CERTIFICATION TEST REPORT

Report Number. : 16U23814-E3V2

Applicant	:	APPLE, INC 1 INFINITE LOOP CUPERTINO, CA 95014, U.S.A.
Model	:	A1823
FCC ID	:	BCGA1823
IC	:	579C-A1823
EUT Description	:	TABLET DEVICE
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C INDUSTRY CANADA RSS - 247 ISSUE 1

Date Of Issue:
February 10, 2017

Prepared by:
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	01/27/2017	Initial Issue	Tina Chu
V2	02/10/2017	Address TCB Questions	Francisco Guarnero

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: TABLE DEVICE

MODEL: A1823

SERIAL NUMBER: F9FSJ008HNCC (CONDUCTED),
F9FSQ02JHNCF (RADIATED)

DATE TESTED: NOVEMBER 07, 2016 – DECEMBER 20, 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
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SENIOR ENGINEER
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Prepared By:

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UL VERIFICATION SERVICES INC.

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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 (IC:2324B-1)	☒ Chamber D (IC:2324B-4)
☐ Chamber B (IC:2324B-2)	☒ Chamber E (IC:2324B-5)
☐ Chamber C (IC:2324B-3)	☐ Chamber F (IC:2324B-6)
	☐ Chamber G (IC:2324B-7)
	☐ Chamber H (IC:2324B-8)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

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

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4.3. MEASUREMENT UNCERTAINTY

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

Parameter	Uncertainty
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

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

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a tablet with multimedia functions (music, application support, and video), Cellular GSM/GPRS/EGPRS/CDMA2000 1xRTT/1x Advanced/EVDO Rev.A/WCDMA /HSPA+/DC-HSDPA/LTE FDD & TDD/TD-SCDMA radio, IEEE 802.11a/b/g/n/ac radio, and Bluetooth radio. The rechargeable battery is not user accessible.

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 1TX	19.47	88.51
	802.11g 1TX	Covered by HT20 1TX	
	802.11g 2TX	Covered by HT20 2TX CDD	
	802.11n HT20 1TX	22.61	182.39
	802.11n HT20 2TX CDD	26.12	409.26

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Gain (dBi)	
	Antenna A	Antenna B
2.4	1.91	0.56

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 14E232.

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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 worst-case scenario.

The output power for PSD and spurious tests was set higher than maximum for the purposes of testing only.

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.

The fundamental of the EUT was investigated in three orthogonal orientations X/Y/Z, it was determined that Y-Landscape orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in Y-Landscape orientation.

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.

- 802.11g and 802.11n HT20 1TX
- 802.11g 2TX and 802.11n HT20 2TX CDD

There are two vendors of the WiFi/Bluetooth radio modules: variant 1 and variant 2. The Wi-Fi/Bluetooth radio modules have the same mechanical outline (e.g., the same package dimension and pin-out layout), use the same on-board antenna matching circuit, have an identical antenna structure, and are built and tested to conform to the same specifications and to operate within the same tolerances.

Baseline testing was performed on the two variants to determine the worst case on all conducted power and radiated emissions.

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Apple	A1286	7313700NAGW	N/A
Laptop AC/DC adapter	Apple	A1343	C062172045DDJ94A6	N/A
Earphone	Apple	NA	NA	N/A
EUT AC/DC adapter	Apple	A1357	W010A051	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	Antenna	1	SMA	Un-Shielded	0.2	To spectrum Analyzer
2	USB	1	USB	Shielded	1	N/A
3	AC	1	AC	Un-shielded	2	N/A

I/O CABLES (RADIATED ABOVE 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
None Used						

I/O CABLES (RADIATED BELOW 1 GHZ AND AC LINE CONDUCTED: AC/DC ADAPTER CONFIGURATION)

I/O Cable List						
Cable No	Port	# of identical	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Earphone Jack	1	3.5mm Audio	Shielded	0.9	N/A
2	USB	1	USB	shielded	1	N/A

I/O CABLES (AC LINE CONDUCTED: LAPTOP CONFIGUARTION)

I/O Cable List						
Cable No	Port	# of identical	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Earphone Jack	1	3.5mm Audio	Shielded	0.9	N/A
2	USB	1	USB	Shielded	1	N/A
3	AC	1	AC	Un-shielded	2	N/A

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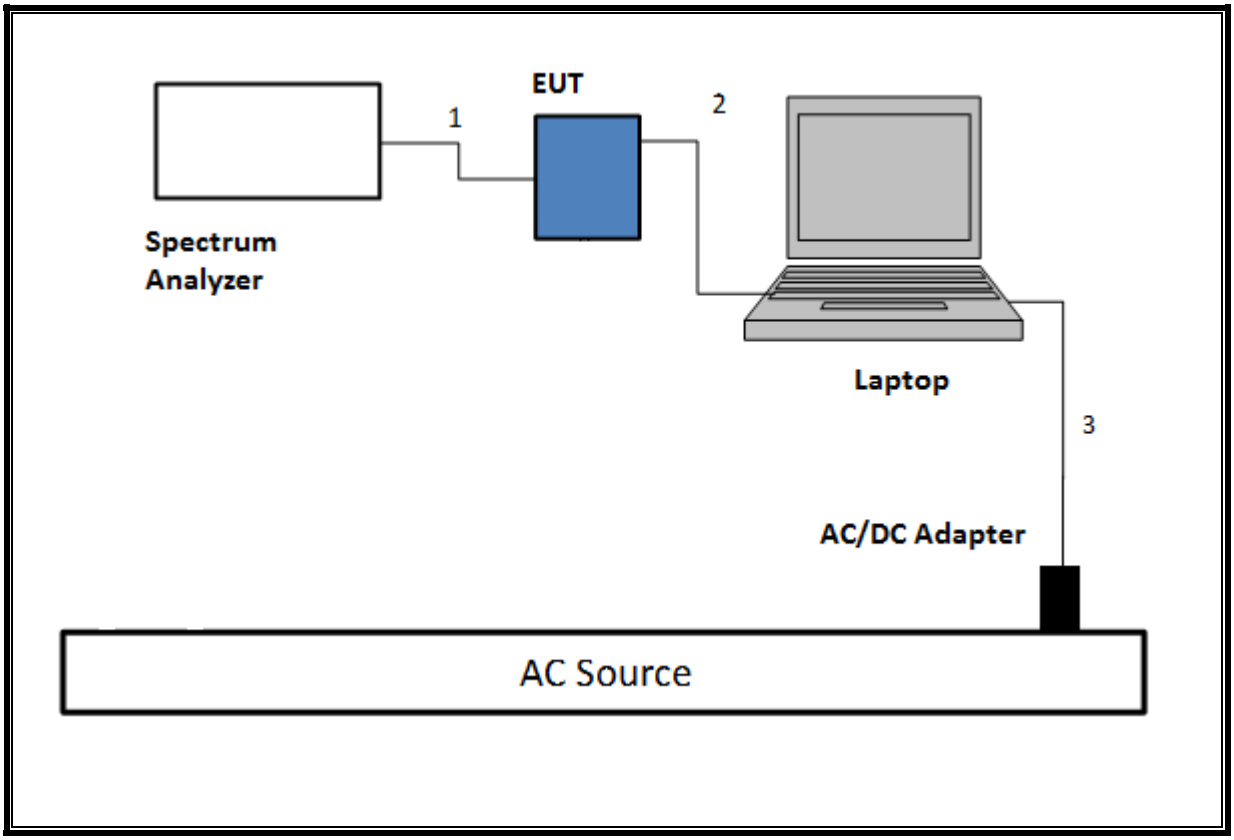
TEST SETUP - CONDUCTED TESTS

The EUT was connected to a host Laptop via USB cable adapter and spectrum analyzer to antenna port. Test software exercised the EUT.

SETUP DIAGRAM



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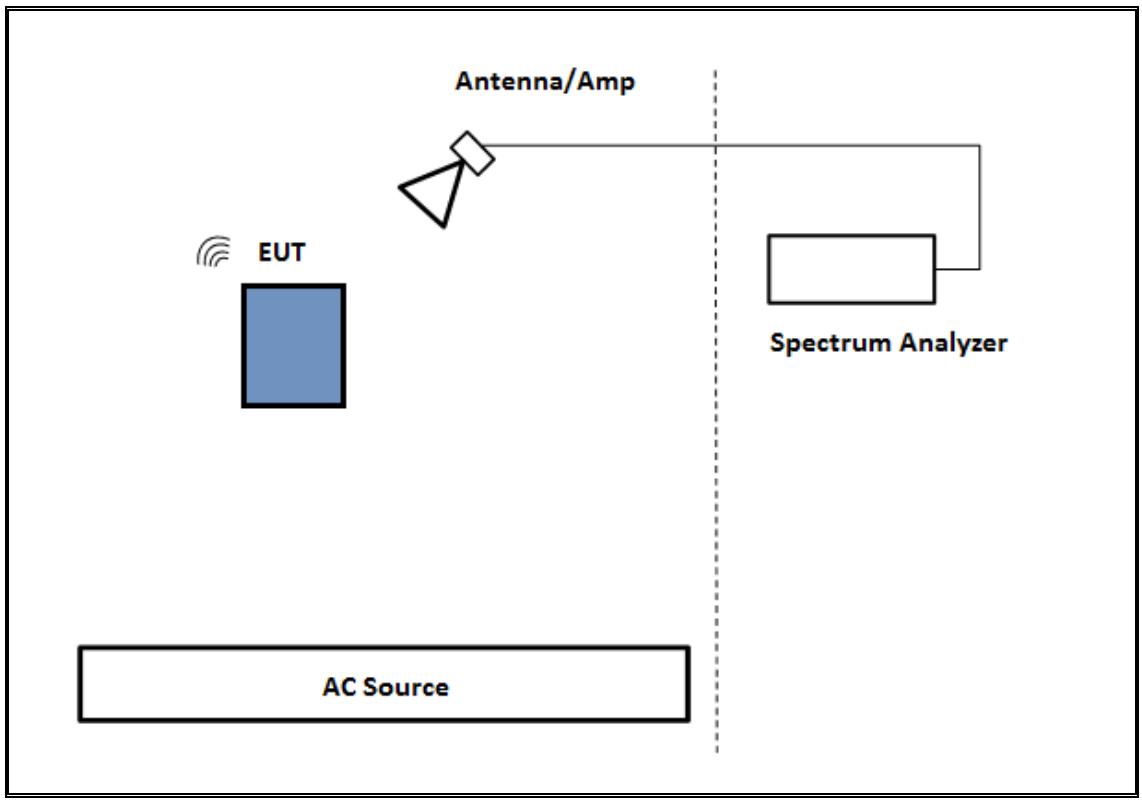
TEST SETUP- RADIATED-ABOVE 1 GHZ

The EUT was powered by battery. Test software exercised the EUT.

SETUP DIAGRAM



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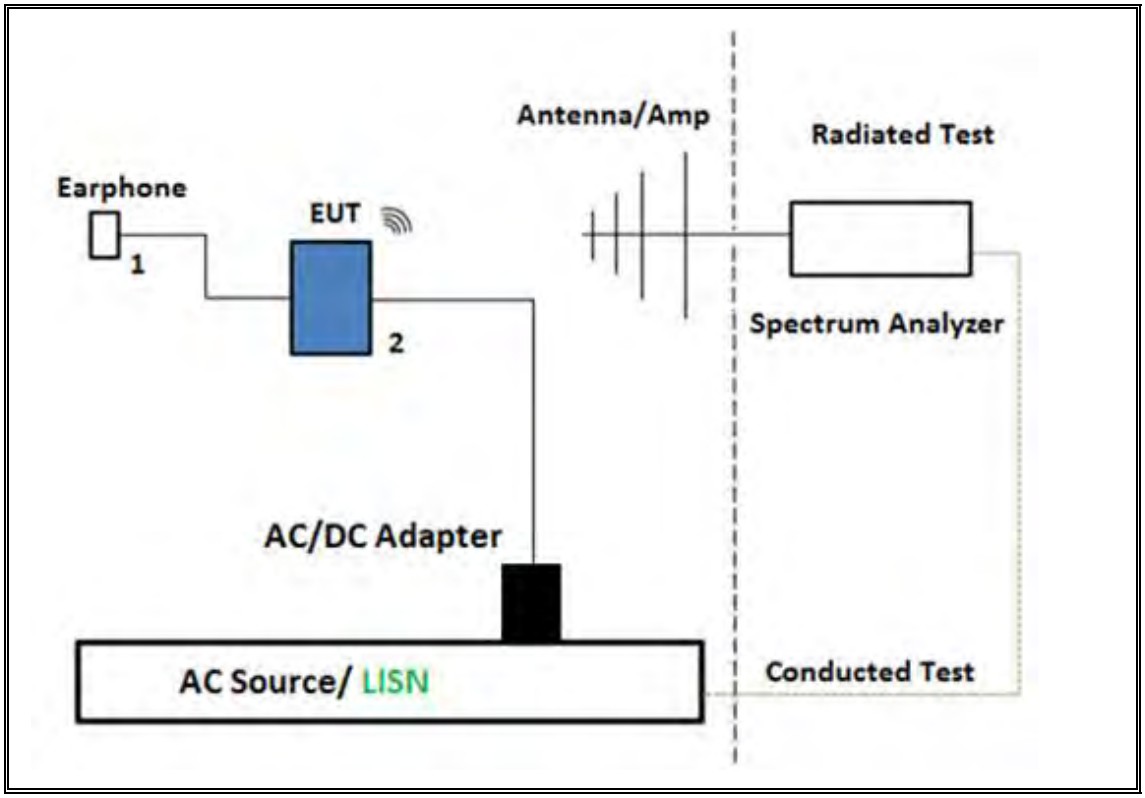
TEST SETUP- BELOW 1GHz

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

SETUP DIAGRAM



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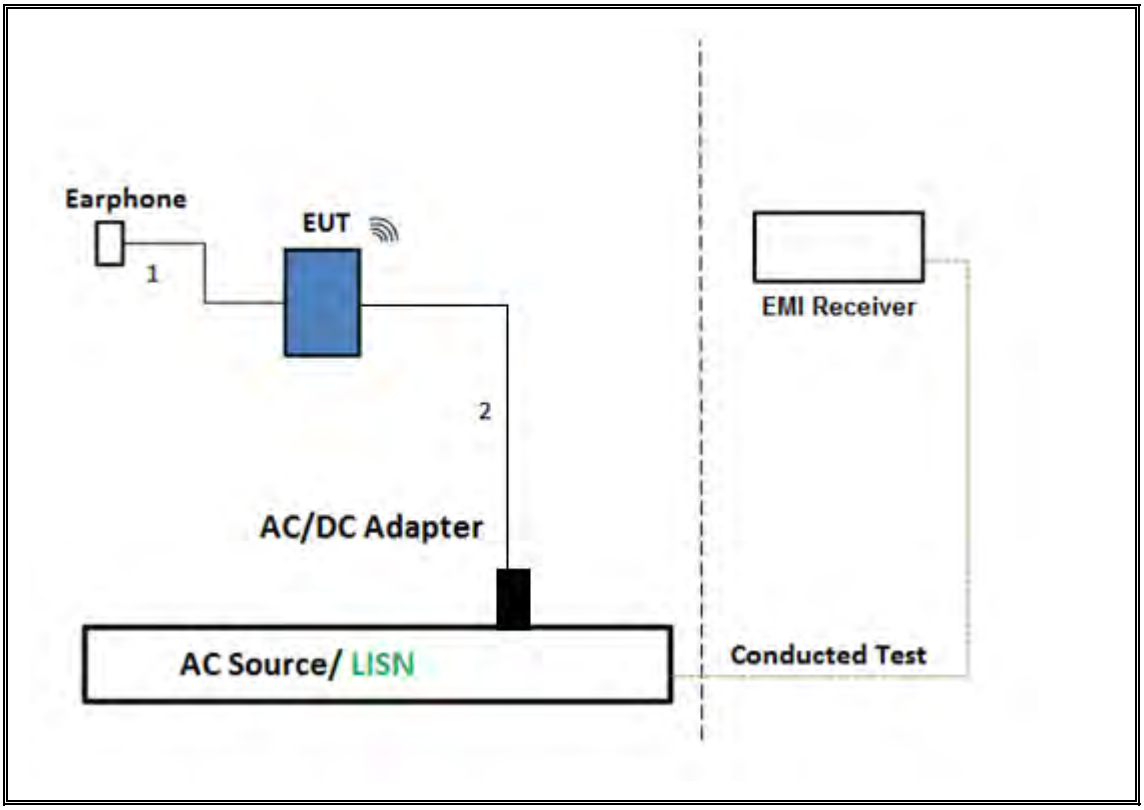
TEST SETUP- AC LINE CONDUCTED: AC/DC ADAPTER CONFIGURATION

The EUT was tested with earphone connected and powered by AC/DC adapter via USB cable. Test software exercised the EUT.

SETUP DIAGRAM



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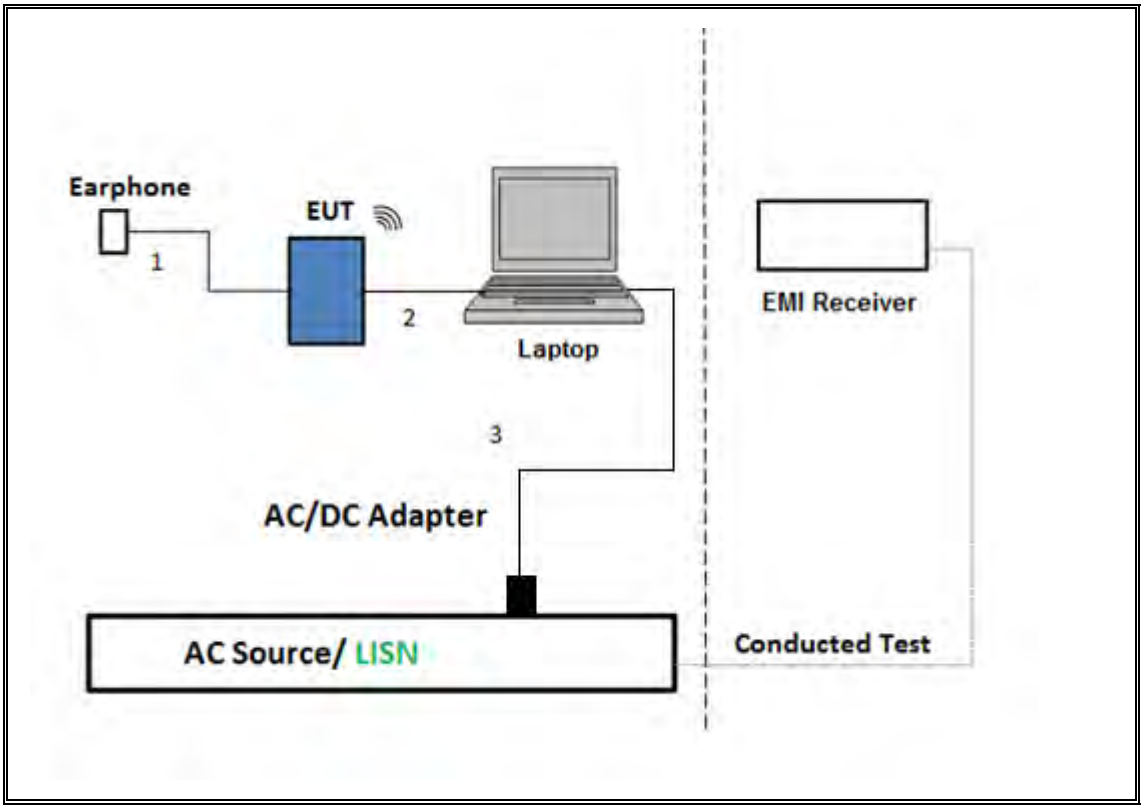
TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION

The EUT was tested with earphone connected and powered by host PC via USB cable. Test software exercised the EUT.

SETUP DIAGRAM



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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	T344	2/22/2017
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	T407	4/4/2017
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T286	5/4/2017
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T740	11/29/2017
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T340	12/14/2017
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T300	11/10/2017
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	T426	9/23/2017
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T243	10/11/2017
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T285	6/20/2017
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T1613	9/23/2017
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T120	4/5/2017
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	T122	1/29/2017
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T742	11/29/2017
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T173	6/17/2017
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T341	10/25/2017
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Agilent	N1921A	T1228	06/20/2017
Power Meter, P-series single channel	Keysight	N1912A	T1273	07/08/2017
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	T905	06/21/2017
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	T339	09/22/2017
Spectrum Analyzer	Keysight	8564E	T106	09/07/2017
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	T447	06/16/2017
Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum	Keysight	8449B	T402	07/05/2017
AC Line Conducted				
*EMI Test Receiver 9Khz-7GHz	Rohde & Schwarz	ESCI7	T1436	12/19/2016
LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	06/08/2017
Power Cable, Line Conducted Emissions	UL	PG1	T861	9/1/2017
UL AUTOMATION SOFTWARE				
Radiated Software	UL	UL EMC	Ver 9.5, April 26, 2016	
Conducted Software	UL	UL EMC	Ver 5.4, October 13, 2016	
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

NOTE: *testing is completed before equipment calibration expiration date.

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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.

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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 B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (khz)
11b 2.4GHz 1TX	1	1	1	1	0	0.01
11n HT20 2.4GHz 1TX	1.915	1.940	0.987	98.7%	0	0.01
11n HT20 2.4GHz CDD	1.920	1.940	0.989	98.9%	0	0.01

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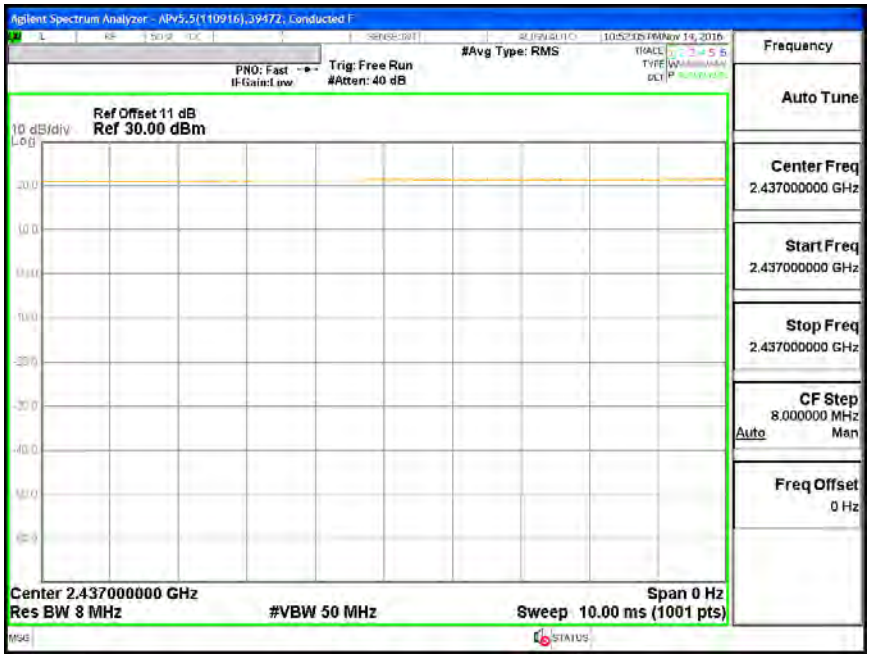
DUTY CYCLE PLOTS

DUTY CYCLE 802.11b 1TX MODE



DUTY CYCLE 802.11n_HT20 SISO MODE

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DUTY CYCLE 802.11n_HT20 CDD MODE

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8.1. 11b ANTENNA A SISO MODE IN THE 2.4GHz BAND

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 BW ANTENNA A (MHz)	Minimum Limit (MHz)
Low_1	2412	7.60	0.5
Middle_6	2437	8.08	0.5
High_11	2462	8.08	0.5
High_12	2467	8.12	0.5
High_13	2472	8.08	0.5

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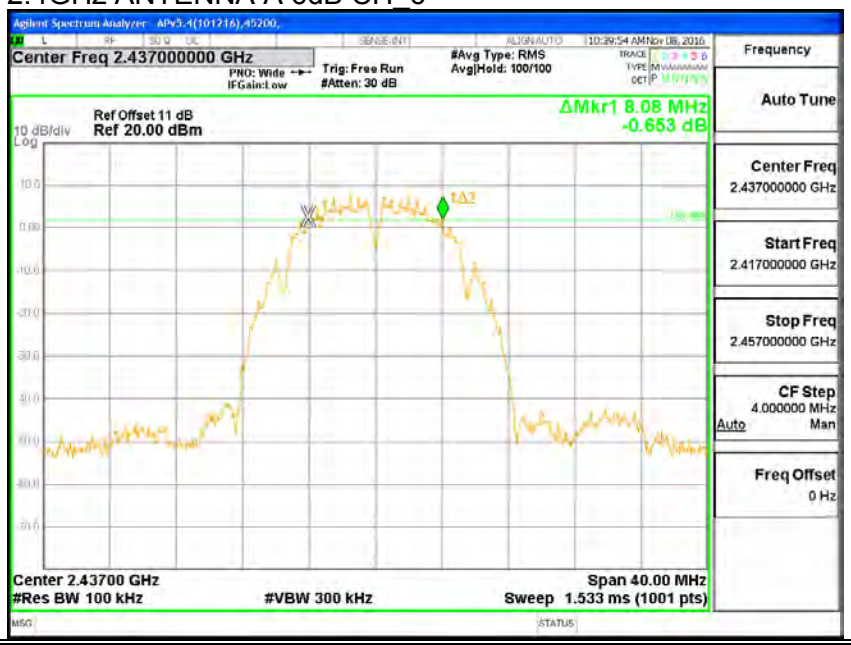
2.4GHz ANTENNA A 6dB CH_1

2.4GHz ANTENNA A 6dB CH_6



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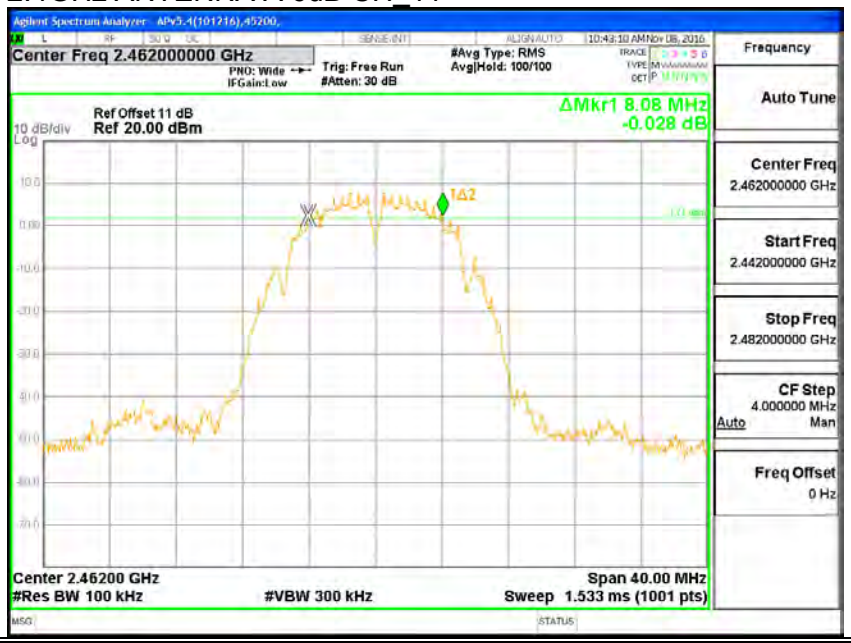
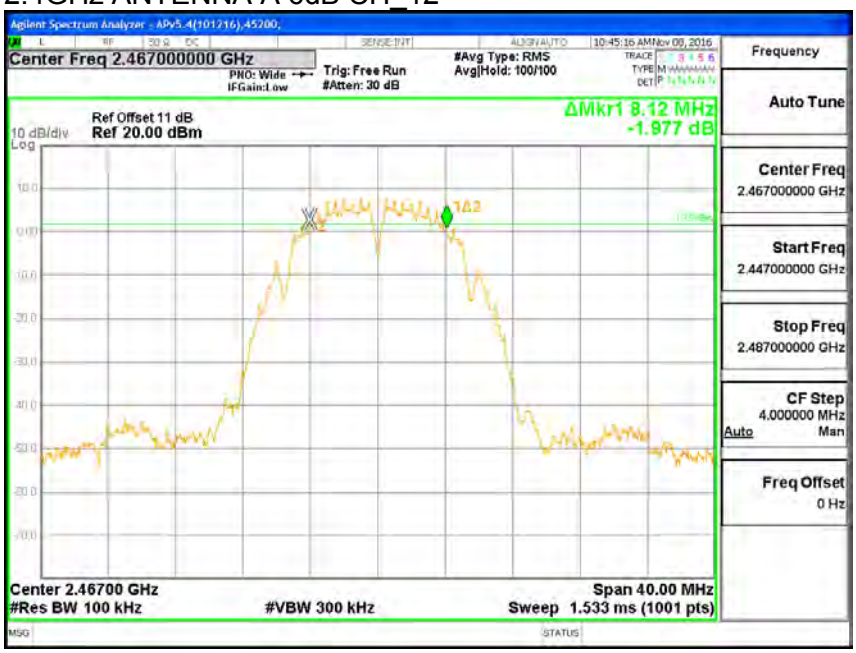
2.4GHz ANTENNA A 6dB CH_11



2.4GHz ANTENNA A 6dB CH_12



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2.4GHz ANTENNA A 6dB CH_13

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8.1.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth ANTENNA A (MHz)
Low_1	2412	10.861
Middle_6	2437	11.079
High_11	2462	10.224
High_12	2467	10.373
High_13	2472	10.252

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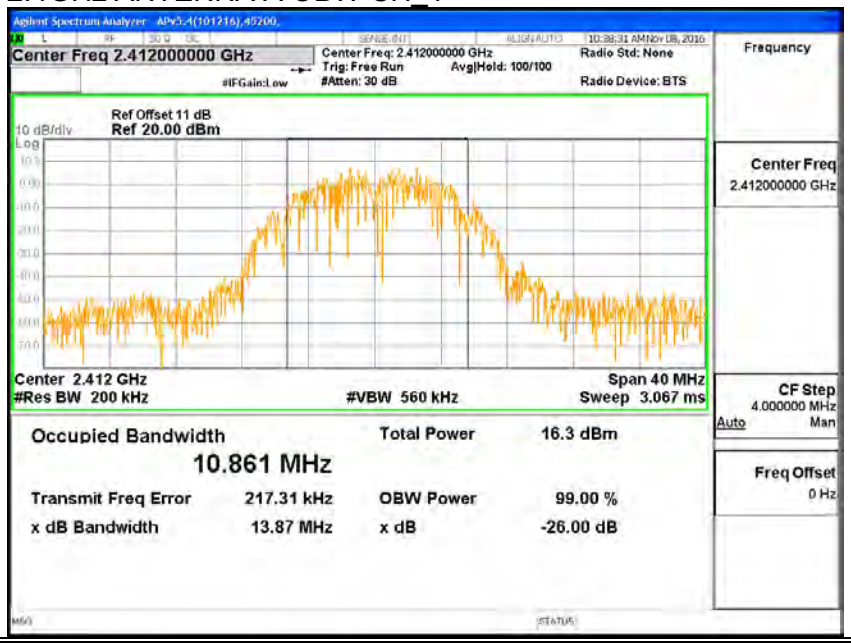
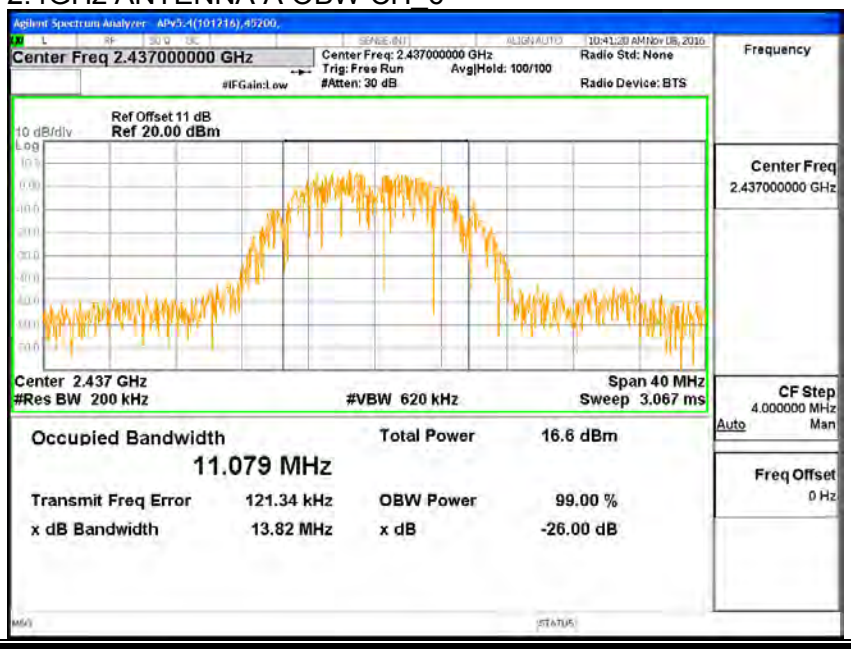
2.4GHz ANTENNA A OBW CH_1



2.4GHz ANTENNA A OBW CH_6



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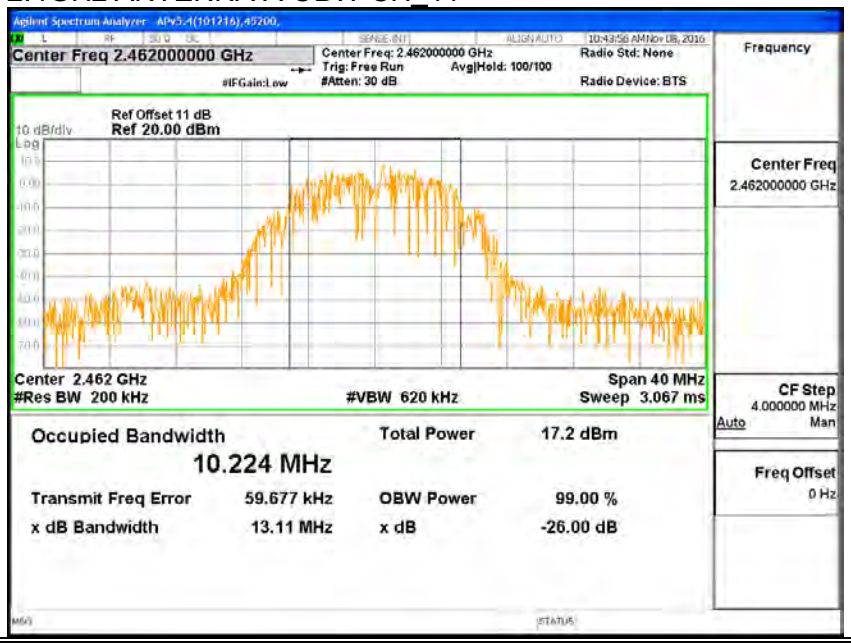
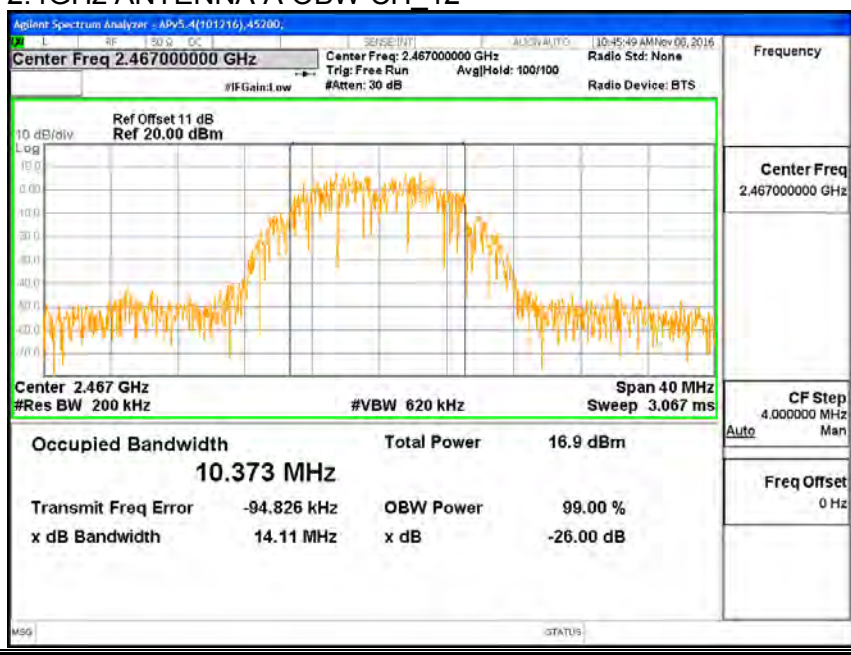
2.4GHz ANTENNA A OBW CH_11



2.4GHz ANTENNA A OBW CH_12



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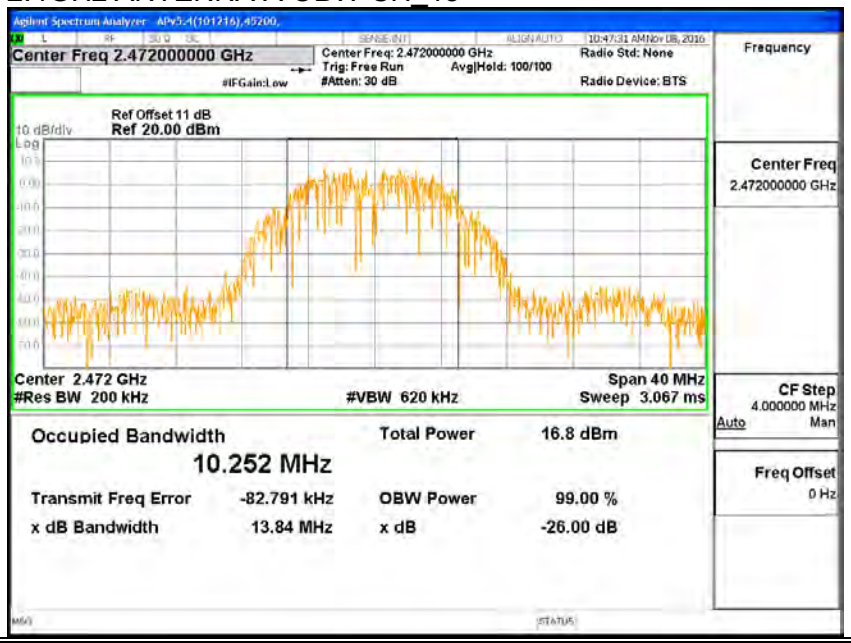
2.4GHz ANTENNA A OBW CH_13



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8.1.3. AVERAGE POWER

ID:	39472	Date:	12/17/16

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	Power ANTENNA A (MHz)
Low_1	2412	15.83
Middle_6	2437	15.70
High_11	2462	15.86
High_12	2467	15.98
High_13	2472	14.47

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8.1.4. OUTPUT POWER

ID:	39472	Date:	12/17/16

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.

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RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low_1	2412	1.91	30	30	36	30
Middle_6	2437	1.91	30	30	36	30
High_11	2462	1.91	30	30	36	30
High_12	2467	1.91	30	30	36	30
High_13	2472	1.91	30	30	36	30

Duty Cycle CF (dB)	0	Included in Calculations of Corr'd Power

Results

Channel	Frequency (MHz)	Power ANTENNA A (MHz)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low_1	2412	19.47	19.47	30	-10.53
Middle_6	2437	19.19	19.19	30	-10.81
High_11	2462	19.22	19.22	30	-10.78
High_12	2467	19.25	19.25	30	-10.75
High_13	2472	17.93	17.93	30	-12.07

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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	Included in Calculations of Corr'd PSD

Results

Channel	Frequency (MHz)	Meas ANTENNA A (MHz)	Total Corr'd Power (dBm)	Limit (dBm)	Margin (dB)
Low_1	2412	-5.68	-5.68	8	-13.68
Middle_6	2437	-6.46	-6.46	8	-14.46
High_11	2462	-6.44	-6.44	8	-14.44
High_12	2467	-5.80	-5.80	8	-13.80
High_13	2472	-9.27	-9.27	8	-17.27

UL VERIFICATION SERVICES INC. FORM NO: CCSUP4701J
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
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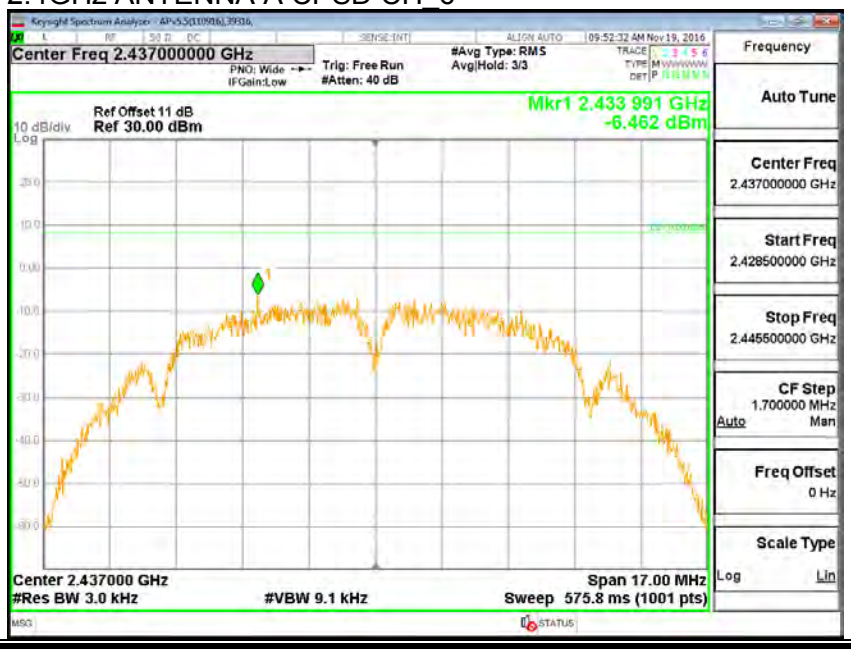
2.4GHz ANTENNA A CPSD CH_1

2.4GHz ANTENNA A CPSD CH_6



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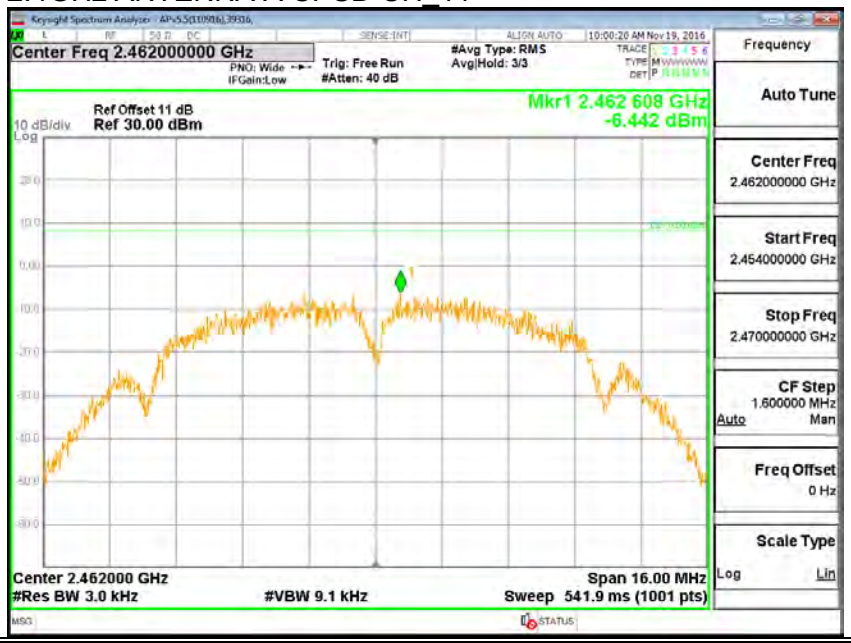
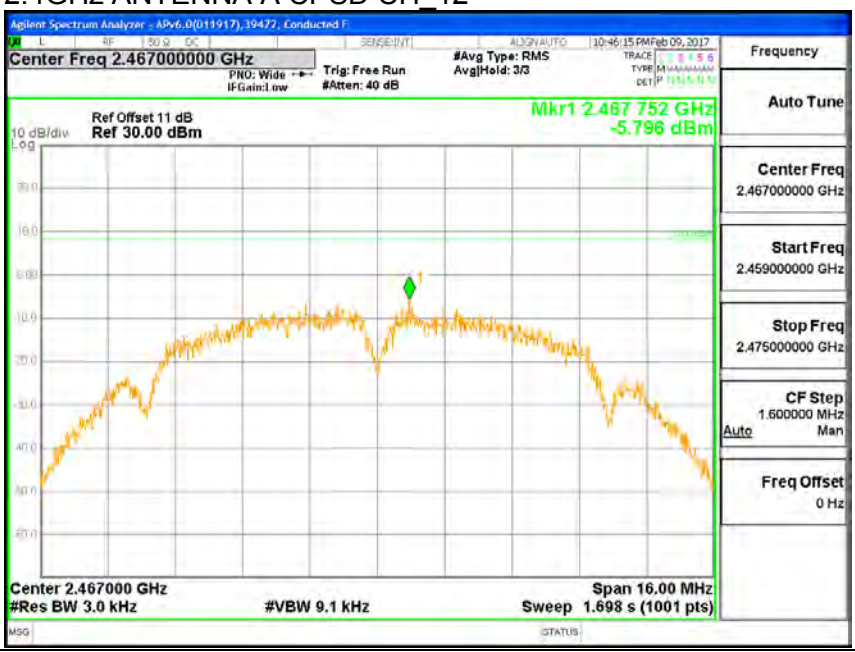
2.4GHz ANTENNA A CPSD CH_11



2.4GHz ANTENNA A CPSD CH_12



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2.4GHz ANTENNA A CPSD CH_13

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8.1.1. CONDUCTED BANDEDGE AND SPURIOUS 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.

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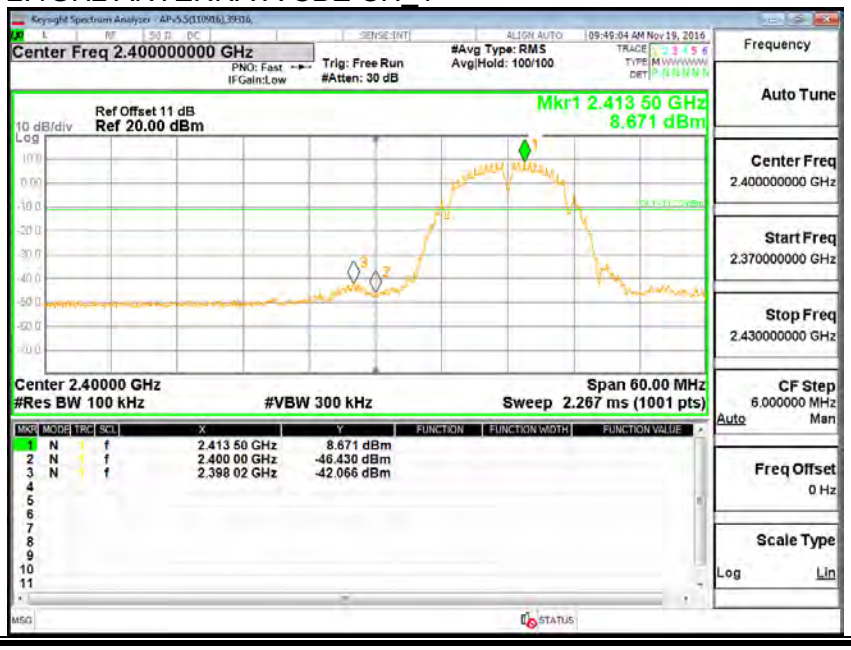
RESULTS

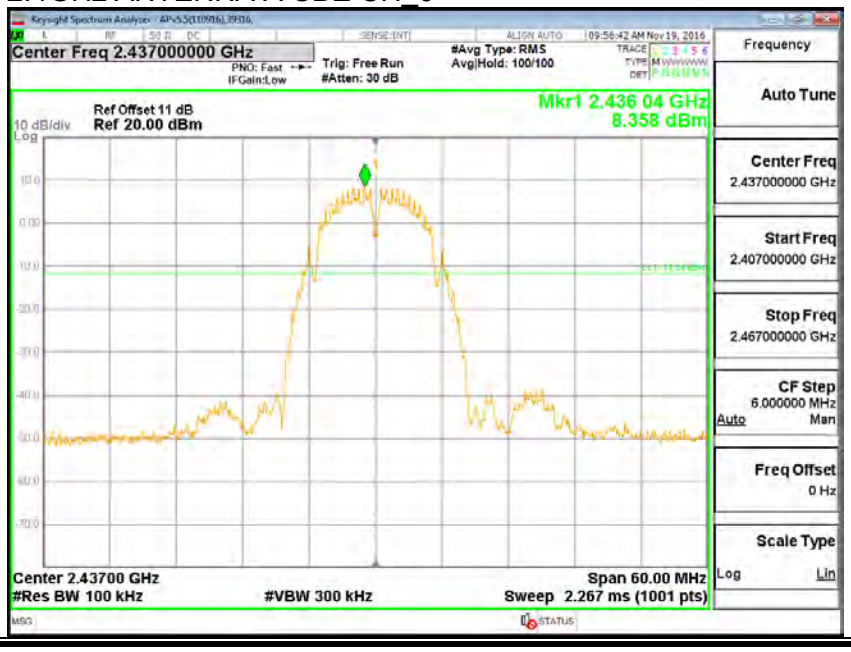
LOW CHANNEL BANDEDGE

2.4GHz ANTENNA A CBE CH_1



MID CHANNEL REFERENCE

2.4GHz ANTENNA A CBE CH_6



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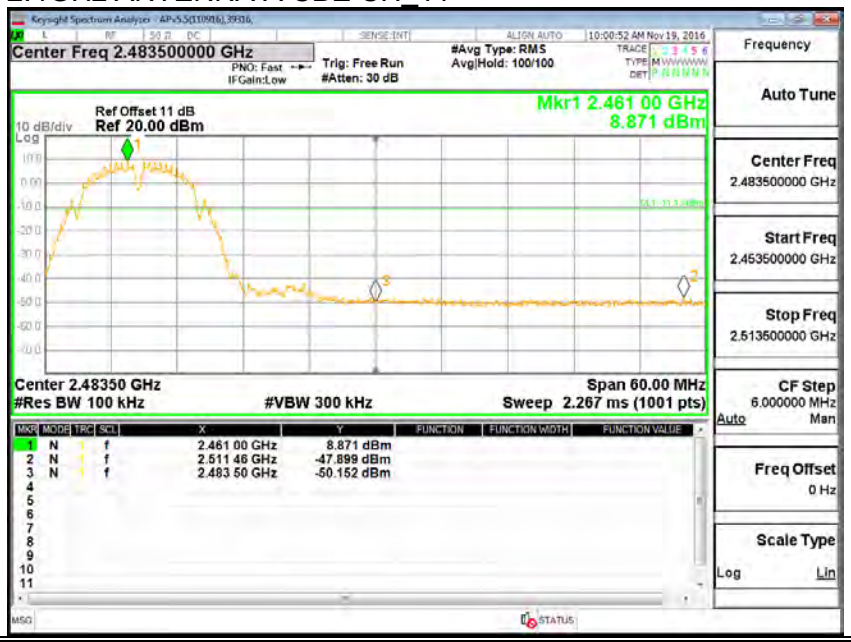
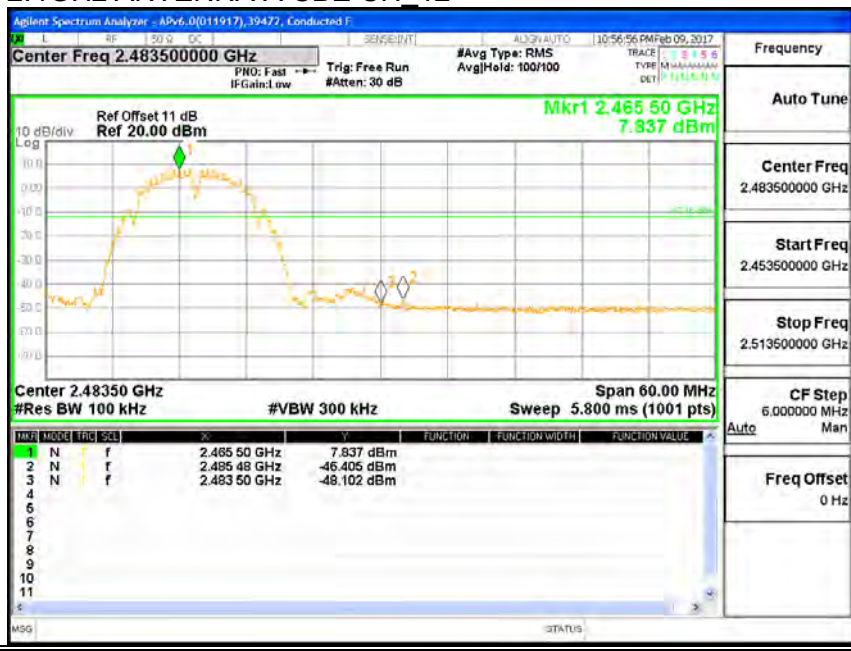
HIGH CHANNEL BANDEDGE

2.4GHz ANTENNA A CBE CH_11



2.4GHz ANTENNA A CBE CH_12



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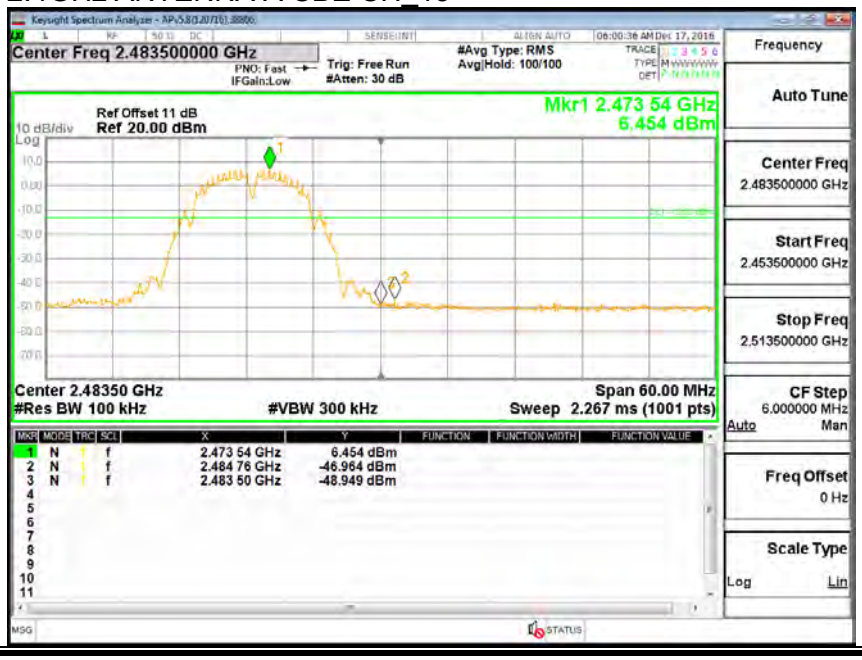
2.4GHz ANTENNA A CBE CH_13



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OUT-OF-BAND EMISSIONS

2.4GHz ANTENNA A CSPUR CH_1

2.4GHz ANTENNA A CSPUR CH_6

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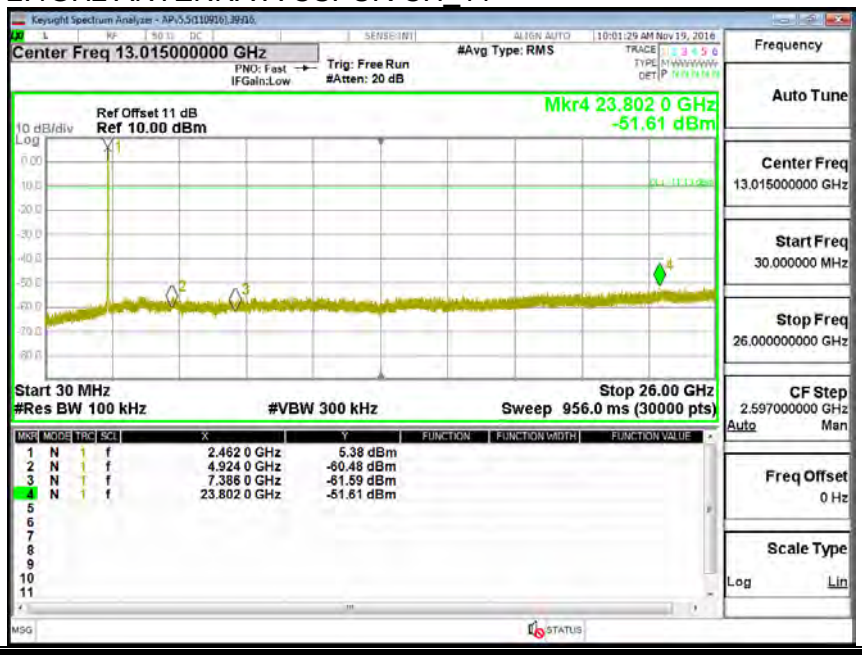
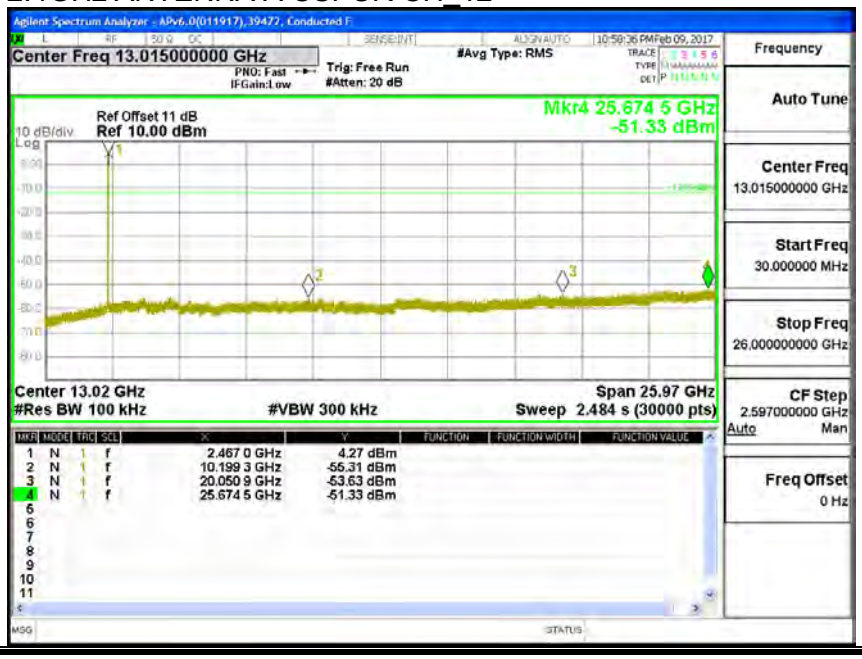
2.4GHz ANTENNA A CSPUR CH_11



2.4GHz ANTENNA A CSPUR CH_12



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2.4GHz ANTENNA A CSPUR CH_13

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8.2. 11b ANTENNA B SISO MODE IN THE 2.4GHz BAND

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 BW ANTENNA B (MHz)	Minimum Limit (MHz)
Low_1	2412	8.08	0.5
Middle_6	2437	8.08	0.5
High_11	2462	8.16	0.5
High_12	2467	8.16	0.5
High_13	2472	7.84	0.5

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2.4GHz ANTENNA B 6dB CH_1

2.4GHz ANTENNA B 6dB CH_6

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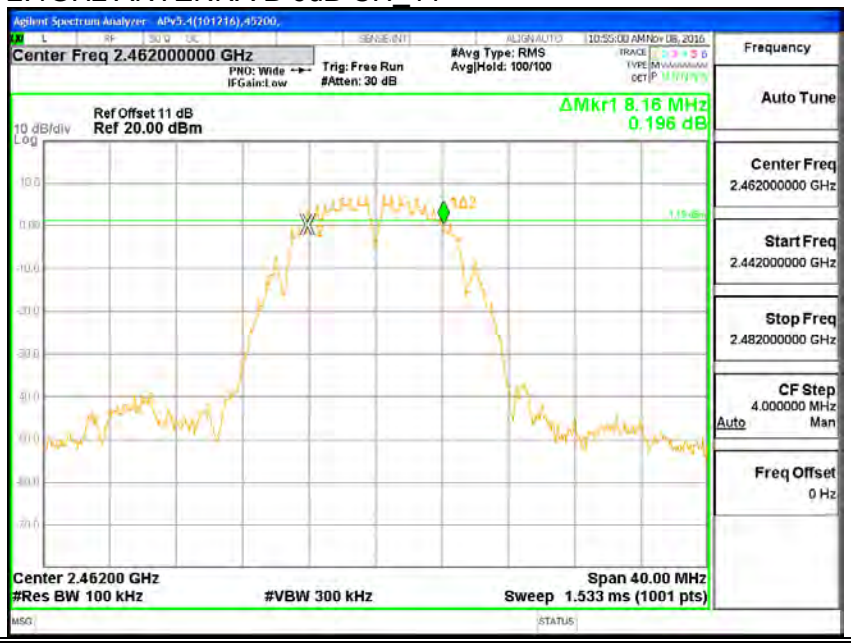
2.4GHz ANTENNA B 6dB CH_11



2.4GHz ANTENNA B 6dB CH_12

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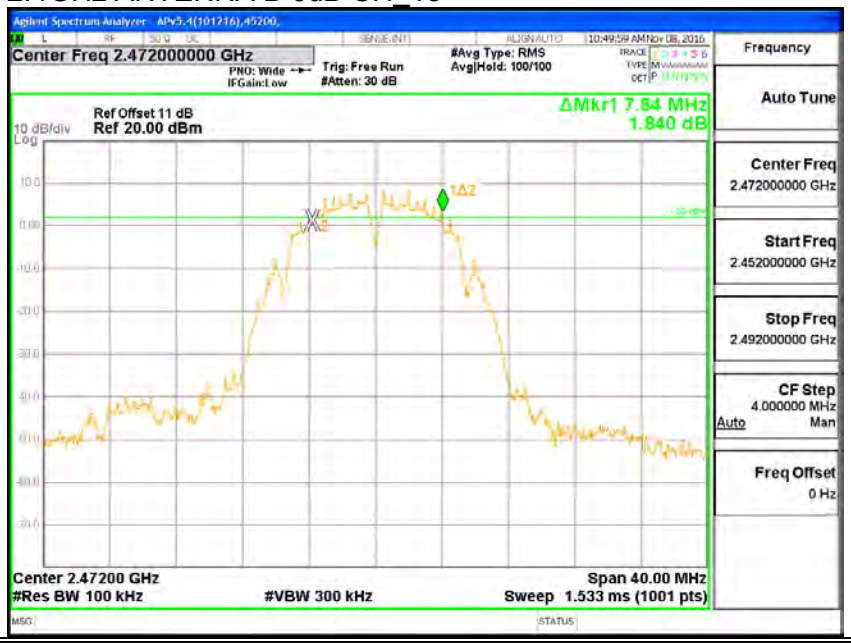
2.4GHz ANTENNA B 6dB CH_13



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8.2.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth ANTENNA B (MHz)
Low_1	2412	10.556
Middle_6	2437	10.091
High_11	2462	10.398
High_12	2467	10.471
High_13	2472	10.226

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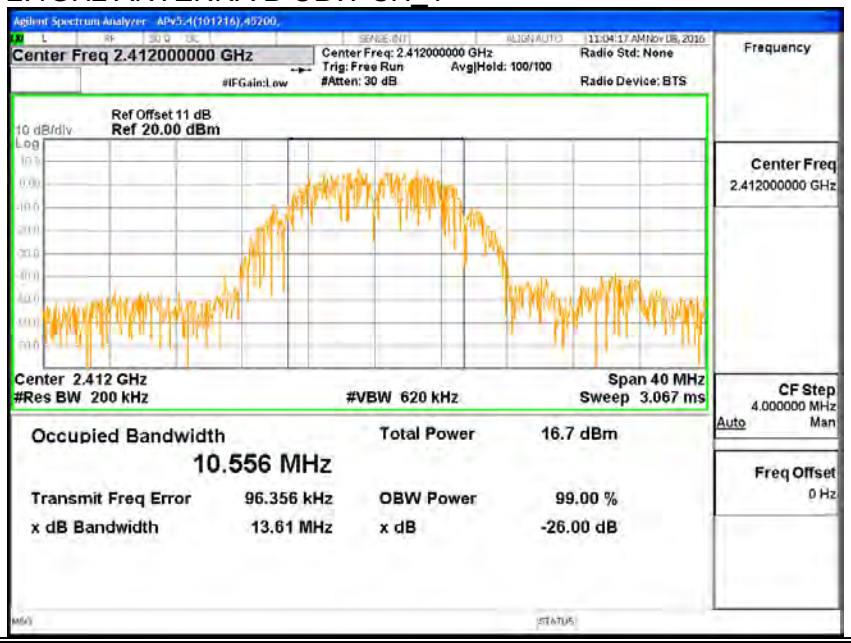
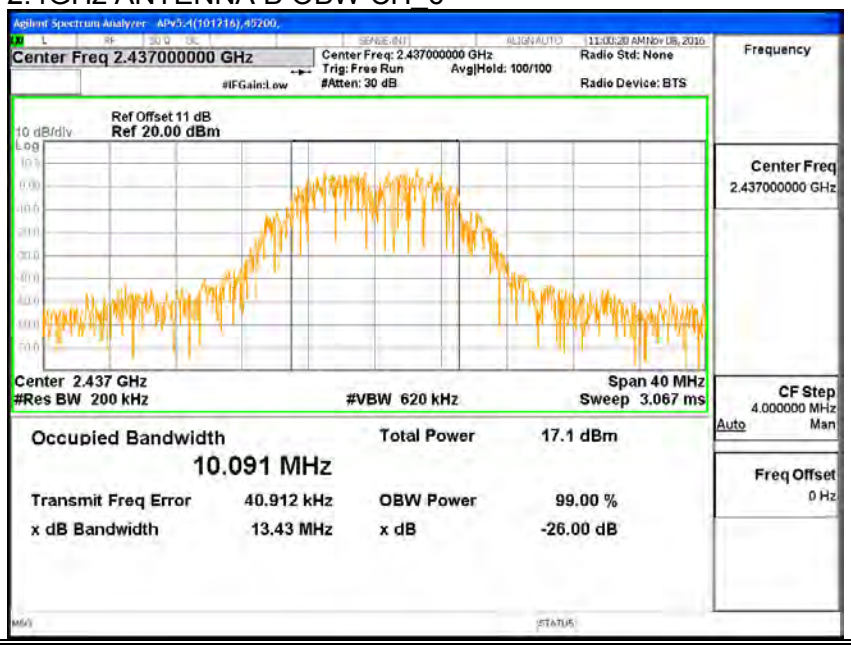
2.4GHz ANTENNA B OBW CH_1



2.4GHz ANTENNA B OBW CH_6



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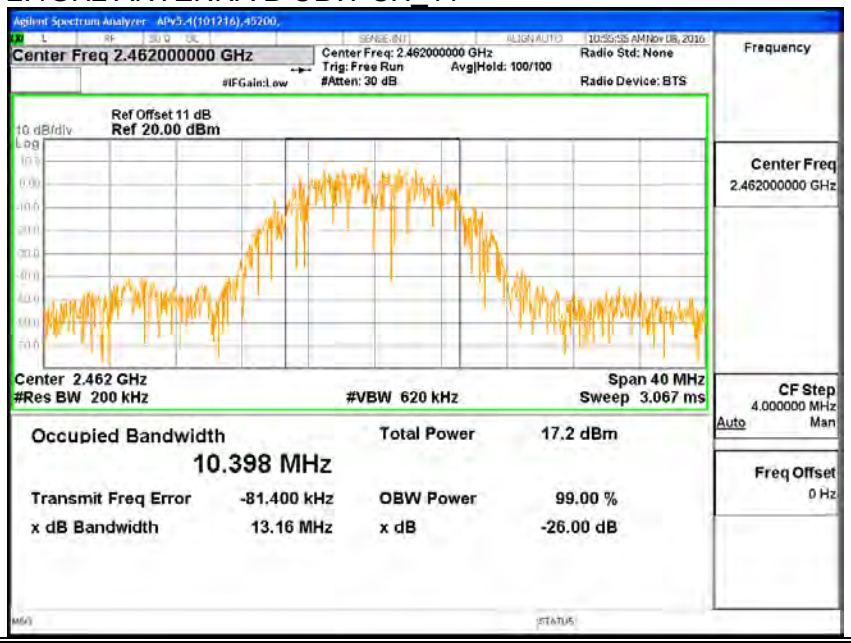
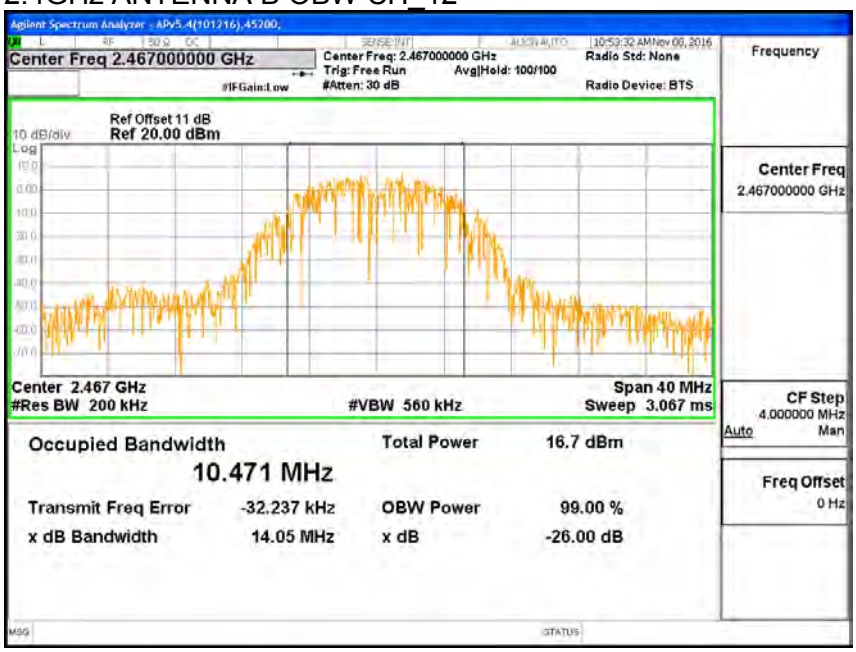
2.4GHz ANTENNA B OBW CH_11



2.4GHz ANTENNA B OBW CH_12



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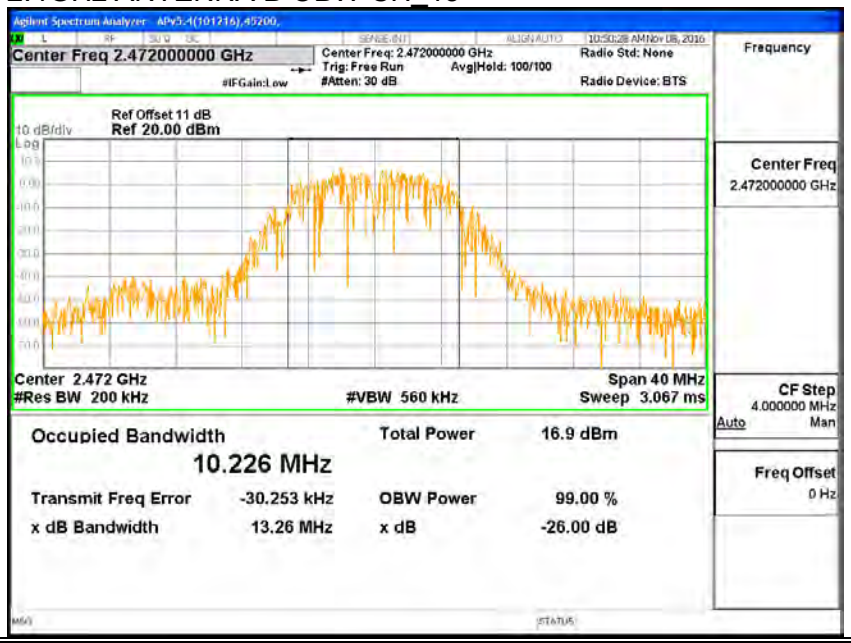
2.4GHz ANTENNA B OBW CH_13



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8.2.3. AVERAGE POWER

ID:	39472	Date:	12/19/16

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	Power ANTENNA B (MHz)
Low_1	2412	15.10
Middle_6	2437	15.14
High_11	2462	15.12
High_12	2467	15.38
High_13	2472	14.10

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8.2.4. OUTPUT POWER

ID:	39472	Date:	12/19/16

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.

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RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low_1	2412	0.56	30	30	36	30
Middle_6	2437	0.56	30	30	36	30
High_11	2462	0.56	30	30	36	30
High_12	2467	0.56	30	30	36	30
High_13	2472	0.56	30	30	36	30

Duty Cycle CF (dB)	0	Included in Calculations of Corr'd Power

Results

Channel	Frequency (MHz)	Power ANTENNA B (MHz)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low_1	2412	18.69	18.69	30	-11.31
Middle_6	2437	18.63	18.63	30	-11.37
High_11	2462	18.57	18.57	30	-11.43
High_12	2467	18.71	18.71	30	-11.29
High_13	2472	17.44	17.44	30	-12.56

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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	Included in Calculations of Corr'd PSD

Results

Channel	Frequency (MHz)	Meas ANTENNA B (MHz)	Total Corr'd Power (dBm)	Limit (dBm)	Margin (dB)
Low_1	2412	-6.27	-6.27	8	-14.27
Middle_6	2437	-7.22	-7.21	8	-15.21
High_11	2462	-6.75	-6.75	8	-14.75
High_12	2467	-6.96	-6.96	8	-14.96
High_13	2472	-8.86	-8.86	8	-16.86

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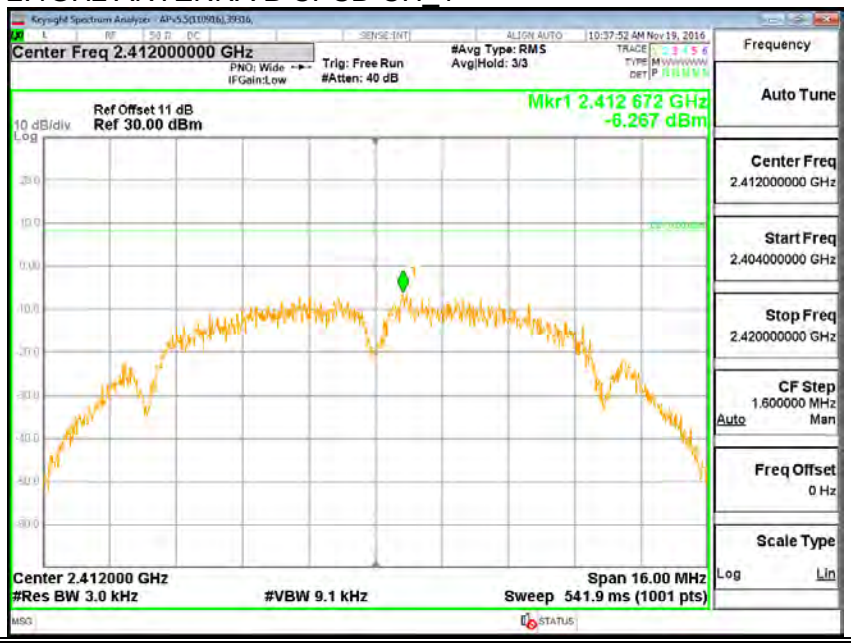
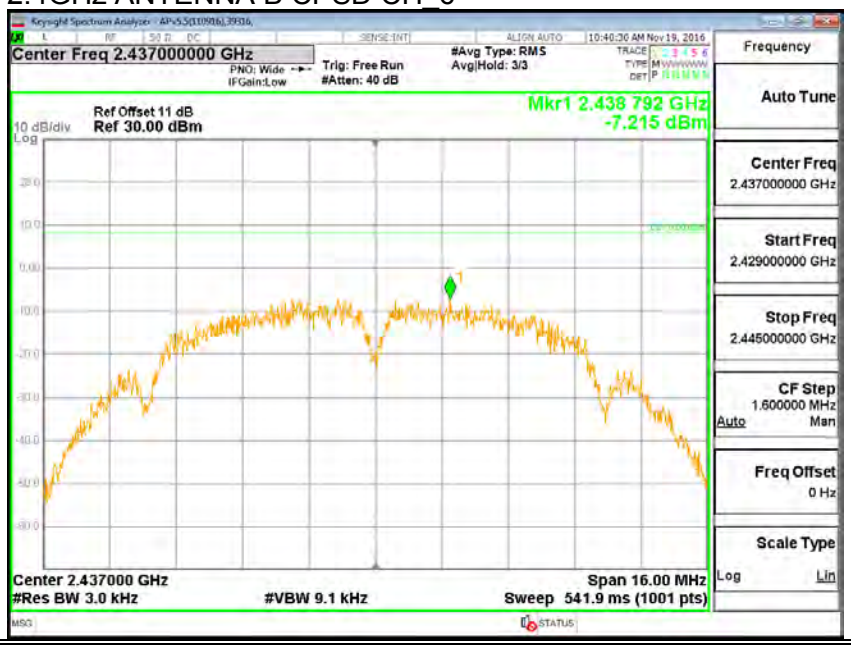
2.4GHz ANTENNA B CPSD CH_1



2.4GHz ANTENNA B CPSD CH_6



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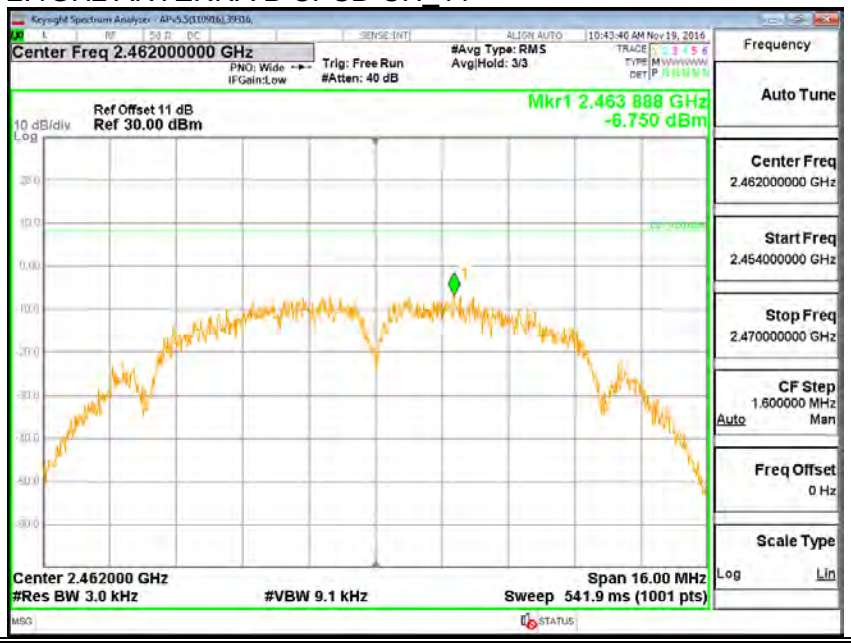
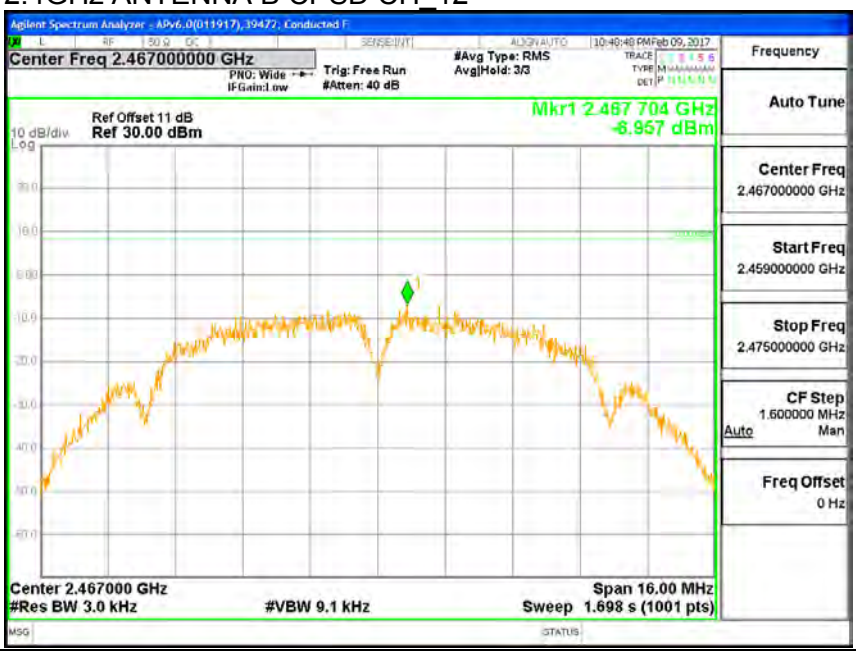
2.4GHz ANTENNA B CPSD CH_11



2.4GHz ANTENNA B CPSD CH_12



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2.4GHz ANTENNA B CPSD CH_13

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8.2.6. CONDUCTED BANDEDGE AND SPURIOUS 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.

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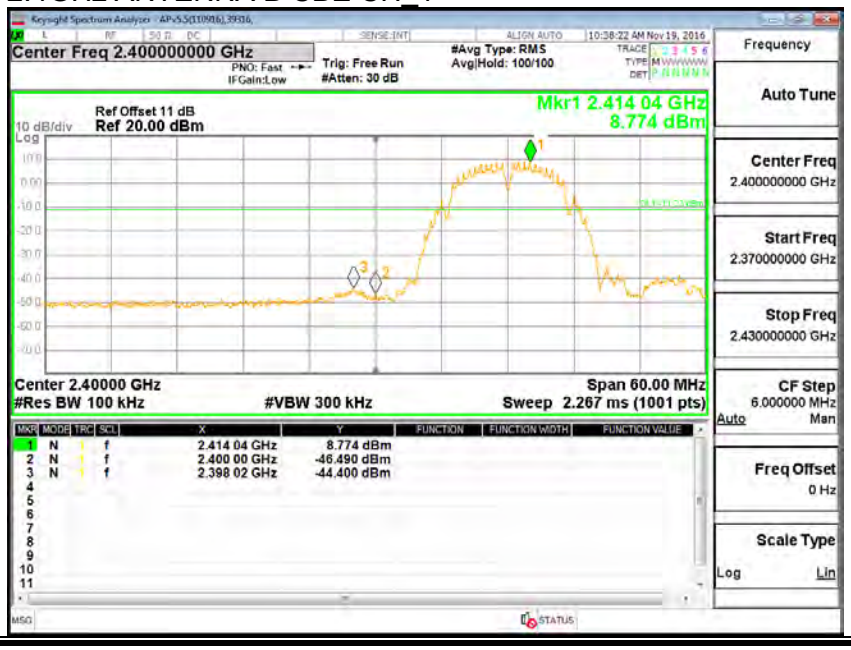
RESULTS

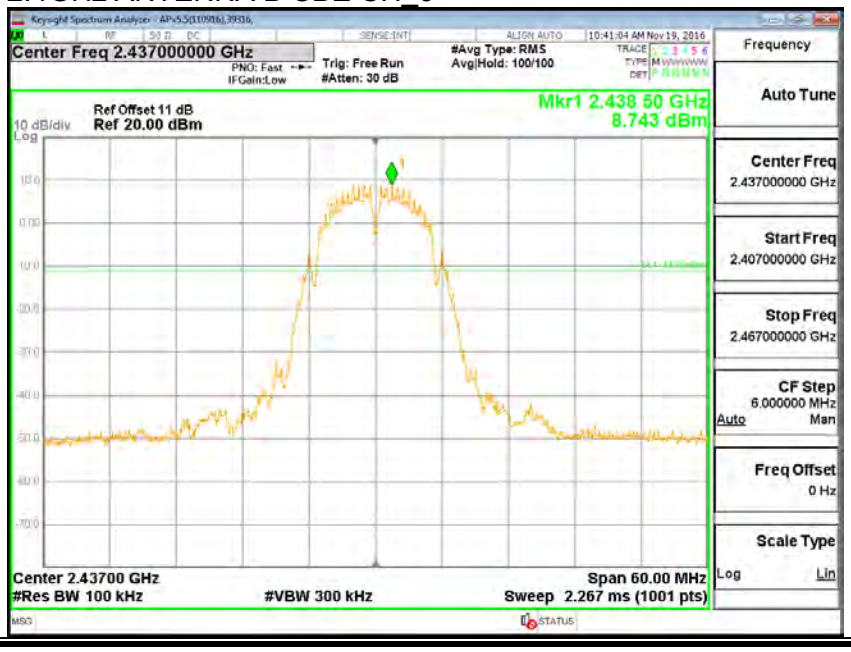
LOW CHANNEL BANDEDGE

2.4GHz ANTENNA B CBE CH_1



MID CHANNEL REFERENCE

2.4GHz ANTENNA B CBE CH_6



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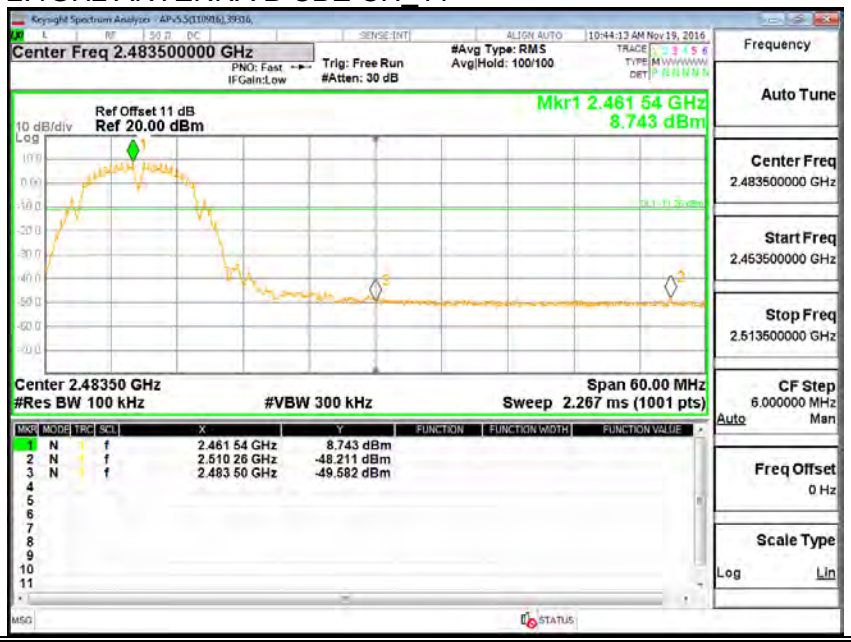
HIGH CHANNEL BANDEDGE

2.4GHz ANTENNA B CBE CH_11



2.4GHz ANTENNA B CBE CH_12

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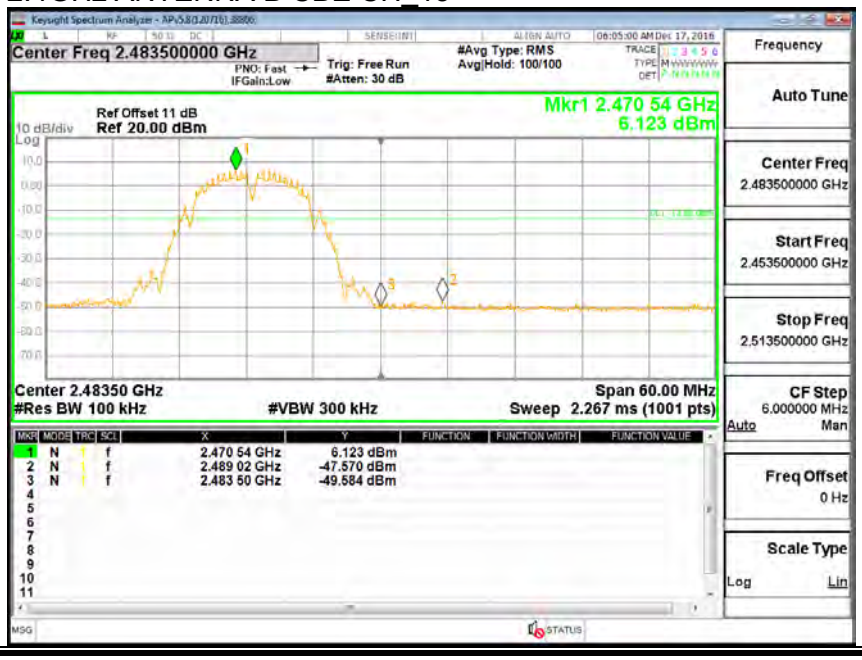
2.4GHz ANTENNA B CBE CH_13



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OUT-OF-BAND EMISSIONS

2.4GHz ANTENNA B CSPUR CH_1

2.4GHz ANTENNA B CSPUR CH_6

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2.4GHz ANTENNA B CSPUR CH_11

2.4GHz ANTENNA B CSPUR CH_12

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2.4GHz ANTENNA B CSPUR CH_13

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8.3. 11n HT20 ANTENNA A SISO MODE IN THE 2.4GHz 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 ANTENNA A (MHz)	Minimum Limit (MHz)
Low_1	2412	15.12	0.5
Middle_6	2437	17.20	0.5
High_10	2457	17.52	0.5
High_11	2462	16.52	0.5
High_12	2467	15.12	0.5
High_13	2472	16.96	0.5

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HT20 2.4GHz ANTENNA A 6dB CH_1

HT20 2.4GHz ANTENNA A 6dB CH_6

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HT20 2.4GHz ANTENNA A 6dB CH_10

HT20 2.4GHz ANTENNA A 6dB CH_11

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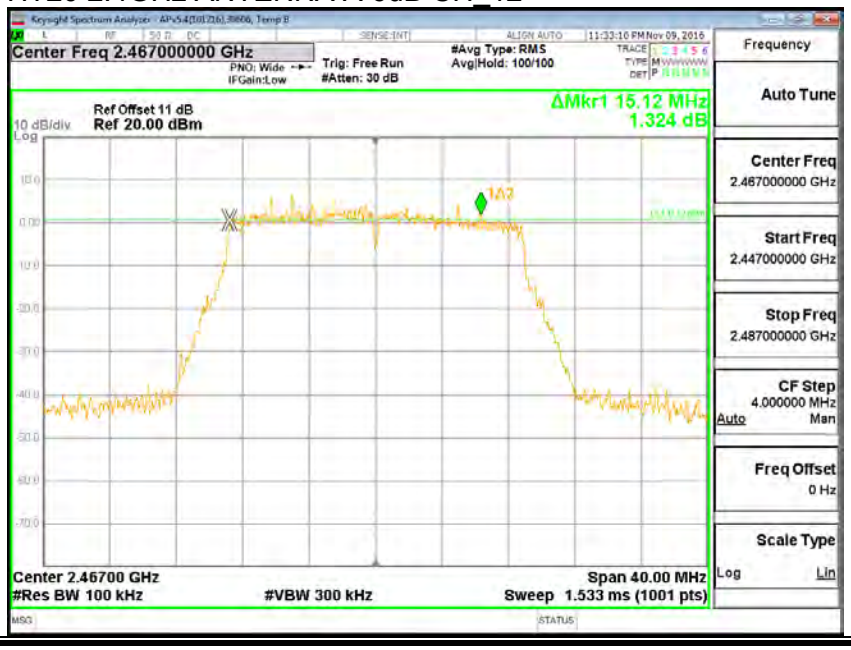
HT20 2.4GHz ANTENNA A 6dB CH_12



HT20 2.4GHz ANTENNA A 6dB CH_13

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8.3.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth ANTENNA A (MHz)
Low_1	2412	17.905
Middle_6	2437	17.887
High_10	2457	17.822
High_11	2462	17.664
High_12	2467	17.630
High_13	2472	17.681

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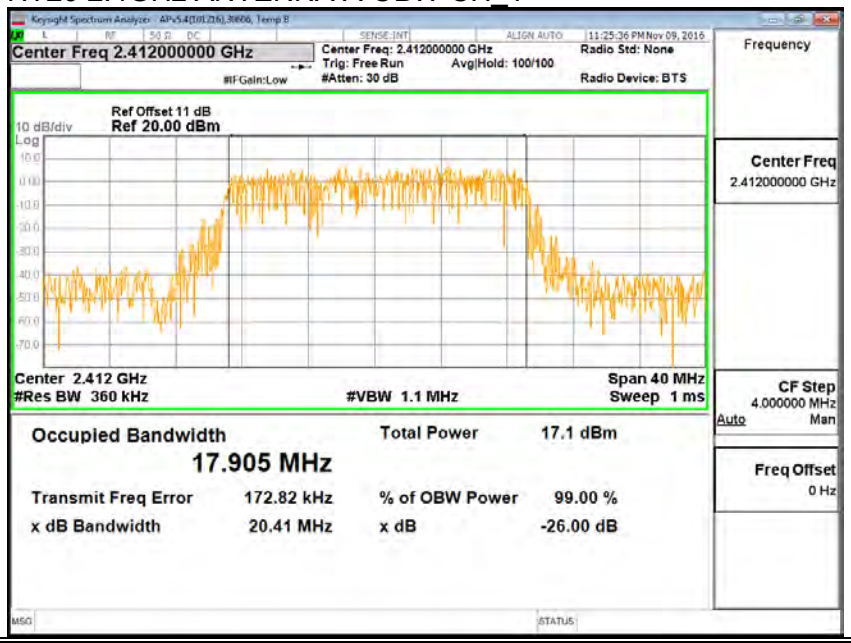
HT20 2.4GHz ANTENNA A OBW CH_1



HT20 2.4GHz ANTENNA A OBW CH_6

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HT20 2.4GHz ANTENNA A OBW CH_10

HT20 2.4GHz ANTENNA A OBW CH_11

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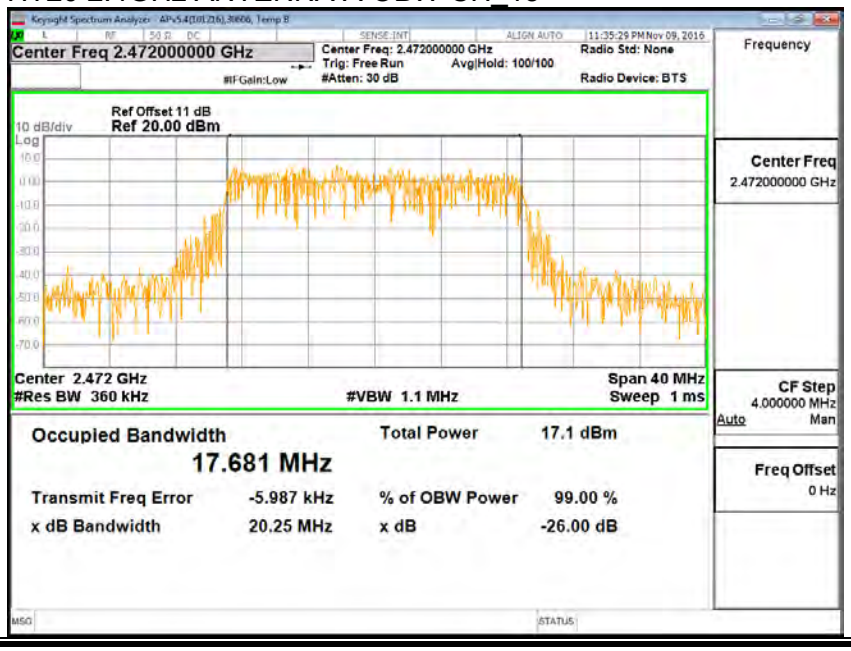
HT20 2.4GHz ANTENNA A OBW CH_12

HT20 2.4GHz ANTENNA A OBW CH_13



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8.3.3. AVERAGE POWER

ID:	39472	Date:	12/17/16

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	Power ANTENNA A (MHz)
Low_1	2412	14.90
Middle_6	2437	15.70
High_10	2457	15.71
High_11	2462	13.25
High_12	2467	11.80
High_13	2472	3.52

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8.3.4. OUTPUT POWER

ID:	39472	Date:	12/17/16

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.

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RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low_1	2412	1.91	30	30	36	30
Middle_6	2437	1.91	30	30	36	30
High_10	2457	1.91	30	30	36	30
High_11	2462	1.91	30	30	36	30
High_12	2467	1.91	30	30	36	30
High_13	2472	1.91	30	30	36	30

Duty Cycle CF (dB)	0	Included in Calculations of Corr'd Power

Results

Channel	Frequency (MHz)	Power ANTENNA A (MHz)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low_1	2412	22.67	21.67	30	-8.33
Middle_6	2437	22.53	22.53	30	-7.47
High_10	2457	22.61	22.61	30	-7.39
High_11	2462	20.17	20.17	30	-6.97
High_12	2467	18.32	18.32	30	-11.68
High_13	2472	9.84	9.84	30	-20.16

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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	Included in Calculations of Corr'd PSD

Results

Channel	Frequency (MHz)	Meas ANTENNA A (MHz)	Total Corr'd Power (dBm)	Limit (dBm)	Margin (dB)
Low_1	2412	-8.38	-8.38	8	-16.38
Middle_6	2437	-8.73	-8.73	8	-16.73
High_10	2457	-8.99	-8.99	8	-16.99
High_11	2462	-7.84	-7.84	8	-15.84
High_12	2467	-13.22	-13.22	8	-21.22
High_13	2472	-22.82	-22.82	8	-30.82

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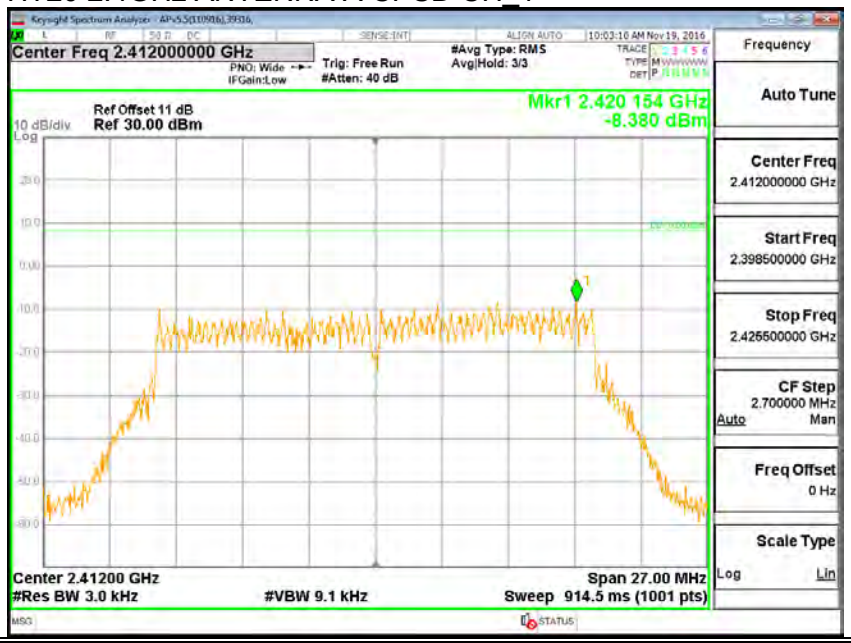
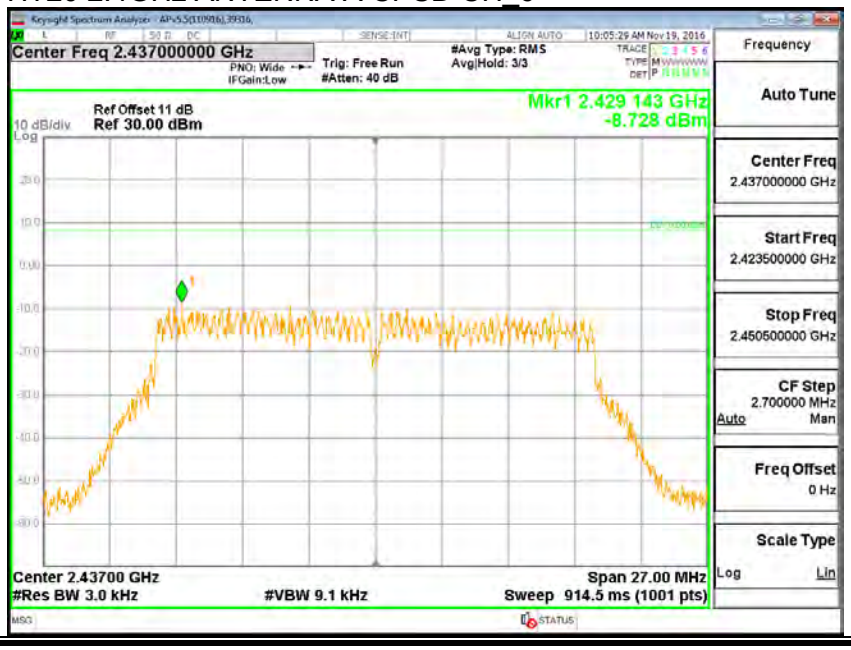
HT20 2.4GHz ANTENNA A CPSD CH_1



HT20 2.4GHz ANTENNA A CPSD CH_6



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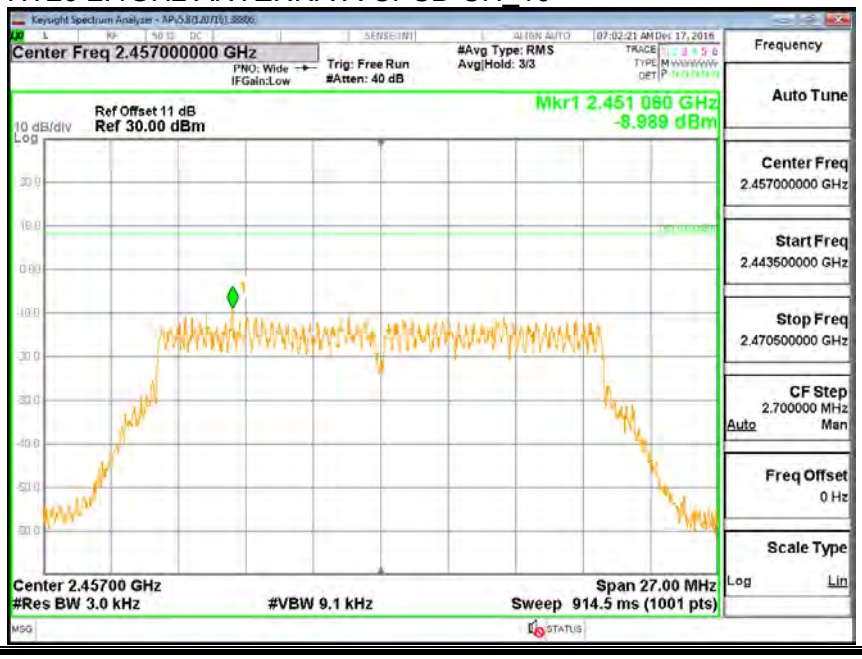
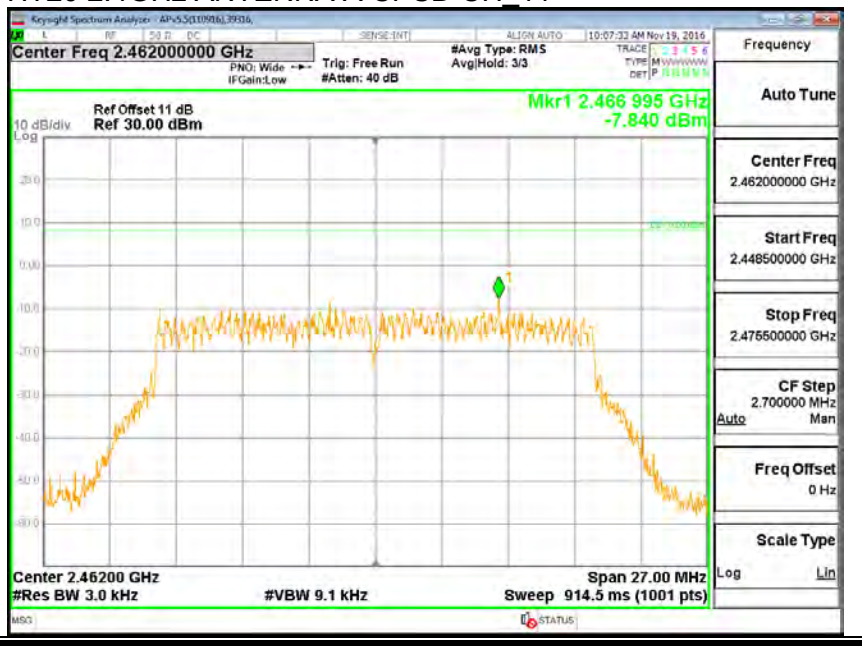
HT20 2.4GHz ANTENNA A CPSD CH_10



HT20 2.4GHz ANTENNA A CPSD CH_11



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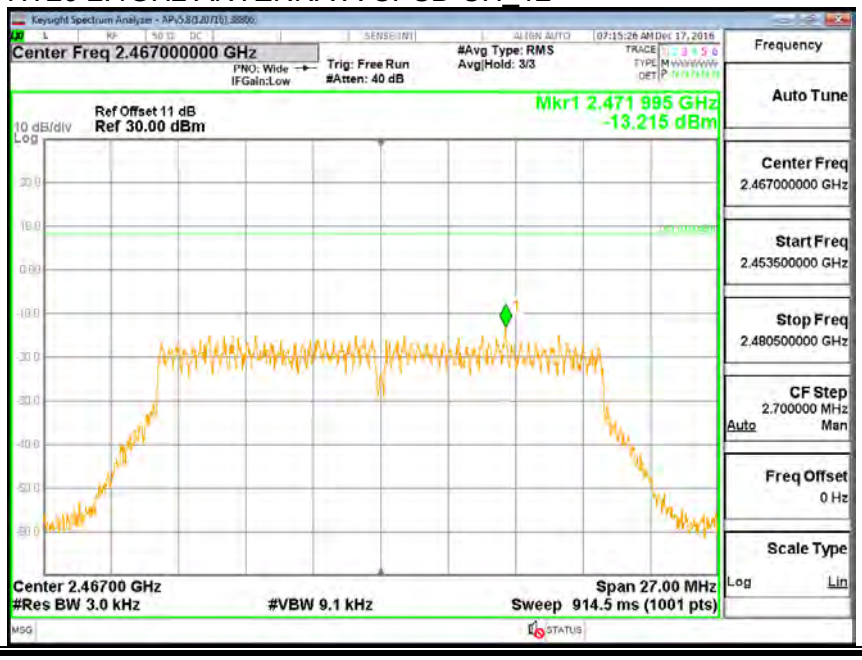
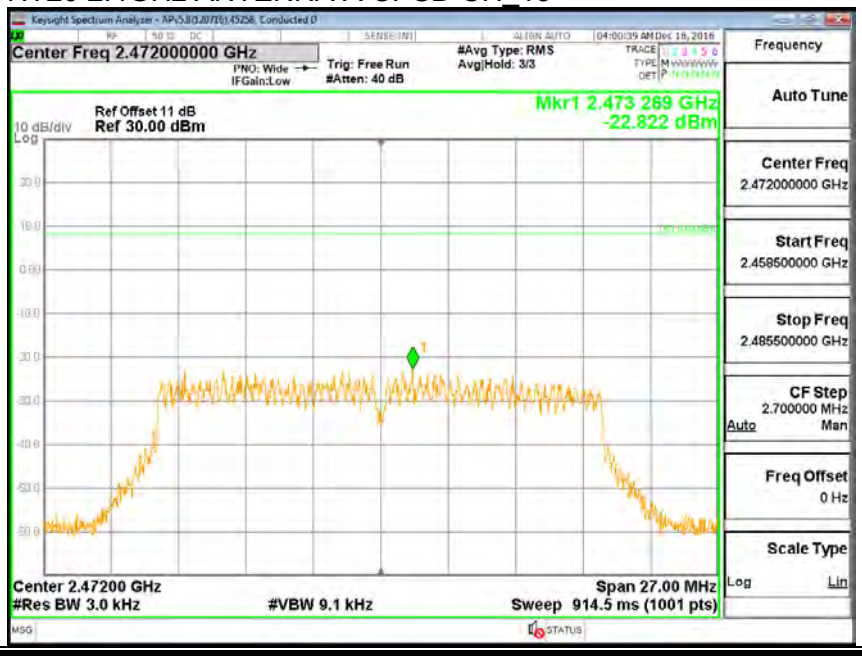
HT20 2.4GHz ANTENNA A CPSD CH_12



HT20 2.4GHz ANTENNA A CPSD CH_13



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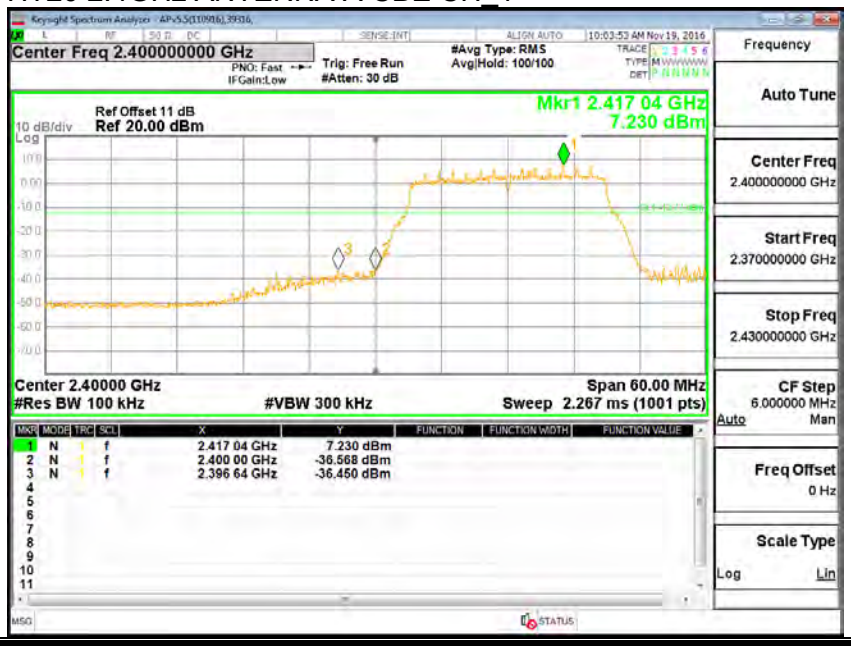
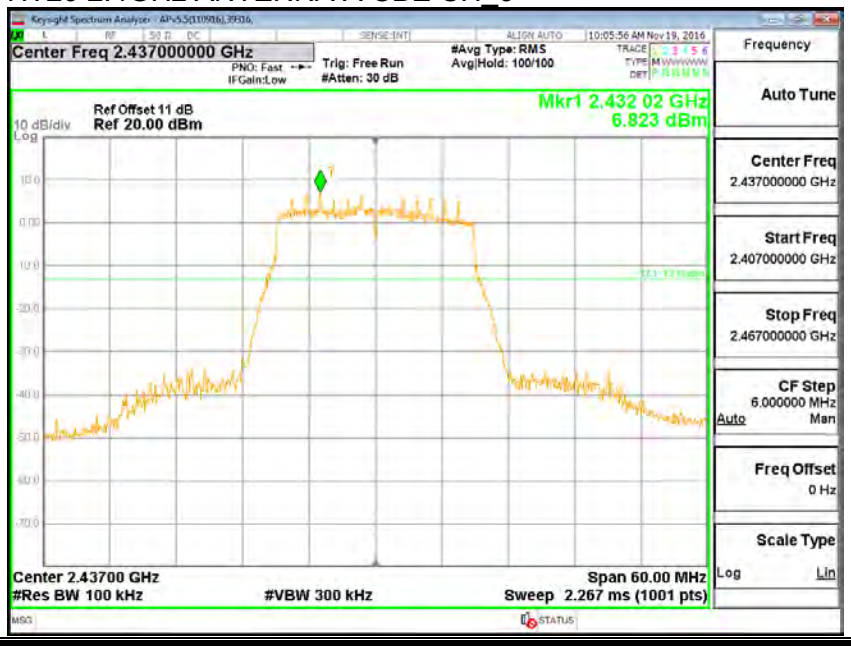
8.3.6. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

HT20 2.4GHz ANTENNA A CBE CH_1



HT20 2.4GHz ANTENNA A CBE CH_6



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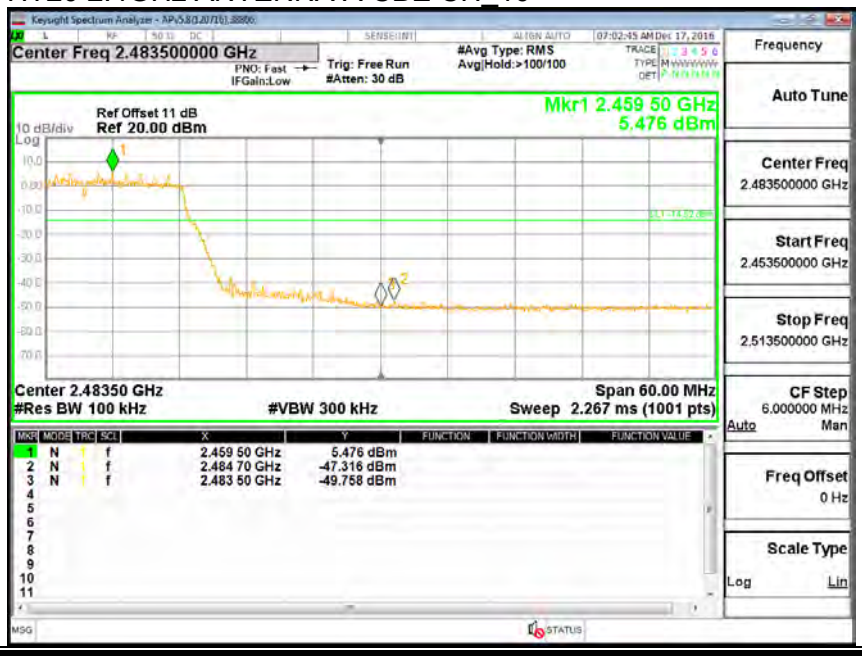
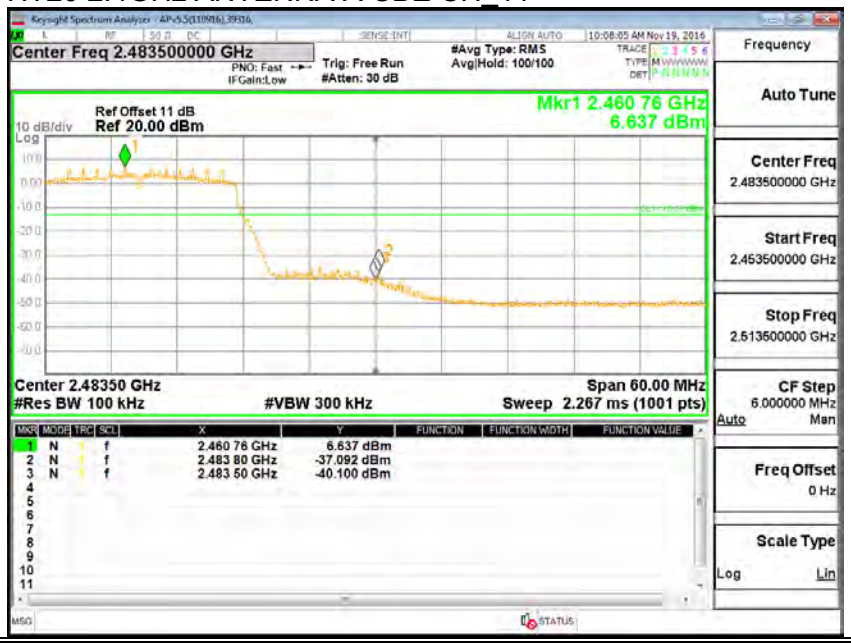
HT20 2.4GHz ANTENNA A CBE CH_10



HT20 2.4GHz ANTENNA A CBE CH_11



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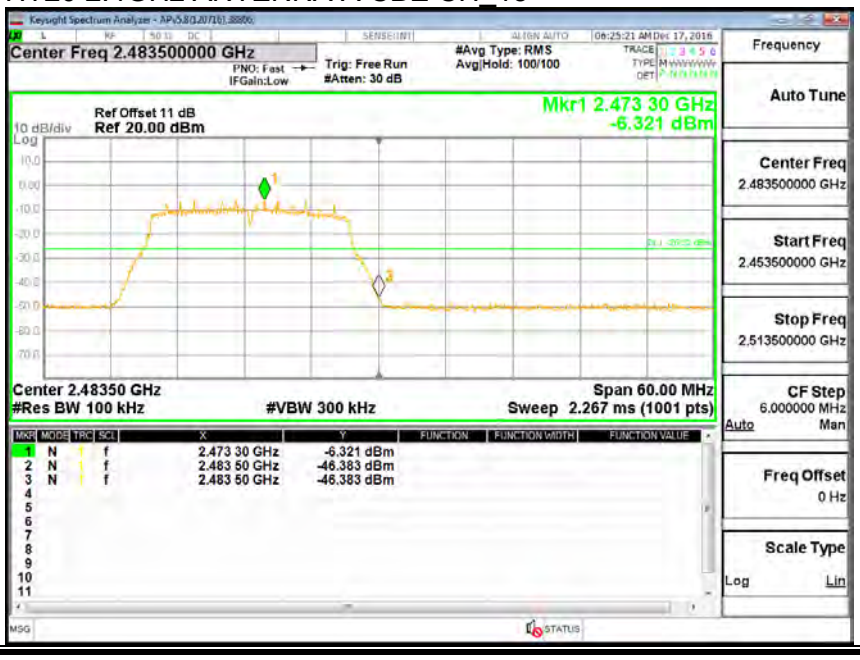
HT20 2.4GHz ANTENNA A CBE CH_12

HT20 2.4GHz ANTENNA A CBE CH_13



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HT20 2.4GHz ANTENNA A CSPUR CH_1

HT20 2.4GHz ANTENNA A CSPUR CH_6

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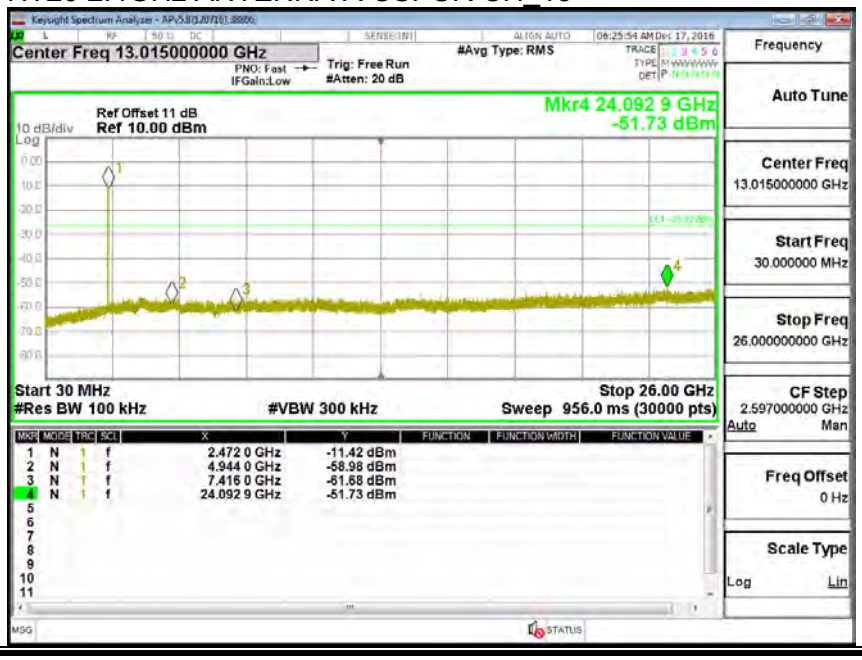
HT20 2.4GHz ANTENNA A CSPUR CH_13



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8.4. 11n HT20 ANTENNA B SISO MODE IN THE 2.4GHz BAND

8.4.1. 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 ANTENNA B (MHz)	Minimum Limit (MHz)
Low_1	2412	17.56	0.5
Middle_6	2437	17.36	0.5
High_10	2457	17.56	0.5
High_11	2462	16.68	0.5
High_12	2467	16.92	0.5
High_13	2472	16.68	0.5

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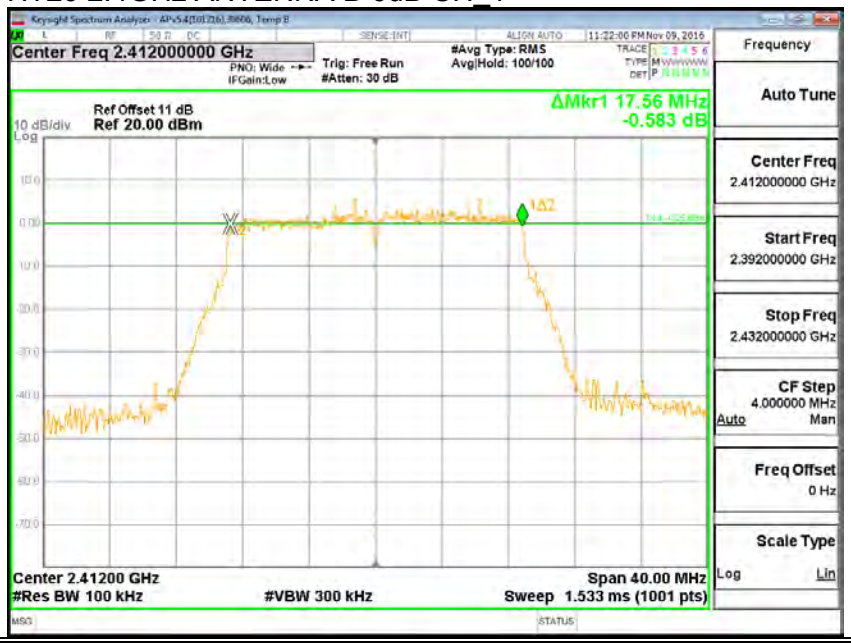
HT20 2.4GHz ANTENNA B 6dB CH_1



HT20 2.4GHz ANTENNA B 6dB CH_6

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HT20 2.4GHz ANTENNA B 6dB CH_10

HT20 2.4GHz ANTENNA B 6dB CH_11

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HT20 2.4GHz ANTENNA B 6dB CH_12

HT20 2.4GHz ANTENNA B 6dB CH_13

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8.4.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth ANTENNA B (MHz)
Low_1	2412	17.799
Middle_6	2437	17.784
High_10	2457	17.701
High_11	2462	17.728
High_12	2467	17.710
High_13	2472	17.813

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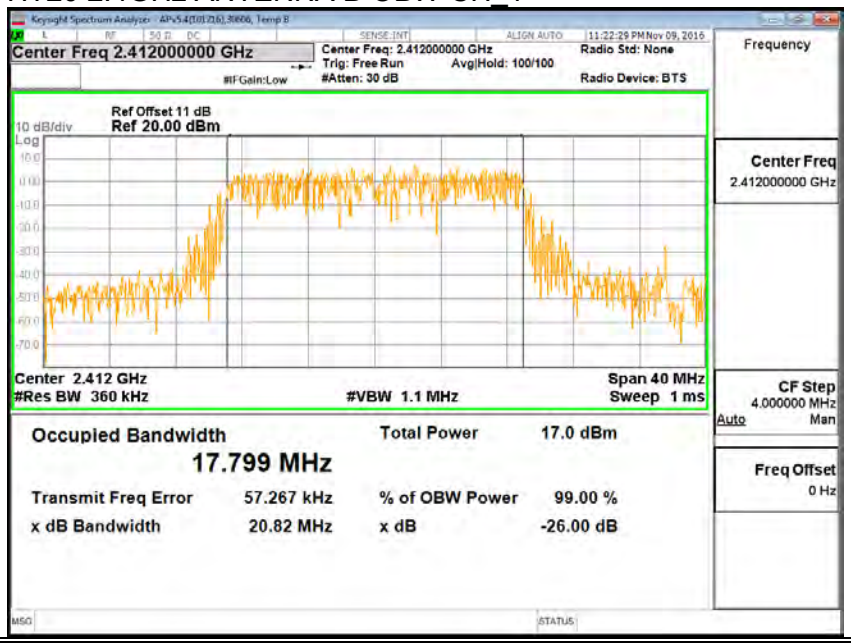
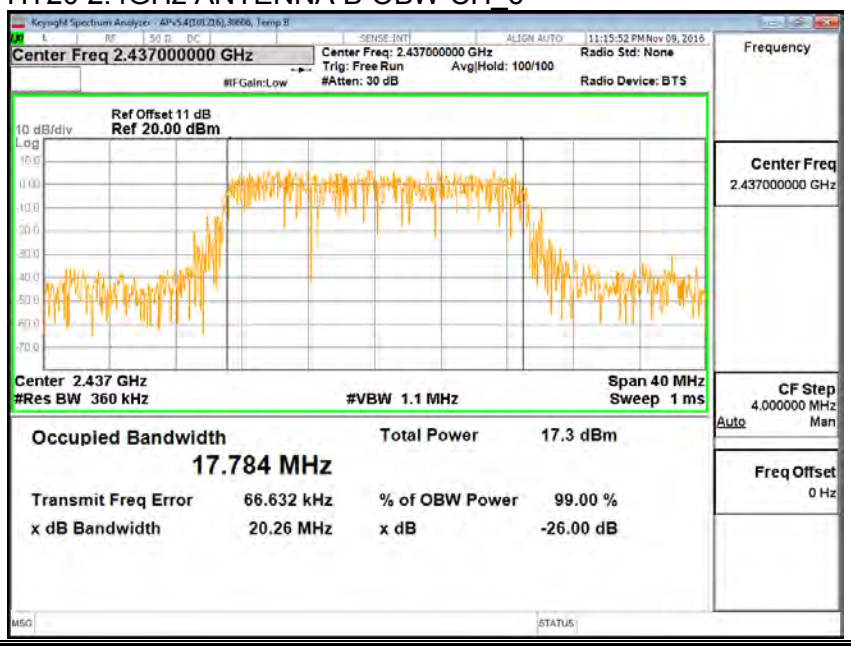
HT20 2.4GHz ANTENNA B OBW CH_1



HT20 2.4GHz ANTENNA B OBW CH_6



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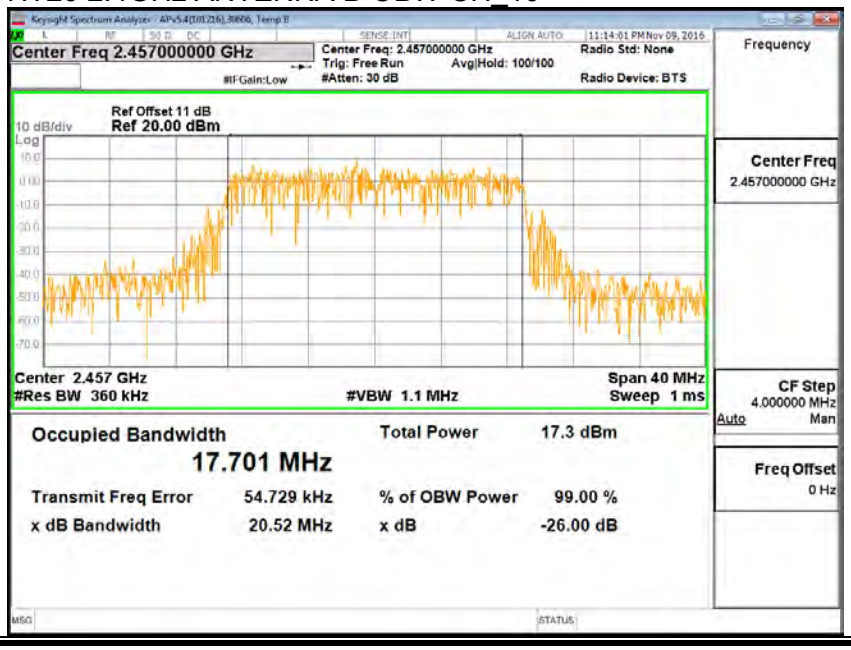
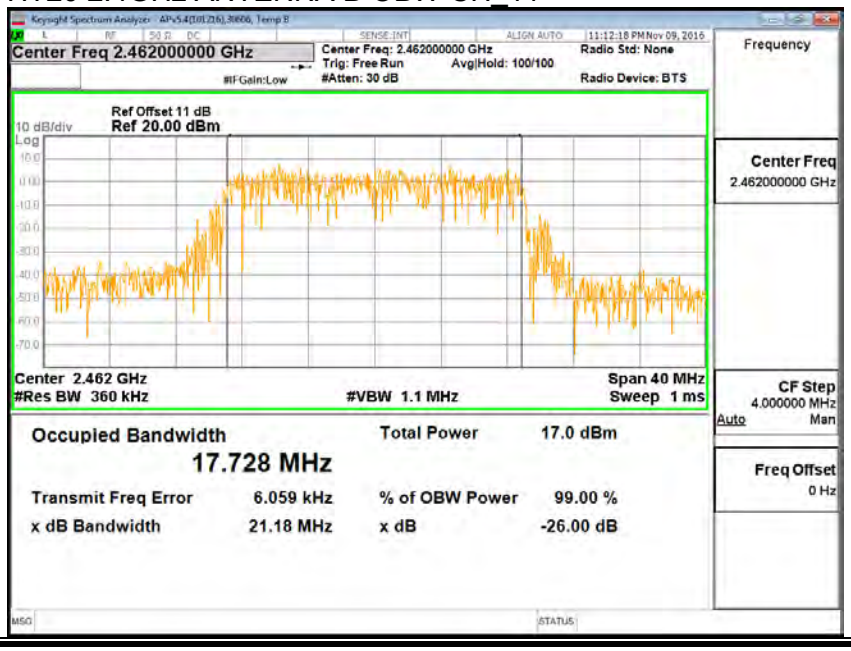
HT20 2.4GHz ANTENNA B OBW CH_10



HT20 2.4GHz ANTENNA B OBW CH_11



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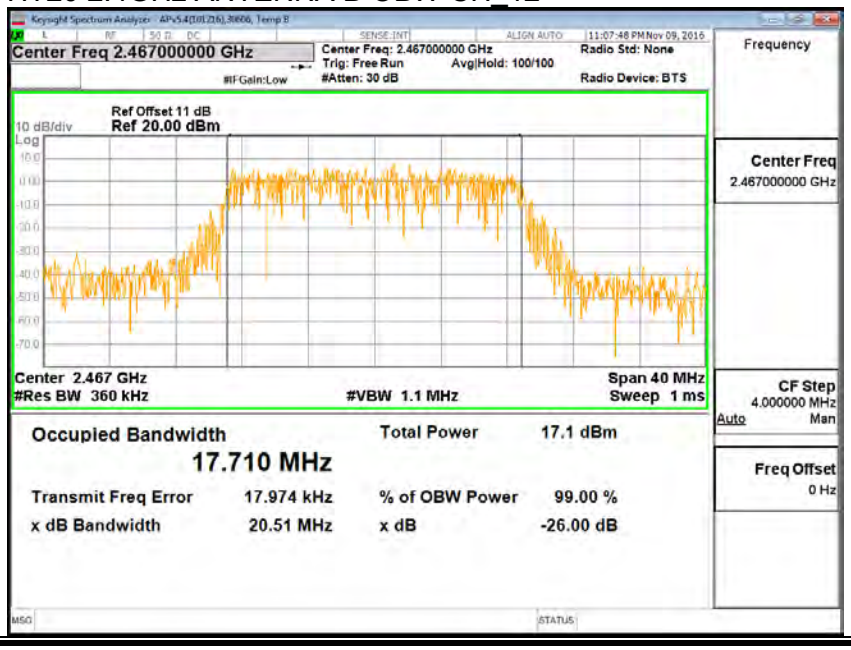
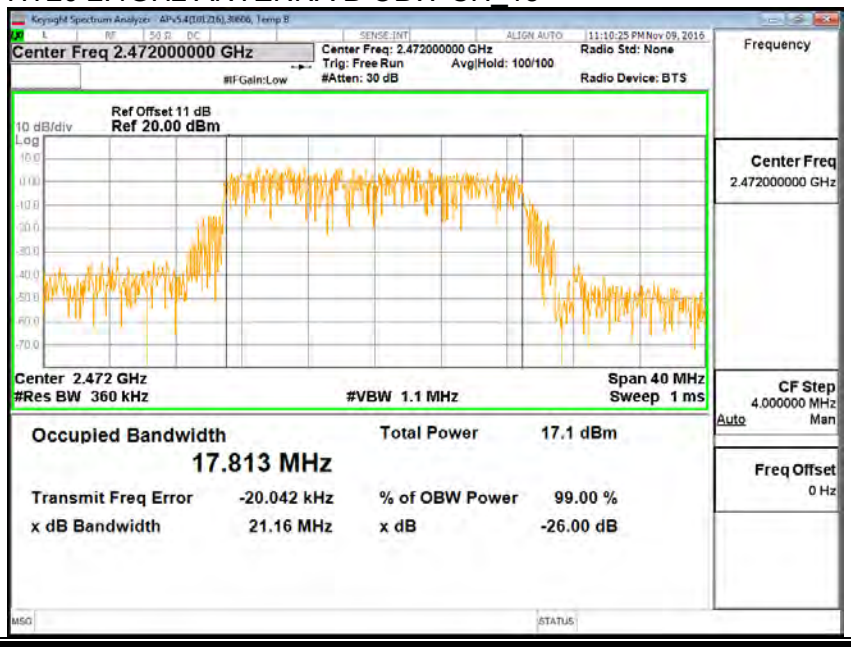
HT20 2.4GHz ANTENNA B OBW CH_12



HT20 2.4GHz ANTENNA B OBW CH_13



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8.4.3. AVERAGE POWER

ID:	39472	Date:	12/17/16

LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	Power ANTENNA B (MHz)
Low_1	2412	14.52
Middle_6	2437	15.20
High_10	2457	15.36
High_11	2462	13.44
High_12	2467	11.60
High_13	2472	3.45

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8.4.4. OUTPUT POWER

ID:	39472	Date:	12/17/16

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.

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RESULTS

Limits

Channel	Frequency (MHz)	Directional Gain (dBi)	FCC Power Limit (dBm)	IC Power Limit (dBm)	IC EIRP Limit (dBm)	Max Power (dBm)
Low_1	2412	0.56	30	30	36	30
Middle_6	2437	0.56	30	30	36	30
High_10	2457	0.56	30	30	36	30
High_11	2462	0.56	30	30	36	30
High_12	2467	0.56	30	30	36	30
High_13	2472	0.56	30	30	36	30

Duty Cycle CF (dB)	0	Included in Calculations of Corr'd Power

Results

Channel	Frequency (MHz)	Power ANTENNA B (MHz)	Total Corr'd Power (dBm)	Power Limit (dBm)	Margin (dB)
Low_1	2412	21.68	21.68	30	-8.32
Middle_6	2437	22.39	22.39	30	-7.61
High_10	2457	22.59	22.59	30	-7.41
High_11	2462	20.24	20.24	30	-6.76
High_12	2467	18.94	18.94	30	-11.06
High_13	2472	9.87	9.87	30	-20.13

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8.4.5. 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	Included in Calculations of Corr'd PSD

Results

Channel	Frequency (MHz)	Meas ANTENNA B (MHz)	Total Corr'd Power (dBm)	Limit (dBm)	Margin (dB)
Low_1	2412	-9.60	-9.60	8	-17.60
Middle_6	2437	-9.50	-9.49	8	-17.49
High_10	2457	-10.76	-10.76	8	-18.76
High_11	2462	-9.41	-9.41	8	-17.41
High_12	2467	-14.11	-14.11	8	-22.11
High_13	2472	-22.45	-22.45	8	-30.45

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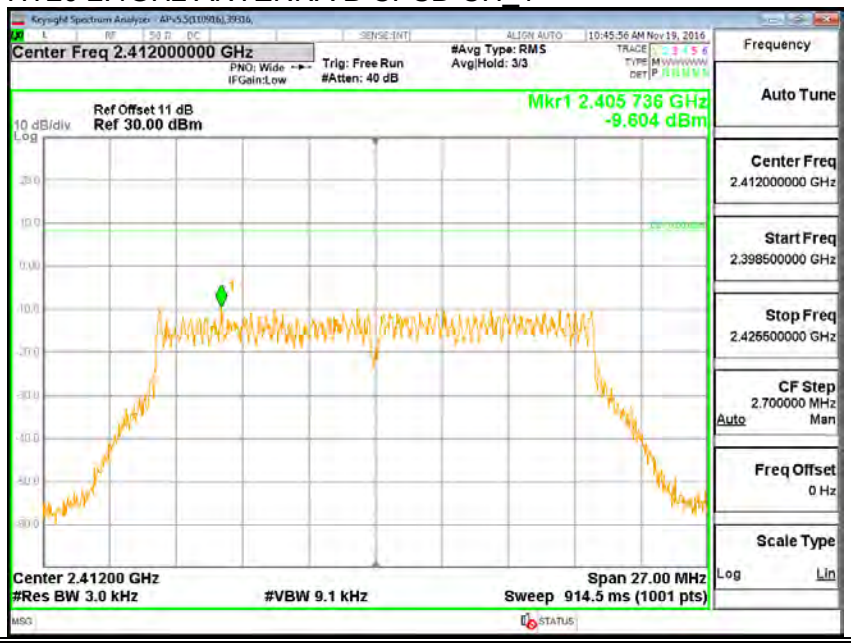
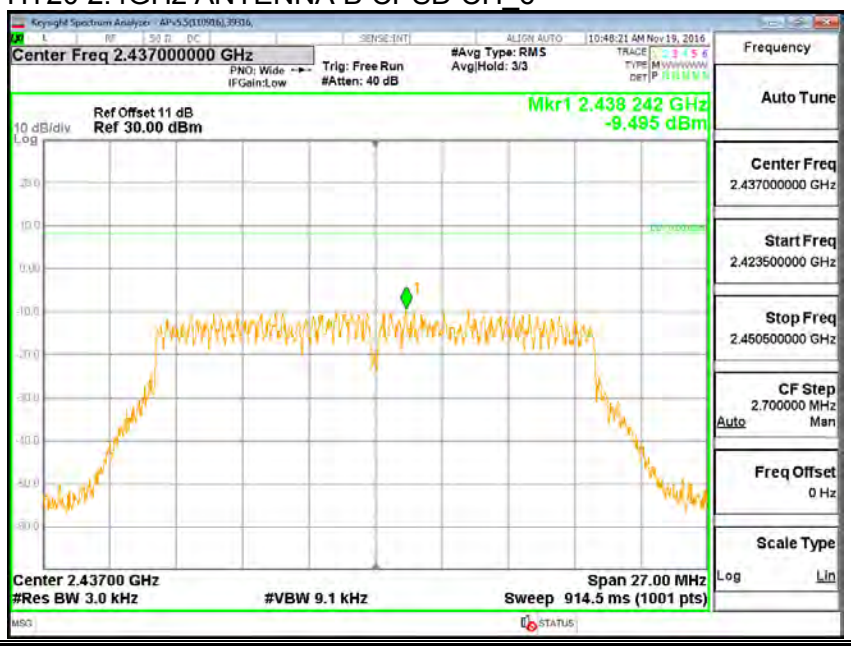
HT20 2.4GHz ANTENNA B CPSD CH_1



HT20 2.4GHz ANTENNA B CPSD CH_6



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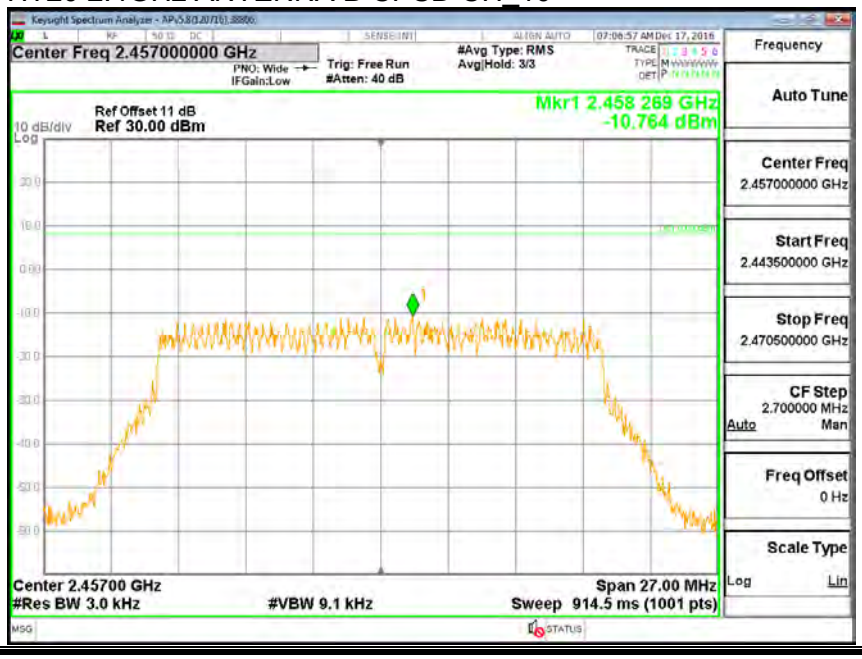
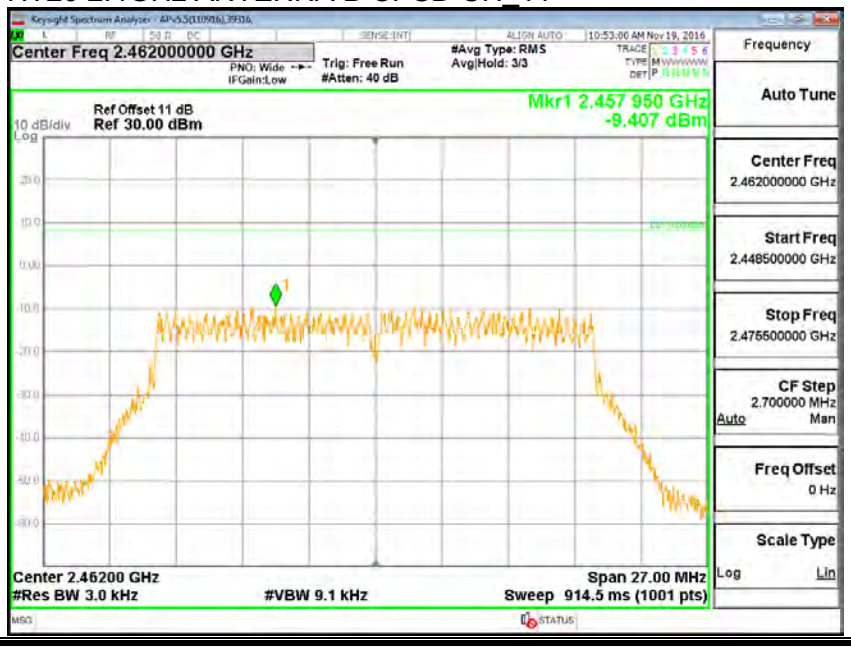
HT20 2.4GHz ANTENNA B CPSD CH_10



HT20 2.4GHz ANTENNA B CPSD CH_11



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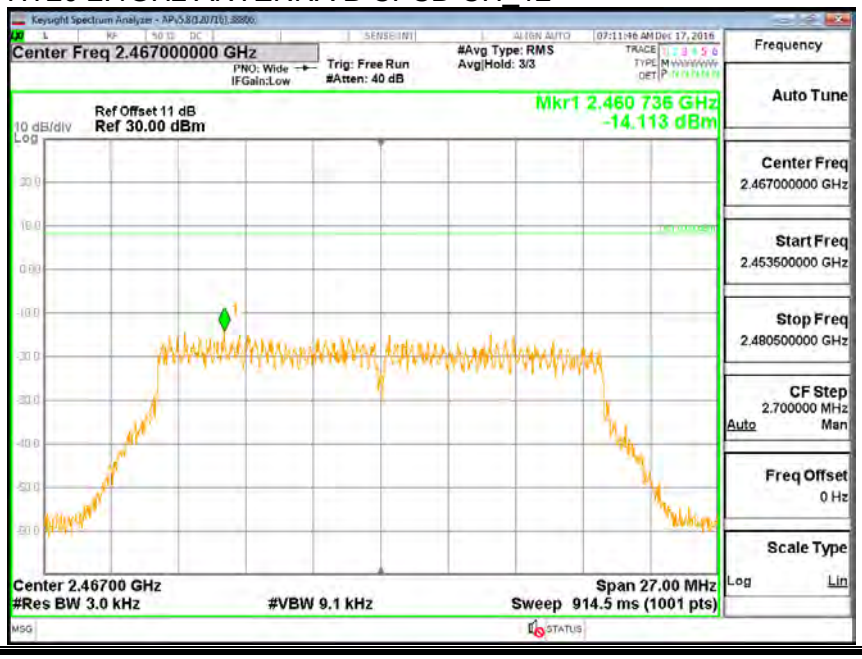
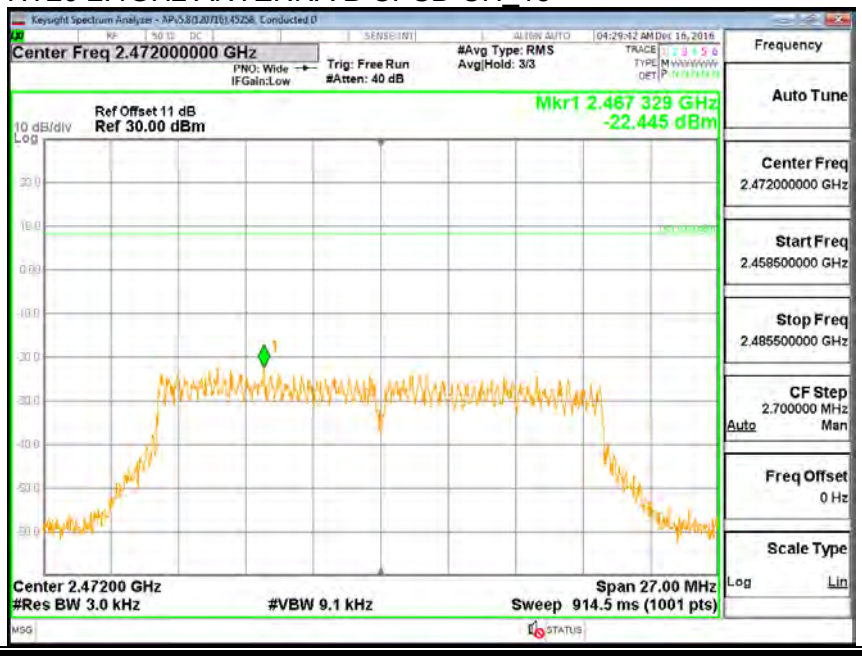
HT20 2.4GHz ANTENNA B CPSD CH_12



HT20 2.4GHz ANTENNA B CPSD CH_13



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8.4.6. CONDUCTED BANDEDGE AND SPURIOUS 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.

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