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

CERTIFICATION TEST REPORT

FOR

Tablet with cellular GSM/GPRS/EGPRS/WCDMA/HSPA+/DC-HSDPA /CDMA 1xRTT /1x Advanced/EV-DO Rev 0, A, B/LTE/IEEE 802.11a/b/g/n (MIMO 2x2) and Bluetooth Radio

Model: A1490

FCC ID: BCGA1490
IC: 579C-A1490

REPORT NUMBER: 13U15668-5

ISSUE DATE: SEPTEMBER 17, 2013

Prepared for

APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

Prepared by

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	09/17/13	Initial Issue	T. Chan

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: Tablet with cellular GSM/GPRS/EGPRS/WCDMA/HSPA+/DC-HSDPA/CDMA1xRTT/1x Advanced/EV-DO Rev 0, A, B/LTE/IEEE 802.11a/b/g/n (MIMO 2x2) and Bluetooth radio

MODEL: A1490

SERIAL NUMBER: DLXL106FFMNK (Conducted); DLXL104WFMNF (Radiated)

DATE TESTED: JULY 19 – SEPTEMBER 16, 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 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 and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services 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:

Thu Chan
WiSE Operations Manager
UL Verification Services Inc.

Tested By:

Tom Chen
WiSE 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 C63.10-2009, 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.

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A	☐ Chamber D
☐ Chamber B	☒ Chamber E
☐ Chamber C	☒ Chamber F

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

The Apple iPad Model A1475 is a Tablet with cellular GSM/GPRS/EGPRS/WCDMA/HSPA+ DC-HSDPA/ CDMA 1xRTT/1x Advanced/EV-DO Rev 0, A, B/LTE/IEEE 802.11a/b/g/n (MIMO 2x2) and Bluetooth radio.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted peak output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2472	802.11b	19.76	94.62
2413 - 2472	802.11g	25.01	316.96
2414 - 2472	802.11n HT20 CDD 2TX	28.54	714.50
5745 - 5825	802.11a	22.89	194.54
5745 - 5825	802.11n HT20 CDD 2TX	25.49	354.00
5755 - 5795	802.11n HT40 SISO	23.06	202.30
5755 - 5795	802.11n HT40 CDD 2TX	26.02	399.94

List of test reduction and modes covering other modes:

Frequency Range (MHz)	Mode	Covered by
2.4 GHz band		
2412 - 2472	802.11g 2TX CDD	802.11n HT20 CDD 2TX
2412 - 2472	802.11n SISO	802.11g SISO
2412 - 2472	802.11n HT20 2TX STBC	802.11n HT20 CDD 2TX
2412 - 2472	802.11n HT20 2TX SDM	802.11n HT20 CDD 2TX
5.8 GHz band		
5745 - 5825	802.11a 2TX CDD	802.11n HT20 CDD 2TX
5745 - 5825	802.11n SISO	802.11a SISO
5745 - 5825	802.11n HT20 2TX STBC	802.11n HT20 CDD 2TX
5745 - 5825	802.11n HT20 2TX SDM	802.11n HT20 CDD 2TX
5755 - 5795	802.11n HT40 2TX STBC	802.11n HT40 CDD 2TX
5755 - 5795	802.11n HT40 2TX SDM	802.11n HT40 CDD 2TX

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Gain		Uncorrelated Gain
	Tx1	Tx2	
2.4	0.81	-1.86	-0.32
5.2	-0.02	3.06	1.79
5.3	0.75	3.25	2.18
5.5	2.43	4.29	3.46
5.8	2.68	3.76	3.25

5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was Broadcom WL Tool Version 6.25.86.

5.5. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated in three orthogonal orientations X, Y, Z, with AC Adapter and Headset, it was determined that X orientation without AC Adapter and Headset was the worst-case orientation for 2.4GHz band, and Z orientation was the worst-case orientation for 5.8 GHz band; therefore, all final radiated testing was performed with the EUT in X orientation for 2.4GHz band, and Z orientation for 5.8 GHz band.

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

802.11b mode: 1 Mbps
802.11g mode: 6 Mbps
802.11a mode: 6 Mbps
802.11n HT20mode: MCS0
802.11n HT40mode: MCS0

Worst-case mode and channel used for 30-1000 MHz radiated and power line conducted emissions was including headset, AC charger and the mode and channel with the highest output power.

For all modes with single chain, chain 0 was selected per the software provided by the client. Based on the client a preliminary investigation was performed on the two chains and chain 0 was found to be worst-case for the antenna port. The radiated emissions test was based on the port with the higher antenna gain.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/DC Adapter	Apple	A1357	A/12981EA	DoC
Earphone	Apple	NA	NA	NA

I/O CABLES (CONDUCTED TEST)

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

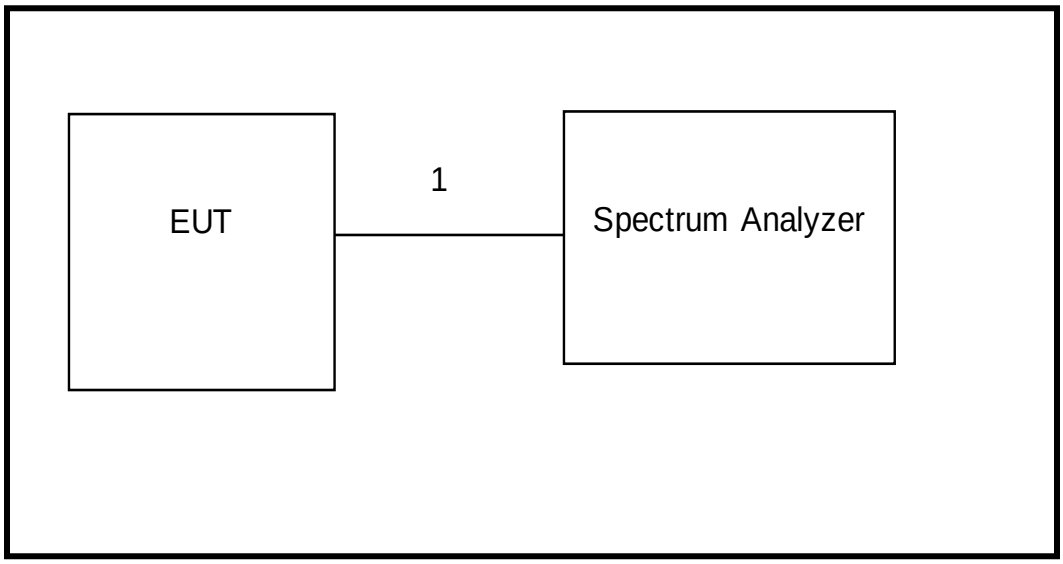
I/O CABLES (RADIATED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Audio	1	Jack	Un-Shielded	0.5m	NA

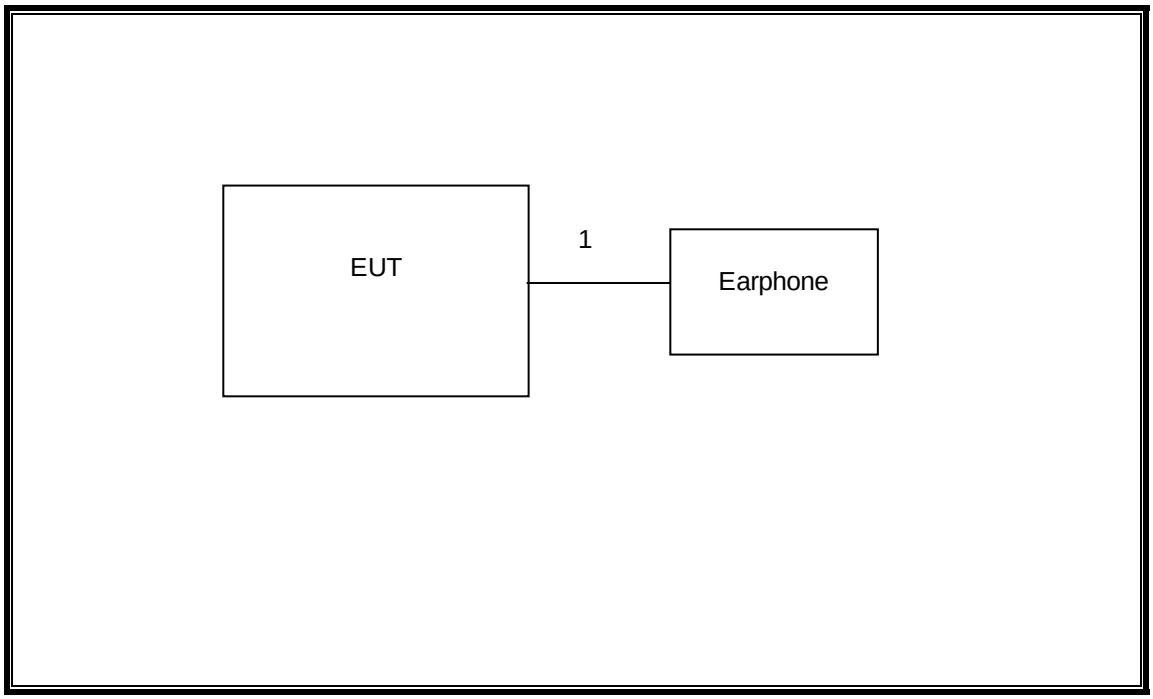
I/O CABLES (AC POWER CONDUCTED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	US115	Un-Shielded	2m	NA
2	DC	1	USB	Un-Shielded	2m	NA
3	Audio	1	Jack	Un-Shielded	0.5m	NA

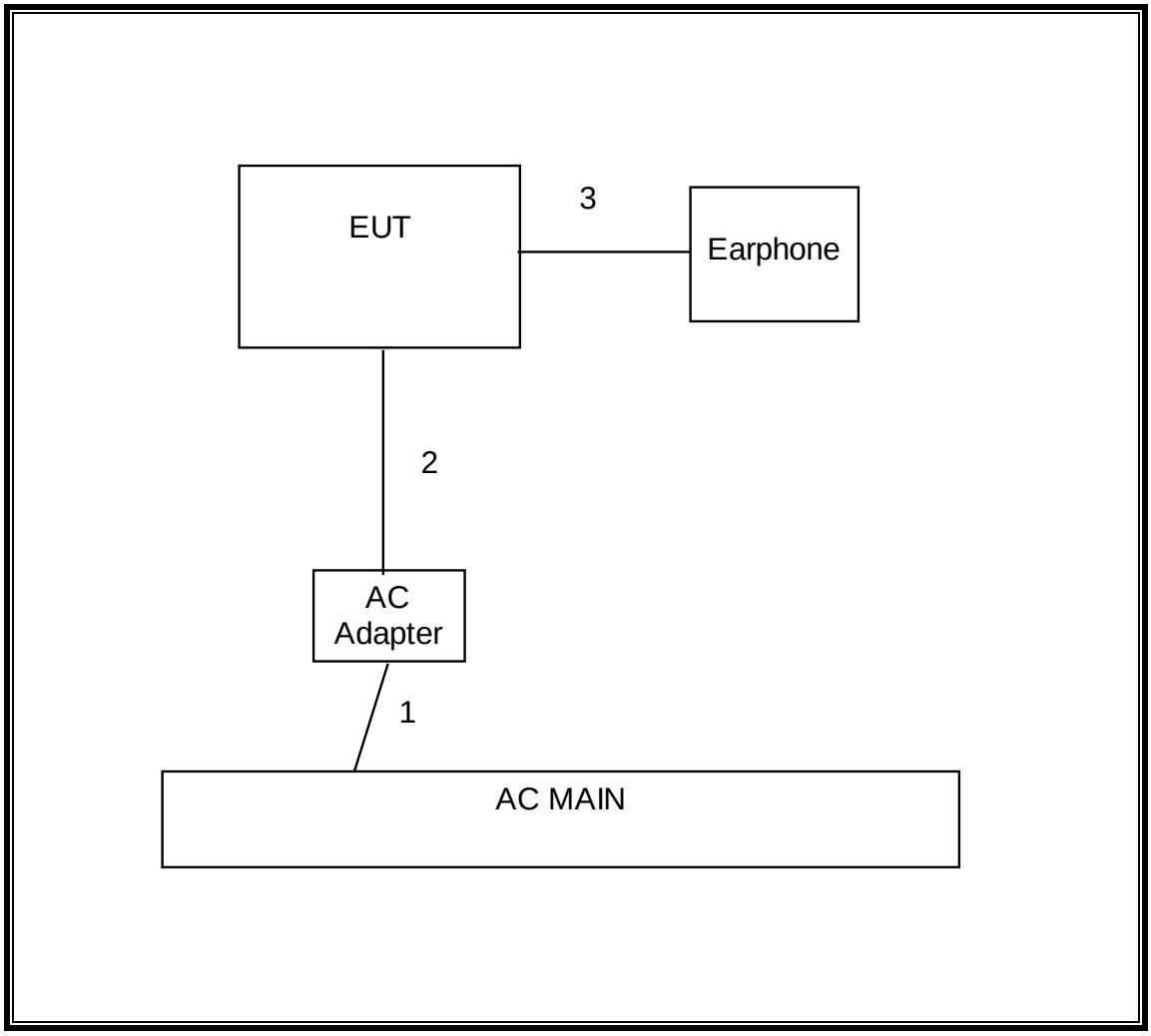
SETUP DIAGRAM FOR CONDUCTED TESTS



SETUP DIAGRAM FOR RADIATED TESTS



SETUP DIAGRAM FOR BELOW 1GHZ & 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**
Horn Antenna 1-18GHz	ETS Lindgren	3117	F00131	02/19/14
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	01/28/14
Antenna, Horn, 26.5 GHz	ARA	SWH-28	C01015	05/06/14
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	F00027	03/07/14
Peak / Average Power Sensor	Agilent / HP	E9323A	F00163	04/03/14
P-Series single channel Power Meter	Agilent / HP	N1911A	F00164	04/03/14
Spectrum Analyzer, 3Hz-44GHz	Agilent	N9030A	F00127	02/22/14
Spectrum Analyzer, 3Hz-44GHz	Agilent	E4446A	C01012	10/21/13
PreApmplifier, 1-26.5GHz	Agilent	8449B	C01052	10/22/13
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	F00194	05/14/14
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/15/14
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	08/20/14

7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 789033 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)	1/T Minimum VBW (kHz)
2.4 GHz						
802.11b	12.44	12.47	1.000	100.0%	0.00	0.010
802.11g	2.064	2.094	0.986	98.6%	0.00	0.010
802.11n HT20	1.91	1.94	0.986	98.6%	0.00	0.010
5.8 GHz						
802.11a	2.060	2.076	0.992	99.2%	0.00	0.010
802.11n HT20 CDD	1.904	1.940	0.981	98.1%	0.00	0.010
802.11n HT40 SISO	0.924	0.942	0.981	98.1%	0.00	0.010
802.11n HT40 CDD	0.928	0.946	0.981	98.1%	0.00	0.010

7.2. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01.

Output Power: KDB 558074 D01.

Power Spectral Density: KDB 558074 D01.

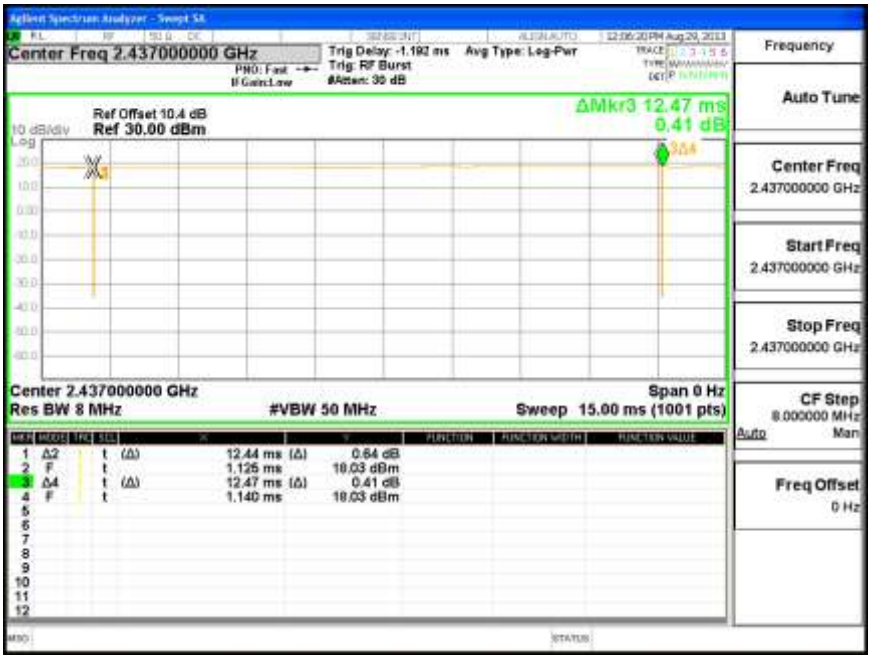
Out-of-band emissions in non-restricted bands: KDB 558074 D01.

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

7.2.1. DUTY CYCLE PLOTS

2.4 GHz Band

DUTY CYCLE 802.11b MODE

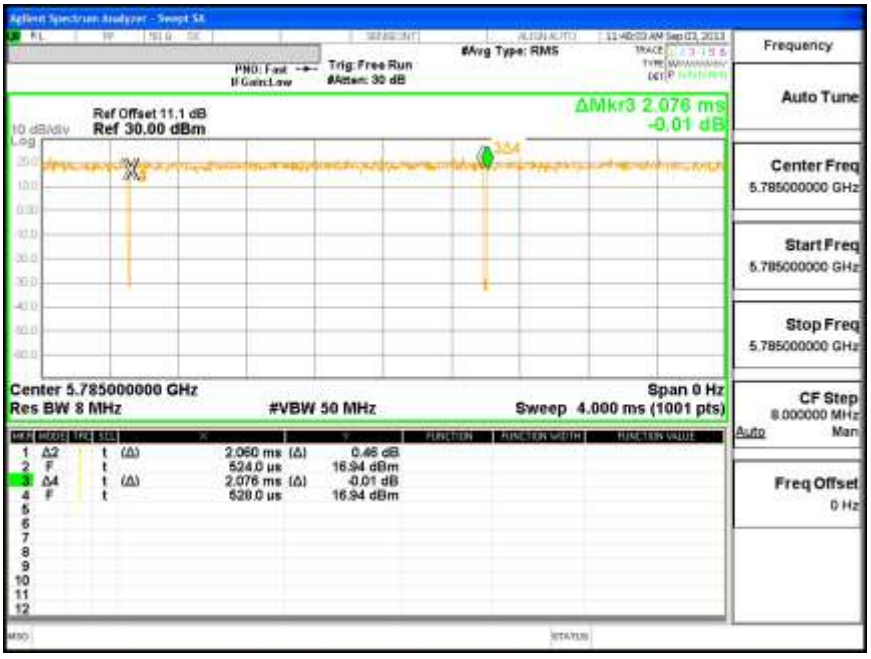


DUTY CYCLE 802.11g MODE

DUTY CYCLE 802.11n HT20 MODE

5.8GHz Band

DUTY CYCLE 802.11a MODE



DUTY CYCLE 802.11n HT20 CDD MODE

DUTY CYCLE 802.11n HT40 SISO MODE

DUTY CYCLE 802.11n HT40 CDD 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.

TEST PROCEDURE

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

RESULTS

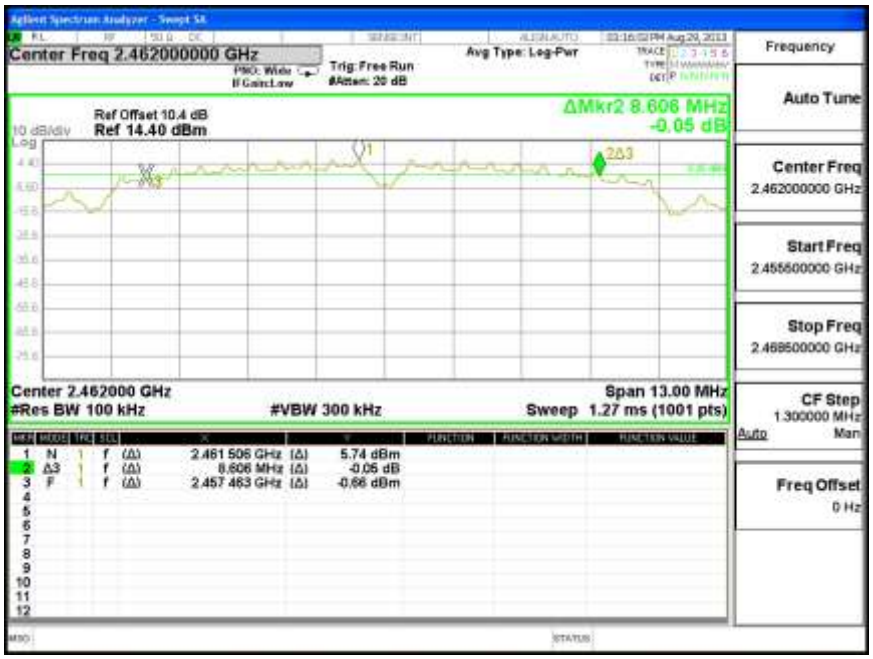
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
1	2412	9.056	0.5
6	2437	9.069	0.5
11	2462	8.606	0.5
12	2467	8.606	0.5
13	2472	8.606	0.5

6 dB BANDWIDTH

6 dB BANDWIDTH CH 1

6 dB BANDWIDTH CH 6

6 dB BANDWIDTH CH 11



6 dB BANDWIDTH CH 12

6 dB BANDWIDTH CH 13

8.1.2. 99% BANDWIDTH

LIMITS

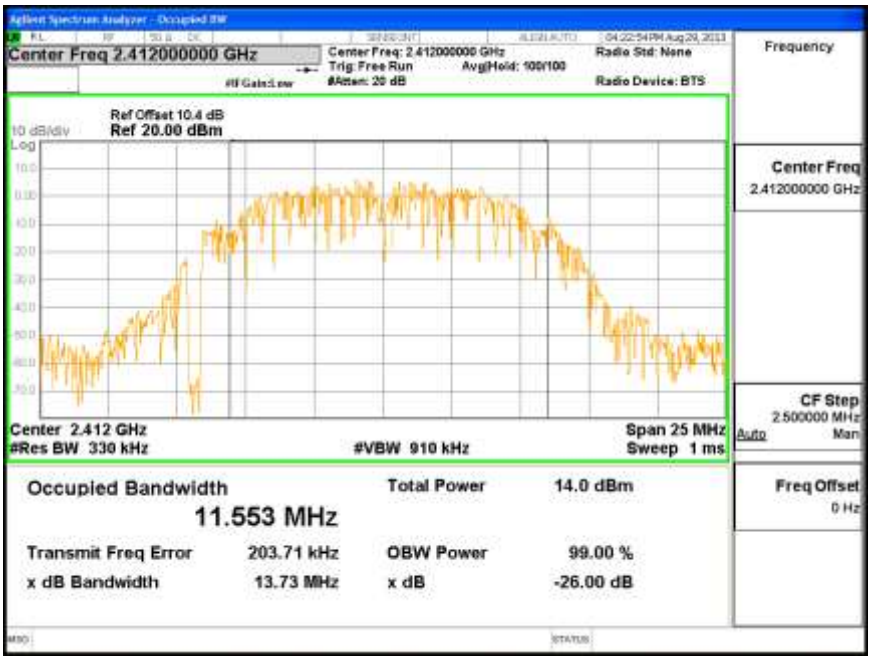
None; for reporting purposes only.

RESULTS

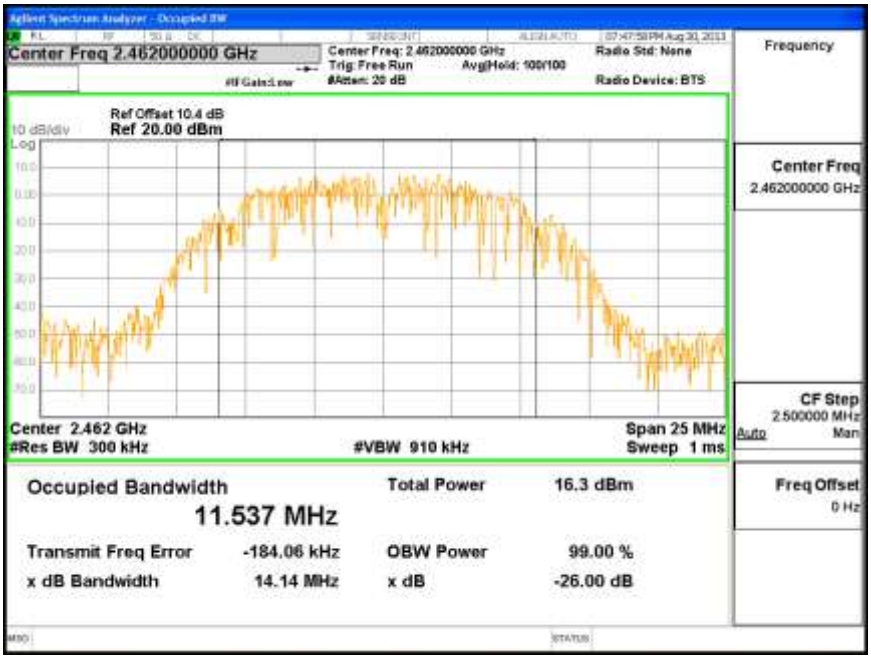
Channel	Frequency (MHz)	99% Bandwidth (MHz)
1	2412	11.5530
6	2437	11.5370
11	2462	11.5700
12	2467	11.4150
13	2472	11.4350

99% BANDWIDTH

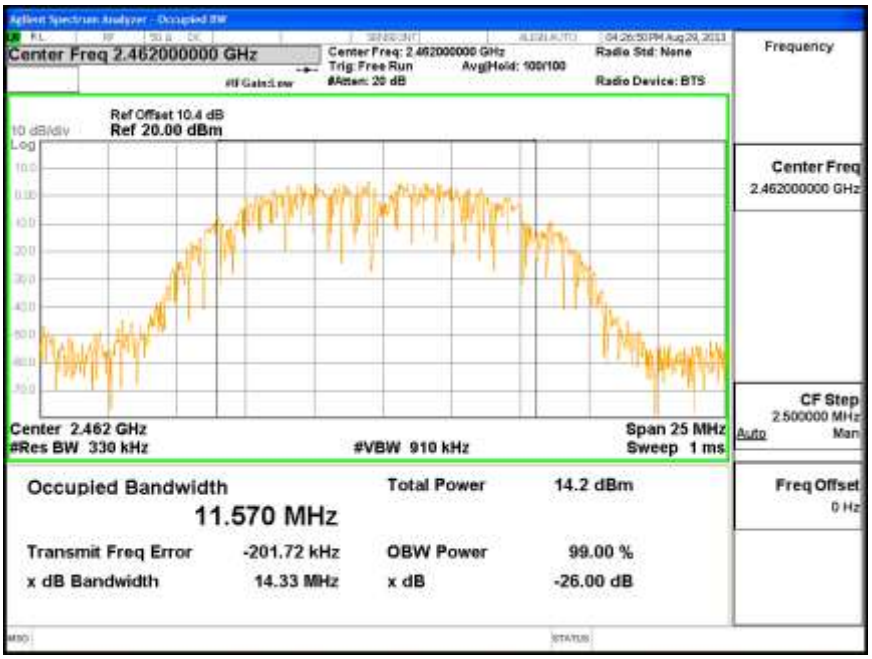
99% BANDWIDTH CH 1



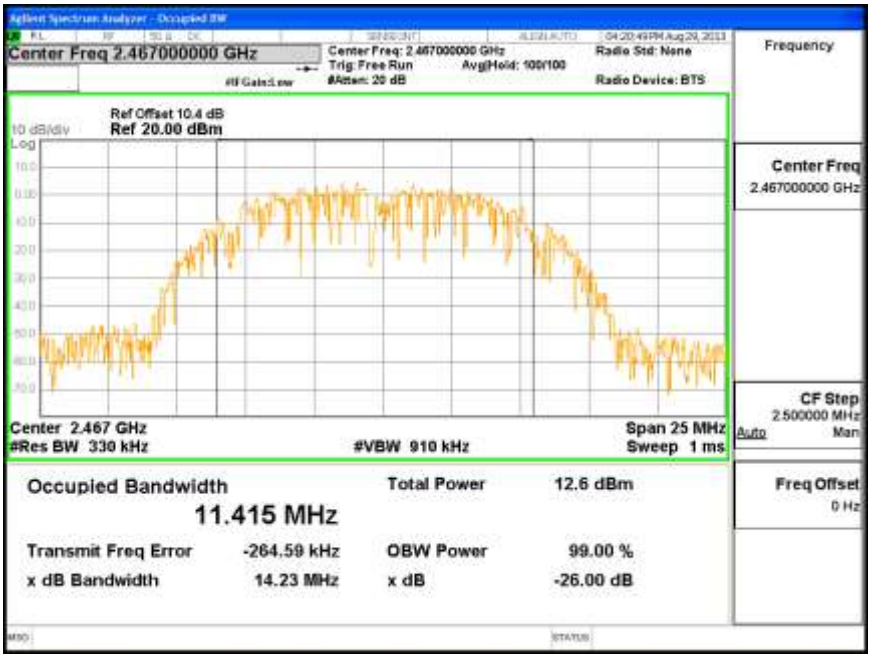
99% BANDWIDTH CH 6



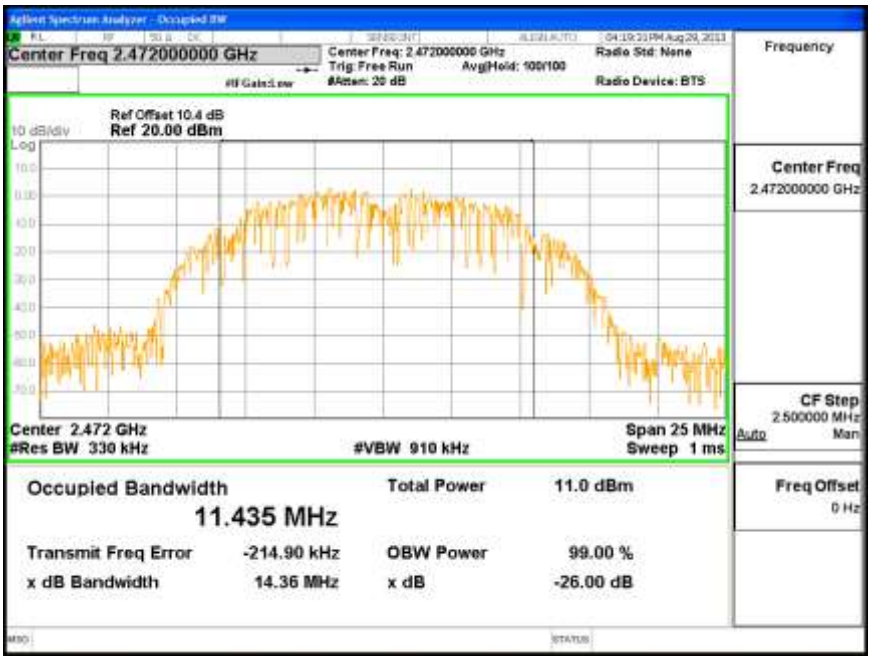
99% BANDWIDTH CH 11



99% BANDWIDTH CH 12



99% BANDWIDTH CH 13



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 10.4 dB (including 10 dB pad and 0.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
1	2412	16.50
6	2437	16.47
11	2462	16.46
12	2467	15.00
13	2472	13.98

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

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

RESULTS

Limits

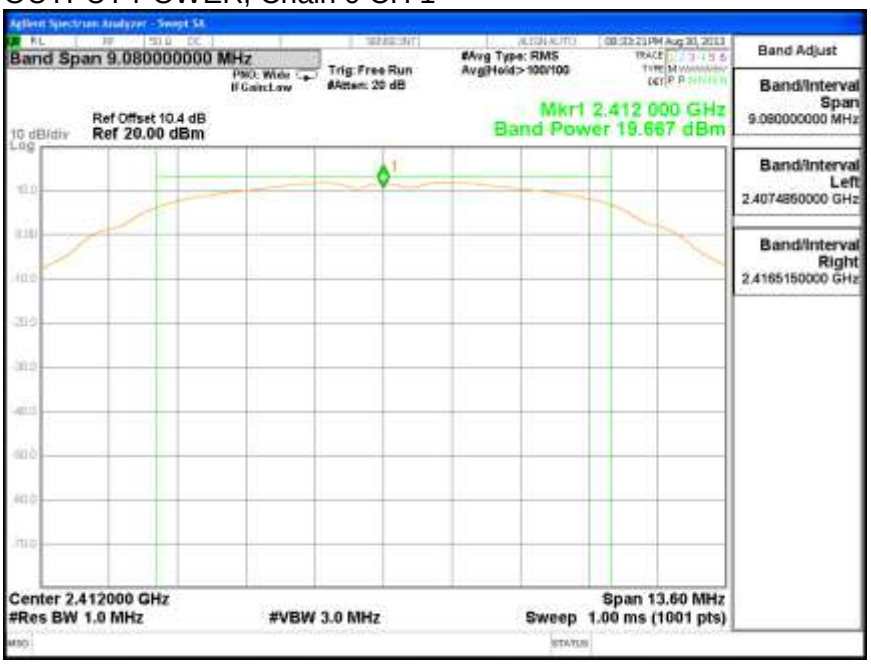
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
1	2412	0.81	30.00	30	36	30.00
6	2437	0.81	30.00	30	36	30.00
11	2462	0.81	30.00	30	36	30.00
12	2467	0.81	30.00	30	36	30.00
13	2472	0.81	30.00	30	36	30.00

Results

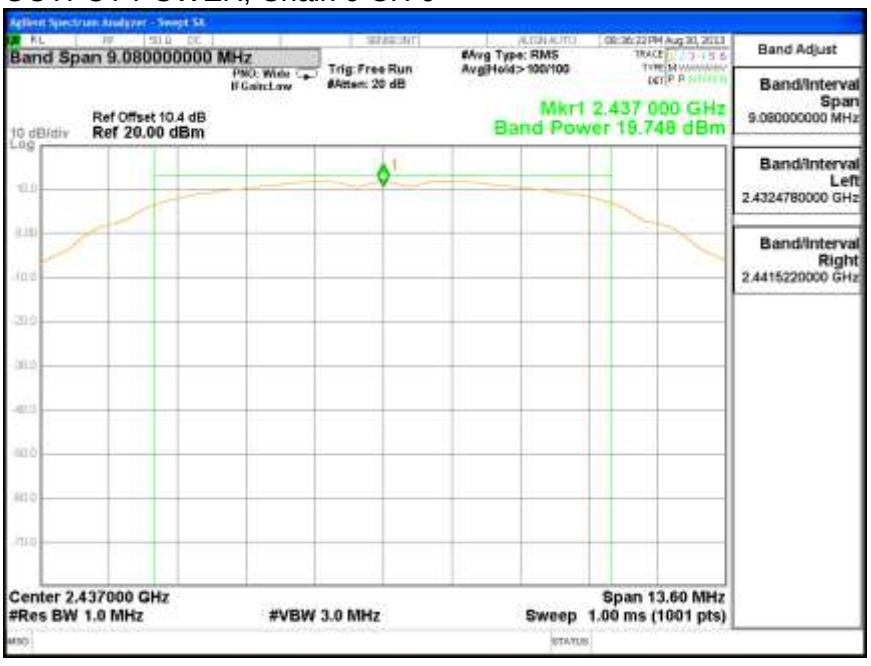
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
1	2412	19.67	19.67	30.00	-10.33
6	2437	19.75	19.75	30.00	-10.25
11	2462	19.76	19.76	30.00	-10.24
12	2467	18.23	18.23	30.00	-11.77
13	2472	17.34	17.34	30.00	-12.66

OUTPUT POWER, Chain 0

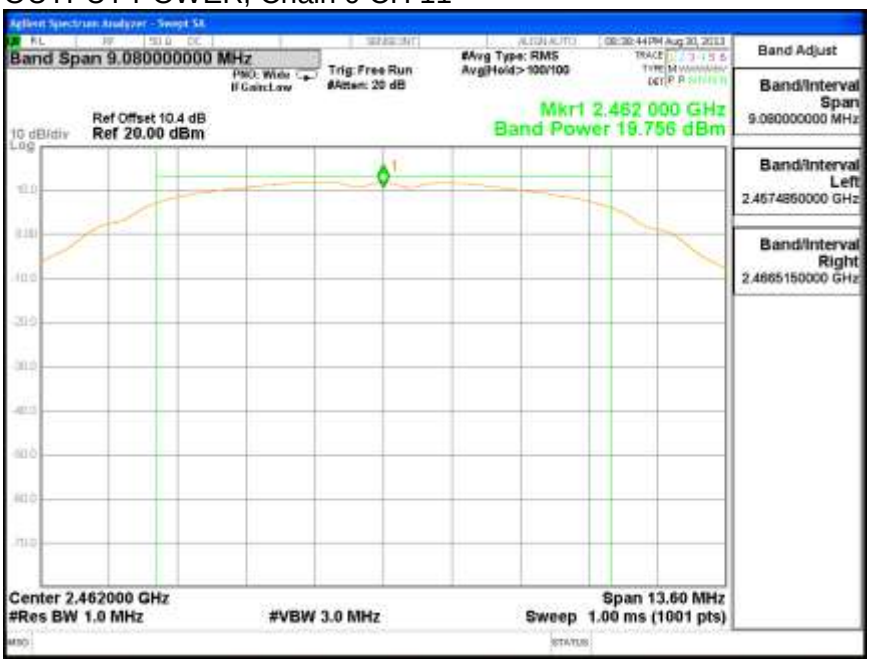
OUTPUT POWER, Chain 0 CH 1



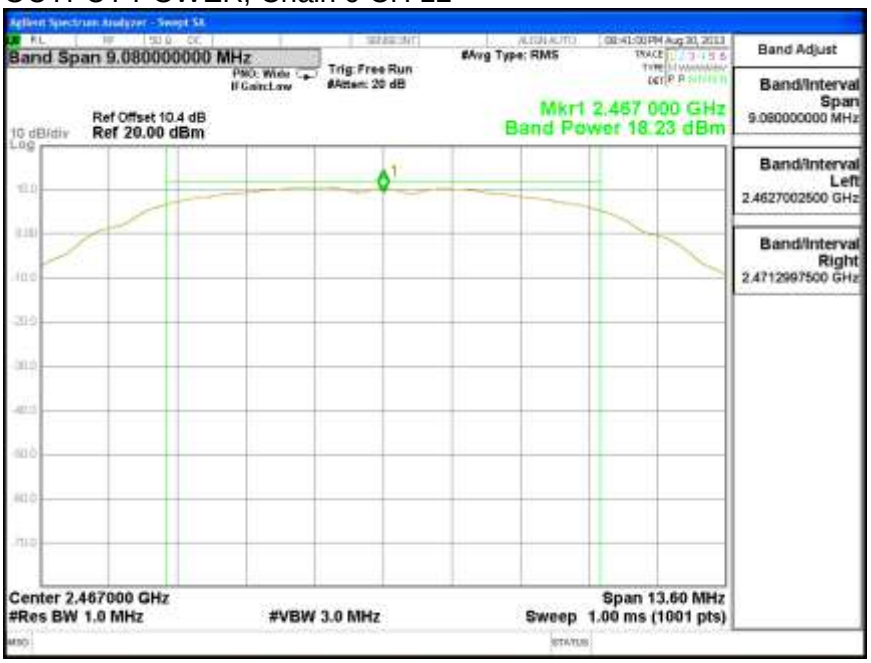
OUTPUT POWER, Chain 0 CH 6



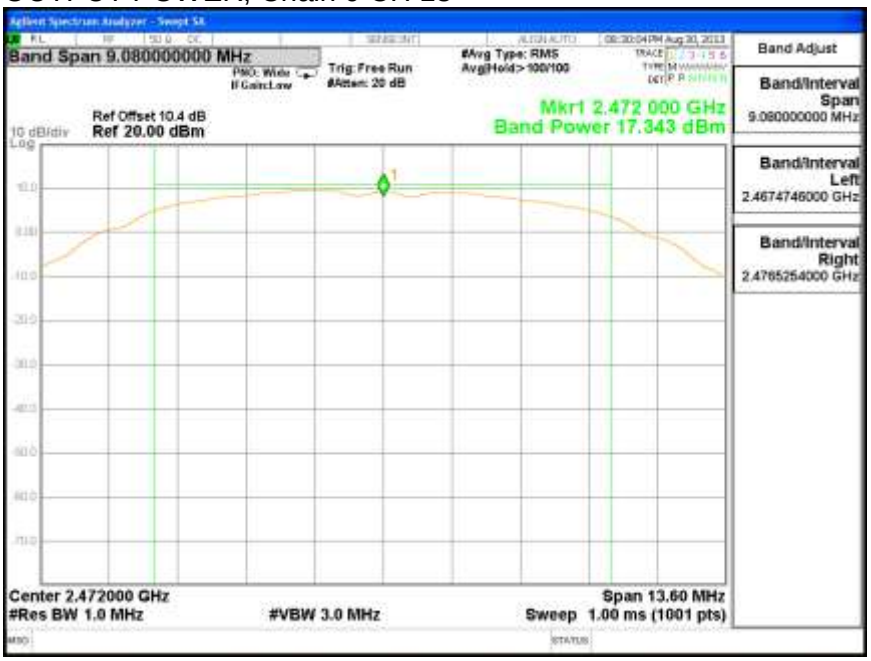
OUTPUT POWER, Chain 0 CH 11



OUTPUT POWER, Chain 0 CH 12



OUTPUT POWER, Chain 0 CH 13



8.1.5. 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.

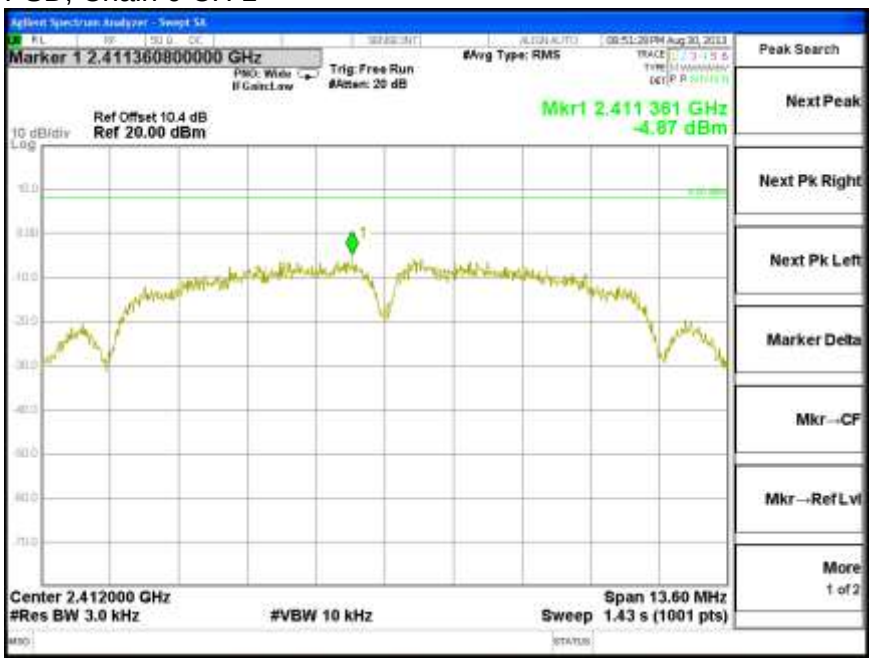
RESULTS

PSD Results

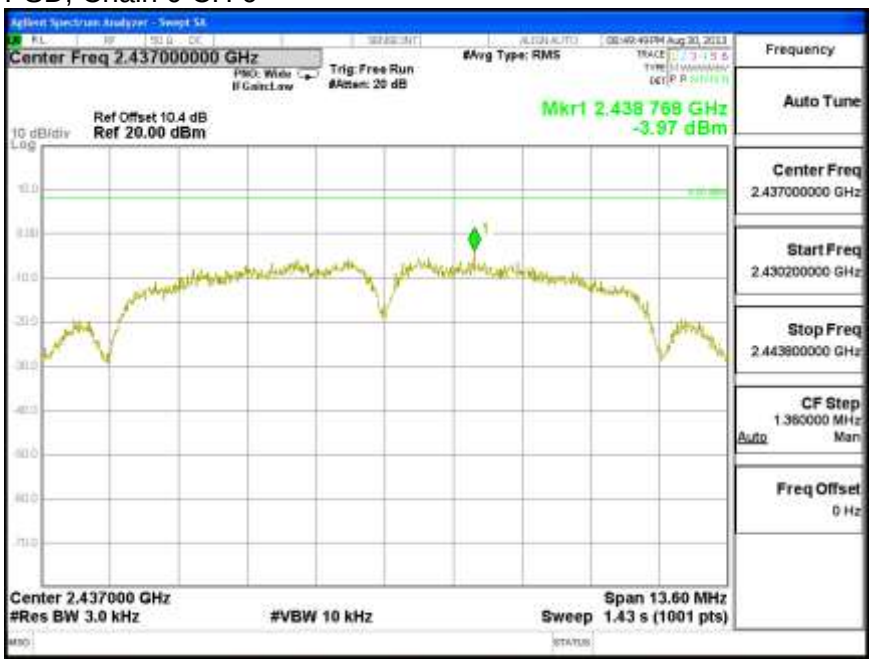
Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Limit (dBm)	Margin (dB)
1	2412	-4.87	8.0	-12.9
6	2437	-3.97	8.0	-12.0
11	2462	-5.48	8.0	-13.5
12	2467	-5.45	8.0	-13.5
13	2472	-7.59	8.0	-15.6

PSD, Chain 0

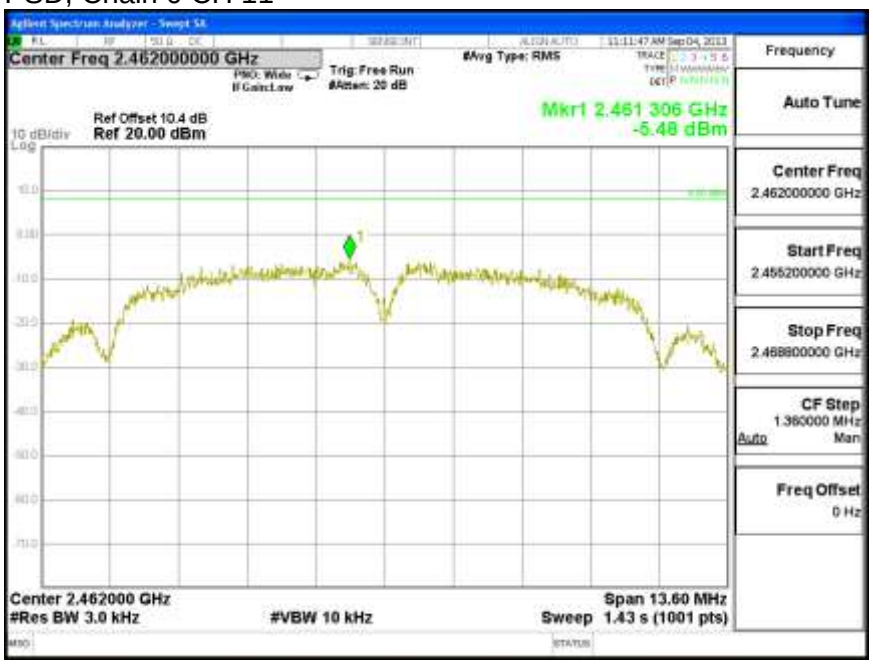
PSD, Chain 0 CH 1



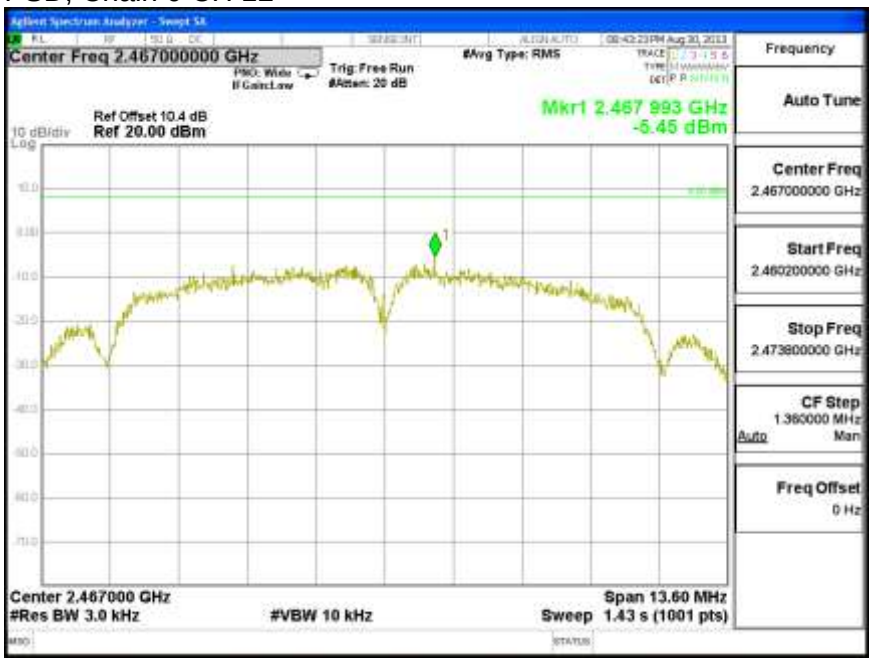
PSD, Chain 0 CH 6



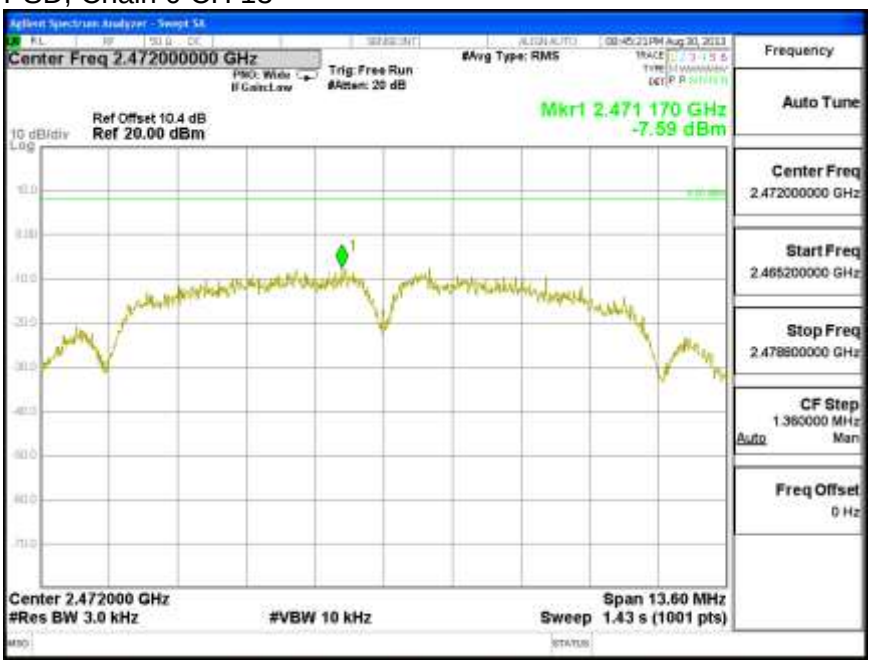
PSD, Chain 0 CH 11



PSD, Chain 0 CH 12



PSD, Chain 0 CH 13



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.

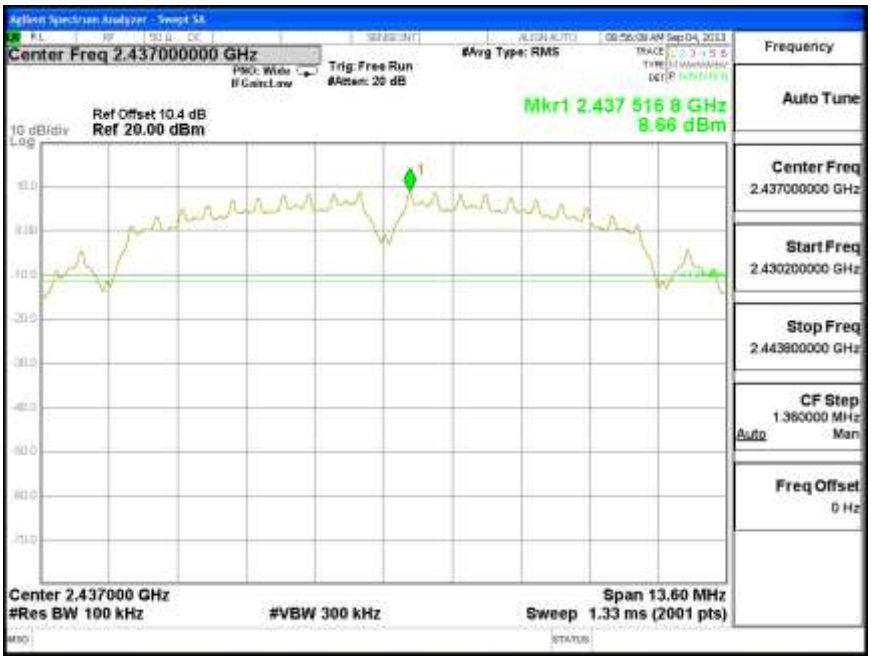
TEST PROCEDURE

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.

RESULTS

IN-BAND REFERENCE LEVEL

REFERENCE LEVEL CH 6

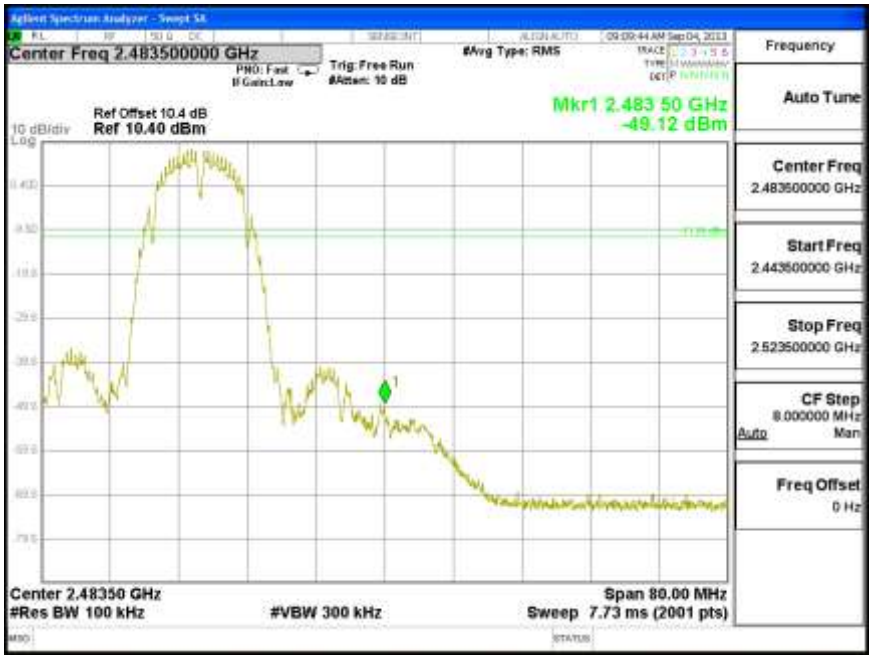


LOW CHANNEL BANDEDGE

AUTHORIZED BAND EDGE CH 1

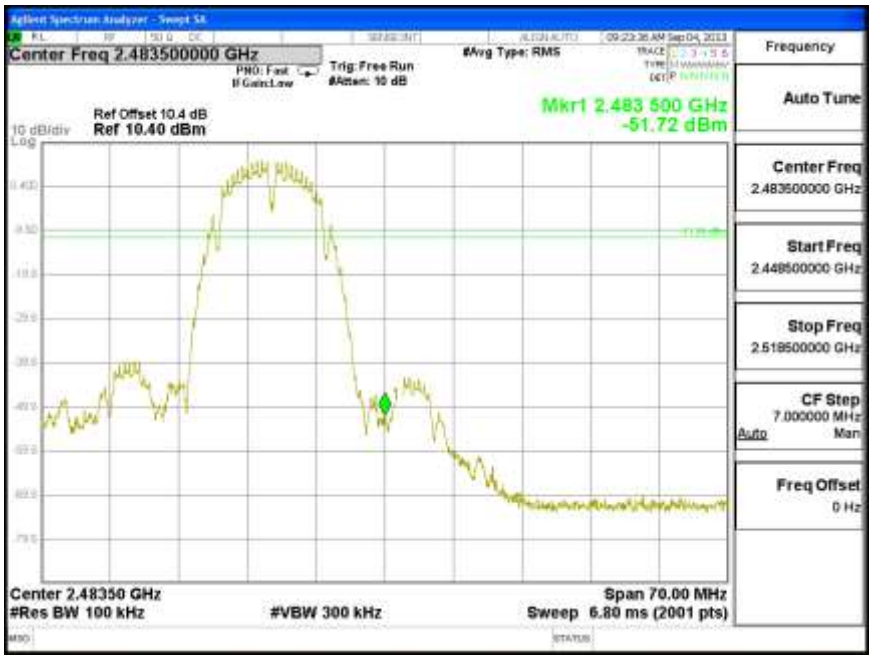
HIGH CHANNEL BANDEDGE

AUTHORIZED BAND EDGE CH 11



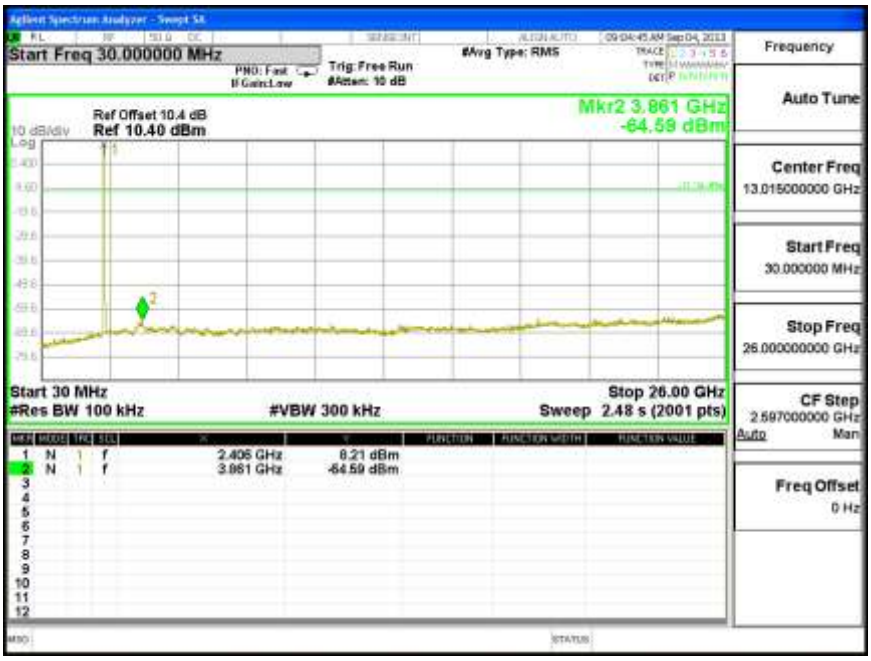
AUTHORIZED BAND EDGE CH 12

AUTHORIZED BAND EDGE CH 13



OUT-OF-BAND EMISSIONS

OUT OF BAND CH 1



OUT OF BAND CH 6

OUT OF BAND CH 11

OUT OF BAND CH 12

OUT OF BAND CH 13

8.2. 802.11g MODE IN THE 2.4 GHz BAND

8.2.1. 6 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

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
1	2412	15.151	0.5
6	2437	15.151	0.5
11	2462	15.463	0.5
12	2467	15.463	0.5
13	2472	15.440	0.5

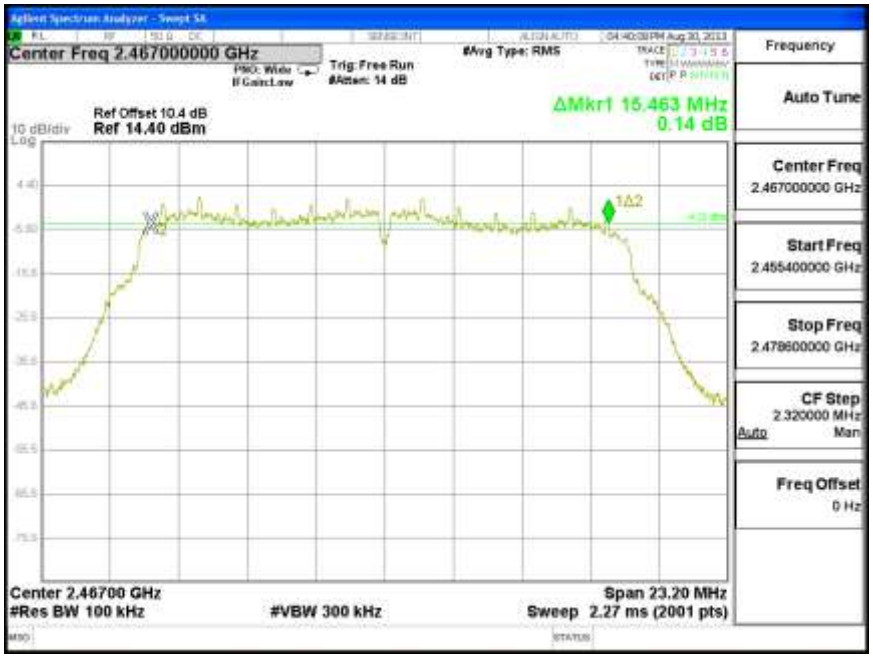
6 dB BANDWIDTH

6 dB BANDWIDTH CH 1

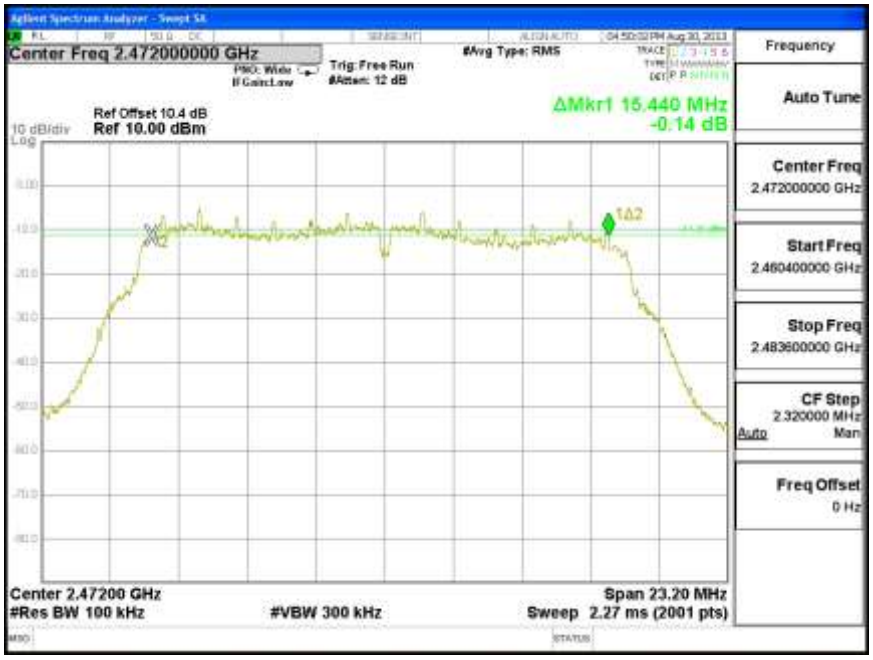
6 dB BANDWIDTH CH 6

6 dB BANDWIDTH CH 11

6 dB BANDWIDTH CH 12



6 dB BANDWIDTH CH 13



8.2.2. 99% BANDWIDTH

LIMITS

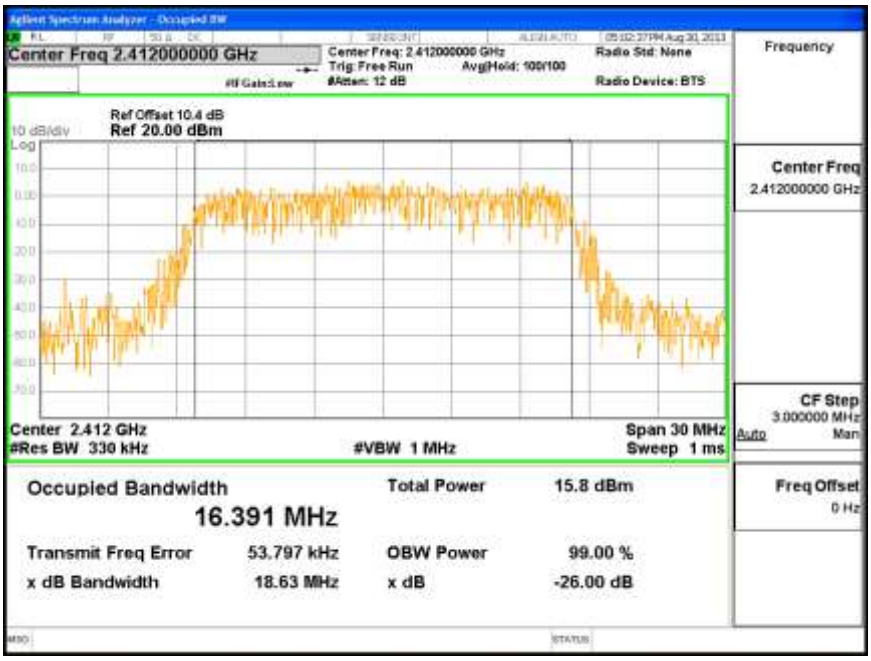
None; for reporting purposes only.

RESULTS

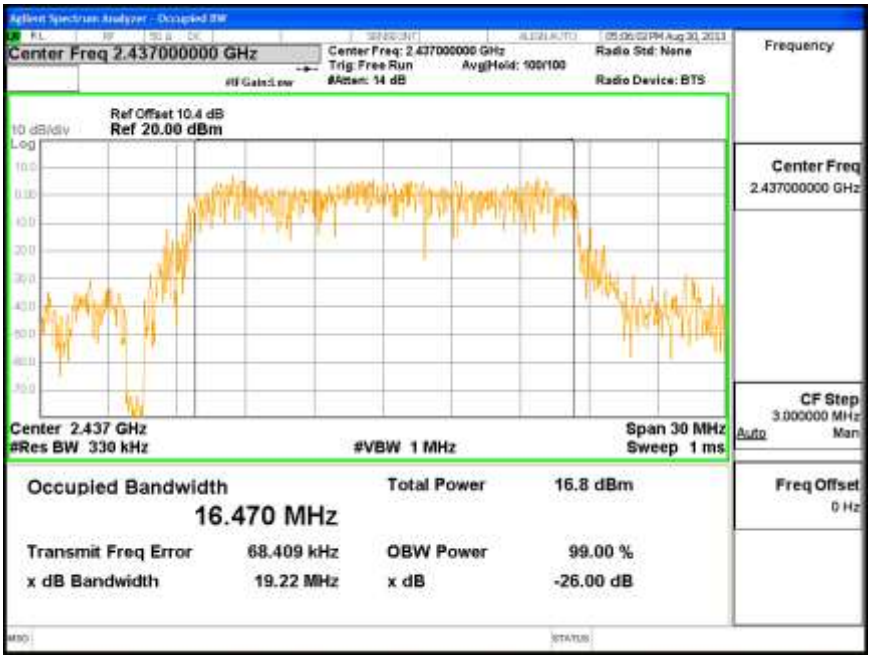
Channel	Frequency (MHz)	99% Bandwidth (MHz)
1	2412	16.3910
6	2437	16.4700
11	2462	16.4200
12	2467	16.4230
13	2472	16.4500

99% BANDWIDTH

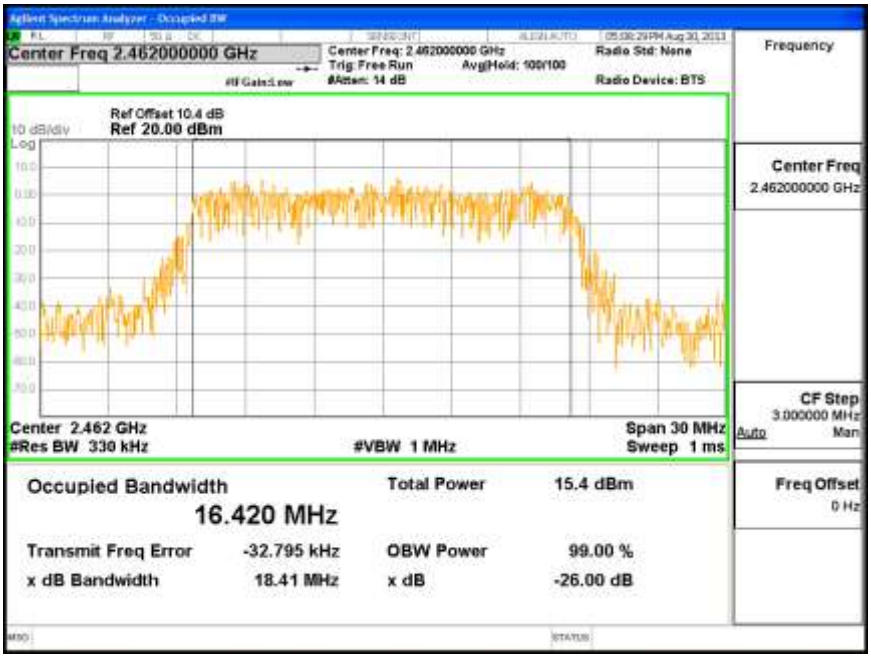
99% BANDWIDTH CH 1



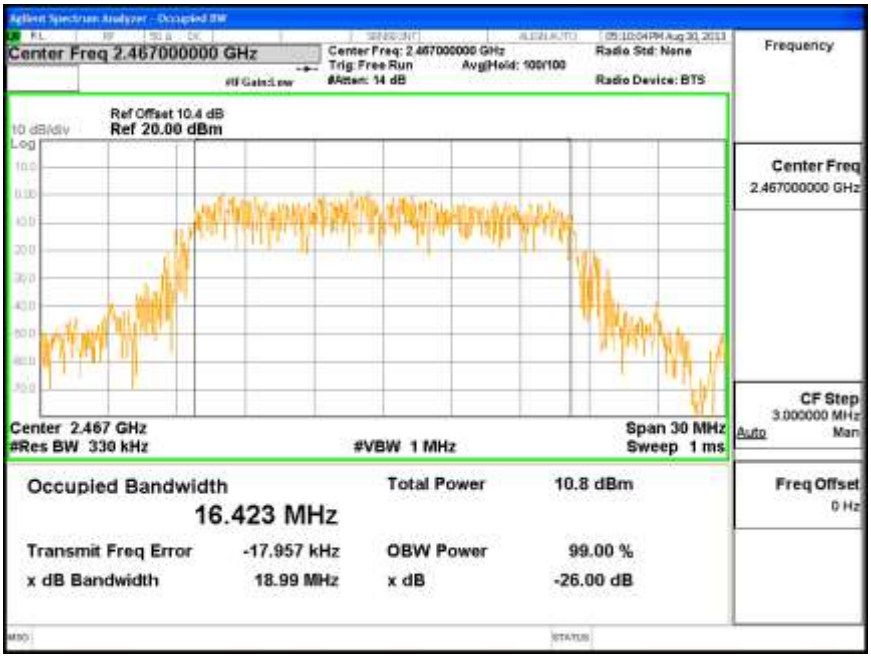
99% BANDWIDTH CH 6



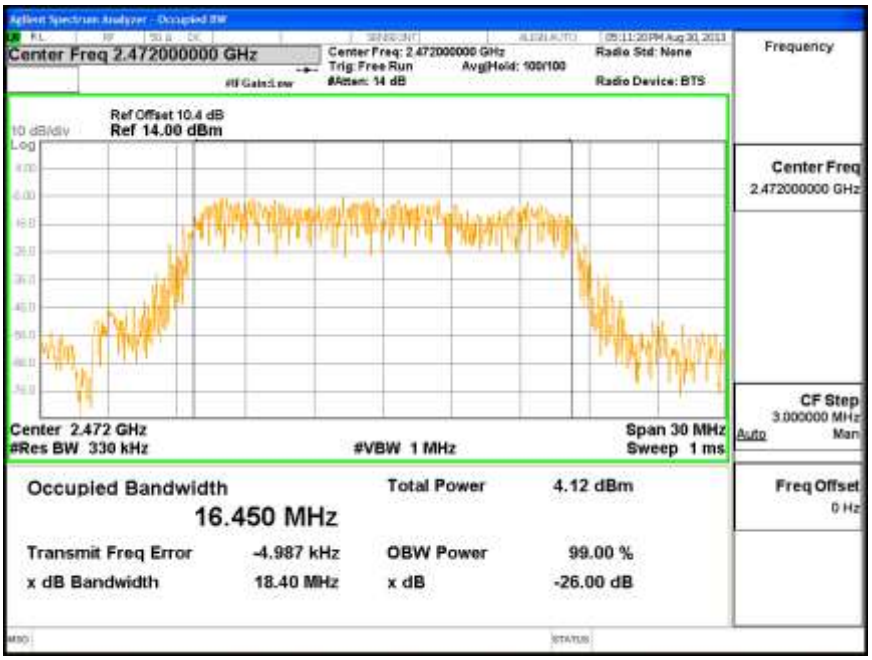
99% BANDWIDTH CH 11



99% BANDWIDTH CH 12



99% BANDWIDTH CH 13



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 10.4 dB (including 10 dB pad and 0.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
1	2412	15.47
6	2437	16.49
11	2462	15.00
12	2467	10.95
13	2472	3.45

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

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

RESULTS

Limits

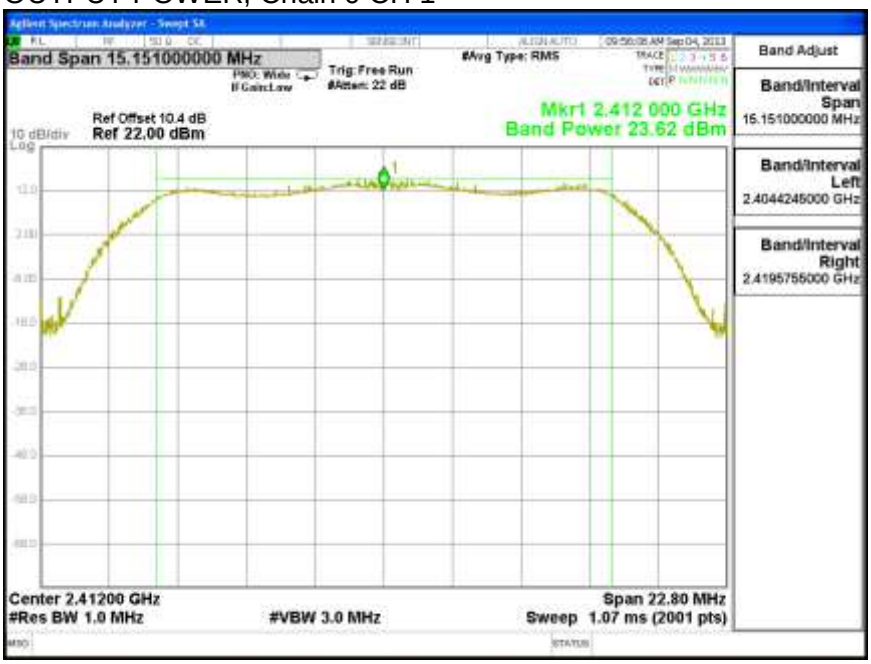
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
1	2412	0.81	30.00	30	36	30.00
6	2437	0.81	30.00	30	36	30.00
11	2462	0.81	30.00	30	36	30.00
12	2467	0.81	30.00	30	36	30.00
13	2472	0.81	30.00	30	36	30.00

Results

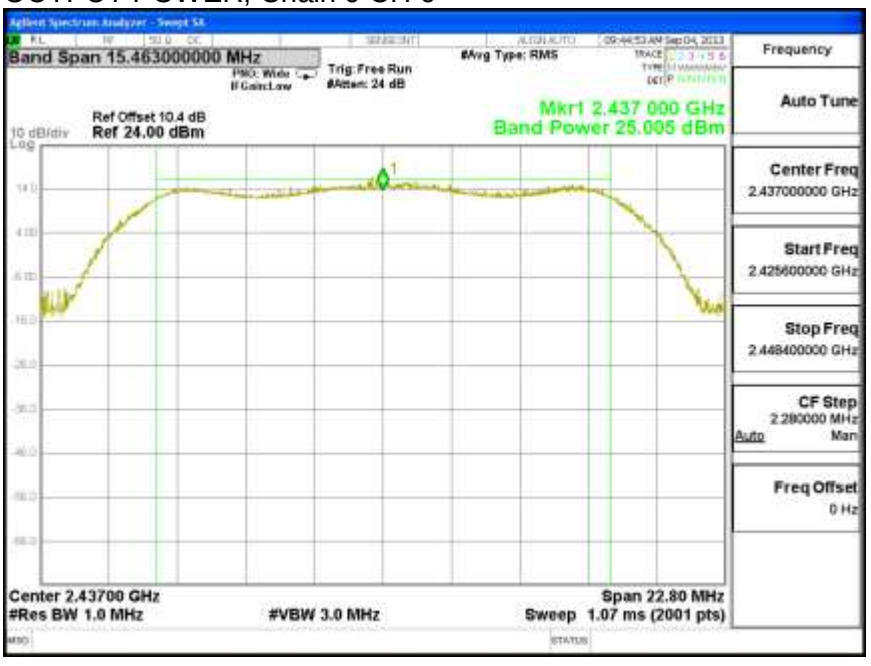
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
1	2412	23.62	23.62	30.00	-6.38
6	2437	25.01	25.01	30.00	-5.00
11	2462	23.42	23.42	30.00	-6.58
12	2467	19.18	19.18	30.00	-10.82
13	2472	11.78	11.78	30.00	-18.22

OUTPUT POWER, Chain 0

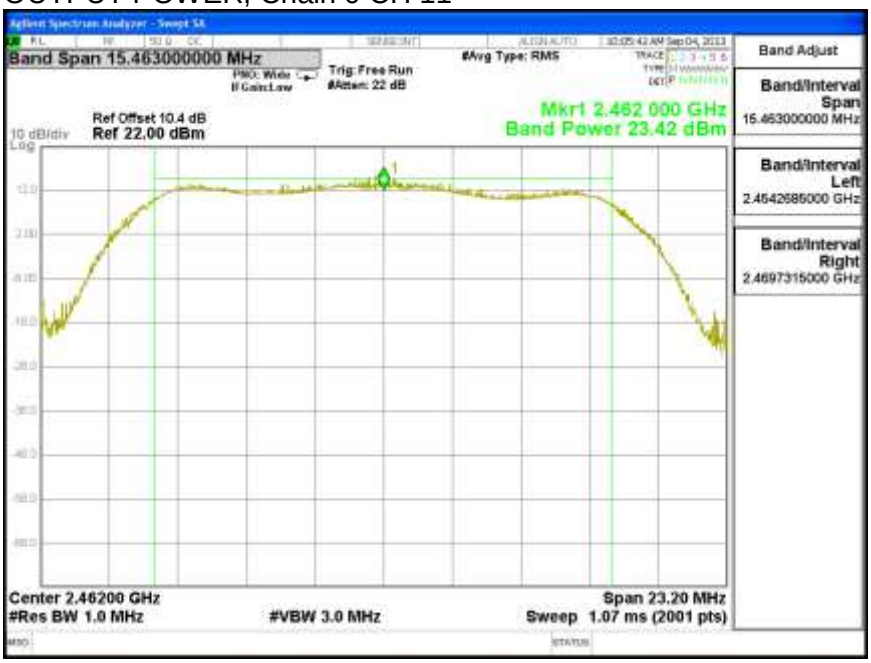
OUTPUT POWER, Chain 0 CH 1



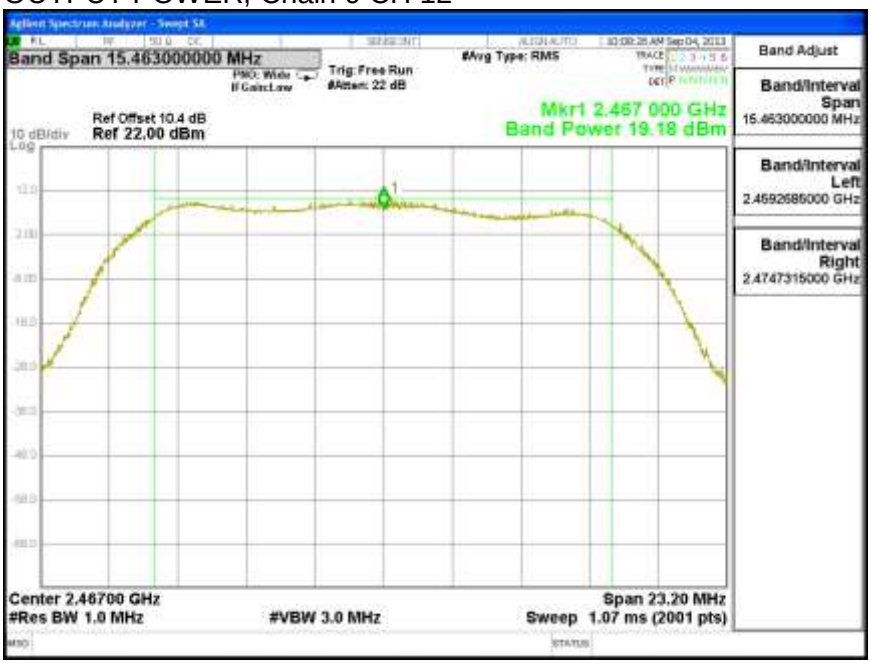
OUTPUT POWER, Chain 0 CH 6



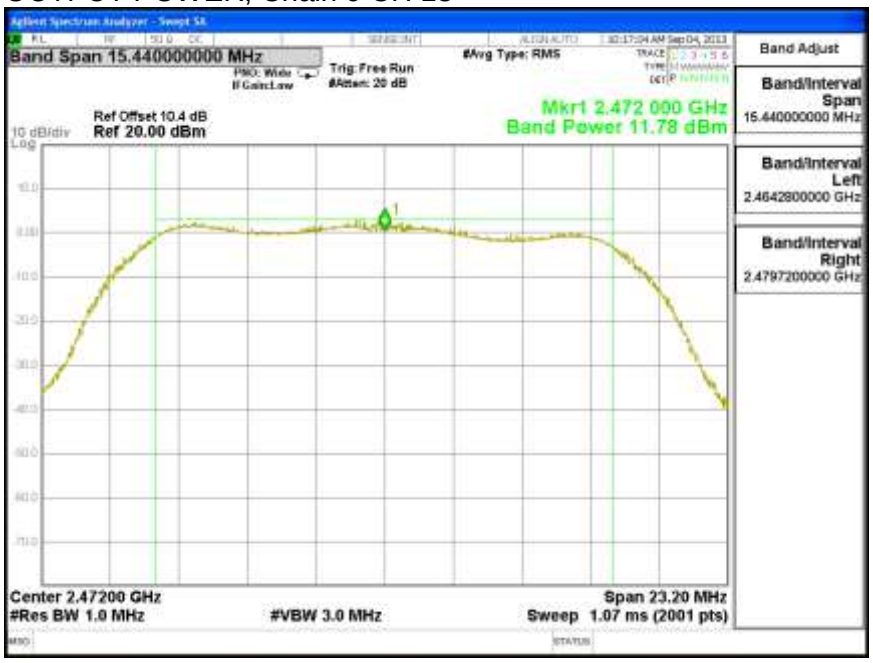
OUTPUT POWER, Chain 0 CH 11



OUTPUT POWER, Chain 0 CH 12



OUTPUT POWER, Chain 0 CH 13



8.2.5. 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.

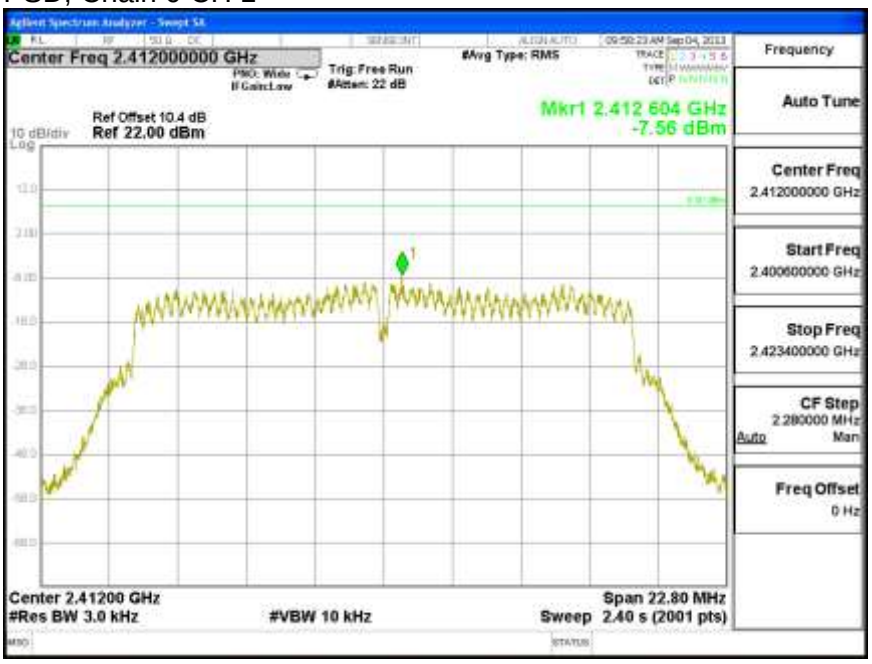
RESULTS

PSD Results

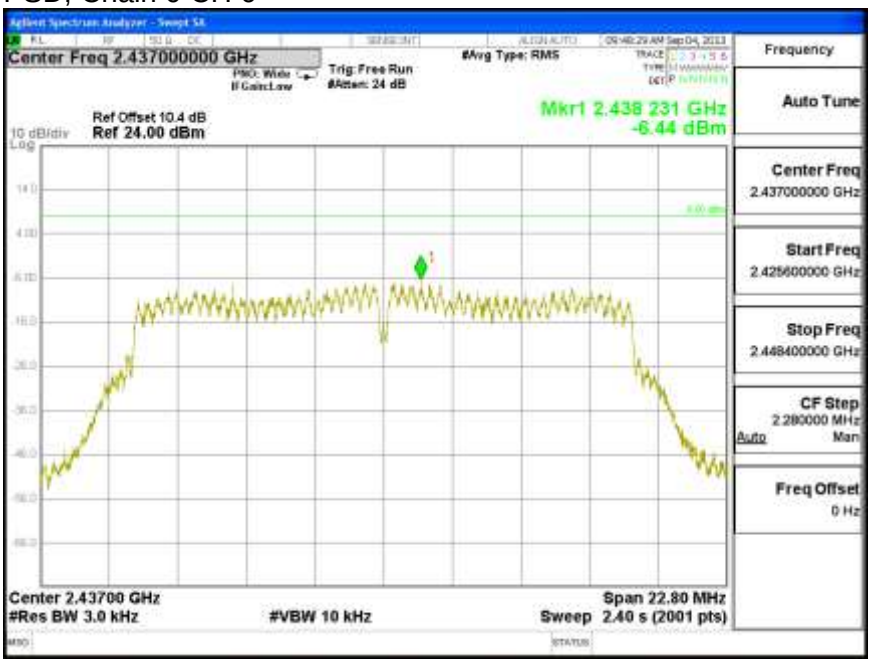
Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Limit (dBm)	Margin (dB)
1	2412	-7.56	8.0	-15.6
6	2437	-6.44	8.0	-14.4
11	2462	-8.35	8.0	-16.4
12	2467	-12.77	8.0	-20.8
13	2472	-19.87	8.0	-27.9

PSD, Chain 0

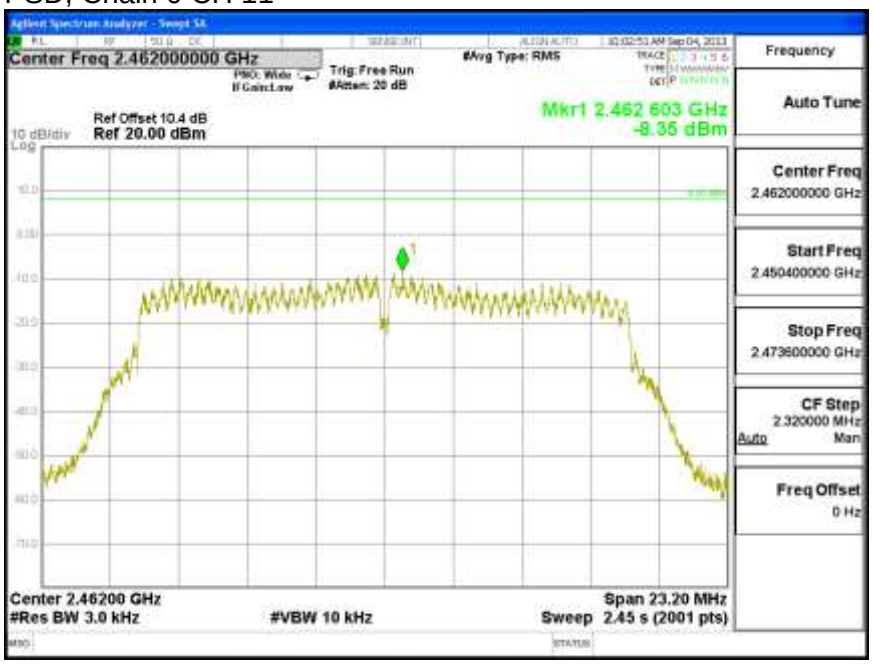
PSD, Chain 0 CH 1



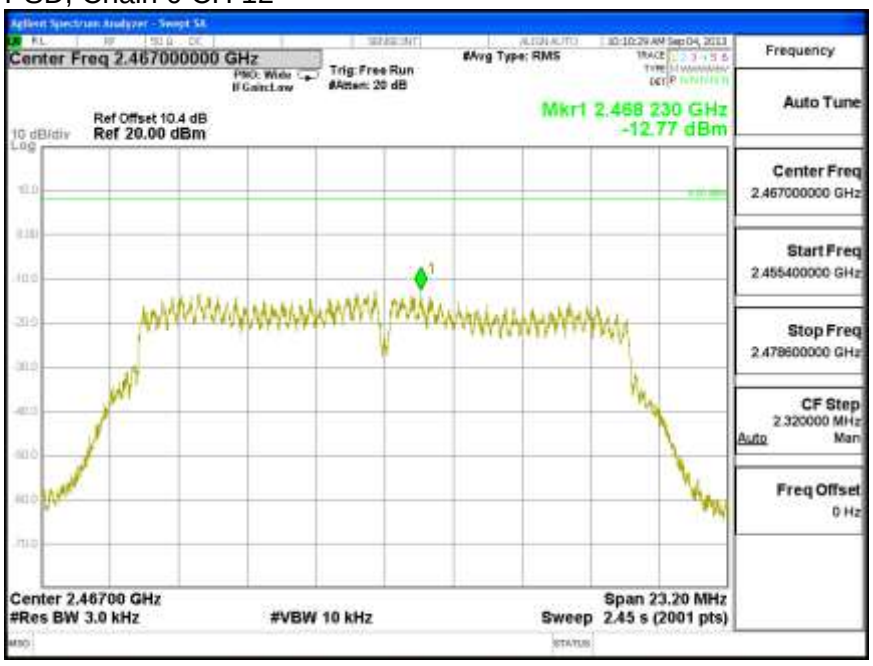
PSD, Chain 0 CH 6



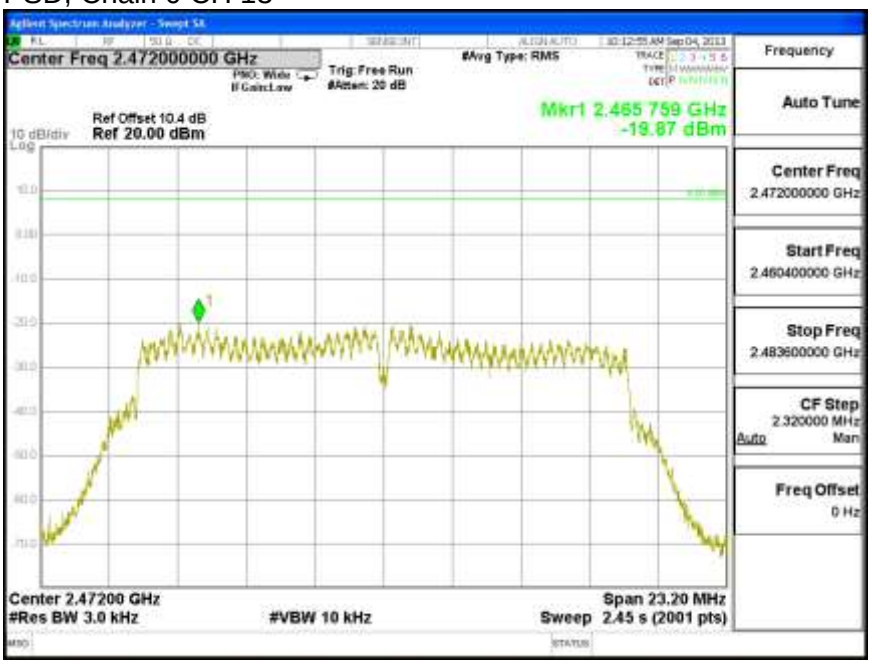
PSD, Chain 0 CH 11



PSD, Chain 0 CH 12



PSD, Chain 0 CH 13



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.

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.

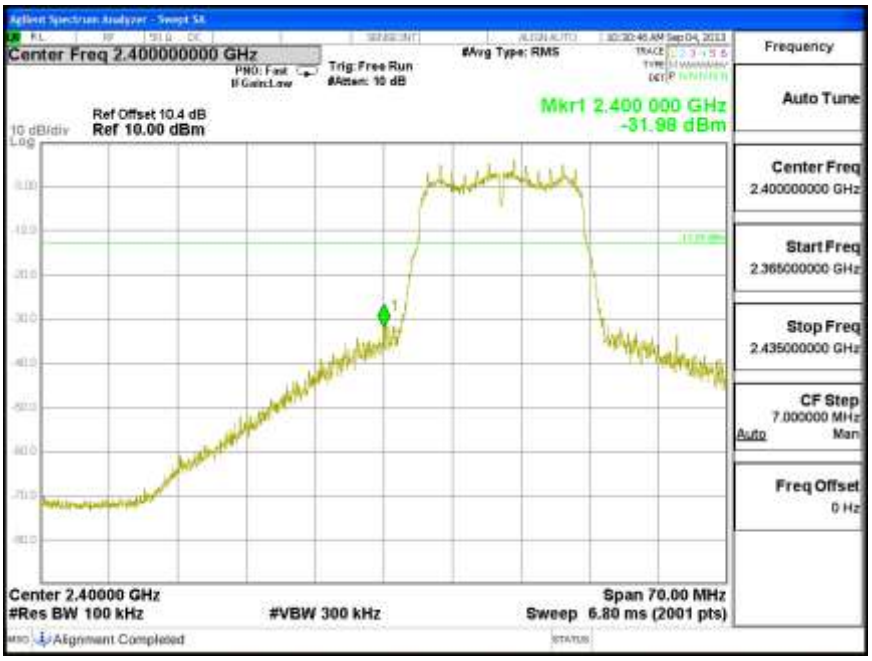
RESULTS

IN-BAND REFERENCE LEVEL

REFERENCE LEVEL CH 6

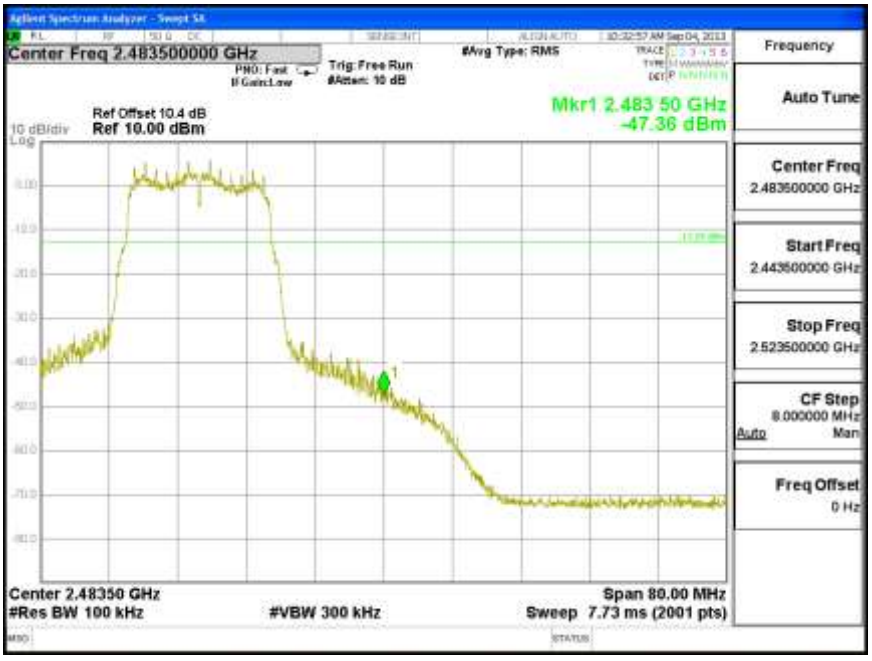
LOW CHANNEL BANDEDGE

AUTHORIZED BAND EDGE CH 1



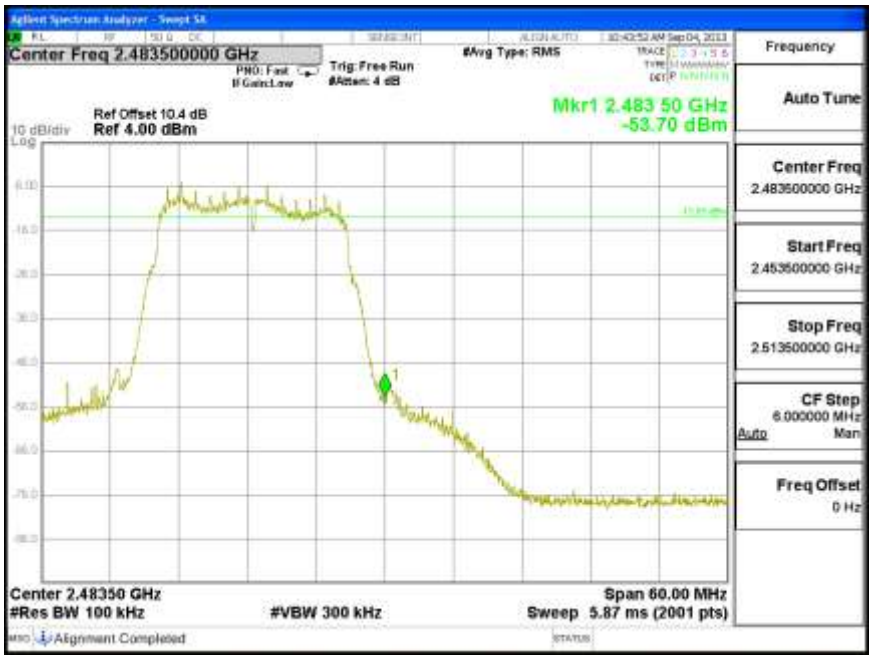
HIGH CHANNEL BANDEDGE

AUTHORIZED BAND EDGE CH 11



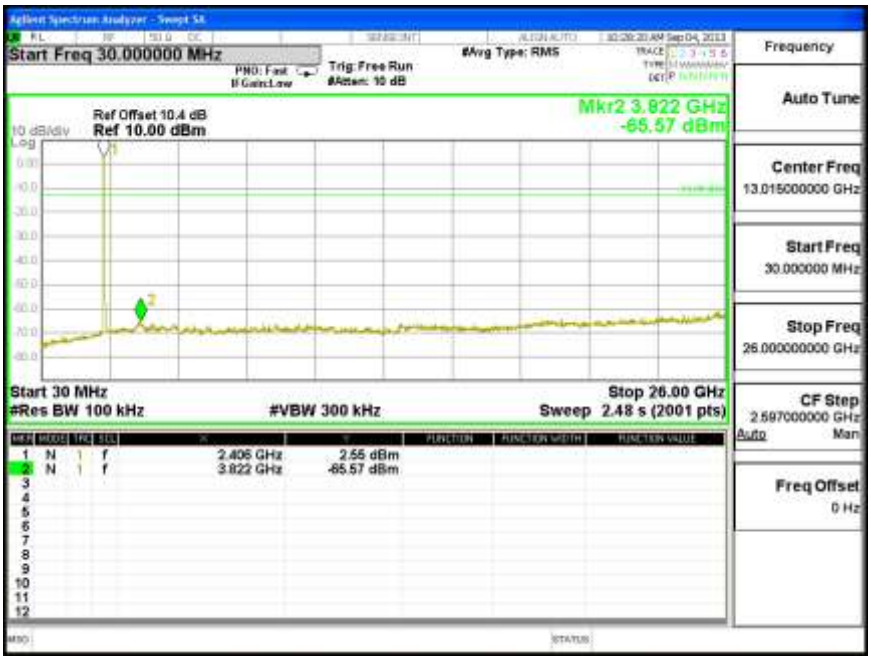
AUTHORIZED BAND EDGE CH 12

AUTHORIZED BAND EDGE CH 13

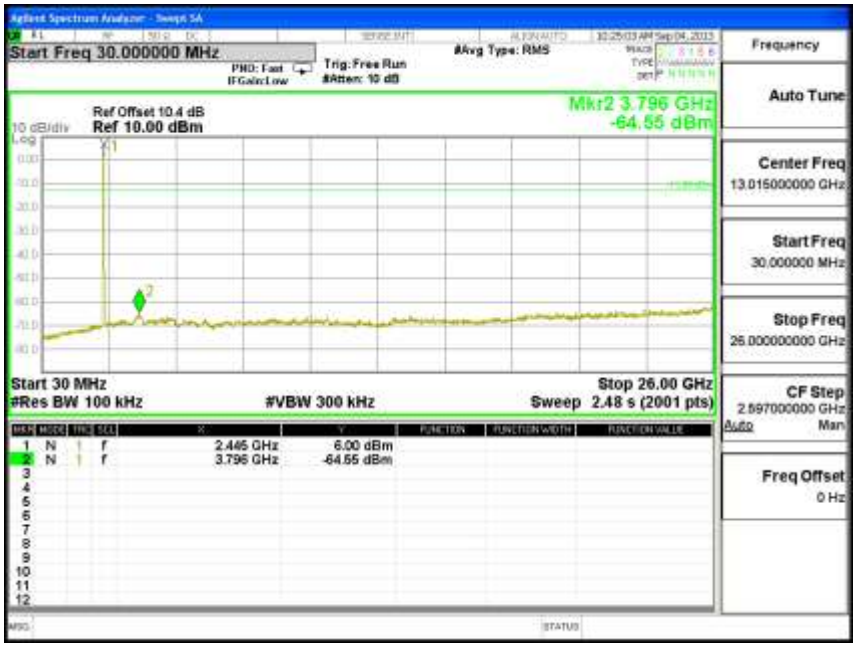


OUT-OF-BAND EMISSIONS

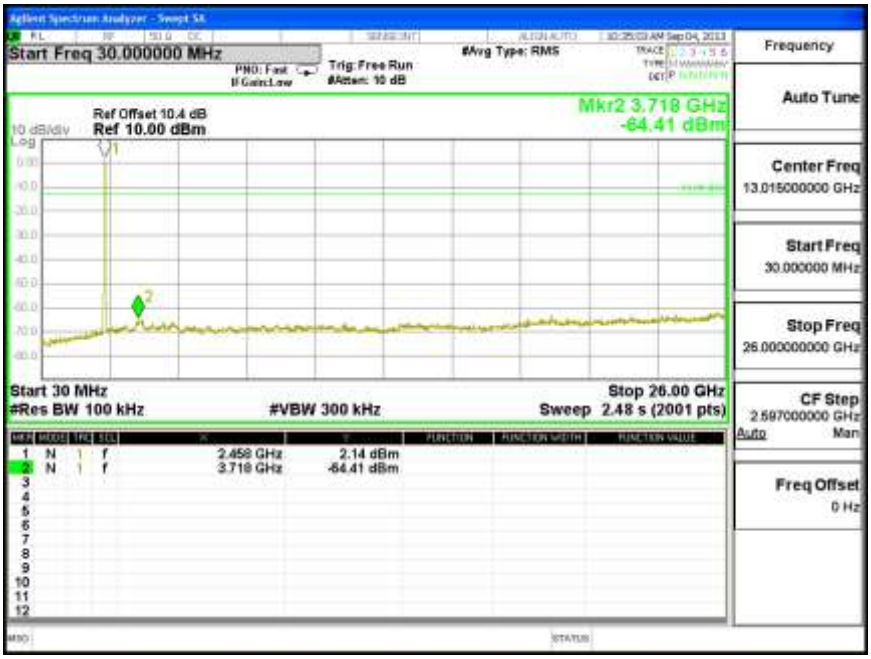
OUT OF BAND CH 1



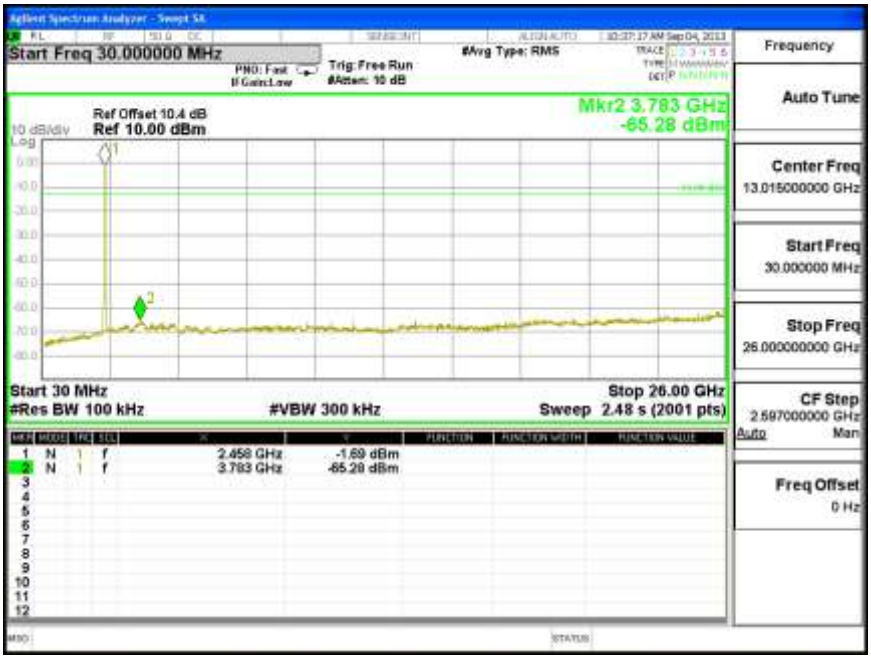
OUT OF BAND CH 6



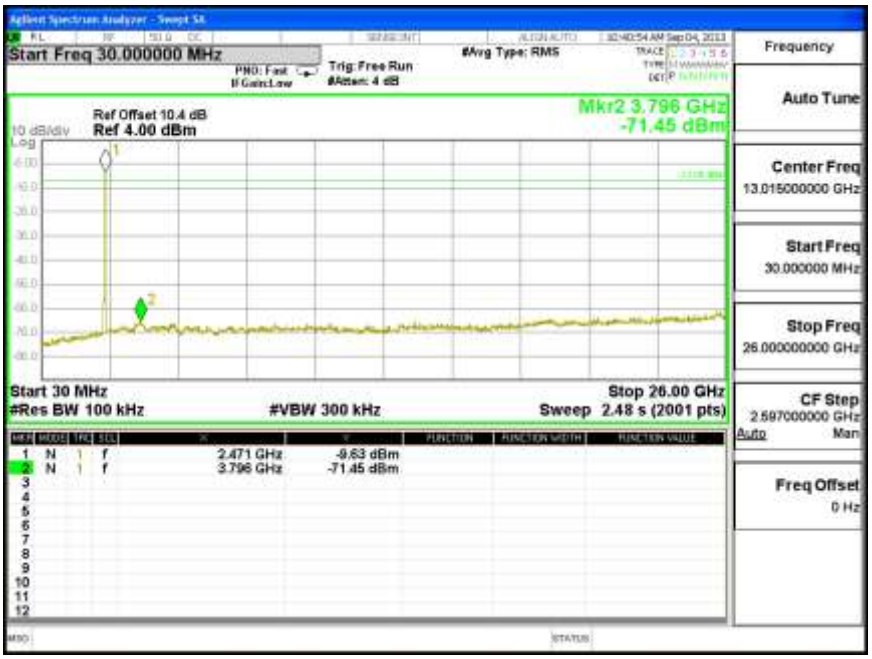
OUT OF BAND CH 11



OUT OF BAND CH 12



OUT OF BAND CH 13



8.3. 802.11n HT20 MIMO 2TX CDD 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.

TEST PROCEDURE

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

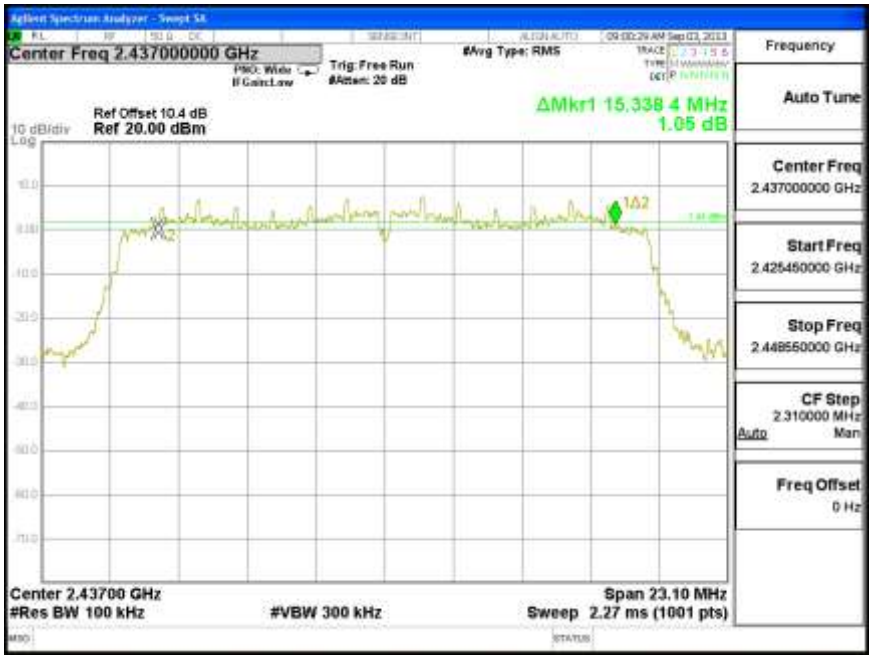
RESULTS

Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
1	2412	15.162	15.151	0.5
6	2437	15.338	16.334	0.5
11	2462	15.318	15.694	0.5
12	2467	15.463	16.293	0.5
13	2472	15.451	16.317	0.5

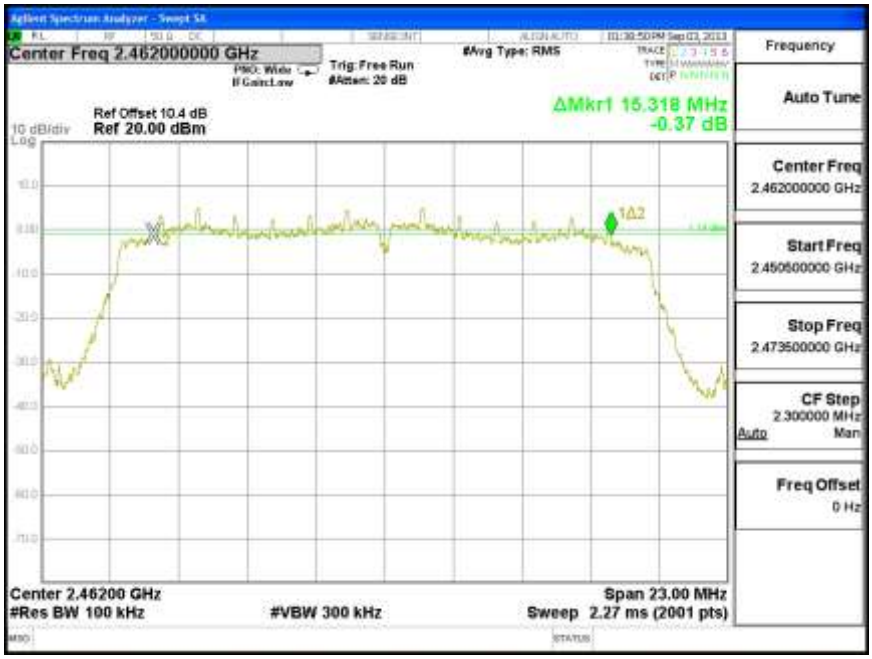
6 dB BANDWIDTH, Chain 0

6 dB BANDWIDTH Chain 0 CH 1

6 dB BANDWIDTH Chain 0 CH 6



6 dB BANDWIDTH Chain 0 CH 11



6 dB BANDWIDTH Chain 0 CH 12

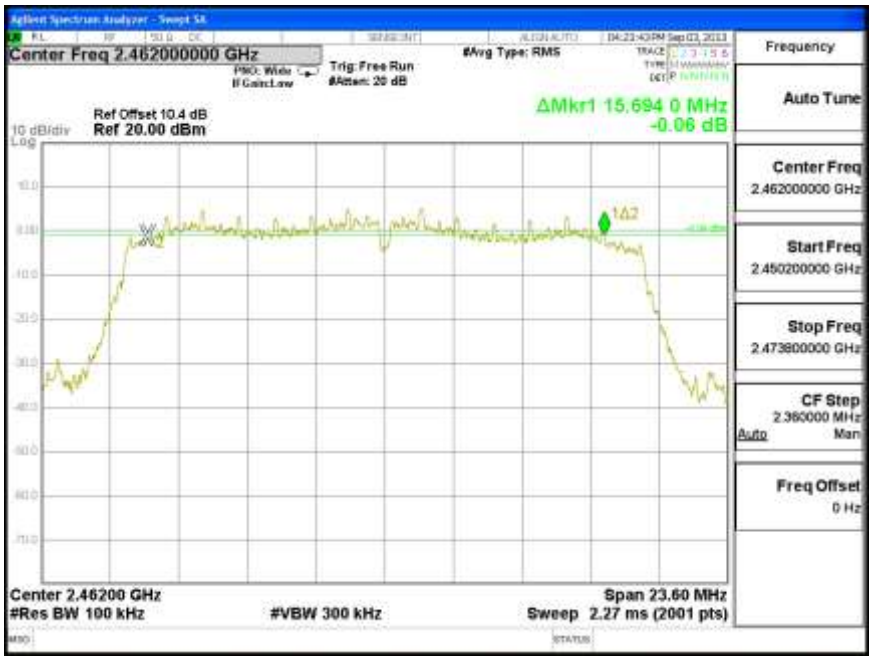
6 dB BANDWIDTH Chain 0 CH 13

6 dB BANDWIDTH, Chain 1

6 dB BANDWIDTH Chain 1 CH 1

6 dB BANDWIDTH Chain 1 CH 6

6 dB BANDWIDTH Chain 1 CH 11



6 dB BANDWIDTH Chain 0 CH 12

6 dB BANDWIDTH Chain 0 CH 13

8.3.2. 99% BANDWIDTH

LIMITS

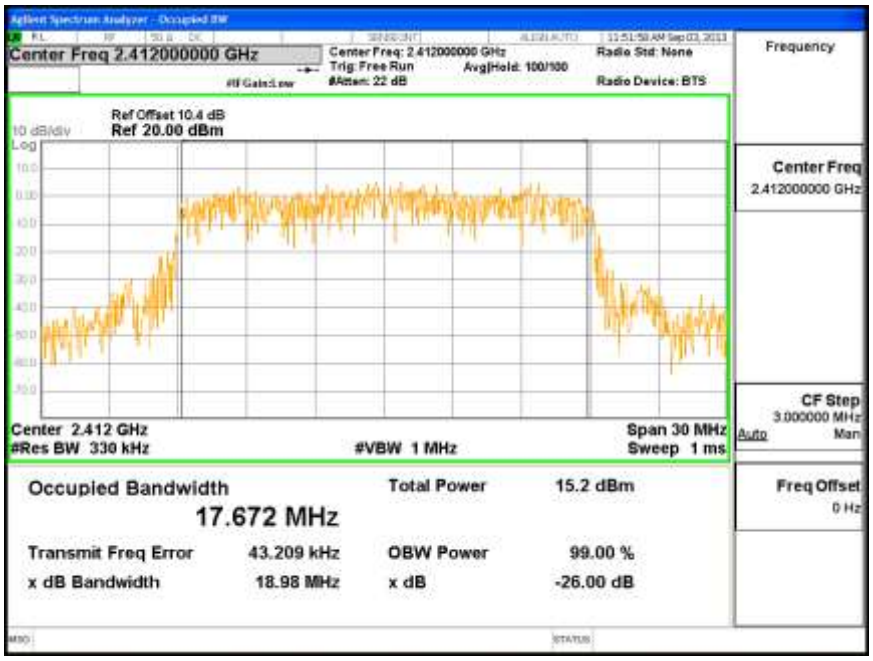
None; for reporting purposes only.

RESULTS

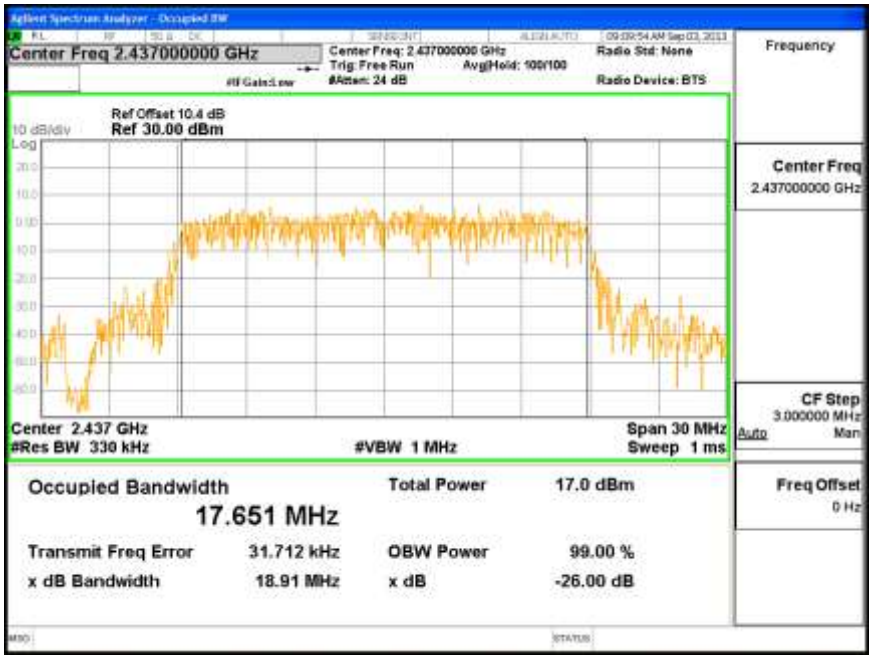
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
1	2412	17.6720	17.5810
6	2437	17.6510	17.6920
11	2462	17.6370	17.6080
12	2467	17.6390	17.6550
13	2472	17.6730	17.6600

99% BANDWIDTH, Chain 0

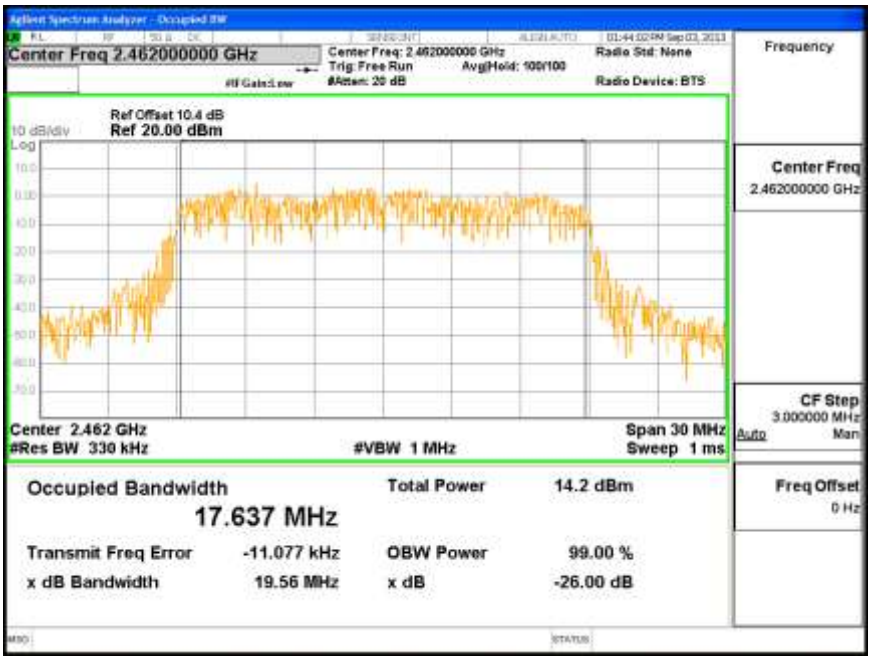
99% BANDWIDTH Chain 0 CH 1



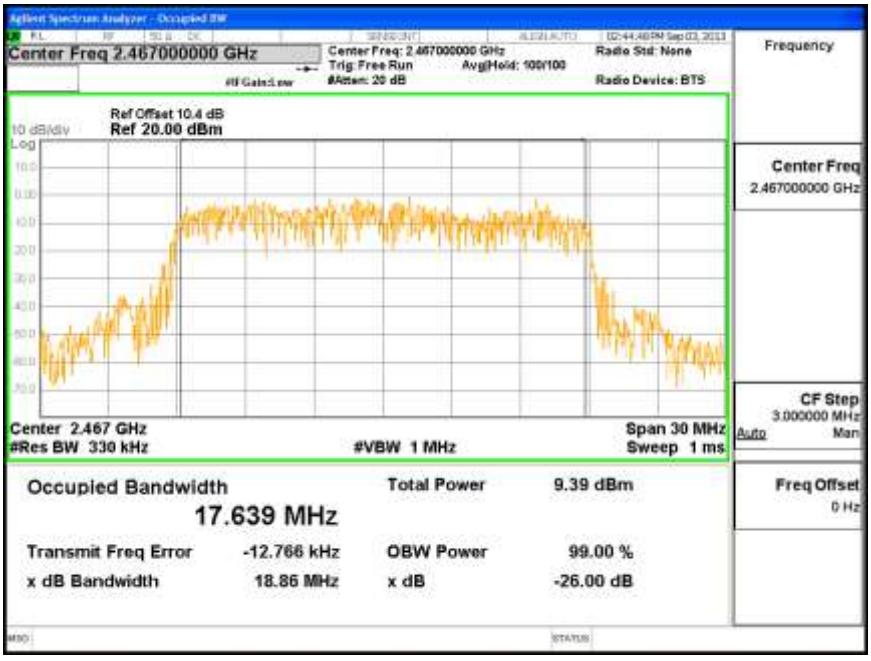
99% BANDWIDTH Chain 0 CH 6



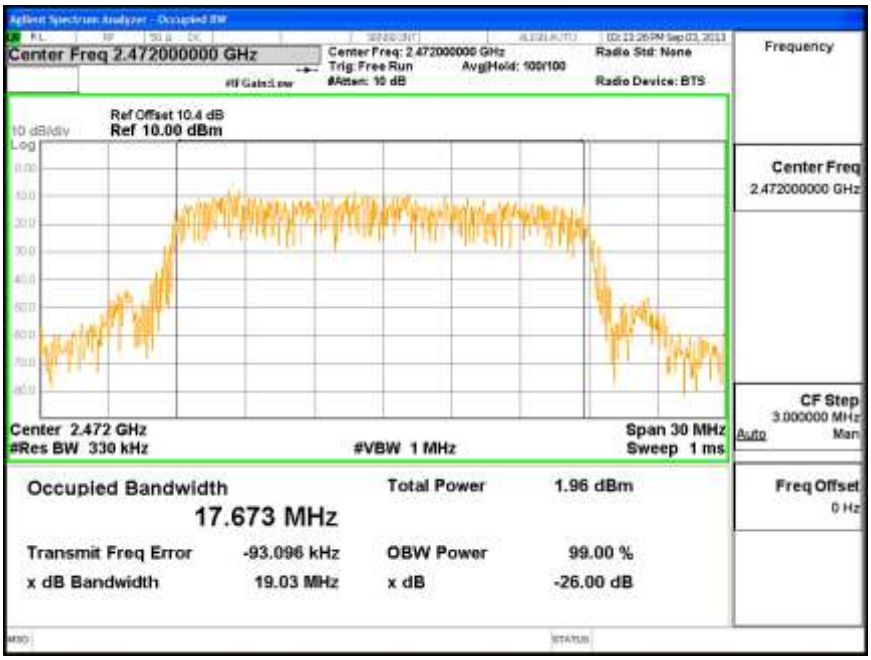
99% BANDWIDTH Chain 0 CH 11



99% BANDWIDTH Chain 0 CH 12

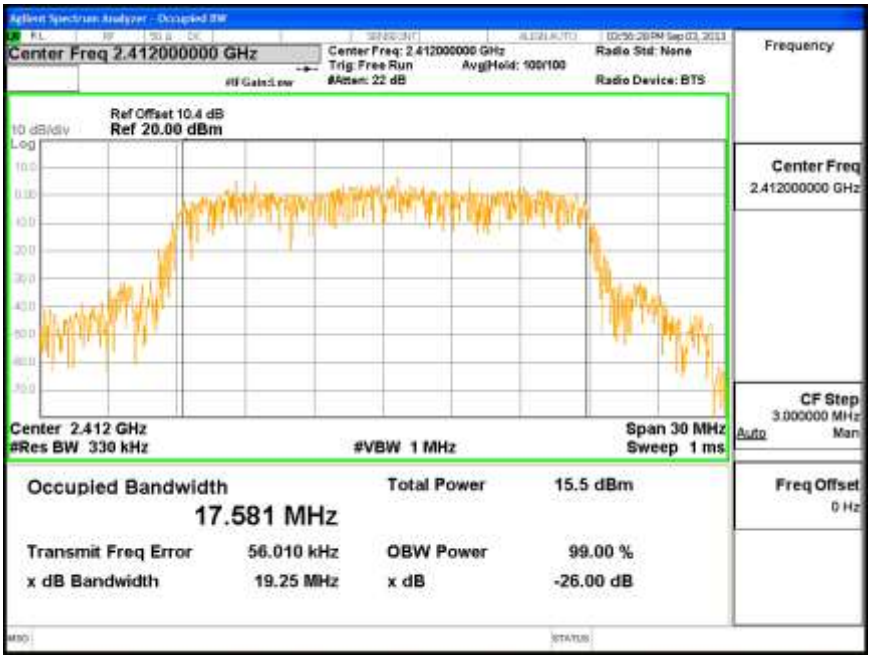


99% BANDWIDTH Chain 0 CH 13

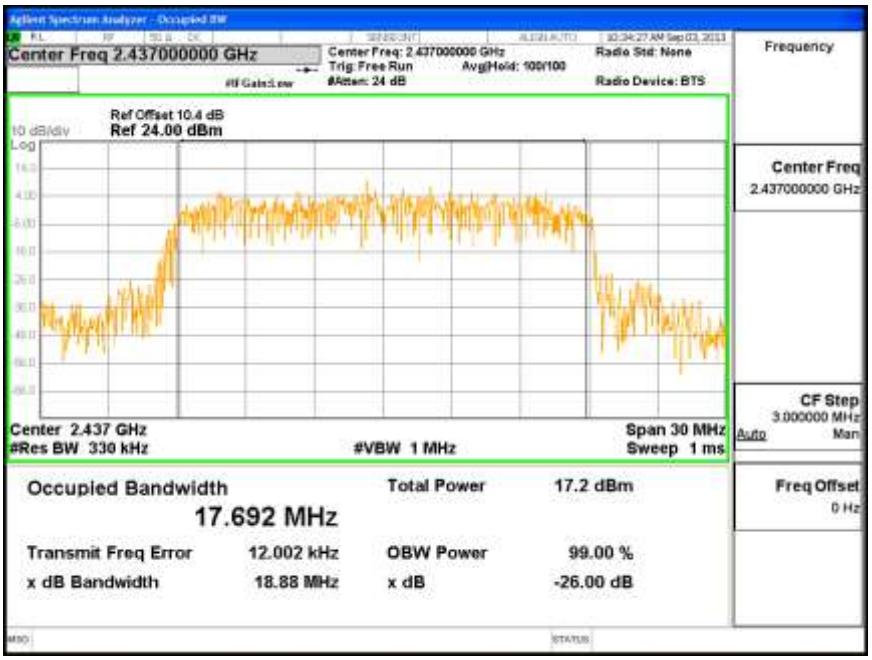


99% BANDWIDTH, Chain 1

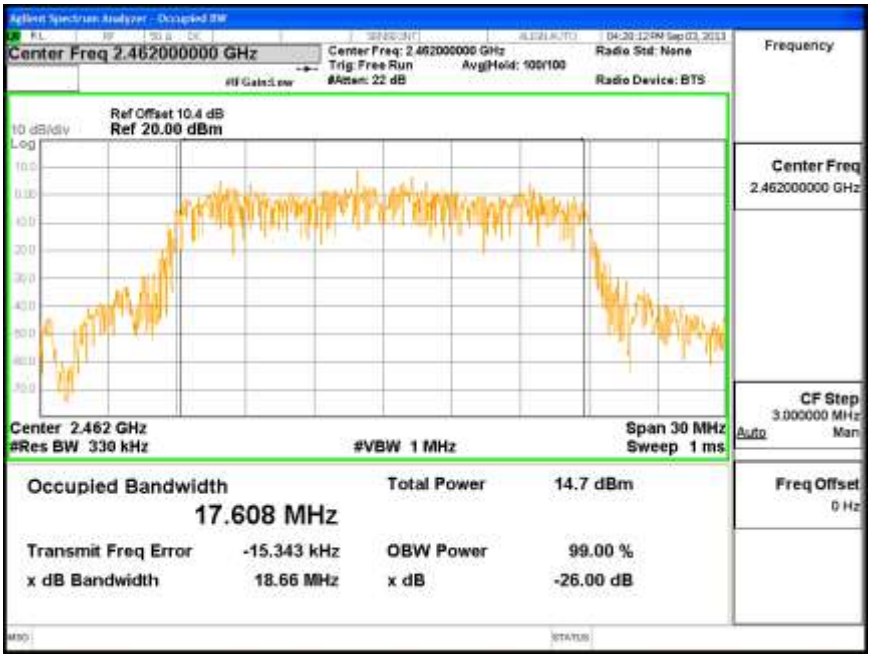
99% BANDWIDTH Chain 1 CH 1



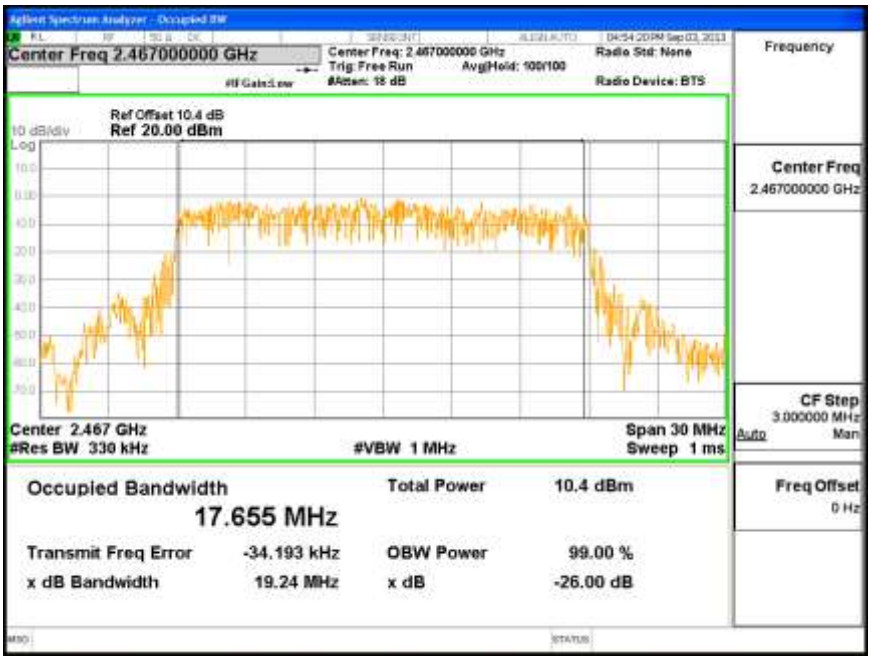
99% BANDWIDTH Chain 1 CH 6



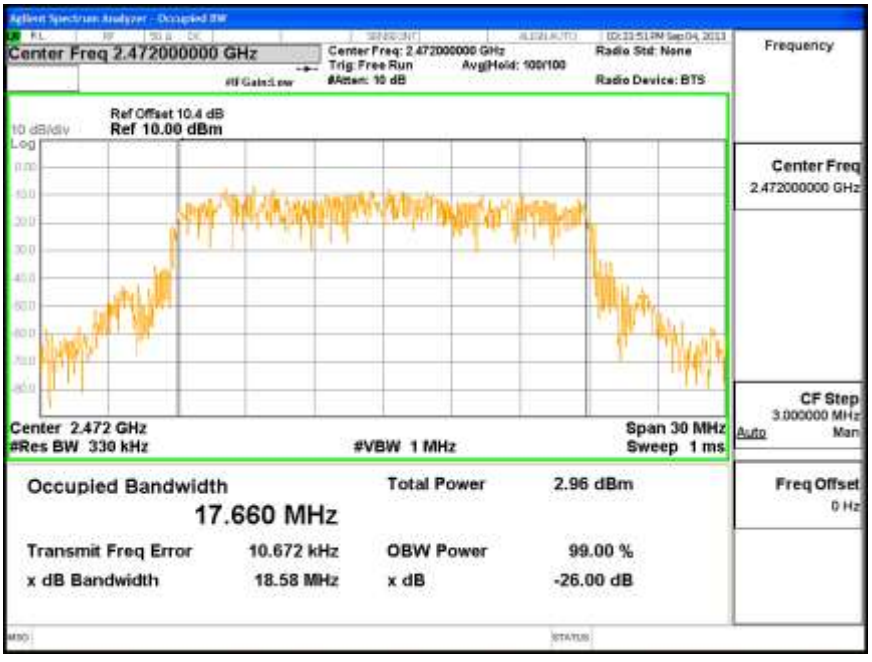
99% BANDWIDTH Chain 1 CH 11



99% BANDWIDTH Chain 1 CH 12



99% BANDWIDTH Chain 1 CH 13



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 10.4 dB (including 10 dB pad and 0.4 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)
1	2412	14.50	14.50	17.51
6	2437	16.47	16.38	19.44
11	2462	13.99	14.00	17.01
12	2467	8.98	9.00	12.00
13	2472	1.49	1.50	4.51

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)
0.81	-1.86	-0.32

RESULTS

Limits

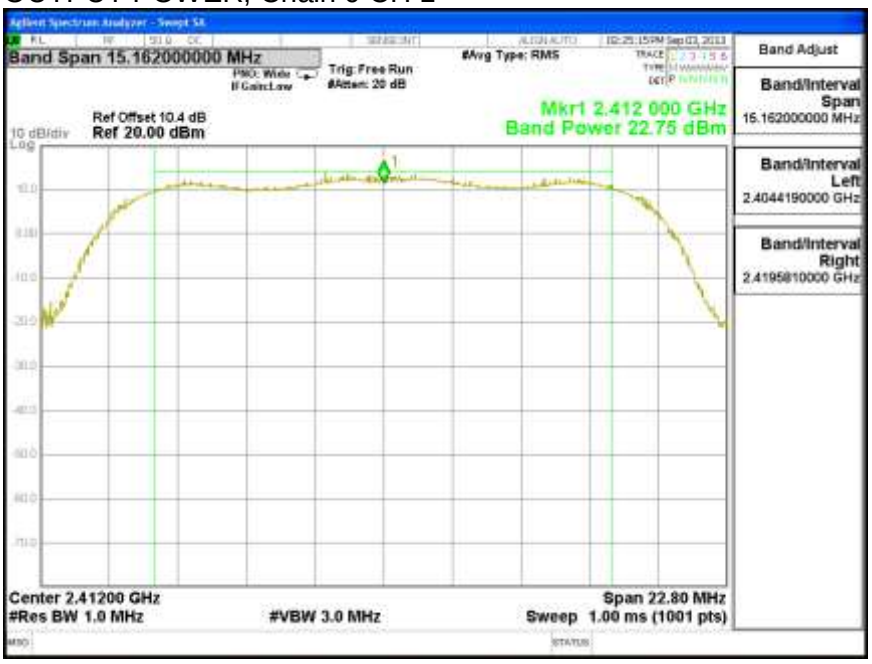
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
1	2412	-0.32	30.00	30	36	30.00
6	2437	-0.32	30.00	30	36	30.00
11	2462	-0.32	30.00	30	36	30.00
12	2467	-0.32	30.00	30	36	30.00
13	2472	-0.32	30.00	30	36	30.00

Results

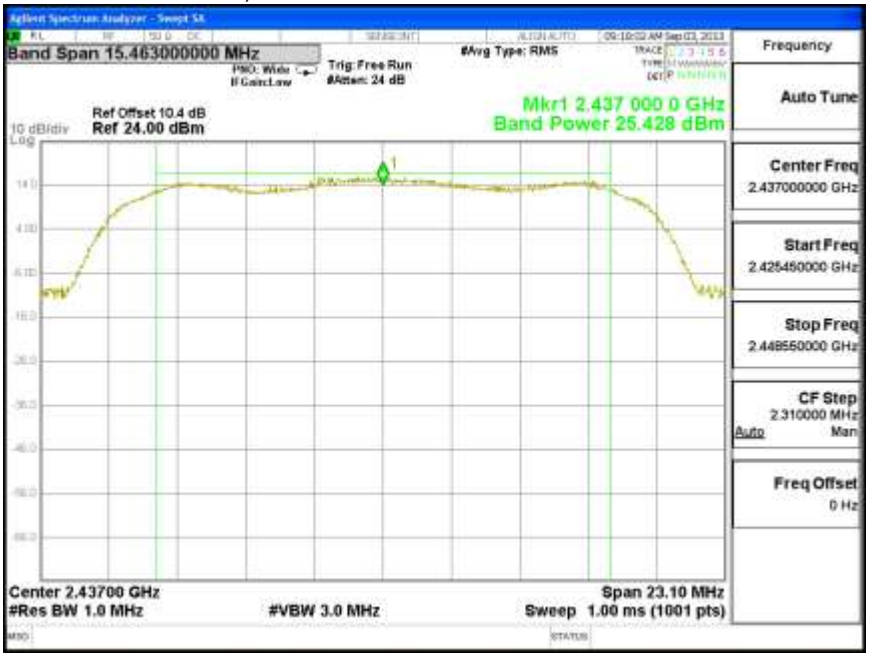
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
1	2412	22.75	22.86	25.82	30.00	-4.18
6	2437	25.43	25.63	28.54	30.00	-1.46
11	2462	21.93	21.88	24.92	30.00	-5.08
12	2467	17.18	17.51	20.36	30.00	-9.64
13	2472	9.81	10.14	12.99	30.00	-17.01

OUTPUT POWER, Chain 0

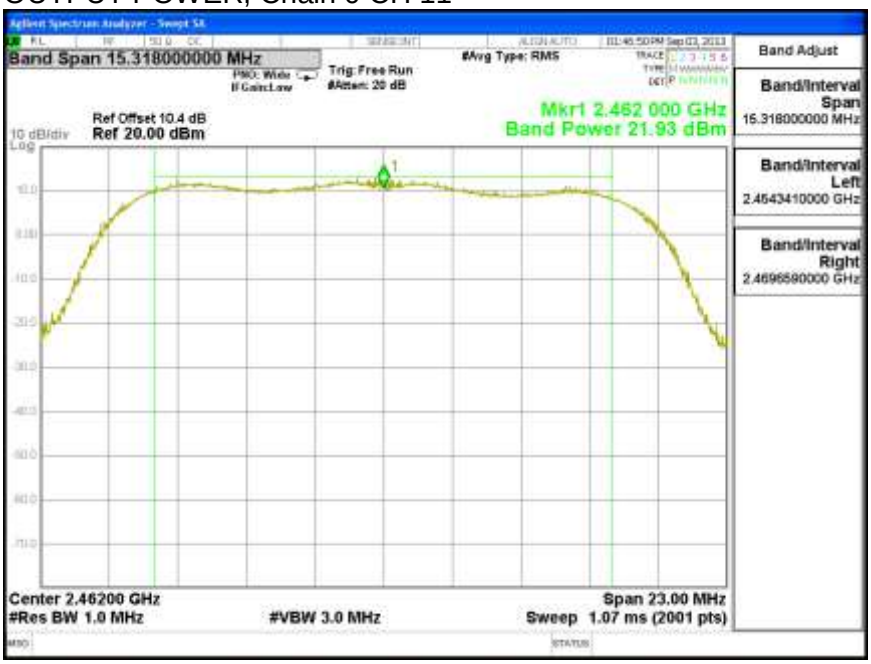
OUTPUT POWER, Chain 0 CH 1



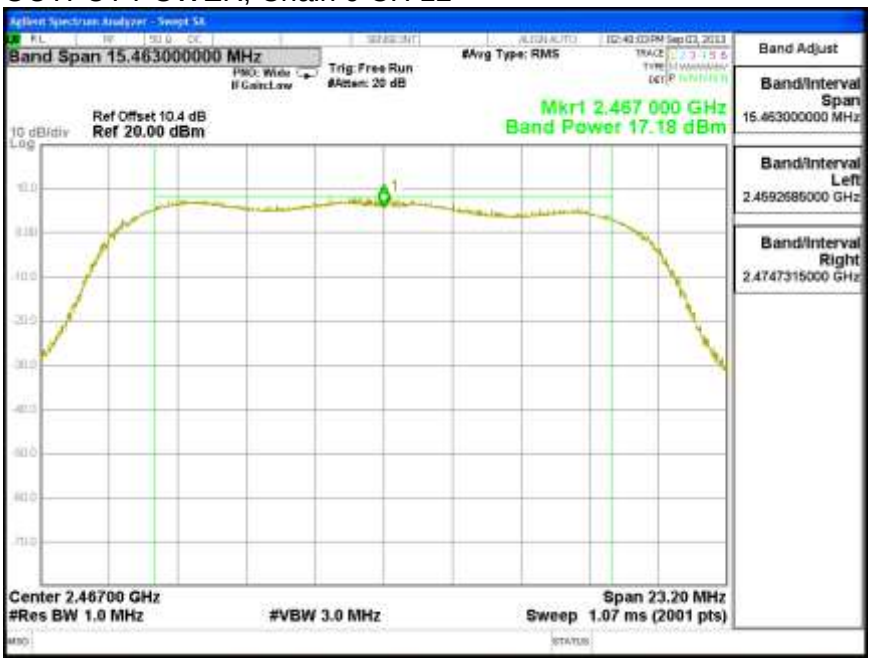
OUTPUT POWER, Chain 0 CH 6



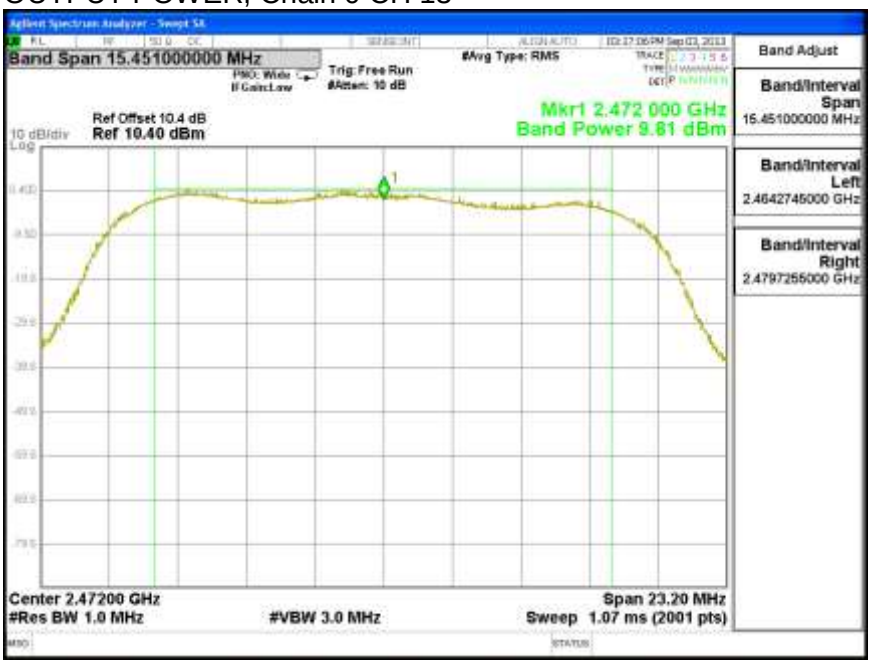
OUTPUT POWER, Chain 0 CH 11



OUTPUT POWER, Chain 0 CH 12

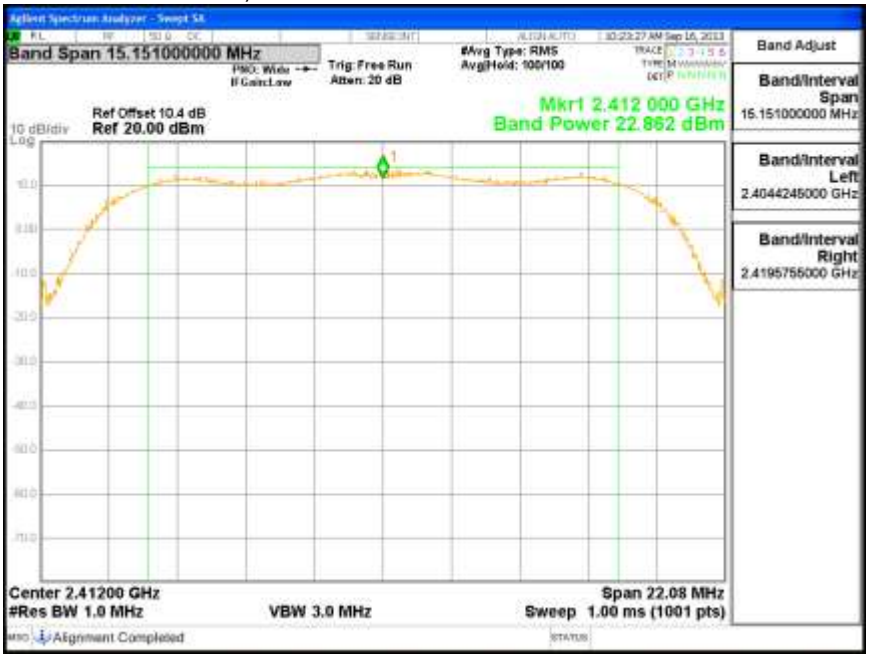


OUTPUT POWER, Chain 0 CH 13

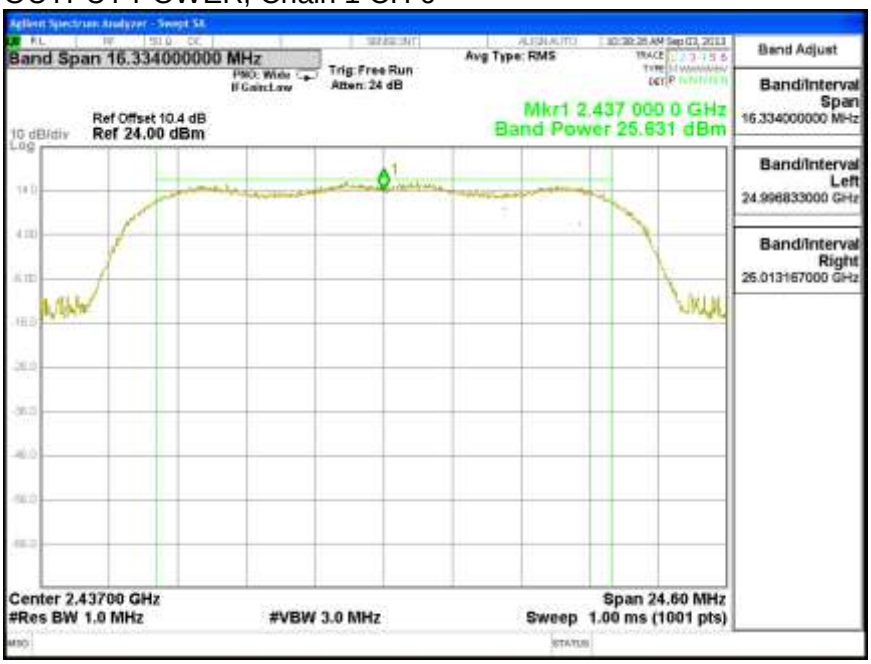


OUTPUT POWER, Chain 1

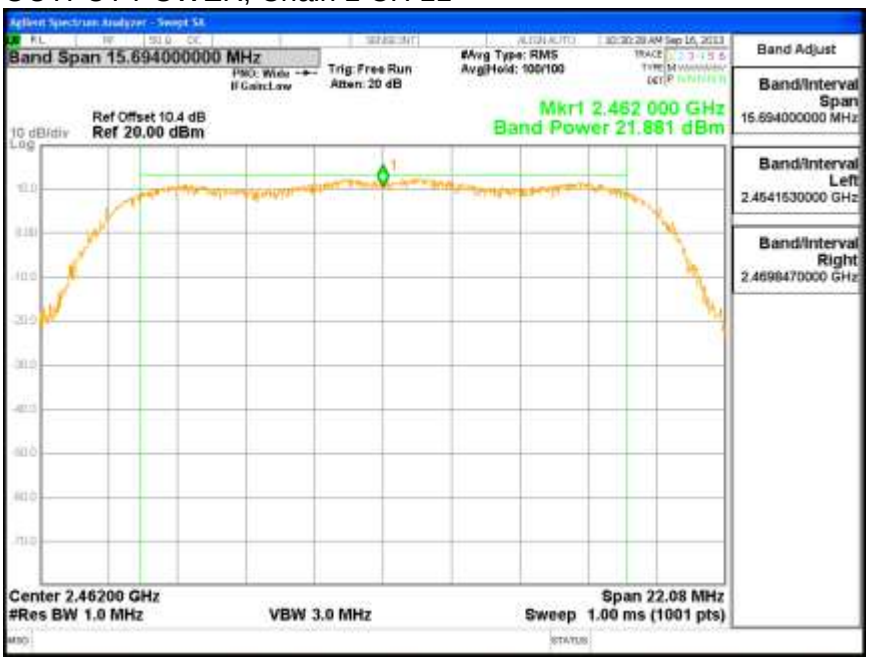
OUTPUT POWER, Chain 1 CH 1



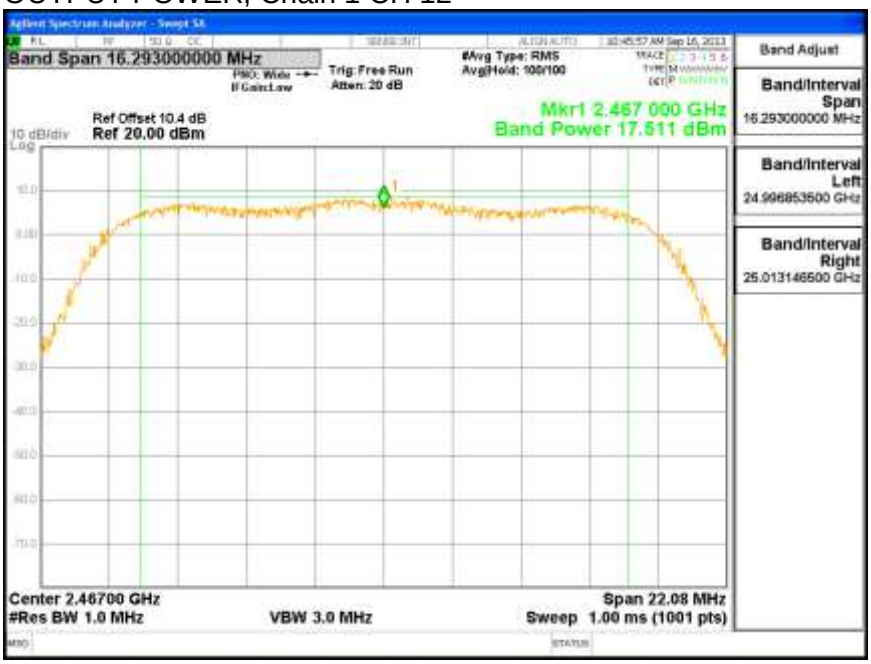
OUTPUT POWER, Chain 1 CH 6



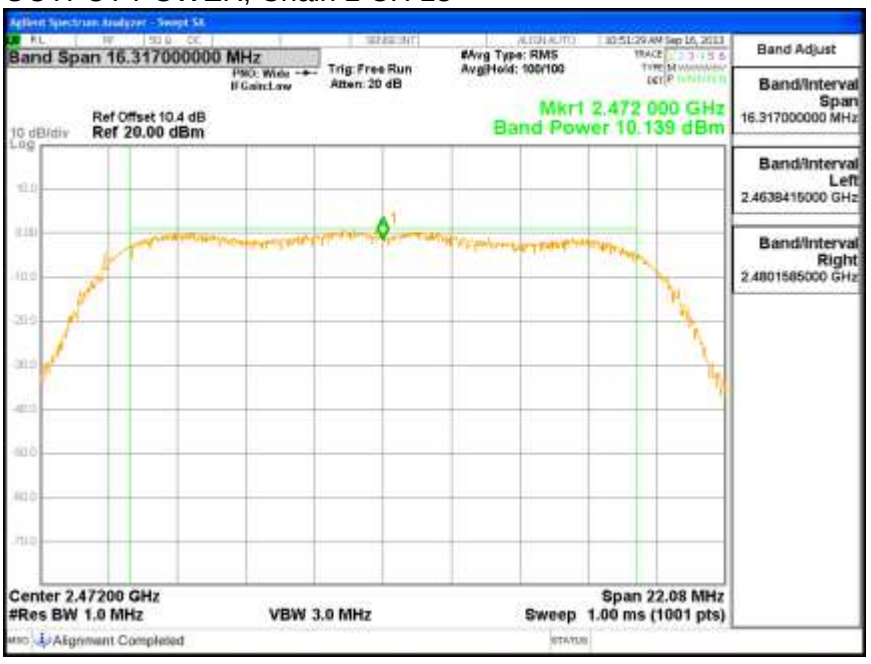
OUTPUT POWER, Chain 1 CH 11



OUTPUT POWER, Chain 1 CH 12



OUTPUT POWER, Chain 1 CH 13



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.

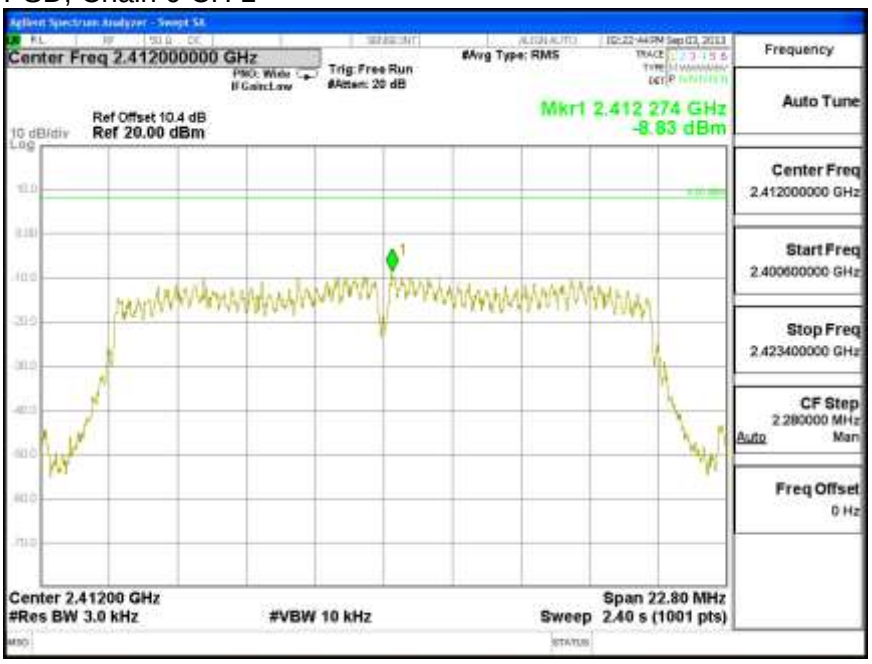
RESULTS

PSD Results

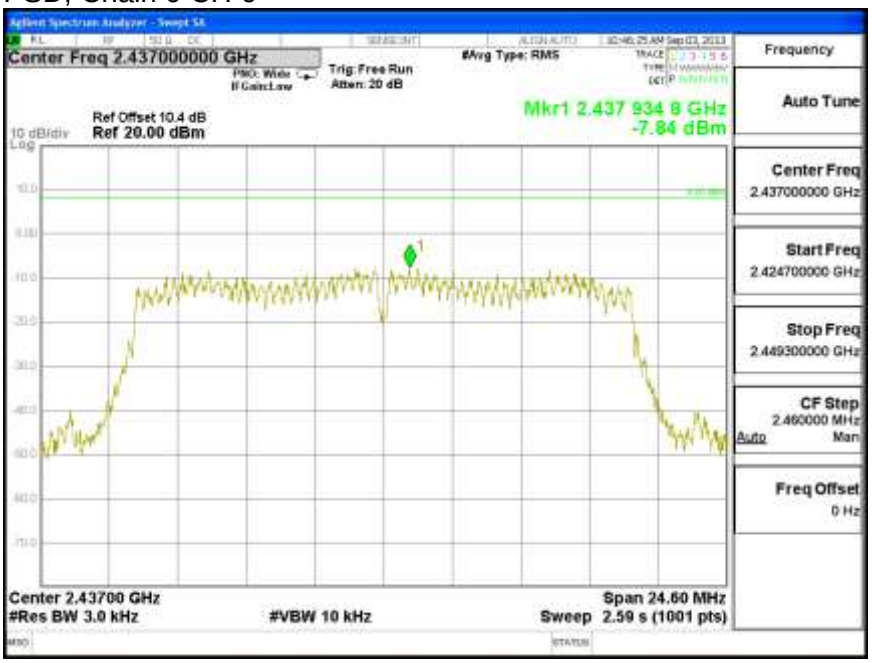
Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Chain 1 Meas (dBm)	Total PSD (dBm)	Limit (dBm)	Margin (dB)
1	2412	-8.83	-8.29	-5.54	8.0	-13.5
6	2437	-7.84	-7.38	-4.59	8.0	-12.6
11	2462	-10.36	-9.73	-7.02	8.0	-15.0
12	2467	-14.74	-14.40	-11.56	8.0	-19.6
13	2472	-22.90	-23.06	-19.97	8.0	-28.0

PSD, Chain 0

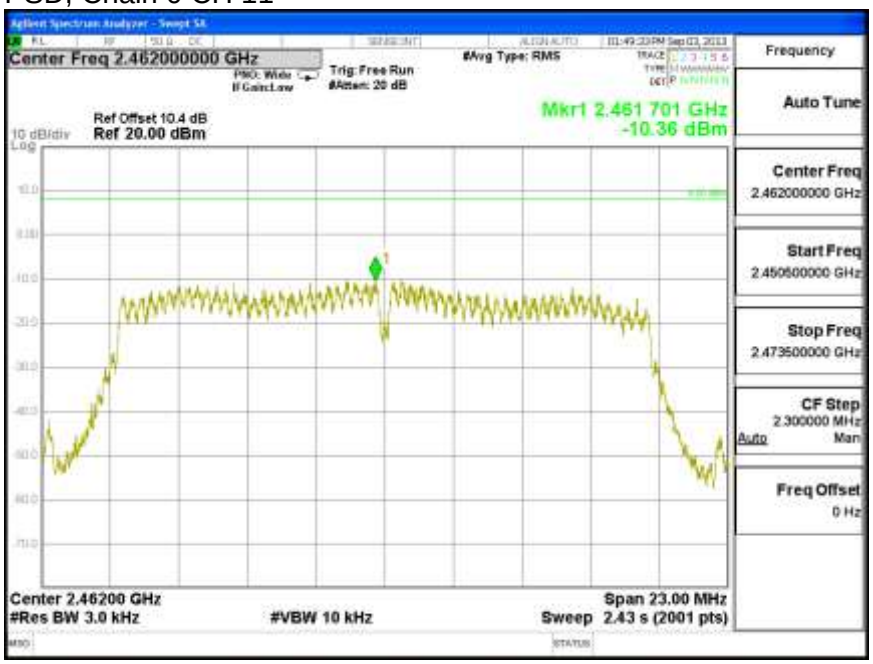
PSD, Chain 0 CH 1



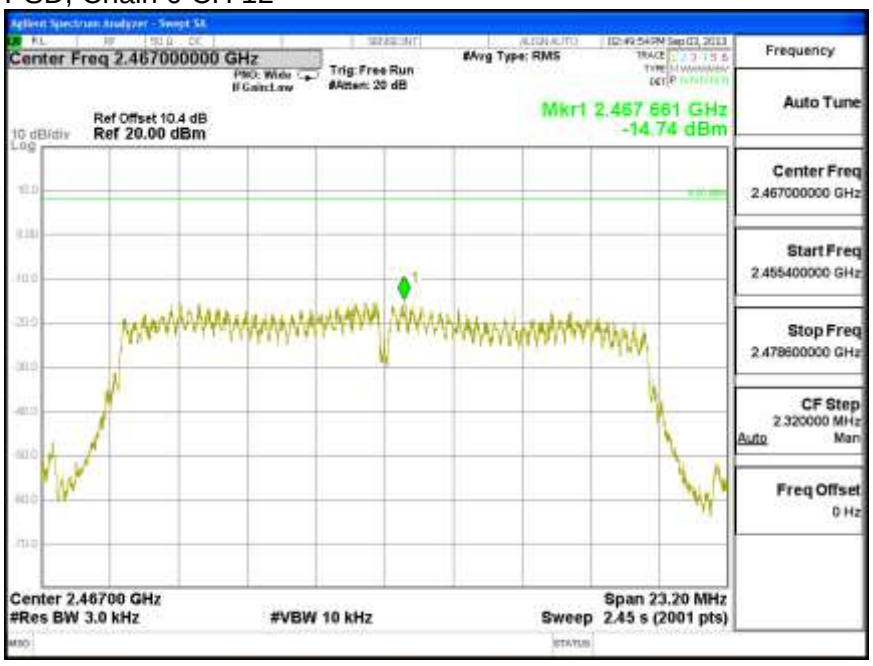
PSD, Chain 0 CH 6



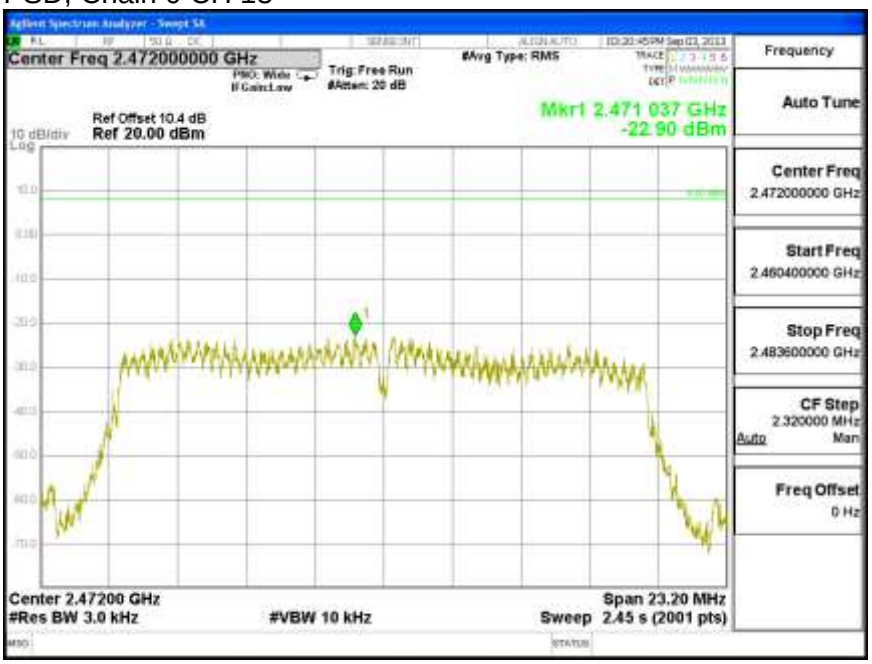
PSD, Chain 0 CH 11



PSD, Chain 0 CH 12

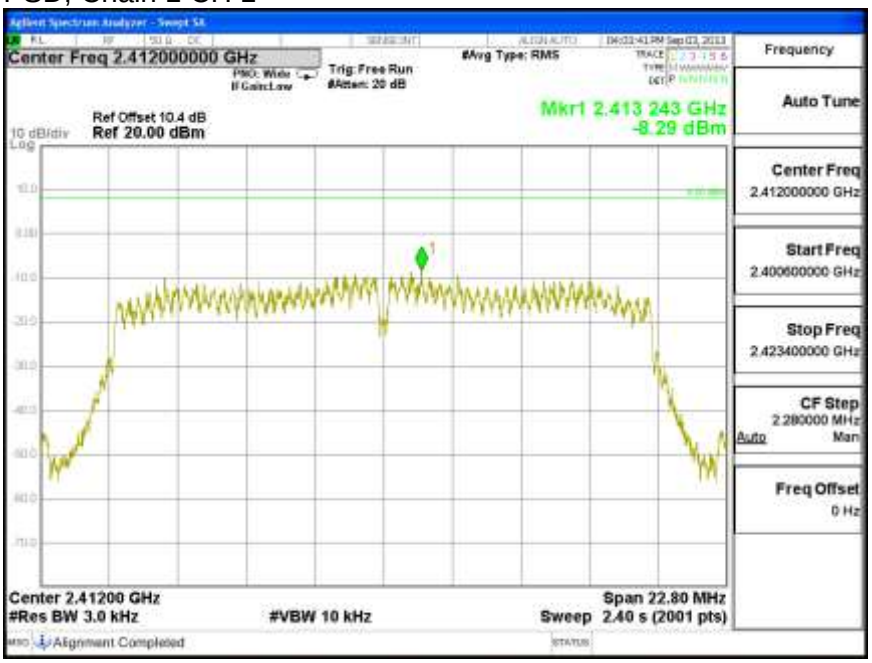


PSD, Chain 0 CH 13

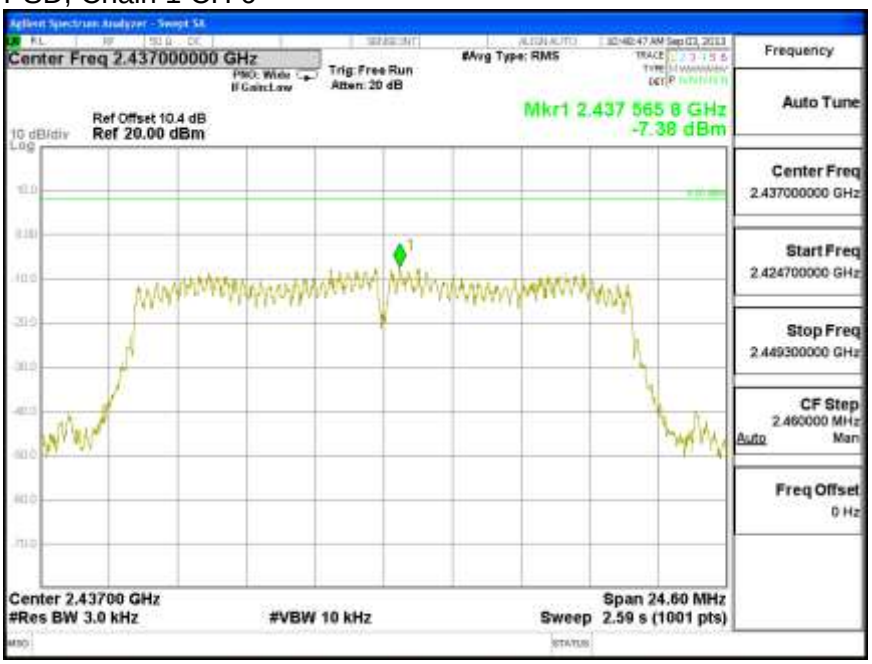


PSD, Chain 1

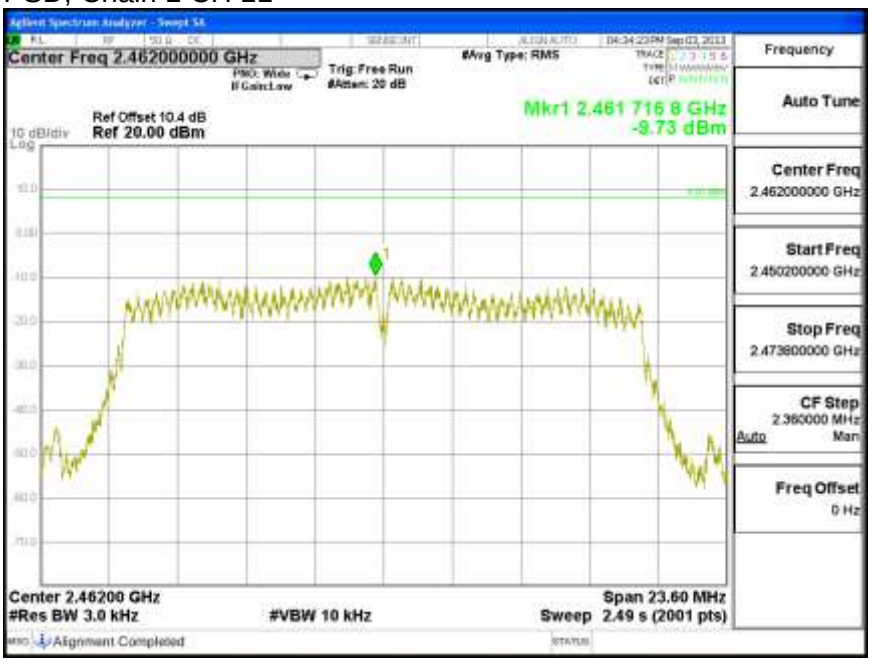
PSD, Chain 1 CH 1



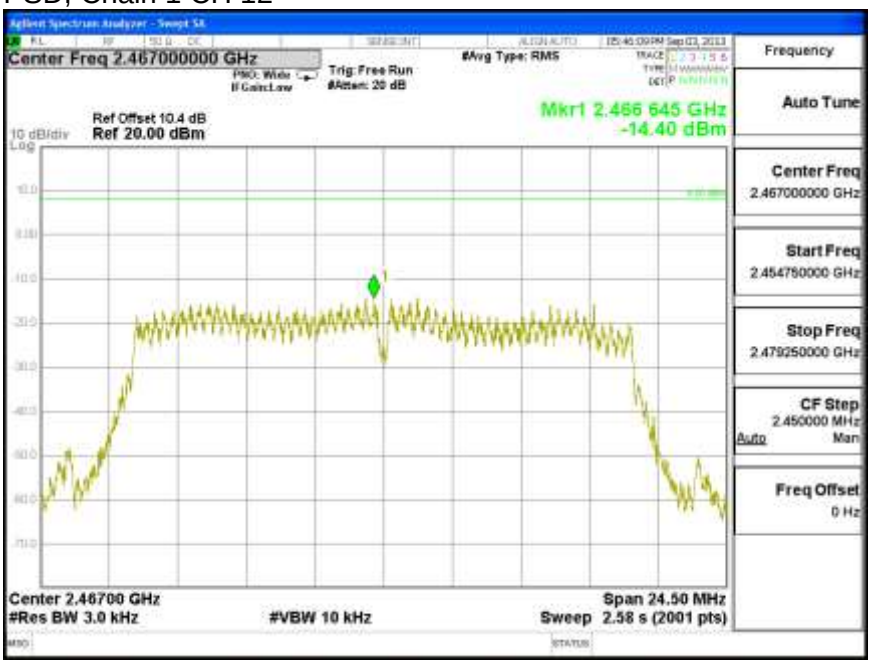
PSD, Chain 1 CH 6



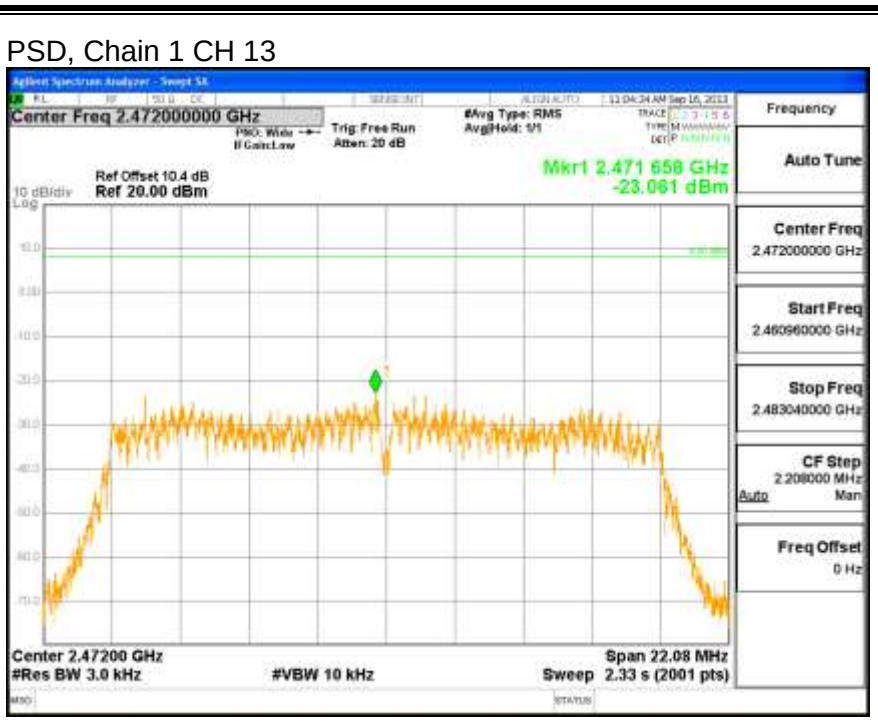
PSD, Chain 1 CH 11



PSD, Chain 1 CH 12



PSD, Chain 1 CH 13



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.

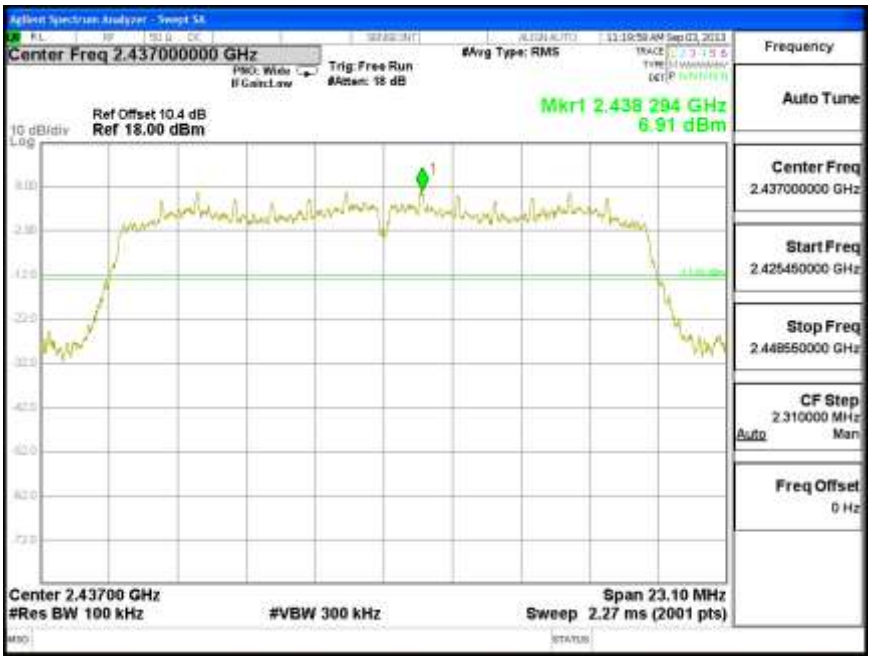
TEST PROCEDURE

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.

RESULTS

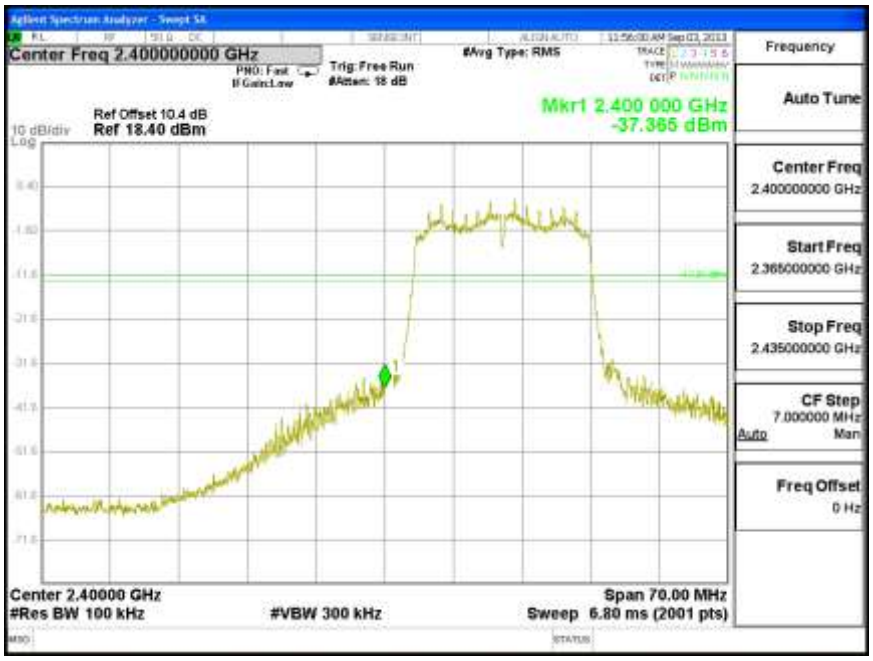
IN-BAND REFERENCE LEVEL, Chain 0

REFERENCE LEVEL Chain 0 CH 6



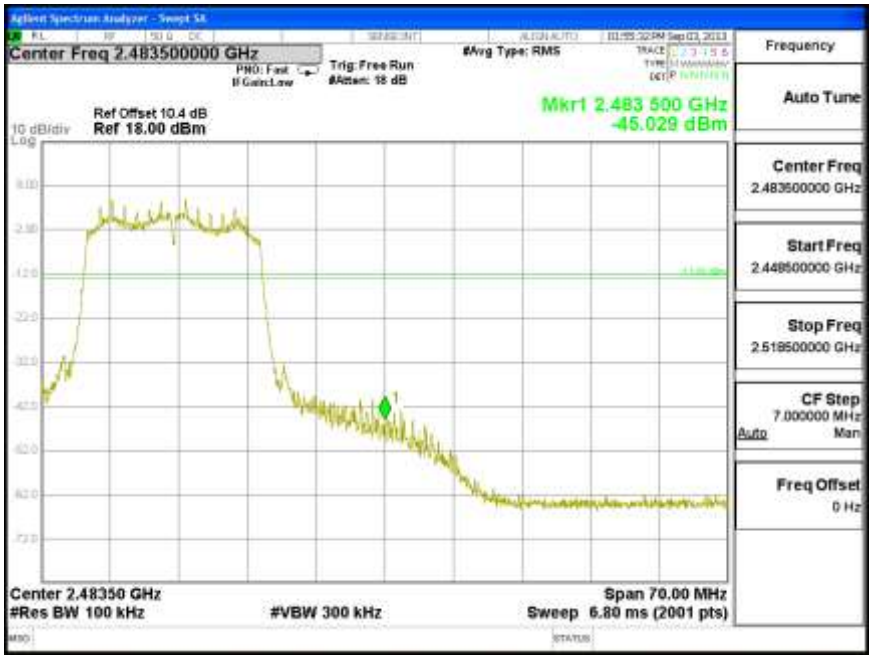
LOW CHANNEL BANDEDGE, Chain 0

AUTHORIZED BAND EDGE Chain 0 CH 1

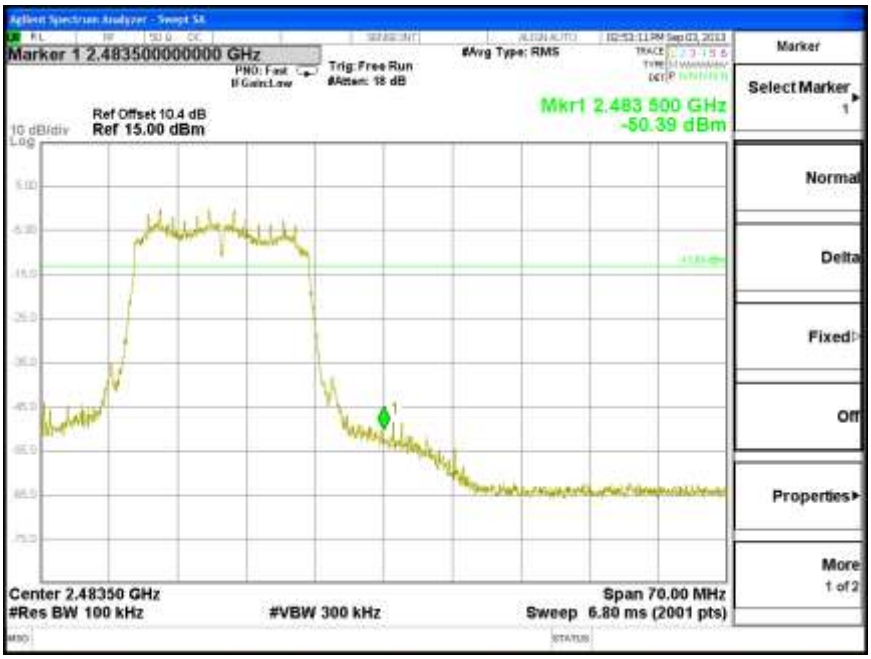


HIGH CHANNEL BANDEDGE, Chain 0

AUTHORIZED BAND EDGE Chain 0 CH 11



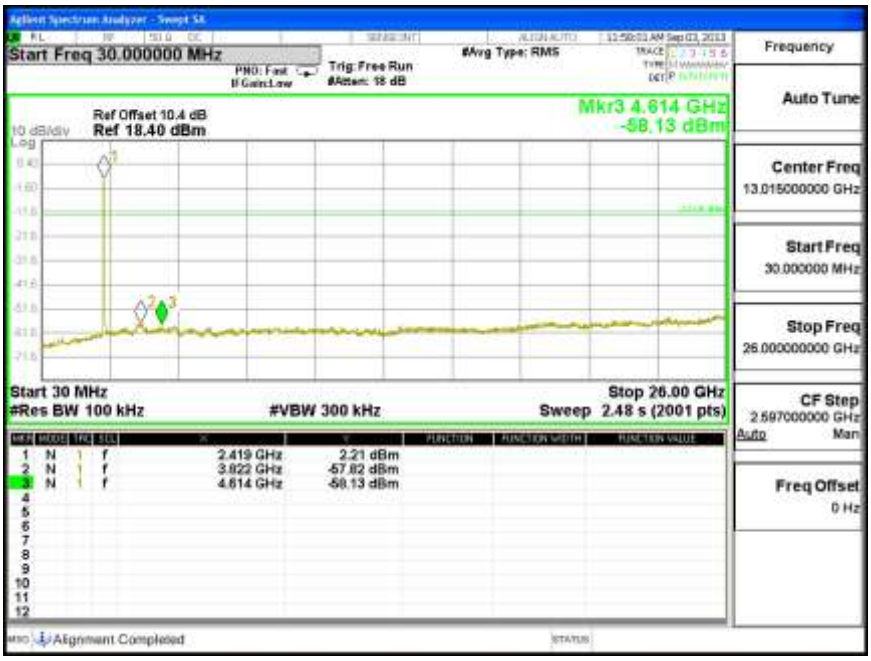
AUTHORIZED BAND EDGE Chain 0 CH 12



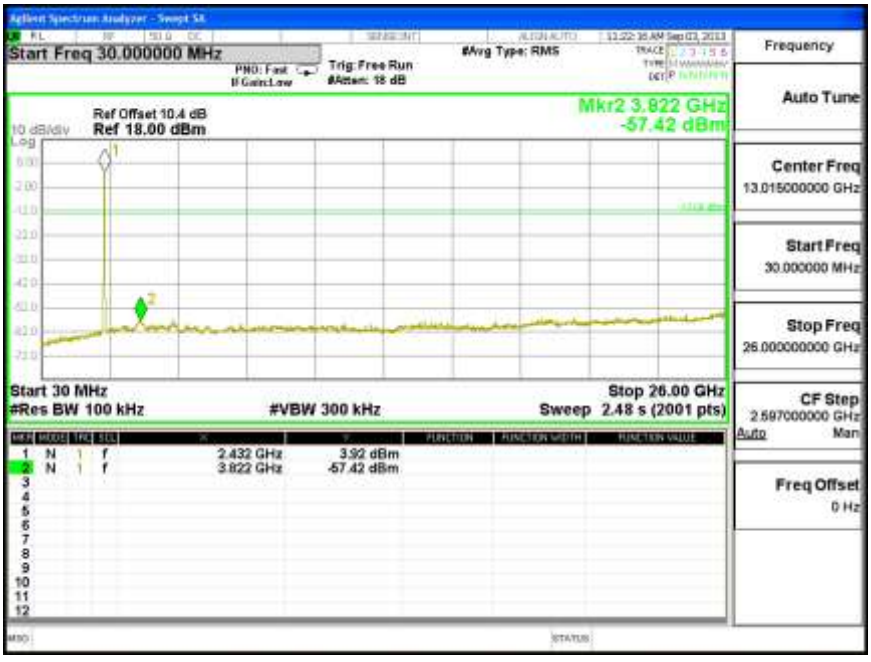
AUTHORIZED BAND EDGE Chain 0 CH 13

OUT-OF-BAND EMISSIONS, Chain 0

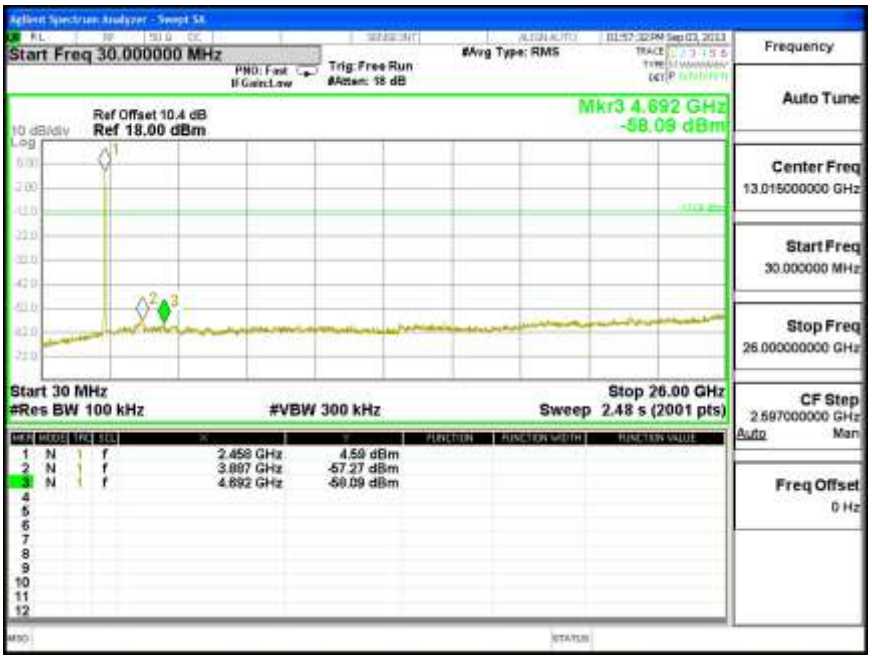
OUT OF BAND Chain 0 CH 1



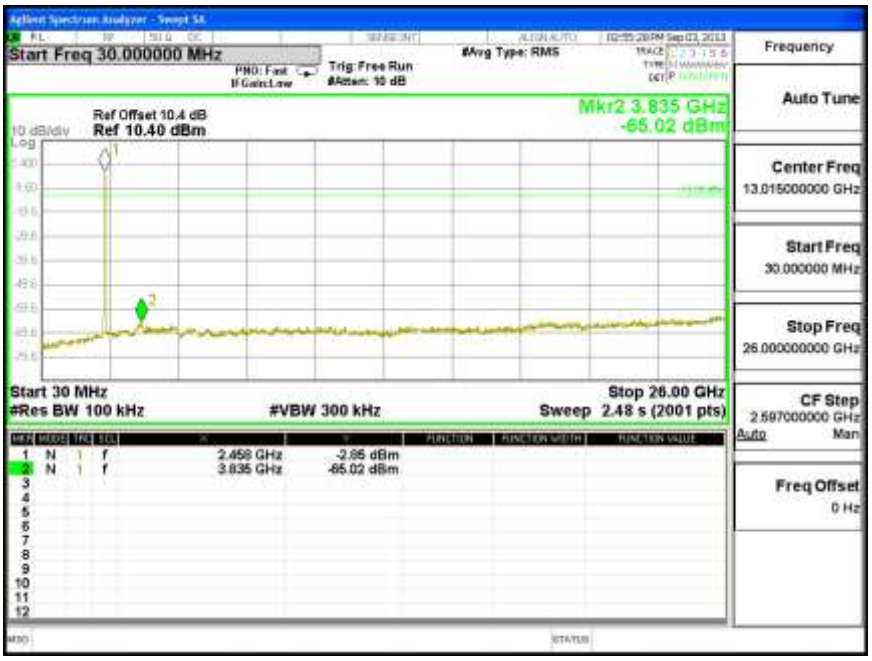
OUT OF BAND Chain 0 CH 6



OUT OF BAND Chain 0 CH 11



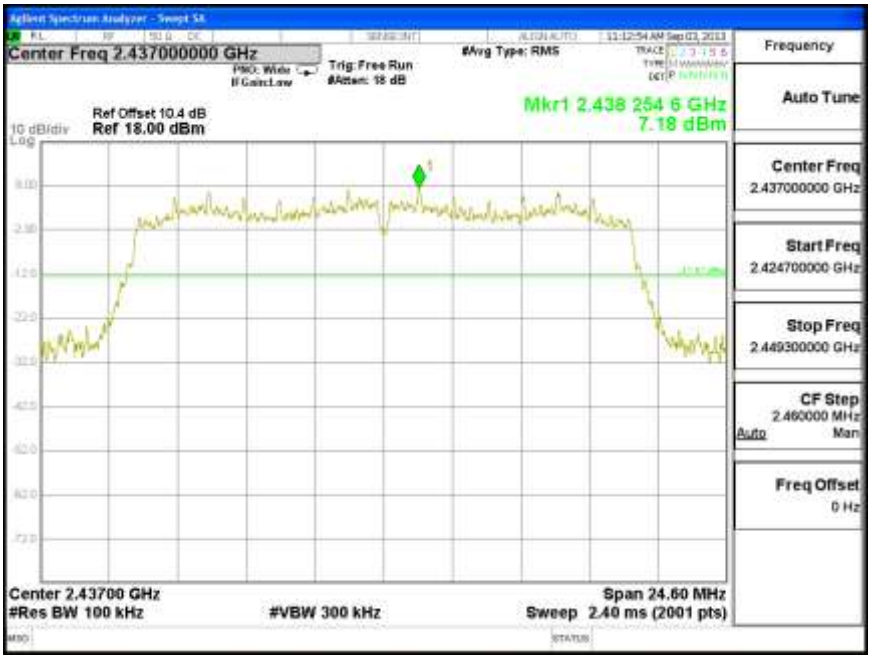
OUT OF BAND Chain 0 CH 12



OUT OF BAND Chain 0 CH 13

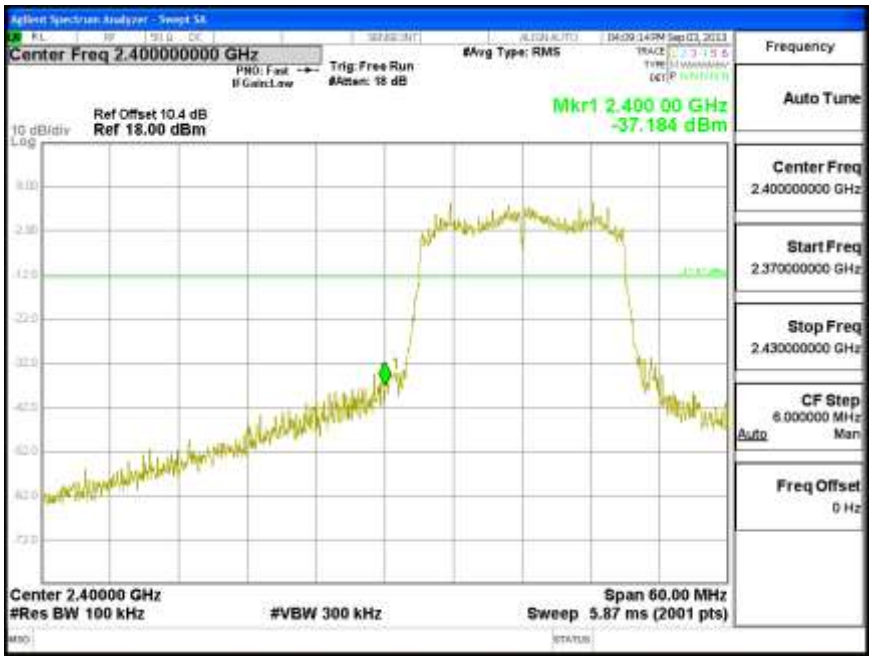
IN-BAND REFERENCE LEVEL, Chain 1

REFERENCE LEVEL Chain 1 CH 6



LOW CHANNEL BANDEDGE, Chain 1

AUTHORIZED BAND EDGE Chain 1 CH 1

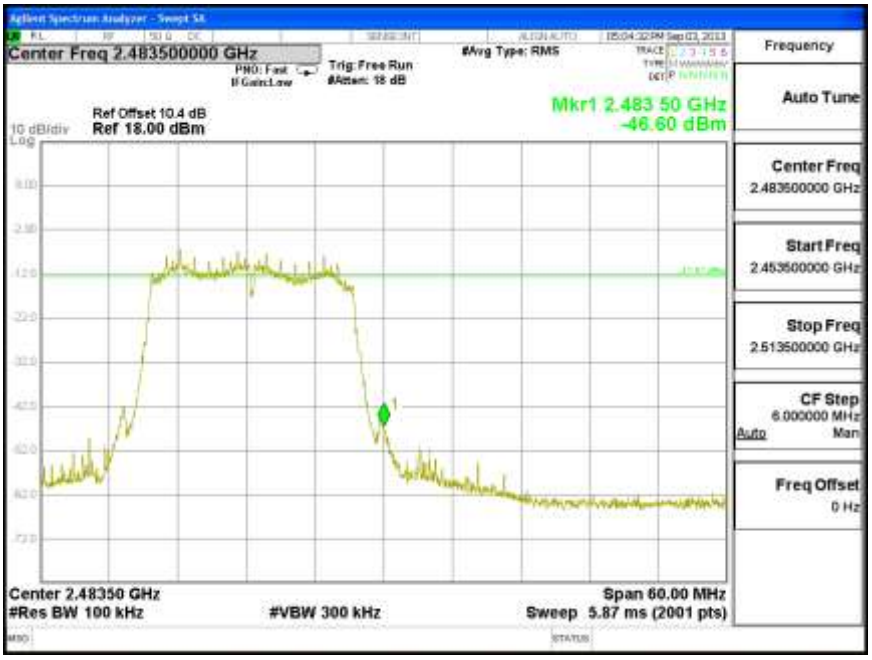


HIGH CHANNEL BANDEDGE, Chain 1

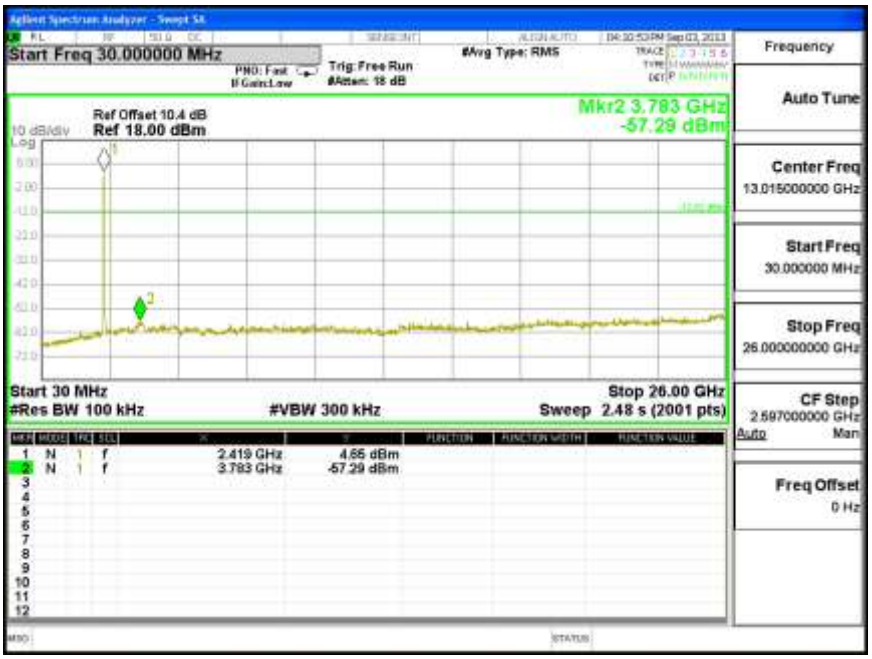
AUTHORIZED BAND EDGE Chain 1 CH 11

AUTHORIZED BAND EDGE Chain 1 CH 12

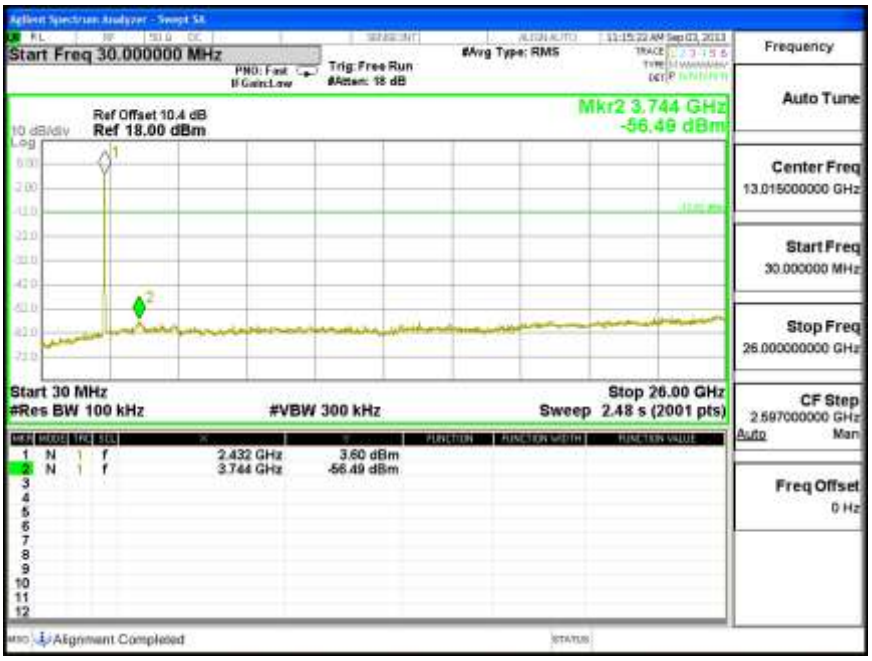
AUTHORIZED BAND EDGE Chain 1 CH 13



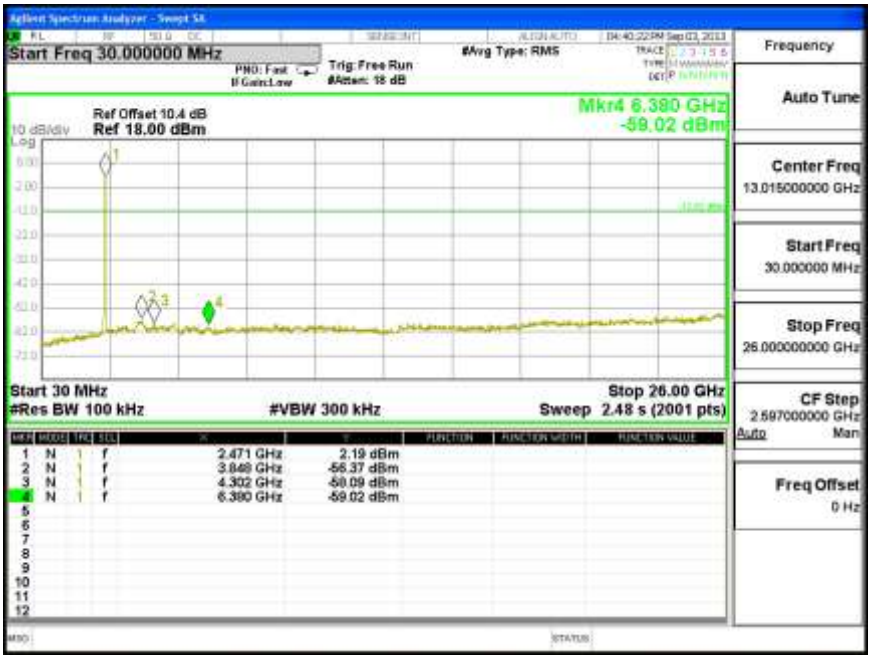
OUT OF BAND Chain 1 CH 1



OUT OF BAND Chain 1 CH 6

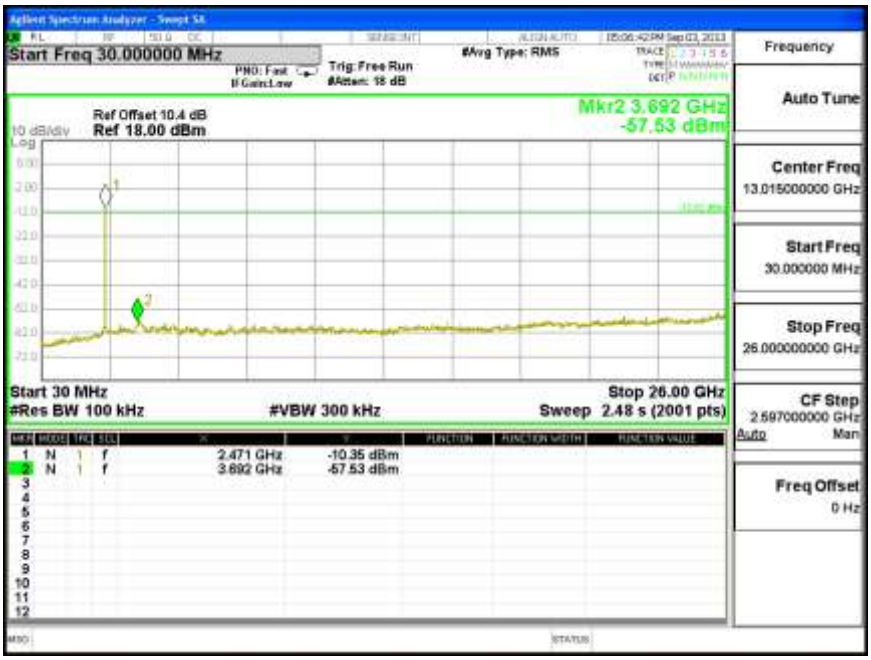


OUT OF BAND Chain 1 CH 11



OUT OF BAND Chain 1 CH 12

OUT OF BAND Chain 1 CH 13



8.4. 802.11a 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.

TEST PROCEDURE

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

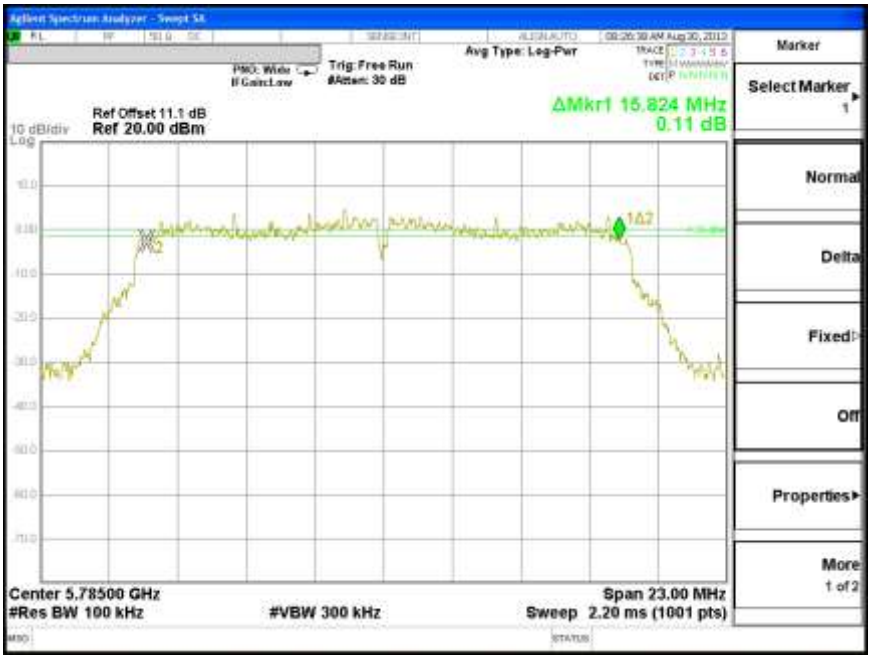
RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	5745	16.284	0.5
Mid	5785	15.824	0.5
High	5825	15.571	0.5

6 dB BANDWIDTH

6 dB BANDWIDTH LOW CH

6 dB BANDWIDTH MID CH



6 dB BANDWIDTH HIGH CH

8.4.2. 99% BANDWIDTH

LIMITS

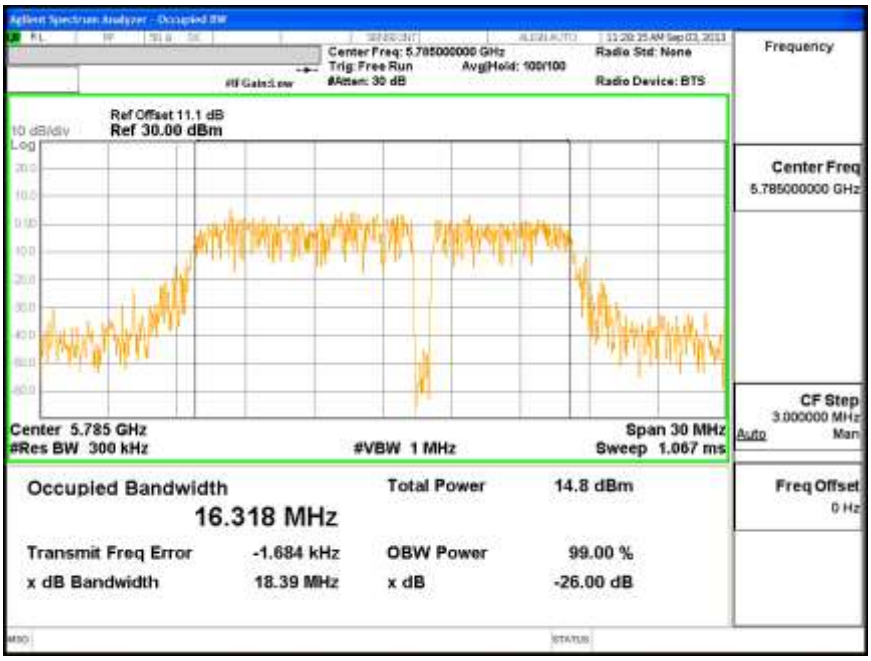
None; for reporting purposes only.

RESULTS

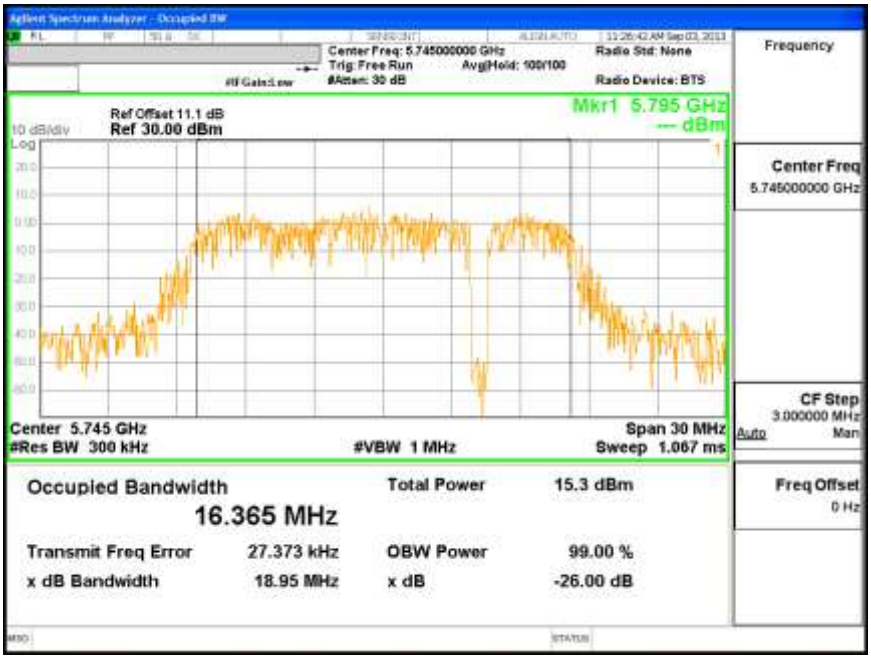
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5745	16.3180
Mid	5785	16.3650
High	5825	16.3300

99% BANDWIDTH

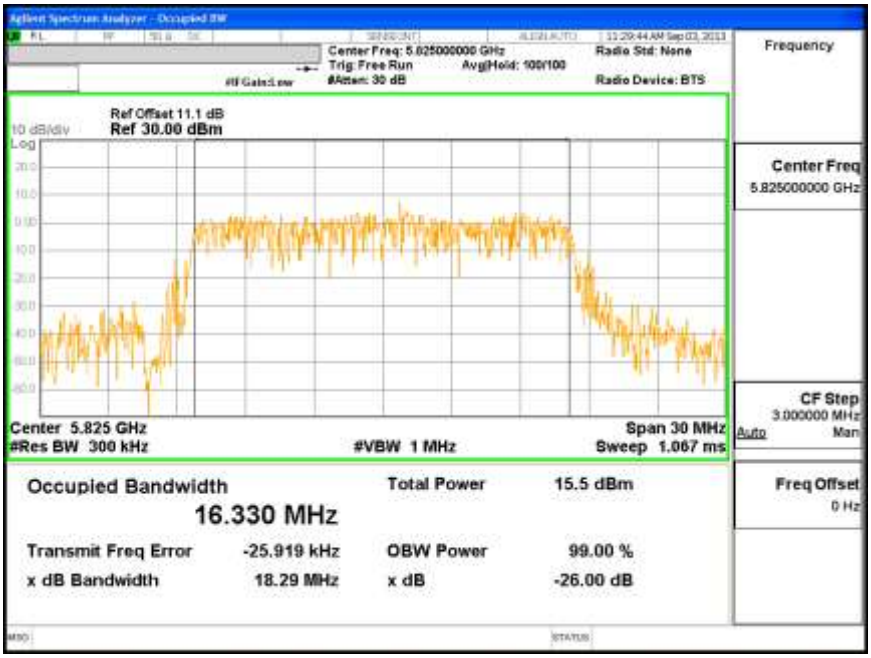
99% BANDWIDTH LOW CH



99% BANDWIDTH MID CH



99% BANDWIDTH HIGH CH



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 11.1 dB (including 10 dB pad and 1.1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5745	15.49
Mid	5785	15.50
High	5825	15.45

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

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

RESULTS

Limits

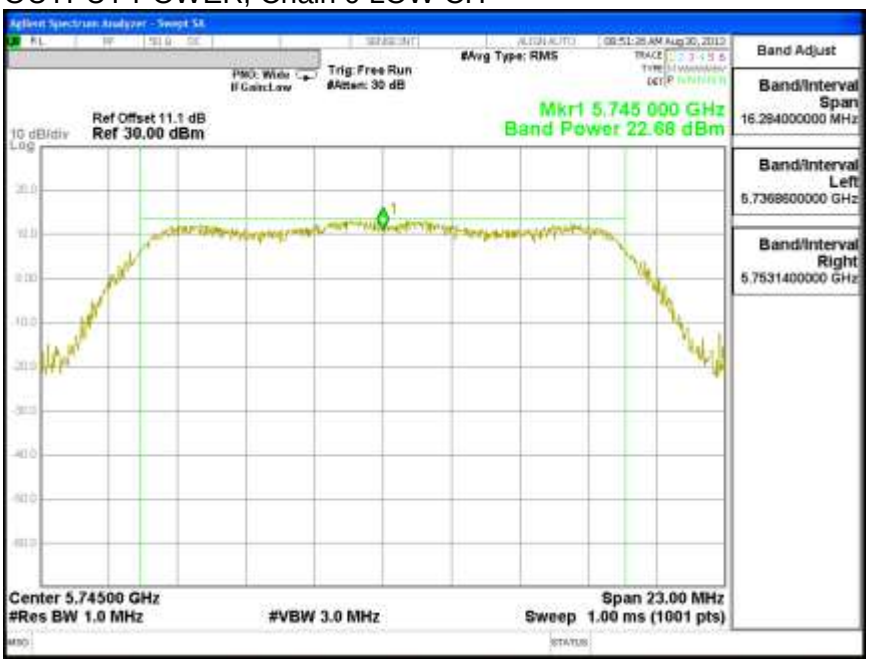
Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	5745	3.76	30.00	30	36	30.00
Mid	5785	3.76	30.00	30	36	30.00
High	5825	3.76	30.00	30	36	30.00

Results

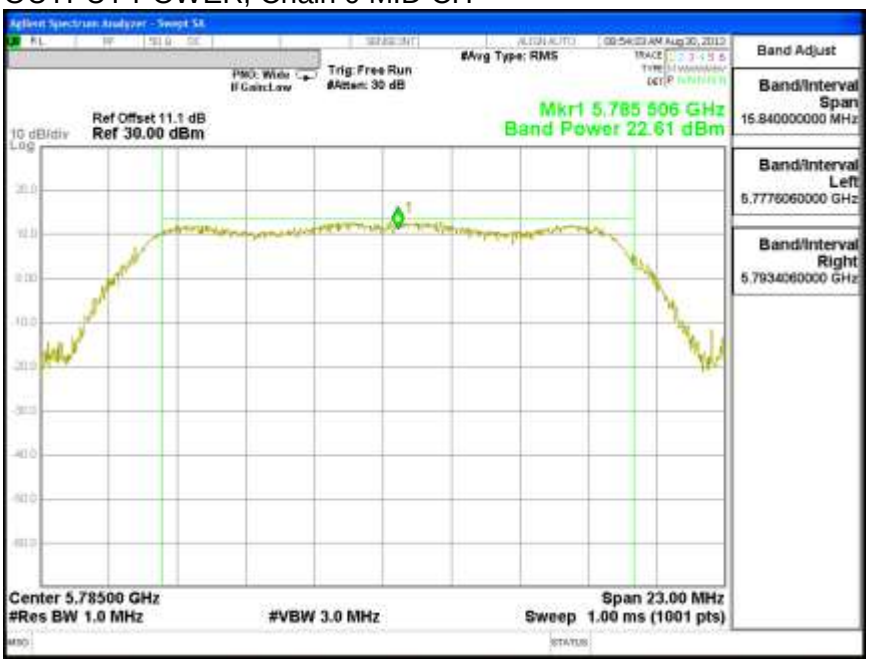
Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	5745	22.68	22.68	30.00	-7.32
Mid	5785	22.61	22.61	30.00	-7.39
High	5825	22.89	22.89	30.00	-7.11

OUTPUT POWER, Chain 0

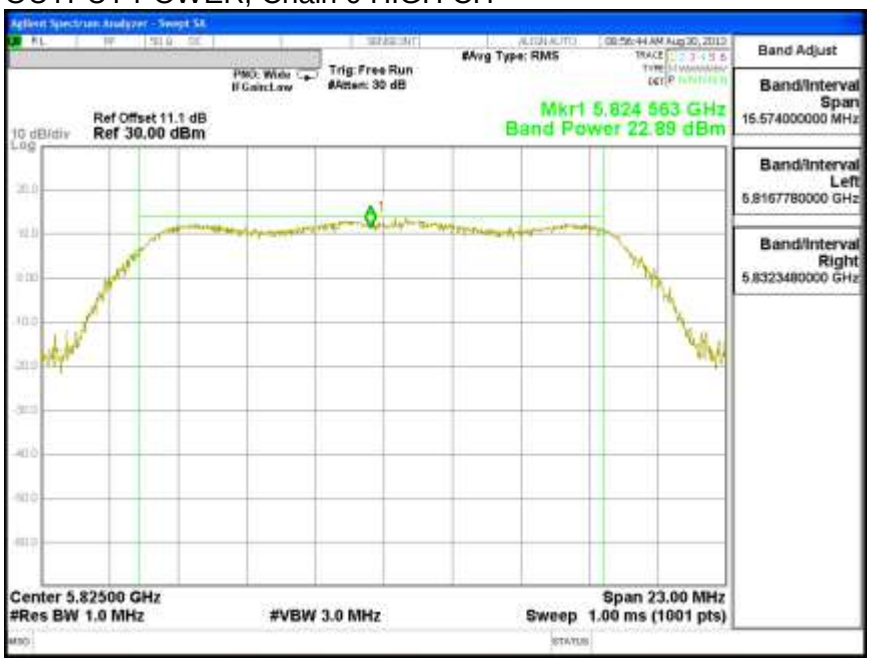
OUTPUT POWER, Chain 0 LOW CH



OUTPUT POWER, Chain 0 MID CH



OUTPUT POWER, Chain 0 HIGH CH



8.4.5. 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.

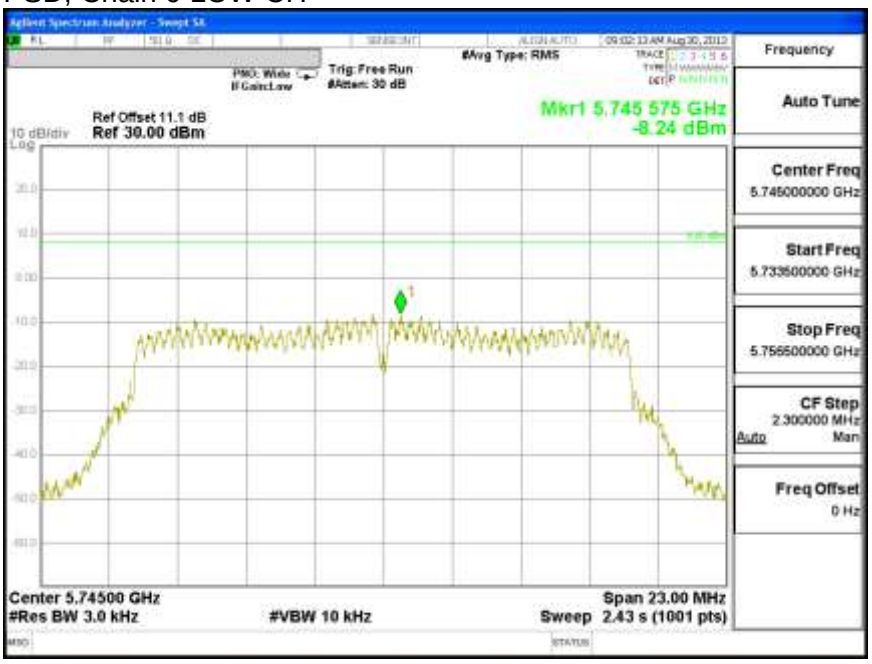
RESULTS

PSD Results

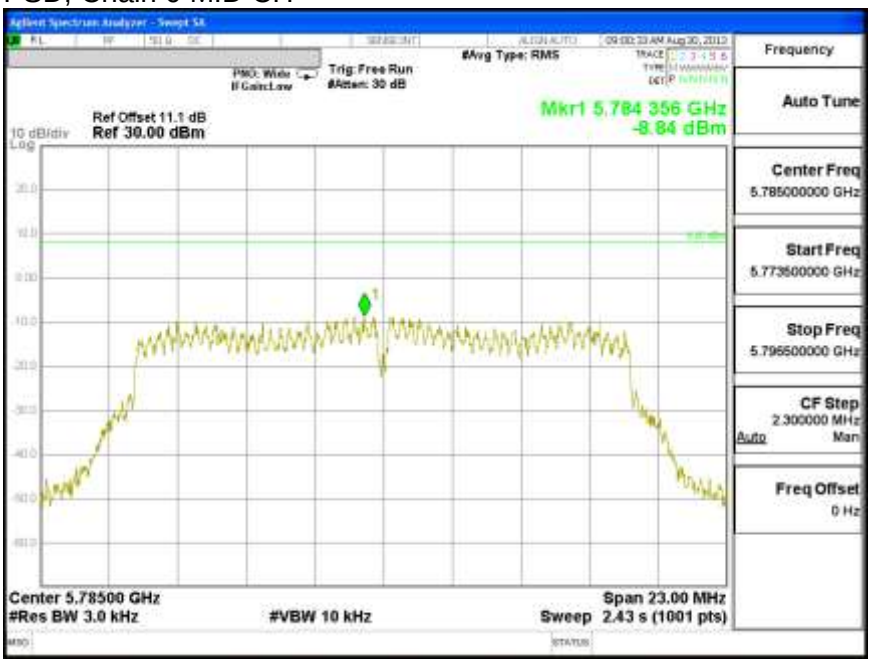
Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Limit (dBm)	Margin (dB)
Low	5745	-8.24	8.0	-16.2
Mid	5785	-8.84	8.0	-16.8
High	5825	-8.11	8.0	-16.1

PSD, Chain 0

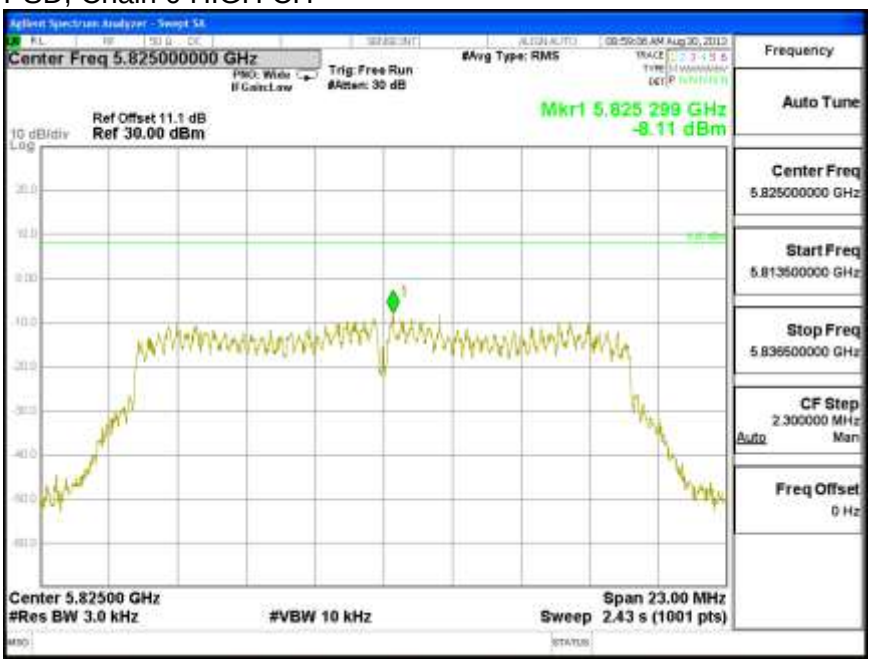
PSD, Chain 0 LOW CH



PSD, Chain 0 MID CH



PSD, Chain 0 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.

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.

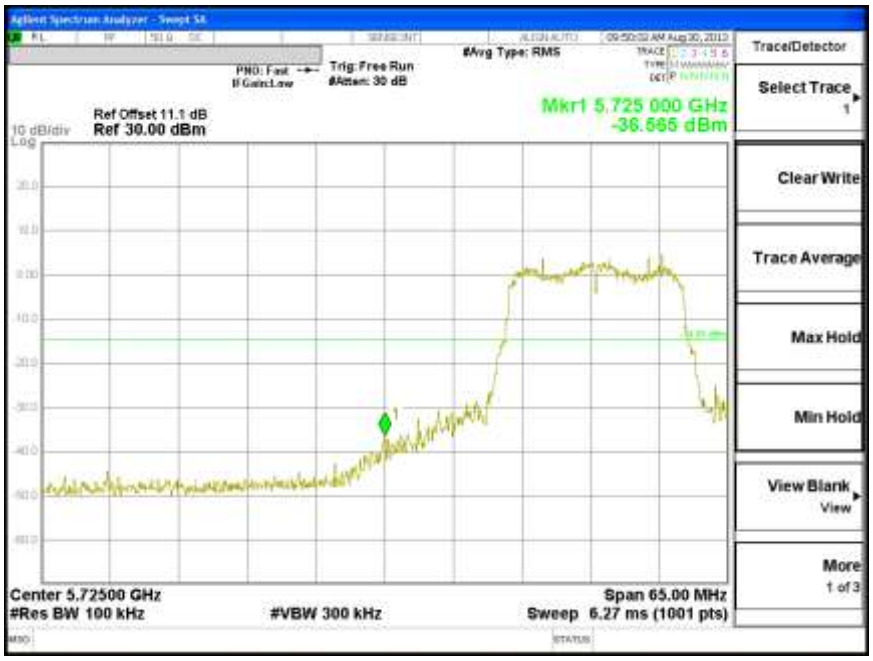
RESULTS

IN-BAND REFERENCE LEVEL

REFERENCE LEVEL MID CH

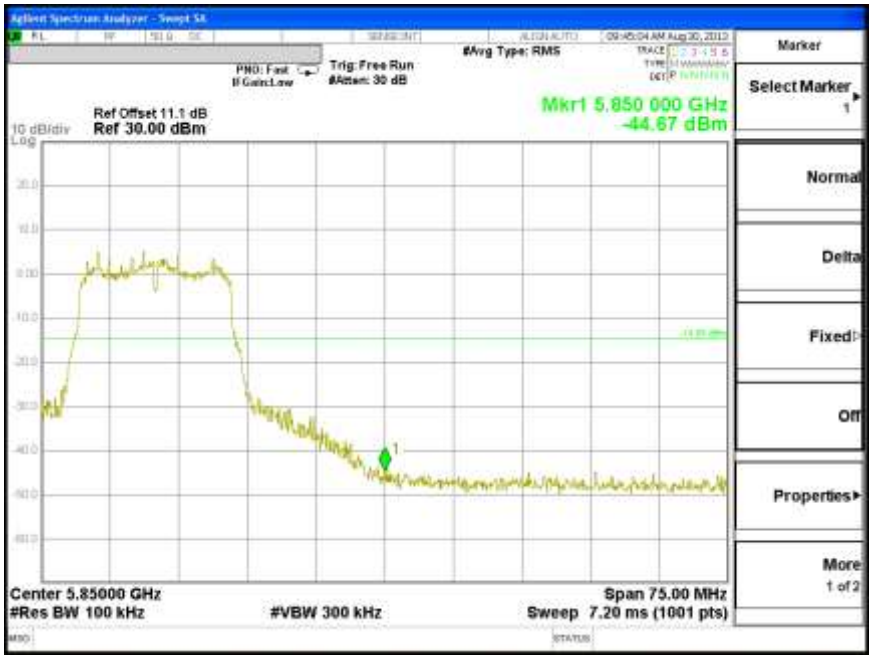
LOW CHANNEL BANDEDGE

AUTHORIZED BAND EDGE LOW CH



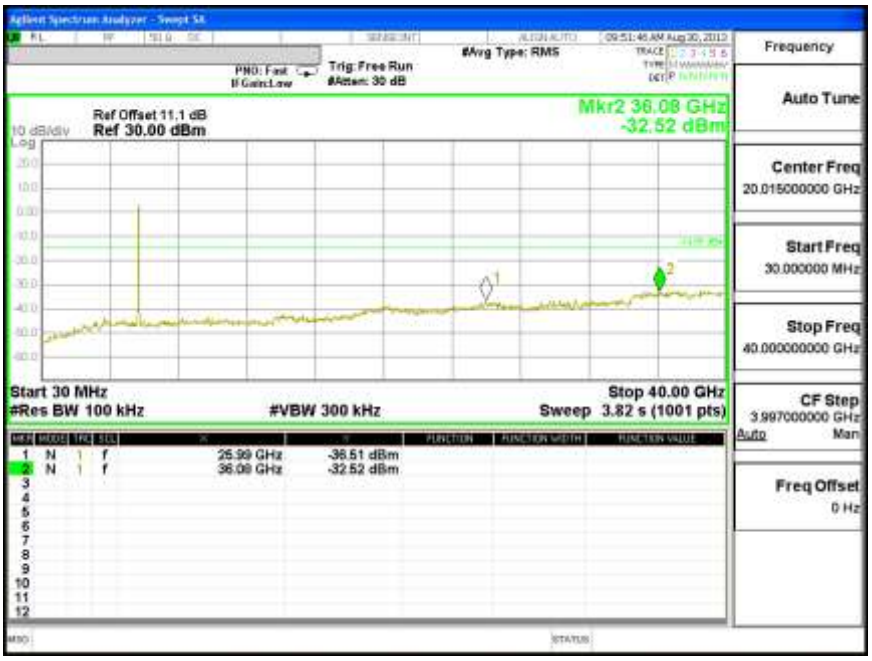
HIGH CHANNEL BANDEDGE

AUTHORIZED BAND EDGE HIGH CH

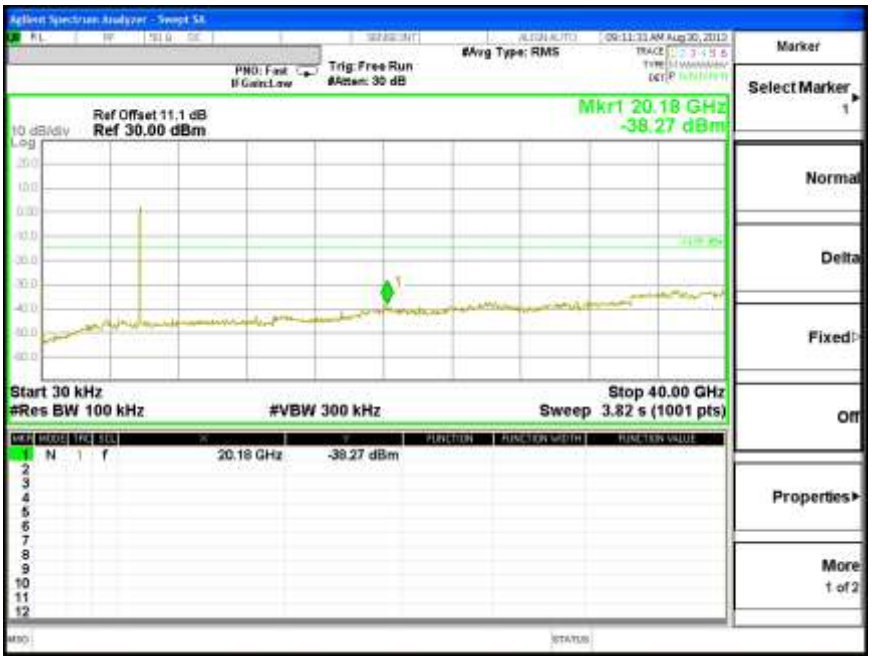


OUT-OF-BAND EMISSIONS

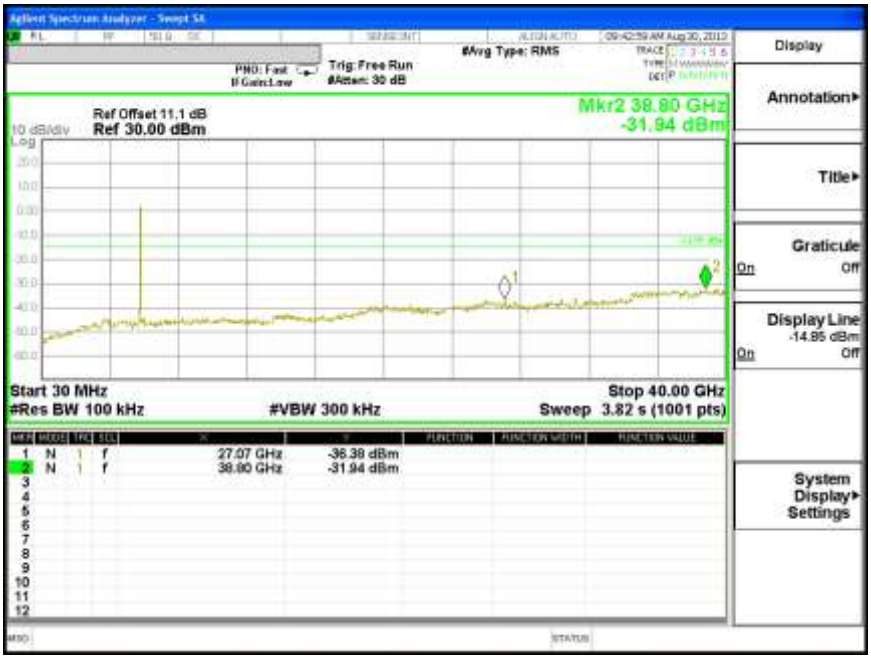
OUT OF BAND LOW CH



OUT OF BAND MID CH



OUT OF BAND HIGH CH



8.5. 802.11n HT20 MODE IN THE 5.8 GHz BAND

8.5.1. 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

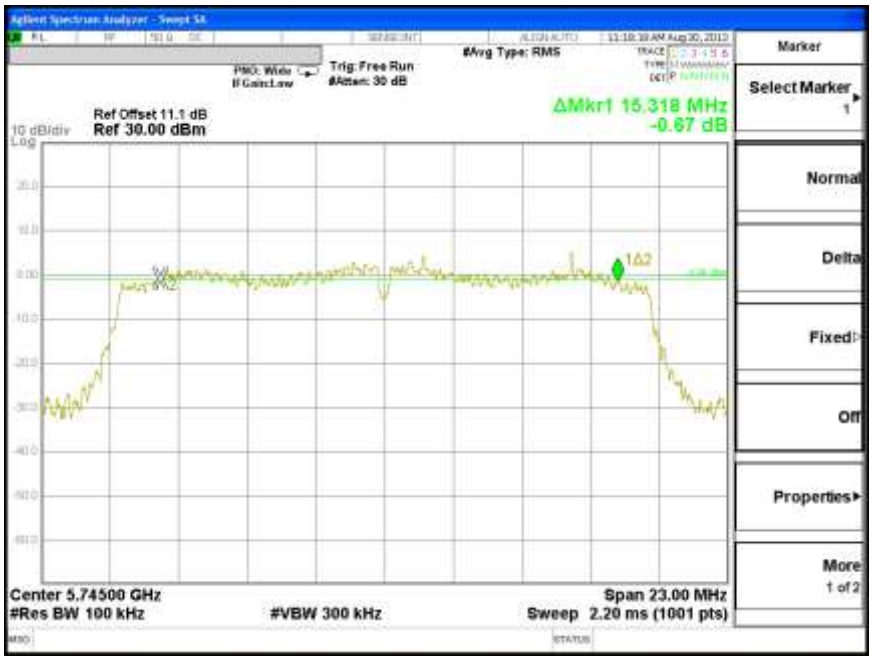
KDB 558074 D01 v01 “Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247”.

RESULTS

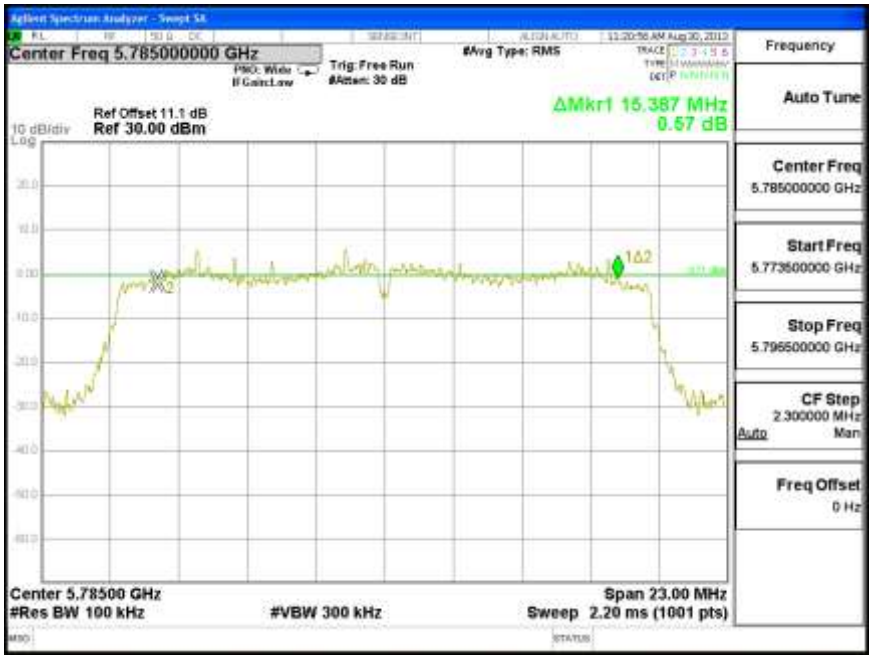
Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low	5745	15.318	15.249	0.5
Mid	5785	15.387	15.479	0.5
High	5825	15.387	15.709	0.5

6 dB BANDWIDTH, Chain 0

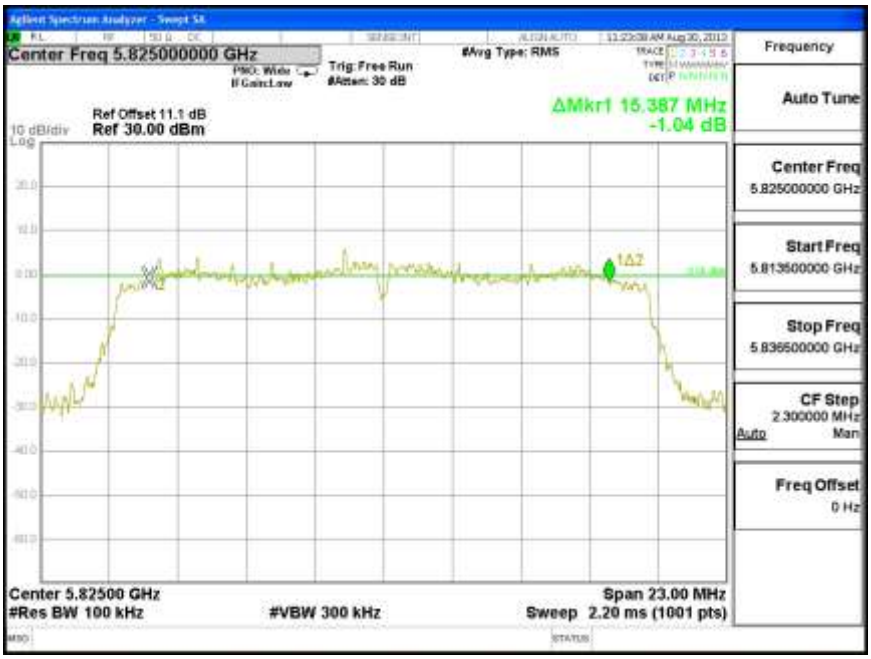
6 dB BANDWIDTH Chain 0 LOW CH



6 dB BANDWIDTH Chain 0 MID CH

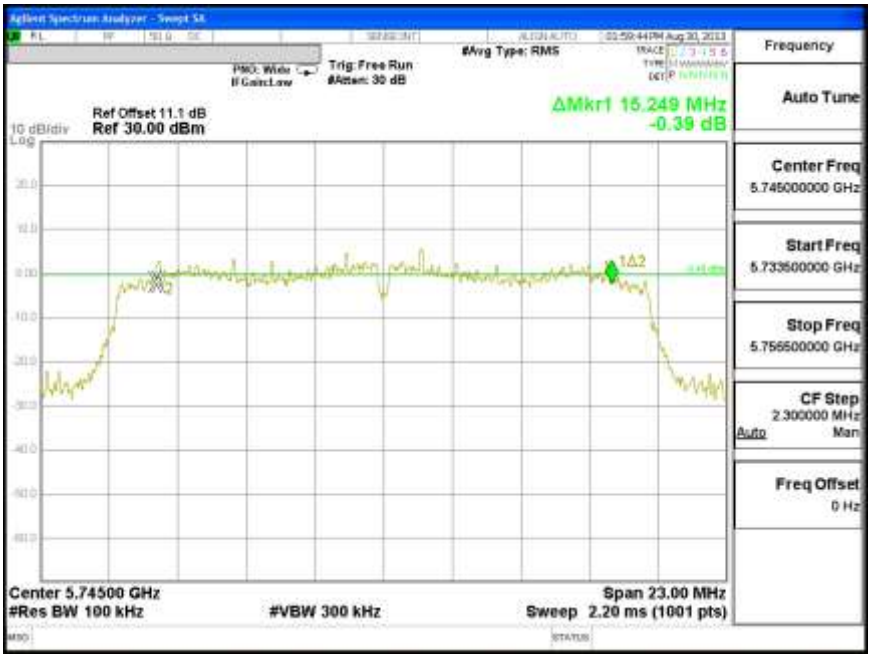


6 dB BANDWIDTH Chain 0 HIGH CH

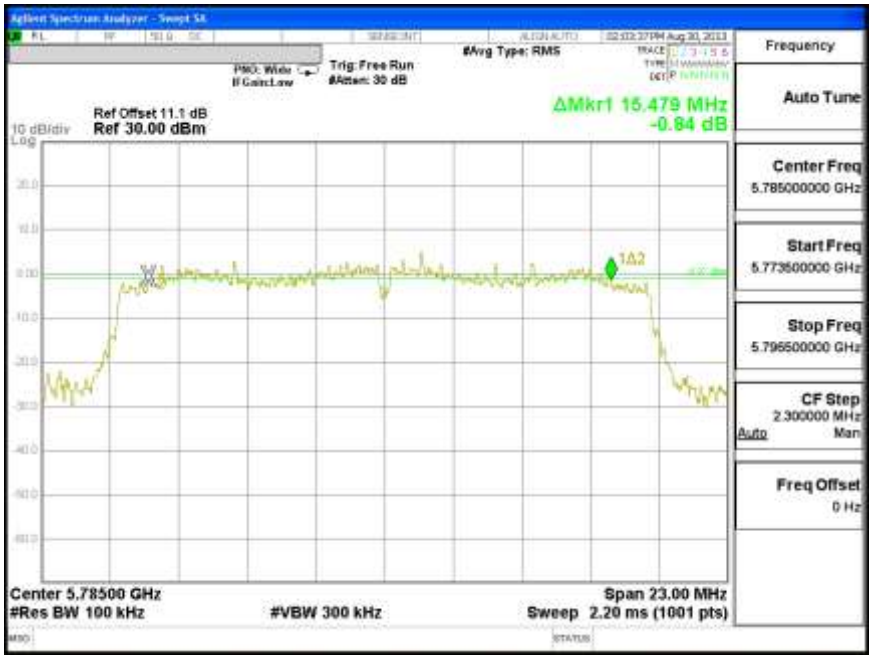


6 dB BANDWIDTH, Chain 1

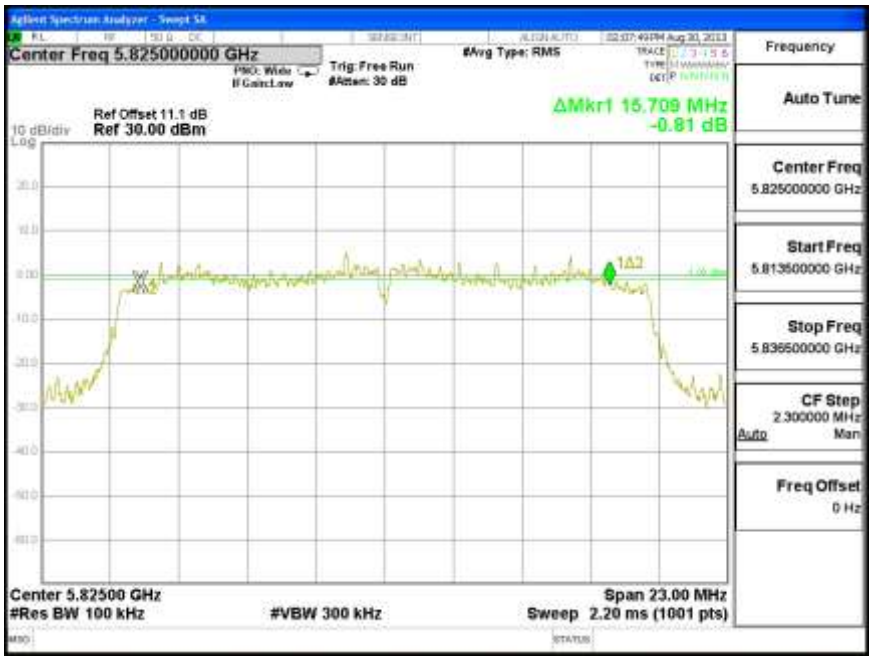
6 dB BANDWIDTH Chain 1 LOW CH



6 dB BANDWIDTH Chain 1 MID CH



6 dB BANDWIDTH Chain 1 HIGH CH



8.5.2. 99% BANDWIDTH

LIMITS

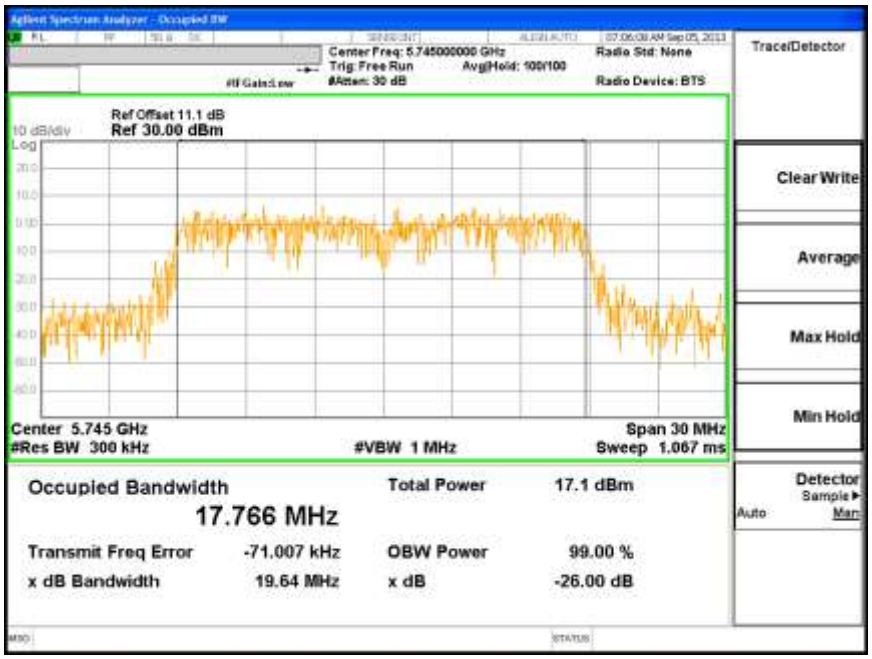
None; for reporting purposes only.

RESULTS

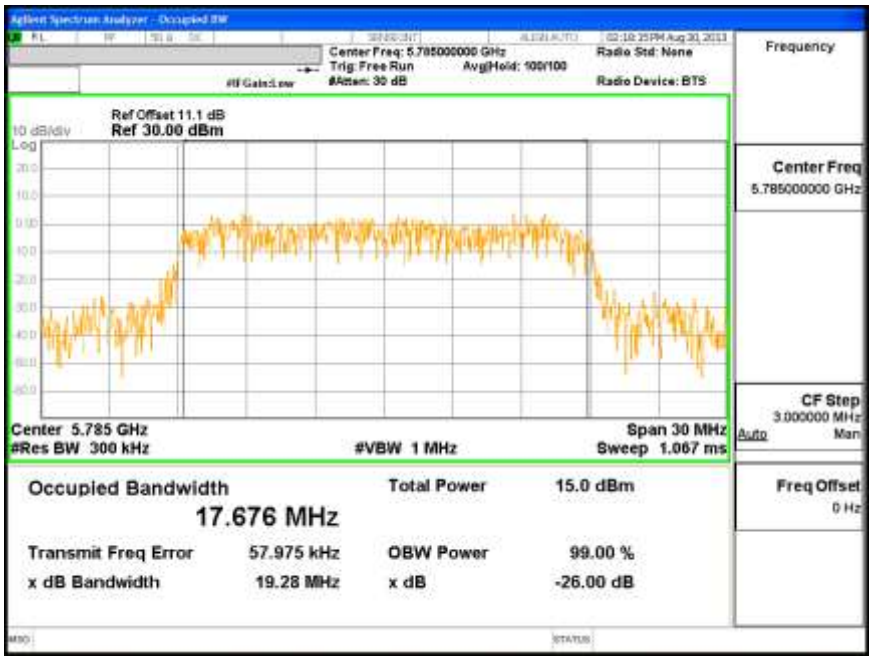
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low	5745	17.766	17.604
Mid	5785	17.676	17.676
High	5825	17.765	17.689

99% BANDWIDTH, Chain 0

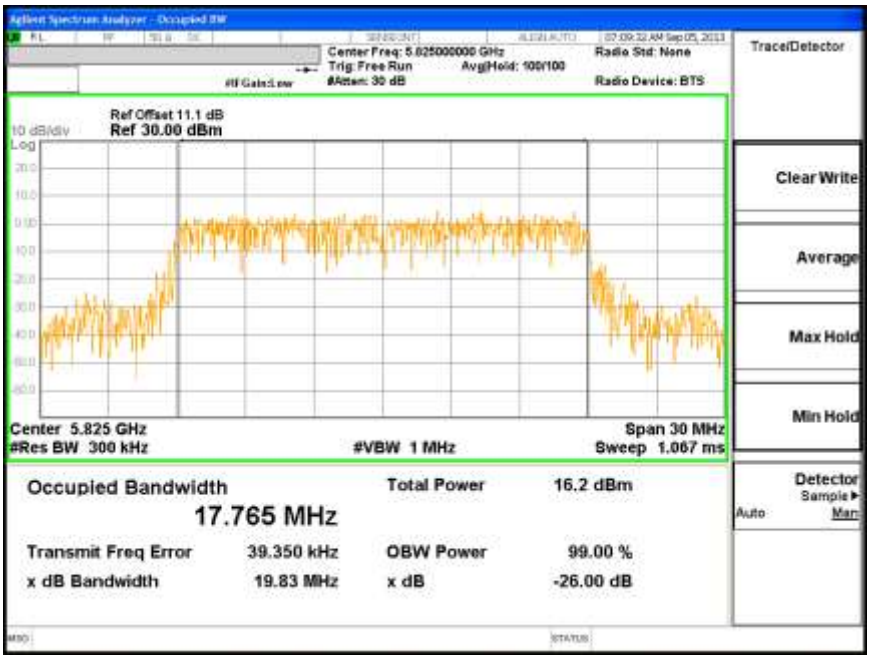
99% BANDWIDTH Chain 0 LOW CH



99% BANDWIDTH Chain 0 MID CH

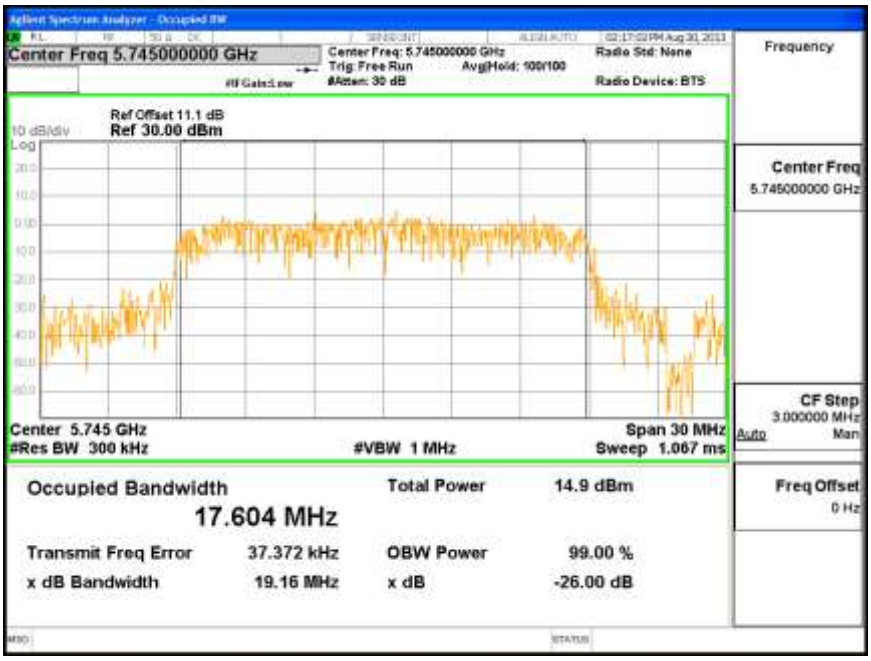


99% BANDWIDTH Chain 0 HIGH CH

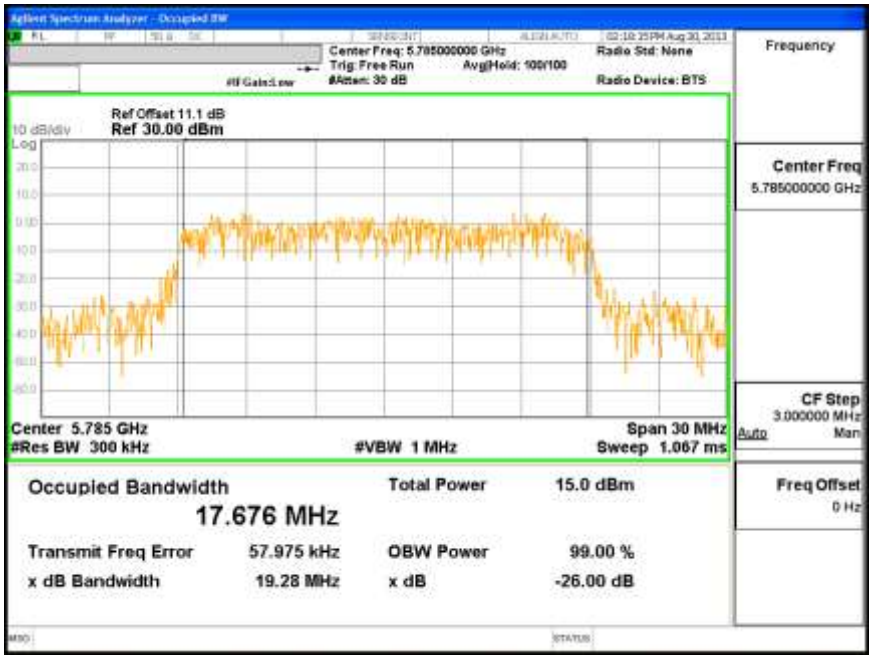


99% BANDWIDTH, Chain 1

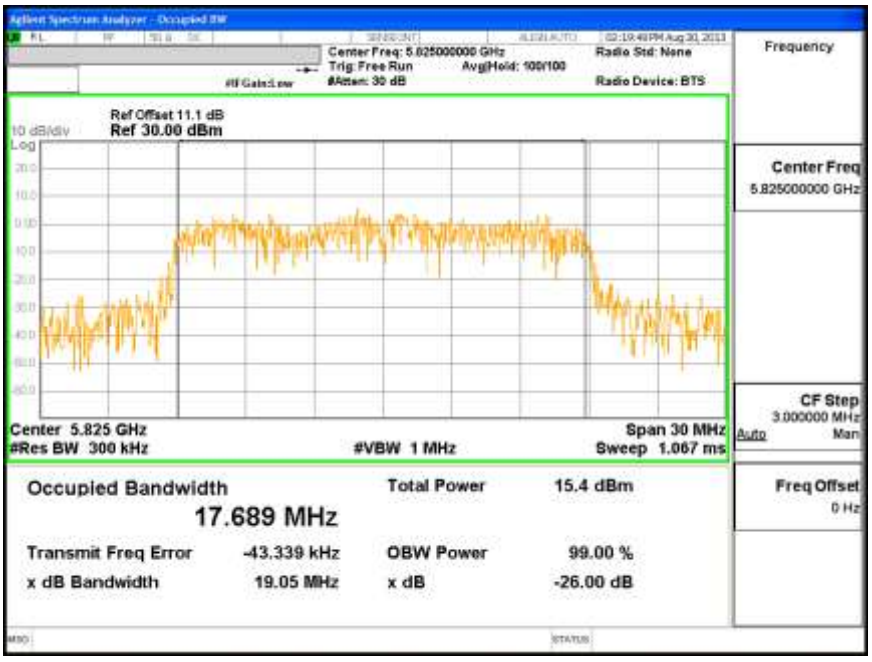
99% BANDWIDTH Chain 1 LOW CH



99% BANDWIDTH Chain 1 MID CH



99% BANDWIDTH Chain 1 HIGH CH



8.5.3. 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 11.1 dB (including 10 dB pad and 1.1 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	15.45	15.50	18.49
Mid	5785	15.48	15.50	18.50
High	5825	15.50	15.45	18.49

8.5.4. 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)
2.68	3.76	3.25