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Test of CISCO 74-3624, 802.11a/b/g Wireless Module

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

Test Report Serial No.: TUVR48-A1 REV A

TEST REPORT

FROM

Test of CISCO 74-3624, 802.11a/b/g Wireless Module

To FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: TUVR48-A1 Rev A

This report supersedes None

Manufacturer: Cisco Systems
170 W. Tasman Ave
San Jose
California 95134, USA

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

Copy No: pdf **Issue Date:** 9th February '05

This Test Report is Issued Under the Authority of;

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

2106

MiCOM Labs is a UKAS (United Kingdom Accreditation Service)

Accredited Test Laboratory

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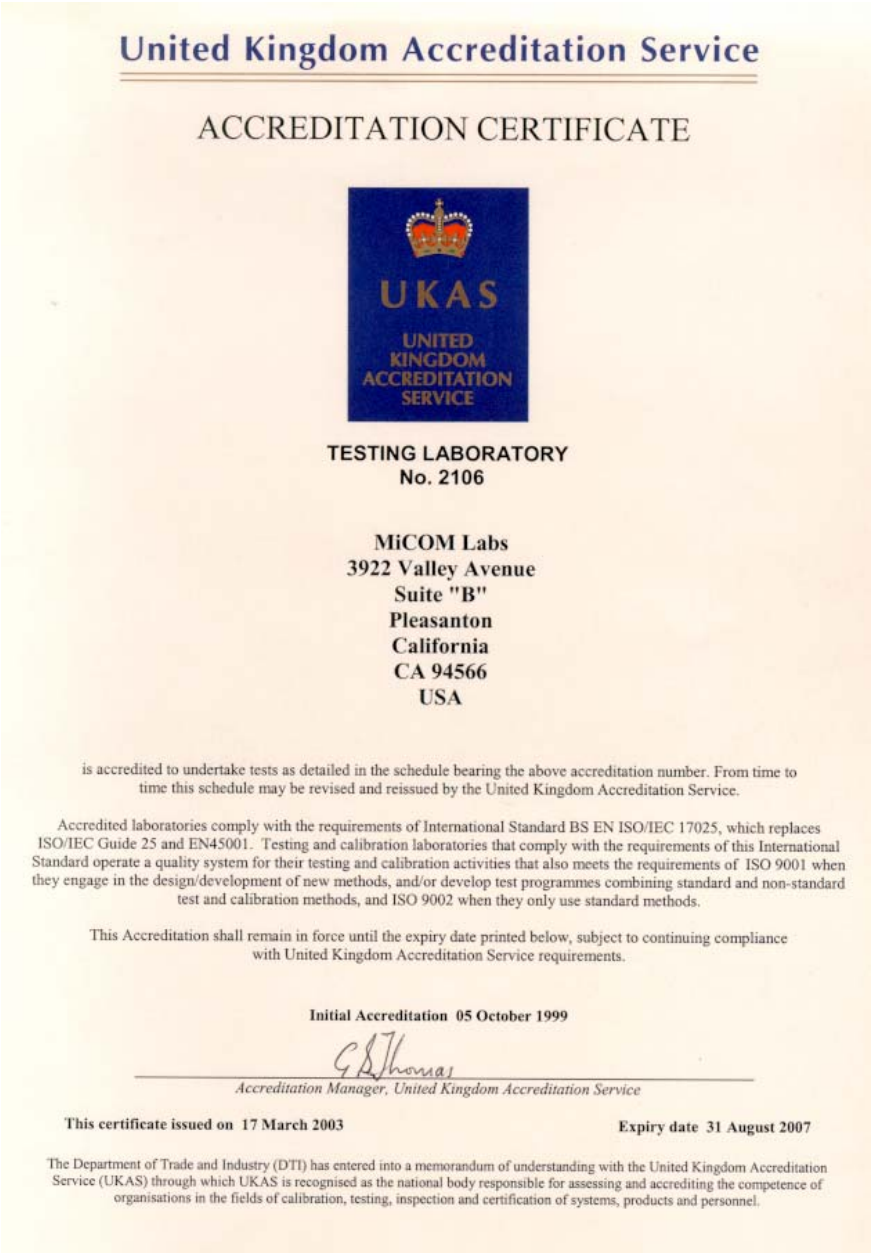
ACCREDITATION & LISTINGS

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



United Kingdom Accreditation Service

ACCREDITATION CERTIFICATE

UKAS
UNITED KINGDOM ACCREDITATION SERVICE

TESTING LABORATORY
No. 2106

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

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

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

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

Initial Accreditation 05 October 1999

G R Thomas
Accreditation Manager, United Kingdom Accreditation Service

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

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

LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

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

Canada
Industry Canada (IC) Listing #: **4143**

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	2nd February '05	
Rev A	9th February '05	

1. TEST RESULT CERTIFICATE

Manufacturer:	Cisco Systems 170 W. Tasman Ave San Jose California 95134, USA	Tested By:	MiCOM Labs, Inc. 3922 Valley Avenue 'B' Pleasanton California, 94566, USA
EUT:	802.11a/b/g Wireless Module	Tel:	+1 925 462 0304
Model #:	CISCO 74-3624	Fax:	+1 925 462 0306
S/N:	Not Available		
Test Date(s):	9th Sept - 14th Jan '05	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.247 & IC RSS-210	EQUIPMENT COMPLIES

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

Notes:

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

Approved & Released for MiCOM Labs, Inc. by:

UKAS TESTING
2106

Graeme Grieve
Quality Manager MiCOM Labs, Inc.

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	2004	Code of Federal Regulations
(ii)	Industry Canada RSS-210	Issue 5 Nov. 2001	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands)
(iii)	ANSI C63.4	2003	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(iv)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(v)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vi)	LAB34	Edition 1 August 2002	The expression of uncertainty in EMC Testing
(vii)	ETSI TR 100 028	ETSI TR 100 028	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(viii)	UKAS LAB 1	Edition 4 May 2004	Reference to Accreditation for Laboratories.
(ix)	DTI URN 98/997	1998	Conditions for the use of National Accreditation Marks by UKAS and UKAS Accredited Organisations.

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

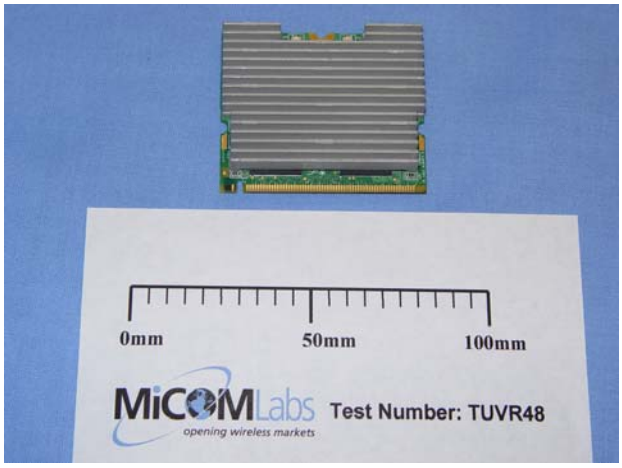
3.1. Technical Details

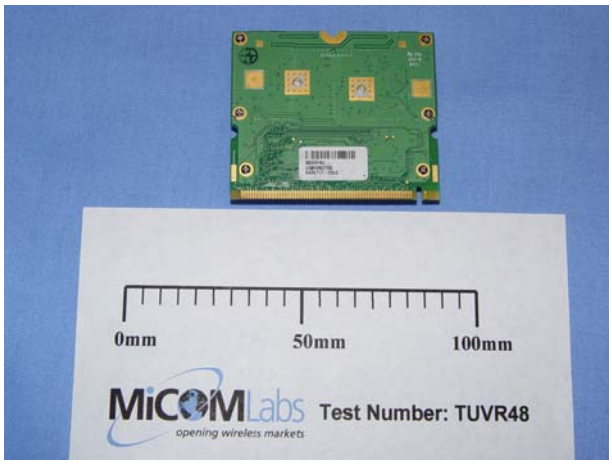
Details	Description
Purpose:	Test of the CISCO 74-3624 to FCC 47 Part 15.247 & and Industry Canada regulations IC RSS-210
Applicant:	TUV Rheinland of N. America 1279 Quarry Lane, Suite A Pleasanton, California 94566, USA
Manufacturer:	Cisco Systems 170 W. Tasman Ave San Jose, California 95134, USA
Laboratory performing the tests:	MiCOM Labs, Inc. 3922 Valley Avenue, Suite "B" Pleasanton, California 94566 USA
Test report reference number:	TUVR48-A1
Date EUT received:	6th September '04
Standard(s) applied:	FCC 47 CFR Part 15.247 & IC RSS-210
Dates of test (from - to):	9th Sept - 14th Jan '05
Type of Equipment:	802.11a/b/g Wireless Access Point
Manufacturers Trade Name:	CISCO 74-3624
Model:	CISCO 74-3624
Location for use:	Indoor use only
Declared Frequency Range(s):	2.412 – 2,462 MHz 5,725 – 5,850 MHz
Type of Modulation:	Per 802.11 – DBPSK, DQPSK, CCK,OFDM
Client Declared Nominal Output Power:	802.11b: +20dBm (100mW) 802.11g: +17dBM (50mW) 802.11a: +16dBm (40mW)
Transmit/Receive Operation:	Simplex
Rated Input Voltage and Current:	3 Volts DC, 800mA
Operating Temperature Range:	0ºC to +35 ºC
ITU Emission Designator:	802.11b – 15M7W7D 802.11g - 18M7W7D 802.11a - 19M2W7D
Microprocessor(s) Model:	Atheros AR5213
Clock/Oscillator(s):	40MHz
Frequency Stability:	±20ppm
Equipment Dimensions:	2" x 2.5"
Weight:	0.2lbs
Primary function of equipment:	To initiate and receive data transmissions, telemetry and telecommand

3.2. Scope of Test Program

The scope of the test program was to test the CISCO 74-3624, 802.11a/b/g Wireless Module against the current FCC and Industry Canada specifications FCC Part 15.247 and IC RSS-210, Normative References (i) & (ii).

CISCO 74-3624: 2.4 and 5 GHz 802.11a/b/g Wireless Access Point Module





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

Name	Manufacturer	Model No.	Serial No.
CISCO 74-3624	Foxconn	U58H062T00	N/A

Support Equipment

Name	Description	Model No.	Serial No.
Atheros test box	Host development system	NL5354AP	035057010
Class II AC Adaptor	PSU 120VAC 60Hz	AM-121000	710101040000
IBM Laptop	Computer	600E	78-PKNM0-03/00
IBM AC Adaptor	100-240VAC 50/60Hz	02K6749	ZJ1MN33631NN

3.4. Antenna Details

Antenna Type	Gain (dBi) 2.4GHz/5GHz	Manufacturer	Model No.	Serial No.
Swivel Mount Dipole	2.0 / 5.0	Radial	AIR-ANTM2050D-R	N/A
Ceiling Mount Omni	4.0 / 5.0	Cushcraft	AIR-ANTM4050V-R	N/A
Wallmount Patch	5.5 / 6.0	Cushcraft	AIR-ANTM5560P-R	N/A

3.5. Cabling and I/O Ports

Number and type of I/O ports

1.

3.6. Test Configurations

Matrix of test configurations

Operational Mode (802.11)	Operating Channel	Frequencies (MHz)	Maximum Data Rates (MBit/s)	Data Rate(s) Selected for Test Purposes (MBit/s)
a	149, 157, 165	5,745 5,785 5,825	54	54
b	1, 6, 11	2,412 2,437 2,462	11	11
g			54	54

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

Conducted testing on the Aircard wireless module was not performed in a host device therefore host software was not exercised. Maximum output power was set available via the Atheros software. A host device was used for radiated emission testing, see picture of Atheros host device below.

Conducted Testing – Atheros Host Device
The antennas on the Atheros host device were not utilized for test purposes. These were disconnected internally.

3.7. Equipment Modifications

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

1. NONE

3.8. Deviations from the Test Standard

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

1. NONE

3.9. Subcontracted Testing

Radiated emission testing 30 MHz-1 GHz (Section 5.1.6.3) and AC Wireline Emissions (Section 5.1.7) were subcontracted to the following test facility;

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

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

Sanmina SCI: FCC Registration Number: **90844**

IC Registration Number: **IC5541**

4. TEST SUMMARY

List of Measurements

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

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(a)(2) **5.9.1**	6 dB and 99 % Bandwidth	>=500 kHz	Conducted	Complies	5.1.1
15.247(b) **15.31(e)** **6.2.2 (o) (b)**	Peak Output Power Voltage Variation	Shall not exceed 1W Variation of supply voltage 85 % -115 %	Conducted	Complies	5.1.2
15.247(d) **6.2.2 (o) (b)**	Peak Power Spectral Density	Shall not be greater than +8 dBm in any 3 kHz band	Conducted	Complies	5.1.3
15.247(b)(5) **14**	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	5.1.4
15.247(c) **15.205(a) /** **15.209(a)** **6.2.2 (o) (e1)**	Conducted Spurious Emissions (1-26 GHz)	The radiated emission in any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density	Conducted	Complies	5.1.5
5.205(a) / **15.209(a)** **6.3**	Radiated Emissions	Restricted Bands	Radiated	Complies	5.1.6
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*5.1.6.1*
	Radiated Band Edge	Band edge results		Complies	*5.1.6.2*
	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)		Complies	*5.1.6.3*

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.207 **6.6**	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Complies	5.1.7

Note 1: *Test results reported in this document relate only to the items tested*
Note 2: *The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria*
Note 3: *Section 3.7 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix*

5. TEST RESULTS

5.1. Device Characteristics

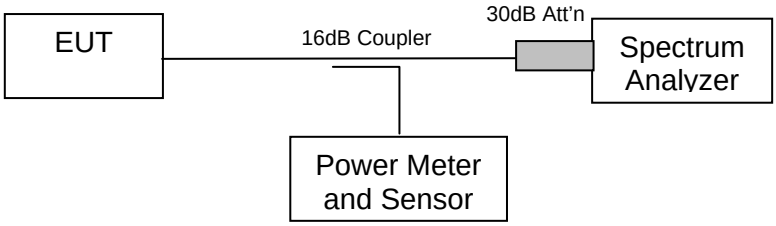
5.1.1. 6 dB and 99 % Bandwidth

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

Test Procedure
The bandwidth at 6 dB and 99 % is measured with a spectrum analyser connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency. Using a 6 dB resolution bandwidth filter setting the spectrum analyzer was set to the following for both 6 dB BW and 99 % BW measurements;

RBW= 1 MHz, VBW= 1 MHz, Span= 50 MHz, Sweep = 5 mS

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: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

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

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	99 % BW (MHz)	99 % BW Plots
2,412	12.5250	On File	15.7315	On File
2,437	12.7255	01	15.6313	On File
2,462	12.5251	On File	15.7315	02

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

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	99 % BW (MHz)	99 % BW Plots
2,412	17.0341	On File	18.7375	On File
2,437	17.2345	03	18.6373	On File
2,462	17.1343	On File	18.7375	04

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

Center Frequency (MHz)	6 dB Bandwidth (MHz)	6 dB Plot #	99 % BW (MHz)	99 % BW Plots
5,745	17.0741	On File	19.2384	06
5,785	17.3146	05	18.8777	On File
5,825	17.1543	On File	18.9979	On File

Specification

Limits

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

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	±2.81 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0156, 0193, 0252, 0313, 0314

5.1.2. Peak Output Power

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

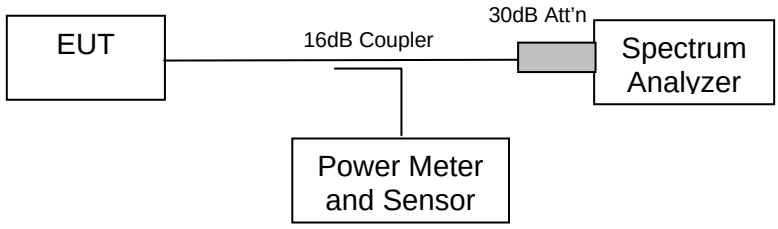
Test Procedure

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

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

Spectrum analyzer settings: RBW=1 MHz, VBW=10 MHz, Span=50 MHz, Sweep = 200 mS

Test Measurement Set up



Measurement set up for Transmitter Peak Output Power

Measurement Results for Peak Output Power

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

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

Center Frequency (MHz)	Measurement Bandwidth (MHz)	Peak Power (dBm)	Peak Power Plot #
2,412	15.7300	22.26	On File
2,437	15.7300	23.27	On File
2,462	15.7300	23.62	07

PEAK POWER (EIRP) = conducted power level + antenna gain (dBi) dBm

PEAK POWER ($EIRP_{max}$) = +23.62 + 5.5 = +29.12 dBm

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

Center Frequency (MHz)	Measurement Bandwidth (MHz)	Peak Power (dBm)	Peak Power Plot #
2,412	18.73	21.61	08
2,437	18.73	21.38	On File
2,462	18.73	21.49	On File

PEAK POWER (EIRP) = conducted power level + antenna gain (dBi) dBm

PEAK POWER ($EIRP_{max}$) = +21.61 + 5.5 = +27.11 dBm

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

Center Frequency (MHz)	Measurement Bandwidth (MHz)	Peak Power (dBm)	Peak Power Plot #
5,745	19.24	21.80	On File
5,785	19.24	22.12	On File
5,825	19.24	22.22	09

PEAK POWER (EIRP) = conducted power level + antenna gain (dBi) dBm

PEAK POWER ($EIRP_{max}$) = +22.22 + 6.0 = +28.22 dBm

Antenna Gain - Maximum Permissible Power Level

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

For Antenna Gains greater than 6dBi

Maximum permissible Peak Power = +30 – (antenna gain - 6) dBm

Antenna Type	Gain (dBi)	Antenna Gain >6 dBi (dB)	Max. Allowable Peak Power (dBm)

Gain for all antenna(s) is 6.0 dBi or less.

Supply Voltage Variation

The supply voltage was varied between 97.75 VAC and 132.25 VAC. 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: 1watt

§15.247 (b) (4) Except as shown in paragraphs (b)(3)(i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b) (1) or (b)(2) of this section, as appropriate by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§6.2.2(o)(b) For the band 2400-2483.5 MHz, the transmitter output power shall not exceed 1.0 watt

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0156, 0193, 0252, 0313, 0314

5.1.3. Peak Power Spectral Density

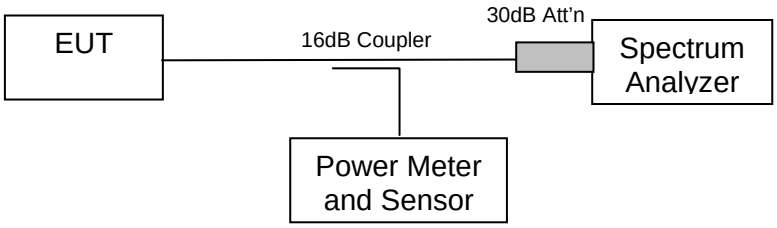
FCC, Part 15 Subpart C §15.247(d)
Industry Canada RSS-210 §6.2.2(o)(b)

Test Procedure

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

RBW = 3 kHz, VBW =10 kHz, Span = >312 kHz, Sweep time = >350s, RBW Filter = 3 dB

Test Measurement Set up



Measurement set up for Peak Power Spectral Density

Measurement Results for Peak Power Spectral Density

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

Radio parameters.
Data Rate(s): 11MBit/s

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

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Plot #
2,412	2412.47	-1.28	On File
2,437	2437.39	-0.60	10
2,462	2461.98	-1.96	On File

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

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Plot #
2,412	2412.93	-9.44	On File
2,437	2438.24	-9.00	On File
2,462	2456.71	-8.37	11

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

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Plot #
5,745	5746.86	-10.92	On File
5,785	5783.71	-8.91	12
5,825	5801.23	-9.59	On File

Specification

Peak Power Spectral Density Limits

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

RSS-210 §**6.2.2(o)(b)** The transmitter power spectral density (into the antenna) shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0 second duration.

Laboratory Measurement Uncertainty Spectral Density

Measurement uncertainty	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-01 'Measuring RF Output Power'	0156, 0193, 0252, 0313, 0314

5.1.4. Maximum Permissible Exposure

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

Calculations for Maximum Permissible Exposure Levels

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

EIRP = P * G

P = Peak output power (mW)

G = Antenna gain (numeric)

d = Separation distance (cm)

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

P (worst case) 2.4GHz = +**23.62 dBm, 230mW,** Antenna Gain = 5.5 dBi / **3.55 numeric**

P (worst case) 5,725GHz = +**22.22 dBm, 168mW,** Antenna Gain = 6.0 dBi / **3.98 numeric**

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

Freq. Band (MHz)	Antenna Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated RF Exposure at d=20cm (mW/cm^2)	Limit (mW/cm^2)
2,400	3.55	23.62	230.14	0.162	1
5,725	3.98	22.22	166.72	0.132	1

Specification

Maximum Permissible Exposure Limits

§15.247 (b)(5) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency levels in excess of the Commission's guidelines. See §1.1307 (b)(1) of this chapter.

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

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

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

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

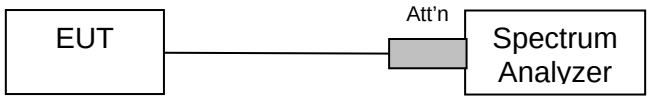
5.1.5. Conducted Spurious Emissions

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

Test Procedure
The band-edge if measured at 20 dB below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Measurements were made while EUT was operating in a continuous transmission mode i.e. 100 % duty cycle at the appropriate center frequency.

The spectrum analyzer is set to:
RBW=100 kHz, VBW=300 kHz, Span=110 MHz, Sweep = 200 mS

Test Measurement Set up



Band-edge measurement test configuration

Measurement Results of Conducted Spurious Emissions

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

Band-Edge Results

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

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit @ 20 dB below peak	Amplitude @ Band edge (dBm)	Plot #	Margin (dB)
2,412	2,400	-10.28	-37.44	13	-27.16
2,462	2,483.5	-9.48	-43.35	14	-33.87

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

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit @ 20 dB below peak	Amplitude @ Band edge (dBm)	Plot #	Margin (dB)
2,412	2,400	-16.30	-25.12	15	-8.82
2,462	2,483.5	-16.06	-39.78	16	-23.72

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

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit @ 20 dB below peak	Amplitude @ Band edge (dBm)	Plot #	Margin (dB)
5,745	5,725	-17.88	-29.21	17	-11.33
5,825	5,850	-17.58	-44.47	18	-26.89

Spurious Emissions (above 1 GHz)

Conducted spurious emissions (above 1 GHz) are provided indicated by the following matrix. Measurements were performed with the transmitter tuned to the channel closest to the band-edge being measured. All emissions were maximized during measurement. Limits which were derived from the band-edge measurements provided below are drawn on each plot.

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

LIMIT: -10.28 dBm

CH #	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Plot #	Margin (dB)
1	30	2400	-37.95	19	-17.47
1	2483	5000	-37.25	20	-26.97
1	5000	26000	-41.59	21	-31.31
6	30	2400	-42.95	On File	-32.67
6	2483	5000	-37.59	On File	-27.31
6	5000	26000	-42.25	On File	-31.97
11	30	2400	-44.28	On File	-34.00
11	2483	5000	-25.75	On File	-15.47
11	5000	26000	-41.92	On File	-31.64

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

Limit: -16.06 dBm

CH #	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Plot #	Margin (dB)
1	30	2400	-26.54	22	-10.48
1	2483	5000	-37.59	23	-21.53
1	5000	26000	-41.09	24	-25.03
6	30	2400	-43.17	On File	-27.11
6	2483	5000	-37.09	On File	-21.03
6	5000	26000	-41.75	On File	-25.69
11	30	2400	-43.27	On File	-27.21
11	2483	5000	-27.25	On File	-11.19
11	5000	26000	-41.92	On File	-25.86

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

Limit: -17.58

CH #	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Plot #	Margin (dB)
149	30	3000	-43.15	25	-25.57
149	3000	5725	-31.44	26	-13.86
149	5850	13000	-59.66	27	-42.08
149	13000	26000	-59.33	28	-41.75
149	26000	40000	-55.83	29	-38.25
157	30	3000	-44.16	On File	-26.58
157	3000	5725	-43.89	On File	-26.31
157	5850	13000	-55.50	On File	-37.92
157	13000	26000	-59.66	On File	-42.08
157	26000	40000	-55.50	On File	-37.92
161	2483	5000	-43.57	On File	-25.99
161	5000	26000	-43.53	On File	-25.95
161	5850	13000	-46.50	On File	-28.92
161	13000	26000	-59.33	On File	-41.75
161	26000	40000	-56.50	On File	-38.92

Specification

Limits Band-Edge

Lower Limit Band-edge	Upper Limit Band-edge	Limit below highest level of desired intentional radiator power level
2,400 MHz	2,483.5 MHz	>= 20 dB

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

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

Measurement Uncertainty Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions'	0156, 0193, 0088, 0252, 0313, 0314

5.1.6. Radiated Emissions

5.1.6.1. Transmitter Radiated Spurious Emissions (above 1 GHz)

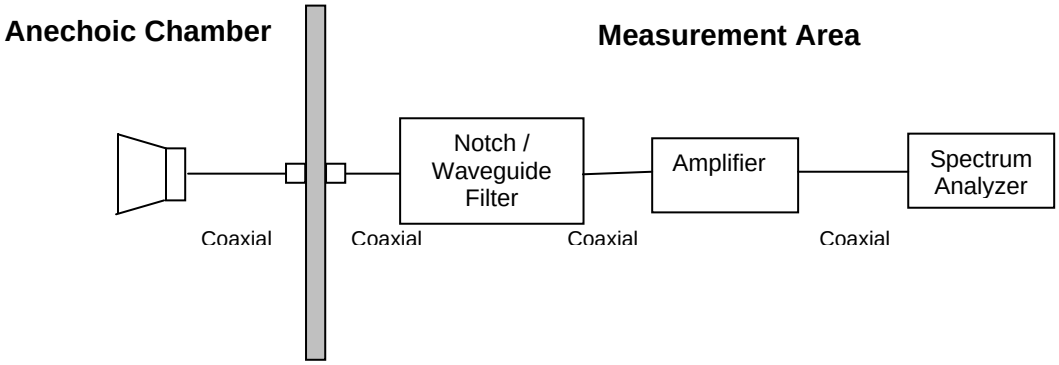
FCC, Part 15 Subpart C §15.247(c)
Industry Canada RSS-210 §6.3

Test Procedure

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

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

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

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

FS = R + AF + CORR - FO

where:

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

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

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

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

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

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

Measurement Results Transmitter Radiated Spurious Emissions 1 GHz - 26 GHz

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

Radio parameters.
Transmission: Stand alone configuration in Atheros test box

ANTENNA: AIR-ANTM2050D-R Swivel Mount Dipole

TABLE OF RESULTS – **802.11b**

CH.	Freq. (MHz)	Pol. (H/V)	Peak Reading (dBµV/m)	Ave Reading (dBµV/m)	Corr'n Factor (dB)	Corr'd Field Strength (dBµV/m)	Ave Limit (dBµV/m)	Margin (dB)
1	13011.2	H	53.30	--	--	--	54.00	--
1	13002.5	V	53.97	--	--	--	54.00	--
6	13008.7	V	53.63	--	--	--	54.00	--
6	13006.2	H	53.30	--	--	--	54.00	--
11	13450.0	H	53.47	--	--	--	54.00	--

TABLE OF RESULTS – **802.11g**

CH.	Freq. (MHz)	Pol. (H/V)	Peak Reading (dBµV/m)	Ave Reading (dBµV/m)	Corr'n Factor (dB)	Corr'd Field Strength (dBµV/m)	Ave Limit (dBµV/m)	Margin (dB)
1	13605.0	H	53.30	--	--	--	54.00	--
6	13397.5	H	53.97	--	--	--	54.00	--
6	13005.0	V	53.13	--	--	--	54.00	--
11	13015.0	H	53.30	--	--	--	54.00	--

TABLE OF RESULTS – **802.11a**

CH.	Freq. (MHz)	Pol. (H/V)	Peak Reading (dBµV/m)	Ave Reading (dBµV/m)	Corr'n Factor (dB)	Corr'd Field Strength (dBµV/m)	Ave Limit (dBµV/m)	Margin (dB)
--	--	--	--	--	--	--	54.00	--
--	--	--	--	--	--	--	54.00	--
--	--	--	--	--	--	--	54.00	--
--	--	--	--	--	--	--	54.00	--

No emissions were observed close to the limit while operating in 802.11a mode using the **AIR-ANTM2050D-R** antenna

ANTENNA: AIR-ANTM4050V-R Diversity Omni Ceiling Antenna

TABLE OF RESULTS – **802.11b**

CH.	Freq. (MHz)	Pol. (H/V)	Peak Reading (dBµV/m)	Ave Reading (dBµV/m)	Corr'n Factor (dB)	Corr'd Field Strength (dBµV/m)	Ave Limit (dBµV/m)	Margin (dB)
1	8989.88	H	53.42	32.96	15.42	48.38	54	-5.62
11	9130.14	V	53.61	32.98	14.94	47.92	54	-6.08

TABLE OF RESULTS – **802.11g**

CH.	Freq. (MHz)	Pol. (H/V)	Peak Reading (dBµV/m)	Ave Reading (dBµV/m)	Corr'n Factor (dB)	Corr'd Field Strength (dBµV/m)	Ave Limit (dBµV/m)	Margin (dB)
1	9020.18	H	53.36	33.08	15.36	48.44	54	-5.56
11	10691.2	H	53.44	33.81	13.94	47.75	54	-6.25
11	17234.3	V	53.27	32.03	14.35	48.38	54	-5.62

TABLE OF RESULTS – **802.11a**

CH.	Freq. (MHz)	Pol. (H/V)	Peak Reading (dBµV/m)	Ave Reading (dBµV/m)	Corr'n Factor (dB)	Corr'd Field Strength (dBµV/m)	Ave Limit (dBµV/m)	Margin (dB)
157	11570.2	V	54.91	33.62	14.41	48.03	54	-5.97
165	11570.2	V	54.03	33.62	14.41	48.03	54	-5.97

ANTENNA: AIR-ANTM5560P-R Wall Mount Patch Antenna

TABLE OF RESULTS – **802.11b**

CH.	Freq. (MHz)	Pol. (H/V)	Peak Reading (dBµV/m)	Ave Reading (dBµV/m)	Corr'n Factor (dB)	Corr'd Field Strength (dBµV/m)	Ave Limit (dBµV/m)	Margin (dB)
1	9648.05	H	53.61	32.98	14.94	47.92	54	-6.08
1	9648.48	V	53.36	33.08	15.36	48.44	54	-5.56

TABLE OF RESULTS – **802.11g**

CH.	Freq. (MHz)	Pol. (H/V)	Peak Reading (dBµV/m)	Ave Reading (dBµV/m)	Corr'n Factor (dB)	Corr'd Field Strength (dBµV/m)	Ave Limit (dBµV/m)	Margin (dB)
6	9060.56	H	53.88	33.35	15.20	48.55	54	-5.45
11	15533.4	V	53.43	33.44	12.59	48.03	54	-5.97

TABLE OF RESULTS – **802.11a**

CH.	Freq. (MHz)	Pol. (H/V)	Peak Reading (dBµV/m)	Ave Reading (dBµV/m)	Corr'n Factor (dB)	Corr'd Field Strength (dBµV/m)	Ave Limit (dBµV/m)	Margin (dB)
165	11648.4	V	53.86	33.35	14.36	47.71	54	-6.29
165	11650.2	H	55.20	33.22	14.36	47.58	54	-6.42

5.1.6.2. Radiated Band-Edge – Restricted Bands

In making band-edge measurements, there can be a problem obtaining meaningful data since a measurement instrument that is tuned to a band-edge frequency may also capture some in-band signals when using the resolution bandwidth (RBW) required by measurement procedure ANSI C63.4. In an effort to compensate for this problem, the following technique sanctioned by the FCC for determining band-edge compliance has been developed.

INDIRECT TEST METHODOLOGY

Equipment must be operated on the frequency channel closest to the restricted band in each case. Measurements are performed on the polarization giving maximum field strength.

STEP 1) Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function required by C63.4 and the Rules for the frequency being measured.

STEP 2) Encompass both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to 1 % of the total span, never using a RBW less than 30 kHz. Use a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission. Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not a field strength measurement, it is only a relative measurement to determine how much the emission drops at the band-edge relative to the highest fundamental emission level.

STEP 3) Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance as required by either 15.249(c) or 15.205.

STEP 4) You can use the above "delta" measurement technique for measuring emissions that are up to two "standard" bandwidths away from the band-edge, where a "standard" bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band-edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the "delta" technique for measuring emissions up to 2 MHz removed from the band-edge. Radiated emissions that are removed by more than two bandwidths must be measured in the conventional (direct) manner.

<u>Corrected Reading</u>

Corrected Peak Band Edge$_{PBE}$ = Peak Reading + Antenna Gain - Delta

Corrected Average Band Edge$_{ABE}$ = Average Reading + Antenna Gain - Delta

Antenna Gain @ 2.4 GHz = 30.7 dB/m

Note:

Amplifier gain and cable loss of -29.7 dB was included as a spectrum analyzer offset

ANTENNA: AIR-ANTM2050D-R Swivel Mount Dipole Antenna

TABLE OF RESULTS – 802.11b

Direct Test Methodology for Band Edge 2,390 MHz

Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Plot #	Margin (dB)
$2{,}412_{PEAK}$	2,390	64.51	74.00	On File	-9.49
$2{,}412_{AVE}$	2,390	48.85	54.00	On File	-5.15

Indirect Test Methodology for Band Edge 2,483.5 MHz

Tx Freq. MHz	Restricted Band Frequency MHz	Limit (dBuV/m)	Measured (dBuV/m)	Delta dB	Corrected Reading dBuV/m	Plot #	Margin dB
$2{,}462_{PEAK}$	2,483.5	74.00	80.75	55.09	56.36	33	-17.64
$2{,}462_{AVE}$	2,483.5	54.00	60.96	55.09	36.57	33	-17.43

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

Direct Test Methodology for Band Edge 2,390 MHz

Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Plot #	Margin (dB)
$2{,}412_{PEAK}$	2,390	60.43	74.00	On File	-13.57
$2{,}412_{AVE}$	2,390	47.40	54.00	On File	-6.60

Indirect Test Methodology for Band Edge 2,483.5 MHz

Tx Freq. MHz	Restricted Band Frequency MHz	Limit (dBuV/m)	Measured (dBuV/m)	Delta dB	Corrected Reading dBuV/m	Plot #	Margin dB
$2{,}462_{PEAK}$	2,483.5	74.00	78.21	49.04	59.87	On File	-14.13
$2{,}462_{AVE}$	2,483.5	54.00	64.38	49.04	46.04	On File	-7.96

ANTENNA: AIR-ANTM4050V-R Diversity Omni Ceiling Antenna

TABLE OF RESULTS – 802.11b

Direct Test Methodology

Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Plot #	Margin (dB)
$2{,}412_{PEAK}$	2,390	59.72	74.00	34	-14.28
$2{,}412_{AVE}$	2,390	48.92	54.00	34	-5.08
$2{,}462_{PEAK}$	2,483.5	48.56	74.00	On File	-25.44
$2{,}462_{AVE}$	2,483.5	36.01	54.00	On File	-17.99

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

Direct Test Methodology

Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Plot #	Margin (dB)
$2{,}412_{PEAK}$	2,390	63.83	74.00	On File	-10.17
$2{,}412_{AVE}$	2,390	45.23	54.00	On File	-8.77
$2{,}462_{PEAK}$	2,483.5	57.46	74.00	On File	-16.54
$2{,}462_{AVE}$	2,483.5	38.53	54.00	On File	-15.47

ANTENNA: AIR-ANTM5560P-R Wall Mount Patch Antenna

TABLE OF RESULTS – 802.11b

Direct Test Methodology for Band Edge 2,390 MHz

Center Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Plot #	Margin (dB)
$2{,}412_{PEAK}$	2,390	64.34	74.00	On File	-9.66
$2{,}412_{AVE}$	2,390	52.26	54.00	On File	-1.54
$2{,}462_{PEAK}$	2,483.5	58.33	74.00	On File	-15.67
$2{,}462_{AVE}$	2,483.5	48.24	54.00	On File	-5.76

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

Direct Test Methodology for Band Edge 2,390 MHz

Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Plot #	Margin (dB)
$2{,}412_{PEAK}$	2,390	70.31	74.00	On File	-3.69
$2{,}412_{AVE}$	2,390	52.31	54.00	On File	-1.69
$2{,}462_{PEAK}$	2,483.5	72.98	74.00	35	-1.02
$2{,}462_{AVE}$	2,483.5	53.52	54.00	35	-0.48

Specification

Limits

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

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

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

Frequency (MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance (meters)
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Measurement Uncertainty Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

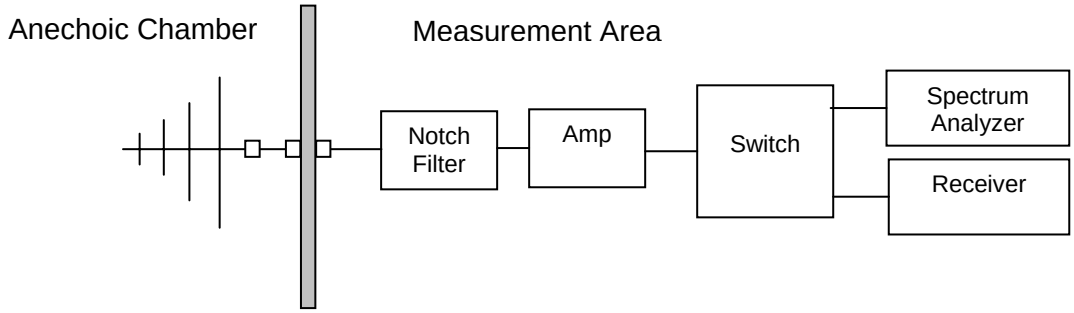
Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-07 ‘Measurement of Spurious Emissions’	0088, 0156, 0134, 0304, 0311, 0315, 0310, 0312

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

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

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

Test Measurement Set up



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

$$FS = R + AF + CORR$$

where:

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

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

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

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

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

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

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

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

Radio parameters.
Data Rate(s): 11MBit/s
Transmission: Communicating and passing data with support equipment

TABLE OF RESULTS

Freq. (MHz)	Peak (dBuV/m)	QP (dBuV/m)	QP Lmt (dBuV/m)	QP Margin (dB)	Angle (deg)	Hgt (cm)	Pol	Total Corr'n Factor
74.9970	34.58	34.45	40.00	-5.55	90	394	Vert	-24.04
124.994	35.60	34.74	40.00	-5.26	311	100	Vert	-23.08
174.998	32.57	30.46	40.00	-9.54	109	102	Vert	-20.22
224.999	33.47	32.80	40.00	-7.20	266	102	Vert	-18.02
525.001	40.73	40.12	47.00	-6.88	40	200	Horz	-8.57
800.001	42.07	39.55	47.00	-7.45	68	102	Horz	-4.43

Specification

Limits

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

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

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

Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance (meters)
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Measurement Uncertainty Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

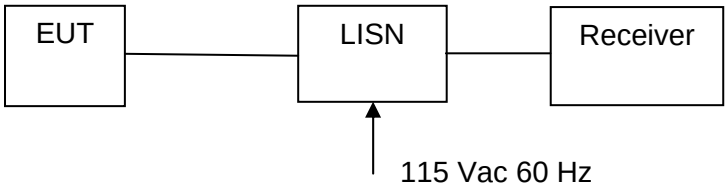
Method	Test Equipment Used
Measurements were made per Sanmina work instruction	8546A HP Receiver and RF Filter, HP Pre-amp, Antenna EMCO Biconilog

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

FCC, Part 15 Subpart C §15.207
Industry Canada RSS-210 §6.6(b), §7.4

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

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

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

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

Radio parameters.
Data Rate(s): 11MBit/s

TABLE OF RESULTS
LINE - LIVE

Frequency (MHz)	Peak (dBµV)	QP (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Ave. (dBµV)	Ave. Limit (dBµV)	Ave. Margin (dB)
0.585810	45.04	--.--	56.00	--.--	--.--	46.00	--.--
0.708195	45.29	--.--	56.00	--.--	--.--	46.00	--.--
0.955950	45.12	--.--	56.00	--.--	--.--	46.00	--.--
1.141020	43.05	--.--	56.00	--.--	--.--	46.00	--.--
1.242510	43.28	--.--	56.00	--.--	--.--	46.00	--.--
1.367880	43.03	--.--	56.00	--.--	--.--	46.00	--.--

LINE – NEUTRAL

Frequency (MHz)	Peak (dBμV)	QP (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Ave. (dBμV)	Ave. Limit (dBμV)	Ave. Margin (dB)
15.182460	42.20	--.--	60.00	--.--	--.--	50.00	--.--
15.558570	42.06	--.--	60.00	--.--	--.--	50.00	--.--
15.677970	42.77	--.--	60.00	--.--	--.--	50.00	--.--
15.803340	42.24	--.--	60.00	--.--	--.--	50.00	--.--
17.042115	42.38	--.--	60.00	--.--	--.--	50.00	--.--
17.286885	42.35	--.--	60.00	--.--	--.--	50.00	--.--

Emission plots are provided in Section 8, Graphical Results

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.

6.6(b) On any frequency or frequencies within the band of 0.15-30 MHz, the measured RF voltage (CISPR meter) shall not exceed 250 μV, 48 dBμV (across 50 ohms)

Transmitters marketed for use only in a commercial, industrial or business environment and not intended for use in homes are permitted a limit of 1000 μV (60 dBμV, 0.45 - 1.705 MHz) and 3000 μV (69.5 dBμV, 1.705 - 30 MHz).

§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 Sanmina work instruction	8546A HP Receiver and RF Filter, HP Pre-amp

6. TEST SET-UP PHOTOGRAPHS

6.1. Radiated Emissions (30 MHz-1 GHz)

6.2. Spurious Emissions >1 GHz

6.3. Conducted Emissions (150 kHz - 30 MHz)

6.4. General Measurement Test Set-Up

7. TEST EQUIPMENT DETAILS

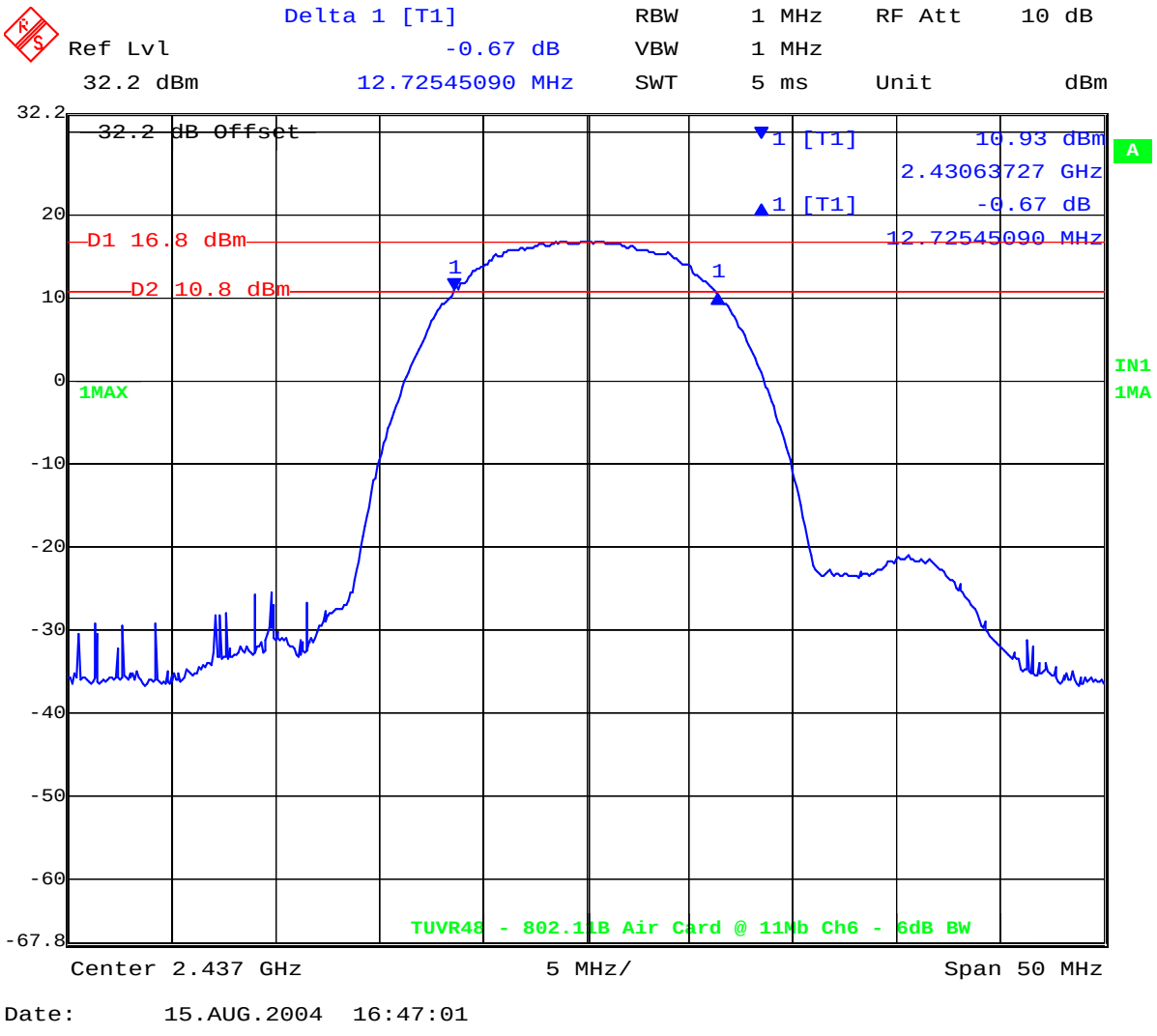
Asset #	Instrument	Manufacturer	Part #	Calibration Due Date	Serial #
0070	Power Meter	Hewlett Packard	437B	13th May '05	3125U13554
0078	Antenna (30M-2GHz)	Schaffner and Chase	CBLG140A	Not Applicable	1195
0088	Spectrum Analyzer	Hewlett Packard	8564E	15th May '05	
0104	1-18GHz Horn Antenna	The Electro-Mechanics Company	3115	12th Aug '05	9205-3882
0107	26.5GHz-40GHz	Northeast Microwave System	261A1599	30th Apr '05	971716-027
0116	Power Sensor	Hewlett Packard	R8485A	16th Mar '05	3318A19694
0134	Amplifier	Com Power	PA 122	1st Sept '05	181910
0145	18GHz-26.5GHz	Millimeter Products	261K	30th Apr '05	595
0156	Barometer /Thermometer	Control Co.	4196	12th Aug '05	E2844
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	1st Dec '05	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	3rd Apr '05	836679/006
0193	EMI Receiver	Rhode & Schwartz	ESI 7	16th Mar '05	838496/007
0213	20-300MHz Antenna	Schwarzbeck	VHBB 9124	6th Apr '05	9124/0257
0250	230MHz-1GHz Antenna	Schwarzbeck	VUSLP9111	6th Apr '05	186
0251	SMA Cable	Megaphase	Sucoflex 104	18th Jun '05	Unknown
0252	SMA Cable	Megaphase	Sucoflex 104	18th Jun '05	Unknown
0253	SMA Cable	Megaphase	Sucoflex 104	18th Jun '05	Unknown
0256	SMA Cable	Megaphase	Sucoflex 104	18th Jun '05	Unknown
0293	BNC Cable	Megaphase	Unknown	18th Jun '05	Unknown
0304	2.4GHz Notch Filter	Micro-Tronics	--	N/A	--
0307	BNC Cable	Megaphase	Unknown	18th Jun '05	Unknown
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	16th Dec '05	209089-001
0311	12-18GHz High Pass Filter	CMT	--	--	--
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	16th Dec '05	209092-001
0313	Coupler	Hewlett Packard	86205A	N/A	1623
0314	30dB N-Type Attenuator	NARDA	32319	N/A	--
0315	17-26.5GHz High Pass Filter	HP	--	--	--

8. GRAPHICAL RESULTS

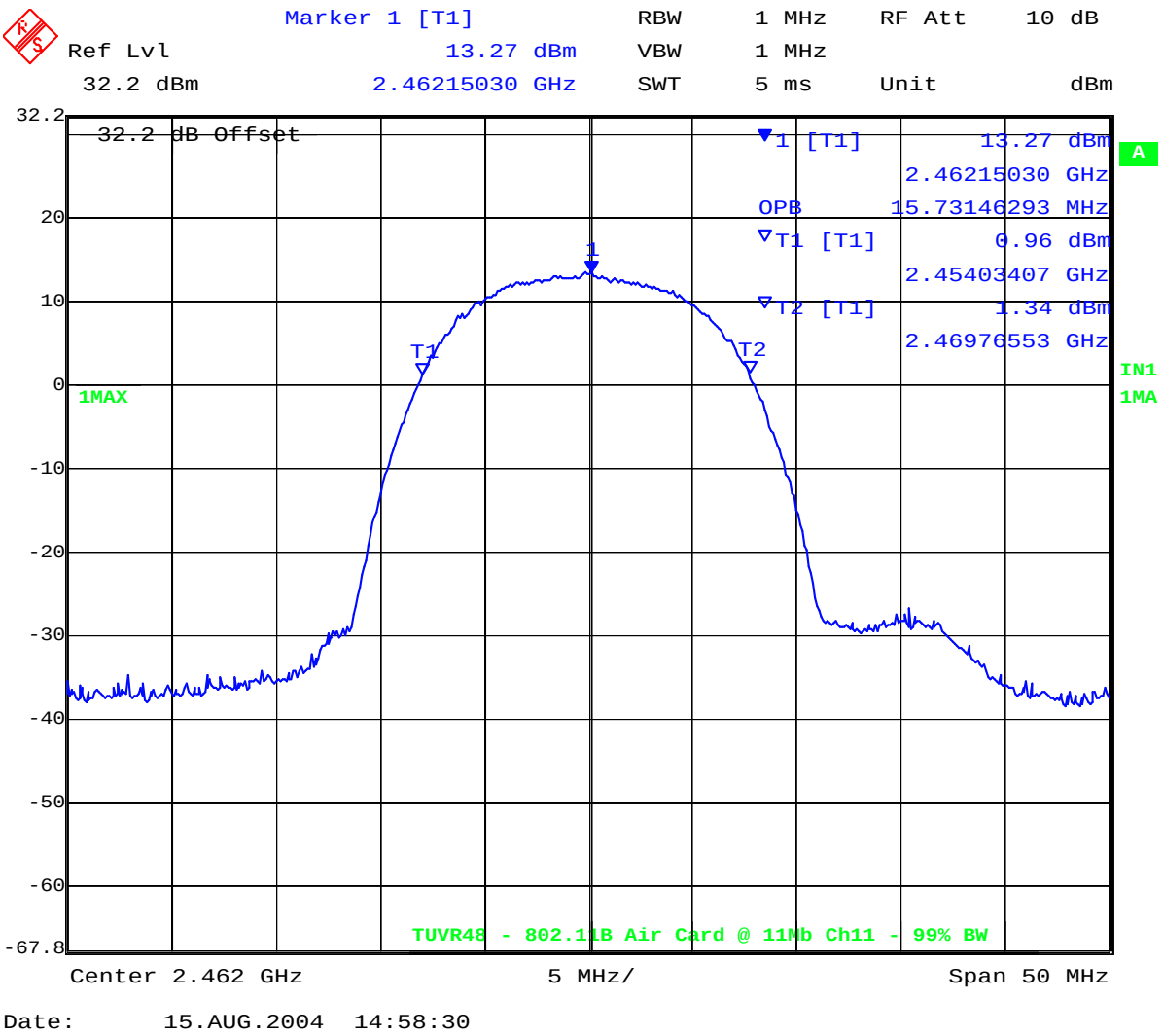
This report contains the following plots as referenced in the test results, Section 5 of this report. Only worst case plots are reported. All additional plots are held on file in the laboratory.

2.4GHz 802.11b/g & 5GHz 802.11a	
Parameter	**Plot No.**
Section 5.1.1 6dB Bandwidth	
802.11b, Channel 6 (2,437 MHz)	01
802.11g, Channel 6 (2,462 MHz)	03
802.11a, Channel 157 (5,785 MHz)	05
Section 5.1.1 99% Bandwidth	
802.11b, Channel 11 (2,462 MHz)	02
802.11g, Channel 11 (2,462 MHz)	04
802.11a, Channel 149 (5,745 MHz)	06
Section 5.1.2 Peak Output Power	
802.11b, Channel 11 (2,462 MHz)	07
802.11g, Channel 1 (2,412 MHz)	08
802.11a, Channel 165 (5,825 MHz)	09
Section 5.1.3 Peak Power Spectral Density	
802.11b, Channel 6 (2,437 MHz)	10
802.11g, Channel 11 (2,462MHz)	11
802.11a, Channel 157 (5,785MHz)	12
Section 5.1.5 Conducted Spurious Emissions	
802.11b	
Lower Band Edge 2,400MHz	13
Upper Band Edge 2,483.5MHz	14
1-26GHz conducted spurious emissions	
30 – 2,400 MHz	19
2,483 – 5,000 MHz	20
5,000 – 26,000MHz	21
802.11g	
Lower Band Edge 2,400MHz	15
Upper Band Edge 2,483.5MHz	16
1-26GHz conducted spurious emissions	
30 – 2,400MHz	22
2,483 – 5,000MHz	23
5,000 – 26,000MHz	24

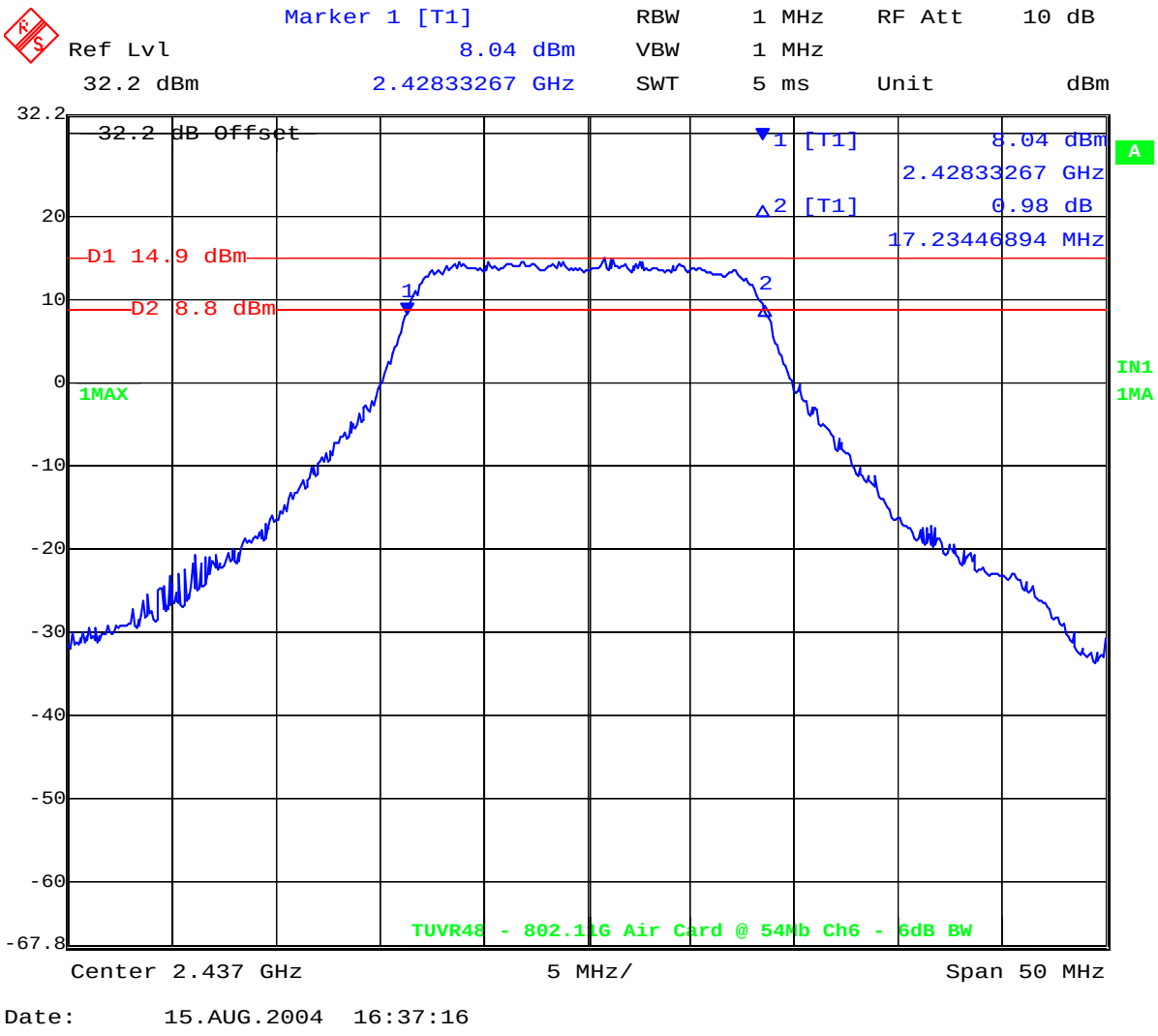
Plot 01 - 6 dB Bandwidth 802.11b CH 6 (2,437 MHz)



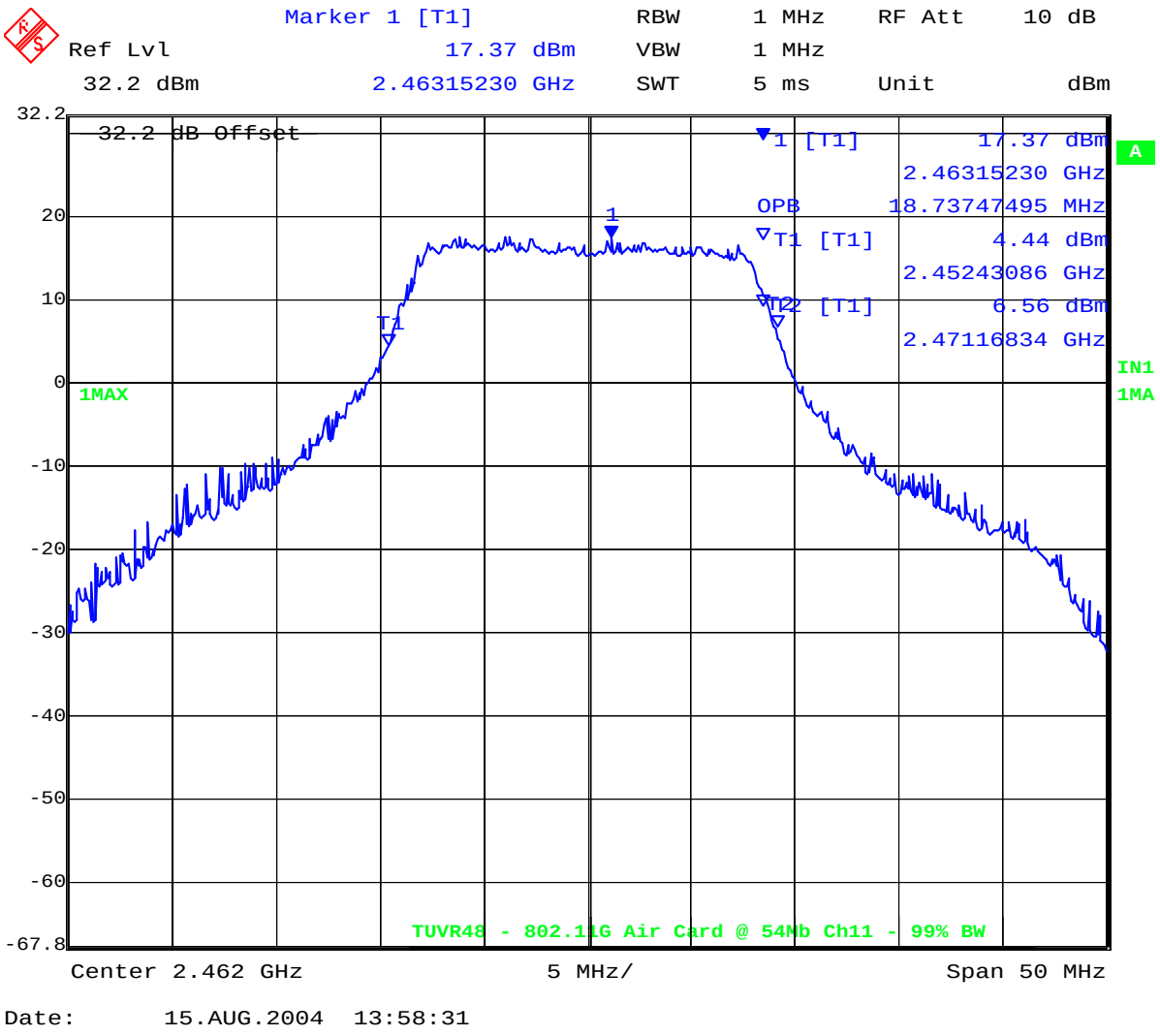
Plot 02 - 99 % Bandwidth 802.11b CH 11 (2,462 MHz)



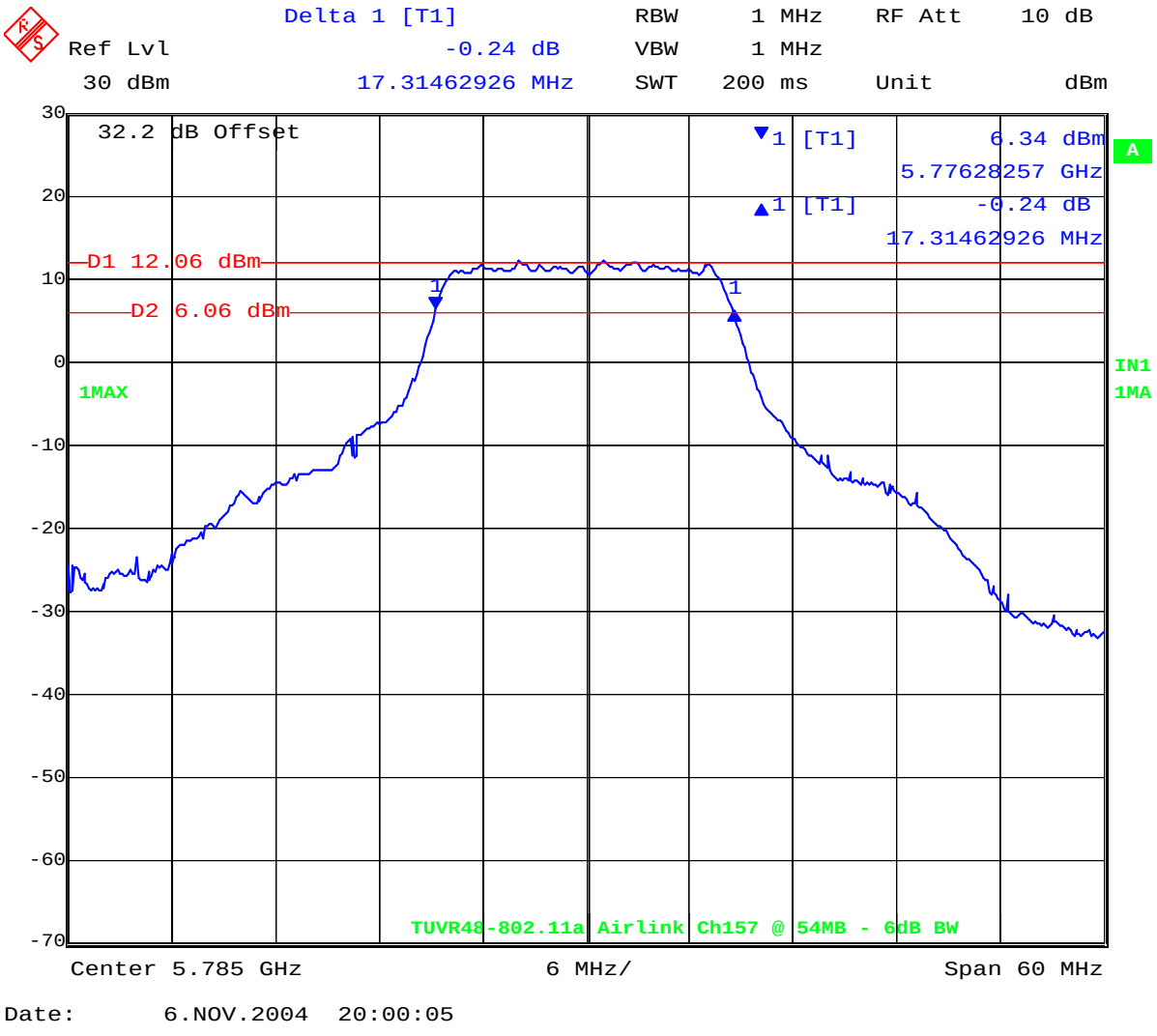
Plot 03 - 6 dB Bandwidth 802.11g CH 6 (2,437 MHz)



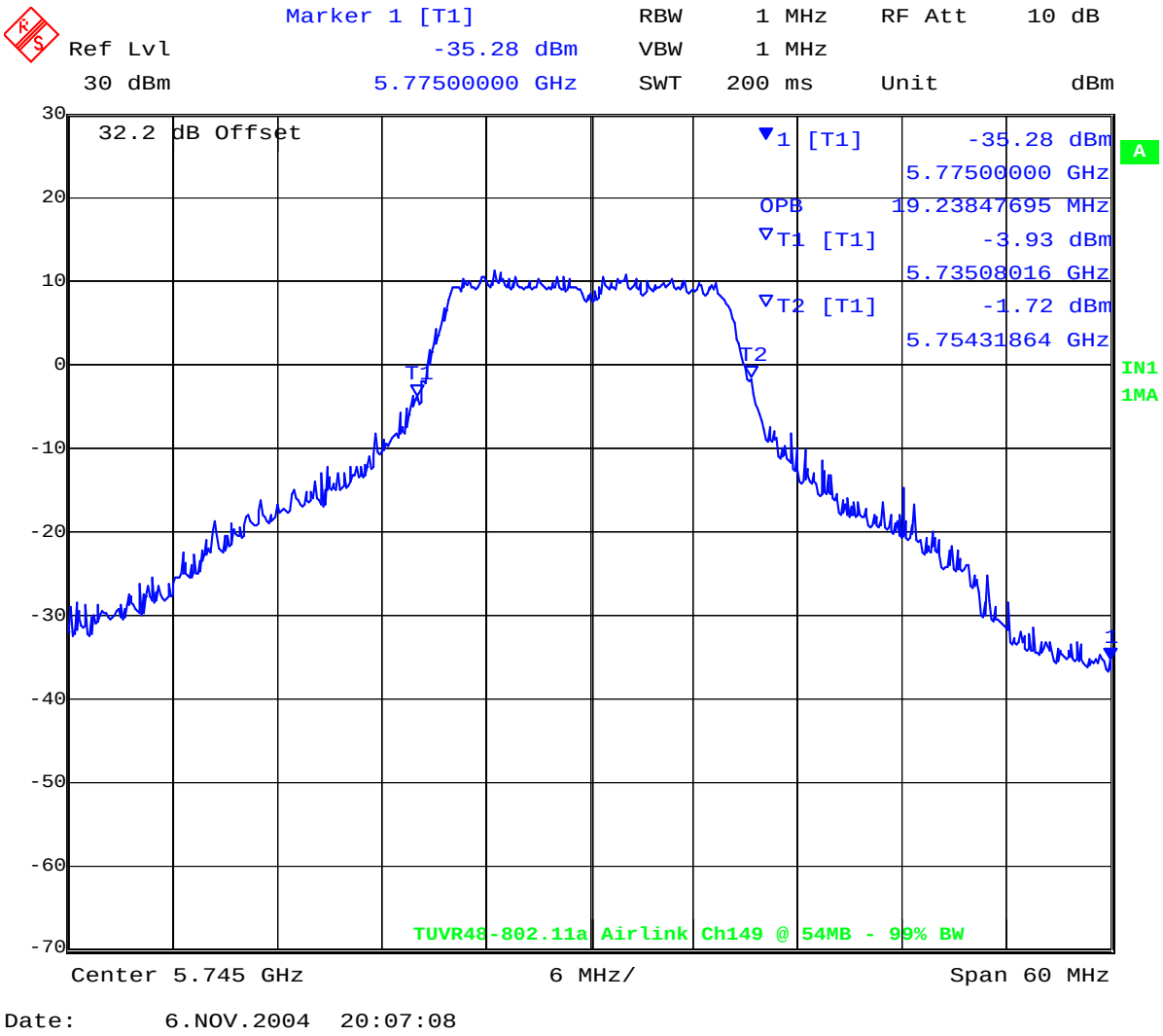
Plot 04 - 99 % Bandwidth 802.11g CH 11 (2,462 MHz)



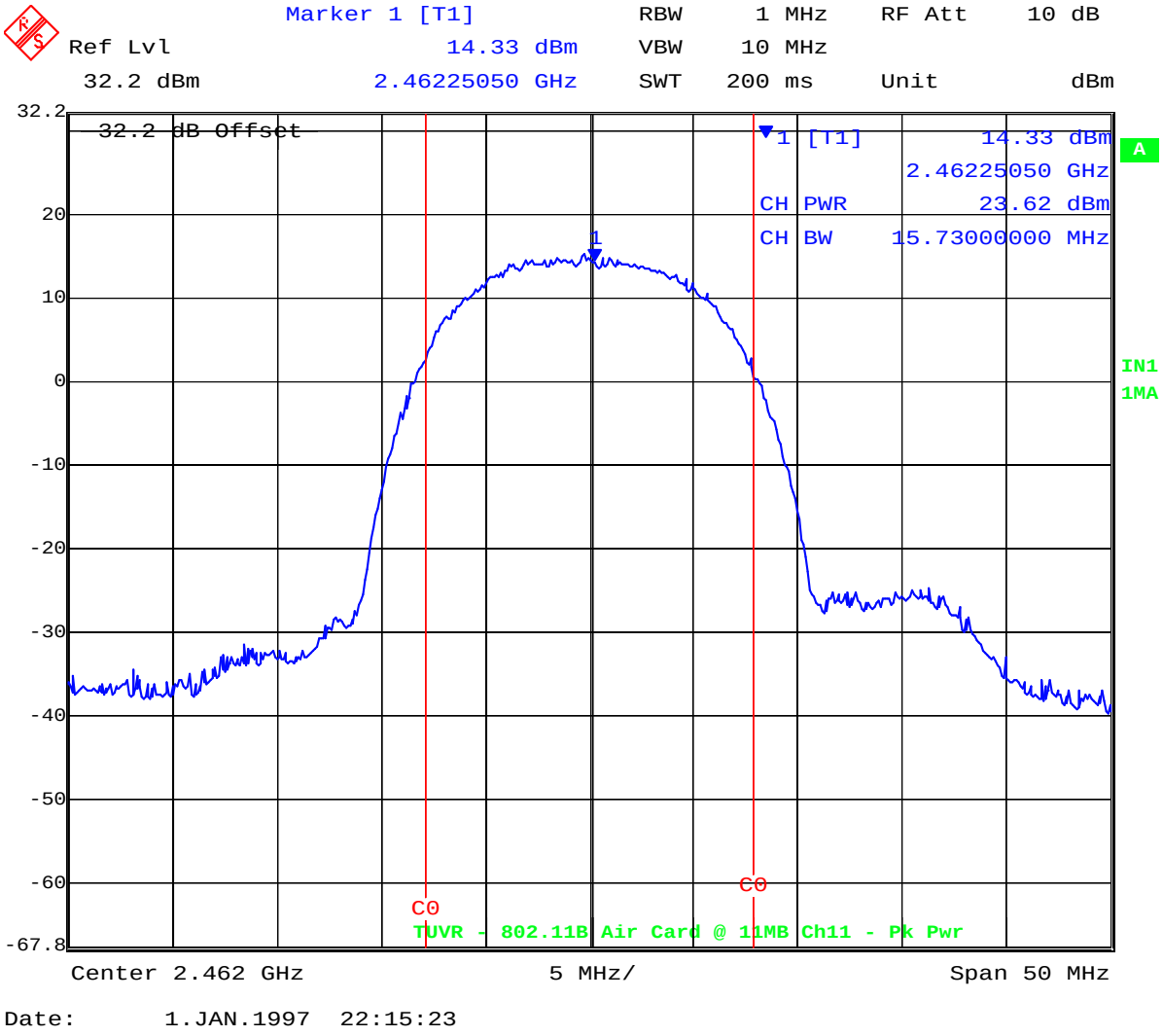
Plot 05 - 6 dB Bandwidth 802.11a CH 157 (5,785 MHz)



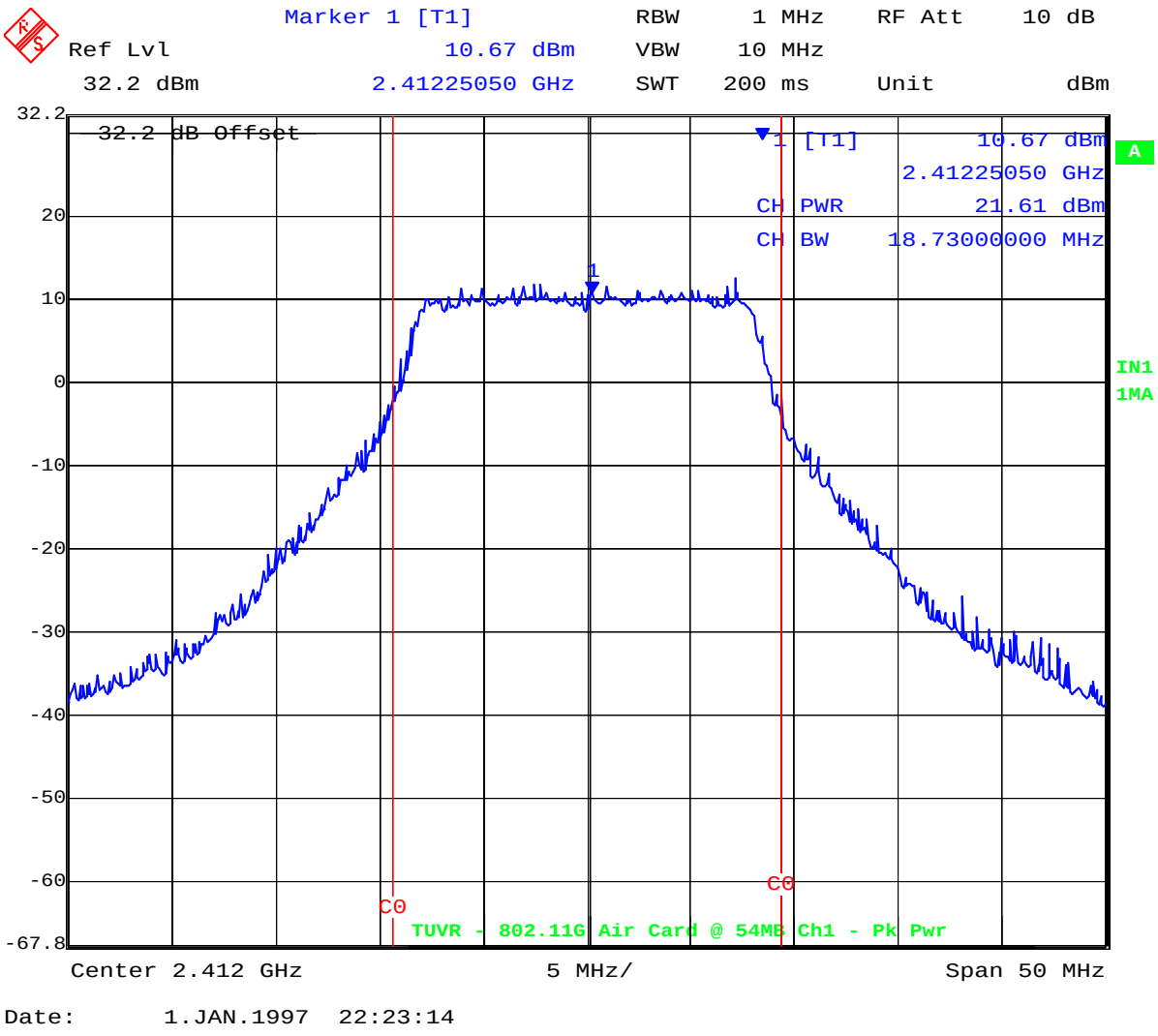
Plot 06 - 99 % Bandwidth 802.11a CH 149 (5,745 MHz)



Plot 07 - 802.11b Peak Output Power Ch 11 (2,462 MHz)

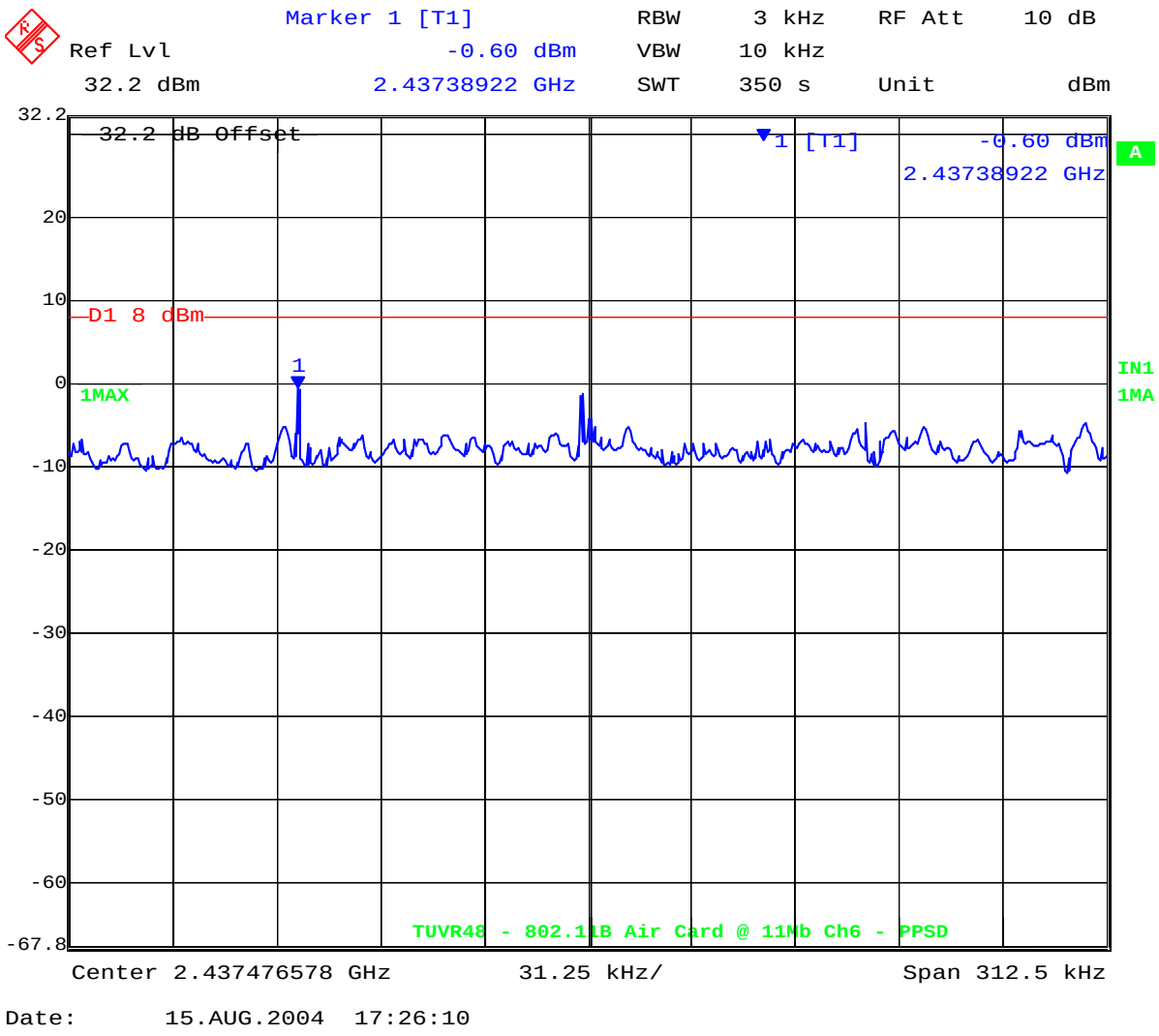


Plot 08 - 802.11g Peak Output Power Ch 1 (2,412 MHz)

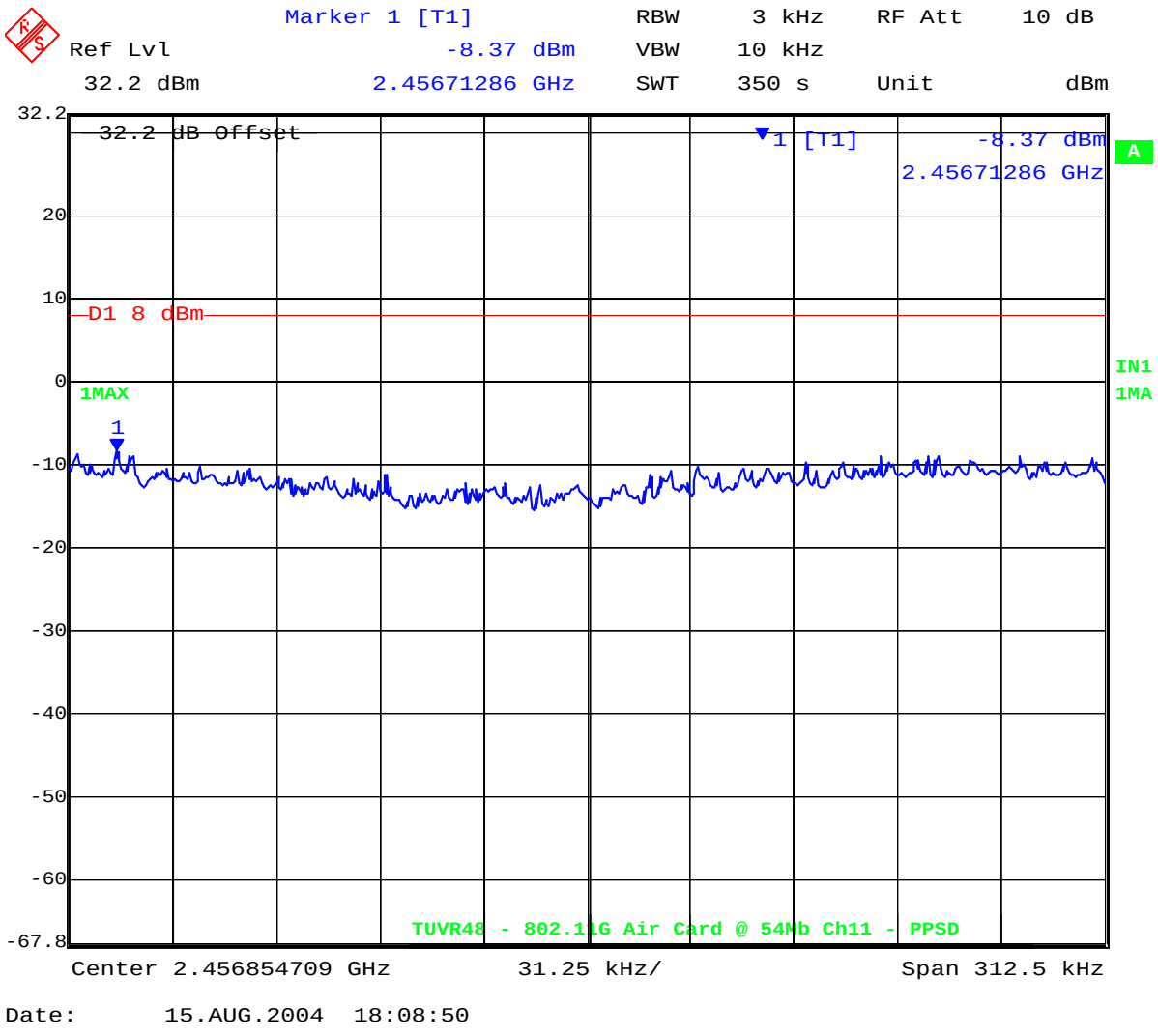


Plot 09 - 802.11a Peak Output Power Ch 165 (5,825 MHz)

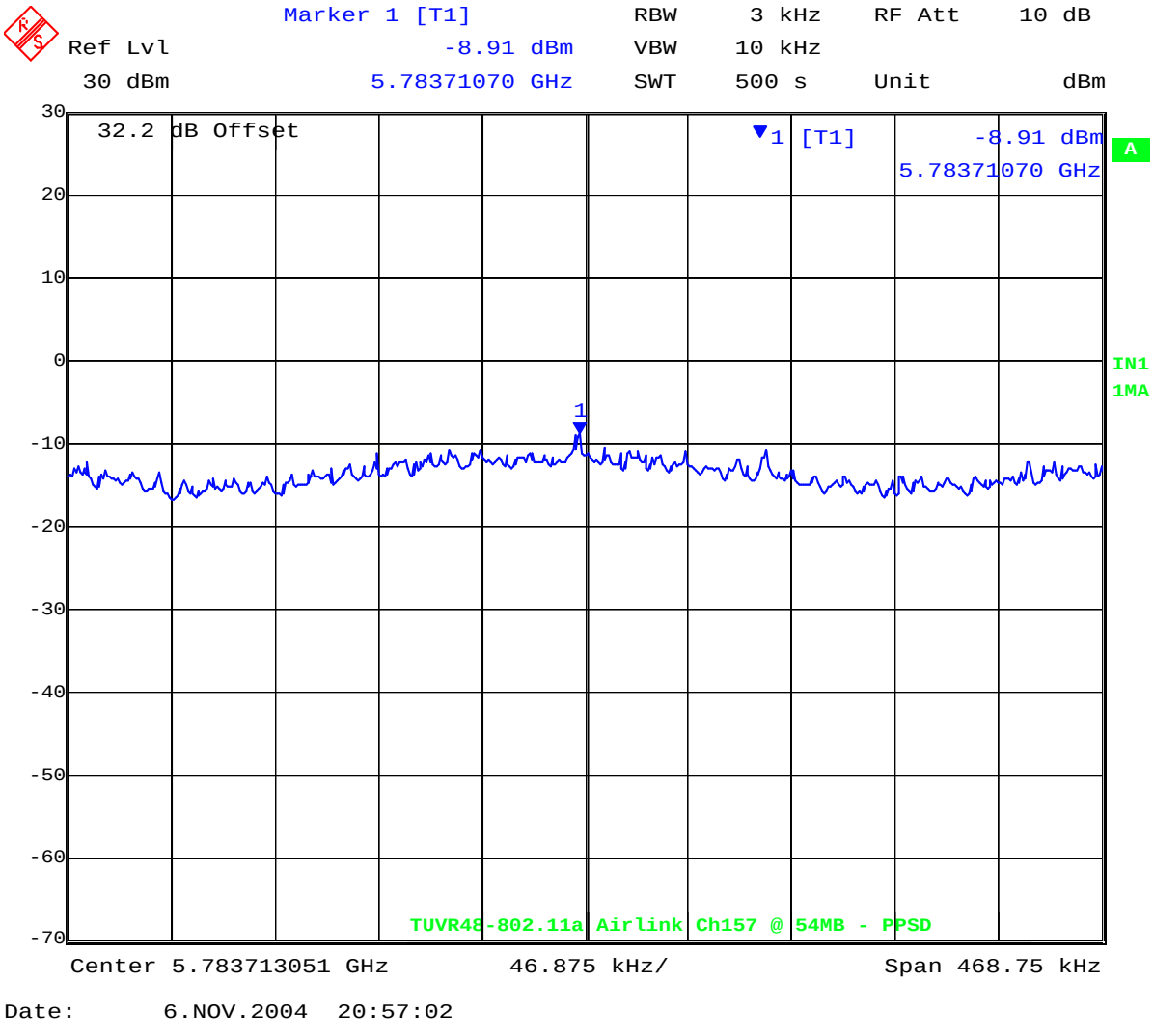
Plot 10 - 802.11b Peak Power Spectral Density Ch 6 (2,437 MHz)



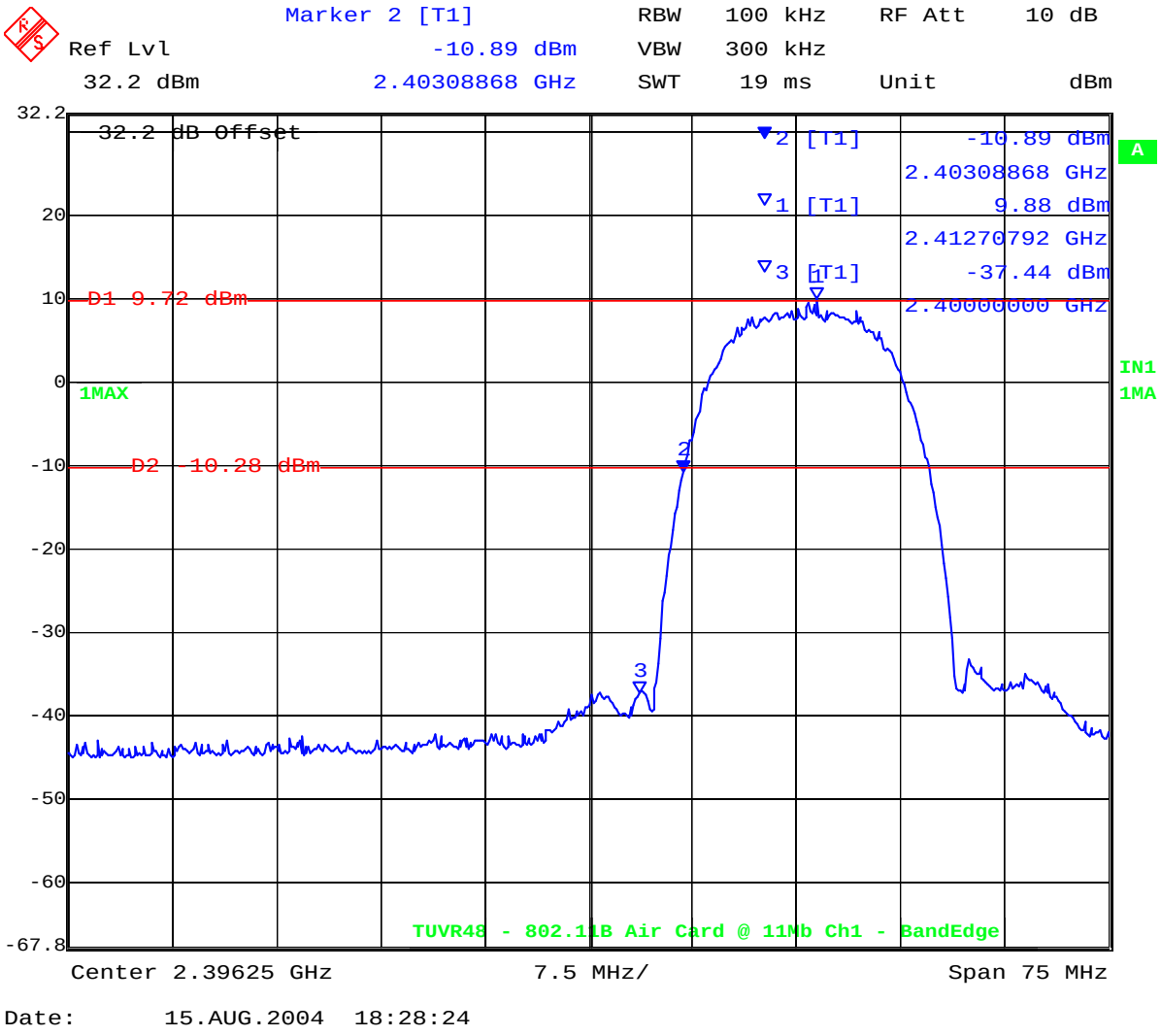
Plot 11 - 802.11g Peak Power Spectral Density Ch 11 (2,462 MHz)



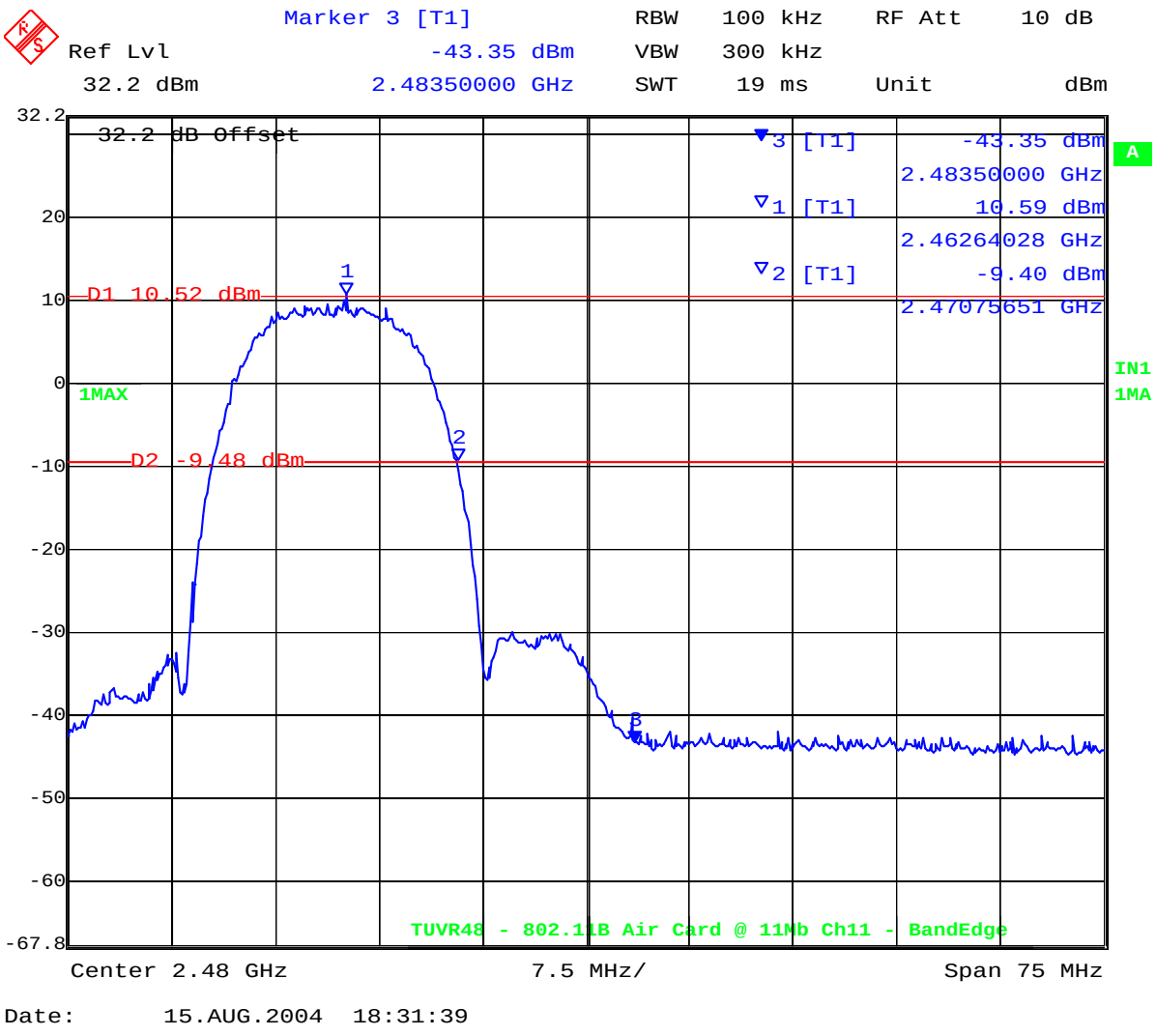
Plot 12 - 802.11a Peak Power Spectral Density Ch 157 (5,785 MHz)



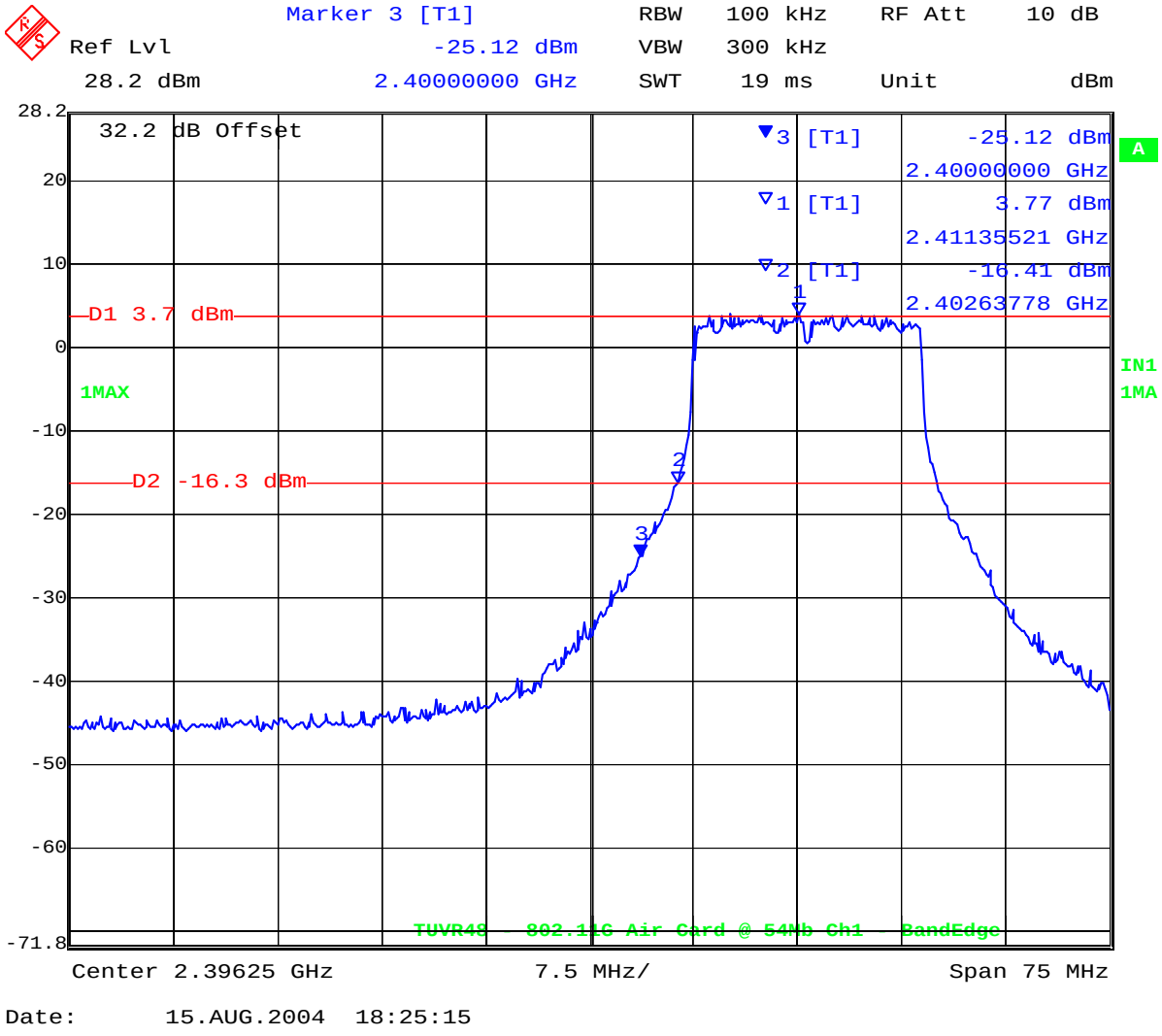
Plot 13 - 802.11b Conducted Spurious Emissions, CH 1 Lower Band Edge



Plot 14 - 802.11b Conducted Spurious Emissions, CH 11 Upper Band Edge

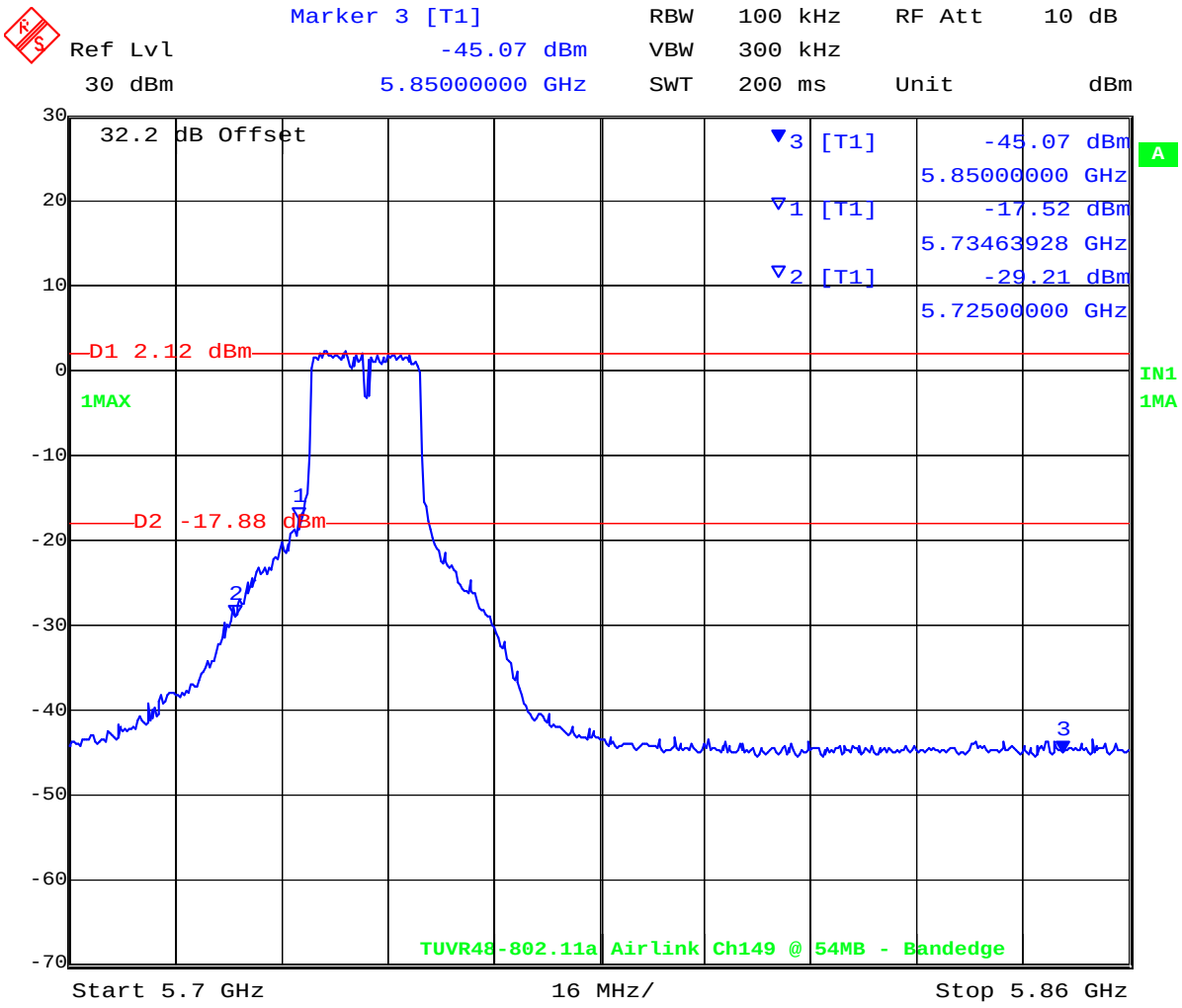


Plot 15 - 802.11g Conducted Spurious Emissions, CH 1 Lower Band Edge

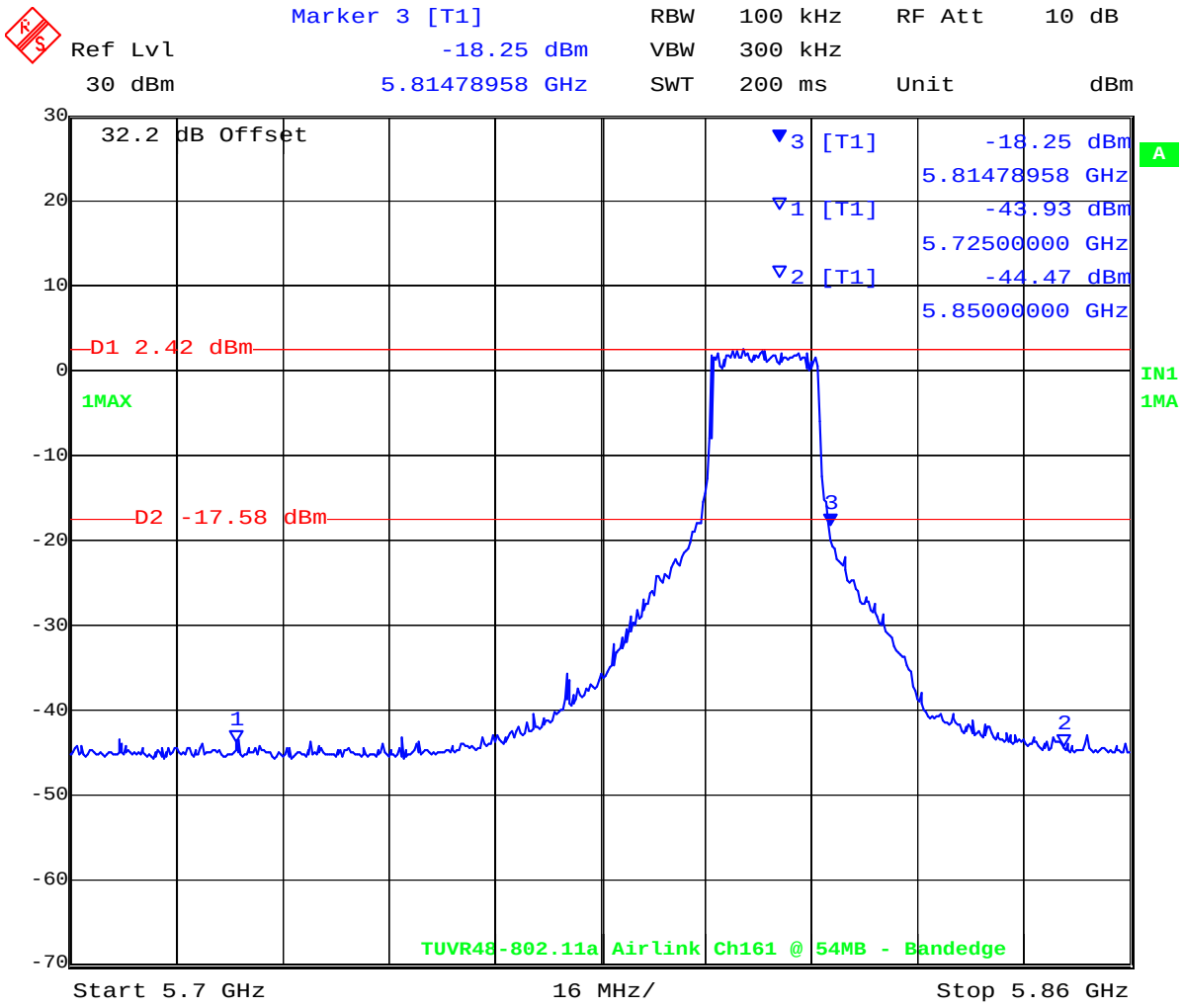


Plot 16 - 802.11g Conducted Spurious Emissions, CH 11 Upper Band Edge

Plot 17 - 802.11a Conducted Spurious Emissions, CH 149 Lower Band Edge

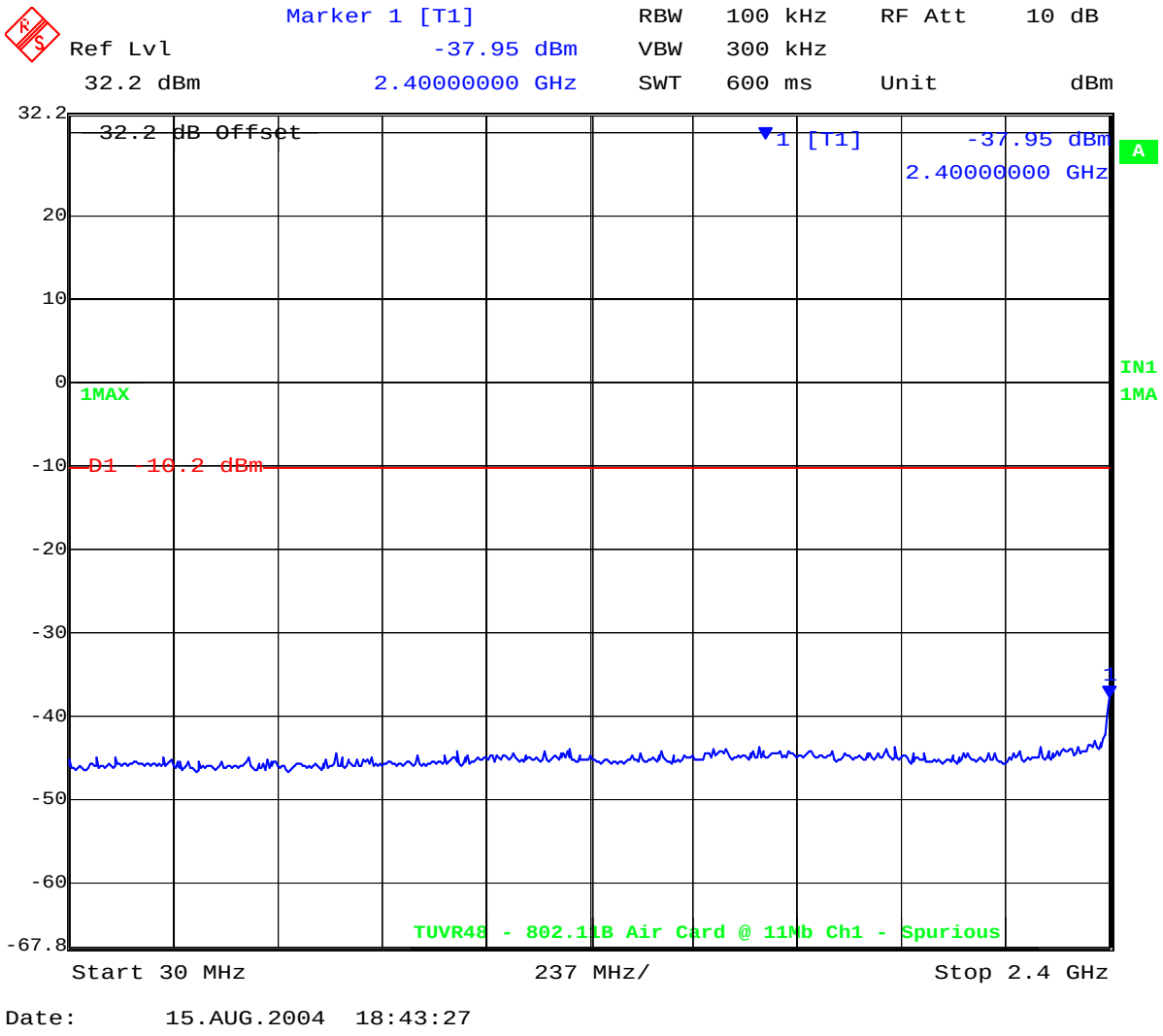


Plot 18 - 802.11a Conducted Spurious Emissions, CH 11 Upper Band Edge

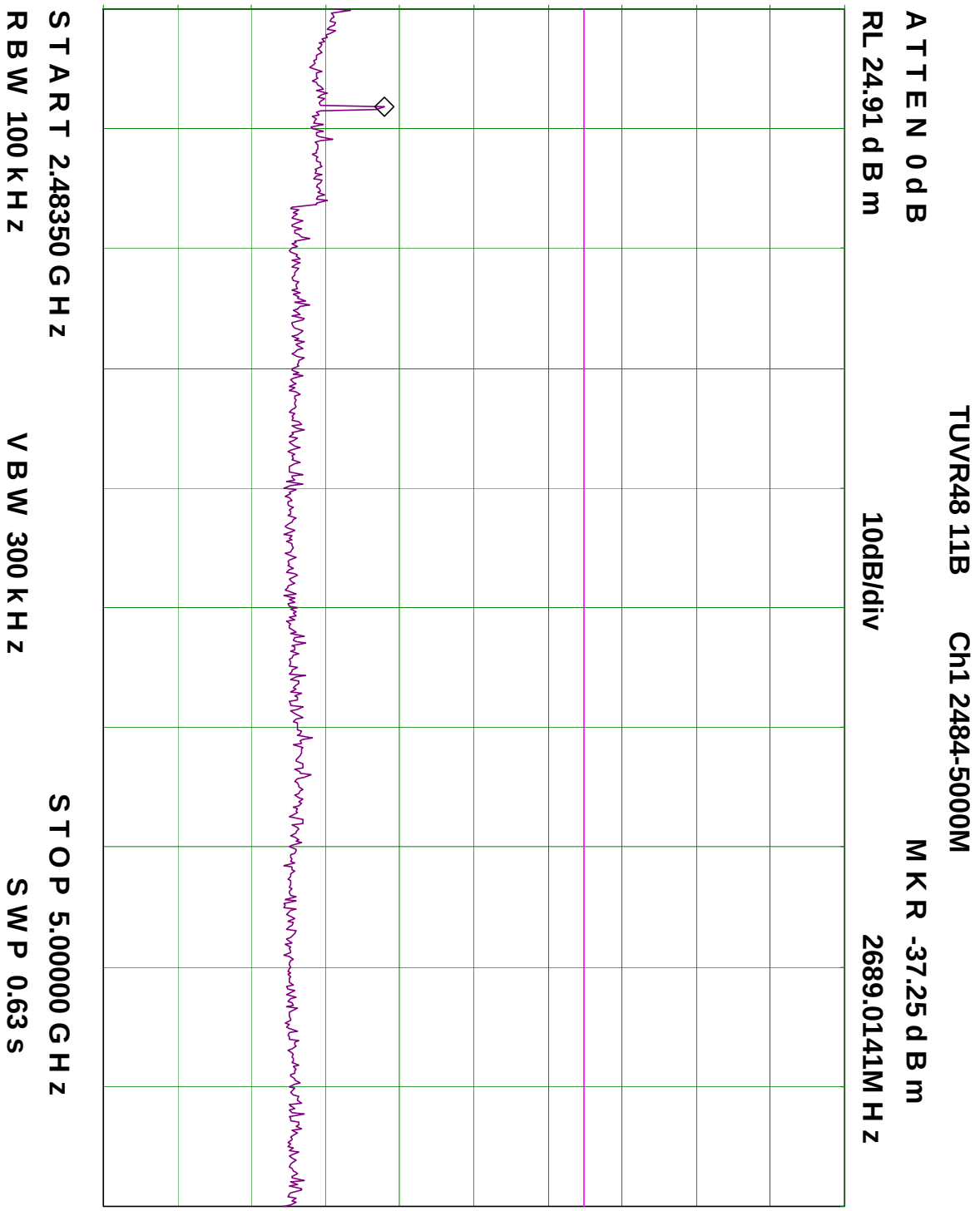


Date: 6.NOV.2004 21:18:33

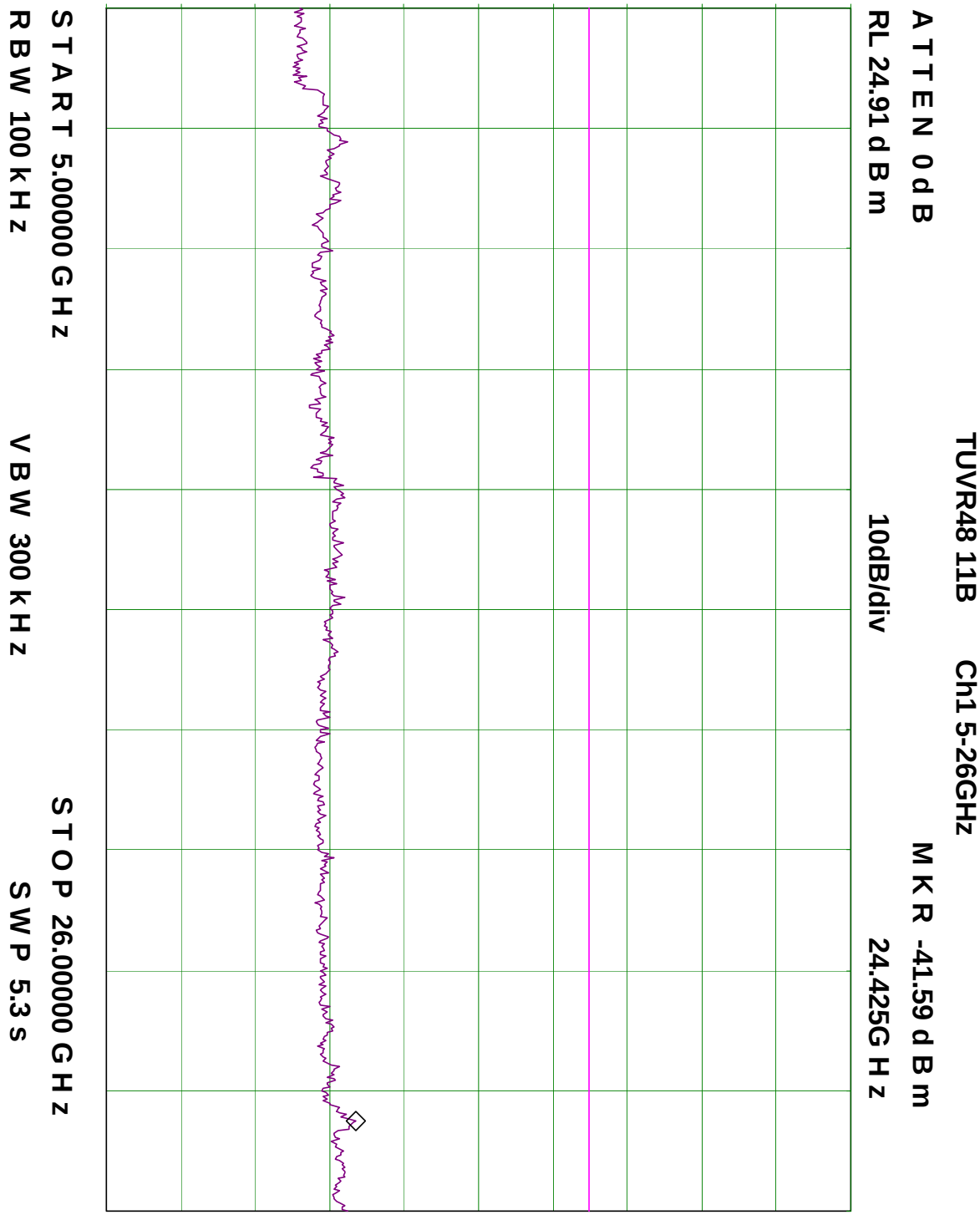
Plot 19 - 802.11b Conducted Spurious Emissions CH 1 30 to 2,400 MHz



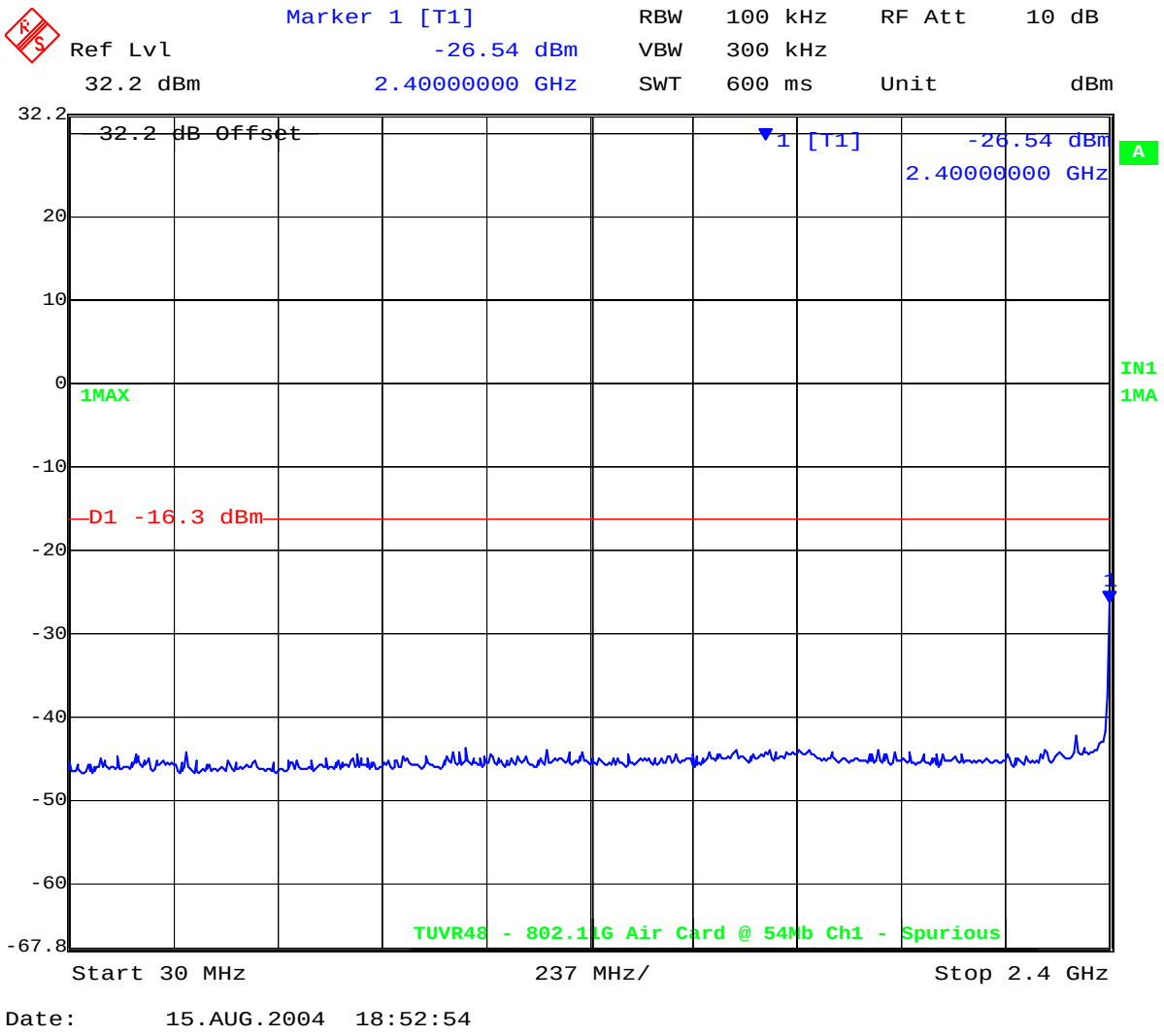
Plot 20 - 802.11b Conducted Spurious Emissions CH 1 2,483 to 5,000 MHz



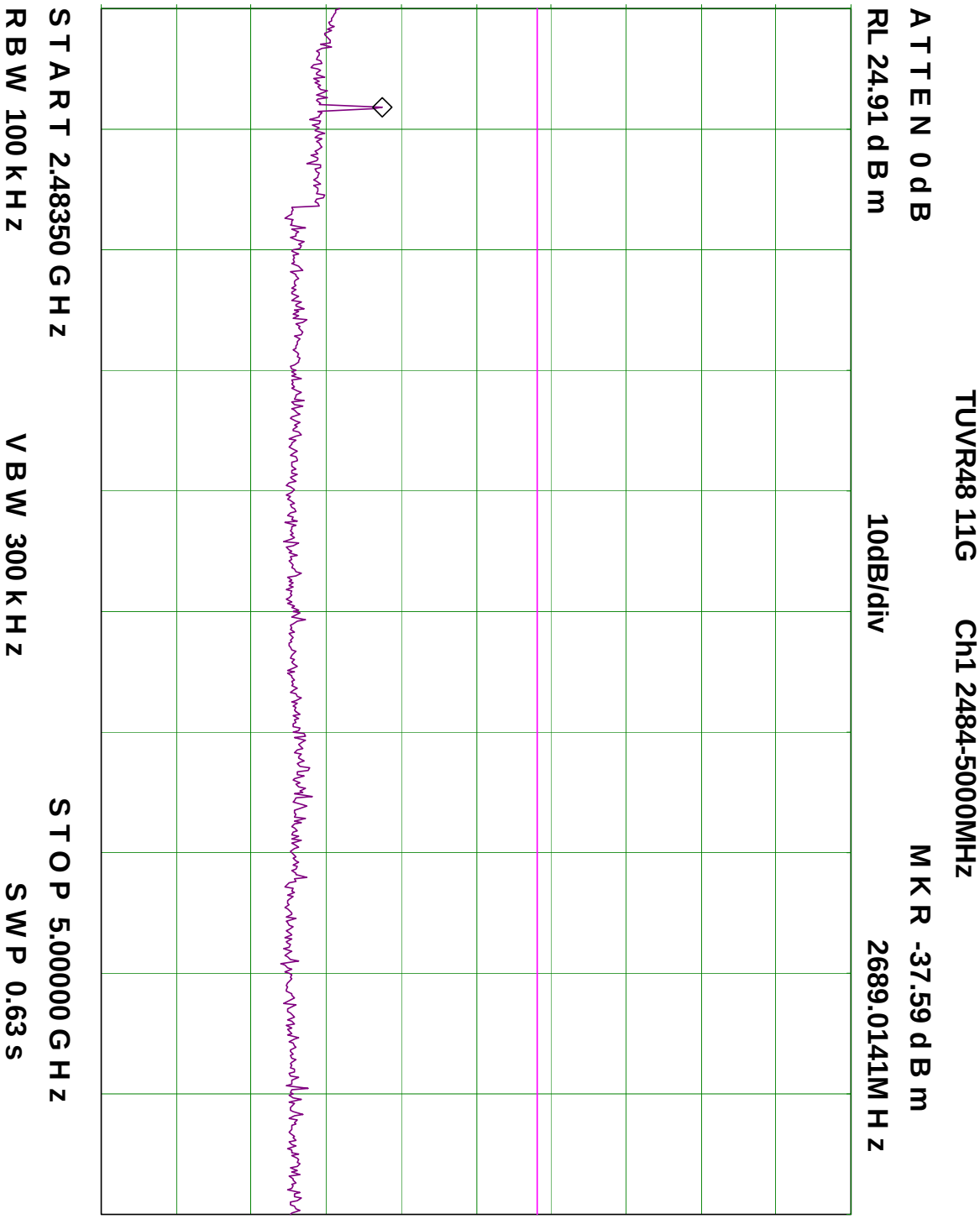
Plot 21 - 802.11b Conducted Spurious Emissions CH 1 5,000 to 26,000 MHz



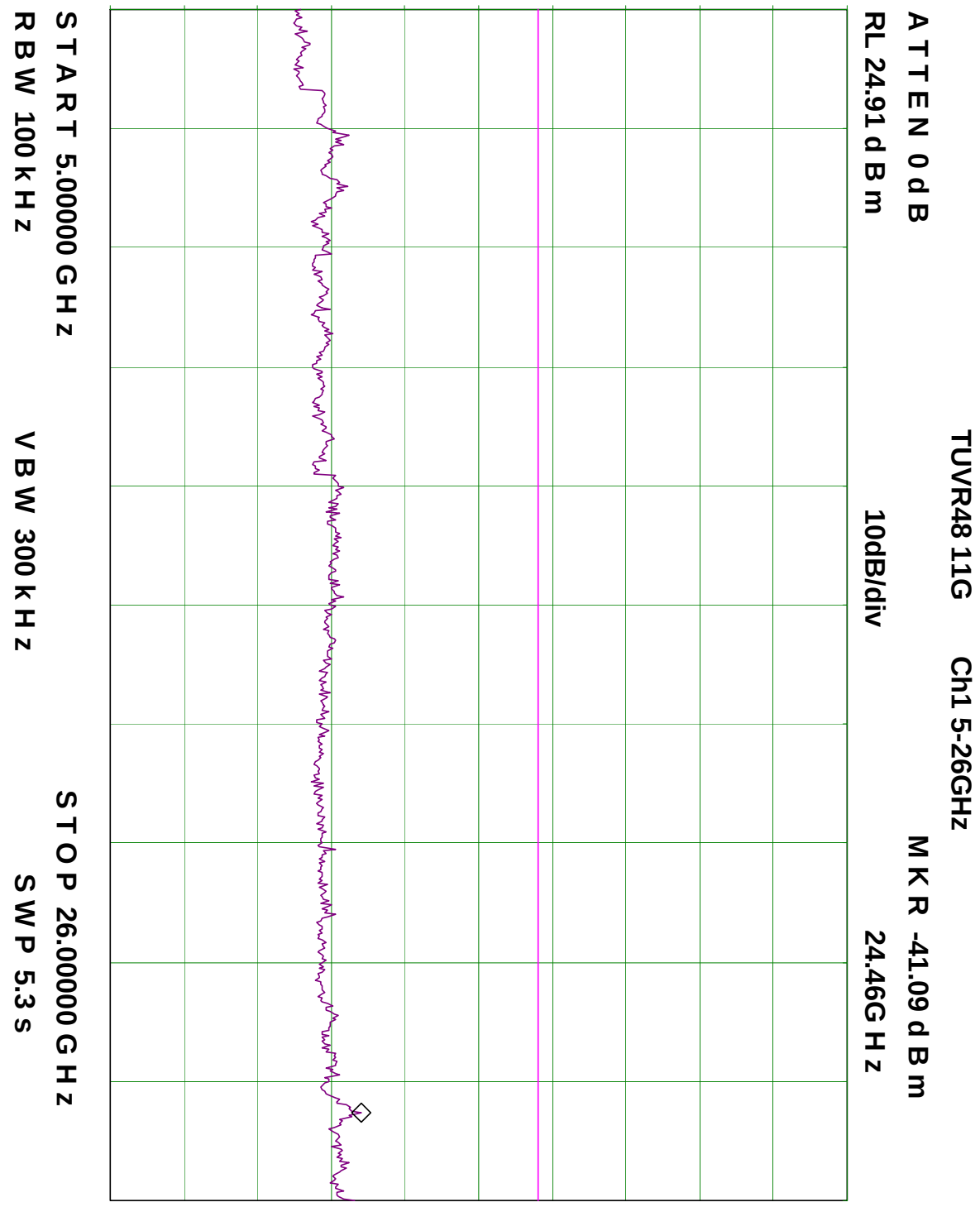
Plot 22 - 802.11g Conducted Spurious Emissions CH 1 30 to 2,400 MHz



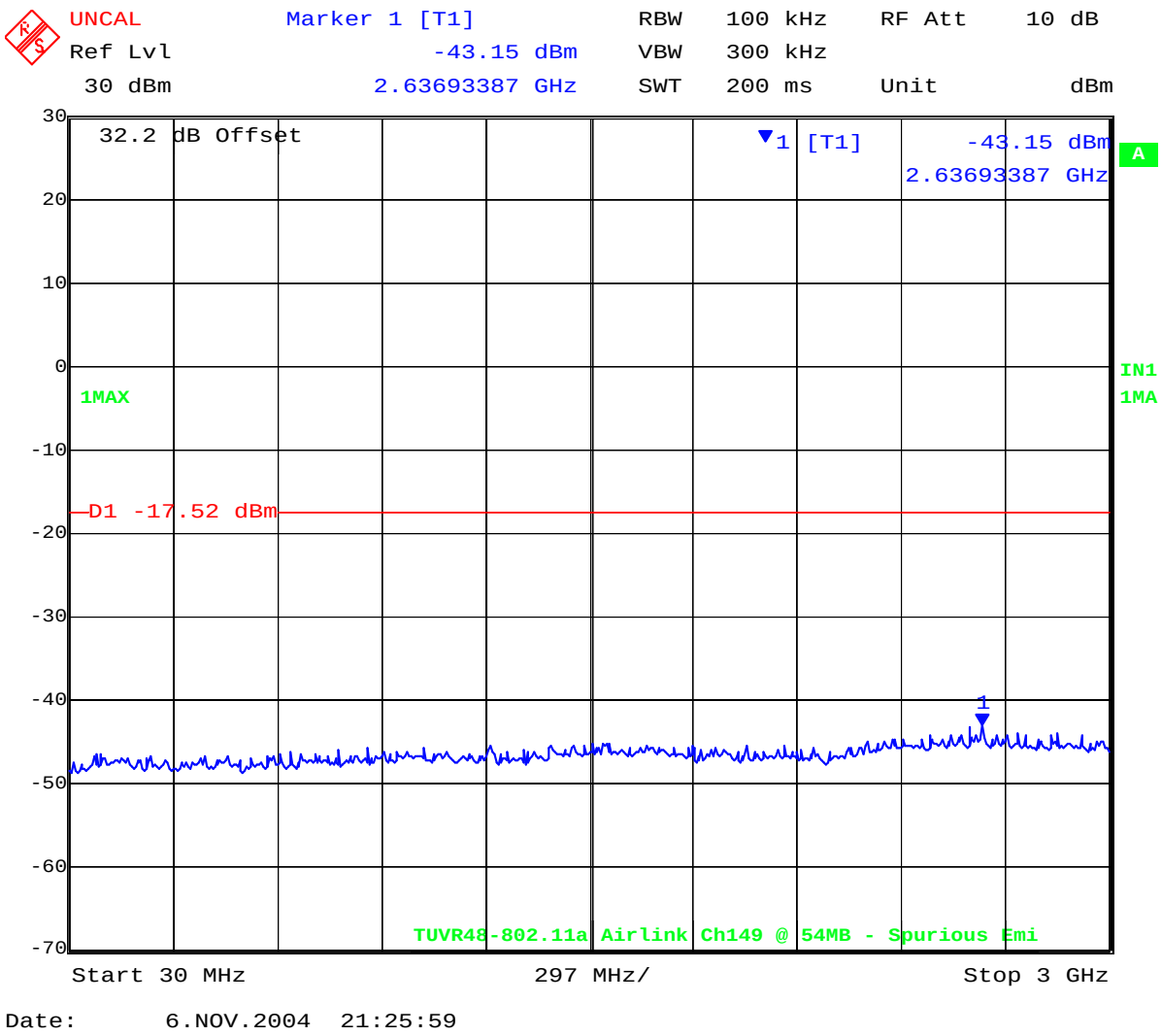
Plot 23 - 802.11g Conducted Spurious Emissions CH 1 2,483 to 5,000 MHz



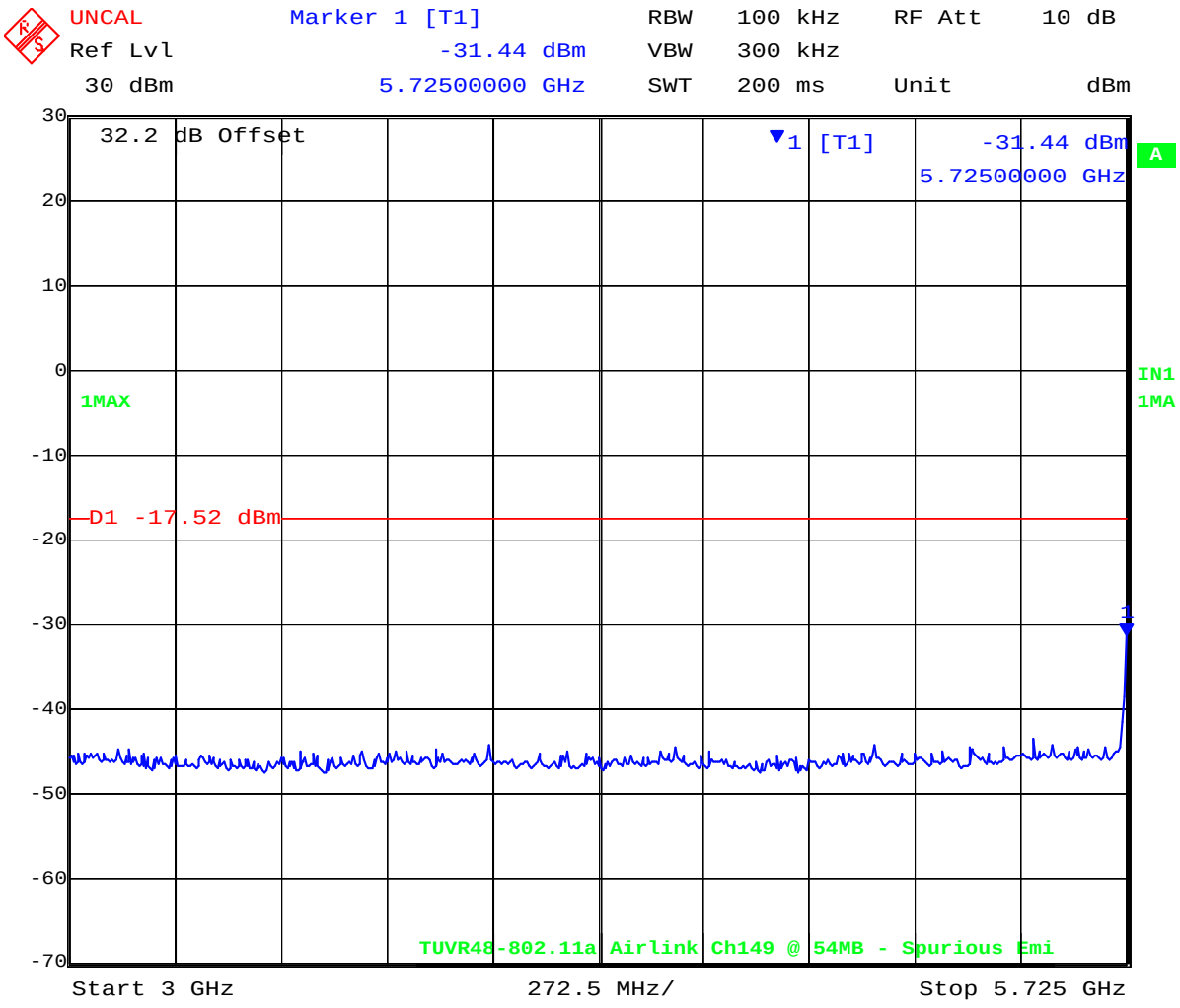
Plot 24 - 802.11g Conducted Spurious Emissions CH 1 5,000 to 26,000 MHz



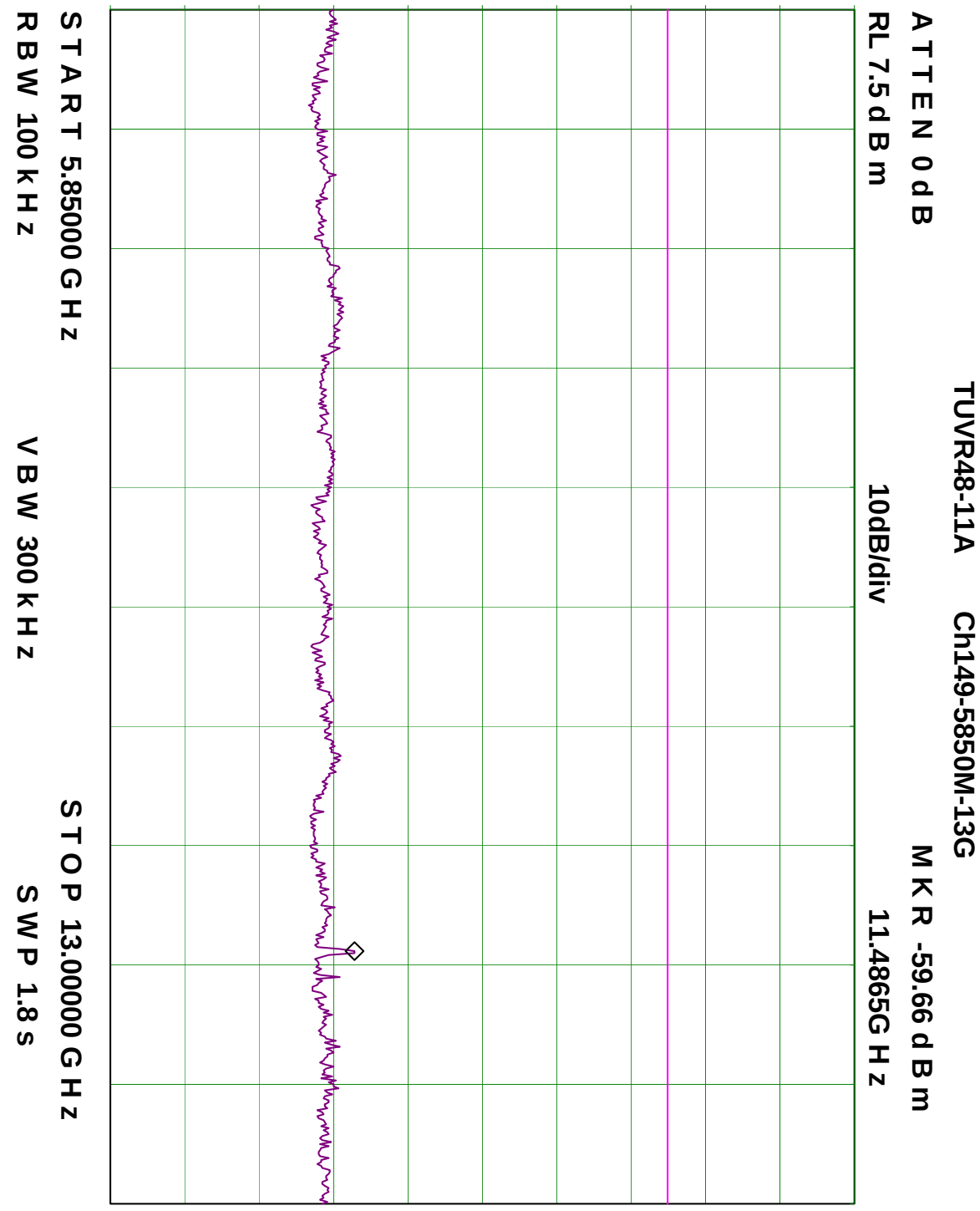
Plot 25 - 802.11a Conducted Spurious Emissions CH 149 30 to 3,000 MHz



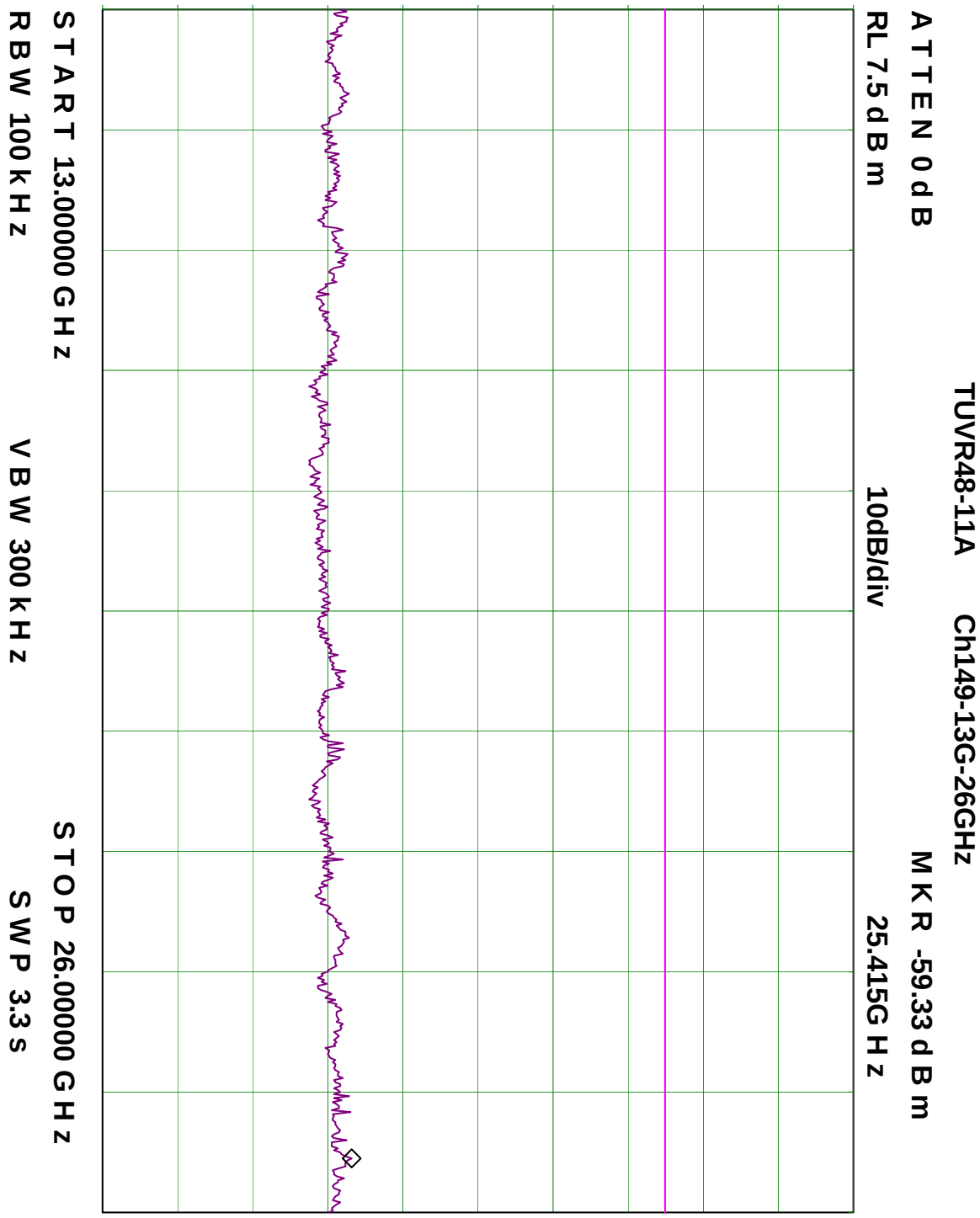
Plot 26 - 802.11a Conducted Spurious Emissions CH 149 3,000 to 5,725 MHz



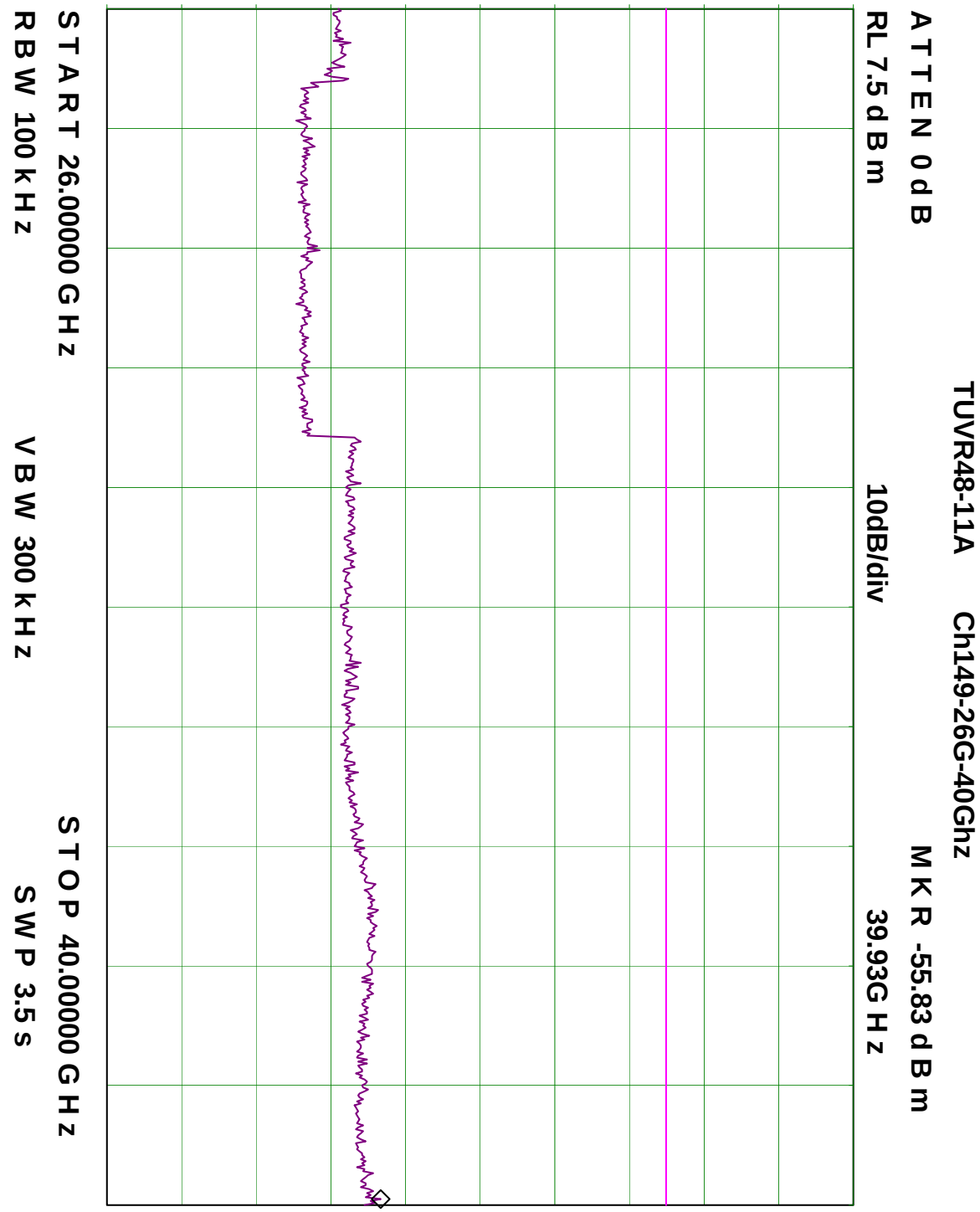
Plot 27 - 802.11a Conducted Spurious Emissions CH 149 5,850 to 13,000 MHz



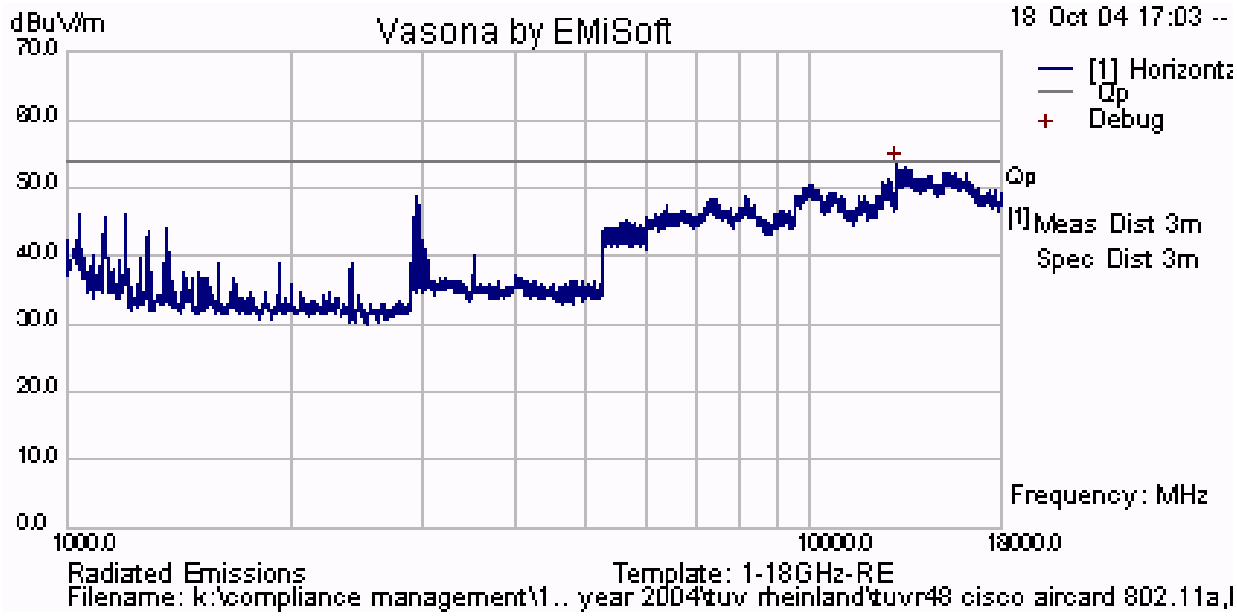
Plot 28 - 802.11a Conducted Spurious Emissions CH 149 13,000 to 26,000 MHz

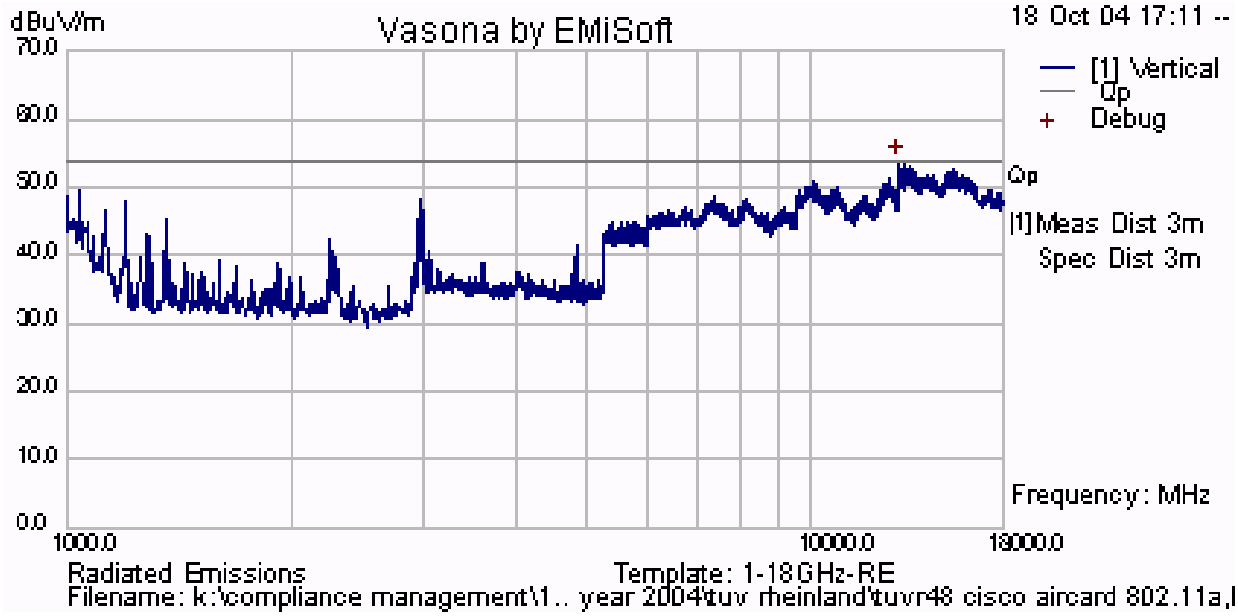


Plot 29 - 802.11a Conducted Spurious Emissions CH 149 26,000 to 40,000 MHz

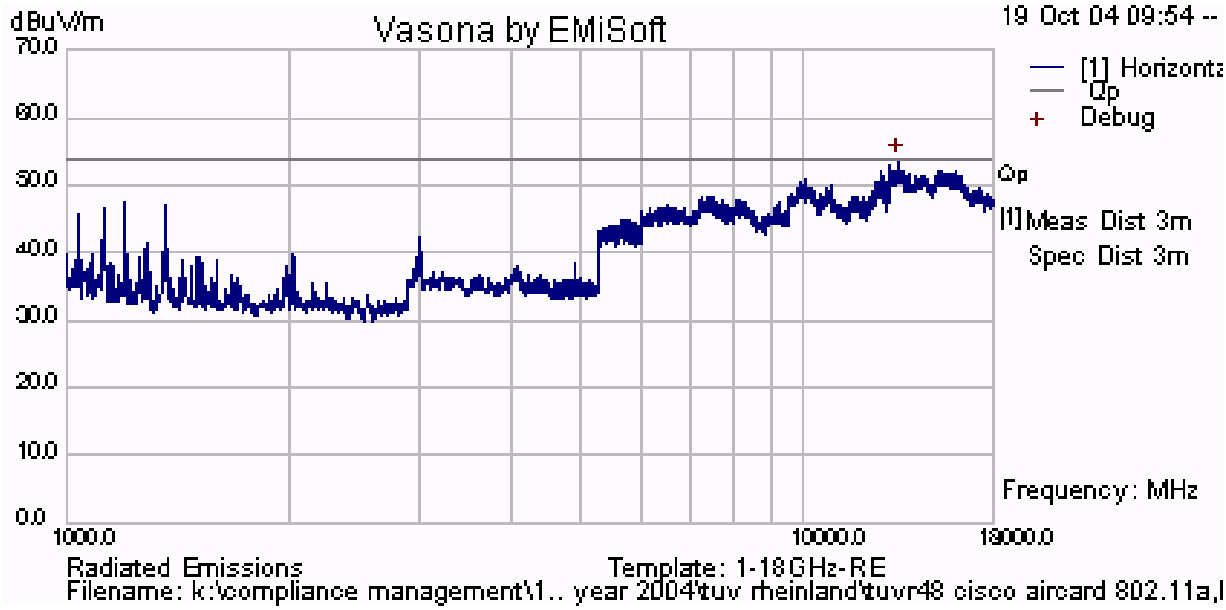


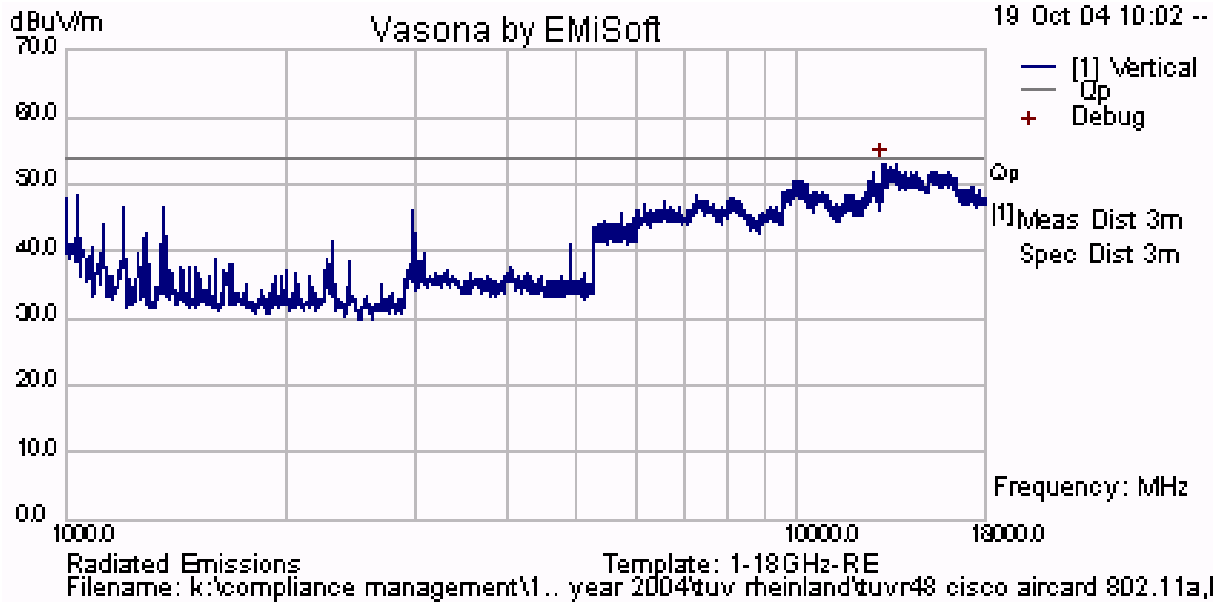
Plot 30 - 802.11b Spurious Emissions > 1GHz CH 1



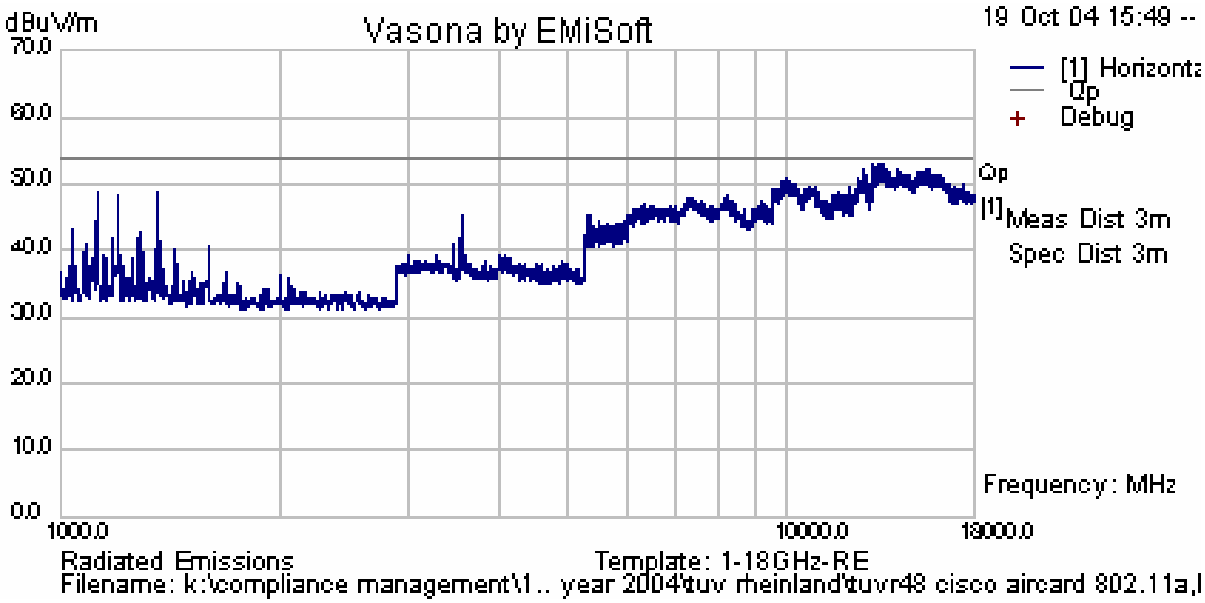


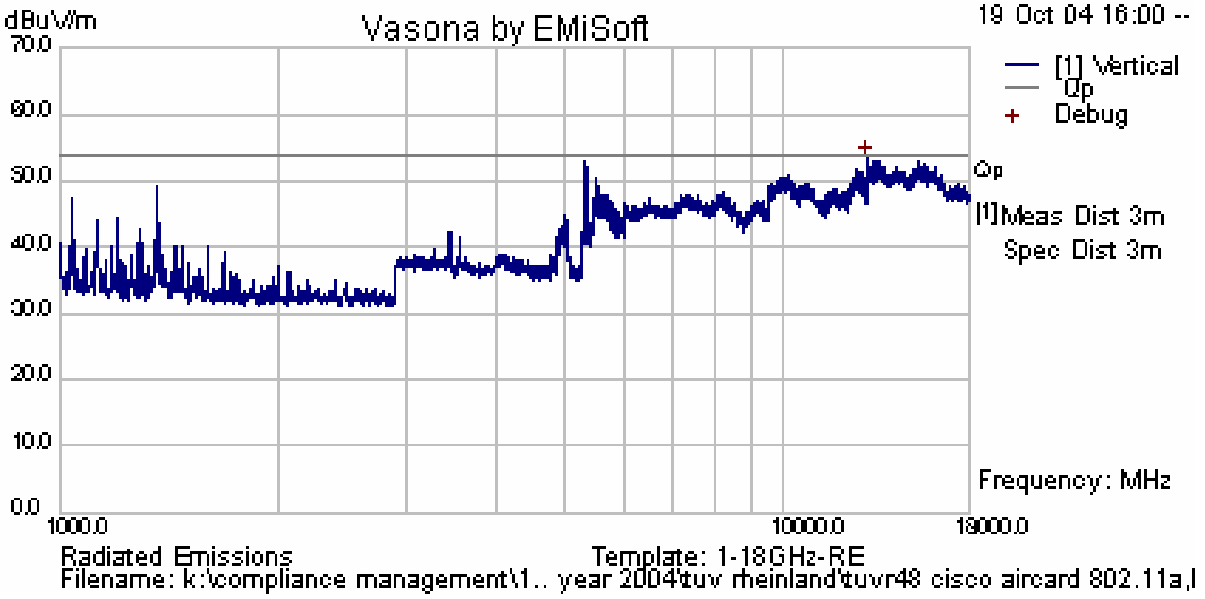
Plot 31 - 802.11g Spurious Emissions > 1GHz CH 6



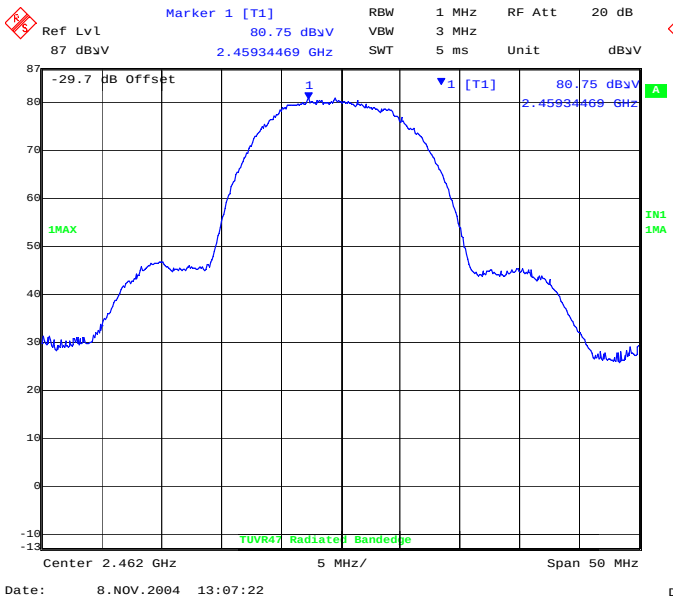


Plot 32 - 802.11a Spurious Emissions > 1GHz CH 149

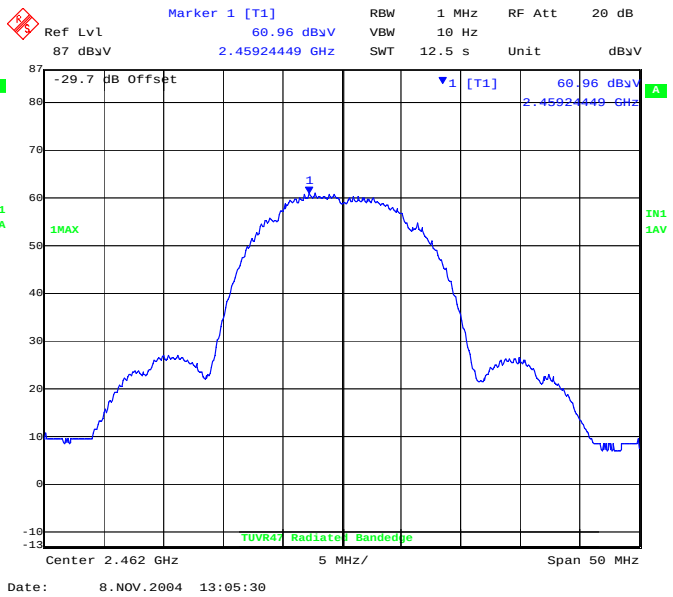




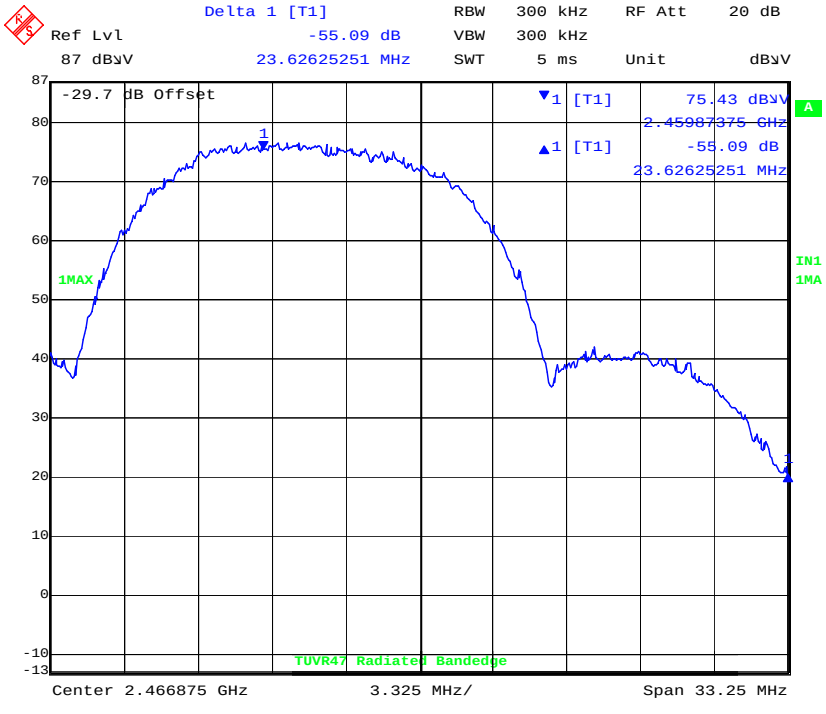
Plot 33 - 802.11b Radiated Band Edge CH 11, 2,483.5 MHz



CH 11 PEAK

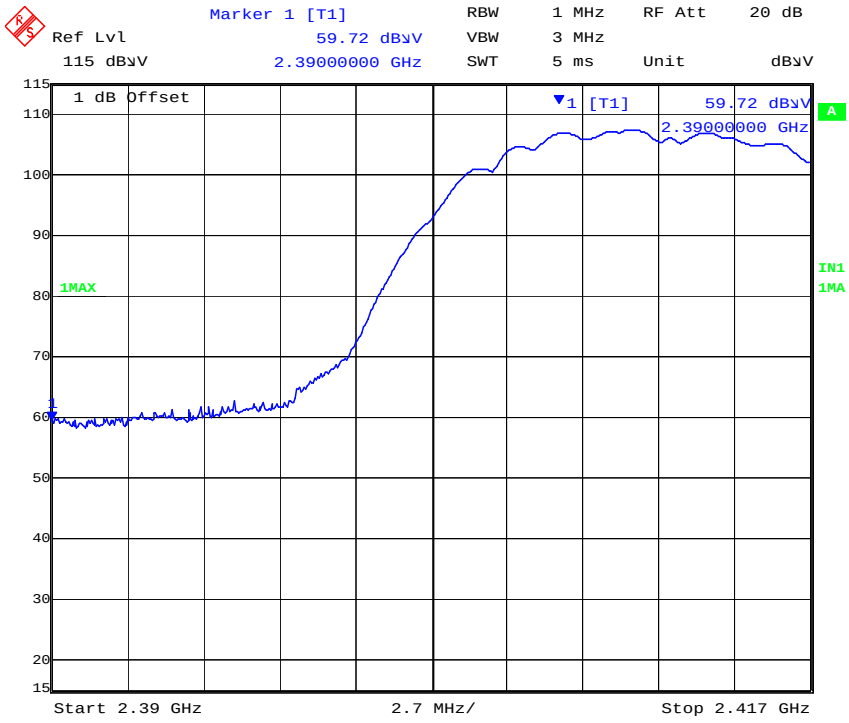


CH11 AVERAGE

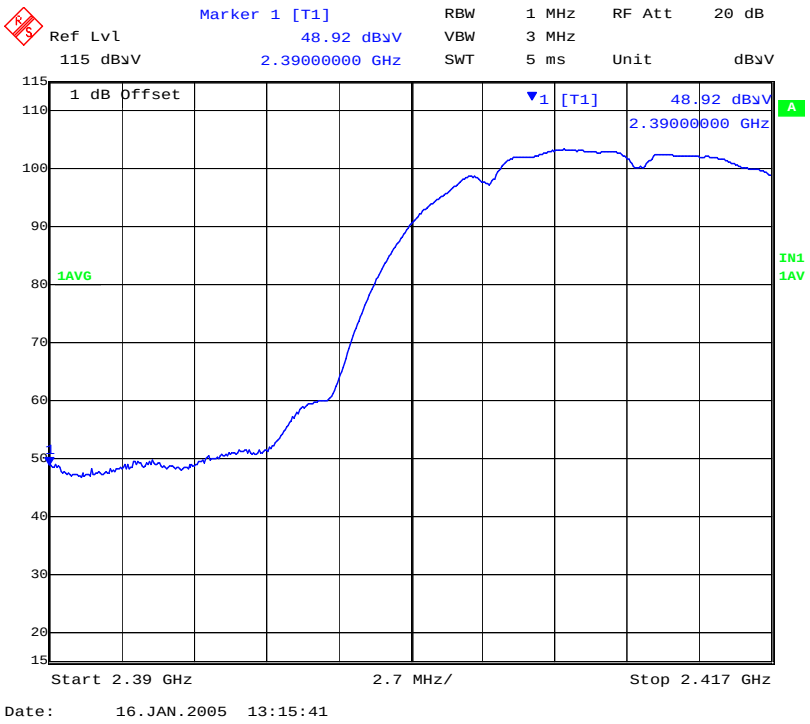


CH11 DELTA

Plot 34 - 802.11b Radiated Band Edge CH 1, 2,390 MHz

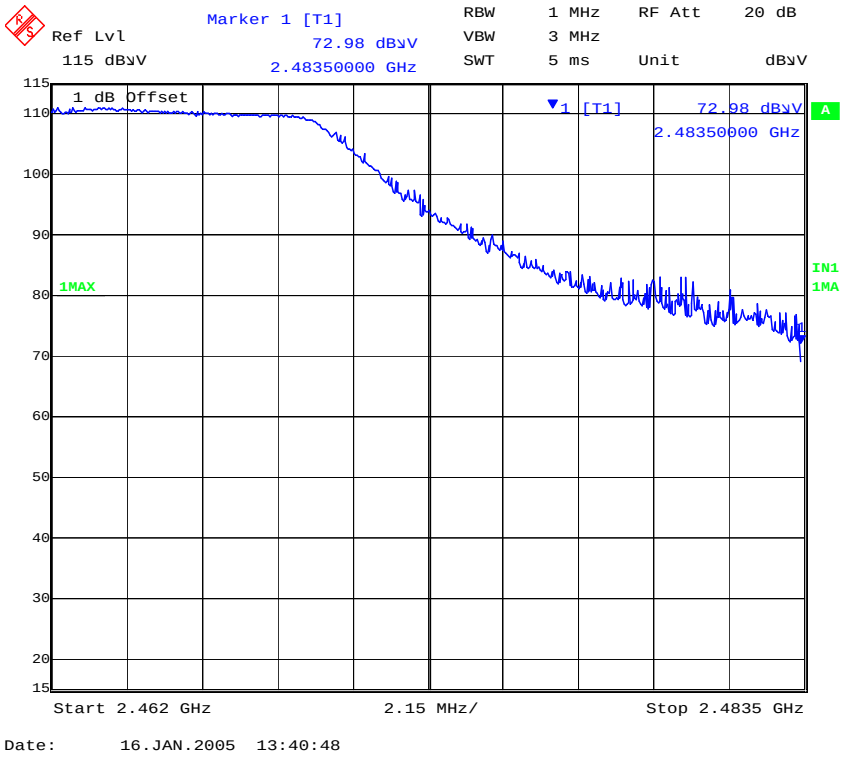


BAND EDGE - PEAK



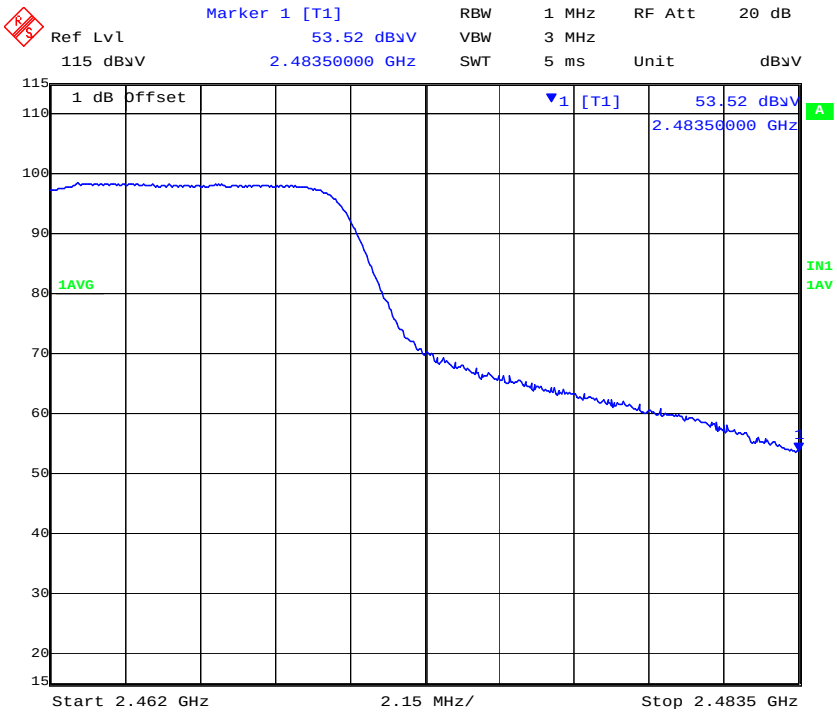
BAND EDGE – AVE.

Plot 35 - 802.11g Radiated Band Edge CH 11, 2,483.5 MHz



BAND EDGE - PEAK

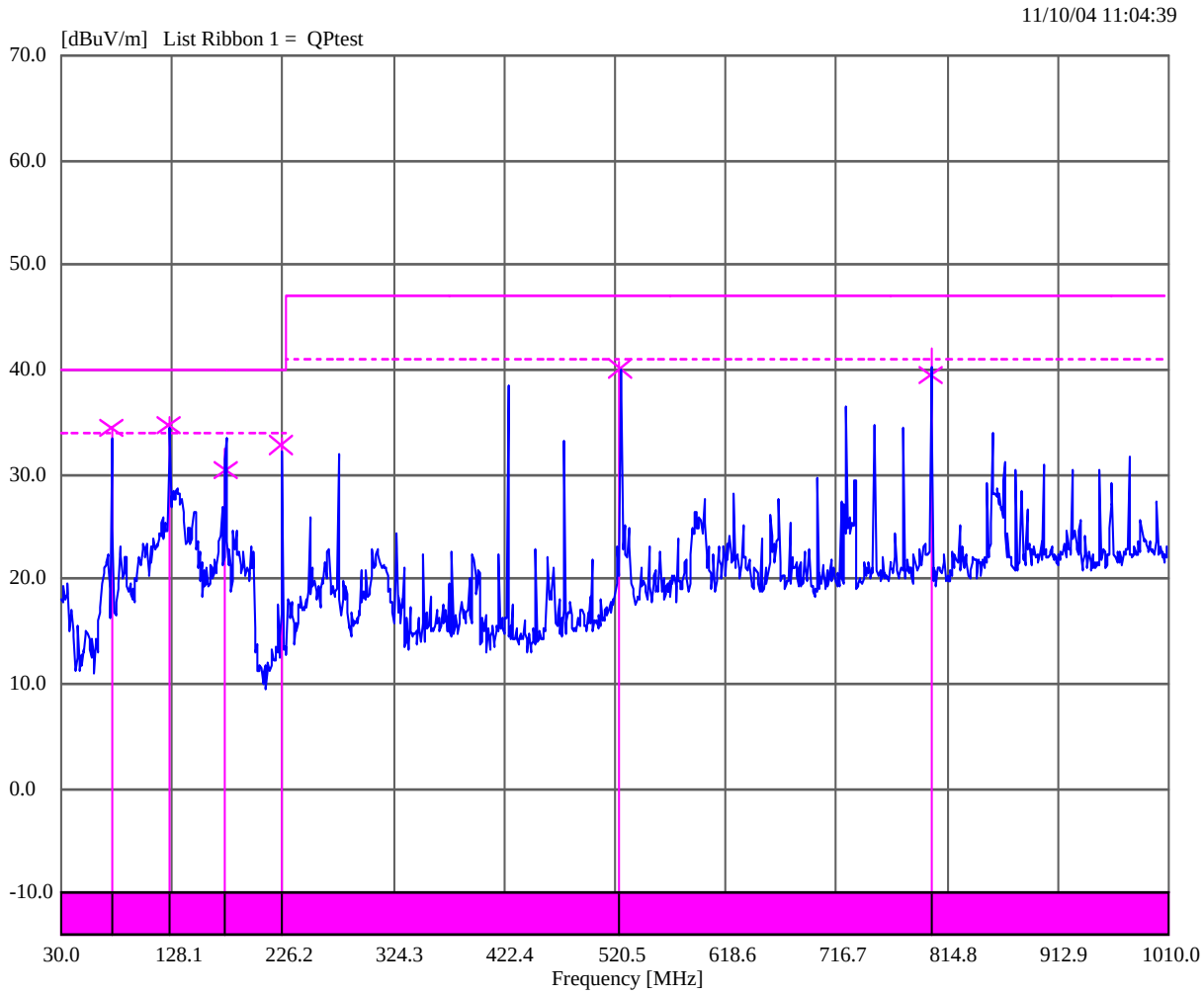
Date: 16.JAN.2005 13:40:48



BAND EDGE - AVE

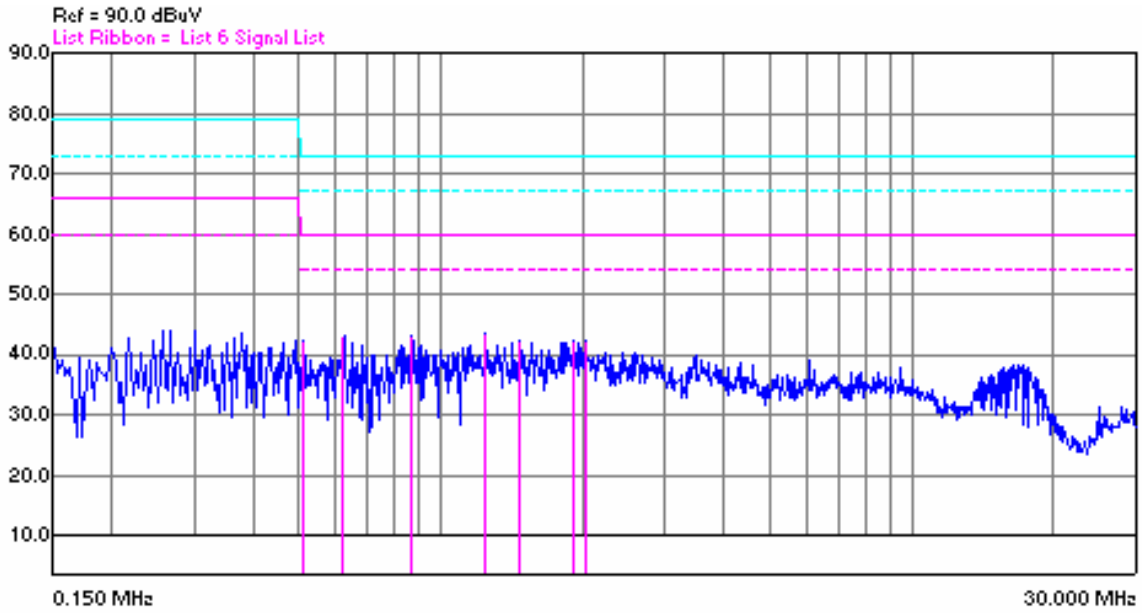
Date: 16.JAN.2005 13:38:43

Plot 36 - Radiated Emissions 30MHz – 1GHz

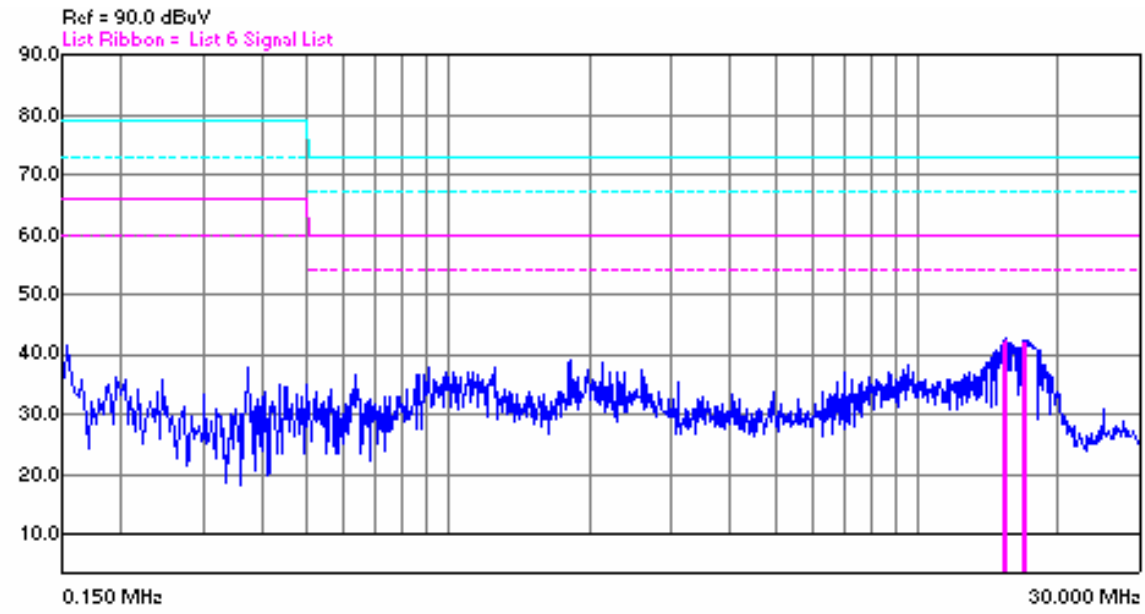


Plot 37 - AC Wireline Conducted Emissions

Line: Live



Line: Neutral



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