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Test of StarMOBILE CH9801

To FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No; TUVR85-A1 REV A

MiCOM Labs

opening wireless markets

TEST REPORT

FROM

MiCOM Labs

Test of StarMOBILE CH9801

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

Test Report Serial No.: TUVR85-A1 Rev A

This report supersedes None

Manufacturer: Bright Star Engineering
150 Presidential Way, Suite 220
Woburn MA, 01801, USA

Product Function: Wireless 802.11b/g Automobile Diagnostic

Copy No: pdf **Issue Date:** 6th July '05

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
3922 Valley Avenue, Suite B
Pleasanton, California 94566, USA
Phone: 925.462.0304
Fax: 925.462.0306
www.micomlabs.com

UKAS TESTING
2106

MiCOM Labs is a UKAS (United Kingdom Accreditation Service)

Accredited Testing Laboratory

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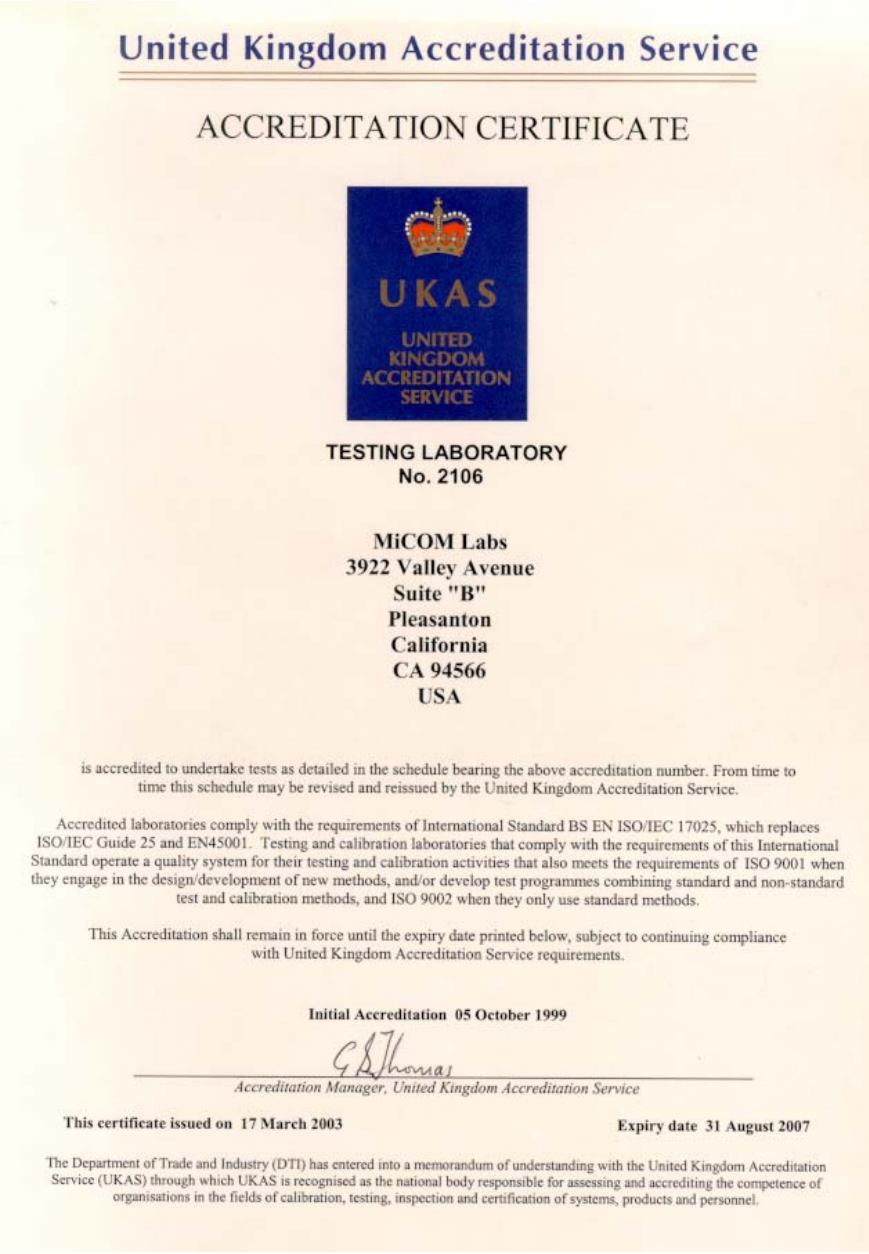
ACCREDITATION & LISTINGS

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS EN ISO/IEC 17025. The company is accredited by the United Kingdom Accreditation Service (UKAS) www.ukas.org test laboratory number 2106. MiCOM Labs test schedule is available at the following URL;
http://www.ukas.org/testing/lab_detail.asp?lab_id=875&location_id=&vMenuOption=3 .



United Kingdom Accreditation Service

ACCREDITATION CERTIFICATE

UKAS
UNITED KINGDOM ACCREDITATION SERVICE

TESTING LABORATORY
No. 2106

MiCOM Labs
3922 Valley Avenue
Suite "B"
Pleasanton
California
CA 94566
USA

is accredited to undertake tests as detailed in the schedule bearing the above accreditation number. From time to time this schedule may be revised and reissued by the United Kingdom Accreditation Service.

Accredited laboratories comply with the requirements of International Standard BS EN ISO/IEC 17025, which replaces ISO/IEC Guide 25 and EN45001. Testing and calibration laboratories that comply with the requirements of this International Standard operate a quality system for their testing and calibration activities that also meets the requirements of ISO 9001 when they engage in the design/development of new methods, and/or develop test programmes combining standard and non-standard test and calibration methods, and ISO 9002 when they only use standard methods.

This Accreditation shall remain in force until the expiry date printed below, subject to continuing compliance with United Kingdom Accreditation Service requirements.

Initial Accreditation 05 October 1999

G R Thomas
Accreditation Manager, United Kingdom Accreditation Service

This certificate issued on 17 March 2003 Expiry date 31 August 2007

The Department of Trade and Industry (DTI) has entered into a memorandum of understanding with the United Kingdom Accreditation Service (UKAS) through which UKAS is recognised as the national body responsible for assessing and accrediting the competence of organisations in the fields of calibration, testing, inspection and certification of systems, products and personnel.

LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

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

Canada
Industry Canada (IC) Listing #: 4143

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	30th June '05	
Rev A	6th July '05	

1. TEST RESULT CERTIFICATE

Manufacturer:	Bright Star Engineering 150 Presidential Way, Suite 220 Woburn MA, 01801, USA	Tested By:	MiCOM Labs, Inc. 3922 Valley Avenue 'B' Pleasanton California, 94566, USA
EUT:	Wireless 802.11 b/g Automobile Diagnostic	Telephone:	+1 925 462 0304
Model:	StarMOBILE CH9801	Fax:	+1 925 462 0306
S/N:	CO504-00075		
Test Date(s):	18th to 26th June 05	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.

Approved & Released for MiCOM Labs, Inc. by:

UKAS TESTING
2106

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	2001	Code of Federal Regulations
(ii)	Industry Canada RSS-210	Issue 5 Nov. 2001	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands)
(iii)	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
(iv)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(v)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vi)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(vii)	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
(viii)	UKAS LAB 1	Edition 4 May 2004	Reference to Accreditation for Laboratories.
(ix)	DTI URN 98/997	2003	Conditions for the use of National Accreditation Marks by UKAS and UKAS Accredited Organizations.

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

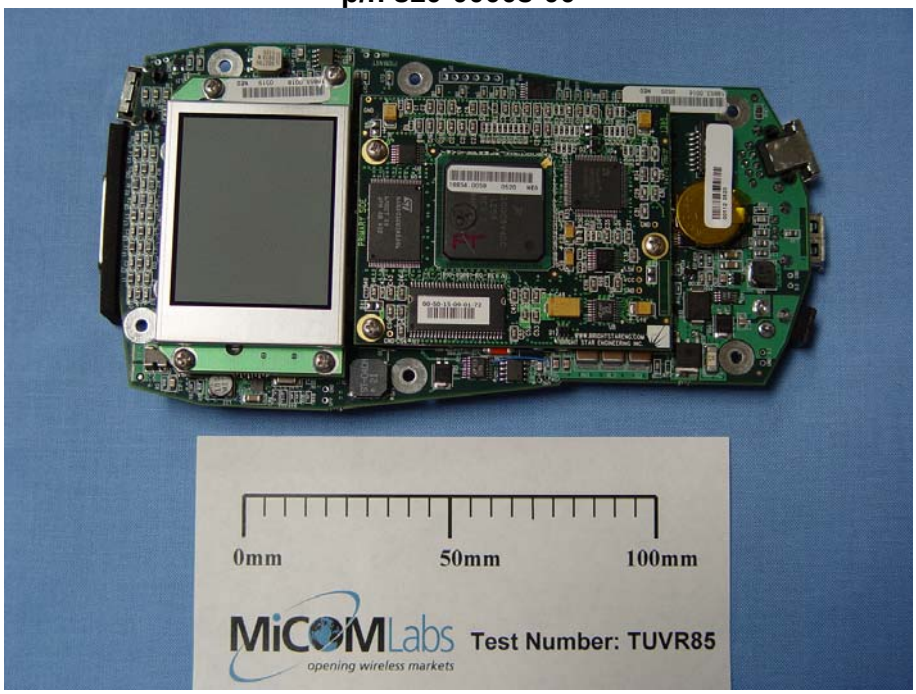
Details	Description
Purpose:	Test of the StarMOBILE CH9801 to FCC and Industry Canada regulations for a wireless device
Applicant:	TUV Rheinland of North America 1279 Quarry Lane, Suite Pleasanton CA, 94566,USA
Manufacturer:	Bright Star Engineering 150 Presidential Way, Suite 220 Woburn MA, 01801, USA
Laboratory performing the tests:	MiCOM Labs, Inc. 3922 Valley Avenue, Suite "B" Pleasanton, California 94566 USA
Test report reference number:	TUVR85-A1 Rev A
Date EUT received:	16th June 05
Standard(s) applied:	FCC 47 CFR Part15.247 & IC RSS-210
Dates of test (from - to):	18th to 26th June 05
No of Units Tested:	1
Type of Equipment:	Industrial WLAN 802.11b/g Wireless device
Manufacturers Trade Name:	StarMOBILE
Model:	CH9801
Location for use:	Indoor and Outdoor
Declared Frequency Range(s):	2,412 – 2,462 MHz
Type of Modulation:	DSSS
Declared Nominal Output Power:	19.97 dBm
EUT Modes of Operation:	Intermittent Transmitter (Master and Slave)
Transmit/Receive Operation:	Simplex Transceiver
Rated Input Voltage and Current:	15 Vdc 300mA
Operating Temperature Range:	-20 to + 50ºC
ITU Emission Designator:	802.11b: 15M5W7D 802.11g: 16M5W7D
Microprocessor(s) Model:	Freescale MPC5200
Clock/Oscillator(s):	Oscillators: 33MHz Crystals: 8MHz, 32.768KHz, 4MHz DC/DC: 330KHz, 1.25MHz, 1MHz, 200KHZ
Frequency Stability:	±20ppm
Equipment Dimensions:	5"x4"x1.5"
Weight:	Approximately 1.27lb
Primary function of equipment:	Automobile diagnostic

3.2. Scope of Test Program

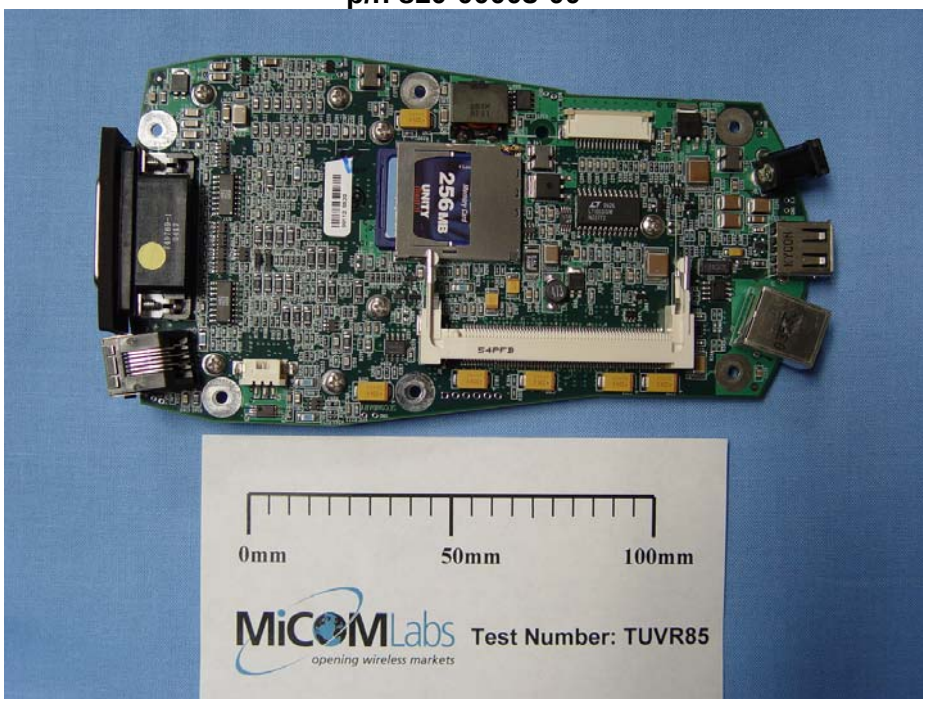
The scope of the test program was to test the Bright Star Engineering StarMOBILE 802.11b/g Wireless device against the current FCC and Industry Canada specifications FCC Part 15.247 and IC RSS-210, Normative References (i) & (ii).

StarMOBILE 802.11b/g Wireless device

StarMOBILE Main Assy Top with LCD Assy
p/n 810-00003-00

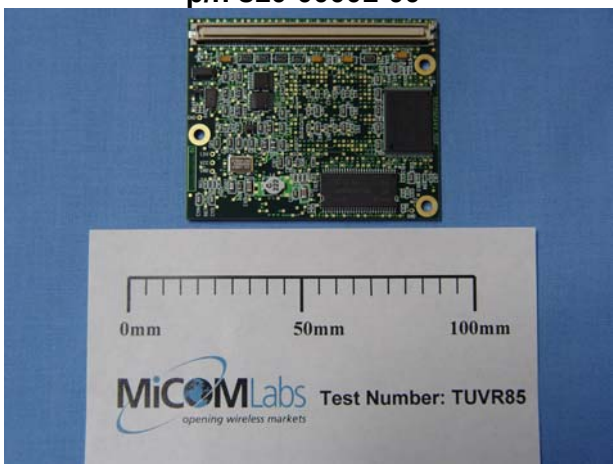


StarMOBILE Main Assy Top with LCD Assy
p/n 810-00003-00

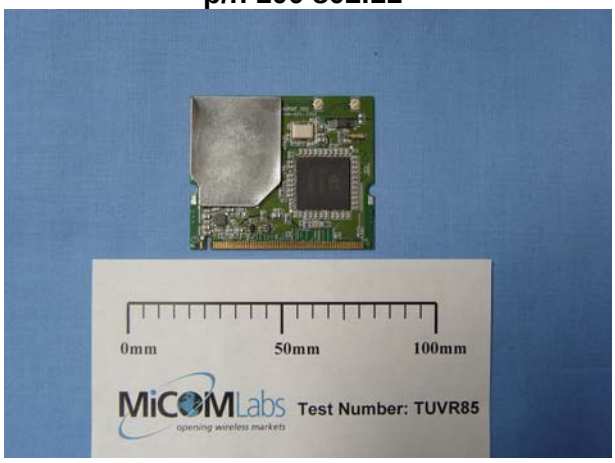


Power Engine Assy Top
p/n 810-00001-00

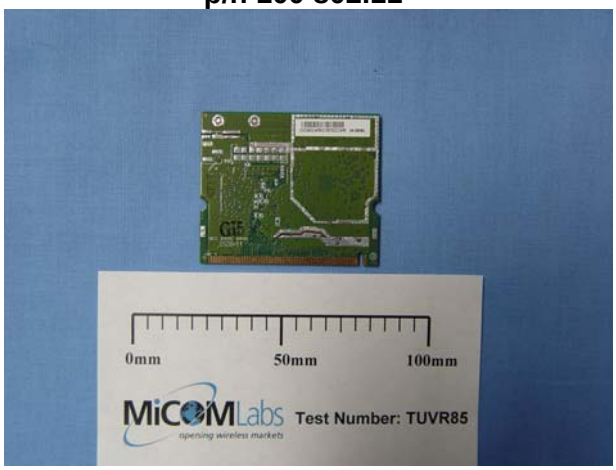
Power Engine Assy Lower Side
p/n 810-00001-00



Mini-PCI Wireless Card Top
p/n 100 802.11



Mini-PCI Wireless Card Lower Side
p/n 100 802.11



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

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	StarMOBILE 802.11 b/g Automobile Diagnostic	Bright Star Engineering	CH9801	CO504-00075
Support	Cable 15 pin RS 232			
Support	Cable 15 PIN RS232 to RJ11			
Support	Laptop computer	IBM	Thinkpad R40	

3.4. Antenna Details

Antenna Type	Gain (dBi)	Manufacturer	Model No.	Serial No.
Detachable Dipole	2 dBi	Nearson	141	None

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. RS232
2. RJ11
3. Ethernet
4. USB
5. dc power

3.6. Test Configurations

Matrix of test configurations

Operational Mode (802.11)	Operating Channel	Frequencies (MHz)	Maximum Data Rates (MBit/s)	Data Rate(s) Selected for Test Purposes (Mbit/s)	
				Conducted	Radiated
b	1, 6, 11	2,412 2,437 2,462	11	11	11
g			54	54	54

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 emission testing 30 MHz-1 GHz (Section 5.1.6.4 within this report) was subcontracted to the following test facility;

Sanmina-SCI
Homologation Services
EMI Test Laboratory
2305 Mission College Blvd.
Santa Clara, California 95054
USA

Sanmina-SCI, NVLAP (National Voluntary Laboratory Accreditation Program) Lab Code 100411-0 are ISO/IEC 17025 accredited for emission testing 30 MHz-1 GHz.

Sanmina SCI: FCC Registration Number: 90844

IC Registration Number: IC5541

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**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(a)(2) **5.9.1**	6 dB and 99 % Bandwidths	>=500 kHz	Conducted	Complies	5.1.1
15.247(b) **15.31(e)** **6.2.2 (o) (b)**	Peak Output Power Voltage Variation	Shall not exceed 1W Variation of supply voltage 85 % -115 %	Conducted	Complies	5.1.2
15.247(d) **6.2.2 (o) (b)**	Peak Power Spectral Density	Shall not be greater than +8 dBm in any 3 kHz band	Conducted	Complies	5.1.3
15.247(b)(5) **14**	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	5.1.4
15.247(c) **15.205(a) /** **15.209(a)** **6.2.2 (o) (e1)**	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
5.205(a) / **15.209(a)** **6.3**	Radiated Emissions	Restricted Bands	Radiated	Complies	5.1.6
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*5.1.6.1*
IC RSS-210 only Section 7.3	Receiver Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*5.1.6.2*
	Radiated Band Edge	Band edge results		Complies	*5.1.6.3*

Section(s)	Test Items	Description	Condition	Result	Test Report Section
5.205(a) / 15.209(a) 6.3	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies	*5.1.6.4*
15.207 6.6	AC Wireline Conducted Emissions 150 kHz– 30 MHz	Conducted Emissions	Conducted	Not Applicable Battery Operated	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: *Section 3.7 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix*

5. TEST RESULTS

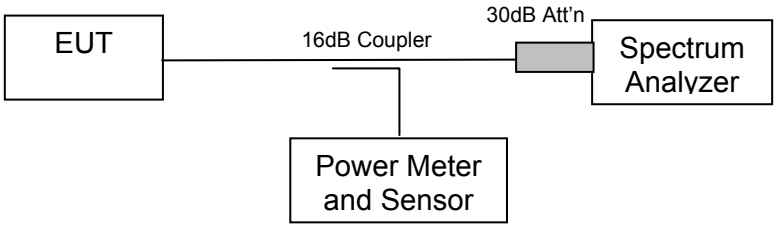
5.1. Device Characteristics

5.1.1. 6 dB and 99 % Bandwidth

FCC, Part 15 Subpart C §15.247(a)(2)
Industry Canada RSS-210 §5.9.1

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 Duty Cycle of the EUT was set to 100%. A 3 dB resolution bandwidth filter was set on the spectrum analyzer for the 6 dB and 99% bandwidth measurements.

Test Measurement Set up



Measurement set up for 6 dB and 99 % bandwidth test

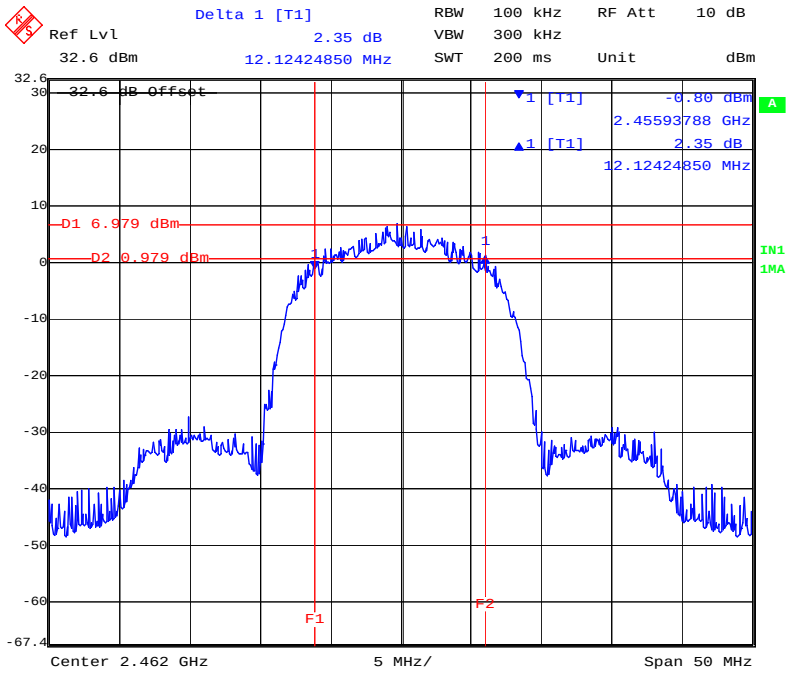
Measurement Results for 6 dB and 99 % Operational Bandwidth(s)

Ambient conditions.
Temperature:24 to 26°C Relative humidity: 44 % Pressure:1003 mbar

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

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	99 % BW (MHz)	99 % BW Plots
2,412	11.52305	On File	15.33066	On File
2,437	11.57315	On File	15.43086	On File
2,462	12.12425	Plot 1	15.53106	Plot 2

Plot 1 Ch 11 2,642 MHz 6 dB Bandwidth



Plot 2 Ch 11 2,642 MHz 99% Bandwidth

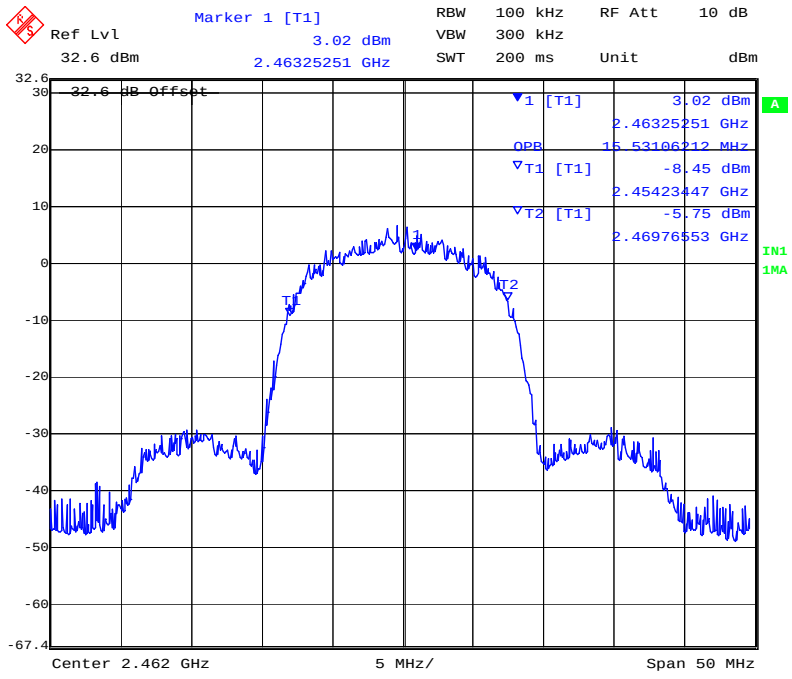
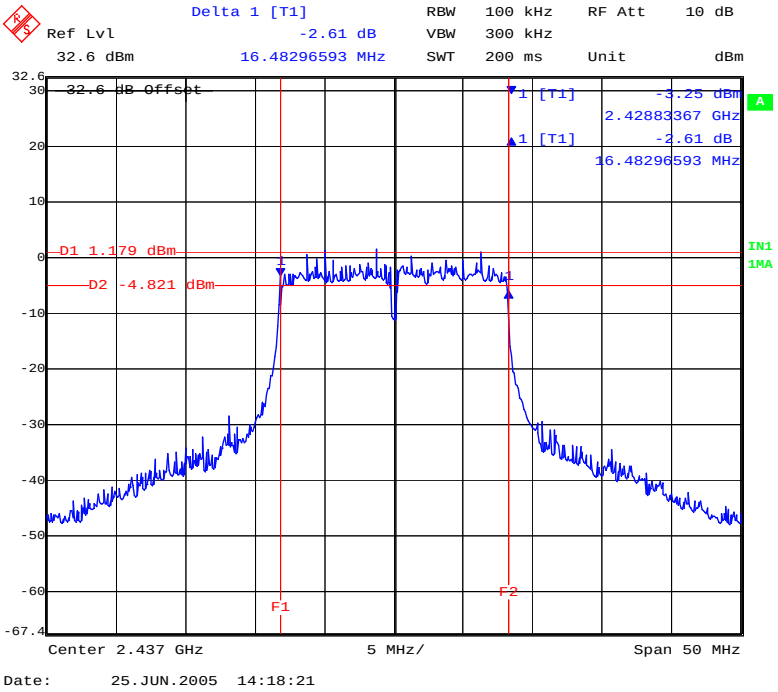


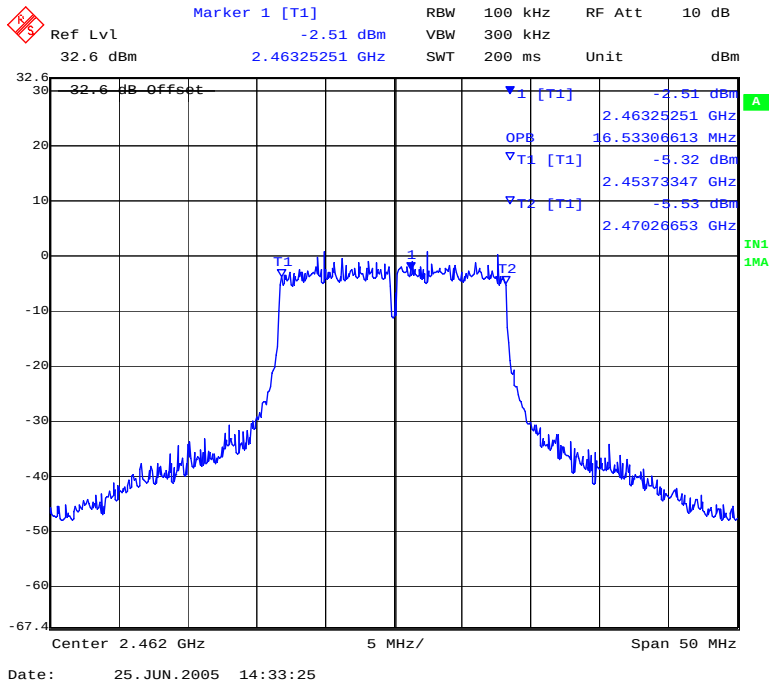
TABLE OF RESULTS – **802.11g 54Mbit/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	99 % BW (MHz)	99 % BW Plots
2,412	16.28257	On File	16.53306	On File
2,437	16.48297	Plot 3	16.33267	On File
2,462	16.43230	On File	16.53370	Plot 4

Plot 3 Ch 6 2,437 MHz 6 dB Bandwidth



Plot 4 Ch 11 2,642 MHz 99% Bandwidth



Specification

Limits

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

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'	0156, 0193, 0252, 0313, 0314

5.1.2. Peak Output Power

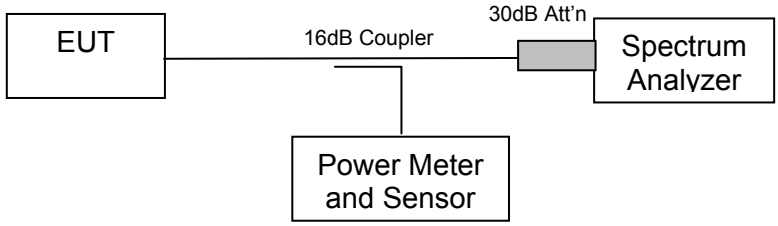
FCC, Part 15 Subpart C §15.247(b)
Industry Canada RSS-210 §6.2.2(o)(b)

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 3 dB, peak detector selected and the analyzer built-in power function was used to measure peak power over the measured 99 % bandwidth.

Measurements were made while EUT was operating in a continuous transmission mode i.e. 100 % duty cycle at the appropriate center frequency.

Test Measurement Set up



Measurement set up for Transmitter Peak Output Power

Antenna Gain - Maximum Allowable Power Level

If transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Type	Antenna No.	Gain (dBi)	Antenna Gain >6dBi (dB)	Max. Allowable Peak Power (dBm)

Measurement Results for Peak Output Power

Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

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

Center Frequency (MHz)	Measurement Bandwidth (MHz)	Peak Power (dBm)	Peak Power Plot #
2,412	15.331	+20.53	On File
2,437	15.431	+20.73	Plot 5
2,462	15.531	+20.58	On File

PEAK POWER EIRP

Max. Peak Power EIRP = max. conducted power + antenna gain (dBi)

Antenna No.	Gain (dBi)	Max. Peak Power EIRP (dBm)

Plot 5 Ch 6 2,437 MHz Peak Power (dBm)

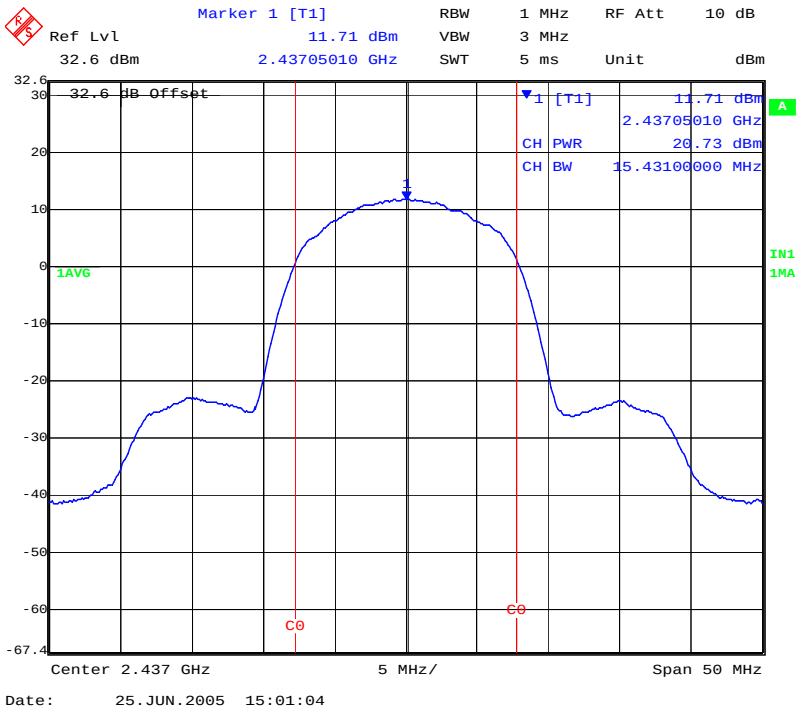


TABLE OF RESULTS – **802.11g 54Mbit/s**

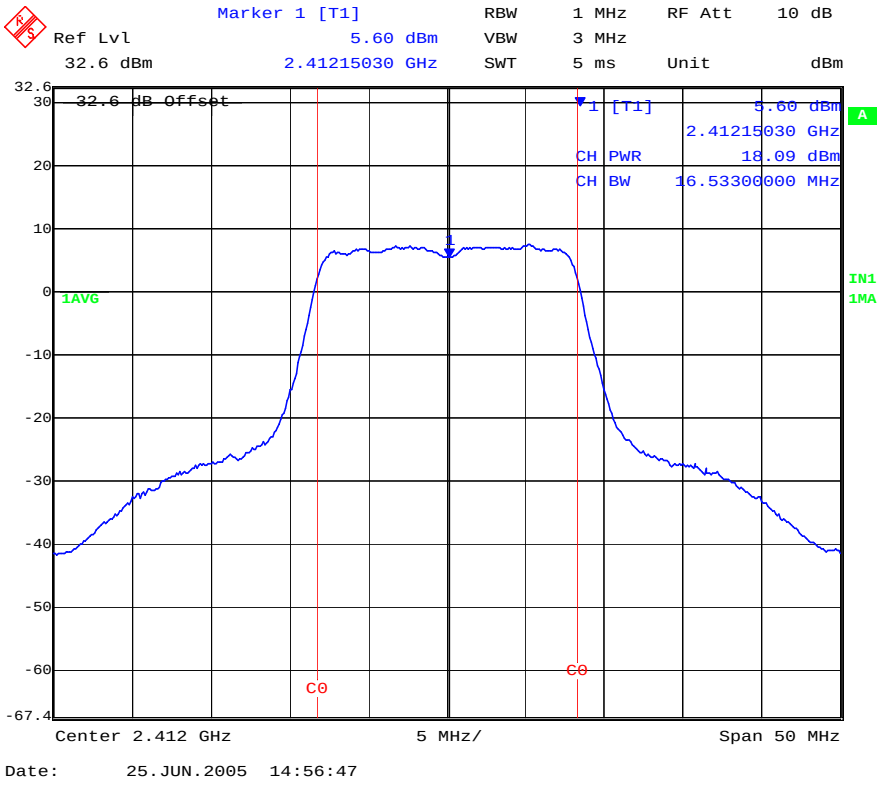
Center Frequency (MHz)	Measurement Bandwidth (MHz)	Peak Power (dBm)	Peak Power Plot #
2,412	16.53306	+18.09	Plot 6
2,437	16.33267	+18.05	On File
2,462	16.53307	+17.84	On File

PEAK POWER EIRP

Max. Peak Power EIRP = max. conducted power + antenna gain (dBi)

Antenna No.	Gain (dBi)	Max. Peak Power EIRP (dBm)

Plot 6 Ch 1 2,412 MHz 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: 1watt **§15.247 (b) (4)** Except as shown in paragraphs (b)(3)(i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b) (1) or (b)(2) of this section, as appropriate by the amount in dB that the directional gain of the antenna exceeds 6 dBi. **§6.2.2(o)(b)** For the band 2400-2483.5 MHz, the transmitter output power shall not exceed 1.0 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'	0156, 0193, 0252, 0313, 0314

5.1.3. Peak Power Spectral Density

FCC, Part 15 Subpart C §15.247(d)
Industry Canada RSS-210 §6.2.2(o)(b)

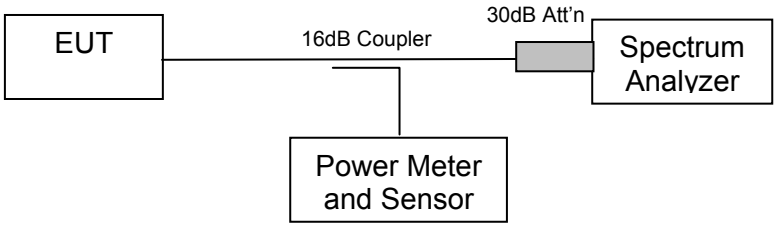
Test Procedure

The transmitter output was connected to a spectrum analyser 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. Spectrum analyzer settings:

Measurements were made while EUT was operating in a continuous transmission mode i.e.

100 % duty cycle at the appropriate center frequency.

Test Measurement Set up



Measurement set up for Peak Power Spectral Density

Measurement Results for Peak Power Spectral Density

Ambient conditions.
Temperature:25°C Relative humidity:45 to 50 % Pressure:1000 to 1005 mbar

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

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Plot #
2,412	2411.33417	-7.22	On File
2,437	2436.33417	-7.03	Plot 7
2,462	2461.33417	-7.14	On File

Plot 7 Ch 6 2,437 MHz Peak Power Spectral Density

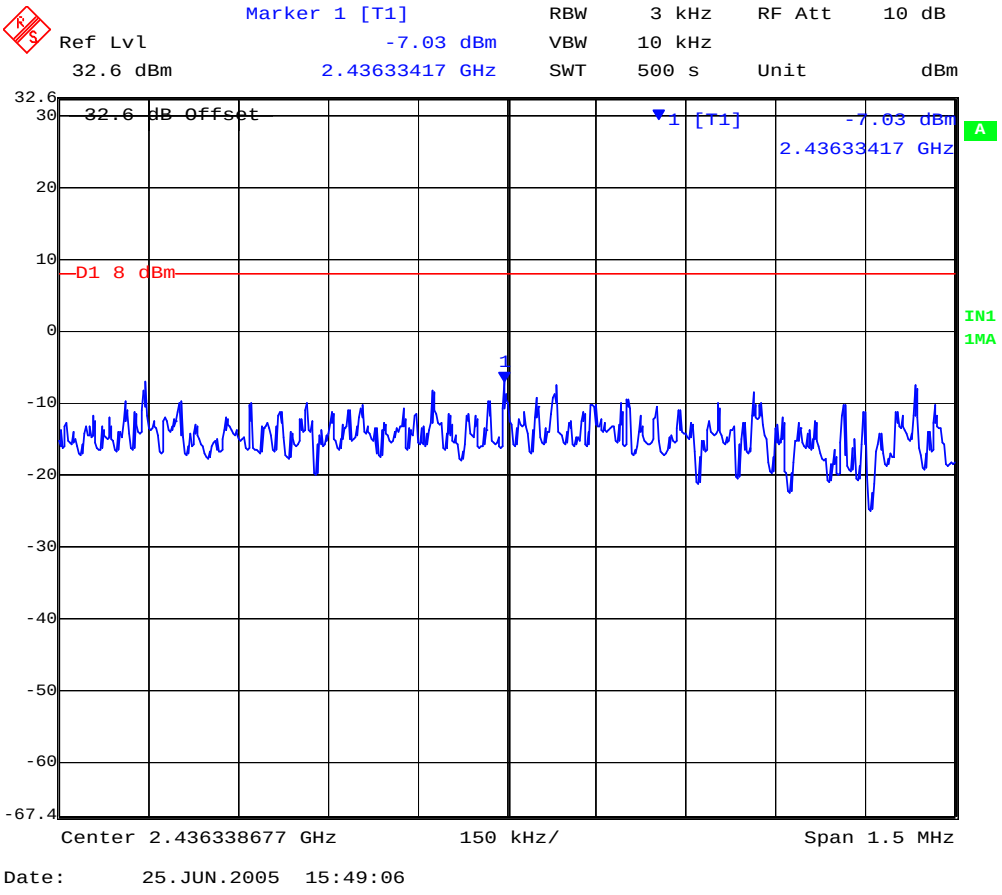
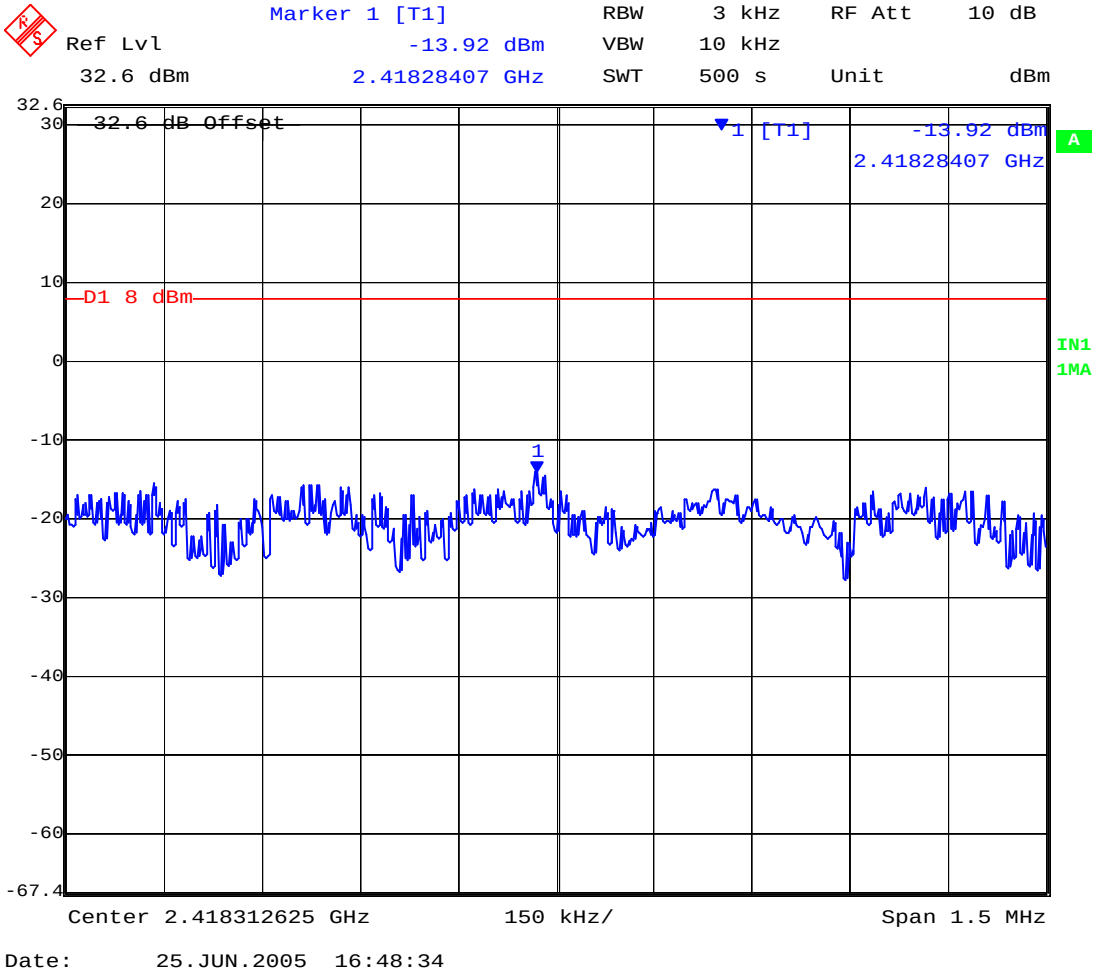


TABLE OF RESULTS – **802.11g 54Mbit/s**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Plot #
2,412	2418.28407	-13.92	Plot 8
2,437	2437.64028	-13.96	On File
2,462	2466.38627	-14.01	On File

Plot 8 Ch 1 2,412 MHz Peak Power Spectral Density



Specification
Peak Power Spectral Density Limits

§15.247 (d) For direct sequence systems the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission

RSS-210 §**6.2.2(o)(b)** 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'	0156, 0193, 0252, 0313, 0314

5.1.4. Maximum Permissible Exposure

FCC, Part 15 Subpart C §15.247(b)(5)
Industry Canada RSS-210 §14

Calculations for Maximum Permissible Exposure Levels

Power Density = Pd (mW/cm^2) = $EIRP/(4\pi d^2)$

EIRP = P * G

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

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

P (worst case) = +**20.73 dBm**

Antenna Gain = **1.58** numeric

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

Antenna Gain (dBi)	Numeric Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure at d=20cm (mW/cm^2)	Limit (mW/cm^2)
2	1.58	+20.73	118.3	0.037	1

Specification

Maximum Permissible Exposure Limits

§15.247 (b)(5) 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. See §1.1307 (b)(1) of this chapter.

Limit S = 1mW / cm^2 from 1.310 Table 1

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

RSS-210 §14 Before equipment certification is granted, the procedures of RSS-102 must be followed concerning exposure of humans to RF fields.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

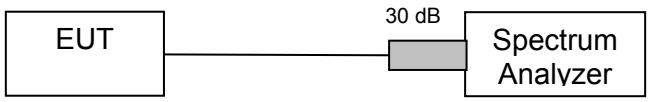
5.1.5. Conducted Spurious Emissions

FCC, Part 15 Subpart C §15.247(c)
Industry Canada RSS-210 §5.9.1, §6.2.2 (o)(e1)

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 with a 100% duty cycle 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:24°C Relative humidity:45 to 50 % Pressure:100 to 1005 mbar

Conducted Band-Edge Results

TABLE OF RESULTS – **802.11b 11Mbit/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	-7.9	-24.22	Plot 9	-16.32
2,462	2,483.5	-7.9	-38.40	On File	-30.50

Plot 9 Ch 1 2,412 MHz Conducted Spurious Band Edge

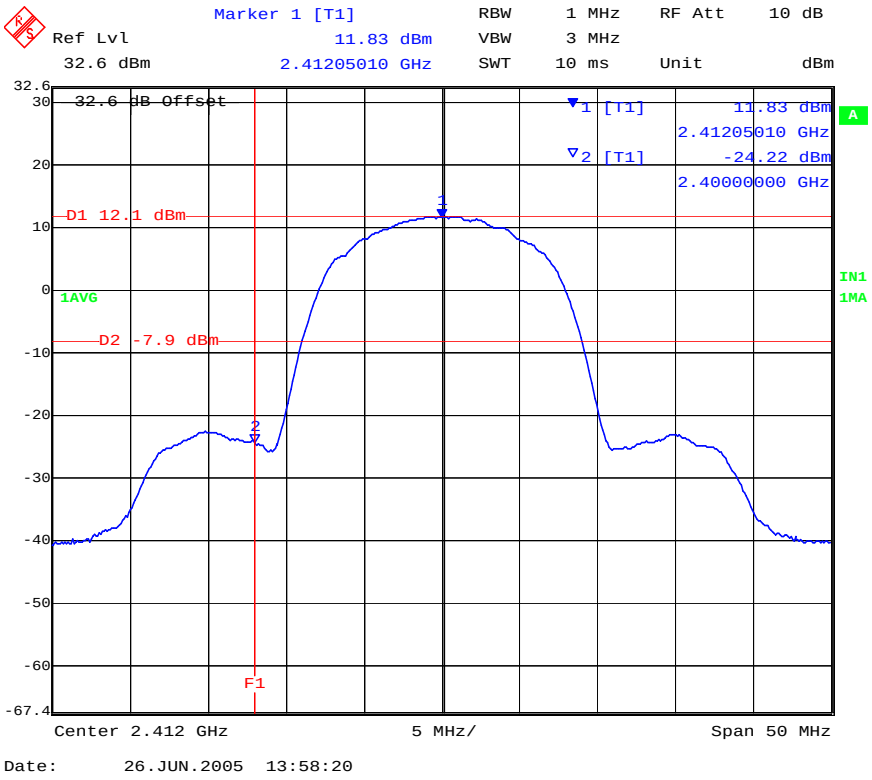
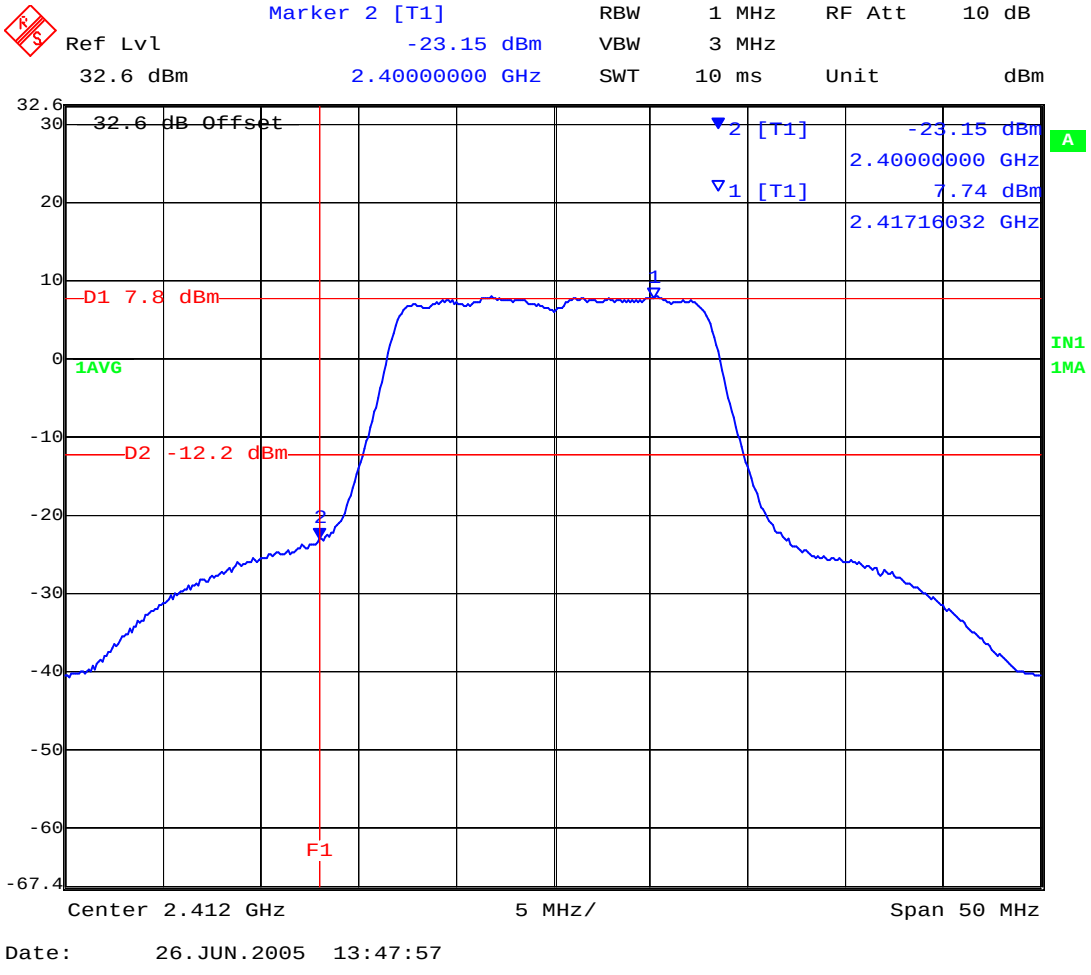


TABLE OF RESULTS – **802.11G 54MBIT/S**

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	-12.2	-23.15	Plot 10	-10.95
2,462	2,483.5	-12.2	-35.15	On file	-22.95

Plot 10 Ch 1 2,412 MHz Conducted Spurious Band Edge



Spurious Emissions (1-26.5 GHz)

Conducted spurious emissions (1-26 GHz) are provided indicated by the following matrix. 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 11Mbit/s**

CH	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
1	1,000	26,500	+8.73	-11.27	On File	-30.8
6	1,000	26,500	+8.73	-11.27	On File	-32.7
11	1,000	26,500	+9.07	-10.93	Plot 11	-33.1

Plot 11 Ch 1 2,412 MHz Conducted Spurious 1 to 26 GHz

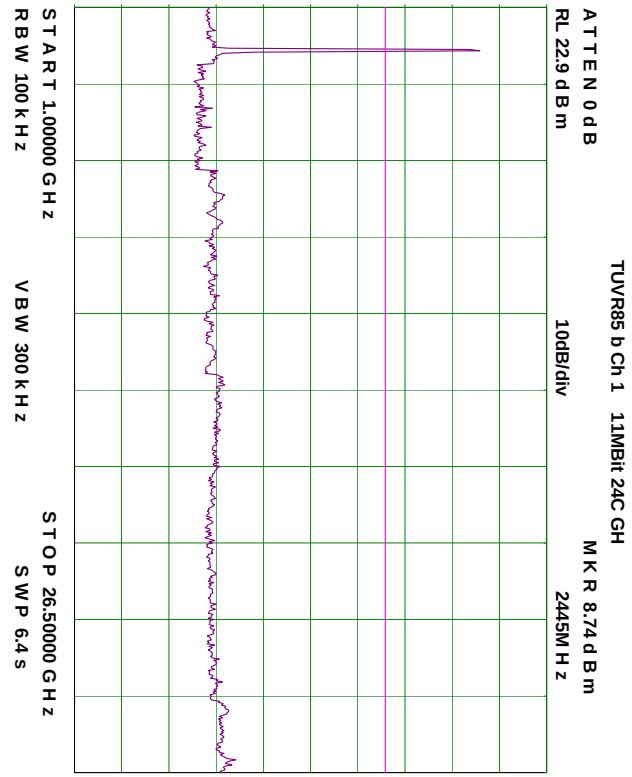
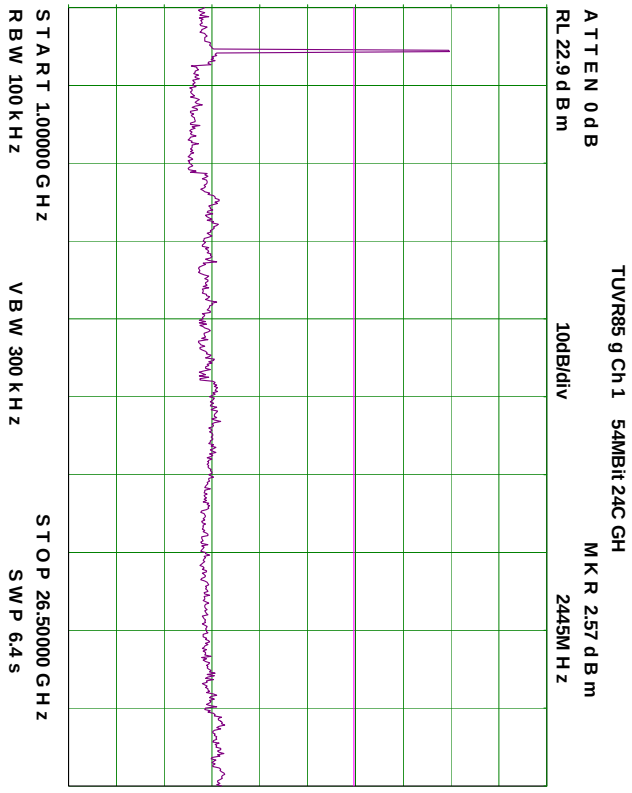


TABLE OF RESULTS – **802.11g 54Mbit/s**

CH	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Plot #	Margin (dB)
1	1,000	26,500	+2.57	-17.43	On File	-27.0
6	1,000	26,500	+2.90	-17.10	On File	-28.0
11	1,000	26,500	+3.90	-16.10	Plot 12	-28.4

Plot 12 Ch 1 2,412 MHz Conducted Spurious 1 to 26 GHz



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(c)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or radiated measurement. Attenuation below the general limits specified in §**15.209(a)** is not required.

§**6.2.2 (o)(e1)** In any 100 kHz bandwidth outside the operating frequency bands, between 30 MHz and 5 times the carrier frequency, the unwanted emission spectral density shall be either at least 20 dB below the in-band spectral density, or shall not exceed the levels specified in Table 3, whichever is less stringent.

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'	0156, 0193, 0252, 0313, 0314

5.1.6. Radiated Emissions

5.1.6.1. Transmitter Radiated Spurious Emissions (above 1 GHz)

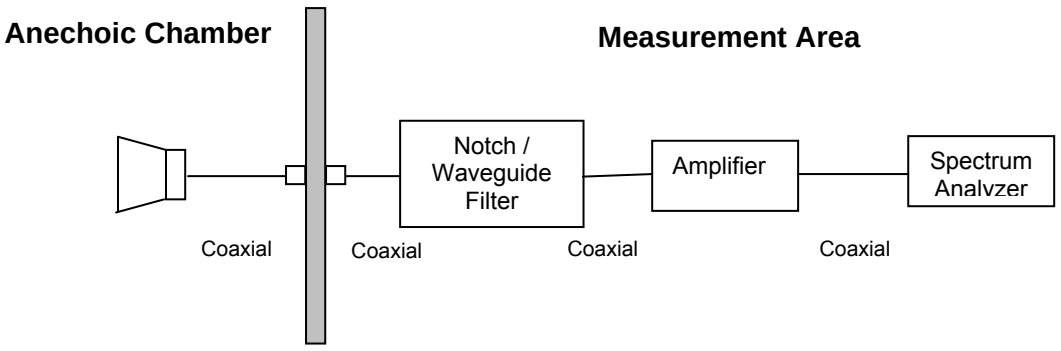
FCC, Part 15 Subpart C §15.247(c)
Industry Canada RSS-210 §6.3

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

Measurement Results Transmitter Radiated Spurious Emissions above 1 GHz

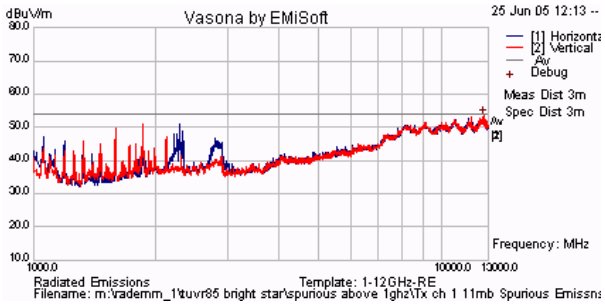
Ambient conditions.
Temperature: 19 to 26°C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

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

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1						54.00	
6						54.00	
11						54.00	

No peak emissions were observed above the limit

CH 1 802.11b 11Mbit/s



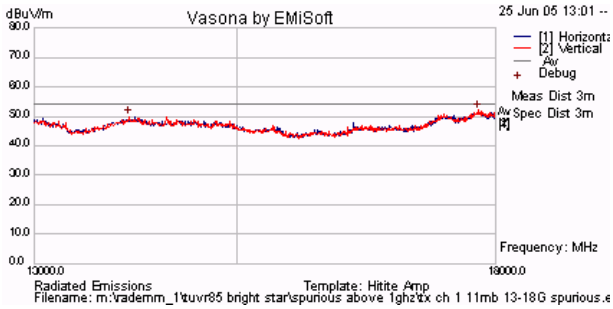
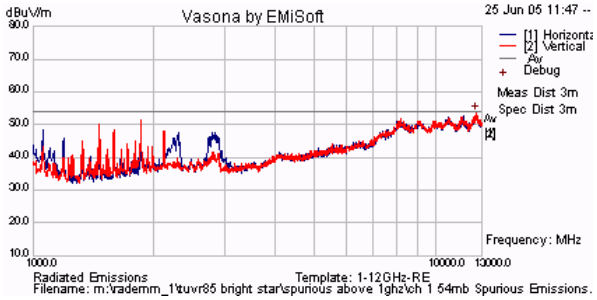


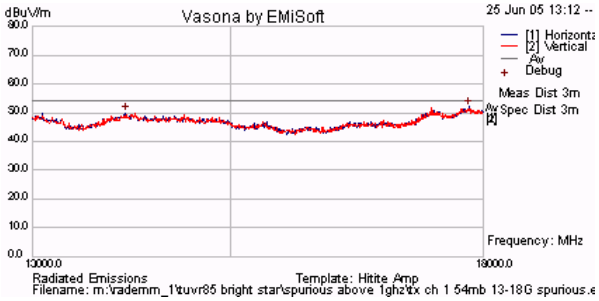
TABLE OF RESULTS – **802.11g 54Mbit/s**

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1						54.00	
6						54.00	
11						54.00	

No emissions peak were observed above the limit

CH 1 802.11b 11Mbit/s





5.1.6.2. Receiver Radiated Spurious Emissions (above 1 GHz)

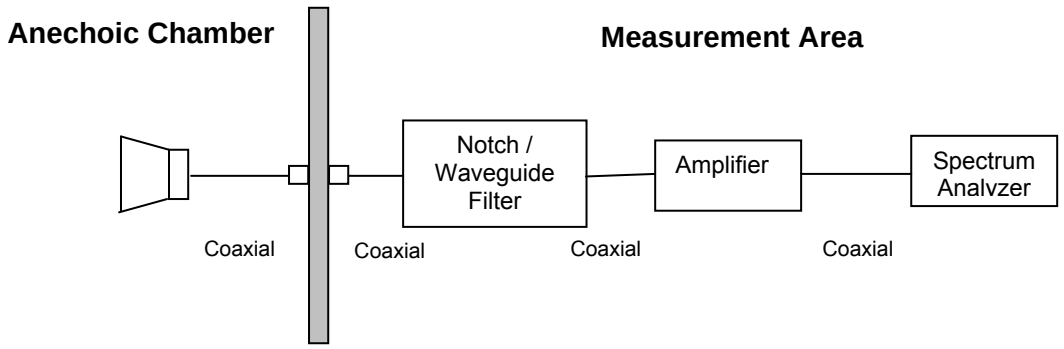
Industry Canada RSS-210 §7.3

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

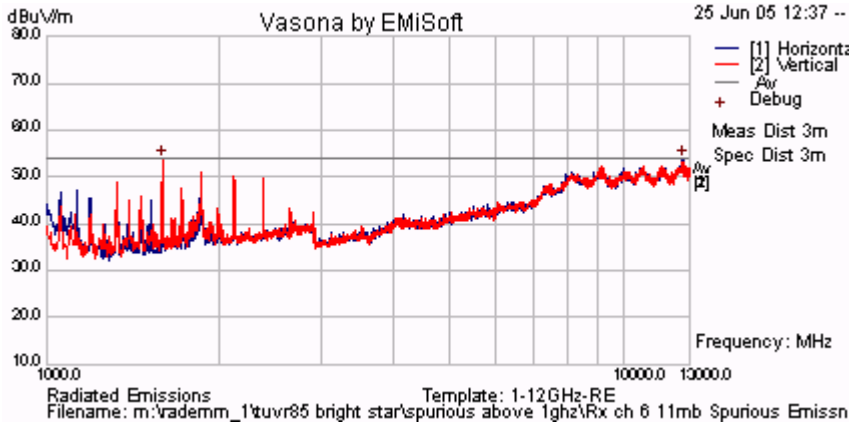
Ambient conditions.
Temperature: 19 to 26°C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

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

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dBμV/m)	Correction Factor (dB)	Corrected Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1						54.00	
6						54.00	
11						54.00	

No peak emissions were observed above the limit

CH 6 802.11b 11Mbit/s



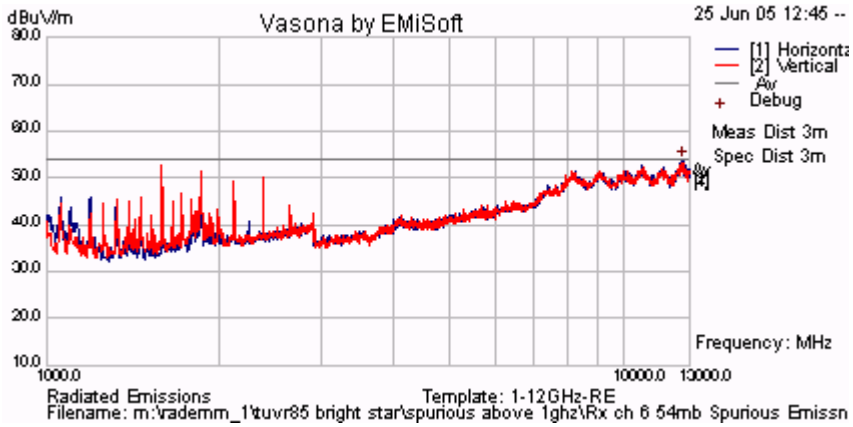
Receiver Radiated Spurious Emissions above 1 GHz

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

CH.	Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1						54.00	
6						54.00	
11						54.00	

No peak emissions were observed above the limit

CH 6 802.11g 11Mbit/s



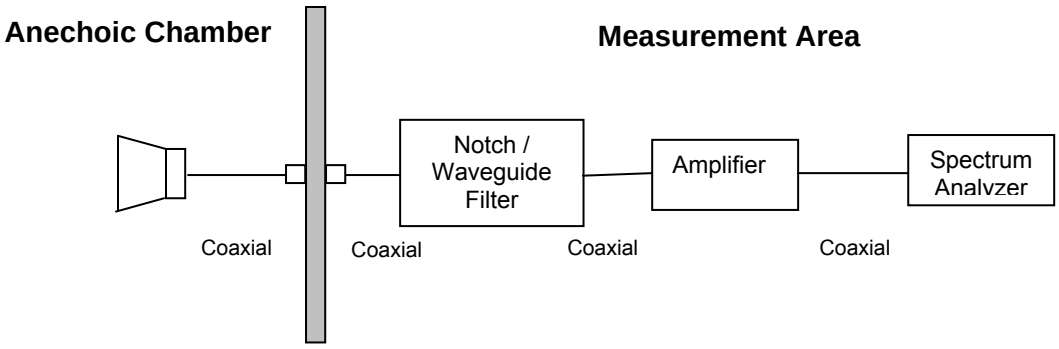
5.1.6.3. Radiated Band-Edge – Restricted Bands

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. 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:

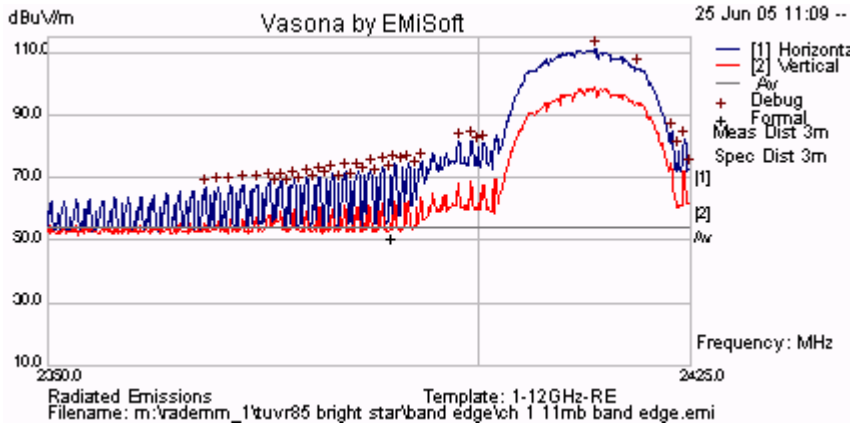
Level (dBμV/m) = 20 * Log (level (μV/m))

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

TABLE OF RESULTS – **802.11b 11Mbps**

Ch #	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	$2{,}412_{PEAK}$	2,390	73.80	74.00	-0.20
1	$2{,}412_{AVE}$	2,390	47.44	54.00	-6.56
11	$2{,}462_{PEAK}$	2,483.5	72.56	74.00	-1.44
11	$2{,}462_{AVE}$	2,483.5	45.51	54.00	-8.49

Channel 1 Band Edge. Peak Emission = 111.36 dBµV



Channel 11 Band Edge. Peak Emission = 109.18 dBµV

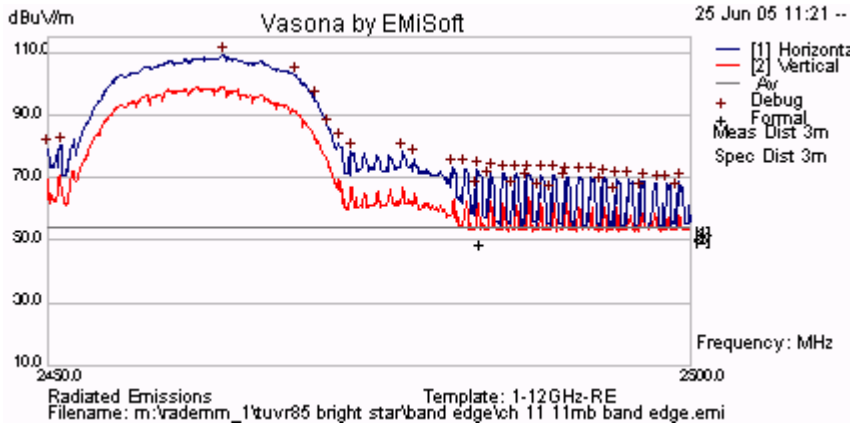
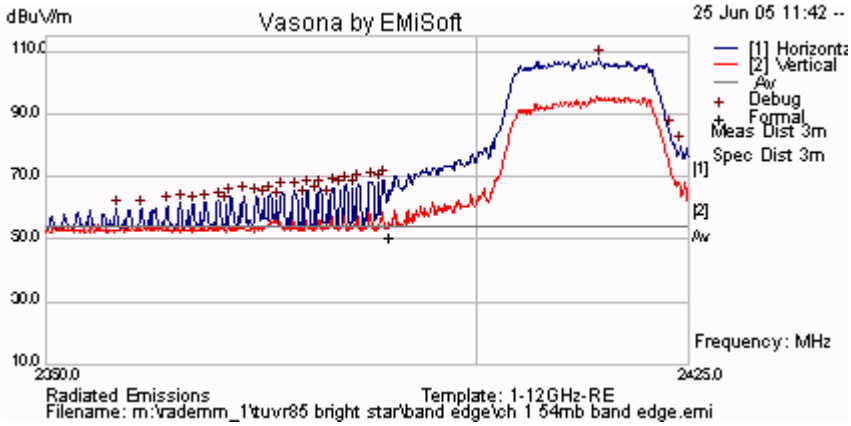


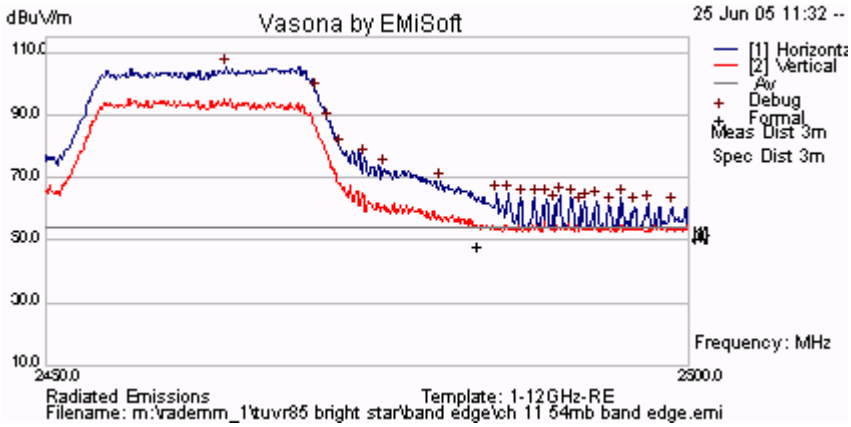
TABLE OF RESULTS – **802.11g 54 MBit/s**

Ch #	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	$2{,}412_{PEAK}$	2,390	69.12	74.00	-4.88
1	$2{,}412_{AVE}$	2,390	47.66	54.00	-6.34
11	$2{,}462_{PEAK}$	2,483.5	67.00	74.00	-7.00
11	$2{,}462_{AVE}$	2,483.54	44.53	54.00	-9.47

Channel 1 Band Edge. Peak Emission = 108.03 dBµV



Channel 11 Band Edge. Peak Emission = 105.51 dBµV



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.

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, 0104, 0156, 0134, 0304, 0311, 0315, 0310, 0312

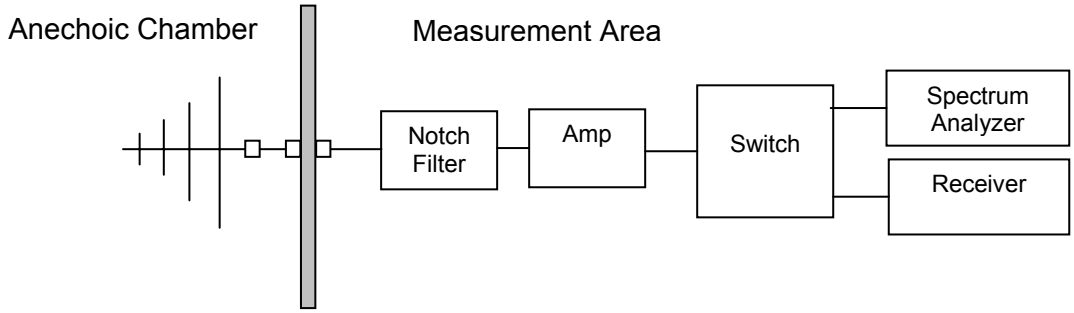
5.1.6.4. Radiated Spurious Emissions (30M-1 GHz)

FCC, Part 15 Subpart C §15.247(c)/ §15.209
Industry Canada RSS-210 §6.2.2(q1)(ii)

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

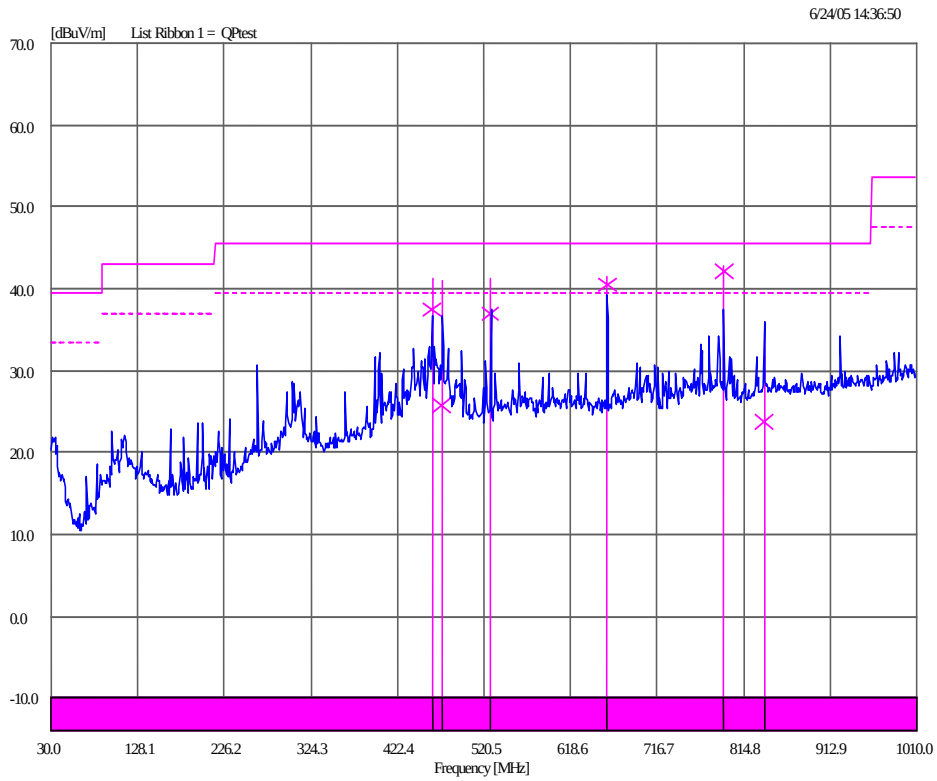
Measurement Results for Spurious Emissions (30 MHz – 1 GHz)

Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

Radio parameters.
Data Rate(s): 11MBit/s
Transmission: 100% Duty Cycle

TABLE OF RESULTS

Freq. (MHz)	Peak (dBuV/m)	QP (dBuV/m)	QP Lmt (dBuV/m)	QP Margin (dB)	Angle (deg)	Height (cm)	Pol
461.993784	41.65	37.97	45.95	-7.98	98	200	Horz
473.395883	41.55	26.2	45.95	-19.75	99	200	Horz
527.999757	41.8	37.44	45.95	-8.51	230	294	Vert
659.989704	42	40.91	45.95	-5.04	175	240	Vert
791.993511	43.21	42.58	45.95	-3.37	71	103	Horz
838.05372	36.49	24.21	45.95	-21.74	88	296	Horz



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.

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

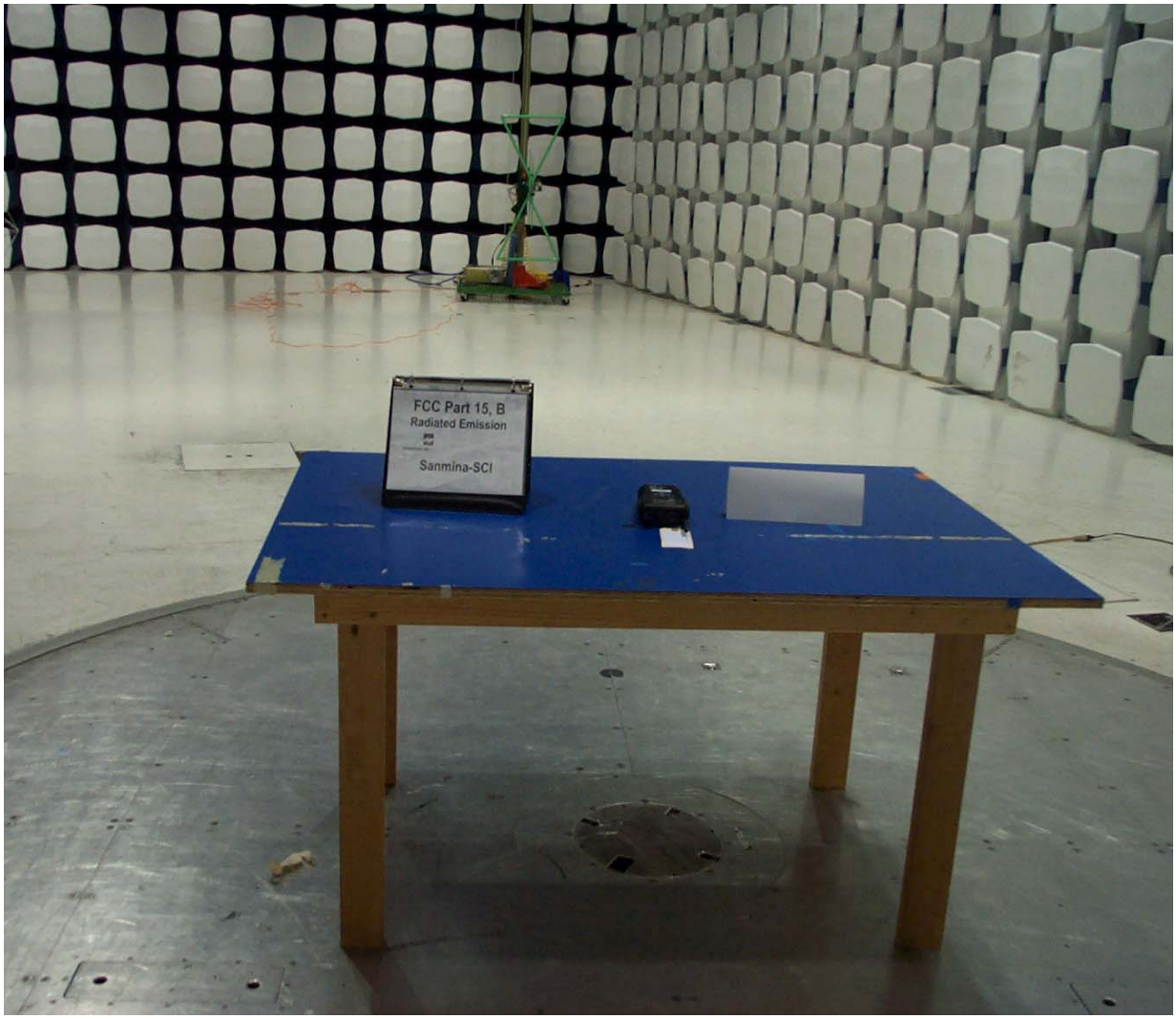
Method	Test Equipment Used
Measurements were made per Sanmina work instruction	8546A HP Receiver and RF Filter, HP Pre-amp, Antenna EMCO Biconilog

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

Not applicable. Battery powered product.

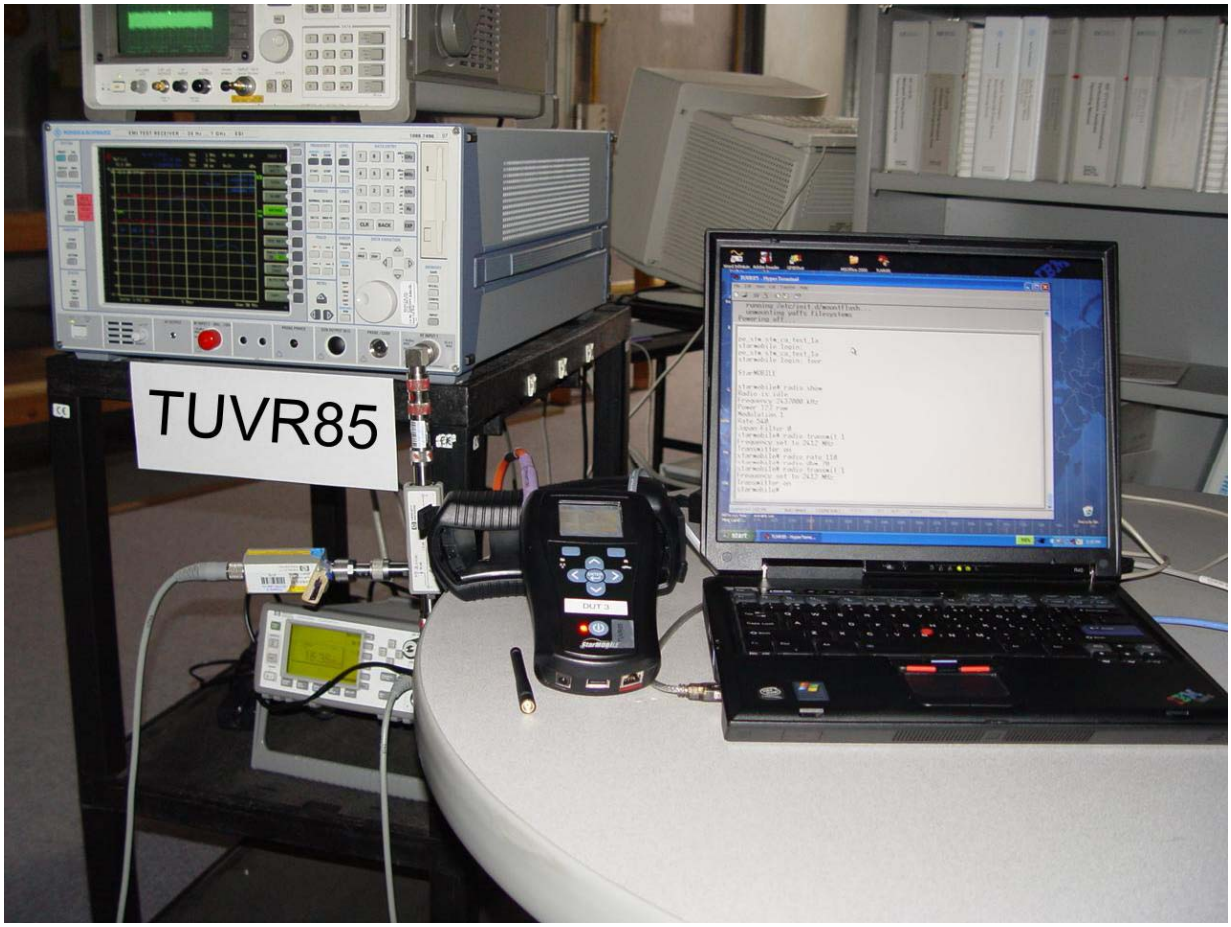
6. TEST SET-UP PHOTOGRAPHS

6.1. Radiated Emissions (30 MHz-1 GHz)



6.2. Spurious Emissions >1 GHz

6.3. General Measurement Test Set-Up



7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Calibration Due Date	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	20th June '06	3410A00141
0104	1-18GHz Horn Antenna	The Electro-Mechanics Company	3115	21st Oct '05	9205-3882
0134	Amplifier	Com Power	PA 122	1st Sept '05	181910
0156	Barometer /Thermometer	Control Co.	4196	12th Aug '05	E2844
0193	EMI Receiver	Rhode & Schwartz	ESI 7	8th Apr '06	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	18th Jun '06	Unknown
0304	2.4GHz Notch Filter	Micro-Tronics	--	N/A	--
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	7th Dec '05	209089-001
0311	12-18GHz High Pass Filter	CMT	--	3rd Nov '05	--
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	9h Dec '05	209092-001
0313	Coupler	Hewlett Packard	86205A	N/A	1623
0314	30dB N-Type Attenuator	NARDA	32319	N/A	--
0315	17-26.5GHz High Pass Filter	HP	--	21st Aug 05	--

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