Test of Aruba AP-85FX 802.11 a/b/g Wireless AP

To: FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: ARUB25-A2 Rev A

TEST REPORT

FROM

Test of Aruba AP-85FX 802.11 a/b/g Wireless AP
to
To FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: ARUB25-A2 Rev A

This report supersedes: None

Manufacturer: Aruba Networks
1322 Crossman Avenue
Sunnyvale
CA 94089, USA

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

Copy No: pdf **Issue Date:** 29th October 2008

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
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ACCREDITED
CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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ACCREDITATION, LISTINGS and RECOGNITION

ACCREDITITION

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): 102167

Canada
Industry Canada: 4143A

RECOGNITION

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

Conformity Assessment Body (CAB) – MiCOM Labs

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

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

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	29th October 2008	Initial Release

1. TEST RESULT CERTIFICATE

Manufacturer:	Aruba Networks 1322 Crossman Avenue Sunnyvale CA 94089, USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	Wireless Access Point	Telephone:	+1 925 462 0304
Model:	AP-85FX	Fax:	+1 925 462 0306
S/N:	AB0000291		
Test Date(s):	10th to 27th September 2008	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.

ACCREDITED
CERTIFICATE #2381.01

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 15.247	2007	Code of Federal Regulations
(ii)	Industry Canada RSS-210	Issue 7 June 2007	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands)
(iii)	Industry Canada RSS-Gen	Issue 2 June 2007	General Requirements and Information for the Certification of Radiocommunication Equipment.
(iv)	ANSI C63.4	2003	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(v)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(vi)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vii)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(viii)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(ix)	A2LA	14th September 2005	Reference to A2LA Accreditation Status – A2LA Advertising Policy

2.2. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Test of the Aruba AP-85FX 802.11 a/b/g Wireless AP to FCC Part 15.247 and Industry Canada RSS-210 regulations.
Applicant:	As Manufacturer
Manufacturer:	Aruba Networks 1322 Crossman Avenue Sunnyvale CA 94089, USA
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	ARUB25-A2 Rev A
Date EUT received:	10th September 2008
Standard(s) applied:	FCC 47 CFR Part 15.247 & IC RSS-210
Dates of test (from - to):	10th to 27th September 2008
No of Units Tested:	1
Type of Equipment:	802.11a/b/g Wireless Access Point
Manufacturers Trade Name:	Wireless Access Point
Model:	AP-85FX (multi-mode fiber)
Location for use:	Outdoor
Declared Frequency Range(s):	2400 - 2483.5 MHz 5725 - 5850 MHz
Type of Modulation:	Per 802.11 –CCK, BPSK, QPSK, DSSS, OFDM
Declared Nominal Average Output Power:	802.11b: +22 dBm 802.11g: +21 dBm 802.11a: +17 dBm
EUT Modes of Operation:	802.11a/b/g
Transmit/Receive Operation:	Time Division Duplex
Rated Input Voltage and Current:	100-240VAC 0.5A,12VDC 2 A
Operating Temperature Range:	Declared range -30 to +55ºC
ITU Emission Designator:	802.11b – 15M7W7D 802.11g – 16M7W7D 802.11a – 16M8W7D
Frequency Stability:	±20 ppm max
Equipment Dimensions:	14 ½” x 11 ¼” x 3”
Weight:	9.5 lbs
Primary function of equipment:	Wireless Access Point

3.2. Scope of Test Program

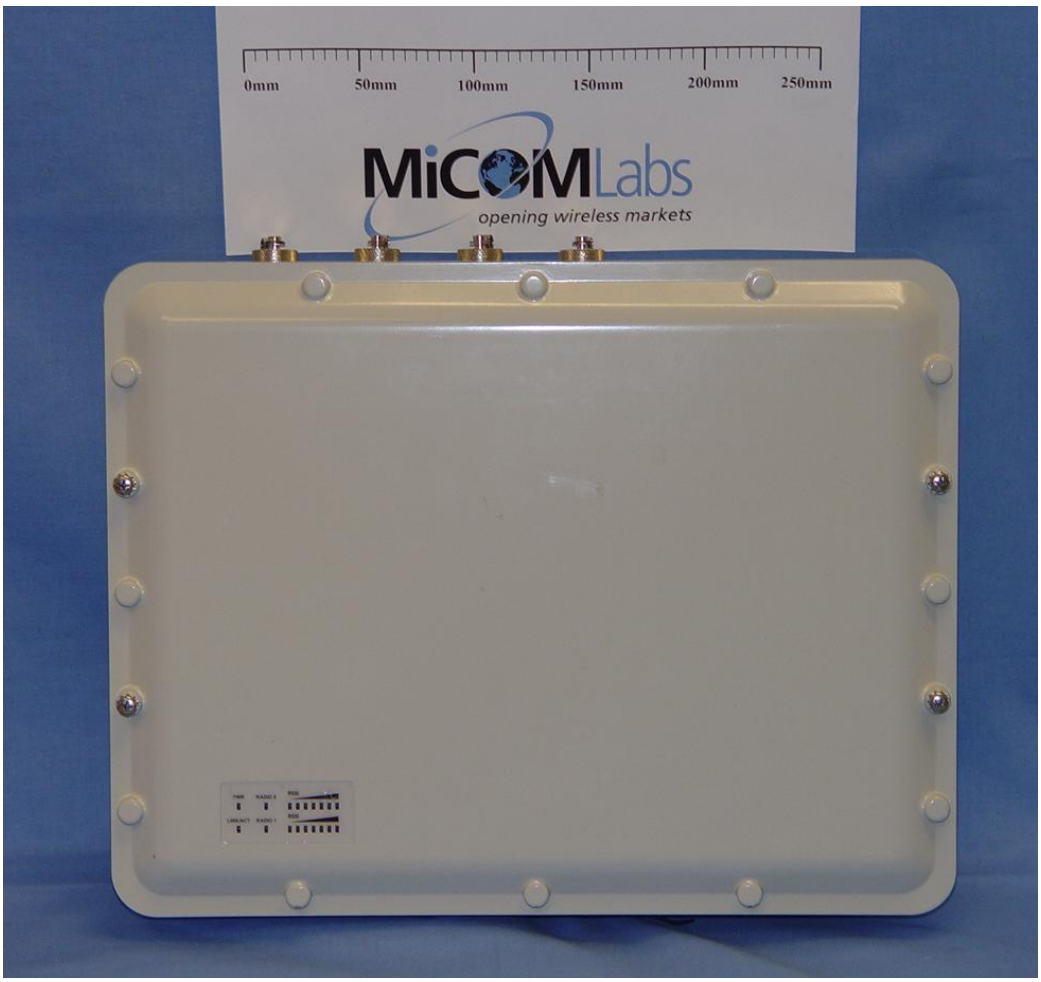
The scope of the test program was to test the Aruba Networks AP-85FX wireless Access Point in the frequency ranges 2400 - 2483.5 MHz, and 5725 – 5850 MHz for compliance against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications. This equipment is intended for Point to Multi point deployment.

The AP-85FX and AP-85LX have a 1 x 100BaseT, 1310 nm wavelength dual fiber LC interface. The FX and LX models are electrically identical, the difference is that the AP-85FX has a multi-mode optical interface; the AP-85LX has a single-mode optical interface. The FX model was tested during this program.

The Aruba Networks AP-85FX access point has two independent transmitters. System identifies antennas as primary and secondary (diversity) devices. A maximum of two transmitters can operate at any given time, one operating in IEEE 802.11b/g mode (2.4 GHz) and the other in IEEE 802.11a mode (5 GHz band).

The unit operates via either a 12Vdc or 115Vac 60Hz voltage sources. Both ports were exercised during the test program.

Aruba Networks
AP-85FX Wireless Access Point



Aruba Networks
AP-85FX Wireless Access Point

Aruba Networks
AP-85FX Wireless Access Point

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

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	Access Point	Aruba Networks	AP-85FX	AB0000291
Support	Laptop PC	IBM	Thinkpad	None

3.4. Antenna Details

1. 2400-2500 MHz
    - AP-ANT-2418 18 dBi Panel (MARS Antennas & RF Systems WA24-2X)
2. 5725-5850 MHz
    - AP-ANT-5016 16 dBi Panel (MARS Antennas & RF Systems MA-WA57-3X)

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. 10/100 Ethernet (with POE capability)
2. 1 X 100BaseT multi-mode 1310 nm wavelength dual fiber LC interface
3. 4 X N-Type antenna connections (Primary and Secondary (diversity))
4. 3 pin 12 Vdc 2A dc PWR connector
5. 100 – 240 Vac 50-60 Hz

3.6. Test Configurations

Testing was performed to determine the highest power level versus bit rate. 802.11b 1 MB/s, 6 MB/s for 802.11g and 6 MB/s for 802.11a were found to provide the highest power levels. These data rates were used to exercise the product throughout the entire test program.

Matrix of Channel test configurations.

Operational Mode (802.11)	Frequencies (MHz)
b, g	2,412 2,437 2,462
a	5,745 5,785 5,825

Matrix of Access Point Data Rate Configurations

'b' Mode Data Rate	'a' and 'g' Mode Data Rate
1 Mb/s	6 Mb/s

Antenna Test Configurations for Radiated Emissions

Freq Band (GHz)	802.11 Mode	18 dBi Panel	16 dBi Panel
2.4	b	X	
	g	X	
5.8	a		X

3.7. Equipment Modifications

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

1. Radiated Emissions testing

   - The EUT power had to be reduced for radiated emissions testing to meet the EIRP limits. Refer to limit calculations in Section 5.1.2 of this report.

EUT Power Settings for Radiated Emissions Testing					
802.11	Frequency (MHz)	Spurious Emissions		Band-edge	
		Software Power Setting	Conducted Power (dBm)	Software Power Setting	Conducted Power (dBm)
b	2412	31	14.20	31	14.20
	2437	31	15.60	31	15.60
	2462	31	14.76	31	14.76
g	2412	26	11.28	23*	9.78
	2437	26	10.43	26	10.43
	2462	26	11.01	23*	9.51
a	5745	29	8.9	29	8.9
	5785	29	10.38	29	10.38
	5825	29	9.03	29	9.03

* Reduction in power required in order to comply with restricted band-edge compliance requirements

   - A grounding wire internal to the EUT had to be removed to reduce emissions, see photograph.

2. AC Wireline Emission

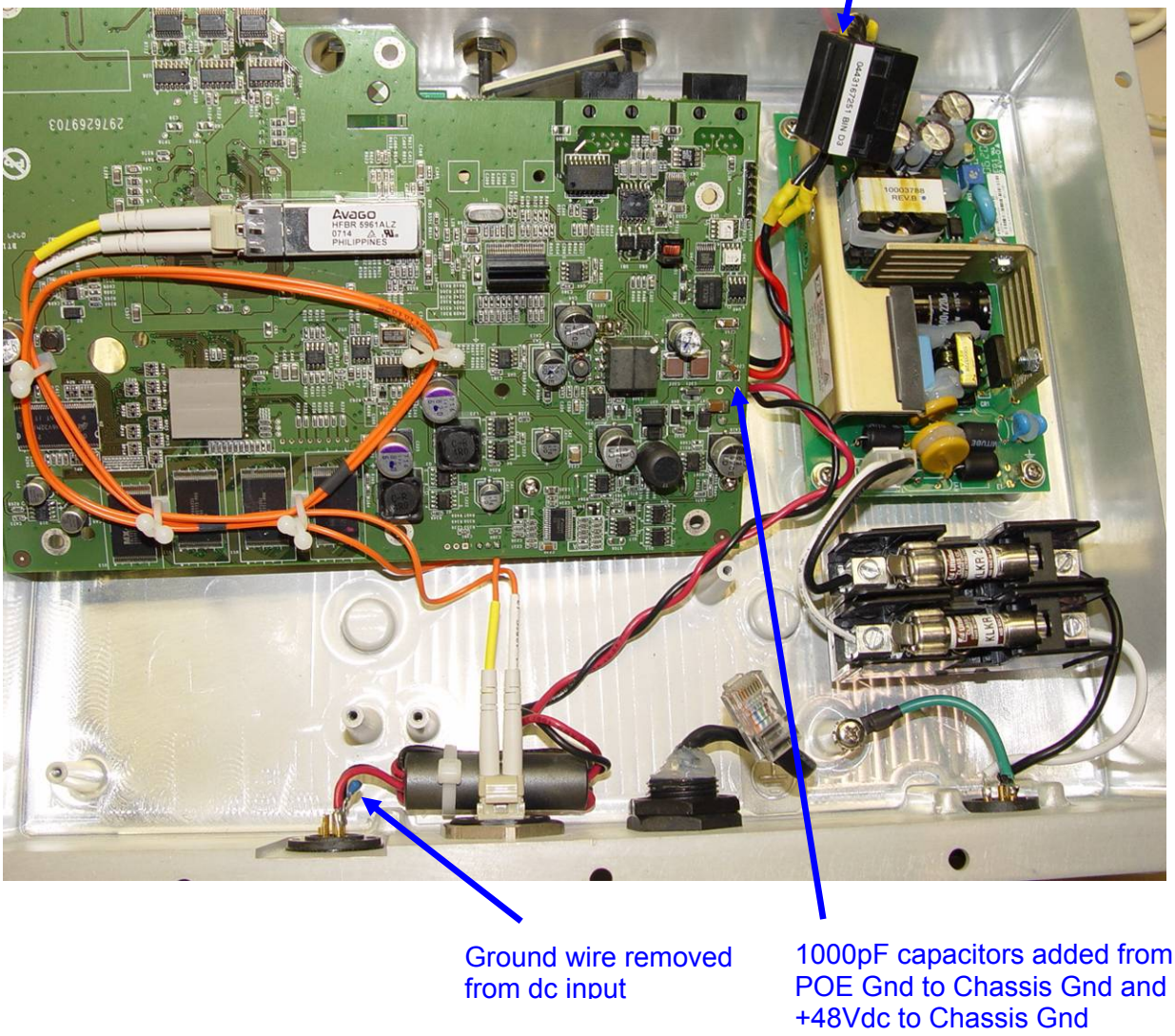
   - A ferrite choke (Fair-Rite #0443167251) was installed on the dc output of the PSU (power supply unit) within the EUT

   - 1000pF capacitors added from POE Gnd to Chassis Gnd and +48Vdc to Chassis Gnd

   A photograph of the modifications is included

Modification Photograph

Aruba Networks
AP-85FX Equipment Modifications



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

4. TEST SUMMARY

List of Measurements

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

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(a)(2) **A8.2(1)** **4.4**	6 dB and 99 % Bandwidths	≥500 kHz	Conducted	Complies	5.1.1
15.247(b)(3) **15.31(e)** **A8.4(4)**	Peak Output Power Voltage Variation	Shall not exceed 1W Variation of supply voltage 85 % -115 %	Conducted	Complies	5.1.2
15.247(e) **A8.2**	Peak Power Spectral Density	Shall not be greater than +8 dBm in any 3 kHz band	Conducted	Complies	5.1.3
15.247(i) **5.5**	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	5.1.4
15.247(d) **15.205 /** **15.209** **A8.5** **2.2** **4.7**	Spurious Emissions (30MHz - 26 GHz b/g and 30 MHz – 40 GHz a)	The radiated emission in any 100 kHz of out-band shall be at least 20 dB below the highest in-band spectral density	Conducted	Complies	5.1.5

List of Measurements (continued)

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

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(d) **15.205 /** **15.209** **A8.5** **2.2** **2.6** **4.7**	Radiated Emissions	Restricted Bands	Radiated	Complies	5.1.6
	Transmitter Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*5.1.6.1*
	Radiated Band Edge	Band-edge results Peak Emissions		Complies	*5.1.6.2.*
Industry Canada only **RSS-Gen §4.8, §6**	Receiver Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*5.1.6.3*
15.205 / **15.209** **2.2**	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies	*5.1.6.4*
15.207 **7.2.2**	AC Wireline Conducted Emissions 150 kHz–30 MHz	Conducted Emissions	Conducted	Complies	*5.1.7*

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

5. TEST RESULTS

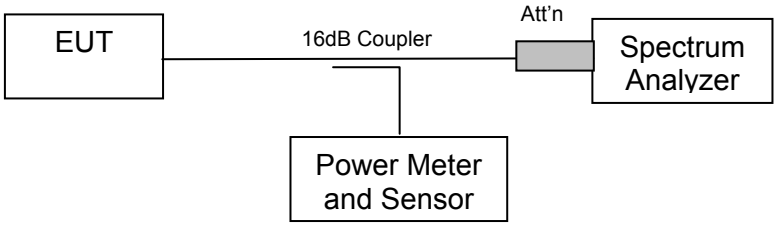
5.1. Device Characteristics

5.1.1. 6 dB and 99 % Bandwidth

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

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

Test Measurement Set up



Measurement set up for 6 dB and 99 % bandwidth test

Measurement Results for 6 dB & 99% Bandwidth

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

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier
Power: Maximum

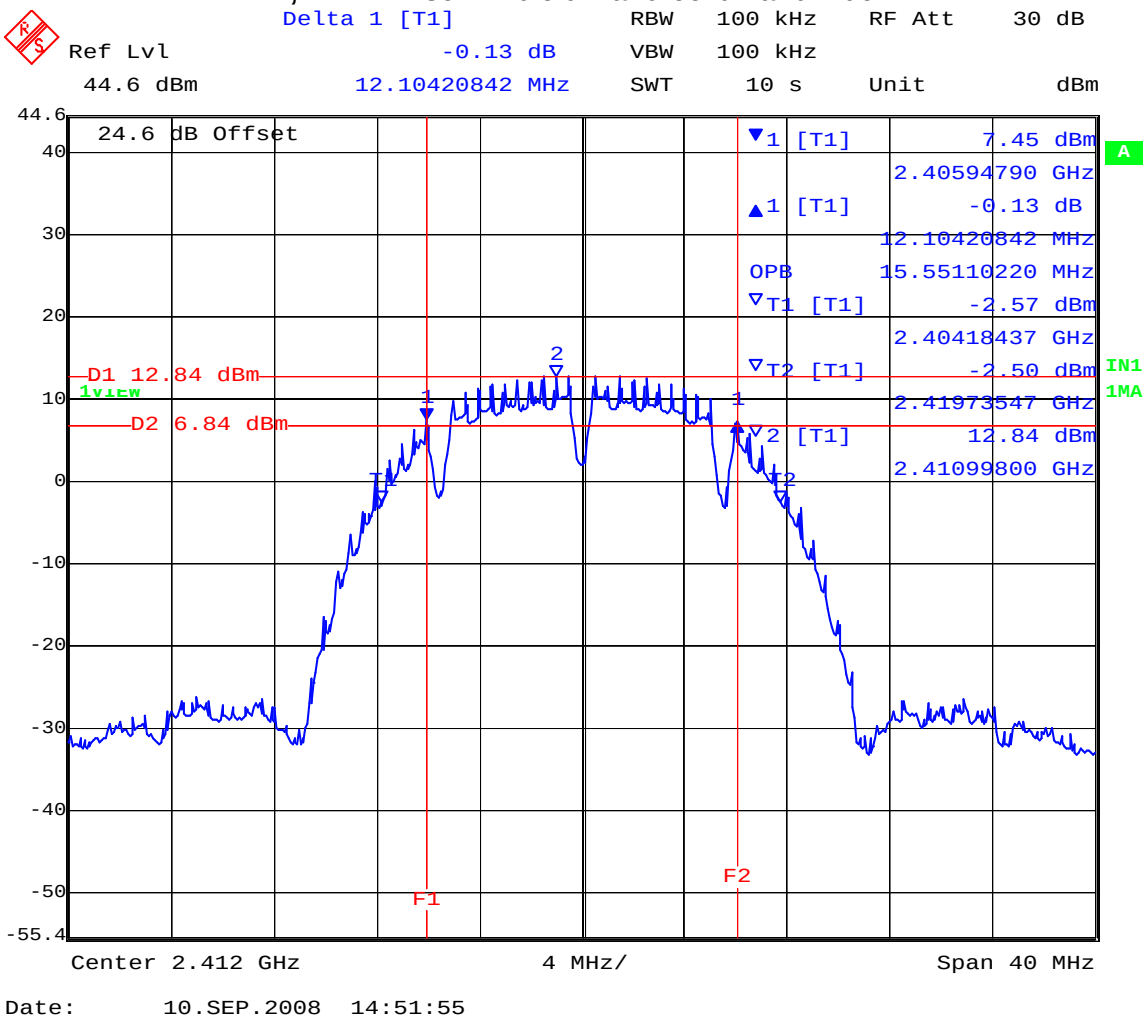
Measurement Results for 6 dB and 99% Operational Bandwidth(s)

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

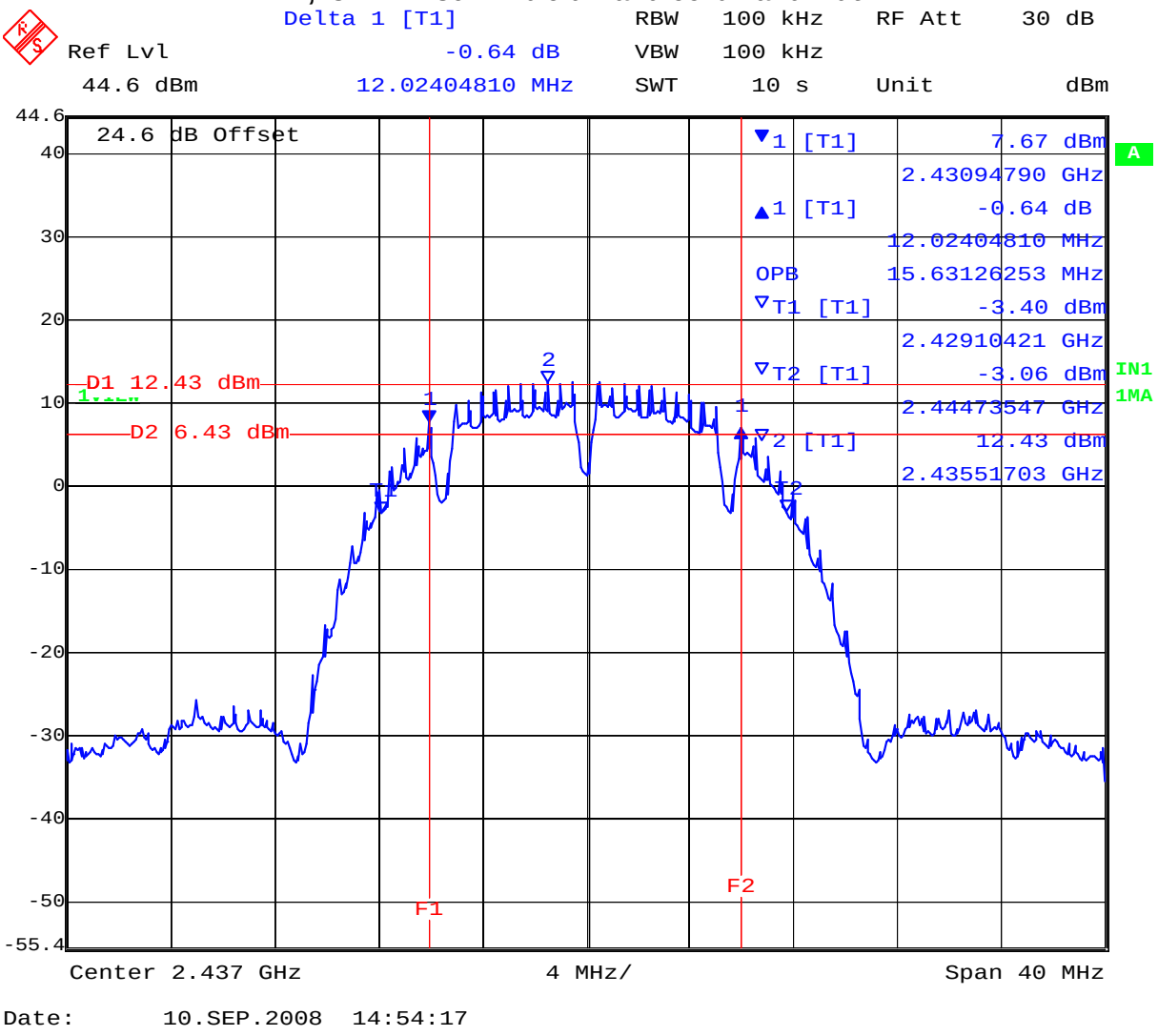
TABLE OF RESULTS – **802.11b - 1 Mb/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)
2,412	12.104	15.551
2,437	12.024	15.631
2,462	12.024	15.631

2,412 MHz 802.11b 6 dB and 99% Bandwidth



2,437 MHz 802.11b 6 dB and 99% Bandwidth



2,462 MHz 802.11b 6 dB and 99% Bandwidth

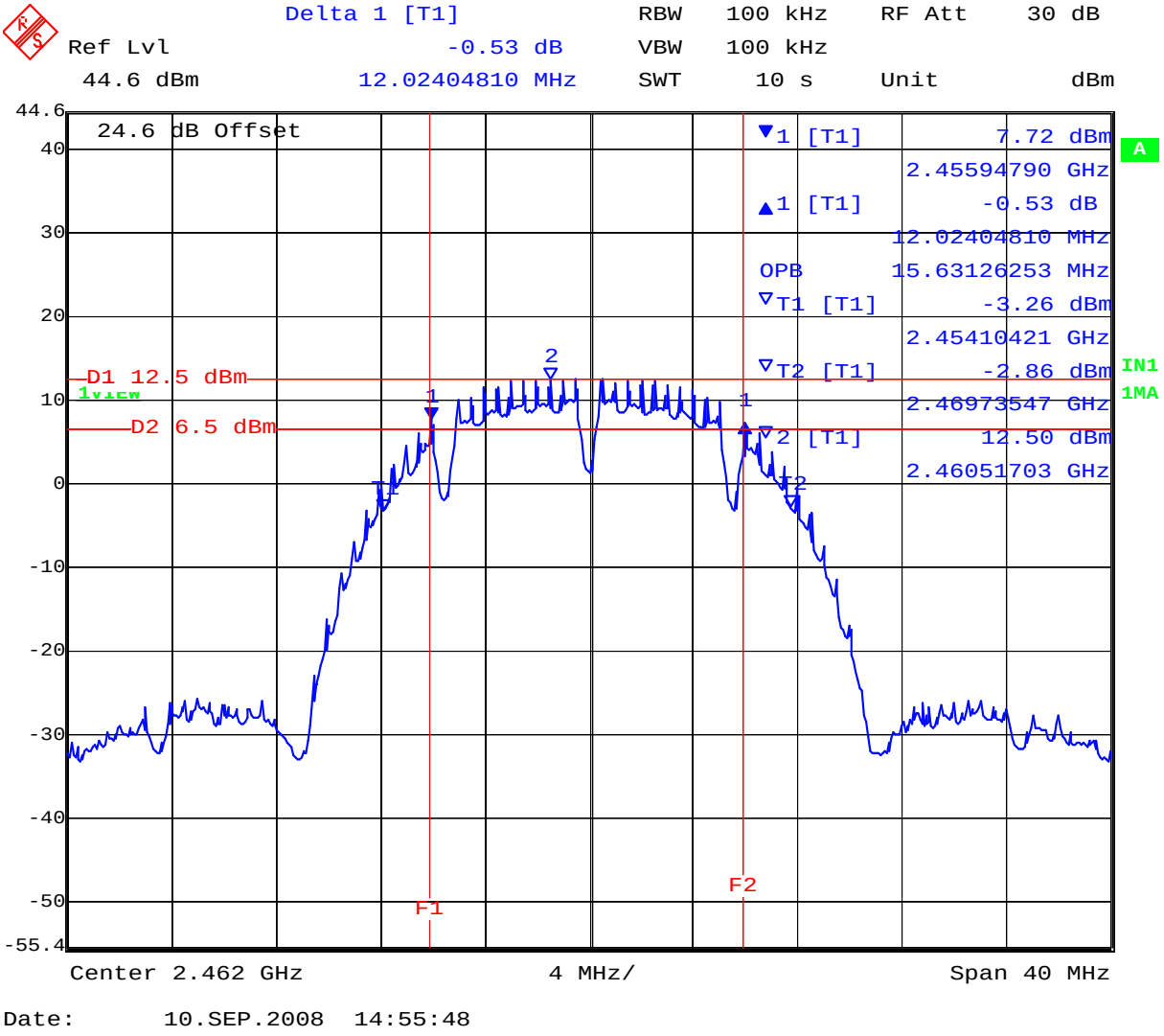
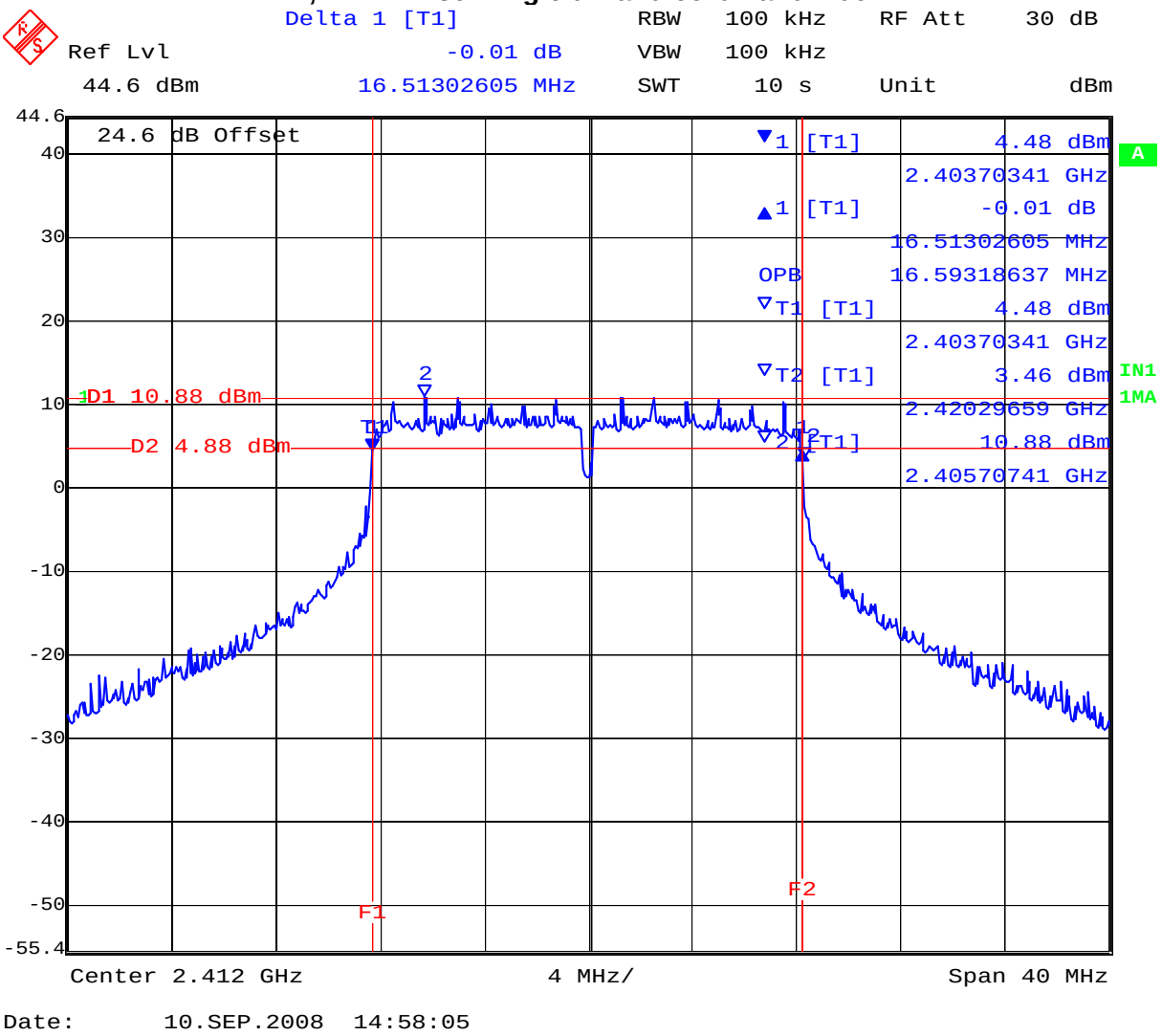


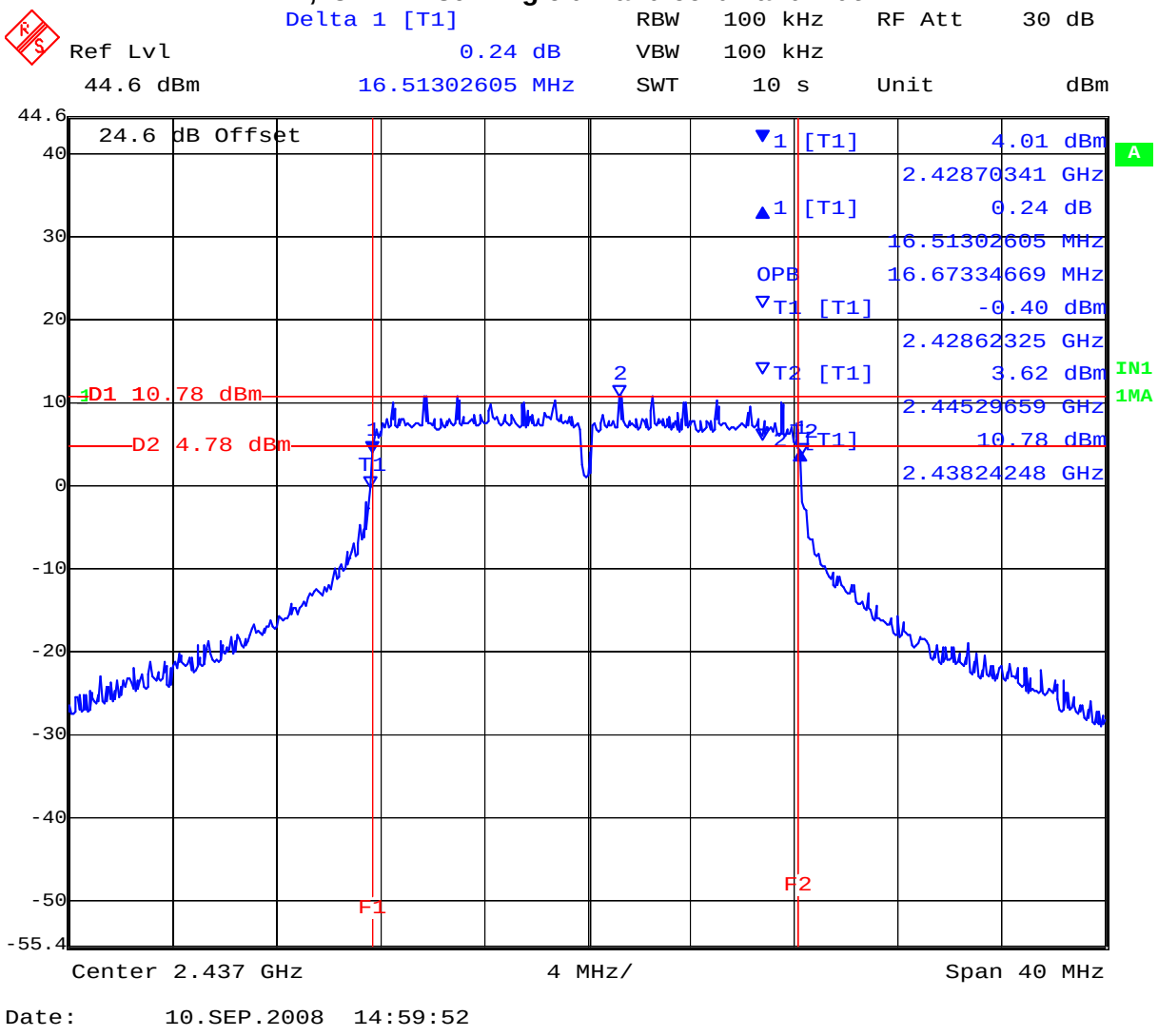
TABLE OF RESULTS – **802.11g - 6 Mb/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)
2,412	16.513	16.593
2,437	16.513	16.673
2,462	16.513	16.593

2,412 MHz 802.11g 6 dB and 99% Bandwidth



2,437 MHz 802.11g 6 dB and 99% Bandwidth



2,462 MHz 802.11g 6 dB and 99% Bandwidth

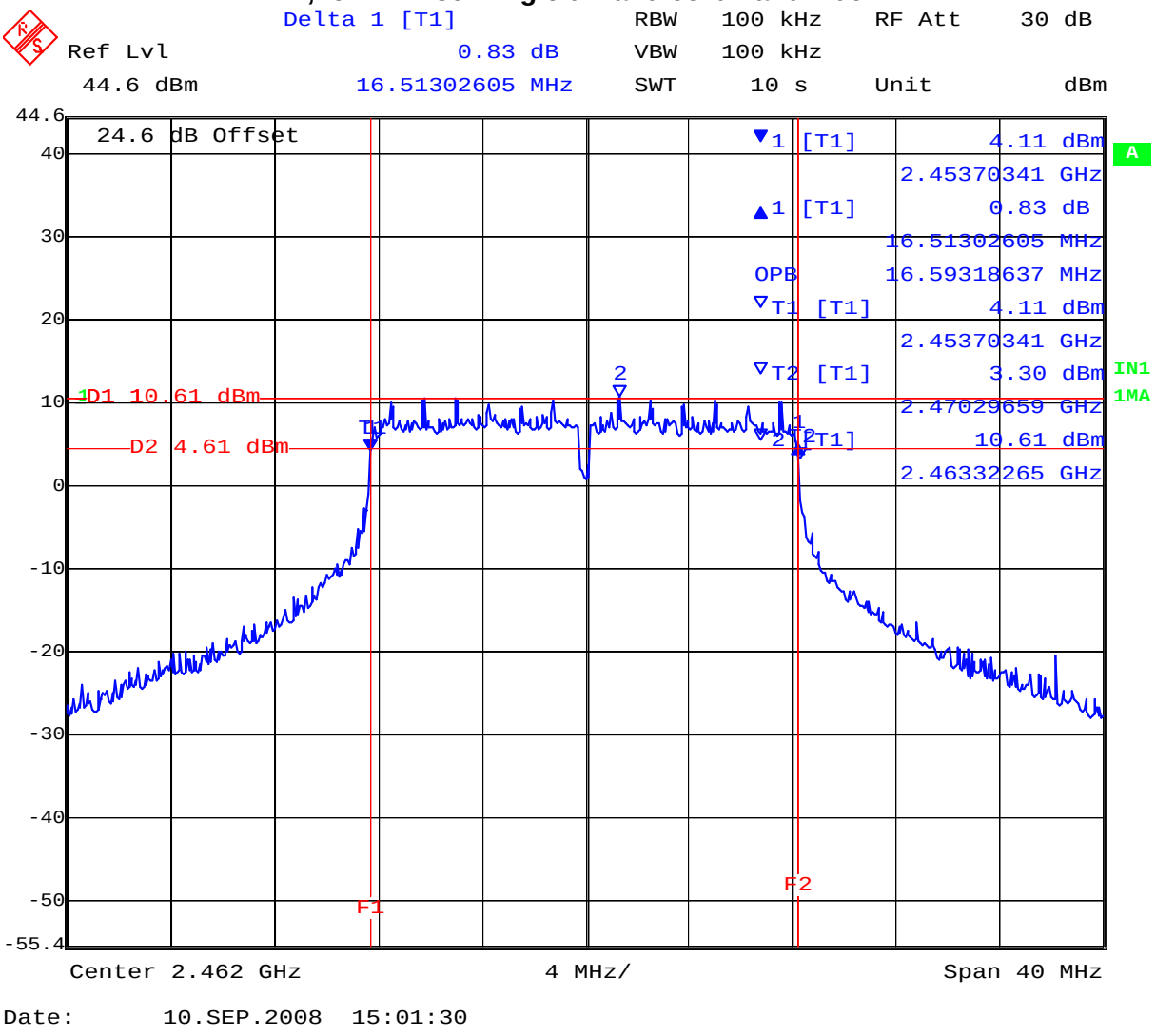
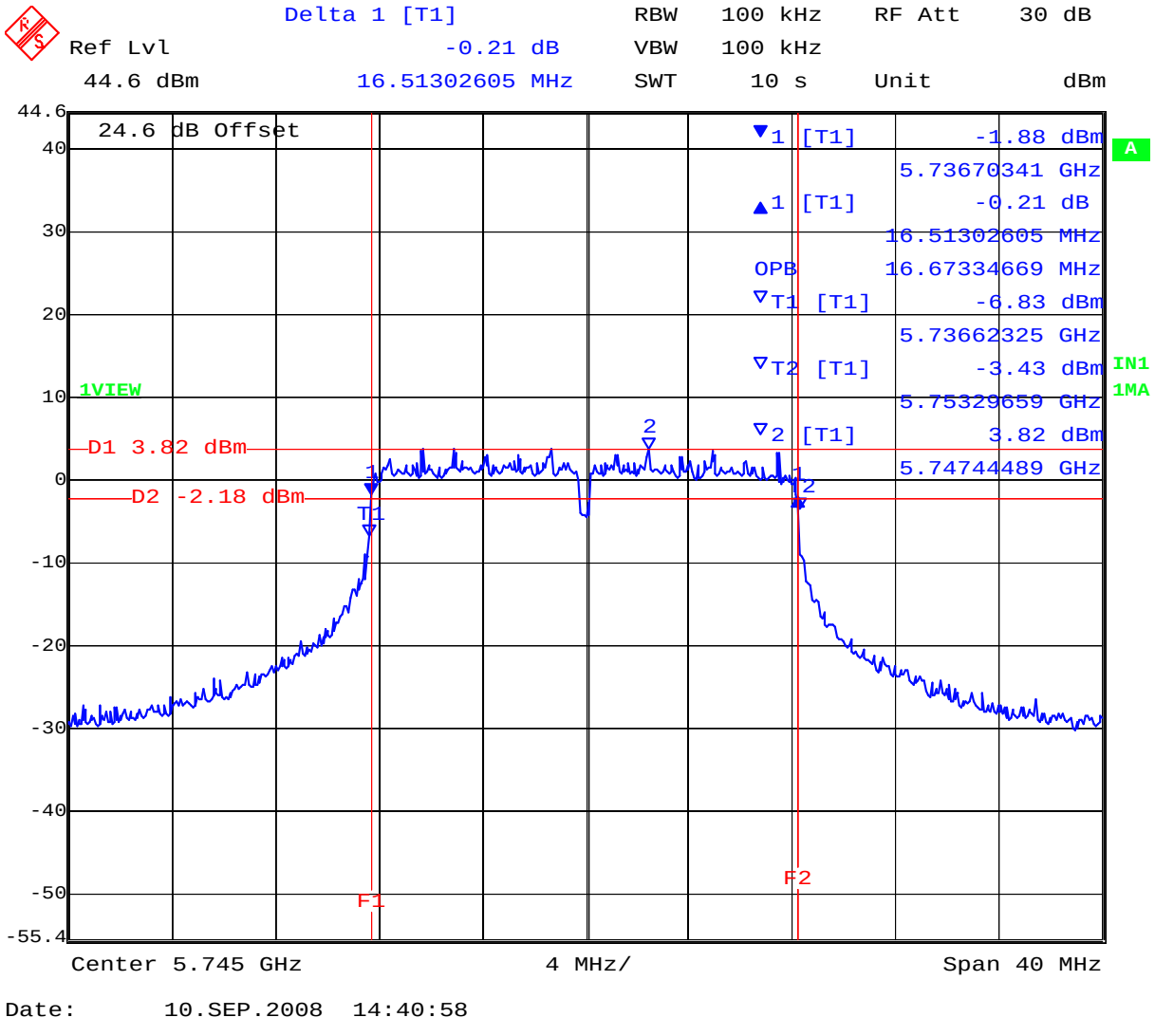


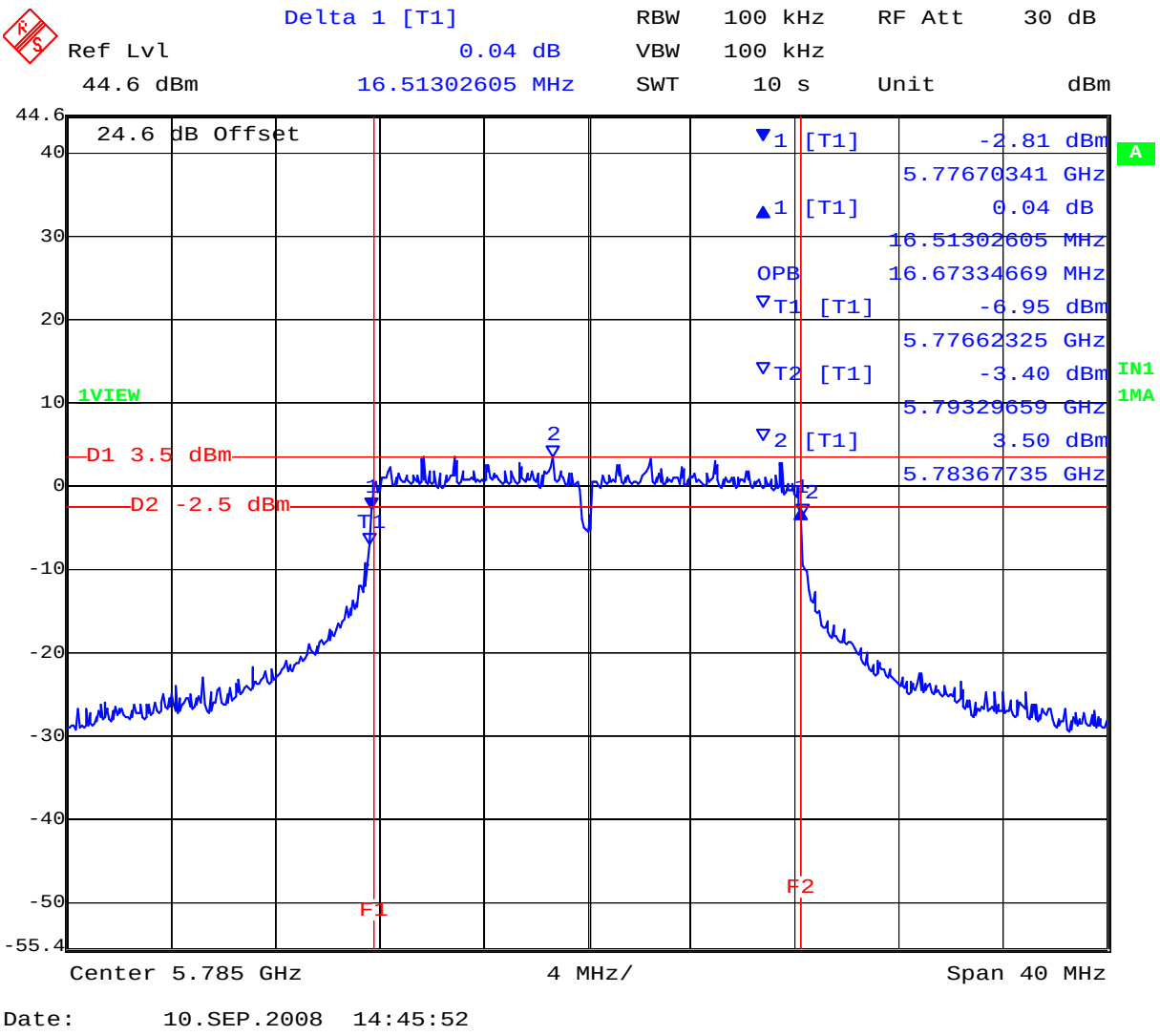
TABLE OF RESULTS – **802.11a - 6 Mb/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)
5,745	16.513	16.673
5,785	16.513	16.673
5,825	16.513	16.754

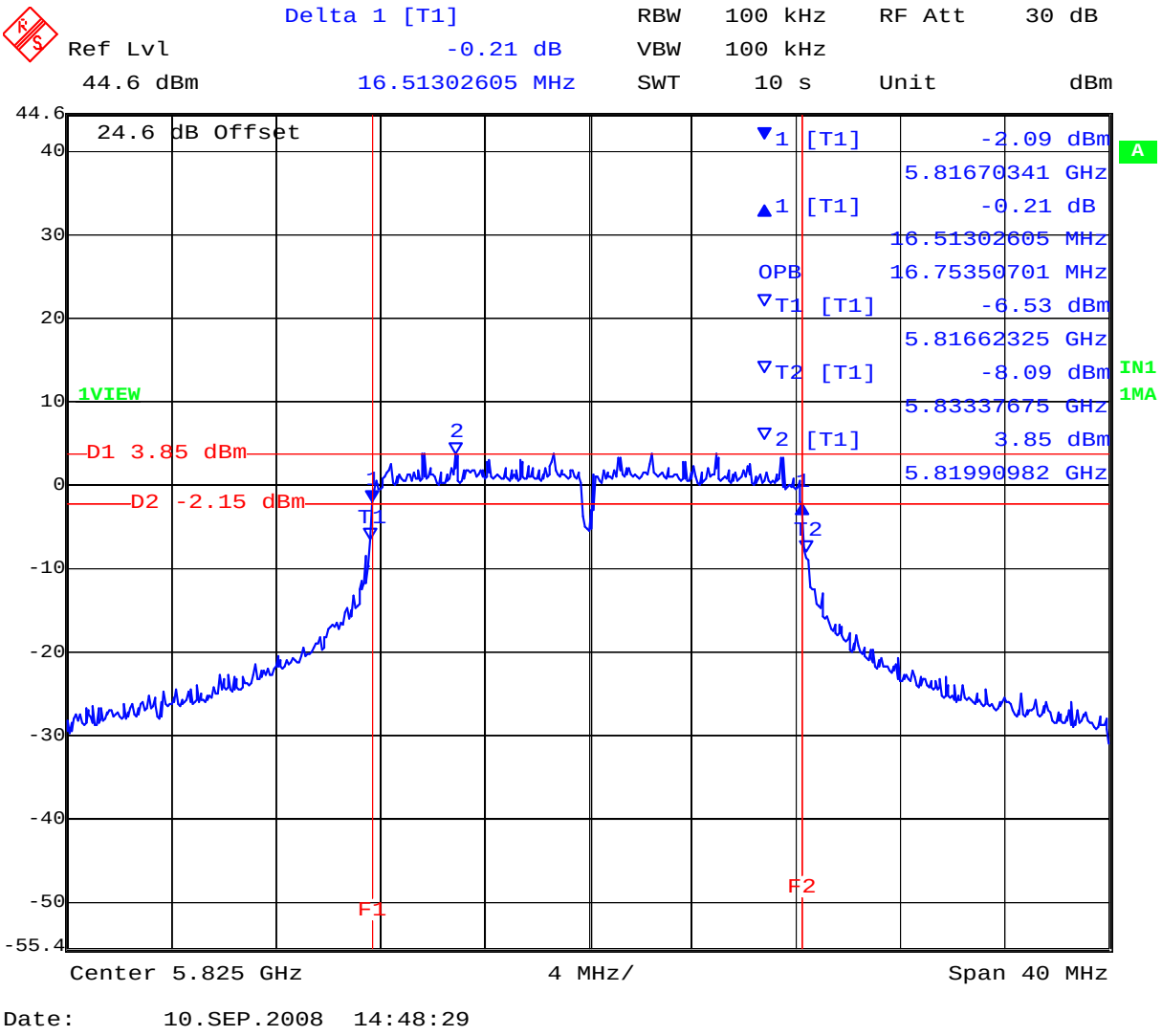
5,745 MHz 802.11a 6 dB and 99% Bandwidth



5,785 MHz 802.11a 6 dB and 99% Bandwidth



5,825 MHz 802.11a 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

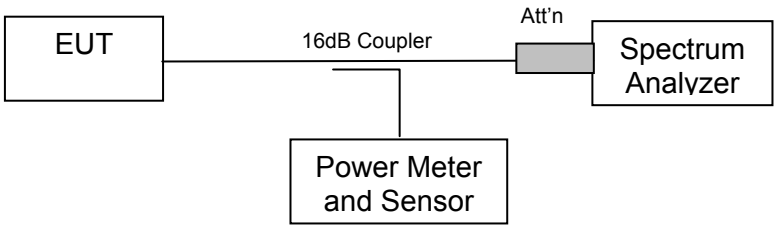
Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0158, 0193, 0252, 0313, 0314, 0070, 0116, 0117

5.1.2. Peak Output Power

FCC, Part 15 Subpart C §15.247(b)(3), §15.31(e)
Industry Canada RSS-210 §A8.4(4)

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

Test Measurement Set up



Measurement set up for Transmitter Peak Output Power

Ambient conditions.

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

b/g (2.4 GHz) Maximum Antenna Gain = +18 dBi

a (5.8 GHz) Maximum Antenna Gain = +16 dBi

15.247 (c) Operation with directional antenna gains greater than 6 dBi.

(1) Point-to-Multipoint Operation
For point-to-multipoint operation the conducted output power limit is based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

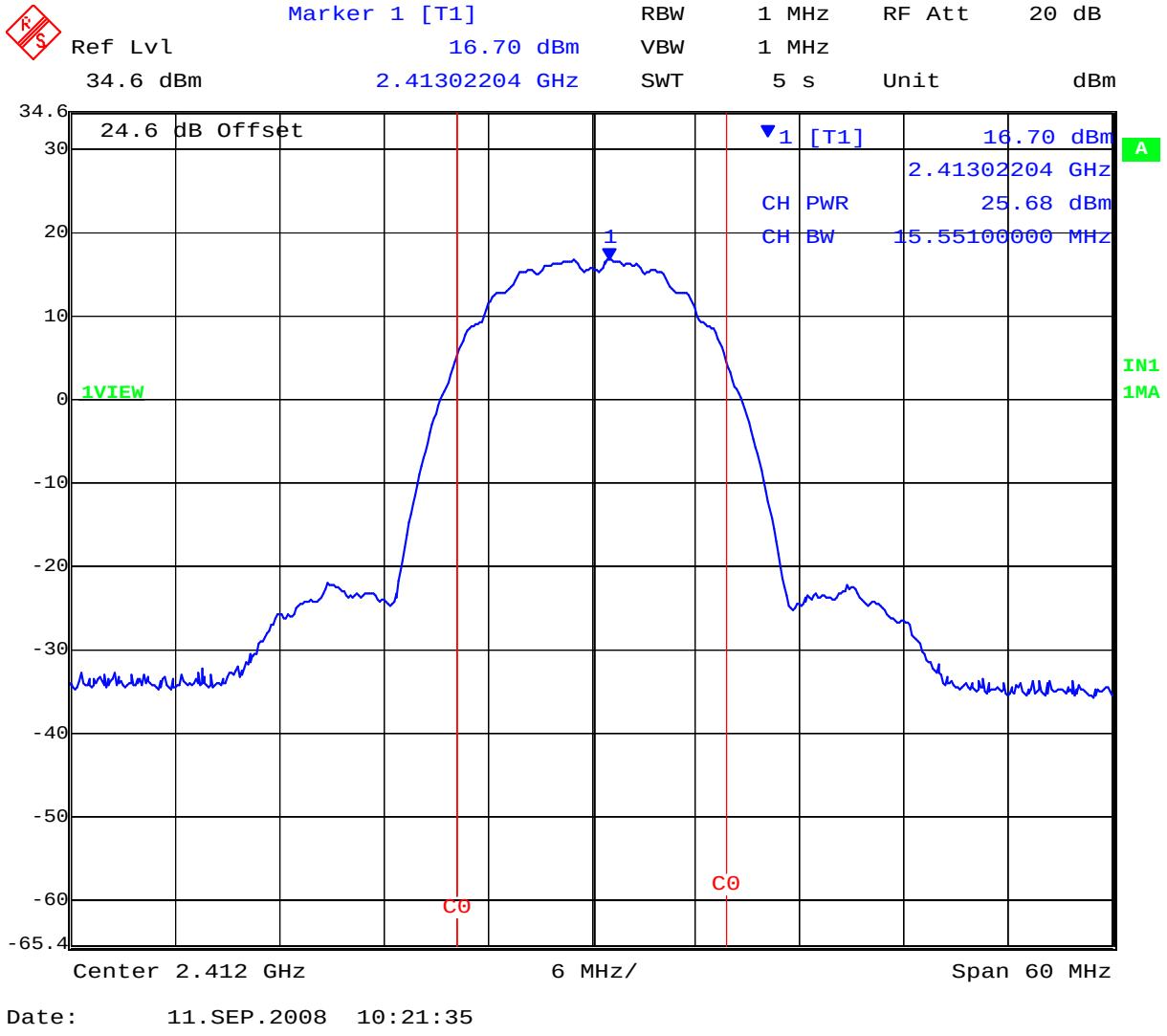
Point to Multipoint limit equals +36dbM EIRP

Antenna Type	Gain (dBi)	Antenna Gain >6dBi (dB)	Power Reduction (dB)	Max. Allowable Conducted Peak Power (dBm)	Maximum EIRP (dBm)
2.4GHz WA24-2X	18	12	12	+18	+36
5.8GHz MA-WA57-3X	16	10	10	+20	+36

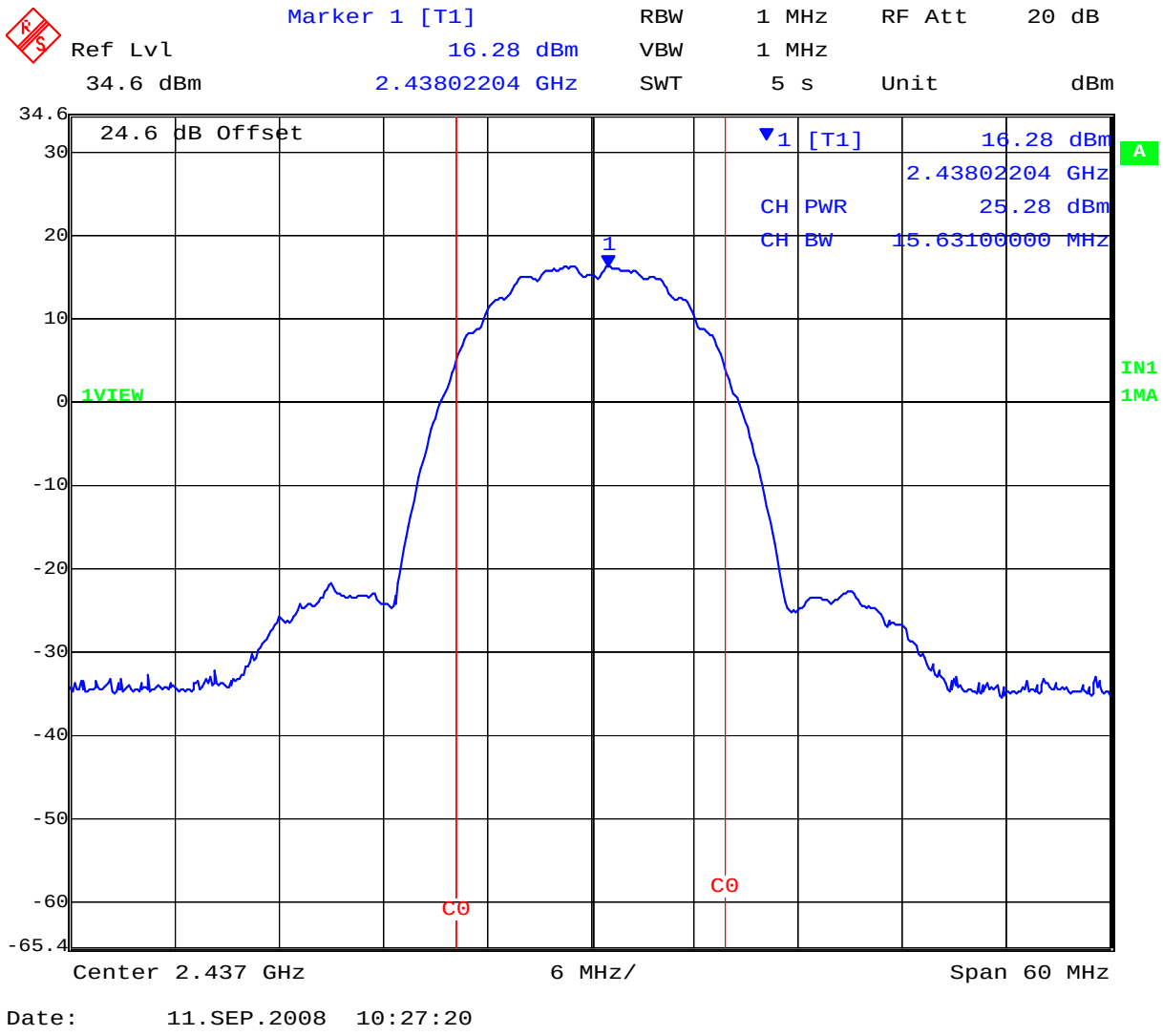
TABLE OF RESULTS – **802.11b – 1Mb/s**
Maximum Conducted Power

Center Frequency (MHz)	Software Setting	99% Measurement Bandwidth (MHz)	Average Power (dBm)	Peak Power (dBm)	EIRP (dBm) 0dBi Antenna
2,412	60	15.551	+21.65	+25.68	+25.68
2,437	60	15.631	+21.82	+25.28	+25.28
2,462	60	15.631	+21.77	+25.68	+25.68

Software Power Setting = 60
2,412 MHz 802.11b Peak Power (dBm)



Software Power Setting = 60
2,437 MHz 802.11b Peak Power (dBm)



Software Power Setting = 60
2,462 MHz 802.11b Peak Power (dBm)

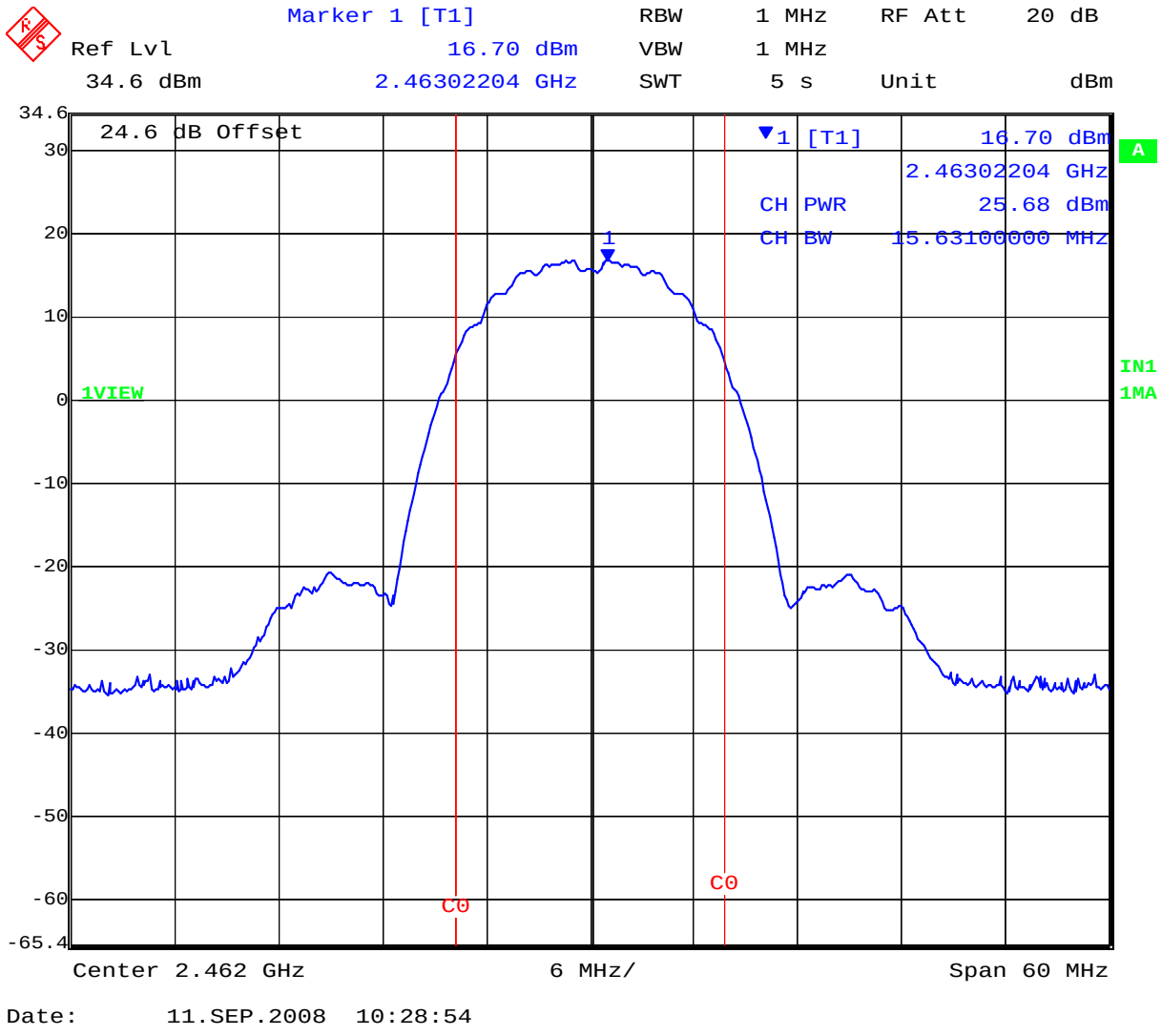


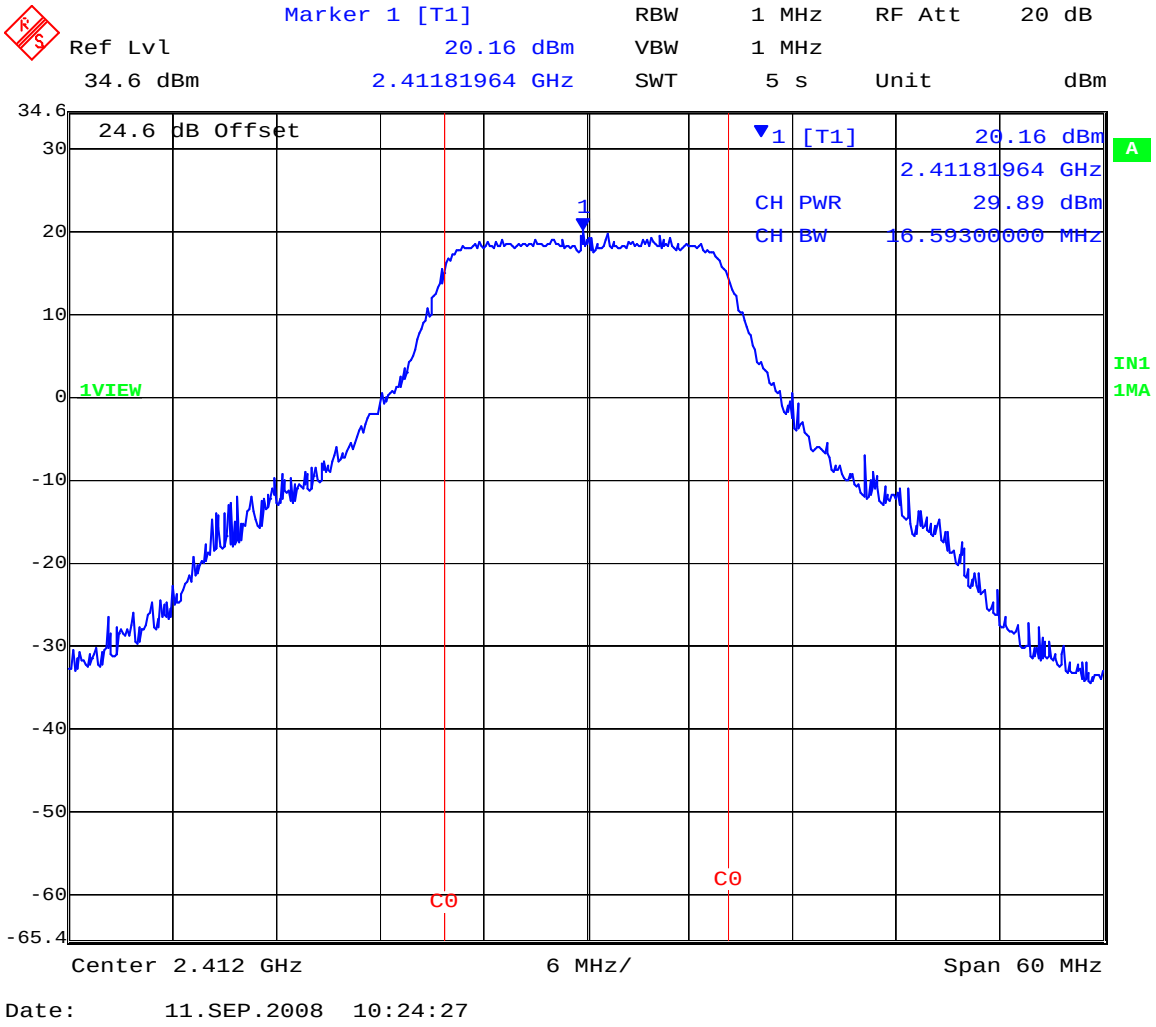
TABLE OF RESULTS – **802.11g – 6Mb/s**

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	99% Measurement Bandwidth (MHz)	Average Power (dBm)	Peak Power (dBm)	EIRP (dBm) 0dBi Antenna
2,412	60	16.593	+20.93	+29.89	+29.89
2,437	60	16.593	+20.50	+29.42	+29.42
2,462	60	16.593	+21.05	+30.00	+30.00

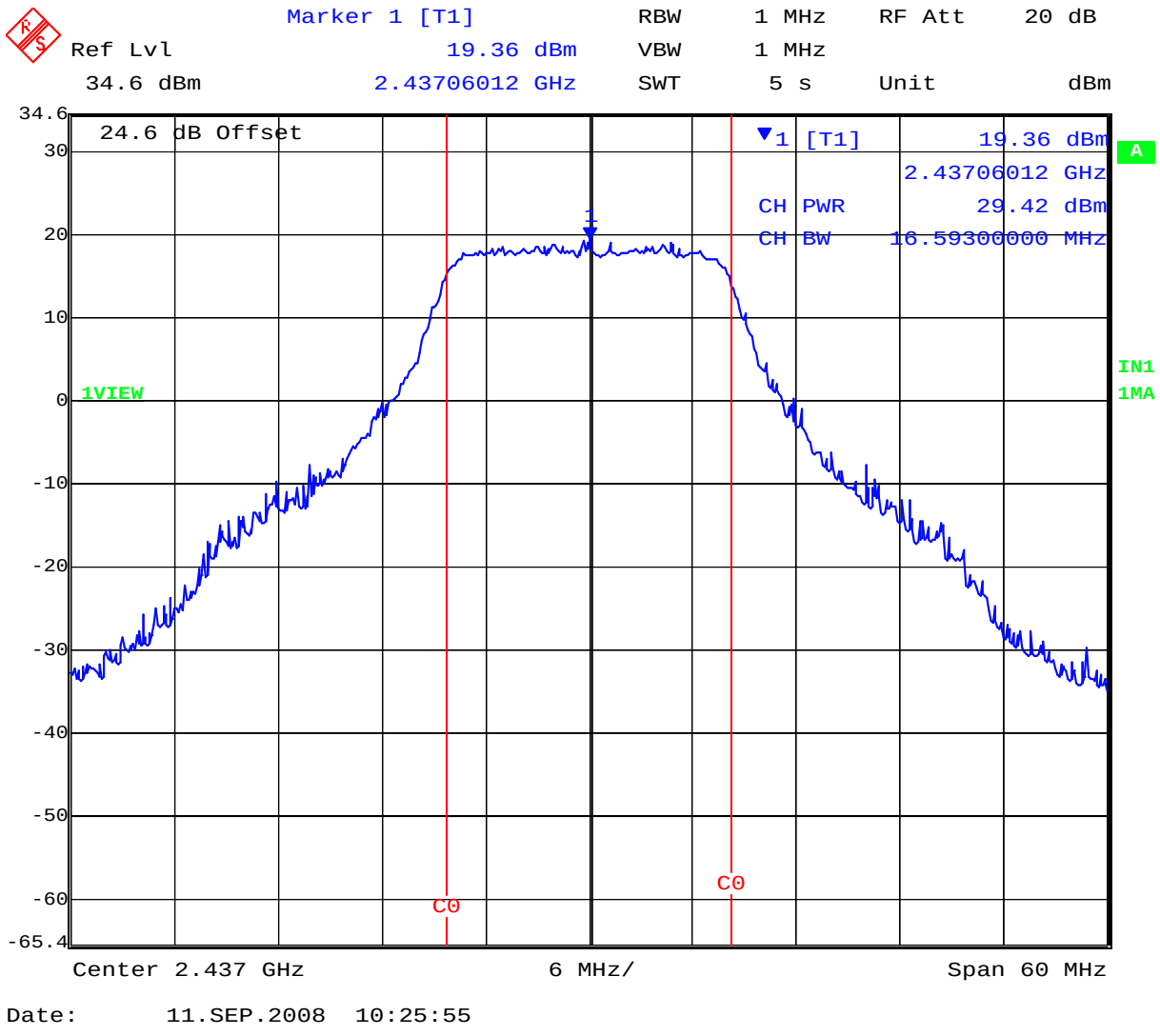
Software Power Setting = 60

2,412 MHz 802.11g Peak Power (dBm)



Software Power Setting = 60

2,437 MHz 802.11g Peak Power (dBm)



Software Power Setting = 60

2,462 MHz 802.11g Peak Power (dBm)

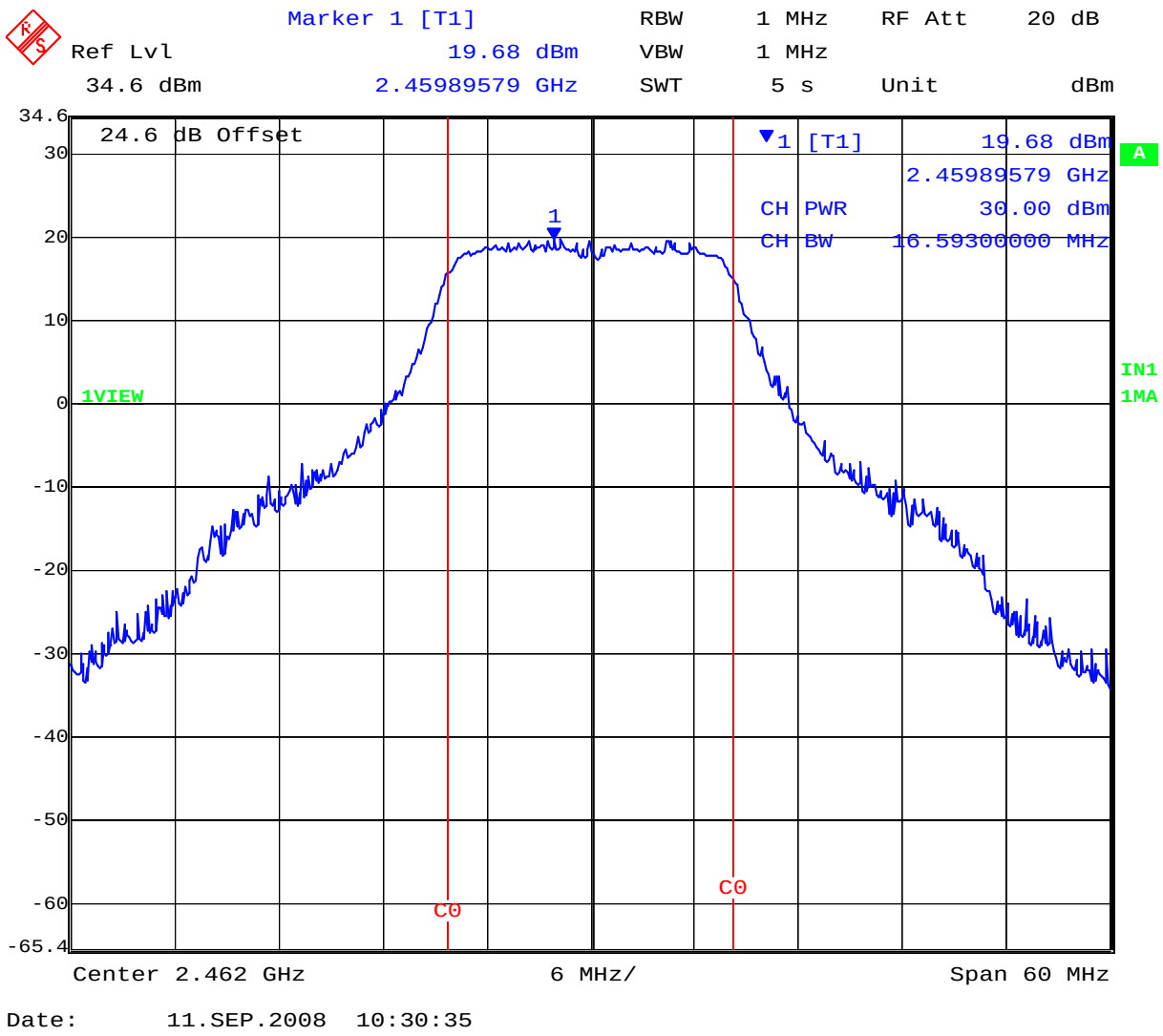


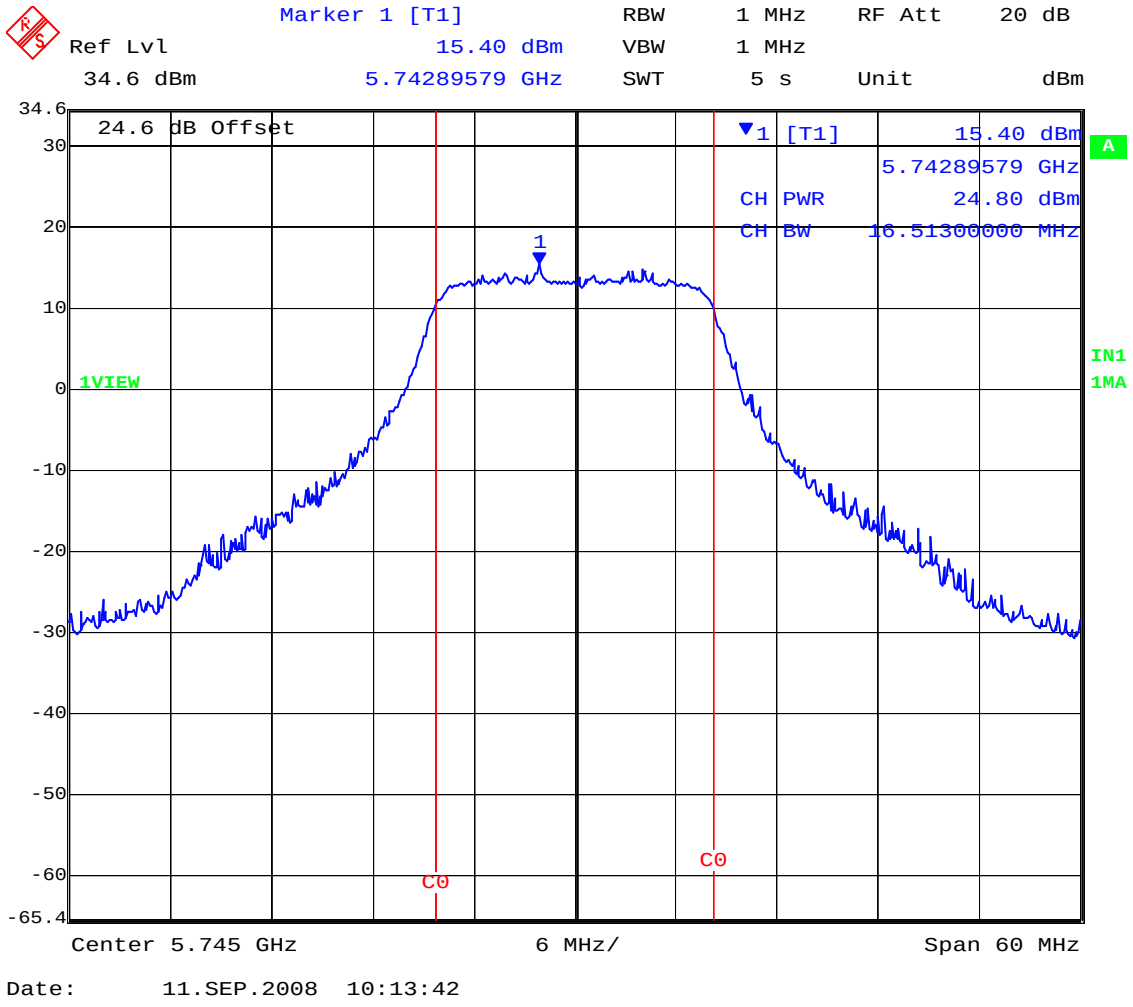
TABLE OF RESULTS – **802.11a – 6 Mb/s**

Maximum Conducted Power

Center Frequency (MHz)	Software Setting	99% Measurement Bandwidth (MHz)	Average Power (dBm)	Peak Power (dBm)	EIRP (dBm) 0dBi Antenna
5,745	60	16.513	+17.12	+24.80	+24.80
5,785	60	16.513	+17.11	+24.78	+24.78
5,825	60	16.513	+17.21	+24.84	+24.84

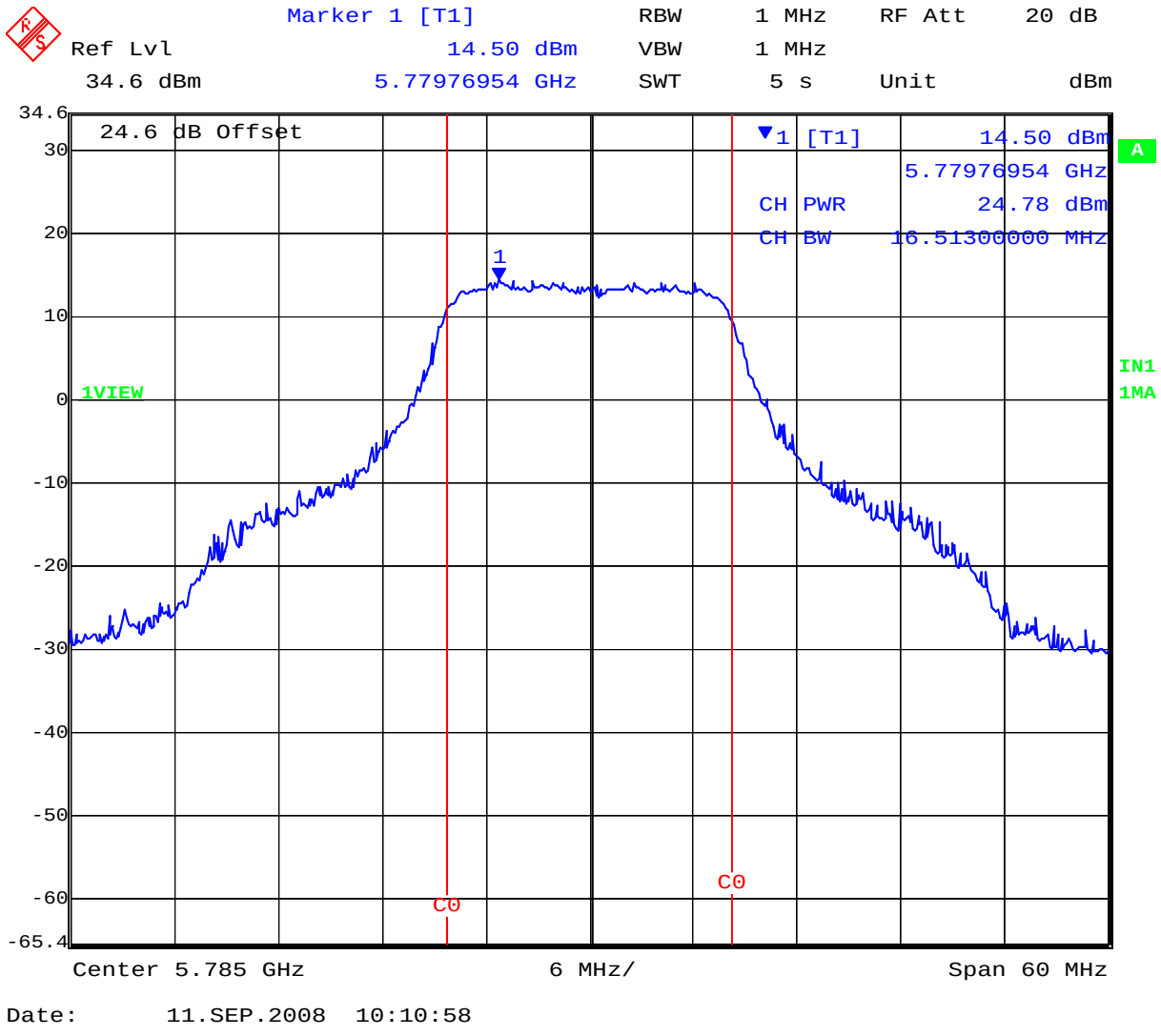
Software Power Setting = 60

5,745 MHz 802.11a Peak Power (dBm)



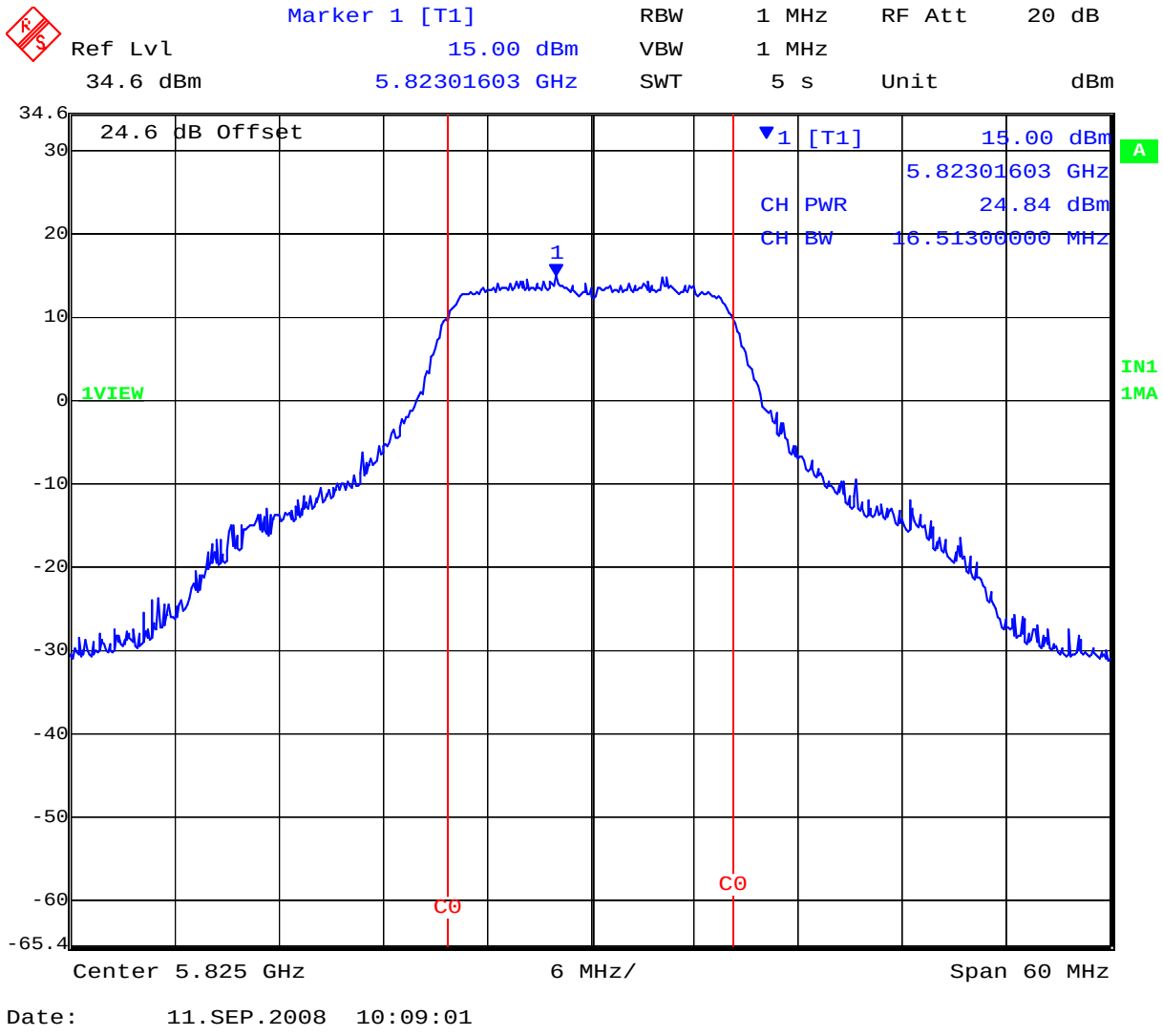
Software Power Setting = 60

5,785 MHz 802.11a Peak Power (dBm)



Software Power Setting = 60

5,825 MHz 802.11a Peak Power (dBm)



Specification

Limits

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

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

15.247 (b) (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

15.247 (c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

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

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

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

Traceability

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

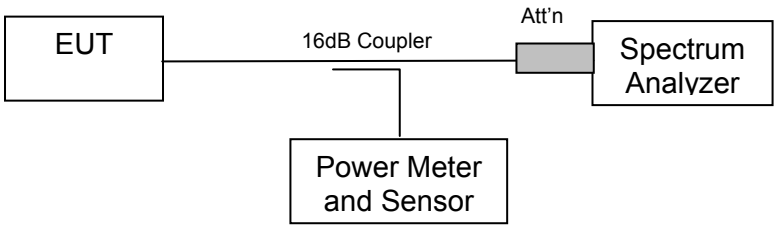
5.1.3. Peak Power Spectral Density

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

Test Procedure

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

Test Measurement Set up



Measurement set up for Peak Power Spectral Density

Measurement Results for Peak Power Spectral Density

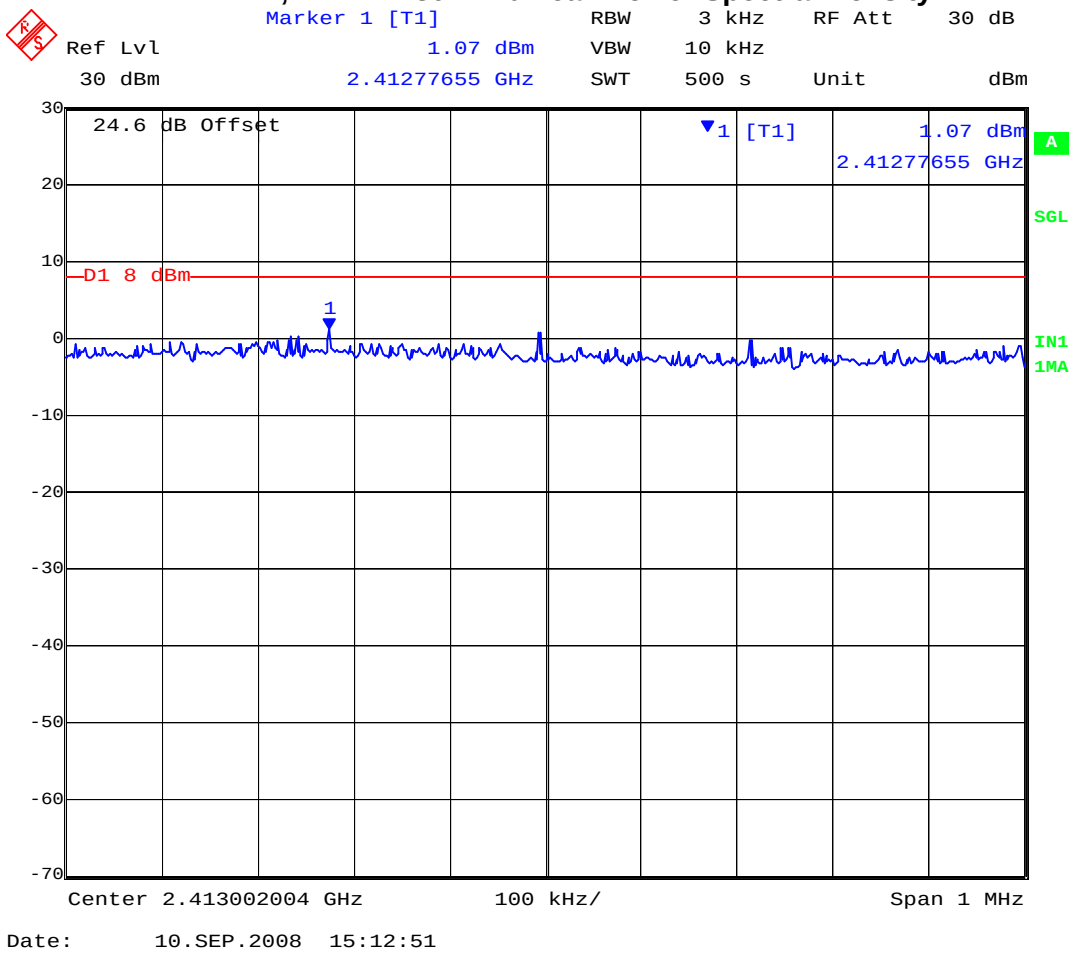
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier

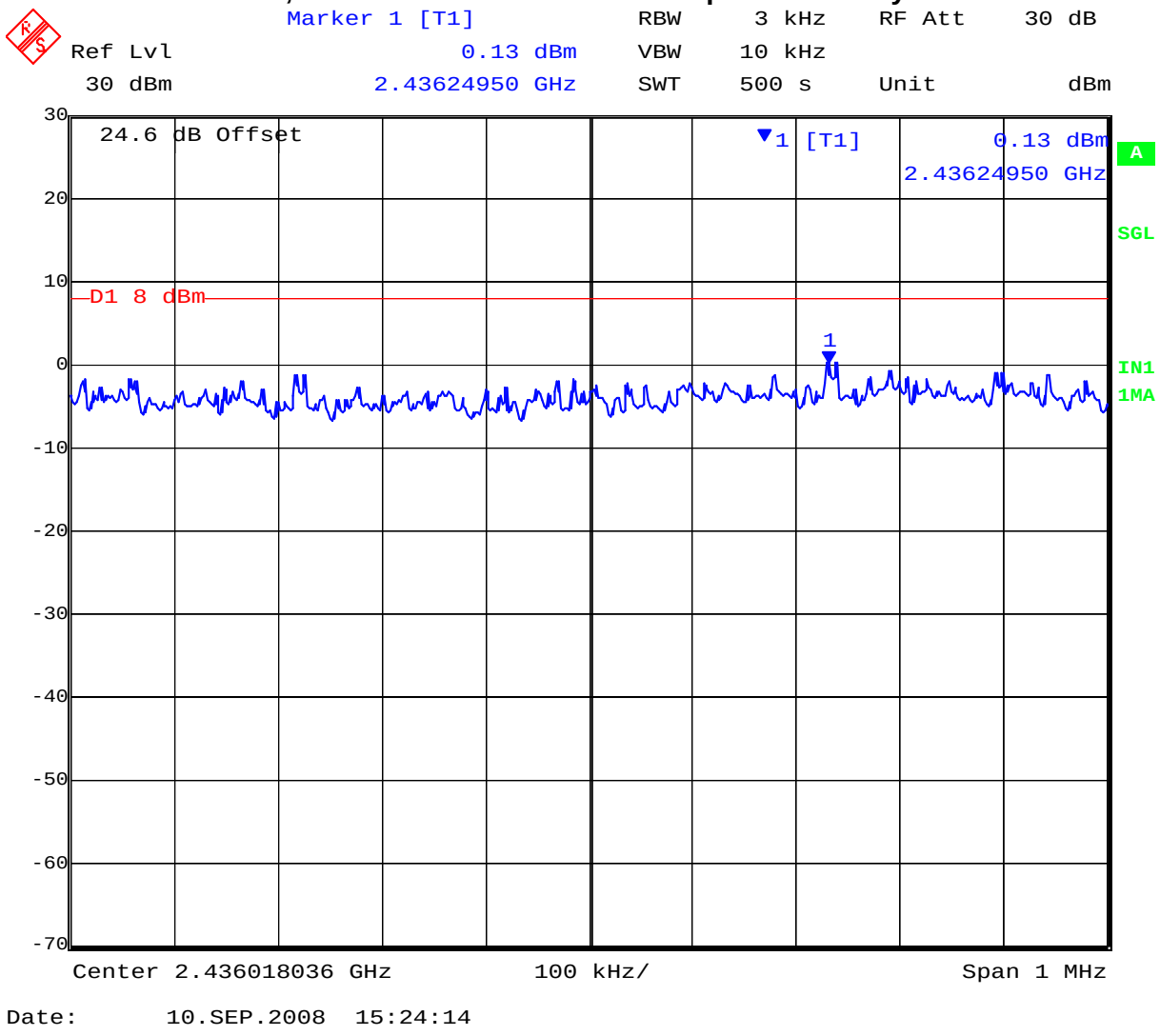
TABLE OF RESULTS – **802.11B – 1MB/S**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2412.77655	+1.07	+8	-6.93
2,437	2436.24950	+0.13	+8	-7.87
2,462	2461.21543	+0.89	+8	-7.11

2,412 MHz 802.11b Peak Power Spectral Density



2,437 MHz 802.11b Peak Power Spectral Density



2,462 MHz 802.11b Peak Power Spectral Density

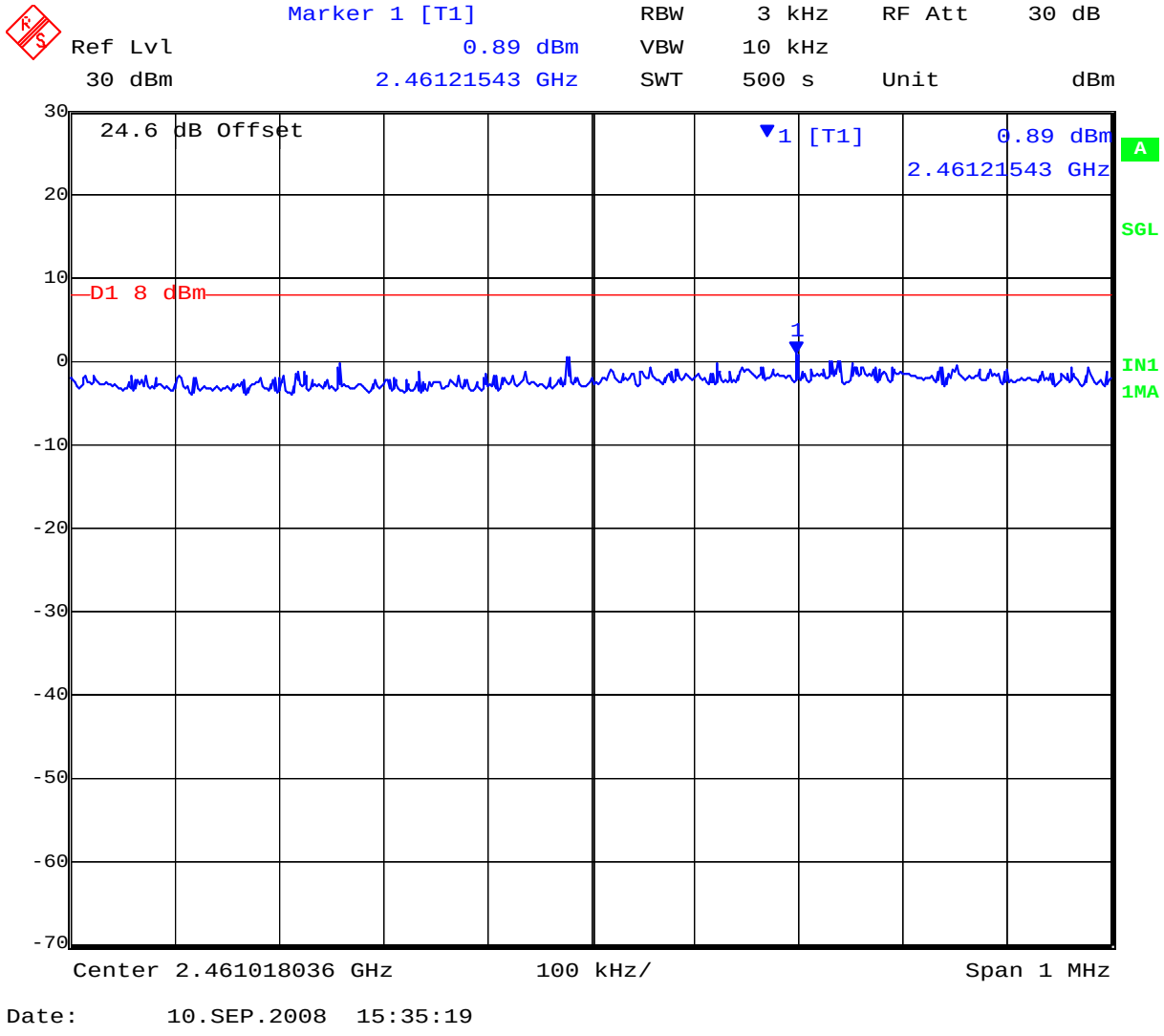
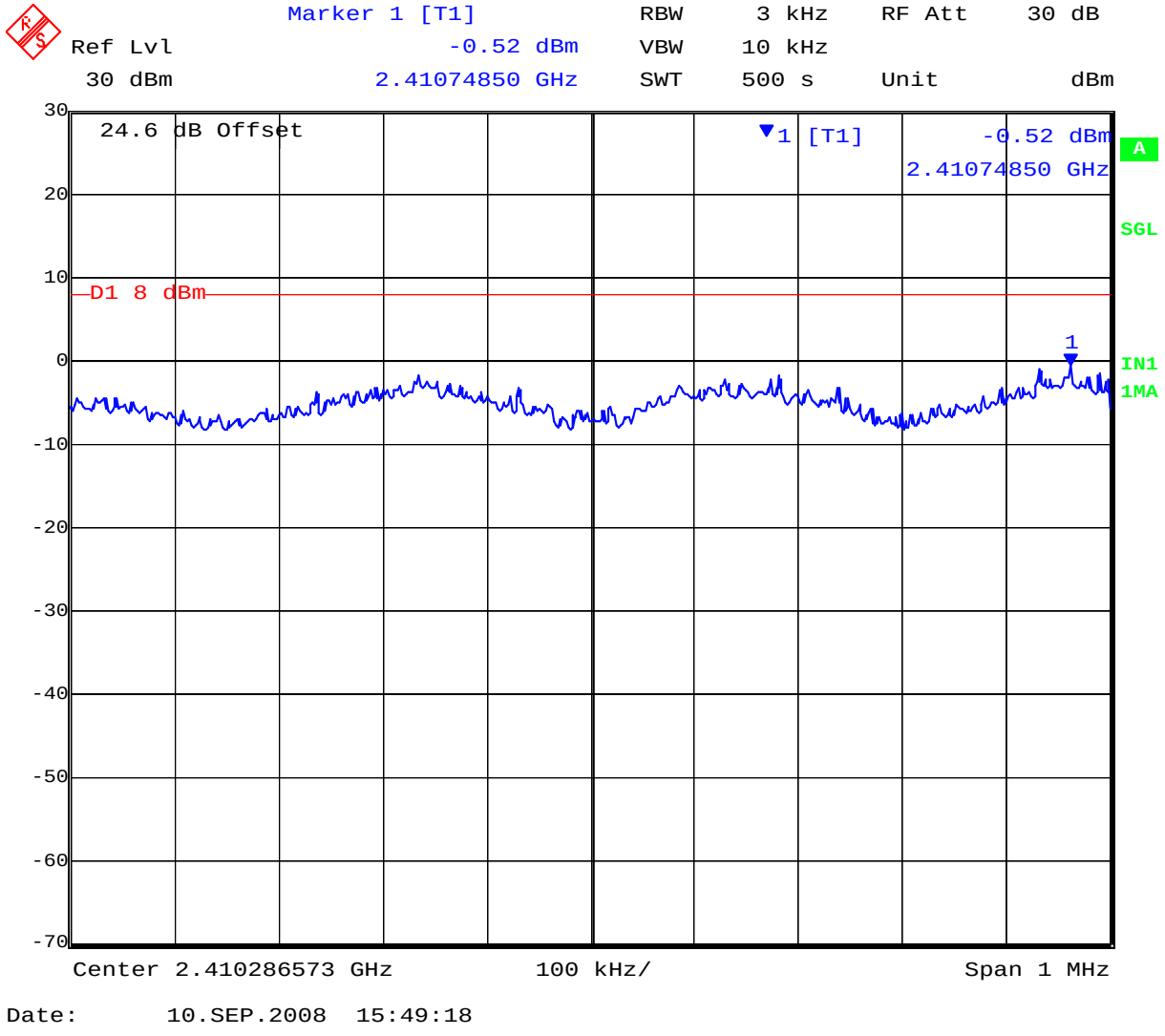


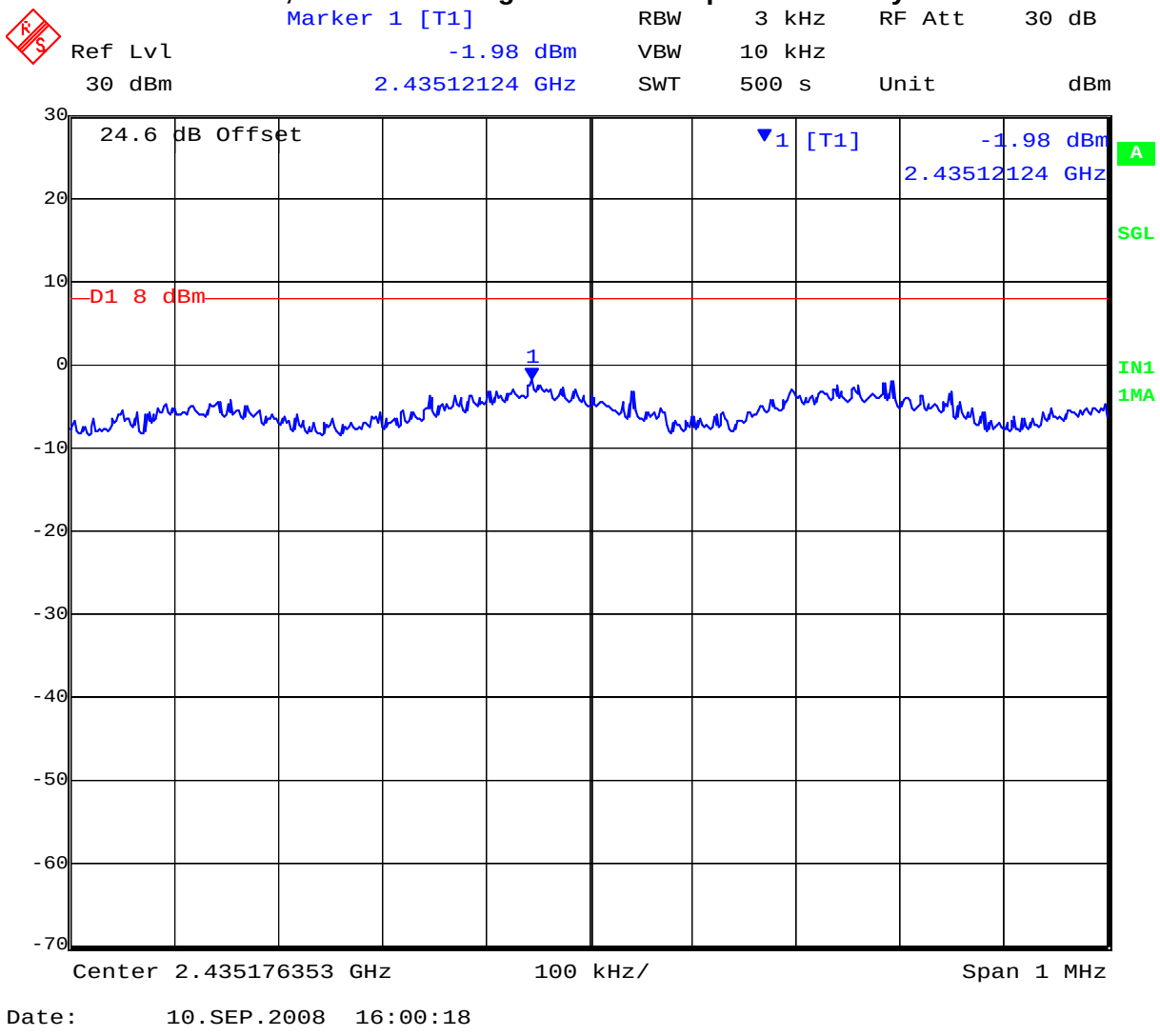
TABLE OF RESULTS – **802.11g – 6 Mb/s**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2410.74850	-0.52	+8	-8.52
2,437	2435.12124	-1.98	+8	-9.98
2,462	2460.12124	-2.06	+8	-10.06

2,412 MHz 802.11g Peak Power Spectral Density



2,437 MHz 802.11g Peak Power Spectral Density



2,462 MHz 802.11g Peak Power Spectral Density

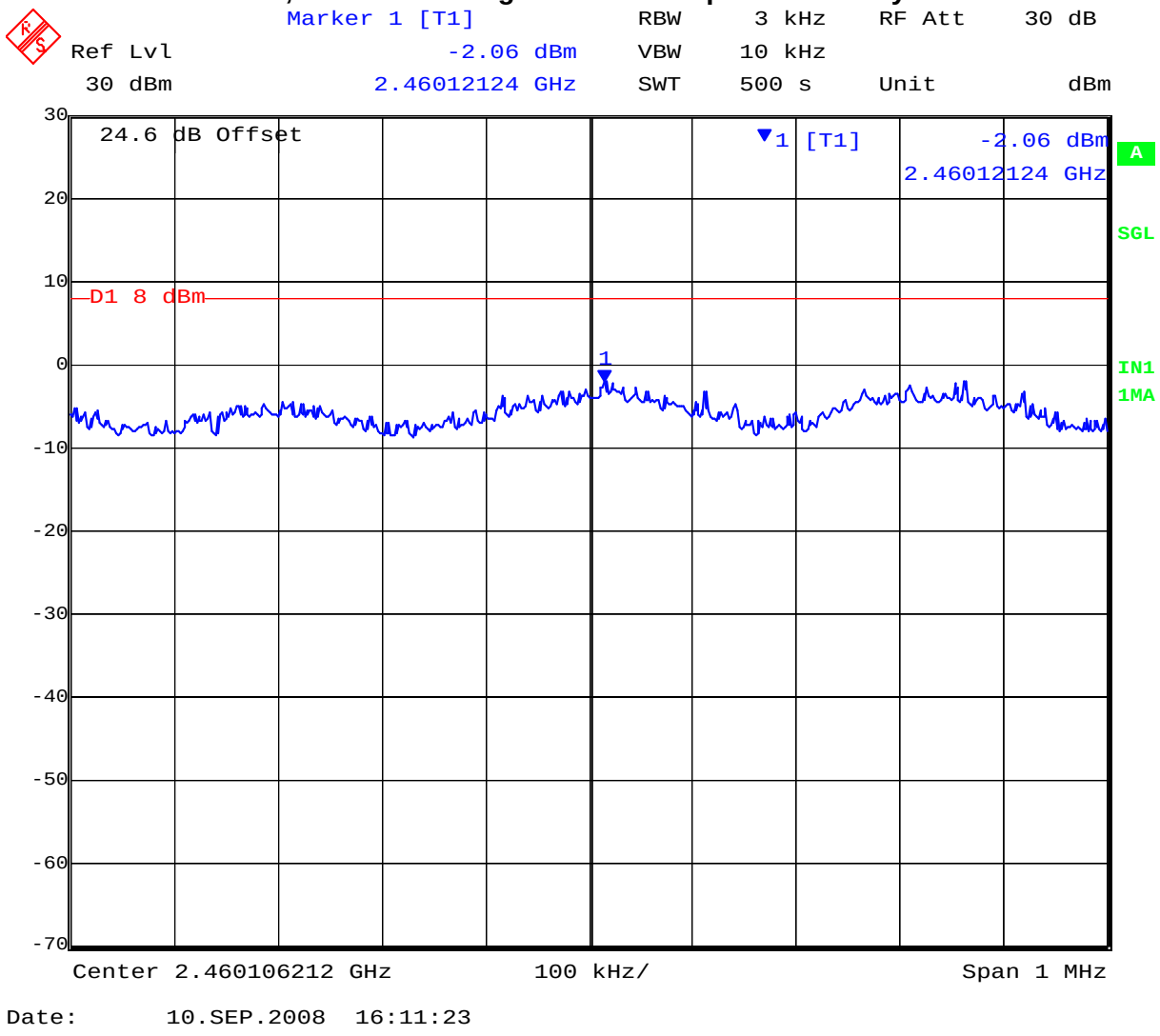
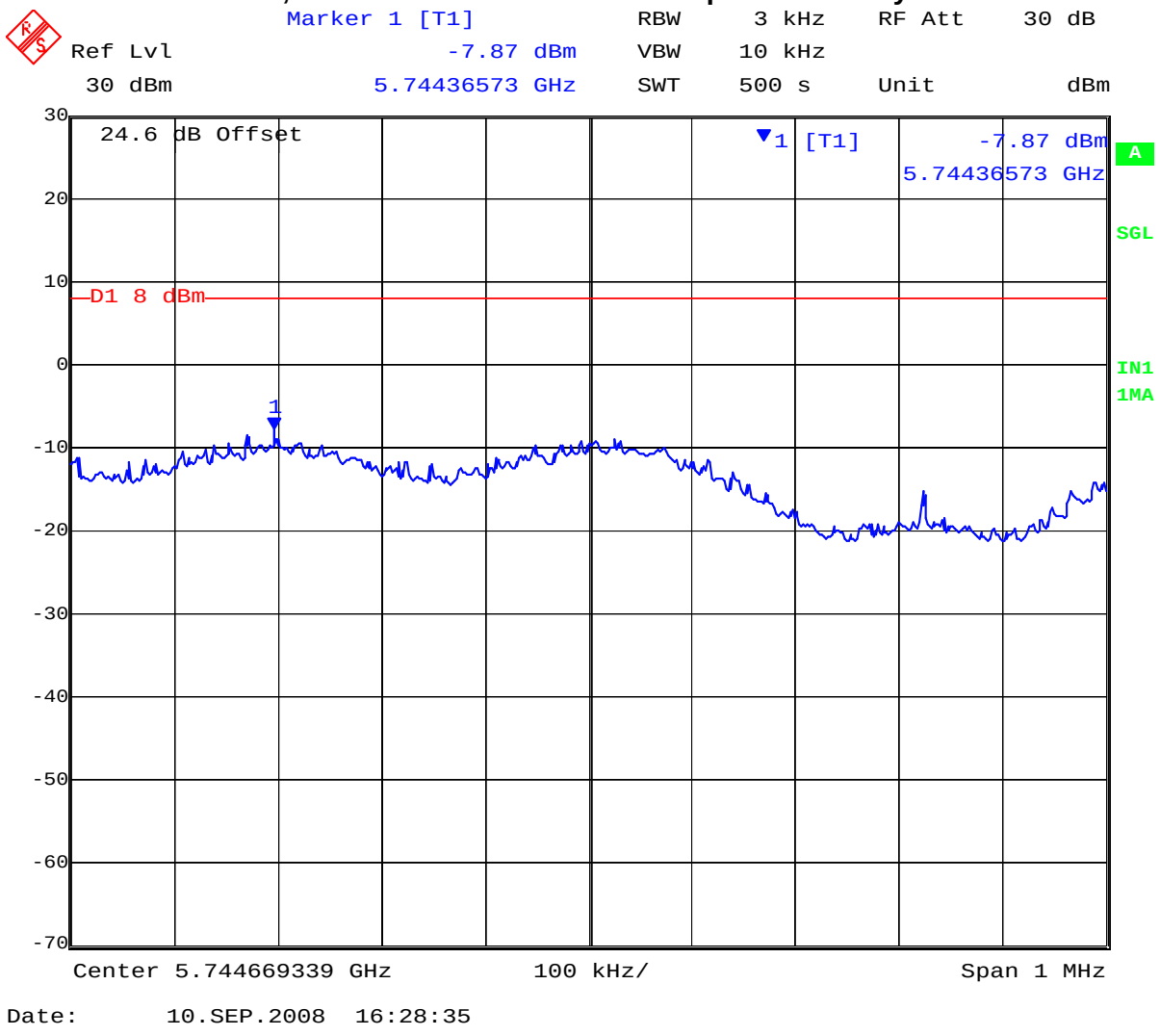


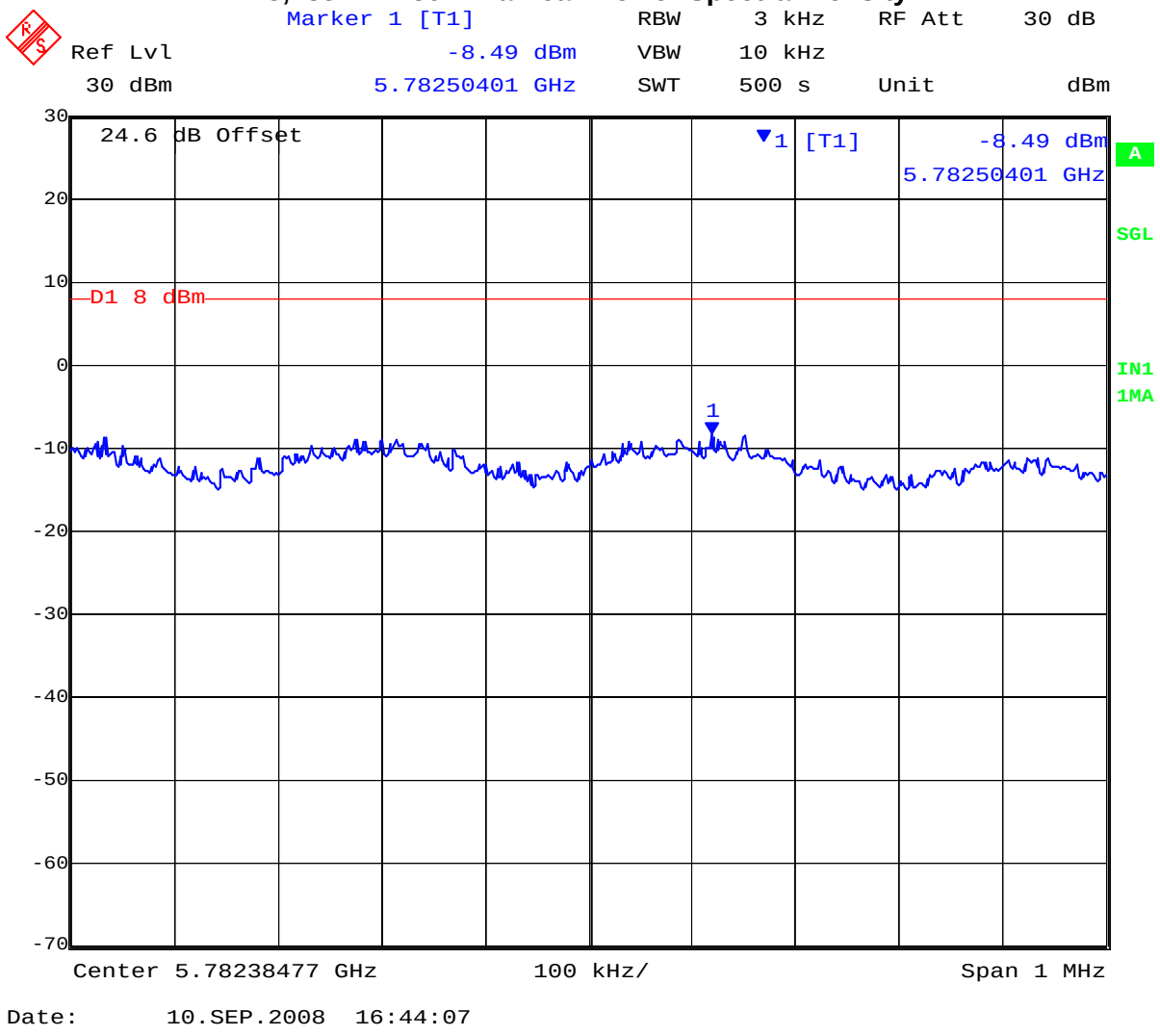
TABLE OF RESULTS – **802.11a – 6Mbit/s**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
5,745	5744.36573	-7.87	+8	-15.87
5,785	5782.50401	-8.49	+8	-16.49
5,825	5829.36172	-8.06	+8	-16.08

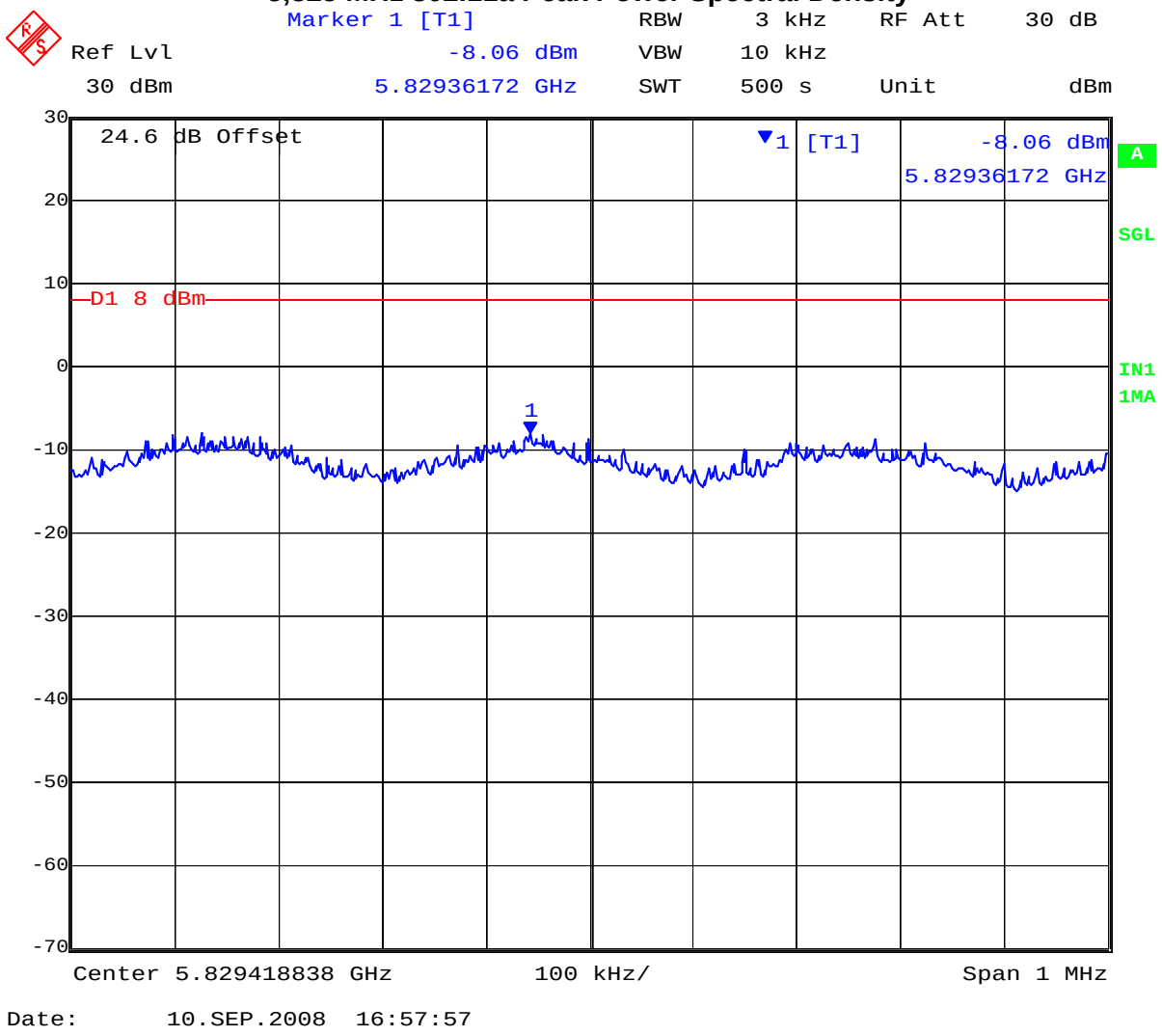
5,745 MHz 802.11a Peak Power Spectral Density



5,785 MHz 802.11a Peak Power Spectral Density



5,825 MHz 802.11a Peak Power Spectral Density



Specification
Peak Power Spectral Density Limits

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

Laboratory Measurement Uncertainty for Spectral Density

Measurement uncertainty	±1.33 dB

Traceability

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

5.1.4. Maximum Permissible Exposure

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

Calculations for Maximum Permissible Exposure Levels

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

EIRP = P * G

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

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

The Aruba AP-85FX has two transmitters. The peak power in the table below is calculated by assuming a worst case scenario where the two transmitters are operating simultaneously in the same band. The Peak Power in mW is calculated by taking the maximum allowable conducted power in each band and multiplying by 2.

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

Freq. Band (GHz)	Antenna Gain (dBi)	Numeric Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated Safe Distance @ 1mW/cm^2 Limit(cm)	Minimum Separation Distance (cm)
2.4(b)	18	63.10	+18.0	126.2	25.2	25.2
2.4(g)	18	63.10	+18.0	126.2	25.2	25.2
5.8	16	39.81	+20.0	200.0	25.2	25.2

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

Specification

Maximum Permissible Exposure Limits

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

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

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

Laboratory Measurement Uncertainty for Power Measurements

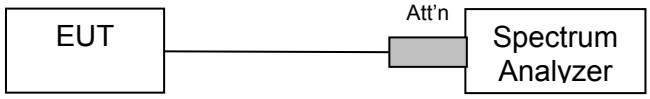
Measurement uncertainty	±1.33 dB

5.1.5. Conducted Spurious Emissions

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

Test Procedure
Conducted emissions were measured at a limit of 20 dB below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Emissions at the band edge were measured and recorded. Measurements were made while EUT was operating in transmit mode of operation at the appropriate center frequency.

Test Measurement Set up



Band-edge measurement test configuration

Measurement Results of Conducted Spurious Emissions

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

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier

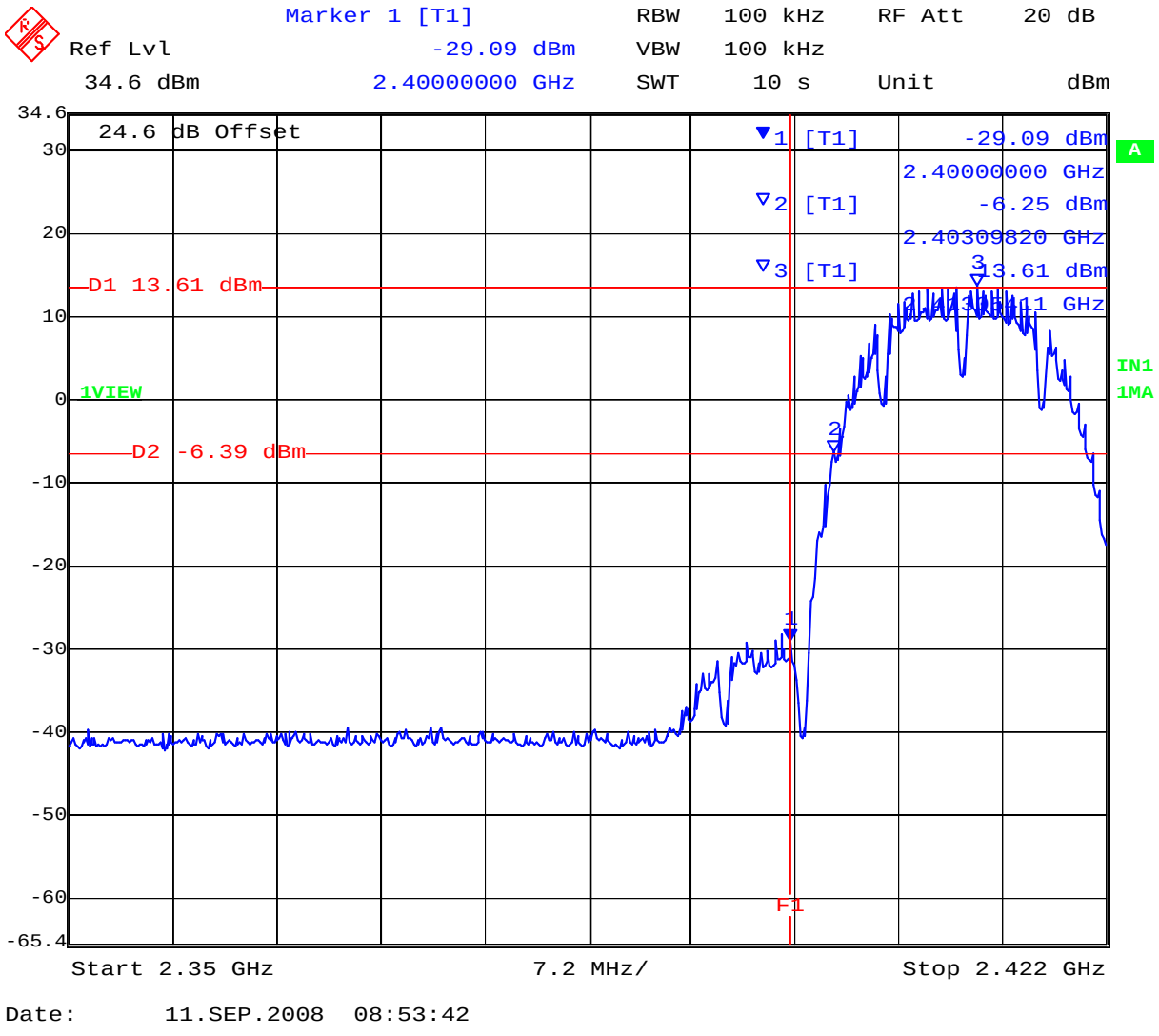
Conducted Band-Edge Results

Measurements were performed with the transmitter tuned to the channel closest to the band-edge being measured. All emissions were maximized during measurement. Limits which were derived from the band-edge measurements provided below are drawn on each plot.

TABLE OF RESULTS – **802.11b – 1 Mbit/s**

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
2,412	2,400	-6.39	-29.09	-22.70
2,462	2,483.5	-6.58	-41.91	-35.33

Conducted Spurious Emissions at the 2,400 MHz Band Edge



Conducted Spurious Emissions at the 2,483.5 MHz Band Edge

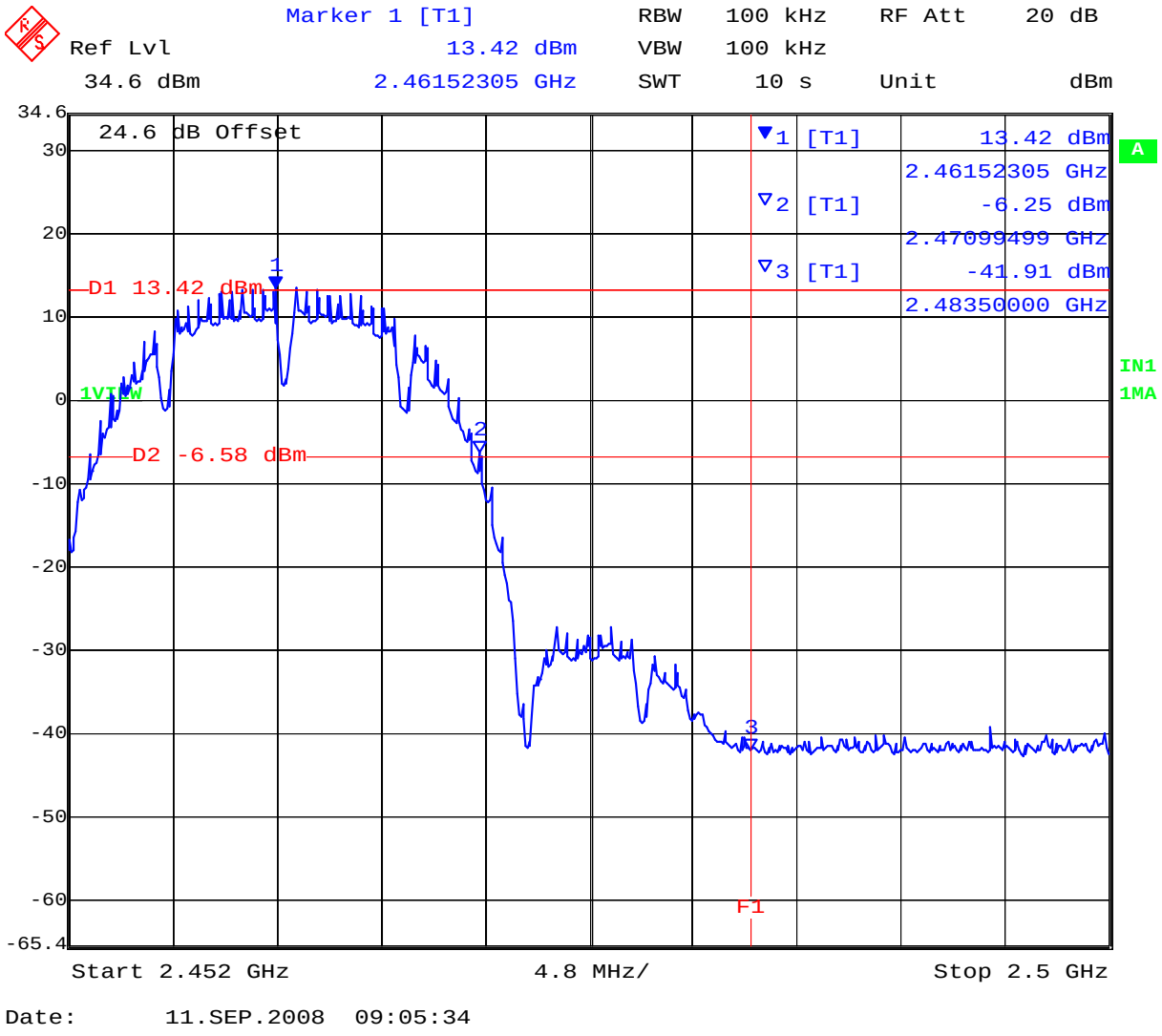
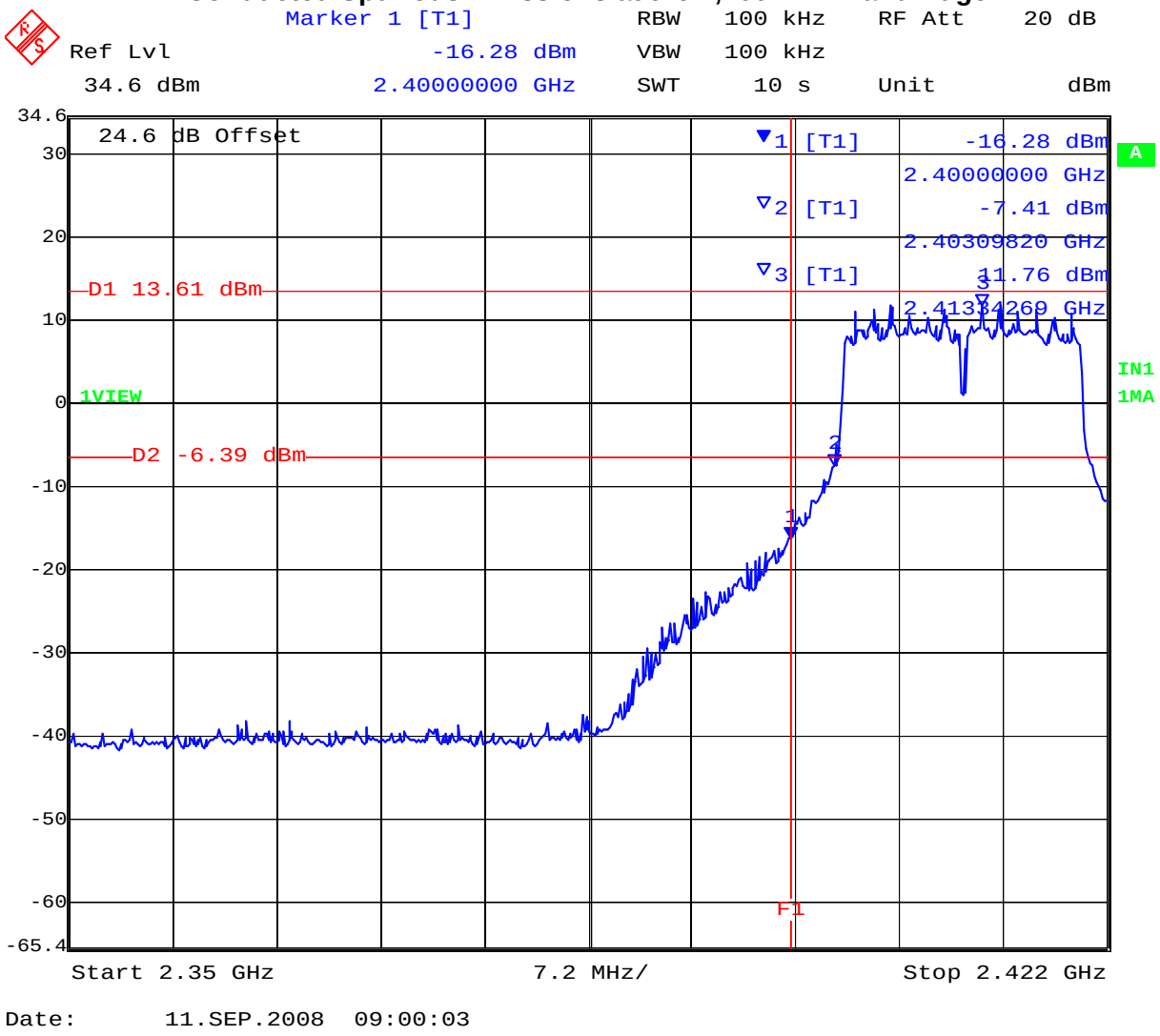


TABLE OF RESULTS – **802.11g – 6 Mbit/s**

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
2,412	2,400	-6.39	-16.28	-9.89
2,462	2,483.5	-8.62	-32.36	-23.74

Conducted Spurious Emissions at the 2,400 MHz Band Edge



Conducted Spurious Emissions at the 2,483.5 MHz Band Edge

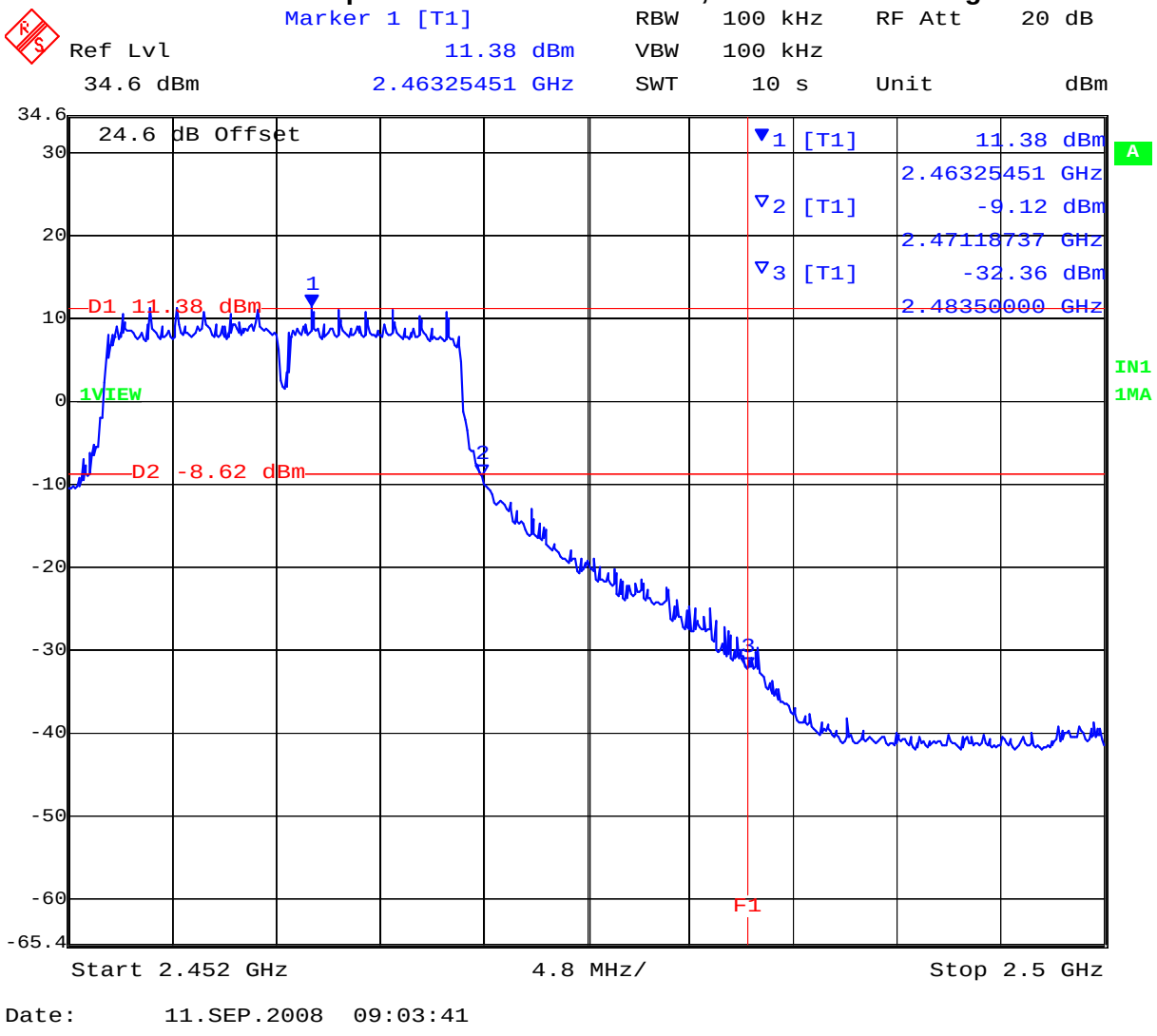
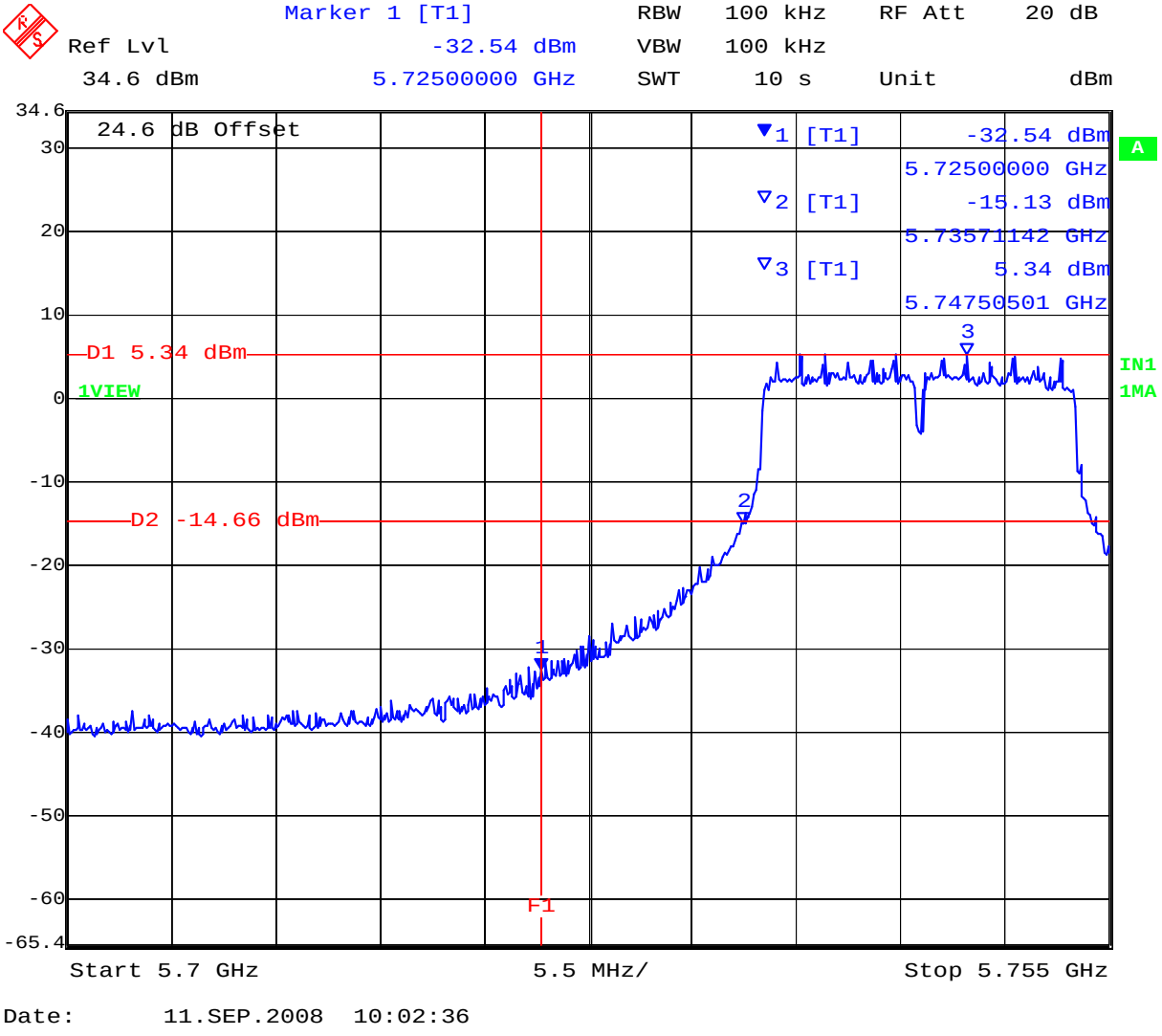


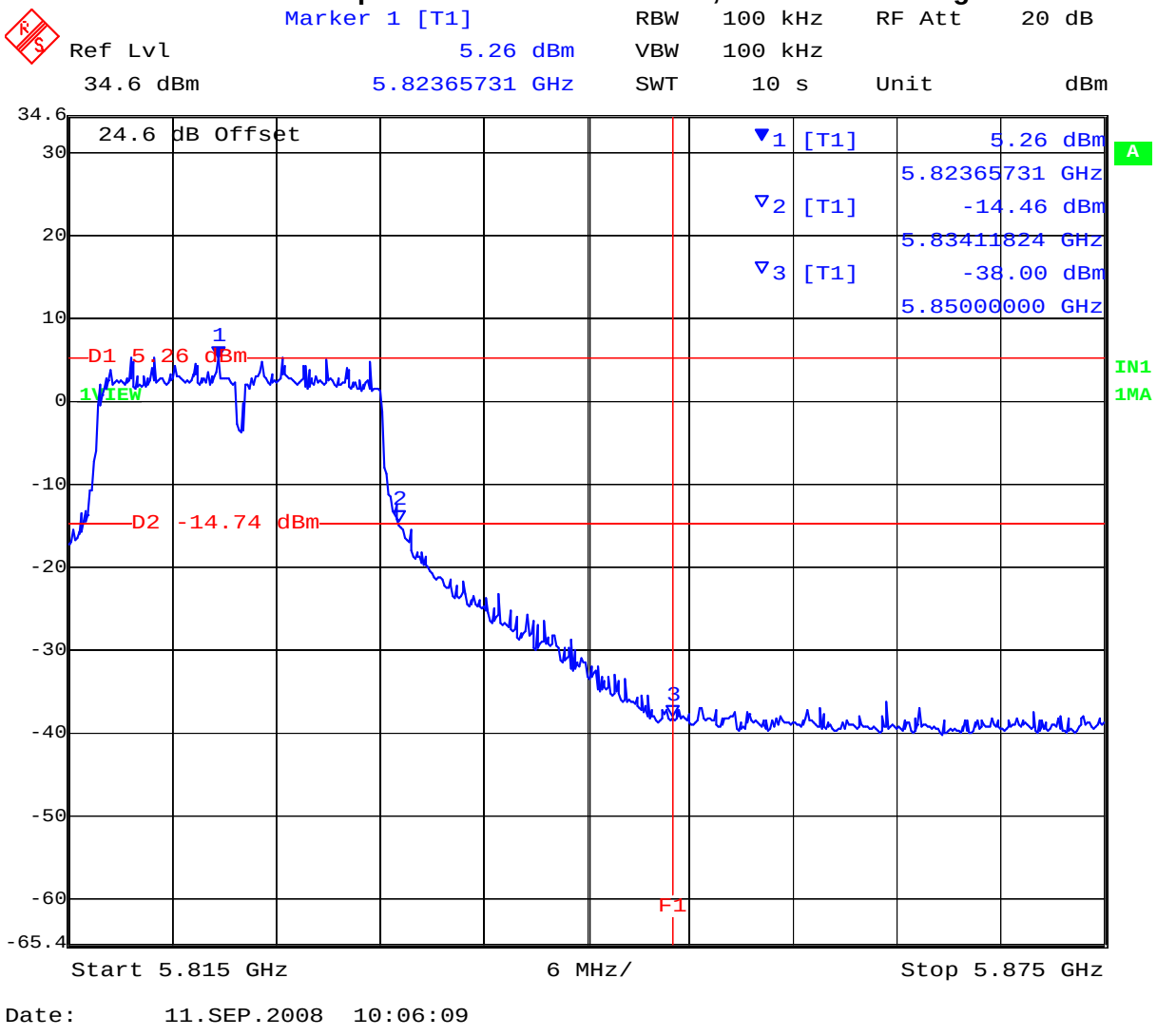
TABLE OF RESULTS – **802.11a – 6Mbit/s**

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band edge (dBm)	Margin (dB)
5,745	5,725	-14.66	-32.54	-17.88
5,825	5,850	-14.74	-38.00	-23.26

Conducted Spurious Emissions at the 5,725 MHz Band Edge



Conducted Spurious Emissions at the 5,850 MHz Band Edge



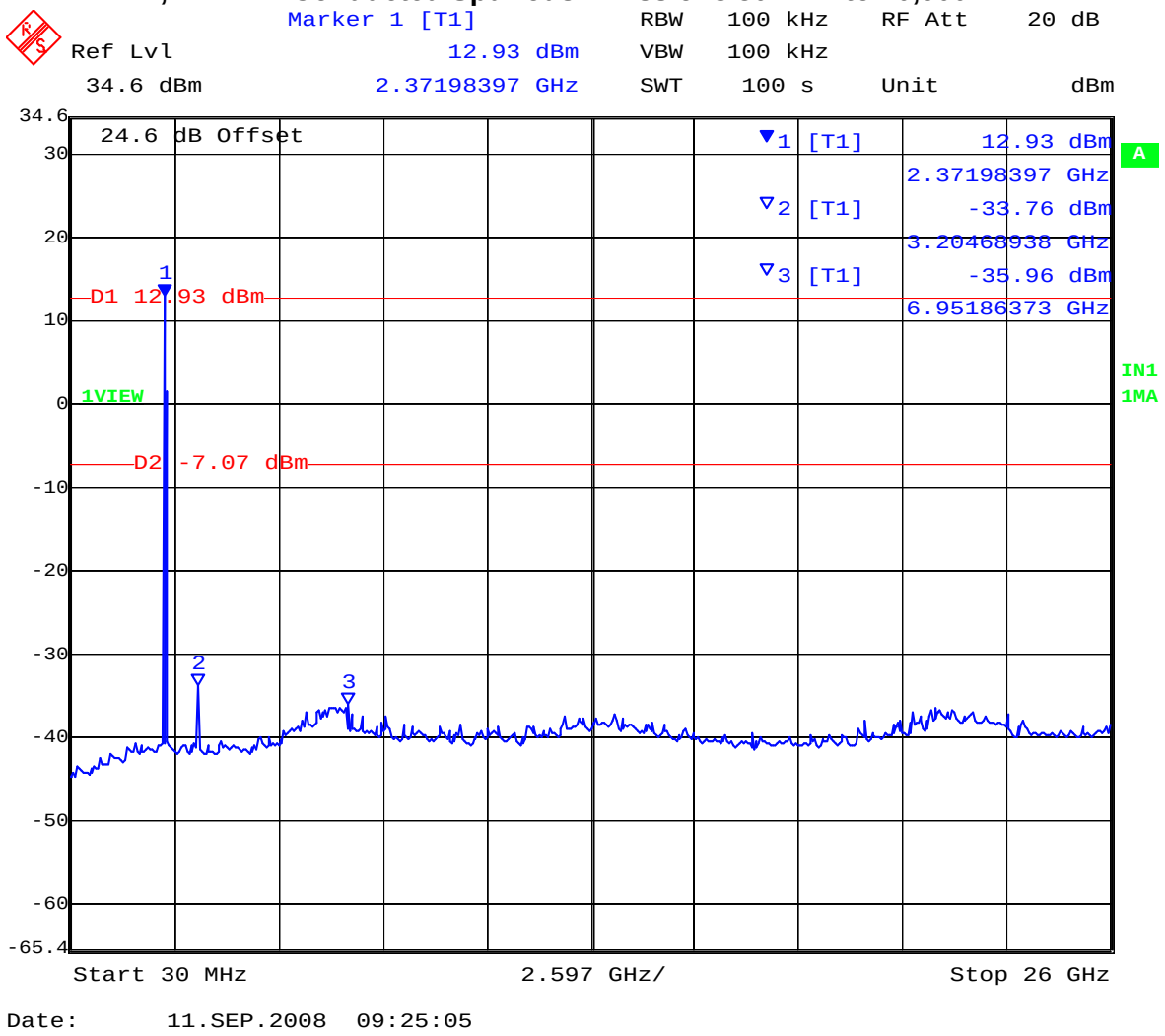
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – **802.11b – 1 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,412	30	40,000	-33.76	-7.07	-26.69

802.11b – 1 Mbit/s

2,412 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



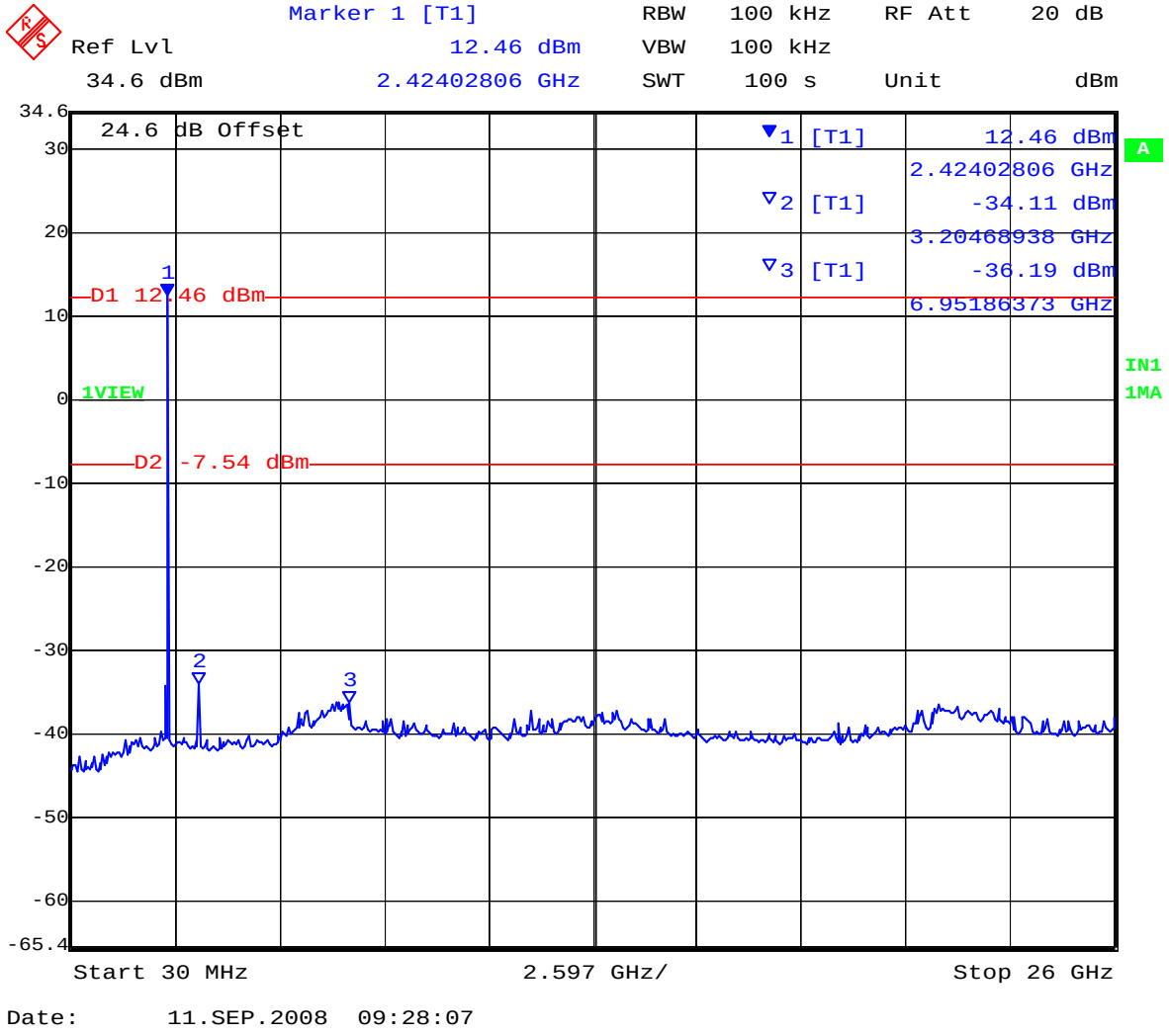
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – **802.11b – 1 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,437	30	40,000	-34.11	-7.54	-26.57

802.11b – 1 Mbit/s

2,437 **MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz**



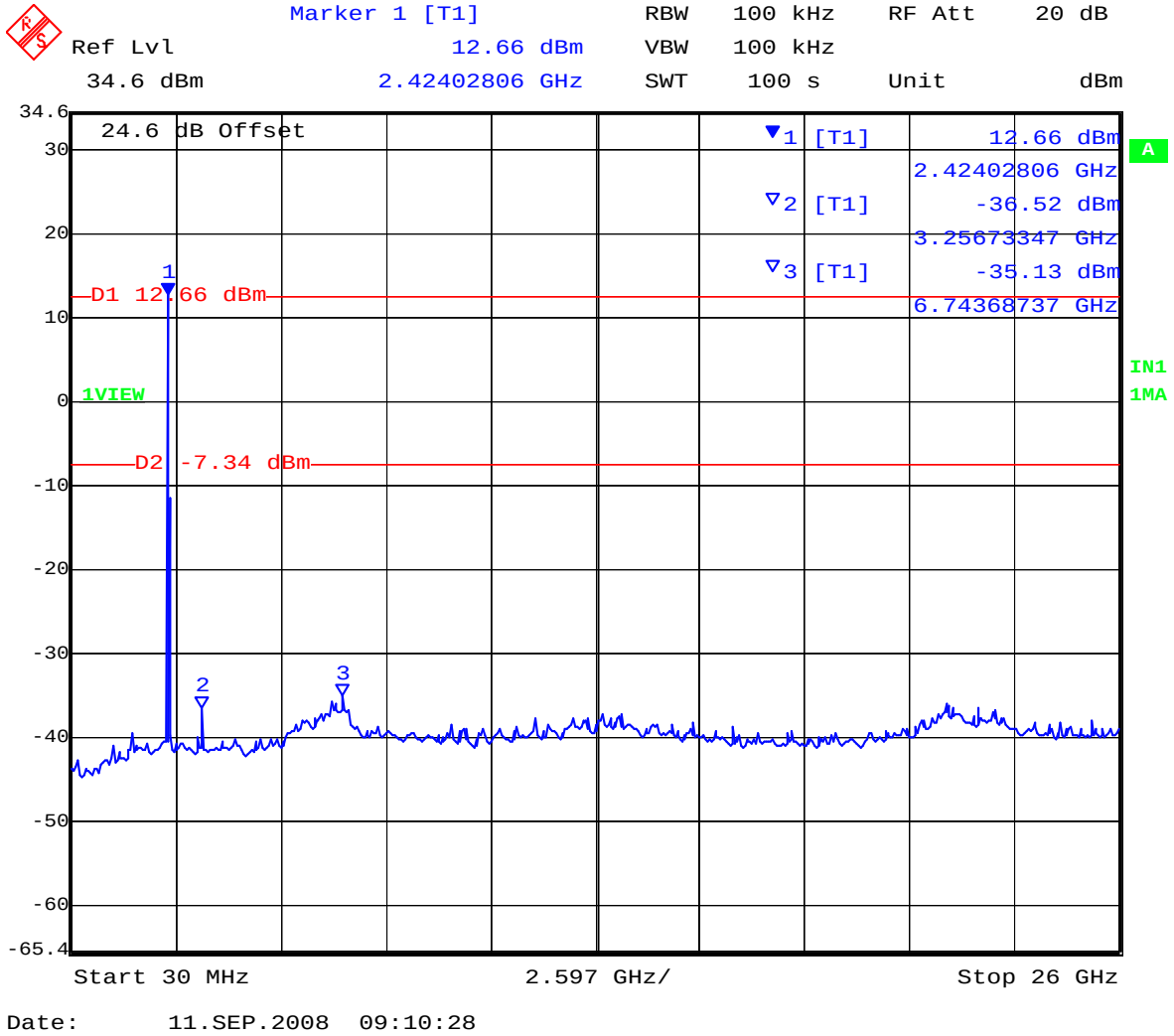
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – **802.11b – 1 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,462	30	40,000	-35.13	-7.34	-27.79

802.11b – 1 Mbit/s

2,462 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



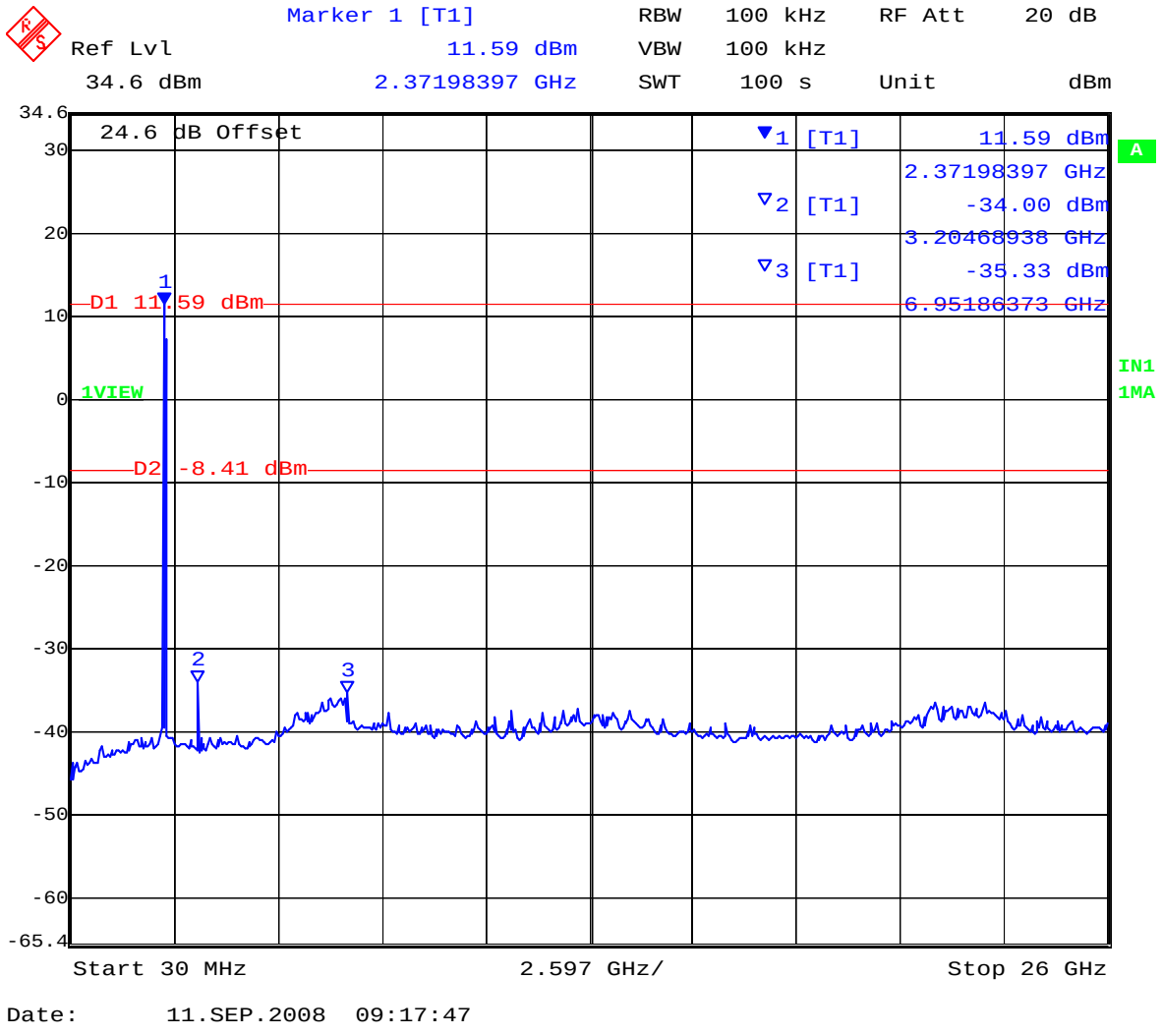
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – **802.11g – 6 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,412	30	40,000	-34.00	-8.41	-25.59

802.11g – 6 Mbit/s

2,412 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



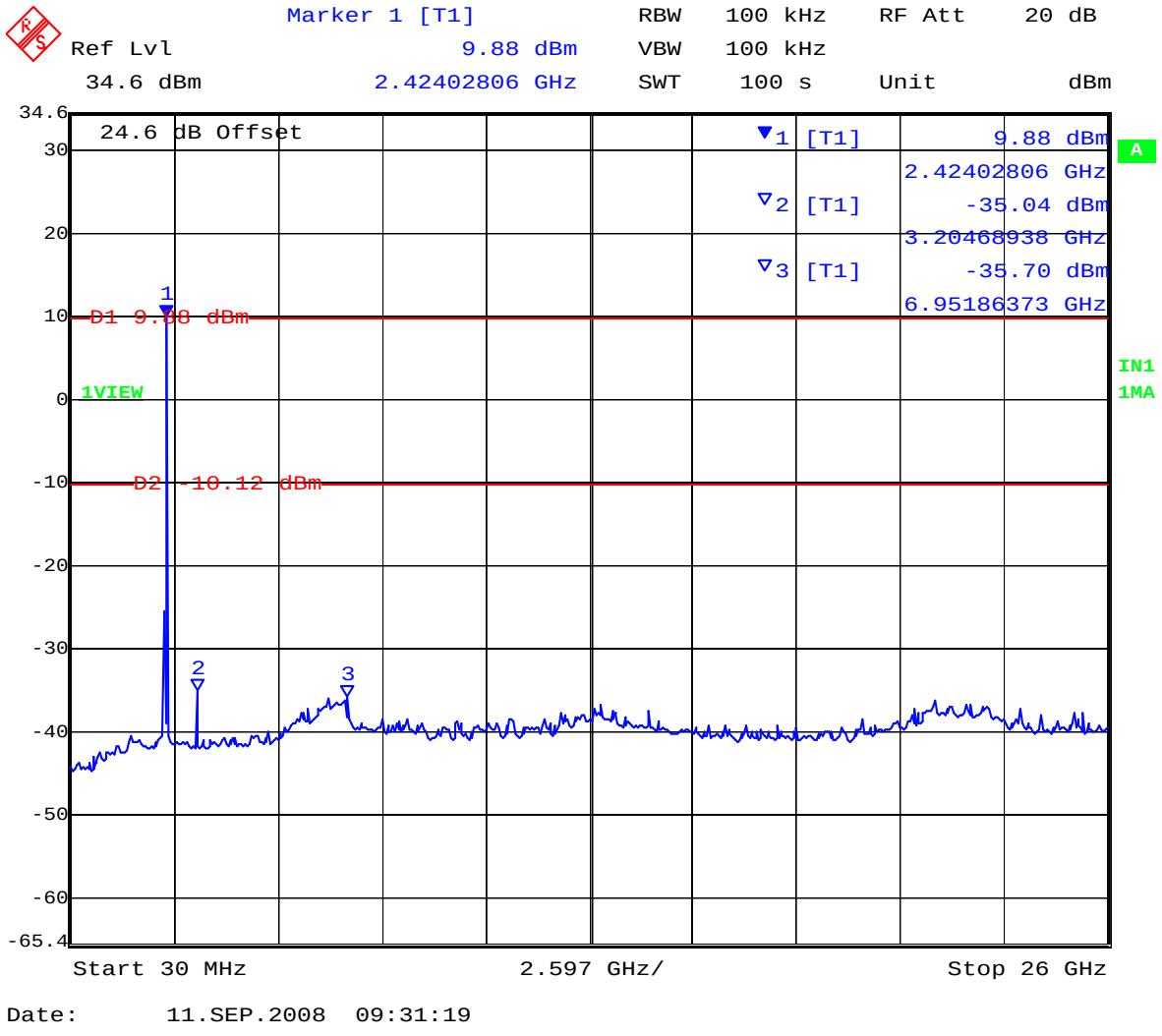
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – **802.11g – 6 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,437	30	40,000	-35.04	-10.12	-24.92

802.11g – 6 Mbit/s

2,437 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



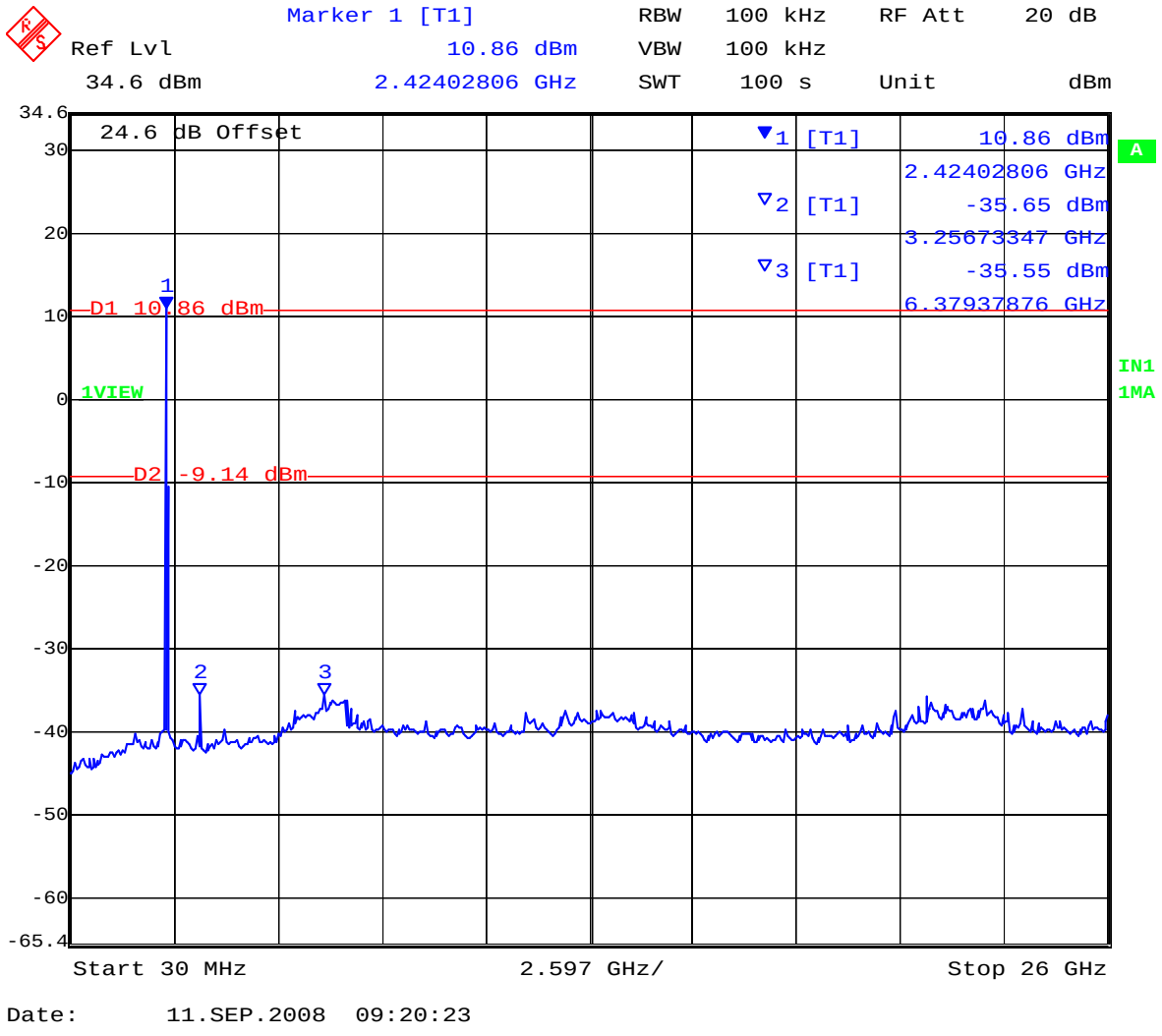
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – **802.11g – 6 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
2,462	30	40,000	-35.55	-9.14	-26.41

802.11g – 6 Mbit/s

2,462 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



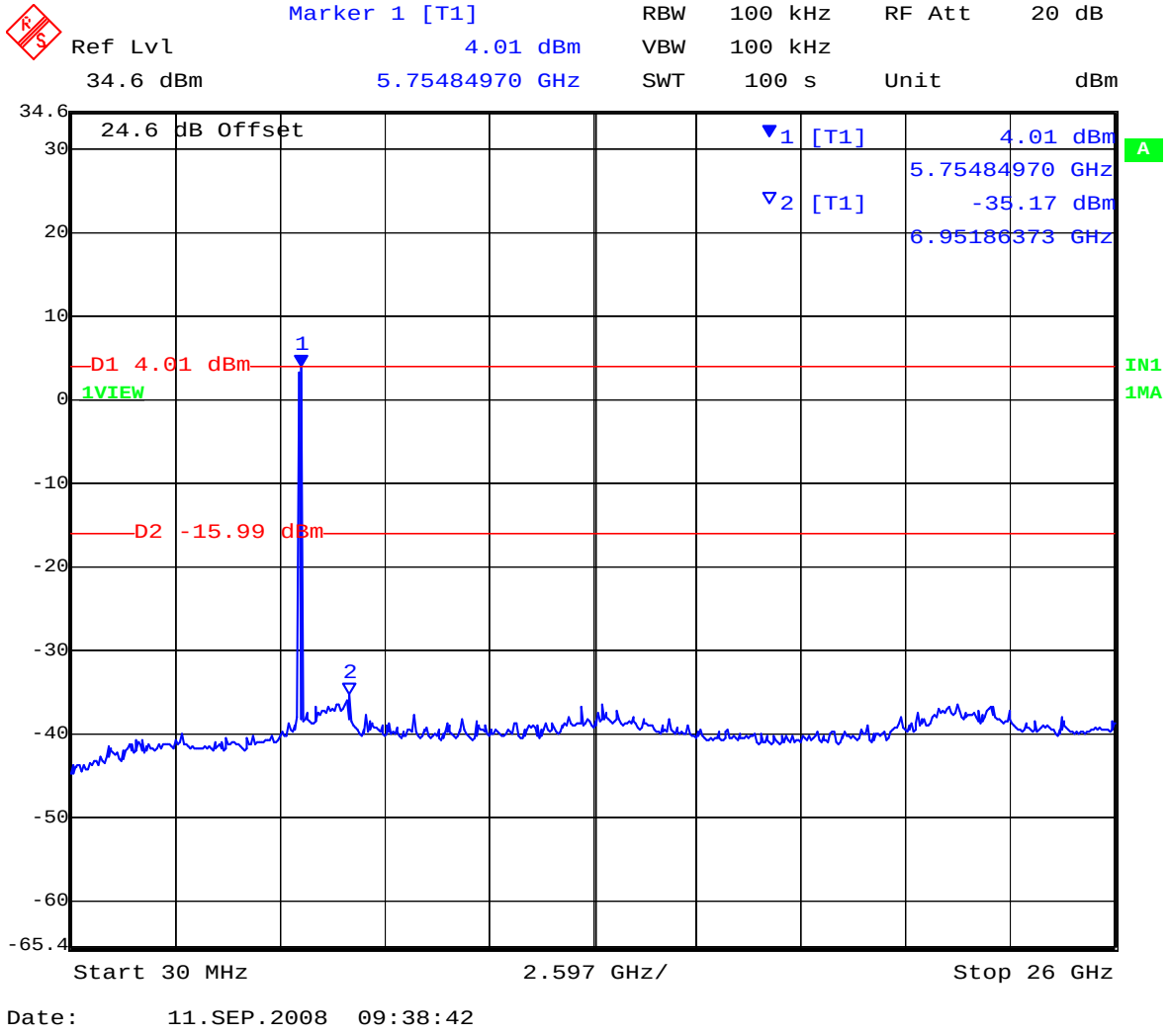
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – **802.11a – 6 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
5,745	30	40,000	-35.17	-15.99	-19.18

802.11a – 6 Mbit/s

5,745 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



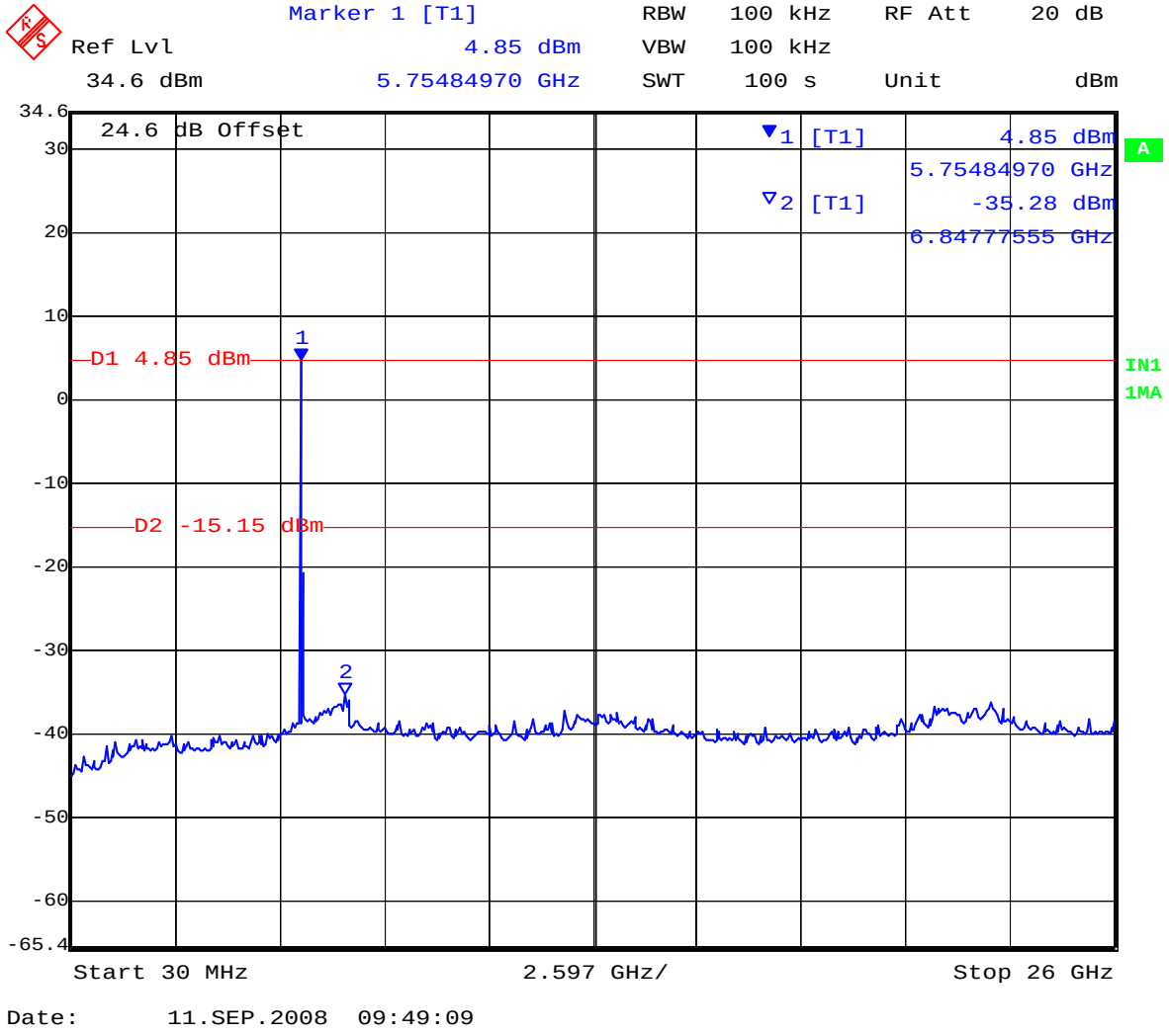
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – **802.11a – 6 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
5,785	30	40,000	-35.28	-15.15	-20.13

802.11a – 6 Mbit/s

5,785 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



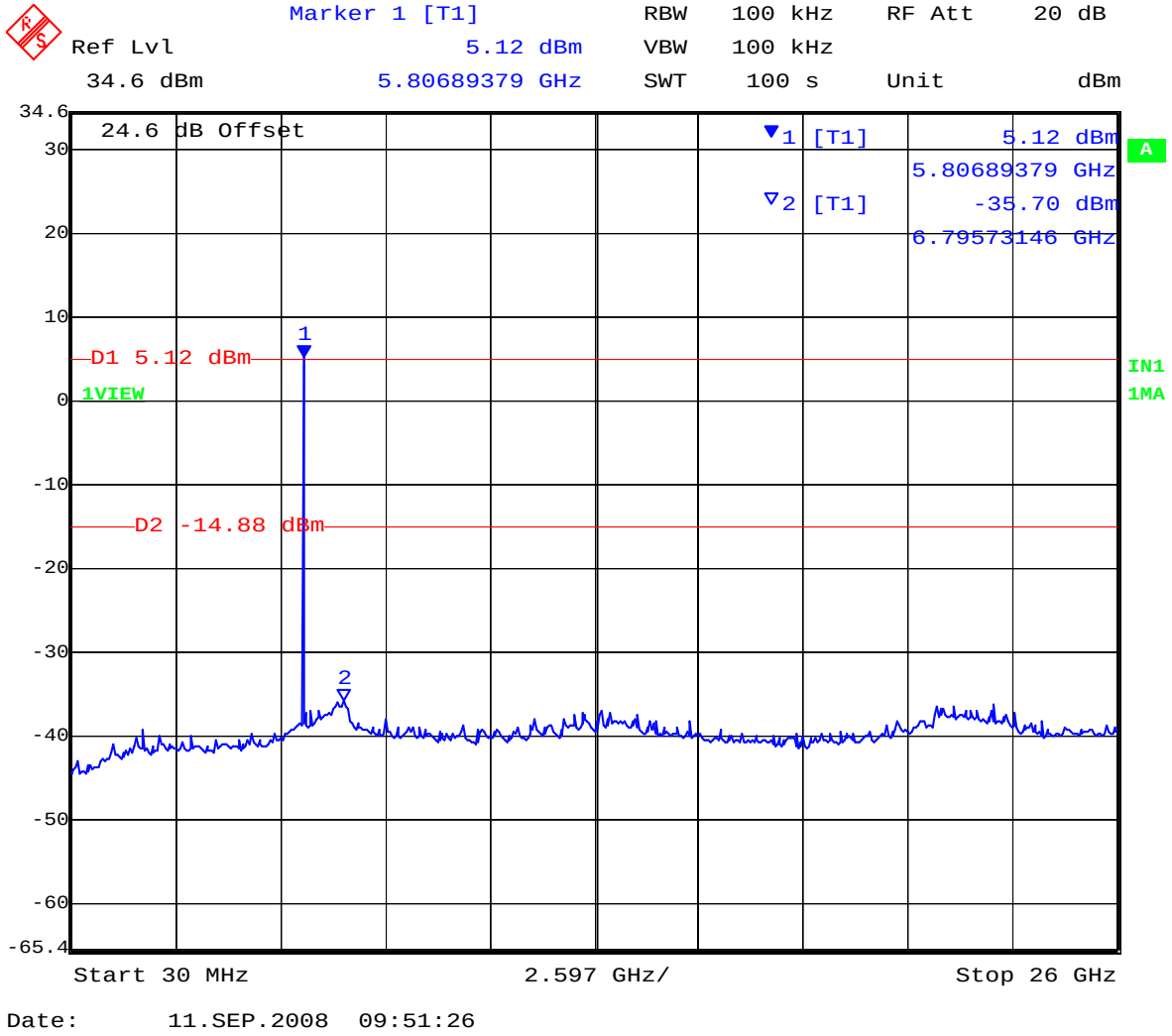
Spurious Emissions (30 - 40,000 MHz)

TABLE OF RESULTS – **802.11a – 6 Mbit/s**

Channel Centre Frequency (MHz)	Start Frequency (MHz)	Stop Frequency (MHz)	Maximum Emission Observed (dBm)	Limit (dBm)	Margin (dB)
5,825	30	40,000	-35.70	-14.88	-20.82

802.11a – 6 Mbit/s

5,825 MHz Conducted Spurious Emissions 30 MHz to 40,000 MHz



Specification

Limits Band-Edge

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

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

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

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

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

Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB

Traceability

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

5.1.6. Radiated Emissions

5.1.6.1. Transmitter Radiated Spurious Emissions (above 1 GHz)

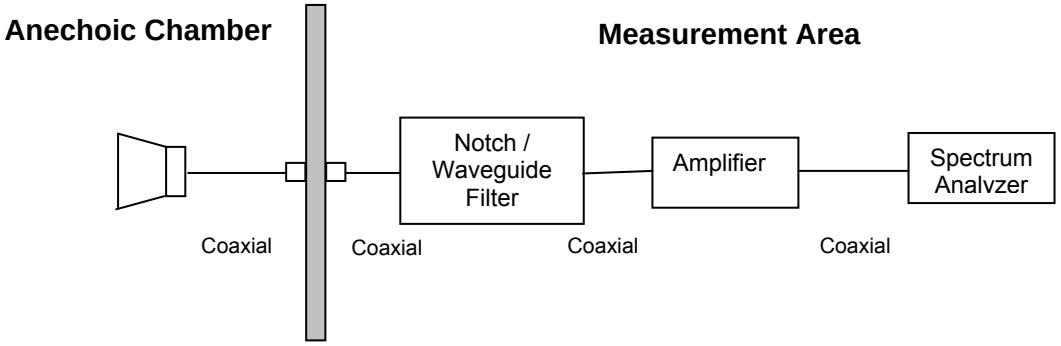
FCC, Part 15 Subpart C §15.247(d) 15.205; 15.209
Industry Canada RSS-210 §A8.5, §2.2, §2.6
Industry Canada RSS-Gen §4.7

Test Procedure

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

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

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

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

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

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

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

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

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

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

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

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier

Radiated Spurious Emissions above 1 GHz

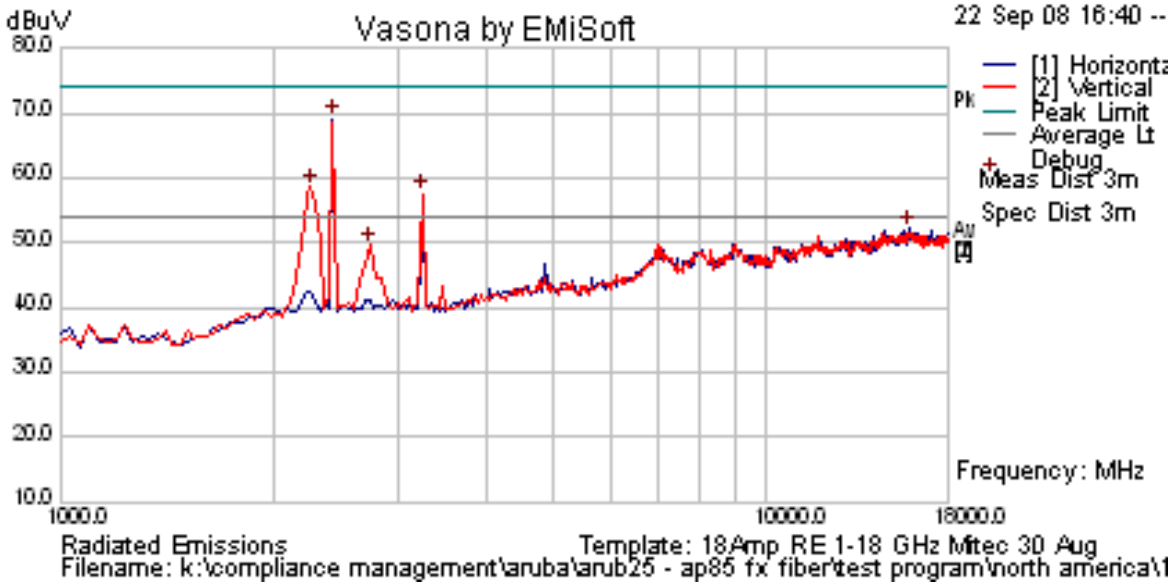
Test Setup - 802.11b – 1Mb/s
TABLE OF RESULTS – 802.11b, 1Mb/s Channel 1 (2,412 MHz) WA24-2X Antenna 18dBi

Software Power Setting = 31
Ethernet Cables # 2&3 with ferrites: Bin H4 0461176451 (NC)

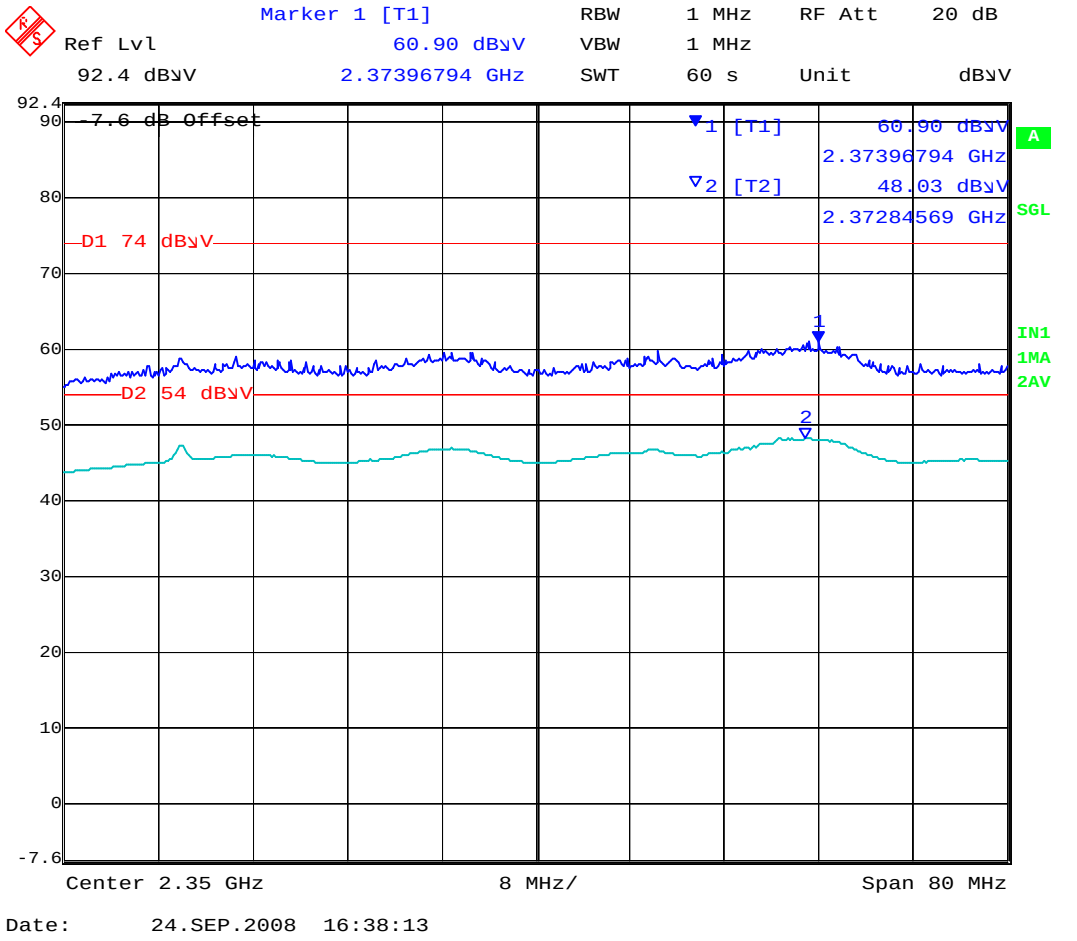
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Limit dBuV	Margin dB	Pass /Fail	Comments
2412.0	76.76	2.97	-10.56	121.30	Peak [Scan]	V	150	N/A	N/A	N/A	Pk Emission
2390	Power Setting = 31			60.90	Peak Max	V	100	74	-13.1	Pass	Band Edge
2390				48.03	Average Max	V	100	54	-5.97	Pass	Band Edge
3248.497	65.24	3.49	-11.14	57.6	Peak	V	100	101.30	-43.7	Pass	NR BAND

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

Radiated Emissions



Band Edge Emissions for 802.11b –2,412 MHz



802.11b 2,412 MHz - WA24-2X Antenna
Peak Emission = 121.30 dBµV/m

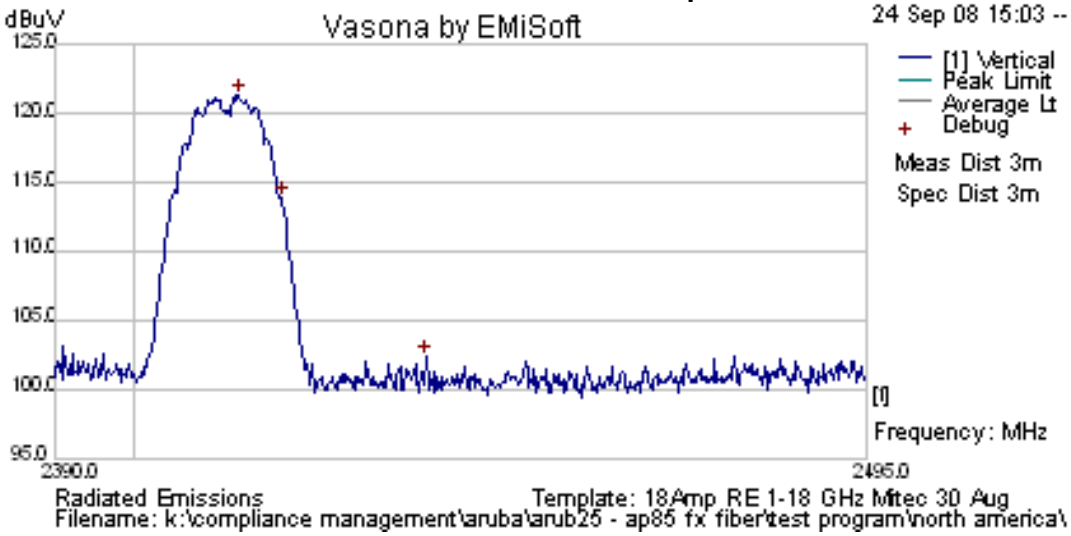


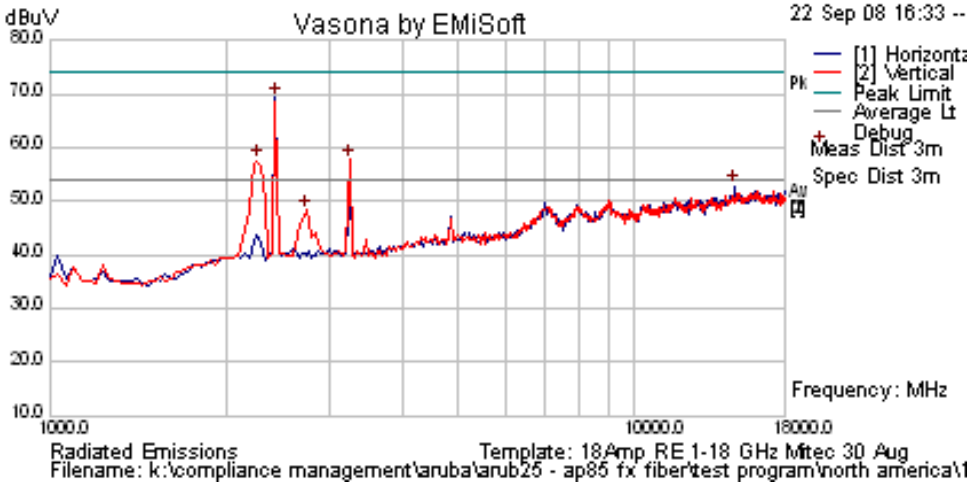
TABLE OF RESULTS – 802.11b, 1Mb/s Channel 6 (2,437) WA24-2X Antenna 18dBi

Software Power Setting = 31
Ethernet Cables # 2&3 with ferrites: Bin H4 0461176451 (NC)

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Limit dBuV	Margin dB	Pass /Fail	Comments
2437.0	76.88	2.97	-10.56	121.27	Peak [Scan]	V	150	N/A	N/A	N/A	Pk Emission
3248.497	65.43	3.49	-11.14	57.79	Peak [Scan]	V	100	101.27	-43.48	Pass	NR BAND

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

Radiated Emissions



802.11b 2,437 MHz - WA24-2X Antenna
Peak Emission = 121.27 dBµV/m

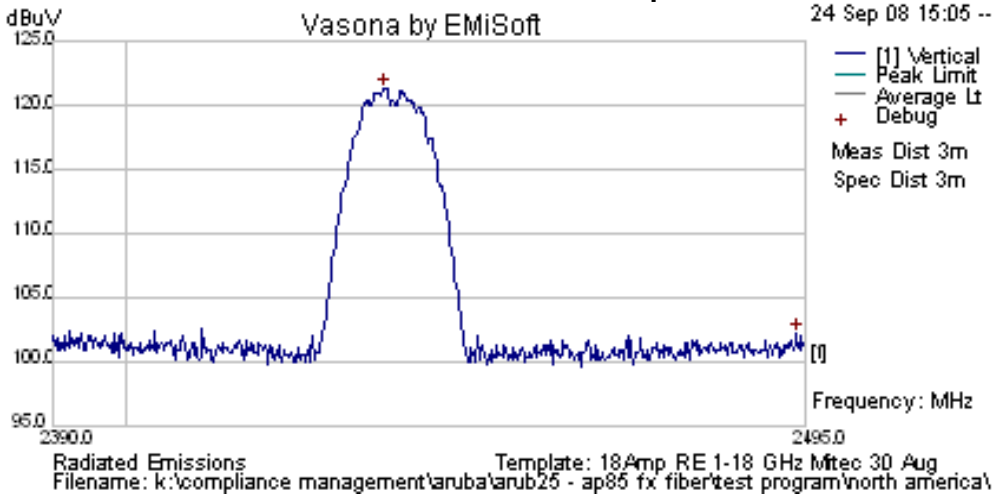


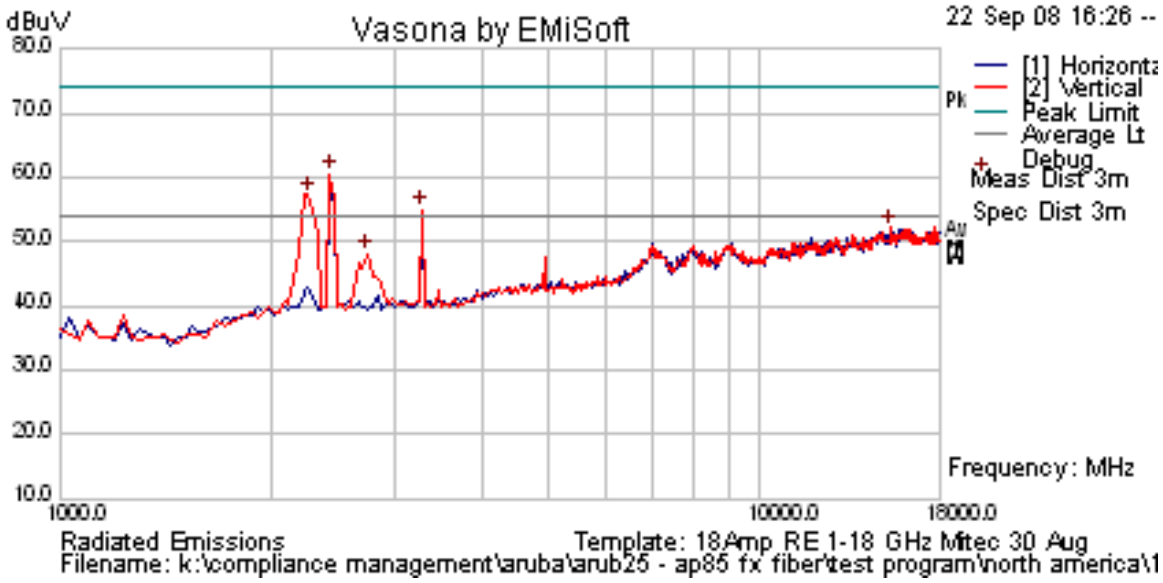
TABLE OF RESULTS – 802.11b, 1Mb/s Channel 11 (2,462 MHz) WA24-2X Antenna 18dBi

Software Power Setting = 31
Ethernet Cables # 2&3 with ferrites: Bin H4 0461176451 (NC)

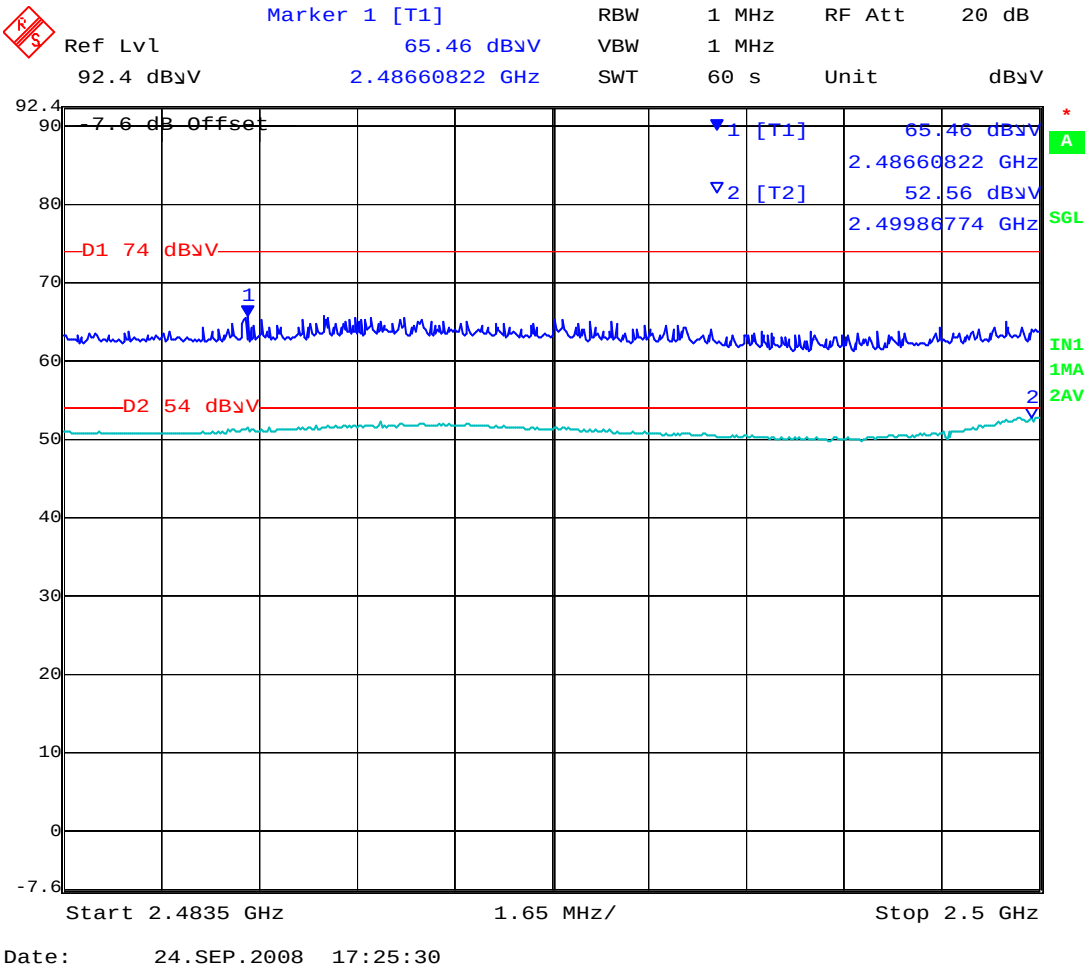
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Limit dBuV	Margin dB	Pass /Fail	Comments
2462.0	68.07	2.97	-10.56	121.02	Peak [Scan]	V	150	N/A	N/A	N/A	Pk Emission
2483.5	Power Setting = 31			65.46	Peak Max	V	100	74	-8.54	Pass	Band Edge
2483.5				52.56	Average Max	V	100	54	-1.44	Pass	Band Edge
3282.565	62.5	3.51	-11.08	54.92	Peak [Scan]	V	100	101.02	-46.10	Pass	NR BAND

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

Radiated Emissions



802.11b –2,462 MHz



802.11b 2,462 MHz - WA24-2X Antenna
Peak Emission = 121.02 dBµV/m

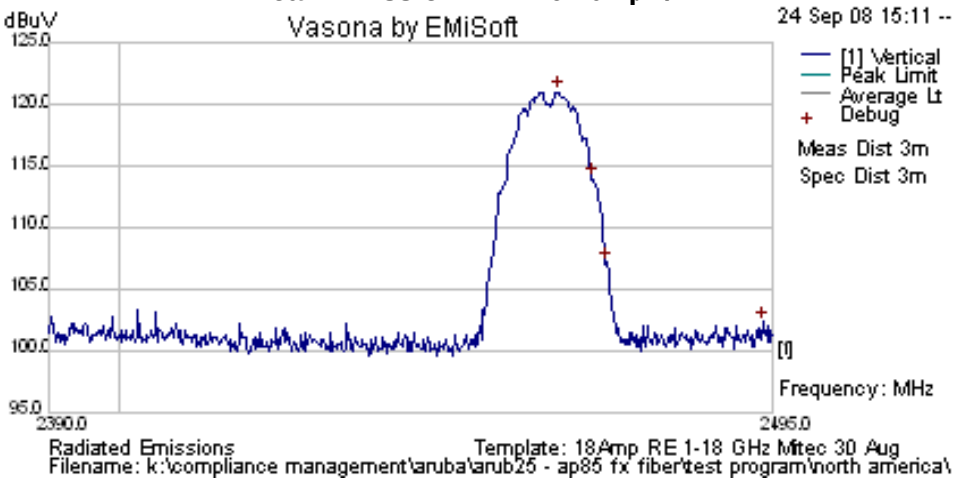


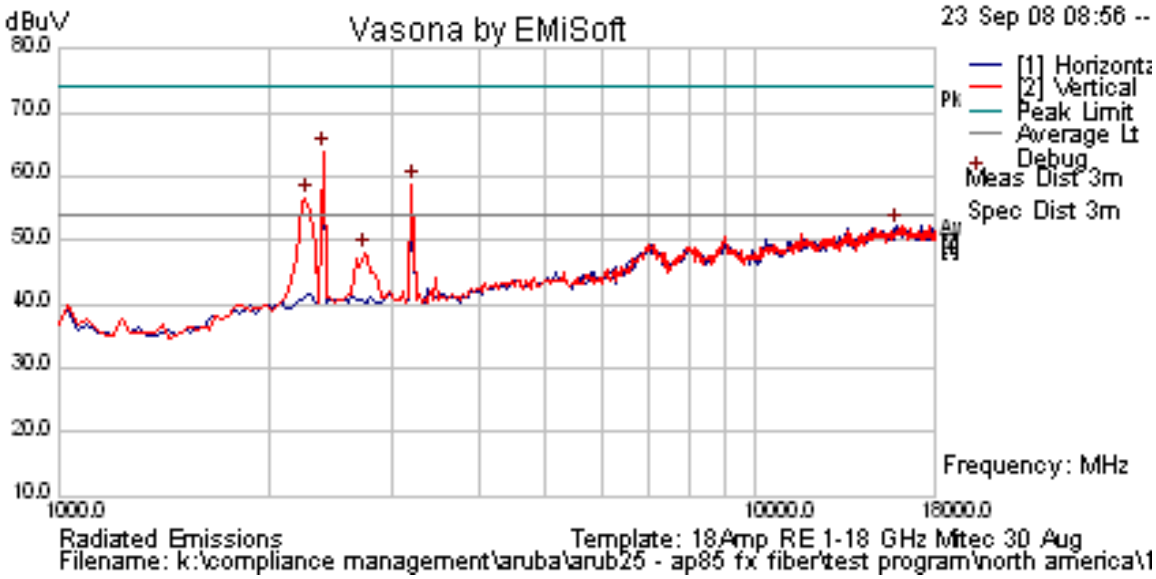
TABLE OF RESULTS – 802.11g, 6 Mb/s Channel 1 (2,412 MHz) WA24-2X Antenna 18dBi

Software Power Setting = 26
Ethernet Cables # 2&3 with ferrites: Bin H4 0461176451 (NC)

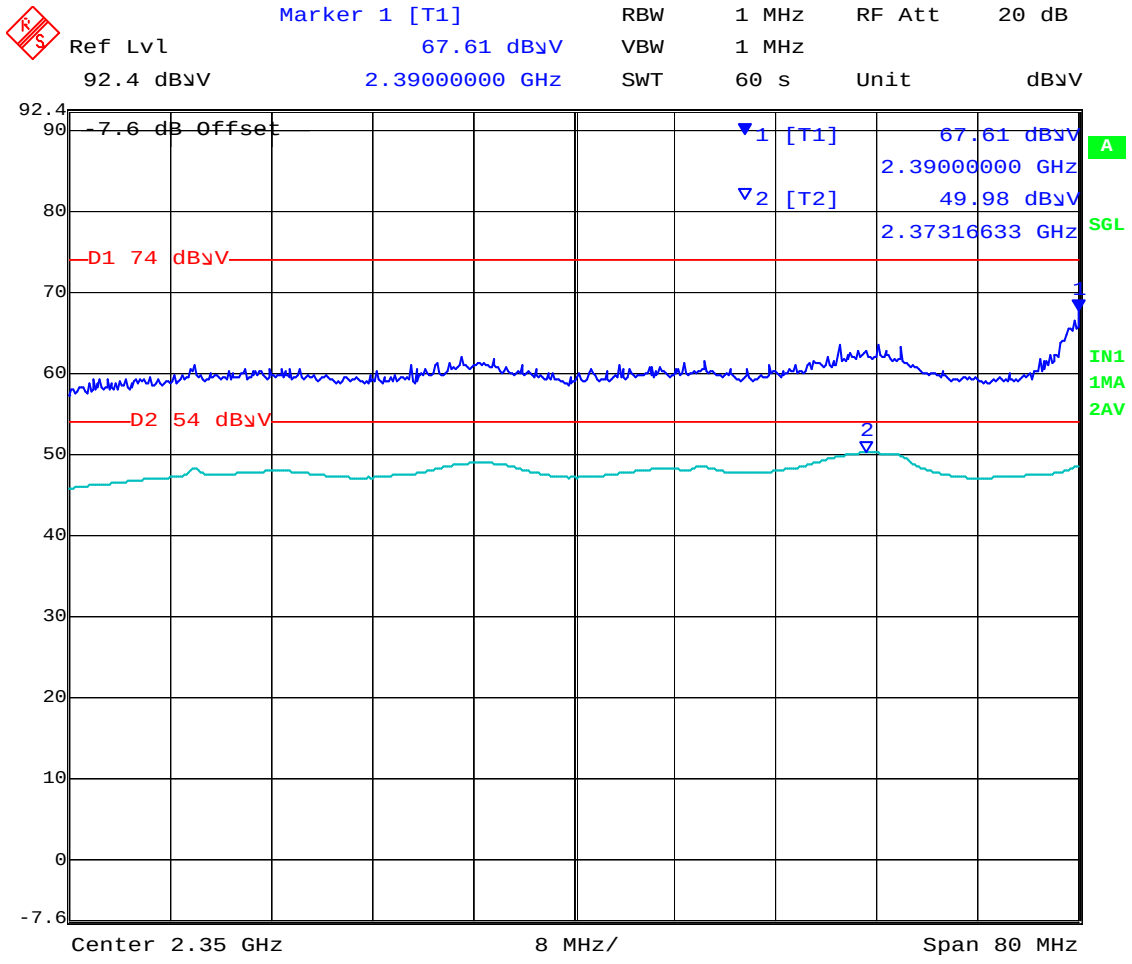
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Limit dBuV	Margin dB	Pass /Fail	Comments
2412.0	71.66	2.95	-10.56	118.19	Peak [Scan]	V	100	N/A	N/A	N/A	Pk Emission
2390	Power Setting = 23			67.61	Peak Max	V	100	74	-6.39	Pass	Band Edge
2390				49.98	Average Max	V	100	54	-4.02	Pass	Band Edge
3214.429	66.51	3.48	-11.07	58.92	Peak [Scan]	V	100	98.19	-39.27	Pass	NR BAND

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

Radiated Emissions



Band Edge Emissions for 802.11g – 2,412 MHz



802.11g 2,412 MHz - WA24-2X Antenna
Peak Emission = 118.19 dBµV/m

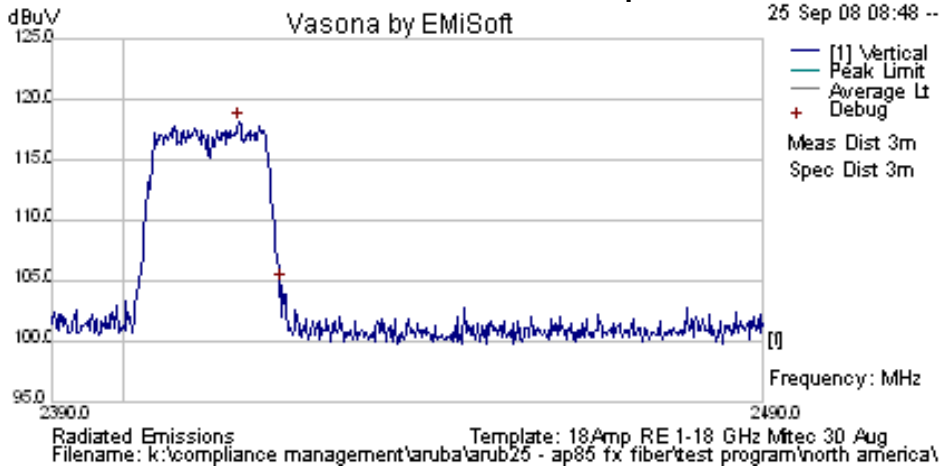


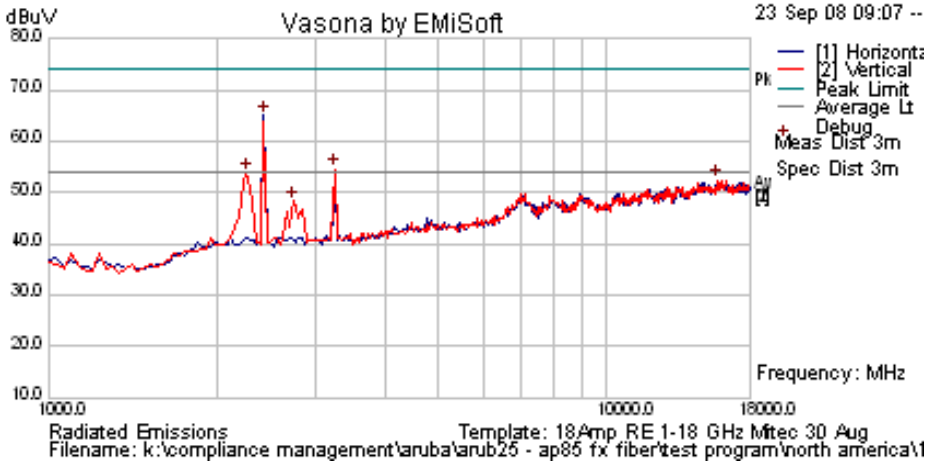
TABLE OF RESULTS – 802.11g, 6 Mb/s Channel 6 (2,437) WA24-2X Antenna 18dBi

Software Power Setting = 26
Ethernet Cables # 2&3 with ferrites: Bin H4 0461176451 (NC)

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Limit dBuV	Margin dB	Pass /Fail	Comments
2437.0	72.56	2.97	-10.56	118.24	Peak [Scan]	V	100	N/A	N/A	N/A	Pk Emission
3248.497	62.2	3.49	-11.14	54.56	Peak [Scan]	V	100	98.24	-43.68	Pass	NR BAND

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

Radiated Emissions



802.11g 2,437 MHz - WA24-2X Antenna
Peak Emission = 118.24 dBµV/m

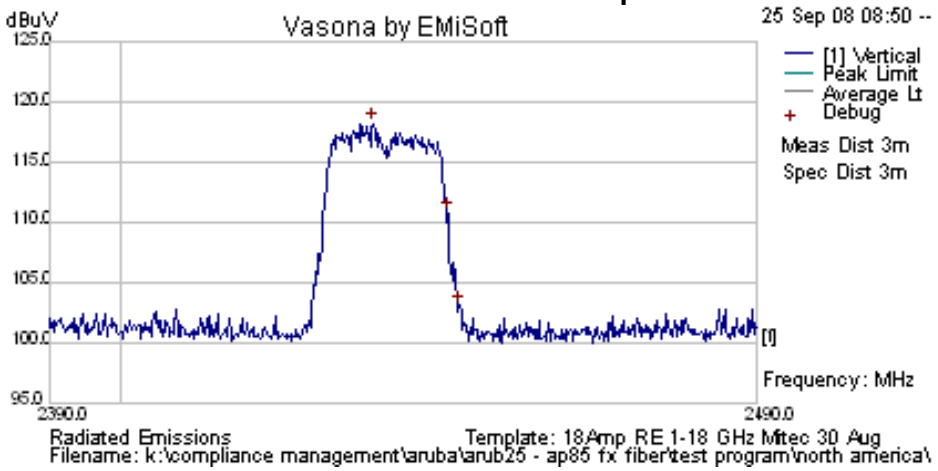


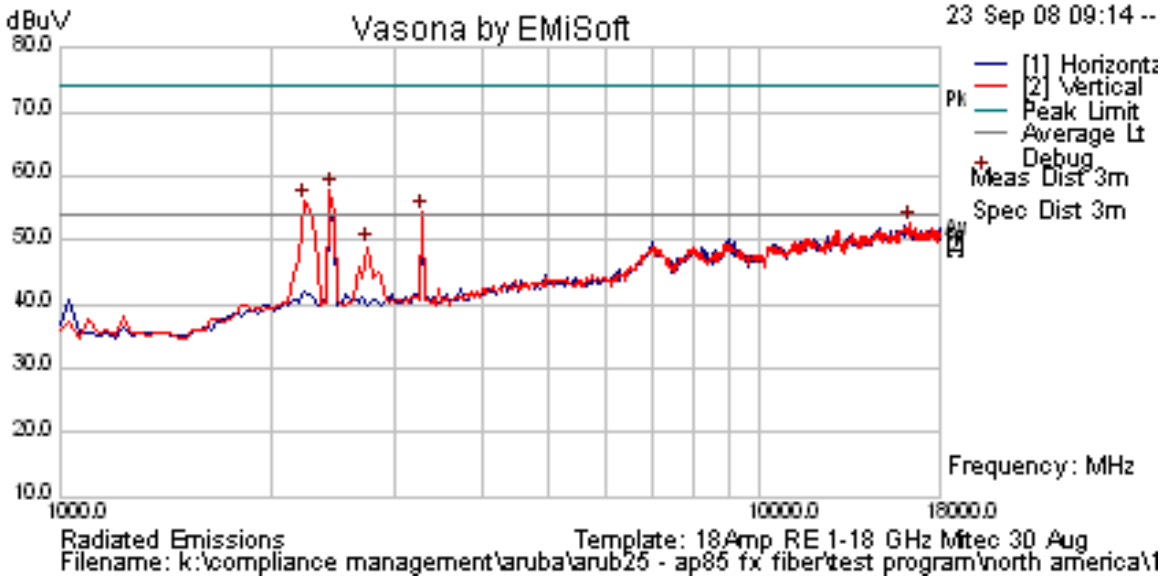
TABLE OF RESULTS – 802.11g – 6 Mb/s Channel 11 (2,462 MHz) WA24-2X Antenna 18dBi

Software Power Setting = 26
Ethernet Cables # 2&3 with ferrites: Bin H4 0461176451 (NC)

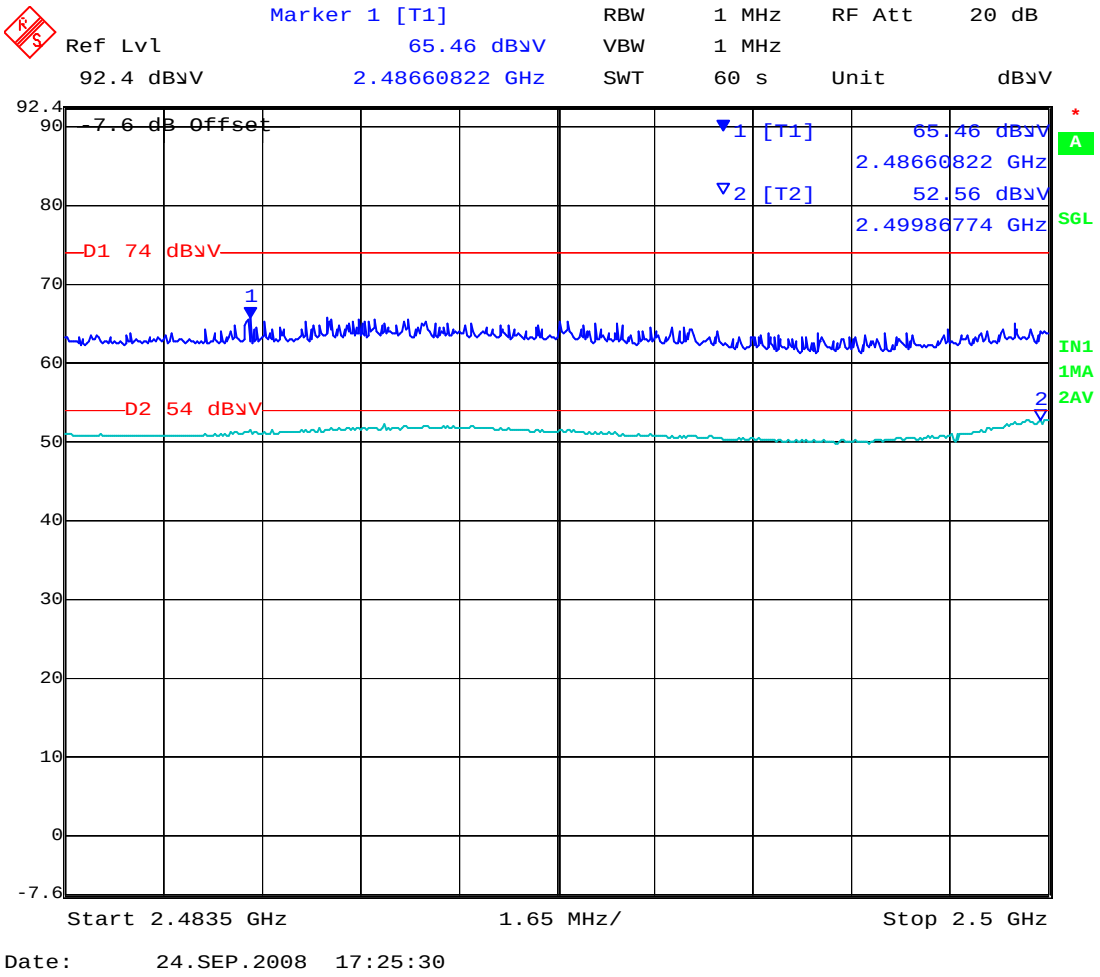
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Limit dBuV	Margin dB	Pass /Fail	Comments
2462.0	65.25	2.97	-10.56	118.09	Peak [Scan]	V	100	N/A	N/A	N/A	Pk Emission
2483.5	Power Setting = 23			70.38	Peak Max	V	100	74	-3.62	Pass	Band Edge
2483.5				50.20	Average Max	V	100	54	-3.80	Pass	Band Edge
3282.565	61.85	3.51	-11.08	54.28	Peak [Scan]	V	100	98.09	-43.81	Pass	NR BAND

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

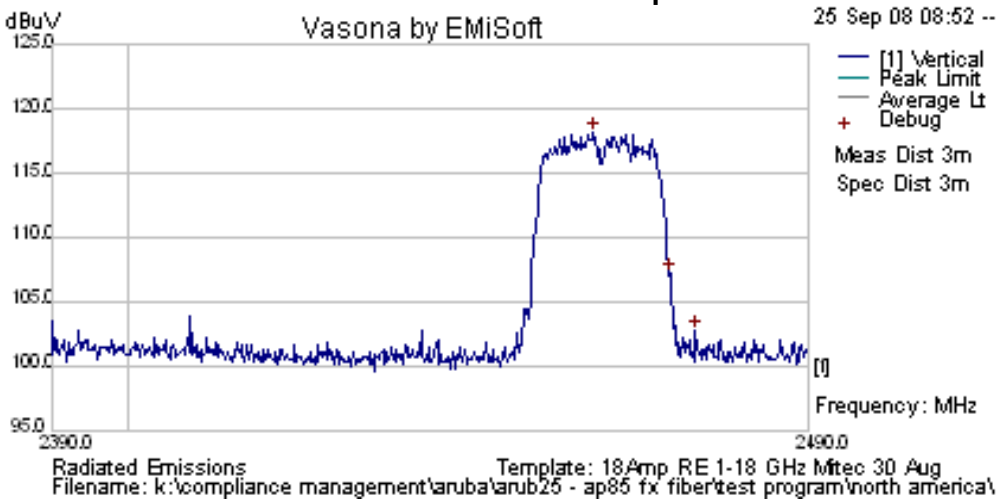
Radiated Emissions



802.11g –2,462 MHz



802.11g 2,462 MHz - WA24-2X Antenna
Peak Emission = 118.09 dBµV/m



Test Setup - 802.11a – 6Mb/s

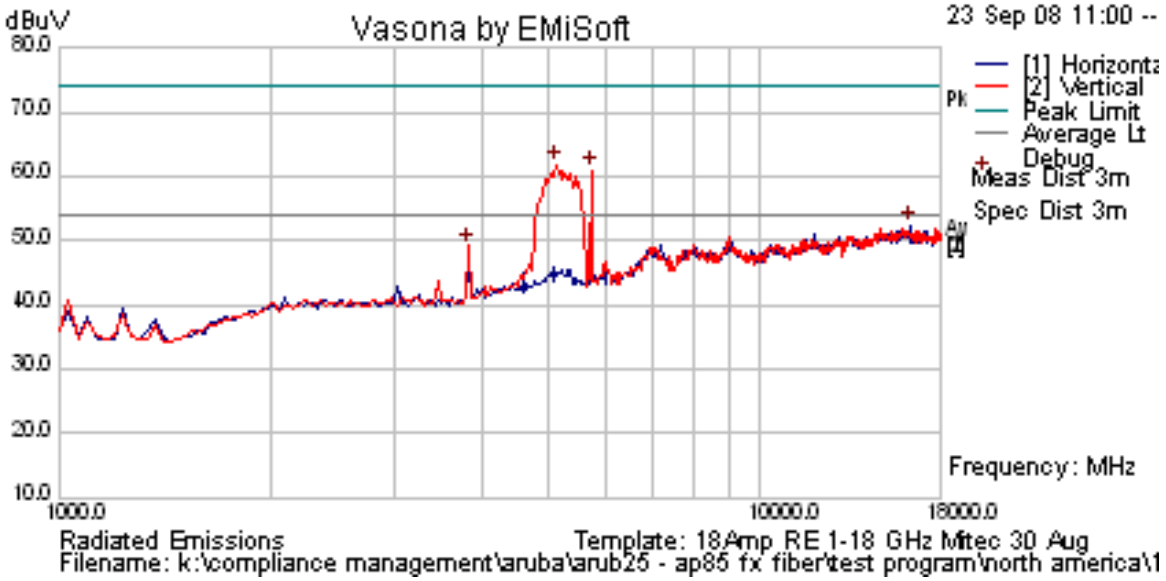
TABLE OF RESULTS – 802.11a – 6 Mb/s Channel 149 (5,745) WA57-3X Antenna 16dBi

Software Power Setting = 29
Ethernet Cables # 2&3 with ferrites: Bin H4 0461176451 (NC)

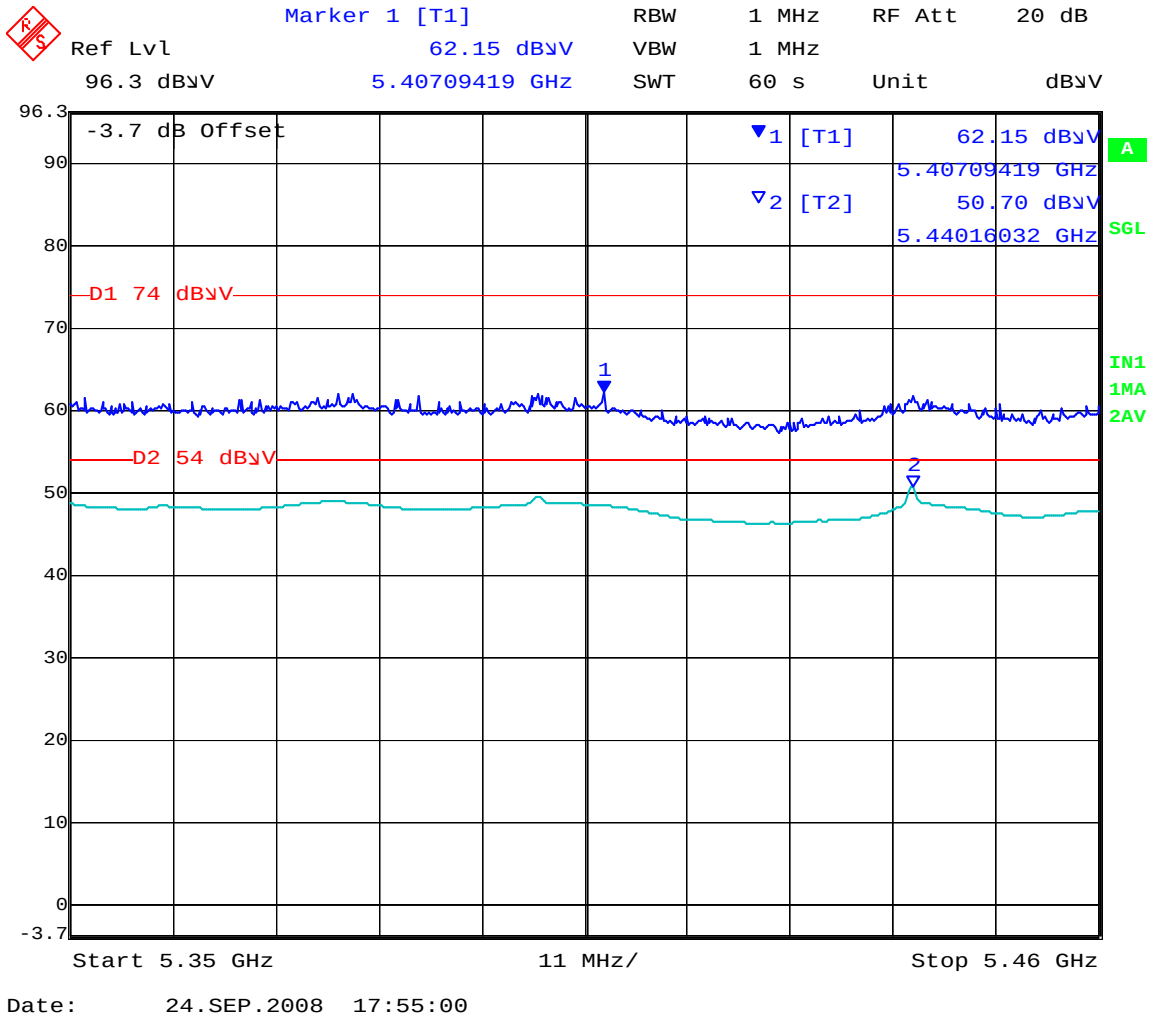
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Limit dBuV	Margin dB	Pass /Fail	Comments
5745	64.27	4.75	-7.96	119..61	Peak [Scan]	V	100	N/A	N/A	N/A	Pk Emission
5470	Power Setting = 29			62.15	Peak Max	V	100	74	-11.85	Pass	Band Edge
5470				50.70	Average Max	V	100	54	-3.30	Pass	Band Edge
3827.655	55.83	3.8	-10.35	49.28	Peak [Scan]	V	100	74	-24.72	Pass	
3824.577	54.75	3.8	-10.35	48.20	Average Max	V	100	54	-5.80	Pass	

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

Radiated Emissions



Band Edge Emissions for 802.11a –5,745 MHz



802.11a 5,745 MHz - MA-WA57-3X Antenna
Peak Emission = 119.61 dBµV/m

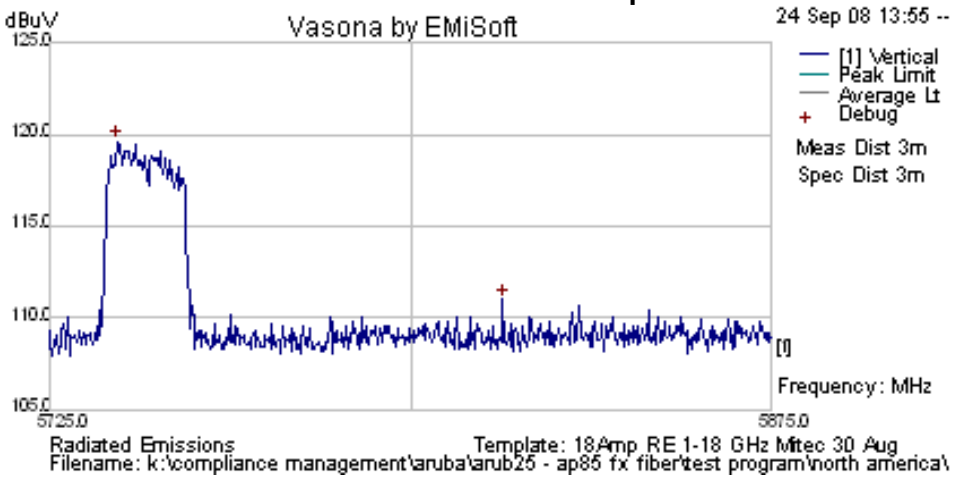


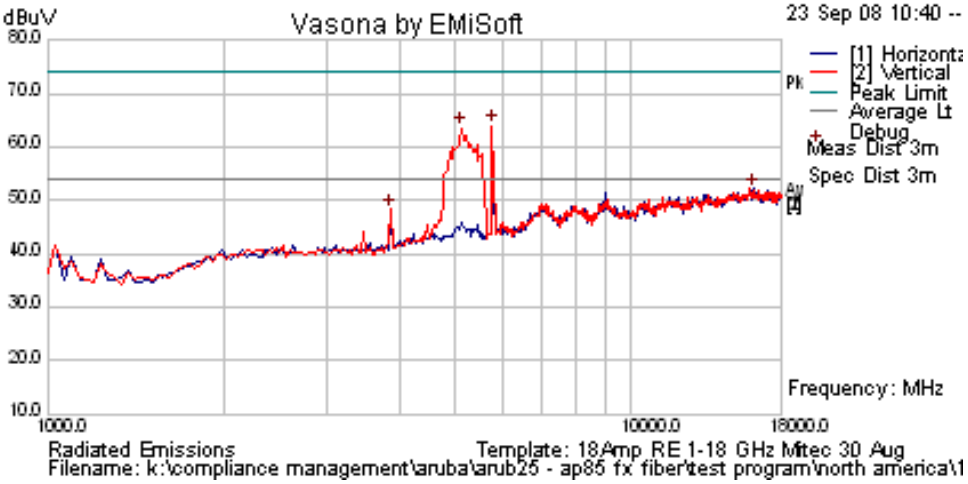
TABLE OF RESULTS – 802.11a – 6 Mb/s Channel 157 (5,785) WA57-3X Antenna 16dBi

Software Power Setting = 29
Ethernet Cables # 2&3 with ferrites: Bin H4 0461176451 (NC)

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Limit dBuV	Margin dB	Pass /Fail	Comments
5785	67.06	4.77	-7.88	120.09	Peak [Scan]	V	100	N/A	N/A	N/A	Pk Emission
3861.723	54.72	3.82	-10.15	48.39	Peak [Scan]	V	100	74	-25.61	Pass	
3856.633	53.82	3.82	-10.18	47.46	Average Max	V	112	54	-6.54	Pass	

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

Radiated Emissions



802.11a 5,785 MHz - MA-WA57-3X Antenna
Peak Emission = 120.09 dBµV/m

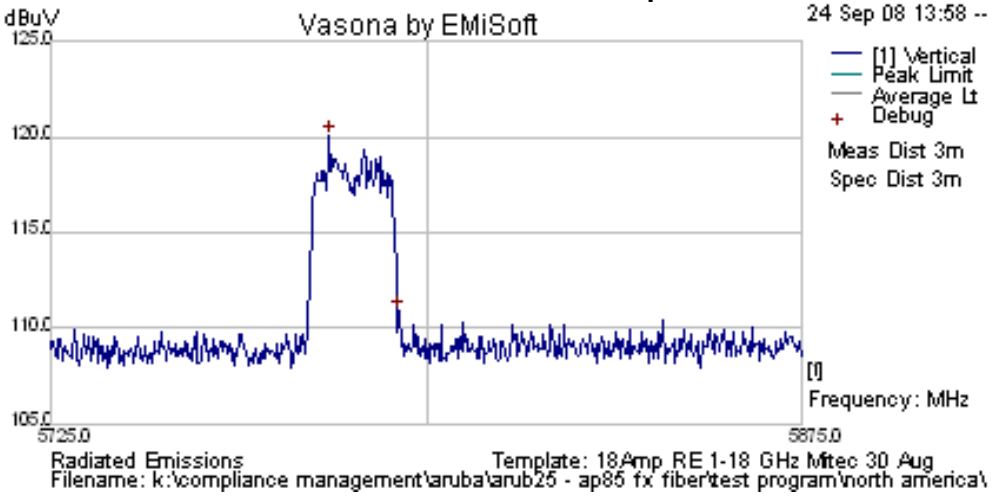


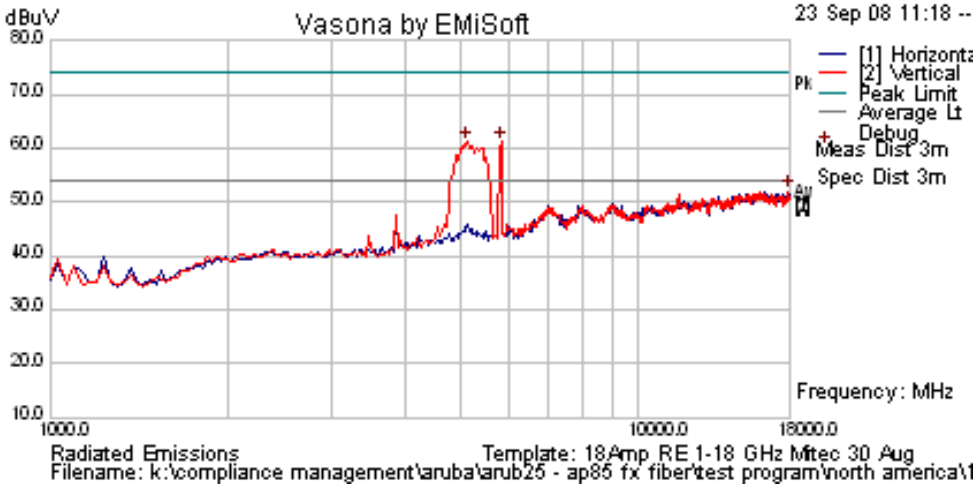
TABLE OF RESULTS – 802.11a – 6 Mb/s Channel 165 (5,825) WA57-3X Antenna 16dBi

Software Power Setting = 29
Ethernet Cables # 2&3 with ferrites: Bin H4 0461176451 (NC)

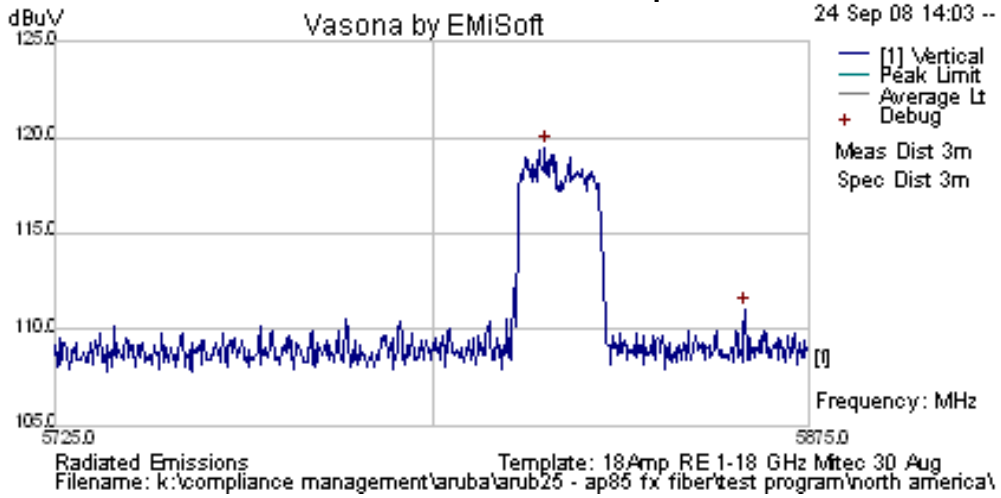
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Limit dBuV	Margin dB	Pass /Fail	Comments
5825	64.15	4.8	-7.81	119.50	Peak [Scan]	V	100	N/A	N/A	N/A	Pk Emission

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

Radiated Emissions



802.11a 5,825 MHz - MA-WA57-3X Antenna
Peak Emission = 119.50 dBµV/m



Specification Limits

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

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

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

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

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

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

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

§15.209 (a) Limit Matrix

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

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

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

5.1.6.2. Receiver Radiated Spurious Emissions (above 1 GHz)

Industry Canada RSS-Gen §4.8, §6

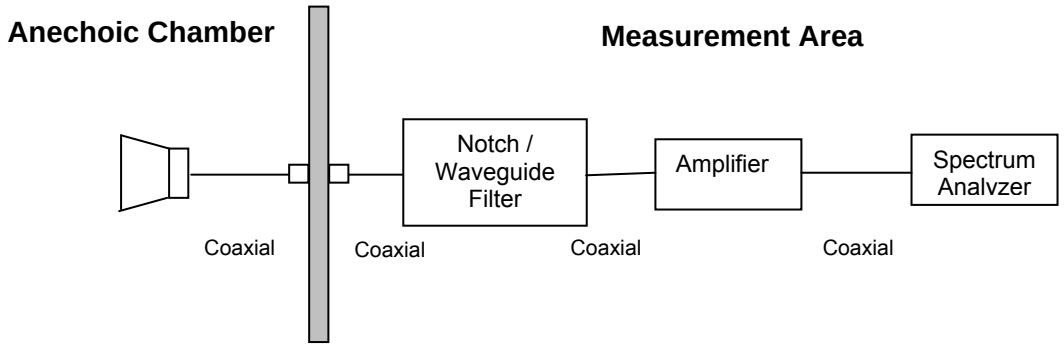
Test Procedure

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

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

All Sectors of the EUT were tested simulatneously

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

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

FS = R + AF + CORR - FO

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

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

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

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

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

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

Receiver Radiated Spurious Emissions above 1 GHz

The 2.4 GHz and 5 GHz receiver radiated spurious emissions were tested simultaneously on mid-channel.

WA24-2X Antenna 18dBi

MAWA57-3X Antenna 16dBi

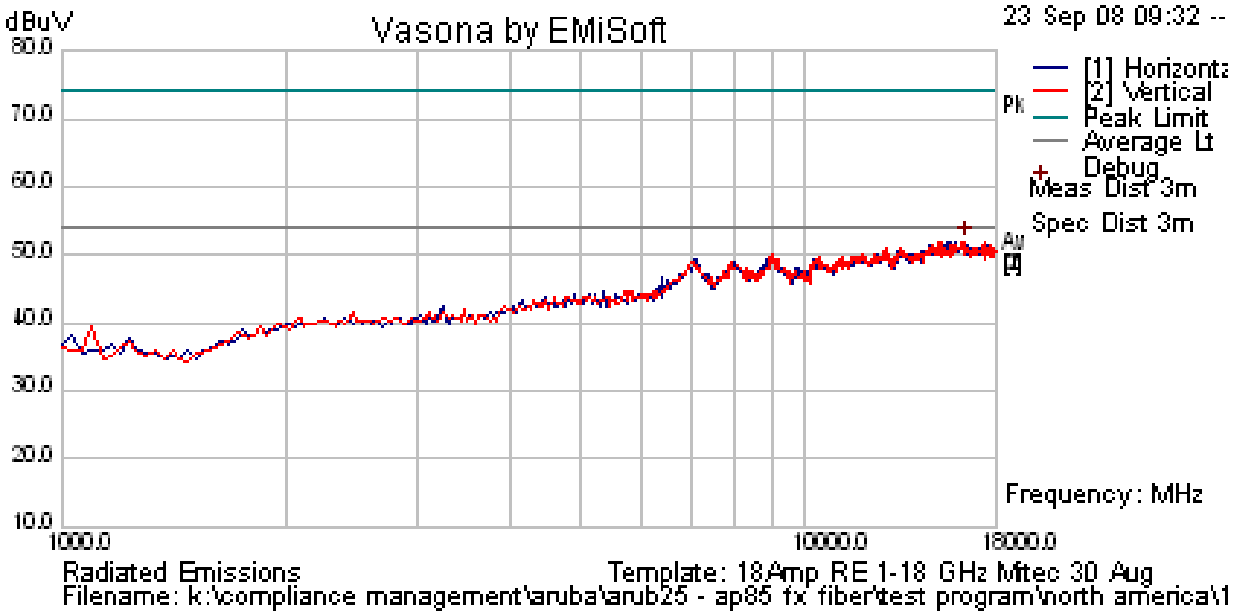
Test Setup – 2.4 GHz channel 2437 GHz, 5 GHz channel 5785 MHz

TABLE OF RESULTS –

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

No Receiver Spurious Emissions were observed above 1 GHz

Radiated Emissions



The above is a peak emission plot

Specification

Receiver Radiated Spurious Emissions

Industry Canada RSS-Gen §4.8,
The search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tunable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

RSS-Gen §6
The following receiver spurious emission limits shall be complied with;
(a) If a radiated measurement is made, all spurious emissions hall comply with the limits of Table 1.

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

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

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

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

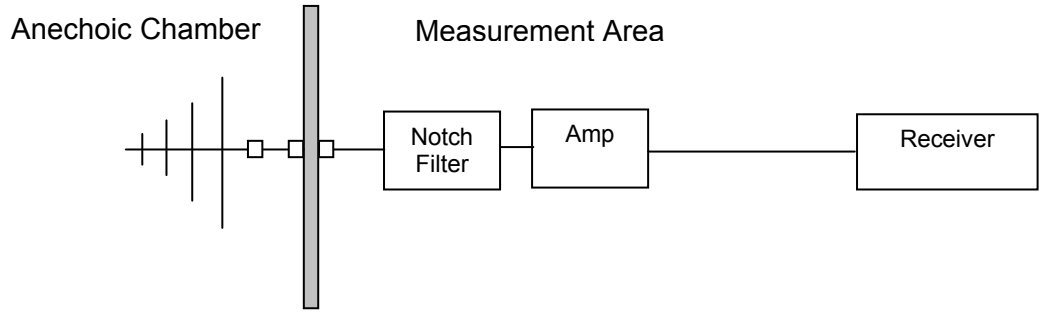
FCC, Part 15 Subpart C §15.205/ §15.209
Industry Canada RSS-210 §2.2

Test Procedure

Testing 30M-1 GHz was performed in a 3-meter anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

The EUT had two methods of powering on ac/dc converter and Power over Ethernet (POE). Both modes were tested for emissions below 1GHz.

Test Measurement Set up



Field Strength Calculation

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

$$FS = R + AF + CORR$$

where:

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

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

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

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

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

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

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

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

EUT parameters:

Transmitter operation: 802.11b
Data Rate(s): 1 Mb/s
Frequency: 2412 MHz
Power Level: Maximum

TABLE OF RESULTS – 115VAC 60 Hz

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB
30.266	49.07	3.38	-13.98	38.46	Quasi Max	V	106	60	40.5	-2.04
43.356	53.78	3.61	-25.87	31.52	Quasi Max	V	120	325	40.5	-8.98
200.532	50.15	4.75	-29.42	25.48	Quasi Max	V	118	18	40.5	-15.02
127.327	50.05	4.35	-27.82	26.58	Quasi Max	V	98	345	40.5	-13.92
349.9	57.21	5.45	-27.92	34.74	Quasi Max	H	102	225	47.5	-12.76
494.99	59.13	5.98	-25.16	39.95	Quasi Max	H	183	112	47.5	-7.55

Radiated Spurious Emissions 30 MHz to 1 GHz (115Vac 60Hz)

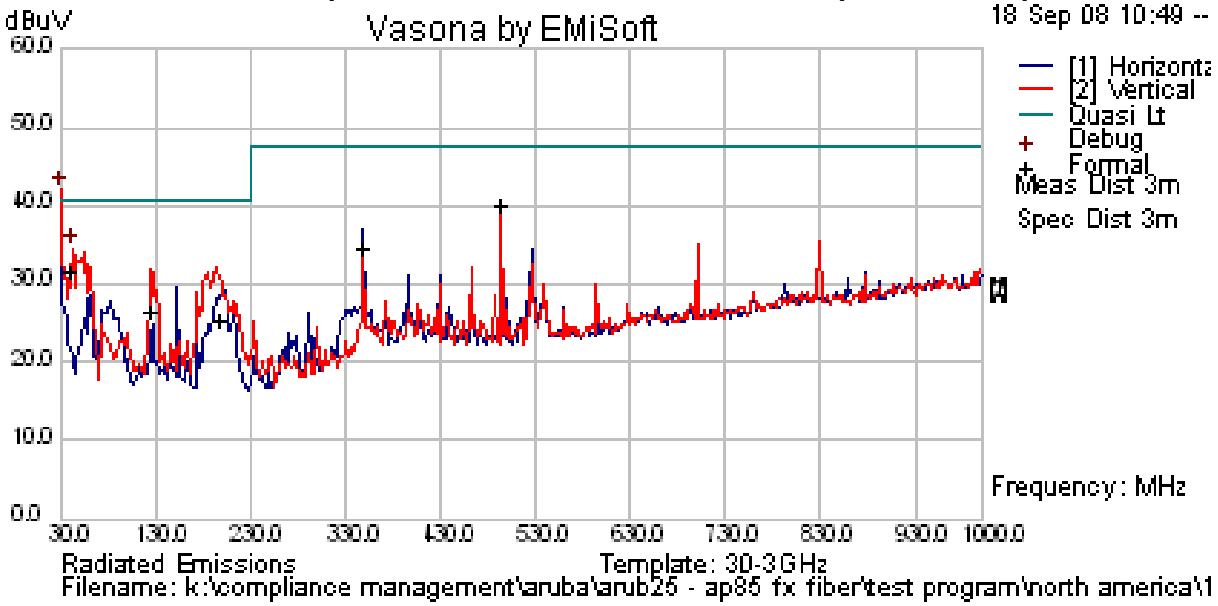
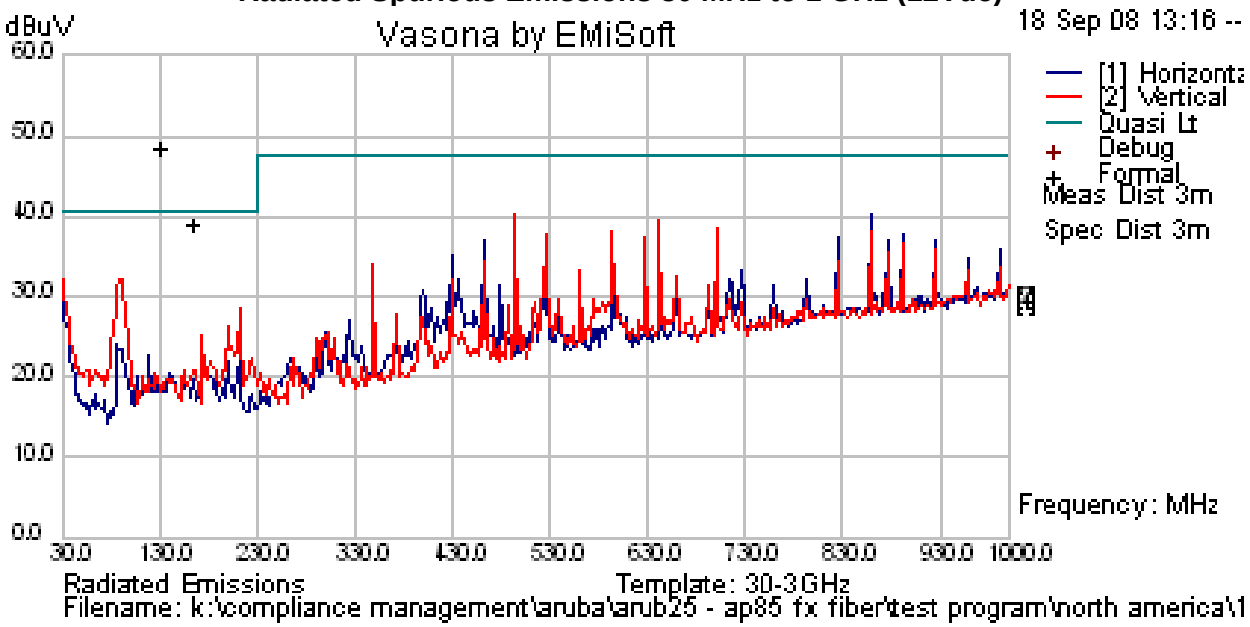


TABLE OF RESULTS – 12Vdc

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB
30.357	34.73	3.38	-14.08	24.02	Quasi Max	V	382	193	40.5	-16.48
90.142	57.36	4.07	-33.38	28.06	Quasi Max	V	259	331	40.5	-12.44
699.828	53.82	6.68	-22.49	38.01	Quasi Max	V	165	238	47.5	-9.49
349.905	58.36	5.45	-27.92	35.89	Quasi Max	V	137	357	47.5	-11.61
494.987	58.96	5.98	-25.16	39.77	Quasi Max	V	98	359	47.5	-7.73
857.982	53.95	7.19	-20.8	40.34	Quasi Max	H	197	40	47.5	-7.16

Radiated Spurious Emissions 30 MHz to 1 GHz (12Vdc)



Specification

Limits

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

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

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

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

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

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

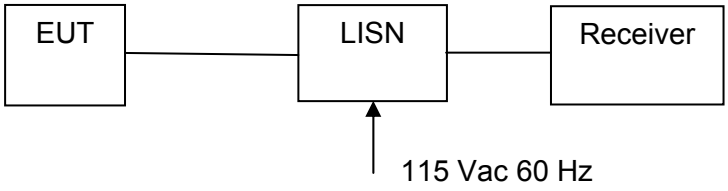
Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312

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

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

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

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

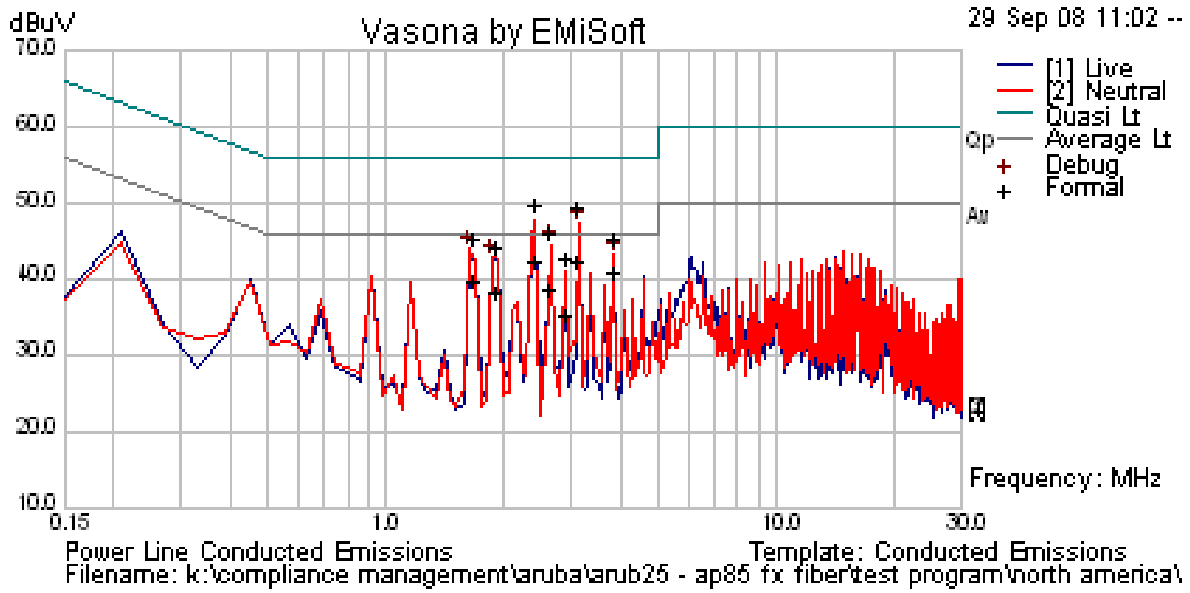
Measurement Results for AC Wireline Conducted Emissions (150 kHz – 30 MHz)

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

TABLE OF RESULTS – 115Vac 60Hz

Freq (MHz)	Line	Peak (dBµV)	QP (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Ave. (dBµV)	Ave. Limit (dBµV)	Ave. Margin (dB)
2.422	Neutral	47.93	47.9	56	-8.1	40.56	46	-5.44
3.148	Neutral	47.5	47.71	56	-8.29	40.73	46	-5.27
2.664	Neutral	44.57	44.48	56	-11.52	37.05	46	-8.95
1.696	Neutral	43.94	43.61	56	-12.39	38.06	46	-7.94
3.875	Neutral	43.4	43.54	56	-12.46	39.08	46	-6.92
1.937	Neutral	42.82	42.43	56	-13.57	36.37	46	-9.63
2.906	Neutral	41.11	40.84	56	-15.16	33.57	46	-12.43

AC Wireline Conducted Emissions 150 kHz – 30 MHz, 115Vac 60 Hz



Specification

Limit

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μΩ line impedance stabilization network (LISN), see §15.207 (a) matrix below. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

RSS-Gen §7.2.2
The radio frequency voltage that is conducted back into the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table below. The tighter limit applies at the frequency range boundaries.

§15.207 (a) and **RSS-Gen §7.2.2** Limit Matrix
The lower limit applies at the boundary between frequency ranges

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

Laboratory Measurement Uncertainty for Conducted Emissions

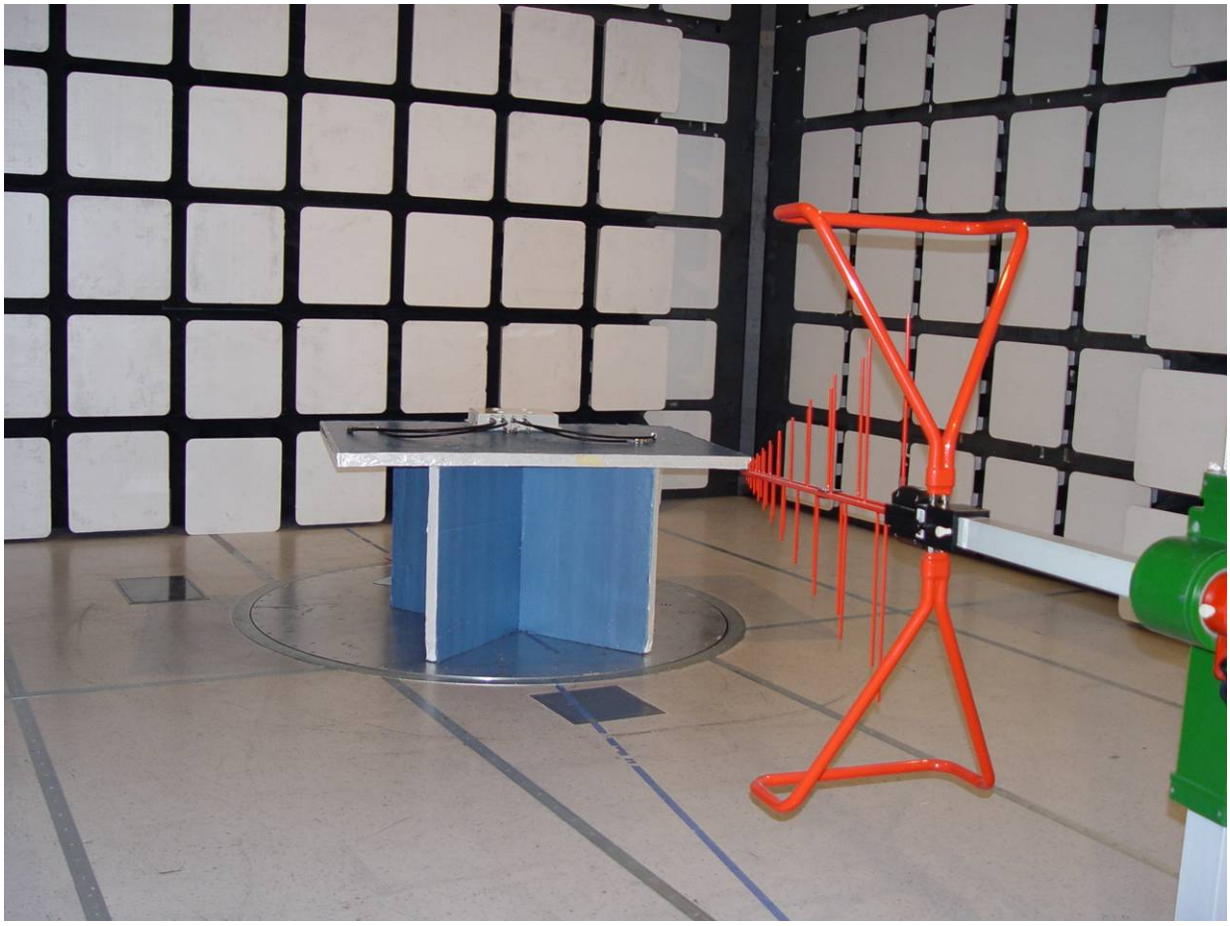
Measurement uncertainty	±2.64 dB

Traceability

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

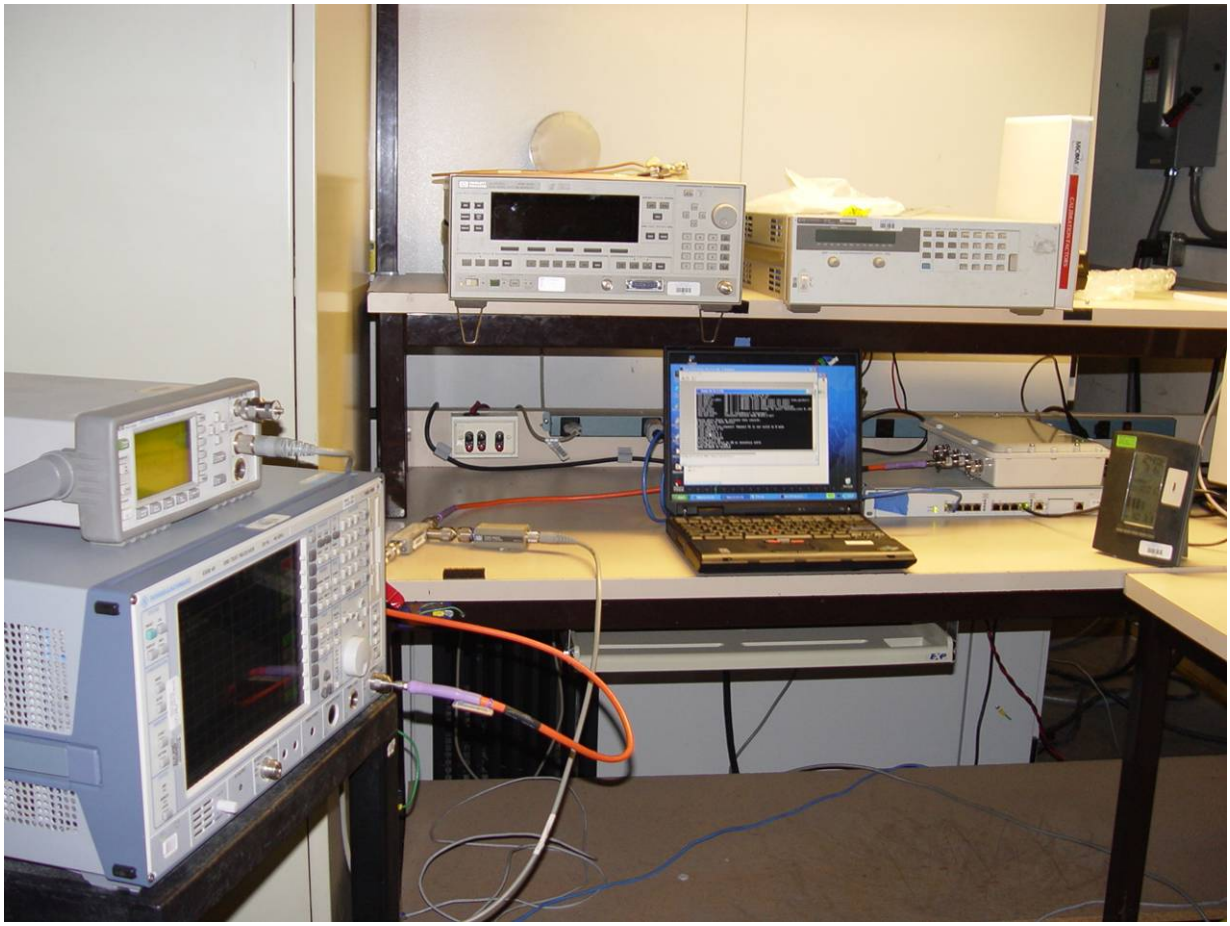
6. PHOTOGRAPHS

6.1. Radiated Spurious Emissions 115 Vac 60 Hz



All ports were terminated during testing

6.2. General Measurement Test Set-Up



6.3. AC Wireline Emissions Test Set-Up

7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	None
0310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	3140A01285
0314	30dB N-Type Attenuator	ARRA	N9444-30	1623
0070	Power Meter	Hewlett Packard	437B	3125U11552
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0301	5.6 GHz Notch Filter	Micro-Tronics	RBC50704	001
0302	5.25 GHz Notch Filter	Micro-Tronics	BRC50703	002
0303	5.8 GHz Notch Filter	Micro-Tronics	BRC50705	003
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907

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