Test of WhereCall IV Class II Permissive Change
Test Report

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

Test Report Serial No.: ETSD18-A2 Rev A

TEST REPORT

FROM

MiCOM Labs

Test of WhereCall IV
Class II Permissive Change Test Report

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

Test Report Serial No.: ETSD18-A2 Rev A

This report supersedes: NONE

Manufacturer: Zebra Technologies Corp
333 Corporate Woods Parkway
Vernon Hills
Illinois 60061, USA

Product Function: RFID and Real Time Local Positioning and Tracking

Copy No: pdf **Issue Date:** 14th July 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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1. ACCREDITATION, LISTINGS & RECOGNITION

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

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	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	I I	

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	14th July 2009	Initial release.

2. TEST RESULT CERTIFICATE

Manufacturer:	Zebra Technologies Corp 333 Corporate Woods Parkway Vernon Hills Illinois 60061, USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	WhereCall IV PLC	Telephone:	+1 925 462 0304
Model:	TFF-2220	Fax:	+1 925 462 0306
S/N:	0039021755 / 0039021753		
Test Date(s):	22nd - 26th June 2009	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:

ACCREDITED
CERTIFICATE #2381.01

Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

3. REFERENCES AND MEASUREMENT UNCERTAINTY

3.1. 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	Edition 5.2 2006-03	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(vi)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vii)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(viii)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(ix)	A2LA	14th September 2005	Reference to A2LA Accreditation Status – A2LA Advertising Policy

3.2. 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.

4. PRODUCT DETAILS AND TEST CONFIGURATIONS

4.1. Technical Details

Details	Description
Purpose:	Test of the WhereNet WhereCall IV to FCC Part 15.247 and Industry Canada RSS-210 regulations as a Class II Permissive Change.
Applicant:	As Manufacturer
Manufacturer:	Zebra Technologies Corp 333 Corporate Woods Parkway Vernon Hills Illinois 60061, USA
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	ETSD18-A2 Rev A
Date EUT received:	22nd June 2009
Standard(s) applied:	FCC 47 CFR Part15.247 & IC RSS-210
Dates of test (from - to):	22nd - 26th June 2009
No of Units Tested:	2
Type of Equipment:	DSSS/OOK/802.11b RFID Active Tag
Manufacturers Trade Name:	WhereCall IV
Model:	TFF-2220
Location for use:	Indoor/Outdoor use
Declared Frequency Range(s):	2400 - 2483.5 MHz
Type of Modulation:	DSSS, OOK, CCK
Declared Nominal Output Power:	DSSS: +13 ± 1.5 dBm OOK: -1.5 ± 1.5 dBm 802.11b: +10 ± 1.5 dBm
EUT Modes of Operation:	DSSS, OOK, 802.11b
Transmit/Receive Operation:	Time Division Duplex
Rated Input Voltage and Current:	3.6 Vdc, 200 mA
Operating Temperature Range:	Declared range -40 to +85ºC
ITU Emission Designator:	DSSS – 67M3W7D OOK – 10M3W7D 802.11b – 15M9W7D
Microprocessor(s) Model:	Integrated LEON SPARC
Clock/Oscillator(s):	32.768 kHz, 44.00 MHz
Frequency Stability:	±20 ppm
Equipment Dimensions:	4.7” x 3.0” x 1.6”
Weight:	170 grams
Primary function of equipment:	RFID and real time local positioning and tracking device

4.2. Scope of Test Program

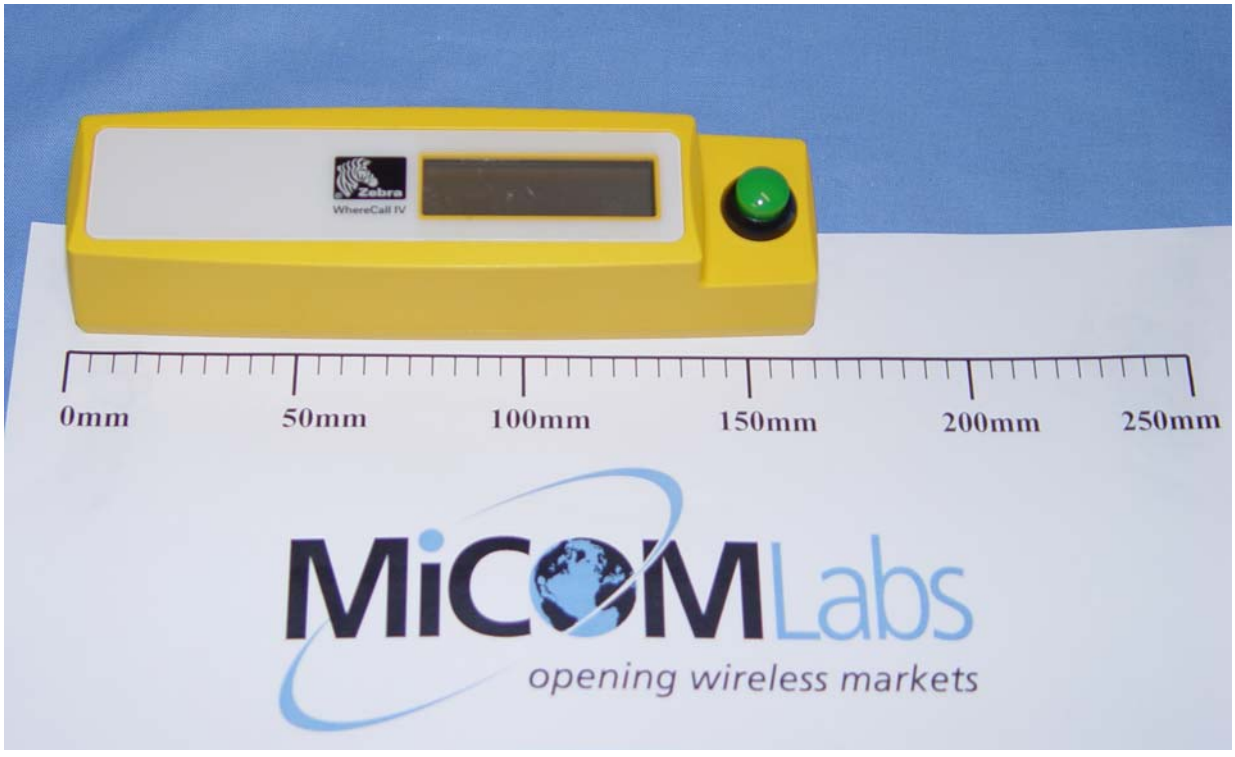
The WhereCall IV, WhereCall IV PLC and WhereCall IV IT (Installation Tool) models are identical. The WhereCall IV has an integral call button built into it's front panel, the WhereCall IV PLC has a remote call button that plugs via a cable into the front panel.

All conducted testing and radiated testing was performed on the WhereCall IV PLC as this configuration represents the worst case for conducted and radiated emissions.

The WhereCall IV / WhereCall IV PLC / WhereCall IV IT have three modes of operation which are not operating simultaneously;

- DSSS: 2,441.75 MHz
- OOK: 2,446.519 MHz
- 802.11b: 2,412 – 2,262 MHz

WhereCall IV

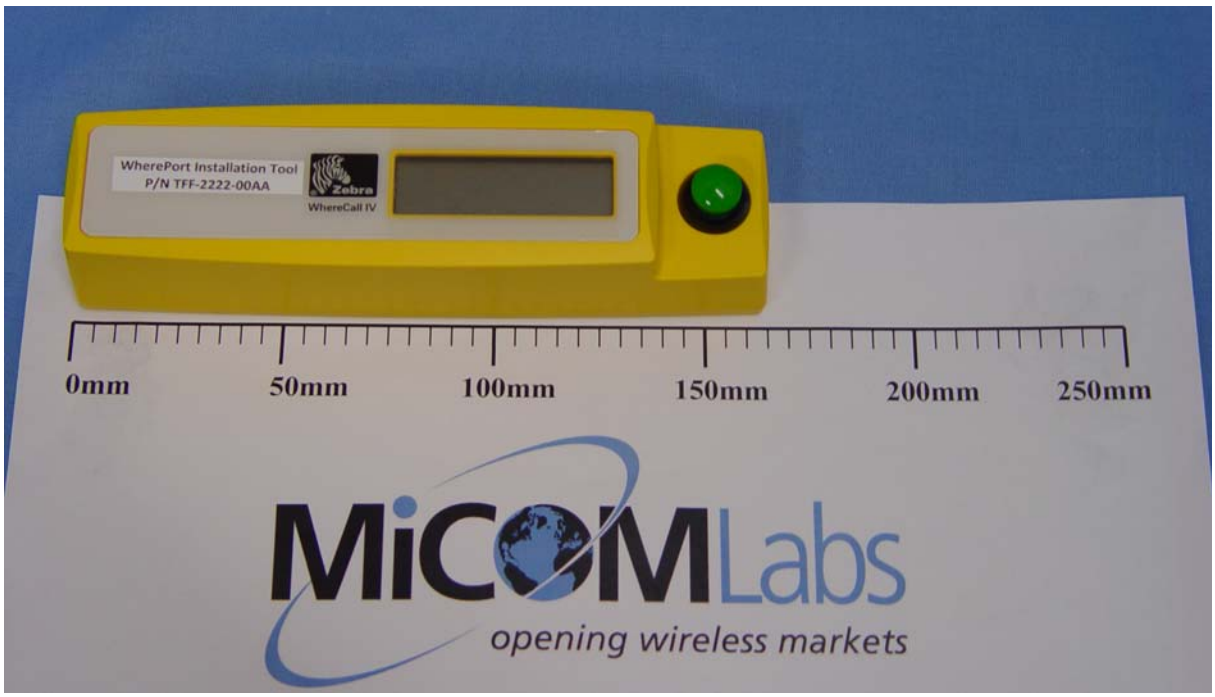


WhereCall IV (continued)

WhereCall IV PLC

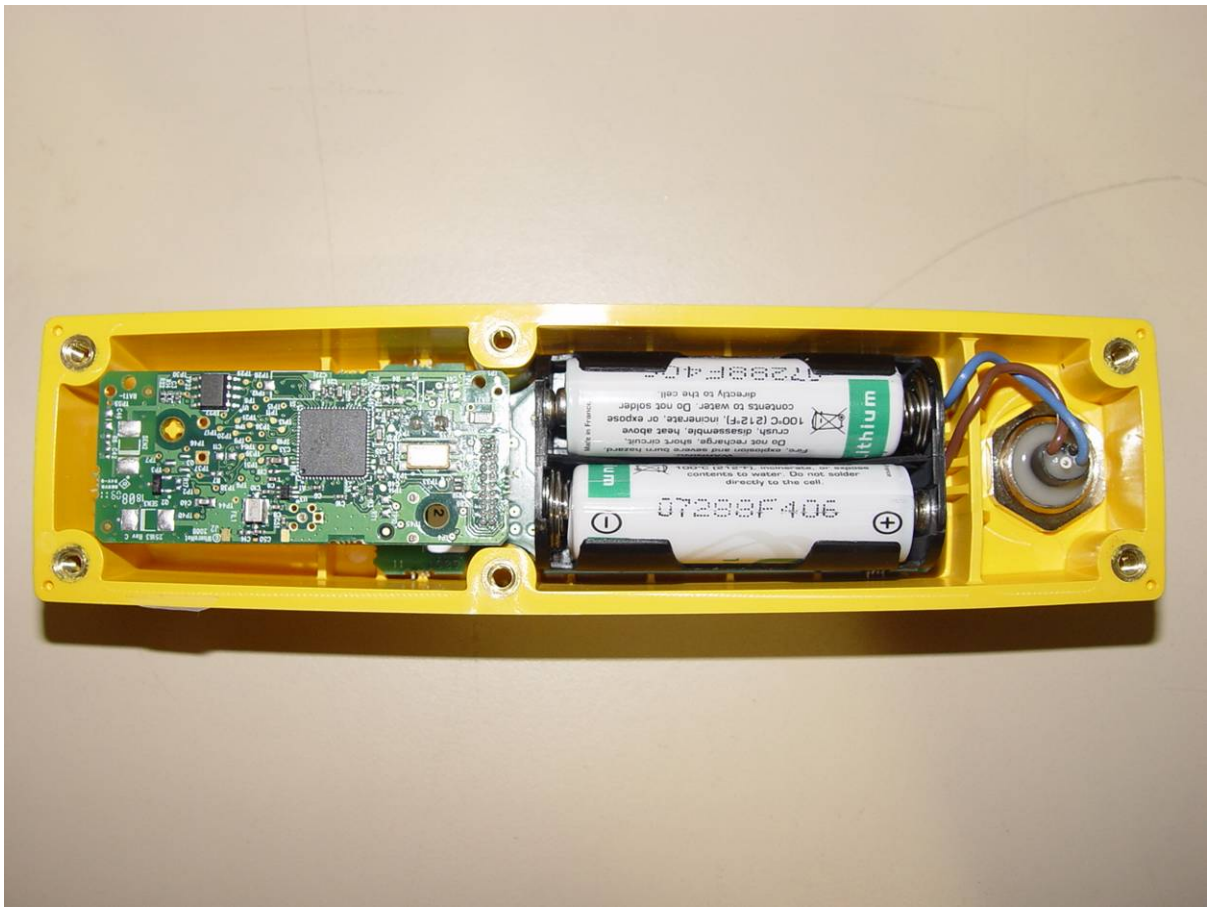
WhereCall IV PLC (continued)

WhereCall IV IT

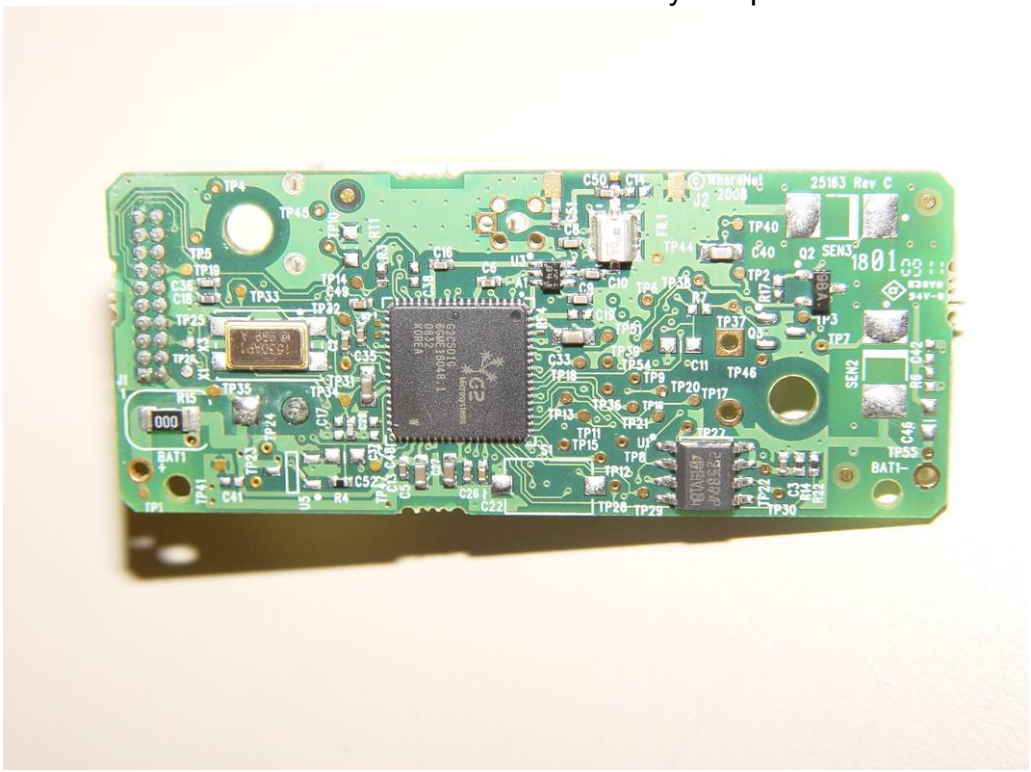


WhereCall IV IT (continued)

WhereNet WhereCall IV Internal



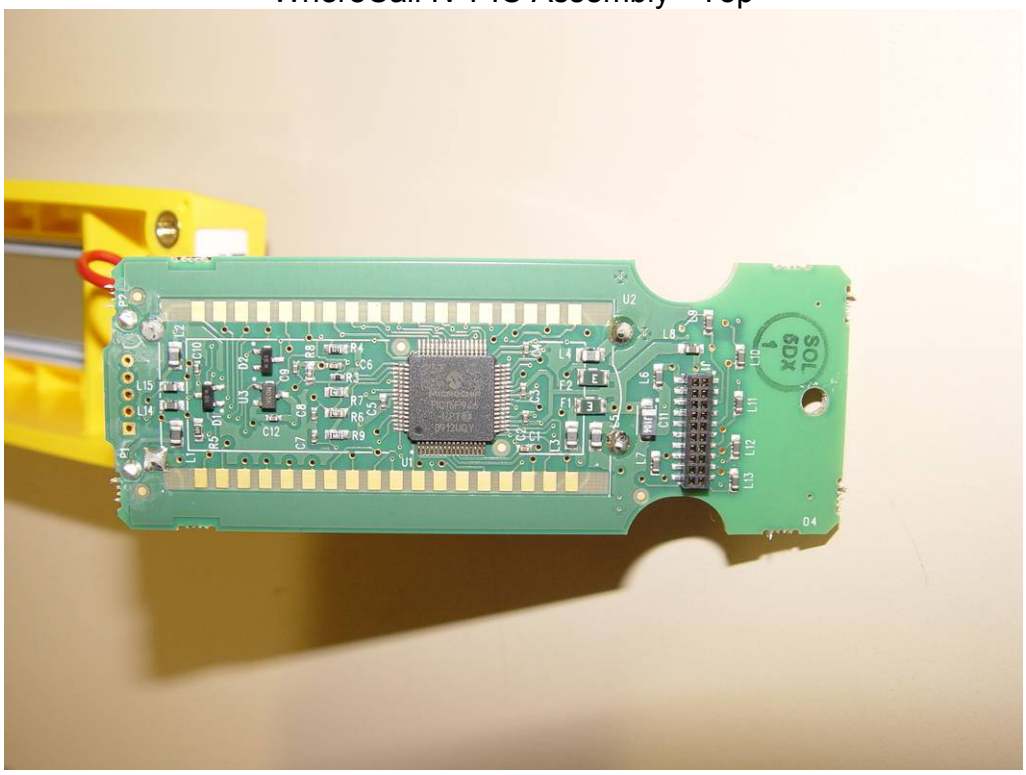
WhereCall IV RFID Assembly - Top



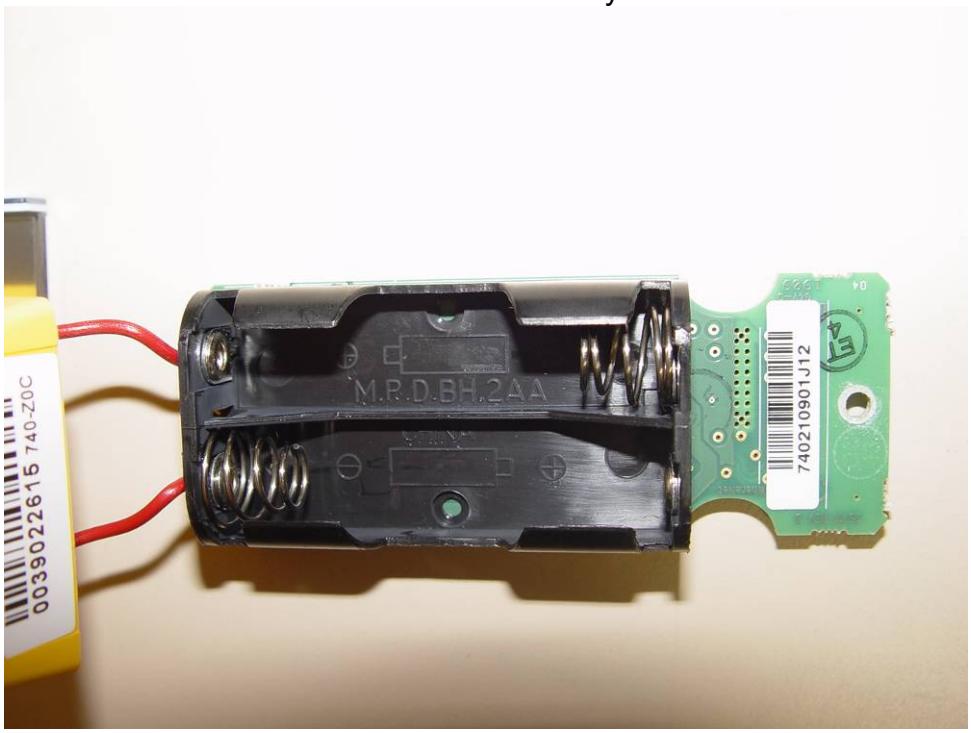
WhereCall IV RFID Assembly - Bottom

4.2.1.

WhereCall IV PIC Assembly - Top



WhereCall IV PIC Assembly - Bottom



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

Type (EUT) Support	Equipment Description (Manufacturer and Product Name)	Model No.	Part Number	Serial No.
EUT	WhereCall IV PLC (Conducted EUT)	TFF-2220	TFF-2221-00AA	0039021755
EUT	WhereCall IV PLC (Radiated EUT)	TFF-2220	TFF-2221-00AA	0039021753
Support	Dell Laptop	LATITUDE	Not Available	Not Available
Location Sensor	WhereNet Location Sensor LOS-4100	LOS-4100	M09350503A09	P000177

4.4. Antenna Details

Antenna Type	Gain (dBi)	Manufacturer	Model No.	Serial No.
Inverted F	-1.0	WhereNet	10370	--

4.5. Cabling and I/O Ports

Number and type of I/O ports

WhereCall IV PLC:

- Cable with remote button activation on PLC model.

Wherecall IV:

- No ports

Wherecall IV IT

- No ports

4.6. Test Configurations

Matrix of test configurations

Operational Mode	# Operating Channel(s)	Nominal Tx Pwr (dBm)	Frequencies (MHz)
DSSS	1	+13.0	2441.75
OOK	1	-1.5	2446.519
802.11b	3	+10.0	2412, 2437, 2462

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.

There were two RFID tags used for test purposes;

1) Conducted testing – WhereCall PLC with 100% duty cycle; Conducted testing required modification (i.e. soldering an SMA connector) to the pcb; No switch cable attached.

2) Radiated testing – WhereCall IV PLC with 100% duty cycle; Switch cable connected during testing.

4.7. Equipment Modifications

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

NONE

4.8. Deviations from the Test Standard

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

NONE

5. 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(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	5.1.4

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	5.1.5
	Transmitter Radiated Spurious Emissions, Peak Emissions, Band Edge	Emissions above 1 GHz		Complies	*5.1.5.1*
Industry Canada only **RSS-Gen §4.8, §6**	Receiver Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*5.1.5.2*
15.205 / **15.209** **2.2**	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies	*5.1.5.3*
15.207 **7.2.2**	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Not Applicable Device dc powered	*5.1.6*

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

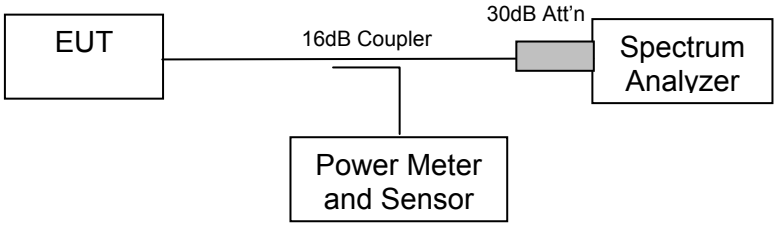
6. TEST RESULTS

6.1. 6 dB and 99 % Bandwidth

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

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

Test Measurement Set up



Measurement set up for 6 dB and 99 % bandwidth test

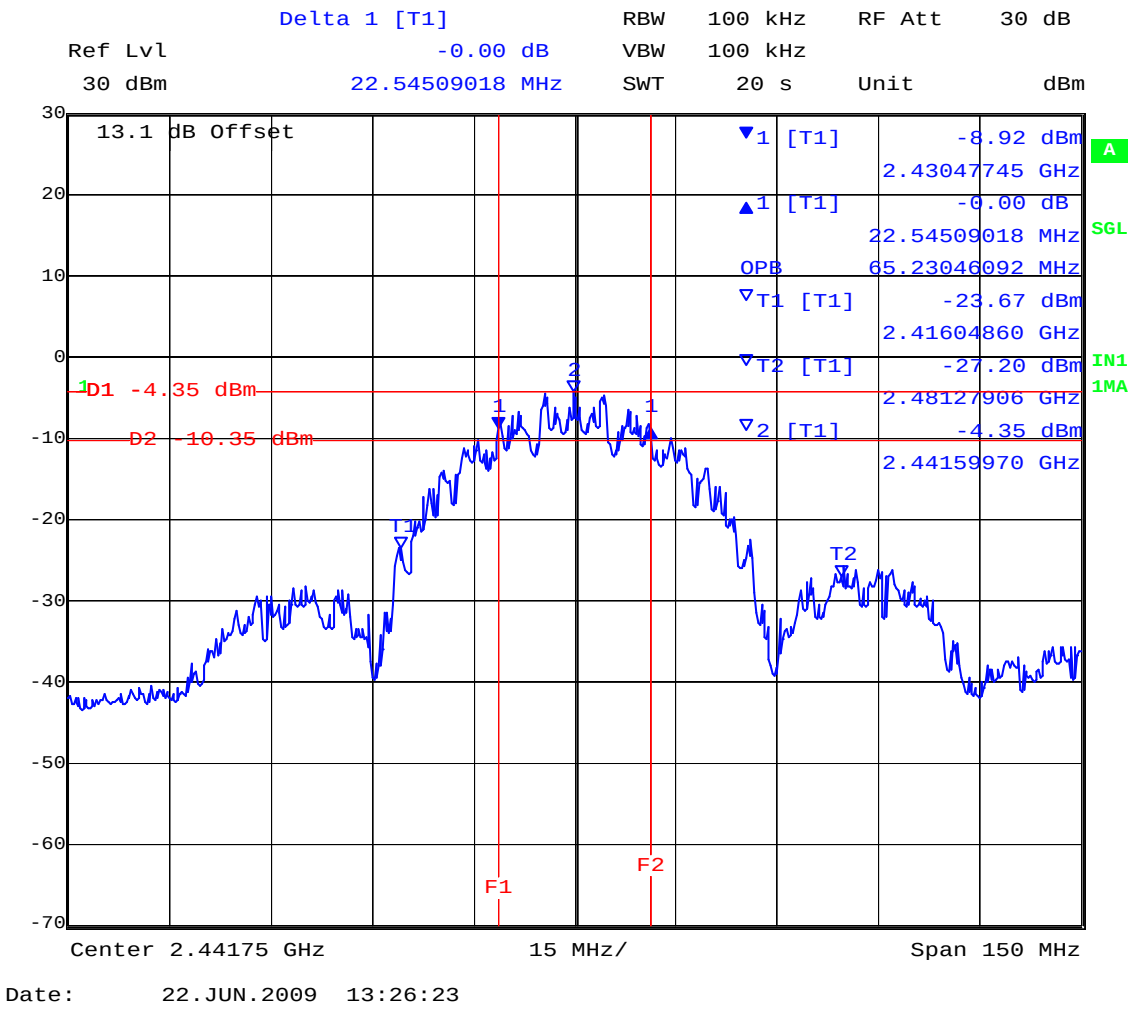
Measurement Results for 6 dB and 99 % Operational Bandwidth(s)

Ambient conditions.

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

TABLE OF RESULTS – **DSSS**

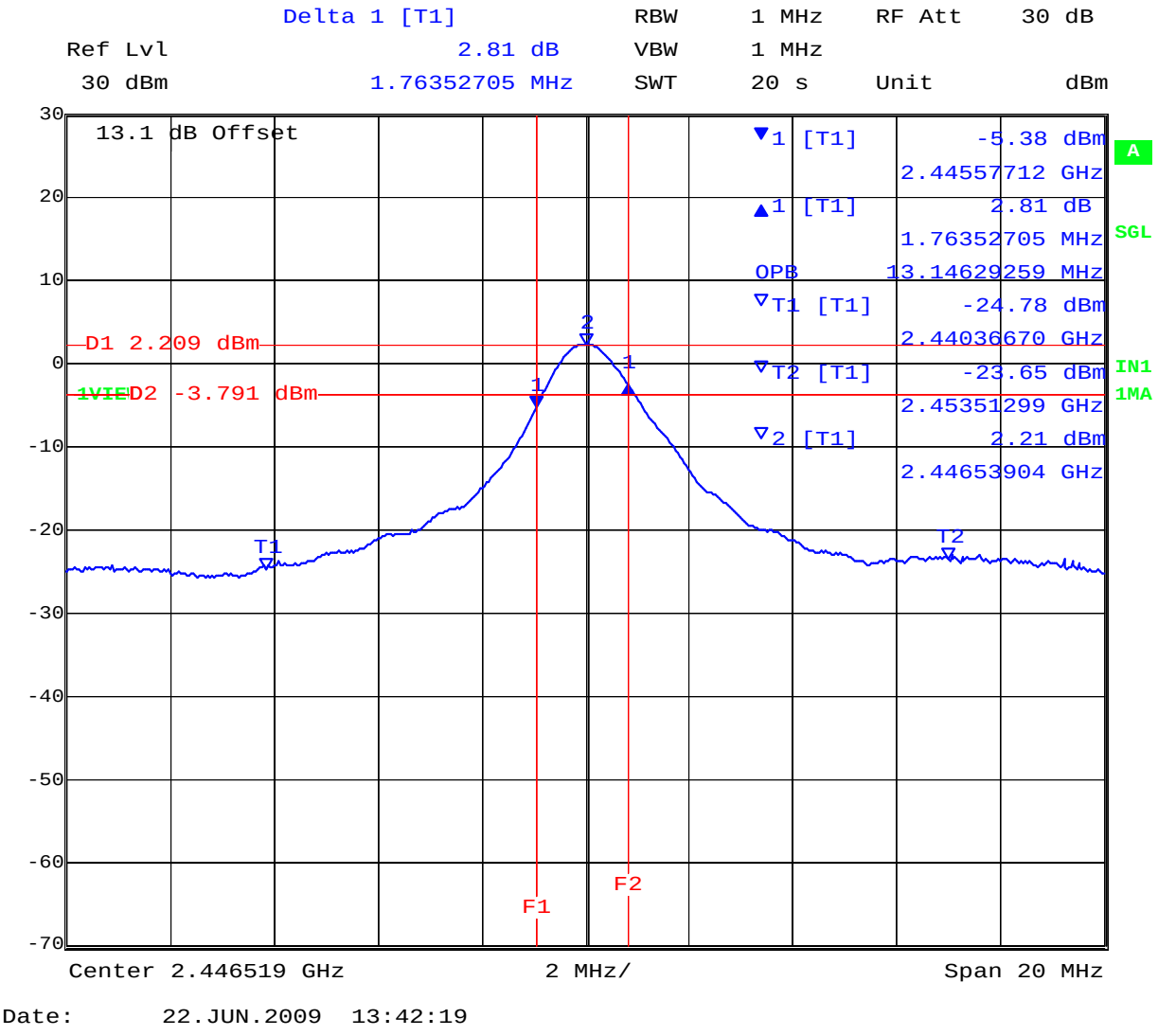
Center Frequency (MHz)	6 dB Bandwidth (MHz)	99 % BW (MHz)
2441.75	22.5451	65.2305



6 dB and 99% Bandwidth

TABLE OF RESULTS – **OOK**

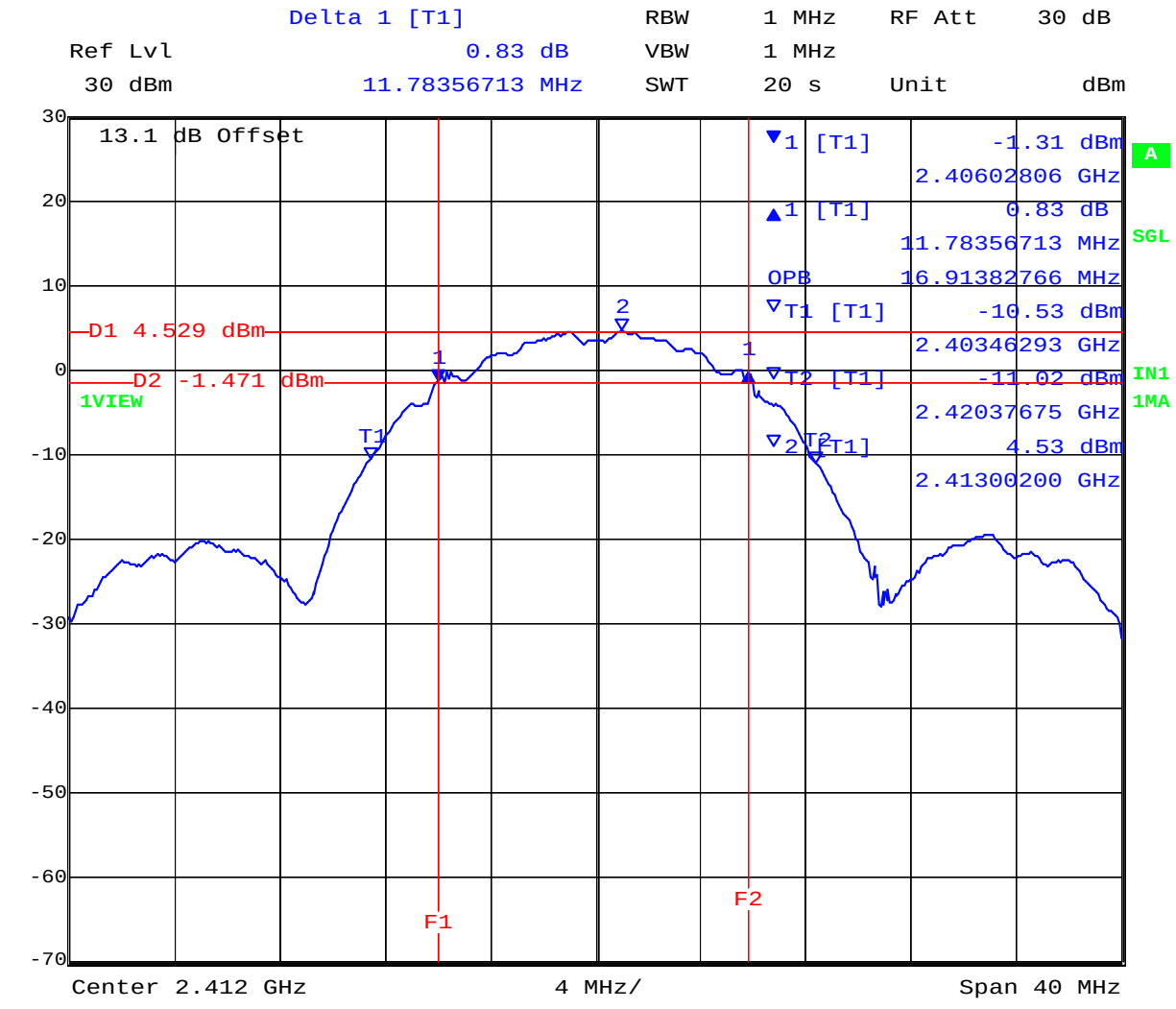
Center Frequency (MHz)	6 dB Bandwidth (MHz)	99 % BW (MHz)
2446.519	1.7635	13.1463



6 dB and 99% Bandwidth

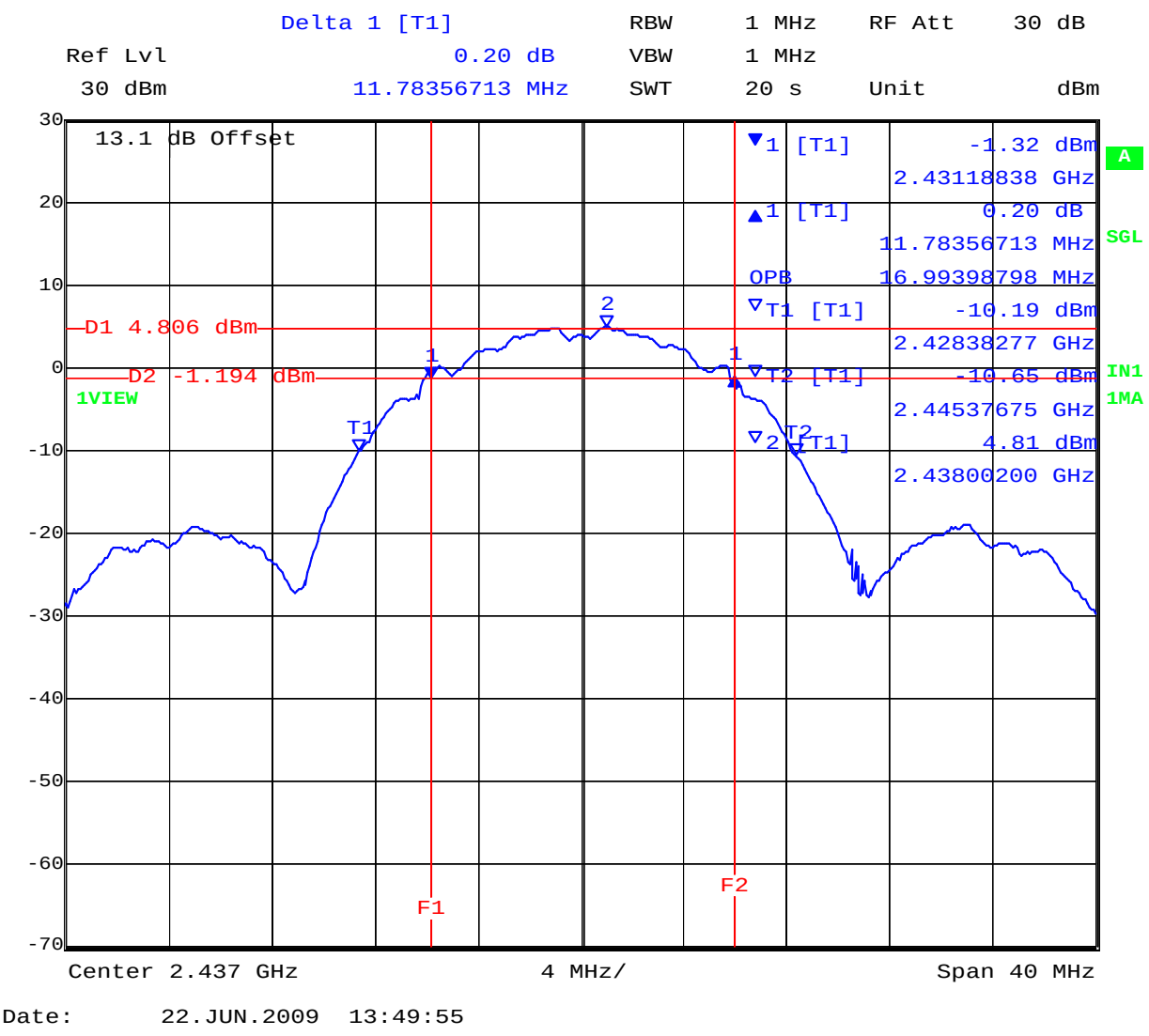
TABLE OF RESULTS – **802.11B**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99 % BW (MHz)
2412	11.7836	16.9138
2437	11.7836	16.9940
2462	11.9439	17.2345



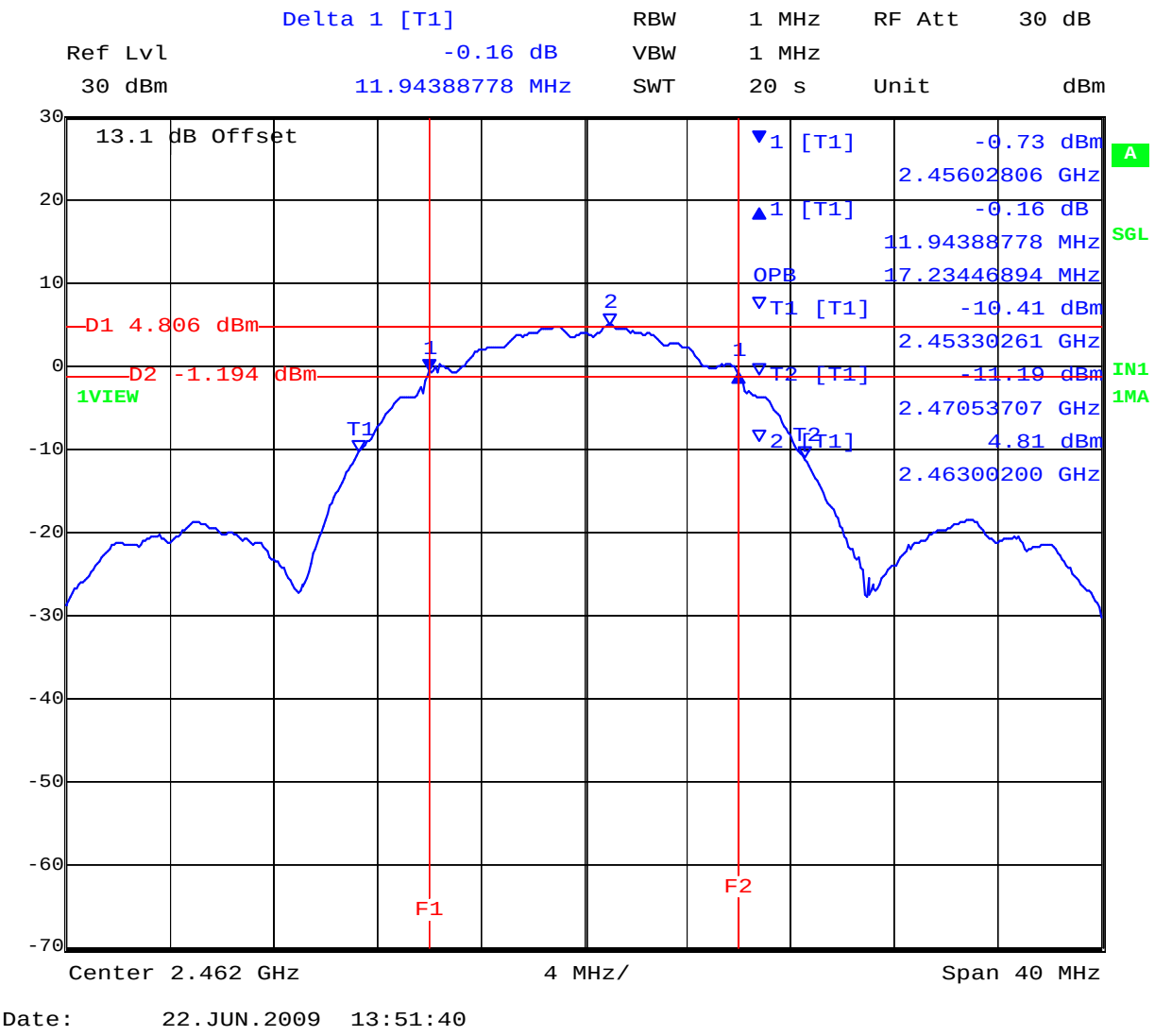
2412 MHz 6 dB and 99% Bandwidth

802.11b (continued)



2437 MHz 6 db and 99 % Bandwidth

802.11b (continued)



2462 MHz 6 dB and 99% Bandwidth

Specification

Limits

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

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

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

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	±2.81 dB

Traceability

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

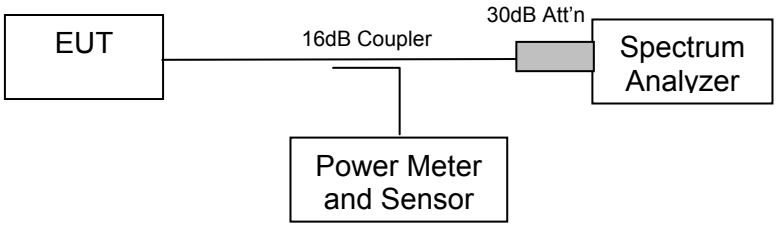
6.2. Peak Output Power

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

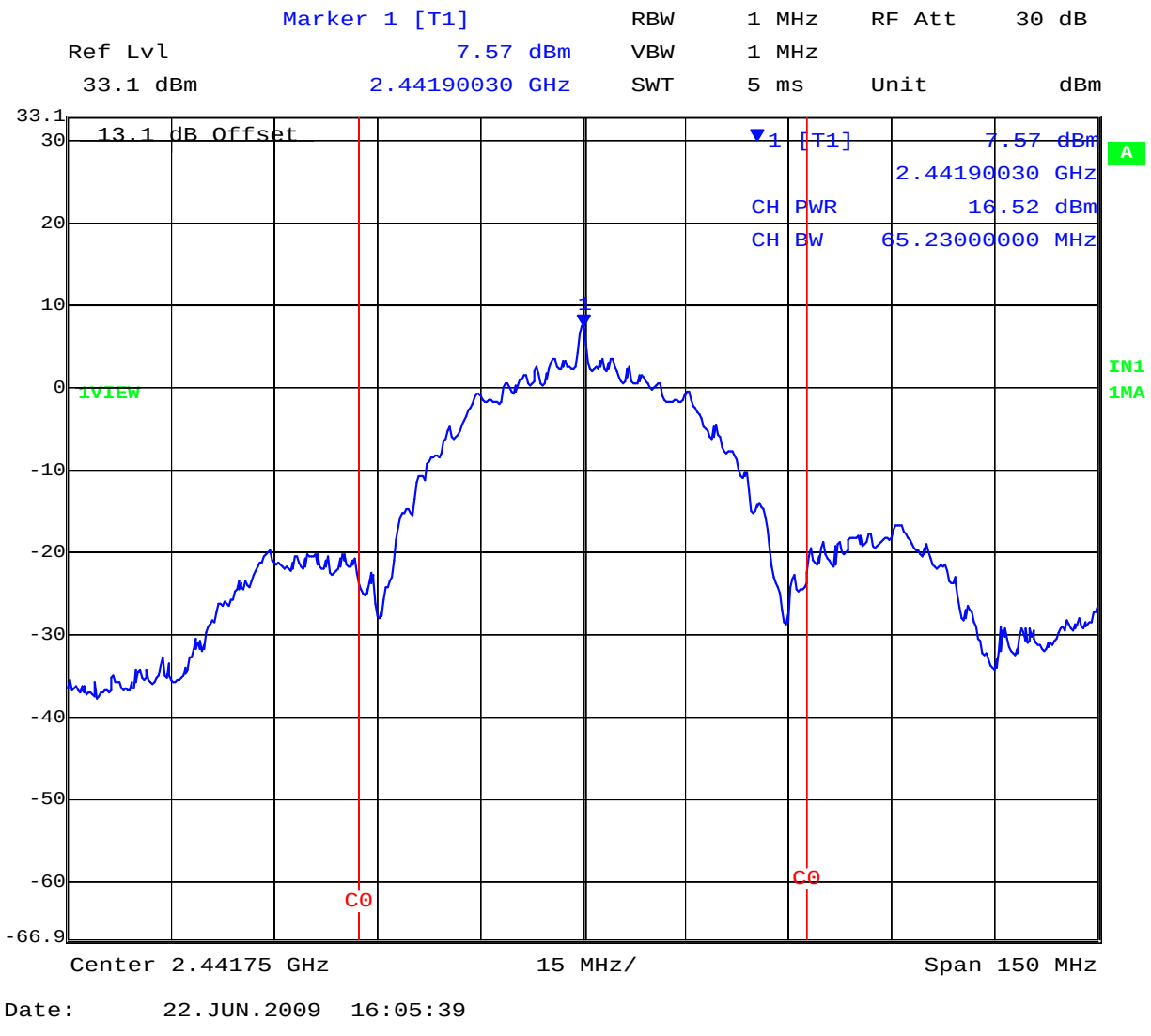
Antenna Type	Gain (dBi)	Antenna Gain >6dBi (dB)	Max. Allowable Peak Power (dBm)	Maximum EIRP (dBm)
Integral	-1.0	No	30	36

Ambient conditions.

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

TABLE OF RESULTS – **DSSS**

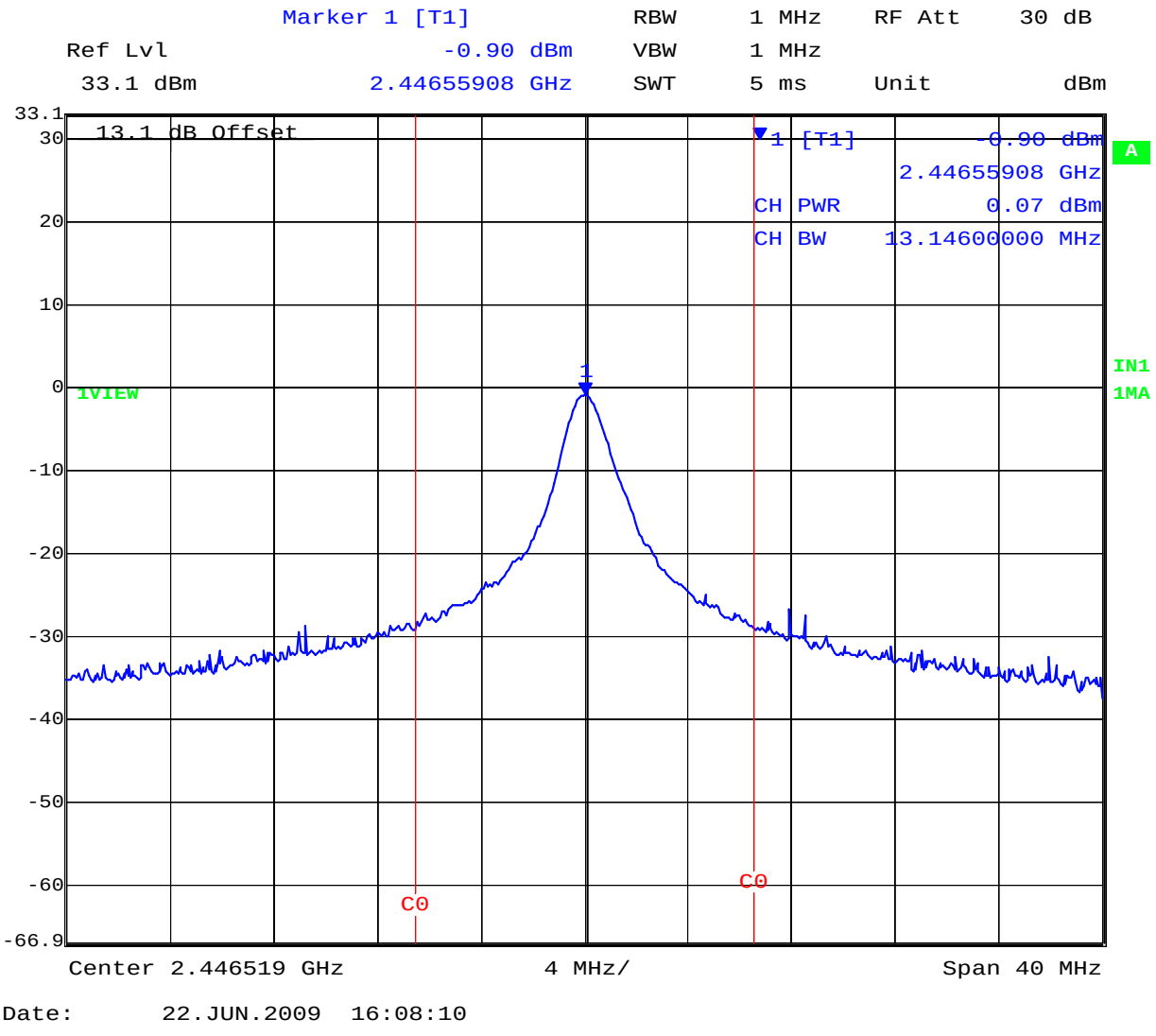
Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)
2441.75	65.2300	+16.52	+ 15.52



2441.75 MHz Peak Power (dBm)

TABLE OF RESULTS – **OOK**

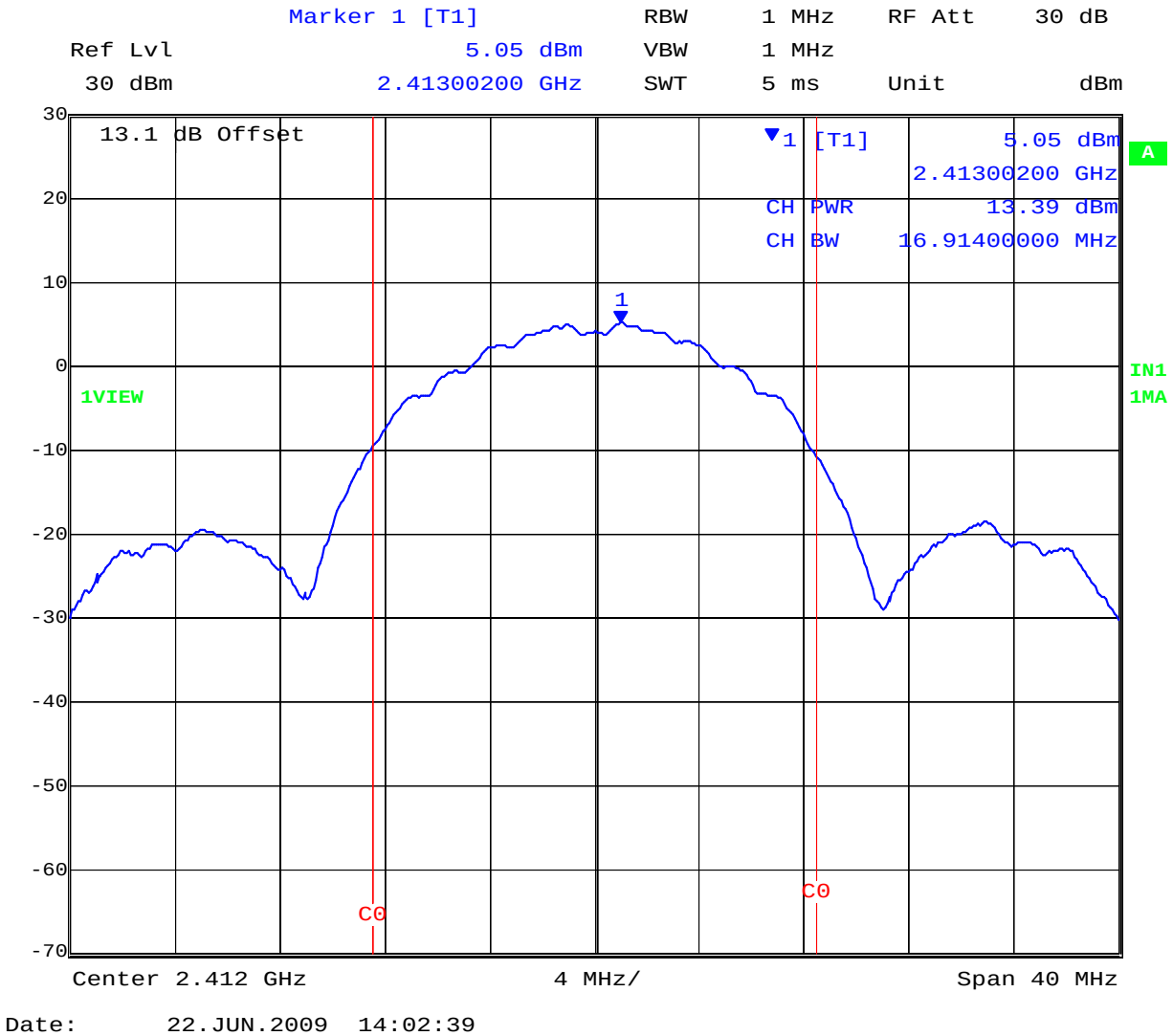
Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)
2446.519	13.1460	+0.07	- 0.93



2446.519 MHz Peak Power (dBm)

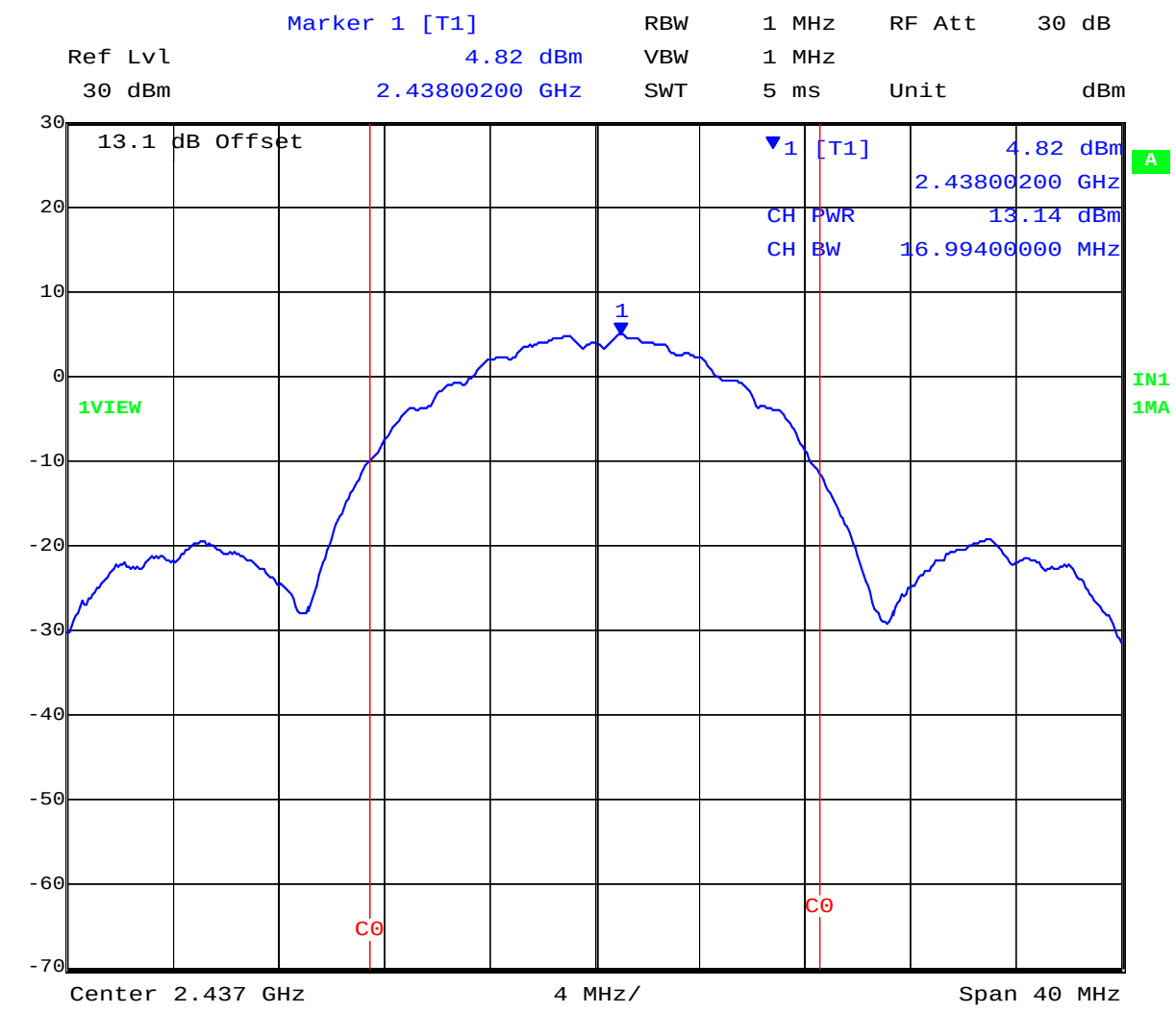
TABLE OF RESULTS – **802.11b**

Center Frequency (MHz)	99%Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)
2,412	16.9140	+13.39	+ 12.39
2,437	16.9940	+13.14	+ 12.14
2,462	17.2340	+13.37	+ 12.37



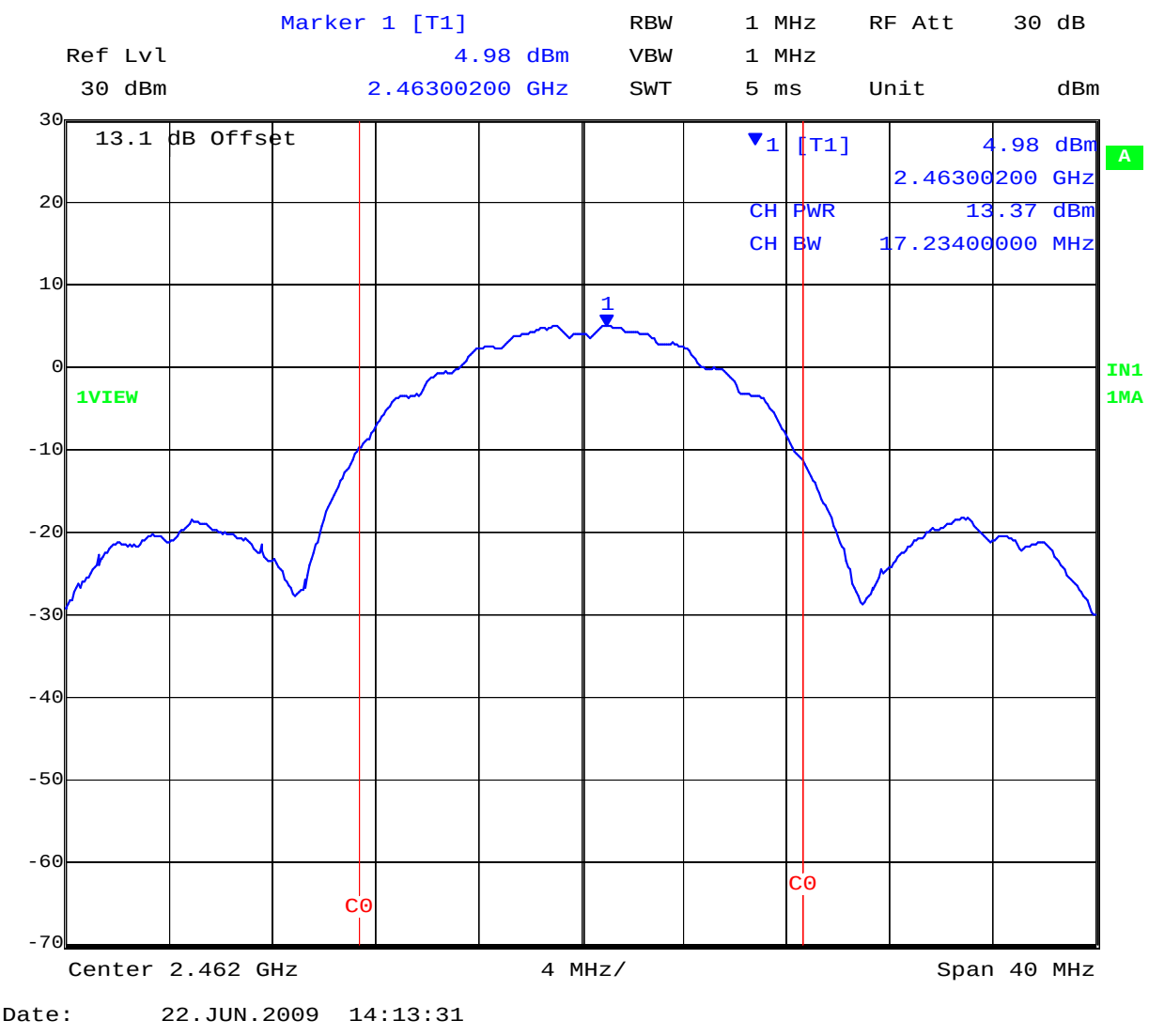
2,412 MHz 802.11b Peak Power (dBm)

802.11b (continued)



2,437 MHz 802.11b Peak Power (dBm)

802.11b (continued)



2,462 MHz 802.11b Peak Power (dBm)

Supply Voltage Variation

The supply voltage was varied 15% between 3.06 Vdc and 3.96 Vdc. The system operated as intended at either extreme with no change in the above measurement bandwidths.

Specification

Limits

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

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

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

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

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

Traceability

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

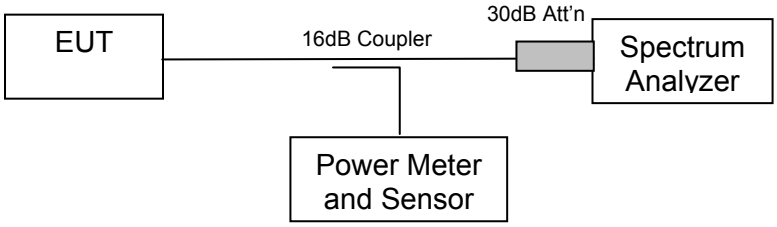
6.3. Peak Power Spectral Density

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



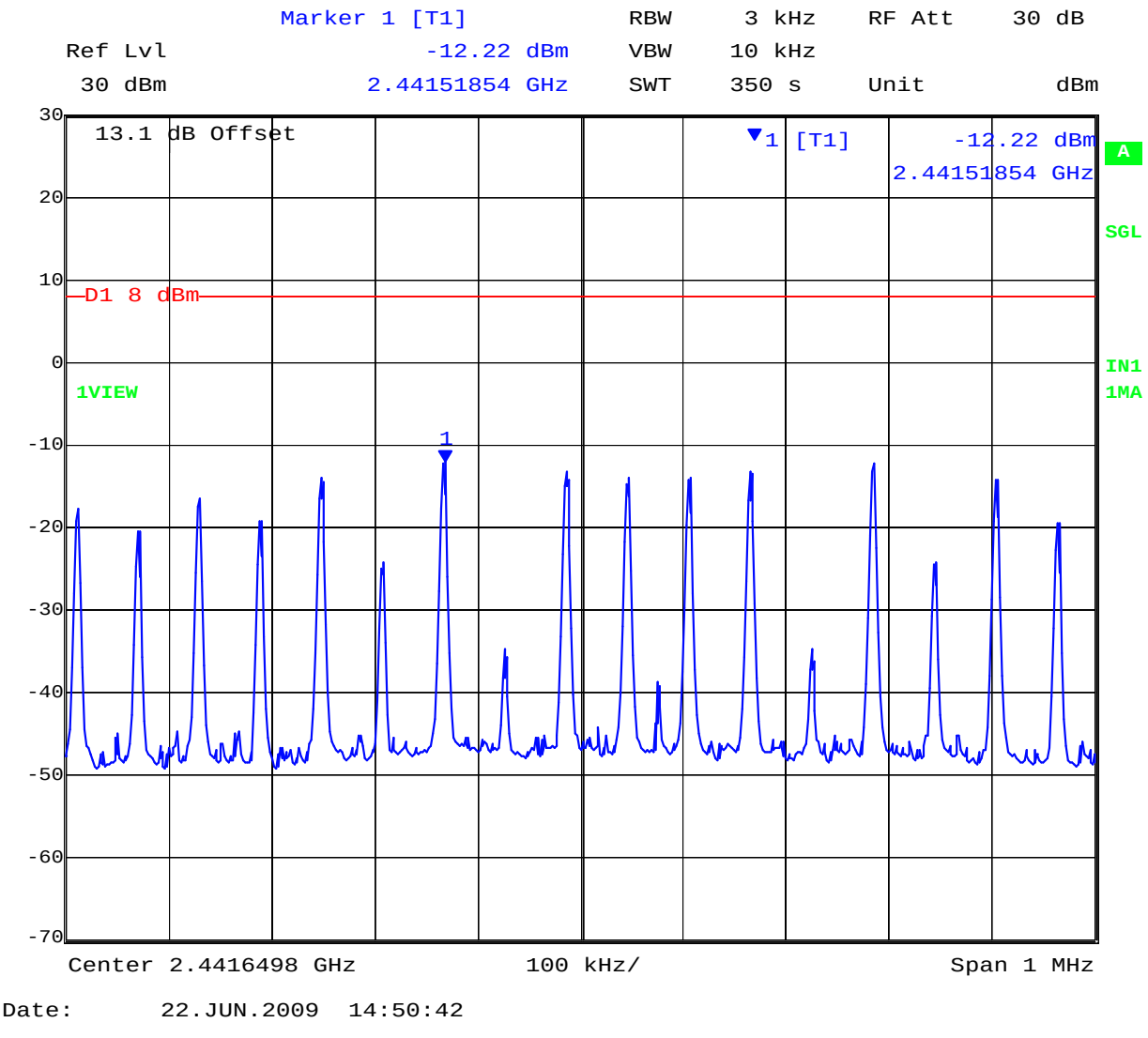
Measurement set up for Peak Power Spectral Density

Measurement Results for Peak Power Spectral Density

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

TABLE OF RESULTS – **DSSS**

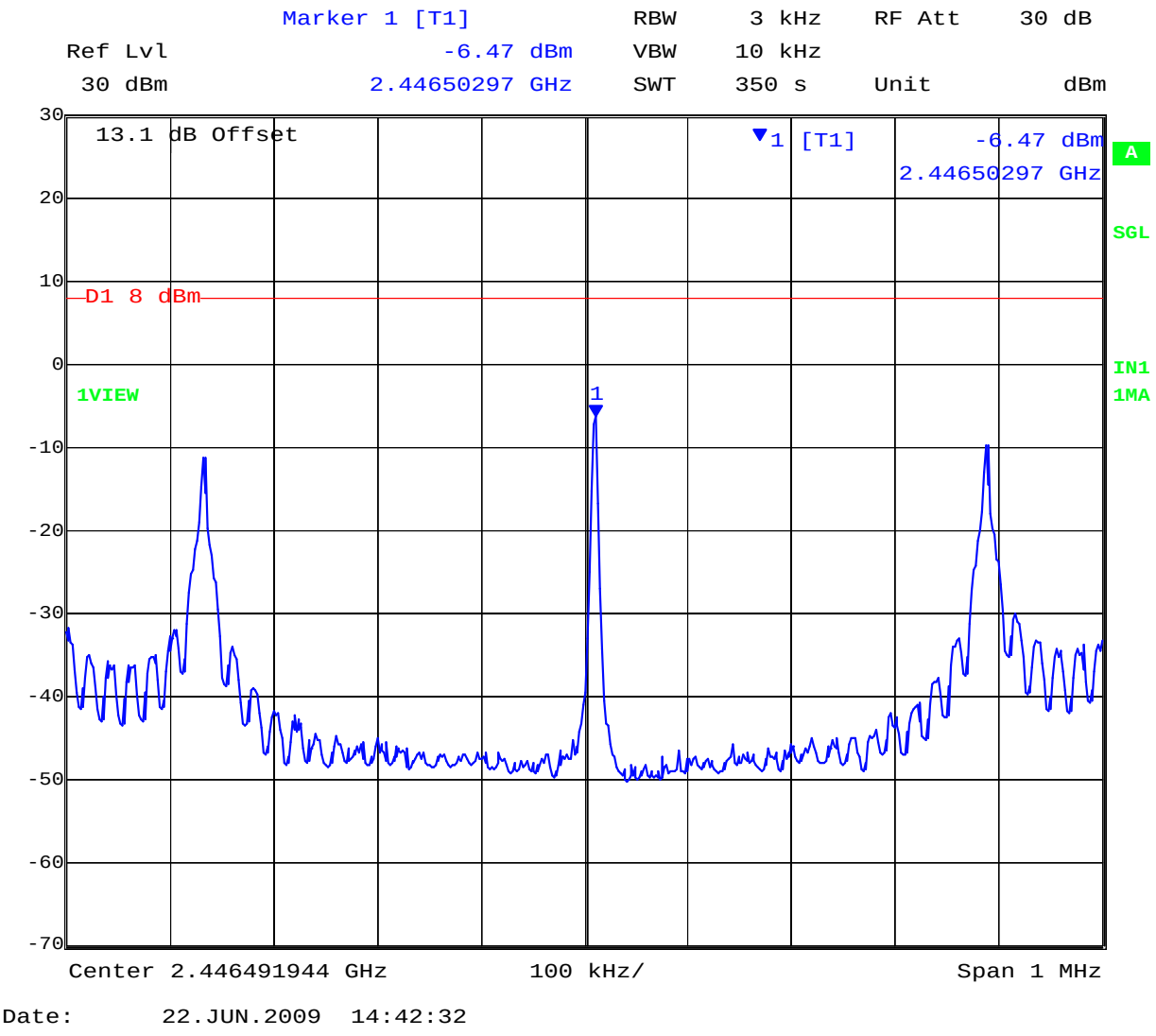
Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,441.75	2,441.52	-12.22	+8	-20.22



DSSS Peak Power Spectral Density

TABLE OF RESULTS – **OOK**

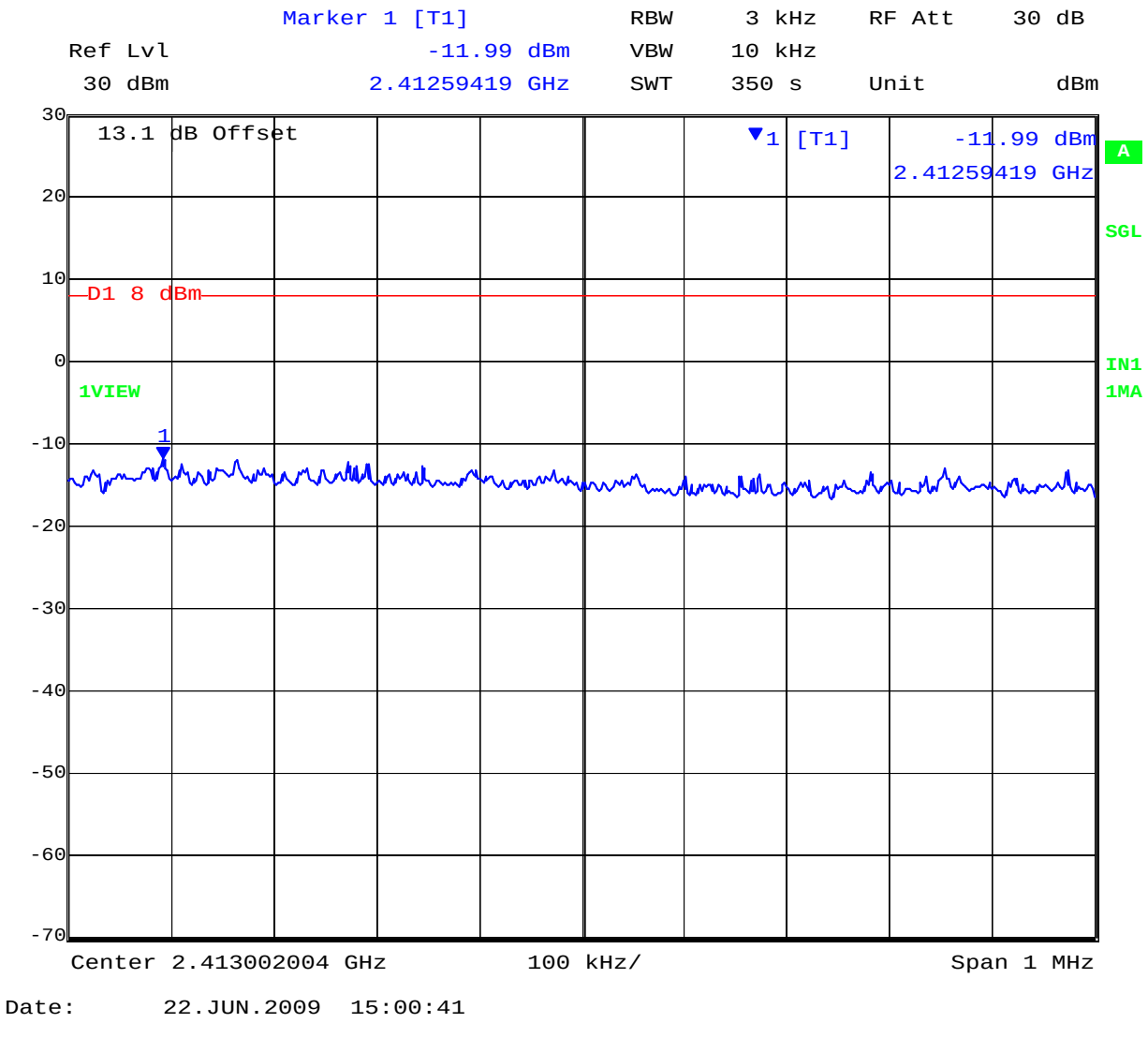
Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,446.519	2446.50	-6.47	+8	-14.47



OOK Peak Power Spectral Density

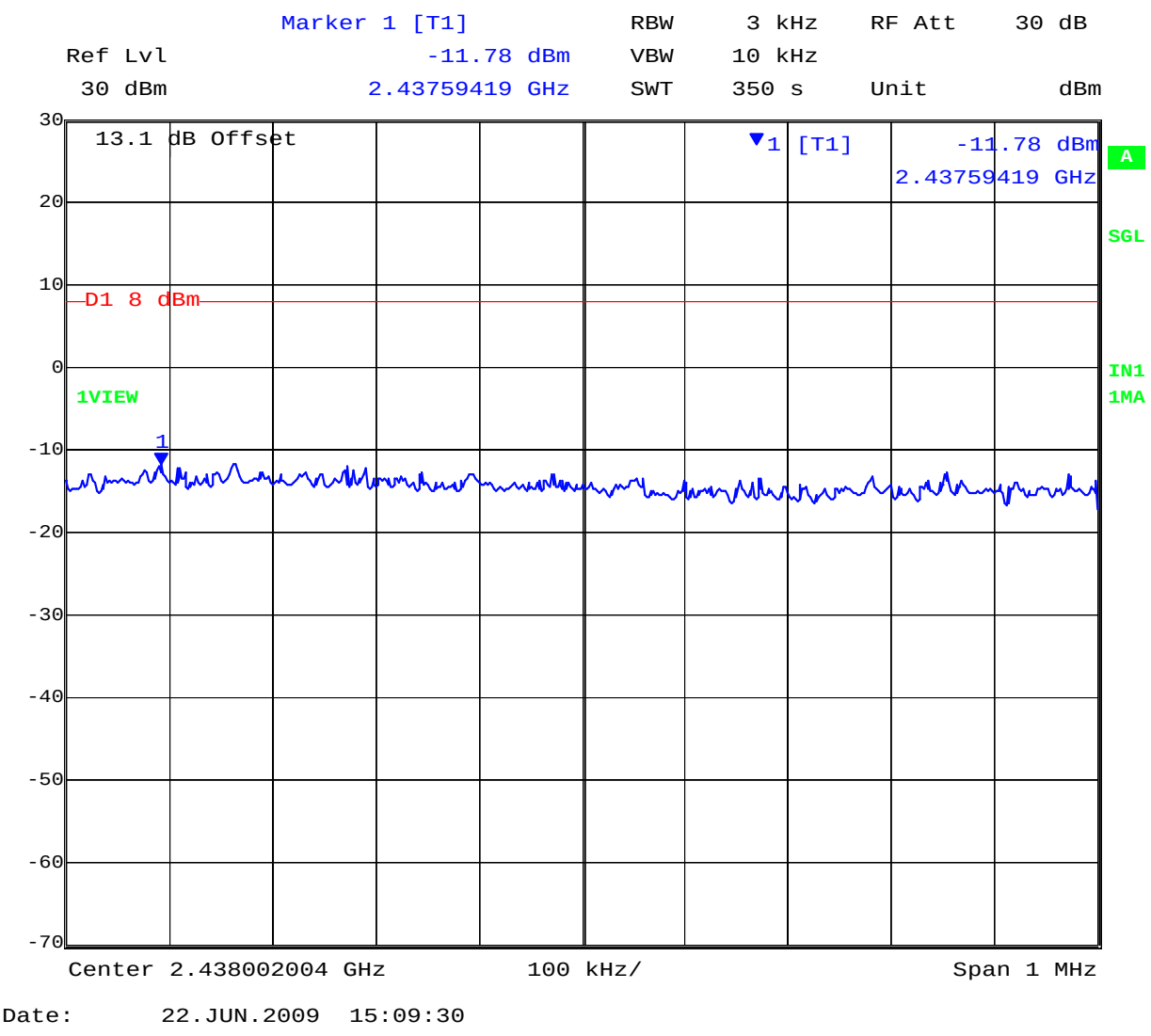
TABLE OF RESULTS – 802.11b

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2412.59	-11.99	+8	-19.99
2,437	2437.59	-11.78	+8	-19.78
2,462	2462.59	-11.75	+8	-19.75



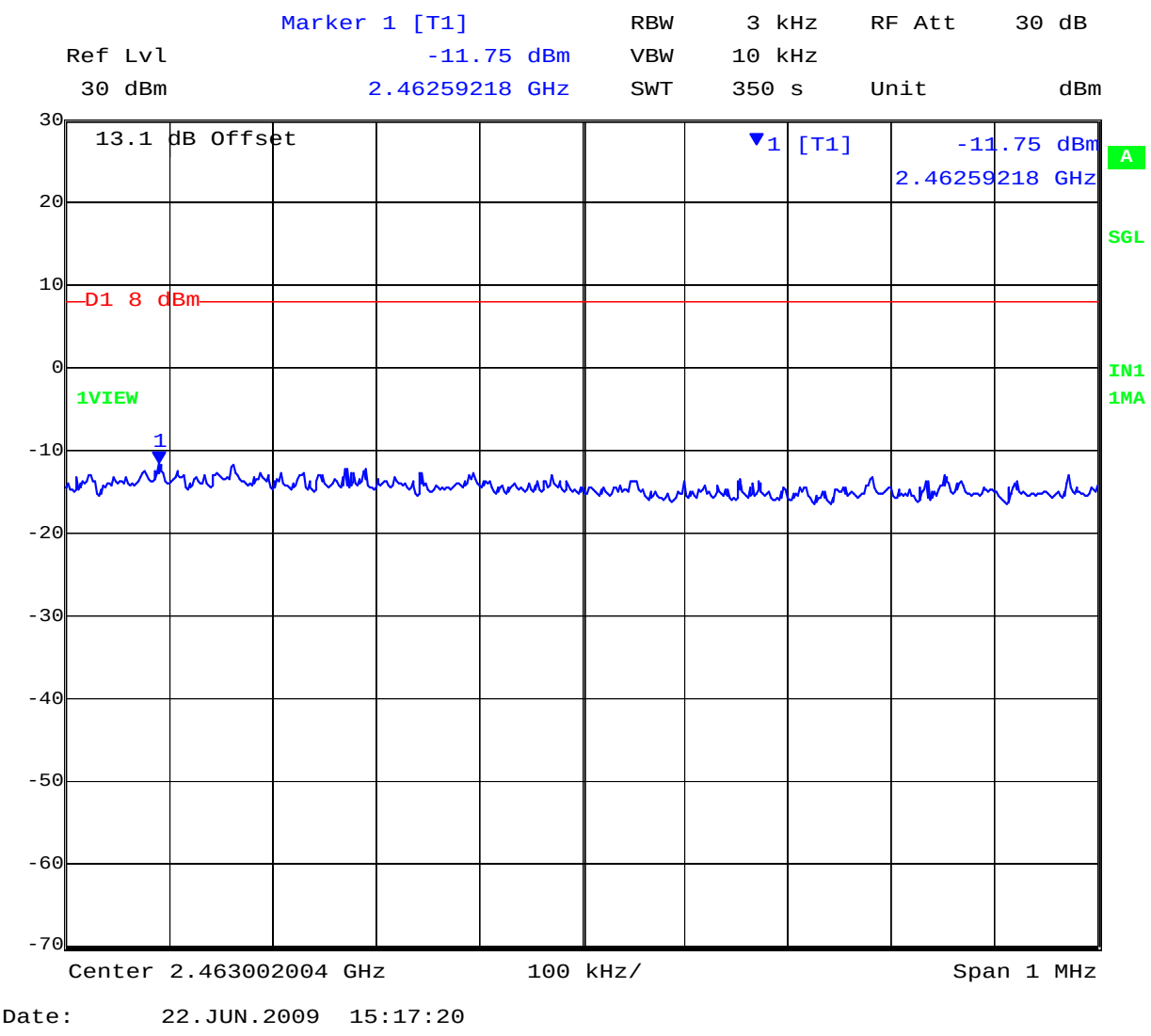
2,412 MHz 802.11b Peak Power Spectral Density

802.11b (continued)



2,437 MHz 802.11b Peak Power Spectral Density

802.11b (continued)



2,462 MHz 802.11b Peak Power Spectral Density

Specification

Peak Power Spectral Density Limits

§15.247(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission **RSS-210** §**A8.2(2)** The transmitter power spectral density (into the antenna) shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0 second duration.

Laboratory Measurement Uncertainty for Spectral Density

Measurement uncertainty	±1.33 dB

Traceability

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

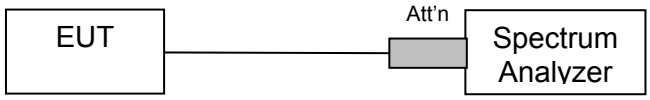
6.4. Conducted Spurious Emissions

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.

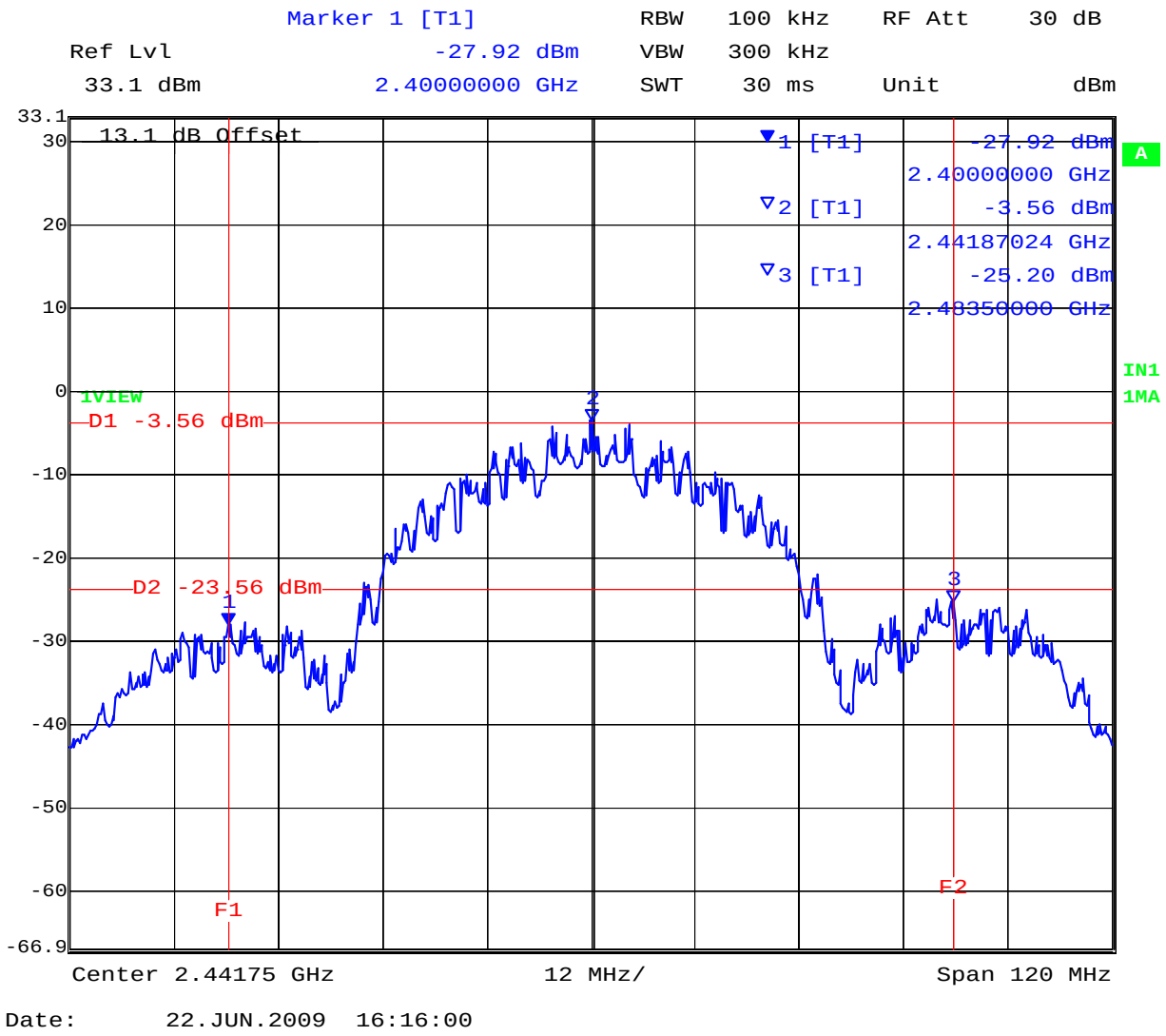
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

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 – **DSSS**

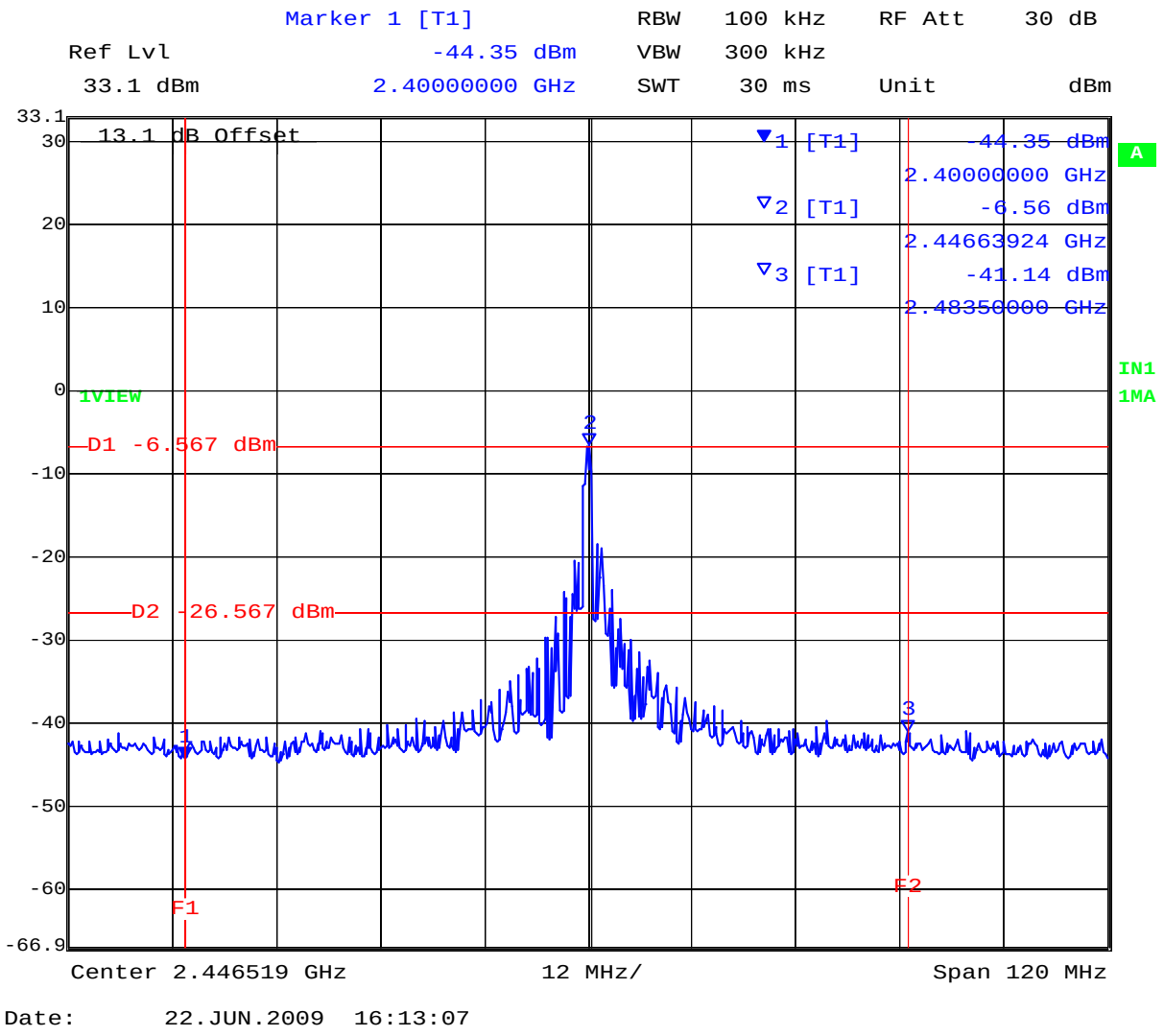
Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental) (dBm)	Amplitude @ Band edge (dBm)	Margin (dB)
2,441.75	2,400	-23.56	-27.92	-4.36
2,441.75	2,483.5	-23.56	-25.20	-1.64



DSSS Conducted Spurious Emissions at the 2,400 & 2483.5 MHz Band Edge(s)

TABLE OF RESULTS – **OOK**

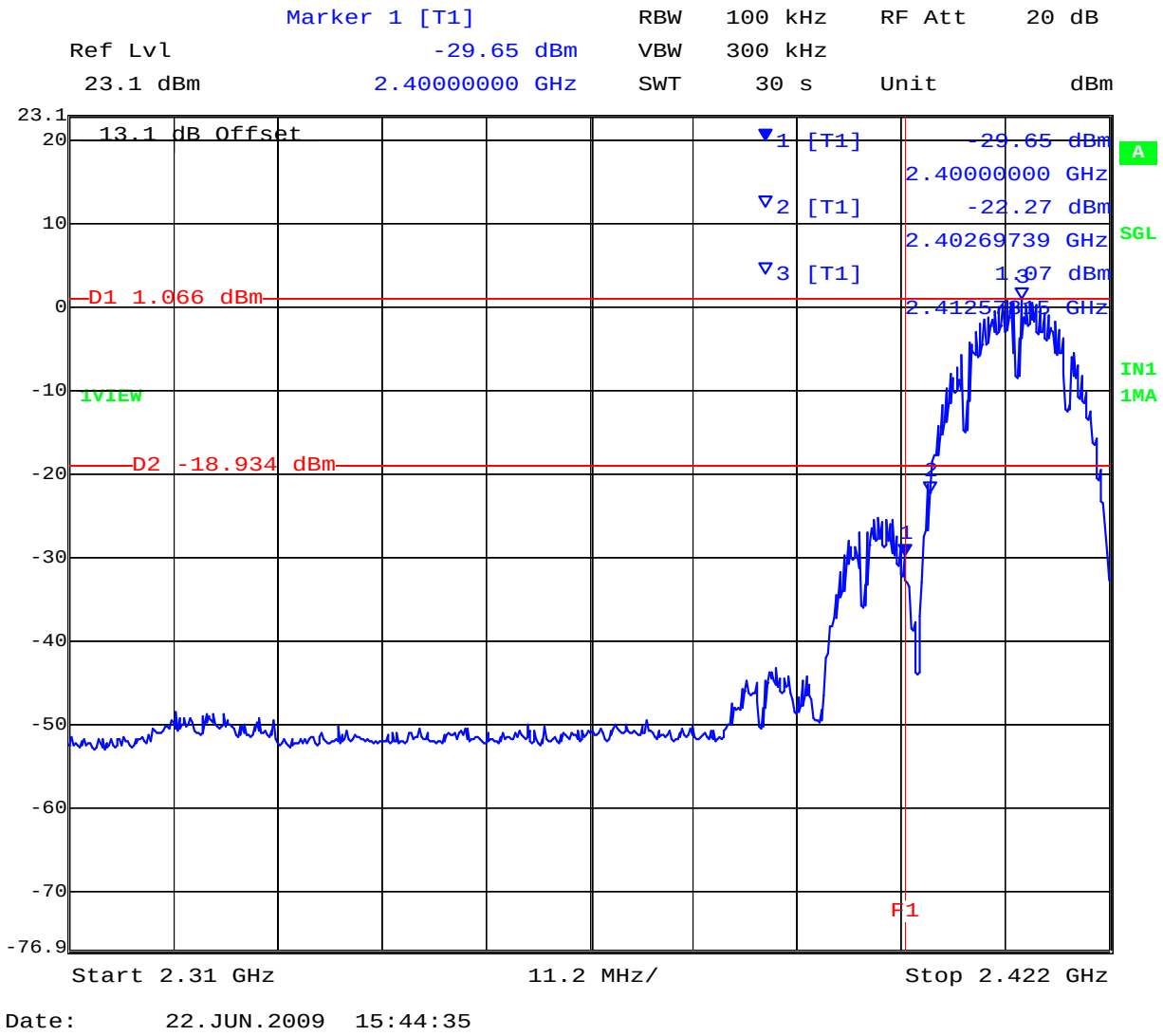
Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental) (dBm)	Amplitude @ Band edge (dBm)	Margin (dB)
2,446.519	2,400	-26.57	-44.35	-17.78
2,446.519	2,483.5	-26.57	-41.14	-14.57



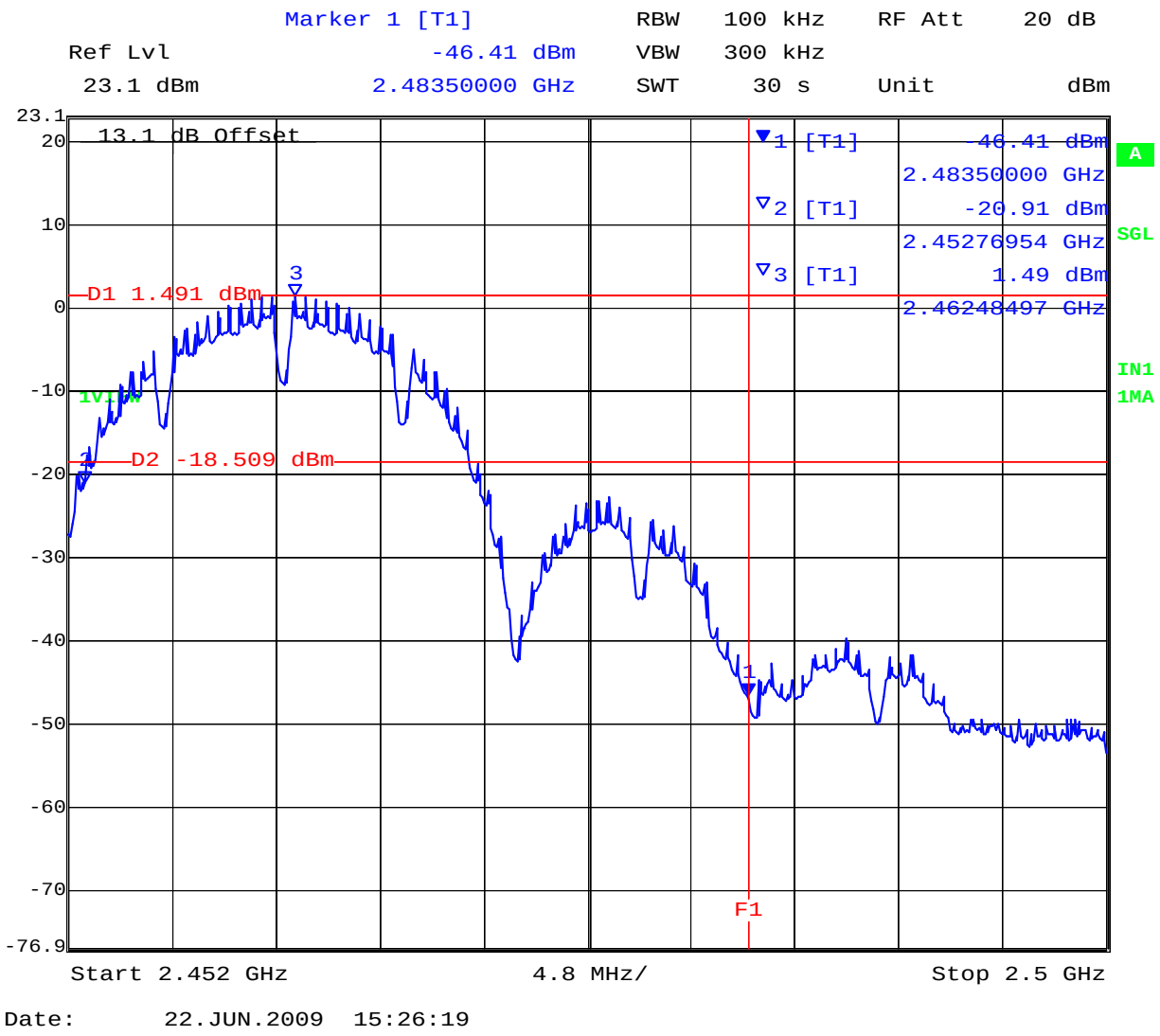
OOK Conducted Spurious Emissions at the 2,400 & 2483.5 MHz Band Edge(s)

Table of Results – **802.11b**

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental) (dBm)	Amplitude @ Band edge (dBm)	Margin (dB)
2412	2,400	-18.93	-29.65	-10.72
2462	2,483.5	-18.51	-46.41	-27.90



802.11b Conducted Spurious Emissions at the 2,400 MHz Band Edge

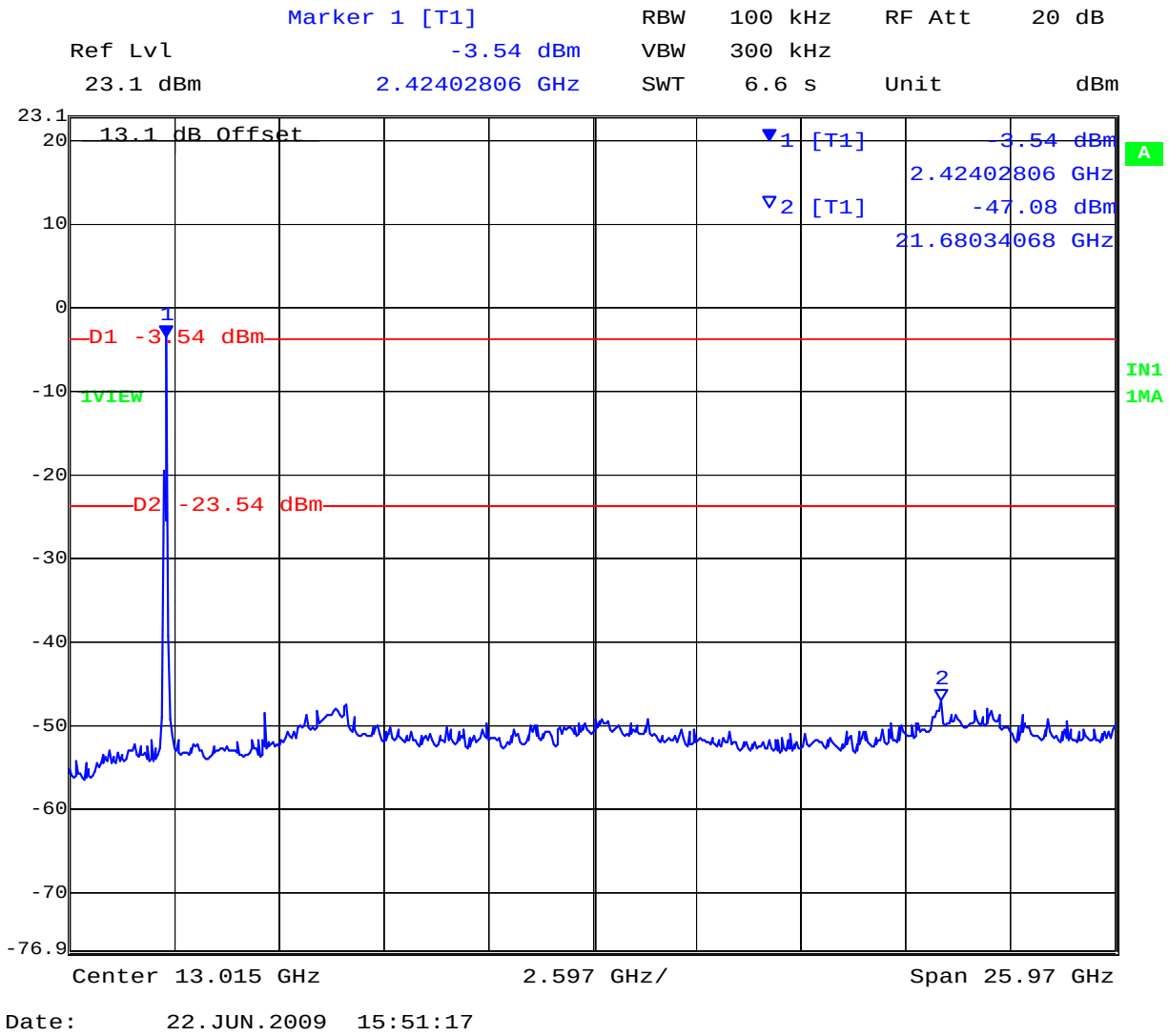


802.11b Conducted Spurious Emissions at the 2483.5 MHz Band Edge

Spurious Emissions (1-26 GHz)

TABLE OF RESULTS – **DSSS**

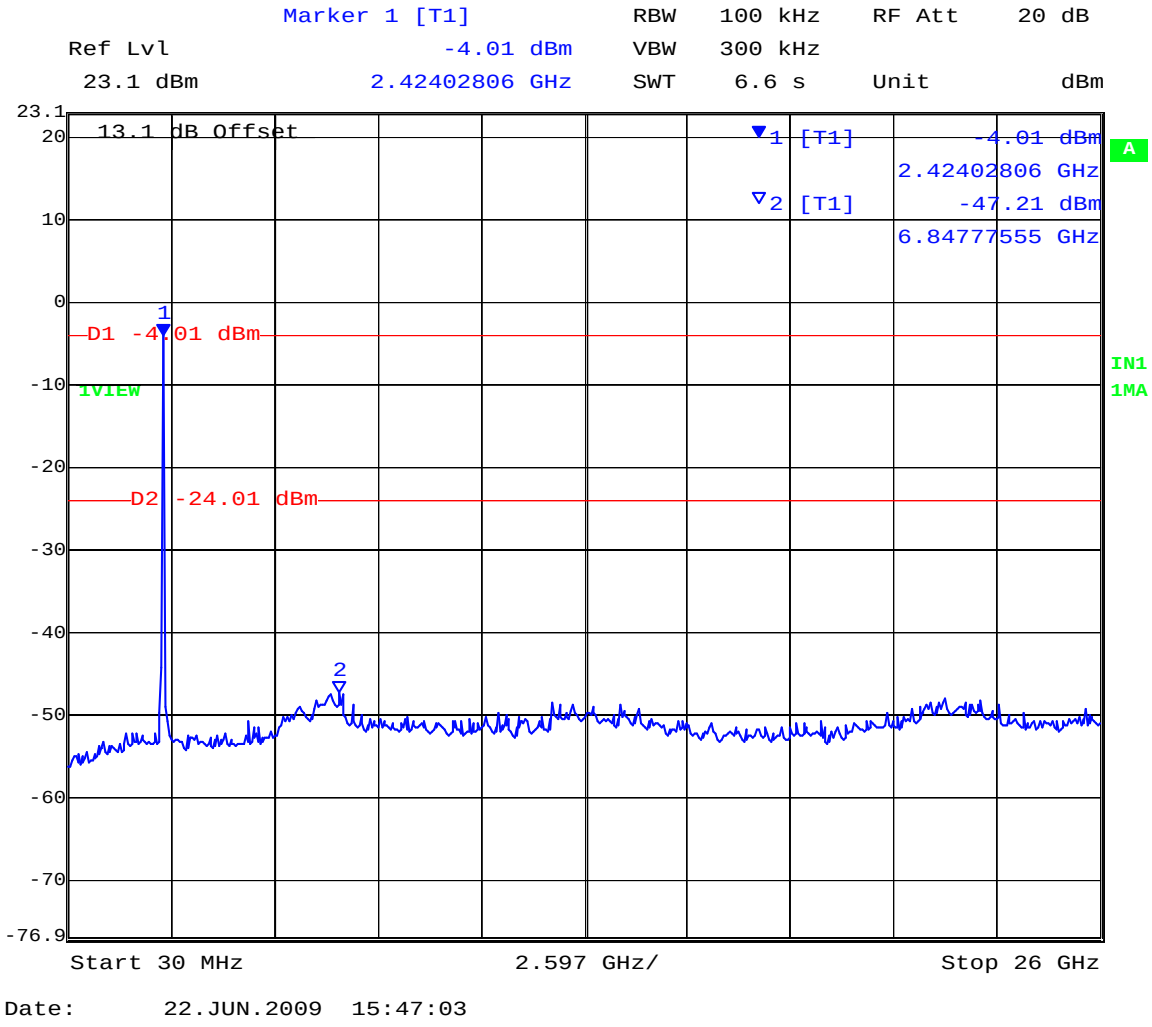
Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2441.75	1,000	26,000	-47.08	-23.54	-23.54



DSSS Conducted Spurious Emissions 1,000 MHz to 26,000 MHz

TABLE OF RESULTS – **OOK**

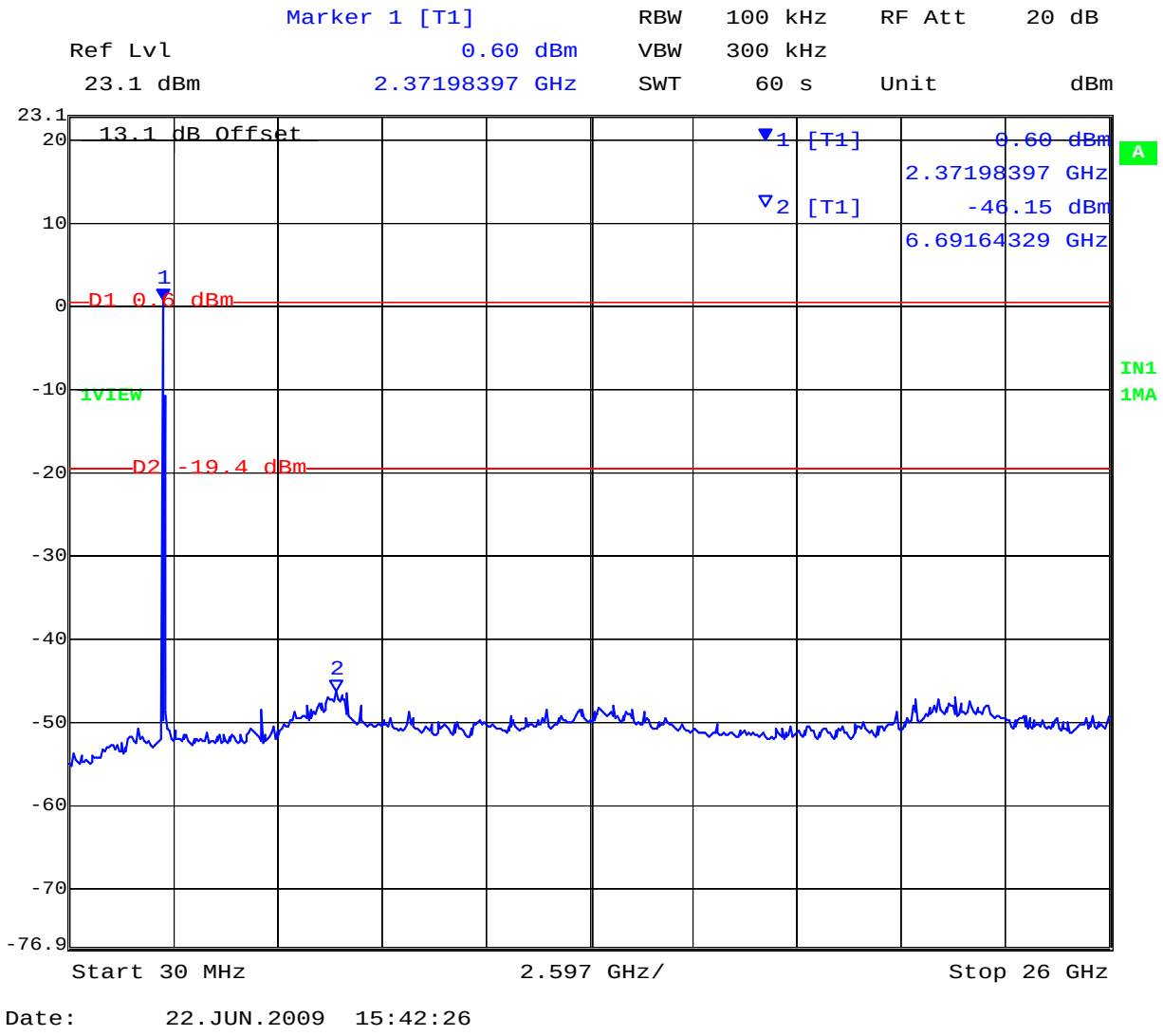
Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2446.519	1,000	26,000	-47.21	-24.01	-23.20



OOK Conducted Spurious Emissions 1,000 MHz to 26,000 MHz

TABLE OF RESULTS – **802.11B**

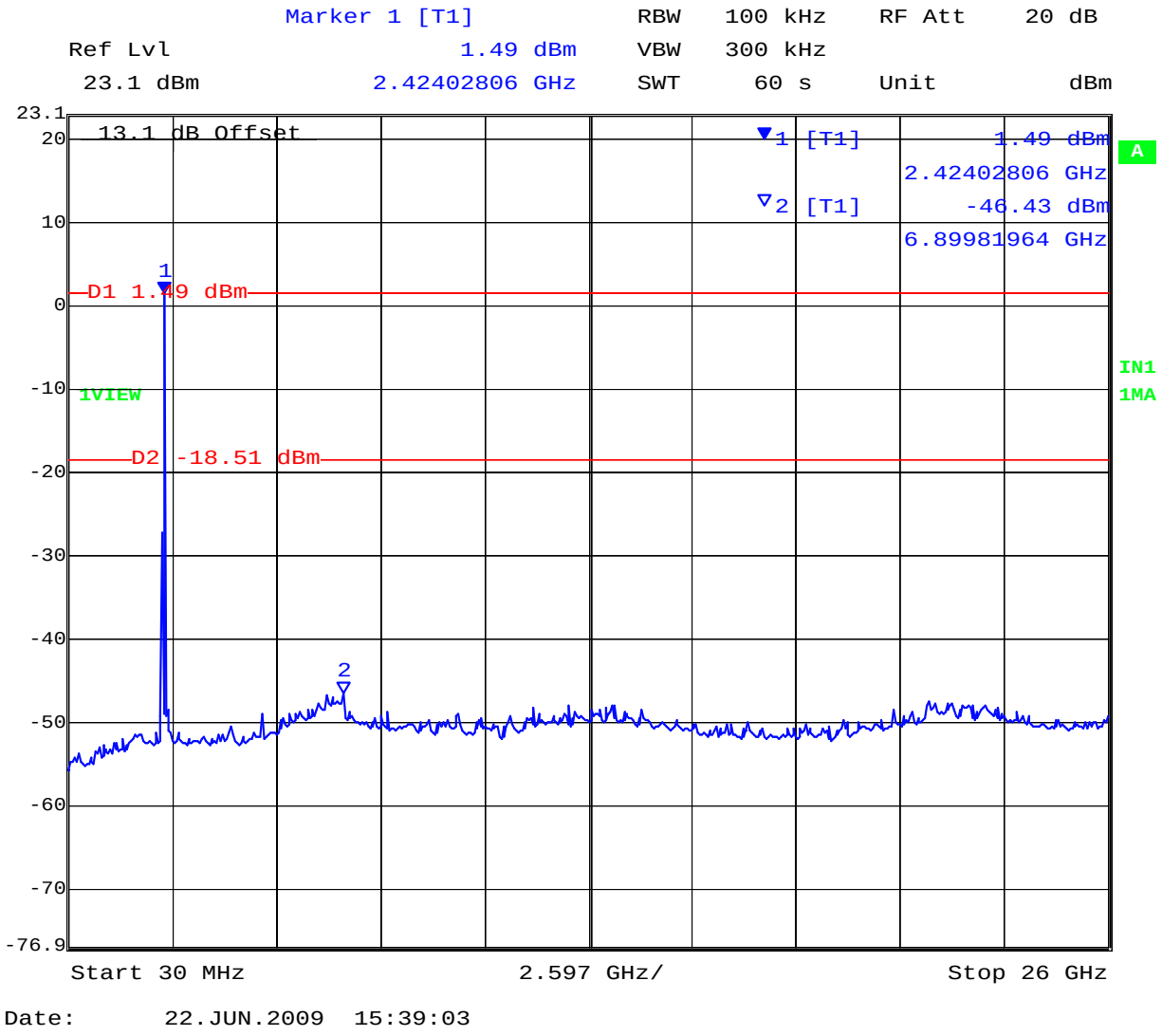
Channel Centre Frequency (MHz)	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,412	1,000	26,000	-46.15	-19.40	-26.75



802.11b 2,412 MHz Conducted Spurious Emissions 1,000 MHz to 26,000 MHz

TABLE OF RESULTS – **802.11B**

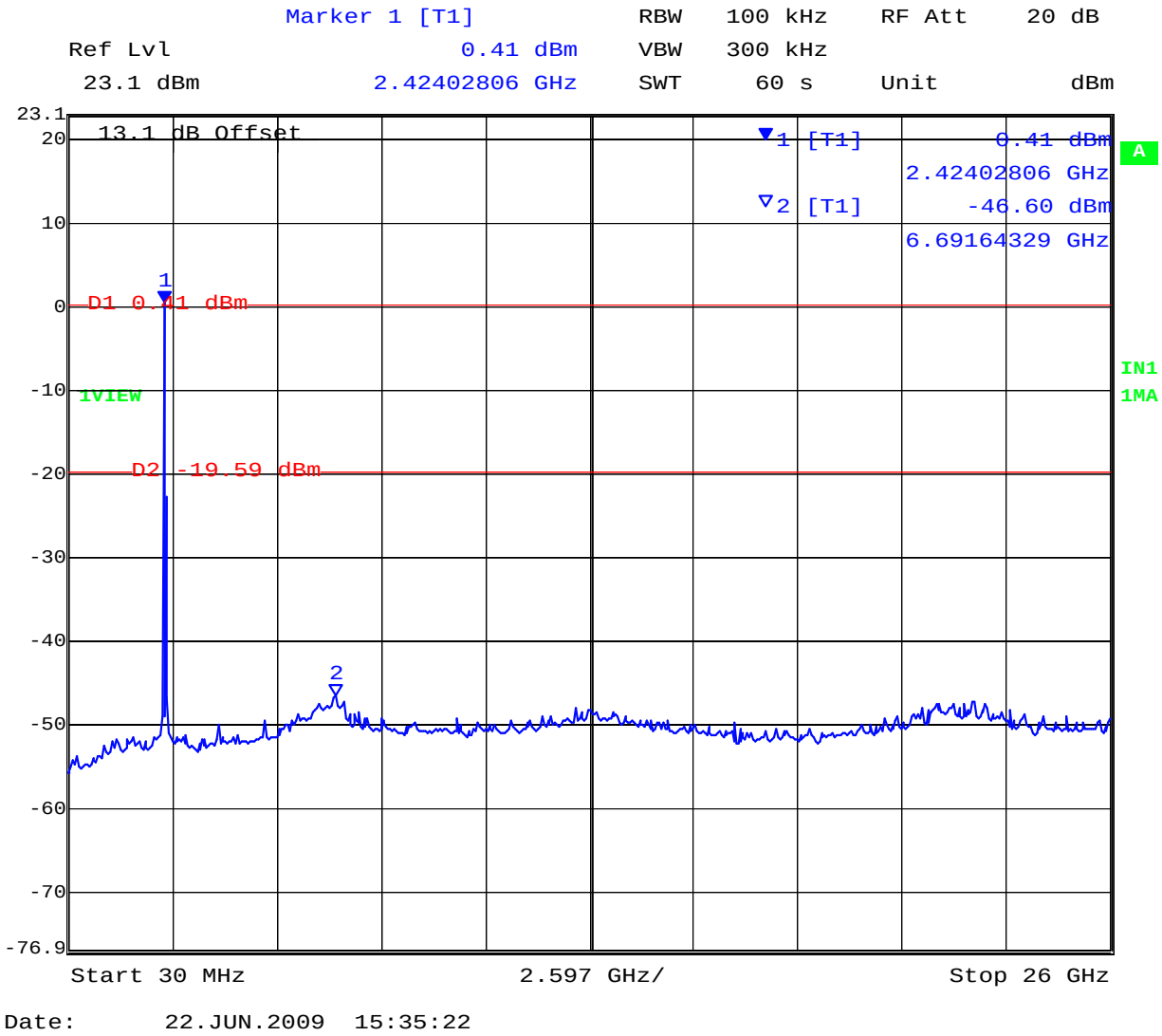
Channel Centre Frequency	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,437	1,000	26,000	-46.43	-18.51	-27.92



802.11b 2,437 MHz Conducted Spurious Emissions 1,000 MHz to 26,000 MHz

TABLE OF RESULTS – **802.11B**

Channel Centre Frequency	Start Frequency(MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,462	1,000	26,000	-46.60	-19.59	-27.01



802.11b 2,462 MHz Conducted Spurious Emissions 1,000 MHz to 7,000 MHz

Specification

Limits Band-Edge

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

§15.247(d) and RSS-210 §A8.5 In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

§15.247(d)
If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section §15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(a)).

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

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

Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB

Traceability

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

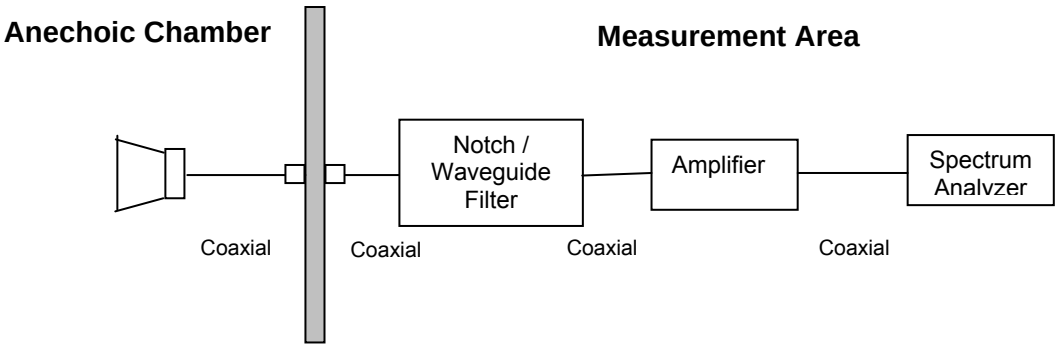
6.5. Radiated Emissions

6.5.1. 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.
Due to the battery drain as a result of the 100% duty cycle transmission the internal battery was disconnected and an external power source (3.6 Vdc) was used.

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:

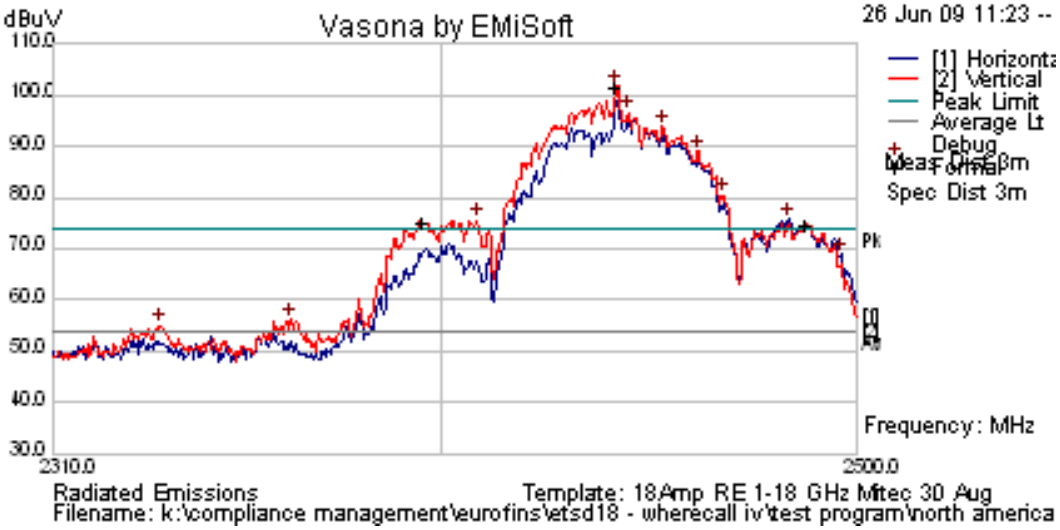
Level (dBμV/m) = 20 * Log (level (μV/m))

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

Ambient conditions.

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

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	DSSS - 2441.75 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Power Setting 13
Test Conditions	Max Emissions - Switch cable connected to EUT Y Orientation (Top Facing Antenna - Horizontal)



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2441.743	99.36	12.97	-10.57	101.8	Peak	V					N/A	FUND
2395.916	72.64	12.95	-10.56	75.03	Peak	H	98	334	54	-10.84	Pass	DCCF
2487.877	72.21	12.99	-10.61	74.6	Peak	H	98	334	54	-11.27	Pass	DCCF

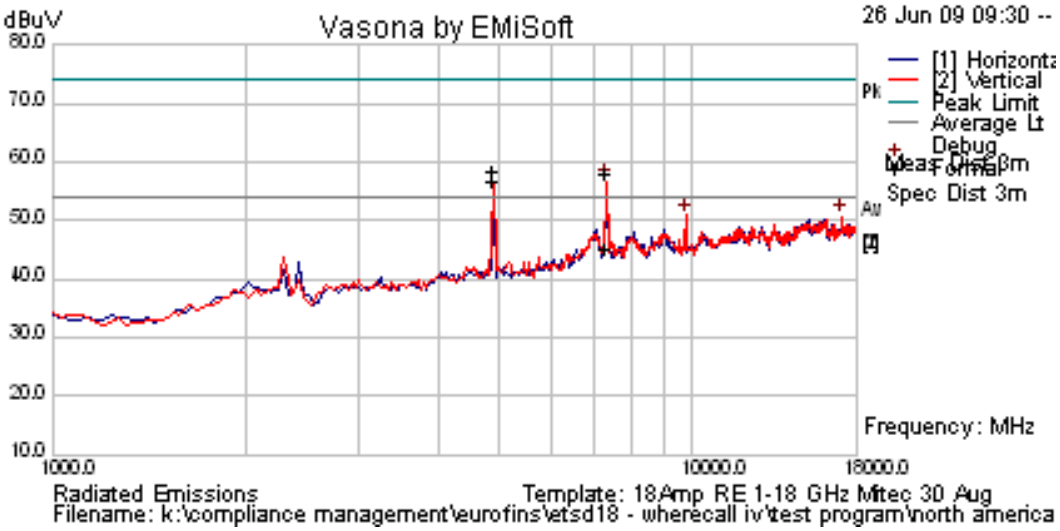
Notes:

DCCF: Measurements performed with EUT set for 100% Duty Cycle. Manufacturer's Declared Operational Duty Cycle: 2.55%

Band edge measurement: Per FCC's Digital Transmission Systems, Measurements and Procedures Public Notice DA 00-705 Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. Average value of emission is calculated by the following equation;

Peak value - 20 Log (duty cycle)
Operational duty cycle: 2.55% (ON 2.55 mS) where 100mS is the measurement period
Peak value - 20 Log (0.0255) = -31.87 dB

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	DSSS - 2441.75 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Power Setting 13
Test Conditions	Max Emissions - Switch cable connected to EUT Y Orientation (Top Facing Antenna - Horizontal)

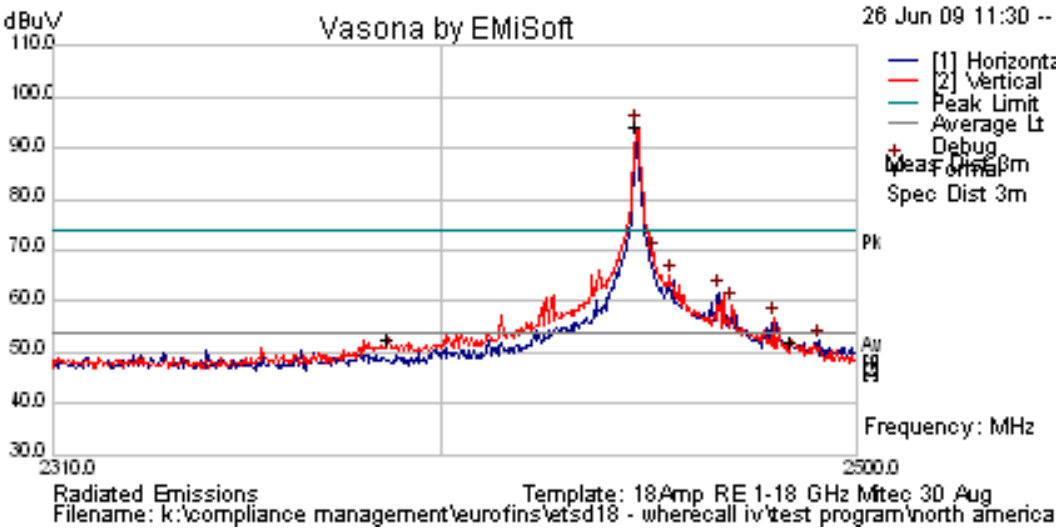


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
4883.479	62.78	4.52	-8.74	58.56	Peak Max	V	114	181	74	-15.44	Pass	
4883.479	60.96	4.52	-8.74	56.74	Average Max	V	114	181	54	-27.31	Pass	DCCF
7325.22	42.54	5.45	-2.91	45.08	Average Max	H	112	0	54	-8.92	Pass	
7325.22	55.54	5.45	-2.91	58.08	Peak Max	H	112	0	74	-15.92	Pass	
9766.883	46.27	6.36	-1.82	50.81	Peak [Scan]	V	100	0	81.8	>20dB	Pass	NRB

DCCF: Applied Duty cycle correction factor of -31.87 dB

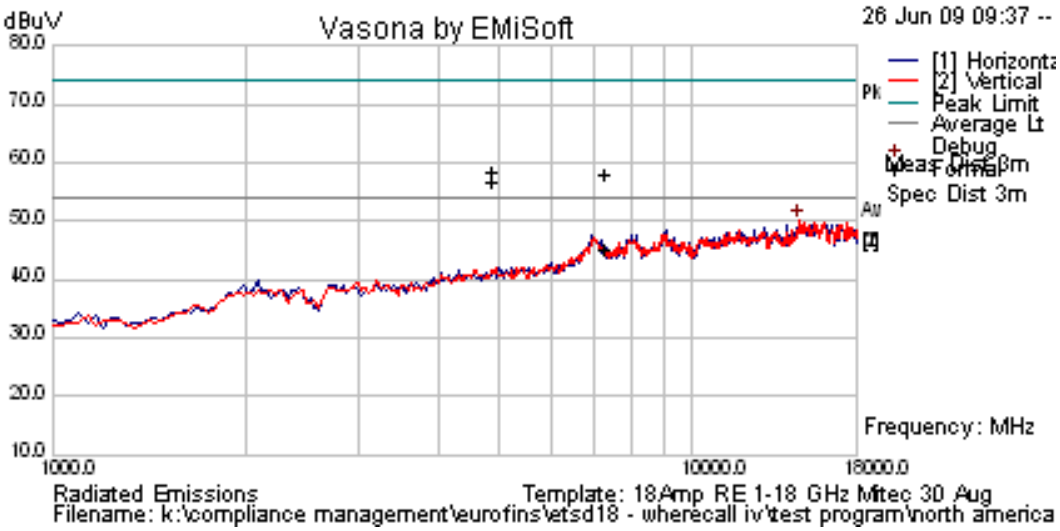
NRB: Non-Restricted Band emission, limit 20 dB below fundamental peak level.

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	OOK - 2446.519 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Power Setting in Firmware (OOK mode)
Test Conditions	Max Emissions - Switch cable connected to EUT Y Orientation (Top Facing Antenna - Horizontal)



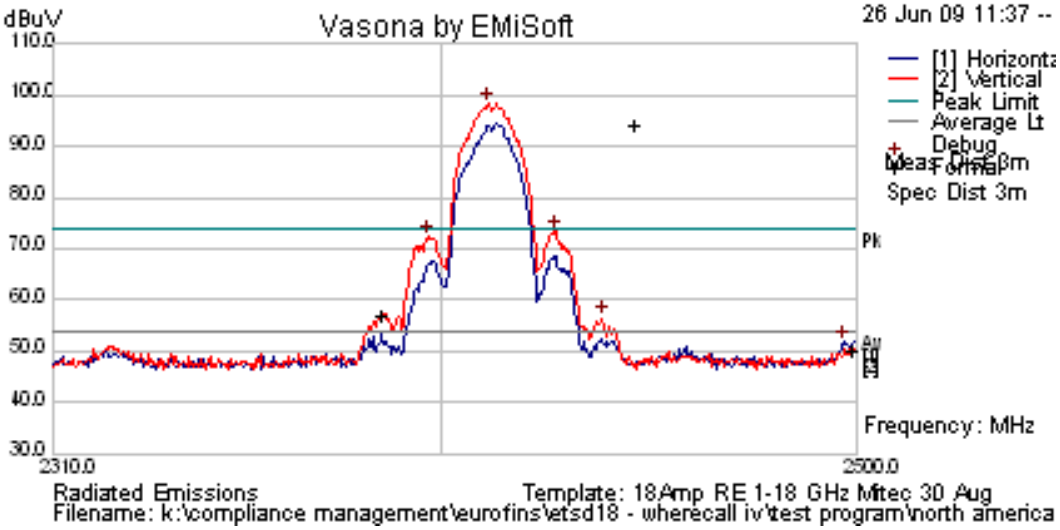
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2446.693	91.81	12.98	-10.57	94.21	Peak [Scan]	V	100				N/A	FUND
2387.692	50.18	12.95	-10.56	52.56	Peak [Scan]	H	98	360	54	-1.44	Pass	BE
2484.241	49.69	12.99	-10.6	52.08	Peak [Scan]	H	98	360	54	-1.92	Pass	BE

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	OOK - 2446.519 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Power Setting in Firmware (OOK mode)
Test Conditions	Max Emissions - Switch cable connected to EUT Y Orientation (Top Facing Antenna - Horizontal)



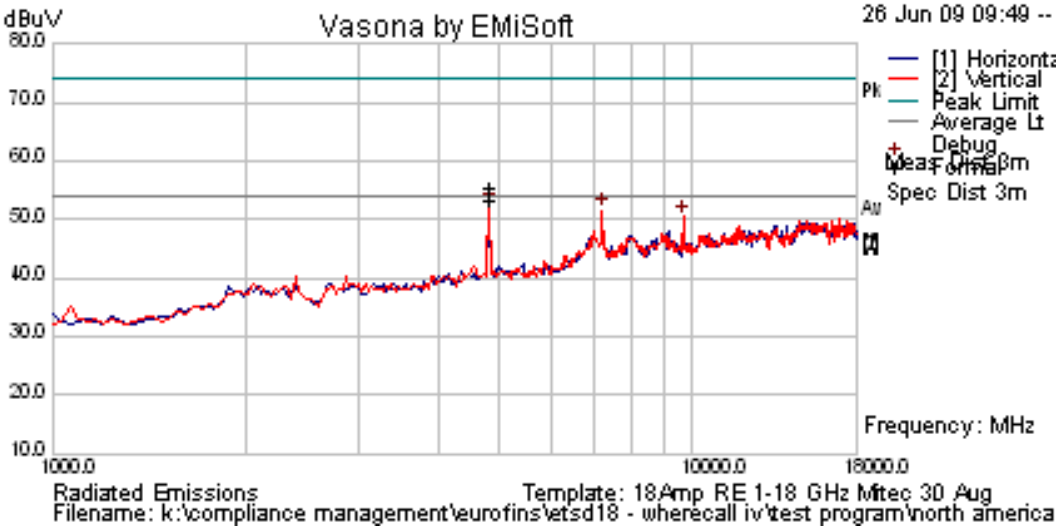
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
No emissions within 6 dB of AVG limit.												

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	802.11b - 2412 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Power Setting 10
Test Conditions	Max Emissions - Switch cable connected to EUT Y Orientation (Top Facing Antenna - Horizontal)



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2411.283	95.84	12.96	-10.56	98.24	Peak	V	100				N/A	FUND
2386.465	42.03	12.95	-10.56	44.42	Average Max	H	98	159	54	-9.58	Pass	BE
2386.465	52.04	12.95	-10.56	54.43	Peak Max	H	98	159	74	-19.57	Pass	BE
2497.136	49.2	13	-10.61	51.59	Peak	H	98	159	54	-2.41	Pass	BE

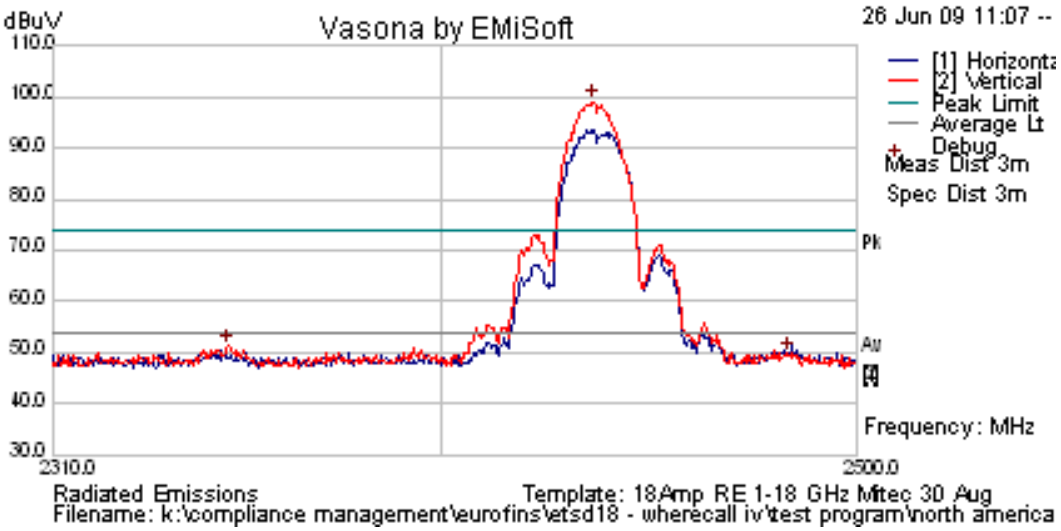
Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	802.11b - 2412 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Power Setting 10
Test Conditions	Max Emissions - Switch cable connected to EUT Y Orientation (Top Facing Antenna - Horizontal)



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
4823.984	59.75	4.47	-8.75	55.48	Peak Max	V	142	229	74	-18.52	Pass	
4823.984	57.41	4.47	-8.75	53.13	Average Max	V	142	229	54	-0.87	Pass	
7236.814	48.52	5.43	-2.47	51.48	Peak [Scan]	V	100	0	78.24	>20dB	Pass	NRB
9647.896	45.76	6.31	-1.64	50.43	Peak [Scan]	V	100	0	78.24	>20dB	Pass	NRB

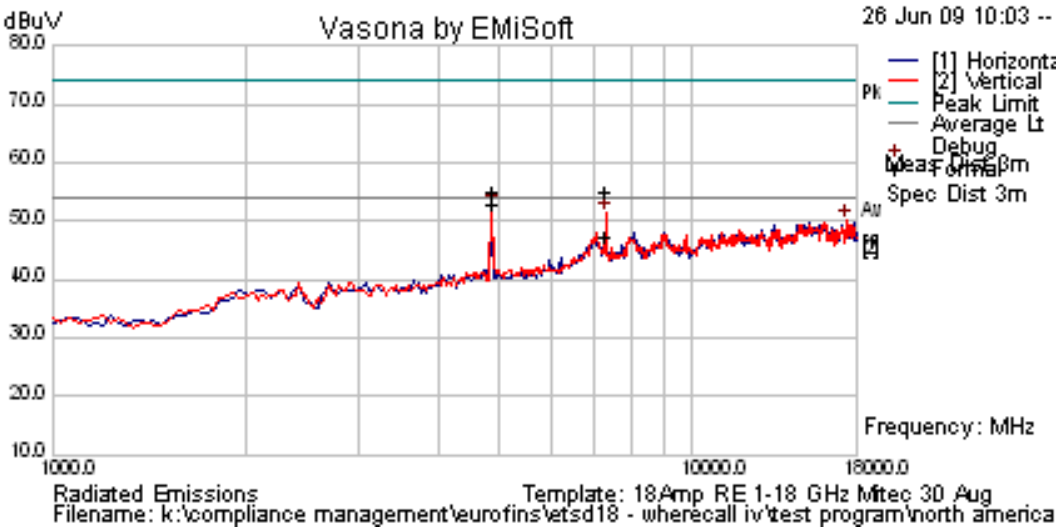
NRB: Non-Restricted Band emission, limit 20 dB below fundamental peak level.

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	802.11b - 2437 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Power Setting 10
Test Conditions	Max Emissions - Switch cable connected to EUT Y Orientation (Top Facing Antenna - Horizontal)



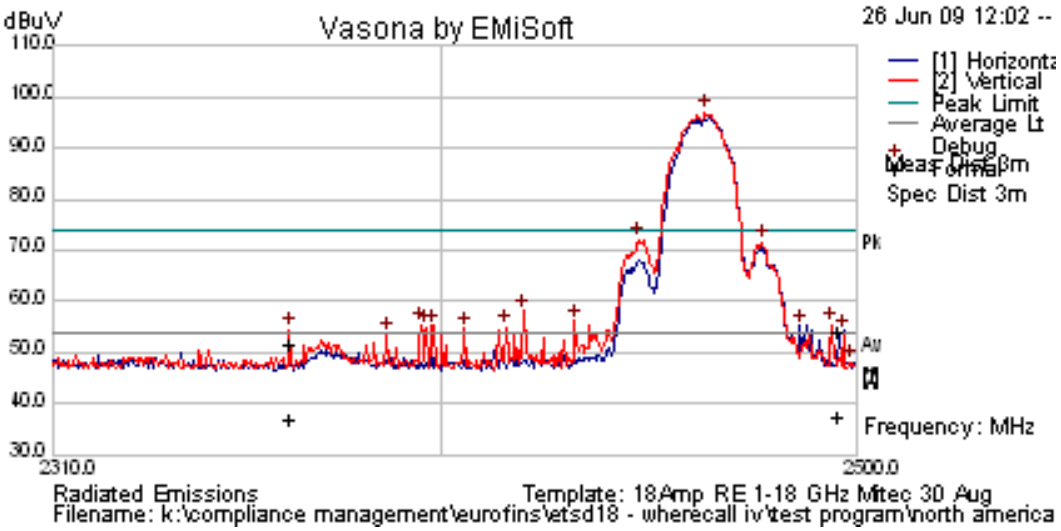
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2436.032	96.72	12.97	-10.57	99.13	Peak [Scan]	V					N/A	FUND
2350.335	48.64	12.93	-10.48	51.09	Peak [Scan]	H	98	360	54	-2.91	Pass	BE
2483.554	47.14	12.99	-10.6	49.53	Peak [Scan]	H	98	360	54	-4.47	Pass	BE

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	802.11b - 2437 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Power Setting 10
Test Conditions	Max Emissions - Switch cable connected to EUT Y Orientation (Top Facing Antenna - Horizontal)



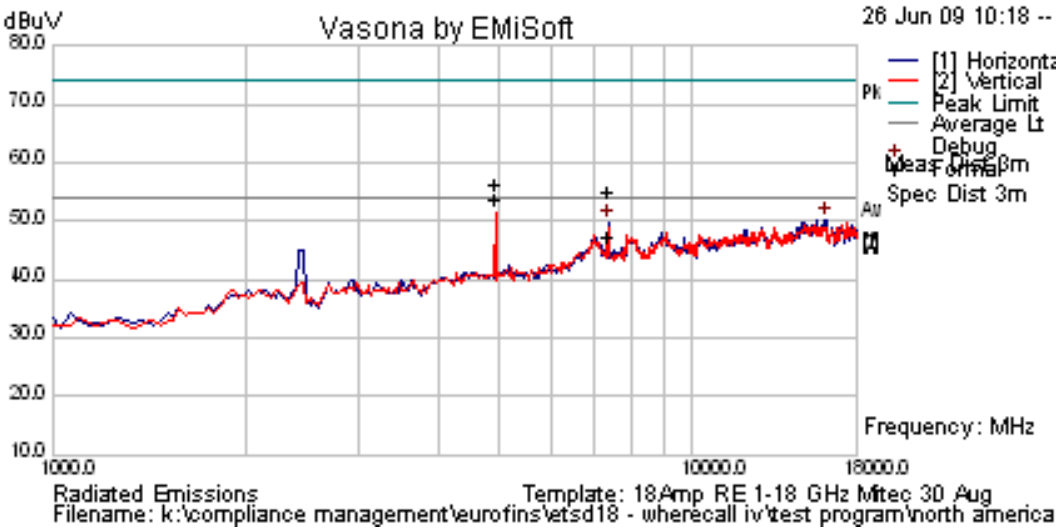
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
4873.978	57.03	4.51	-8.75	52.79	Average Max	V	141	226	54	-1.21	Pass	
4873.978	59.27	4.51	-8.75	55.03	Peak Max	V	141	226	74	-18.97	Pass	
7311.864	44.72	5.44	-2.84	47.32	Average Max	H	99	147	54	-6.68	Pass	
7311.864	52.58	5.44	-2.84	55.19	Peak Max	H	99	147	74	-18.81	Pass	

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	802.11b - 2462 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Power Setting 10
Test Conditions	Max Emissions - Switch cable connected to EUT Y Orientation (Top Facing Antenna - Horizontal)



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
2463.066	94.61	12.98	-10.59	97.01	Peak [Scan]	V					N/a	FUND
2364.526	49.11	12.94	-10.52	51.54	Peak Max	H	98	156	74	-22.46	Pass	BE
2364.526	34.6	12.94	-10.52	37.02	Average Max	H	98	156	54	-16.98	Pass	BE
2495.719	34.88	13	-10.61	37.26	Average Max	H	98	273	54	-16.74	Pass	BE
2495.719	51.54	13	-10.61	53.93	Peak Max	H	98	273	74	-20.07	Pass	BE

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	802.11b - 2462 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Power Setting 10
Test Conditions	Max Emissions - Switch cable connected to EUT Y Orientation (Top Facing Antenna - Horizontal)



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
4924.013	58.01	4.55	-8.76	53.81	Average Max	V	141	181	54	-0.19	Pass	
4924.013	60.7	4.55	-8.76	56.5	Peak Max	V	141	181	74	-17.5	Pass	
7386.854	45.14	5.46	-3.23	47.37	Average Max	V	109	81	54	-6.63	Pass	
7386.854	52.99	5.46	-3.23	55.22	Peak Max	V	109	81	74	-18.78	Pass	

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

6.5.2. Receiver Radiated Spurious Emissions (above 1 GHz)

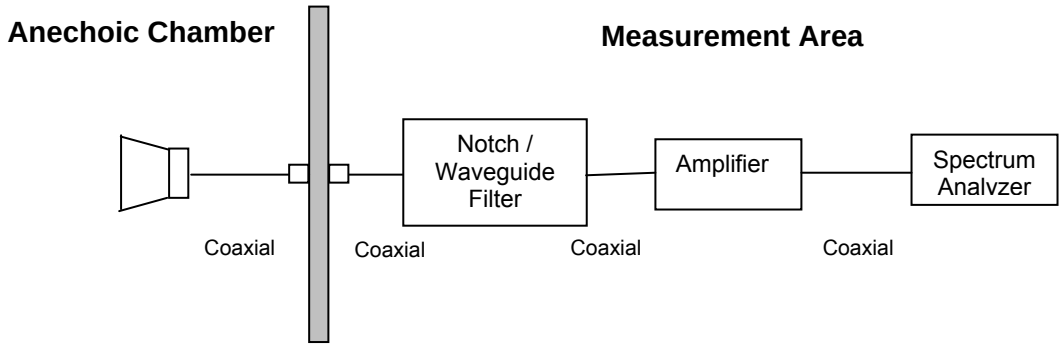
Industry Canada RSS-Gen §4.8, §6

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:

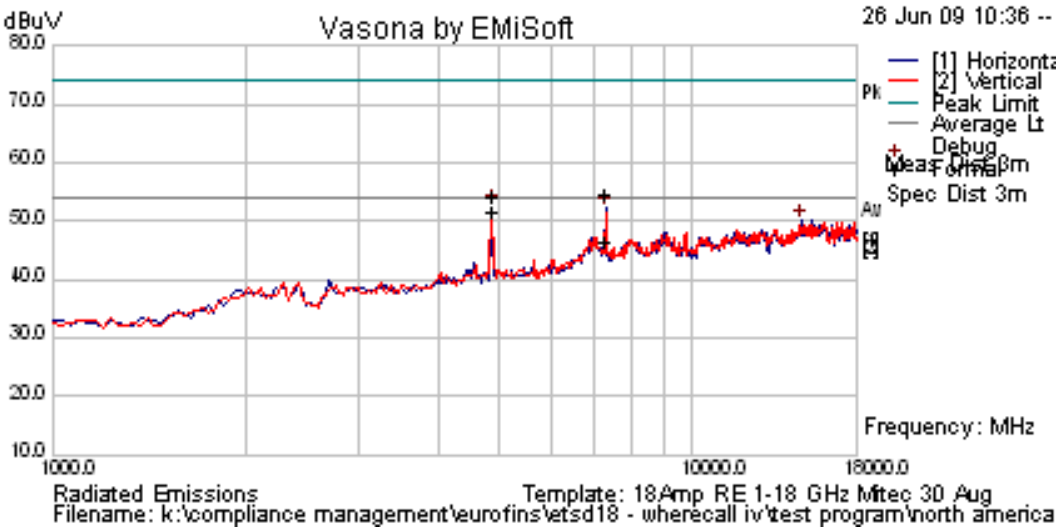
FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBμV/m

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

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	802.11b - 2437 MHz Standby Mode - Covers all modes in Standby/Receive
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Power Setting 10
Test Conditions	Max Emissions - Switch cable connected to EUT Y Orientation (Top Facing Antenna - Horizontal)



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
4873.979	56.02	4.51	-8.75	51.78	Average Max	V	141	182	54	-2.22	Pass	
7311.904	43.78	5.44	-2.84	46.39	Average Max	H	98	139	54	-7.61	Pass	

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 shall 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

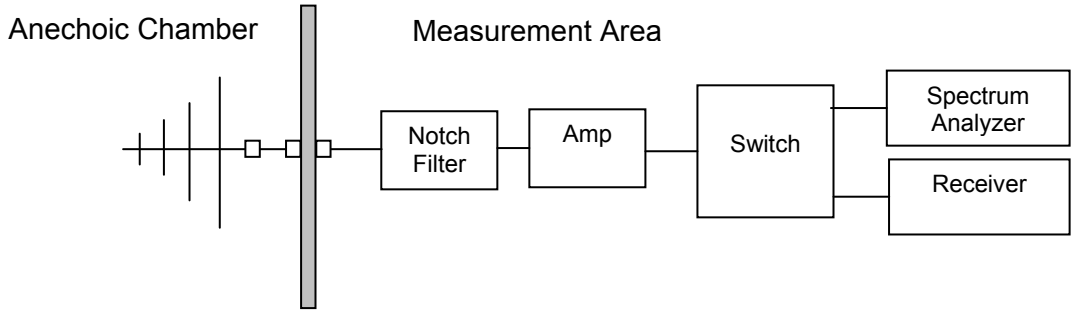
Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

6.5.3. 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 the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

Test Measurement Set up



Field Strength Calculation

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

$$FS = R + AF + CORR$$

where:

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

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

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

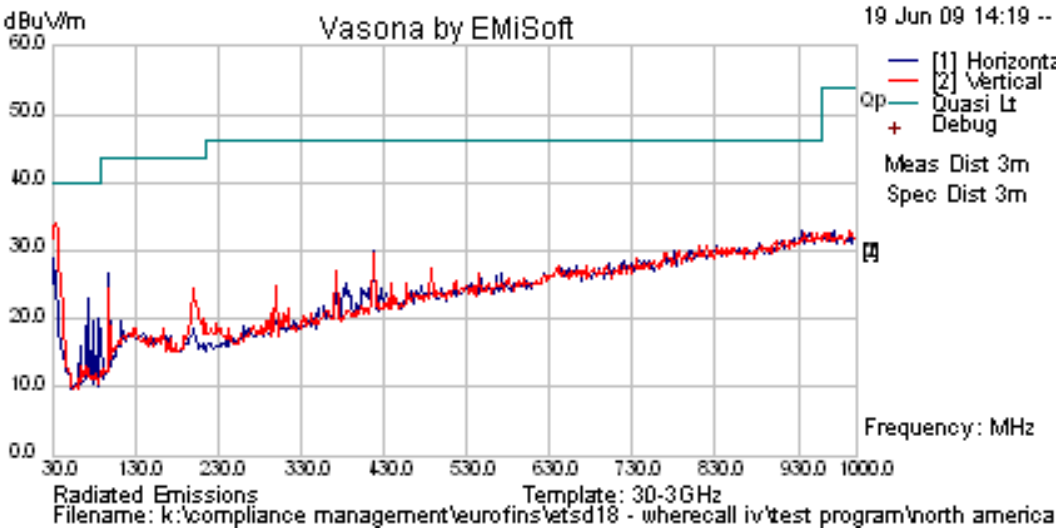
Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

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

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

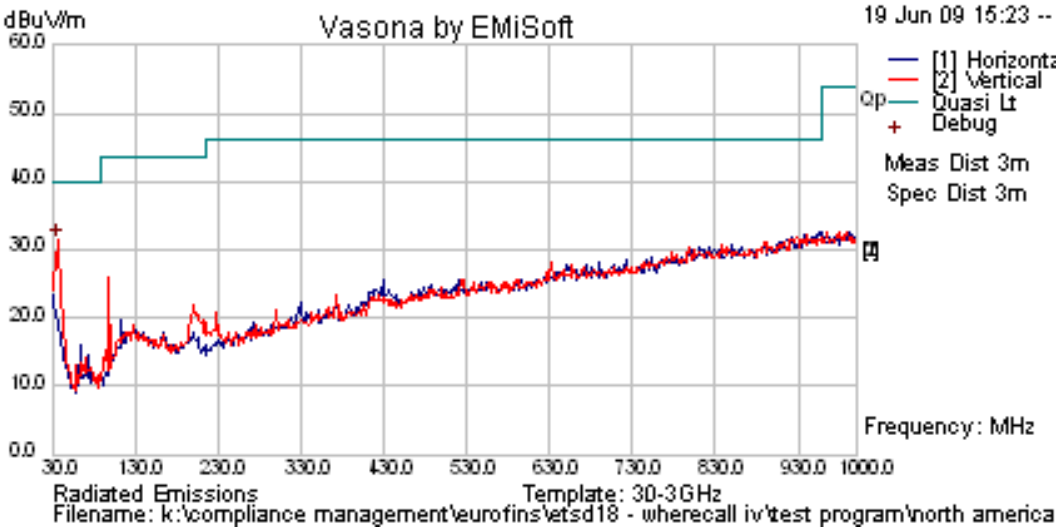
Measurement Results for Spurious Emissions (30 MHz – 1 GHz)
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	DSSS - 2441.75 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Max Power - Power Setting 13
Test Conditions	Max Emissions - Switch cable connected to EUT X Orientation (Side Facing Antenna - Horizontal)



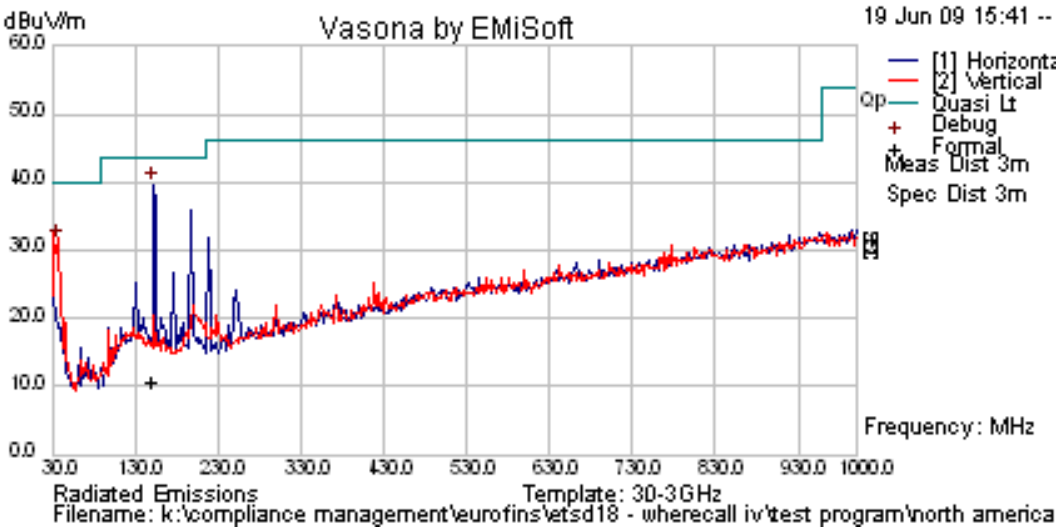
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail	Comments
No Emissions within 6 dB of limit												

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	DSSS - 2441.75 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Max Power - Power Setting 13
Test Conditions	Max Emissions - Switch cable connected to EUT Y Orientation (Top Facing Antenna - Horizontal)



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
35.66	41.81	3.49	-14.13	31.18	Peak [Scan]	H	98	360	40	-8.82	Pass	

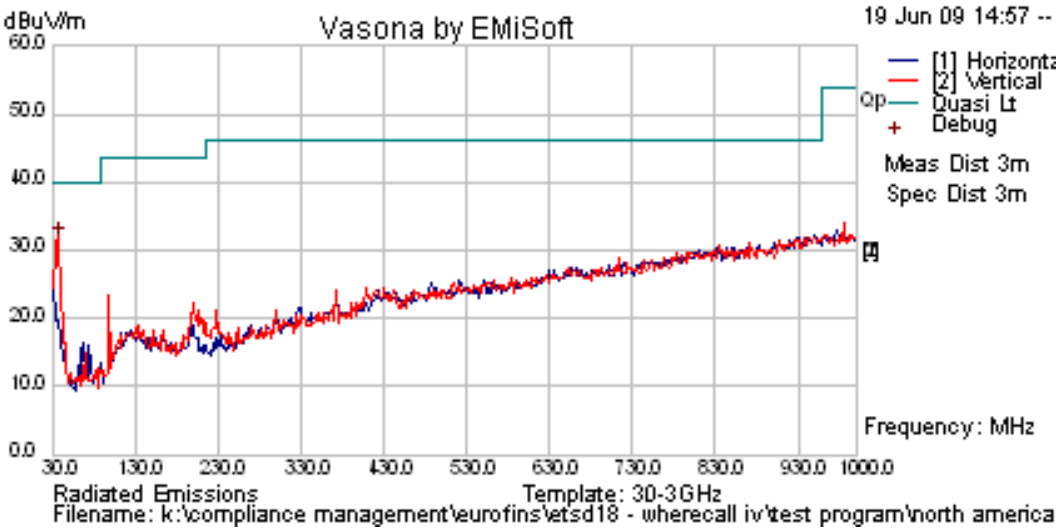
Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	DSSS - 2441.75 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Max Power - Power Setting 13
Test Conditions	Max Emissions - Switch cable connected to EUT Z Orientation (Top Facing Antenna - Verticle)



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
152.2577	24.57	4.49	-18.45	10.62	Quasi Peak	H	138	143	43.5	-32.88	Pass	Trans.
35.294	41.54	3.49	-13.83	31.19	Peak [Scan]	H	98	360	40	-8.81	Pass	

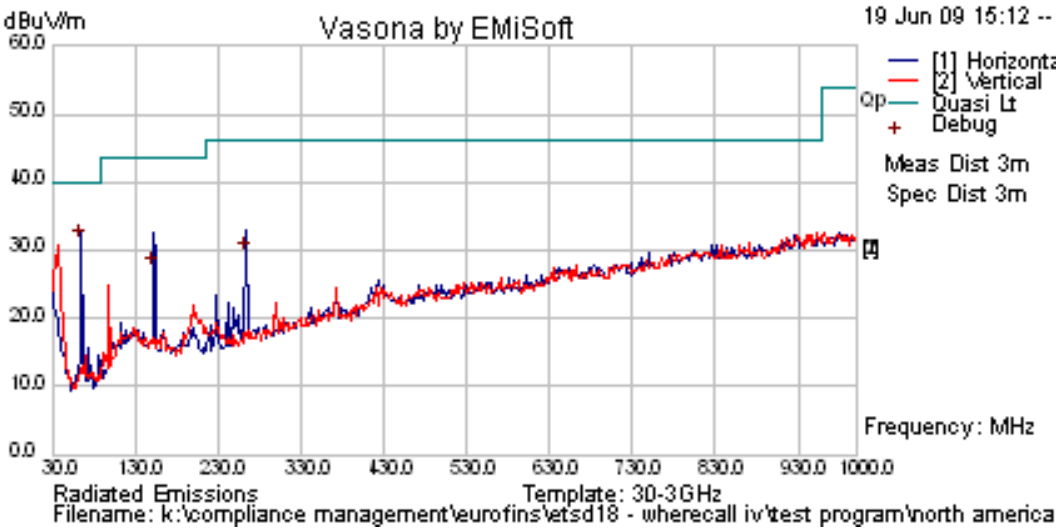
Trans: Transient emission from EUT. Was not present during maximization.

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	OOK - 2446.519 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Max Power - Power Setting 13
Test Conditions	Max Emissions - Switch cable connected to EUT



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
37.827	43.93	3.53	-15.78	31.68	Peak [Scan]	H	98	360	40	-8.32	Pass	

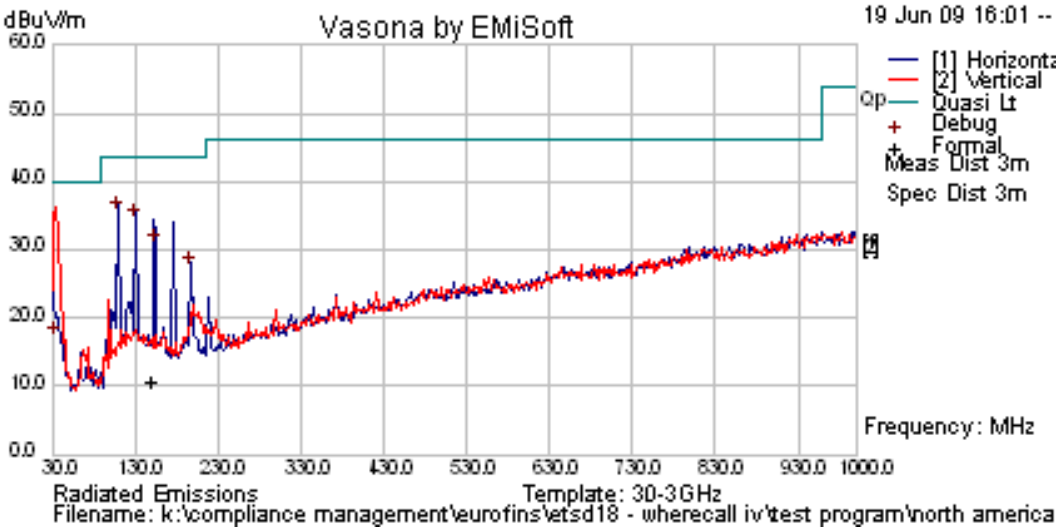
Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	802.11b Ch 7, Tx CW
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Max Power - Power Setting 13
Test Conditions	Max Emissions - Switch cable connected to EUT



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
63.652	50.77	3.85	-23.47	31.14	Peak [Scan]	H	98	360	40	-8.86	Pass	Trans
151.841	41.2	4.49	-18.44	27.26	Peak [Scan]	H	98	360	43.5	-16.24	Pass	Trans
263.686	42.3	5.04	-17.75	29.59	Peak [Scan]	H	98	360	46	-16.41	Pass	Trans

Trans: Transient emission from EUT. Was not present during maximization.

Date	6/19/2009
Engineer	CSB
Test Case	ETSD18
Frequency	DSSS - 2441.75 MHz
Antenna Model	Integral Antenna; Inverted F; #10370
Power setting	Receiver - Covers all Modes
Test Conditions	Max Emissions - Switch cable connected to EUT X Orientation (Side Facing Antenna - Horizontal)



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
33.67301	26.02	3.45	-12.58	16.9	Quasi Peak	V	173	120	40	-23.1	Pass	
109.54	49.66	4.24	-18.53	35.37	Peak [Scan]	H	98	0	43.5	-8.13	Pass	Trans
130.88	46.98	4.37	-17.18	34.17	Peak [Scan]	H	98	0	43.5	-9.33	Pass	Trans
154.645	44.59	4.51	-18.49	30.61	Peak [Scan]	H	98	0	43.5	-12.89	Pass	Trans
197.325	40.46	4.74	-17.98	27.22	Peak [Scan]	H	98	0	43.5	-16.28	Pass	Trans

Trans: Transient emission from EUT. Was not present during maximization.

Specification
Limits

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

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

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

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

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

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

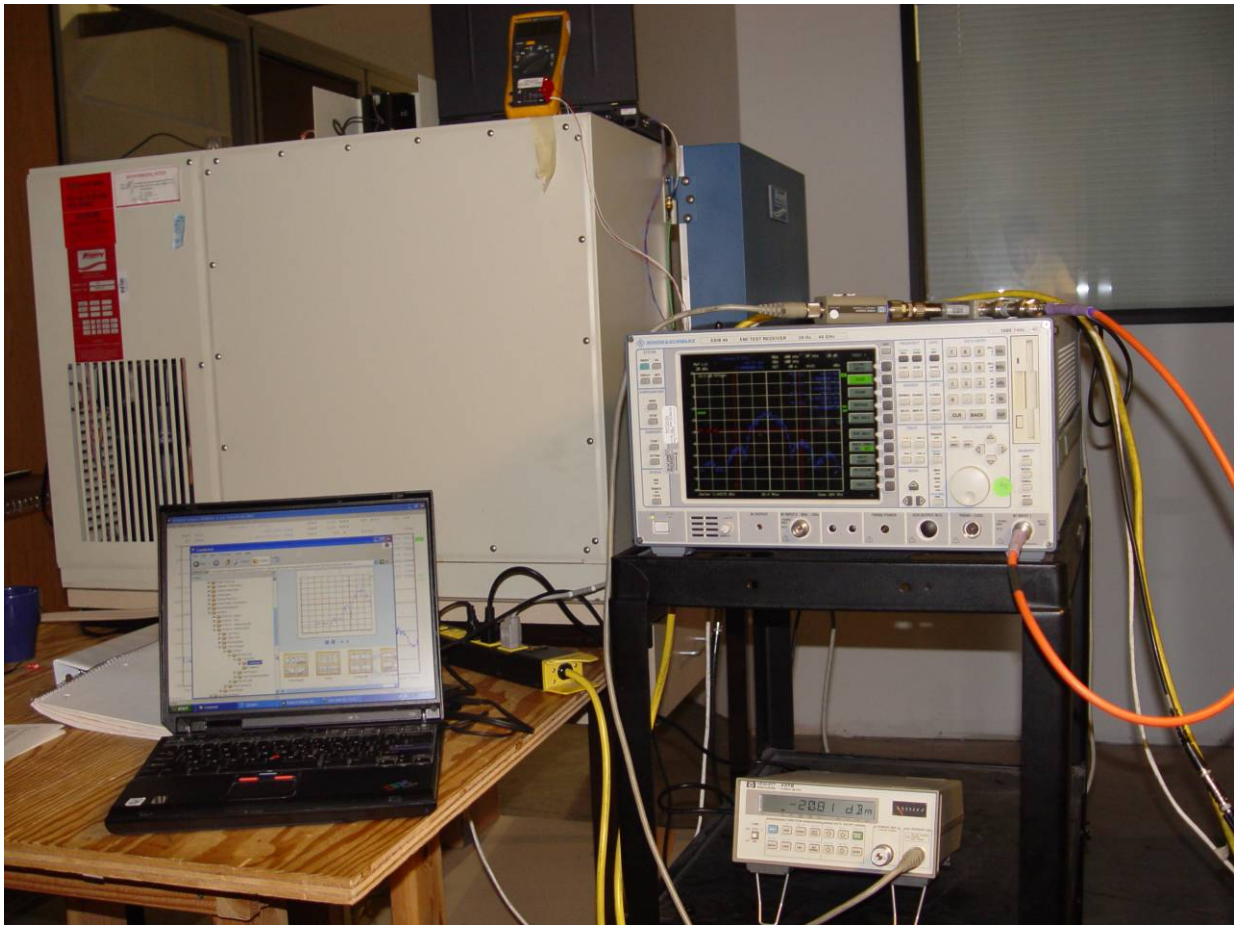
Method	Test Equipment Used
Measurements were made per Sanmina work instruction	8546A HP Receiver and RF Filter, HP Pre-amp, Antenna EMCO Biconilog

7. PHOTOGRAPHS

7.1. Radiated Emissions (Above 1 GHz)

7.2. Radiated Emissions (Below 1 GHz)

7.3. General Measurement Test Set-Up



8. 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
287	EMI Receiver	Rhode & Schwartz	ESIB40	100201
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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