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FCC DTS REPORT

FCC Certification

Applicant Name:
SAMSUNG Electronics Co.,Ltd.

Address:
129, Samsung-ro, Yeongtong-gu, Suwon-si,
Gyeonggi-do, 16677, Rep. of Korea

Date of Issue:
December 30, 2015
Test Site/Location:
HCT CO., LTD., 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea
Report No.: HCT-R-1512-F031-2
HCT FRN: 0005866421

FCC ID	**: A3LSMA510FD**
APPLICANT	**: SAMSUNG Electronics Co.,Ltd.**

FCC Model(s):	SM-A510FD
EUT Type:	Mobile Phone
RF Avg. Output Power:	Wi-Fi 802.11b (17.50 dBm) / Wi-Fi 802.11g (14.50 dBm) / Wi-Fi 802.11n_20MHz BW (13.18 dBm)
Frequency Range:	2412 MHz - 2472 MHz (2.4 GHz Band)
Modulation type:	CCK/DSSS/OFDM
FCC Classification:	Digital Transmission System(DTS)
FCC Rule Part(s):	Part 15.247

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.

HCT CO., LTD. Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998,21 U.S. C.853(a)

Report prepared by
: Kyung Soo Kang
Test Engineer of RF Team

Approved by
: Sang Jun Lee
Manager of RF Team

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Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1512-F031	December 18, 2015	- First Approval Report
HCT-R-1512-F031-1	December 22, 2015	- Revised Frequency Range. - Retested Conducted Output Peak Power
HCT-R-1512-F031-2	December 30, 2015	- Revised RF Output Power on page 1. - Retested Section 8.5.

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1. GENERAL INFORMATION

Applicant:	SAMSUNG Electronics Co.,Ltd.
Address:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
FCC ID:	A3LSMA510FD
EUT Type:	Mobile Phone
Model name(s):	SM-A510FD
Date(s) of Tests:	November 30, 2015 ~ December 21, 2015
Place of Tests:	HCT Co., Ltd. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea (IC Recognition No. : 5944A-5)

2. EUT DESCRIPTION

FCC Model Name	SM-A510FD	
EUT Type	Mobile Phone	
Power Supply	DC 3.85 V	
Battery Infomation	Model: EB-BA510ABE Type: Li-ion Battery	
Frequency Range	TX: 2412 MHz ~ 2472 MHz RX: 2412 MHz ~ 2472 MHz	
Max. RF Output Power	Peak	Wi-Fi 802.11b(20.47 dBm) / Wi-Fi 802.11g (24.86Bm) / Wi-Fi 802.11n_20MHz BW (24.41 dBm)
	Average	Wi-Fi 802.11b(17.50 dBm) / Wi-Fi 802.11g (14.50 dBm) / Wi-Fi 802.11n_20MHz BW (13.18 dBm)
Modulation Type	DSSS/CCK(802.11b), OFDM(802.11g, 802.11n)	
Antenna Specification	Manufacturer: PARTRON CO.,LTD Antenna type: INTERNAL ANTENNA Peak Gain : -2.80 dBi	

3. TEST METHODOLOGY

FCC KDB 558074 D01 DTS Meas Guidance v03r03 dated June 09, 2015 entitled “Guidance for Performing Compliance Measurements on Digital Transmission Systems(DTS) and the measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) Operating Under §15.247” were used in the measurement.

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.

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 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)

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.

All equipments(spectrum, antenna, accessory, etc.) for measurement is calibrated in accordance with the requirements of C63.5 (latest edition).

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. SUMMARY TEST OF RESULTS

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 > 20 dBc		PASS
AC Power line Conducted Emissions	§15.207	cf. Section 8.7		PASS
Radiated Spurious Emissions	§15.205, 15.209	cf. Section 8.6.1	RADIATED	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 8.6.2		PASS

8. TEST RESULT

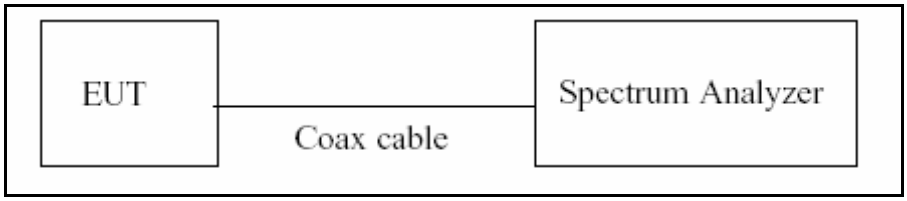
8.1 DUTY CYCLE

▣ TEST PROCEDURE

According to KDB 558074)6)b), issued 06/09/2015)

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 ≥ OBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ 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 ≤ 16.7 microseconds.)

▣ TEST CONFIGURATION



▣ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. We tested accroding to the zero-span measurement method, 6.0)b) in KDB 558074(issued 06/09/2015)

The largest availble 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 ≤ 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 availble value)
2. VBW = 8 MHz (≥ 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*log(1/Duty Cycle)

▣ Duty Cycle Factor

Mode	Data Rate	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
b	1 Mbps	8.600	8.700	0.98850575	0.050
	2 Mbps	4.300	4.400	0.97727273	0.100
	5.5 Mbps	1.620	1.720	0.94186047	0.260
	11 Mbps	0.860	0.960	0.89583333	0.478
g	6 Mbs	1.430	1.530	0.93464052	0.294
	9 Mbs	0.960	1.060	0.90566038	0.430
	12 Mbs	0.724	0.828	0.87439614	0.583
	18 Mbs	0.492	0.596	0.82550336	0.833
	24 Mbs	0.372	0.474	0.78481013	1.052
	36 Mbs	0.256	0.358	0.71508380	1.456
	48 Mbs	0.196	0.300	0.65333333	1.849
	54 Mbs	0.180	0.282	0.63829787	1.950
n_ 20MHz BW	MCS 0	1.335	1.440	0.92708333	0.329
	MCS 1	0.690	0.795	0.86792453	0.615
	MCS 2	0.470	0.575	0.81739130	0.876
	MCS 3	0.364	0.467	0.77944325	1.082
	MCS 4	0.256	0.358	0.71508380	1.456
	MCS 5	0.200	0.302	0.66225166	1.790
	MCS 6	0.184	0.285	0.64561404	1.900
	MCS 7	0.168	0.271	0.61992620	2.077

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

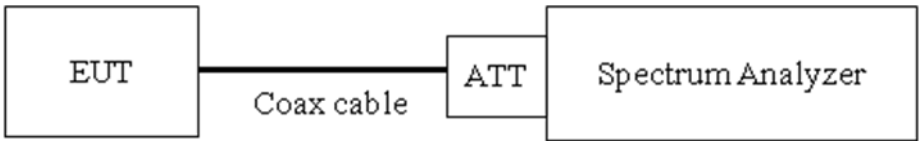
8.2 6dB BANDWIDTH

Test Requirements and limit, §15.247(a)(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, issued 06/09/2015)

RBW = 100 kHz

VBW ≥ 3 x 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	9.098	0.500	Pass
2437	6	9.052	0.500	Pass
2462	11	9.081	0.500	Pass
2467	12	9.084	0.500	Pass
2472	13	8.599	0.500	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	16.350	0.500	Pass
2437	6	16.090	0.500	Pass
2462	11	16.330	0.500	Pass
2467	12	16.060	0.500	Pass
2472	13	15.740	0.500	Pass

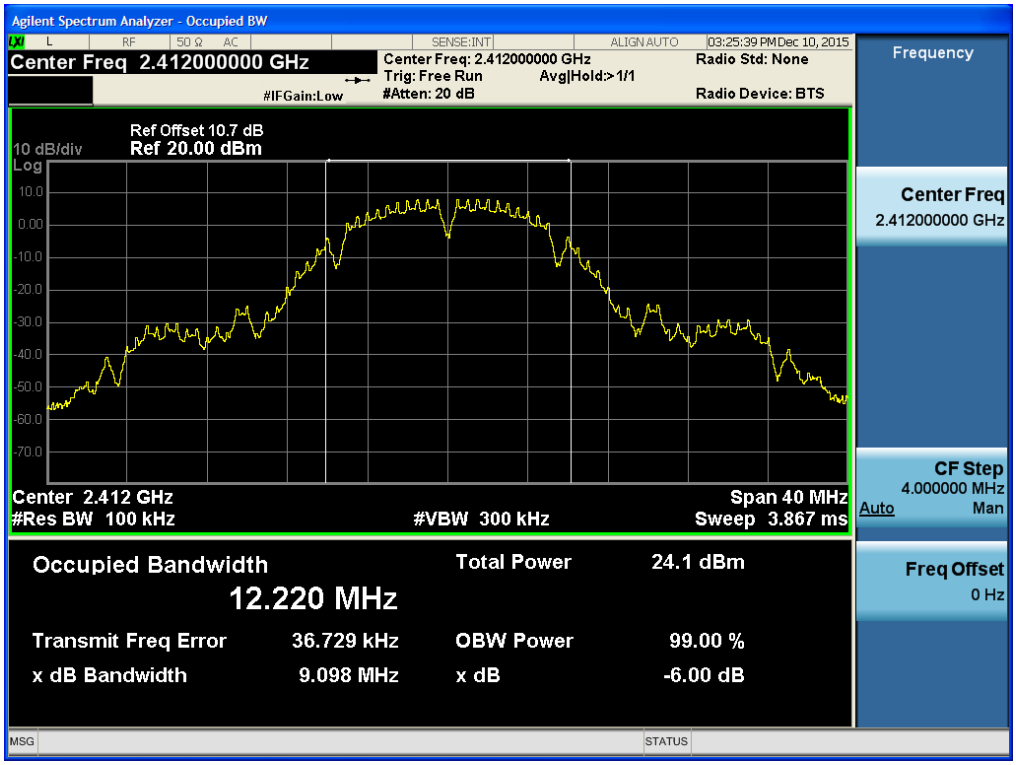
Conducted 6dB Bandwidth Measurements for 802.11n_20 MHz BW

802.11n Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
2412	1	17.320	0.500	Pass
2437	6	16.410	0.500	Pass
2462	11	17.530	0.500	Pass
2467	12	16.350	0.500	Pass
2472	13	15.990	0.500	Pass

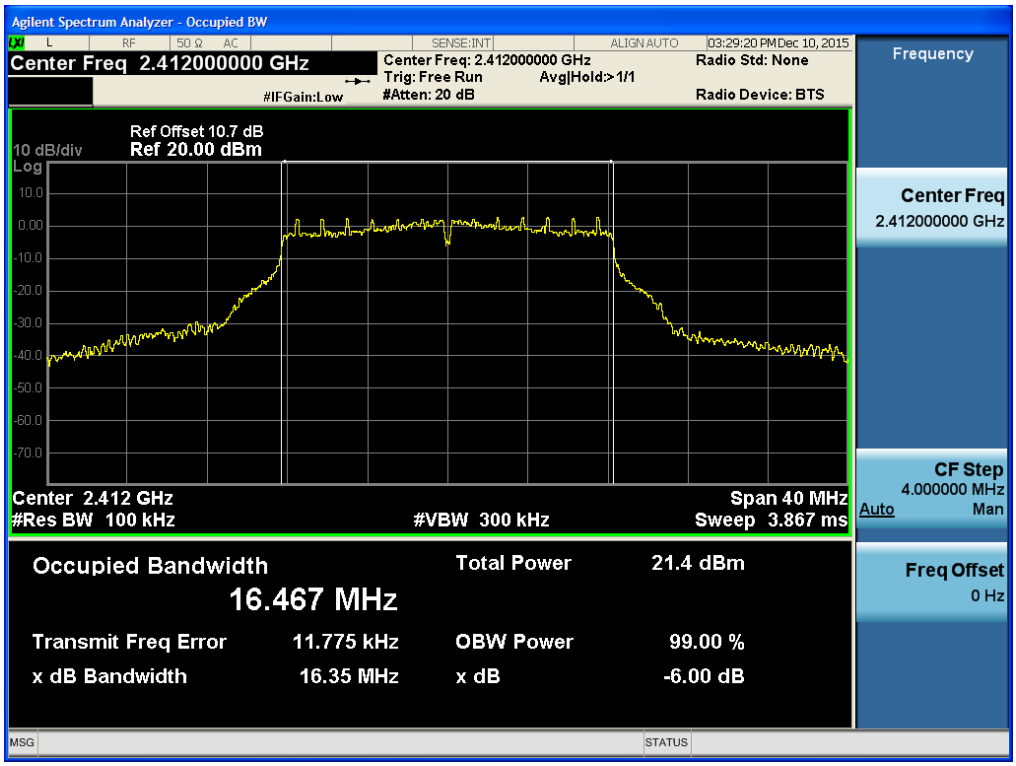
Note : In order to simplify the report, attached plots were only the most wide 6 dB BW channel.

▣ RESULT PLOTS

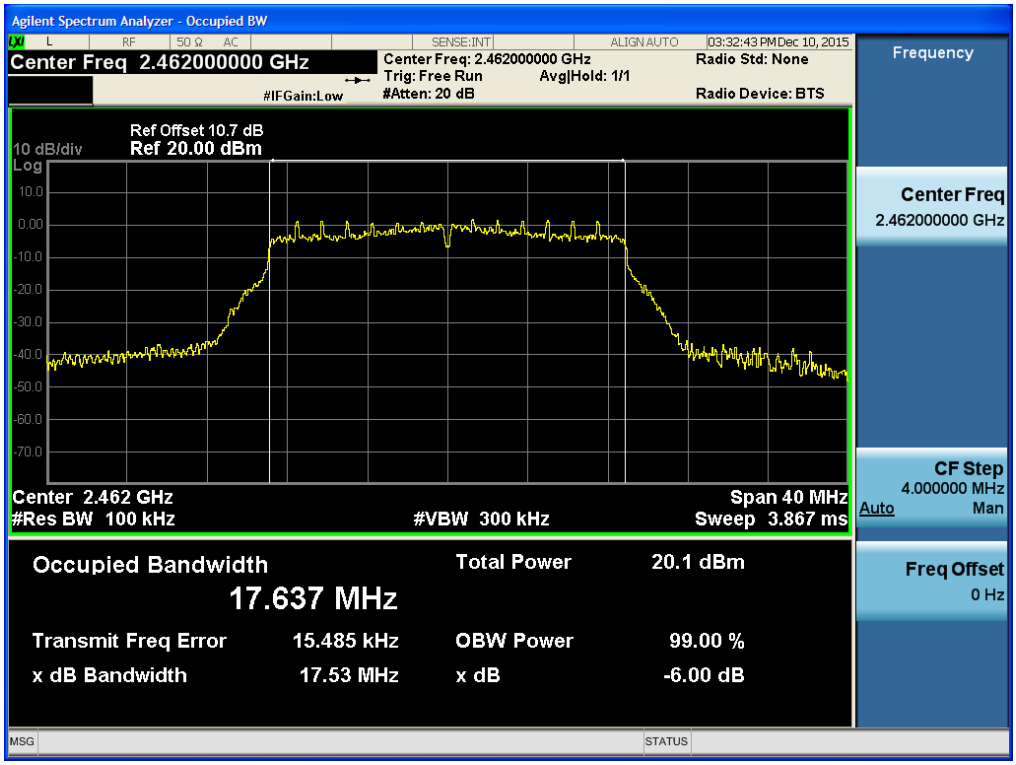
6dB Bandwidth plot (802.11b-CH 1)



6dB Bandwidth plot (802.11g-CH 1)



6dB Bandwidth plot (802.11n_20 MHz BW-CH 11)



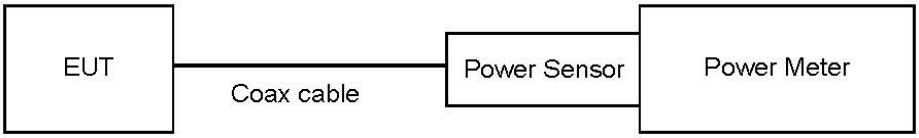
8.3 OUTPUT POWER (802.11b/g/n)

Test Requirements and limit, §15.247(b)(3)

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, issued 06/09/2015)
  1. Measure the peak power of the transmitter.
- Average Power (Procedure 9.2.3.1 in KDB 558074, issued 06/09/2015)
  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	Measured	Limit
Frequency[MHz]	Channel No.	(Mbps)	Power(dBm)	(dBm)
2412	1	1 Mbps	19.46	30
		2 Mbps	19.96	30
		5.5 Mbps	19.79	30
		11 Mbps	19.93	30
2437	6	1 Mbps	19.87	30
		2 Mbps	20.27	30
		5.5 Mbps	20.31	30
		11 Mbps	20.47	30
2462	11	1 Mbps	19.05	30
		2 Mbps	19.60	30
		5.5 Mbps	19.54	30
		11 Mbps	19.70	30
2467	12	1 Mbps	10.88	30
		2 Mbps	11.25	30
		5.5 Mbps	11.11	30
		11 Mbps	11.28	30
2472	13	1 Mbps	10.36	30
		2 Mbps	11.13	30
		5.5 Mbps	11.11	30
		11 Mbps	11.34	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	24.46	30
		9 Mbps	24.19	30
		12 Mbps	23.99	30
		18 Mbps	24.05	30
		24 Mbps	23.81	30
		36 Mbps	23.89	30
		48 Mbps	24.11	30
		54 Mbps	23.80	30
2437	6	6 Mbps	24.86	30
		9 Mbps	24.81	30
		12 Mbps	24.56	30
		18 Mbps	24.53	30
		24 Mbps	24.55	30
		36 Mbps	24.29	30
		48 Mbps	24.84	30
		54 Mbps	24.20	30
2462	11	6 Mbps	24.01	30
		9 Mbps	23.89	30
		12 Mbps	23.73	30
		18 Mbps	23.80	30
		24 Mbps	23.65	30
		36 Mbps	23.37	30
		48 Mbps	24.01	30
		54 Mbps	23.23	30
2467	12	6 Mbps	19.13	30
		9 Mbps	18.79	30
		12 Mbps	17.99	30
		18 Mbps	18.22	30
		24 Mbps	18.06	30
		36 Mbps	17.55	30
		48 Mbps	18.73	30
		54 Mbps	17.25	30
2472	13	6 Mbps	18.97	30
		9 Mbps	18.73	30
		12 Mbps	17.90	30
		18 Mbps	18.27	30
		24 Mbps	17.65	30
		36 Mbps	17.30	30
		48 Mbps	18.86	30
		54 Mbps	16.76	30

Conducted Output Power Measurements (802.11n_20MHz BW Mode)

802.11n Mode		MCS Index	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	0	24.02	30
		1	24.11	30
		2	24.08	30
		3	23.82	30
		4	23.85	30
		5	23.98	30
		6	23.93	30
		7	23.90	30
2437	6	0	24.20	30
		1	24.12	30
		2	24.35	30
		3	24.20	30
		4	24.14	30
		5	24.41	30
		6	24.25	30
		7	24.11	30
2462	11	0	23.56	30
		1	23.55	30
		2	23.72	30
		3	23.65	30
		4	23.47	30
		5	23.81	30
		6	23.42	30
		7	23.39	30
2467	12	0	18.48	30
		1	18.04	30
		2	18.66	30
		3	18.08	30
		4	17.71	30
		5	18.93	30
		6	17.82	30
		7	17.50	30
2472	13	0	18.34	30
		1	18.82	30
		2	18.31	30
		3	18.10	30
		4	17.42	30
		5	18.45	30
		6	17.59	30
		7	17.64	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	16.23	0.050	16.28	30
		2 Mbps	16.66	0.100	16.76	30
		5.5 Mbps	16.87	0.260	17.13	30
		11 Mbps	16.58	0.478	17.06	30
2437	6	1 Mbps	16.71	0.050	16.76	30
		2 Mbps	17.24	0.100	17.34	30
		5.5 Mbps	17.24	0.260	17.50	30
		11 Mbps	17.02	0.478	17.50	30
2462	11	1 Mbps	16.05	0.050	16.10	30
		2 Mbps	16.58	0.100	16.68	30
		5.5 Mbps	16.68	0.260	16.94	30
		11 Mbps	16.27	0.478	16.75	30
2467	12	1 Mbps	7.25	0.050	7.30	30
		2 Mbps	7.75	0.100	7.85	30
		5.5 Mbps	7.68	0.260	7.94	30
		11 Mbps	7.47	0.478	7.95	30
2472	13	1 Mbps	6.97	0.050	7.02	30
		2 Mbps	7.46	0.100	7.56	30
		5.5 Mbps	7.41	0.260	7.67	30
		11 Mbps	7.20	0.478	7.68	30

Conducted Output Power Measurements (802.11g Mode)

802.11g Mode		Rate (Mbps)	Measured Power (dBm)	Duty Cycle Factor	Measured Power (dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	6 Mbps	13.81	0.294	14.10	30
		9 Mbps	13.83	0.430	14.26	30
		12 Mbps	13.72	0.583	14.30	30
		18 Mbps	13.42	0.833	14.25	30
		24 Mbps	12.99	1.052	14.04	30
		36 Mbps	12.61	1.456	14.07	30
		48 Mbps	12.24	1.849	14.09	30
		54 Mbps	12.15	1.950	14.10	30
2437	6	6 Mbps	14.21	0.294	14.50	30
		9 Mbps	14.03	0.430	14.46	30
		12 Mbps	13.89	0.583	14.47	30
		18 Mbps	13.61	0.833	14.44	30
		24 Mbps	13.30	1.052	14.35	30
		36 Mbps	12.88	1.456	14.34	30
		48 Mbps	12.62	1.849	14.47	30
		54 Mbps	12.51	1.950	14.46	30
2462	11	6 Mbps	13.72	0.294	14.01	30
		9 Mbps	13.50	0.430	13.93	30
		12 Mbps	13.28	0.583	13.86	30
		18 Mbps	13.08	0.833	13.91	30
		24 Mbps	12.79	1.052	13.84	30
		36 Mbps	12.32	1.456	13.78	30
		48 Mbps	12.10	1.849	13.95	30
		54 Mbps	11.83	1.950	13.78	30
2467	12	6 Mbps	7.39	0.294	7.68	30
		9 Mbps	7.23	0.430	7.66	30
		12 Mbps	7.16	0.583	7.74	30
		18 Mbps	6.91	0.833	7.74	30
		24 Mbps	6.59	1.052	7.64	30
		36 Mbps	6.07	1.456	7.53	30
		48 Mbps	5.84	1.849	7.69	30
		54 Mbps	5.74	1.950	7.69	30
2472	13	6 Mbps	7.21	0.294	7.50	30
		9 Mbps	7.11	0.430	7.54	30
		12 Mbps	7.00	0.583	7.58	30
		18 Mbps	6.72	0.833	7.55	30
		24 Mbps	6.43	1.052	7.48	30
		36 Mbps	5.96	1.456	7.42	30
		48 Mbps	5.67	1.849	7.52	30
		54 Mbps	5.58	1.950	7.53	30

Conducted Output Power Measurements (802.11n_20MHz BW Mode)

802.11g Mode		MCS Index	Measured Power (dBm)	Duty Cycle Factor	Measured Power (dBm) + Duty Cycle Factor	Limit (dBm)
Frequency [MHz]	Channel No.					
2412	1	0	12.64	0.329	12.97	30
		1	12.28	0.615	12.90	30
		2	12.18	0.876	13.06	30
		3	11.71	1.082	12.79	30
		4	11.41	1.456	12.87	30
		5	11.10	1.790	12.89	30
		6	11.02	1.900	12.92	30
		7	10.71	2.077	12.79	30
2437	6	0	12.79	0.329	13.12	30
		1	12.56	0.615	13.18	30
		2	12.20	0.876	13.08	30
		3	12.00	1.082	13.08	30
		4	11.68	1.456	13.14	30
		5	11.30	1.790	13.09	30
		6	11.14	1.900	13.04	30
		7	11.06	2.077	13.14	30
2462	11	0	12.35	0.329	12.68	30
		1	12.10	0.615	12.72	30
		2	11.79	0.876	12.67	30
		3	11.55	1.082	12.63	30
		4	11.15	1.456	12.61	30
		5	10.72	1.790	12.51	30
		6	10.63	1.900	12.53	30
		7	10.54	2.077	12.62	30
2467	12	0	7.00	0.329	7.33	30
		1	6.58	0.615	7.20	30
		2	6.33	0.876	7.21	30
		3	6.15	1.082	7.23	30
		4	5.88	1.456	7.34	30
		5	5.50	1.790	7.29	30
		6	5.35	1.900	7.25	30
		7	5.34	2.077	7.42	30
2472	13	0	5.84	0.329	6.17	30
		1	5.60	0.615	6.22	30
		2	5.38	0.876	6.26	30
		3	5.20	1.082	6.28	30
		4	4.87	1.456	6.33	30
		5	4.45	1.790	6.24	30
		6	4.33	1.900	6.23	30
		7	4.19	2.077	6.27	30

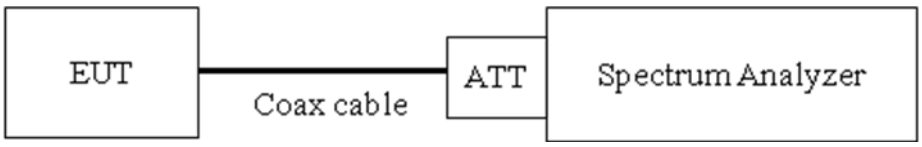
8.4 POWER SPECTRAL DENSITY (802.11b/g/n)

Test Requirements and limit, §15.247(e)

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, issued 06/09/2015

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 x 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.

▣ Sample Calculation

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

Output Power = -5 dBm + 10 dB + 0.8 dB = 5.8 dBm

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

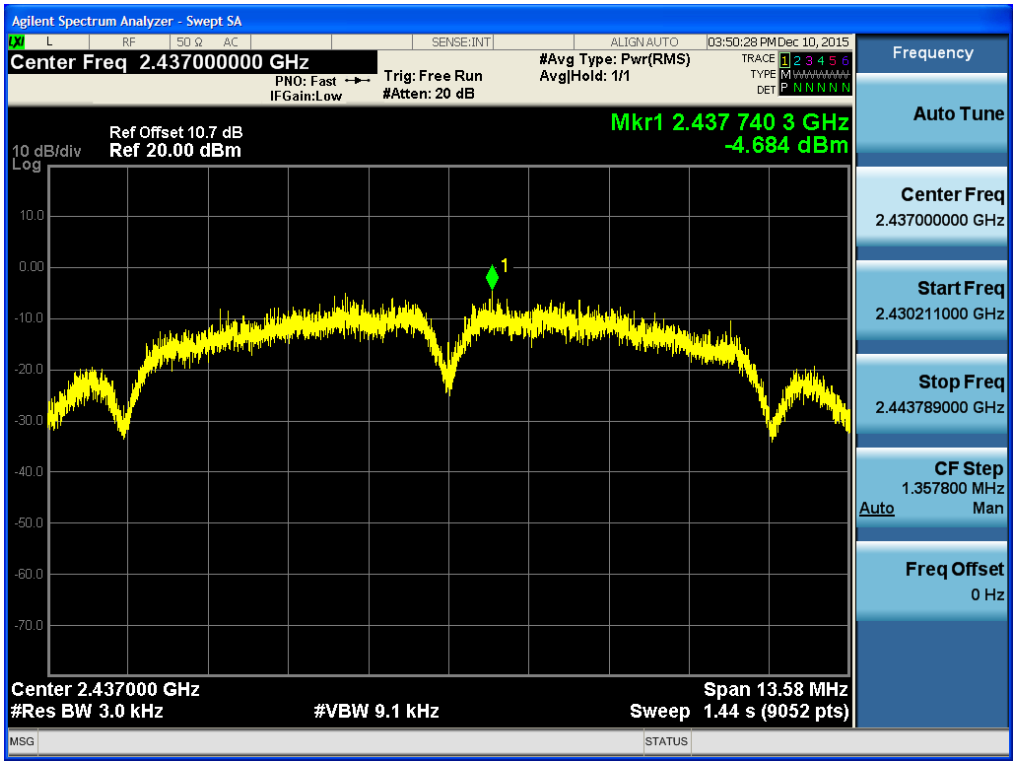
Conducted Power Density Measurements

Frequency (MHz)	Channel No.	Mode	Test Result		
			PSD (dBm)	Limit (dBm)	Pass/Fail
2412	1	802.11b	-5.370	8	Pass
2437	6		-4.684	8	Pass
2462	11		-6.859	8	Pass
2467	12		-15.093	8	Pass
2472	13		-15.281	8	Pass
2412	1	802.11g	-9.365	8	Pass
2437	6		-8.629	8	Pass
2462	11		-9.689	8	Pass
2467	12		-18.158	8	Pass
2472	13		-16.573	8	Pass
2412	1	802.11n 20MHz BW	-10.694	8	Pass
2437	6		-9.146	8	Pass
2462	11		-12.953	8	Pass
2467	12		-16.586	8	Pass
2472	13		-16.845	8	Pass

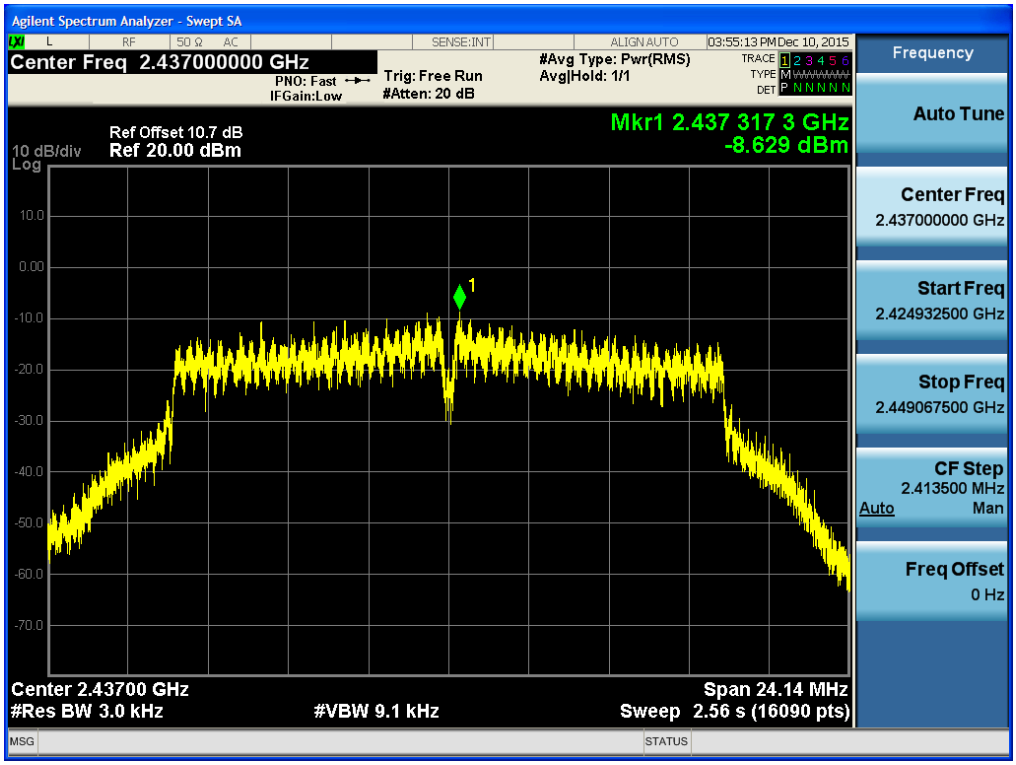
Note : In order to simplify the report, attached plots were only the highest PSD channel.

▣ RESULT PLOTS

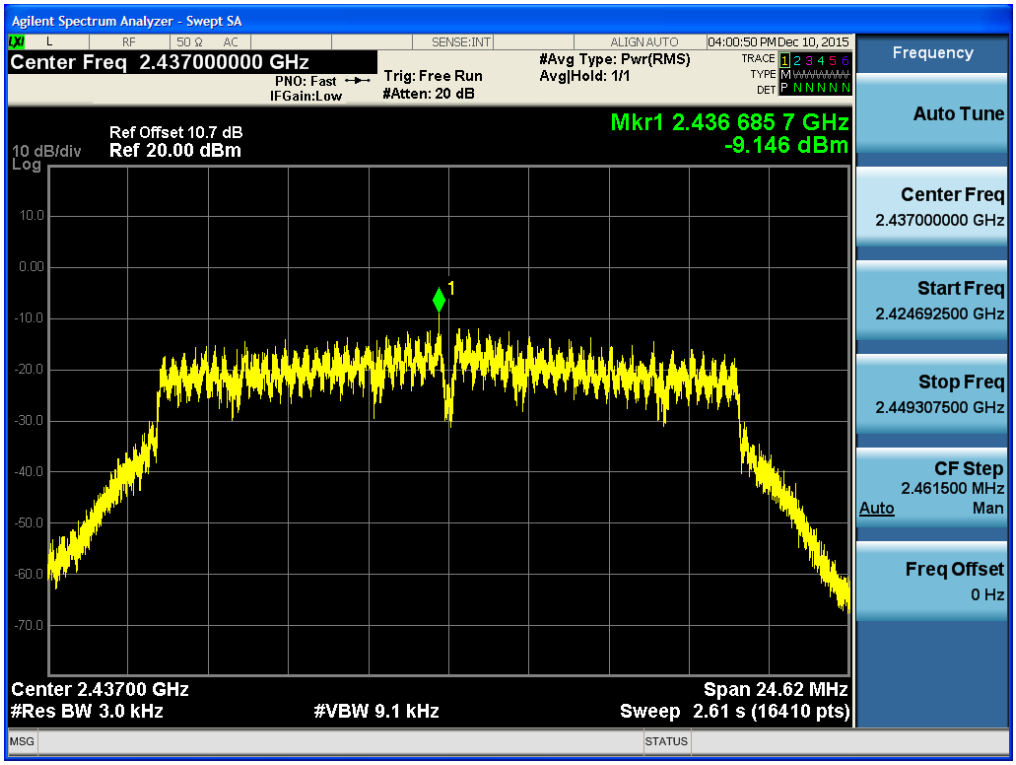
Power Spectral Density (802.11b-CH 6)



Power Spectral Density (802.11g-CH 6)



Power Spectral Density (802.11n_20MHz BW -CH 6)



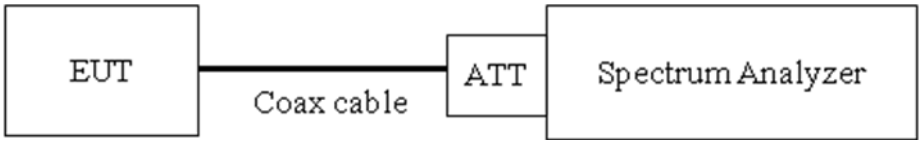
8.5 OUT OF BAND EMISSIONS AT THE BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

Test Requirements and limit, §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. 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 : 30 dBc

▣ TEST CONFIGURATION



▣ TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. (Procedure 11.0 in KDB 558074, issued 06/09/2015)

RBW = 100 kHz

VBW ≥ 3 x RBW

Set span to encompass the spectrum to be examined

Detector = RMS

Trace Mode = Average hold

Sweep time = auto couple

Ensure that the number of measurement points ≥ 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 band edge 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)

4. In case of conducted spurious emissions test, please check factors blow table.
5. 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

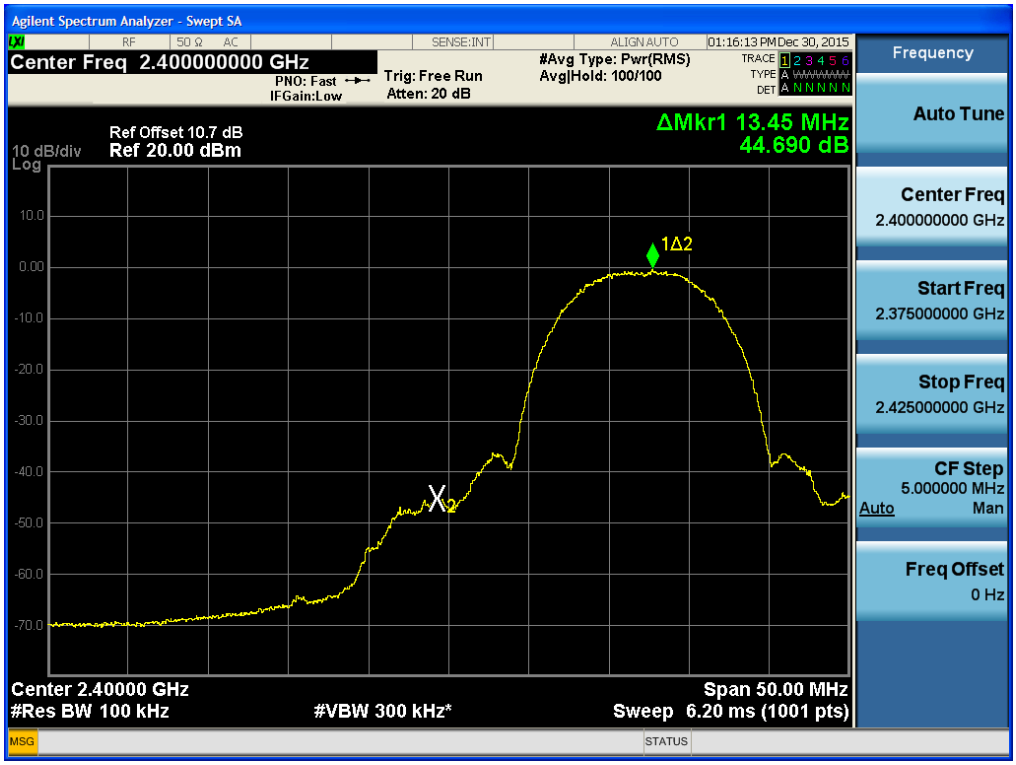
11000	11.56
12000	11.68
13000	11.83
14000	11.90
15000	11.98
16000	12.04
17000	12.02
18000	12.08
19000	12.07
20000	12.14
21000	12.17
22000	12.31
23000	12.60
24000	12.34
25000	12.53

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

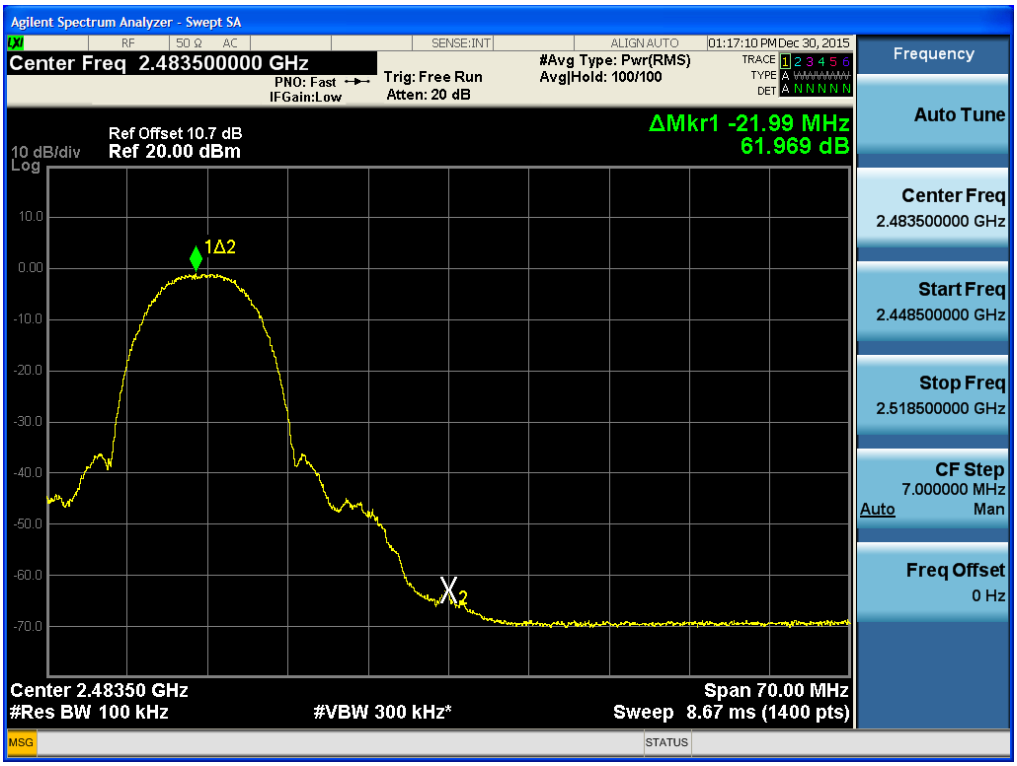
2. Factor = Cable loss + Attenuator loss

▣ RESULT PLOTS

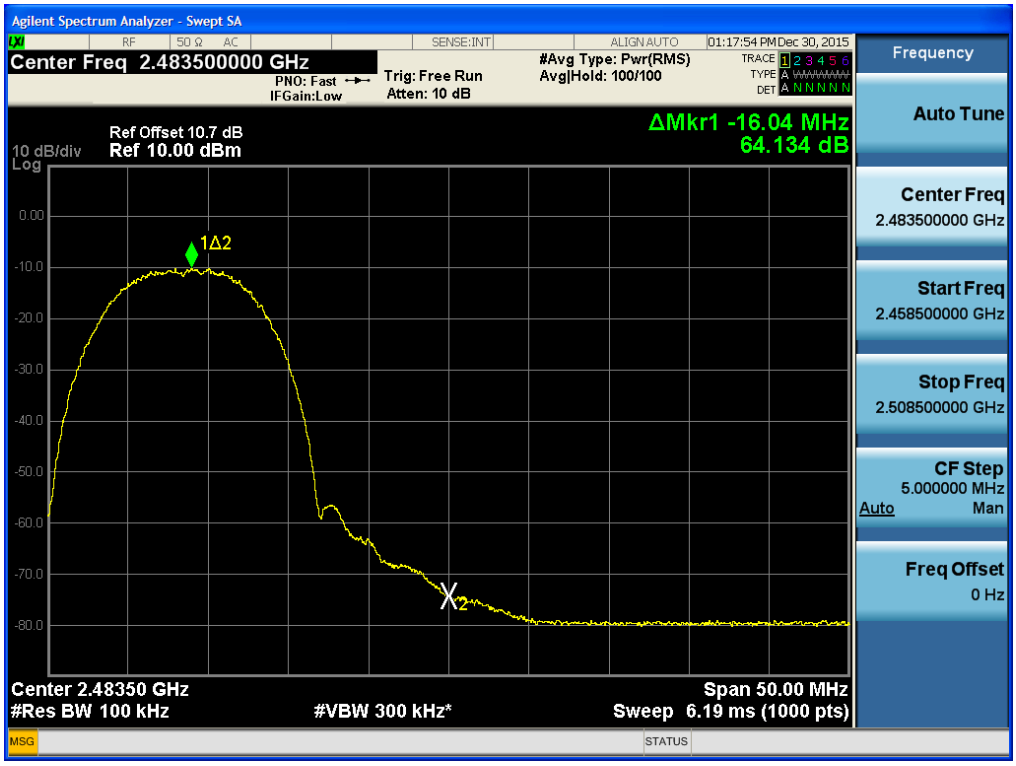
BandEdge (802.11b-CH1)



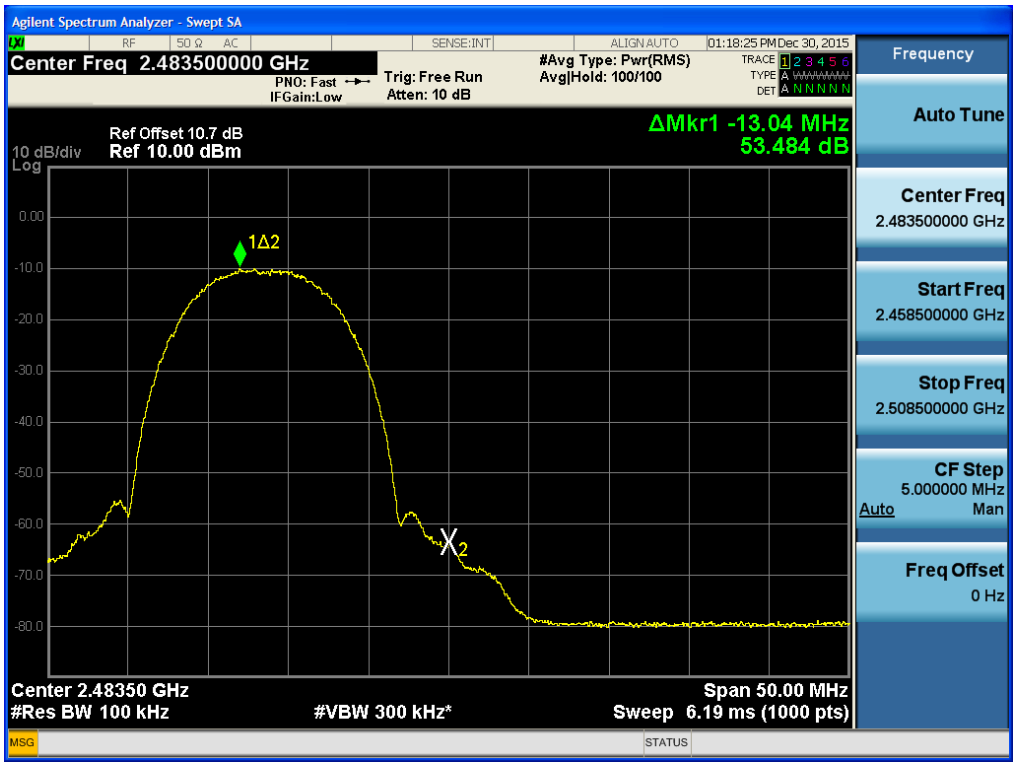
BandEdge (802.11b-CH11)



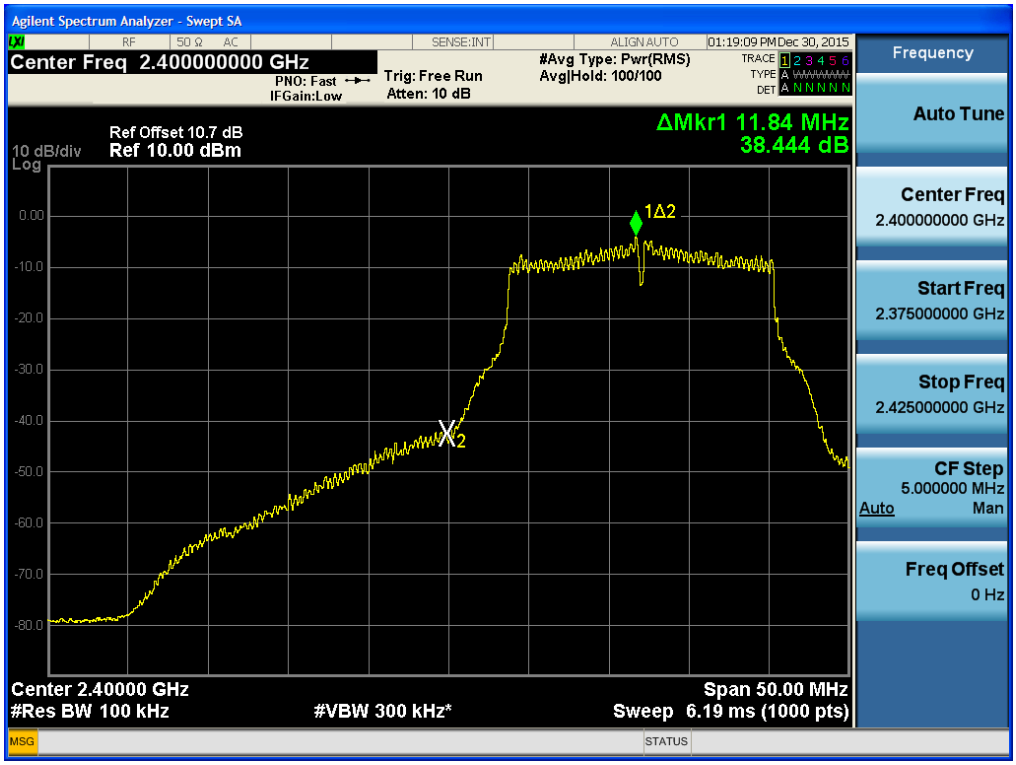
BandEdge (802.11b-CH12)



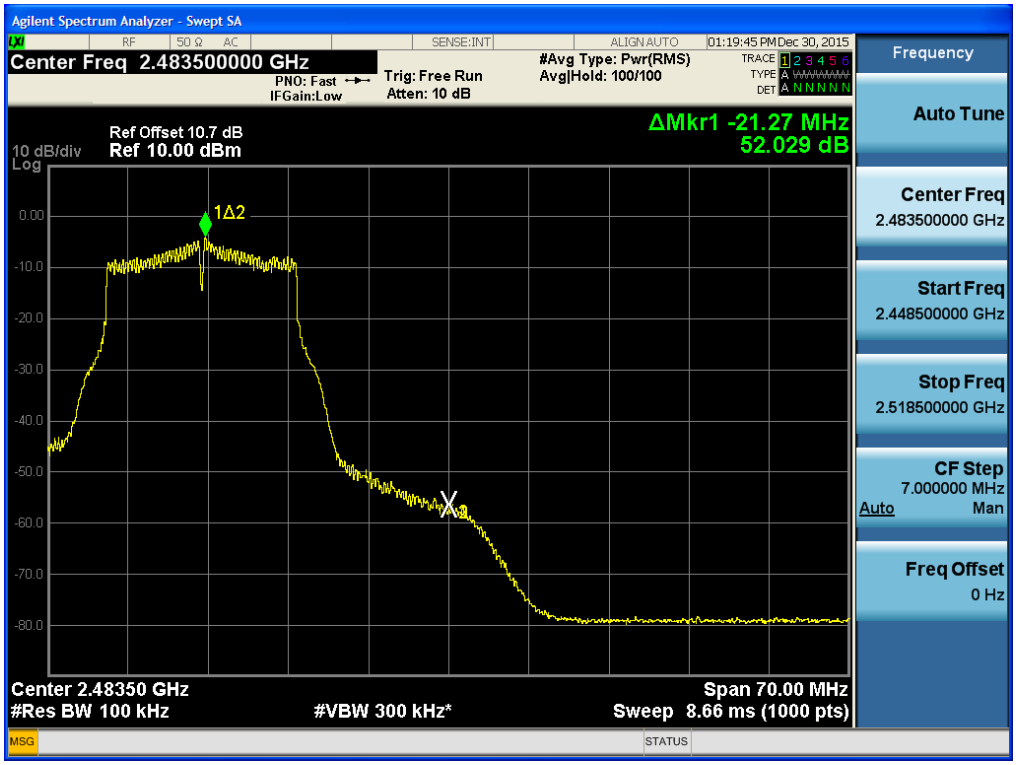
BandEdge (802.11b-CH13)



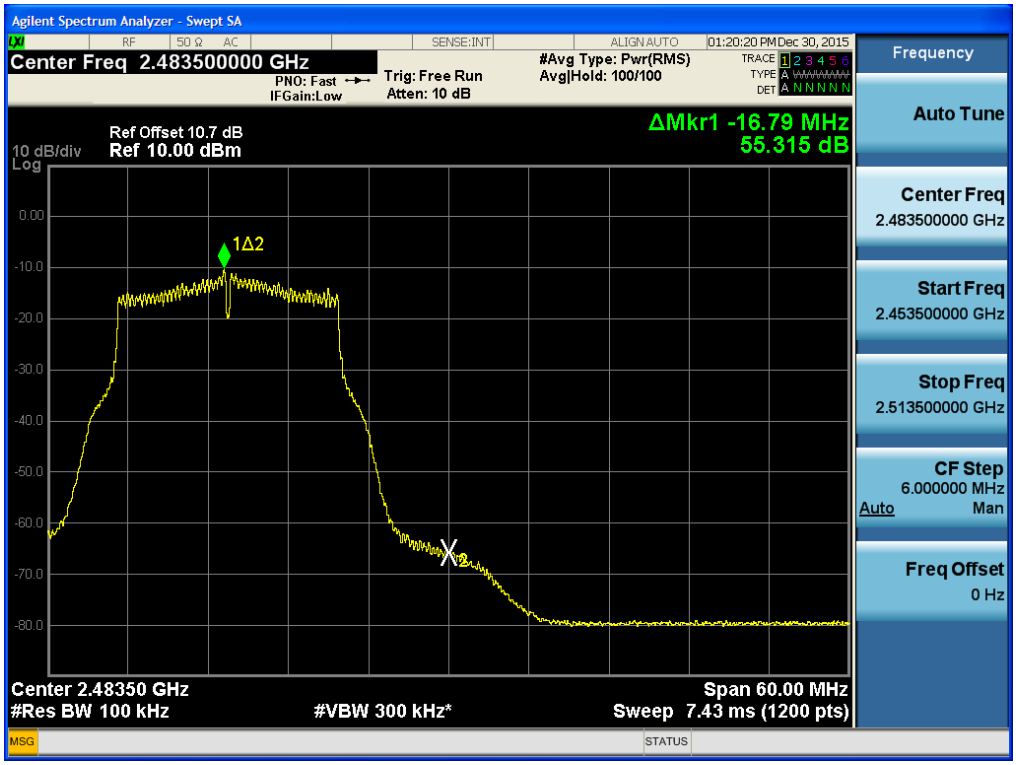
BandEdge (802.11g-CH1)



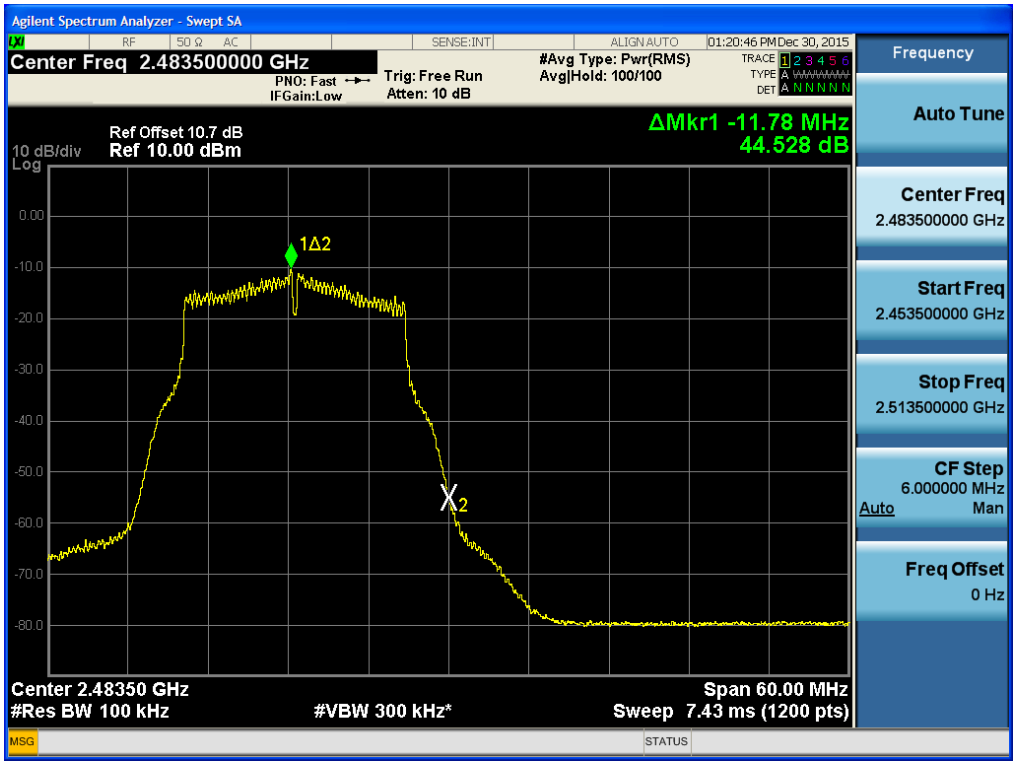
BandEdge (802.11g-CH11)



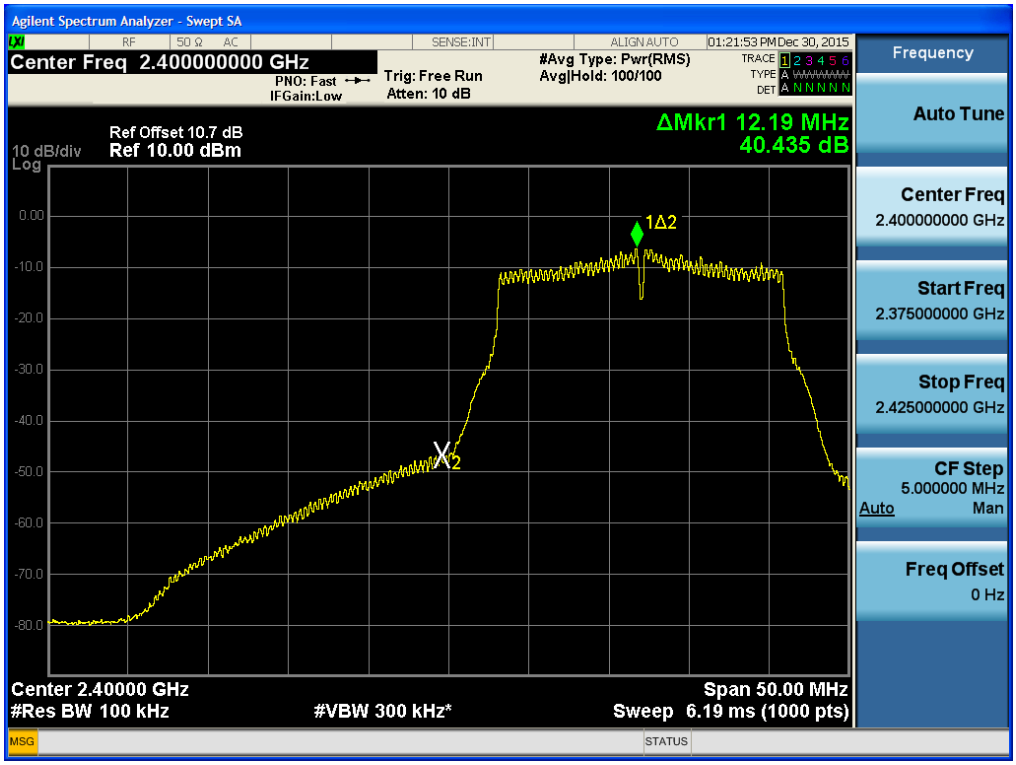
BandEdge (802.11g-CH12)



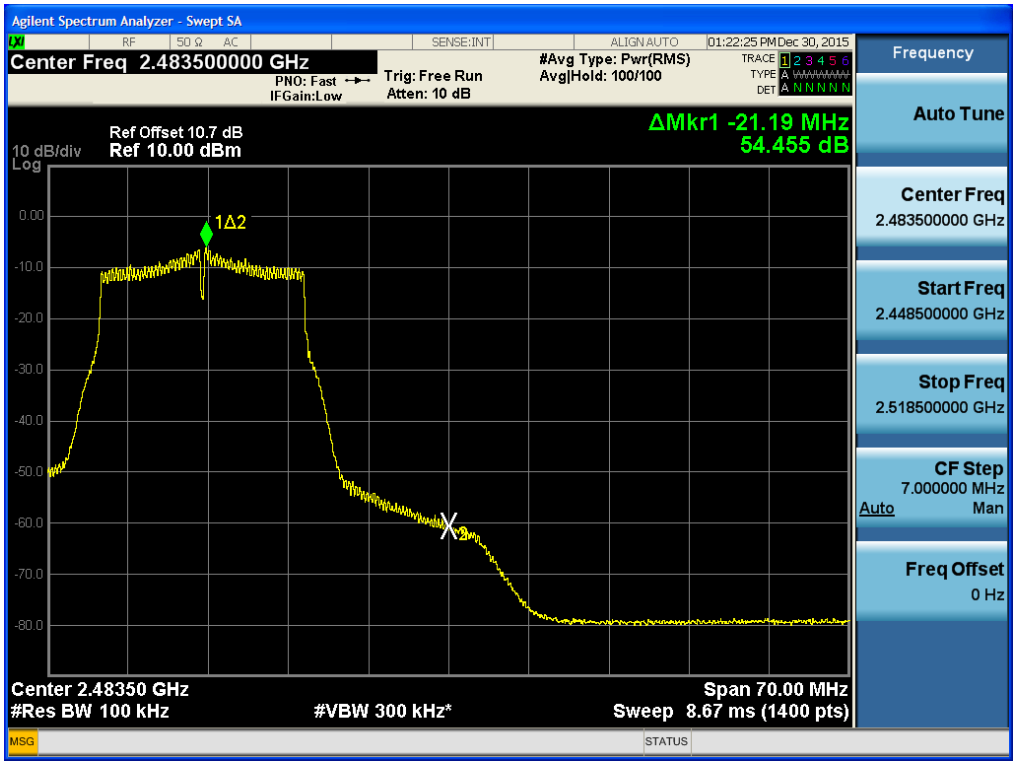
BandEdge (802.11g-CH13)



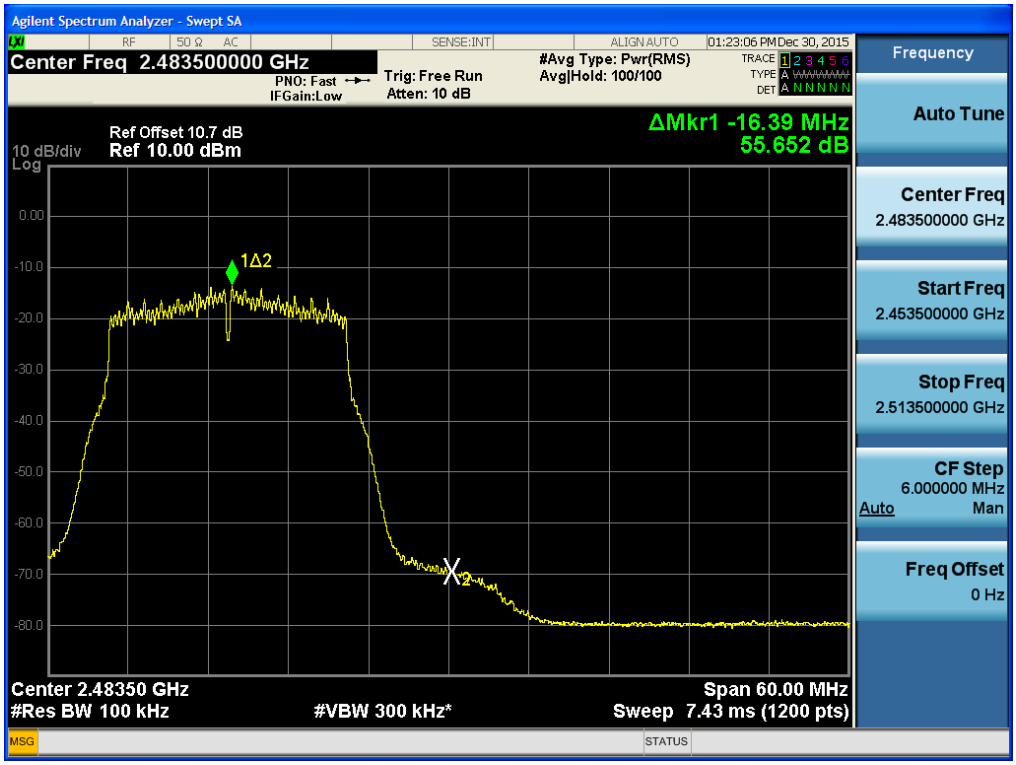
Band Edge (802.11n_20MHz-CH1)



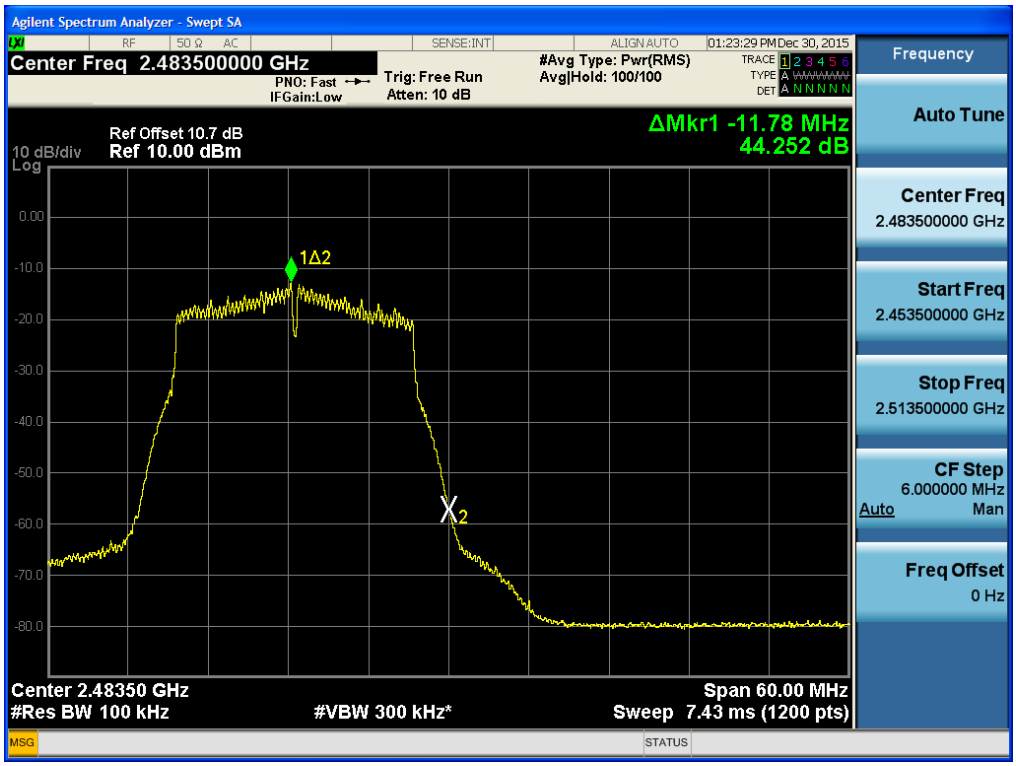
Band Edge (802.11n_20MHz-CH11)



Band Edge (802.11n_20MHz-CH1)

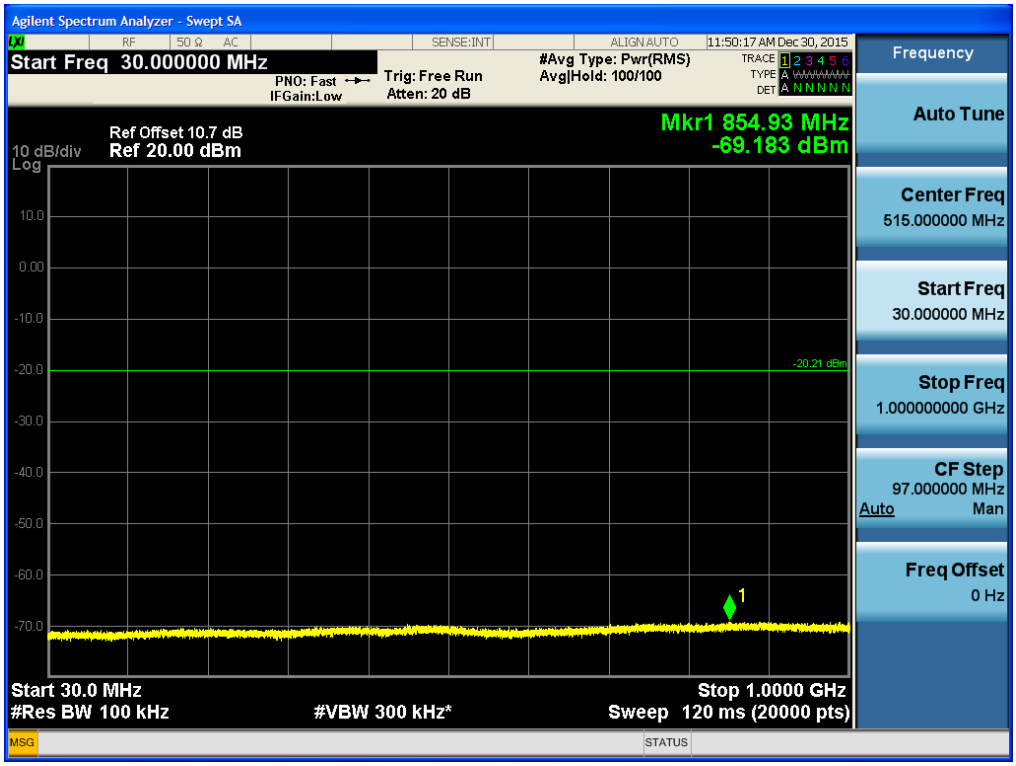


Band Edge (802.11n_20MHz-CH11)



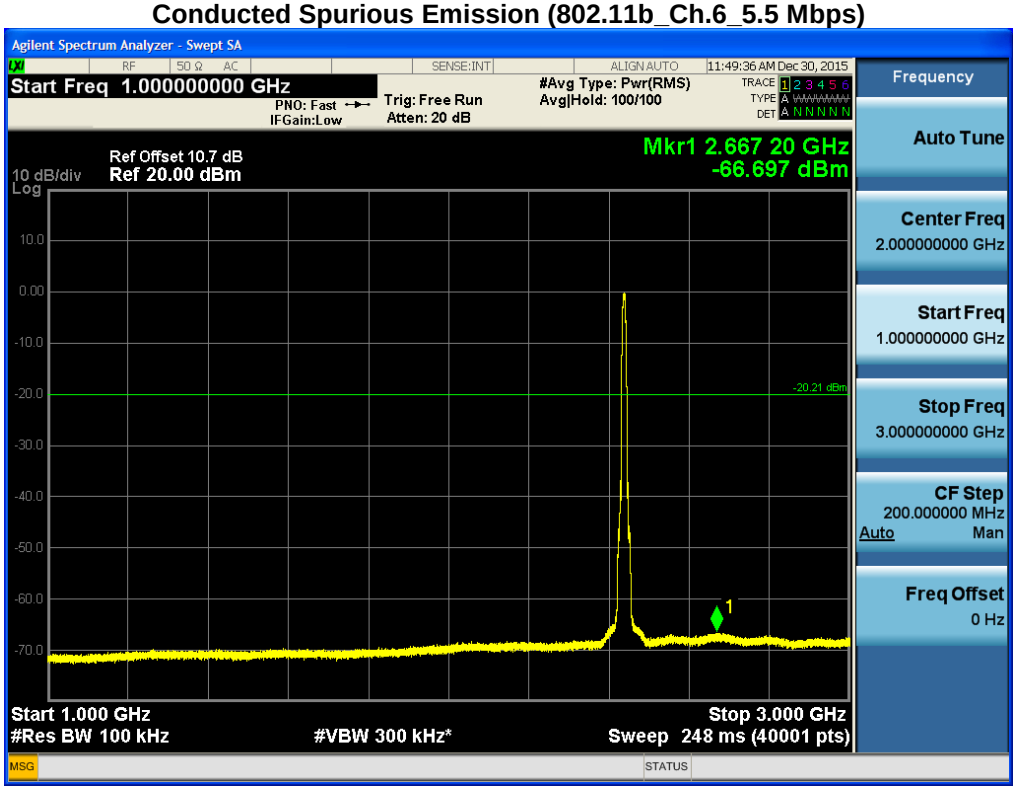
30 MHz ~ 1 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)



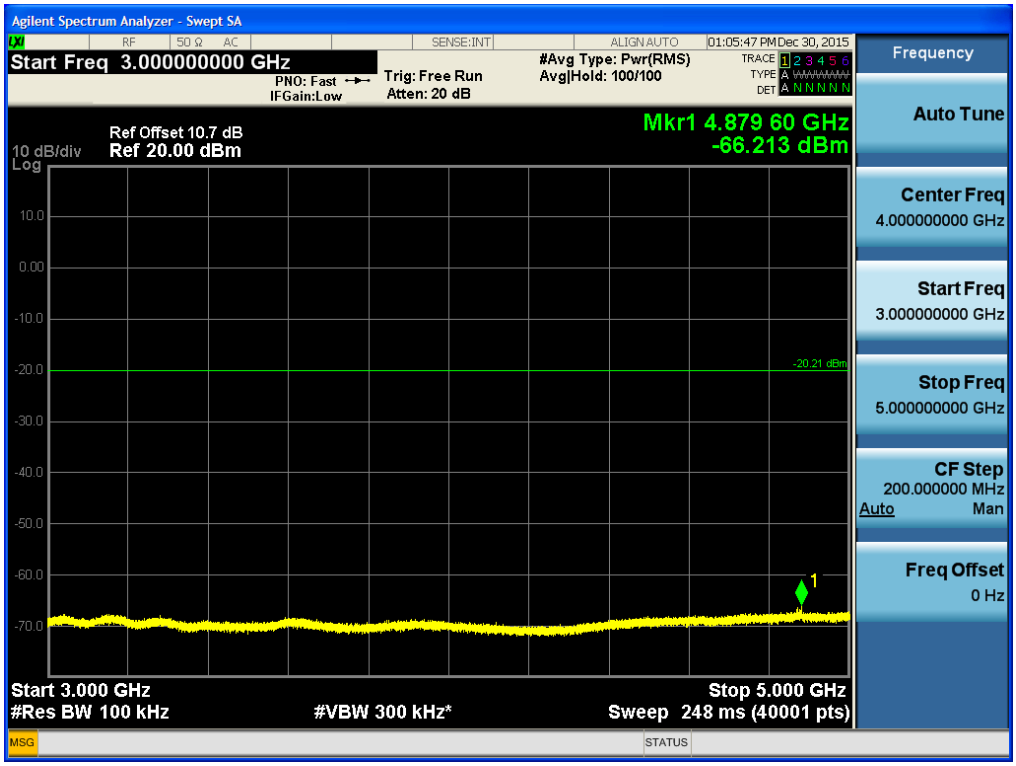
1 GHz ~ 3 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)



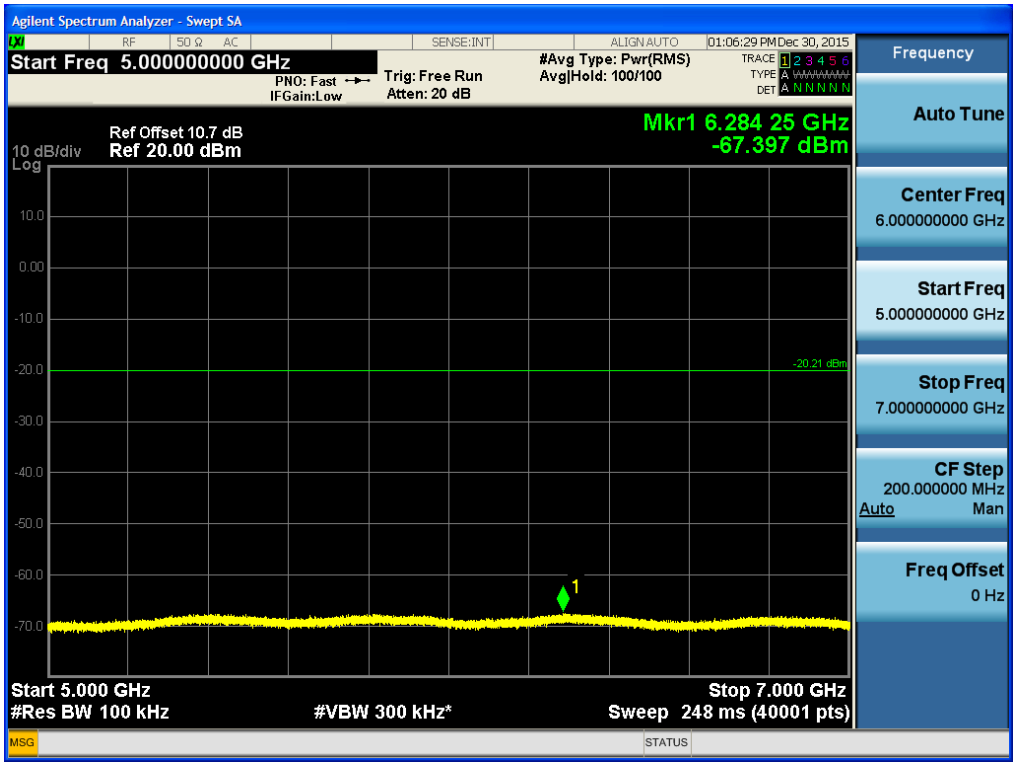
3 GHz ~ 5 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)



5 GHz ~ 7 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)

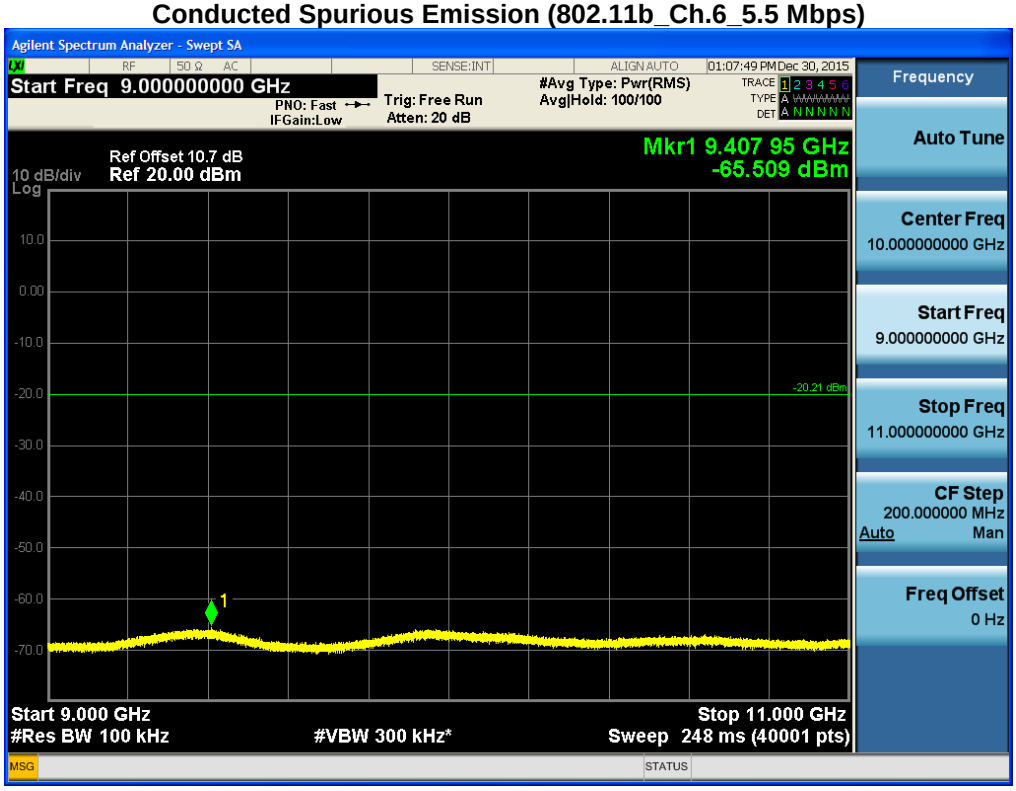


7 GHz ~ 9 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)

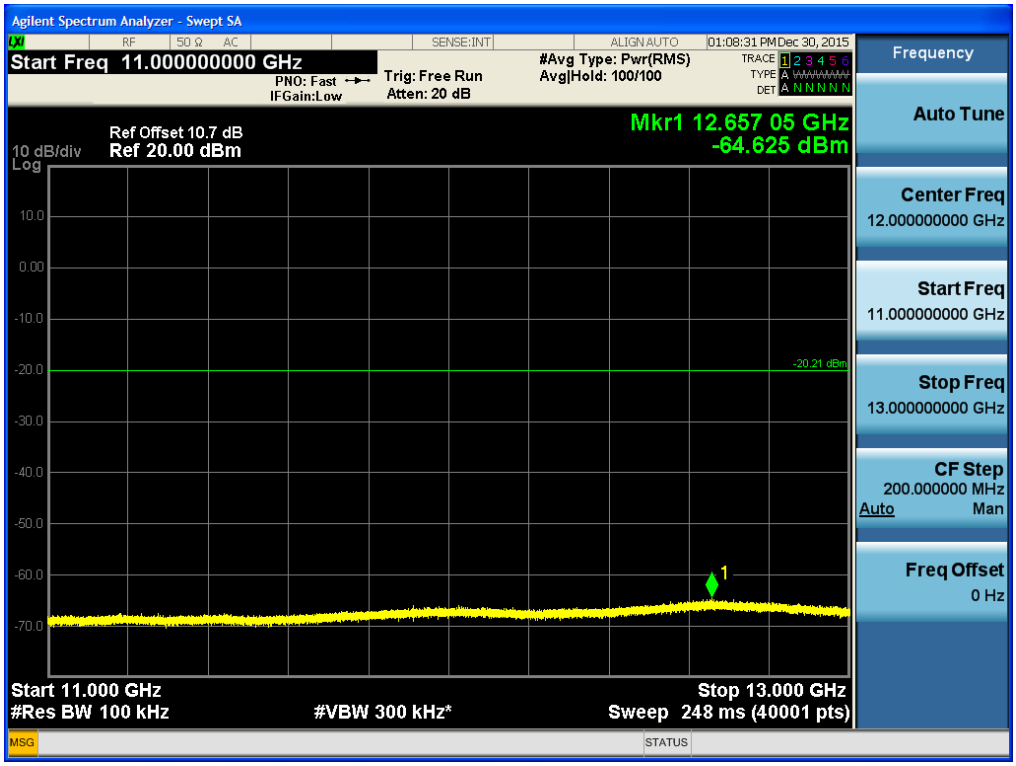
9 GHz ~ 11 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)



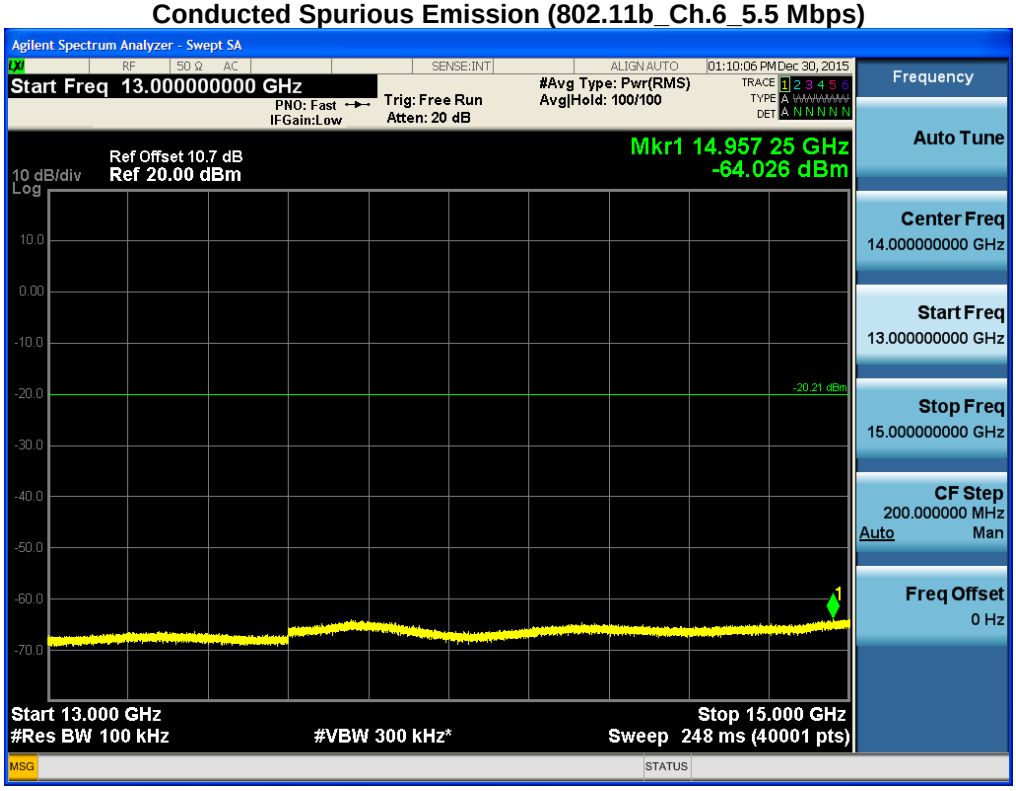
11 GHz ~ 13 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)



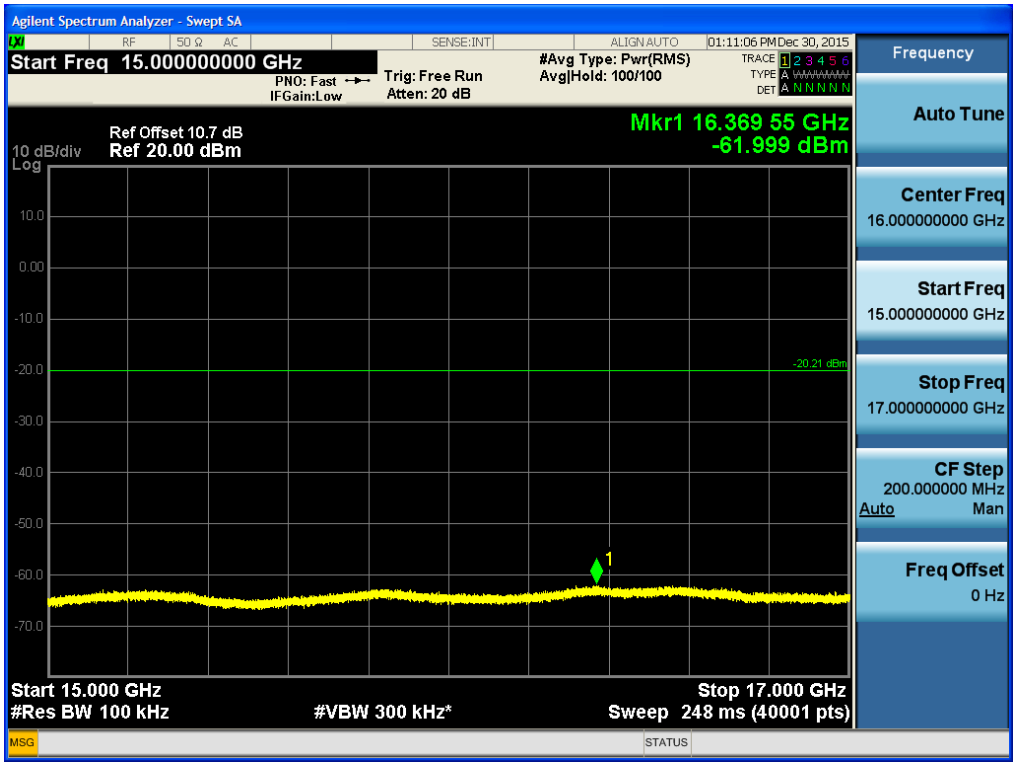
13 GHz ~ 15 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)



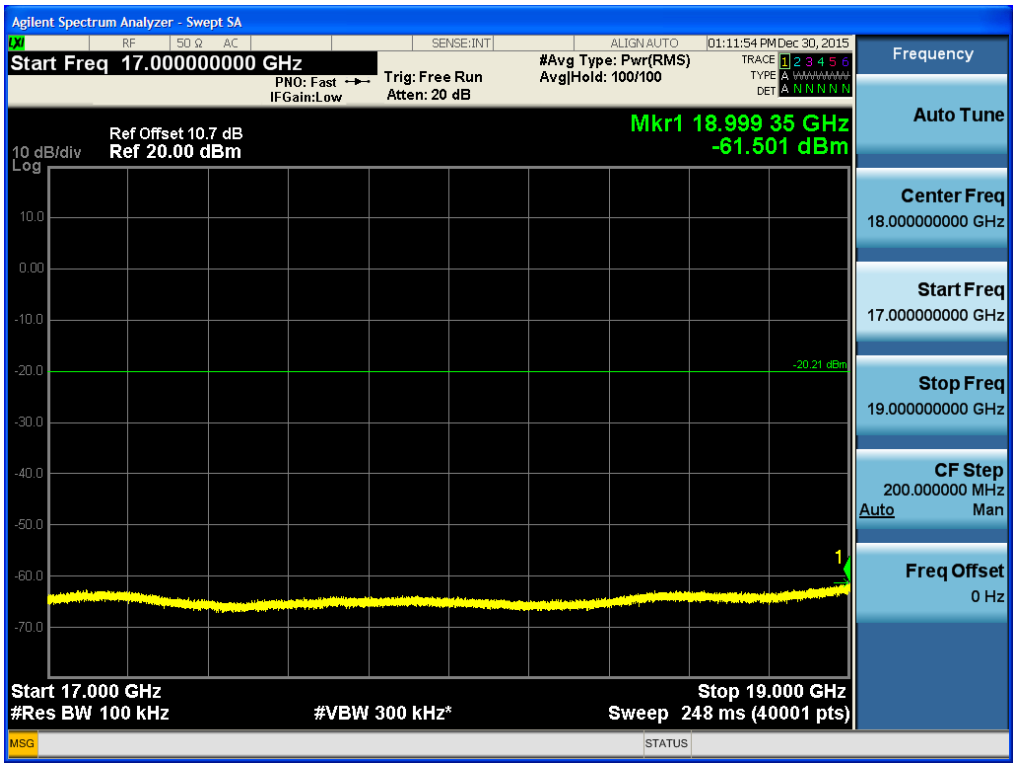
15 GHz ~ 17 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)



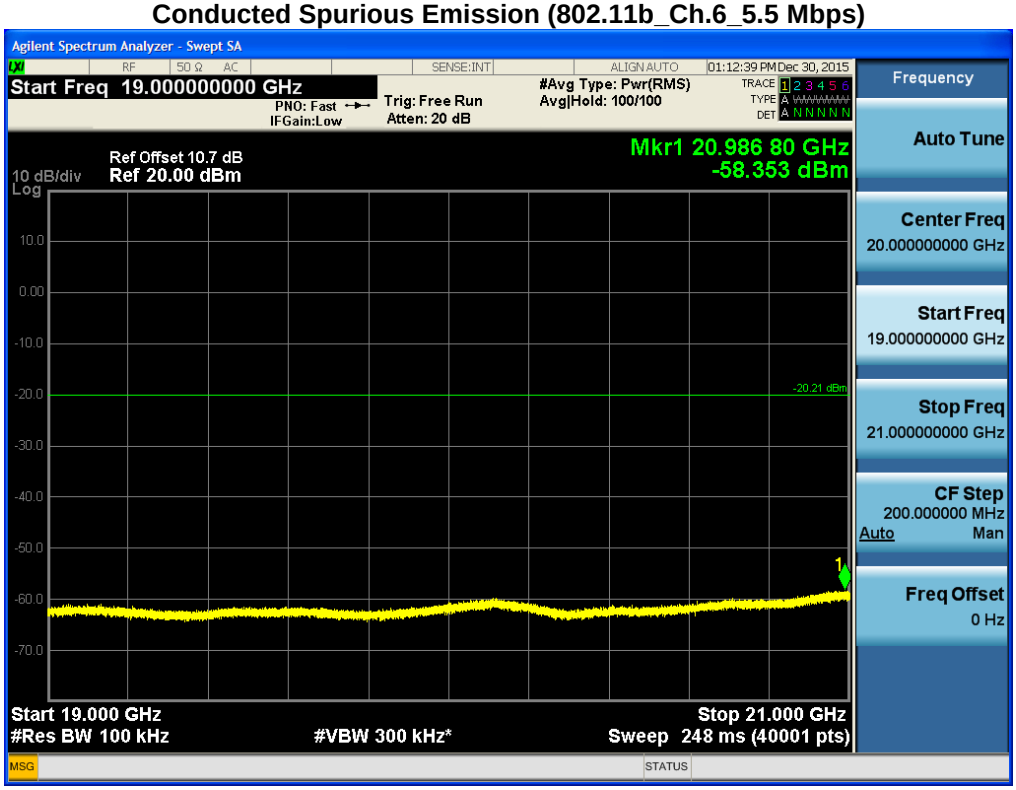
17 GHz ~ 19 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)



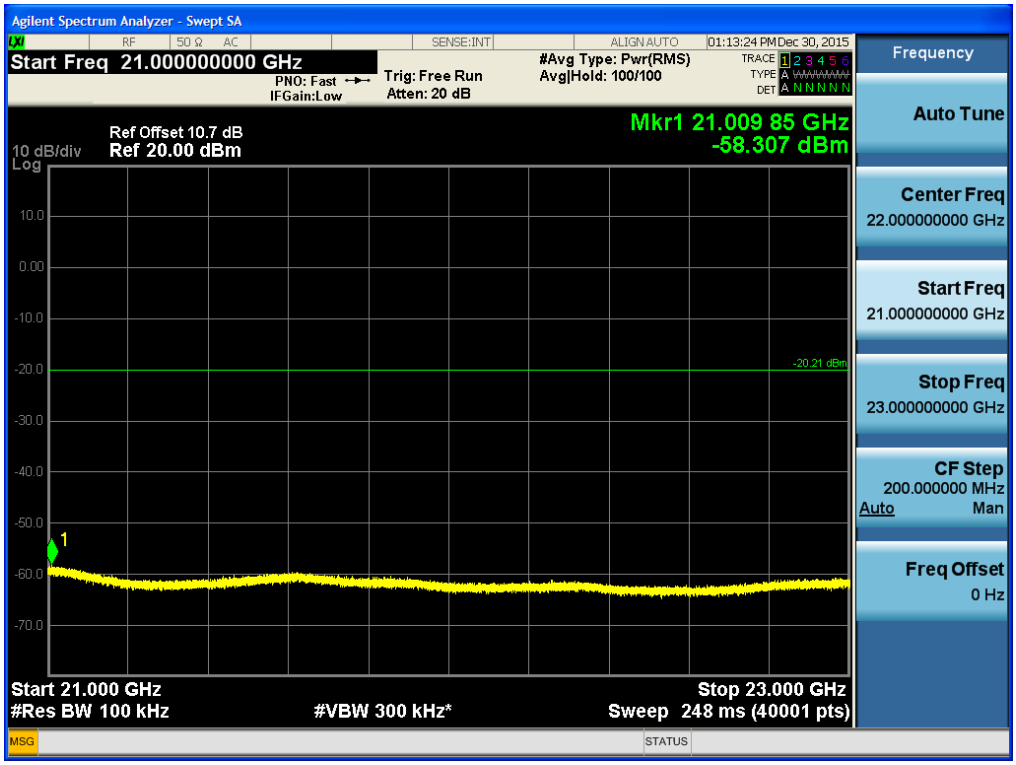
19 GHz ~ 21 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)



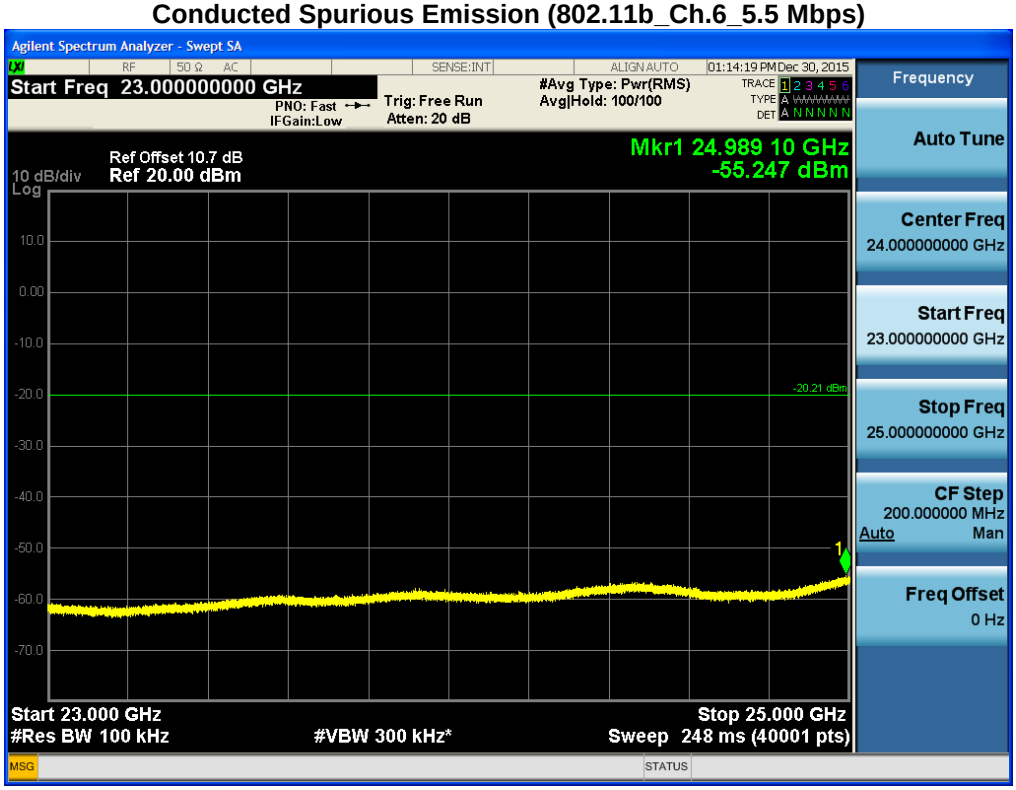
21 GHz ~ 23 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)



23 GHz ~ 25 GHz

Conducted Spurious Emission (802.11b_Ch.6_5.5 Mbps)



8.6 RADIATED MEASUREMENT.

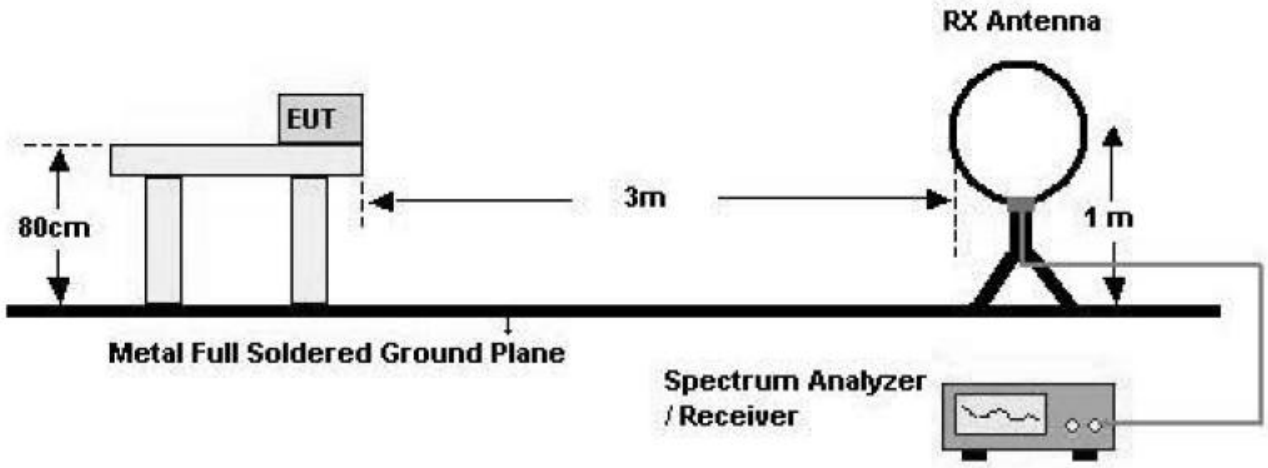
8.6.1 RADIATED SPURIOUS EMISSIONS.

Test Requirements and limit, §15.205, §15.209

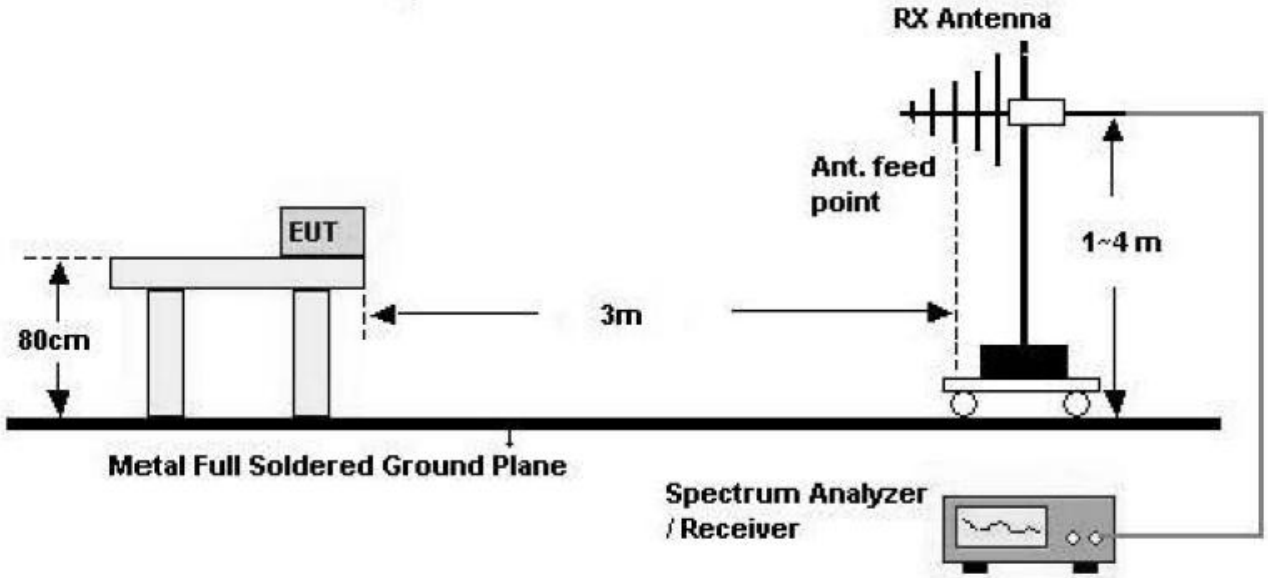
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

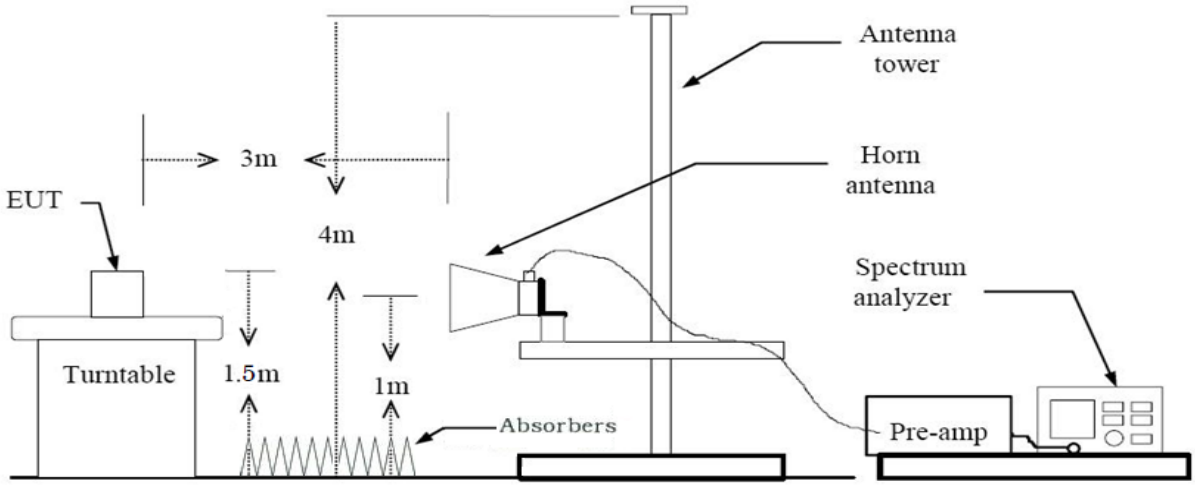
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



TEST PROCEDURE USED

Method 12.1 in KDB 558074, issued 06/09/2015

Spectrum Setting

- Peak

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

RBW = cf. Table 1.

VBW ≥ 3 x 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 ≥ 98%)

Set RBW = 1 MHz

Set VBW ≥ 3 x 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 ±2%)

Set RBW = 1 MHz

Set VBW ≥ 3 x 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.

- Average (duty cycle < 98%, duty cycle variations exceed ±2%)

Set RBW = 1 MHz

Set VBW ≥ 1/T.(at least 100 times less than the resolution bandwidth, but no less than 10 Hz.)

Select spectrum analyzer linear display mode.

Detector = Peak.

Sweep time = auto.

Trace mode = max hold.

Note :

1. We are performed the RSE and radiated band edge using standard radiated method.
2. The duty cycle factor for 802.11 b/g/n

Mode	Worst Data rate (Mbps)	T_{on} (ms)	T_{total} (ms)	Duty Cycle (%)	Duty Cycle Factor (dB)	VBW(1/T) (Hz)
b	1	8.600	8.700	98.85	0.050	116
g	6	1.430	1.530	93.46	0.294	699
n_20MHz	MCS 0	1.335	1.440	92.71	0.329	749

TEST RESULTS

9 kHz – 30MHz

Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBμV	dB /m	dB	(H/V)	dBμV/m	dBμV/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 (specific distance / 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.

TEST RESULTS

Below 1 GHz

Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
㎒	dBμV	dB /m	dB	(H/V)	dBμV/m	dBμV/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.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4824	56.29	-7.72	V	48.57	73.98	25.41	PK
4824	48.86	-7.72	V	41.14	53.98	12.84	AV
7236	55.46	-1.83	V	53.63	73.98	20.35	PK
7236	45.96	-1.83	V	44.13	53.98	9.85	AV
4824	59.06	-7.72	H	51.34	73.98	22.64	PK
4824	52.89	-7.72	H	45.17	53.98	8.81	AV
7236	56.07	-1.83	H	54.24	73.98	19.74	PK
7236	46.11	-1.83	H	44.28	53.98	9.70	AV

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

Frequency [MHz]	Reading dBuV	A.F.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4824	55.98	-7.72	V	48.26	73.98	25.72	PK
4824	43.32	-7.72	V	35.60	53.98	18.38	AV
7236	55.47	-1.83	V	53.64	73.98	20.34	PK
7236	42.58	-1.83	V	40.75	53.98	13.23	AV
4824	56.09	-7.72	H	48.37	73.98	25.61	PK
4824	43.94	-7.72	H	36.22	53.98	17.76	AV
7236	55.08	-1.83	H	53.25	73.98	20.73	PK
7236	42.69	-1.83	H	40.86	53.98	13.12	AV

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

Frequency [MHz]	Reading dBuV	A.F.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4824	56.21	-7.72	V	48.49	73.98	25.49	PK
4824	42.87	-7.72	V	35.15	53.98	18.83	AV
7236	55.79	-1.83	V	53.96	73.98	20.02	PK
7236	42.41	-1.83	V	40.58	53.98	13.40	AV
4824	55.82	-7.72	H	48.10	73.98	25.88	PK
4824	43.30	-7.72	H	35.58	53.98	18.40	AV
7236	56.18	-1.83	H	54.35	73.98	19.63	PK
7236	42.47	-1.83	H	40.64	53.98	13.34	AV

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
5. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
6. 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.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4874	54.88	-7.37	V	47.51	73.98	26.47	PK
4874	43.64	-7.37	V	36.27	53.98	17.71	AV
7311	56.10	-1.64	V	54.46	73.98	19.52	PK
7311	44.86	-1.64	V	43.22	53.98	10.76	AV
4874	55.36	-7.37	H	47.99	73.98	25.99	PK
4874	44.68	-7.37	H	37.31	53.98	16.67	AV
7311	56.16	-1.64	H	54.52	73.98	19.46	PK
7311	44.93	-1.64	H	43.29	53.98	10.69	AV

Operation Mode: 802.11 g
Transfer Rate: 6 Mbps
Operating Frequency 2437
Channel No. 06 Ch

Frequency [MHz]	Reading dBuV	A.F.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4874	55.76	-7.37	V	48.39	73.98	25.59	PK
4874	43.51	-7.37	V	36.14	53.98	17.84	AV
7311	55.26	-1.64	V	53.62	73.98	20.36	PK
7311	42.21	-1.64	V	40.57	53.98	13.41	AV
4874	54.76	-7.37	H	47.39	73.98	26.59	PK
4874	42.58	-7.37	H	35.21	53.98	18.77	AV
7311	55.10	-1.64	H	53.46	73.98	20.52	PK
7311	42.44	-1.64	H	40.80	53.98	13.18	AV

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

Frequency [MHz]	Reading dBuV	A.F.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4874	55.79	-7.37	V	48.42	73.98	25.56	PK
4874	43.11	-7.37	V	35.74	53.98	18.24	AV
7311	55.18	-1.64	V	53.54	73.98	20.44	PK
7311	42.39	-1.64	V	40.75	53.98	13.23	AV
4874	55.95	-7.37	H	48.58	73.98	25.40	PK
4874	43.19	-7.37	H	35.82	53.98	18.16	AV
7311	55.21	-1.64	H	53.57	73.98	20.41	PK
7311	42.55	-1.64	H	40.91	53.98	13.07	AV

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
5. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
6. 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.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4924	58.89	-7.35	V	51.54	73.98	22.44	PK
4924	54.87	-7.35	V	47.52	53.98	6.46	AV
7386	55.57	-1.35	V	54.22	73.98	19.76	PK
7386	45.17	-1.35	V	43.82	53.98	10.16	AV
4924	60.74	-7.35	H	53.39	73.98	20.59	PK
4924	56.14	-7.35	H	48.79	53.98	5.19	AV
7386	55.78	-1.35	H	54.43	73.98	19.55	PK
7386	45.31	-1.35	H	43.96	53.98	10.02	AV

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

Frequency [MHz]	Reading dBuV	A.F.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4924	56.29	-7.35	V	48.94	73.98	25.04	PK
4924	43.48	-7.35	V	36.13	53.98	17.85	AV
7386	54.34	-1.35	V	52.99	73.98	20.99	PK
7386	42.02	-1.35	V	40.67	53.98	13.31	AV
4924	57.52	-7.35	H	50.17	73.98	23.81	PK
4924	45.36	-7.35	H	38.01	53.98	15.97	AV
7386	55.03	-1.35	H	53.68	73.98	20.30	PK
7386	42.05	-1.35	H	40.70	53.98	13.28	AV

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

Frequency [MHz]	Reading dBuV	A.F.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4924	57.01	-7.35	V	49.66	73.98	24.32	PK
4924	44.27	-7.35	V	36.92	53.98	17.06	AV
7386	55.48	-1.35	V	54.13	73.98	19.85	PK
7386	42.32	-1.35	V	40.97	53.98	13.01	AV
4924	57.23	-7.35	H	49.88	73.98	24.10	PK
4924	44.54	-7.35	H	37.19	53.98	16.79	AV
7386	55.69	-1.35	H	54.34	73.98	19.64	PK
7386	42.49	-1.35	H	41.14	53.98	12.84	AV

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
5. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
6. 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 2467
Channel No. 12 Ch

Frequency [MHz]	Reading dBuV	A.F.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4934	55.01	-7.20	V	47.81	73.98	26.17	PK
4934	42.27	-7.20	V	35.07	53.98	18.91	AV
7401	53.00	-1.27	V	51.73	73.98	22.25	PK
7401	41.57	-1.27	V	40.30	53.98	13.68	AV
4934	55.08	-7.20	H	47.88	73.98	26.10	PK
4934	42.30	-7.20	H	35.10	53.98	18.88	AV
7401	53.05	-1.27	H	51.78	73.98	22.20	PK
7401	41.61	-1.27	H	40.34	53.98	13.64	AV

Operation Mode: 802.11 g
Transfer Rate: 6 Mbps
Operating Frequency 2467
Channel No. 12 Ch

Frequency [MHz]	Reading dBuV	A.F.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4934	55.00	-7.20	V	47.80	73.98	26.18	PK
4934	42.21	-7.20	V	35.01	53.98	18.97	AV
7401	52.97	-1.27	V	51.70	73.98	22.28	PK
7401	41.50	-1.27	V	40.23	53.98	13.75	AV
4934	55.02	-7.20	H	47.82	73.98	26.16	PK
4934	42.28	-7.20	H	35.08	53.98	18.90	AV
7401	53.02	-1.27	H	51.75	73.98	22.23	PK
7401	41.57	-1.27	H	40.30	53.98	13.68	AV

Operation Mode:	802.11 n
Transfer MCS Index:	0
Operating Frequency	2467
Channel No.	12 Ch

Frequency [MHz]	Reading dBuV	A.F.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4934	54.89	-7.20	V	47.69	73.98	26.29	PK
4934	42.22	-7.20	V	35.02	53.98	18.96	AV
7401	52.96	-1.27	V	51.69	73.98	22.29	PK
7401	41.50	-1.27	V	40.23	53.98	13.75	AV
4934	54.93	-7.20	H	47.73	73.98	26.25	PK
4934	42.24	-7.20	H	35.04	53.98	18.94	AV
7401	52.84	-1.27	H	51.57	73.98	22.41	PK
7401	41.54	-1.27	H	40.27	53.98	13.71	AV

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
5. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
6. 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 2472
Channel No. 13 Ch

Frequency [MHz]	Reading dBuV	A.F.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4944	53.89	-7.18	V	46.71	73.98	27.27	PK
4944	42.11	-7.18	V	34.93	53.98	19.05	AV
7416	53.58	-1.11	V	52.47	73.98	21.51	PK
7416	41.18	-1.11	V	40.07	53.98	13.91	AV
4944	54.03	-7.18	H	46.85	73.98	27.13	PK
4944	42.15	-7.18	H	34.97	53.98	19.01	AV
7416	53.67	-1.11	H	52.56	73.98	21.42	PK
7416	41.22	-1.11	H	40.11	53.98	13.87	AV

Operation Mode: 802.11 g
Transfer Rate: 6 Mbps
Operating Frequency 2472
Channel No. 13 Ch

Frequency [MHz]	Reading dBuV	A.F.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4944	53.84	-7.18	V	46.66	73.98	27.32	PK
4944	42.07	-7.18	V	34.89	53.98	19.09	AV
7416	53.52	-1.11	V	52.41	73.98	21.57	PK
7416	41.13	-1.11	V	40.02	53.98	13.96	AV
4944	53.97	-7.18	H	46.79	73.98	27.19	PK
4944	42.13	-7.18	H	34.95	53.98	19.03	AV
7416	53.58	-1.11	H	52.47	73.98	21.51	PK
7416	41.17	-1.11	H	40.06	53.98	13.92	AV

Operation Mode:	802.11 n
Transfer MCS Index:	0
Operating Frequency	2472
Channel No.	13 Ch

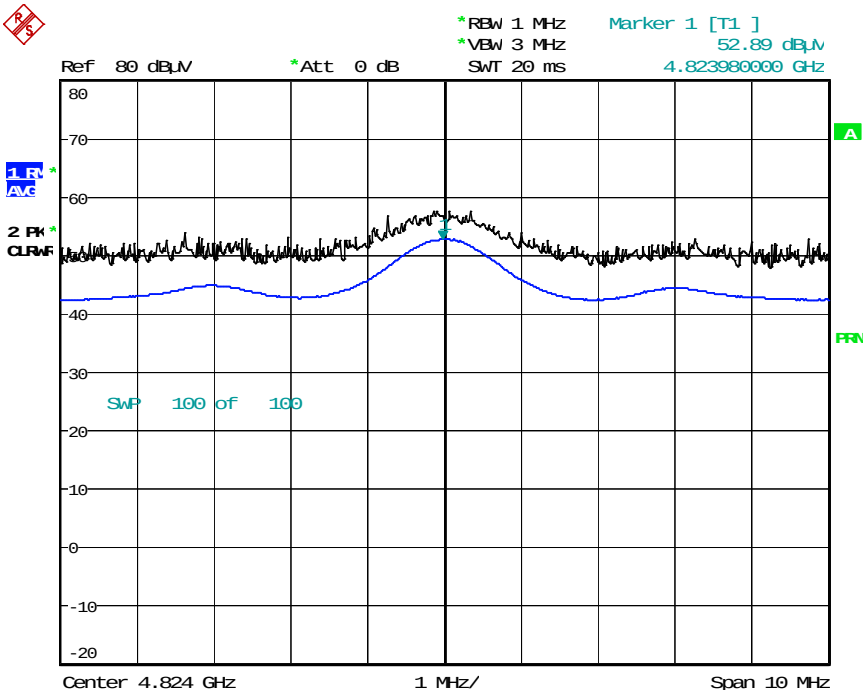
Frequency [MHz]	Reading dBuV	A.F.+CL-AMP G [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
4944	53.67	-7.18	V	46.49	73.98	27.49	PK
4944	42.01	-7.18	V	34.83	53.98	19.15	AV
7416	53.49	-1.11	V	52.38	73.98	21.60	PK
7416	41.10	-1.11	V	39.99	53.98	13.99	AV
4944	53.88	-7.18	H	46.70	73.98	27.28	PK
4944	42.08	-7.18	H	34.90	53.98	19.08	AV
7416	53.64	-1.11	H	52.53	73.98	21.45	PK
7416	41.12	-1.11	H	40.01	53.98	13.97	AV

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
5. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
6. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

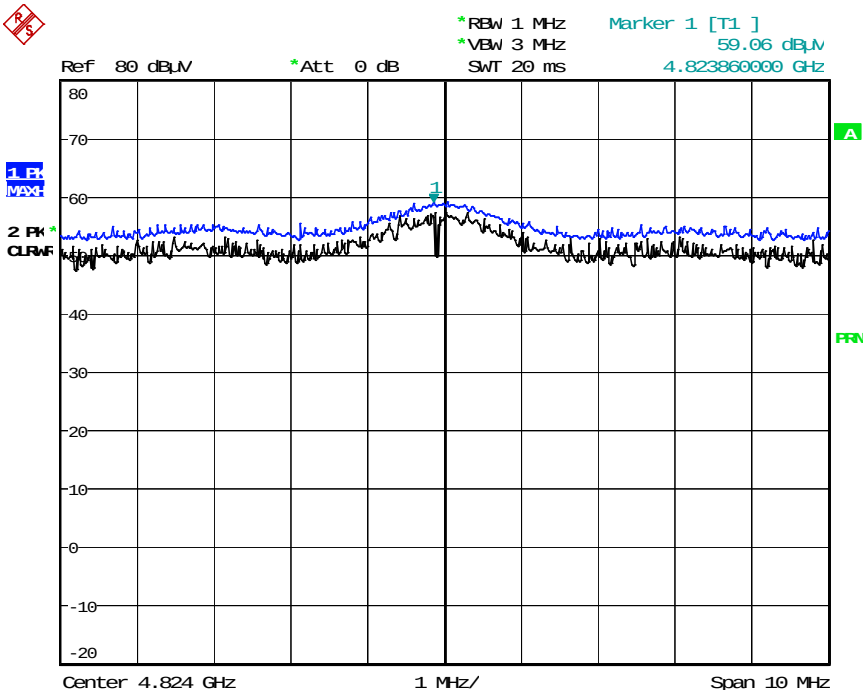
▣ RESULT PLOTS

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



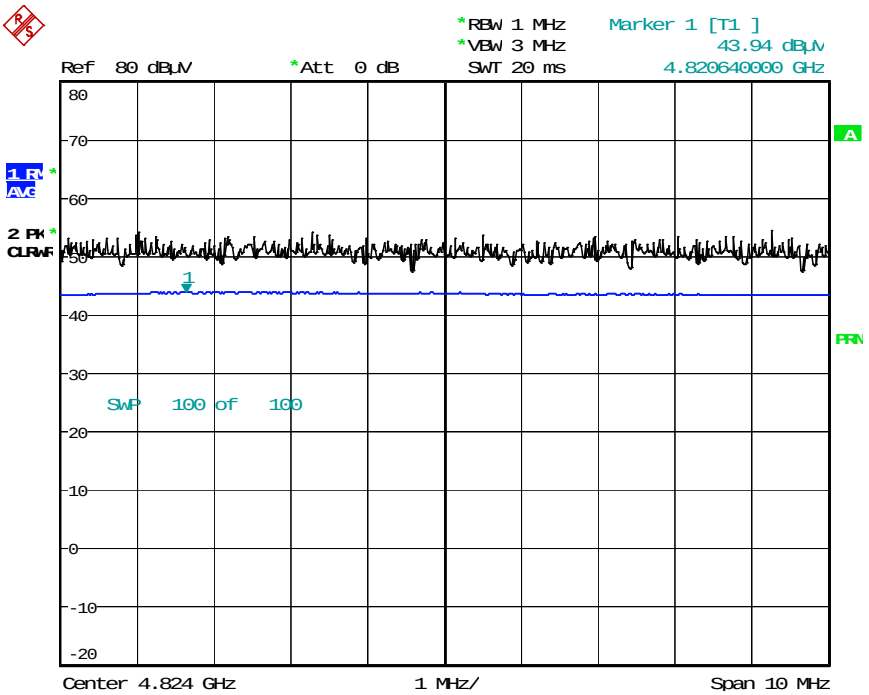
Date: 14.DEC.2015 12:26:10

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



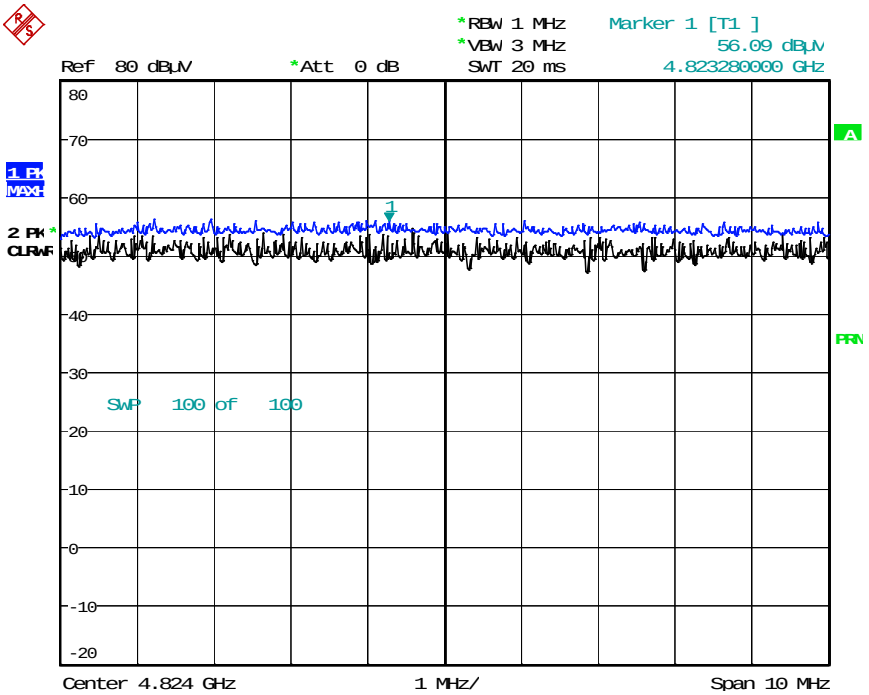
Date: 14.DEC.2015 12:25:43

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



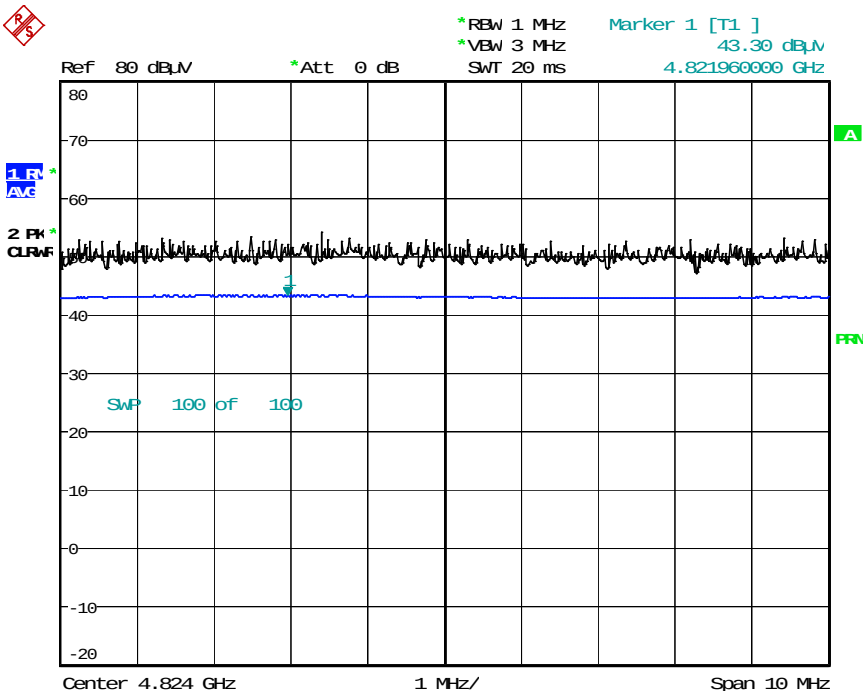
Date: 14.DEC.2015 12:29:28

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



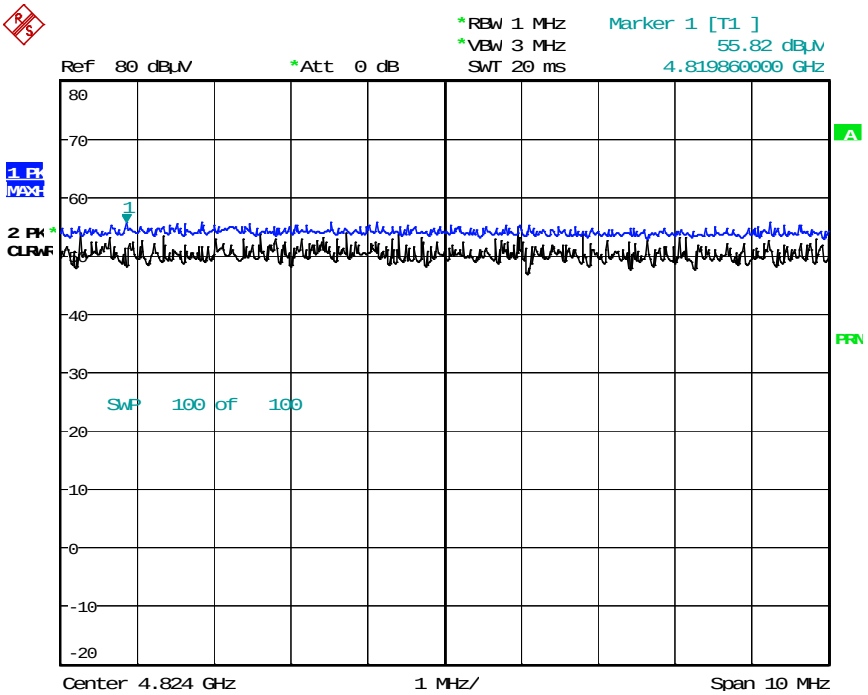
Date: 14.DEC.2015 12:29:52

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



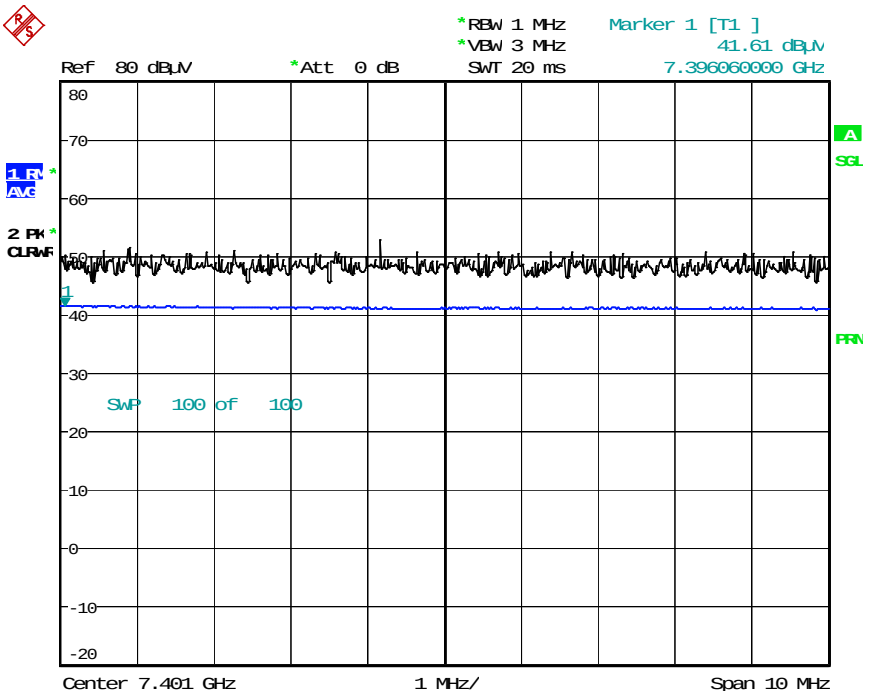
Date: 14.DEC.2015 12:32:57

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



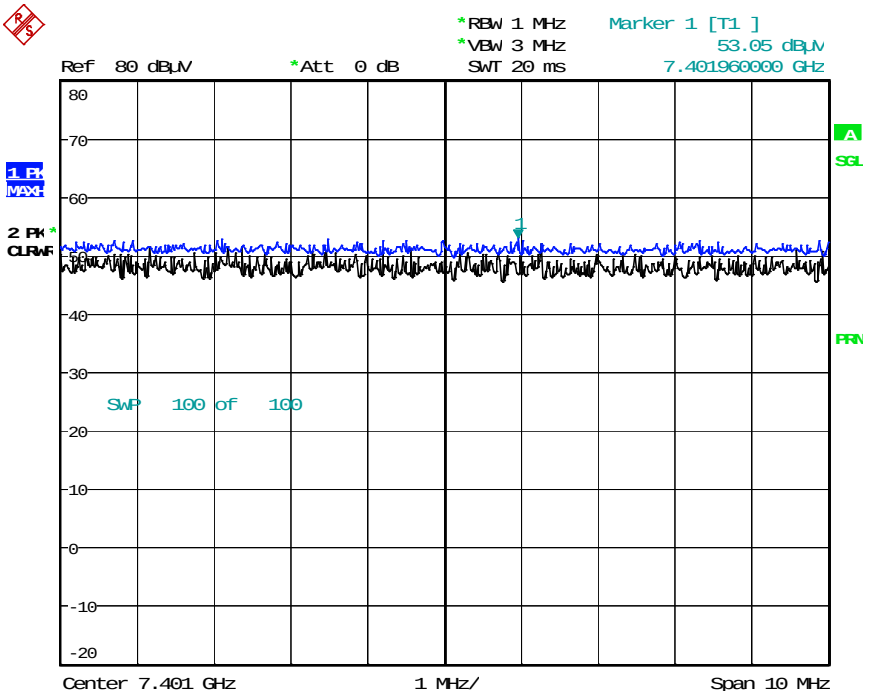
Date: 14.DEC.2015 12:32:13

Radiated Spurious Emissions plot – Average Reading (802.11n, Ch.12 3rd Harmonic)



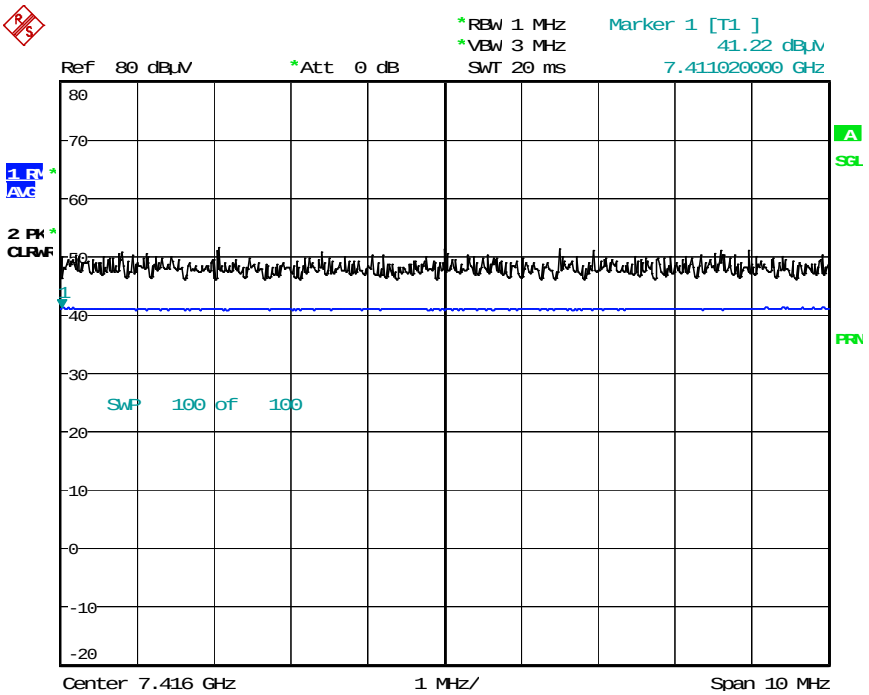
Date: 16.DEC.2015 09:09:22

Radiated Spurious Emissions plot – Peak Reading (802.11n, Ch.12 3rd Harmonic)



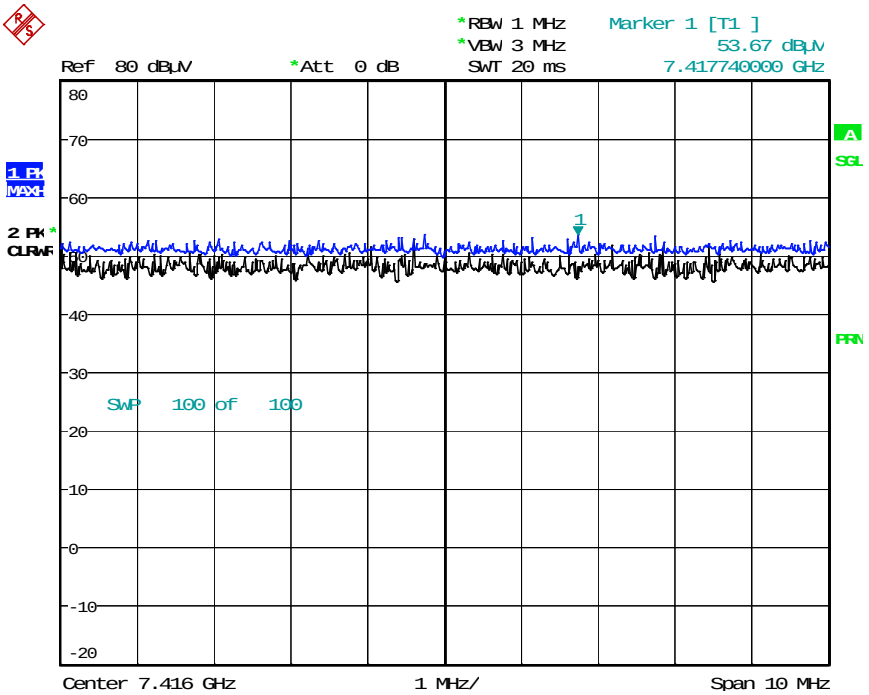
Date: 16.DEC.2015 09:08:53

Radiated Spurious Emissions plot – Average Reading (802.11n, Ch.13 3rd Harmonic)



Date: 16.DEC.2015 09:11:33

Radiated Spurious Emissions plot – Peak Reading (802.11n, Ch.13 3rd Harmonic)



Date: 16.DEC.2015 09:11:03

8.6.2 RADIATED RESTRICTED BAND EDGES

Test Requirements and limit, §15.247(d) §15.205, §15.209

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	A.F.+CL [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	30.85	31.28	H	62.13	73.98	11.85	PK
2390.0	17.12	31.28	H	48.40	53.98	5.58	AV
2390.0	29.96	31.28	V	61.24	73.98	12.74	PK
2390.0	17.01	31.28	V	48.29	53.98	5.69	AV
2483.5	37.69	31.28	H	68.97	73.98	5.01	PK
2483.5	18.12	31.28	H	49.40	53.98	4.58	AV
2483.5	36.21	31.28	V	67.49	73.98	6.49	PK
2483.5	17.54	31.28	V	48.82	53.98	5.16	AV

Operation Mode:	802.11g
Transfer Rate:	6 Mbps

Operating Frequency	2412 MHz, 2462 MHz
Channel No.	12 Ch

Frequency [MHz]	Reading dBuV	A.F.+CL [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2483.5	26.97	31.28	H	58.25	73.98	15.73	PK
2483.5	15.27	31.28	H	46.55	53.98	7.43	AV
2483.5	27.05	31.28	V	58.33	73.98	15.65	PK
2483.5	15.31	31.28	V	46.59	53.98	7.39	AV

Operation Mode:	802.11g
Transfer Rate:	6 Mbps
Operating Frequency	2412 MHz, 2462 MHz
Channel No.	13 Ch

Frequency [MHz]	Reading dBuV	A.F.+CL [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2483.5	37.05	31.28	H	68.33	73.98	5.65	PK
2483.5	20.14	31.28	H	51.42	53.98	2.56	AV
2483.5	37.21	31.28	V	68.49	73.98	5.49	PK
2483.5	20.35	31.28	V	51.63	53.98	2.35	AV

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.+CL [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	26.87	31.28	H	58.15	73.98	15.83	PK
2390.0	15.32	31.28	H	46.60	53.98	7.38	AV
2390.0	26.45	31.28	V	57.73	73.98	16.25	PK
2390.0	15.29	31.28	V	46.57	53.98	7.41	AV
2483.5	27.48	31.28	H	58.76	73.98	15.22	PK
2483.5	16.56	31.28	H	47.84	53.98	6.14	AV
2483.5	28.12	31.28	V	59.40	73.98	14.58	PK
2483.5	16.42	31.28	V	47.70	53.98	6.28	AV

Operation Mode:	802.11b
Transfer Rate:	1 Mbps
Operating Frequency	2412 MHz, 2462 MHz
Channel No.	12 Ch

Frequency [MHz]	Reading dBuV	A.F.+CL [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2483.5	26.95	31.28	H	58.23	73.98	15.75	PK
2483.5	15.24	31.28	H	46.52	53.98	7.46	AV
2483.5	27.02	31.28	V	58.30	73.98	15.68	PK
2483.5	15.28	31.28	V	46.56	53.98	7.42	AV

Operation Mode:	802.11b
Transfer Rate:	1 Mbps

Operating Frequency	2412 MHz, 2462 MHz
Channel No.	13 Ch

Frequency [MHz]	Reading dBuV	A.F.+CL [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2483.5	26.48	31.28	H	57.76	73.98	16.22	PK
2483.5	15.43	31.28	H	46.71	53.98	7.27	AV
2483.5	26.61	31.28	V	57.89	73.98	16.09	PK
2483.5	15.60	31.28	V	46.88	53.98	7.10	AV

Operation Mode:	802.11n_20MHz BW
Transfer MCS Index:	0

Operating Frequency	2412 MHz, 2462 MHz
Channel No.	01 Ch, 11 Ch

Frequency [MHz]	Reading dBuV	A.F.+CL [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2390.0	28.83	31.28	H	60.11	73.98	13.87	PK
2390.0	15.72	31.28	H	47.00	53.98	6.98	AV
2390.0	27.68	31.28	V	58.96	73.98	15.02	PK
2390.0	15.59	31.28	V	46.87	53.98	7.11	AV
2483.5	31.91	31.28	H	63.19	73.98	10.79	PK
2483.5	16.00	31.28	H	47.28	53.98	6.70	AV
2483.5	35.73	31.28	V	67.01	73.98	6.97	PK
2483.5	16.27	31.28	V	47.55	53.98	6.43	AV

Operation Mode:	802.11n_20MHz BW
Transfer MCS Index:	0
Operating Frequency	2412 MHz, 2462 MHz
Channel No.	12 Ch

Frequency [MHz]	Reading dBuV	A.F.+CL [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2483.5	26.96	31.28	H	58.24	73.98	15.74	PK
2483.5	15.25	31.28	H	46.53	53.98	7.45	AV
2483.5	27.05	31.28	V	58.33	73.98	15.65	PK
2483.5	15.09	31.28	V	46.37	53.98	7.61	AV

Operation Mode:	802.11n_20MHz BW
Transfer MCS Index:	0

Operating Frequency	2412 MHz, 2462 MHz
Channel No.	13 Ch

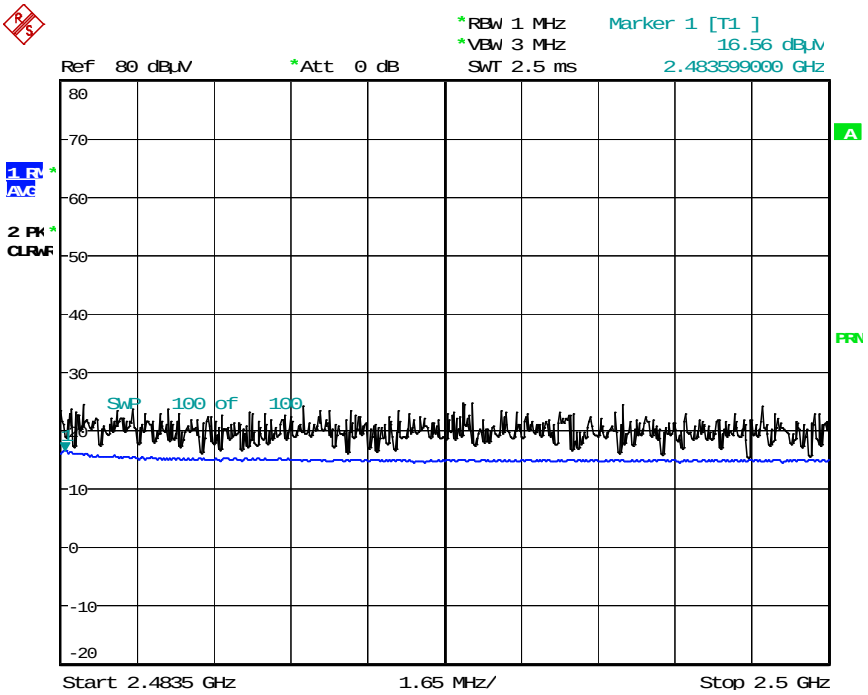
Frequency [MHz]	Reading dBuV	A.F.+CL [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
2483.5	37.24	31.28	H	68.52	73.98	5.46	PK
2483.5	20.29	31.28	H	51.57	53.98	2.41	AV
2483.5	37.62	31.28	V	68.90	73.98	5.08	PK
2483.5	20.55	31.28	V	51.83	53.98	2.15	AV

Notes:

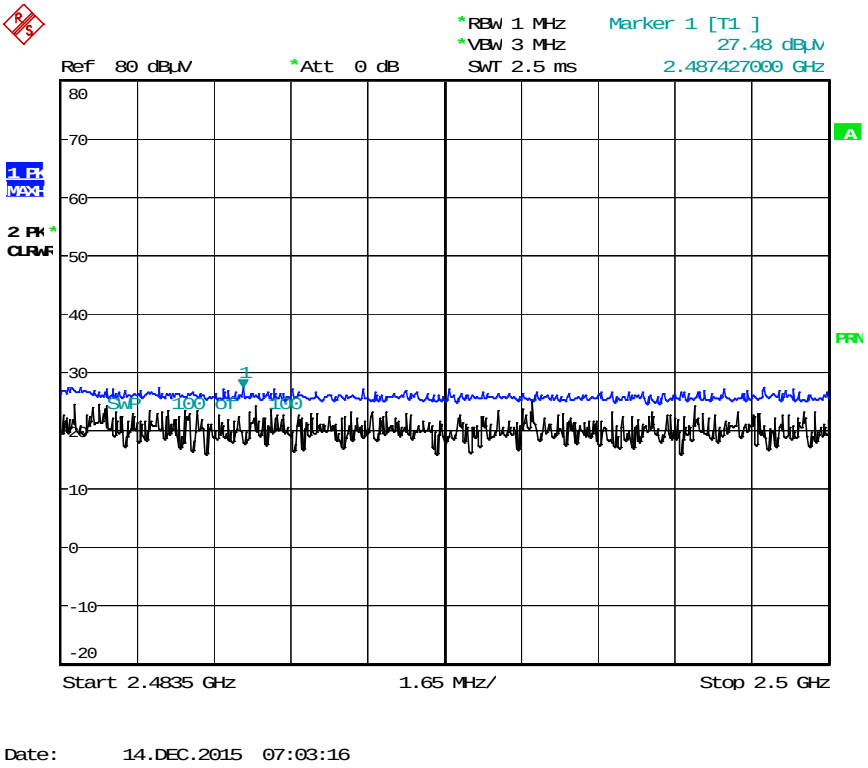
1. Total = Reading Value + Antenna Factor + Cable Loss
2. We have done 802.11b/g/n mode and all data rate. Worst data rate is the lowest data of each mode.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

▣ RESULT PLOTS

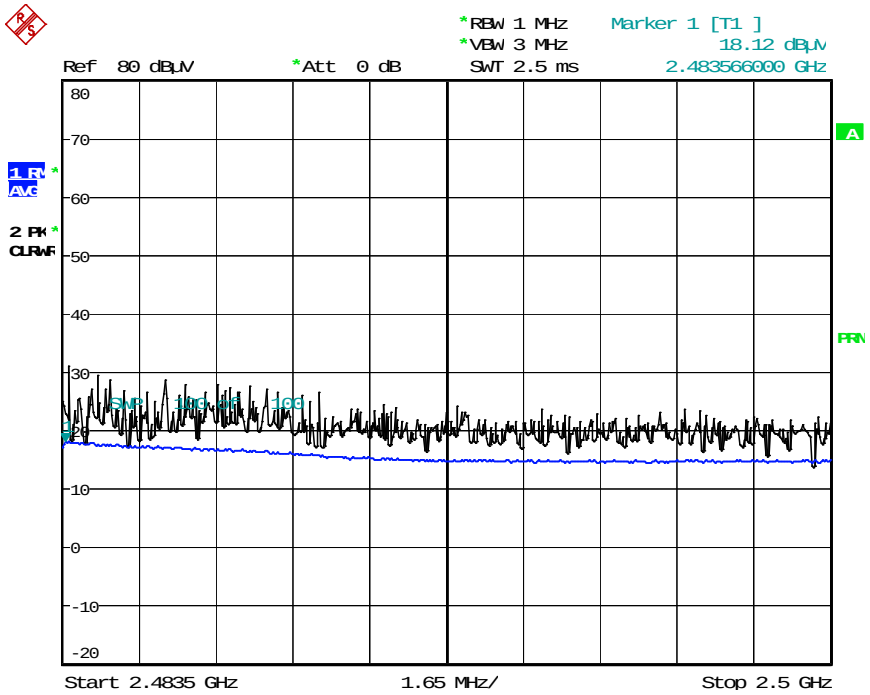
Radiated Restricted Band Edges plot – Average Reading (802.11b, Ch.11)



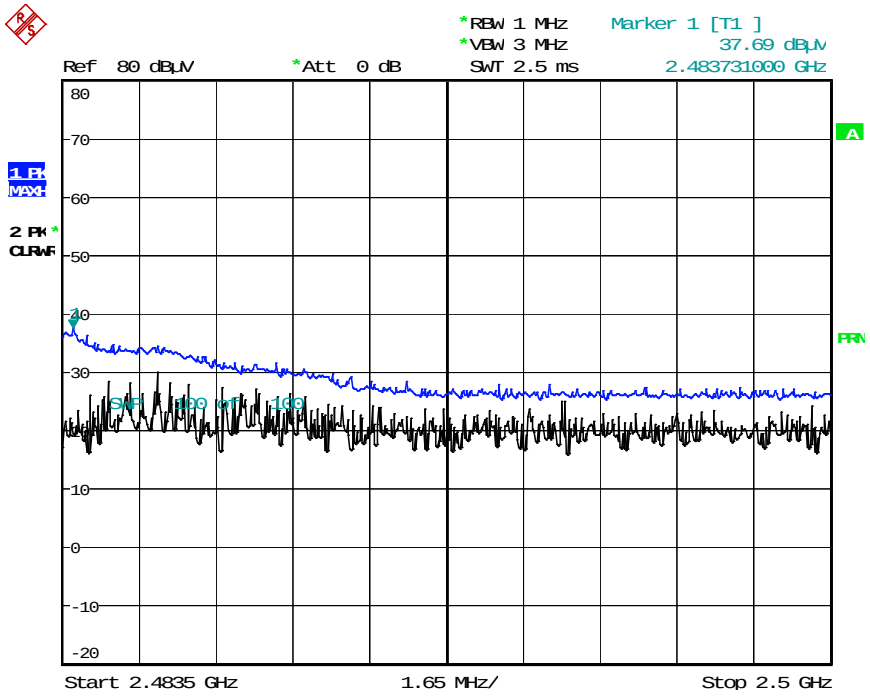
Radiated Restricted Band Edges plot – Peak Reading (802.11b, Ch.11)



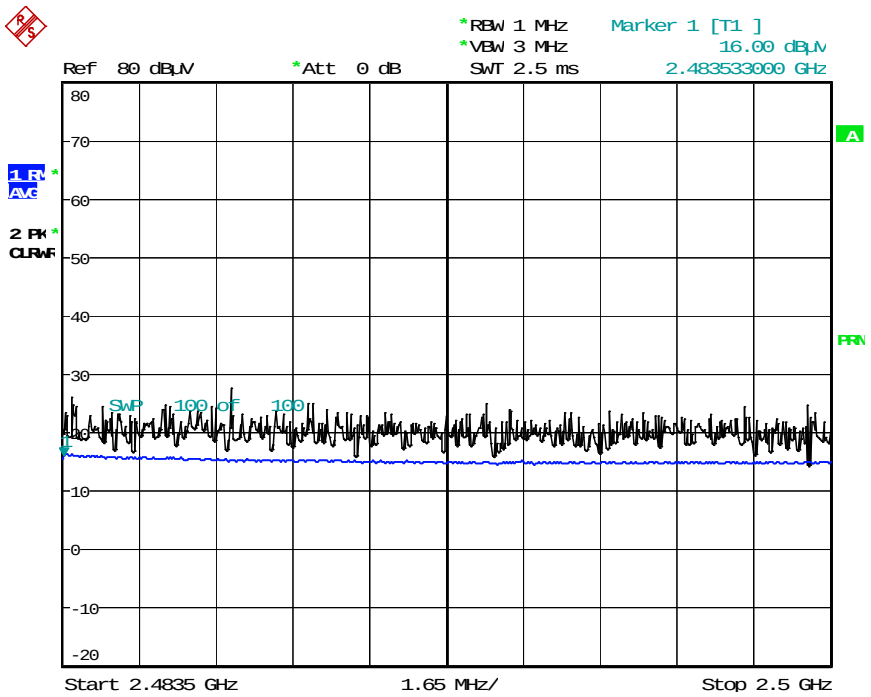
Radiated Restricted Band Edges plot – Average Reading (802.11g, Ch.11)



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

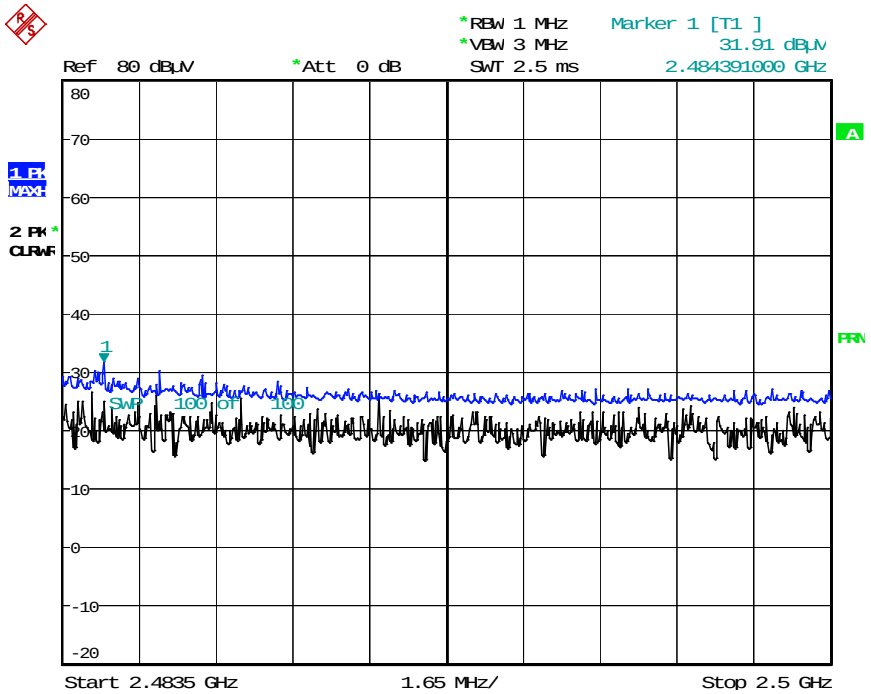


Radiated Restricted Band Edges plot – Average Reading (802.11n, Ch.11)



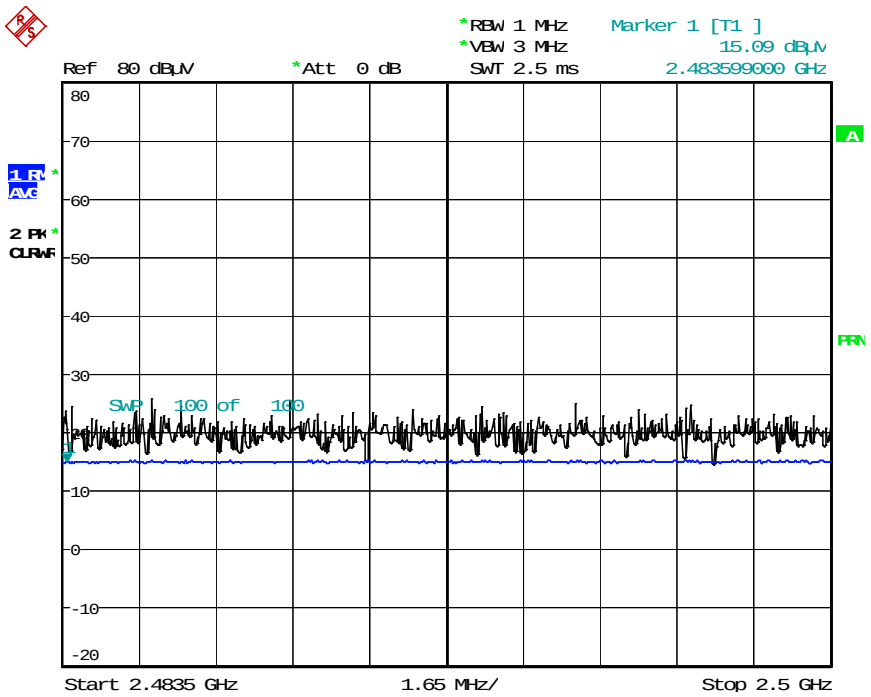
Date: 14.DEC.2015 07:06:42

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



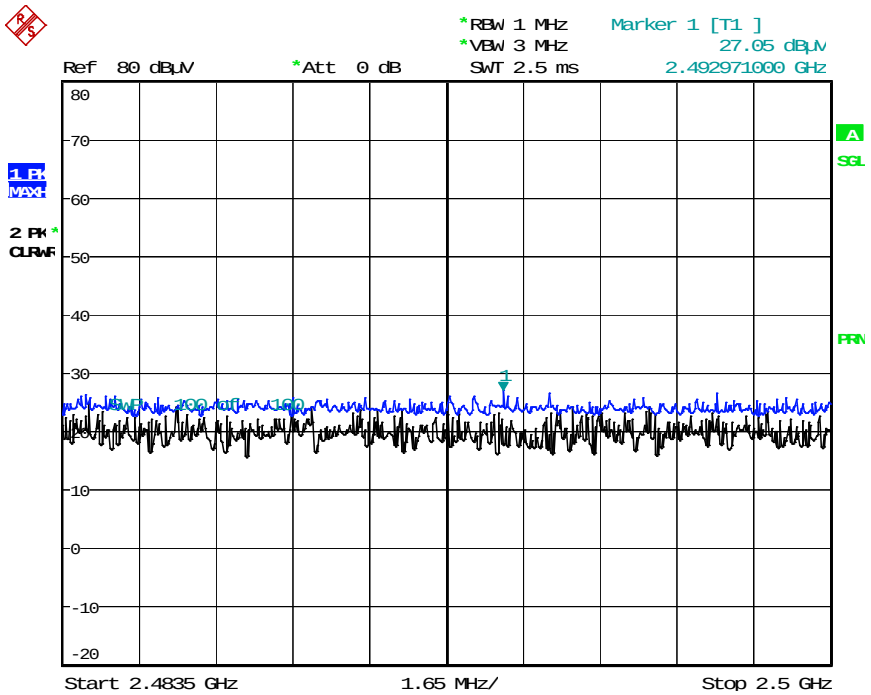
Date: 14.DEC.2015 07:06:20

Radiated Restricted Band Edges plot – Average Reading (802.11n, Ch.12)



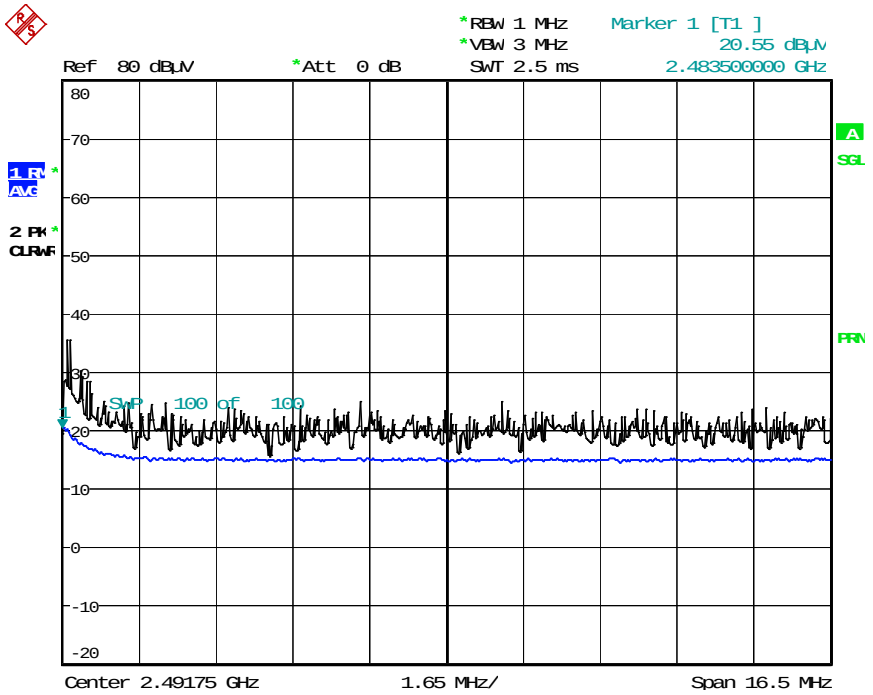
Date: 17.DEC.2015 01:38:04

Radiated Restricted Band Edges plot – Peak Reading (802.11n, Ch.12)

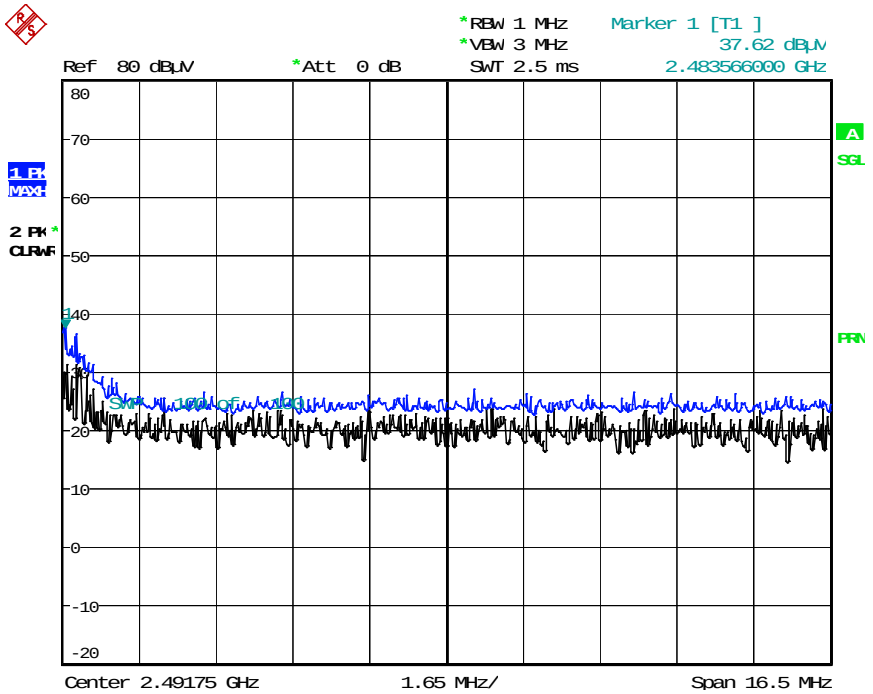


Date: 16.DEC.2015 09:26:05

Radiated Restricted Band Edges plot – Average Reading (802.11n, Ch.13)



Radiated Restricted Band Edges plot – Peak Reading (802.11n, Ch.13)



8.7 POWERLINE CONDUCTED EMISSIONS

Test Requirements and limit, §15.207

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.

Sample Calculation

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

▣ RESULT PLOTS

Conducted Emissions (Line 1)

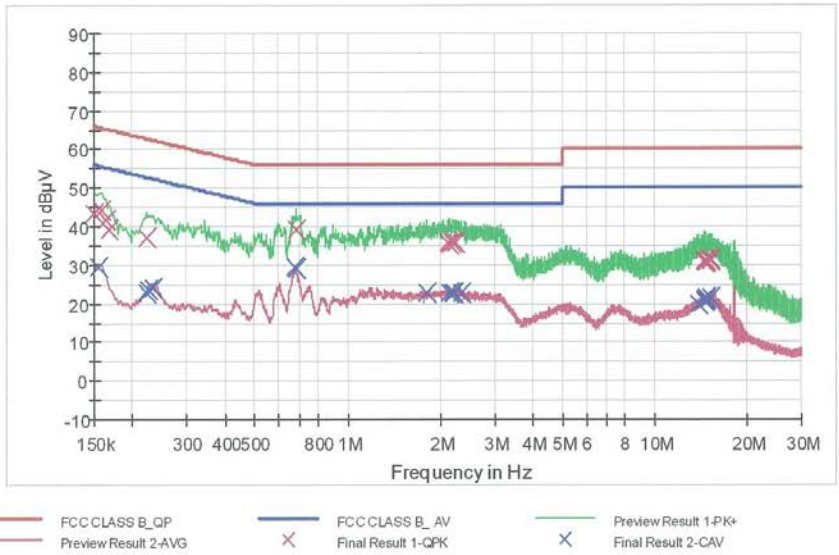
EMI Auto Test(13) 1 / 2

HCT TEST Report

Common Information

EUT:	SM-A510FD
Manufacturer:	SAMSUNG
Test Site:	SHIELD ROOM
Operating Conditions:	WLAN MODE _ 2.4G
Operator Name:	KS KANG

FCC CLASS B



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	43.3	9.000	Off	N	9.6	22.7	66.0
0.158000	44.2	9.000	Off	N	9.6	21.4	65.6
0.164000	41.5	9.000	Off	N	9.6	23.8	65.3
0.168000	39.1	9.000	Off	N	9.6	26.0	65.1
0.222000	37.0	9.000	Off	N	9.6	25.7	62.7
0.682000	39.0	9.000	Off	N	9.6	17.0	56.0
2.116000	35.8	9.000	Off	N	9.7	20.2	56.0
2.142000	35.5	9.000	Off	N	9.7	20.5	56.0
2.146000	35.3	9.000	Off	N	9.7	20.7	56.0
2.156000	35.5	9.000	Off	N	9.7	20.5	56.0
2.206000	35.7	9.000	Off	N	9.7	20.3	56.0
2.234000	35.8	9.000	Off	N	9.7	20.2	56.0
14.464000	31.0	9.000	Off	N	10.1	29.0	60.0
14.512000	30.9	9.000	Off	N	10.1	29.1	60.0
14.628000	30.8	9.000	Off	N	10.1	29.2	60.0
14.770000	31.3	9.000	Off	N	10.1	28.7	60.0

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EMI Auto Test(13) 2 / 2

Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
15.134000	31.1	9.000	Off	N	10.1	28.9	60.0
15.228000	31.4	9.000	Off	N	10.1	28.6	60.0

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.156000	29.5	9.000	Off	N	9.6	26.2	55.7
0.222000	22.7	9.000	Off	N	9.6	30.0	52.7
0.226000	23.6	9.000	Off	N	9.6	29.0	52.6
0.234000	24.2	9.000	Off	N	9.6	28.1	52.3
0.676000	29.3	9.000	Off	N	9.6	16.7	46.0
0.684000	29.2	9.000	Off	N	9.6	16.8	46.0
1.812000	22.6	9.000	Off	N	9.7	23.4	46.0
2.142000	22.6	9.000	Off	N	9.7	23.4	46.0
2.146000	22.6	9.000	Off	N	9.7	23.4	46.0
2.206000	23.0	9.000	Off	N	9.7	23.0	46.0
2.222000	22.9	9.000	Off	N	9.7	23.1	46.0
2.340000	22.9	9.000	Off	N	9.7	23.1	46.0
13.892000	20.0	9.000	Off	N	10.1	30.0	50.0
14.464000	20.8	9.000	Off	N	10.1	29.2	50.0
14.534000	21.1	9.000	Off	N	10.1	28.9	50.0
14.770000	21.4	9.000	Off	N	10.1	28.6	50.0
14.782000	20.9	9.000	Off	N	10.1	29.1	50.0
15.134000	21.4	9.000	Off	N	10.1	28.6	50.0

12/8/2015 10:35:44

Conducted Emissions (Line 2)

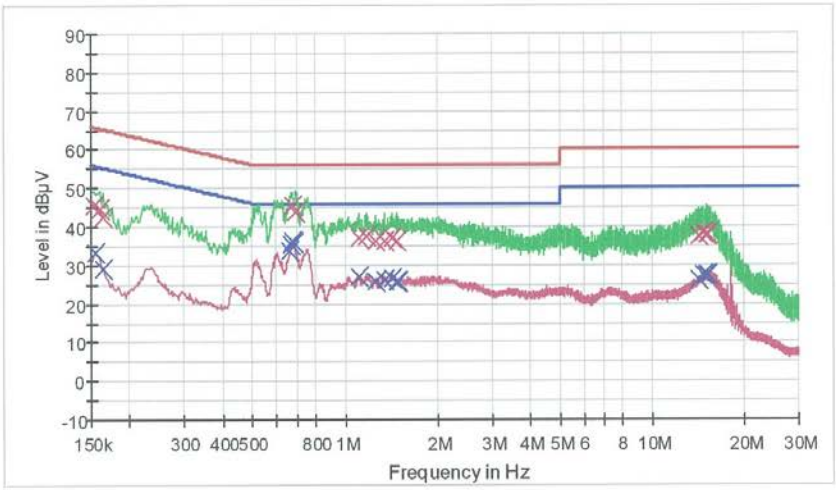
EMI Auto Test(13) 1 / 2

HCT TEST Report

Common Information

EUT:	SM-A510FD
Manufacturer:	SAMSUNG
Test Site:	SHIELD ROOM
Operating Conditions:	WLAN MODE _ 2.4G
Operator Name:	KS KANG

FCC CLASS B



FCC CLASS B_QP
Preview Result 2-AVG
FCC CLASS B_ AV
Final Result 1-QPK
Preview Result 1-PK+
Final Result 2-CAV

Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.154000	45.6	9.000	Off	L1	9.6	20.2	65.8
0.160000	44.7	9.000	Off	L1	9.6	20.9	65.5
0.164000	42.7	9.000	Off	L1	9.6	22.6	65.3
0.674000	45.7	9.000	Off	L1	9.7	10.3	56.0
0.690000	43.7	9.000	Off	L1	9.7	12.3	56.0
0.694000	43.7	9.000	Off	L1	9.7	12.3	56.0
1.114000	37.2	9.000	Off	L1	9.7	18.8	56.0
1.184000	37.3	9.000	Off	L1	9.7	18.7	56.0
1.260000	36.2	9.000	Off	L1	9.7	19.8	56.0
1.350000	36.0	9.000	Off	L1	9.7	20.0	56.0
1.428000	37.1	9.000	Off	L1	9.7	18.9	56.0
1.470000	36.3	9.000	Off	L1	9.7	19.7	56.0
14.282000	37.4	9.000	Off	L1	10.1	22.6	60.0
14.680000	38.2	9.000	Off	L1	10.1	21.8	60.0
15.072000	37.7	9.000	Off	L1	10.1	22.3	60.0
15.216000	38.0	9.000	Off	L1	10.1	22.0	60.0

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EMI Auto Test(13) 2 / 2

Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
15.248000	37.9	9.000	Off	L1	10.1	22.1	60.0
15.270000	37.8	9.000	Off	L1	10.1	22.2	60.0

Final Result 2

Frequency (MHz)	CAverage (dBµV)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.156000	33.1	9.000	Off	L1	9.6	22.6	55.7
0.164000	28.9	9.000	Off	L1	9.6	26.4	55.3
0.662000	33.5	9.000	Off	L1	9.7	12.5	46.0
0.670000	35.4	9.000	Off	L1	9.7	10.6	46.0
0.674000	36.1	9.000	Off	L1	9.7	9.9	46.0
0.682000	35.6	9.000	Off	L1	9.7	10.4	46.0
1.110000	26.9	9.000	Off	L1	9.7	19.2	46.0
1.260000	25.8	9.000	Off	L1	9.7	20.2	46.0
1.350000	26.2	9.000	Off	L1	9.7	19.8	46.0
1.428000	26.6	9.000	Off	L1	9.7	19.4	46.0
1.470000	25.9	9.000	Off	L1	9.7	20.1	46.0
1.490000	25.9	9.000	Off	L1	9.7	20.1	46.0
14.282000	26.3	9.000	Off	L1	10.1	23.7	50.0
14.680000	27.3	9.000	Off	L1	10.1	22.7	50.0
14.744000	27.3	9.000	Off	L1	10.1	22.7	50.0
15.072000	27.3	9.000	Off	L1	10.1	22.7	50.0
15.216000	27.3	9.000	Off	L1	10.1	22.7	50.0
15.270000	27.3	9.000	Off	L1	10.1	22.7	50.0

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9. LIST OF TEST EQUIPMENT

9.1 LIST OF TEST EQUIPMENT(Conducted Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Rohde & Schwarz	ENV216/ LISN	01/13/2015	Annual	100073
Agilent	E4440A/ Spectrum Analyzer	03/18/2015	Annual	US45303008
Agilent	N9020A / SIGNAL ANALYZER	06/30/2015	Annual	MY51110085
Agilent	N9020A / SIGNAL ANALYZER	07/02/2015	Annual	MY50510304
Agilent	N1911A/Power Meter	07/09/2015	Annual	MY45100523
Agilent	N1921A /POWER SENSOR	07/09/2015	Annual	MY45241059
Agilent	87300B/Directional Coupler	11/30/2015	Annual	3116A03621
Hewlett Packard	11667B / Power Splitter	06/15/2015	Annual	5001
Hewlett Packard	E3632A / DC POWER SUPPLY	03/11/2015	Annual	KR75303962
Agilent	8493C / Attenuator(10 dB)	07/21/2015	Annual	07560

9.2 LIST OF TEST EQUIPMENT(Radiated Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Schwarzbeck	VULB 9160/ TRILOG Antenna	10/10/2014	Biennial	3368
HD	MA240/ Antenna Position Tower	N/A	N/A	556
EMCO	1050/ Turn Table	N/A	N/A	114
HD GmbH	HD 100/ Controller	N/A	N/A	13
HD GmbH	KMS 560/ SlideBar	N/A	N/A	12
Schwarzbeck	BBHA 9120D/ Horn Antenna	05/07/2015	Biennial	937
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	04/30/2015	Biennial	BBHA9170124
Rohde & Schwarz	FSP / Spectrum Analyzer	01/22/2015	Annual	839117/011
Wainwright Instrument	WHF3.0/18G-10EF / High Pass Filter	06/29/2015	Annual	8
Wainwright Instrument	WRCJ2400/2483.5-2370/2520-60/14SS / Band Reject Filter	06/15/2015	Annual	1
Rohde & Schwarz	LOOP ANTENNA	09/03/2014	Biennial	1513-175
CERNEX	CBL18265035 / POWER AMP	07/27/2015	Annual	22966
CERNEX	CBL06185030 / POWER AMP	07/21/2015	Annual	22965
CERNEX	CBLU1183540 / POWER AMP	07/21/2015	Annual	22964