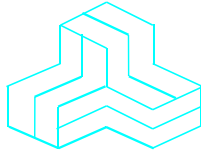


ENGINEERING TEST REPORT



Wireless Radio Printer Interface Model No.: 160612

FCC ID: T89-160612

Applicant:

EPSON Canada Limited
3771 Victoria Park Ave.
Scarborough, ON
Canada M1W 3Z5

In Accordance With

**Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Digital Modulation Systems (DTS)
Operating in 2412-2462 MHz Band**

UltraTech's File No.: EPS-102F15C247

This Test report is Issued under the Authority of
Tri M. Luu, Professional Engineer,
Vice President of Engineering
UltraTech Group of Labs

Date: November 5, 2008



Report Prepared by: Dharmajit Solanki

Tested by: Mr. Hung Trinh, EMI/RFI Technician

Issued Date: November 5, 2008

Test Dates: September 19 to October 20, 2008

*The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.
This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
Tel.: (905) 829-1570 Fax.: (905) 829-8050
Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com



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SL2-IN-E-1119R

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EXHIBIT 1. SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
--	Test Report	<ul style="list-style-type: none">Exhibit 1: Submittal check listsExhibit 2: IntroductionExhibit 3: Performance AssessmentExhibit 4: EUT Operation and Configuration during TestsExhibit 5: Summary of test ResultsExhibit 6: Measurement DataExhibit 7: Measurement Uncertainty	OK
1	Test Setup Photos	<ul style="list-style-type: none">Power Line Conducted Emissions Setup PhotosRadiated Emissions Setup Photos	OK
2	External EUT Photos	External EUT Photos	OK
3	Internal EUT Photos	Internal EUT Photos	OK
4	Cover Letters	<ul style="list-style-type: none">Letter from Ultratech for Certification RequestLetter from the Applicant to appoint Ultratech to act as an agentLetter from the Applicant to request for Confidentiality FilingLetter from the Applicant to request for Modular Approval	OK
5	Attestation Statements	FCC Class B DoC Procedure for Final Product	OK
6	ID Label/Location Info	ID Label and Location of Label	OK
7	Block Diagrams	Block Diagram	OK
8	Schematic Diagrams	Schematics	OK
9	Parts List/Tune Up Info	BOM	OK
10	Operational Description	Operation Description	OK
11	RF Exposure Info	See section 6.11 in this Test Report for details.	OK
12	Users Manual	Installation Manual for the Wireless Radio Printer Interface	OK

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: yic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: EPS-102F15C247
November 5, 2008

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
Purpose of Test:	Equipment Certification for Digital Modulation Systems (DTS) Transmitter Operating in the Frequency Band 2400-2483.5 MHz
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	[x] Commercial, industrial or business environment [] Residential environment

2.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

2.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2007	Code of Federal Regulations – Telecommunication
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CISPR 22 & EN 55022	2006 2006	Information Technology Equipment - Radio Disturbance Characteristics – Limits and Methods of Measurement
CISPR 16-1-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-2-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-1: Conducted disturbance measurement
KDB Publication No. 558074	2005	Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)
KDB Publication No. 447498	2008	Mobile and Portable Device RF Exposure Procedure and Equipment Authorization Policies
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval

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3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	EPSON Canada Limited.
Address:	3771 Victoria Park Ave. Scarborough, ON Canada M1W 3Z5
Contact Person:	Mr. Christopher Wu Phone #: 905-339-0366 Fax #: 905-339-1776 Email Address: Christopher_wu@ea.epson.com

MANUFACTURER	
Name:	EPSON Canada Limited.
Address:	3771 Victoria Park Ave. Scarborough, ON Canada M1W 3Z5
Contact Person:	Mr. Christopher Wu Phone #: 905-339-0366 Fax #: 905-339-1776 Email Address: Christopher_wu@ea.epson.com

3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	EPSON Canada
Product Name:	Wireless Radio Printer Interface
Model Name or Number:	160612
Serial Number:	Test Sample
Type of Equipment:	Wi-Fi Transceiver
Input Power Supply Type:	3.3V DC derived from the Printer
Primary User Functions of EUT:	Wi-Fi Interface for Handheld Printer

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3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
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3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Portable
Intended Operating Environment:	Commercial, industrial or business
Power Supply Requirement:	3.3 VDC
RF Output Power Rating:	802.11b: 2.93 dBm peak conducted 802.11g: 7.42 dBm peak conducted
Operating Frequency Range:	2412-2462 MHz
Channel Spacing:	5 MHz for 802.11b 20 MHz for 802.11g
Duty Cycle:	100%
6 dB bandwidth:	802.11b : 10.38 MHz 802.11g : 16.59 MHz
Modulation Type:	DSSS, OFDM
Antenna Description:	Manufacturer: Taiyo Yuden Type: Integral PCB Antenna Wi-Fi Model No.: AH104F245001-T Freq. Range: 2.412 – 2.462 GHz Gain: 2dBi

3.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Serial Port	1	20 position Flat Flex cable connector	Non-shielded

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3.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Portable Printer
Brand name:	EPSON
Model Name or Number:	P60
Serial Number:	G48G000270
Connected to EUT's Port:	Module serial port

Ancillary Equipment # 2	
Description:	AC/DC Power Adapter
Brand name:	EPSON
Model Name or Number:	PS-10
Serial Number:	FYYZA00902
Connected to EUT's Port:	DC jack of printer

Ancillary Equipment # 3	
Description:	Wireless Router
Brand name:	LinkSys
Model Name or Number:	WAP54GX
Serial Number:	MJD005C04239
Connected to EUT's Port:	N/A

EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

4.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	3.3 VDC via Printer using external AC/DC adapter

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	Each of lowest, middle and highest channel frequencies transmits continuously for emissions measurements.
Special Test Software:	Special software and hardware by the Applicant to operate the EUT at each channel frequency continuously. For example, the transmitter will be operated at each of the lowest, middle and highest frequencies individually continuously during testing.
Special Hardware Used:	The RF Module was tested outside of the enclosure using Flat Flex cable connected to Epson printer.
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integrated PCB antenna.

Transmitter Test Signals	
Frequency Band(s):	2412-2462 MHz
RF Power Output:	802.11b: 2.93 dBm peak conducted 802.11g: 7.42 dBm peak conducted
Normal Test Modulation:	DSSS, OFDM
Modulating Signal Source:	Internal

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EXHIBIT 5. SUMMARY OF TEST RESULTS

5.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada Site No.: 2049A-3, Expiry Date: May 17, 2009).

5.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirements	Yes*
15.207(a)	Power Line Conducted Emissions	Yes
15.247(a)(2)	6 dB Bandwidth	Yes
15.247(b)(3)	Peak Conducted Output Power - DTS	Yes
15.247(d)	Band-Edge and RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
15.247(d), 15.209 & 15.205	Transmitter Spurious Radiated Emissions	Yes
15.247(e)	Power Spectral Density	Yes
15.247(b)(5), (e)(i) 1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure	Yes
Wireless Radio Printer Interface, Model No.: 160612, by EPSON Canada Limited has also been tested and found to comply with FCC Part 15, Subpart B - Class B Digital Devices . The engineering test report has been documented and kept on file and it is available upon request.		

* The Module has integral antenna permanently mounted on the PCB.

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

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EXHIBIT 6. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in ANSI C63.4; FCC KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems.

6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

6.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4 and CISPR 16-1-1.

6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

To provide data communication link to printer using Wi-Fi 802.11 b/g.

6.5. POWER LINE CONDUCTED EMISSIONS [§15.207(a)]

6.5.1. Limit(s)

The equipment shall meet the limits of the following table:

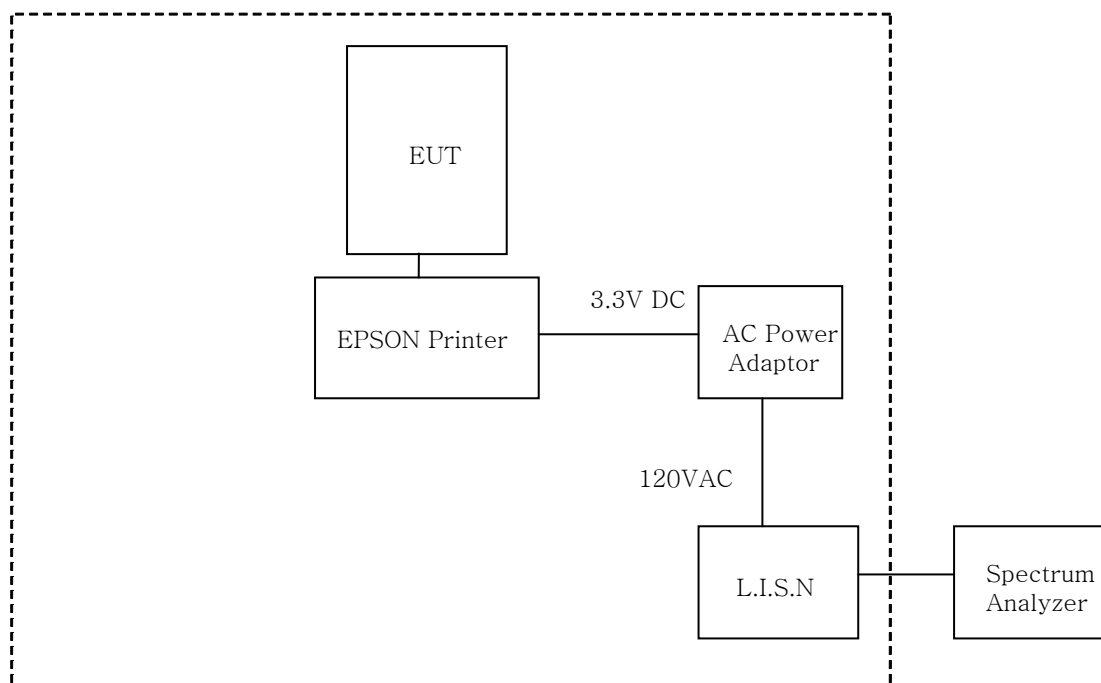
Frequency of emission (MHz)	Conducted Limits (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases linearly with the logarithm of the frequency

6.5.2. Method of Measurements

ANSI C63.4.

6.5.3. Test Arrangement



6.5.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Transient Limiter	Hewlett Packard	11947A	310701998	9 kHz – 200 MHz 10 dB attenuation
L.I.S.N.	EMCO	3825/2	89071531	9 kHz – 200 MHz 50 Ohms / 50 μ H
24'(L) x 16'(W) x 8'(H) RF Shielded Chamber	Braden Shielding

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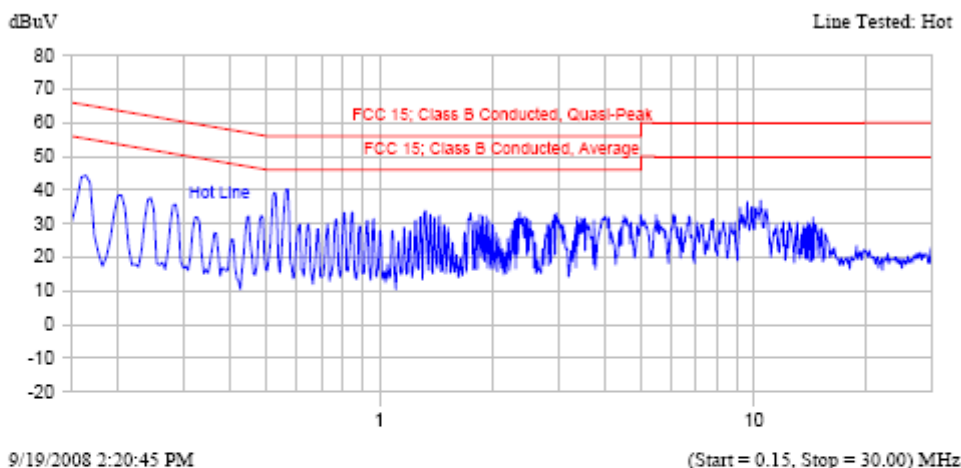
File #: EPS-102F15C247
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6.5.5. Test Data

Plot 6.5.5.1(i) Power Line Conducted Emissions
Line Voltage: 120 VAC 60 Hz; Line Tested: Hot

Current Graph

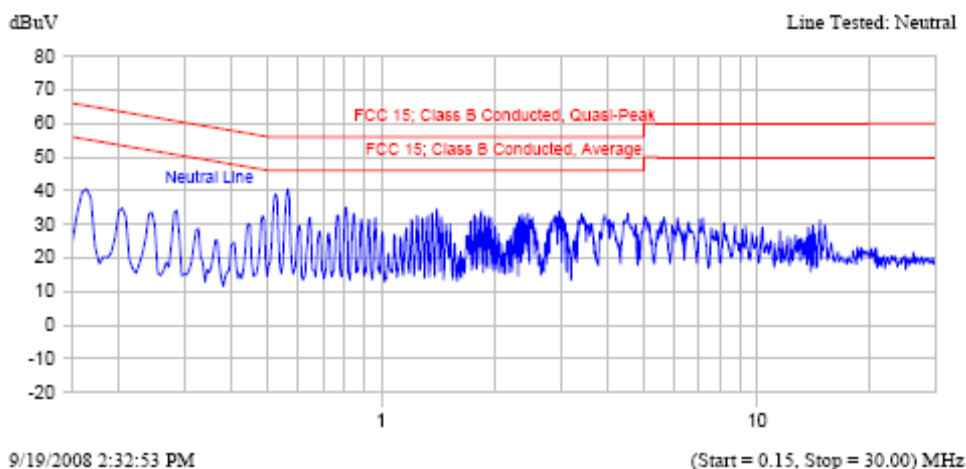


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.161	44.7	44.1	-21.6	39.3	-16.3	Hot Line
0.200	40.1	38.9	-25.7	33.4	-21.1	Hot Line
0.241	37.8	36.4	-26.9	31.4	-22.0	Hot Line
0.281	37.0	35.8	-26.4	31.7	-20.5	Hot Line
0.528	40.3	37.1	-18.9	27.5	-18.5	Hot Line
0.561	40.5	39.5	-16.5	38.0	-8.0	Hot Line
1.320	33.4	31.4	-24.6	28.2	-17.8	Hot Line
9.603	25.2	20.1	-39.9	8.4	-41.6	Hot Line
10.409	28.4	22.9	-37.1	13.6	-36.4	Hot Line

Plot 6.5.5.1(ii) Power Line Conducted Emissions
Line Voltage: 120 VAC 60 Hz; Line Tested: Neutral

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.160	41.6	40.6	-25.1	36.5	-19.2	Neutral Line
0.200	37.4	36.0	-28.5	29.7	-24.8	Neutral Line
0.243	33.8	31.9	-31.4	25.4	-27.9	Neutral Line
0.280	33.8	32.6	-29.6	28.1	-24.1	Neutral Line
0.526	39.6	36.9	-19.1	32.2	-13.8	Neutral Line
0.561	40.7	39.8	-16.2	38.5	-7.5	Neutral Line
0.802	35.1	34.0	-22.0	32.2	-13.8	Neutral Line
1.404	34.0	32.8	-23.2	30.5	-15.5	Neutral Line

6.6. OCCUPIED BANDWIDTH [§ 15.247(a)(2)]

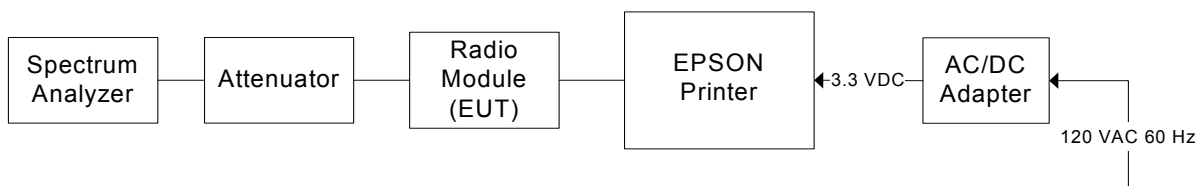
6.6.1. Limit(s)

For a Digital Modulation System, the minimum 6 dB bandwidth shall be at least 500 kHz.

6.6.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

6.6.3. Test Arrangement



6.6.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK30	100077	20 Hz - 40 GHz
Attenuator	Narda	4768-20	--	DC - 40 GHz

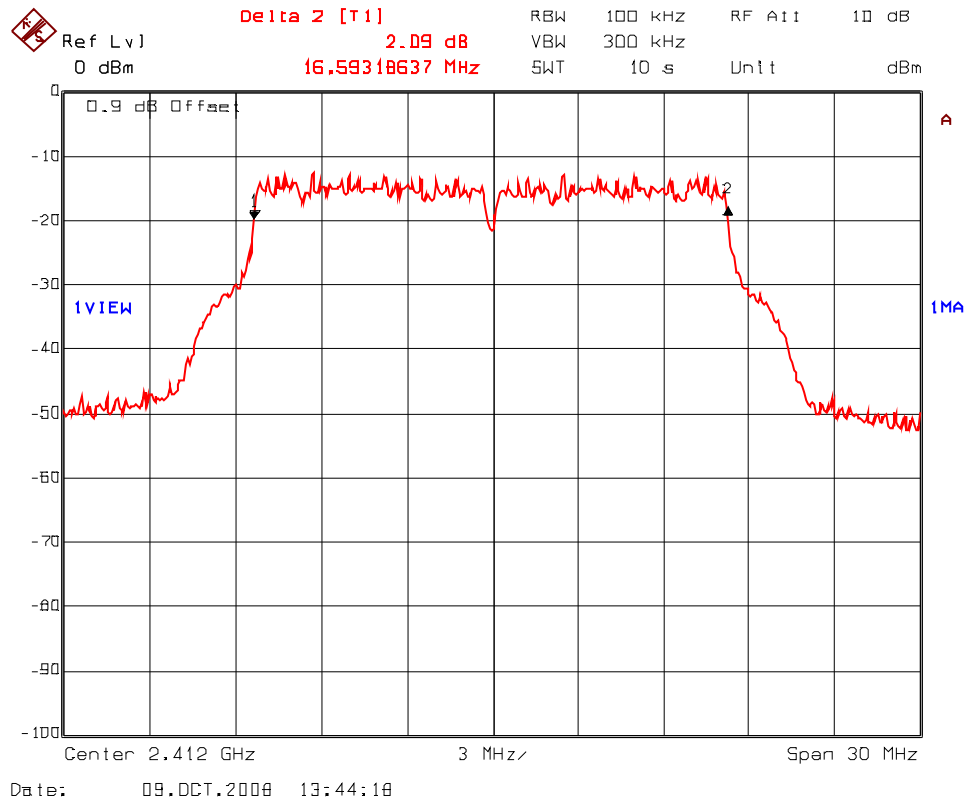
6.6.5. Test Data

6 dB Bandwidth (MHz):

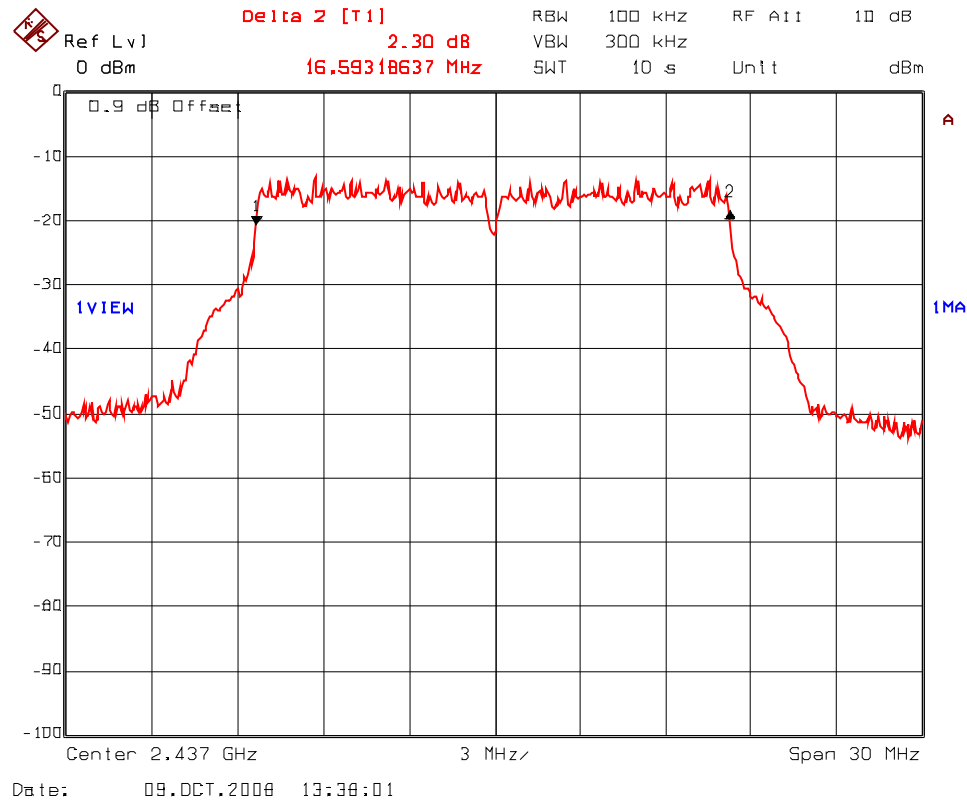
Frequency (MHz)	For OFDM Mode (802.11g, 54 Mbps data rate)	For DSSS Mode (802.11b, 11 Mbps data rate)
2412	16.59	10.34
2437	16.59	10.30
2462	16.59	10.38

See the following plots for detailed measurements.

Plot 6.6.5.1 6 dB Bandwidth
Frequency: 2412 MHz; Modulation: 64-QAM at 54 Mbps



Plot 6.6.5.2 6 dB Bandwidth
Frequency: 2437 MHz; Modulation: 64-QAM at 54 Mbps



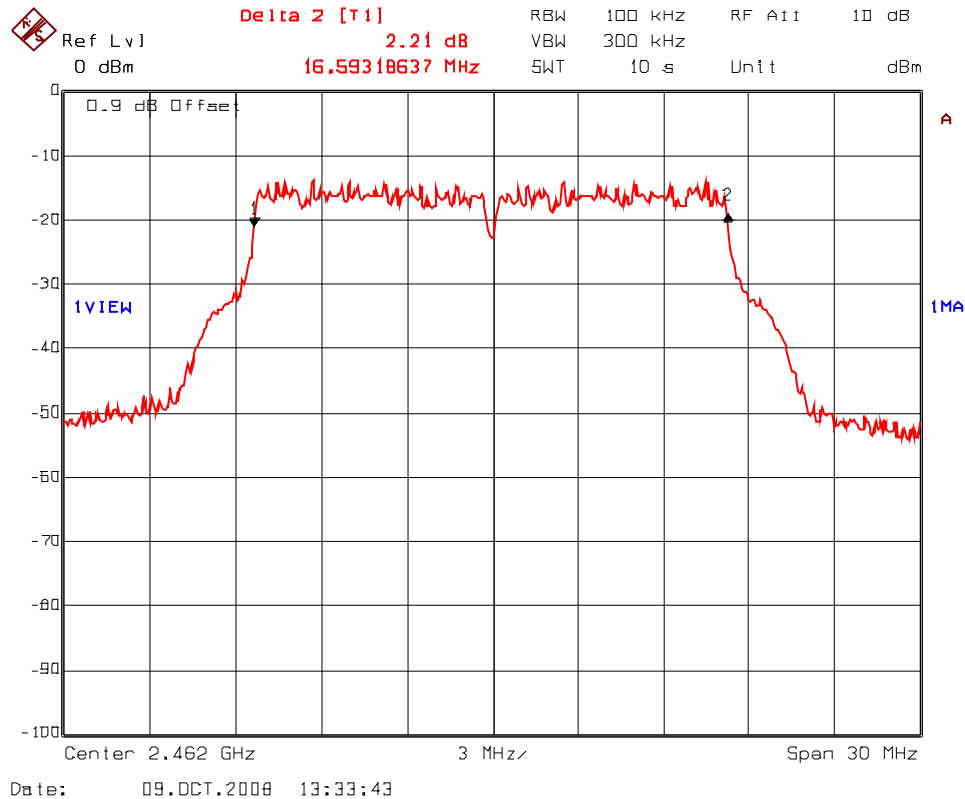
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Plot 6.6.5.3 6 dB Bandwidth
Frequency: 2462 MHz; Modulation: 64-QAM at 54 Mbps



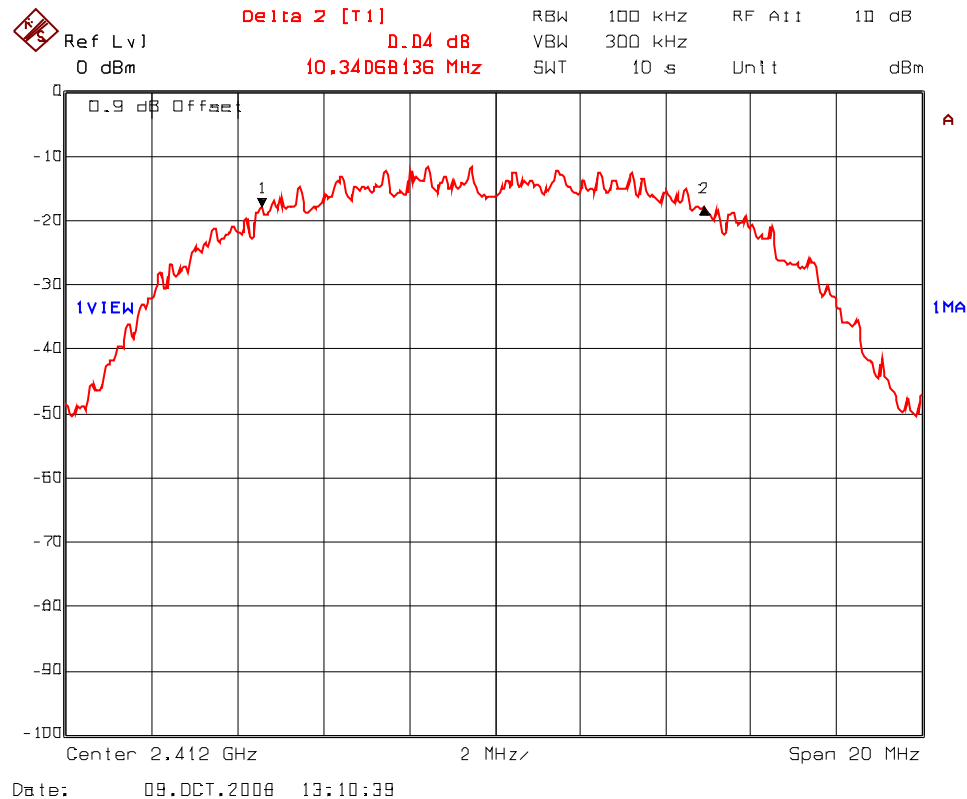
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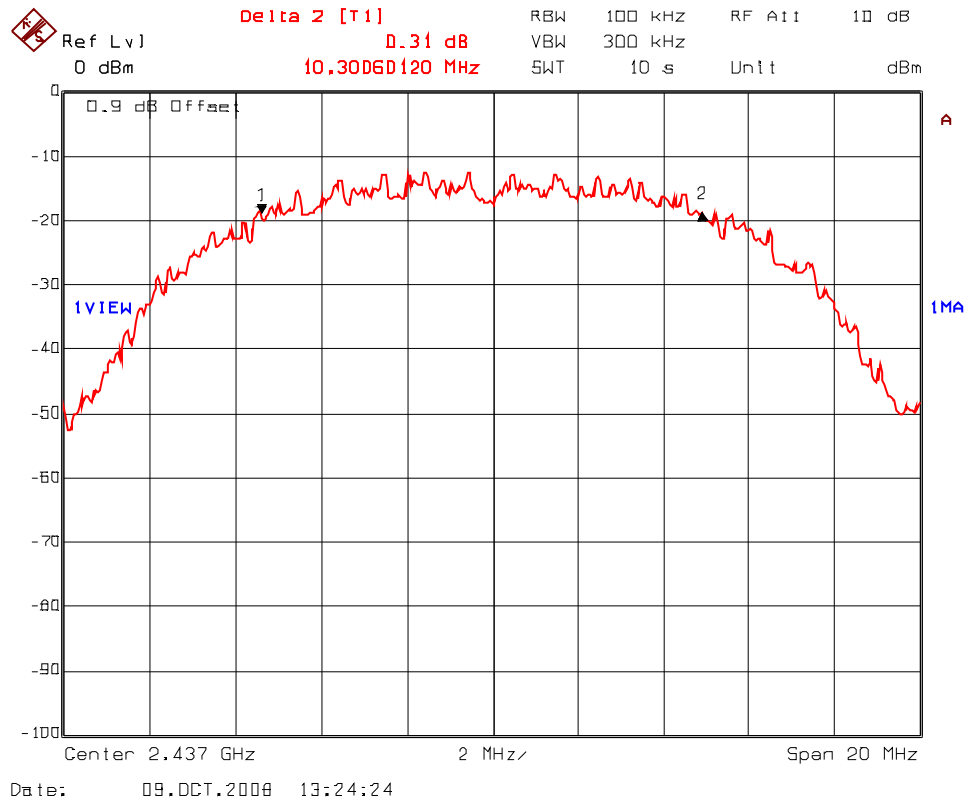
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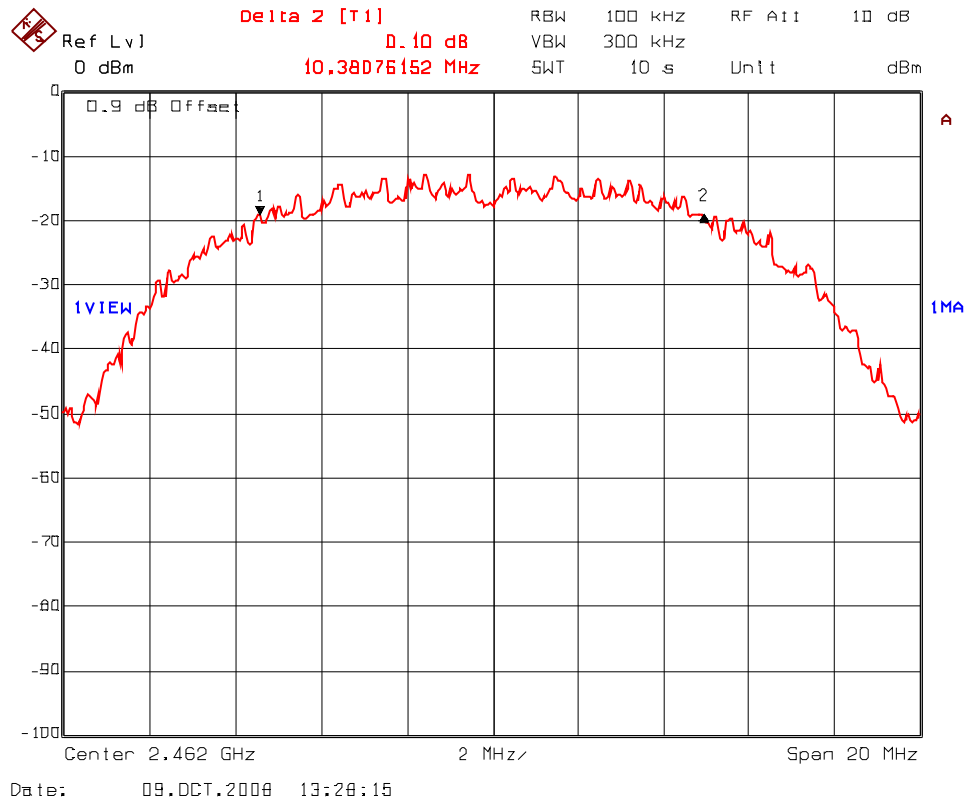
Plot 6.6.5.4 6 dB Bandwidth
Frequency: 2412 MHz; Modulation: CCK 11 Mbps



Plot 6.6.5.5 6 dB Bandwidth
Frequency: 2437 MHz; Modulation: CCK 11 Mbps



Plot 6.6.5.6 6 dB Bandwidth
Frequency: 2462 MHz; Modulation: CCK 11 Mbps



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6.7. PEAK CONDUCTED OUTPUT POWER - DTS [§ 15.247(b)(3)]

6.7.1. Limit(s)

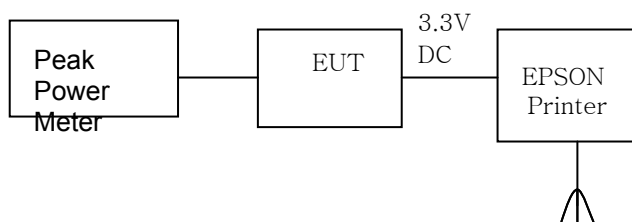
§ 15.247(b)(3):

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.

6.7.2. Method of Measurements & Test Arrangement

Refer to FCC KDB Publication No. 558074, Power Option method 1 and ANSI C63.4 for measurement methods.

6.7.3. Test Arrangement



6.7.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK30	100077	20 Hz - 40 GHz
Attenuator	Narda	4768-20	--	DC - 40 GHz
Peak Power Meter	Hewlett Packard	8900D	2131A01044	0.1 - 18 GHz
Power Sensor	Hewlett Packard	84811A	2551A01484	0.1 - 18 GHz

6.7.5. Test Data

Remarks: Test method: Power Output Option 1, peak measurement

6.7.5.1. 802.11b mode

Data Rate (Mbps)	Peak Power Conducted (dBm)		
	2412 MHz (CH1)	2437 MHz (CH6)	2462 MHz (CH11)
1 (DBPSK)	2.93	2.35	1.68
2 (DQPSK)	2.93	2.35	1.68
11 (CCK)	2.93	2.35	1.68

6.7.5.2. 802.11g mode

Data Rate (Mbps)	Peak Power Conducted (dBm)		
	2412 MHz (CH1)	2437 MHz (CH6)	2462 MHz (CH11)
9 (BPSK)	7.32	6.91	6.45
18 (QPSK)	7.02	6.57	6.08
36 (16-QAM)	7.42	7.02	6.57
54 (64-QAM)	7.22	6.80	6.33

6.8. TRANSMITTER BAND-EDGE & SPURIOUS CONDUCTED EMISSIONS [§ 15.247(d)]

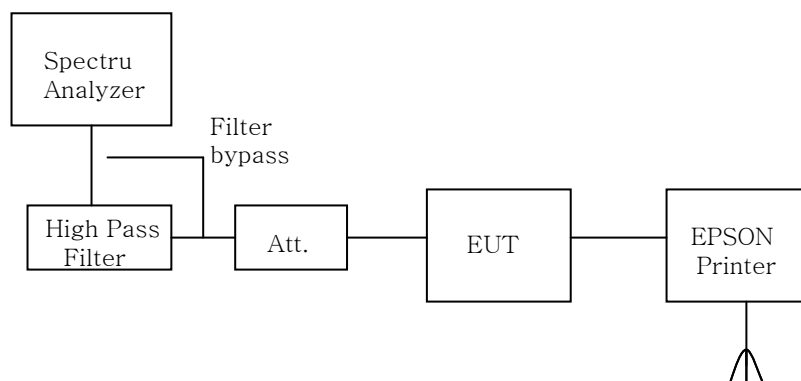
6.8.1. Limit(s)

§ 15.247 (d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

6.8.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

6.8.3. Test Arrangement



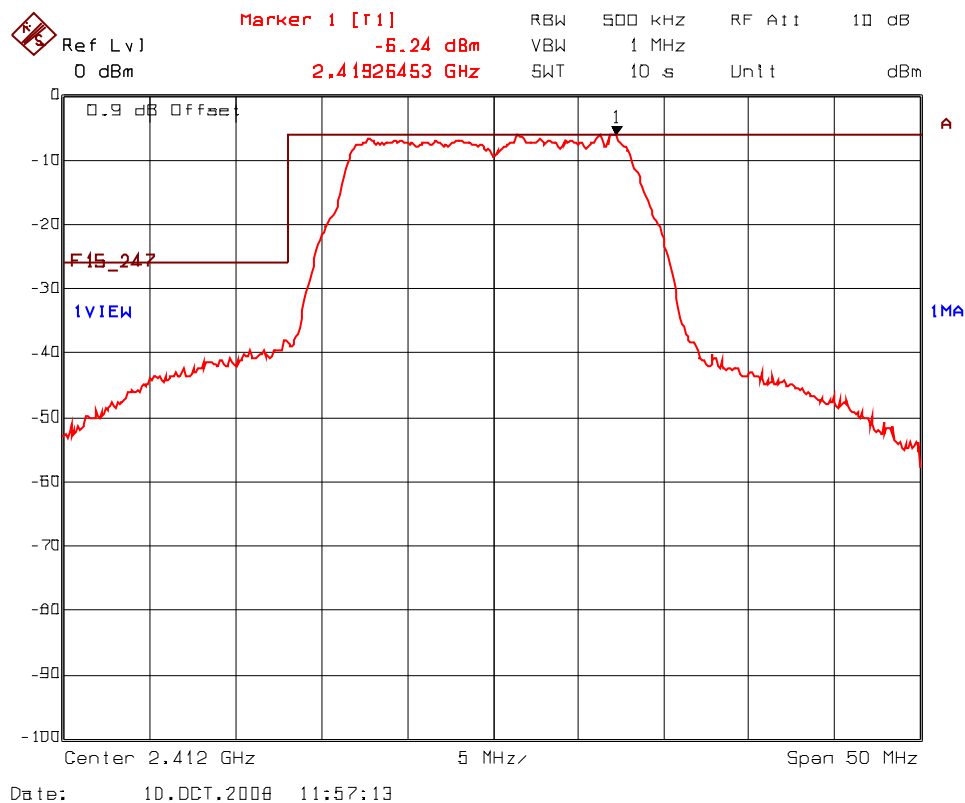
6.8.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK30	100077	20 Hz - 40 GHz
Attenuator	Narda	4768-20	--	DC - 40 GHz
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 3.4 GHz

6.8.5. Test Data

6.8.5.1. Band-Edge RF Conducted Emissions

Plot 6.8.5.1.1 Band-Edge RF Conducted Emissions, 802.11g Mode
Low End of Frequency Band 2412 -2462 MHz



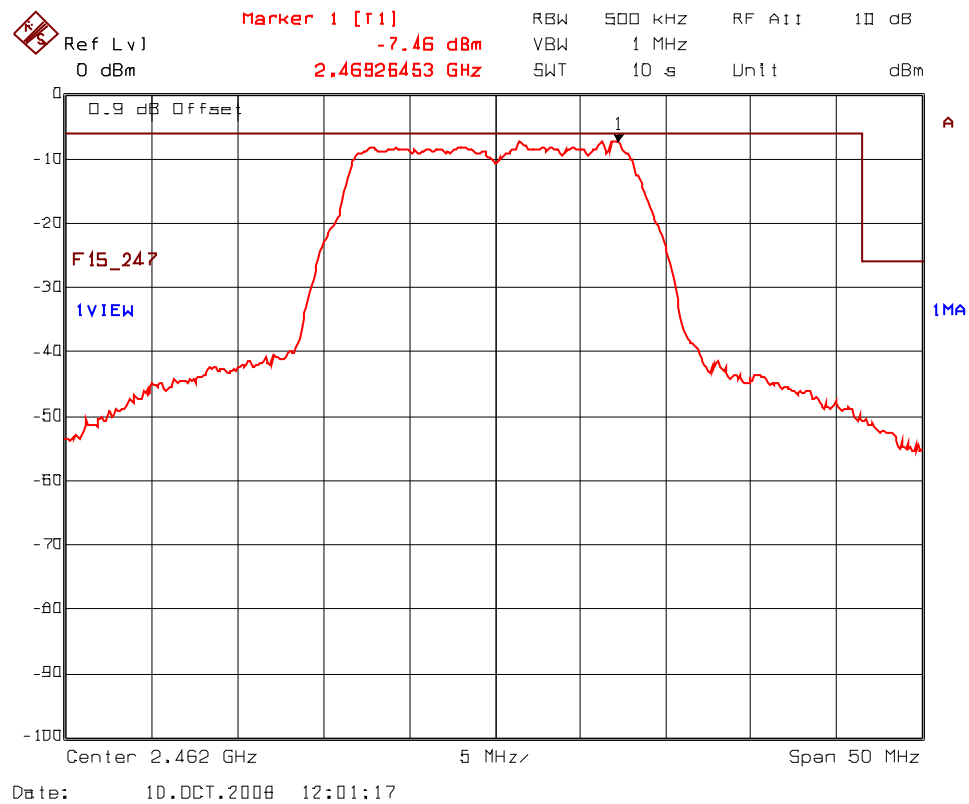
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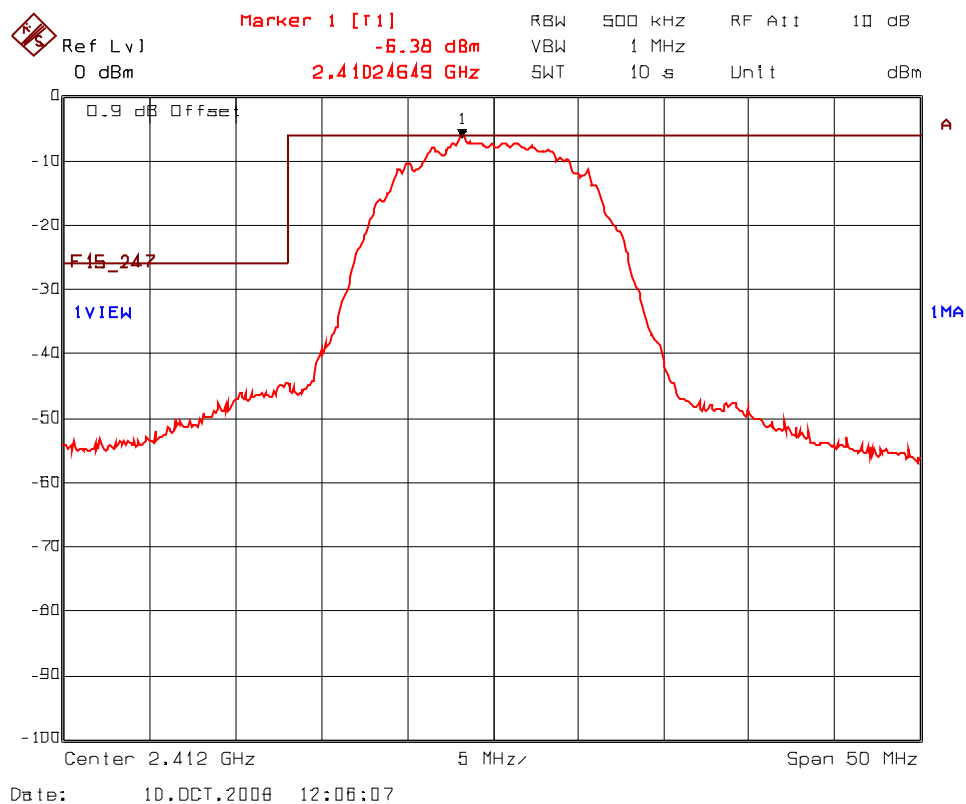
File #: EPS-102F15C247
November 5, 2008

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Plot 6.8.5.1.2 Band-Edge RF Conducted Emissions, 802.11g Mode
High End of Frequency Band 2412 -2462 MHz



Plot 6.8.5.1.3 Band-Edge RF Conducted Emissions, 802.11b Mode
Low End of Frequency Band 2412 -2462 MHz



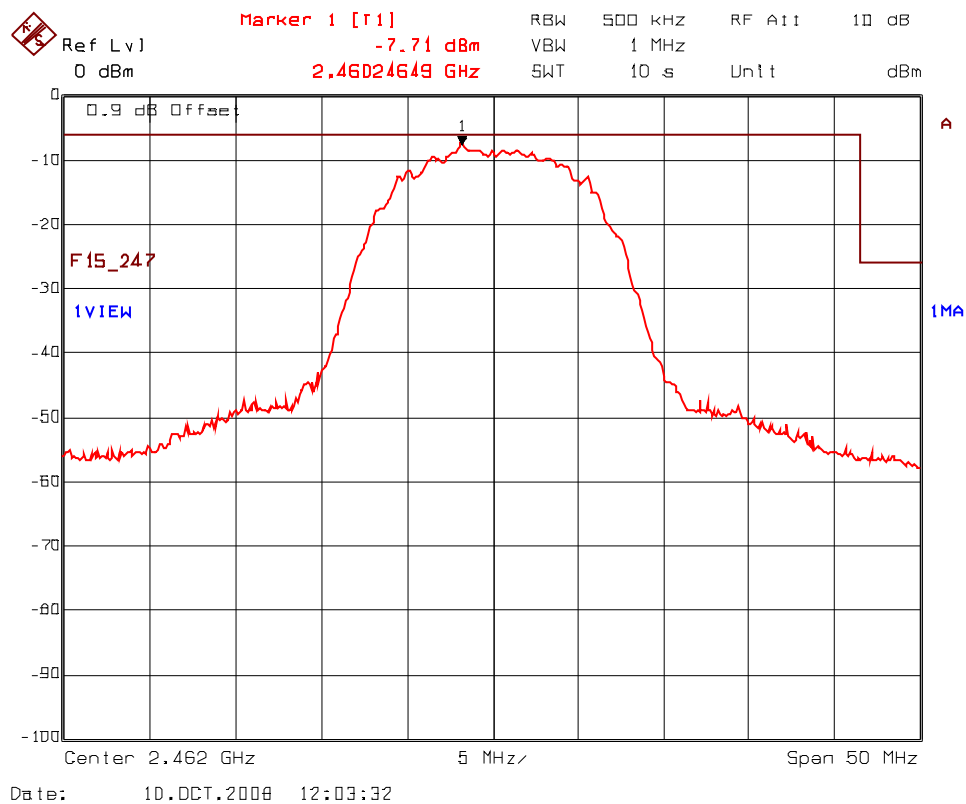
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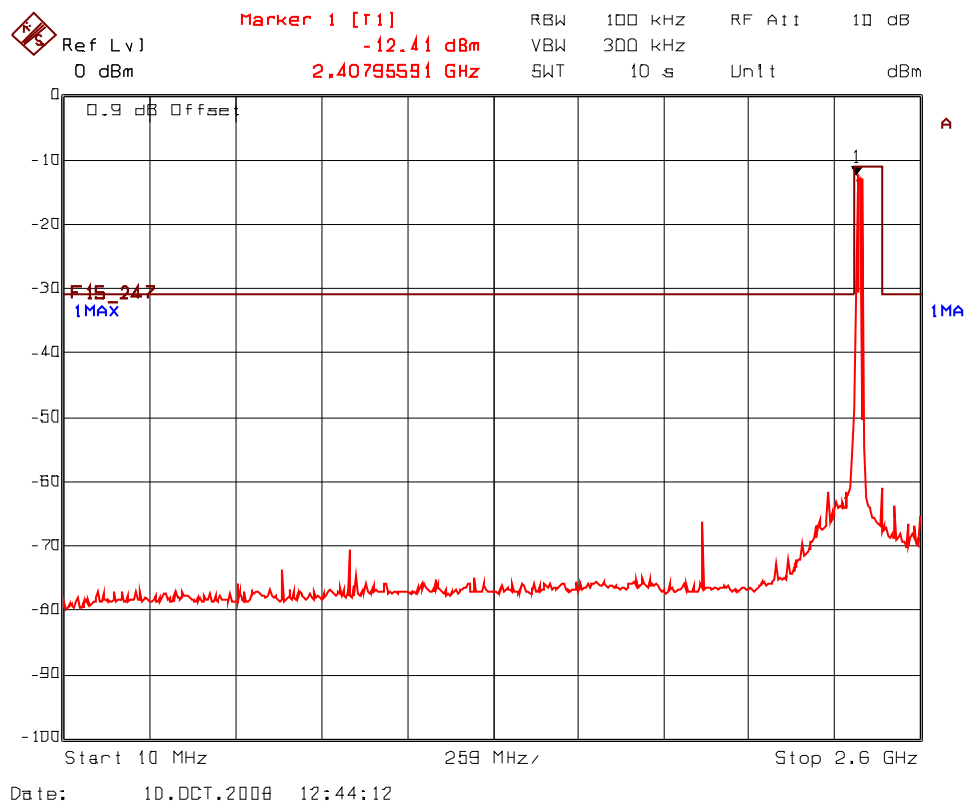
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Plot 6.8.5.1.4 Band-Edge RF Conducted Emissions, 802.11b Mode
High End of Frequency Band 2412 -2462 MHz



6.8.5.2. Spurious RF Conducted Emissions

Plot 6.8.5.2.1(i) Spurious RF Conducted Emissions, 802.11g Mode
Transmitter Frequency: 2412 MHz



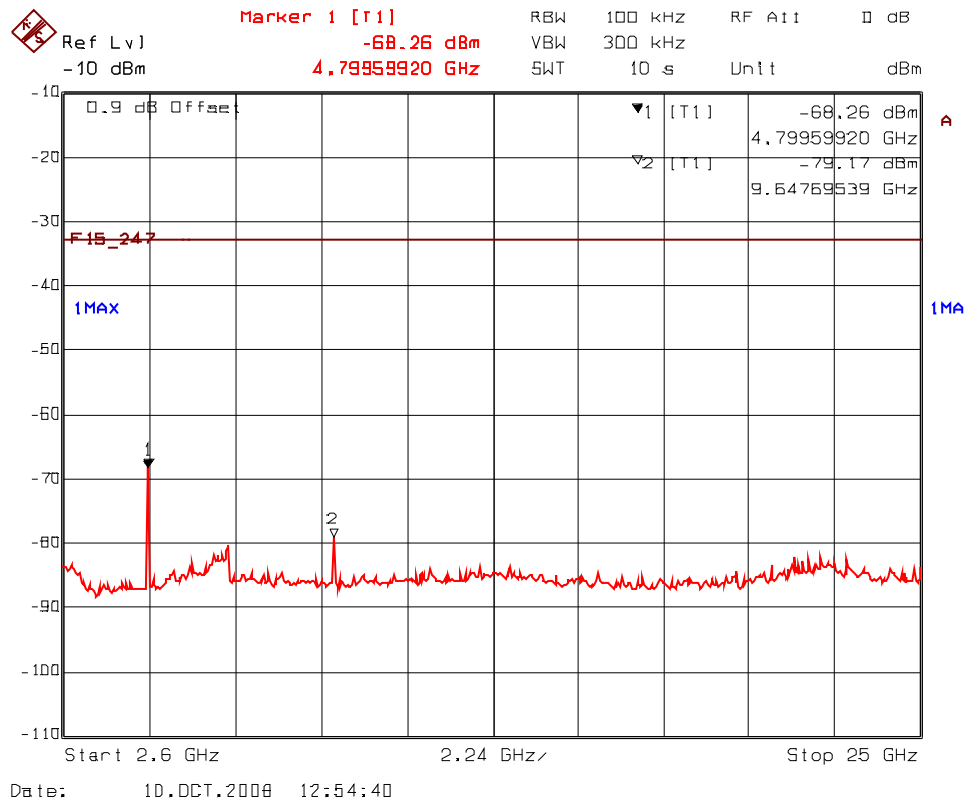
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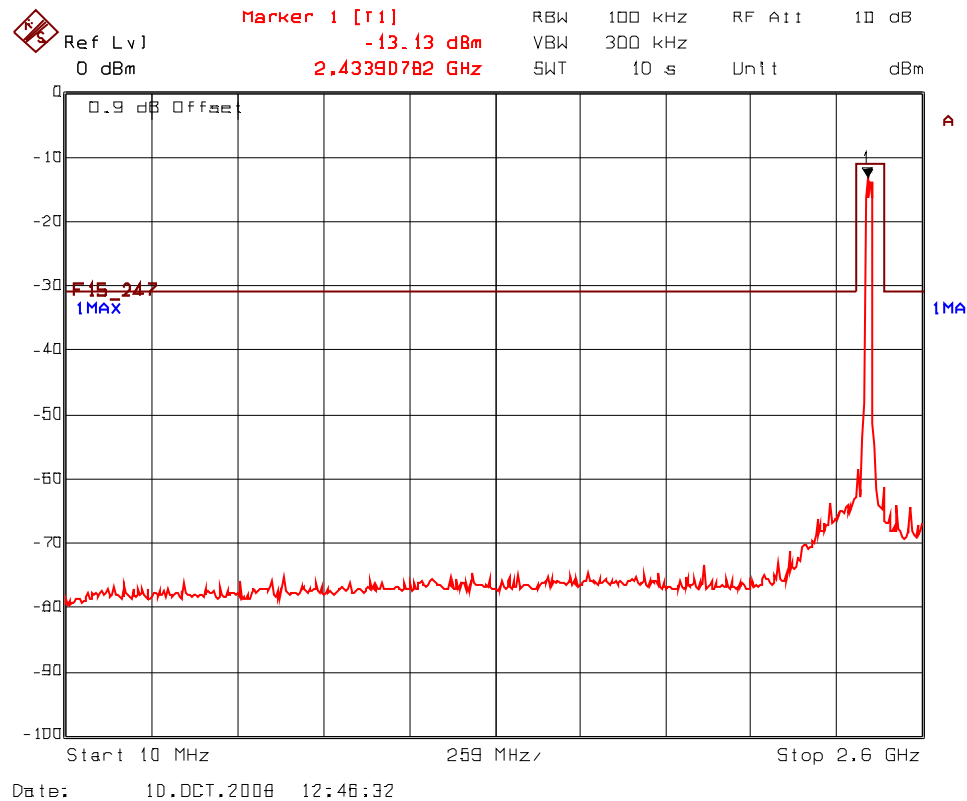
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Plot 6.8.5.2.1(ii) Spurious RF Conducted Emissions, 802.11g Mode
Transmitter Frequency: 2412 MHz



Plot 6.8.5.2.2(i) Spurious RF Conducted Emissions, 802.11g Mode
Transmitter Frequency: 2437 MHz



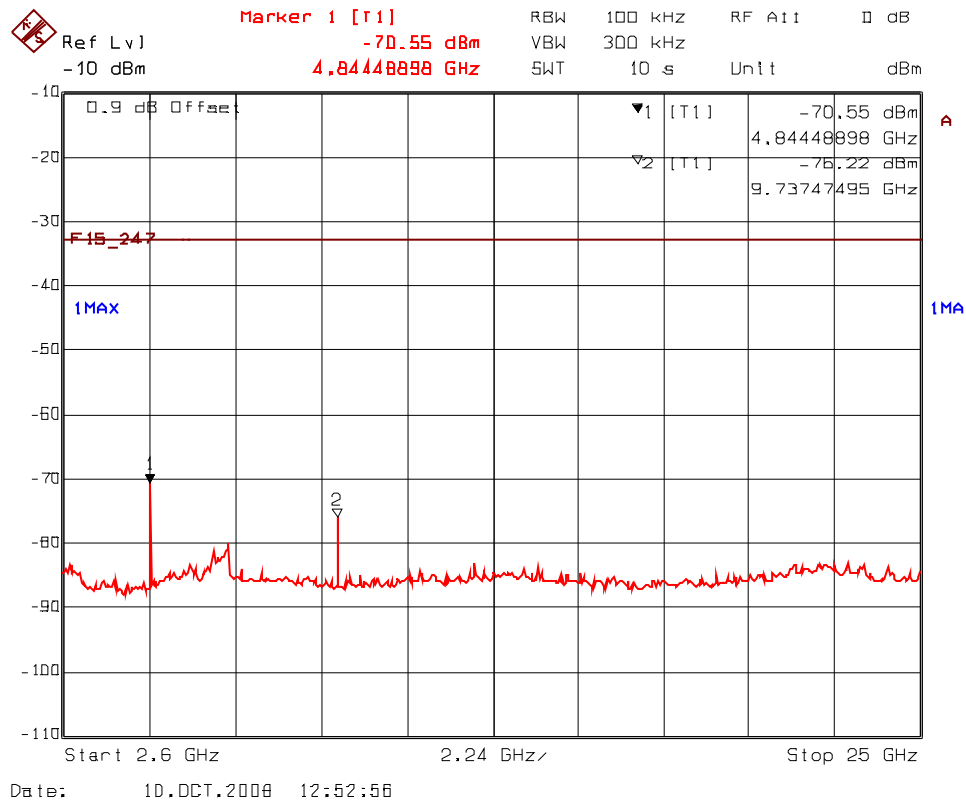
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Plot 6.8.5.2.2(ii) Spurious RF Conducted Emissions, 802.11g Mode
Transmitter Frequency: 2437 MHz



Plot 6.8.5.2.3(i) Spurious RF Conducted Emissions, 802.11g Mode
Transmitter Frequency: 2462 MHz



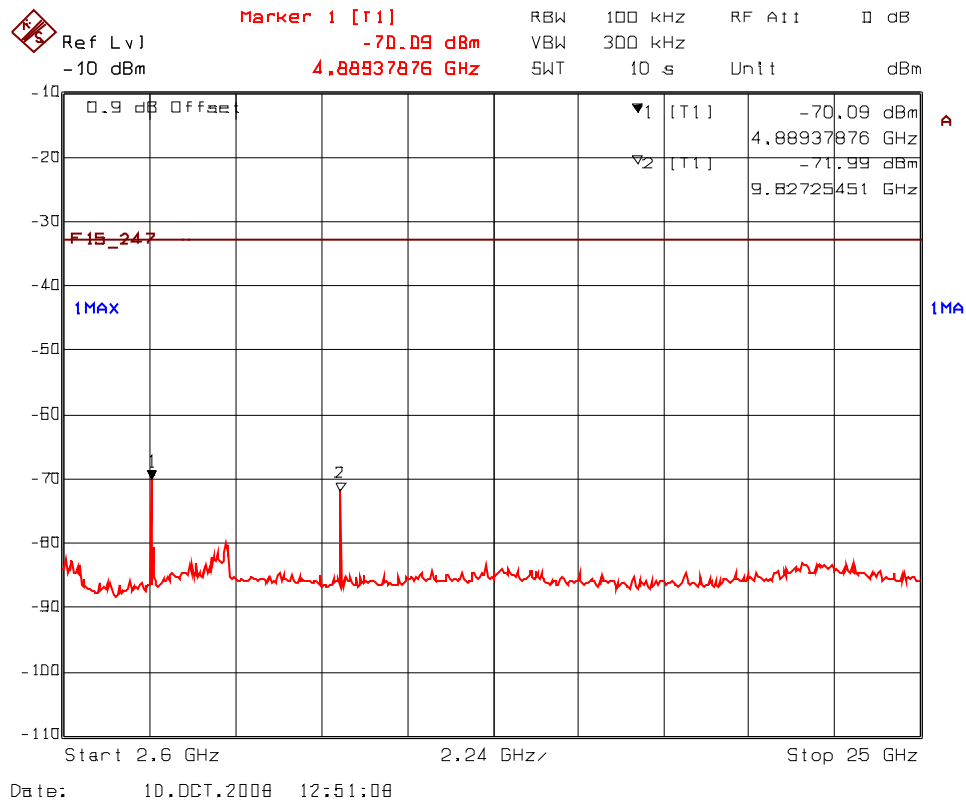
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Plot 6.8.5.2.3(ii) Spurious RF Conducted Emissions, 802.11g Mode
Transmitter Frequency: 2462 MHz



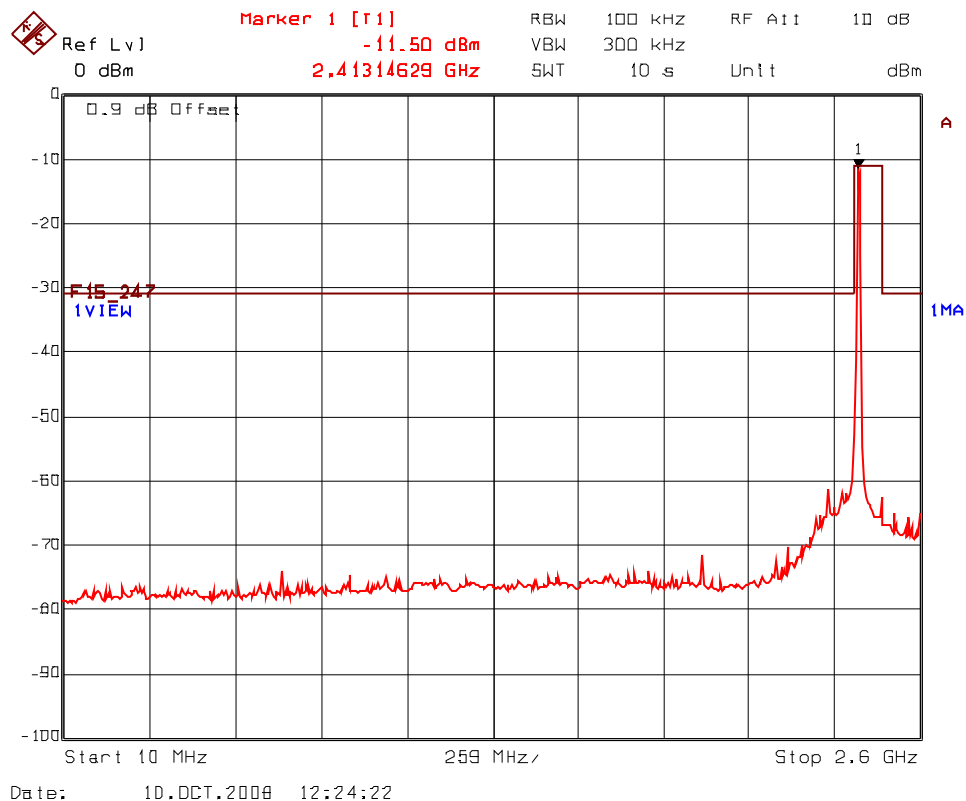
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Plot 6.8.5.2.4(i) Spurious RF Conducted Emissions, 802.11b Mode
Transmitter Frequency: 2412 MHz



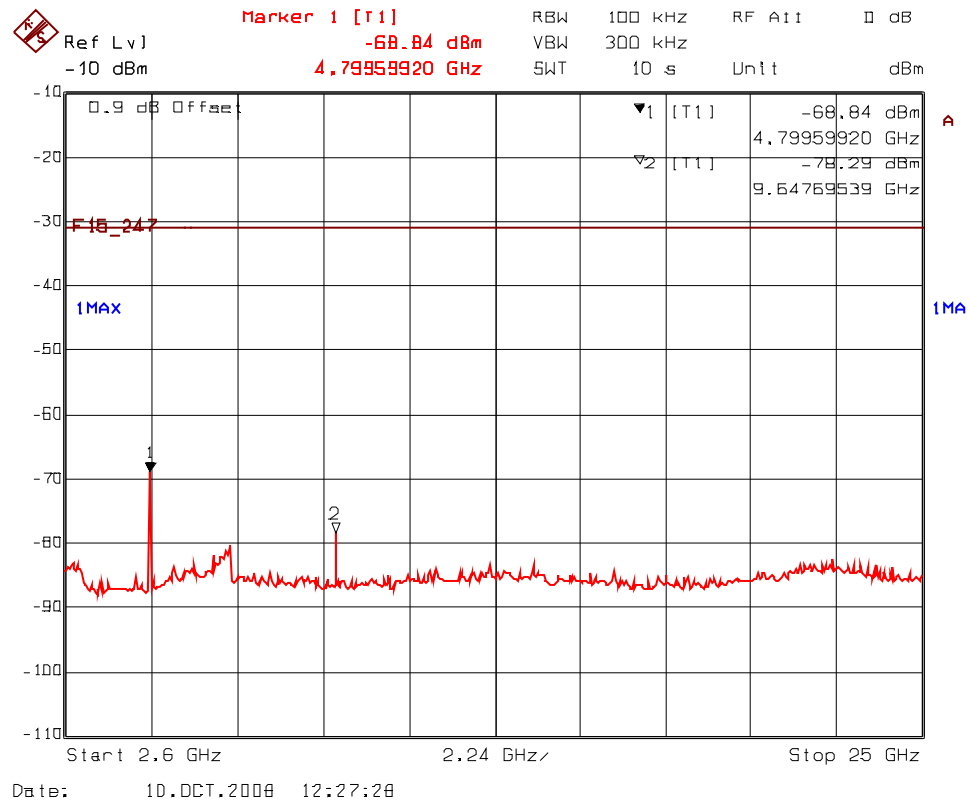
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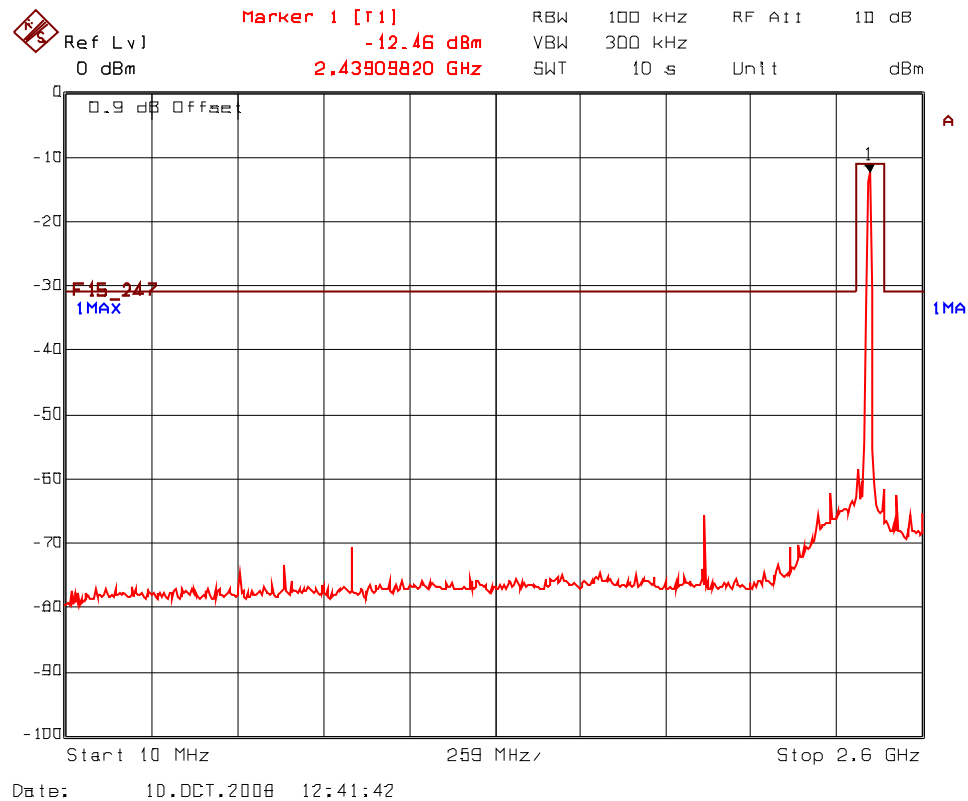
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Plot 6.8.5.2.4(ii) Spurious RF Conducted Emissions, 802.11b Mode
Transmitter Frequency: 2412 MHz



Plot 6.8.5.2.5(i) Spurious RF Conducted Emissions, 802.11b Mode
Transmitter Frequency: 2437 MHz



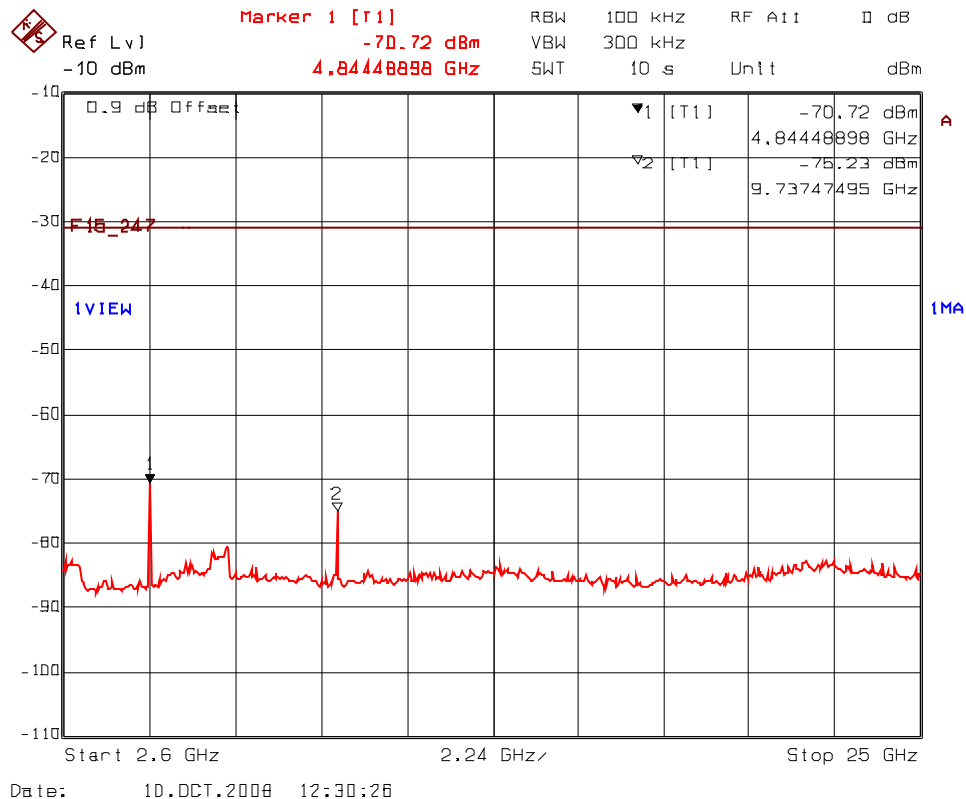
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Plot 6.8.5.2.5(ii) Spurious RF Conducted Emissions, 802.11b Mode
Transmitter Frequency: 2437 MHz



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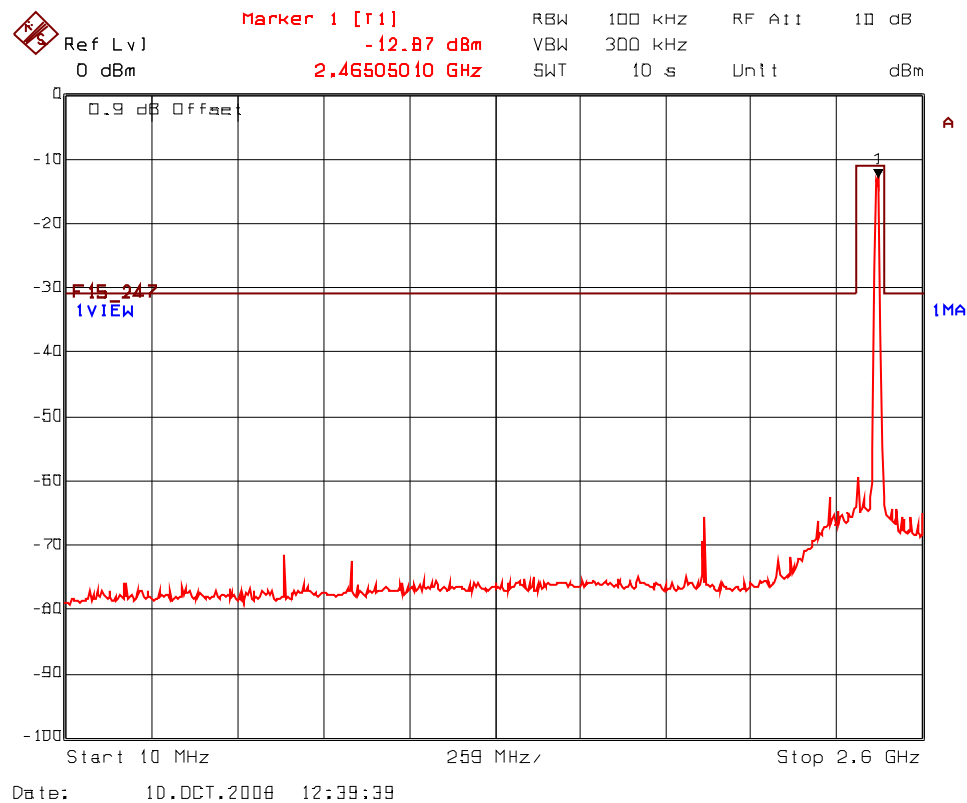
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Plot 6.8.5.2.6(i) Spurious RF Conducted Emissions, 802.11b Mode
Transmitter Frequency: 2462 MHz



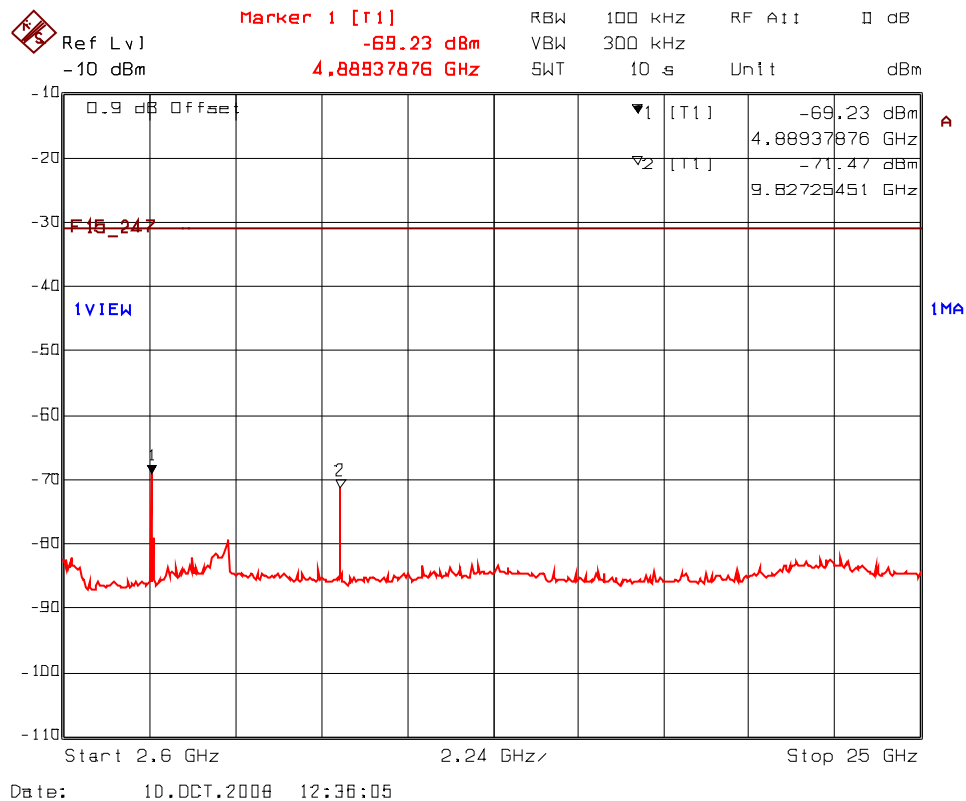
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Plot 6.8.5.2.6(ii) Spurious RF Conducted Emissions, 802.11b Mode
Transmitter Frequency: 2462 MHz



6.9. TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]

6.9.1. Limit(s)

§ 15.247 (d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Section 15.205(a) - Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
¹ 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(²)
13.36–13.41			

¹ Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

² Above 38.6

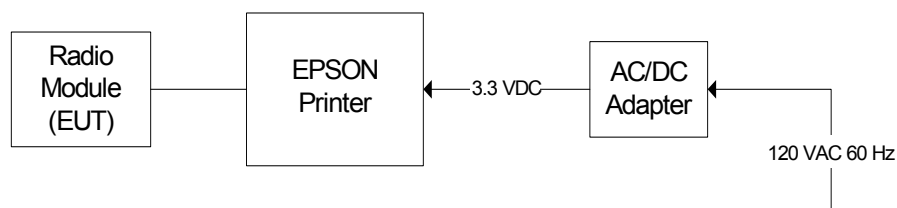
Section 15.209(a) -- Field Strength Limits within Restricted Frequency Bands --

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

6.9.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

6.9.3. Test Arrangement



6.9.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK30	100077	20 Hz - 40 GHz
RF Amplifier	Hewlett Packard	8447F	2944A04098	0.1 - 1300 MHz
RF Amplifier	Hewlett Packard	8449B	3008A00769	1 – 26.5 GHz
Biconilog antenna	EMCO	3142C	34792	26 - 3000 MHz
Horn Antenna	EMCO	3155	6570	1 – 18 GHz
Horn Antenna	EMCO	3160-09	1007	18 – 26.5 GHz
Horn Antenna	EMCO	3160-10	1001	26.5 – 40 GHz

6.9.5. Test Data

Remarks:

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT is tested in three orthogonal positions.
- The following tests are the worst-case test configuration, with the EUT set at maximum data rate (64-QAM at 54 Mbps)

6.9.5.1. Transmitter Radiated Spurious Emissions

Fundamental Frequency:		2412 MHz					
Test Frequency Range:		30 MHz – 25 GHz					
Frequency (MHz)	RF Peak Level (dBμV/m)	RF Avg Level (dBμV/m)	Antenna Plane (H/V)	Limit 15.209 (dBμV/m)	Limit 15.247 (dBμV/m)	Margin (dB)	Pass/Fail
2412	101.02	--	V	--	--	--	--
2412	101.69	--	H	--	--	--	--
4824	52.67	41.28	V	54.0	81.7	-12.7	Pass*
4824	51.80	40.01	H	54.0	81.7	-14.0	Pass*
9648	58.59	52.12	V	54.0	81.7	-29.6	Pass
9648	59.13	52.40	H	54.0	81.7	-29.3	Pass

* Emission within the restricted frequency bands.

Fundamental Frequency:		2437 MHz					
Test Frequency Range:		30 MHz – 25 GHz					
Frequency (MHz)	RF Peak Level (dBμV/m)	RF Avg Level (dBμV/m)	Antenna Plane (H/V)	Limit 15.209 (dBμV/m)	Limit 15.247 (dBμV/m)	Margin (dB)	Pass/Fail
2437	101.84	--	V	--	--	--	--
2437	102.06	--	H	--	--	--	--
4874	50.16	40.32	V	54.0	82.1	-13.7	Pass*
4874	50.37	38.20	H	54.0	82.1	-15.8	Pass*
9748	59.00	51.64	V	54.0	82.1	-30.5	Pass
9748	60.48	53.72	H	54.0	82.1	-28.4	Pass

* Emission within the restricted frequency bands.

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Fundamental Frequency: 2462 MHz							
Test Frequency Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
2462	102.57	--	V	--	--	--	--
2462	102.34	--	H	--	--	--	--
4924	51.10	44.85	V	54.0	82.6	-9.1	Pass*
4924	51.15	42.13	H	54.0	82.6	-11.9	Pass*
9848	59.44	51.98	V	54.0	82.6	-30.6	Pass
9848	59.16	51.69	H	54.0	82.6	-30.9	Pass

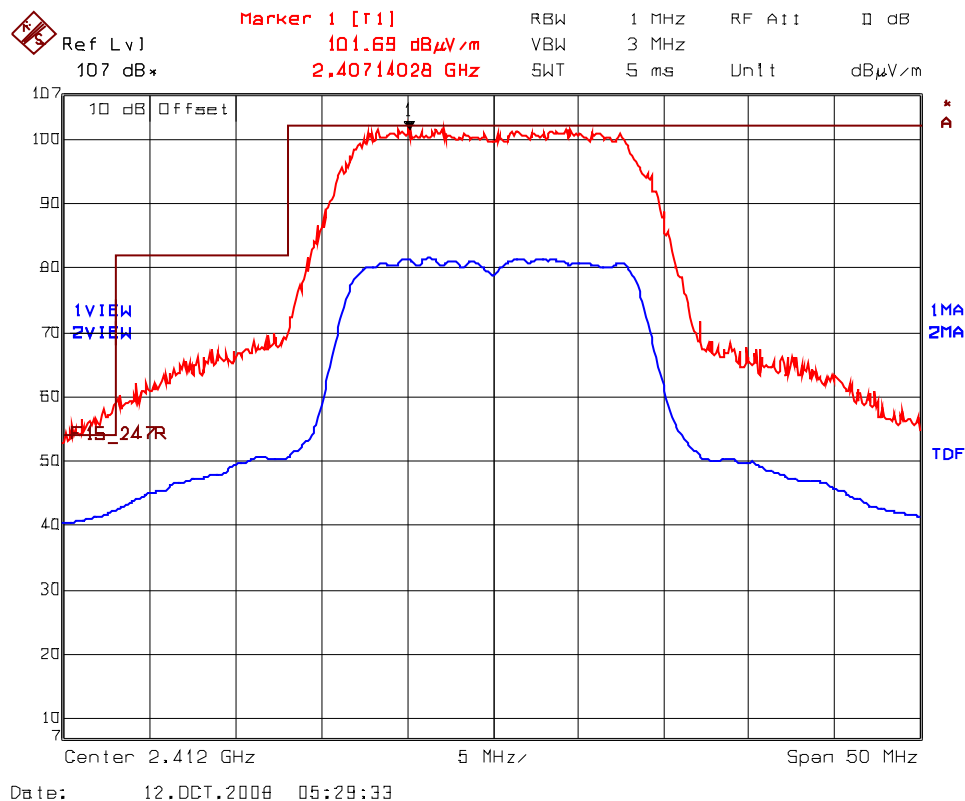
* Emission within the restricted frequency bands.

See the following test data plots for band-edge emissions.

802.11g mode, 54 Mbps data rate, 64QAM:

Plot 6.9.5.1.1 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band; Test Frequency: 2412 MHz
Rx Antenna Orientation: Horizontal

Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz



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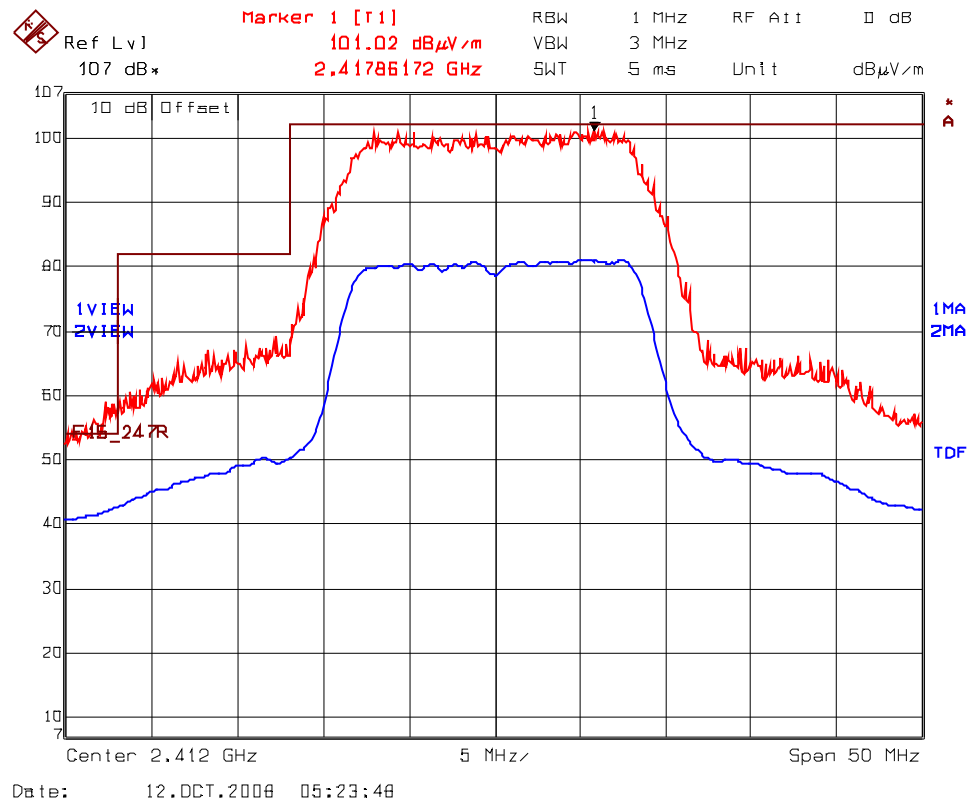
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Plot 6.9.5.1.2 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band; Test Frequency: 2412 MHz
Rx Antenna Orientation: Vertical

Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz



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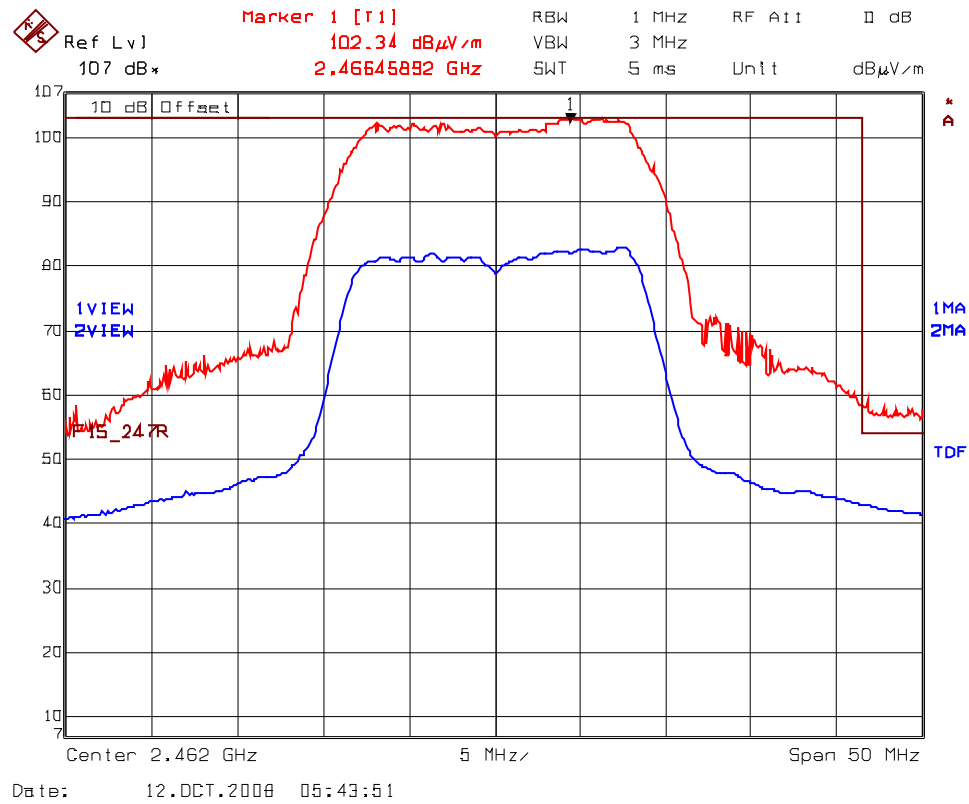
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Plot 6.9.5.1.3 Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2462 MHz
Rx Antenna Orientation: Horizontal

Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz



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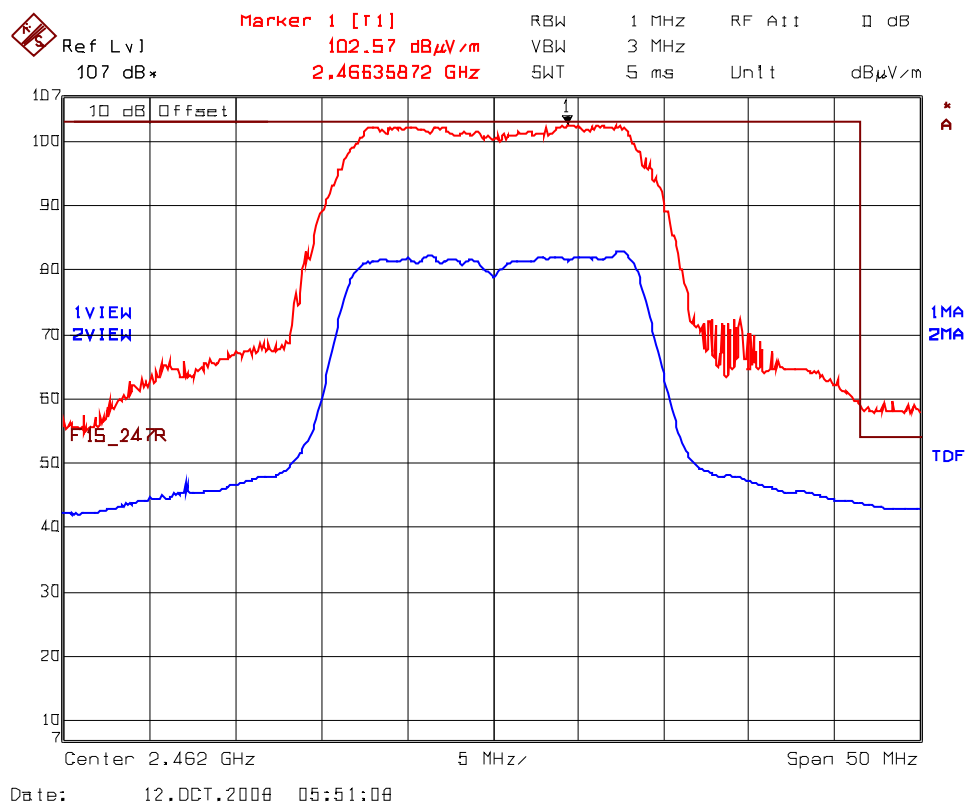
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Plot 6.9.5.1.4 Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2462 MHz
Rx Antenna Orientation: Vertical

Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz



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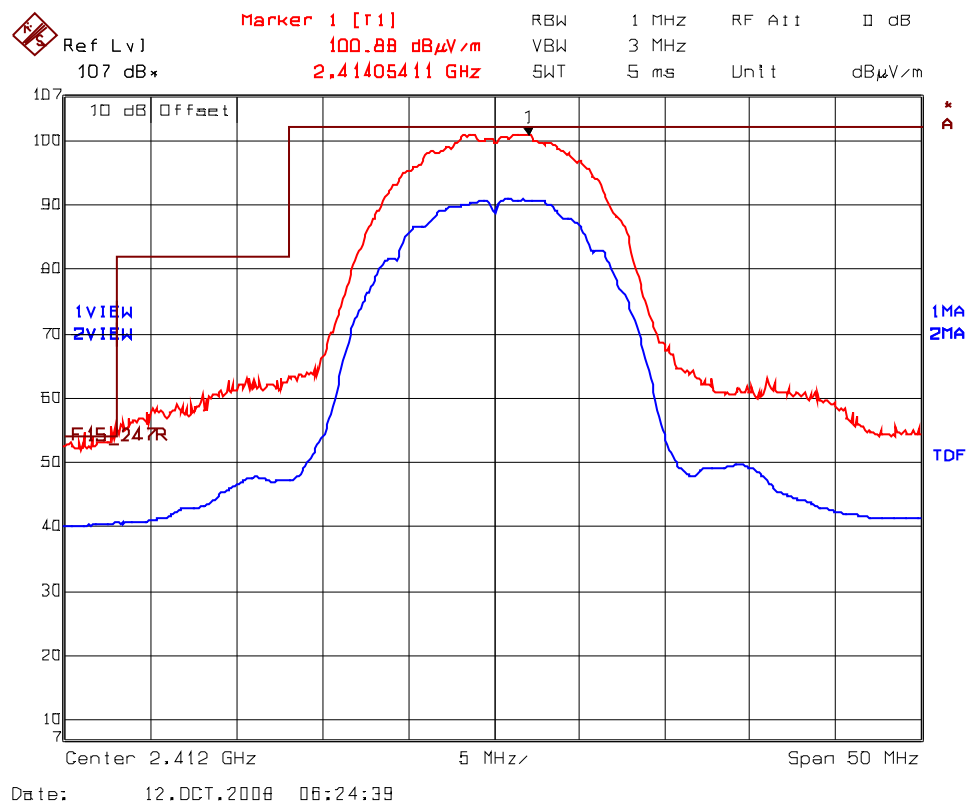
File #: EPS-102F15C247
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802.11b mode, 11 Mbps data rate, CCK:

Plot 6.9.5.1.5 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band; Test Frequency: 2412 MHz
Rx Antenna Orientation: Horizontal

Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz



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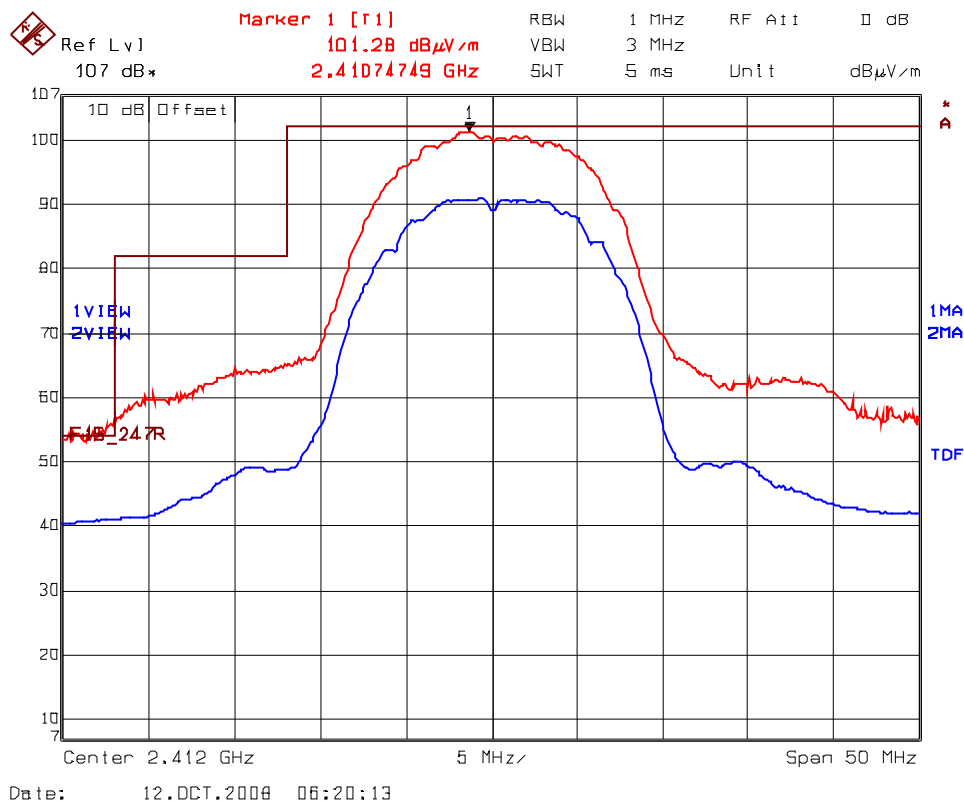
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Plot 6.9.5.1.6 Band-Edge RF Radiated Emissions @ 3 m
Low End of Frequency Band; Test Frequency: 2412 MHz
Rx Antenna Orientation: Vertical

Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz



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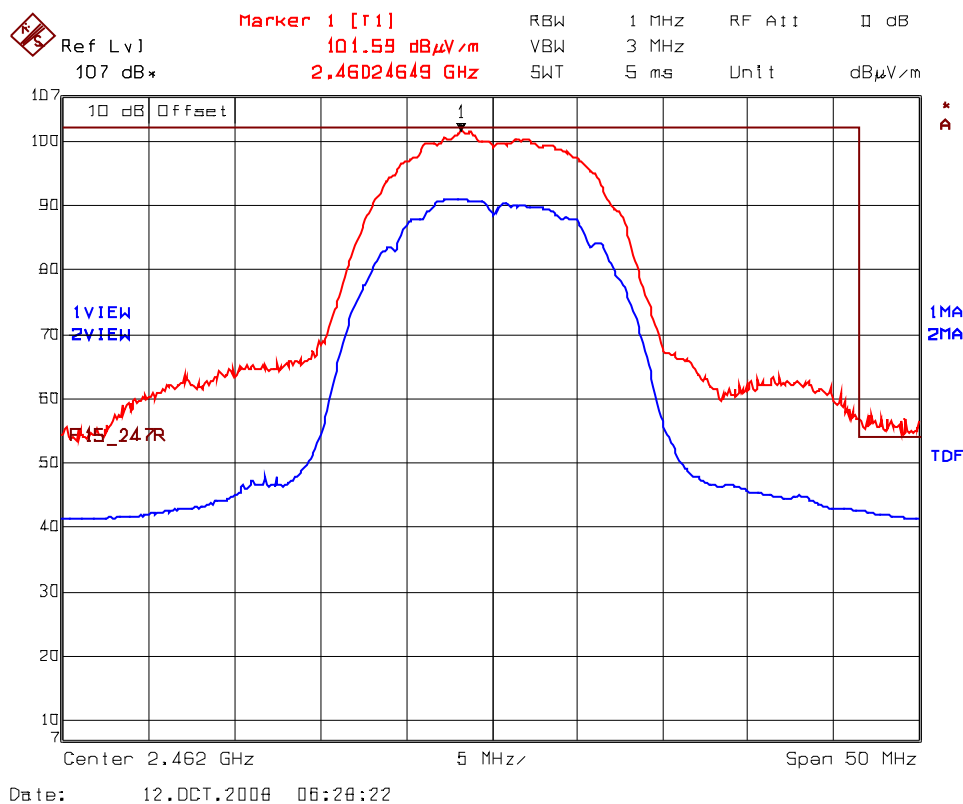
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Plot 6.9.5.1.7 Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2462 MHz
Rx Antenna Orientation: Horizontal

Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz



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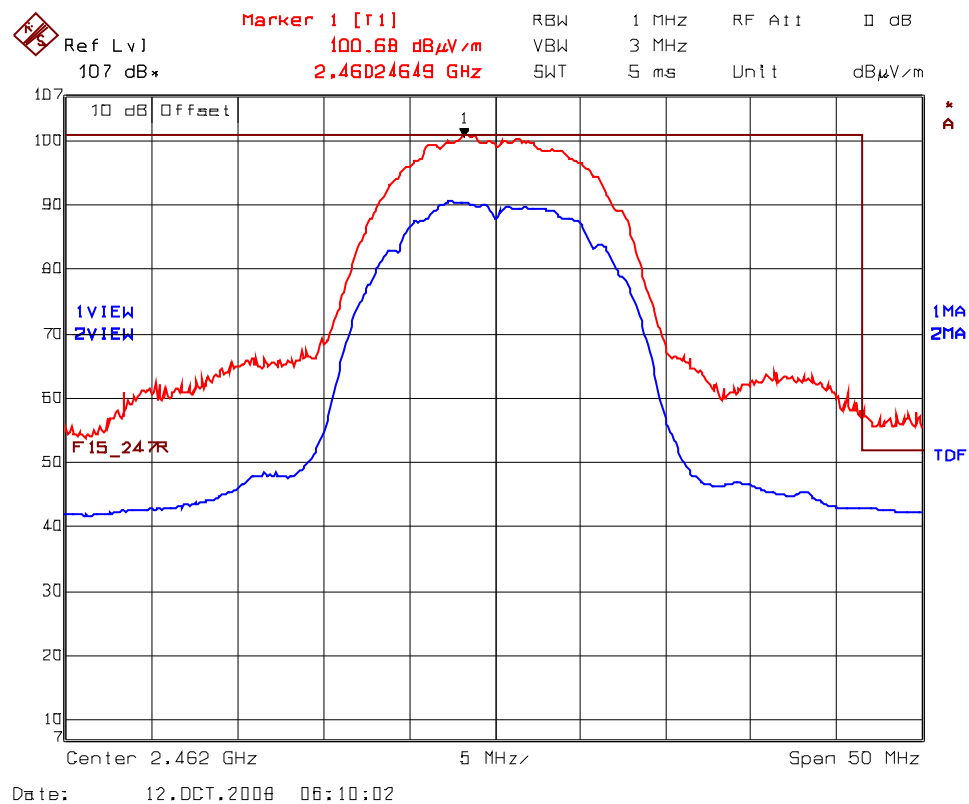
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
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Plot 6.9.5.1.8 Band-Edge RF Radiated Emissions @ 3 m
High End of Frequency Band; Test Frequency: 2462 MHz
Rx Antenna Orientation: Vertical

Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz



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6.10. POWER SPECTRAL DENSITY [§ 15.247(e)]

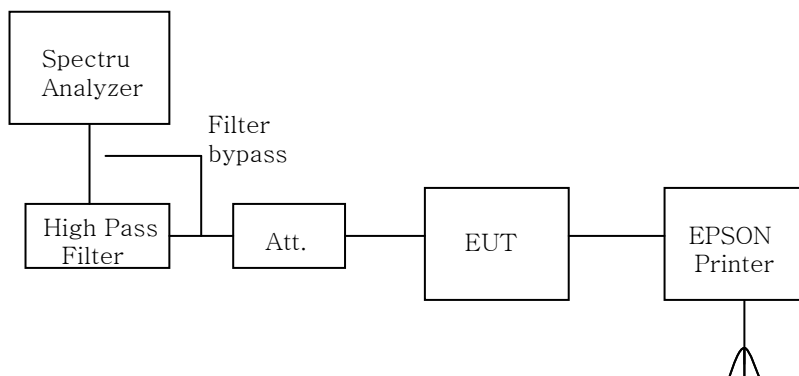
6.10.1. Limit(s)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

6.10.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247), PSD Option 1 method.

6.10.3. Test Arrangement



6.10.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rhode & Schwarz	FSEK30	100077	20 Hz - 40 GHz
Attenuator	Narda	4768-20	--	DC - 40 GHz
High Pass Filter	K & L 11SH10-	11SH10-4000/T12000	4	Cut off 3.4 GHz

6.10.5. Test Data

- Measurement method: Power spectral density (PSD) Option 1.

Frequency (MHz)	*PSD in 3 kHz BW dBm	Limit (dBm)	Margin (dB)	Comments (Pass/Fail)
802.11g mode, 54 Mbps data rate, 64QAM				
2412	-21.67	8	-29.67	Pass
2437	-22.30	8	-30.30	Pass
2462	-23.03	8	-31.03	Pass
802.11b mode, 11 Mbps data rate, CCK				
2412	-26.14	8	-34.14	Pass
2437	-24.96	8	-32.96	Pass
2462	-25.73	8	-33.73	Pass

*See the following plots for measurement details.

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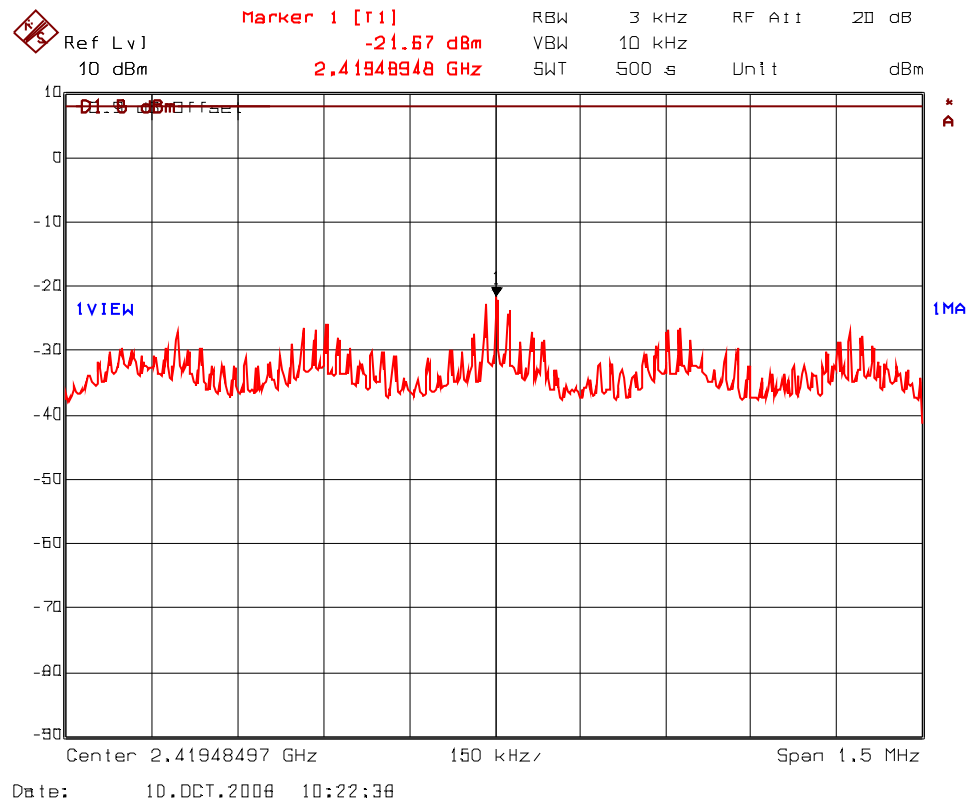
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
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802.11g mode, 54 Mbps data rate, 64QAM:

Plot 6.10.5.1 Power Spectral Density
Frequency: 2412 MHz



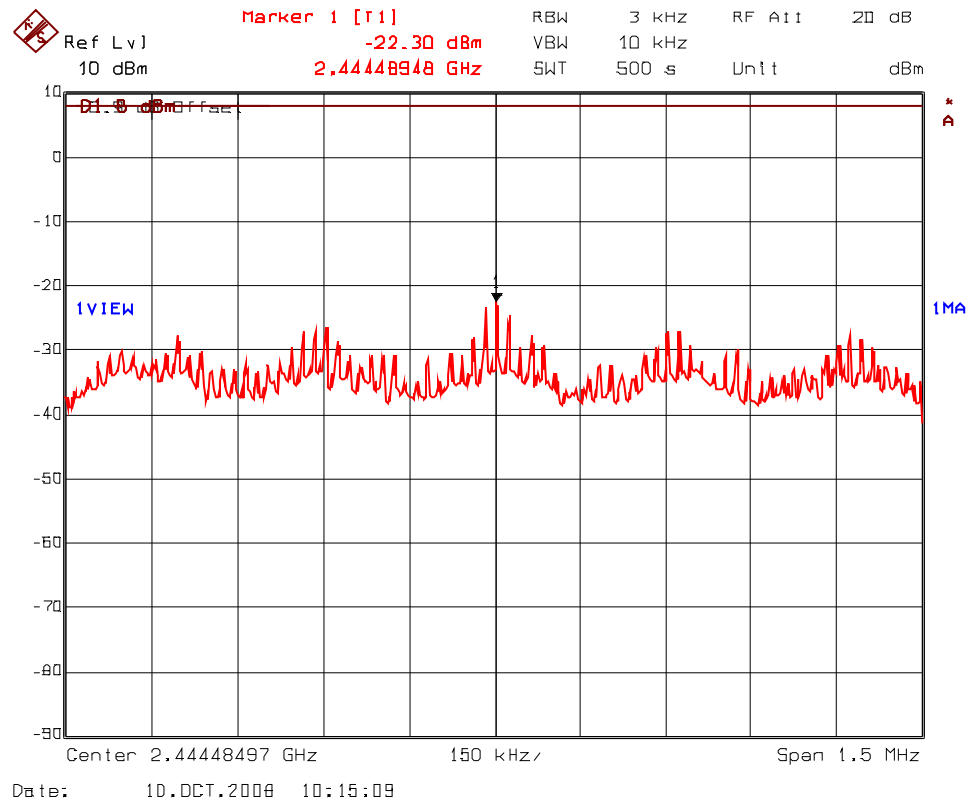
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Plot 6.10.5.2 Power Spectral Density
Frequency: 2437 MHz



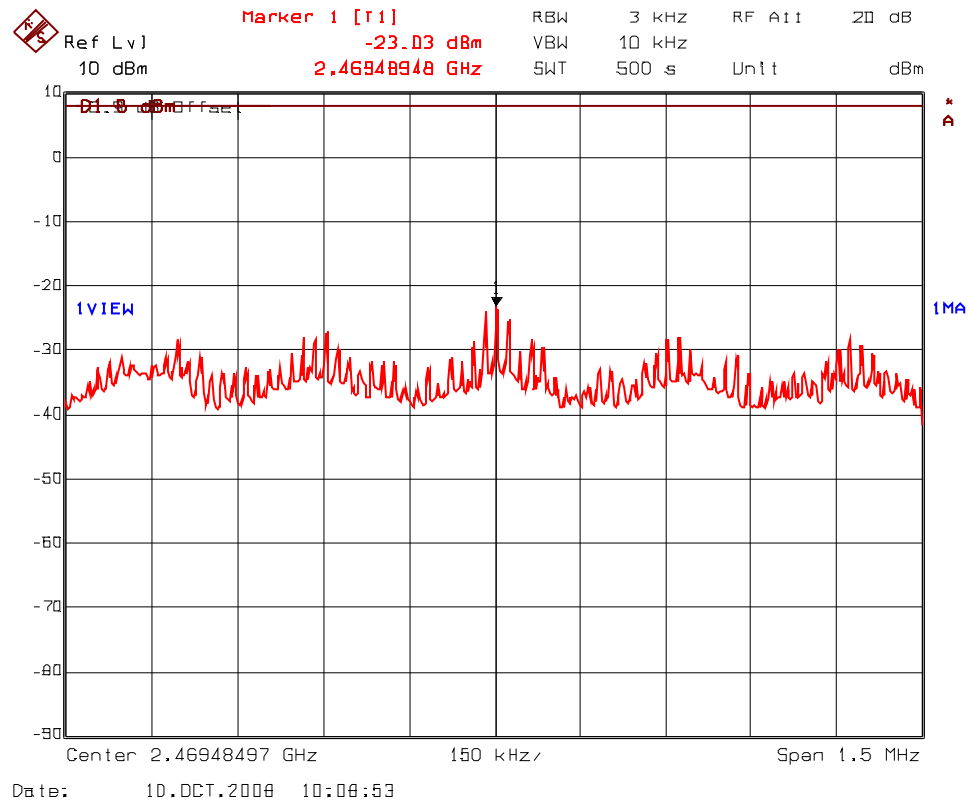
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Plot 6.10.5.3 Power Spectral Density
Frequency: 2462 MHz



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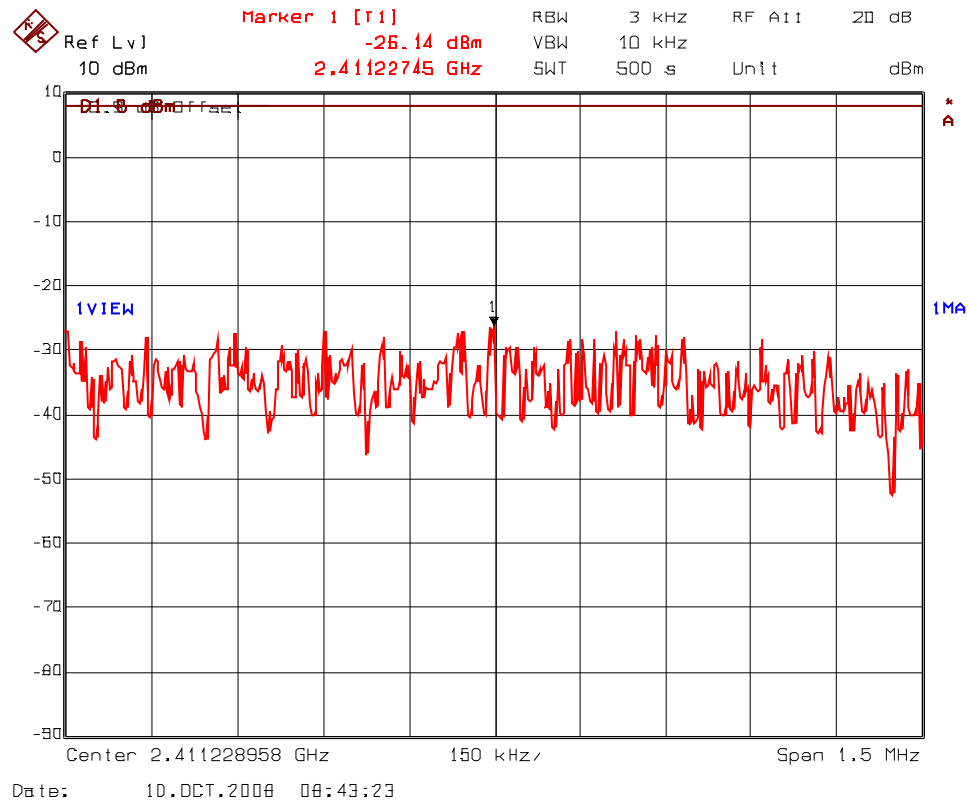
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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802.11b mode, 11 Mbps data rate, CCK:

Plot 6.10.5.4 Power Spectral Density
Frequency: 2412 MHz



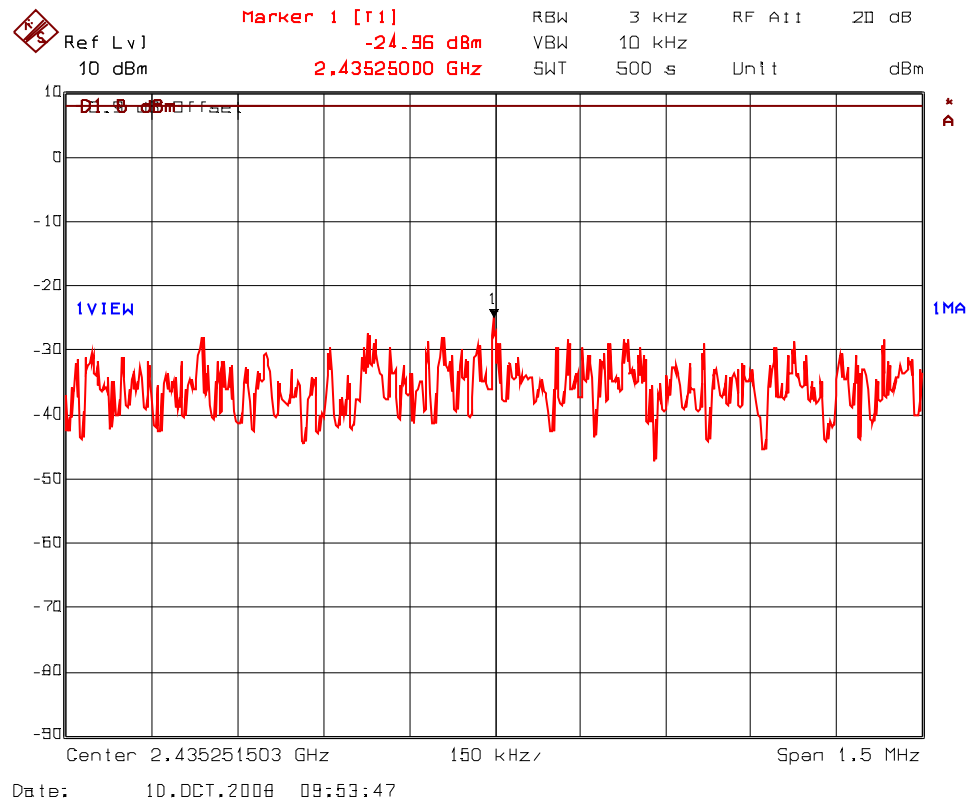
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Plot 6.10.5.5 Power Spectral Density
Frequency: 2437 MHz



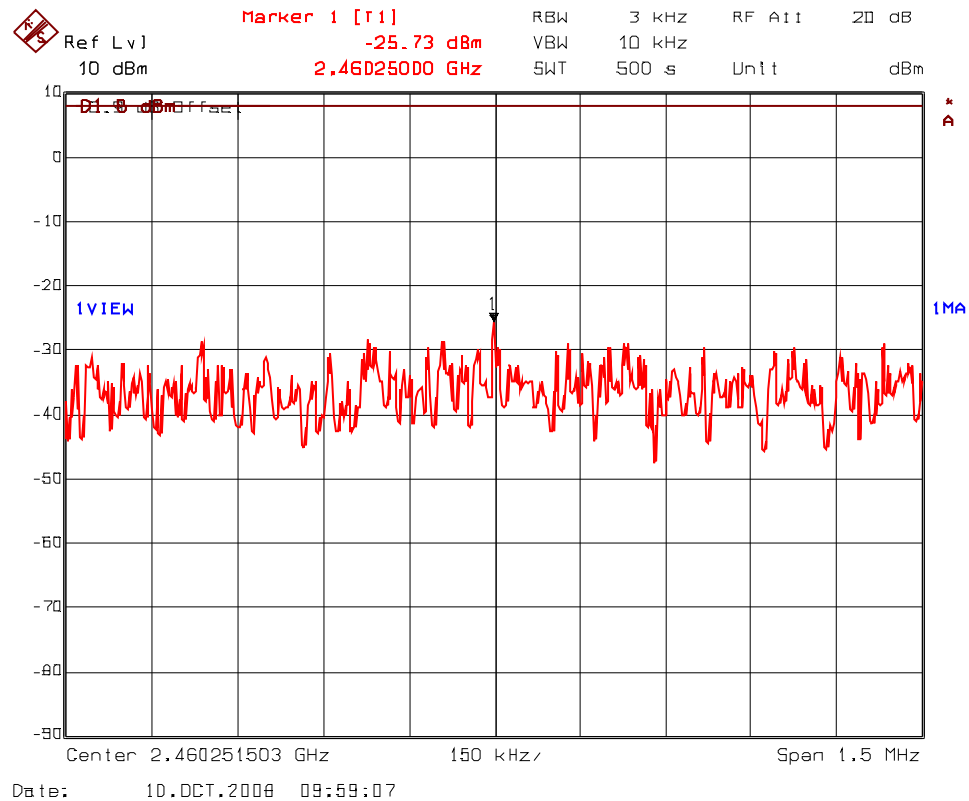
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Plot 6.10.5.6 Power Spectral Density
Frequency: 2462 MHz



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6.11. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1307(b)(1) & 2.1093]

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

FCC 47 CFR § 1.1310:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30
30–300	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

6.11.1. Method of Measurements

Refer to Sections 1.1310, 2.1091.

Spread spectrum transmitters operating under section 15.247 are categorically excluded from routine environmental evaluation to demonstrating RF exposure compliance with respect to MPE and/or SAR limits. These devices are not exempted from compliance (As indicated in Section 15.247(b)(4), these transmitters are required to operate in a manner that ensures that exposure to public users and nearby persons) does not exceed the Commission's RF exposure guidelines (see Section 1.1307 and 2.1093). Unless a device operates at substantially low power levels, with a low gain antenna(s), supporting information is generally needed to establish the various potential operating configurations and exposure conditions of a transmitter and its antenna(s) in order to determine compliance with the RF exposure guidelines.

For portable transmitters (see Section 2.1093), or devices designed to operate next to a person's body, compliance is determined with respect to the SAR limit (define in the body tissues) for near-field exposure conditions. If the maximum average output power, operating condition configurations and exposure conditions are comparable to those of existing cellular and PCS phones, SAR evaluation may be required in order to determine if such a device complies with SAR limit. When SAR evaluation data is not available, and the additional supporting information cannot assure compliance, the Commission may request that an SAR evaluation be performed, as provided for in Section 1.1307(d)

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3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4

Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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6.11.2. RF Evaluation

This device is categorically excluded from routine environmental evaluation for RF Exposure requirement as per section 2.1093.

This module may be used in portable exposure conditions with no restrictions on host platforms when the source-based time-averaged output power is $\leq 60/f_{(\text{GHz})}$ mW as per 2(a)(1) of FCC KDB 447498 v03r02.

Measured Maximum Total Peak Power = 7.42 dBm or 5.52 mW

SAR is not required as Total Peak Power (5.52 mW) is below the low threshold value 24 mW.

Threshold Value = $[60/f(\text{GHz})]$ mW
= $(60/2.5)$ mW
= 24 mW

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	± 1.5	± 1.5
LISN coupling specification	Rectangular	± 1.5	± 1.5
Cable and Input Transient Limiter calibration	Normal (k=2)	± 0.3	± 0.5
Mismatch: Receiver VRC $\Gamma_1 = 0.03$ LISN VRC $\Gamma_R = 0.8(9 \text{ kHz}) 0.2 (30 \text{ MHz})$ Uncertainty limits $20\text{Log}(1+\Gamma_1\Gamma_R)$	U-Shaped	± 0.2	± 0.3
System repeatability	Std. deviation	± 0.2	± 0.05
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	± 1.25	± 1.30
Expanded uncertainty U	Normal (k=2)	± 2.50	± 2.60

Sample Calculation for Measurement Accuracy in 450 kHz to 30 MHz Band:

$$u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)} = \pm \sqrt{(1.5^2 + 1.5^2)/3 + (0.5/2)^2 + (0.05/2)^2 + 0.35^2} = \pm 1.30 \text{ dB}$$

$$U = 2u_c(y) = \pm 2.6 \text{ dB}$$

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (\pm dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	± 1.0	± 1.0
Cable Loss Calibration	Normal (k=2)	± 0.3	± 0.5
EMI Receiver specification	Rectangular	± 1.5	± 1.5
Antenna Directivity	Rectangular	± 0.5	± 0.5
Antenna factor variation with height	Rectangular	± 2.0	± 0.5
Antenna phase center variation	Rectangular	0.0	± 0.2
Antenna factor frequency interpolation	Rectangular	± 0.25	± 0.25
Measurement distance variation	Rectangular	± 0.6	± 0.4
Site imperfections	Rectangular	± 2.0	± 2.0
Mismatch: Receiver VRC $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67$ (Bi) 0.3 (Lp) Uncertainty limits $20\log(1+\Gamma_1\Gamma_R)$	U-Shaped	+1.1 -1.25	± 0.5
System repeatability	Std. Deviation	± 0.5	± 0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k = 2 is used:

$$U = 2u_c(y) = 2x(+2.19) = +4.38 \text{ dB} \quad \text{And} \quad U = 2u_c(y) = 2x(-2.21) = -4.42 \text{ dB}$$