Test of SpectraLink 702X Wireless Telephone

To: FCC 47 CFR Part15.247 & IC RSS-210

Test Report Serial No.: TUVR89-A1 Rev B

MiCOM Labs

opening wireless markets

TEST REPORT

FROM

Test of SpectraLink 702X Wireless Telephone
to
To FCC 47 CFR Part15.247 & IC RSS-210

Test Report Serial No.: TUVR89-A1 Rev B

Note: this report only contains data with regards to the 2.4 and 5.8 GHz operational modes of the SpectraLink 702X Wireless Telephone. 5150-5350 MHz test data is reported in MiCOM Labs test report TUVR89-A2

This report supersedes: None

Manufacturer: SpectraLink Corporation
5755 Central Avenue
Boulder
Colorado 80301, USA

Product Function: 802.11 a/b/g Wireless Telephone

Copy No: pdf **Issue Date:** 28th August 06

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
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Pleasanton, CA 94566 USA
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ACCREDITED
CERTIFICATE #2381.01

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TABLE OF CONTENTS

ACCREDITATION & LISTINGS 5
1. TEST RESULT CERTIFICATE 8
2. REFERENCES AND MEASUREMENT UNCERTAINTY 9
2.1. Normative References 9
2.2. Test and Uncertainty Procedures 9
3. PRODUCT DETAILS AND TEST CONFIGURATIONS 10
3.1. Technical Details 10
3.2. Scope of Test Program 11
3.3. Equipment Model(s) and Serial Number(s) 12
3.4. Antenna Details 12
3.5. Cabling and I/O Ports 12
3.6. Test Configurations 13
3.7. Equipment Modifications 15
3.8. Deviations from the Test Standard 15
3.9. Subcontracted Testing or Third Party Data 16
4. TEST SUMMARY 17
5. TEST RESULTS 19
5.1. Device Characteristics 19
5.1.1. 6 dB and 99 % Bandwidth 19
5.1.2. Peak Output Power 27
5.1.3. Peak Power Spectral Density 32
5.1.4. Maximum Permissible Exposure 37
5.1.5. Conducted Spurious Emissions 38
5.1.6. Radiated Emissions 73
5.1.7. AC Wireline Conducted Emissions (150 kHz – 30 MHz) 100
6. PHOTOGRAPHS 104
6.1. Radiated Emissions (30 MHz-1 GHz) 104
6.2. Spurious Emissions >1 GHz 105
6.3. Conducted Emissions (150 kHz - 30 MHz) 106
6.4. General Measurement Test Set-Up 107
7. TEST EQUIPMENT DETAILS 108

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ACCREDITATION & LISTINGS

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

ACCREDITED LABORATORY

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MICOM LABS
Pleasanton, CA

for technical competence in the field of

Electrical Testing

The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified field of testing.

Presented this 14th day of September 2005.

American Association for Laboratory Accreditation
Corporate SEAL 1978 District of Columbia
A2LA

President
For the Accreditation Council
Certificate Number 2381.01
Valid to: November 30, 2007

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

United States of America
Federal Communications Commission (FCC) Listing #: 102167

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DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	31st May 2006	First issue.
Rev B	28th August 2006	Included duty cycle plots Section 3.6 Test Configurations

1. TEST RESULT CERTIFICATE

Manufacturer:	SpectraLink Corporation 5755 Central Avenue Boulder Colorado 80301, USA	Tested By:	MiCOM Labs, Inc. 3922 Valley Avenue 'B' Pleasanton California, 94566, USA
EUT:	Wireless Telephone	Telephone:	+1 925 462 0304
Model:	702X	Fax:	+1 925 462 0306
S/N:	660324742 & 660324730		
Test Date(s):	8th April to 23rd May '06	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part15.247 & IC RSS-210	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

ACCREDITED

CERTIFICATE #2381.01

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 15.247	Feb 2006	Code of Federal Regulations
(ii)	Industry Canada RSS-210	Issue 6 Sept. 2005	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands)
(iii)	Industry Canada RSS-Gen	Issue 1 Sept. 2005	General Requirements and Information for the Certification of Radiocommunication Equipment.
(iv)	ANSI C63.4	2003	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(v)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(vi)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vii)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(viii)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(ix)	A2LA	14th September 2005	Reference to A2LA Accreditation Status – A2LA Advertising Policy

2.2. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Test of the SpectraLink 702X Wireless Telephone to FCC Part 15.247 and Industry Canada RSS-210 regulations
Applicant:	As Manufacturer
Manufacturer:	SpectraLink Corporation 5755 Central Avenue Boulder Colorado 80301, USA
Laboratory performing the tests:	MiCOM Labs, Inc. 3922 Valley Avenue, Suite "B" Pleasanton, California 94566 USA
Test report reference number:	TUVR89-A1 Rev B
Date EUT received:	7TH April 2006
Standard(s) applied:	FCC 47 CFR Part15.247 & IC RSS-210
Dates of test (from - to):	8th April to 23rd May '06
No of Units Tested:	2
Type of Equipment:	802.11a/b/g Wireless Telephone
Manufacturers Trade Name:	NetLink Wireless Telephone
Model:	702X
Location for use:	Indoor
Declared Frequency Range(s):	2400 - 2483.5 MHz 5725 - 5850 MHz
Type of Modulation:	Per 802.11 – DSSS, CCK, OFDM
Declared Nominal Output Power:	802.11b/g: +20 dBm 802.11a: +20dBm
EUT Modes of Operation:	802.11a/b/g
Transmit/Receive Operation:	Time Division Duplex
Rated Input Voltage and Current:	3.7 Vdc, current (depending on mode) 200mA Avg/ 800 mA peak
Operating Temperature Range:	Declared range -10 to +50ºC
ITU Emission Designator:	802.11b – 15M7W7D 802.11g – 18M4W7D 802.11a – 18M5W7D
Microprocessor(s) Model:	TI TMS320VC5507
Clock/Oscillator(s):	32.768 KHz, 40 MHz, 48 MHz
Frequency Stability:	±20 ppm max
Equipment Dimensions:	137mm x 52mm x 22mm
Weight:	0.3 lbs
Primary function of equipment:	Wireless Telephone Handset

3.2. Scope of Test Program

The scope of the test program was to test the SpectraLink 702X wireless telephone handset in the frequency ranges 2400 - 2483.5 MHz, and 5725 – 5850 MHz in combinations with two headsets, models PTH200 and H251N for compliance against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications.

The SpectraLink 702X wireless telephone employs DSSS CCK, and OFDM modulation.

SpectraLink Corporation
702X Wireless Telephone Handset

Photos of the headsets that were tested in combination with the 702X phone.

PTH200 Headset

H251/N Headset

3.3. Equipment Model(s) and Serial Number(s)

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	Wireless phone	SpectraLink	702X	660324742 & 660324730
EUT	Phone stand and single battery charger	SpectraLink	PCS1850	None
EUT	Phone stand and dual battery charger	SpectraLink	PCD1850	None
EUT	Headset	Plantronics	PTH200	None
EUT	Headset	Plantronics	H251/N	None

3.4. Antenna Details

1. 0 dBi integral antenna

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. 2.4mm socket for headset or earpiece

3.6. Test Configurations

Testing was performed to determine the highest power level versus bit rate. 802.11b 11 MB/s, 12 MB/s for 802.11g and 54 MB/s for 802.11a were found to provide the highest power levels. These data rates were used to exercise the product throughout the entire test program.

Matrix of Channel test configurations.

Operational Mode (802.11)	802.11 Operating Channel #	EUT Channel #	Frequencies (MHz)
b, g	1, 6, 11	1, 6, 11	2,412 2,437 2,462
a	149, 157, 161	20, 22, 23	5,745 5,785 5,805

Matrix of Equipment test configurations

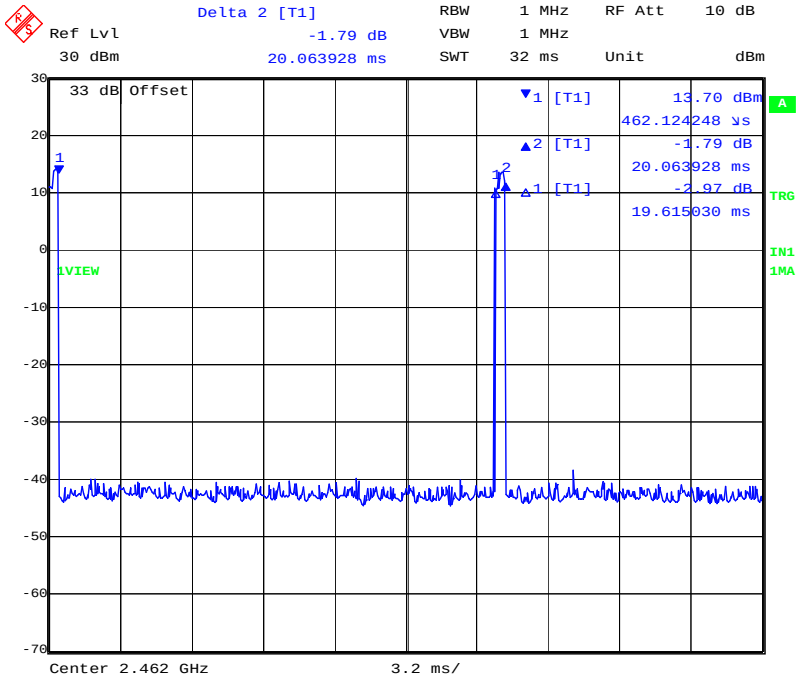
Telephone Model #	Headsets		Desktop Phone stand & Battery Charger	
	PTH200	H251/N	Single	Dual
702X	√	√	√	√

System Duty Cycle
The phones were delivered with a fixed duty cycle. Any emissions (harmonic or otherwise) related to the duty cycle were offset by a correction factor 10*Log(1/duty cycle).

802.11b/g
Duty Cycle 2.24%, correction factor 16.5 dB

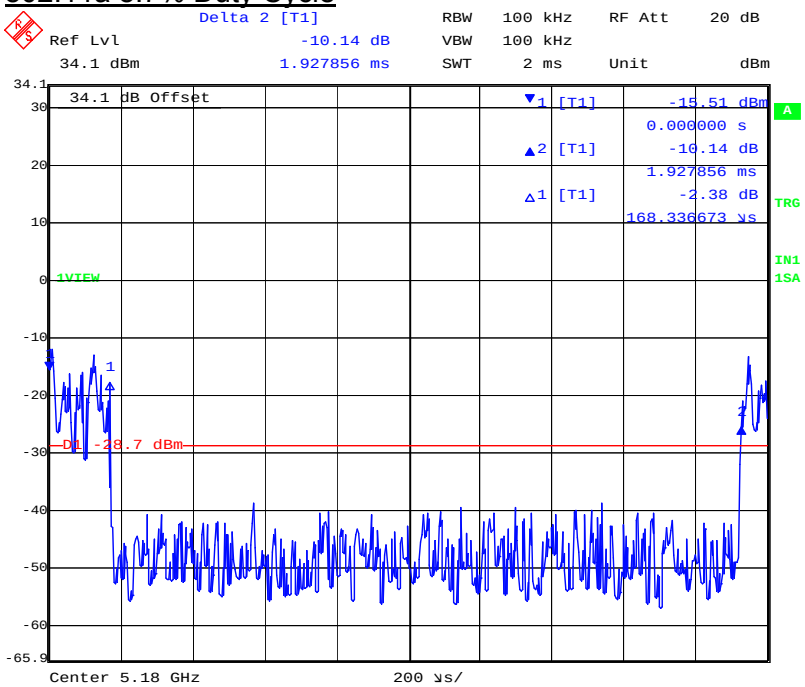
802.11a
Duty Cycle 8.7%, correction factor 10.6 dB

802.11b/g 2.24% Duty Cycle



Date: 8.APR.2006 13:04:44

802.11a 8.7% Duty Cycle



Date: 15.APR.2006 11:20:47

Matrix of Telephone Data Rate Configurations

Rate Selection	'b' Mode Data Rate	'a' and 'g' Mode Data Rate
1	1 Mb/s, Long Preamble	6 Mb/s
2	2 Mb/s, Long Preamble	9 Mb/s
3	5.5 Mb/s, Long Preamble	**12 Mb/s[2]**
4	**11 Mb/s, Long Preamble[1]**	18 Mb/s
5		24 Mb/s
6		36 Mb/s
7		48 Mb/s
8		**54 Mb/s[3]**

[1] - Used to test and exercise 802.11b operational mode at all times
[2] - Used to test and exercise 802.11g operational mode at all times
[3] - Used to test and exercise 802.11a operational mode at all times

Only worst case plots are provided for each test parameter are identified within this report. Plots not included are held on file by the test laboratory and available upon request with client permission.

3.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. None

3.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

3.9. Subcontracted Testing or Third Party Data

Radiated emissions are tested below and verified above 1 GHz at TUV Rheinland of North America's 10m chamber located at the following address;-

2305 Mission College Blvd.
Santa Clara
California 95054
USA

TUV Rheinland of North America IC Registration Number: IC 4453-1

4. TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247** and **Industry Canada RSS-210** and **Industry Canada RSS-Gen.**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(a)(2) **A8.2(1)** **4.4**	6 dB and 99 % Bandwidths	≥500 kHz	Conducted	Complies	5.1.1
15.247(b)(3) **15.31(e)** **A8.4(4)**	Peak Output Power Voltage Variation	Shall not exceed 1W Variation of supply voltage 85 % -115 %	Conducted	Complies	5.1.2
15.247(e) **A8.2**	Peak Power Spectral Density	Shall not be greater than +8 dBm in any 3 kHz band	Conducted	Complies	5.1.3
15.247(i) **5.5**	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	5.1.4
15.247(d) **15.205 /** **15.209** **A8.5** **2.2** **4.7**	Spurious Emissions (30MHz - 26 GHz)	The radiated emission in any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density	Conducted	Complies	5.1.5

List of Measurements (continued)

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247, Industry Canada RSS-210,** and **Industry Canada RSS-Gen.**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(d) **15.205 /** **15.209** **A8.5** **2.2** **2.6** **4.7**	Radiated Emissions	Restricted Bands	Radiated	Complies	5.1.6
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*5.1.6.1*
Industry Canada only **RSS-Gen §4.8, §6**	Receiver Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*5.1.6.2*
	Radiated Band Edge	Band edge results		Complies	*5.1.6.2.1*
15.205 / **15.209** **2.2**	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies	*5.1.6.3*
15.207 **7.2.2**	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Complies	*5.1.7*

Note 1: *Test results reported in this document relate only to the items tested*
Note 2: *The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria*
Note 3: *Appendix A - Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix*

5. TEST RESULTS

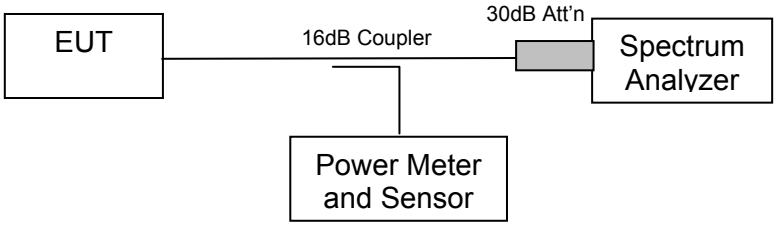
5.1. Device Characteristics

5.1.1. 6 dB and 99 % Bandwidth

FCC, Part 15 Subpart C §15.247(a)(2)
Industry Canada RSS-210 §A8.2
Industry Canada RSS-Gen §4.4

Test Procedure
The bandwidth at 6 dB and 99 % is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency. The analyzer was set for a 6 dB resolution bandwidth filter during this measurement.

Test Measurement Set up



Measurement set up for 6 dB and 99 % bandwidth test

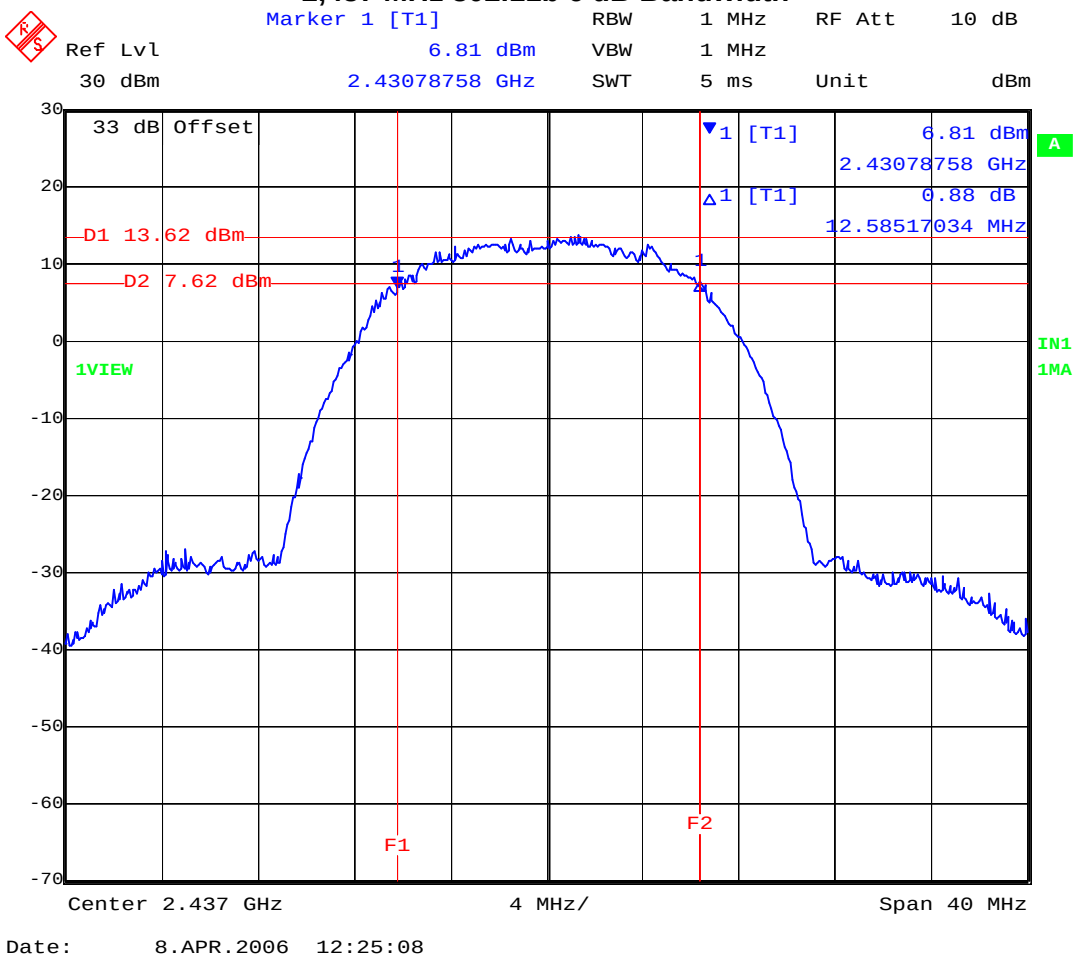
Measurement Results for 6 dB and 99 % Operational Bandwidth(s)

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

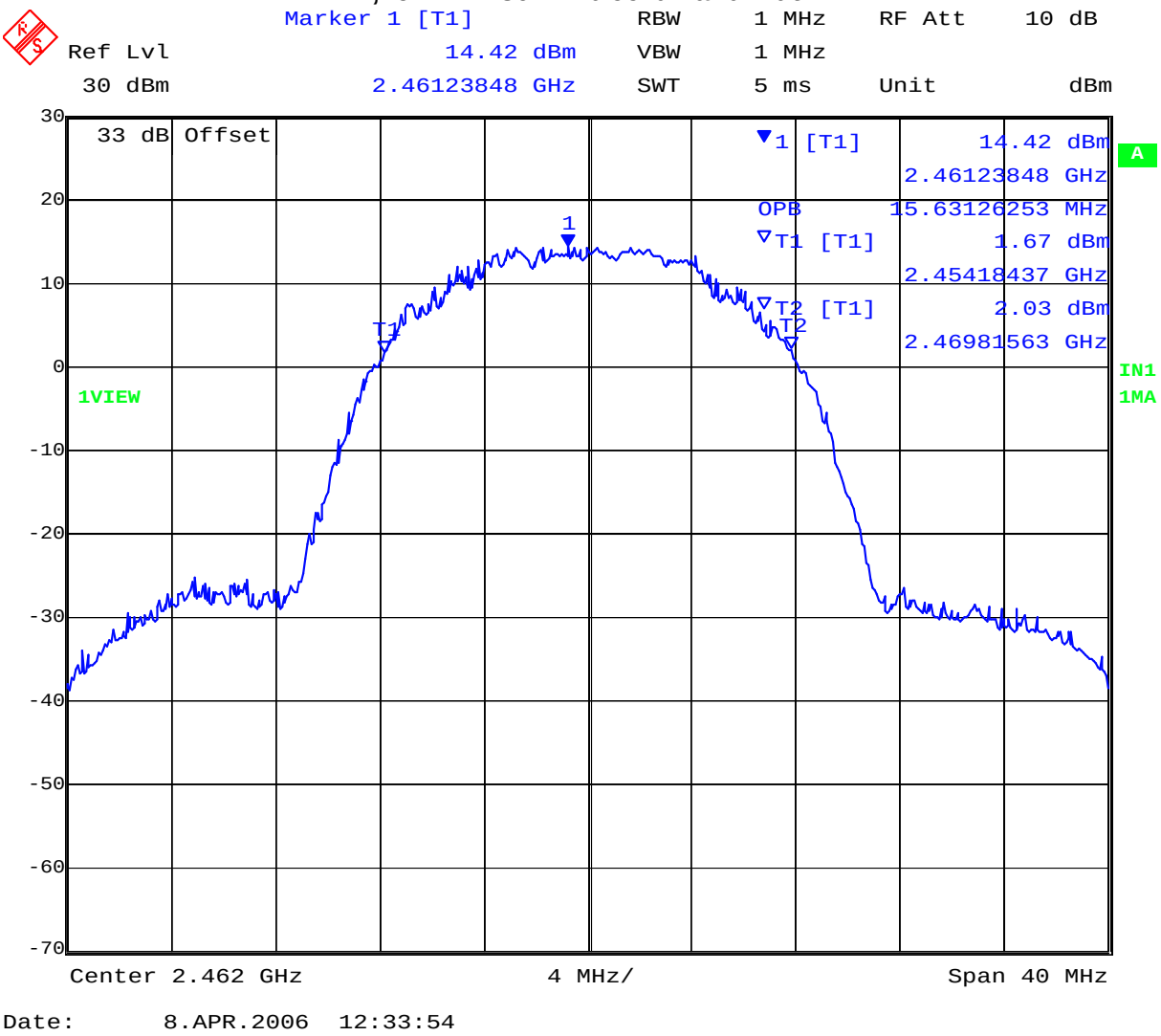
TABLE OF RESULTS – **802.11b Rate 4 - 11 Mb/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	99 % BW (MHz)	99 % BW Plots
2,412	12.024	On File	15.471	On File
2,437	12.585	01	15.551	On File
2,462	12.264	On File	15.631	02

Plot 01
2,437 MHz 802.11b 6 dB Bandwidth



Plot 02
2,462 MHz 802.11b 99% Bandwidth

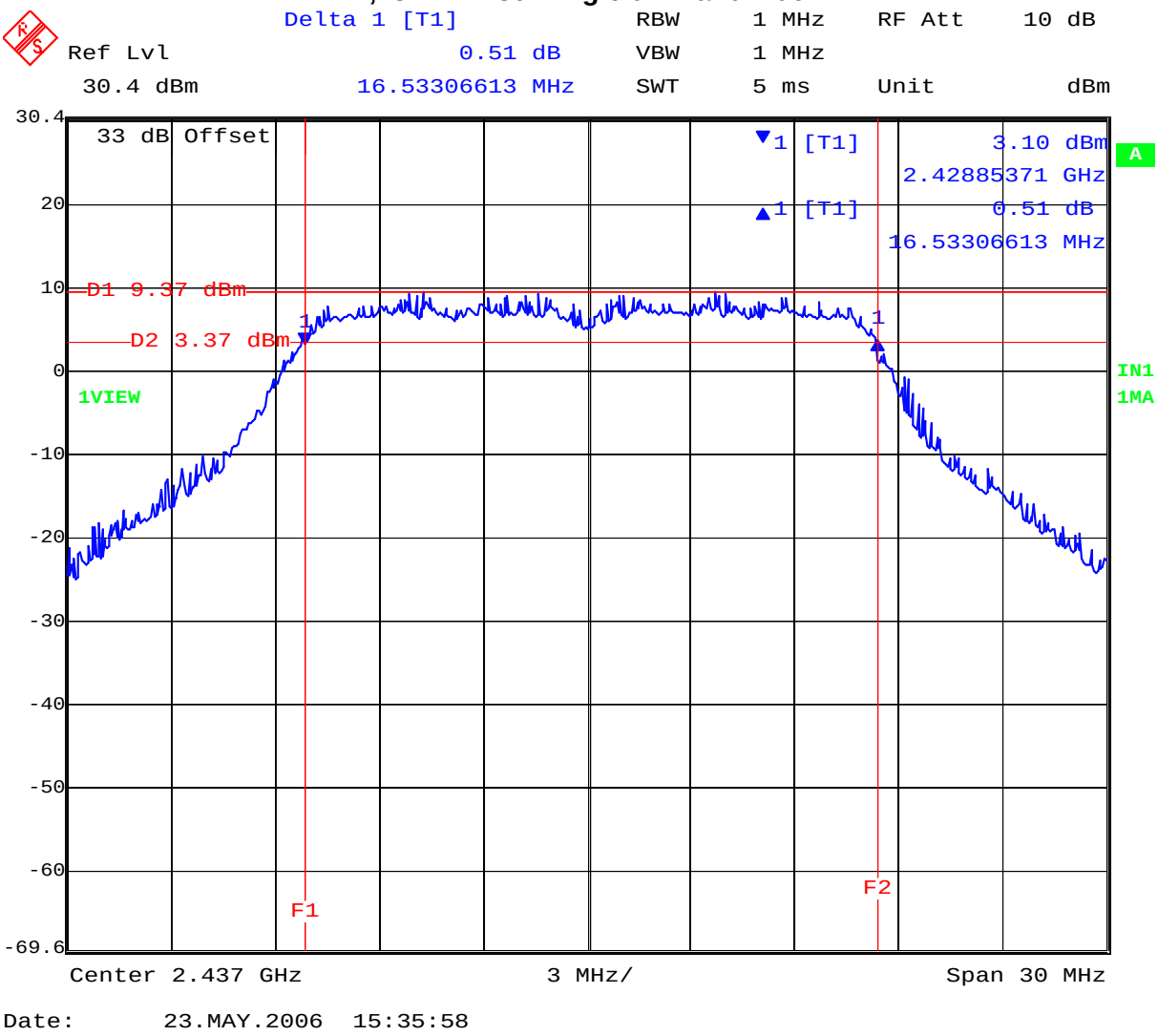


Date: 8.APR.2006 12:33:54

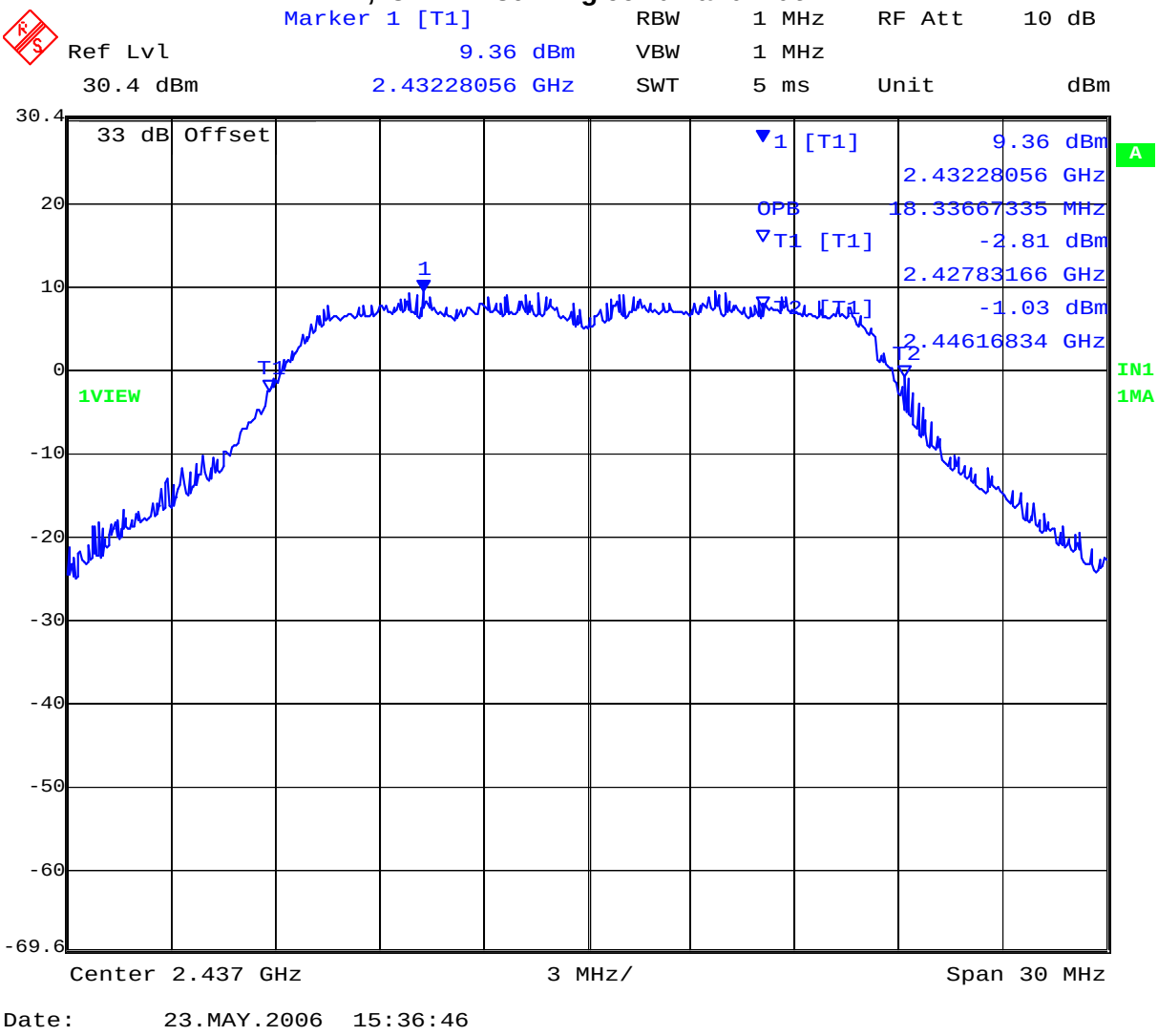
TABLE OF RESULTS – **802.11g Rate 3 - 12 Mb/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	99 % BW (MHz)	99 % BW Plots
2,412	16.23246493	On File	18.09619238	On File
2,437	16.53306613	03	18.33667335	04
2,462	16.41282565	On File	18.21643287	On File

Plot 03
2,437 MHz 802.11g 6 dB Bandwidth



Plot 04
2,437 MHz 802.11g 99 % Bandwidth



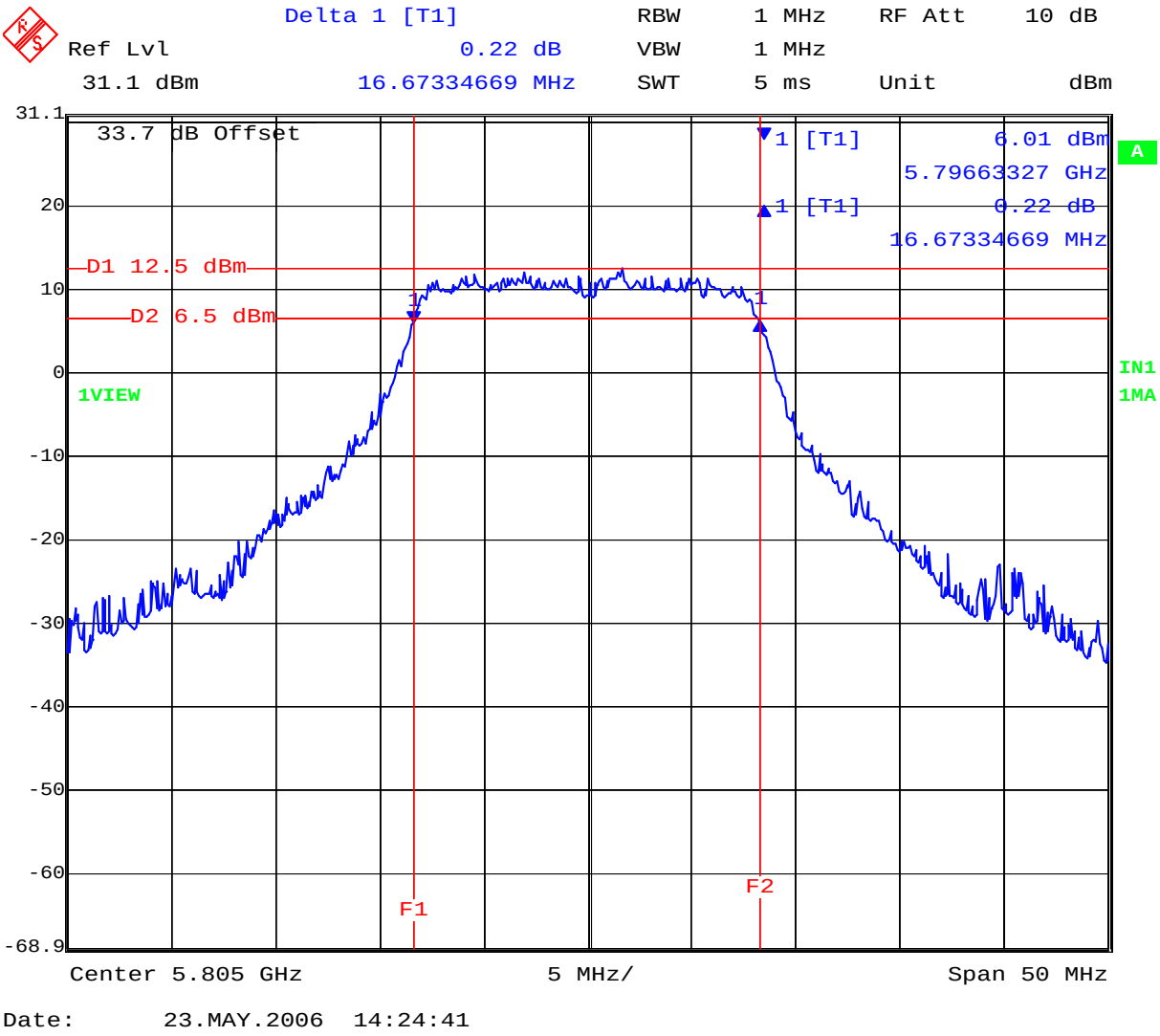
Date: 23.MAY.2006 15:36:46

TABLE OF RESULTS – **802.11a Rate 8 - 54 Mb/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	99 % BW (MHz)	99 % BW Plots
5,745	16.49298597	On File	18.43687375	06
5,785	16.63326653	On File	18.23647295	On File
5,805	16.67334669	05	18.23647295	On File

Plot 05

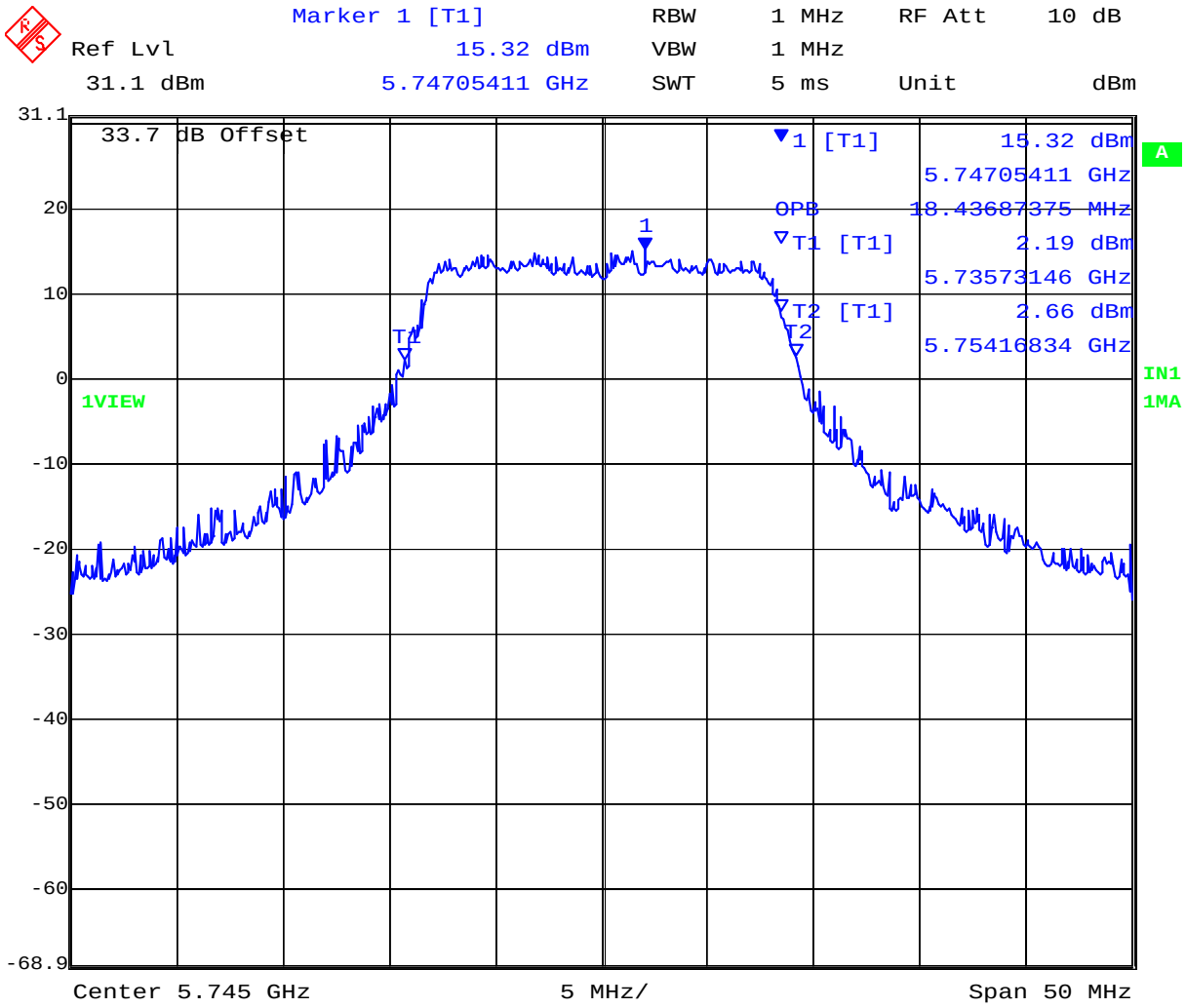
5,805 MHz 802.11a 6 dB Bandwidth



Date: 23.MAY.2006 14:24:41

Plot 06

5,745 MHz 802.11a 99 % Bandwidth



Date: 23.MAY.2006 14:19:57

Specification

Limits

§15.247 (a)(2) & RSS-210 §A8.2(1)
The minimum 6 dB bandwidth shall be at least 500 kHz.

§ IC RSS-Gen 4.4.1 Occupied Bandwidth When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

§ IC RSS-Gen 4.4.2 6 dB Bandwidth Where indicated, the 6 dB bandwidth is measured at the points when the spectral density of the signal is 6 dB down from the in –band spectral density of the modulated signal, with the transmitter modulated by a representative signal.

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	±2.81 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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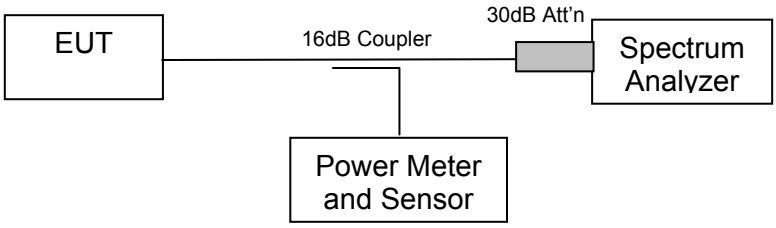
5.1.2. Peak Output Power

FCC, Part 15 Subpart C §15.247(b)(3), §15.31(e)
Industry Canada RSS-210 §A8.4(4)

Test Procedure
The transmitter terminal of EUT was connected to the input of the spectrum analyzer set to measure peak power. The resolution filter bandwidth was set to 6 dB, peak detector selected and the analyzer built-in power function was used to measure peak power over the 99 % bandwidth.

Test Measurement Set up



Measurement set up for Transmitter Peak Output Power

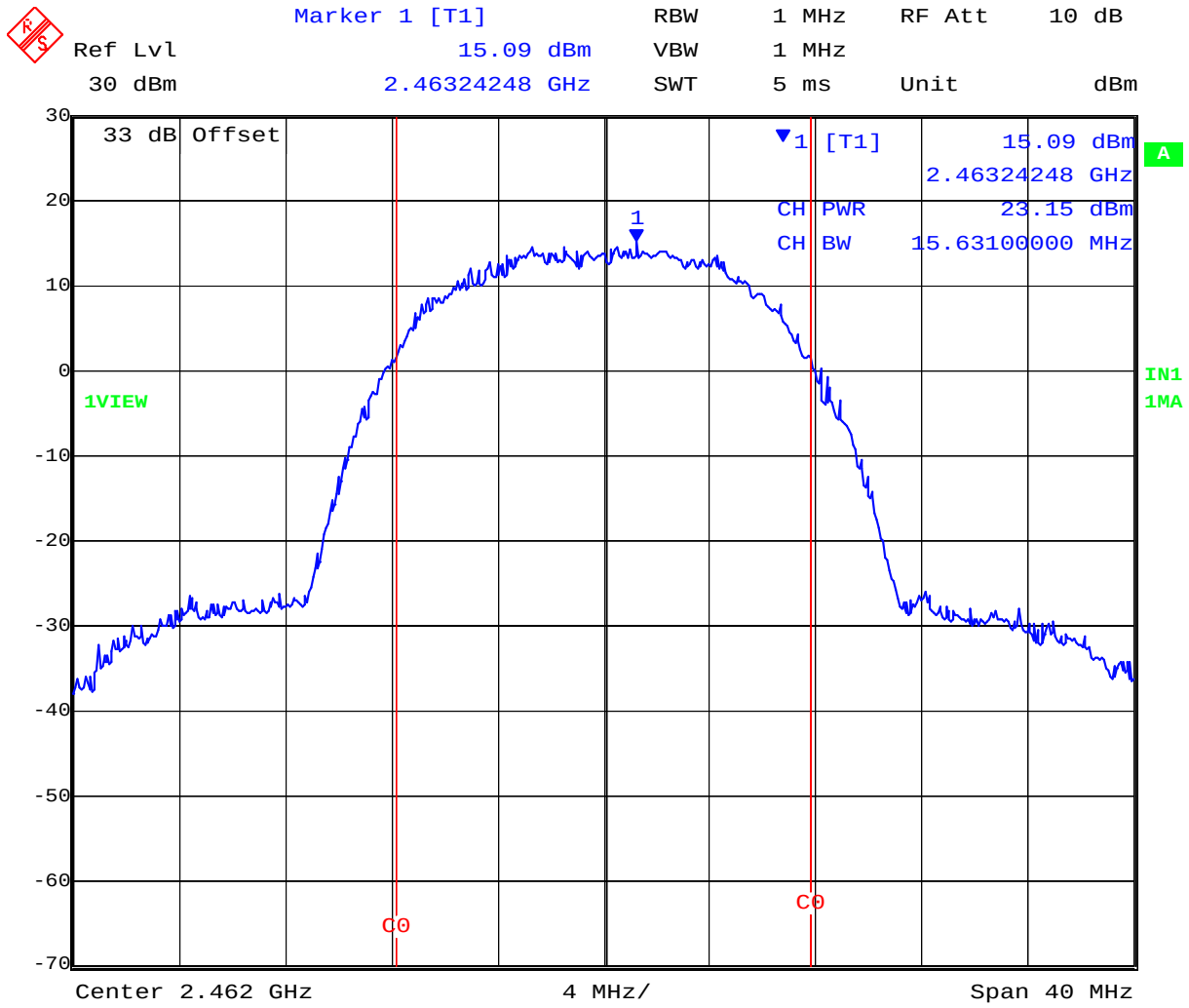
Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

TABLE OF RESULTS – **802.11b Rate 4 – 11Mb/s**

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	Plot #
2,412	15.631	+22.53	On File
2,437	15.631	+22.01	On File
2,462	15.631	+23.15	07

Plot 07
2,462 MHz 802.11b Peak Power (dBm)



Date: 8.APR.2006 12:56:15

TABLE OF RESULTS – **802.11g Rate 3 – 12Mb/s**

Center Frequency (MHz)	99%Measurement Bandwidth (MHz)	Peak Power (dBm)	Plot #
2,412	18.337	+20.01	08
2,437	18.337	+18.67	On File
2,462	18.337	+19.58	On File

Plot 08

2,412 MHz 802.11g Peak Power (dBm)

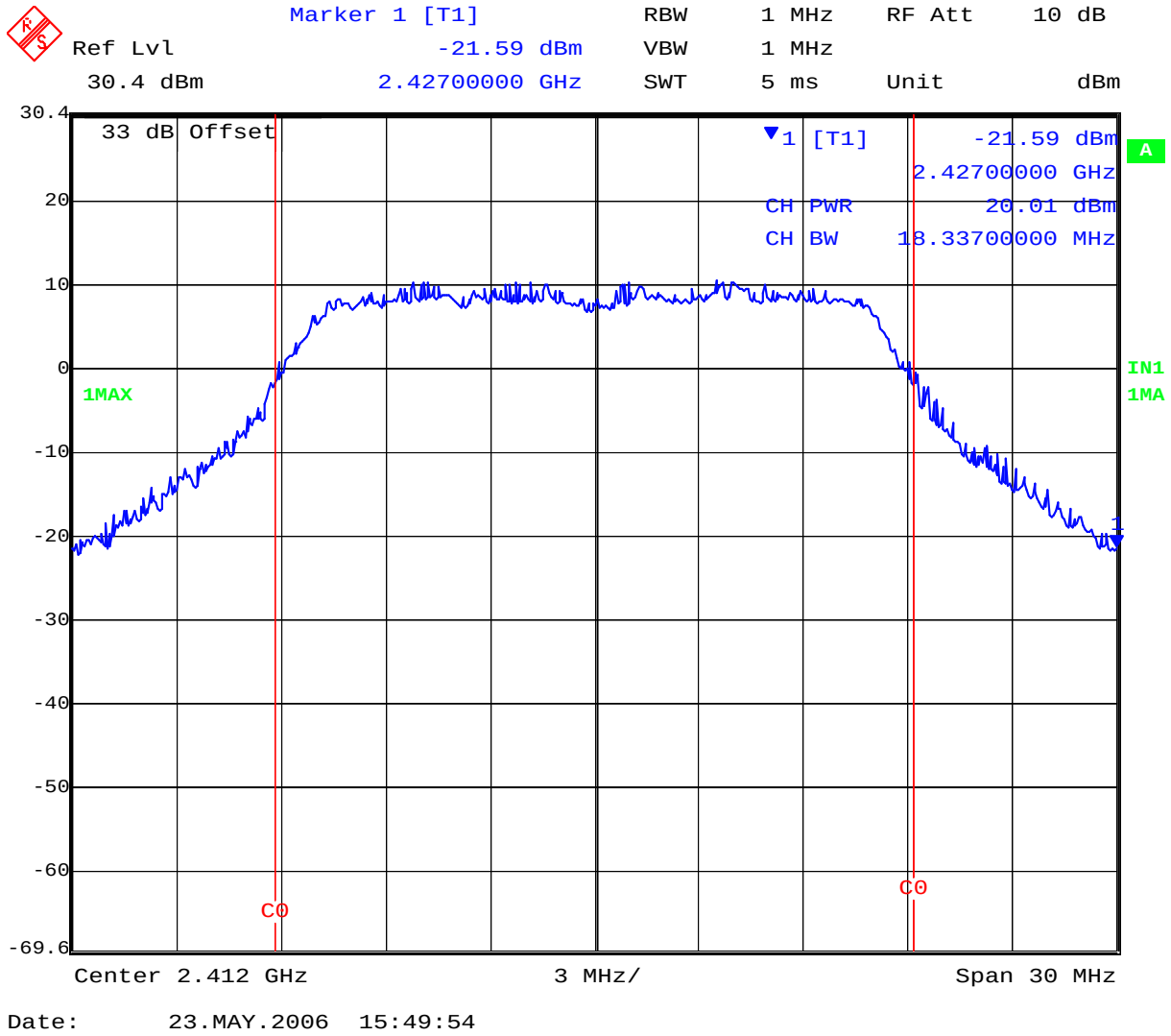
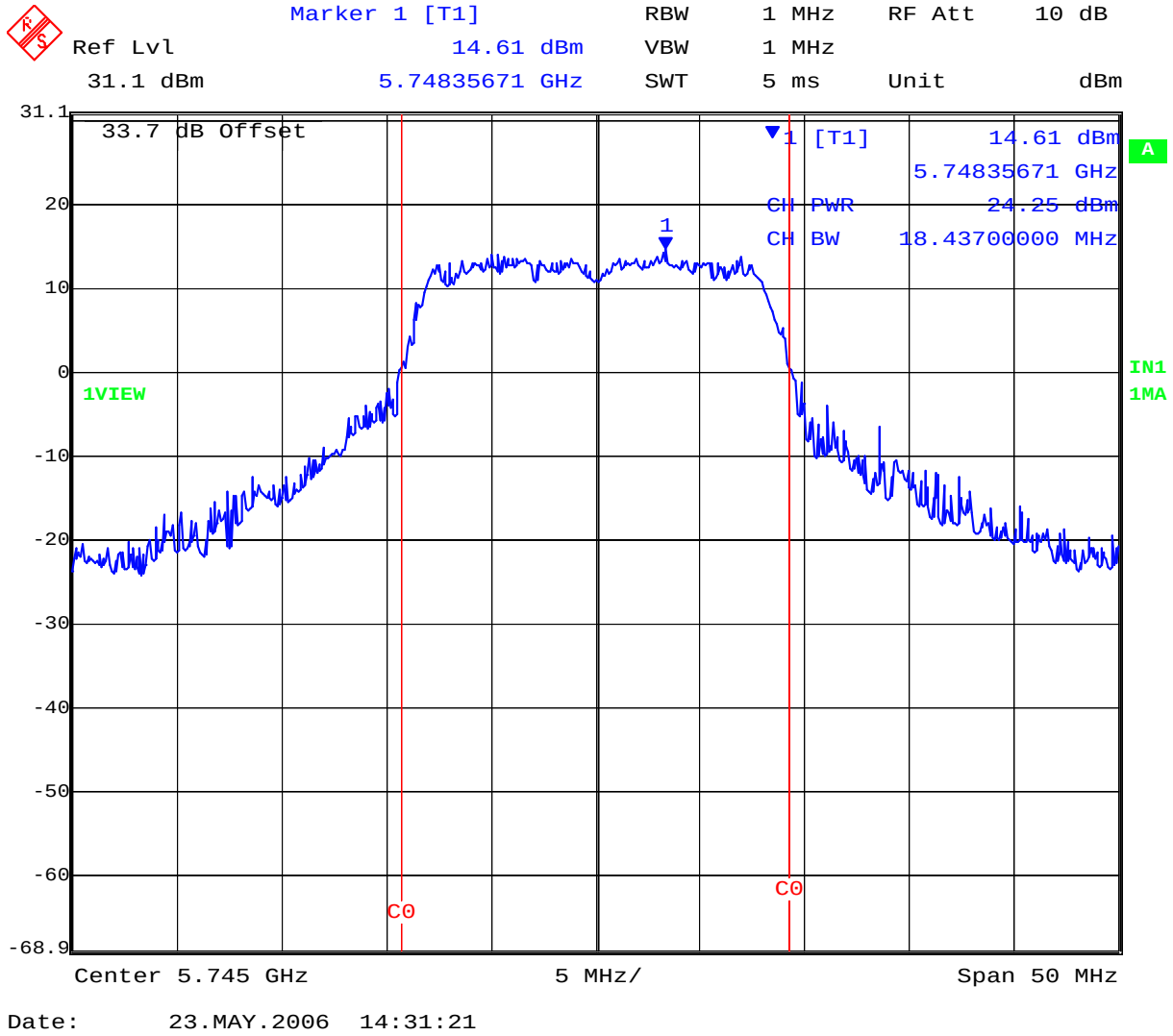


TABLE OF RESULTS – **802.11a Rate 8 – 54 Mb/s**

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	Plot #
5,745	18.437	+24.25	09
5,785	18.437	+22.12	On File
5,805	18.437	+22.10	On File

Plot 09

5,745 MHz 802.11a Peak Power (dBm)



Supply Voltage Variation

The supply voltage was varied between 3.33 Vdc to 4.05 Vdc. The system operated as intended at either extreme with no change in the above measurement bandwidths.

Specification

Limits

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

> **§15.247 (b) (3)** For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands: 1.0 watt.

§15.31 (e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

§ RSS-210 A8.4(4) For systems employing digital modulation techniques operating in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands the maximum peak conducted power shall not exceed 1 watt.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

Traceability

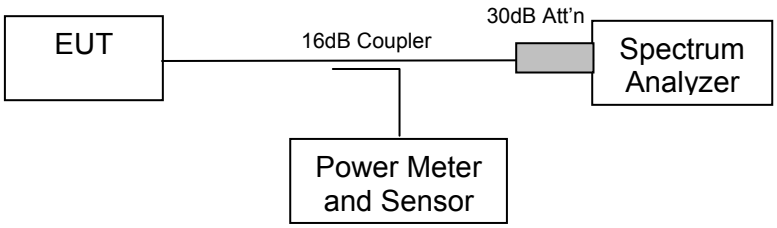
Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

5.1.3. Peak Power Spectral Density

FCC, Part 15 Subpart C §15.247(e)
Industry Canada RSS-210 §A8.2

Test Procedure
The transmitter output was connected to a spectrum analyzer and the maximum level in a 3 kHz bandwidth was measured. A peak value was found over the full emission bandwidth and the frequency span reduced to obtain enhanced resolution. Sweep time ≥ span / 3 kHz with video averaging turned off. The Peak Power Spectral Density is the highest level found across the emission in a 3 kHz resolution bandwidth.

Test Measurement Set up



Measurement set up for Peak Power Spectral Density

Measurement Results for Peak Power Spectral Density

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

TABLE OF RESULTS – **802.11b Rate 4 – 11Mb/s**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)	Plot #
2,412	2413.02906	-1.48	+8	-9.48	On File
2,437	2438.03106	-2.88	+8	-10.88	On File
2,462	2463.71844	+0.60	+8	-7.40	10

Plot 10
2,462 MHz 802.11b Peak Power Spectral Density

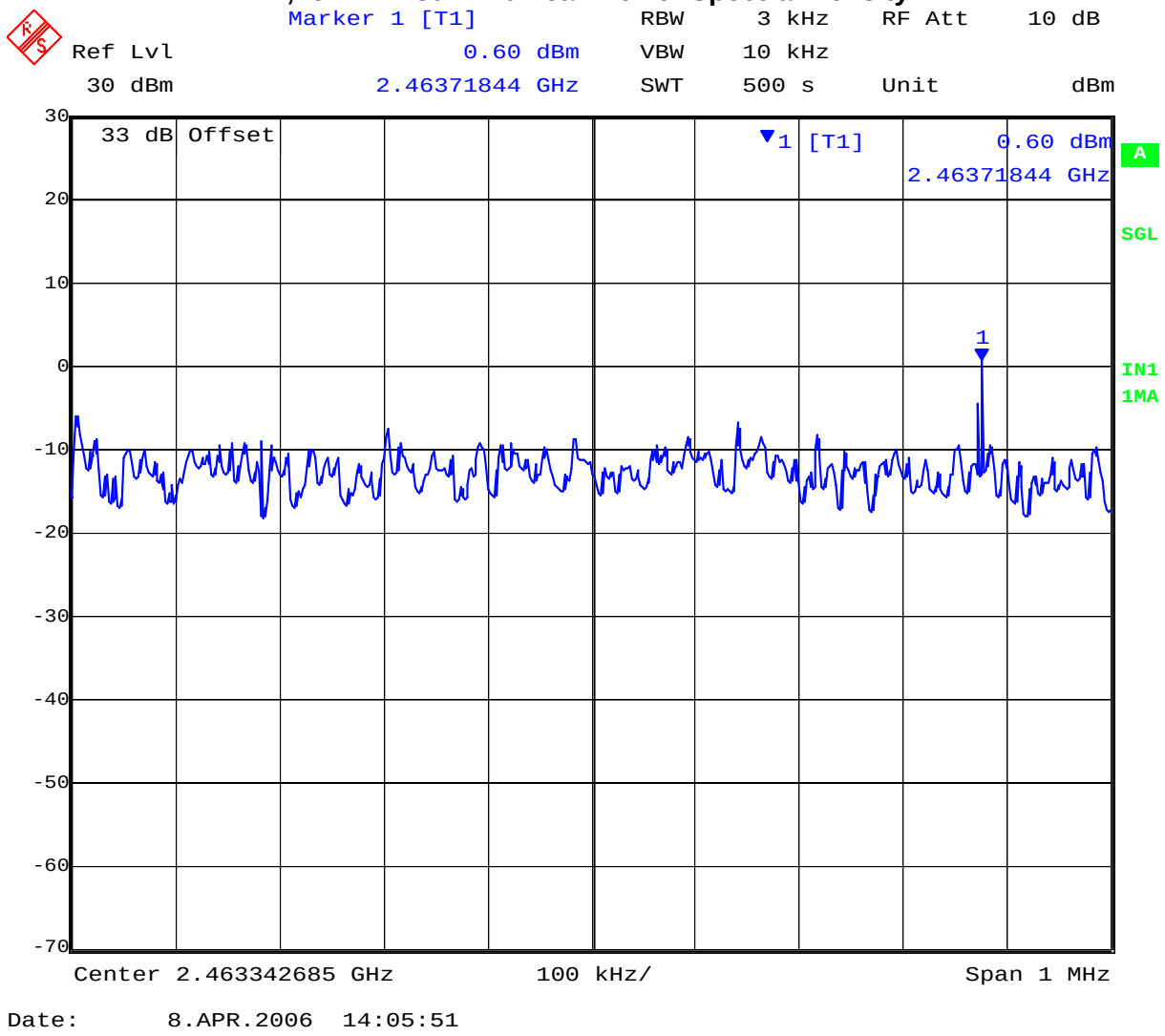


TABLE OF RESULTS – **802.11g Rate 3 – 12 Mb/s**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)	Plot #
2,412	2.41570842	-13.56	+8	-21.56	11
2,437	2.43957825	-15.28	+8	-23.28	On File
2,462	2.45731563	-16.32	+8	-24.32	On File

Plot 11
2,412 MHz 802.11g Peak Power Spectral Density

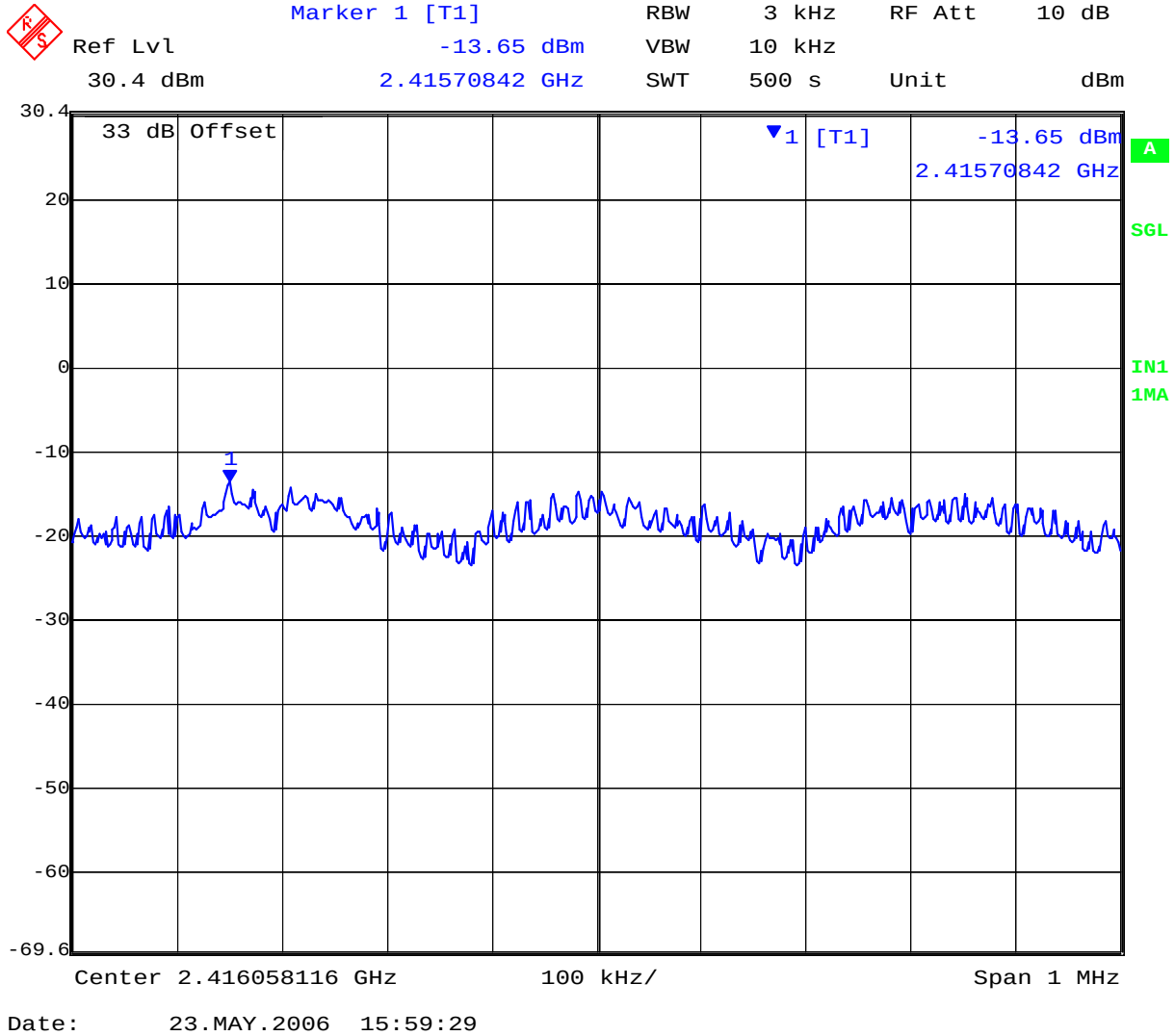
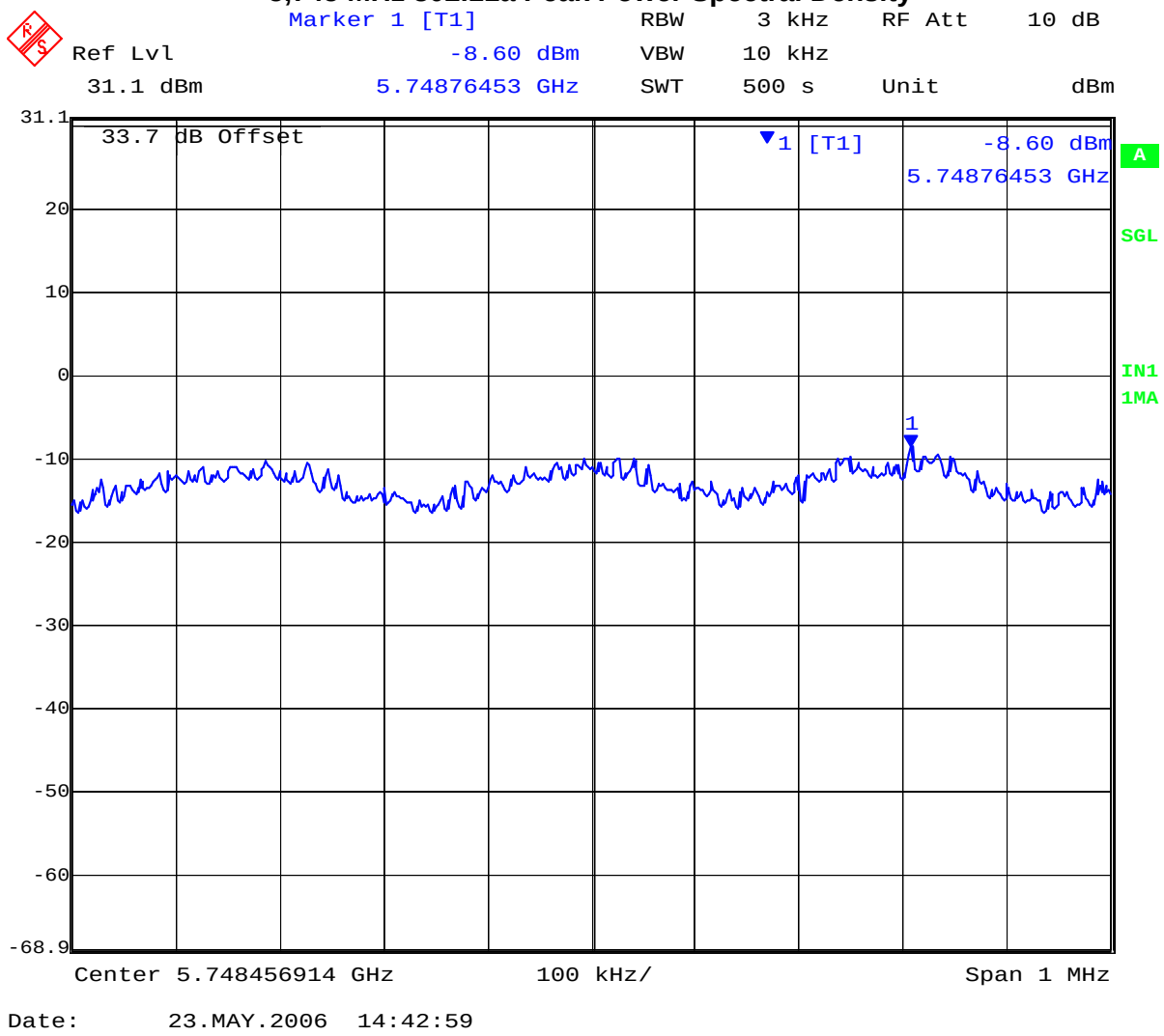


TABLE OF RESULTS – **802.11a Rate 8 – 54Mbit/s**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)	Plot #
5,745	5748.76453	-8.60	+8	-16.60	12
5,785	5786.59419	-12.04	+8	-20.04	On File
5,805	5806.59218	-12.36	+8	-20.36	On File

Plot 12
5,745 MHz 802.11a Peak Power Spectral Density



Specification
Peak Power Spectral Density Limits

§15.247(e) 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

RSS-210 §A8.2(2) The transmitter power spectral density (into the antenna) shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0 second duration.

Laboratory Measurement Uncertainty for Spectral Density

Measurement uncertainty	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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5.1.4. Maximum Permissible Exposure

FCC, Part 15 Subpart C §15.247(i)
Industry Canada RSS-Gen §5.5

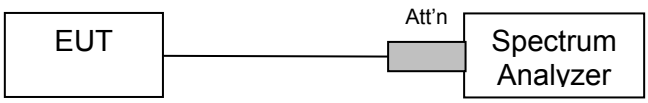
A Specific Absorption Rate (SAR) test report is available for this telephone device.

5.1.5. Conducted Spurious Emissions

FCC, Part 15 Subpart C §15.247(d); 15.205; 15.209
Industry Canada RSS-210 §A8.5, §2.2
Industry Canada RSS-Gen 4.7

Test Procedure
Conducted emissions were measured at a limit of 20 dB below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Emissions at the band edge were measured and recorded. Measurements were made while EUT was operating in transmit mode of operation at the appropriate center frequency.

Test Measurement Set up



Band-edge measurement test configuration

Measurement Results of Conducted Spurious Emissions

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Conducted Band-Edge Results

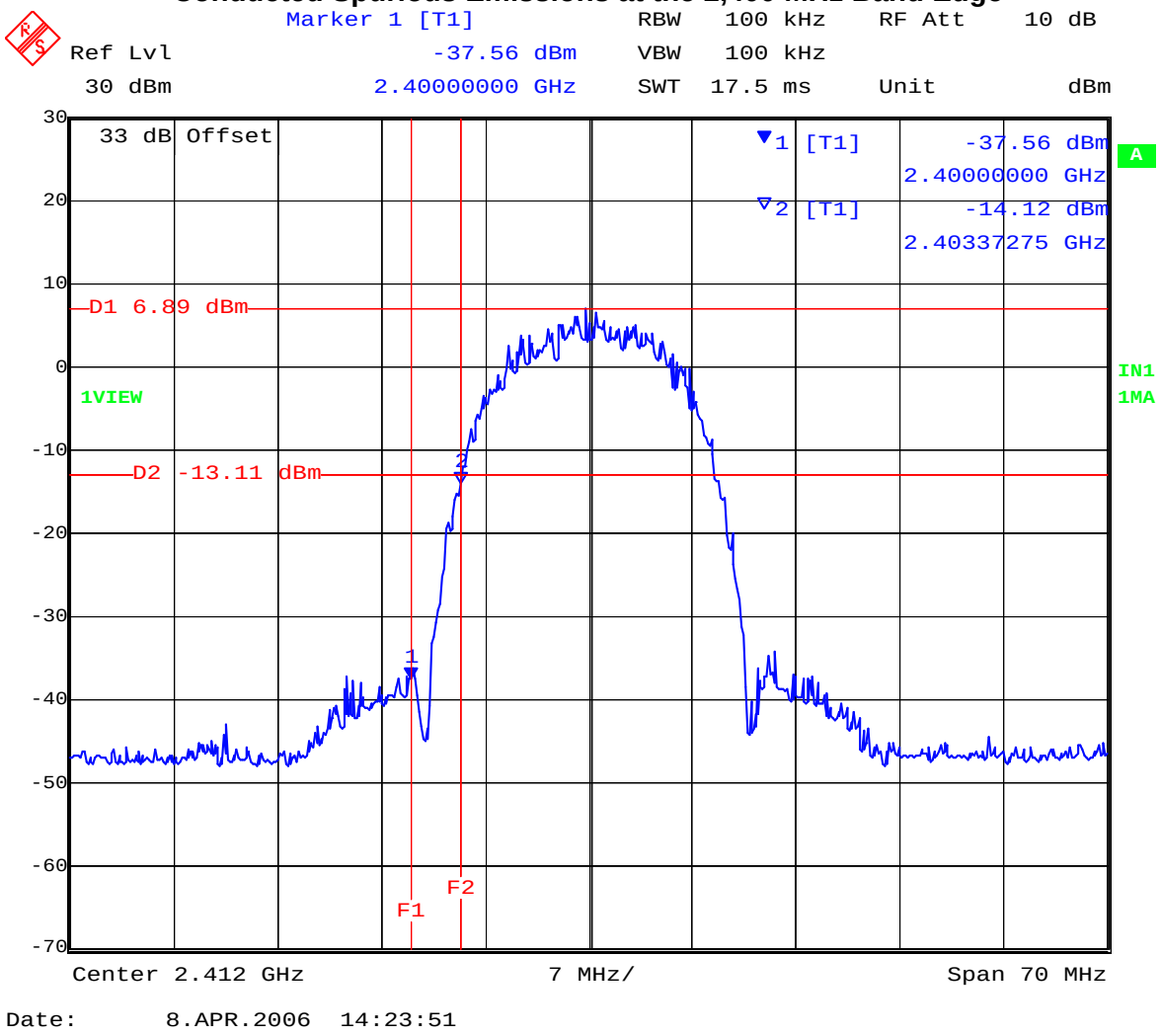
Measurements were performed with the transmitter tuned to the channel closest to the band-edge being measured. All emissions were maximized during measurement. Limits which were derived from the band-edge measurements provided below are drawn on each plot.

TABLE OF RESULTS – **802.11b Rate 4 – 11 Mbit/s**

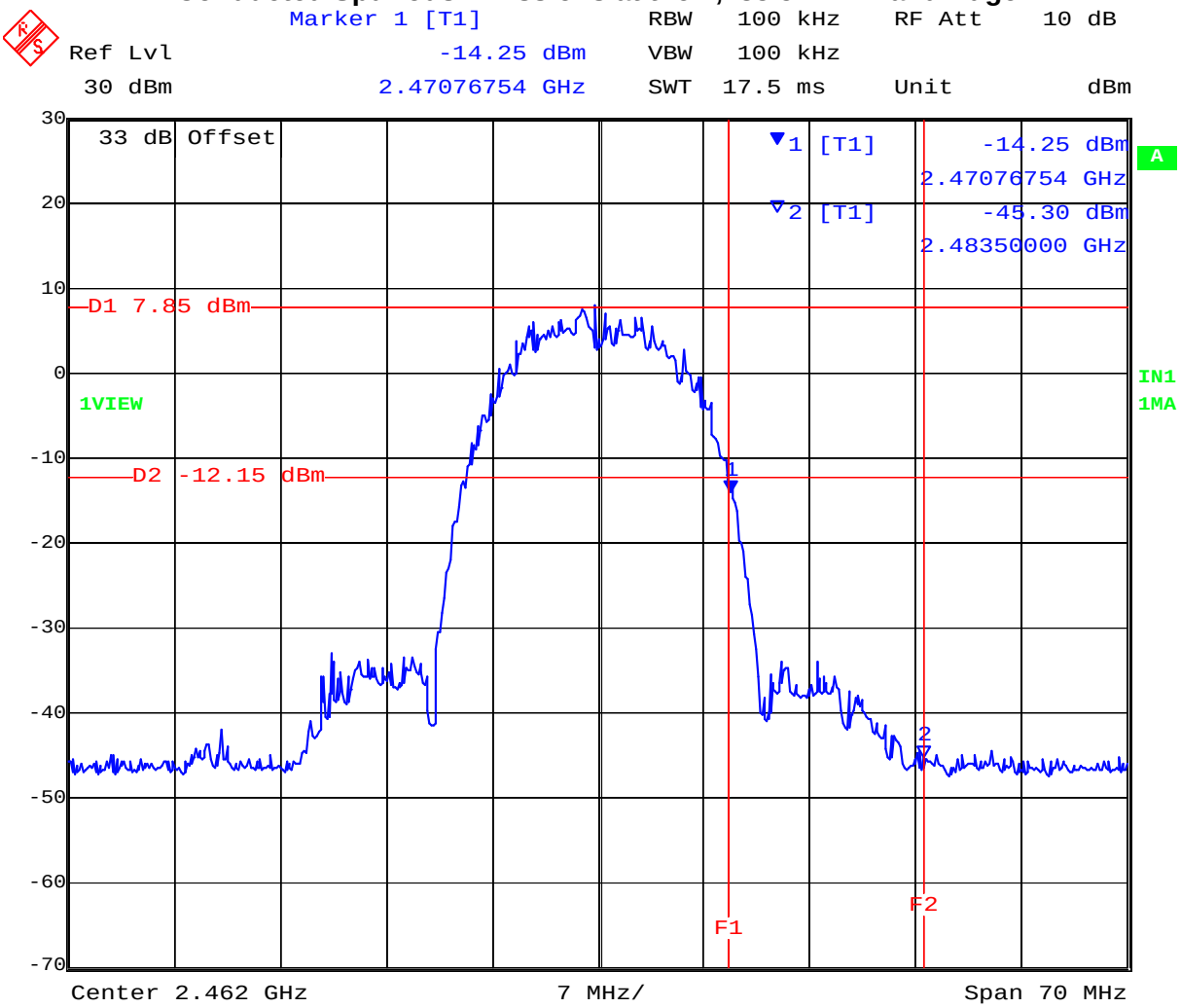
Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Plot #	Margin (dB)
2,412	2,400	-13.11	-37.56	13	-24.45
2,462	2,483.5	-12.15	-45.30	14	-33.15

Plot 13

Conducted Spurious Emissions at the 2,400 MHz Band Edge



Plot 14
Conducted Spurious Emissions at the 2,483.5 MHz Band Edge

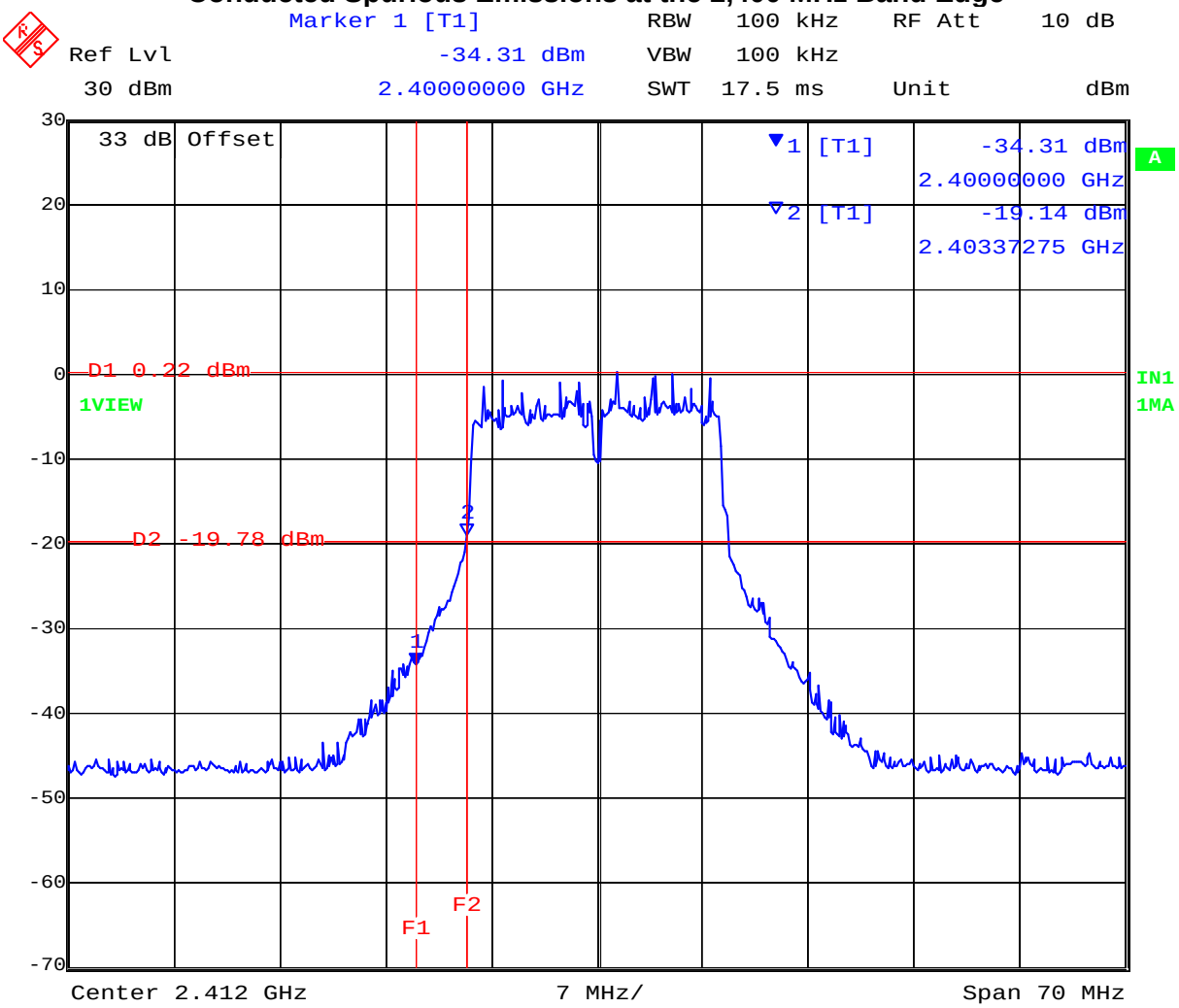


Date: 8.APR.2006 14:33:07

TABLE OF RESULTS – **802.11g Rate 3 – 12 Mbit/s**

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Plot #	Margin (dB)
2,412	2,400	-19.78	-34.31	15	-14.53
2,462	2,483.5	-19.88	-46.63	16	-26.75

Plot 15
Conducted Spurious Emissions at the 2,400 MHz Band Edge



Date: 8.APR.2006 14:27:33

Plot 16
Conducted Spurious Emissions at the 2,483.5 MHz Band Edge

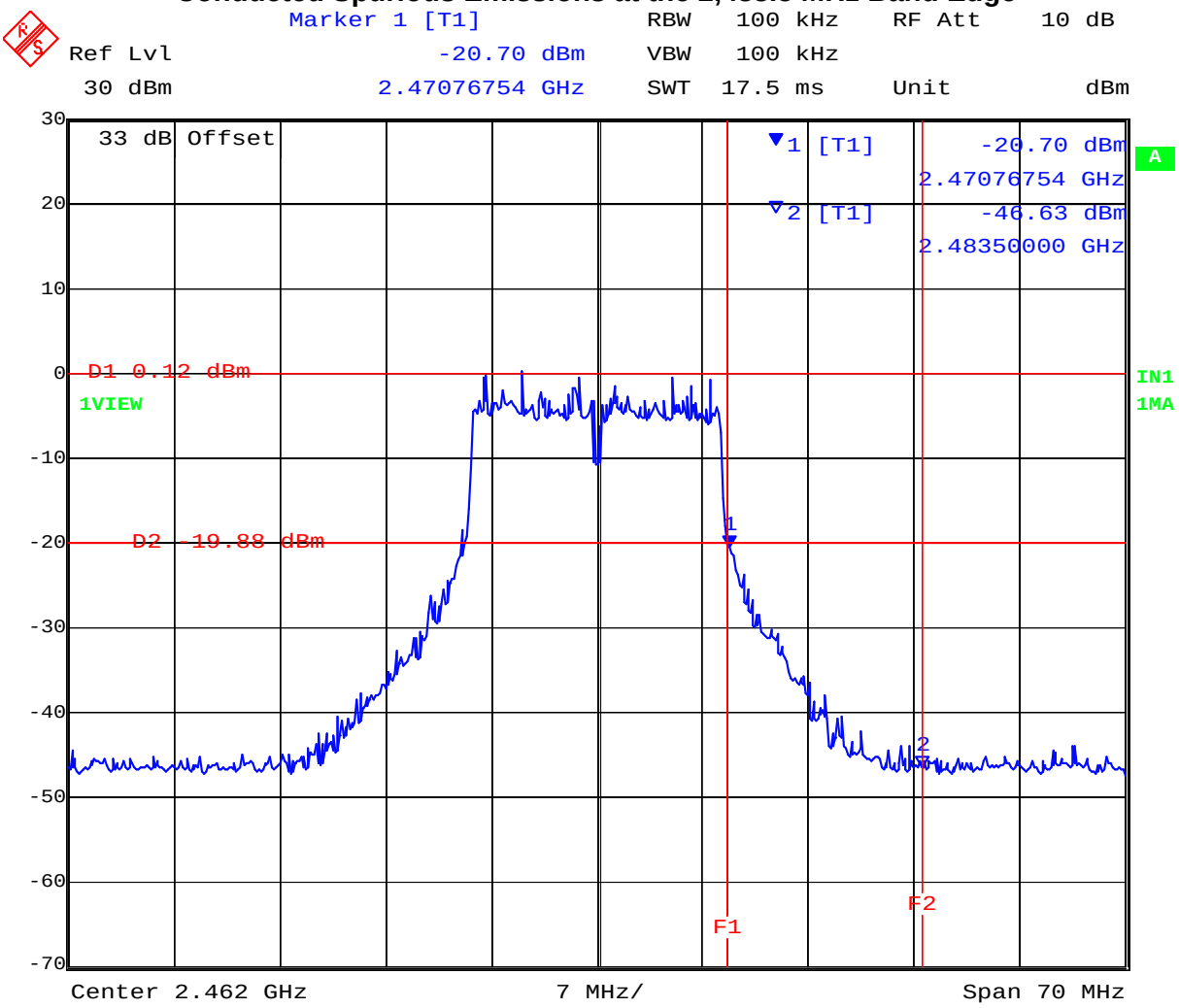
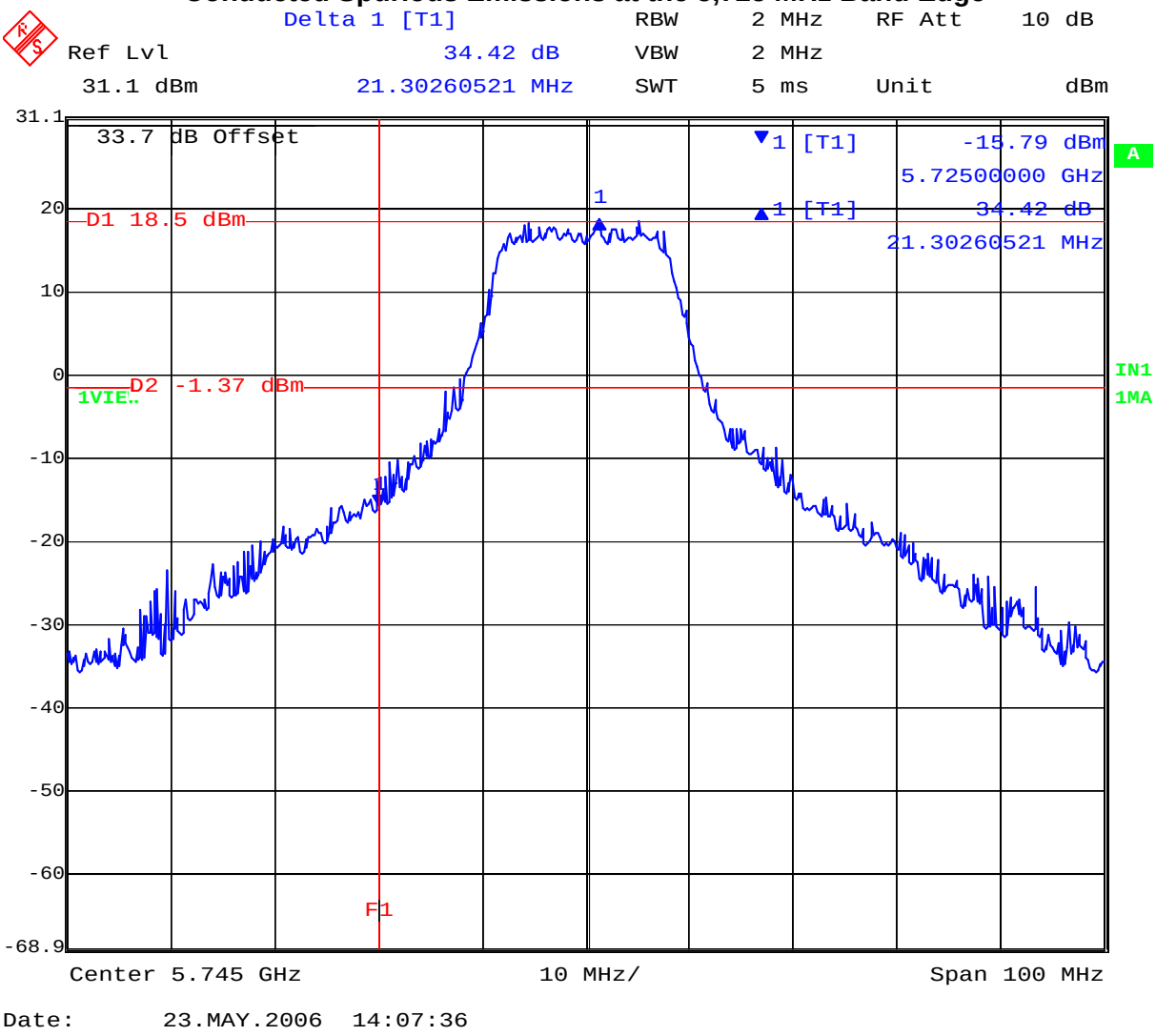


TABLE OF RESULTS – **802.11a Rate 8 – 54Mbit/s**

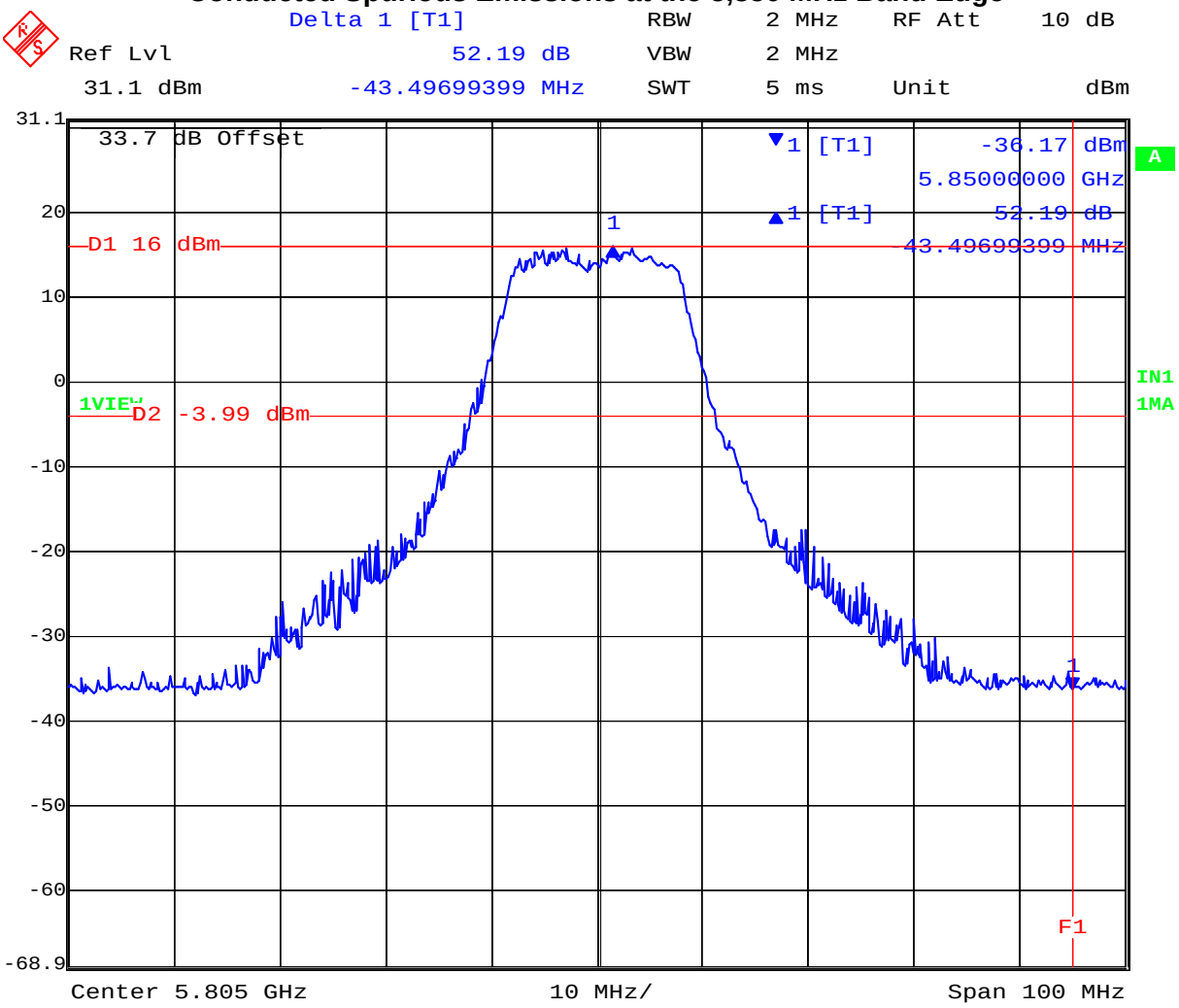
Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Plot #	Margin (dB)
5,745	5,725	-1.37	-15.79	17	-14.42
5,805	5,850	-3.99	-36.17	18	-32.18

Plot 17
Conducted Spurious Emissions at the 5,725 MHz Band Edge



Date: 23.MAY.2006 14:07:36

Plot 18
Conducted Spurious Emissions at the 5,850 MHz Band Edge



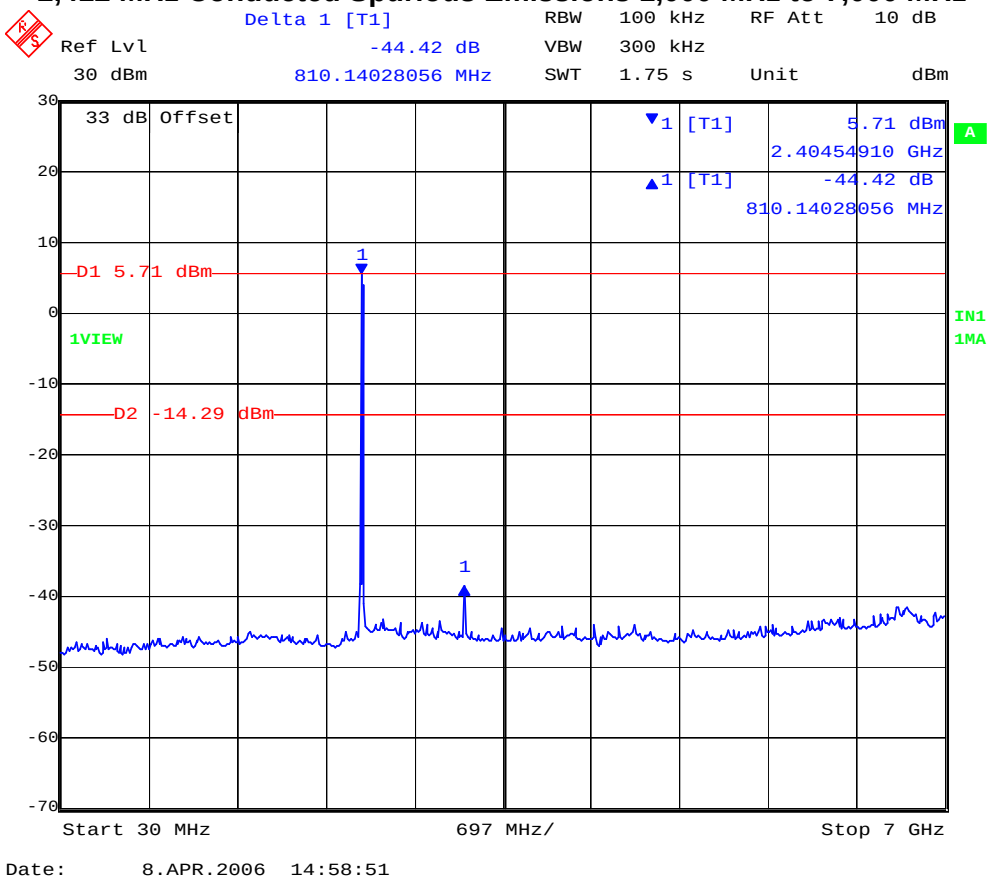
Spurious Emissions (1-25 GHz)

TABLE OF RESULTS – **802.11b Rate 4 – 11 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
2,412	30	7,000	-38.71	-14.29	19	-24.42
2,412	7,000	12,750	-53.97	-14.29	20	-39.68
2,412	12,750	18,000	-53.97	-14.29	21	-39.68
2,412	18,000	25,000	-53.97	-14.29	22	-39.68

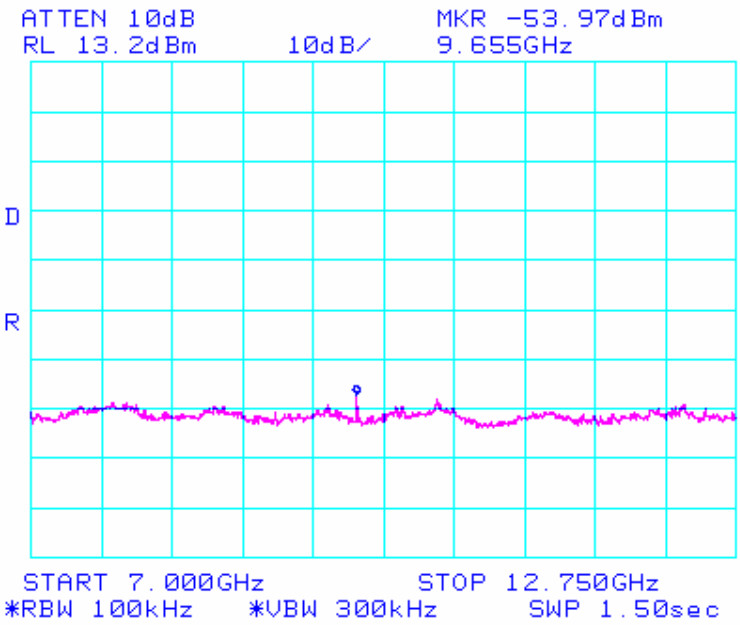
Plot 19 802.11b Rate 4 – 11 Mbit/s

2,412 MHz Conducted Spurious Emissions 1,000 MHz to 7,000 MHz



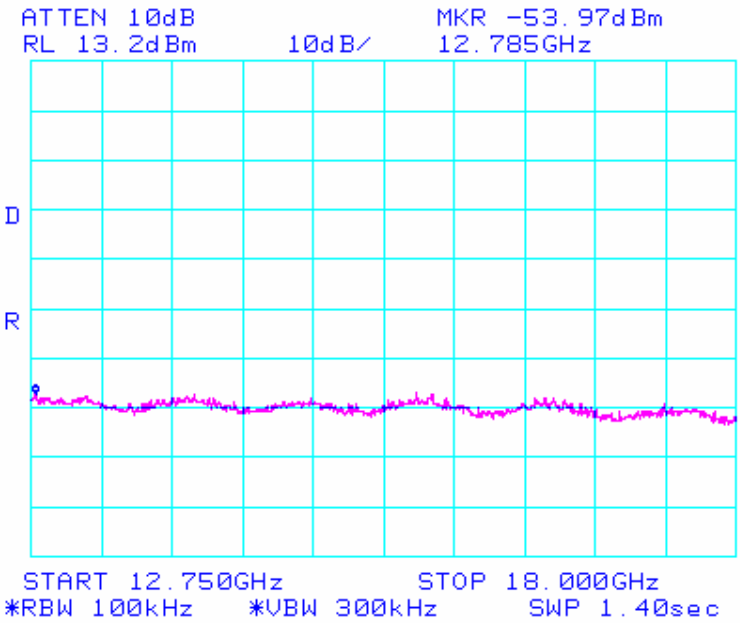
Plot 20 802.11b Rate 4 – 11 Mbit/s

2,412 MHz Conducted Spurious Emissions 7,000 MHz to 12,750 MHz



Plot 21 802.11b Rate 4 – 11 Mbit/s

2,412 MHz Conducted Spurious Emissions 12,750 MHz to 18,000 MHz



Plot 22 802.11b Rate 4 – 11 Mbit/s

2,412 MHz Conducted Spurious Emissions 18,000 MHz to 25,000 MHz

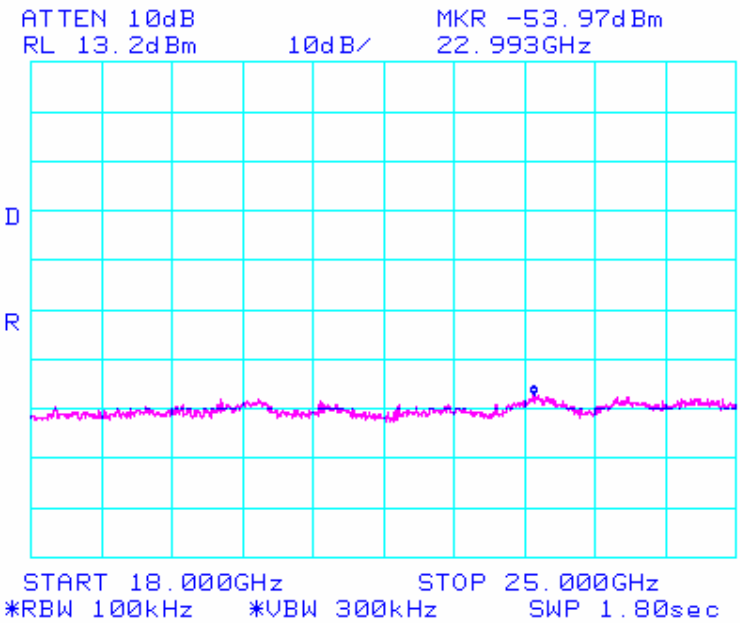
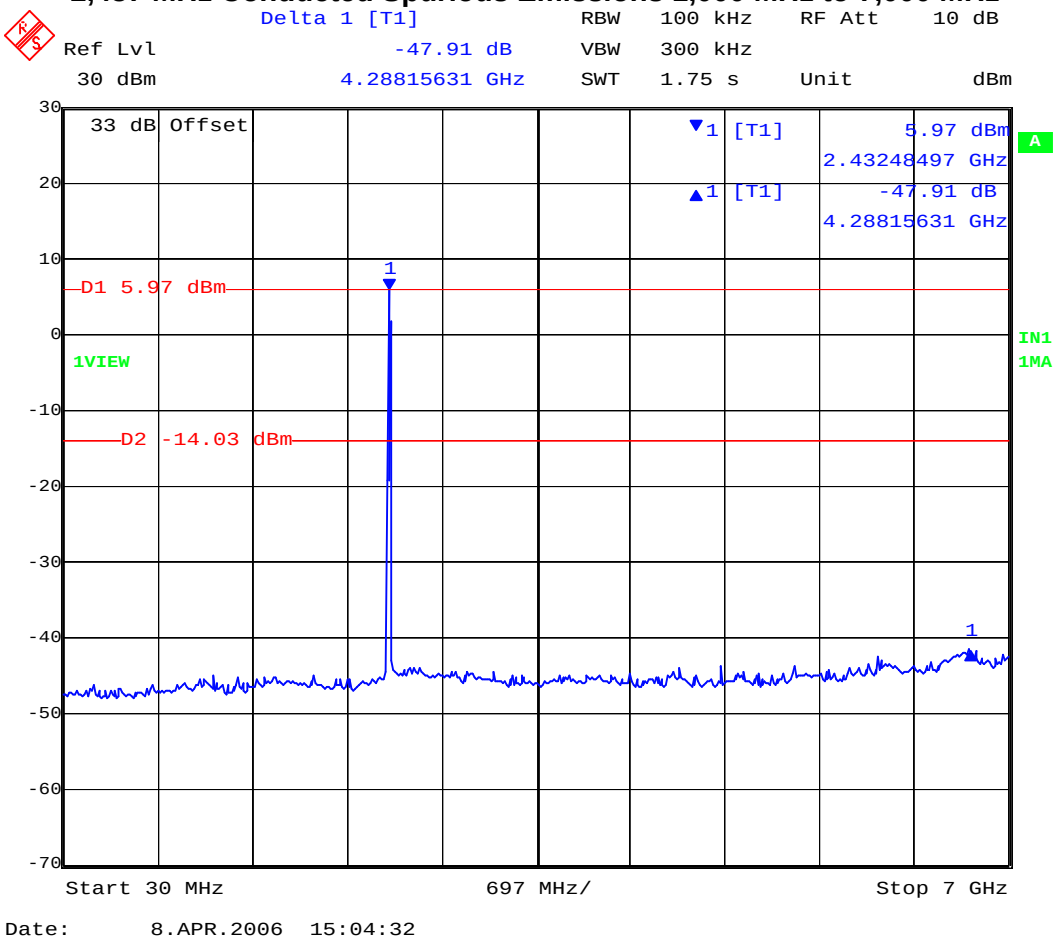


TABLE OF RESULTS – **802.11b Rate 4 – 11 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
2,437	30	7,000	-41.94	-14.03	23	-27.91
2,437	7,000	12,750	-53.80	-14.03	24	-39.77
2,437	12,750	18,000	-53.63	-14.03	25	-39.60
2,437	18,000	25,000	-54.13	-14.03	26	-40.10

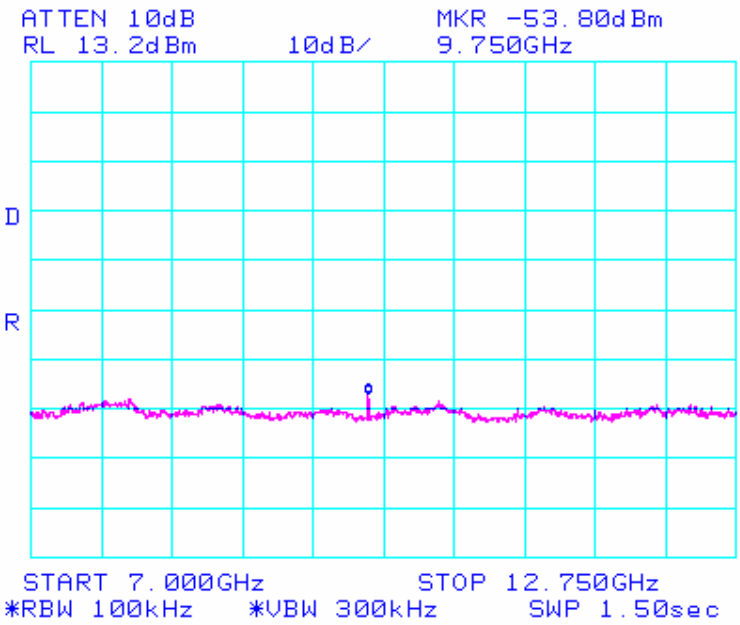
Plot 23 802.11b Rate 4 – 11 Mbit/s

2,437 MHz Conducted Spurious Emissions 1,000 MHz to 7,000 MHz



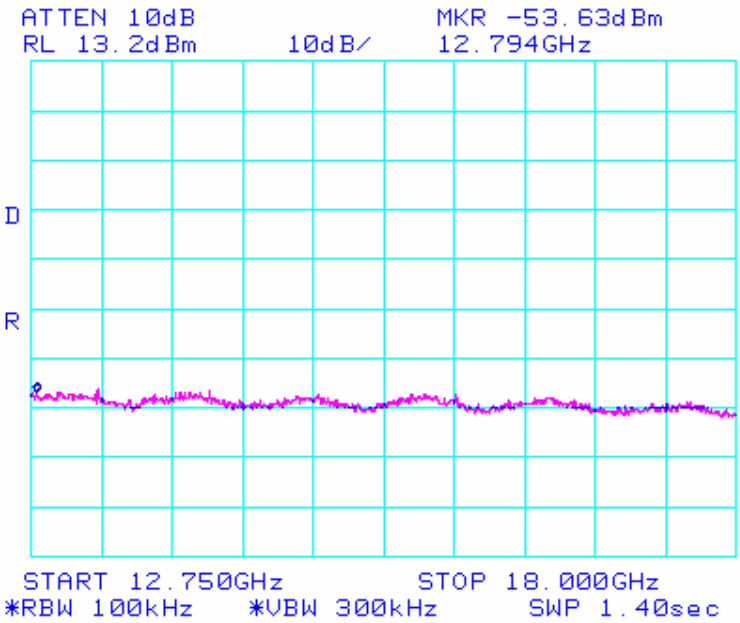
Plot 24 802.11b Rate 4 – 11 Mbit/s

2,437 MHz Conducted Spurious Emissions 7,000 MHz to 12,750 MHz



Plot 25 802.11b Rate 4 – 11 Mbit/s

2,437 MHz Conducted Spurious Emissions 12,750 MHz to 18,000 MHz



Plot 26 802.11b Rate 4 – 11 Mbit/s

2,437 MHz Conducted Spurious Emissions 18,000 MHz to 25,000 MHz

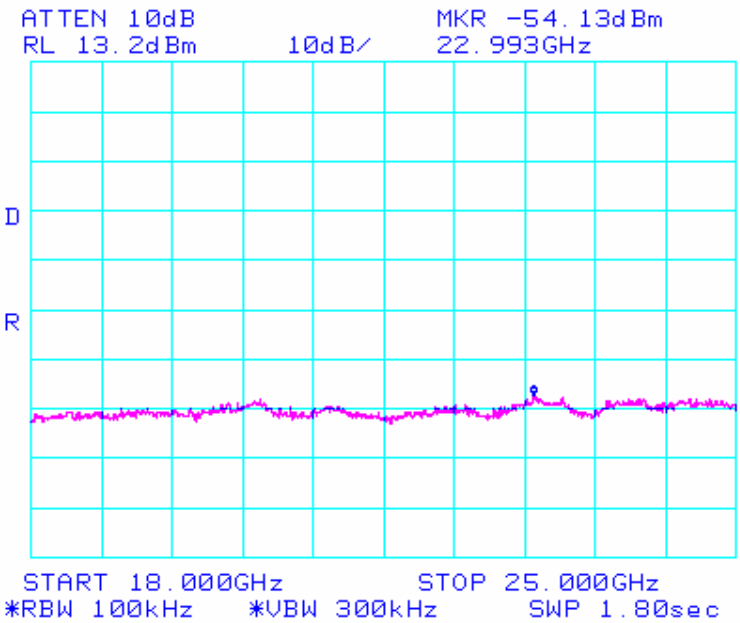
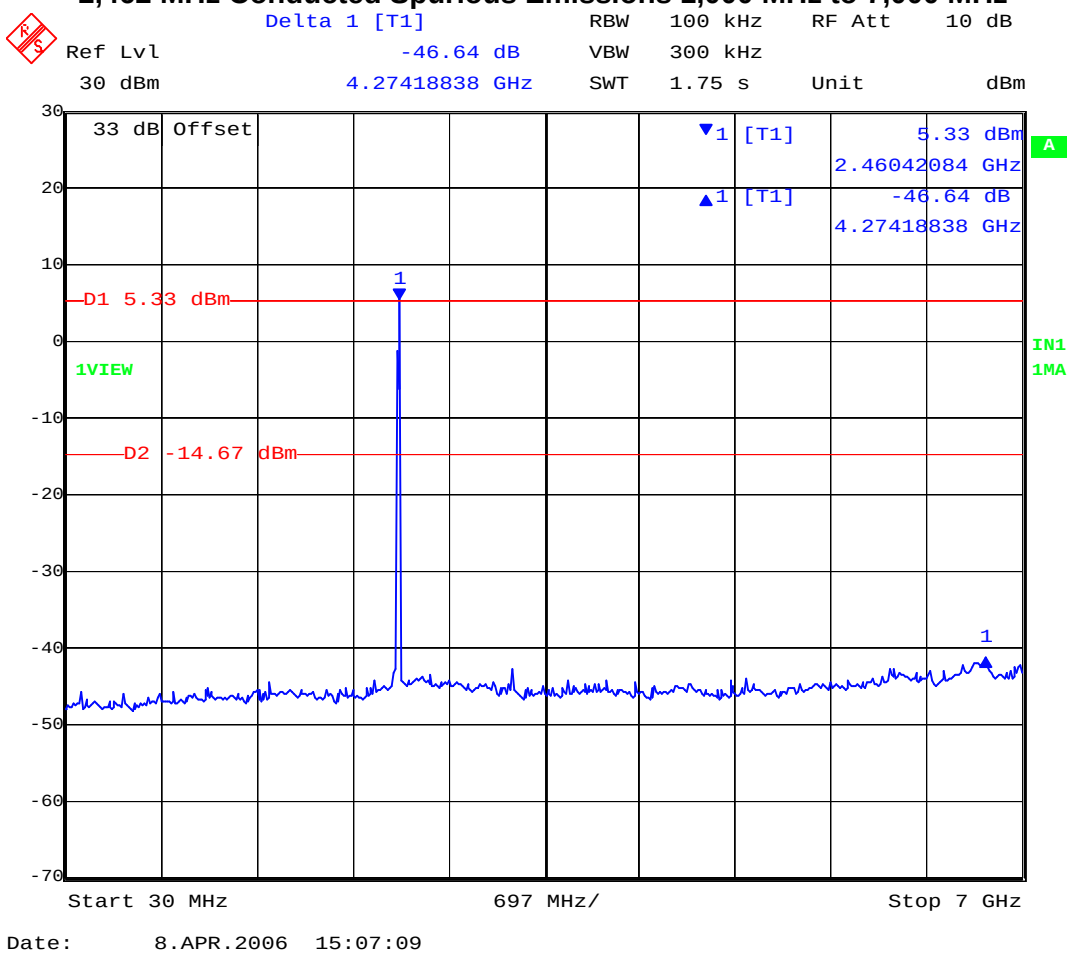


TABLE OF RESULTS – **802.11b Rate 4 – 11 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
2,462	30	7,000	-41.31	-14.67	27	-26.64
2,462	7,000	12,750	-55.80	-14.67	28	-41.13
2,462	12,750	18,000	-54.30	-14.67	29	-39.63
2,462	18,000	25,000	-54.47	-14.67	30	-39.80

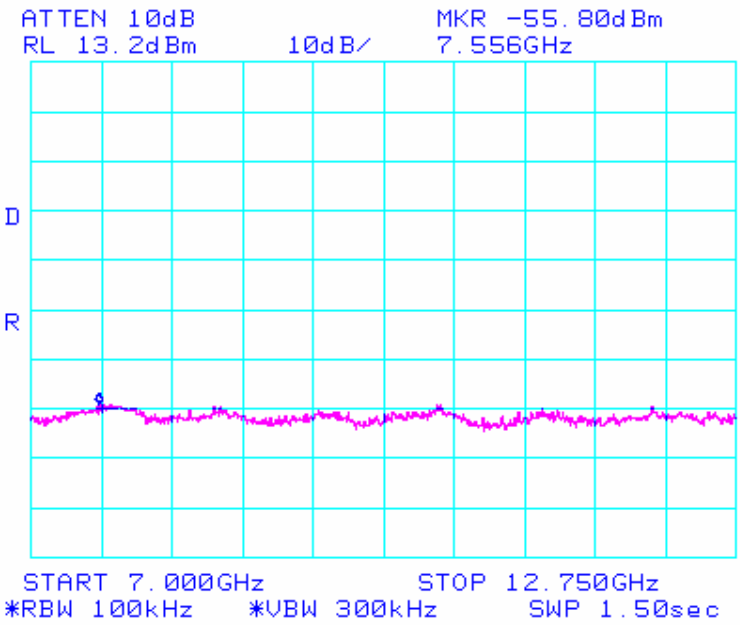
Plot 27 802.11b Rate 4 – 11 Mbit/s

2,462 MHz Conducted Spurious Emissions 1,000 MHz to 7,000 MHz



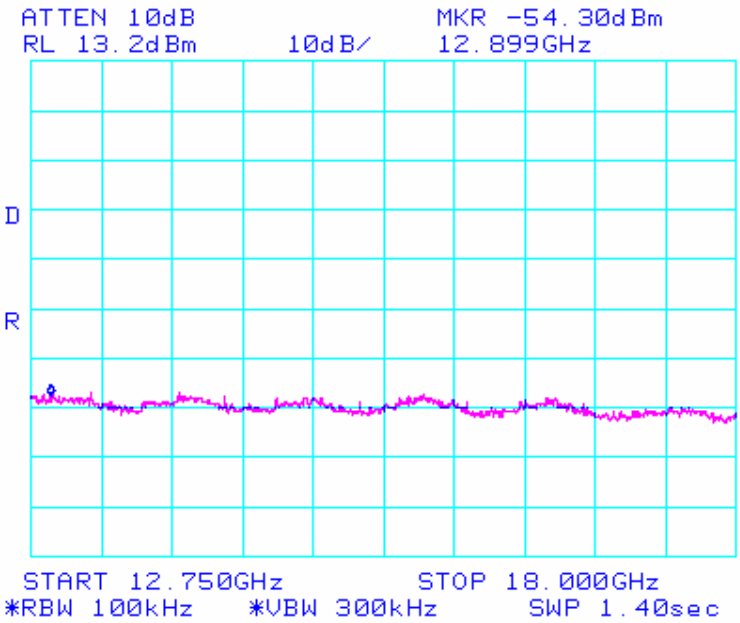
Plot 28 802.11b Rate 4 – 11 Mbit/s

2,462 MHz Conducted Spurious Emissions 7,000 MHz to 12,750 MHz



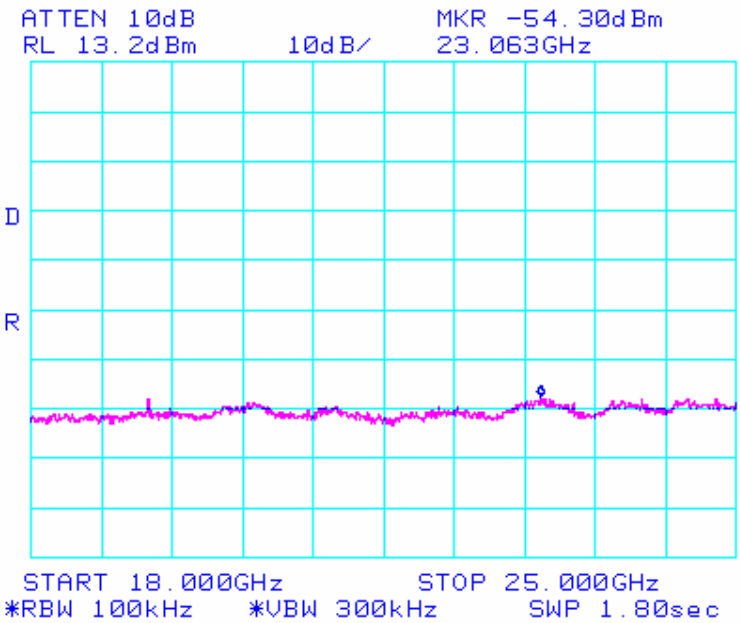
Plot 29 802.11b Rate 4 – 11 Mbit/s

2,462 MHz Conducted Spurious Emissions 12,750 MHz to 18,000 MHz



Plot 30 802.11b Rate 4 – 11 Mbit/s

2,462 MHz Conducted Spurious Emissions 18,000 MHz to 25,000 MHz



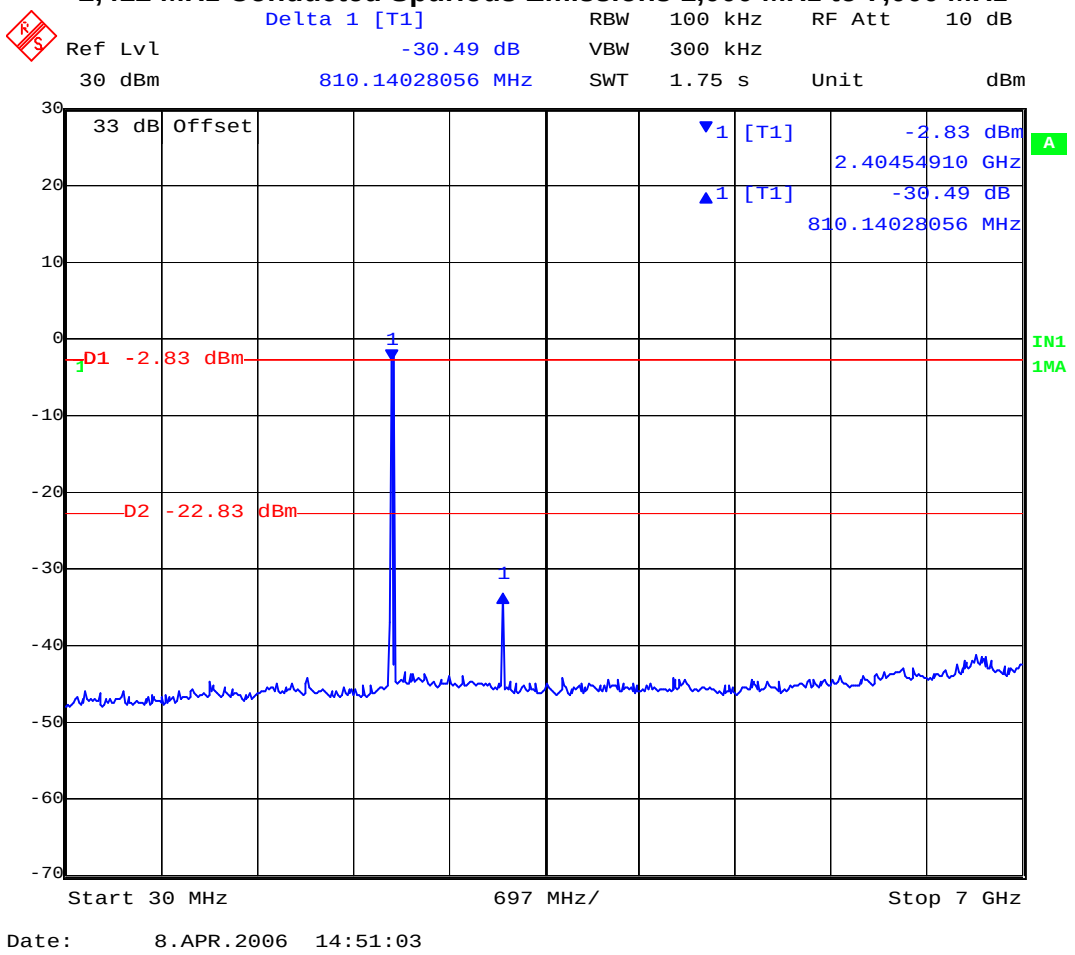
Spurious Emissions (1-25 GHz)

TABLE OF RESULTS – **802.11g Rate 3 – 12 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
2,412	30	7,000	-33.32	-22.83	31	-10.49
2,412	7,000	12,750	-56.13	-22.83	32	-33.30
2,412	12,750	18,000	-54.63	-22.83	33	-31.80
2,412	18,000	25,000	-53.80	-22.83	34	-30.97

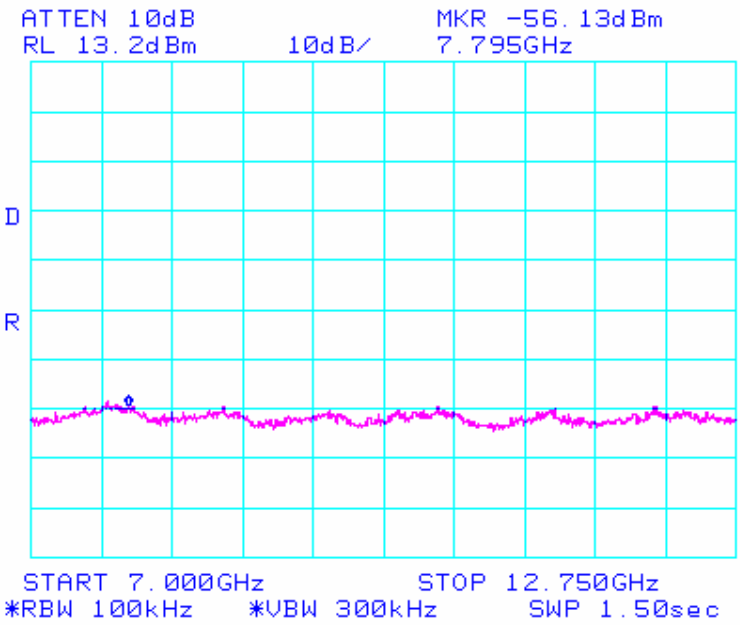
Plot 31 802.11g Rate 3 – 12 Mbit/s

2,412 MHz Conducted Spurious Emissions 1,000 MHz to 7,000 MHz



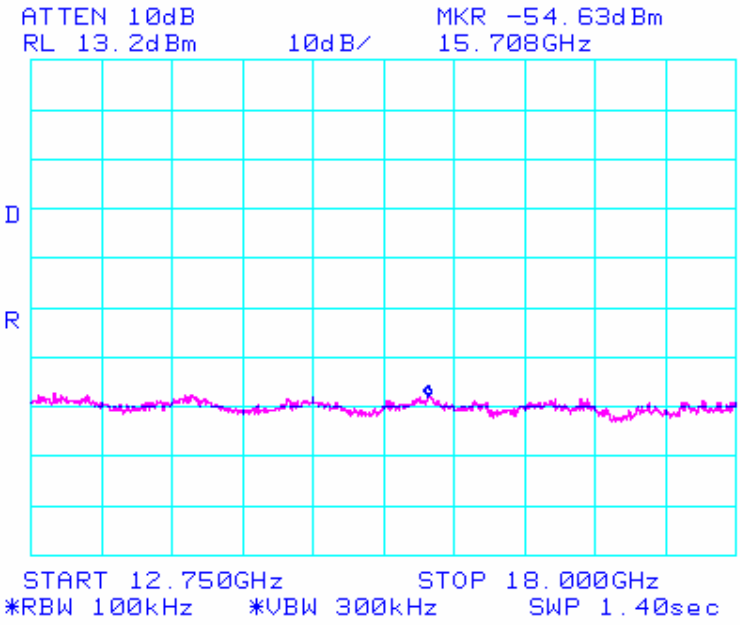
Plot 32 802.11g Rate 3 – 12 Mbit/s

2,412 MHz Conducted Spurious Emissions 7,000 MHz to 12,750 MHz



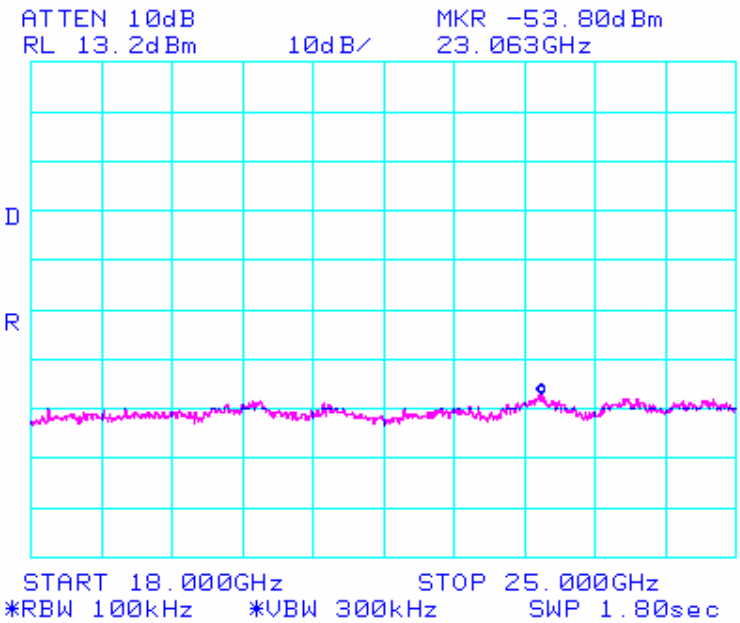
Plot 33 802.11g Rate 3 – 12 Mbit/s

2,412 MHz Conducted Spurious Emissions 12,750 MHz to 18,000 MHz



Plot 34 802.11g Rate 3 – 12 Mbit/s

2,412 MHz Conducted Spurious Emissions 18,000 MHz to 25,000 MHz



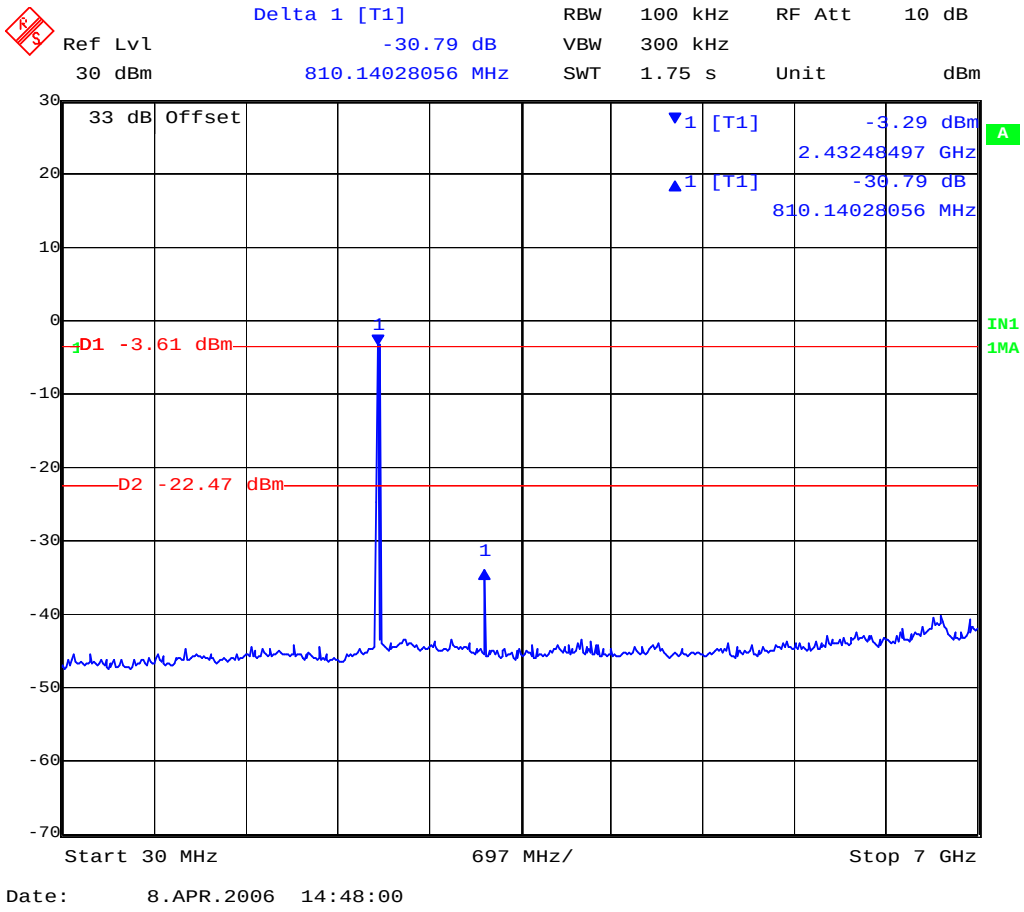
Spurious Emissions (1-25 GHz)

TABLE OF RESULTS – **802.11g Rate 3 – 12 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
2,437	30	7,000	-34.08	-22.47	35	-11.61
2,437	7,000	12,750	-55.47	-22.47	36	-33.00
2,437	12,750	18,000	-54.13	-22.47	37	-31.66
2,437	18,000	25,000	-53.63	-22.47	38	-31.16

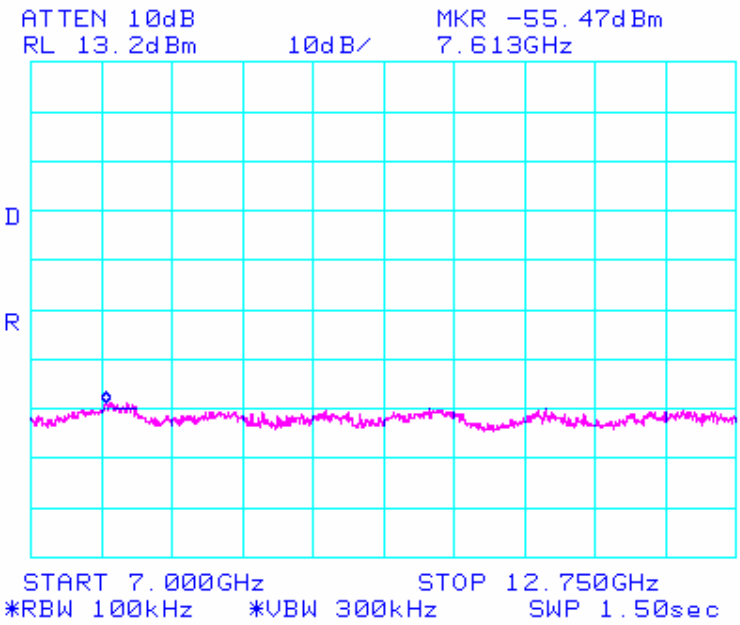
Plot 35 802.11g Rate 3 – 12 Mbit/s

2,437 MHz Conducted Spurious Emissions 1,000 MHz to 7,000 MHz



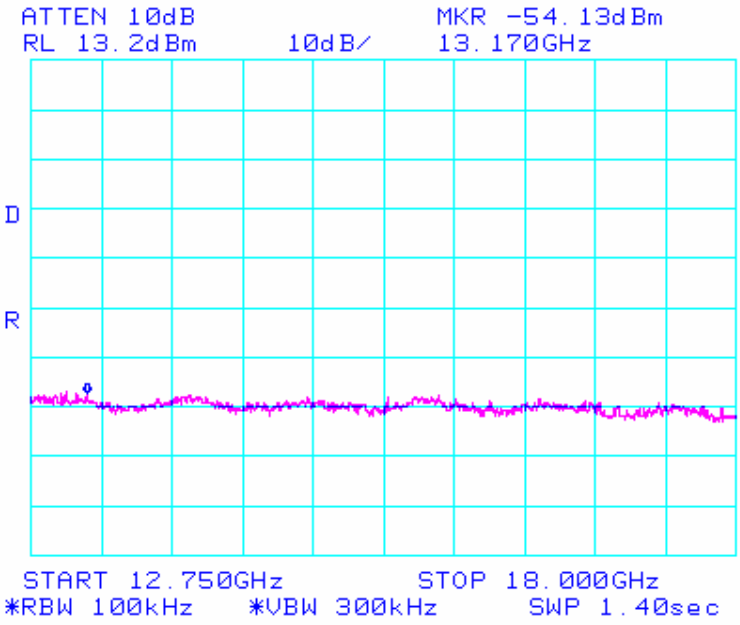
Plot 36 802.11g Rate 3 – 12 Mbit/s

2,437 MHz Conducted Spurious Emissions 7,000 MHz to 12,750 MHz



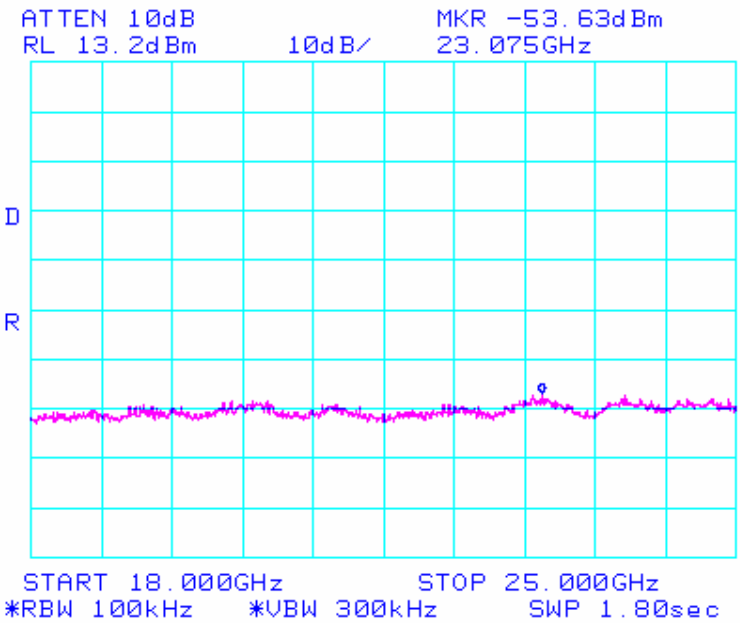
Plot 37 802.11g Rate 3 – 12 Mbit/s

2,437 MHz Conducted Spurious Emissions 12,750 MHz to 18,000 MHz



Plot 38 802.11g Rate 3 – 12 Mbit/s

2,437 MHz Conducted Spurious Emissions 18,000 MHz to 25,000 MHz



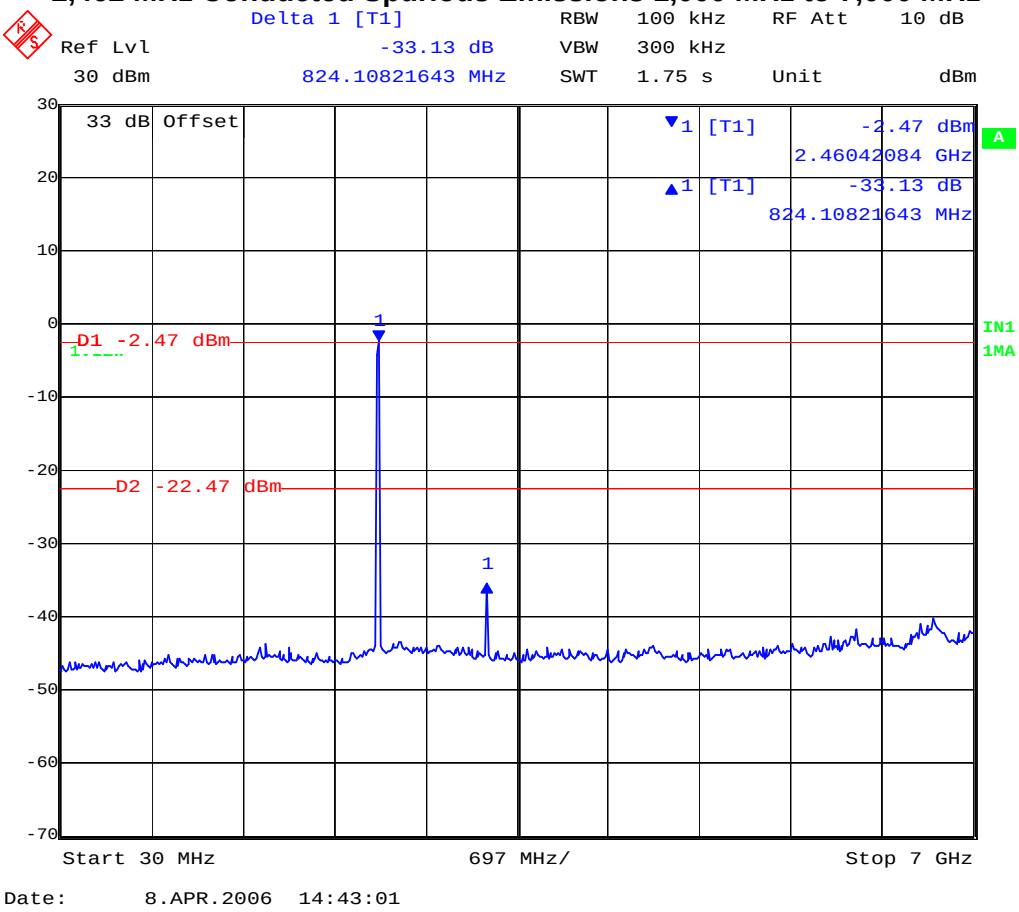
Spurious Emissions (1-25 GHz)

TABLE OF RESULTS – **802.11g Rate 3 – 12 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
2,462	30	7,000	-35.60	-22.47	39	-13.13
2,462	7,000	12,750	-55.47	-22.47	40	-33.00
2,462	12,750	18,000	-54.47	-22.47	41	-32.00
2,462	18,000	25,000	-54.30	-22.47	42	-31.83

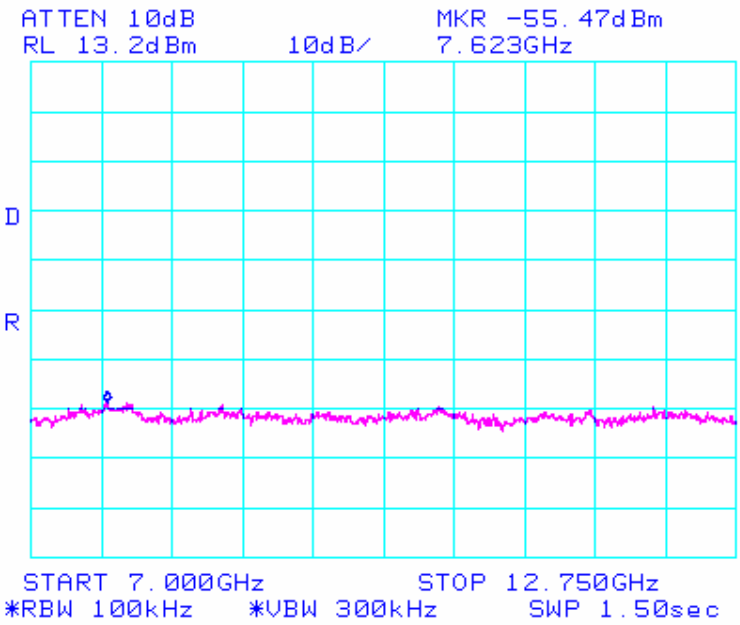
Plot 39 802.11g Rate 3 – 12 Mbit/s

2,462 MHz Conducted Spurious Emissions 1,000 MHz to 7,000 MHz



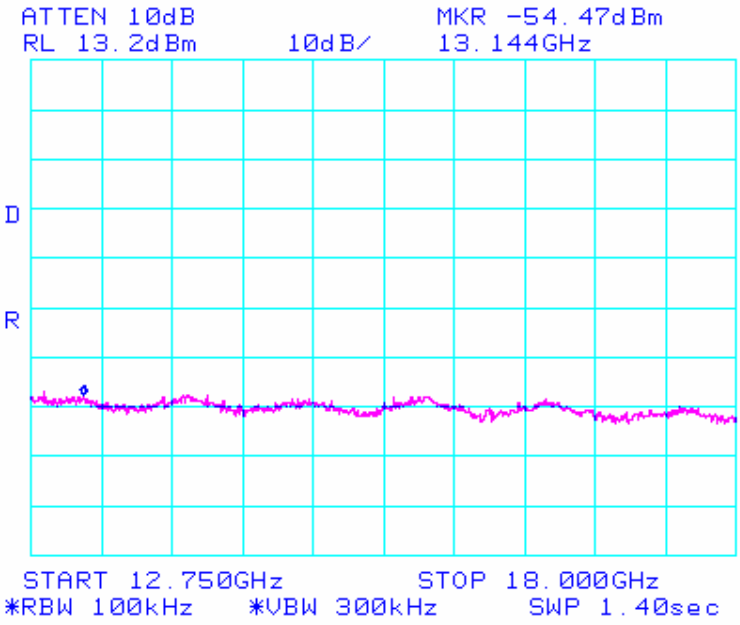
Plot 40 802.11g Rate 3 – 12 Mbit/s

2,462 MHz Conducted Spurious Emissions 7,000 MHz to 12,750 MHz



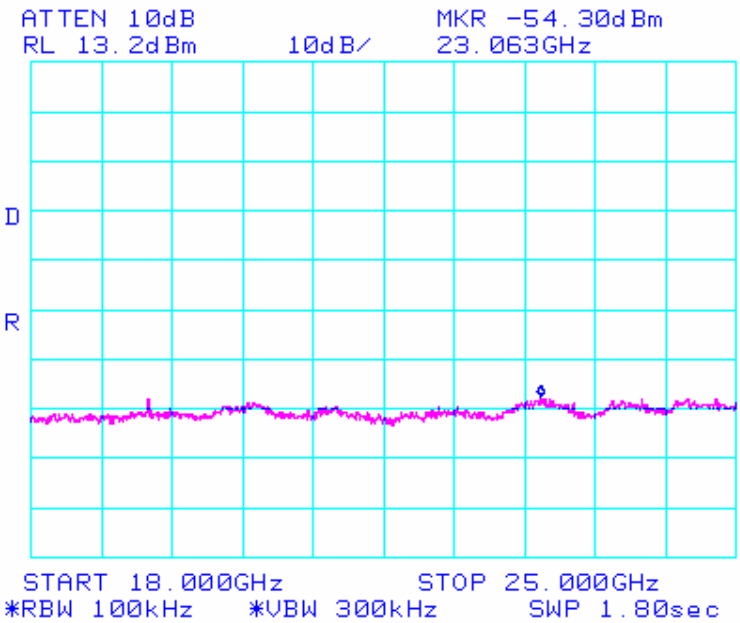
Plot 41 802.11g Rate 3 – 12 Mbit/s

2,462 MHz Conducted Spurious Emissions 12,750 MHz to 18,000 MHz



Plot 42 802.11g Rate 3 – 12 Mbit/s

2,462 MHz Conducted Spurious Emissions 18,000 MHz to 25,000 MHz



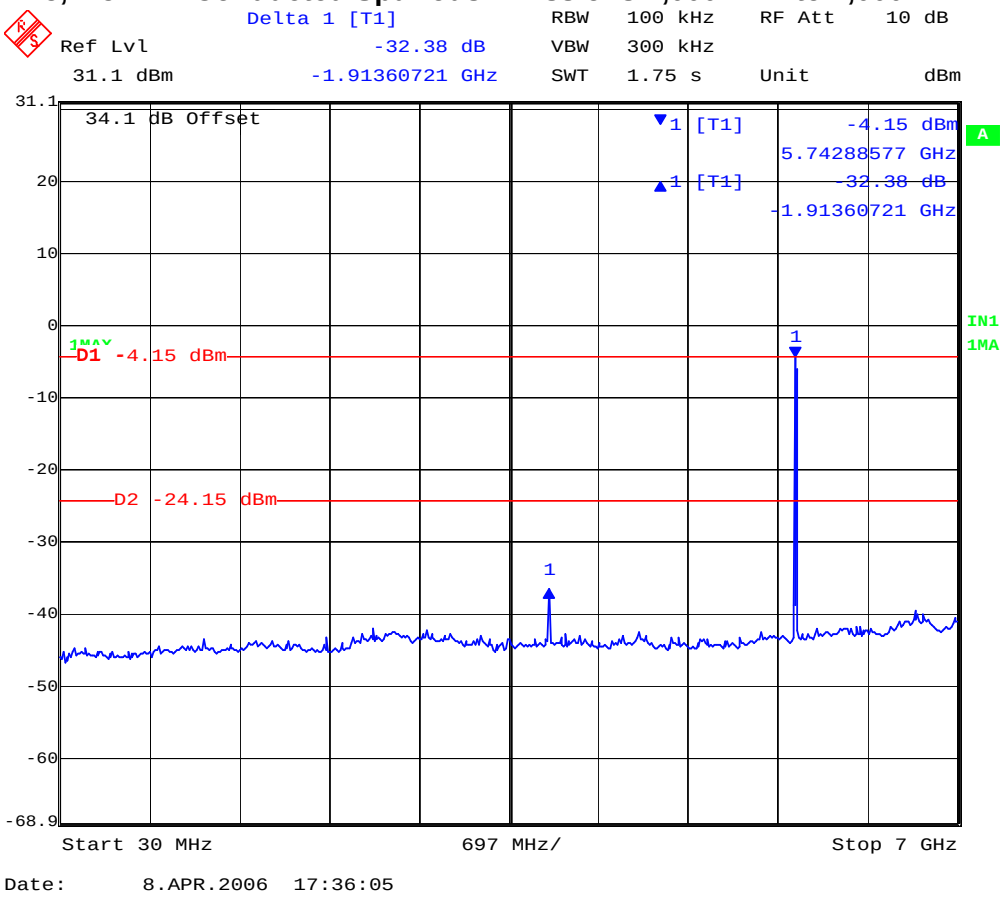
Spurious Emissions (1-25 GHz)

TABLE OF RESULTS – **802.11a Rate 8 – 54 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
5,745	30	7,000	-36.53	-24.15	43	-12.38
5,745	7,000	12,750	-55.47	-24.15	44	-31.32
5,745	12,750	18,000	-53.47	-24.15	45	-29.32
5,745	18,000	25,000	-54.30	-24.15	46	-30.15
5,745	25,000	40,000	-45.47	-24.15	47	-21.32

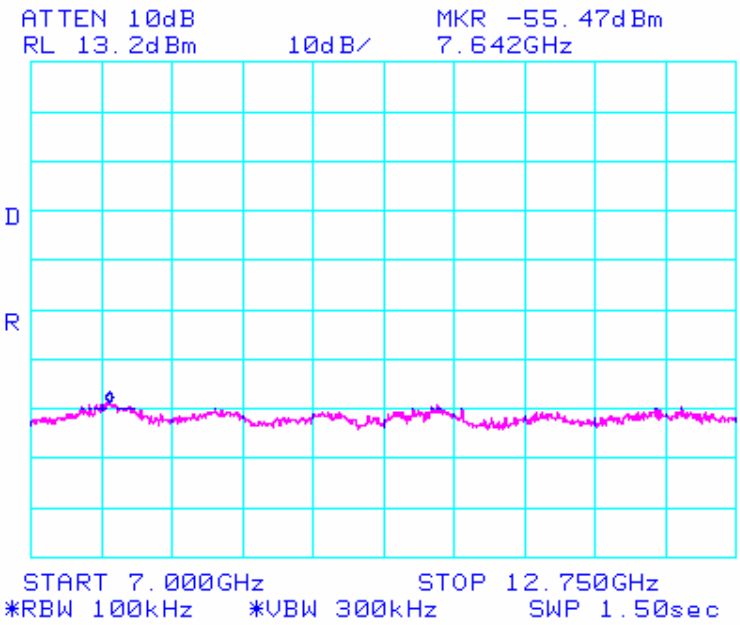
Plot 43 802.11a Rate 8 – 54 Mbit/s

5,745 MHz Conducted Spurious Emissions 1,000 MHz to 7,000 MHz



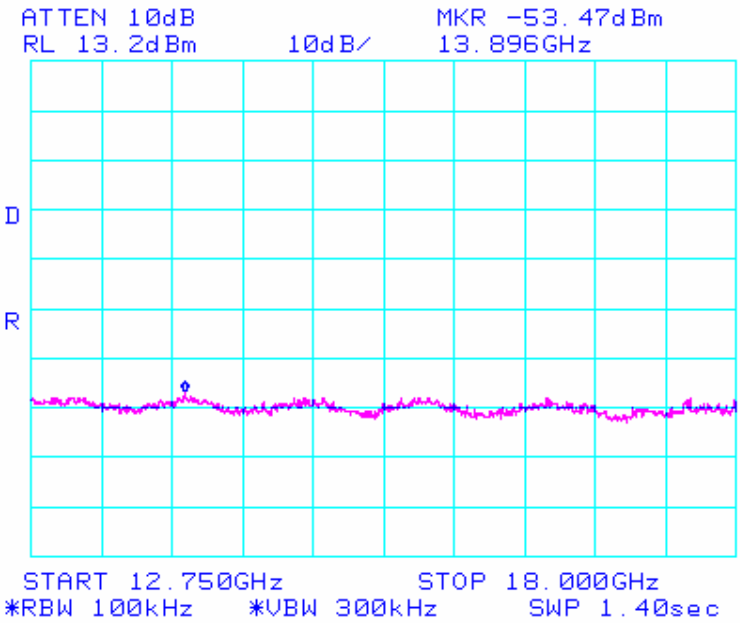
Plot 44 802.11a Rate 8 – 54 Mbit/s

5,745 MHz Conducted Spurious Emissions 7,000 MHz to 12,750 MHz



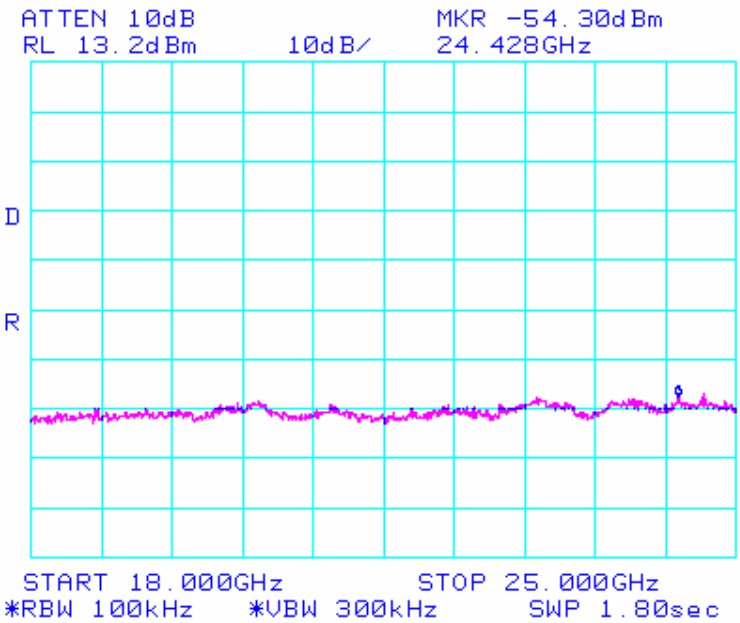
Plot 45 802.11a Rate 8 – 54 Mbit/s

5,745 MHz Conducted Spurious Emissions 12,750 MHz to 18,000 MHz



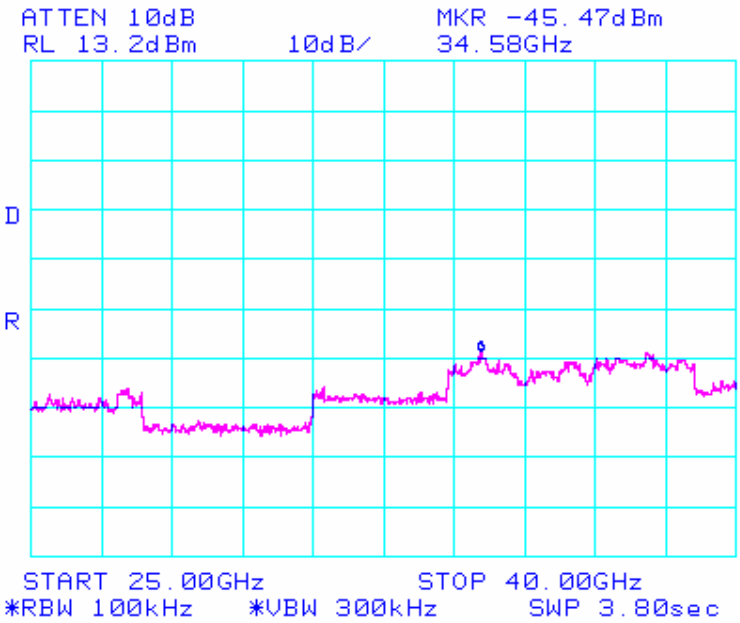
Plot 46 802.11a Rate 8 – 54 Mbit/s

5,745 MHz Conducted Spurious Emissions 18,000 MHz to 25,000 MHz



Plot 47 802.11a Rate 8 – 54 Mbit/s

5,745 MHz Conducted Spurious Emissions 25,000 MHz to 40,000 MHz



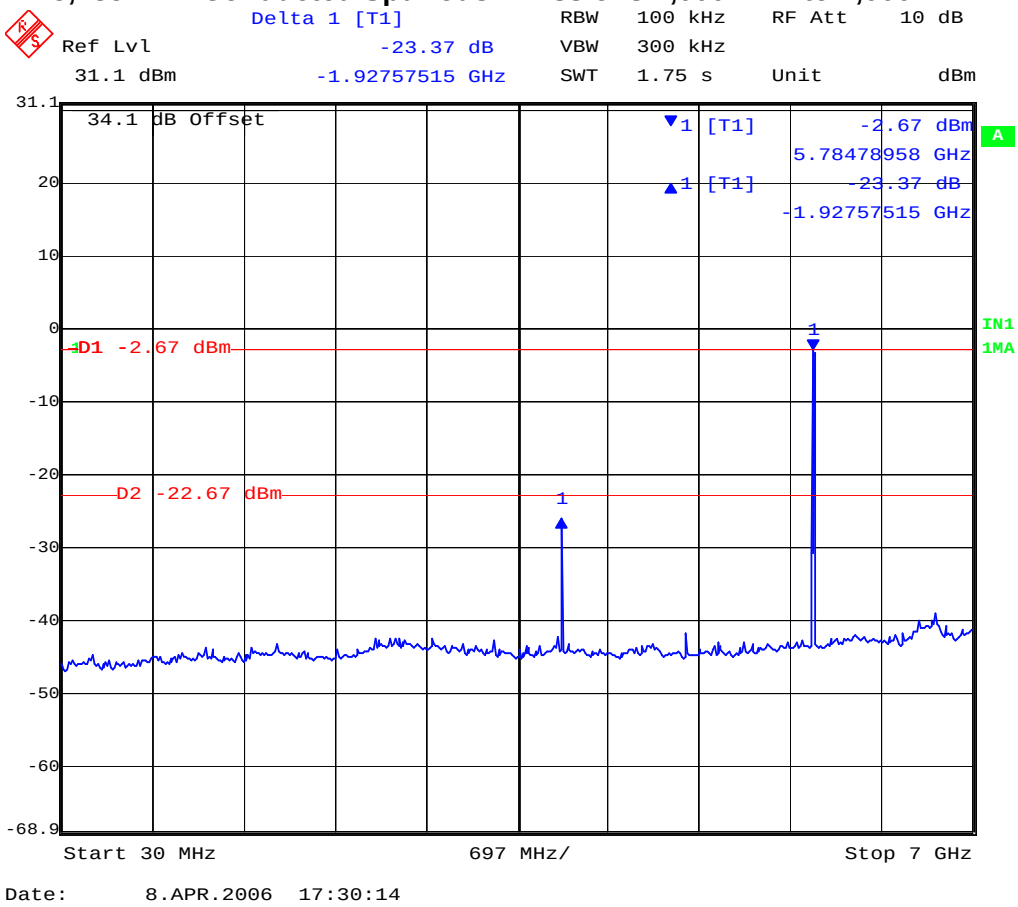
Spurious Emissions (1-25 GHz)

TABLE OF RESULTS – **802.11a Rate 8 – 54 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
5,785	30	7,000	-26.04	-22.67	48	-3.37
5,785	7,000	12,750	-55.80	-22.67	49	-33.13
5,785	12,750	18,000	-54.47	-22.67	50	-31.80
5,785	18,000	25,000	-53.80	-22.67	51	-31.13
5,785	25,000	40,000	-50.13	-22.67	52	-27.46

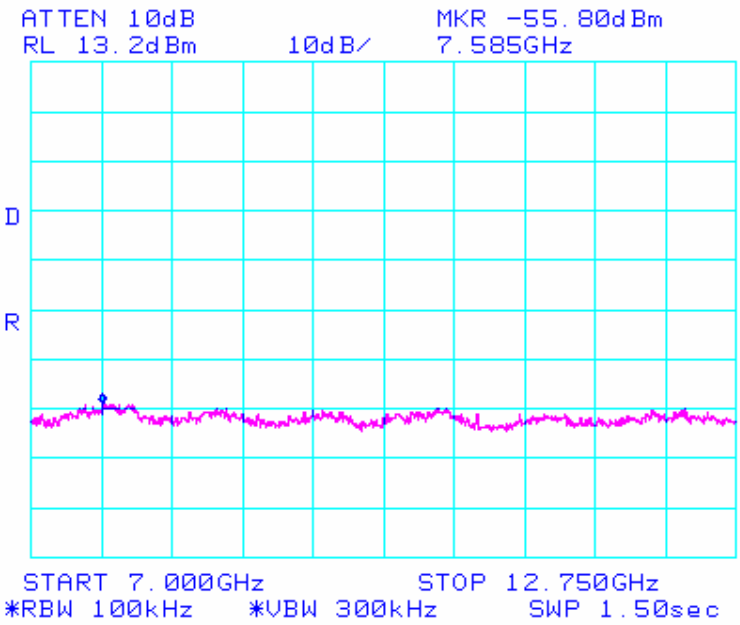
Plot 48 802.11a Rate 8 – 54 Mbit/s

5,785 MHz Conducted Spurious Emissions 1,000 MHz to 7,000 MHz



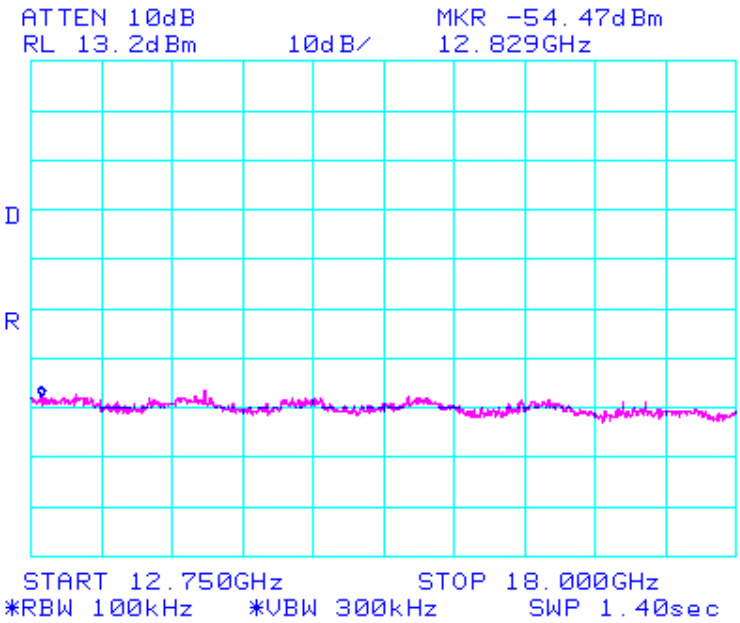
Plot 49 802.11a Rate 8 – 54 Mbit/s

5,785 MHz Conducted Spurious Emissions 7,000 MHz to 12,750 MHz



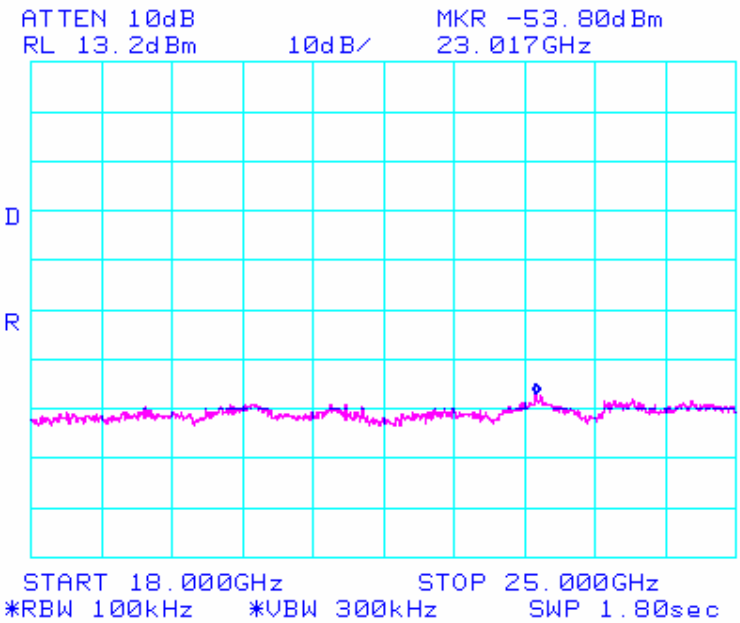
Plot 50 802.11a Rate 8 – 54 Mbit/s

5,785 MHz Conducted Spurious Emissions 12,750 MHz to 18,000 MHz



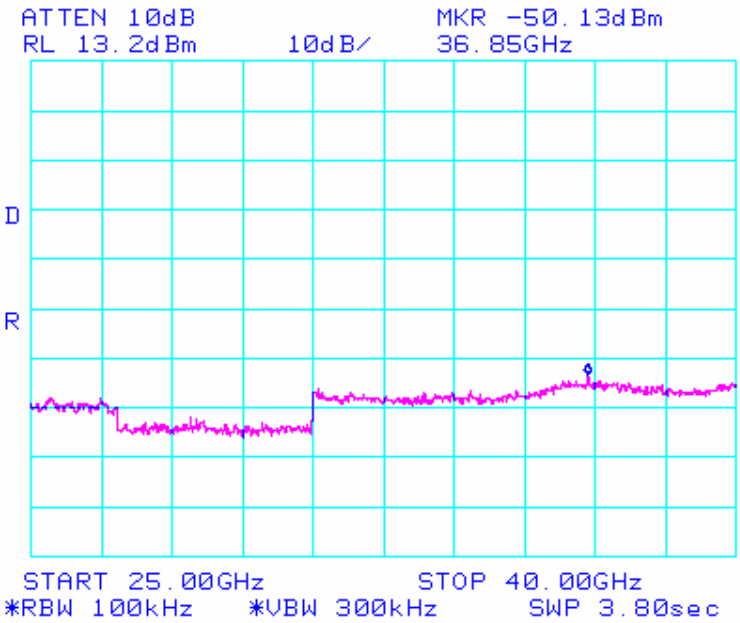
Plot 51 802.11a Rate 8 – 54 Mbit/s

5,785 MHz Conducted Spurious Emissions 18,000 MHz to 25,000 MHz



Plot 52 802.11a Rate 8 – 54 Mbit/s

5,785 MHz Conducted Spurious Emissions 25,000 MHz to 40,000 MHz



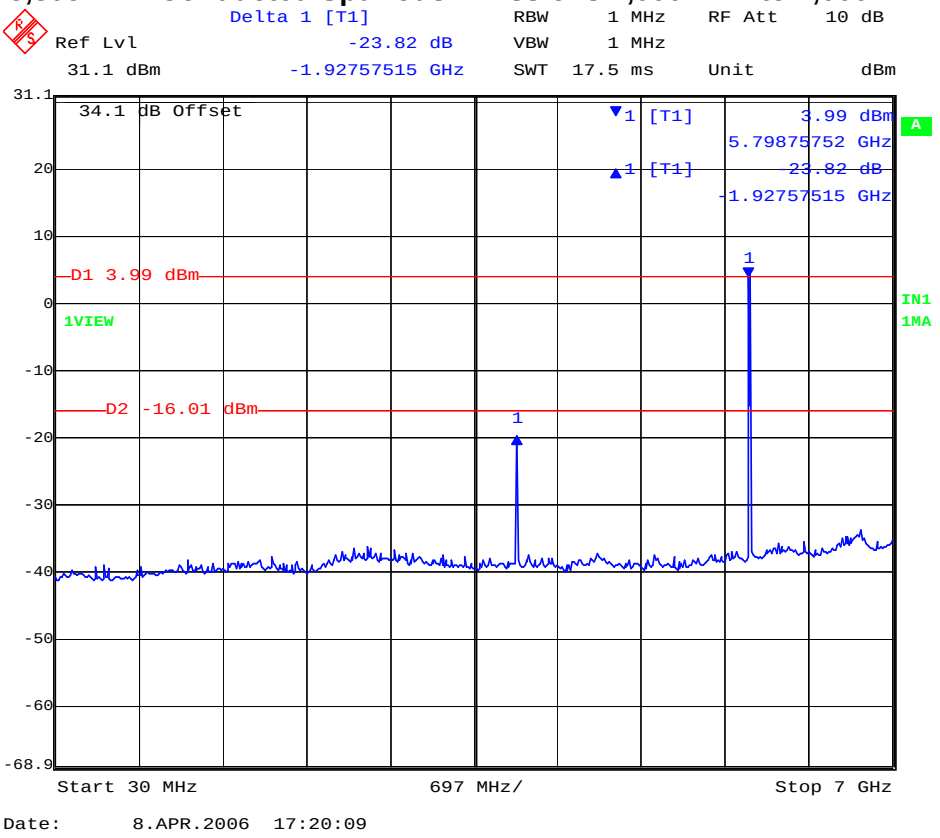
Spurious Emissions (1-25 GHz)

TABLE OF RESULTS – **802.11a Rate 8 – 54 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
5,805	30	7,000	-19.83	-16.01	53	-3.82
5,805	7,000	12,750	-54.97	-16.01	54	-38.96
5,805	12,750	18,000	-54.47	-16.01	55	-38.46
5,805	18,000	25,000	-54.30	-16.01	56	-38.29
5,805	25,000	40,000	-49.80	-16.01	57	-33.79

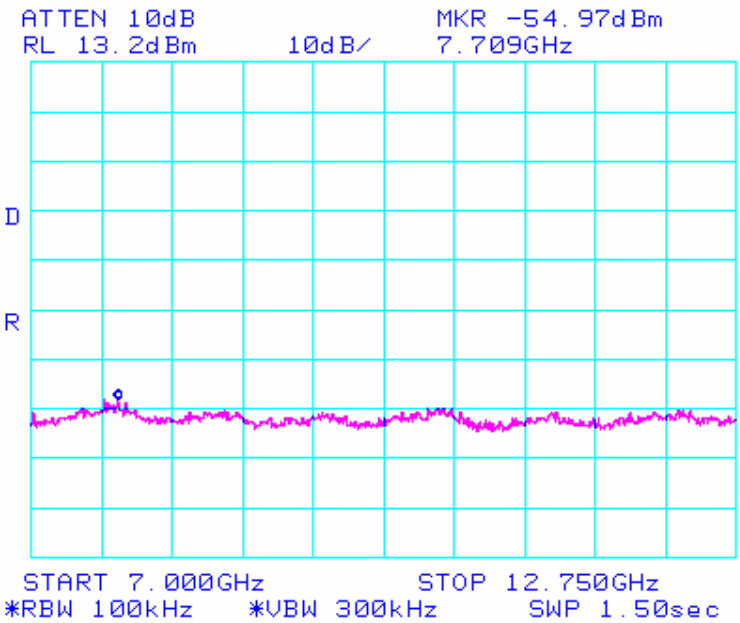
Plot 53 802.11a Rate 8 – 54 Mbit/s

5,805 MHz Conducted Spurious Emissions 1,000 MHz to 7,000 MHz



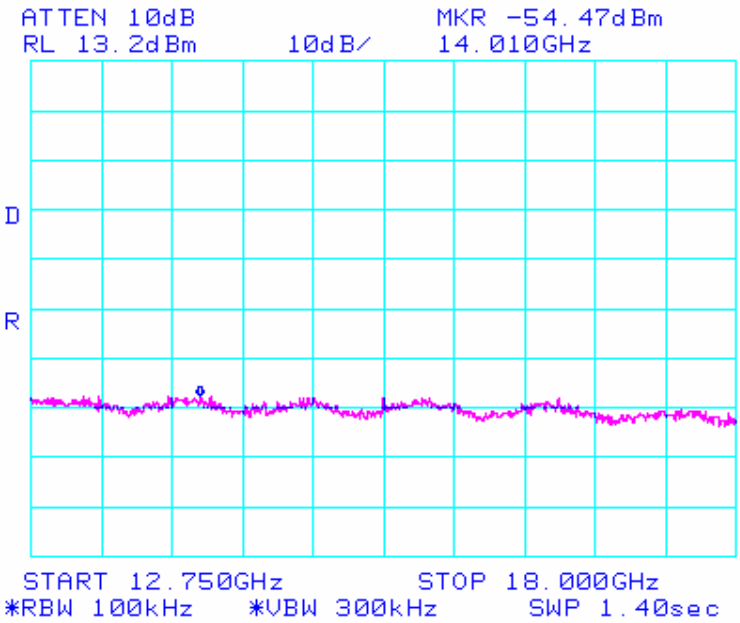
Plot 54 802.11a Rate 8 – 54 Mbit/s

5,805 MHz Conducted Spurious Emissions 7,000 MHz to 12,750 MHz



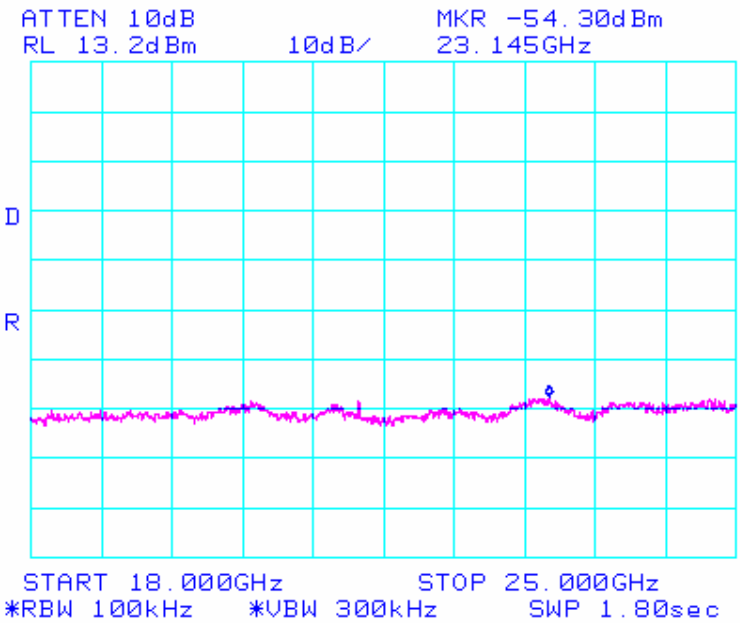
Plot 55 802.11a Rate 8 – 54 Mbit/s

5,805 MHz Conducted Spurious Emissions 12,750 MHz to 18,000 MHz



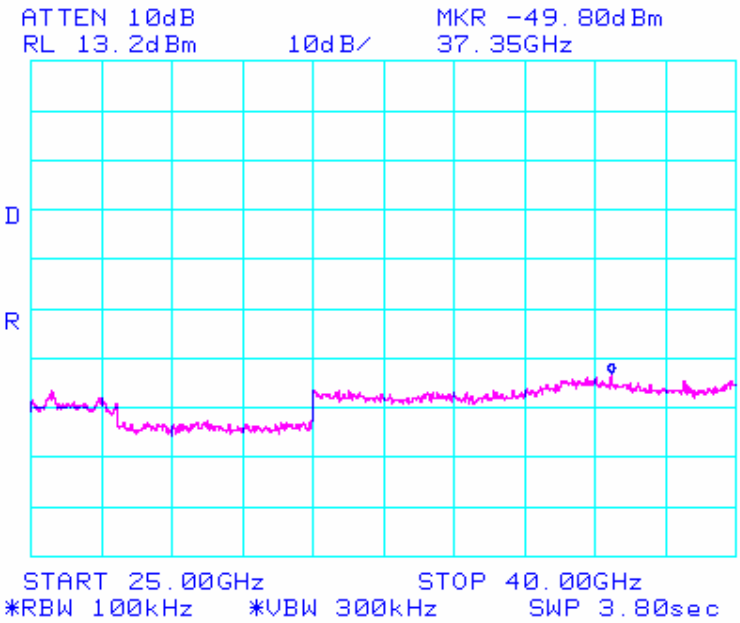
Plot 56 802.11a Rate 8 – 54 Mbit/s

5,805 MHz Conducted Spurious Emissions 18,000 MHz to 25,000 MHz



Plot 57 802.11a Rate 8 – 54 Mbit/s

5,805 MHz Conducted Spurious Emissions 25,000 MHz to 40,000 MHz



Specification

Limits Band-Edge

Lower Limit Band-edge	Upper Limit Band-edge	Limit below highest level of desired power
2,400 MHz	2,483.5 MHz	≥ 20 dB

§15.247(d) and RSS-210 §A8.5 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 radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

§15.247(d)
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 §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(a)).

RSS-210 §A8.5 If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

RSS-Gen §4.7
The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz , whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions'	0088, 0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117.

5.1.6. Radiated Emissions

5.1.6.1. Transmitter Radiated Spurious Emissions (above 1 GHz)

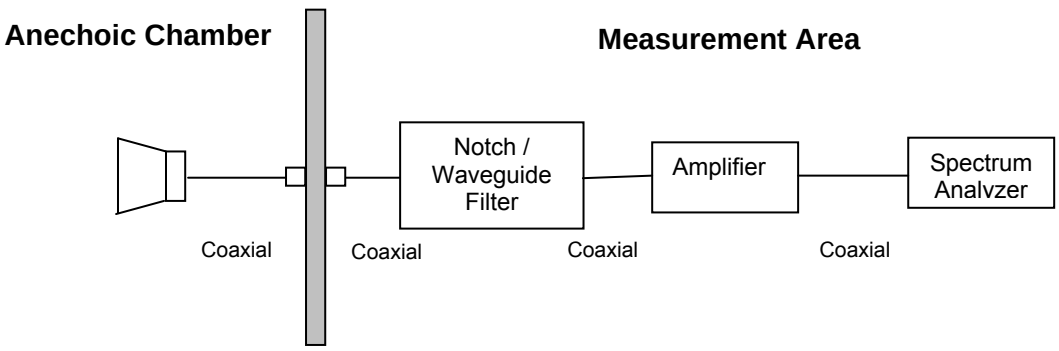
FCC, Part 15 Subpart C §15.247(d) 15.205; 15.209
Industry Canada RSS-210 §A8.5, §2.2, §2.6
Industry Canada RSS-Gen §4.7

Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

FS = R + AF + CORR - FO

where: FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

For example:
Given receiver input reading of 51.5 dBμV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

Radiated Spurious Emissions above 1 GHz

Ambient conditions.
Temperature: 17 to 23°C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar
Duty cycle correction factor (10* Log (1/x)) where x = duty cycle has been included in column 'Correction Factor' for Average Field Strength measurements

Test Setup - 802.11b Rate 4 – 11Mb/s
Phone lying flat on the polystyrene table - worst case orientation.
2.24% duty cycle 11 Mbit/s (Rate 4) Fully charged battery installed prior to each scan.
TABLE OF RESULTS – 802.11b Rate 4 – 11Mb/s Channel 1

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
9648.282	H	53.4	+10.13	63.53	74	-10.47
4824.302	H	57.94	+1.01	58.95	74	-15.05
3216.052	H	56.09	-3.30	52.77	74	-21.23
7235.703	H	52.6	+4.16	56.76	74	-17.24

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
9648.282	H	32.17	+20.13	52.30	54	-1.70
4824.302	H	29.82	+17.51	47.33	54	-6.67
3216.052	H	44.08	+6.68	50.76	54	-3.24
7235.703	H	35.91	+14.16	50.07	54	-3.93

Plot 58
Radiated Emissions

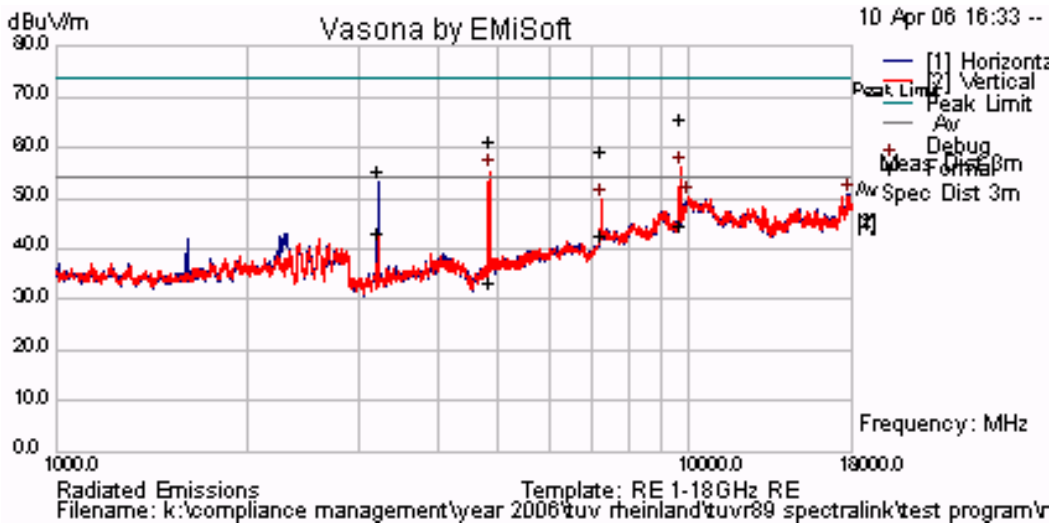


TABLE OF RESULTS – 802.11b Rate 4 – 11Mb/s Channel 6

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
4873.946	V	57.07	+0.85	57.92	74	-16.08

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
4873.946	V	29.15	+17.35	46.5	54	-7.5

Plot 59
Radiated Emissions

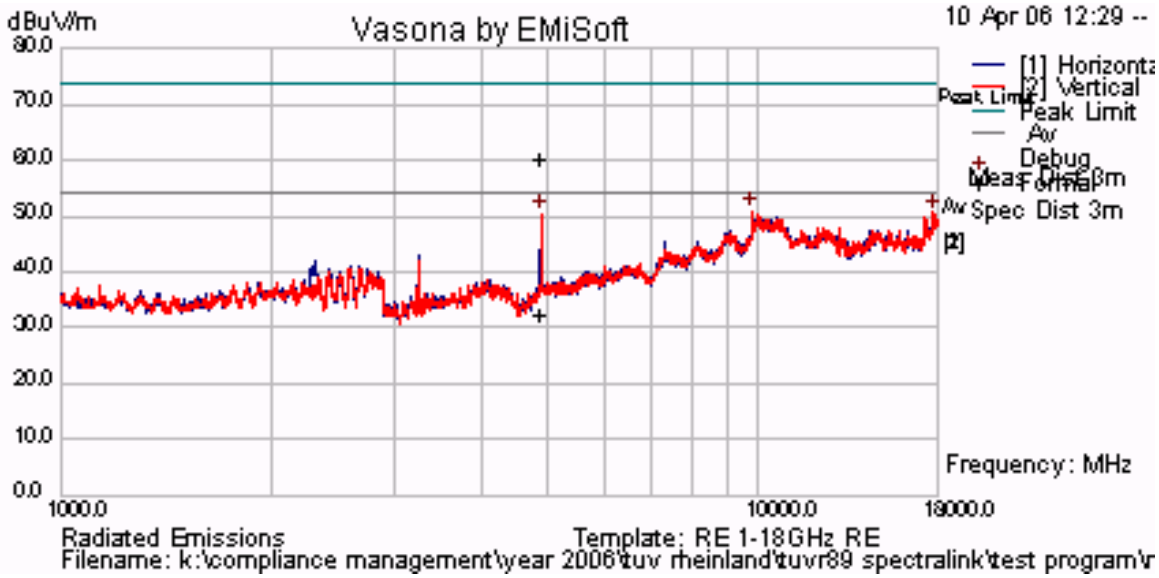
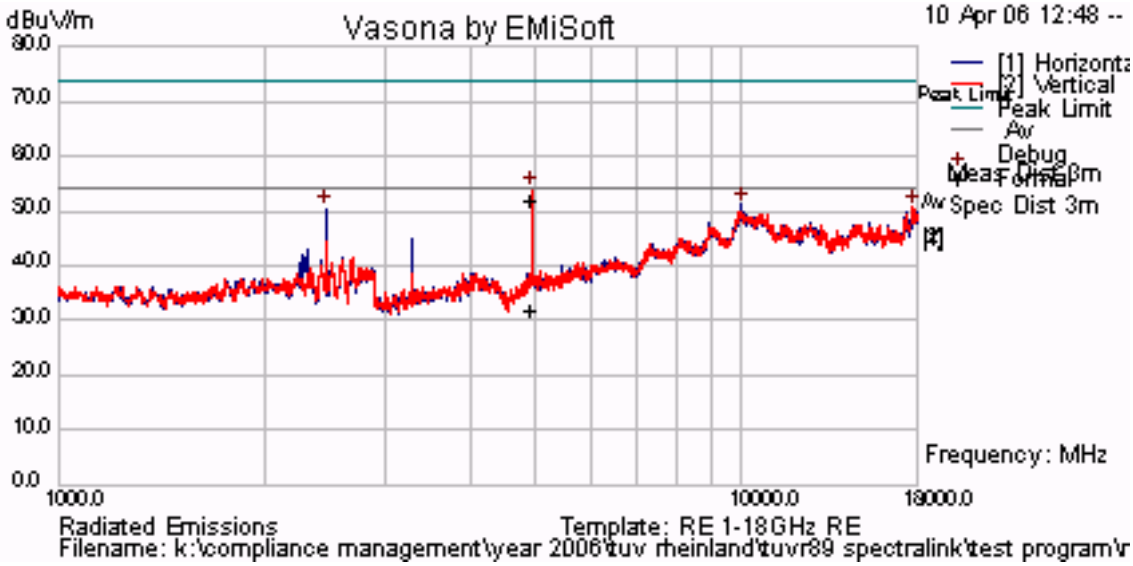


TABLE OF RESULTS – 802.11b Rate 4 – 11Mb/s Channel 11

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
4917.564	H	49.26	+0.49	49.75	74	-24.25

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
4917.564	H	29.18	16.99	46.17	54	-7.83

Plot 60
Radiated Emissions



Test Setup - 802.11g Rate 3 – 12Mb/s

Phone lying flat on the polystyrene table - worst case orientation.

2.24% duty cycle 12 Mbit/s (Mode 3). Fully charged battery installed prior to each scan.
Duty cycle correction factor (10* Log (1/x) where x = duty cycle has been included in column 'Correction Factor' for Average Field Strength measurements

TABLE OF RESULTS – 802.11g Rate 3 – 12 Mb/s Channel 1

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
					74	
					74	

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
					54	
					54	

No emissions observed

Plot 61
Radiated Emissions

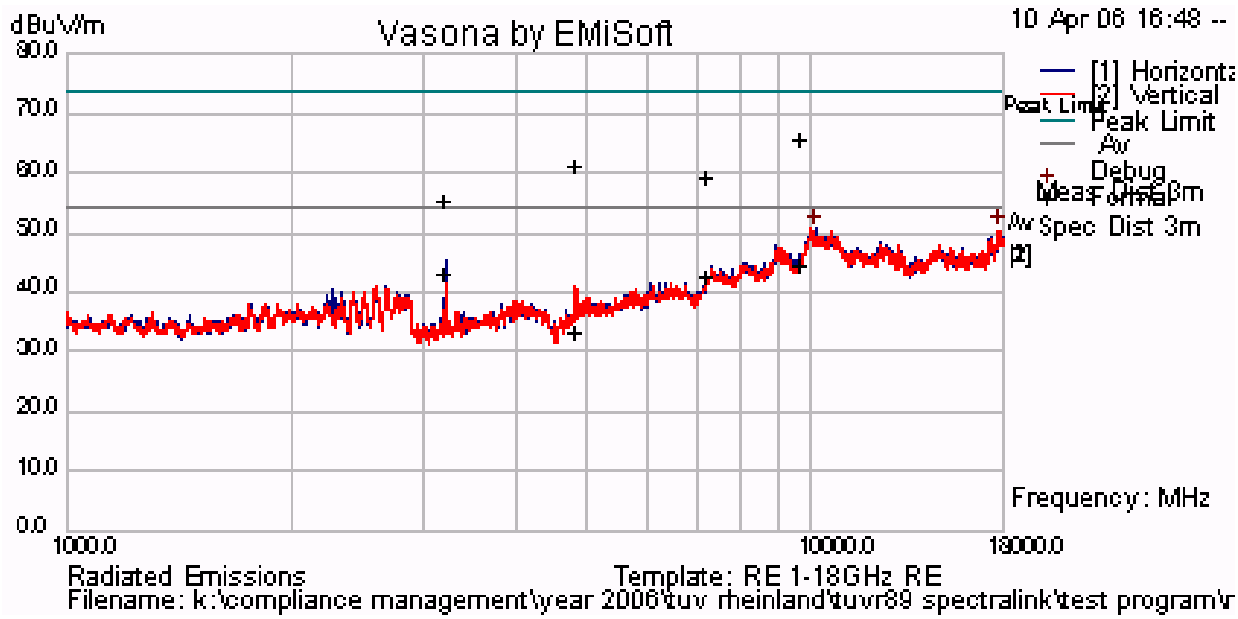


TABLE OF RESULTS – 802.11g Rate 3 – 12 Mb/s Channel 6

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Peak Field Strength (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)
					74	
					74	

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Average Field Strength (dBμV/m)	Average Limit (dBμV/m)	Margin (dB)
					54	
					54	

No emissions observed

Plot 62
Radiated Emissions

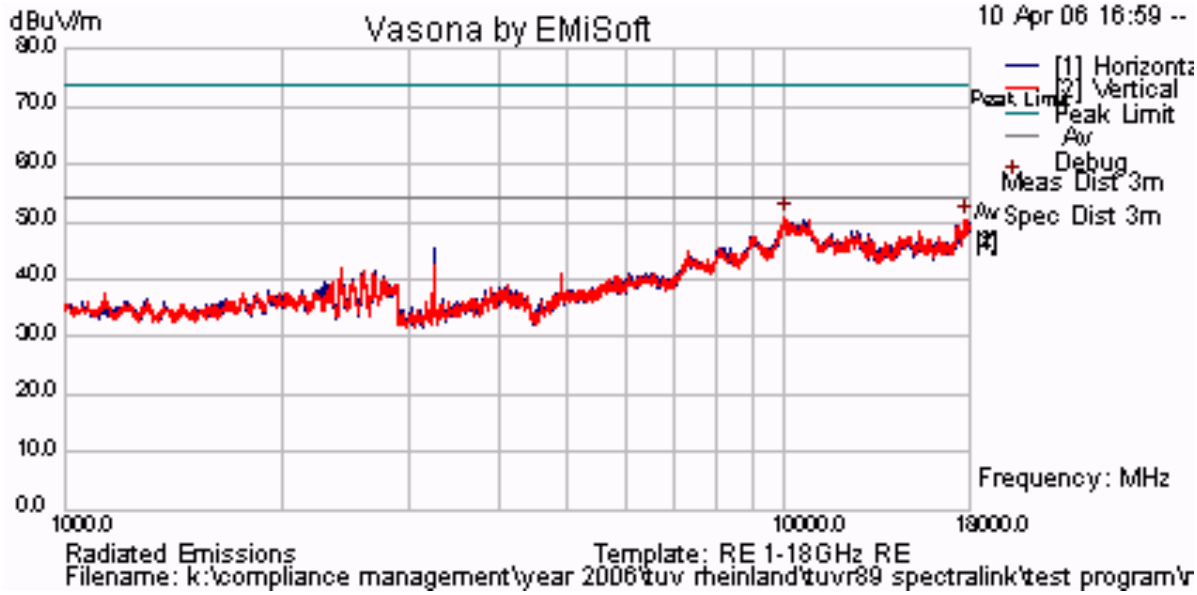


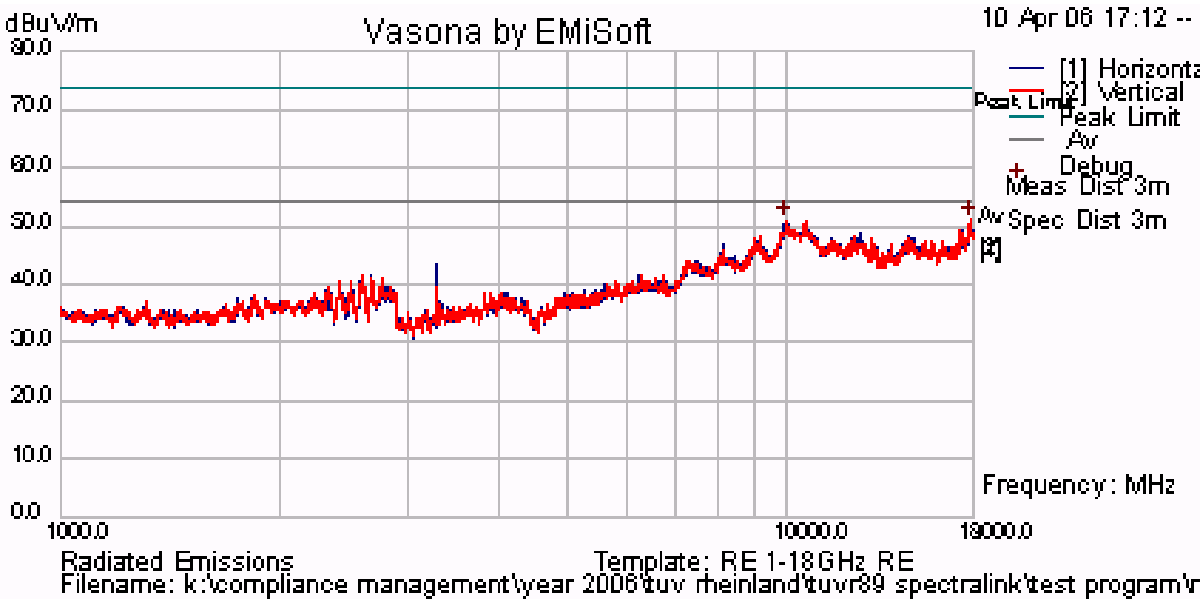
TABLE OF RESULTS – 802.11g Rate 3 – 12 Mb/s Channel 11

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Peak Field Strength (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)
					74	
					74	

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Average Field Strength (dBμV/m)	Average Limit (dBμV/m)	Margin (dB)
					54	
					54	

No emissions observed

Plot 63
Radiated Emissions



Test Setup - 802.11a Rate 8 – 54Mb/s

Phone lying flat on the polystyrene table - worst case orientation.

a mode (5725 - 5850 MHz) – 8.7% duty cycle 54 Mbit/s (Mode 8). Fully charged battery installed prior to each scan.

TABLE OF RESULTS – 802.11a Rate 8 – 54 Mb/s Channel 149

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
3829.854	H	69.96	-0.02	69.94	74	-4.06

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
3829.854	H	37.32	+9.98	47.30	54	-6.70

Plot 64
Radiated Emissions

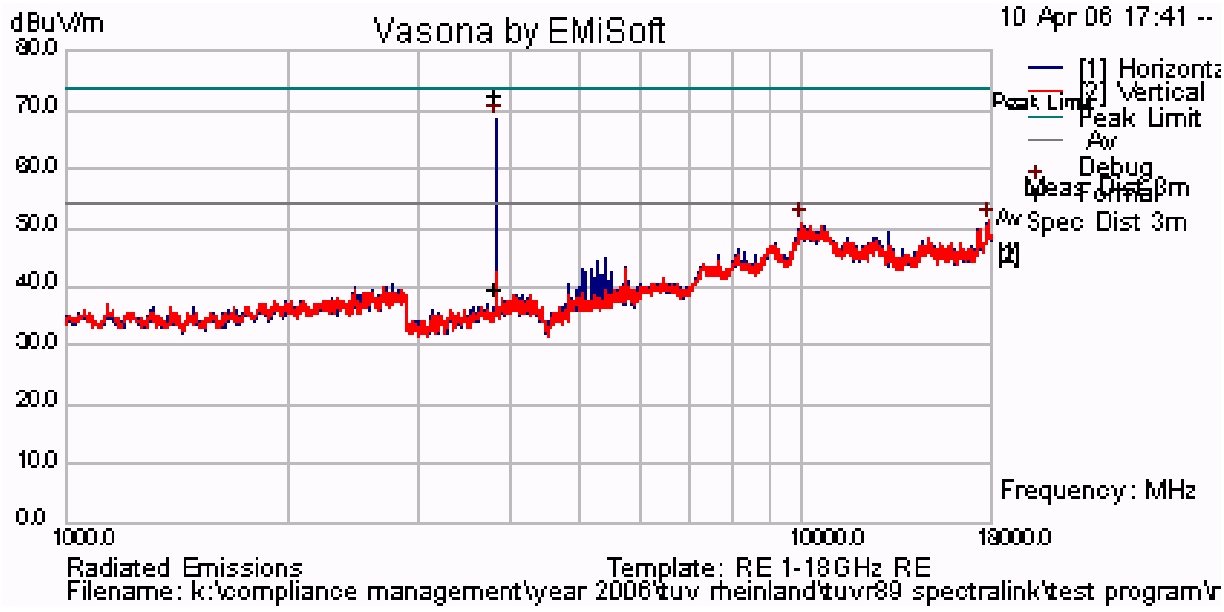


TABLE OF RESULTS – 802.11a Rate 8 – 54 Mb/s Channel 157

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Peak Field Strength (dBμV/m)	Peak Limit (dBμV/m)	Margin (dB)
3856.675	H	69.17	-0.02	69.15	74	-4.85

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Average Field Strength (dBμV/m)	Average Limit (dBμV/m)	Margin (dB)
3856.675	V	32.58	+9.98	42.56	54	-11.44

Plot 65
Radiated Emissions

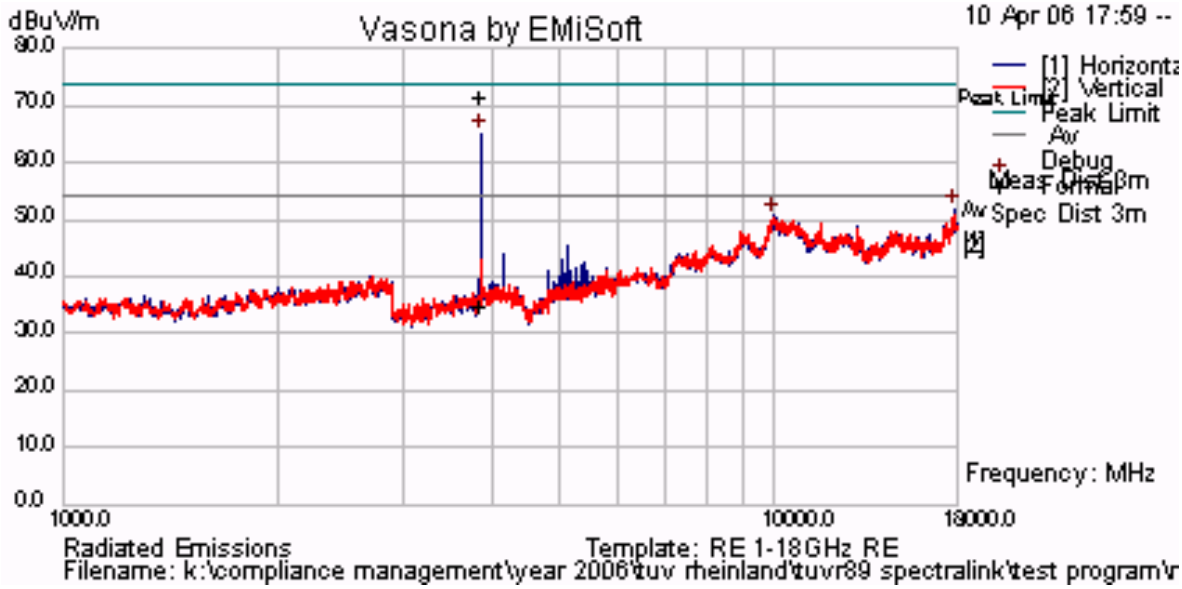
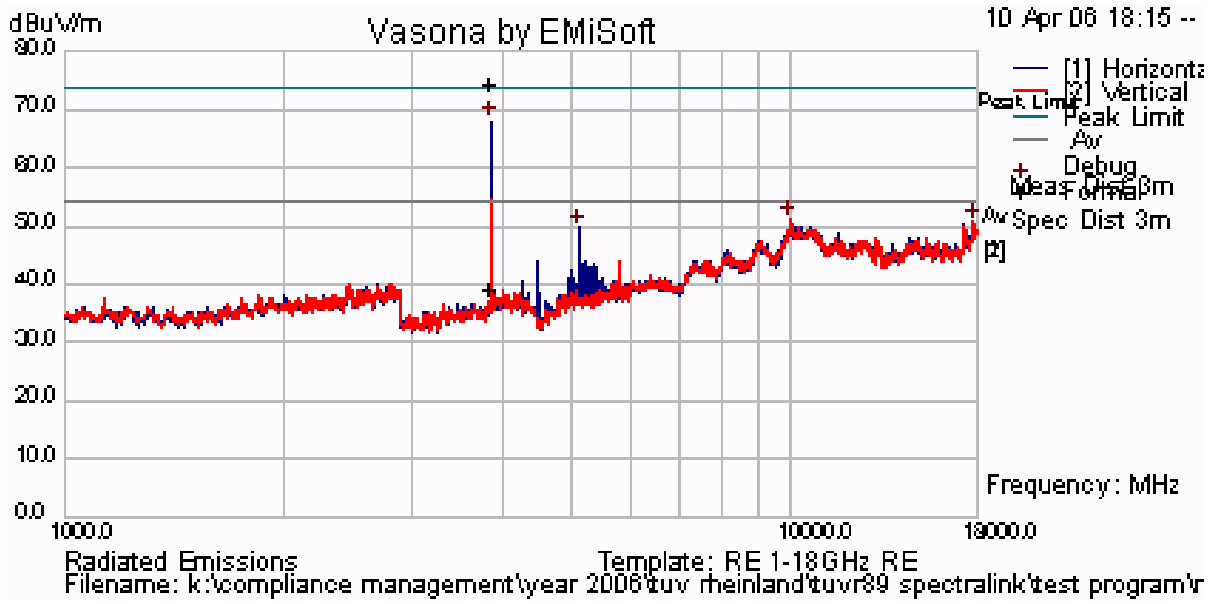


TABLE OF RESULTS – 802.11a Rate 8 – 54 Mb/s Channel 161

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
3869.954	H	71.99	-0.07	71.92	74	-2.08

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
3869.954	V	36.79	9.93	46.72	54	-7.28

Plot 66
Radiated Emissions



5.1.6.2. Receiver Radiated Spurious Emissions (above 1 GHz)

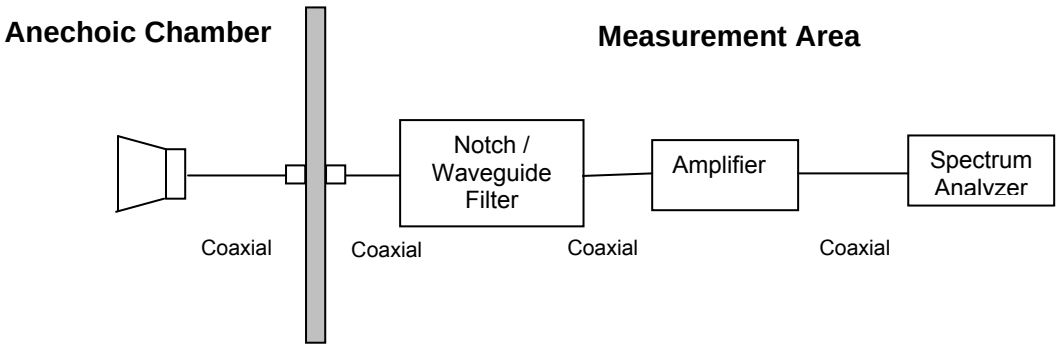
Industry Canada RSS-Gen §4.8, §6

Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

FS = R + AF + CORR - FO

where: FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

For example:
Given receiver input reading of 51.5 dBμV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

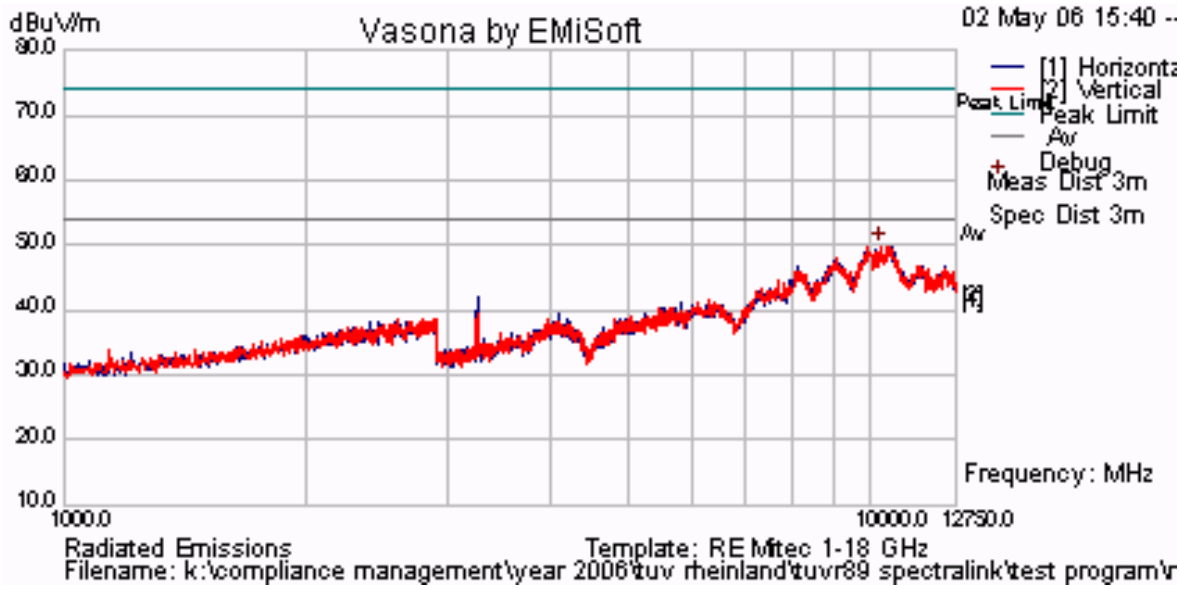
Receiver Radiated Spurious Emissions above 1 GHz

Test Setup - 802.11b/g

TABLE OF RESULTS –802.11b/g

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
10275	V	39.67	10.07	49.74	54	-4.26

Plot 67
Radiated Emissions



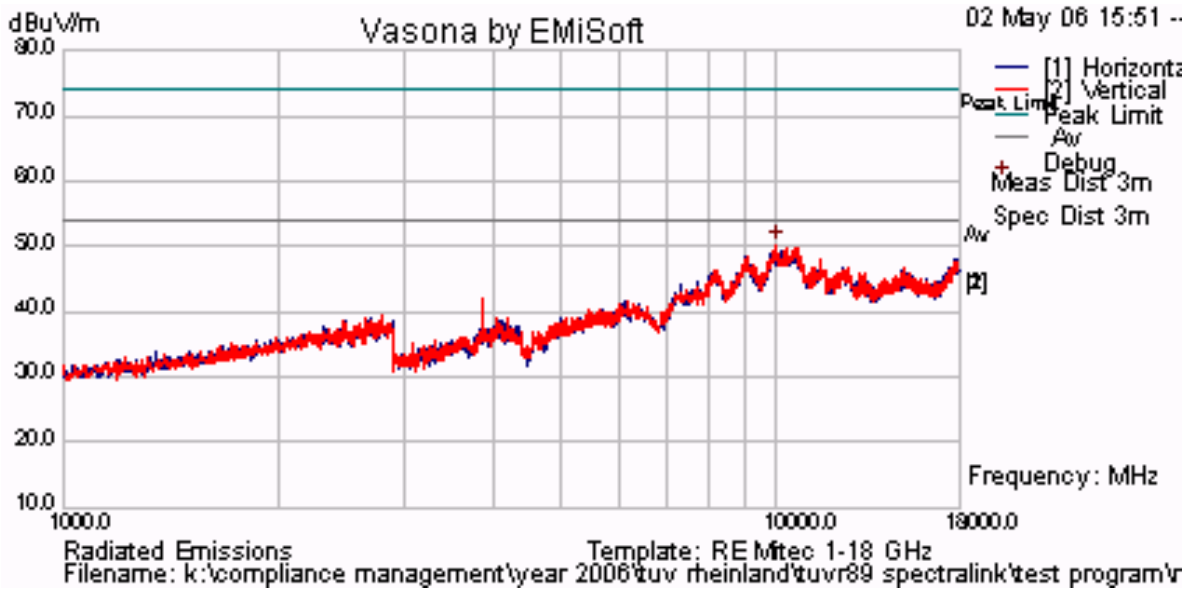
Receiver Radiated Spurious Emissions above 1 GHz

Test Setup - 802.11a

TABLE OF RESULTS –802.11a

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
10001.67	V	39.17	11.03	50.2	54	-3.8

Plot 68
Radiated Emissions



Specification

Receiver Radiated Spurious Emissions

Industry Canada RSS-Gen §4.8,
The search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tunable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

RSS-Gen §6
The following receiver spurious emission limits shall be complied with;
(a) If a radiated measurement is made, all spurious emissions hall comply with the limits of Table 1.

Frequency (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

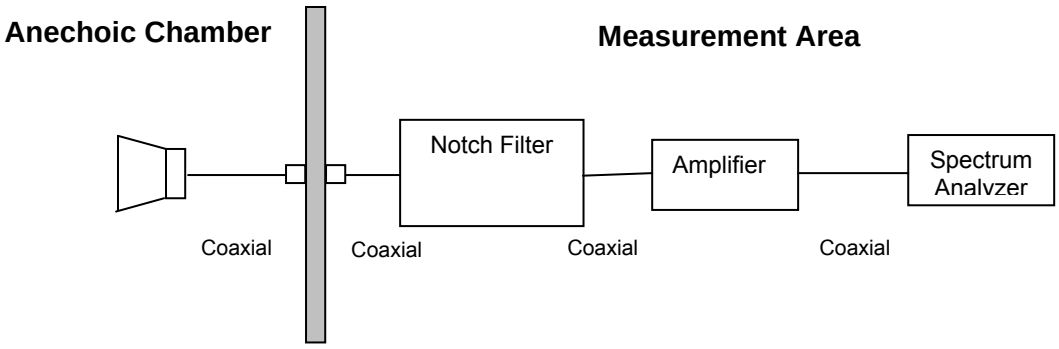
5.1.6.2.1. Radiated Band-Edge – Restricted Bands

Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. The highest emissions relative to the limit are listed for each frequency scanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

FS = R + AF + CORR - FO

where: FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Band-stop Filter Loss or Waveguide Loss

For example:
Given receiver input reading of 51.5 dBμV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

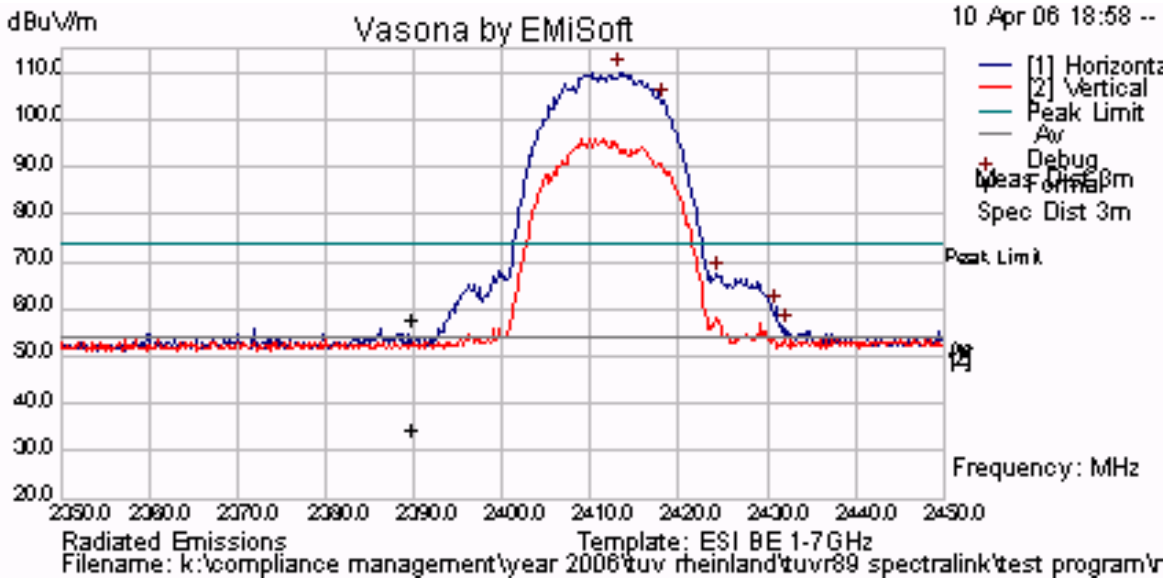
40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

Radiated Band Edge Test Results

TABLE OF RESULTS – **802.11b** b mode - 2.24% duty cycle 11 Mbit/s (Mode 4)

Ch #	Tx Pwr (dBm)	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	+20	$2{,}412_{PEAK}$	2,390	55.20	74	-18.80	69
1	+20	$2{,}412_{AVE}$	2,390	48.27	54	-5.73	69
11	+20	$2{,}462_{PEAK}$	2,483.5	53.90	74	-20.10	70
11	+20	$2{,}462_{AVE}$	2,483.5	49.11	54	-4.89	70

Plot 69 Channel 1 - Lower Band Edge, Peak Emission = 110.08 dBµV/m



Plot 70 Channel 11 – Upper Band Edge, Peak Emission = 108.69 dBµV/m

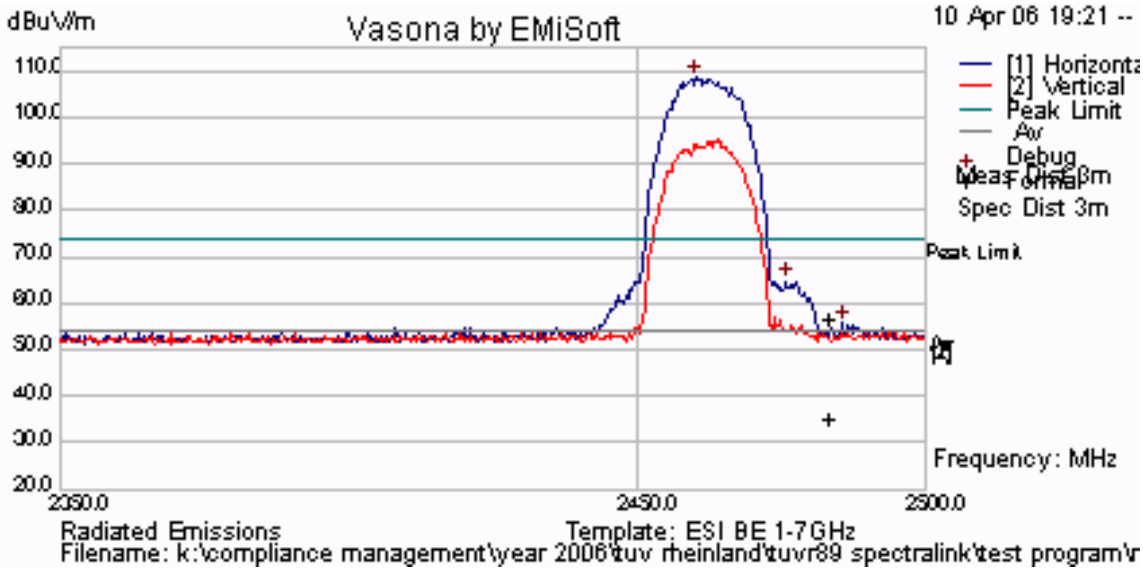
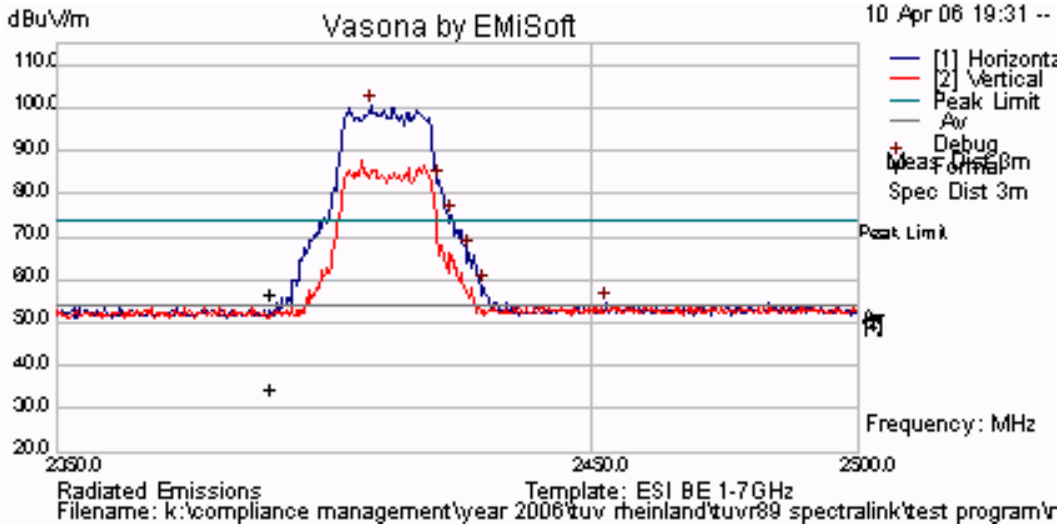


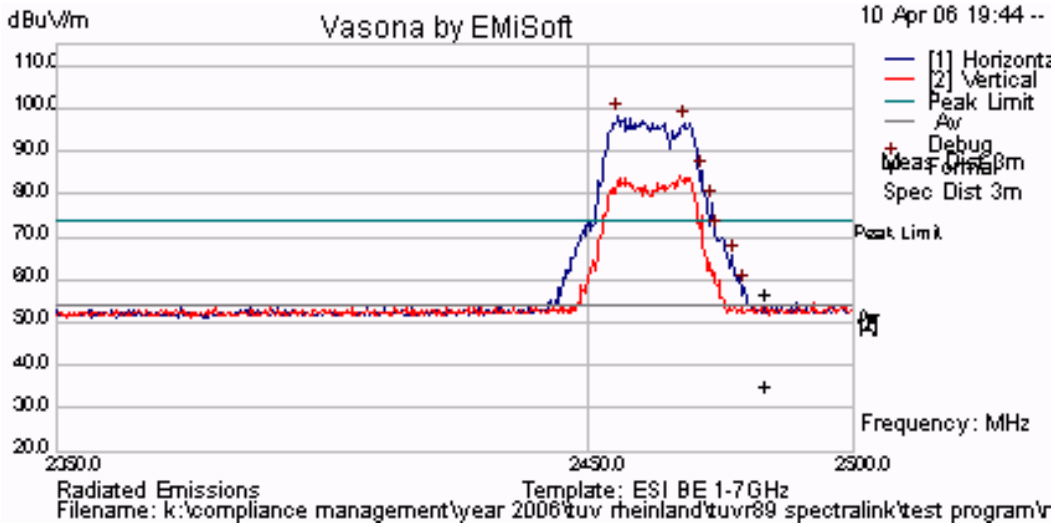
TABLE OF RESULTS – **802.11g** g mode 1.32% duty cycle 12 Mbit/s (Mode 3)

Ch #	Tx Pwr (dBm)	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Plot #
1	+20	$2{,}412_{PEAK}$	2,390	53.80	74	-20.20	71
1	+20	$2{,}412_{AVE}$	2,390	12.97	54	-3.43	71
11	+20	$2{,}462_{PEAK}$	2,483.5	53.90	74	-20.10	72
11	+20	$2{,}462_{AVE}$	2,483.5	13.81	54	-2.59	72

Plot 71 Channel 1 - Lower Band Edge, Peak Emission =100.37 dBµV/m



Plot 72 Channel 11 – Upper Band Edge, Peak Emission =98.39 dBµV/m



Specification Limits

FCC §15.247(d) and RSS-210 §A8.5 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 radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

FCC §15.247(d)
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 §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(a)).

IC RSS-210 §A8.5 If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

IC RSS-Gen §4.7
The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz , whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

FCC §15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

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

FCC §15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

Frequency (MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

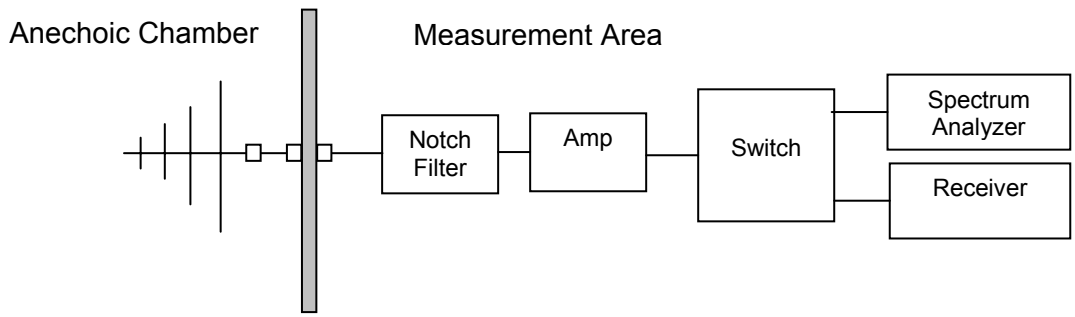
Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

5.1.6.3. Radiated Spurious Emissions (30M-1 GHz)

FCC, Part 15 Subpart C §15.205/ §15.209
Industry Canada RSS-210 §2.2

Test Procedure
Testing 30M-1 GHz was subcontracted to the company identified in Section 3.9 Subcontracted Testing. Preliminary radiated emissions are measured in the anechoic chamber at a 10-meter distance on every azimuth in both horizontal and vertical polarity. The emissions are recorded with a spectrum analyzer in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

Test Measurement Set up



Field Strength Calculation
The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$FS = R + AF + CORR$$

where:

FS = Field Strength
R = Measured Receiver Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain

For example:
Given a Receiver input reading of 51.5dBμV; Antenna Factor of 8.5dB; Cable Loss of 1.3dB; Falloff Factor of 0dB, an Amplifier Gain of 26dB and Notch Filter Loss of 1dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100μV/m
48 dBμV/m = 250μV/m

Measurement Results for Spurious Emissions (30 MHz – 1 GHz)

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

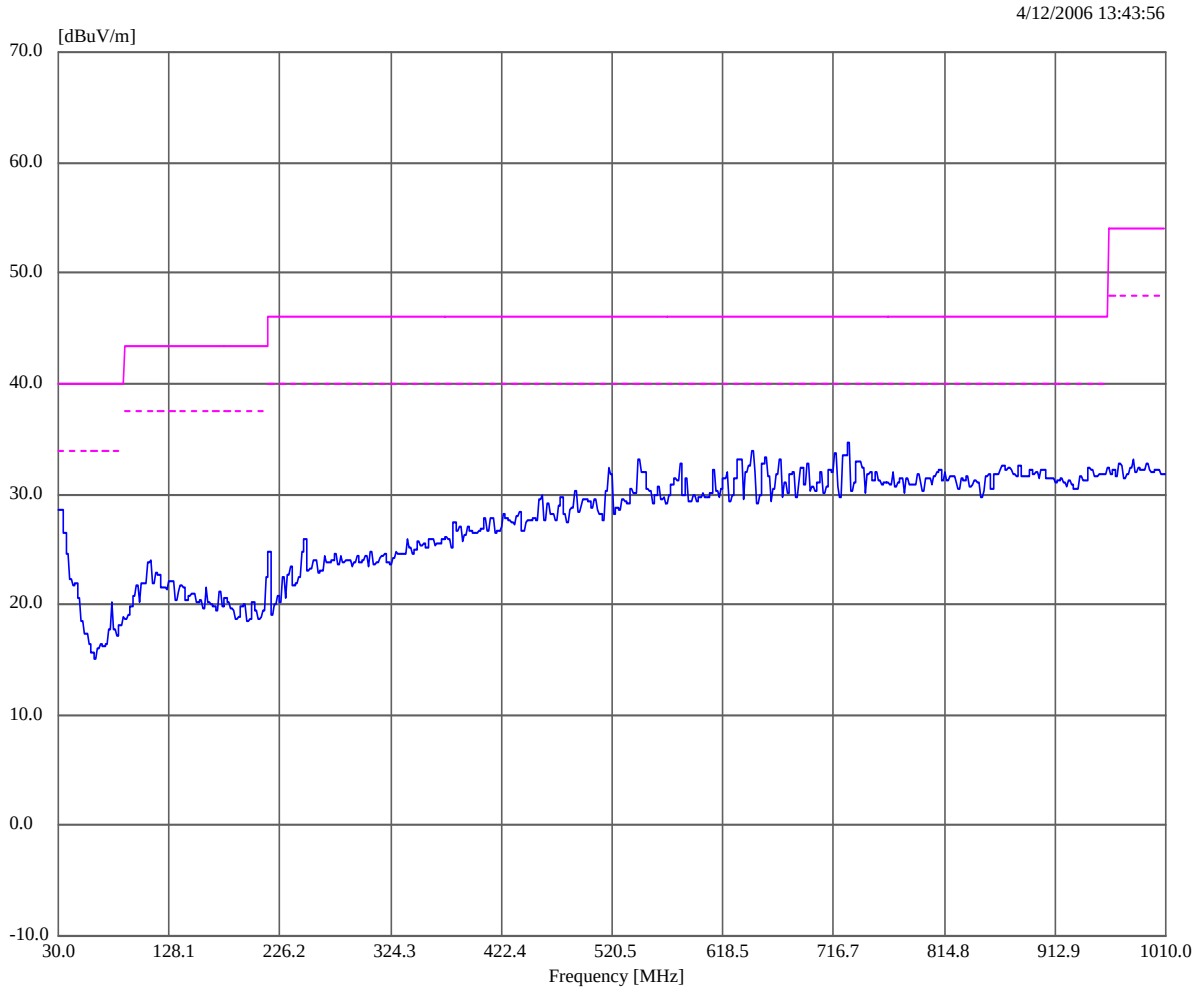
Product: 702X with PTH200 ear piece
Operation mode: 5.8 GHz 54 MBs max power
Model: Serial # Phone: 660324742 with Single Charger

TABLE OF RESULTS

Freq. (MHz)	Peak (dBuV/m)	QP (dBuV/m)	QP Lmt (dBuV/m)	QP Margin (dB)	Angle (deg)	Height (cm)	Polarity

There were no emissions observed within 6 dB of the limit.

Plot 73
Radiated Spurious Emissions 30 MHz to 1 GHz



Specification

Limits

§15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

§15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

§15.209 (a) and **RSS-Gen §2.2** Limit Matrix

Frequency(MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

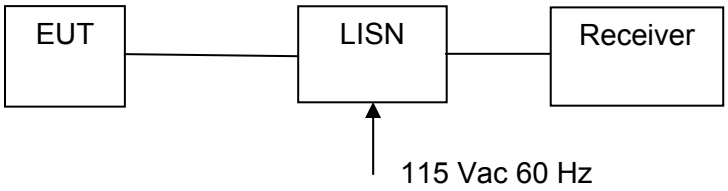
Method	Test Equipment Used
Measurements were made per Sanmina work instruction	8546A HP Receiver and RF Filter, HP Pre-amp, Antenna EMCO Biconilog

5.1.7. AC Wireline Conducted Emissions (150 kHz – 30 MHz)

FCC, Part 15 Subpart C §15.207
Industry Canada RSS-Gen §7.2.2

Test Procedure
The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

Measurement Results for AC Wireline Conducted Emissions (150 kHz – 30 MHz)

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Product: 702X with PTH200 ear piece
Operation mode: 5.8 GHz 54 MBs max power
Model: Serial # Phone: 660324742 with Single Charger

TABLE OF RESULTS – Live Line

Freq (MHz)	Peak (dBμV)	QP (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Ave. (dBμV)	Ave. Limit (dBμV)	Ave. Margin (dB)
0.352462	43.24	--.--	58.97	--.--	4.91	48.97	-44.06
0.383536	43.13	--.--	58.23	--.--	4.56	48.23	-43.67
0.430096	42.99	--.--	57.31	--.--	3.87	47.31	-43.44
0.458976	42.98	--.--	56.77	--.--	3.38	46.77	-43.38
0.473915	42.71	--.--	56.49	--.--	3.84	46.49	-42.65
0.501905	42.23	--.--	56.00	--.--	3.26	46.00	-42.74

Plot 74
AC Wireline Conducted Emissions – LIVE LINE 150 kHz – 30 MHz)

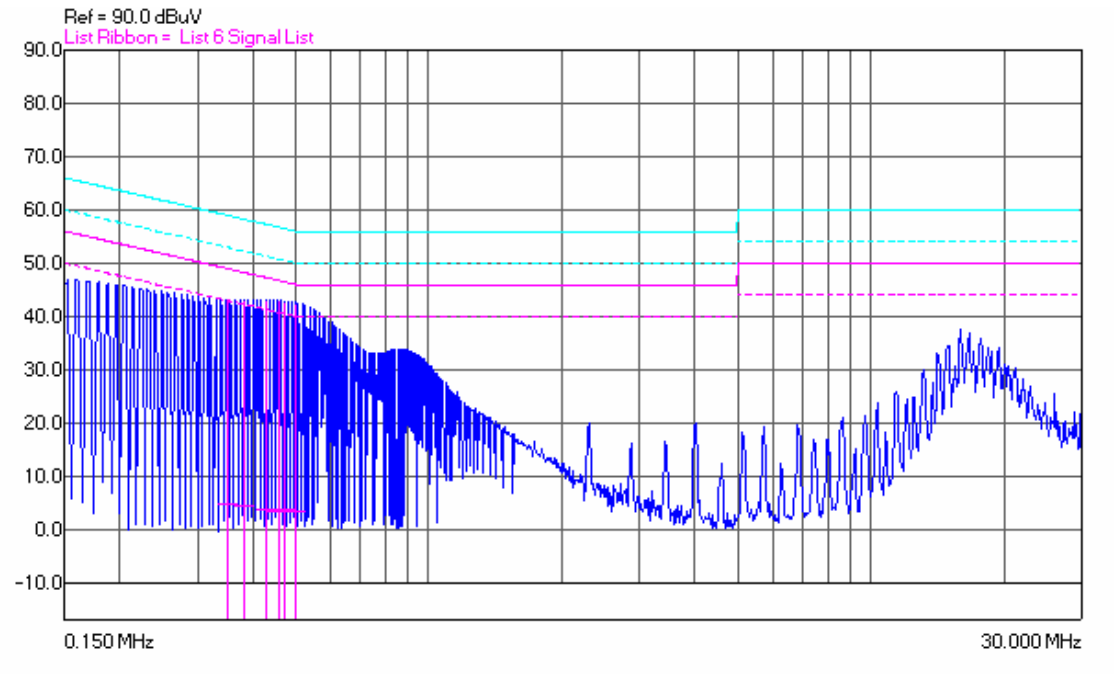
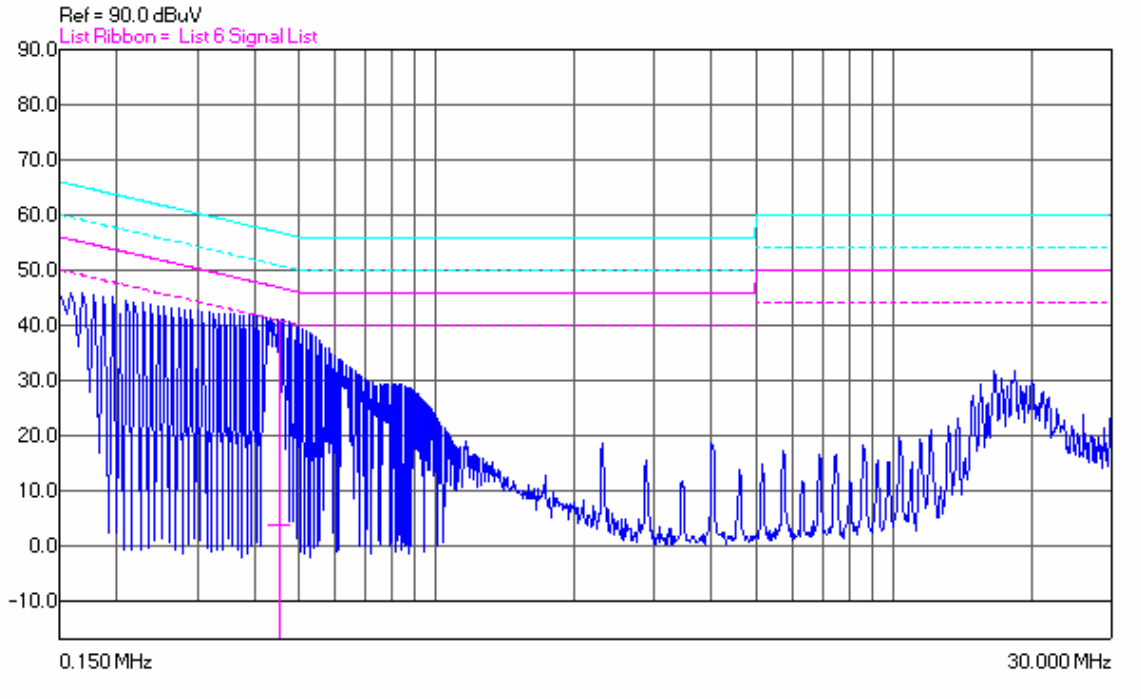


TABLE OF RESULTS – Neutral Line

Freq (MHz)	Peak (dBμV)	QP (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Ave. (dBμV)	Ave. Limit (dBμV)	Ave. Margin (dB)
0.454642	40.84	--.--	56.85	--.--	3.83	46.85	-43.02

Plot 75
AC Wireline Conducted Emissions – NEUTRAL LINE 150 kHz – 30 MHz)



Specification

Limit

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that 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 μΩ line impedance stabilization network (LISN), see §15.207 (a) matrix below. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

RSS-Gen §7.2.2
The radio frequency voltage that is conducted back into the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table below. The tighter limit applies at the frequency range boundaries.

§15.207 (a) and **RSS-Gen §7.2.2** Limit Matrix
The lower limit applies at the boundary between frequency ranges

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	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

Laboratory Measurement Uncertainty for Conducted Emissions

Measurement uncertainty	±2.64 dB

Traceability

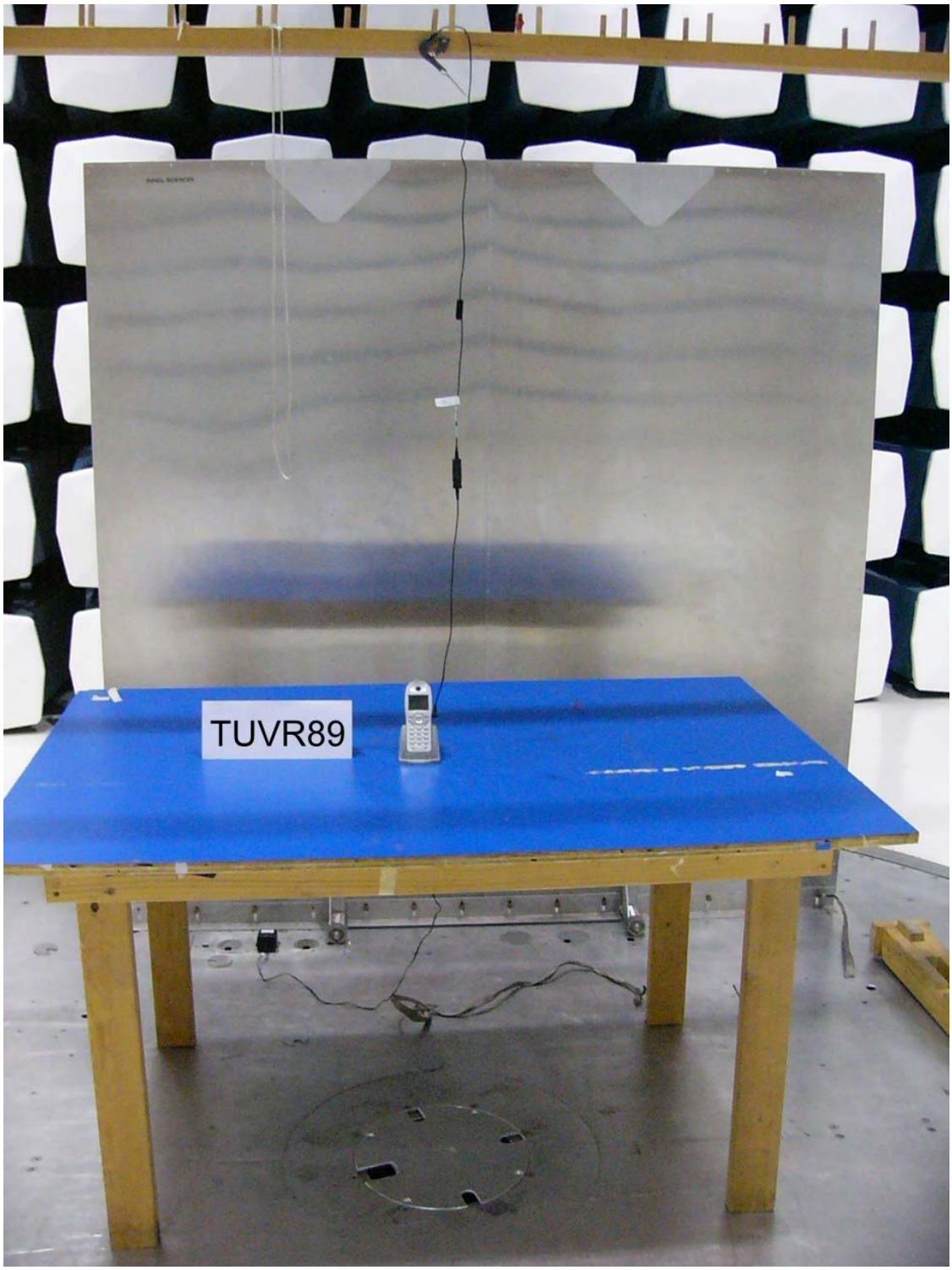
Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307

6. PHOTOGRAPHS

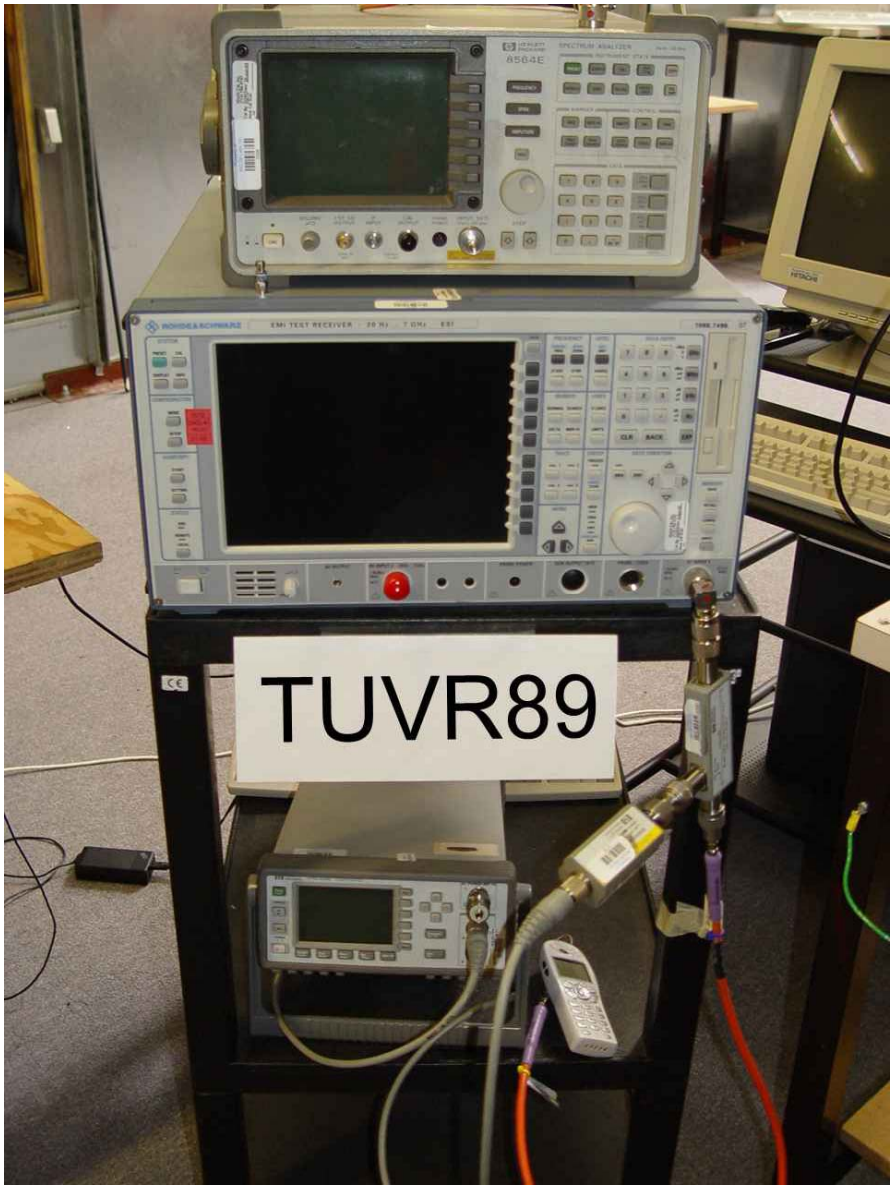
6.1. Radiated Emissions (30 MHz-1 GHz)

6.2. Spurious Emissions >1 GHz

6.3. Conducted Emissions (150 kHz - 30 MHz)



6.4. General Measurement Test Set-Up



7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0104	1-18GHz Horn Antenna	The Electro-Mechanics Company	3115	9205-3882
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	None
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	3140A01285
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002

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