RF TEST REPORT

Test item	:	Industrial PDA
Model No.	:	HM50
Order No.	:	DEMC1207-01246
Date of receipt	:	2012-07-24
Test duration	:	2012-09-14 ~ 2012-09-19
Date of issue	:	2012-10-08
Use of report	:	FCC Original Grant

Applicant : Bluebird Soft Inc.
1242, Gaepo-dong ,Gangnam-gu, Seoul, Korea

Test laboratory : Digital EMC Co., Ltd.
683-3, Yubang-Dong, Cheoin-Gu, Yongin-Si, Kyunggi-Do, 449-080, Korea

Test specification	:	FCC Part 15 Subpart C 247, ANSI C63.4-2003, KDB558074
Test environment	:	See appended test report
Test result	:	☒ Pass ☐ Fail

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DIGITAL EMC CO., LTD.

Tested by:	Witnessed by:	Reviewed by:
Engineer H.H.Lee	N/A	Deputy General Manager Will Lee

Table of Contents

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1. GENERAL INFORMATION

Applicant	:	Bluebird Soft Inc.
Address	:	1242, Gaepo-dong ,Gangnam-gu, Seoul, Korea
FCC ID	:	SS4HM50
EUT	:	Industrial PDA
Model	:	HM50
Additional Model(s)	:	N/A
Data of Test	:	2012-09-14 ~ 2012-09-19
Contact person	:	Joo Hyung Lee

2. EUT DESCRIPTION

Product	Industrial PDA
Model Name	HM50
Power Supply	DC 3.7V
Frequency Range	2.4GHz Band ▪ 802.11b/g/n(20MHz): 2412 ~ 2462 MHz
Max. RF Output Power	2.4GHz Band ▪ 802.11b: 20.89 dBm ▪ 802.11g: 20.85 dBm ▪ 802.11n (HT20): 18.62 dBm
Modulation Type	802.11b: DSSS/CCK 802.11a/g/n: OFDM
Antenna Specification	Internal Antenna (1TX 1RX) ▪ 2.4GHz Band Max. peak gain : 1.4 dBi

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3. SUMMARY OF TESTS

FCC Part Section(s)	Parameter	Limit	Test Condition	Status Note 1
I. Transmitter Mode (TX)				
15.247(a)	6 dB Bandwidth	> 500 kHz	Conducted	**C**
15.247(b)	Transmitter Output Power	< 1Watt		**C**
15.247(c)	Out of Band Emissions / Band Edge	20dBc in any 100kHz BW		**C**
15.247(d)	Transmitter Power Spectral Density	< 8dBm / 3kHz		**C**
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	< FCC 15.209 limits	Radiated	**C** **Note2**
15.207	AC Conducted Emissions	< FCC 15.207 limits	AC Line Conducted	**C**
15.203	Antenna Requirements	FCC 15.203	-	**C**

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable

Note 2: This test item was performed in each axis and the worst case data was reported.

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4. TEST METHODOLOGY

The measurement procedure described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz(ANSI C63.4-2003) and KDB558074

4.1 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.

4.2 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.

4.3 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 13.1.4.1 of ANSI C63.4. (Version :2003) 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. 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 highest emission, the relative positions of the EUT were rotated through three orthogonal axes according to the requirements in Section 13.1.4.1 of ANSI C63.4. (Version: 2003)

4.4 DESCRIPTION OF TEST MODES

The EUT has been tested with several operating conditions for maximizing the emission characteristics. A test program is used to control the EUT for staying in continuous transmitting mode.

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5. 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.

6. FACILITIES AND ACCREDITATIONS

6.1 FACILITIES

The open area test site(OATS) or semi anechoic chamber and conducted measurement facility used to collect the radiated and conducted test data are located at the 683-3, Yubang-Dong, Yongin-Si, Gyunggi-Do, 449-080, South Korea. The site is constructed in conformance with the requirements.

- Semi anechoic chamber registration Number : 678747

6.2 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 peak, 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.”

7. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203 & RSS-Gen [7.1.2]:
“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 internal antenna of this E.U.T is permanently attached on the main PCB.(Please refer to internal Photo.)
* Therefore this E.U.T Complies with the requirement of §15.203

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8. TEST RESULT

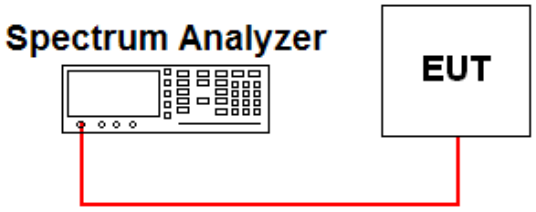
8.1 6dB Bandwidth

Test Requirements and limit, §15.247(a)

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 and used following test procedure of KDB558074.

1. Set resolution bandwidth (RBW) = 1-5 % of the emission bandwidth (EBW).
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
   (RBW:200KHz/VBW:620KHz for EBW < 20 MHz , RBW:390KHz/VBW:1.2MHz for 20 MHz < EBW < 40 MHz)
3. Detector = **Peak**.
4. Trace mode = **max hold**.
5. Sweep = **auto couple**.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. Compare the resultant bandwidth with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is 1-5 %.

▣ TEST RESULTS: Comply

Test Mode	Frequency [MHz]	Test Results [MHz]
802.11b	2412	9.177
	2437	9.167
	2462	9.171
802.11g	2412	16.040
	2437	15.430
	2462	16.050
802.11n (20MHz)	2412	17.090
	2437	16.340
	2462	17.090

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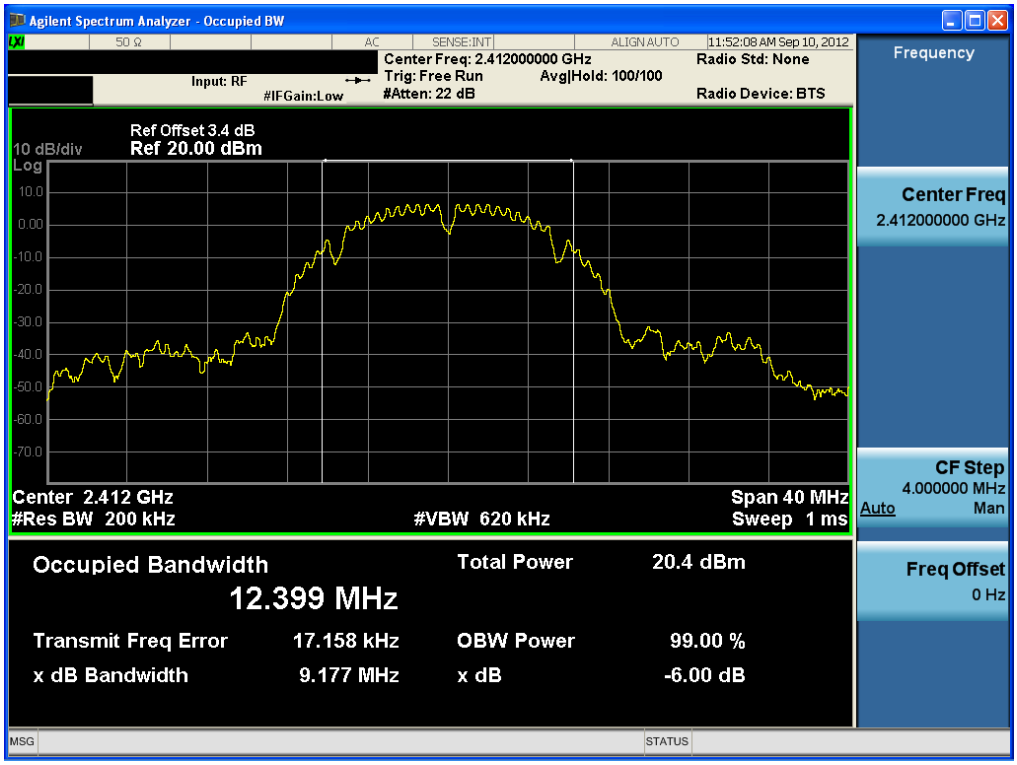
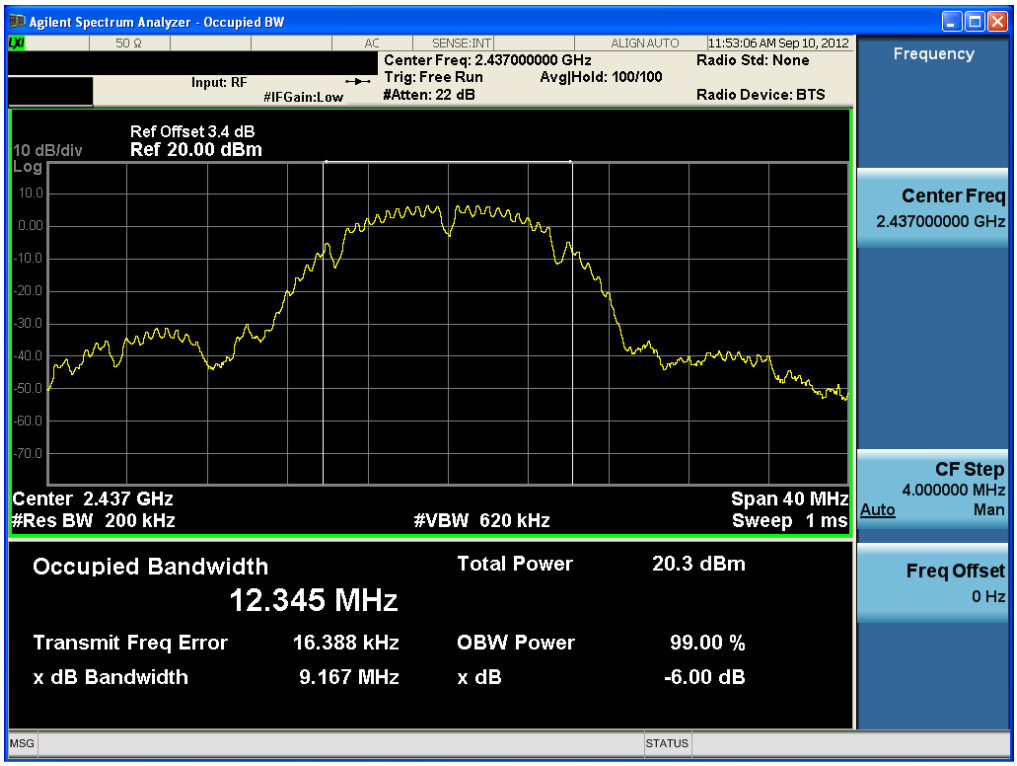
▣ RESULT PLOTS

6 dB Bandwidth Test Mode: 802.11b & 11Mbps & 2412MHz



6 dB Bandwidth Test Mode: 802.11b & 11Mbps & 2437MHz



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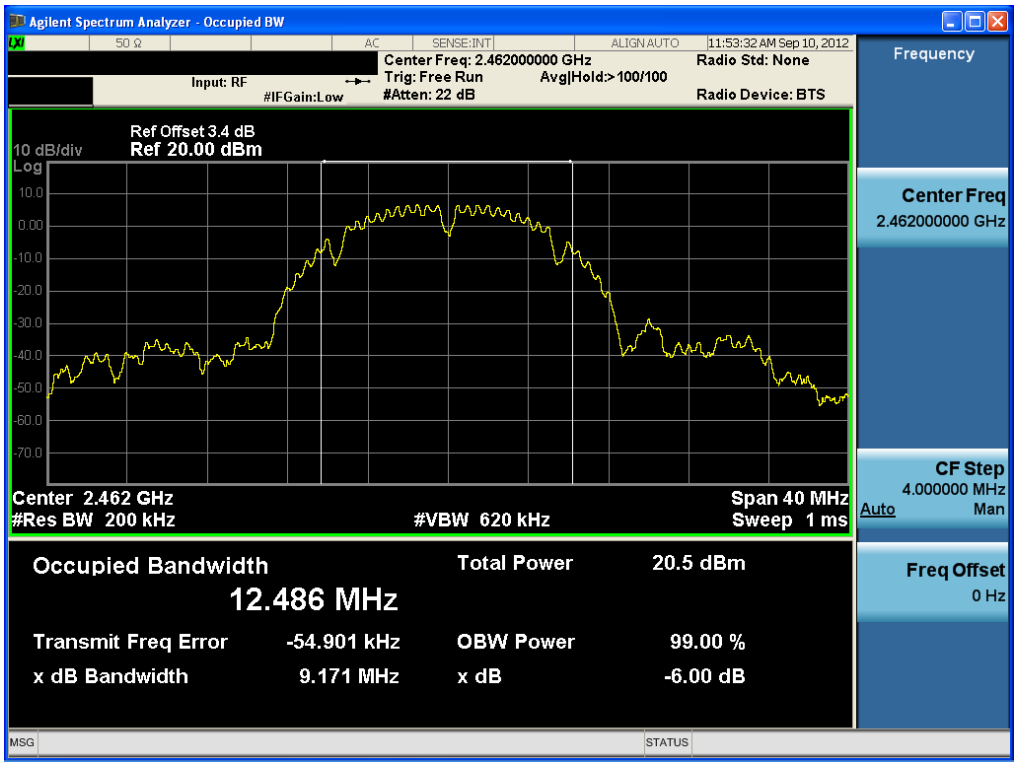
6 dB Bandwidth Test Mode: 802.11b & 11Mbps & 2462MHz



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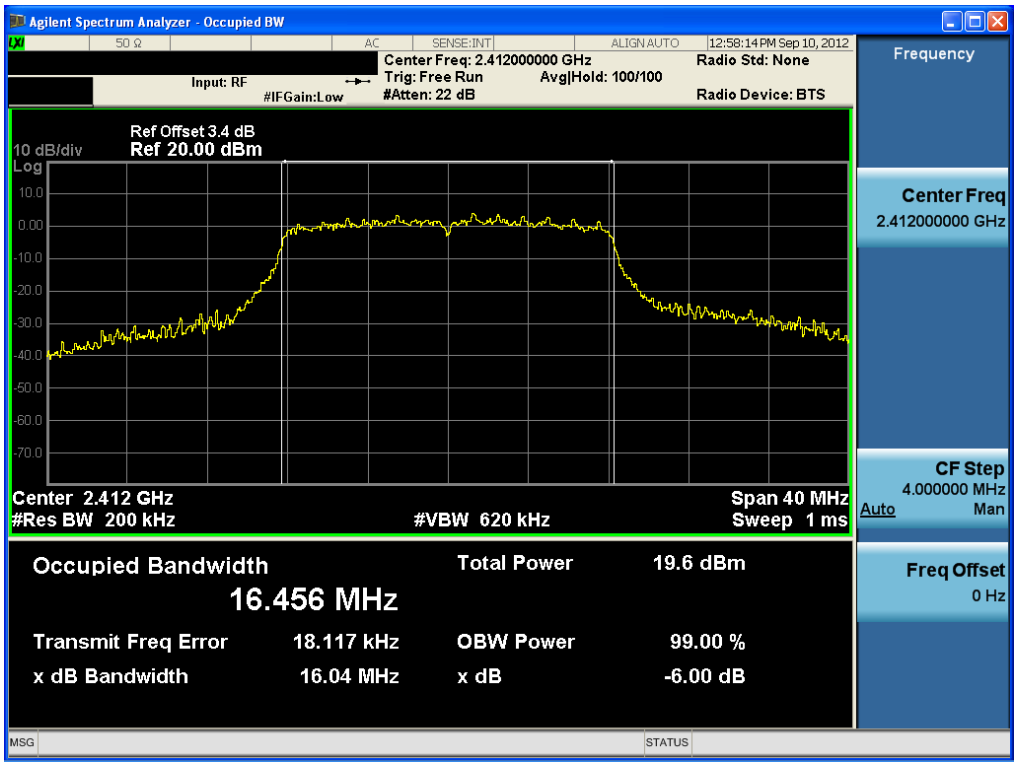
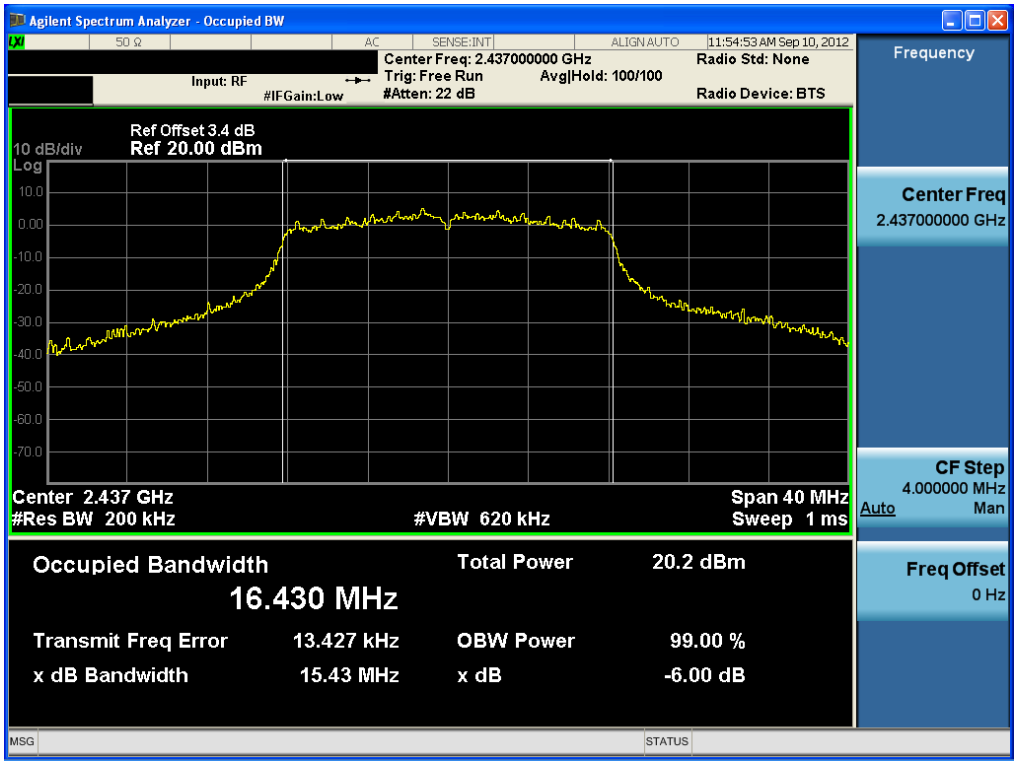
6 dB Bandwidth Test Mode: 802.11g & 24Mbps & 2412MHz



6 dB Bandwidth Test Mode: 802.11g & 36Mbps & 2437MHz



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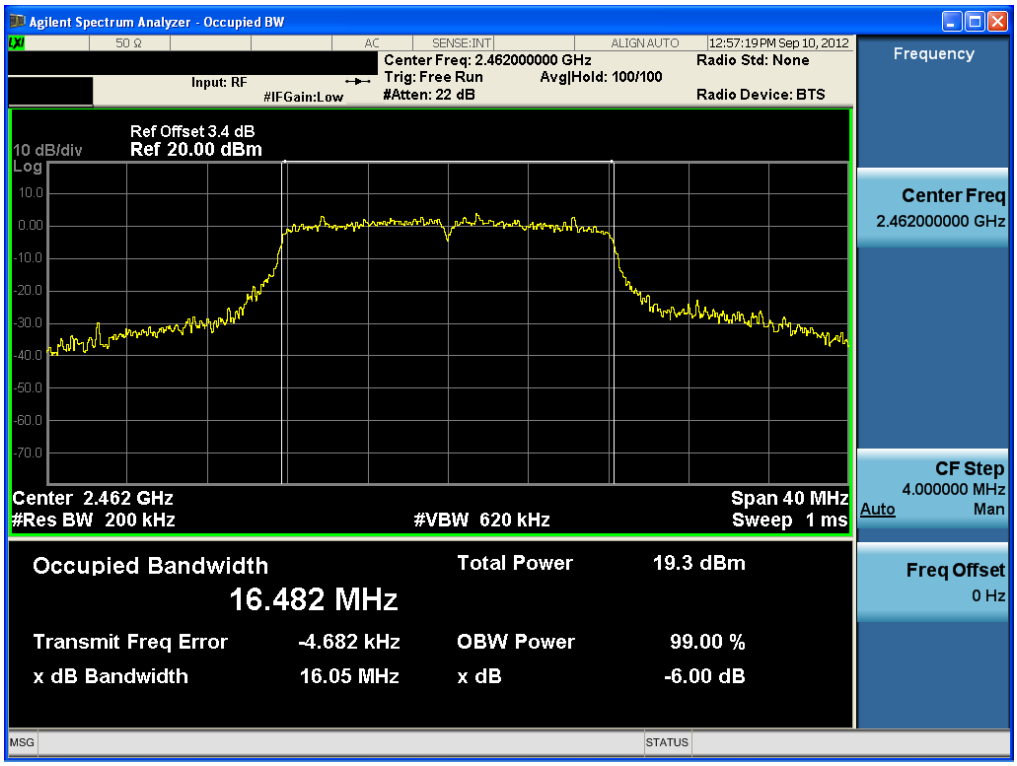
6 dB Bandwidth Test Mode: 802.11g & 48Mbps & 2462MHz



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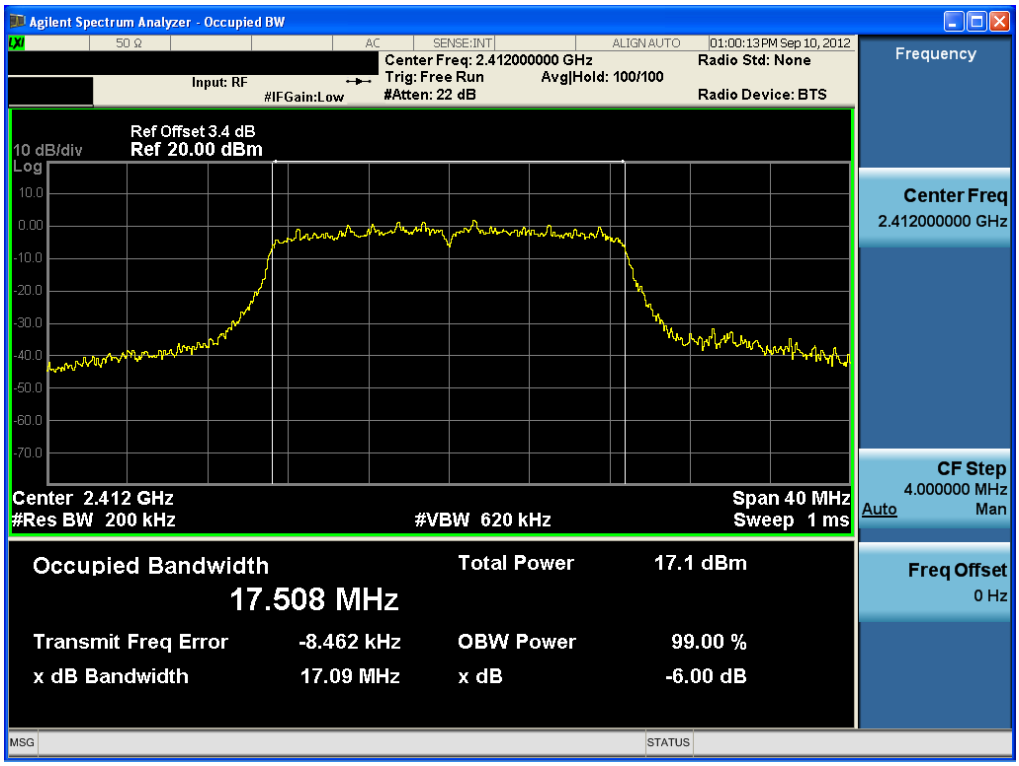
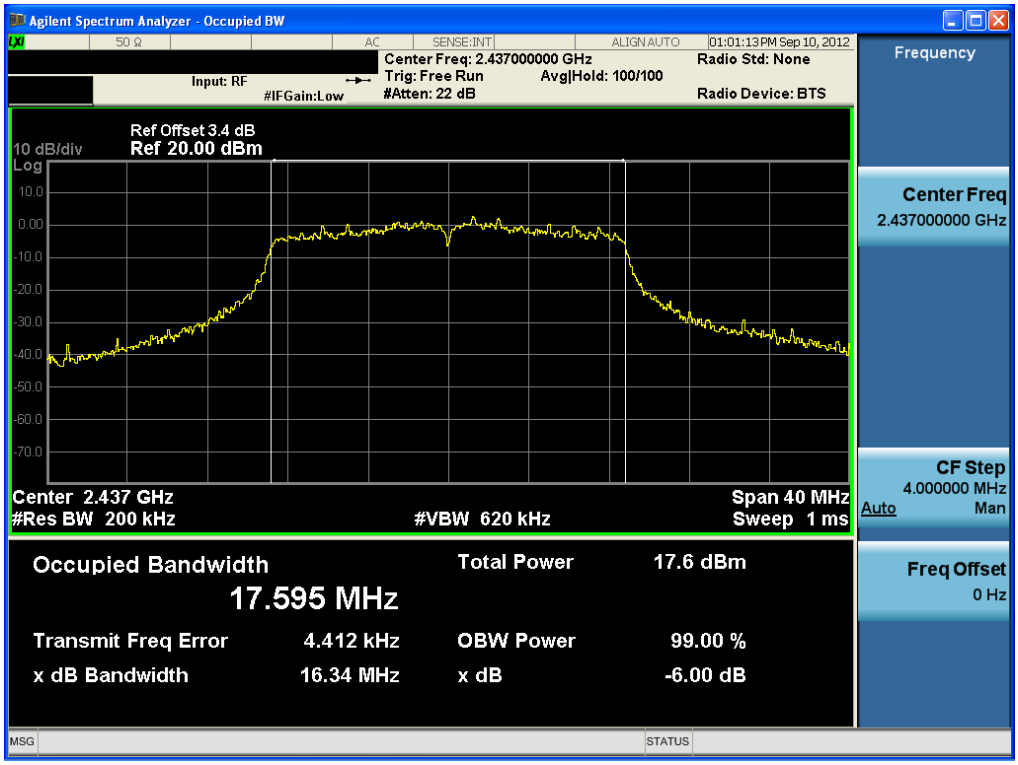
6 dB Bandwidth Test Mode: 802.11n & MCS3 & 2412MHz



6 dB Bandwidth Test Mode: 802.11n & MCS4 & 2437MHz



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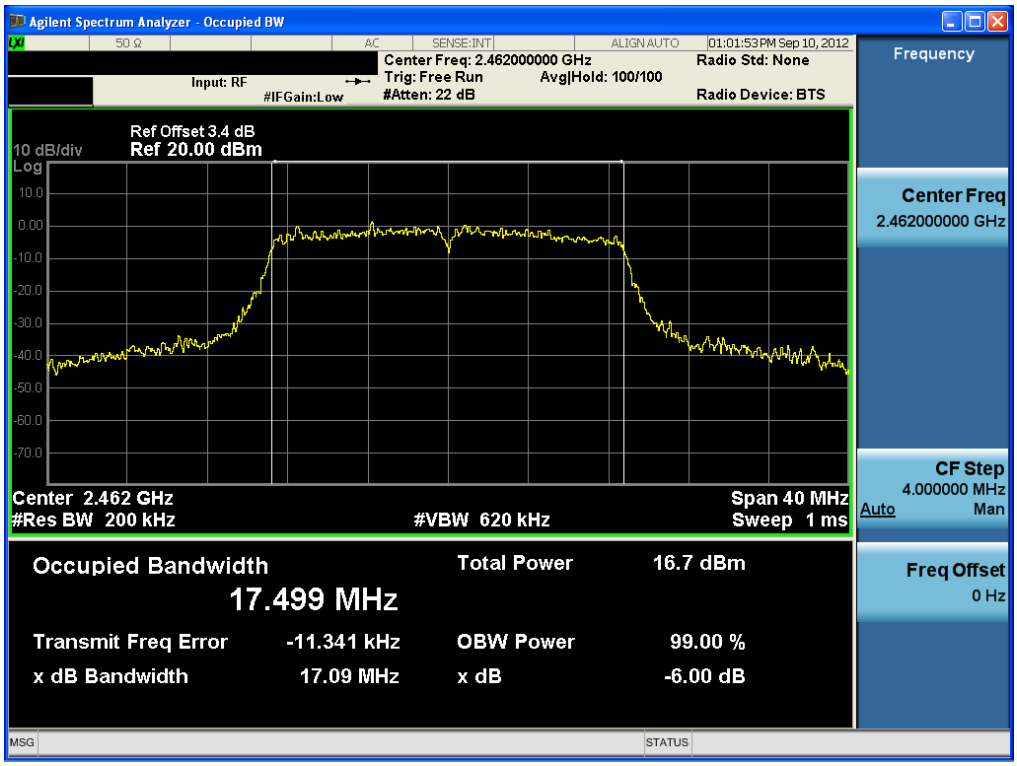
6 dB Bandwidth Test Mode: 802.11n & MCS3 & 2462MHz



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8.2 Maximum Peak Conducted Output Power

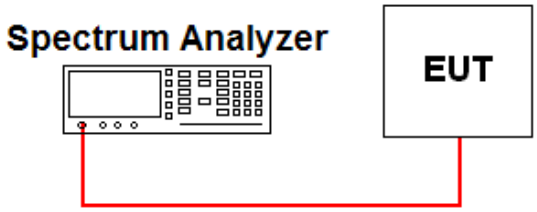
Test Requirements and limit, §15.247(b)

A transmitter antenna terminal of EUT is connected to the input of a spectrum analyzer.

Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

▣ TEST CONFIGURATION



▣ TEST PROCEDURE :

Maximum Peak Conducted Output Power is measured using **the Measurement Procedure PK2 of KDB558074**.

1. Set the **RBW = 1 MHz**.
2. Set the **VBW = 3 MHz**.
3. Set the span to a value that is **5-30 %** greater than the EBW.
4. Detector = **peak**.
5. Sweep time = **auto couple**.
6. Trace mode = **max hold**.
7. Allow trace to fully stabilize.
8. Use the spectrum analyzer's integrated band power measurement function with band limits set equal to the EBW band edges (for some analyzers, this may require a manual override to ensure use of peak detector). If the spectrum analyzer does not have a band power function, sum the spectrum levels (in linear power units) at 1 MHz intervals extending across the EBW of the spectrum.

Note: Tests were performed all possible data rates and the worst case data were reported.

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▣ TEST RESULTS : Comply

- **Measurement Data: Comply**

Summary of Test Results

Mode	Channel	Frequency [MHz]	Test Result	
			[dBm]	[W]
802.11b	1	2412	20.58	0.114
	6	2437	20.80	0.120
	11	2462	**20.89**	**0.123**
802.11g	1	2412	20.23	0.105
	6	2437	20.73	0.118
	11	2462	**20.85**	**0.122**
802.11n HT20	1	2412	18.13	0.065
	6	2437	18.35	0.068
	11	2462	**18.62**	**0.073**

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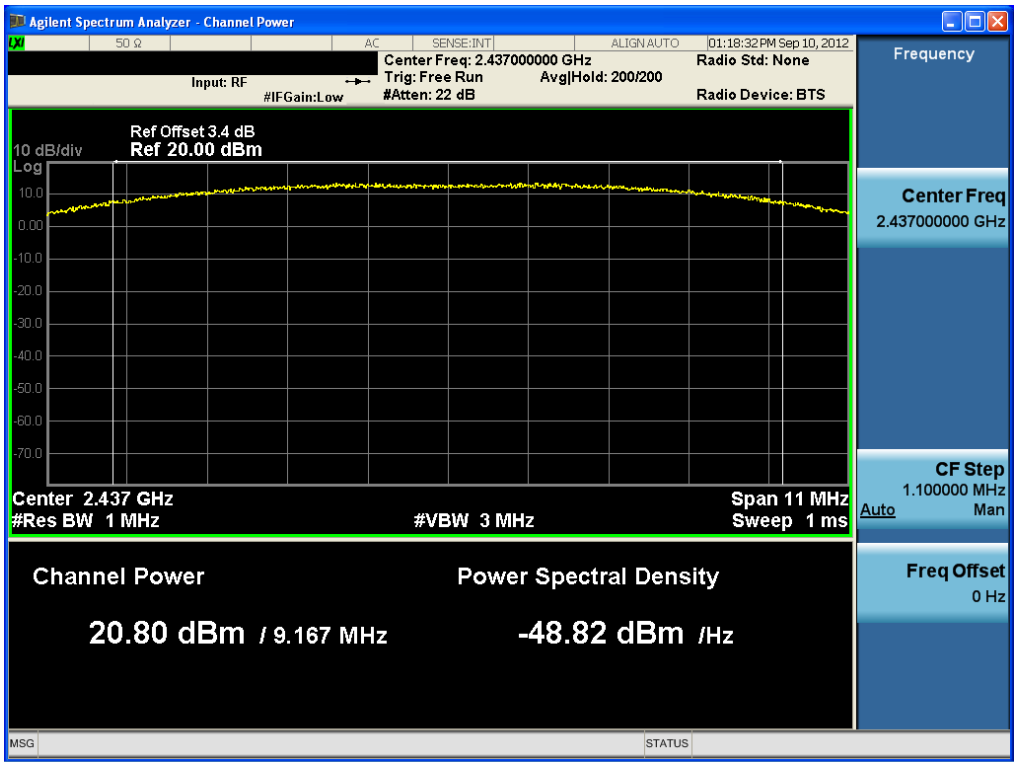
▣ RESULT PLOTS

Peak Output Power Test Mode: 802.11b & 11Mbps & 2412MHz

Peak Output Power Test Mode: 802.11b & 11Mbps & 2437MHz



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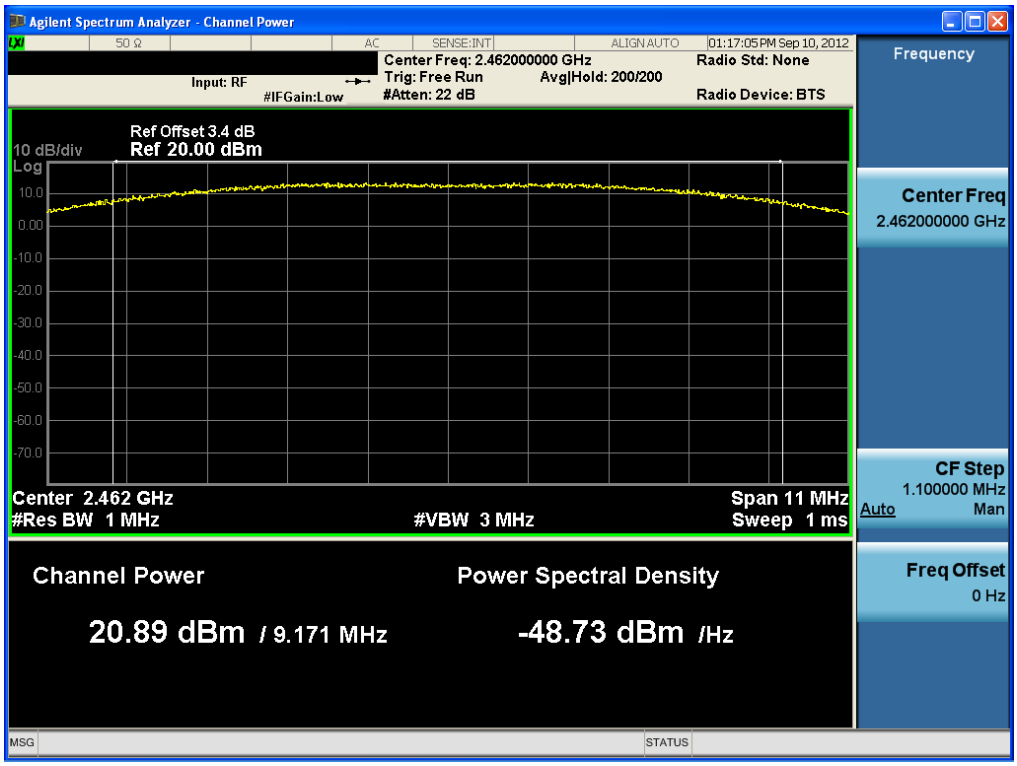
Peak Output Power Test Mode: 802.11b & 11Mbps & 2462MHz



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Peak Output Power Test Mode: 802.11g & 24Mbps & 2412MHz

Peak Output Power Test Mode: 802.11g & 36Mbps & 2437MHz

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Peak Output Power Test Mode: 802.11g & 48Mbps & 2462MHz

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Peak Output Power Test Mode: 802.11n HT20 & MCS3 & 2412MHz

Peak Output Power Test Mode: 802.11n HT20 & MCS4 & 2437MHz

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Peak Output Power Test Mode: 802.11n HT20 & MCS3 & 2462MHz

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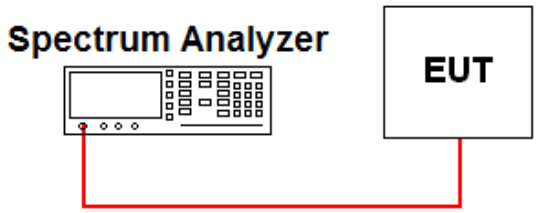
8.3 Maximum Power Spectral Density

Test requirements and limit, §15.247(e)

The peak power 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 –specifies a conducted power spectral density (PSD) limit of 8 dBm in any 3 kHz band segment within the fundamental EBW during any time interval of continuous transmission.

▣ TEST CONFIGURATION



▣ TEST PROCEDURE:

The Measurement Procedure **PKPSD of KDB558074** is used.

1. Set the **RBW = 100 kHz**.
2. Set the **VBW ≥ 300 kHz**.
3. Set the span to **5-30 %** greater than the EBW.
4. Detector = **peak**.
5. Sweep time = **auto couple**.
6. Trace mode = **max hold**.
7. Allow trace to fully stabilize.
8. Use the **peak marker function** to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
9. Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where **BWCF = 10log (3 kHz/100 kHz = -15.2 dB)**.
10. The resulting peak PSD level must be ≤ 8 dBm.

▣ TEST RESULTS: Comply

Test Mode	Frequency [MHz]	S/A Reading [dBm]	B.W.C.F [dB]	PKPSD [dBm]
802.11b	2412	7.126	-15.20	-8.07
	2437	7.229	-15.20	-7.97
	2462	7.143	-15.20	-8.06
802.11g	2412	3.519	-15.20	-11.68
	2437	4.727	-15.20	-10.47
	2462	3.635	-15.20	-11.57
802.11n HT20	2412	1.307	-15.20	-13.89
	2437	2.399	-15.20	-12.80
	2462	1.845	-15.20	-13.36

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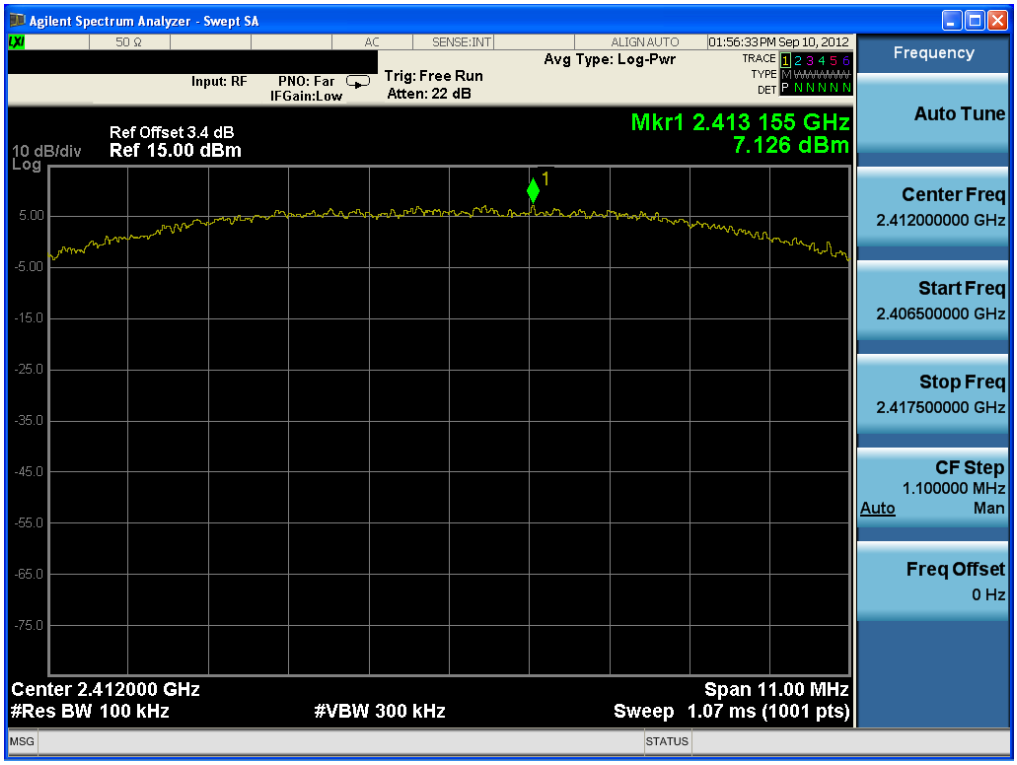
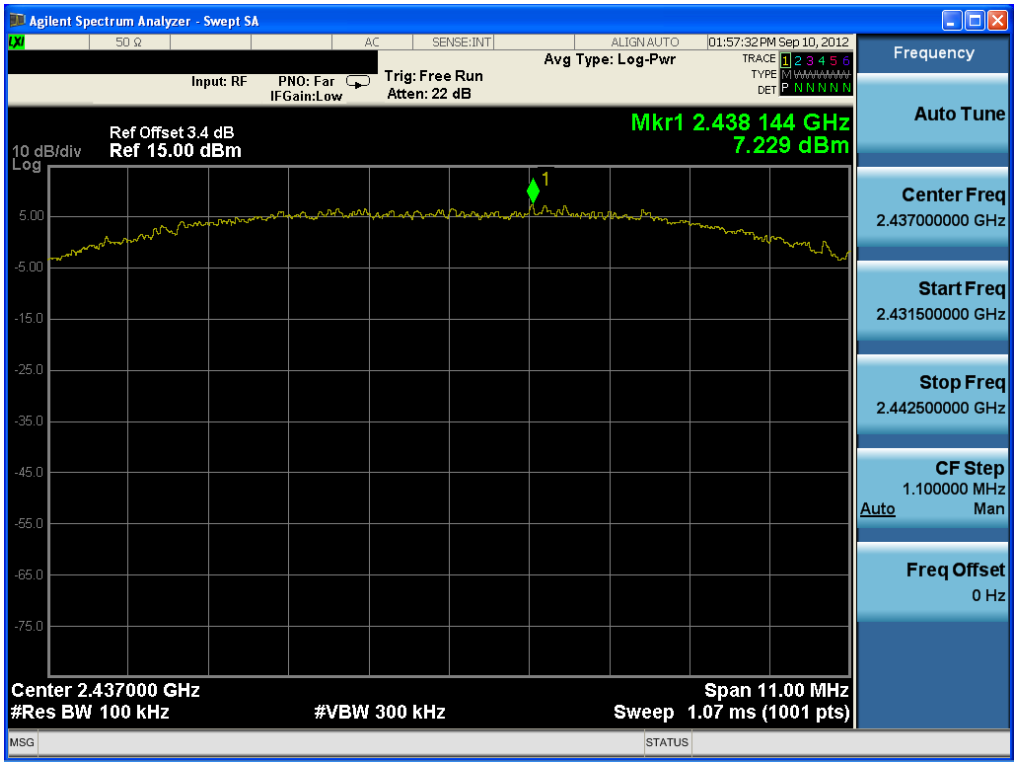
▣ RESULT PLOTS

Maximum PKPSD Test Mode: 802.11b & 11Mbps & 2412MHz



Maximum PKPSD Test Mode: 802.11b & 11Mbps & 2437MHz



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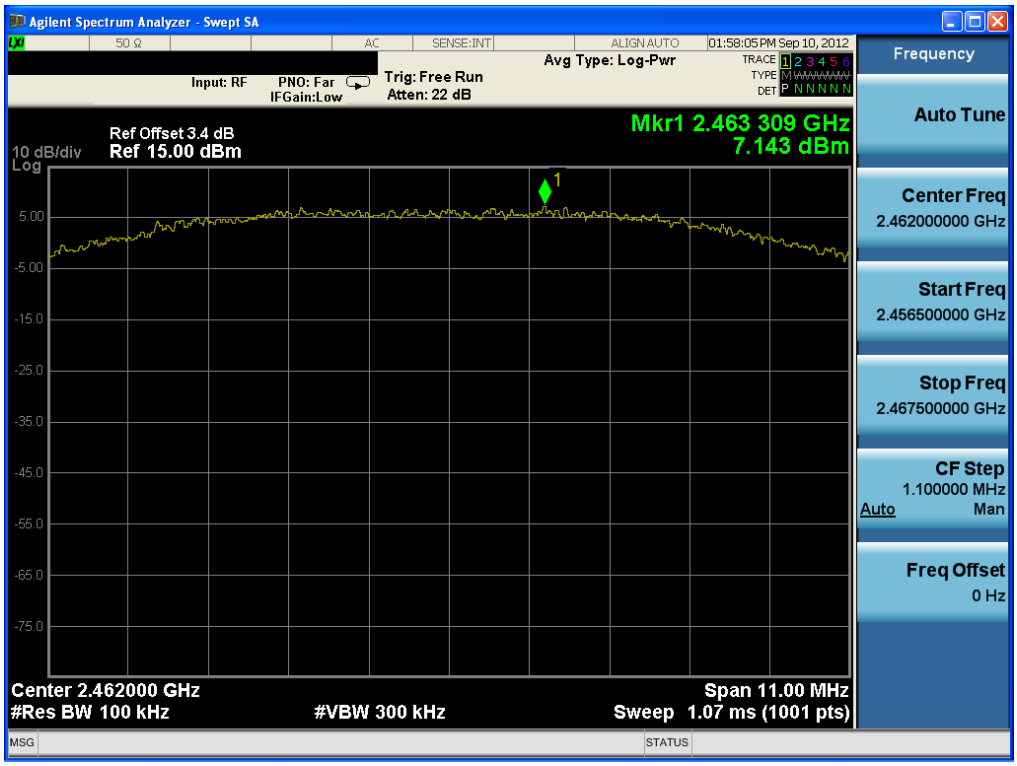
Maximum PKPSD Test Mode: 802.11b & 11Mbps & 2462MHz



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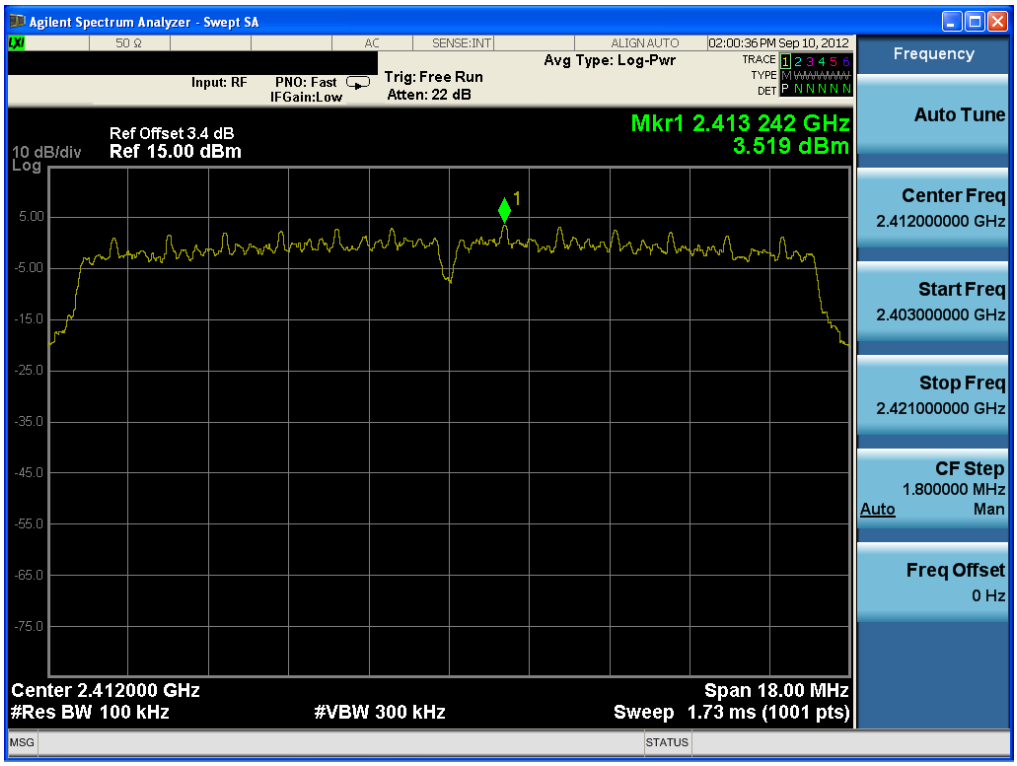
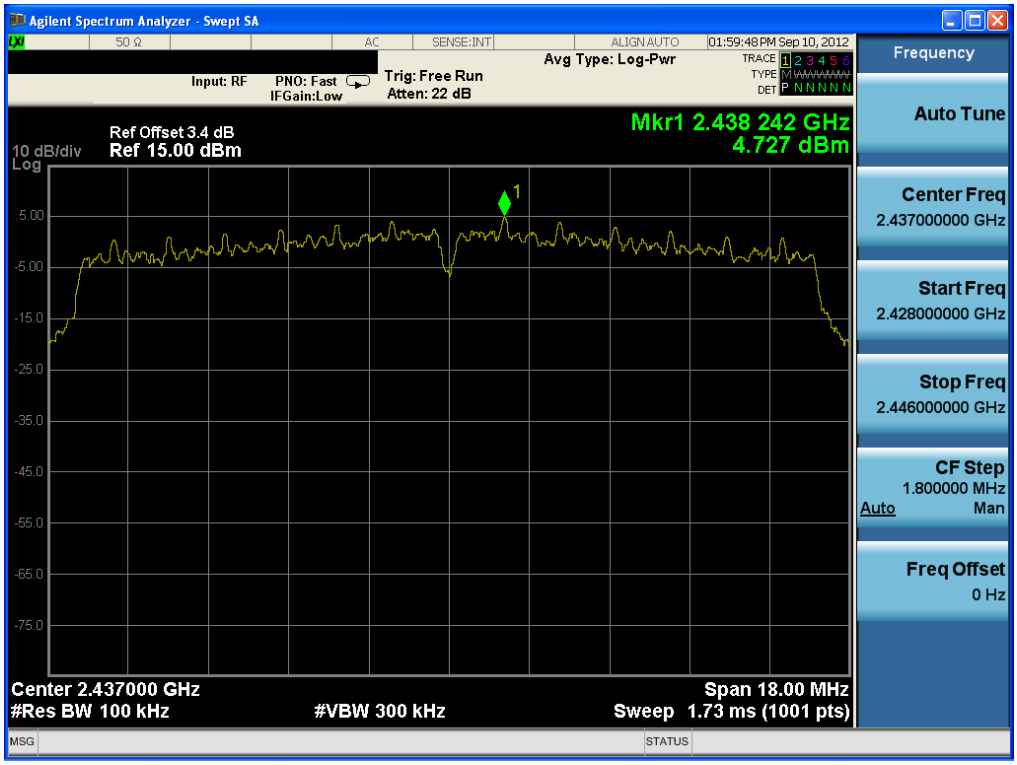
Maximum PKPSD Test Mode: 802.11g & 24Mbps & 2412MHz



Maximum PKPSD Test Mode: 802.11g & 36Mbps & 2437MHz



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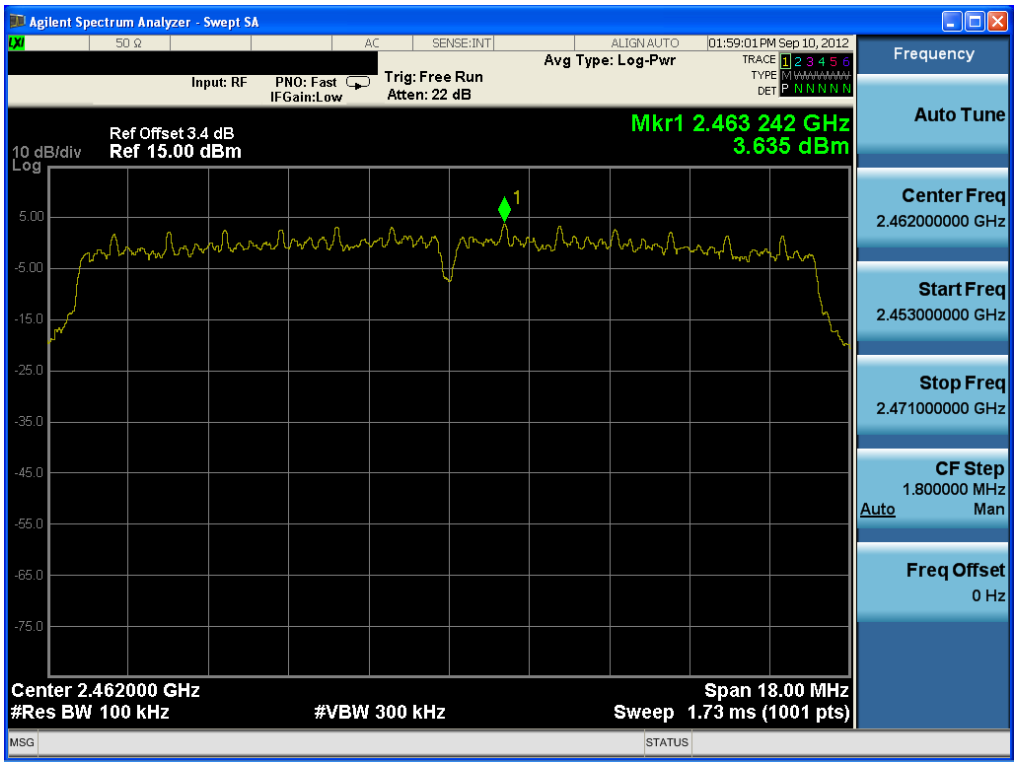
Maximum PKPSD Test Mode: 802.11g & 48Mbps & 2462MHz



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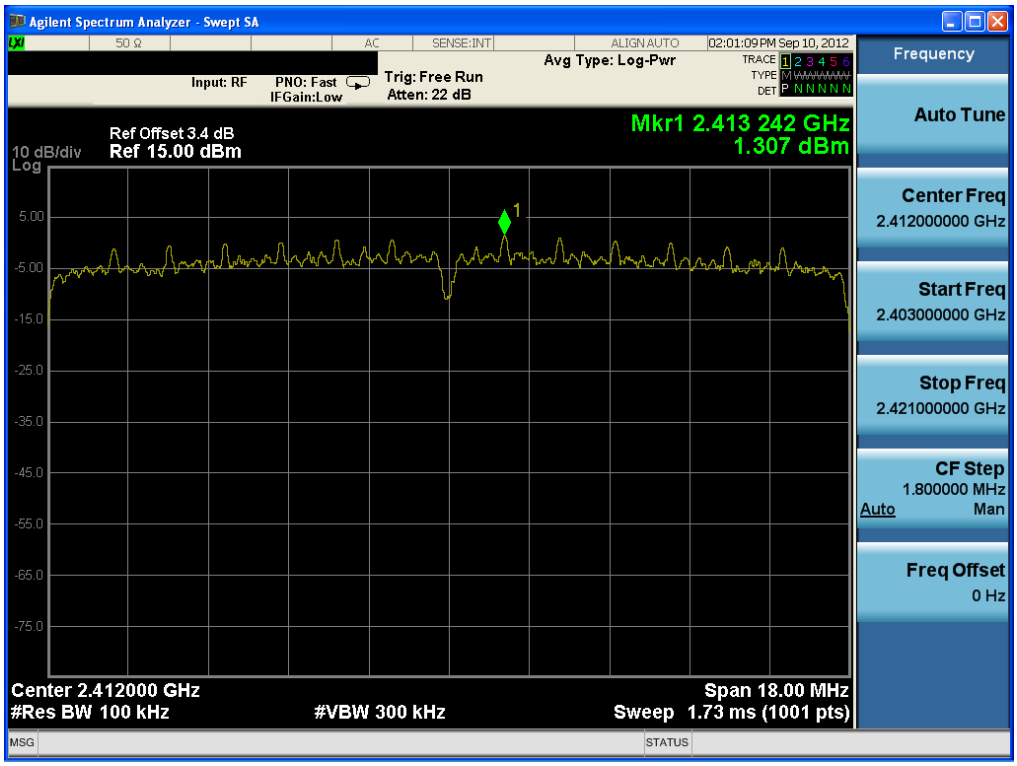
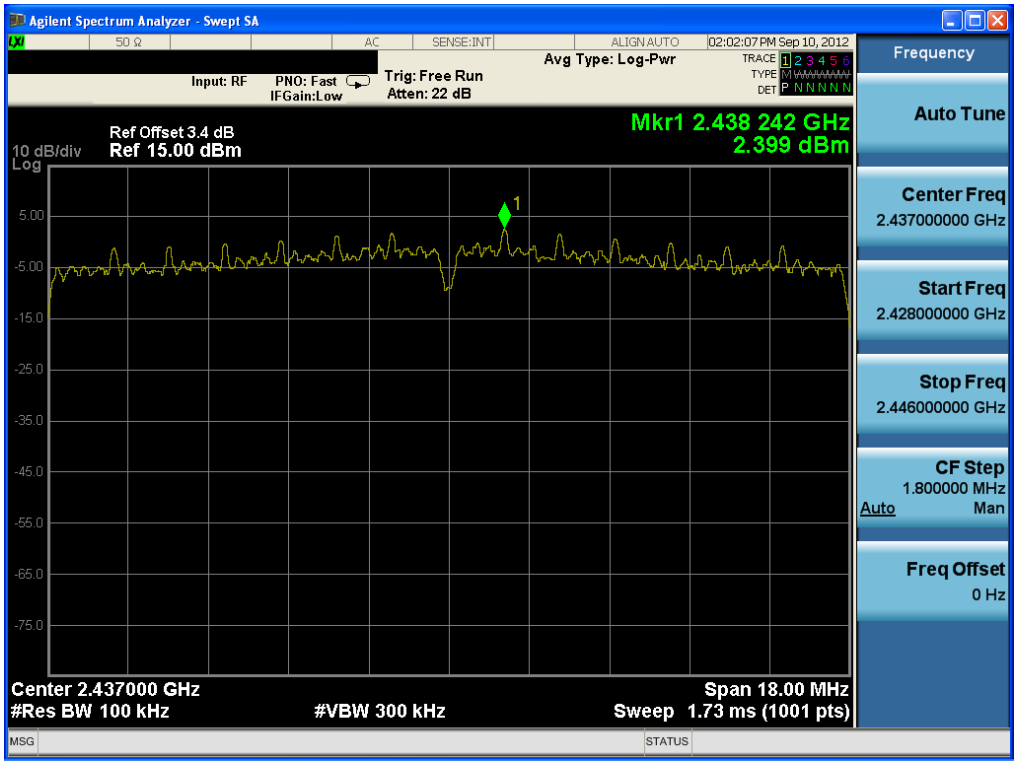
Maximum PKPSD Test Mode: 802.11n(HT20) & MCS3 & 2412MHz



Maximum PKPSD Test Mode: 802.11n(HT20) & MCS4 & 2437MHz



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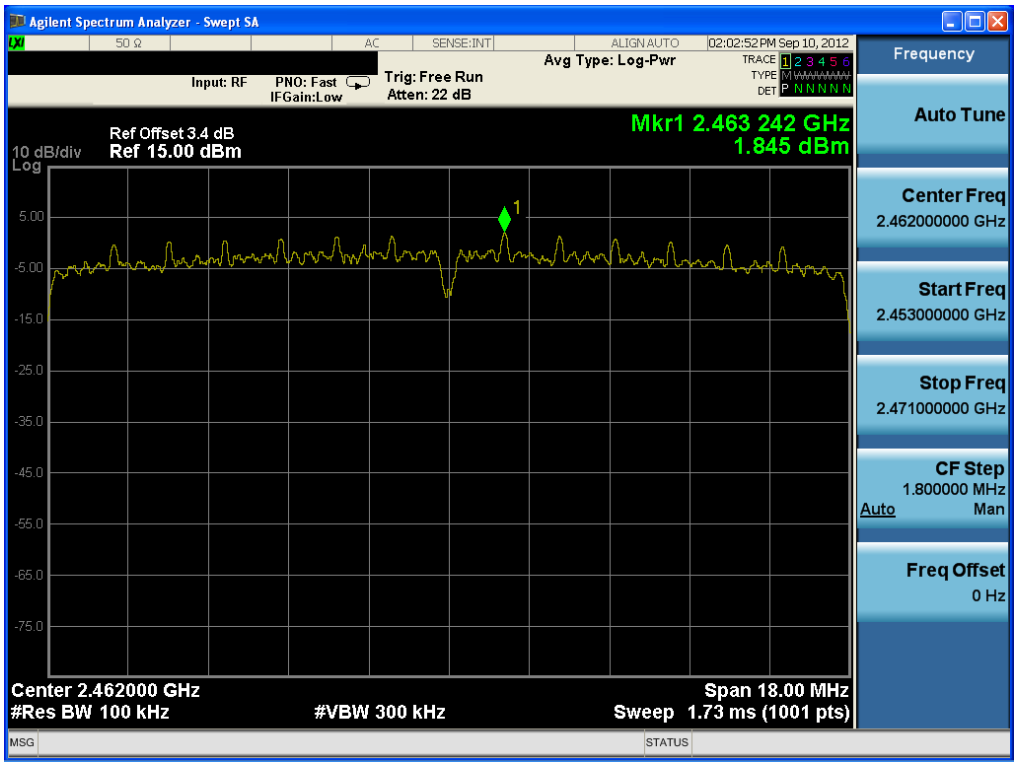
Maximum PKPSD Test Mode: 802.11n(HT20) & MCS3 & 2462MHz



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8.4 Out of Band Emissions at the Band Edge/ Conducted Spurious Emissions

Test requirements and limit, §15.247(d)

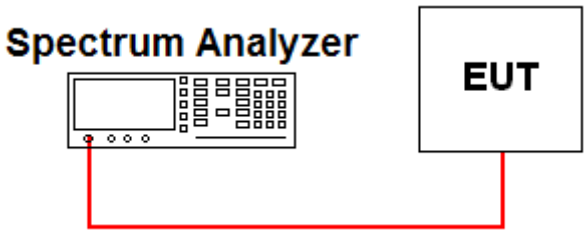
§15.247(d) specifies that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions:

If **the peak output power procedure** is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated **by at least 20 dB** relative to the maximum measured in-band peak PSD level.

If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured inband average PSD level.

In either case, attenuation to levels below the general emission limits specified in **§15.209(a)** is not required.

▣ TEST CONFIGURATION



▣ TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer.

- Measurement Procedure 1 – Reference Level

1. Set the **RBW = 100 kHz**.
2. Set the **VBW ≥ 300 kHz**.
3. Set the span to **5-30 %** greater than the EBW.
4. Detector = **peak**.
5. Sweep time = **auto couple**.
6. Trace mode = **max hold**.
7. Allow trace to fully stabilize.
8. Use the **peak marker function** to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
   Next, **determine the power** in 100 kHz band segments outside of the authorized frequency band using the following measurement:

- Measurement Procedure 2 - Unwanted Emissions

1. Set **RBW = 100 kHz**.
2. Set **VBW ≥ 300 kHz**.
3. Set **span to encompass the spectrum** to be examined.
4. Detector = **peak**.
5. Trace Mode = **max hold**.
6. Sweep = **auto couple**.
7. Allow the trace to stabilize (this may take some time, depending on the extent of the span).

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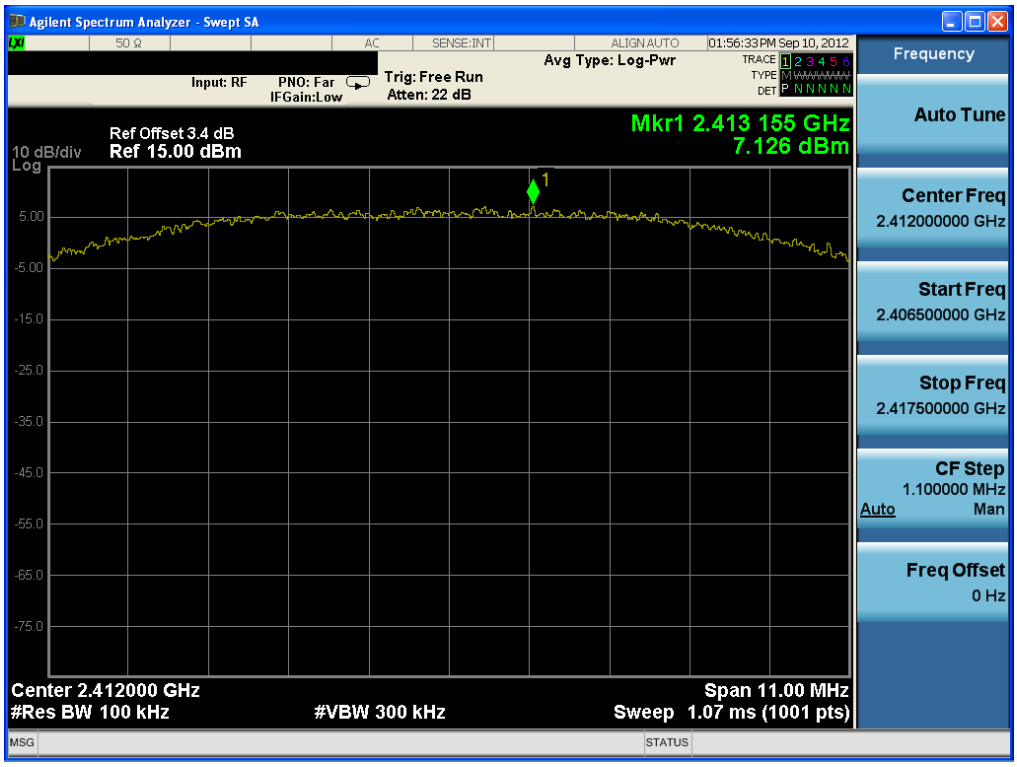
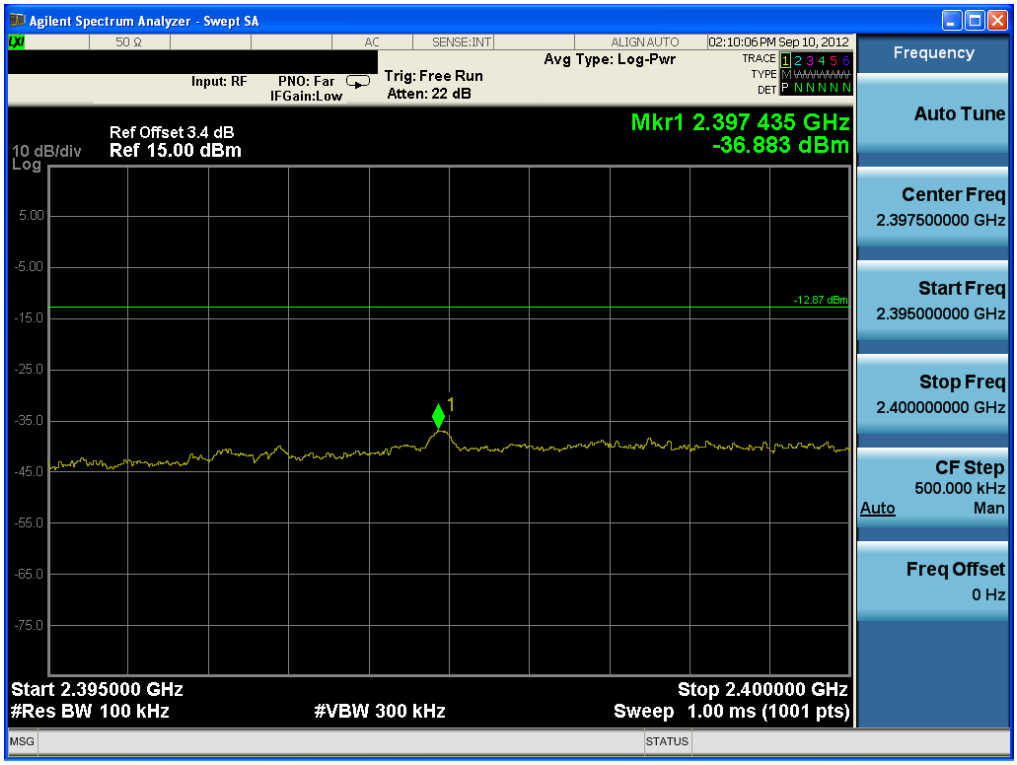
▣ RESULT PLOTS

802.11b & 11Mbps & 2412MHz

Reference



Low Band-edge



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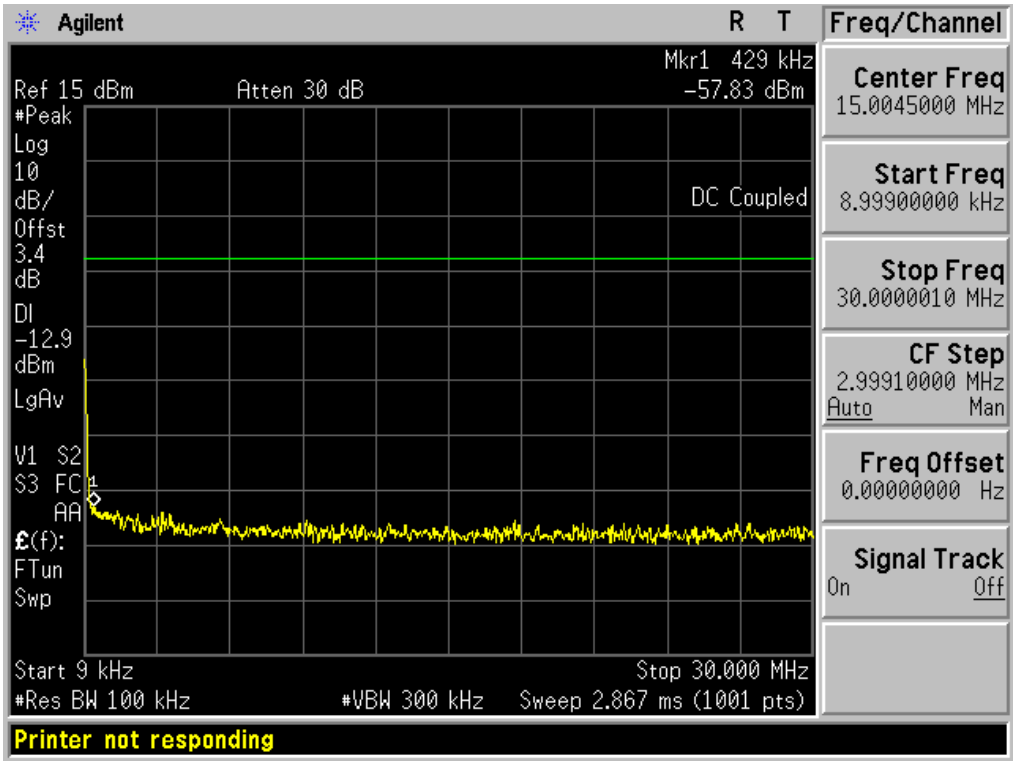
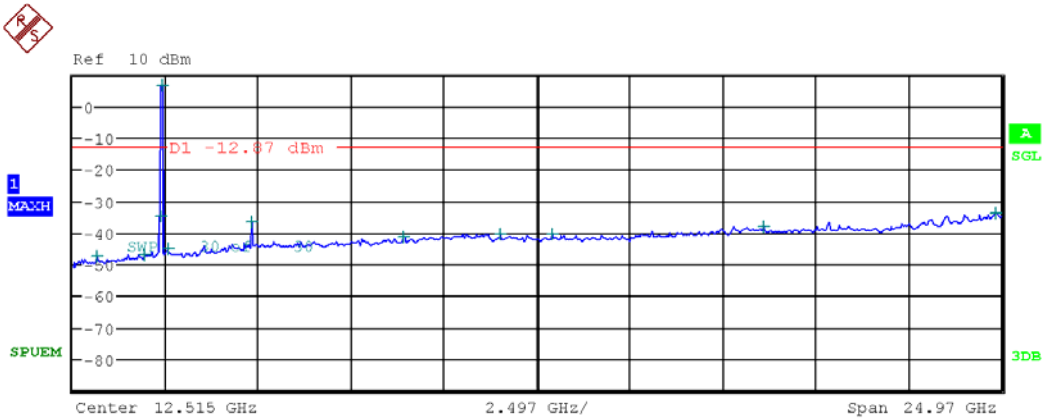
Conducted Spurious Emissions 1



Conducted Spurious Emissions 2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	1.000 G	100.00 k	653.710000 M	-47.43	-200.00
1.000 G	2.000 G	100.00 k	1.952000 G	-46.88	-200.00
2.000 G	2.400 G	100.00 k	2.397480 G	-34.89	-200.00
2.400 G	2.483 G	100.00 k	2.412070 G	6.42	-200.00
2.483 G	3.000 G	100.00 k	2.587265 G	-45.26	-200.00
3.000 G	6.000 G	100.00 k	4.824000 G	-36.83	-200.00
6.000 G	9.000 G	100.00 k	8.907000 G	-41.43	-200.00
9.000 G	12.000 G	100.00 k	11.506000 G	-40.24	-200.00
12.000 G	15.000 G	100.00 k	12.907667 G	-40.68	-200.00
15.000 G	20.000 G	100.00 k	18.588333 G	-38.32	-200.00
20.000 G	25.000 G	100.00 k	24.847222 G	-33.86	-200.00

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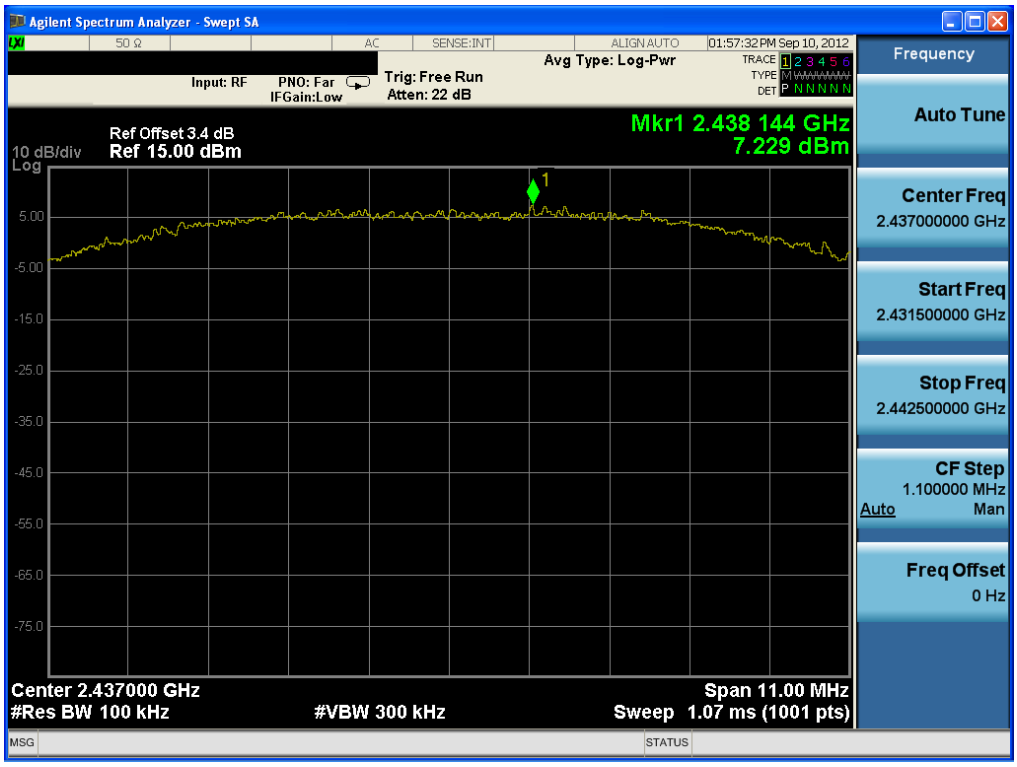
802.11b & 11Mbps & 2437MHz

Reference



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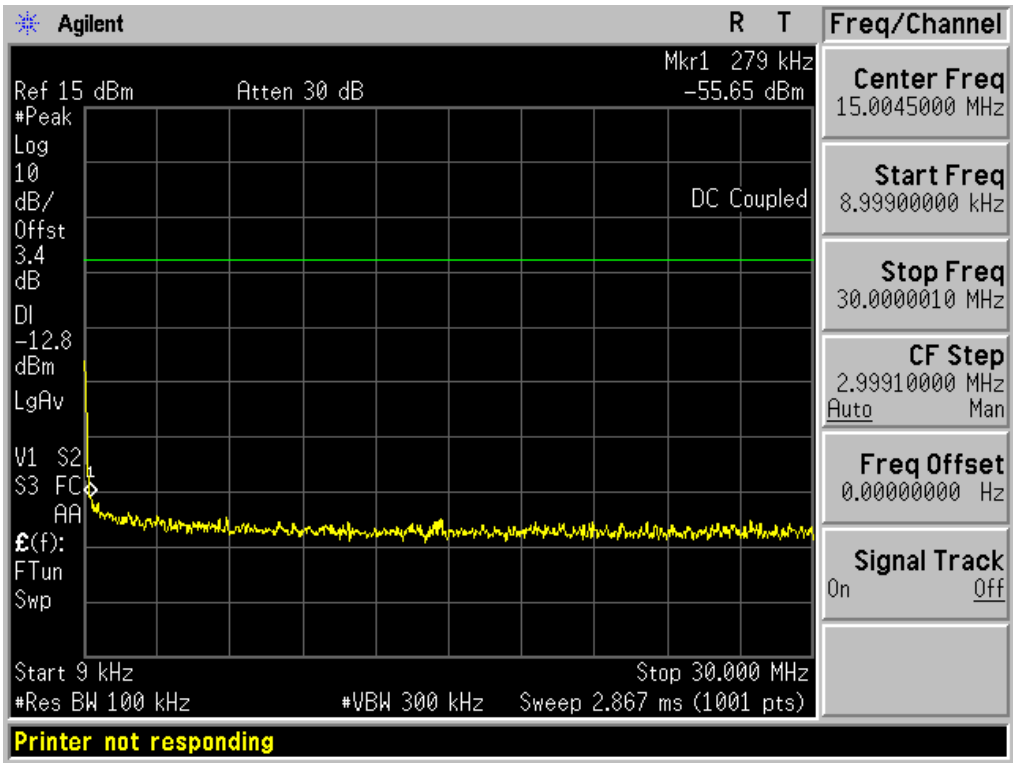
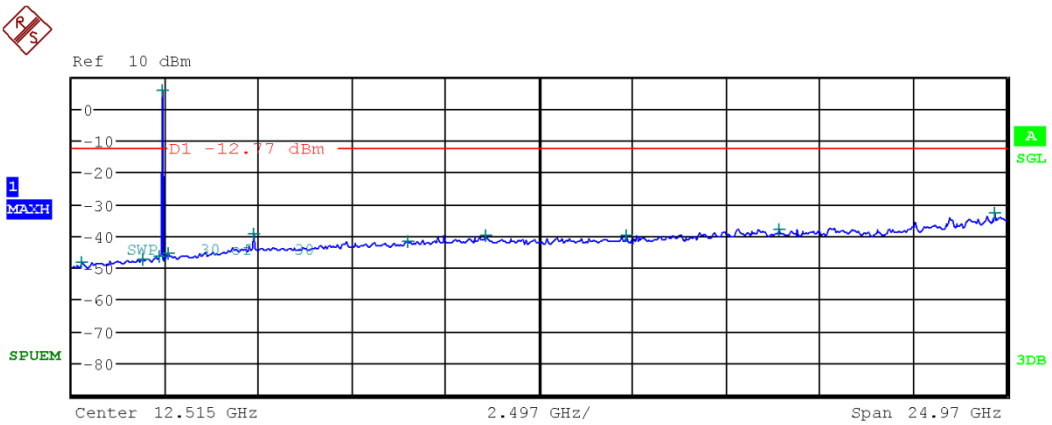
Conducted Spurious Emissions 1



Conducted Spurious Emissions 2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Limit [dB]
30.000 M	1.000 G	100.00 k	270.560000 M	-48.49	-200.00
1.000 G	2.000 G	100.00 k	1.920000 G	-47.43	-200.00
2.000 G	2.400 G	100.00 k	2.353720 G	-46.46	-200.00
2.400 G	2.483 G	100.00 k	2.435746 G	6.68	-200.00
2.483 G	3.000 G	100.00 k	2.594754 G	-45.72	-200.00
3.000 G	6.000 G	100.00 k	4.874000 G	-39.45	-200.00
6.000 G	9.000 G	100.00 k	8.999333 G	-41.82	-200.00
9.000 G	12.000 G	100.00 k	11.069333 G	-39.80	-200.00
12.000 G	15.000 G	100.00 k	14.836333 G	-40.03	-200.00
15.000 G	20.000 G	100.00 k	18.910000 G	-38.05	-200.00
20.000 G	25.000 G	100.00 k	24.680000 G	-32.97	-200.00

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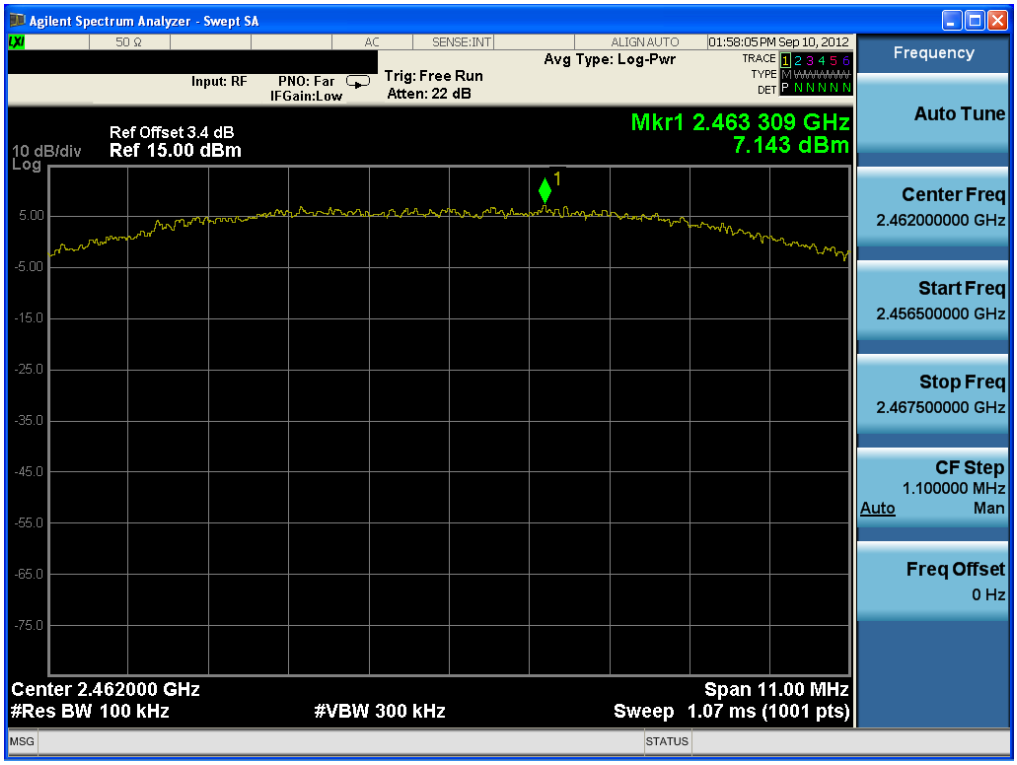
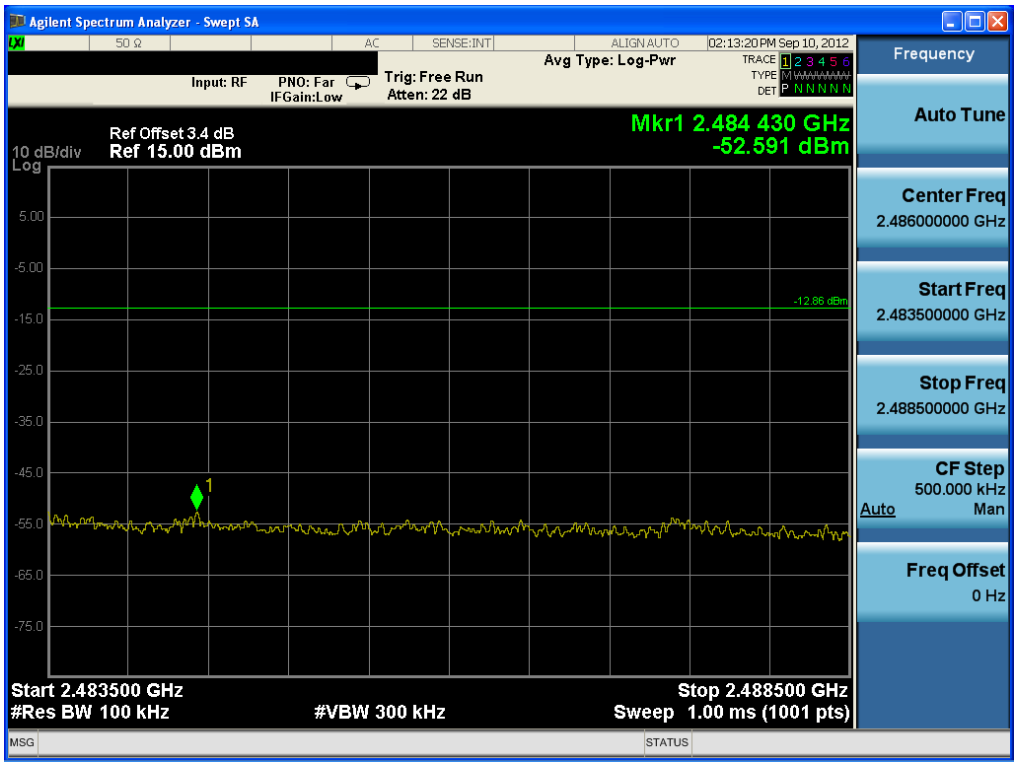
802.11b & 11Mbps & 2462MHz

Reference



High Band-edge



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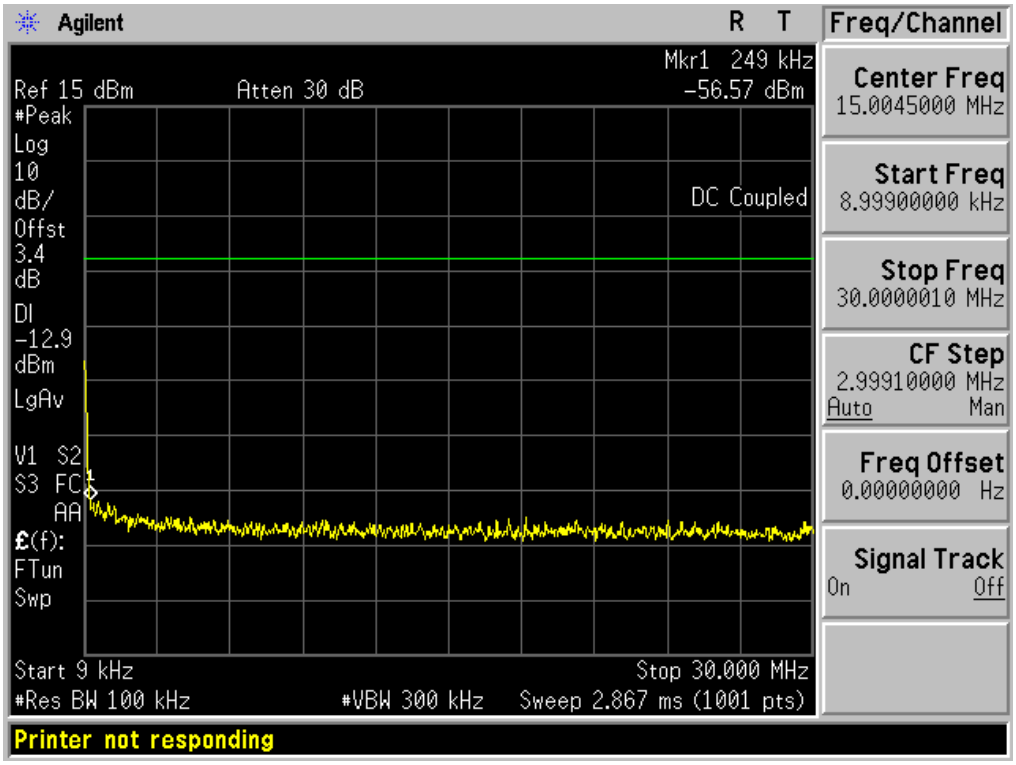
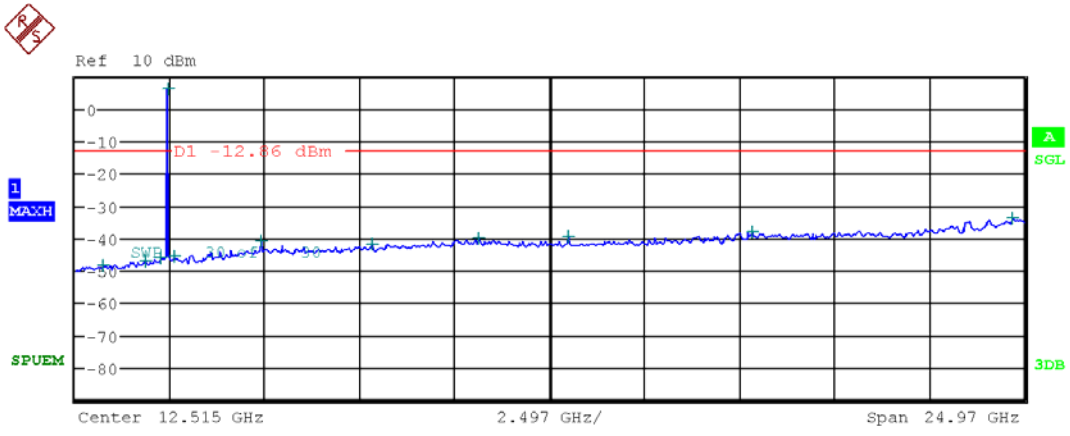
Conducted Spurious Emissions 1



Conducted Spurious Emissions 2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	765.260000 M	-48.47	-200.00
1.000 G	2.000 G	100.00 k	1.873000 G	-46.94	-200.00
2.000 G	2.400 G	100.00 k	2.268760 G	-46.04	-200.00
2.400 G	2.483 G	100.00 k	2.464654 G	3.93	-200.00
2.483 G	3.000 G	100.00 k	2.611076 G	-45.67	-200.00
3.000 G	6.000 G	100.00 k	4.924000 G	-41.15	-200.00
6.000 G	9.000 G	100.00 k	7.851000 G	-41.97	-200.00
9.000 G	12.000 G	100.00 k	10.630000 G	-40.13	-200.00
12.000 G	15.000 G	100.00 k	12.989667 G	-39.73	-200.00
15.000 G	20.000 G	100.00 k	17.847222 G	-38.11	-200.00
20.000 G	25.000 G	100.00 k	24.661111 G	-33.83	-200.00

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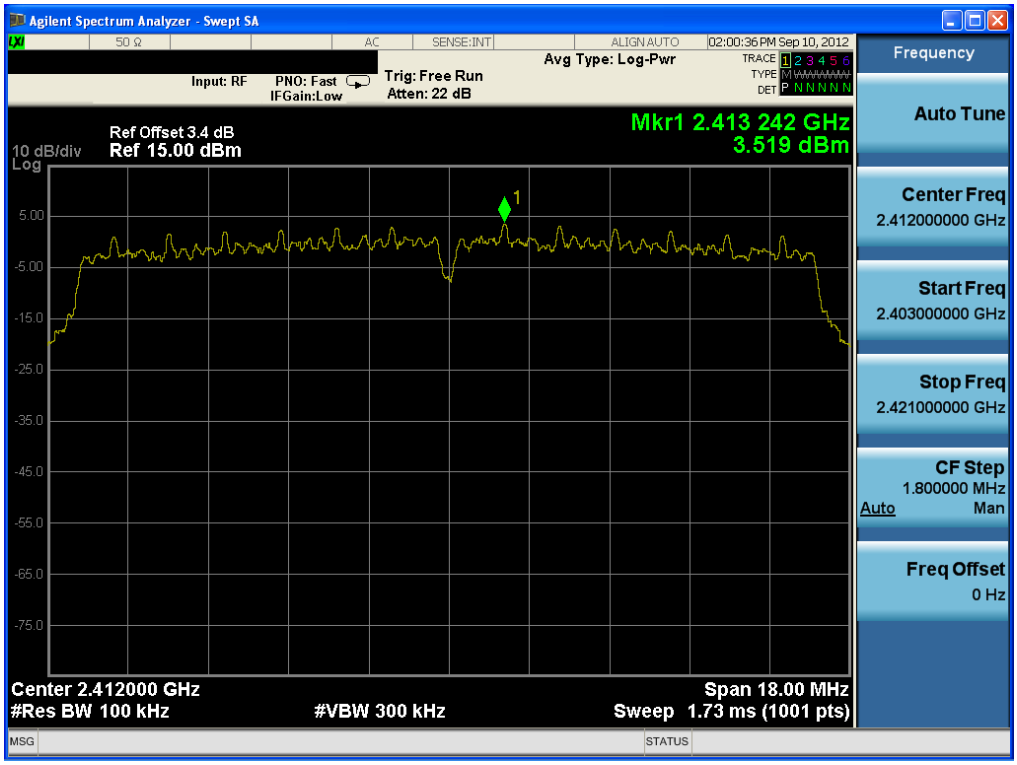
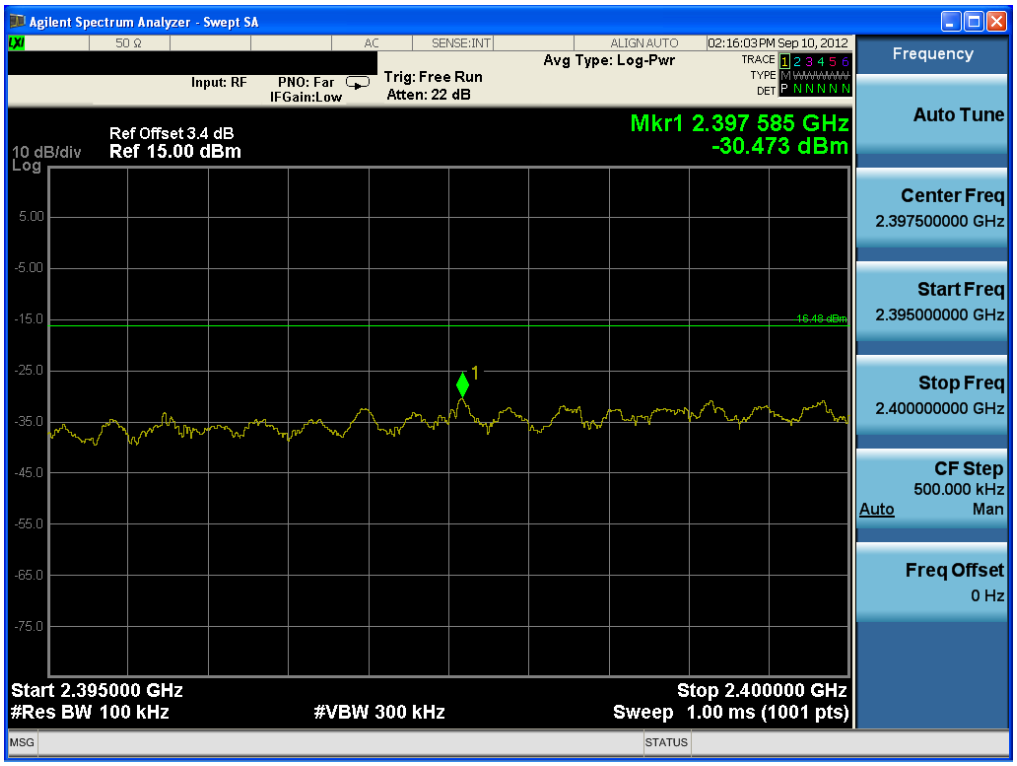
802.11g & 24Mbps & 2412MHz

Reference



Low Band-edge



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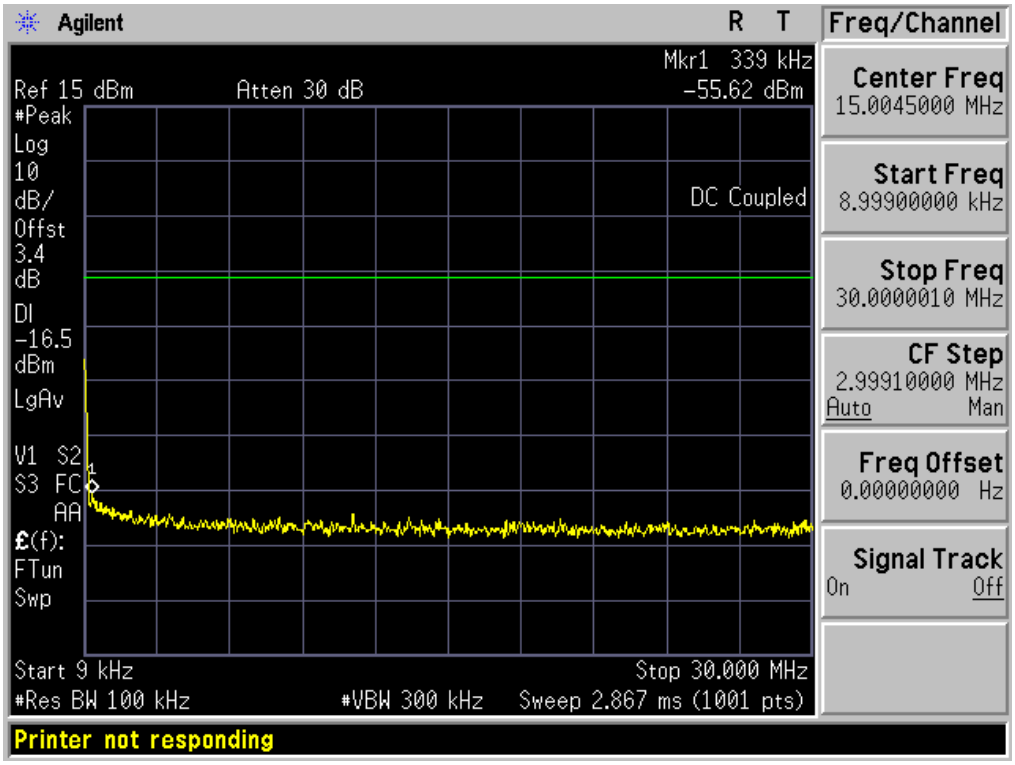
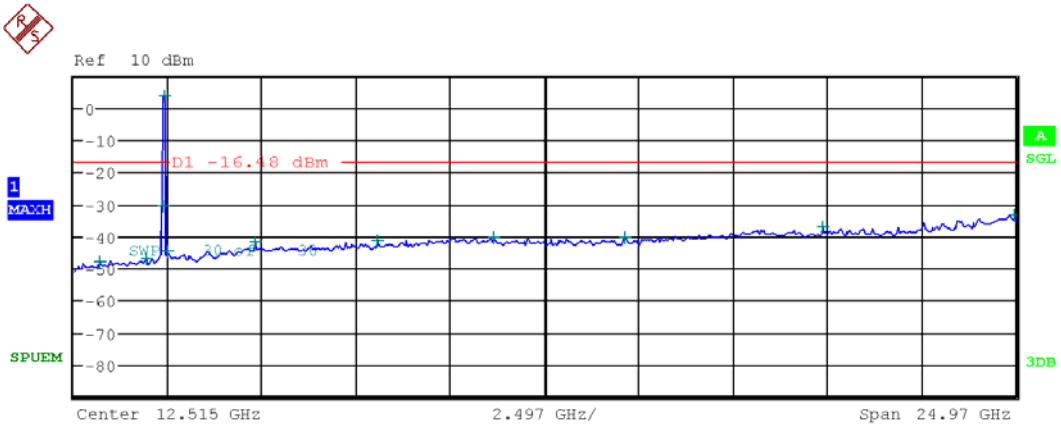
Conducted Spurious Emissions 1



Conducted Spurious Emissions 2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	1.000 G	100.00 k	715.790000 M	-48.20	-200.00
1.000 G	2.000 G	100.00 k	1.936000 G	-47.21	-200.00
2.000 G	2.400 G	100.00 k	2.396960 G	-30.79	-200.00
2.400 G	2.483 G	100.00 k	2.413243 G	3.56	-200.00
2.483 G	3.000 G	100.00 k	2.522496 G	-44.87	-200.00
3.000 G	6.000 G	100.00 k	4.822667 G	-41.90	-200.00
6.000 G	9.000 G	100.00 k	8.063000 G	-41.19	-200.00
9.000 G	12.000 G	100.00 k	11.154667 G	-40.34	-200.00
12.000 G	15.000 G	100.00 k	14.649667 G	-40.38	-200.00
15.000 G	20.000 G	100.00 k	19.888889 G	-37.19	-200.00
20.000 G	25.000 G	100.00 k	24.948333 G	-33.49	-200.00

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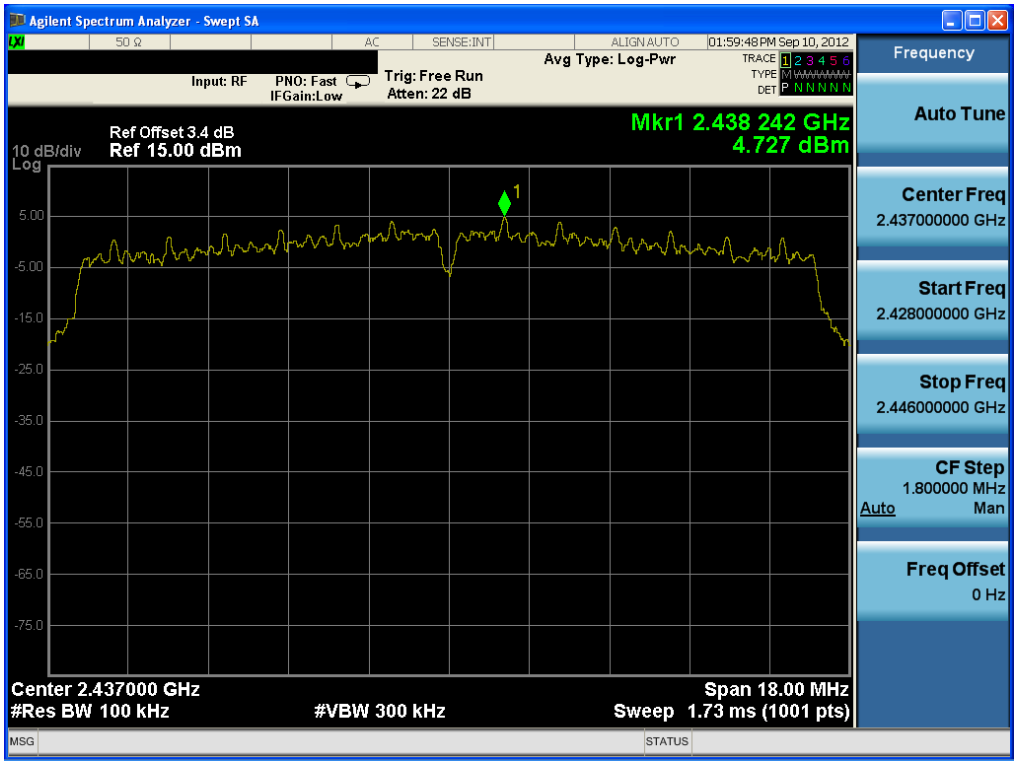
802.11g & 36Mbps & 2437MHz

Reference



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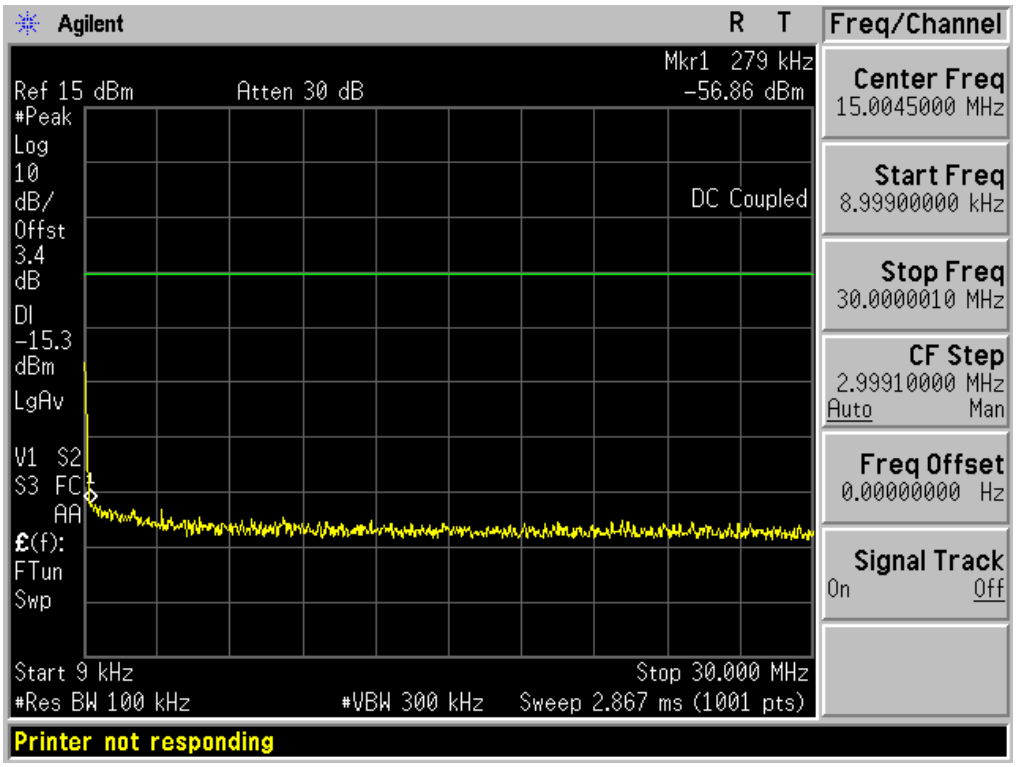
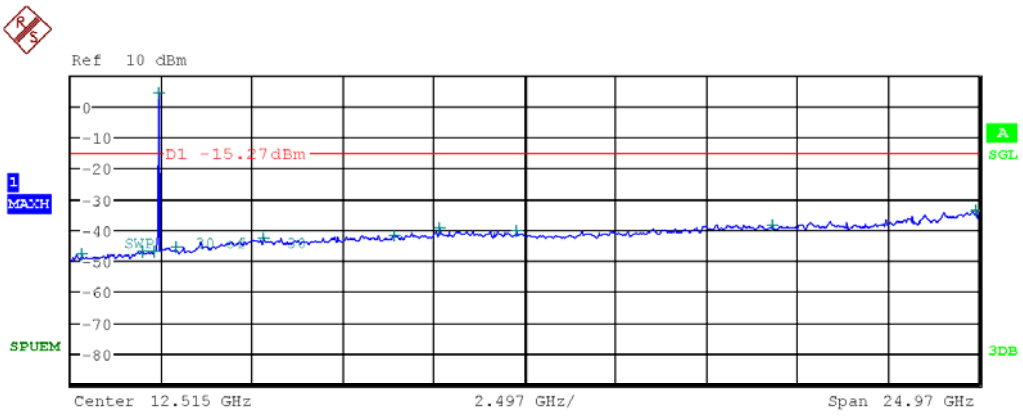
Conducted Spurious Emissions 1



Conducted Spurious Emissions 2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	311.300000 M	-47.96	-200.00
1.000 G	2.000 G	100.00 k	1.976000 G	-47.27	-200.00
2.000 G	2.400 G	100.00 k	2.318640 G	-46.92	-200.00
2.400 G	2.483 G	100.00 k	2.435709 G	3.96	-200.00
2.483 G	3.000 G	100.00 k	2.925934 G	-45.86	-200.00
3.000 G	6.000 G	100.00 k	5.324667 G	-42.68	-200.00
6.000 G	9.000 G	100.00 k	8.921667 G	-41.67	-200.00
9.000 G	12.000 G	100.00 k	10.168667 G	-39.47	-200.00
12.000 G	15.000 G	100.00 k	12.258000 G	-40.53	-200.00
15.000 G	20.000 G	100.00 k	19.312222 G	-38.44	-200.00
20.000 G	25.000 G	100.00 k	24.902222 G	-34.03	-200.00

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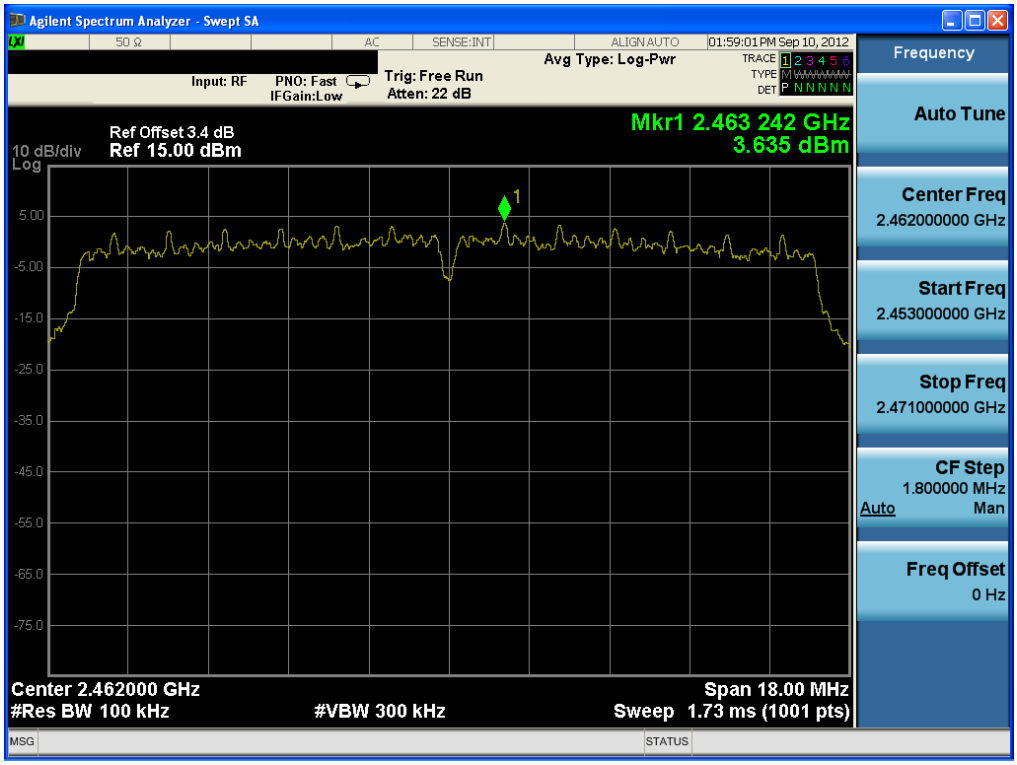
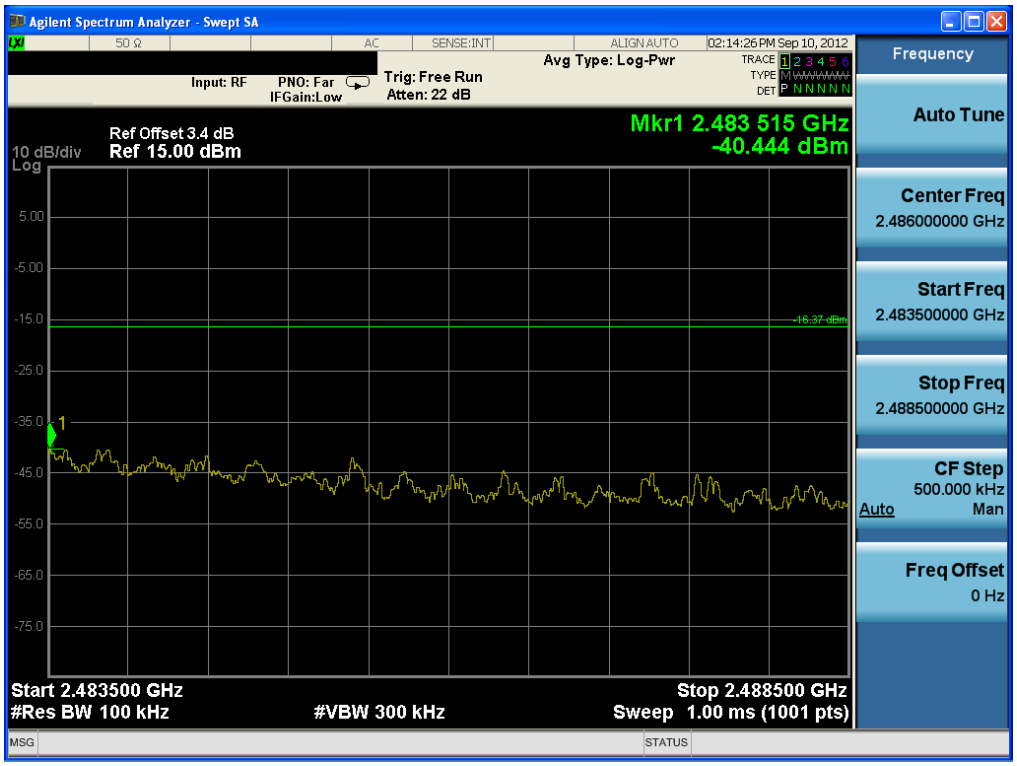
802.11g & 48Mbps & 2462MHz

Reference



High Band-edge



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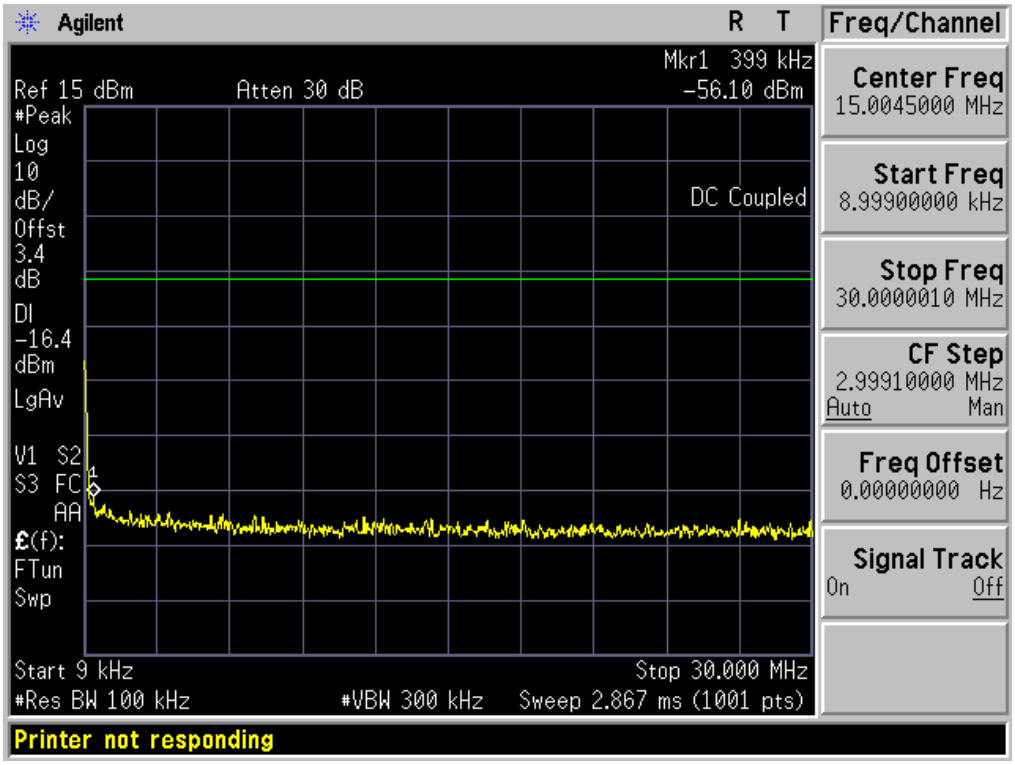
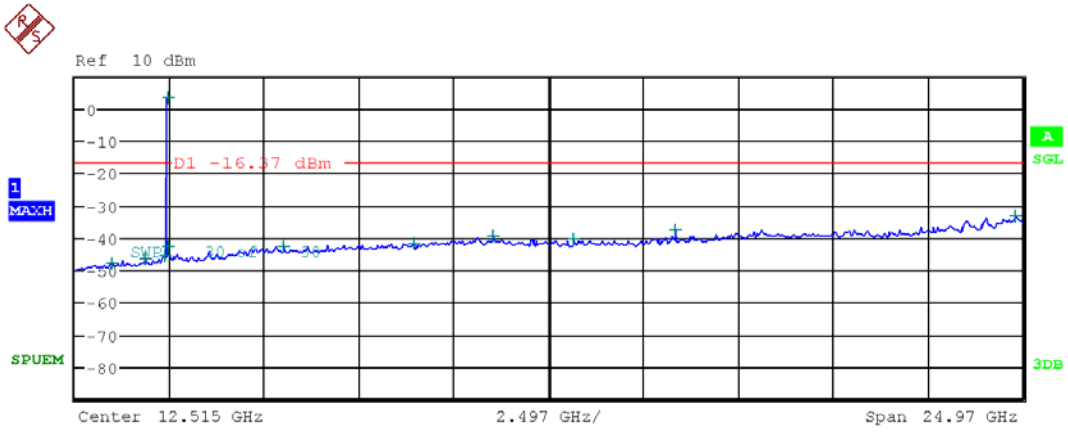
Conducted Spurious Emissions 1



Conducted Spurious Emissions 2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	992.240000 M	-47.97	-200.00
1.000 G	2.000 G	100.00 k	1.875000 G	-46.51	-200.00
2.000 G	2.400 G	100.00 k	2.379400 G	-45.77	-200.00
2.400 G	2.483 G	100.00 k	2.464479 G	3.08	-200.00
2.483 G	3.000 G	100.00 k	2.484171 G	-42.67	-200.00
3.000 G	6.000 G	100.00 k	5.529333 G	-42.65	-200.00
6.000 G	9.000 G	100.00 k	8.964333 G	-41.80	-200.00
9.000 G	12.000 G	100.00 k	11.042333 G	-39.43	-200.00
12.000 G	15.000 G	100.00 k	13.157000 G	-40.41	-200.00
15.000 G	20.000 G	100.00 k	15.817778 G	-37.46	-200.00
20.000 G	25.000 G	100.00 k	24.791111 G	-33.49	-200.00

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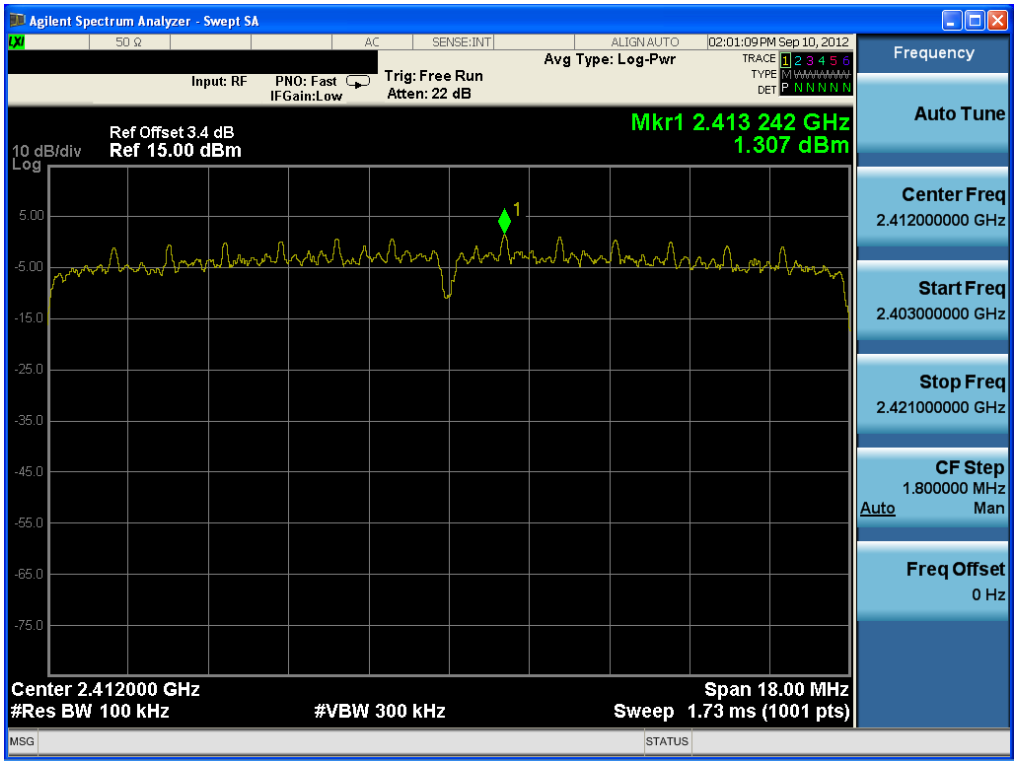
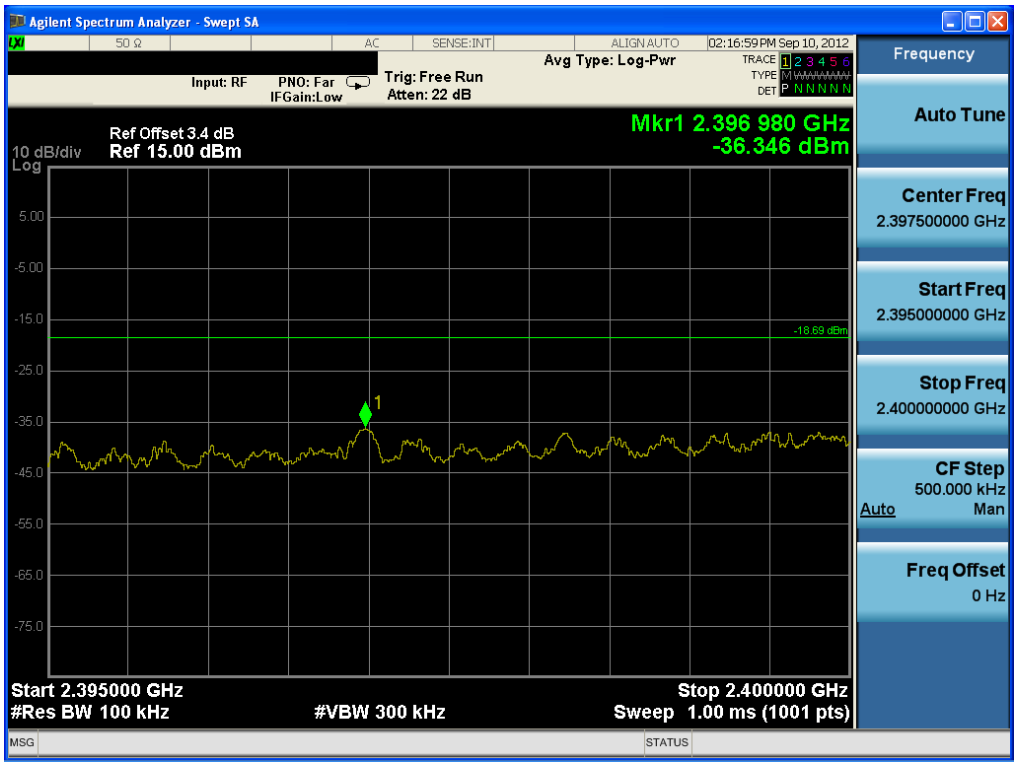
802.11n(HT20) & MCS3 & 2412MHz

Reference



Low Band-edge



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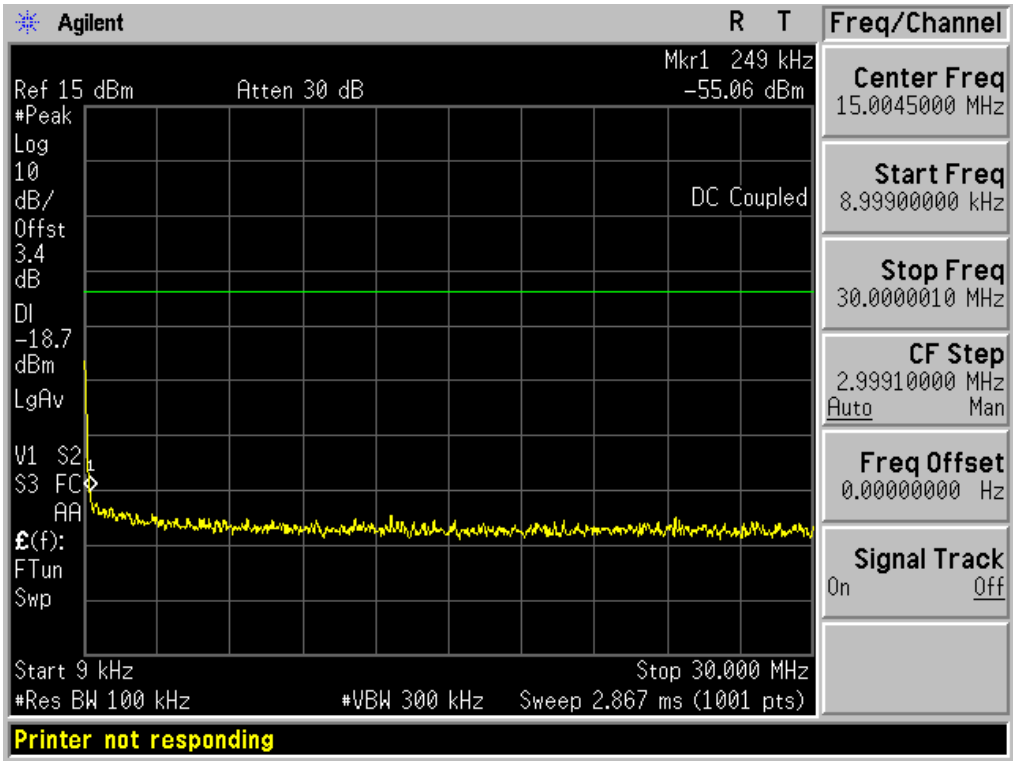
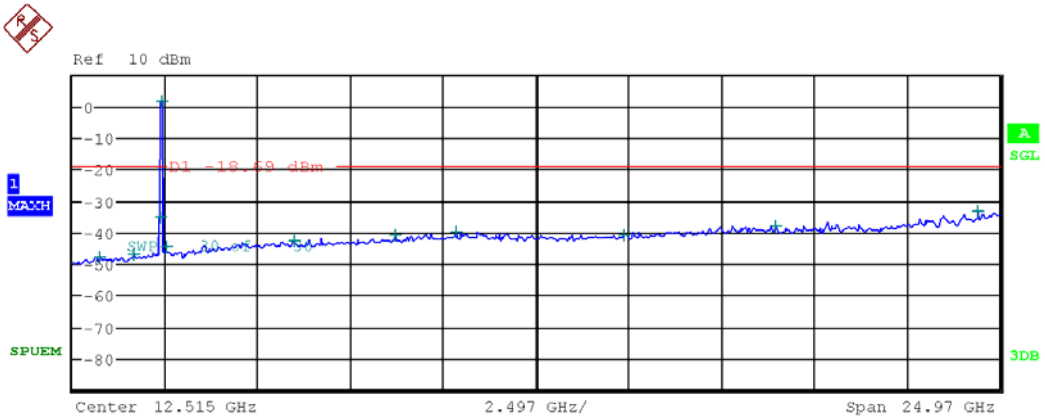
Conducted Spurious Emissions 1



Conducted Spurious Emissions 2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	1.000 G	100.00 k	741.980000 M	-48.05	-200.00
1.000 G	2.000 G	100.00 k	1.682000 G	-47.06	-200.00
2.000 G	2.400 G	100.00 k	2.396960 G	-35.17	-200.00
2.400 G	2.483 G	100.00 k	2.413231 G	1.54	-200.00
2.483 G	3.000 G	100.00 k	2.539798 G	-44.76	-200.00
3.000 G	6.000 G	100.00 k	5.986333 G	-42.62	-200.00
6.000 G	9.000 G	100.00 k	8.712333 G	-40.94	-200.00
9.000 G	12.000 G	100.00 k	10.336333 G	-40.13	-200.00
12.000 G	15.000 G	100.00 k	14.884667 G	-40.80	-200.00
15.000 G	20.000 G	100.00 k	18.963889 G	-37.92	-200.00
20.000 G	25.000 G	100.00 k	24.389444 G	-33.58	-200.00

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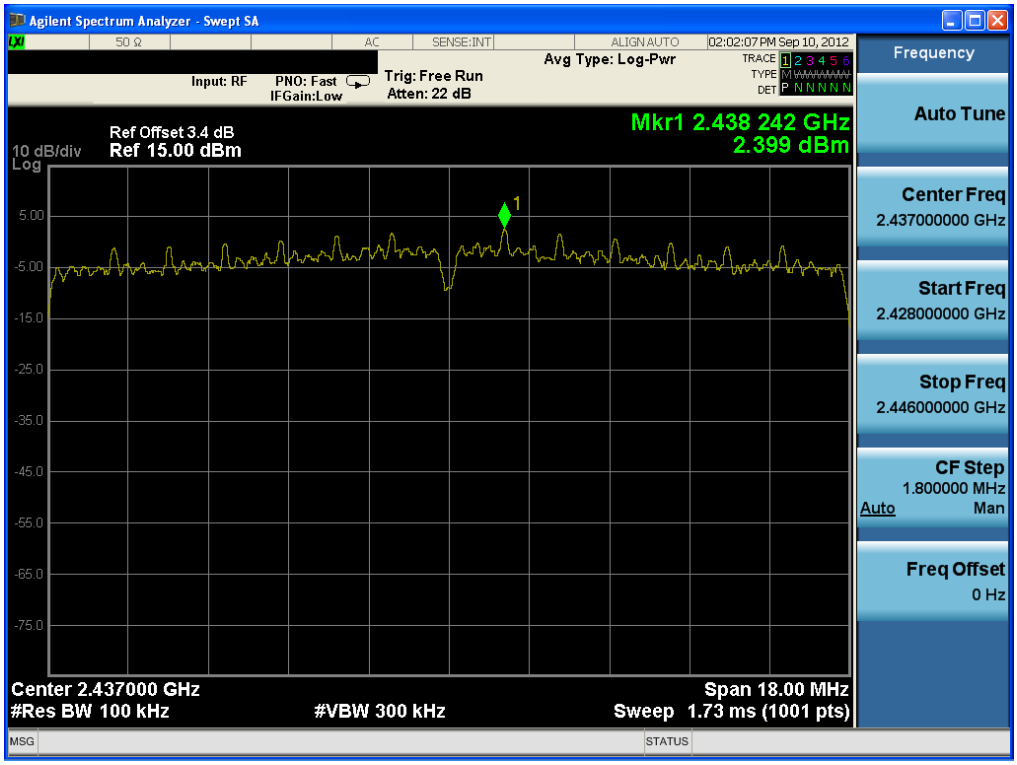
802.11n(HT20) & MCS4 & 2437MHz

Reference



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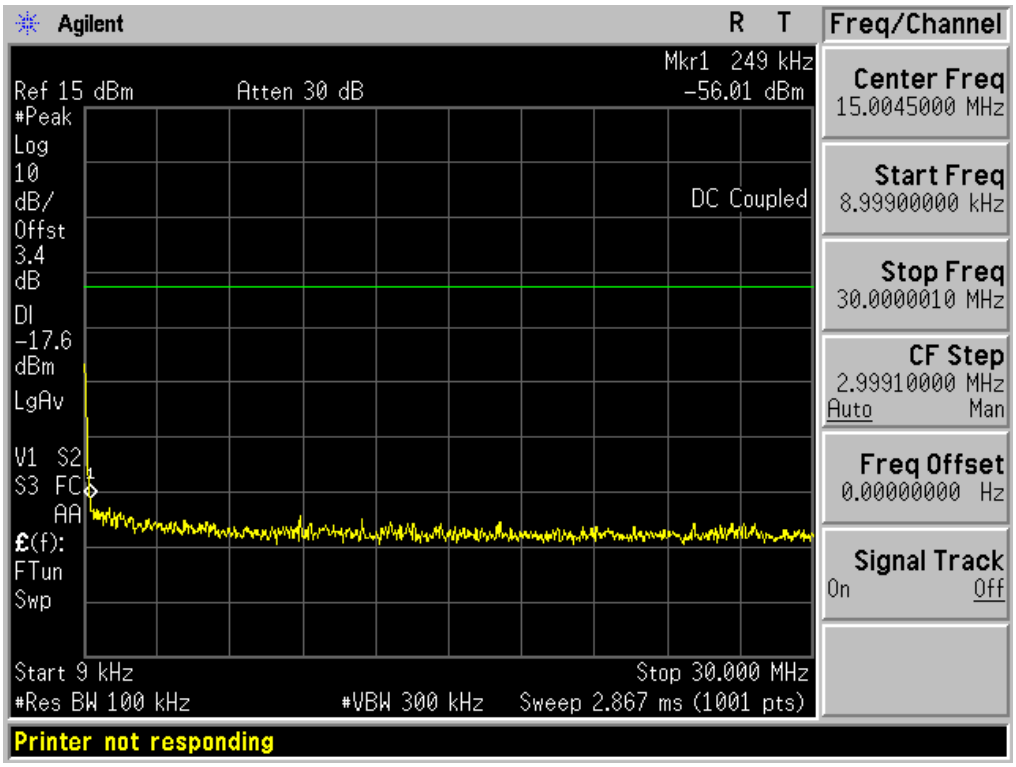
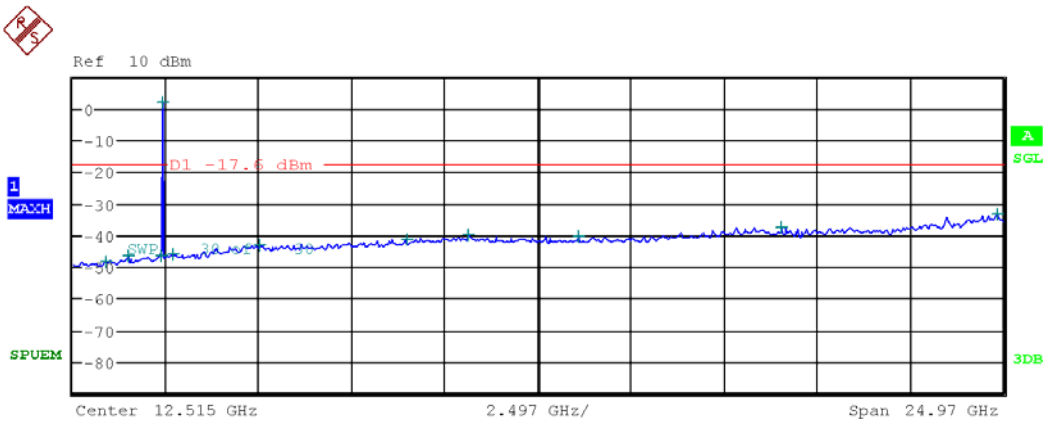
Conducted Spurious Emissions 1



Conducted Spurious Emissions 2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	903.000000 M	-48.25	-200.00
1.000 G	2.000 G	100.00 k	1.522000 G	-46.58	-200.00
2.000 G	2.400 G	100.00 k	2.387720 G	-46.59	-200.00
2.400 G	2.483 G	100.00 k	2.438247 G	1.68	-200.00
2.483 G	3.000 G	100.00 k	2.722175 G	-45.97	-200.00
3.000 G	6.000 G	100.00 k	5.025667 G	-43.25	-200.00
6.000 G	9.000 G	100.00 k	8.994000 G	-41.33	-200.00
9.000 G	12.000 G	100.00 k	10.642333 G	-39.98	-200.00
12.000 G	15.000 G	100.00 k	13.586667 G	-40.51	-200.00
15.000 G	20.000 G	100.00 k	19.041111 G	-37.60	-200.00
20.000 G	25.000 G	100.00 k	24.848333 G	-33.20	-200.00

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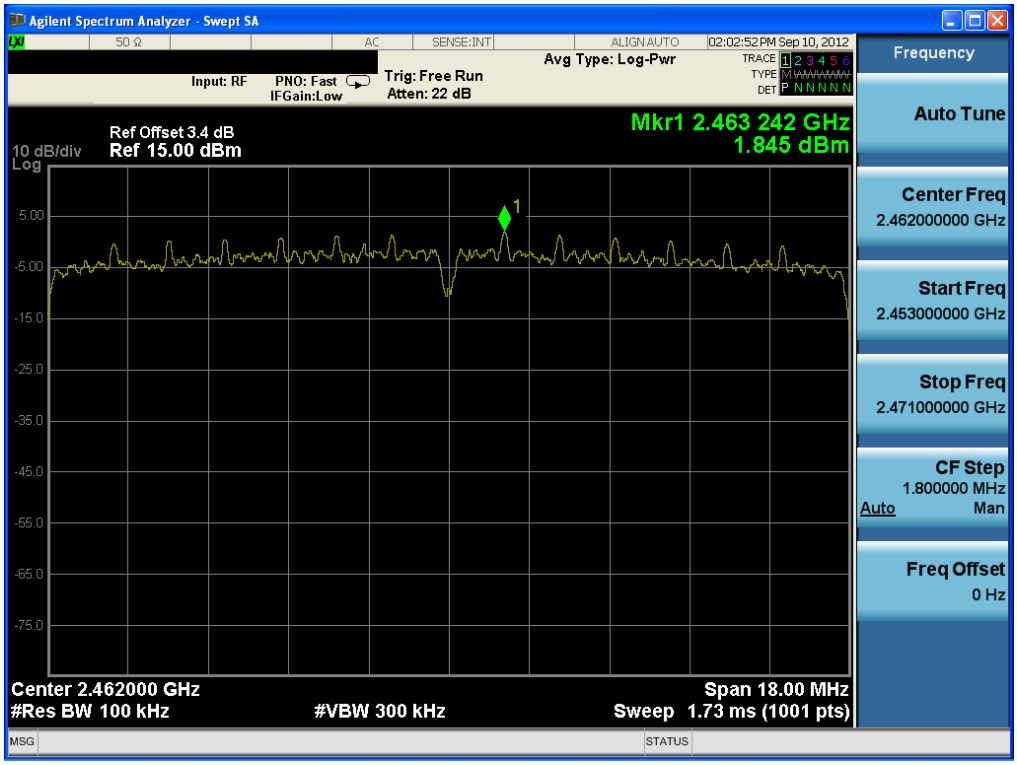
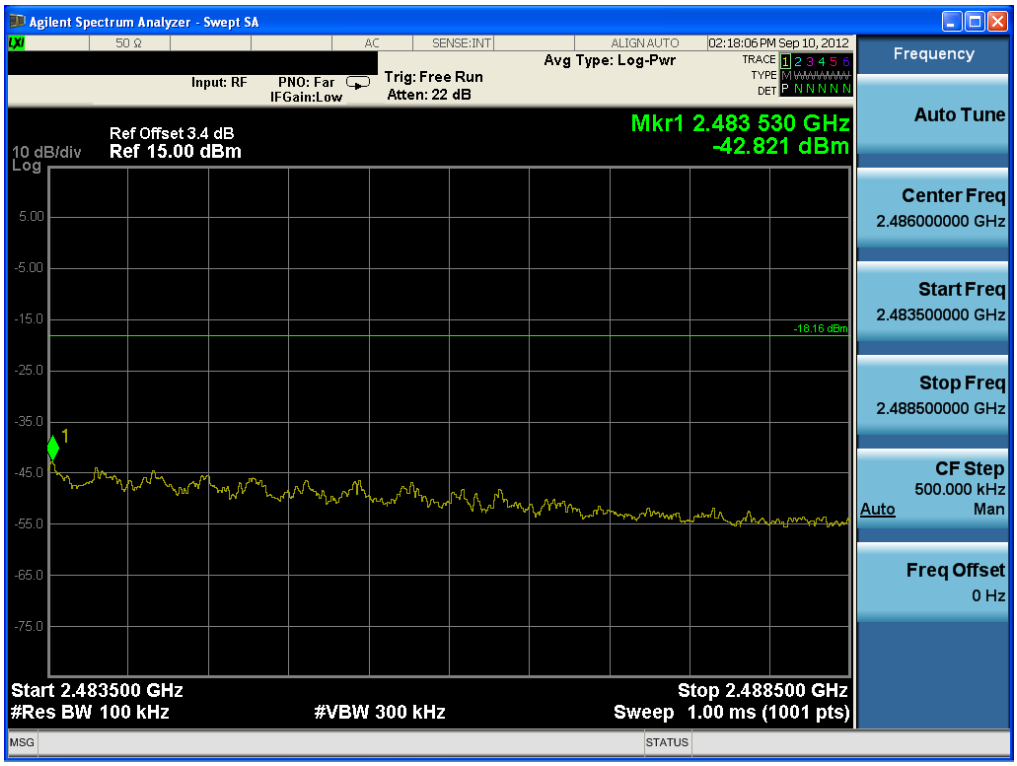
802.11n(HT20) & MCS3 & 2462MHz

Reference



High Band-edge



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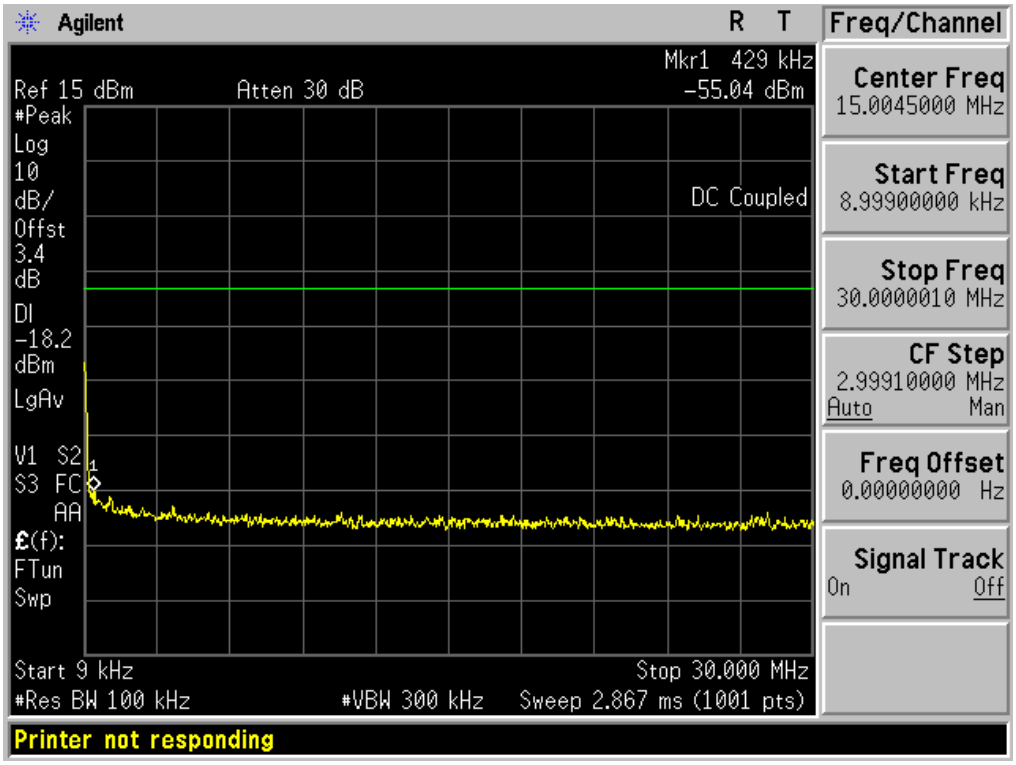
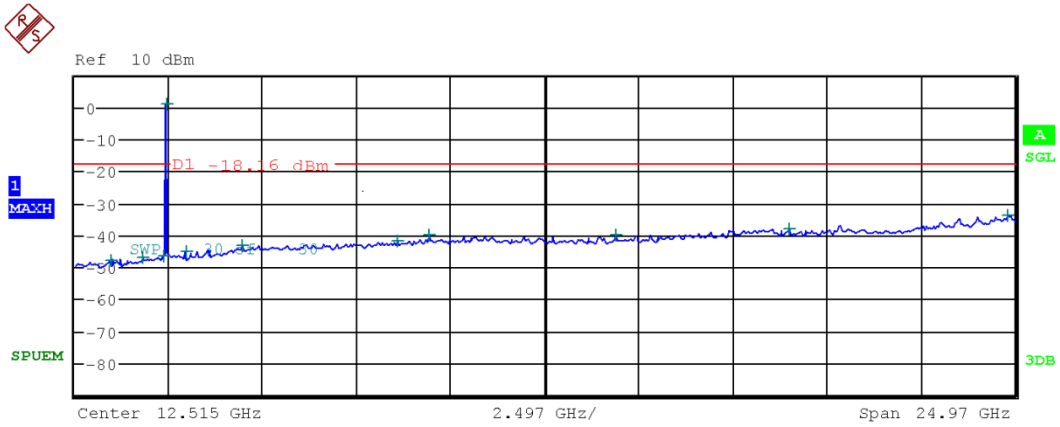
Conducted Spurious Emissions 1



Conducted Spurious Emissions 2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	1.000000 G	-47.80	-200.00
1.000 G	2.000 G	100.00 k	1.820000 G	-46.89	-200.00
2.000 G	2.400 G	100.00 k	2.385200 G	-46.73	-200.00
2.400 G	2.483 G	100.00 k	2.460705 G	1.68	-200.00
2.483 G	3.000 G	100.00 k	2.979288 G	-45.16	-200.00
3.000 G	6.000 G	100.00 k	4.467667 G	-43.10	-200.00
6.000 G	9.000 G	100.00 k	8.610333 G	-41.88	-200.00
9.000 G	12.000 G	100.00 k	9.415667 G	-40.20	-200.00
12.000 G	15.000 G	100.00 k	14.401000 G	-40.18	-200.00
15.000 G	20.000 G	100.00 k	18.984444 G	-38.09	-200.00
20.000 G	25.000 G	100.00 k	24.805000 G	-33.88	-200.00

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8.5 Radiated Spurious Emissions

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

In any 100kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a) and (b), then the 15.209(a) limit in the table below has to be followed

▪ **FCC Part 15.209(a) and (b)**

Frequency (MHz)	Limit (uV/m) @ 3m
30 ~ 88	100 **
88 ~ 216	150 **
216 ~ 960	200 **
Above 960	500

** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88MHz, 174-216MHz or 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

▪ **FCC Part 15.205 (a):** Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	3600 ~ 4400	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	4.5 ~ 5.15	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~	149.9 ~ 150.05	1645.5 ~ 1646.5	5.35 ~ 5.46	17.7 ~ 21.4
4.125 ~ 4.128	12.52025	156.52475 ~	1660 ~ 1710	7.25 ~ 7.75	22.01 ~ 23.12
4.17725 ~ 4.17775	12.57675 ~	156.52525	1718.8 ~ 1722.2	8.025 ~ 8.5	23.6 ~ 24.0
4.20725 ~ 4.20775	12.57725	156.7 ~ 156.9	2200 ~ 2300	9.0 ~ 9.2	31.2 ~ 31.8
6.215 ~ 6.218	13.36 ~ 13.41	162.0125 ~ 167.17	2310 ~ 2390	9.3 ~ 9.5	36.43 ~ 36.5
6.26775 ~ 6.26825	16.42 ~ 16.423	167.72 ~ 173.2	2483.5 ~ 2500	10.6 ~ 12.7	Above 38.6
6.31175 ~ 6.31225	16.69475 ~	240 ~ 285	2655 ~ 2900	13.25 ~ 13.4	
8.291 ~ 8.294	16.69525	322 ~ 335.4	3260 ~ 3267		
8.362 ~ 8.366	16.80425 ~	399.90 ~ 410	3332 ~ 3339		
8.37625 ~ 8.38675	16.80475	608 ~ 614	3345.8 ~ 3358		
	25.5 ~ 25.67	960 ~ 1240			
	37.5 ~ 38.25				
	73 ~ 74.6				
	74.8 ~ 75.2				

▪ **FCC Part 15.205(b):** The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

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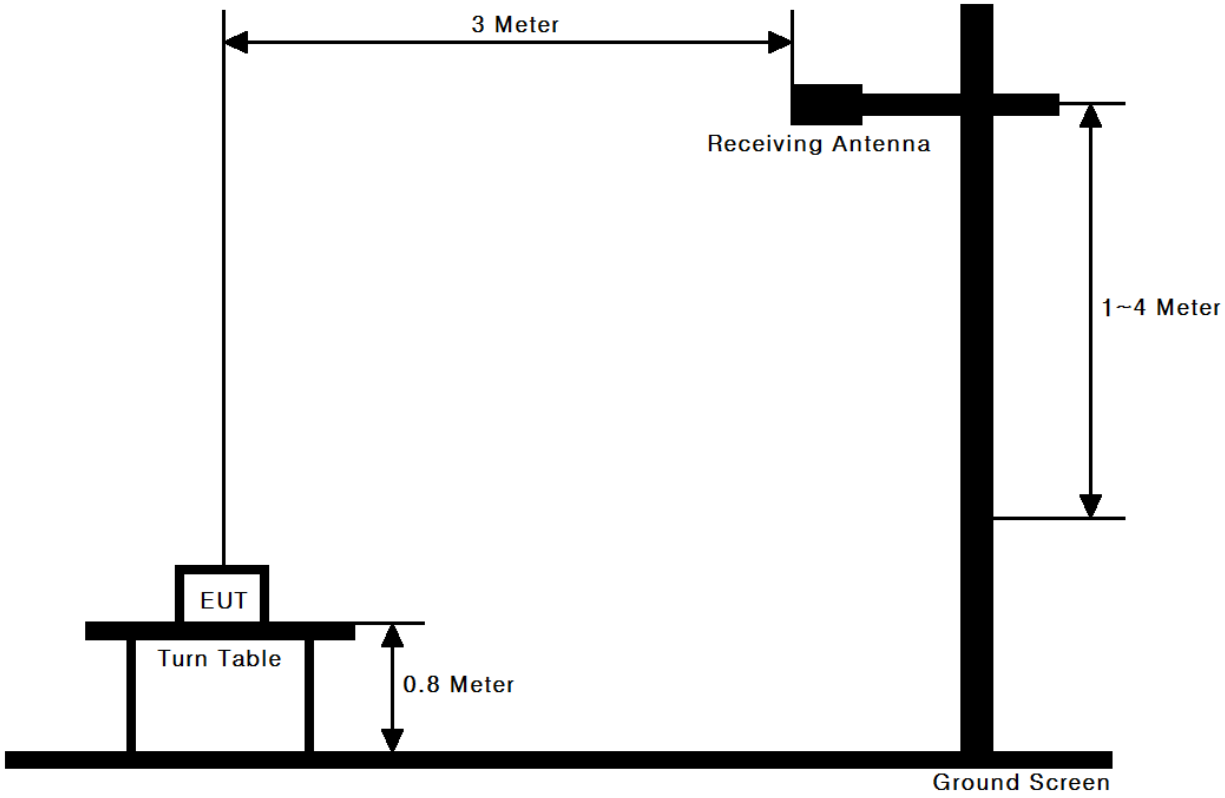
Test Configuration



TEST PROCEDURE

1. The EUT is placed on a turntable, which is 0.8 m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

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9KHz ~ 25GHz Data(*802.11b*)

▪ Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2389.200	H	X	PK	42.34	-4.68	37.66	74.00	36.34
2388.530	H	X	AV	33.29	-4.68	28.61	54.00	25.39
4823.833	H	Z	PK	40.37	2.23	42.60	74.00	31.40
4823.908	H	Z	AV	30.52	2.23	32.75	54.00	21.25

▪ Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4873.750	H	Z	PK	39.50	2.92	42.42	74.00	31.58
4873.900	H	Z	AV	28.25	2.92	31.17	54.00	22.83

▪ Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.679	V	Z	PK	43.16	-4.51	38.65	74.00	35.35
2483.560	V	Z	AV	33.80	-4.51	29.29	54.00	24.71
4924.072	H	Z	PK	39.56	2.62	42.18	74.00	31.82
4923.968	H	Z	AV	29.99	2.62	32.61	54.00	21.39

Note.

1. No other spurious and harmonic emissions were found greater than listed emissions on above table.
2. Above listed point data is the worst case data.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain

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9KHz ~ 25GHz Data(*802.11g*)

▪ Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2389.490	H	X	PK	42.65	-4.68	37.97	74.00	36.03
2388.790	H	X	AV	32.97	-4.68	28.29	54.00	25.71
4823.300	H	Z	PK	38.82	2.23	41.05	74.00	32.95
4824.250	H	Z	AV	28.29	2.23	30.52	54.00	23.48

▪ Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4875.050	H	Z	PK	38.21	2.92	41.13	74.00	32.87
4873.900	H	Z	AV	27.10	2.92	30.02	54.00	23.98

▪ Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.713	V	Z	PK	43.54	-4.51	39.03	74.00	34.97
2483.590	V	Z	AV	34.16	-4.51	29.65	54.00	24.35
4926.770	H	Z	PK	40.28	2.62	42.90	74.00	31.10
4922.900	H	Z	AV	27.80	2.62	30.42	54.00	23.58

Note.

1. No other spurious and harmonic emissions were found greater than listed emissions on above table..
2. Above listed point data is the worst case data.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain

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9KHz ~ 25GHz Data(*802.11n HT20*)

▪ Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2389.340	H	X	PK	42.30	-4.68	37.62	74.00	36.38
2389.000	H	X	AV	33.31	-4.68	28.63	54.00	25.37
4827.150	H	Z	PK	40.33	2.23	42.56	74.00	31.44
4832.400	H	Z	AV	28.01	2.23	30.24	54.00	23.76

▪ Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4875.770	H	Z	PK	39.00	2.92	41.92	74.00	32.08
4876.270	H	Z	AV	27.25	2.92	30.17	54.00	23.83

▪ Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.823	V	Z	PK	43.31	-4.51	38.80	74.00	35.20
2483.563	V	Z	AV	33.93	-4.51	29.42	54.00	24.58
4924.800	H	Z	PK	39.75	2.62	42.37	74.00	31.63
4921.970	H	Z	AV	27.80	2.62	30.42	54.00	23.58

Note.

1. No other spurious and harmonic emissions were found greater than listed emissions on above table..
2. Above listed point data is the worst case data.
3. Sample Calculation.
   Margin = Limit – Result / Result = Reading + T.F / T.F = AF + CL – AG
   Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain

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8.6 Power-line 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 the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network(LISN).

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

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 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 the test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.

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▣ RESULT PLOTS

AC Line Conducted Emissions (Graph)

Test Mode: 802.11b (2.4GHz Band)

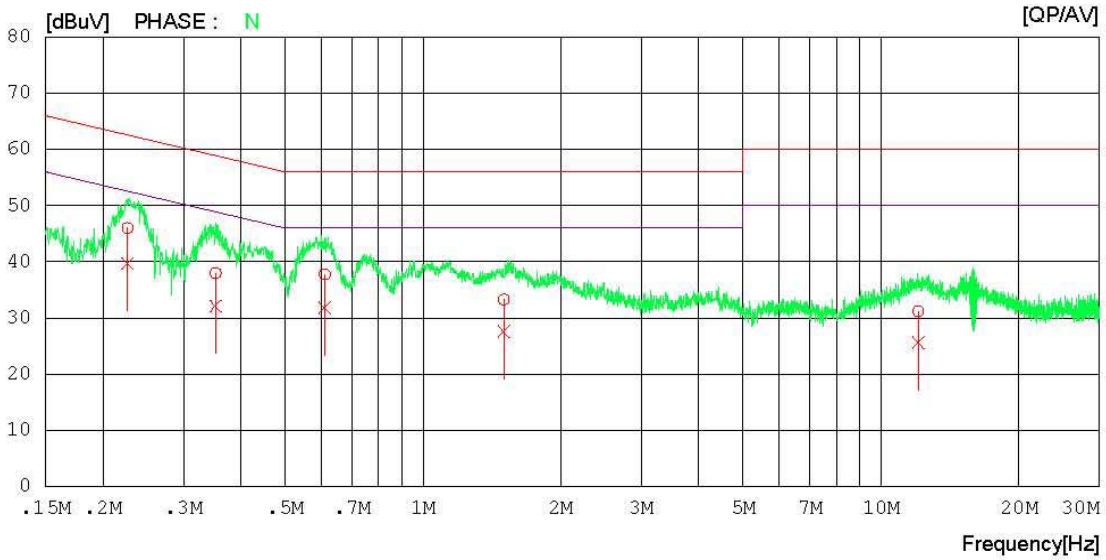
Digital EMC

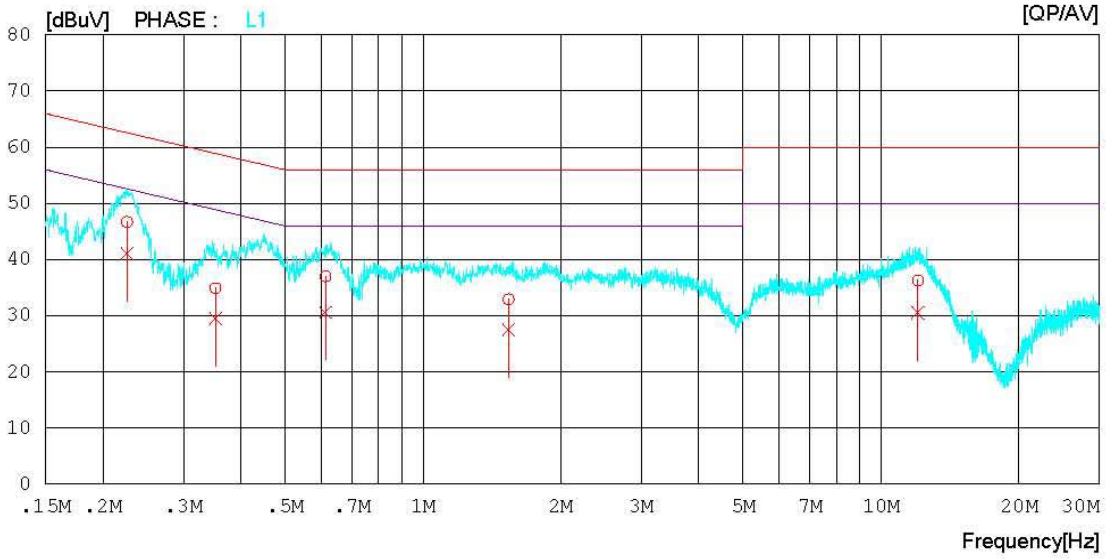
Results of Conducted Emission

Digital EMC
Date : 2012-09-16

Model No.	:	HM50	Referrence No.	:	
Type	:		Power Supply	:	120V 60Hz
Serial No.	:		Temp/Humi.	:	25 'C 46 % R.H.
Test Condition	:		Operator	:	H.H.Lee
Memo	:	WLAN-11b			

LIMIT : CISPR22_B QP
CISPR22_B AV





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AC Line Conducted Emissions (List)

Test Mode: 802.11b (2.4GHz Band)

Results of Conducted Emission

Digital EMC
Date : 2012-09-16

Model No.	:	HM50	Referrence No.	:	
Type	:		Power Supply	:	120V 60Hz
Serial No.	:		Temp/Humi.	:	25 'C 46 % R.H.
Test Condition	:		Operator	:	H.H.Lee

Memo : WLAN-11b

LIMIT : CISPR22_B QP
CISPR22_B AV

NO	FREQ	READING QP	READING AV	C.FACTOR	RESULT QP	RESULT AV	LIMIT QP	LIMIT AV	MARGIN QP	MARGIN AV	PHASE
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	
1	0.22645	45.8	39.5	0.2	46.0	39.7	62.6	52.6	16.6	12.9	N
2	0.35268	37.7	31.8	0.3	38.0	32.1	58.9	48.9	20.9	16.8	N
3	0.61065	37.6	31.6	0.2	37.8	31.8	56.0	46.0	18.2	14.2	N
4	1.50250	33.0	27.3	0.3	33.3	27.6	56.0	46.0	22.7	18.4	N
5	12.07200	30.4	24.8	0.8	31.2	25.6	60.0	50.0	28.8	24.4	N
6	0.22598	46.5	40.9	0.2	46.7	41.1	62.6	52.6	15.9	11.5	L1
7	0.35256	34.6	29.2	0.3	34.9	29.5	58.9	48.9	24.0	19.4	L1
8	0.61328	36.8	30.4	0.2	37.0	30.6	56.0	46.0	19.0	15.4	L1
9	1.53850	32.6	27.2	0.3	32.9	27.5	56.0	46.0	23.1	18.5	L1
10	12.04100	35.5	29.7	0.8	36.3	30.5	60.0	50.0	23.7	19.5	L1

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▣ RESULT PLOTS

AC Line Conducted Emissions (Graph)

Test Mode: 802.11g (2.4GHz Band)

Digital EMC

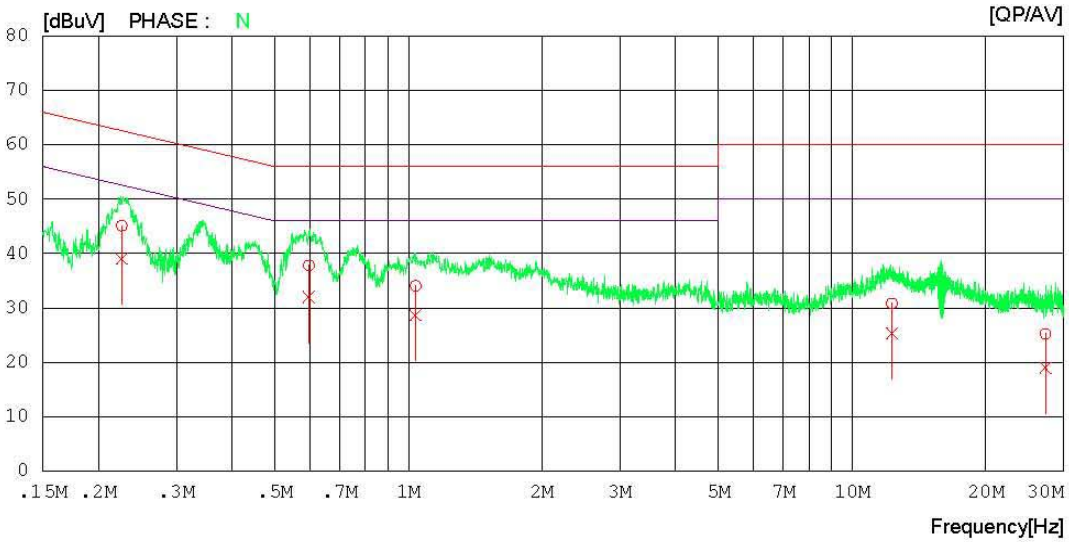
Results of Conducted Emission

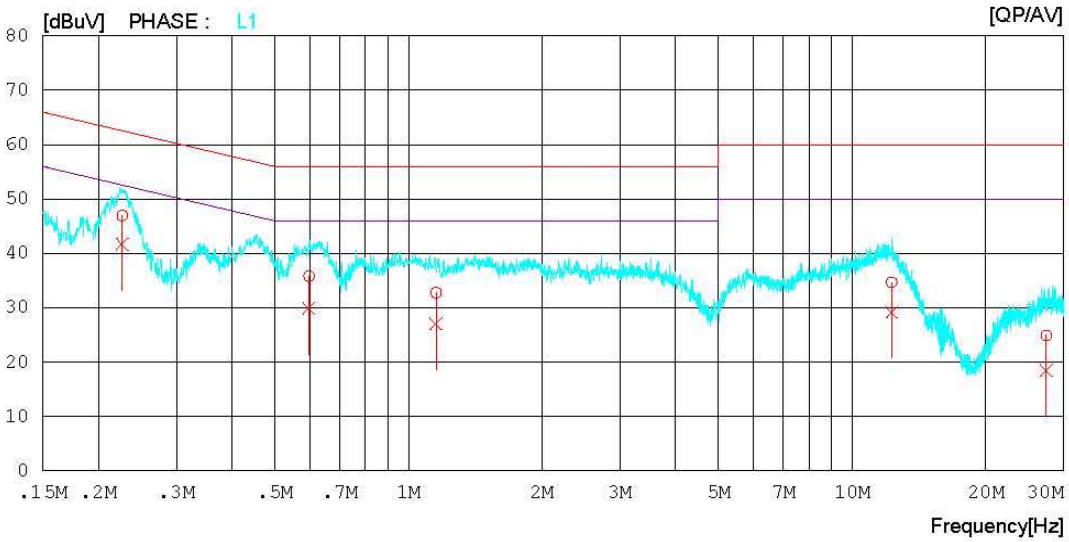
Digital EMC
Date : 2012-09-16

Model No.	:	HM50	Referrence No.	:	
Type	:		Power Supply	:	120V 60Hz
Serial No.	:		Temp/Humi.	:	25 'C 46 % R.H.
Test Condition	:		Operator	:	H.H.Lee

Memo : WLAN-11G

LIMIT : CISPR22_B QP
CISPR22_B AV





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AC Line Conducted Emissions (List)

Test Mode: 802.11g (2.4GHz Band)

Results of Conducted Emission

Digital EMC
Date : 2012-09-16

Model No.	:	HM50	Referrence No.	:	
Type	:		Power Supply	:	120V 60Hz
Serial No.	:		Temp/Humi.	:	25 'C 46 % R.H.
Test Condition	:		Operator	:	H.H.Lee

Memo : WLAN-11G

LIMIT : CISPR22_B QP
CISPR22_B AV

NO	FREQ	READING QP	READING AV	C.FACTOR	RESULT QP	RESULT AV	LIMIT QP	LIMIT AV	MARGIN QP	MARGIN AV	PHASE
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	
1	0.22599	44.9	38.8	0.2	45.1	39.0	62.6	52.6	17.5	13.6	N
2	0.59696	37.6	31.8	0.2	37.8	32.0	56.0	46.0	18.2	14.0	N
3	1.03850	33.7	28.4	0.3	34.0	28.7	56.0	46.0	22.0	17.3	N
4	12.29550	30.0	24.5	0.8	30.8	25.3	60.0	50.0	29.2	24.7	N
5	27.30550	23.9	17.7	1.3	25.2	19.0	60.0	50.0	34.8	31.0	N
6	0.22650	46.8	41.5	0.2	47.0	41.7	62.6	52.6	15.6	10.9	L1
7	0.59709	35.6	29.7	0.2	35.8	29.9	56.0	46.0	20.2	16.1	L1
8	1.15400	32.5	26.8	0.3	32.8	27.1	56.0	46.0	23.2	18.9	L1
9	12.28800	33.9	28.4	0.8	34.7	29.2	60.0	50.0	25.3	20.8	L1
10	27.39000	23.6	17.2	1.3	24.9	18.5	60.0	50.0	35.1	31.5	L1

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▣ RESULT PLOTS

AC Line Conducted Emissions (Graph)

Test Mode: 802.11n HT20 (2.4GHz Band)

Digital EMC

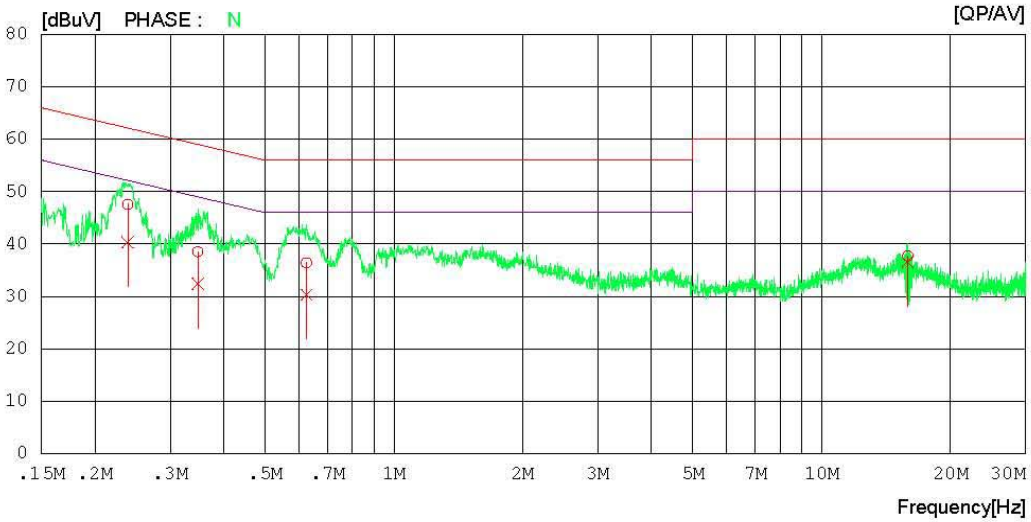
Results of Conducted Emission

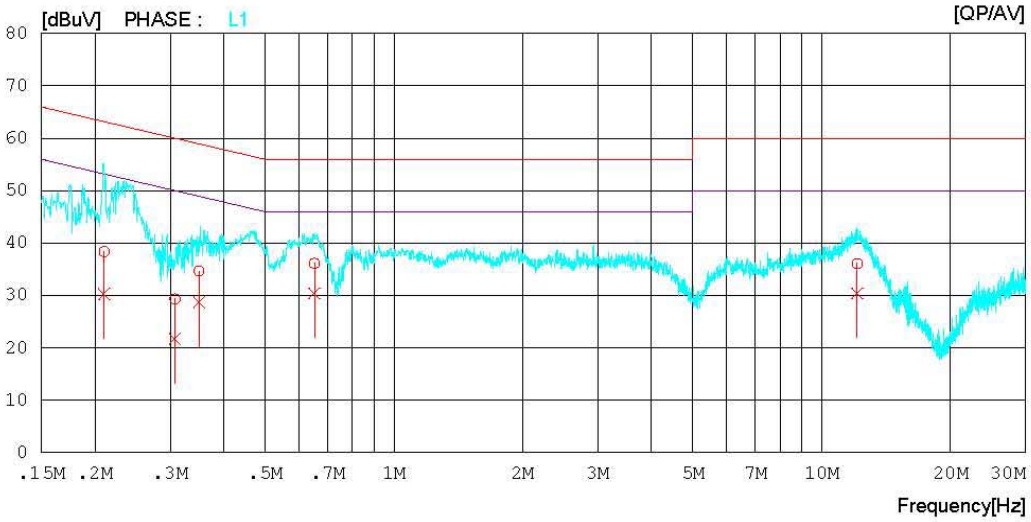
Digital EMC
Date : 2012-09-16

Model No.	:	HM50	Referrence No.	:	
Type	:		Power Supply	:	120V 60Hz
Serial No.	:		Temp/Humi.	:	25 'C 46 % R.H.
Test Condition	:		Operator	:	H.H.Lee

Memo : WLAN-11N

LIMIT : CISPR22_B QP
CISPR22_B AV





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AC Line Conducted Emissions (List)

Test Mode: 802.11n HT20 (2.4GHz Band)

Results of Conducted Emission

Digital EMC
Date : 2012-09-16

Model No.	:	HM50	Referrence No.	:	
Type	:		Power Supply	:	120V 60Hz
Serial No.	:		Temp/Humi.	:	25 'C 46 % R.H.
Test Condition	:		Operator	:	H.H.Lee

Memo : WLAN-11N

LIMIT : CISPR22_B QP
CISPR22_B AV

NO	FREQ	READING QP	READING AV	C.FACTOR	RESULT QP	RESULT AV	LIMIT QP	LIMIT AV	MARGIN QP	MARGIN AV	PHASE
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	
1	0.23876	47.4	40.1	0.2	47.6	40.3	62.1	52.1	14.5	11.8	N
2	0.34808	38.2	32.1	0.3	38.5	32.4	59.0	49.0	20.5	16.6	N
3	0.62488	36.2	30.1	0.2	36.4	30.3	56.0	46.0	19.6	15.7	N
4	15.89950	36.7	35.6	1.0	37.7	36.6	60.0	50.0	22.3	13.4	N
5	0.21028	38.2	30.1	0.2	38.4	30.3	63.2	53.2	24.8	22.9	L1
6	0.30773	29.2	21.5	0.2	29.4	21.7	60.0	50.0	30.6	28.3	L1
7	0.35058	34.4	28.4	0.3	34.7	28.7	58.9	48.9	24.2	20.2	L1
8	0.65236	35.9	30.2	0.2	36.1	30.4	56.0	46.0	19.9	15.6	L1
9	12.11050	35.3	29.6	0.8	36.1	30.4	60.0	50.0	23.9	19.6	L1

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9. LIST OF TEST EQUIPMENT

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent	E4440A	12/09/18	13/09/18	MY45304199
Spectrum Analyzer	Rohde Schwarz	FSQ26	12/01/09	13/01/09	200445
Digital Multimeter	H.P	34401A	12/03/05	13/03/05	3146A13475, US36122178
Spectrum Analyzer	Agilent	N9020A	12/01/09	13/01/09	MY49100833
Signal Generator	Rohde Schwarz	SMR20	12/03/05	13/03/05	101251
Vector Signal Generator	Rohde Schwarz	SMJ100A	12/01/09	13/01/09	100148
Thermo hygrometer	BODYCOM	BJ5478	12/01/13	13/01/13	090205-2
DC Power Supply	HP	6622A	12/03/05	13/03/05	3448A03760
High-pass filter	Wainwright	WHNX3.0	12/09/17	13/09/17	9
LOOP Antenna	ETS	6502	10/10/29	12/10/29	3471
BILOG ANTENNA	SCHAFFNER	CBL6112D	10/12/21	12/12/21	22609V
HORN ANT	ETS	3115	12/02/20	13/02/20	6419
HORN ANT	A.H.Systems	SAS-574	11/03/25	13/03/25	154
Attenuator (3dB)	WEINSCHEL	56-3	12/09/17	13/09/17	Y2342
Amplifier (22dB)	H.P	8447E	12/01/09	13/01/09	2945A02865
Amplifier (30dB)	Agilent	8449B	12/03/05	13/03/05	3008A01590
EMI TEST RECEIVER	R&S	ESU	12/03/05	13/03/05	100014
RFI/Field intensity Meter	KYORITSU	KNM-2402	12/07/02	13/07/02	4N-170-3
Spectrum Analyzer	H/P	8591E	12/03/05	13/03/05	3649A05889
CVCF	NF Electronic	4420	12/03/06	13/03/06	304935/337980
ARTIFICIAL MAINS NETWORK	R&S	ESH2-Z5	12/09/18	13/09/18	828739/006

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