



849 NW STATE ROAD 45
 NEWBERRY, FL 32669 USA
 PH: 888.472.2424 OR 352.472.5500
 FAX: 352.472.2030
 EMAIL: TEI@TIMCOENGR.COM
 HTTP: [//WWW.TIMCOENGR.COM](http://WWW.TIMCOENGR.COM)

**FCC PART 15.247
 DIRECT SEQUENCE TEST REPORT**

APPLICANT	ROOT INC.
ADDRESS	8F 2nd TOC BUILDING 7-21-11 NISHI-GOTANDA, SHINAGAWA-KU TOKYO JAPAN
FCC ID	NN4RZ2009
MODEL NUMBER	N/A
PRODUCT DESCRIPTION	802.11b/g mini PCI card
DATE SAMPLE RECEIVED	July 17, 2006
DATE TESTED	July 17, 2006
TESTED BY	Nam Nguyen
APPROVED BY	Mario de Aranzeta C.E.T.
TIMCO REPORT NO.	2118AJT6TestReport
TEST RESULTS	<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL

**THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT
 THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.**



Certificate # 0955-01



Certificate # 0955-01

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STATEMENT OF COMPLIANCE

This equipment has been tested in accordance with the standards identified in the referenced test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report and demonstrate that the equipment complies with the appropriate standards.

I attest that the necessary measurements were made by me or under my supervision, at Timco Engineering, Inc. located at 849 N.W. State Road 45, Newberry, Florida 32669 USA.

Authorized by: Mario de Aranzeta

Signature:

Function: Engineer

Date: July 19, 2006

Tested by: Nam Nguyen

Signature: on file

Date: July 17, 2006



Certificate # 0955-01

GENERAL INFORMATION

Test Report Purpose: The test report is to show the compliance of tested article with FCC Part 15.247 modular approval requirement.

Test Results: The test results relate only to the items tested.

Test Article:

FCC ID:	NN4RZ2009
Model Number:	RZ2009
Serial Number:	N/A
Product Description:	802.11b/g mini PCI card
Operating Frequency:	2412 - 2462 GHz
Max. output power (conducted):	mode 11b: 13 dBm; mode 11g: 18.2 dBm
Type of Modulation:	CCK and OFDM
Power Supply:	<i>Primary Power</i> 110VAC/50-60Hz <i>Secondary Power</i> 3.3 Vdc for module
Test Item:	Pre-Production
Type of Equipment:	Mobile
Antenna Type:	26 dBi Parabolic antenna, m/n: AT373
Antenna Connector:	Standard connector ('N' type) Professional installation required

Modification to the EUT: none

Description of certified system: The system consists of a mini PCI module and the following antenna system: 16 meters of 5D2V coaxial cable and a 26 dBi parabolic reflector antenna.

The test platform (host) was the applicants AT-TQ5528 router system.

Test Facilities: All measurements were made at one or more of the test sites of TIMCO ENGINEERING INC. located at 849 N.W. State Road 45, Newberry, FL 32669.

Test Exercise (e.g software description, test signal, etc.): The EUT was set in continuous transmit mode of operation.

Test Conditions: All the tests were performed at a temperature of 78°F and a relative humidity of 55%.

Test Standards: ANSI C63.4: 2003, FCC Part 15.247

APPLICANT: ROOT Inc.

FCC ID: NN4RZ2009

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EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
3/10-Meter OATS	TEI	N/A	N/A	Listed 3/27/04	3/26/07
3-Meter OATS	TEI	N/A	N/A	Listed 1/11/06	1/10/09
Biconnical Antenna	Eaton	94455-1	1057	CAL 12/12/05	12/12/07
Biconnical Antenna	Eaton	94455-1	1096	CAL 8/17/04	8/17/06
Biconnical Antenna	Electro-Metrics	BIA-25	1171	CAL 4/29/05	4/29/07
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 12/8/05	12/8/07
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 12/8/05	12/8/07
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 12/7/05	12/7/07
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 12/7/05	12/7/07
LISN	Electro-Metrics	ANS-25/2	2604	CAL 8/27/04	8/27/06
LISN	Electro-Metrics	EM-7820	2682	CAL 4/28/05	4/28/07
Log-Periodic Antenna	Eaton	96005	1243	CAL 12/14/05	12/14/07

APPLICANT: ROOT Inc.

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TEST PROCEDURE

Power Line Conducted Interference: The procedure used was ANSI STANDARD C63.4-2003 using a 50uH LISN. The spectrum was scanned from .15 to 30 MHz. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed.

Bandwidth 6 dB: The measurements were made with the spectrum analyzer's resolution bandwidth (RBW) = 100kHz and the video bandwidth (VBW) = 3 MHz and the span set as shown on plot.

Power Output: The RF power output was measured at the antenna feed point using a peak power meter.

Antenna Conducted Emissions: The RBW = 100 kHz, VBW = 300 kHz and the span set to 10 MHz and the spectrum was scanned from lowest frequency used in the EUT to the 10th harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 3 MHz and the span to 50 MHz.

Radiation Interference: The test procedure used was ANSI STANDARD C63.4-2003 using an Agilent spectrum receiver with pre-selector. The bandwidth (RBW) of the spectrum receiver was 100 kHz up to 1 GHz and 1 MHz above 1 GHz with an appropriate sweep speed. The VBW above 1 GHz was 3 MHz. The analyzer was calibrated in dB above a microvolt at the output of the antenna.

Radiated Spurious Emissions Into Adjacent Restricted Band: An in band field strength measurement of the fundamental Emission using the RBW and detector function required by C63.4-2003 and FCC Rules. The procedure was repeated with an average detector and a plot made.



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POWER LINE CONDUCTED INTERFERENCE

Rules Part No.: 15.207(a)

Requirements:

Emission Frequency (MHz)	FCC Conducted Limit (dBμV)	
	Quasi-peak (QP)	Average (AV)
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 Data:

The plots on the following pages represent the emissions taken for this device.

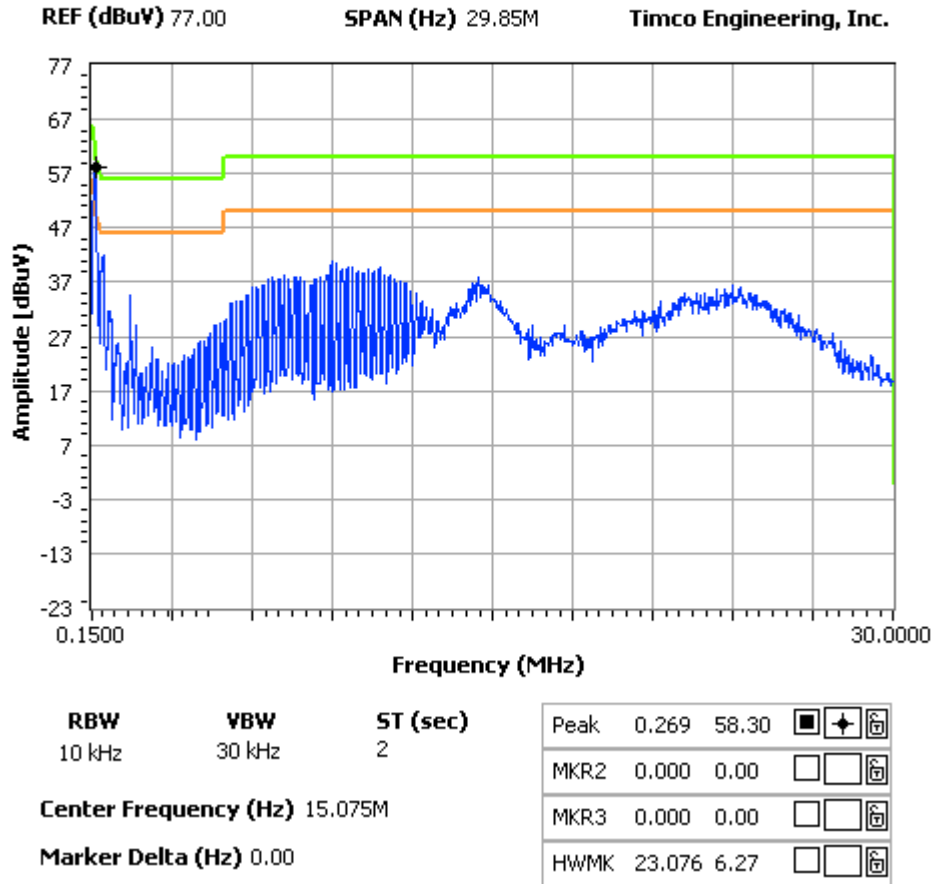


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NOTES:

ROOT INC. - FCC ID: NN4RZ2009
POWER LINE CONDUCTED PLOT - LINE 1

FCC 15.107 Mask Class B



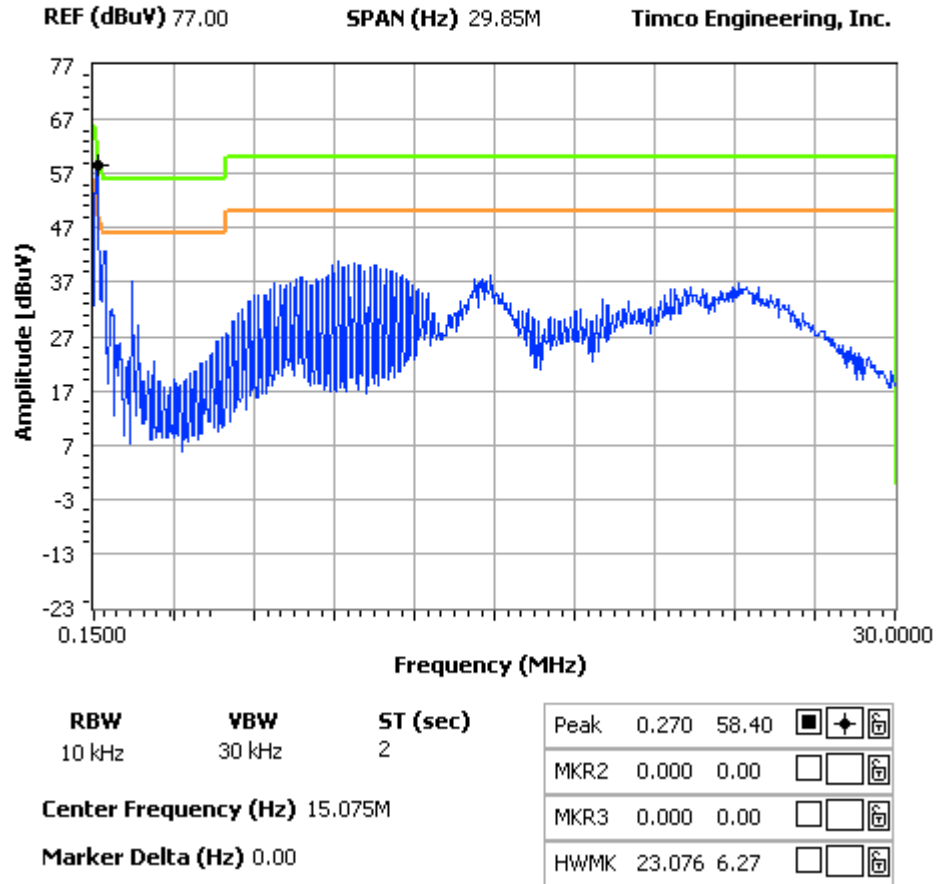


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NOTES:

ROOT INC. - FCC ID: NN4RZ2009
POWER LINE CONDUCTED PLOT - LINE 2

FCC 15.107 Mask Class B





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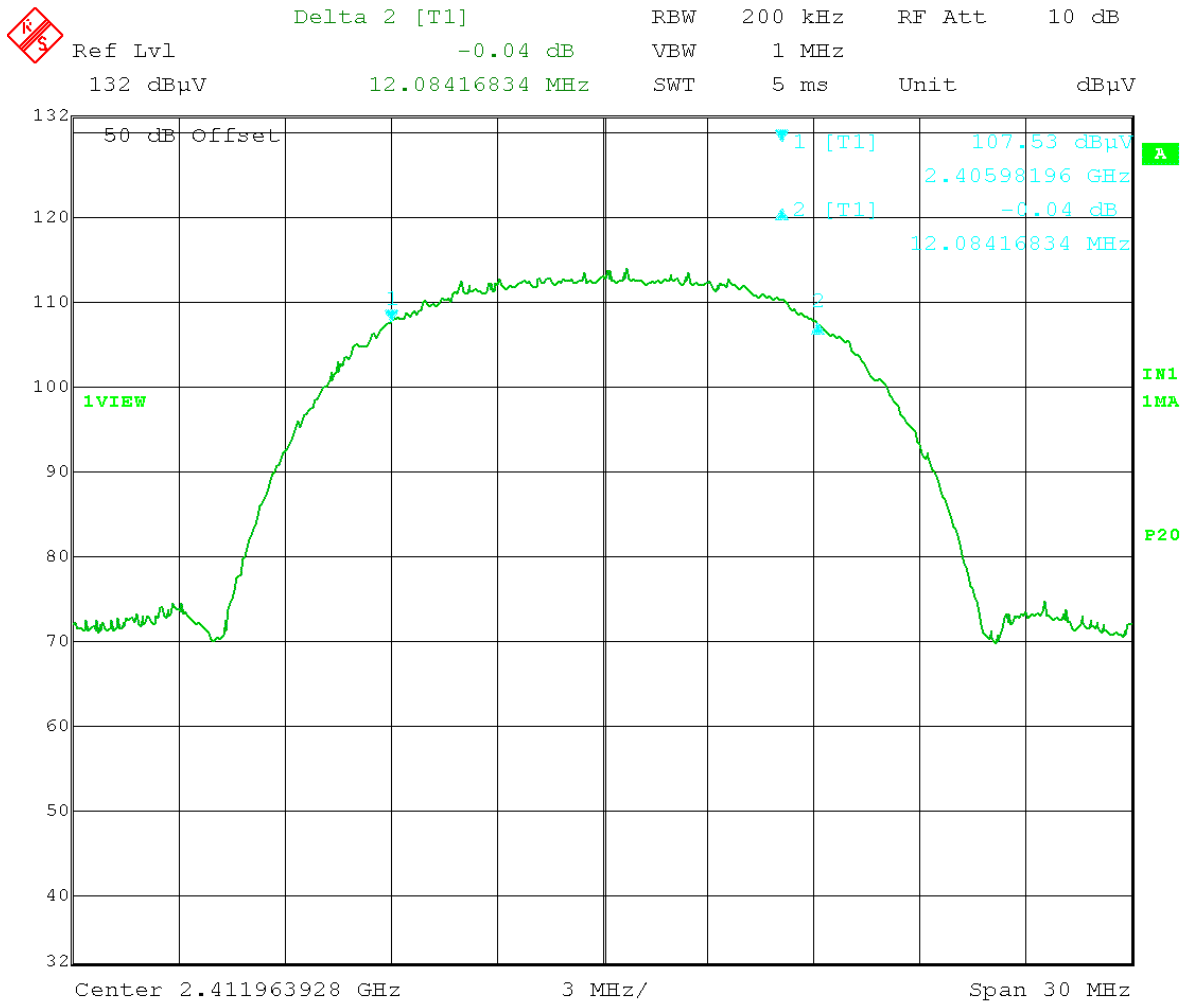
6.0dB BANDWIDTH

Rules Part No.: 15.247(a)(2)

Requirements: The 6.0dB bandwidth must be greater than 500 kHz.

Test Data: See the following plots. 3 places of the band were measured and the worst case presented.

Mode 802.11b:



Date: 17.JUL.2006 15:38:00

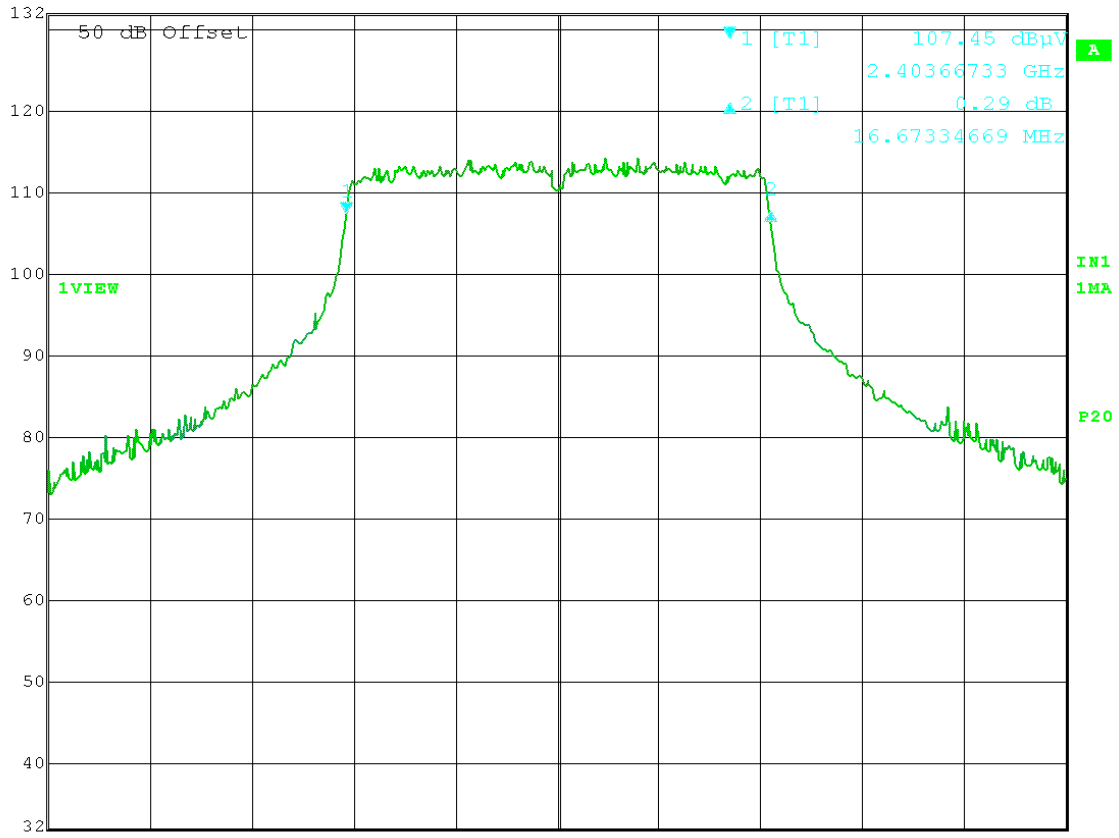


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Mode 802.11g



Ref Lvl	Delta 2 [T1]	RBW	200 kHz	RF Att	10 dB
132 dBμV	0.29 dB	VBW	1 MHz		
	16.67334669 MHz	SWT	5 ms	Unit	dBμV



Center 2.411963928 GHz 4 MHz/ Span 40 MHz

Date: 17.JUL.2006 15:26:28



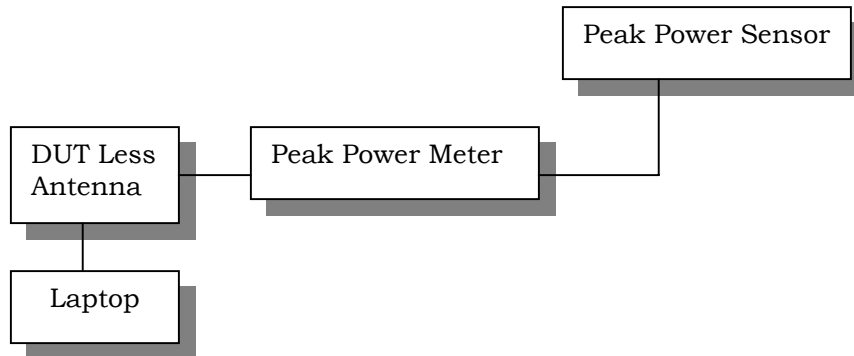
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POWER OUTPUT

Rules Part No.: 15.247(b), 15.247(C)

Requirements: 1.0Watt or +30dBm

Test Method Power Sensor was connected in place of the antenna. Harmonics were checked through the 10th harmonic*



Test Data:

Mode 802.11b

Channel	Frequency (MHz)	Output Power (dBm)
Low	2412.00	12.8
Middle	2437.00	12.2
High	2762.00	13.0

Mode 802.11g

Channel	Frequency (MHz)	Output Power (dBm)
Low	2412.00	18.1
Middle	2437.00	17.8
High	2762.00	18.2



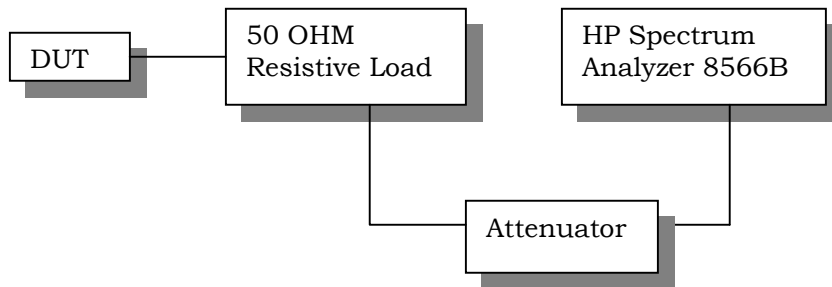
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SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Rules Part No.: Pt 15.247

Requirements Emissions must be at least 20dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW. The spectrum was scanned to the tenth harmonic.

Test Setup:



Test Data:

Mode 802.11b		
Tuned Freq MHz	Emission Freq. MHz	Readings dBuV
2412	2412.00	107.8
	4824.00	57.7
	7236.00	68.9
2437	2437.00	108.1
	4874.00	55.5
	7311.00	69.8
2462	2462.00	109.6
	4924.00	56.7
	7386.00	67.5

Mode 802.11g		
Tuned Freq. MHz	Emission Freq. MHz	Readings dBuV
2412	2412.00	109
	4824.00	60
	7236.00	68.5
2437	2437.00	108.6
	4874.00	61.8
	7311.00	69.1
2462	2462.00	109.3
	4924.00	61.4
	7386.00	64.7



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FIELD STRENGTH OF SPURIOUS EMISSIONS

Rules Part No.: 15.247(c), 15.205, & 15.209(b)

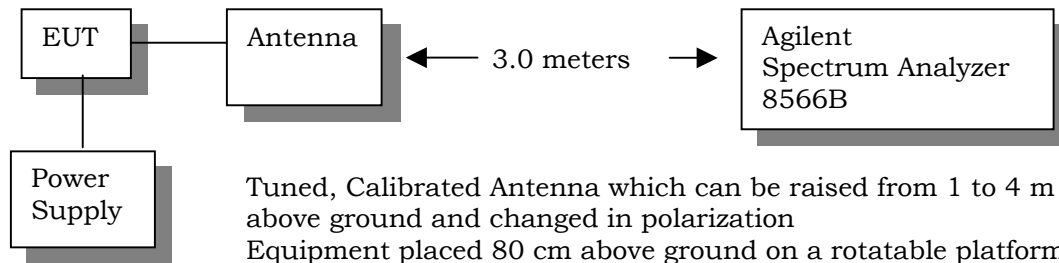
Requirements:

Frequency	Fundamental Limits	Field Strength Limits
902 – 928 MHz	127.37dBuV/m @3M	54 dBuV/m @3M
2.4 GHz	127.37 dBuV/m @3M	54 dBuV/m @3M

Frequency (MHz)	Limits
30 - 88 MHz	40 dBuV/m @3M
88 - 216 MHz	43 dBuV/m @3M
216 – 960 MHz	46 dBuV/m @3M
Above 960 MHz	54 dBuV/m @3M

Emissions that fall in the restricted bands (15.205) must be less than or equal to 500 uV/m (54 dBuV/m). Spurious not in a restricted band must be 20 dBc. Harmonics were checked through the 10th harmonic.

Test Method:



Test Data: Please refer to the following data



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Mode 802.11b								
Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBuV	Ant. Polarity	Coax Loss dB	Correction Factor dB	Field Strength dBuV/m	Margin dB	Notes
2,412.00	2,016.00	13.5	V	2.91	31.24	47.65	48.79	
2,412.00	2,280.00	17.4	V	3.1	31.98	52.48	1.52	
2,412.00	2,292.00	15.5	V	3.1	32.02	50.62	3.38	
2,412.00	2,320.00	17.4	V	3.12	32.1	52.62	1.38	
2,412.00	2,358.00	26	V	3.15	32.2	61.35	12.65	P
2,412.00	2,358.10	15.6	V	3.15	32.2	50.95	3.05	A
2,412.00	2,360.00	18.5	V	3.15	32.21	53.86	0.14	
2,412.00	2,412.00	80.9	V	3.19	32.35	116.44	10.94	
2,442.00	2,262.00	18.8	V	3.08	31.93	53.81	0.19	P
2,442.00	2,280.00	19.4	V	3.1	31.98	54.48	19.52	P
2,442.00	2,280.10	11	V	3.1	31.98	46.08	7.92	A
2,442.00	2,320.00	12.9	V	3.12	32.1	48.12	5.88	A
2,442.00	2,320.00	21.2	V	3.12	32.1	56.42	17.58	P
2,442.00	2,442.00	79.9	V	3.21	32.44	115.55	11.83	
2,462.00	2,280.00	23.7	V	3.1	31.98	58.78	15.22	P
2,462.00	2,280.10	13.6	V	3.1	31.98	48.68	5.32	A
2,462.00	2,320.00	22.4	V	3.12	32.1	57.62	16.38	P
2,462.00	2,320.10	14.5	V	3.12	32.1	49.72	4.28	A
2,462.00	2,462.00	79.4	V	3.22	32.49	115.11	12.27	
2,462.00	2,687.00	17.1	V	3.38	32.82	53.3	0.7	

P – Peak
A – Average
R – Restricted

Note: No emissions were found greater than 20 dB below the limits.



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Mode 802.11g								
Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBuV	Ant. Polarity V/H	Coax Loss dB	Correction Factor dB/m	Field Strength dBuV/m	Margin dB	Notes
2,412.00	2,320.00	15.6	V	3.12	32.1	50.82	3.18	R
2,412.00	2,412.00	74.5	V	3.19	32.35	110.04	17.34	
2,442.00	2,262.00	15.2	V	3.08	31.93	50.21	3.79	R
2,442.00	2,320.00	15.2	V	3.12	32.1	50.42	3.58	R
2,442.00	2,442.00	75.2	V	3.21	32.44	110.85	16.53	
2,462.00	2,320.00	15.3	V	3.12	32.1	50.52	3.48	R
2,462.00	2,462.00	75.0	V	3.22	32.49	110.71	16.67	

P – Peak
A – Average
R – Restricted

Note: No emissions were found greater than 20 dB below the limits.



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RADIATED SPURIOUS EMISSIONS INTO ADJACENT RESTRICTED BAND

Rules Part No.: Pt 15.205

Requirements: The emissions must be less than or equal to 500 uV/m (54 dBuV/m).

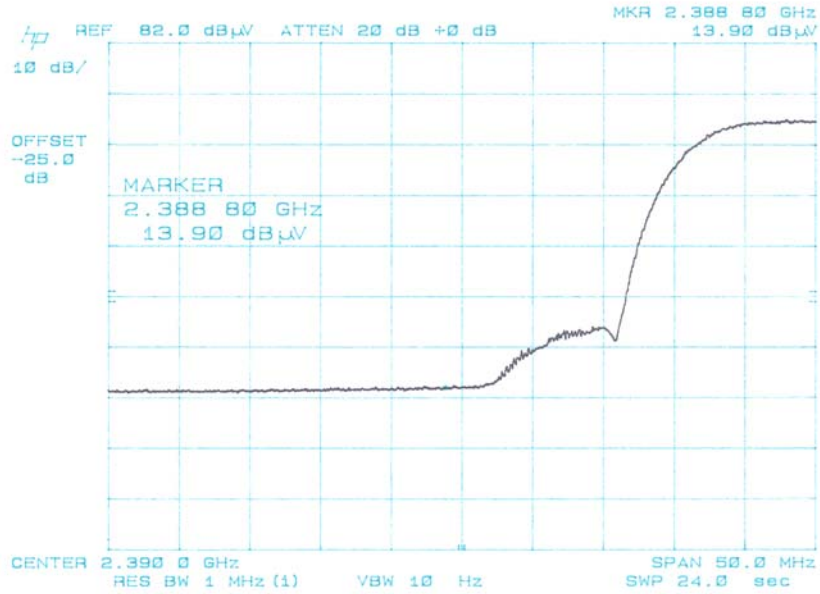
Test Data: Please refer to the following plots. No emissions were found greater than 20 dB below the limits.



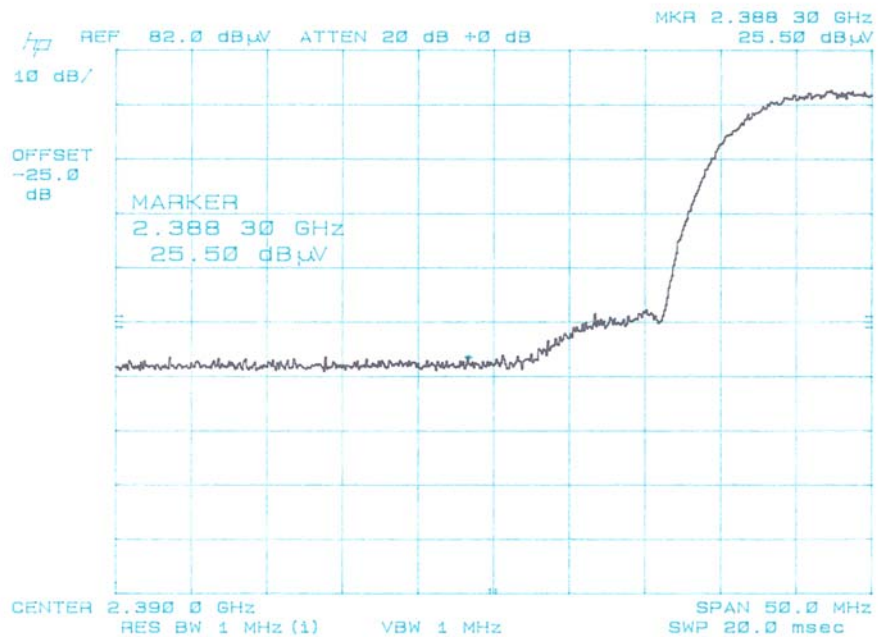
Certificate # 0955-01

Mode 802.11b

Peak F.S.= 60.96 dBuV/m
Average F.S.= 49.36 dBuV/m



Mode 802.11b

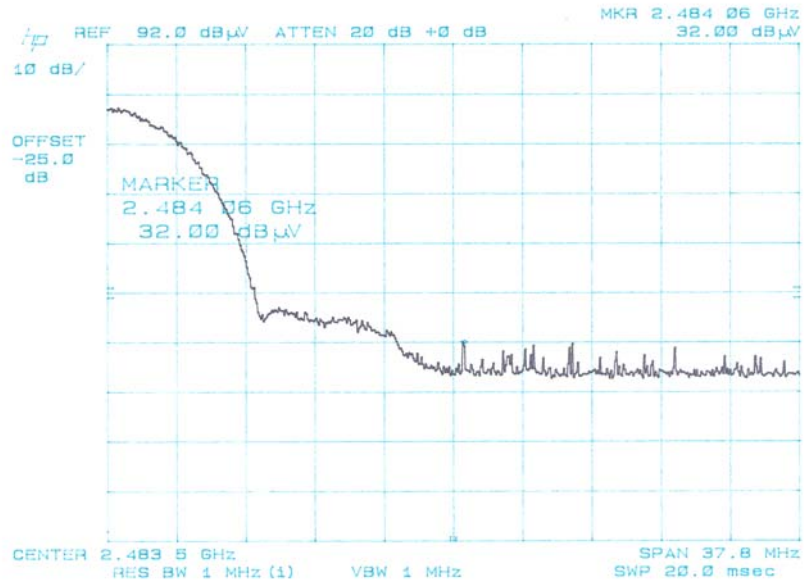




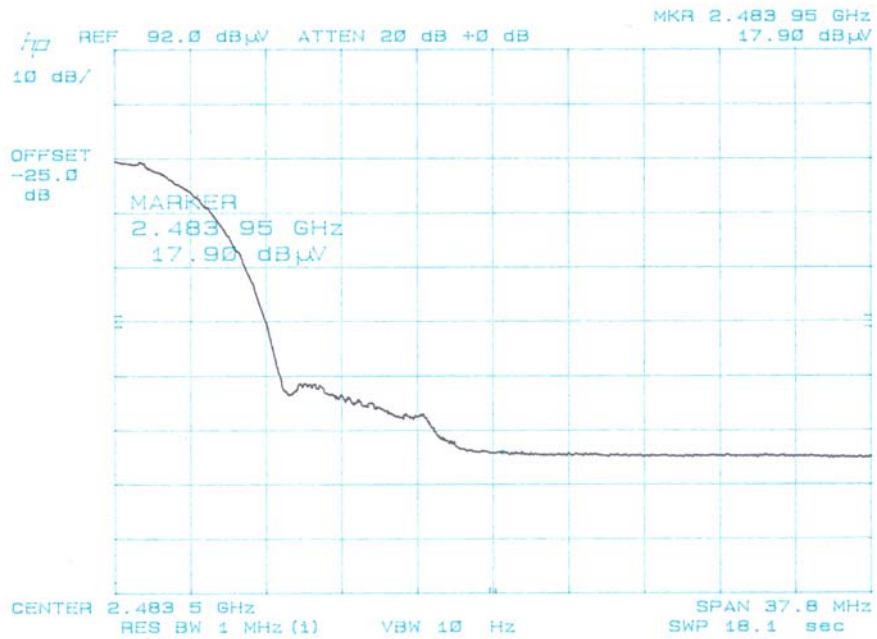
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Mode 802.11b

Peak F.S.=67.79 dBuV/m
Average F.S.=53.69 dBuV/m



Mode 802.11b





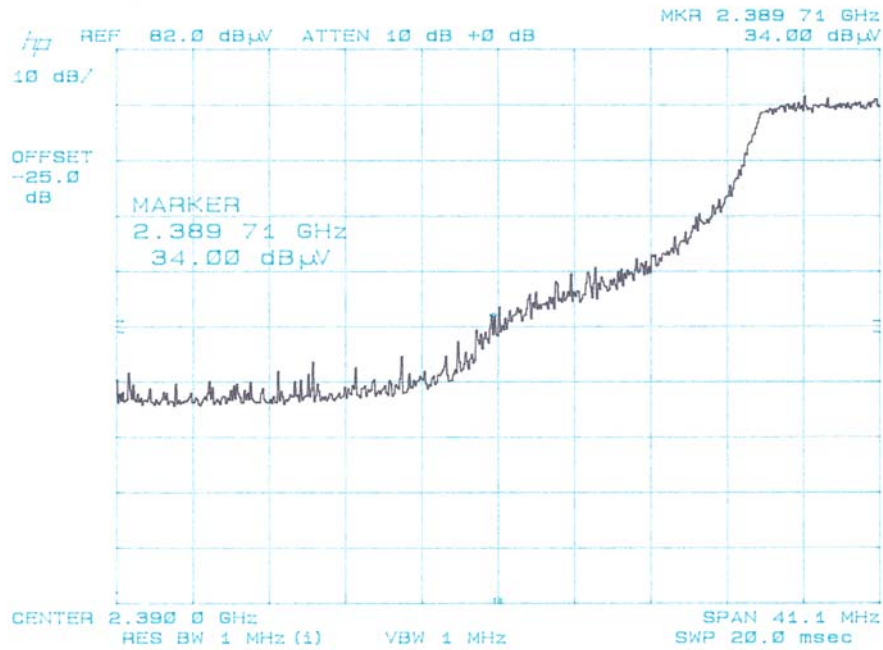
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mode 802.11g

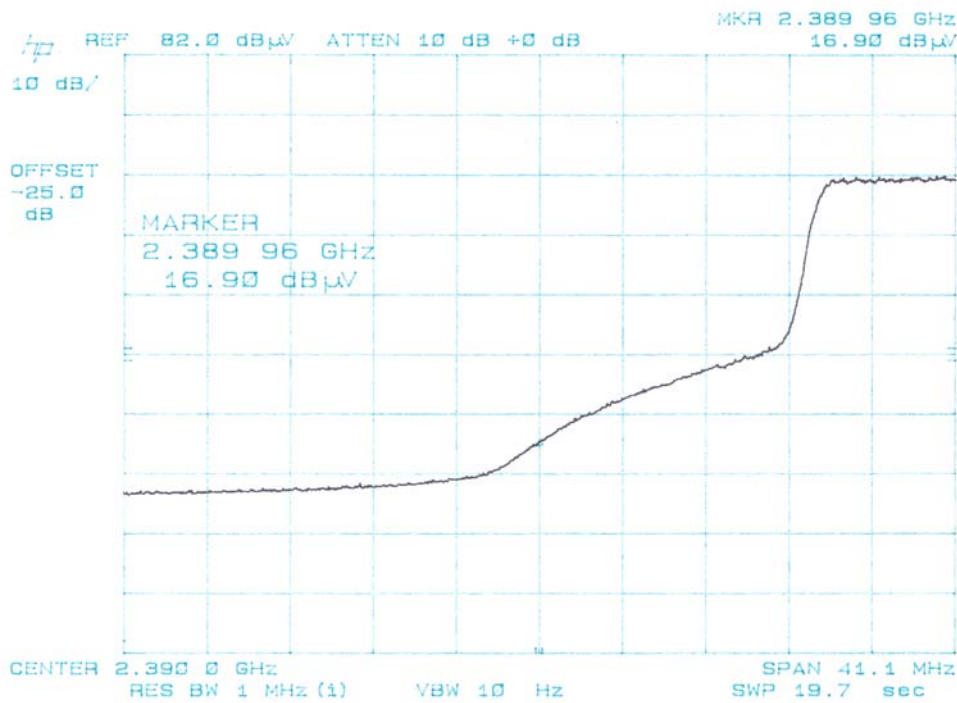
Peak F.S.=69.46 dBuV/m

Average F.S.=52.36 dBuV/m

Peak



mode 802.11g



APPLICANT: ROOT Inc.

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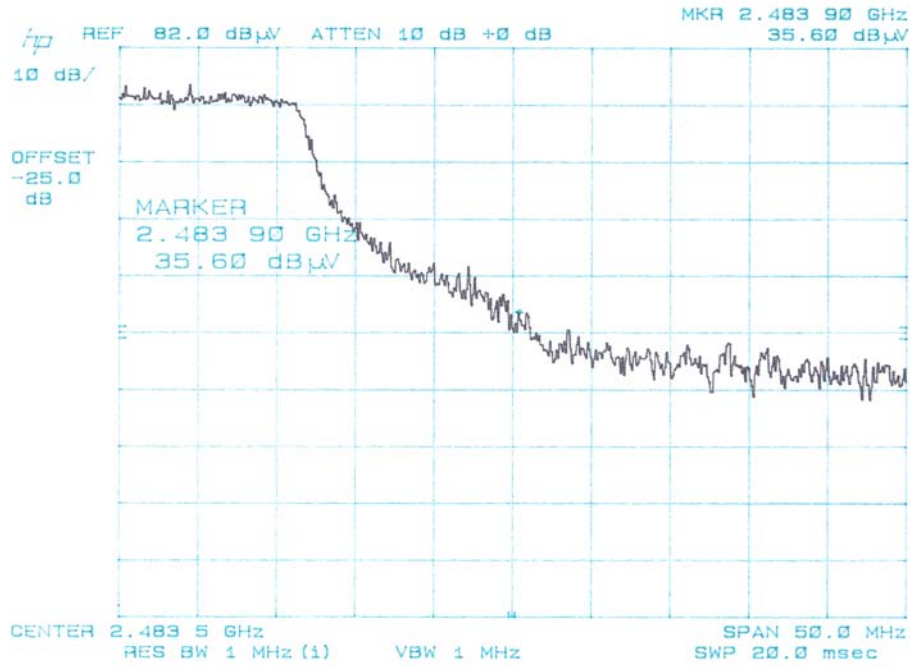
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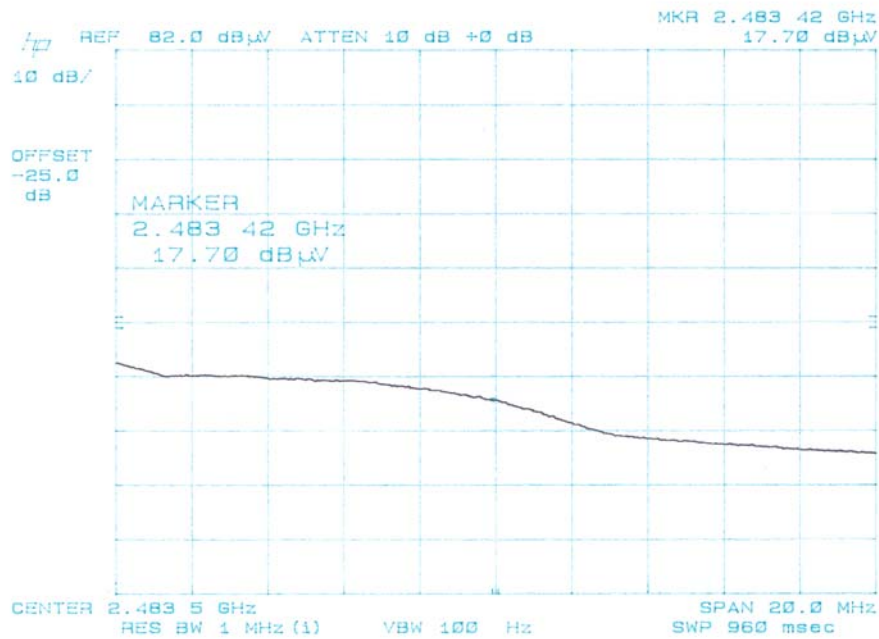
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mode 802.11g

Peak F.S.= 71.39 dBuV/m
Average F.S.= 53.49 dBuV/m



mode 802.11g





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POWER SPECTRAL DENSITY

Rules Part No.: 15.247(d)

Requirements: The peak level measured must be no greater than +8.0dBm.

Test Data: SEE THE FOLLOWING PLOTS

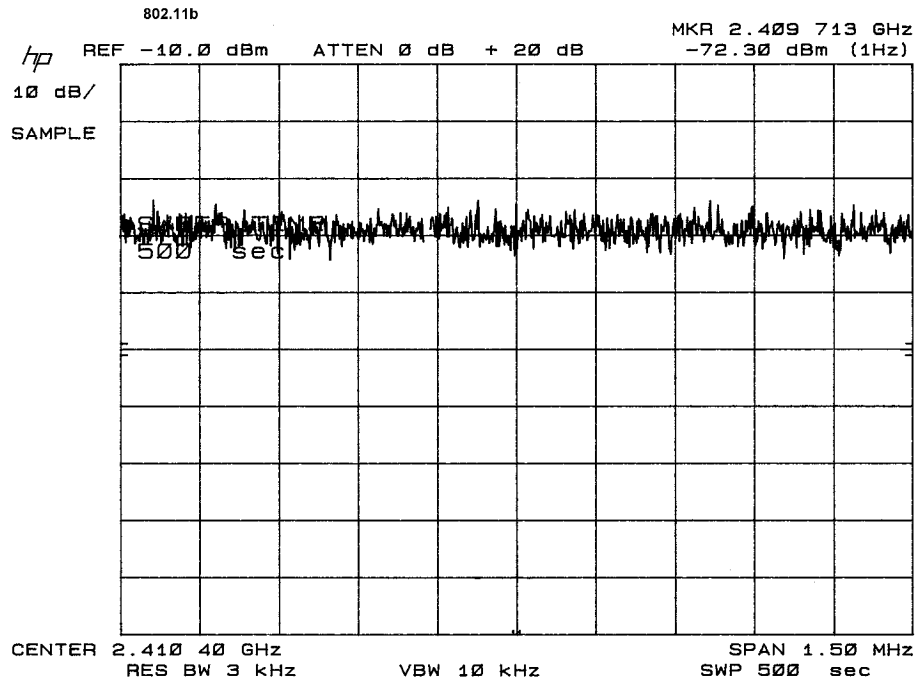
Mode	Plot Frequency (MHz)	Plot Reading (dBm)	Attenuator (dB)	Correction Factor (dB)	Result (dBm)	Limit (dBm)
802.11b	2409.71	-72.3	+20	+ 35	-17.3	8
802.11g	2410.39	-73.1	+20	+ 35	-18.1	8



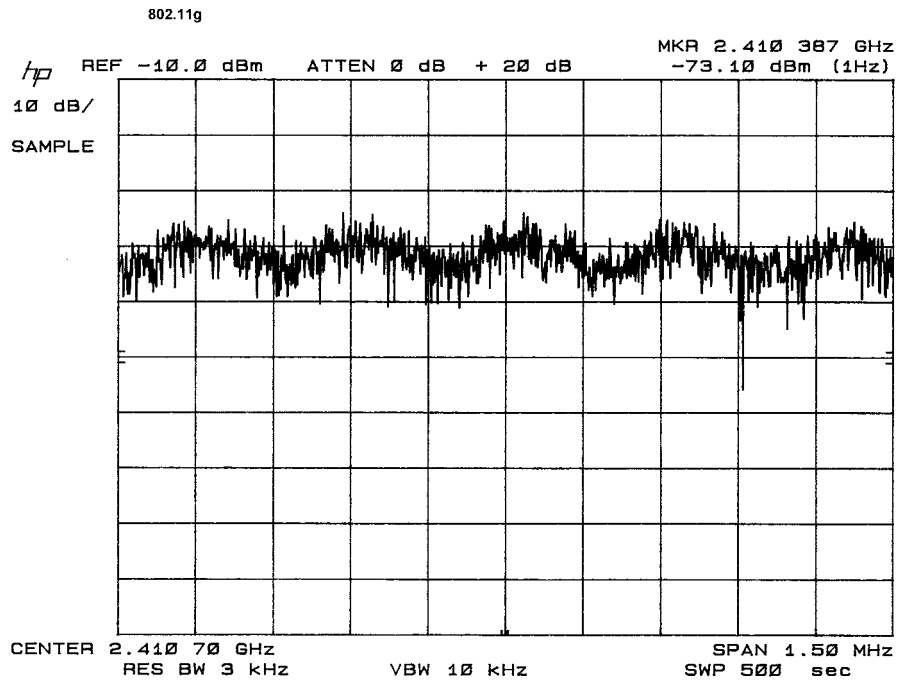
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POWER SPECTRAL DENSITY PLOT

Mode 802.11b



mode 802.11g



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RF EXPOSURE REQUIREMENT

Rules Part No.: 47 CFR §1.1307(b), FCC OST/OET Bulletin Number 65

Requirements: 47 CFR §1.1310

MPE Calculation:

EUT Frequency Band: 2412 - 2462 MHz

EUT Maximum Measured Conducted Power: 18.2 dBm (watt)

EUT Antenna Gain: 26 dBi

Other system losses: 14 dB of coax loss

S=1mW/cm² for all transmitters above 1500 MHz

Po := 66 mWatts dBd := 10 antenna gain f := 1500 Frequency in MHz

G := dBd + 2.15 gain in dBi

Gn := 10^{G/10} gain numeric

S := f / 1500

controlled exposure

300 for controlled

1500 for uncontrolled

Gn = 16.406

S = 1

$$R := \sqrt{\frac{(Po \cdot Gn)}{(4 \cdot \pi \cdot S)}}$$

$$\text{Rinches} := \frac{R}{2.54}$$

R = 9.283 distance in centimeters
required for compliance

Rinches = 3.655