



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

CERTIFICATION TEST REPORT

FOR

QUAD-BAND RADIO WITH WLAN AND BT RADIO

MODEL NUMBER: A1457

**FCC ID: BCG-E2643B
IC: 579C-E2643B**

REPORT NUMBER: 13U15637-16

ISSUE DATE: JULY 22, 2013

Prepared for

APPLE

1 INFINITE LOOP

CUPERTINO, CA 95014, U.S.A

Prepared by

UL VERIFICATION SERVICES INC.

47173 BENICIA STREET

FREMONT, CA 94538, U.S.A.

TEL: (510) 771-1000

FAX: (510) 661-0888



NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	07/22/13	Initial Issue	T. Chan

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	5
2. TEST METHODOLOGY	6
3. FACILITIES AND ACCREDITATION	6
4. CALIBRATION AND UNCERTAINTY	6
4.1. MEASURING INSTRUMENT CALIBRATION	6
4.2. SAMPLE CALCULATION	6
4.3. MEASUREMENT UNCERTAINTY	6
5. EQUIPMENT UNDER TEST	7
5.1. DESCRIPTION OF EUT	7
5.2. MAXIMUM OUTPUT POWER.....	7
5.3. DESCRIPTION OF AVAILABLE ANTENNAS	7
5.4. SOFTWARE AND FIRMWARE.....	7
5.5. WORST-CASE CONFIGURATION AND MODE.....	8
5.6. DESCRIPTION OF TEST SETUP.....	9
6. TEST AND MEASUREMENT EQUIPMENT	12
7. ANTENNA PORT TEST RESULTS	13
7.1. 2.4 GHz BAND.....	13
7.1.1. 6 dB BANDWIDTH.....	13
7.1.2. 99% BANDWIDTH.....	20
7.1.3. AVERAGE POWER	27
7.1.4. OUTPUT POWER	28
7.1.5. PSD	37
7.1.6. OUT-OF-BAND EMISSIONS	44
7.2. 5.8 GHz BAND.....	57
7.2.1. 6 dB BANDWIDTH.....	57
7.2.2. 99% BANDWIDTH.....	63
7.2.3. AVERAGE POWER	69
7.2.4. OUTPUT POWER	70
7.2.5. PSD	78
7.2.6. OUT-OF-BAND EMISSIONS	84
8. RADIATED TEST RESULTS.....	96
8.1. LIMITS AND PROCEDURE	96
8.2. TRANSMITTER ABOVE 1 GHz	97
8.3. TX ABOVE 1 GHz 802.11b MODE IN THE 2.4 GHz BAND	97
8.4. TX ABOVE 1 GHz 802.11g MODE IN THE 2.4 GHz BAND	107
8.5. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 2.4 GHz BAND.....	117

8.6.	<i>TX ABOVE 1 GHz 802.11a MODE IN THE 5.8 GHz BAND</i>	<i>127</i>
8.7.	<i>TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.8 GHz BAND.....</i>	<i>133</i>
8.8.	<i>TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.8 GHz BAND.....</i>	<i>139</i>
8.9.	<i>WORST-CASE BELOW 1 GHz.....</i>	<i>143</i>
9.	AC POWER LINE CONDUCTED EMISSIONS	145
10.	SETUP PHOTOS	149

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

EUT DESCRIPTION: QUAD-BAND RADIO WITH WLAN AND BT RADIO

MODEL: A1457

SERIAL NUMBER: C39KD00CFJ0Y

DATE TESTED: APRIL 24 – JUNE 10, 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:

Tested By:



Thu Chan
WiSE Operations Manager
UL Verification Services Inc.



Francisco Guarnero
WiSE Lab Technician
UL Verification Services Inc.

2. TEST METHODOLOGY

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

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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT, Model A1457 is a mobile phone with multimedia functions (music, application support, and video), cellular GSM/GPRS/EGPRS/WCDMA/HSPA+/DC-HSDPA/LTE radio, IEEE 802.11a/b/g/n, Bluetooth and GPS radio. The rechargeable battery is not user accessible.

Testing of Model A1457 (FCC ID: BCG-E2643B) and (IC #: 579C-E2643B) is considered representative of Model A1530 (FCC ID: BCG-E2643A) and (IC #: 579C-E2643A). Model A1457 is identical to Model A1530 except for the WWAN functions. Both the WLAN and WWAN antenna locations for both models are identical.

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	17.238	52.94
2412 - 2462	802.11g	23.161	207.06
2412 - 2462	802.11n HT20	23.041	201.42
5745 - 5825	802.11a	24.141	259.48
5745 - 5825	802.11n HT20	23.590	228.56
5755 - 5795	802.11n HT40	24.005	251.48

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA antenna, with a maximum gain as below table.

FREQUENCY (MHZ)	ANTENNA GAIN (dBi)
2400 – 2483.5	1.09
5150 -- 5250	-5.91
5250 -- 5350	-5.83
5500 -- 5700	-4.25
5725 -- 5850	-4.21

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was WL Tool FW 6.10.56.166

5.5. WORST-CASE CONFIGURATION AND MODE

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

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

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

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

802.11b mode: 1 Mbps

802.11g mode: 6 Mbps

802.11a mode: 6 Mbps

802.11n HT20mode: MCS0

802.11n HT40mode: MCS0

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List			
Description	Manufacturer	Model	Serial Number
AC adapter	Apple	A1385	D292365D11QDHLHCA
Earphone	Apple	NA	NA

I/O CABLES (Conducted Setup)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	SMA	Shielded	0.1m	To Spectrum Analyzer

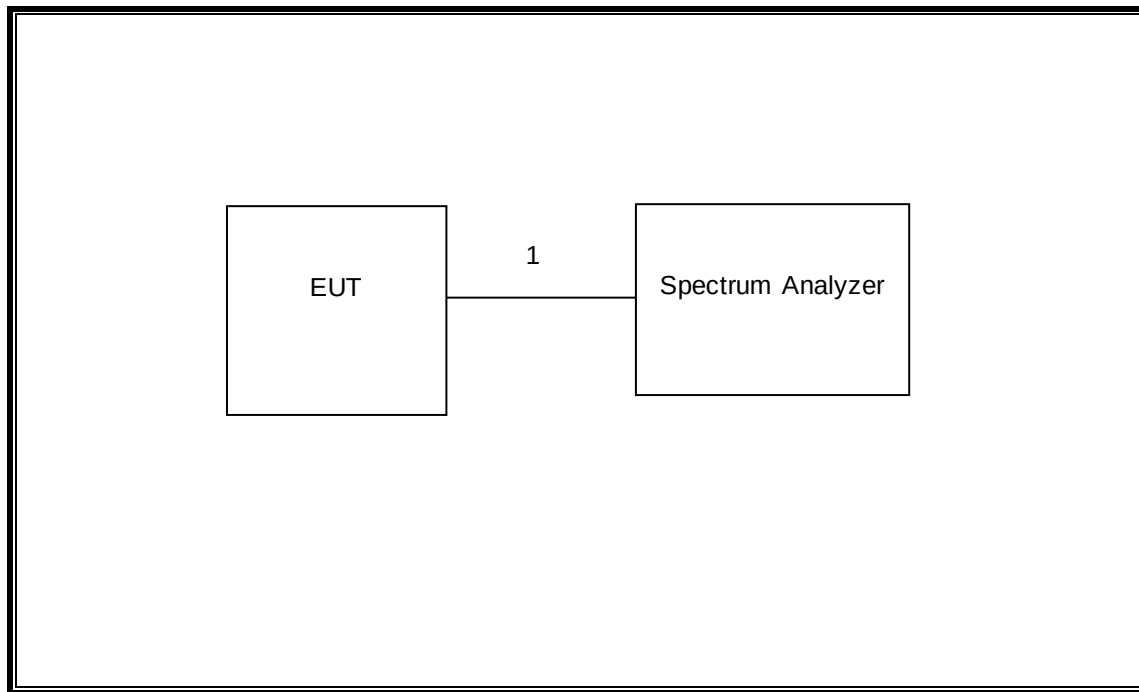
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Jack	1	Earphone	Unshielded	0.5m	N/A

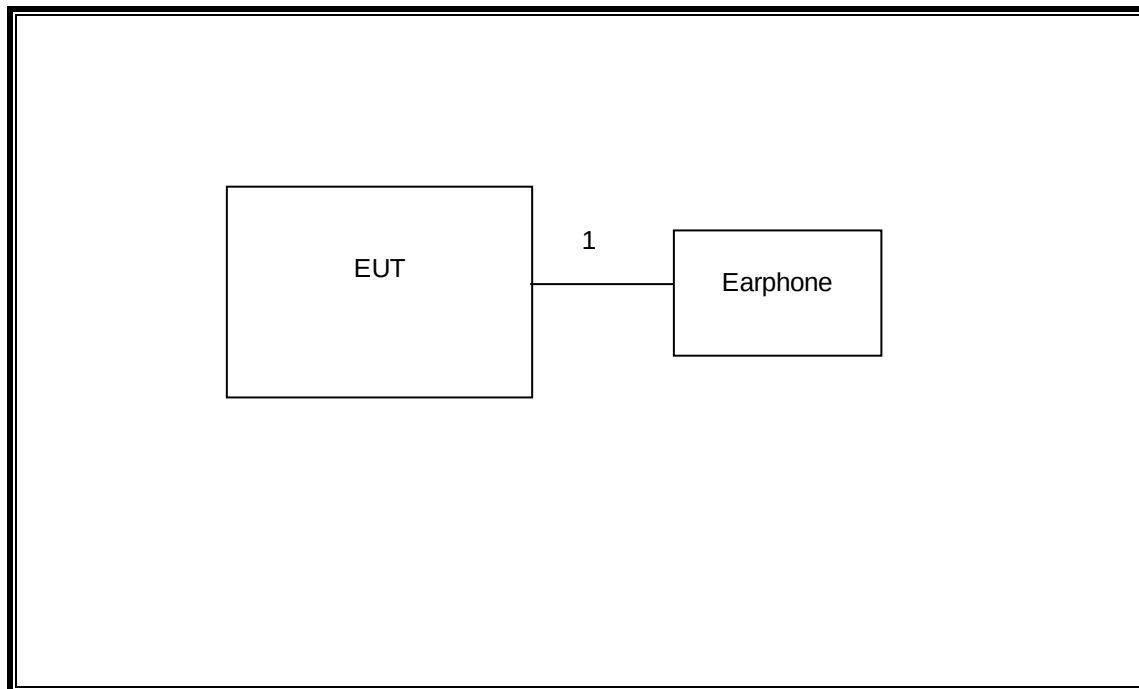
TEST SETUP

The EUT is a stand-alone device.

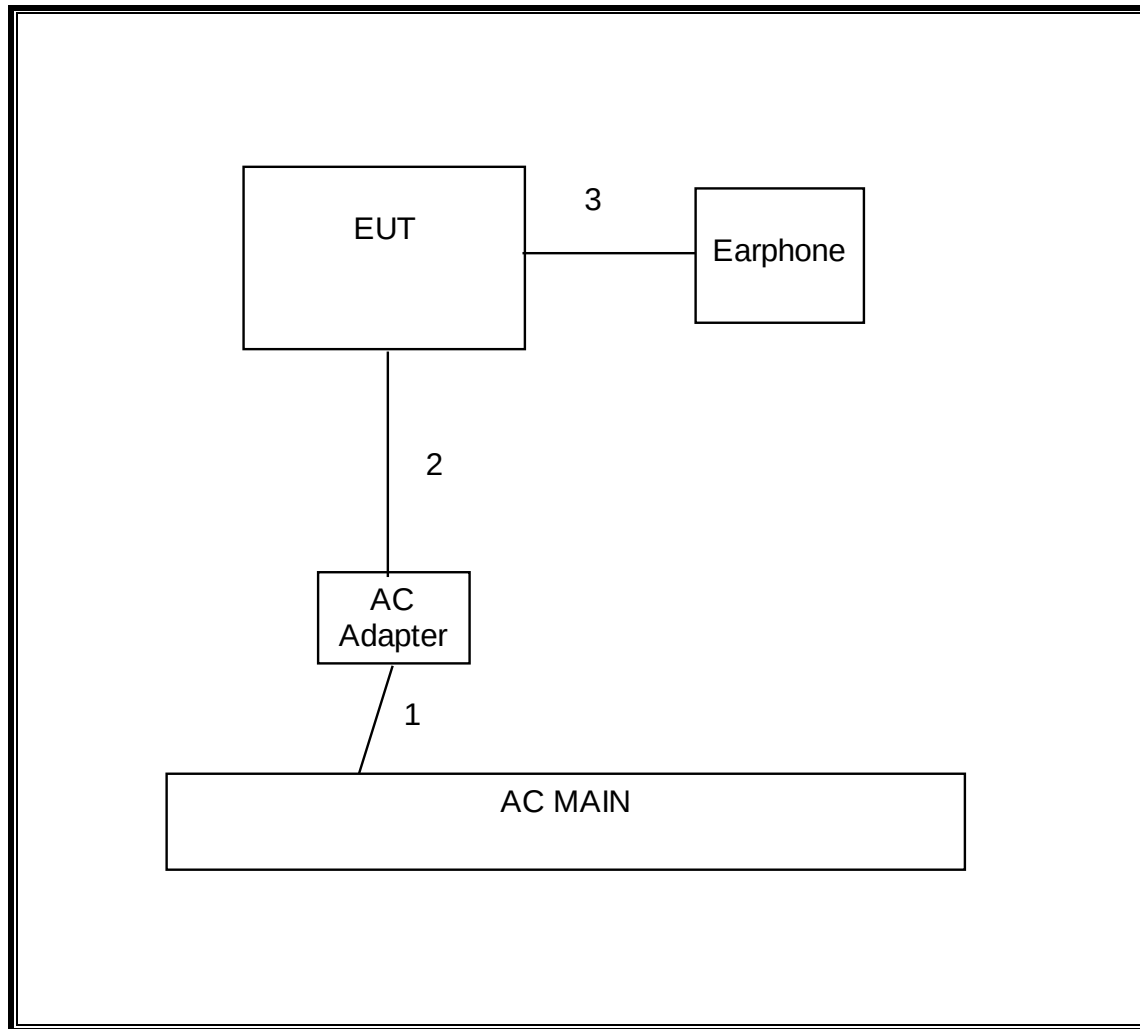
SETUP DIAGRAM FOR TESTS



SETUP DIAGRAM FOR RADIATED TESTS



SETUP DIAGRAM FOR AC POWER CONDUCTED 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 Due
Spectrum Analyzer, 44GHz	Agilent	N9030A	F00129	02/22/14
Spectrum Analyzer, 44GHz	Agilent	E4446A	C01159	04/10/14
Directional Coupler	Krytar	1817	N02656	CNR
Communication Test Set	Agilent / HP	E5515C	C01086	11/10/13
Communication Test Set	R & S	CMW500	F00014	02/21/14
Temperature / Humidity Chamber	Thermotron	SE 600-10-10	C00930	01/09/14
Signal generator, 6 GHz	Agilent / HP	8665B	F00066	05/07/14
Highpass Filter, 2.7 GHz	Micro-Tronics	HPM13194	N02686	CNR
Highpass Filter, 1.5 GHz	Micro-Tronics	HPM13193	N02688	CNR
Bilog, 30-1GHz	Sunol Science	JB1	C01011	03/28/14
Peak Power Meter	Agilent	N1911A	F00026	04/02/14
Peak Power Sensor	Agilent	E9323A	F00160	04/03/14
Horn Antenna	ETS Lindgren	3117	C01005	2/21/2014
Horn Antenna	ETS Lindgren	3117	F00131	2/19/2014
PreAmp 1-18GHz	Agilent/HP	8449B	F00167	3/23/2014
PreAmp 1300MHz	Agilent	8447D	C00580	1/28/2014

MEASUREMENT METHODS

KDB 558074 Measurement Procedure PK2 is used for power and PKPSD is used for power spectral density.

KDB 558074 Measurement Procedure AVG1 is used for power and PKAVG is used for power spectral density.

KDB 558074 Measurement Procedure AVG2 is used for power and PKAVG is used for power spectral density.

Unwanted emissions within Restricted Bands are measured using traditional radiated procedures.

7. ANTENNA PORT TEST RESULTS

7.1. 2.4 GHz BAND

7.1.1. 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.

TEST PROCEDURE

KDB 558074 D01 v01 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247".

RESULTS

b Mode

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2412	8.556	0.5
Mid	2437	8.076	0.5
High	2462	8.088	0.5

g Mode

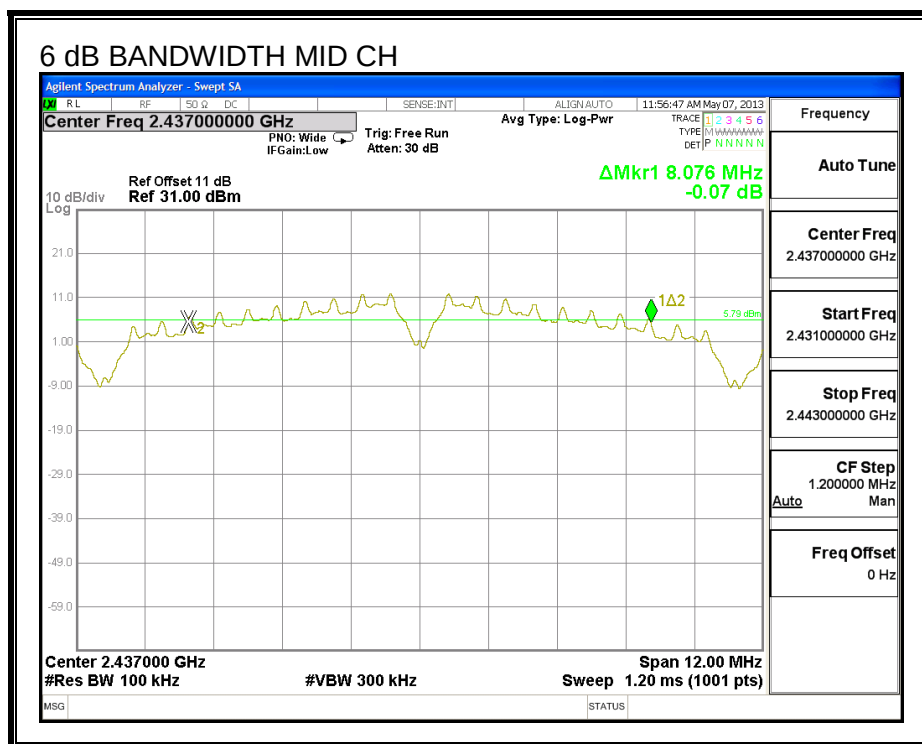
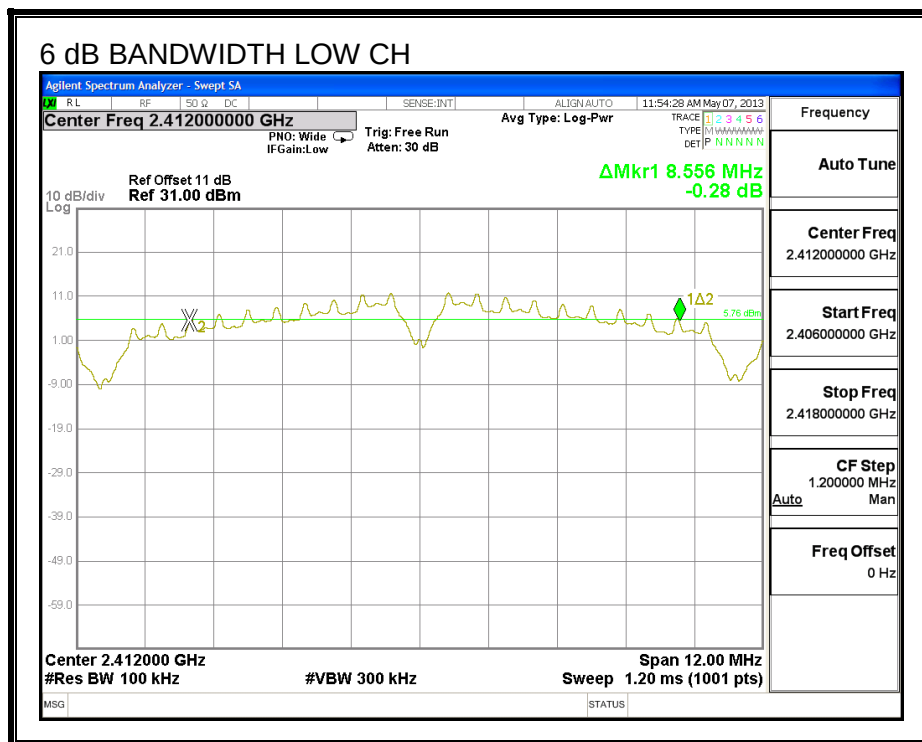
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2412	16.376	0.5
Mid	2437	16.434	0.5
High	2462	16.491	0.5

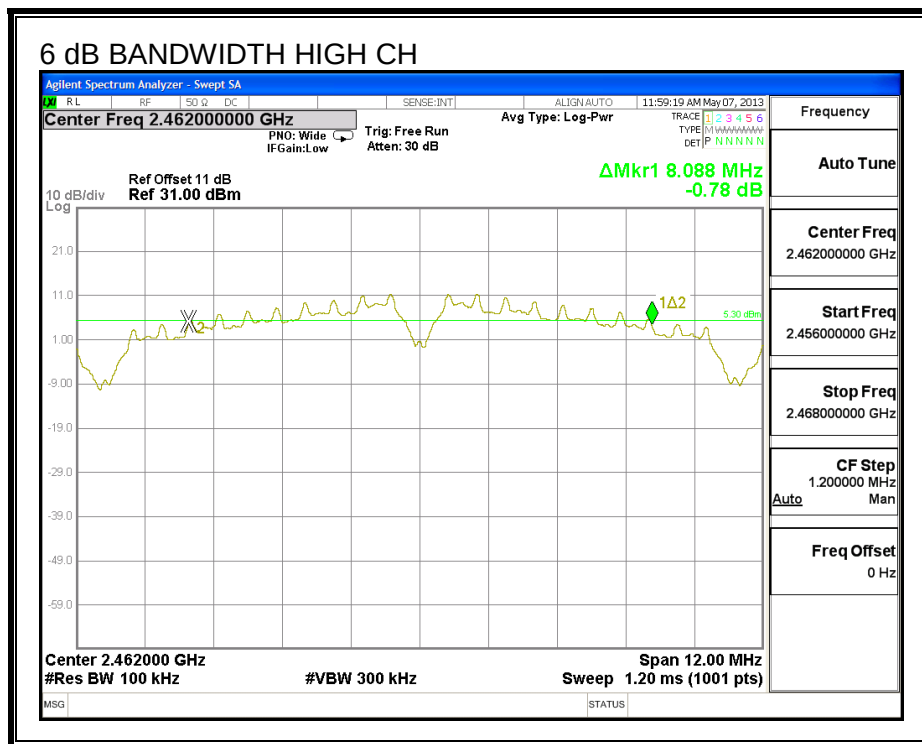
HT20

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2412	17.411	0.5
Mid	2437	17.630	0.5
High	2462	17.676	0.5

b mode

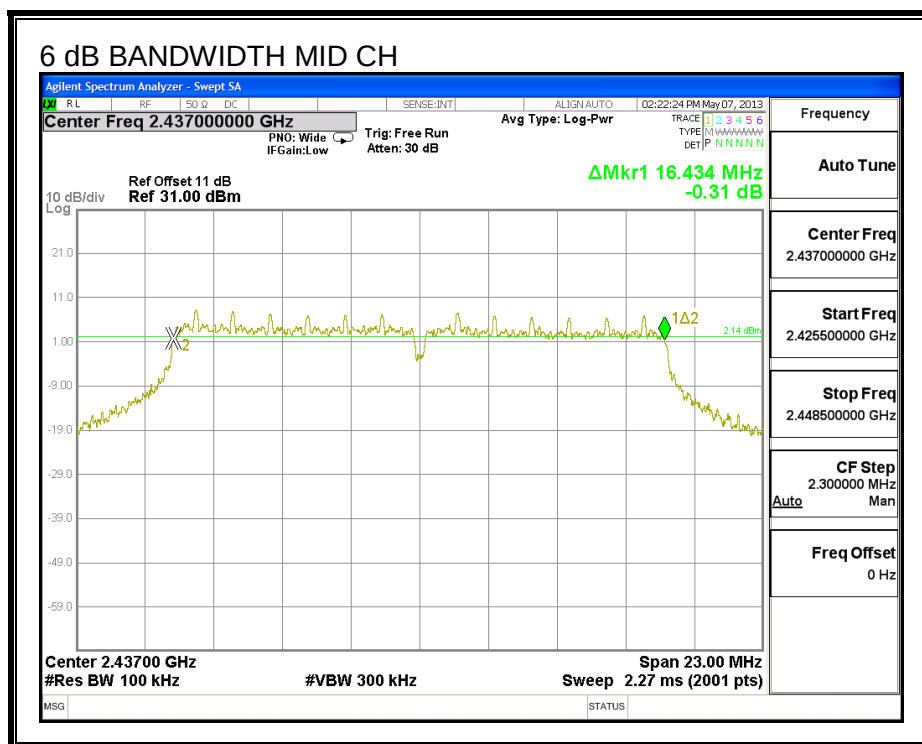
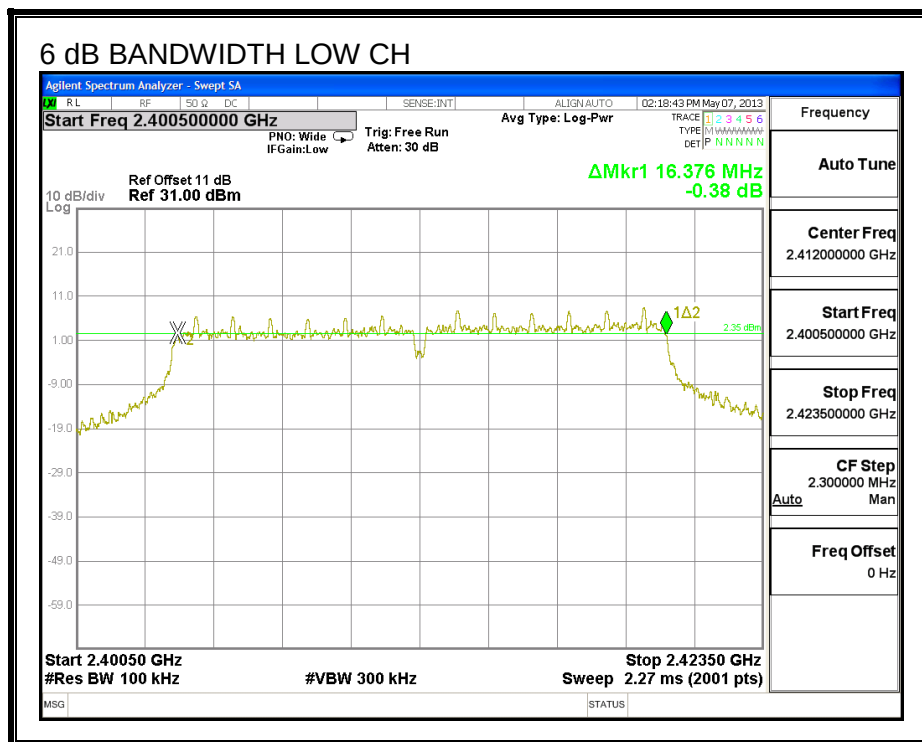
6 dB BANDWIDTH

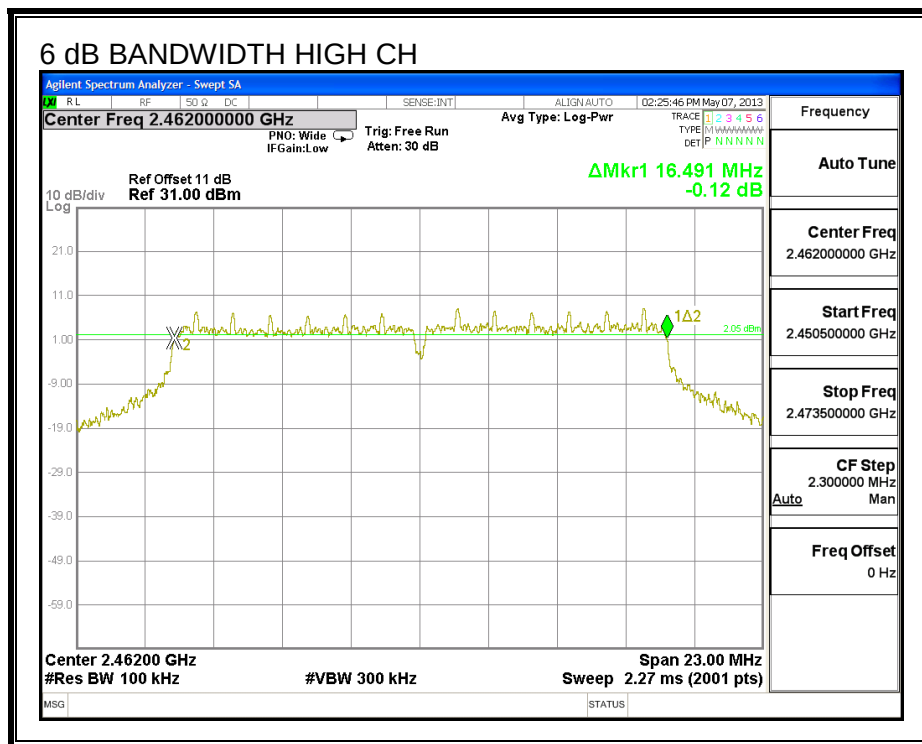




g mode

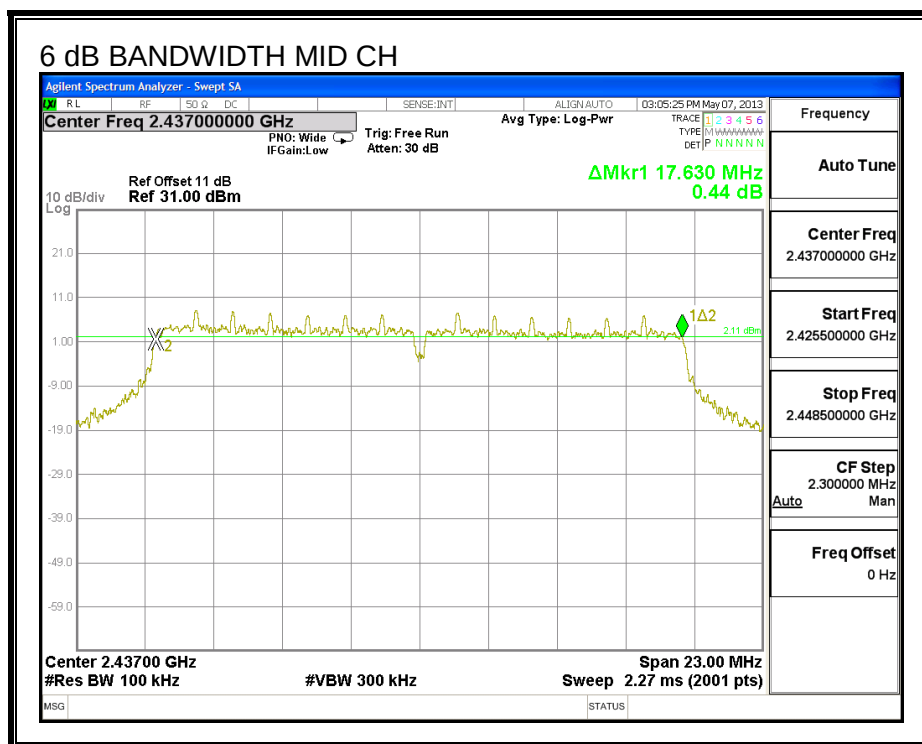
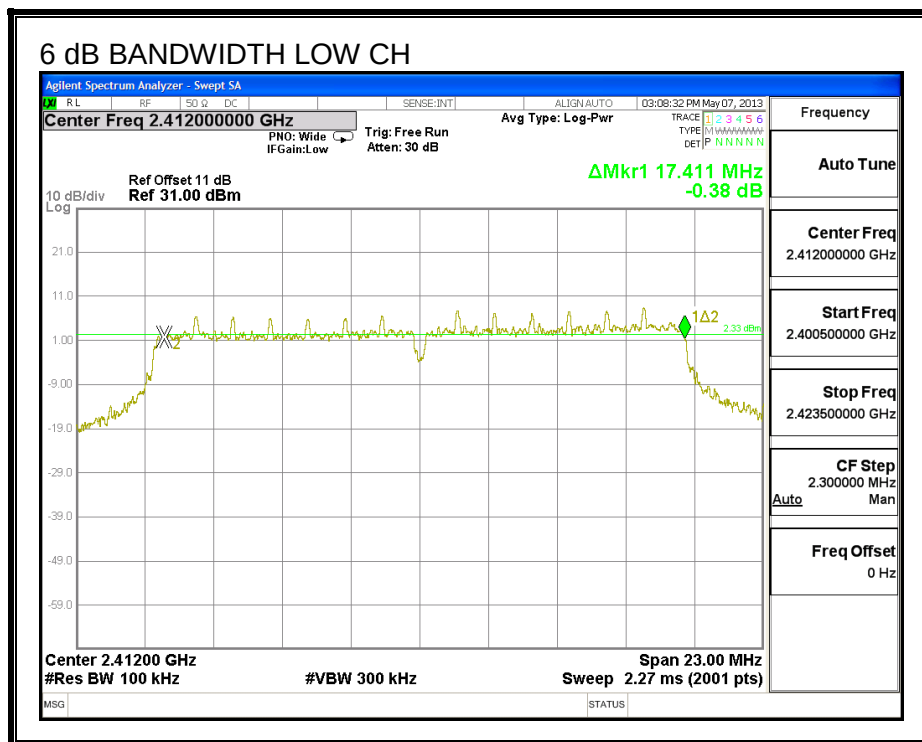
6 dB BANDWIDTH

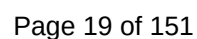




HT20

6 dB BANDWIDTH





7.1.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

b Mode

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	12.6060
Mid	2437	12.5900
High	2462	12.2920

g mode

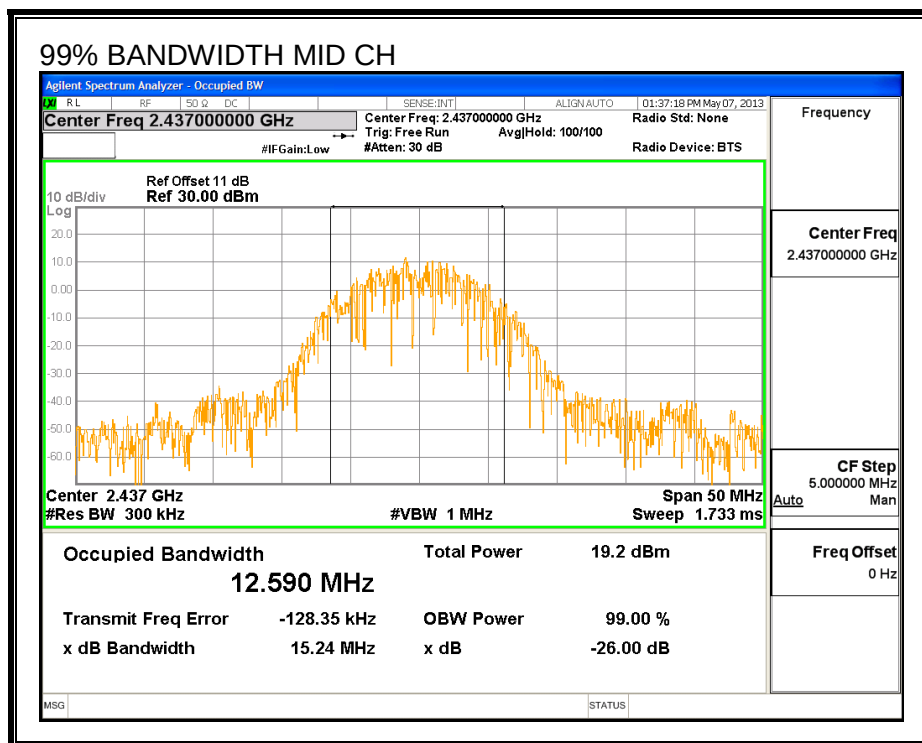
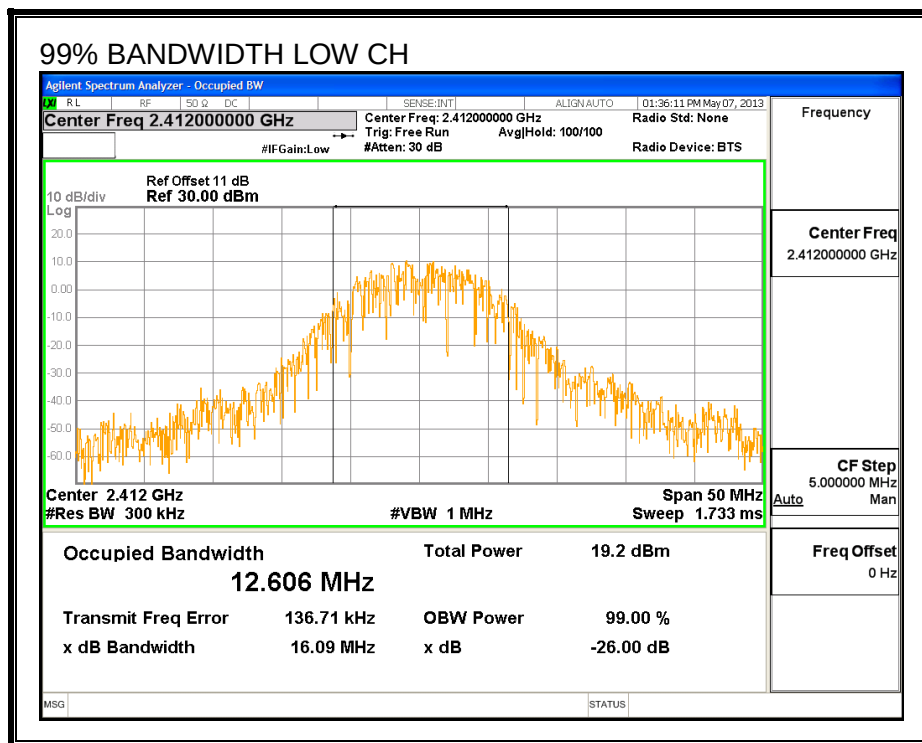
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	16.6810
Mid	2437	16.5840
High	2462	16.6870

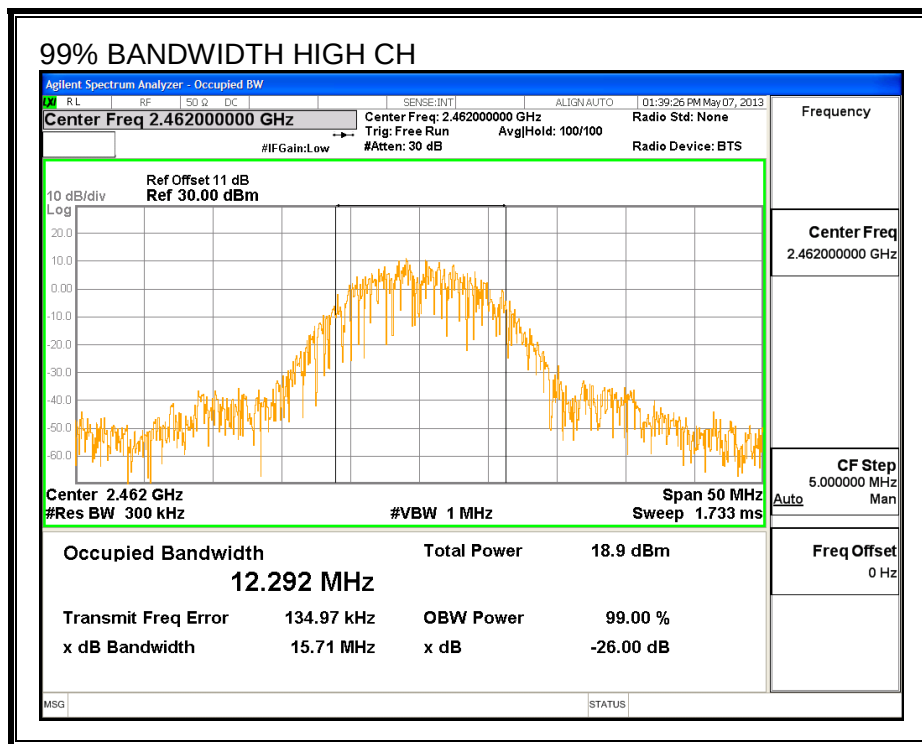
HT20

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	17.8860
Mid	2437	17.7810
High	2462	17.9130

b mode

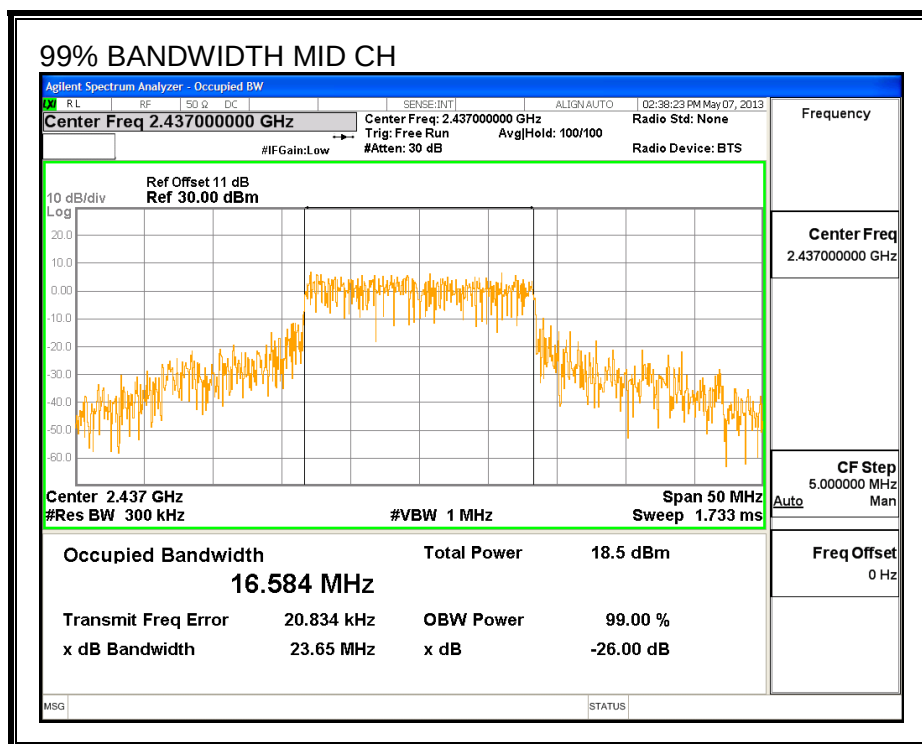
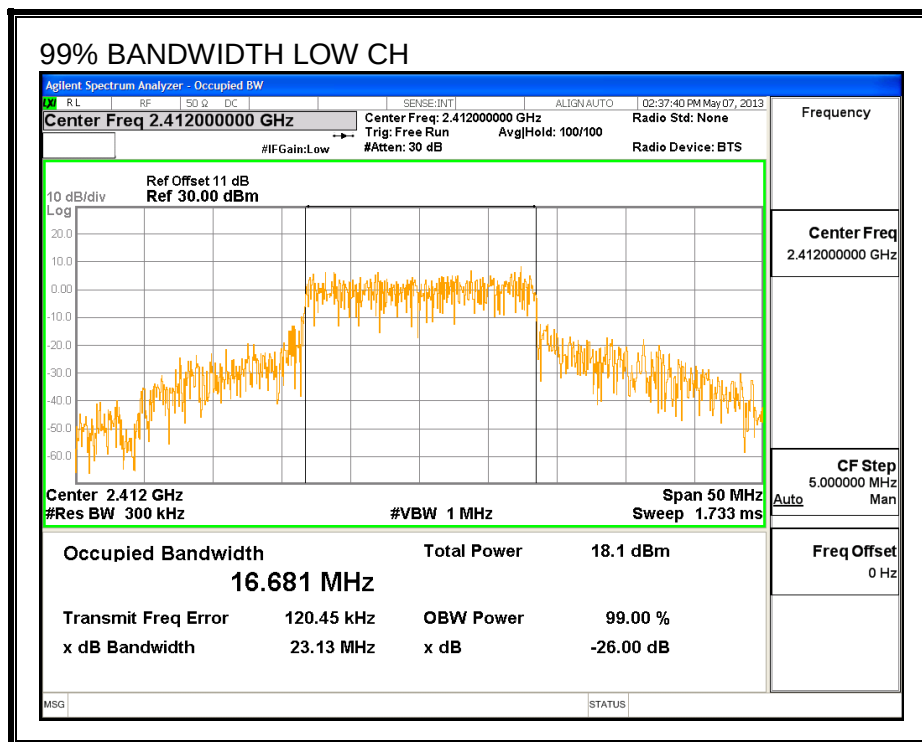
99% BANDWIDTH

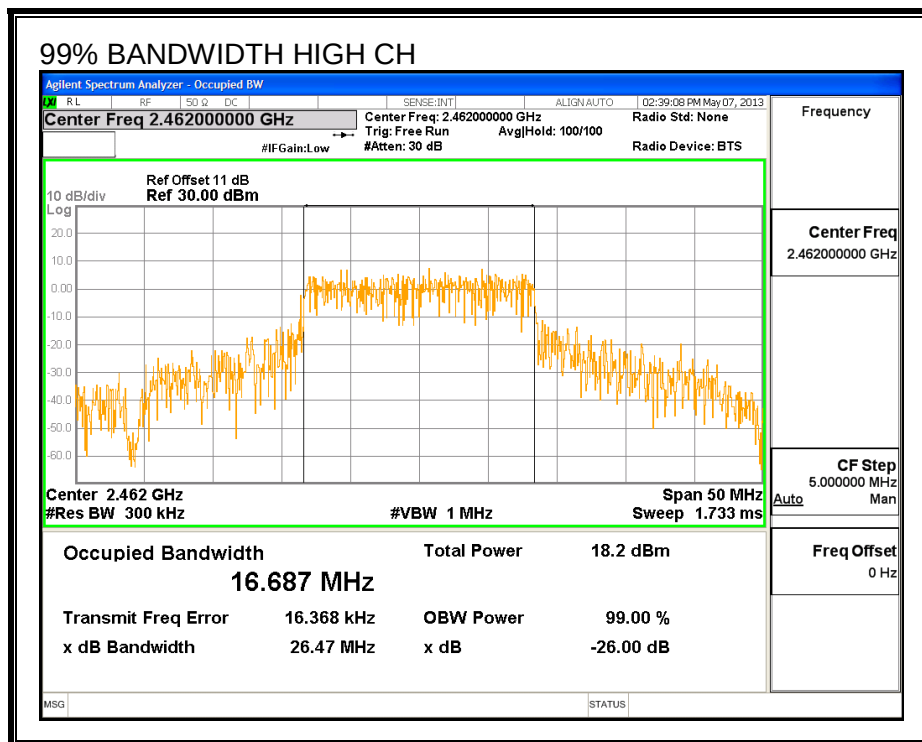




g mode

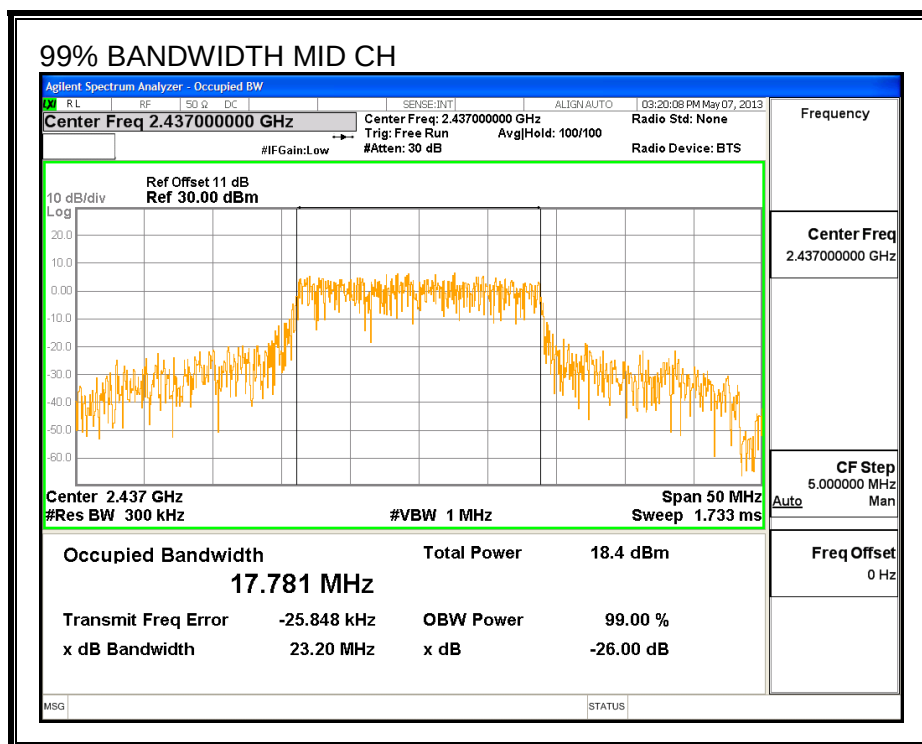
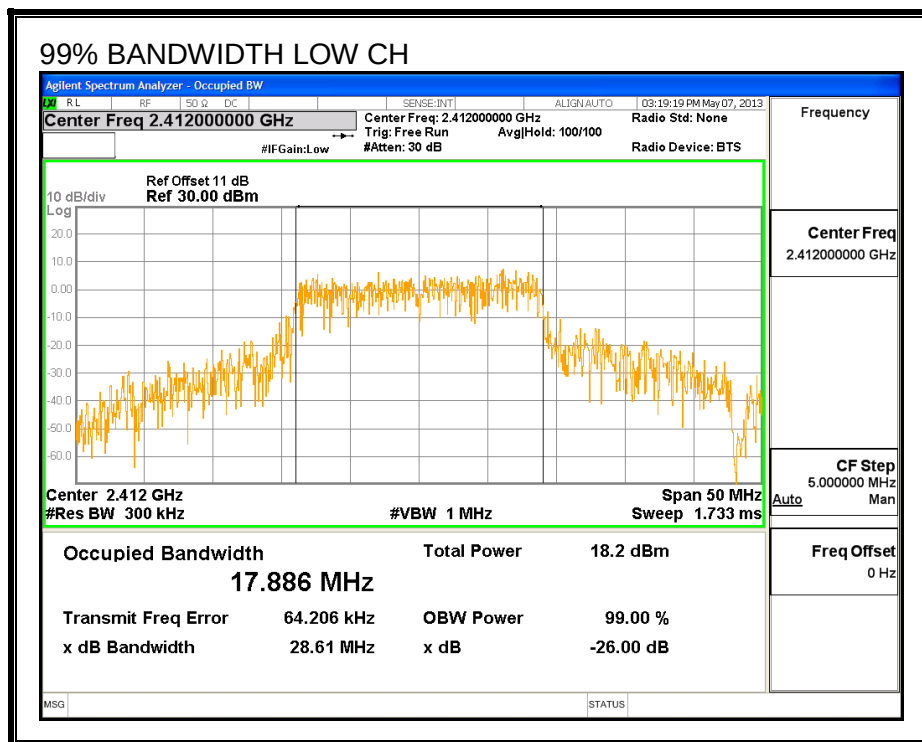
99% BANDWIDTH

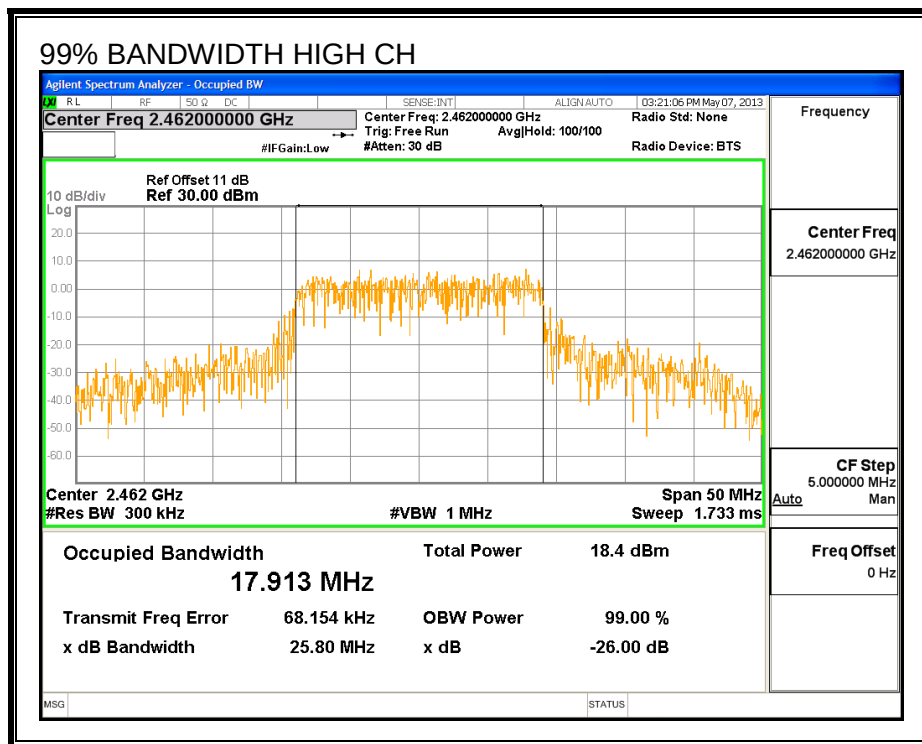




HT20

99% BANDWIDTH





7.1.3. 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 1dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

b mode

Channel	Frequency (MHz)	Power (dBm)
Low	2412	14.50
Mid	2437	14.62
High	2462	14.63

g mode

Channel	Frequency (MHz)	Power (dBm)
Low	2412	14.54
Mid	2437	14.64
High	2462	14.57

HT20

Channel	Frequency (MHz)	Power (dBm)
Low	2412	14.54
Mid	2437	14.65
High	2462	14.57

7.1.4. 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

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

RESULTS

b mode

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	2412	1.09	30.00	30	36	30.00
Mid	2437	1.09	30.00	30	36	30.00
High	2462	1.09	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	2412	17.135	17.14	30.00	-12.87
Mid	2437	17.238	17.24	30.00	-12.76
High	2462	17.136	17.14	30.00	-12.86

g mode

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	2412	1.09	30.00	30	36	30.00
Mid	2437	1.09	30.00	30	36	30.00
High	2462	1.09	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	2412	22.647	22.65	30.00	-7.35
Mid	2437	23.095	23.10	30.00	-6.91
High	2462	23.161	23.16	30.00	-6.84

HT20

Limits

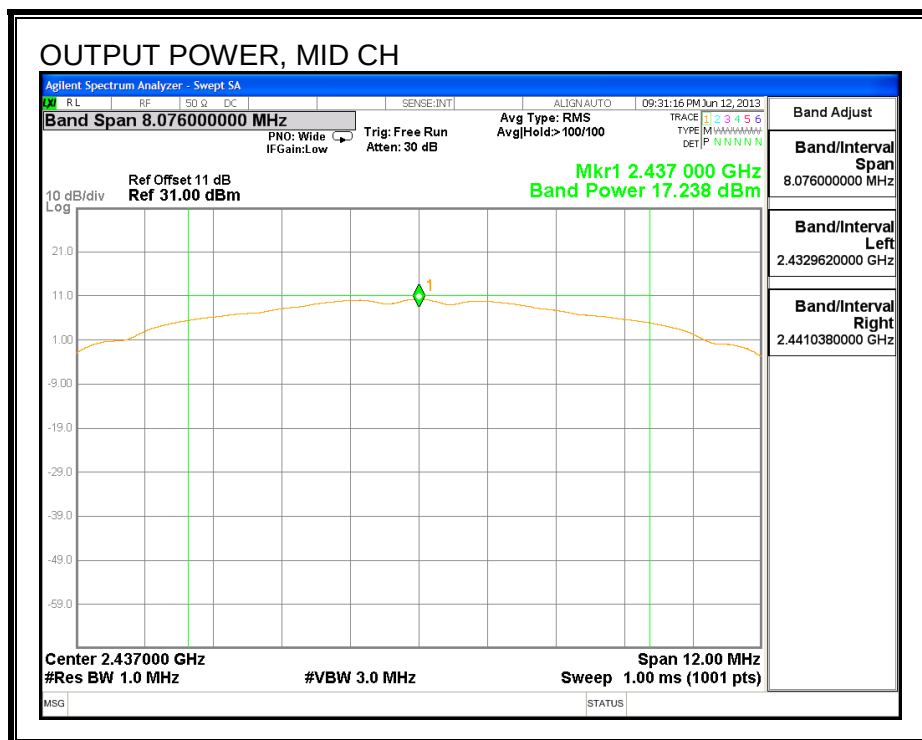
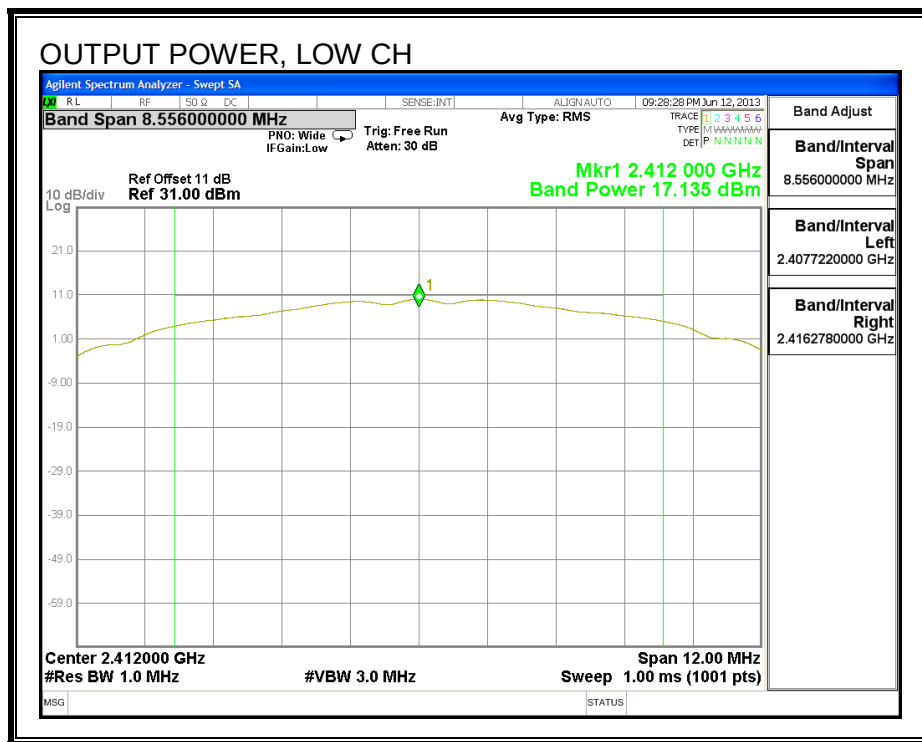
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	2412	1.09	30.00	30	36	30.00
Mid	2437	1.09	30.00	30	36	30.00
High	2462	1.09	30.00	30	36	30.00

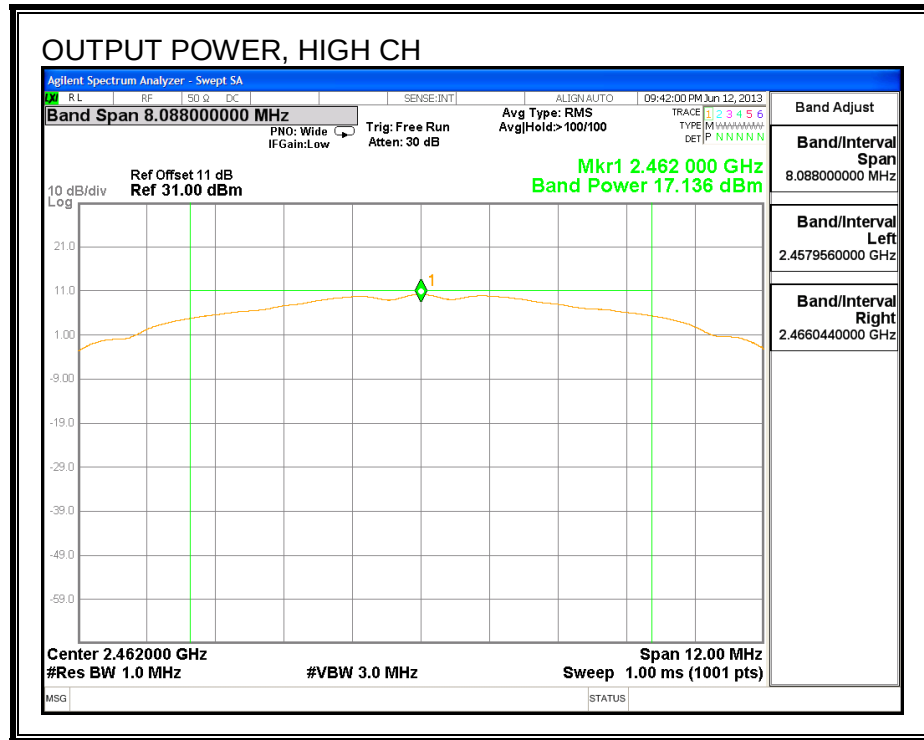
Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	2412	22.600	22.60	30.00	-7.40
Mid	2437	23.041	23.04	30.00	-6.96
High	2462	22.855	22.86	30.00	-7.15

b mode

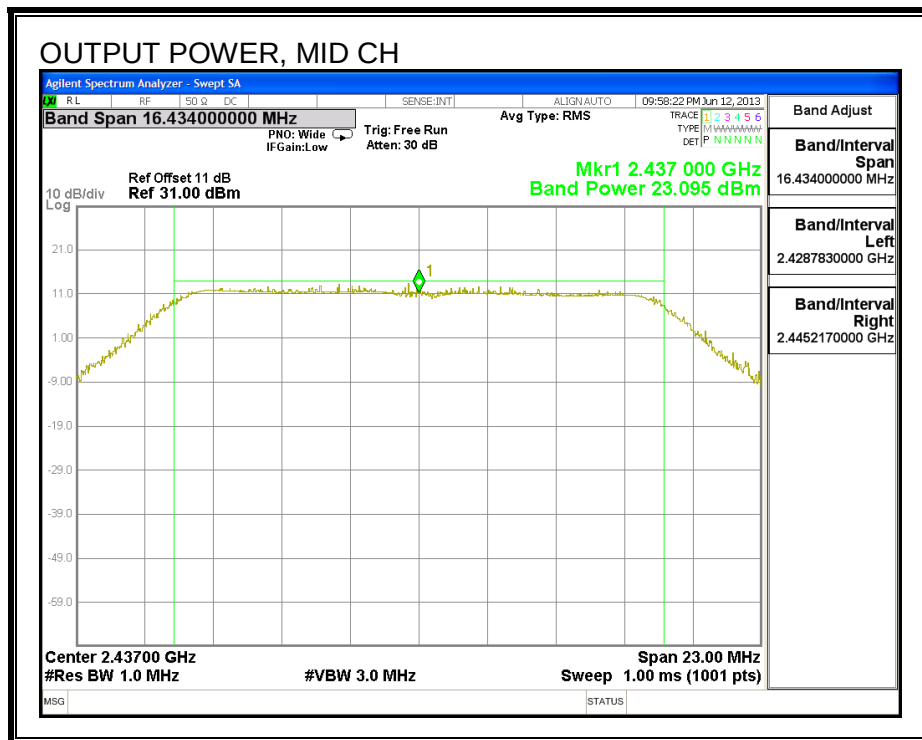
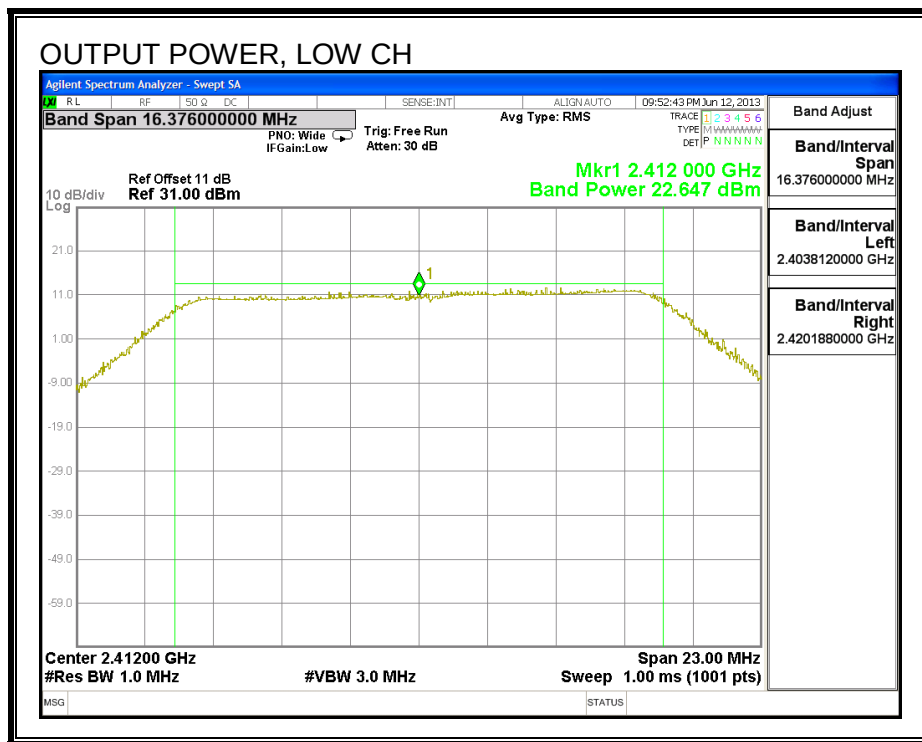
OUTPUT POWER

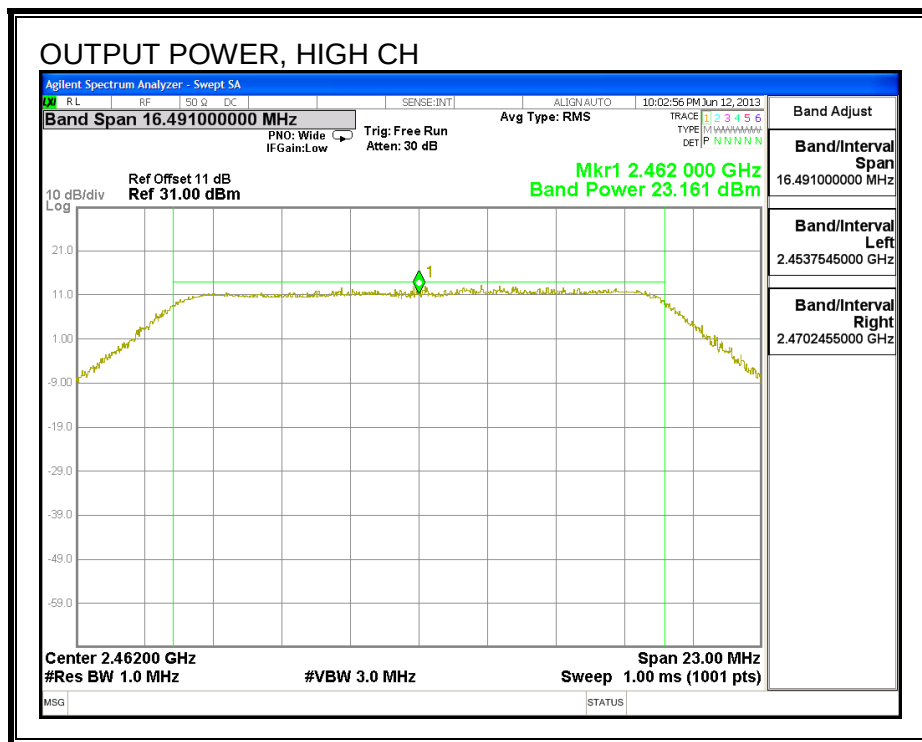




g mode

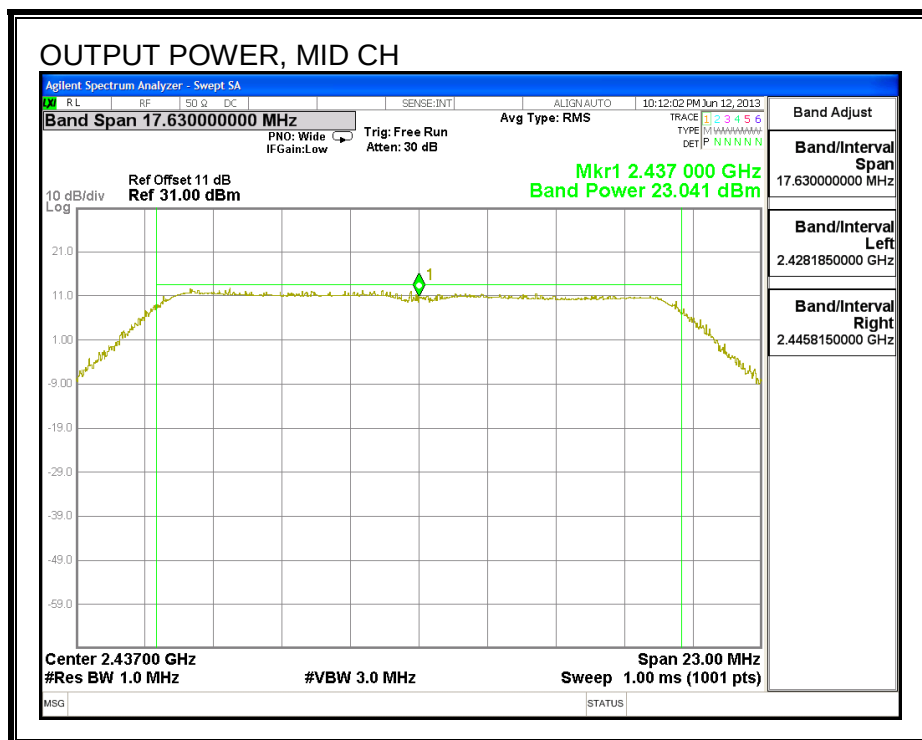
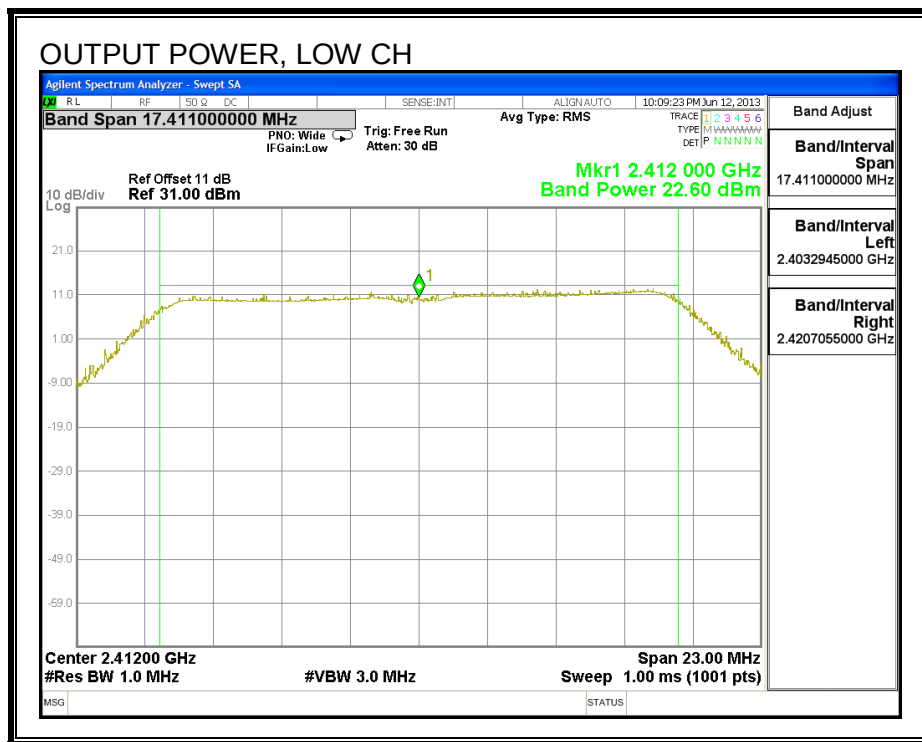
OUTPUT POWER

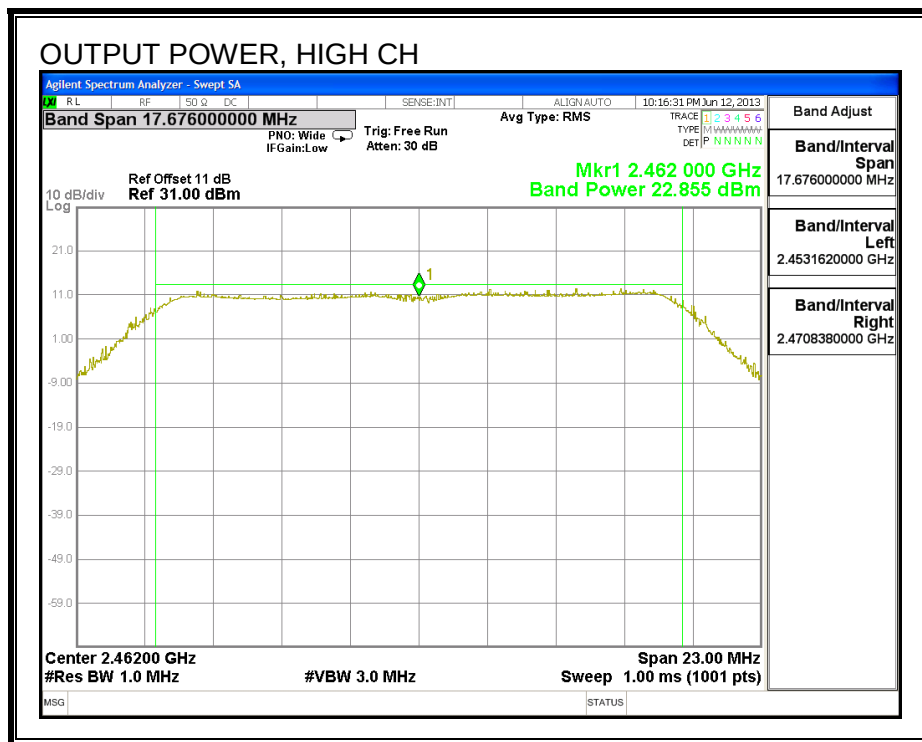




HT20

OUTPUT POWER





7.1.5. 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

b mode

PSD Results

Channel	Frequency (MHz)	Meas (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-2.32	8.00	-10.32
Mid	2437	-2.47	8.00	-10.47
High	2462	-3.07	8.00	-11.07

g mode

PSD Results

Channel	Frequency (MHz)	Meas (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-7.13	8.00	-15.13
Mid	2437	-6.13	8.00	-14.13
High	2462	-7.04	8.00	-15.04

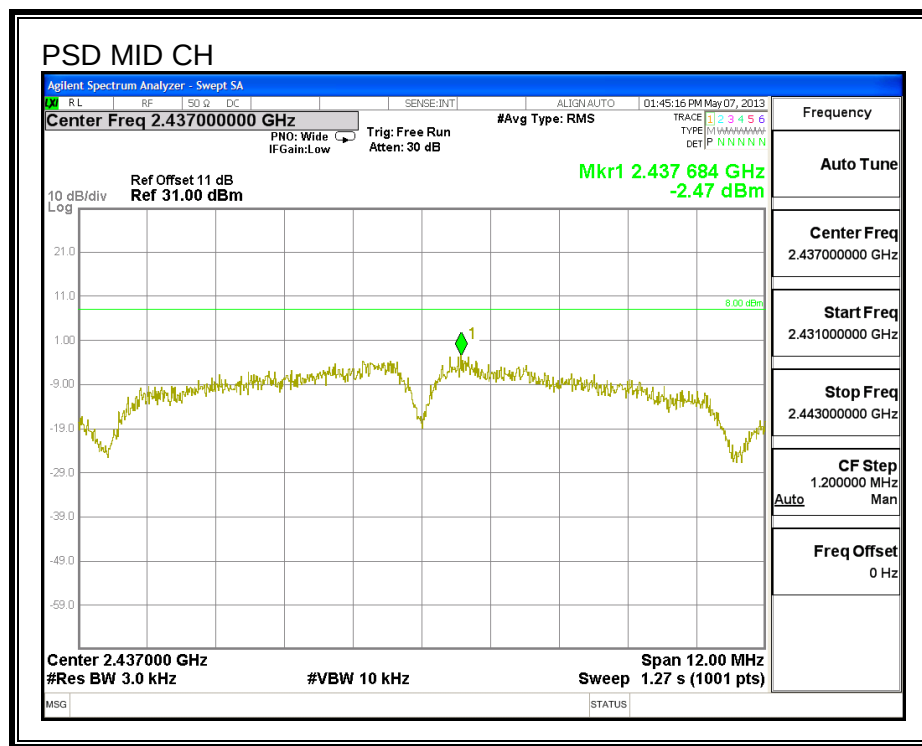
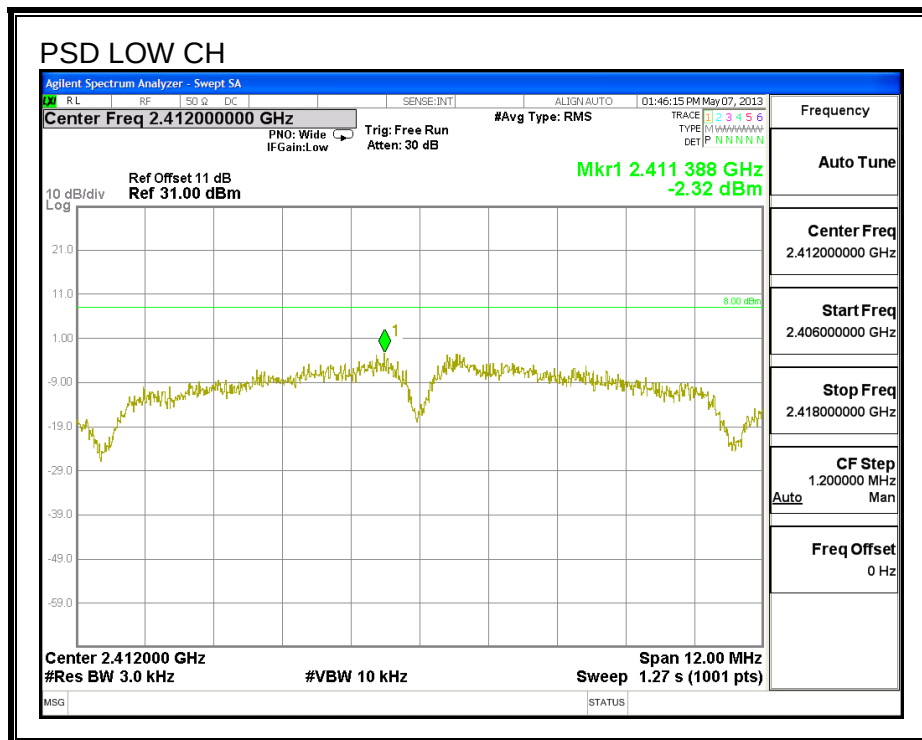
HT20

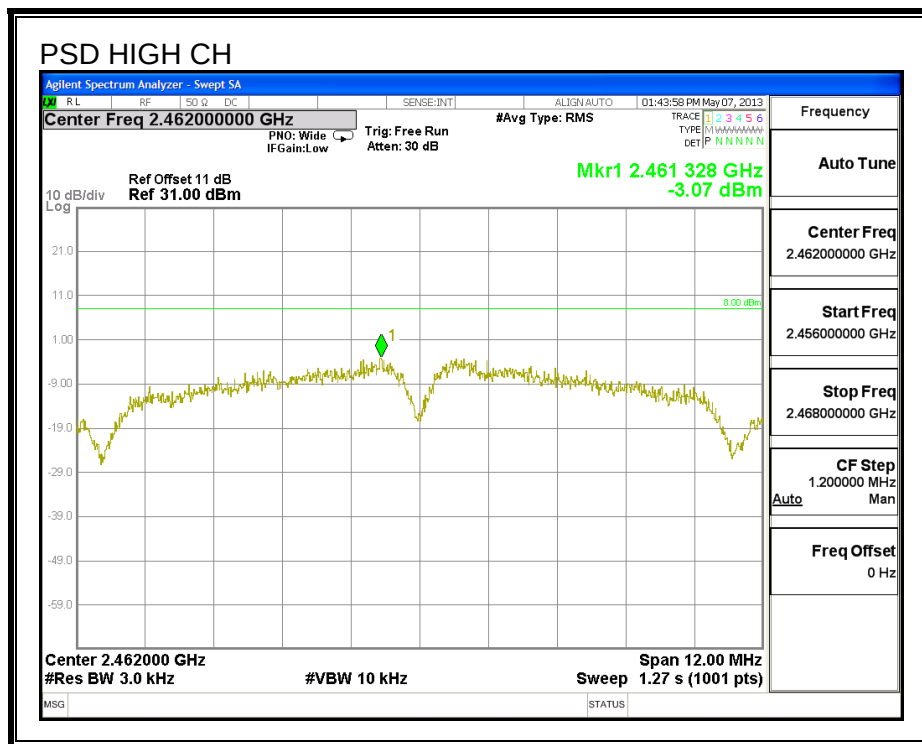
PSD Results

Channel	Frequency (MHz)	Meas (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-6.88	8.00	-14.88
Mid	2437	-6.47	8.00	-14.47
High	2462	-7.02	8.00	-15.02

b mode

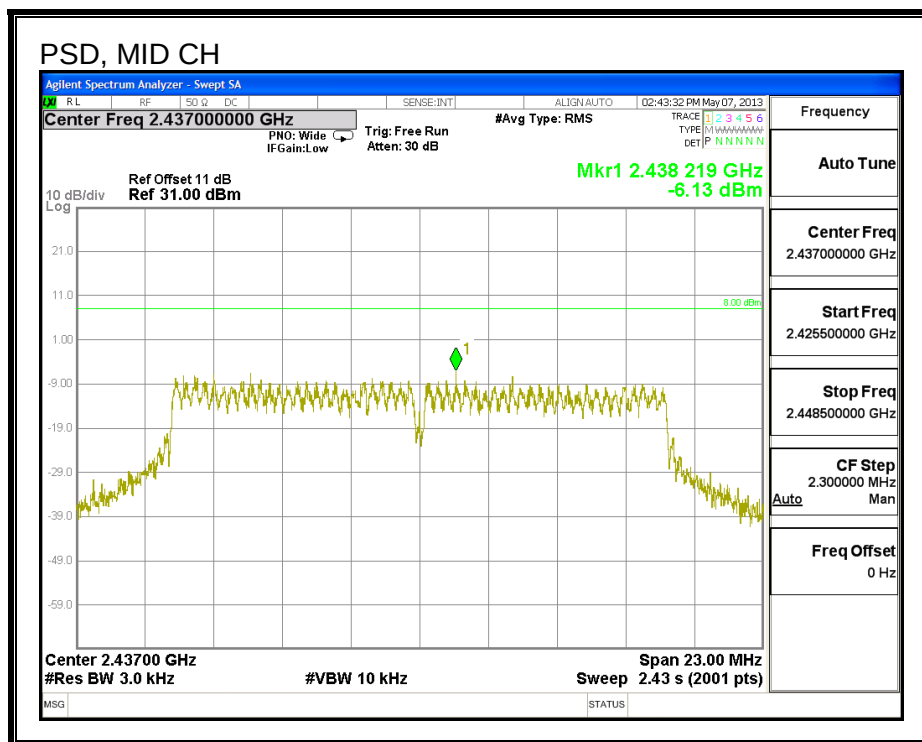
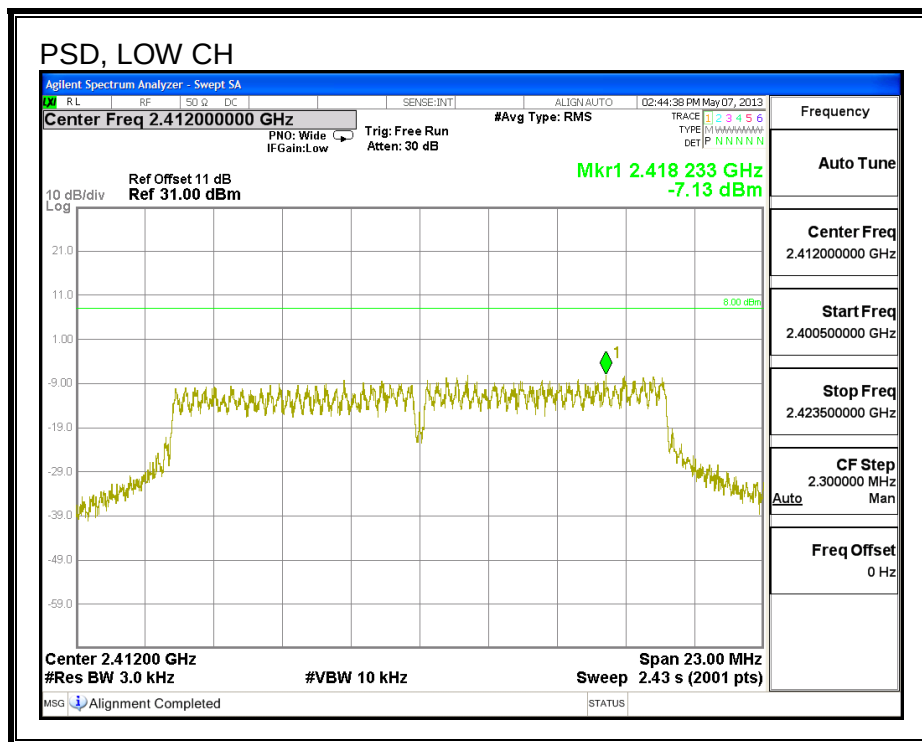
PSD

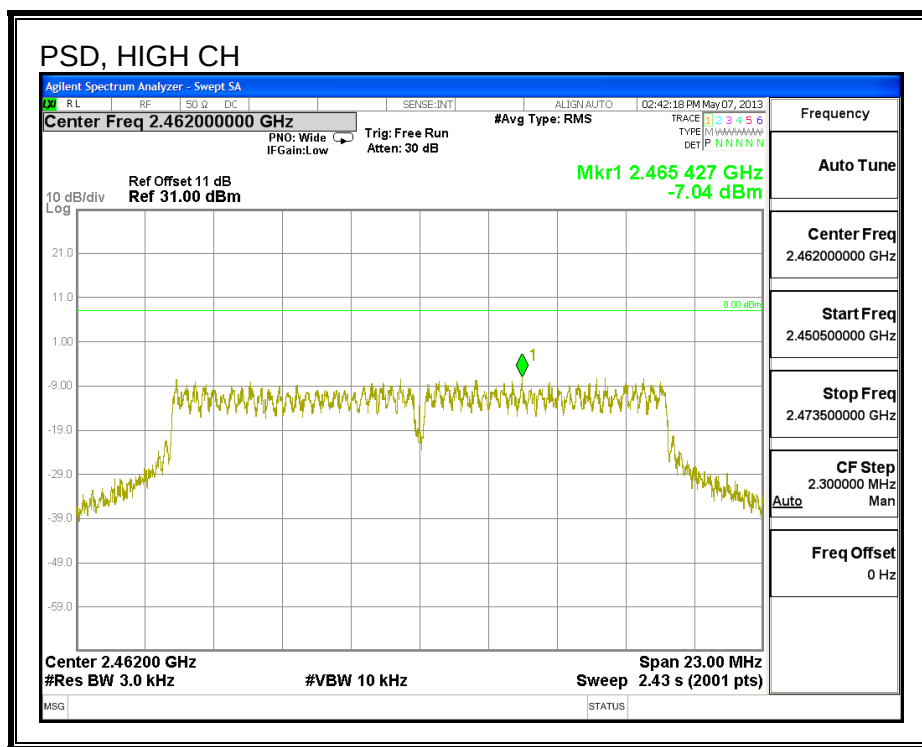




g mode

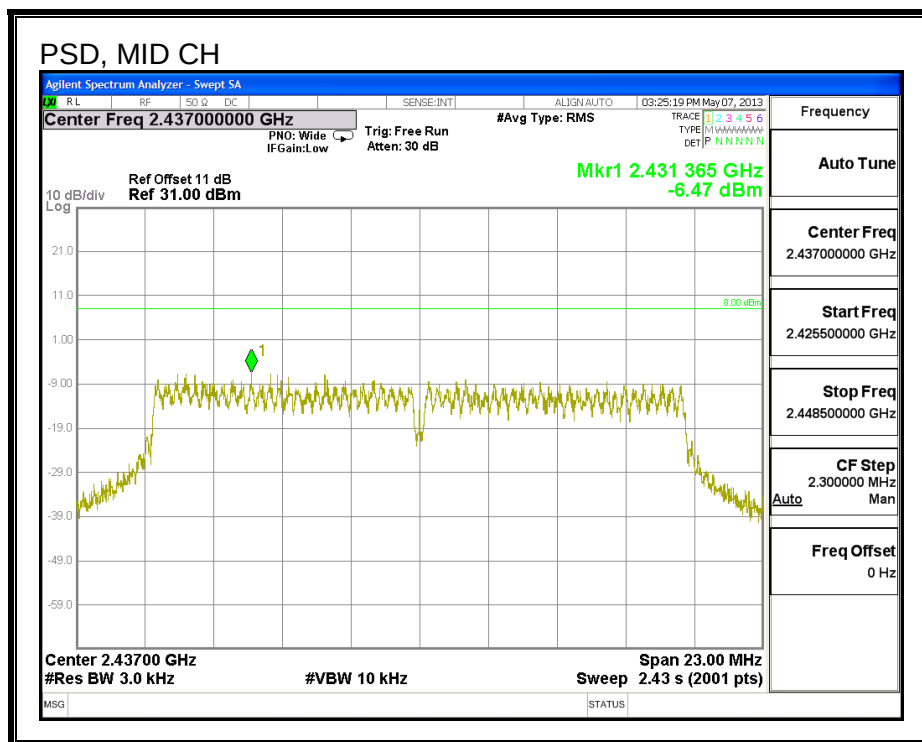
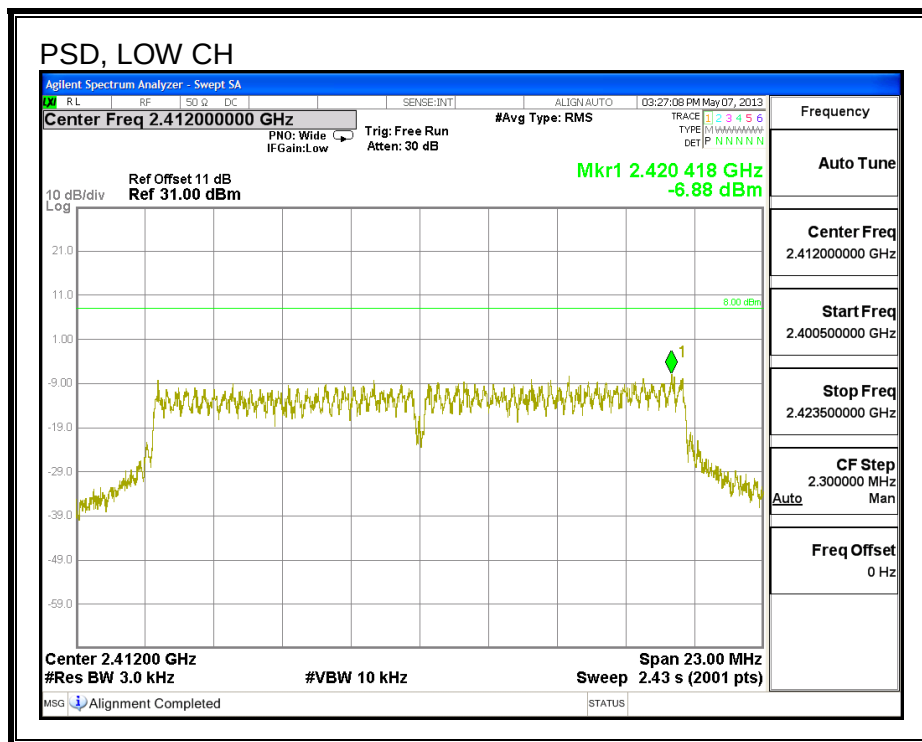
PSD

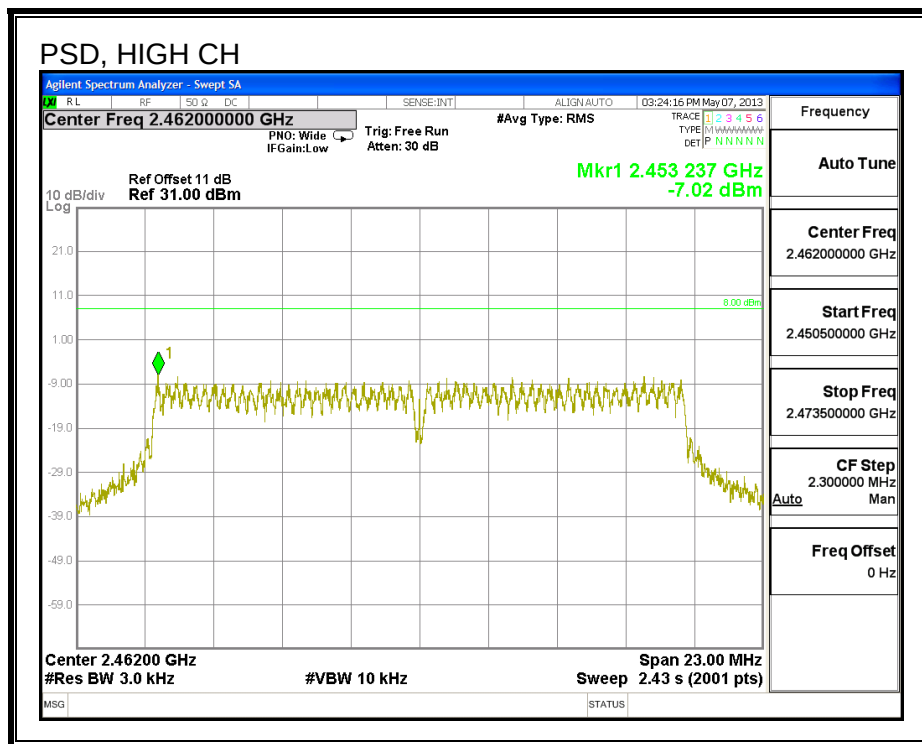




HT20

PSD





7.1.6. 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.

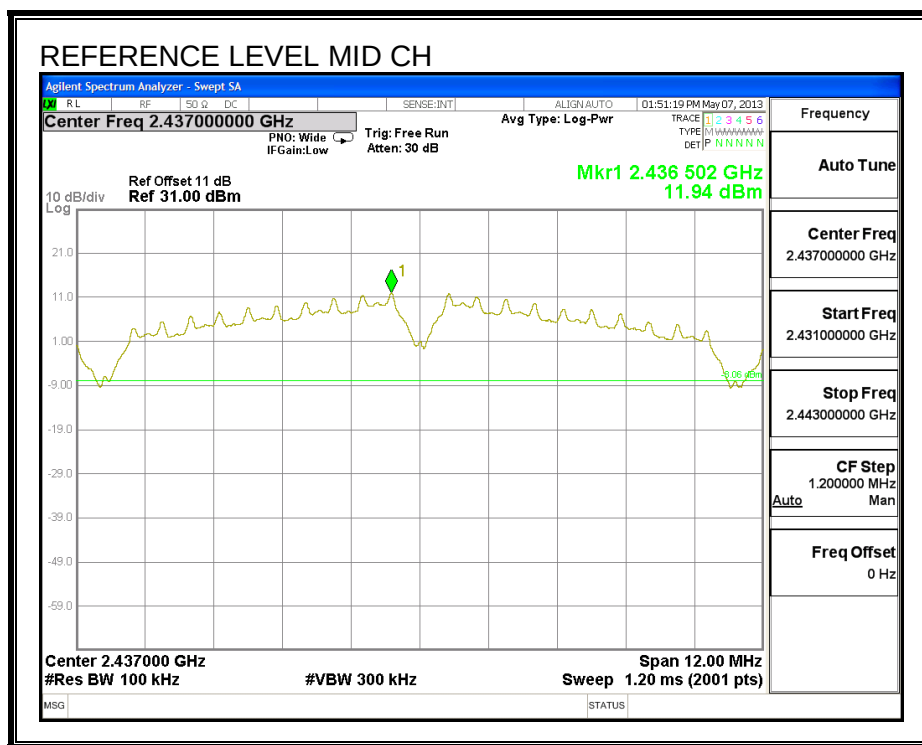
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer with RBW = 100 kHz, VBW = 300 kHz, peak detector, and max hold. Measurements utilizing these settings are made of the in-band reference level, bandedge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

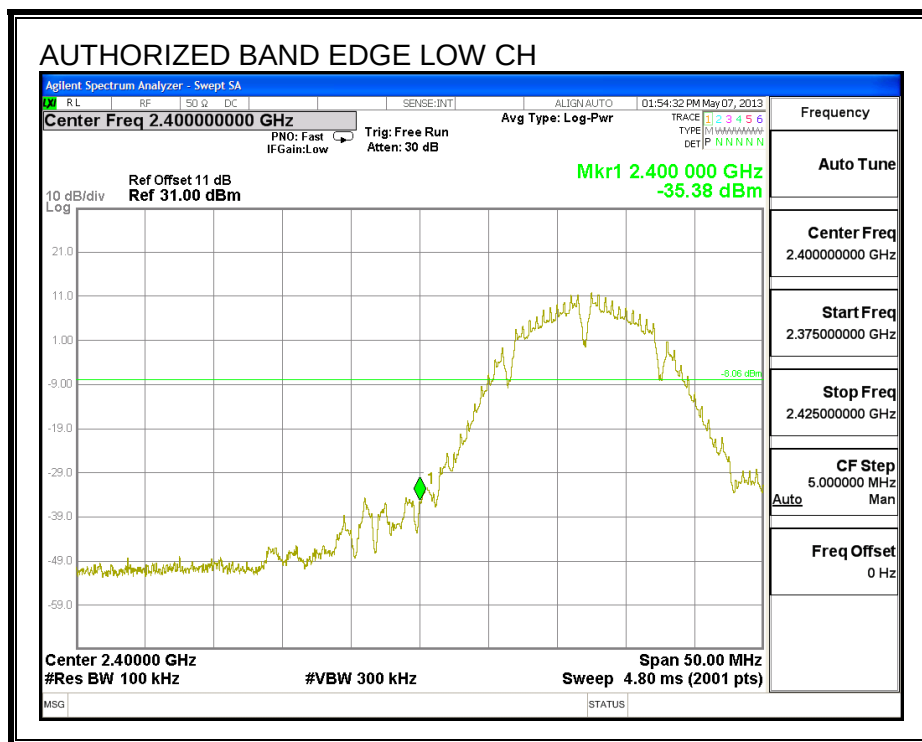
b mode

RESULTS

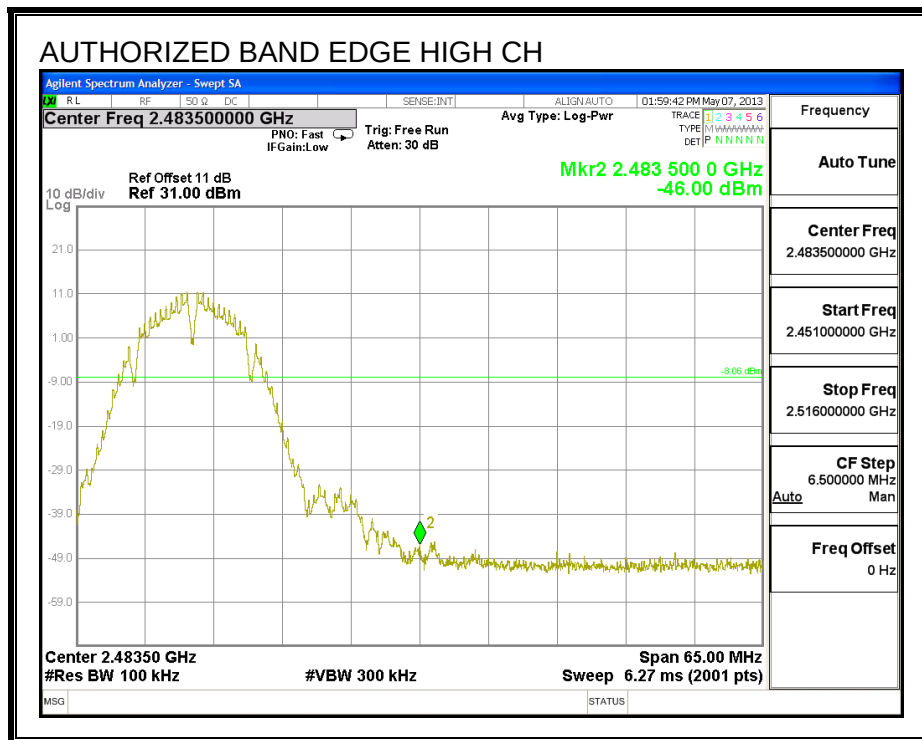
IN-BAND REFERENCE LEVEL



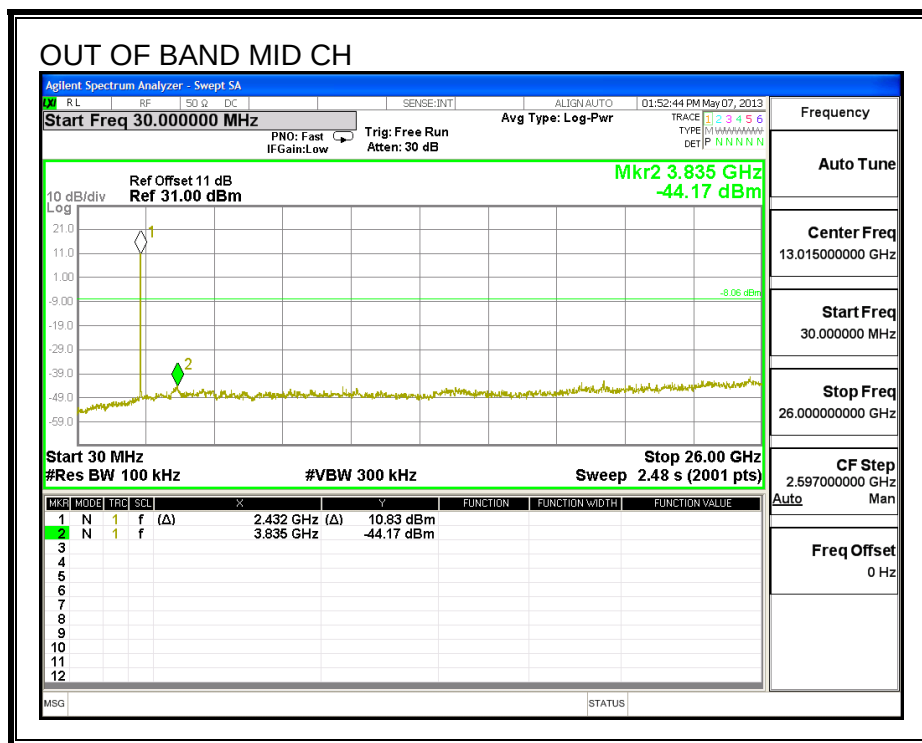
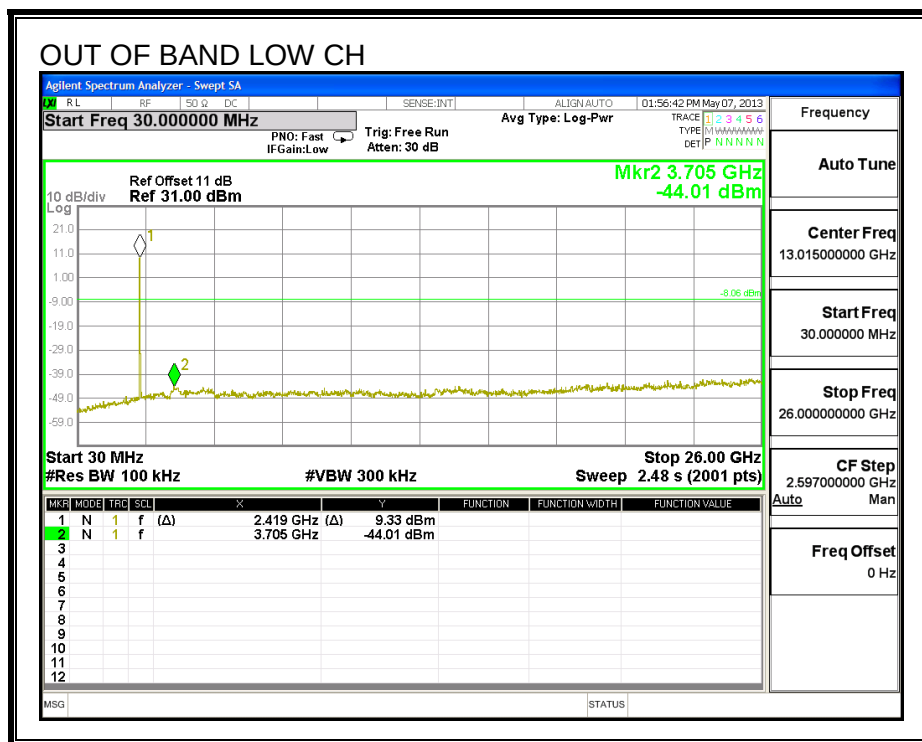
LOW CHANNEL BANDEDGE

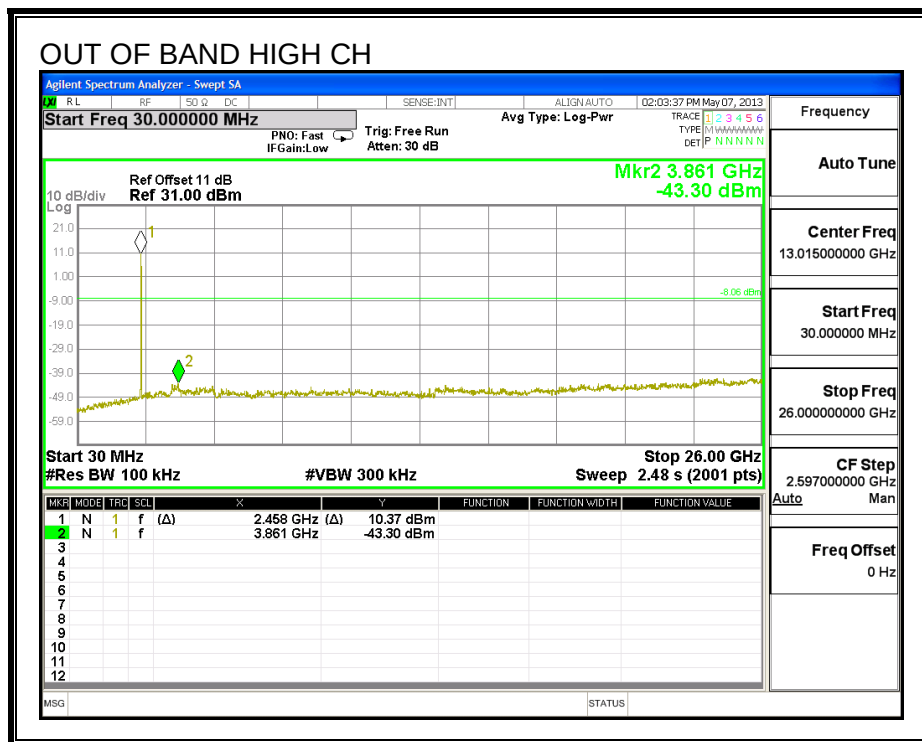


HIGH CHANNEL BANDEDGE



OUT-OF-BAND EMISSIONS

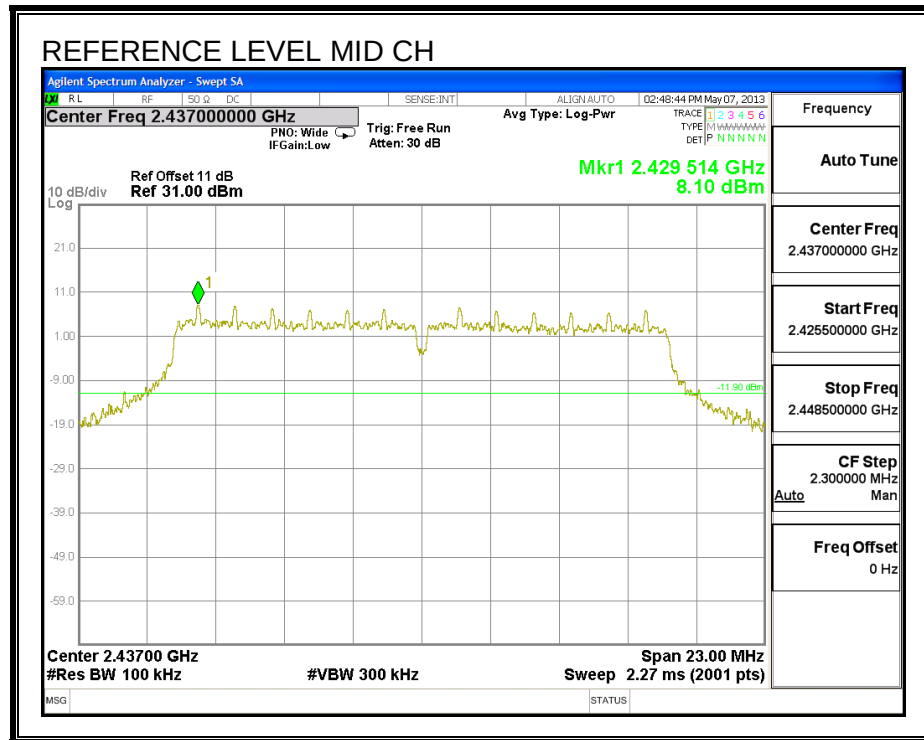




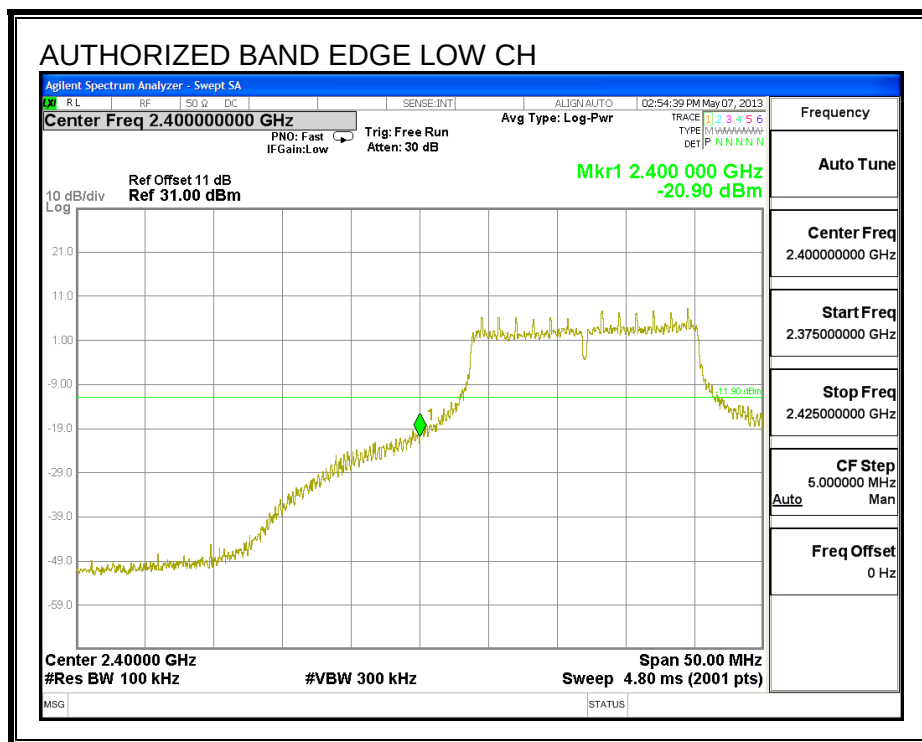
g mode

RESULTS

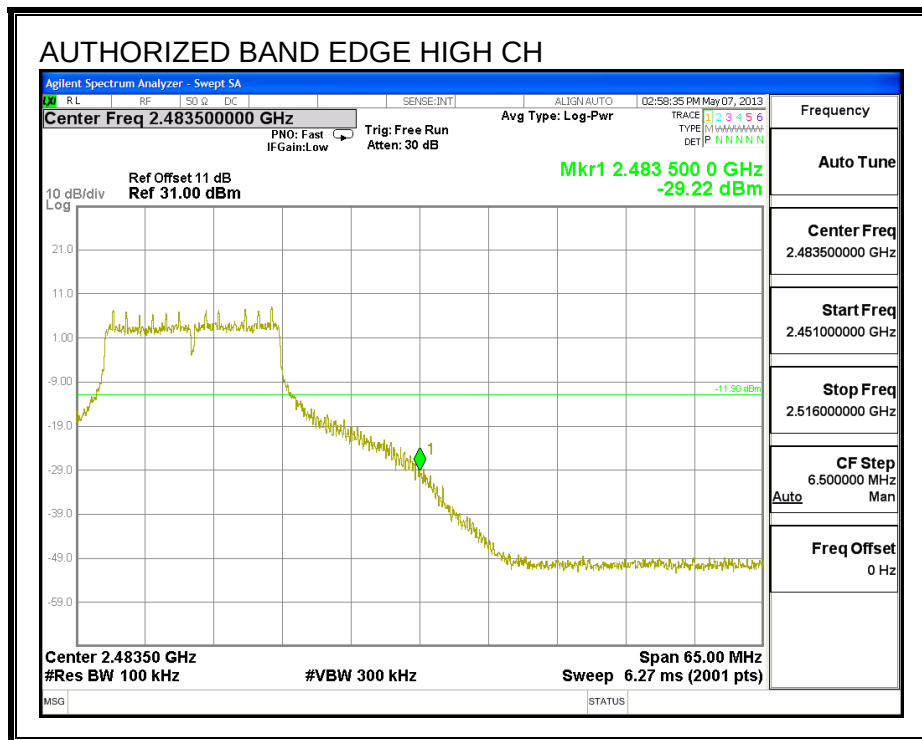
IN-BAND REFERENCE LEVEL



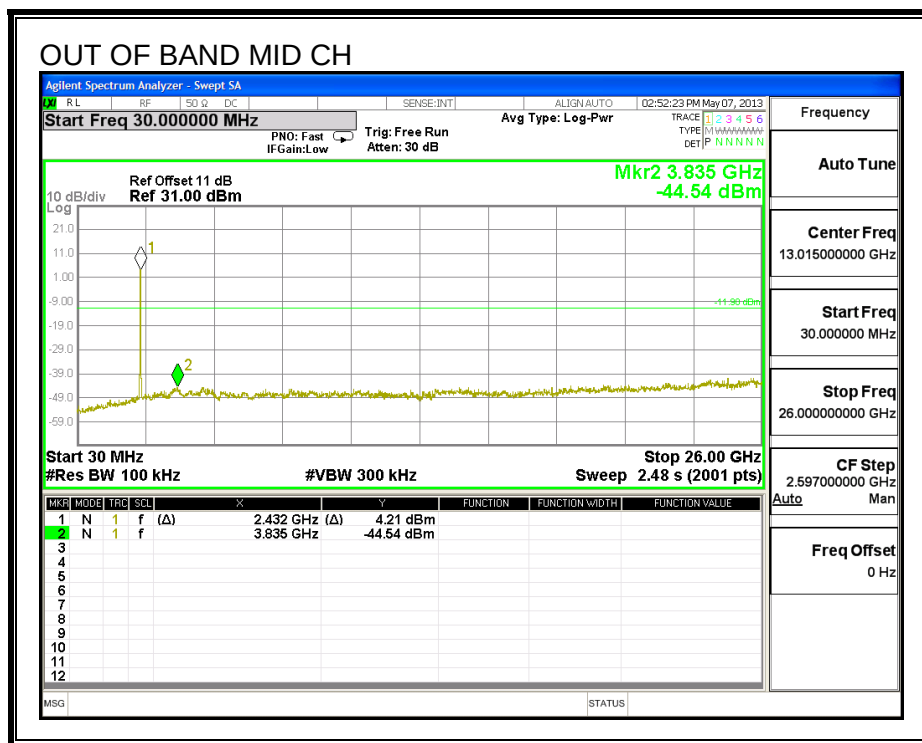
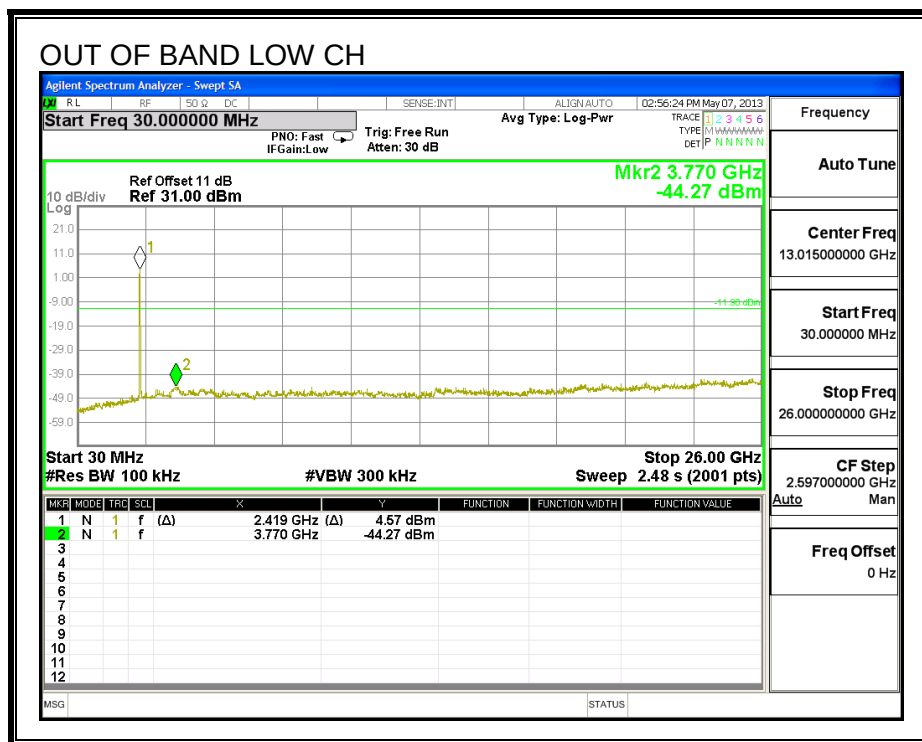
LOW CHANNEL BANDEDGE

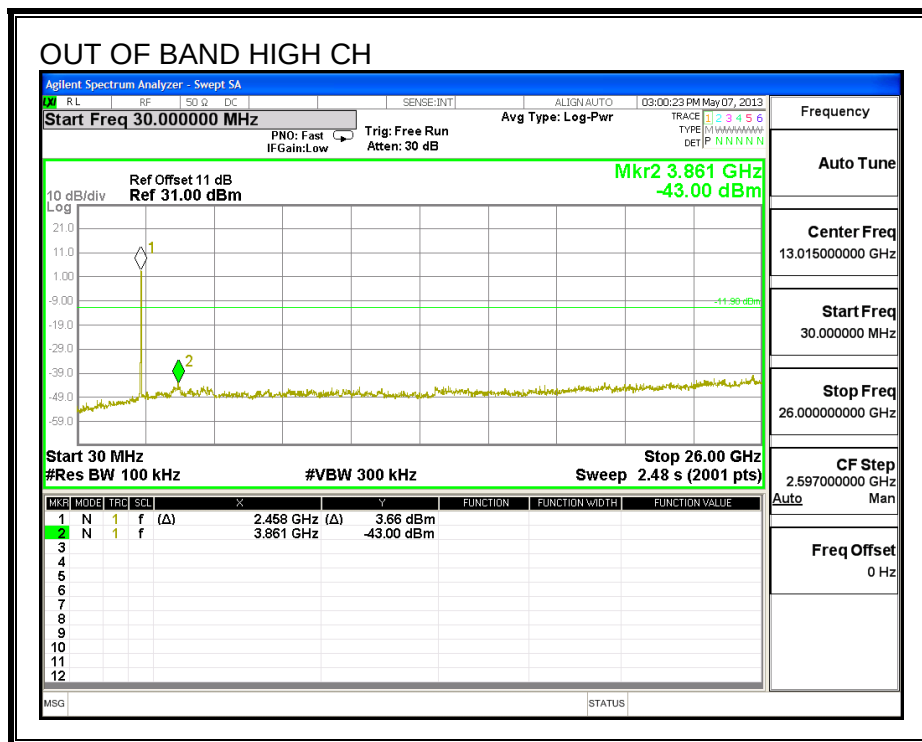


HIGH CHANNEL BANDEDGE



OUT-OF-BAND EMISSIONS

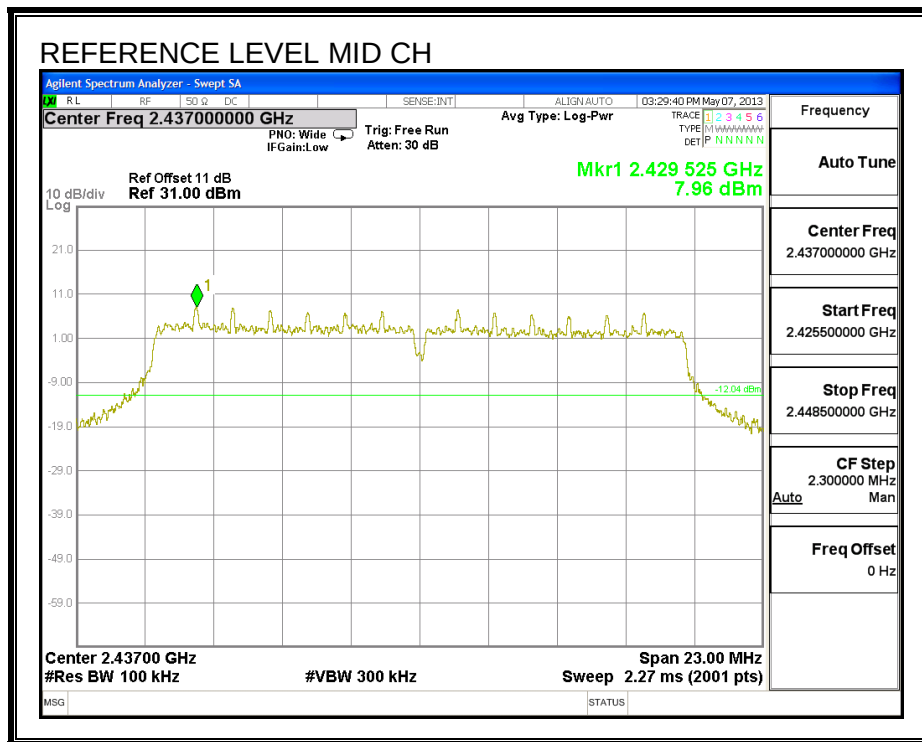




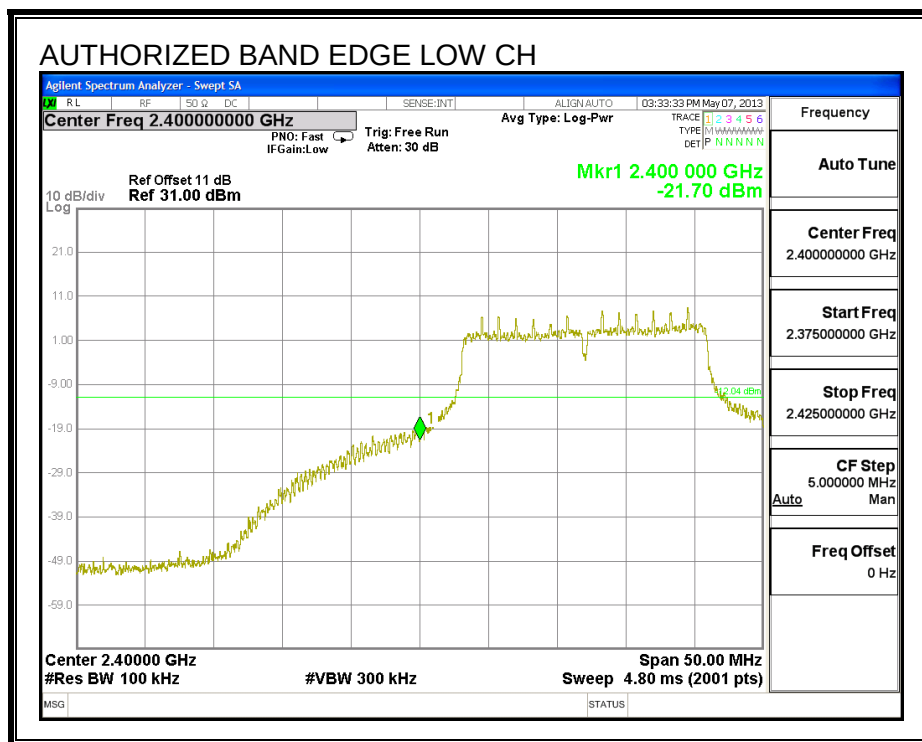
HT20

RESULTS

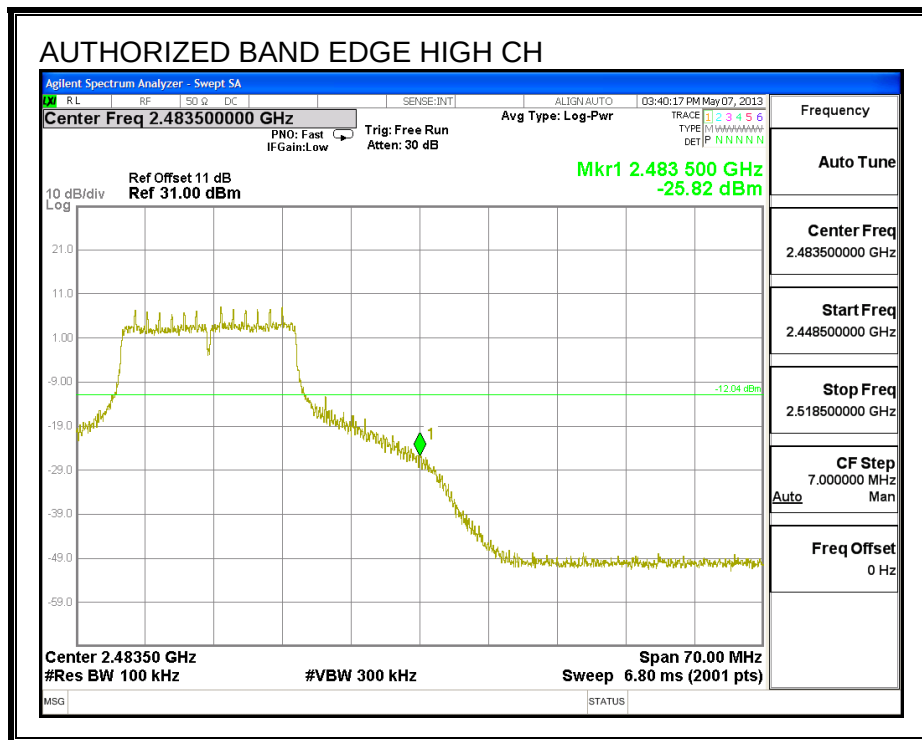
IN-BAND REFERENCE LEVEL



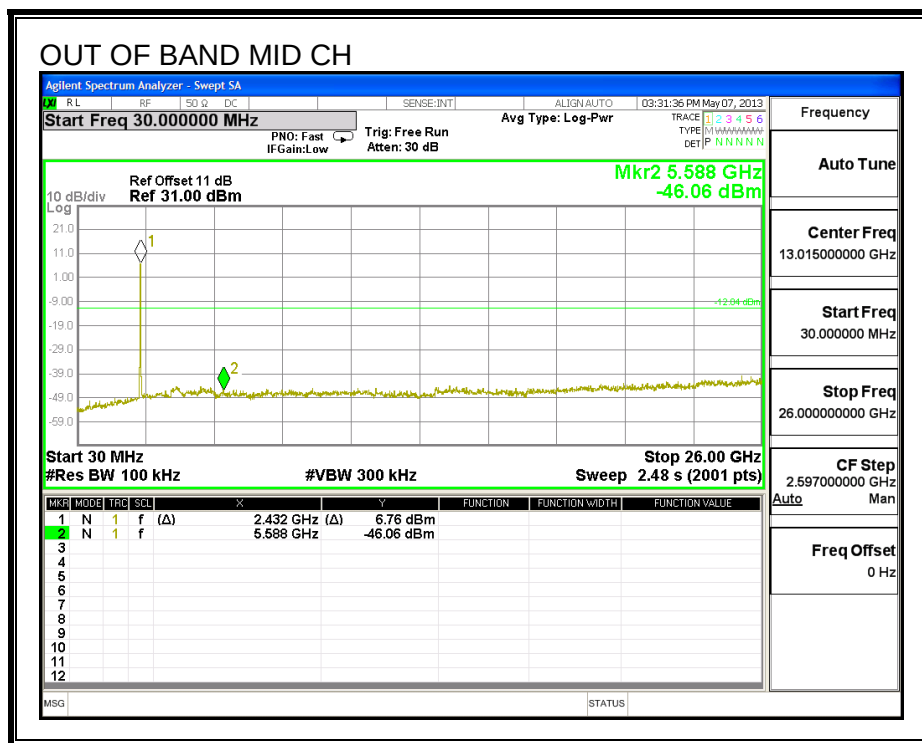
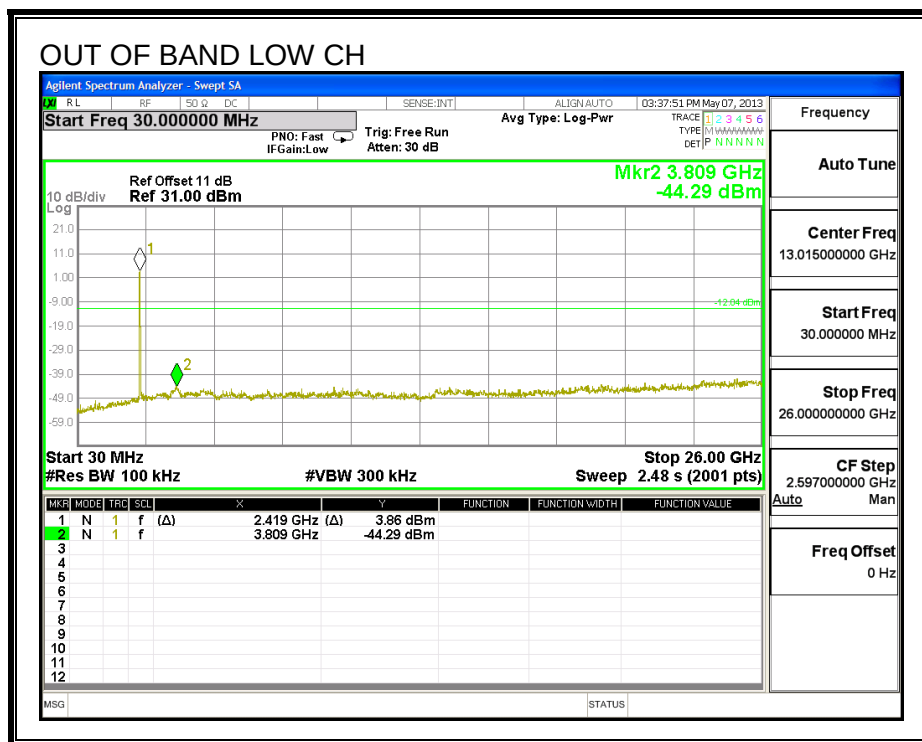
LOW CHANNEL BANDEDGE

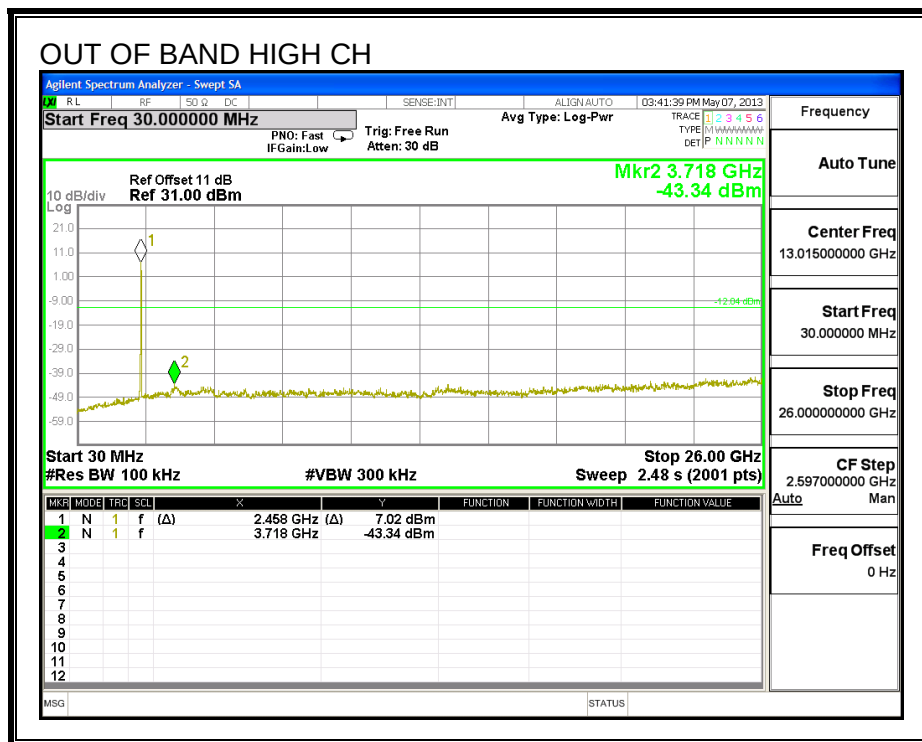


HIGH CHANNEL BANDEDGE



OUT-OF-BAND EMISSIONS





7.2. 5.8 GHz BAND

7.2.1. 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.

TEST PROCEDURE

KDB 558074 D01 v01 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247".

RESULTS

a mode

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	5745	15.111	0.5
Mid	5785	15.111	0.5
High	5825	15.295	0.5

HT20

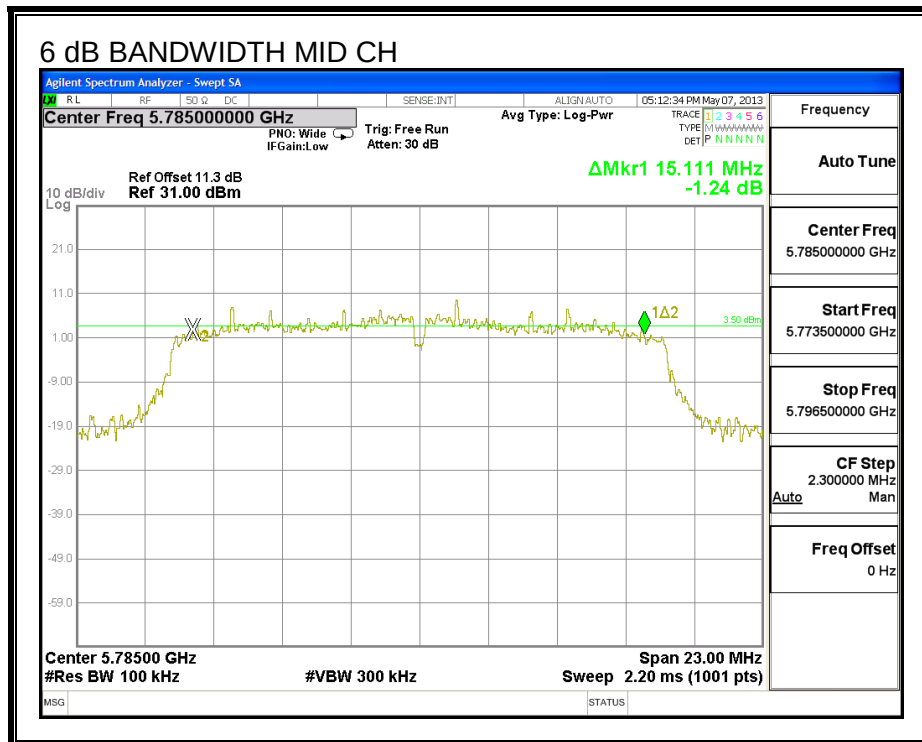
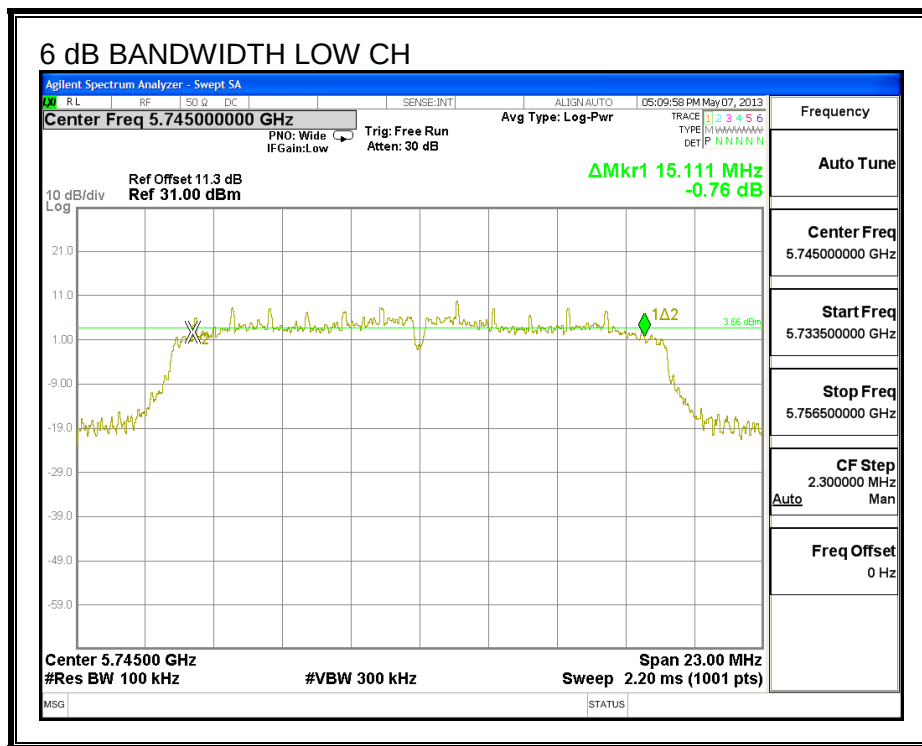
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	5745	15.134	0.5
Mid	5785	15.123	0.5
High	5825	15.065	0.5

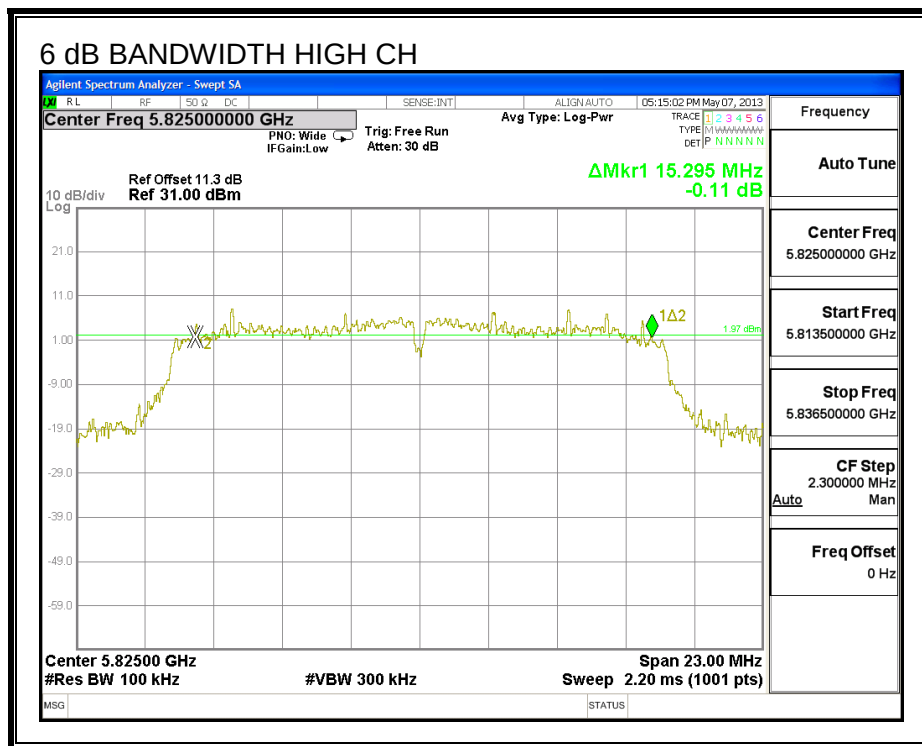
HT40

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	5755	32.591	0.5
High	5795	35.144	0.5

a mode

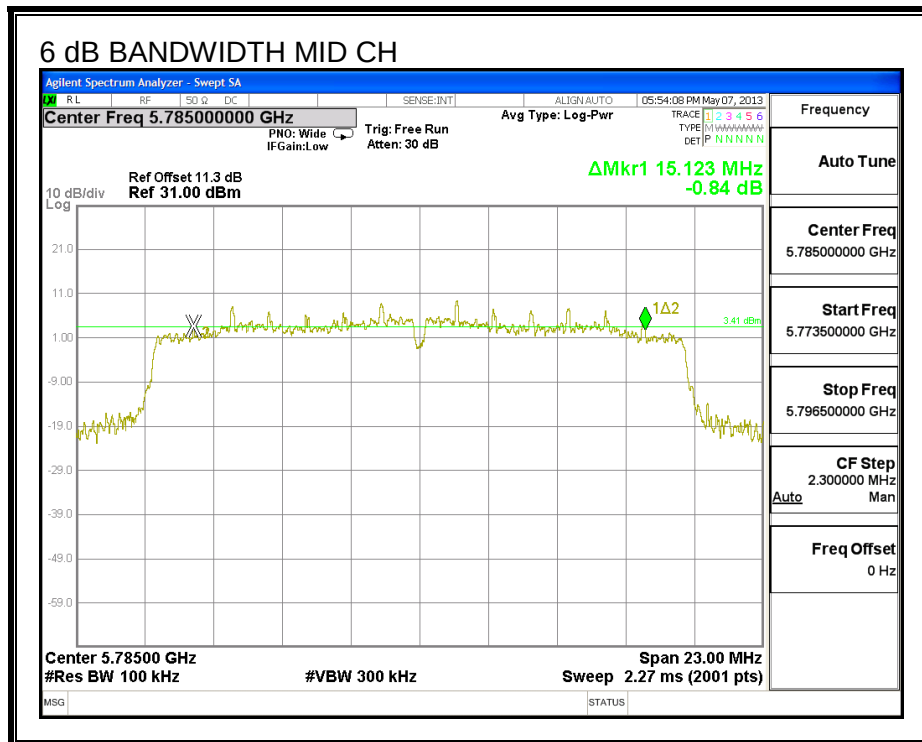
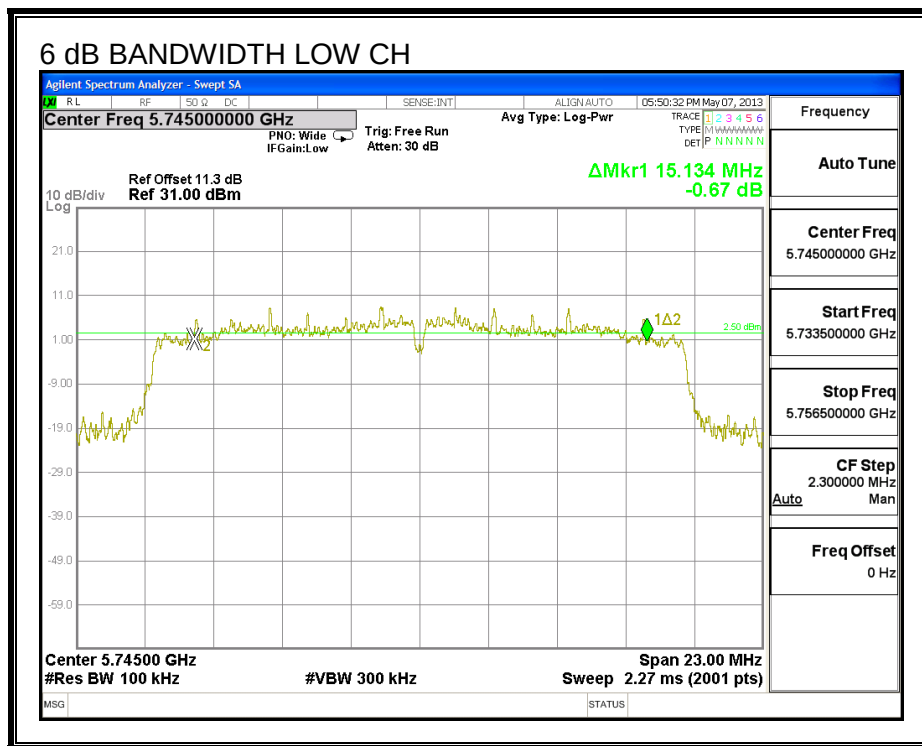
6 dB BANDWIDTH

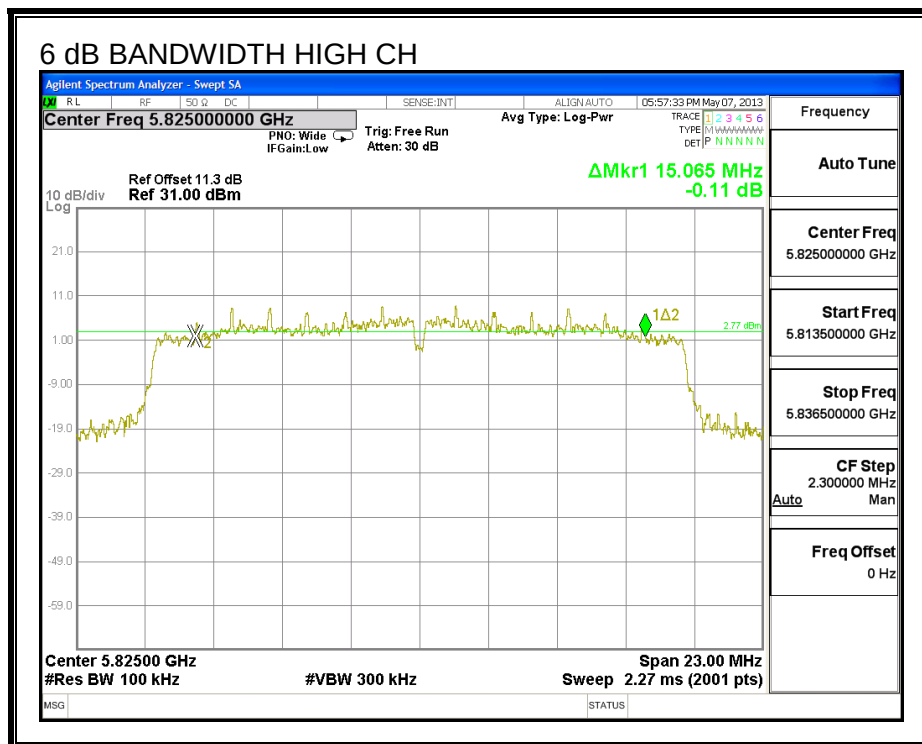




HT20

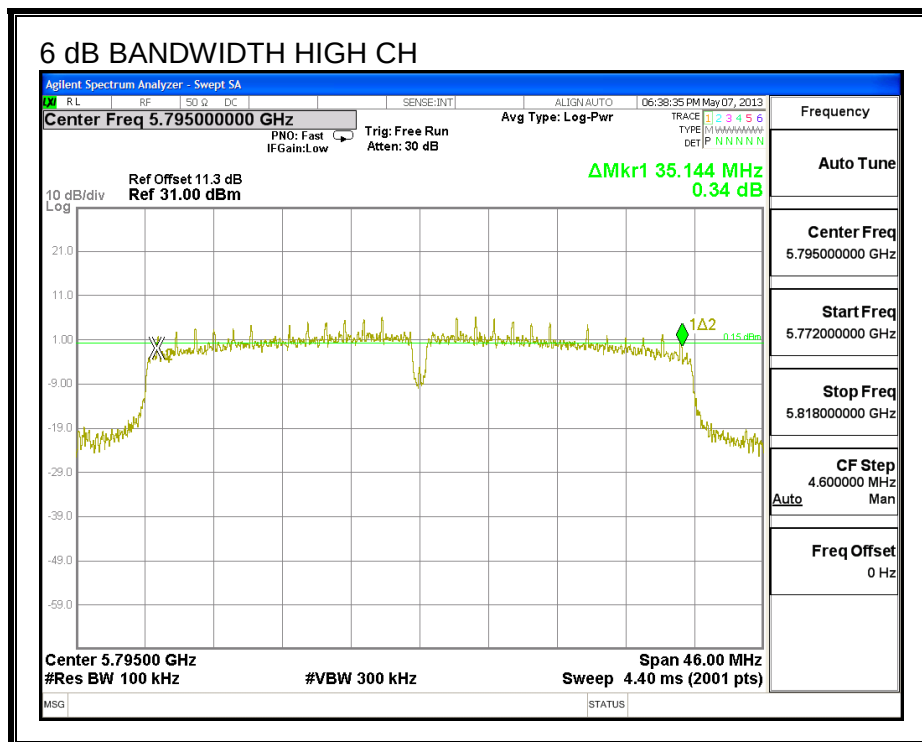
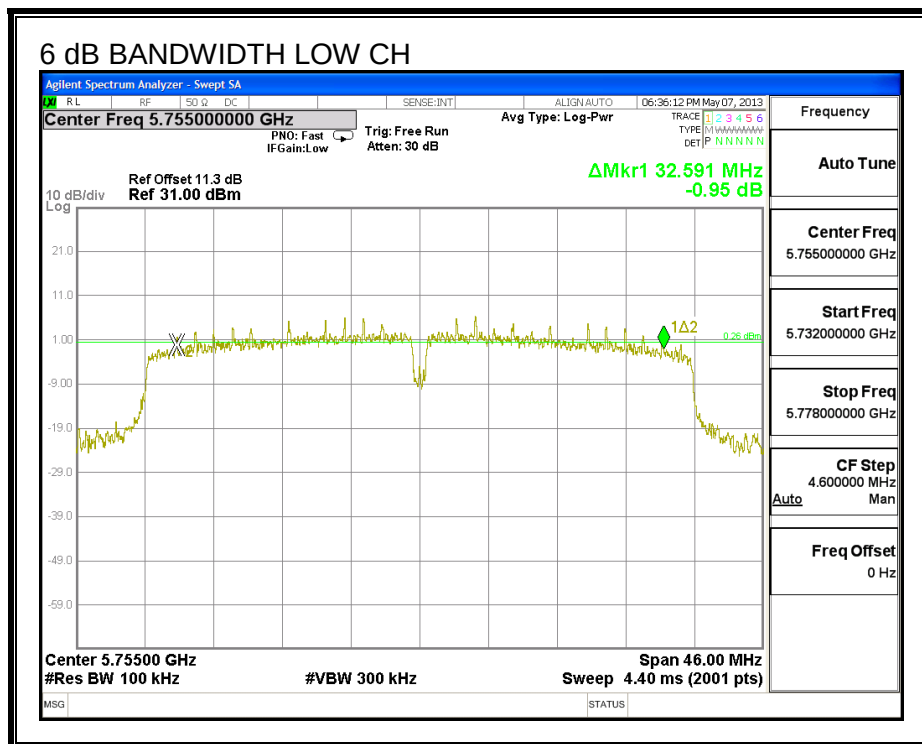
6 dB BANDWIDTH





HT40

6 dB BANDWIDTH



7.2.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

a mode

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5745	16.4530
Mid	5785	16.4300
High	5825	16.4160

HT20

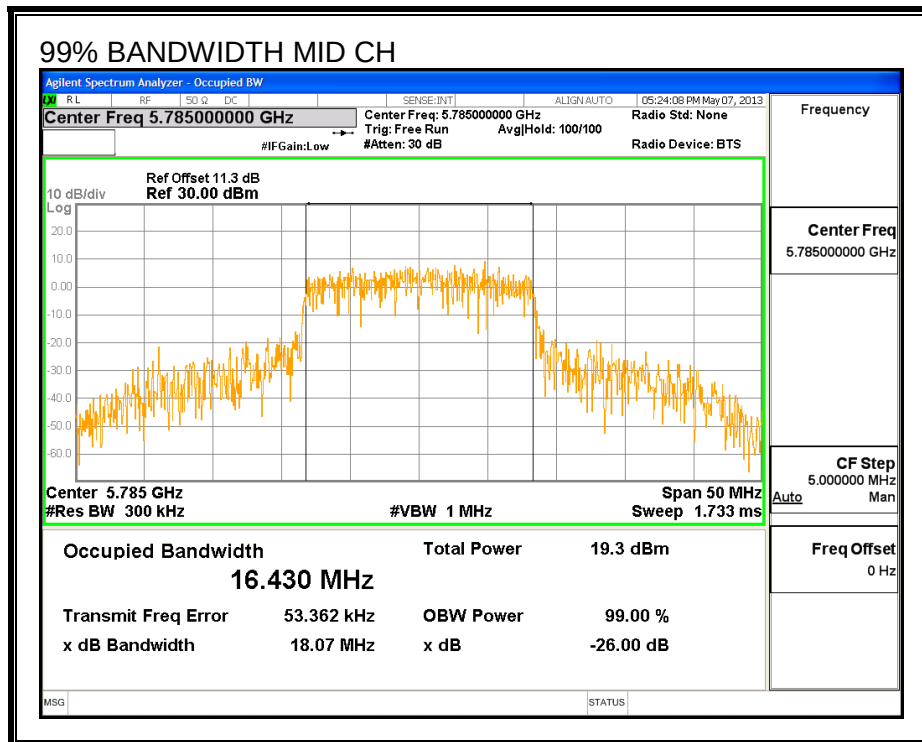
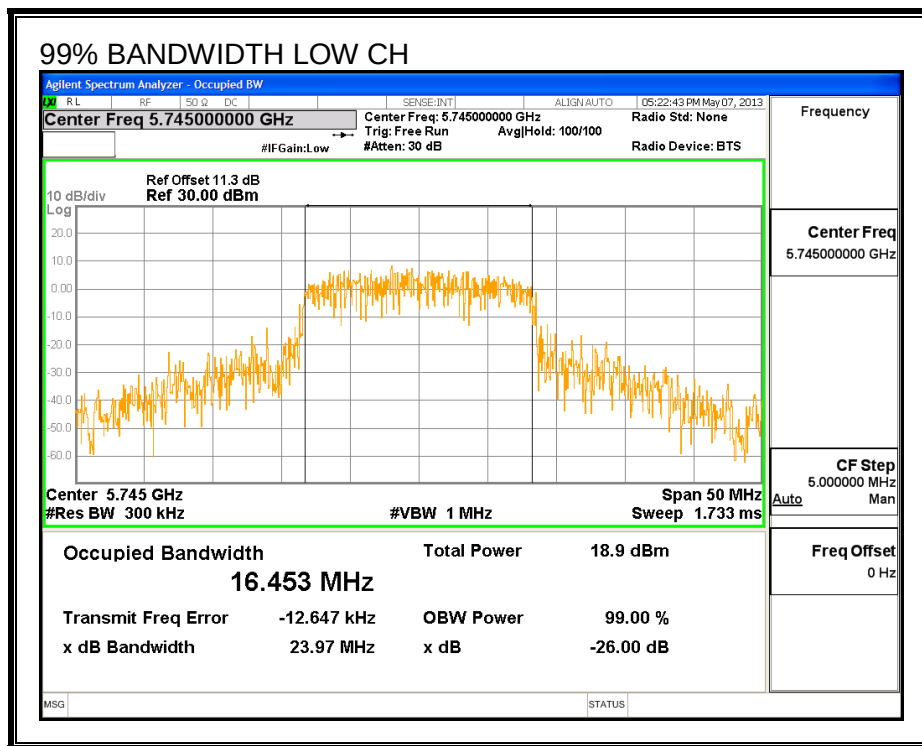
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5745	17.6150
Mid	5785	17.5220
High	5825	17.6670

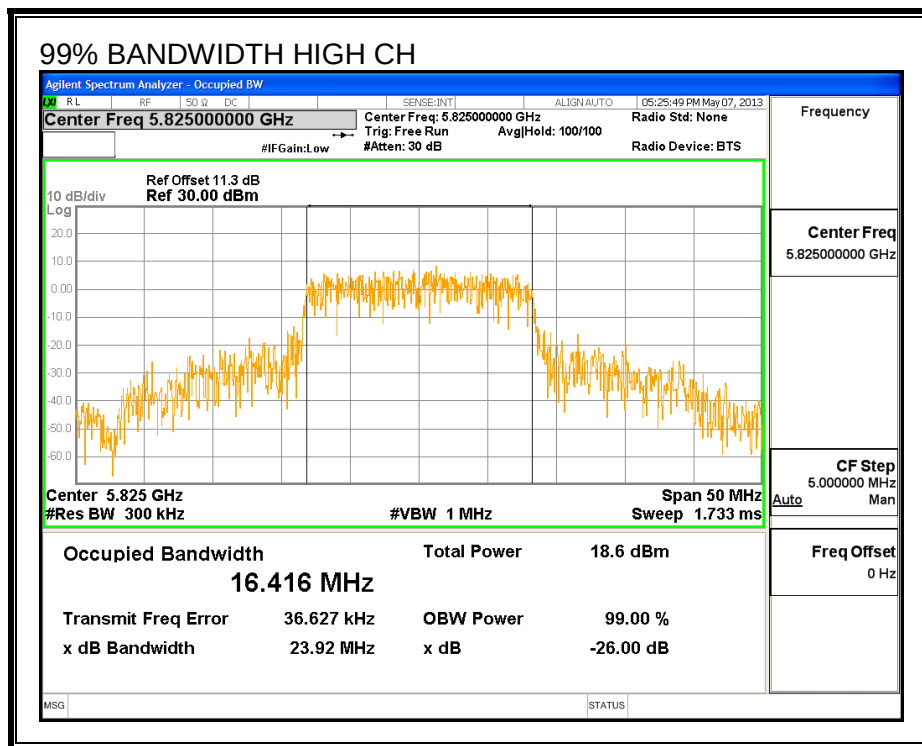
HT40

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5755	35.8960
High	5795	35.2580

a mode

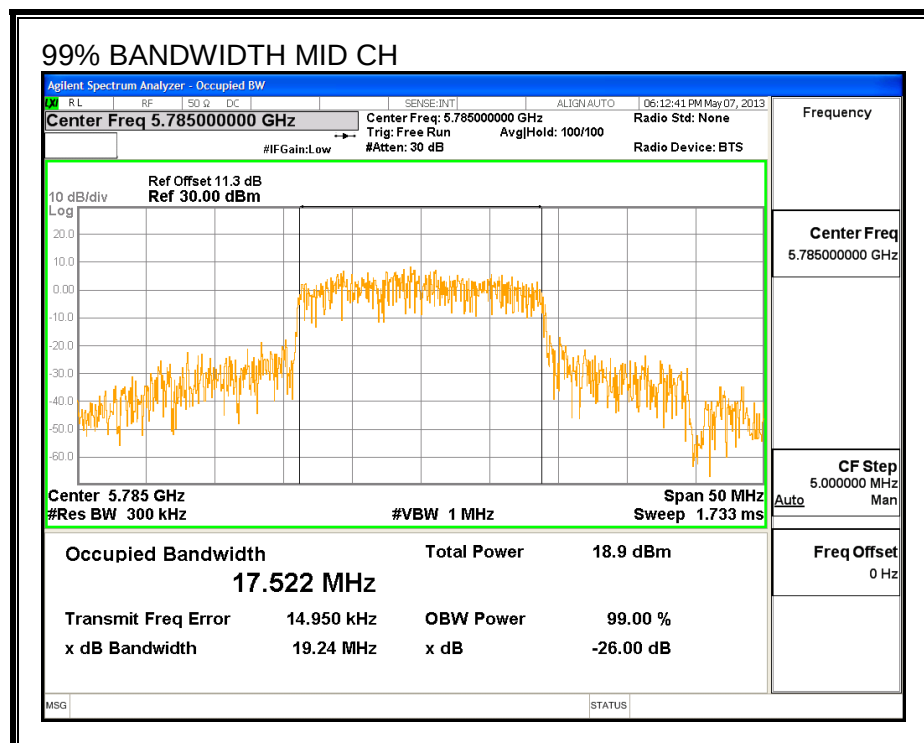
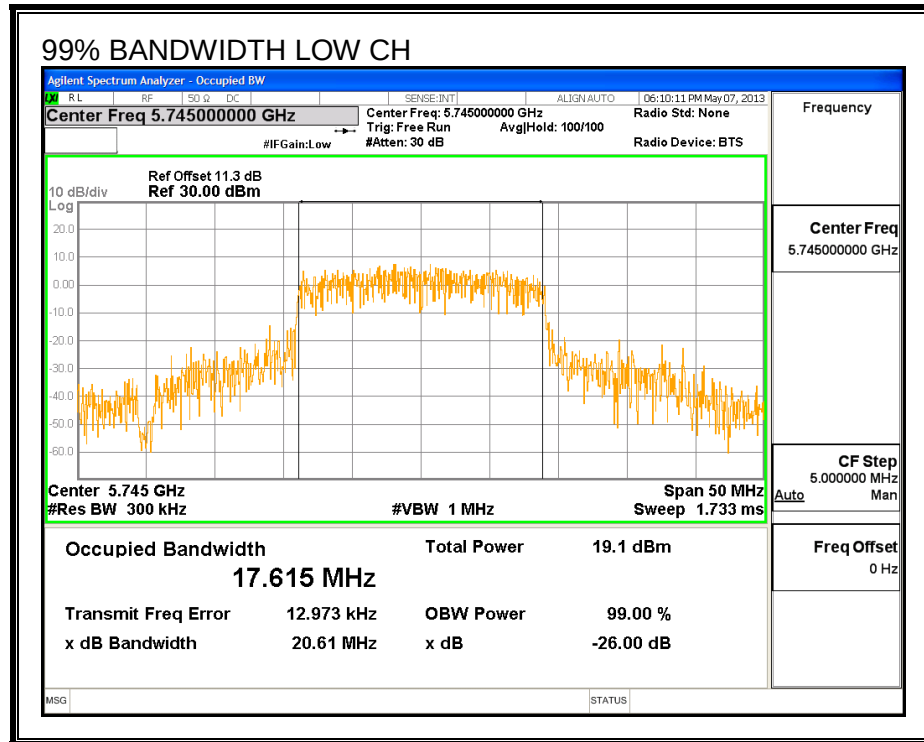
99% BANDWIDTH

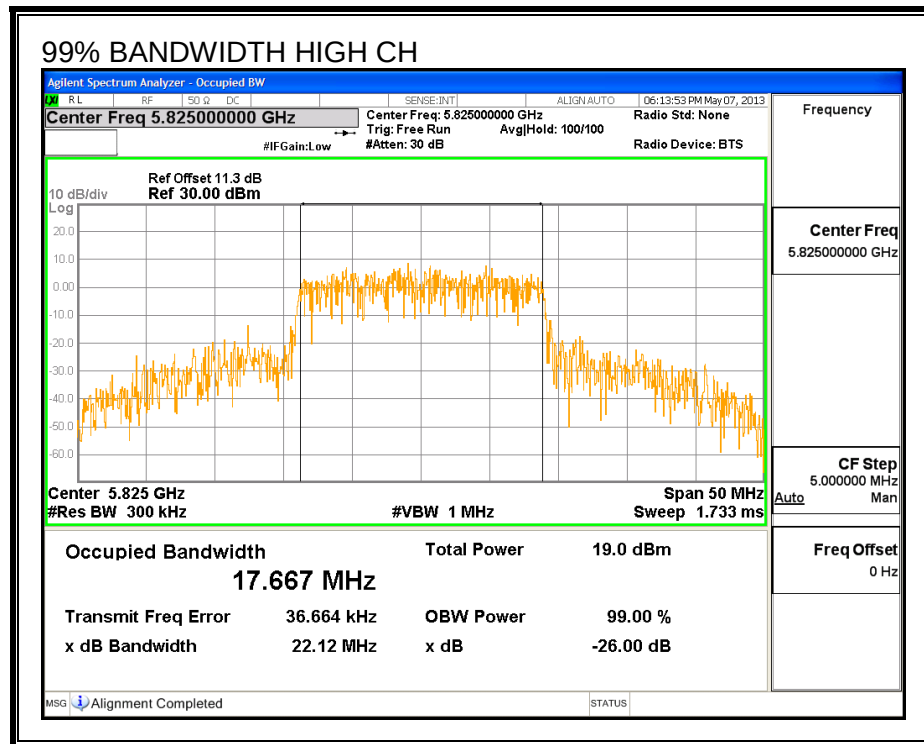




HT20

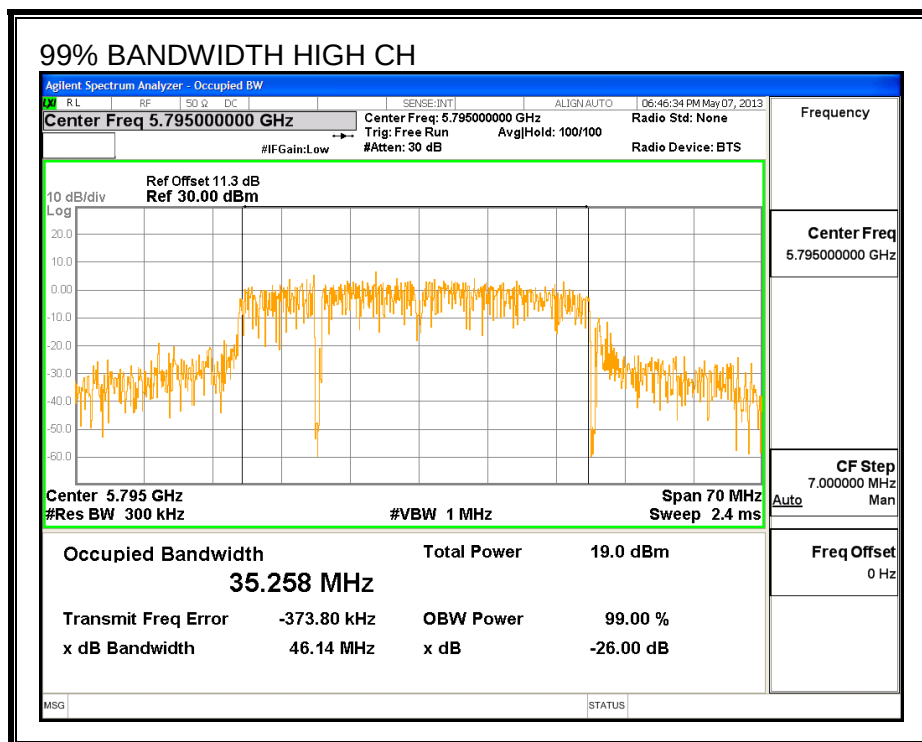
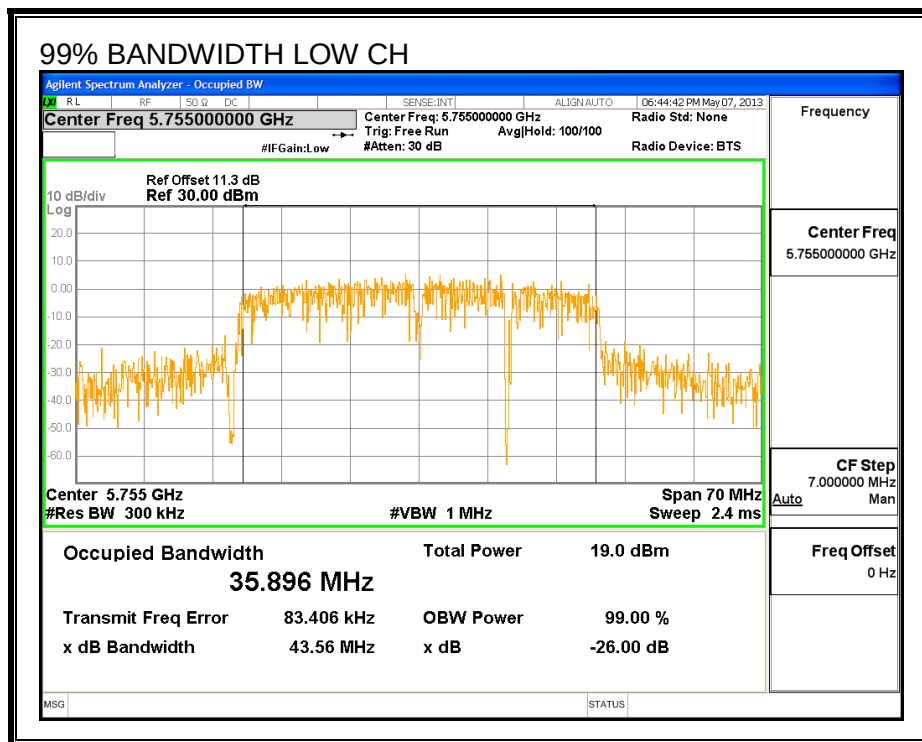
99% BANDWIDTH





HT40

99% BANDWIDTH



7.2.3. AVERAGE POWER

LIMITS

Note; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.3 dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

a mode

Channel	Frequency (MHz)	Power (dBm)
Low	5745	16.19
Mid	5785	16.06
High	5825	15.91

HT20

Channel	Frequency (MHz)	Power (dBm)
Low	5745	16.06
Mid	5785	15.78
High	5825	15.60

HT40

Channel	Frequency (MHz)	Power (dBm)
Low	5755	16.09
High	5795	15.86

7.2.4. 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

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

RESULTS

a mode

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	5745	-4.21	30.00	30	36	30.00
Mid	5785	-4.21	30.00	30	36	30.00
High	5825	-4.21	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	5745	24.141	24.14	30.00	-5.86
Mid	5785	23.373	23.37	30.00	-6.63
High	5825	23.280	23.28	30.00	-6.72

HT20

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	5745	-4.21	30.00	30	36	30.00
Mid	5785	-4.21	30.00	30	36	30.00
High	5825	-4.21	30.00	30	36	30.00

Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	5745	23.590	23.59	30.00	-6.41
Mid	5785	23.206	23.21	30.00	-6.79
High	5825	22.978	22.98	30.00	-7.02

HT40

Limits

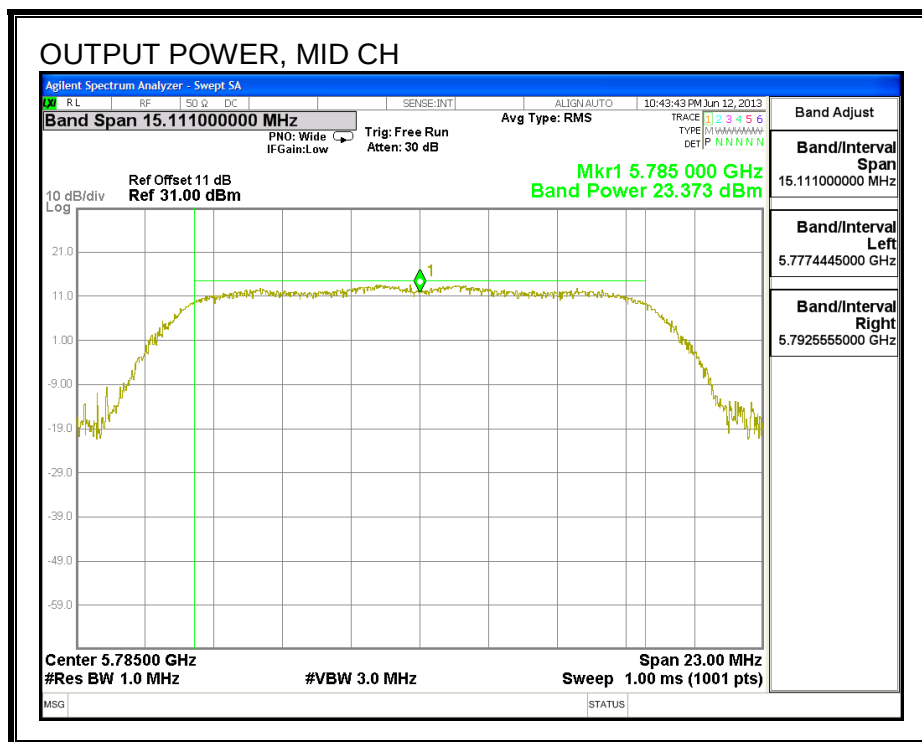
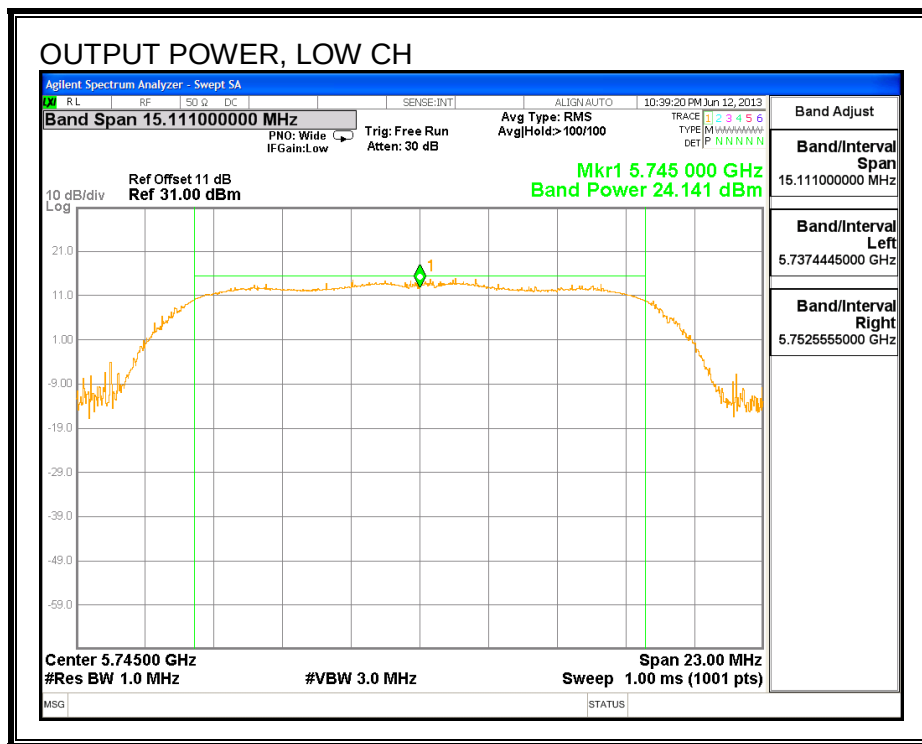
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	5755	-4.21	30.00	30	36	30.00
High	5795	-4.21	30.00	30	36	30.00

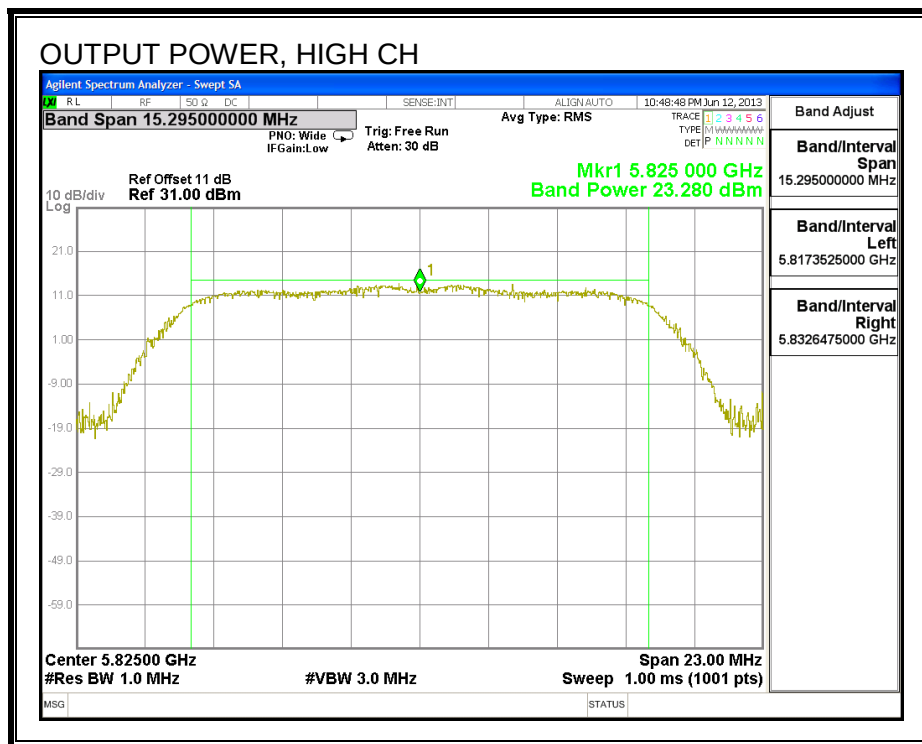
Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	5755	24.005	24.01	30.00	-6.00
High	5795	23.632	23.63	30.00	-6.37

a mode

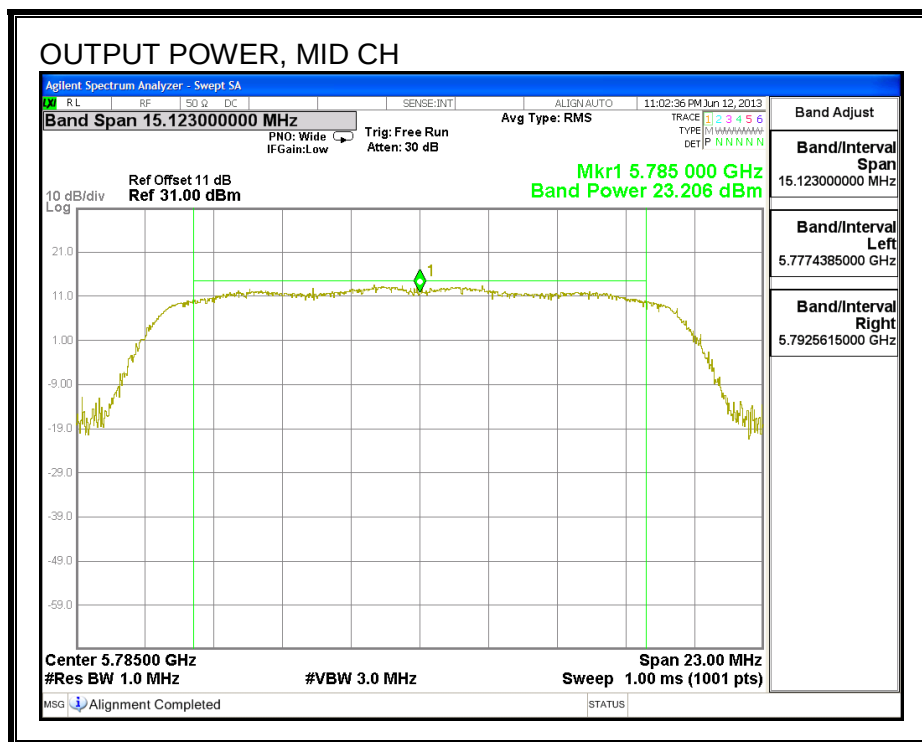
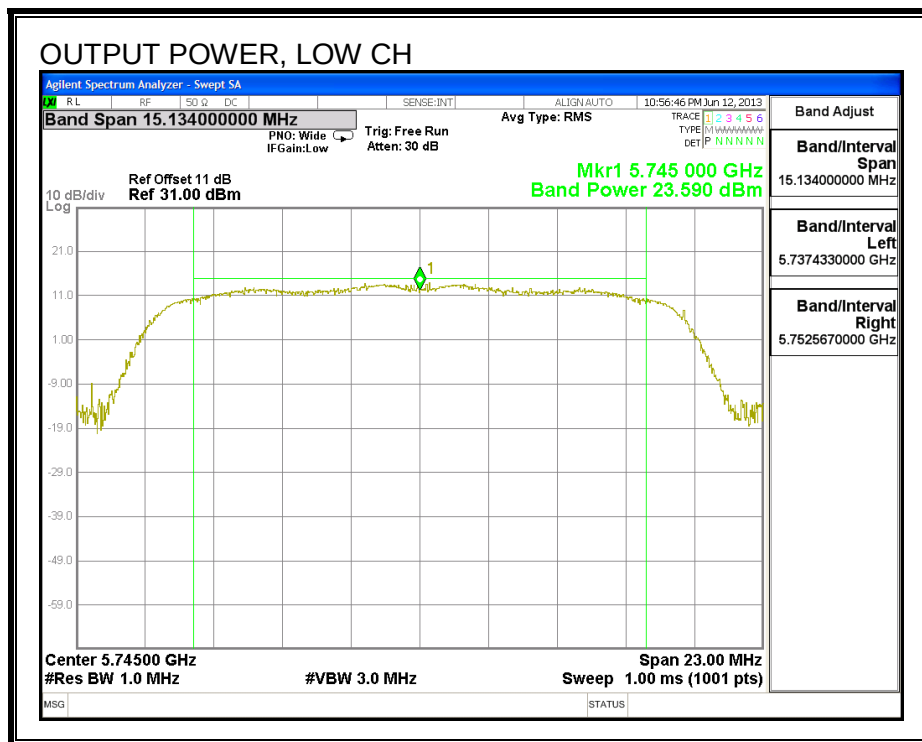
OUTPUT POWER

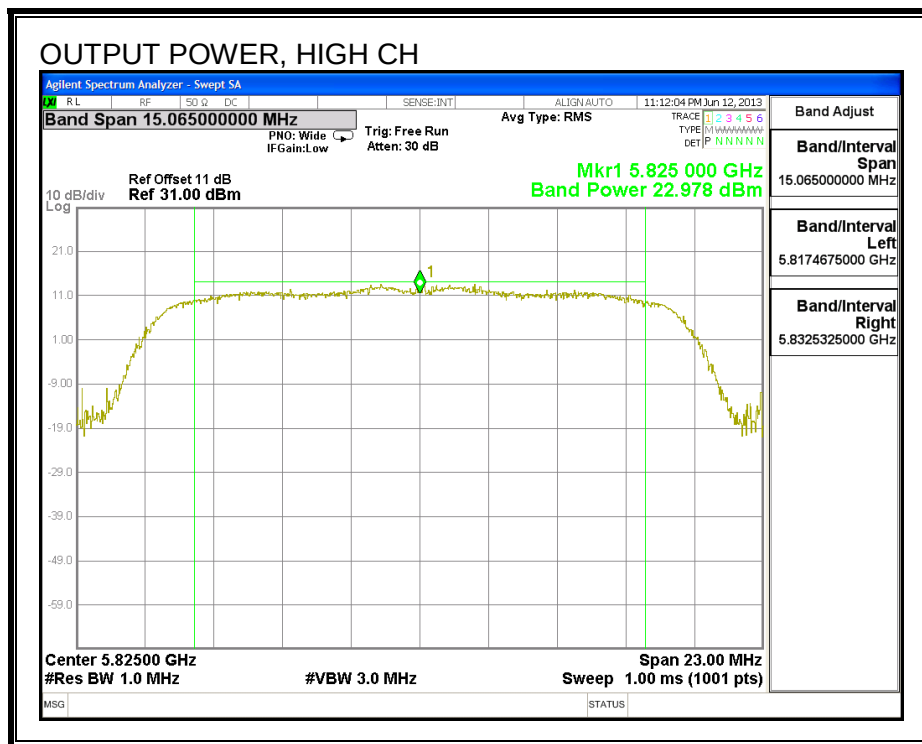




HT20

OUTPUT POWER





7.2.5. 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

a mode

PSD Results

Channel	Frequency	Meas	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	5745	-5.60	8.00	-13.60
Mid	5785	-6.16	8.00	-14.16
High	5825	-5.32	8.00	-13.32

HT20

PSD Results

Channel	Frequency	Meas	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	5745	-5.50	8.00	-13.50
Mid	5785	-5.67	8.00	-13.67
High	5825	-5.38	8.00	-13.38

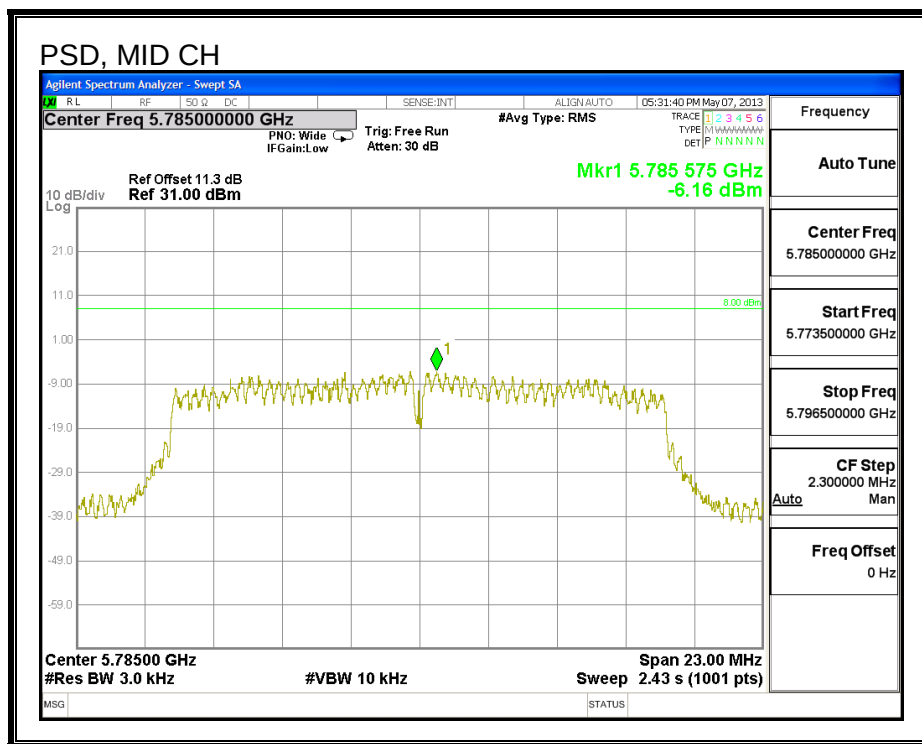
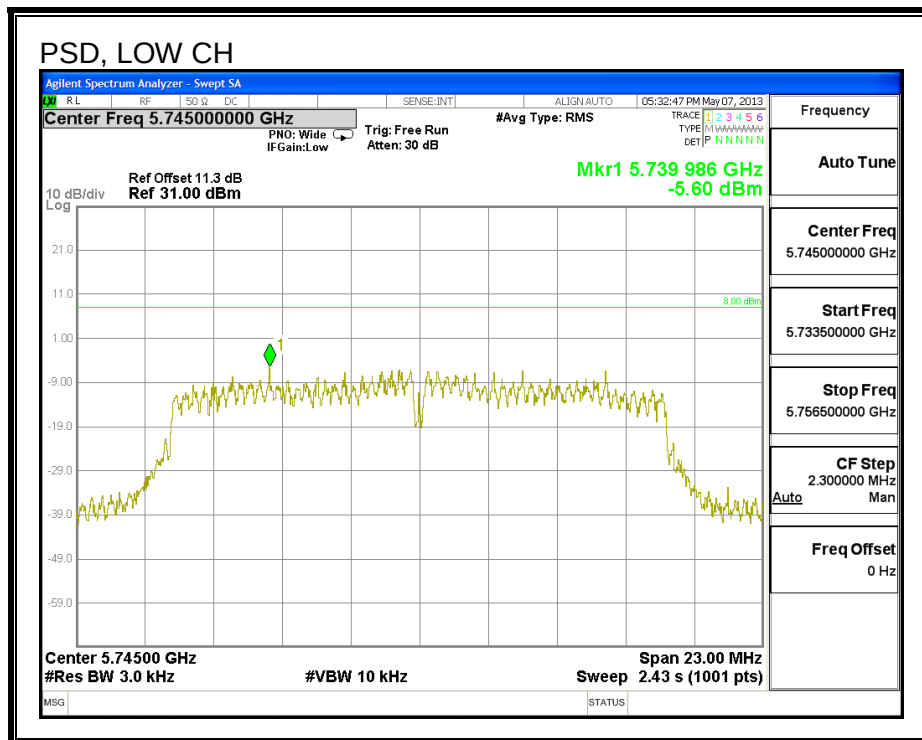
HT40

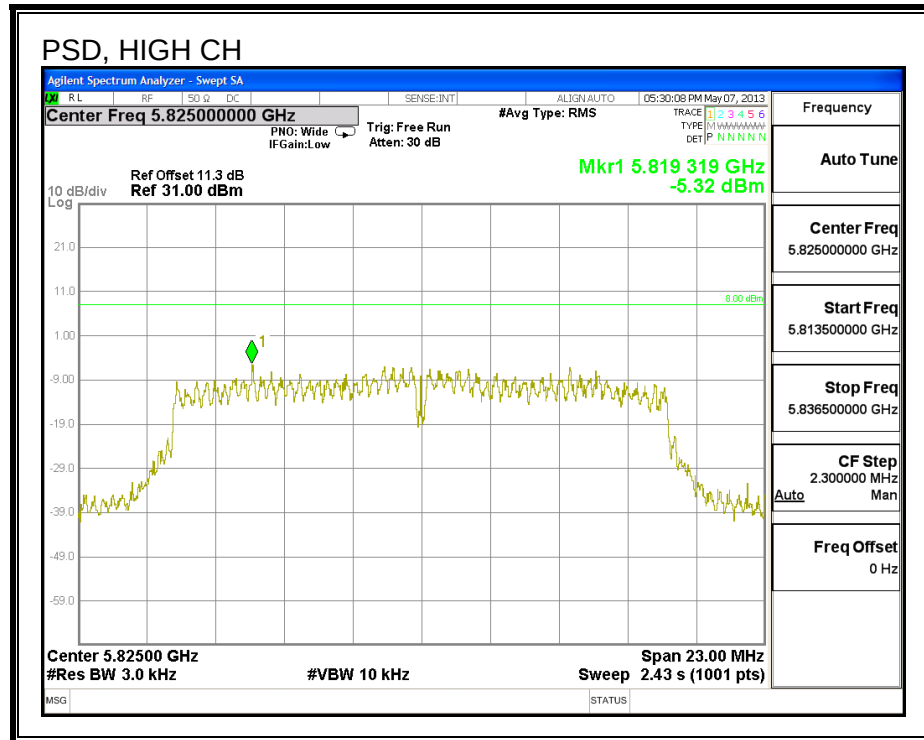
PSD Results

Channel	Frequency	Meas	Limit	Margin
	(MHz)	(dBm)	(dBm)	(dB)
Low	5755	-9.50	8.00	-17.50
High	5795	-8.61	8.00	-16.61

a mode

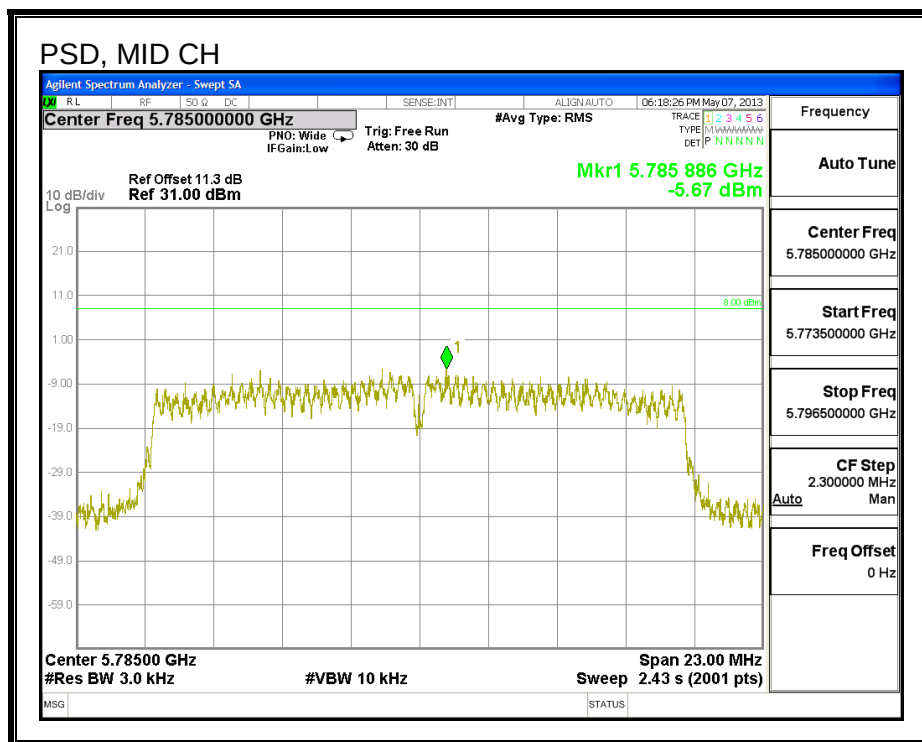
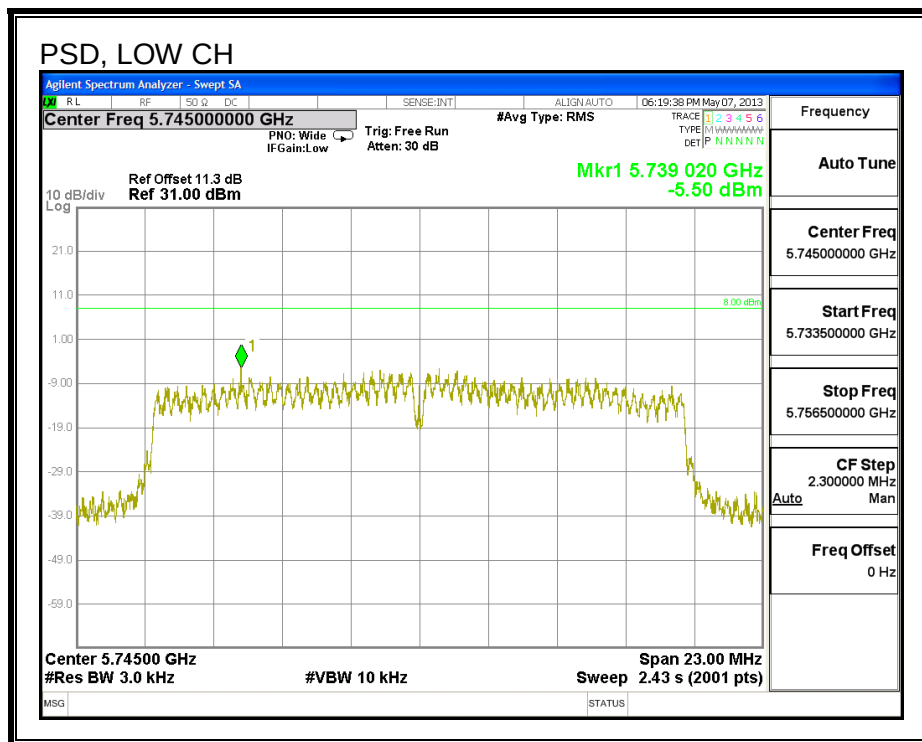
PSD

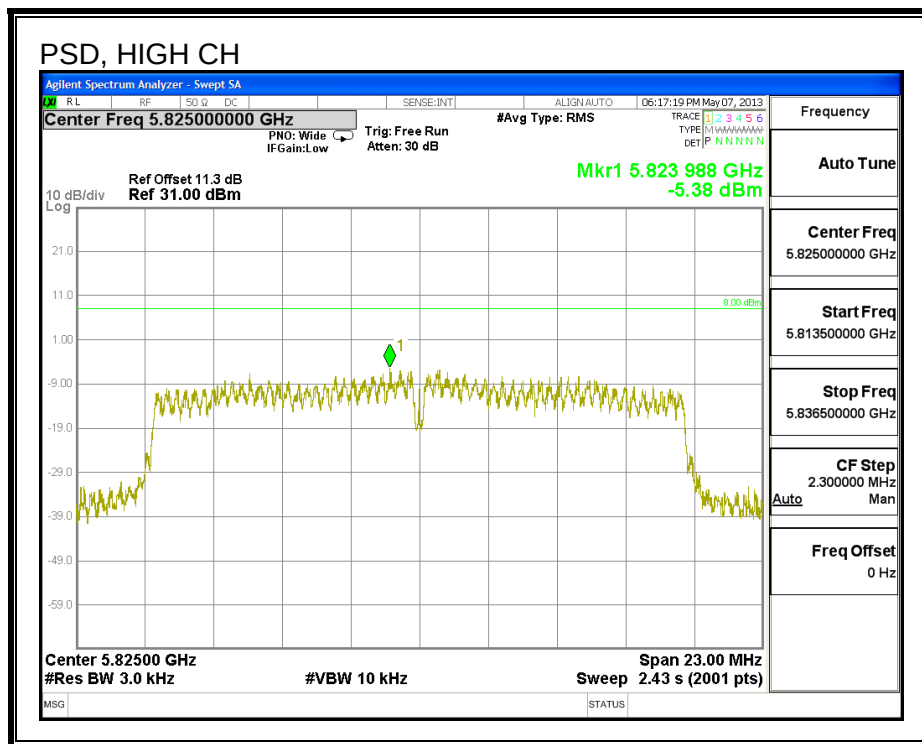




HT20

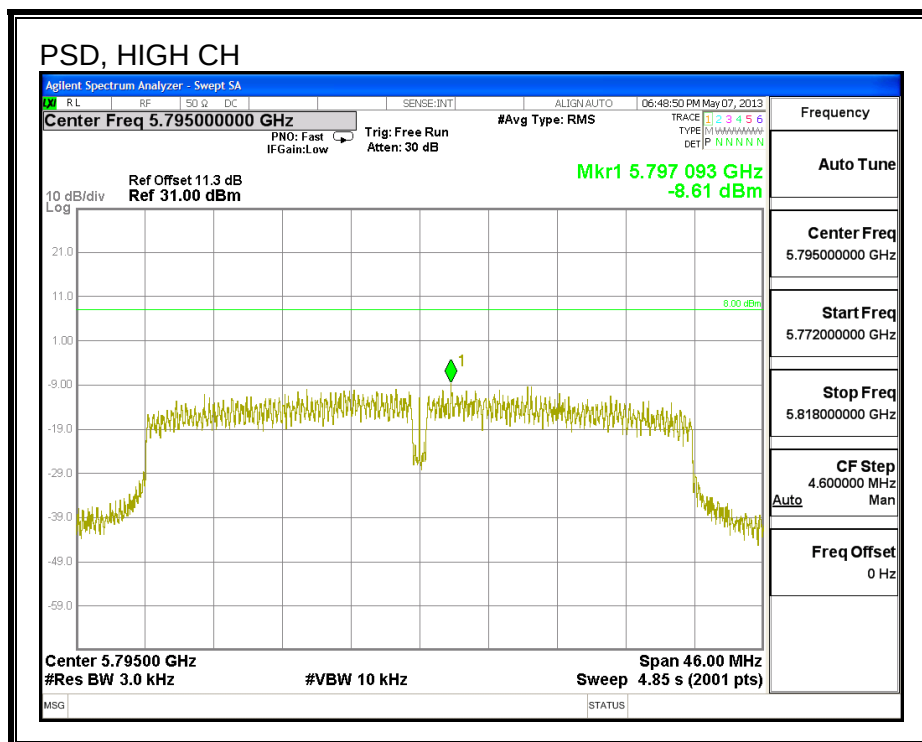
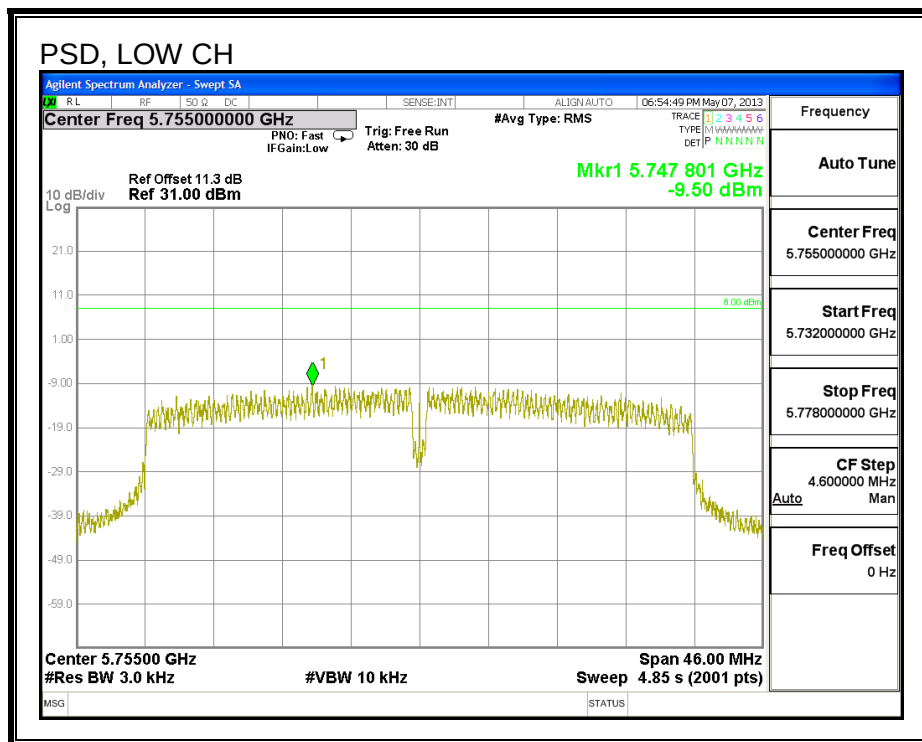
PSD





HT40

PSD



7.2.6. 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.

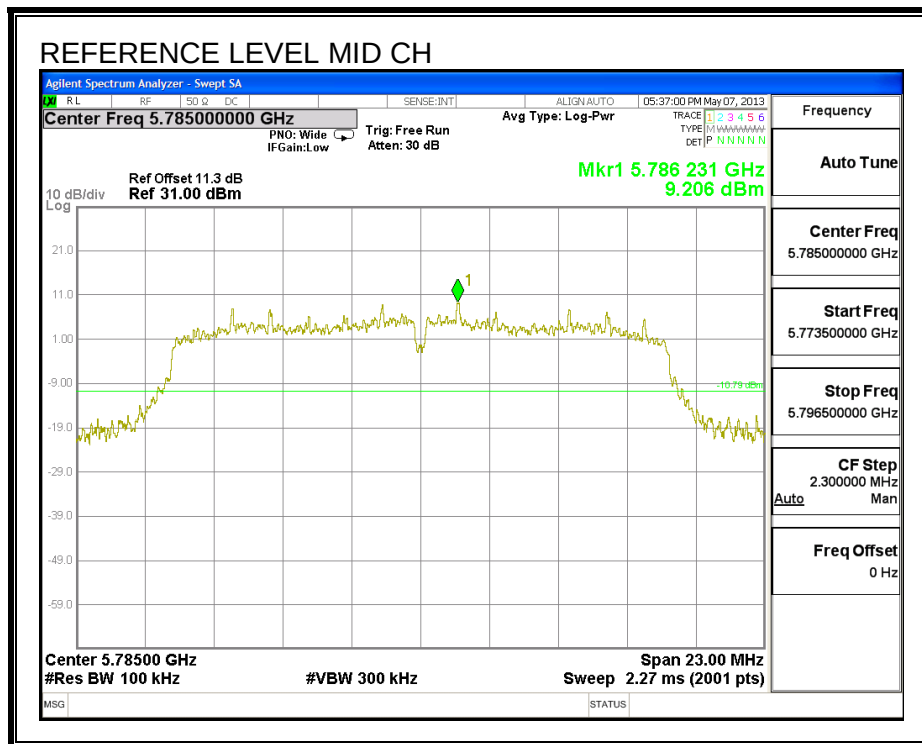
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer with RBW = 100 kHz, VBW = 300 kHz, peak detector, and max hold. Measurements utilizing these settings are made of the in-band reference level, bandedge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

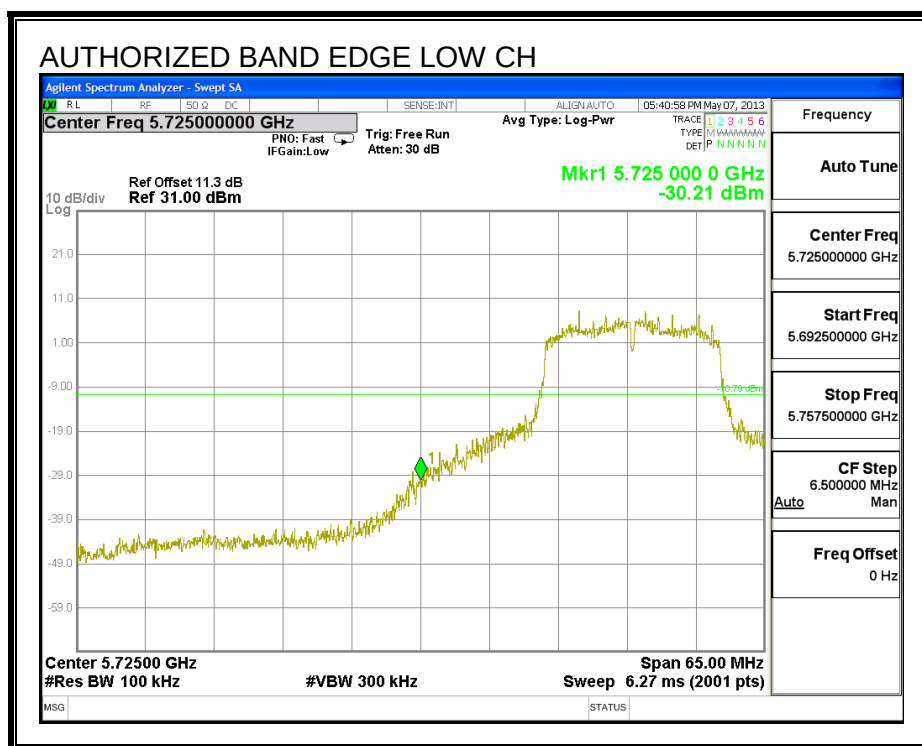
a mode

RESULTS

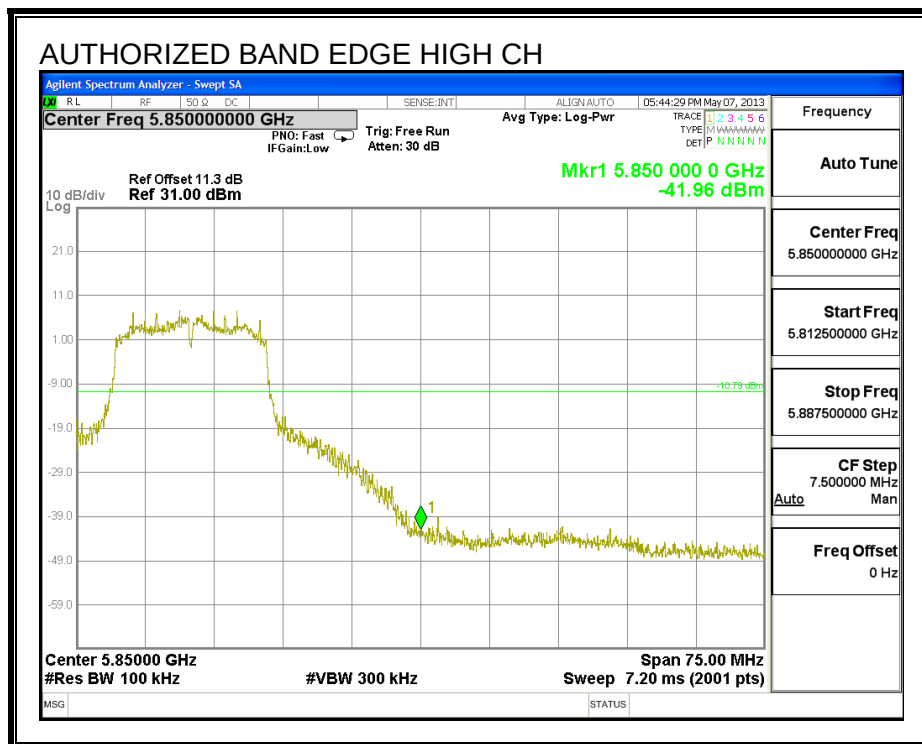
IN-BAND REFERENCE LEVEL



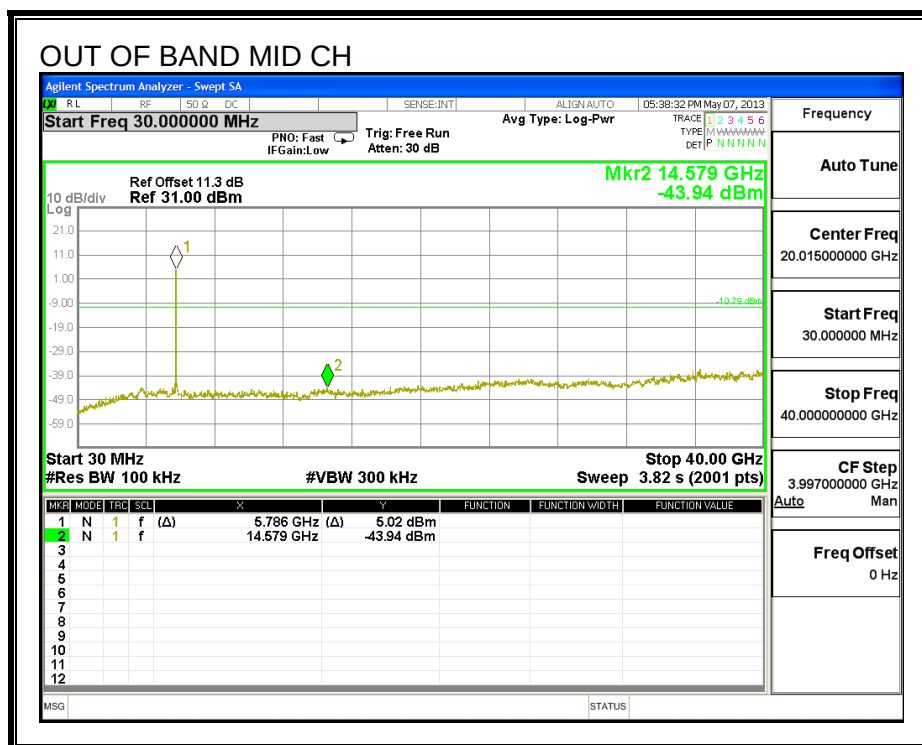
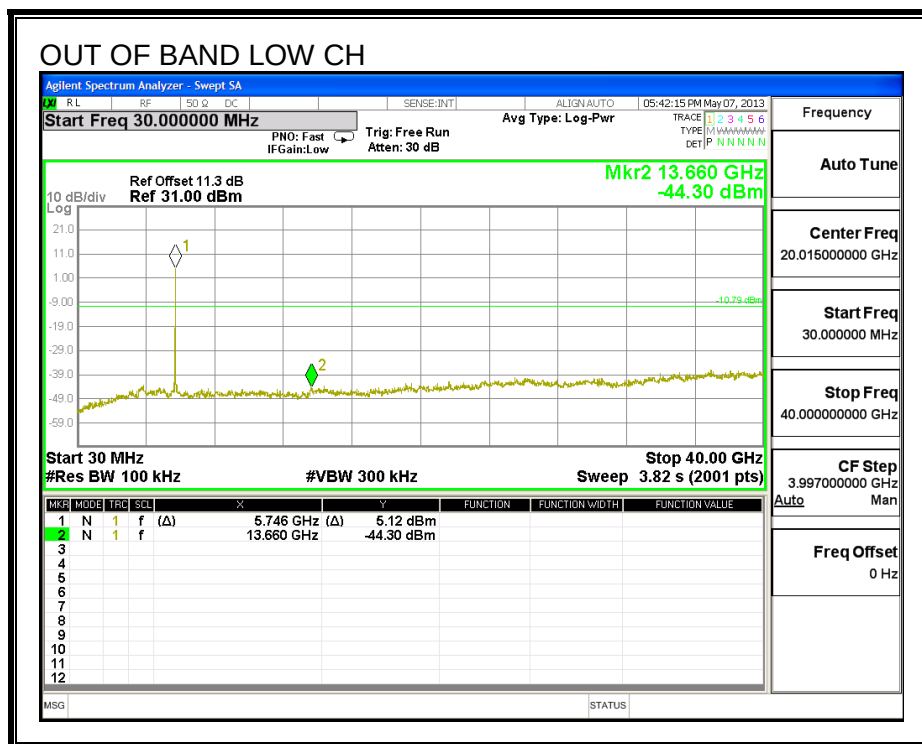
LOW CHANNEL BANDEDGE

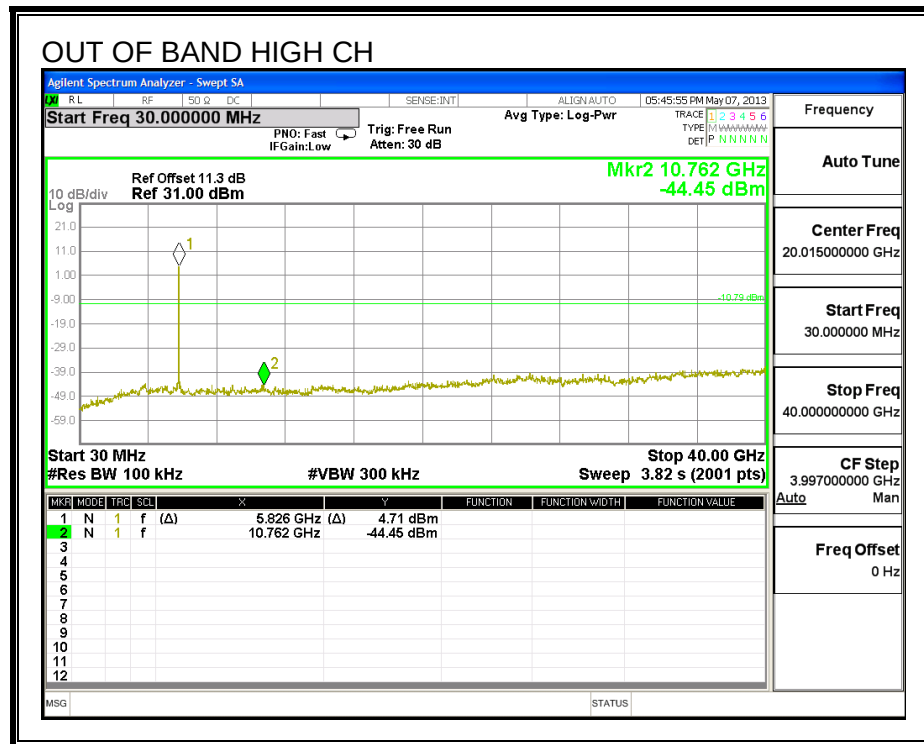


HIGH CHANNEL BANDEDGE



OUT-OF-BAND EMISSIONS

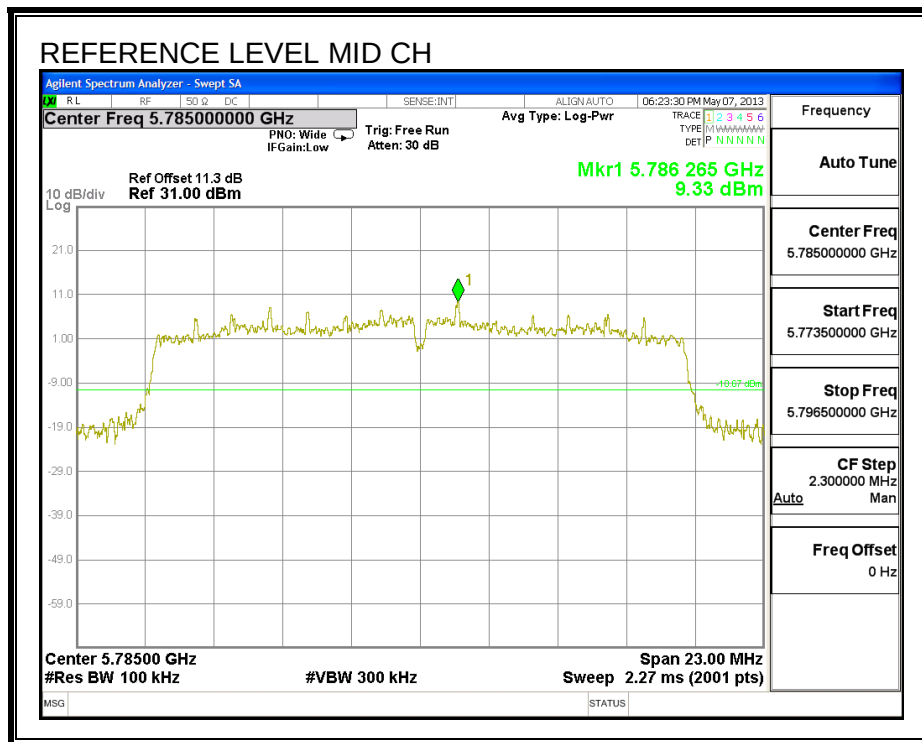




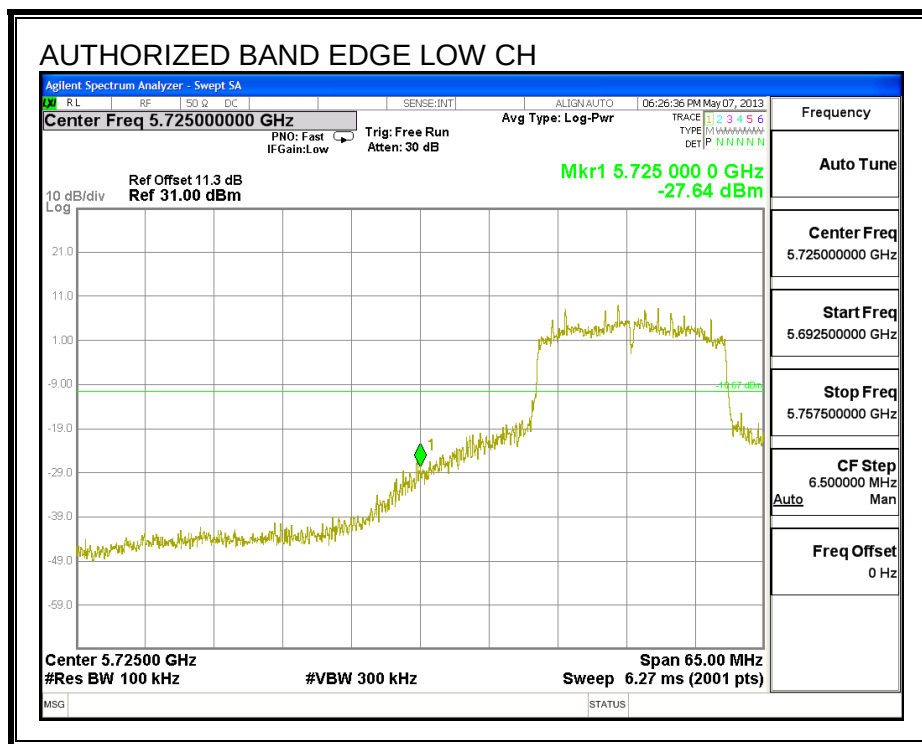
HT20

RESULTS

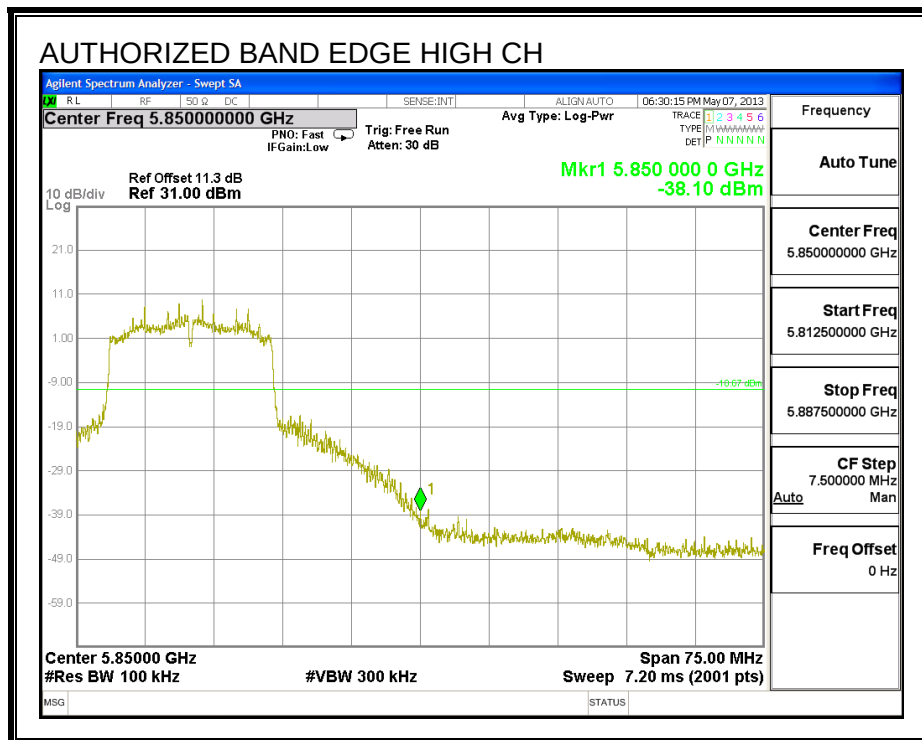
IN-BAND REFERENCE LEVEL



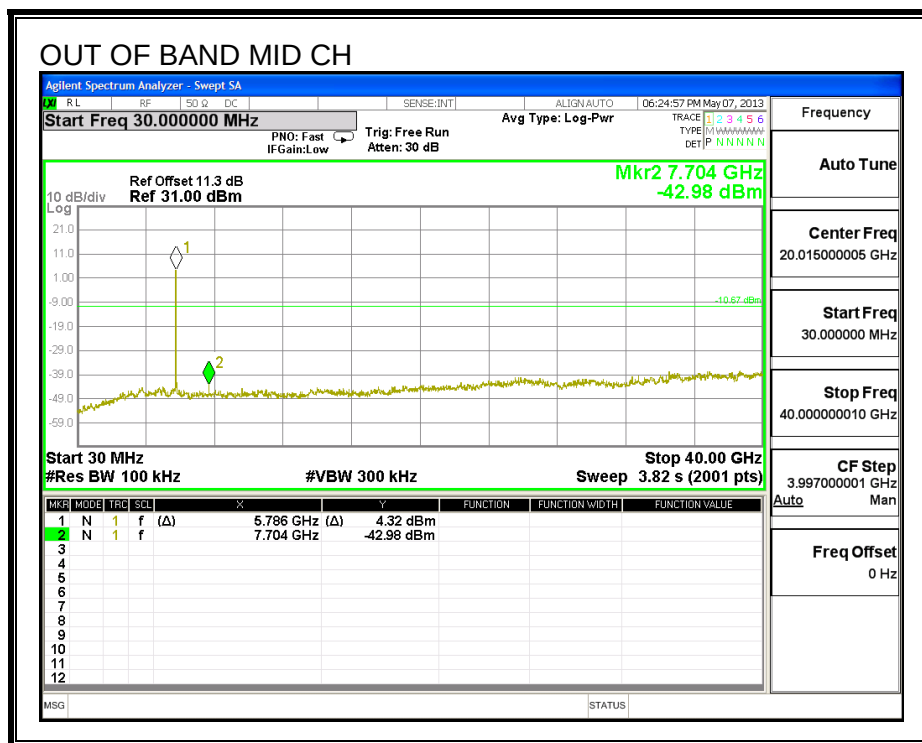
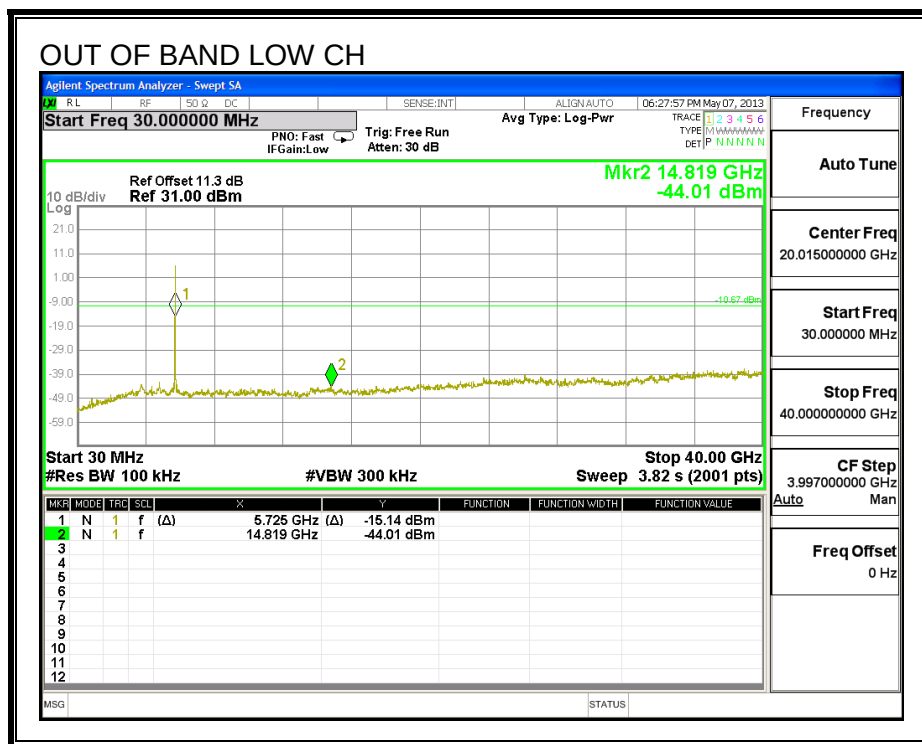
LOW CHANNEL BANDEDGE

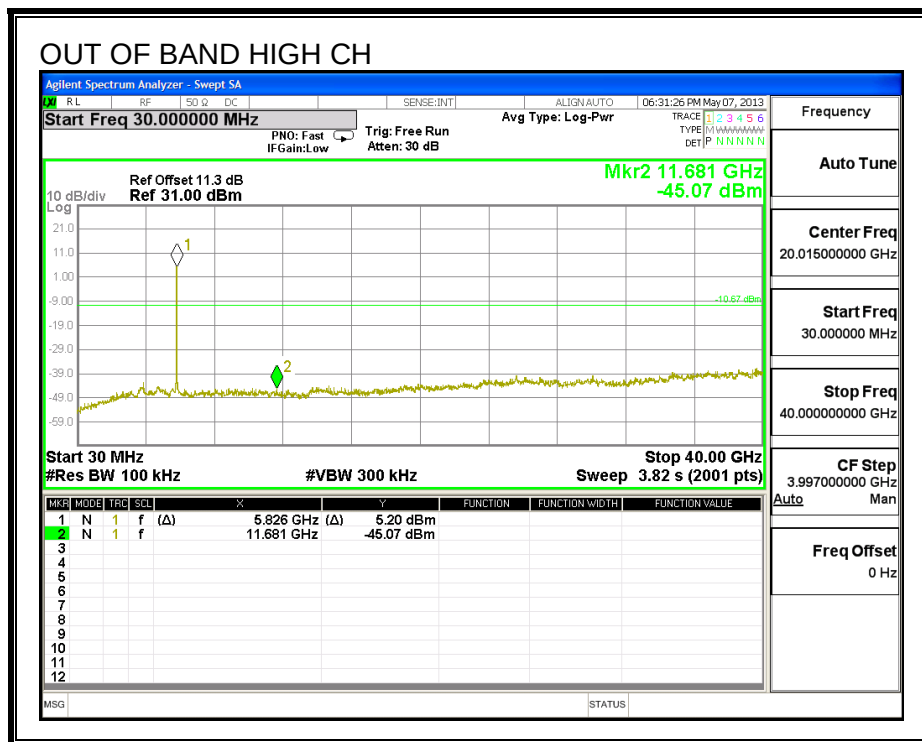


HIGH CHANNEL BANDEDGE



OUT-OF-BAND EMISSIONS

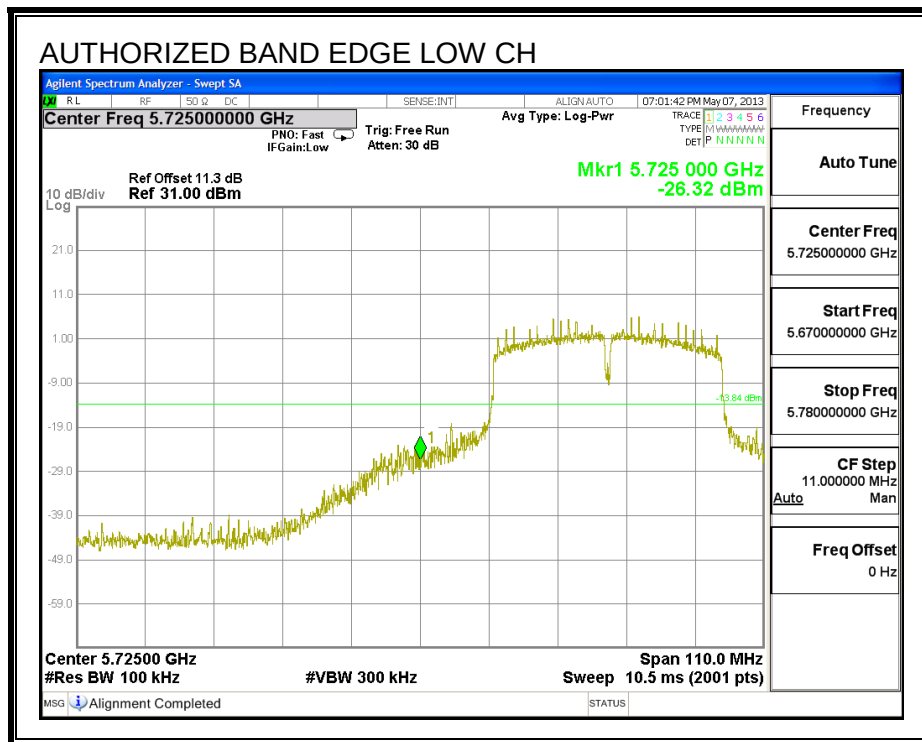




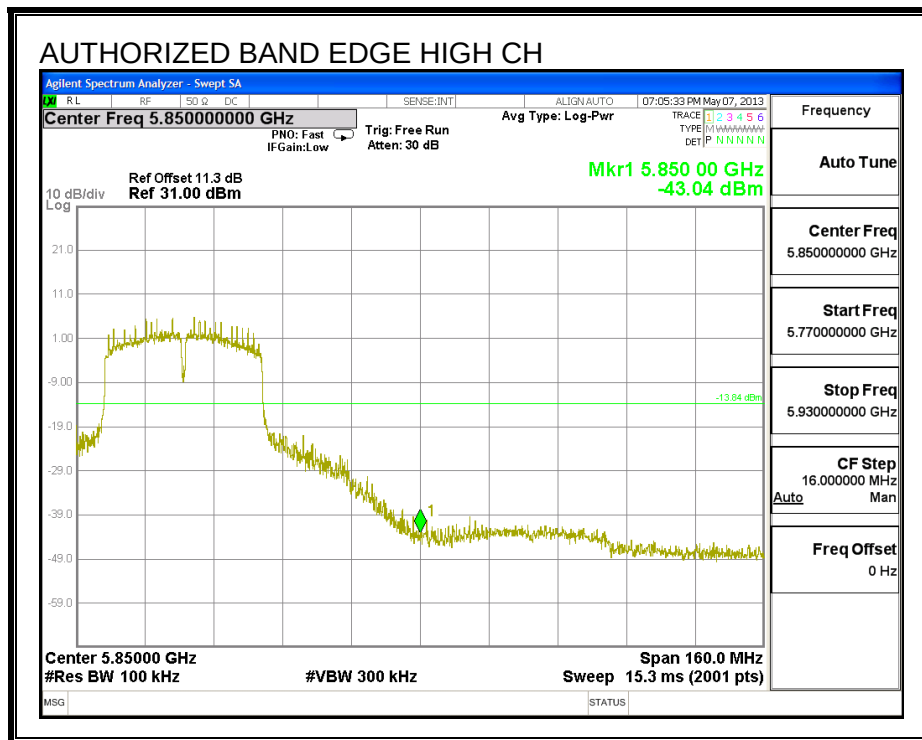
HT40

RESULTS

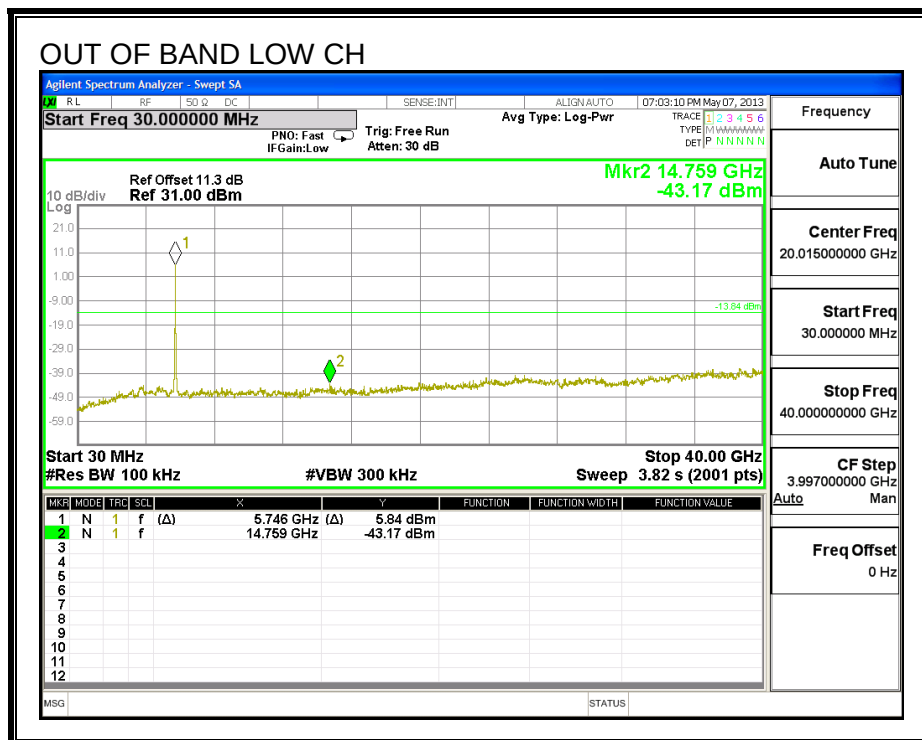
LOW CHANNEL BANDEDGE

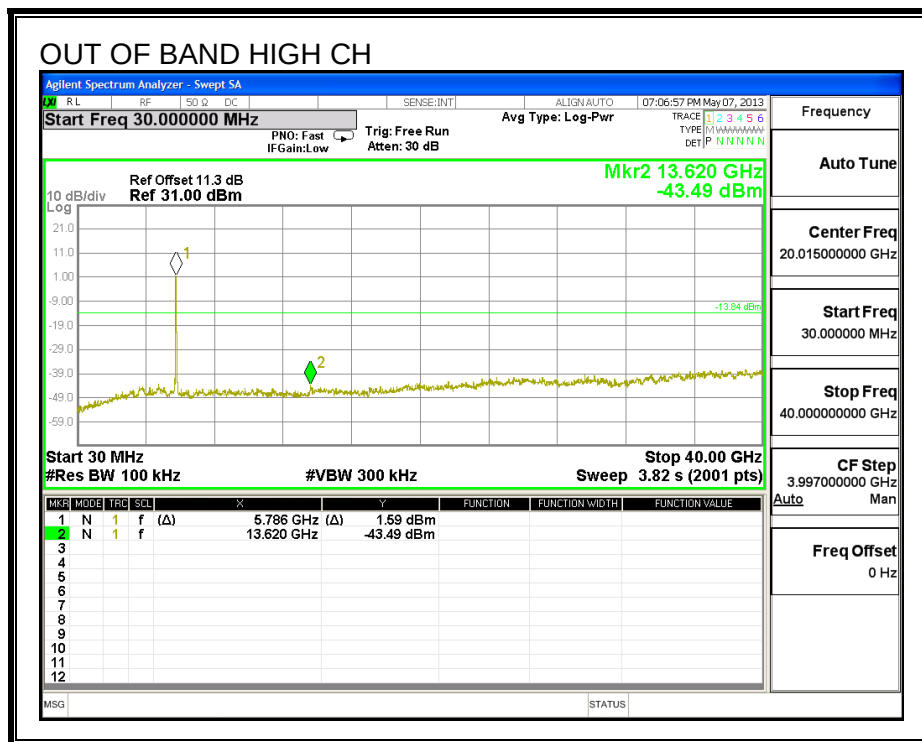


HIGH CHANNEL BANDEDGE



OUT-OF-BAND EMISSIONS





8. RADIATED TEST RESULTS

8.1. 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.

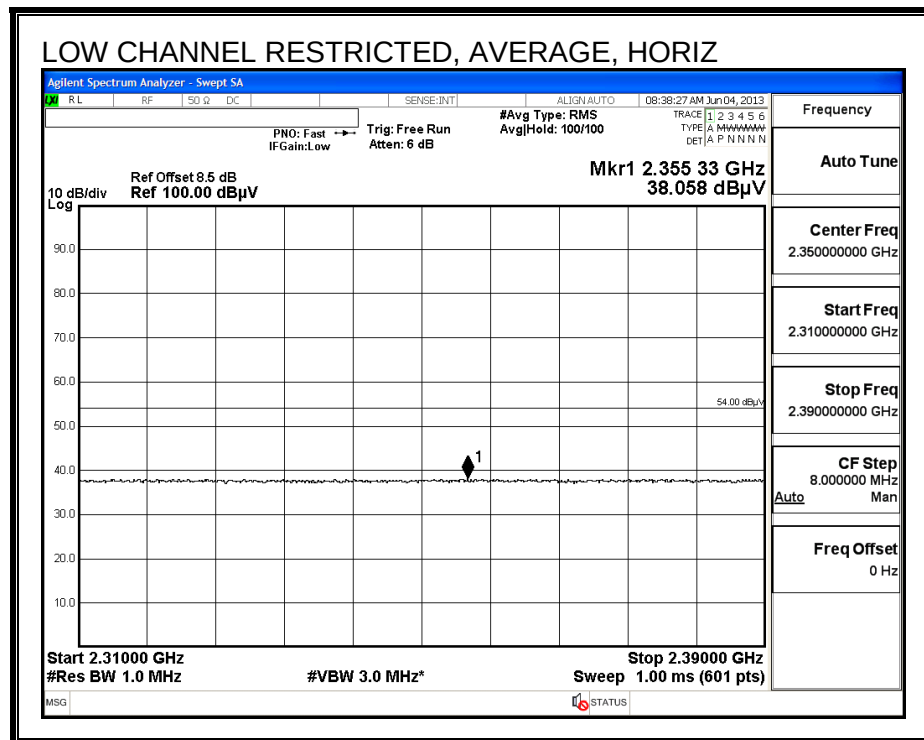
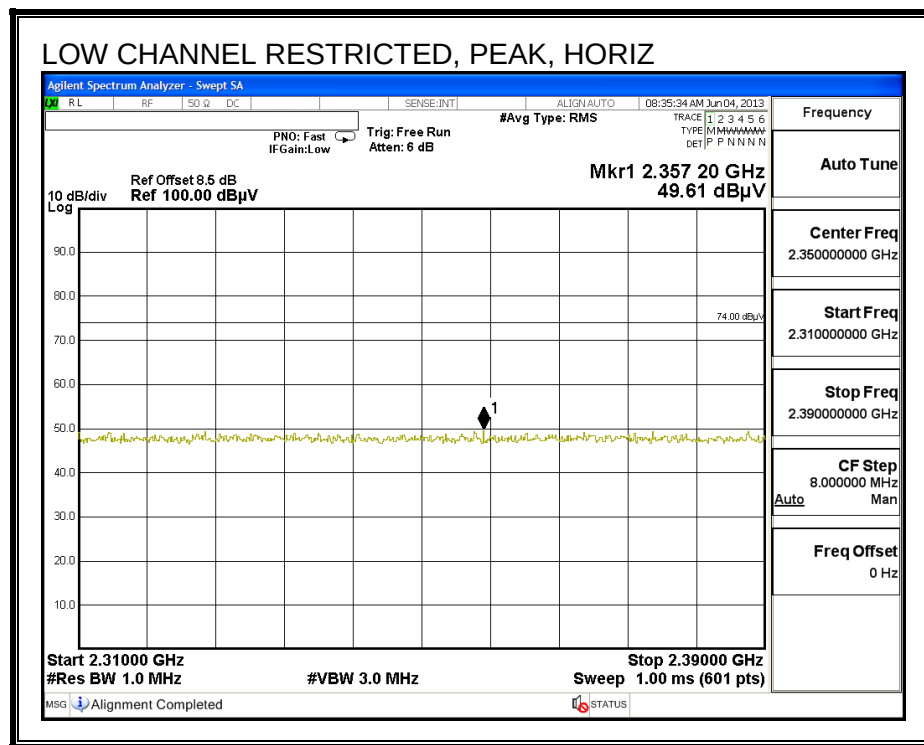
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

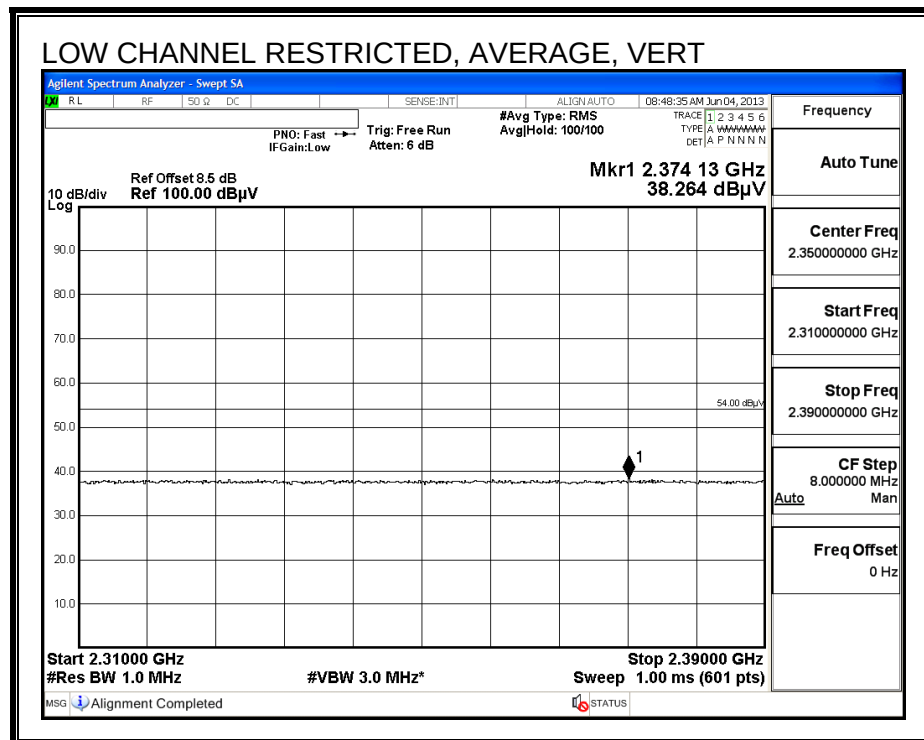
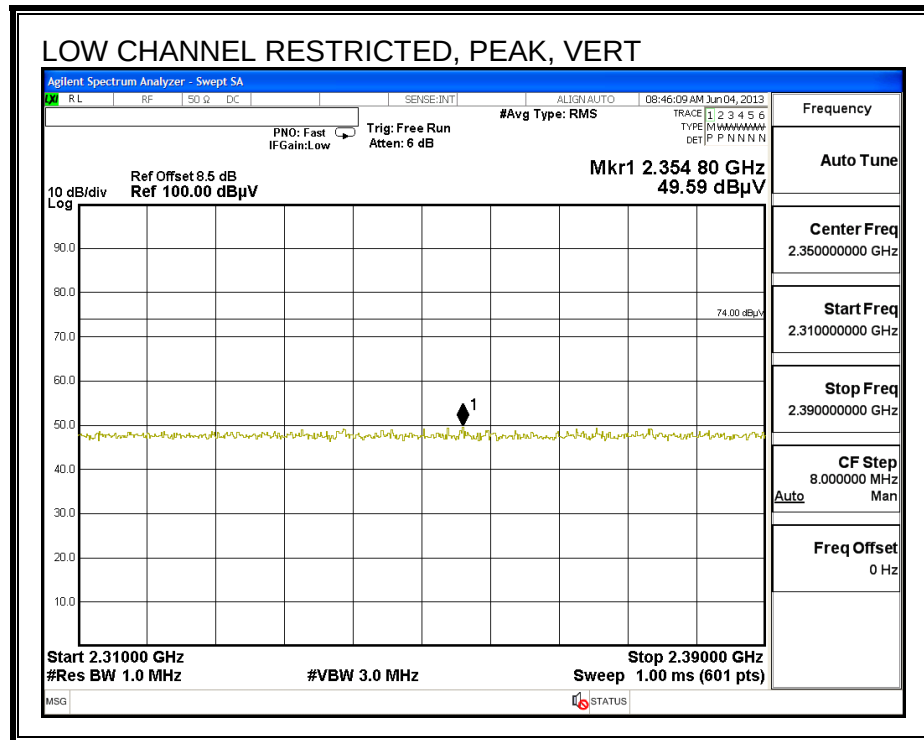
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.2. TRANSMITTER ABOVE 1 GHz

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

RESTRICTED BANDEDGE (LOW CHANNEL)





AUTHORIZED BANDEDGE (HIGH CHANNEL)

