Test of Bandspeed 3100AG 802.11 Wireless AP

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

Test Report Serial No.: BAND05-A2 Rev B

TEST REPORT

FROM

Test of Bandspeed 3100AG 802.11 Wireless AP
to
To FCC 47 CFR Part15.247 & IC RSS-210

Test Report Serial No.: BAND05-A2 Rev B

Note: this report only contains data with regards to the 2.4 and 5.8 GHz operational modes of the Bandspeed Wireless Access Point. 5150-5350 MHz and 5,470-5,725 MHz test data is reported in MiCOM Labs test report BAND05-A4

This report supersedes: None

Manufacturer: Bandspeed Inc
4301 Westbank Drive,
Bldg. B, Suite 100
Austin, Texas 78746 USA

Product Function: 802.11 a/b/g Wireless Access Point

Copy No: pdf **Issue Date:** 19th September 2007

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
440 Boulder Court, Suite 200
Pleasanton, CA 94566 USA
Phone: +1 (925) 462-0304
Fax: +1 (925) 462-0306
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ACCREDITED
CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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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
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ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

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

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	12th July 2007	First issue.
Rev B	19th September 2007	Clarification of MPE calculations

1. TEST RESULT CERTIFICATE

Manufacturer:	Bandspeed Inc 4301 Westbank Drive, Bldg. B, Suite 100 Austin, Texas 78746 USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	Wireless Access Point	Telephone:	+1 925 462 0304
Model:	3100AG	Fax:	+1 925 462 0306
S/N:	SRKTMC-061906-0077		
Test Date(s):	4th to 8th June 2007	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	2007	Code of Federal Regulations
(ii)	Industry Canada RSS-210	Issue 7 June 2007	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands)
(iii)	Industry Canada RSS-Gen	Issue 2 June 2007	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

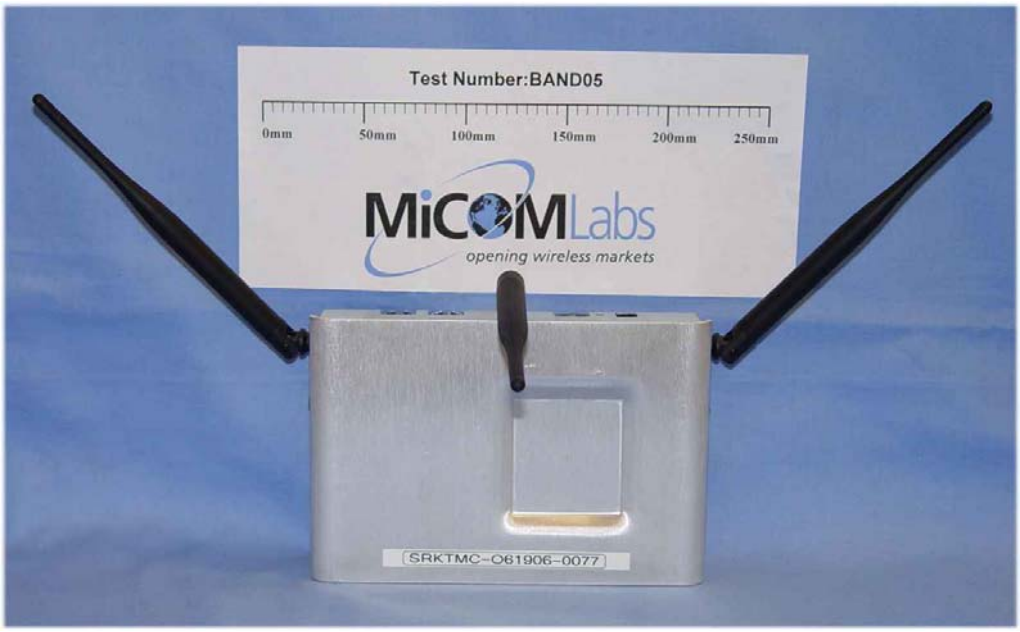
Details	Description
Purpose:	Test of the Bandspeed 3100AG 802.11 Wireless AP to FCC Part 15.247 and Industry Canada RSS-210 regulations.
Applicant:	As Manufacturer
Manufacturer:	Bandspeed Inc 4301 Westbank Drive, Bldg. B, Suite 100 Austin, Texas 78746 USA
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	BAND05-A2 Rev B
Date EUT received:	4TH June 2006
Standard(s) applied:	FCC 47 CFR Part15.247 & IC RSS-210
Dates of test (from - to):	4th to 8th June 2007
No of Units Tested:	1
Type of Equipment:	802.11a/b/g Wireless Access Point
Manufacturers Trade Name:	Wireless Access Point
Model:	3100AG
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:	5 Vdc, 2.6 A
Operating Temperature Range:	Declared range 0 to +50ºC
ITU Emission Designator:	802.11b – 14M3W7D 802.11g – 18M2W7D 802.11a – 19M3W7D
Microprocessor(s) Model:	Intel IXP425
Clock/Oscillator(s):	33.33 MHz, 40 MHz, 80 MHz
Frequency Stability:	±20 ppm max
Equipment Dimensions:	7½" X 5" X 1½"
Weight:	2 lbs
Primary function of equipment:	Wireless Access Point

3.2. Scope of Test Program

The scope of the test program was to test the Bandspeed 3100AG wireless Access Point in the frequency ranges 2400 - 2483.5 MHz, and 5725 – 5850 MHz for compliance against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications.

The Bandspeed 3100AG access point has three independent transmitters. Each antennae comprises two individual antennae, this addresses space diversity requirements. System identifies antenna as primary and secondary devices. A maximum of three transmitters can operate at any given time in any configuration;

Bandspeed 3100AG
Wireless Access Point



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

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	Wireless AP	Bandspeed	3100AG	SRKTMC-061906-0077
EUT	Power Supply	Good Power	JOD-SMU02131	None
Support	Laptop PC	Dell	Inspiron	None

3.4. Antenna Details

1. 802.11b/g Maximum Antenna Gain = +1.52 dBi
2. 802.11a Maximum Antenna Gain = + 5.00 dBi

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. 10/100 Ethernet
2. POE 10/100 Ethernet
3. Local maintenance terminal (Serial RS-232, 9-pin cable)
4. 5 Vdc, 4mm supply connector

3.6. Test Configurations

Testing was performed to determine the highest power level versus bit rate. 802.11b 1 MB/s, 54 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)	Frequencies (MHz)
b, g	2,412 2,437 2,462
a	5,745 5,785 5,825

Antenna configuration identified as “Sector 2 “ was used to generated all conducted results. A worst case configuration all transmitters operating was used for emissions below 1 GHz and AC Wireline Emissions.

Matrix of Access Point Data Rate Configurations

‘b’ Mode Data Rate	‘a’ and ‘g’ Mode Data Rate
1 Mb/s	54 Mb/s

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. Problem with radiated emissions below 1 GHz. Harmonics from 80 MHz local oscillator were generated and radiated from the EUT.

   Solution

   Manufacturer slowed rise time on the edges of the oscillator which reduced harmonic content (required termination resistor change, product BOM updated as a result). Section 5.1.6.3 identifies compliant emission profile after the fix.

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

1. NONE

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 b/g and 30 MHz – 40 GHz a)	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

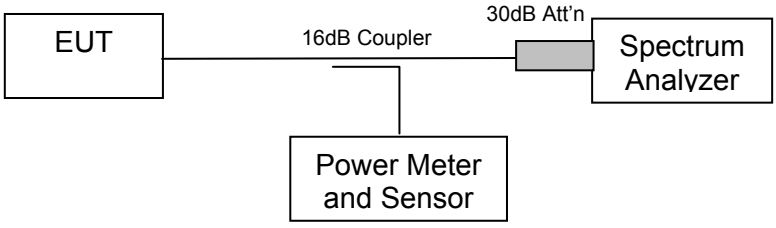
5.1. Device Characteristics

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 - 1 Mb/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	99 % BW (MHz)	99 % BW Plots
2,412	10.98196393	On File	14.10821643	On File
2,437	11.12224449	On File	14.12825651	On File
2,462	11.20240481	01	14.22845691	01

Plot 01
2,462 MHz 802.11b 6 dB Bandwidth

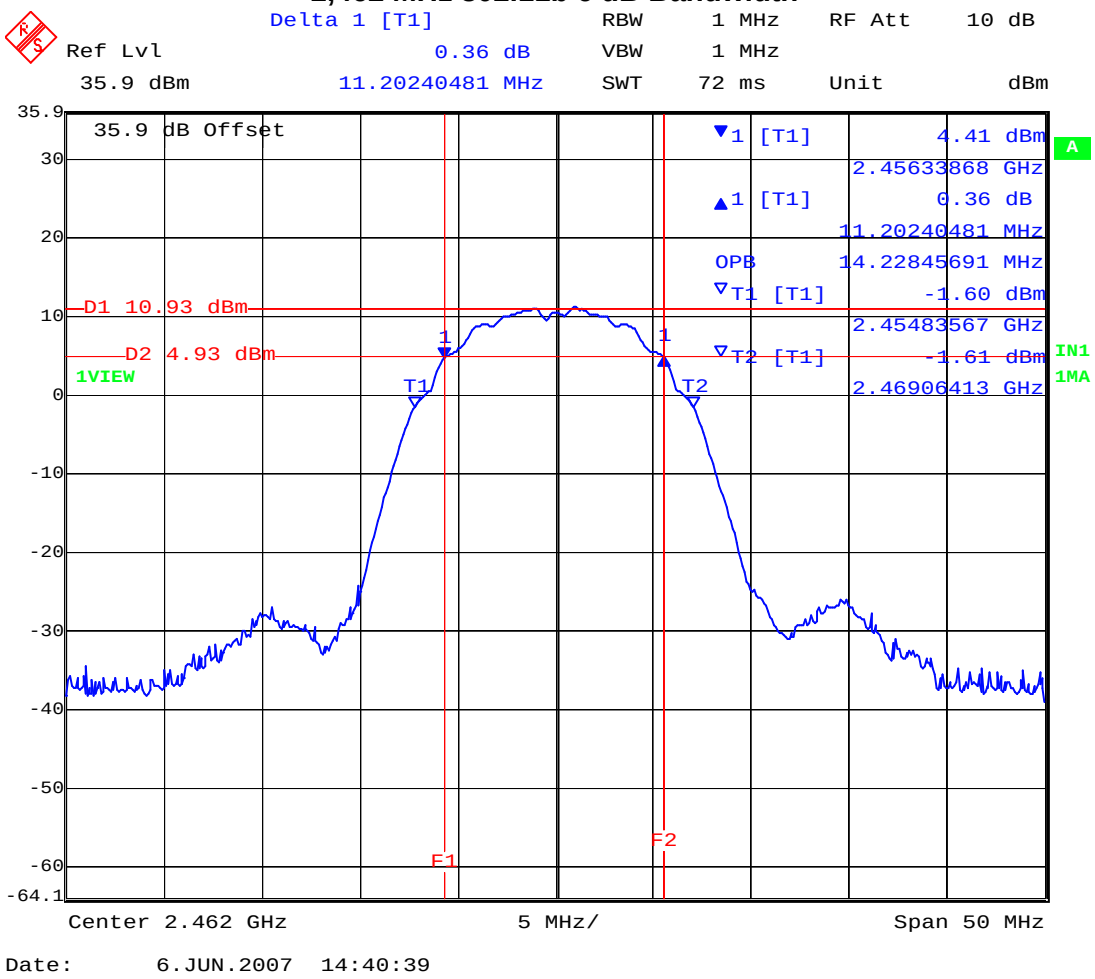


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TABLE OF RESULTS – **802.11g - 54 Mb/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	99 % BW (MHz)	99 % BW Plots
2,412	16.99398798	On File	17.55511022	On File
2,437	17.05410822	02	18.13627255	02
2,462	16.71342685	On File	17.43486974	On File

Plot 02
2,437 MHz 802.11g 6 dB Bandwidth

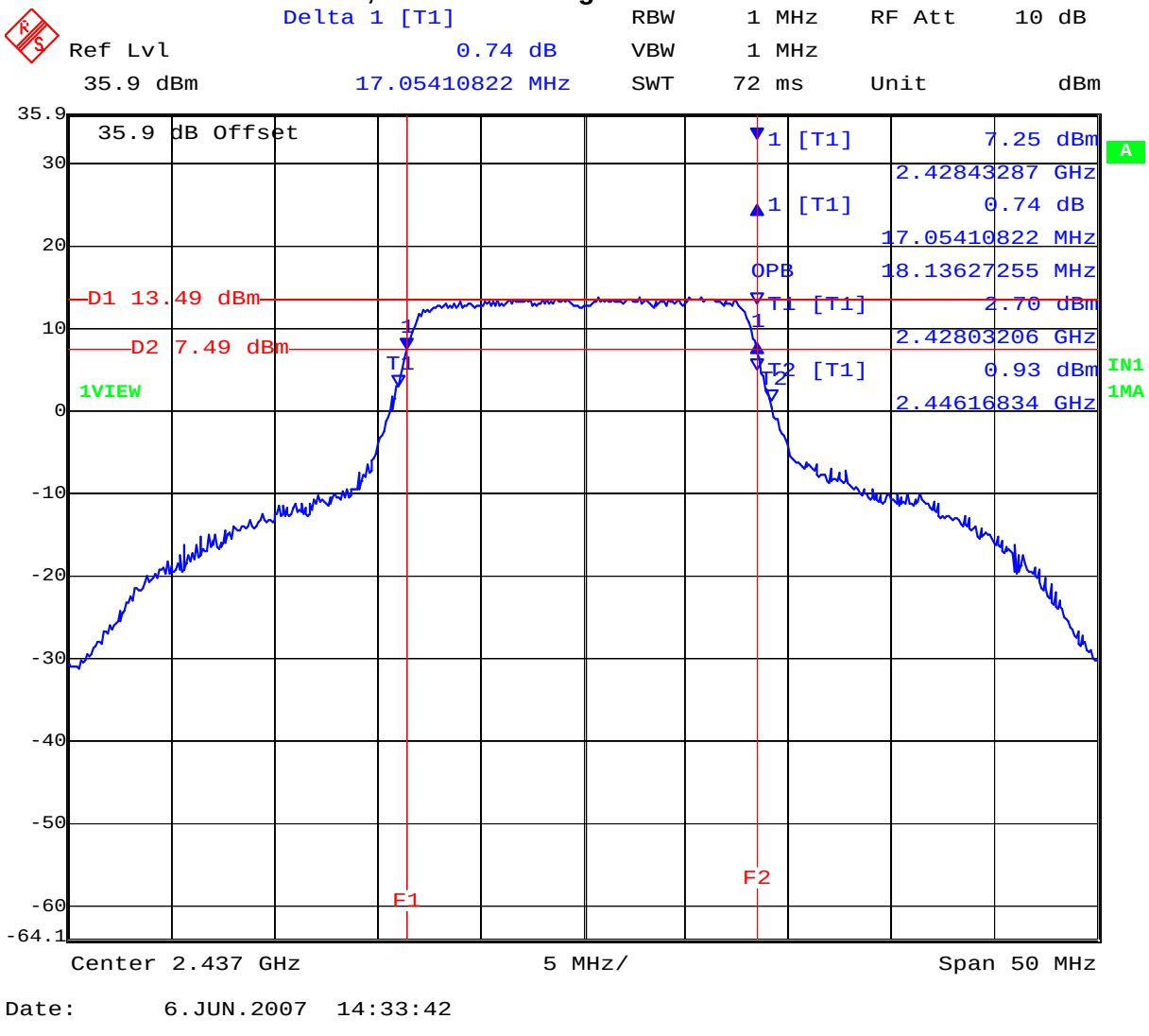
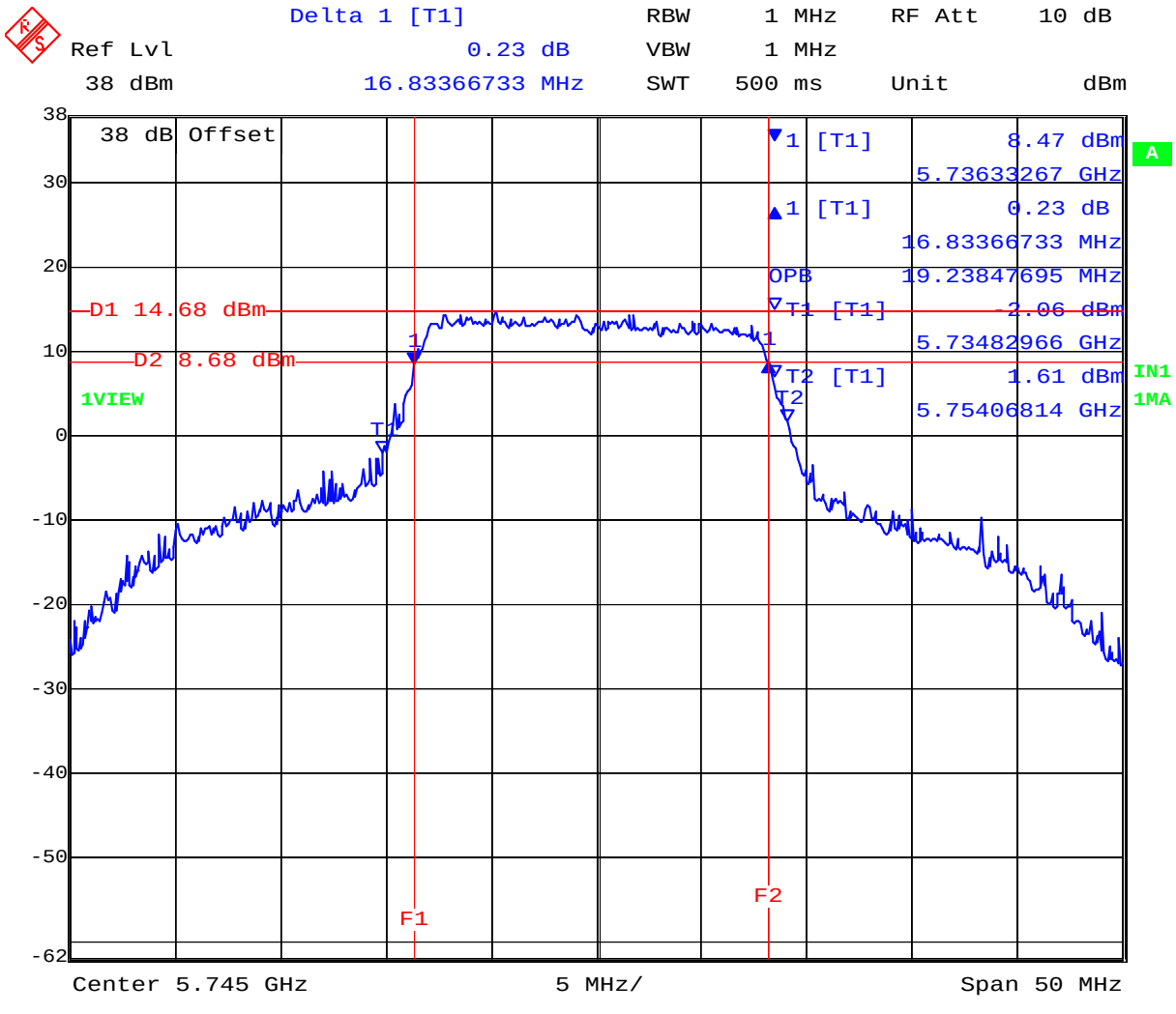


TABLE OF RESULTS – **802.11a - 54 Mb/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	99 % BW (MHz)	99 % BW Plots
5,745	16.83366733	03	19.23847695	03
5,785	16.73346693	On File	18.33667335	On File
5,825	16.93386774	On File	17.83567134	On File

Plot 03

5,745 MHz 802.11a 6 dB Bandwidth



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

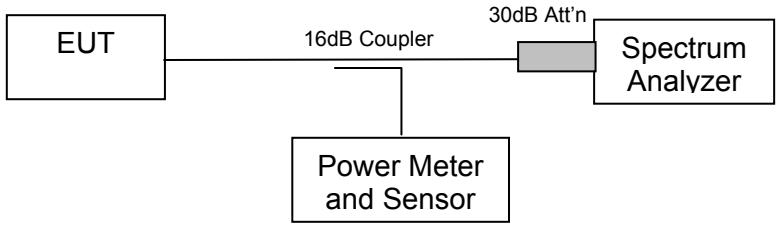
Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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

b/g Maximum Antenna Gain = +1.52 dBi

a Maximum Antenna Gain = + 5.01 dBi

TABLE OF RESULTS – **802.11b – 1Mb/s** Maximum Antenna Gain = +1.52 dBi

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)	Plot #
2,412	14.1082	+18.53	+20.05	On File
2,437	14.1283	+19.23	+20.75	On File
2,462	14.2284	+19.60	+21.12	04

Plot 04
2,462 MHz 802.11b Peak Power (dBm)

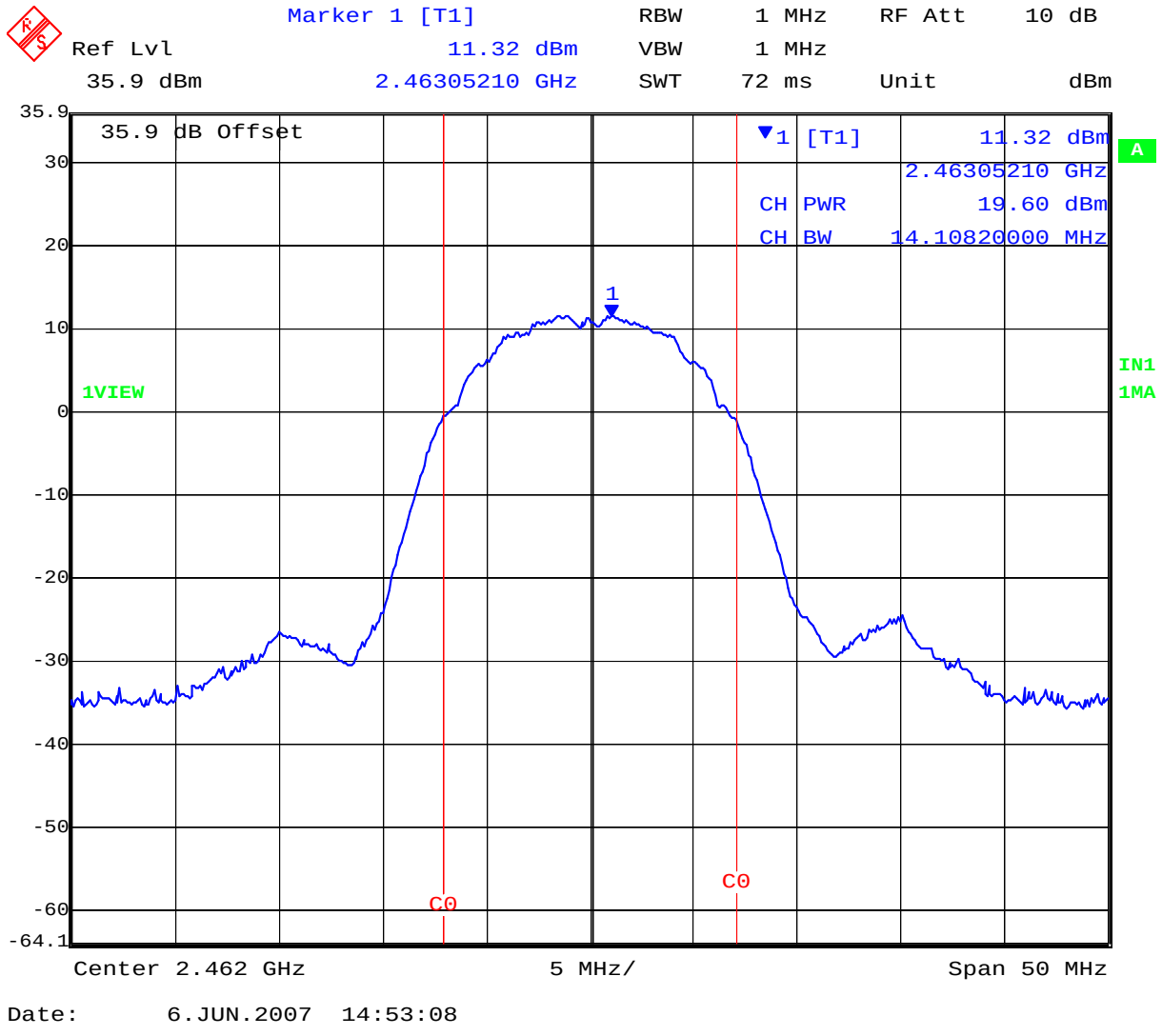


TABLE OF RESULTS – **802.11g – 54Mb/s** Maximum Antenna Gain = +1.52 dBi

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)	Plot #
2,412	17.555	+24.67	+26.19	On File
2,437	18.1363	+26.12	+27.64	05
2,462	17.4349	+21.16	+22.68	On File

Plot 05

2,437 MHz 802.11g Peak Power (dBm)

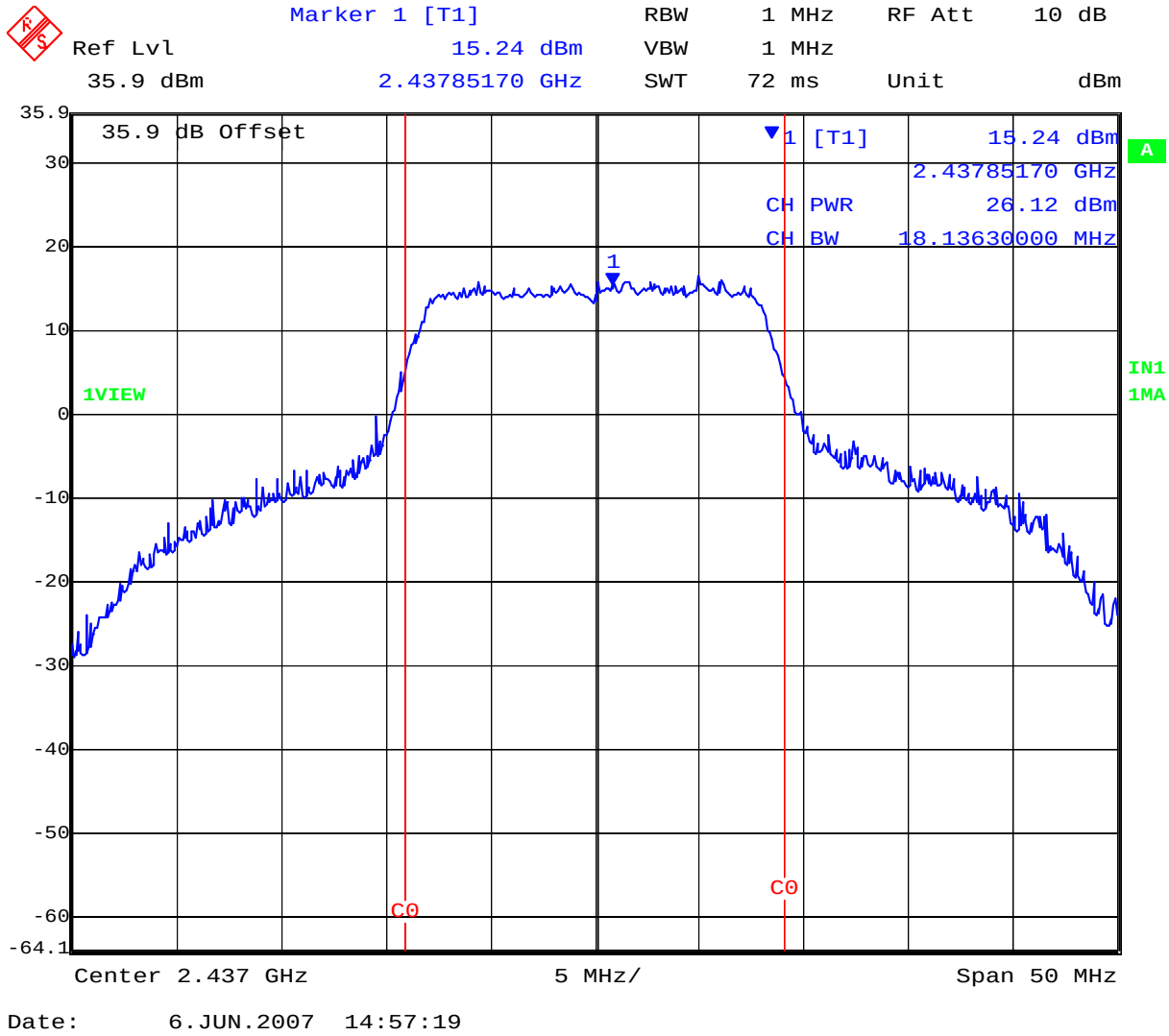
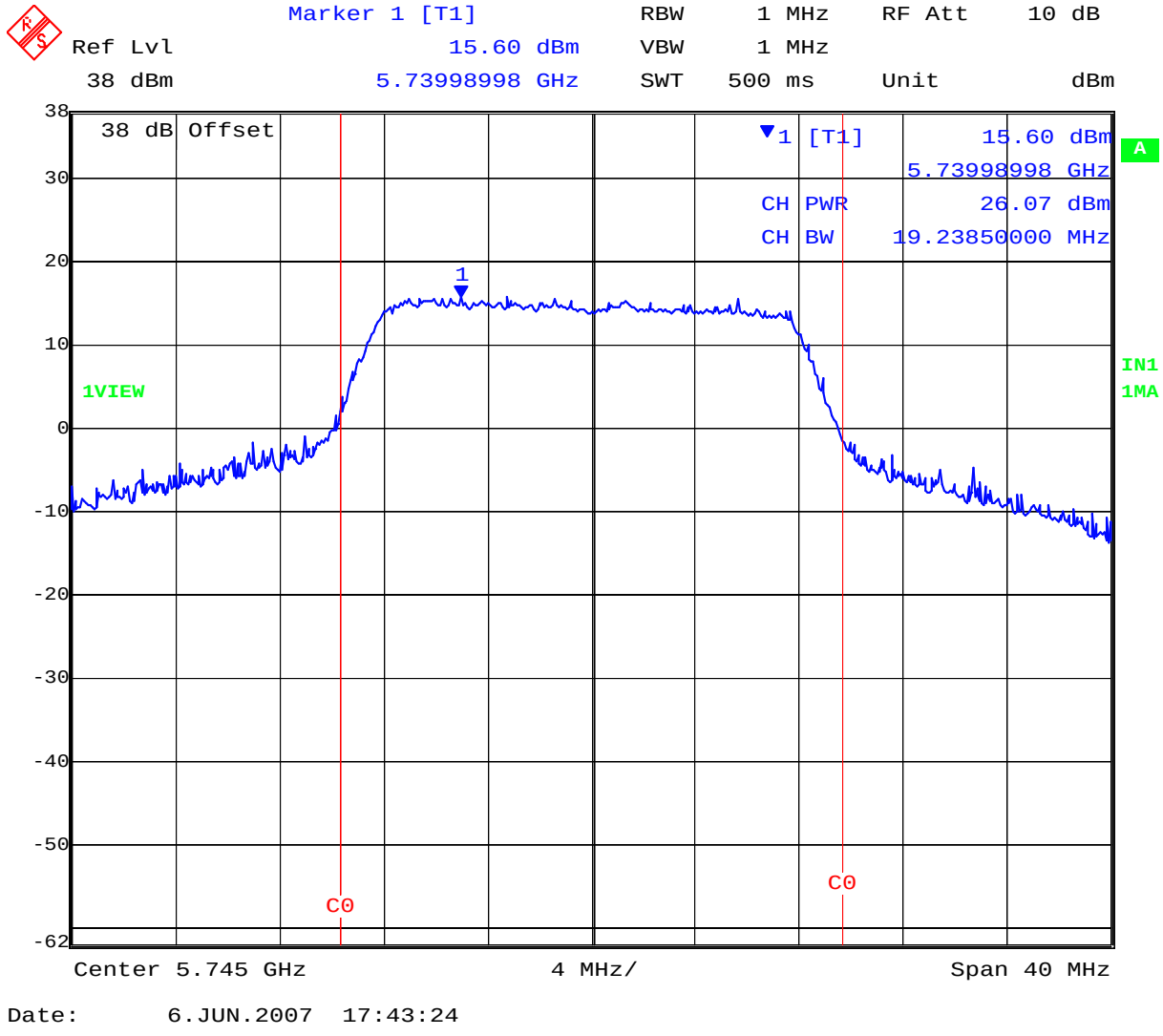


TABLE OF RESULTS – **802.11a – 54 Mb/s** Maximum Antenna Gain = +5.01 dBi

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)	Plot #
5,745	19.2385	+26.07	+31.08	06
5,785	18.3367	+24.39	+29.40	On File
5,825	17.8357	+25.33	+30.34	On File

Plot 06

5,745 MHz 802.11a Peak Power (dBm)



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

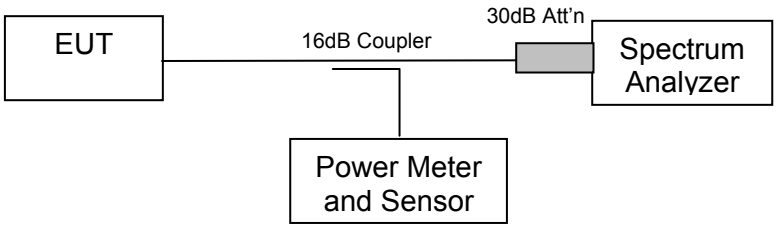
5.1.3. Peak Power Spectral Density

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 – 1Mb/s**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)	Plot #
2,412	2411.18737	-5.31	+8	-13.31	On File
2,437	2437.83066	-4.52	+8	-12.52	07
2,462	2461.12325	-5.49	+8	-13.49	On File

Plot 07
2,437 MHz 802.11b Peak Power Spectral Density

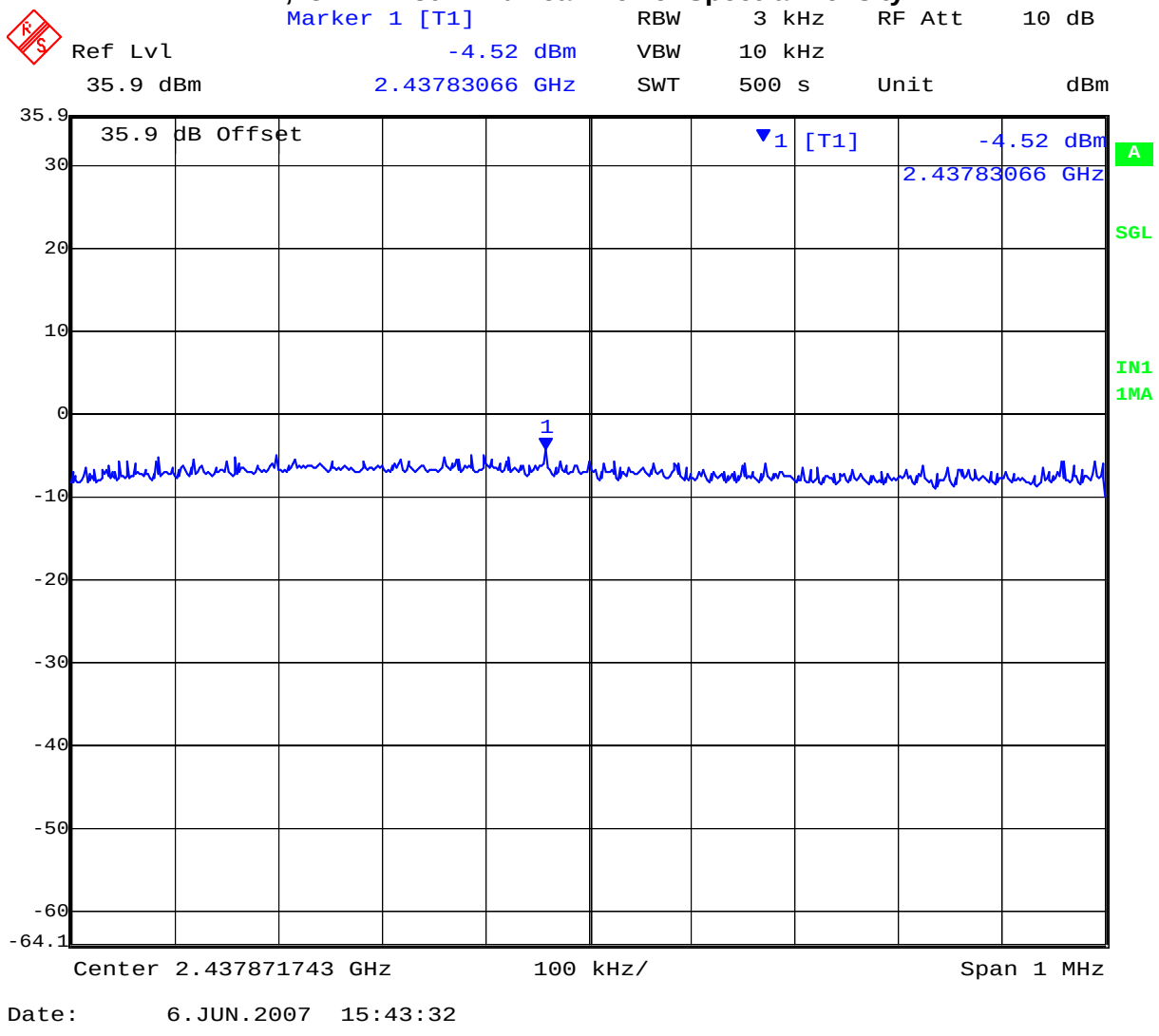


TABLE OF RESULTS – **802.11g – 54 Mb/s**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)	Plot #
2,412	2416.67836	-8.27	+8	-16.27	On File
2,437	2443.23146	-6.16	+8	-14.16	08
2,462	2460.40782	-10.54	+8	-18.54	On File

Plot 08
2,437 MHz 802.11g Peak Power Spectral Density

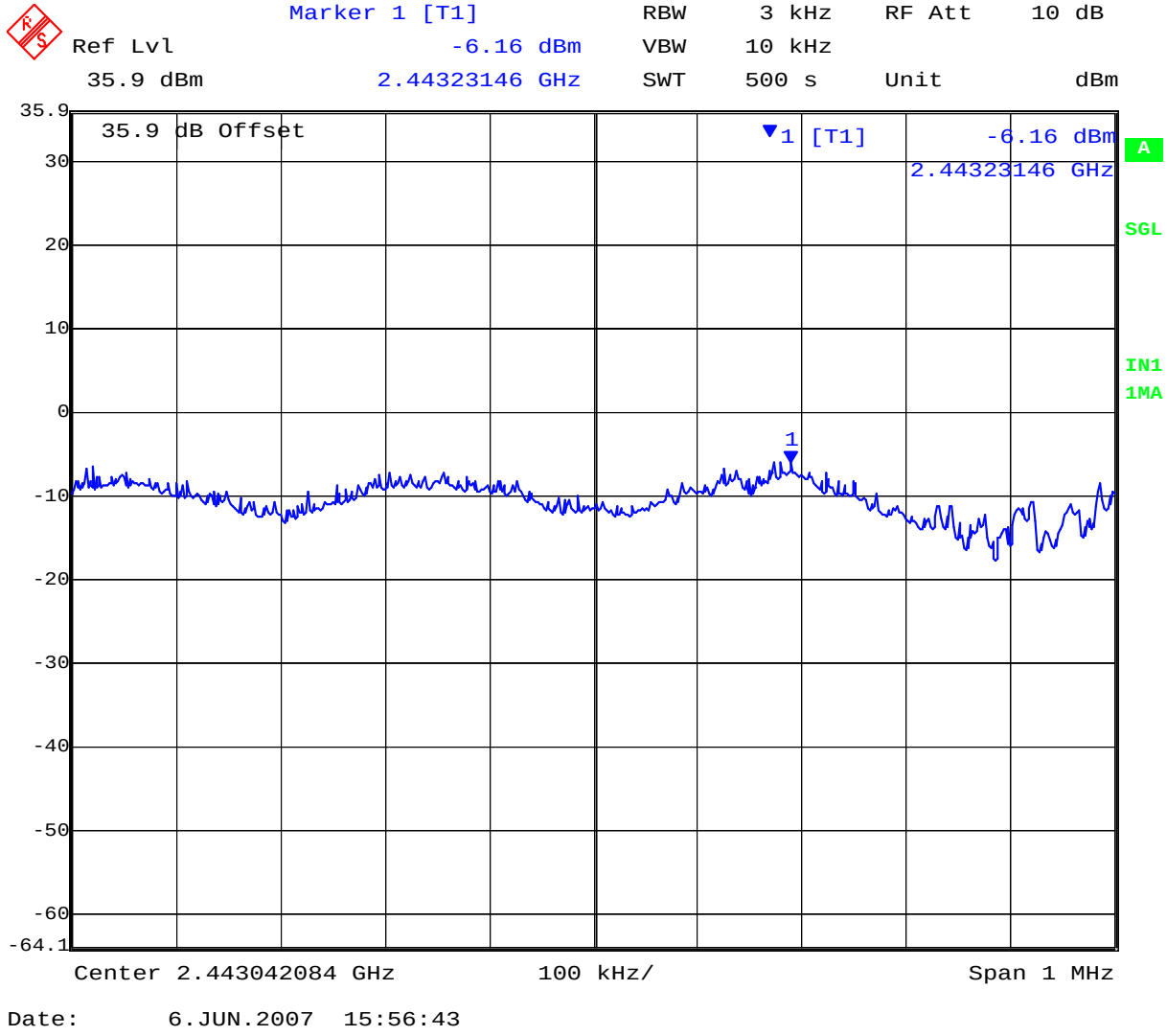
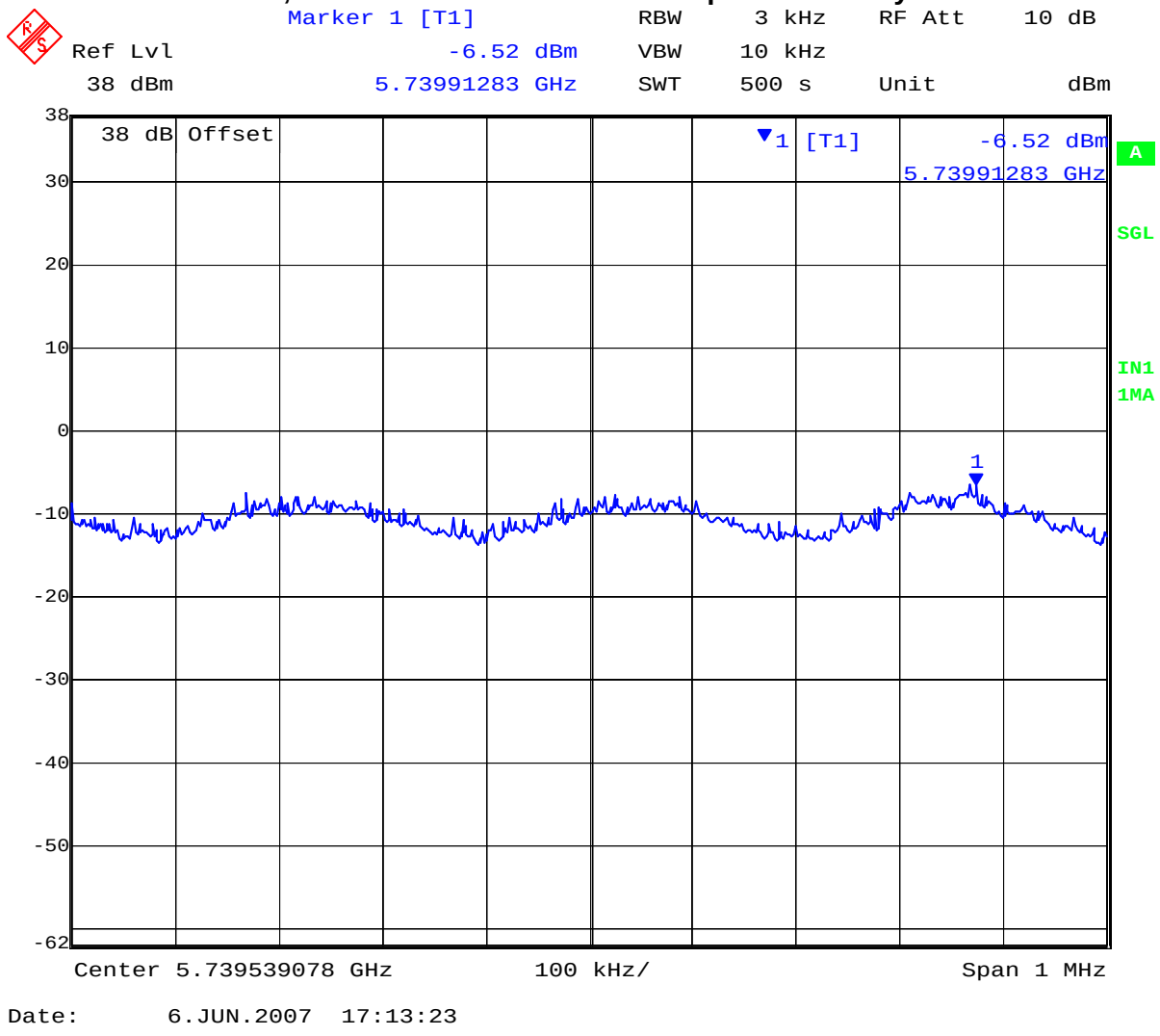


TABLE OF RESULTS – **802.11a – 54Mbit/s**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)	Plot #
5,745	5739.91283	-6.52	+8	-14.52	12
5,785	5784.57014	-7.99	+8	-15.99	On File
5,825	5828.96693	-7.36	+8	-15.39	On File

Plot 09
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

5.1.4. Maximum Permissible Exposure

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

Calculations for Maximum Permissible Exposure Levels

Power Density = Pd (mW/cm^2) = EIRP/(4πd^2)

EIRP = P * G * 3

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

Numeric Gain = 10 ^ (G (dBi)/10)

The Bandspeed 3100AG has three transmitters operating over four different frequency bands. The peak power in the table below is calculated for each frequency band by assuming a worst case scenario where the three transmitters are operating simultaneously in the same band. The Peak Power in mW is calculated by taking the maximum conducted power measured in each band and multiplying by 3.

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm^2

Freq. Band (GHz)	Antenna Gain (dBi)	Numeric Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated Safe Distance @ 1mW/cm^2 Limit(cm)	Minimum Separation Distance (cm)
2.4	1.52	1.42	+26.12	1227.79	11.8	20
5.8	5.0	3.17	+26.07	1213.73	17.5	20

Note: for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.

Specification

Maximum Permissible Exposure Limits

§15.247(i) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency levels in excess of the Commission's guidelines.

FCC §1.1310 Limit = 1mW / cm^2 from 1.310 Table 1

RSS-Gen §5.5 Before equipment certification is granted, the applicable requirements of RSS-102 shall be met.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

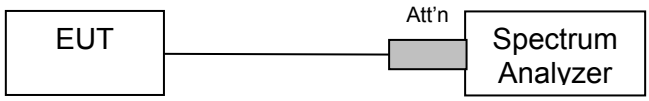
5.1.5. Conducted Spurious Emissions

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

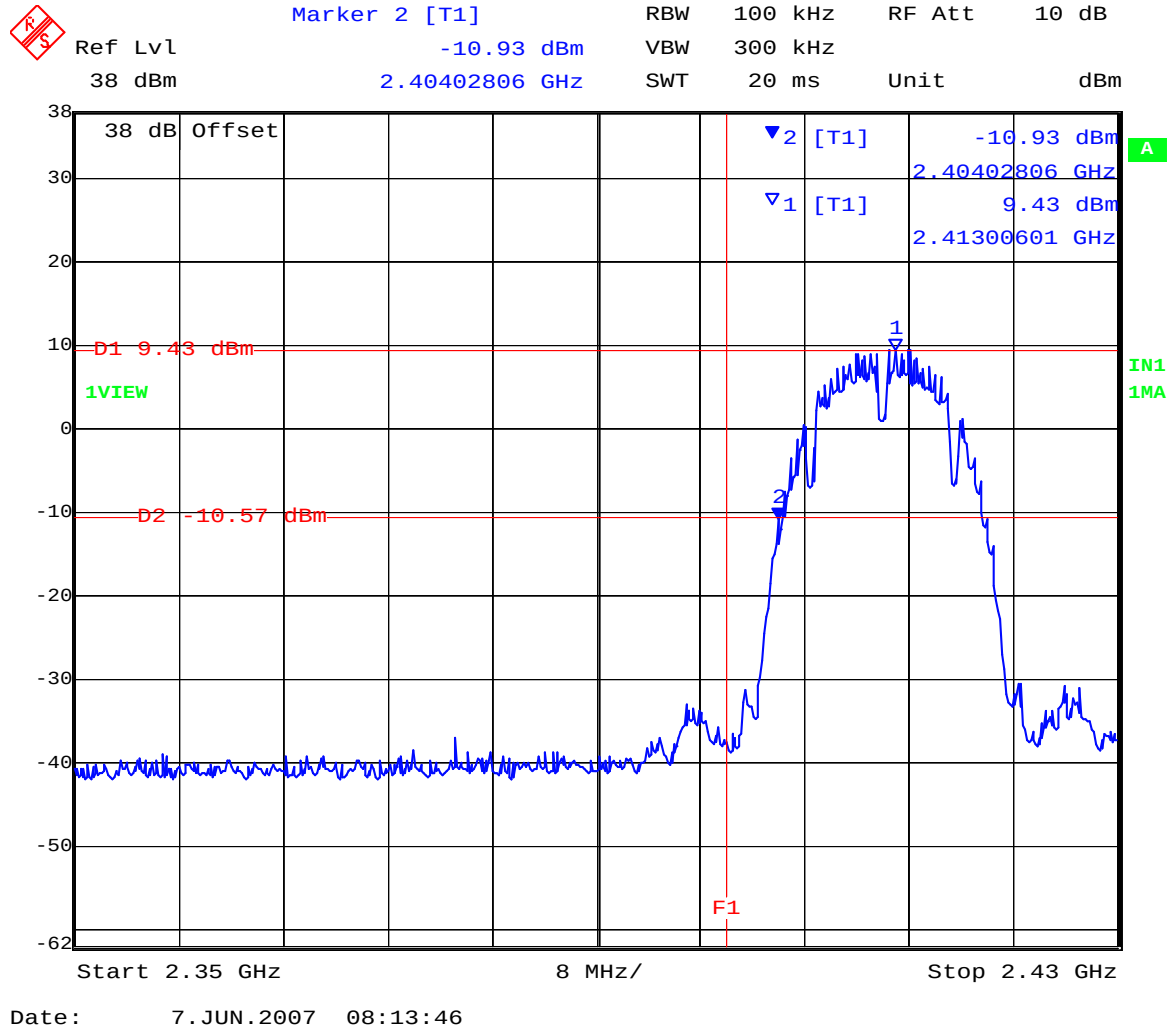
Conducted Band-Edge Results

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 – 1 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	-10.57	-33.00	10	-22.43
2,462	2,483.5	-9.92	-38.73	11	-28.81

Plot 10
Conducted Spurious Emissions at the 2,400 MHz Band Edge



Plot 11
Conducted Spurious Emissions at the 2,483.5 MHz Band Edge

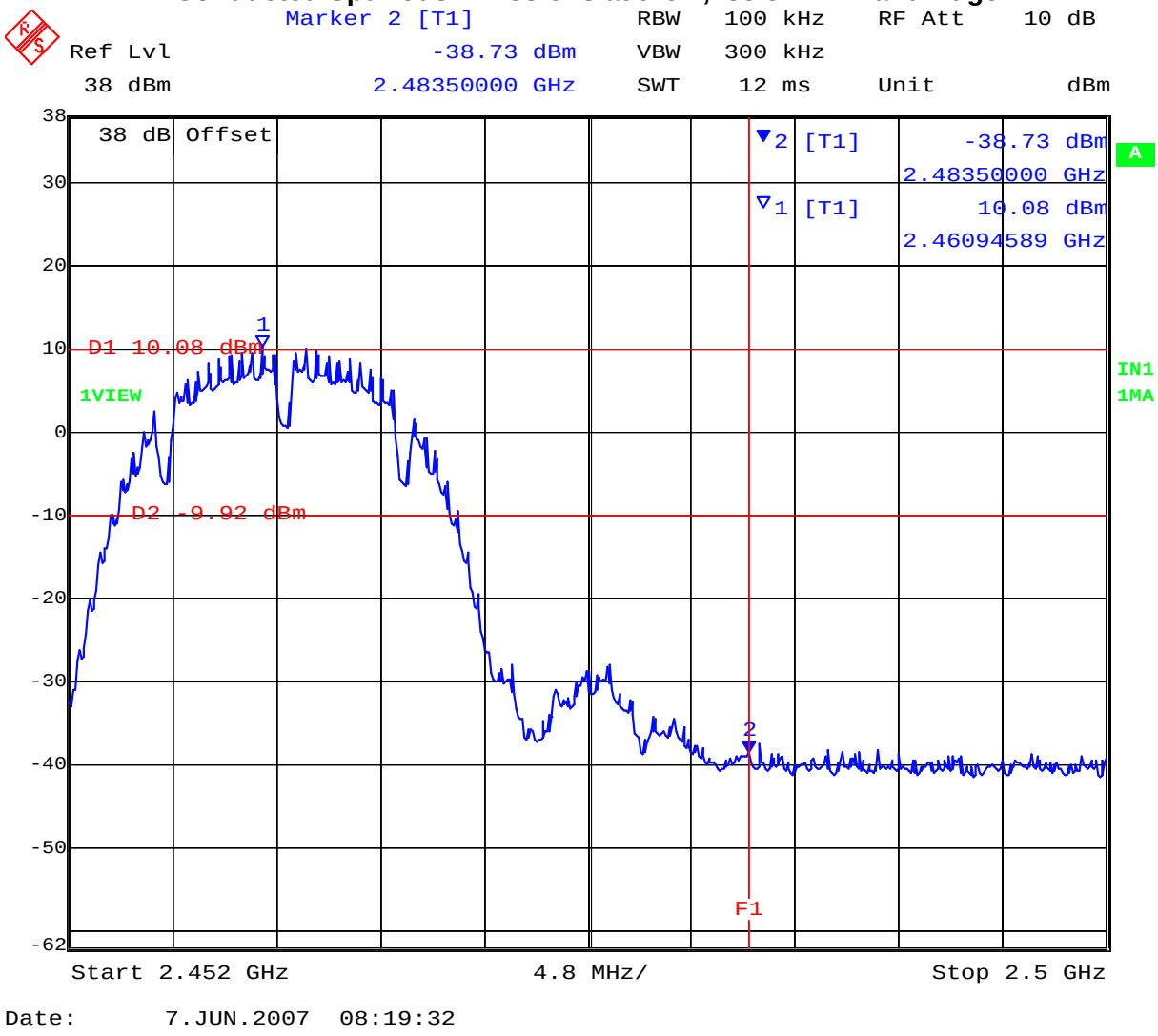
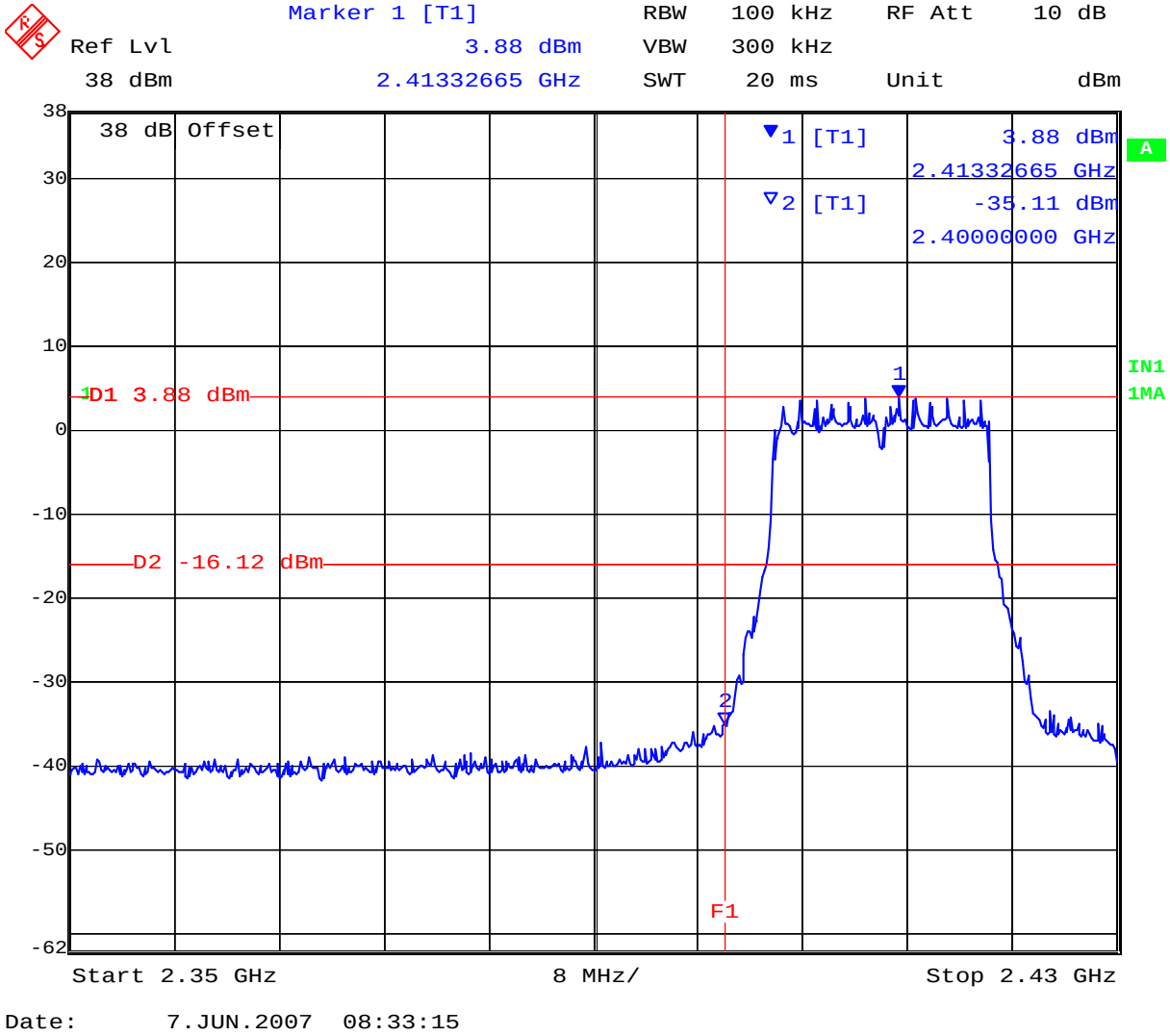


TABLE OF RESULTS – **802.11g – 54 Mbit/s**

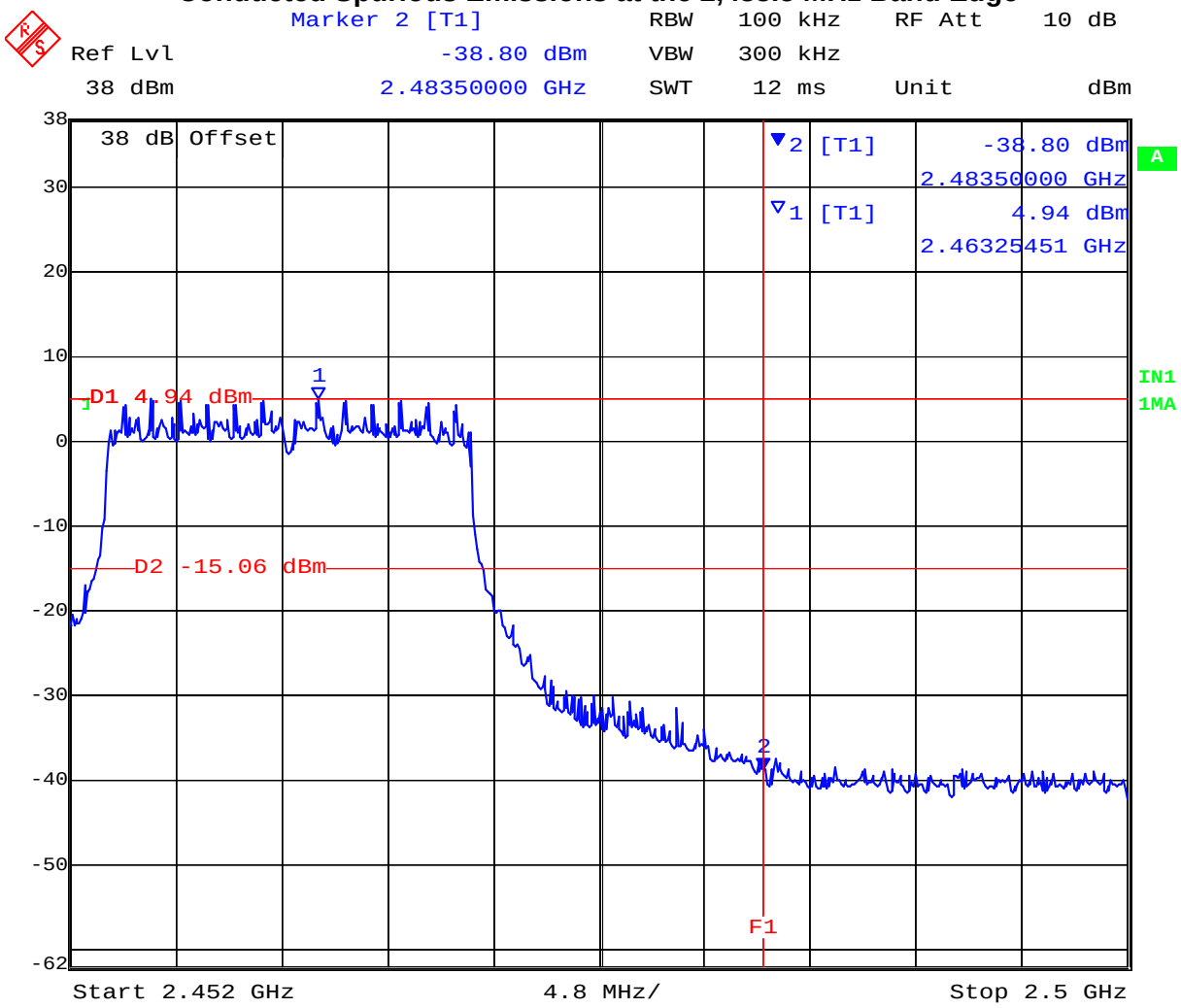
Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Plot #	Margin (dB)
2,412	2,400	-16.12	-35.11	12	-18.99
2,462	2,483.5	-15.06	-38.80	13	-23.74

Plot 12
Conducted Spurious Emissions at the 2,400 MHz Band Edge



Date: 7.JUN.2007 08:33:15

Plot 13
Conducted Spurious Emissions at the 2,483.5 MHz Band Edge

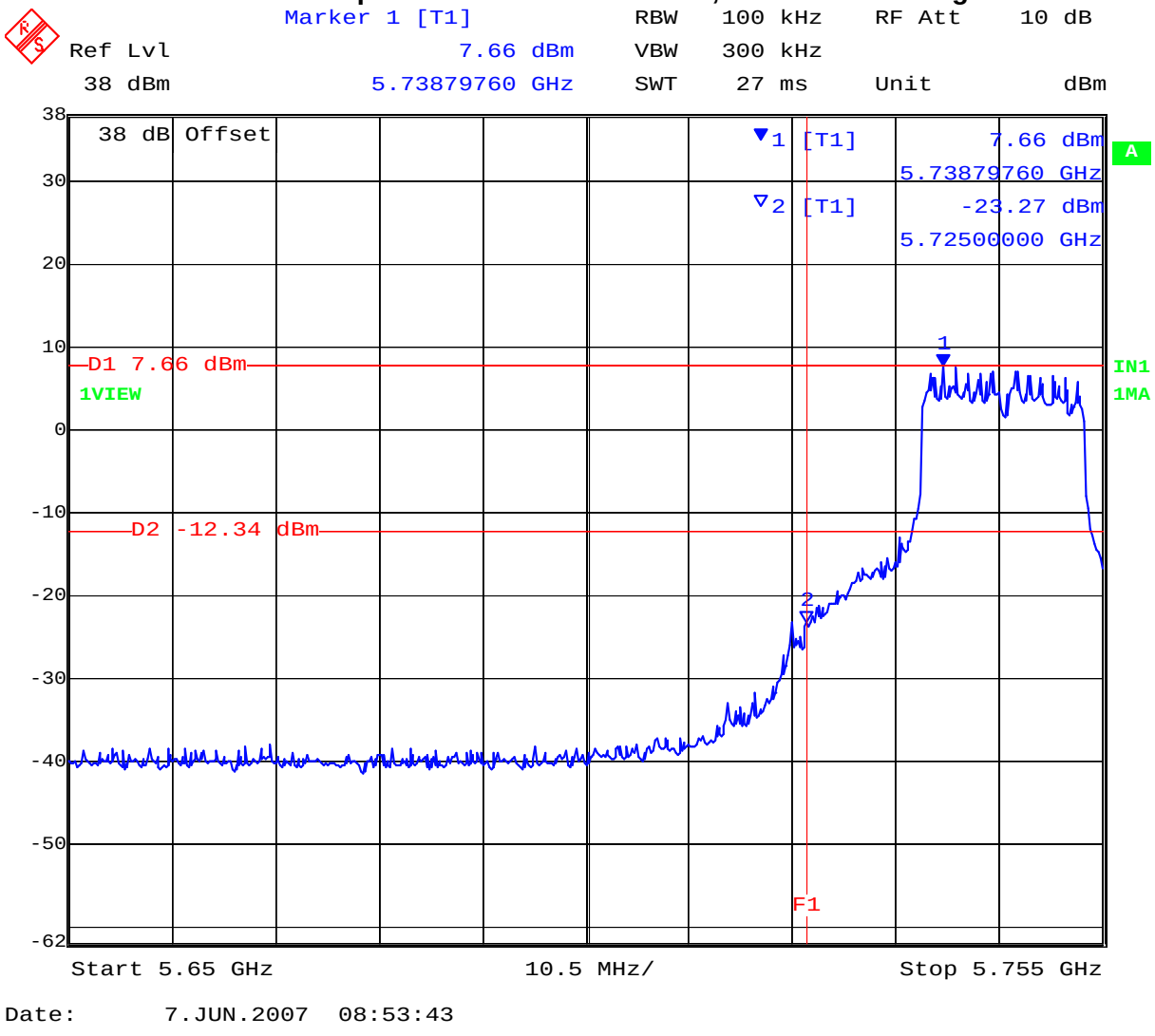


Date: 7.JUN.2007 08:23:58

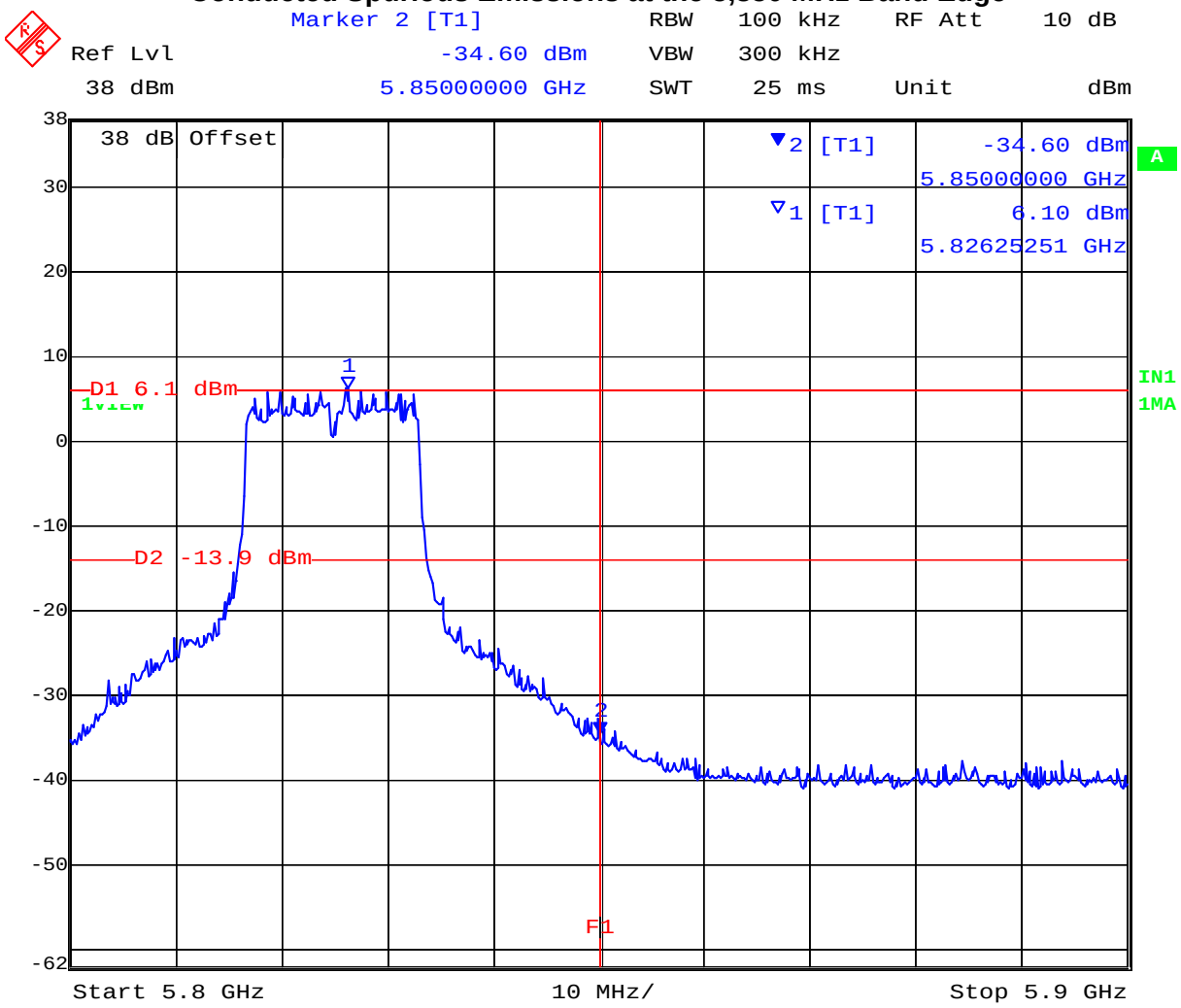
TABLE OF RESULTS – **802.11a – 54Mbit/s**

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	-12.34	-23.27	14	-10.93
5,825	5,850	-13.90	-34.60	15	-20.70

Plot 14
Conducted Spurious Emissions at the 5,725 MHz Band Edge



Plot 15
Conducted Spurious Emissions at the 5,850 MHz Band Edge



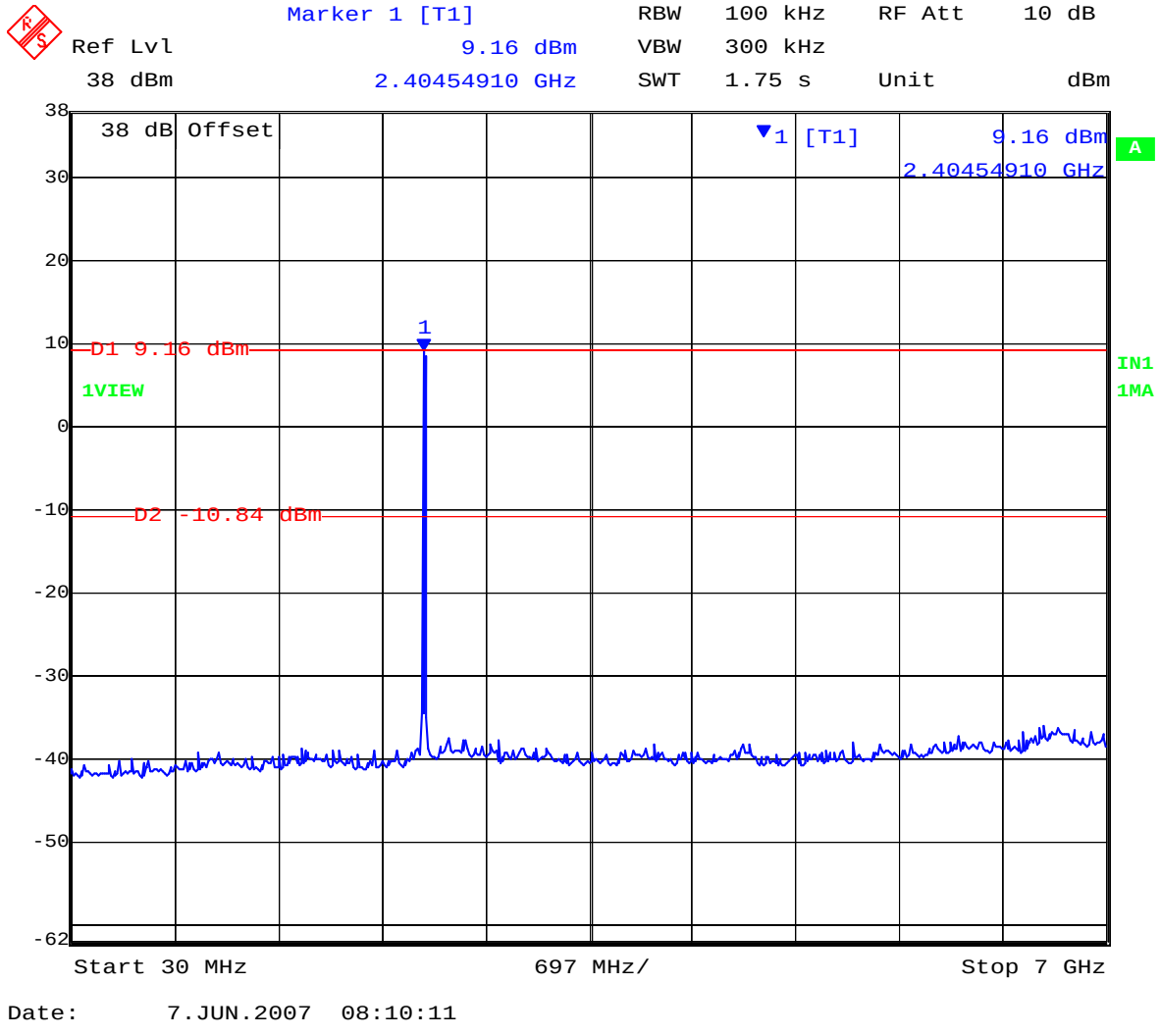
Spurious Emissions (30 - 26,000 MHz)

TABLE OF RESULTS – **802.11b – 1 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	-36.00	-10.84	16	-25.16
2,412	7,000	26,000	-34.57	-10.84	17	-23.73

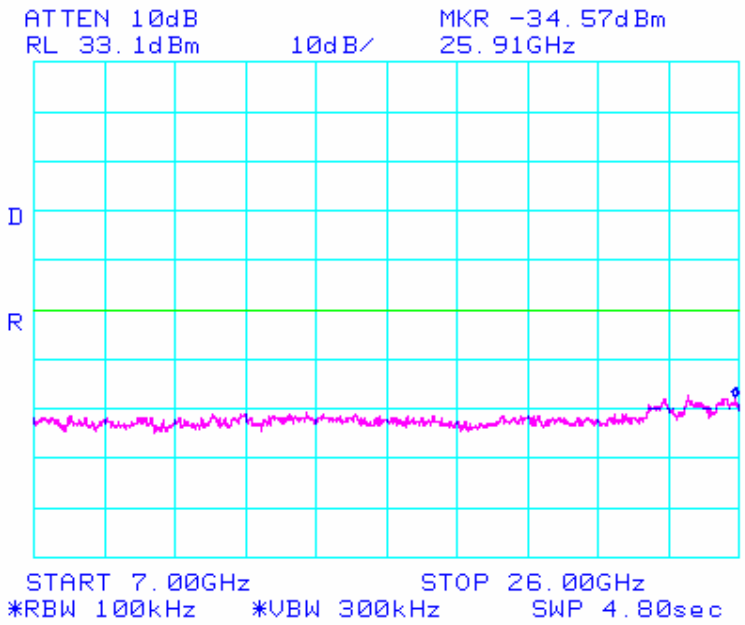
Plot 16 802.11b – 1 Mbit/s

2,412 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



Plot 17 802.11b – 1 Mbit/s

2,412 MHz Conducted Spurious Emissions 7,000 MHz to 26,000 MHz



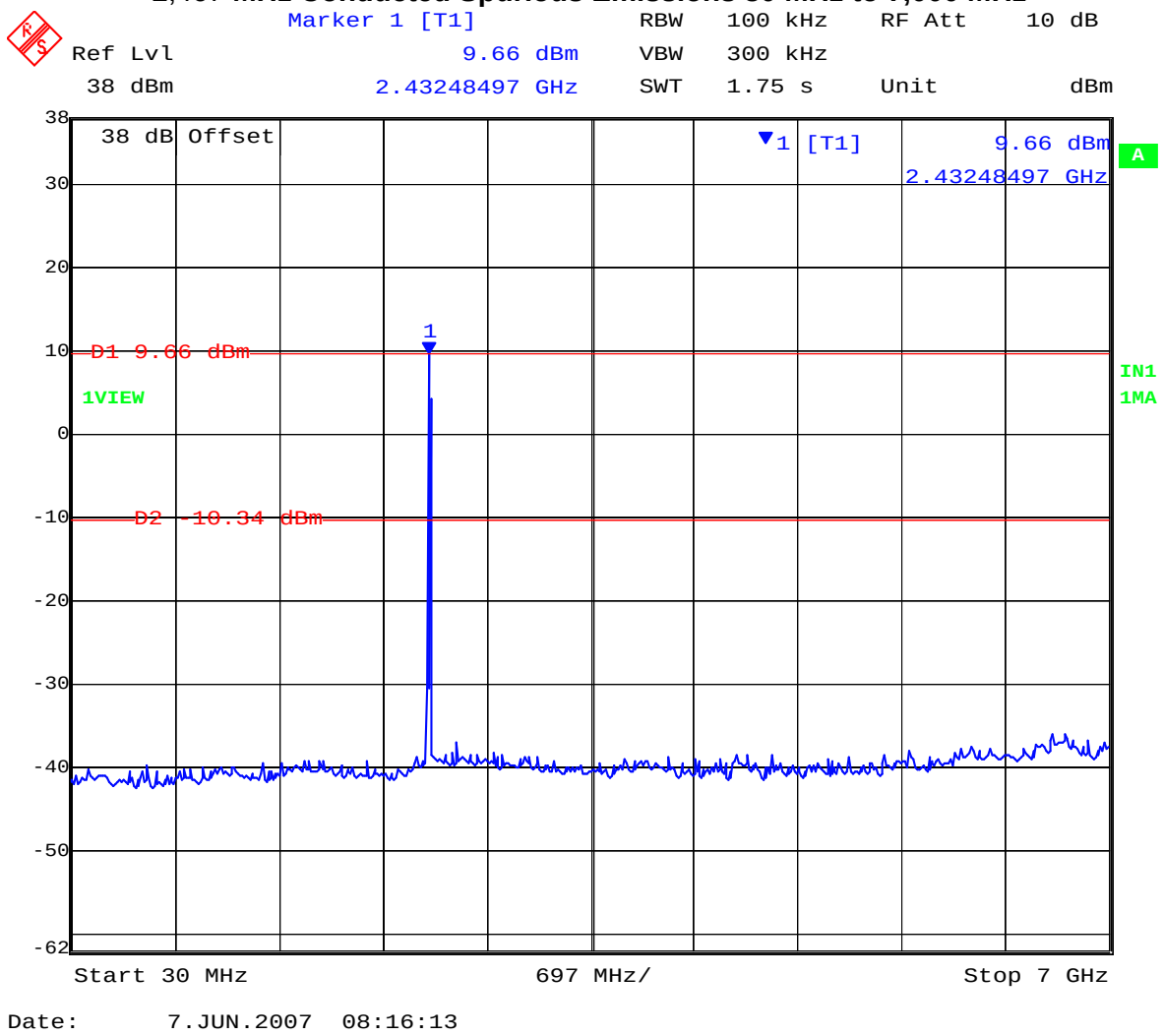
Spurious Emissions (30 - 26,000 MHz)

TABLE OF RESULTS – **802.11b – 1 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	-36.00	-10.34	18	-25.66
2,437	7,000	26,000	-34.07	-10.34	19	-23.73

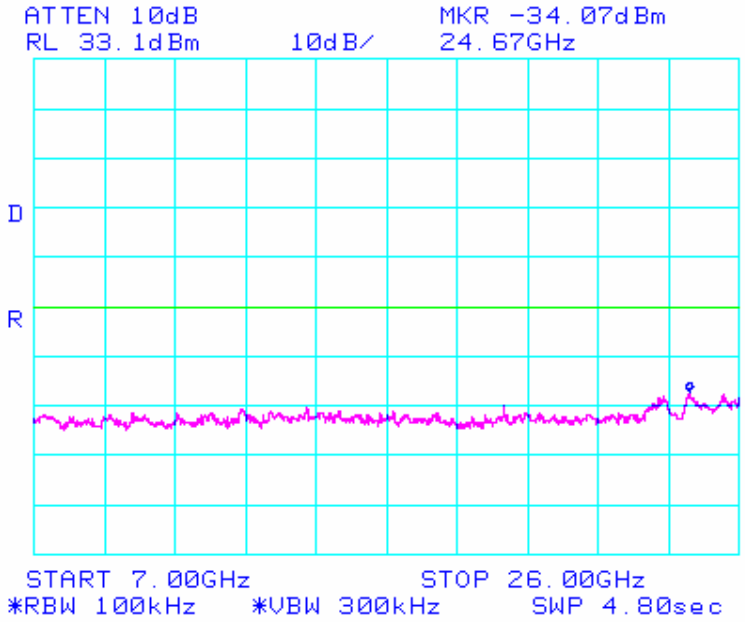
Plot 18 802.11b – 1 Mbit/s

2,437 **MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz**



Plot 19 802.11b – 1 Mbit/s

2,437 **MHz Conducted Spurious Emissions 7,000 MHz to 26,000 MHz**



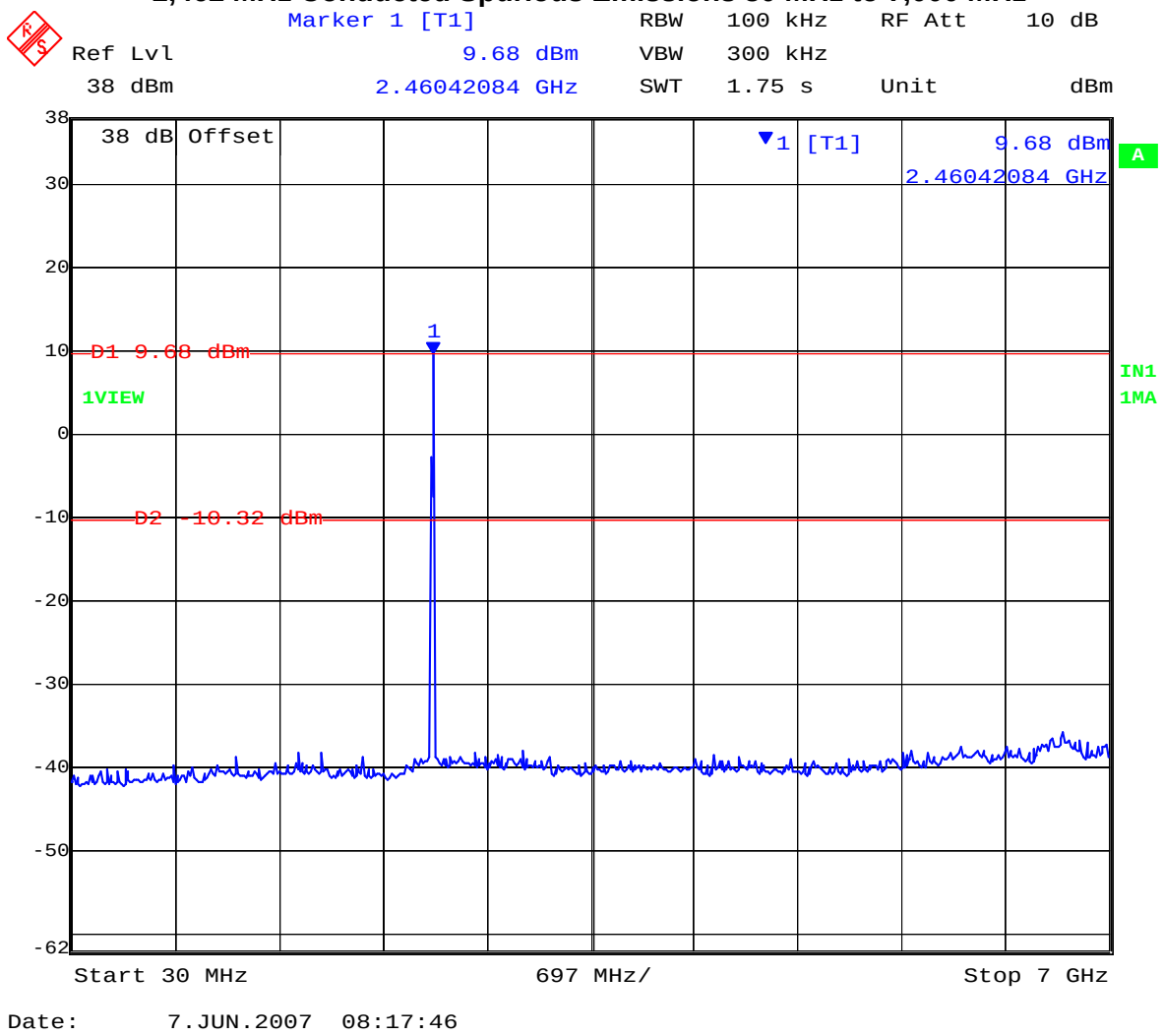
Spurious Emissions (30 - 26,000 MHz)

TABLE OF RESULTS – **802.11b – 1 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	-36.00	-10.32	20	-25.68
2,462	7,000	26,000	-33.73	-10.32	21	-23.41

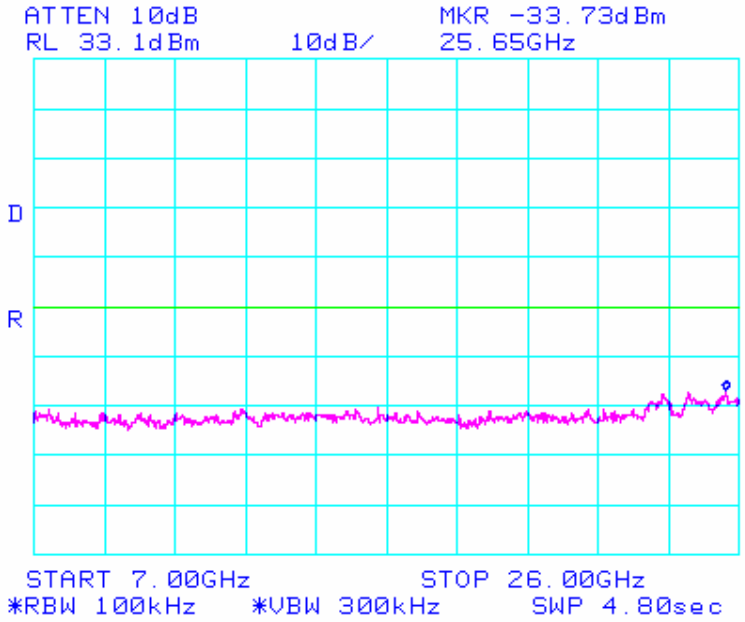
Plot 20 802.11b – 1 Mbit/s

2,462 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



Plot 21 802.11b – 1 Mbit/s

2,462 MHz Conducted Spurious Emissions 7,000 MHz to 26,000 MHz



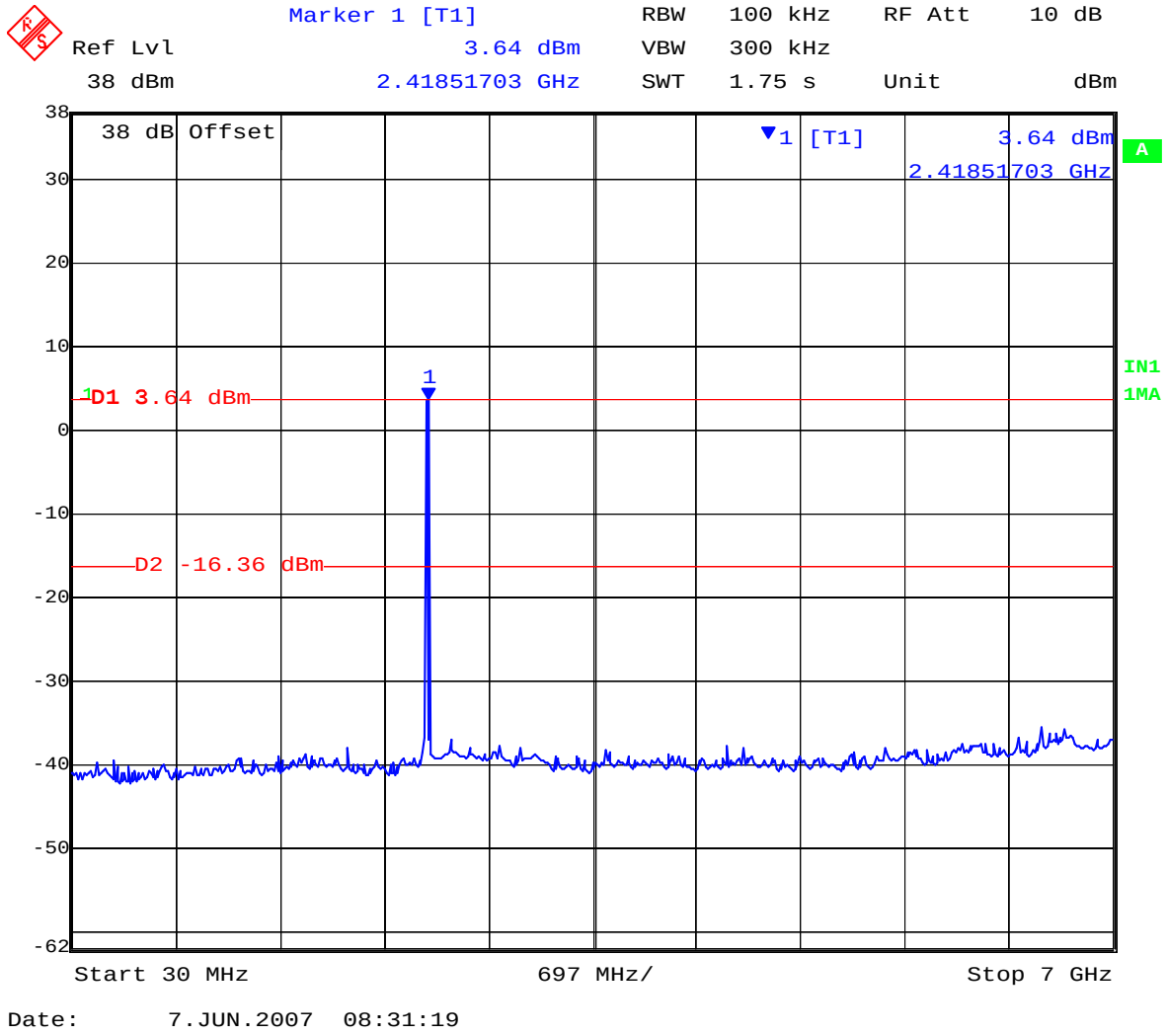
Spurious Emissions (30 - 26,000 MHz)

TABLE OF RESULTS – **802.11g – 54 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	-36.00	-16.36	22	-19.64
2,412	7,000	26,000	-34.40	-16.36	23	-18.04

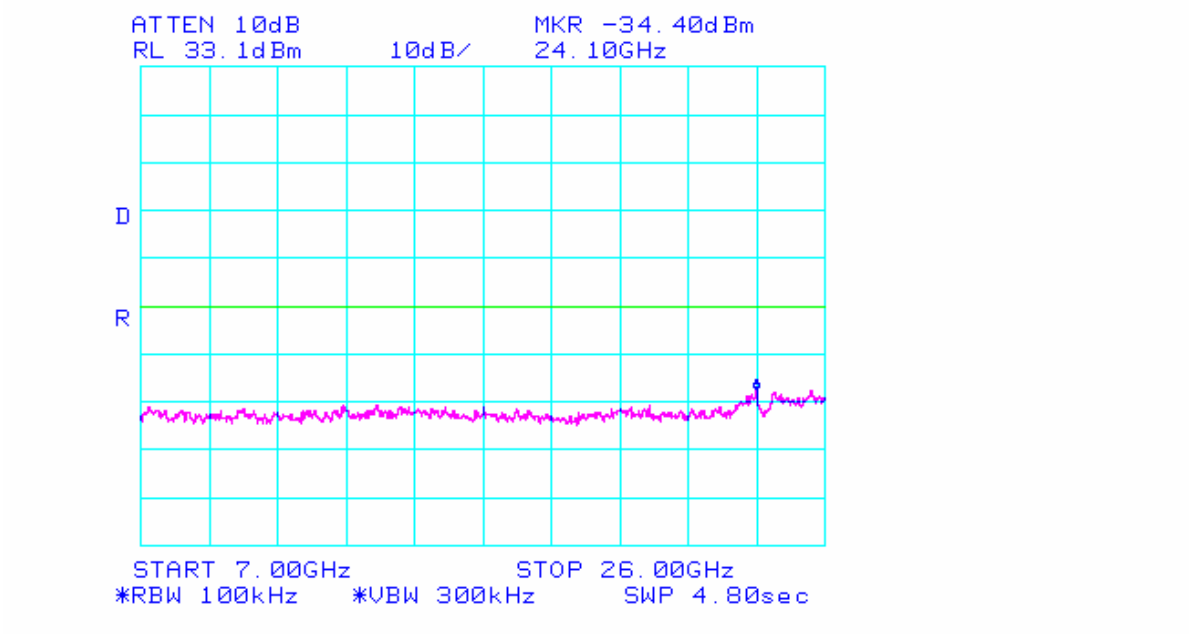
Plot 22 802.11g – 54 Mbit/s

2,412 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



Plot 23 802.11g – 54 Mbit/s

2,412 MHz Conducted Spurious Emissions 7,000 MHz to 26,000 MHz



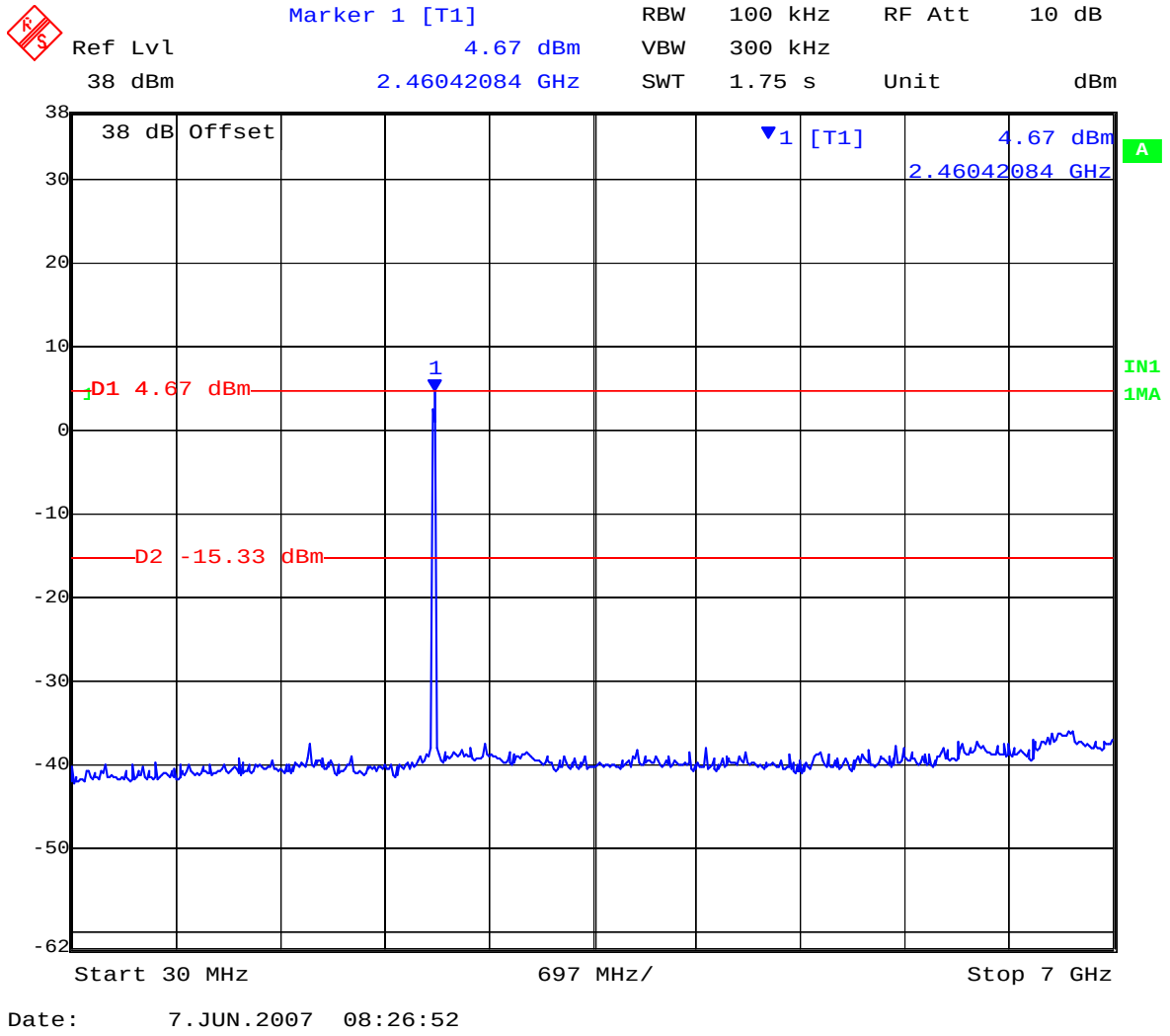
Spurious Emissions (30 - 26,000 MHz)

TABLE OF RESULTS – **802.11g – 54 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	-36.00	-15.33	24	-20.67
2,437	7,000	26,000	-34.07	-15.33	25	-18.74

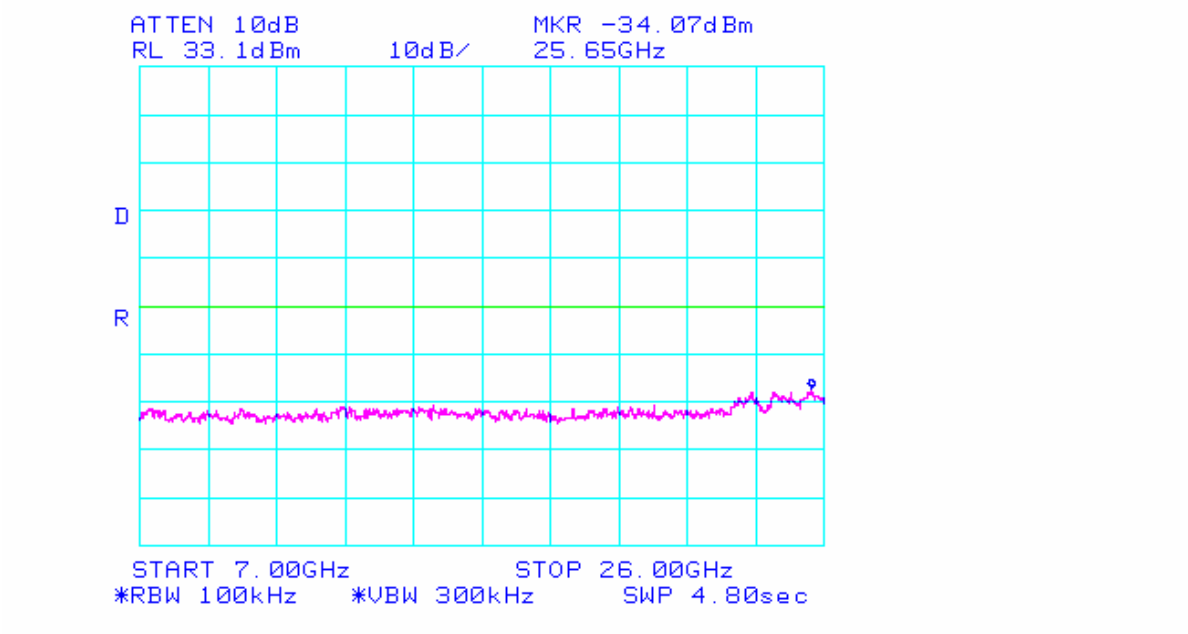
Plot 24 802.11g – 54 Mbit/s

2,437 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



Plot 25 802.11g – 54 Mbit/s

2,437 MHz Conducted Spurious Emissions 7,000 MHz to 26,000 MHz



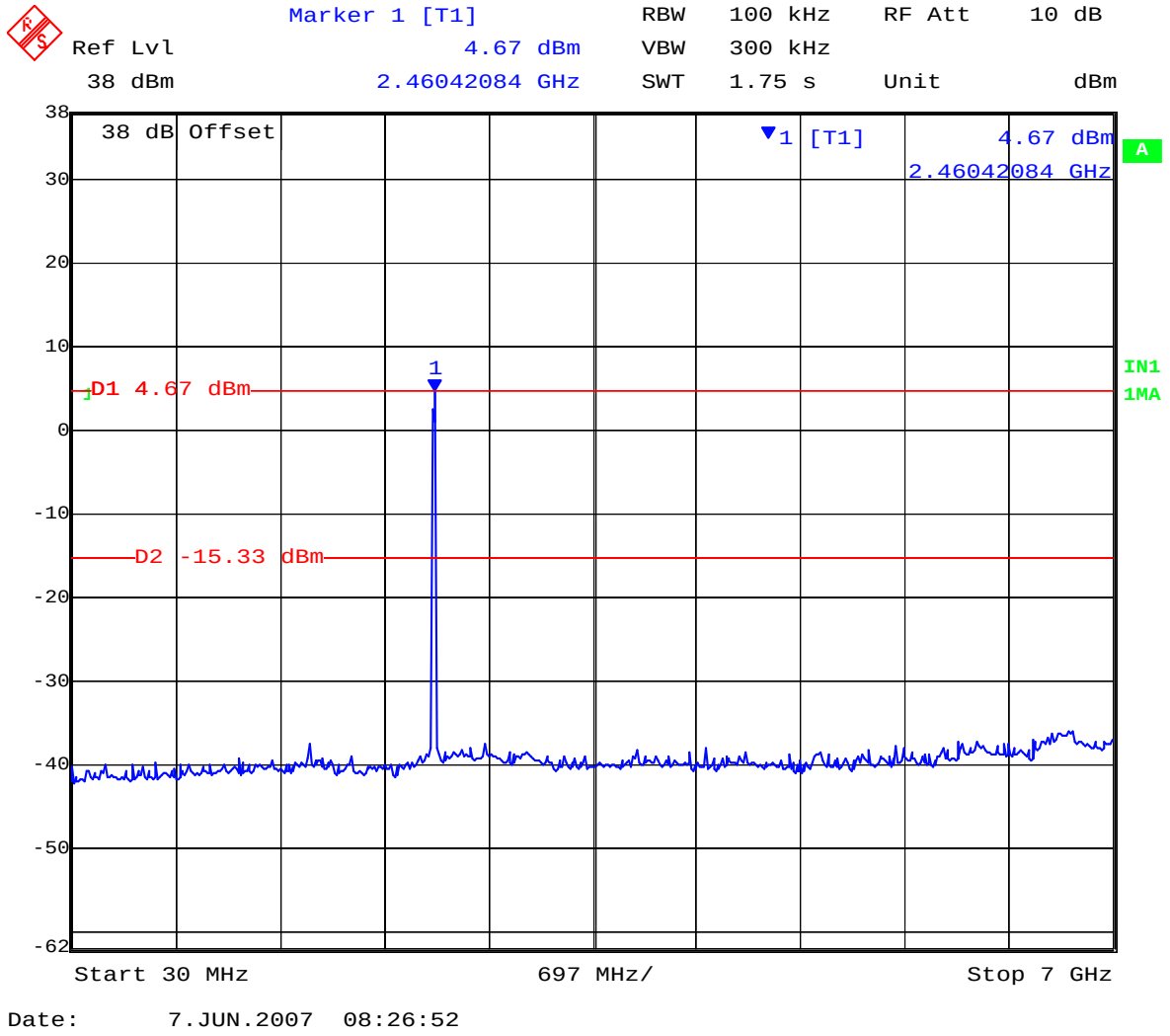
Spurious Emissions (30 - 26,000 MHz)

TABLE OF RESULTS – **802.11g – 54 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	-36.00	-15.33	26	-20.67
2,462	7,000	26,000	-34.90	-15.33	27	-19.57

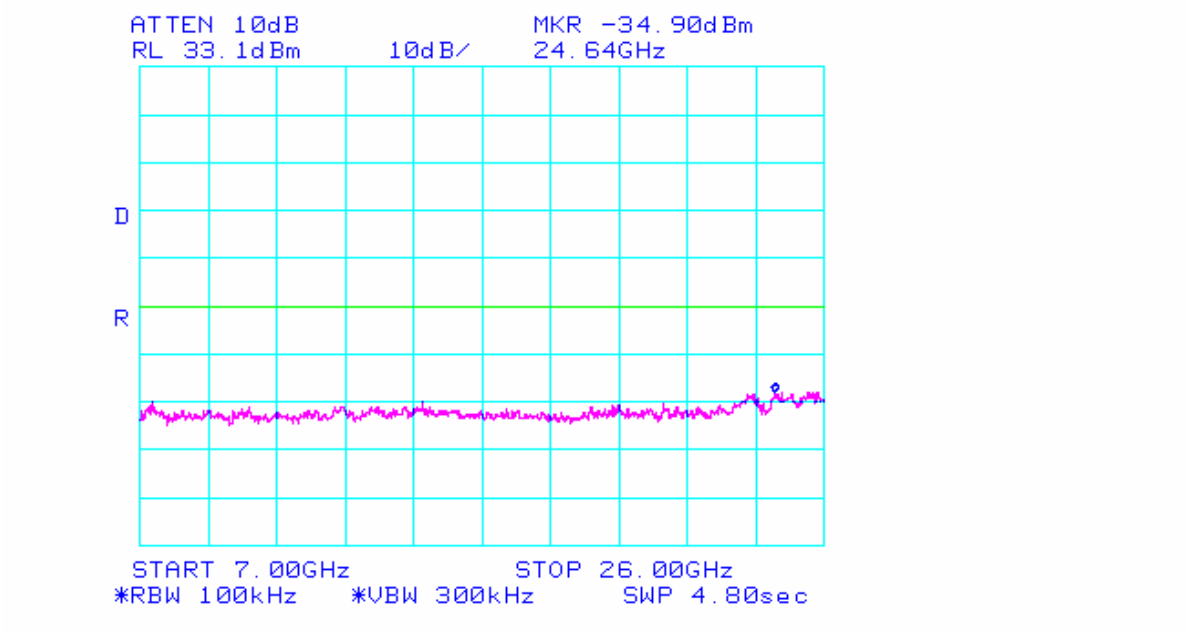
Plot 26 802.11g – 54 Mbit/s

2,462 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



Plot 27 802.11g – 54 Mbit/s

2,412 MHz Conducted Spurious Emissions 7,000 MHz to 26,000 MHz



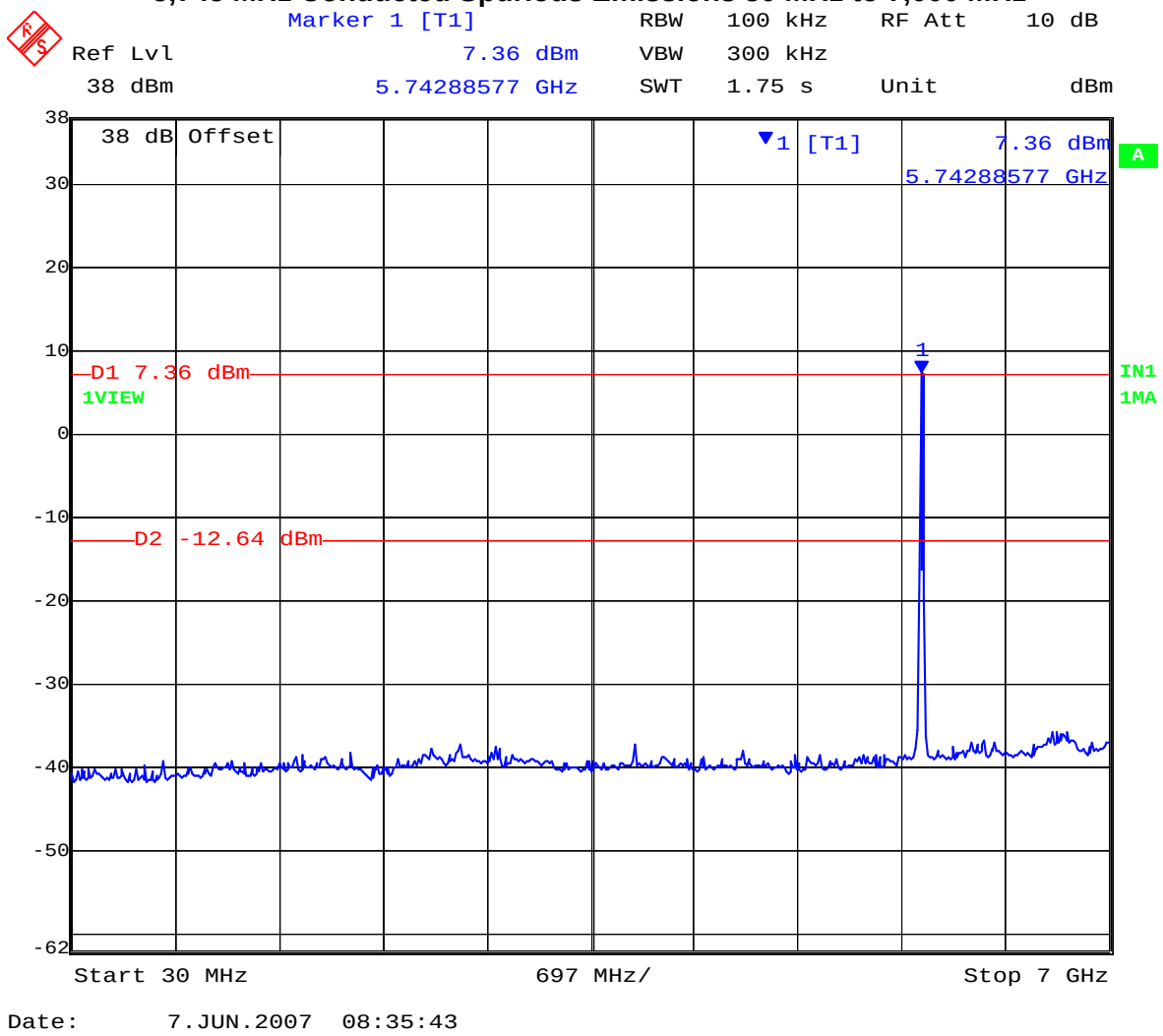
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – **802.11a – 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	-36.00	-12.64	28	-23.36
5,745	7,000	40,000	-26.13	-12.64	29	-13.49

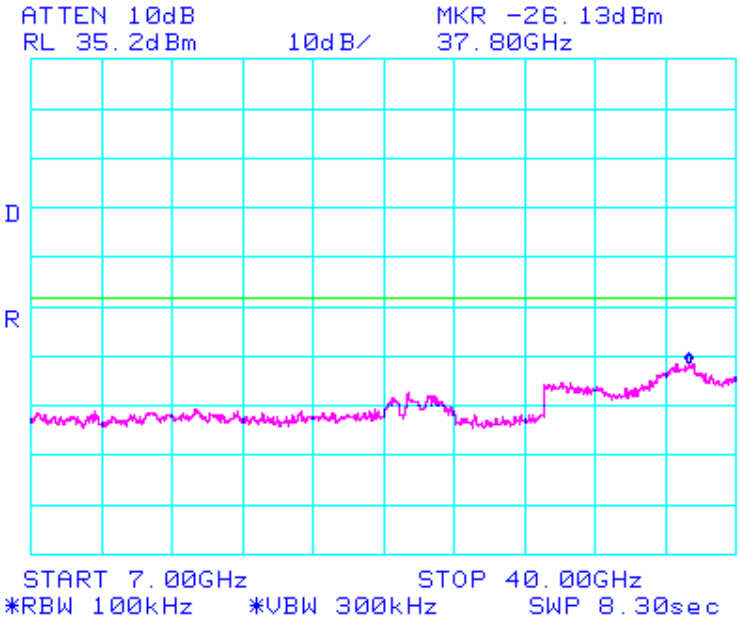
Plot 28 802.11a – 54 Mbit/s

5,745 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



Plot 29 802.11a – 54 Mbit/s

5,745 MHz Conducted Spurious Emissions 7,000 MHz to 40,000 MHz



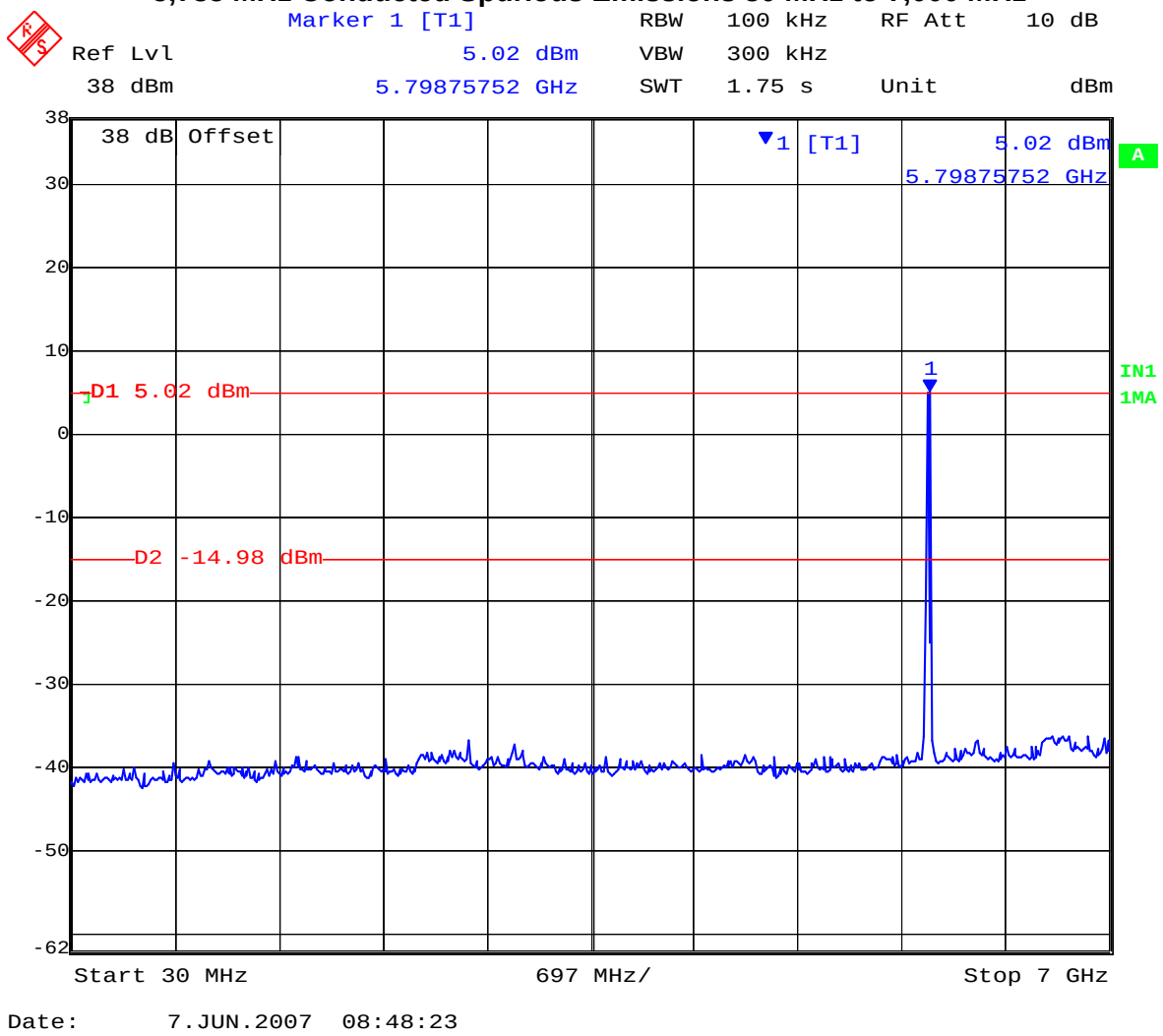
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – **802.11a – 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	-36.00	-14.98	30	-21.02
5,785	7,000	40,000	-26.30	-14.98	31	-11.32

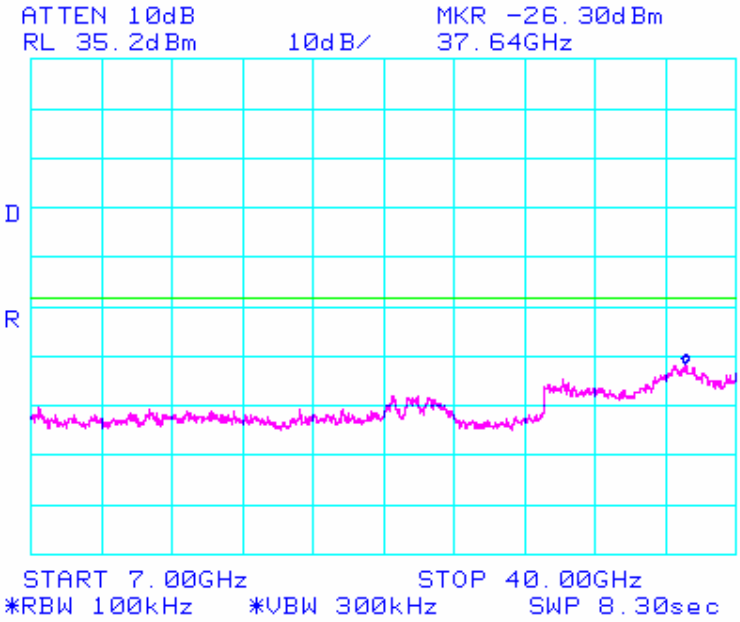
Plot 30 802.11a – 54 Mbit/s

5,785 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



Plot 31 802.11a – 54 Mbit/s

5,785 MHz Conducted Spurious Emissions 7,000 MHz to 40,000 MHz



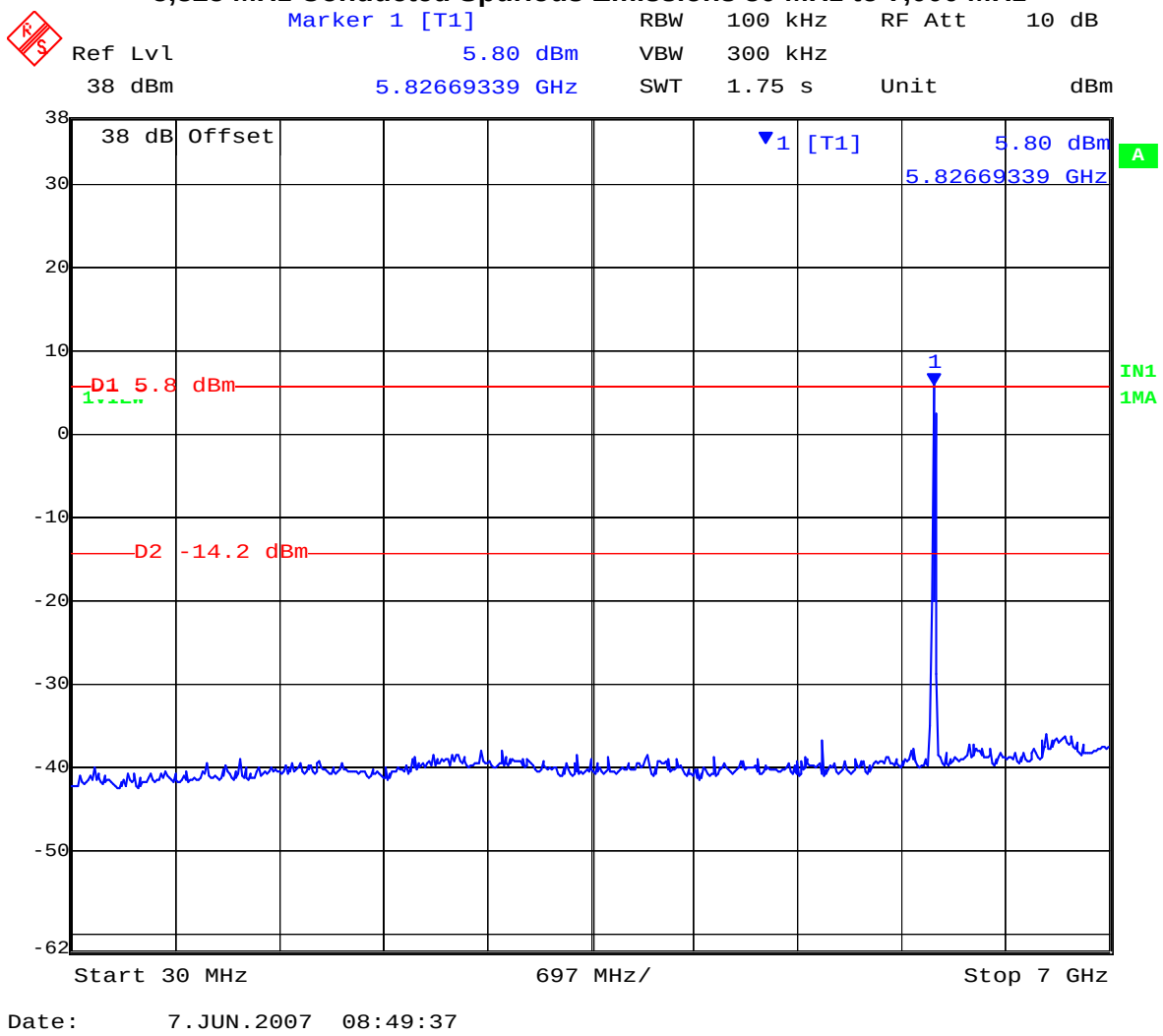
Spurious Emissions (30 - 40,000 MHz)

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

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
5,825	30	7,000	-36.00	-14.20	32	-21.8
5,825	7,000	40,000	-26.47	-14.20	33	-12.27

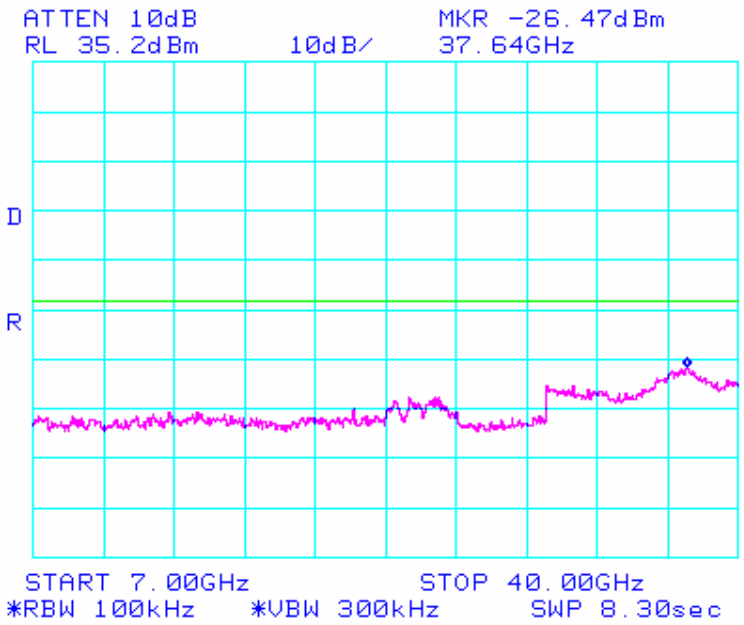
Plot 32 802.11a – 54 Mbit/s

5,825 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



Plot 33 802.11a – 54 Mbit/s

5,825 MHz Conducted Spurious Emissions 7,000 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)

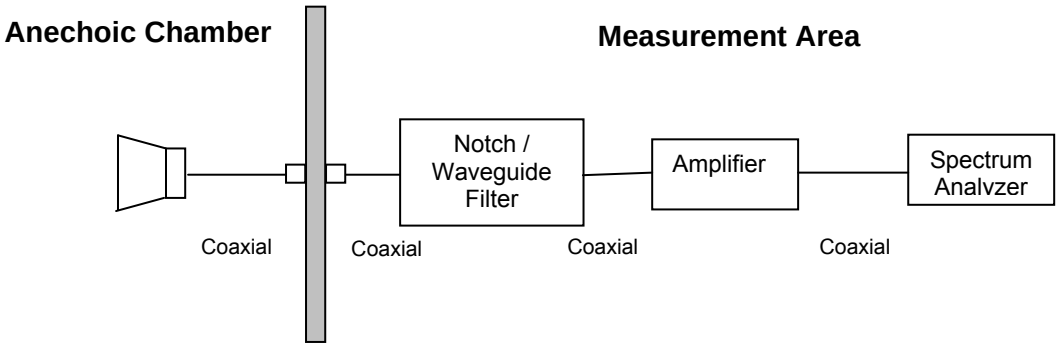
FCC, Part 15 Subpart C §15.247(d) 15.205; 15.209
Industry Canada RSS-210 §A8.5, §2.2, §2.6
Industry Canada RSS-Gen §4.7

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

Maximum Emissions
It was found that the AP lying flat on the polystyrene table was the worst case orientation for radiated emissions.

Radiated Spurious Emissions above 1 GHz

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

Test Setup - 802.11b – 1Mb/s
TABLE OF RESULTS – 802.11b – 1Mb/s Channel 1 Primary Antenna
Peak

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

Average

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

Radiated Emissions

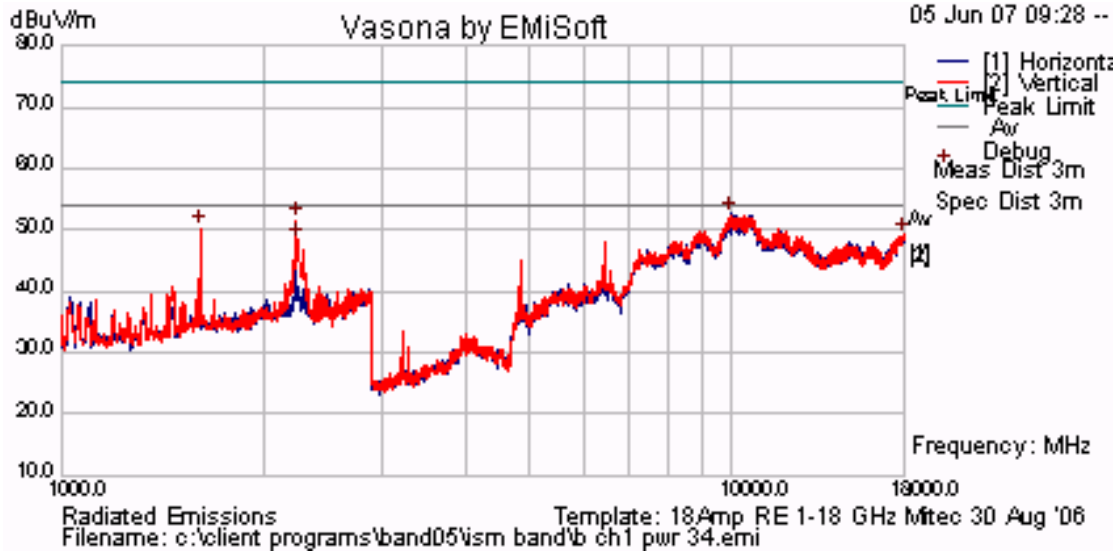


TABLE OF RESULTS – 802.11b – 1Mb/s Channel 6 Primary Antenna

Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
4873.836	V	53.94	-4.36	49.58	74	-24.42
9747.91	V	49.86	+9.23	59.09	74	-14.91

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
4873.836	V	50.45	-4.46	45.99	54	-8.01
9747.91	V	40.82	+9.14	49.96	54	-4.04

Radiated Emissions

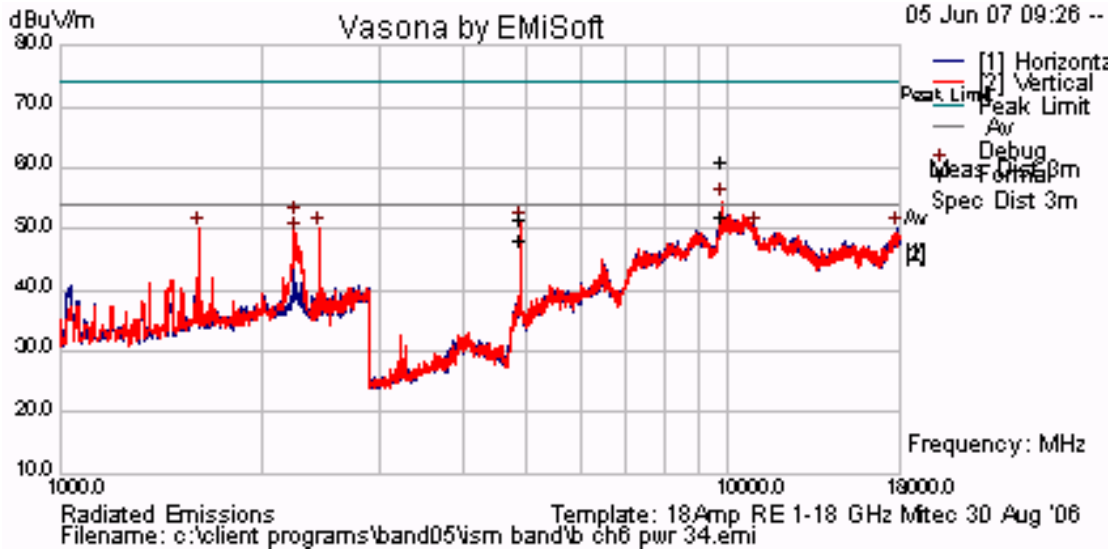


TABLE OF RESULTS – 802.11b – 1Mb/s Channel 11 Primary Antenna

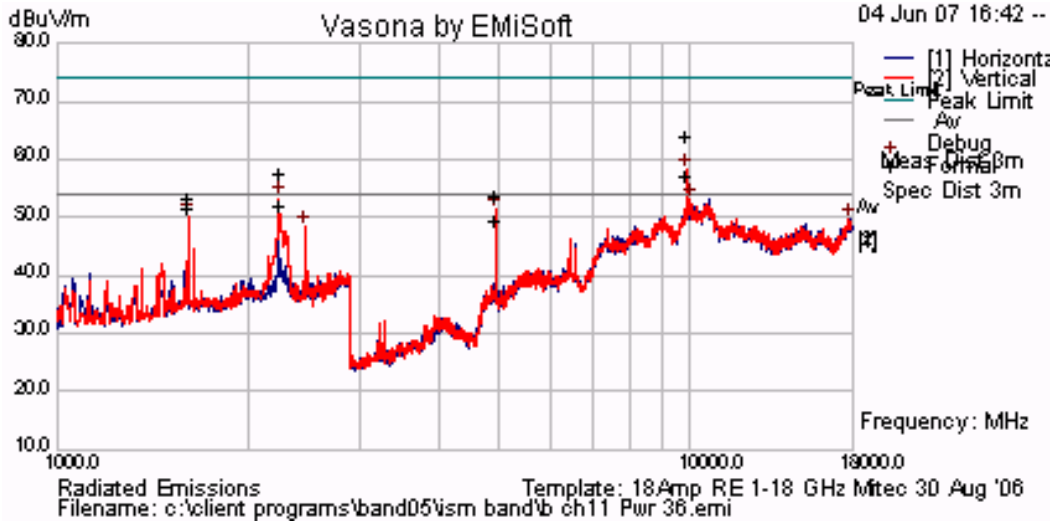
Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
1607.961	V	64.47	-13.18	51.29	74	-22.71
2239.975	V	66.1	-10.48	55.62	74	-18.38
4923.762	V	55.74	-4.28	51.46	74	-22.54
9847.908	V	50.14	+10.07	60.21	74	-13.79

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
1607.961	V	62.69	-13.18	49.51	54	-4.49
2239.975	V	60.36	-10.48	49.88	54	-4.12
4923.762	V	51.8	-4.28	47.52	54	-6.48
9847.908	V	42.34	+9.97	52.31	54	-1.69

Radiated Emissions



Test Setup - 802.11g – 54Mb/s

TABLE OF RESULTS – 802.11g – 54 Mb/s Channel 1 Primary Antenna

Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
4823.085	V	65.47	-4.59	60.88	74	-13.12
7229.864	V	55.80	+2.29	58.09	74	-15.91
9651.667	V	55.48	+8.17	63.65	74	-10.35
12033.74	H	44.96	+8.90	53.86	74	-20.14

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
4823.085	V	45.09	-4.59	40.50	54	-13.50
7229.864	V	40.62	+2.29	42.91	54	-11.09
9651.667	V	38.55	+8.17	46.72	54	-7.28
12033.74	V	32.41	+8.90	41.31	54	-12.69

Radiated Emissions

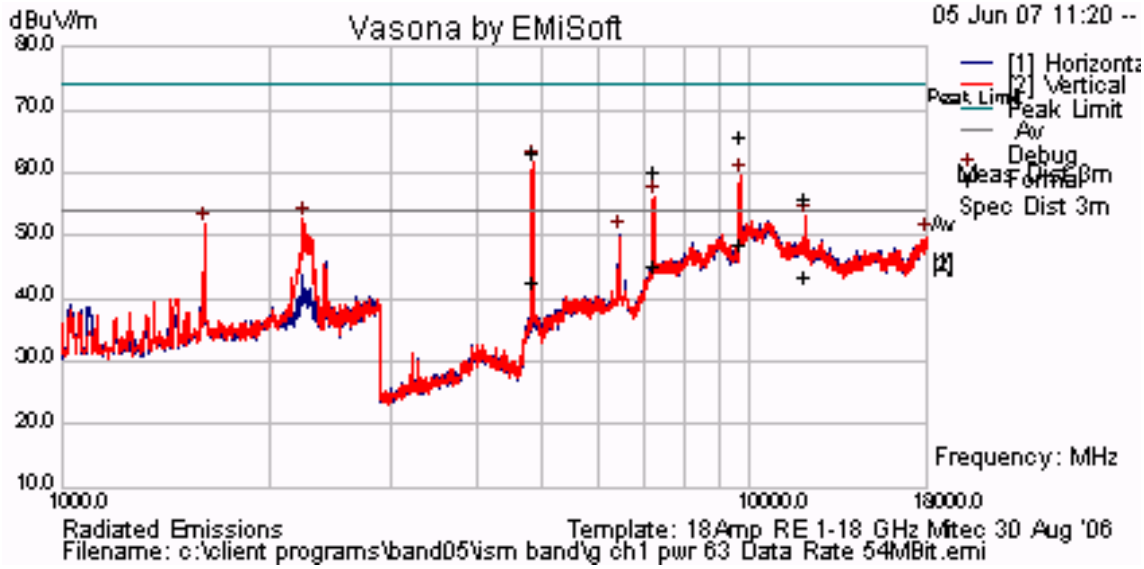


TABLE OF RESULTS – 802.11g – 54 Mb/s Channel 6 Primary Antenna

Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
4874.080	V	62.89	-4.36	58.53	74	-15.47
7307.526	V	56.46	+2.41	58.87	74	-15.13
9743.516	V	58.10	+9.19	67.29	74	-6.71

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
4874.080	V	44.13	-4.36	39.77	54	-14.23
7307.526	V	41.50	+2.41	43.91	54	-10.09
9743.516	V	40.14	+9.19	49.33	54	-4.67

Radiated Emissions

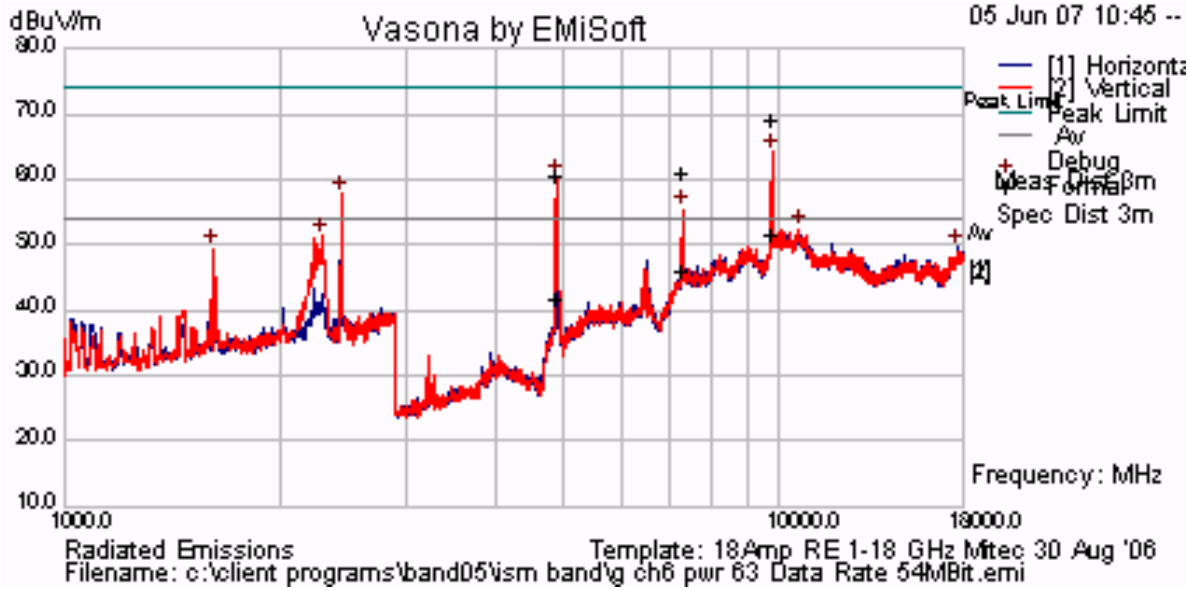


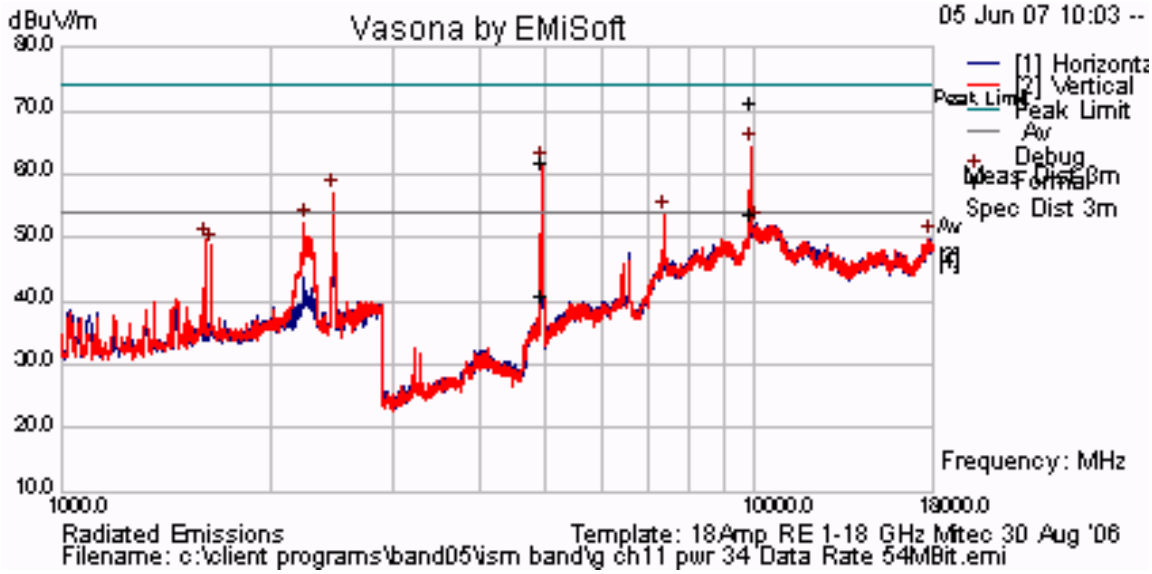
TABLE OF RESULTS – 802.11g – 54 Mb/s Channel 11 Primary Antenna, Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
2298.431	V	62.37	-10.28	52.09	74	-21.91
4919.172	V	64.26	-4.29	59.97	74	-14.03
7388.845	H	54.67	+2.52	57.19	74	-16.81
9854.115	V	59.33	+10.10	69.43	74	-4.57

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
2298.431	V	46.45	-10.28	36.17	54	-17.83
4919.172	V	43.22	-4.29	38.93	54	-15.07
7388.845	H	40.42	+2.52	42.94	54	-11.06
9854.115	V	41.59	+10.10	51.69	54	-2.31

Radiated Emissions



Test Setup - 802.11a – 54Mb/s

TABLE OF RESULTS – 802.11a – 54 Mb/s Channel 149 Primary Antenna, Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
11488.49	V	58.91	+7.38	66.29	74	-7.71
17238.94	V	51.38	+11.01	62.39	74	-11.61

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
11488.49	V	41.29	+7.38	48.67	54	-5.33
17238.94	V	36.41	+11.01	47.42	54	-6.58

Radiated Emissions

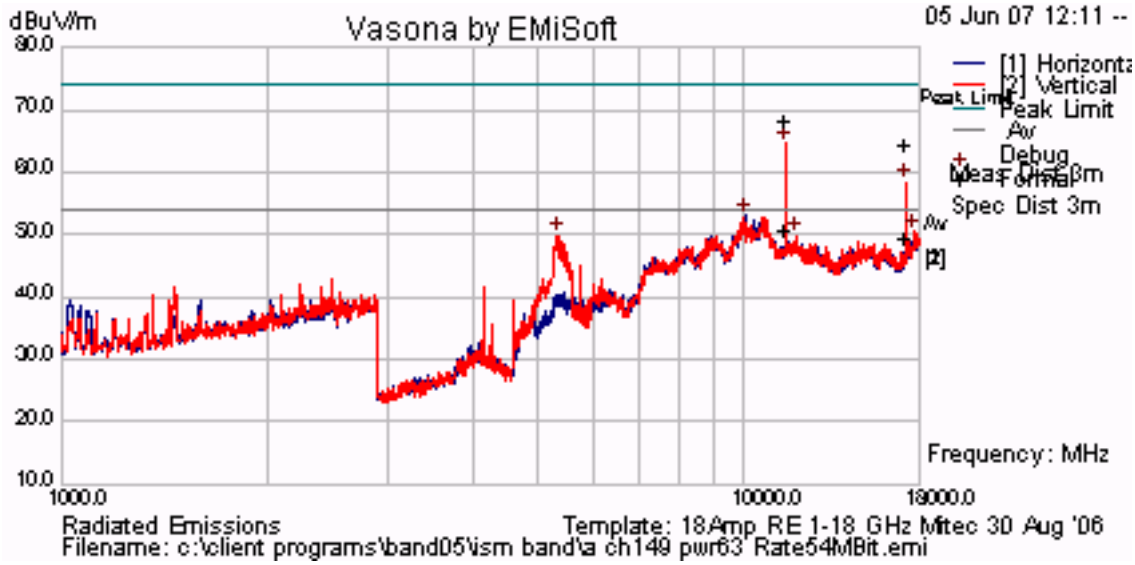


TABLE OF RESULTS – 802.11a – 54 Mb/s Channel 157 Primary Antenna

Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
11572.100	V	59.46	+7.64	67.10	74	-6.90
17359.710	V	55.03	+11.39	66.42	74	-7.58

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
11572.100	V	41.64	+7.64	49.28	54	-4.72
17359.710	V	38.95	+11.39	50.34	54	-3.66

Radiated Emissions

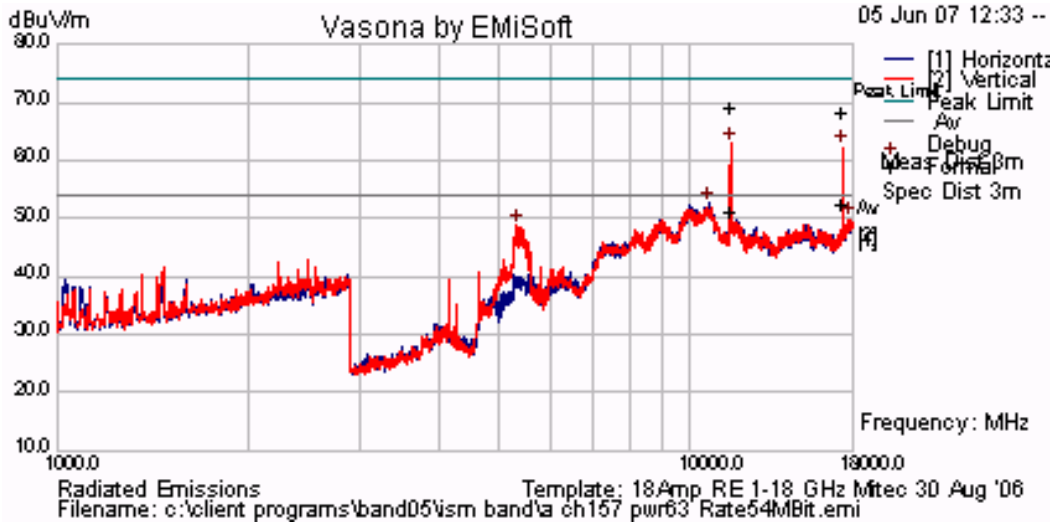


TABLE OF RESULTS – 802.11a – 54 Mb/s Channel 165 Primary Antenna

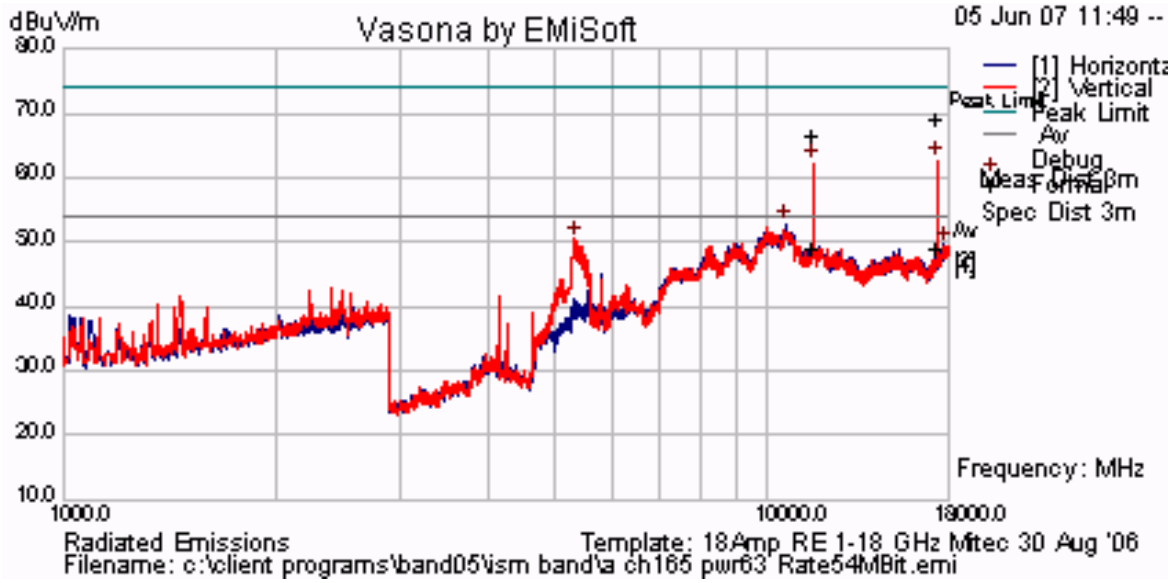
Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
11602.03	V	56.84	+7.79	64.63	74	-9.37
17428.91	V	55.39	+11.56	66.95	74	-7.05

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
11602.03	V	39.25	+7.79	47.04	54	-6.96
17428.91	V	35.33	+11.56	46.89	54	-7.11

Radiated Emissions



5.1.6.2. Receiver Radiated Spurious Emissions (above 1 GHz)

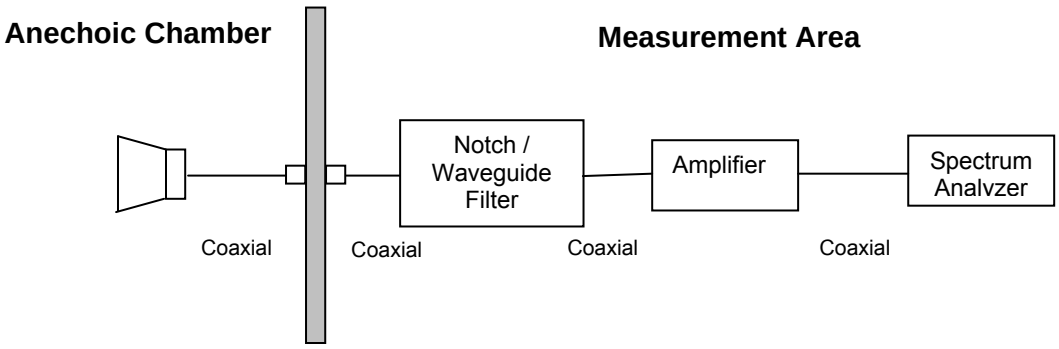
Industry Canada RSS-Gen §4.8, §6

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

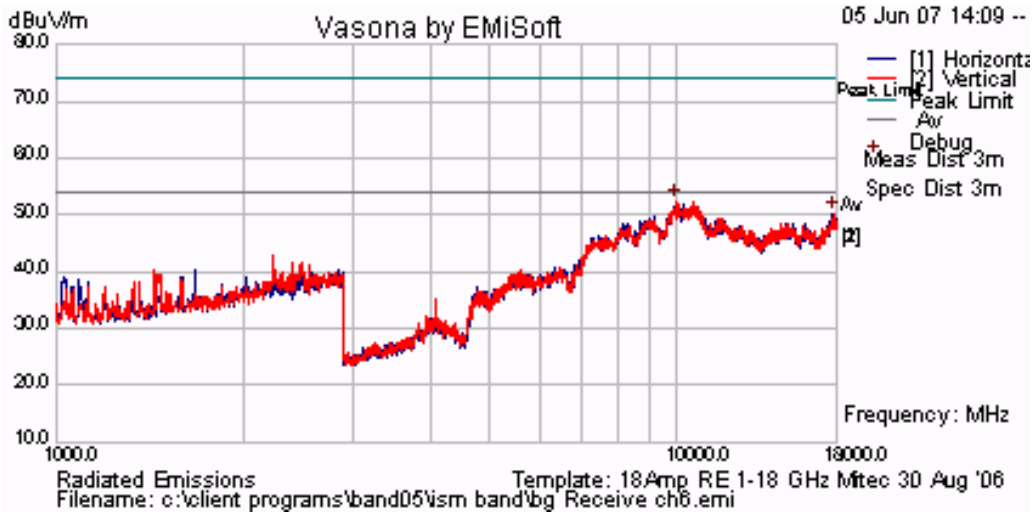
Receiver Radiated Spurious Emissions above 1 GHz

Test Setup - 802.11b/g

TABLE OF RESULTS –802.11b/g Channel 6, 2442 MHz

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

Radiated Emissions



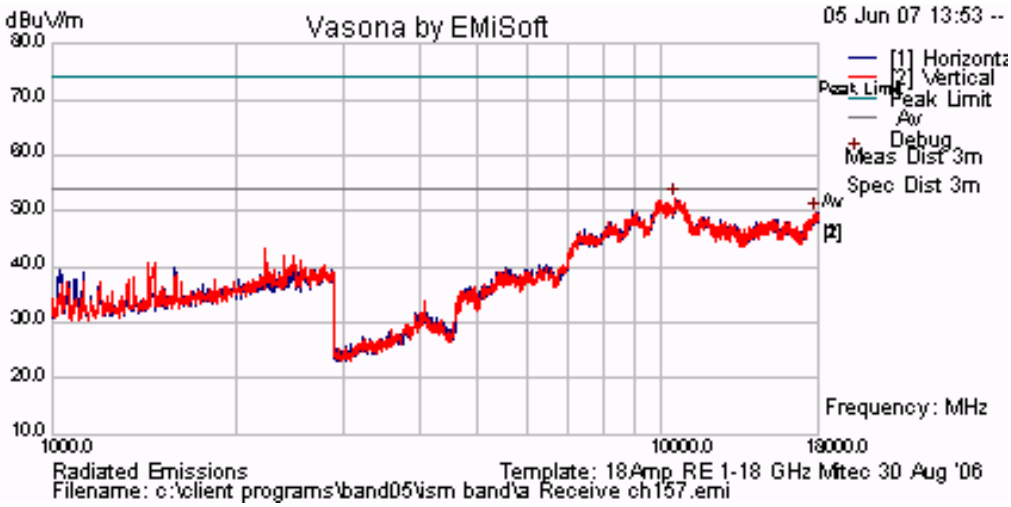
Receiver Radiated Spurious Emissions above 1 GHz

Test Setup - 802.11a

TABLE OF RESULTS –802.11a Channel 157, 5785 MHz

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

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

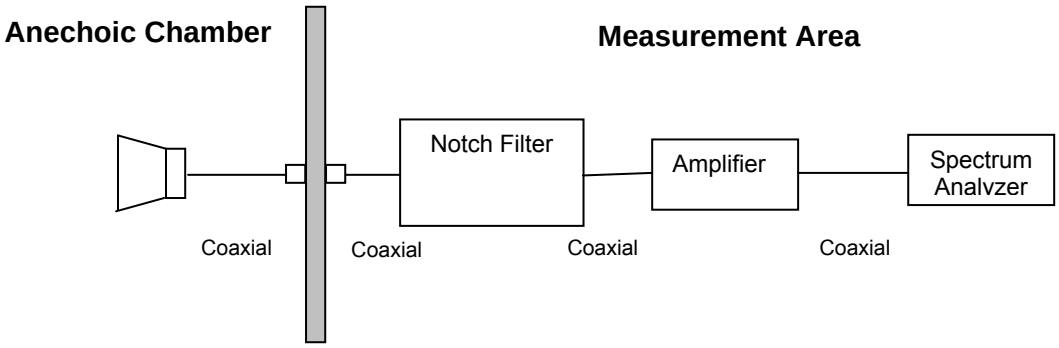
5.1.6.2.1. Peak Field Strength Measurements and Radiated Band-Edge – Restricted Bands

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

Band Edge -Restricted Bands Test Results

TABLE OF RESULTS – **802.11b** Primary Antenna, Power Code = 34

Ch #	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	$2{,}412_{PEAK}$	2,390	57.29	74	-16.71
1	$2{,}412_{AVE}$	2,390	36.65	54	-17.35

TABLE OF RESULTS – **802.11b** Primary Antenna, Power Code = 34

Ch #	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
11	$2{,}462_{PEAK}$	2,483.5	59.45	74	-14.55
11	$2{,}462_{AVE}$	2,483.5	39.29	54	-14.71

TABLE OF RESULTS – **802.11g** Primary Antenna, Power Code = 46

Ch #	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	$2{,}412_{PEAK}$	2,390	70.68	74	-3.32
1	$2{,}412_{AVE}$	2,390	40.24	54	-13.76

TABLE OF RESULTS – **802.11g** Primary Antenna, Power Code = 3**8**

Ch #	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
11	$2{,}462_{PEAK}$	2,483.5	70.87	74	-3.13
11	$2{,}462_{AVE}$	2,483.5	42.32	54	-11.68

Peak Field Strength Measurements

TABLE OF RESULTS – **802.11b** Primary Antenna

Channel 1 - Lower Band Edge, Peak Emission = 108.90 dBµV/m

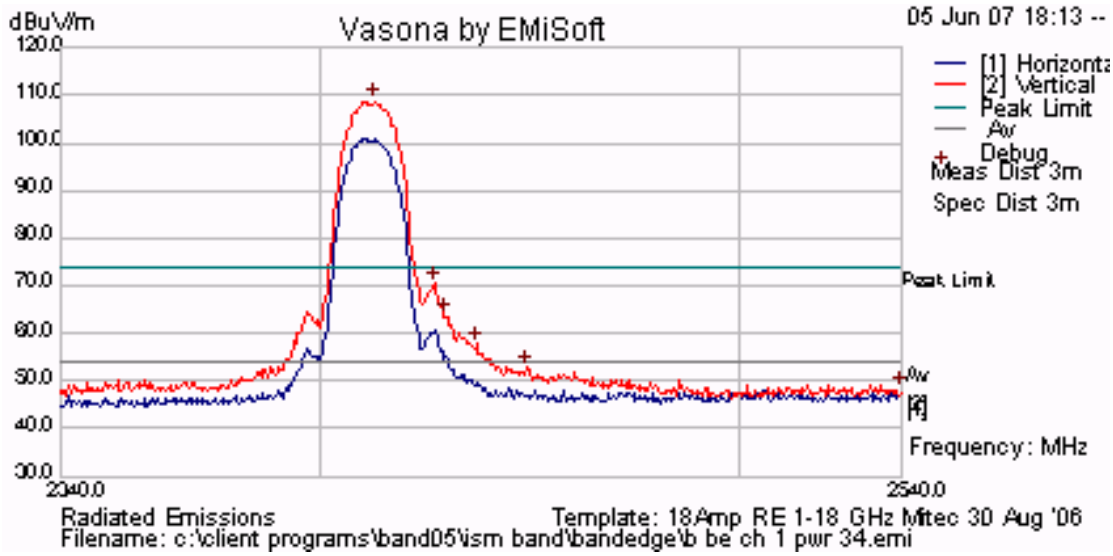


TABLE OF RESULTS – **802.11b** Primary Antenna

Channel 6 Peak Emission = 111.74 dBµV/m

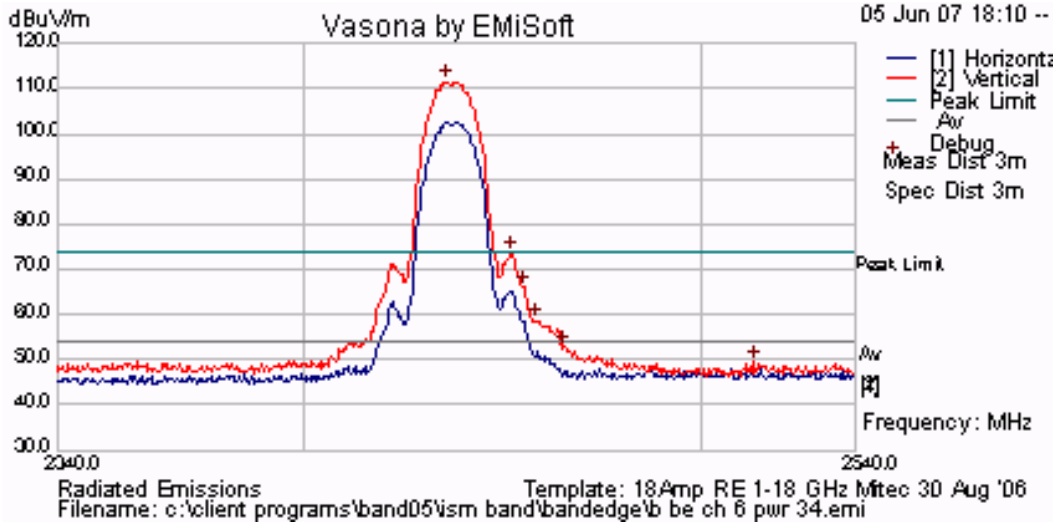


TABLE OF RESULTS – **802.11b** Primary Antenna, Power Code = 34

Channel 11 – Upper Band Edge, Peak Emission = 110.77 dBµV/m

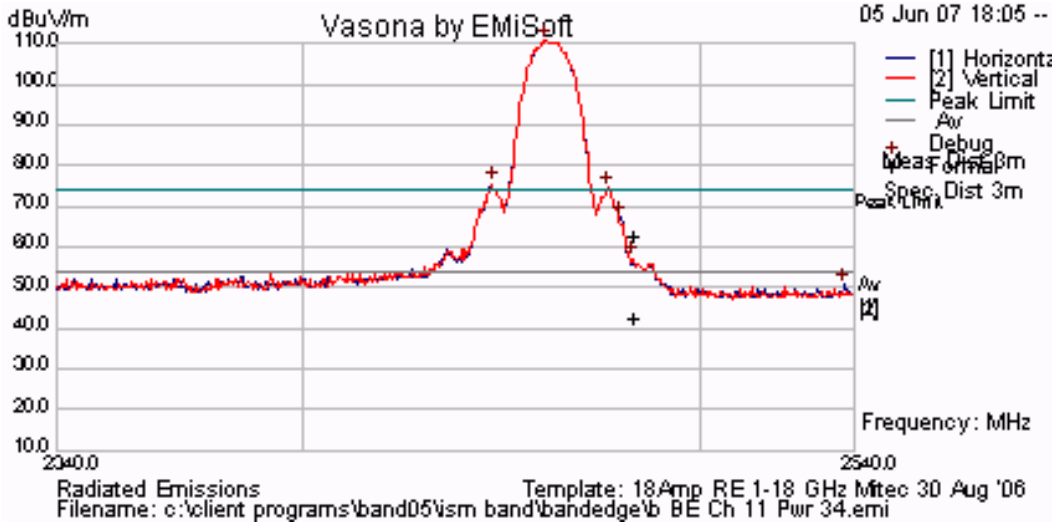


TABLE OF RESULTS – **802.11g** Primary Antenna, Power Code = 46

Channel 1 - Lower Band Edge, Peak Emission =112.64 dBµV/m

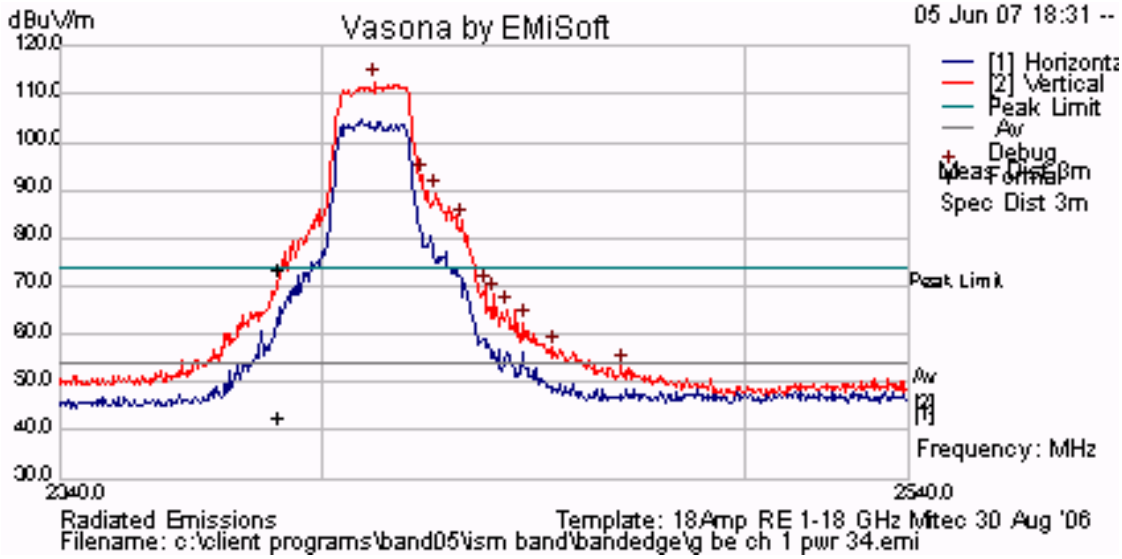


TABLE OF RESULTS – **802.11g** Primary Antenna, Power Code = 56

Channel 6 - Peak Emission = 117.96 dBµV/m

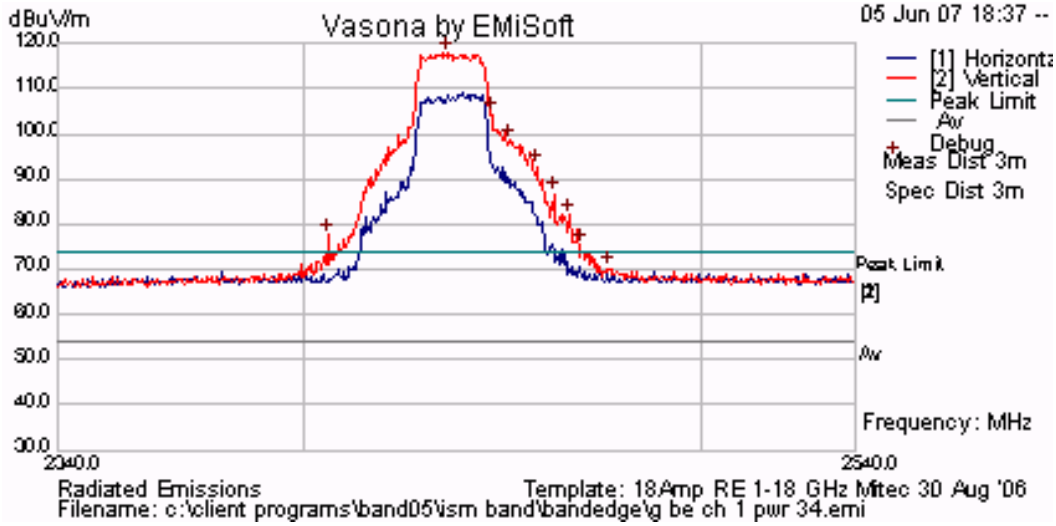


TABLE OF RESULTS – **802.11g** Primary Antenna, Power Code = 3**8**

Channel 11 – Upper Band Edge, Peak Emission =110.90 dBµV/m

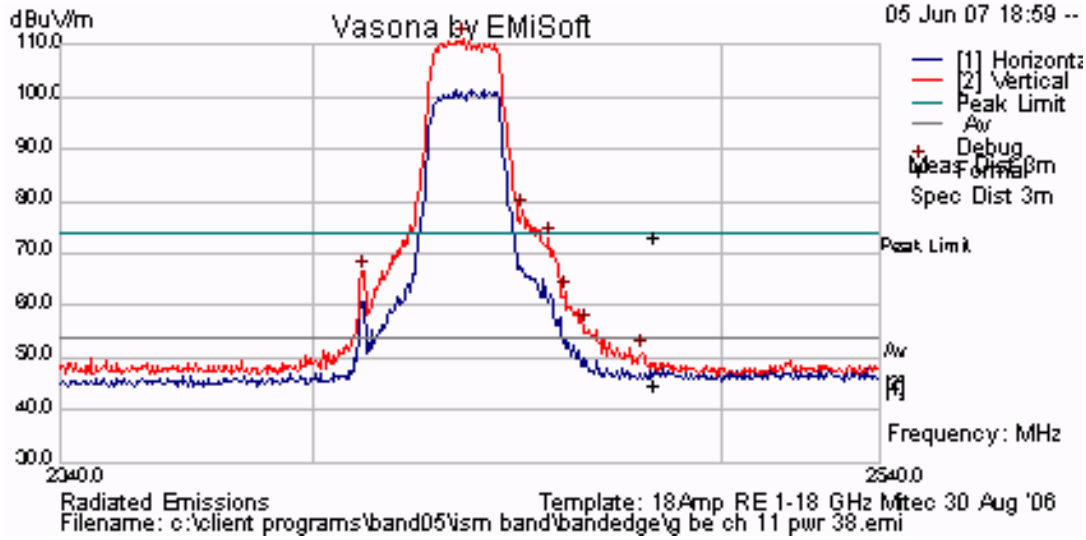


TABLE OF RESULTS – **802.11a** Primary Antenna, Power Code = 58

5,745 MHz - Peak Emission =110.65 dBµV/m

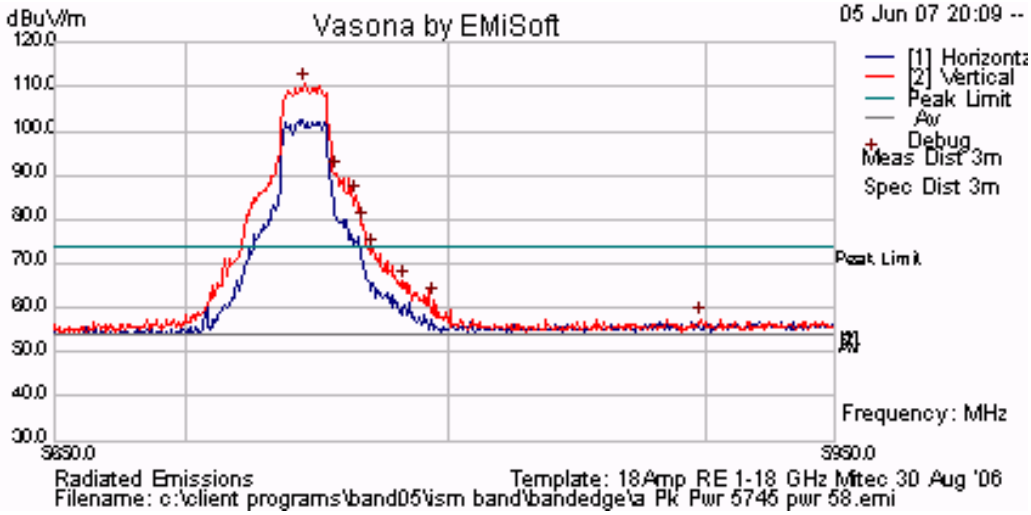


TABLE OF RESULTS – **802.11a** Primary Antenna, Power Code = 58

5,785 MHz - Peak Emission = 108.93 dBµV/m

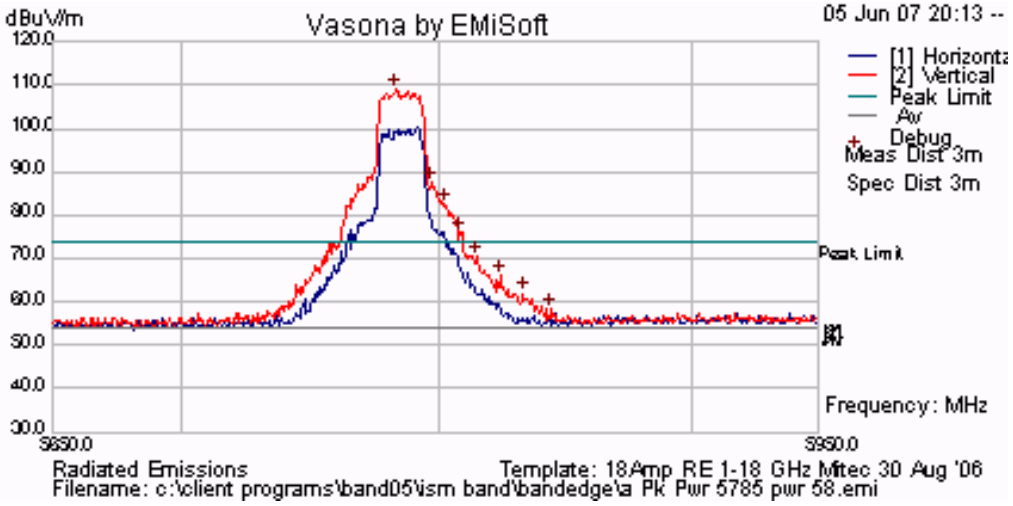
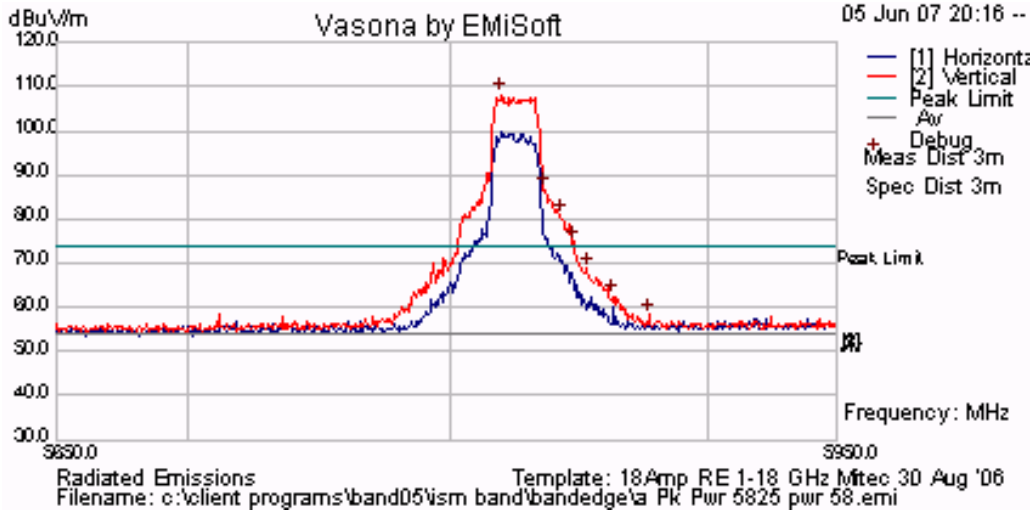


TABLE OF RESULTS – **802.11a** Primary Antenna, Power Code = 5**8**

5,825 MHz – Peak Emission = 108.16 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)

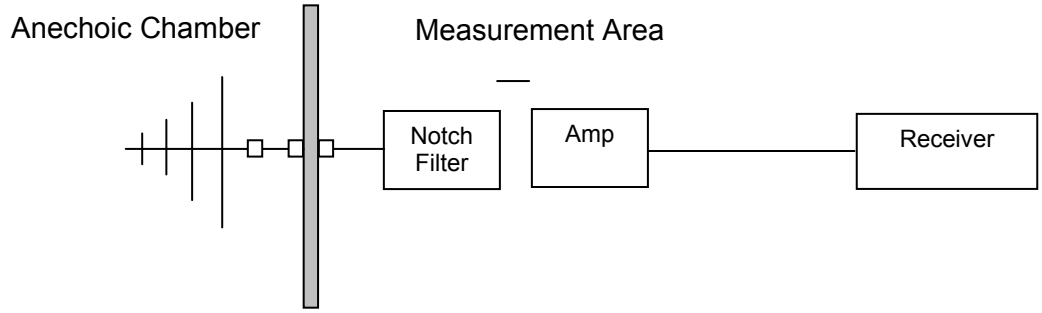
FCC, Part 15 Subpart C §15.205/ §15.209
Industry Canada RSS-210 §2.2

Test Procedure

Testing 30M-1 GHz was performed in a 3-meter anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver 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.

Radiated Spurious emissions were maximized by operating all three transmitters simultaneously

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)

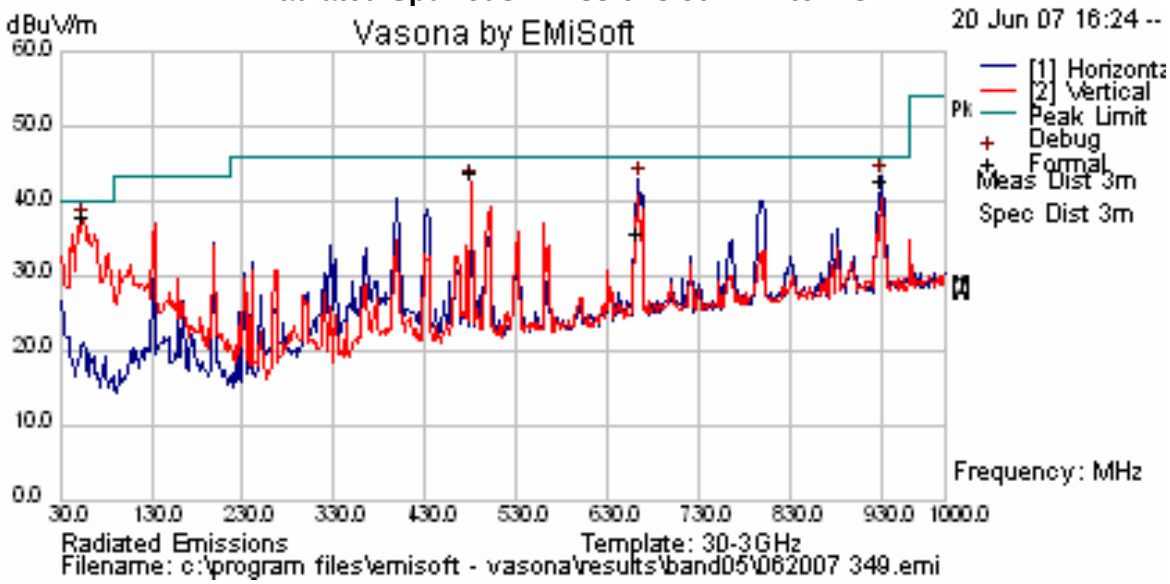
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

EUT parameters.
Data Rate(s): 11MBit/s
Three channel operating simultaneously – 802.11b Channels 1, 6, and 11.
Power Level: Maximum

TABLE OF RESULTS

Freq. (MHz)	Peak (dBuV/m)	QP (dBuV/m)	QP Lmt (dBuV/m)	QP Margin (dB)	Angle (deg)	Height (cm)	Polarity
928.264	43.38	40.9	46	-5.1	256	173	H
54.941	37.29	36.2	40	-3.8	51	99	V
663.074	42.82	33.97	46	-12.03	318	98	V
479.995	42.54	42.2	46	-3.8	211	106	V

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

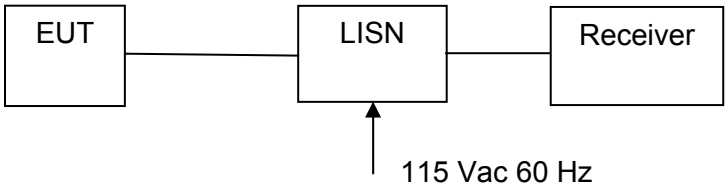
5.1.7. AC Wireline Conducted Emissions (150 kHz – 30 MHz)

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.

AC wireline emissions were maximized by operating all three transmitters simultaneously

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

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

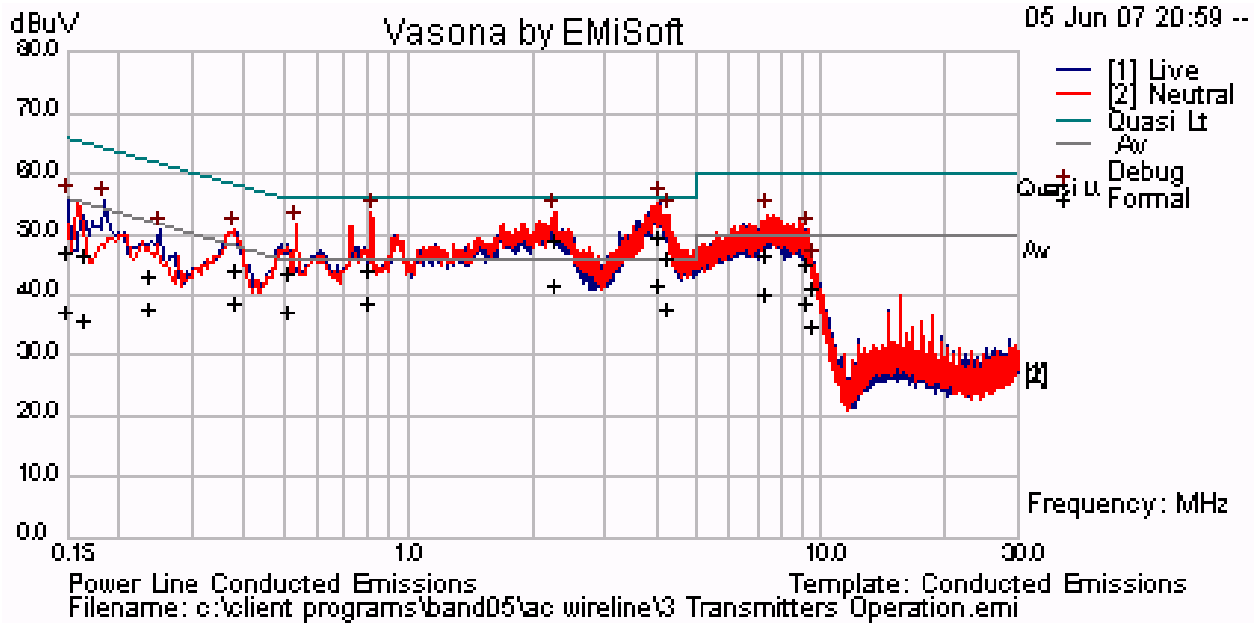
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

EUT parameters.
Data Rate(s): 11MBit/s
Three channel operating simultaneously – 802.11b Channels 1, 6, and 11.
Power Level: Maximum

TABLE OF RESULTS –

Freq (MHz)	LIne	Peak (dBµV)	QP (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Ave. (dBµV)	Ave. Limit (dBµV)	Ave. Margin (dB)
0.150	L	56.15	44.89	66	-21.11	34.8	56	-21.20
0.166	L	55.55	43.99	65.15	-21.16	33.47	55.15	-21.68
0.240	L	50.76	40.54	62.09	-21.55	35.36	52.09	-16.73
0.387	N	50.68	41.74	58.12	-16.38	36.29	48.12	-11.82
0.517	N	51.59	41.49	56	-14.51	34.99	46	-11.01
0.815	N	53.57	41.70	56	-14.3	36.39	46	-9.61
2.275	N	53.60	46.52	56	-9.48	39.23	46	-6.77
4.073	L	55.31	47.11	56	-8.89	39.29	46	-6.71
4.262	N	53.29	43.55	56	-12.45	35.61	46	-10.39
7.345	N	53.37	44.11	60	-15.89	37.58	50	-12.42
9.243	L	50.74	42.63	60	-17.37	36.22	50	-13.78
9.543	L	45.31	38.64	60	-21.36	32.27	50	-17.73

AC Wireline Conducted Emissions – LIVE 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

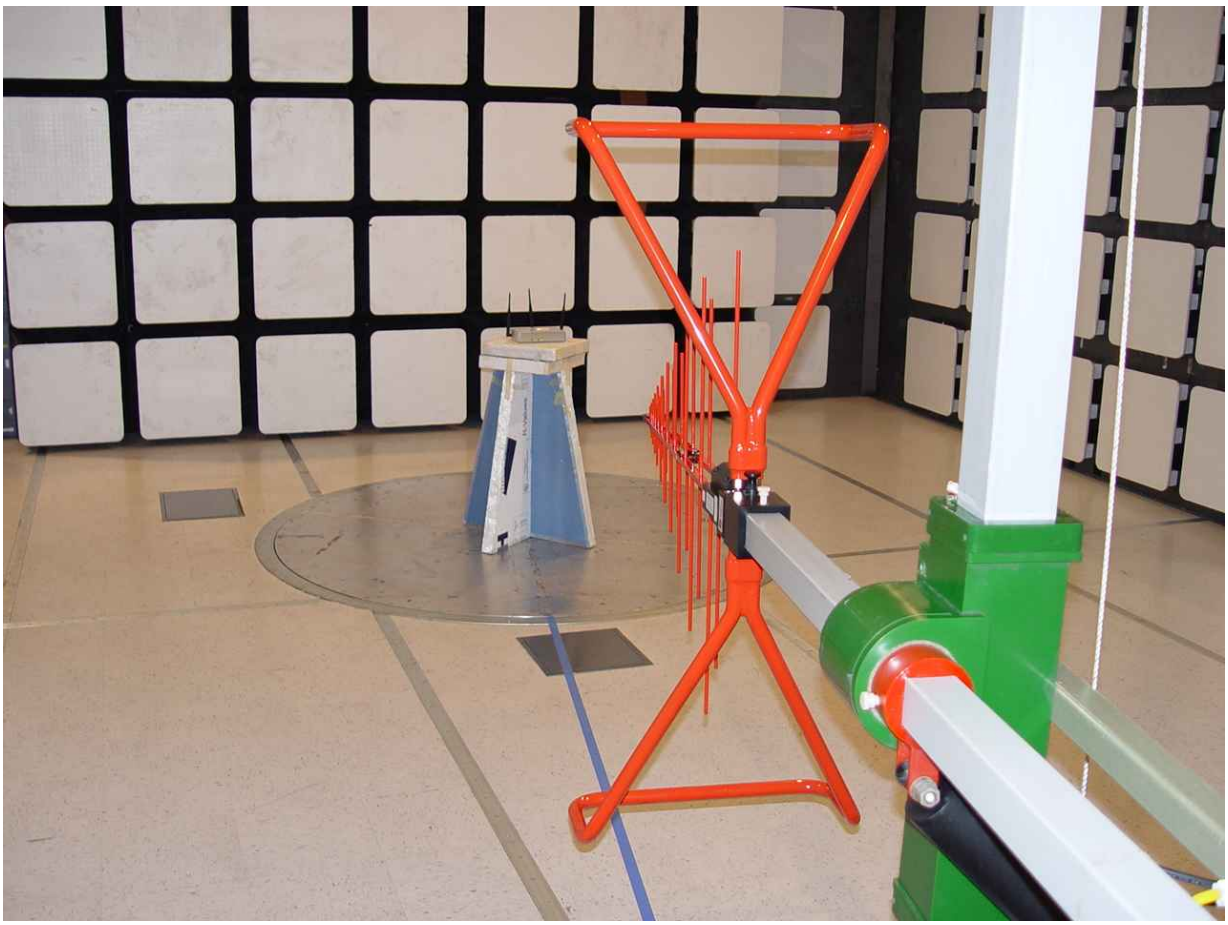
Measurement uncertainty	±2.64 dB

Traceability

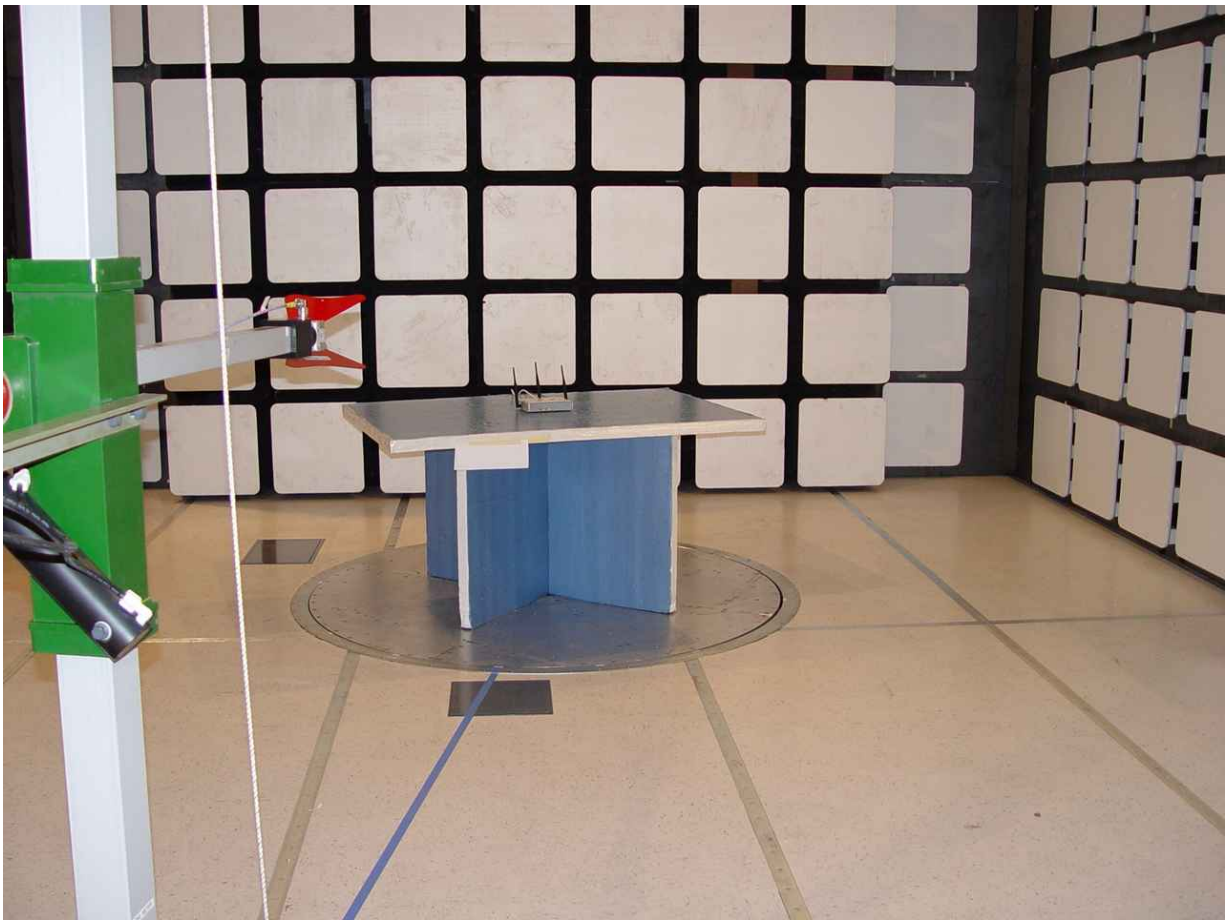
Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307

6. PHOTOGRAPHS

6.1. Radiated Emissions (30 MHz-1 GHz)

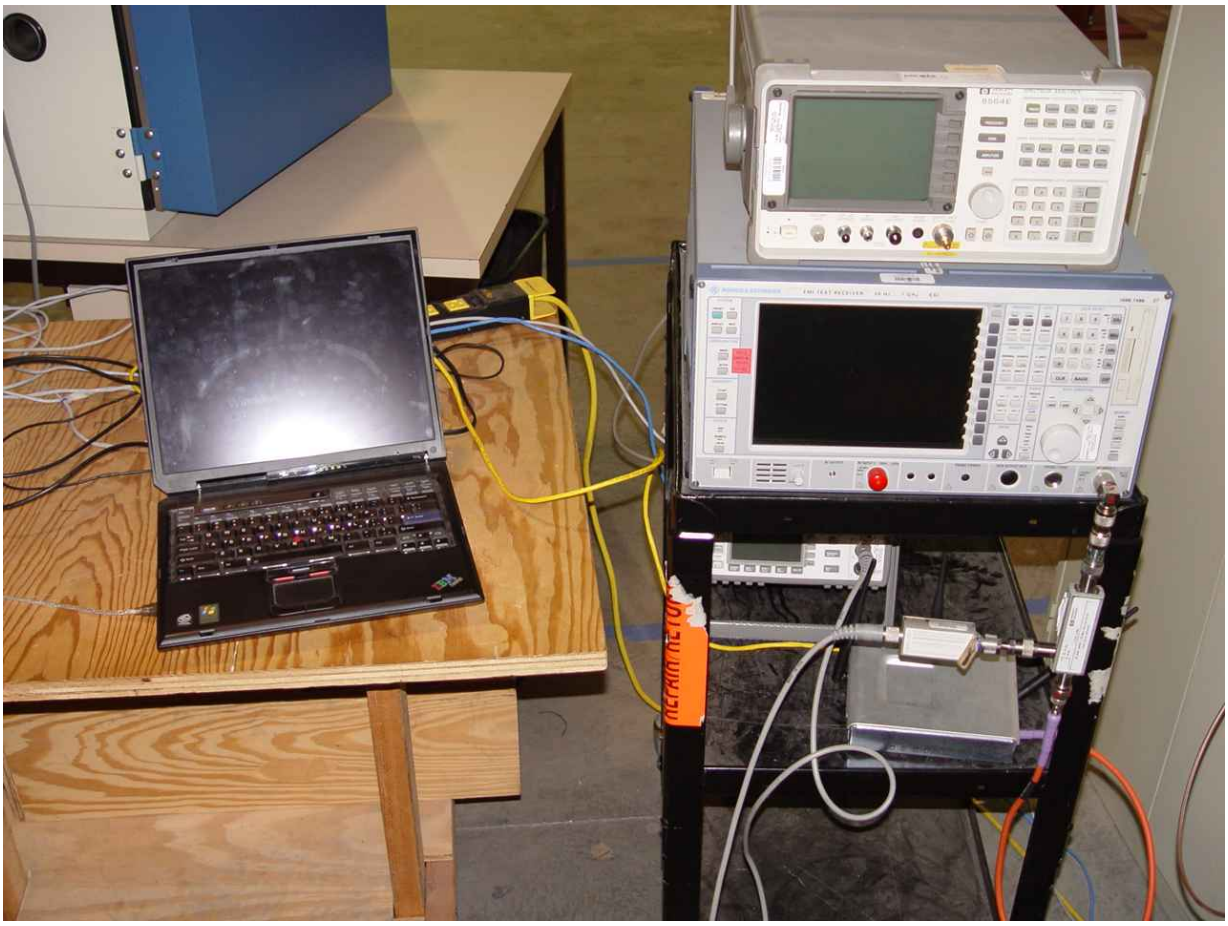


6.2. Spurious Emissions >1 GHz



6.3. AC Wireline 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
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
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
0301	5.6 GHz Notch Filter	Micro-Tronics	RBC50704	001
0302	5.25 GHz Notch Filter	Micro-Tronics	BRC50703	002
0303	5.8 GHz Notch Filter	Micro-Tronics	BRC50705	003
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907

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