Test of G2 Microsystems Model G2M5477

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

Test Report Serial No.: GMIS15-A2 Rev A

TEST REPORT

FROM

Test of G2 Microsystems Model G2M5477
to
FCC 47 CFR Part15.247 & IC RSS-210

Test Report Serial No.: GMIS15-A2 Rev A

This report supersedes: None

Applicant: G2 Microsystems
Level 15, 24 Campbell St
Haymarket, New South Wales
Australia

Product Function: 2.4 GHz Active RFID Tag

Copy No: pdf **Issue Date:** 10th February 2009

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
www.micomlabs.com

ACCREDITED
CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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ACCREDITATION, LISTINGS & RECOGNITION

ACCREDITATION

MiCOM Labs, Inc. an accredited laboratory complies with the international standard 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

ilac-MRA

THE AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

MICOM LABS
Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 18 June 2005*).

Presented this 26th day of February 2008.

President
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2009

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION CORPORATE SEAL 1978 DISTRICT OF COLUMBIA A2LA

For the 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

Canada

Industry Canada (IC) Listing #: 4143A

Japan Registration

VCCI Membership Number: 2959

- Radiation 3 meter site; Registration No. R-2881
- Line Conducted, Registration Nos. C-3181 & T-1470
- Emissions; Registration Nos. C-3180 & T-1469

RECOGNITION

APEC MRA (Asia-Pacific Economic Community Mutual Recognition Agreement)

Conformity Assessment Body (CAB) – MiCOM Labs

Test data generated by MiCOM Labs is accepted in the following countries under the APEC MRA.

Country	Recognition Body	Phase	CAB Identification No.
Australia	Australian Communications and Media Authority (ACMA)	I	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	I	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	I	
Singapore	Infocomm Development Authority (IDA)	I	
Taiwan	Directorate General of Telecommunications (DGT) Bureau of Standards, Metrology and Inspection (BSMI)	I I	

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	10th February 2009	Initial Release

1. TEST RESULT CERTIFICATE

Applicant:	G2 Microsystems Level 15, 24 Campbell St Haymarket, New South Wales Australia	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	802.11b/g RFID Device	Telephone:	+1 925 462 0304
Model:	G2M5477	Fax:	+1 925 462 0306
S/N:	0587-000305		
Test Date(s):	19th Jan to 4th Feb '09	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 '05	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

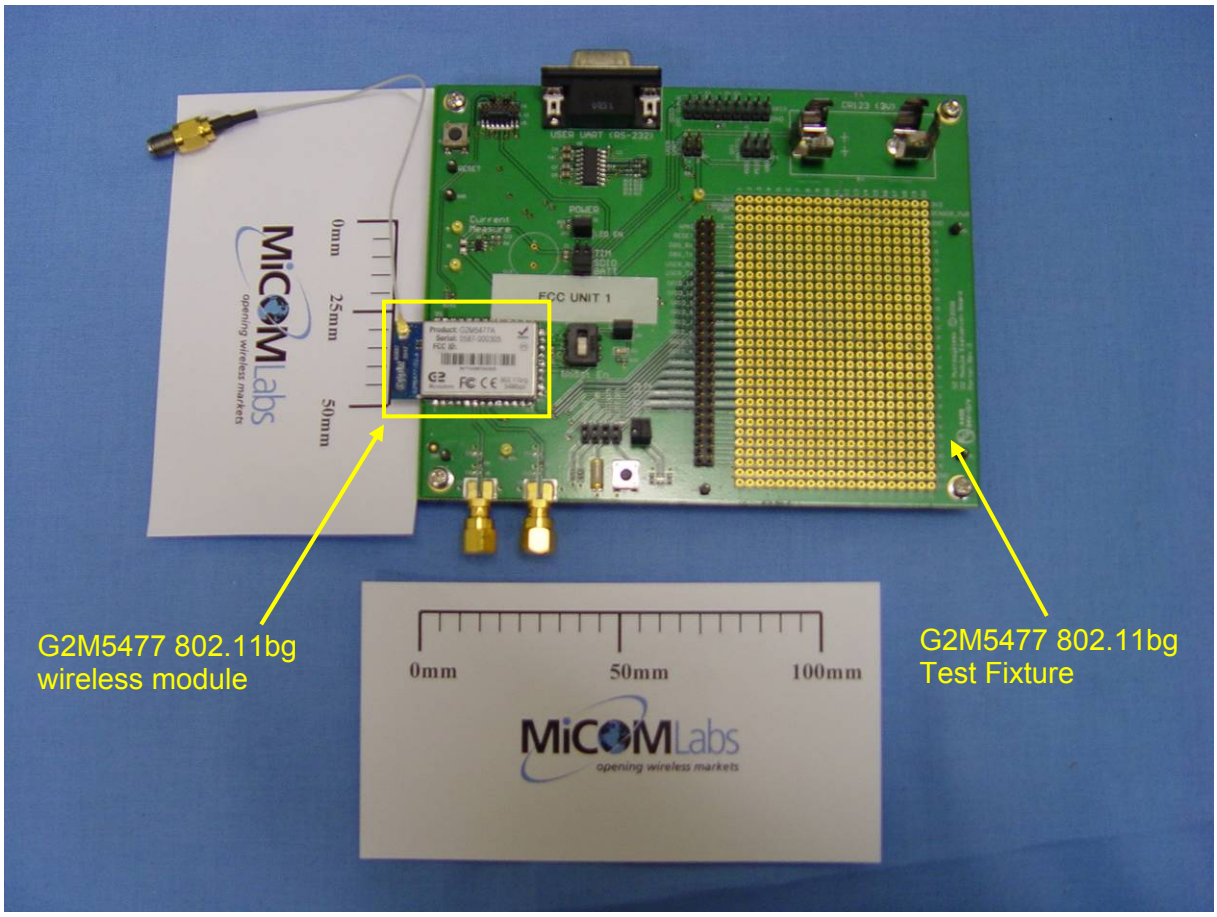
Details	Description	
Purpose:	Test of the G2 Microsystems Model G2M5477 to FCC Part 15.247.	
Applicant:	G2 Microsystems Level 15, 24 Campbell St Haymarket, New South Wales Australia	
Manufacturer:	As Applicant	
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA	
Test report reference number:	GMIS15-A2 Rev A	
Date EUT received:	19TH January 2009	
Standard(s) applied:	FCC 47 CFR Part15.247 & IC RSS-210	
Dates of test (from - to):	19th Jan to 4th Feb '09	
No of Units Tested:	1	
Type of Equipment:	DSSS/802.11b/g RFID active tag	
Model:	G2 Microsystems Model G2M5477	
Location for use:	Indoor/Outdoor use	
Declared Frequency Range(s):	2412 - 2462 MHz	
Type of Modulation:	Per 802.11b/g –CCK, BPSK, QPSK, OFDM	
Declared Nominal Output Power:	+18 dBm	
EUT Modes of Operation:	802.11b/g	
Transmit/Receive Operation:	Half Duplex	
Rated Input Voltage and Current:	Two regulator operational modes – Boost/No Boost	
	Boost Mode (Switch Mode)	No Boost Mode
	Nominal: +3.0 Vdc Min: +2.0 Vdc Max: +3.3 Vdc	Nominal: +3.3 Vdc Min: +3.0 Vdc Max: +3.7 Vdc
Operating Temperature Range:	Declared range -30 to +85ºC	
ITU Emission Designator:	802.11b: 15M8W7D 802.11g: 16M4W7D	
Clock/Oscillator(s):	32.768 kHz, 40 MHz, 44 MHz, 80 MHz	
Frequency Stability:	±1 ppm/year	
Equipment Dimensions:	37 x 20 x 4 mm	
Weight:	5 grams	
Primary function of equipment:	WiFi interoperability - RFID and real time local positioning and tracking device	

3.2. Scope of Test Program

The scope of the test program was to test the G2 Microsystems, RFID and real time local positioning and tracking device for compliance against FCC 47 CFR Part 15.247 and IC RSS-210 for modular approval.

In order to drive the G2M5477 802.11b/g wireless chipset a motherboard was utilized which could place the module into test mode with a 100% duty cycle.

G2 Microsystems 2.4 GHz RFID



G2 Microsystems 2.4 GHz Wireless Module

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

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	802.11bg RFID Wireless Module	G2 Microsystems	G2M5477	0587-000305
Support	Evaluation Board	G2 Microsystems	Morton Rev 3	--
Support	Laptop	Dell	--	--

3.4. Antenna Details

Antenna Type	Gain (dBi)	Integral	Manufacture	Model
Dipole	2.0	No	Pulse	W1010
Printed monopole/Chip	2.1	Yes	Antenova/GigaAnt	Rufa

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. UFL connector for external dipole antenna

3.6. Test Configurations

Matrix of test configurations

Power Regulation	Operational Mode	Data Rates (MBit/s)	Frequencies (MHz)
No Boost	802.11b	1	2412, 2437, 2462
Boost*	802.11g	6	

*Only Boost mode was utilized for radiated testing as it was determined from conducted testing this was worst case emissions.

The device was connected to an external power supply to complete the conducted test suite. A battery was utilized for all radiated testing. The voltage on the battery was continually monitored and replaced when necessary.

3.7. Equipment Modifications

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

1. During radiated emission testing the module had a problem failing the second harmonic 802.11b, channel 1 (2412 MHz), integral antenna in maximum power mode.

   Solution

   The client found that the power to the integral antenna was 2.5 dB higher than designed. The power was reduced through firmware update and retested. The EUT passed with maximum power to the integral antenna.

2. The equipment under test (EUT) was not under the control of the laboratory during the test program. The client removed the EUT and all support equipment upon completion of testing on a daily basis.

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

The following subcontracted testing was required in order to complete the test program:

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)	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, Peak Emissions, Band Edge	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*
15.205 / **15.209** **2.2**	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies **Class B**	*5.1.6.3*
15.207 **7.2.2**	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Not Applicable Device battery powered	*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 - Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix*

5. TEST RESULTS

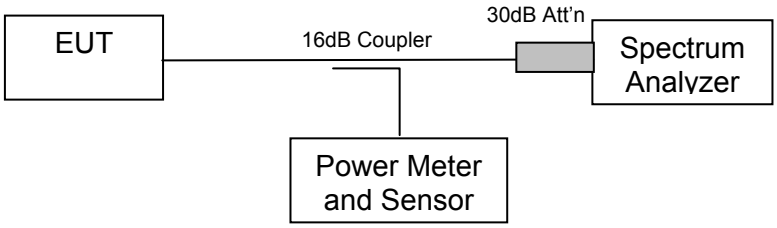
5.1. Device Characteristics

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

Operational Modes

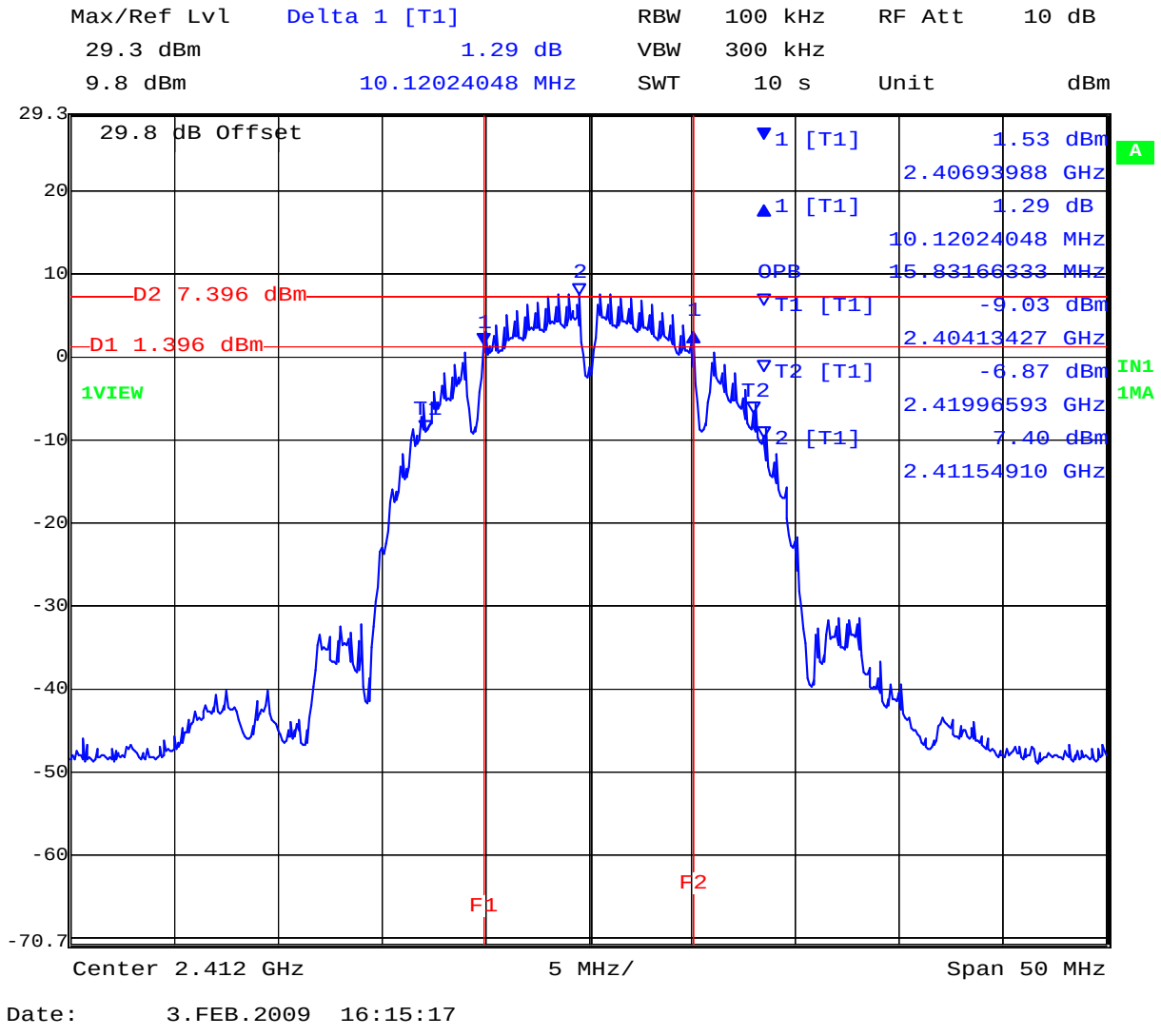
1).. Boost
2).. No Boost

Boost Mode

TABLE OF RESULTS – 802.11b Boost Mode

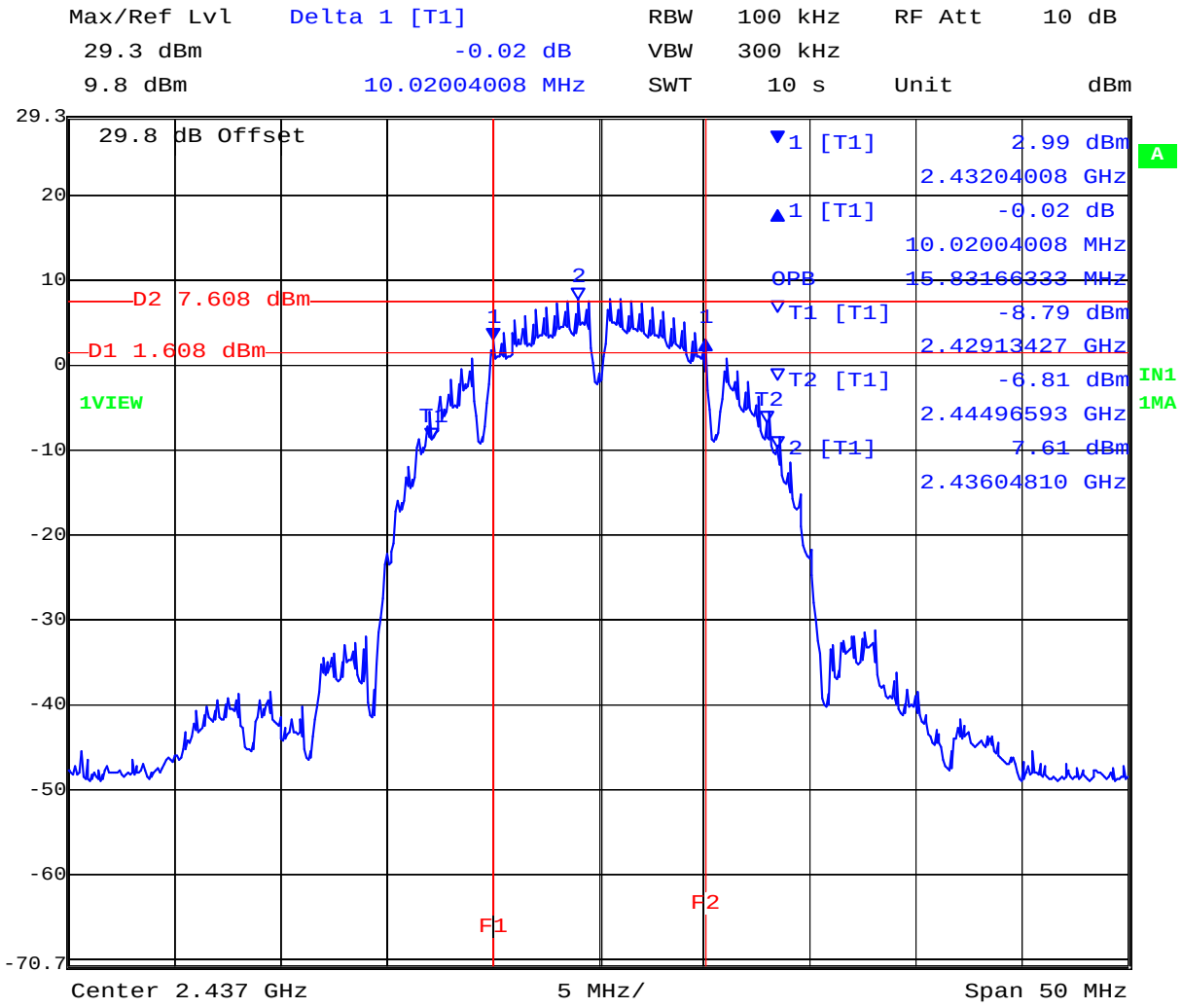
Center Frequency (MHz)	6 dB Bandwidth (MHz)	99 % BW (MHz)
2,412	10.120	15.832
2,437	10.020	15.832
2,462	10.020	15.832

2412 MHz 6 dB and 99% Bandwidth



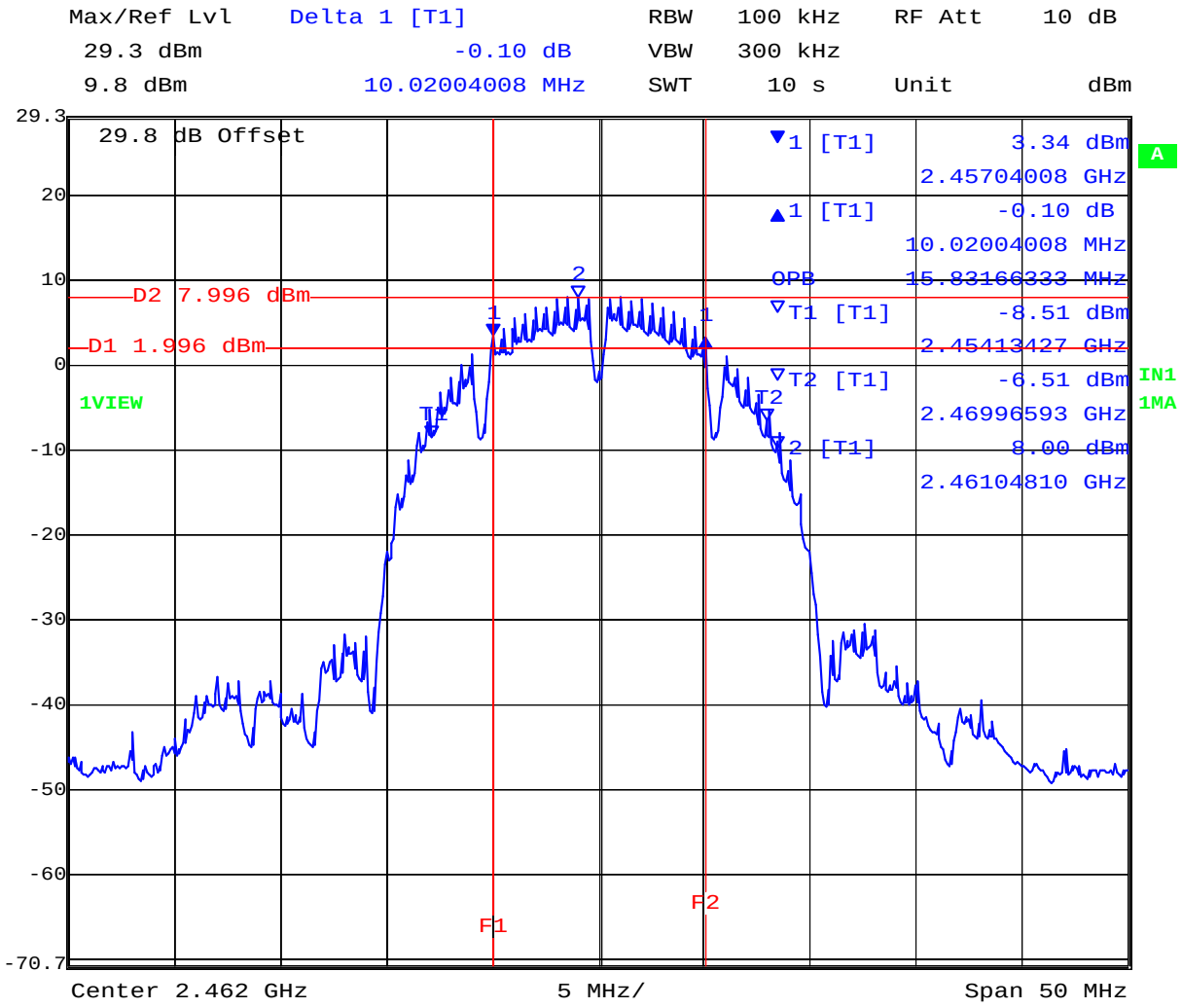
802.11b Boost Mode

2437 MHz 6 dB and 99% Bandwidth



802.11b Boost Mode

2462 MHz 6 dB and 99% Bandwidth

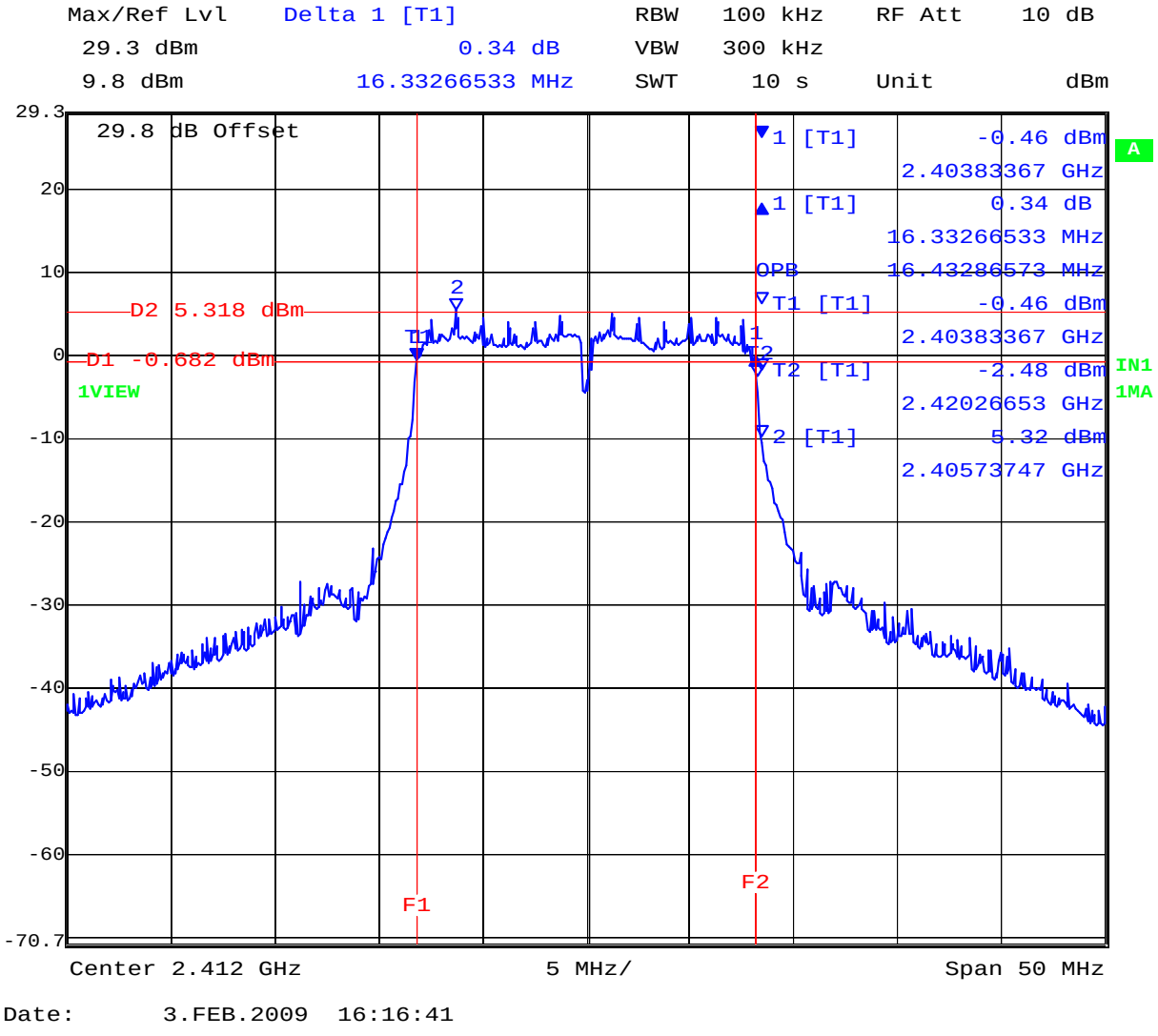


802.11g Boost Mode

TABLE OF RESULTS – 802.11g

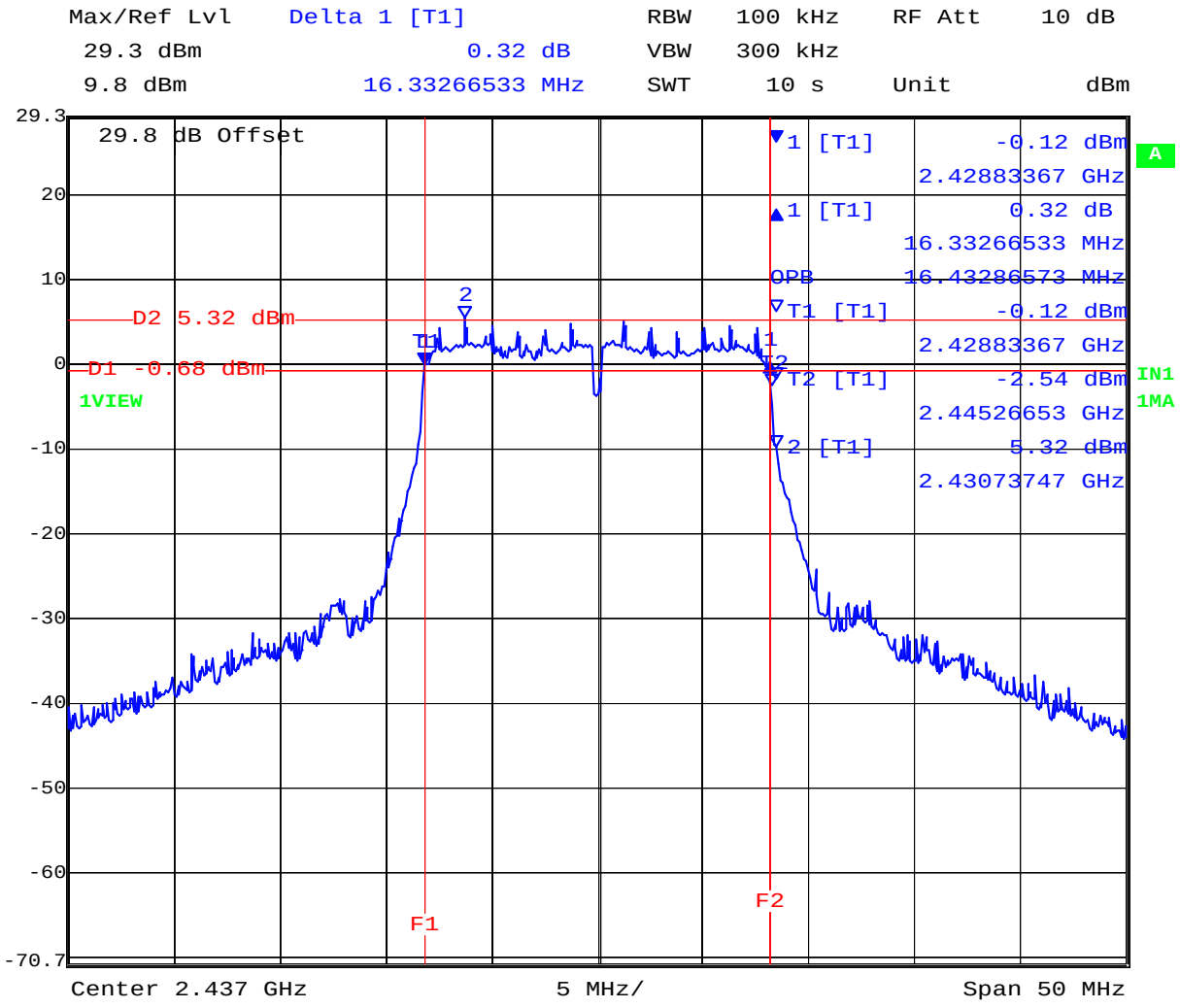
Center Frequency (MHz)	6 dB Bandwidth (MHz)	99 % BW (MHz)
2,412	16.333	16.433
2,437	16.333	16.433
2,462	16.333	16.433

2412 MHz 6 dB and 99% Bandwidth



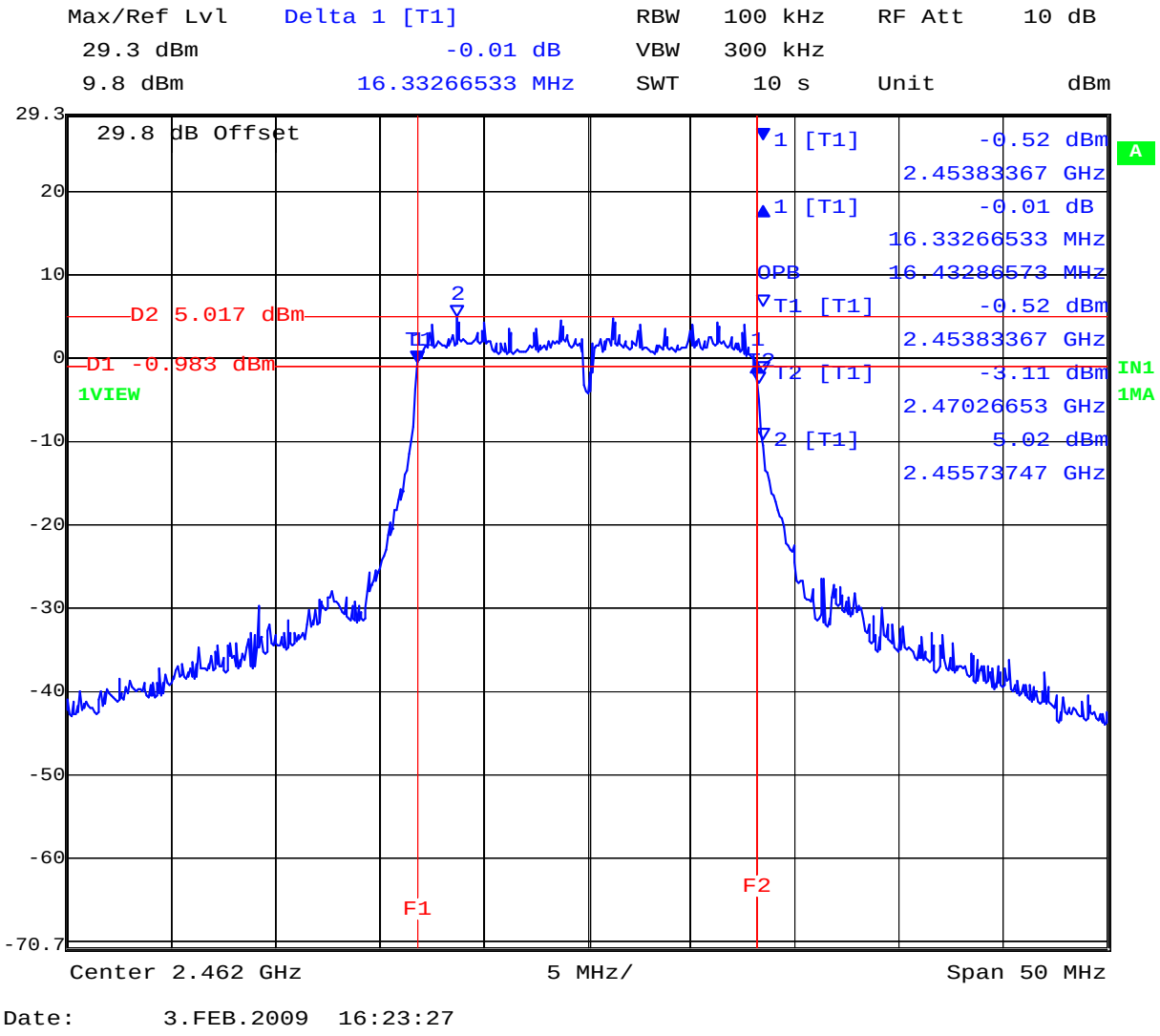
802.11g Boost Mode

2437 MHz 6 dB and 99% Bandwidth



802.11g Boost Mode

2462 MHz 6 dB and 99% Bandwidth

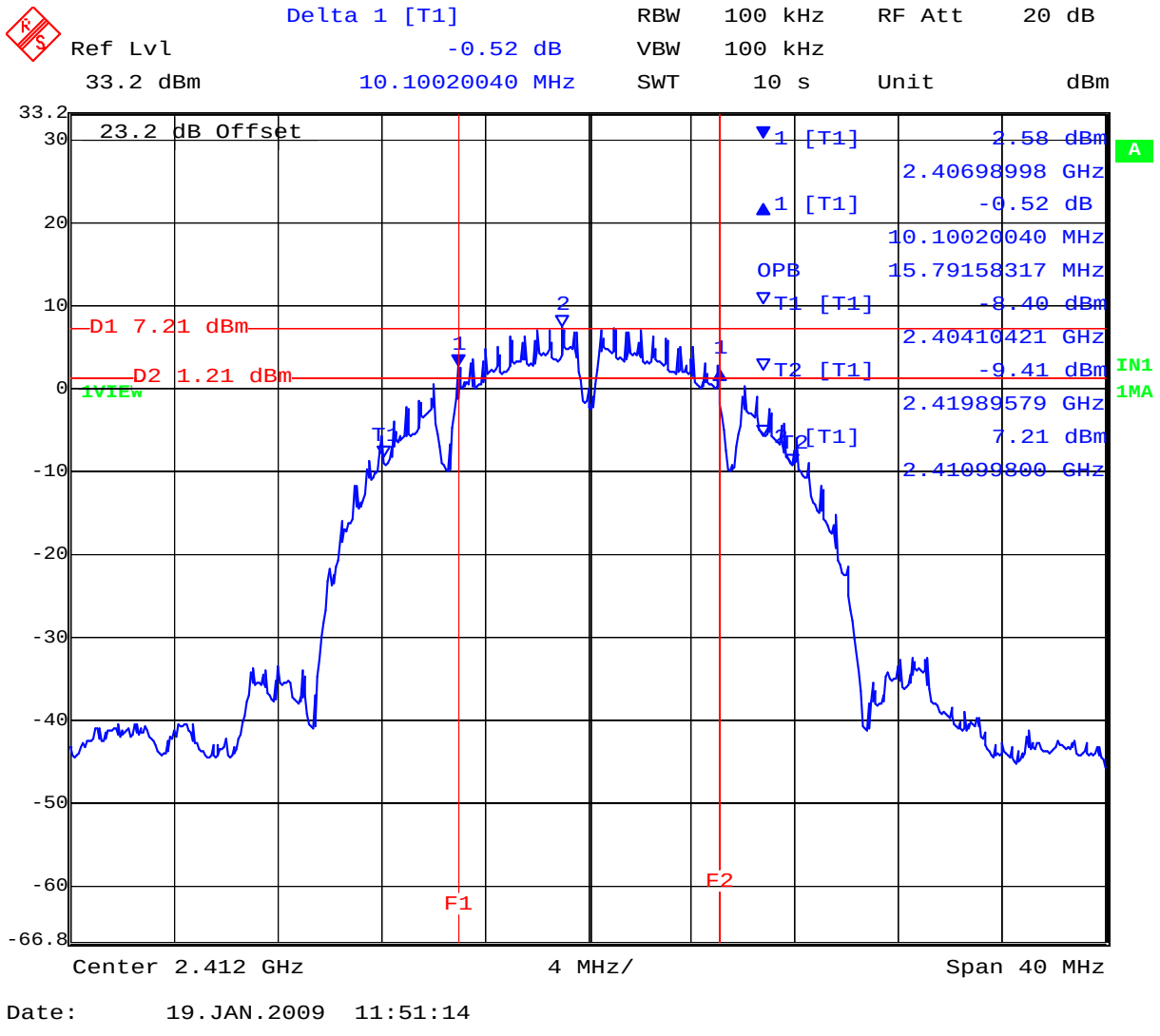


No Boost Mode

TABLE OF RESULTS – 802.11b Boost Mode

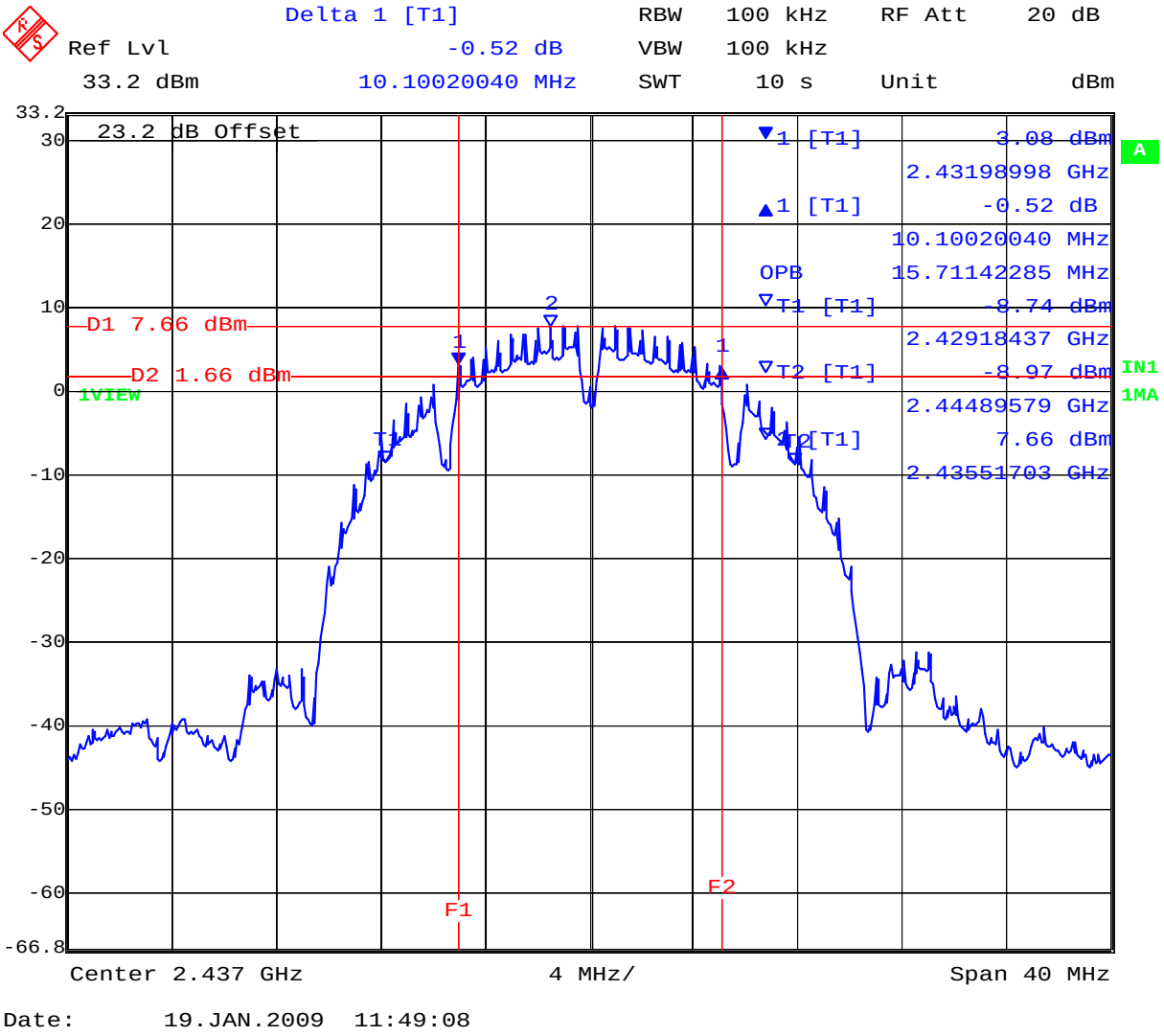
Center Frequency (MHz)	6 dB Bandwidth (MHz)	99 % BW (MHz)
2,412	10.100	15.791
2,437	10.100	15.711
2,462	10.100	15.792

2412 MHz 6 dB and 99% Bandwidth



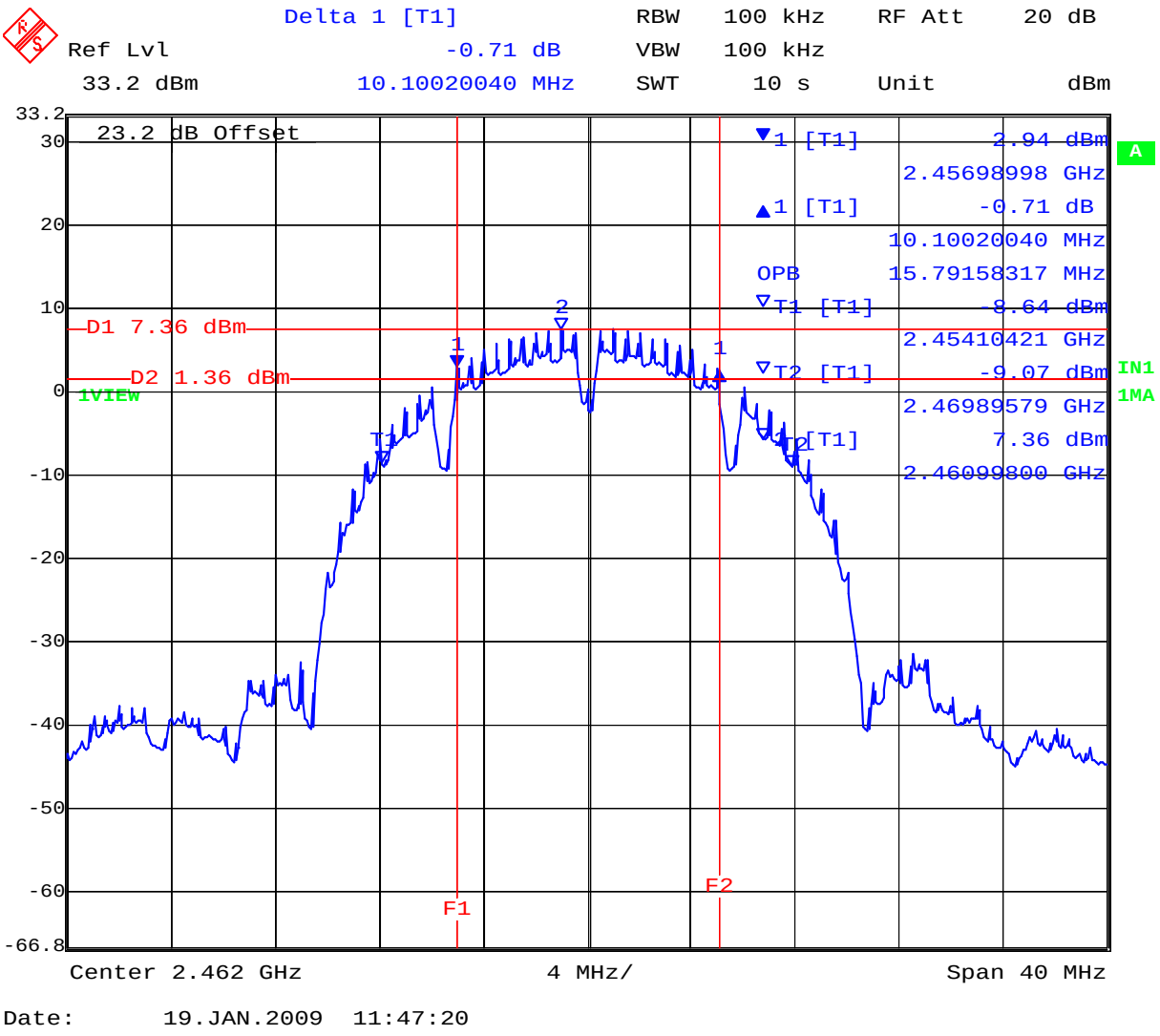
802.11b No Boost Mode

2437 MHz 6 dB and 99% Bandwidth



802.11b No Boost Mode

2462 MHz 6 dB and 99% Bandwidth

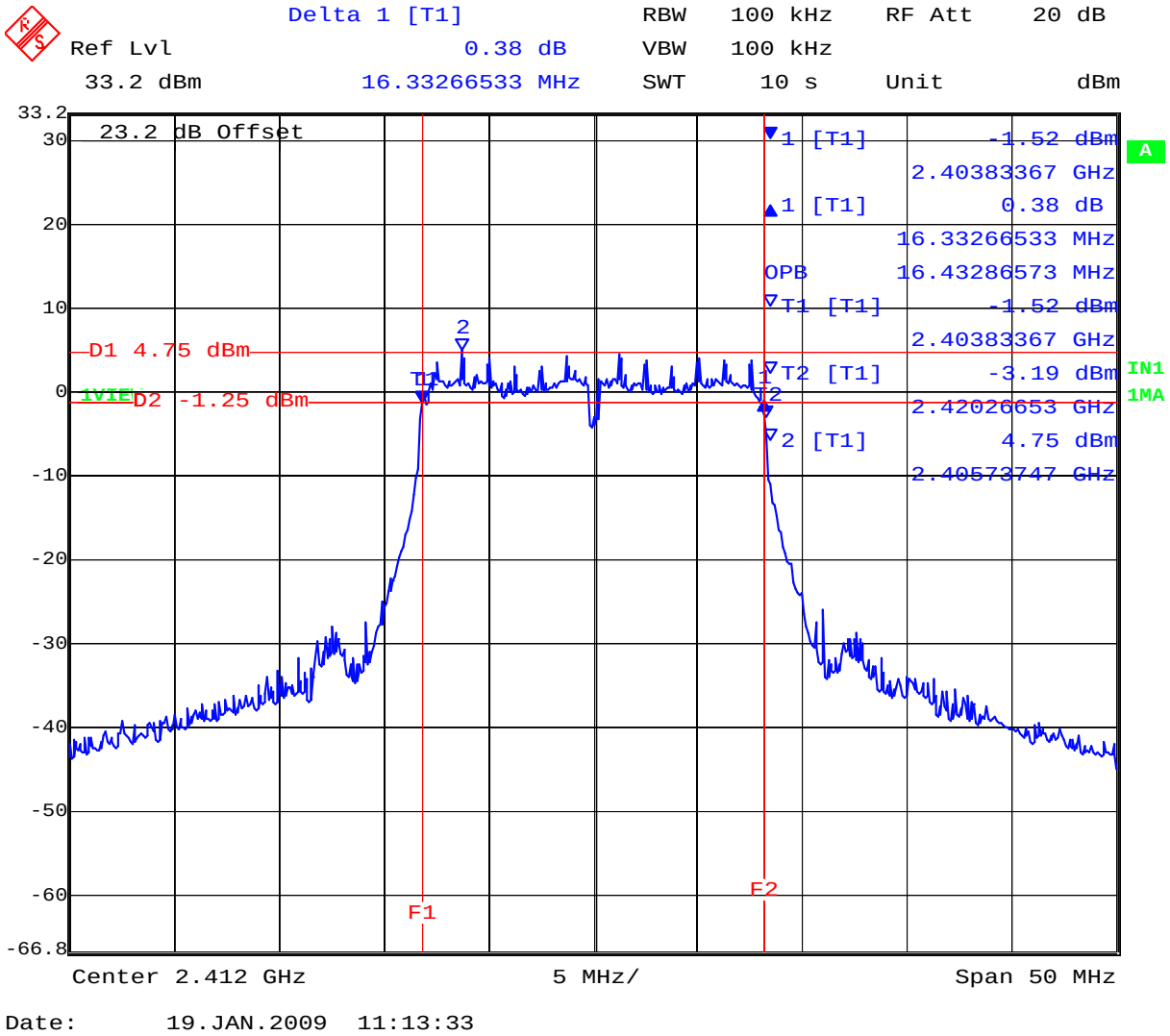


802.11g No Boost Mode

TABLE OF RESULTS – 802.11g No Boost

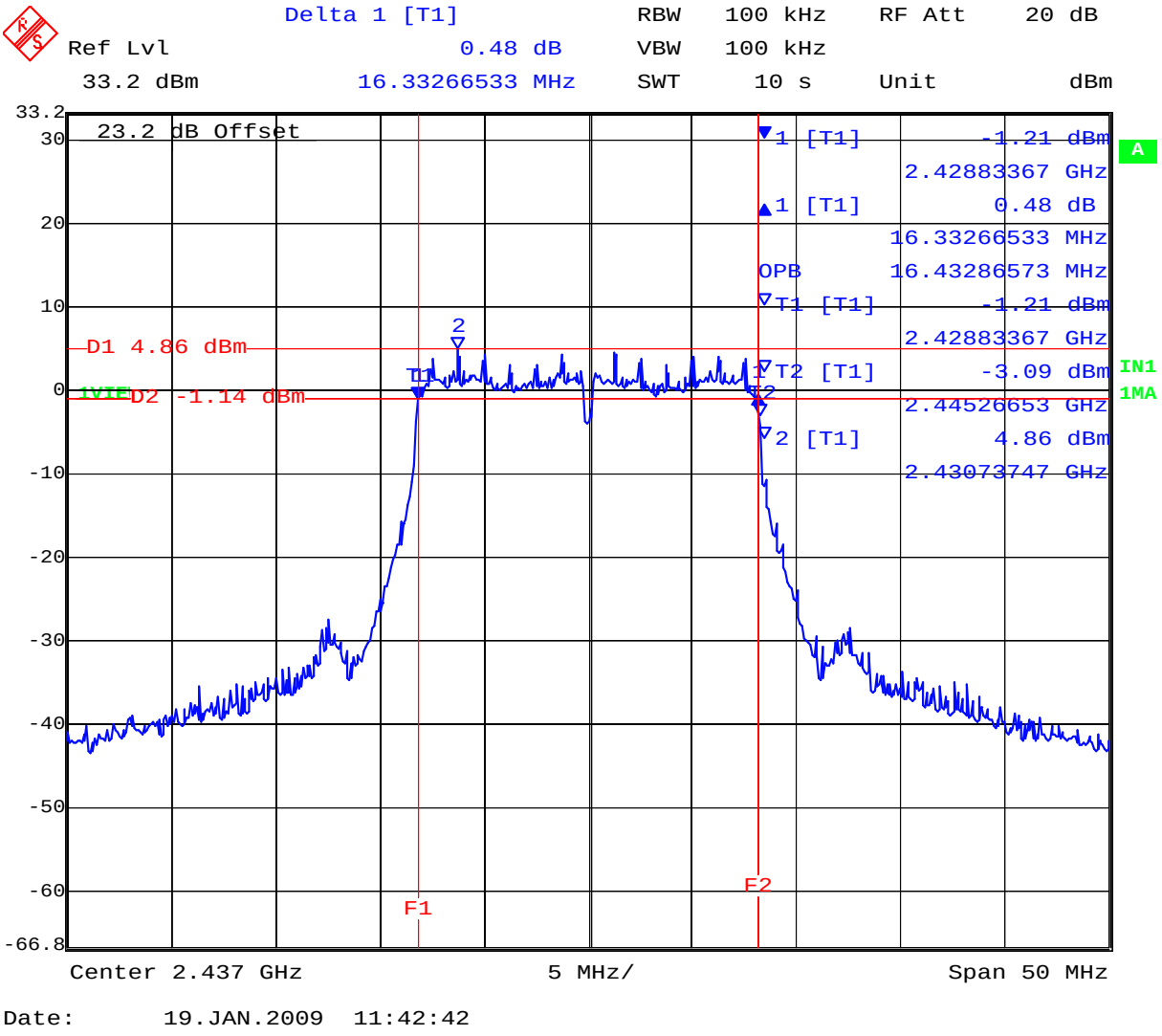
Center Frequency (MHz)	6 dB Bandwidth (MHz)	99 % BW (MHz)
2,412	16.333	16.433
2,437	16.333	16.433
2,462	16.333	16.433

2412 MHz 6 dB and 99% Bandwidth



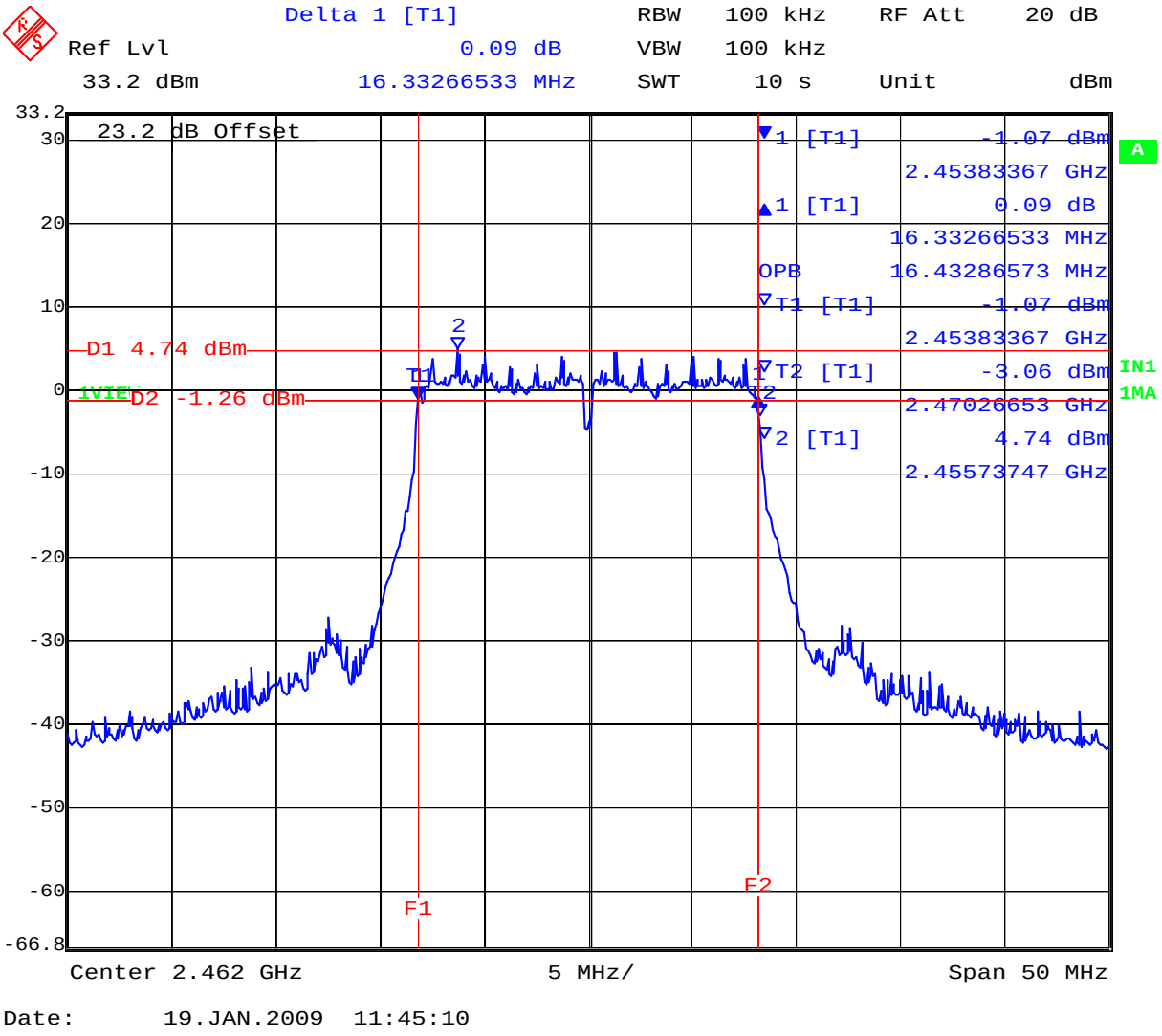
802.11g No Boost Mode

2437 MHz 6 dB and 99% Bandwidth



802.11g No Boost Mode

2462 MHz 6 dB and 99% Bandwidth



Specification

Limits

§15.247 (a)(2)
The minimum 6 dB bandwidth shall be at least 500 kHz.

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	±2.81 dB

Traceability

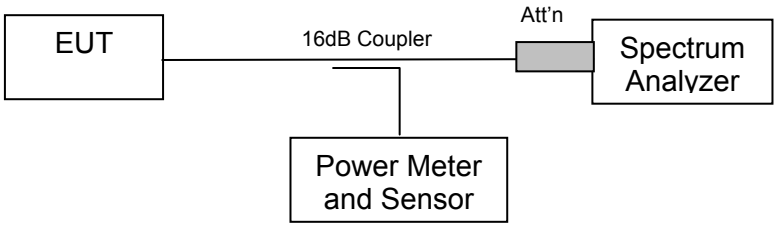
Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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. Initial measurements were employed to define which data rate provided the highest output power. 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

Ambient conditions.

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

Operational Modes

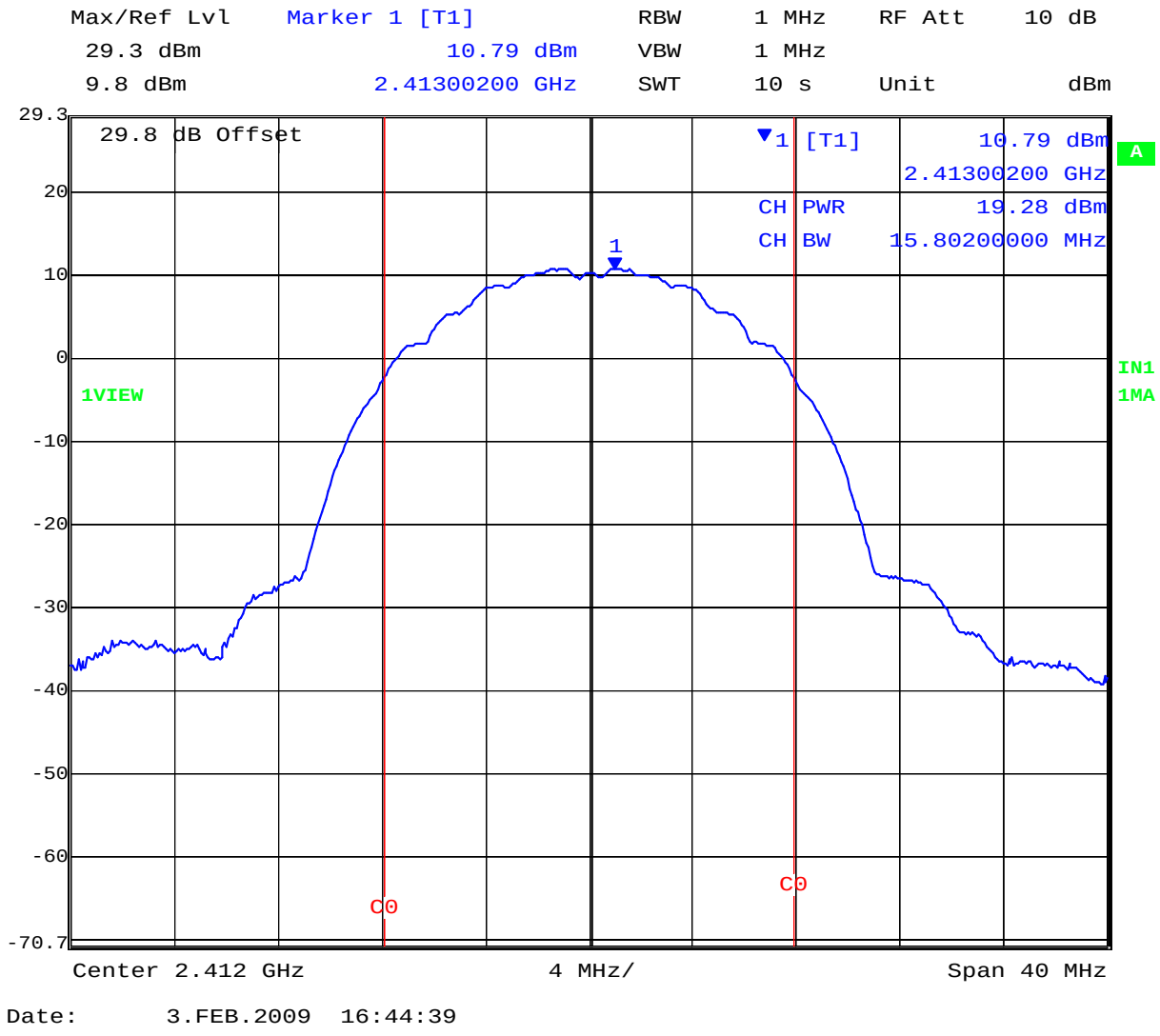
1).. Boost
2).. No Boost

EIRP Calculation based on 2 dBi dipole antenna

TABLE OF RESULTS – 802.11b Boost Mode

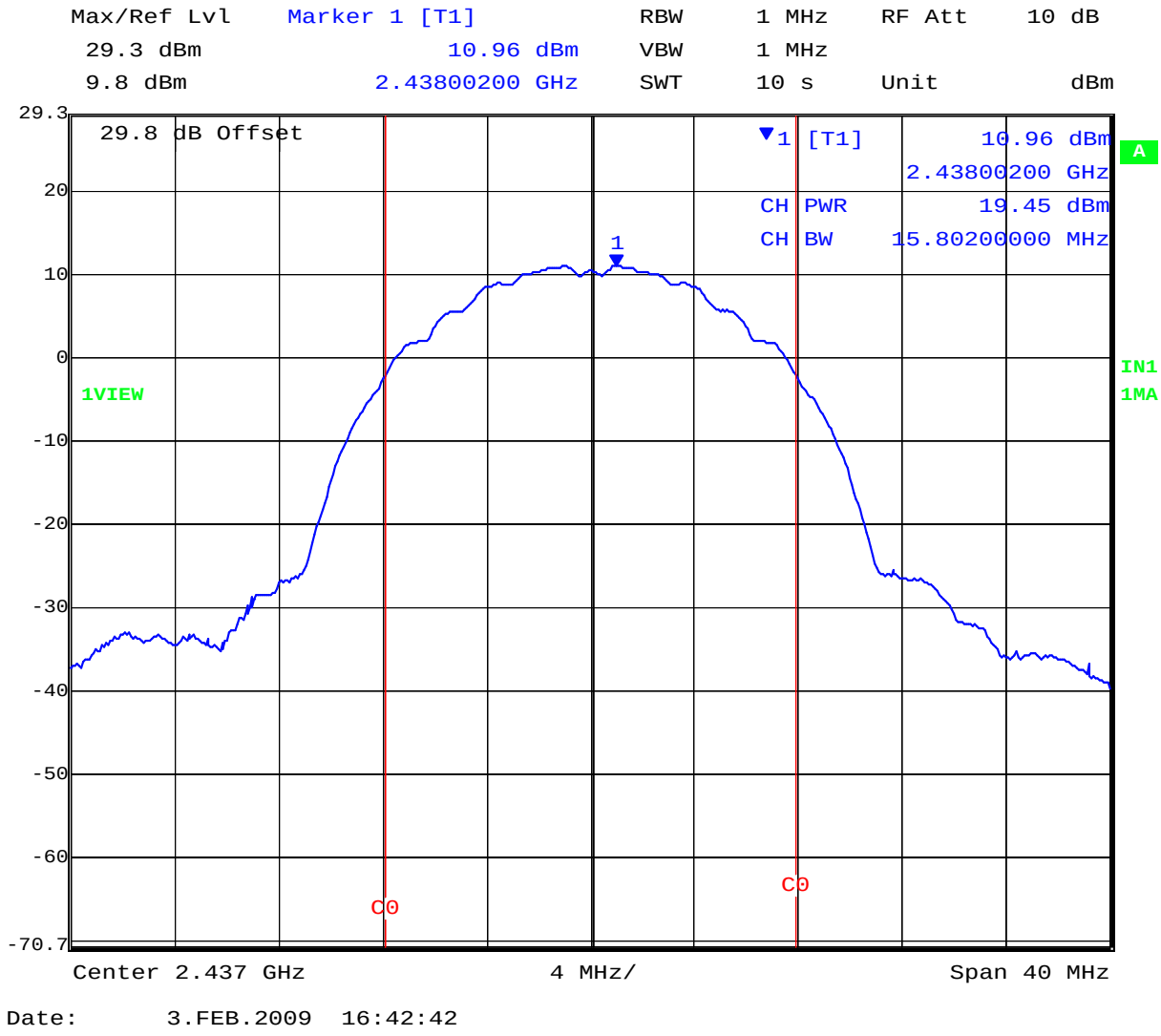
Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)
2,412	15.832	+19.28	+21.28
2,437	15.832	+19.45	+21.45
2,462	15.832	+19.03	+21.03

2412 MHz Peak Power (dBm)



802.11b Boost Mode

2437 MHz Peak Power (dBm)



802.11b Boost Mode

2462 MHz Peak Power (dBm)

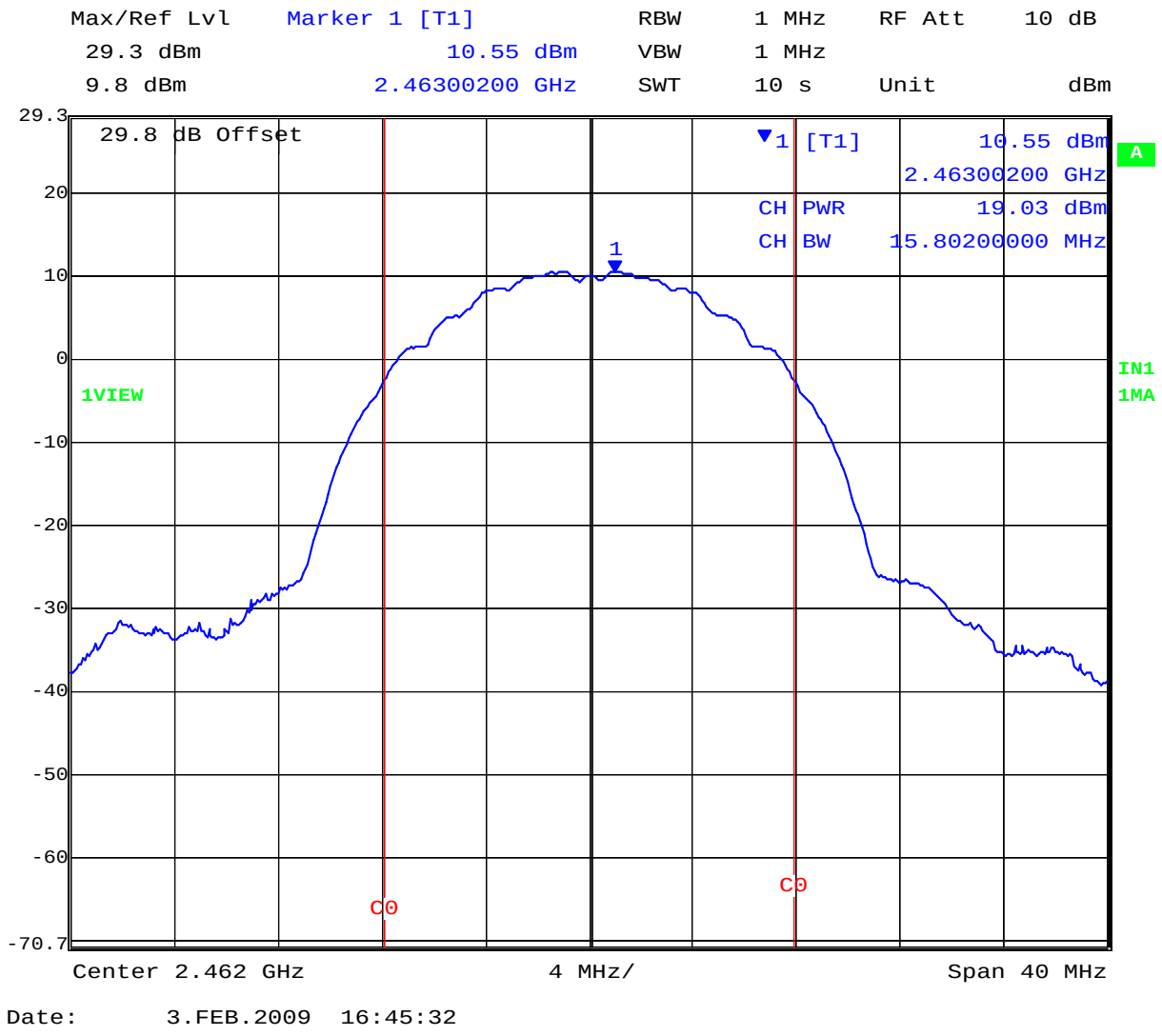
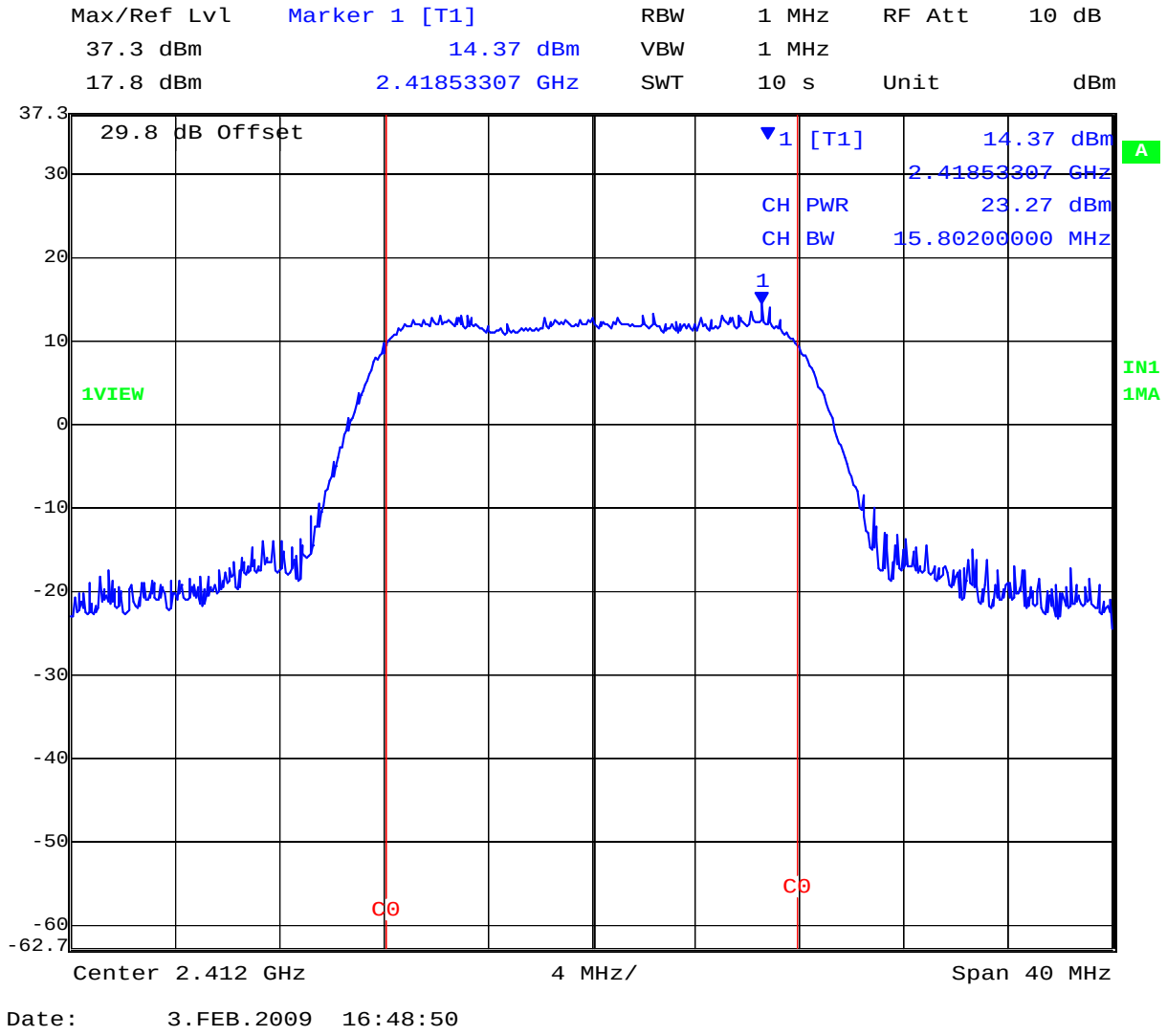


TABLE OF RESULTS – 802.11g Boost Mode

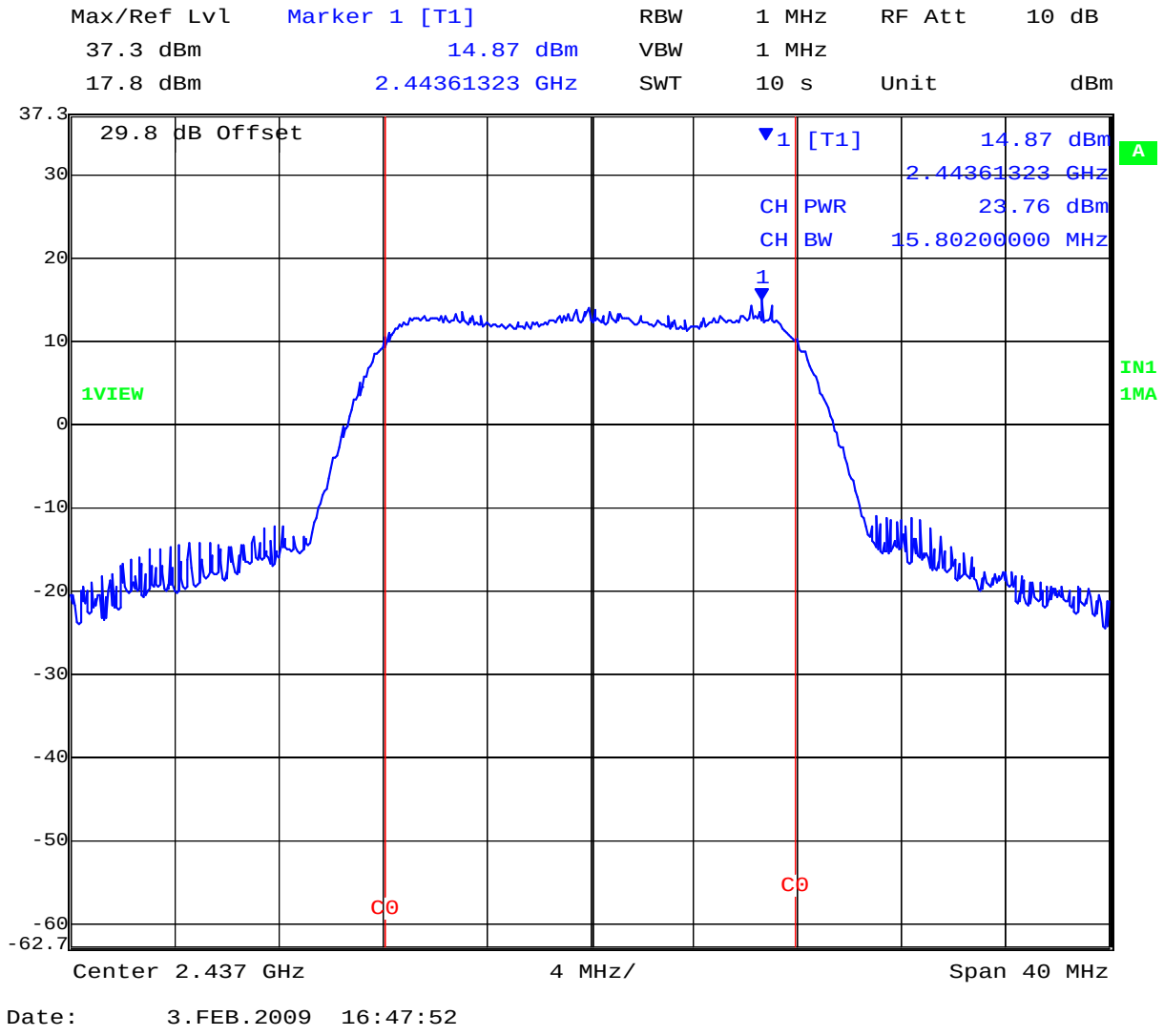
Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)
2,412	16.433	+23.27	+25.27
2,437	16.433	+23.76	+25.76
2,462	16.433	+23.45	+25.45

2412 MHz Peak Power (dBm)



802.11g Boost Mode

2437 MHz Peak Power (dBm)



802.11g Boost Mode

2462 MHz Peak Power (dBm)

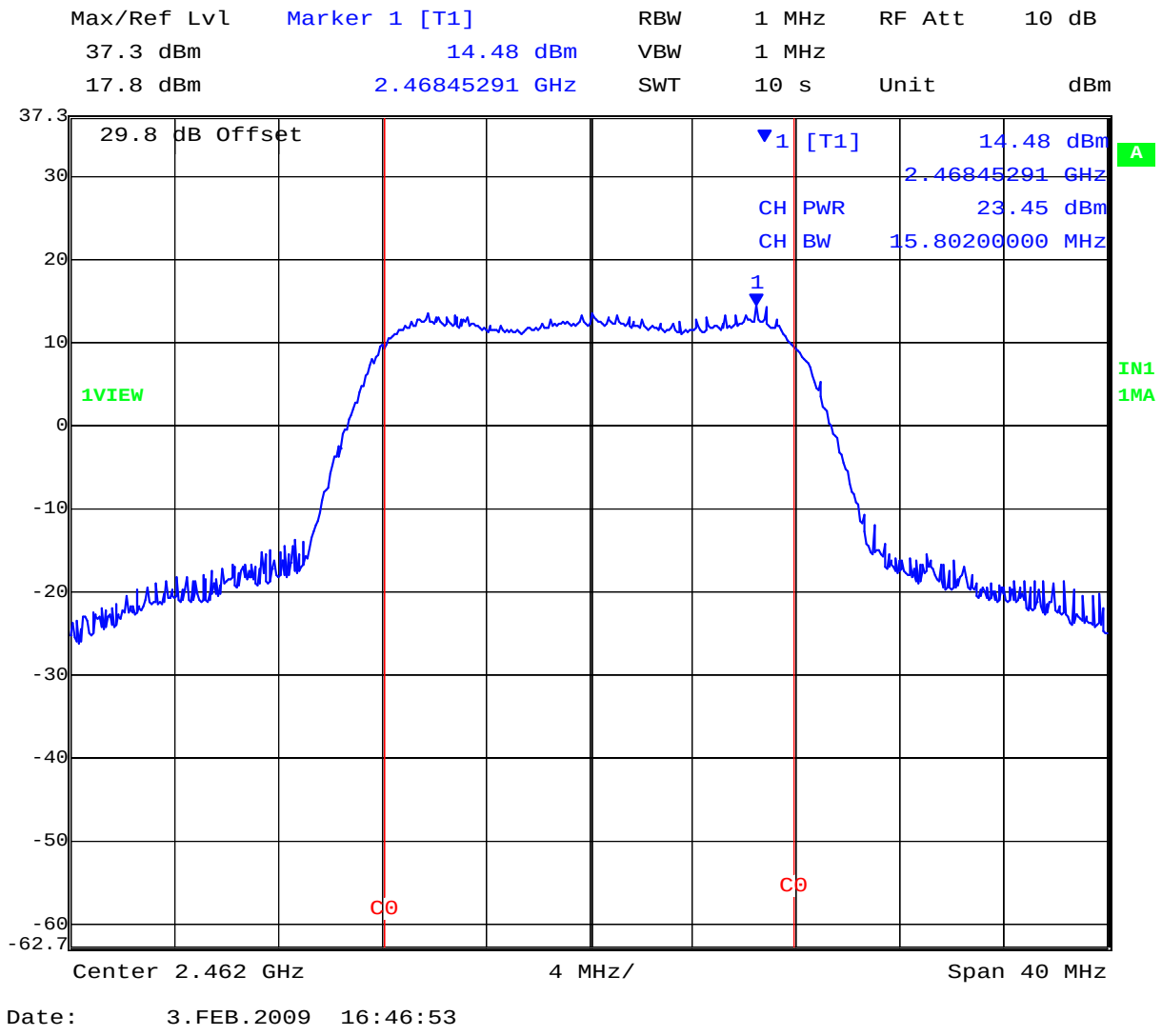
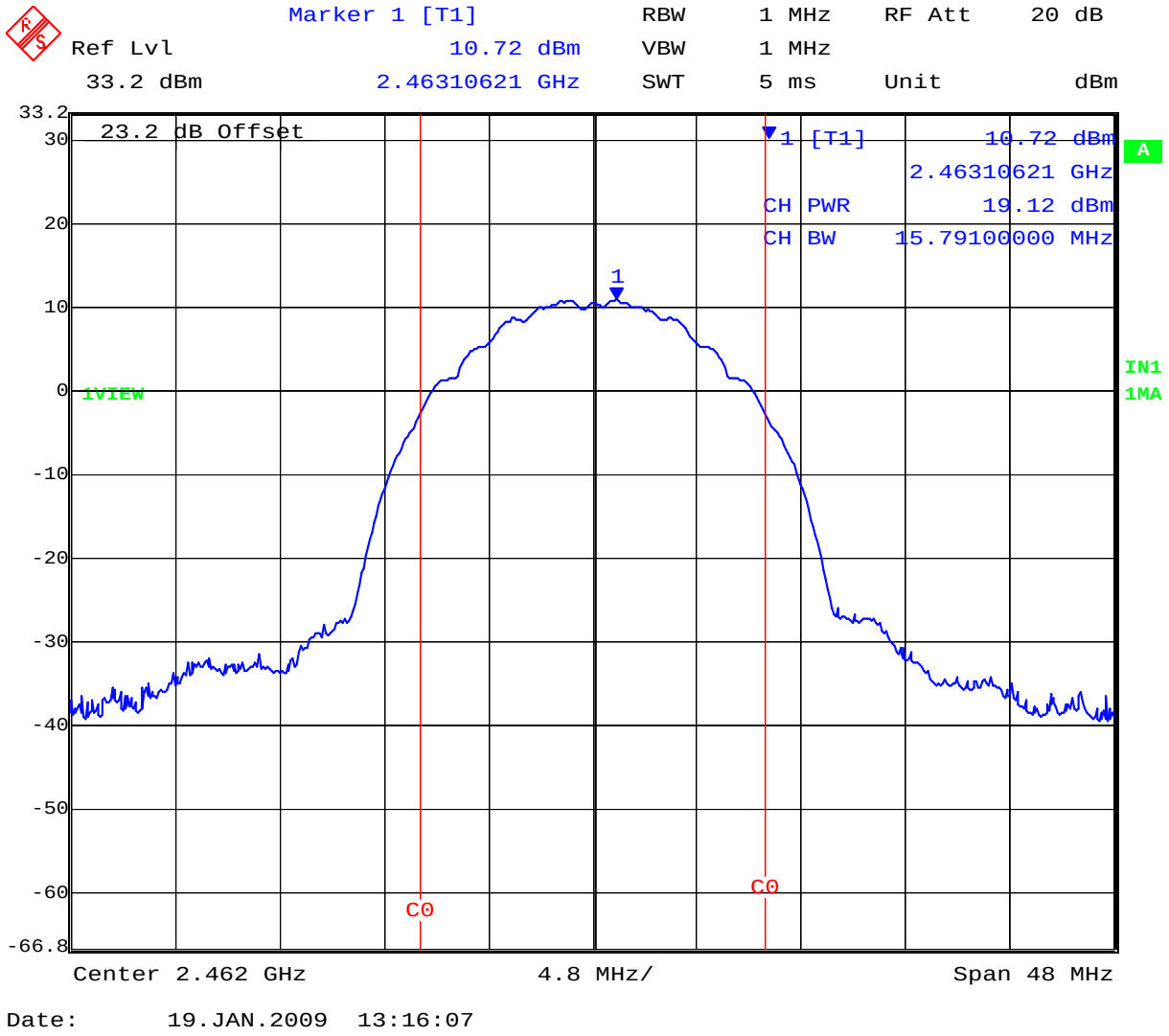


TABLE OF RESULTS – 802.11b No Boost Mode

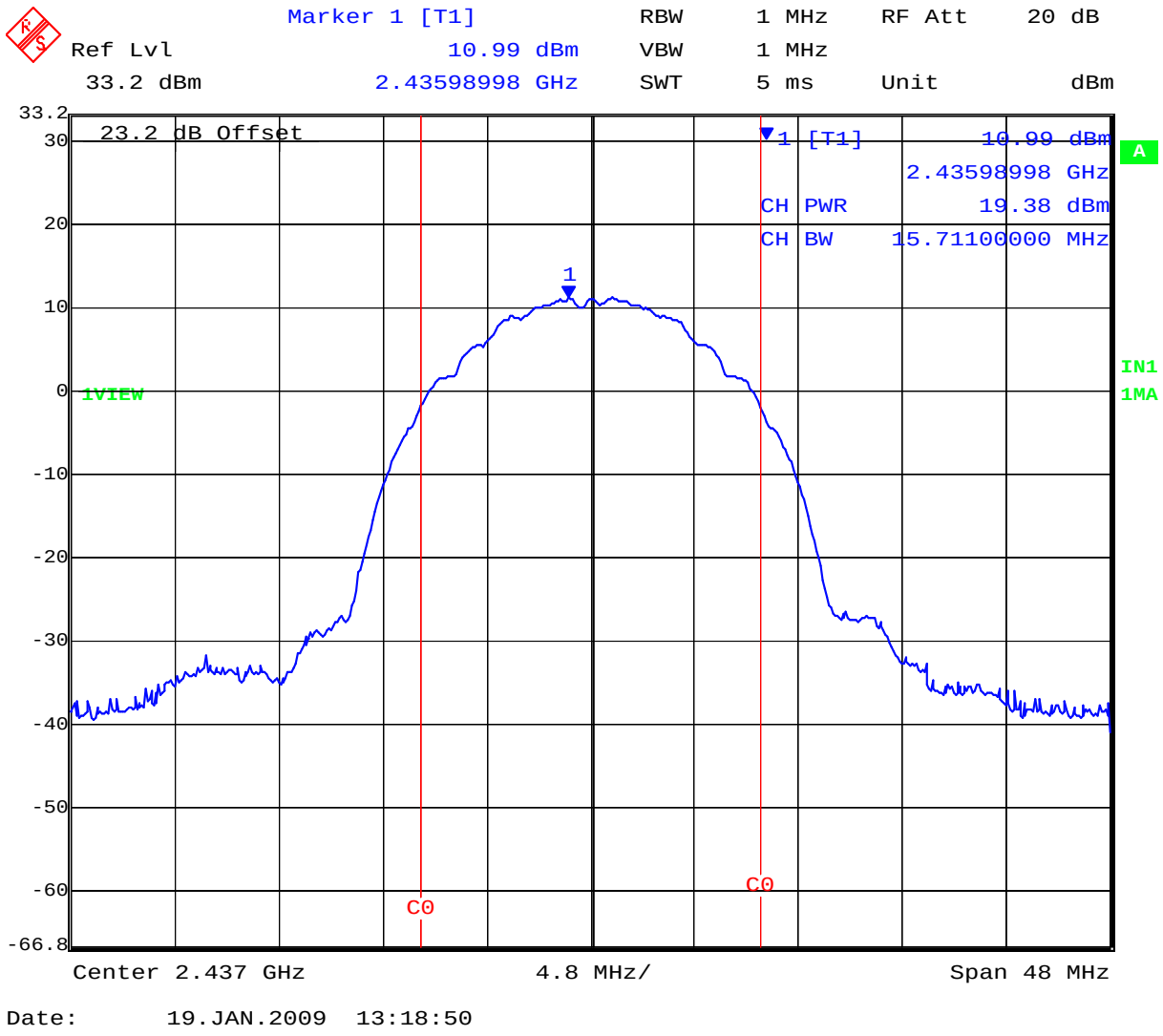
Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)
2,412	15.791	+19.12	+21.12
2,437	15.711	+19.38	+21.38
2,462	15.792	+19.44	+21.44

2412 MHz Peak Power (dBm)



802.11b No Boost Mode

2437 MHz Peak Power (dBm)



802.11b No Boost Mode

2462 MHz Peak Power (dBm)

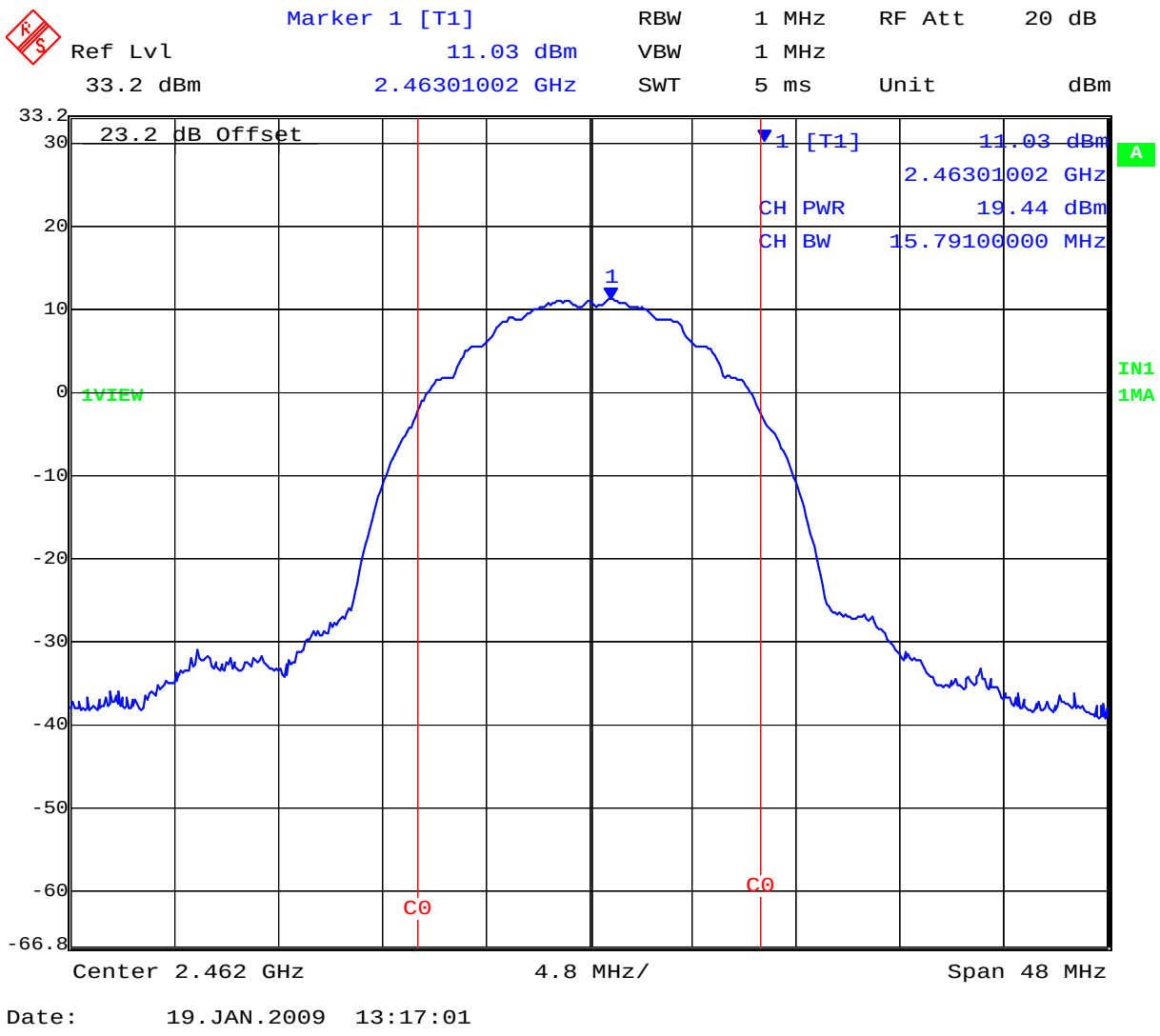
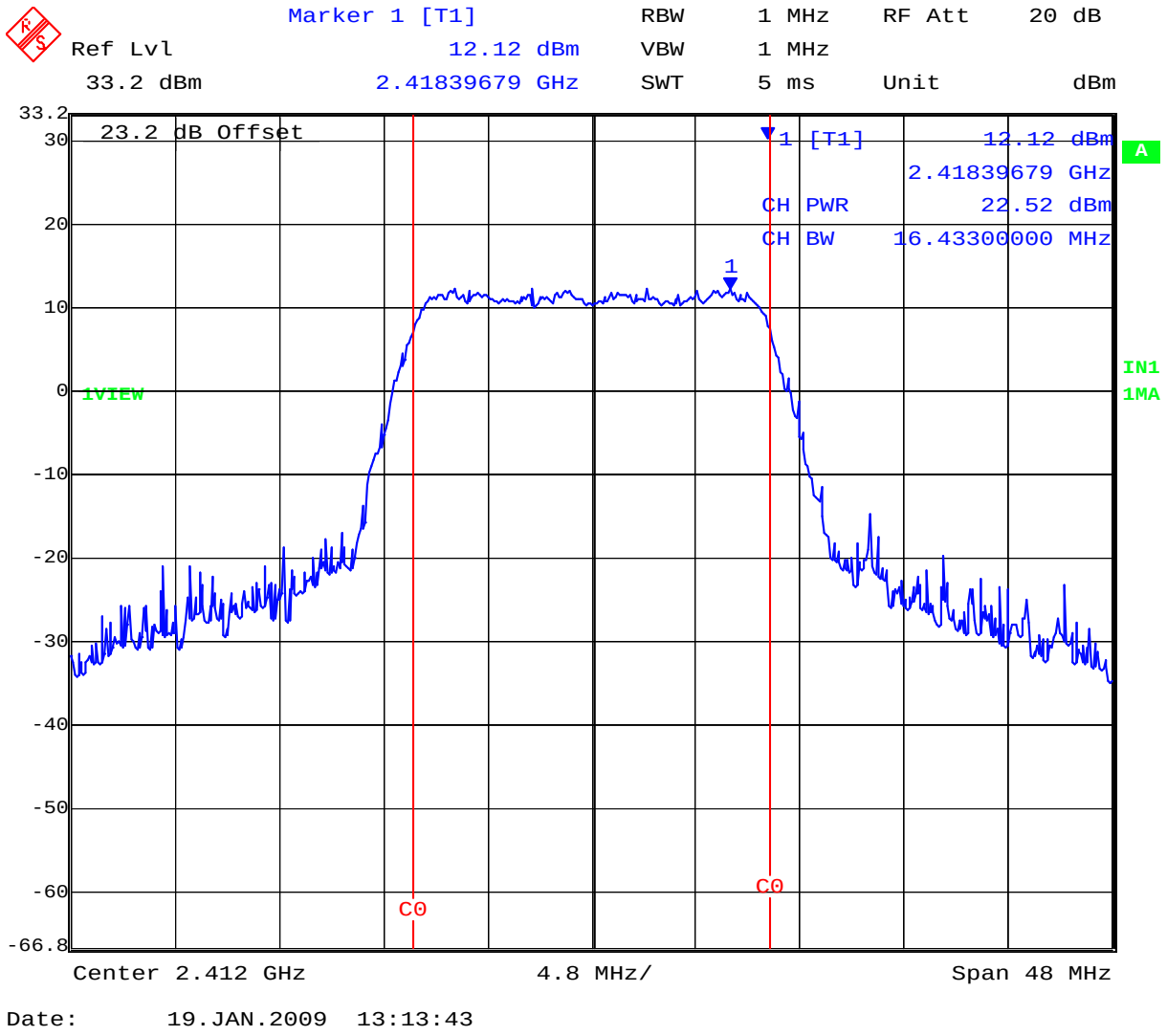


TABLE OF RESULTS – 802.11g No Boost Mode

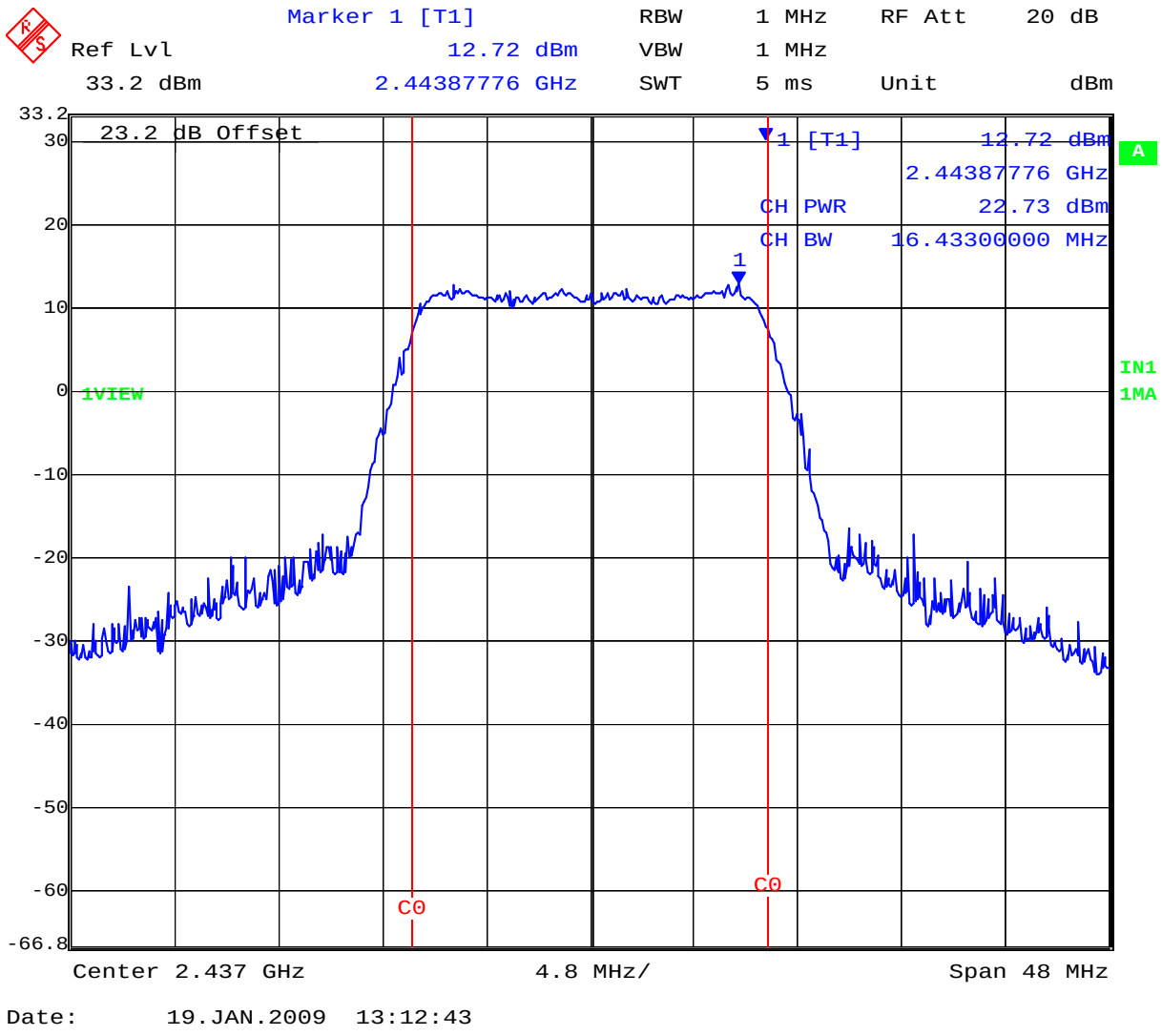
Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)
2,412	16.433	+22.52	+24.52
2,437	16.433	+22.73	+24.73
2,462	16.433	+22.26	+24.26

2412 MHz Peak Power (dBm)



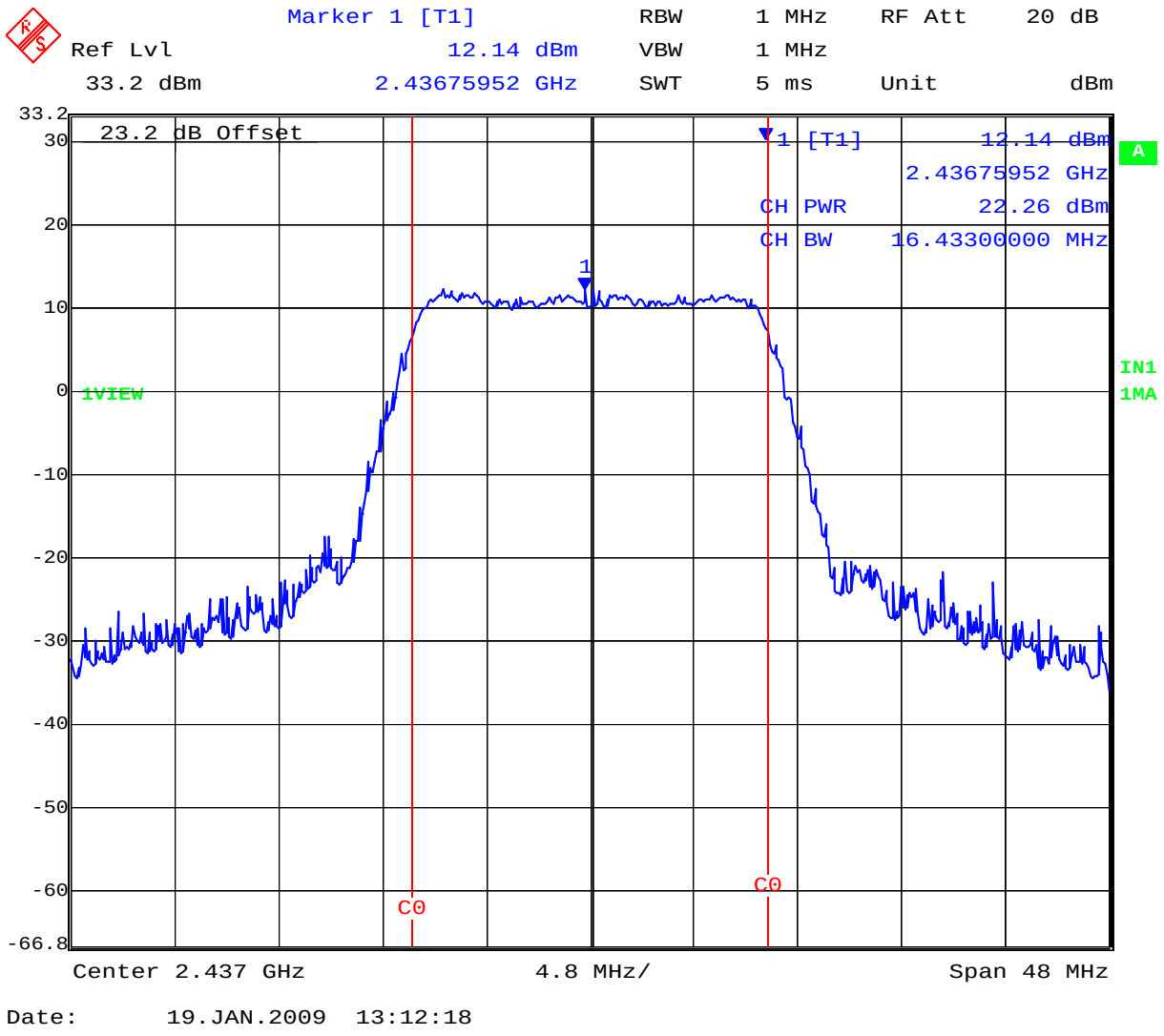
802.11g No Boost Mode

2437 MHz Peak Power (dBm)



802.11g No Boost Mode

2462 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: 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.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

Traceability

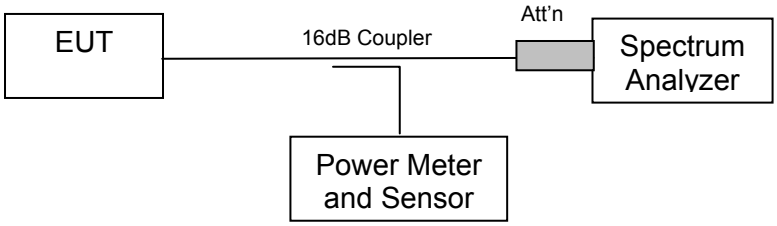
Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

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. Spectrum analyzer settings:

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

Operational Modes

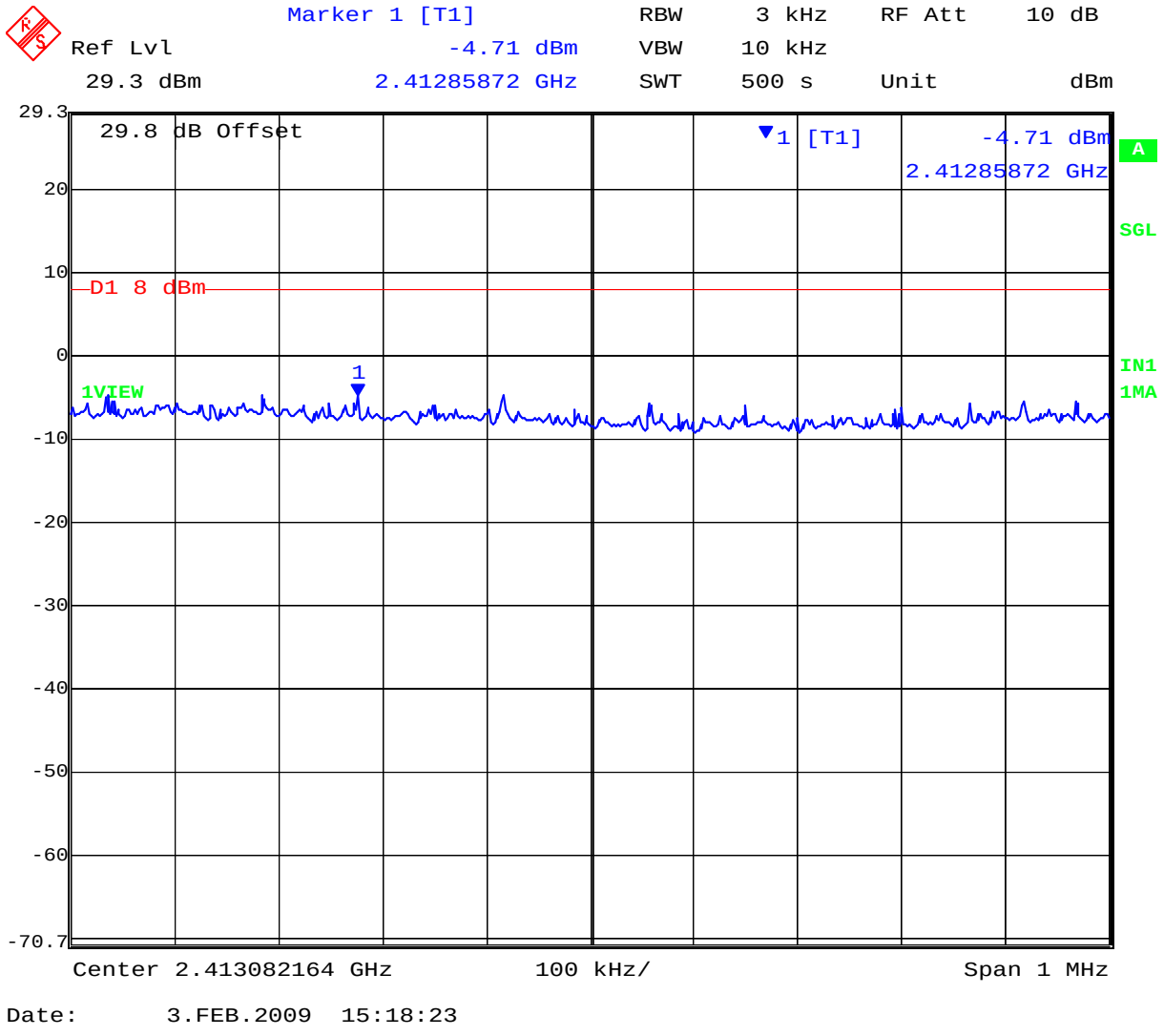
1).. Boost
2).. No Boost

802.11b Boost Mode

TABLE OF RESULTS – 802.11b Boost Mode

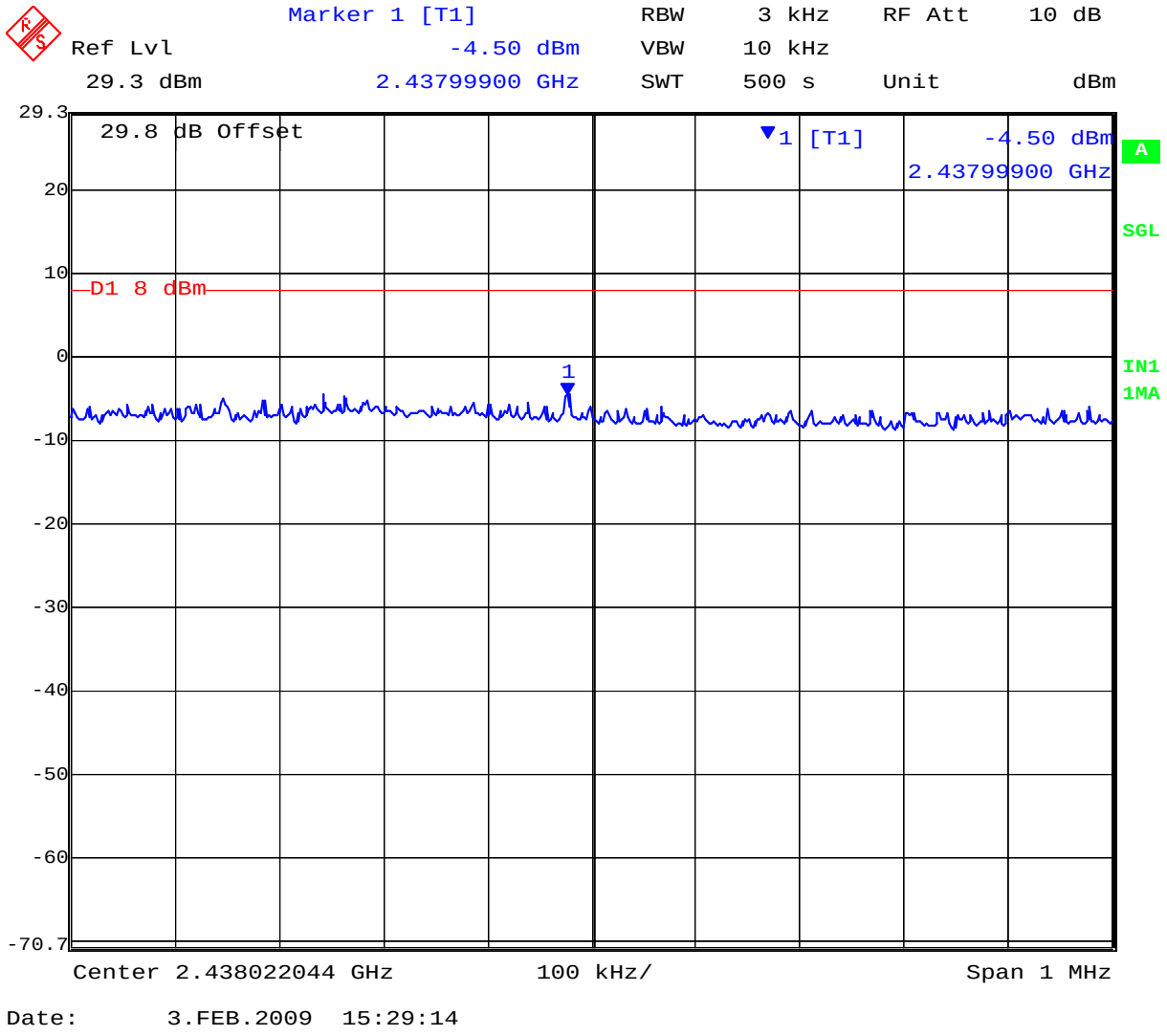
Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2412	2412.85872	-4.71	+8	-12.71
2437	2437.99900	-4.50	+8	-12.50
2462	2462.56212	-4.72	+8	-12.72

Peak Power Spectral Density
Ch 1 2412 MHz 802.11b



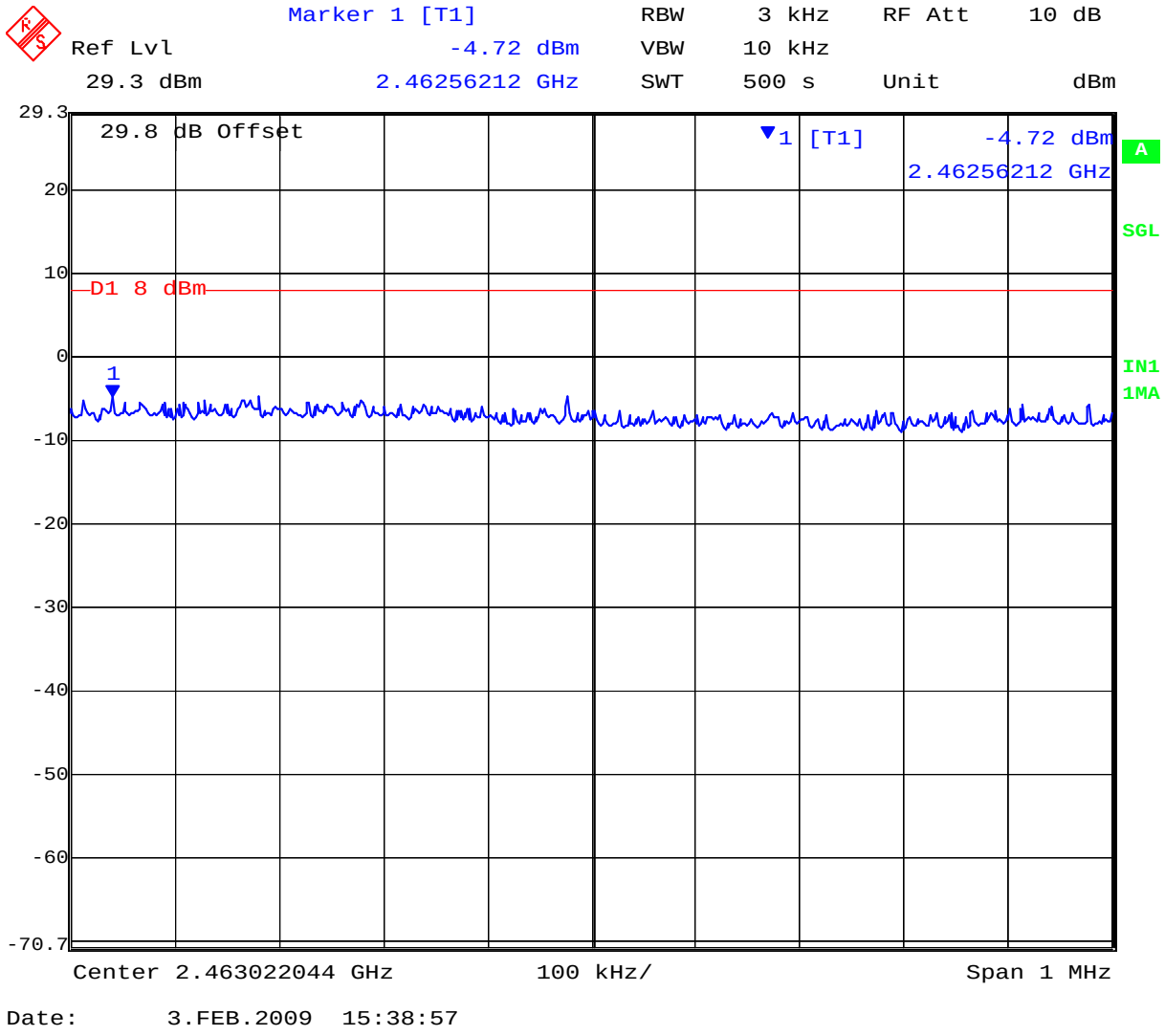
802.11b Boost Mode

Peak Power Spectral Density
Ch 6 2437 MHz 802.11b



802.11b Boost Mode

Peak Power Spectral Density
Ch 11 2462 MHz 802.11b

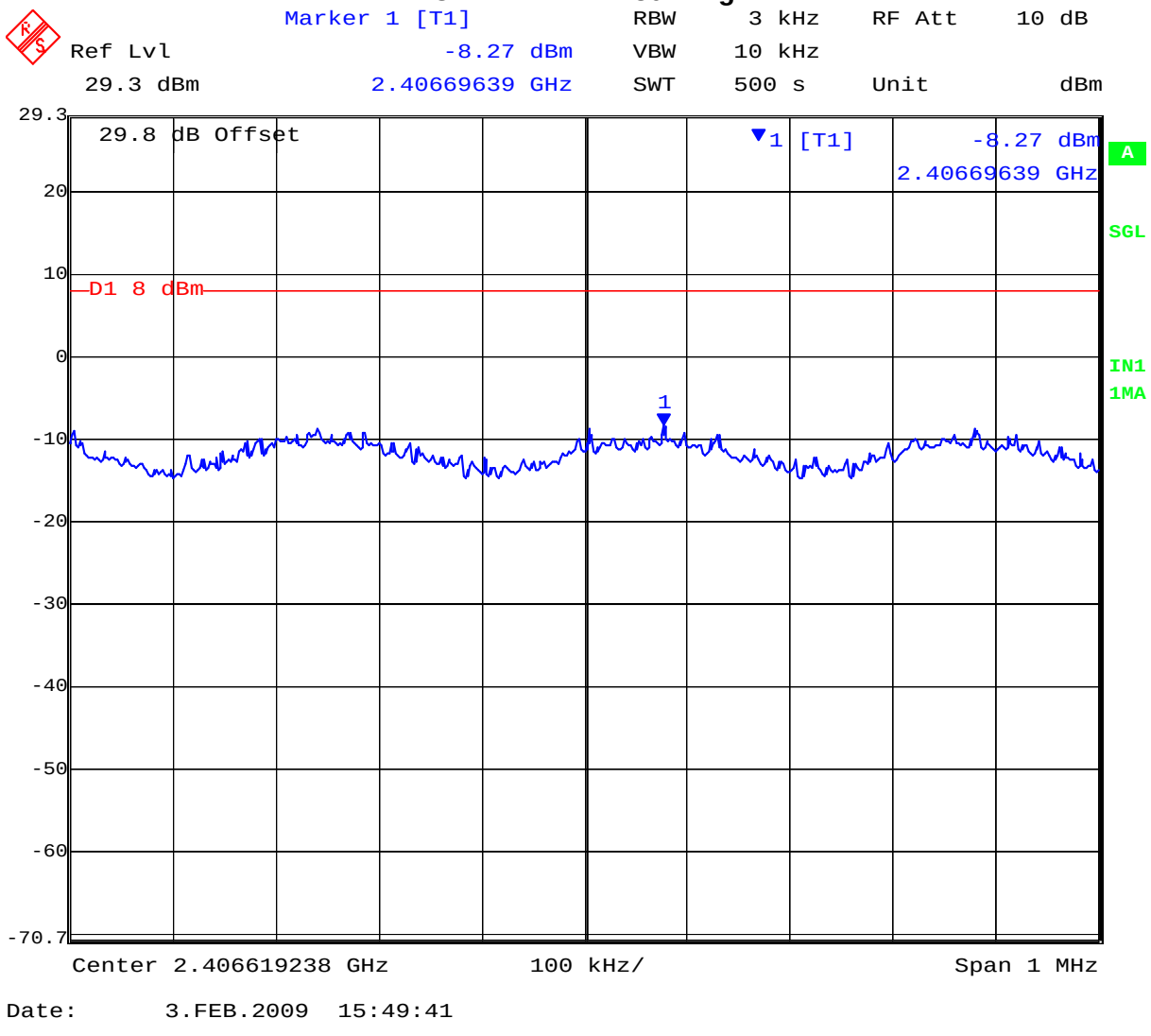


802.11g Boost Mode

TABLE OF RESULTS – **802.11g**

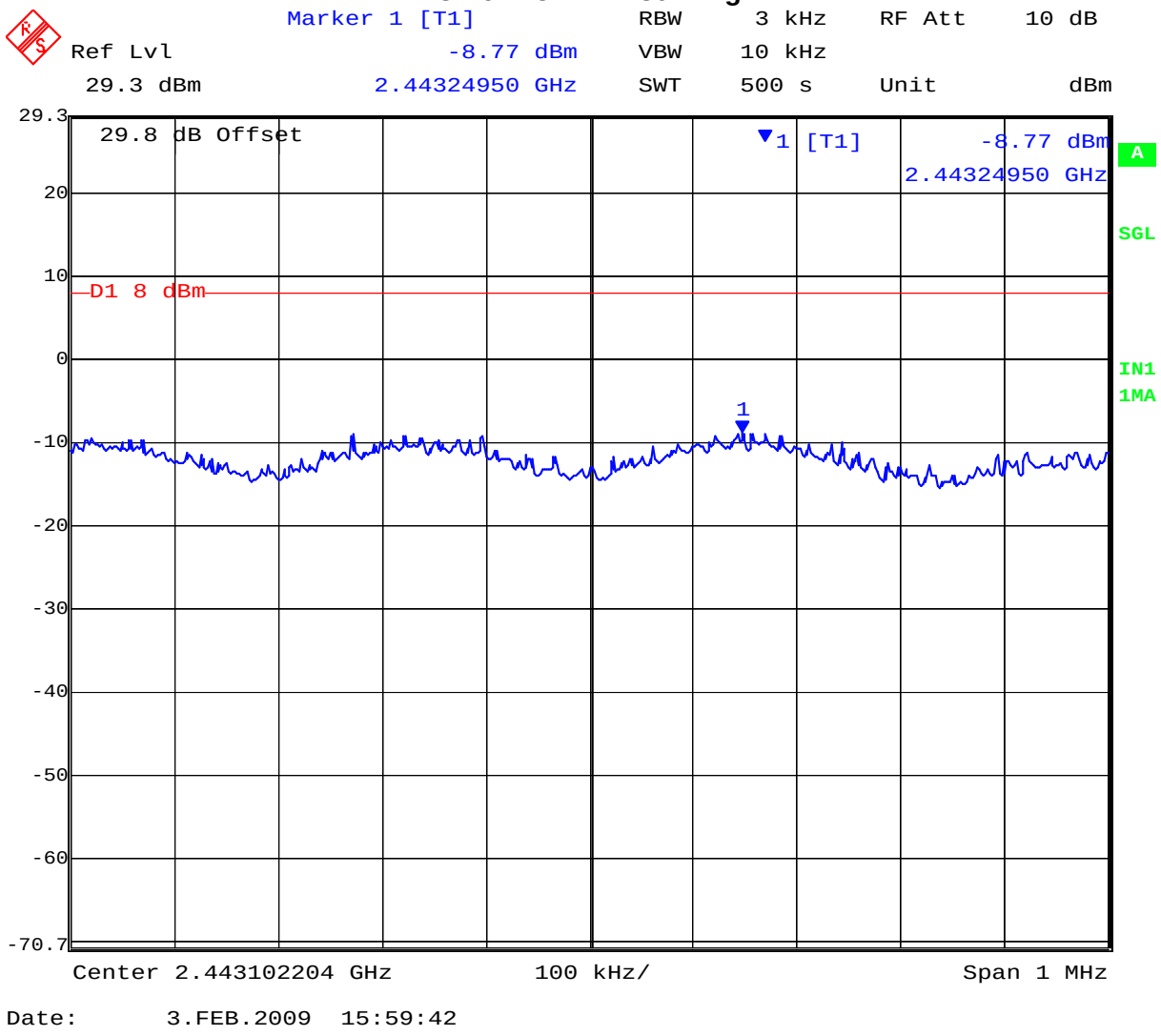
Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2412	2406.69639	-8.27	+8	-16.27
2437	2443.24950	-8.77	+8	-16.77
2462	2456.06112	-8.21	+8	-16.21

Peak Power Spectral Density
Ch 1 2412 MHz 802.11g



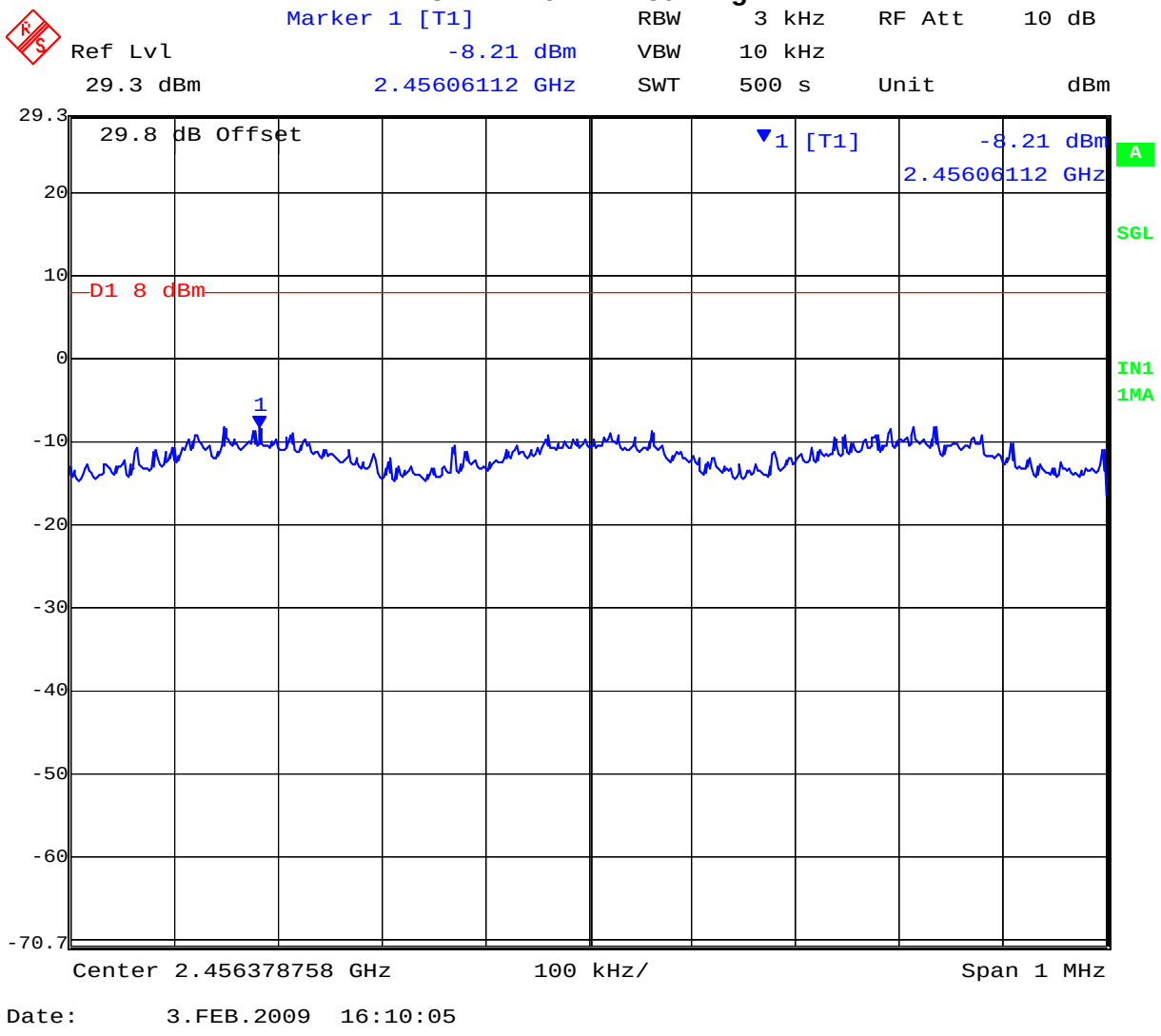
802.11G Boost Mode

Peak Power Spectral Density
Ch 6 2437 MHz 802.11g



802.11g Boost Mode

Peak Power Spectral Density
Ch 11 2462 MHz 802.11g

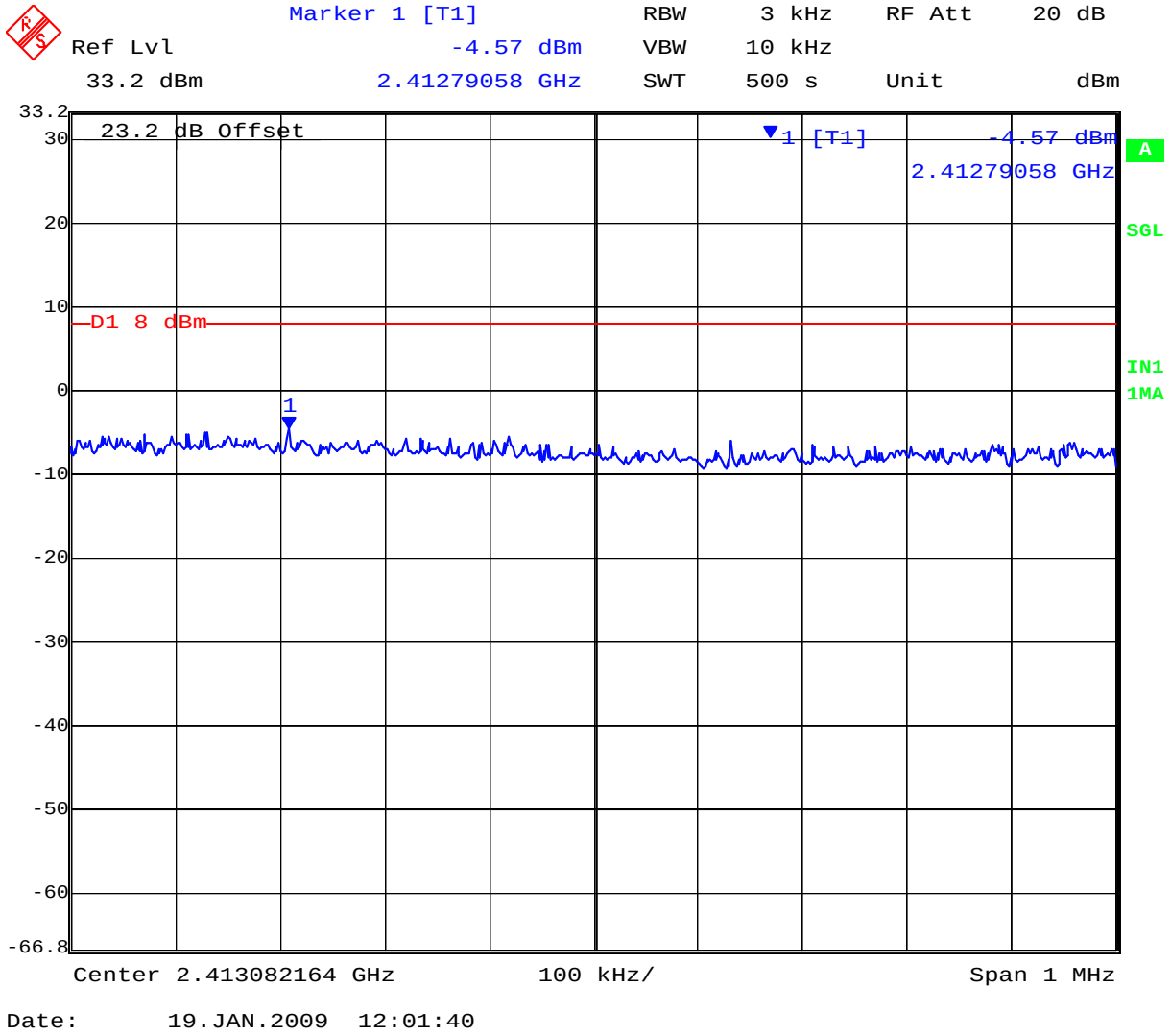


802.11b No Boost Mode

TABLE OF RESULTS – 802.11b No Boost Mode

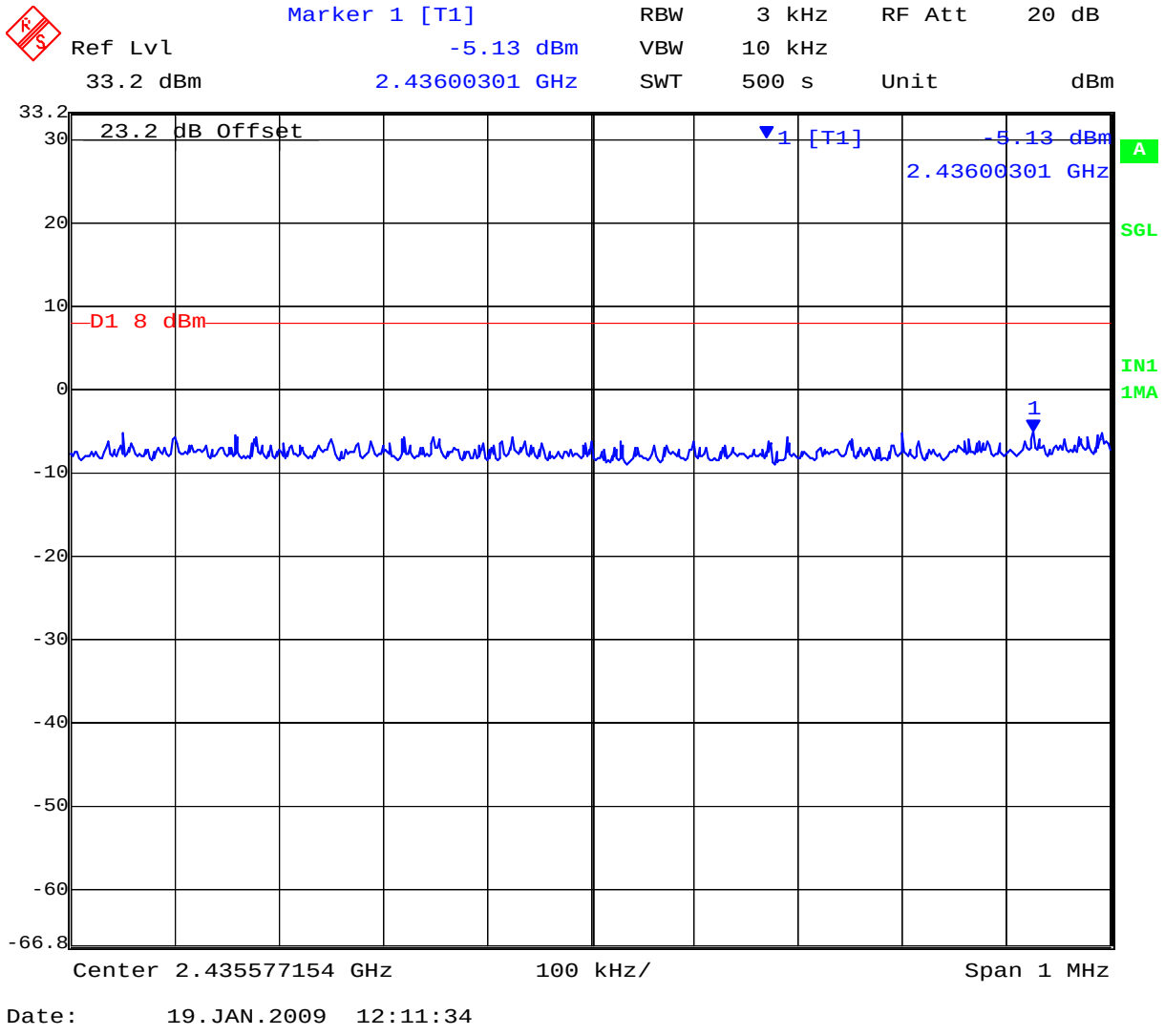
Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2412	2412.79058	-4.57	+8	-12.57
2437	2436.00301	-5.13	+8	-13.13
2462	2462.54008	-4.78	+8	-12.78

Peak Power Spectral Density
Ch 1 2412 MHz 802.11b



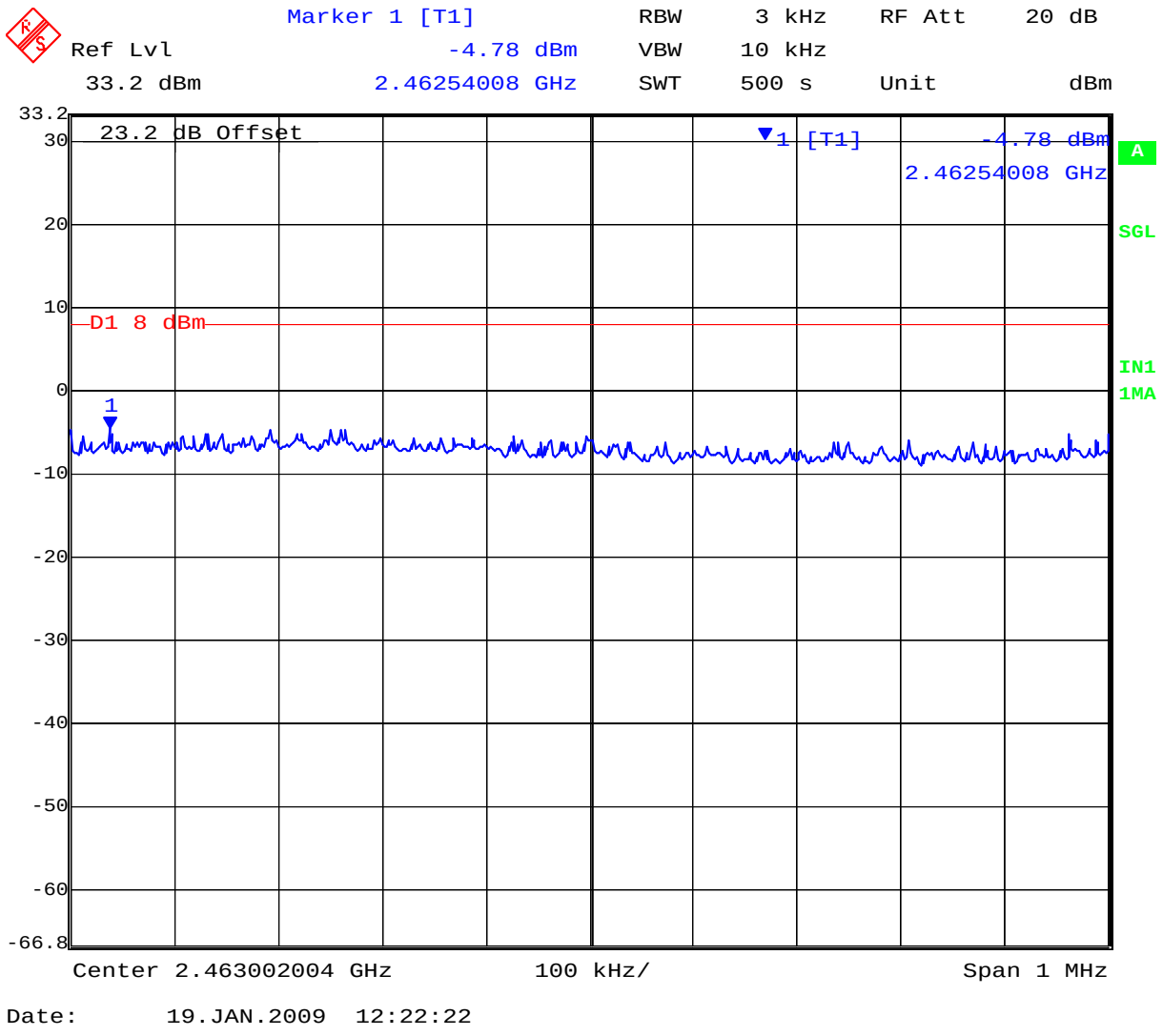
802.11b No Boost Mode

Peak Power Spectral Density
Ch 6 2437 MHz 802.11b



802.11b No Boost Mode

Peak Power Spectral Density
Ch 11 2462 MHz 802.11b

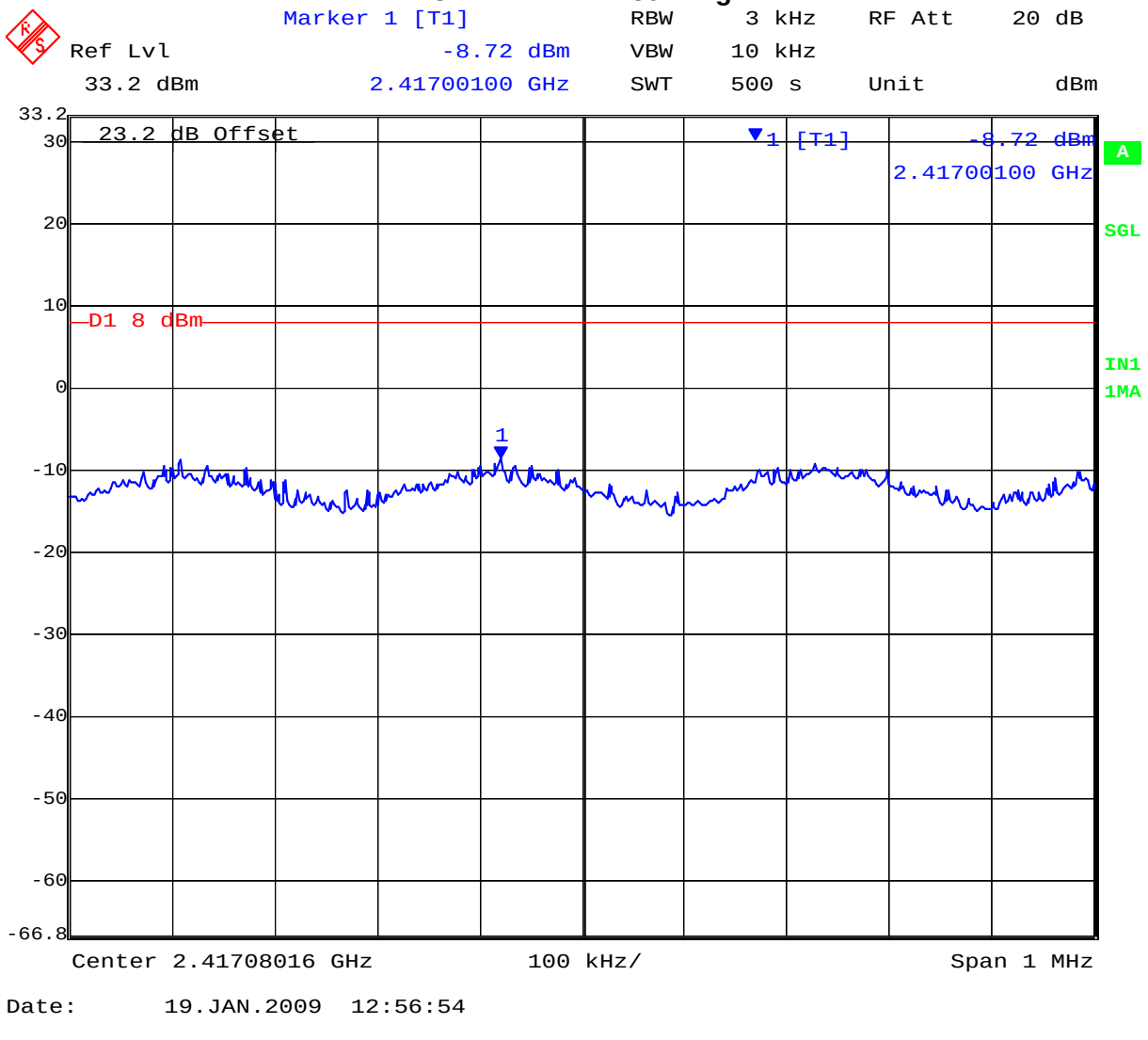


802.11g No Boost Mode

TABLE OF RESULTS – **802.11g**

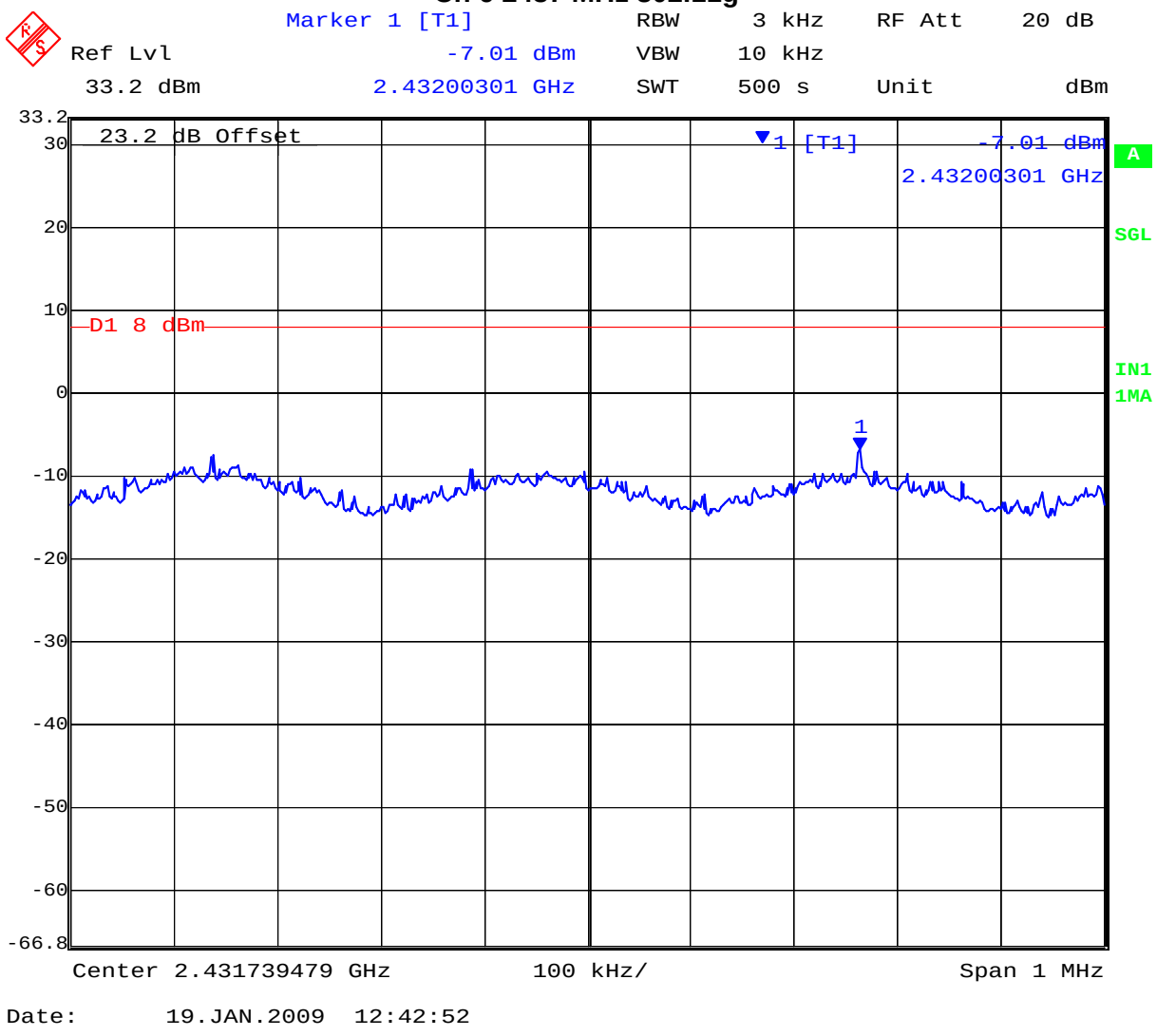
Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2412	2417.00100	-8.72	+8	-16.72
2437	2432.00301	-7.01	+8	-15.01
2462	2467.00100	-8.75	+8	-16.75

Peak Power Spectral Density
Ch 1 2412 MHz 802.11g



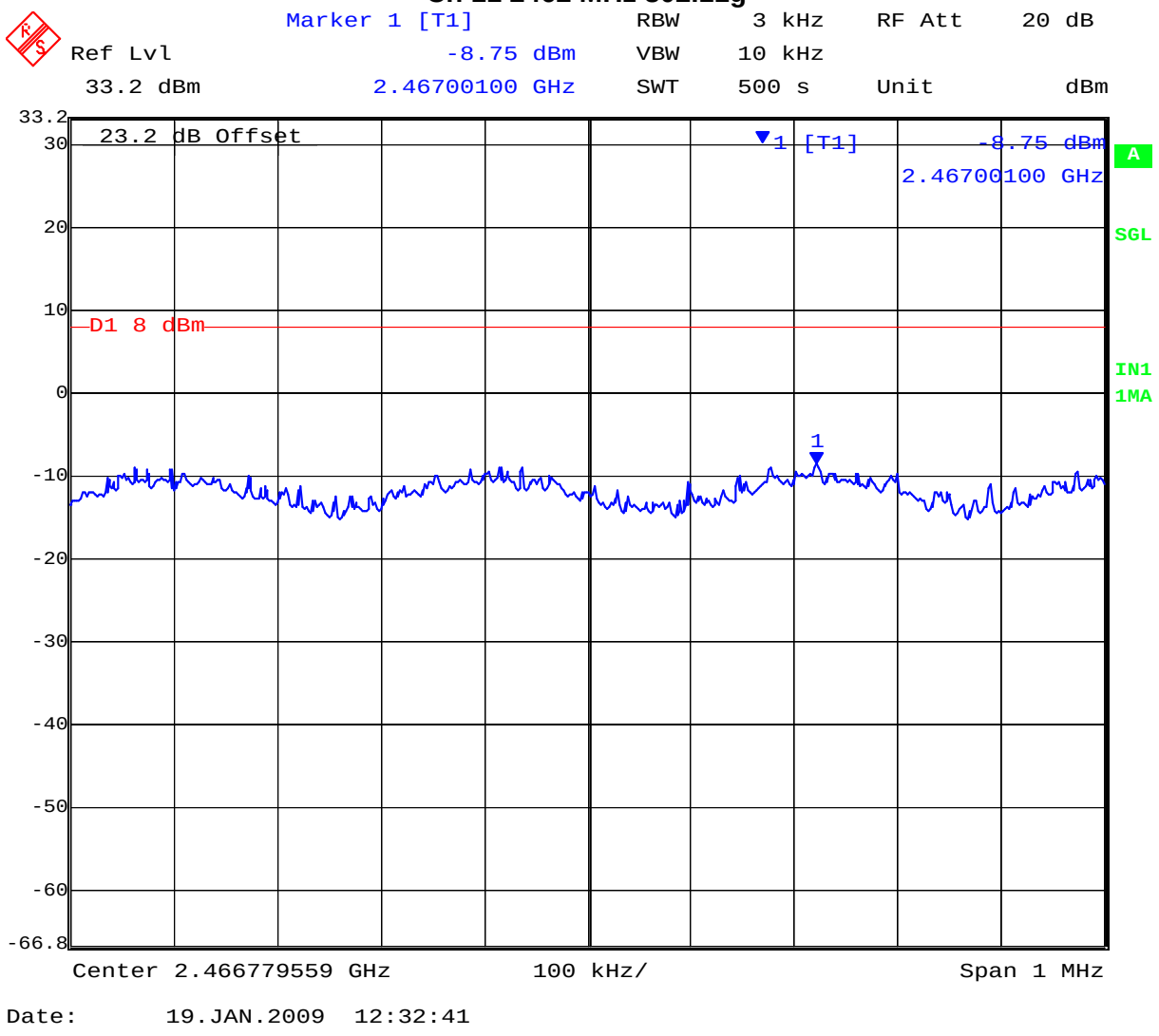
802.11g No Boost Mode

Peak Power Spectral Density
Ch 6 2437 MHz 802.11g



802.11g No Boost Mode

Peak Power Spectral Density
Ch 11 2462 MHz 802.11g



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

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

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

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

P (worst case) = +23.76 dBm, 237.7 mW

Antenna Gain (Worst Case) = 2.0 dBi, 1.58 numeric

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

The MPE calculations are calculated using the maximum allowable power levels calculated for each antenna in Section 5.1.2 “Peak Output Power” of the report.

Antenna Gain (dBi)	Numeric Gain (numeric)	Max Allowable Peak Power (dBm)	Max Allowable Peak Power (mW)	Calculated Safe Distance at 1 mW/cm^2 (cm)	Minimum Separation Distance (cm)
2.0	1.58	+23.76	237.7	5.5	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.

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.

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

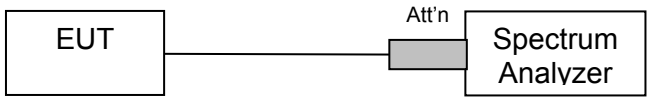
5.1.5. Conducted Spurious Emissions

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

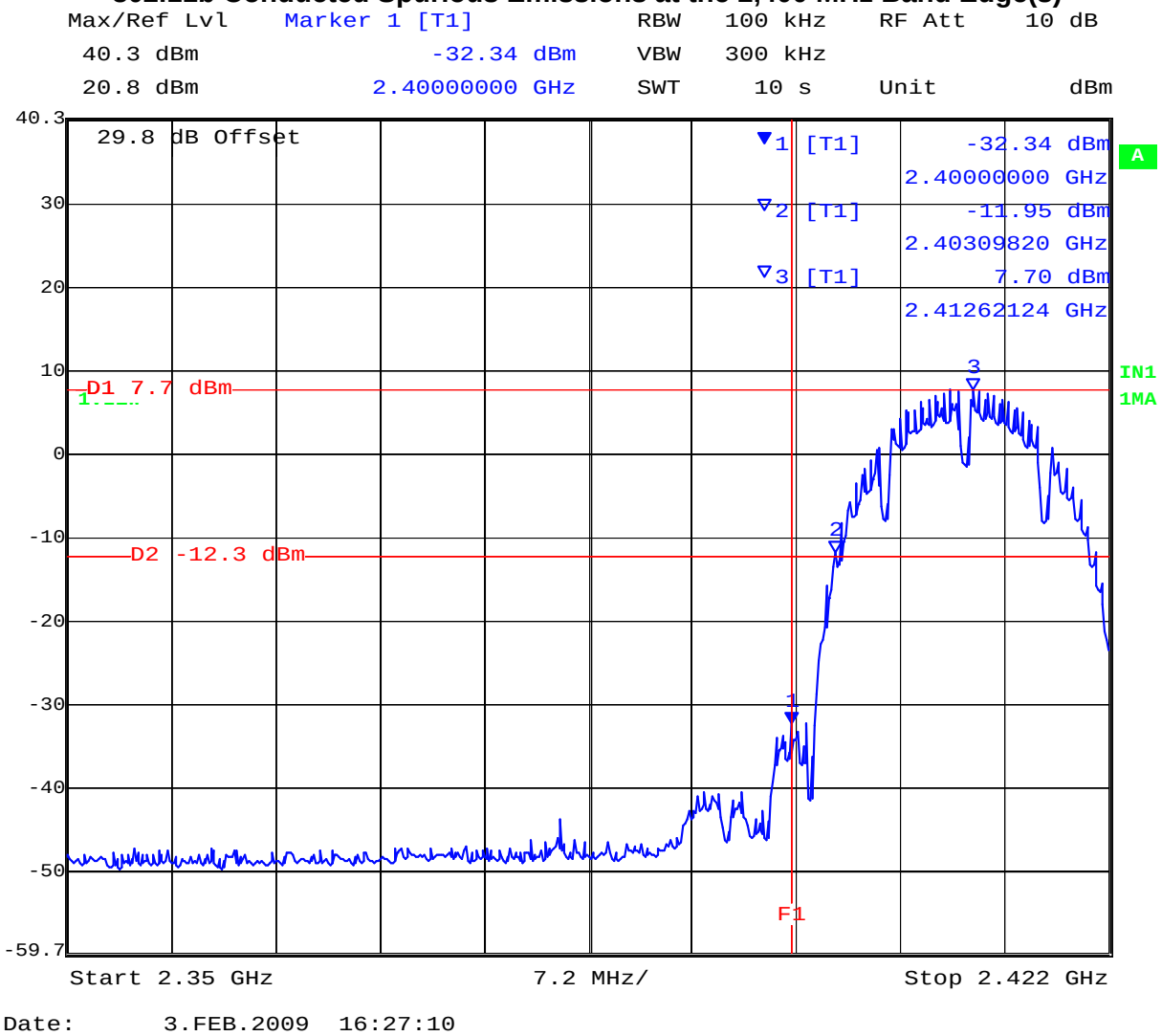
Conducted Band-Edge Results

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 Boost Mode

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental) (dBm)	Amplitude @ Band edge (dBm)	Margin (dB)
2412	2,400	-12.30	-32.34	-20.04
2462	2,483.5	-12.56	-47.92	-35.36

Lower Band Edge
802.11b Conducted Spurious Emissions at the 2,400 MHz Band Edge(s)



Date: 3.FEB.2009 16:27:10

Boost Mode

Upper Band Edge

802.11b Conducted Spurious Emissions at the 2483.5 MHz Band Edge(s)

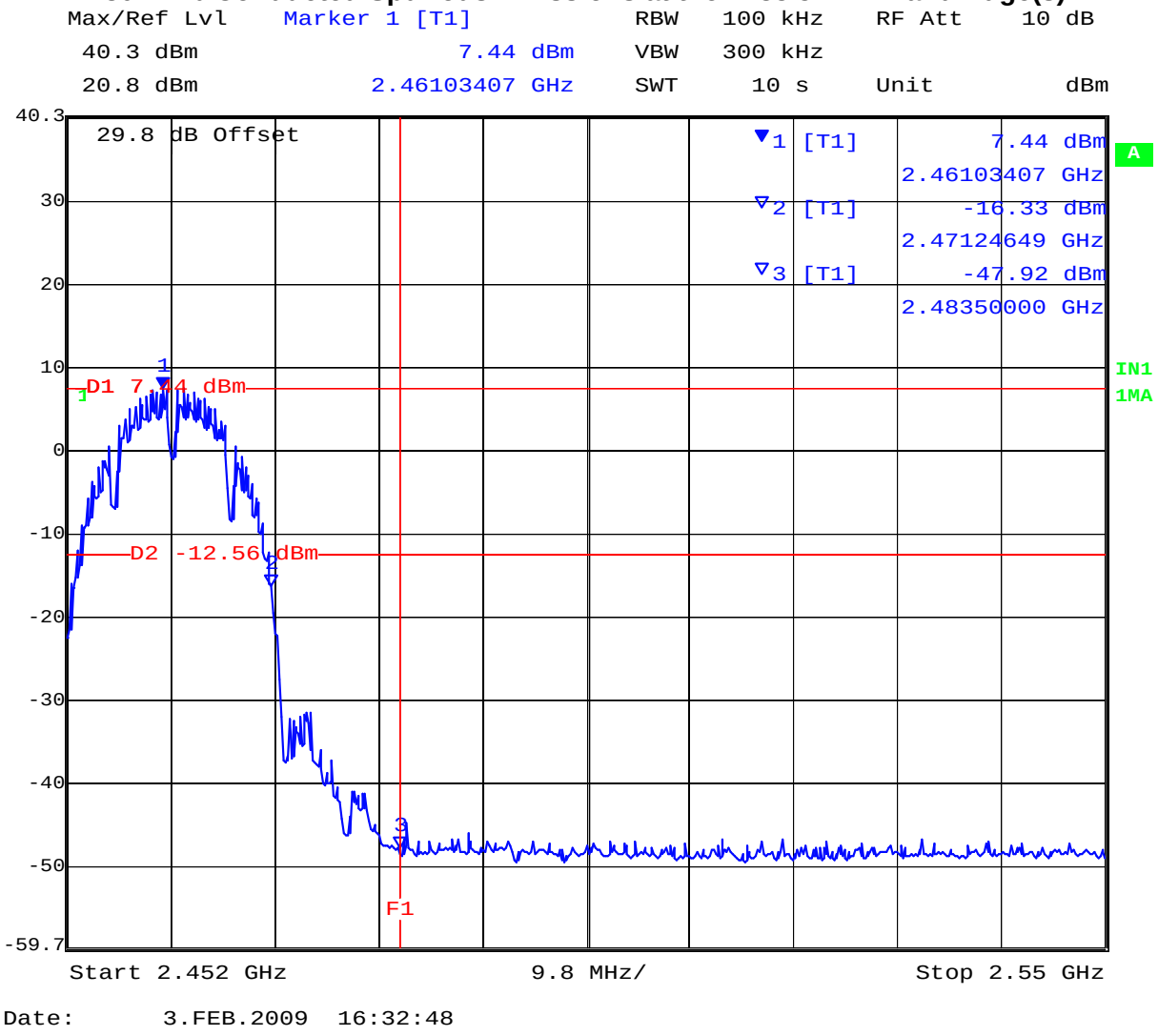
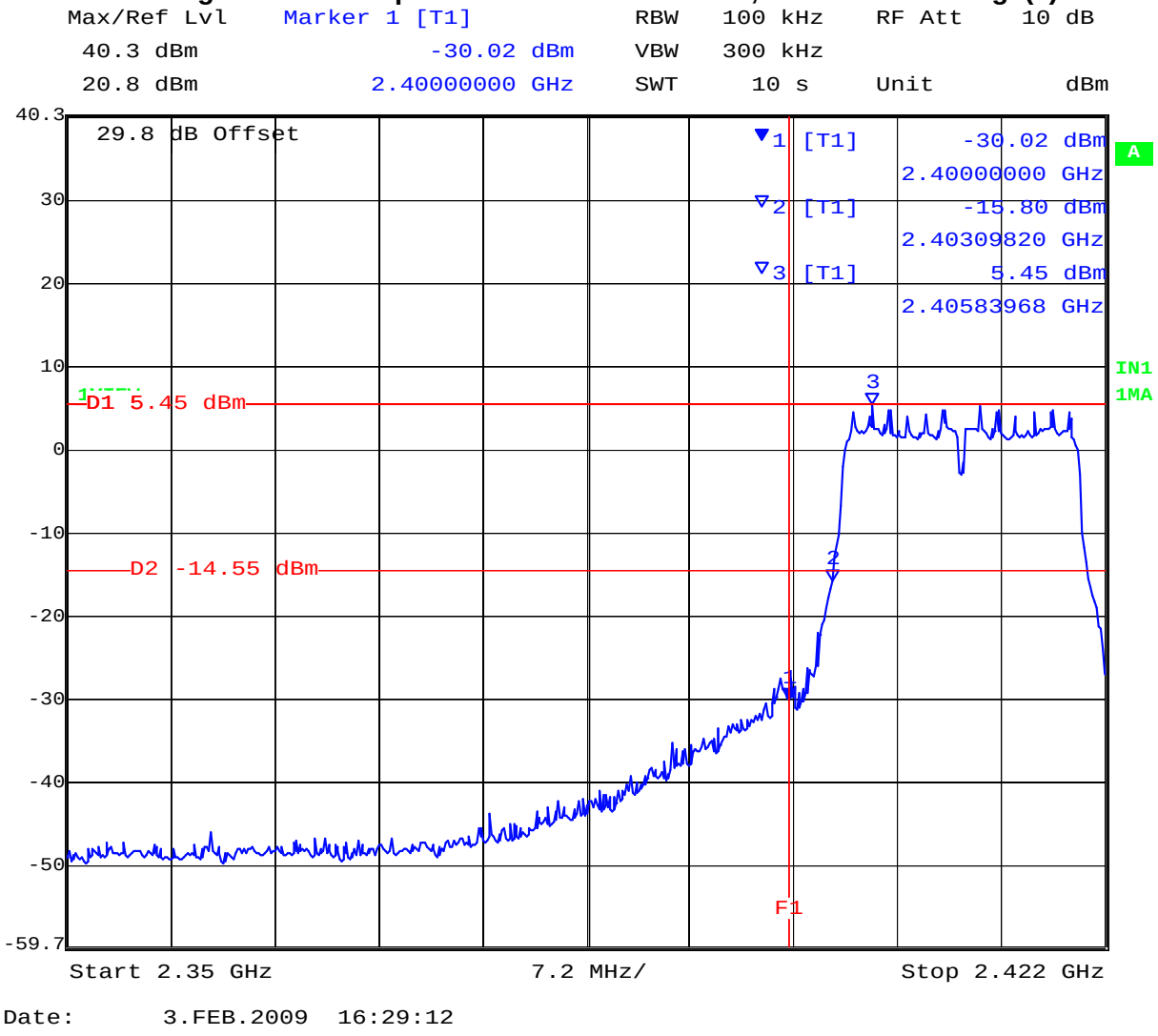


TABLE OF RESULTS – 802.11g Boost Mode

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental) (dBm)	Amplitude @ Band edge (dBm)	Margin (dB)
2412	2,400	-14.55	-30.02	-15.47
2462	2,483.5	-14.85	-41.64	-26.79

Lower Band Edge

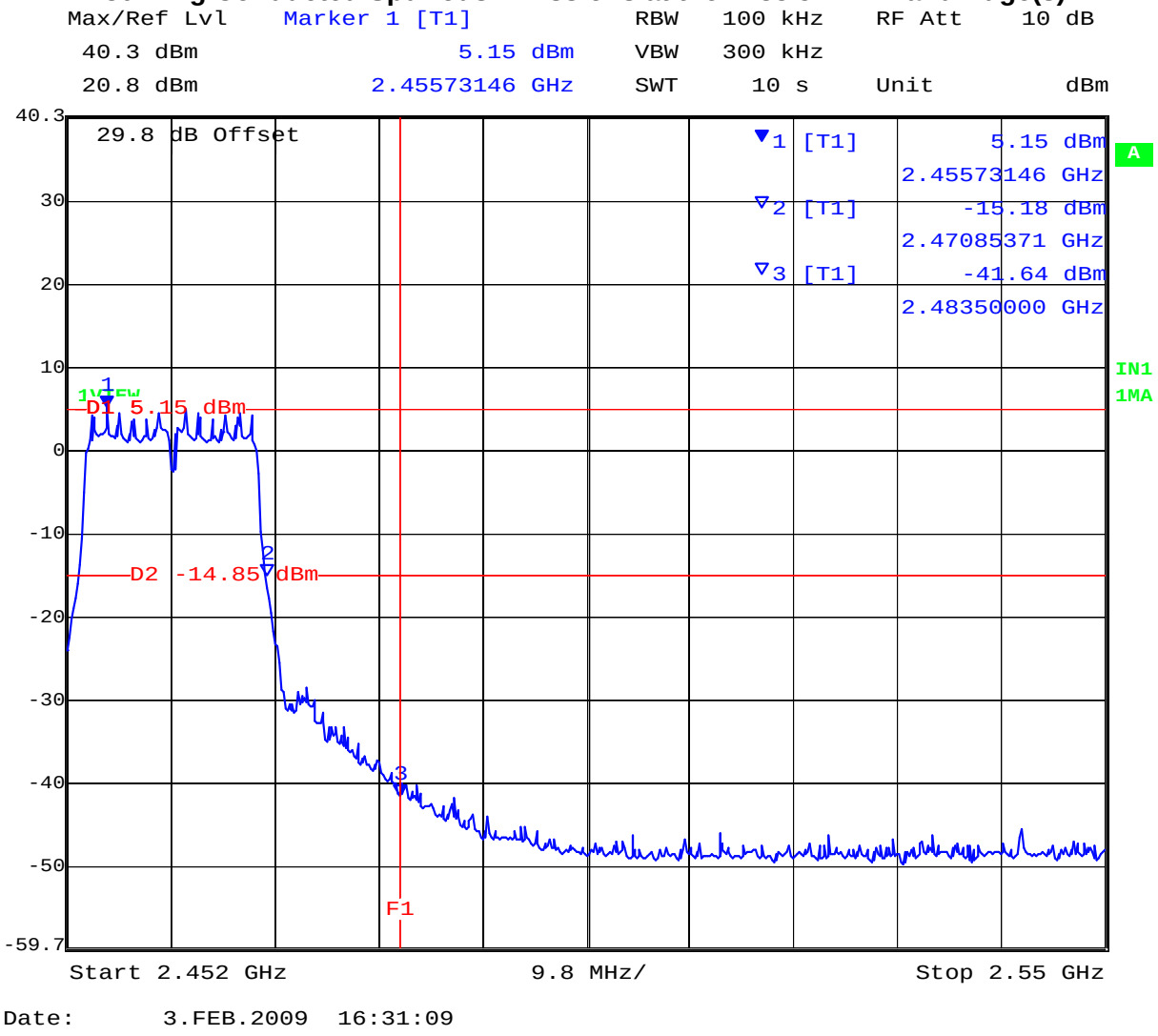
802.11g Conducted Spurious Emissions at the 2,400 MHz Band Edge(s)



Boost Mode

Upper Band Edge

802.11g Conducted Spurious Emissions at the 2483.5 MHz Band Edge(s)

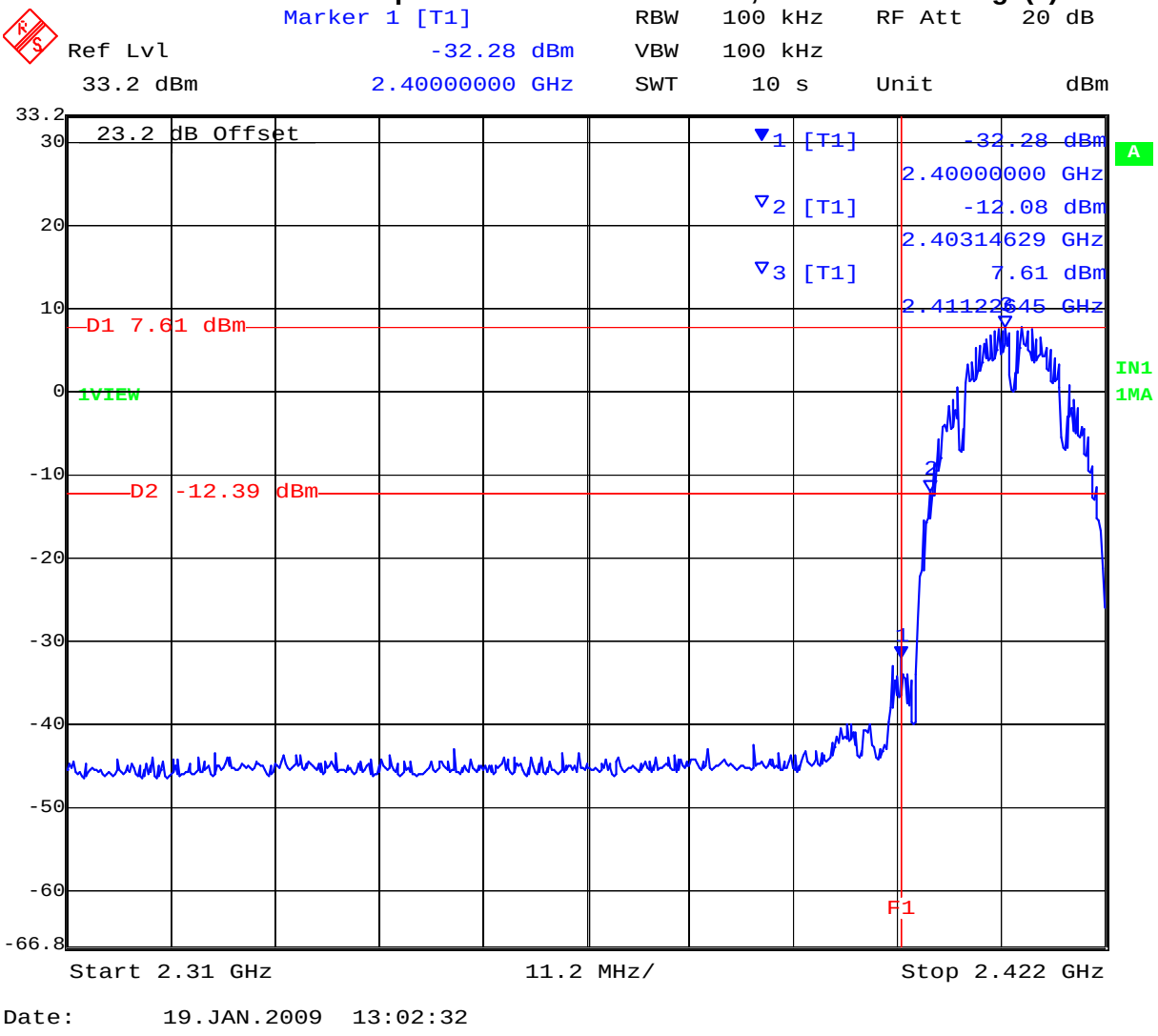


Date: 3.FEB.2009 16:31:09

TABLE OF RESULTS – 802.11b No Boost Mode

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental) (dBm)	Amplitude @ Band edge (dBm)	Margin (dB)
2412	2,400	-12.39	-32.28	-19.89
2462	2,483.5	-12.69	-44.99	-32.30

Lower Band Edge
802.11b Conducted Spurious Emissions at the 2,400 MHz Band Edge(s)



No Boost Mode

Upper Band Edge

802.11b Conducted Spurious Emissions at the 2483.5 MHz Band Edge(s)

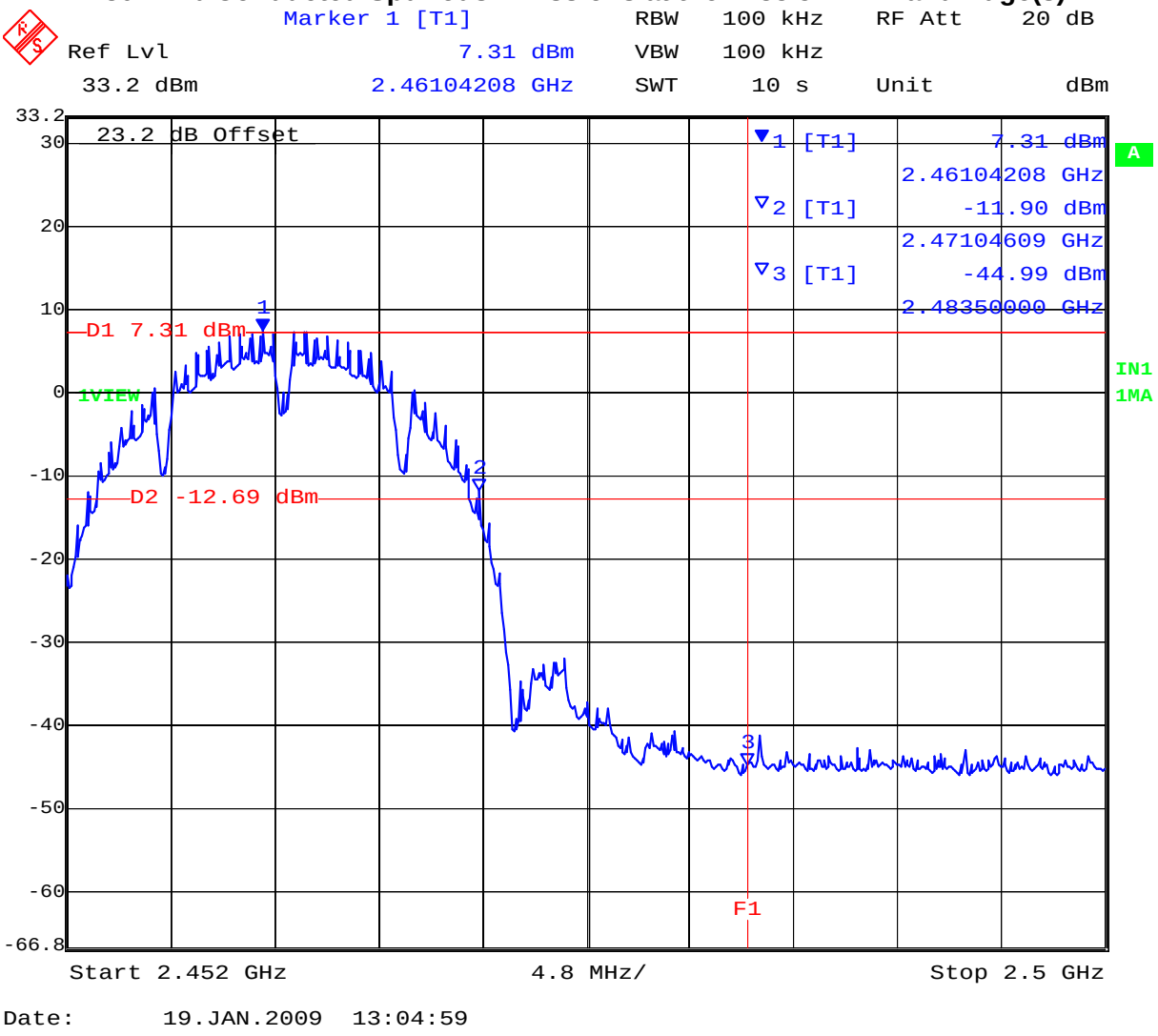
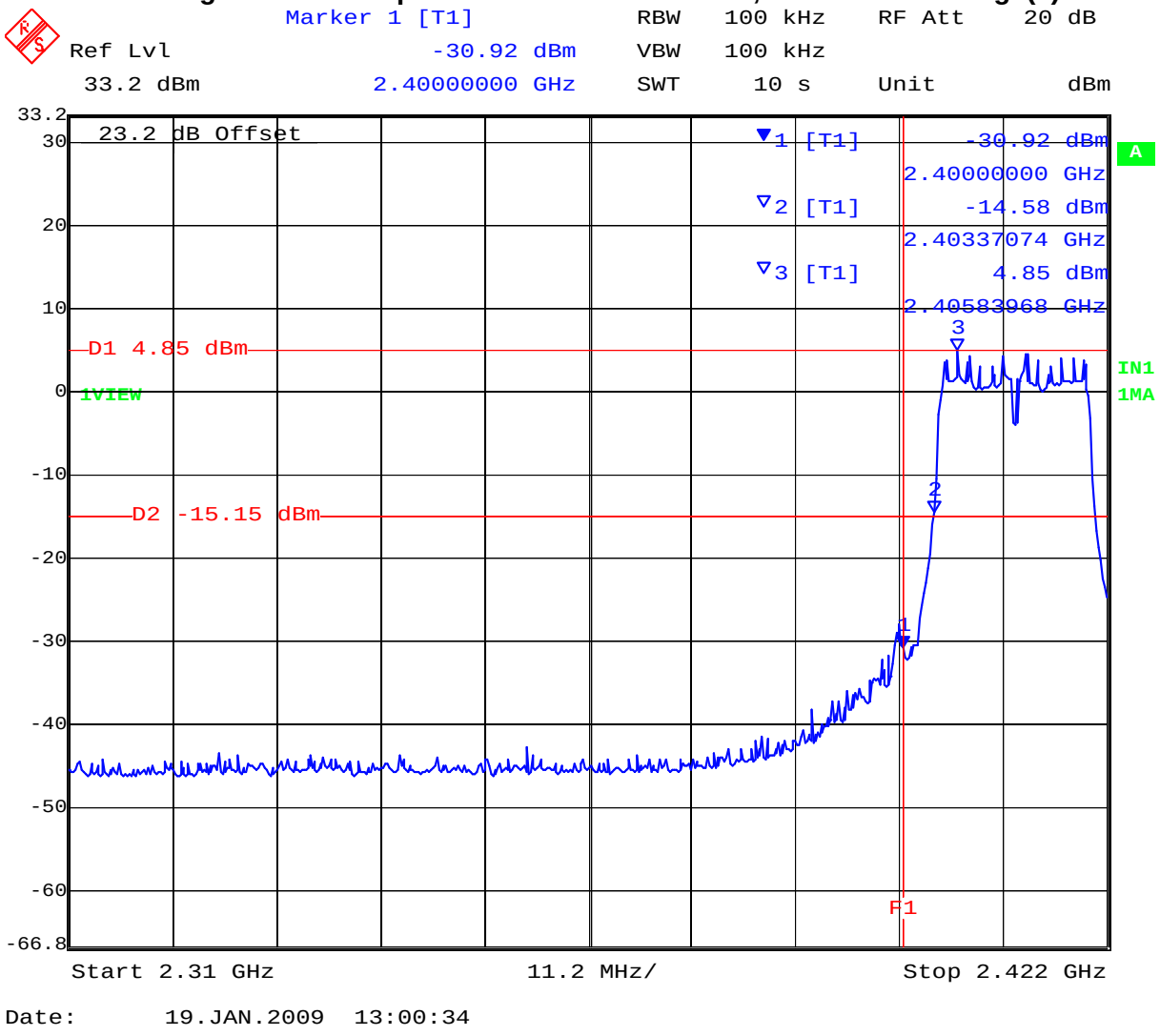


TABLE OF RESULTS – 802.11g No Boost Mode

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental) (dBm)	Amplitude @ Band edge (dBm)	Margin (dB)
2412	2,400	-15.15	-30.92	-15.77
2462	2,483.5	-14.83	-40.82	-25.99

Lower Band Edge
802.11g Conducted Spurious Emissions at the 2,400 MHz Band Edge(s)

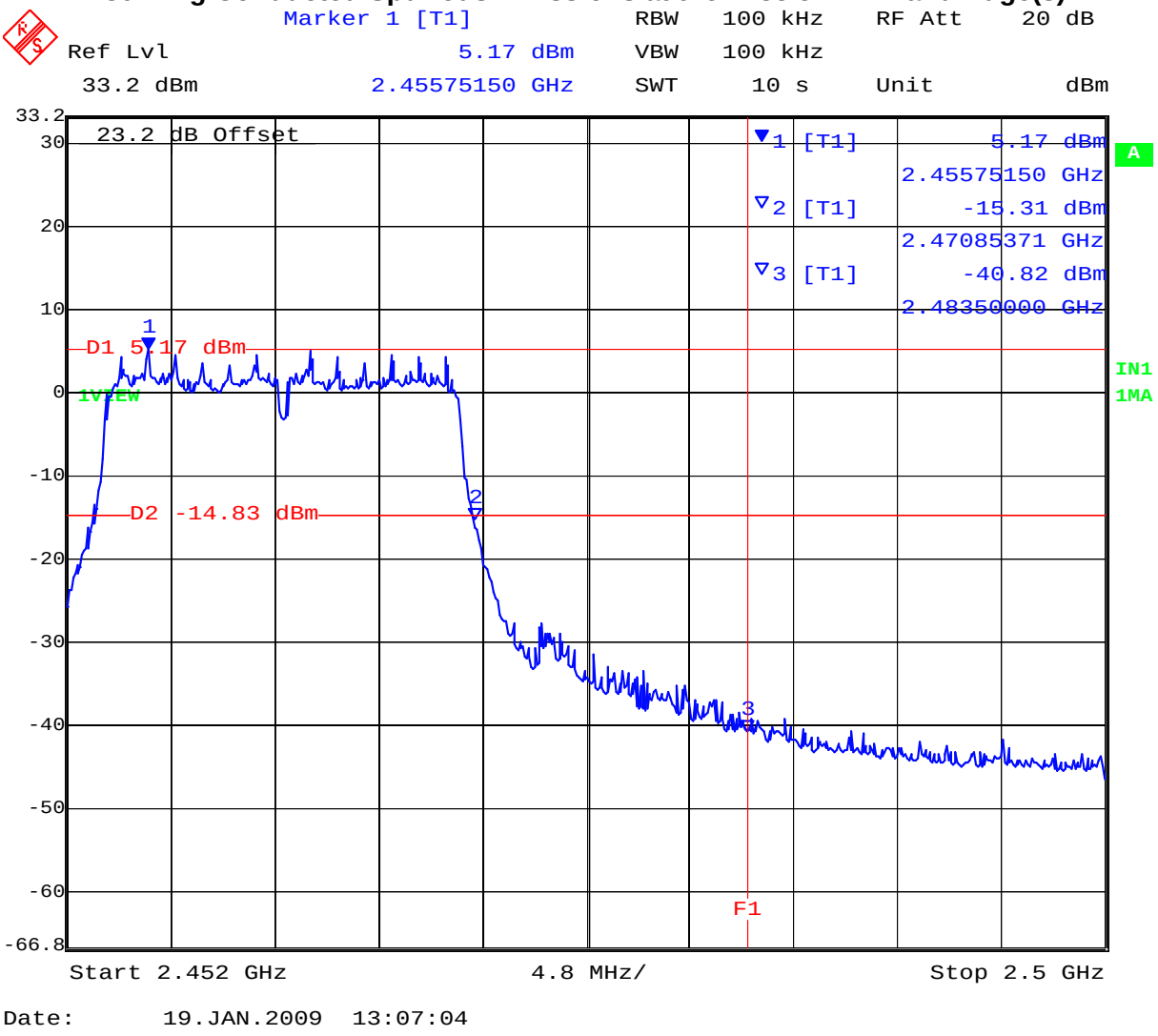


Date: 19.JAN.2009 13:00:34

No Boost Mode

Upper Band Edge

802.11g Conducted Spurious Emissions at the 2483.5 MHz Band Edge(s)



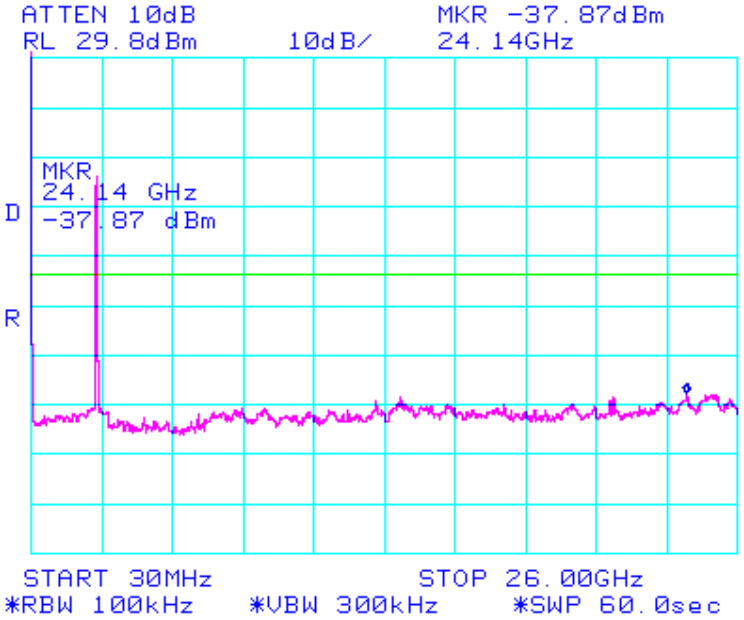
Date: 19.JAN.2009 13:07:04

Spurious Emissions (0.03-26 GHz)

TABLE OF RESULTS – 802.11b Boost Mode

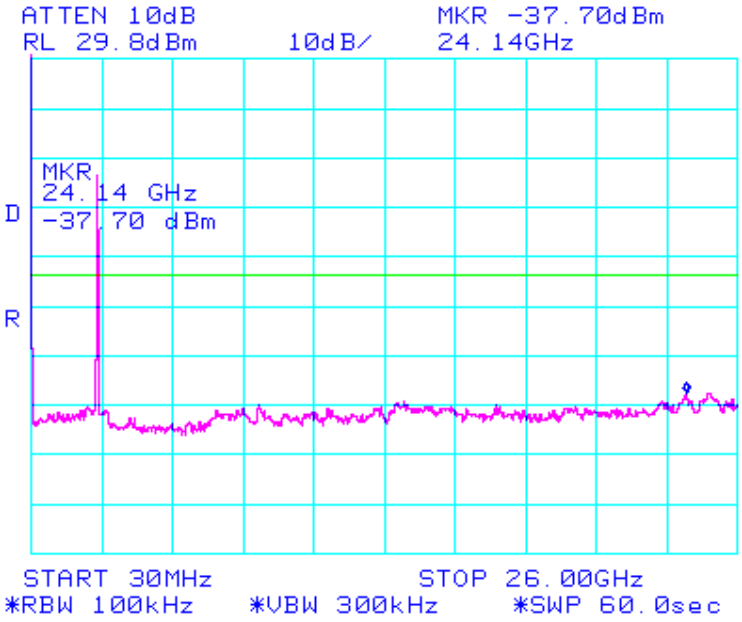
Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2412	30	26,000	-37.87	-12.30	-25.57
2437	30	26,000	-37.70	-12.66	-25.04
2462	30	26,000	-37.87	-12.56	-25.31

802.11b 2412 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz



Boost Mode

802.11b 2,437 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz



Boost Mode

802.11b 2,462 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz

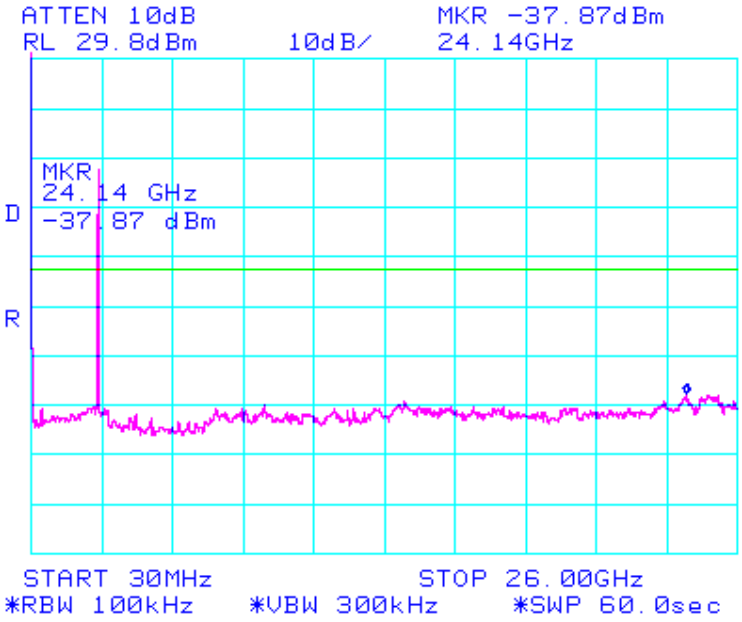
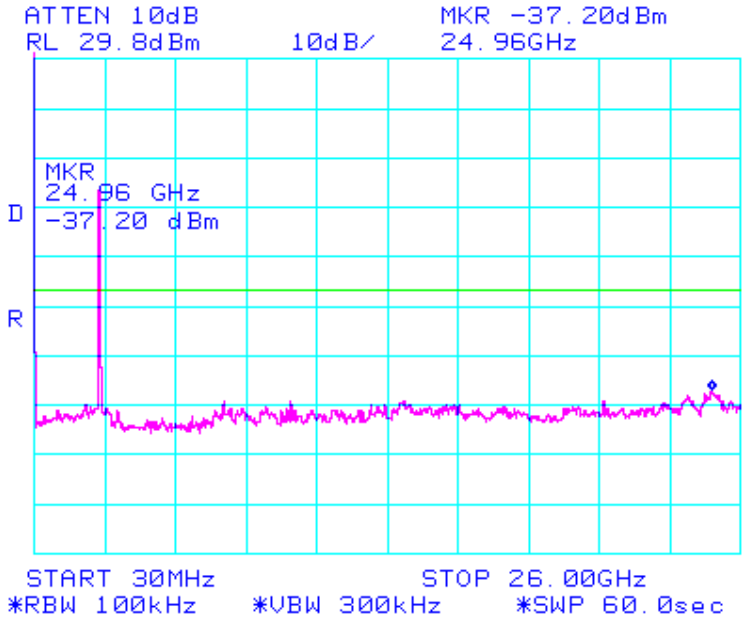


TABLE OF RESULTS – 802.11g Boost Mode

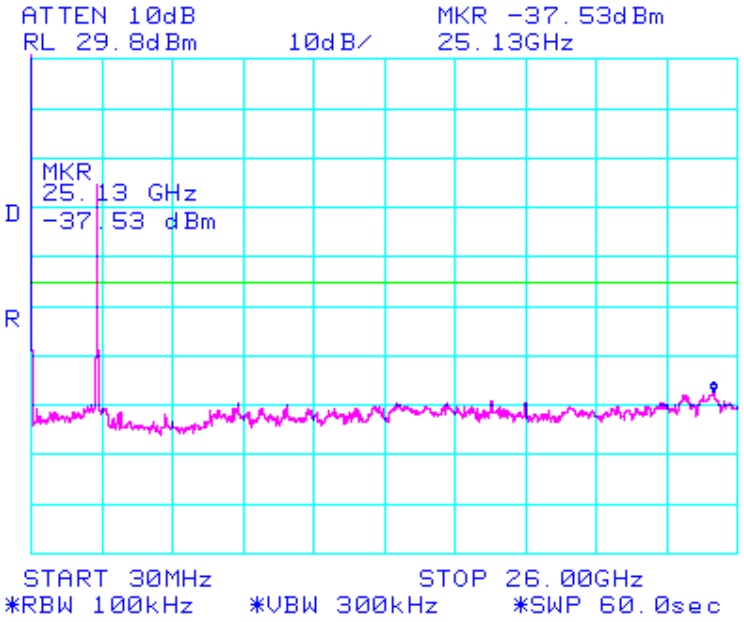
Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2412	30	26,000	-37.20	-14.55	-22.65
2437	30	26,000	-37.53	-14.45	-23.08
2462	30	26,000	-38.03	-14.85	-23.18

802.11g 2412 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz



Boost Mode

802.11g 2,437 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz



Boost Mode

802.11g 2,462 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz

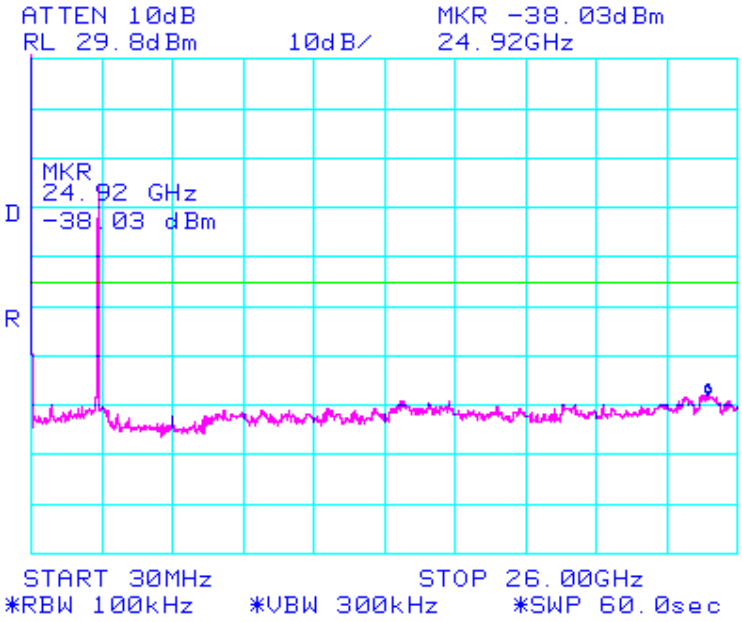
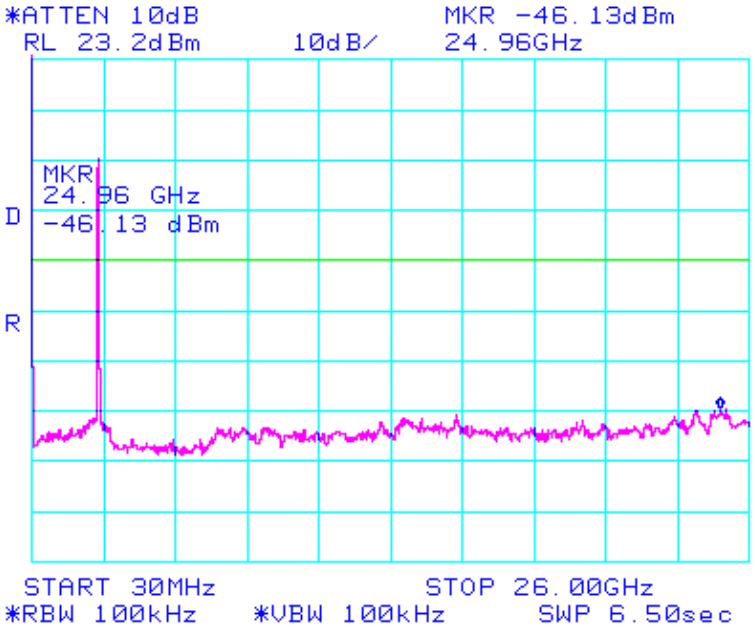


TABLE OF RESULTS – 802.11b No Boost Mode

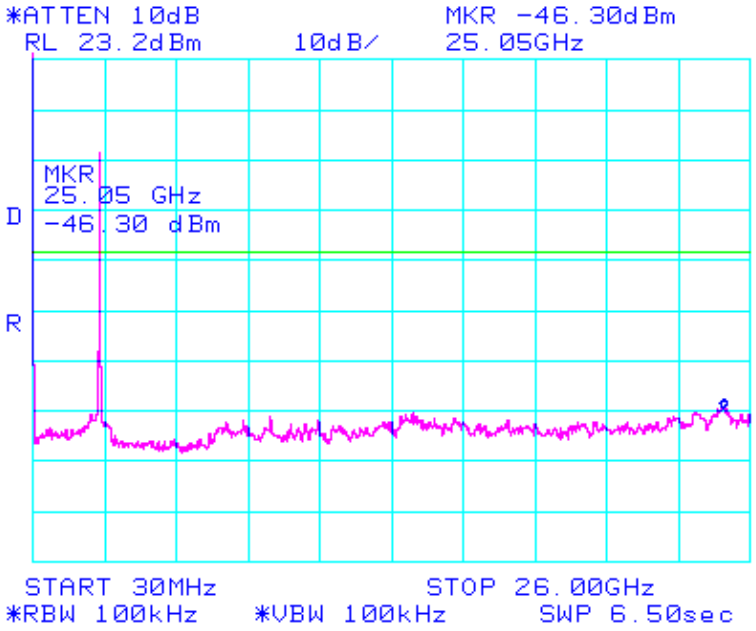
Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2412	30	26,000	-46.13	-12.39	-33.74
2437	30	26,000	-46.30	-12.50	-33.80
2462	30	26,000	-46.13	-12.69	-33.44

802.11b 2412 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz



No Boost Mode

802.11b 2,437 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz



No Boost Mode

802.11b 2,462 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz

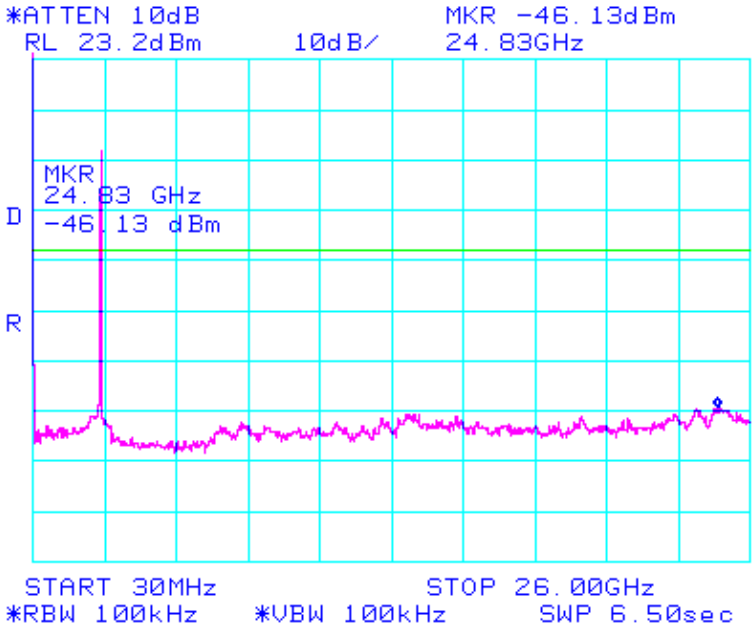
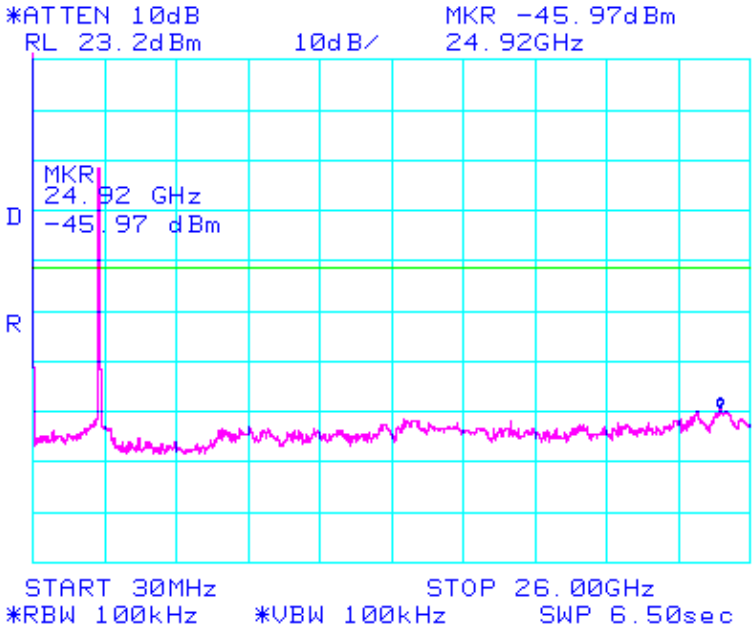


TABLE OF RESULTS – 802.11g No Boost Mode

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2412	30	26,000	-45.97	-15.15	-30.82
2437	30	26,000	-46.63	-15.67	-30.96
2462	30	26,000	-45.63	-14.83	-30.80

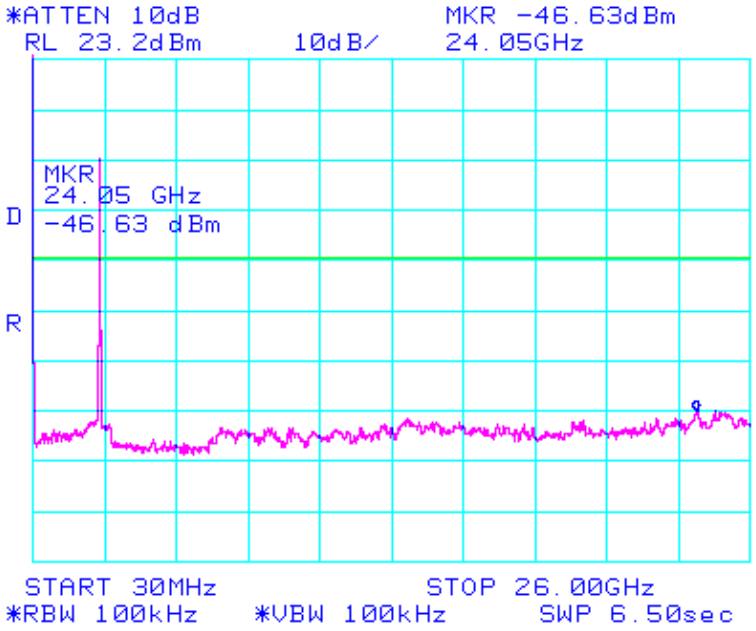
No Boost Mode

802.11g 2412 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz



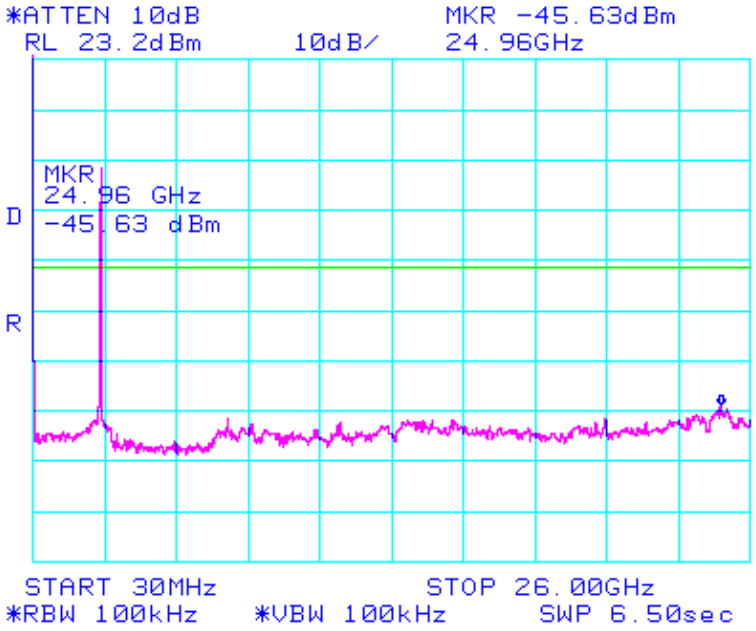
No Boost Mode

802.11g 2,437 MHz Conducted Spurious Emissions 0.03 - 26,000 MHz



No Boost Mode

802.11g 2,462 MHz Conducted Spurious Emissions 0.03 - 26,000 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) 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)).

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

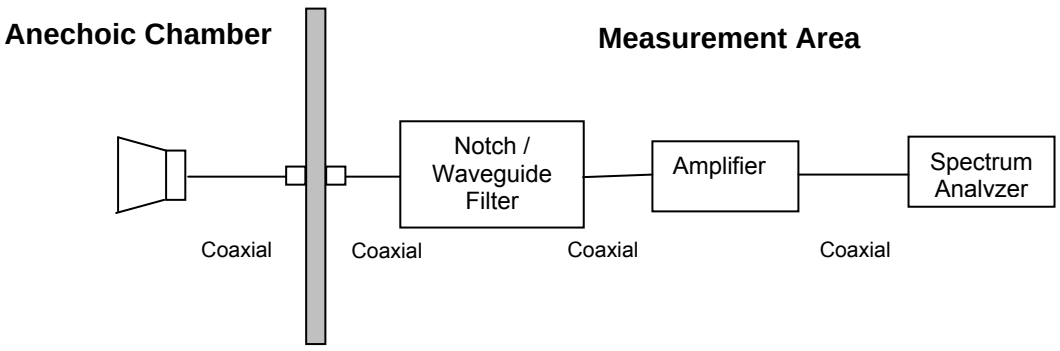
Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the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

The product was initially tested to find worst case orientation for the maximization of spurious emissions. Worst case orientation was used for all emission testing.

The voltage on the battery was continually monitored and replaced when necessary.

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

Boost operational mode was used to prove compliance for radiated emissions. Boost mode was used as this was the worst case operational mode i.e. widest bandwidth and highest conducted power levels.

Integral and external antennas were exercised in order to prove compliance.

External Dipole Antenna Gain 2dBi

802.11b Channel 2412 MHz

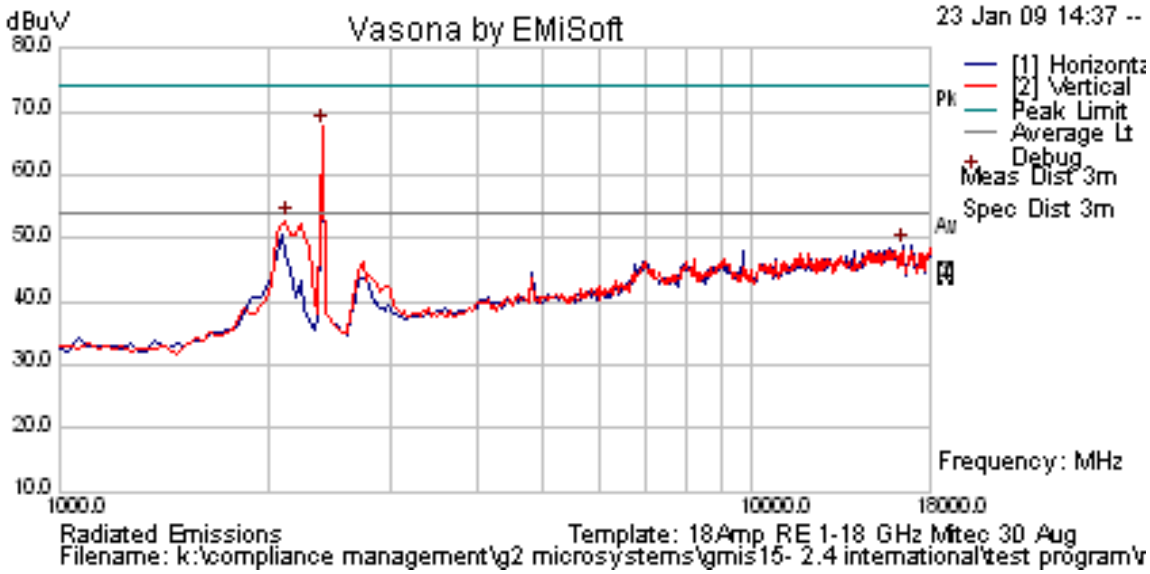
Power Setting = Maximum

TABLE OF RESULTS

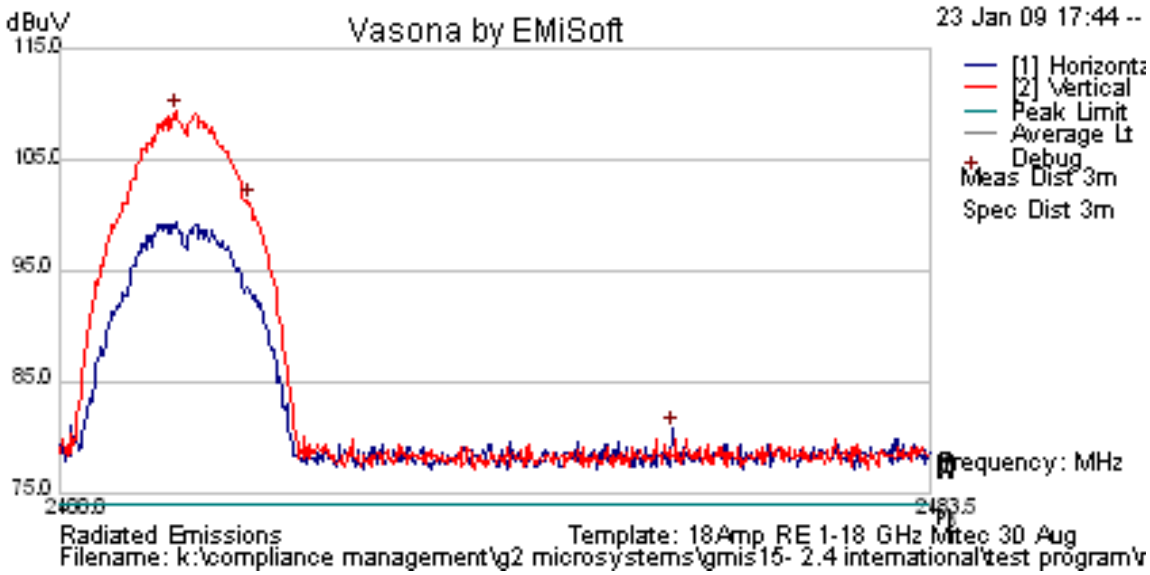
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2411.044	64.11	12.96	32.35	109.42	Peak [Scan]	H	N/A	N/A	N/A	N/A	N/A	Pk Emission
2373.006	Power Setting = Maximum			51.44	Peak Max	V	--	--	74	-22.56	Pass	Band Edge
2333.727				39.64	Average Max	V	--	--	54	-14.36	Pass	Band Edge

Pk Emission – Peak Emission
Band-Edge – Restricted Bands
RB – Restricted Band
NRB – Non-Restricted Band

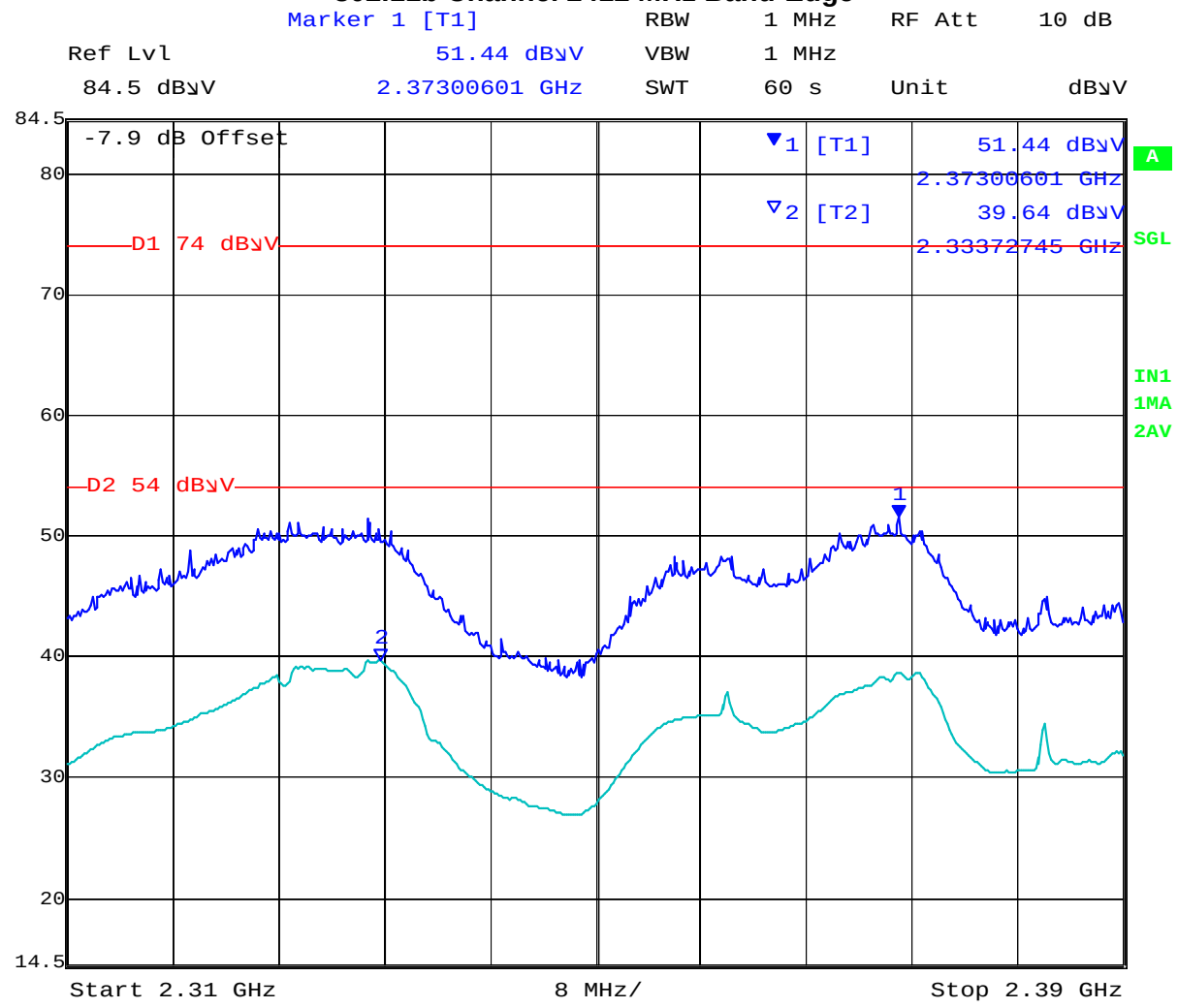
802.11b Channel 2412 MHz Radiated Emissions



802.11b Channel 2412 MHz Peak Emission



802.11b Channel 2412 MHz Band-Edge



802.11b Channel 2437 MHz, External Dipole Antenna Gain 2 dBi

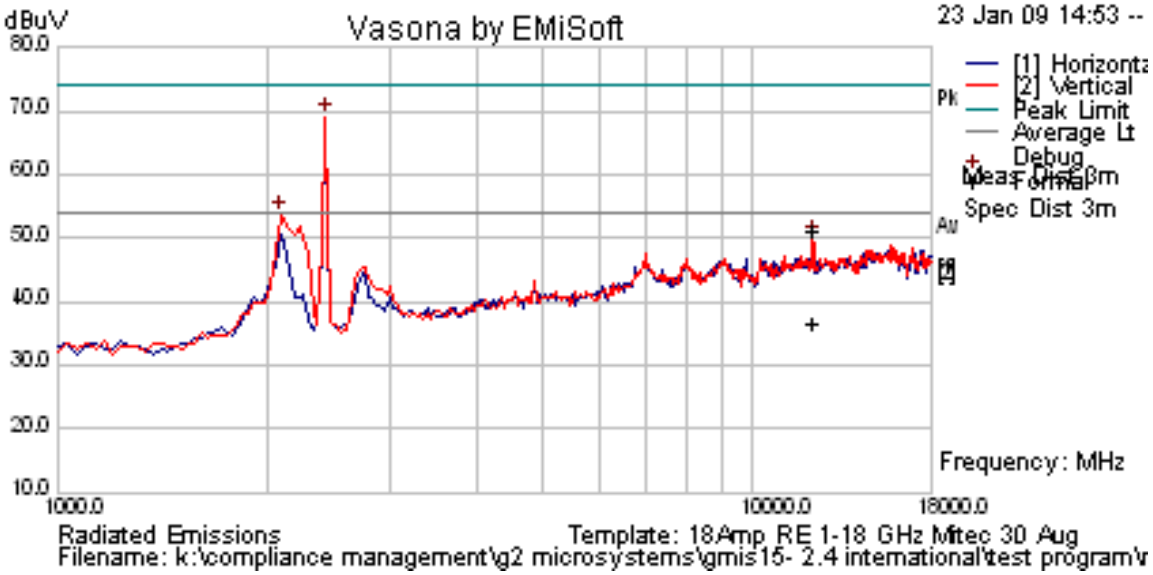
Power Setting = Maximum

TABLE OF RESULTS

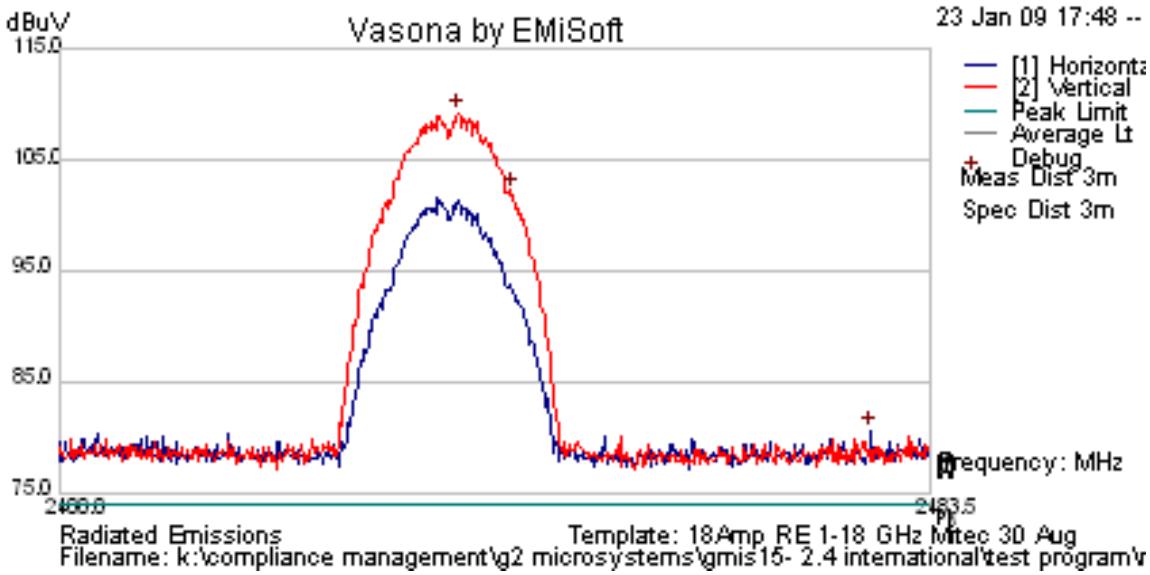
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2437.985	63.9	12.97	32.37	109.24	Peak [Scan]	H	N/A	N/A	N/A	N/A	N/A	Pk Emission
12186.86	45.57	7	-1.53	51.04	Peak Max	H	101	235	74	-22.96	Pass	RB
12186.81	30.95	7	-1.53	36.42	Average	V	100	235	54	-17.58	Pass	RB

Pk Emission – Peak Emission
RB – Restricted Band
NRB – Non-Restricted Band

802.11b Channel 2437 MHz Radiated Emissions



802.11b Channel 2437 MHz Peak Emission



802.11b Channel 2462 MHz External Dipole Antenna Gain 2 dBi

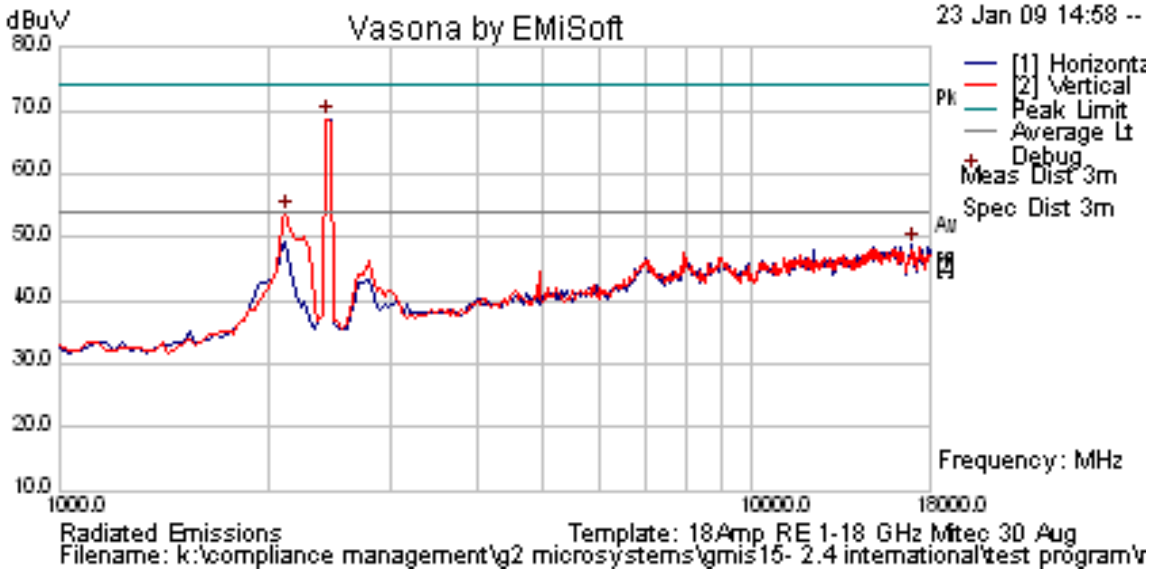
Power Setting = Maximum

TABLE OF RESULTS

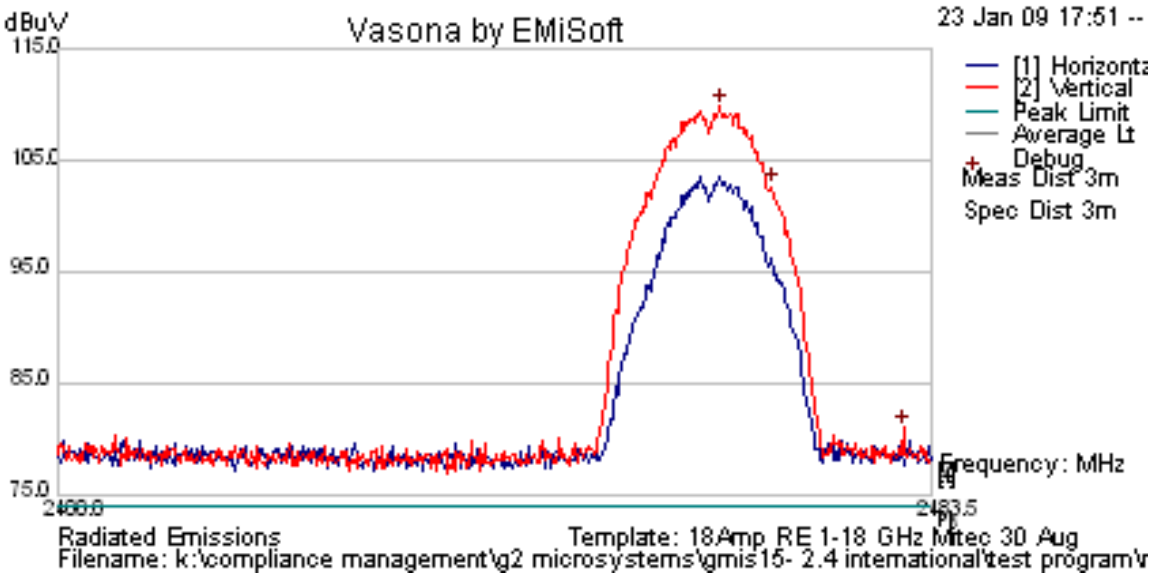
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2463.085	64.47	12.98	32.38	109.84	Peak [Scan]	H	N/A	N/A	N/A	N/A	N/A	Pk Emission
2483.996	Power Setting = Maximum			56.55	Peak Max	V	--	--	74	-17.45	Pass	Band-Edge
2483.963				47.01	Average Max	V	--	--	54	-6.99	Pass	Band-Edge

Pk Emission – Peak Emission
Band-Edge – Restricted Bands
RB – Restricted Band
NRB – Non-Restricted Band

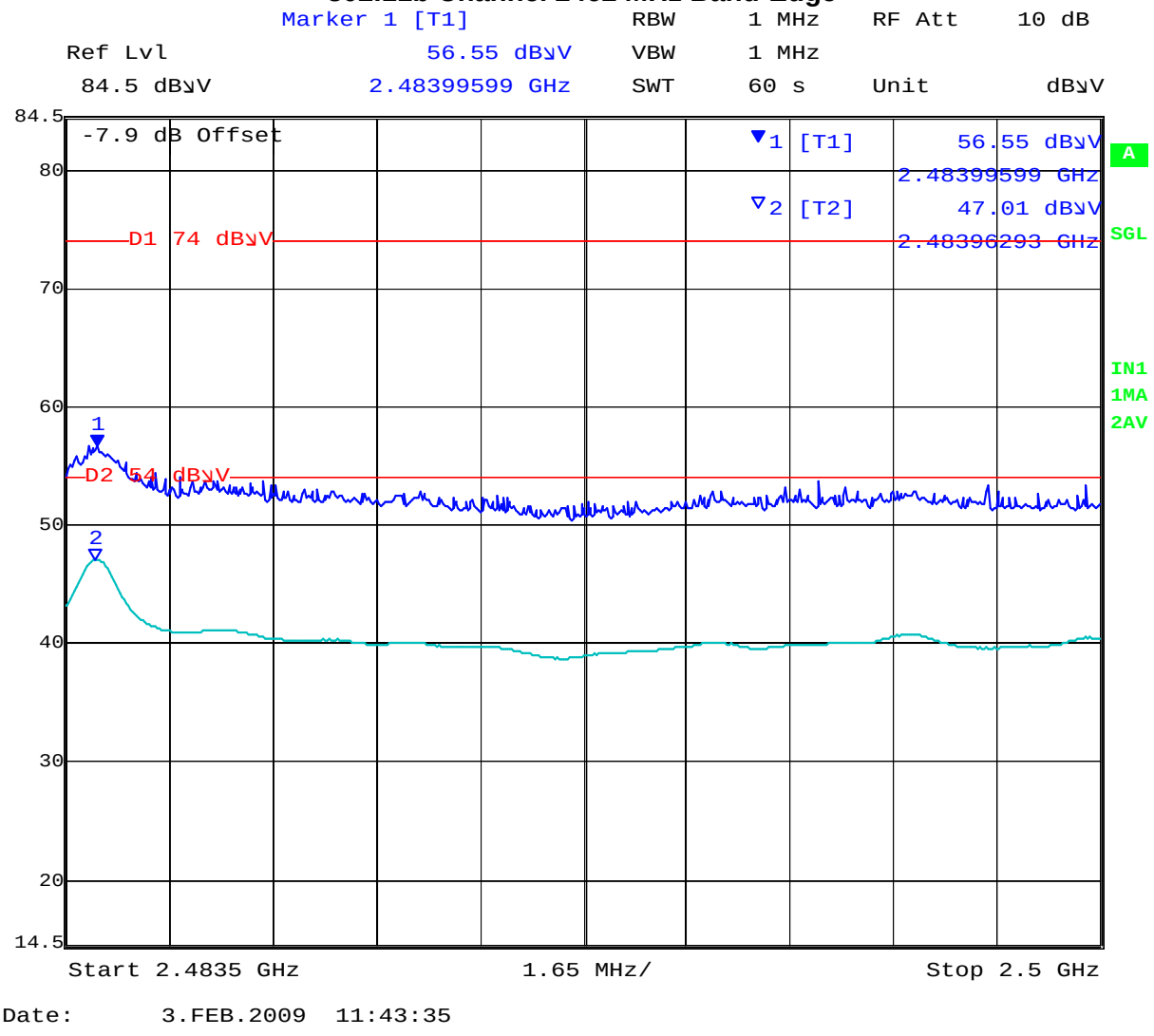
802.11b Channel 2462 MHz Radiated Emissions



802.11b Channel 2462 MHz Peak Emission



802.11b Channel 2462 MHz Band-Edge



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802.11g Channel 2412 MHz External Dipole Antenna Gain 2 dBi

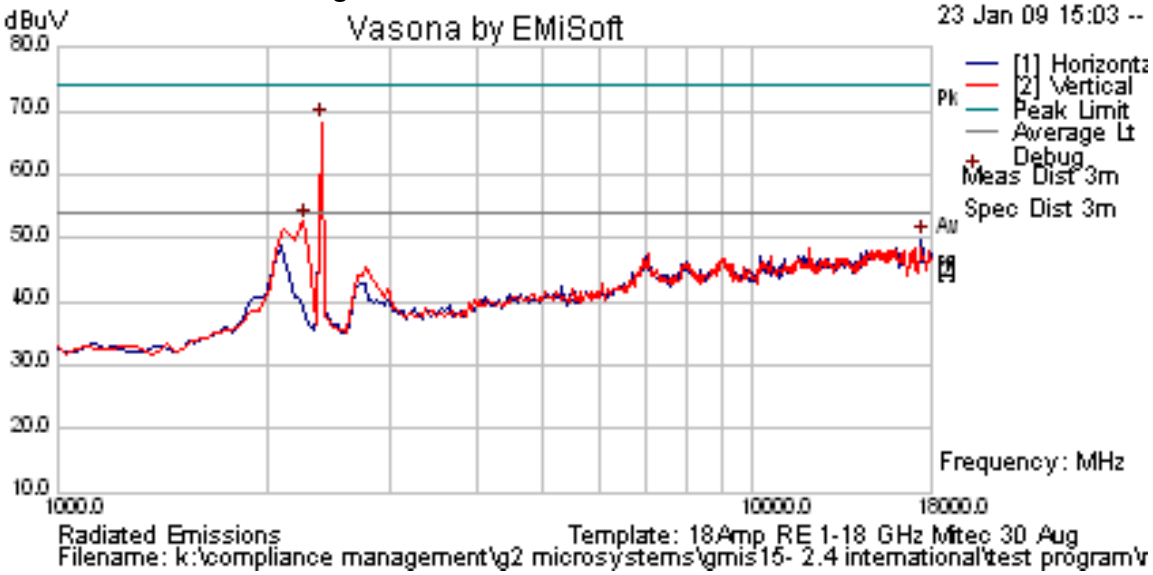
Power Setting = Maximum

TABLE OF RESULTS

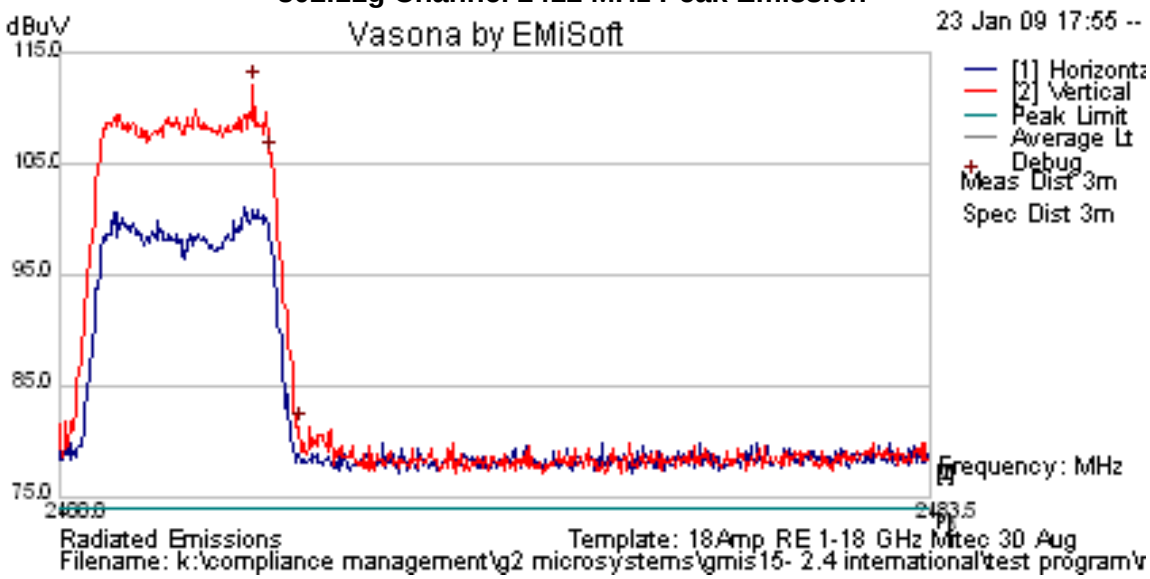
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2418.407	66.86	12.96	32.36	112.18	Peak [Scan]	H	N/A	N/A	N/A	N/A	N/A	Pk Emission
2390.000	Power Setting = Maximum			57.52	Peak Max	V	--	--	74	-16.48	Pass	Band Edge
2325.551				39.41	Average Max	V	--	--	54	-14.59	Pass	Band Edge

Pk Emission – Peak Emission
Band-Edge – Restricted Bands
RB – Restricted Band
NRB – Non-Restricted Band

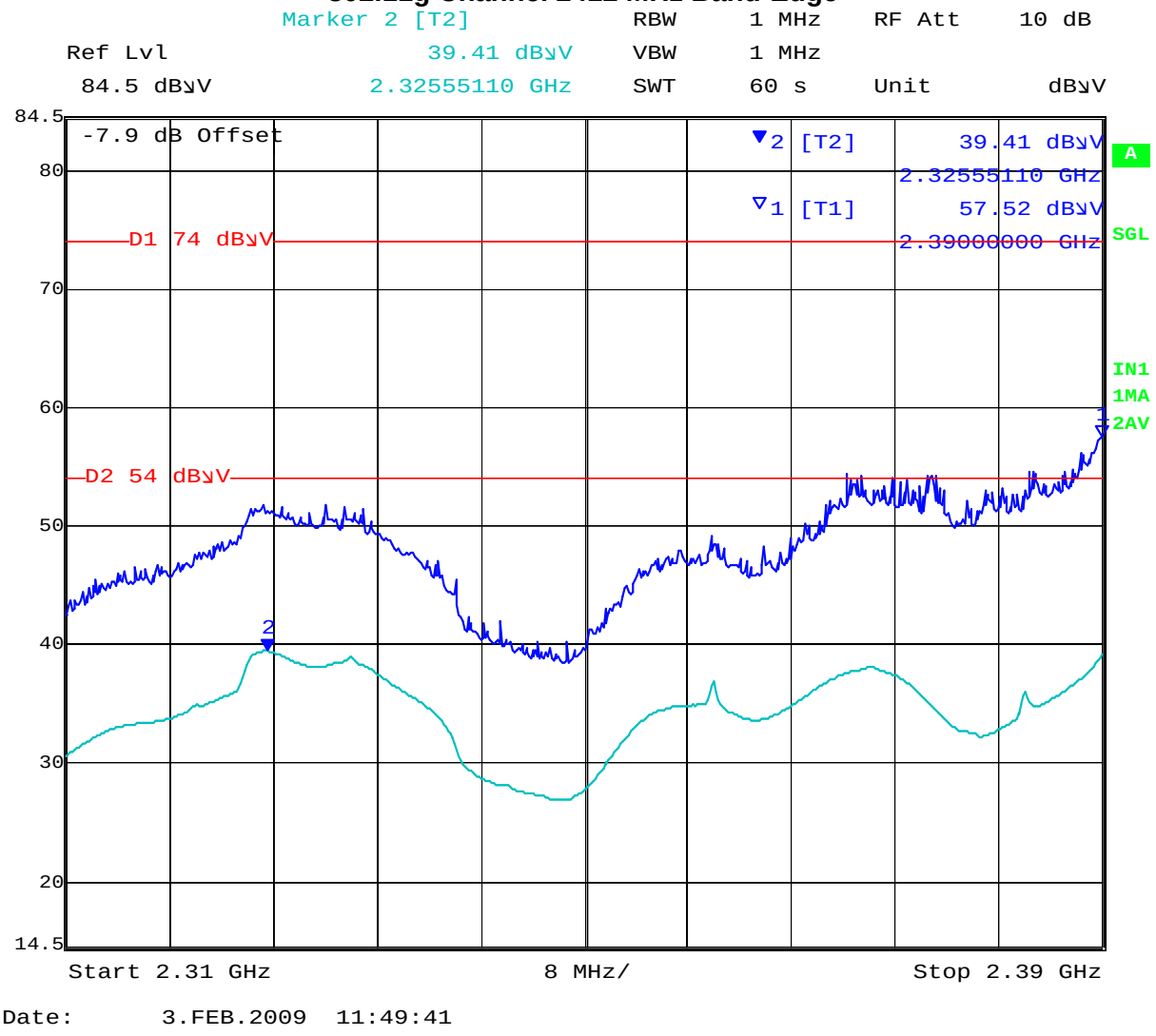
802.11g Channel 2412 MHz Radiated Emissions



802.11g Channel 2412 MHz Peak Emission



802.11g Channel 2412 MHz Band-Edge



802.11g Channel 2437 MHz External Dipole Antenna Gain 2 dBi

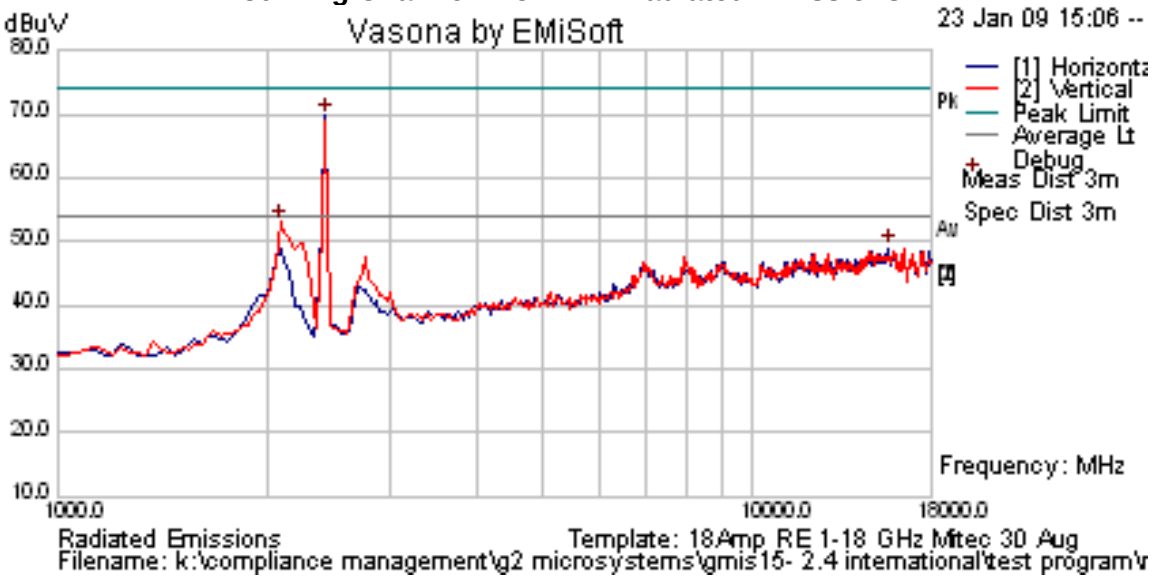
Power Setting = Maximum

TABLE OF RESULTS

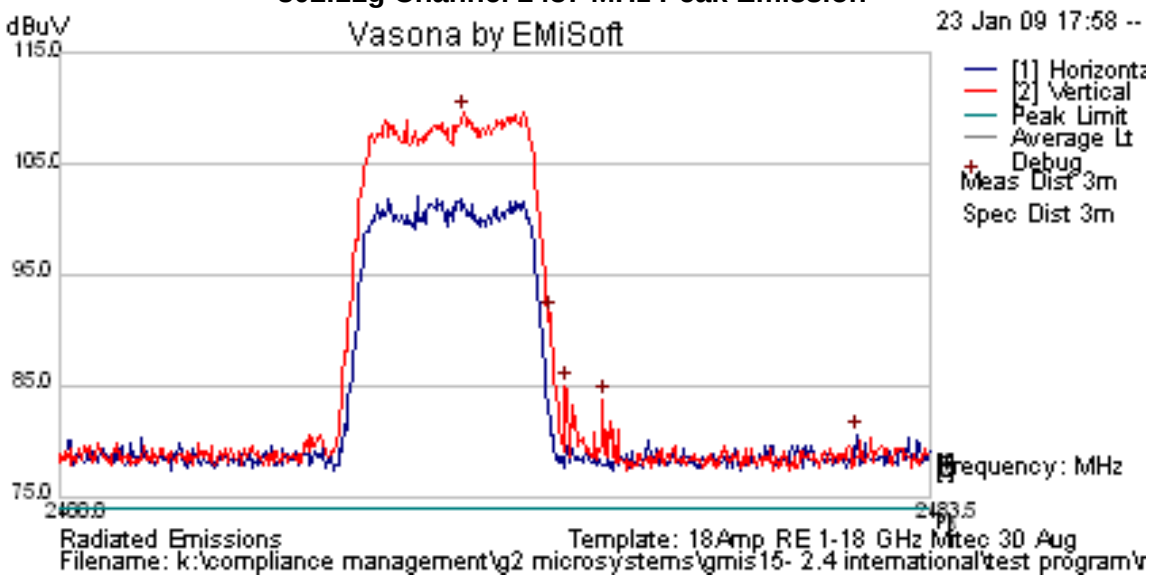
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2438.487	64.35	12.97	32.37	109.68	Peak [Scan]	H	N/A	N/A	N/A	N/A	N/A	Pk Emission

Pk Emission – Peak Emission
Band-Edge – Restricted Bands
RB – Restricted Band
NRB – Non-Restricted Band

802.11g Channel 2437 MHz Radiated Emissions



802.11g Channel 2437 MHz Peak Emission



802.11g Channel 2462 MHz External Dipole Antenna Gain 2 dBi

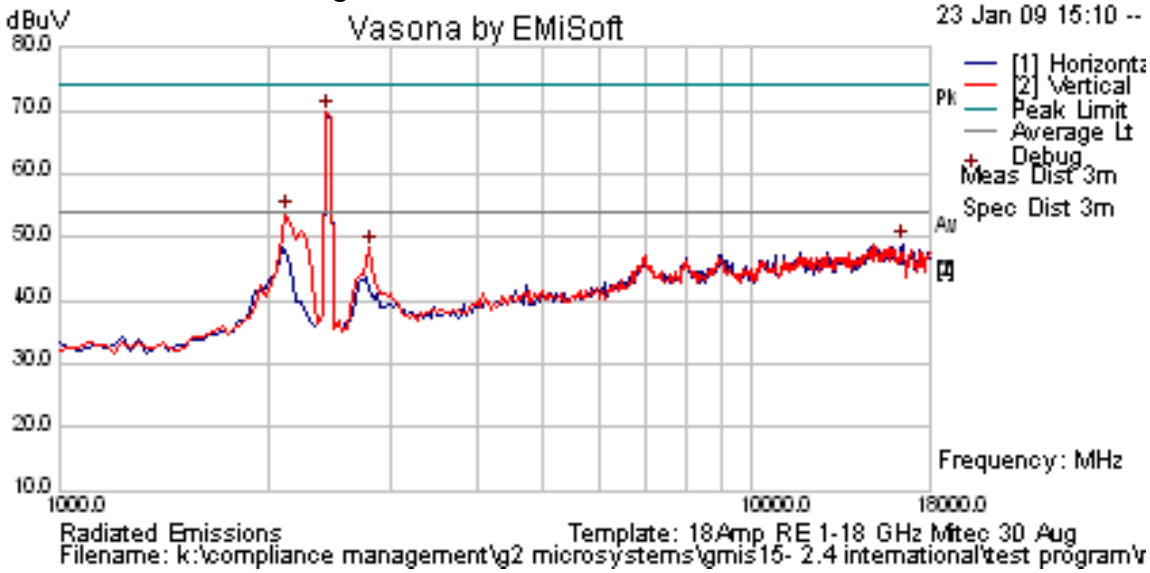
Power Setting = Maximum

TABLE OF RESULTS

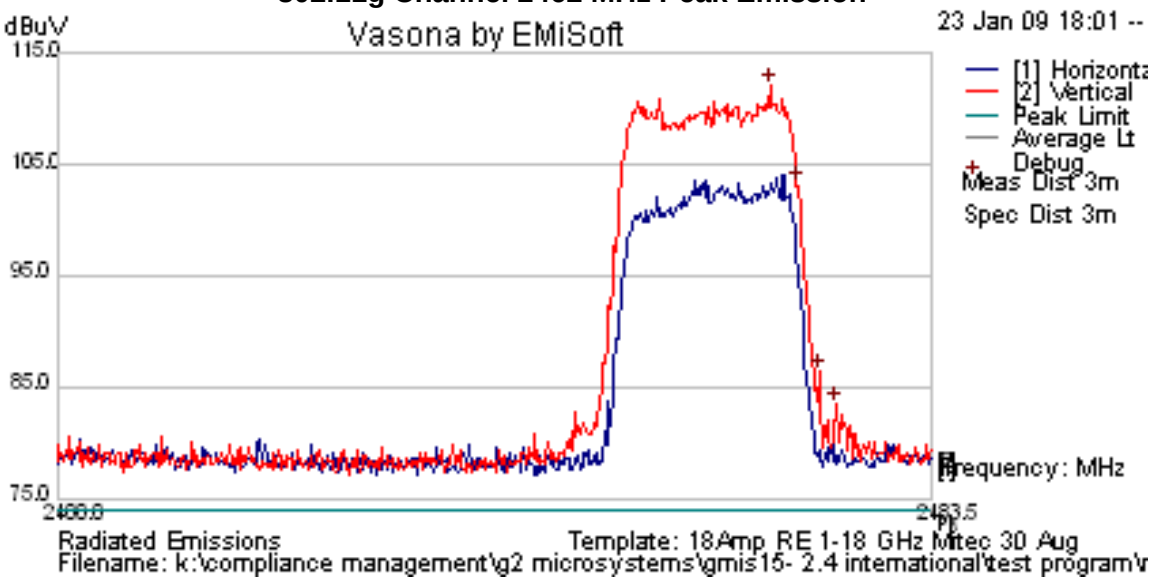
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2467.938	66.73	12.99	32.38	112.1	Peak [Scan]	H	N/A	N/A	N/A	N/A	N/A	Pk Emission
2483.533	Power Setting = Maximum			71.04	Peak Max	V	--	--	74	-17.45	Pass	Band-Edge
2483.897				51.56	Average Max	V	--	--	54	-6.99	Pass	Band-Edge

Pk Emission – Peak Emission
Band-Edge – Restricted Bands
RB – Restricted Band
NRB – Non-Restricted Band

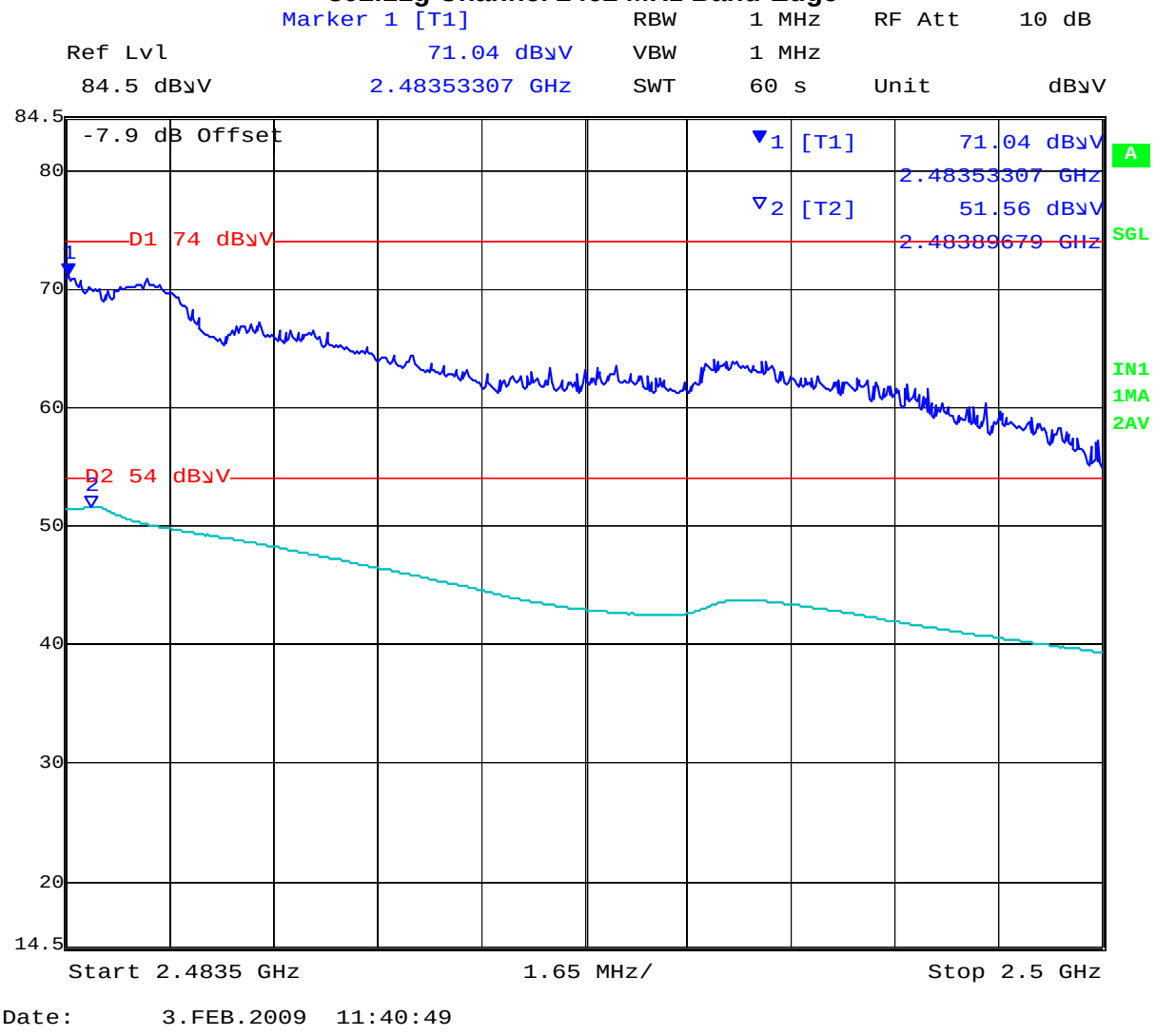
802.11g Channel 2462 MHz Radiated Emissions



802.11g Channel 2462 MHz Peak Emission



802.11g Channel 2462 MHz Band-Edge



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Integral Antenna

802.11b Channel 2412 MHz

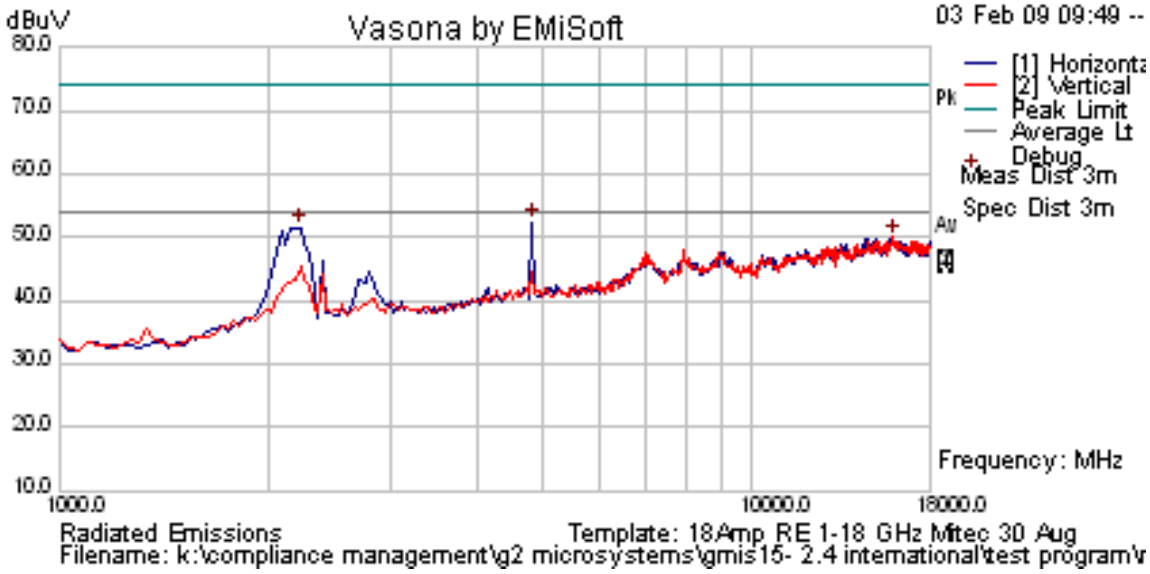
Power Setting = Maximum

TABLE OF RESULTS

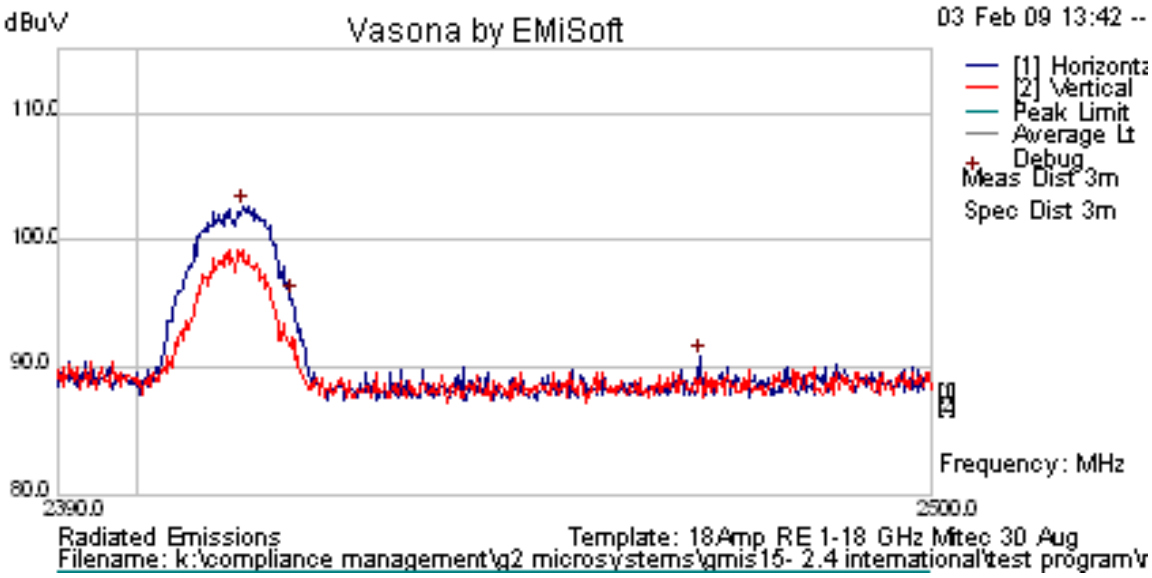
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2412.926	57.32	12.96	32.35	102.63	Peak [Scan]	H	N/A	N/A	N/A	N/A	N/A	Pk Emission
2319.138	Power Setting = Maximum			42.88	Peak Max	V	--	--	74	-31.12	Pass	Band-Edge
2319.299				30.07	Average Max	V	--	--	54	-23.93	Pass	Band-Edge
4824.206	58.96	4.47	-8.75	54.68	Peak Max	H	110	188	74	-19.32	Pass	RB
4824.206	56.18	4.47	-8.75	51.90	Average Max	H	110	188	54	-2.10	Pass	RB

Pk Emission – Peak Emission
Band-Edge – Restricted Bands
RB – Restricted Band
NRB – Non-Restricted Band

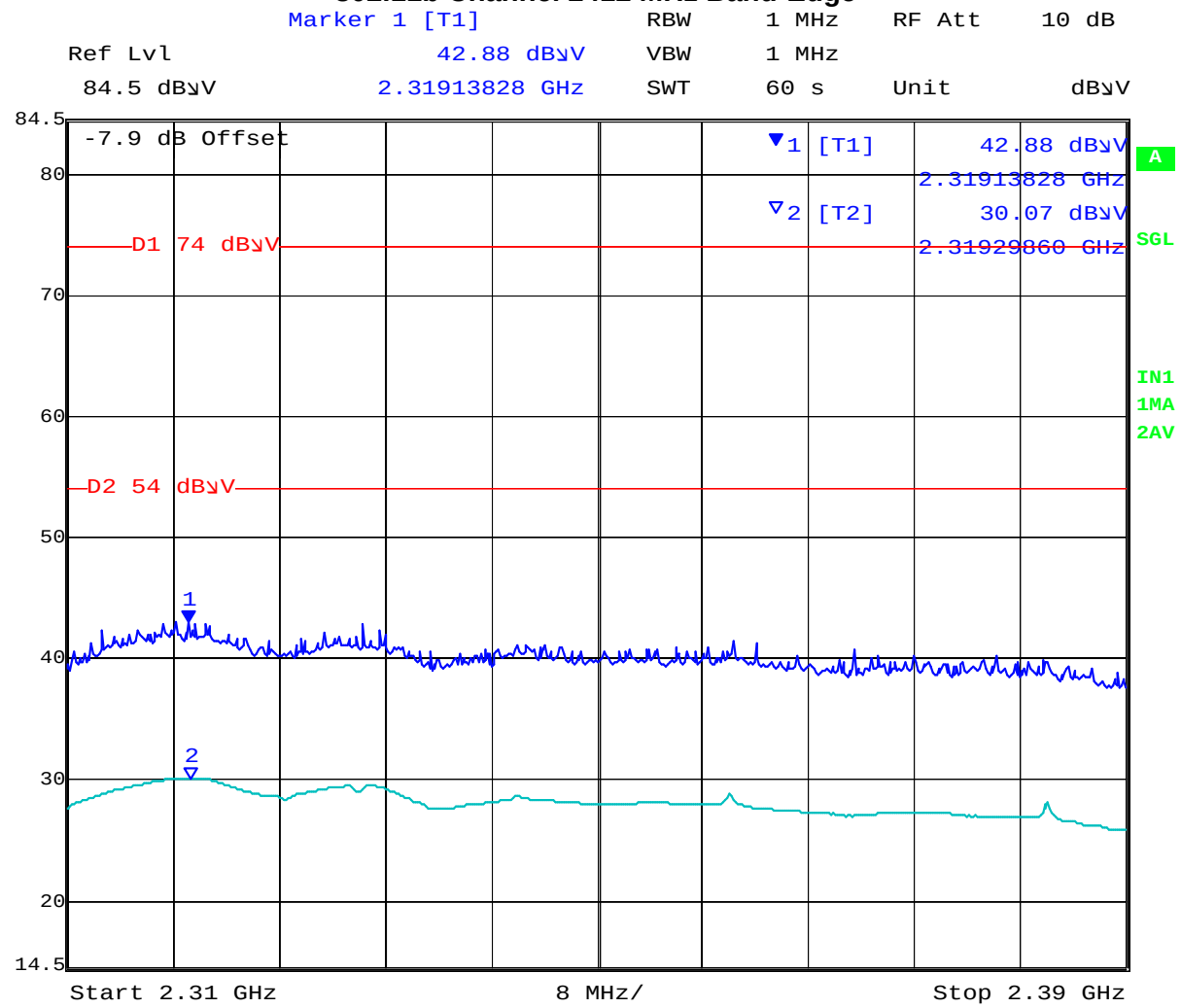
802.11b Channel 2412 MHz Radiated Emissions



802.11b Channel 2412 MHz Peak Emission



802.11b Channel 2412 MHz Band-Edge



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802.11b Channel 2437 MHz, Integral Antenna

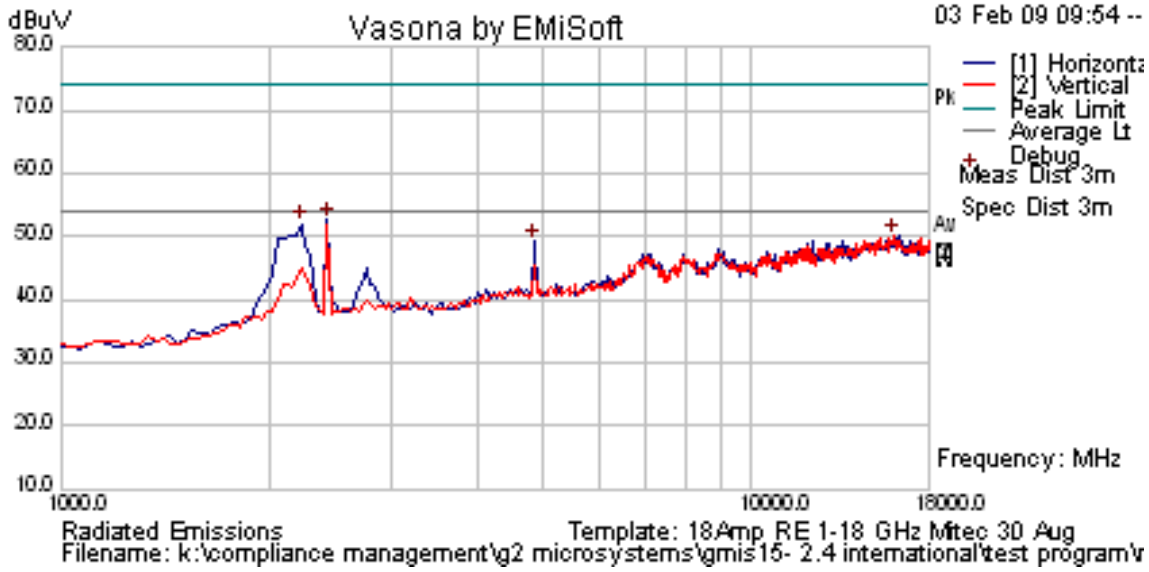
Power Setting = Maximum

TABLE OF RESULTS

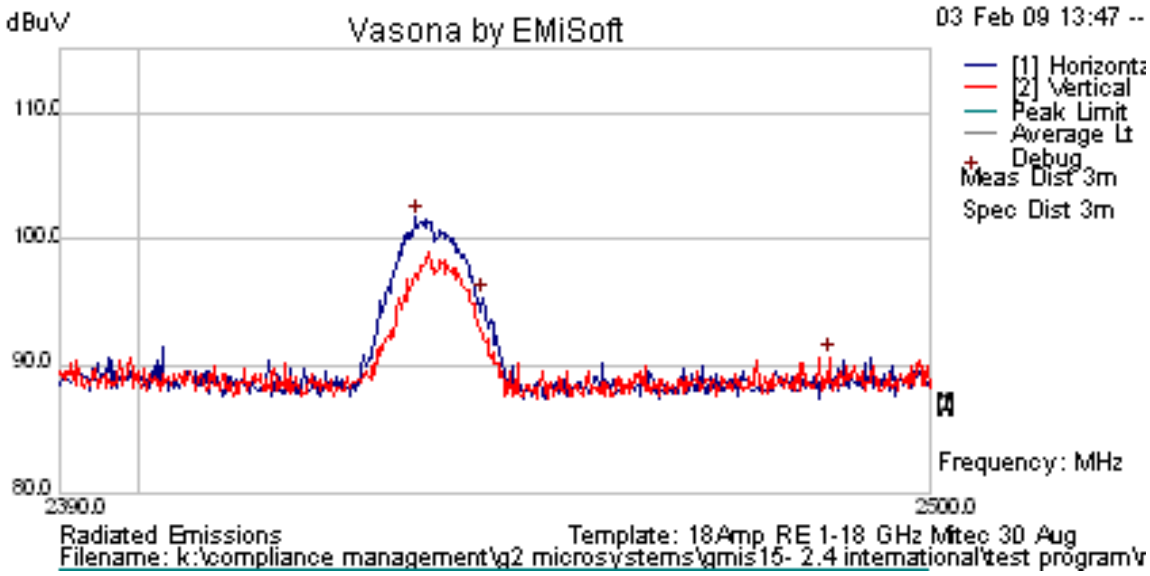
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2434.529	56.43	12.97	32.36	101.76	Peak [Scan]	H	N/A	N/A	N/A	N/A	N/A	Pk Emission
4874.045	58.17	4.51	-8.75	53.93	Peak Max	H	125	193	74	-20.07	Pass	RB
4874.045	55.05	4.51	-8.75	50.81	Average Max	H	125	193	54	-3.19	Pass	RB

Pk Emission – Peak Emission
RB – Restricted Band
NRB – Non-Restricted Band

802.11b Channel 2437 MHz Radiated Emissions



802.11b Channel 2437 MHz Peak Emission



802.11b Channel 2462 MHz Integral Antenna

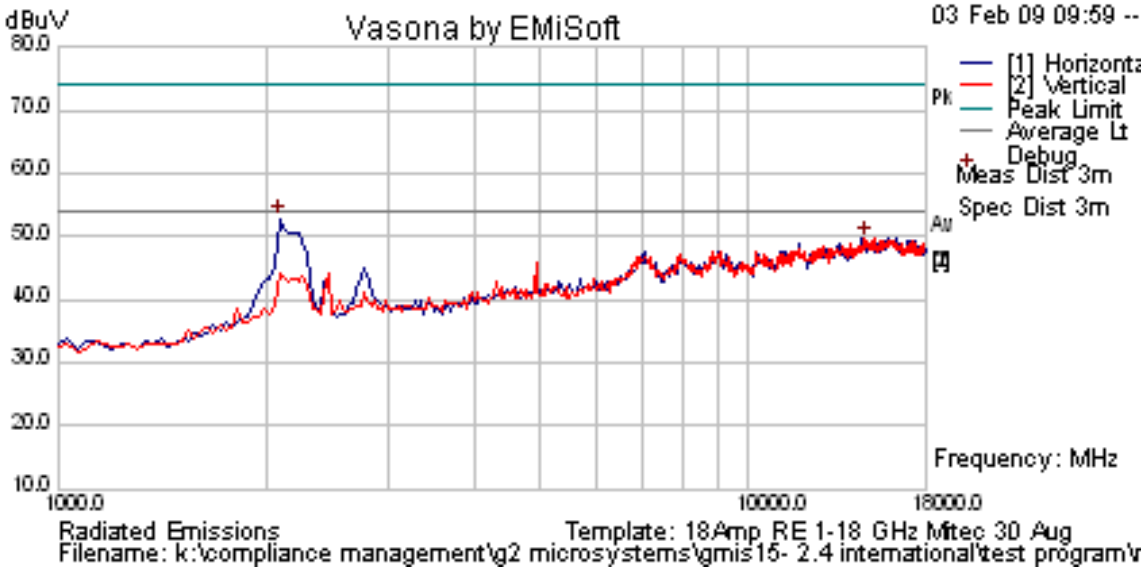
Power Setting = Maximum

TABLE OF RESULTS

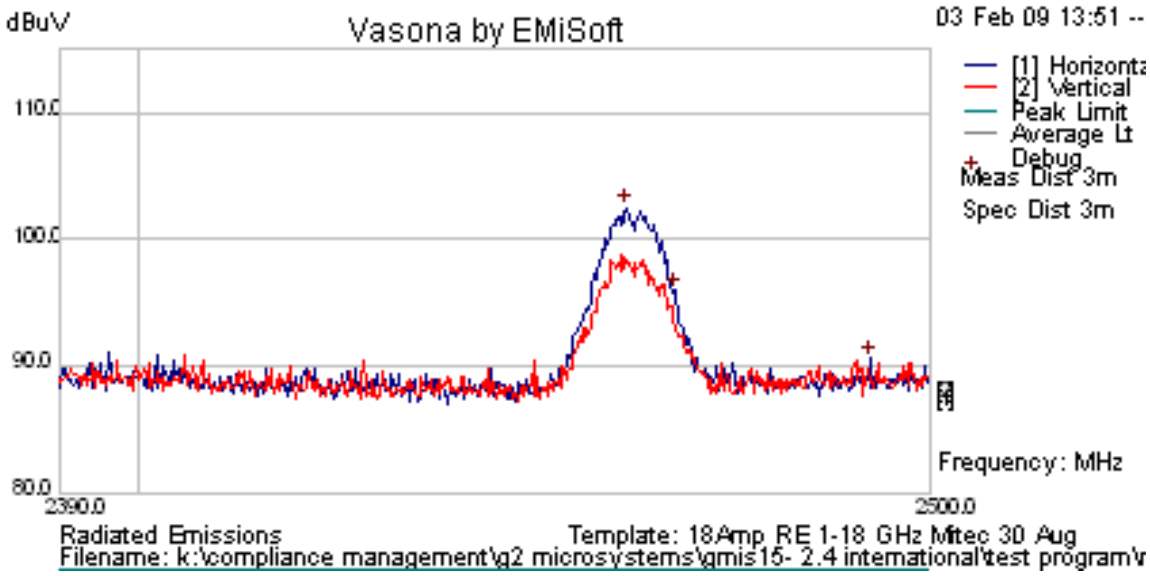
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2461.202	57.08	12.98	32.38	102.44	Peak [Scan]	H	N/A	N/A	N/A	N/A	N/A	Pk Emission
2484.062	Power Setting = Maximum			47.88	Peak Max	V	--	--	74	-26.12	Pass	Band-Edge
2483.996				37.78	Average Max	V	--	--	54	-16.22	Pass	Band-Edge

Pk Emission – Peak Emission
Band-Edge – Restricted Bands
RB – Restricted Band
NRB – Non-Restricted Band

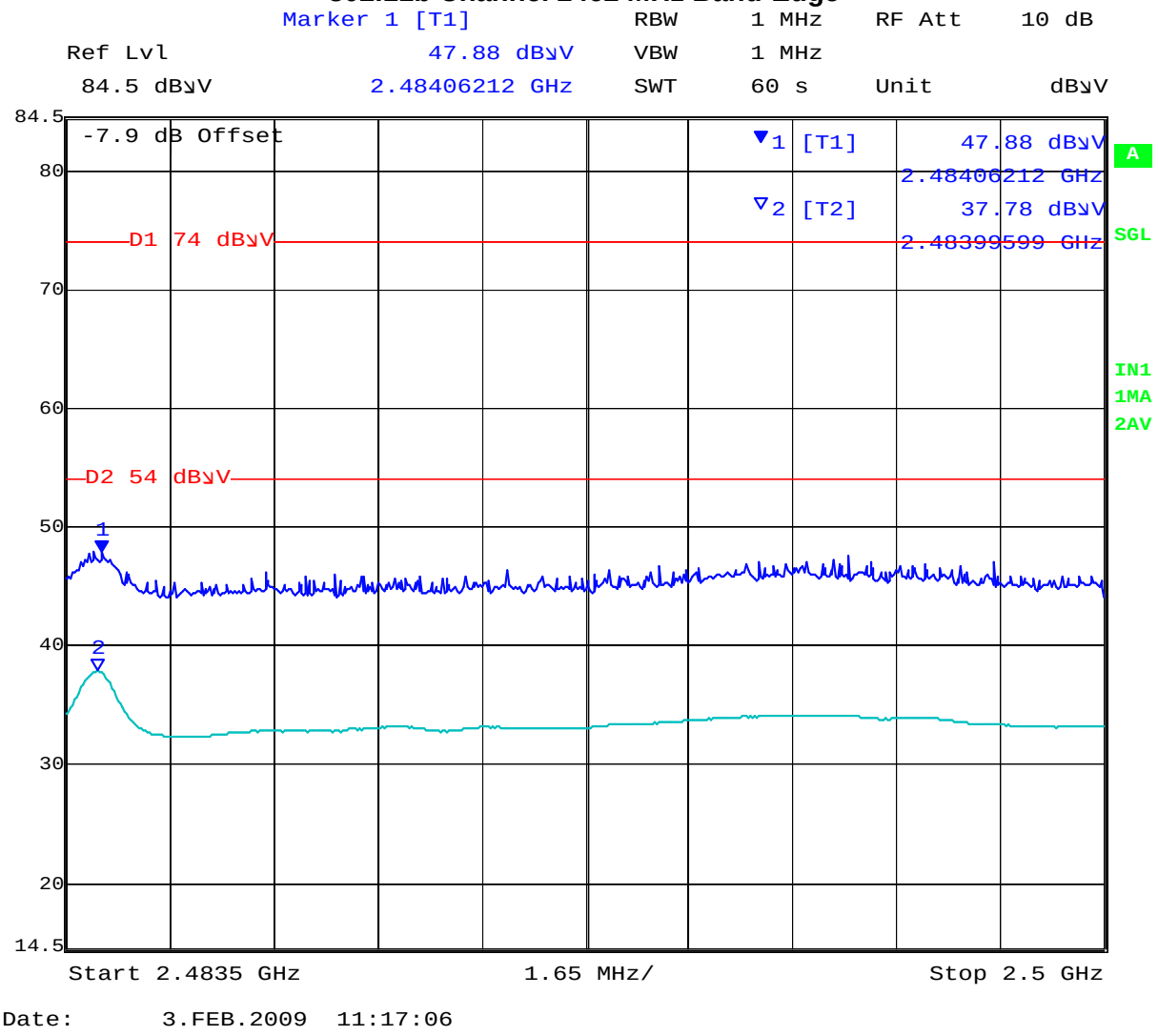
802.11b Channel 2462 MHz Radiated Emissions



802.11b Channel 2462 MHz Peak Emission



802.11b Channel 2462 MHz Band-Edge



802.11g Channel 2412 MHz Integral Antenna

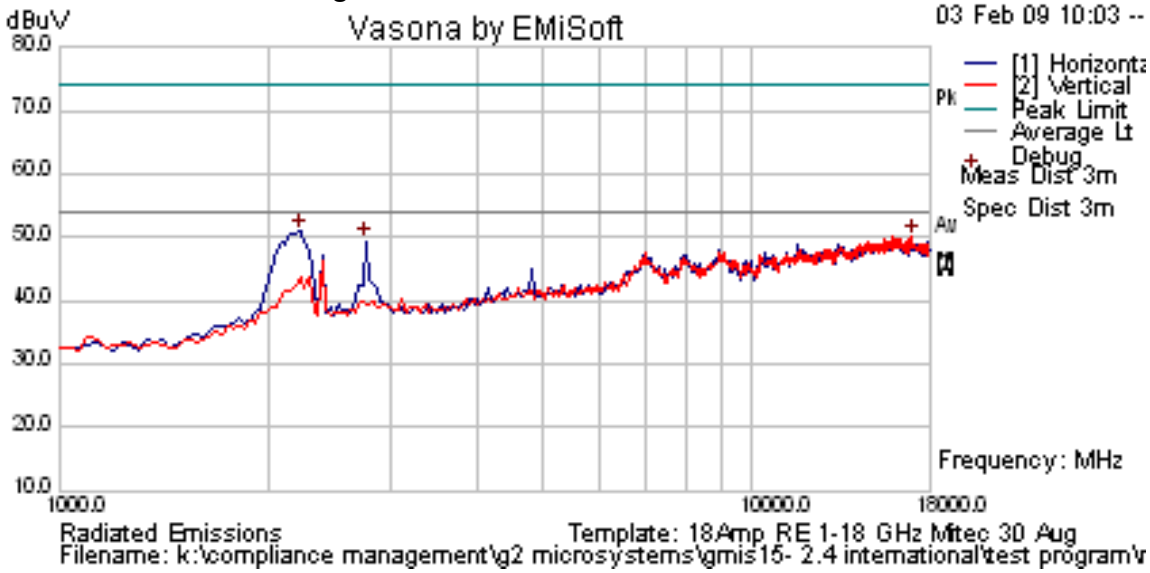
Power Setting = Maximum

TABLE OF RESULTS

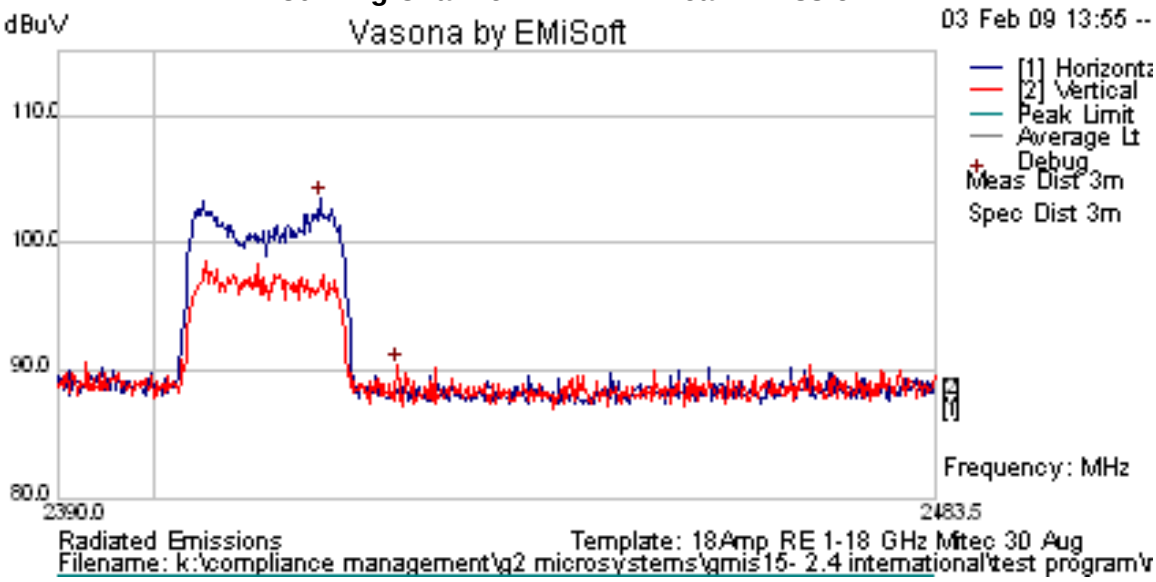
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2417.544	58.18	12.96	32.35	103.5	Peak [Scan]	H	N/A	N/A	N/A	N/A	N/A	Pk Emission
2317.535	Power Setting = Maximum			42.97	Peak Max	V	--	--	74	-31.03	Pass	Band Edge
2319.780				29.76	Average Max	V	--	--	54	-24.24	Pass	Band Edge

Pk Emission – Peak Emission
Band-Edge – Restricted Bands
RB – Restricted Band
NRB – Non-Restricted Band

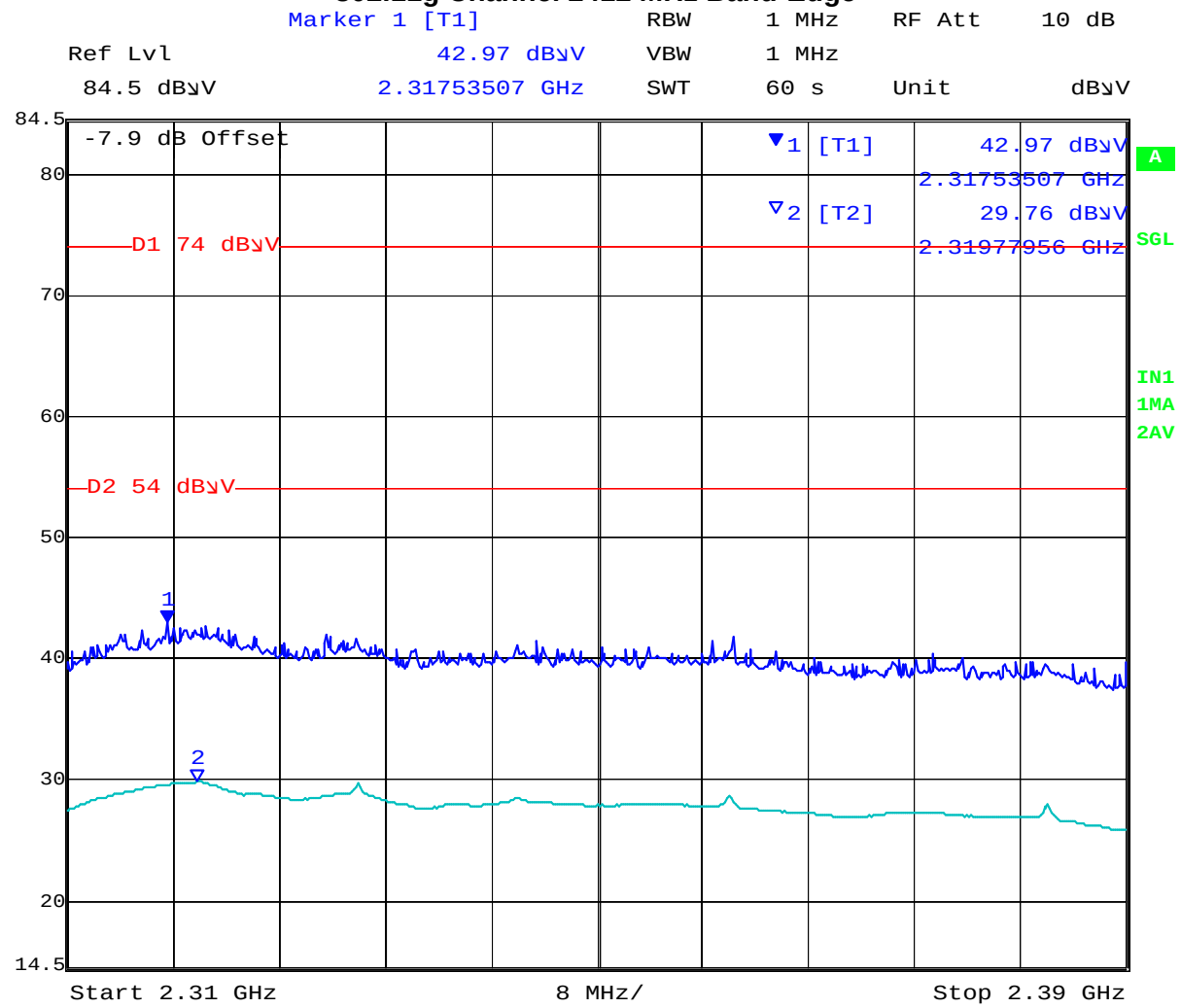
802.11g Channel 2412 MHz Radiated Emissions



802.11g Channel 2412 MHz Peak Emission



802.11g Channel 2412 MHz Band-Edge



Date: 3.FEB.2009 11:07:42

802.11g Channel 2437 MHz Integral Antenna

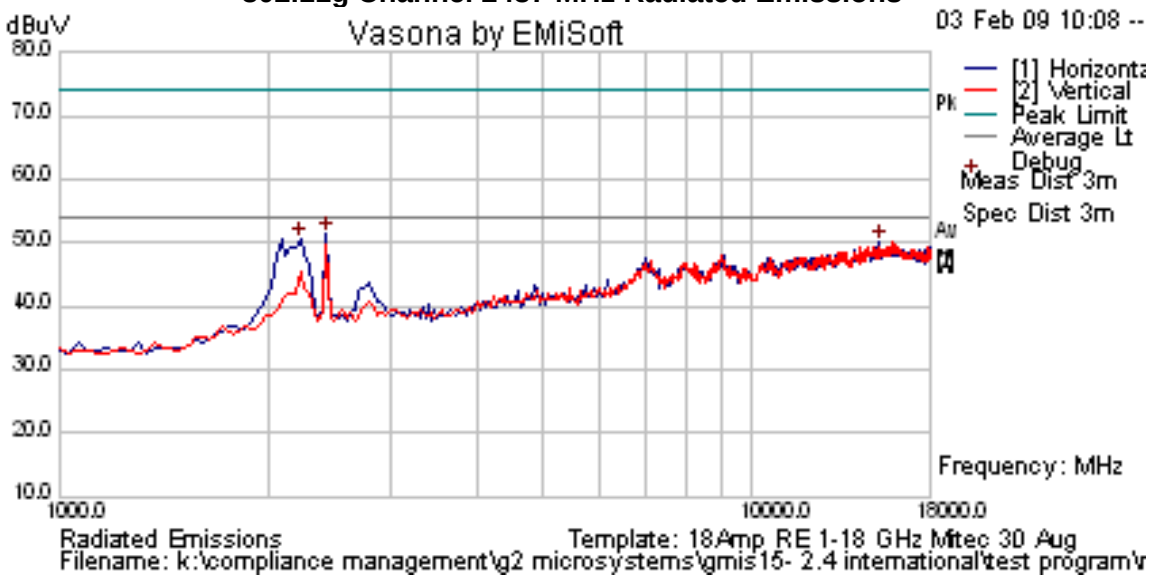
Power Setting = Maximum

TABLE OF RESULTS

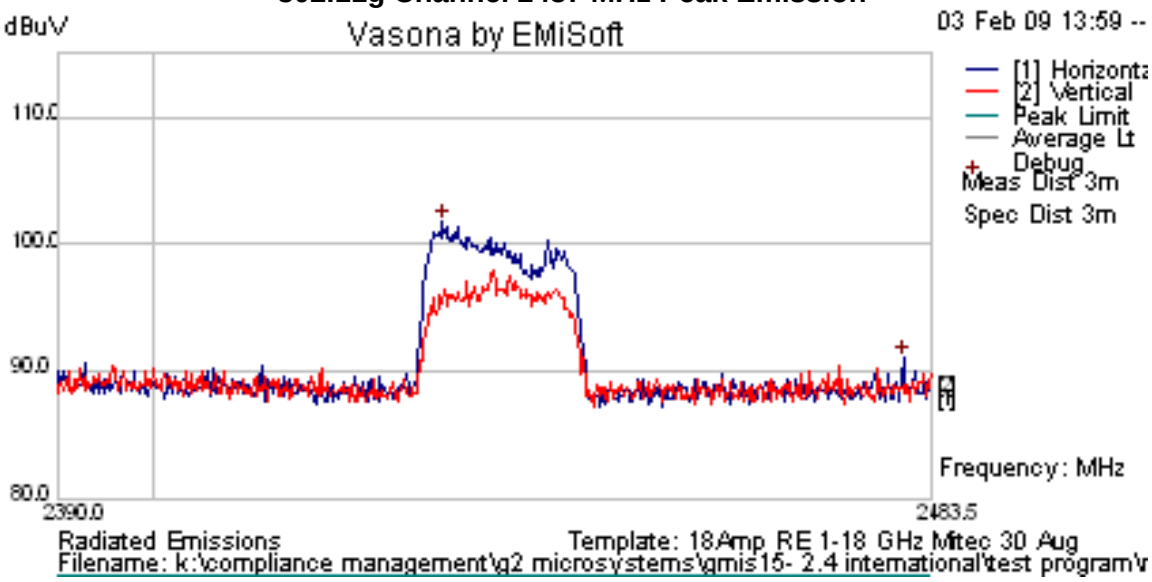
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2430.848	56.4	12.97	32.36	101.73	Peak [Scan]	H	N/A	N/A	N/A	N/A	N/A	Pk Emission

Pk Emission – Peak Emission
Band-Edge – Restricted Bands
RB – Restricted Band
NRB – Non-Restricted Band

802.11g Channel 2437 MHz Radiated Emissions



802.11g Channel 2437 MHz Peak Emission



802.11g Channel 2462 MHz Integral Antenna

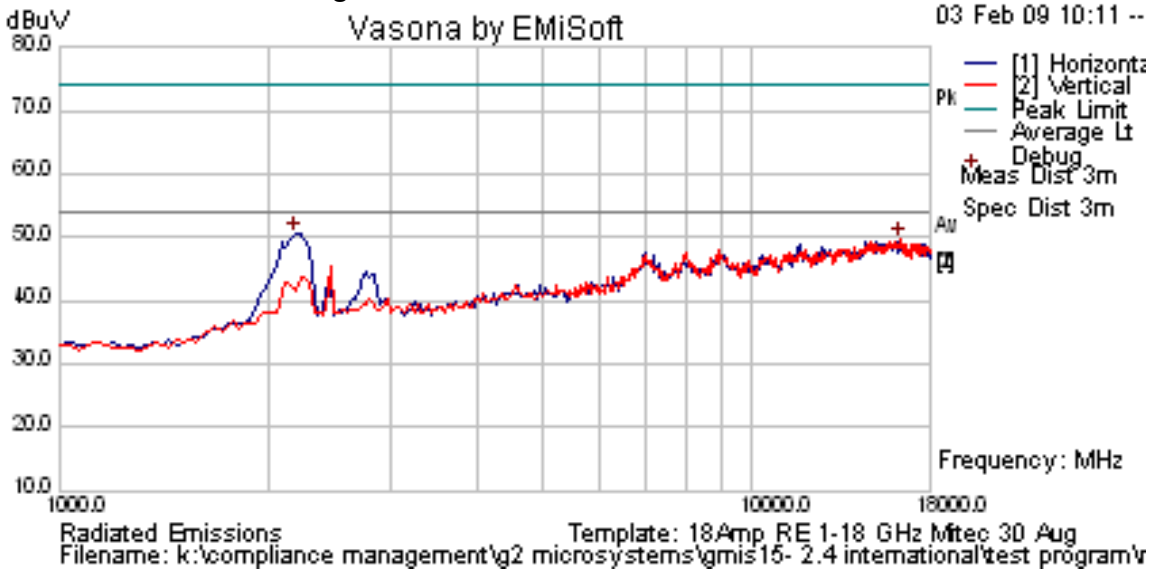
Power Setting = Maximum

TABLE OF RESULTS

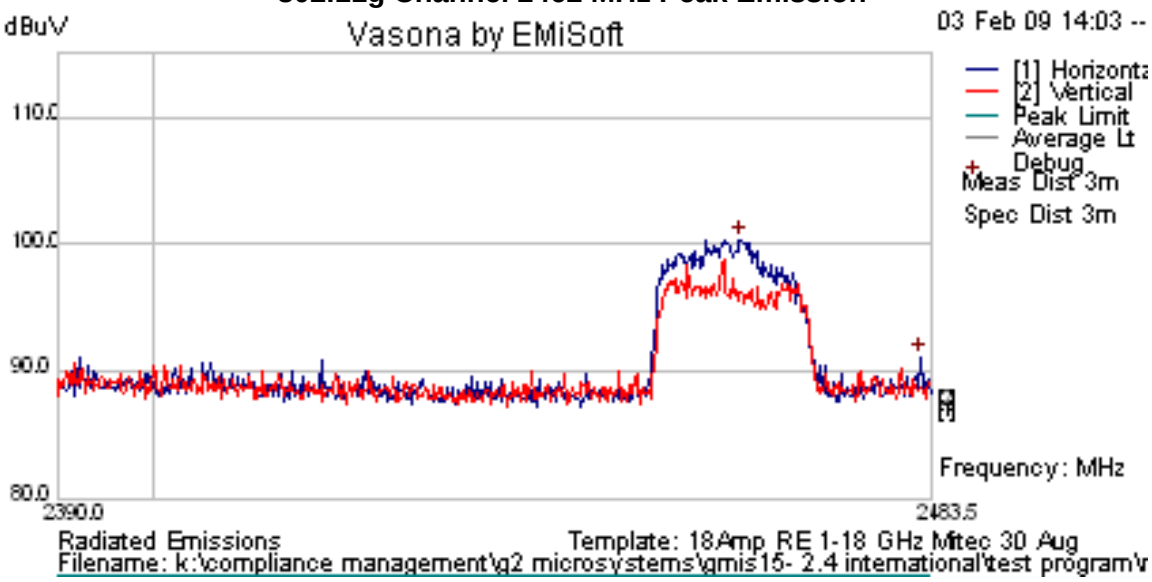
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2462.889	55	12.98	32.38	100.36	Peak [Scan]	H	N/A	N/A	N/A	N/A	N/A	Pk Emission
2485.120	Power Setting = Maximum			52.53	Peak Max	V	--	--	74	-21.47	Pass	Band-Edge
2483.963				37.88	Average Max	V	--	--	54	-16.16	Pass	Band-Edge

Pk Emission – Peak Emission
Band-Edge – Restricted Bands
RB – Restricted Band
NRB – Non-Restricted Band

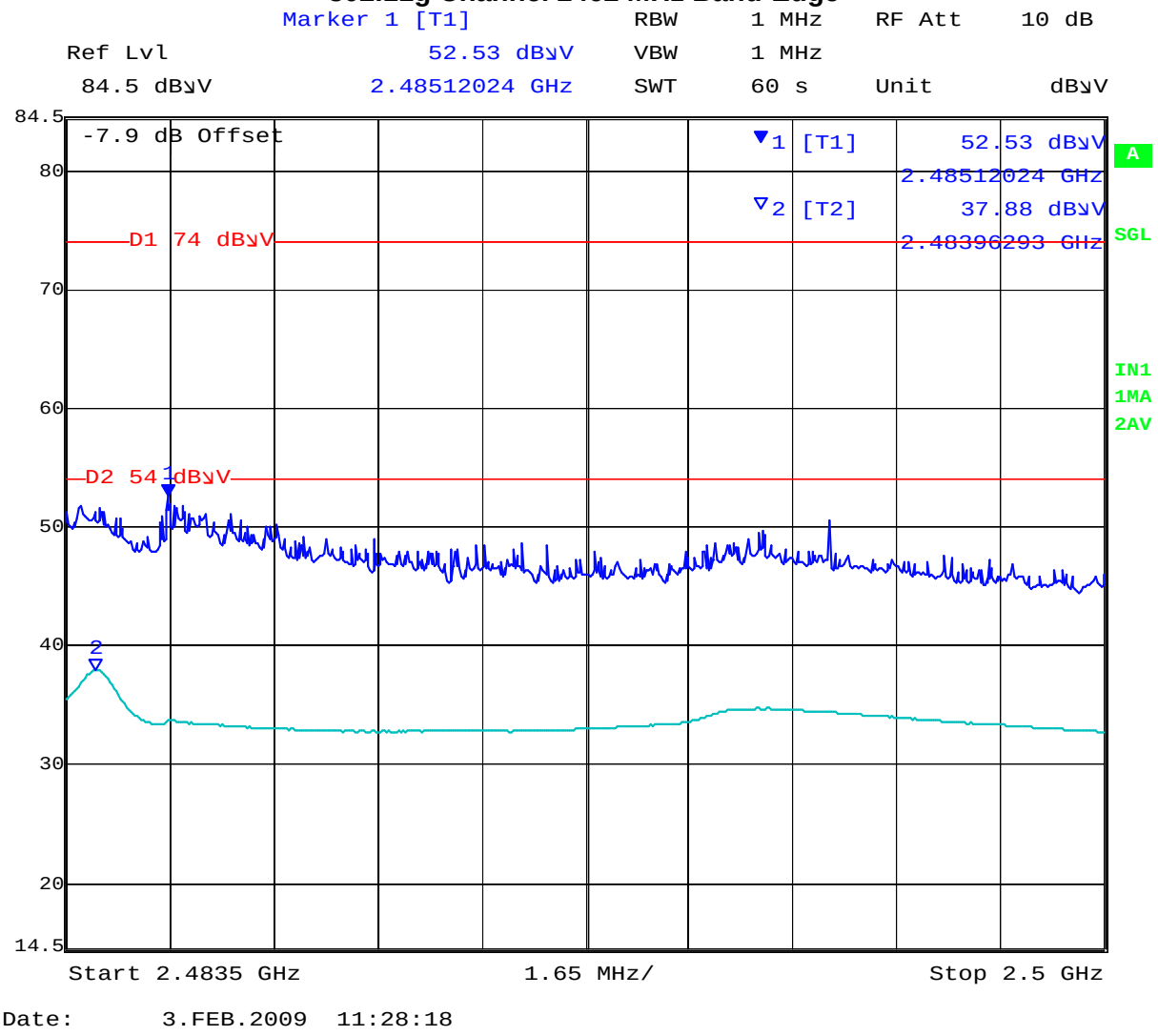
802.11g Channel 2462 MHz Radiated Emissions



802.11g Channel 2462 MHz Peak Emission



802.11g Channel 2462 MHz Band-Edge



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

5.1.6.2. Receiver Radiated Spurious Emissions (above 1 GHz)

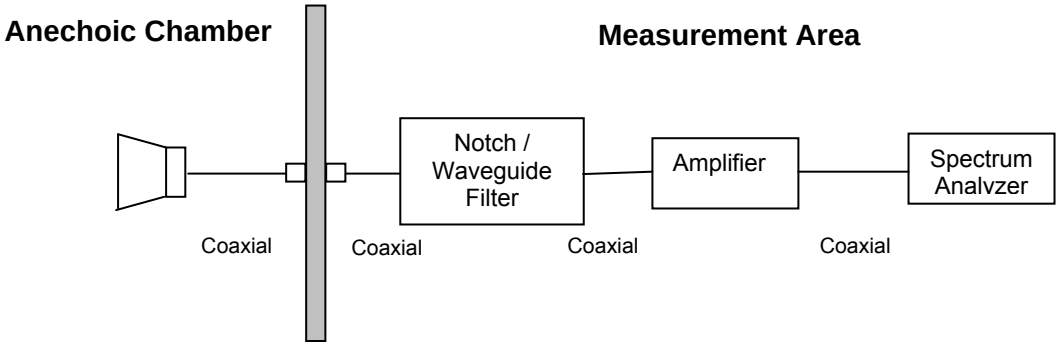
Industry Canada RSS-Gen §4.8, §6

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

The voltage on the battery was continually monitored and replaced when necessary.

Receiver Radiated Spurious Emissions above 1 GHz

Receiver results cover all variants

TABLE OF RESULTS

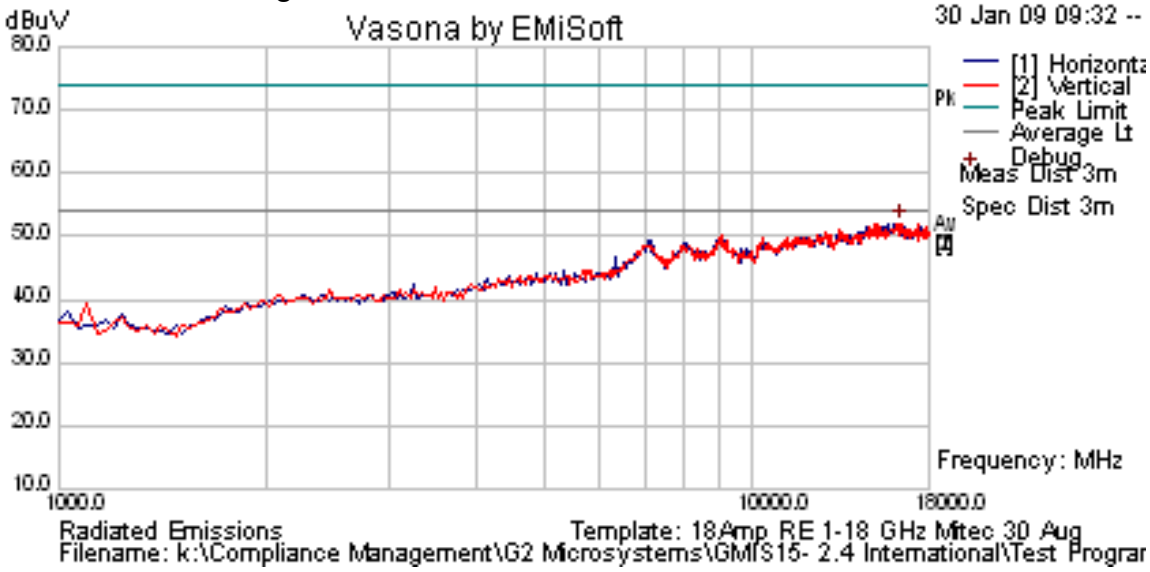
802.11bg Channel 2437 MHz Integral Antenna

TABLE OF RESULTS

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments

No emissions found within 6 dB of the limit line

802.11bg Channel 2437 MHz Receiver Radiated Emissions



The above plot identifies peak emissions only

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

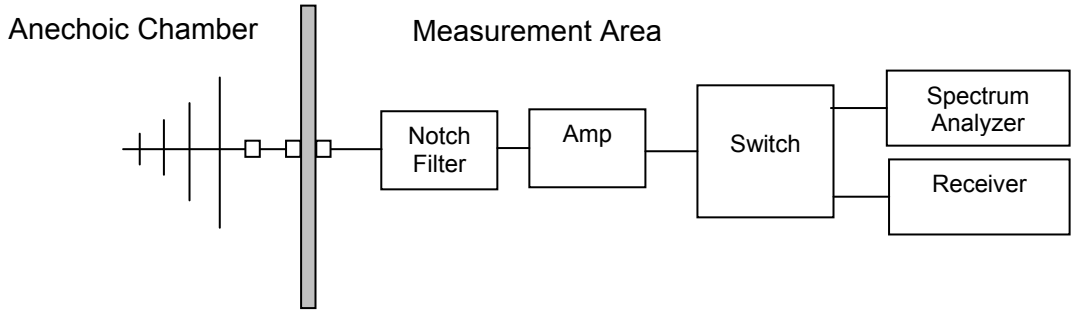
Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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

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

Test Procedure
Preliminary radiated emissions are measured in the anechoic chamber at a 3-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 a CISPR compliant receiver. Only the highest emissions relative to the limit are listed.

Test Measurement Set up



The product was initially tested to find worst case orientation for the maximization of spurious emissions. Worst case orientation was used for all emission testing.

The voltage on the battery was continually monitored and replaced when necessary.

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)

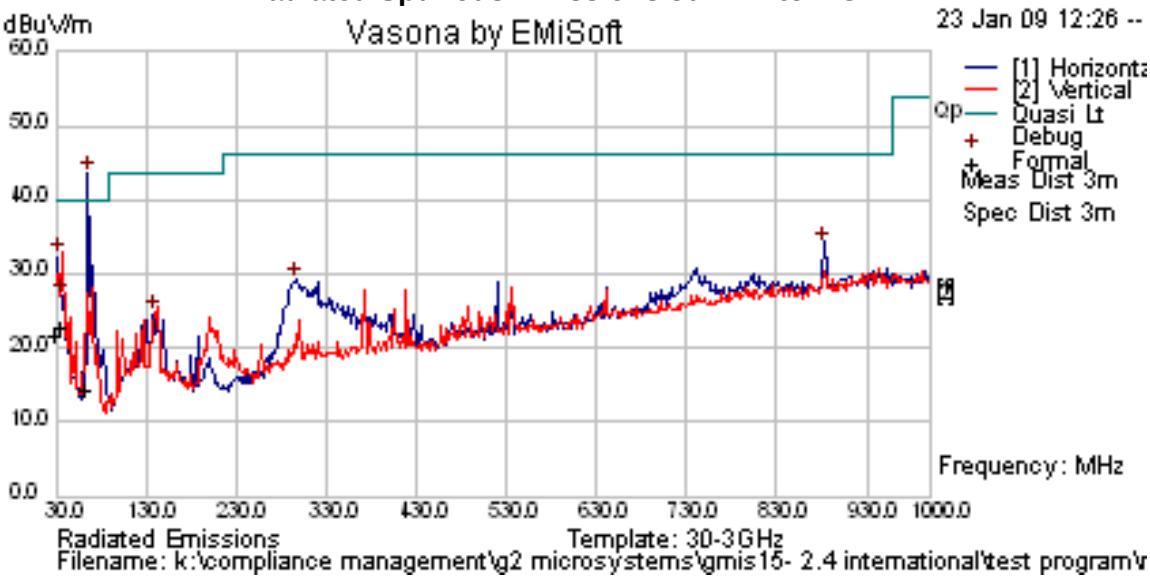
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

TABLE OF RESULTS – CHANNEL 2412 802.11b Integral Antenna

Boost Mode

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB
63.614	42.35	3.85	-31.79	14.4	Quasi Max	H	143	178	40	-25.6
30	31.89	3.37	-13.7	21.56	Quasi Max	H	247	300	40	-18.44
36.468	39.46	3.51	-20.09	22.88	Quasi Max	V	107	183	40	-17.12
883.625	47.1	7.27	-20.54	33.82	Peak [Scan]	H	204	0	46	-12.18
297.255	53.19	5.21	-29.16	29.23	Peak [Scan]	H	204	0	46	-16.77
138.925	49.03	4.41	-28.8	24.64	Peak [Scan]	H	204	0	43.5	-18.86

Radiated Spurious Emissions 30 MHz to 1 GHz



The above plot identifies peak emissions only

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 work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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

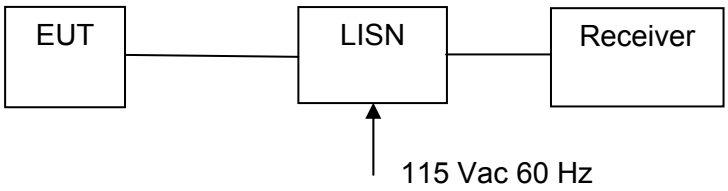
FCC, Part 15 Subpart C §15.207
Industry Canada RSS-Gen §7.2.2

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.

All six transmitters were operational and terminated in a 50Ω load.

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

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

No test required the device was battery operated

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.

§15.207 (a) 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

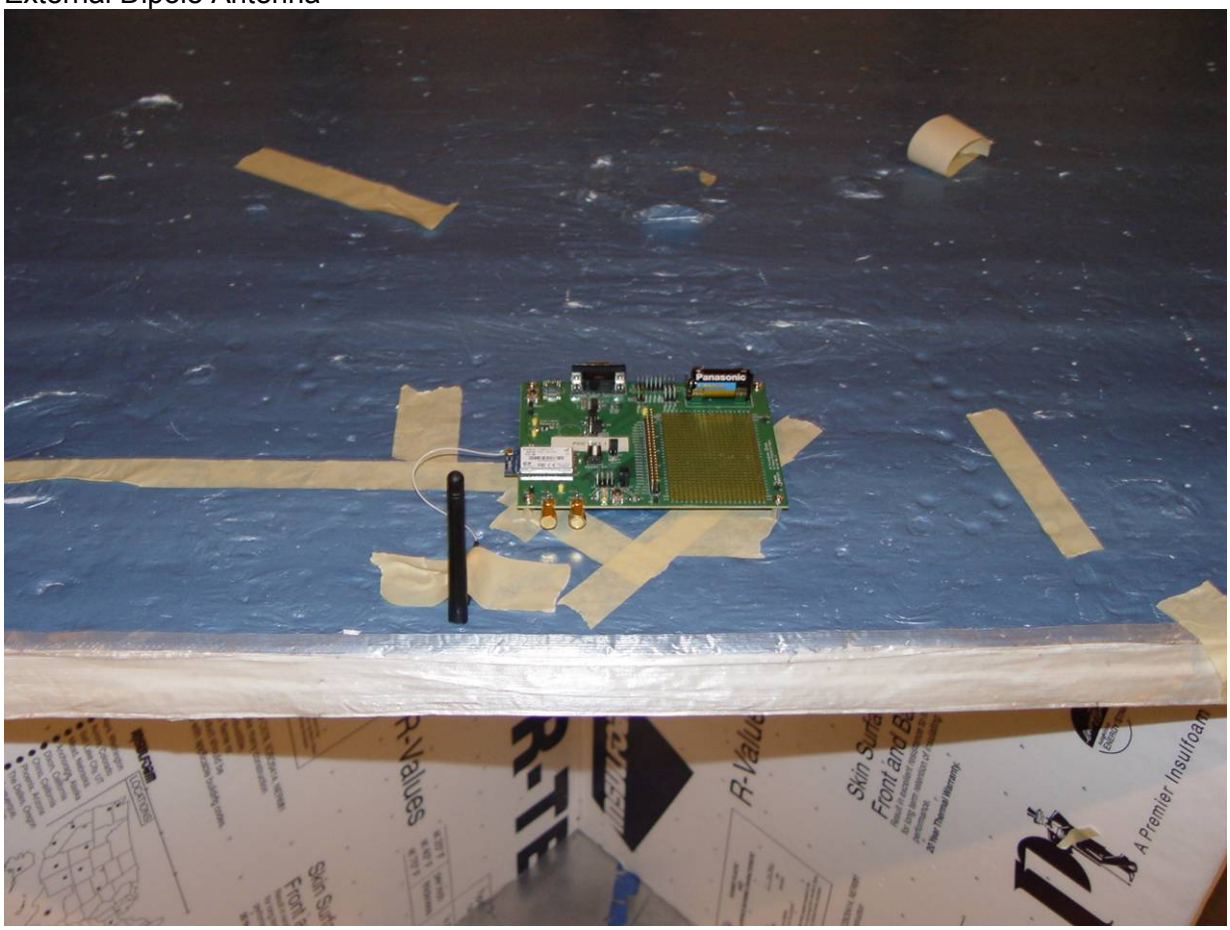
Traceability

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

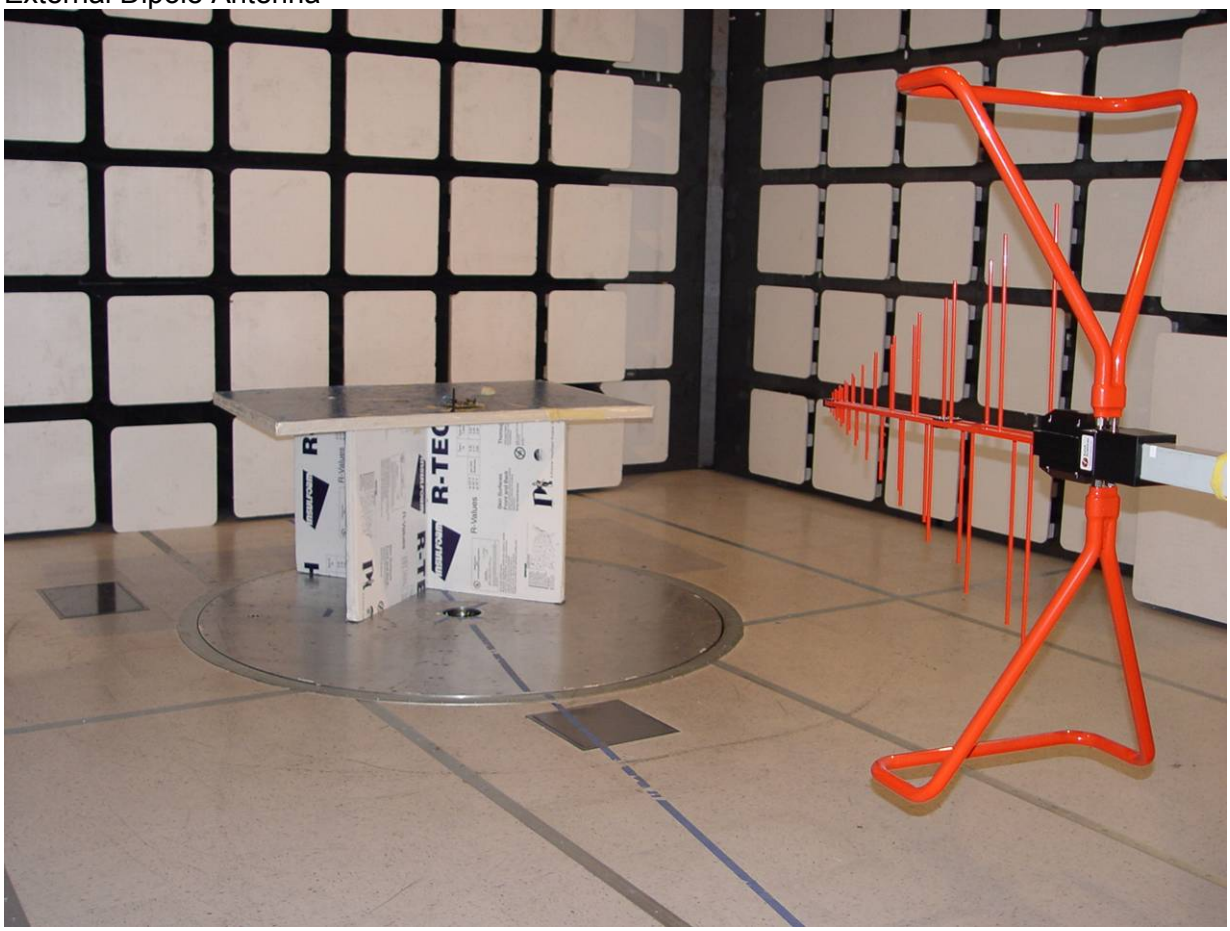
6.1. Radiated Emissions Test Configuration (below 1 GHz)

External Dipole Antenna



6.2. Radiated Emissions (below 1 GHz)

External Dipole Antenna



6.3. Radiated Emissions (above 1 GHz)

Integral Antenna

6.4. General Measurement Test Set-Up

6.5. Conducted Testing - Test Equipment

7. TEST EQUIPMENT DETAILS

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

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