FCC CFR47 PART 15 SUBPART C

DTS Wireless LAN

CERTIFICATION TEST REPORT

FOR

Bluetooth/BLE, DTS b/g/n WATCH

MODEL NUMBER : SM-R732

FCC ID: A3LSMR732DG

REPORT NUMBER: 16K23469-E1V1

ISSUE DATE: JUN 07, 2016

Prepared for
SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI,
GYEONGGI-DO, 16677, KOREA

Prepared by
UL Korea, Ltd. Suwon Laboratory
218 Maeyeong-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16675, Korea
TEL: (031) 337-9902
FAX: (031) 213-5433

ACCREDITED
TL-637

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	06/07/16	Initial issue	Junwhan Lee

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: SAMSUNG ELECTRONICS CO., LTD.

EUT DESCRIPTION: Bluetooth/BLE and DTS b/g/n WATCH

MODEL NUMBER: SM-R732

SERIAL NUMBER: R3AG900E4PP, R3AG900E50X (RADIATED); R3AG9004UL (CONDUCTED)

DATE TESTED: MAY 24, 2016 - JUN 07, 2016

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass

UL Korea, Ltd. 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 Korea, Ltd. 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 Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. 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 IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Korea, Ltd. By:

CY Choi
Suwon Lab Engineer
UL Korea, Ltd.

Tested By:

Junwhan Lee
Suwon Lab Engineer
UL Korea, Ltd.

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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 and ANSI C63.10-2009.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 218 Maeyeong-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16675, Korea. Line conducted emissions are measured only at the 218 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.

218 Maeyeong-ro
☒ Chamber 1
☐ Chamber 2

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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
Conducted Disturbance, 0.15 to 30 MHz	2.32 dB
Radiated Disturbance, Below 1GHz	4.14 dB
Radiated Disturbance, Above 1 GHz	5.97 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 Bluetooth/BLE and DTS b/g/n WATCH.
This test report addresses the DTS (WLAN) operational mode.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum total conducted average output power as follows:

Frequency Range [MHz]	Mode	Output Power [dBm]	Output Power [mW]
2412 - 2472	802.11b	16.37	43.35
	802.11g	14.01	25.18
	802.11n HT20	12.99	19.91

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antennas, with a antenna's maximum gain of -2.45 dBi.

5.4. WORST-CASE CONFIGURATION AND MODE

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

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

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

802.11b mode: 1 Mbps
802.11g mode: 6 Mbps
802.11n HT20 mode: MCS0

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5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Adapter	SAMSUNG	ETA0U60JBE	DK1G725HS/7-E	N/A
Wireless Charger	SAMSUNG	EP-OR720	N/A	N/A
Data Cable	SAMSUNG	ECB-DU6ABE	N/A	N/A

I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	DC Power	1	Mini-USB	Shielded	0.8m	N/A

TEST SETUP

The EUT is a stand-alone unit during the tests.
Test software in hidden menu exercised the EUT to enable DTS mode.

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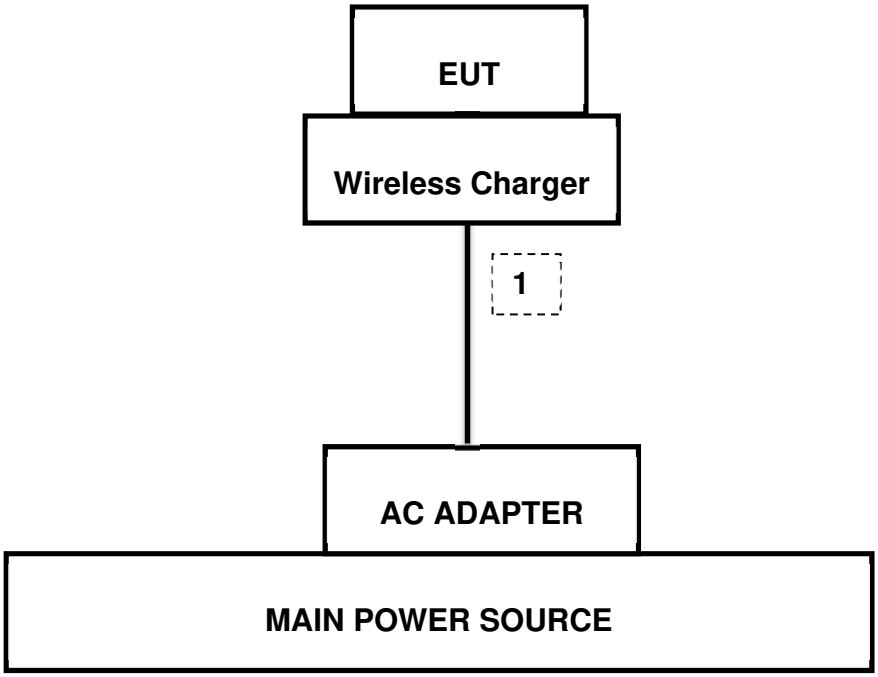
SETUP DIAGRAM FOR TESTS



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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**	**S/N**	**Cal Due**
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	750	11-17-16
Antenna, Bilog, 30MHz-1GHz	SCHWARZBECK	VULB9163	749	04-25-17
Antenna, Horn, 18 GHz	ETS	3115	00167211	09-20-16
Antenna, Horn, 18 GHz	ETS	3115	00161451	05-17-17
Antenna, Horn, 18 GHz	ETS	3117	00168724	06-17-17
Antenna, Horn, 18 GHz	ETS	3117	00168717	06-17-17
Antenna, Horn, 40 GHz	ETS	3116C	00166155	11-30-17
Antenna, Horn, 40 GHz	ETS	3116C-PA	00168841	12-15-17
Preamplifier, 1000 MHz	Sonoma	310N	341282	08-18-16
Preamplifier, 1000 MHz	Sonoma	310N	351741	08-18-16
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1876511	08-18-16
Preamplifier, 18 GHz	Miteq	AFS42-00101800-25-S-42	1896138	08-18-16
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54170614	08-19-16
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	MY54490312	08-19-16
Bluetooth Tester	TESCOM	TC-3000C	3000C000546	08-18-16
Average Power Sensor	R&S	NRZ-Z91	102681	08-18-16
Average Power Sensor	Agilent / HP	U2000	MY54270007	08-18-16
EMI Test Receive, 40 GHz	R&S	ESU40	100439	08-19-16
EMI Test Receive, 40 GHz	R&S	ESU40	100457	08-19-16
EMI Test Receive, 3 GHz	R&S	ESR3	101832	08-19-16
Attenuator / Switch driver	HP	11713A	3748A04272	N/A
Low Pass Filter 3GHz	Micro-Tronics	LPS17541	009	08-18-16
Low Pass Filter 3GHz	Micro-Tronics	LPS17541	015	08-18-16
High Pass Filter 5GHz	Micro-Tronics	HPS17542	009	08-18-16
High Pass Filter 6GHz	Micro-Tronics	HPM17543	010	08-18-16
High Pass Filter 5GHz	Micro-Tronics	HPS17542	016	08-18-16
High Pass Filter 6GHz	Micro-Tronics	HPM17543	015	08-18-16
LISN	R&S	ENV-216	101836	08-19-16
LISN	R&S	ENV-216	101837	08-19-16
Attenuator	PASTERNACK	PE7087-10	A009	08-19-16

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7. MEASUREMENT METHODS

KDB 558074 D01 DTS Meas Guidance v03r05: Measurement Procedure §9.2.3.1 AVGPM is used for average power and §10.5 AVGPSD-2 is used for power spectral density.

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

Band edge emissions within Restricted Bands are measured using RMS with duty cycle factor offset method.

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8. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

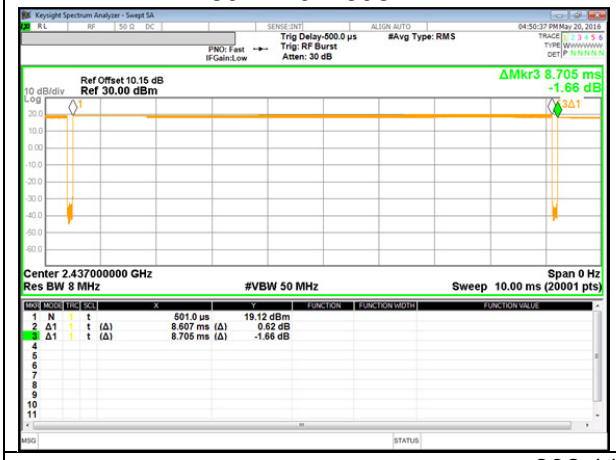
LIMITS

None; for reporting purposes only.

8.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B [msec)	Period [msec]	Duty Cycle x [linear]	Duty Cycle [%]	Duty Cycle Correction Factor [dB]	1/T Minimum VBW [kHz]
2400MHz Bands						
802.11b	8.607	8.705	0.989	98.9%	0.00	0.010
802.11g	1.428	1.53	0.933	93.3%	0.30	0.700
802.11n HT20	1.336	1.437	0.930	93.0%	0.32	0.749

802.11b mode



802.11g mode

802.11n mode

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9. SUMMARY TABLE

FCC Part Section	Test Description	Test Limit	Test Condition	Test Result	Worst Case
15.247 (a)(2)	Occupied Band width (6dB)	>500KHz	Conducted	Pass	9.023 MHz
2.1051, 15.247 (d)	Band Edge / Conducted Spurious Emission	-20dBc		Pass	-26.891 dBm
15.247	TX conducted output power	<30dBm		Pass	16.37 dBm
15.247	PSD	<8dBm		Pass	-14.1 dBm
15.207 (a)	AC Power Line conducted emissions	Section 10	Power Line conducted	Pass	41.83 dBuV (PK)
15.205, 15.209	Radiated Spurious Emission	< 74dBuV/m	Radiated	Pass	71.5 dBuV/m (PK)

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10. ANTENNA PORT TEST RESULTS

10.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

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

TEST PROCEDURE

Reference to KDB 558074 D01 DTS Meas Guidance v03r05: The transmitter output is connected to a spectrum analyzer with the RBW set to100KHz, the VBW >= 3 x RBW, peak detector and max hold.

RESULTS

10.1.1. 802.11b MODE IN THE 2.4 GHz BAND

Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Minimum Limit [MHz]
1	2412	9.023	0.5
2	2417	9.049	0.5
6	2437	9.051	0.5
11	2462	9.043	0.5
12	2467	9.043	0.5
13	2472	9.041	0.5
Worst		9.023	0.5

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10.1.2. 802.11g MODE IN THE 2.4 GHz BAND

Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Minimum Limit [MHz]
Low	2412	15.129	0.5
Mid	2437	15.106	0.5
High	2462	15.117	0.5
12	2467	15.120	0.5
13	2472	15.111	0.5
Worst		15.106	0.5

10.1.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	Minimum Limit [MHz]
Low	2412	15.108	0.5
Mid	2437	15.112	0.5
High	2462	15.112	0.5
12	2467	15.114	0.5
13	2472	15.113	0.5
Worst		15.108	0.5

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10.1.4. 6 dB BANDWIDTH PLOTS

802.11b Mode 1 CH			
802.11b Mode 2 CH			
802.11b Mode 6 CH			

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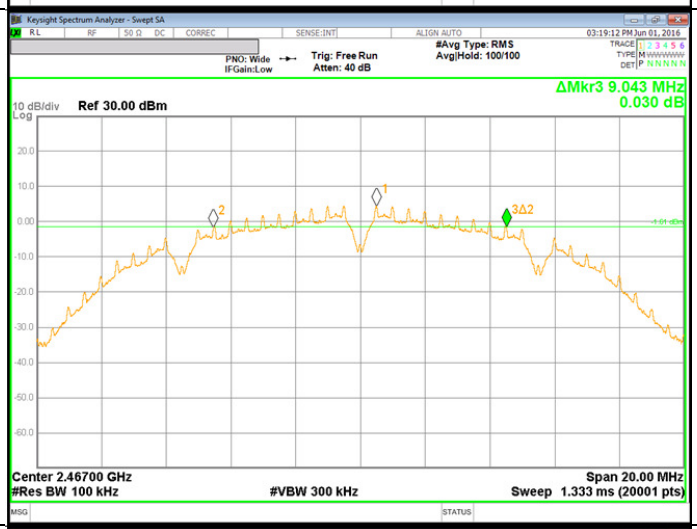
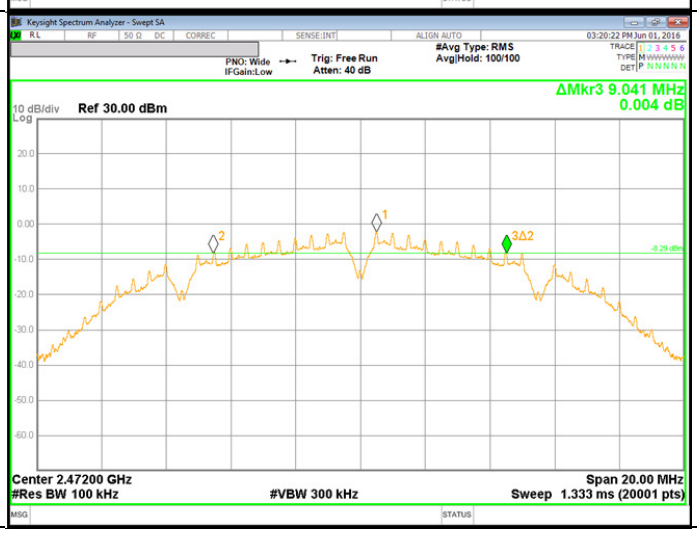
802.11b Mode 11 CH			
802.11b Mode 12 CH			
802.11b Mode 13 CH			

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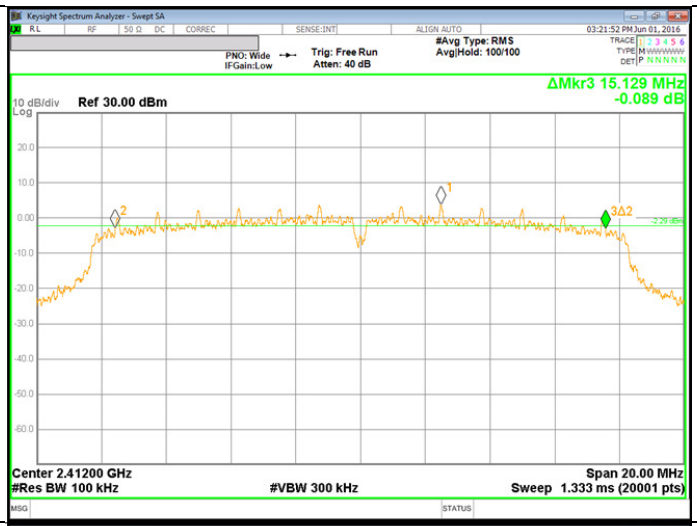
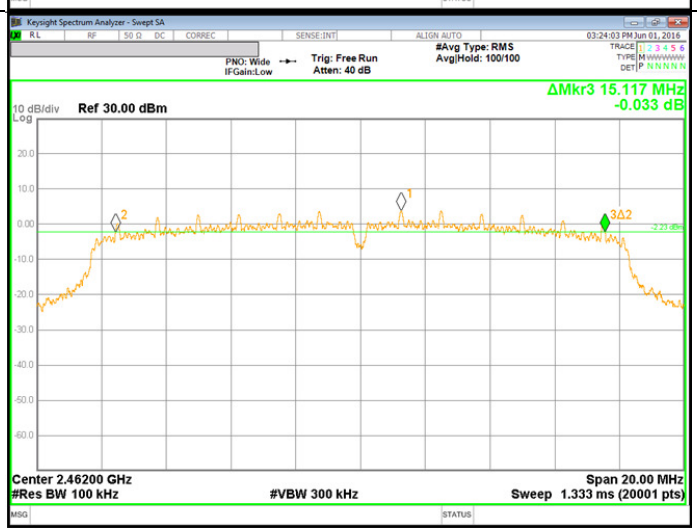
802.11g Mode Low CH			
802.11g Mode Middle CH			
802.11g Mode High CH			

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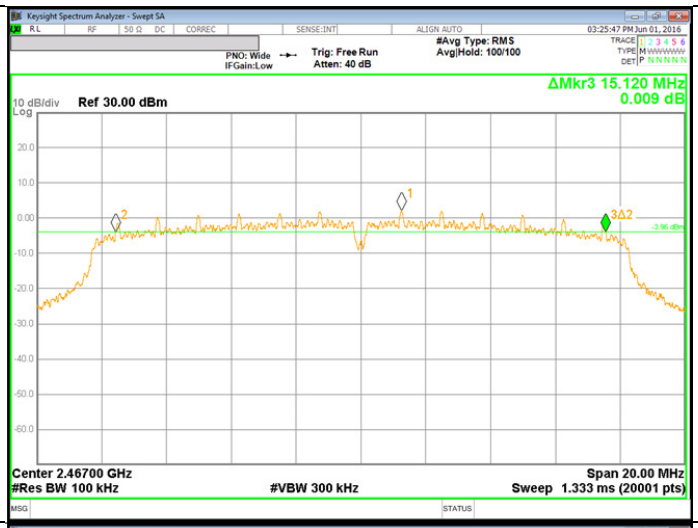
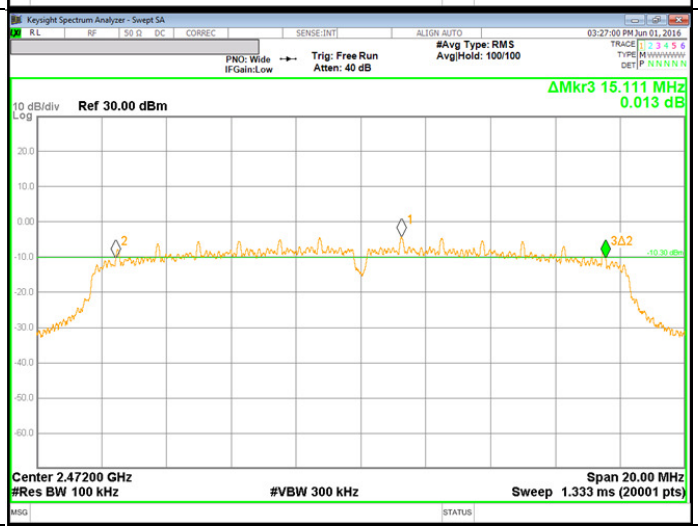
802.11g Mode 12 CH			
802.11g Mode 13 CH			

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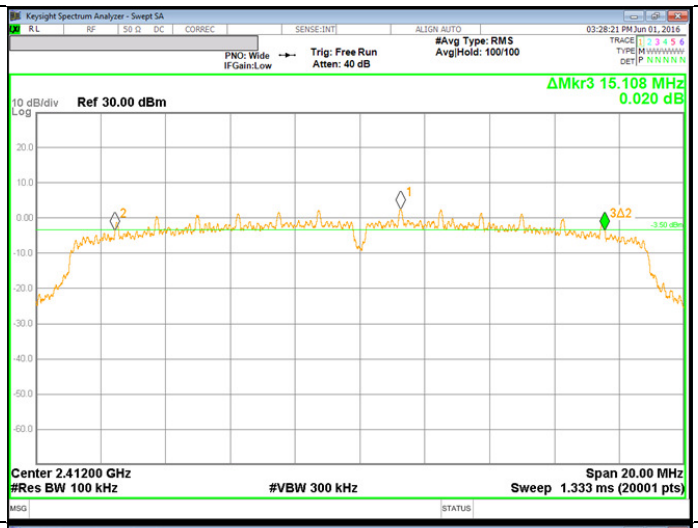
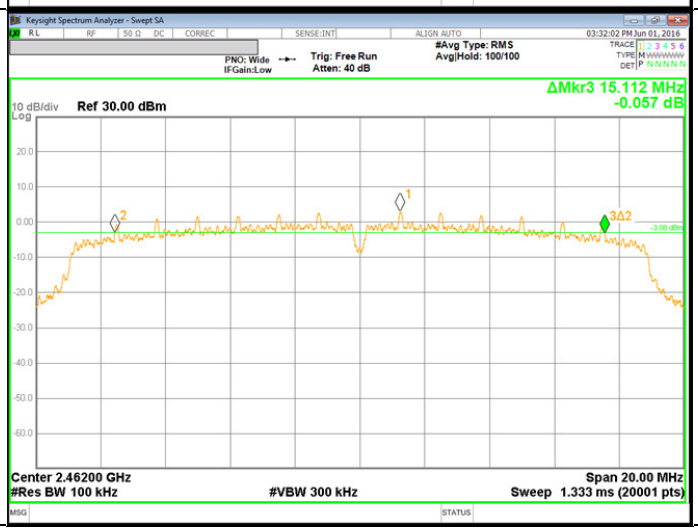
802.11n Mode Low CH			
802.11n Mode Middle CH			
802.11n Mode High CH			

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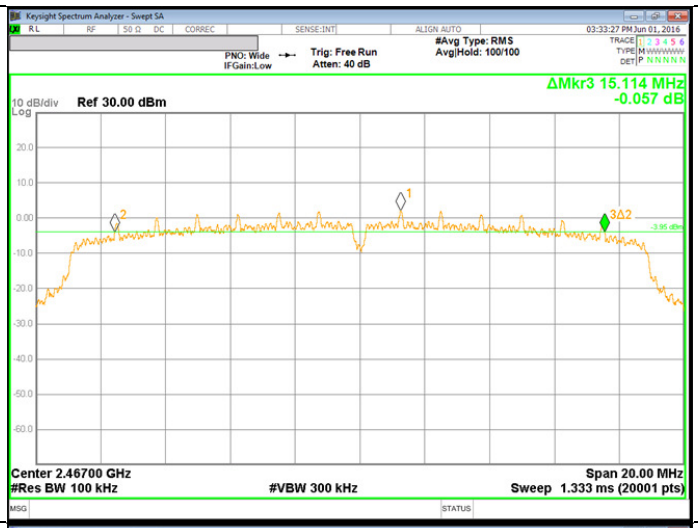
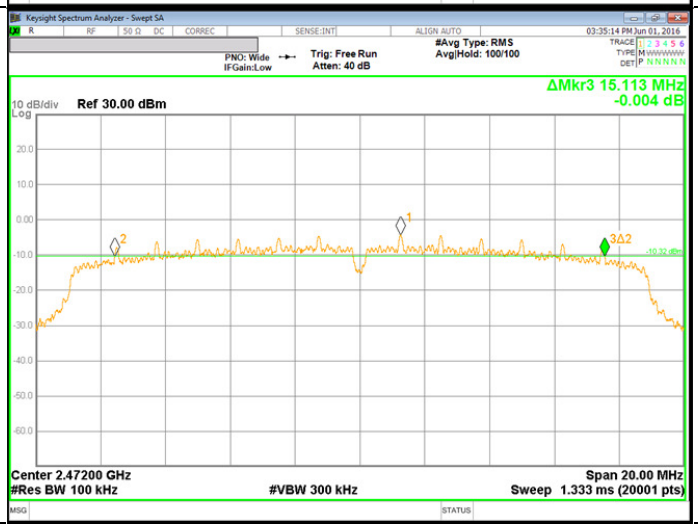
802.11n Mode 12 CH			
802.11n Mode 13 CH			

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10.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

RESULTS

10.2.1. 802.11b MODE IN THE 2.4 GHz BAND

Channel	Frequency [MHz]	99% Bandwidth [MHz]
1	2412	14.104
2	2417	14.196
6	2437	14.299
11	2462	14.263
12	2467	14.081
13	2472	14.071
Worst		14.299

10.2.2. 802.11g MODE IN THE 2.4 GHz BAND

Channel	Frequency [MHz]	99% Bandwidth [MHz]
Low	2412	16.317
Mid	2437	16.289
High	2462	16.338
12	2467	16.288
13	2472	16.312
Worst		16.338

10.2.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

Channel	Frequency [MHz]	99% Bandwidth [MHz]
Low	2412	17.488
Mid	2437	17.436
High	2462	17.498
12	2467	17.496
13	2472	17.482
Worst		17.498

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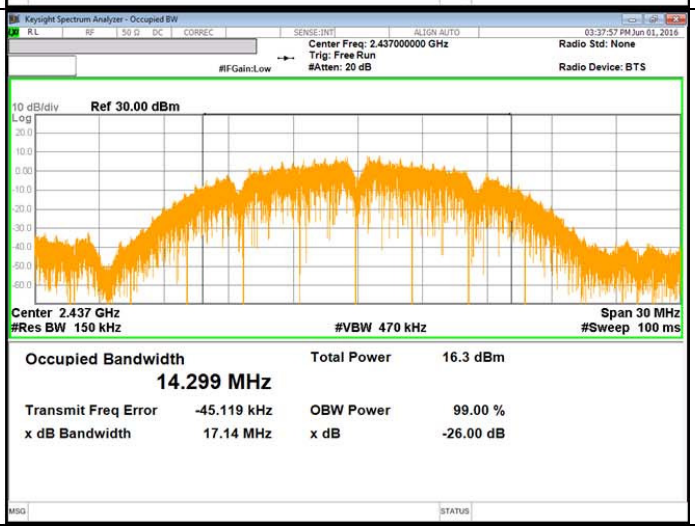
10.2.4. 99% BANDWIDTH PLOTS

802.11b Mode 1 CH			
802.11b Mode 2 CH			
802.11b Mode 6 CH			

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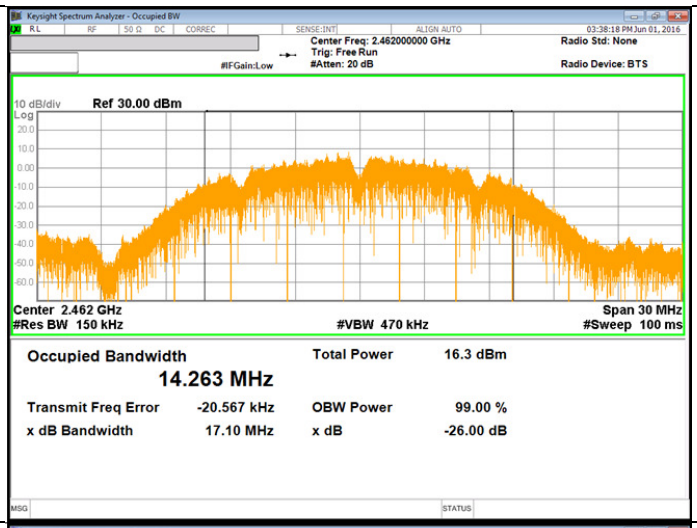
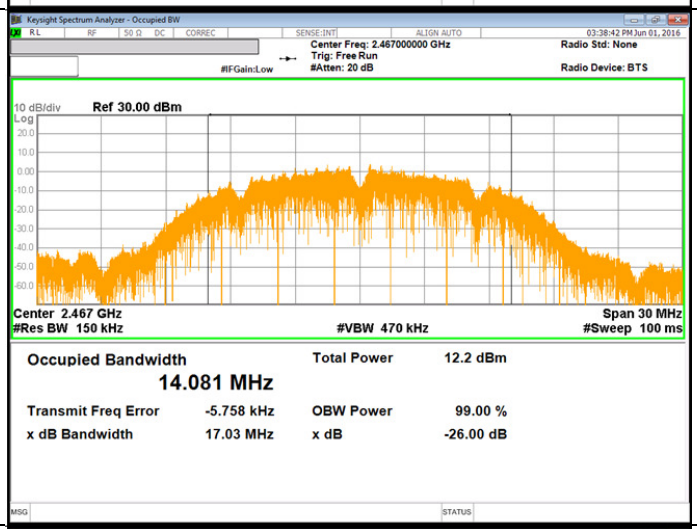
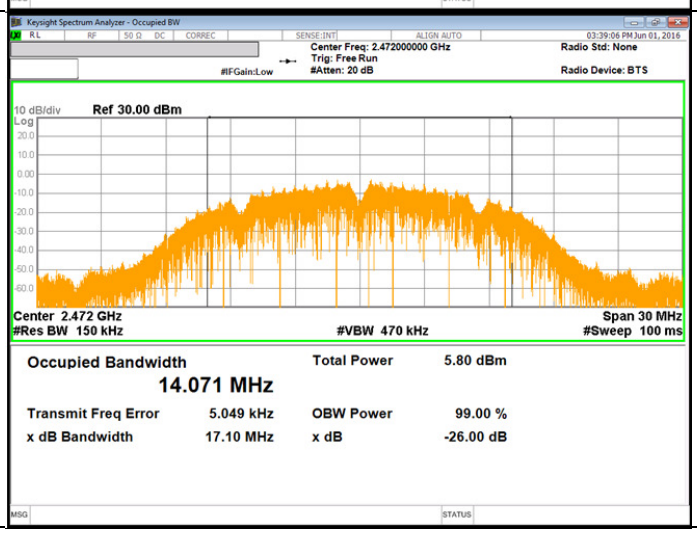
802.11b Mode 11 CH			
802.11b Mode 12 CH			
802.11b Mode 13 CH			

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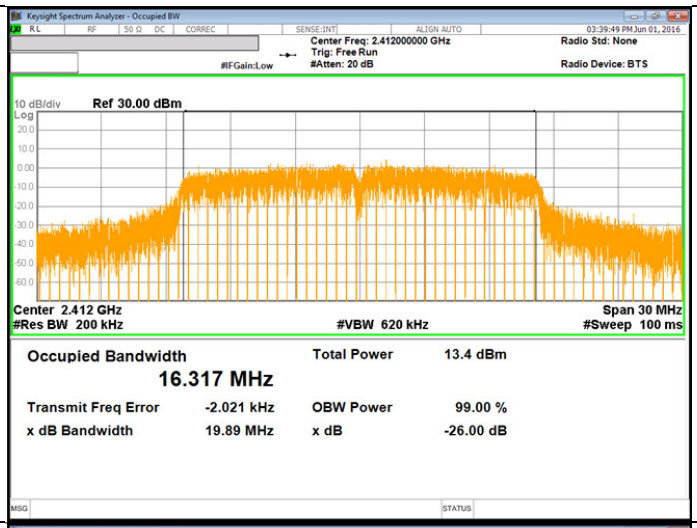
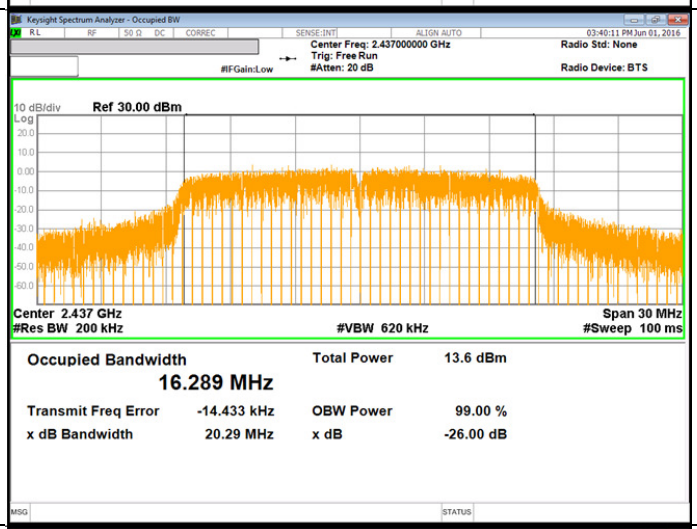
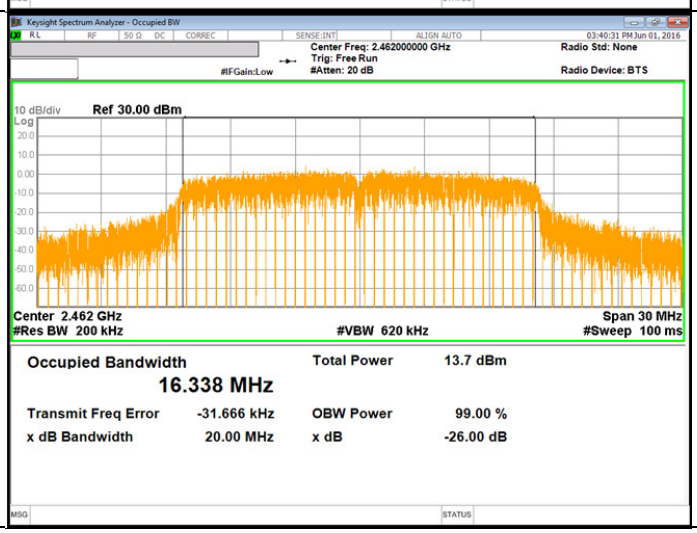
802.11g Mode Low CH			
802.11g Mode Middle CH			
802.11g Mode High CH			

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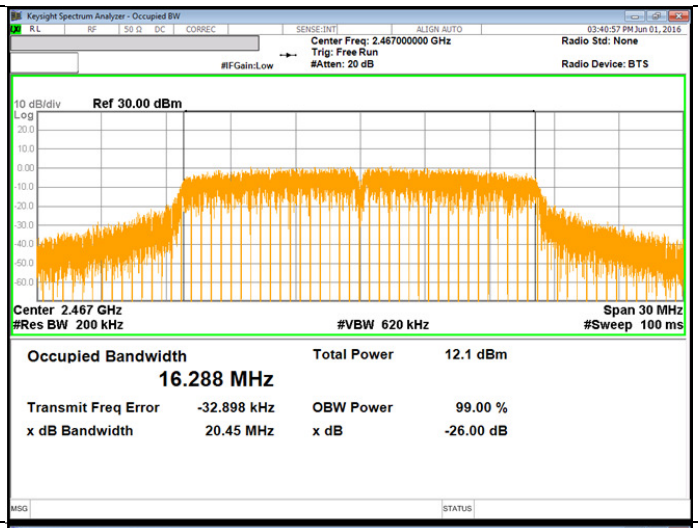
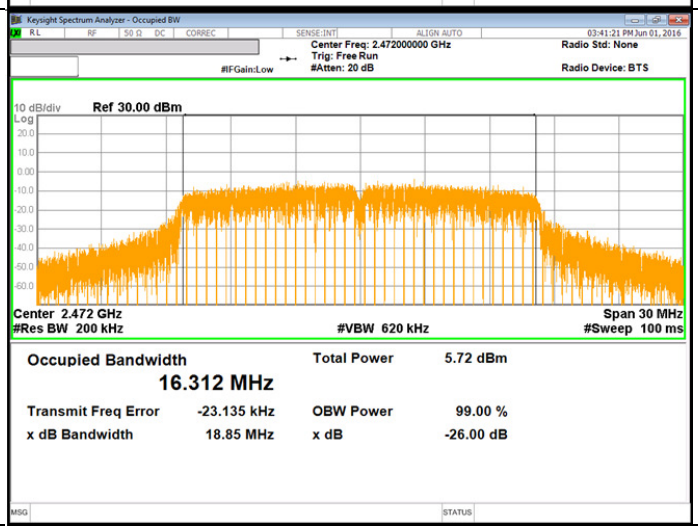
802.11g Mode 12 CH			
802.11g Mode 13 CH			

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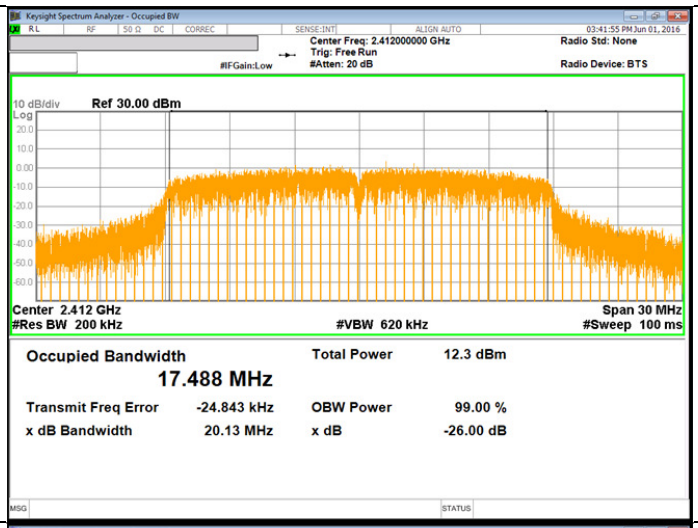
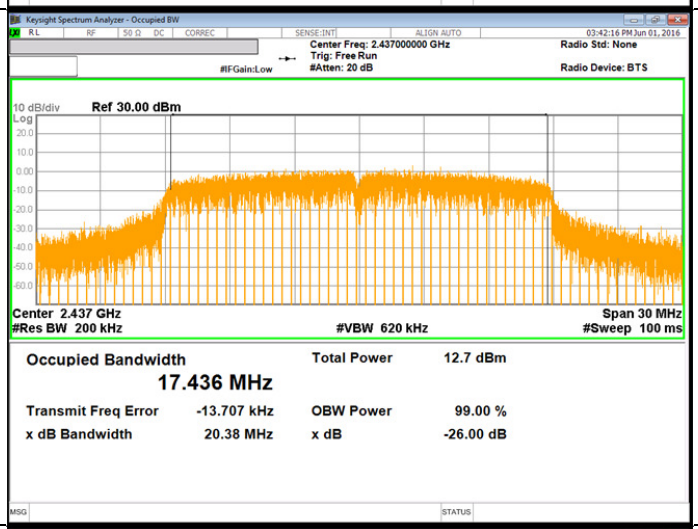
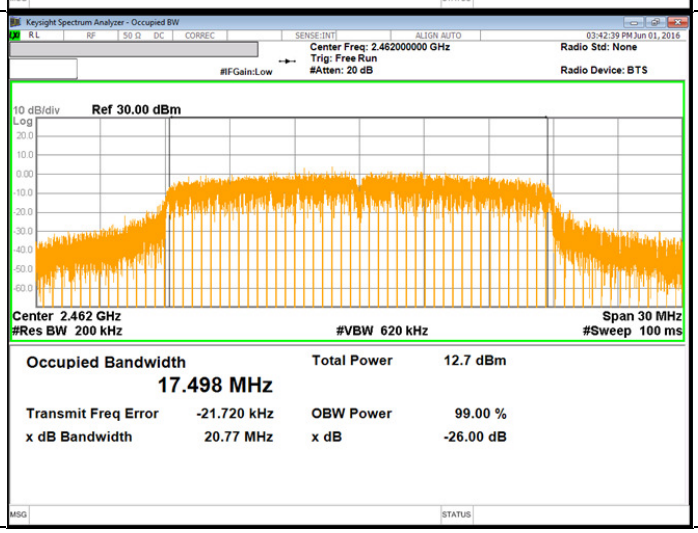
802.11n Mode Low CH			
802.11n Mode Middle CH			
802.11n Mode High CH			

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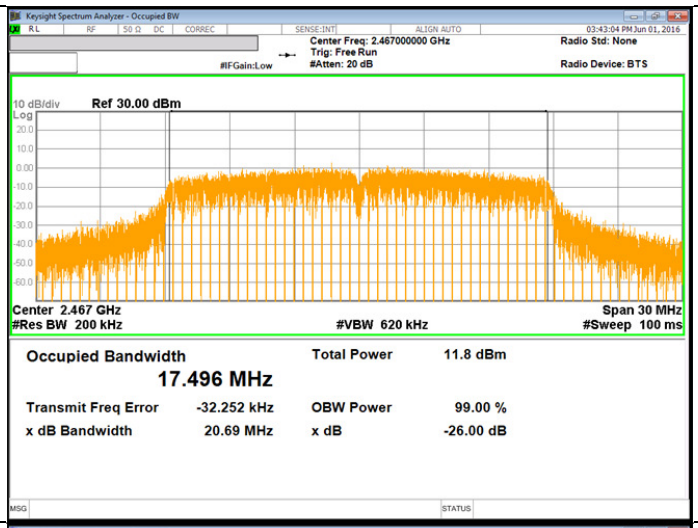
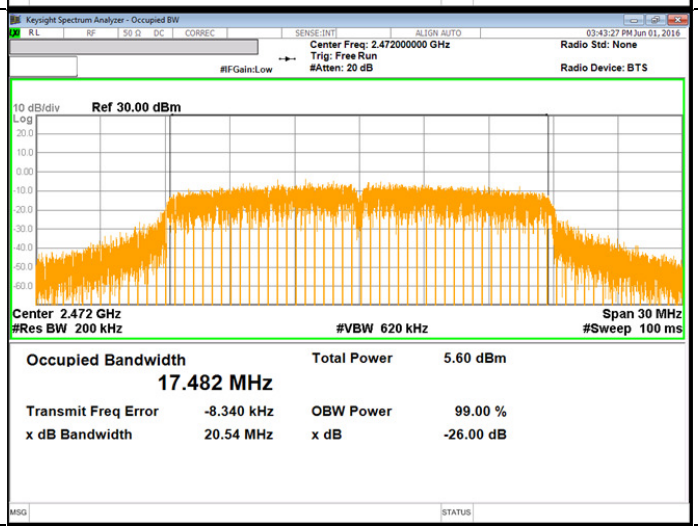
802.11n Mode 12 CH			
802.11n Mode 13 CH			

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10.3. OUTPUT POWER

LIMITS

FCC §15.247

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

DIRECTIONAL ANTENNA GAIN

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

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.1 dB (including 10 dB pad and 0.1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Duty cycle correction factor is already added to the average output power results for duty cycle factor < 98%. (802.11g, 802.11n mode)

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RESULTS

10.3.1. 802.11b MODE IN THE 2.4 GHz BAND

Limits

Channel	Frequency [MHz]	Directional Gain Primary [dBi]	FCC Power Limit [dBm]	IC Power Limit [dBm]	IC EIRP Limit [dBm]	Max Power [dBm]
1	2412	-2.45	30.00	30.00	36.00	30.00
2	2417	-2.45	30.00	30.00	36.00	30.00
6	2437	-2.45	30.00	30.00	36.00	30.00
11	2462	-2.45	30.00	30.00	36.00	30.00
12	2467	-2.45	30.00	30.00	36.00	30.00
13	2472	-2.45	30.00	30.00	36.00	30.00

Results

Channel	Frequency [MHz]	Primary Meas Power [dBm]	Total Corr'd Power [dBm]	Power Limit [dBm]	Margin [dB]
1	2412	14.95	14.95	36.00	-21.05
2	2417	16.27	16.27	36.00	-19.73
6	2437	16.28	16.28	36.00	-19.72
11	2462	16.37	16.37	36.00	-19.63
12	2467	12.3	12.30	36.00	-23.70
13	2472	5.64	5.64	36.00	-30.36
Worst			16.37	36.00	-19.63

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10.3.2. 802.11g MODE IN THE 2.4 GHz BAND

Limits

Channel	Frequency [MHz]	Directional Gain Primary [dBi]	FCC Power Limit [dBm]	IC Power Limit [dBm]	IC EIRP Limit [dBm]	Max Power [dBm]
Low	2412	-2.45	30.00	30.00	36.00	30.00
Mid	2437	-2.45	30.00	30.00	36.00	30.00
High	2462	-2.45	30.00	30.00	36.00	30.00
12	2467	-2.45	30.00	30.00	36.00	30.00
13	2472	-2.45	30.00	30.00	36.00	30.00

Channel	Frequency [MHz]	Primary Meas Power [dBm]	Total Corr'd Power [dBm]	Power Limit [dBm]	Margin [dB]
Low	2412	13.59	13.59	36.00	-22.41
Mid	2437	13.85	13.85	36.00	-22.15
High	2462	14.01	14.01	36.00	-21.99
12	2467	12.35	12.35	36.00	-23.65
13	2472	6.07	6.07	36.00	-29.93
Worst			14.01	36.00	-21.99

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10.3.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

Limits

Channel	Frequency [MHz]	Directional Gain Primary [dBi]	FCC Power Limit [dBm]	IC Power Limit [dBm]	IC EIRP Limit [dBm]	Max Power [dBm]
Low	2412	-2.45	30.00	30.00	36.00	30.00
Mid	2437	-2.45	30.00	30.00	36.00	30.00
High	2462	-2.45	30.00	30.00	36.00	30.00
12	2467	-2.45	30.00	30.00	36.00	30.00
13	2472	-2.45	30.00	30.00	36.00	30.00

Results

Channel	Frequency [MHz]	Primary Meas Power [dBm]	Total Corr'd Power [dBm]	Power Limit [dBm]	Margin [dB]
Low	2412	12.62	12.62	36.00	-23.38
Mid	2437	12.79	12.79	36.00	-23.21
High	2462	12.99	12.99	36.00	-23.01
12	2467	12.14	12.14	36.00	-23.86
13	2472	5.92	5.92	36.00	-30.08

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10.4. PSD

LIMITS

FCC §15.247

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

TEST PROCEDURE

Power Spectral Density was performed utilizing the “Method AVGPSD-1” under KDB558074 D01 DTS Meas Guidance v03r05

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RESULTS

10.4.1. 802.11b MODE IN THE 2.4 GHz BAND

Channel	Frequency [MHz]	PSD Meas [dBm]	Duty Factor [dB]	Final PSD [dBm]	Limit [dBm]	Margin [dB]
1	2412	-16.165	0.00	-16.17	8.00	-24.17
2	2417	-14.469	0.00	-14.47	8.00	-22.47
6	2437	-14.597	0.00	-14.60	8.00	-22.60
11	2462	-14.104	0.00	-14.10	8.00	-22.10
12	2467	-18.587	0.00	-18.59	8.00	-26.59
13	2472	-25.214	0.00	-25.21	8.00	-33.21

10.4.2. 802.11g MODE IN THE 2.4 GHz BAND

Channel	Frequency [MHz]	PSD Meas [dBm]	Duty Factor [dB]	Final PSD [dBm]	Limit [dBm]	Margin [dB]
Low	2412	-19.829	0.30	-19.53	8.00	-27.83
Mid	2437	-19.725	0.30	-19.43	8.00	-27.73
High	2462	-19.336	0.30	-19.04	8.00	-27.34
12	2467	-21.116	0.30	-20.82	8.00	-29.12
13	2472	-27.226	0.30	-26.93	8.00	-35.23

10.4.3. 802.11n HT20 MODE IN THE 2.4 GHz BAND

Channel	Frequency [MHz]	PSD Meas [dBm]	Duty Factor [dB]	Final PSD [dBm]	Limit [dBm]	Margin [dB]
Low	2412	-20.592	0.32	-20.27	8.00	-28.59
Mid	2437	-20.623	0.32	-20.30	8.00	-28.62
High	2462	-20.337	0.32	-20.02	8.00	-28.34
12	2467	-21.24	0.32	-20.92	8.00	-29.24
13	2472	-27.551	0.32	-27.23	8.00	-35.55

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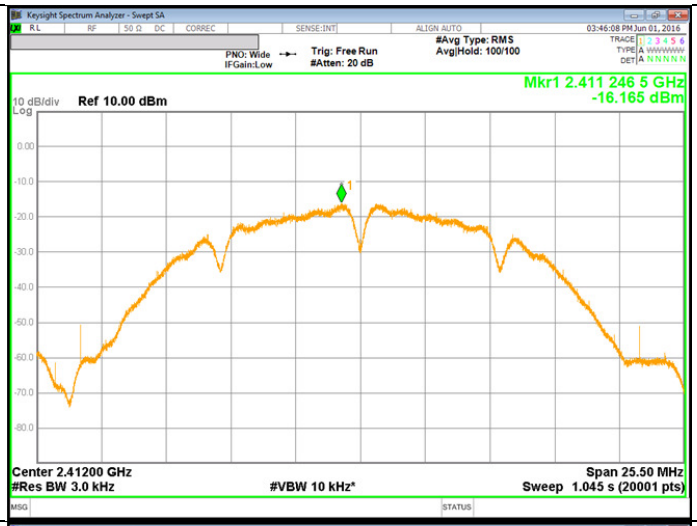
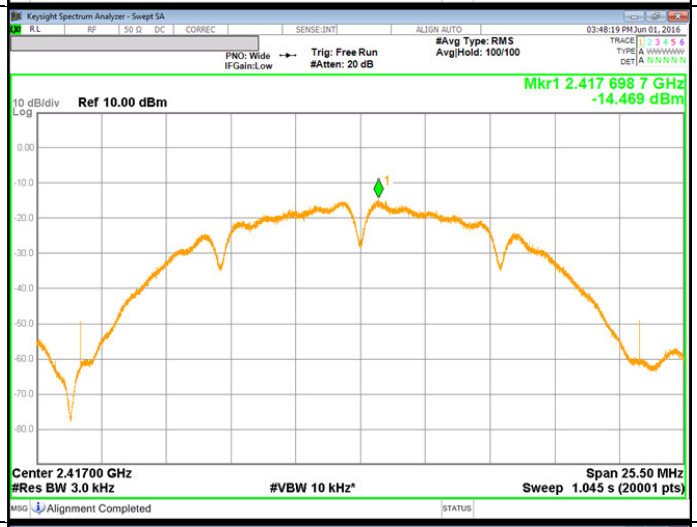
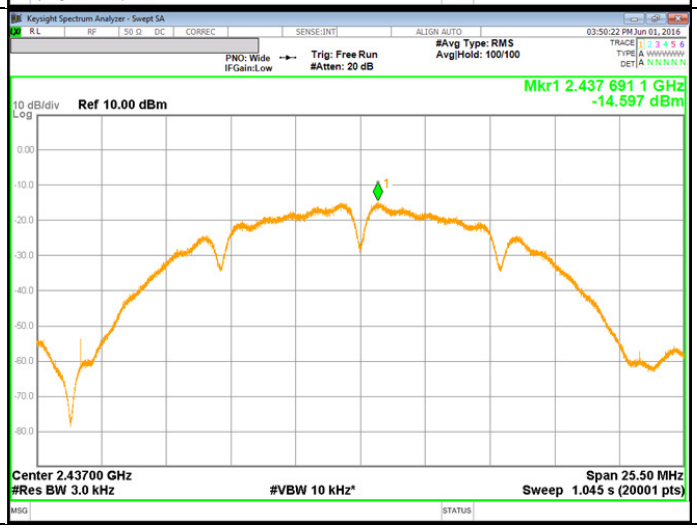
10.4.4. PSD PLOTS

802.11b Mode 1 CH			
802.11b Mode 2 CH			
802.11b Mode 6 CH			

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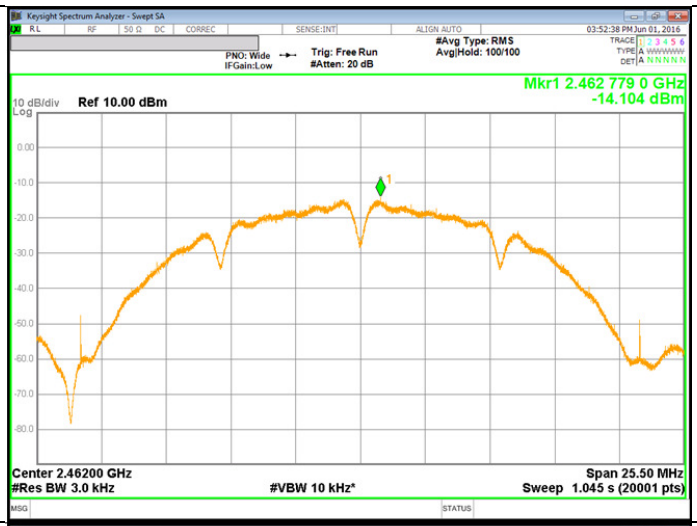
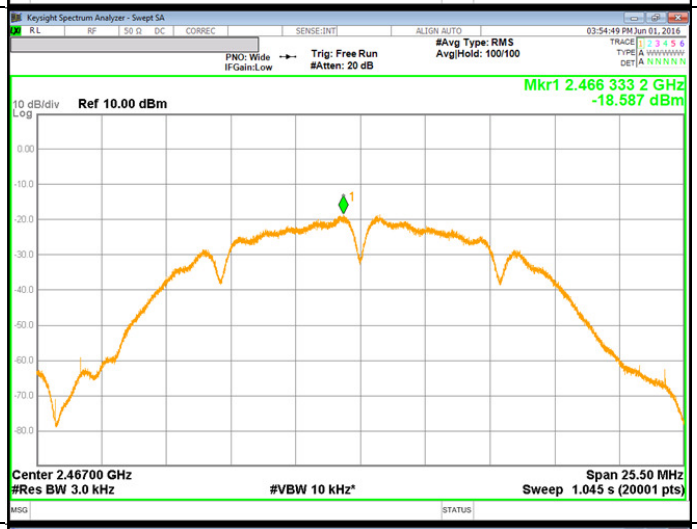
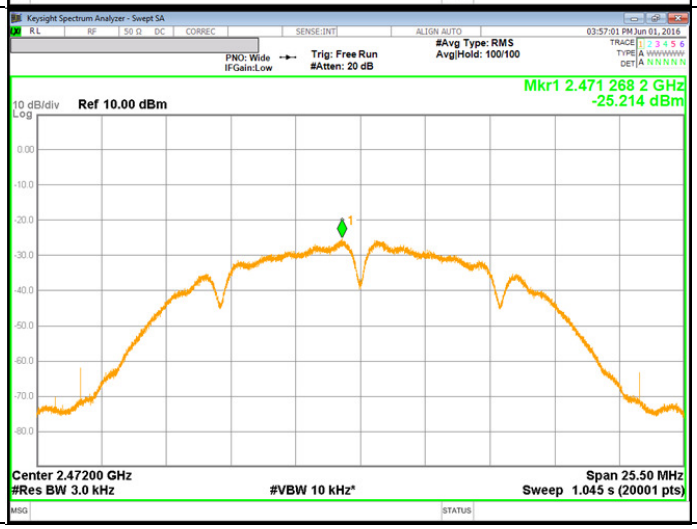
802.11b Mode 11 CH			
802.11b Mode 12 CH			
802.11b Mode 13 CH			

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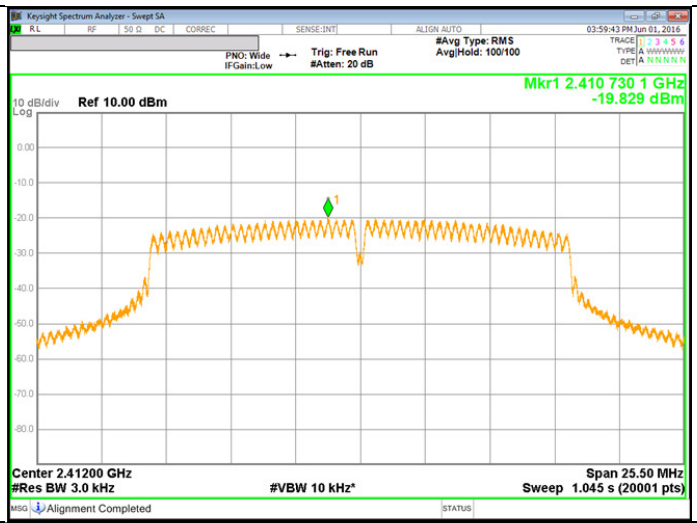
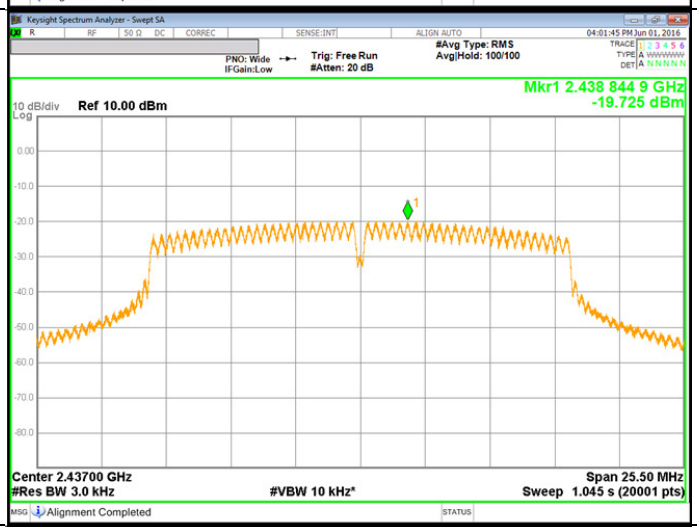
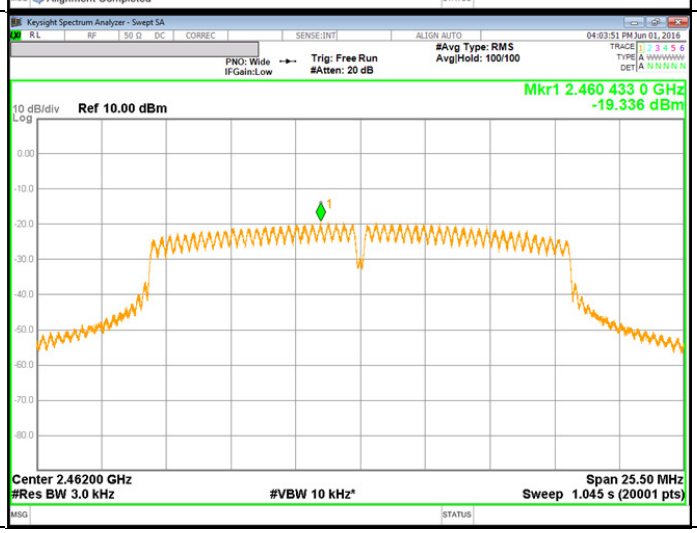
802.11g Mode Low CH			
802.11g Mode Middle CH			
802.11g Mode High CH			

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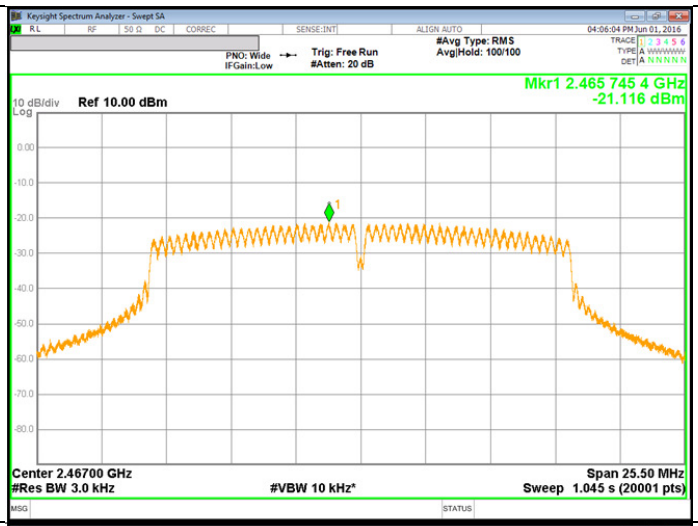
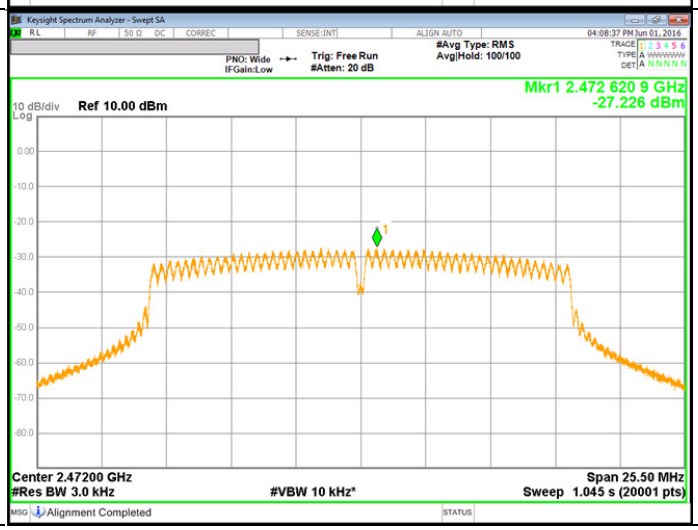
802.11g Mode 12 CH			
802.11g Mode 13 CH			

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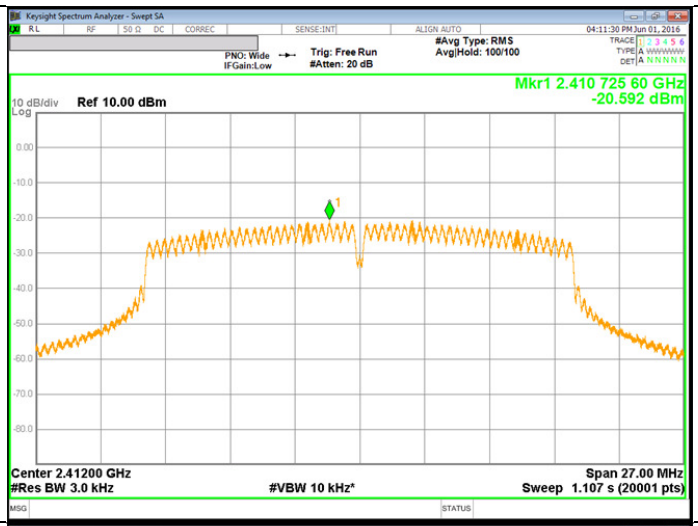
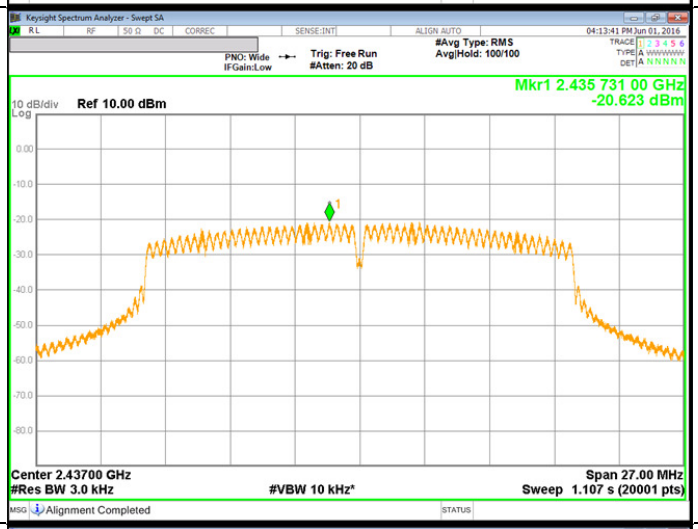
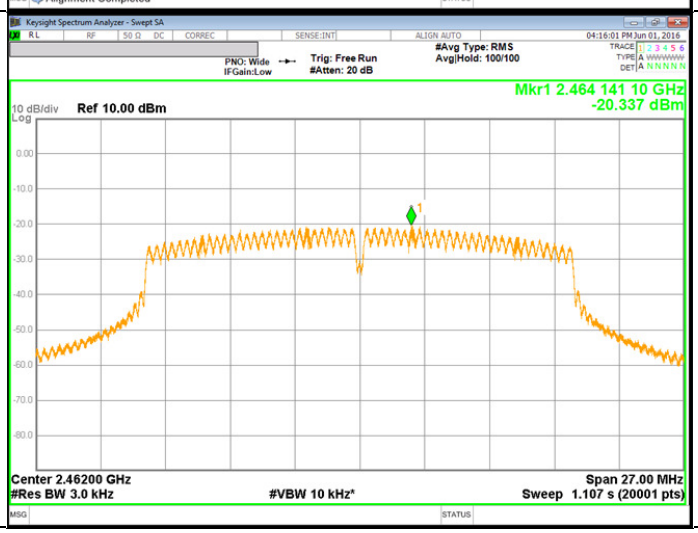
802.11n Mode Low CH			
802.11n Mode Middle CH			
802.11n Mode High CH			

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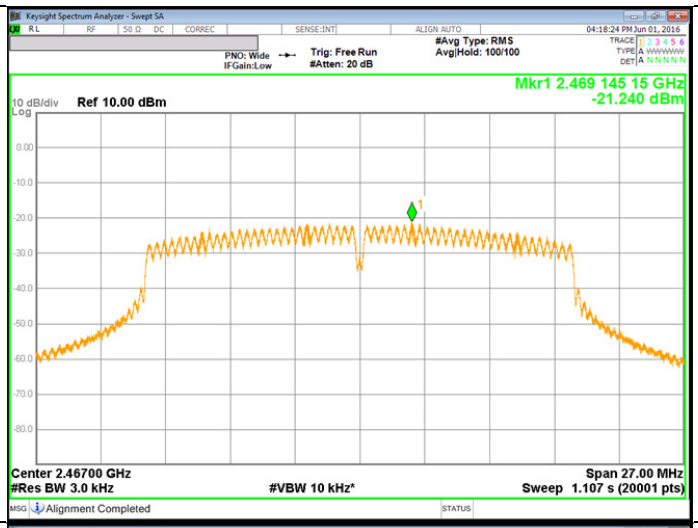
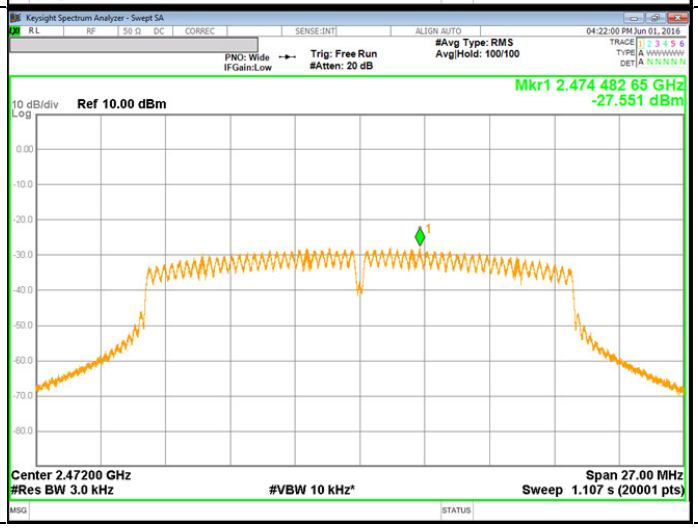
802.11n Mode 12 CH			
802.11n Mode 13 CH			

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10.5. OUT-OF-BAND EMISSIONS

LIMITS

FCC §15.247 (d)

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

TEST PROCEDURE

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

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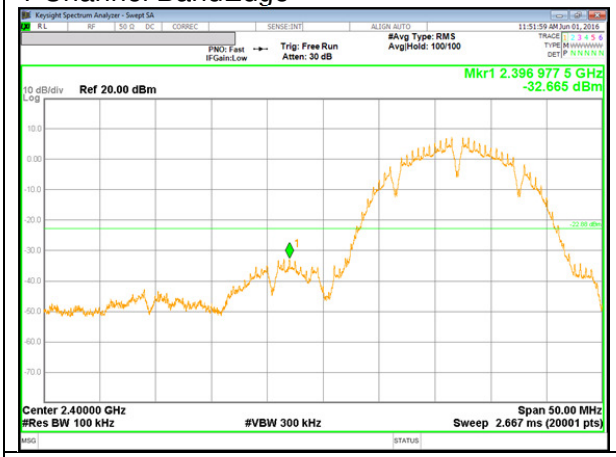
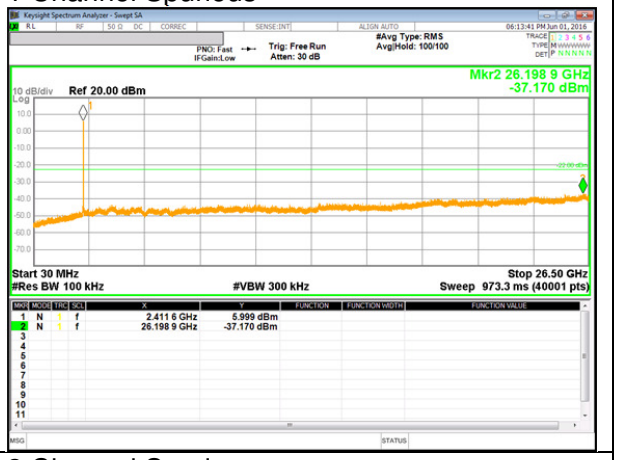
RESULTS

10.5.1. 802.11b MODE IN THE 2.4 GHz BAND

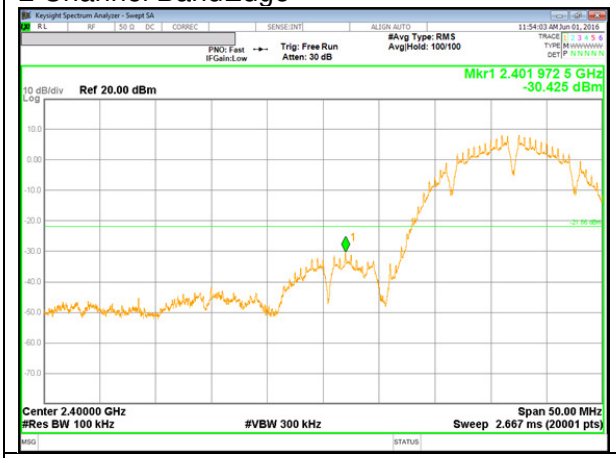
1 Channel BandEdge



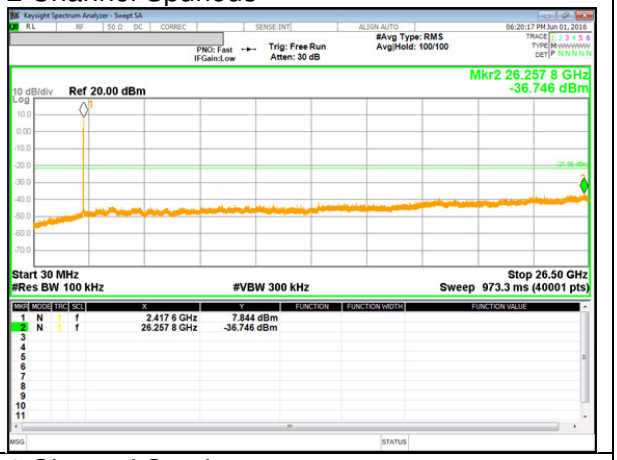
1 Channel Spurious



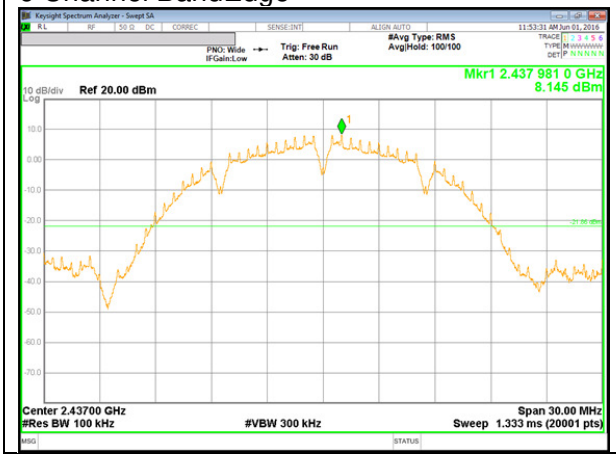
2 Channel BandEdge



2 Channel Spurious



6 Channel BandEdge



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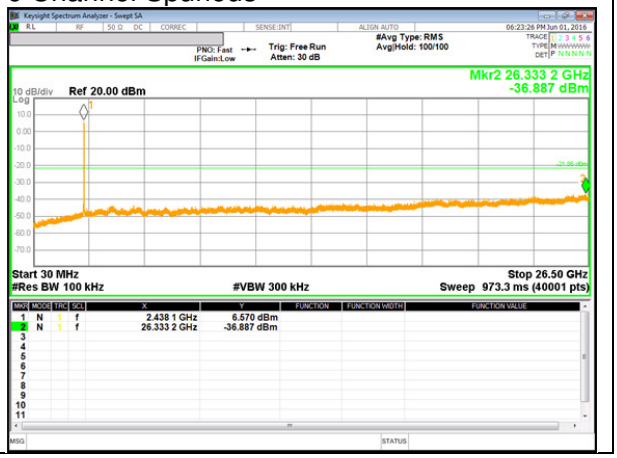

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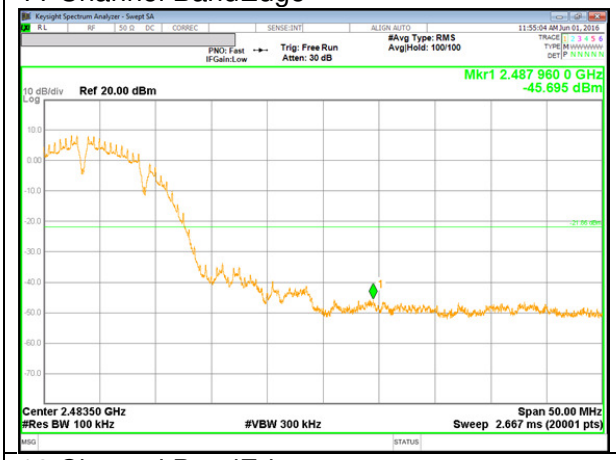
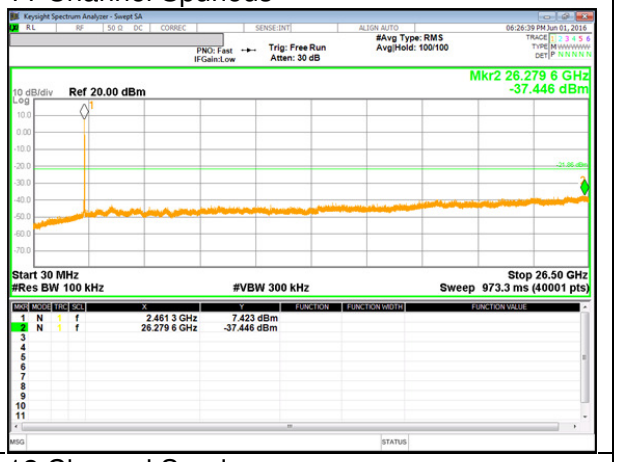
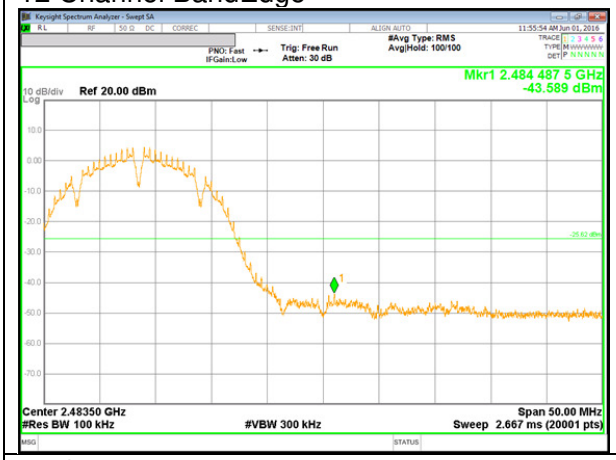
11 Channel BandEdge



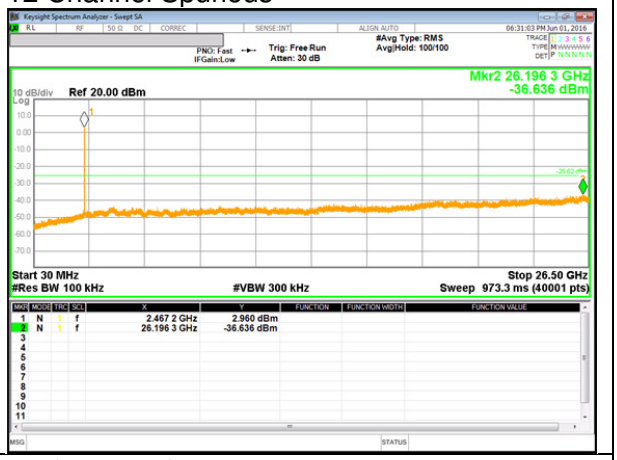
11 Channel Spurious



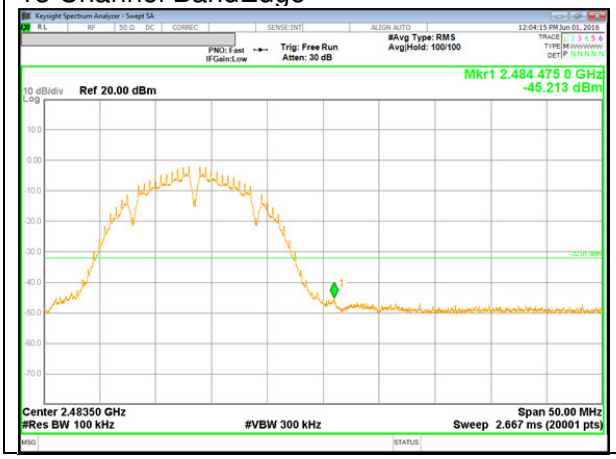
12 Channel BandEdge



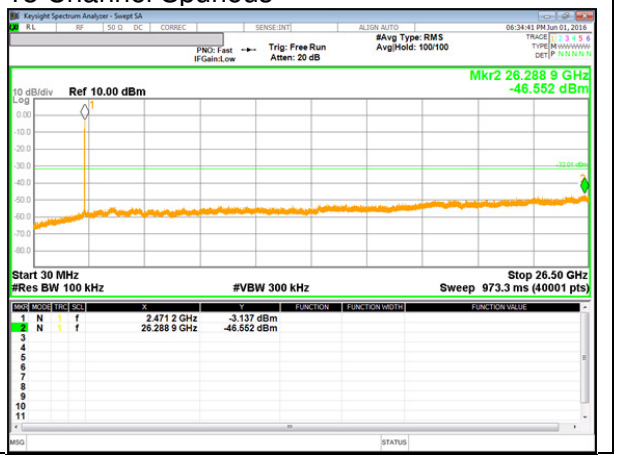
12 Channel Spurious



13 Channel BandEdge



13 Channel Spurious



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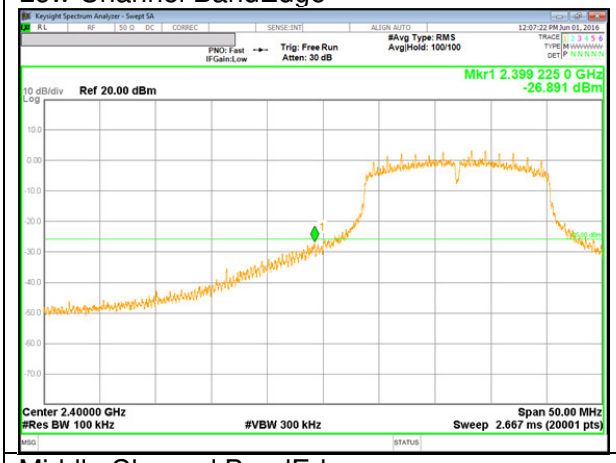
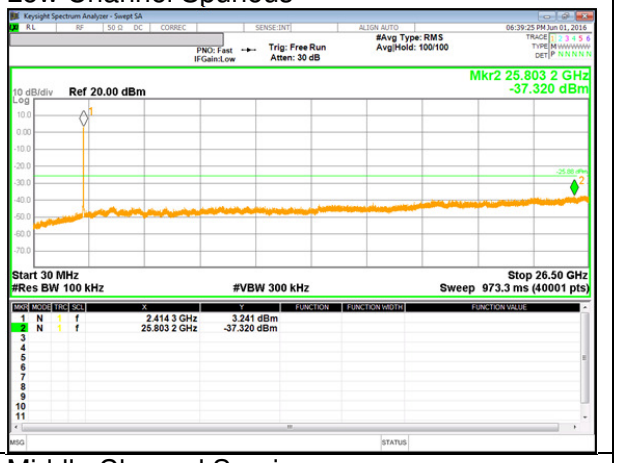
10.5.2. 802.11g MODE IN THE 2.4 GHz BAND

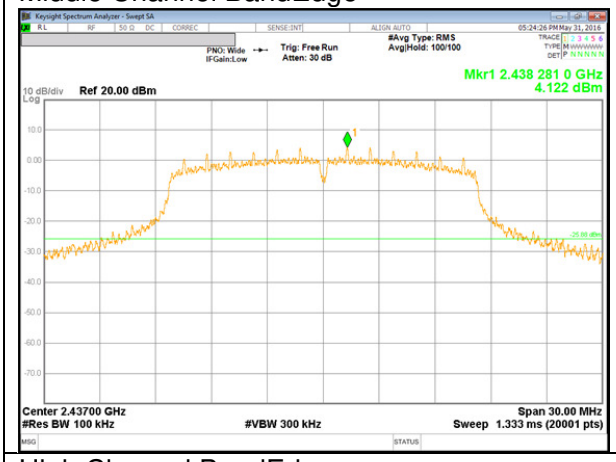
Low Channel BandEdge



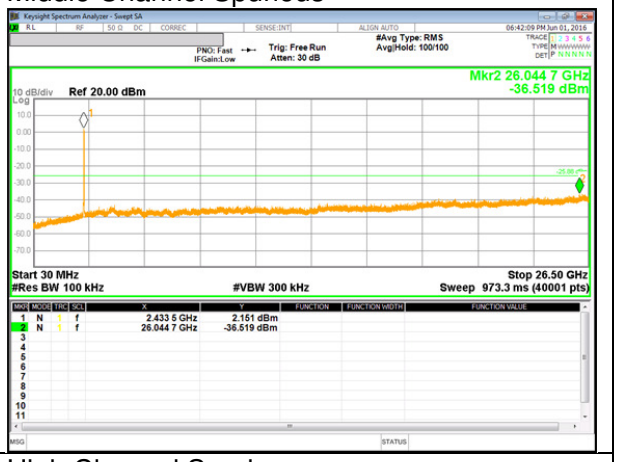
Low Channel Spurious



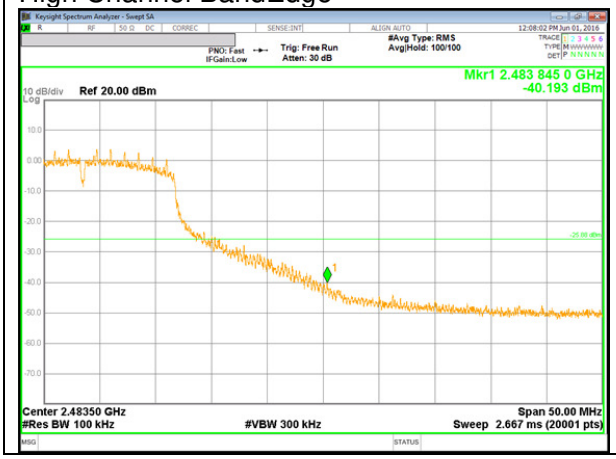
Middle Channel BandEdge



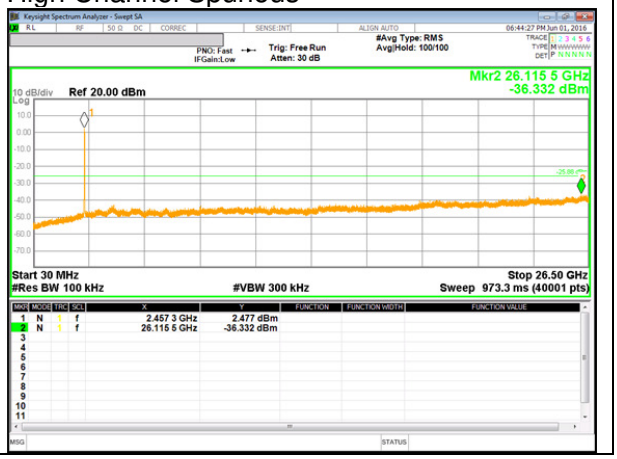
Middle Channel Spurious



High Channel BandEdge



High Channel Spurious



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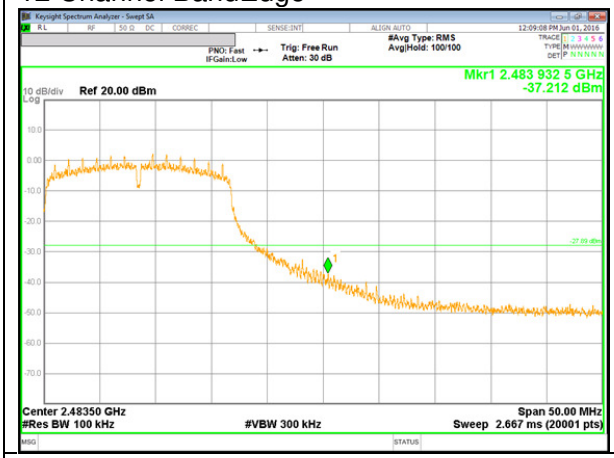
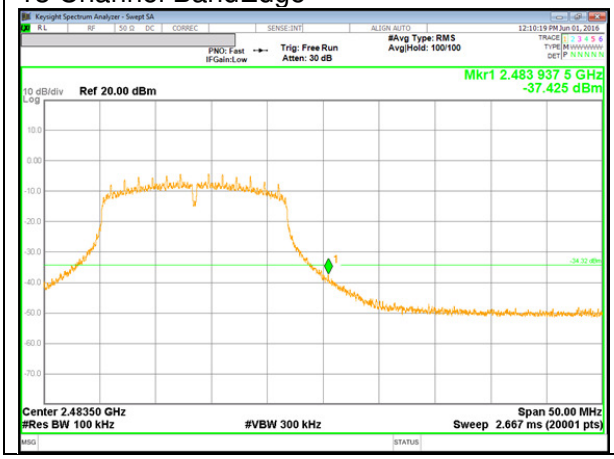
12 Channel BandEdge

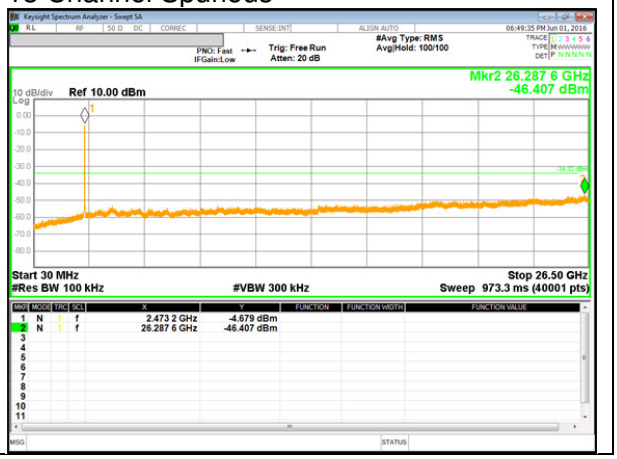


12 Channel Spurious

13 Channel BandEdge



13 Channel Spurious



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