

FCC / ISED DTS REPORT

Certification

Applicant Name:
LG Electronics USA**Address:**
1000 Sylvan Avenue Englewood Cliffs, NJ 07632
United States**Date of Issue:**

September 15, 2017

Test Site/Location:

HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

Report No.: HCT-R-1709-F008**HCT FRN:** 0005866421**ISED Registration Number:** 5944A-5

FCC ID :	BEJID7SF
ISED ID :	2703H-ID7SF
APPLICANT :	LG Electronics USA

Model: ID7SF**EUT Type:** Silverbox RADIO ASM-RECEIVER**Peak Output Power:** Wi-Fi 802.11b (21.30 dBm) / Wi-Fi 802.11g (24.50 dBm) /
Wi-Fi 802.11n_HT20 (24.55 dBm) / Wi-Fi 802.11n_HT40 (18.49 dBm)**Frequency Range:** 2412 MHz - 2462 MHz (2.4 GHz Band)**Modulation type:** CCK/DSSS/OFDM**FCC Classification:** Digital Transmission System(DTS)**FCC Rule Part(s):** Part 15.247**ISED Rule Part(s):** RSS-247 Issue 2(February 2017), RSS-Gen Issue 4(November 2014)**Engineering Statement:**

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC / IC Rules under normal use and maintenance.

**Report prepared by : Kyung Soo Kang**
Engineer of Telecommunication testing center**Approved by : Jong Seok Lee**
Manager of Telecommunication testing center

This report only responds to the tested sample and may not be reproduced, except in full, without written approval of the HCT Co., Ltd.

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1709-F008	September 15, 2017	- First Approval Report

Table of Contents

1. GENERAL INFORMATION	4
2. EUT DESCRIPTION	4
3. TEST METHODOLOGY	5
3.1 EUT CONFIGURATION	5
3.2 EUT EXERCISE	5
3.3 GENERAL TEST PROCEDURES	5
3.4 DESCRIPTION OF TEST MODES	5
4. INSTRUMENT CALIBRATION.....	6
5. FACILITIES AND ACCREDITATIONS	6
5.1 FACILITIES	6
5.2 EQUIPMENT	6
6. ANTENNA REQUIREMENTS	6
7. MEASUREMENT UNCERTAINTY	7
8. SUMMARY TEST OF RESULTS	8
8.1 FCC Part	8
8.2 ISED Part	9
9. TEST RESULT	10
9.1 DUTY CYCLE.....	10
9.2 6dB BANDWIDTH.....	12
9.3 99% BANDWIDTH	16
9.4 OUTPUT POWER (802.11b/g/n)	24
9.5 POWER SPECTRAL DENSITY (802.11b/g/n).....	33
9.6 OUT OF BAND EMISSIONS AT THE BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS	38
9.7 RADIATED MEASUREMENT.....	52
9.7.1 RADIATED SPURIOUS EMISSIONS.....	52
9.7.2 RADIATED RESTRICTED BAND EDGES	69
9.7.3 RECEIVER SPURIOUS EMISSIONS.....	74
9.8 POWERLINE CONDUCTED EMISSIONS	75
10. LIST OF TEST EQUIPMENT	76
10.1 LIST OF TEST EQUIPMENT(Conducted Test)	76
10.2 LIST OF TEST EQUIPMENT(Radiated Test).....	77

1. GENERAL INFORMATION

Applicant: LG Electronics USA
Address: 1000 Sylvan Avenue Englewood Cliffs, NJ 07632 United States
FCC ID: BEJID7SF
ISED ID: 2703H-ID7SF
EUT Type: Silverbox RADIO ASM-RECEIVER
Model: ID7SF
Date(s) of Tests: July 24, 2017 ~ September 14, 2017
Place of Tests: HCT Co., Ltd.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea

2. EUT DESCRIPTION

Model	ID7SF	
EUT Type	Silverbox RADIO ASM-RECEIVER	
Power Supply	DC 12 V	
Frequency Range	TX: 2412 MHz ~ 2462 MHz RX: 2412 MHz ~ 2462 MHz	
Max. RF Output Power	Peak	Wi-Fi 802.11b (21.30 dBm) / Wi-Fi 802.11g (24.50 dBm) / Wi-Fi 802.11n_HT20 (24.55 dBm) / Wi-Fi 802.11n_HT40 (18.49 dBm)
	Average	Wi-Fi 802.11b (18.81 dBm) / Wi-Fi 802.11g (15.75 dBm) / Wi-Fi 802.11n_HT20 (15.87 dBm) / Wi-Fi 802.11n_HT40 (9.88 dBm)
Modulation Type	DSSS/CCK(802.11b), OFDM(802.11g, 802.11n)	
Antenna Specification	Manufacturer: Amotech CO.LTD Antenna type: Dielectric Chip Antenna Peak Gain : 3.7 dBi	

3. TEST METHODOLOGY

FCC KDB 558074 D01 DTS Meas Guidance v04 dated April 05, 2017 entitled "Guidance for Performing Compliance Measurements on Digital Transmission Systems(DTS) and the measurement procedure described in ANSI C63.10(Version : 2013) 'the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices'.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C/ RSS-Gen issue 4, RSS-247 issue 2.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3.75 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013)

Conducted Antenna Terminal

See Section from 9.1 to 9.2.(KDB 558074 v04)

3.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low, mid and high with highest data rate (worst case) is chosen for full testing.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2006).

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated July 07, 2015 (Registration Number: 90661)

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

* The antennas of this E.U.T are permanently attached.

*The E.U.T Complies with the requirement of §15.203

7. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.4:2014.

All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence.

Parameter	Expanded Uncertainty ($\pm$ dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.82
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70

8. SUMMARY TEST OF RESULTS

8.1 FCC Part

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§15.247(a)(2)	> 500 kHz	CONDUCTED	PASS
Conducted Maximum Peak Output Power	§15.247(b)(3)	< 1 Watt		PASS
Power Spectral Density	§15.247(e)	< 8 dBm / 3 kHz Band		PASS
Band Edge(Out of Band Emissions)	§15.247(d)	Conducted > 30 dBc		PASS
AC Power line Conducted Emissions	§15.207	cf. Section 9.8		PASS
Radiated Spurious Emissions	§15.205, 15.209	cf. Section 9.7.1	RADIATED	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 9.7.2		PASS

8.2 ISED Part

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	RSS-247, 5.2	> 500 kHz	CONDUCTED	PASS
99% Bandwidth	RSS-GEN, 6.6	NA		NA
Conducted Maximum Peak Output Power And e.i.r.p.	RSS-247, 5.4.d.	< 1 Watt <4 Watt(e.i.r.p.)		PASS
Power Spectral Density	RSS-247, 5.2	< 8 dBm / 3 kHz Band		PASS
Band Edge(Out of Band Emissions)	RSS-247, 5.5	Conducted > 20 dBc		PASS
AC Power line Conducted Emissions	RSS-GEN, 8.8	cf. Section 8.7		PASS
Radiated Spurious Emissions	RSS-GEN, 8.9	RSS-GEN section 8.9 table 4, 5	RADIATED	PASS
Receiver Spurious Emissions	RSS-GEN, 5 RSS-GEN, 7.1.2	RSS-GEN section 7.1.2 table 2		PASS
Radiated Restricted Band Edge	RSS-GEN, 8.10	RSS-GEN section 8.10 table 6		PASS

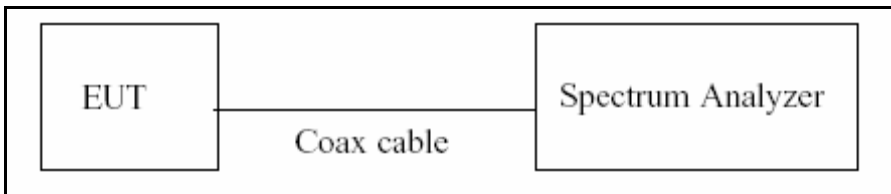
9. TEST RESULT

9.1 DUTY CYCLE

According to Section 6.0)b) in KDB 558074 v04

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set $RBW \geq OBW$ if possible; otherwise, set RBW to the largest available value. Set $VBW \geq RBW$. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are $> 50/T$ and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if $T \leq 16.7$ microseconds.)

■ TEST CONFIGURATION



■ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. We tested according to the zero-span measurement method, 6.0)b) in KDB 558074 v04.

The largest available value of RBW is 8 MHz and VBW is 50 MHz. The zero-span method of measuring duty cycle shall not be used if $T \leq 6.25$ microseconds. ($50/6.25 = 8$)

The zero-span method was used because all measured T data are > 6.25 microseconds and both RBW and VBW are $> 50/T$.

1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz ($\geq$ RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on} / T_{total} and Duty Cycle Factor = $10 \cdot \log(1/\text{Duty Cycle})$

■ Duty Cycle Factor

Mode	Data Rate	T _{on} (ms)	T _{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
b	1 Mbps	12.418	12.538	0.99040502	0.042
	2 Mbps	6.311	6.419	0.98308272	0.074
	5.5 Mbps	2.414	2.516	0.95938110	0.180
	11 Mbps	1.303	1.405	0.92790477	0.325
g	6 Mbps	2.063	2.171	0.95010134	0.222
	9 Mbps	1.385	1.491	0.92884408	0.321
	12 Mbps	1.044	1.150	0.90756566	0.421
	18 Mbps	0.704	0.810	0.86873431	0.611
	24 Mbps	0.532	0.637	0.83472847	0.785
	36 Mbps	0.364	0.471	0.77348066	1.116
	48 Mbps	0.276	0.382	0.72108844	1.420
	54 Mbps	0.249	0.354	0.70170989	1.538
n_HT20	MCS Index 0	1.924	2.029	0.94789259	0.232
	MCS Index 1	0.982	1.087	0.90303936	0.443
	MCS Index 2	0.670	0.775	0.86400000	0.635
	MCS Index 3	0.508	0.624	0.81346154	0.897
	MCS Index 4	0.353	0.458	0.76963351	1.137
	MCS Index 5	0.272	0.378	0.71881607	1.434
	MCS Index 6	0.248	0.354	0.69977427	1.550
	MCS Index 7	0.228	0.334	0.68181818	1.663
n_HT40	MCS Index 0	0.947	1.054	0.89878258	0.463
	MCS Index 1	0.492	0.598	0.82174632	0.853
	MCS Index 2	0.340	0.446	0.76315807	1.174
	MCS Index 3	0.263	0.370	0.71181710	1.476
	MCS Index 4	0.188	0.294	0.63983787	1.939
	MCS Index 5	0.152	0.259	0.58809903	2.305
	MCS Index 6	0.140	0.246	0.56730867	2.462
	MCS Index 7	0.128	0.234	0.54797864	2.612

Note : Duty Cycle Factor = $10 \cdot \log(1/\text{Duty Cycle})$. where, Duty Cycle = T_{on} / T_{total}

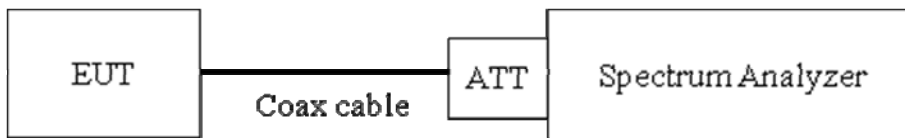
9.2 6dB BANDWIDTH

Test Requirements and limit, §15.247(a)(2) / RSS-247(Issue 2) Section 5.2.

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

The minimum permissible 6dB bandwidth is 500 kHz.

■ TEST CONFIGURATION



■ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to (Procedure 8.1 in KDB 558074 v04)

RBW = 100 kHz

VBW $\geq 3 \times$ RBW

Detector = Peak

Trace mode = max hold

Sweep = auto couple

Allow the trace to stabilize

Note : We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

■ TEST RESULTS

Conducted 6dB Bandwidth Measurements for 802.11b

802.11b Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
2412	1	8.106	0.5	Pass
2437	6	8.107	0.5	Pass
2462	11	8.106	0.5	Pass

Conducted 6dB Bandwidth Measurements for 802.11g

802.11g Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
2412	1	15.14	0.5	Pass
2437	6	15.16	0.5	Pass
2462	11	15.18	0.5	Pass

Conducted 6dB Bandwidth Measurements for 802.11n_HT20

802.11n Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
2412	1	15.10	0.5	Pass
2437	6	15.17	0.5	Pass
2462	11	15.17	0.5	Pass

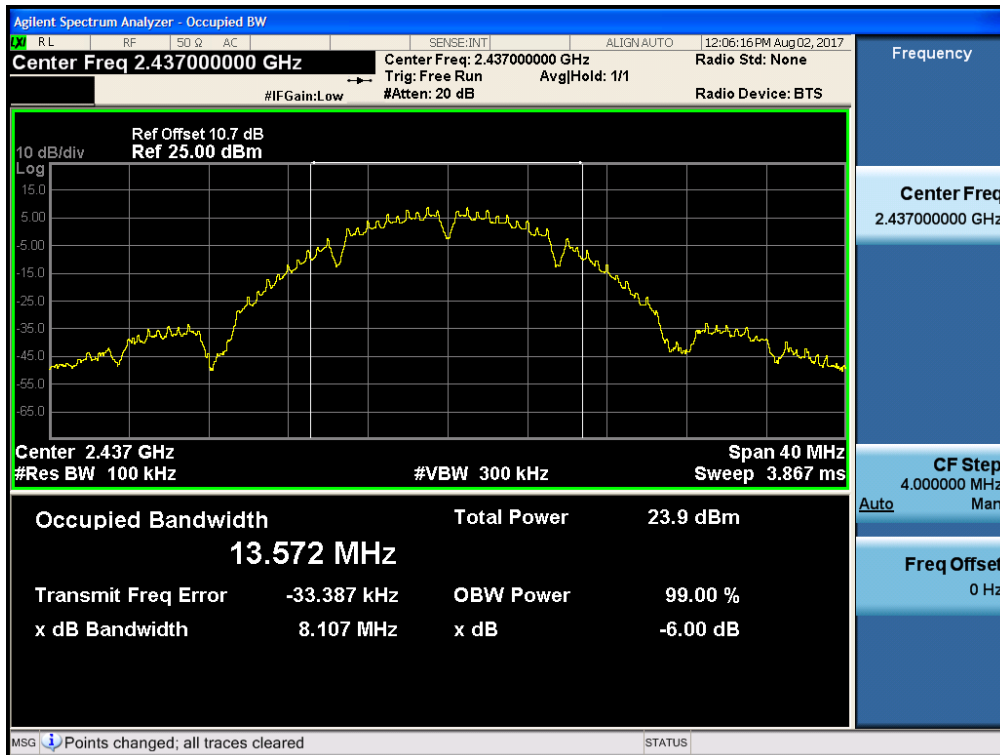
Conducted 6dB Bandwidth Measurements for 802.11n_HT40

802.11n Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
2422	3	35.17	0.5	Pass
2437	6	35.13	0.5	Pass
2452	9	35.14	0.5	Pass

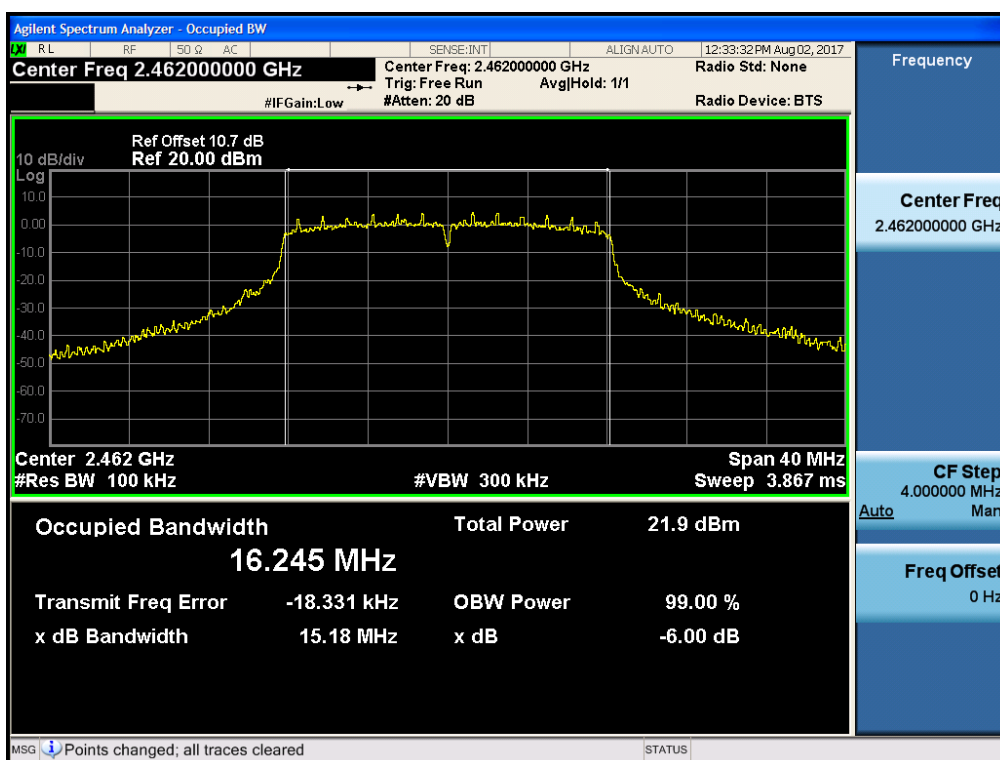
Note : In order to simplify the report, attached plots were only the most wide 6 dB BW channel.

RESULT PLOTS

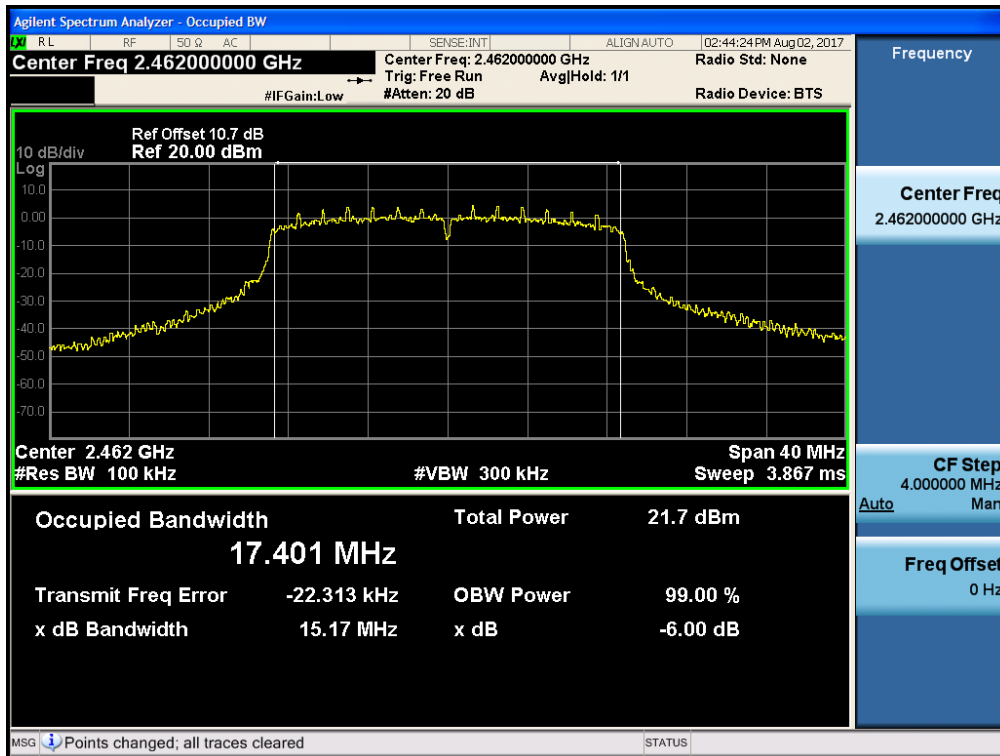
6dB Bandwidth plot (802.11b-CH 6)



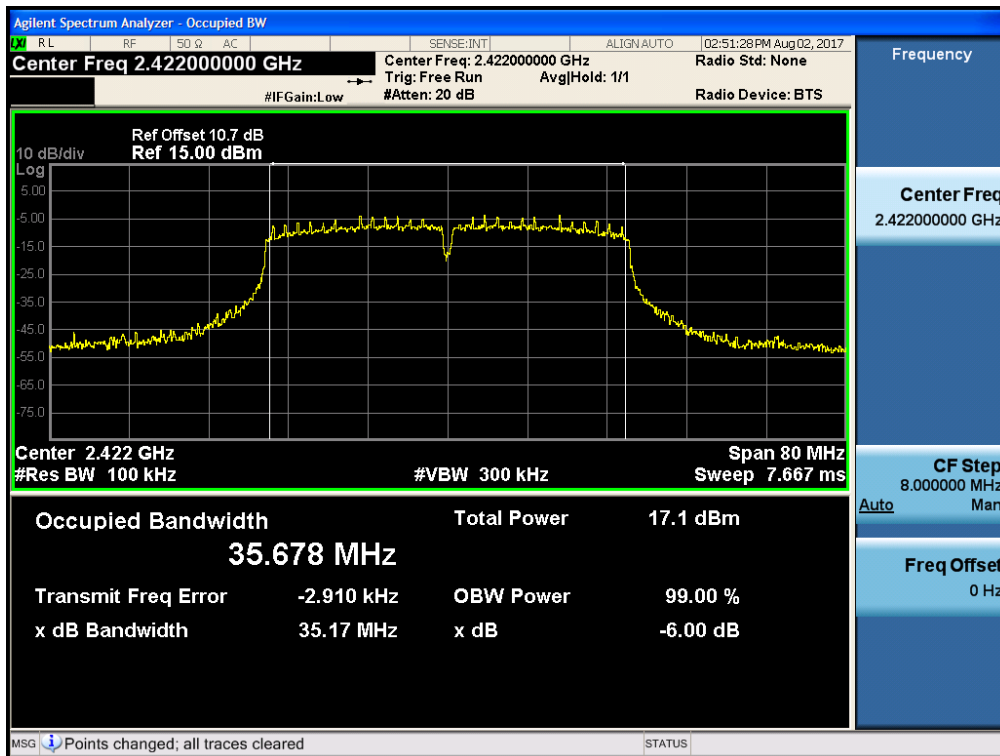
6dB Bandwidth plot (802.11g-CH 11)



6dB Bandwidth plot (802.11n_HT20-CH 11)



6dB Bandwidth plot (802.11n_HT40-CH 3)

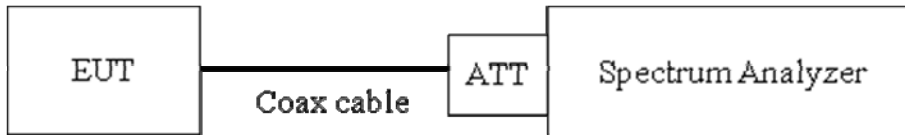


9.3 99% BANDWIDTH

Limit, RSS-Gen(Issue 4) Section 6.6

The 99 % bandwidth is used to determine the conducted power limits.

■ TEST CONFIGURATION



■ TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer.

RBW = 1% ~ 5% of the occupied bandwidth

VBW $\approx$ 3 x RBW

Detector = Peak

Trace mode = max hold

Sweep = auto couple

Allow the trace to stabilize

Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

■ TEST RESULTS

Conducted 99% Bandwidth Measurements for 802.11b

802.11b Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	13.44	N/A
2437	6	13.49	N/A
2462	11	13.59	N/A

Conducted 99% Bandwidth Measurements for 802.11g

802.11b Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	16.36	N/A
2437	6	16.37	N/A
2462	11	16.36	N/A

Conducted 99% Bandwidth Measurements for 802.11n_HT20

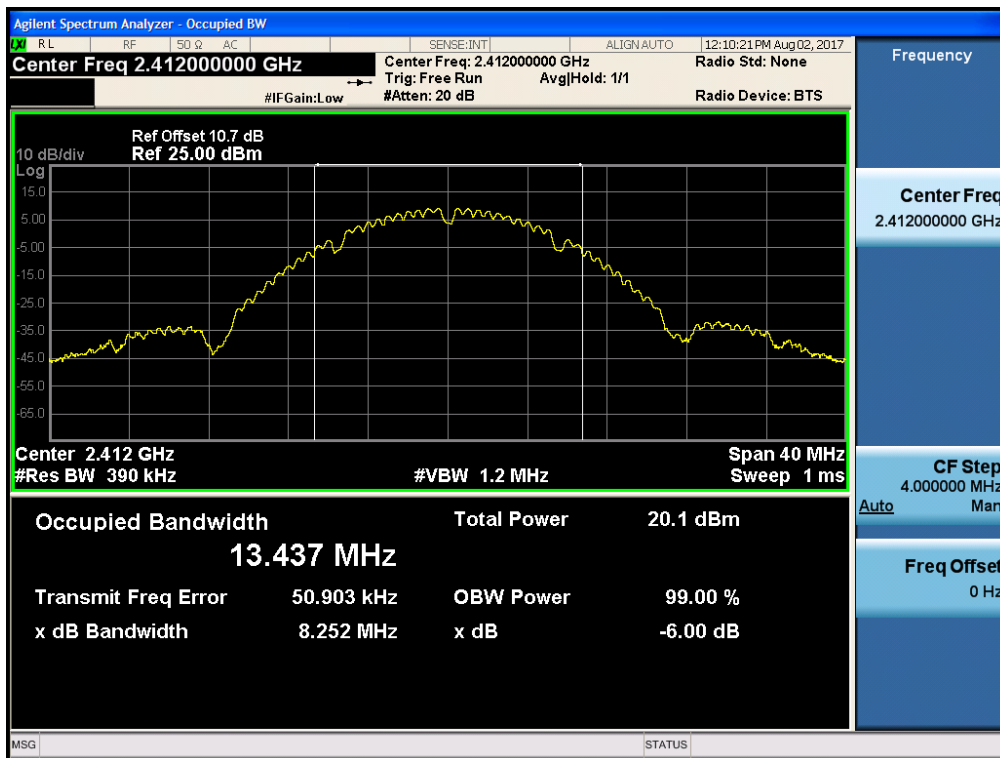
802.11b Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2412	1	17.44	N/A
2437	6	17.45	N/A
2462	11	17.45	N/A

Conducted 99% Bandwidth Measurements for 802.11n_HT40

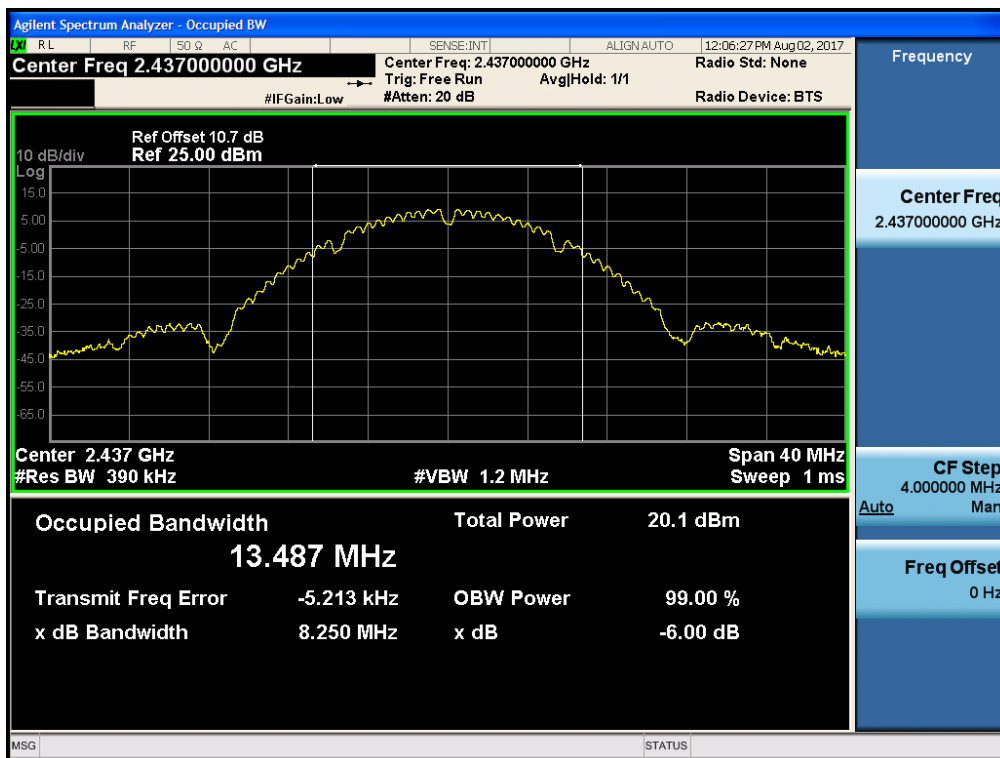
802.11b Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2422	3	35.94	N/A
2437	6	35.95	N/A
2452	9	35.97	N/A

■ RESULT PLOTS

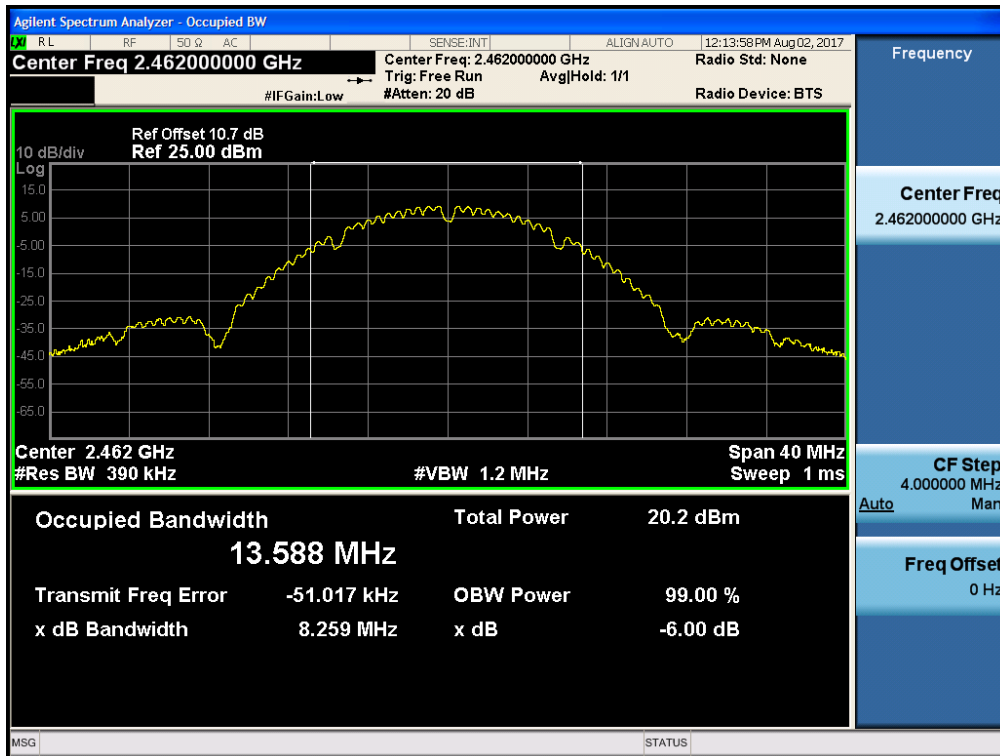
99% Bandwidth plot (802.11b - CH 1)



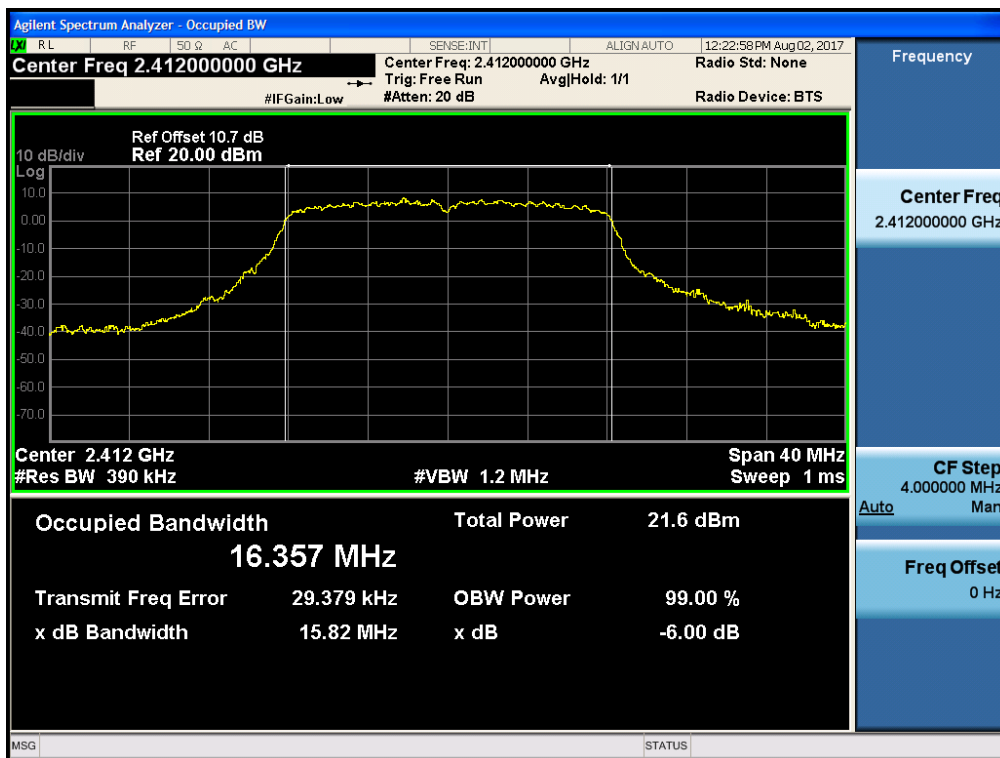
99% Bandwidth plot (802.11b - CH 6)



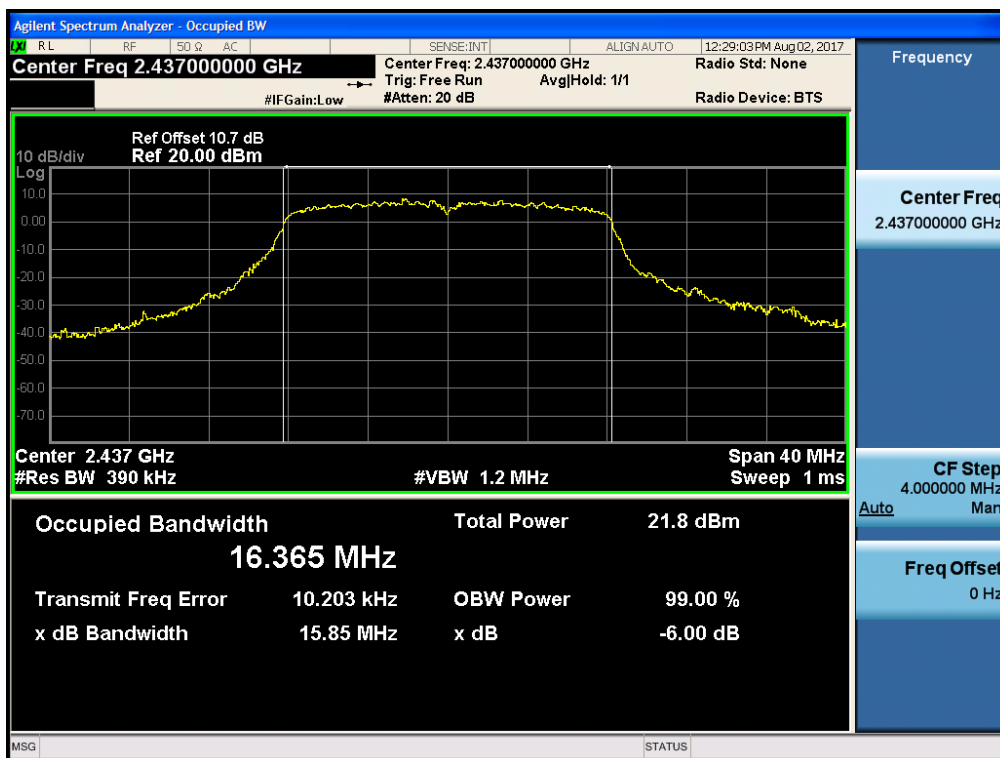
99% Bandwidth plot (802.11b - CH 11)



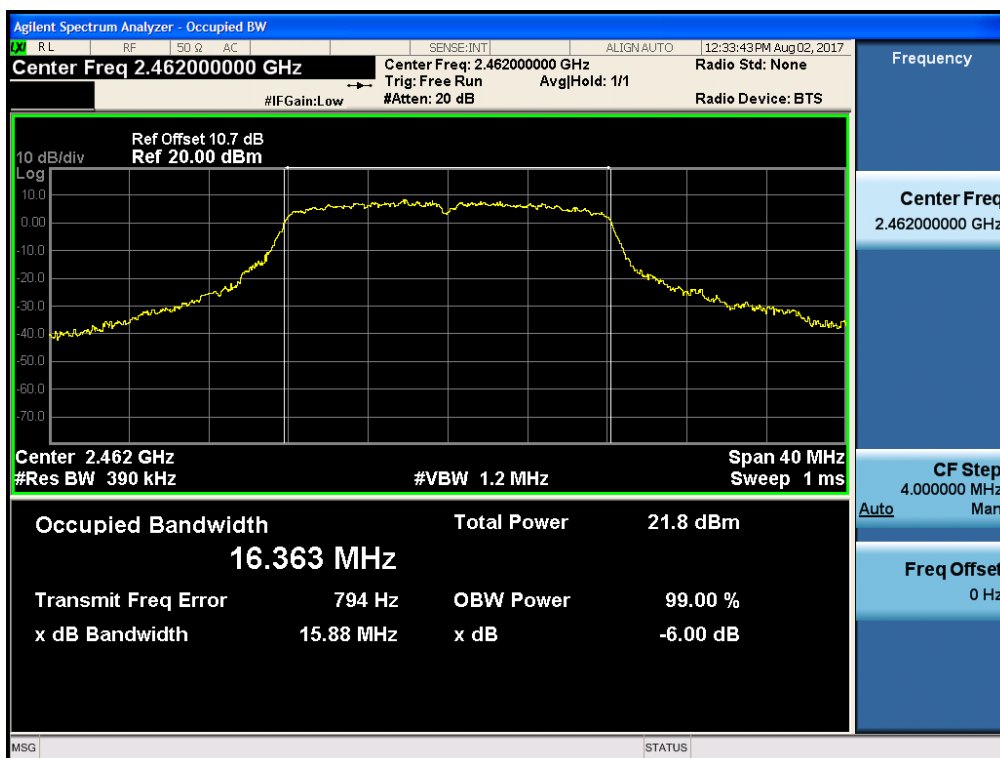
99% Bandwidth plot (802.11g - CH 1)



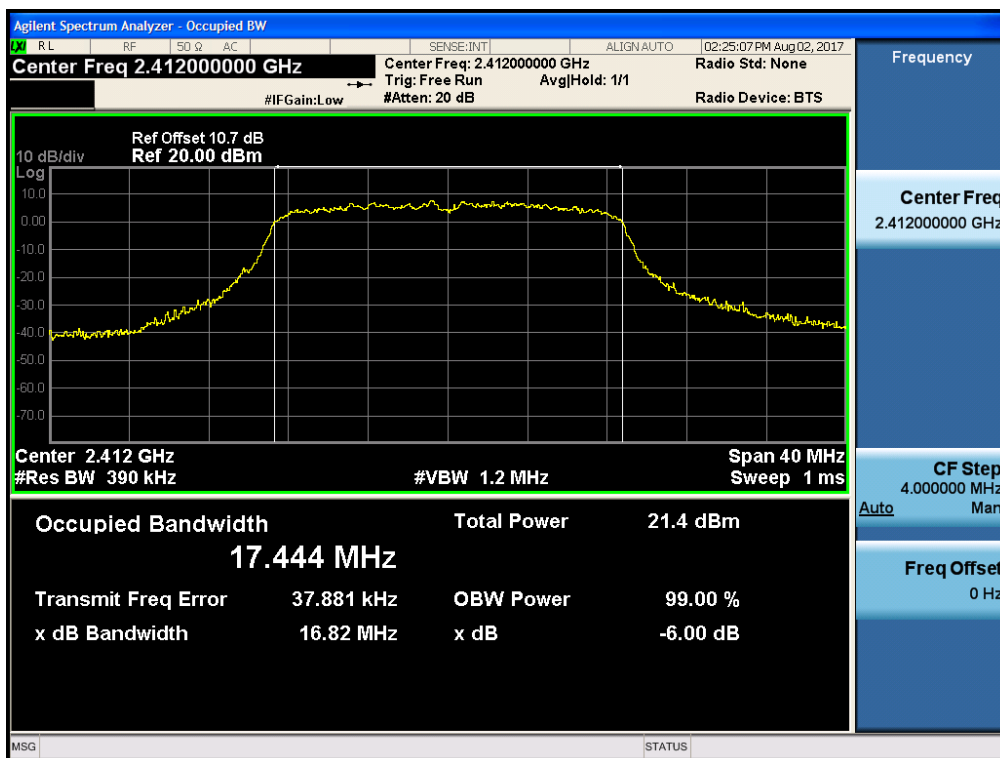
99% Bandwidth plot (802.11g - CH 6)



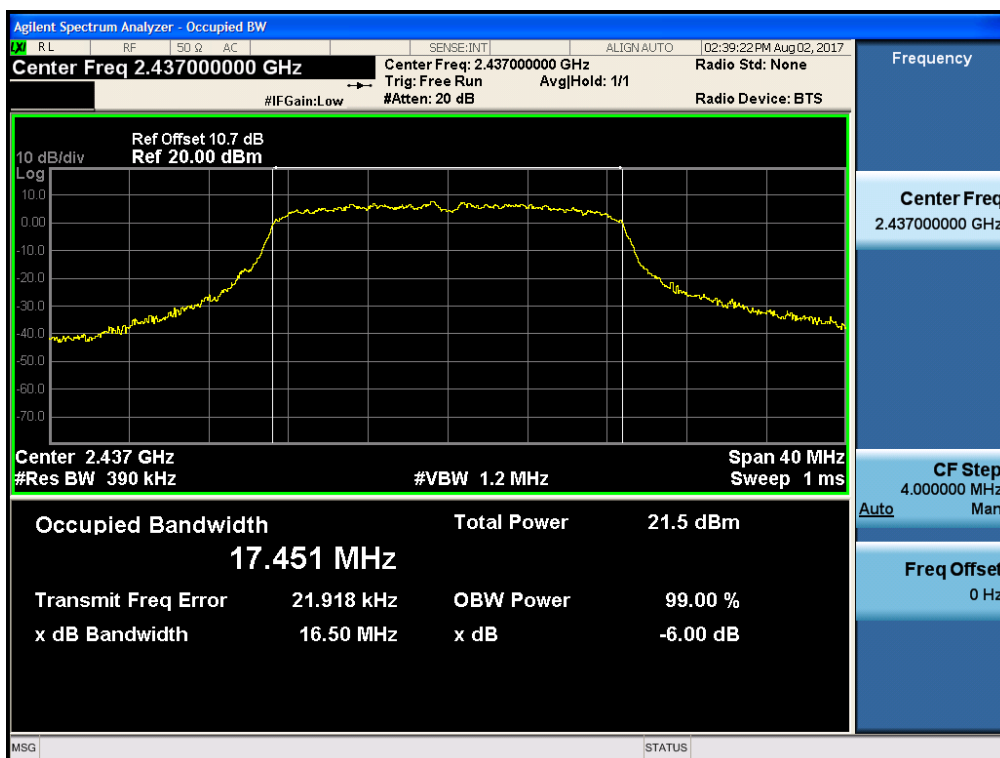
99% Bandwidth plot (802.11g - CH 11)



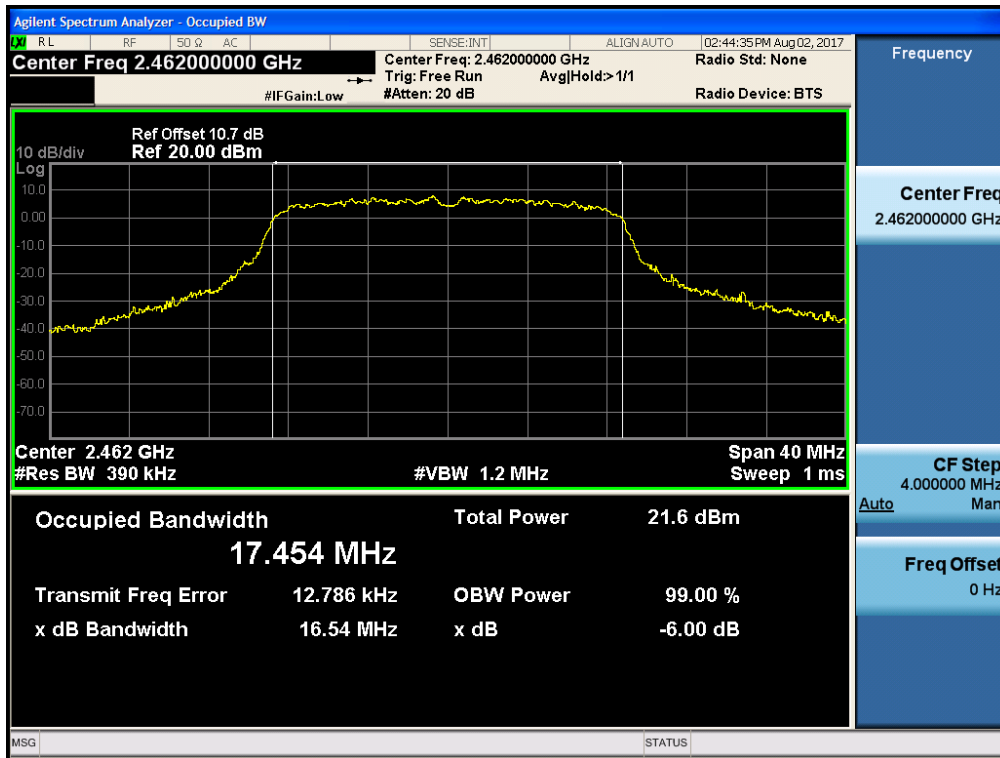
99% Bandwidth plot (802.11n_HT20 - CH 1)



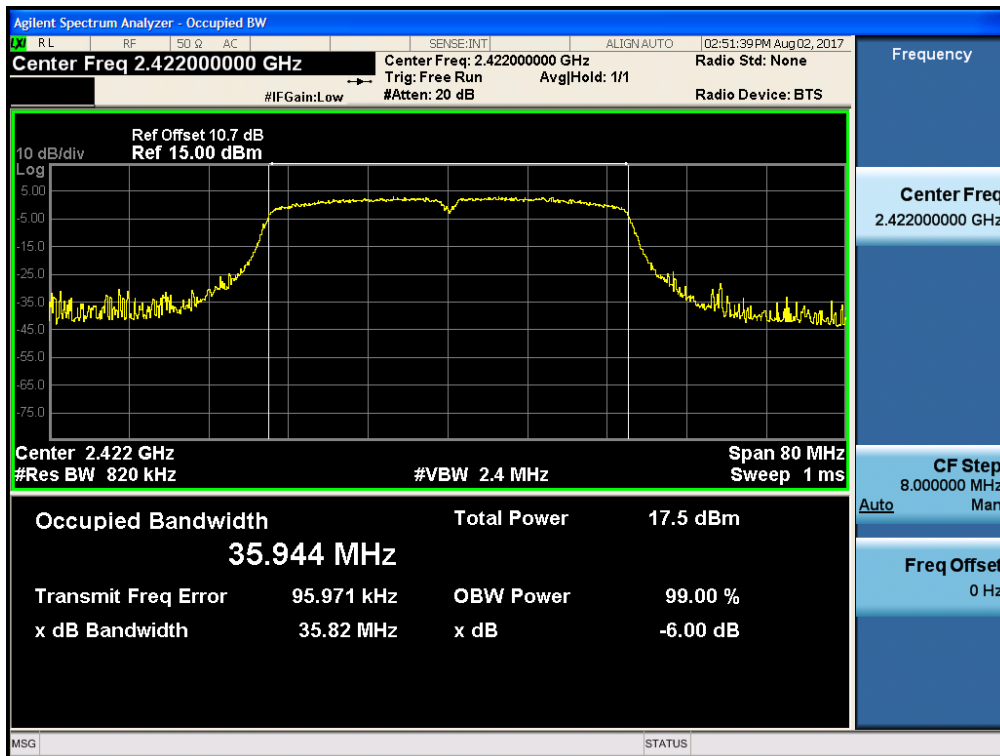
99% Bandwidth plot (802.11n_HT20 - CH 6)



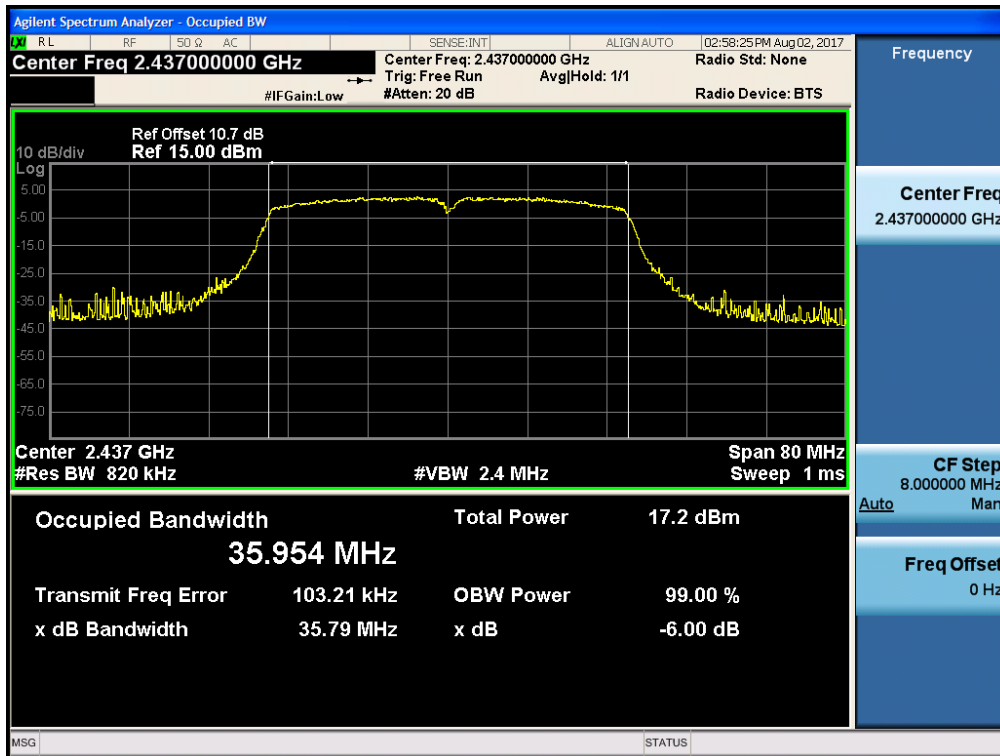
99% Bandwidth plot (802.11n_HT20 - CH 11)



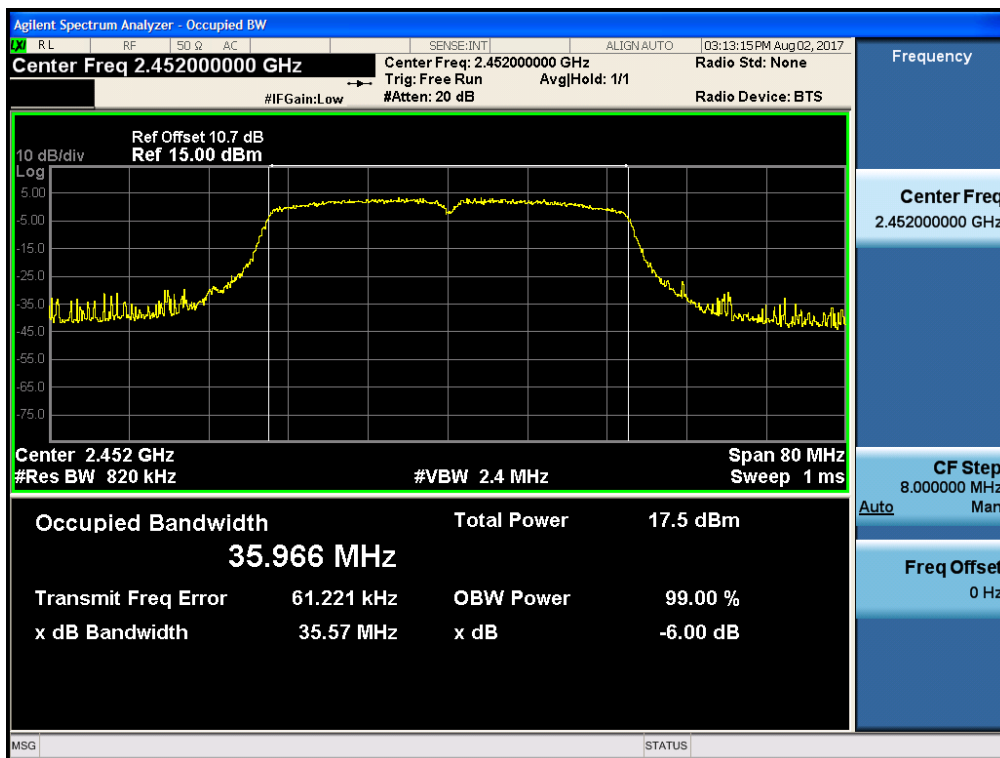
99% Bandwidth plot (802.11n_HT40 - CH 3)



99% Bandwidth plot (802.11n_HT40 - CH 6)



99% Bandwidth plot (802.11n_HT40 - CH 9)



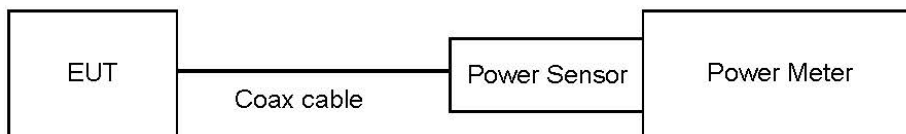
9.4 OUTPUT POWER (802.11b/g/n)

Test Requirements and limit, §15.247(b)(3) / RSS-247(Issue 2) Section 5.4.4.

The transmitter output is connected to the input of an RF power sensor. Measurement is made using a broadband power meter capable of making peak and average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

■ TEST CONFIGURATION(20 MHz BW)



■ TEST PROCEDURE(20 MHz BW)

- Peak Power (Procedure 9.1.2 in KDB 558074 v04)
 1. Measure the peak power of the transmitter.
- Average Power (Procedure 9.2.3.1 in KDB 558074 v04)
 1. Measure the duty cycle.
 2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
 3. Add $10 \log (1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Note :

1. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. So, 10.7 dB is offset for 2.4 GHz Band.

Actual value of loss for the attenuator and cable combination is below table.

Band	Frequency[MHz]	Loss[dB]
2.4 GHz	2412	10.65
	2437	10.65
	2462	10.66

(Actual value of loss for the attenuator and cable combination)

■ TEST RESULTS-Peak

Conducted Output Power Measurements (802.11b Mode)

802.11b Mode		Rate [Mbps]	Measured Power[dBm]	Limit [dBm]
Frequency[MHz]	Channel No.			
2412	1	1 Mbps	20.75	30
		2 Mbps	20.79	30
		5.5 Mbps	20.74	30
		11 Mbps	20.79	30
2437	6	1 Mbps	20.90	30
		2 Mbps	20.91	30
		5.5 Mbps	20.95	30
		11 Mbps	20.93	30
2462	11	1 Mbps	21.26	30
		2 Mbps	21.27	30
		5.5 Mbps	21.24	30
		11 Mbps	21.30	30

Conducted Output Power Measurements (802.11g Mode)

802.11g Mode		Rate [Mbps]	Measured Power[dBm]	Limit [dBm]
Frequency[MHz]	Channel No.			
2412	1	6 Mbps	21.69	30
		9 Mbps	21.88	30
		12 Mbps	22.27	30
		18 Mbps	22.19	30
		24 Mbps	24.18	30
		36 Mbps	24.13	30
		48 Mbps	24.00	30
		54 Mbps	24.32	30
2437	6	6 Mbps	21.94	30
		9 Mbps	22.13	30
		12 Mbps	22.40	30
		18 Mbps	22.27	30
		24 Mbps	24.28	30
		36 Mbps	24.45	30
		48 Mbps	24.20	30
		54 Mbps	24.36	30
2462	11	6 Mbps	22.08	30
		9 Mbps	22.34	30
		12 Mbps	22.61	30
		18 Mbps	22.40	30
		24 Mbps	24.21	30
		36 Mbps	24.26	30
		48 Mbps	24.17	30
		54 Mbps	24.50	30

Conducted Output Power Measurements (802.11n_HT20 Mode)

802.11n Mode		MCS Index	Measured Power[dBm]	Limit [dBm]
Frequency[MHz]	Channel No.			
2412	1	0	21.88	30
		1	22.13	30
		2	22.17	30
		3	23.96	30
		4	23.97	30
		5	24.07	30
		6	24.12	30
		7	23.89	30
2437	6	0	22.12	30
		1	22.37	30
		2	22.26	30
		3	23.99	30
		4	24.39	30
		5	24.09	30
		6	24.40	30
		7	24.07	30
2462	11	0	22.28	30
		1	22.47	30
		2	22.44	30
		3	24.17	30
		4	24.55	30
		5	24.08	30
		6	24.32	30
		7	24.06	30

Conducted Output Power Measurements (802.11n_HT40 Mode)

802.11n Mode		MCS Index	Measured Power[dBm]	Limit [dBm]
Frequency[MHz]	Channel No.			
2422	3	0	17.83	30
		1	17.63	30
		2	17.30	30
		3	17.89	30
		4	17.76	30
		5	17.94	30
		6	17.86	30
		7	17.59	30
2437	6	0	17.94	30
		1	17.72	30
		2	17.61	30
		3	18.01	30
		4	17.89	30
		5	18.11	30
		6	18.00	30
		7	17.75	30
2452	9	0	18.38	30
		1	18.11	30
		2	18.03	30
		3	18.45	30
		4	18.30	30
		5	18.49	30
		6	18.42	30
		7	18.14	30

■ TEST RESULTS-Average

Conducted Output Power Measurements (802.11b Mode)

802.11b Mode		Rate [Mbps]	Measured Power[dBm]	Duty Cycle Factor [dB]	Measured Power(dBm) + Duty Cycle Factor[dB]	Limit [dBm]
Frequency [MHz]	Channel No.					
2412	1	1 Mbps	18.00	0.042	18.04	30
		2 Mbps	17.97	0.074	18.04	30
		5.5 Mbps	18.01	0.180	18.19	30
		11 Mbps	17.79	0.325	18.12	30
2437	6	1 Mbps	18.23	0.042	18.27	30
		2 Mbps	18.19	0.074	18.27	30
		5.5 Mbps	18.25	0.180	18.43	30
		11 Mbps	18.01	0.325	18.34	30
2462	11	1 Mbps	18.54	0.042	18.59	30
		2 Mbps	18.54	0.074	18.61	30
		5.5 Mbps	18.63	0.180	18.81	30
		11 Mbps	18.38	0.325	18.70	30

Conducted Output Power Measurements (802.11g Mode)

802.11g Mode		Rate [Mbps]	Measured Power[dBm]	Duty Cycle Factor [dB]	Measured Power(dBm) + Duty Cycle Factor[dB]	Limit [dBm]
Frequency [MHz]	Channel No.					
2412	1	6 Mbps	14.54	0.222	14.77	30
		9 Mbps	14.42	0.321	14.74	30
		12 Mbps	14.28	0.421	14.71	30
		18 Mbps	14.24	0.611	14.85	30
		24 Mbps	14.31	0.785	15.10	30
		36 Mbps	13.93	1.116	15.05	30
		48 Mbps	13.66	1.420	15.08	30
		54 Mbps	13.51	1.538	15.05	30
2437	6	6 Mbps	14.89	0.222	15.11	30
		9 Mbps	14.78	0.321	15.10	30
		12 Mbps	14.64	0.421	15.06	30
		18 Mbps	14.59	0.611	15.20	30
		24 Mbps	14.64	0.785	15.42	30
		36 Mbps	14.27	1.116	15.38	30
		48 Mbps	14.00	1.420	15.42	30
		54 Mbps	13.84	1.538	15.38	30
2462	11	6 Mbps	15.24	0.222	15.47	30
		9 Mbps	15.13	0.321	15.46	30
		12 Mbps	15.00	0.421	15.42	30
		18 Mbps	14.95	0.611	15.56	30
		24 Mbps	14.97	0.785	15.75	30
		36 Mbps	14.60	1.116	15.71	30
		48 Mbps	14.32	1.420	15.74	30
		54 Mbps	14.17	1.538	15.71	30

Conducted Output Power Measurements (802.11n_HT20 Mode)

802.11n Mode		MCS Index	Measured Power[dBm]	Duty Cycle Factor [dB]	Measured Power(dBm) + Duty Cycle Factor[dB]	Limit [dBm]
Frequency [MHz]	Channel No.					
2412	1	0	14.29	0.232	14.53	30
		1	13.96	0.443	14.40	30
		2	13.94	0.635	14.58	30
		3	14.29	0.897	15.19	30
		4	13.94	1.137	15.08	30
		5	13.65	1.434	15.08	30
		6	13.56	1.550	15.11	30
		7	13.38	1.663	15.04	30
2437	6	0	14.66	0.232	14.89	30
		1	14.30	0.443	14.75	30
		2	14.29	0.635	14.93	30
		3	14.63	0.897	15.53	30
		4	14.29	1.137	15.43	30
		5	13.98	1.434	15.42	30
		6	13.89	1.550	15.44	30
		7	13.71	1.663	15.38	30
2462	11	0	15.01	0.232	15.25	30
		1	14.67	0.443	15.12	30
		2	14.65	0.635	15.29	30
		3	14.97	0.897	15.87	30
		4	14.62	1.137	15.75	30
		5	14.31	1.434	15.74	30
		6	14.22	1.550	15.77	30
		7	14.05	1.663	15.71	30

Conducted Output Power Measurements (802.11n_HT40 Mode)

802.11n Mode		MCS Index	Measured Power[dBm]	Duty Cycle Factor [dB]	Measured Power(dBm) + Duty Cycle Factor[dB]	Limit [dBm]
Frequency [MHz]	Channel No.					
2422	3	0	8.79	0.463	9.26	30
		1	8.64	0.853	9.49	30
		2	8.23	1.174	9.40	30
		3	7.85	1.476	9.33	30
		4	7.31	1.939	9.25	30
		5	7.03	2.305	9.33	30
		6	6.81	2.462	9.27	30
		7	6.60	2.612	9.21	30
2437	6	0	9.06	0.463	9.53	30
		1	8.78	0.853	9.63	30
		2	8.34	1.174	9.51	30
		3	8.01	1.476	9.48	30
		4	7.55	1.939	9.49	30
		5	7.14	2.305	9.44	30
		6	7.00	2.462	9.46	30
		7	6.76	2.612	9.37	30
2452	9	0	9.25	0.463	9.71	30
		1	9.02	0.853	9.87	30
		2	8.71	1.174	9.88	30
		3	8.35	1.476	9.83	30
		4	7.82	1.939	9.76	30
		5	7.43	2.305	9.73	30
		6	7.29	2.462	9.75	30
		7	7.11	2.612	9.72	30

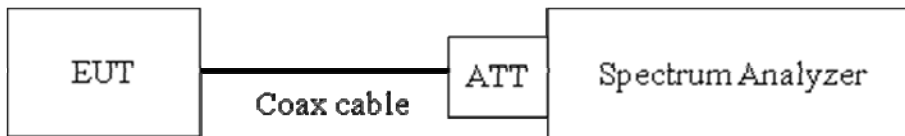
9.5 POWER SPECTRAL DENSITY (802.11b/g/n)

Test Requirements and limit, §15.247(e) / RSS-247(Issue 2) Section 5.2.

The peak power spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Minimum Standard – the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

■ TEST CONFIGURATION



■ TEST PROCEDURE

We tested according to Procedure 10.2 in KDB 558074 v04

Peak PSD

The spectrum analyzer is set to :

Set analyzer center frequency to DTS channel center frequency.

Span = 1.5 times the DTS channel bandwidth.

RBW = 3 kHz ≤ RBW ≤ 100 kHz.

VBW ≥ 3 × RBW.

Sweep = auto couple

Detector = peak

Trace Mode = max hold

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Average PSD

The spectrum analyzer is set to :

Set analyzer center frequency to DTS channel center frequency.

Span = 1.5 times the DTS channel bandwidth.

RBW = 3 kHz ≤ RBW ≤ 100 kHz.

VBW ≥ 3 × RBW.

Sweep = auto couple

Detector = power averaging (RMS) or sample detector (when RMS not available).

Ensure that the number of measurement points in the sweep ≥ 2 × span/RBW.

Employ trace averaging (RMS) mode over a minimum of 100 traces.

Use the peak marker function to determine the maximum amplitude level.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

Note:

We apply to KDB 558074 v04(AVG PSD) method 10.3 for only 802.11b.

■ SAMPLE CALCULATION

PSD = Reading Value + ATT loss + Cable loss(1 ea)

Note :

1. Spectrum reading values are not plot data. The PSD results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. So, 10.7 dB is offset for 2.4 GHz Band.

Actual value of loss for the attenuator and cable combination is below table.

Band	Frequency(MHz)	Loss(dB)
2.4 GHz	2412	10.65
	2437	10.65
	2462	10.66

(Actual value of loss for the attenuator and cable combination)

TEST RESULTS

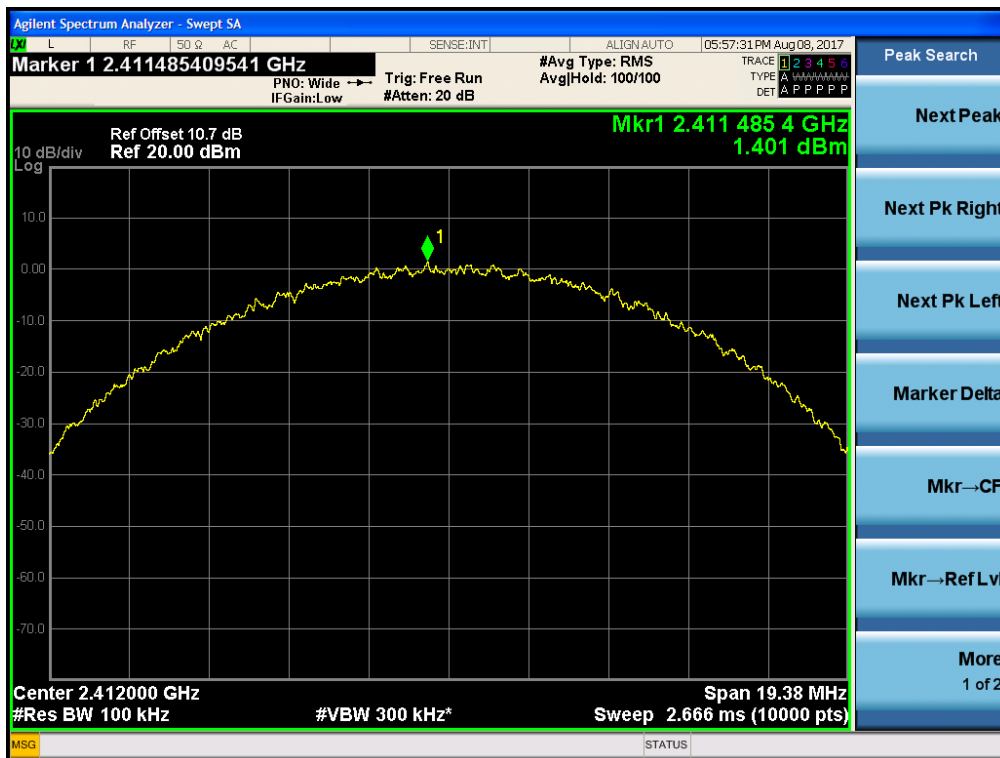
Conducted Power Density Measurements

Frequency [MHz]	Channel No.	Mode	Test Result		
			PSD [dBm]	Limit [dBm]	Pass/Fail
2412	1	802.11b	1.401	8	Pass
2437	6		1.229	8	Pass
2462	11		1.288	8	Pass
2412	1	802.11g	-10.377	8	Pass
2437	6		-11.078	8	Pass
2462	11		-9.859	8	Pass
2412	1	802.11n _HT20	-10.106	8	Pass
2437	6		-10.523	8	Pass
2462	11		-10.916	8	Pass
2422	3	802.11n _HT40	-20.198	8	Pass
2437	6		-19.946	8	Pass
2452	9		-18.620	8	Pass

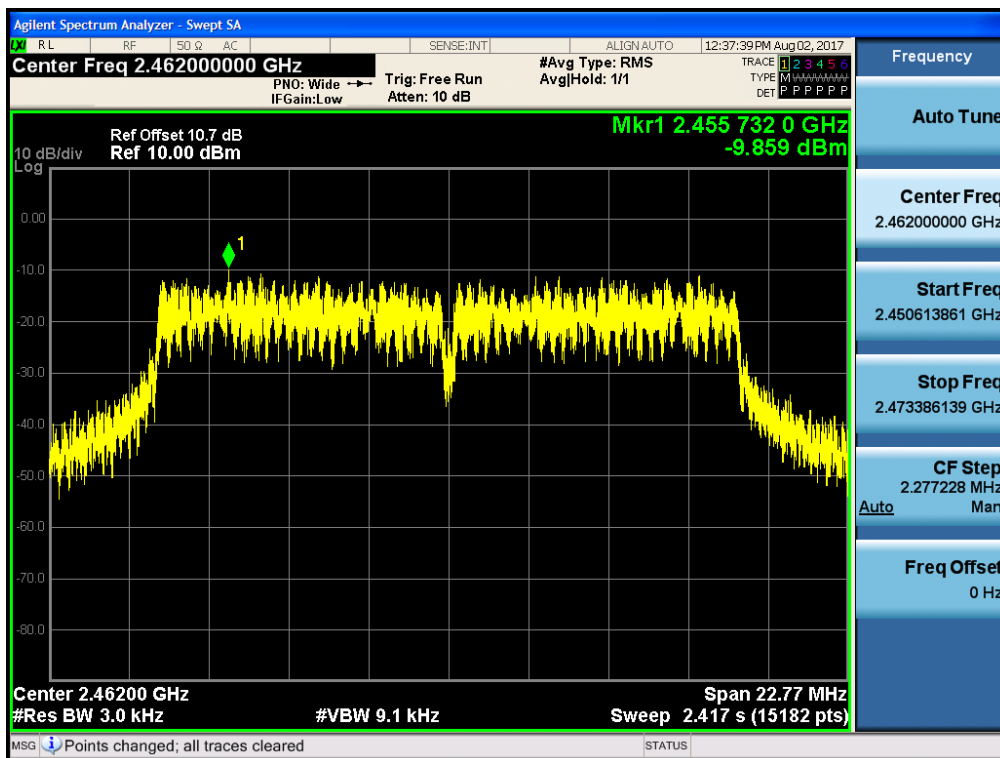
Note : In order to simplify the report, attached plots were only the highest PSD channel.

■ RESULT PLOTS

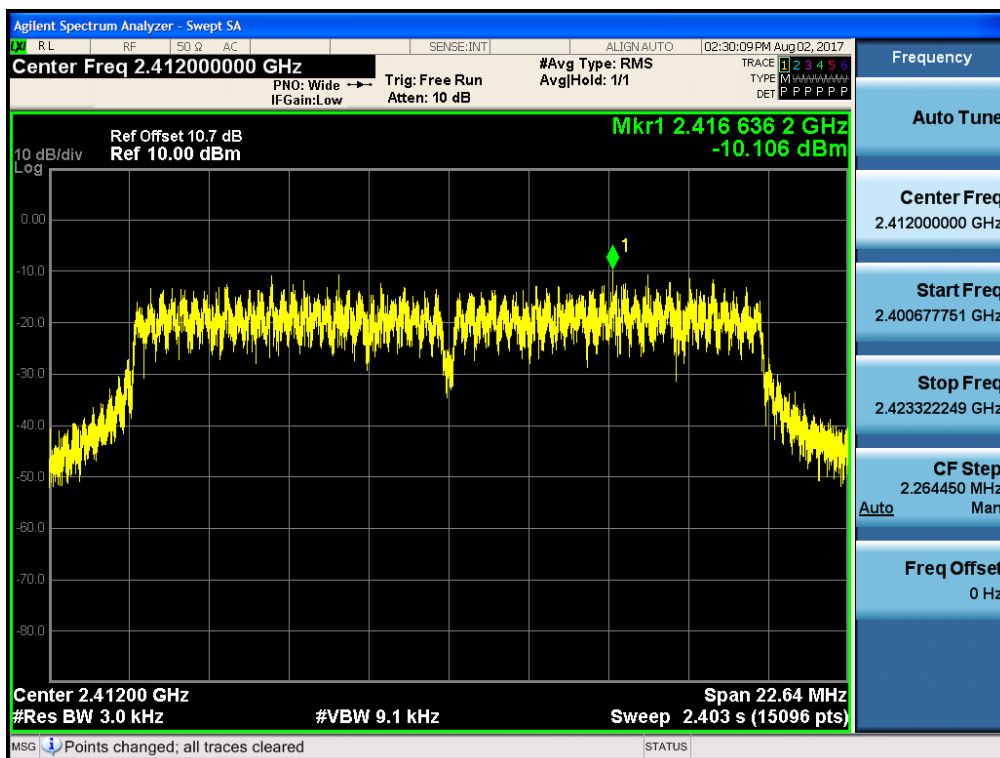
Power Spectral Density (802.11b-CH 1)



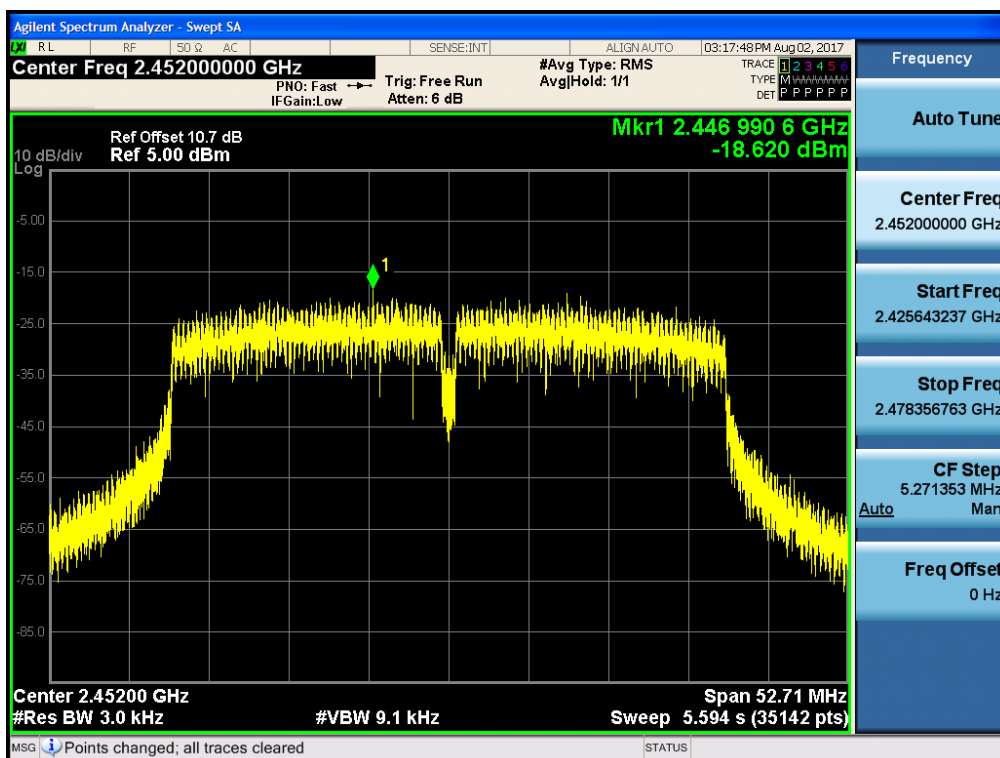
Power Spectral Density (802.11g-CH 11)



Power Spectral Density (802.11n_HT20 -CH 1)

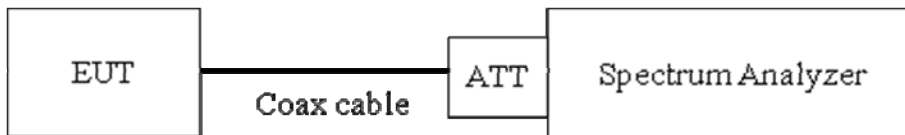


Power Spectral Density (802.11n_HT40 -CH 9)



9.6 OUT OF BAND EMISSIONS AT THE BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS**Test Requirements and limit, §15.247(d) / RSS-247(Issue 2) Section 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) / RSS-Gen is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Limit : 20 dBc**■ TEST CONFIGURATION****■ TEST PROCEDURE**

The transmitter output is connected to the spectrum analyzer. (Procedure 11.0 in KDB 558074 v04)

RBW = 100 kHz

VBW $\geq 3 \times$ RBW

Set span to encompass the spectrum to be examined

Detector = Peak

Trace Mode = max hold

Sweep time = auto couple

Ensure that the number of measurement points $\geq$ Span/RBW

Allow trace to fully stabilize.

Use peak marker function to determine the maximum amplitude level.

Measurements are made over the 30 MHz to 10th harmonic range with the transmitter set to the lowest, middle, and highest channels.

Note :

1. The maximum peak conducted output power procedure was used to demonstrate compliance as described in 9.1(KDB558074 v04), so the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

2. The band edge results in plot is already including the actual values of loss for the attenuator and cable combination.
3. Spectrum offset = Attenuator loss + Cable loss
4. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. So, 10.7 dB is offset for 2.4 GHz Band. Actual value of loss for the attenuator and cable combination is below table.

Band	Frequency(MHz)	Loss(dB)
2.4 GHz	2412	10.65
	2437	10.65
	2462	10.66

(Actual value of loss for the attenuator and cable combination)

5. In case of conducted spurious emissions test, please check factors blow table.
6. In order to simplify the report, attached plots were only the worst case channel.

■ FACTORS FOR FREQUENCY

Freq(MHz)	Factor(dB)
30	11.30
100	9.83
200	10.19
300	10.13
400	10.23
500	10.25
600	10.32
700	10.35
800	10.35
900	10.34
1000	10.39
2000	10.64
2400*	10.65
2500*	10.67
3000	10.68
4000	10.89
5000	11.07
6000	11.06
7000	11.35
8000	11.32
9000	11.48

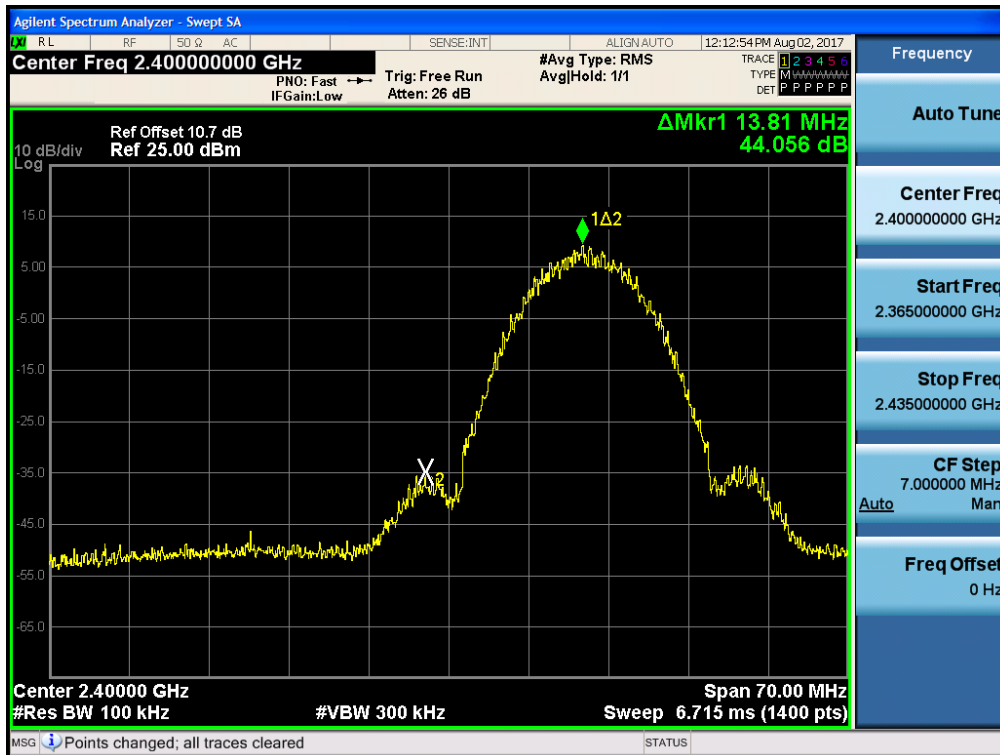
10000	11.56
11000	11.56
12000	11.68
13000	11.83
14000	11.90
15000	11.98
16000	12.04
17000	12.02
18000	12.08
19000	12.07
20000	12.14
21000	12.17
22000	12.31
23000	12.60
24000	12.34
25000	12.53

Note : 1. '*' is fundamental frequency range.

2. Factor = Cable loss + Attenuator loss

■ RESULT PLOTS

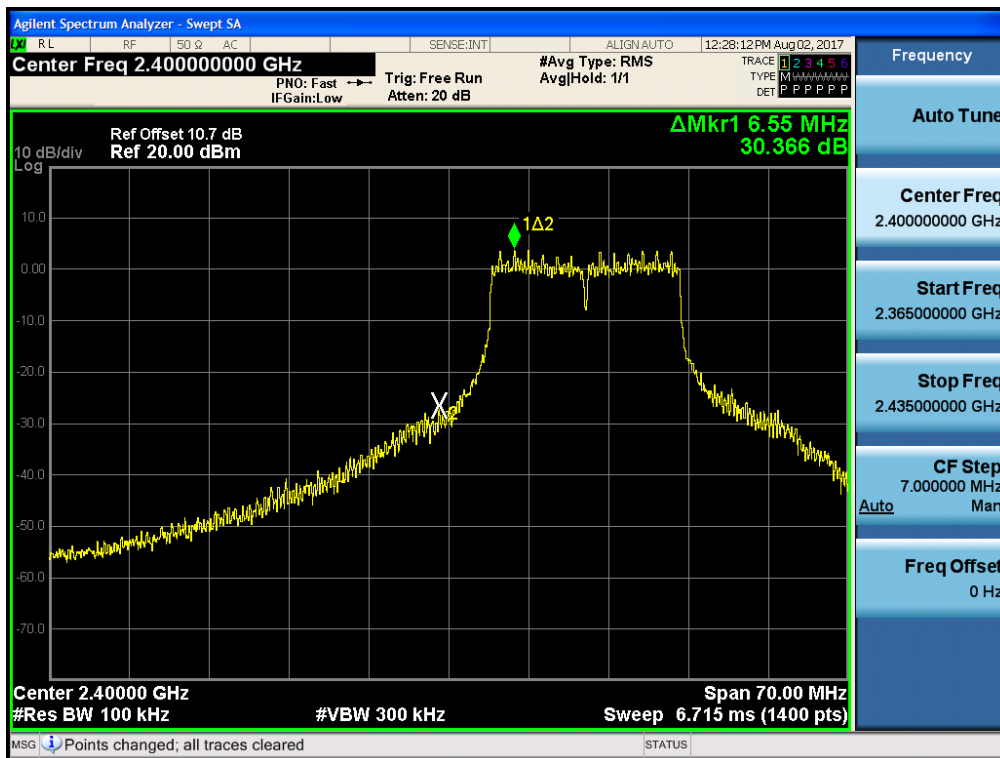
Band Edge (802.11b-CH1)



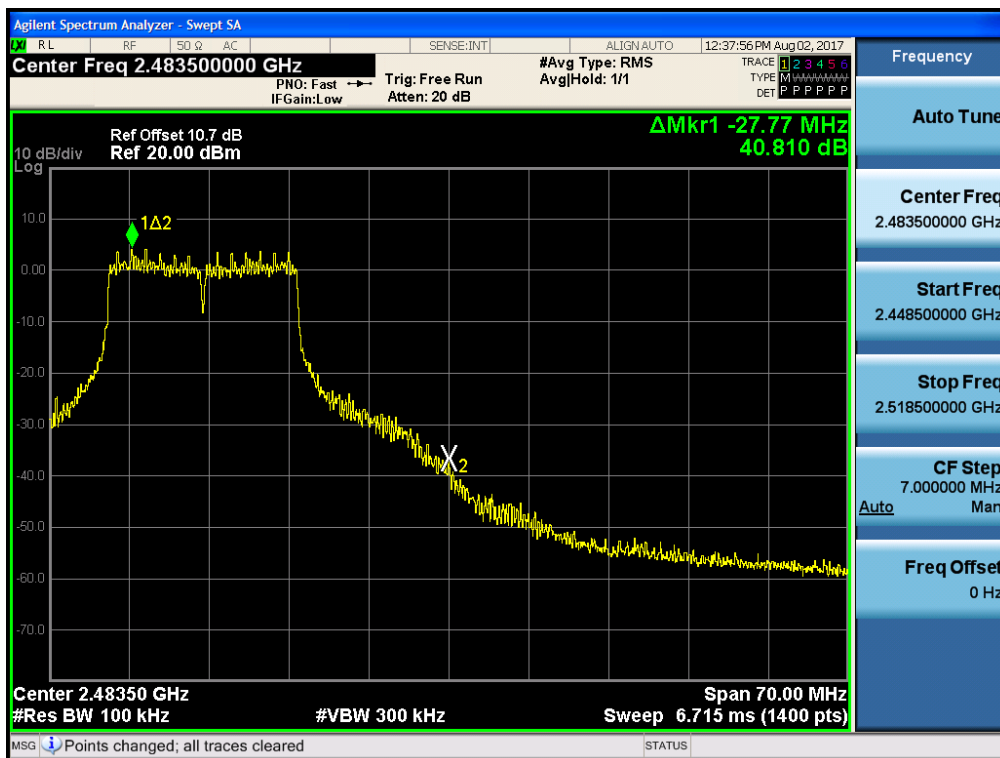
Band Edge (802.11b-CH11)



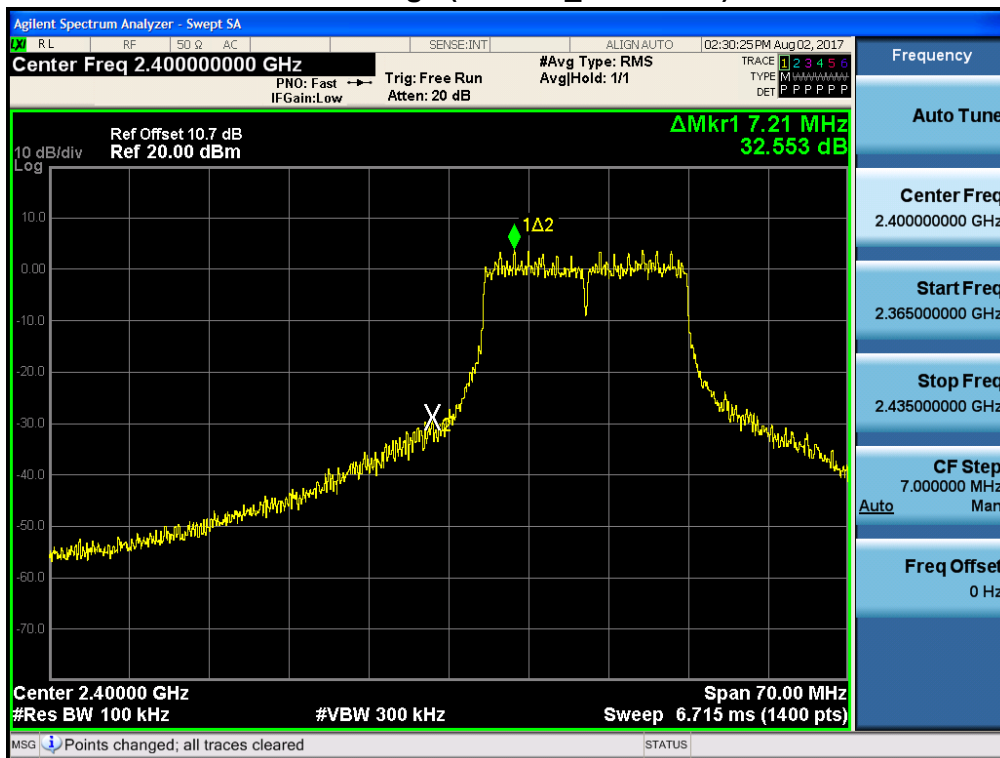
Band Edge (802.11g-CH1)



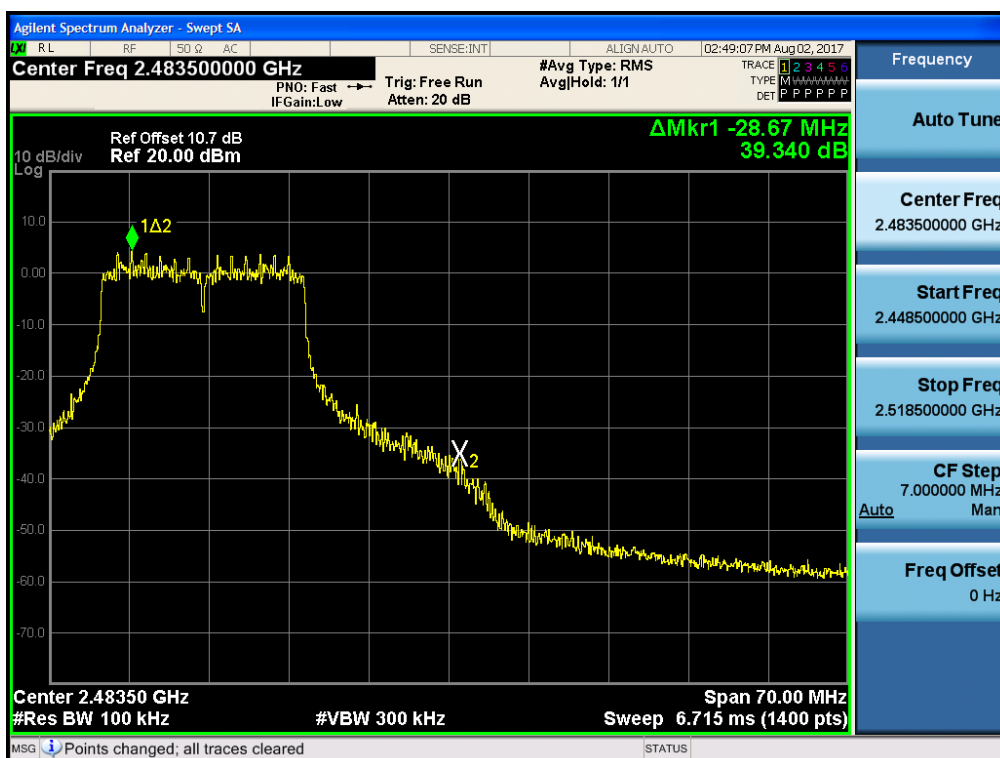
Band Edge (802.11g-CH11)



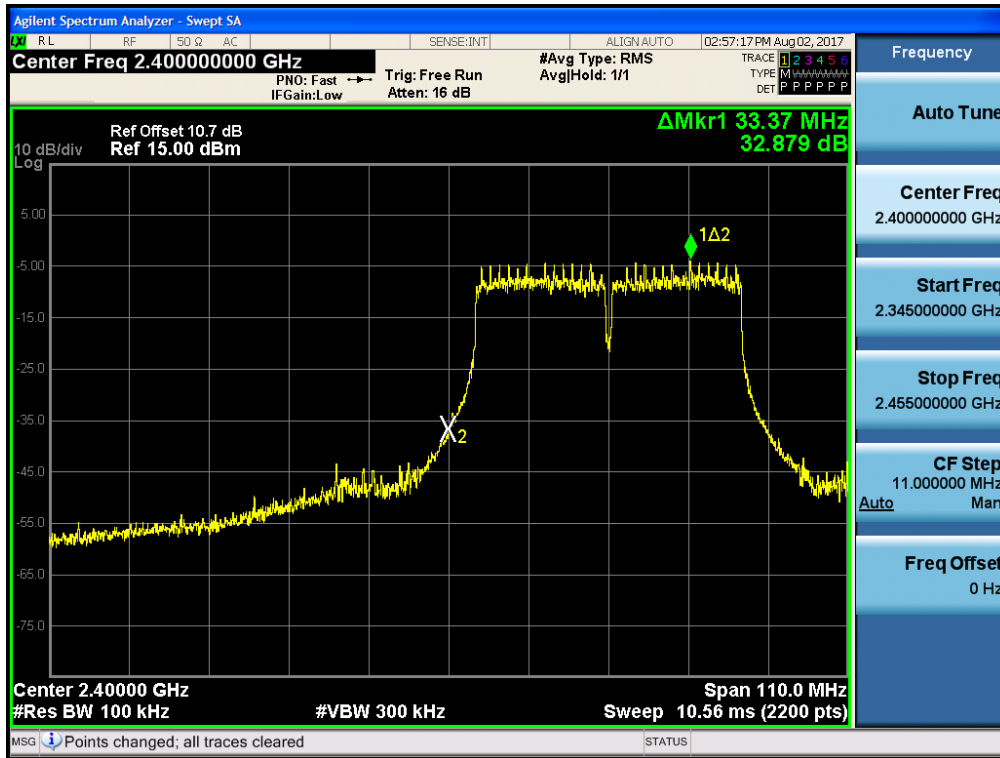
Band Edge (802.11n_HT20-CH1)



Band Edge (802.11n_HT20-CH11)



Band Edge (802.11n_HT40-CH3)

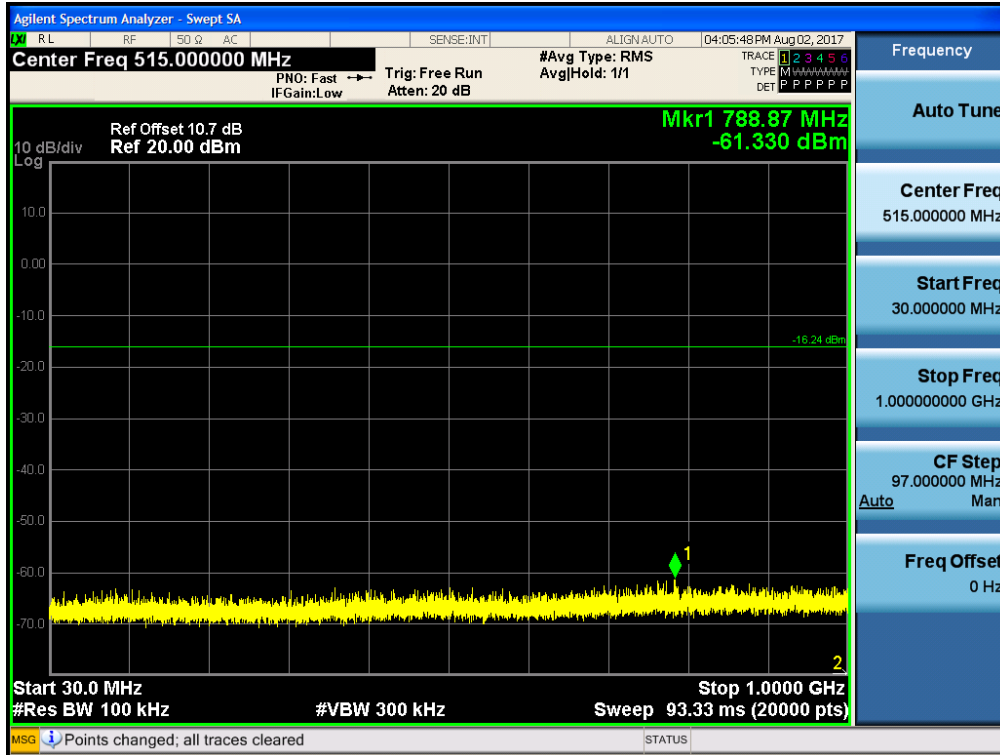


Band Edge (802.11n_HT40-CH9)



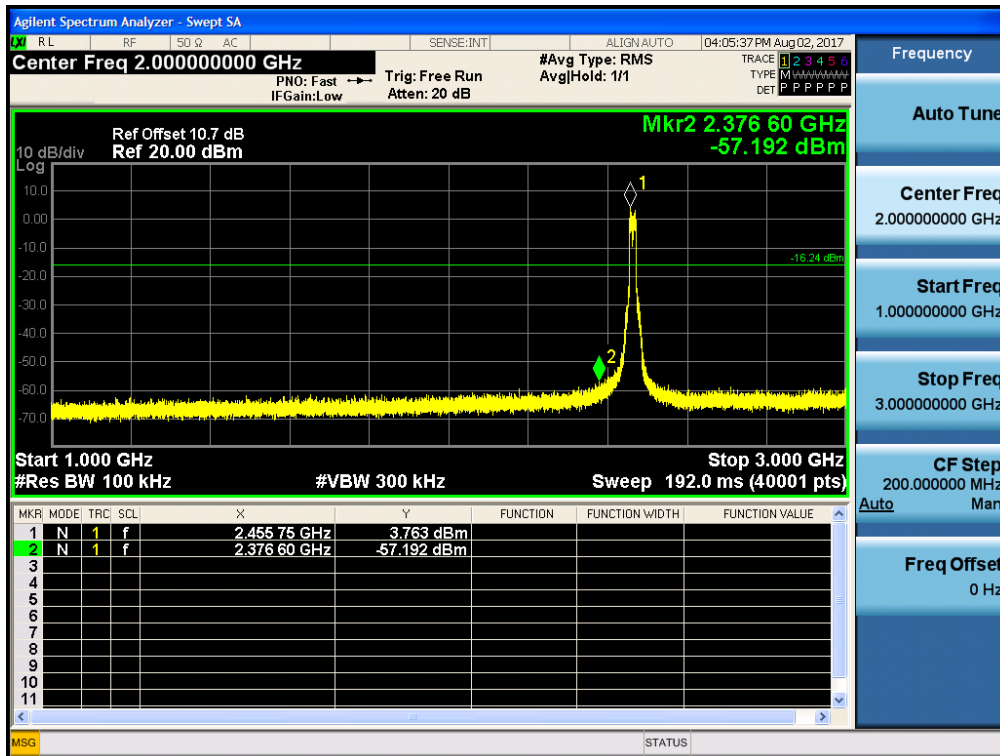
30 MHz ~ 1 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)



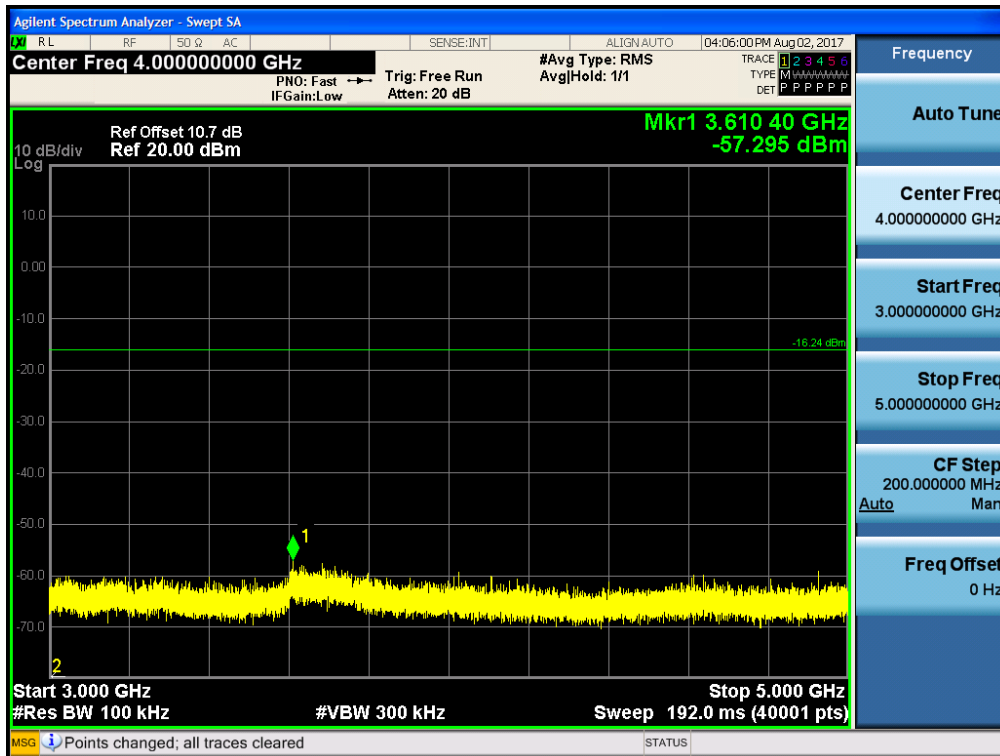
1 GHz ~ 3 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)



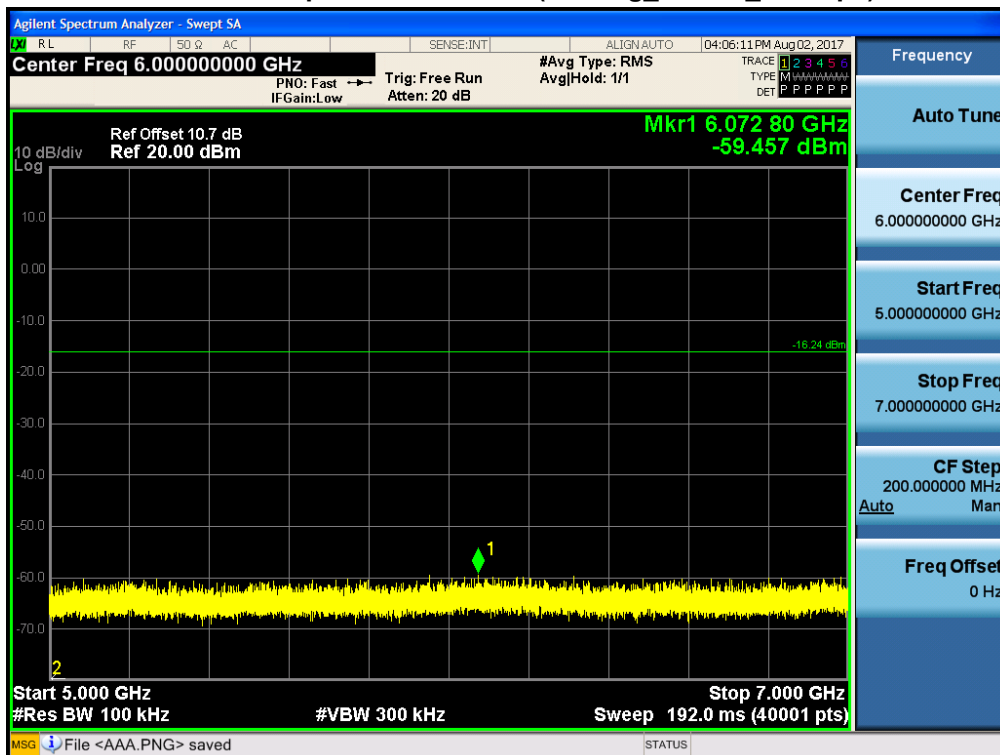
3 GHz ~ 5 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)



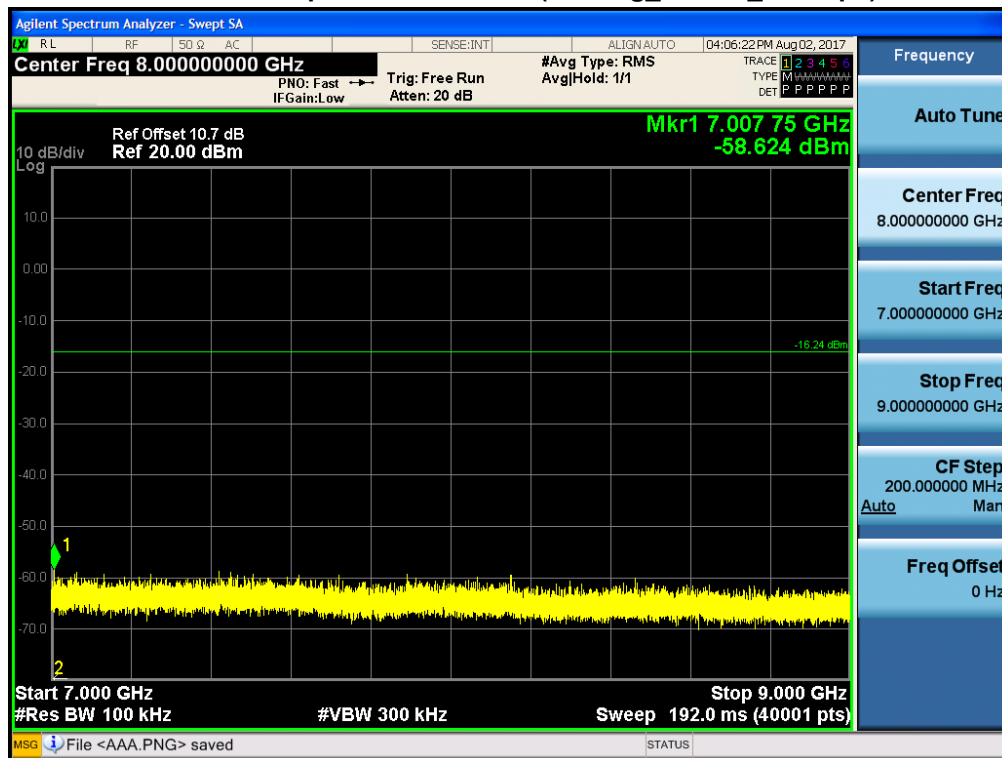
5 GHz ~ 7 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)



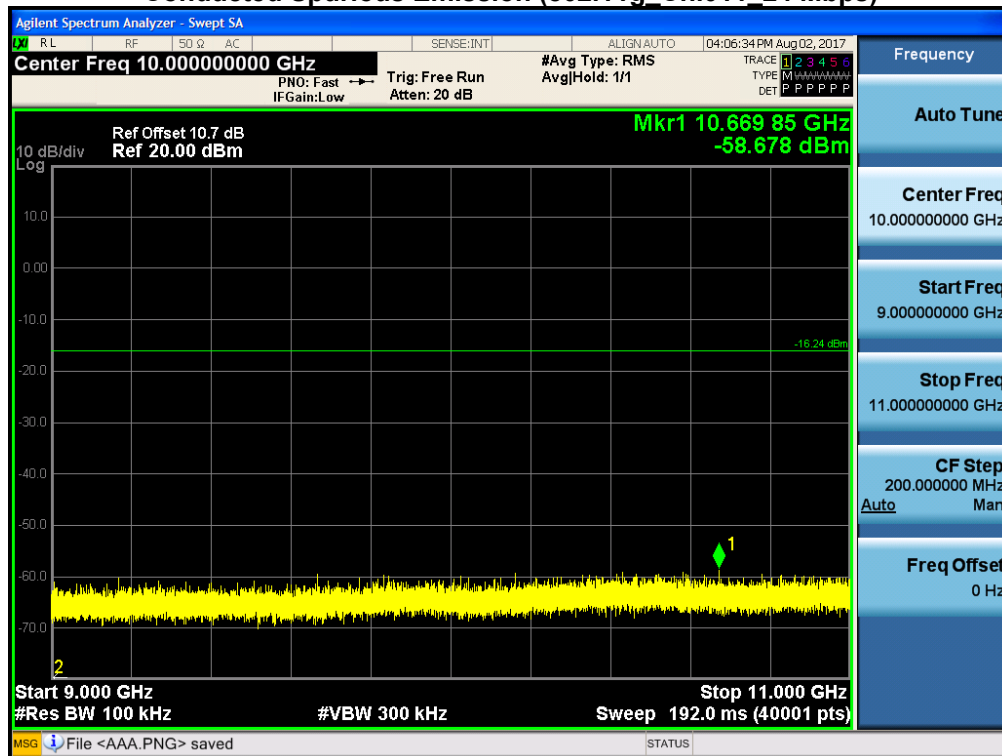
7 GHz ~ 9 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)



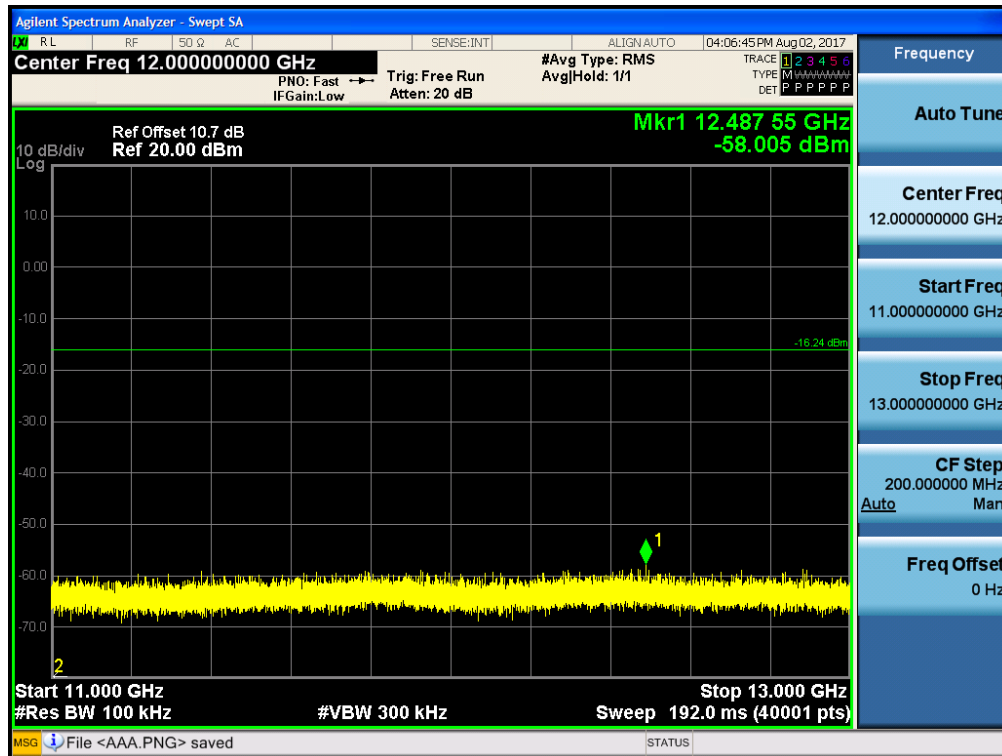
9 GHz ~ 11 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)



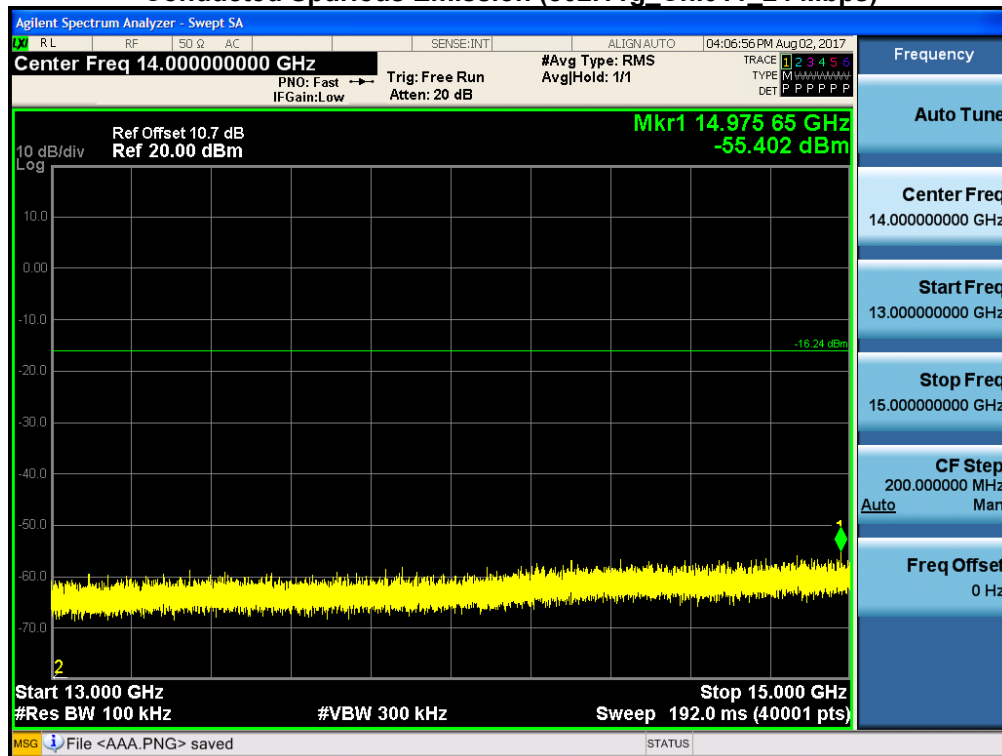
11 GHz ~ 13 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)



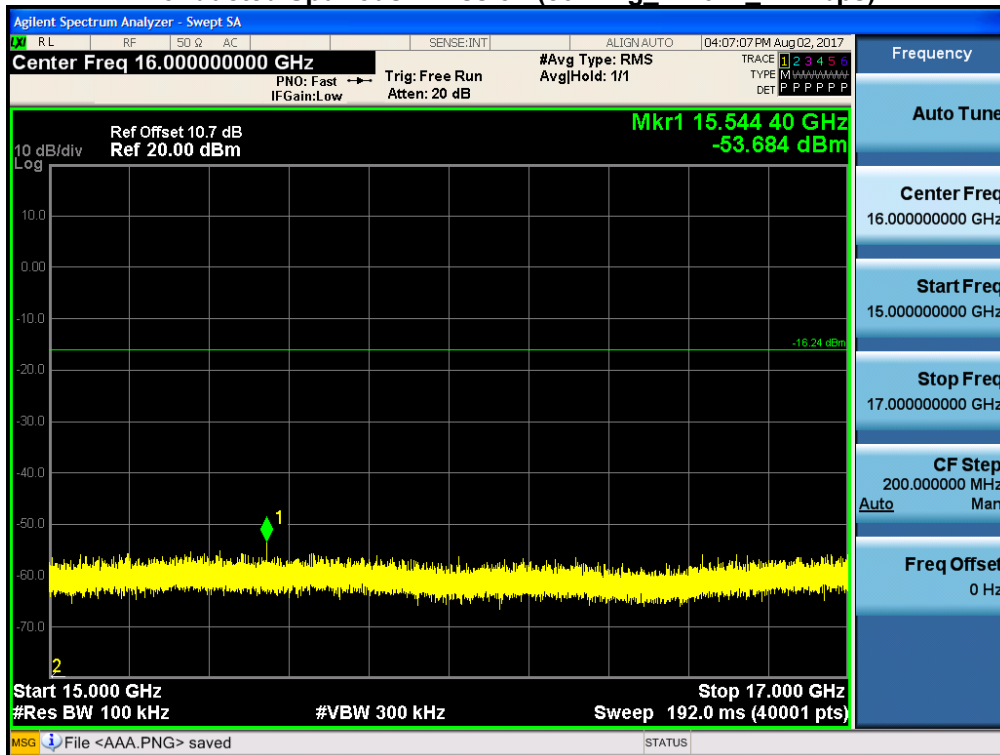
13 GHz ~ 15 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)



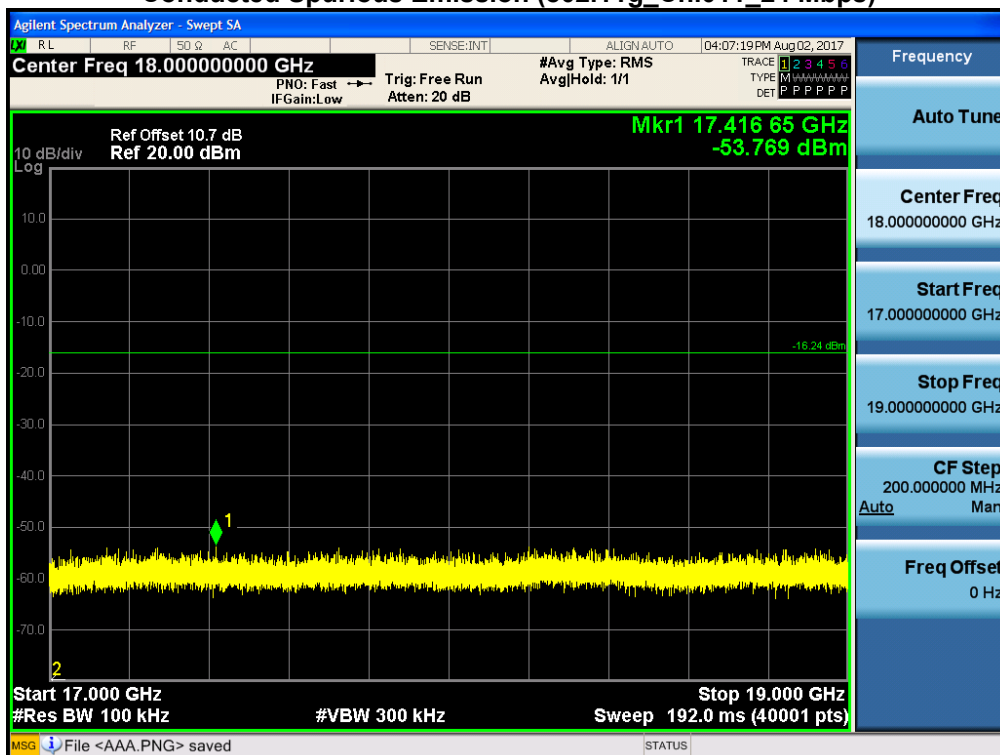
15 GHz ~ 17 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)



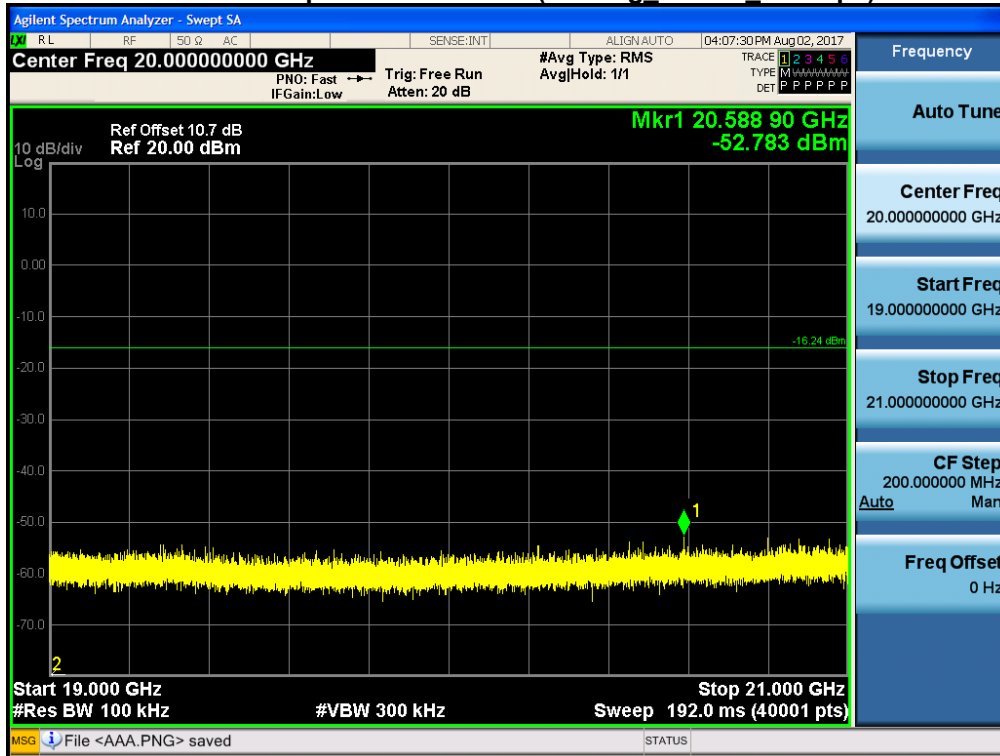
17 GHz ~ 19 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)



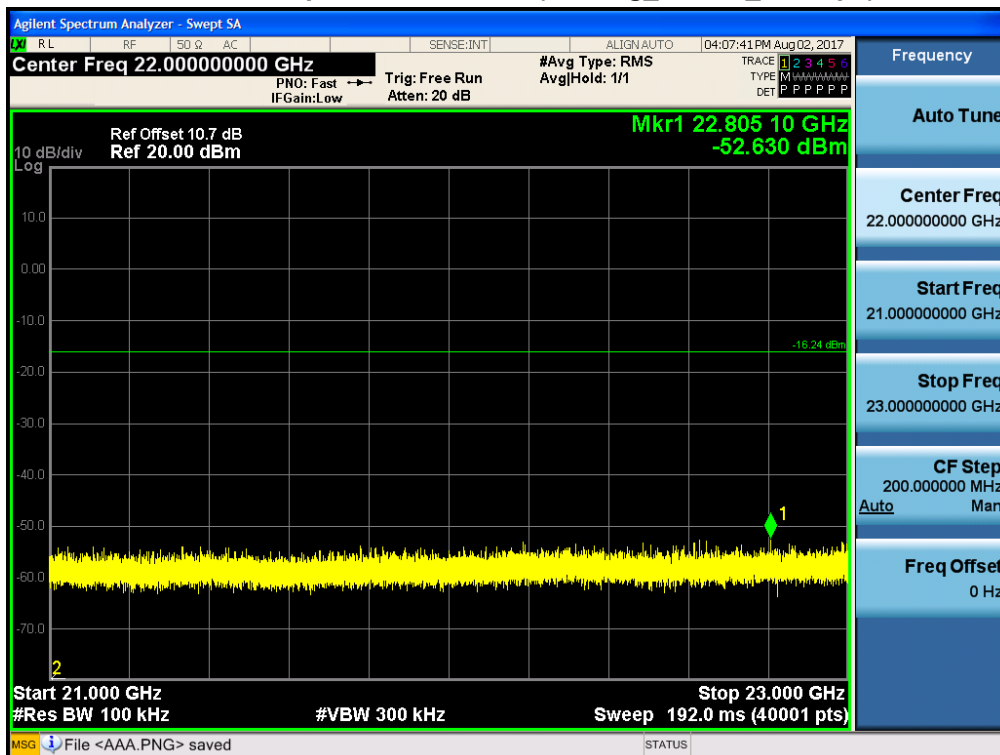
19 GHz ~ 21 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)



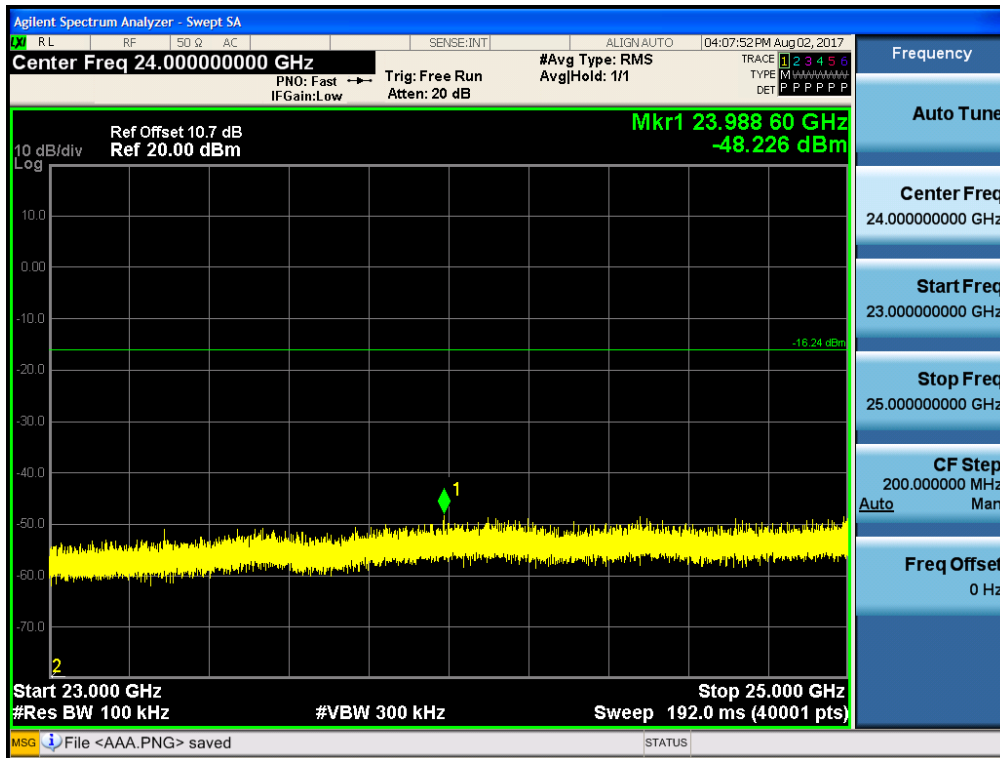
21 GHz ~ 23 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)



23 GHz ~ 25 GHz

Conducted Spurious Emission (802.11g_Ch.011_24 Mbps)

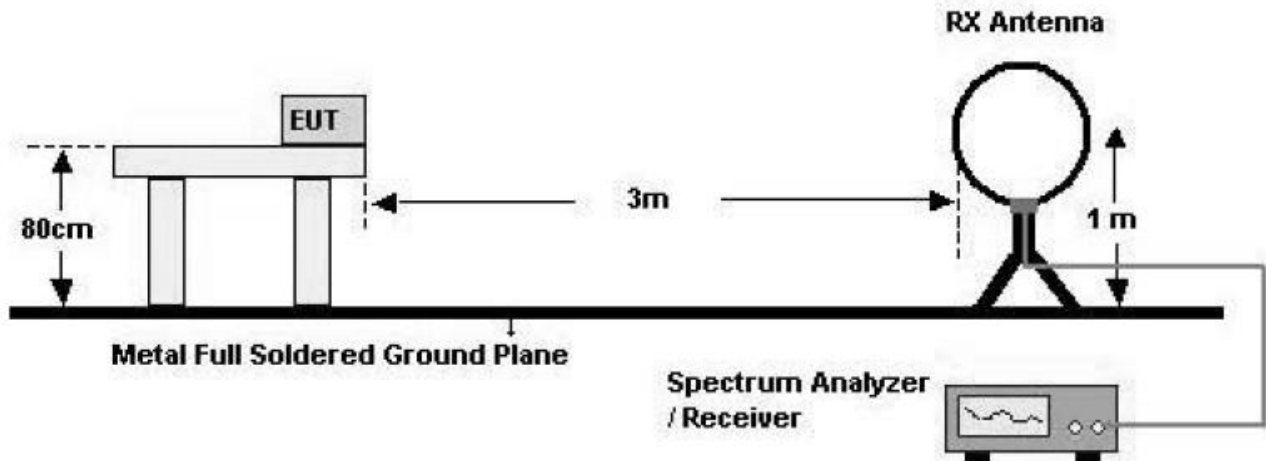


9.7 RADIATED MEASUREMENT.**9.7.1 RADIATED SPURIOUS EMISSIONS.****Test Requirements and limit, §15.205, §15.209/ RSS-Gen(Issue 4) Section 8.9.**

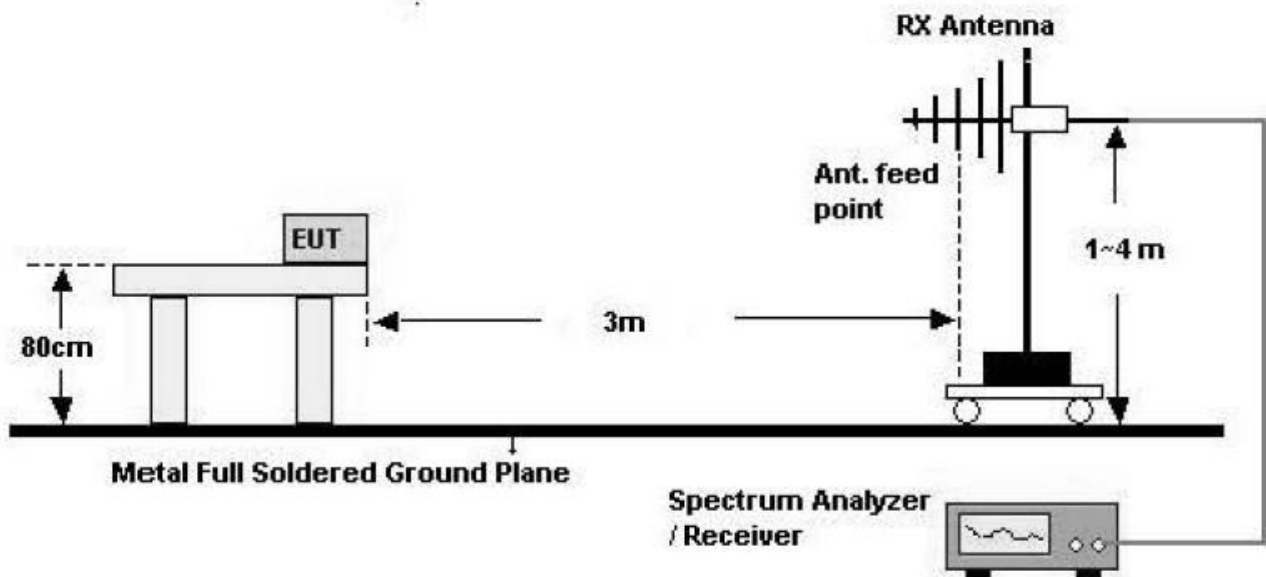
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

TEST CONFIGURATION

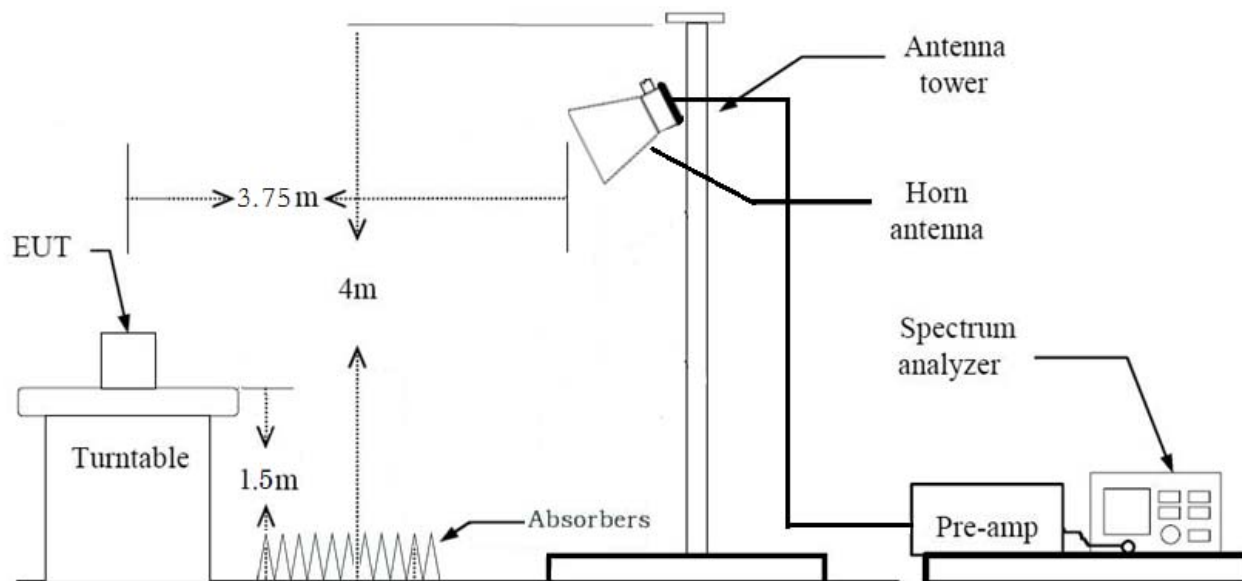
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



TEST PROCEDURE USED

Method 12.1 in KDB 558074 v04

Spectrum Setting

- Peak

Peak emission levels are measured by setting the instrument as follows:

RBW = cf. Table 1.

VBW $\geq 3 \times$ RBW.

Detector = Peak.

Sweep time = auto.

Trace mode = max hold.

Allow sweeps to continue until the trace stabilizes.

(Note that the required measurement time may be longer for low duty cycle applications).

Table 1 —RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

- Average (duty cycle $\geq 98\%$)

Set RBW = 1 MHz

Set VBW $\geq 3 \times$ RBW

Detector = RMS

Averaging type = power (*i.e.*, RMS).

Sweep time = auto.

Trace mode = average (at least 100 traces).

- Average (duty cycle $< 98\%$, duty cycle variations are less than $\pm 2\%$)

Set RBW = 1 MHz

Set VBW $\geq 3 \times$ RBW

Detector = RMS.

Averaging type = power (*i.e.*, RMS).

Sweep time = auto.

Trace mode = average (at least 100 traces).

A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle.

Note :

1. We are performed the RSE and radiated band edge using standard radiated method(RMS).
2. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
3. Distance extrapolation factor = $20 \log (\text{test distance} / \text{specific distance})$ (dB)
4. The duty cycle factor for 802.11 b/g/n_HT20/n_HT40

Mode	Worst Data rate (Mbps)	T _{on} (ms)	T _{total} (ms)	Duty Cycle (%)	Duty Cycle Factor (dB)
b	1	12.418	12.538	99.04	0.042
g	6	2.063	2.171	95.01	0.222
n_HT20	MCS Index 0	1.924	2.029	94.79	0.232
n_HT40	MCS Index 0	0.947	1.054	89.88	0.463

TEST RESULTS**9 kHz – 30MHz****Operation Mode:** Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB)
4. Limit line = specific Limits (dBuV) + Distance extrapolation factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
6. The test results for below 30 MHz is correlated to an open site.
The result on OATS is about 2 dB higher than semi-anechoic chamber (10 m chamber)

TEST RESULTS**Below 1 GHz****Operation Mode:** Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBuV/m	dBm/m	dBm	(H/V)	dBuV/m	dBuV/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

Above 1 GHz

Operation Mode:	802.11 b
Transfer Rate:	1 Mbps
Operating Frequency	2412
Channel No.	01 Ch

Frequency [MHz]	Reading [dBuV]	A.F.+C.L.-A.G+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4824	53.14	-0.64	V	52.50	73.98	21.48	PK
4824	46.10	-0.64	V	45.46	53.98	8.52	AV
7236	48.85	8.49	V	57.34	73.98	16.64	PK
7236	39.82	8.49	V	48.31	53.98	5.67	AV
4824	51.20	-0.64	H	50.56	73.98	23.42	PK
4824	42.06	-0.64	H	41.42	53.98	12.56	AV
7236	47.89	8.49	H	56.38	73.98	17.60	PK
7236	37.39	8.49	H	45.88	53.98	8.10	AV

Operation Mode:	802.11 g
Transfer Rate:	6 Mbps
Operating Frequency	2412
Channel No.	01 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	A.F.+CL-AMP G+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4824	49.92	0.00	-0.64	V	49.28	73.98	24.70	PK
4824	37.75	0.22	-0.64	V	37.33	53.98	16.65	AV
7236	46.06	0.00	8.49	V	54.55	73.98	19.43	PK
7236	33.85	0.22	8.49	V	42.56	53.98	11.42	AV
4824	49.74	0.00	-0.64	H	49.10	73.98	24.88	PK
4824	37.74	0.22	-0.64	H	37.32	53.98	16.66	AV
7236	45.48	0.00	8.49	H	53.97	73.98	20.01	PK
7236	33.83	0.22	8.49	H	42.54	53.98	11.44	AV

Operation Mode: 802.11 n_HT20
Transfer MCS Index: 0
Operating Frequency: 2412
Channel No. 01 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	A.F.+CL-AMP G+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4824	49.93	0.00	-0.64	V	49.29	73.98	24.69	PK
4824	37.74	0.23	-0.64	V	37.33	53.98	16.65	AV
7236	45.84	0.00	8.49	V	54.33	73.98	19.65	PK
7236	33.84	0.23	8.49	V	42.56	53.98	11.42	AV
4824	49.85	0.00	-0.64	H	49.21	73.98	24.77	PK
4824	37.72	0.23	-0.64	H	37.31	53.98	16.67	AV
7236	45.42	0.00	8.49	H	53.91	73.98	20.07	PK
7236	33.83	0.23	8.49	H	42.55	53.98	11.43	AV

Operation Mode: 802.11 n_HT40
Transfer MCS Index: 0
Operating Frequency: 2422
Channel No. 03 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	A.F.+CL-AMP G+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4844	49.78	0.00	-0.40	V	49.38	73.98	24.60	PK
4844	37.44	0.46	-0.40	V	37.50	53.98	16.48	AV
7266	46.30	0.00	8.69	V	54.99	73.98	18.99	PK
7266	33.23	0.46	8.69	V	42.38	53.98	11.60	AV
4844	49.67	0.00	-0.40	H	49.27	73.98	24.71	PK
4844	37.43	0.46	-0.40	H	37.49	53.98	16.49	AV
7266	46.25	0.00	8.69	H	54.94	73.98	19.04	PK
7266	33.21	0.46	8.69	H	42.36	53.98	11.62	AV

*A.F. : Antenna Factor / C.L. : Cable Loss / A.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor (802.11b)
5. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
+ Duty Cycle Factor (802.11g/n)
6. Distance extrapolation factor = $20 \log (\text{test distance} / \text{specific distance})$ (dB)
7. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
8. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

Operation Mode: 802.11 b

Transfer Rate: 1 Mbps

Operating Frequency: 2437

Channel No.: 06 Ch

Frequency [MHz]	Reading [dBuV]	A.F.+C.L.-A.G+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4874	50.57	0.01	V	50.58	73.98	23.40	PK
4874	42.01	0.01	V	42.02	53.98	11.96	AV
7311	48.31	8.94	V	57.25	73.98	16.73	PK
7311	38.33	8.94	V	47.27	53.98	6.71	AV
4874	50.15	0.01	H	50.16	73.98	23.82	PK
4874	38.58	0.01	H	38.59	53.98	15.39	AV
7311	47.86	8.94	H	56.80	73.98	17.18	PK
7311	35.13	8.94	H	44.07	53.98	9.91	AV

Operation Mode: 802.11 g

Transfer Rate: 6 Mbps

Operating Frequency: 2437

Channel No.: 06 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	A.F.+CL-AMP G+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4874	49.38	0.00	0.01	V	49.39	73.98	24.59	PK
4874	37.58	0.22	0.01	V	37.81	53.98	16.17	AV
7311	47.04	0.00	8.94	V	55.98	73.98	18.00	PK
7311	34.37	0.22	8.94	V	43.53	53.98	10.45	AV
4874	49.18	0.00	0.01	H	49.19	73.98	24.79	PK
4874	37.55	0.22	0.01	H	37.78	53.98	16.20	AV
7311	46.49	0.00	8.94	H	55.43	73.98	18.55	PK
7311	34.34	0.22	8.94	H	43.50	53.98	10.48	AV

Operation Mode: 802.11 n_HT20
Transfer MCS Index: 0
Operating Frequency: 2437
Channel No.: 06 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	A.F.+CL-AMP G+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4874	49.59	0.00	0.01	V	49.60	73.98	24.38	PK
4874	37.57	0.23	0.01	V	37.81	53.98	16.17	AV
7311	46.48	0.00	8.94	V	55.42	73.98	18.56	PK
7311	34.35	0.23	8.94	V	43.52	53.98	10.46	AV
4874	49.13	0.00	0.01	H	49.14	73.98	24.84	PK
4874	37.55	0.23	0.01	H	37.79	53.98	16.19	AV
7311	46.39	0.00	8.94	H	55.33	73.98	18.65	PK
7311	34.33	0.23	8.94	H	43.50	53.98	10.48	AV

Operation Mode: 802.11 n_HT40
Transfer MCS Index: 0
Operating Frequency: 2437
Channel No.: 06 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	A.F.+CL-AMP G+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4874	49.75	0.00	0.01	V	49.76	73.98	24.22	PK
4874	37.56	0.46	0.01	V	38.03	53.98	15.95	AV
7311	46.58	0.00	8.94	V	55.52	73.98	18.46	PK
7311	34.23	0.46	8.94	V	43.63	53.98	10.35	AV
4874	49.34	0.00	0.01	H	49.35	73.98	24.63	PK
4874	37.55	0.46	0.01	H	38.02	53.98	15.96	AV
7311	46.52	0.00	8.94	H	55.46	73.98	18.52	PK
7311	34.11	0.46	8.94	H	43.51	53.98	10.47	AV

*A.F. : Antenna Factor / C.L. : Cable Loss / A.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor (802.11b)
5. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
+ Duty Cycle Factor (802.11g/n)
6. Distance extrapolation factor = $20 \log (\text{test distance} / \text{specific distance})$ (dB)
7. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
8. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

Operation Mode: 802.11 b

Transfer Rate: 1 Mbps

Operating Frequency: 2462

Channel No.: 11 Ch

Frequency [MHz]	Reading [dBuV]	A.F.+C.L.-A.G+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4924	50.83	0.38	V	51.21	73.98	22.77	PK
4924	41.42	0.38	V	41.80	53.98	12.18	AV
7386	48.06	9.02	V	57.08	73.98	16.90	PK
7386	37.43	9.02	V	46.45	53.98	7.53	AV
4924	50.03	0.38	H	50.41	73.98	23.57	PK
4924	38.09	0.38	H	38.47	53.98	15.51	AV
7386	46.03	9.02	H	55.05	73.98	18.93	PK
7386	35.07	9.02	H	44.09	53.98	9.89	AV

Operation Mode: 802.11 g

Transfer Rate: 6 Mbps

Operating Frequency: 2462

Channel No.: 11 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	A.F.+CL-AMP G+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4924	49.02	0.00	0.38	V	49.40	73.98	24.58	PK
4924	36.76	0.22	0.38	V	37.36	53.98	16.62	AV
7386	46.06	0.00	9.02	V	55.08	73.98	18.90	PK
7386	33.19	0.22	9.02	V	42.43	53.98	11.55	AV
4924	48.79	0.00	0.38	H	49.17	73.98	24.81	PK
4924	36.73	0.22	0.38	H	37.33	53.98	16.65	AV
7386	45.72	0.00	9.02	H	54.74	73.98	19.24	PK
7386	33.17	0.22	9.02	H	42.41	53.98	11.57	AV

Operation Mode: 802.11 n_HT20
Transfer MCS Index: 0
Operating Frequency: 2462
Channel No. 11 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	A.F.+CL-AMP G+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4924	49.03	0.00	0.38	V	49.41	73.98	24.57	PK
4924	36.75	0.23	0.38	V	37.36	53.98	16.62	AV
7386	45.76	0.00	9.02	V	54.78	73.98	19.20	PK
7386	33.18	0.23	9.02	V	42.43	53.98	11.55	AV
4924	48.92	0.00	0.38	H	49.30	73.98	24.68	PK
4924	36.74	0.23	0.38	H	37.35	53.98	16.63	AV
7386	45.69	0.00	9.02	H	54.71	73.98	19.27	PK
7386	33.17	0.23	9.02	H	42.42	53.98	11.56	AV

Operation Mode: 802.11 n_HT40
Transfer MCS Index: 0
Operating Frequency: 2452
Channel No. 9 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	A.F.+CL-AMP G+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4904	49.91	0.00	0.38	V	50.29	73.98	23.69	PK
4904	36.74	0.46	0.38	V	37.58	53.98	16.40	AV
7356	45.93	0.00	9.02	V	54.95	73.98	19.03	PK
7356	33.75	0.46	9.02	V	43.23	53.98	10.75	AV
4904	49.81	0.00	0.38	H	50.19	73.98	23.79	PK
4904	36.72	0.46	0.38	H	37.56	53.98	16.42	AV
7356	45.83	0.00	9.02	H	54.85	73.98	19.13	PK
7356	33.73	0.46	9.02	H	43.21	53.98	10.77	AV

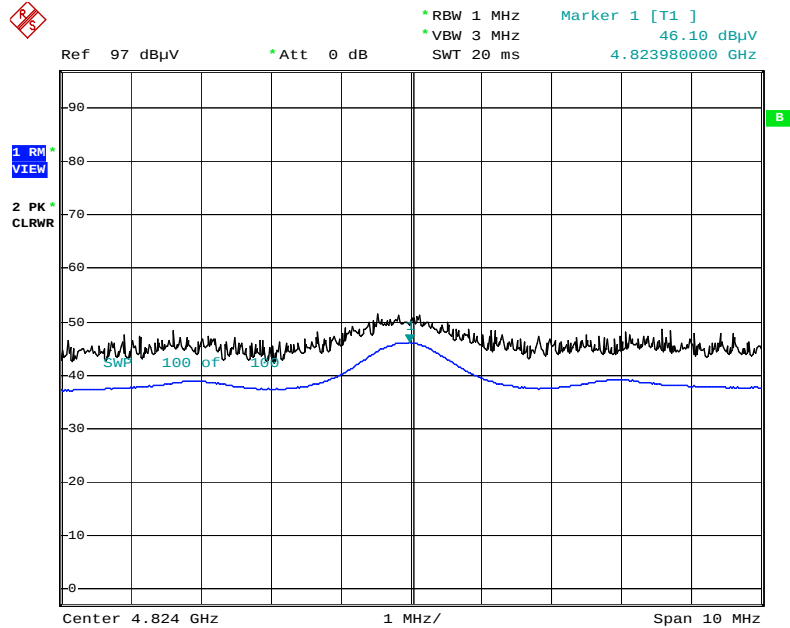
*A.F. : Antenna Factor / C.L. : Cable Loss / A.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor (802.11b)
5. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
+ Duty Cycle Factor (802.11g/n)
6. Distance extrapolation factor = $20 \log (\text{test distance} / \text{specific distance})$ (dB)
7. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
8. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

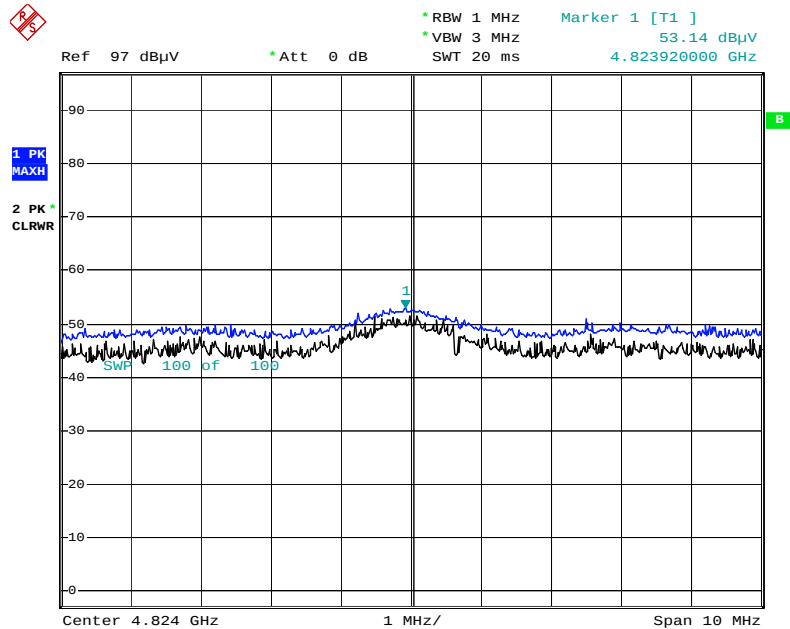
■ **RESULT PLOTS (Worst case : X-V)**

Radiated Spurious Emissions plot – Average Reading (802.11b, Ch.1 2nd Harmonic)



Date: 1.AUG.2017 17:57:38

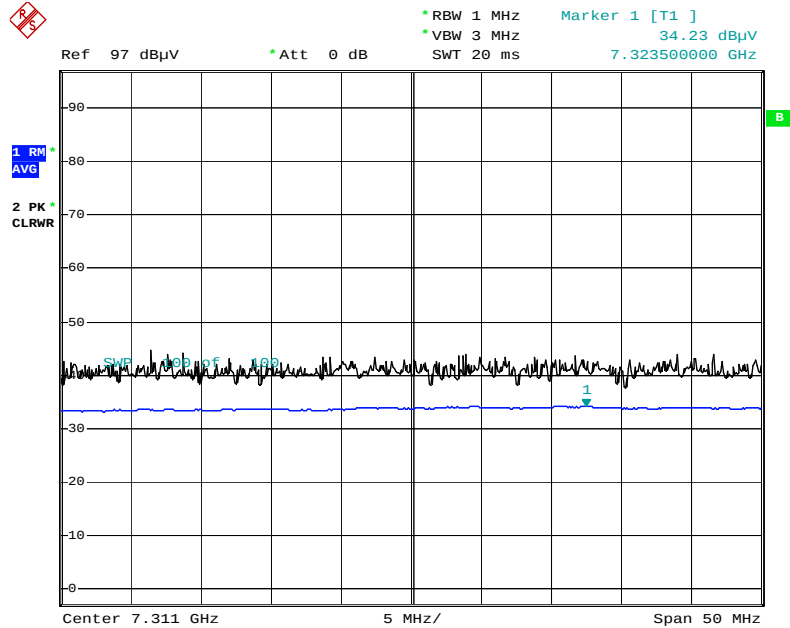
Radiated Spurious Emissions plot – Peak Reading (802.11b, Ch.1 2nd Harmonic)



Date: 1.AUG.2017 17:58:31

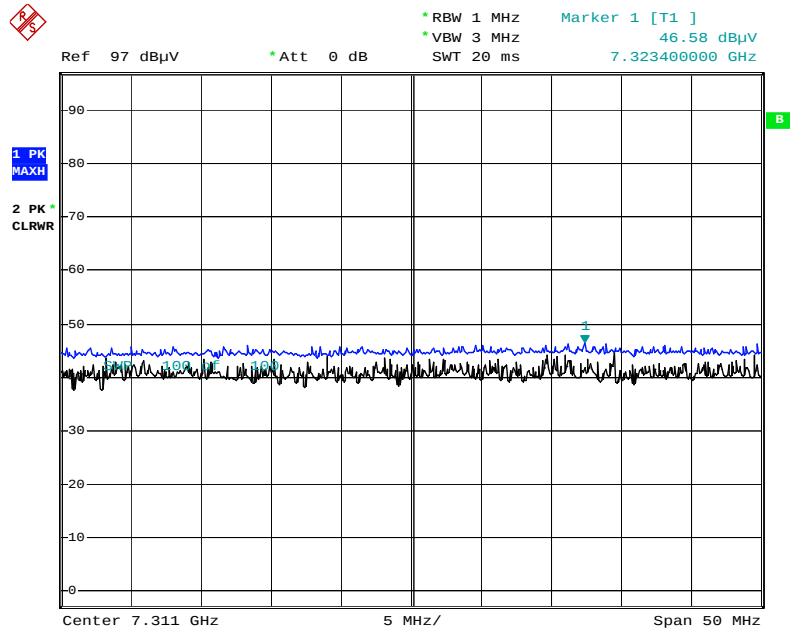
Note : Only the worst case plots for Radiated Spurious Emissions.

Radiated Spurious Emissions plot – Average Reading (802.11n_HT40, Ch.6 3rd Harmonic)



Date: 16.AUG.2017 15:24:02

Radiated Spurious Emissions plot – Peak Reading (802.11n_HT40, Ch.6 3rd Harmonic)



Date: 16.AUG.2017 15:25:34

Note : Only the worst case plots for Radiated Spurious Emissions.

9.7.2 RADIATED RESTRICTED BAND EDGES

Test Requirements and limit, §15.247(d) §15.205, §15.209, RSS-Gen(Issue 4) 8.10

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a) (See section 15.205(c)).

Operation Mode:	802.11g
Transfer Rate:	6 Mbps
Operating Frequency	2412 MHz, 2462 MHz
Channel No.	01 Ch, 11 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	A.F.+CL+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	61.12	0.00	0.06	H	61.18	73.98	12.80	PK
2390.0	47.92	0.22	0.06	H	48.20	53.98	5.78	AV
2390.0	60.00	0.00	0.06	V	60.06	73.98	13.92	PK
2390.0	46.44	0.22	0.06	V	46.72	53.98	7.26	AV
2483.5	56.72	0.00	0.15	H	56.87	73.98	17.11	PK
2483.5	44.23	0.22	0.15	H	44.60	53.98	9.38	AV
2483.5	62.05	0.00	0.15	V	62.20	73.98	11.78	PK
2483.5	49.01	0.22	0.15	V	49.38	53.98	4.60	AV

*A.F. : Antenna Factor / C.L. : Cable Loss / D.F. : Distance Factor

Operation Mode: 802.11b
Transfer Rate: 1 Mbps
Operating Frequency: 2412 MHz, 2462 MHz
Channel No.: 01 Ch, 11 Ch

Frequency [MHz]	Reading [dBuV]	A.F.+C.L.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	54.66	0.06	H	54.72	73.98	19.26	PK
2390.0	44.04	0.06	H	44.10	53.98	9.88	AV
2390.0	53.90	0.06	V	53.96	73.98	20.02	PK
2390.0	43.20	0.06	V	43.26	53.98	10.72	AV
2483.5	56.25	0.15	H	56.40	73.98	17.58	PK
2483.5	43.72	0.15	H	43.87	53.98	10.11	AV
2483.5	56.86	0.15	V	57.01	73.98	16.97	PK
2483.5	45.61	0.15	V	45.76	53.98	8.22	AV

Operation Mode: 802.11n_HT20
Transfer MCS Index: 0
Operating Frequency: 2412 MHz, 2462 MHz
Channel No.: 01 Ch, 11 Ch

Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	A.F.+CL+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	61.43	0.00	0.06	H	61.49	73.98	12.49	PK
2390.0	48.92	0.23	0.06	H	49.21	53.98	4.77	AV
2390.0	59.36	0.00	0.06	V	59.42	73.98	14.56	PK
2390.0	46.83	0.23	0.06	V	47.12	53.98	6.86	AV
2483.5	58.21	0.00	0.15	H	58.36	73.98	15.62	PK
2483.5	45.53	0.23	0.15	H	45.91	53.98	8.07	AV
2483.5	63.60	0.00	0.15	V	63.75	73.98	10.23	PK
2483.5	50.22	0.23	0.15	V	50.60	53.98	3.38	AV

Operation Mode: 802.11n_HT40
Transfer MCS Index: 0
Operating Frequency: 2422 MHz, 2452 MHz
Channel No. 03 Ch, 09 Ch

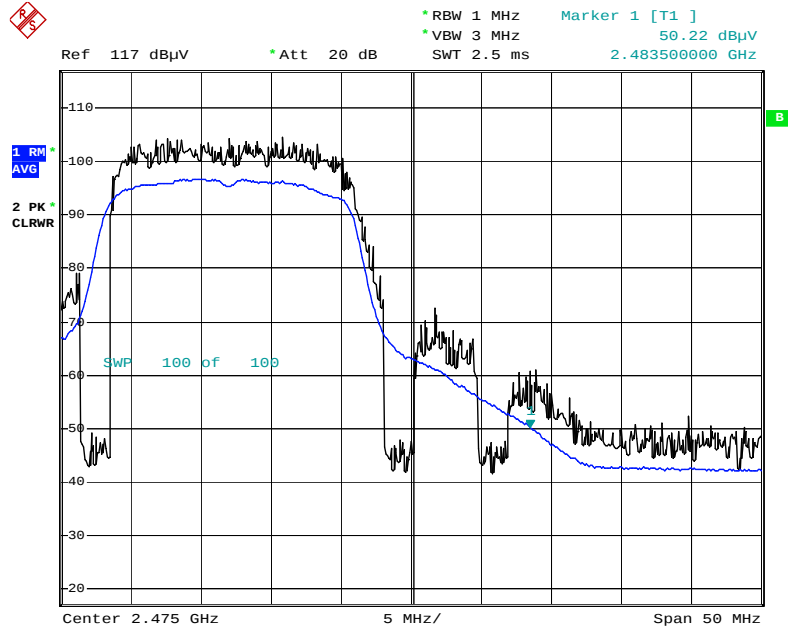
Frequency [MHz]	Reading [dBuV]	Duty Cycle Factor [dB]	A.F.+CL+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	67.53	0.00	0.06	H	67.59	73.98	6.39	PK
2390.0	49.21	0.46	0.06	H	49.73	53.98	4.25	AV
2390.0	64.41	0.00	0.06	V	64.47	73.98	9.51	PK
2390.0	46.00	0.46	0.06	V	46.52	53.98	7.46	AV
2483.5	65.22	0.00	0.15	H	65.37	73.98	8.61	PK
2483.5	48.90	0.46	0.15	H	49.51	53.98	4.47	AV
2483.5	63.63	0.00	0.15	V	63.78	73.98	10.20	PK
2483.5	46.73	0.46	0.15	V	47.34	53.98	6.64	AV

Notes:

1. Total = Reading Value + Antenna Factor + Cable Loss + Distance Factor(802.11b)
2. Total = Reading Value + Antenna Factor + Cable Loss + Distance Factor + Duty Cycle Factor (802.11g/n)
3. Distance extrapolation factor = $20 \log (\text{test distance} / \text{specific distance})$ (dB)
4. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

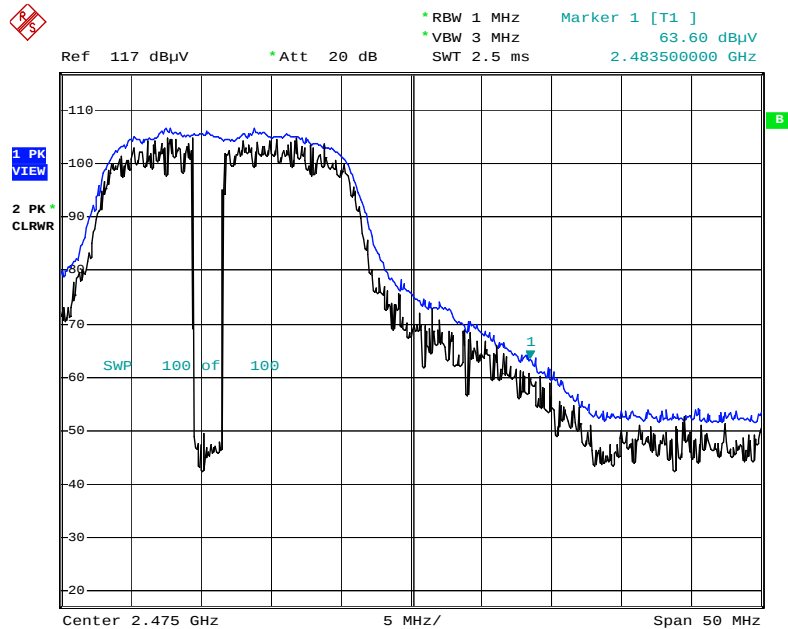
■ **RESULT PLOTS (Worst case : X-V)**

Radiated Restricted Band Edges plot – Average Reading (802.11n_HT20, Ch.11)



Date: 1.AUG.2017 15:19:23

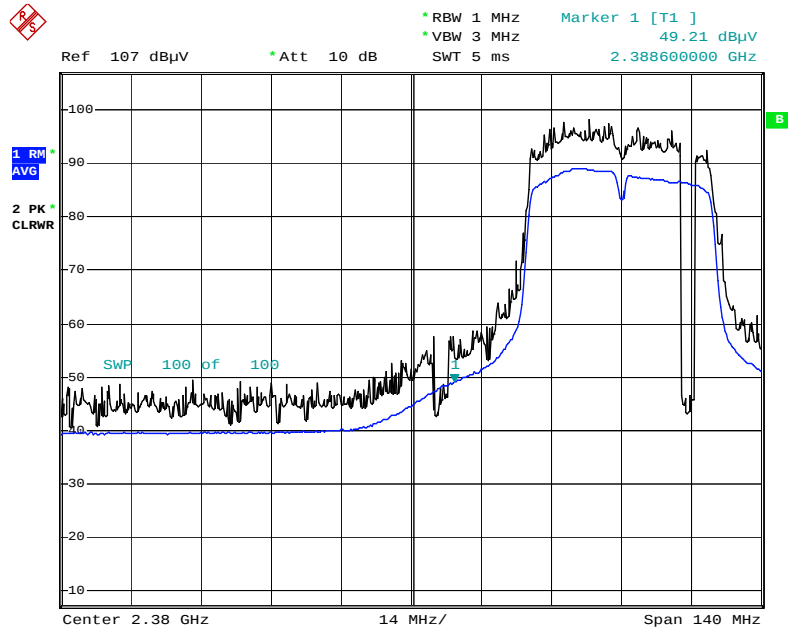
Radiated Restricted Band Edges plot – Peak Reading ((802.11n_HT20, Ch.11)



Date: 1.AUG.2017 15:20:56

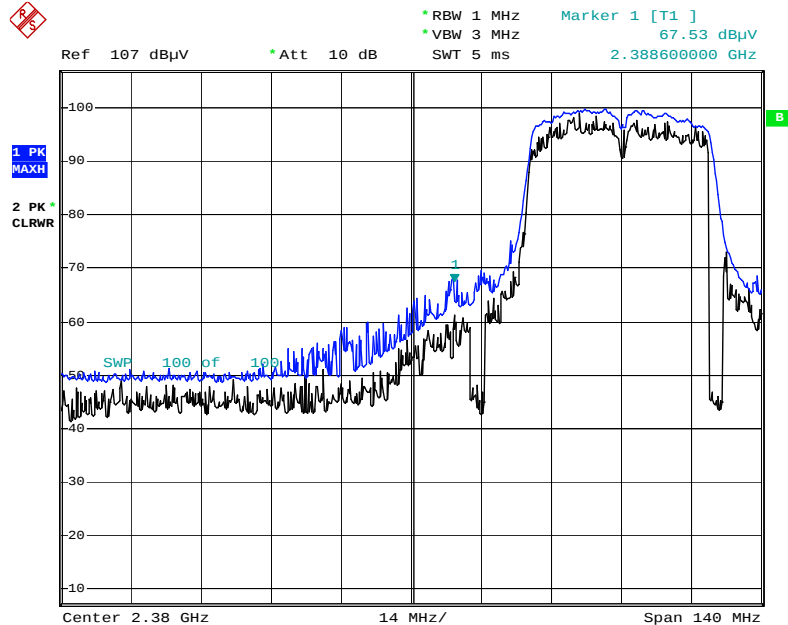
Note : Only the worst case plots for Radiated Restricted Band Edges.

Radiated Restricted Band Edges plot – Average Reading (802.11n_HT40, Ch.3)



Date: 16.AUG.2017 15:42:01

Radiated Restricted Band Edges plot – Peak Reading ((802.11n_HT40, Ch.3)



Date: 16.AUG.2017 15:40:08

Note : Only the worst case plots for Radiated Restricted Band Edges.

9.7.3 RECEIVER SPURIOUS EMISSIONS

ISED Rule(s) RSS-Gen
Test Requirements: Blow the table
Operating conditions: Under normal test conditions
Method of testing: Radiated

S/A. Settings: F < 1 GHz: RBW: 120 kHz, VBW: 300 kHz (Quasi Peak)
F > 1 GHz: RBW: 1 MHz, VBW: 3 MHz (Peak)

Mode of operation: Receive

Frequency (MHz)	Field Strength (microvolts/m at 3 meters)
30 – 88	100
88 - 216	150
216 – 960	200
Above 960	500

Operation Mode: Receive:

30 MHz ~ 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dB μ V	dB /m	dB	(H/V)	dB μ V/m	dB μ V/m	dB
No critical peaks found							

Above 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dB μ V	dB /m	dB	(H/V)	dB μ V/m	dB μ V/m	dB
No critical peaks found							

9.8 POWERLINE CONDUCTED EMISSIONS

Test Requirements and limit, §15.207, RSS-Gen(Issue 4) Section 8.8

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.
5. We are performed the AC Power Line Conducted Emission test for worst data rate, channel, operation mode.

Sample Calculation

Quasi-peak(Final Result) = Reading Value + Correction Factor

Note : We don't perform powerline conducted emission test. Because this EUT is used with vehicle.

10. LIST OF TEST EQUIPMENT

10.1 LIST OF TEST EQUIPMENT(Conducted Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Rohde & Schwarz	ENV216 / LISN	12/23/2016	Annual	100073
Rohde & Schwarz	ESCI / Test Receiver	12/23/2016	Annual	100584
Agilent	N9020A / Signal Analyzer	06/13/2017	Annual	MY51110085
Agilent	N9030A / Signal Analyzer	11/30/2016	Annual	MY49431210
Agilent	N1911A / Power Meter	04/17/2017	Annual	MY45100523
Agilent	N1921A / Power Sensor	04/17/2017	Annual	MY52260025
Agilent	87300B / Directional Coupler	11/23/2016	Annual	3116A03621
Hewlett Packard	11667B / Power Splitter	06/12/2017	Annual	05001
Hewlett Packard	E3632A / DC Power Supply	06/30/2017	Annual	KR75303960
Agilent	8493C / Attenuator(10 dB)	07/10/2017	Annual	07560
Rohde & Schwarz	EMC32 / Software	-	-	-

10.2 LIST OF TEST EQUIPMENT(Radiated Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Audix	AM4000 / Antenna Position Tower	N/A	N/A	N/A
Audix	Turn Table	N/A	N/A	N/A
Audix	EM1000 / Controller	N/A	N/A	060520
Rohde & Schwarz	Loop Antenna	04/19/2017	Biennial	1513-175
Schwarzbeck	VULB 9168 / Hybrid Antenna	04/06/2017	Biennial	760
Schwarzbeck	BBHA 9120D / Horn Antenna	08/25/2016	Biennial	9120D-1300
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	04/25/2017	Biennial	BBHA9170541
Rohde & Schwarz	FSP(9 kHz ~ 30 GHz) / Spectrum Analyzer	09/06/2017	Annual	100688
Rohde & Schwarz	FSP(9 kHz ~ 40 GHz) / Spectrum Analyzer	07/27/2017	Annual	100843
Wainwright Instruments	WHK3.0/18G-10EF / High Pass Filter	06/12/2017	Annual	8
Wainwright Instruments	WHFX7.0/18G-8SS / High Pass Filter	05/15/2017	Annual	29
Wainwright Instruments	WRCJV2400/2483.5-2370/2520-60/12SS / Band Reject Filter	06/30/2017	Annual	2
Wainwright Instruments	WRCJV5100/5850-40/50-8EEK / Band Reject Filter	01/24/2017	Annual	2
Api tech.	18B-03 / Attenuator (3 dB)	06/12/2017	Annual	1
Agilent	8493C-10 / Attenuator(10 dB)	07/19/2017	Annual	08285
CERNEX	CBLU1183540 / Power Amplifier	07/11/2017	Annual	22964
CERNEX	CBL06185030 / Power Amplifier	07/11/2017	Annual	22965
CERNEX	CBL18265035 / Power Amplifier	01/23/2017	Annual	22966
CERNEX	CBL26405040 / Power Amplifier	06/30/2017	Annual	25956