

FCC CFR47 PART 15 SUBPART C INDUSTRY CANADA RSS-210 ISSUE 7 CERTIFICATION TEST REPORT

FOR

WIRELESS 802.11b EMBEDDED MODULE

MODEL NUMBER: RCM4400W

FCC ID: VCB-540d144

IC: 7143A-5400d144

REPORT NUMBER: 07U11043-1, REVISION B

ISSUE DATE: OCTOBER 22, 2007

Prepared for

RABBIT SEMICONDUCTOR A DIGI INTERNATIONAL COMPANY 2900 SPAFFORD STREET DAVIS, CA 95618, U.S.A.

Prepared by

COMPLIANCE CERTIFICATION SERVICES
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.

TEL: (510) 771-1000 FAX: (510) 661-0888



Revision History

	Issue		
Rev.	Date	Revisions	Revised By
	10/04/07	Initial Issue	H. Shih
B	10/22/07	Corrected FCC ID	T. Hong

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: RABBIT SEMICONDUCTOR

2900 SPAFFORD STREET DAVIS, CA 95618, USA

EUT DESCRIPTION: WIRELESS 802.11B EMBEDDED MODULE

MODEL: RCM4400W

SERIAL NUMBER: D31769

DATE TESTED: OCTOBER 3 - 4, 2007

APPLICABLE STANDARDS

STANDARD TEST RESULTS

CFR 47 Part 15 Subpart C and Subpart E No Non-Compliance Noted

RSS-210 Issue 7 Annex 8 and RSS-GEN Issue 2 No Non-Compliance Noted

Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By: Tested By:

THU CHAN

COMPLIANCE CERTIFICATION SERVICES

EMC SUPERVISOR

TOM CHEN EMC ENGINEER

COMPLIANCE CERTIFICATION SERVICES

DATE: OCTOBER 22, 2007

IC: 7143A-540d144

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 2, and RSS-210 Issue 7.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Radiated Emission, 30 to 200 MHz	+/- 3.3 dB
Radiated Emission, 200 to 1000 MHz	+4.5 / -2.9 dB
Radiated Emission, 1000 to 2000 MHz	+4.5 / -2.9 dB
Power Line Conducted Emission	+/- 2.9 dB

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

This report shall not be reproduced except in full, without the written approval of CCS.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

EUT is a Wireless 802.11b Embedded Module operating in the frequency range 2400-2483.5MHz.

The radio module is manufactured by Rabbit Semiconductor.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range	Mode	Output Power	Output Power
(MHz)		(dBm)	(mW)
2412 - 2462	802.11b	17.61	57.68

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a dipole antenna with a maximum peak gain of 2 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Dynamic C rev. 10.21

The test utility software used during testing was FCC_program_3.C

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power at mid channel 2437MHz.

The worst-case data rate for this channel is determined to be 2 Mb/s.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST							
Description Manufacturer Model Serial Number FCC ID							
DC Power Supply	Kaga Component Co.	SP15U-0522T	02046	NA			
Test Fixture	Rabbit Semiconductor	20-175-0342A	27450	NA			
Laptop	Sony Vasio	PCG-6B1L	3001990	DoC			
AC adapter	Sony	PCGA-AC16V6	147774951	DoC			

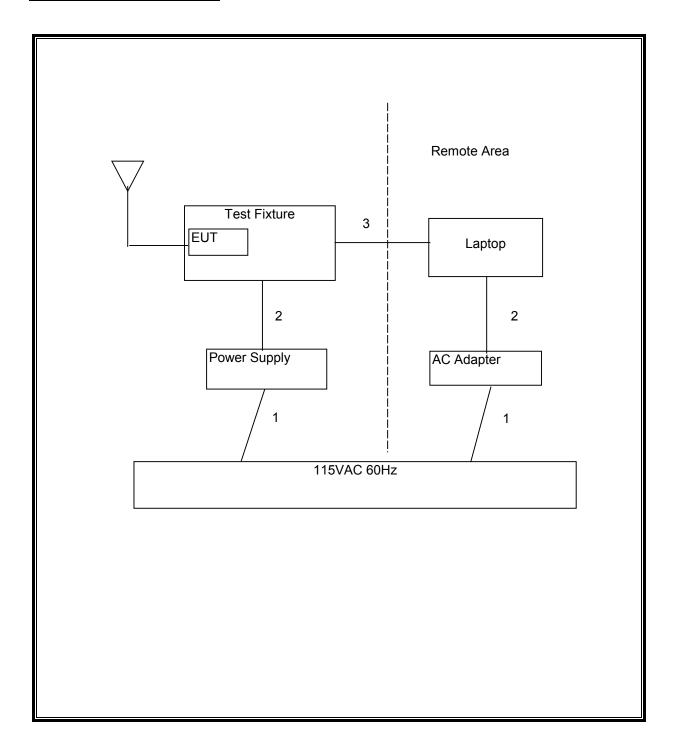
I/O CABLES

	I/O CABLE LIST							
Cable Port # of Identical Ports		Connector Type	Cable Type	Cable Length	Remarks			
1	AC	2	US 115V	Un-shielded	2m	NA		
2	DC	2	DC	Un-shielded	2m	NA		
3	RS-232	1	DB9	Un-shielded	5m	Connected to Remote Laptop		

TEST SETUP

The EUT is installed in a test fixture and is connected to a Laptop during the tests. Test software exercised the radio module.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST						
Description	Manufacturer	Model	Serial Number	Cal Due		
Antenna, Bilog 30 MHz ~ 2 Ghz	Sunol Sciences	JB1	A0022704	9/28/2008		
Preamplifier, 1300 MHz	Agilent / HP	8447D	1937A02062	9/26/2008		
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	6717	4/15/2008		
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00931	9/26/2008		
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	MY45300064	3/18/2008		
EMI Receiver, 9 kHz ~ 2.9 GHz	Agilent / HP	8542E	3942A00286	6/12/2008		
RF Filter Section	Agilent / HP	85420E	3705A00256	6/13/2008		
Peak Power Meter	Agilent / HP	E4416A	GB41291160	12/2/2007		
Peak / Average Power Sensor	Agilent	E9327A	US40440755	12/2/2007		

6.1.1. 6 dB BANDWIDTH

LIMIT

§15.247 (a) (2) For direct sequence systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

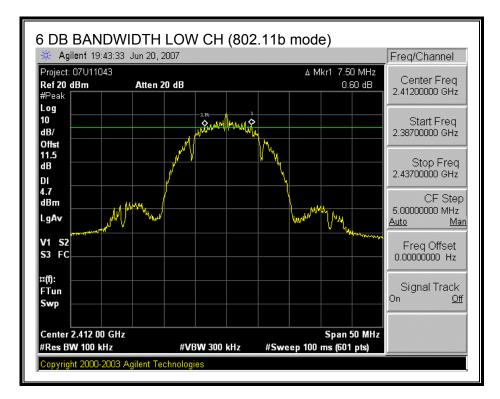
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the 802.11b Mode

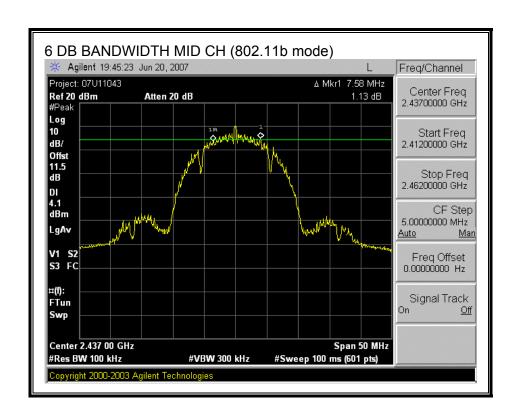
Channel	Frequency	6 dB Bandwidth	Minimum Limit	Margin
	(MHz)	(kHz)	(kHz)	(kHz)
Low	2412	7500	500	7000
Middle	2437	7580	500	7080
High	2462	7500	500	7000

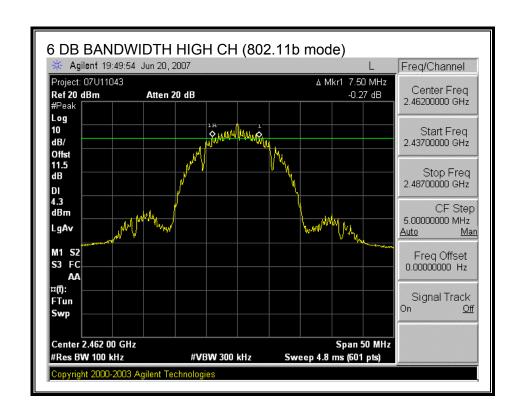
VBW is set to 300 kHz. The sweep time is coupled.

RESULTS

6 DB BANDWIDTH (802.11b MODE)







6.1.2. 99% BANDWIDTH

<u>LIMIT</u>

None; for reporting purposes only.

TEST PROCEDURE

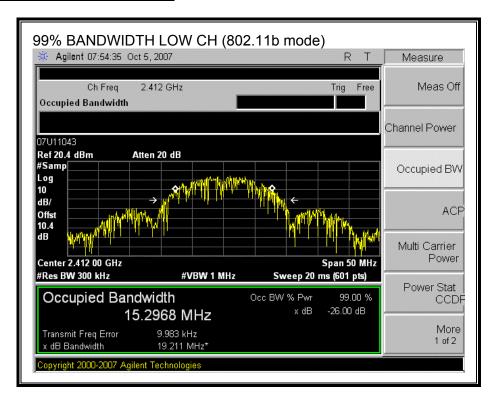
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

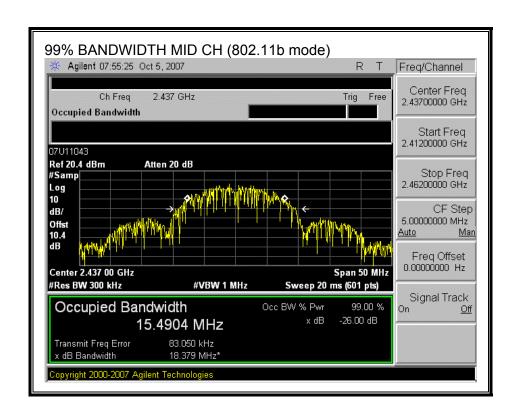
RESULTS

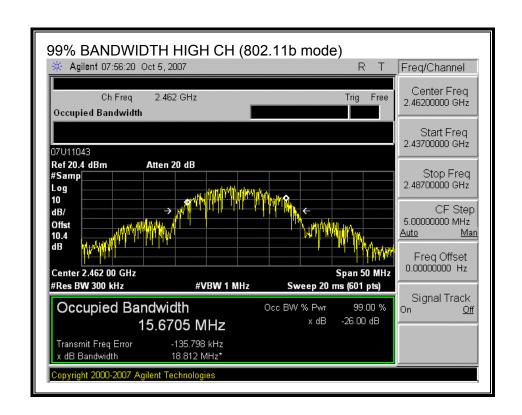
802.11b Mode

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2412	15.2968
Middle	2437	15.4904
High	2462	15.6705

99% BANDWIDTH (802.11b MODE)







6.1.3. PEAK OUTPUT POWER

PEAK POWER LIMIT

§15.247 (b) The maximum peak output power of the intentional radiator shall not exceed the following:

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\$15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz , and 5725-5850 MHz bands: 1 watt.

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz , and 5725-5850 MHz bands: 1 watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

§15.247 (b) (4) (i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer and the analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth.

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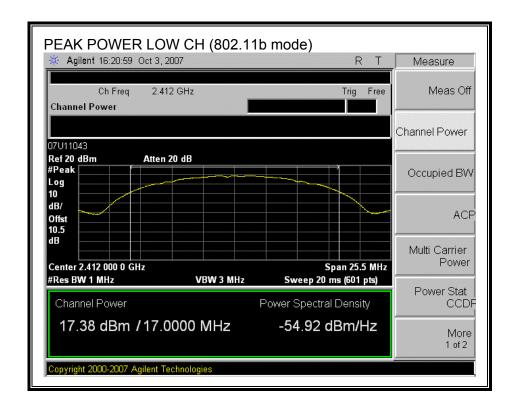
RESULTS

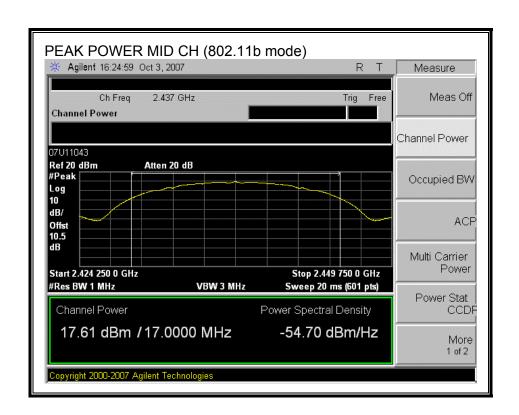
The maximum antenna gain is 2 dBi for other than fixed, point-to-point operations, therefore the limit is 30 dBm.

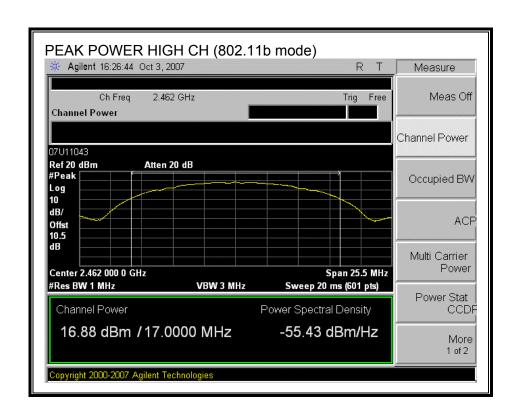
802.11b Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	17.38	30	-12.62
Middle	2437	17.61	30	-12.39
High	2462	16.88	30	-13.12

OUTPUT POWER (802.11b MODE)







6.1.4. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

No non-compliance noted:

The cable assembly insertion loss of 10.5dB (including 10.dB pad and 0.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

802.11b Mode

Channel	Frequency	Power
	(MHz)	(dBm)
Low	2412	13.93
Middle	2437	14.15
High	2462	13.46

6.1.5. PEAK POWER SPECTRAL DENSITY

LIMIT

§15.247 (d) For direct sequence systems, the peak 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 PROCEDURE

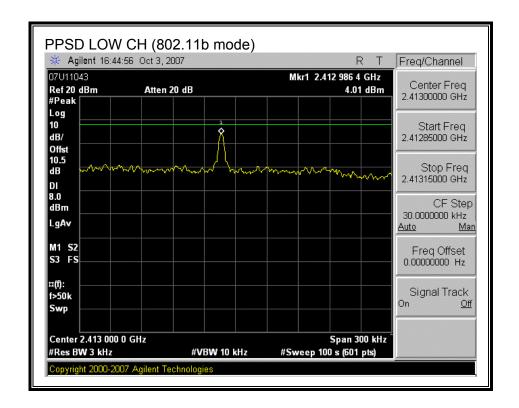
The transmitter output is connected to a spectrum analyzer, the maximum level in a 3 kHz bandwidth is measured with the spectrum analyzer using RBW = 3 kHz and VBW > 3 kHz, sweep time = span / 3 kHz, and video averaging is turned off. The PPSD is the highest level found across the emission in any 3 kHz band.

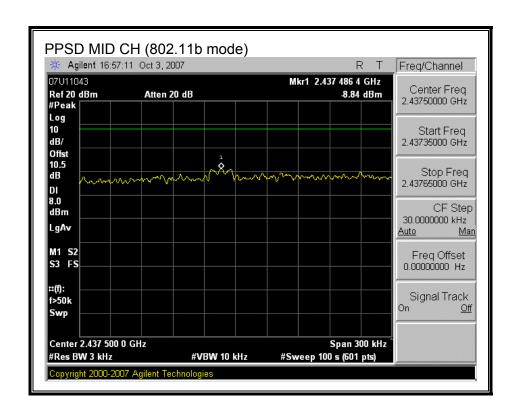
RESULTS

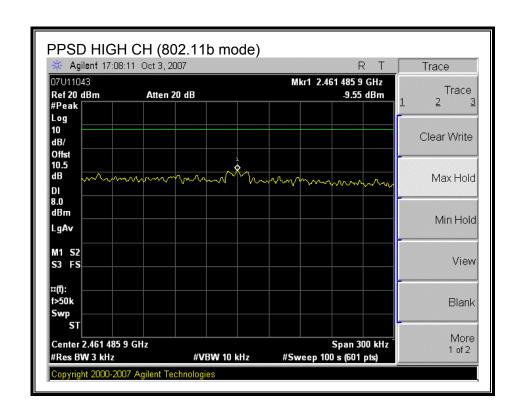
802.11b Mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	4.01	8	-3.99
Middle	2437	-8.84	8	-16.84
High	2462	-9.55	8	-17.55

PEAK POWER SPECTRAL DENSITY (802.11b MODE)







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6.1.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

§15.247 (c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. 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)).

Conducted power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

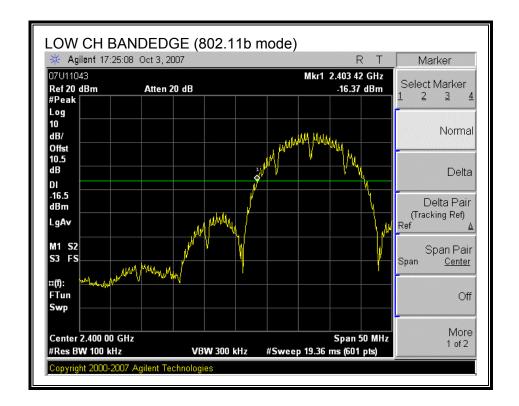
TEST PROCEDURE

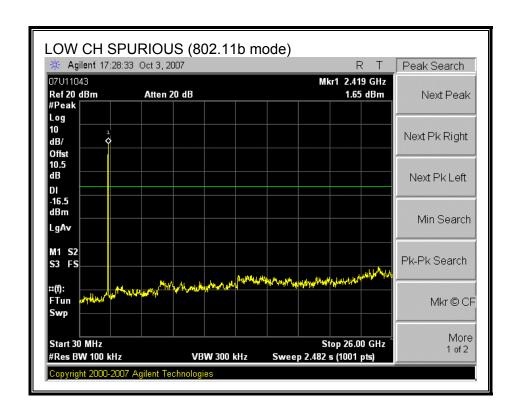
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

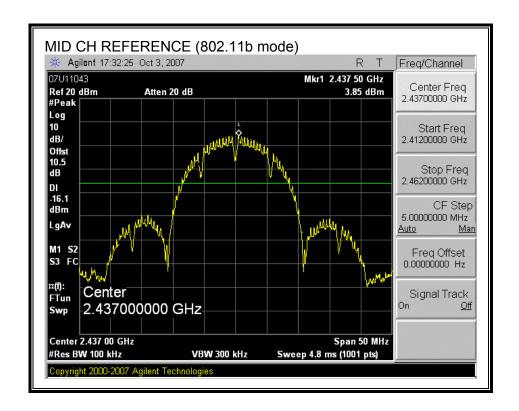
RESULTS

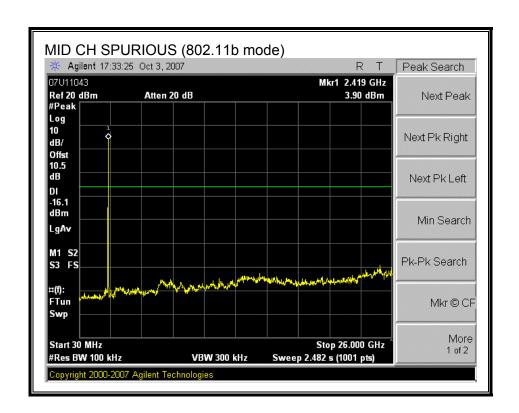
SPURIOUS EMISSIONS, LOW CHANNEL (802.11b MODE)



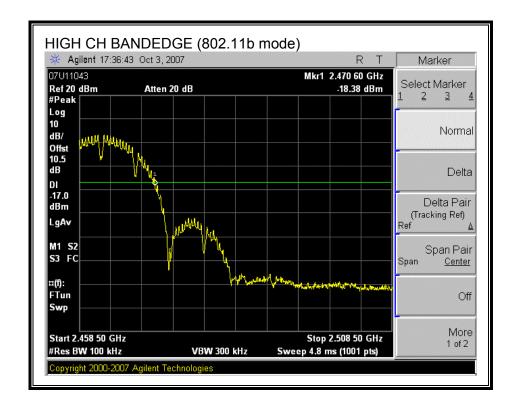


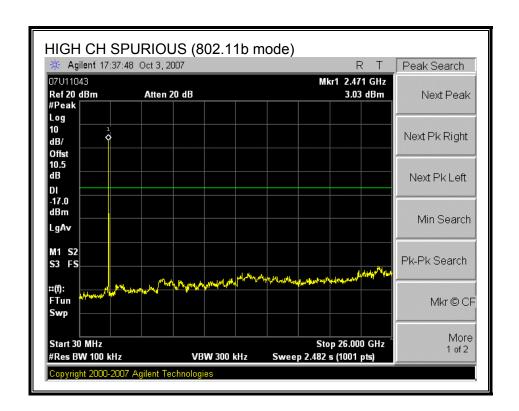
SPURIOUS EMISSIONS, MID CHANNEL (802.11b MODE)





SPURIOUS EMISSIONS, HIGH CHANNEL (802.11b MODE)





7. RADIATED TEST RESULTS

7.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

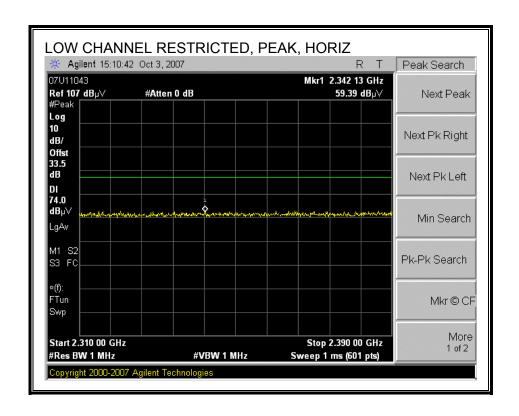
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

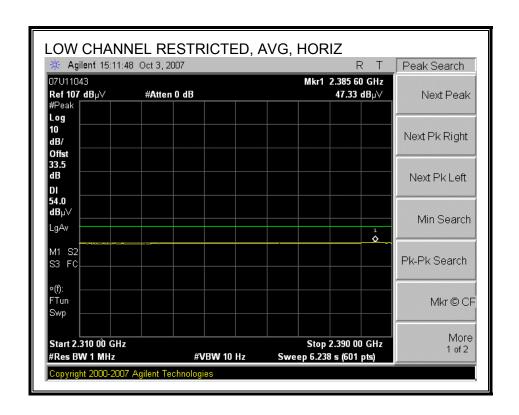
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

7.1.1. TRANSMITTER ABOVE 1 GHz FOR 802.11b MODE IN THE 2.4 GHz **BAND**

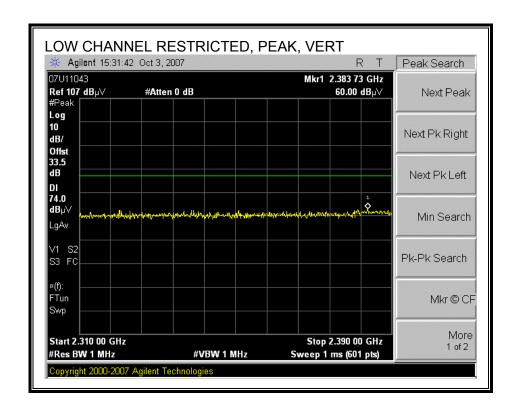
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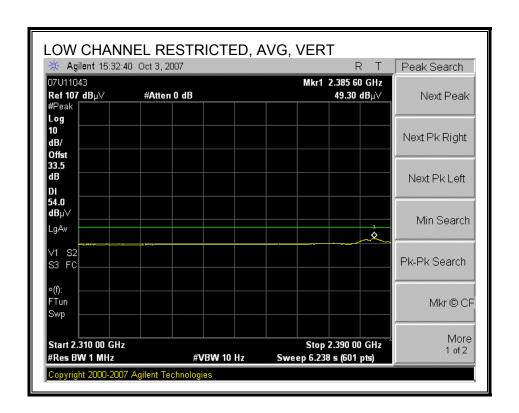
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



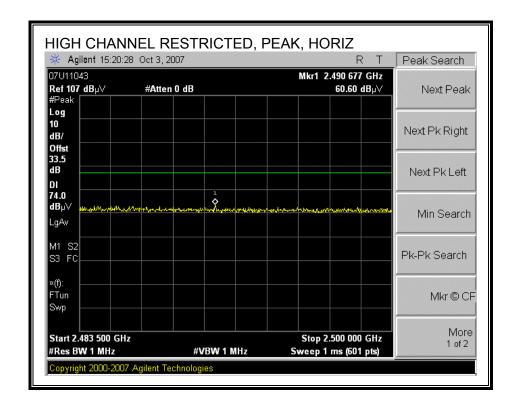


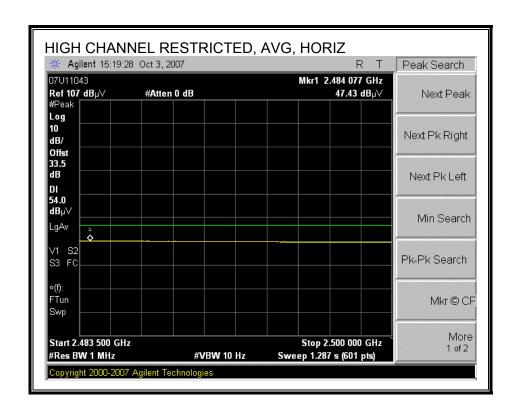
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



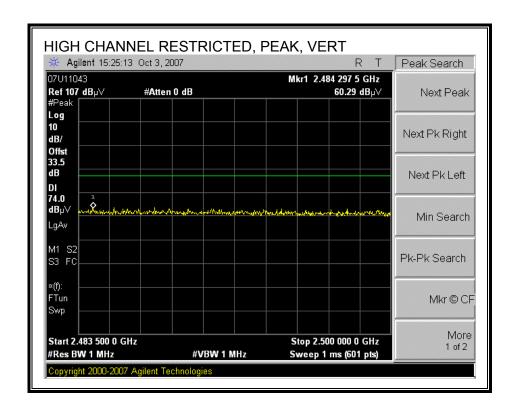


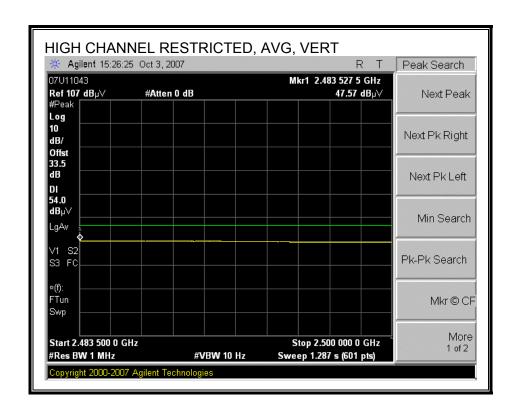
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



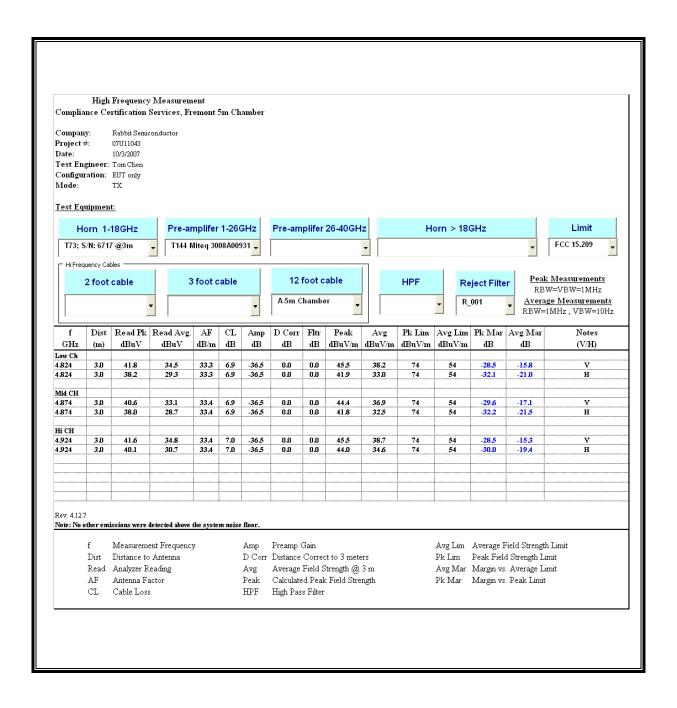


RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



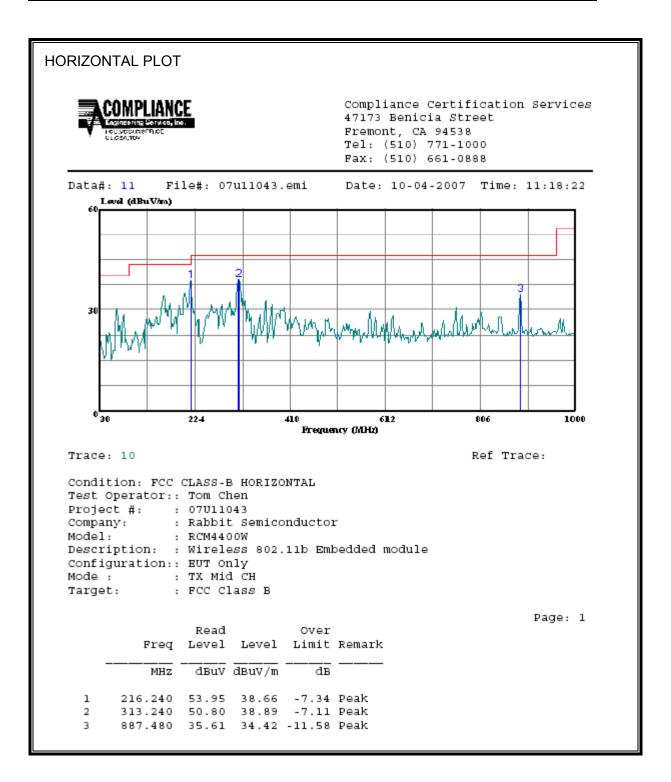


HARMONICS AND SPURIOUS EMISSIONS

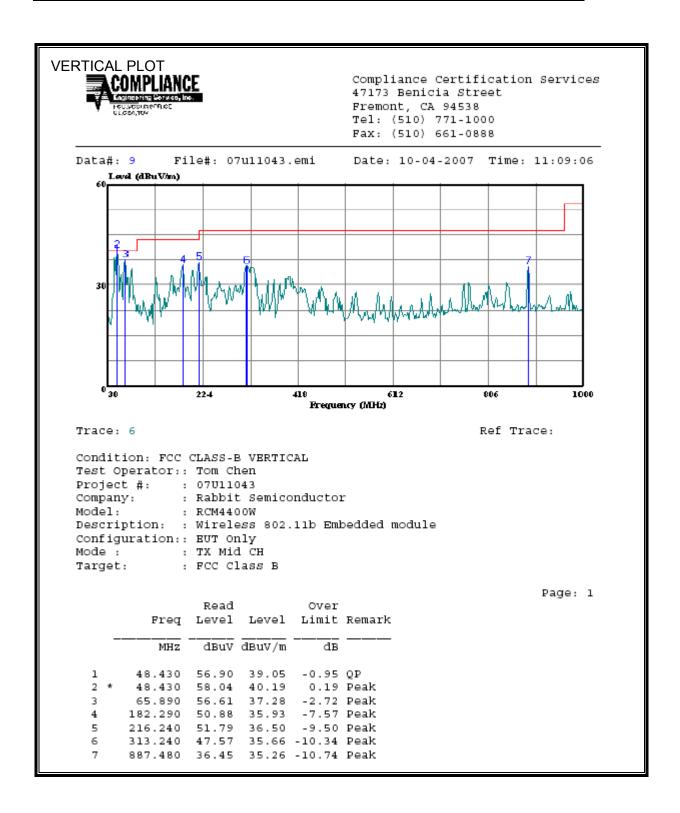


7.2. WORST-CASE BELOW 1 GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

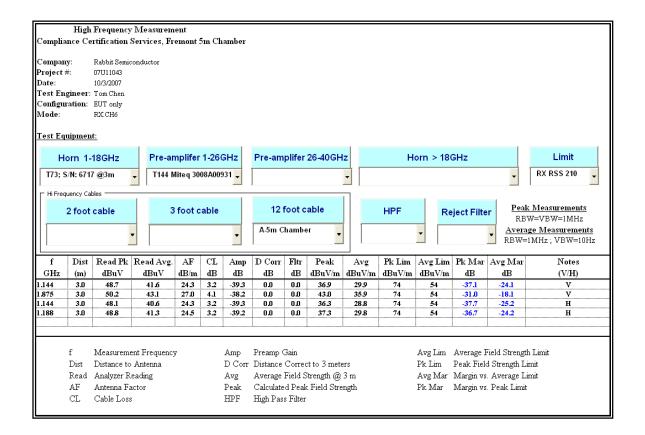


SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)



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7.3. RECEIVER ABOVE 1 GHz



8. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (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.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

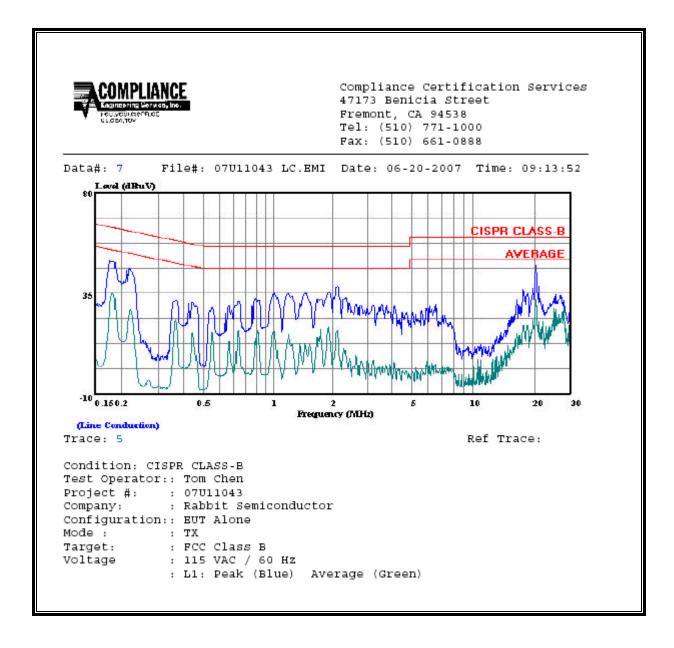
Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

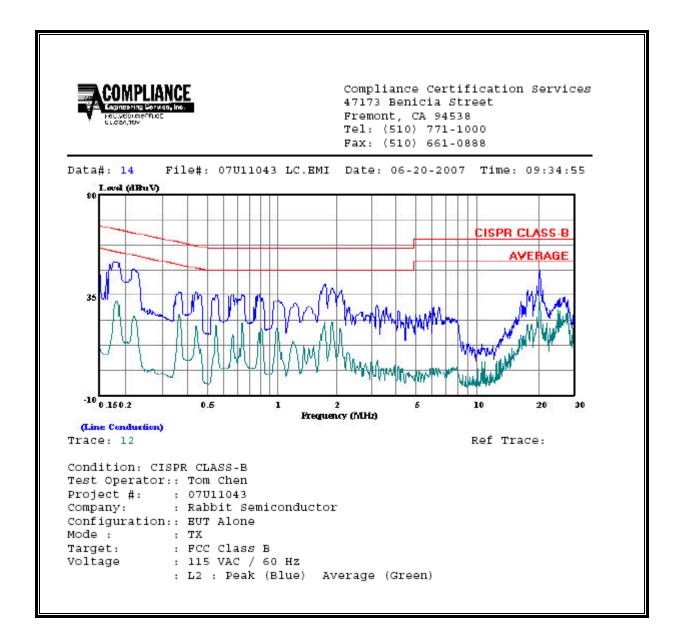
6 WORST EMISSIONS

Freq.	Reading		Closs	Limit	FCC_B	Margin		Remark	
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.18	49.25		34.81	0.00	64.44	54.44	-15.19	-19.63	L1
0.22	45.81		26.39	0.00	62.86	52.86	-17.05	-26.47	L1
20.27	47.50		32.32	0.00	60.00	50.00	-12.50	-17.68	L1
0.15	47.88		10.31	0.00	66.00	56.00	-18.12	-45.69	L2
0.18	50.20		24.10	0.00	64.67	54.67	-14.47	-30.57	L2
20.27	46.14		31.75	0.00	60.00	50.00	-13.86	-18.25	L2

LINE 1 RESULTS

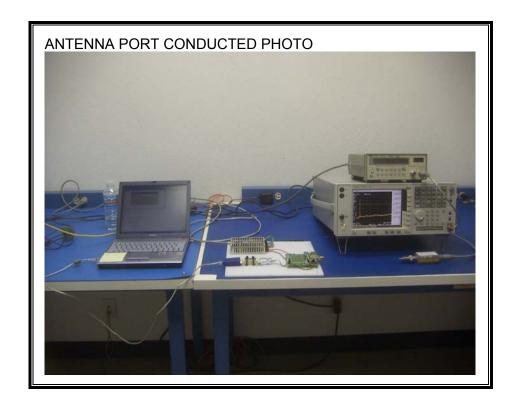


LINE 2 RESULTS



9. SETUP PHOTOS

ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP



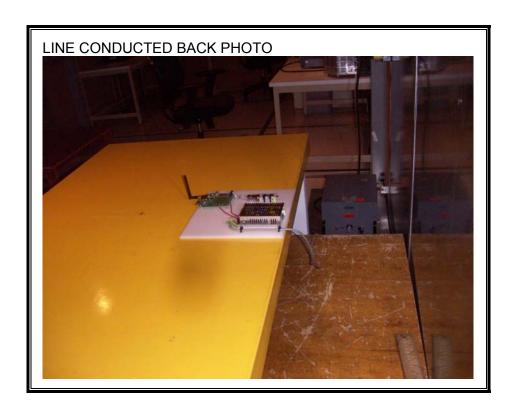
RADIATED RF MEASUREMENT SETUP





POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP





END OF REPORT