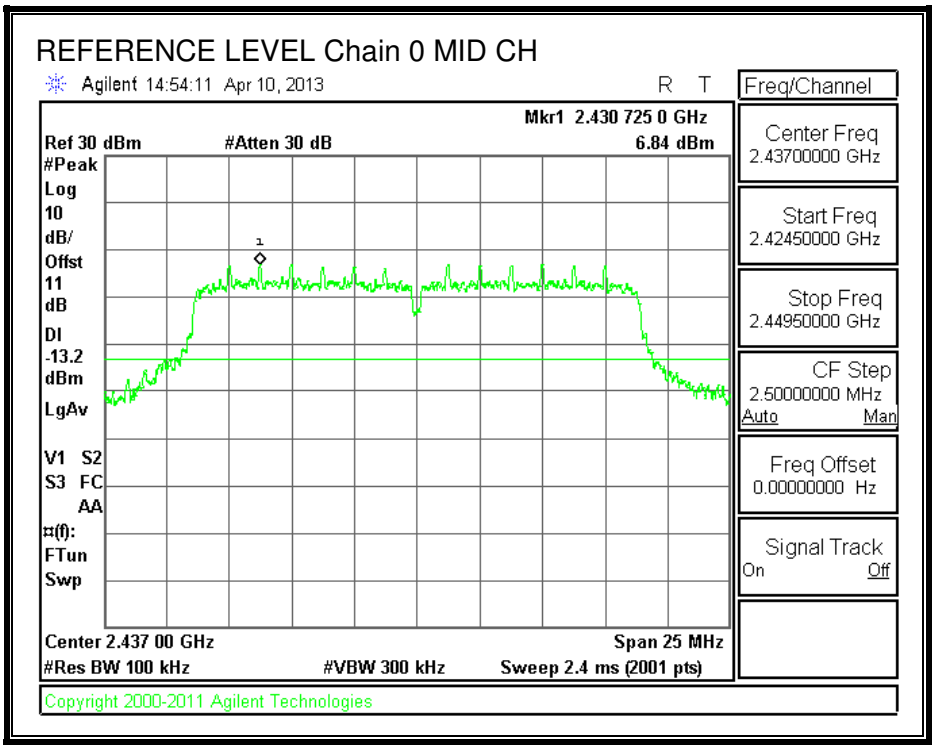
FCC §15.247 (d)

IC RSS-210 A8.5

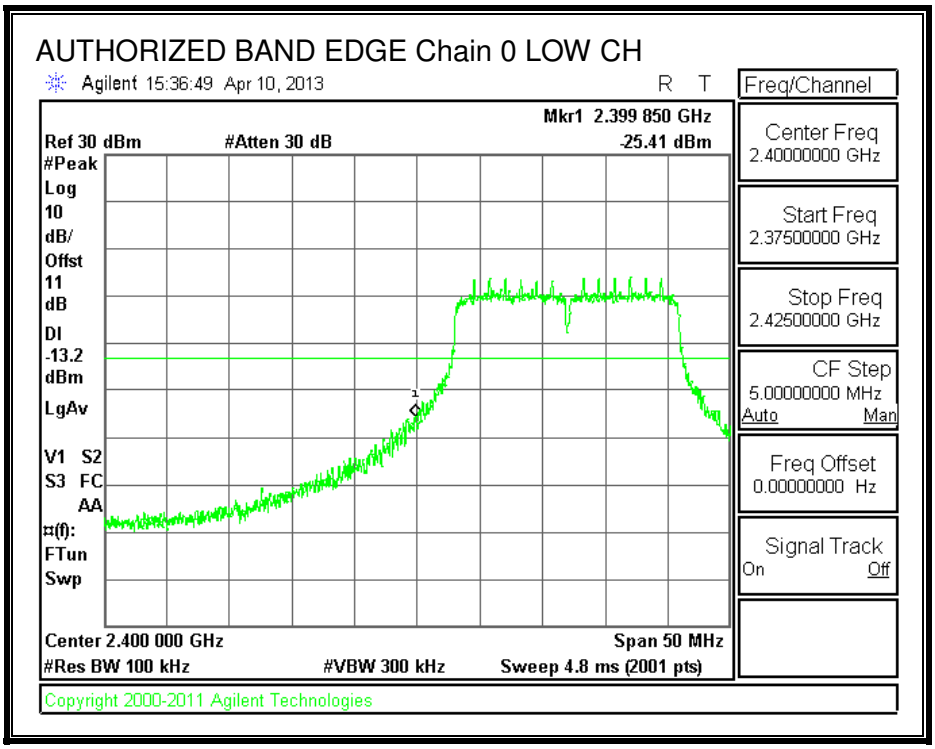
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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.

RESULTS

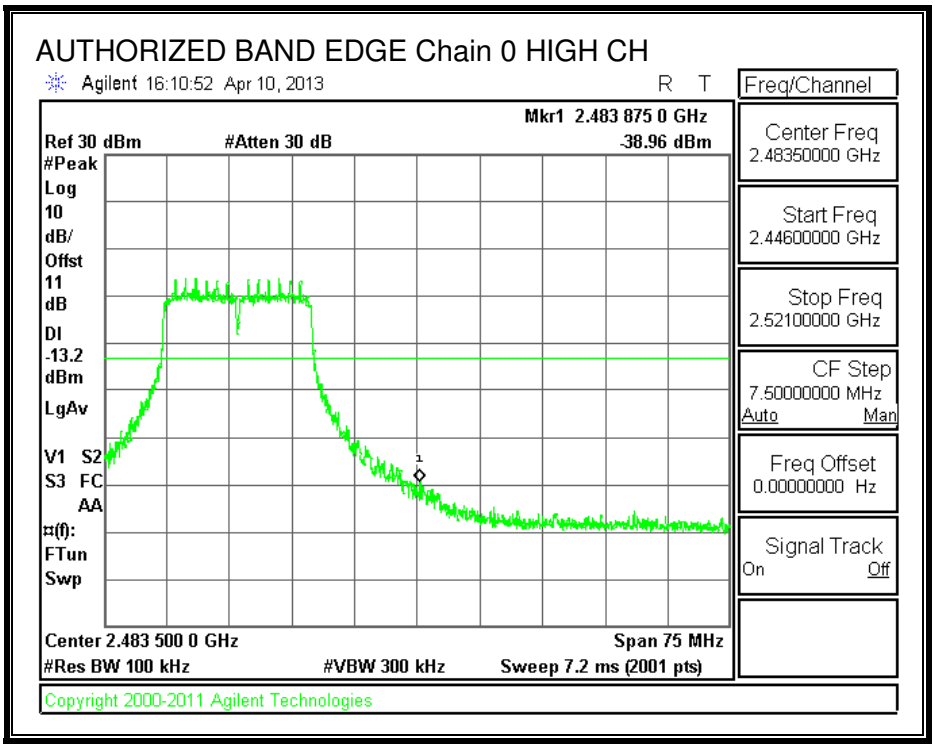
IN-BAND REFERENCE LEVEL, Chain 0



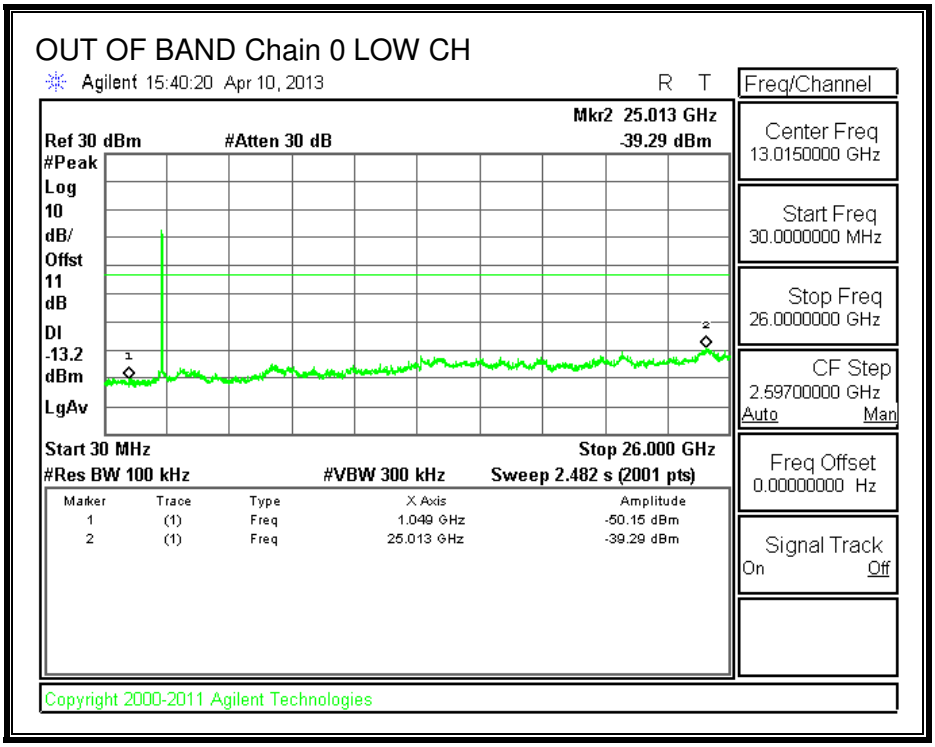
LOW CHANNEL BANDEDGE, Chain 0

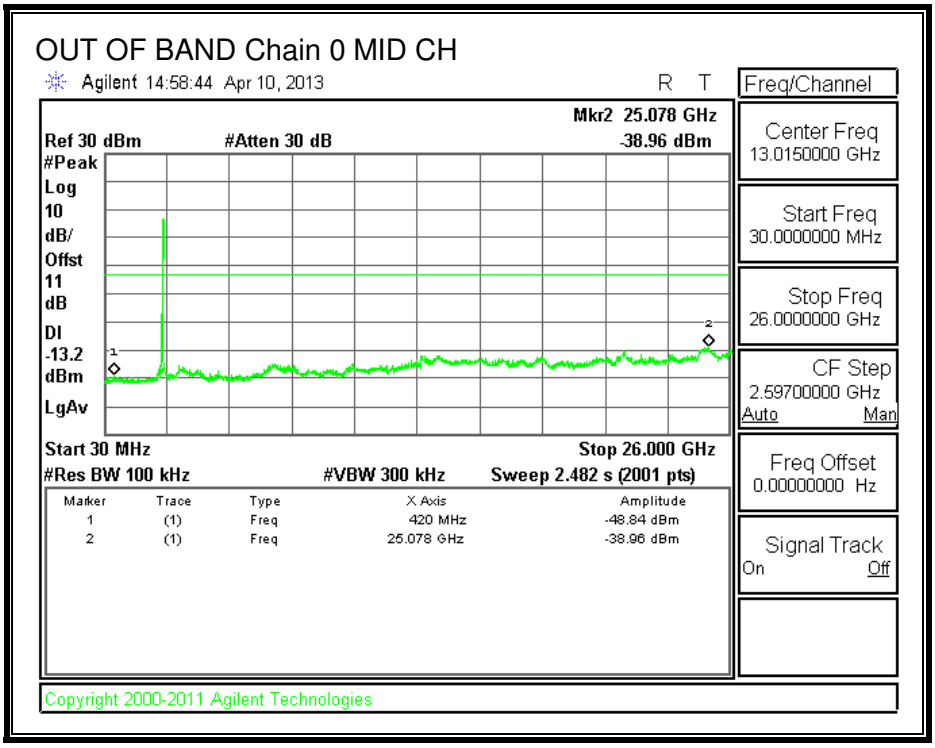


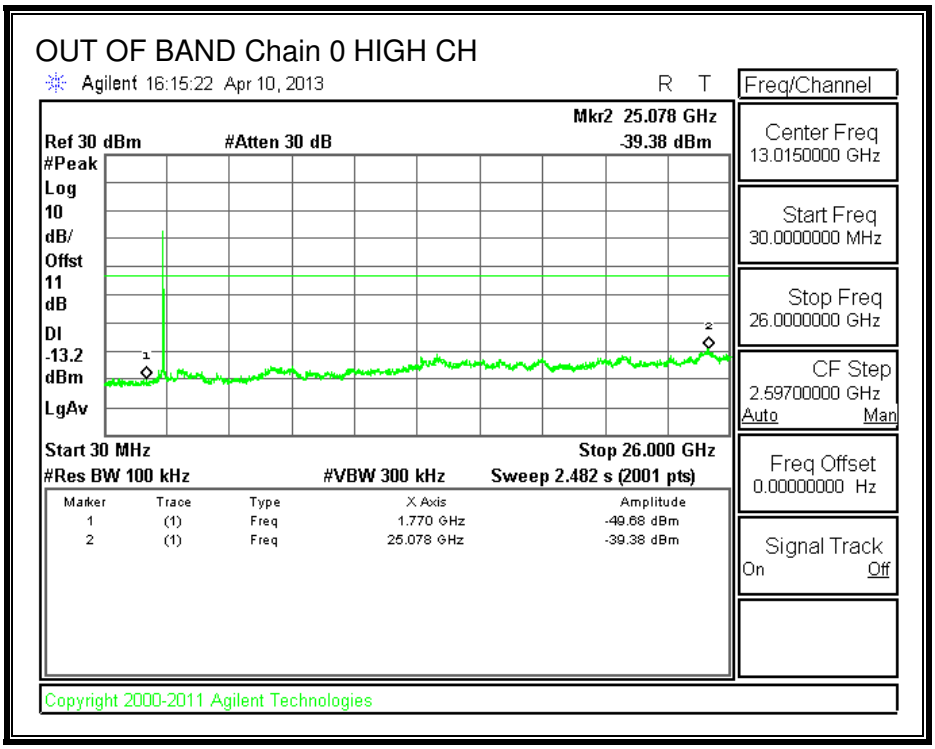
HIGH CHANNEL BANDEDGE, Chain 0



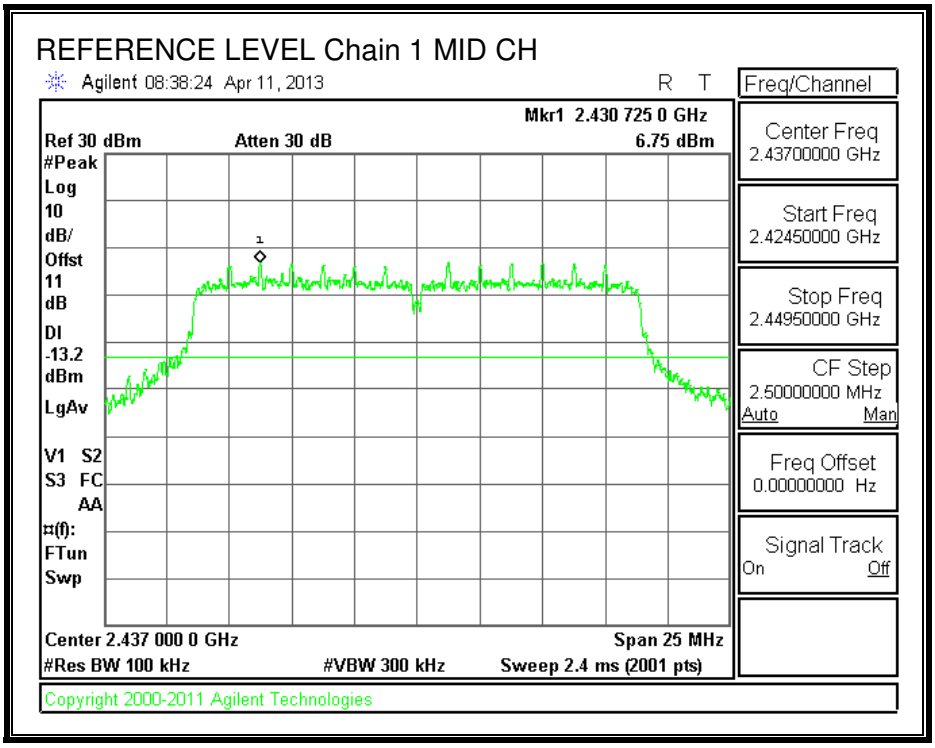
OUT-OF-BAND EMISSIONS, Chain 0



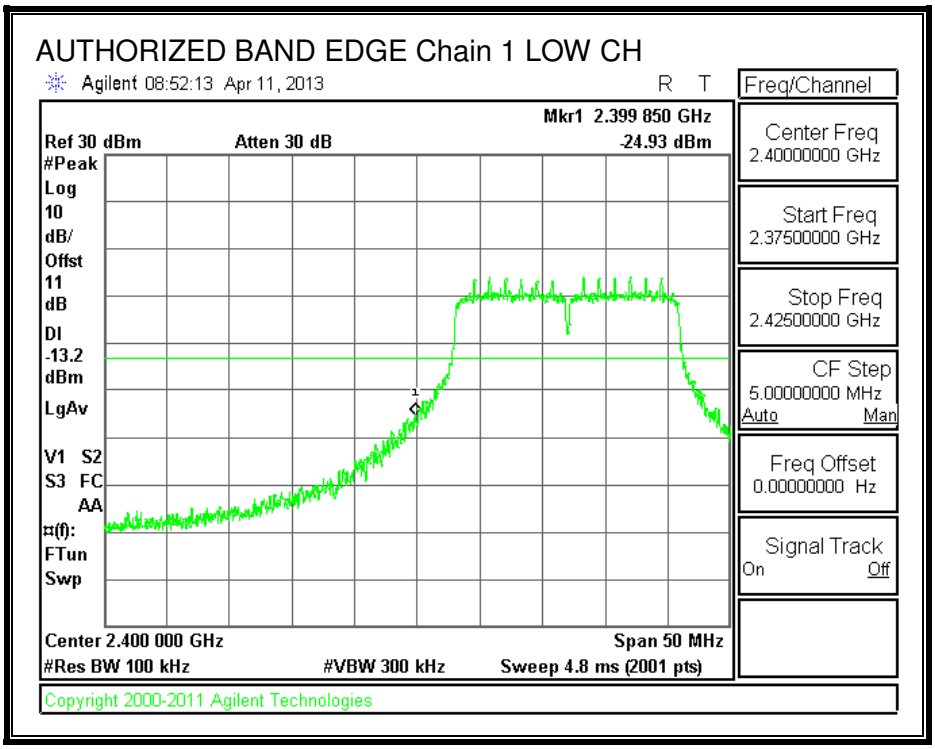




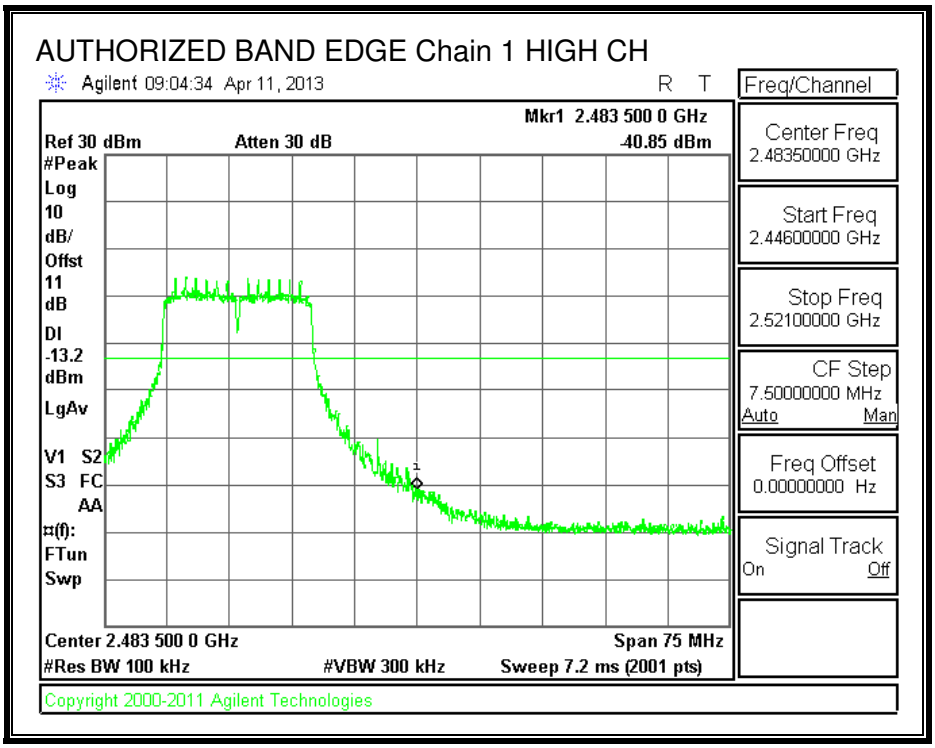
IN-BAND REFERENCE LEVEL, Chain 1

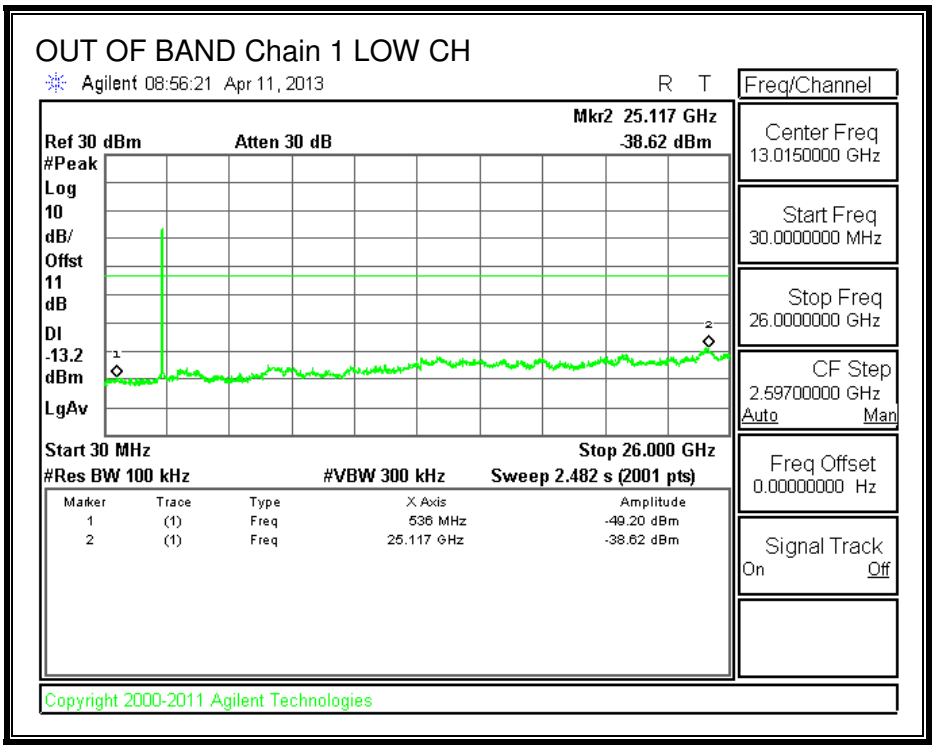


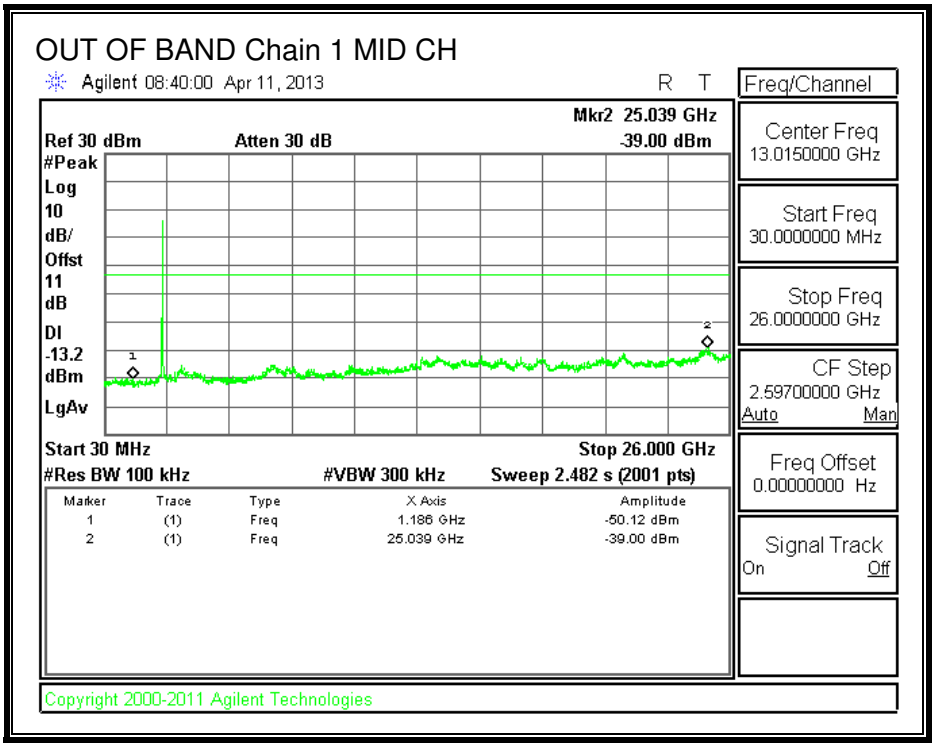
LOW CHANNEL BANDEDGE, Chain 1

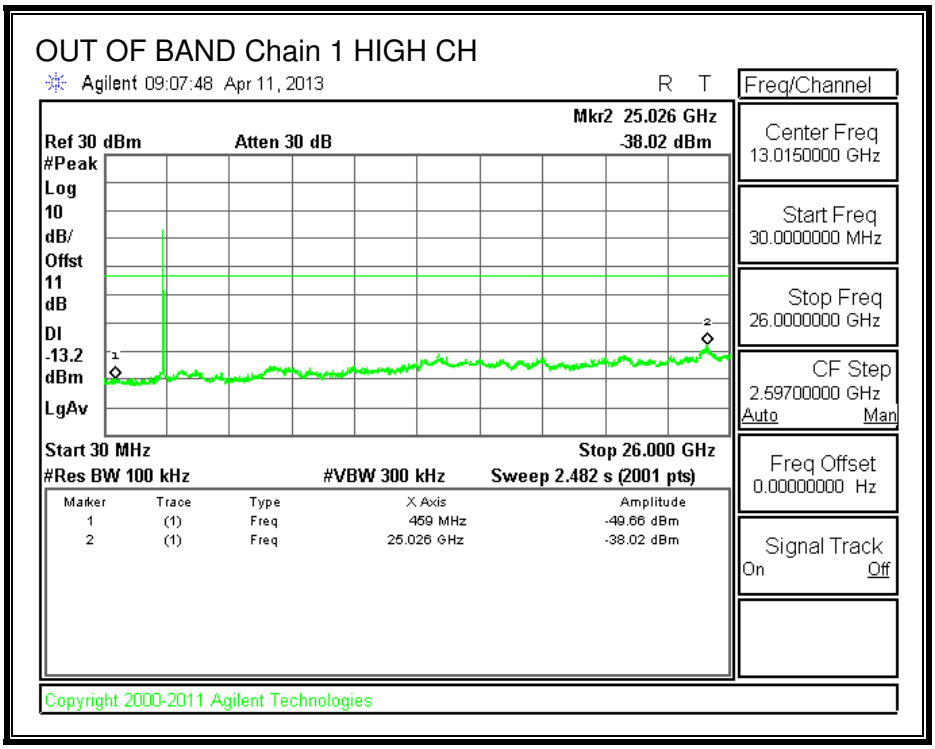


HIGH CHANNEL BANDEDGE, Chain 1









8.4. 802.11n HT20 MODE IN THE 5.8 GHz BAND

8.4.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

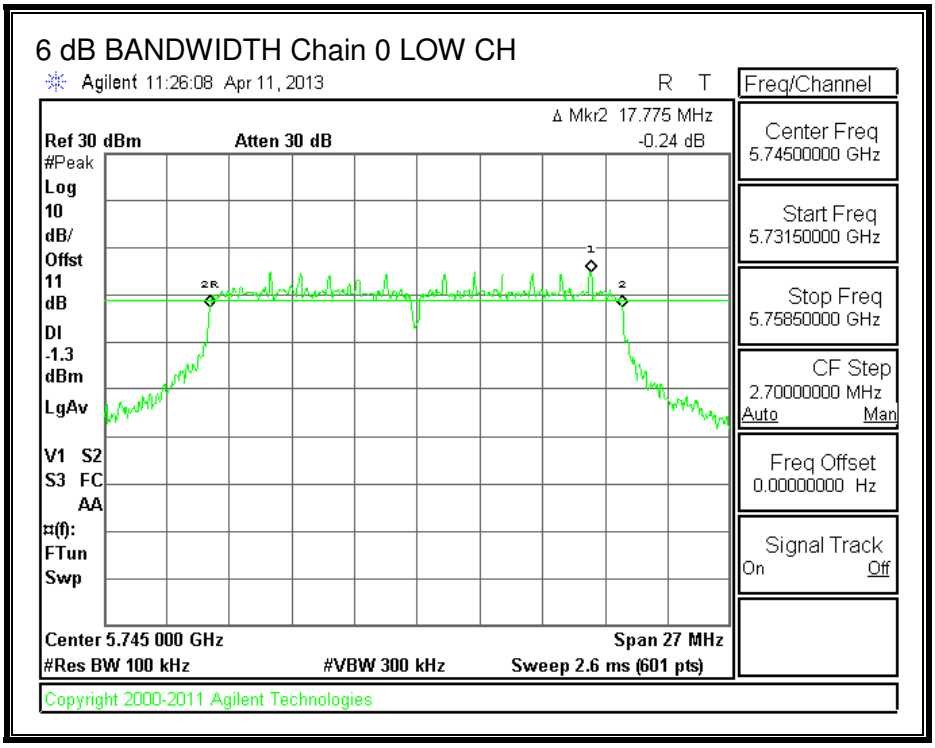
IC RSS-210 A8.2 (a)

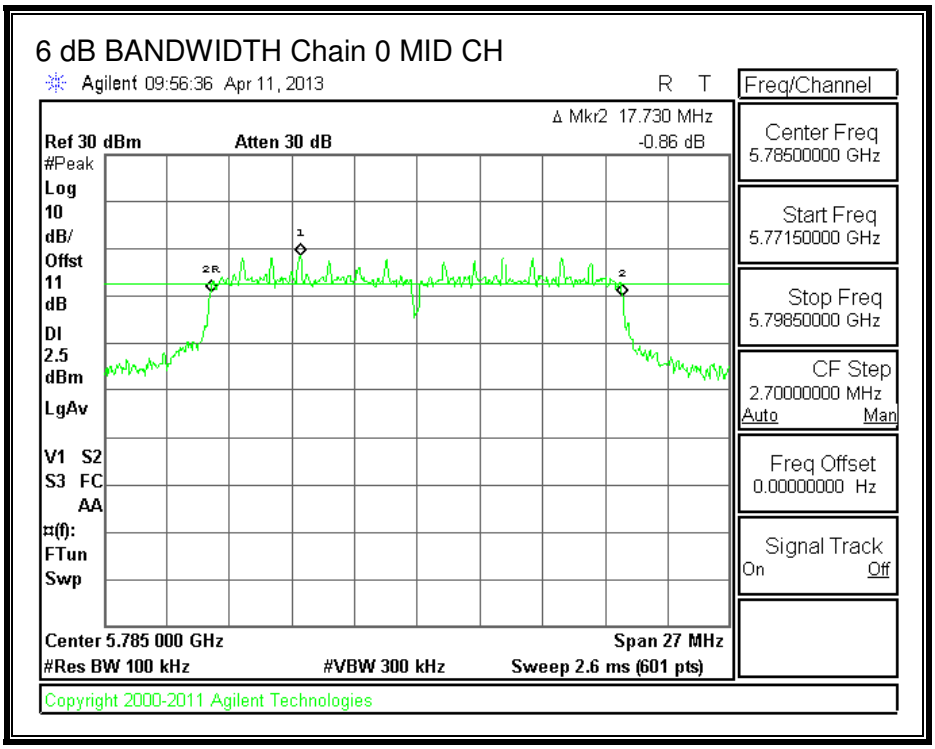
The minimum 6 dB bandwidth shall be at least 500 kHz.

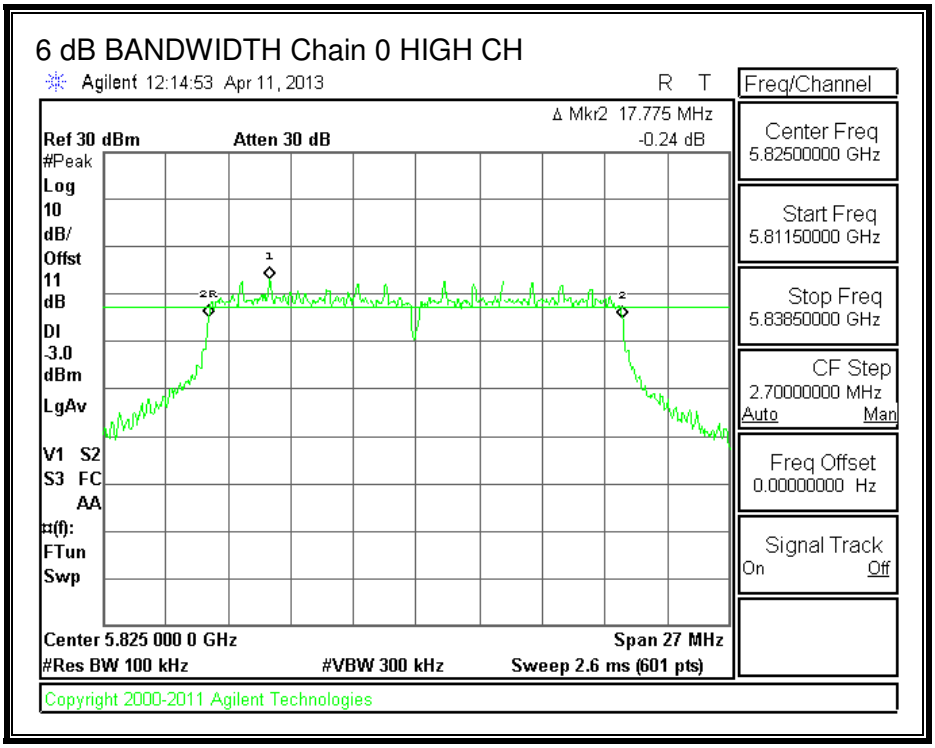
RESULTS

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low	5745	17.775	17.775	0.5
Mid	5785	17.730	17.685	0.5
High	5825	17.775	17.730	0.5

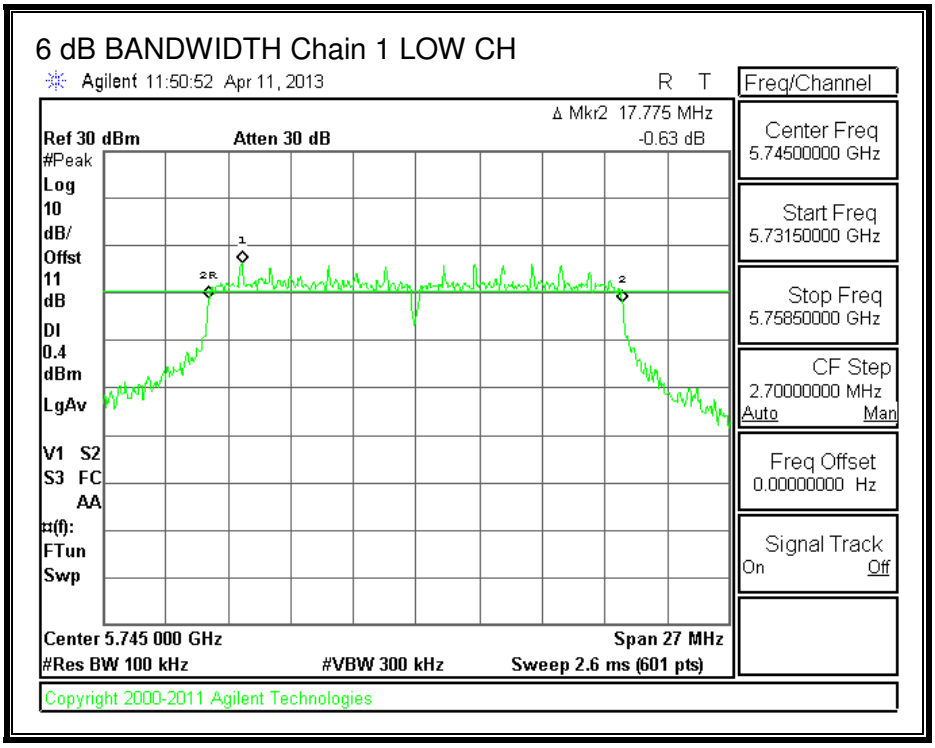
6 dB BANDWIDTH, Chain 0

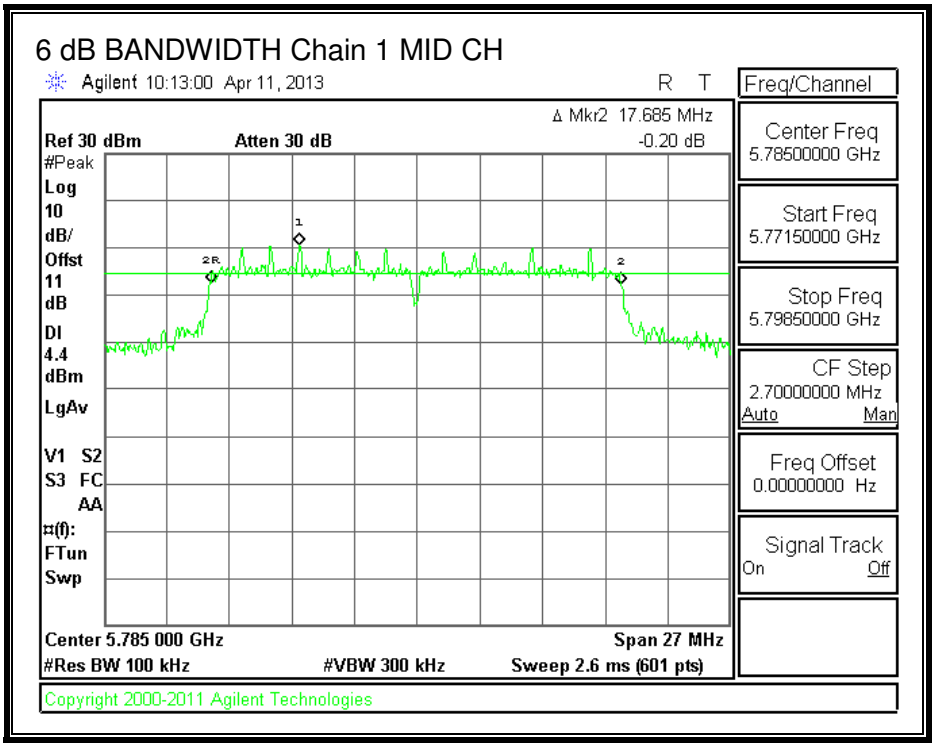


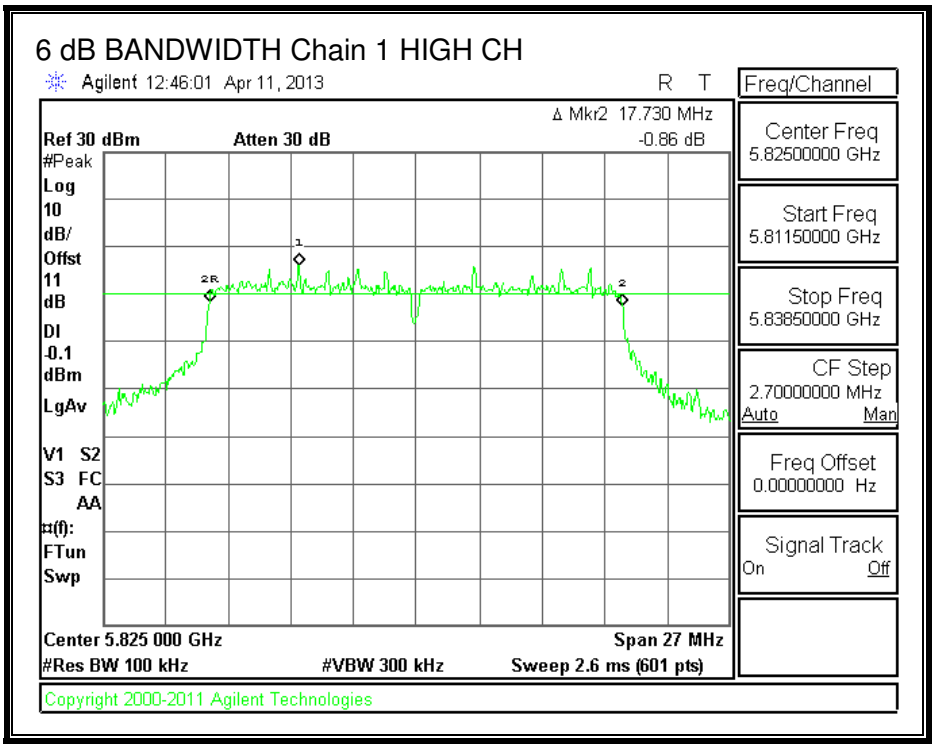




6 dB BANDWIDTH, Chain 1







8.4.2. 99% BANDWIDTH

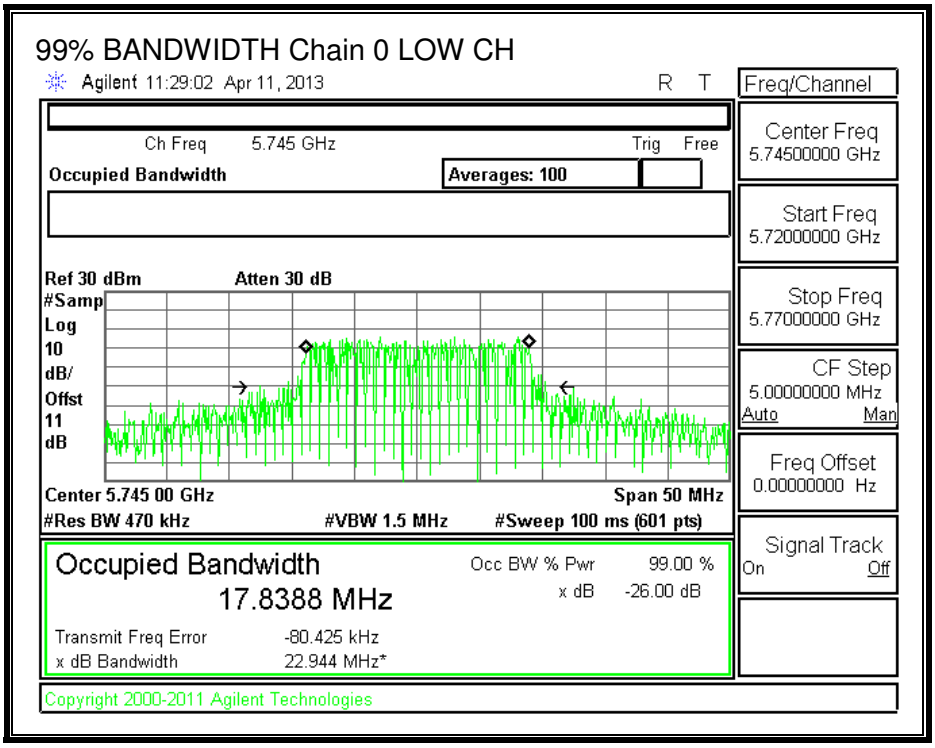
LIMITS

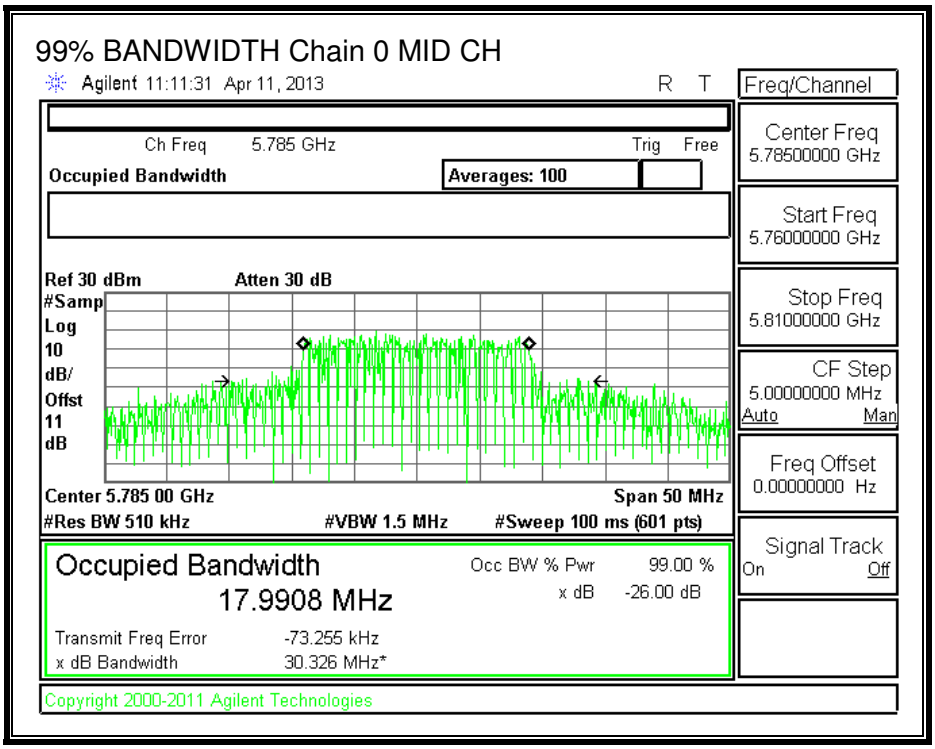
None; for reporting purposes only.

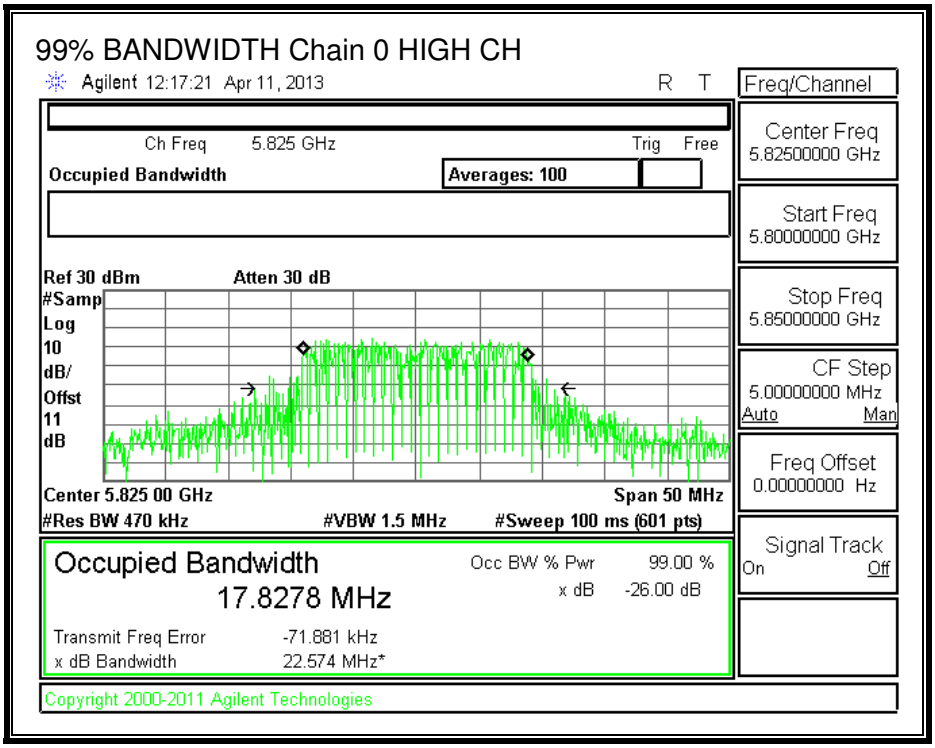
RESULTS

Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5745	17.8388	17.9264
Mid	5785	17.9908	18.0926
High	5825	17.8278	17.8673

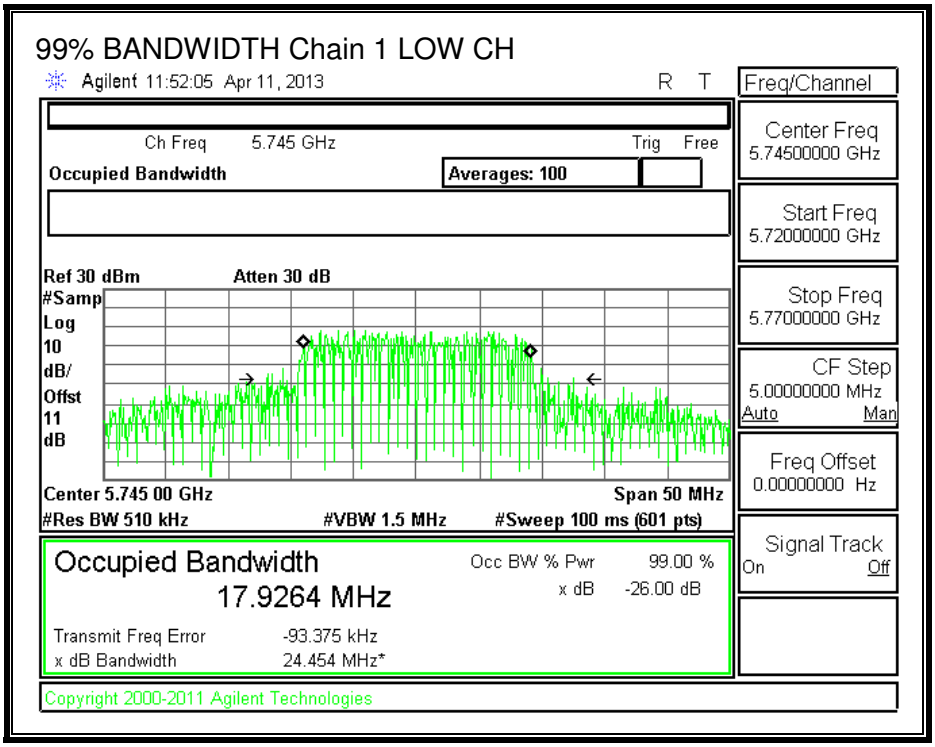
99% BANDWIDTH, Chain 0

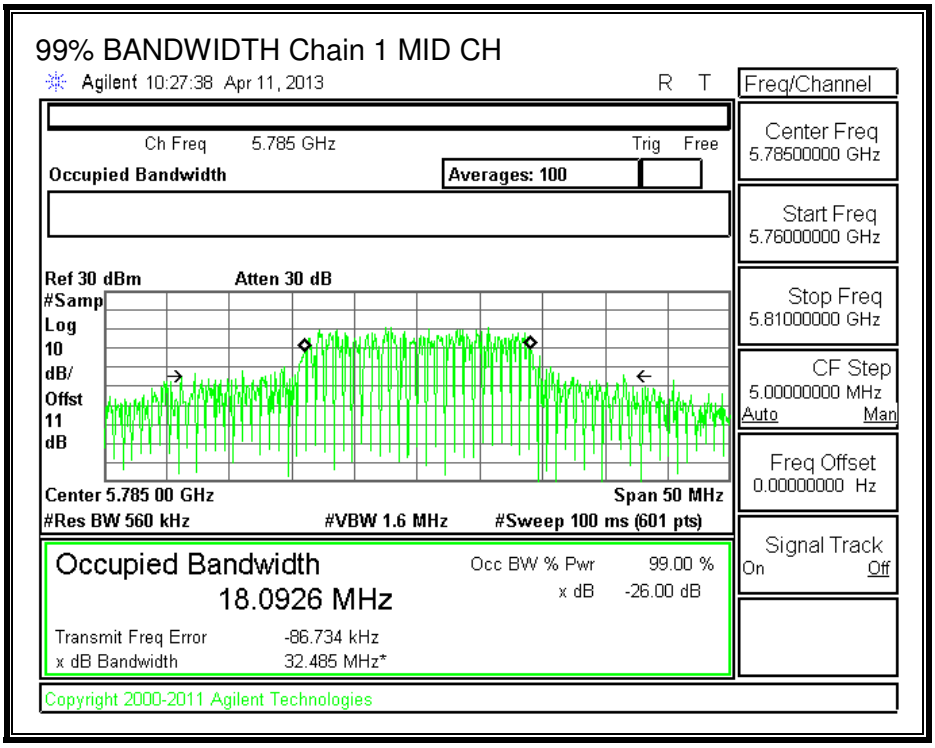


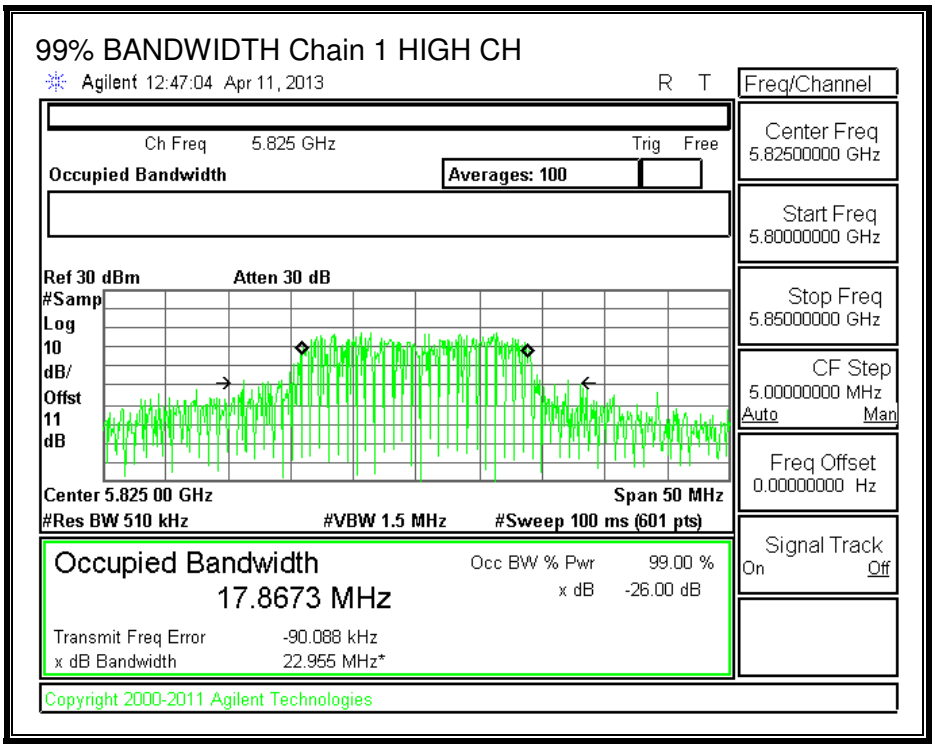




99% BANDWIDTH, Chain 1







8.4.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1.0 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5745	14.60	16.51	18.67
Mid	5785	16.10	16.45	19.29
High	5825	13.00	15.40	17.37

8.4.4. OUTPUT POWER

LIMITS

FCC §15.247

IC RSS-210 A8.4

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 unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
3.59	3.29	3.44

RESULTS

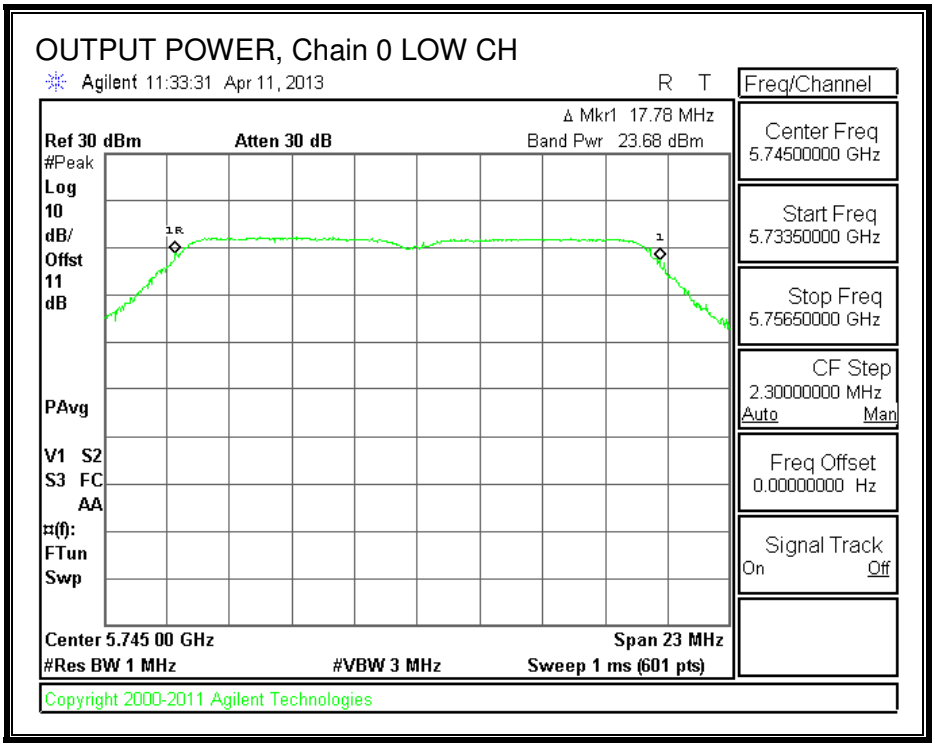
Limits

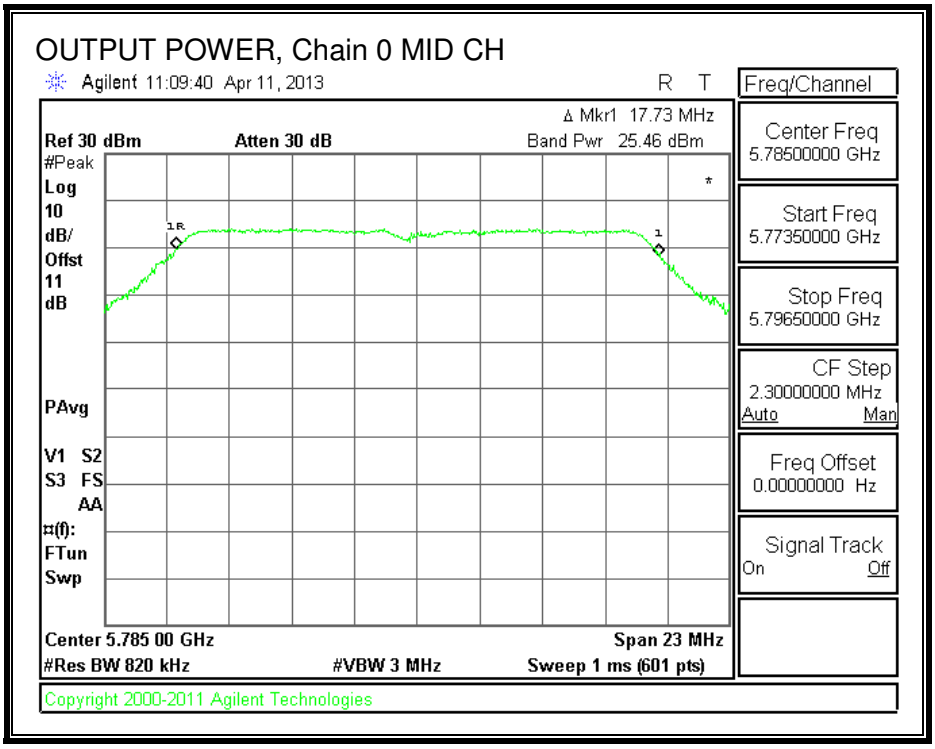
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	5745	3.44	30.00	30	36	30.00
Mid	5785	3.44	30.00	30	36	30.00
High	5825	3.44	30.00	30	36	30.00

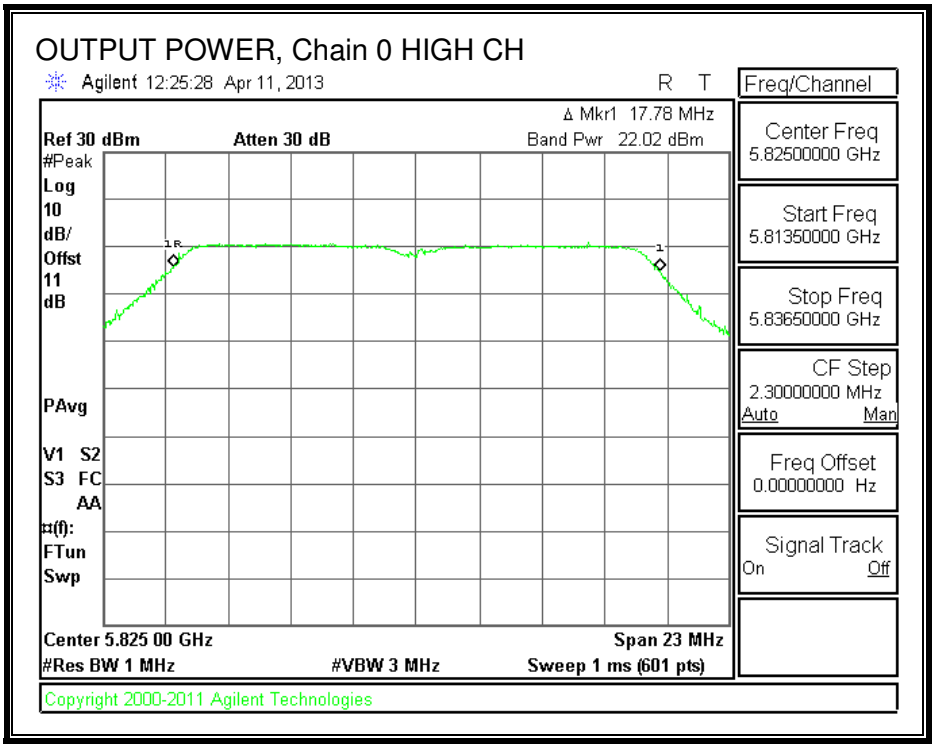
Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margi (dB)
Low	5745	23.68	25.42	27.65	30.00	-2.35
Mid	5785	25.46	27.01	29.31	30.00	-0.69
High	5825	22.02	24.91	26.71	30.00	-3.29

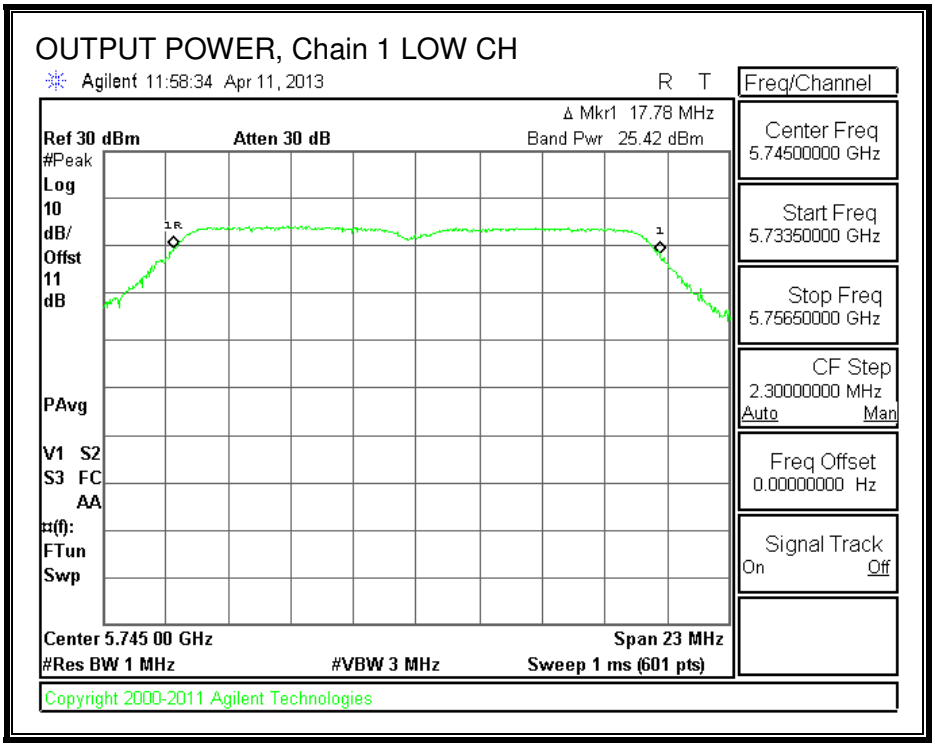
OUTPUT POWER, Chain 0

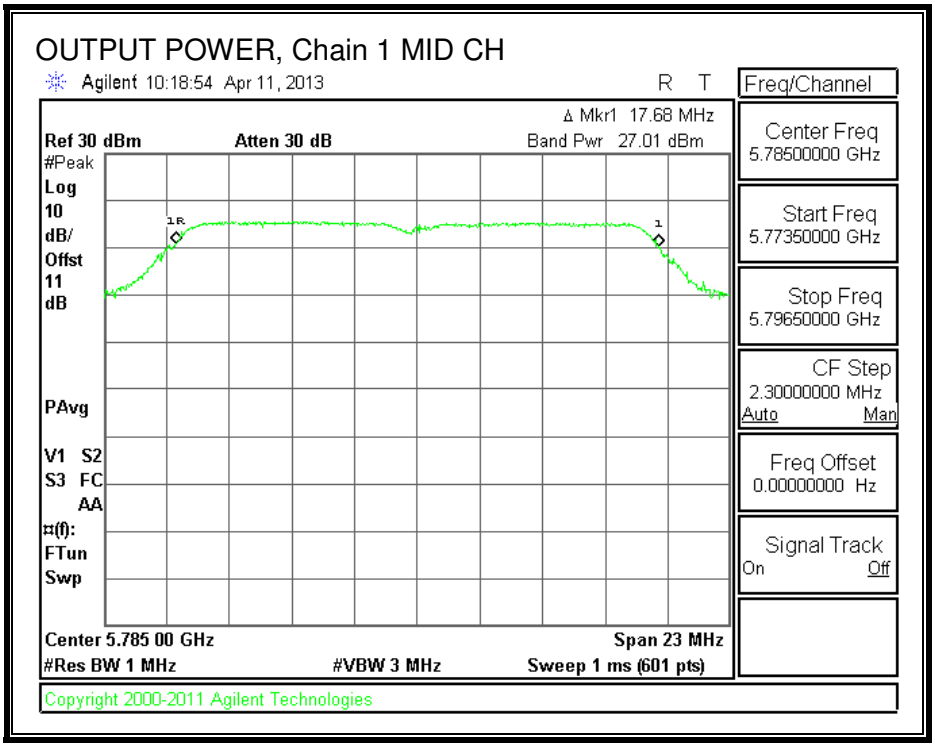


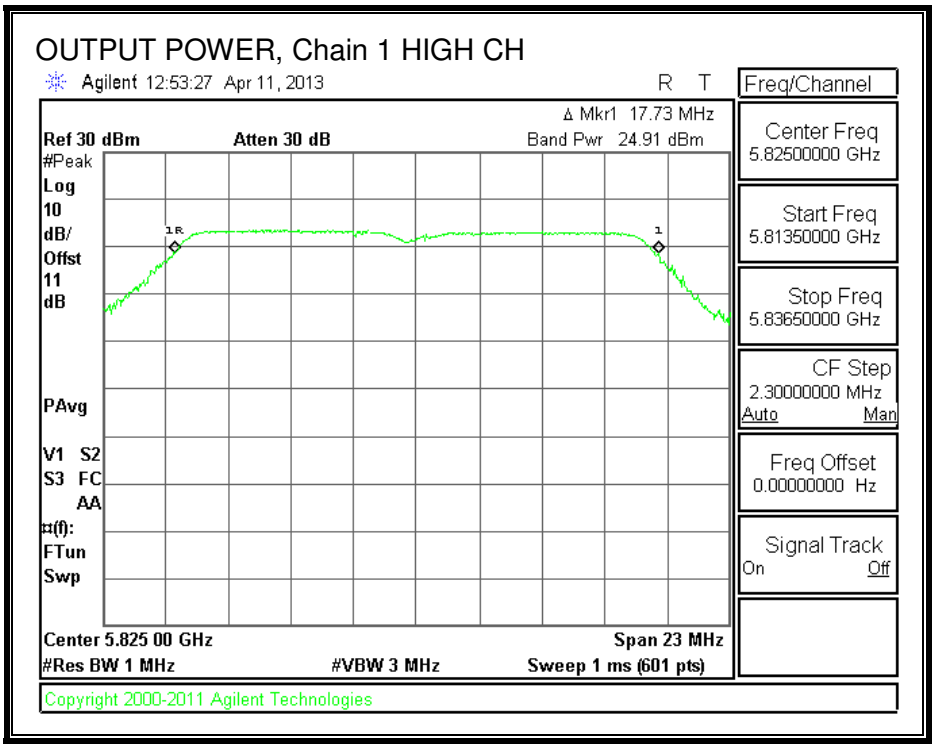




OUTPUT POWER, Chain 1







8.4.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247

IC RSS-210 A8.2

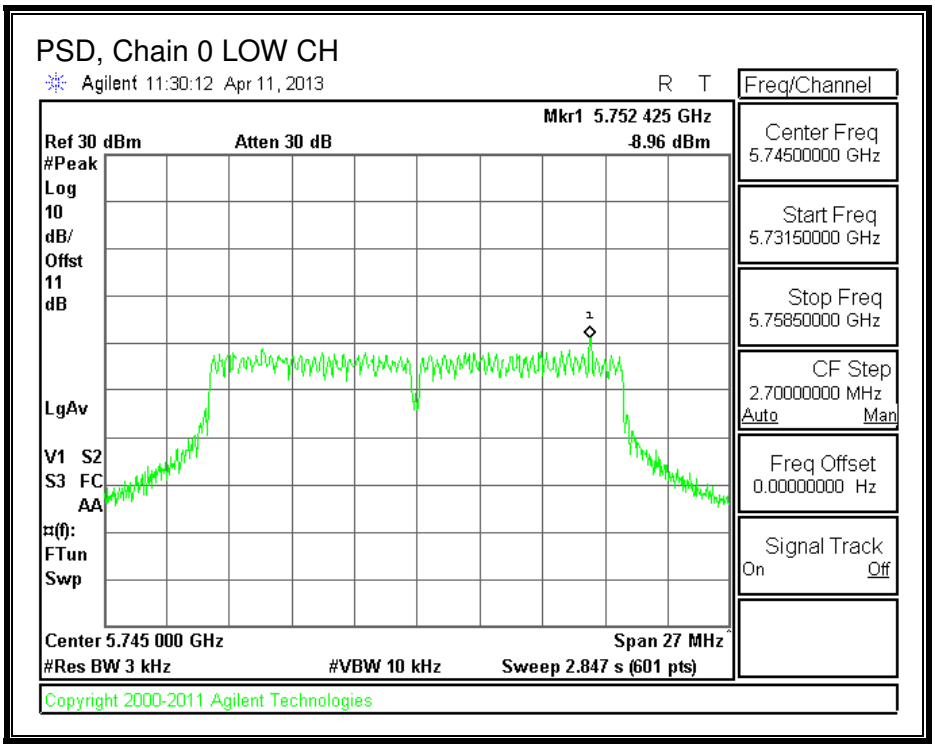
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

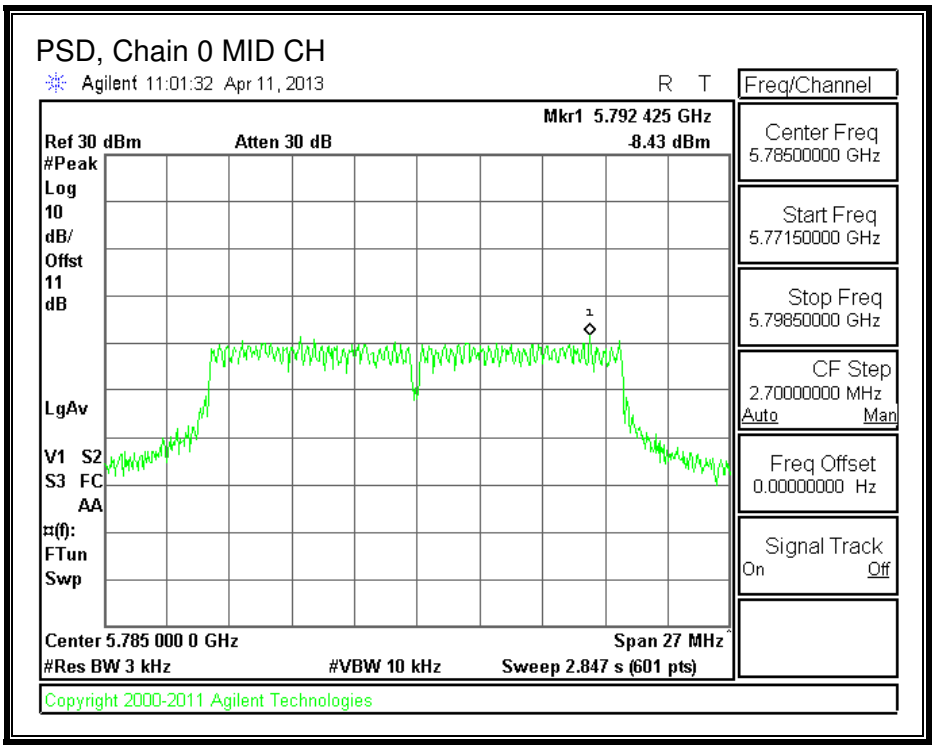
RESULTS

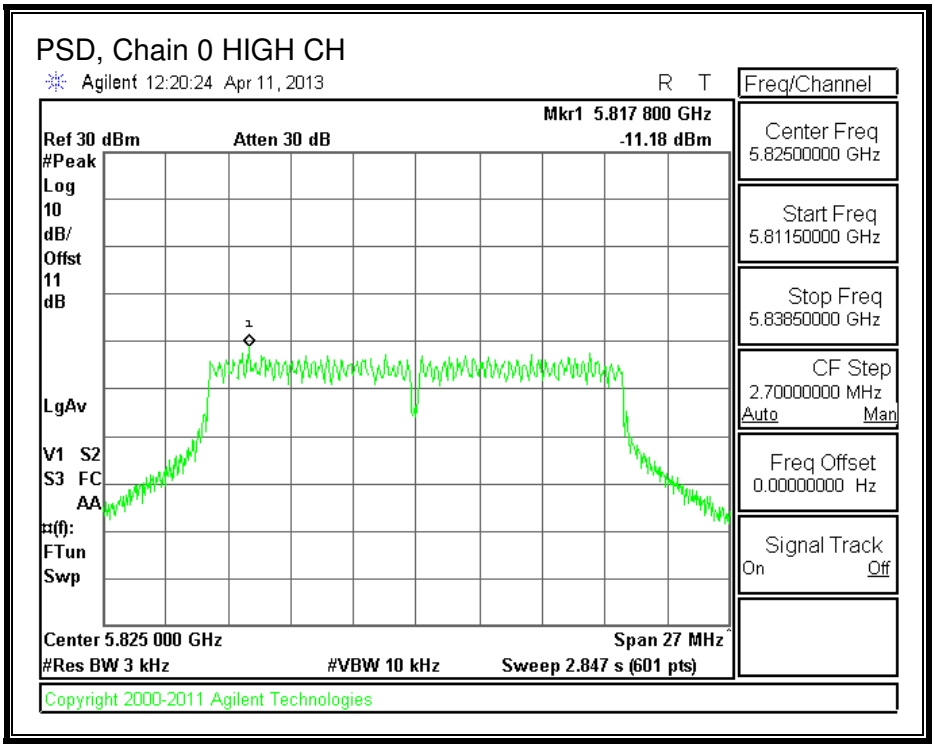
PSD Results

Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Chain 1 Meas (dBm)	Total PSD (dBm)	Limit (dBm)	Margin (dB)
Low	5745	-8.96	-8.43	-5.68	8.0	-13.7
Mid	5785	-8.43	-6.85	-4.56	8.0	-12.6
High	5825	-11.18	-10.14	-7.62	8.0	-15.6

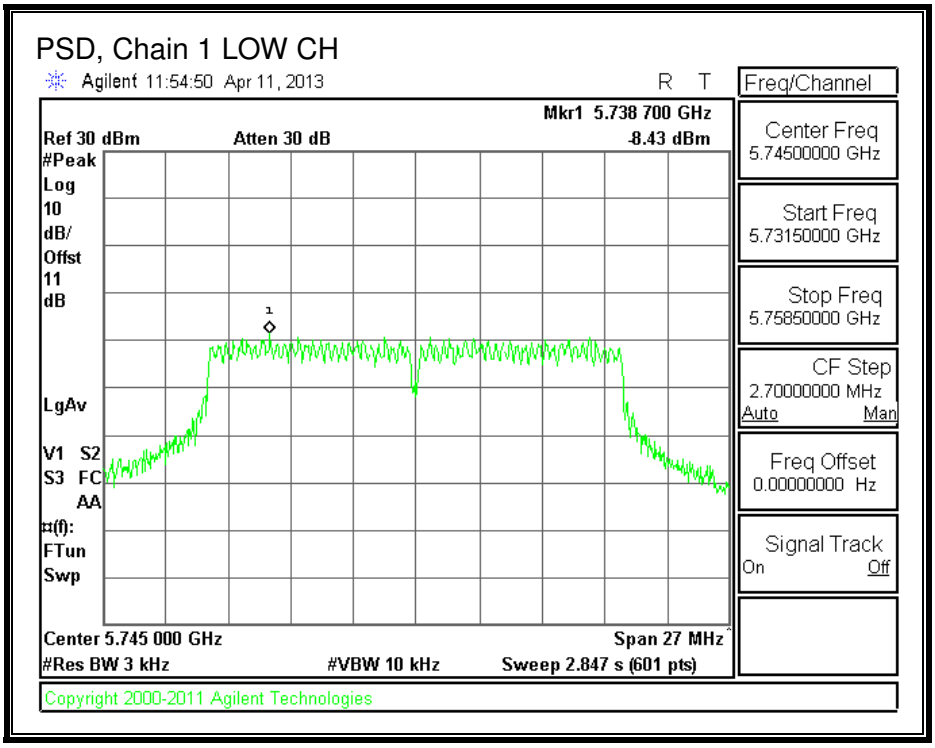
PSD, Chain 0



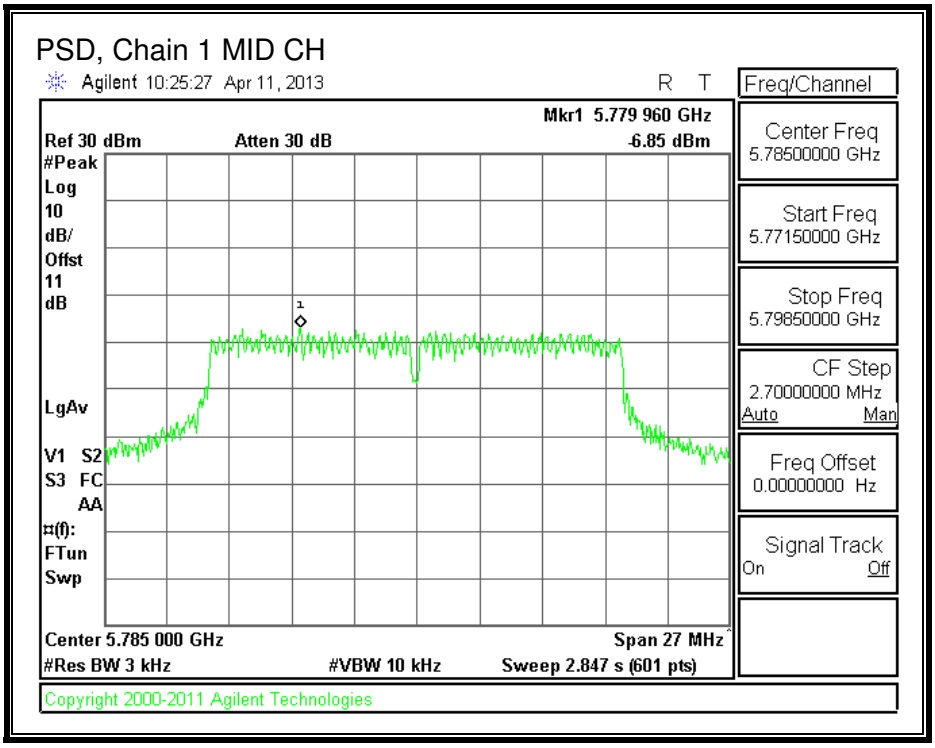




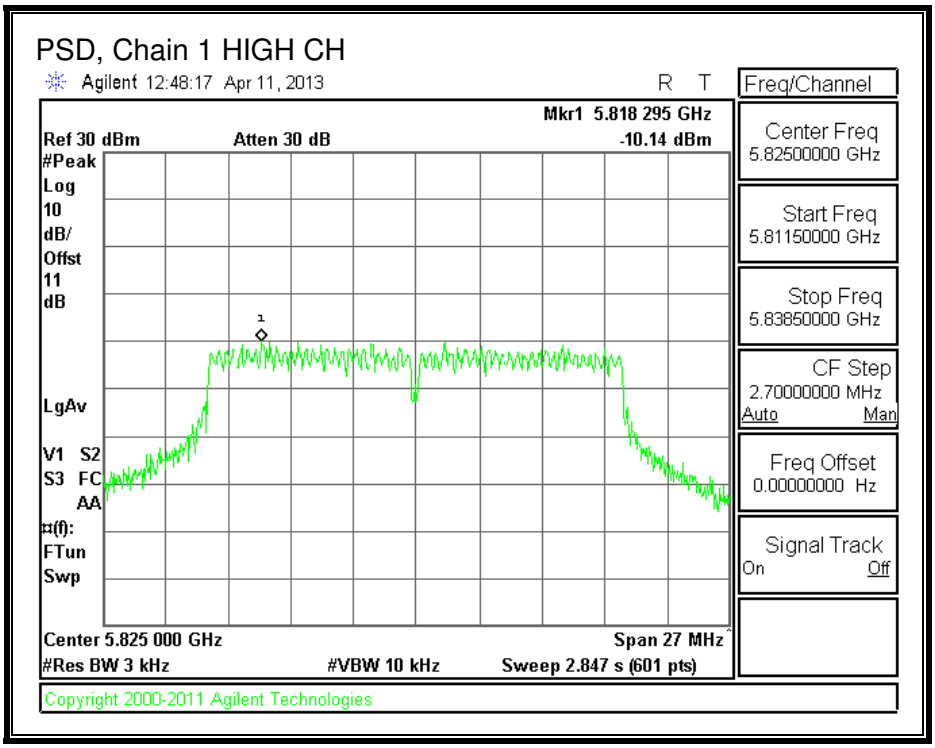
PSD, Chain 1



PSD, Chain 1 MID CH



PSD, Chain 1 HIGH CH



8.4.6. OUT-OF-BAND EMISSIONS

LIMITS

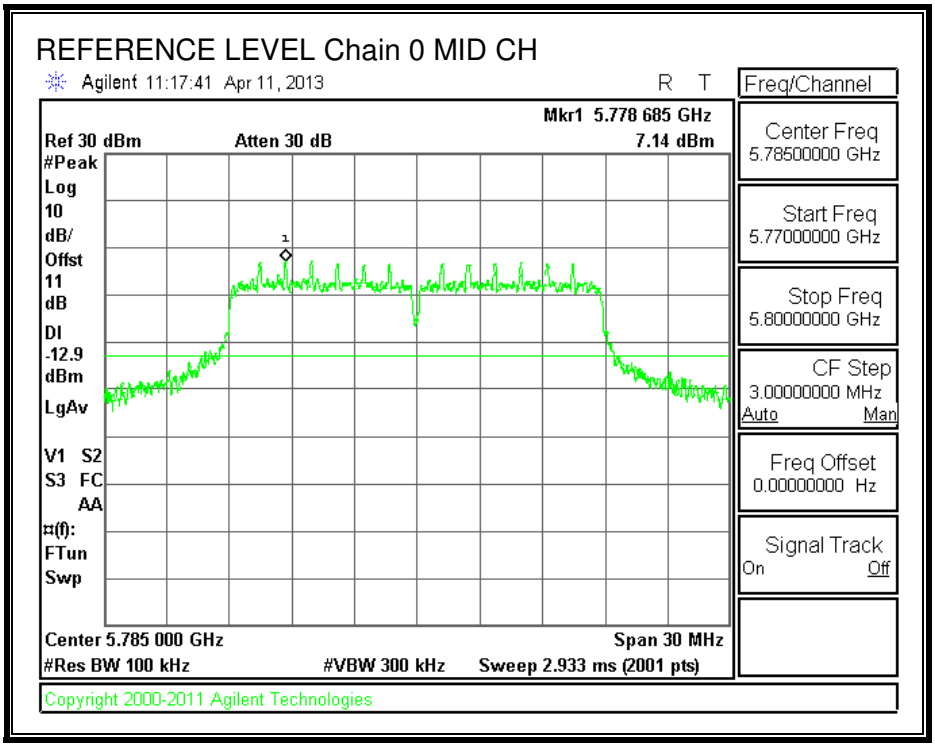
FCC §15.247 (d)

IC RSS-210 A8.5

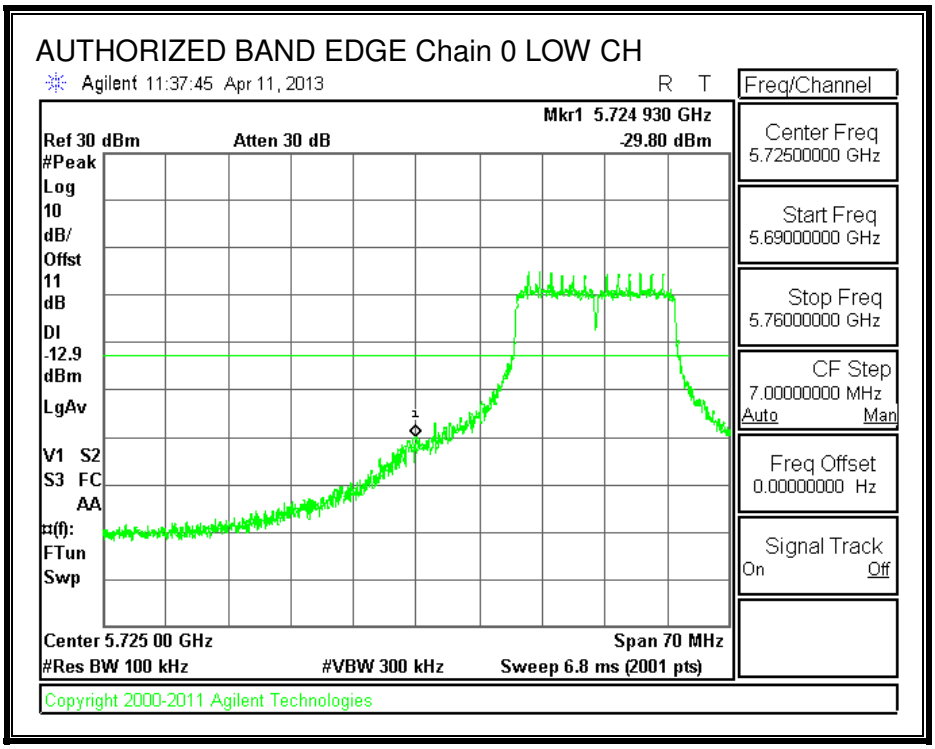
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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.

RESULTS

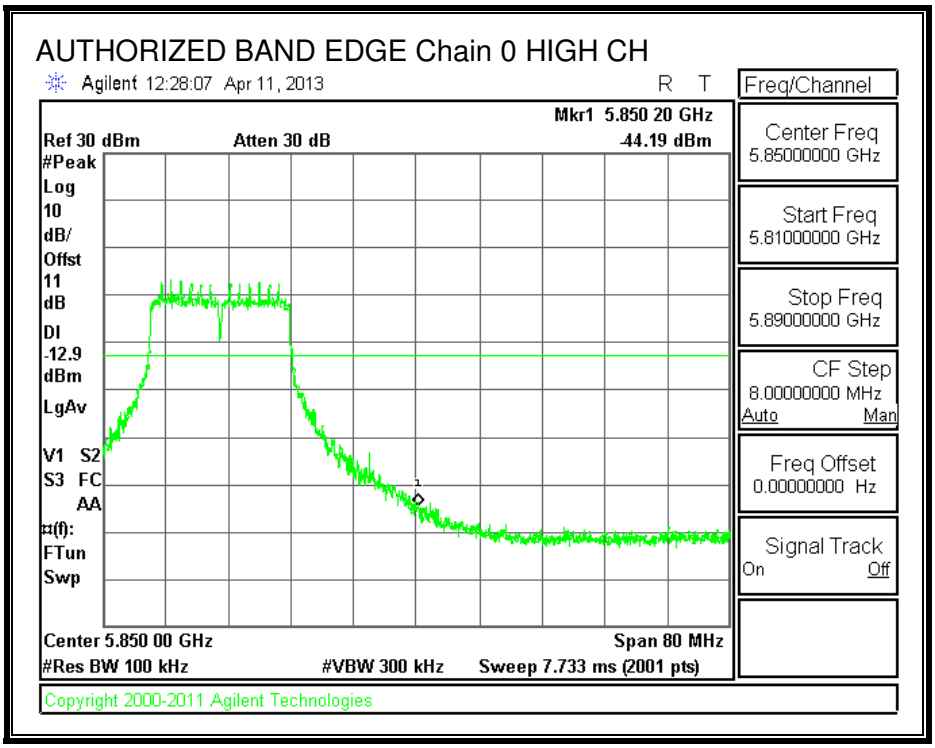
IN-BAND REFERENCE LEVEL, Chain 0



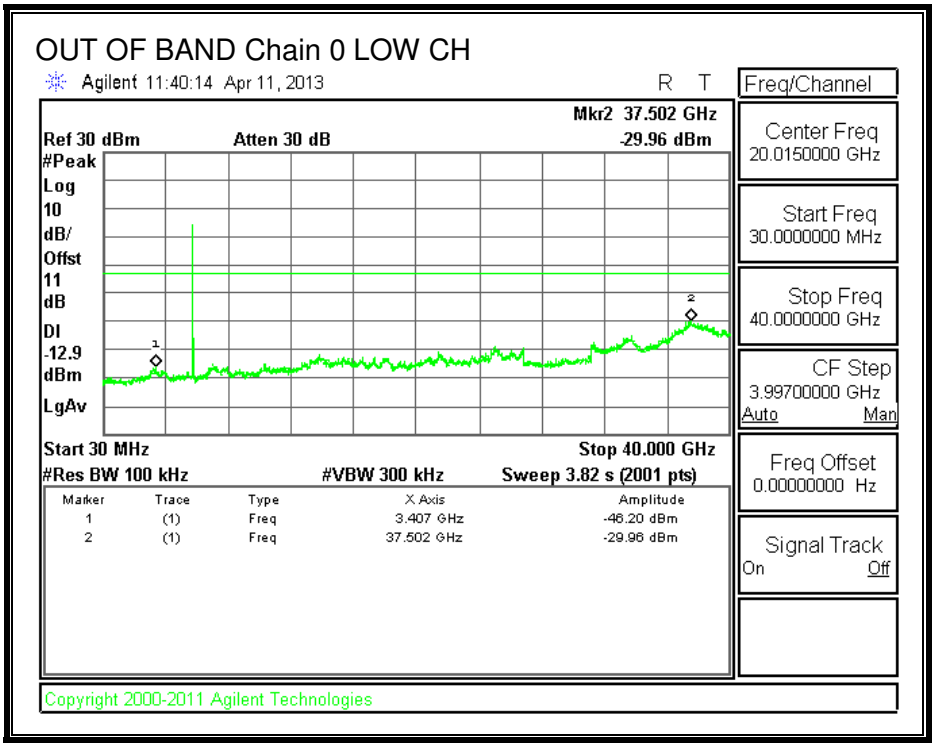
LOW CHANNEL BANDEDGE, Chain 0

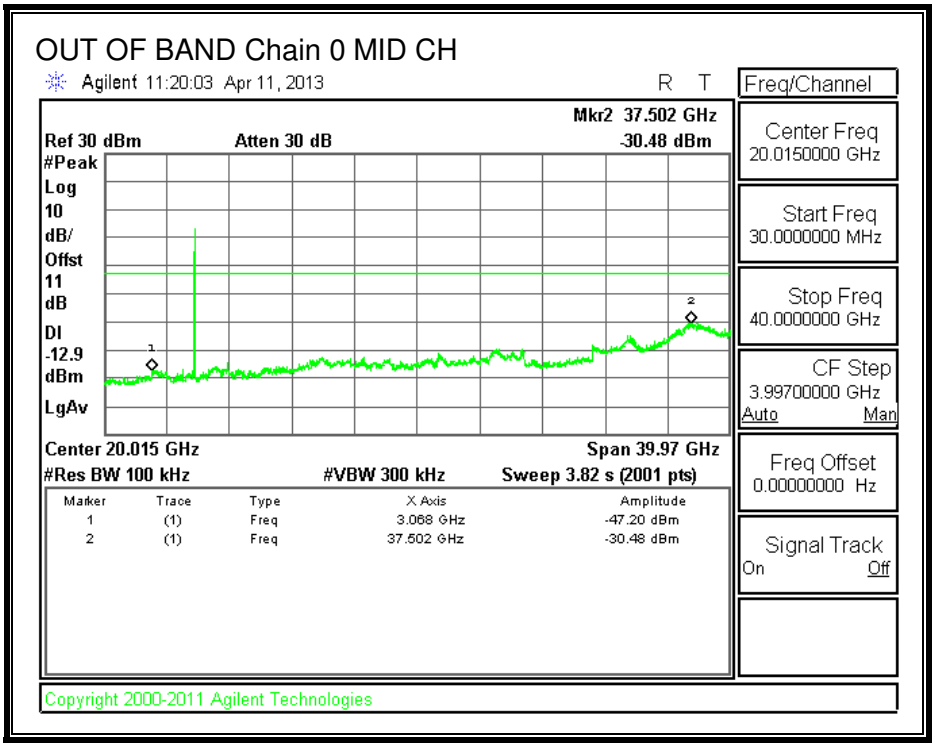


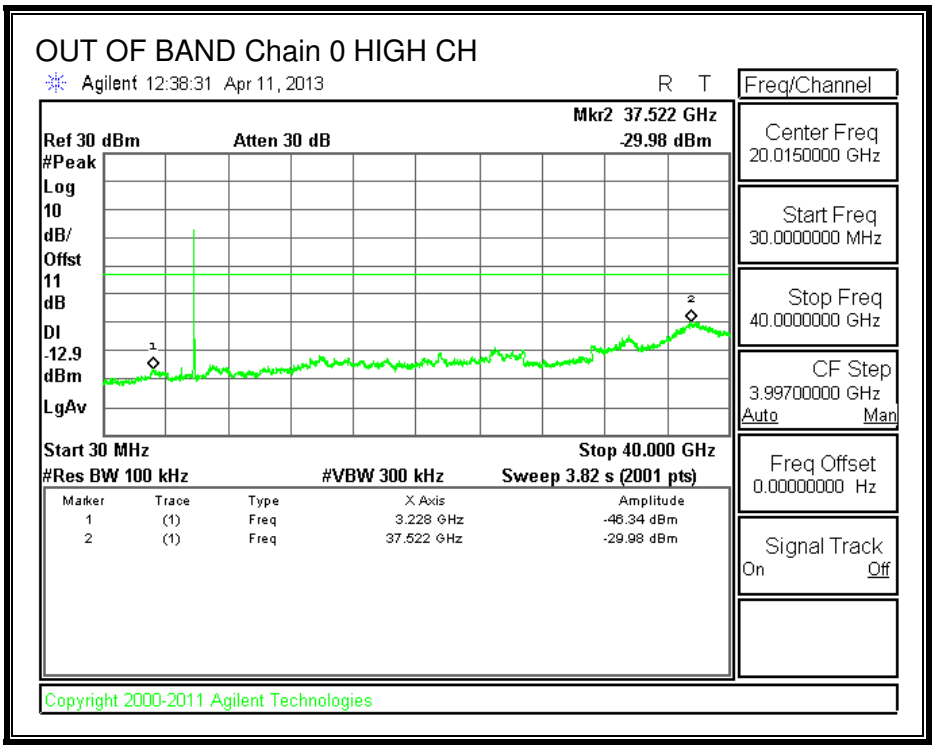
HIGH CHANNEL BANDEDGE, Chain 0



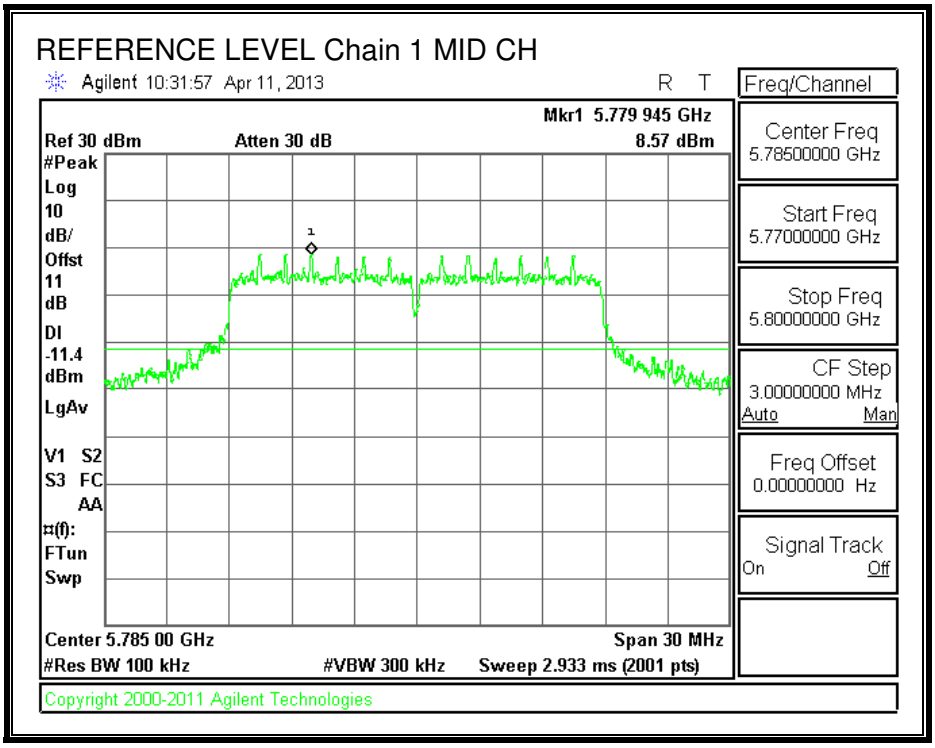
OUT-OF-BAND EMISSIONS, Chain 0



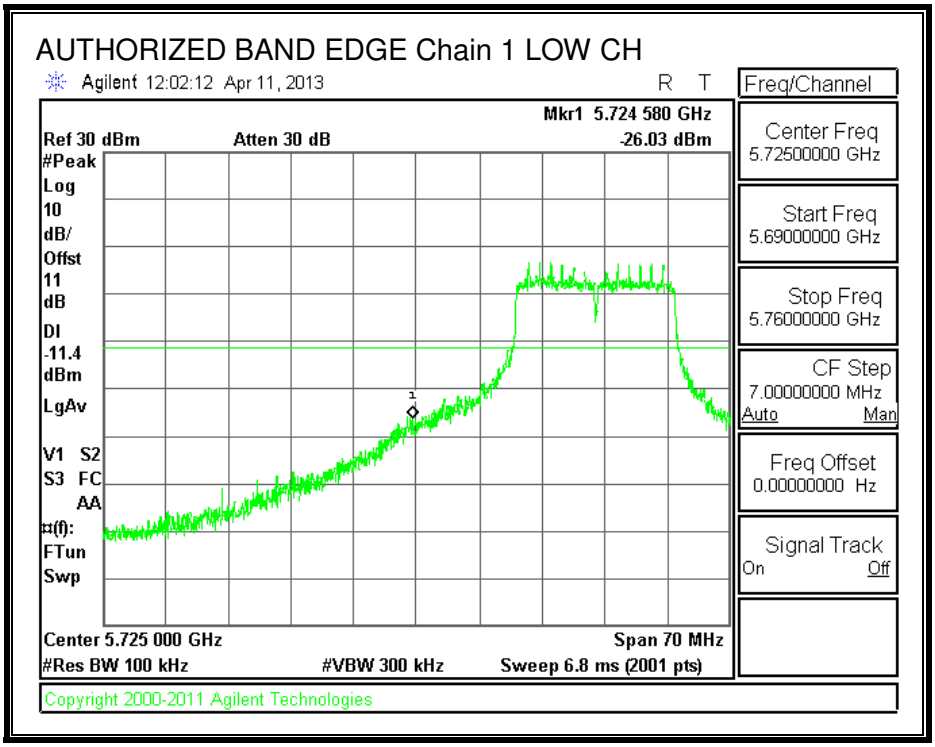




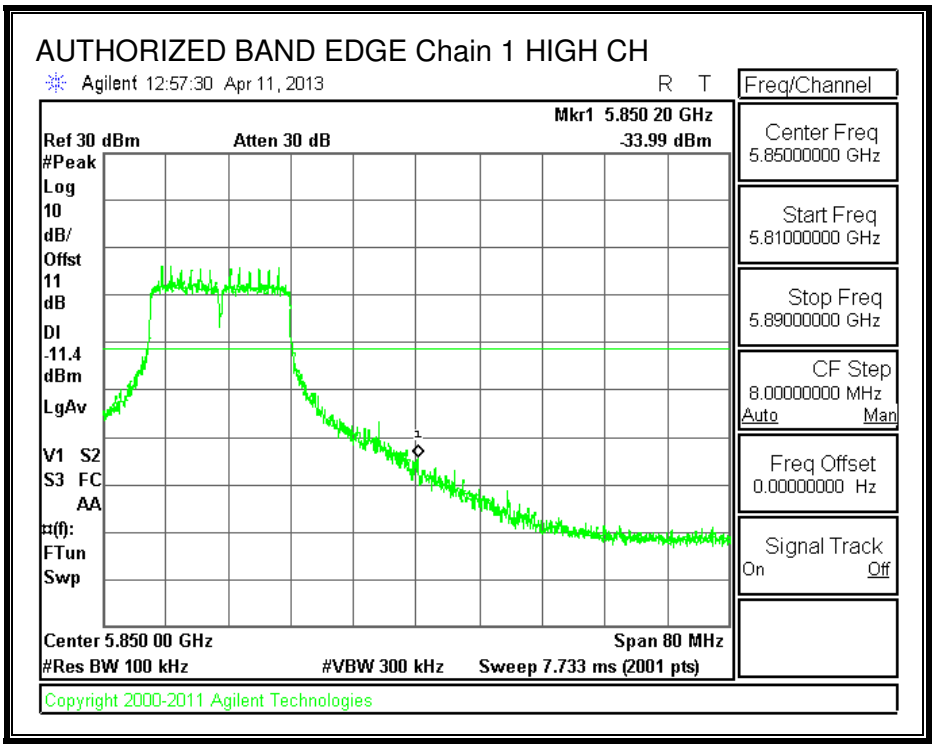
IN-BAND REFERENCE LEVEL, Chain 1

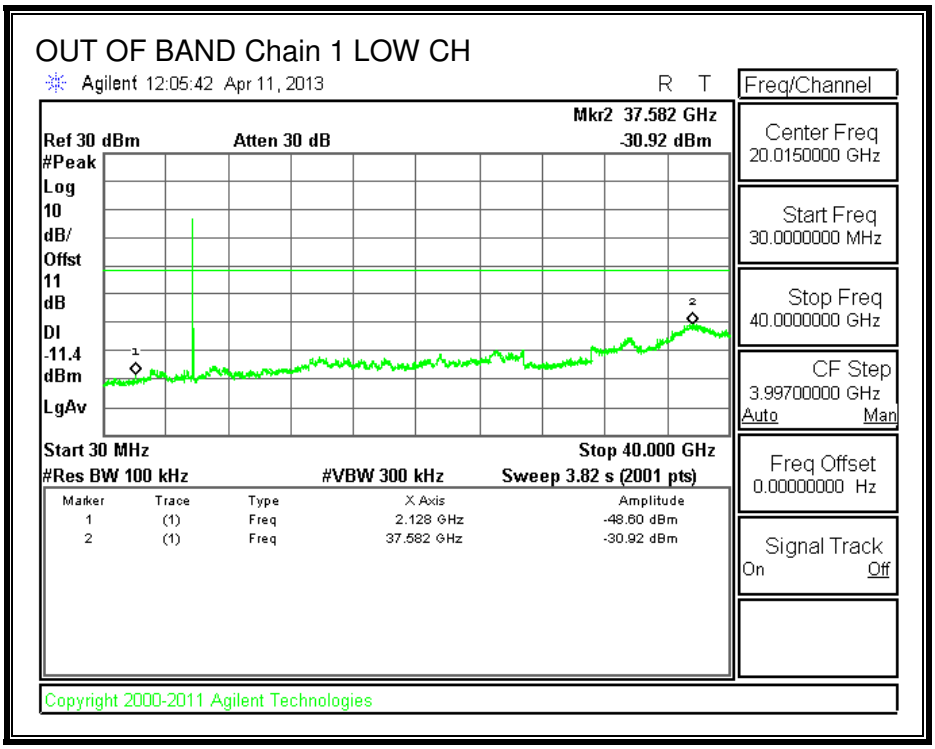


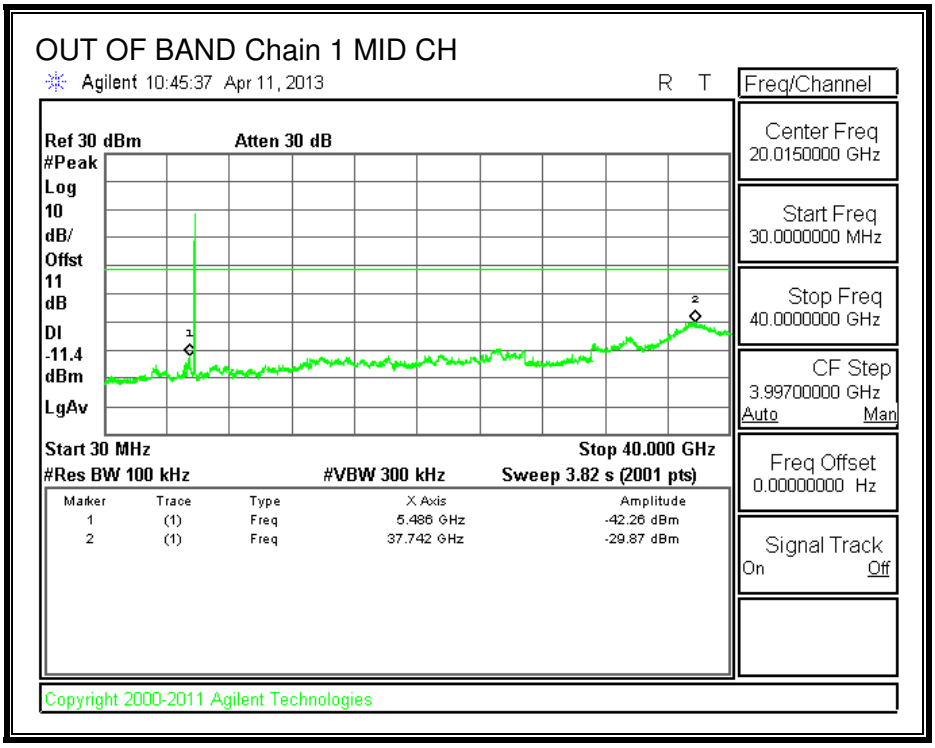
LOW CHANNEL BANDEDGE, Chain 1

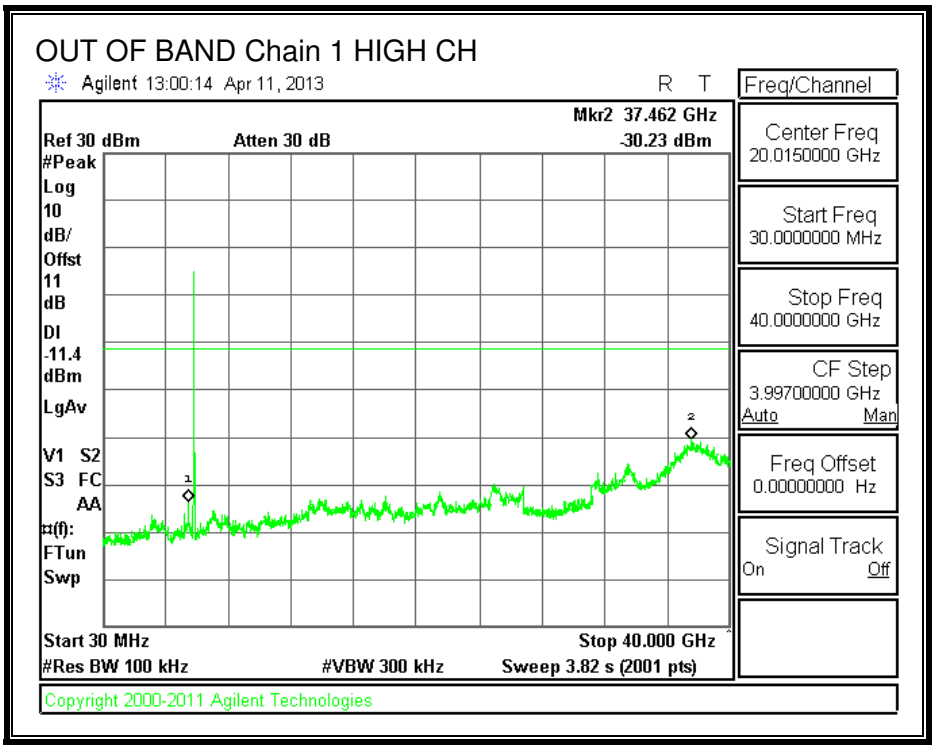


HIGH CHANNEL BANDEDGE, Chain 1









9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 1 MHz for peak measurements and as applicable for average measurements.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

Notes:

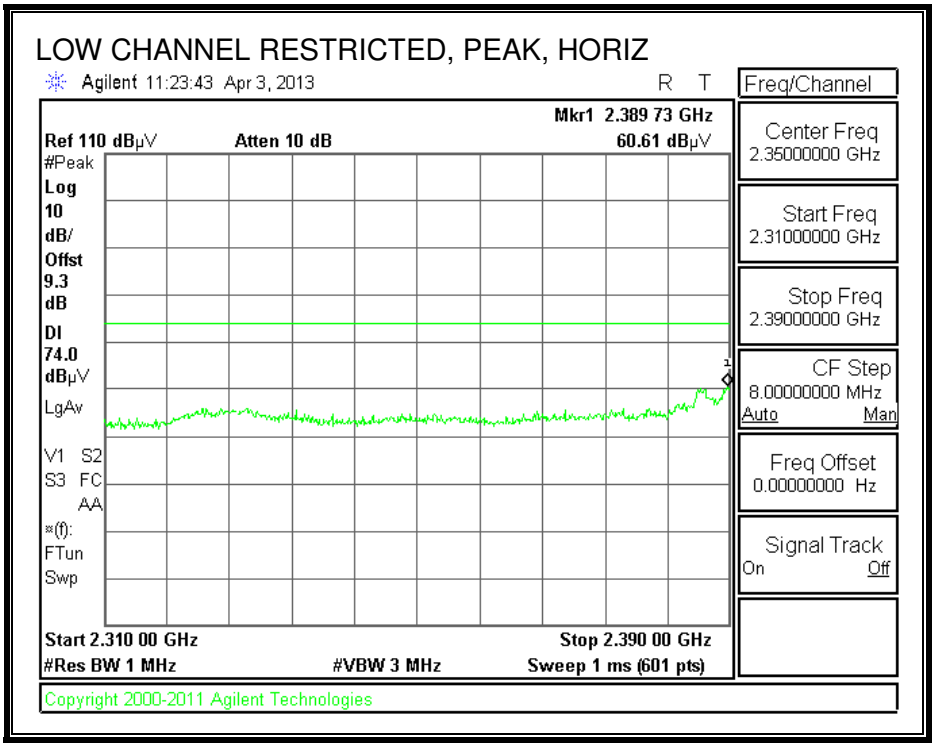
1) For 802.11g mode, a DCCF of 0.77 dB was included in the spectrum analyzer offset for both PK and AVG measurements, for both radiated BE and Harmonics.

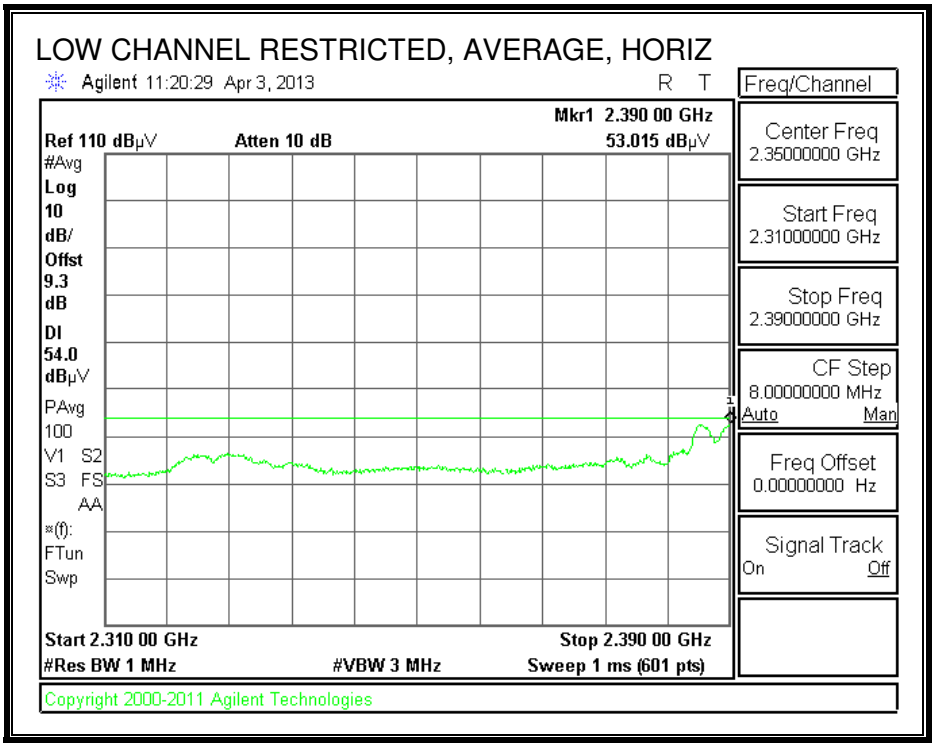
2) For 802.11n HT20 mode, a DCCF of 0.77 dB was included in the spectrum analyzer offset for both PK and AVG measurements for radiated BE, whereas the DCCF for 11n HT20 is 1.7 dB; therefore, the delta of 1.7-0.77 = 0.93 dB was added manually for radiated BE for both PK and AVG measurements (as shown in the note under the plots). For Harmonics, the DDCF of 1.7 dB was included in the spectrum analyzer offset for both PK and AVG measurements.

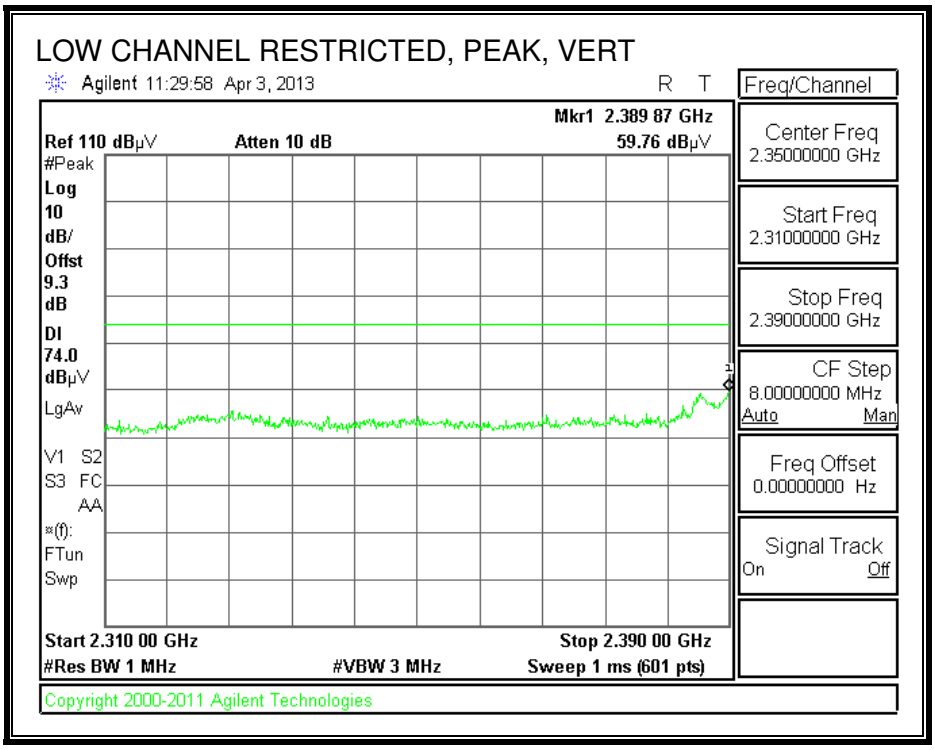
9.2. TRANSMITTER ABOVE 1 GHz

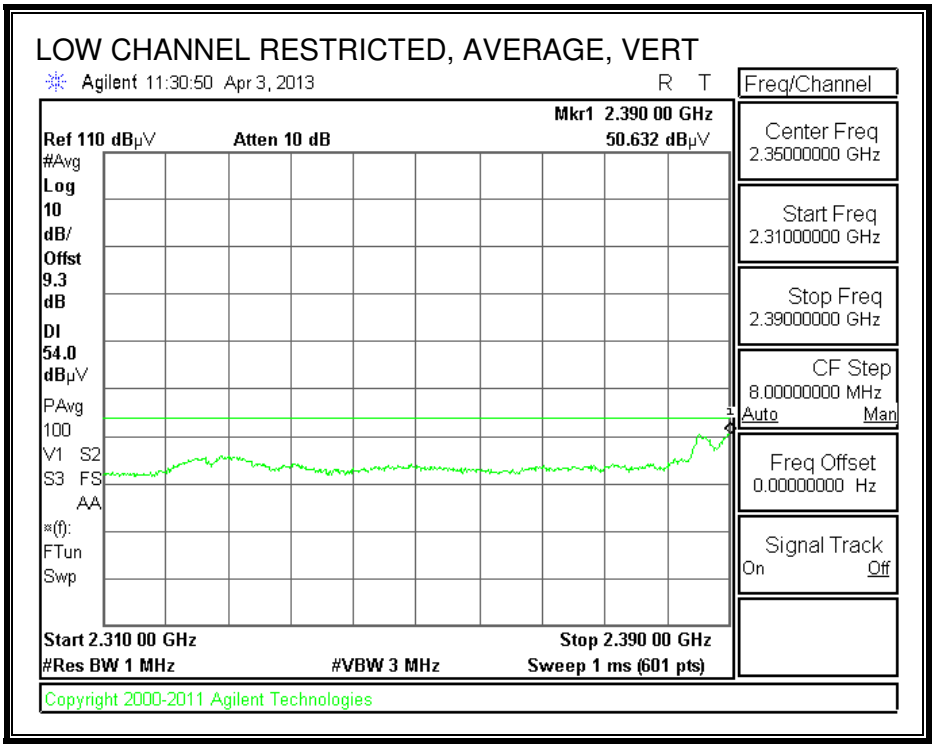
9.2.1. TX ABOVE 1 GHz 802.11b MODE IN THE 2.4 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL)

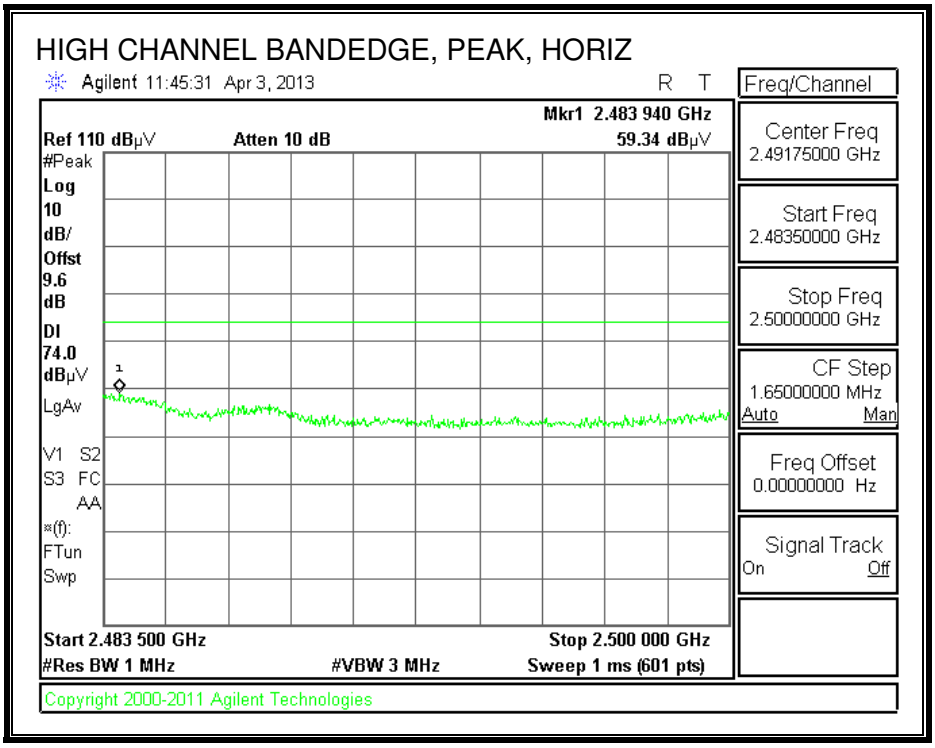


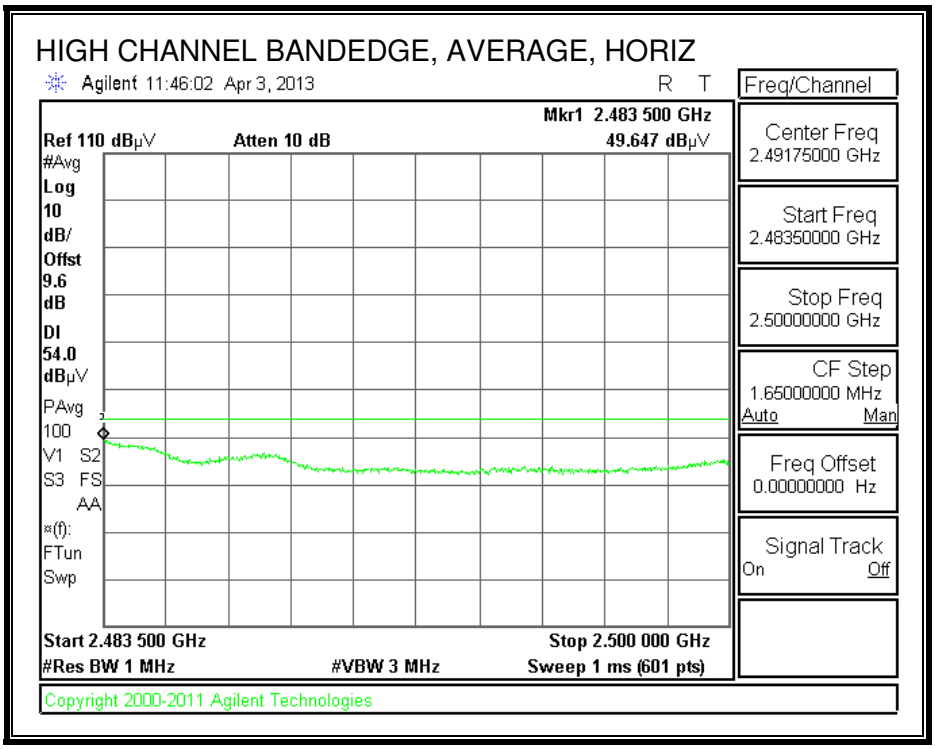




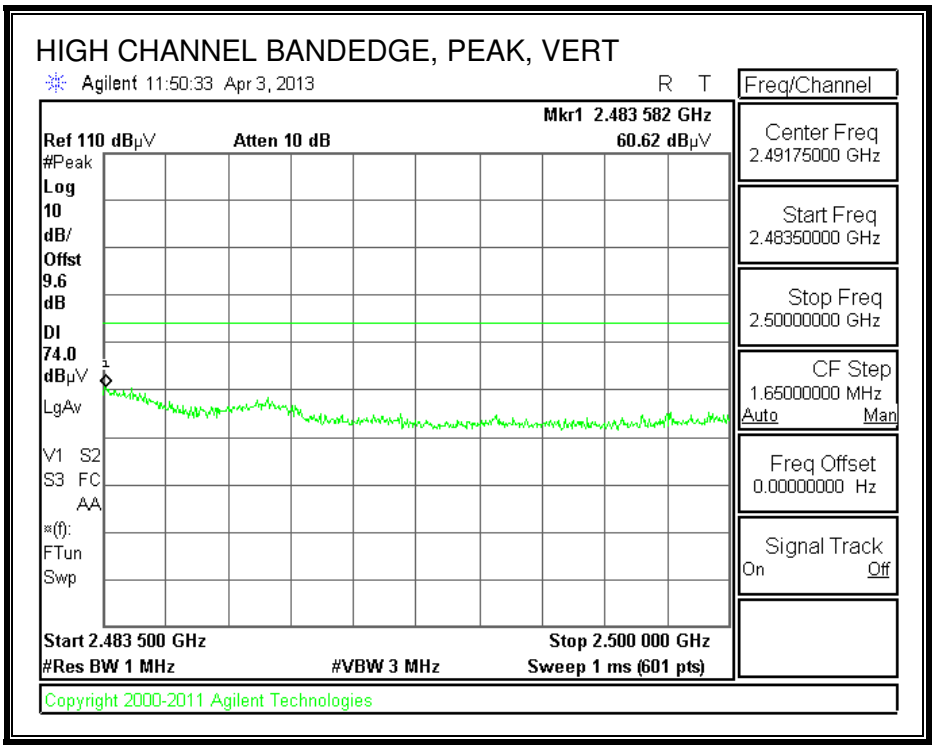


AUTHORIZED BANDEDGE (HIGH CHANNEL)

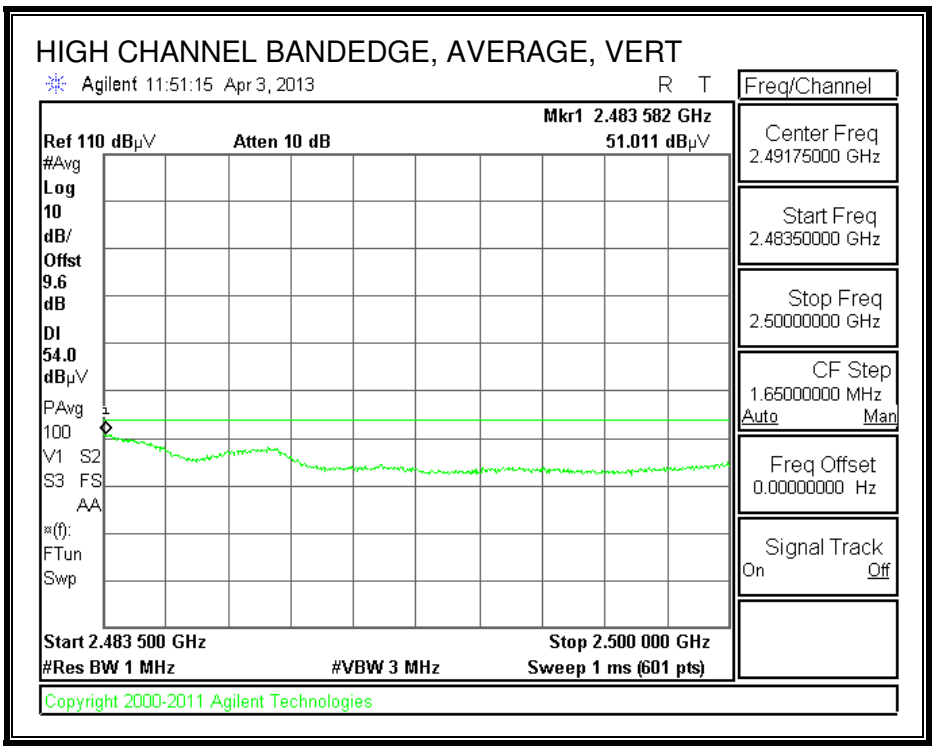




HIGH CHANNEL BANDEDGE, PEAK, VERT

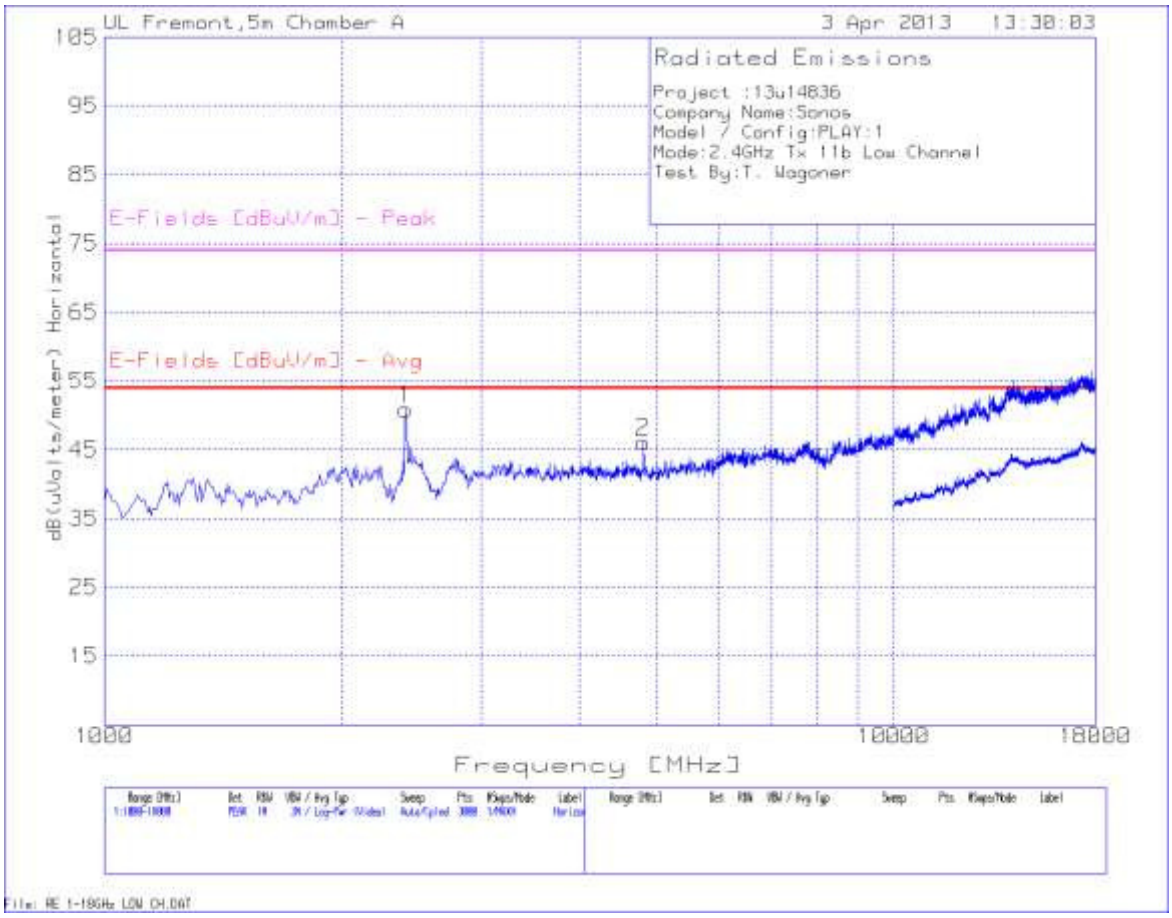


HIGH CHANNEL BANDEDGE, AVERAGE, VERT

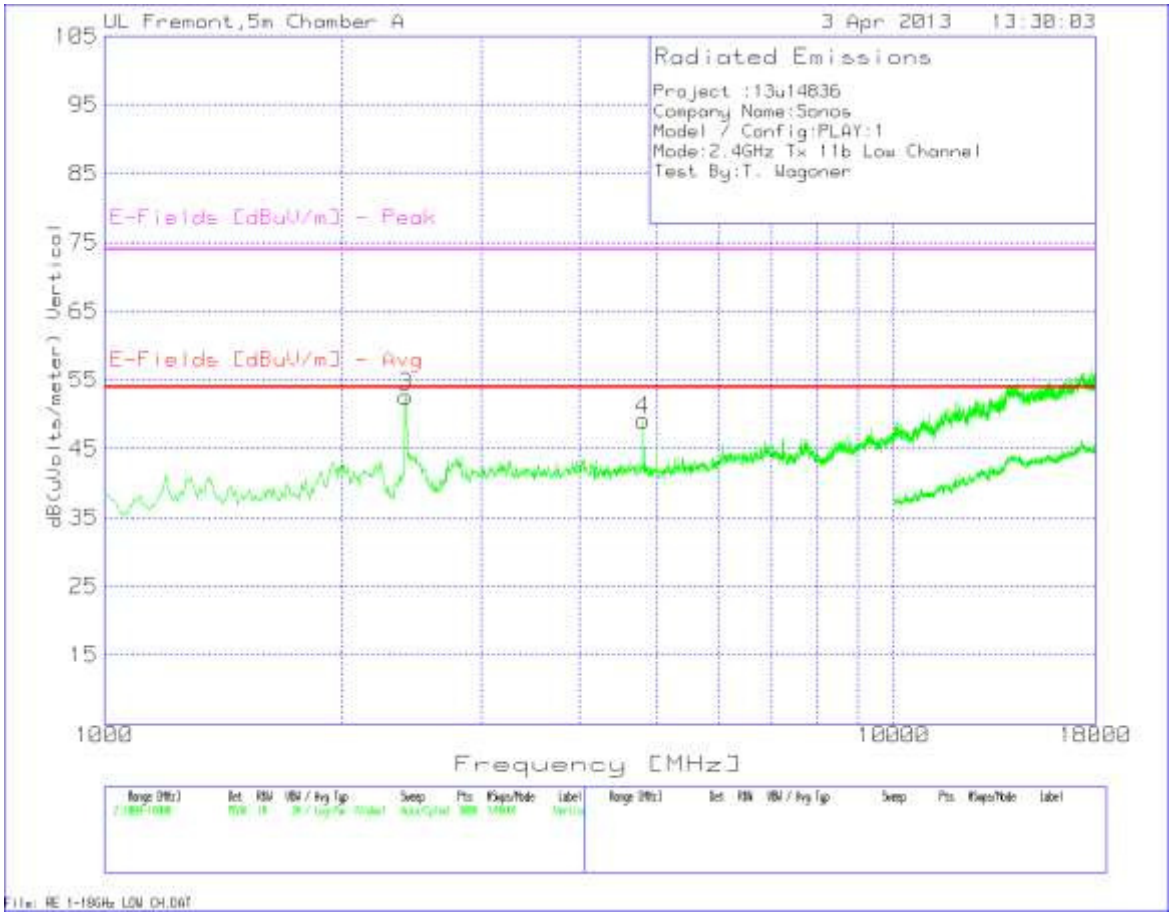


HARMONICS AND SPURIOUS EMISSIONS

Low Channel, Horizontal



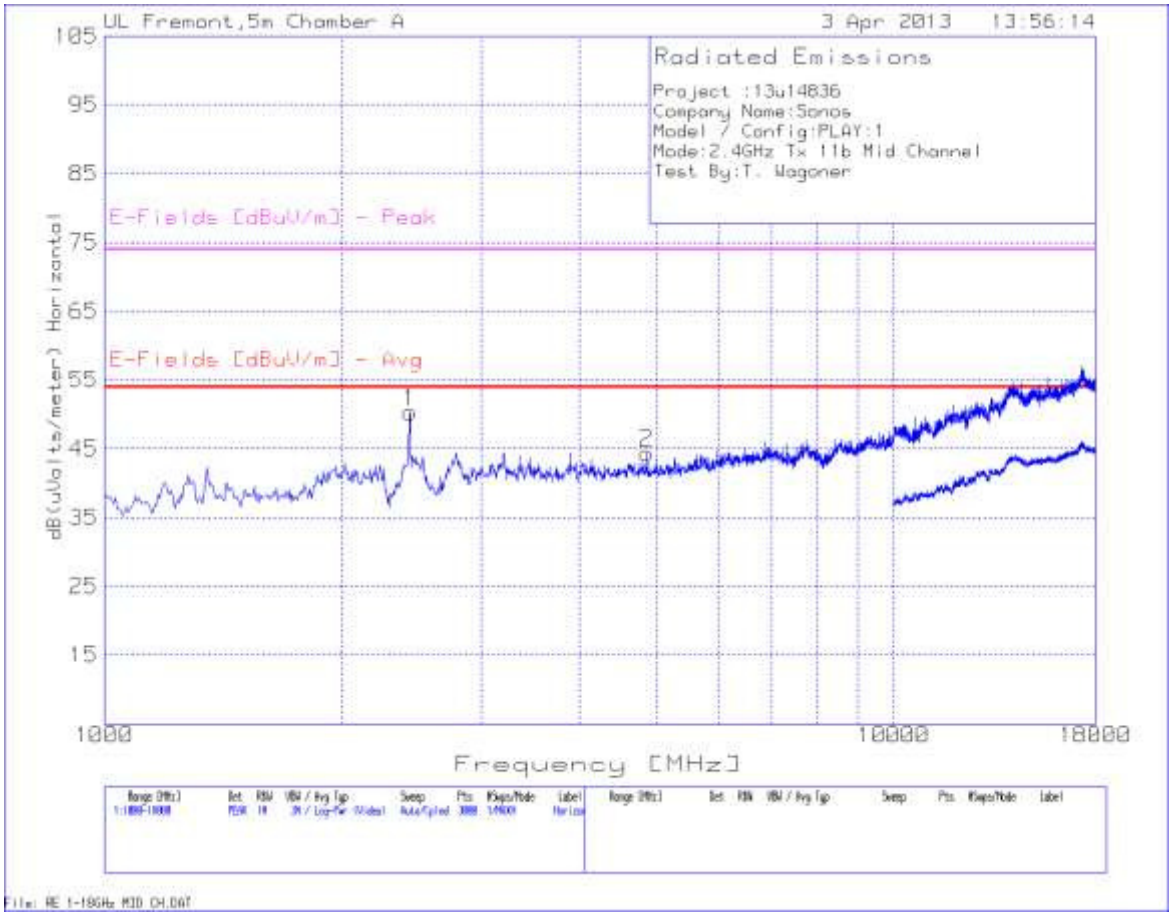
Low Channel, Vertical



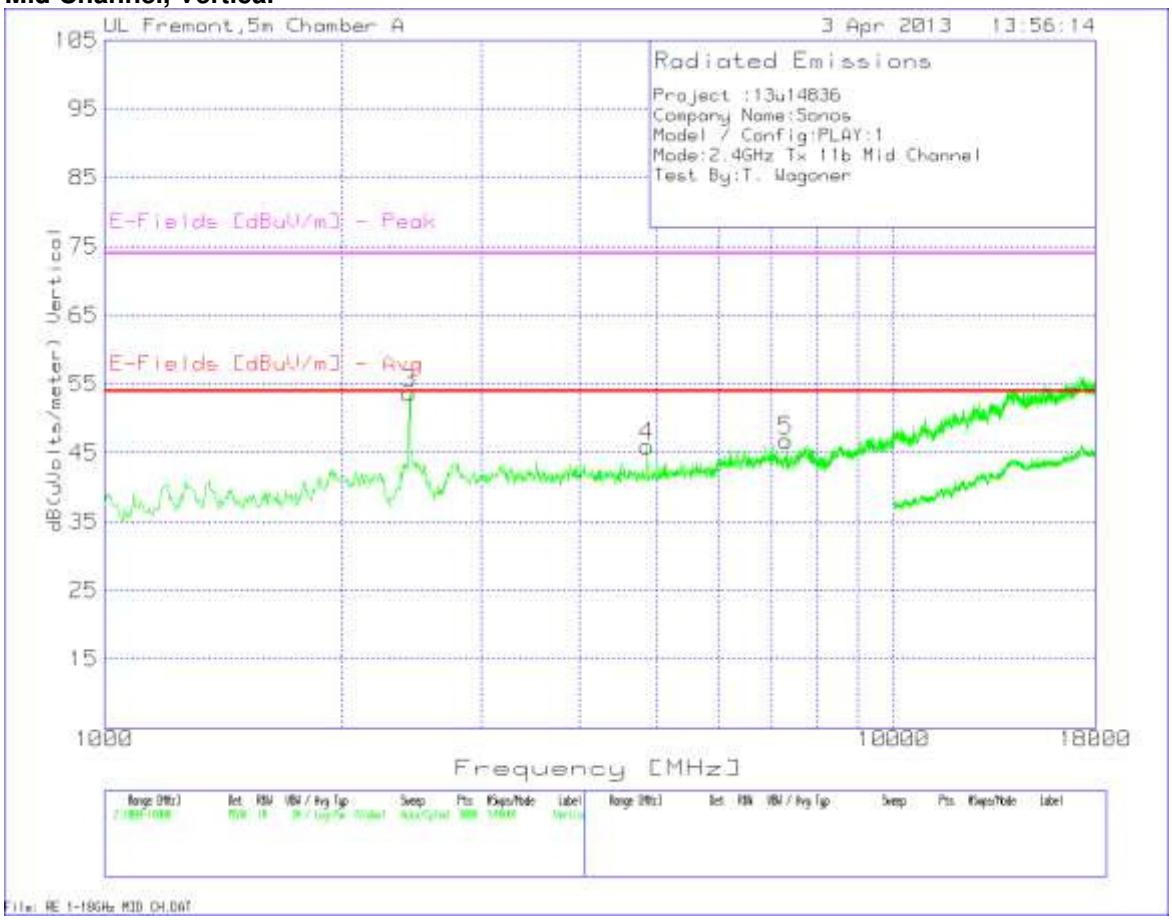
Low Channel, Data

Project :		13u14836												
Company Name:		Sonos												
Model / Config:		PLAY:1												
Mode:		2.4GHz Tx 11b Low Channel												
Test By:		T. Wagoner												
Marker No.	Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T160 BRF [dB]	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
1*	2410.06	50.25	PK	32.2	-36.9	4.4	0.9	50.85	53.97	-3.12	74	-23.15	131	Horz
2	4822.452	40.99	PK	33.9	-35.7	6.7	0.2	46.09	53.97	-7.88	74	-27.91	131	Horz
3*	2410.06	52.05	PK	32.2	-36.9	4.4	0.9	52.65	53.97	-1.32	74	-21.35	200	Vert
4	4822.452	44.08	PK	33.9	-35.7	6.7	0.2	49.18	53.97	-4.79	74	-24.82	100	Vert
Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T160 BRF [dB]	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
4823.93	32.21	MAv1	33.9	-35.7	6.7	0.2	37.31	53.97	-16.66	74	-36.69	0	100	Vert
*= Fundamental Frequency														
PK - Peak detector														

Mid Channel, Horizontal



Mid Channel, Vertical



Mid Channel, Data

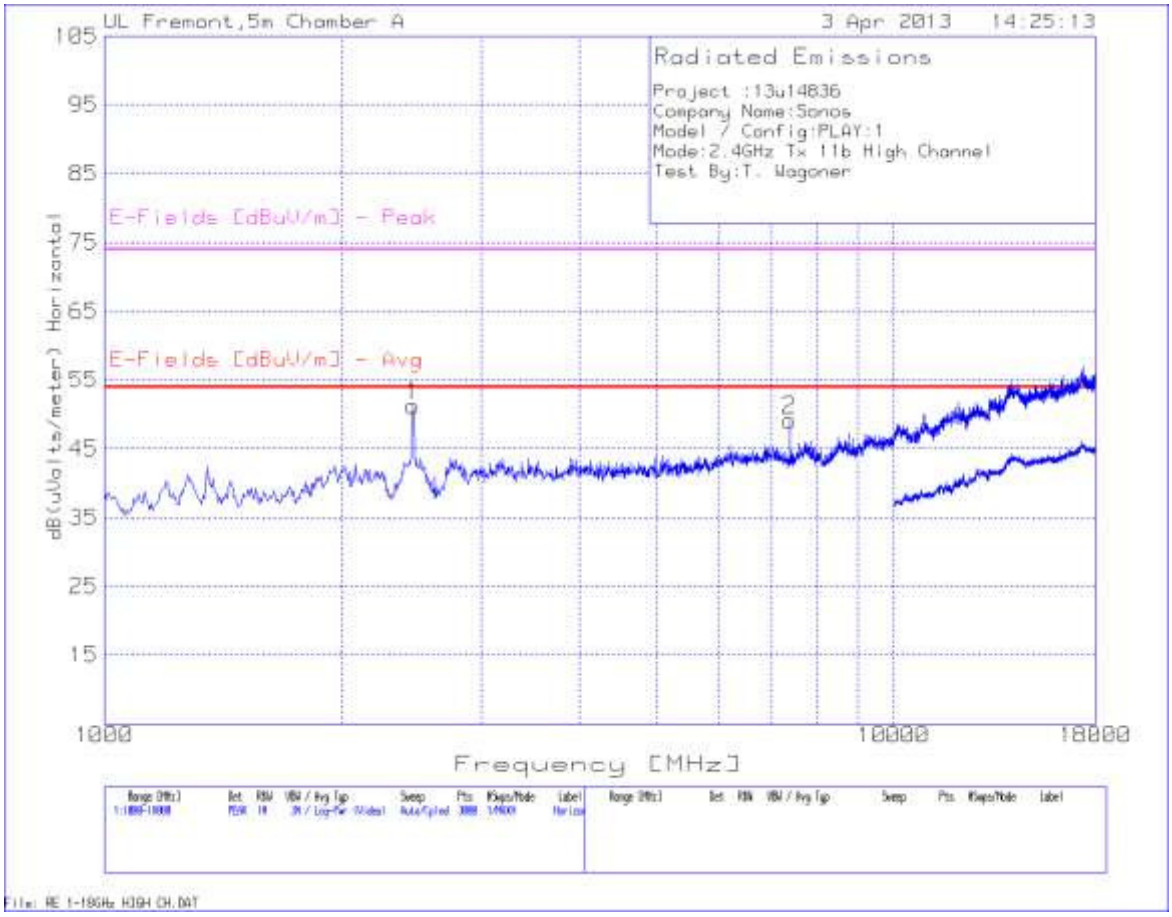
Project :	13u14836
Company Name:	Sonos
Model / Config:	PLAY:1
Mode:	2.4GHz Tx 11b Mid Channel
Test By:	T. Wagoner

Marker No.	Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T160 BRF [dB]	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
*1	2438.374	49.48	PK	32.3	-36.9	4.5	0.9	50.28	53.97	-3.69	74	-23.72	200	Horz
2	4873.418	39.03	PK	34	-35.7	6.8	0.2	44.33	53.97	-9.64	74	-29.67	200	Horz
*3	2432.712	52.86	PK	32.3	-36.9	4.5	0.9	53.66	53.97	-0.31	74	-20.34	200	Vert
4	4873.418	40.64	PK	34	-35.7	6.8	0.2	45.94	53.97	-8.03	74	-28.06	200	Vert
5	7314.124	38.3	PK	35.3	-35.8	8.7	0.3	46.8	53.97	-7.17	74	-27.2	100	Vert

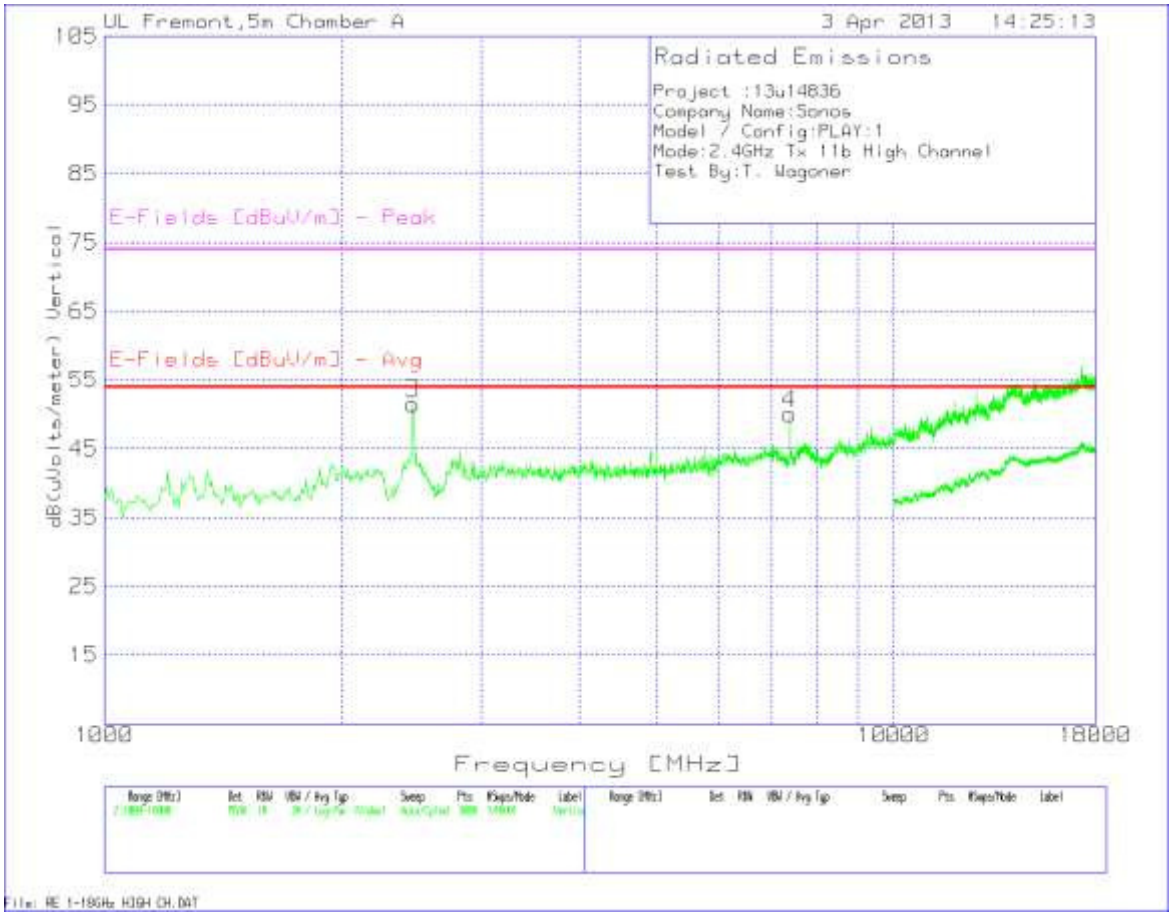
*= Fundamental Frequency

PK - Peak detector

High Channel, Horizontal



High Channel, Vertical



High Channel, Data

Project :	13u14836
Company Name:	Sonos
Model / Config:	PLAY:1
Mode:	2.4GHz Tx 11b High Channel
Test By:	T. Wagoner

Marker No.	Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T160 BRF [dB]	dB(uVolts/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
1*	2461.026	50.25	PK	32.4	-36.8	4.5	0.9	51.25	53.97	-2.72	74	-22.75	200	Horz
2	7387.742	40.7	PK	35.4	-35.8	8.7	0.2	49.2	53.97	-4.77	74	-24.8	100	Horz
3*	2461.026	50.54	PK	32.4	-36.8	4.5	0.9	51.54	53.97	-2.43	74	-22.46	200	Vert
4	7387.742	41.62	PK	35.4	-35.8	8.7	0.2	50.12	53.97	-3.85	74	-23.88	100	Vert

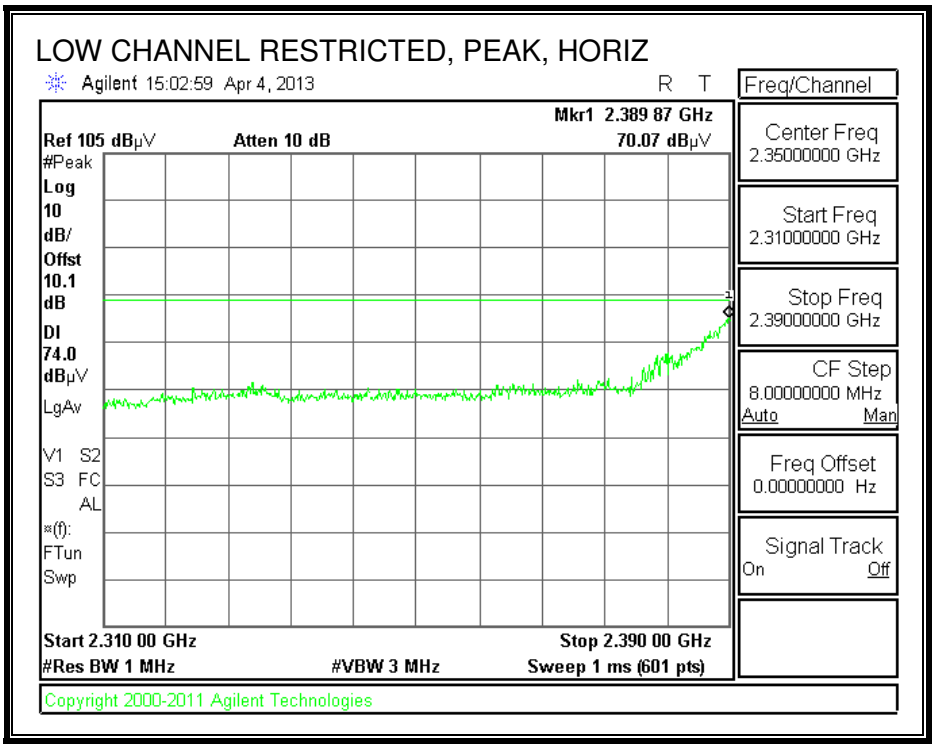
Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T160 BRF [dB]	dB(uVolts/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
7385.12	30.85	MAv1	35.4	-35.8	8.7	0.2	39.35	53.97	-14.62	74	-34.65	66	108	Horz
7385	31.85	MAv1	35.4	-35.8	8.7	0.3	40.45	53.97	-13.52	74	-33.55	299	118	Vert

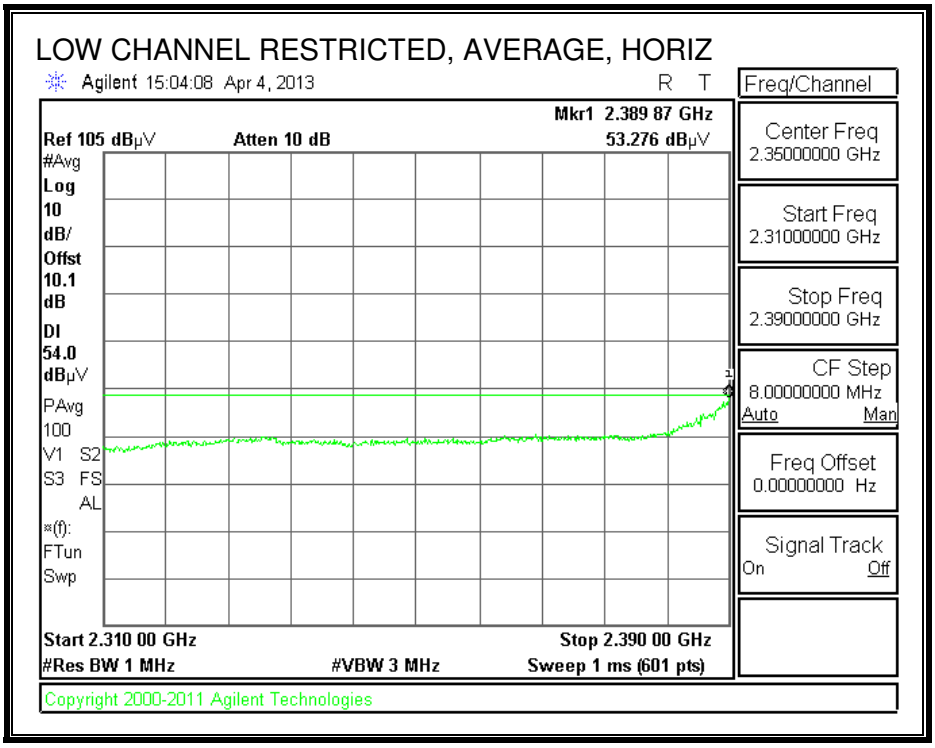
*= Fundamental Frequency

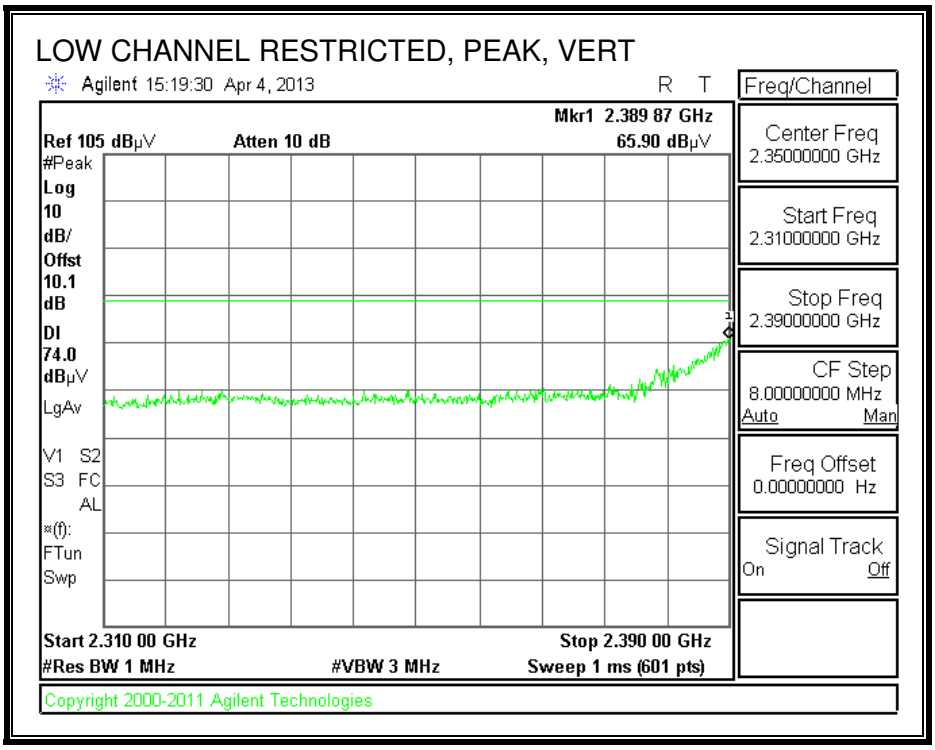
PK - Peak detector

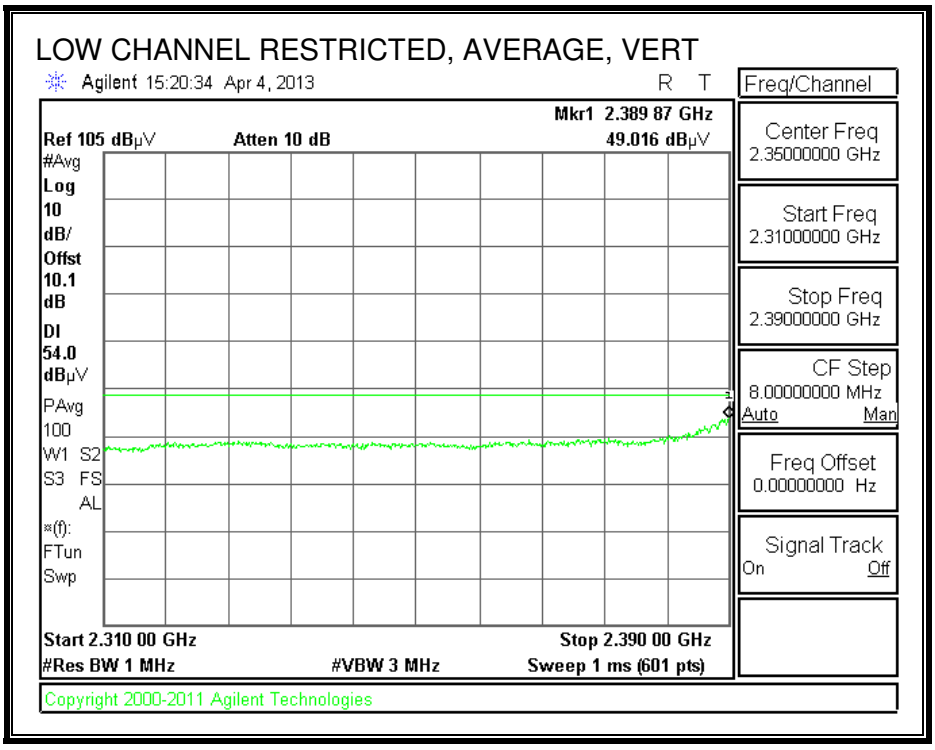
9.2.2. TX ABOVE 1 GHz 802.11g MODE IN THE 2.4 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL)

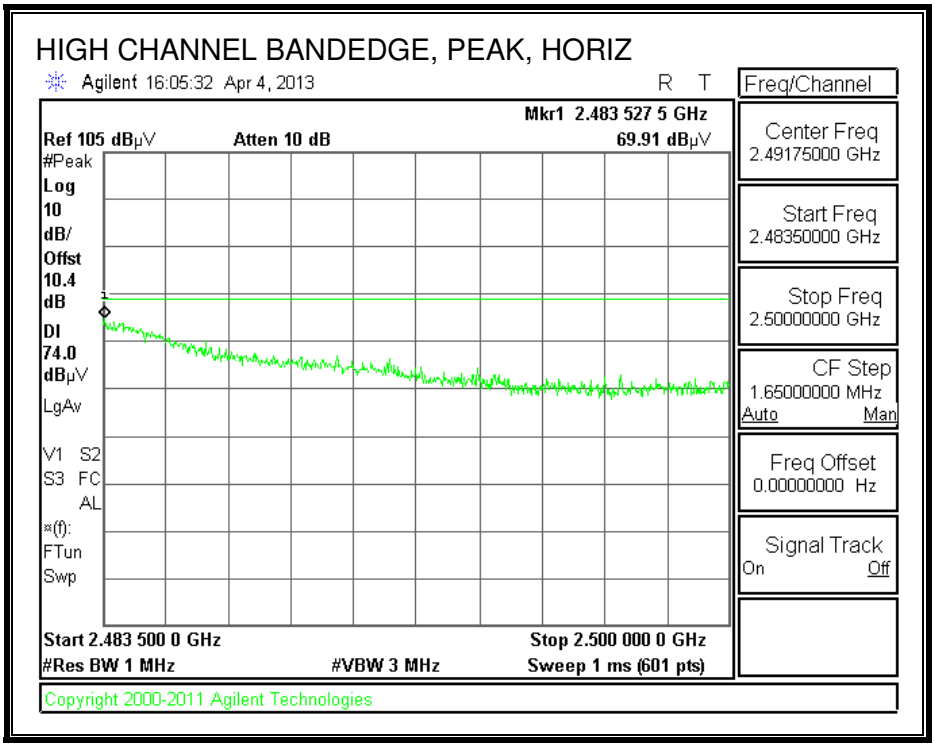


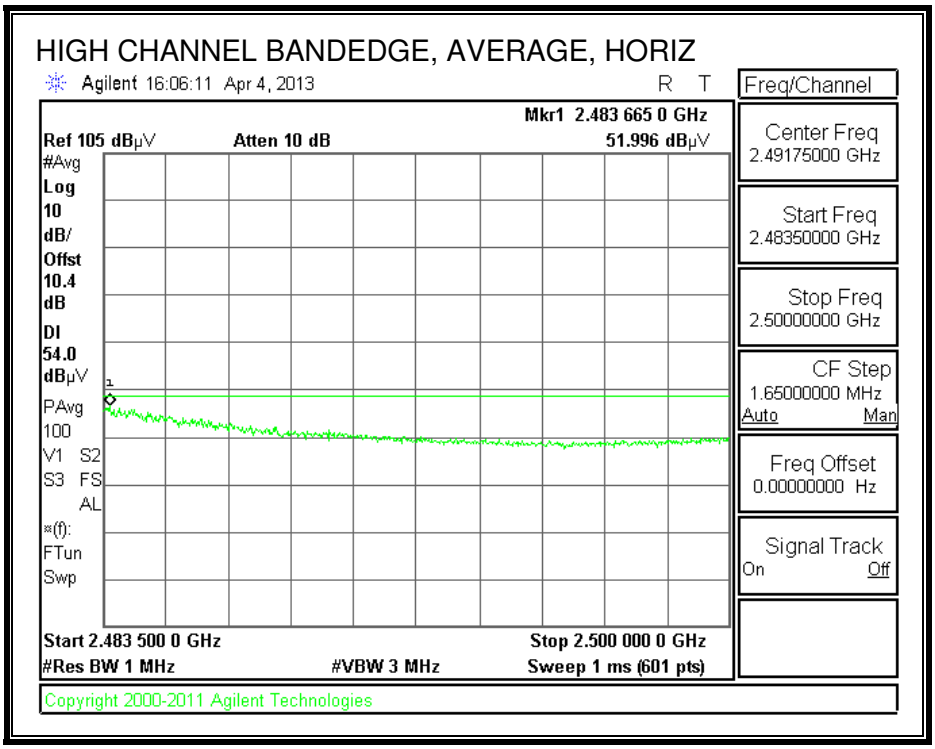




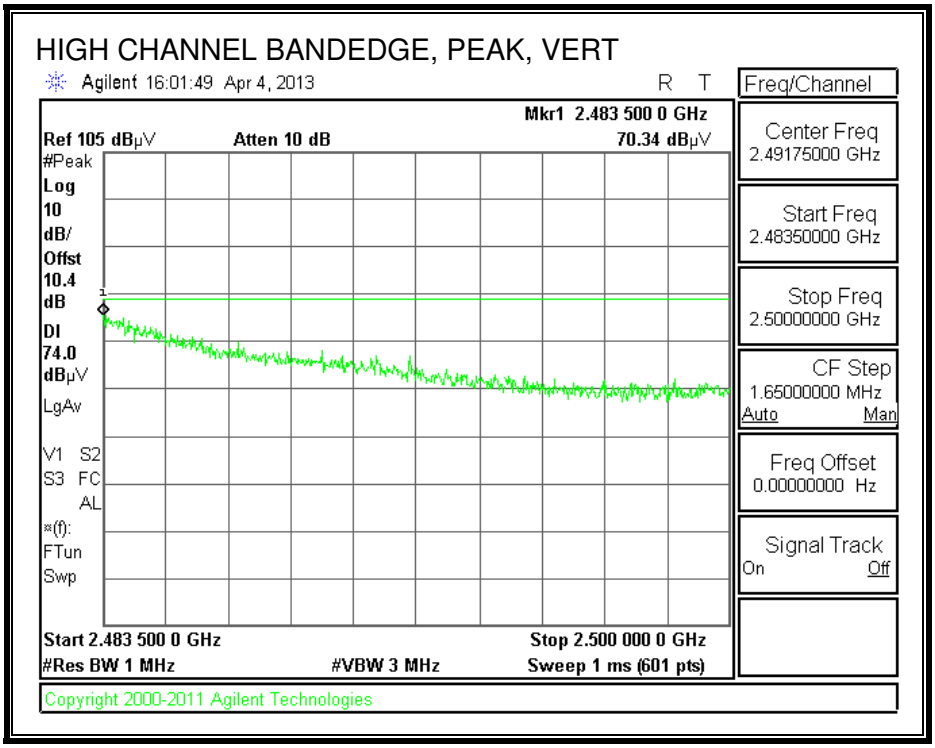


AUTHORIZED BANDEDGE (HIGH CHANNEL)

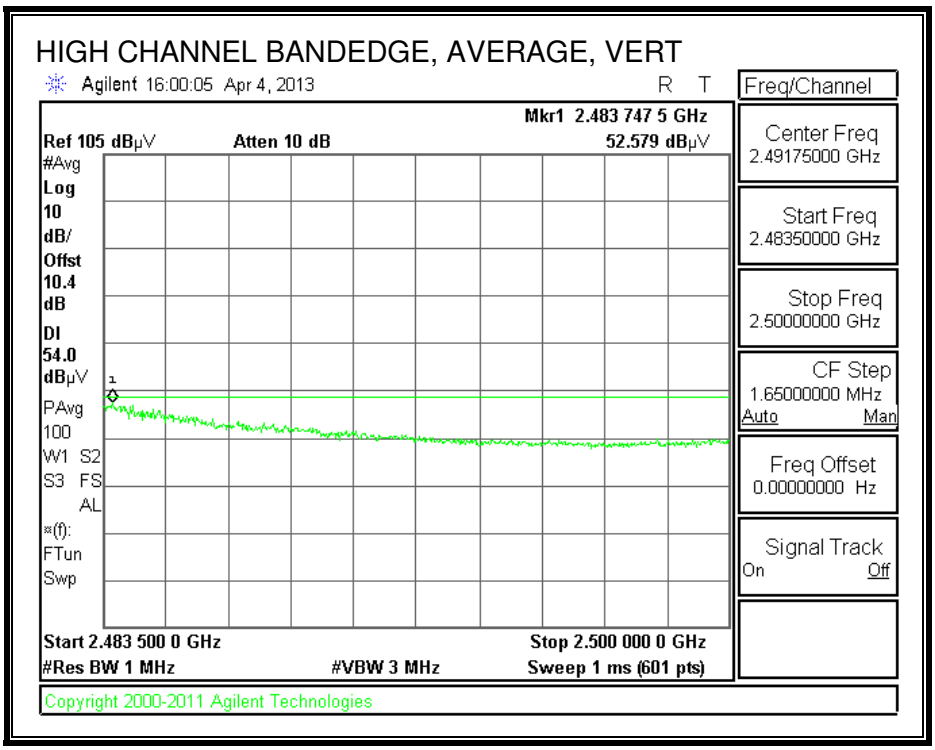




HIGH CHANNEL BANDEDGE, PEAK, VERT

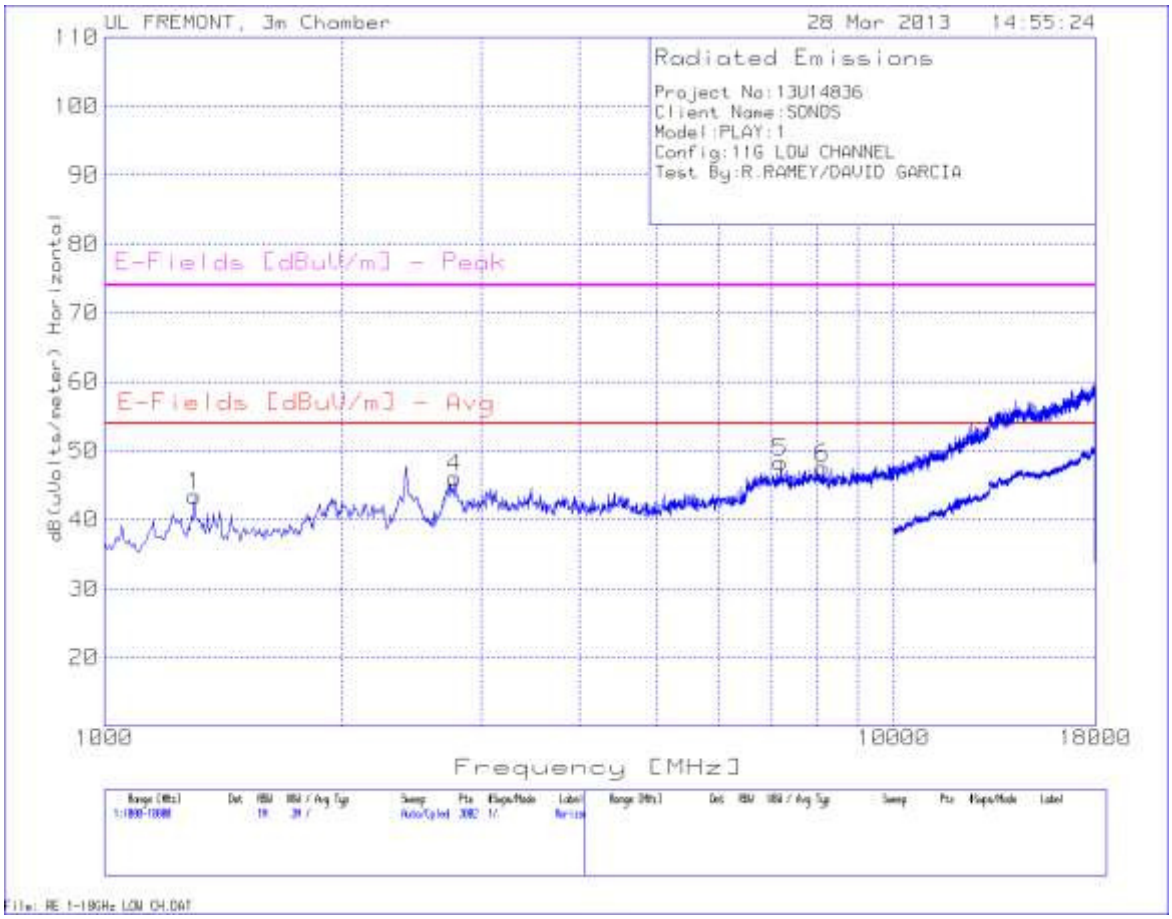


HIGH CHANNEL BANDEDGE, AVERAGE, VERT

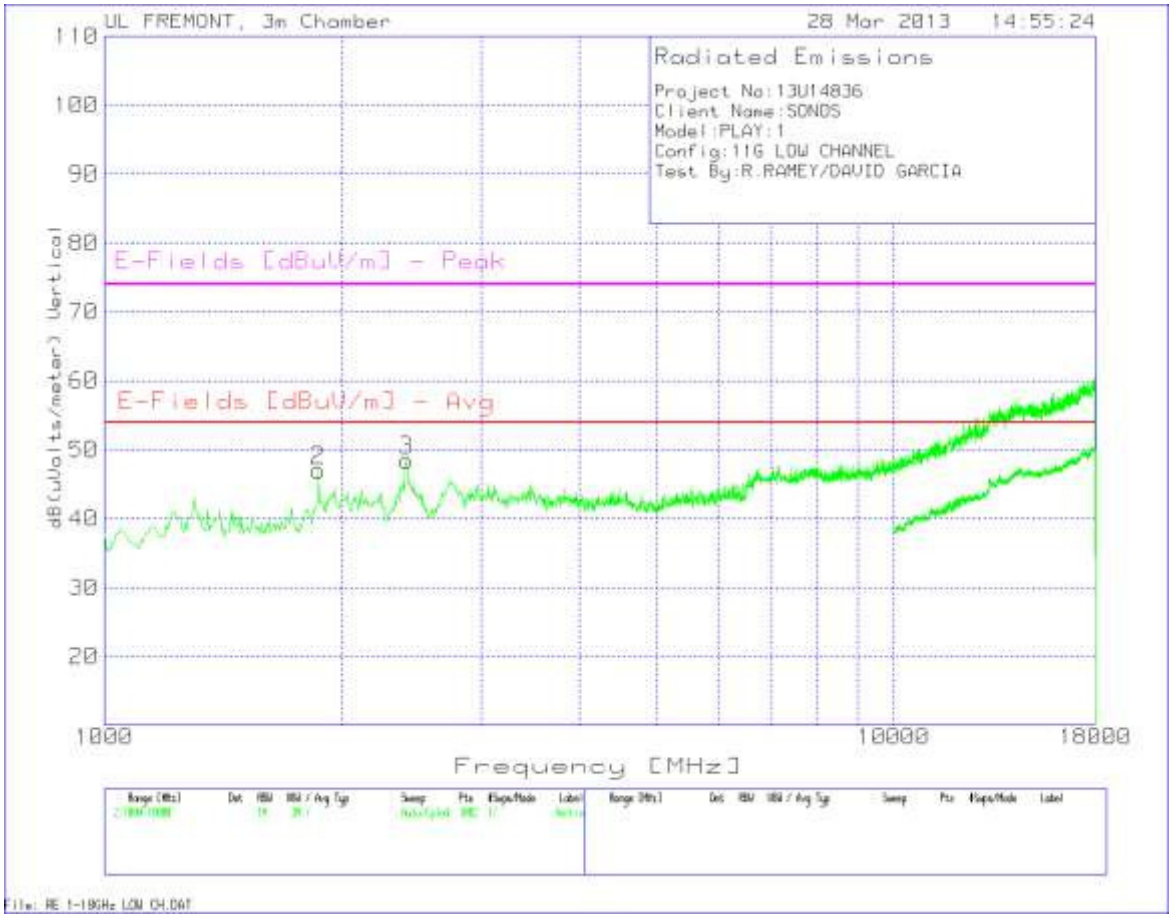


HARMONICS AND SPURIOUS EMISSIONS

Low Channel Horizontal



Low Channel Vertical



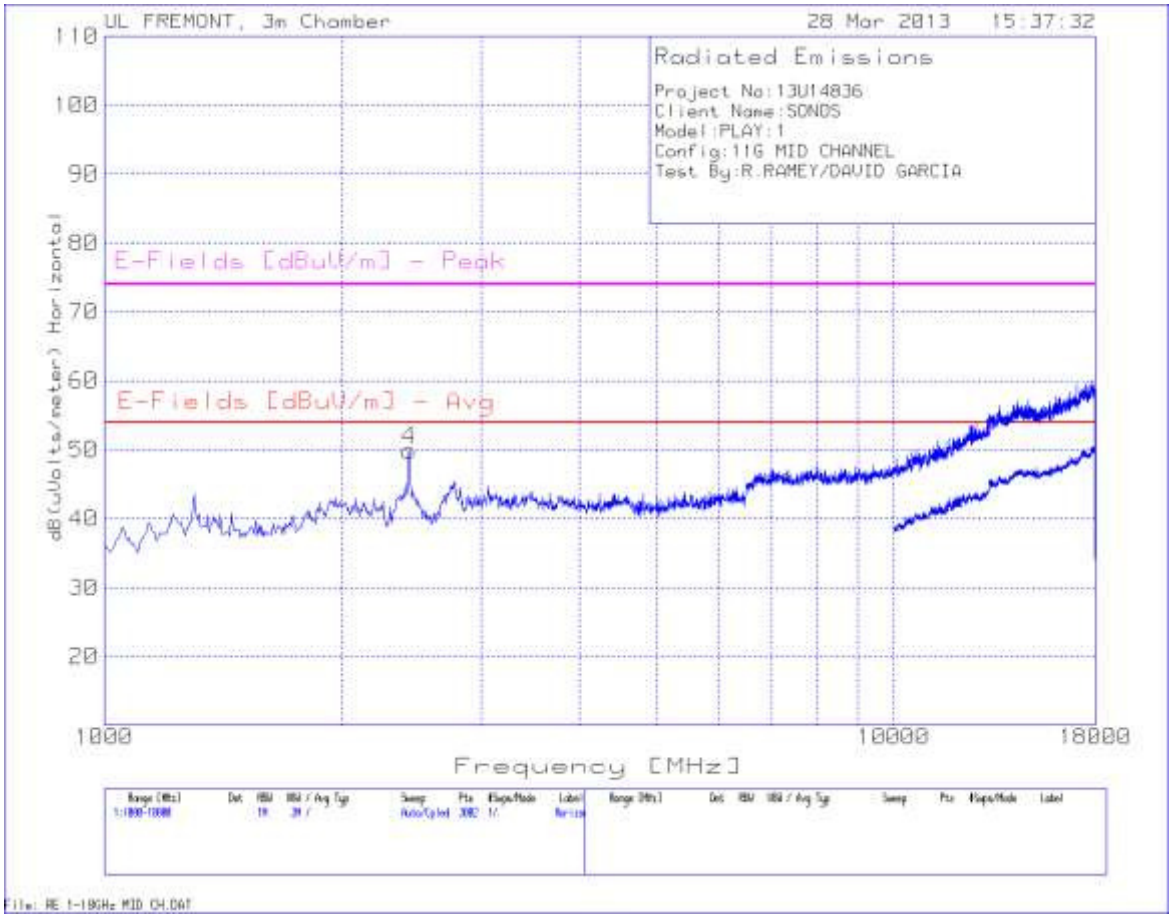
Low Channel, Data

Project No:	13U14836
Client Name:	SONOS
Model:	PLAY:1
Config:	11G LOW CHANNEL
Test By:	R.RAMEY/DAVID GARCIA

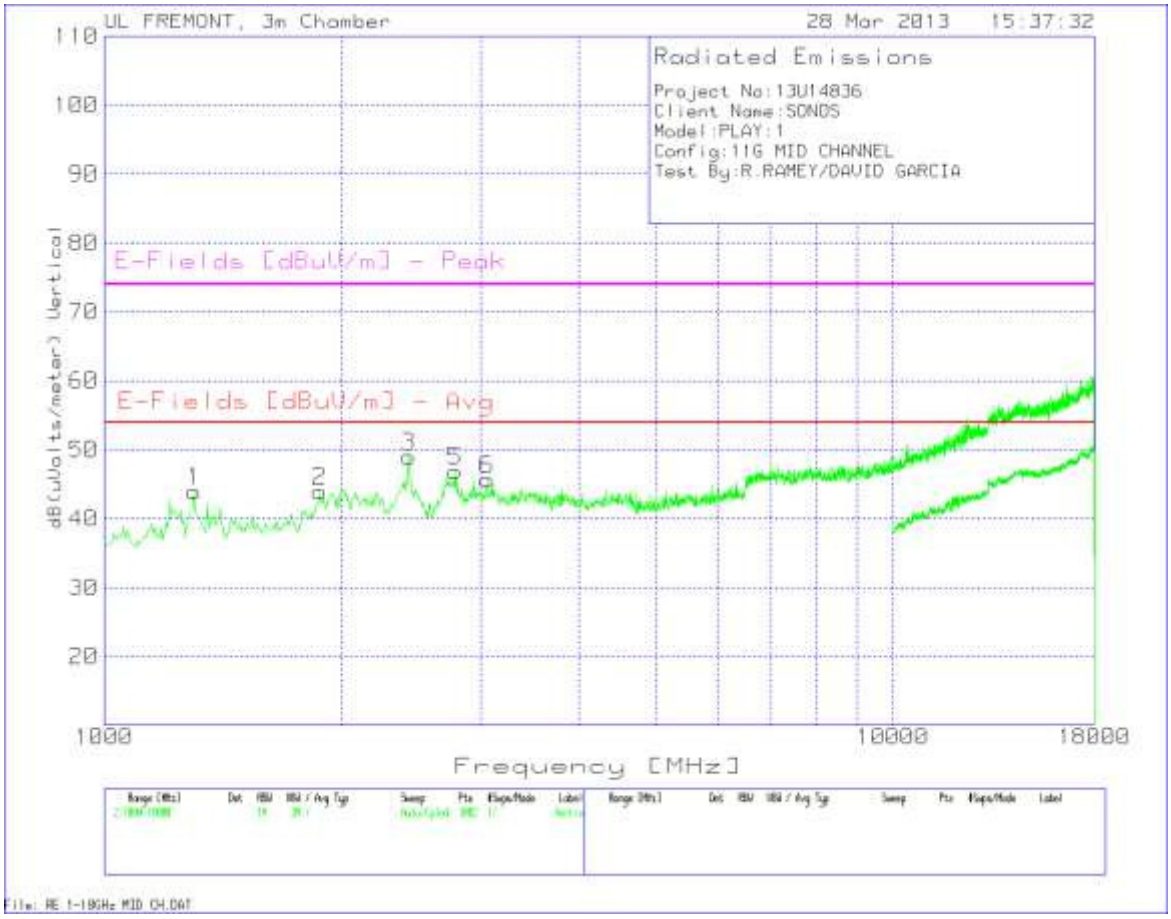
Marker No.	Test Frequency	Meter Reading	Detector	T119 Ant Factor [dB/m]	T34 Preamp/ Cable Loss [dB]	T160 BRF [dB]	dB(uVolts/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
1	1300.133	45.75	PK	30.2	-32.9	0.4	43.45	53.97	-10.52	74	-30.55		Horiz
4	2778.148	41.43	PK	32.7	-28.9	0.9	46.13	53.97	-7.84	74	-27.87		Horiz
5	7189.54	35.57	PK	35.6	-23.1	0.3	48.37	53.97	-5.6	74	-25.63		Horiz
6	8123.917	33.84	PK	35.7	-22.3	0.3	47.54	53.97	-6.43	74	-26.46		Horiz
2	1866.422	45.46	PK	30.9	-31	0.8	46.96	53.97	-7.01	74	-27.04		Vert
3*	2415.723	44.25	PK	32.1	-29.7	0.9	48.45	53.97	-5.52	74	-25.55		Vert

*= Fundamental Frequency
PK - Peak detector
Av - Average detector

Mid Channel Horizontal



Mid Channel Vertical



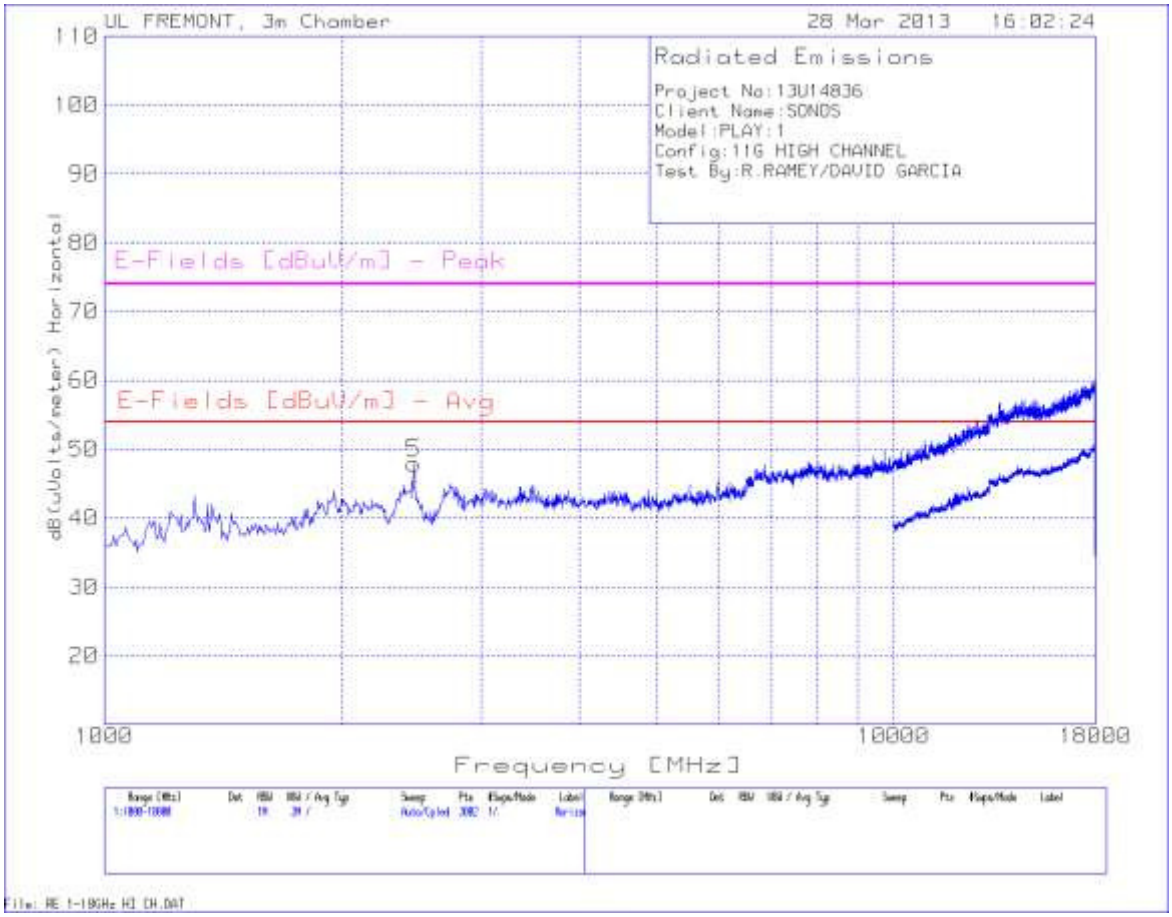
Mid Channel, Data

Project No:	13U14836
Client Name:	SONOS
Model:	PLAY:1
Config:	11G MID CHANNEL
Test By:	R.RAMEY/DAVID GARCIA

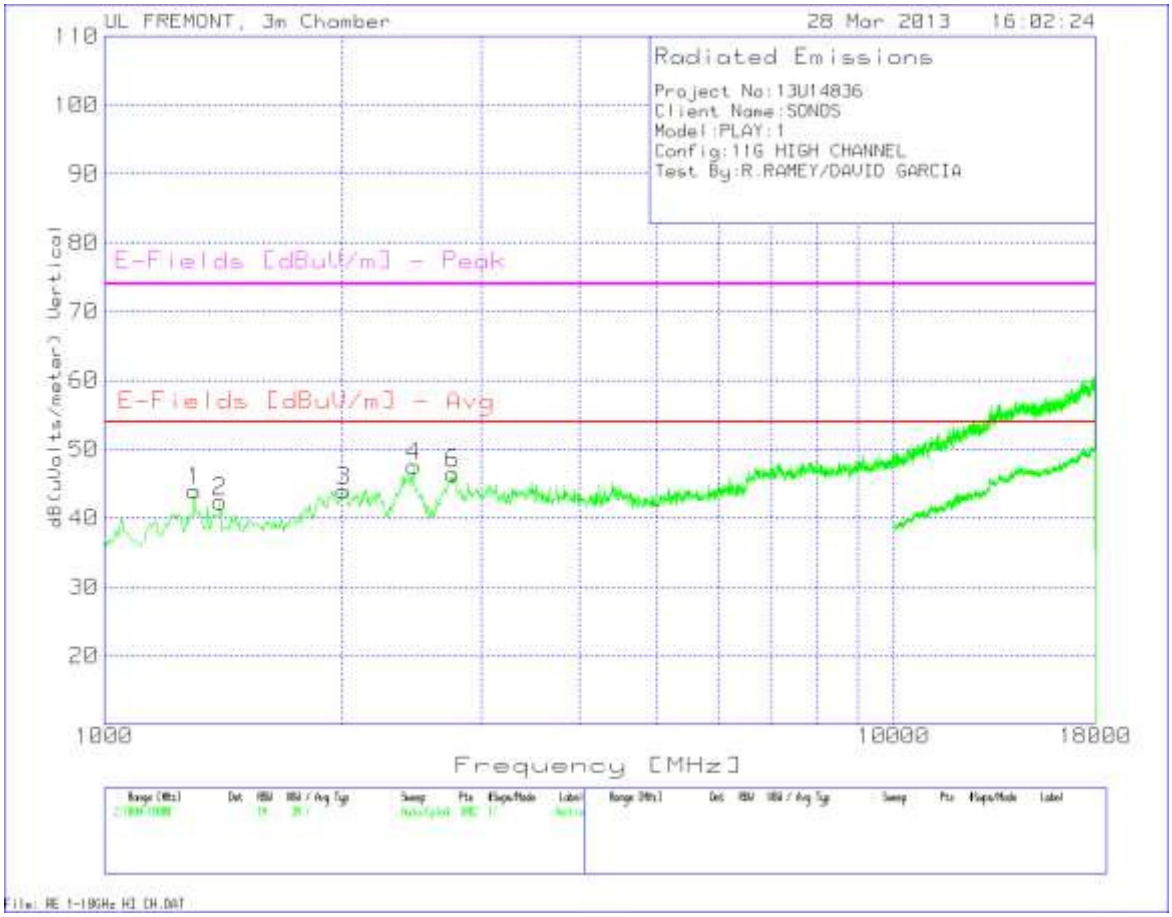
Marker No.	Test Frequency	Meter Reading	Detector	T119 Ant Factor [dB/m]	T34 Preamp/ Cable Loss [dB]	T160 BRF [dB]	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
4*	2432.712	46.47	PK	32.2	-29.7	0.9	49.87	53.97	-4.1	74	-24.13		Horiz
1	1300.133	45.83	PK	30.2	-32.9	0.4	43.93	53.97	-10.04	74	-30.07		Vert
2	1877.748	42.43	PK	31	-31	0.8	44.03	53.97	-9.94	74	-29.97		Vert
3*	2432.712	44.71	PK	32.2	-29.7	0.9	49.01	53.97	-4.96	74	-24.99		Vert
5	2789.474	41.22	PK	32.7	-28.8	0.9	46.92	53.97	-7.05	74	-27.08		Vert
6	3055.63	39.64	PK	33	-28.4	0.7	45.64	53.97	-8.33	74	-28.36		Vert

*= Fundamental Frequency
PK - Peak detector
Av - Average detector

High Channel Horizontal



High Channel Vertical



High Channel, Data

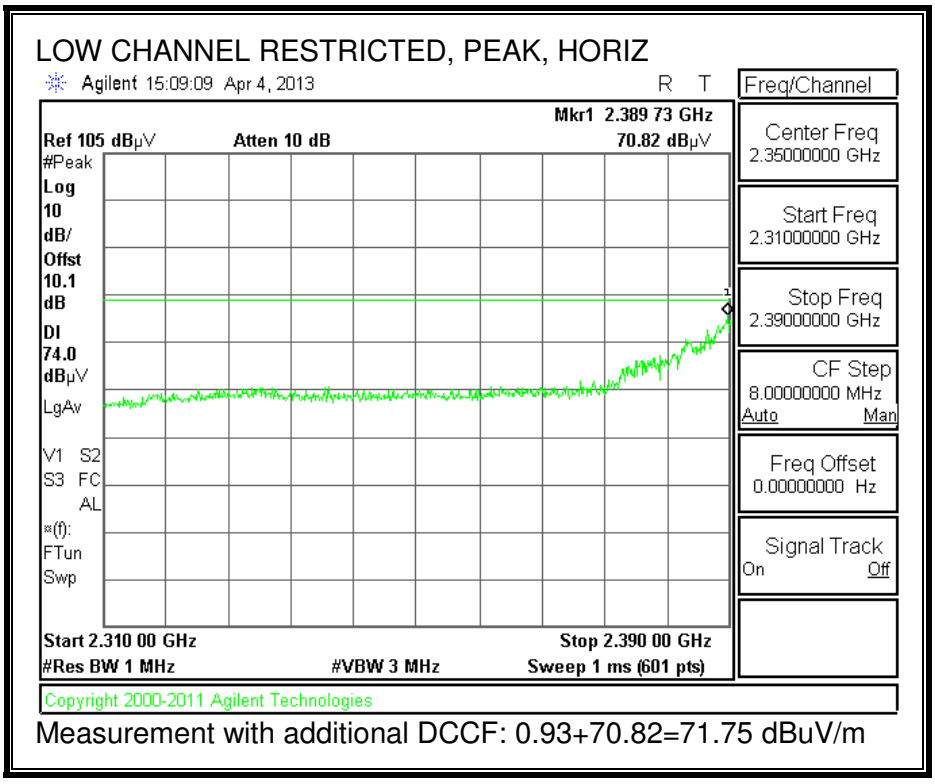
Project No:	13U14836
Client Name:	SONOS
Model:	PLAY:1
Config:	11G HIGH CHANNEL
Test By:	R.RAMEY/DAVID GARCIA

Marker No.	Test Frequency	Meter Reading	Detector	T119 Ant Factor [dB/m]	T34 Preamp/ Cable Loss [dB]	T160 BRF [dB]	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
5*	2466.689	44.5	PK	32.2	-29.6	0.9	48	53.97	-5.97	74	-26		Horiz
1	1300.133	45.94	PK	30.2	-32.9	0.4	44.04	53.97	-9.93	74	-29.96		Vert
2	1402.065	44.99	PK	29.1	-32.5	0.4	42.39	53.97	-11.58	74	-31.61		Vert
3	2007.995	41.15	PK	31.6	-30.6	0.9	43.95	53.97	-10.02	74	-30.05		Vert
4*	2466.689	43.08	PK	32.2	-29.6	0.9	47.48	53.97	-6.49	74	-26.52		Vert
6	2761.159	40.9	PK	32.7	-28.9	0.9	46.5	53.97	-7.47	74	-27.5		Vert

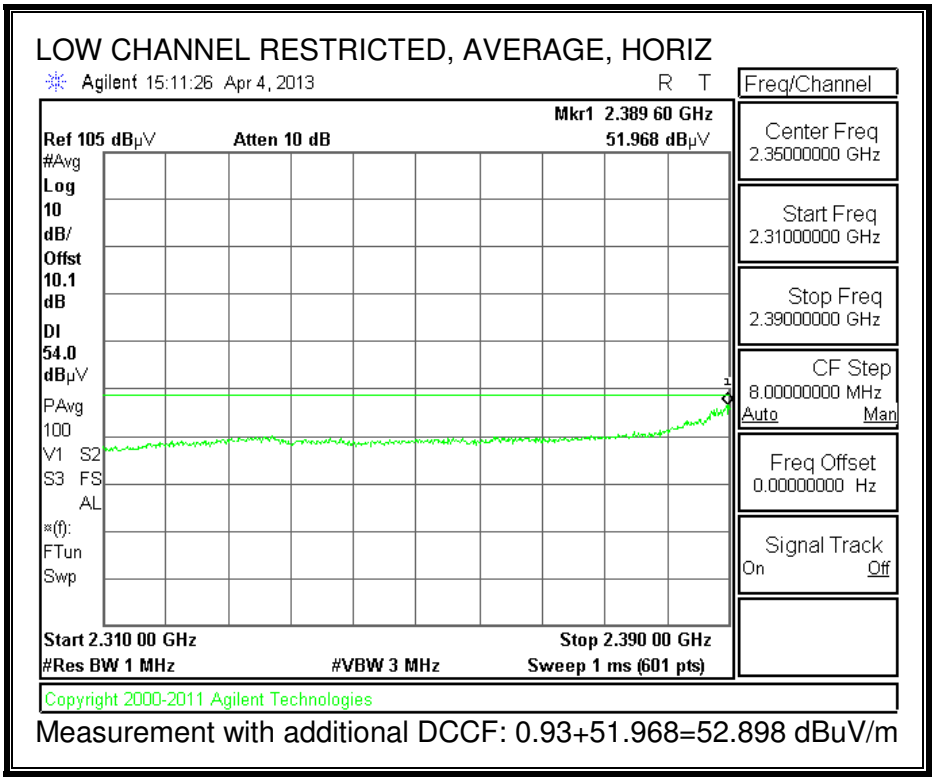
*= Fundamental Frequency
PK - Peak detector
Av - Average detector

9.2.3. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 2.4 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL)

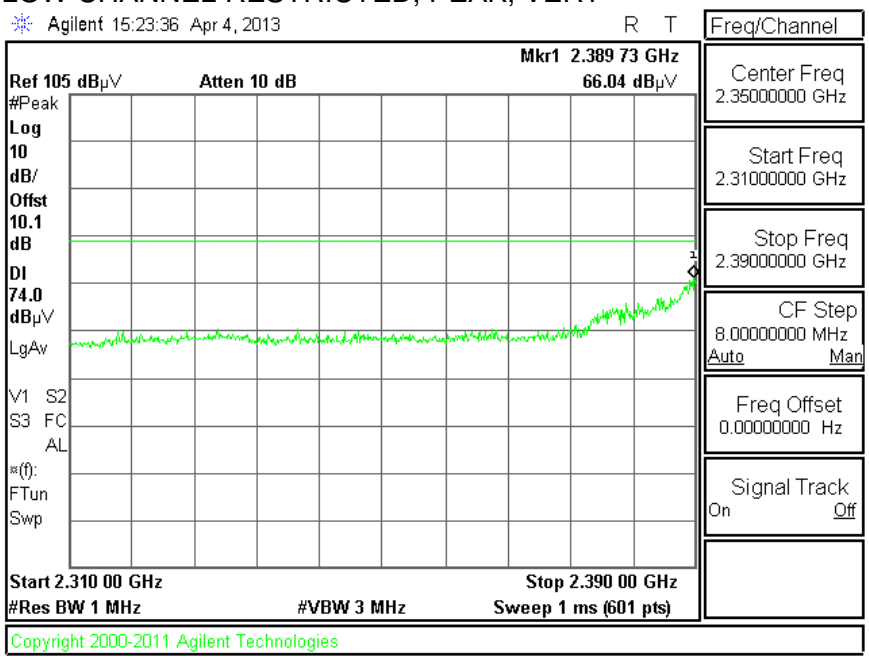


Measurement with additional DCCF: 0.93+70.82=71.75 dBuV/m



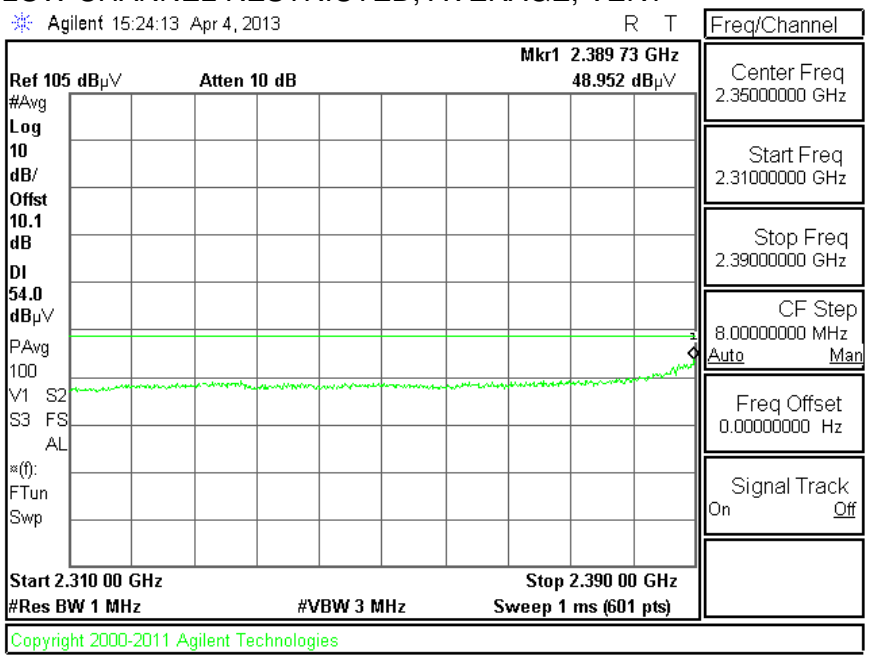
Measurement with additional DCCF: 0.93+51.968=52.898 dBuV/m

LOW CHANNEL RESTRICTED, PEAK, VERT



Measurement with additional DCCF: 0.93+66.04=66.97 dBuV/m

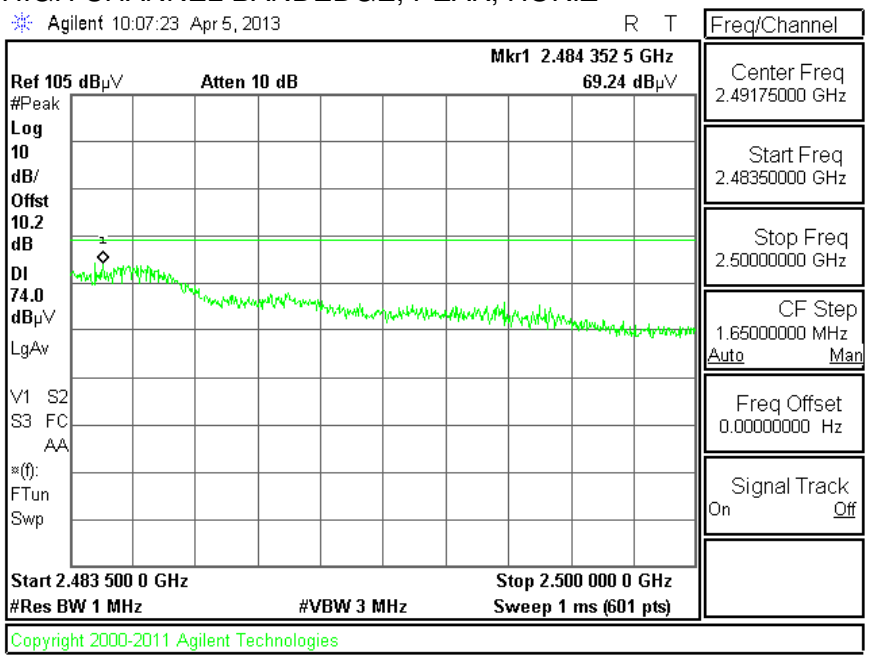
LOW CHANNEL RESTRICTED, AVERAGE, VERT



Measurement with additional DDCF:0.93+48.952= 49.882 dBuV/m

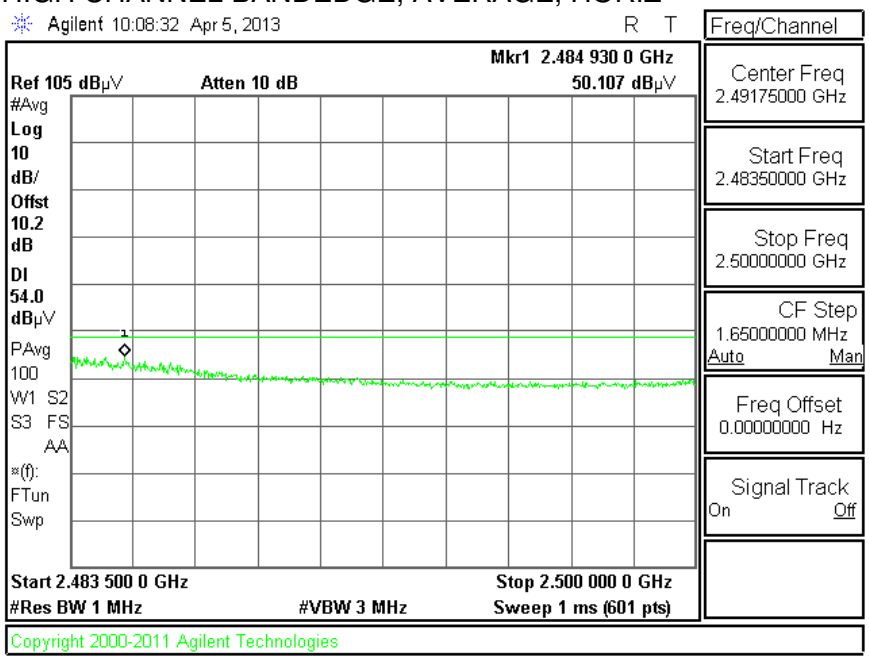
AUTHORIZED BANDEDGE (HIGH CHANNEL)

HIGH CHANNEL BANDEDGE, PEAK, HORIZ



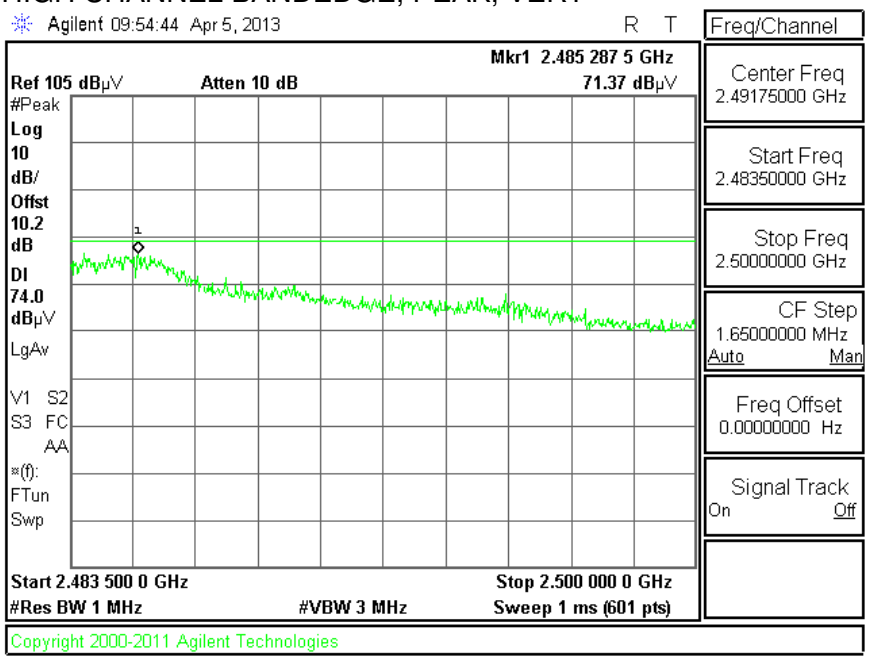
Measurement with additional DCCF: 0.93+69.24=70.17 dBuV/m

HIGH CHANNEL BANDEDGE, AVERAGE, HORIZ



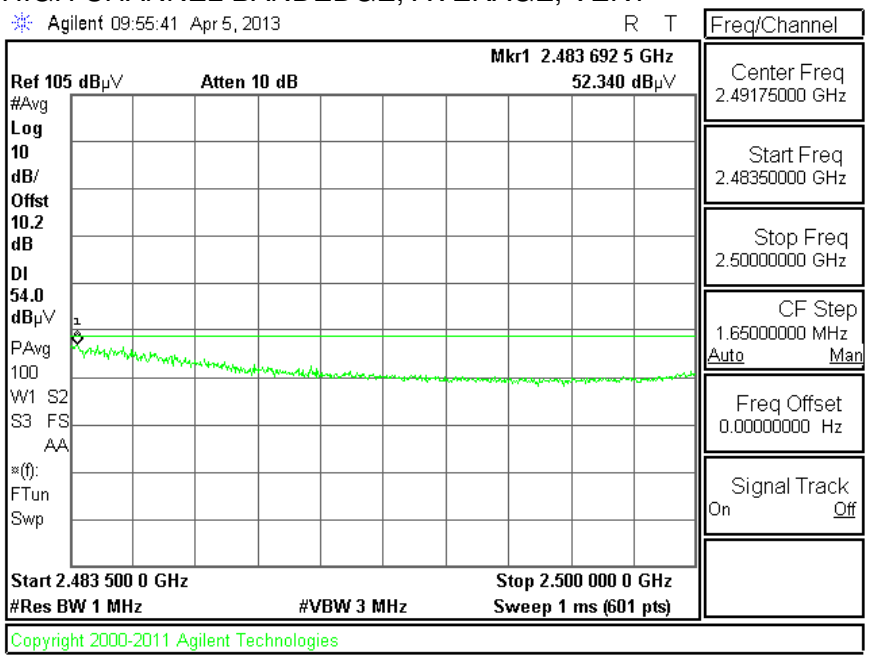
Measurement with additional DCCF: 0.93+50.107=51.037 dBuV/m

HIGH CHANNEL BANDEDGE, PEAK, VERT



Measurement with additional DCCF: 0.93+71.37=72.3 dBuV/m

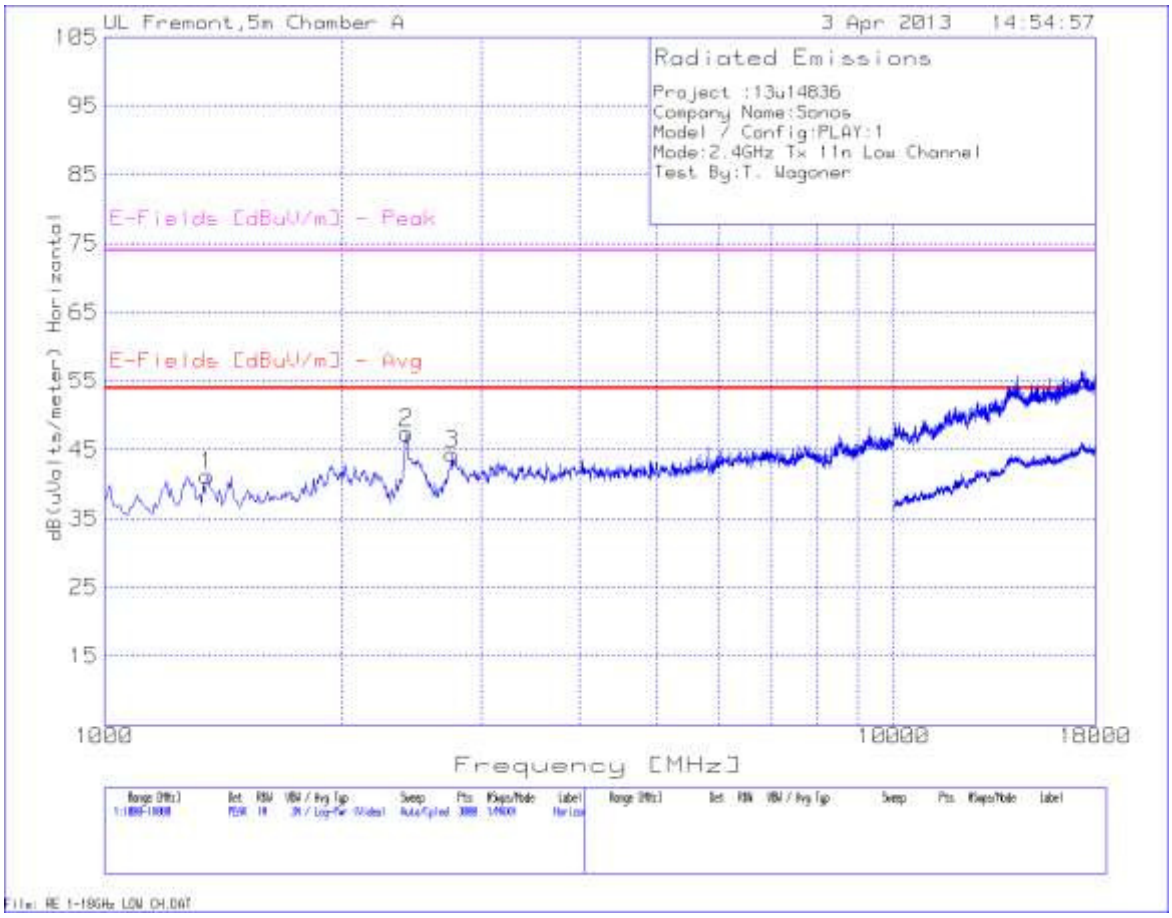
HIGH CHANNEL BANDEDGE, AVERAGE, VERT



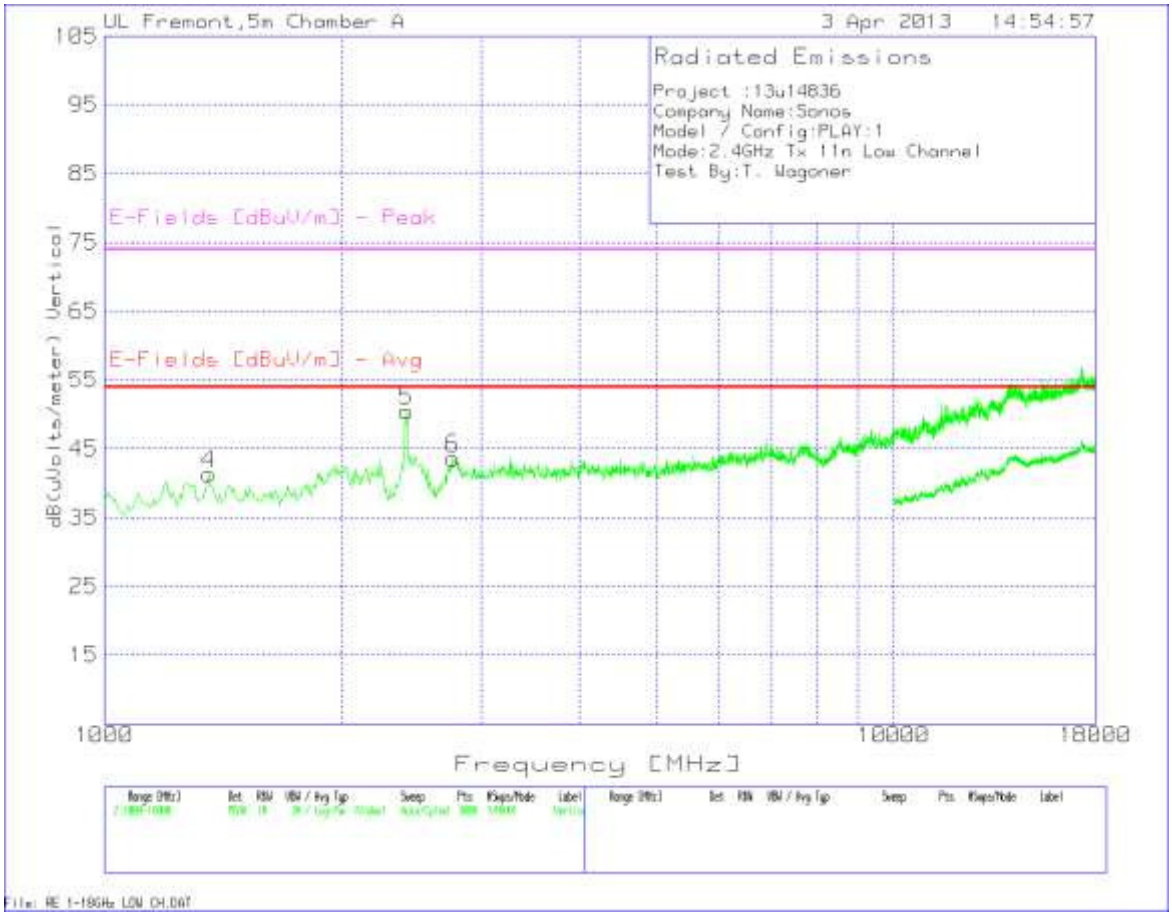
Measurement with additional DCCF: 0.93+52.340=53.27 dBuV/m

HARMONICS AND SPURIOUS EMISSIONS

Low Channel, Horizontal



Low Channel, Vertical



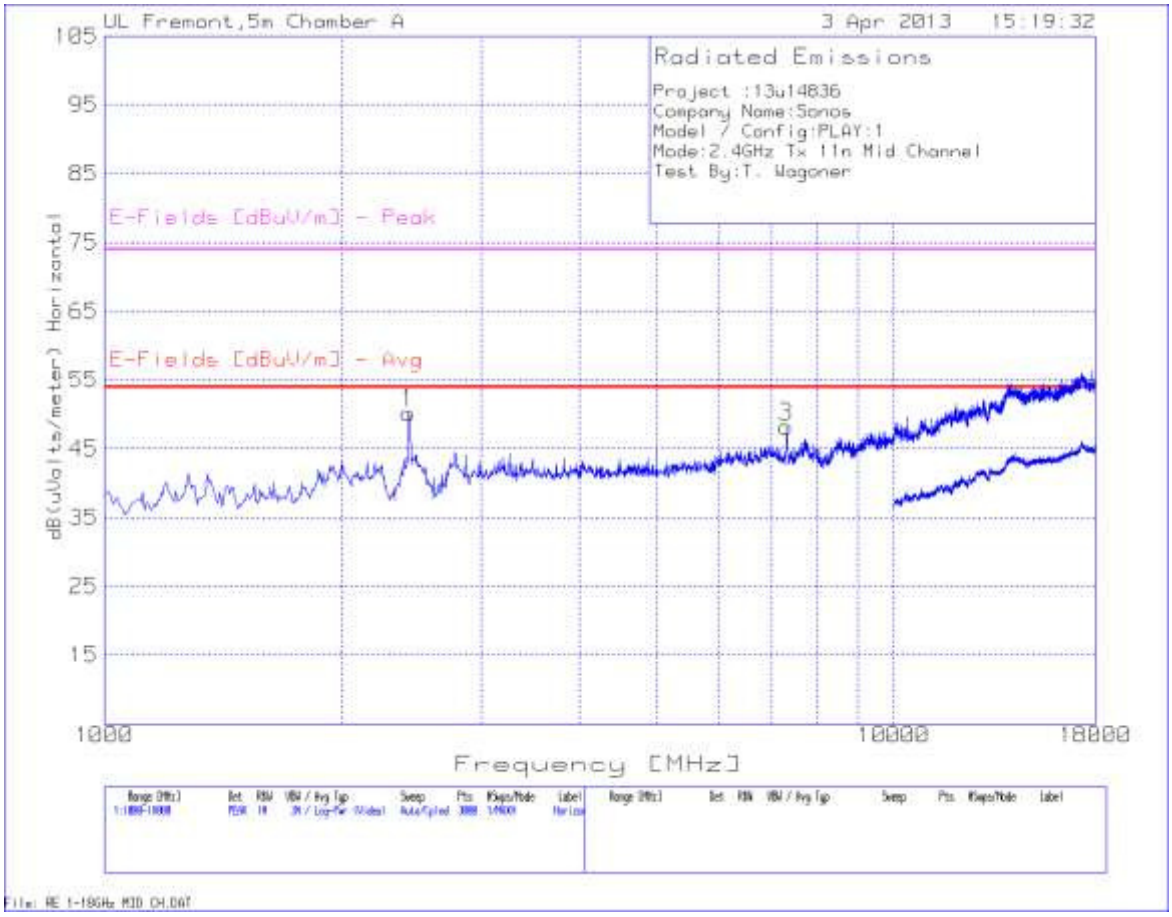
Low Channel, Data

Project :	13u14836
Company Name:	Sonos
Model / Config:	PLAY:1
Mode:	2.4GHz Tx 11n Low Channel
Test By:	T. Wagoner

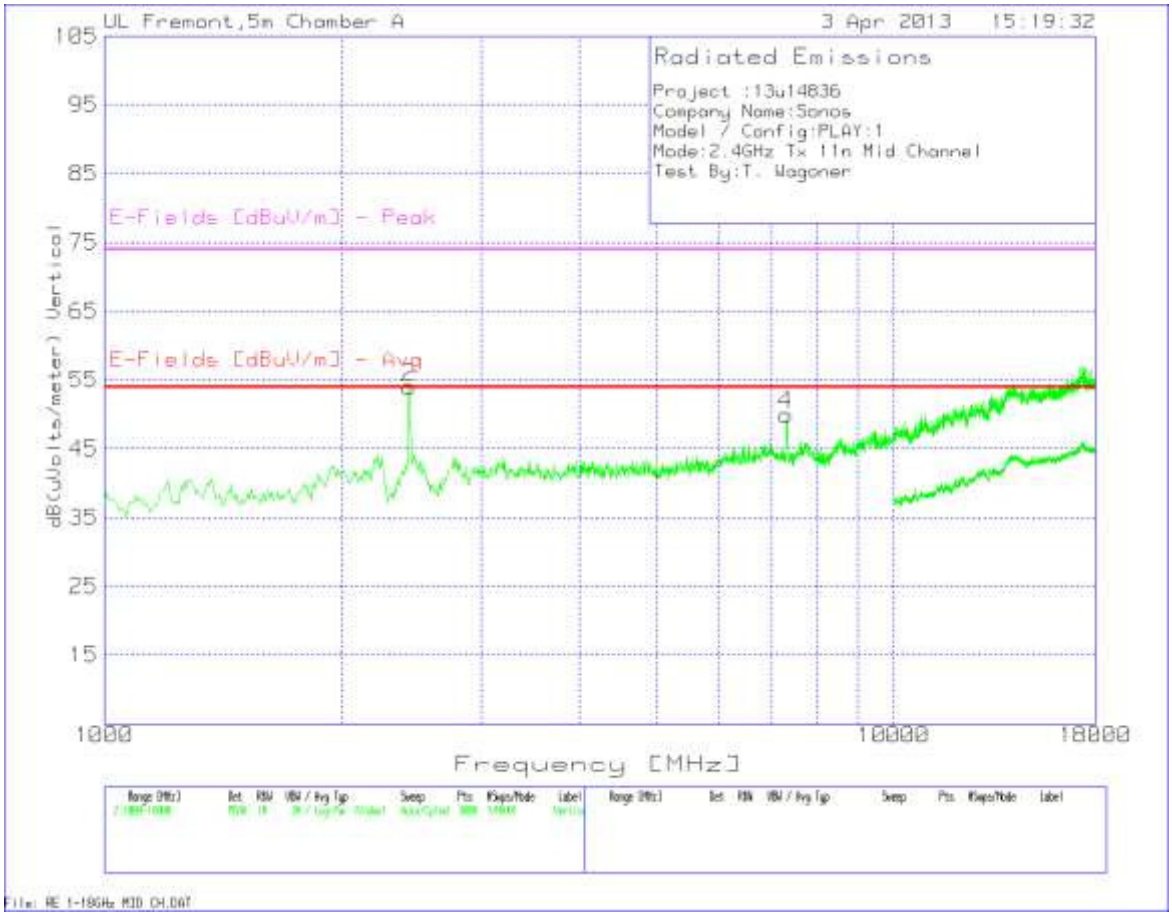
Marker No.	Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T160 BRF [dB]	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
1	1351.099	45.54	PK	30	-38.1	3.4	0.4	41.24	53.97	-12.73	74	-32.76	200	Horz
2*	2415.723	46.69	PK	32.2	-36.9	4.5	0.9	47.39	53.97	-6.58	74	-26.61	100	Horz
3	2755.496	42.87	PK	32.6	-36.8	4.8	0.9	44.37	53.97	-9.6	74	-29.63	100	Horz
4	1356.762	45.63	PK	30	-38.1	3.4	0.4	41.33	53.97	-12.64	74	-32.67	200	Vert
5*	2415.723	49.82	PK	32.2	-36.9	4.5	0.9	50.52	53.97	-3.45	74	-23.48	200	Vert
6	2766.822	42.14	PK	32.6	-36.8	4.8	0.9	43.64	53.97	-10.33	74	-30.36	200	Vert

*=Fundamental Frequency
PK - Peak detector
Av - Average detector

Mid Channel, Horizontal



Mid Channel, Vertical



Mid Channel, Data

Project :	13u14836
Company Name:	Sonos
Model / Config:	PLAY:1
Mode:	2.4GHz Tx 11n Mid Channel
Test By:	T. Wagoner

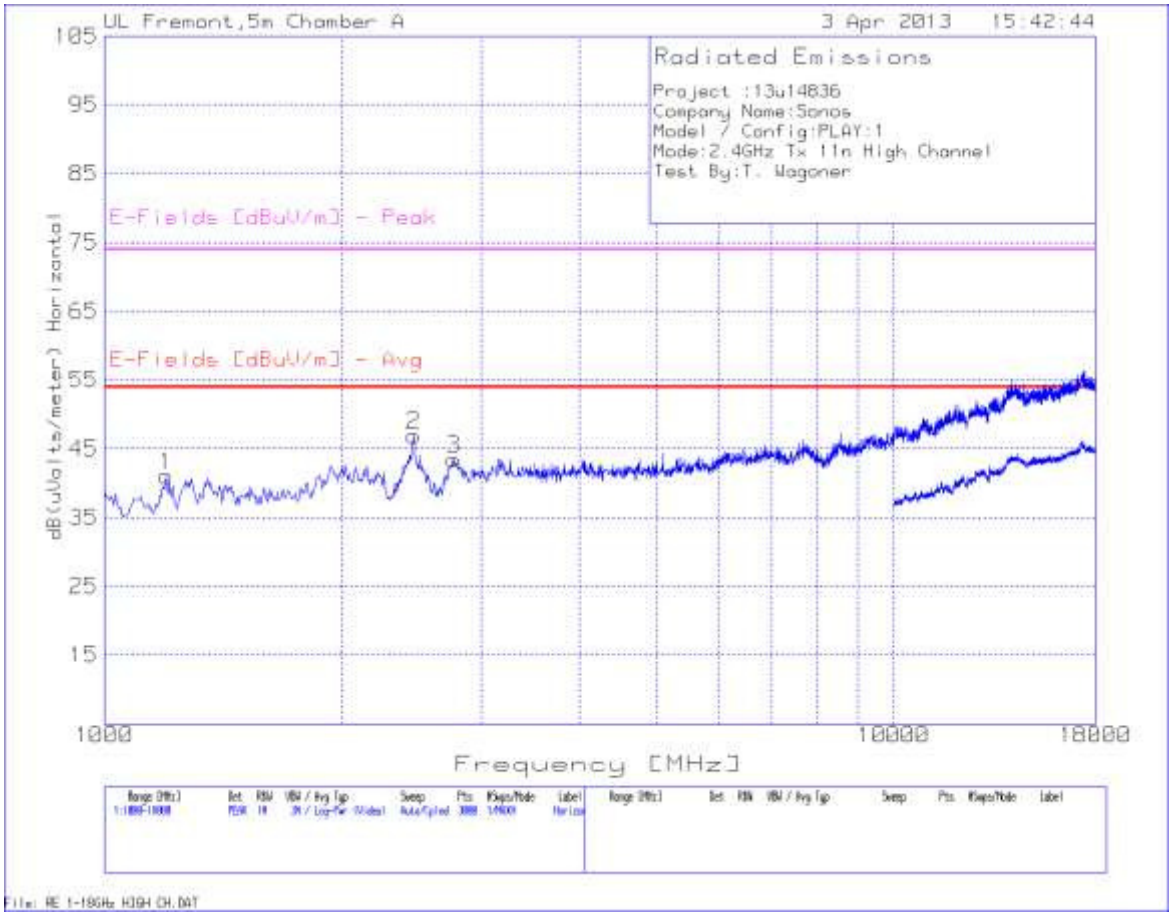
Marker No.	Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T160 BRF [dB]	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
1*	2427.049	49.5	PK	32.2	-36.9	4.5	0.9	50.2	53.97	-3.77	74	-23.8	200	Horz
3	7314.124	39.71	PK	35.3	-35.8	8.7	0.3	48.21	53.97	-5.76	74	-25.79	200	Horz
2*	2432.712	53.18	PK	32.3	-36.9	4.5	0.9	53.98	53.97	0.01	74	-20.02	200	Vert
4	7314.124	41.45	PK	35.3	-35.8	8.7	0.3	49.95	53.97	-4.02	74	-24.05	100	Vert

Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T160 BRF [dB]	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
7295.08	26.56	MAv1	35.3	-35.8	8.7	0.3	35.06	53.97	-18.91	74	-38.94	345	122	Horz
7316.88	27.37	MAv1	35.3	-35.8	8.7	0.3	35.87	53.97	-18.1	74	-38.13	32	153	Vert

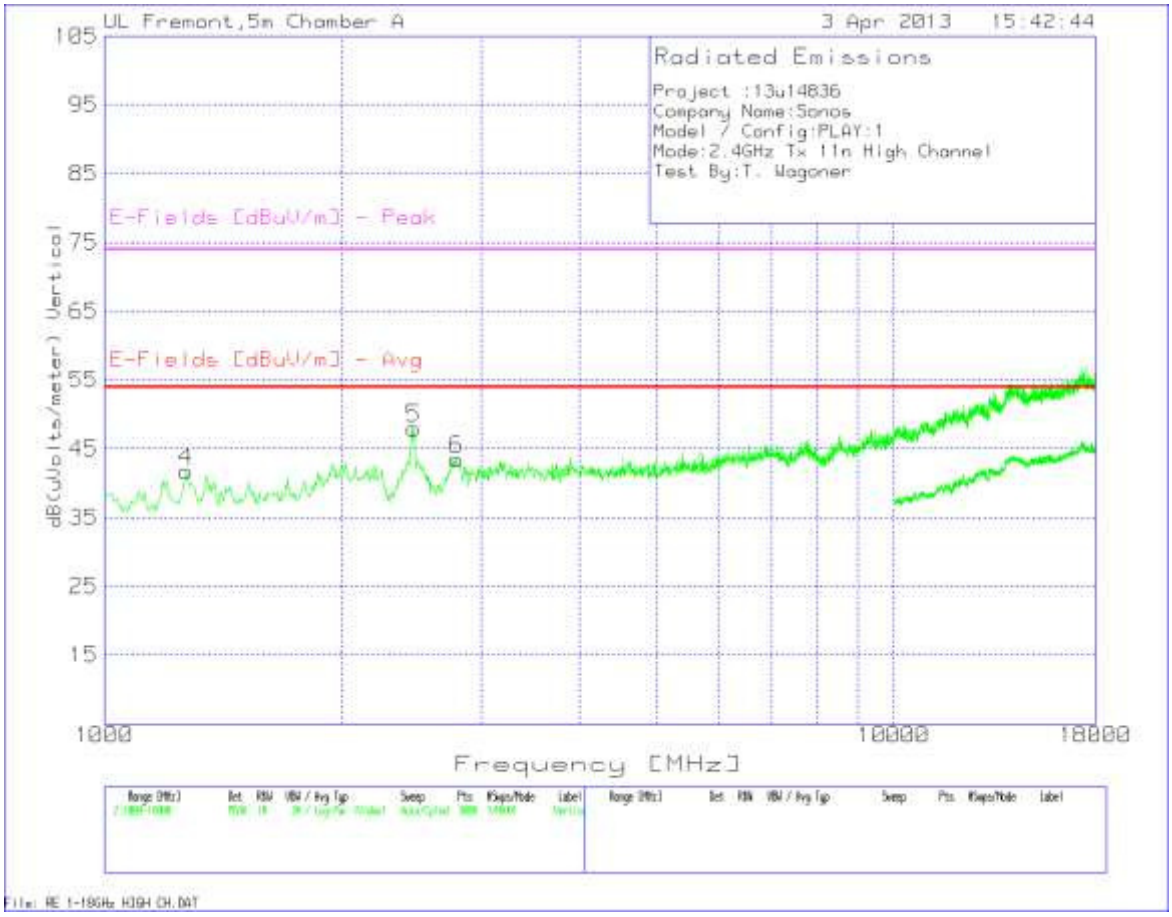
*= Fundamental Frequency

PK - Peak detector

High Channel, Horizontal



High Channel, Vertical



High Channel, Data

Project :	13u14836
Company Name:	Sonos
Model / Config:	PLAY:1
Mode:	2.4GHz Tx 11n High Channel
Test By:	T. Wagoner

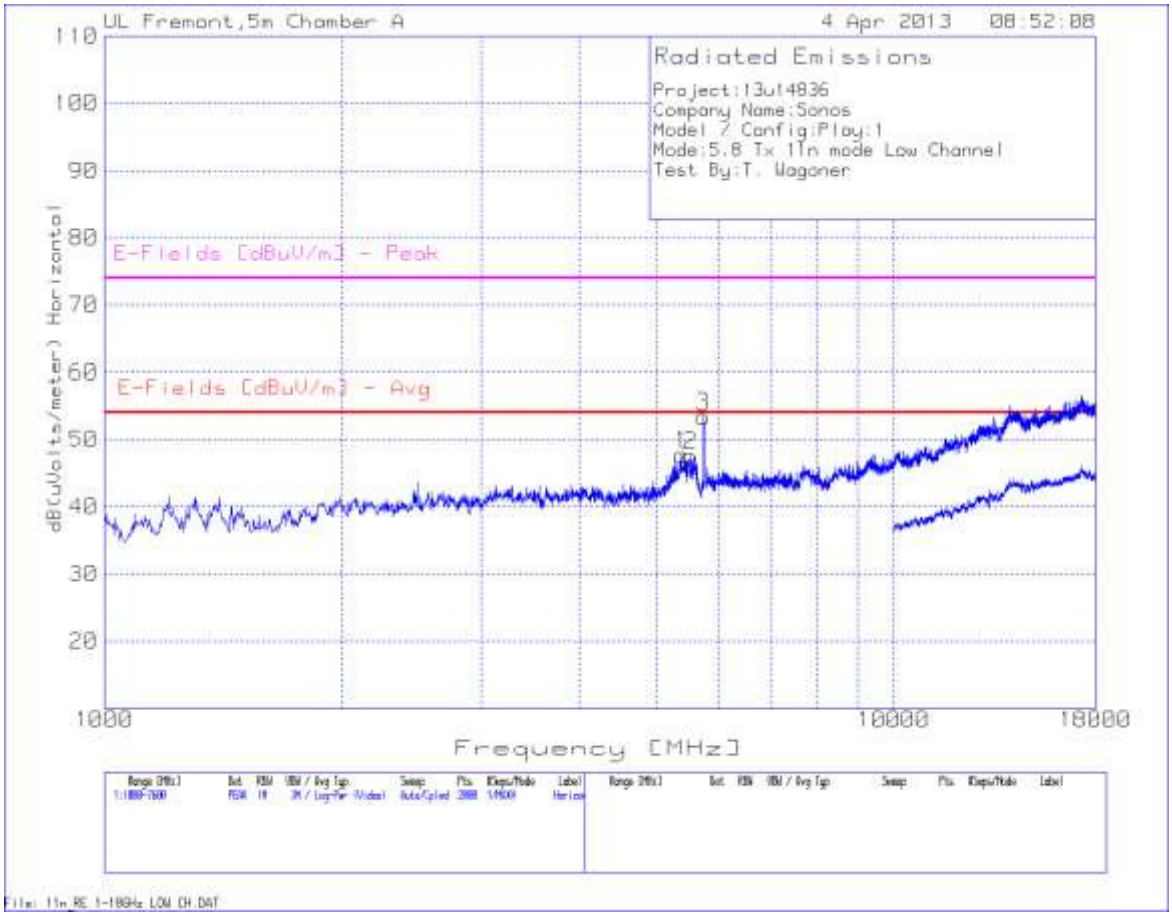
Marker No.	Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T160 BRF [dB]	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
1	1198.201	46.42	PK	29.5	-38.4	3.2	0.3	41.02	53.97	-12.95	74	-32.98	100	Horz
2*	2466.689	45.88	PK	32.4	-36.8	4.5	0.9	46.88	53.97	-7.09	74	-27.12	200	Horz
3	2772.485	41.99	PK	32.6	-36.8	4.8	0.9	43.49	53.97	-10.48	74	-30.51	100	Horz
4	1271.819	46.28	PK	30.1	-38.3	3.3	0.3	41.68	53.97	-12.29	74	-32.32	100	Vert
5*	2466.689	47.01	PK	32.4	-36.8	4.5	0.9	48.01	53.97	-5.96	74	-25.99	200	Vert
6	2795.137	41.89	PK	32.6	-36.7	4.8	0.9	43.49	53.97	-10.48	74	-30.51	200	Vert

*= Fundamental Frequency
PK - Peak detector
Av - Average detector

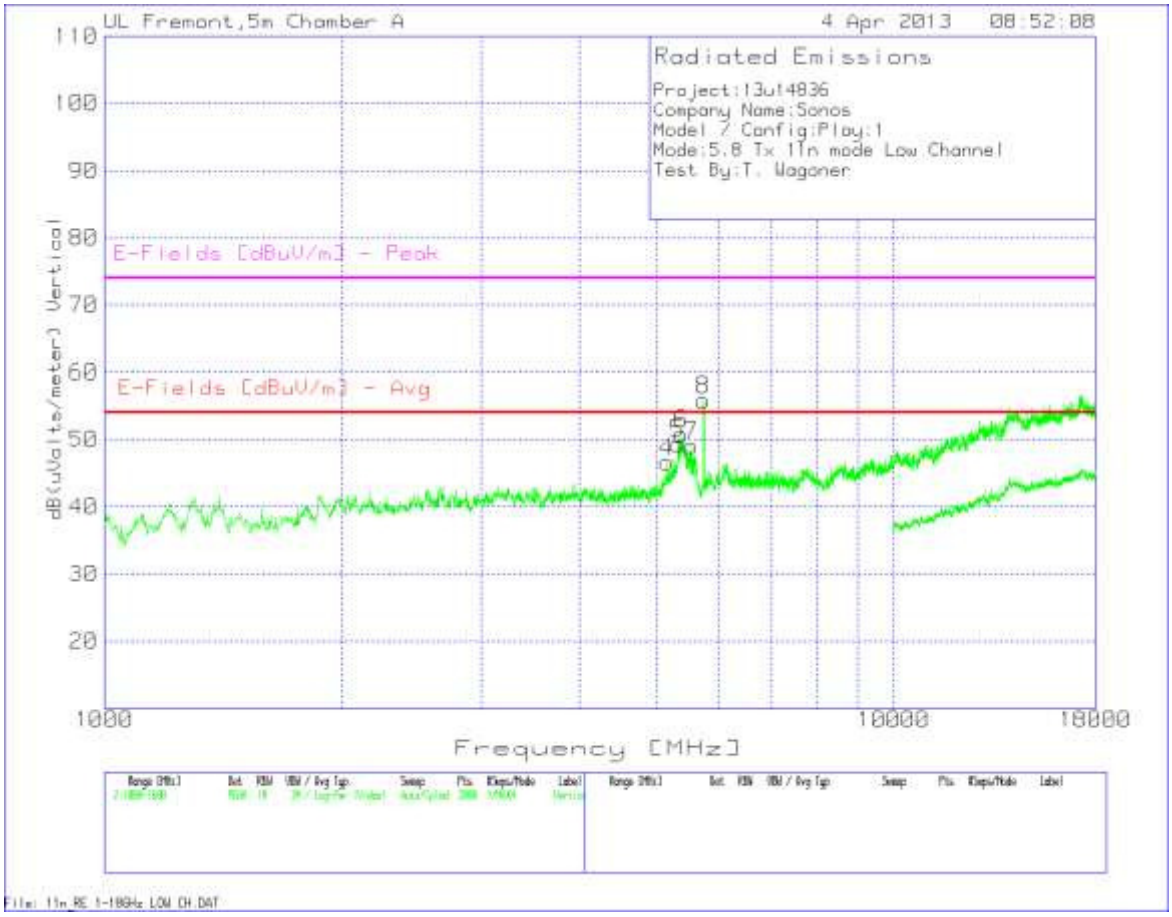
9.2.4. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.8 GHz BAND

HARMONICS AND SPURIOUS EMISSIONS

Low Channel, Horizontal



Low Channel, Vertical



Low Channel, Data

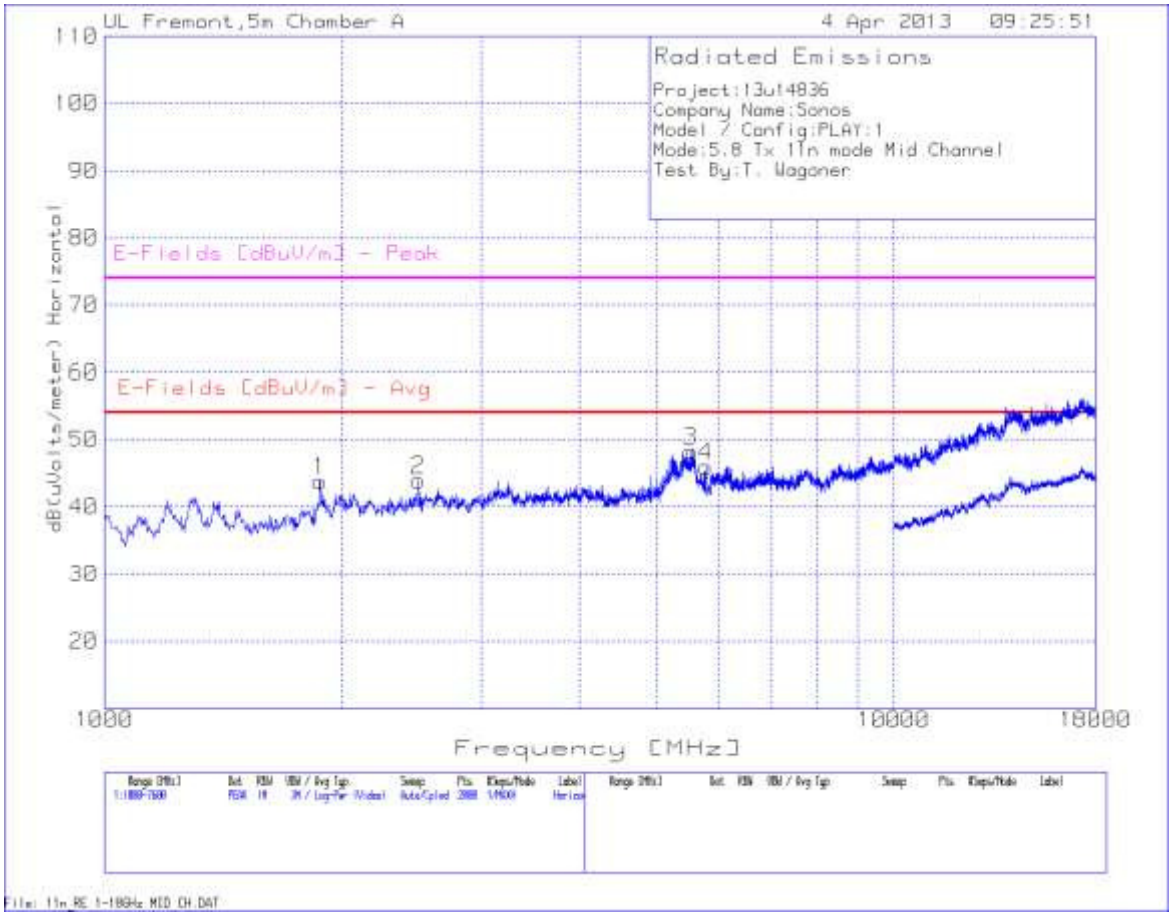
Project:	13u14836
Company Name:	Sonos
Model / Config:	Play:1
Mode:	5.8 Tx 11n mode Low Channel
Test By:	T. Wagoner

Marker No.	Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T163 BRF [dB]	dB(uVolts/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
1	5380.21	41.35	PK	34.4	-35.5	7.2	0.3	47.75	53.97	-6.22	74	-26.25	100	Horz
2	5531.934	40.81	PK	34.4	-35.5	7.3	0.6	47.61	53.97	-6.36	74	-26.39	100	Horz
3*	5739.73	45.79	PK	34.7	-35.5	7.5	0.9	53.39	53.97	-0.58	74	-20.61	200	Horz
4	5159.22	40.84	PK	34.1	-35.5	7	0.2	46.64	53.97	-7.33	74	-27.36	100	Vert
5	5327.436	43.14	PK	34.3	-35.5	7.2	0.2	49.34	53.97	-4.63	74	-24.66	100	Vert
6	5383.508	44.44	PK	34.4	-35.5	7.2	0.3	50.84	53.97	-3.13	74	-23.16	100	Vert
7**	5548.426	42.13	PK	34.4	-35.5	7.3	0.7	49.03	53.97	-4.94	74	-24.97	100	Vert
8*	5739.73	48.23	PK	34.7	-35.5	7.5	0.9	55.83	53.97	1.86	74	-18.17	200	Vert

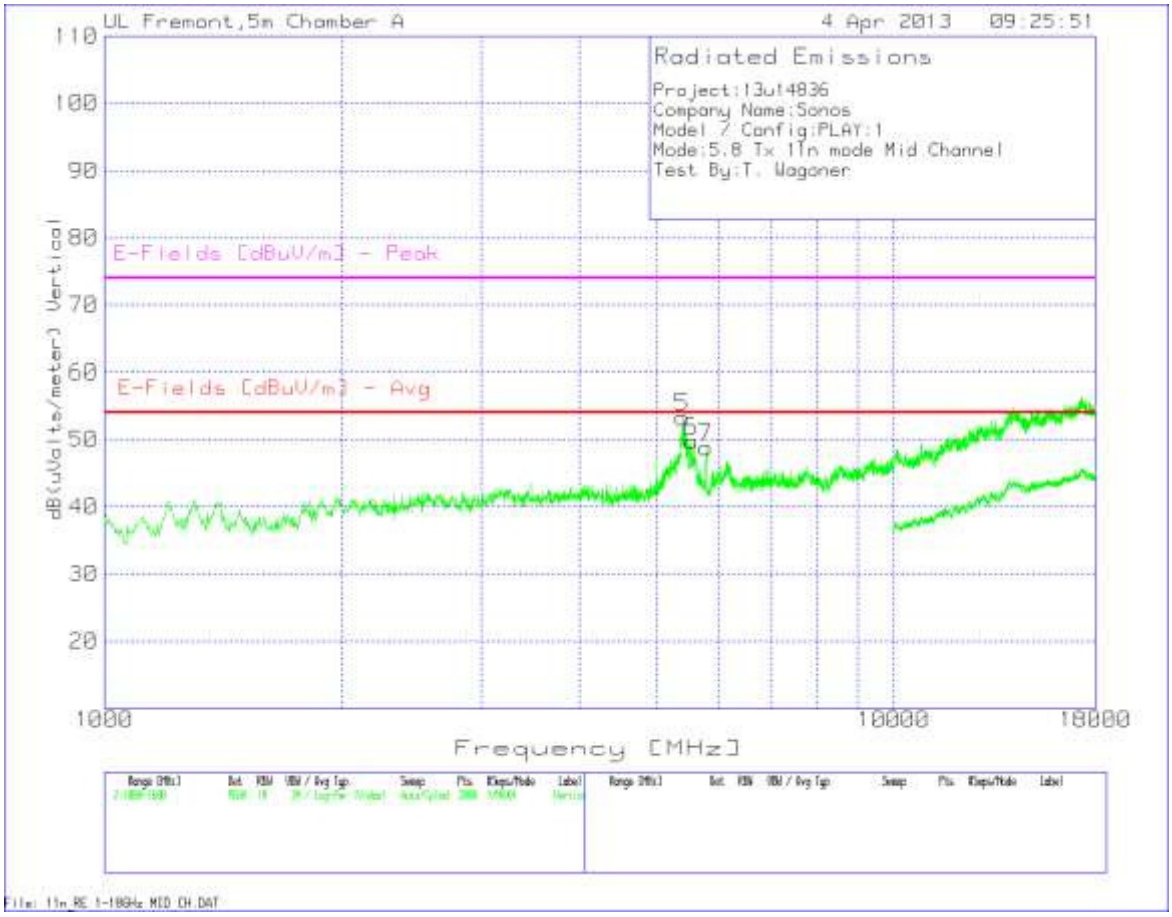
Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T163 BRF [dB]	dB(uVolts/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
5336.18	33.31	MAv1	34.3	-35.5	7.2	0.2	39.51	53.97	-14.46	74	-34.49	297	144	Vert
5400.1	30.87	MAv1	34.4	-35.5	7.2	0.3	37.27	53.97	-16.7	74	-36.73	214	115	Vert

*= Fundamental Frequency
**= Not in Restriced Band
PK - Peak detector

Mid Channel, Horizontal



Mid Channel, Vertical



Mid Channel, Data

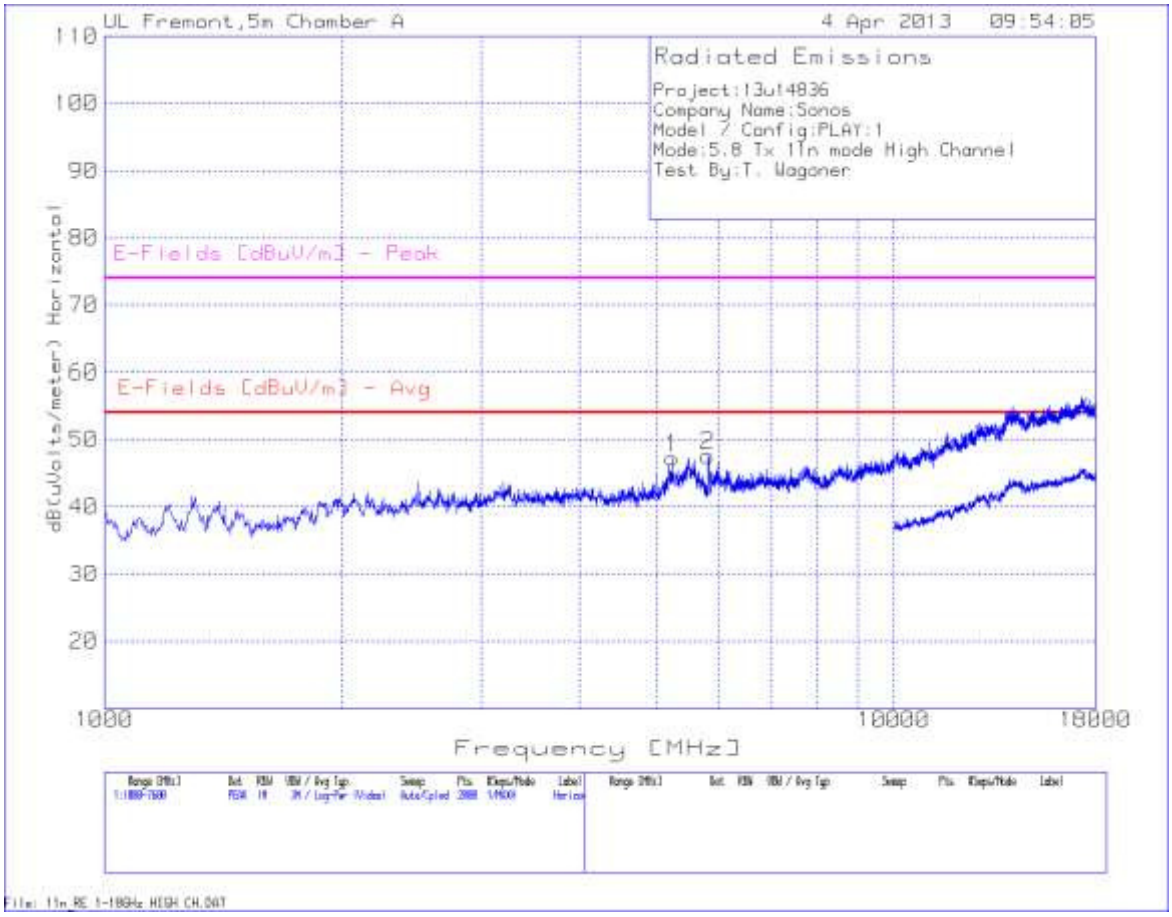
Project:	13u14836
Company Name:	Sonos
Model / Config:	PLAY:1
Mode:	5.8 Tx 11n mode Mid Channel
Test By:	T. Wagoner

Marker No.	Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T163 BRF [dB]	dB(uVolts/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
1	1877.361	45.63	PK	31.4	-37.2	3.9	0.1	43.83	53.97	-10.14	74	-30.17	100	Horz
2	2497.451	43.56	PK	32.6	-36.8	4.5	0.1	43.96	53.97	-10.01	74	-30.04	200	Horz
3	5528.636	41.44	PK	34.4	-35.5	7.3	0.6	48.24	53.97	-5.73	74	-25.76	100	Horz
4*	5782.609	38.26	PK	34.8	-35.5	7.5	0.9	45.96	53.97	-8.01	74	-28.04	100	Horz
5	5403.298	46.82	PK	34.4	-35.5	7.2	0.3	53.22	53.97	-0.75	74	-20.78	100	Vert
6**	5538.531	42.95	PK	34.4	-35.5	7.3	0.6	49.75	53.97	-4.22	74	-24.25	100	Vert
7*	5789.205	41.09	PK	34.8	-35.5	7.5	0.9	48.79	53.97	-5.18	74	-25.21	200	Vert

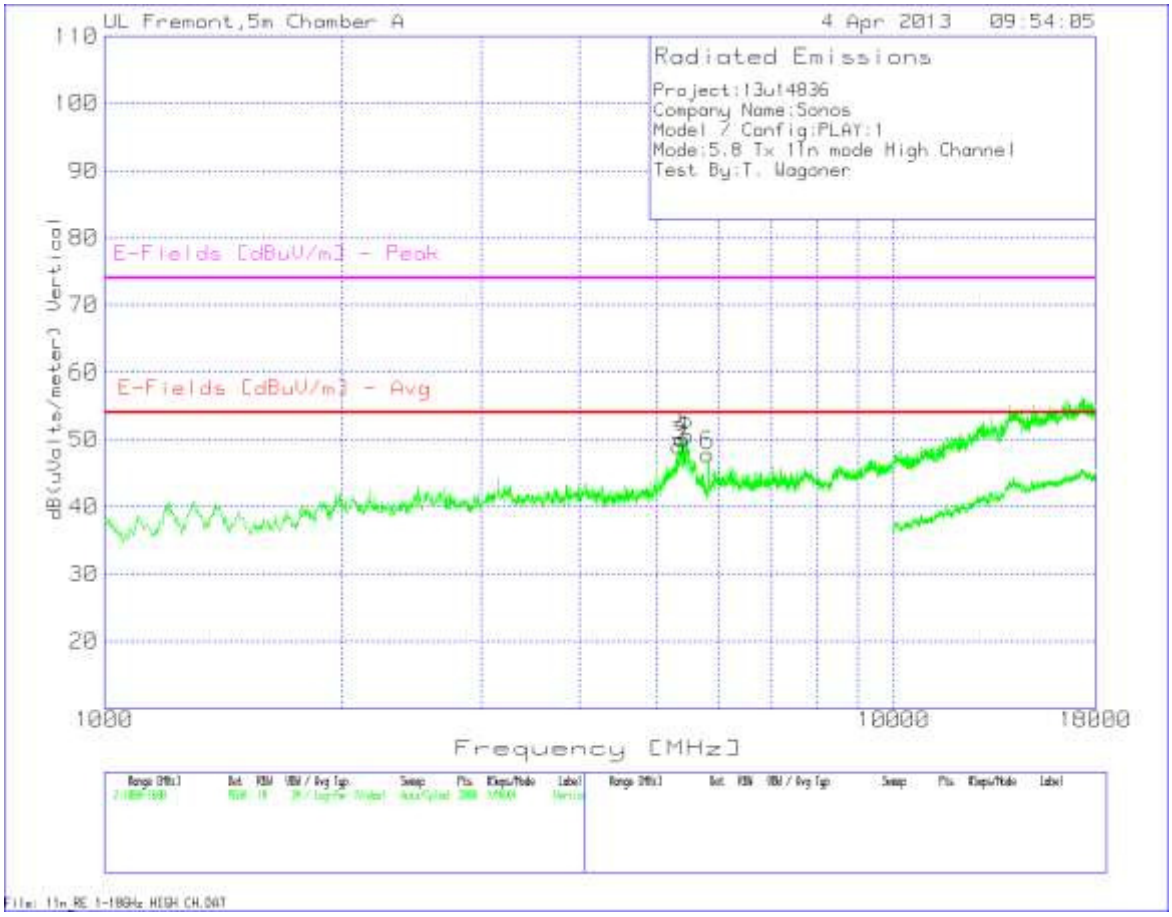
Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T163 BRF [dB]	dB(uVolts/meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
5402.5	36.31	MAv1	34.4	-35.5	7.2	0.3	42.71	53.97	-11.26	74	-31.29	290	116	Vert

*= Fundamental Frequency
**= Not in Restricted Band
PK - Peak detector

High Channel, Horizontal



High Channel, Vertical



High Channel, Data

Project:	13u14836
Company Name:	Sonos
Model / Config:	PLAY:1
Mode:	5.8 Tx 11n mode High Channel
Test By:	T. Wagoner

Marker No.	Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T163 BRF [dB]	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Height [cm]	Polarity
1	5241.679	41.25	PK	34.2	-35.5	7.1	0.2	47.25	53.97	-6.72	74	-26.75	200	Horz
2*	5822.189	39.7	PK	34.9	-35.5	7.6	0.9	47.6	53.97	-6.37	74	-26.4	200	Horz
3	5347.226	42.94	PK	34.3	-35.5	7.2	0.2	49.14	53.97	-4.83	74	-24.86	100	Vert
4	5393.403	43.65	PK	34.4	-35.5	7.2	0.3	50.05	53.97	-3.92	74	-23.95	100	Vert
5	5465.967	43.92	PK	34.4	-35.5	7.3	0.4	50.52	53.97	-3.45	74	-23.48	100	Vert
6*	5822.189	39.89	PK	34.9	-35.5	7.6	0.9	47.79	53.97	-6.18	74	-26.21	100	Vert

Test Frequency	Meter Reading	Detector	T136 Ant Factor [dB/m]	T144 Preamp Gain [dB]	Cable Factor [dB]	T163 BRF [dB]	dB(uVolts /meter)	E-Fields [dBuV/m] - Avg	Margin (dB)	E-Fields [dBuV/m] - Peak	Margin (dB)	Azimuth [Degs]	Height [cm]	Polarity
5346.51	33.94	MAv1	34.3	-35.5	7.2	0.2	40.14	53.97	-13.83	74	-33.86	290	132	Vert
5399.72	30.64	MAv1	34.4	-35.5	7.2	0.3	37.04	53.97	-16.93	74	-36.96	180	174	Vert
5471.11	31.1	MAv1	34.4	-35.5	7.3	0.4	37.7	53.97	-16.27	74	-36.3	135	101	Vert

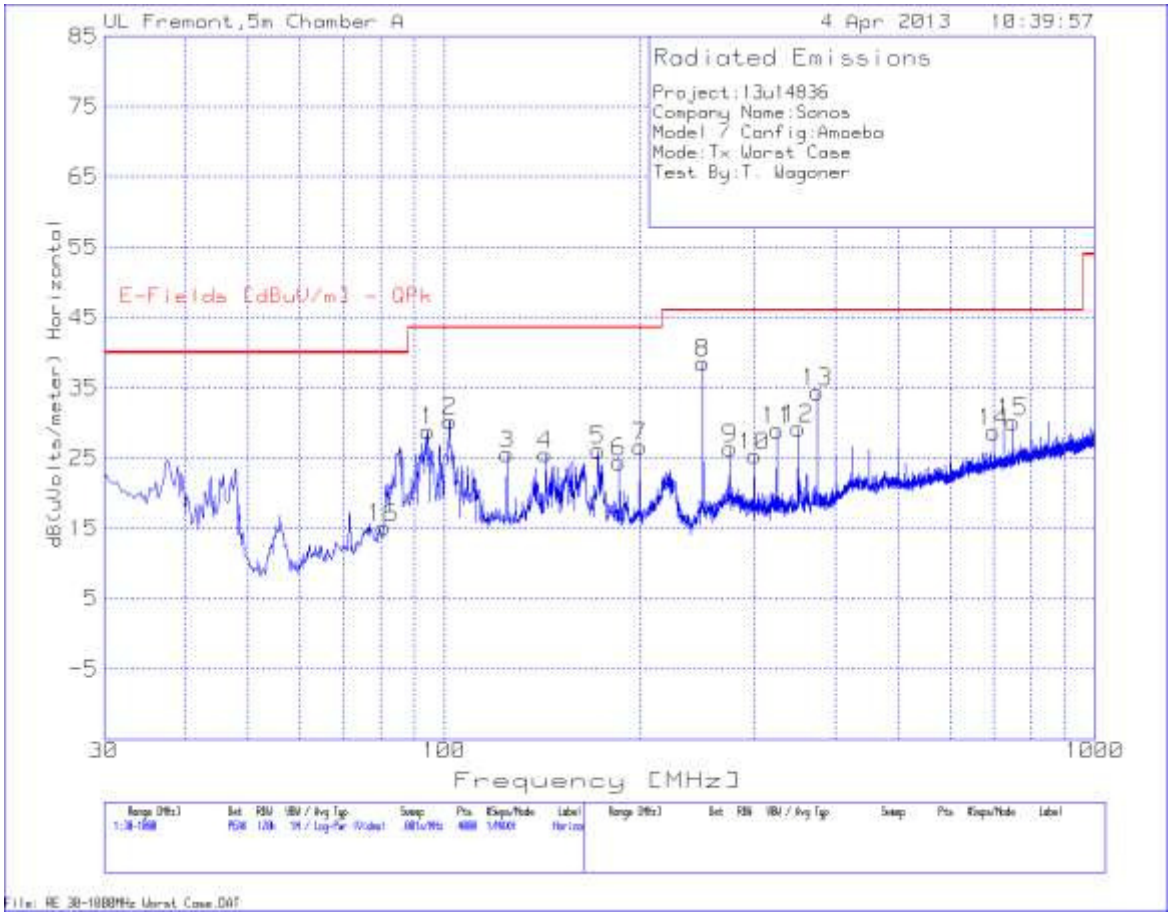
*= Fundamental Frequency

PK - Peak detector

9.3. WORST-CASE BELOW 1 GHz

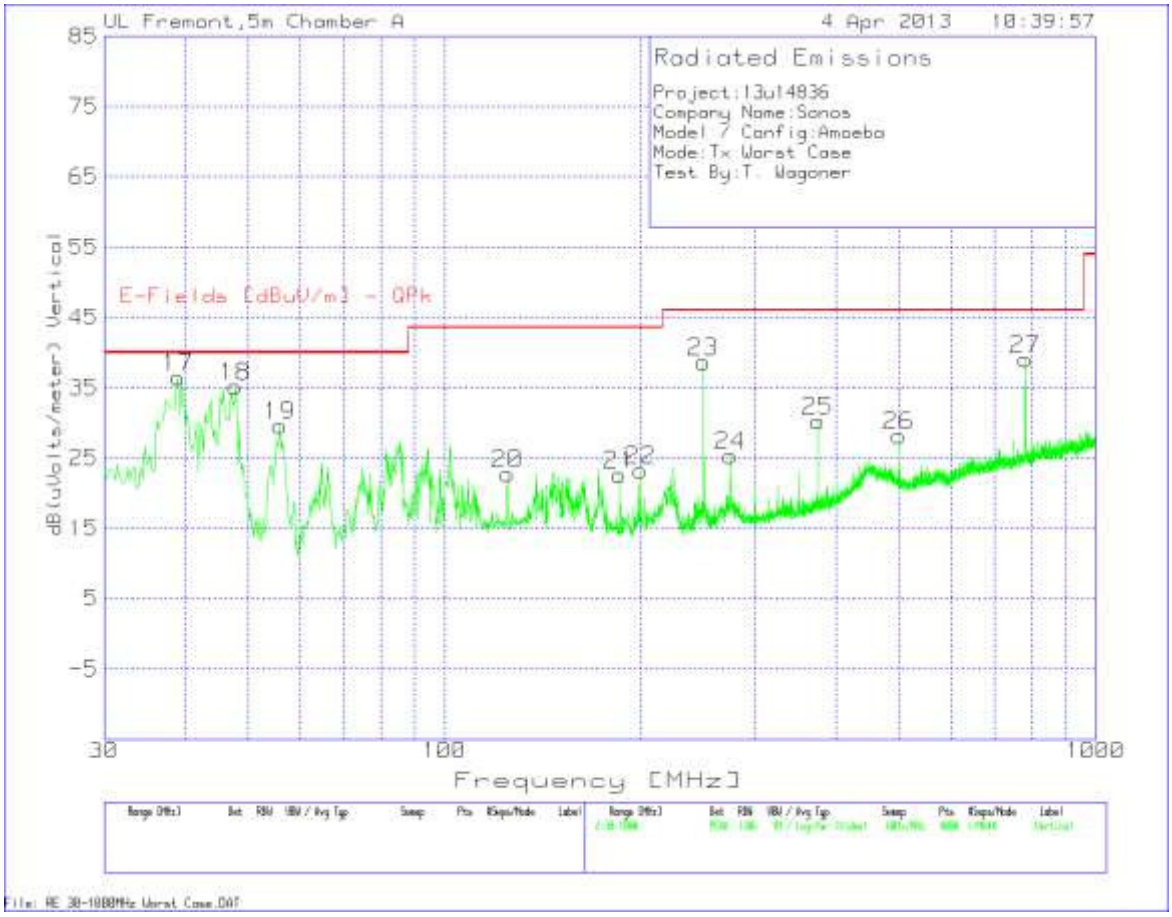
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT



SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL PLOT



DATA

Project:	13u14836
Company Name:	Sonos
Model / Config:	Amoeba
Mode:	Tx Worst Case
Test By:	T. Wagoner

Marker No.	Test Frequency	Meter Reading	Detector	T185 Antenna Factor dB/m	T64 preamp/cable loss [dB]	dB(uVolts /meter)	E-Fields [dBuV/m] - QPk	Margin (dB)	Height [cm]	Polarity
1	94.4567	47.25	PK	8.6	-27	28.85	43.52	-14.67	200	Horz
2	101.9685	46.58	PK	10.6	-26.9	30.28	43.52	-13.24	300	Horz
3	124.9888	38.23	PK	14.2	-26.9	25.53	43.52	-17.99	200	Horz
4	143.1626	39.42	PK	12.8	-26.7	25.52	43.52	-18	200	Horz
5	172.7255	41.28	PK	11.3	-26.5	26.08	43.52	-17.44	200	Horz
6	186.053	39.85	PK	10.9	-26.3	24.45	43.52	-19.07	100	Horz
7	199.8651	40.47	PK	12.3	-26.2	26.57	43.52	-16.95	200	Horz
8	249.7827	53.15	PK	11.5	-26.1	38.55	46.02	-7.47	100	Horz
9	274.9838	39.18	PK	13.3	-26.1	26.38	46.02	-19.64	100	Horz
10	299.9425	37.77	PK	13.3	-25.8	25.27	46.02	-20.75	100	Horz
11	324.9013	40.69	PK	13.9	-25.6	28.99	46.02	-17.03	100	Horz
12	350.1024	40.29	PK	14.3	-25.4	29.19	46.02	-16.83	100	Horz
13	375.0612	44.69	PK	15	-25.3	34.39	46.02	-11.63	100	Horz
14	700.01	31.56	PK	20.1	-23	28.66	46.02	-17.36	200	Horz
15	749.9276	32.44	PK	20.6	-22.9	30.14	46.02	-15.88	200	Horz
16	80.6445	34.69	PK	7.6	-27.2	15.09	40	-24.91	400	Horz
17	38.9658	49.69	PK	14.3	-27.5	36.49	40	-3.51	200	Vert
18	47.6892	53.98	PK	8.7	-27.5	35.18	40	-4.82	200	Vert
19	55.9281	50.14	PK	6.9	-27.4	29.64	40	-10.36	200	Vert
20	124.9888	35.4	PK	14.2	-26.9	22.7	43.52	-20.82	200	Vert
21	186.053	38.05	PK	10.9	-26.3	22.65	43.52	-20.87	200	Vert
22	199.8651	37.16	PK	12.3	-26.2	23.26	43.52	-20.26	200	Vert
23	249.7827	53.27	PK	11.5	-26.1	38.67	46.02	-7.35	200	Vert
24	274.9838	38.1	PK	13.3	-26.1	25.3	46.02	-20.72	200	Vert
25	375.0612	40.5	PK	15	-25.3	30.2	46.02	-15.82	200	Vert
26	499.8551	34.67	PK	17.9	-24.4	28.17	46.02	-17.85	200	Vert
27	781.1866	40.49	PK	21.2	-22.7	38.99	46.02	-7.03	200	Vert

PK - Peak detector
QP - Quasi-Peak detector
Av - Average detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

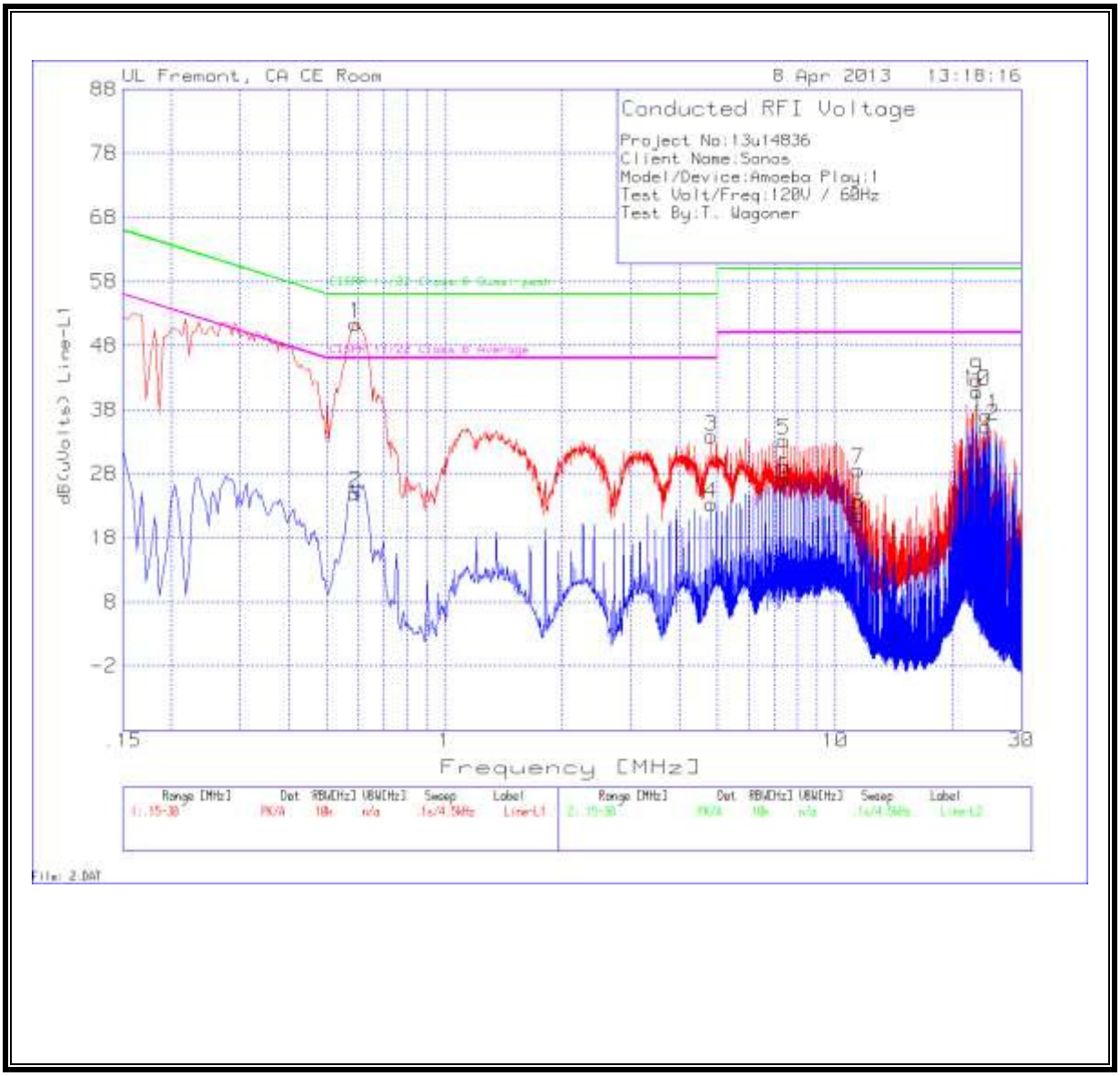
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

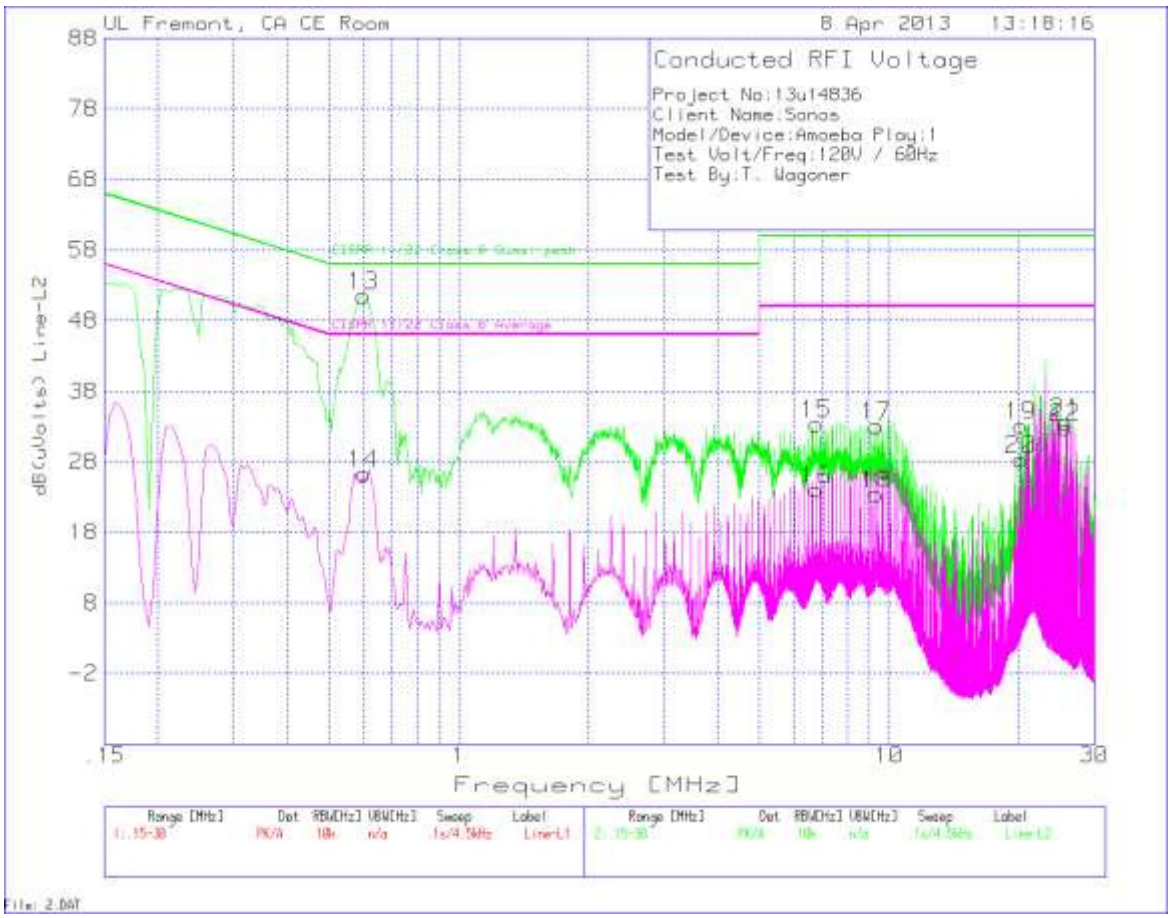
RESULTS

6 WORST EMISSIONS

LINE 1 RESULTS



LINE 2 RESULTS



Data

Project No:	13u14836
Client Name:	Sonos
Model/Device:	Amoeba Play:1
Test Volt/Freq:	120V / 60Hz
Test By:	T. Wagoner

Line-L1 .15 - 30MHz									
Test Frequency	Meter Reading	Detector	T24 IL L1.TXT (dB)	LC Cables 1&3.TXT (dB)	dB(uVolts)	CISPR 11/22 Class B Quasi-peak	Margin	CISPR 11/22 Class B Average	Margin
0.591	51.23	PK	0.1	0	51.33	56	-4.67	-	-
0.591	24.85	Av	0.1	0	24.95	-	-	46	-21.05
4.8255	33.59	PK	0.1	0.1	33.79	56	-22.21	-	-
4.8255	23.06	Av	0.1	0.1	23.26	-	-	46	-22.74
7.3905	32.95	PK	0.1	0.1	33.15	60	-26.85	-	-
7.3905	26.89	Av	0.1	0.1	27.09	-	-	50	-22.91
11.463	28.17	PK	0.2	0.2	28.57	60	-31.43	-	-
11.463	21.26	Av	0.2	0.2	21.66	-	-	50	-28.34
23.1315	42.02	PK	0.4	0.2	42.62	60	-17.38	-	-
23.1315	40.24	Av	0.4	0.2	40.84	-	-	50	-9.16
24.3555	36.53	PK	0.4	0.2	37.13	60	-22.87	-	-
24.3555	34.84	Av	0.4	0.2	35.44	-	-	50	-14.56
Line-L2 .15 - 30MHz									
0.6	51.37	PK	0.1	0	51.47	56	-4.53	-	-
0.6	26.11	Av	0.1	0	26.21	-	-	46	-19.79
6.7785	33.17	PK	0.1	0.1	33.37	60	-26.63	-	-
6.7785	23.79	Av	0.1	0.1	23.99	-	-	50	-26.01
9.339	32.93	PK	0.1	0.1	33.13	60	-26.87	-	-
9.339	23.15	Av	0.1	0.1	23.35	-	-	50	-26.65
20.2605	32.62	PK	0.3	0.2	33.12	60	-26.88	-	-
20.2605	27.78	Av	0.3	0.2	28.28	-	-	50	-21.72
25.6965	32.84	PK	0.5	0.3	33.64	60	-26.36	-	-
25.6965	31.97	Av	0.5	0.3	32.77	-	-	50	-17.23
PK - Peak detector									
Av - Average detector									