FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-247 ISSUE 1

CERTIFICATION TEST REPORT

FOR

PORTABLE COMPUTER

MODEL NUMBER: A1708

FCC ID: BCGA1708
IC: 579C-A1708

REPORT NUMBER: 16U23796-E3V3

ISSUE DATE: OCBTOBER 07, 2016

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
V1	9/22/2016	Initial Issue	Mengistu Mekuria
V2	9/23/2016	Corrected IC ID on header	Tina Chu
V3	10/07/2016	Revised Section 5.2 to address TCB's questions	Tina Chu

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: PORTABLE COMPUTER

MODEL: A1708

SERIAL NUMBER: C02RV00WH9FM (CONDUCTED),
C02RT00HH4RK (RADIATED)

DATE TESTED: JUNE 28, 2016 – SEPTEMBER 08, 2016

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-247 Issue 1	Pass
INDUSTRY CANADA RSS-GEN Issue 4	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:

MENGISTU MEKURIA
PROJECT LEADER
UL VERIFICATION SERVICES INC.

Prepared By:

JOE VANG
EMC ENGINEER
UL VERIFICATION SERVICES INC.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, KDB 558074 D01 v03r05, ANSI C63.10-2013, RSS-GEN Issue 4, and RSS-247 Issue 1.

3. FACILITIES AND ACCREDITATION

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

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

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-8, respectively.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Radiated Disturbance,1000 to 18000 MHz	4.32 dB
Radiated Disturbance,18000 to 26000 MHz	4.45 dB
Radiated Disturbance,26000 to 40000 MHz	5.24 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a laptop device with Bluetooth and WLAN Radios (AC 80 MHZ Beam-Forming).

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2472	802.11b 1TX	21.04	127.06
2412 - 2472	802.11b 2TX	23.90	245.47
2412 - 2472	802.11g 1TX	Covered by HT20 1TX	
2412 - 2472	802.11g 2TX	Covered by HT20 2TX CDD	
2412 - 2472	802.11n HT20 1TX	24.11	257.63
2412 - 2472	802.11n HT20 2TX CDD	28.21	662.22
2412 - 2472	802.11ac VHT20 2TX Beam Forming	25.44	349.95

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Gain (dBi)	
	Chain 0	Chain 1
2.4	4.2	5.1

5.4. SOFTWARE AND FIRMWARE

The firmware version installed in the EUT during testing was 7.21.163

5.5. WORST-CASE CONFIGURATION AND MODE

For below 1G radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as the worst-case scenario.

For g and HT20 modes, radiated harmonics spurious and power line conducted emissions were performed with the EUT set at the CDD mode at highest power setting among the CDD/STBC/SDM/Beamforming modes as worst-case scenario.

EUT was investigated with and without AC/DC Charger and the worst case was determined to be with charger. Therefore, all testing was performed with AC/DC charger in normal use orientation as described by the manufacturer.

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

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

The following modes have the same target power and use the same modulation (OFDM). Therefore, 802.11g 1TX and 802.11g 2TX are covered by 802.11n HT20 1TX and 802.11n HT20 2TX CDD respectively.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/ DC Adapter	Apple Inc.	A1718	N/A	N/A
Earphone	Apple Inc.	N/A	N/A	N/A

I/O CABLES (CONDUCTED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC	1	USB-C	Un-Shielded	2	N/A
2	Antenna	2	SMA	Un-Shielded	0.2	To Spectrum Analyzer

I/O CABLES (ABOVE 1G RADIATED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC	1	USB-C	Un-Shielded	2	N/A

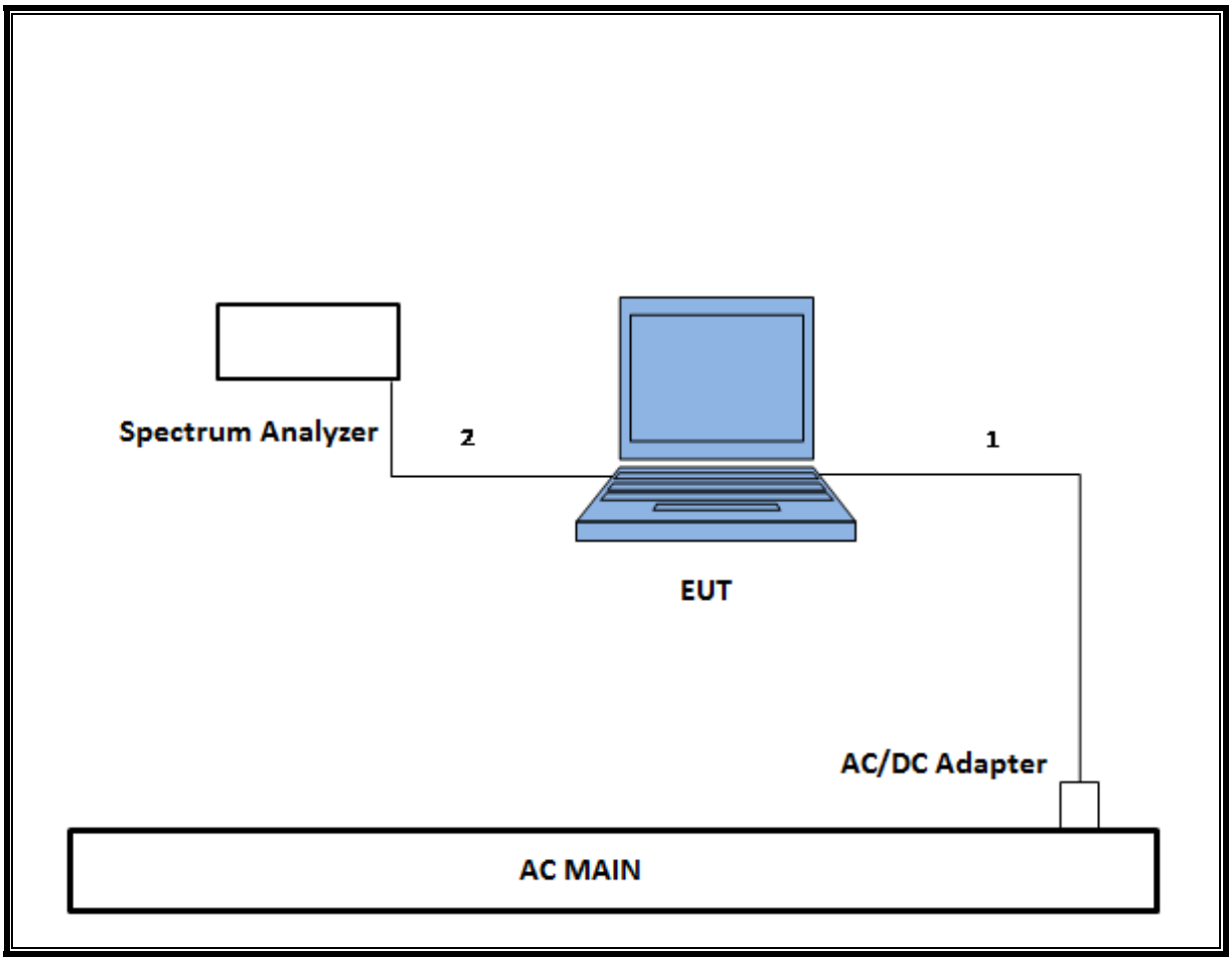
I/O CABLES (BELOW 1G RADIATED AND AC POWER CONDUCTED TEST)

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

TEST SETUP- CONDUCTED PORT

The EUT was tested connected to spectrum analyzer via antenna port. Test software exercised the EUT.

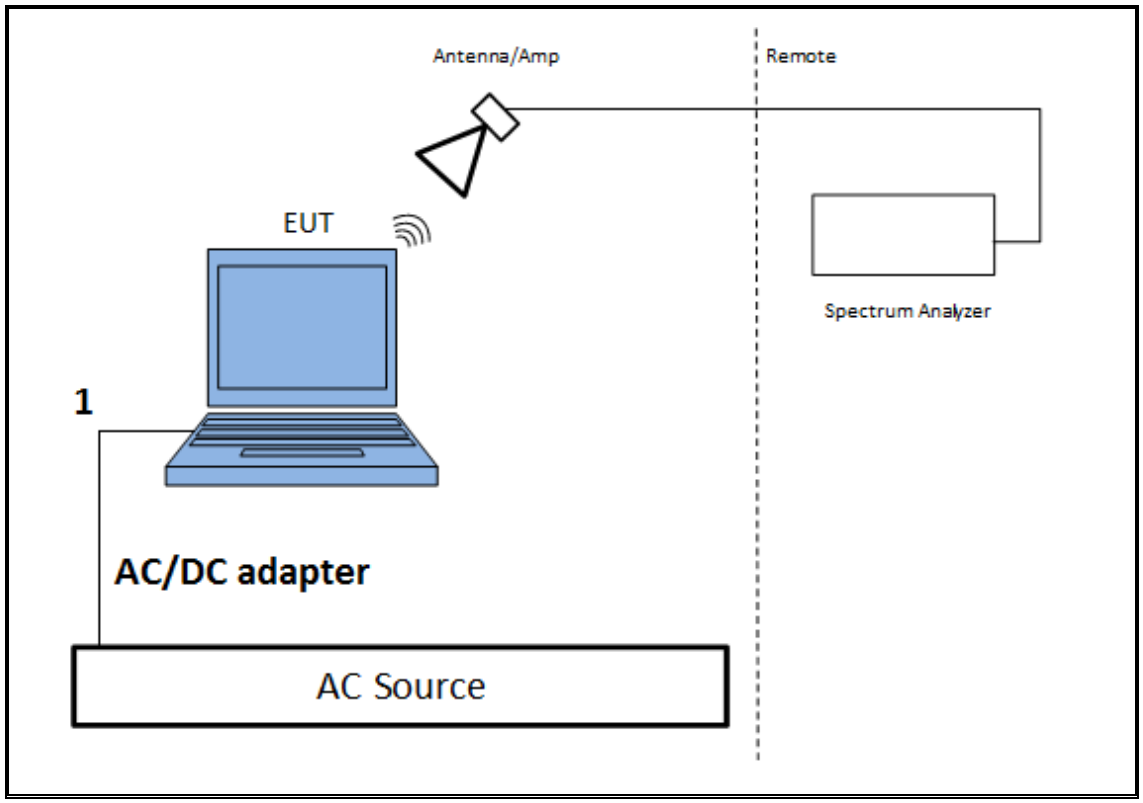
SETUP DIAGRAM



TEST SETUP- RADIATED- ABOVE 1 GHz

The EUT was powered by AC/DC adapter. Test software exercised the EUT.

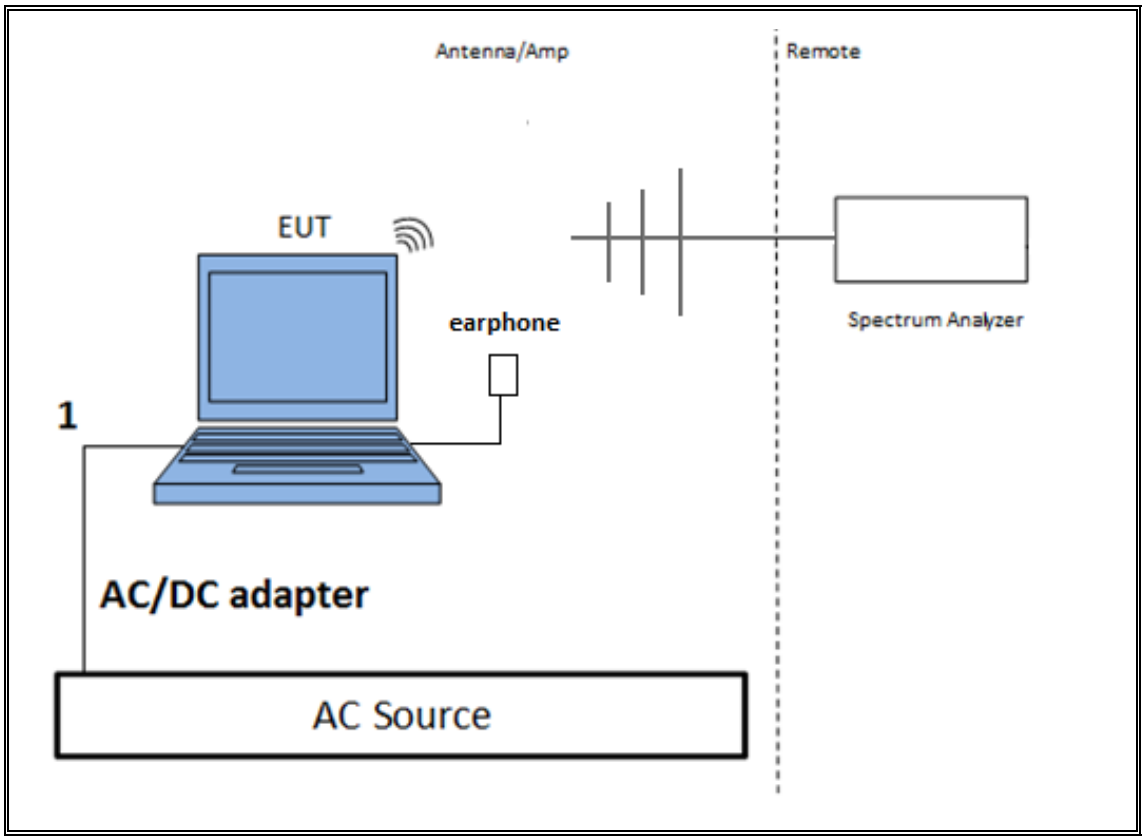
SETUP DIAGRAM



TEST SETUP- RADIATED- BELOW 1 GHz

The EUT was powered by AC/DC adapter and with earphone plugged in. Test software exercised the EUT.

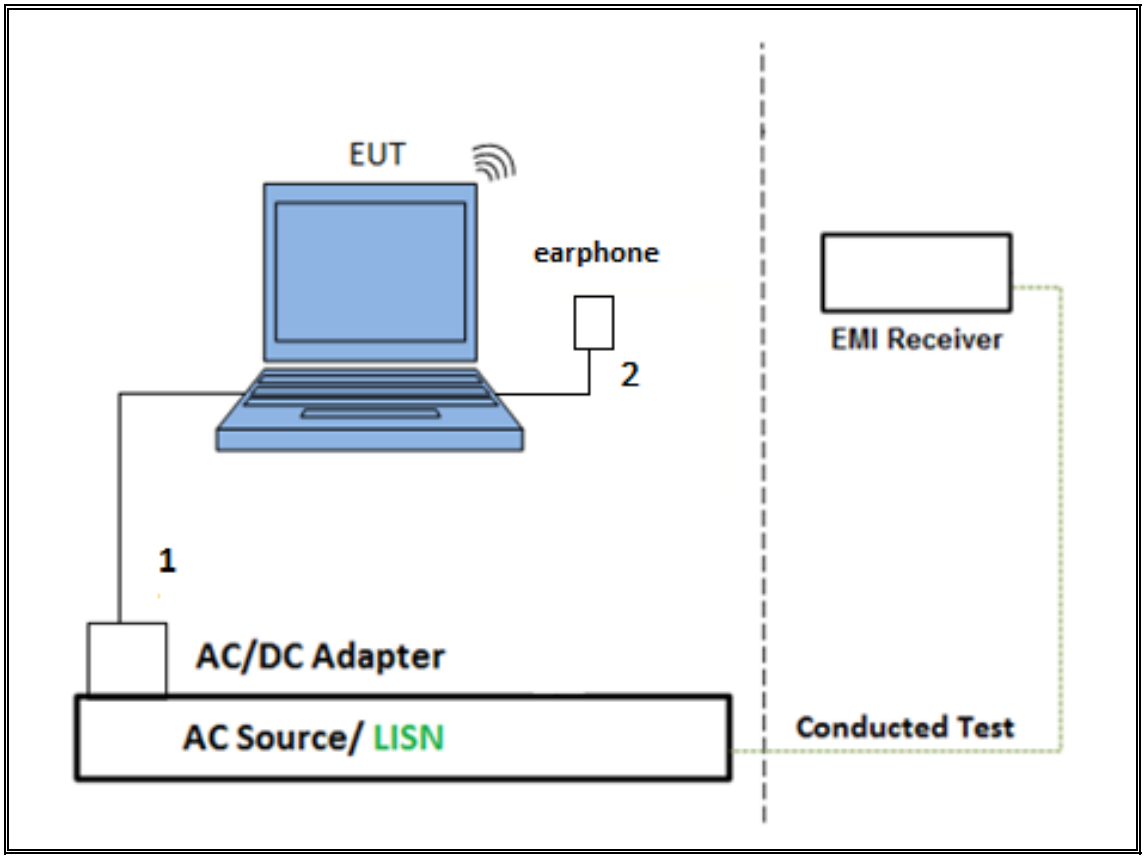
SETUP DIAGRAM



TEST SETUP- AC LINE CONDUCTED TESTS

The EUT was powered by AC/DC adapter and with earphone plugged in. Test software exercised the EUT.

SETUP DIAGRAM



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**
Antenna, Horn 1-18GHz	ETS Lindgren	3117	00154522	1/12/2017
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	A022813-1	10/28/2016
Amplifier, 1 - 18GHz	Miteq	AFS42-00101800-25-S-42	1782158	1/25/2017
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	323562	5/4/2017
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	MY52350675	11/15/2016
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	MY51380911	10/15/2016
Power Meter, P-series single channel	Agilent	N1911A	GB45100212	9/25/2016
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Agilent	N1921A	MY53260010	7/8/2017
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826	209336	5/26/2017
Spectrum Analyzer, 40 GHz	Agilent	8564E	3943A01643	8/14/2016
Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum	Keysight	8449B	3008A04710	7/5/2017
AC Line Conducted				
EMI Test Receiver 9Khz-7GHz	Rohde & Schwarz	ESCI7	100935	9/10/2016
LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2	161124	9/16/2016
Power Cable, Line Conducted Emissions	U L	PG1	N/A	7/28/2017
UL SOFTWARE				
* Radiated Software	UL	UL EMC	Ver 9.5, June 24, 2015	
* Conducted Software	UL	UL EMC	Ver 5.0, June 22, 2016	
* AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

Note: * indicates automation software version used in the compliance certification testing

7. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01 v03r05, Section 8.1.

Output Power: KDB 558074 D01 v03r05, Section 9.1.2.

Power Spectral Density: KDB 558074 D01 v03r05, Section 10.2.

Out-of-band emissions in non-restricted bands: KDB 558074 D01 v03r05, Section 11.0.

Out-of-band emissions in restricted bands: KDB 558074 D01 v03r05, Section 12.1.

Band-edge: KDB 558074 D01 v03r05, Section 12.1.

8. ANTENNA PORT TEST RESULTS

ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

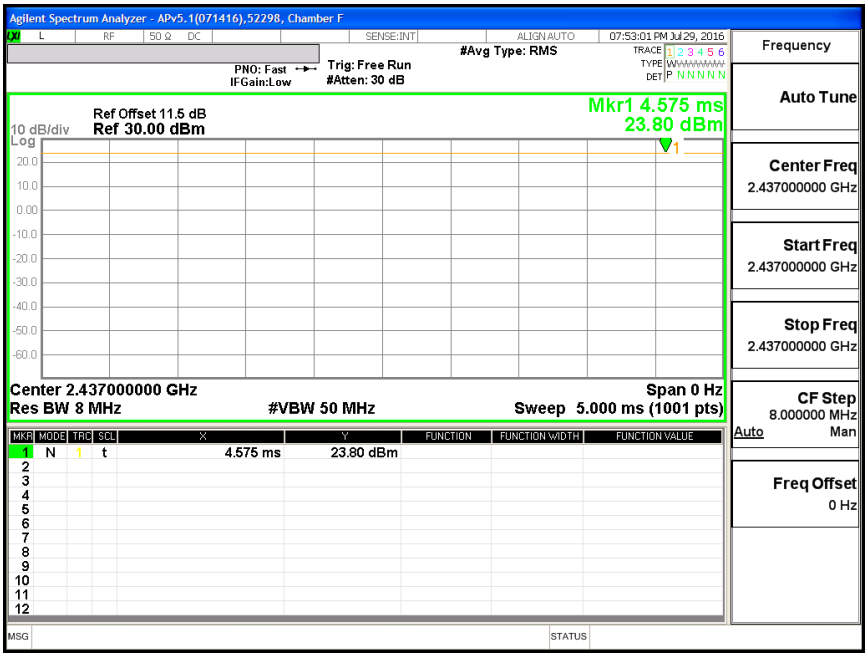
KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

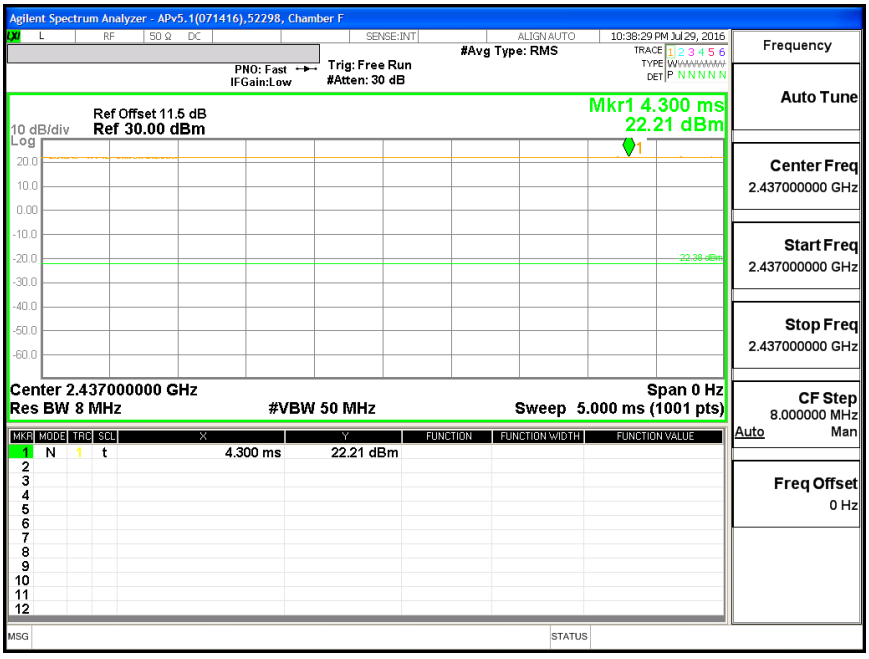
Mode	ON Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4GHz Band						
802.11b 1TX	1.000	1.000	1.000	100.00%	0.00	0.010
802.11b CDD	1.000	1.000	1.000	100.00%	0.00	0.010
802.11n HT20 1TX	1.920	1.940	0.990	98.97%	0.00	0.010
802.11n HT20 CDD	1.920	1.944	0.988	98.77%	0.00	0.010
802.11ac VHT20 Beam Forming	3.830	3.940	0.972	97.21%	0.123	0.261

DUTY CYCLE PLOTS

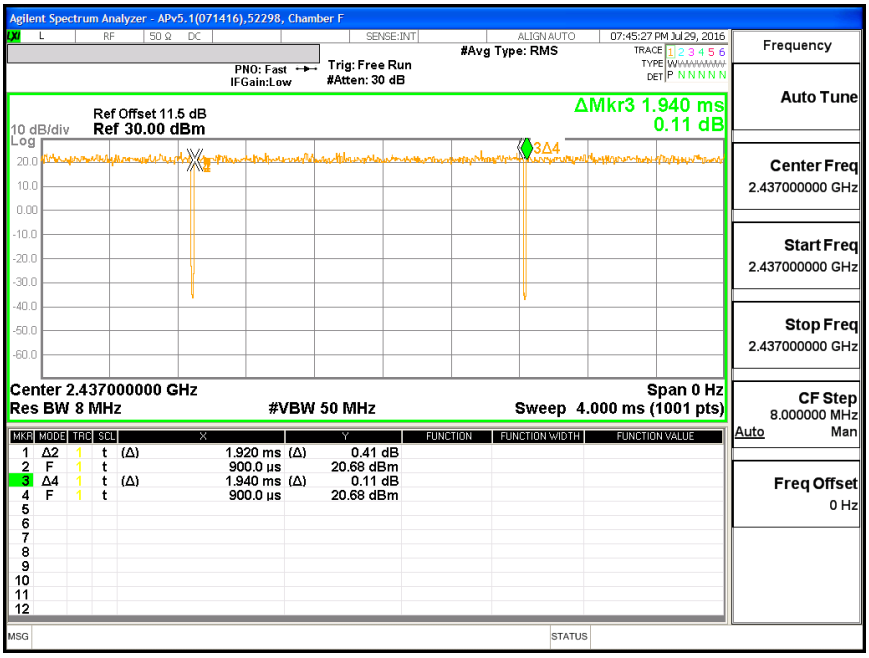
DUTY CYCLE 802.11b 1TX MODE



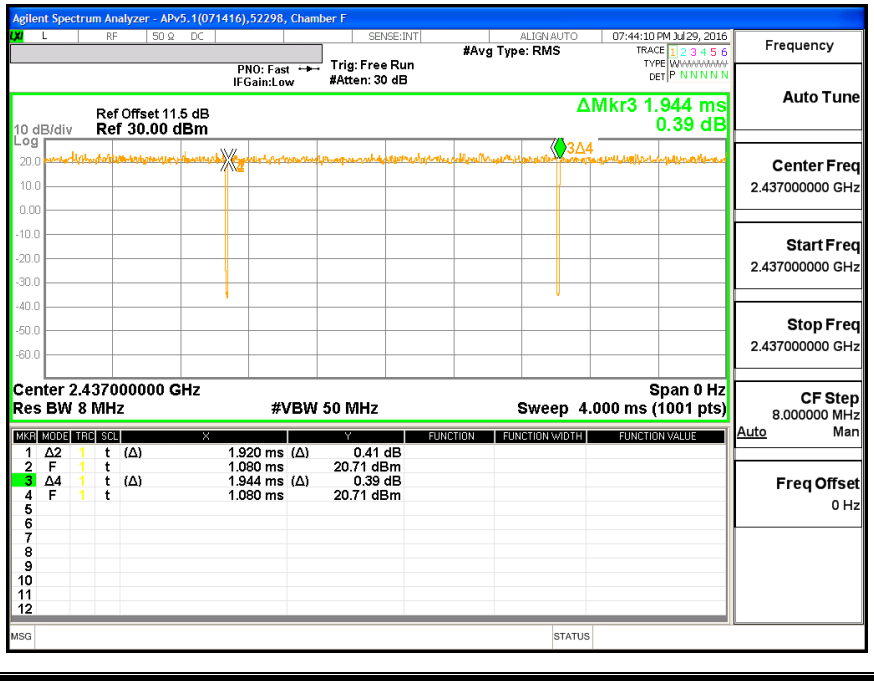
DUTY CYCLE 802.11b CDD MODE



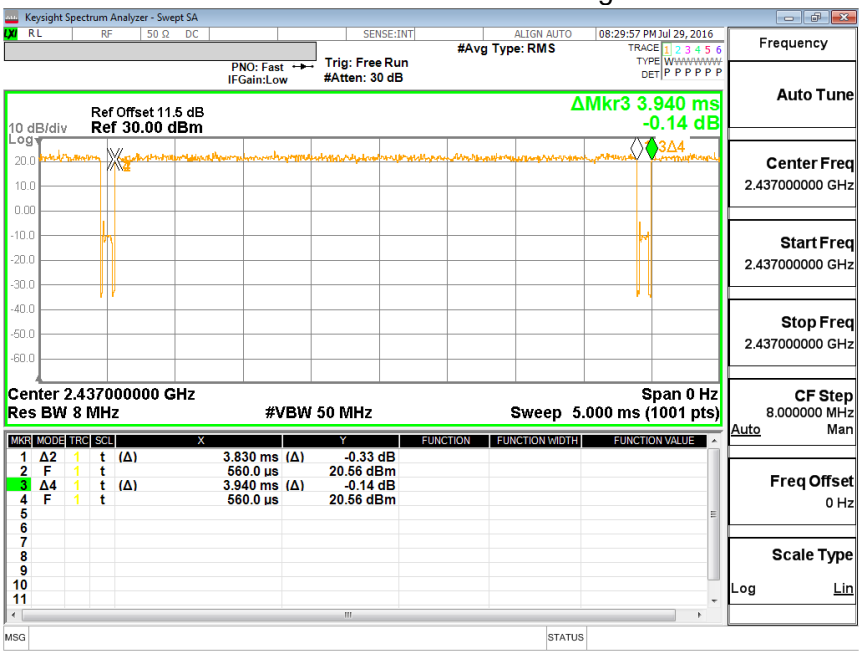
DUTY CYCLE 802.11n HT20 1TX MODE



DUTY CYCLE 802.11n HT20 CDD MODE



DUTY CYCLE 802.11ac VHT20 Beam Forming



8.1. 802.11b SISO MODE IN THE 2.4 GHz BAND, CHAIN 0

8.1.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-247 (5.2) (1)

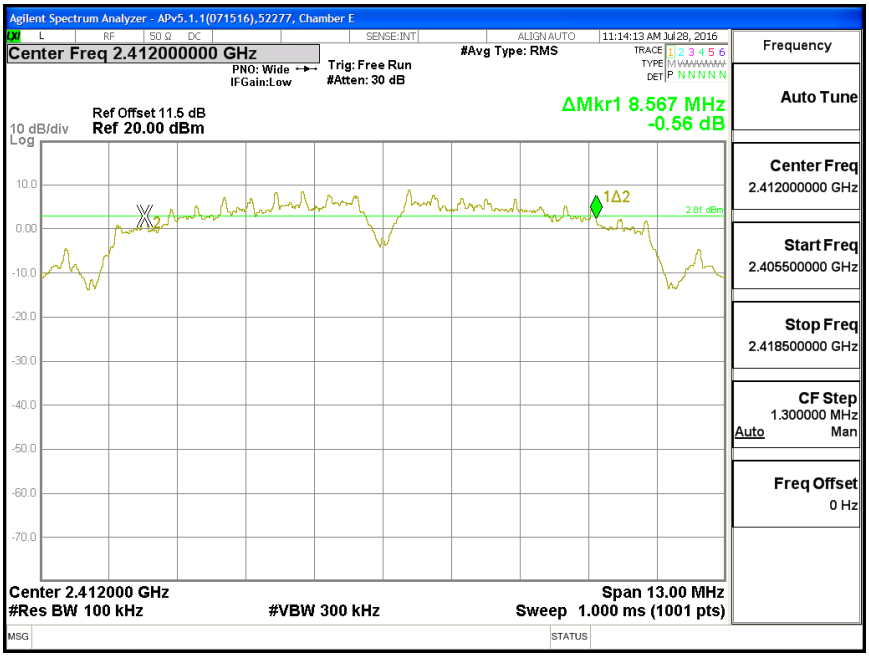
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

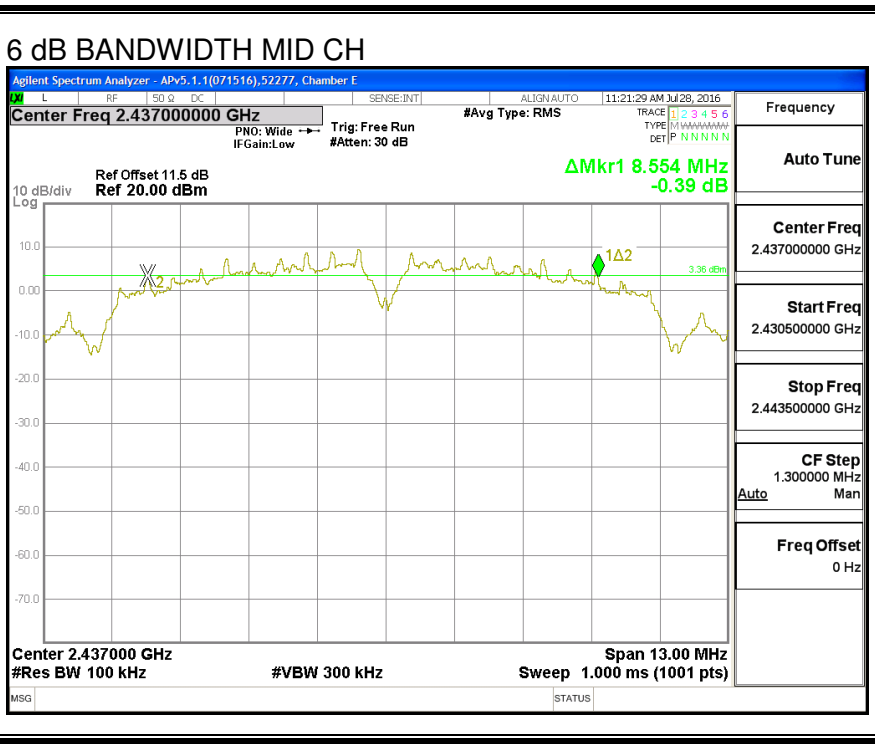
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2412	8.567	0.5
Mid	2437	8.554	0.5
High_11	2462	8.060	0.5
High_12	2467	8.554	0.5
High_13	2472	8.086	0.5

6 dB BANDWIDTH

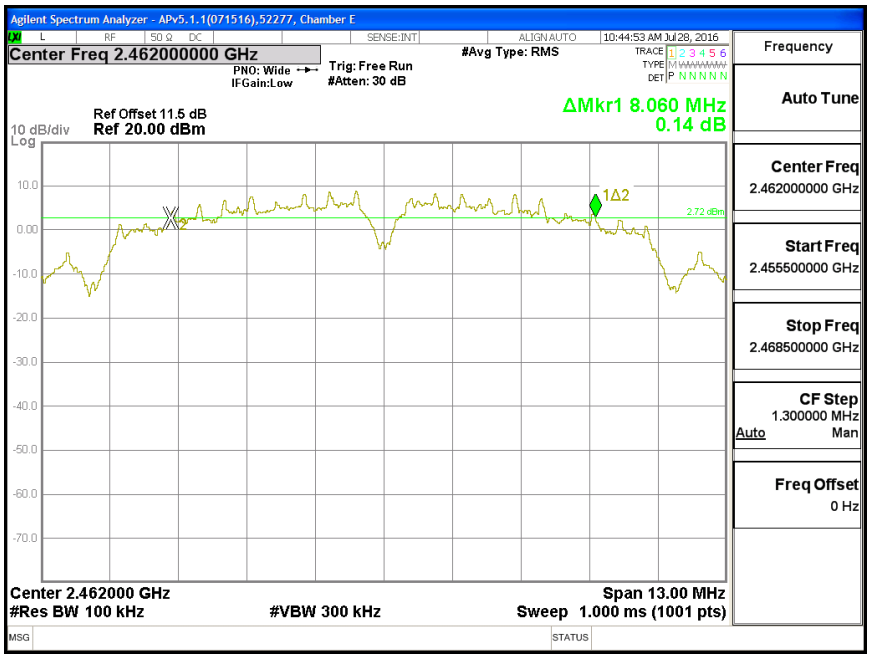
6 dB BANDWIDTH LOW CH



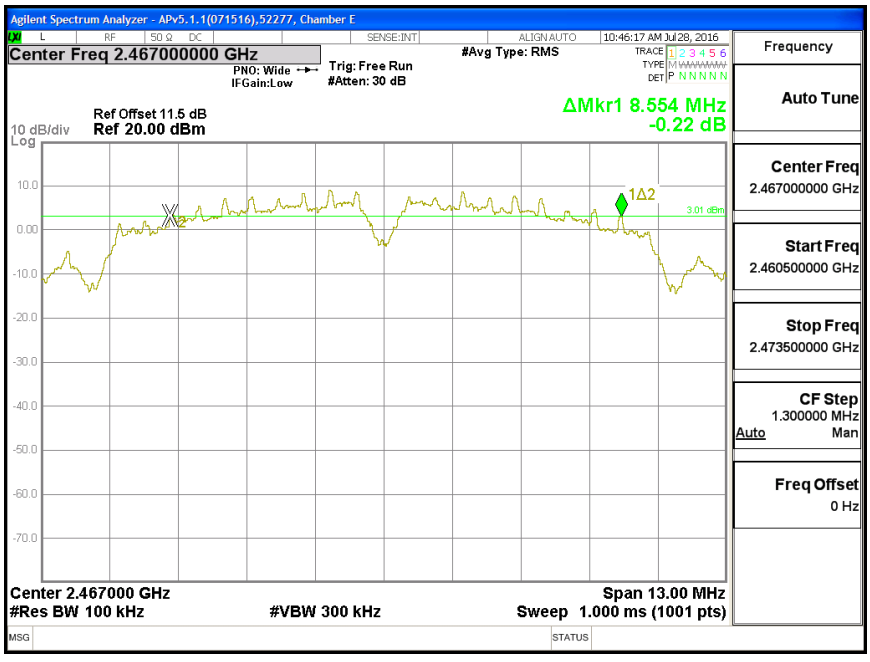
6 dB BANDWIDTH MID CH



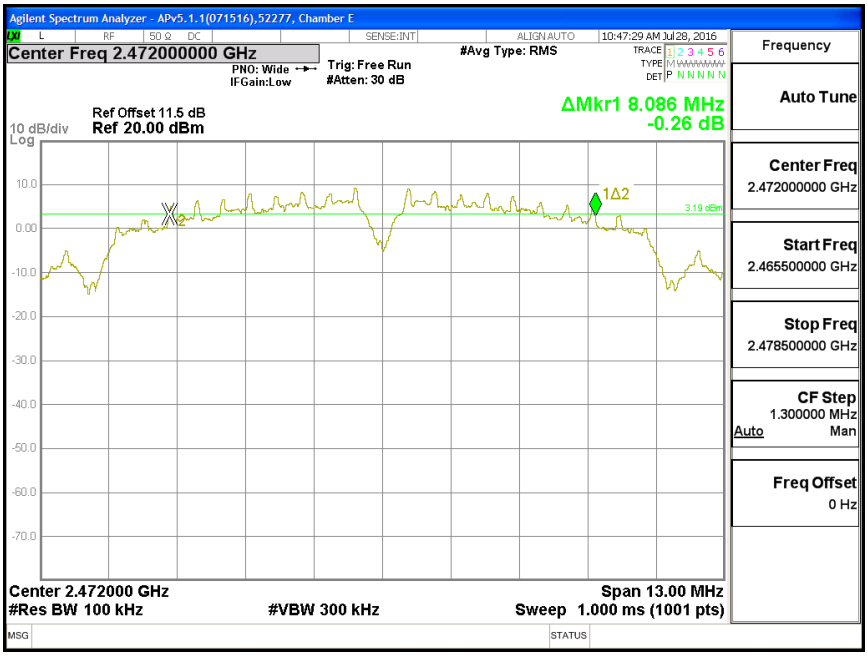
6 dB BANDWIDTH HIGH CH 11



6 dB BANDWIDTH HIGH CH 12



6 dB BANDWIDTH HIGH CH 13



8.1.2. 99% BANDWIDTH

LIMITS

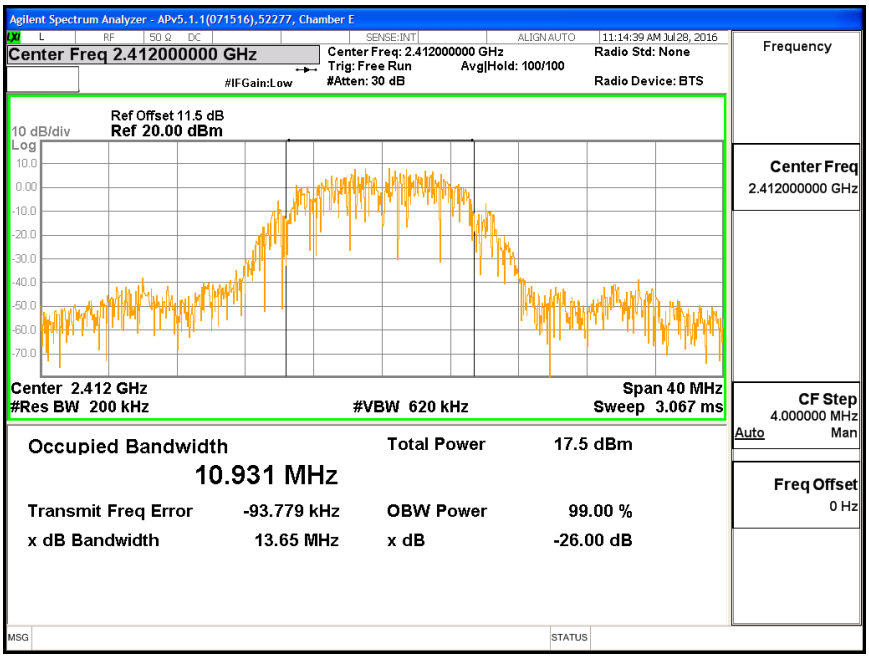
None; for reporting purposes only.

RESULTS

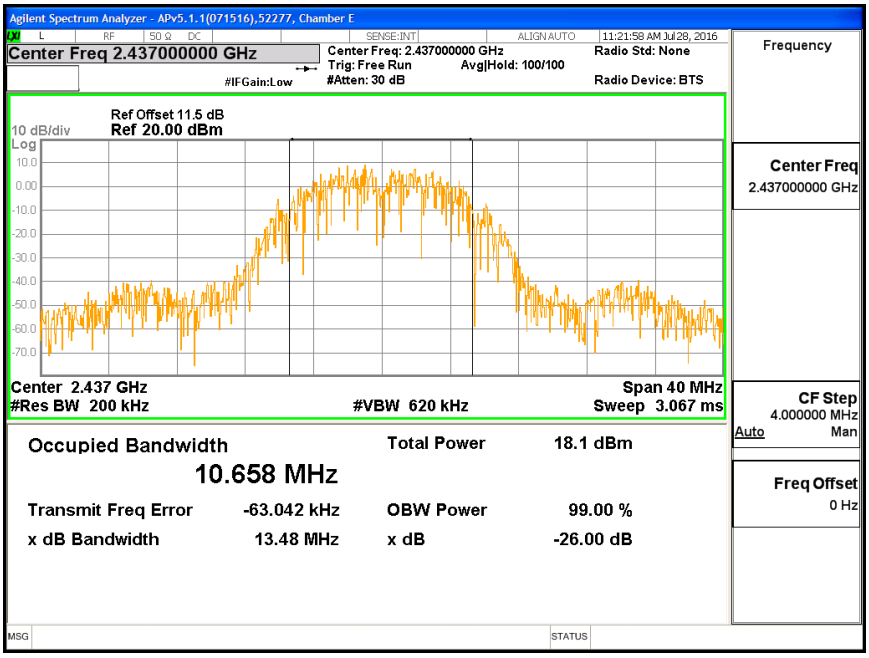
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	10.931
Mid	2437	10.658
High_11	2462	11.167
High_12	2467	11.635
High_13	2472	11.030

99% BANDWIDTH

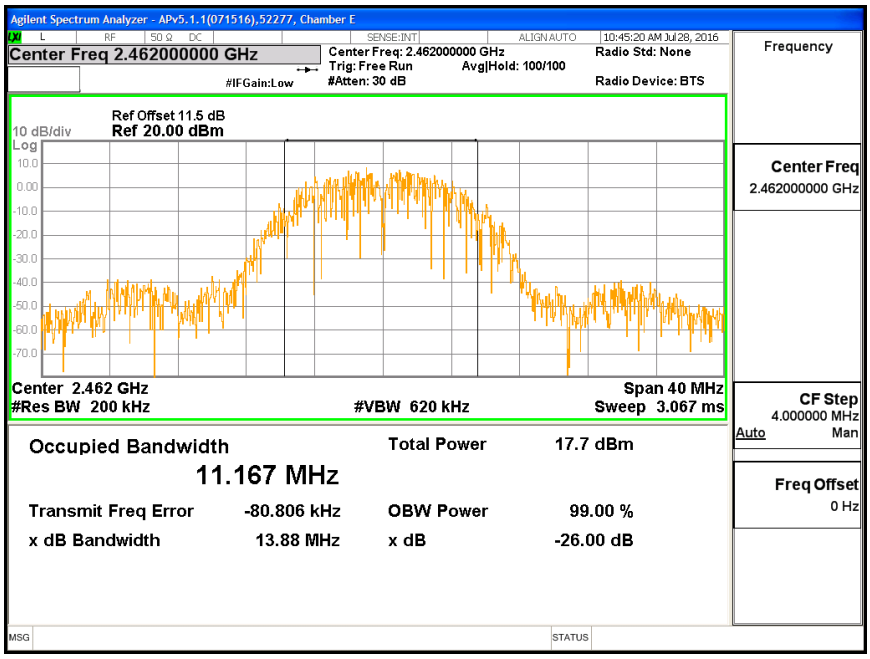
BANDWIDTH LOW CH



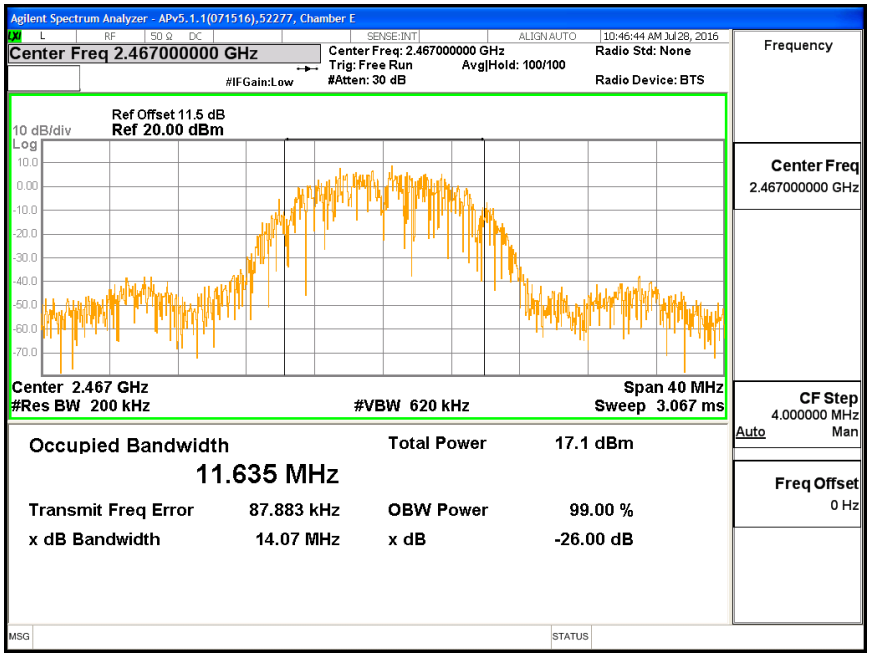
BANDWIDTH MID CH



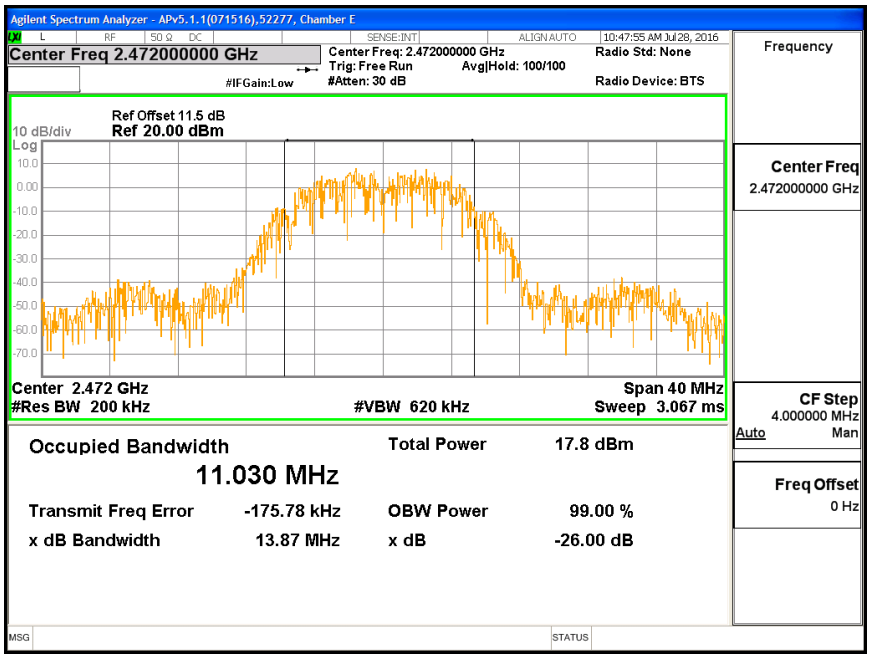
BANDWIDTH HIGH CH 11



BANDWIDTH HIGH CH 12



BANDWIDTH HIGH CH 13



8.1.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

RESULTS

ID:	39919	Date:	8/30/16

Channel	Frequency (MHz)	Power (dBm)
Low	2412	16.55
Mid	2437	16.71
High_11	2462	16.64
High_12	2467	15.48
High_13	2472	9.97

8.1.4. OUTPUT POWER

LIMITS

FCC §15.247

IC RSS-247 (5.4) (4)

For systems using digital modulation in the 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

ID:	39919	Date:	8/30/16

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	2412	4.20	30.00	30	36	30.00
Mid	2437	4.20	30.00	30	36	30.00
High_11	2462	4.20	30.00	30	36	30.00
High_12	2467	4.20	30.00	30	36	30.00
High_13	2472	4.20	30.00	30	36	30.00

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

Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	2412	20.05	20.05	30.00	-9.95
Mid	2437	20.61	20.61	30.00	-9.39
High_11	2462	20.42	20.42	30.00	-9.58
High_12	2467	19.42	19.42	30.00	-10.58
High_13	2472	13.84	13.84	30.00	-16.16

8.1.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247

IC RSS-247 (5.2) (2)

For digitally modulated systems, the power spectral density conducted form the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 KHz band during any time interval of continuous transmissions.

RESULTS

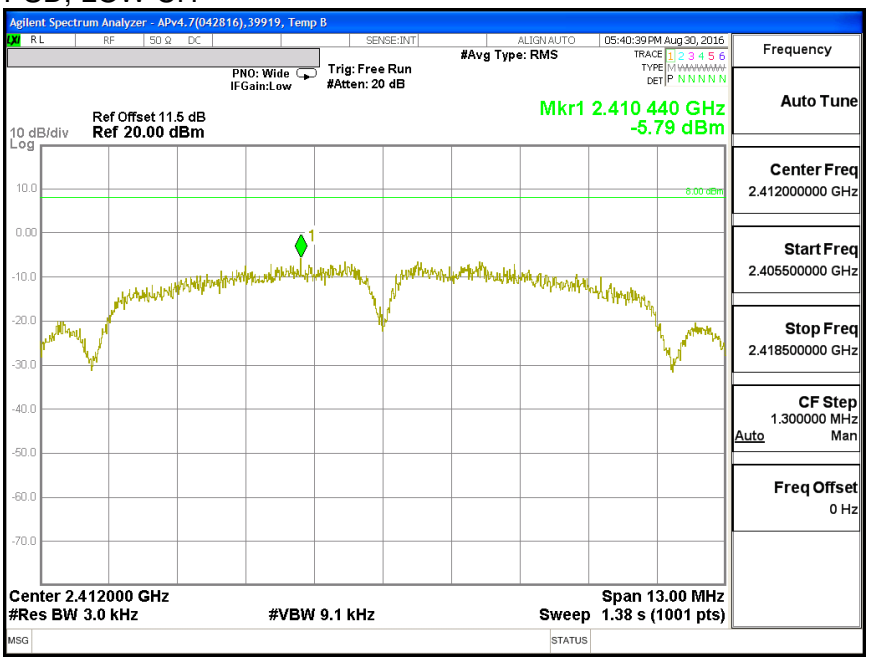
Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD

PSD Results

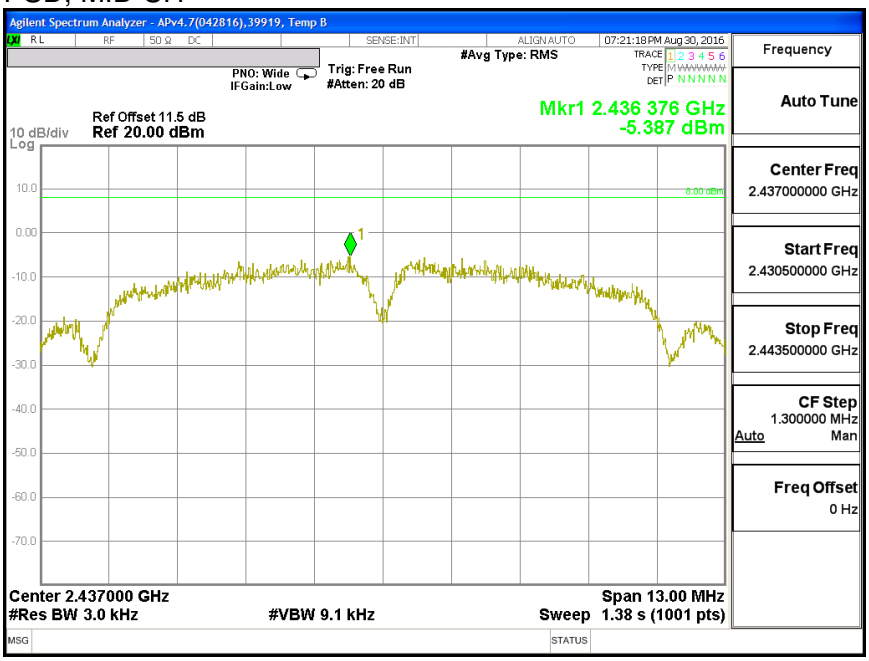
Channel	Frequency (MHz)	Meas (dBm)	Total Corr'd PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-5.79	-5.79	8.0	-13.8
Mid	2437	-5.39	-5.39	8.0	-13.4
High_11	2462	-5.56	-5.56	8.0	-13.6
High_12	2467	-6.56	-6.56	8.0	-14.6
High_13	2472	-11.50	-11.50	8.0	-19.5

PSD

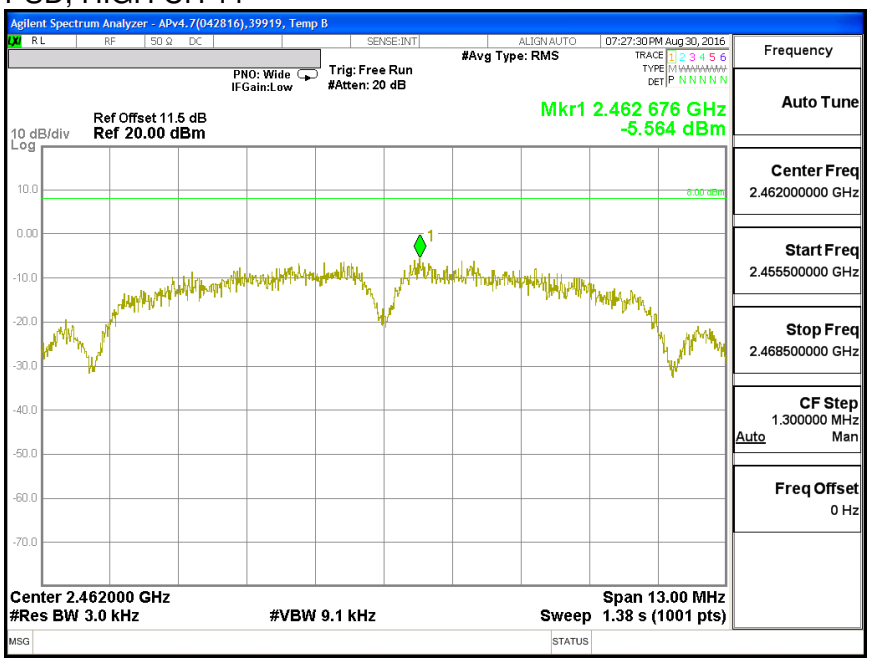
PSD, LOW CH



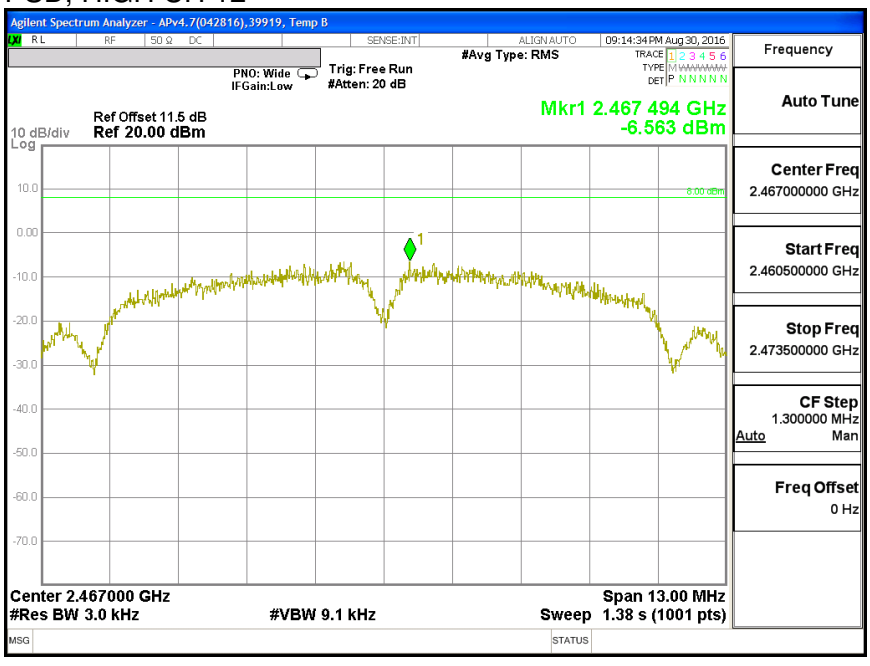
PSD, MID CH



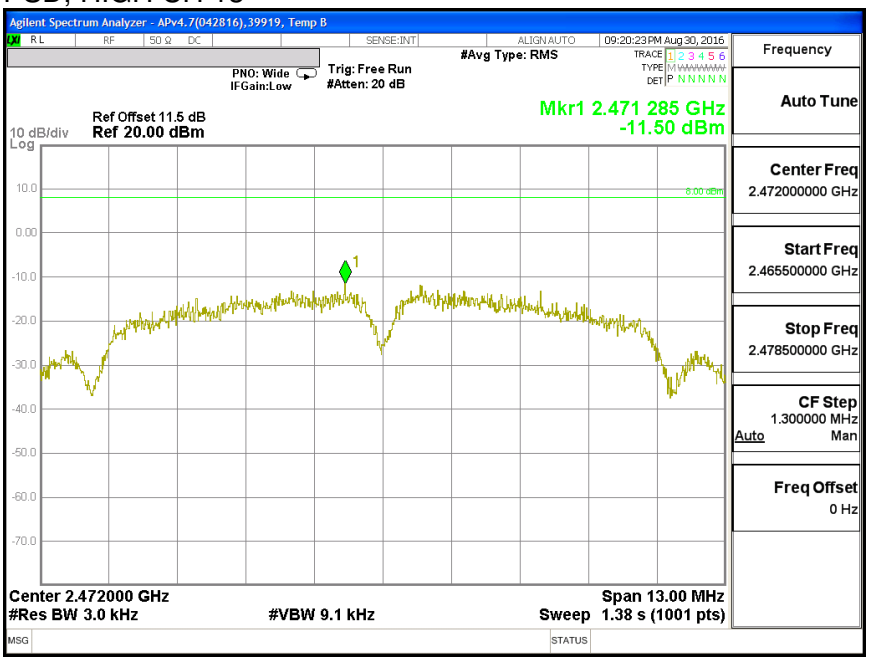
PSD, HIGH CH 11



PSD, HIGH CH 12



PSD, HIGH CH 13



8.1.6. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.247 (d)

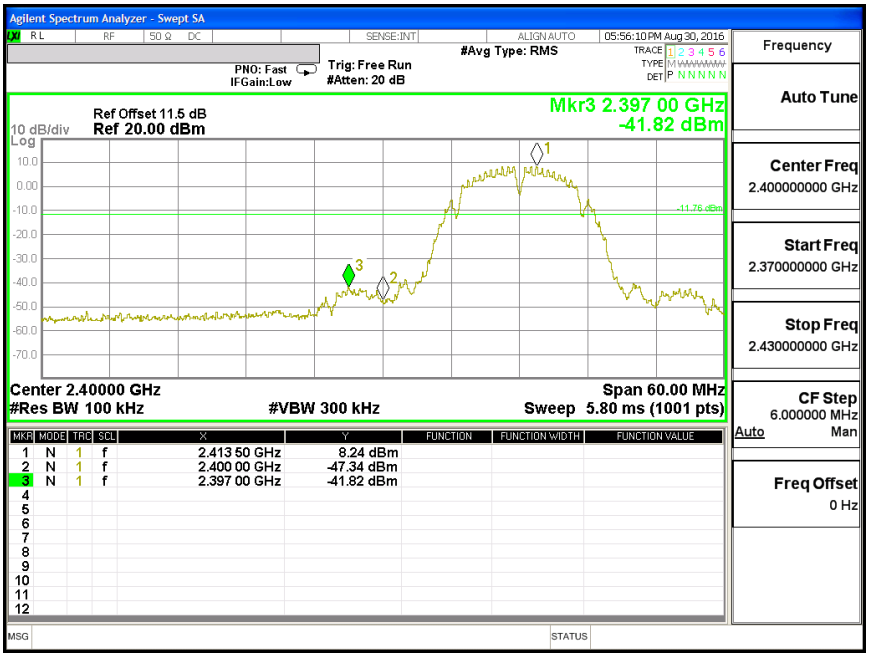
IC RSS-247 (5.5)

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

RESULTS

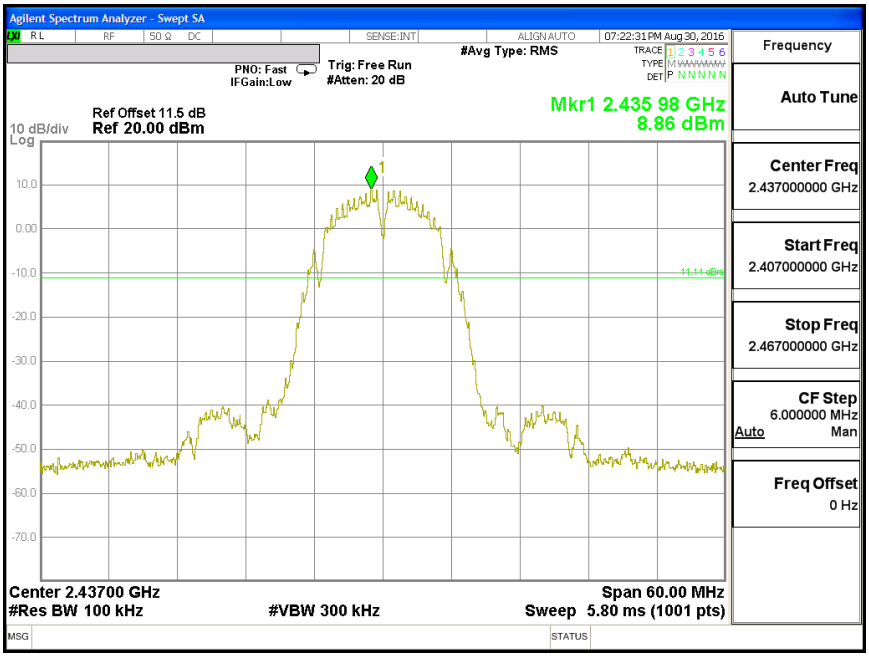
LOW CHANNEL BANDEDGE

AUTHORIZED BAND EDGE LOW CH



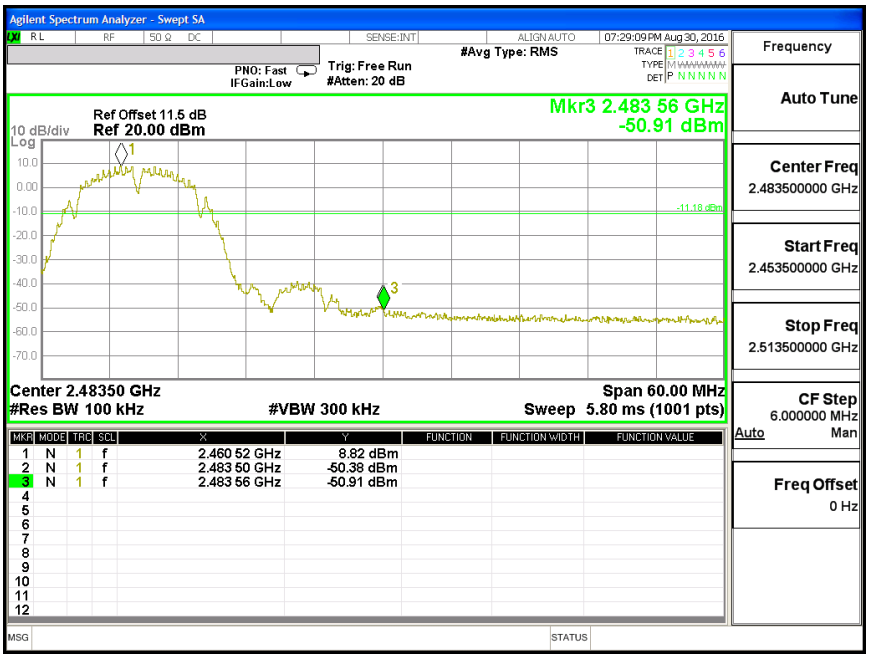
MID CHANNEL REFERENCE

REFERENCE MID CH

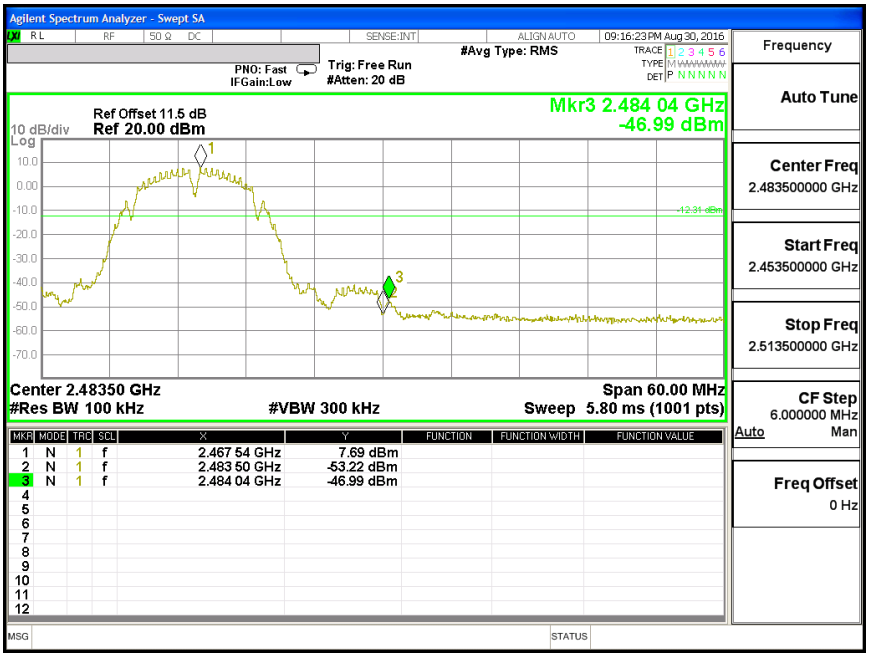


HIGH CHANNEL BANDEDGE

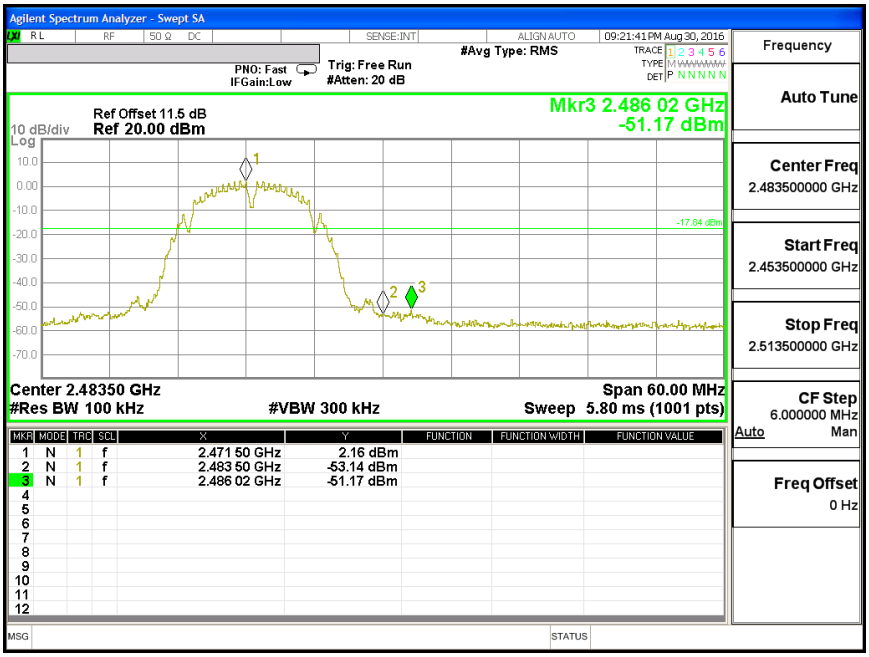
AUTHORIZED BAND EDGE HIGH CH 11



AUTHORIZED BAND EDGE HIGH CH 12

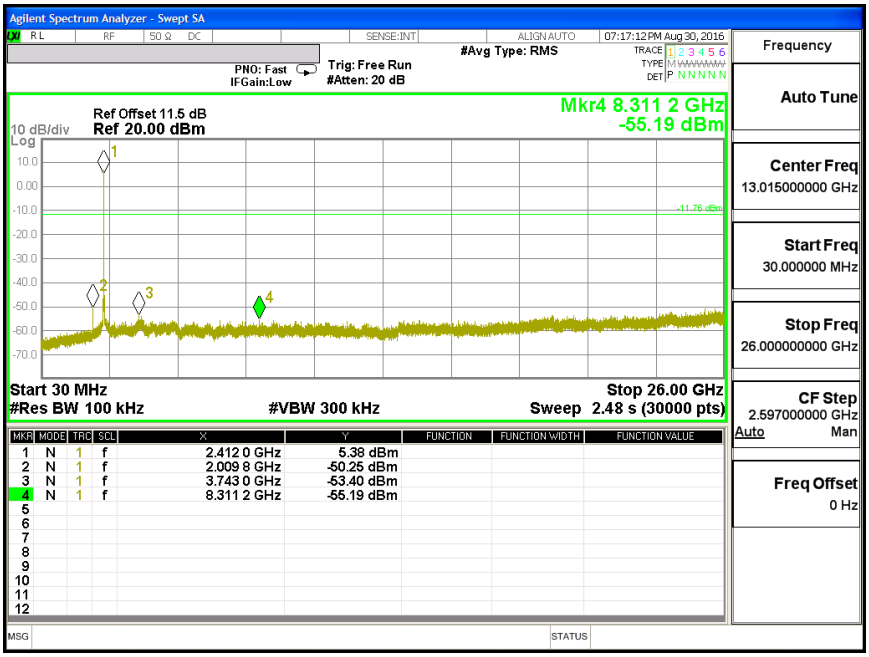


AUTHORIZED BAND EDGE HIGH CH 13

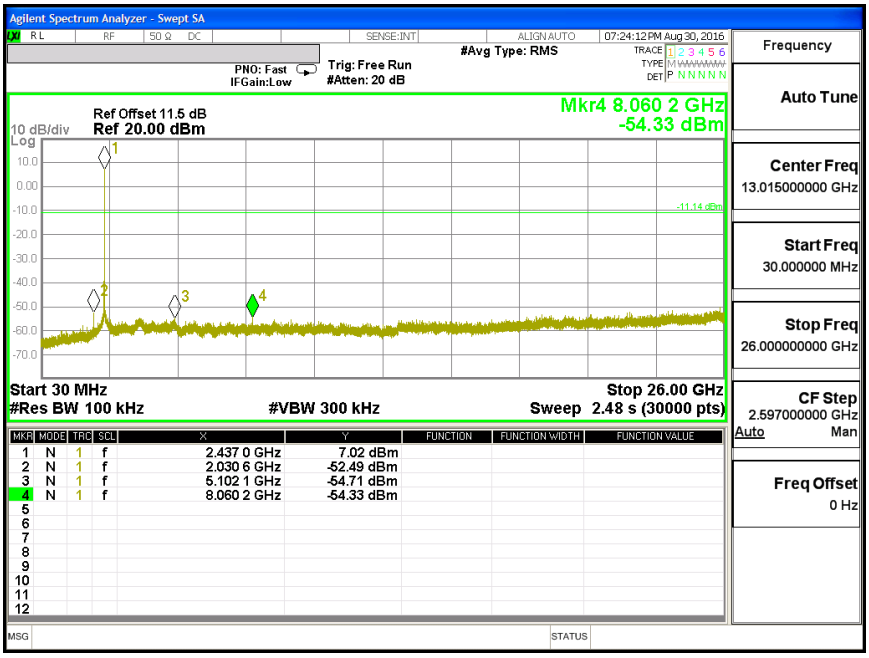


OUT-OF-BAND EMISSIONS

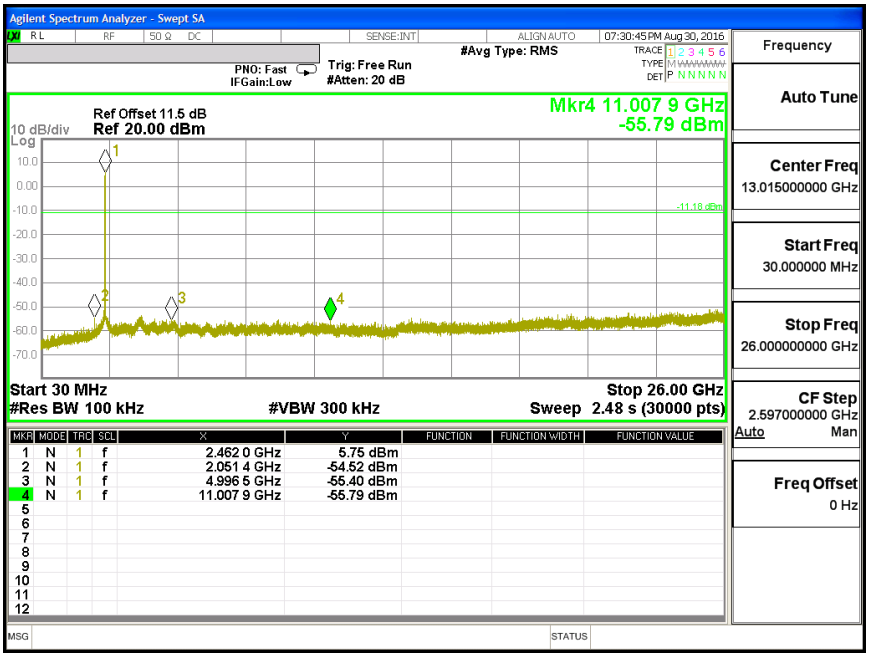
OUT OF BAND LOW CH



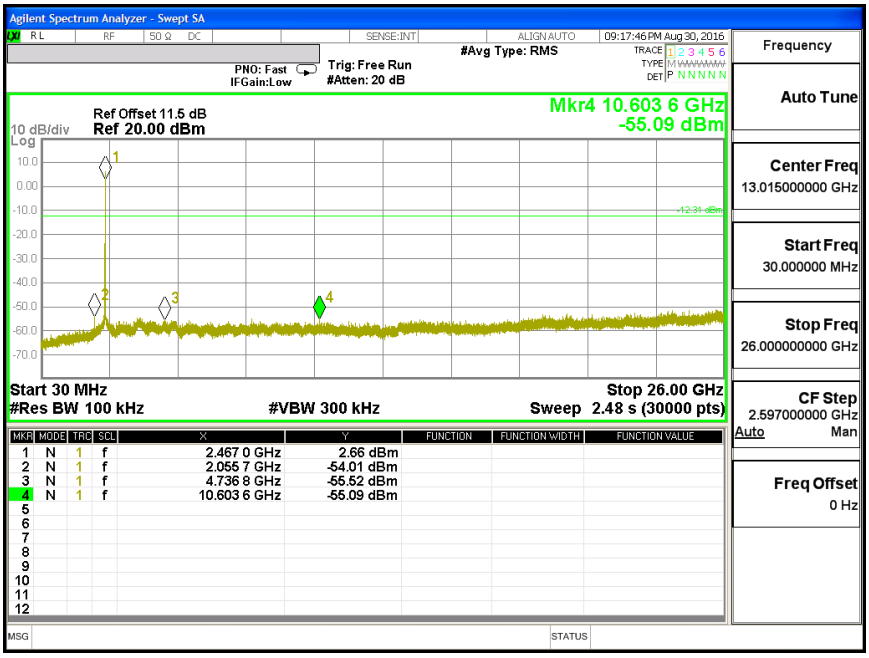
OUT OF BAND MID CH



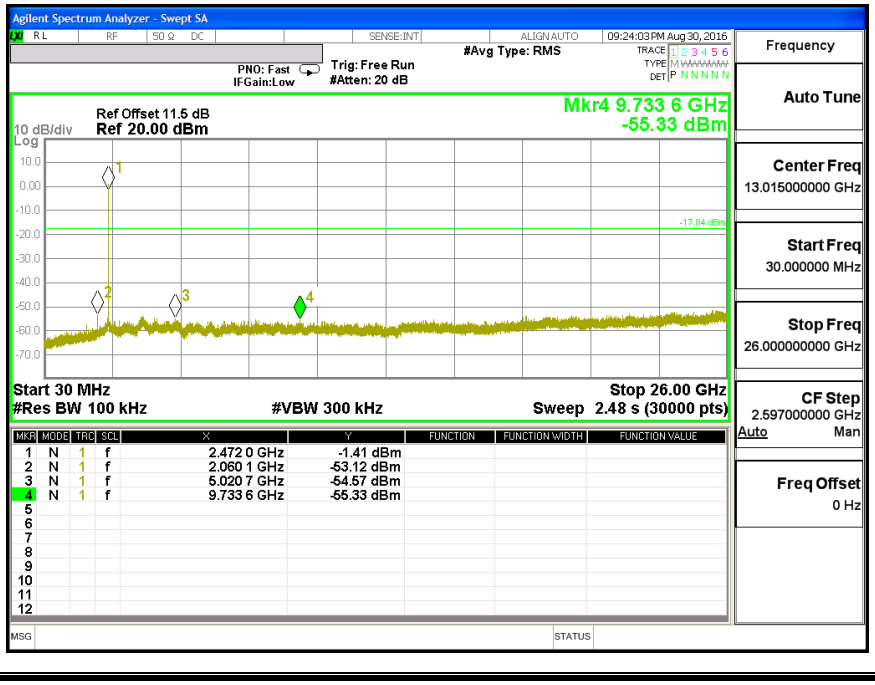
OUT OF BAND HIGH CH 11



OUT OF BAND HIGH CH 12



OUT OF BAND HIGH CH 13



8.2. 802.11b SISO MODE IN THE 2.4 GHz BAND, CHAIN 1

8.2.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-247 (5.2) (1)

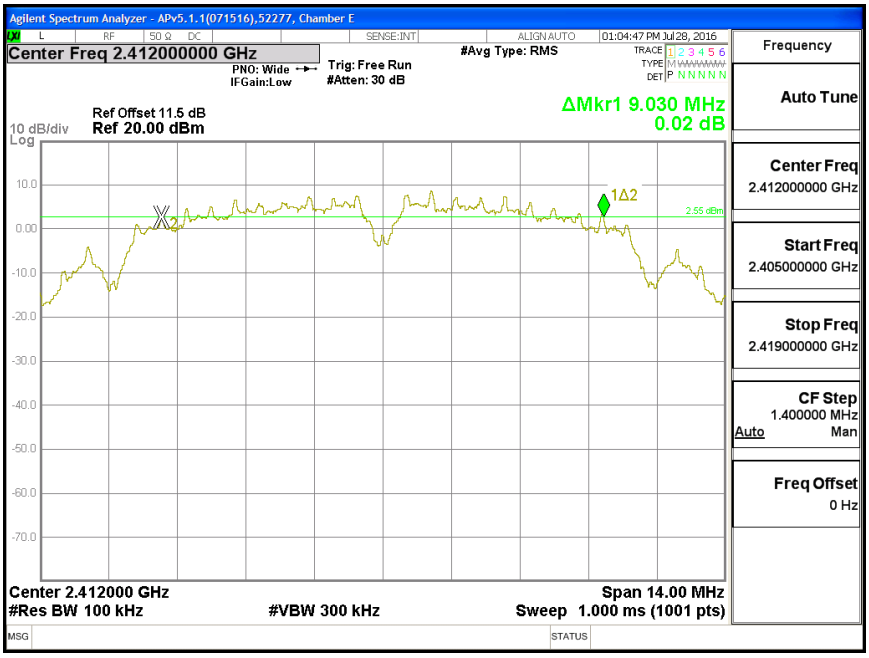
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

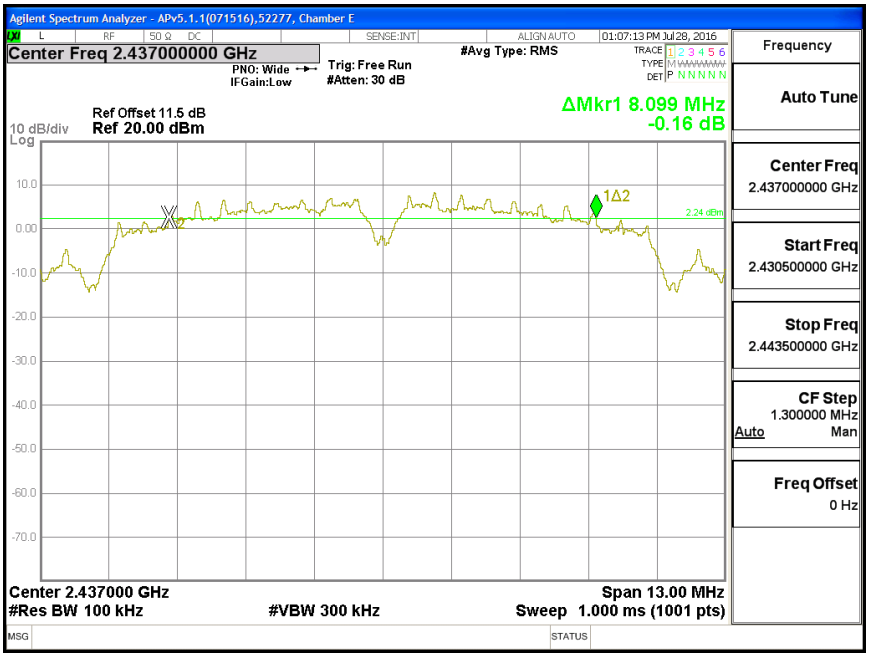
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2412	9.030	0.5
Mid	2437	8.099	0.5
High_11	2462	9.072	0.5
High_12	2467	8.606	0.5
High_13	2472	8.593	0.5

6 dB BANDWIDTH

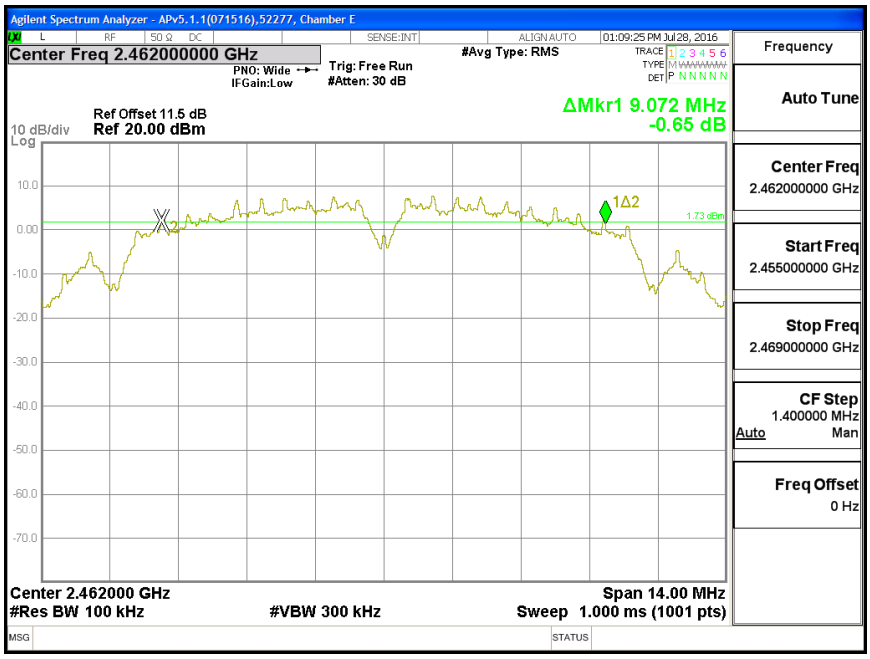
6 dB BANDWIDTH LOW CH



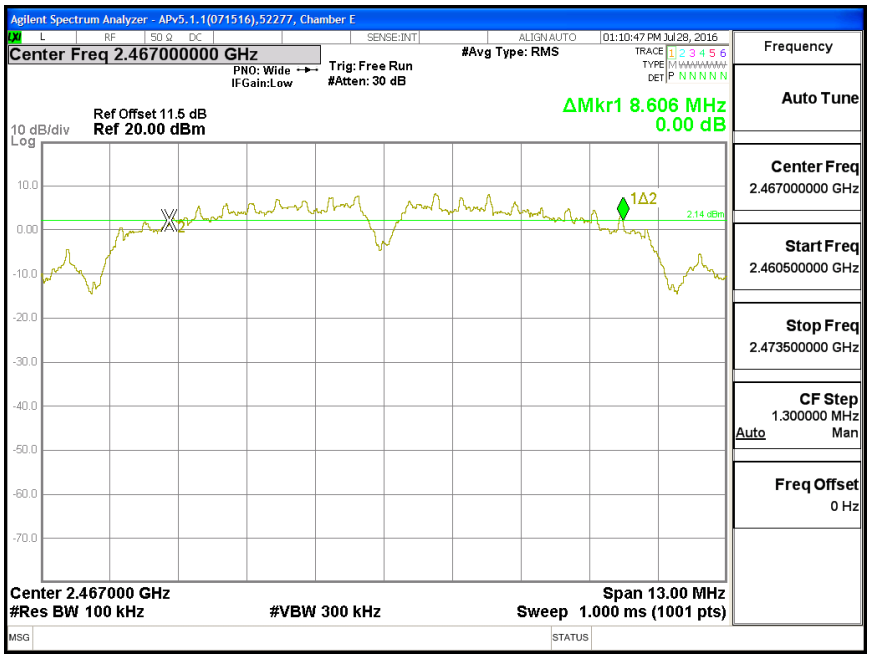
6 dB BANDWIDTH MID CH



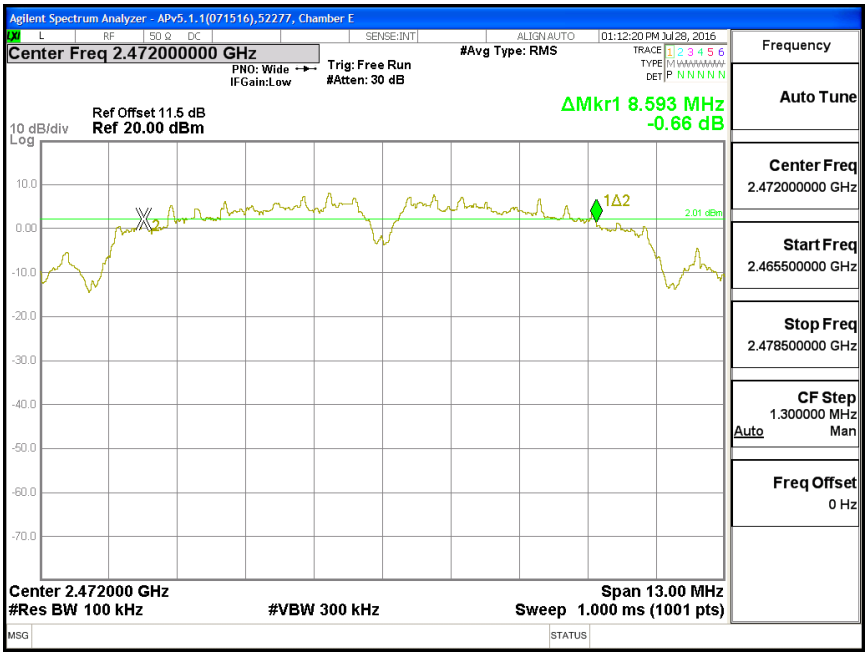
6 dB BANDWIDTH HIGH CH 11



6 dB BANDWIDTH HIGH CH 12



6 dB BANDWIDTH HIGH CH 13



8.2.2. 99% BANDWIDTH

LIMITS

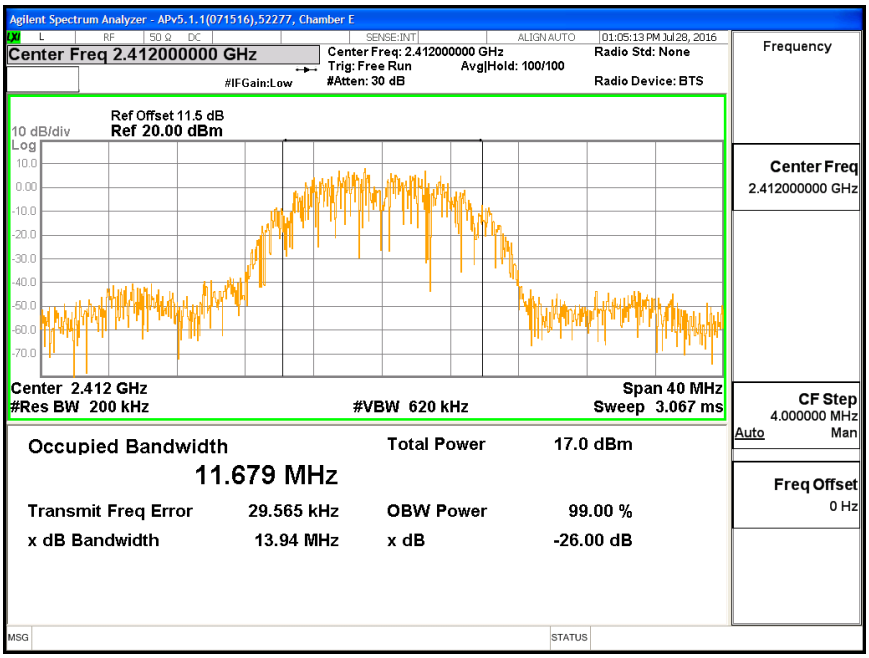
None; for reporting purposes only.

RESULTS

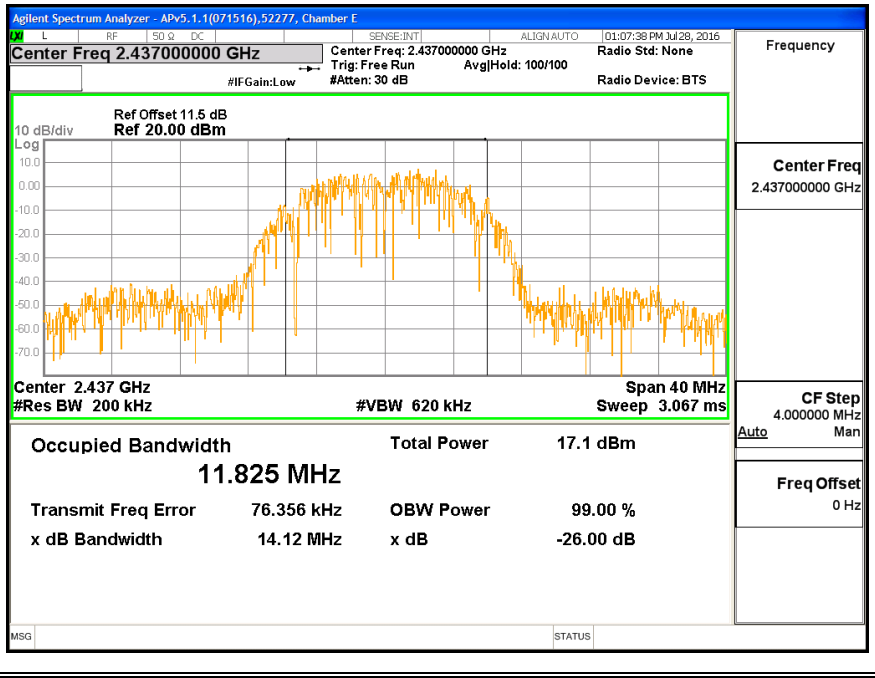
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	11.679
Mid	2437	11.825
High_11	2462	11.368
High_12	2467	10.943
High_13	2472	11.411

99% BANDWIDTH

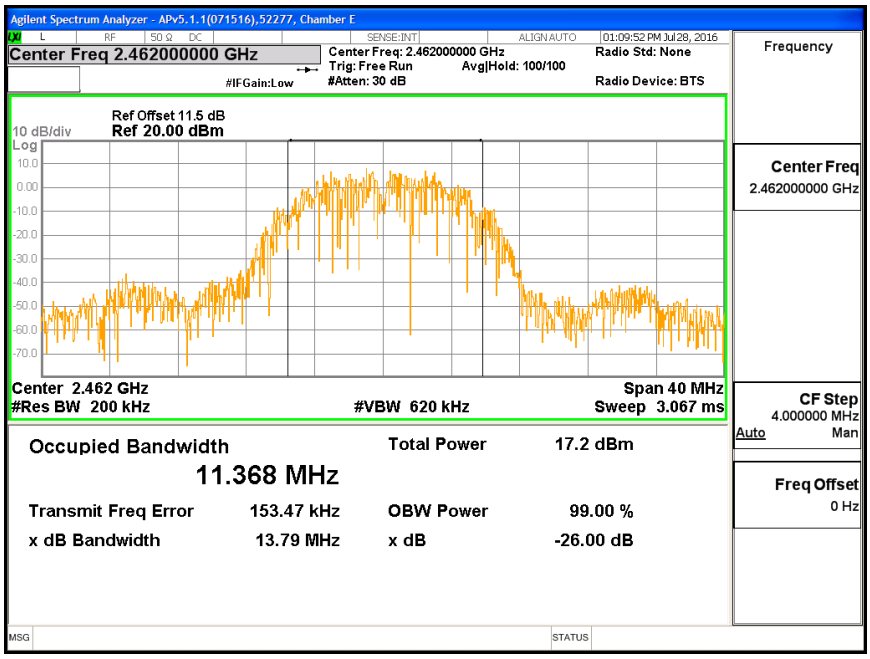
BANDWIDTH LOW CH



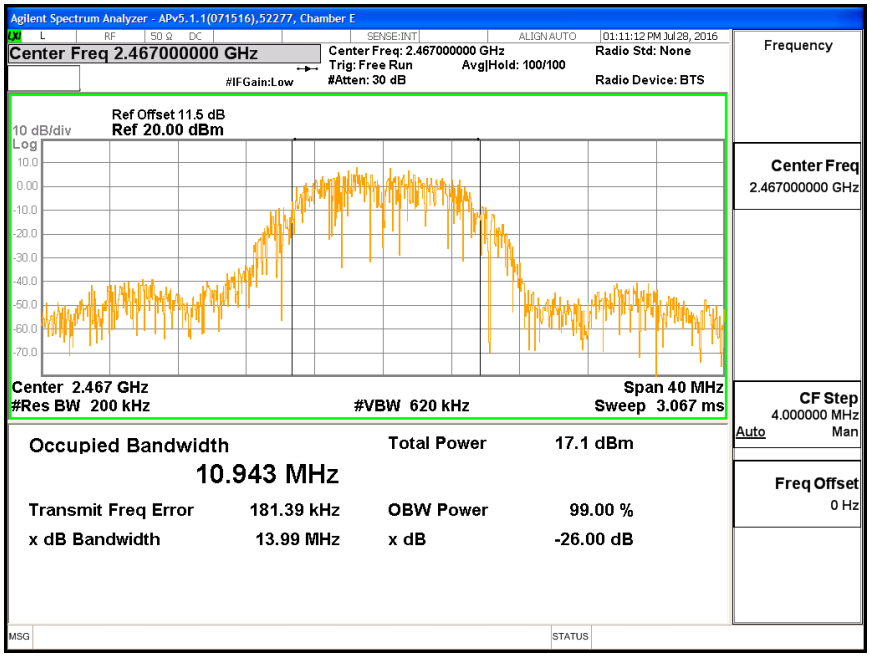
BANDWIDTH MID CH



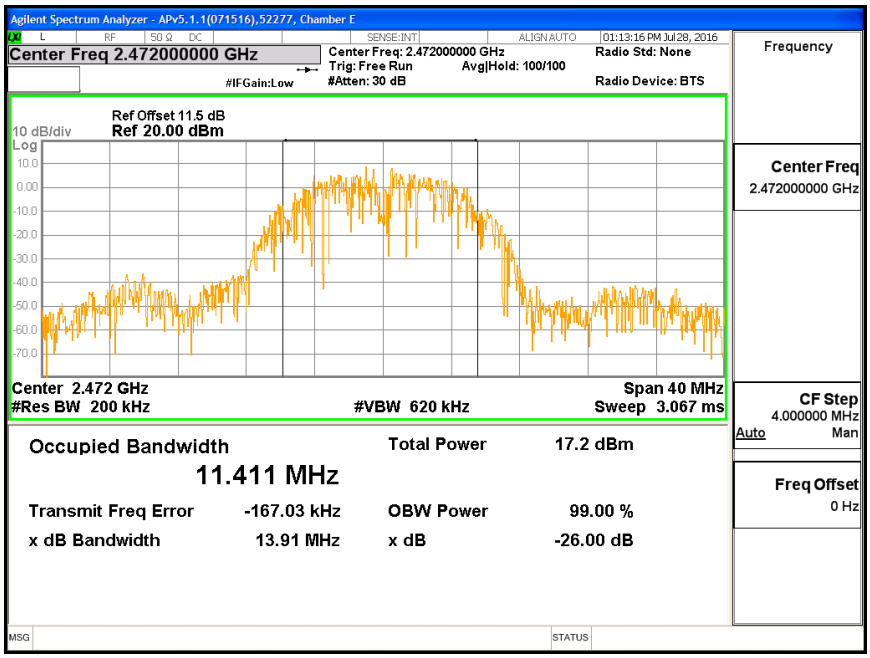
BANDWIDTH HIGH CH 11



BANDWIDTH HIGH CH 12



BANDWIDTH HIGH CH 13



8.2.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

RESULTS

ID:	39919	Date:	8/30/16

Channel	Frequency (MHz)	Power (dBm)
Low	2412	16.61
Mid	2437	16.74
High_11	2462	16.69
High_12	2467	15.47
High_13	2472	10.00

8.2.4. OUTPUT POWER

LIMITS

FCC §15.247

IC RSS-247 (5.4) (4)

For systems using digital modulation in the 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

ID:	39919	Date:	8/30/16

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low	2412	5.10	30.00	30	36	30.00
Mid	2437	5.10	30.00	30	36	30.00
High_11	2462	5.10	30.00	30	36	30.00
High_12	2467	5.10	30.00	30	36	30.00
High_13	2472	5.10	30.00	30	36	30.00

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

Results

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low	2412	20.77	20.77	30.00	-9.23
Mid	2437	21.04	21.04	30.00	-8.96
High_11	2462	20.91	20.91	30.00	-9.09
High_12	2467	19.73	19.73	30.00	-10.27
High_13	2472	14.07	14.07	30.00	-15.93

8.2.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247

IC RSS-247 (5.2) (2)

For digitally modulated systems, the power spectral density conducted form the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 KHz band during any time interval of continuous transmissions.

RESULTS

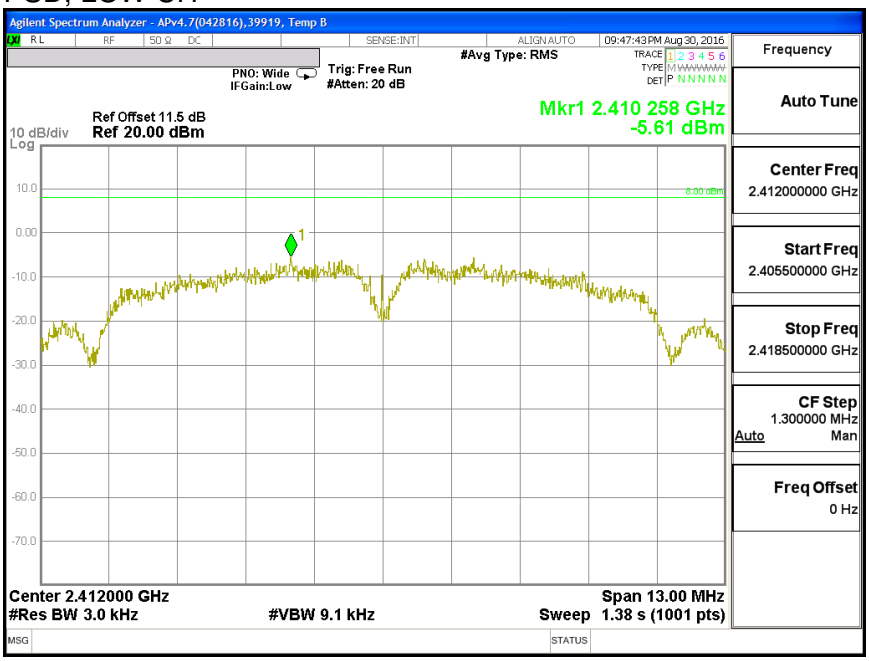
Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD

PSD Results

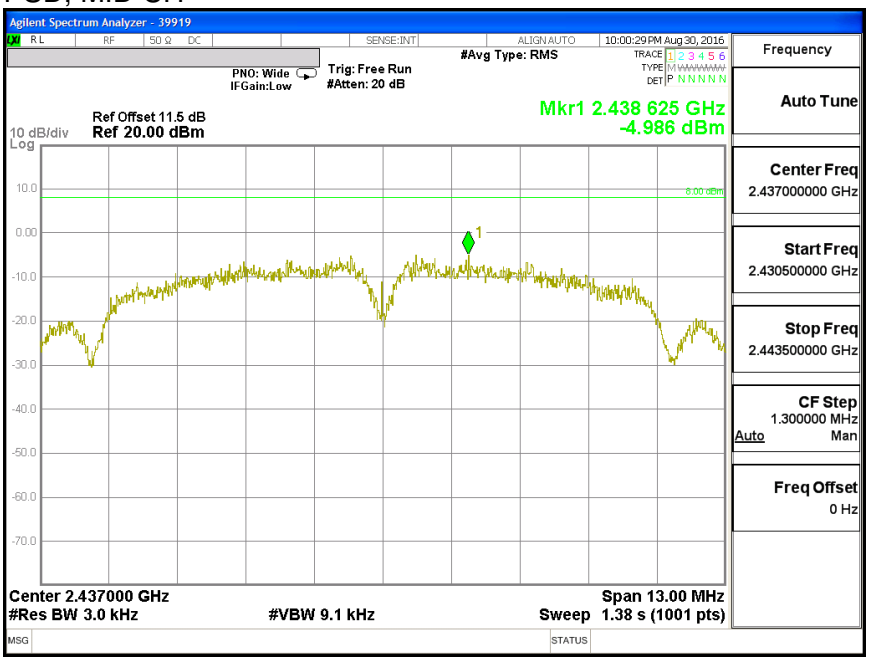
Channel	Frequency (MHz)	Meas (dBm)	Total Corr'd PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-5.61	-5.61	8.0	-13.6
Mid	2437	-4.99	-4.99	8.0	-13.0
High_11	2462	-5.34	-5.34	8.0	-13.3
High_12	2467	-6.87	-6.87	8.0	-14.9
High_13	2472	-11.18	-11.18	8.0	-19.2

PSD

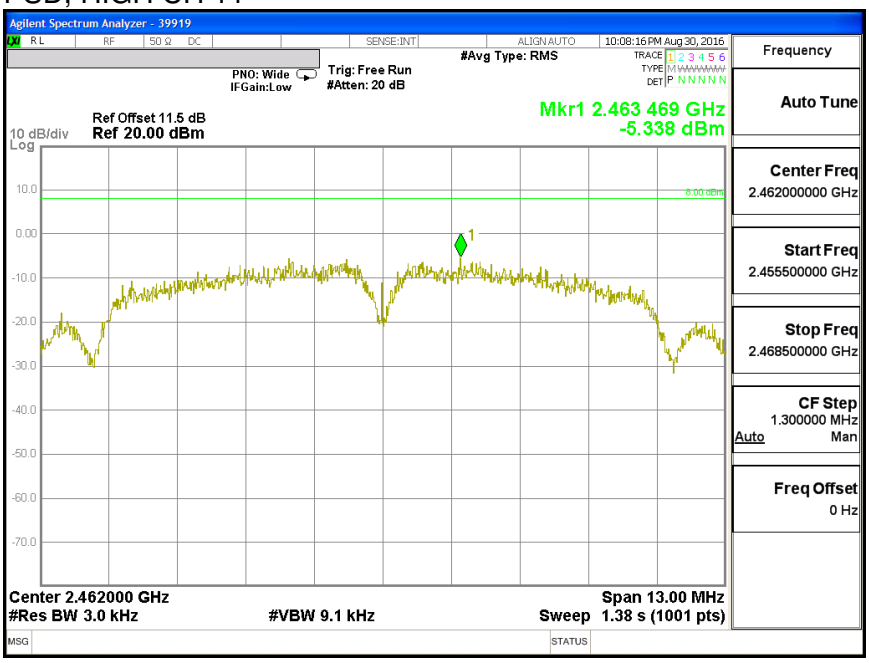
PSD, LOW CH



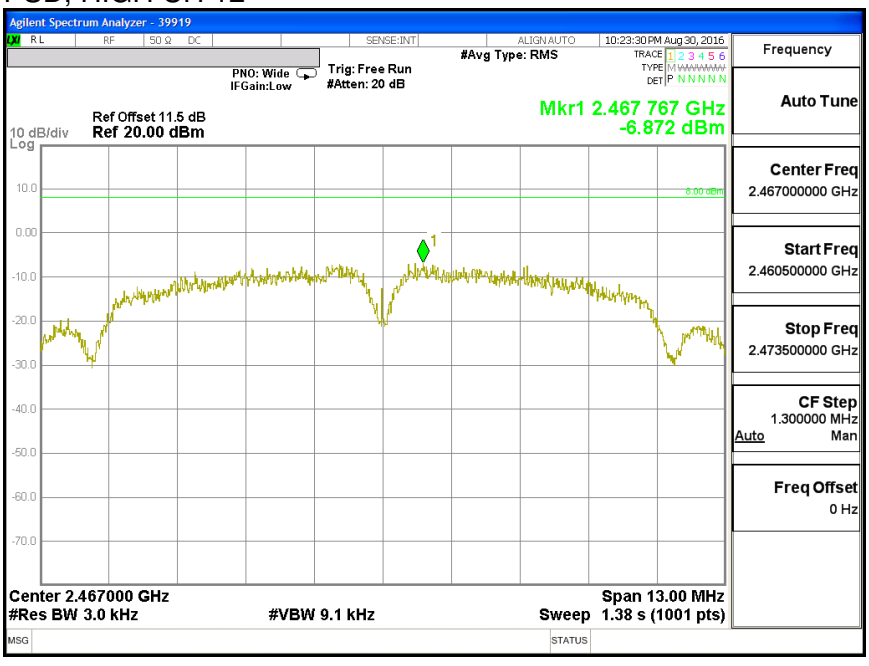
PSD, MID CH



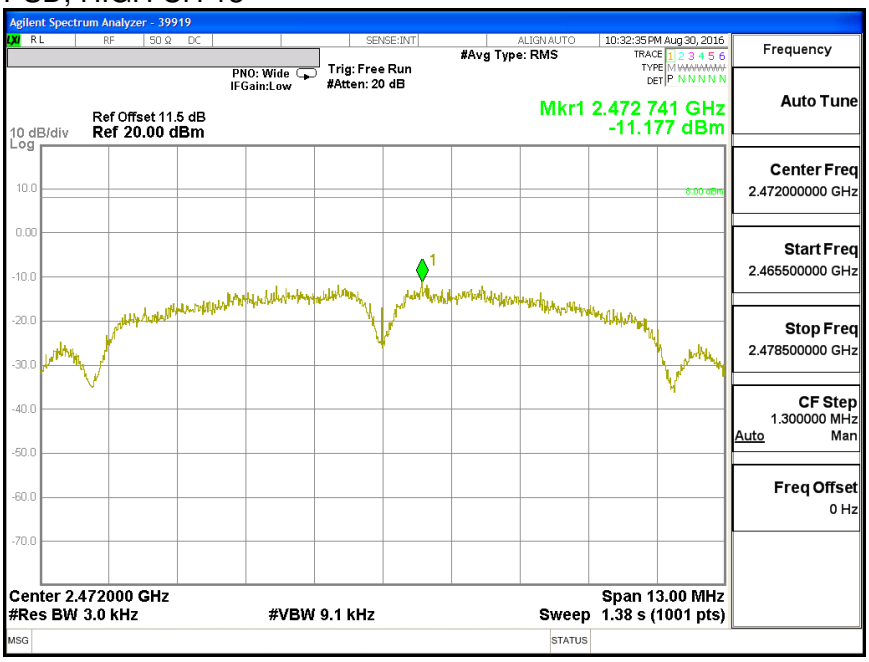
PSD, HIGH CH 11



PSD, HIGH CH 12



PSD, HIGH CH 13



8.2.6. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.247 (d)

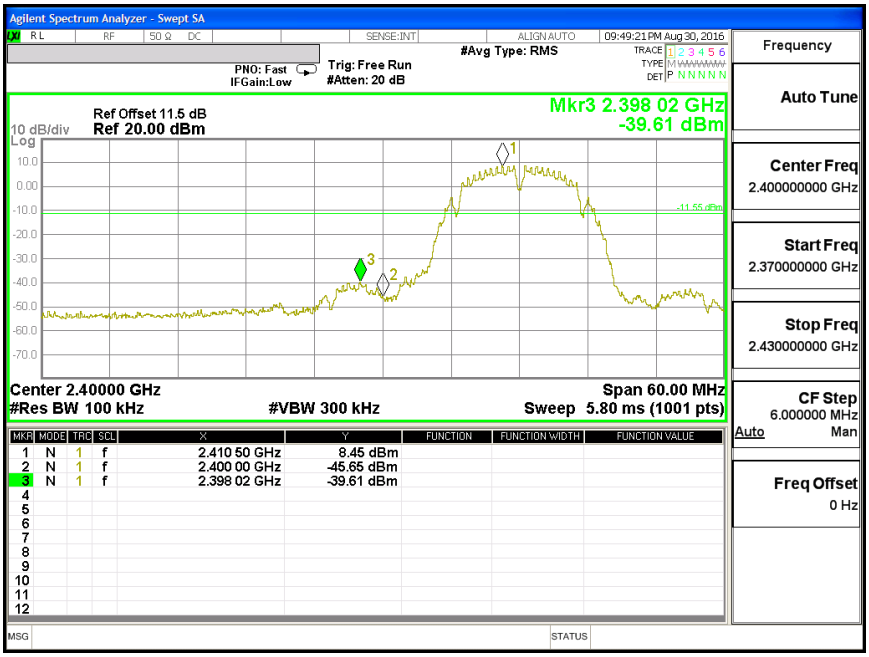
IC RSS-247 (5.5)

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

RESULTS

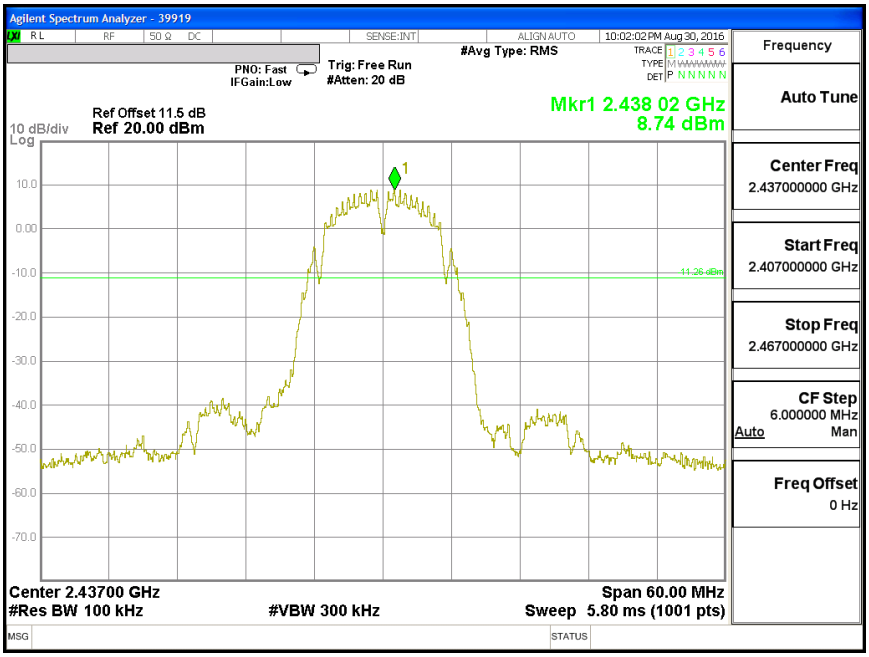
LOW CHANNEL BANDEDGE

AUTHORIZED BAND EDGE LOW CH



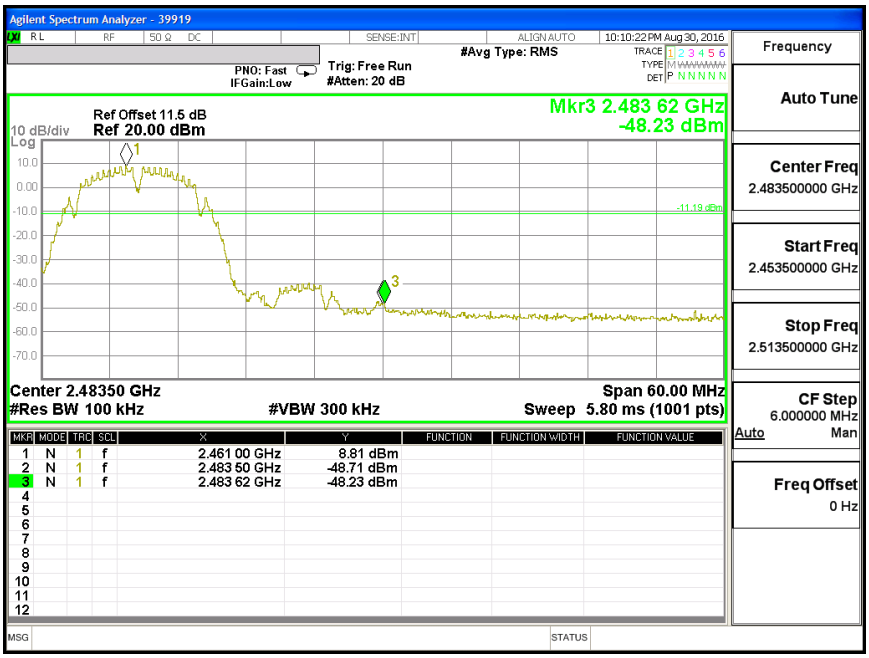
MID CHANNEL REFERENCE

REFERENCE MID CH

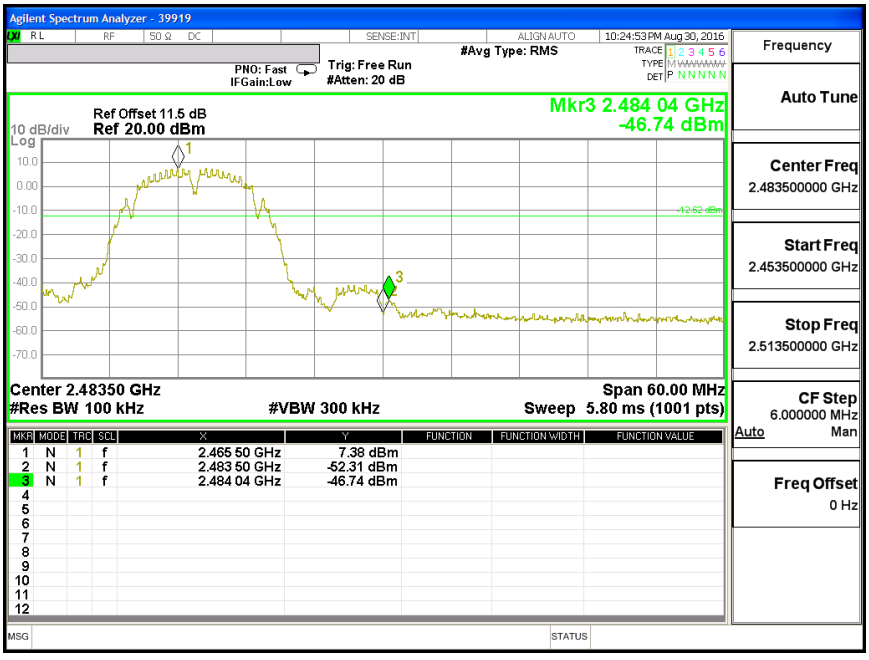


HIGH CHANNEL BANDEDGE

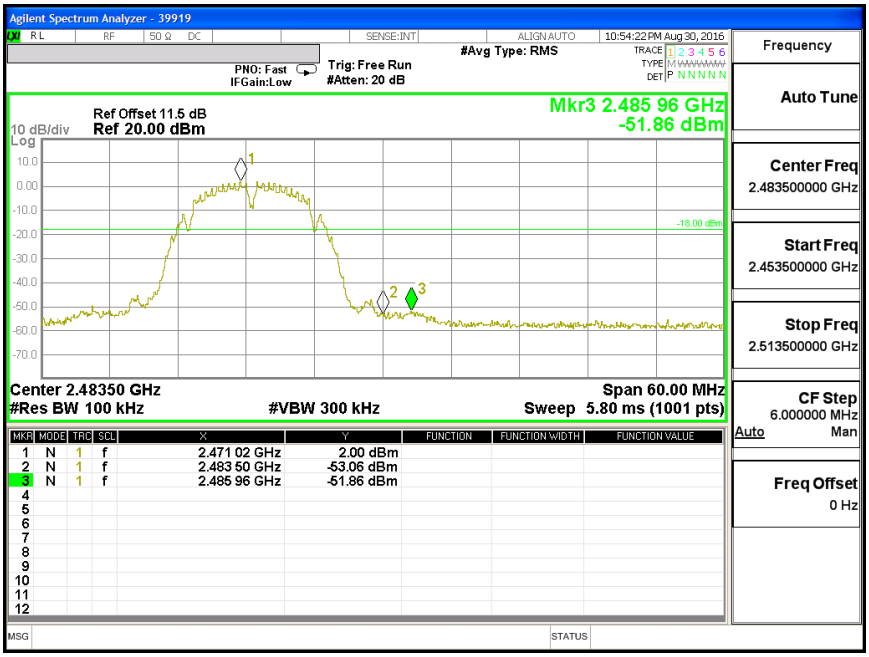
AUTHORIZED BAND EDGE HIGH CH 11



AUTHORIZED BAND EDGE HIGH CH 12

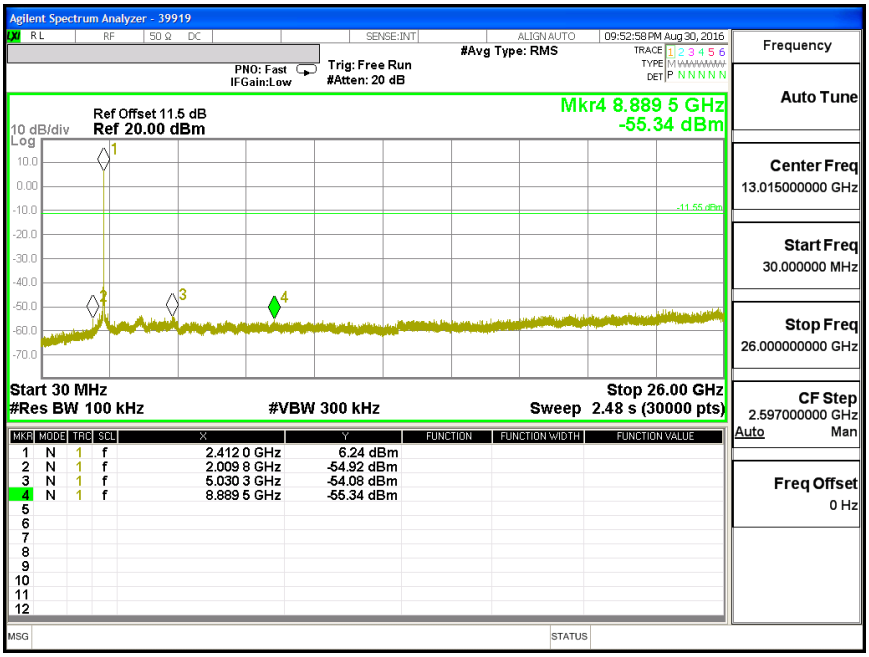


AUTHORIZED BAND EDGE HIGH CH 13

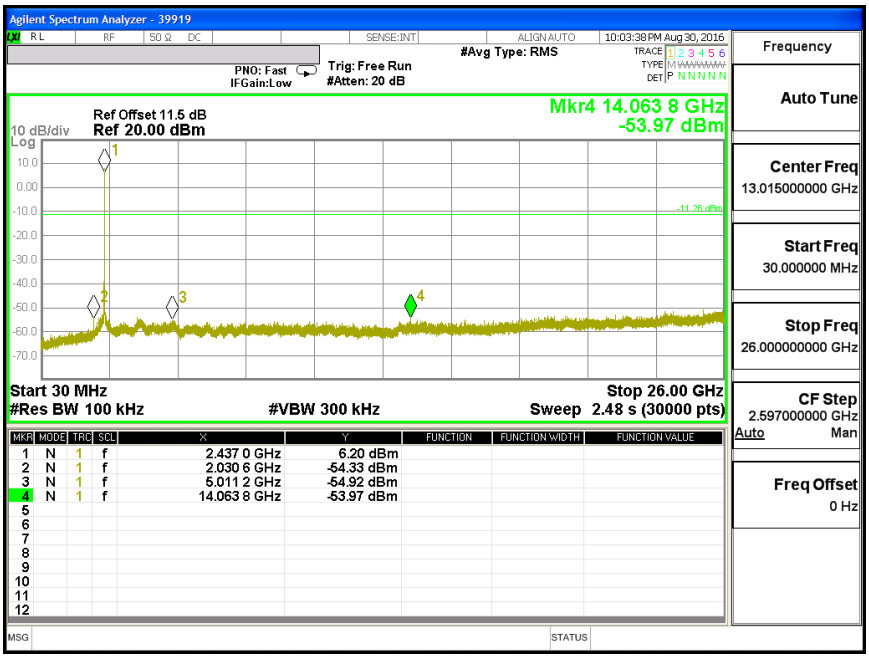


OUT-OF-BAND EMISSIONS

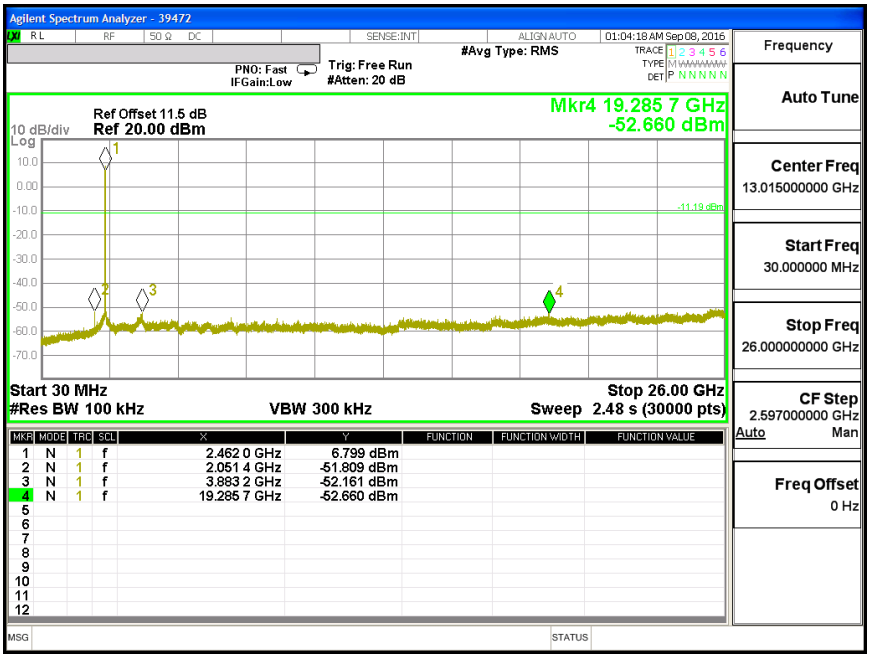
OUT OF BAND LOW CH



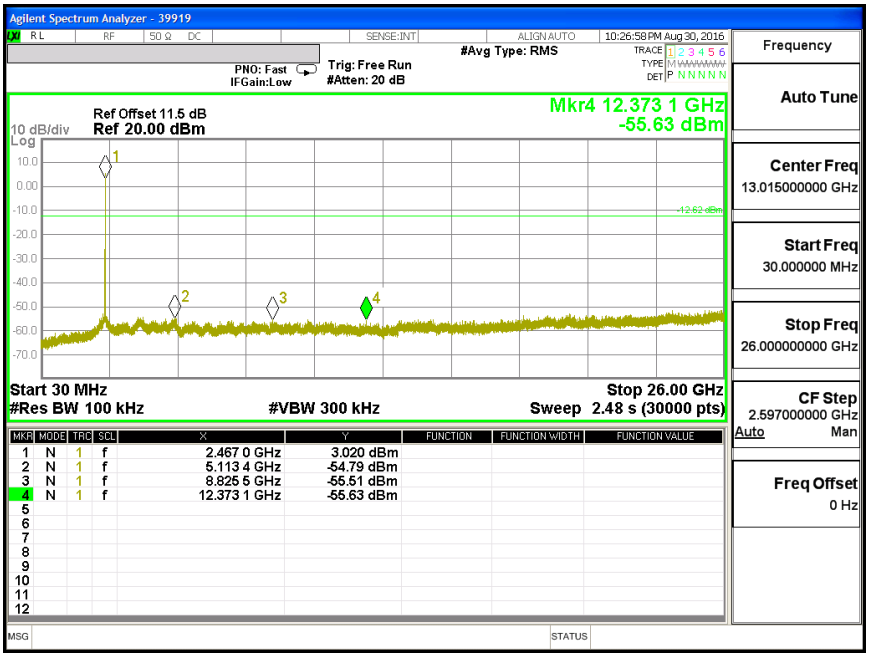
OUT OF BAND MID CH



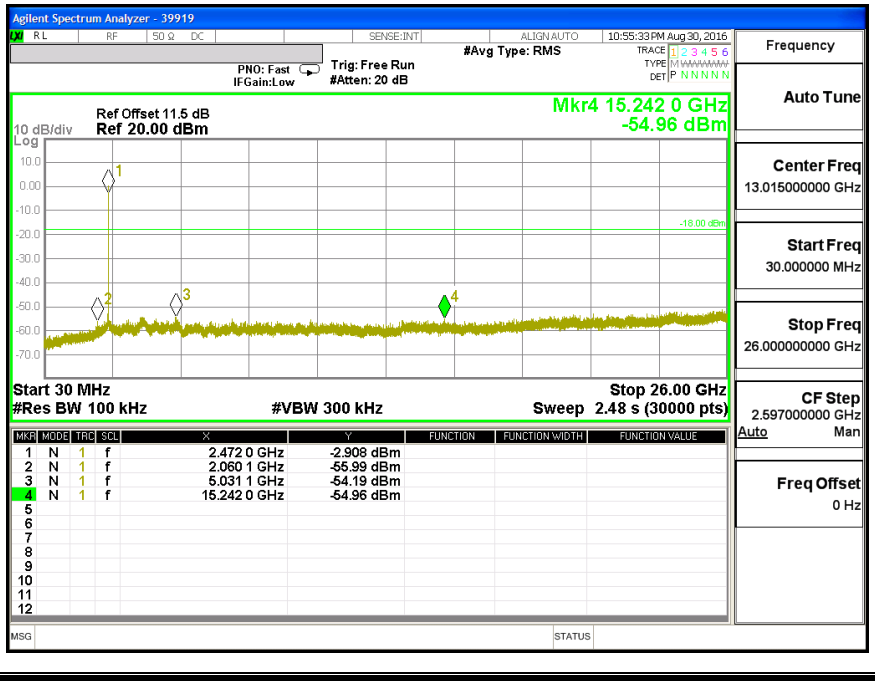
OUT OF BAND HIGH CH 11



OUT OF BAND HIGH CH 12



OUT OF BAND HIGH CH 13



8.3. 802.11b 2TX MODE IN THE 2.4 GHz BAND

8.3.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-247 (5.2) (1)

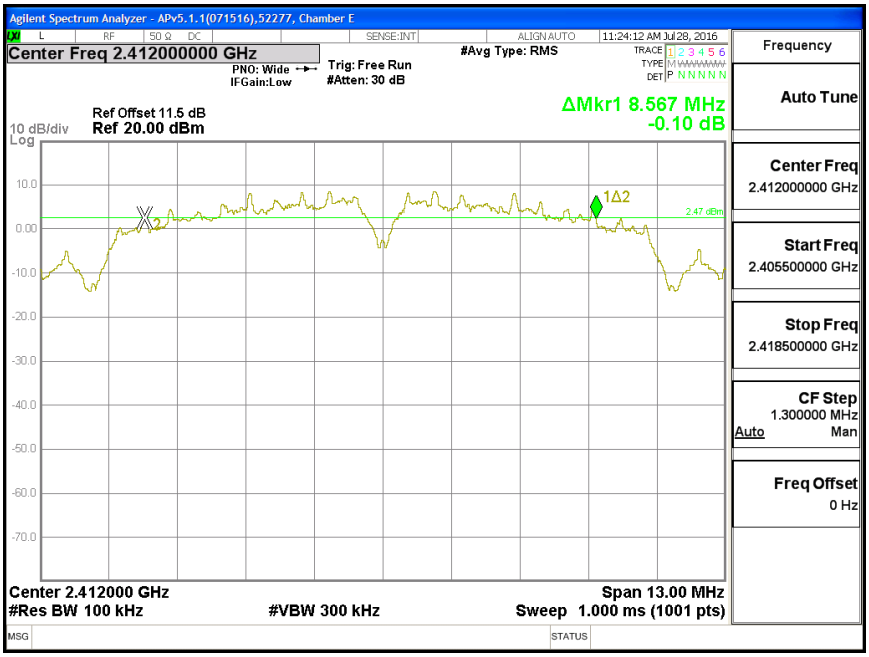
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

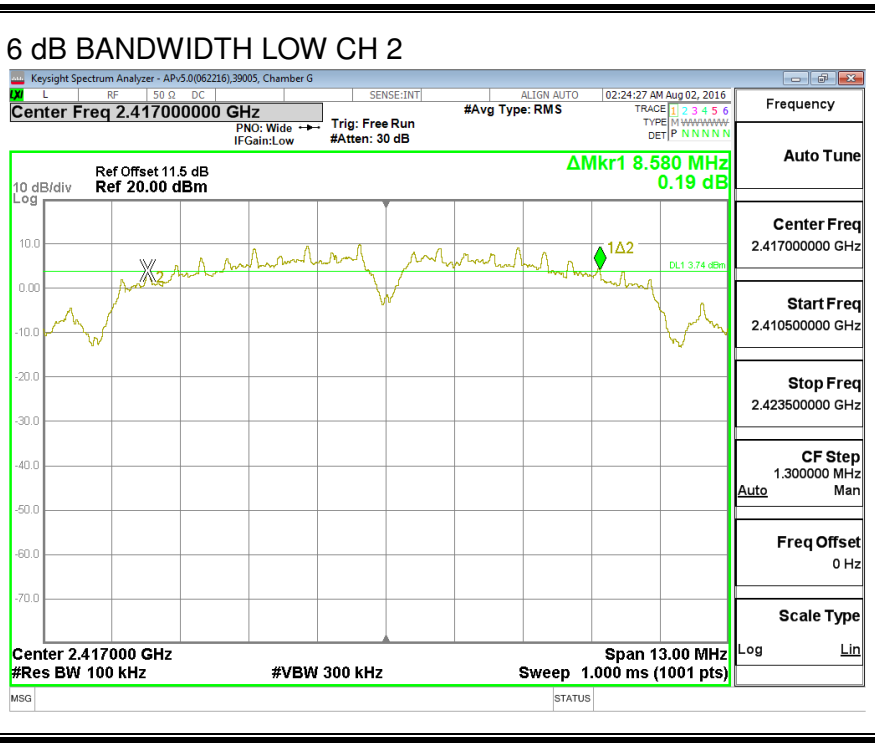
Channel	Frequency (MHz)	6 dB BW Chain 0 (MHz)	6 dB BW Chain 1 (MHz)	Minimum Limit (MHz)
Low_1	2412	8.567	8.580	0.5
Low_2	2417	8.580	8.580	0.5
Mid	2437	8.593	8.106	0.5
High_10	2457	8.086	8.554	0.5
High_11	2462	8.086	8.593	0.5
High_12	2467	8.580	9.058	0.5
High_13	2472	8.554	9.044	0.5

6 dB BANDWIDTH, CHAIN 0

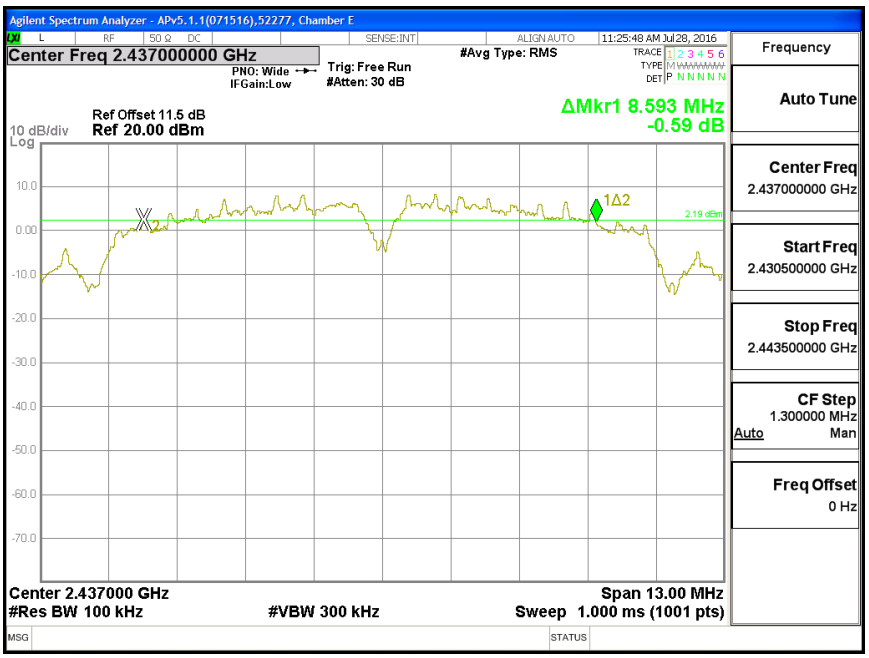
6 dB BANDWIDTH LOW CH



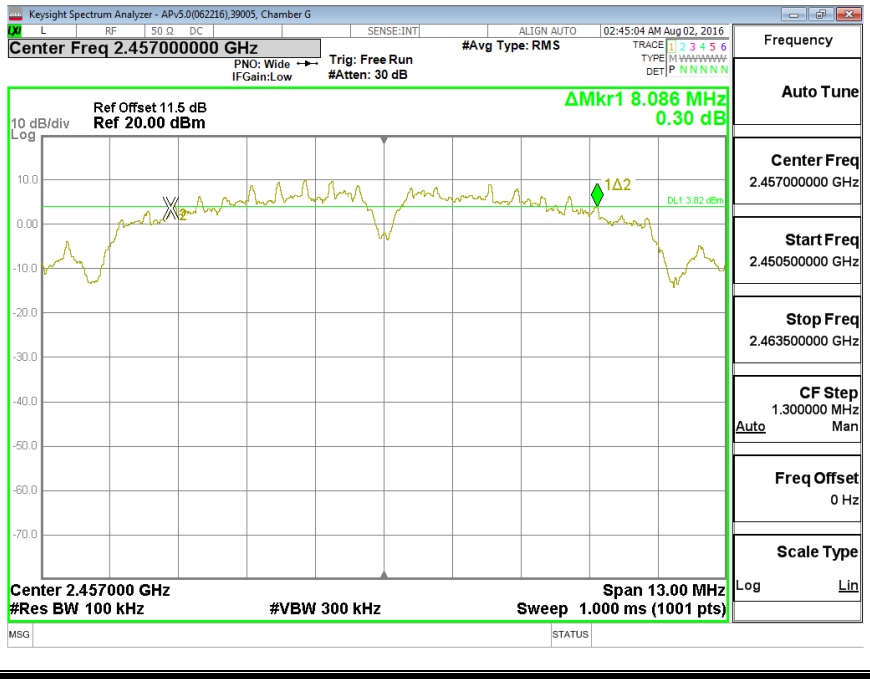
6 dB BANDWIDTH LOW CH 2



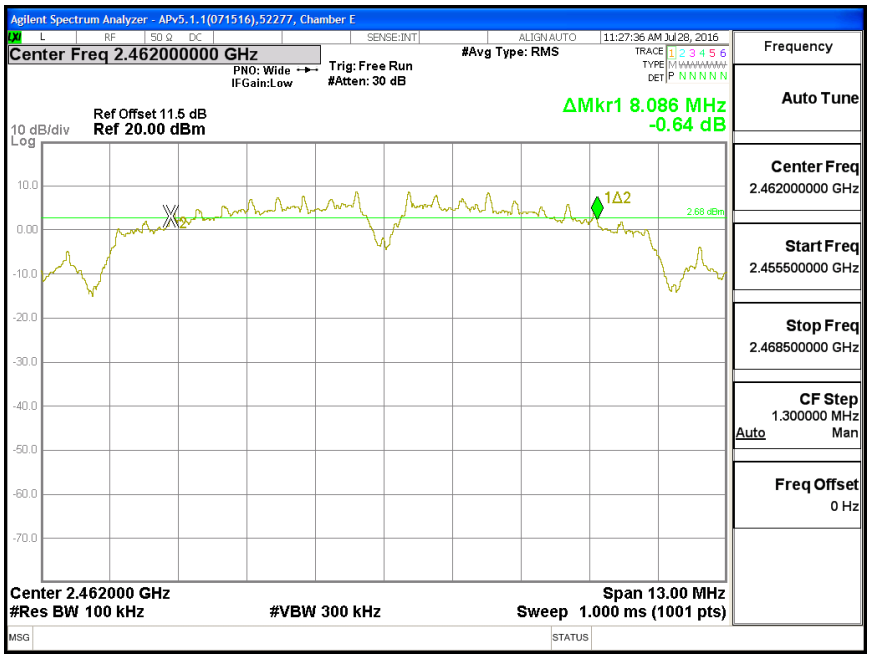
6 dB BANDWIDTH MID CH



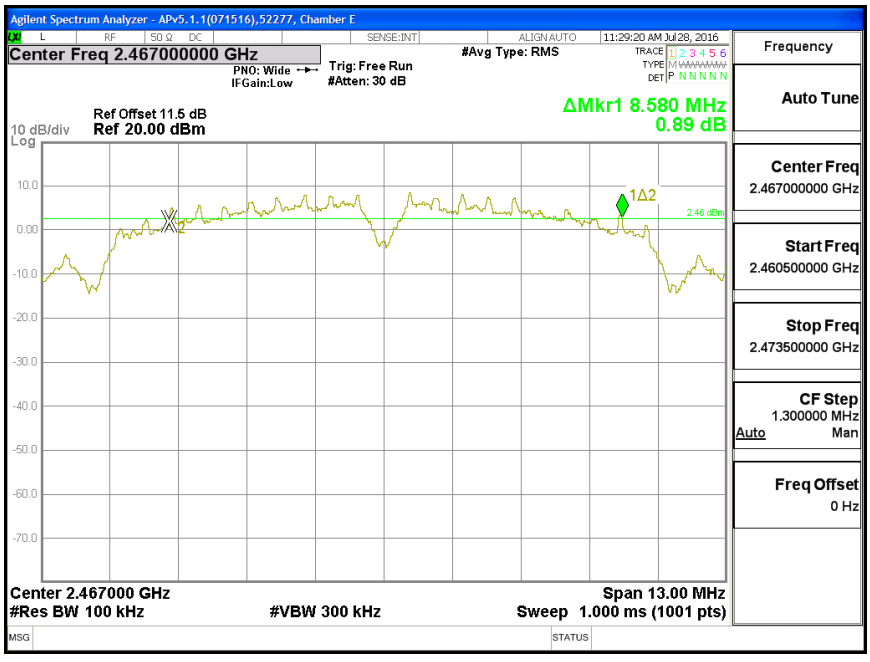
6 dB BANDWIDTH HIGH CH 10



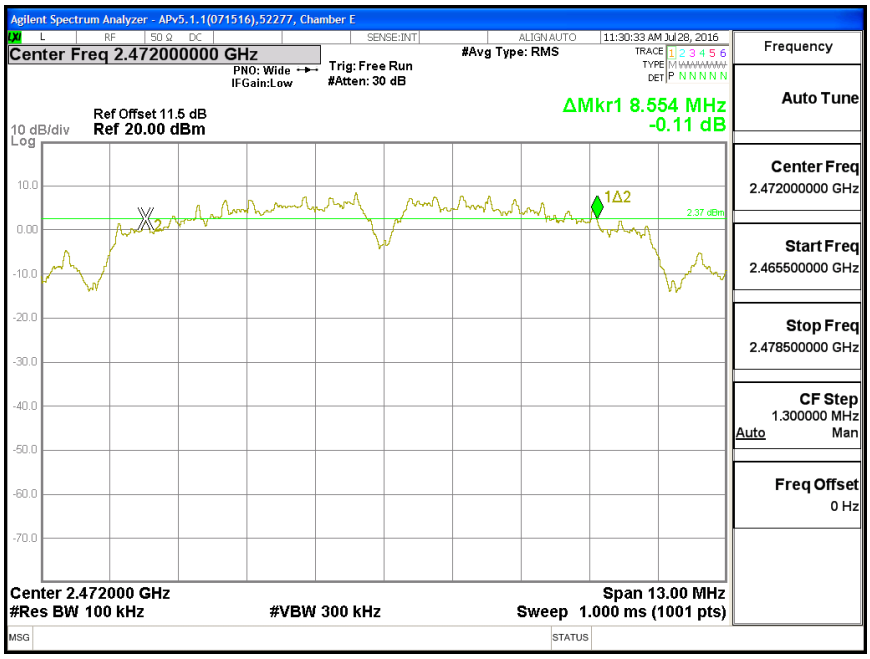
6 dB BANDWIDTH HIGH CH 11



6 dB BANDWIDTH HIGH CH 12

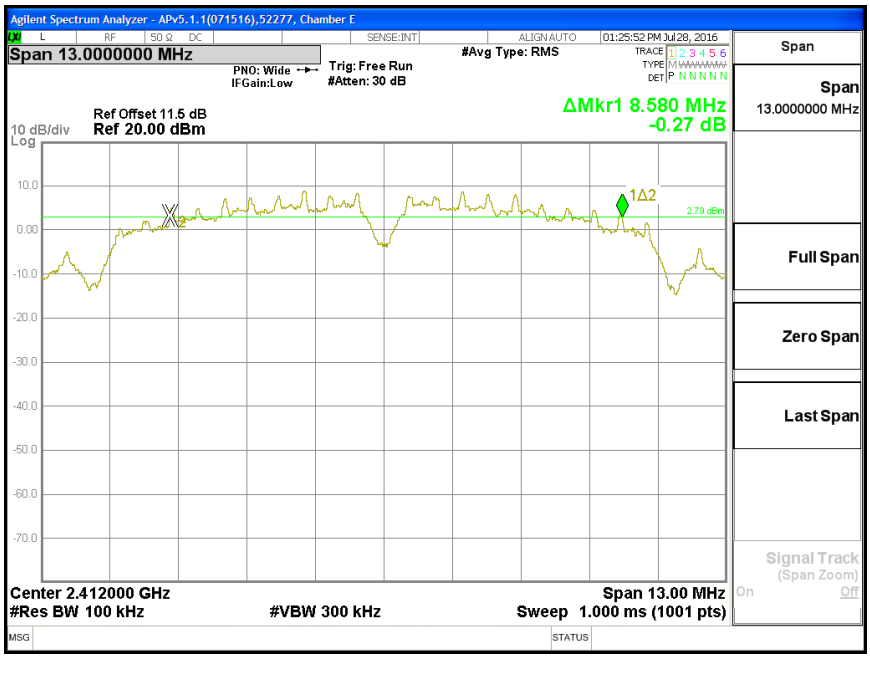


6 dB BANDWIDTH HIGH CH 13

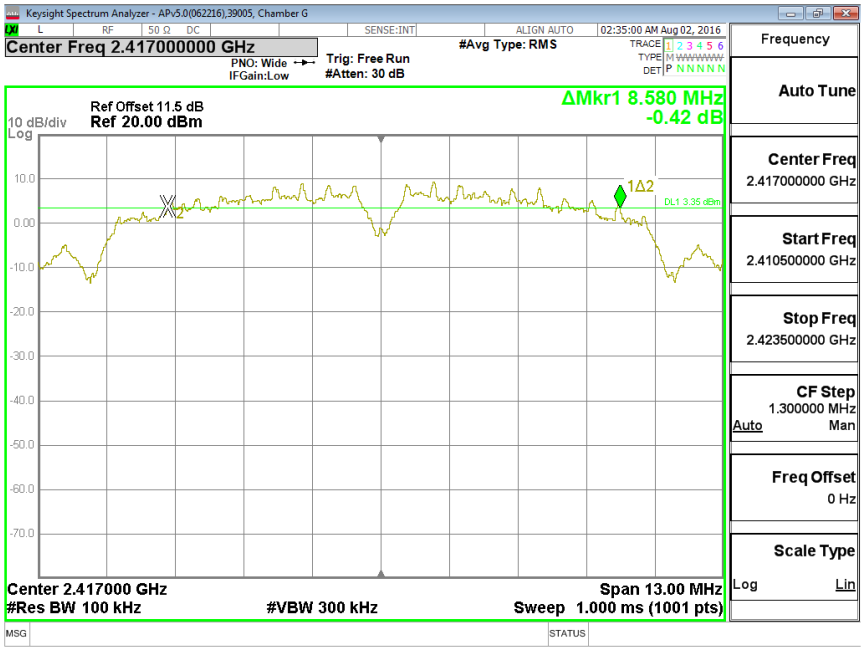


6 dB BANDWIDTH, CHAIN 1

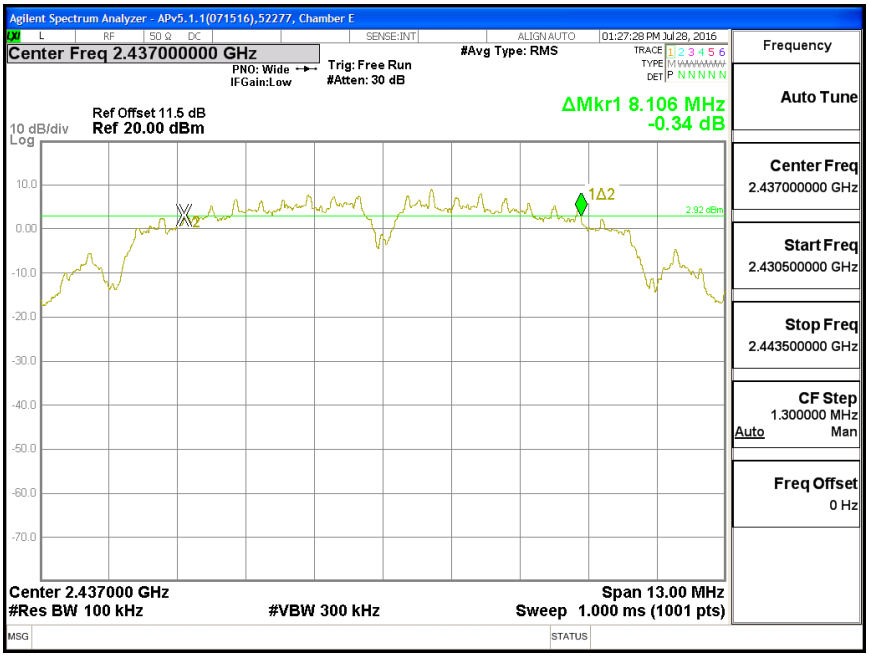
6 dB BANDWIDTH LOW CH



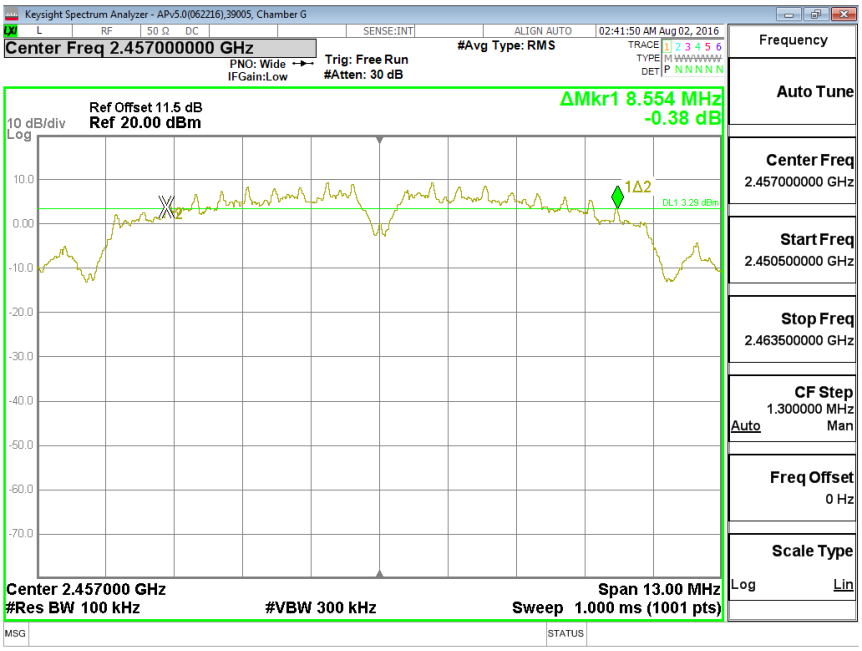
6 dB BANDWIDTH LOW CH 2



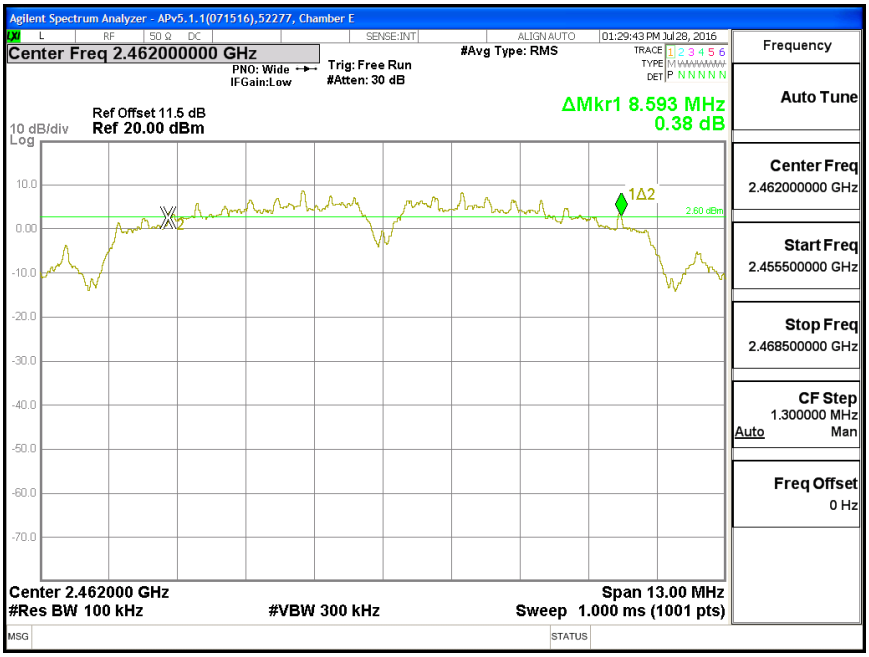
6 dB BANDWIDTH MID CH



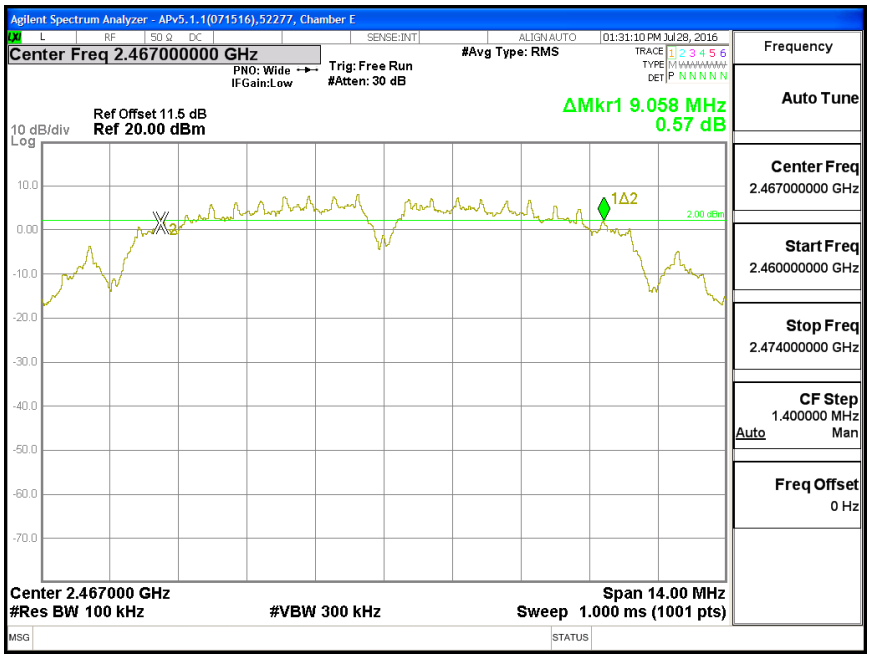
6 dB BANDWIDTH HIGH CH 10



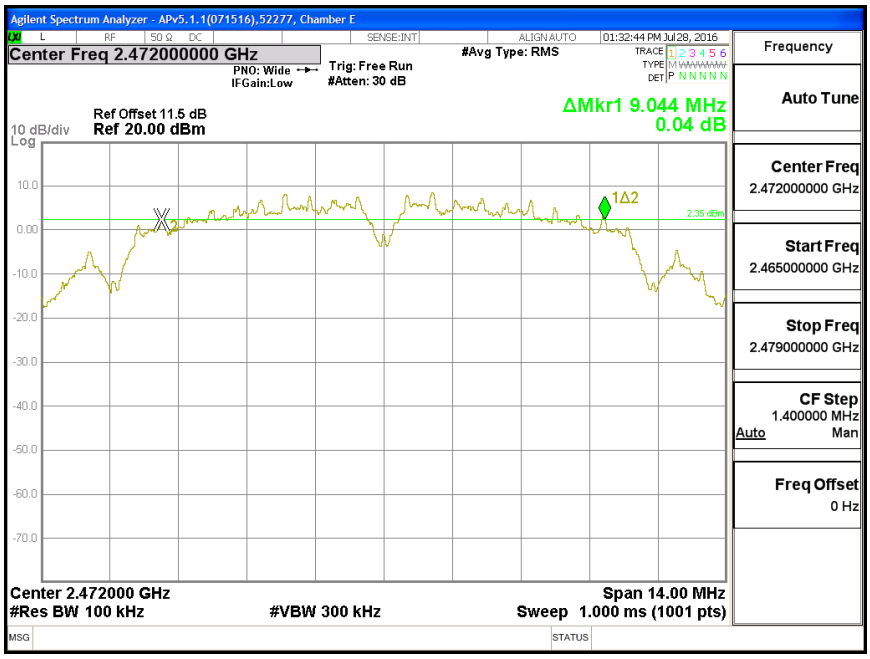
6 dB BANDWIDTH HIGH CH 11



6 dB BANDWIDTH HIGH CH 12



6 dB BANDWIDTH HIGH CH 13



8.3.2. 99% BANDWIDTH

LIMITS

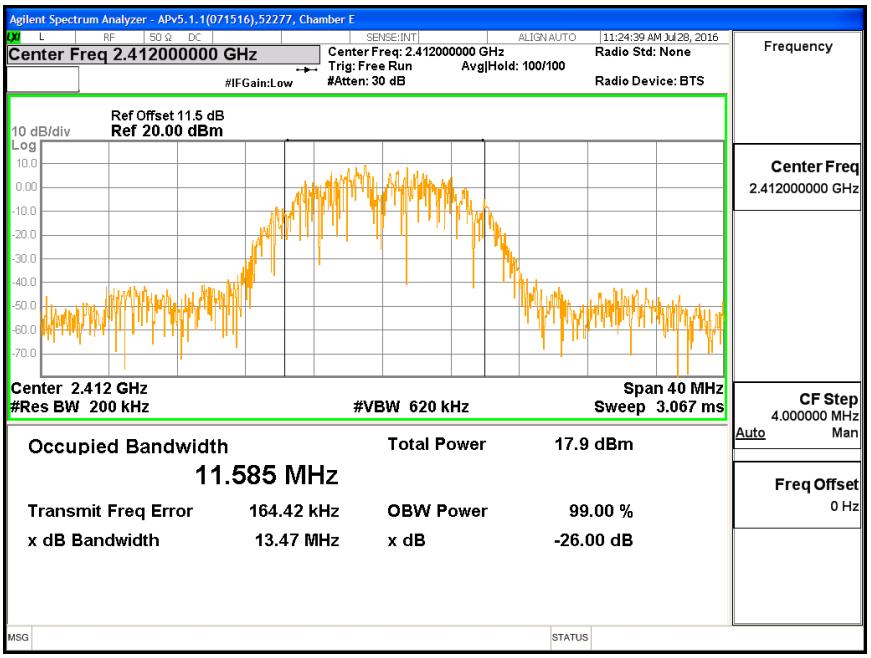
None; for reporting purposes only.

RESULTS

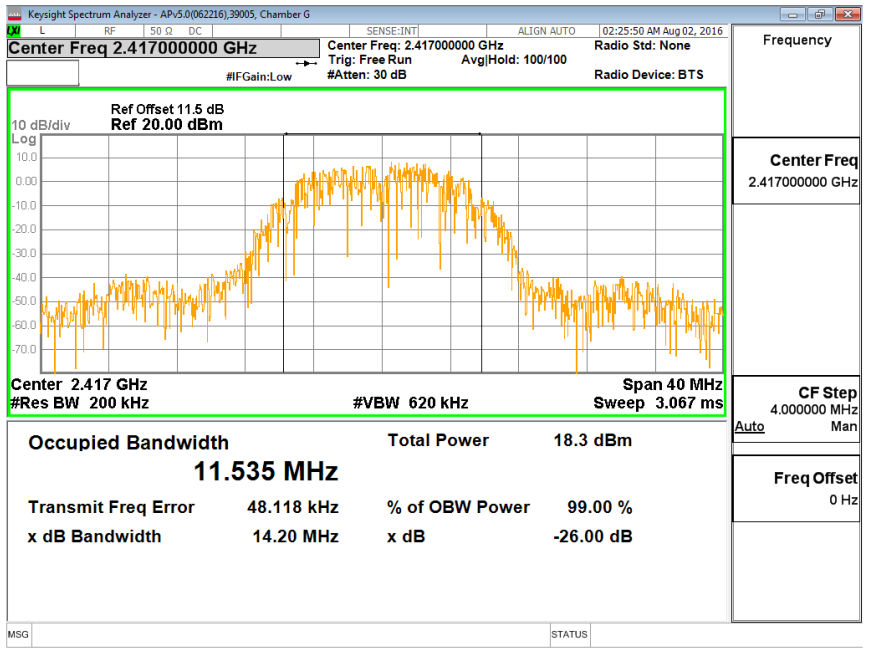
Channel	Frequency (MHz)	99% BW Chain 0 (MHz)	99% BW Chain 1 (MHz)
Low_1	2412	11.585	11.338
Low_2	2417	11.535	12.005
Mid	2437	11.107	11.118
High_10	2457	10.990	11.761
High_11	2462	11.941	11.670
High_12	2467	11.580	11.864
High_13	2472	11.409	11.672

99% BANDWIDTH, CHAIN 0

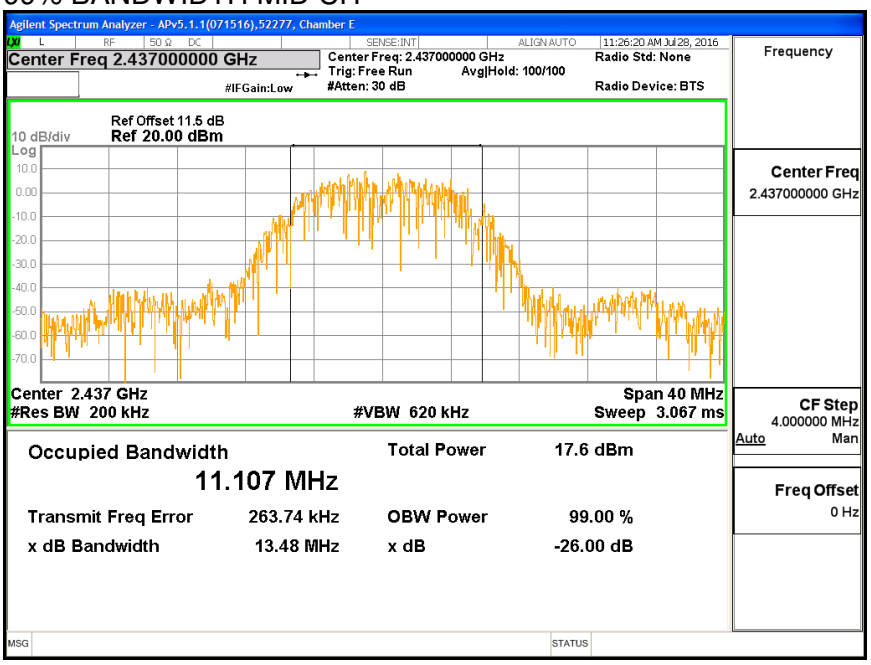
99% BANDWIDTH LOW CH



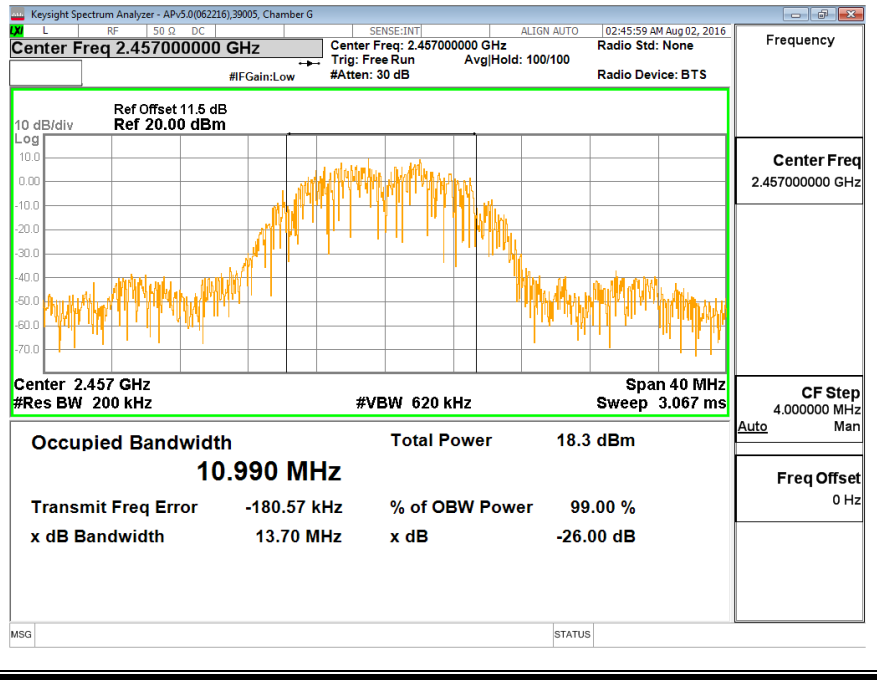
99% BANDWIDTH LOW CH 2



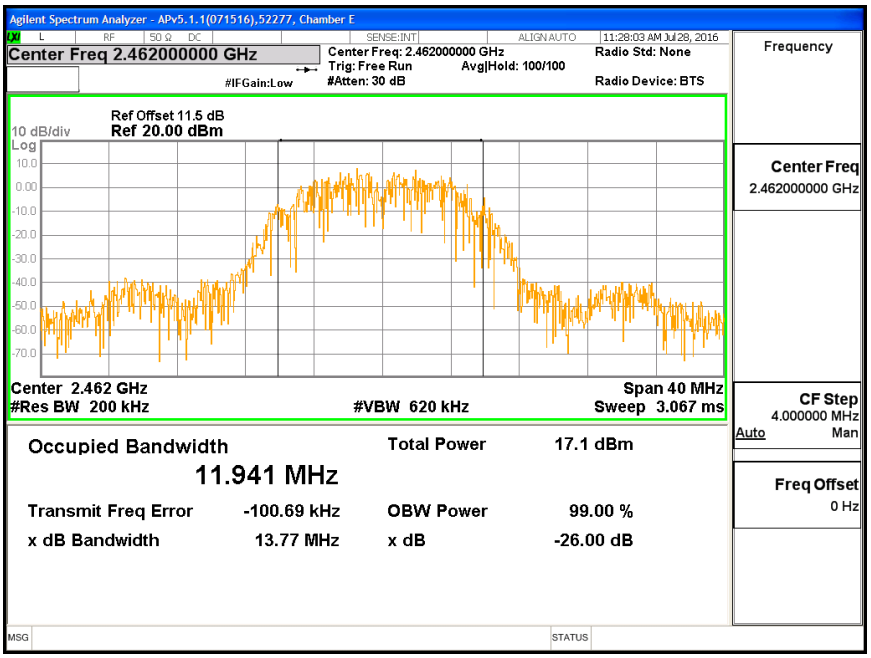
99% BANDWIDTH MID CH



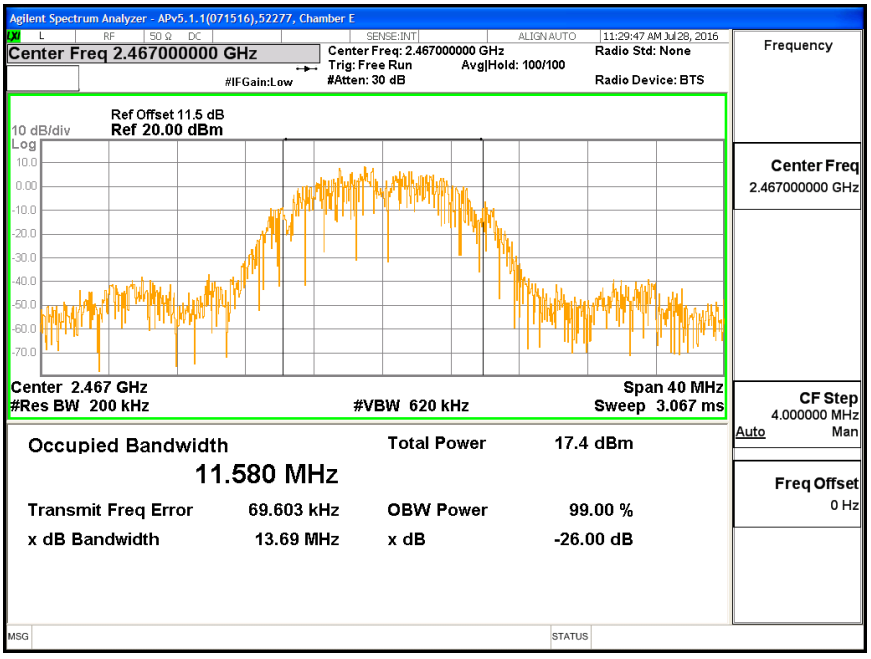
99% BANDWIDTH HIGH CH 10



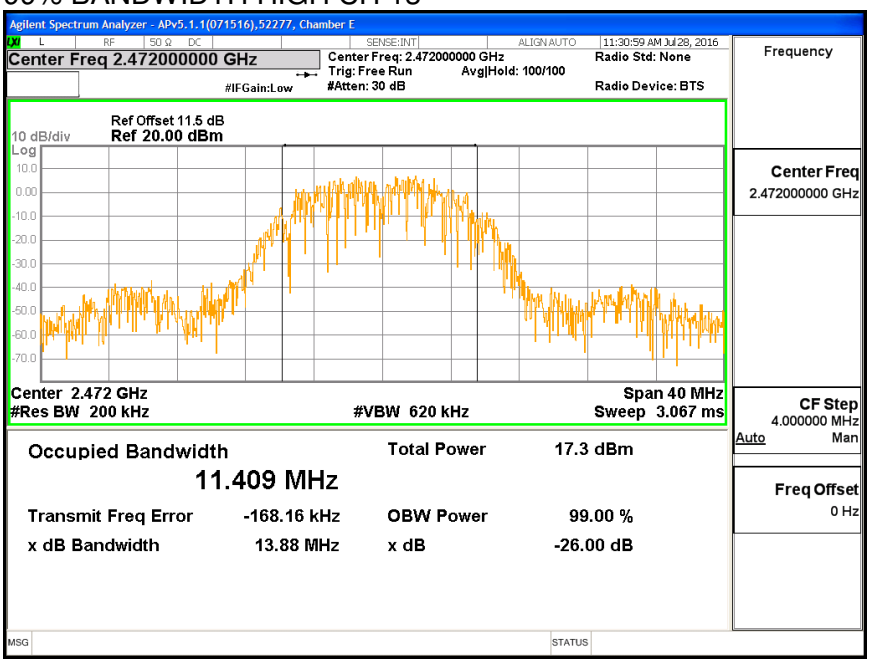
99% BANDWIDTH HIGH CH 11



99% BANDWIDTH HIGH CH 12

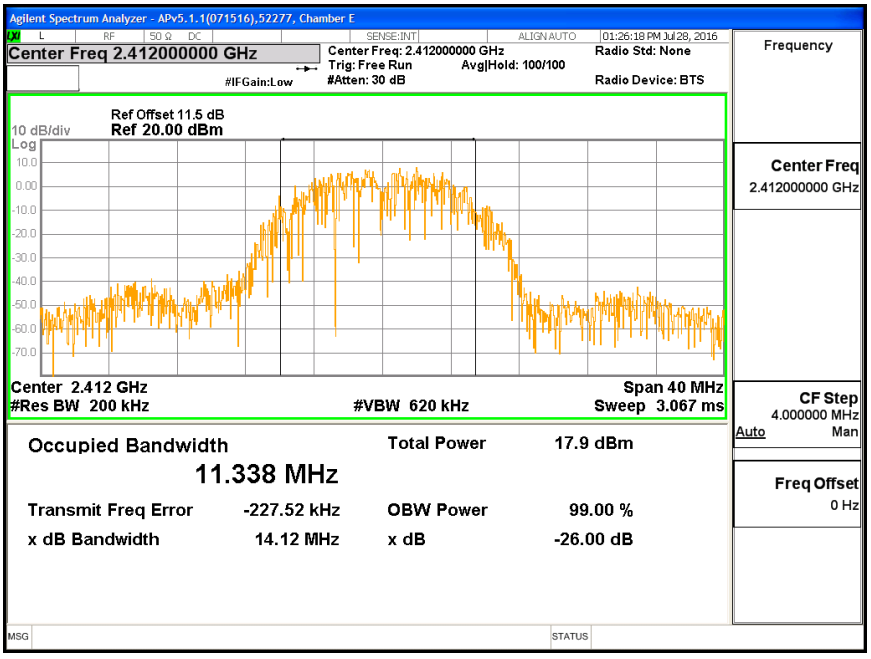


99% BANDWIDTH HIGH CH 13

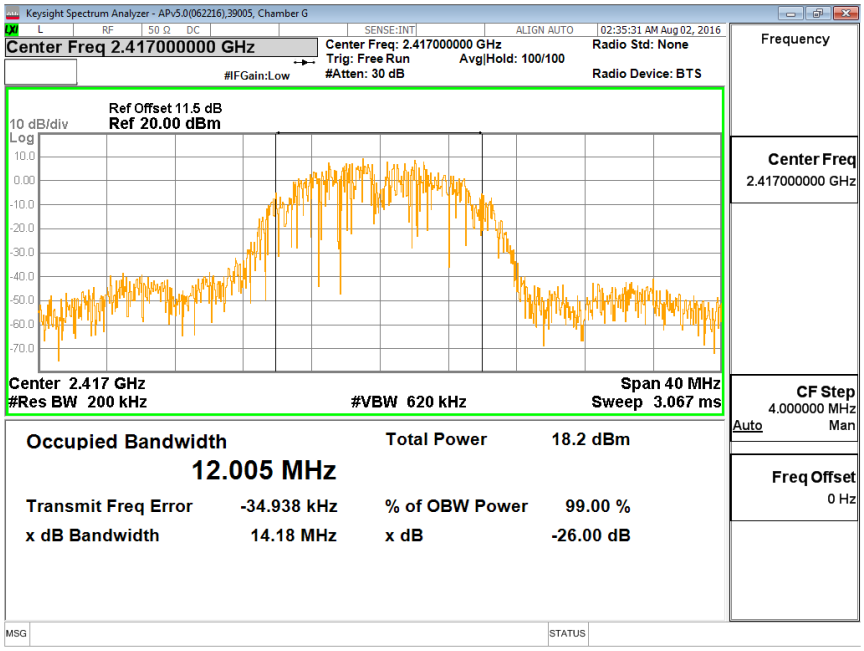


99% BANDWIDTH, CHAIN 1

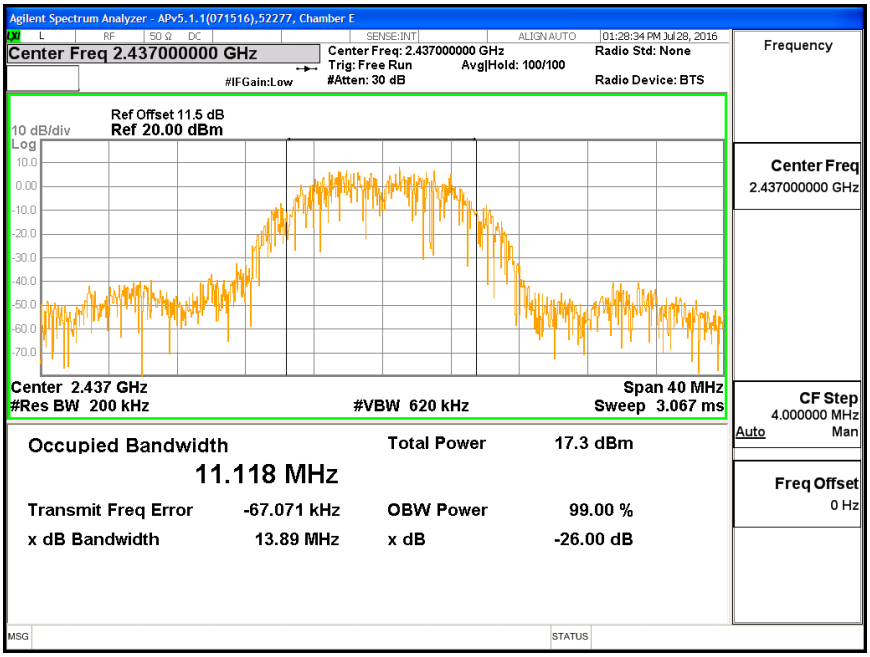
99% BANDWIDTH LOW CH



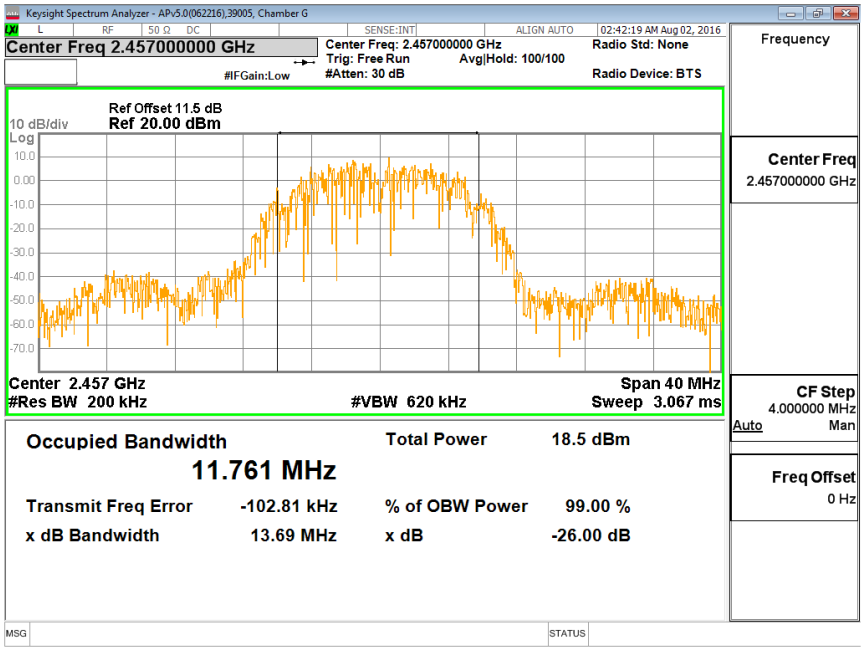
99% BANDWIDTH LOW CH 2



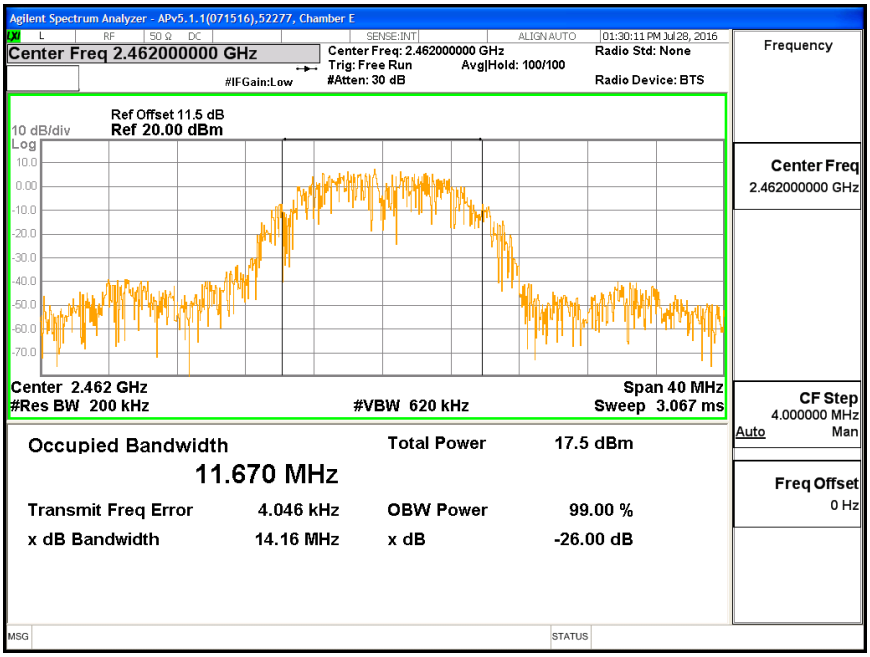
99% BANDWIDTH MID CH



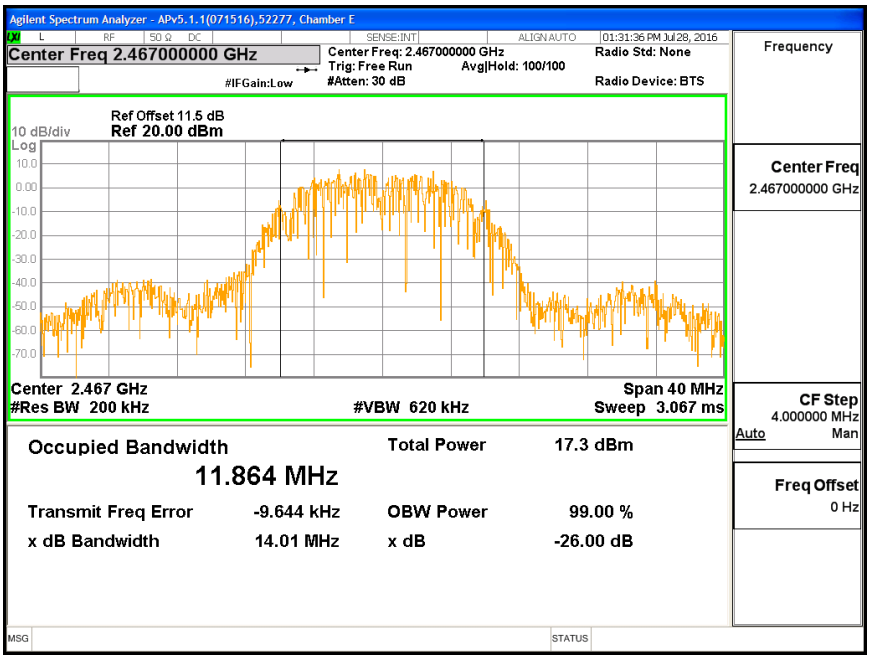
99% BANDWIDTH HIGH CH 10



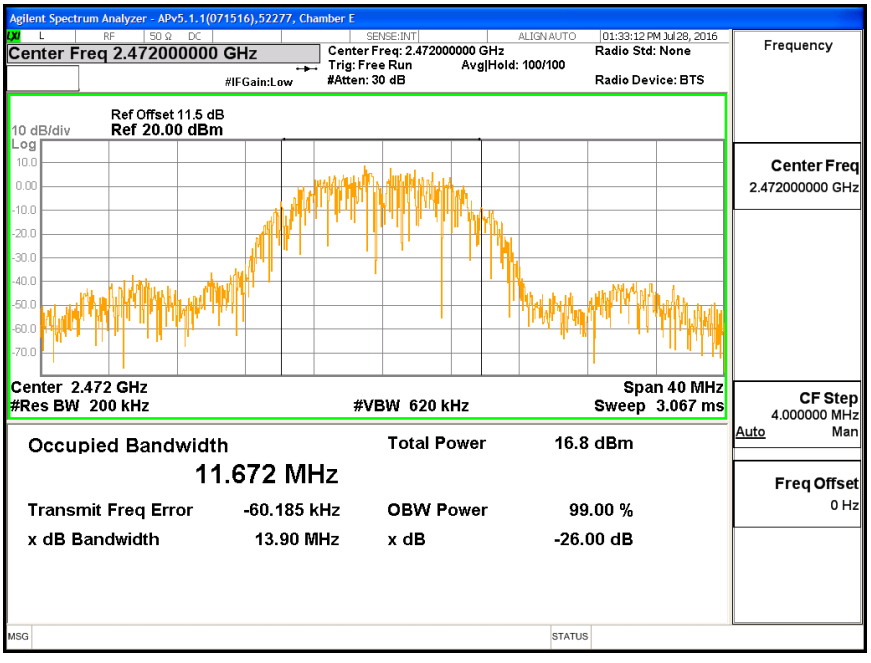
99% BANDWIDTH HIGH CH 11



99% BANDWIDTH HIGH CH 12



99% BANDWIDTH HIGH CH 13



8.3.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

RESULTS

ID:	39919	Date:	8/31/16

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low_1	2412	16.40	16.48	19.45
Low_2	2417	16.66	16.71	19.70
Mid	2437	16.72	16.75	19.75
High_10	2457	16.63	16.70	19.68
High_11	2462	15.50	15.41	18.47
High_12	2467	13.49	13.39	16.45
High_13	2472	10.42	10.49	13.47

8.3.4. OUTPUT POWER

LIMITS

FCC §15.247

IC RSS-247 (5.4) (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)
4.20	5.10	4.67

RESULTS

ID:	39919	Date:	8/31/16

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low_1	2412	4.67	30.00	30	36	30.00
Low_2	2417	4.67	30.00	30	36	30.00
Mid	2437	4.67	30.00	30	36	30.00
High_10	2457	4.67	30.00	30	36	30.00
High_11	2462	4.67	30.00	30	36	30.00
High_12	2467	4.67	30.00	30	36	30.00
High_13	2472	4.67	30.00	30	36	30.00

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

Results

Channel	Frequency (MHz)	Chain 0 Meas Power (dBm)	Chain 1 Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margi (dB)
Low_1	2412	19.22	19.31	22.28	30.00	-7.72
Low_2	2417	20.48	20.65	23.58	30.00	-6.42
Mid	2437	20.74	21.03	23.90	30.00	-6.10
High_10	2457	20.56	20.58	23.58	30.00	-6.42
High_11	2462	18.55	18.39	21.48	30.00	-8.52
High_12	2467	16.23	16.15	19.20	30.00	-10.80
High_13	2472	13.39	13.55	16.48	30.00	-13.52

8.3.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247

IC RSS-247 (5.2) (2)

For digitally modulated systems, the power spectral density conducted form the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 KHz band during any time interval of continuous transmissions.

RESULTS

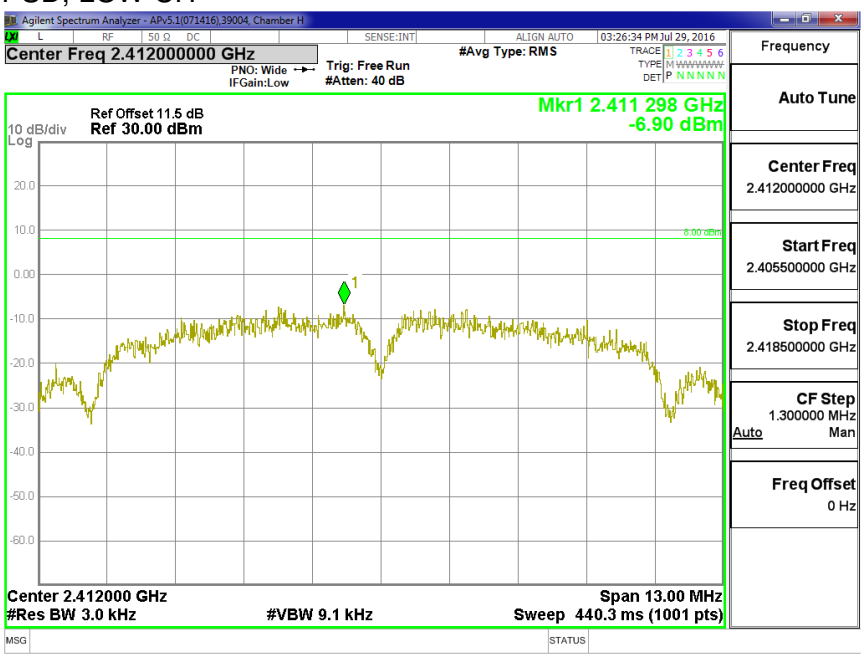
Duty Cycle CF (dB)	0.00	Included in Calculations of Corr'd PSD

PSD Results

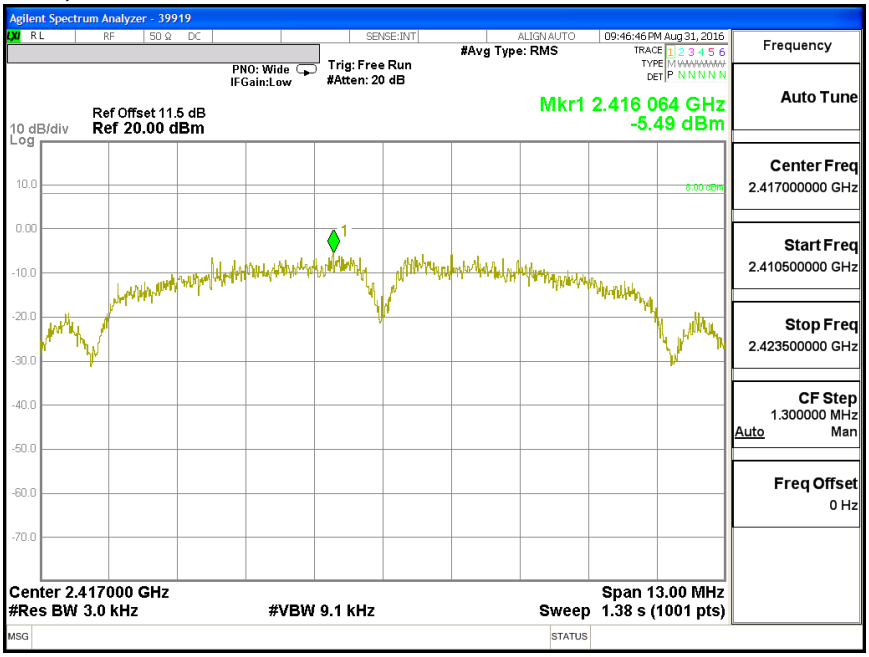
Channel	Frequency (MHz)	Chain 0 Meas (dBm)	Chain 1 Meas (dBm)	Total Corr'd PSD (dBm)	Limit (dBm)	Margin (dB)
Low_1	2412	-6.90	-6.34	-3.60	8.0	-11.6
Low_2	2417	-5.49	-5.35	-2.41	8.0	-10.4
Mid	2437	-5.39	-5.26	-2.31	8.0	-10.3
High_10	2457	-5.53	-5.36	-2.43	8.0	-10.4
High_11	2462	-7.47	-8.57	-4.97	8.0	-13.0
High_12	2467	-8.16	-10.99	-6.34	8.0	-14.3
High_13	2472	-13.76	-13.30	-10.51	8.0	-18.5

PSD, CHAIN 0

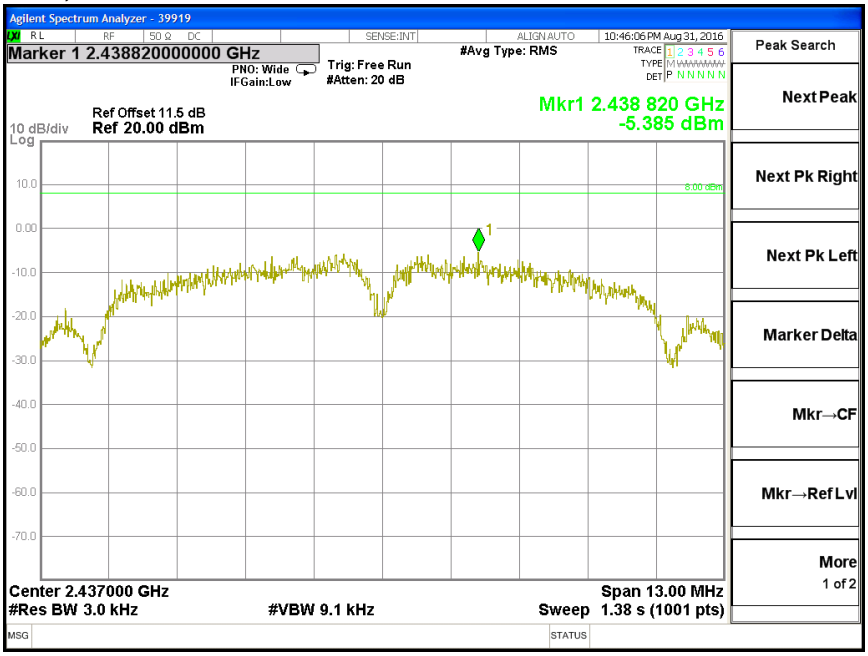
PSD, LOW CH



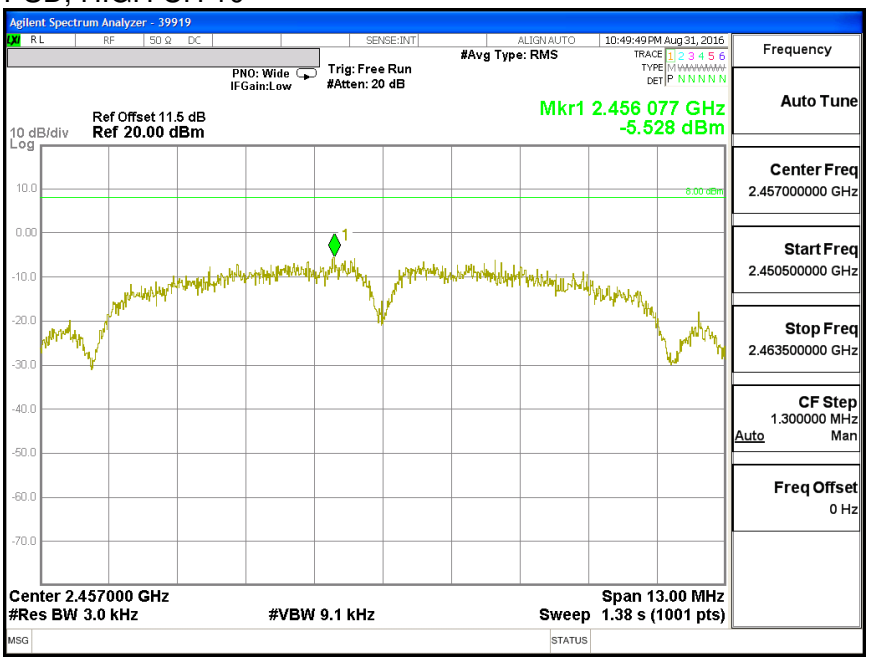
PSD, LOW CH 2



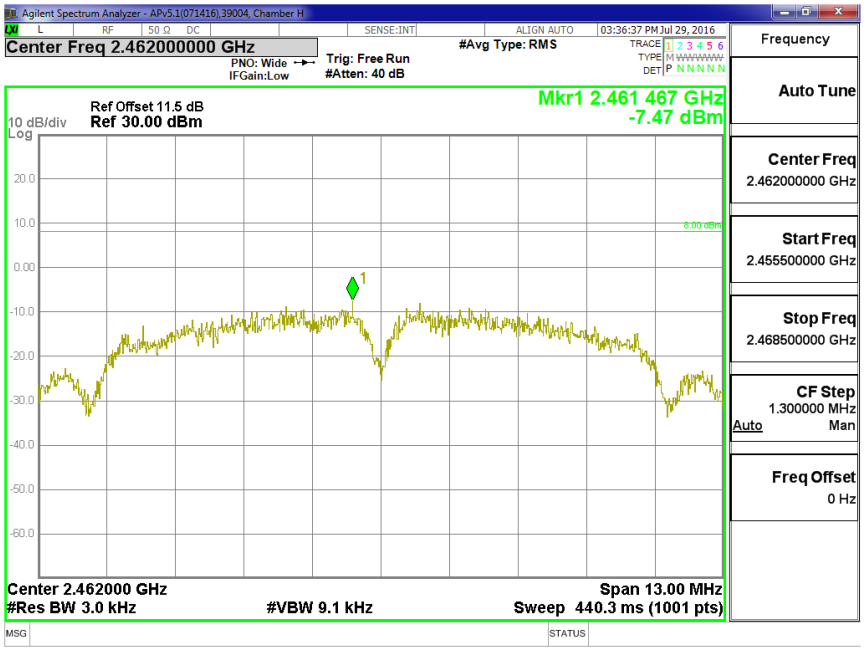
PSD, MID CH



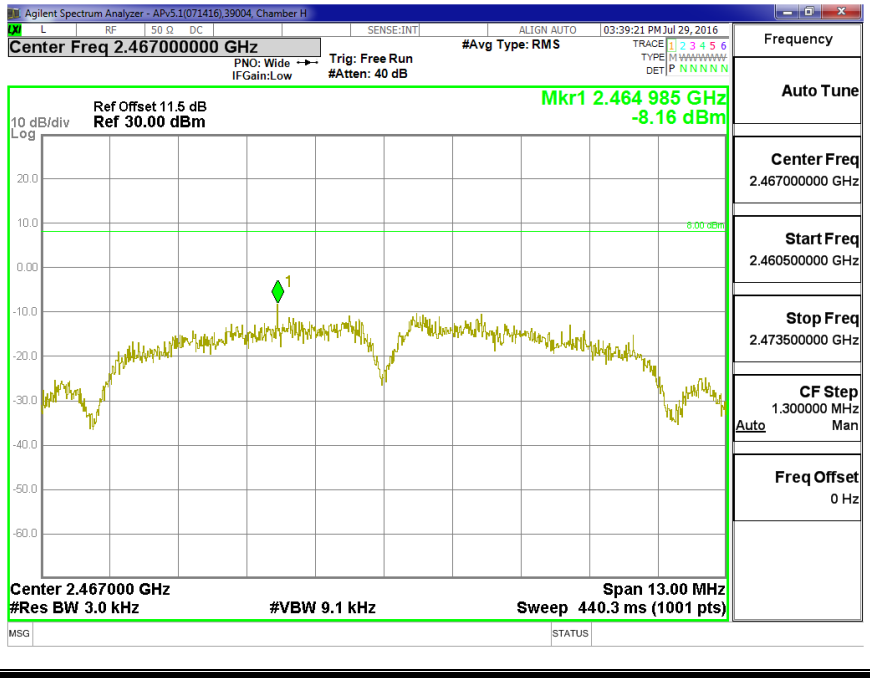
PSD, HIGH CH 10



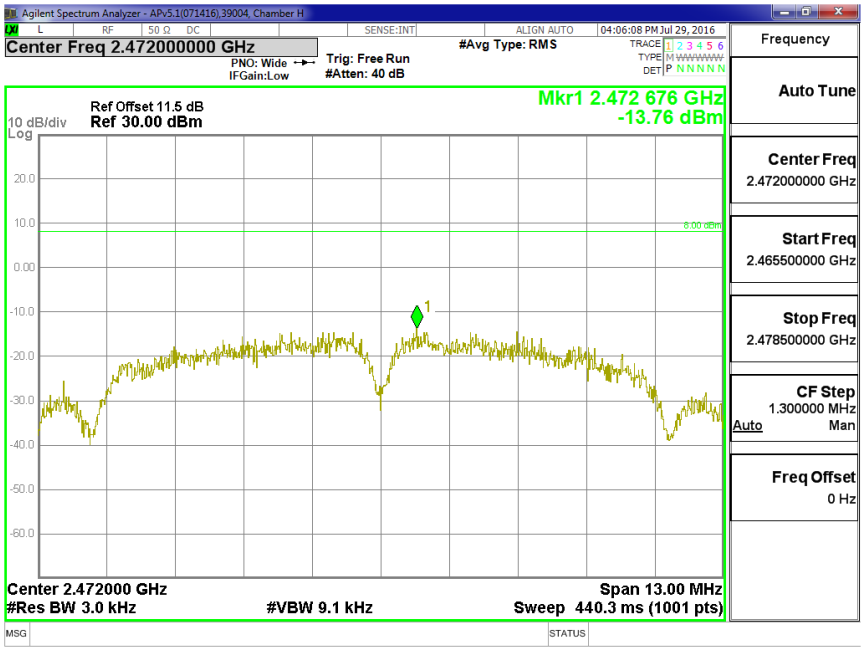
PSD, HIGH CH 11



PSD, HIGH CH 12

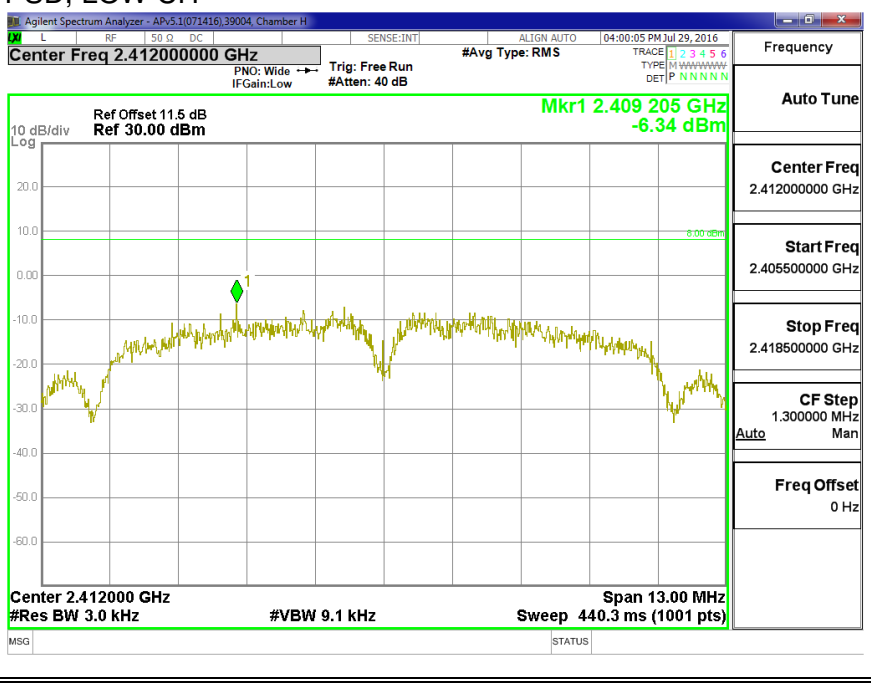


PSD, HIGH CH 13

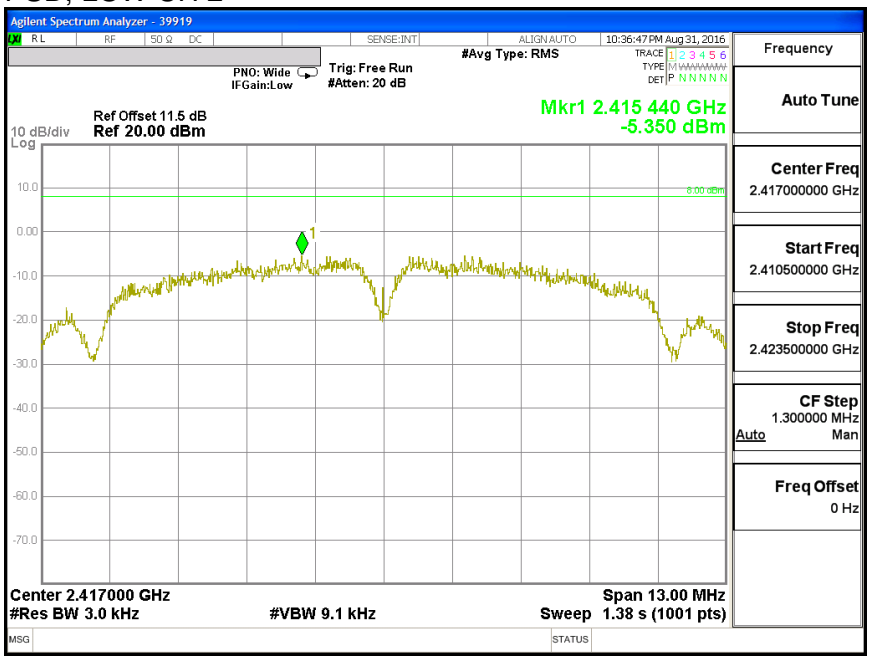


PSD, CHAIN 1

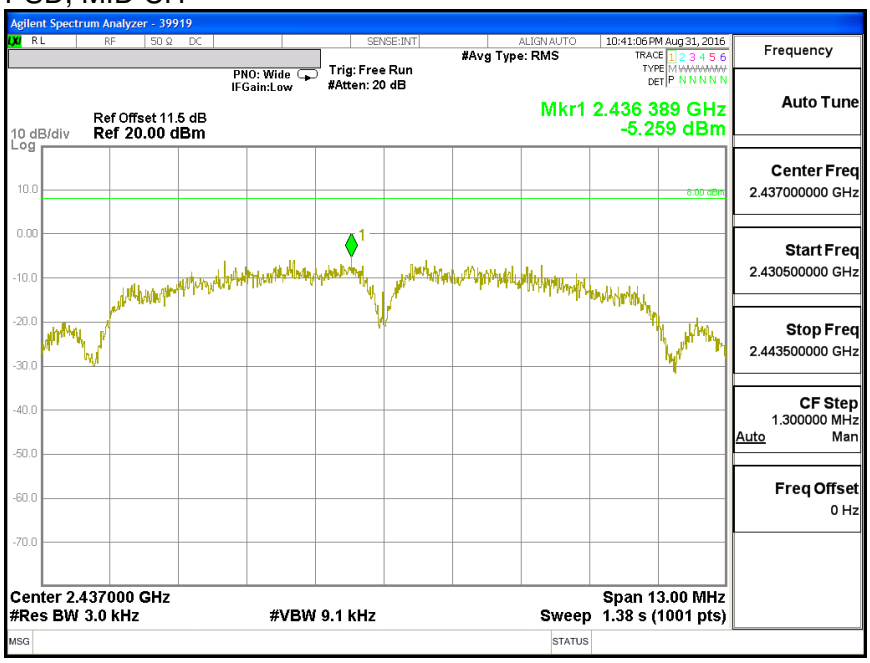
PSD, LOW CH



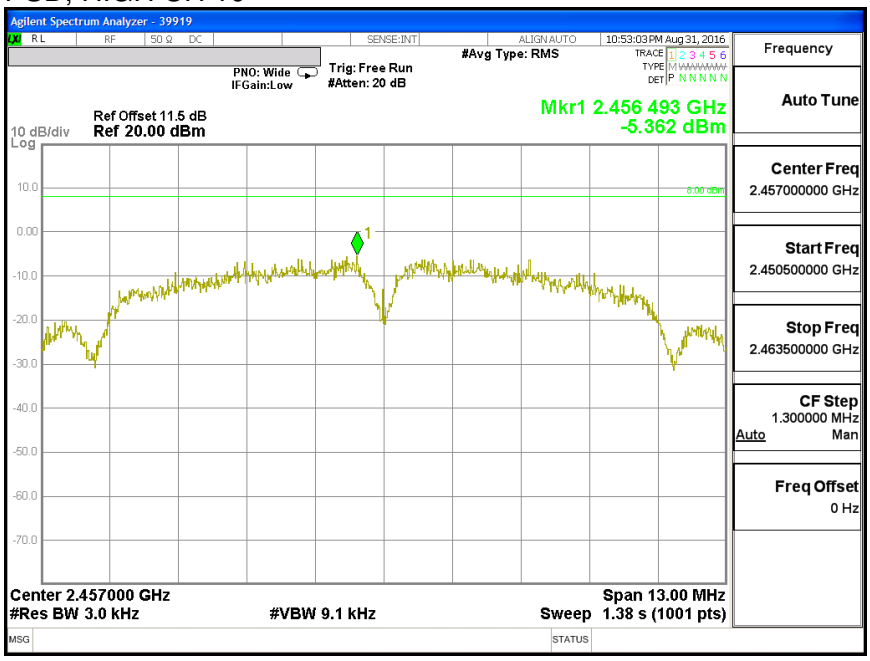
PSD, LOW CH 2



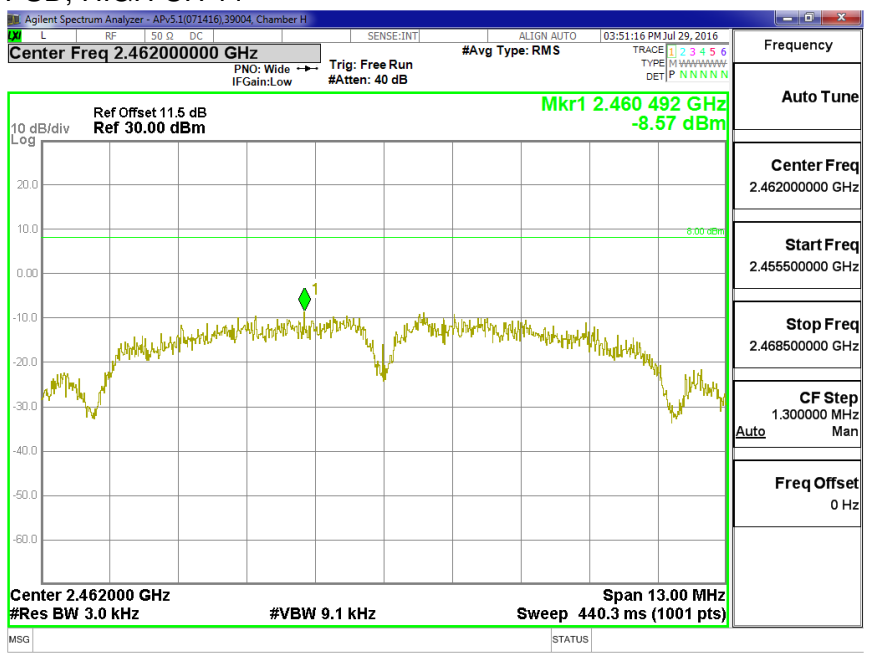
PSD, MID CH



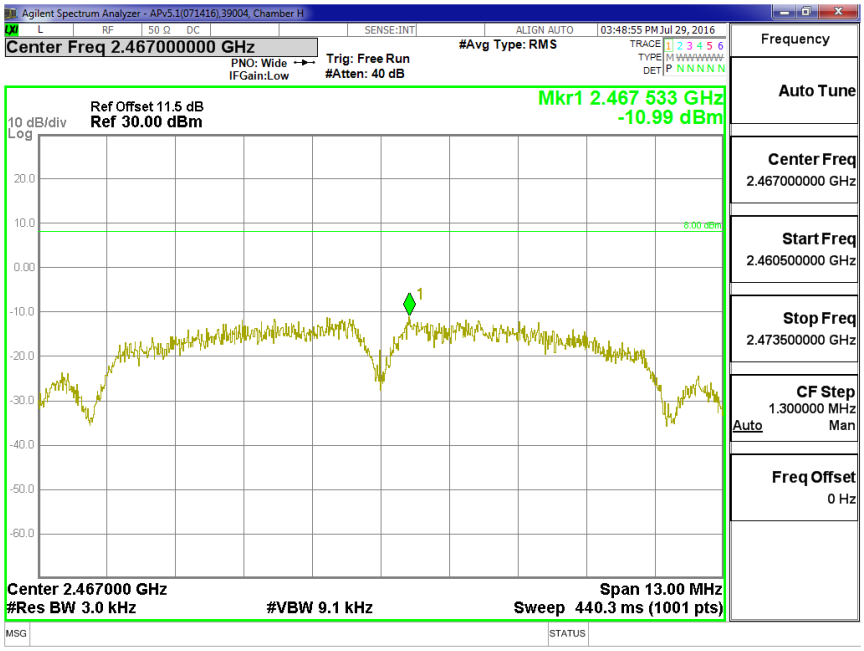
PSD, HIGH CH 10



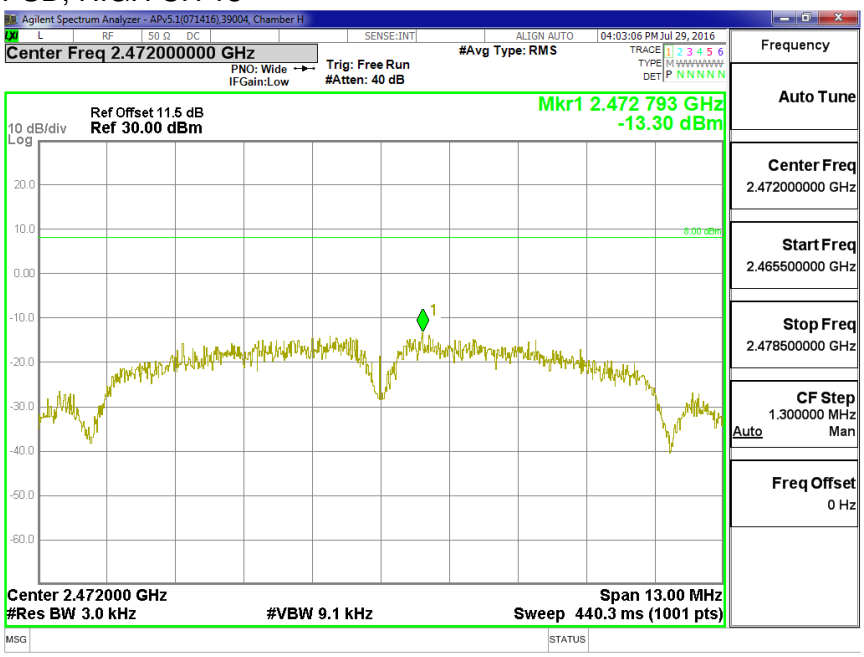
PSD, HIGH CH 11



PSD, HIGH CH 12



PSD, HIGH CH 13



8.3.6. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.247 (d)

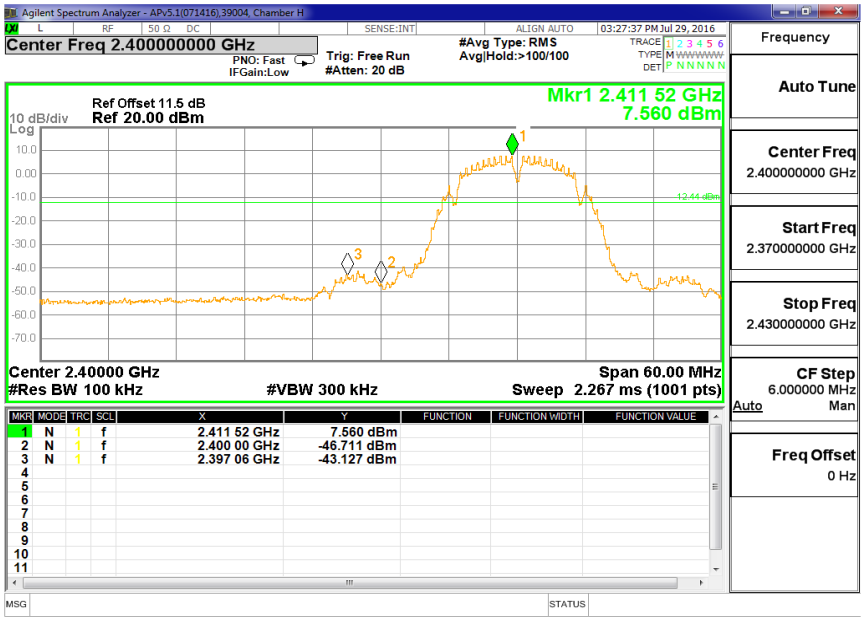
IC RSS-247 (5.5)

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

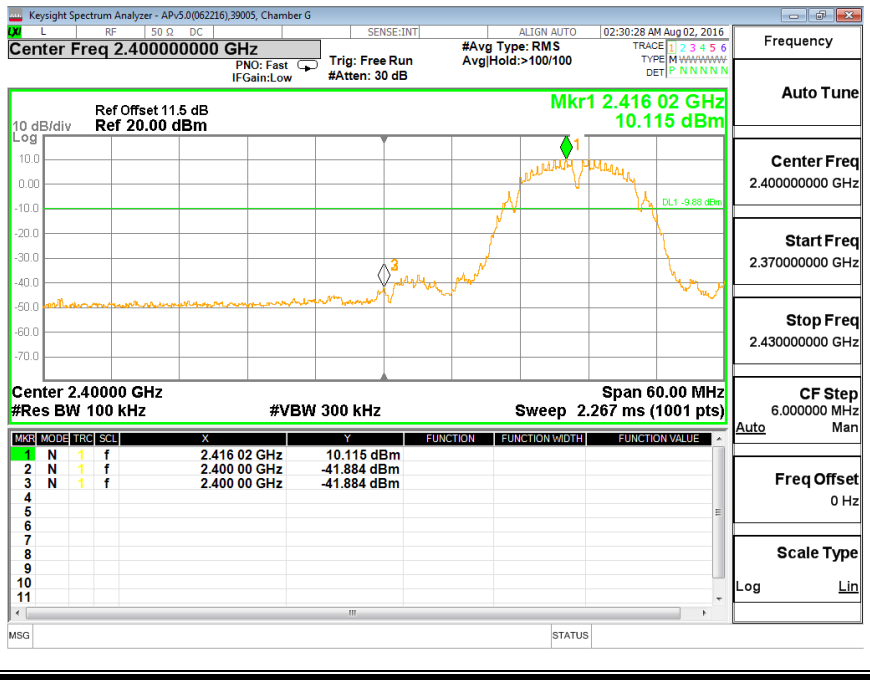
RESULTS

LOW CHANNEL BANDEDGE, CHAIN 0

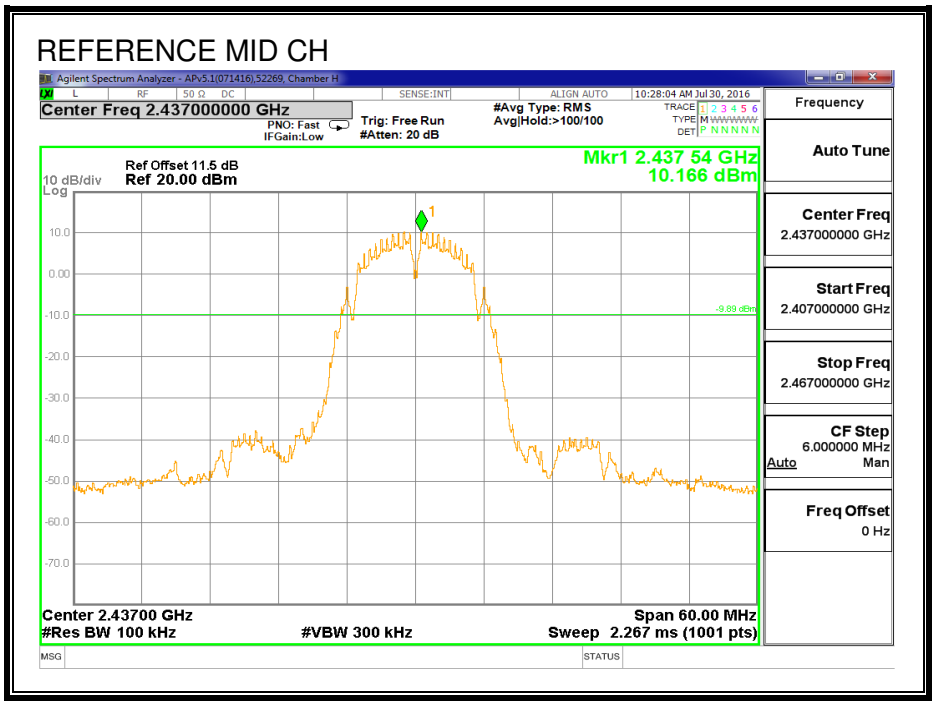
AUTHORIZED BAND EDGE LOW CH



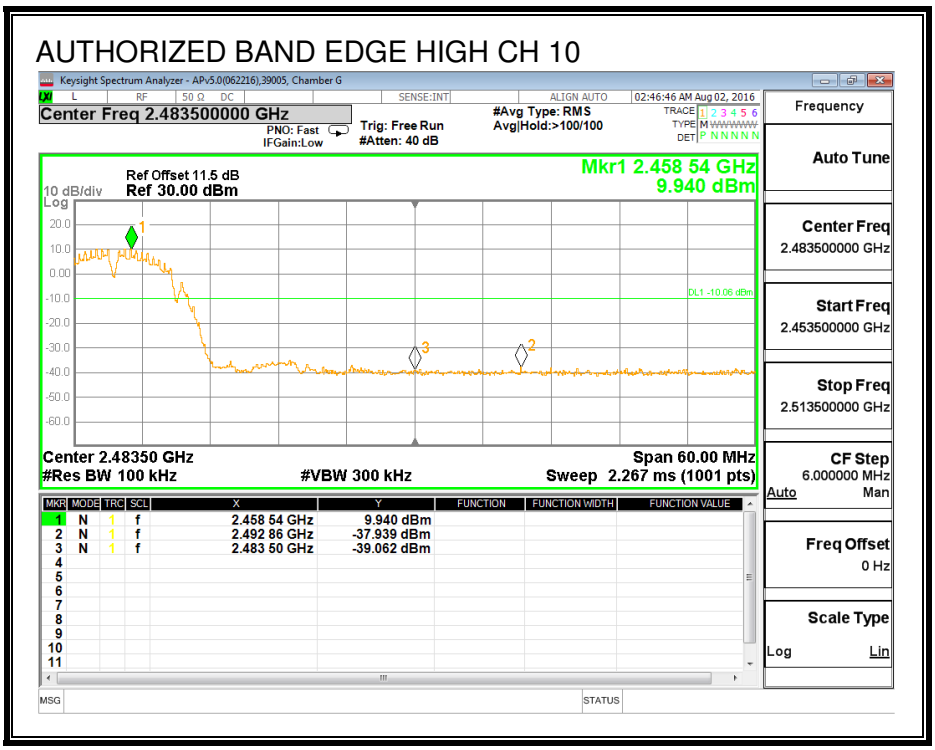
AUTHORIZED BAND EDGE LOW CH 2



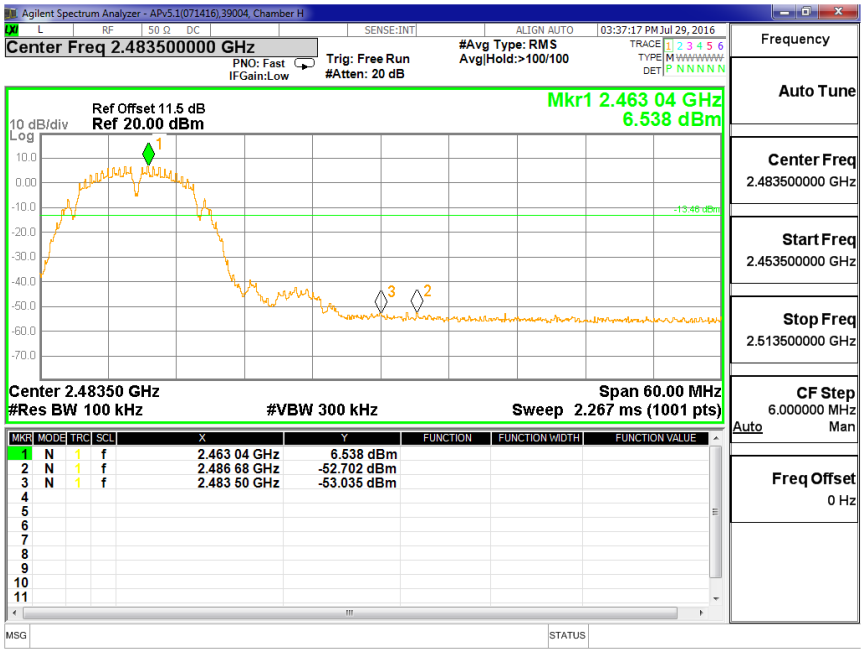
MID CHANNEL REFERENCE, CHAIN 0



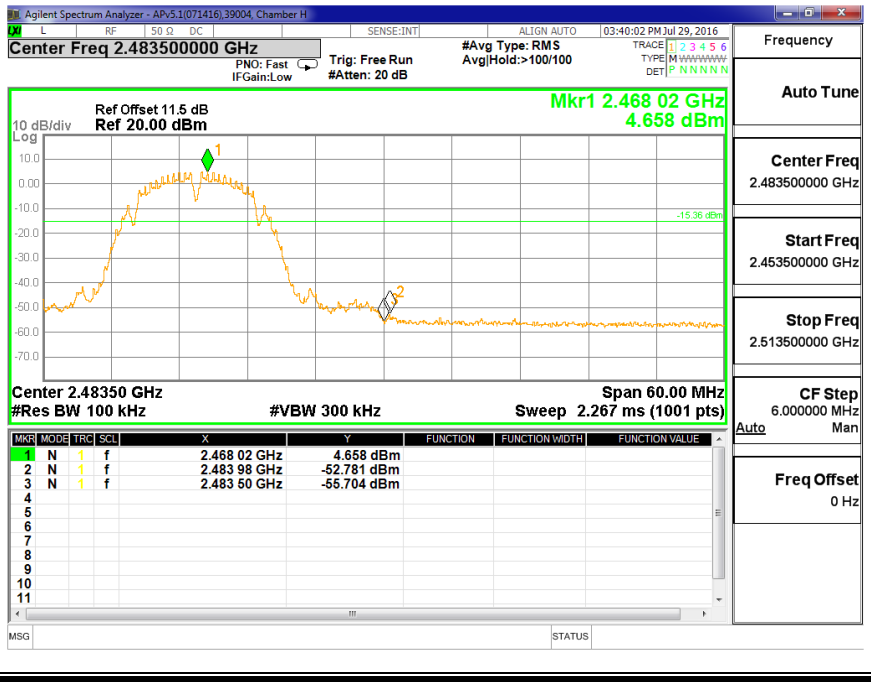
HIGH CHANNEL BANDEDGE, CHAIN 0



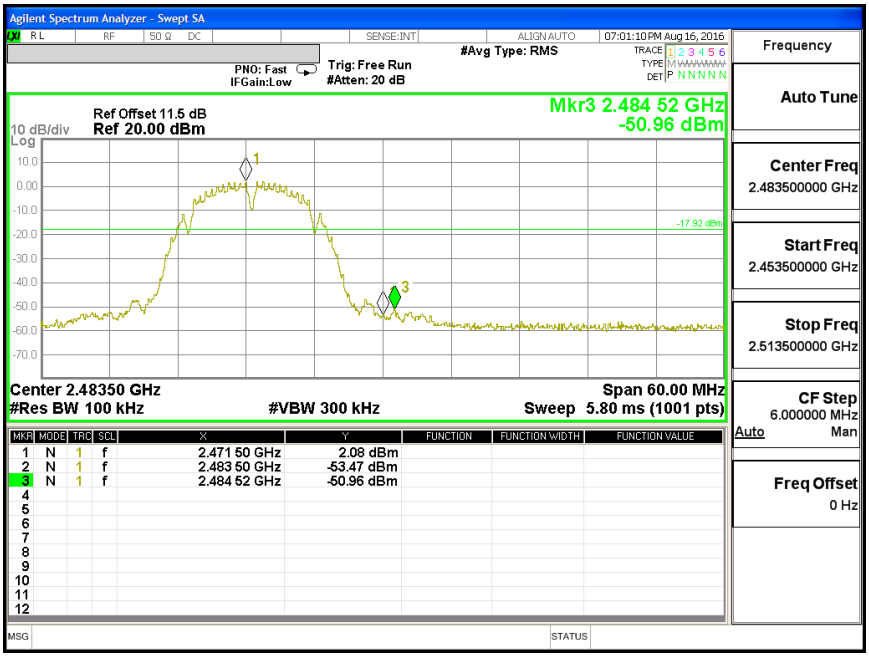
AUTHORIZED BAND EDGE HIGH CH 11



AUTHORIZED BAND EDGE HIGH CH 12

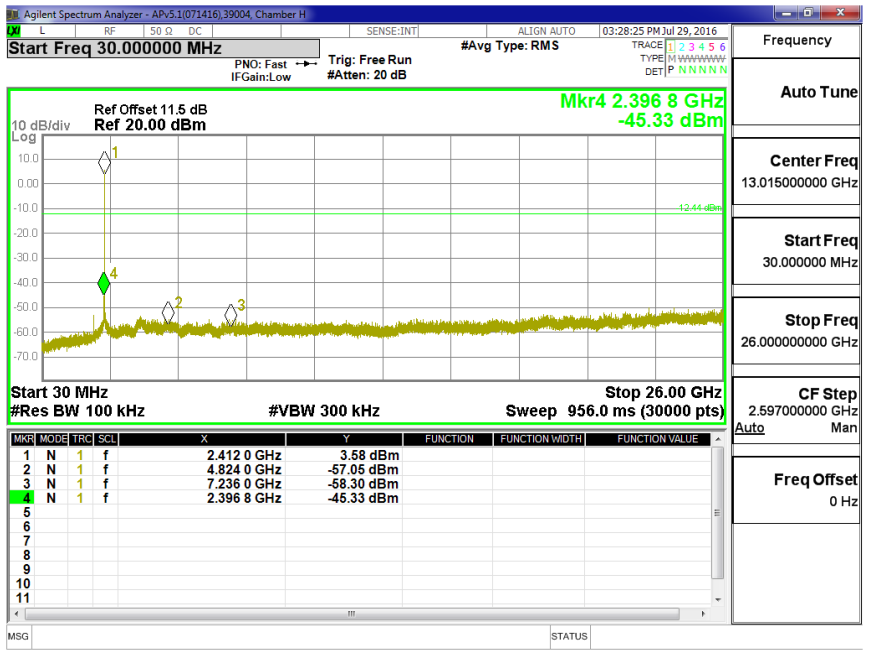


AUTHORIZED BAND EDGE HIGH CH 13

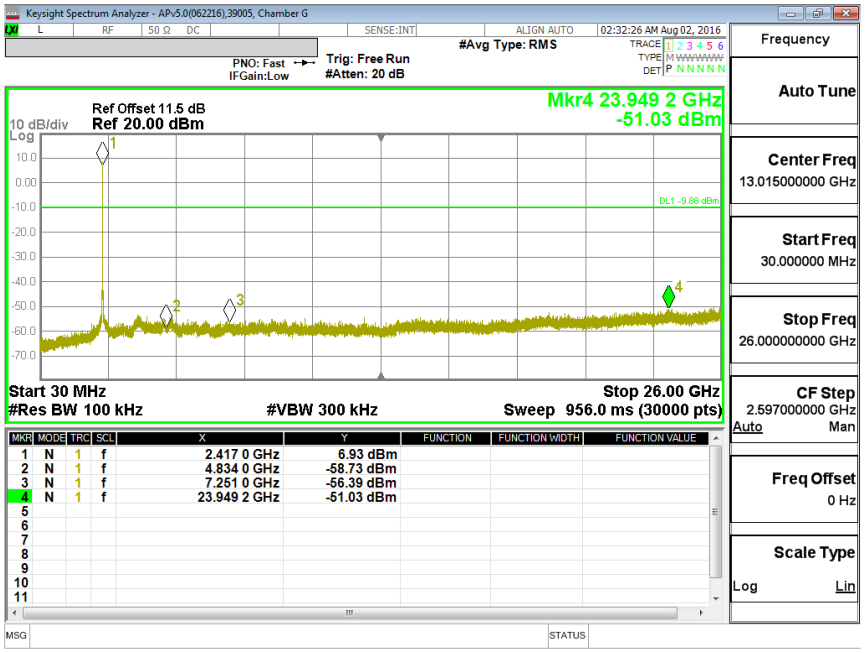


OUT-OF-BAND EMISSIONS, CHAIN 0

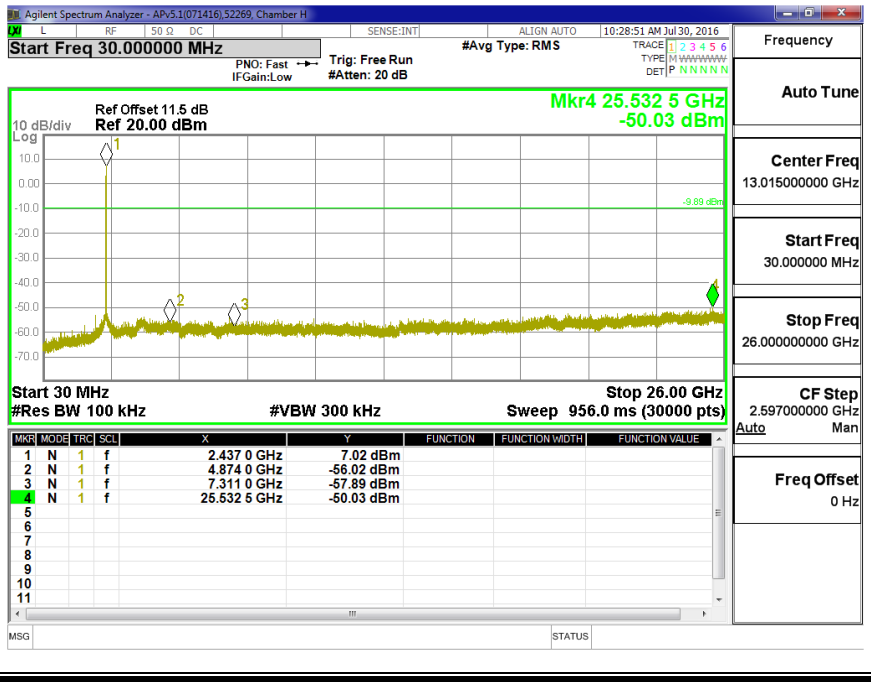
OUT OF BAND LOW CH



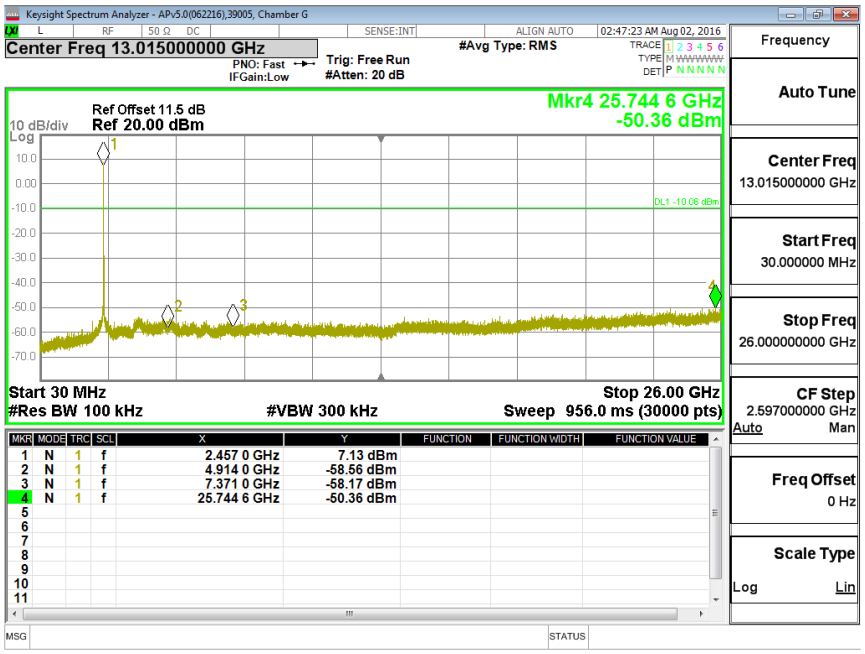
OUT OF BAND LOW CH 2



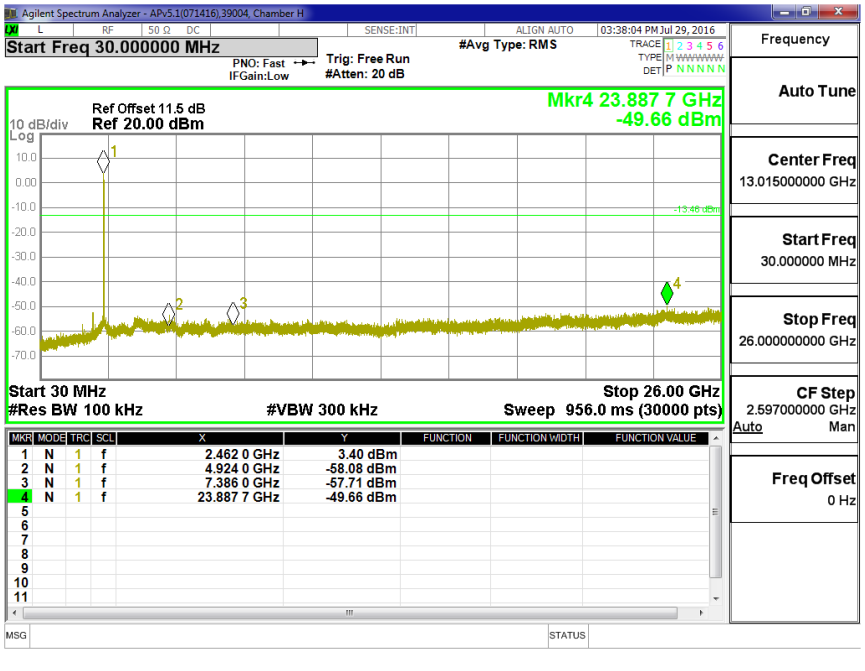
OUT OF BAND MID CH



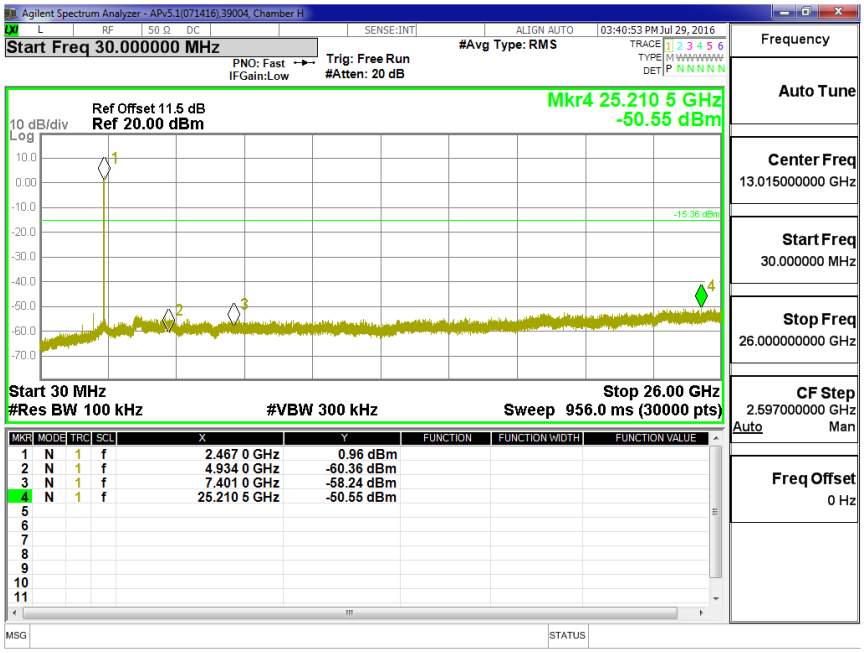
OUT OF BAND HIGH CH 10



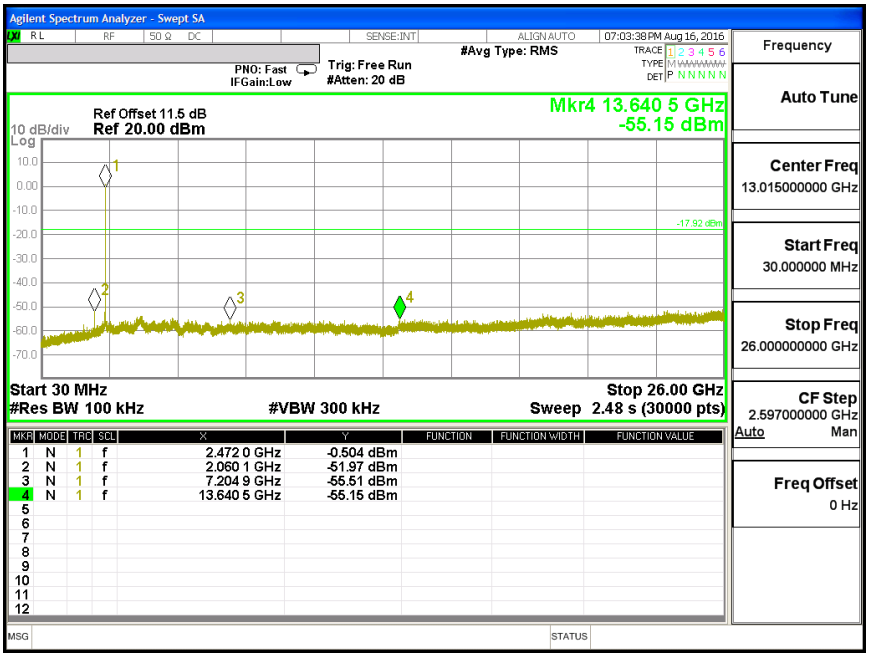
OUT OF BAND HIGH CH 11



OUT OF BAND HIGH CH 12

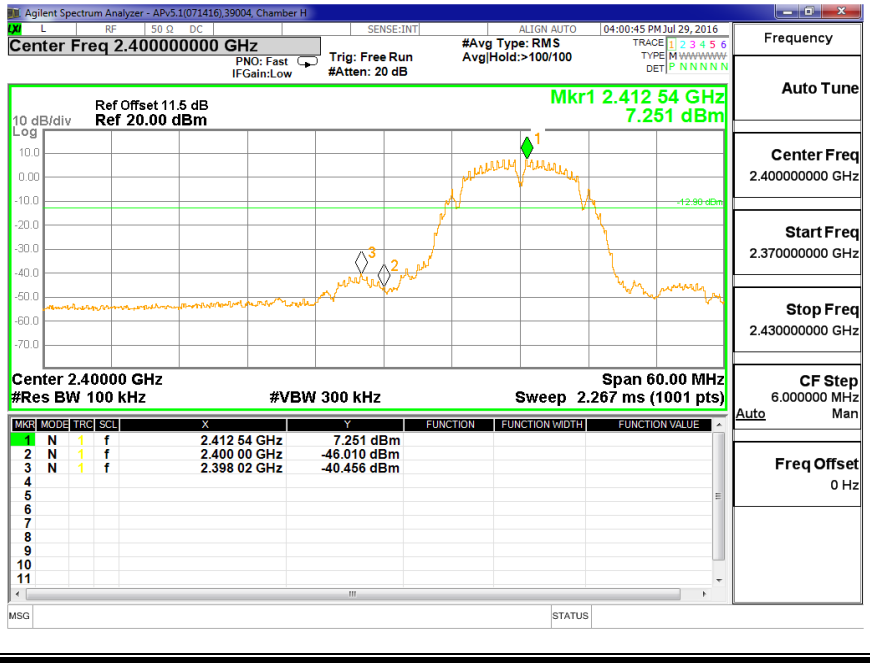


OUT OF BAND HIGH CH 13

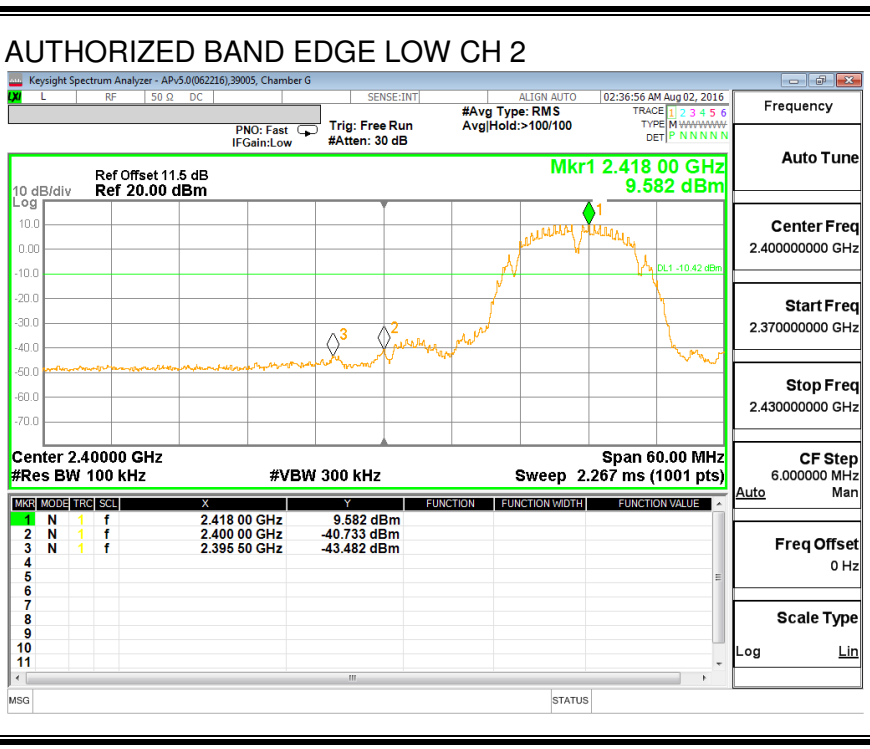


LOW CHANNEL BANDEDGE, CHAIN 1

AUTHORIZED BAND EDGE LOW CH

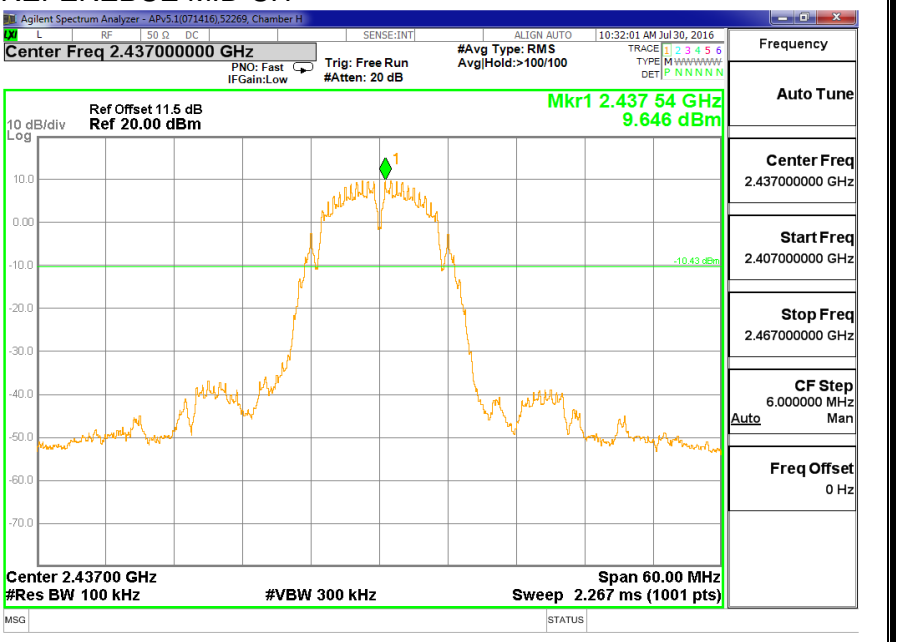


AUTHORIZED BAND EDGE LOW CH 2



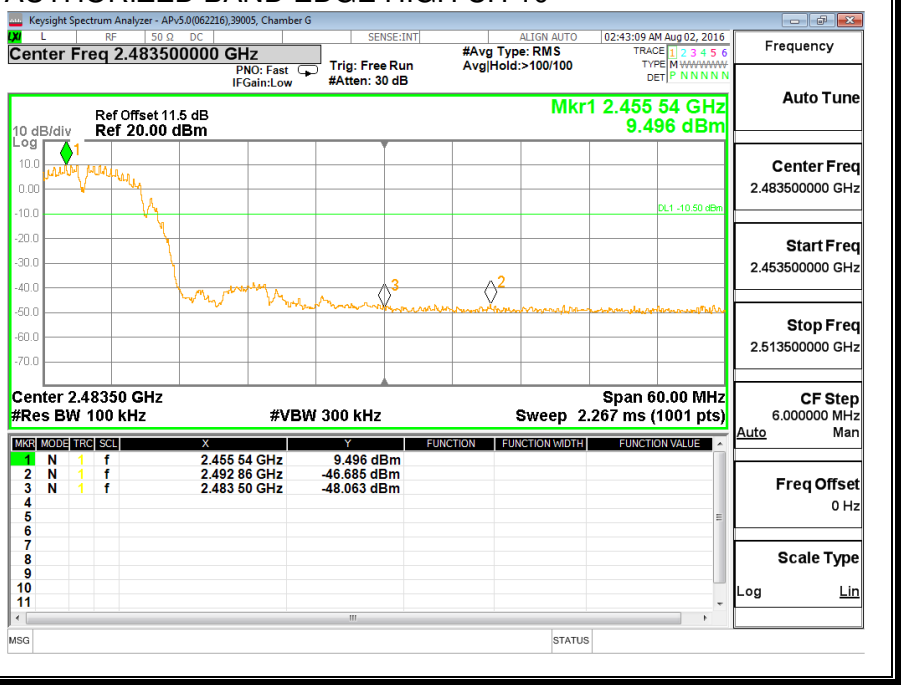
MID CHANNEL REFERENCE, CHAIN 1

REFEREBCE MID CH



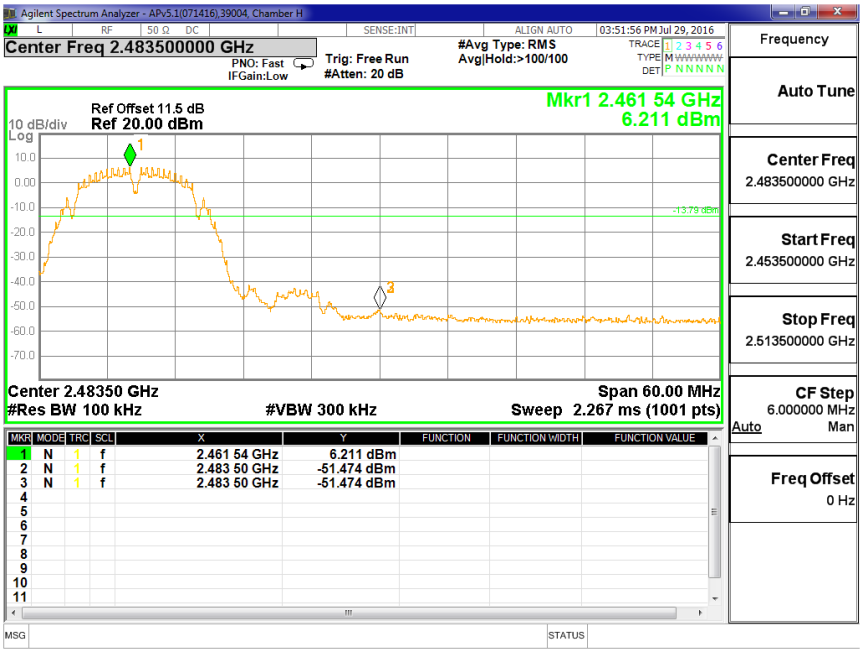
HIGH CHANNEL BANDEDGE, CHAIN 1

AUTHORIZED BAND EDGE HIGH CH 10



HIGH CHANNEL BANDEDGE, CHAIN 1

AUTHORIZED BAND EDGE HIGH CH 11



AUTHORIZED BAND EDGE HIGH CH 12