Test of Aruba AP-65 802.11 a/b/g Wireless AP

To: FCC 47 CFR Part 15.247

Test Report Serial No.: ARUB12-A2 Rev B

TEST REPORT

FROM

Test of Aruba AP-65 802.11 a/b/g Wireless AP
to
To FCC 47 CFR Part 15.247

Test Report Serial No.: ARUB12-A2 Rev B

Note: this report only contains data with regards to the 2.4 and 5.8 GHz operational modes of the Aruba Networks AP-65 Wireless Access Point. 5150-5350 MHz and 5,470-5,725 MHz test data is reported in MiCOM Labs test report ARUB12-A4

This report supersedes: ARUB12-A2 Rev A

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:** 24th July 2007

This Test Report is Issued Under the Authority of;

MiCOM Labs, Inc.
440 Boulder Court, Suite 200
Pleasanton, CA 94566 USA
Phone: +1 (925) 462-0304
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CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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ACCREDITATION & LISTINGS

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS EN ISO/IEC 17025. The company is accredited by the 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

THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

MICOM LABS
Pleasanton, CA

for technical competence in the field of

Electrical Testing

The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified field of testing.

Presented this 14th day of September 2005.

American Association for Laboratory Accreditation
Corporate SEAL 1978 District of Columbia
A2LA

President
For the Accreditation Council
Certificate Number 2381.01
Valid to: November 30, 2007

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

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

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	20th July 2007	Initial Release
Rev B	24th July 2007	Typographical error corrected on page 11

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-65	Fax:	+1 925 462 0306
S/N:	A90066821 (conducted tests) A90071973 (radiated tests)		
Test Date(s):	6th to 14th July 2007	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.247	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	Feb 2006	Code of Federal Regulations
(ii)	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
(iii)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(iv)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(v)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(vi)	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
(vii)	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

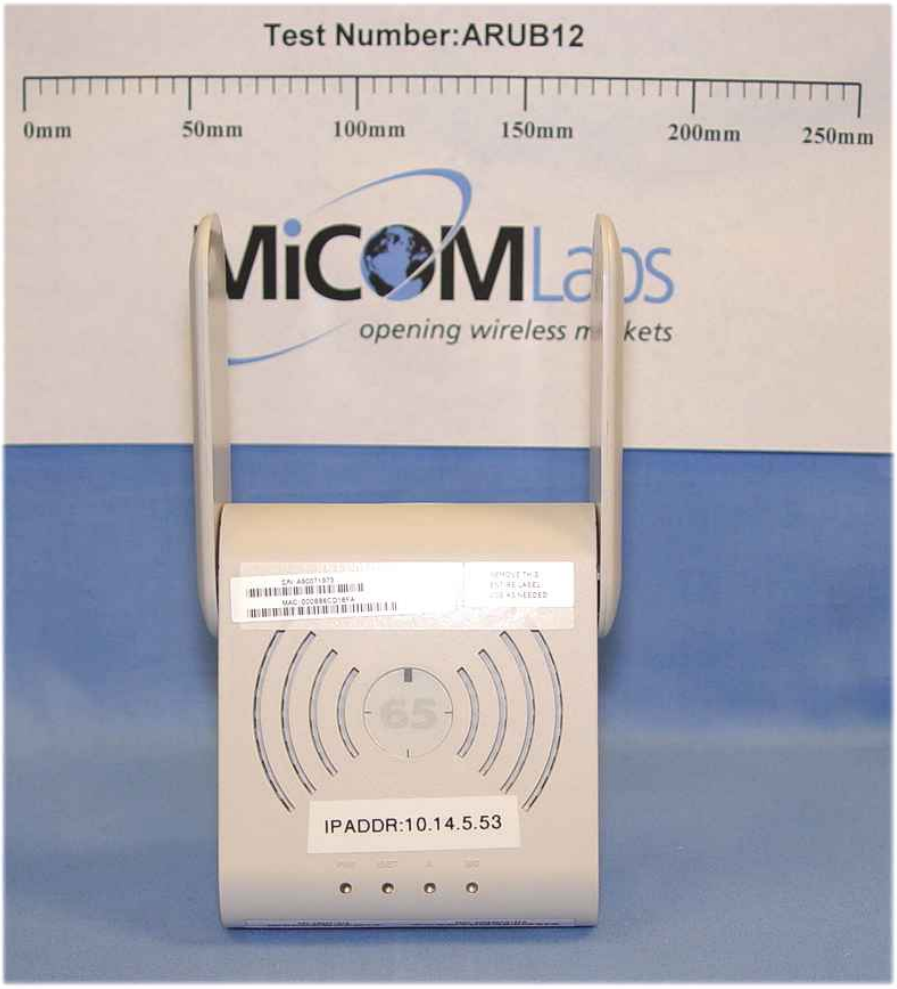
3.1. Technical Details

Details	Description
Purpose:	Test of the Aruba AP-65 802.11 a/b/g Wireless AP to FCC Part 15.247 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:	ARUB12-A2 Rev B
Date EUT received:	6TH July 2006
Standard(s) applied:	FCC 47 CFR Part 15.247
Dates of test (from - to):	6th to 14th July 2007
No of Units Tested:	1
Type of Equipment:	802.11a/b/g Wireless Access Point
Manufacturers Trade Name:	Wireless Access Point
Model:	AP-65
Location for use:	Indoor
Declared Frequency Range(s):	2400 - 2483.5 MHz 5725 - 5850 MHz
Type of Modulation:	Per 802.11 – DSSS, CCK, OFDM
Declared Nominal Output Power:	802.11b/g: +17 dBm (average) 802.11a: +16 dBm (average)
EUT Modes of Operation:	802.11a/b/g
Transmit/Receive Operation:	Time Division Duplex
Rated Input Voltage and Current:	5V DC / 2A supplied externally 48V DC / 220mA power-over-Ethernet
Operating Temperature Range:	Declared range 0 to +50ºC
ITU Emission Designator:	802.11b – 15M5W7D 802.11g – 16M5W7D 802.11a – 16M6W7D
Frequency Stability:	±20 ppm max
Equipment Dimensions:	Antenna Stowed-100x100x37mm (3.94 x 3.94 x 1.47 in) Antenna Extended-167x100x37mm (6.58 x 3.94 x 1.47 in)
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-65 wireless Access Point in the frequency ranges 2400 - 2483.5 MHz, and 5725 – 5850 MHz for compliance against FCC 47 CFR Part 15.247 specifications.

Aruba Networks
AP-65 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	Wireless AP	Aruba Networks	AP-65	A90066821[1]
EUT	Wireless AP	Aruba Networks	AP-65	A90071973[2]
EUT	Power Supply 100-240 Vac	CUI Inc.	A1-15S05	R00042200045
EUT	Power Over Ethernet (POE)	PowerDsine	PD-6001/AC	IO41760400073 31B 03
Support	Laptop PC	IBM	Thinkpad	None

[1] – used for conducted testing
[2] - used for radiated testing

3.4. Antenna Details

1. 2.4-2.5 GHz / 3.30 dBi
2. 5.150 GHz / 2.50 dBi
3. 5.350 GHz / 3.30 dBi
4. 5.725 GHz / 3.30 dBi

3.5. Cabling and I/O Ports

Number and type of I/O ports

5. 10/100 Ethernet (10/100 POE)
6. 5 Vdc, 4mm supply connector

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

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.

Freq Band (GHz)	802.11 Mode	Integral
2.4	b	X
	g	X
5	a	X

Although the device operates with integral antennas the antennas were removed to perform conducted testing.

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:

2. NONE

3.9. Subcontracted Testing or Third Party Data

1. NONE

4. TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(a)(2)	6 dB and 99 % Bandwidths	≥500 kHz	Conducted	Complies	5.1.1
15.247(b)(3) **15.31(e)**	Peak Output Power Voltage Variation	Shall not exceed 1W Variation of supply voltage 85 % -115 %	Conducted	Complies	5.1.2
15.247(e)	Peak Power Spectral Density	Shall not be greater than +8 dBm in any 3 kHz band	Conducted	Complies	5.1.3
15.247(i)	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Conducted	Complies	5.1.4
15.247(d) **15.205 /** **15.209**	Spurious Emissions (30MHz - 40 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.**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(d) **15.205 /** **15.209**	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*
15.205 / **15.209**	Radiated Spurious Emissions	Emissions <1 GHz (30M-1 GHz)	Radiated	Complies	*5.1.6.3*
15.207	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: *Appendix A - 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

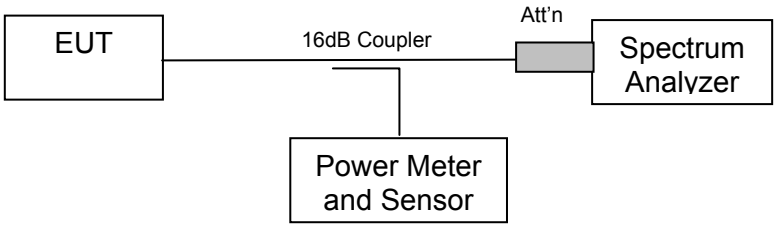
5.1.1. 6 dB and 99 % Operational Bandwidth

FCC, Part 15 Subpart C §15.247(a)(2)

Test Procedure

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

Test Measurement Set up



Measurement set up for 6 dB and 99 % bandwidth test

Measurement Results for 6 dB & 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

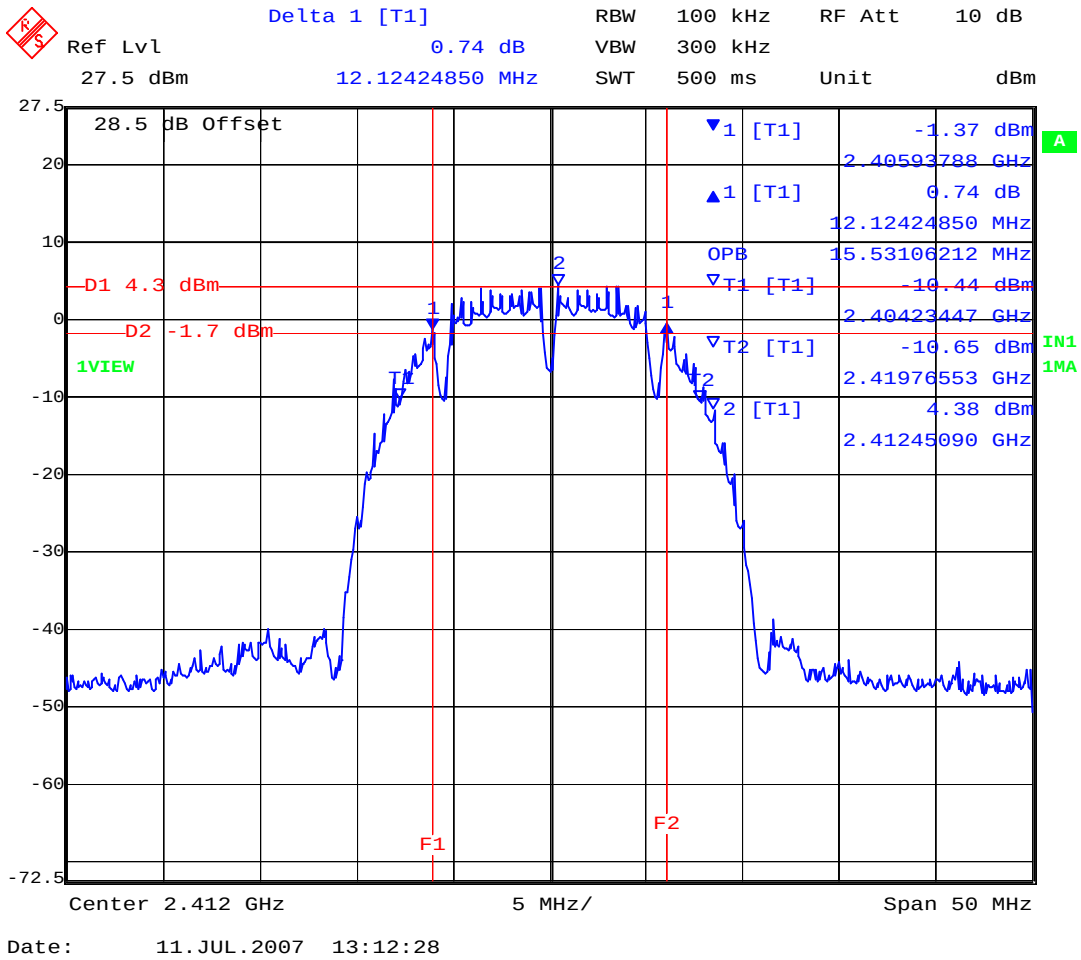
Measurement Results for 6 dB and 99 % Operational Bandwidth

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

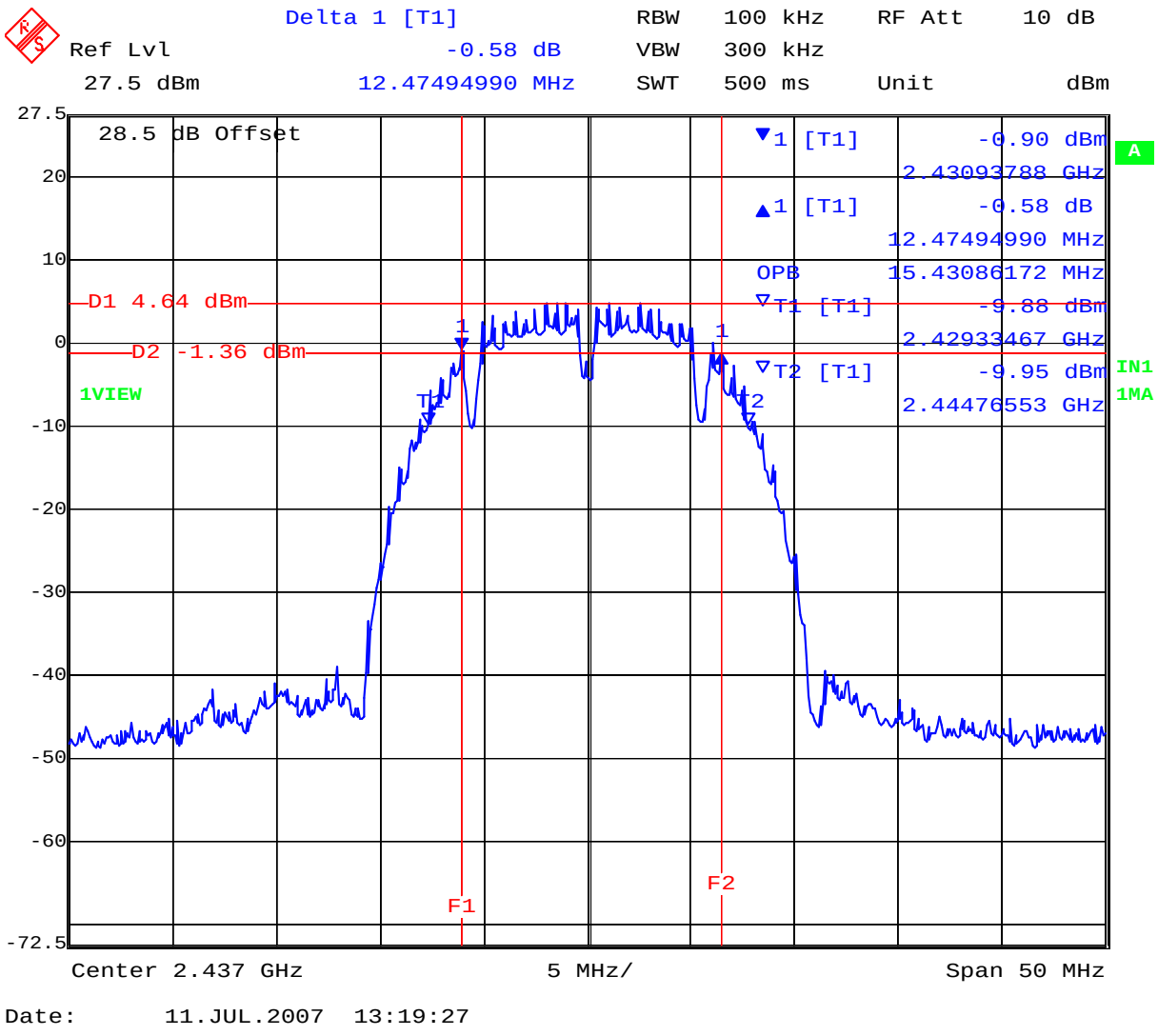
TABLE OF RESULTS – **802.11b - 1 Mb/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99 % BW (MHz)
2,412	12.124	15.531
2,437	12.475	15.431
2,462	11.022	15.531

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



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



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

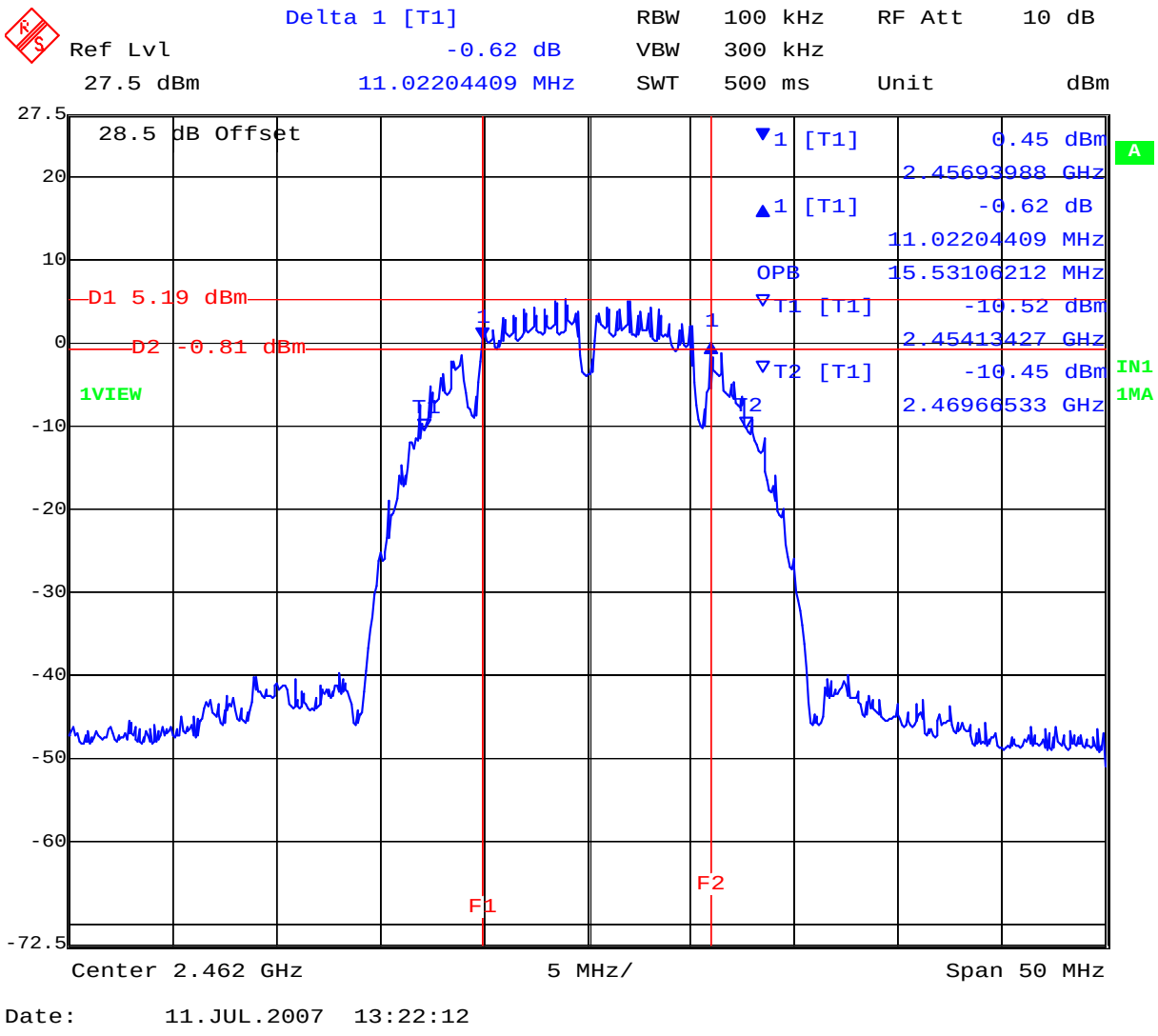
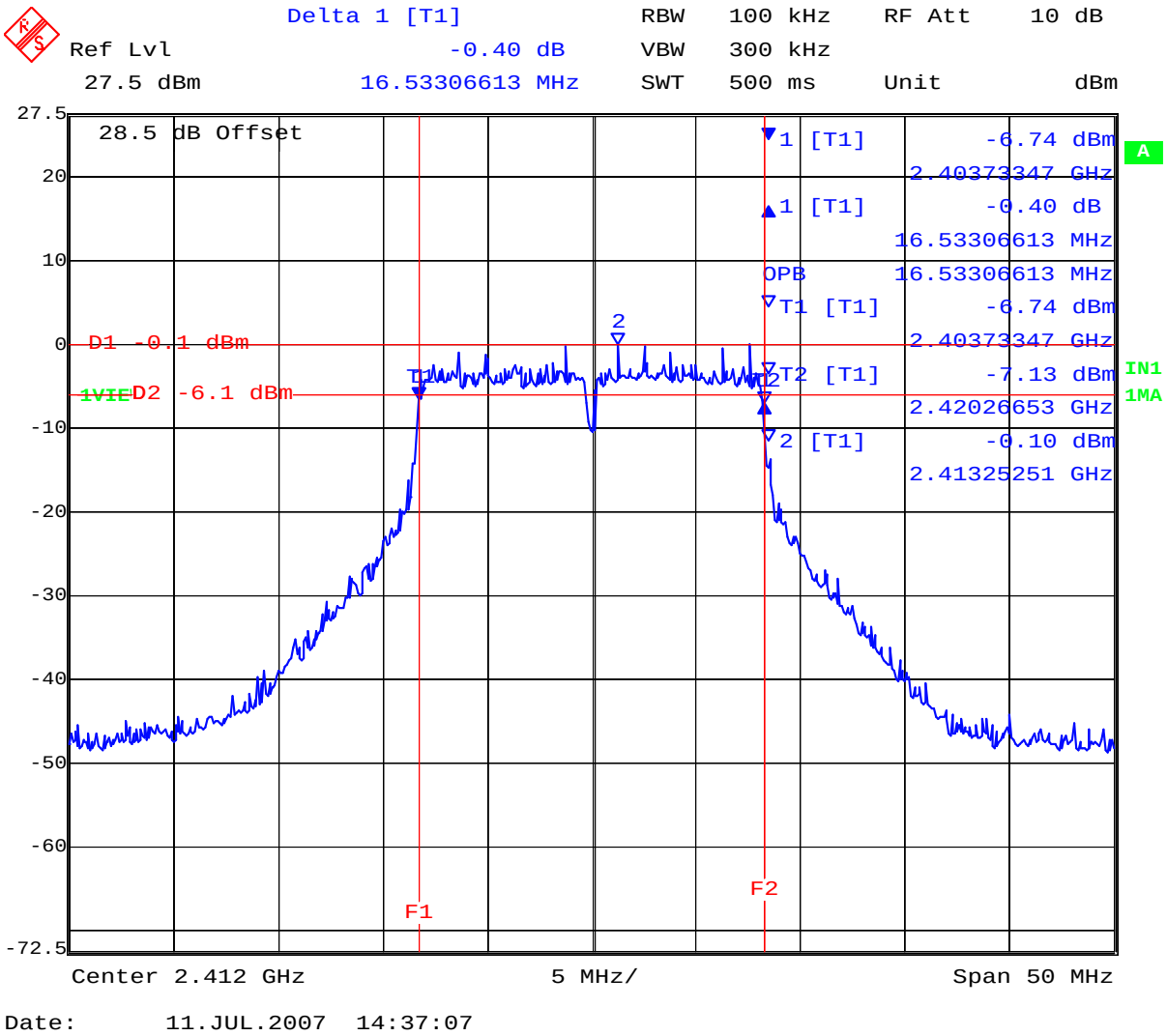


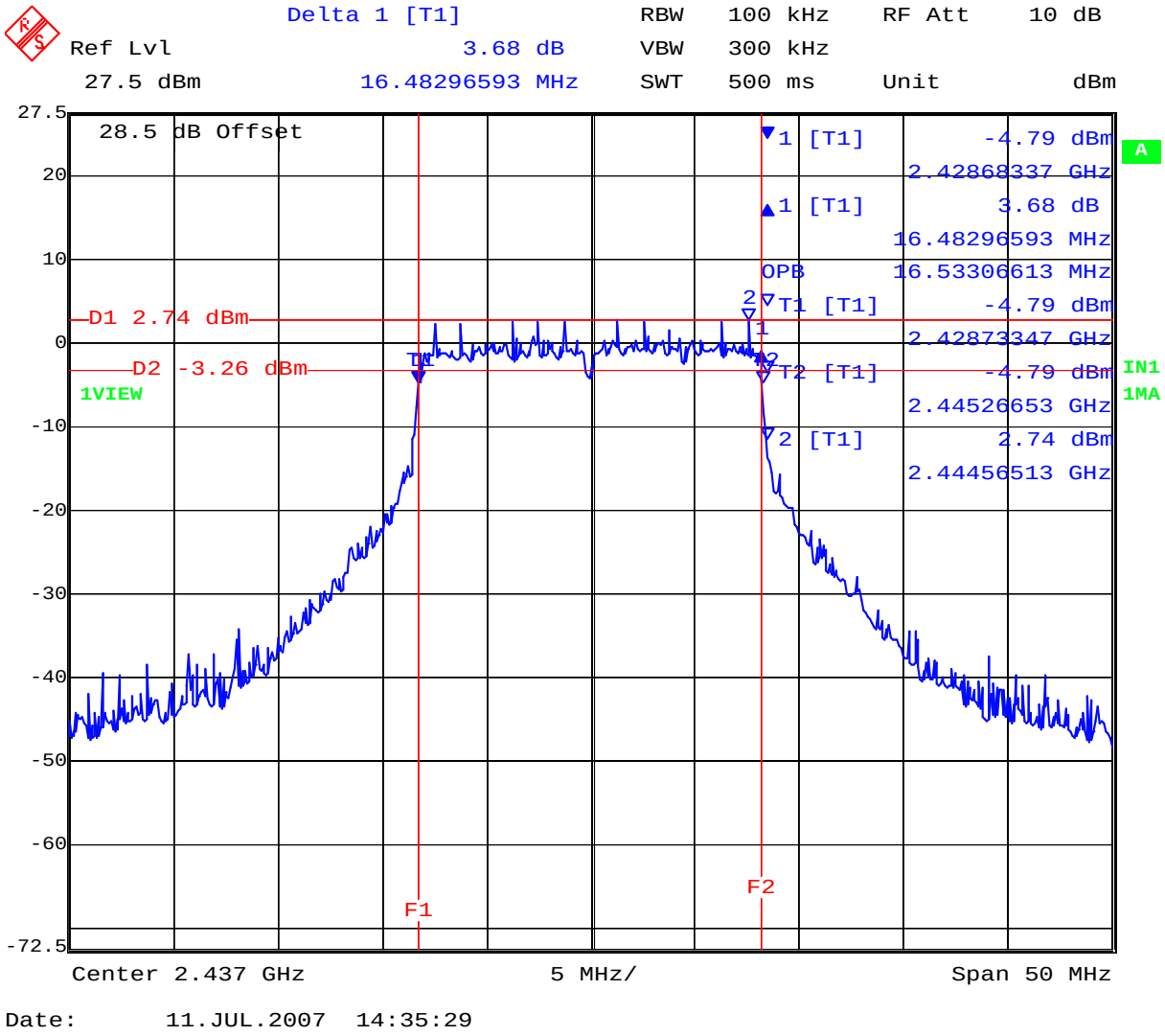
TABLE OF RESULTS – **802.11g - 6 Mb/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99 % BW (MHz)
2,412	16.533	16.533
2,437	16.483	16.533
2,462	16.432	16.533

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



2,437 MHz 802.11G 6 dB & 99% Bandwidth



2,462 MHz 802.11G 6 dB & 99% Bandwidth

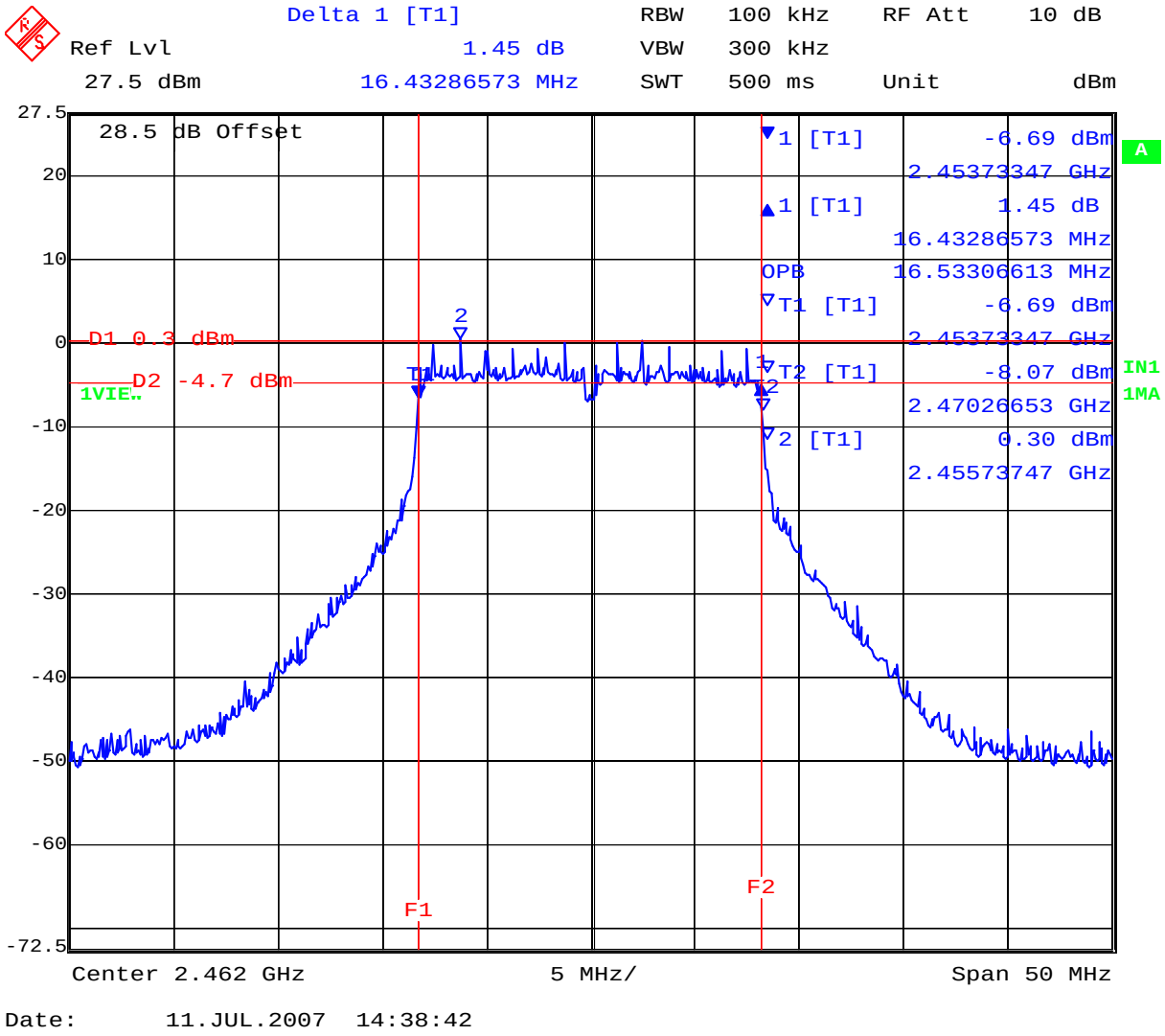
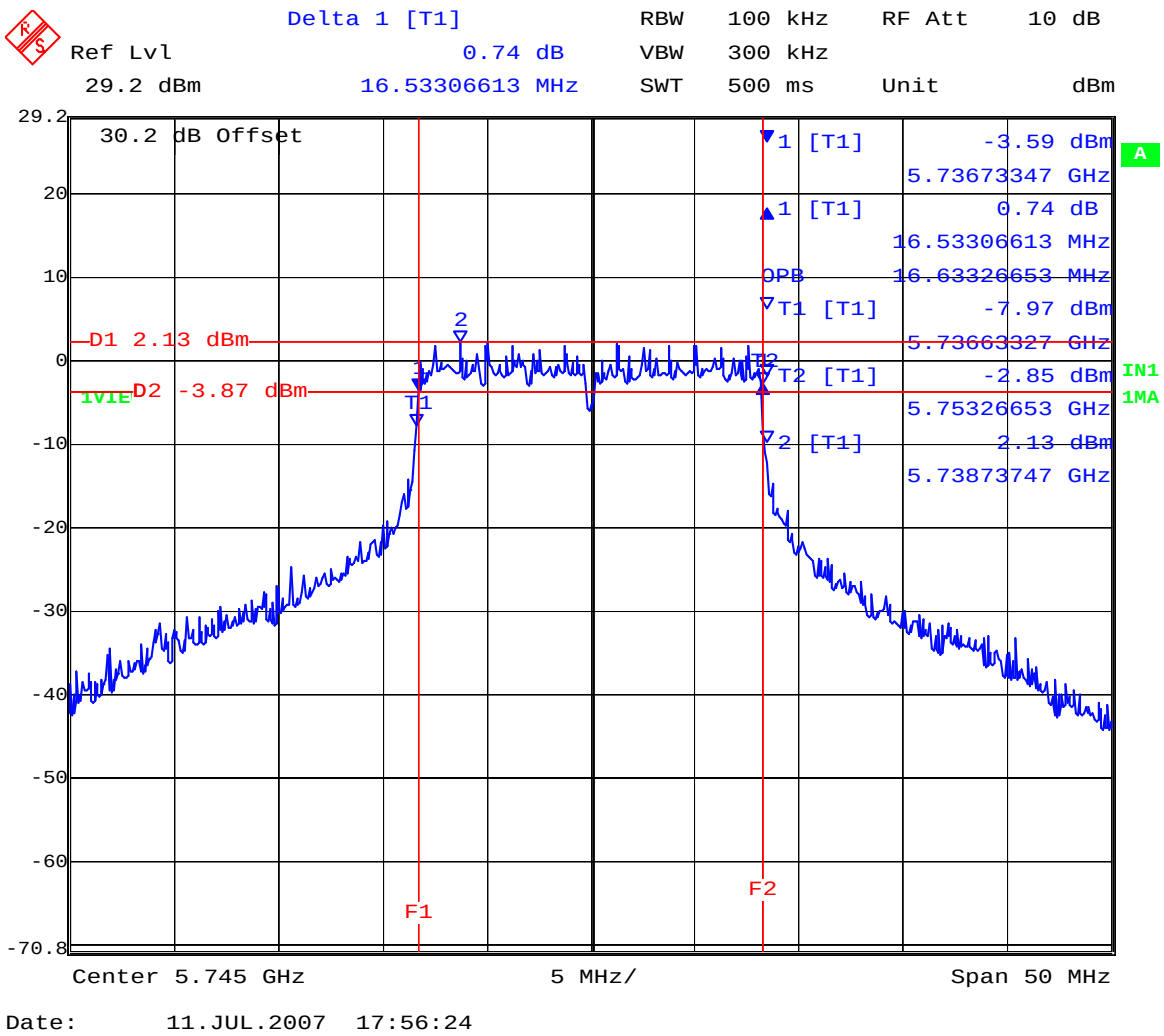


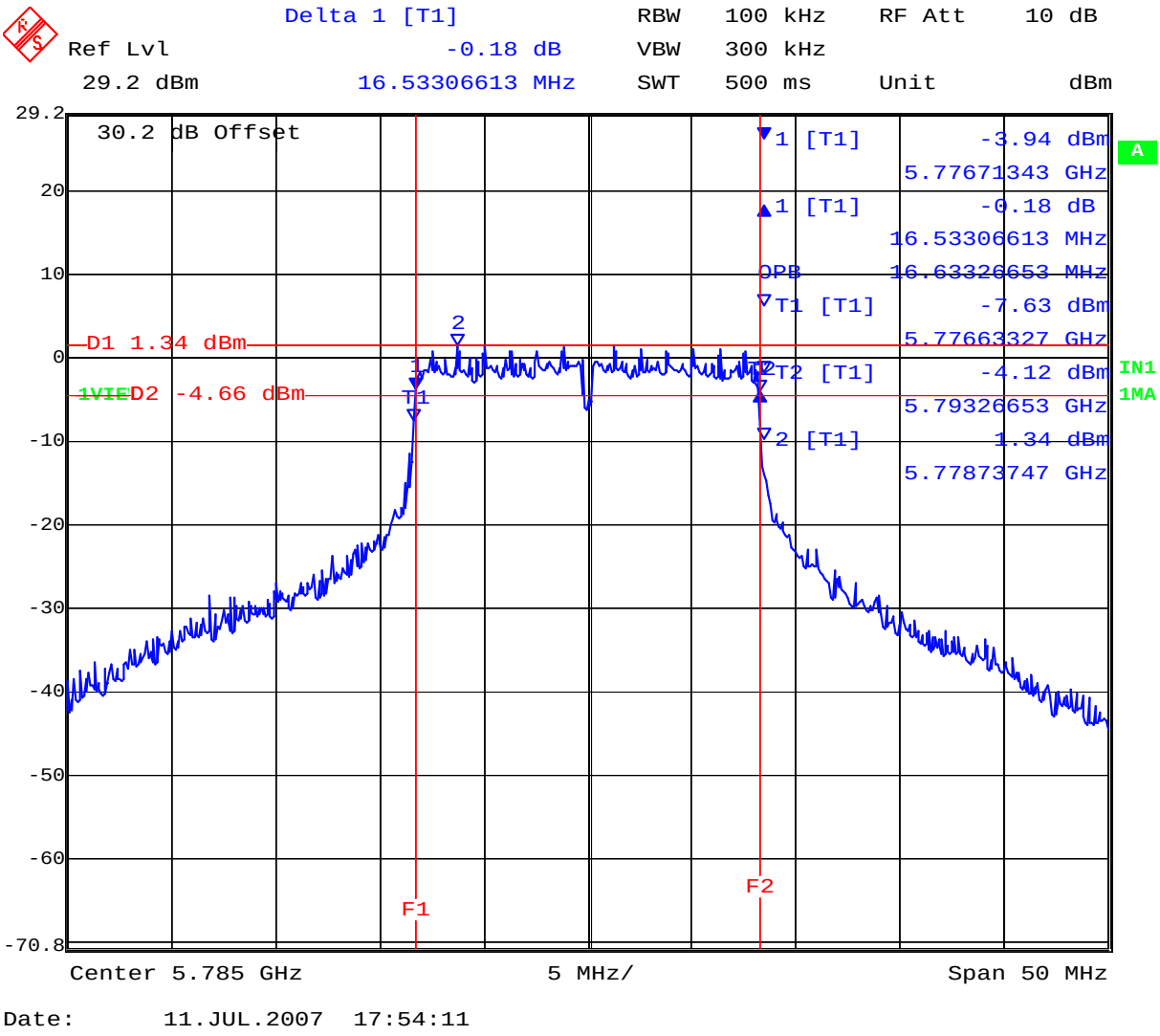
TABLE OF RESULTS – **802.11a - 6 Mb/s**

Center Frequency (MHz)	6 dB Bandwidth (MHz)	99 % BW (MHz)
5,745	16.533	16.633
5,785	16.533	16.633
5,825	16.533	16.533

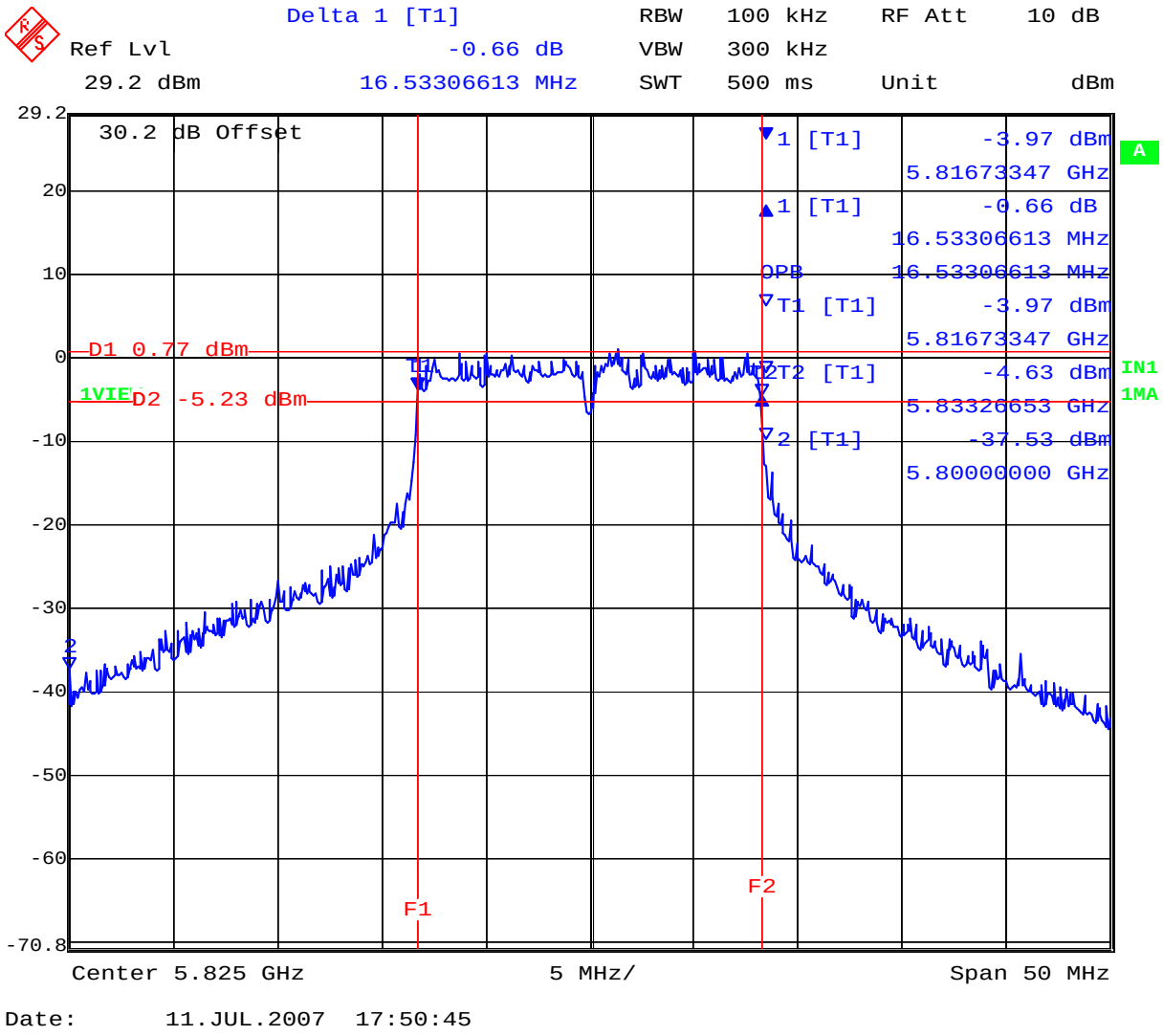
5,745 MHz 802.11a 6 dB & 99% Bandwidth



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



5,825 MHz 802.11a 6 dB & 99% Bandwidth



Specification

Limits

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

Laboratory Measurement Uncertainty for Spectrum Measurement

Measurement uncertainty	±2.81 dB

Traceability

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

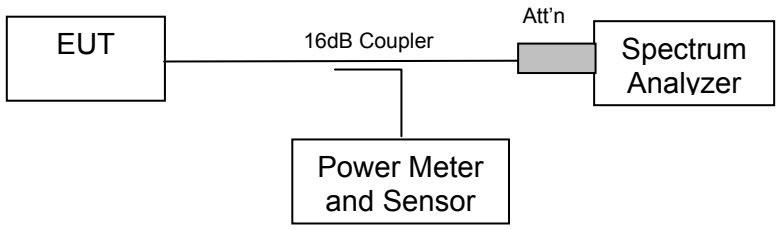
5.1.2. Peak Output Power

FCC, Part 15 Subpart C §15.247(b)(3), §15.31(e)

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

Measurement Results for Peak Output Power

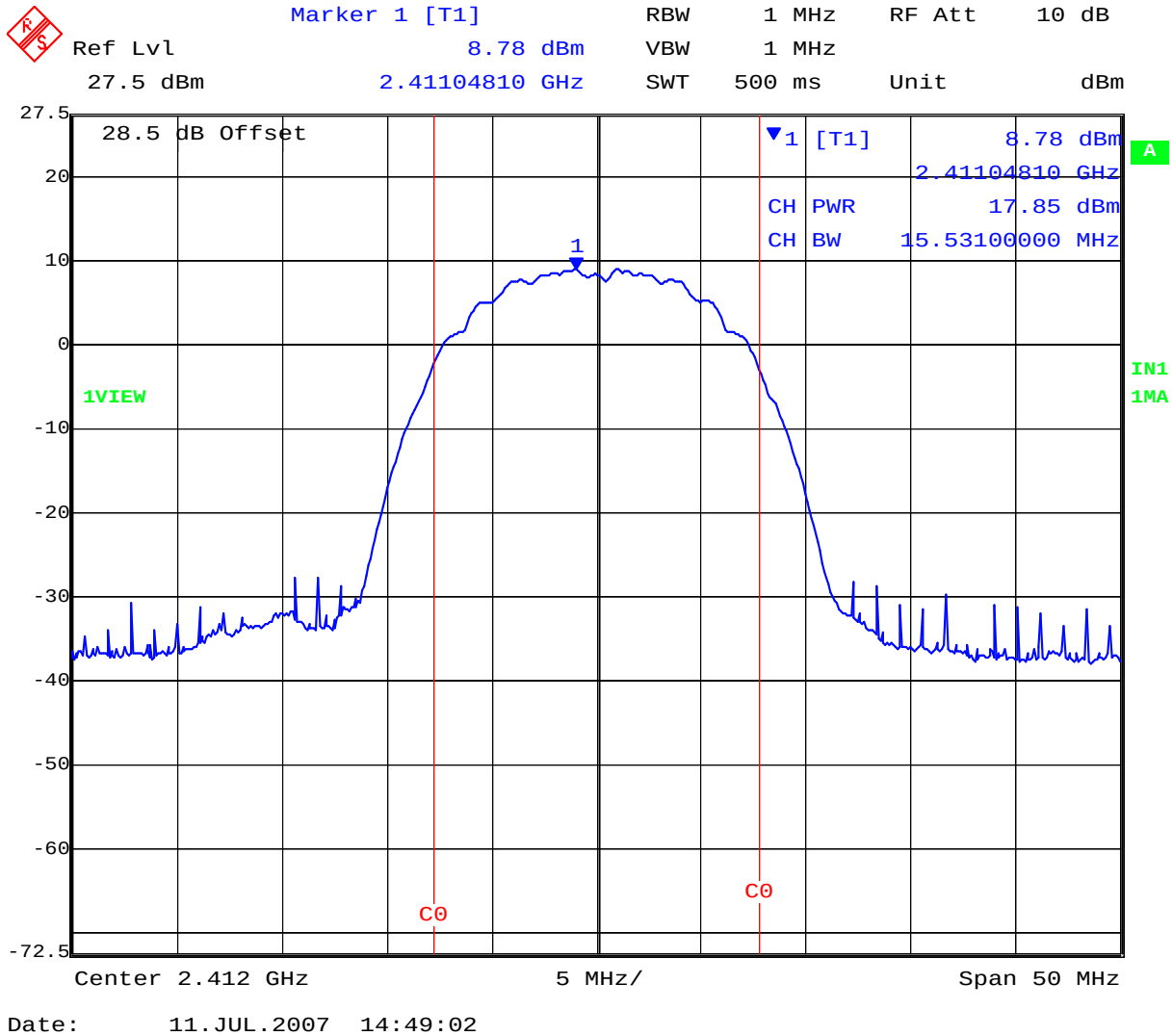
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier
Power: Maximum
Antenna Gain: b/g Maximum Antenna Gain = +2.5 dBi, a Maximum Antenna Gain = +3 dBi

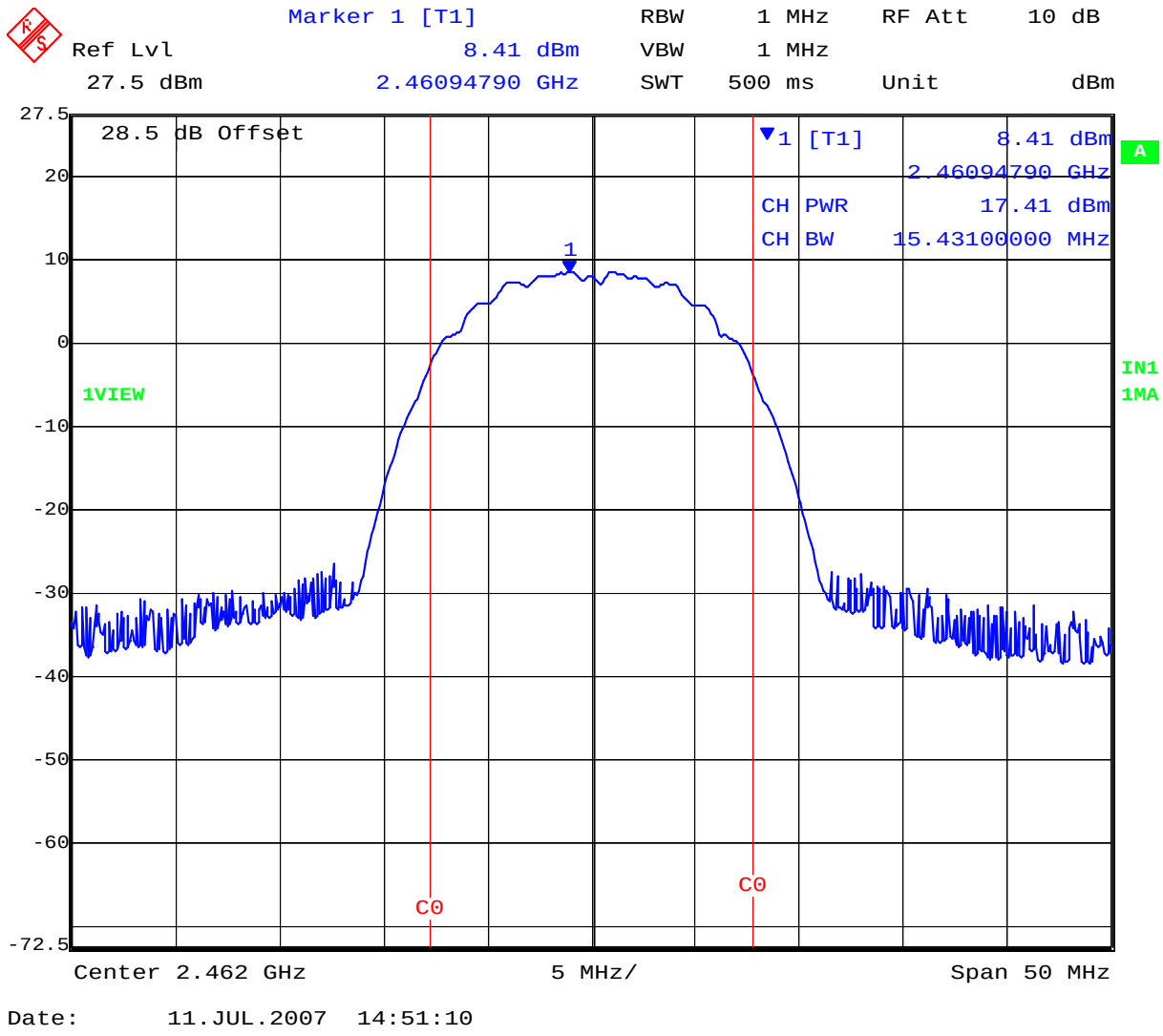
TABLE OF RESULTS – **802.11b, 1Mb/s** Maximum Antenna Gain = +2.5 dBi

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)
2,412	15.531	+17.85	+20.35
2,437	15.431	+17.41	+19.91
2,462	15.531	+17.53	+20.03

2,412 MHz 802.11b Peak Power (dBm)



2,437 MHz 802.11b Peak Power (dBm)



2,462 MHz 802.11b Peak Power (dBm)

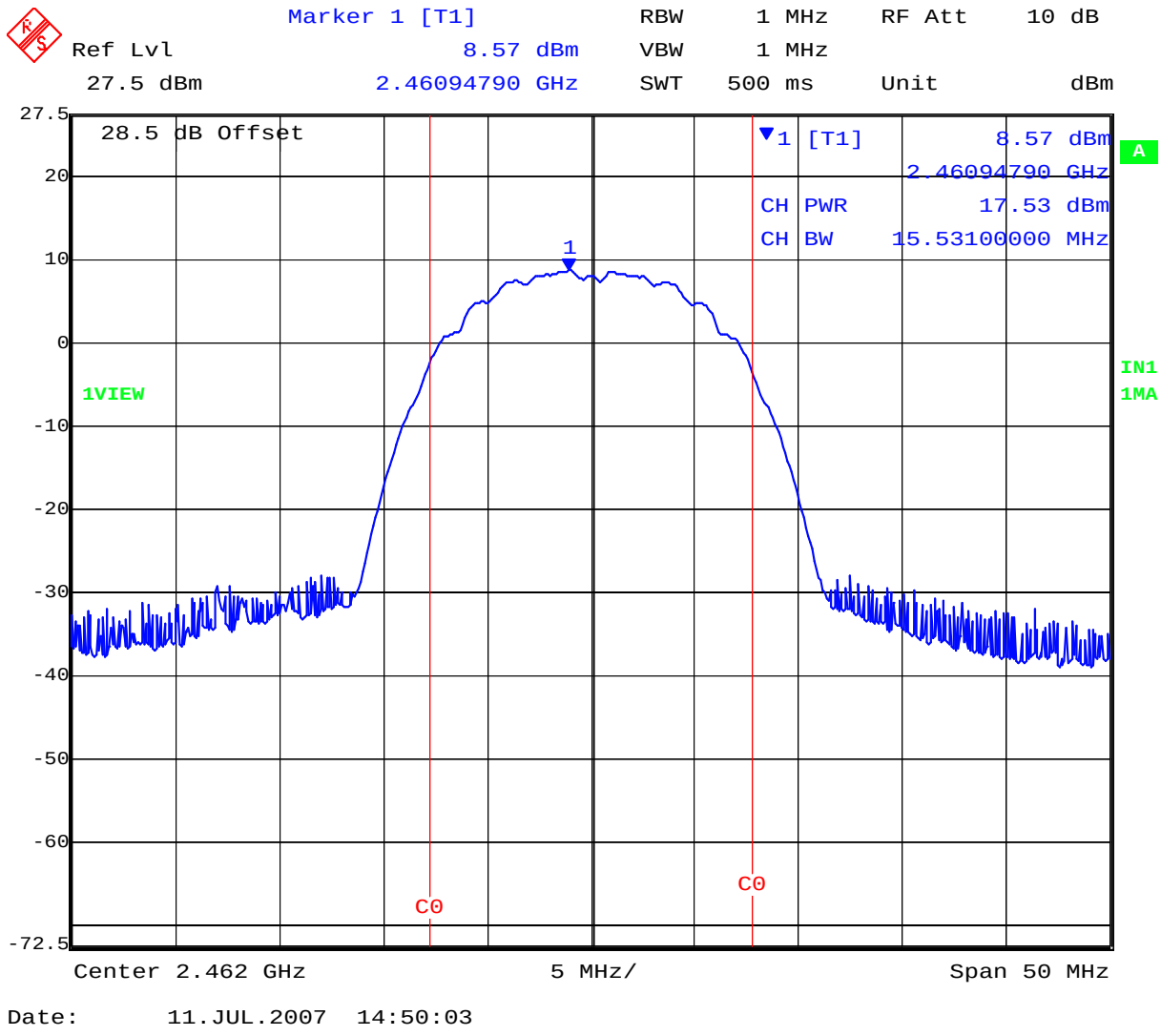
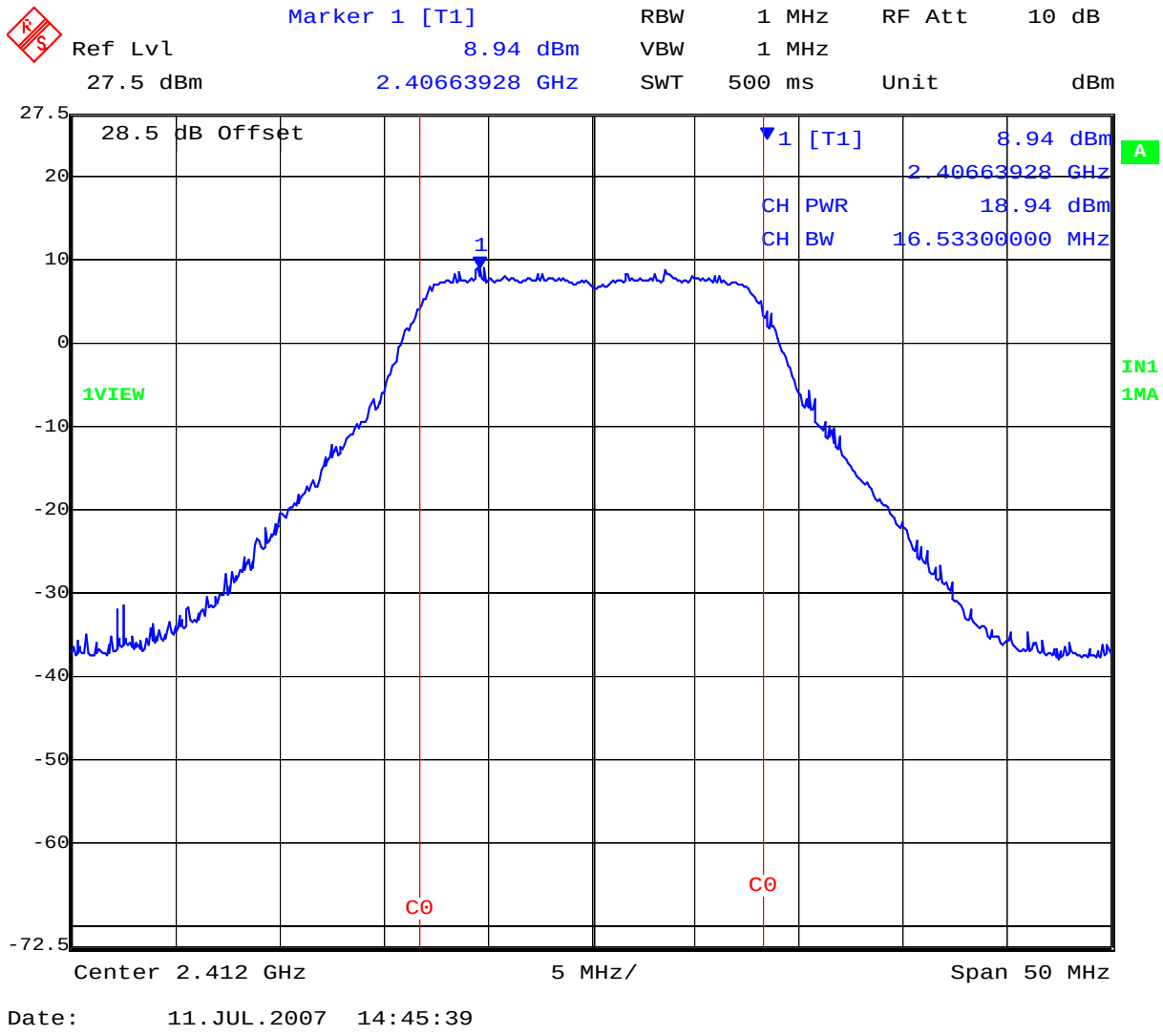


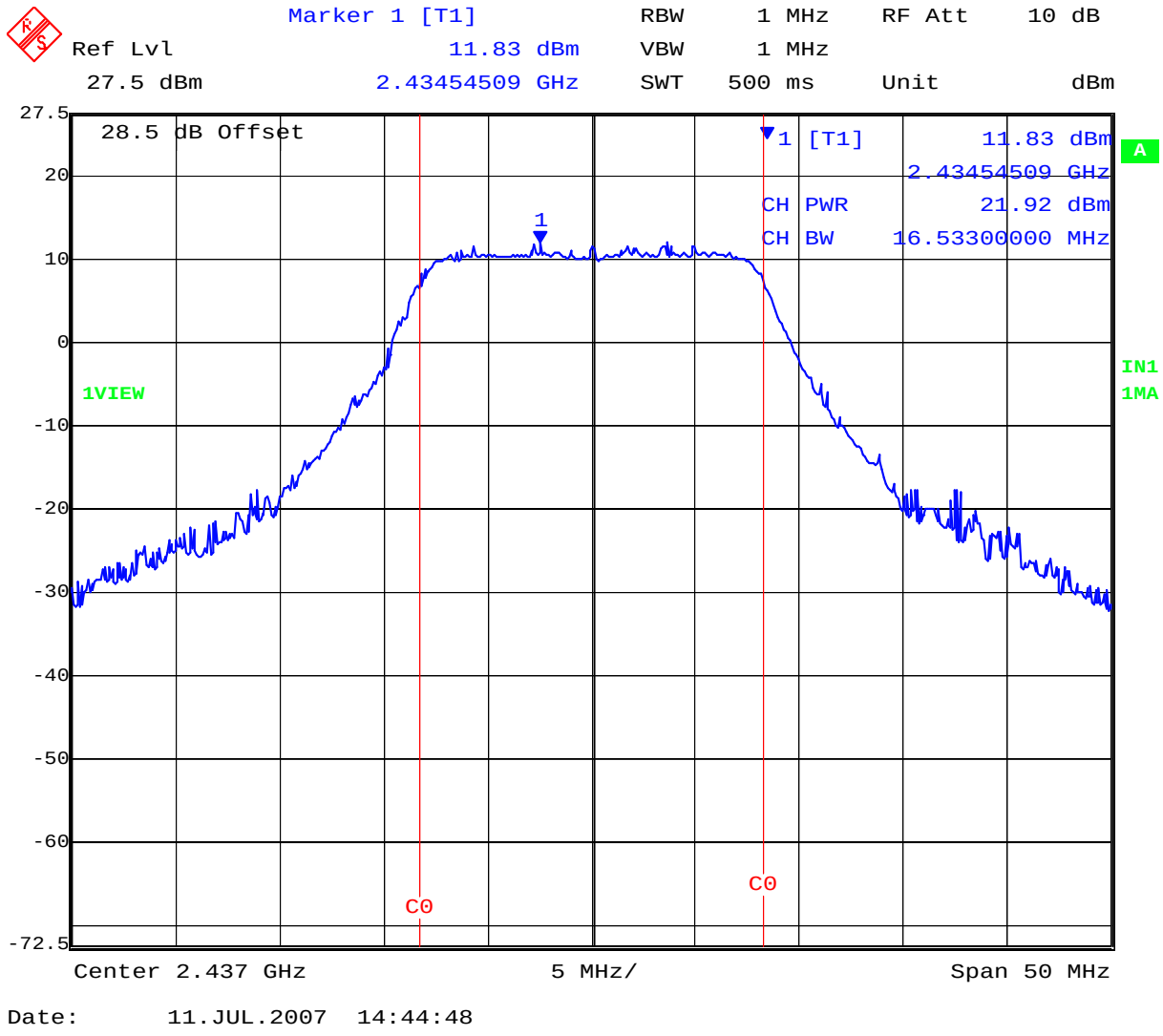
TABLE OF RESULTS – **802.11g, 6Mb/s** Maximum Antenna Gain = +2.5 dBi

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)
2,412	16.533	+18.94	+21.44
2,437	16.533	+21.92	+24.42
2,462	16.533	+19.13	+21.63

2,412 MHz 802.11g Peak Power (dBm)



2,437 MHz 802.11g Peak Power (dBm)



2,462 MHz 802.11g Peak Power (dBm)

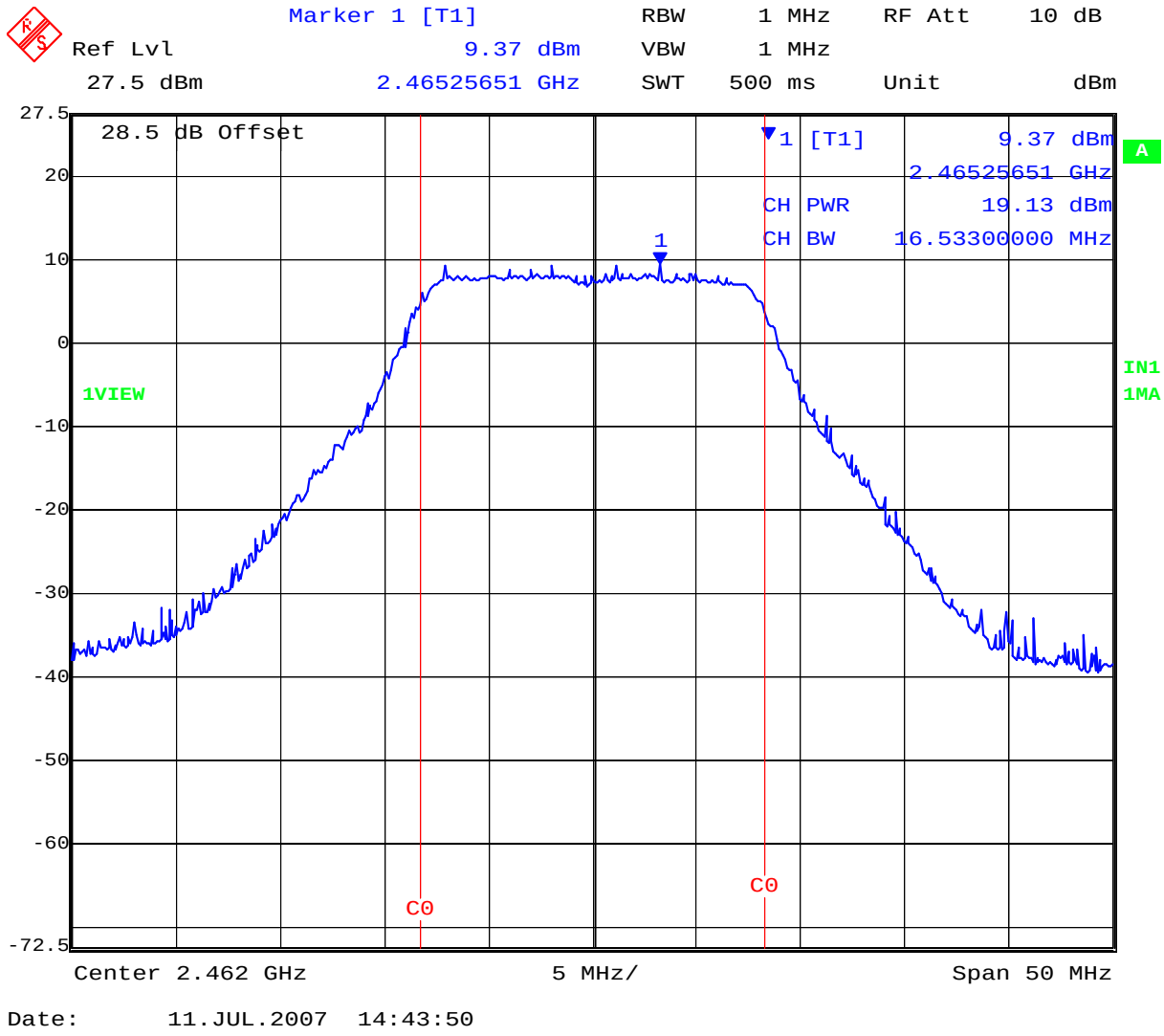
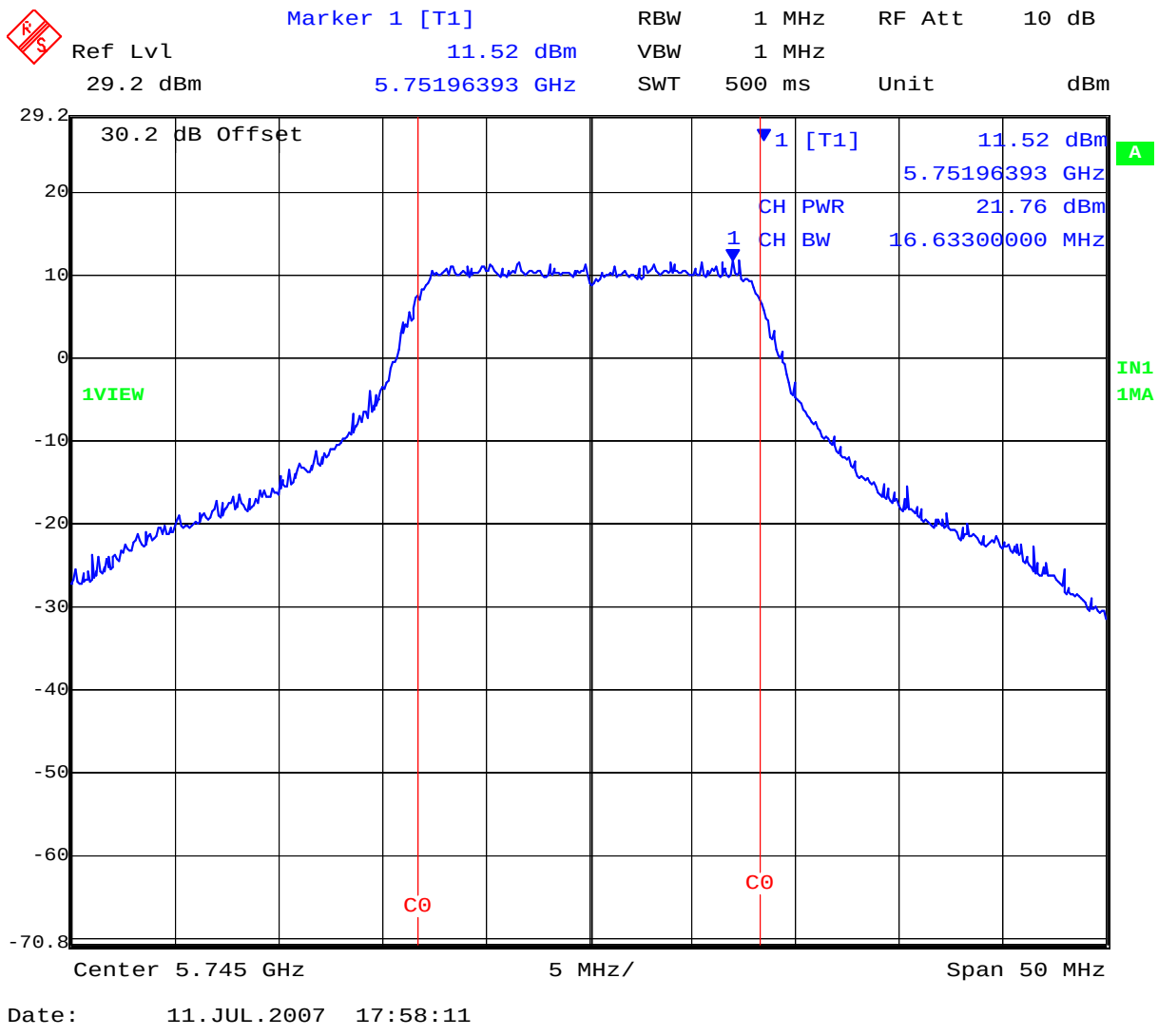


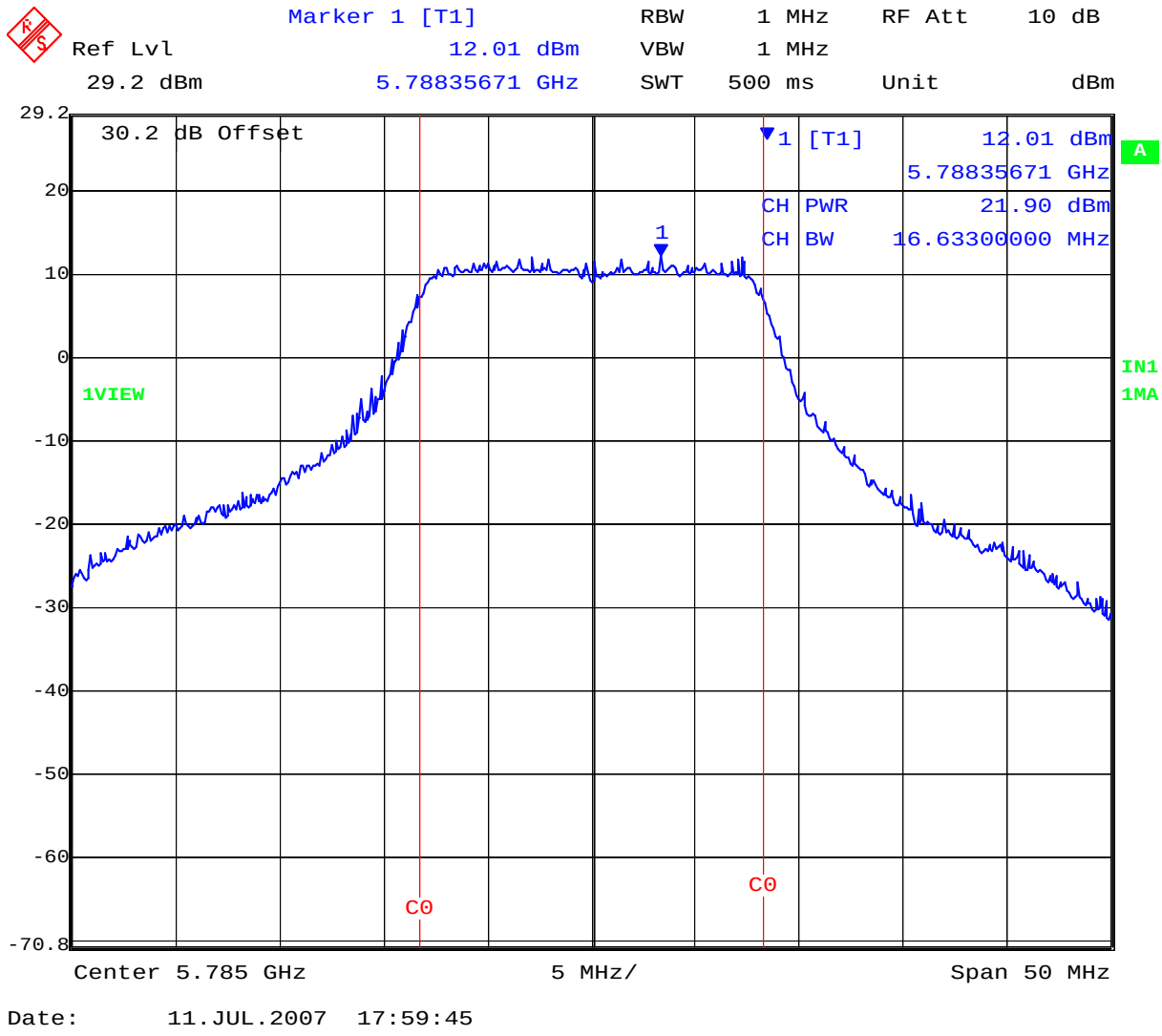
TABLE OF RESULTS – **802.11a, 6 Mb/s** Maximum Antenna Gain = +3 dBi

Center Frequency (MHz)	99% Measurement Bandwidth (MHz)	Peak Power (dBm)	EIRP (dBm)
5,745	16.633	+21.76	+24.76
5,785	16.633	+21.90	+24.90
5,825	16.533	+21.25	+24.25

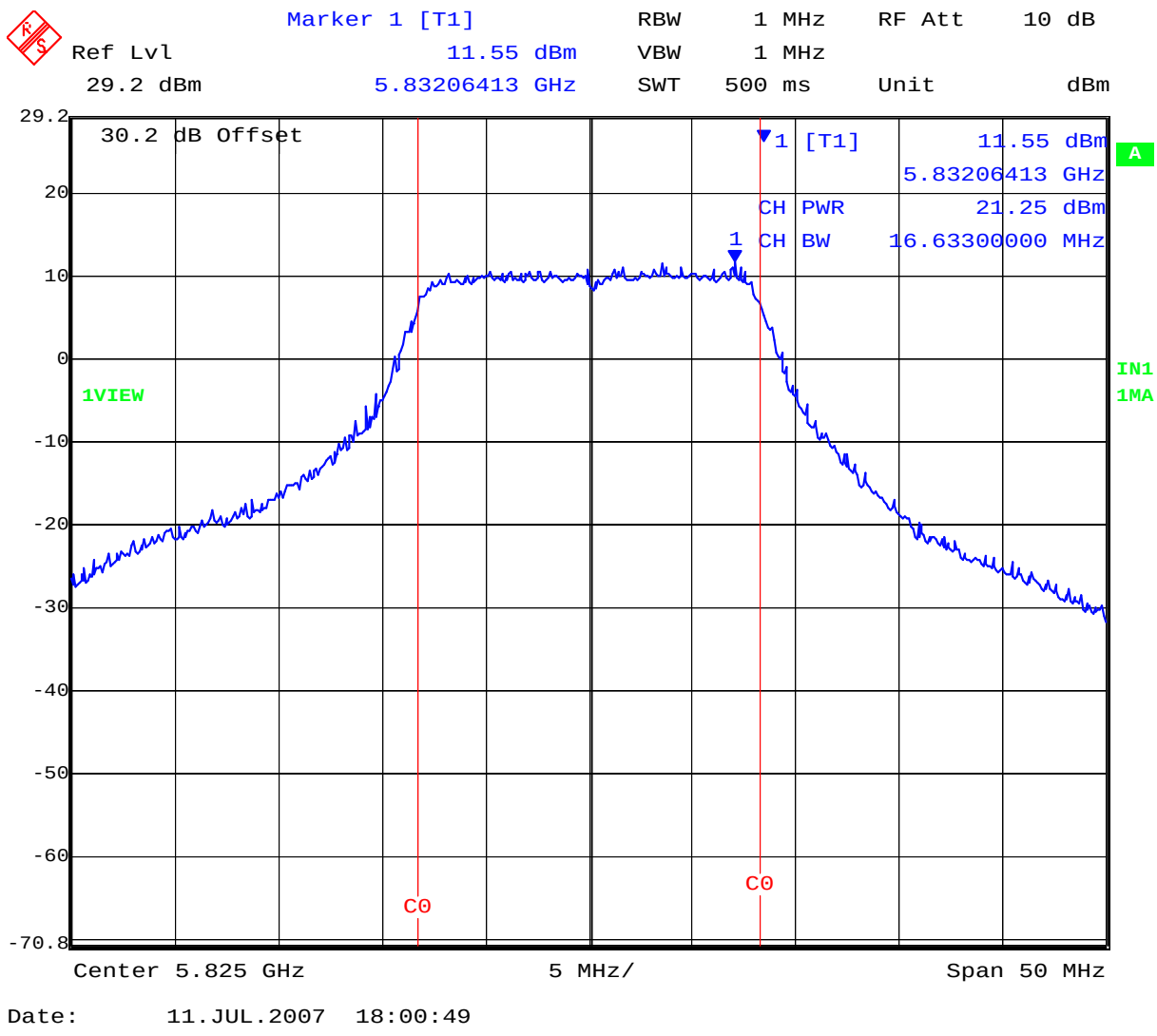
5,745 MHz 802.11a Peak Power (dBm)



5,785 MHz 802.11a Peak Power (dBm)



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.

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

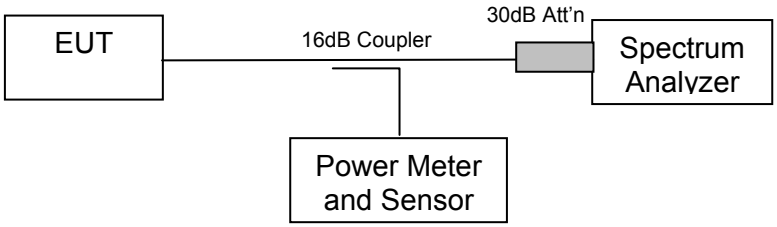
5.1.3. Peak Power Spectral Density

FCC, Part 15 Subpart C §15.247(e)

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

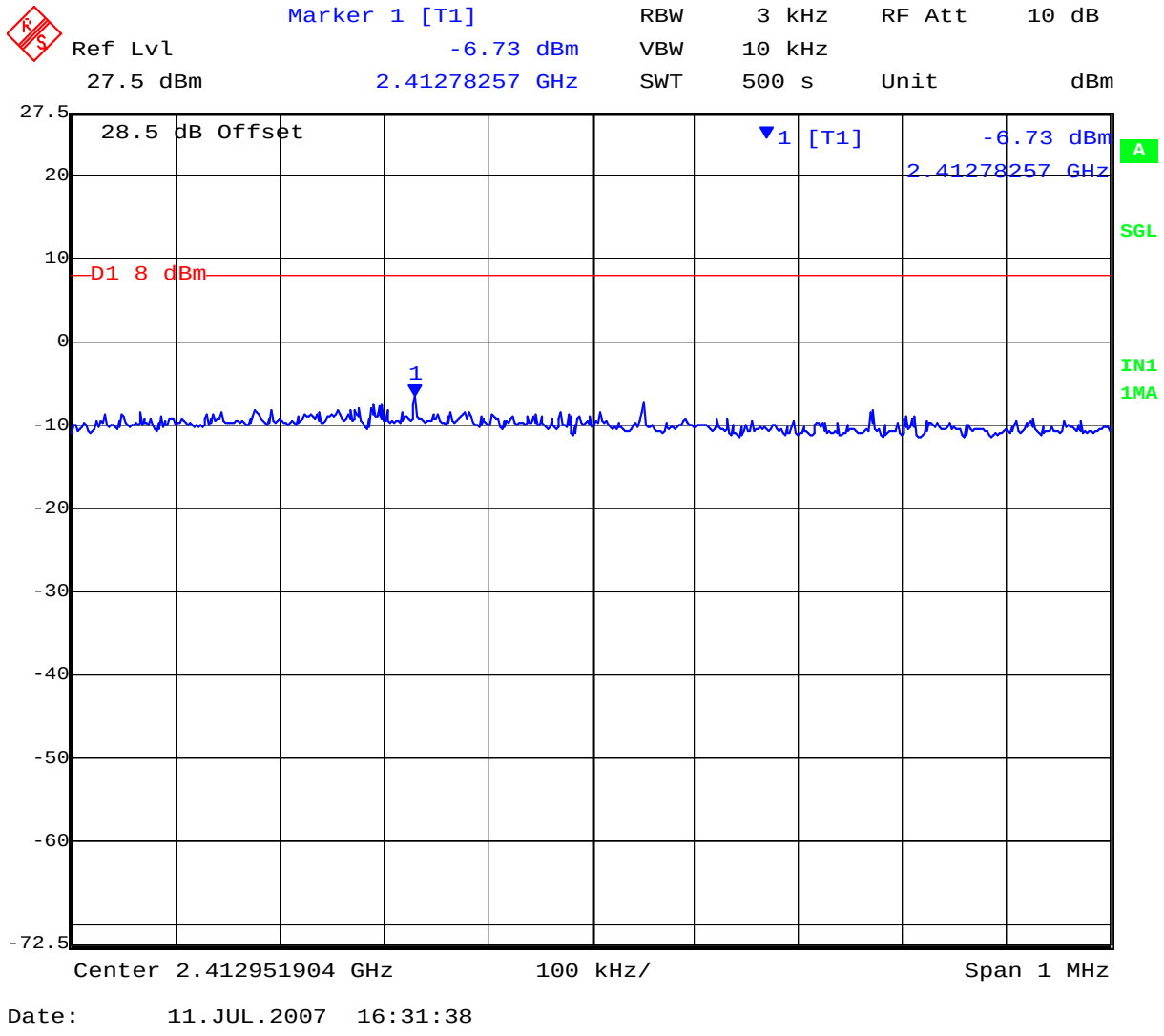
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

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

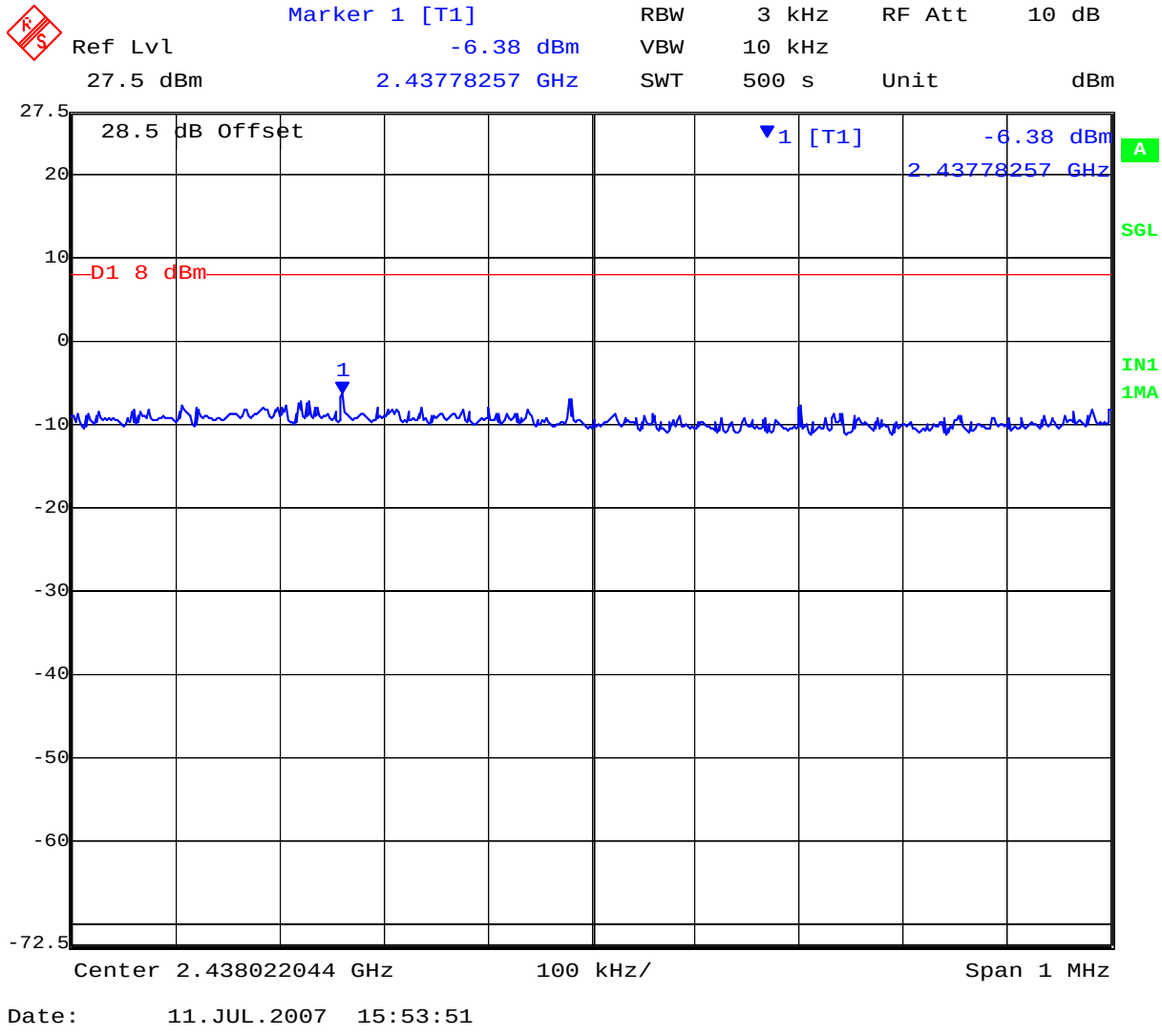
TABLE OF RESULTS – **802.11b – 1Mb/s**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2412.78257	-6.73	+8	-14.73
2,437	2437.78257	-6.38	+8	-14.38
2,462	2461.22345	-6.87	+8	-14.87

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

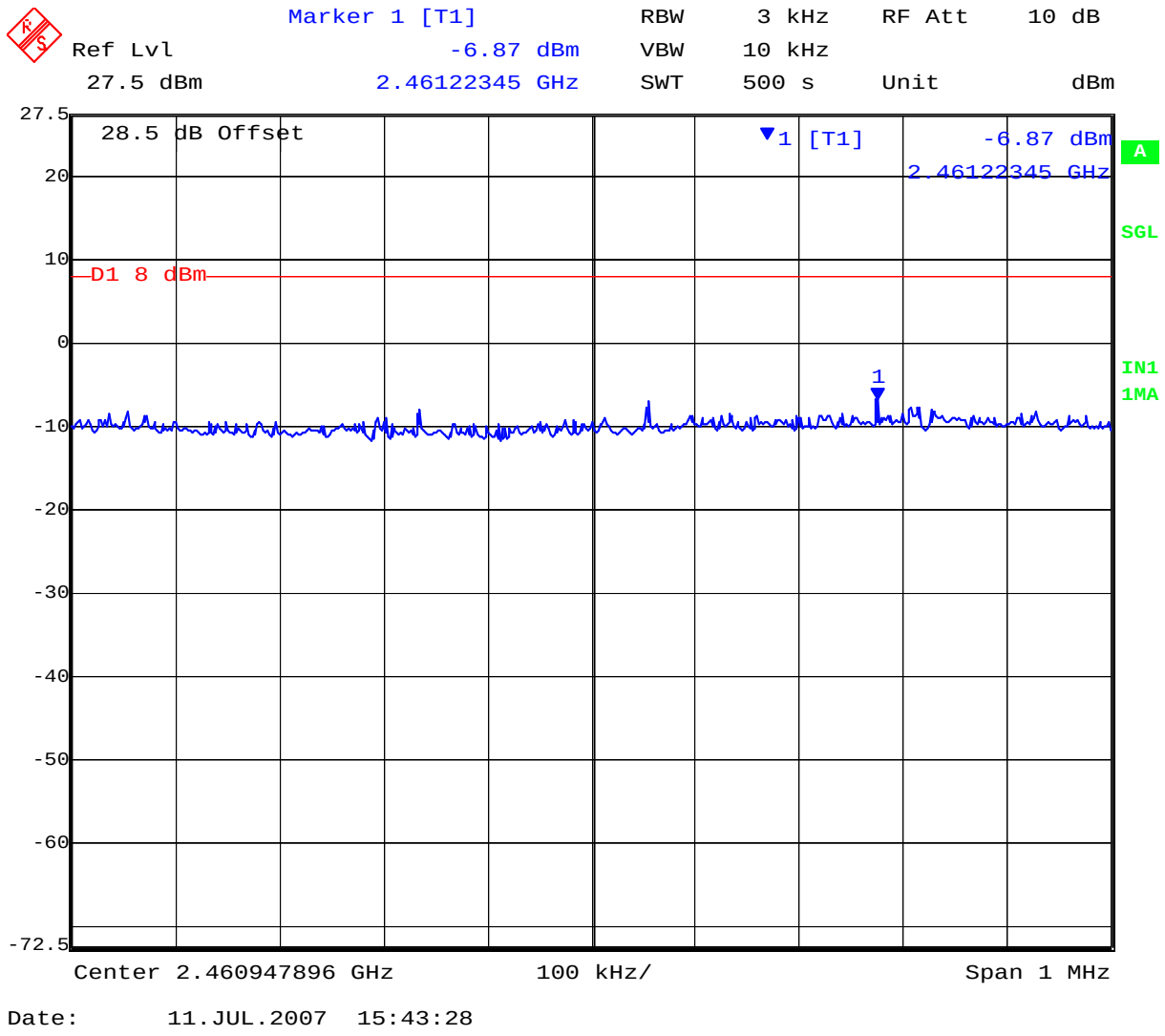
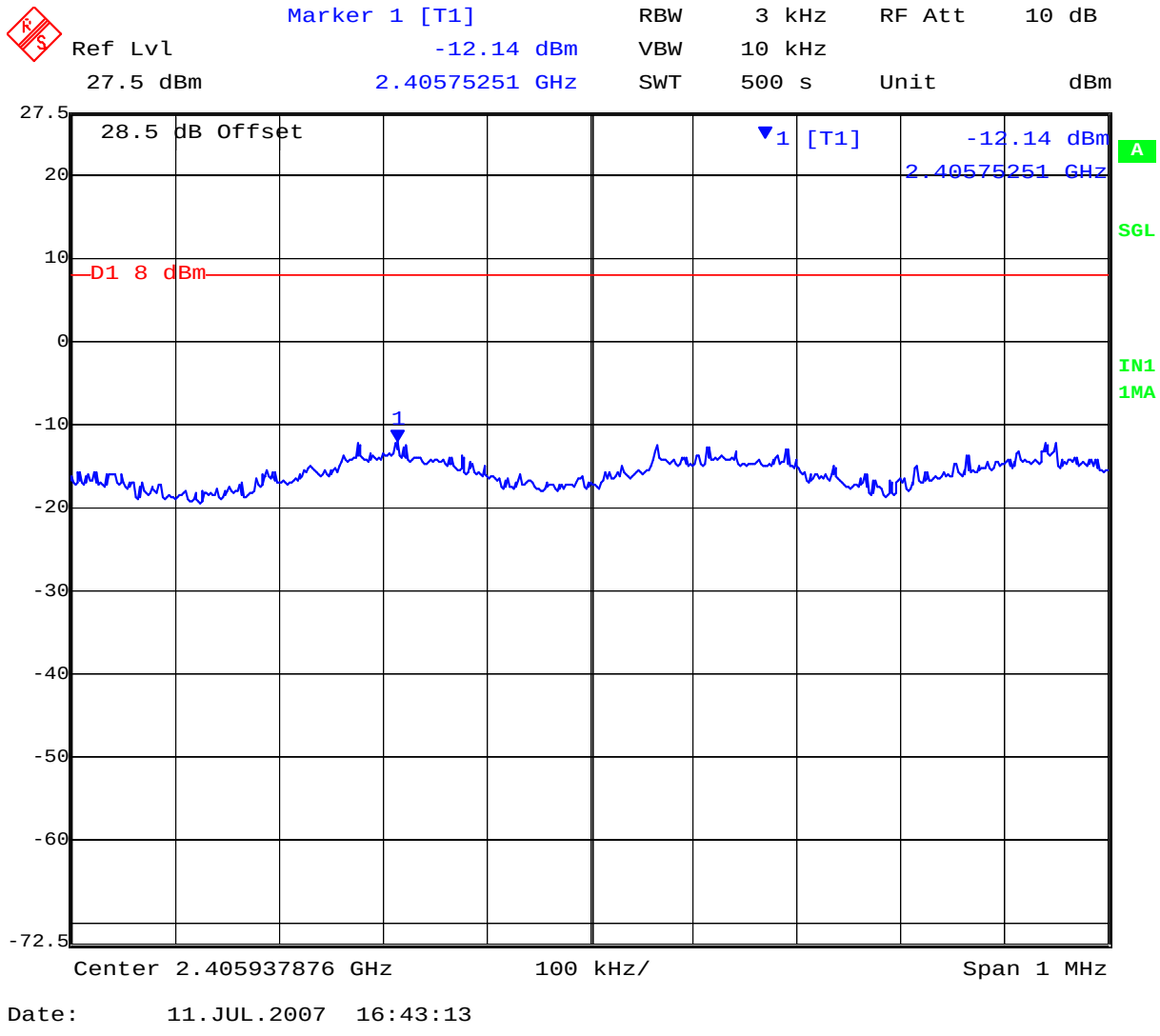


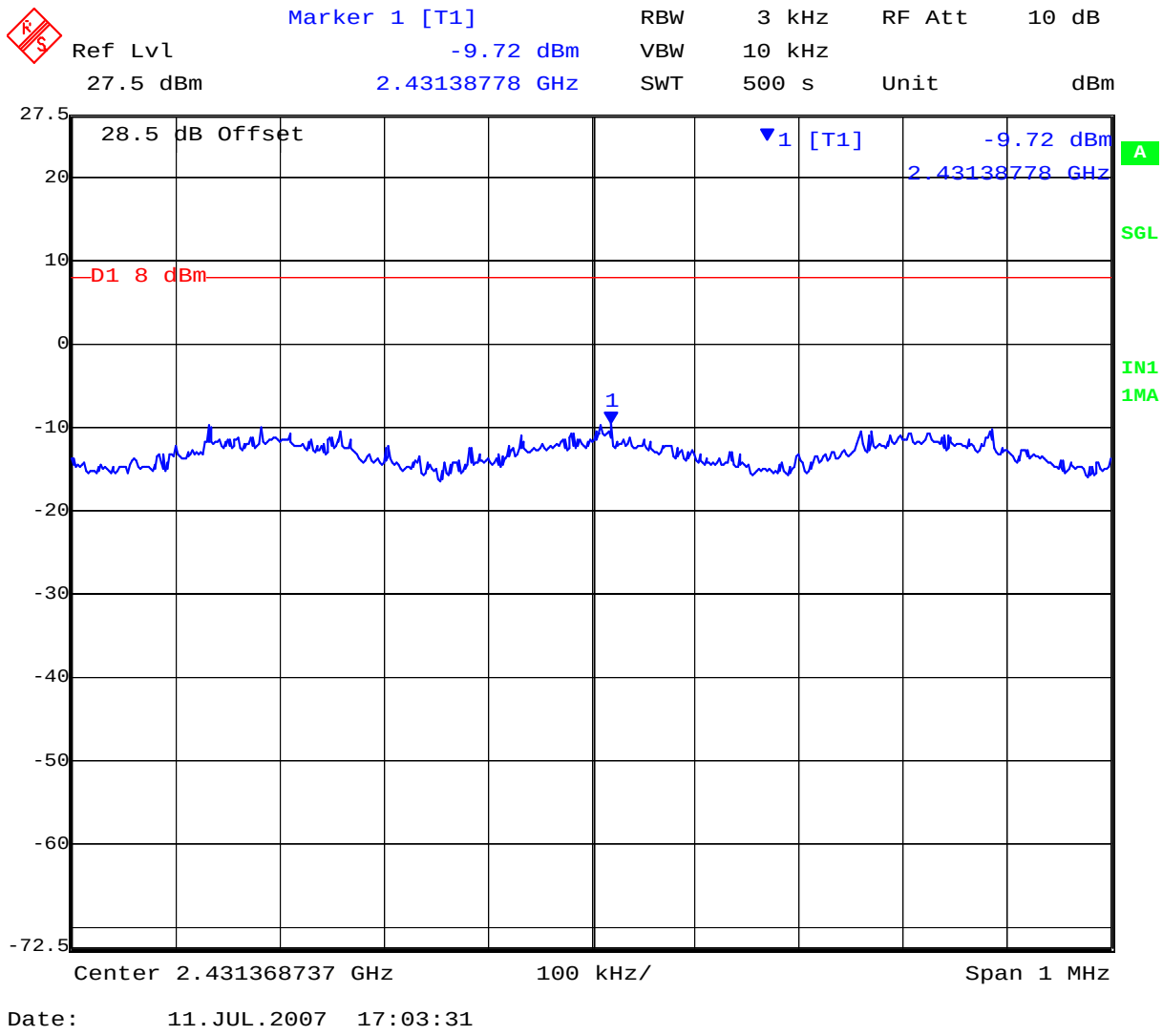
TABLE OF RESULTS – **802.11g – 6 Mb/s**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
2,412	2405.75251	-12.14	+8	-20.14
2,437	2431.38778	-9.72	+8	-17.72
2,462	2465.75251	-11.91	+8	-19.91

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

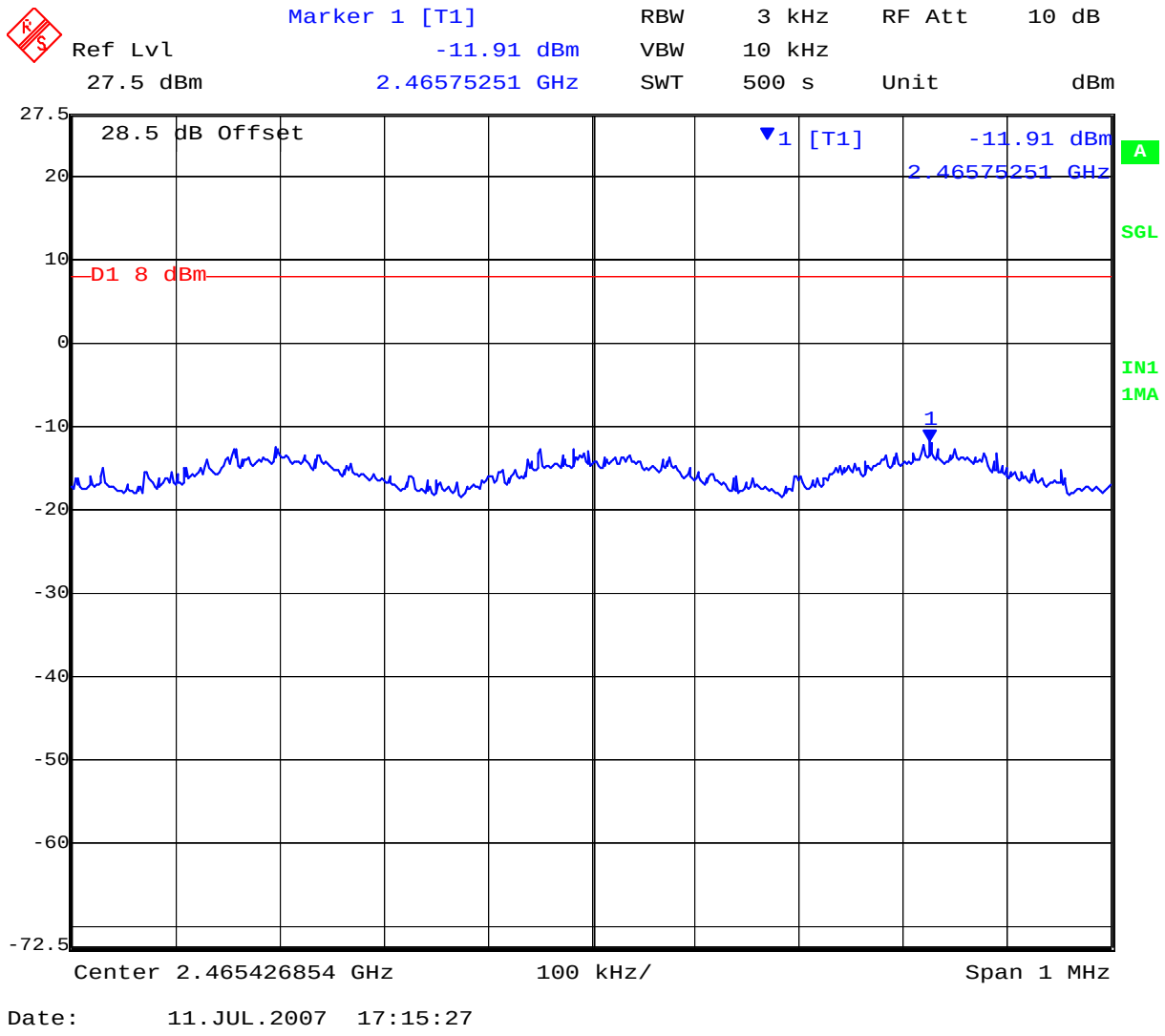
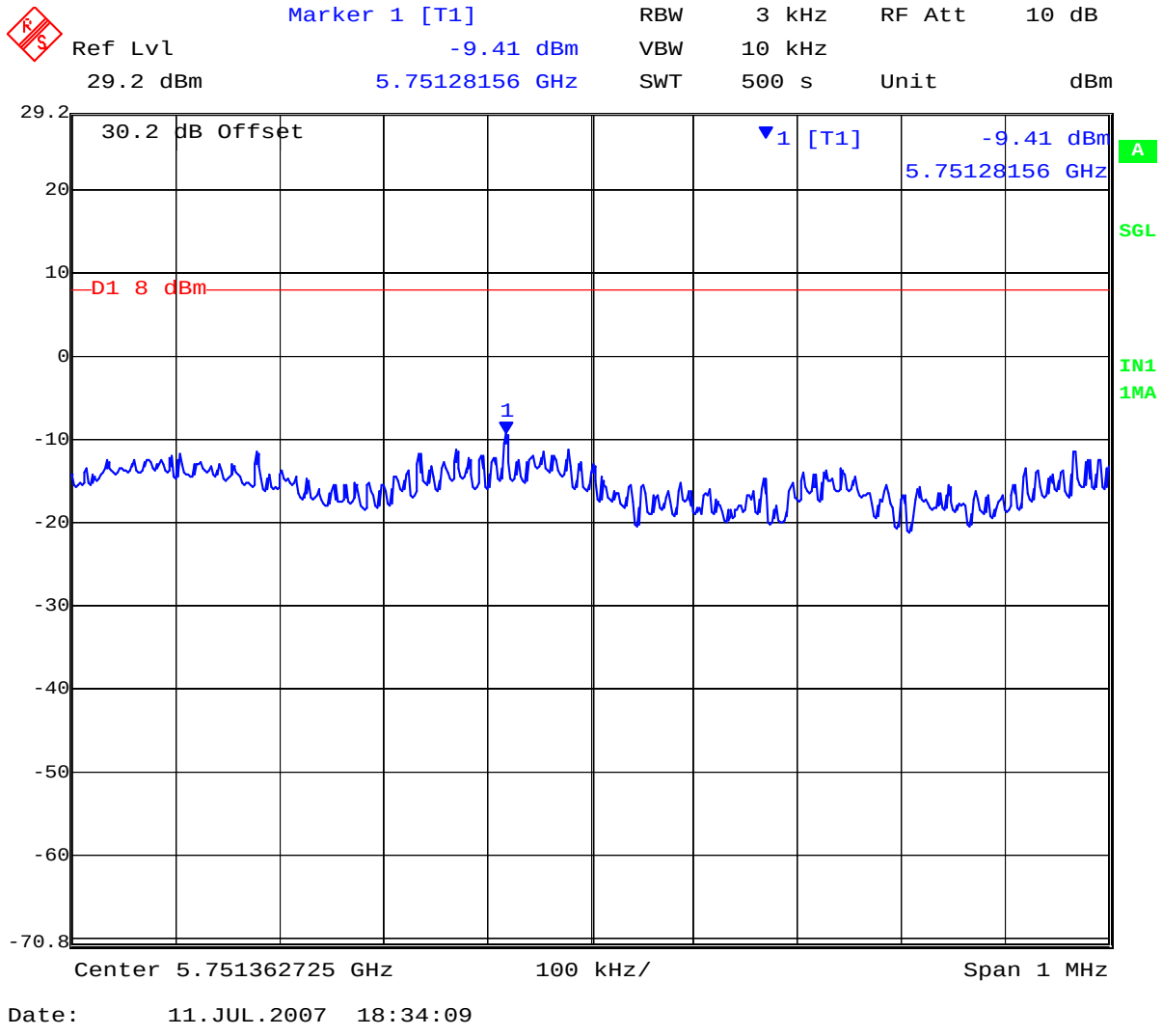


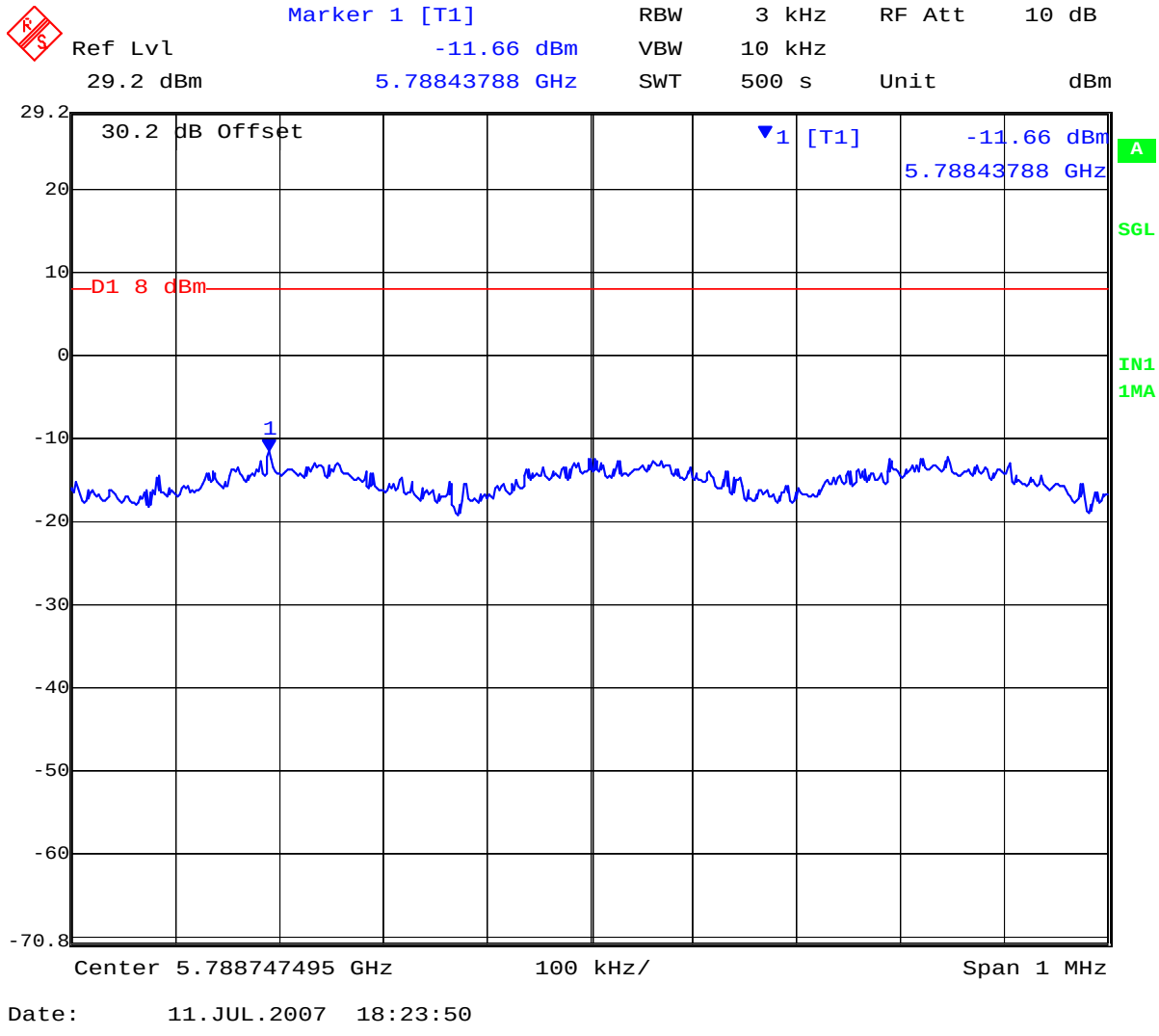
TABLE OF RESULTS – **802.11a – 6Mbit/s**

Center Frequency (MHz)	Peak Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dBm)
5,745	5751.28156	-9.41	+8	-17.41
5,785	5788.43788	-11.66	+8	-19.66
5,825	5832.23347	-11.04	+8	-19.04

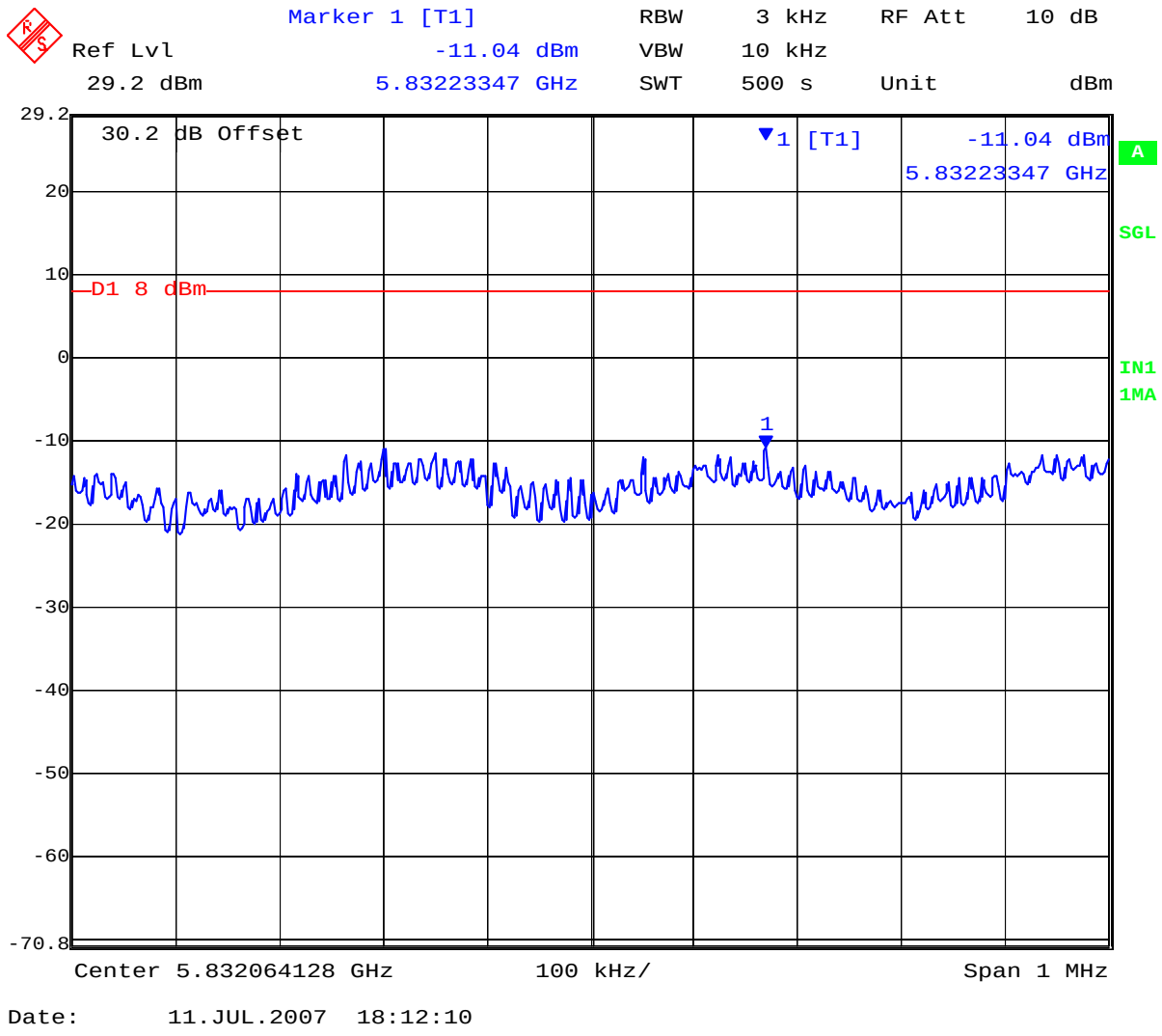
5,745 MHz 802.11a Peak Power Spectral Density



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

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)

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)

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)
2.4(b)	2.5	1.78	+17.85	60.95	2.94
2.4(g)	2.5	1.78	+21.92	155.60	4.70
5.8	3.0	1.99	+21.90	154.88	4.96

Specification

Maximum Permissible Exposure Limits

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

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

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

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

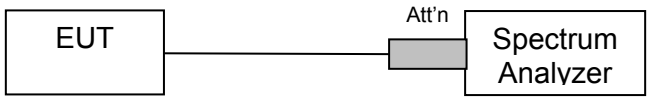
5.1.5. Conducted Spurious Emissions

FCC, Part 15 Subpart C §15.247(d); 15.205; 15.209

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

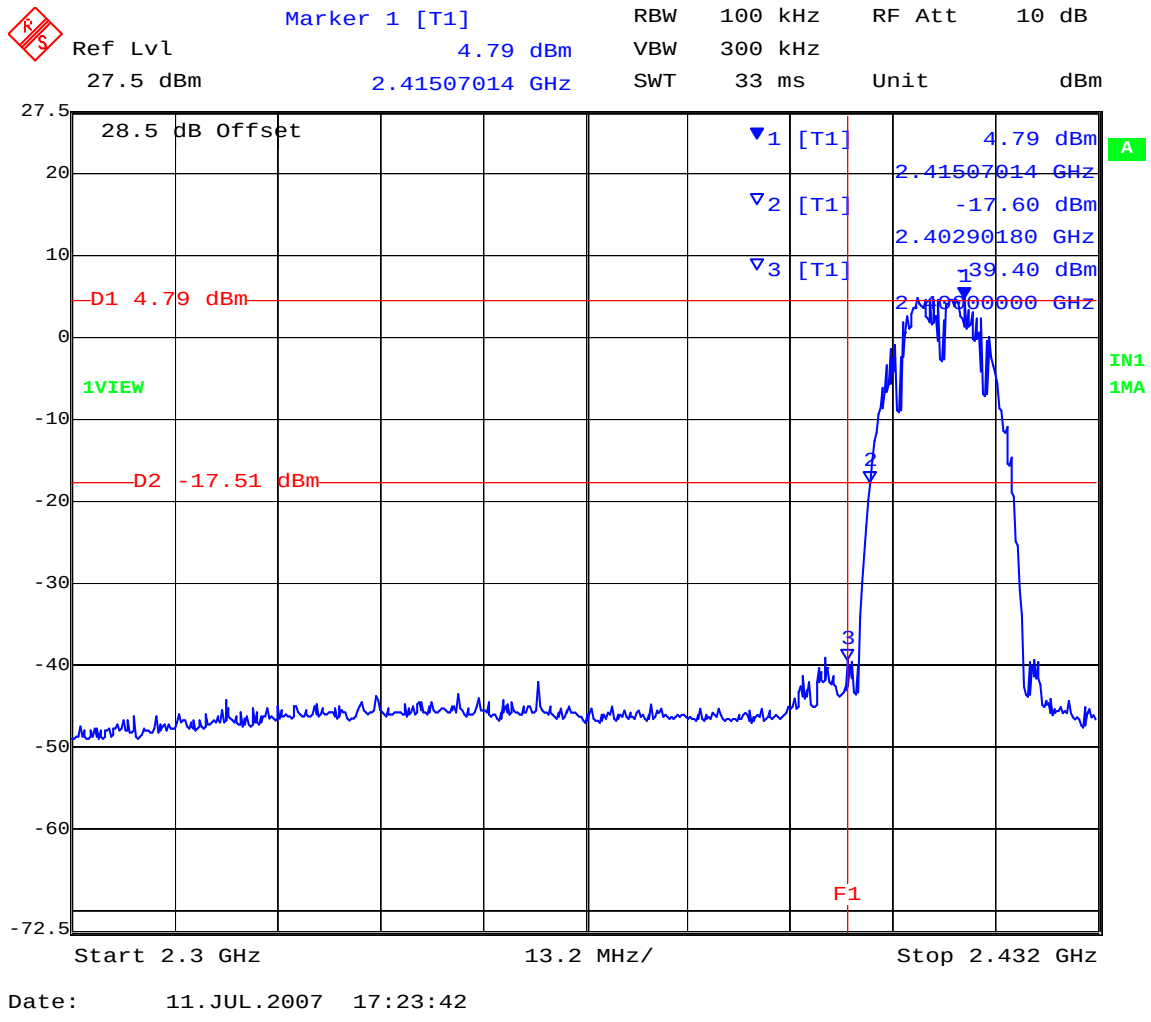
Conducted Band-Edge Results

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	-17.51	-39.40	-21.89
2,462	2,483.5	-15.07	-48.05	-32.98

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



802.11b Conducted Band-Edge Emissions at the 2,483.5 MHz Band Edge

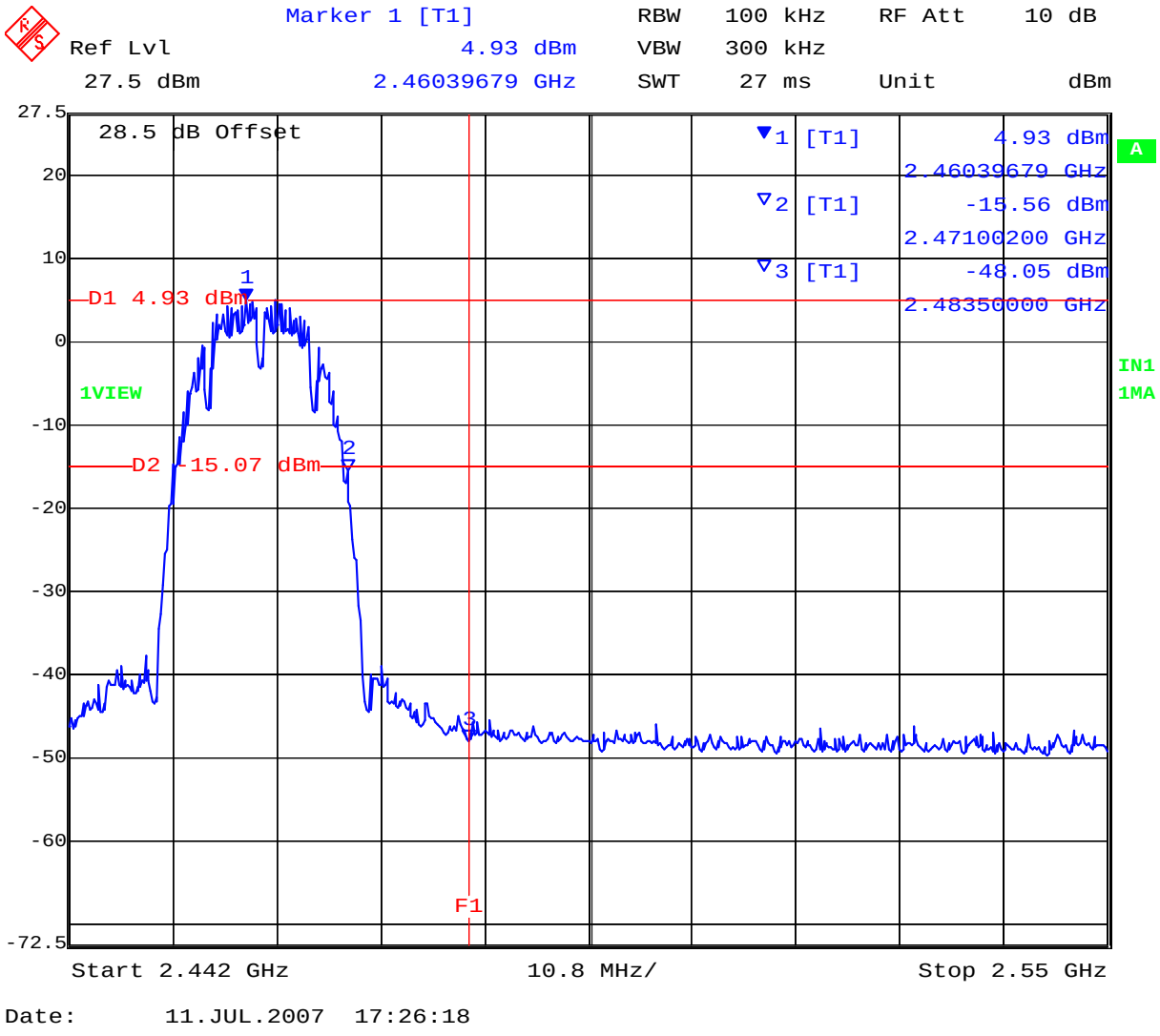
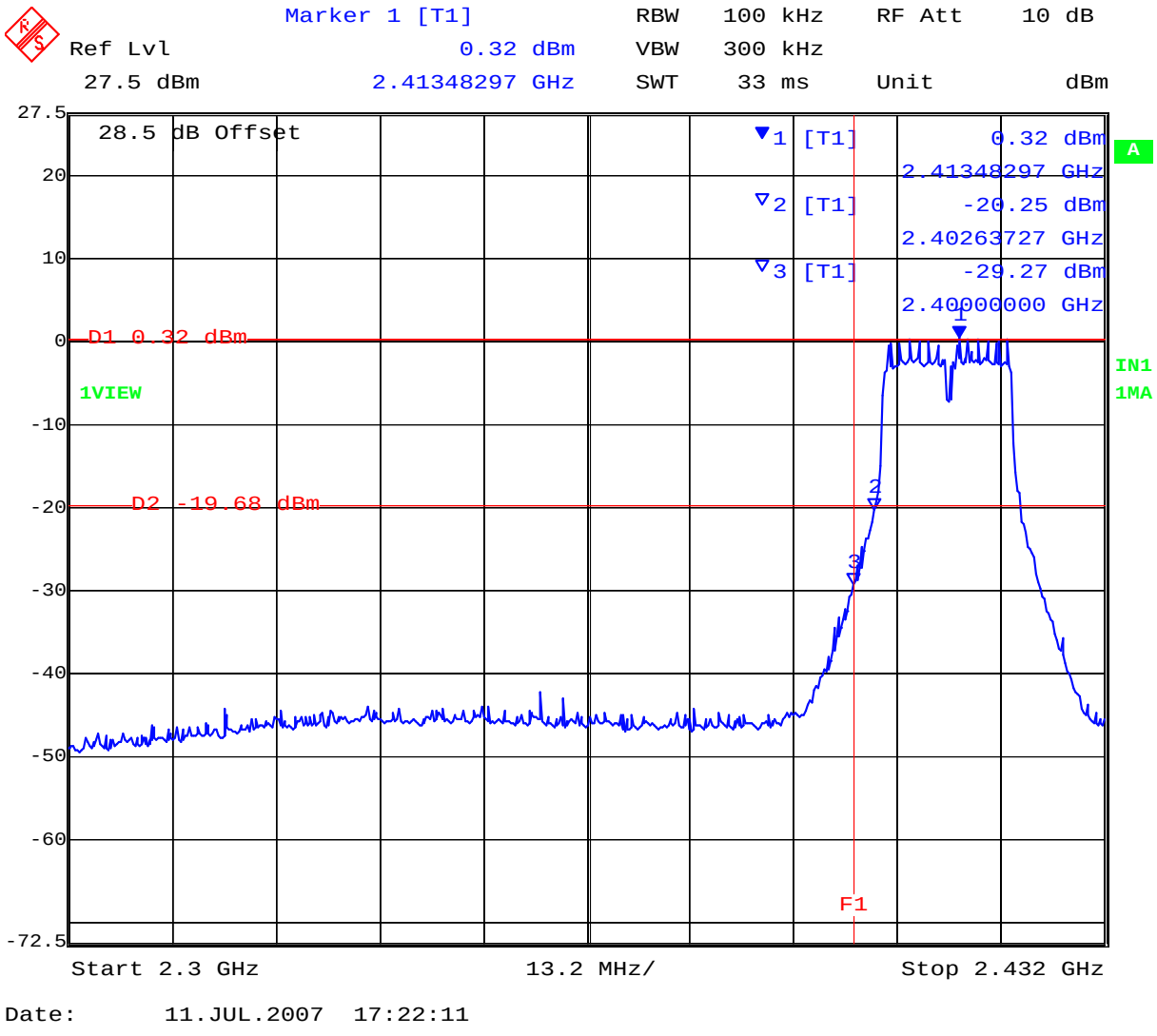


TABLE OF RESULTS – **802.11g, 6 Mbit/s**

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band Edge (dBm)	Margin (dB)
2,412	2,400	-19.68	-29.27	-9.59
2,462	2,483.5	-19.55	-47.19	-27.64

802.11g Conducted Band-Edge Emissions at the 2,400 MHz Band Edge



802.11g Conducted Band Edge Emissions at the 2,483.5 MHz Band Edge

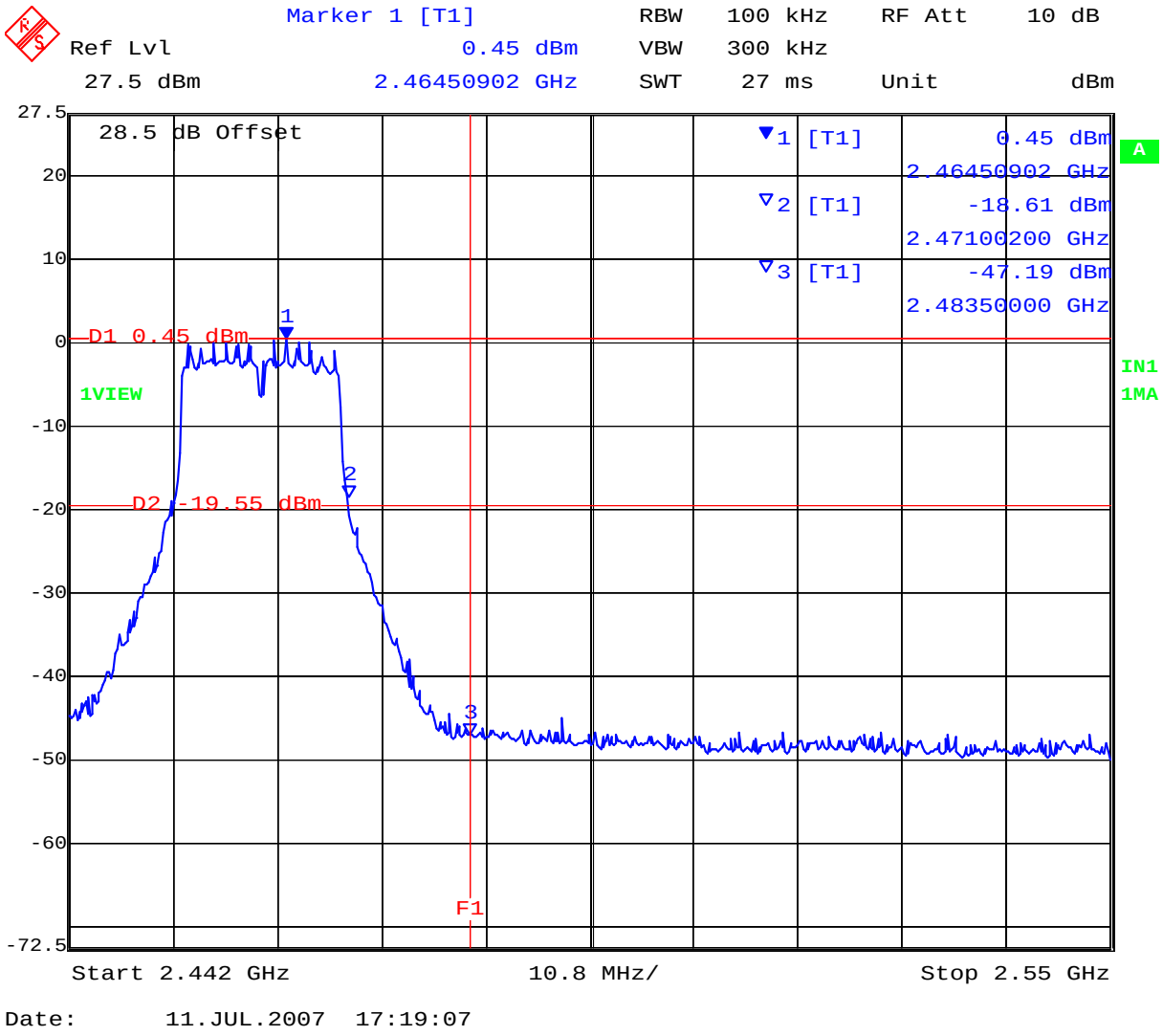
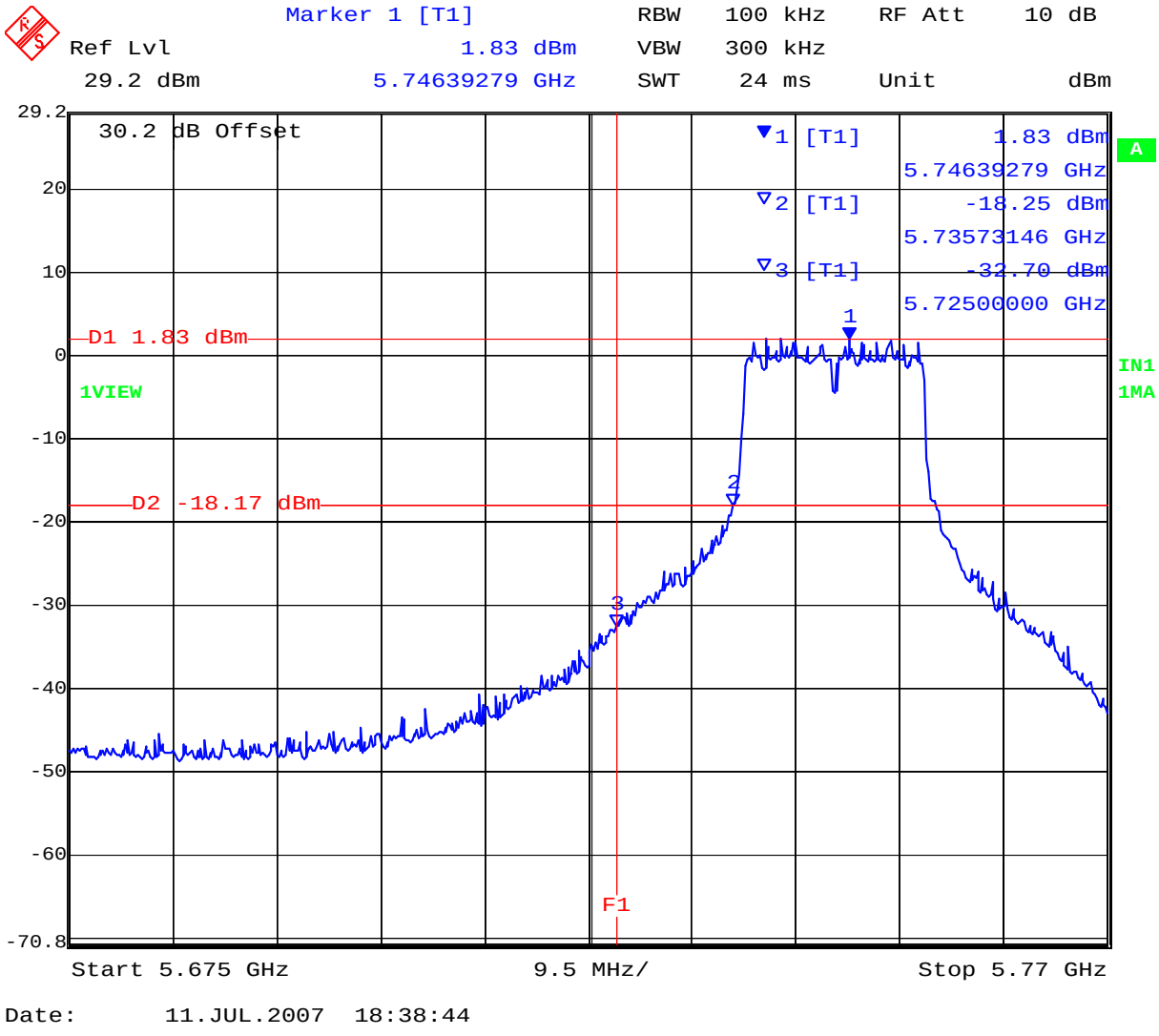


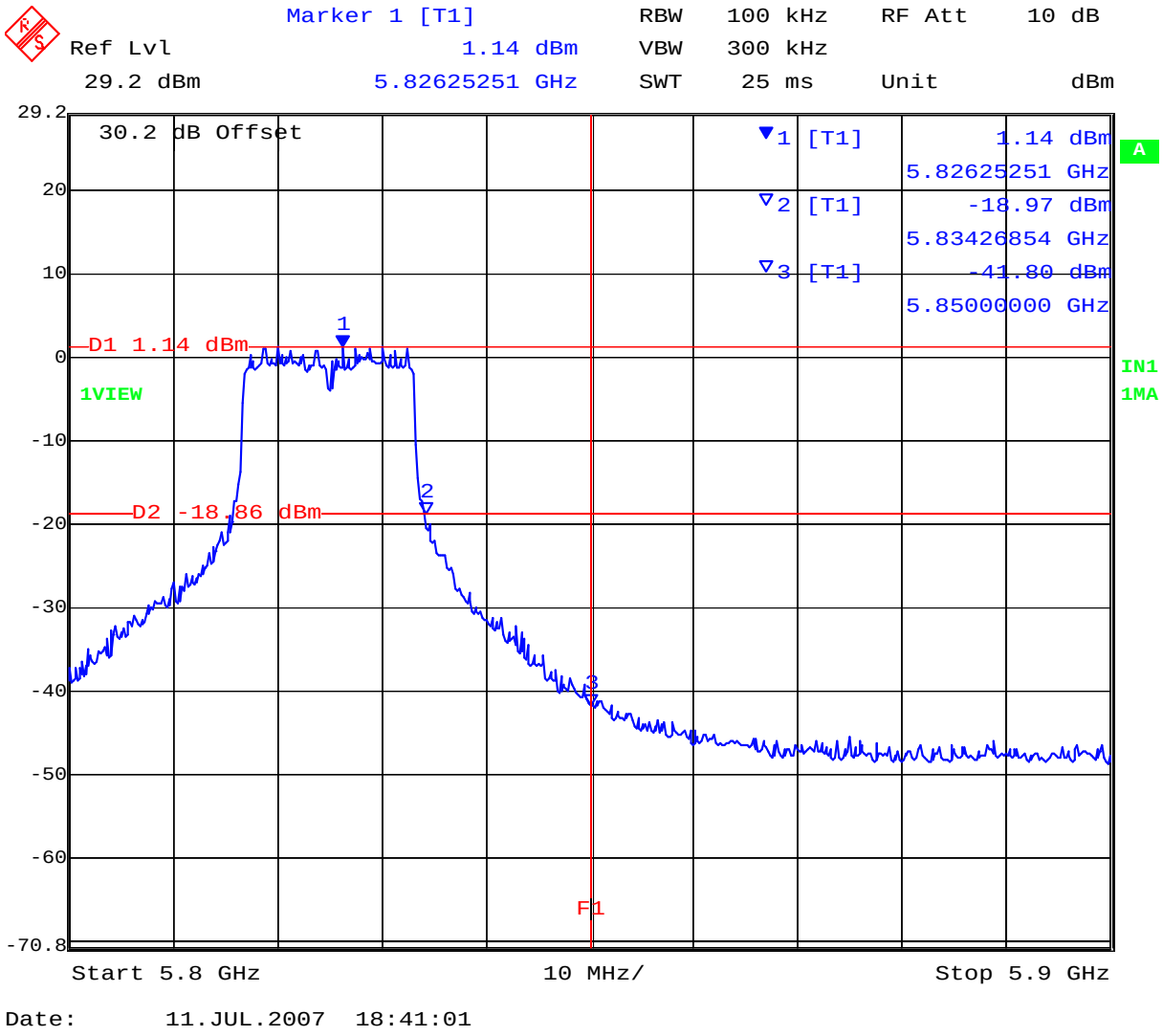
TABLE OF RESULTS – **802.11a, 6Mbit/s**

Center Frequency (MHz)	Band edge Frequency (MHz)	Limit (20 dB below peak of fundamental)	Amplitude @ Band Edge (dBm)	Margin (dB)
5,745	5,725	-18.17	-32.70	-14.53
5,825	5,850	-18.86	-41.80	-22.94

802.11a Conducted Band-Edge Emissions at the 5,725 MHz Band Edge



802.11a Conducted Band-Edge Emissions at the 5,850 MHz Band Edge



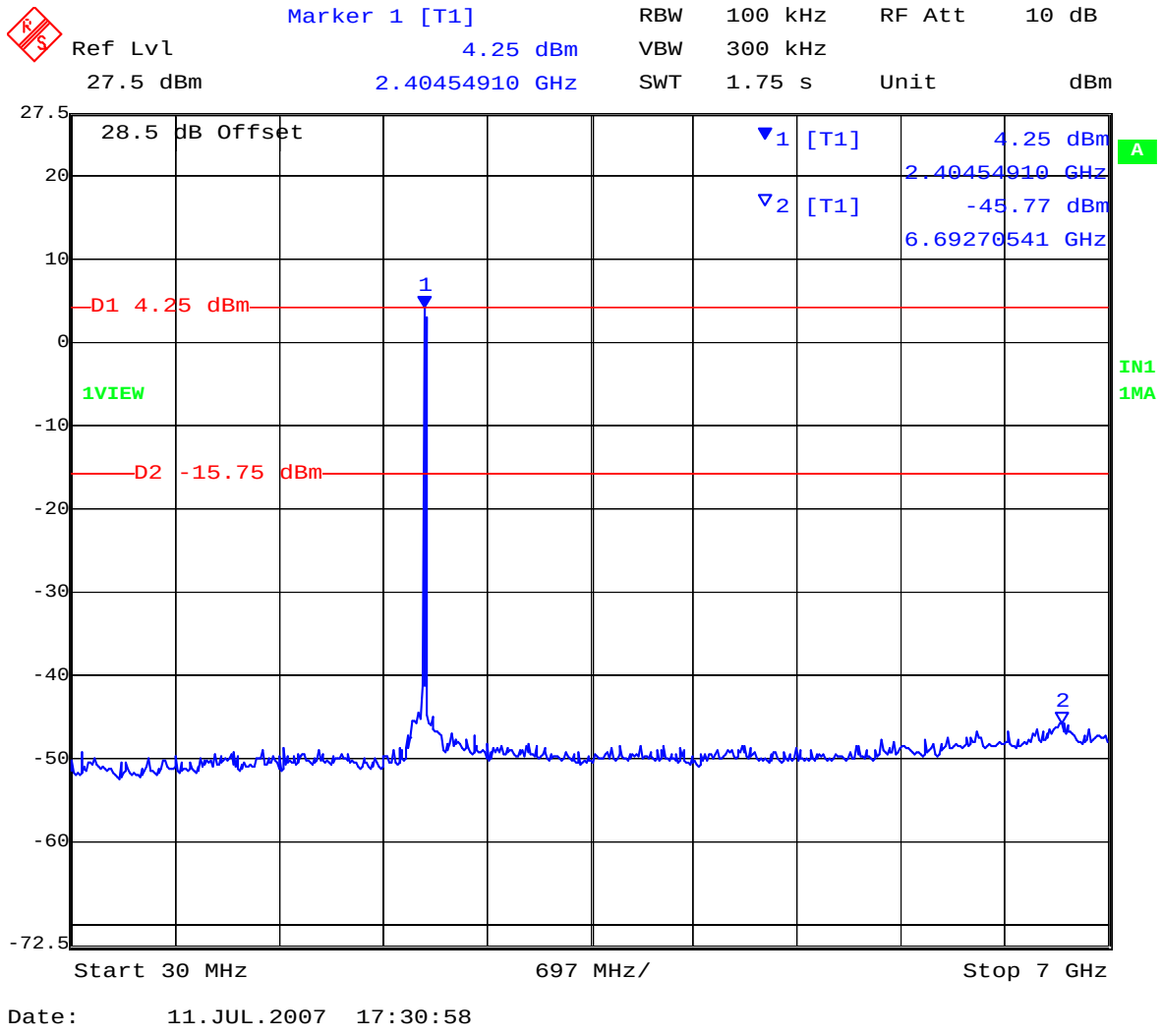
Spurious Emissions (30 - 26,000 MHz)

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	7,000	-45.77	-15.75	-30.02
2,412	7,000	40,000	-31.60	-15.75	-15.85

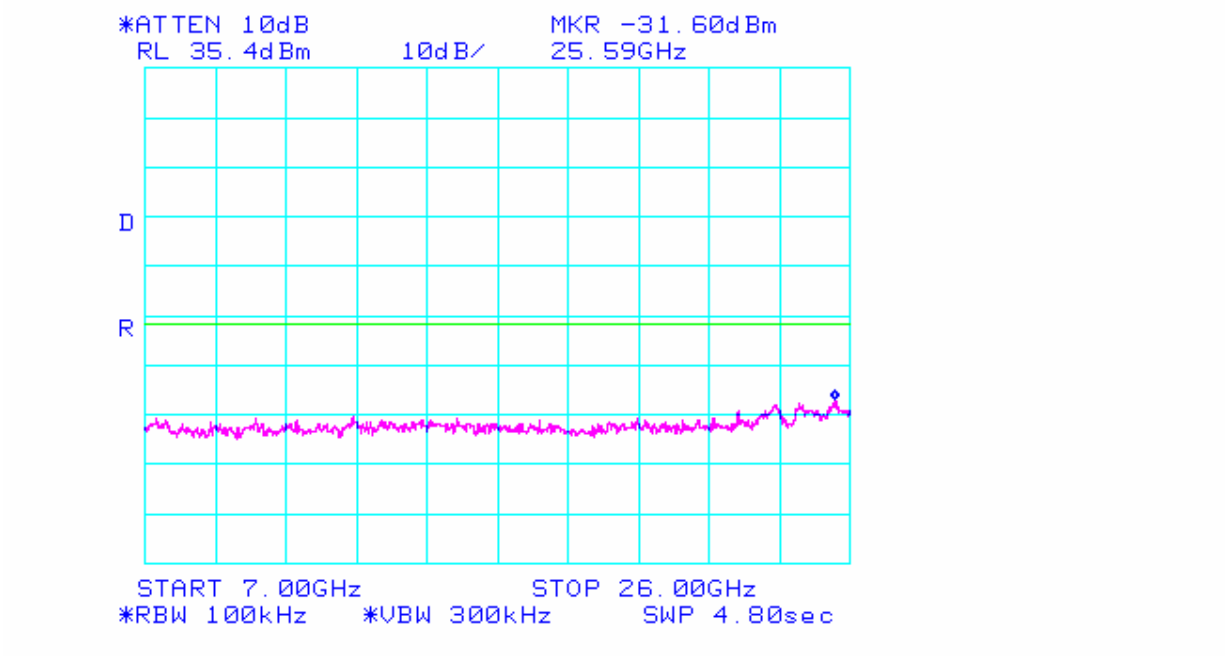
802.11b, 1 Mbit/s

2,412 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



802.11b – 1 Mbit/s

2,412 MHz Conducted Spurious Emissions 7,000 MHz to 26,000 MHz



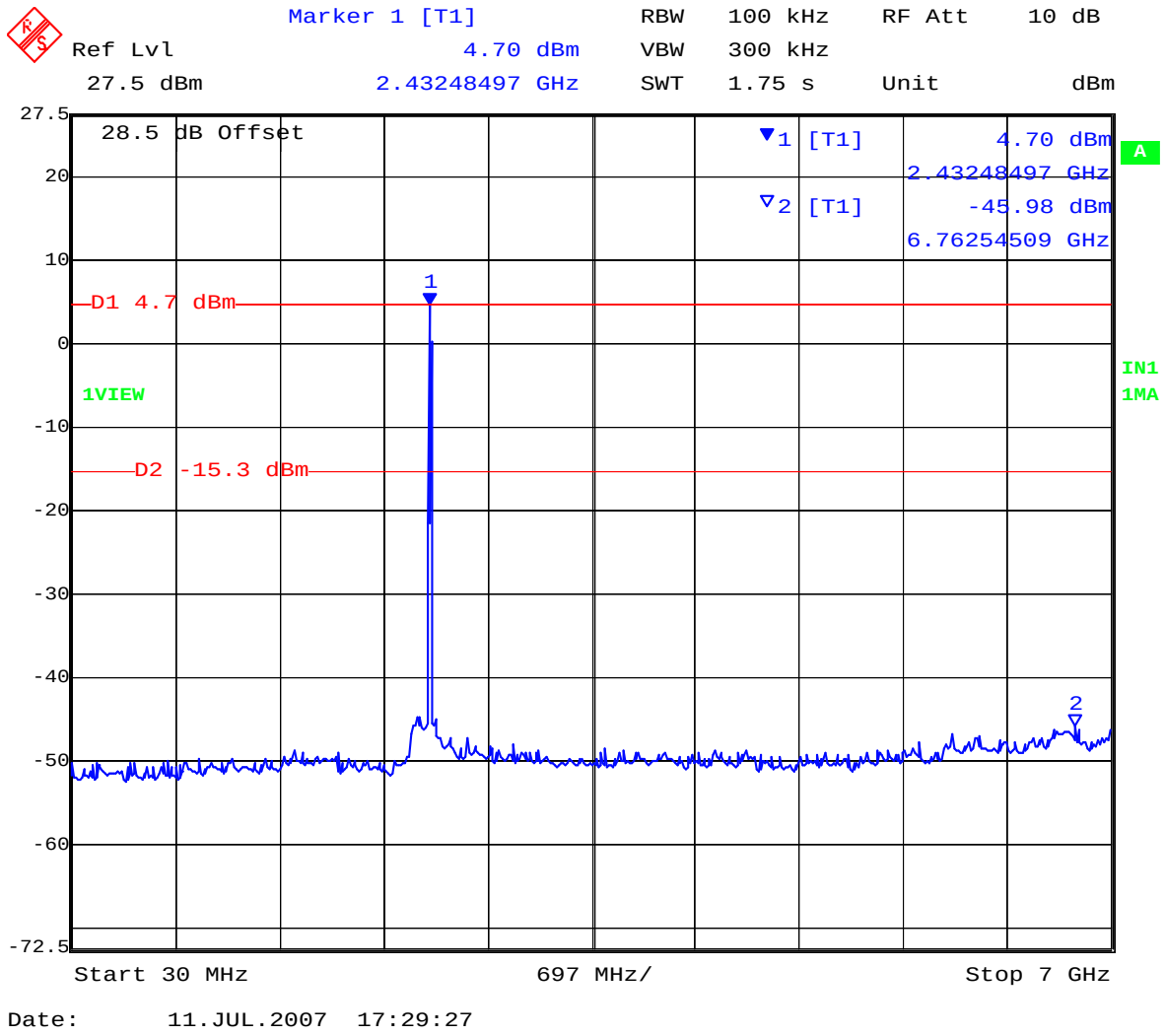
Spurious Emissions (30 - 26,000 MHz)

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	7,000	-45.98	-15.30	-30.68
2,437	7,000	40,000	-31.77	-15.30	-16.47

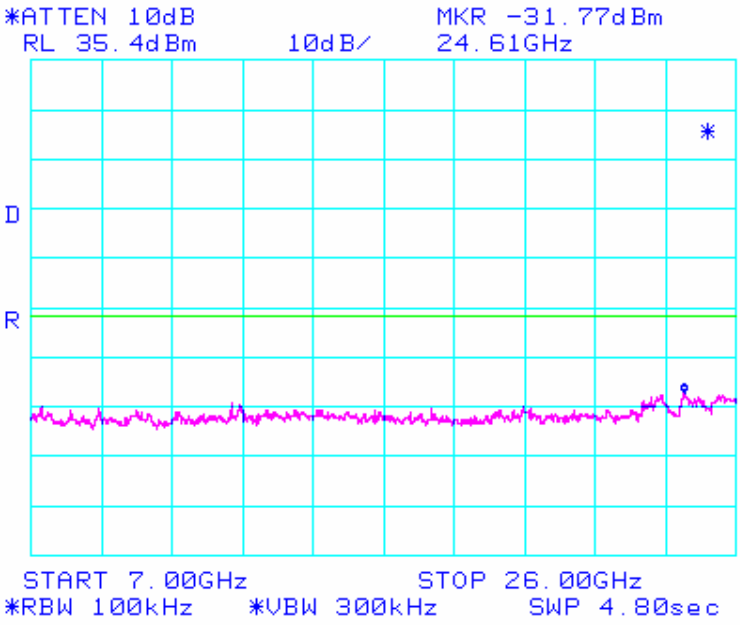
802.11b, 1 Mbit/s

2,437 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



802.11b, 1 Mbit/s

2,437 MHz Conducted Spurious Emissions 7,000 MHz to 26,000 MHz



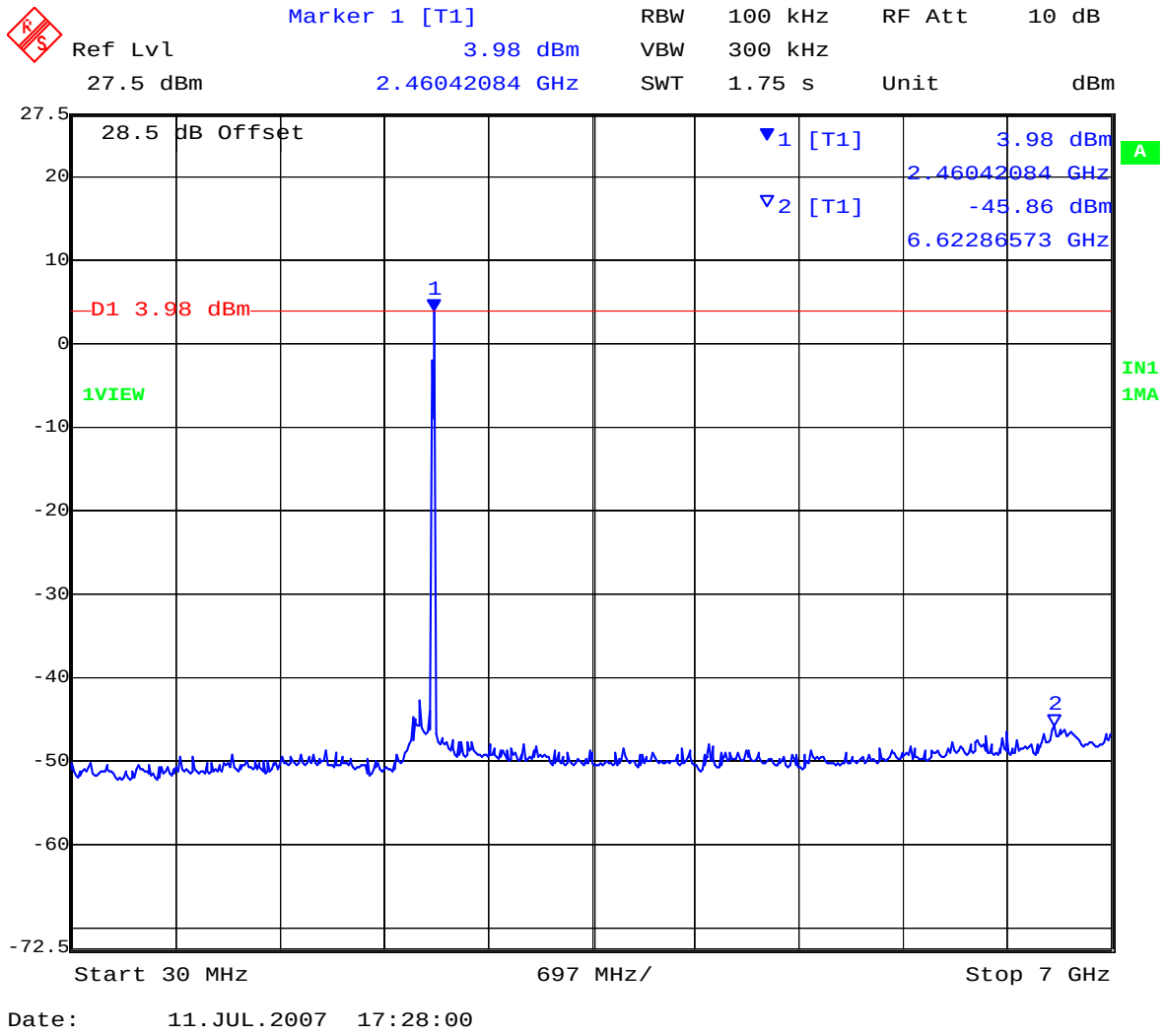
Spurious Emissions (30 - 26,000 MHz)

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	7,000	-45.86	-16.02	-29.84
2,462	7,000	40,000	-31.77	-16.02	-15.75

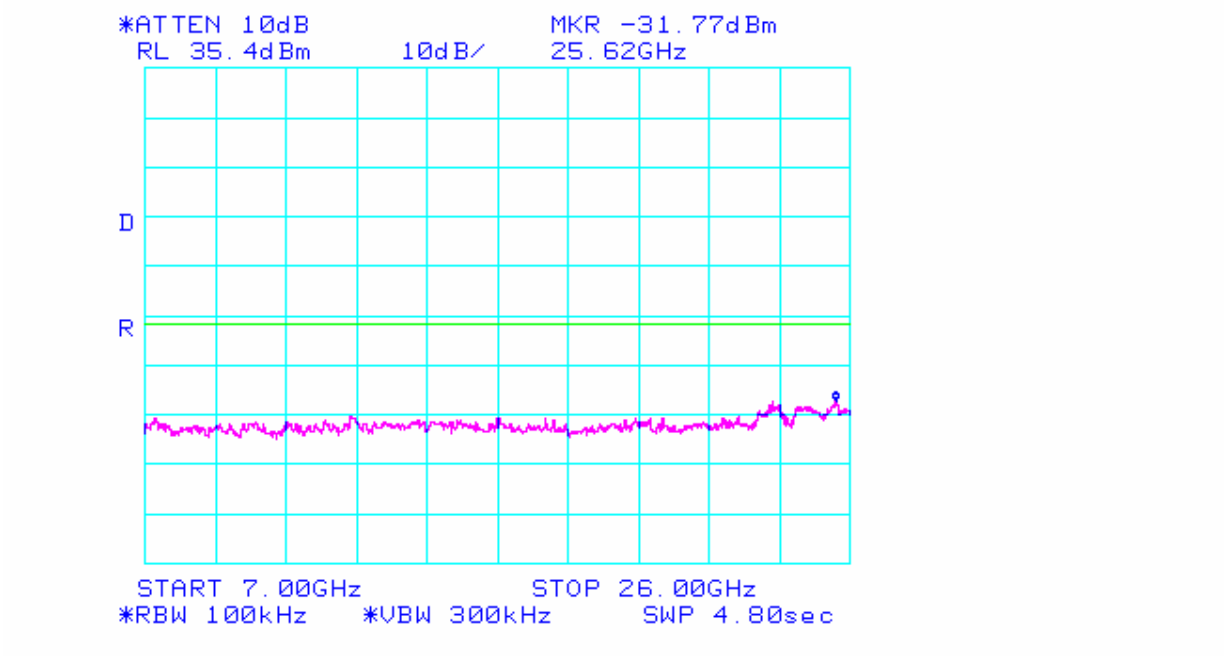
802.11b, 1 Mbit/s

2,462 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



802.11b, 1 Mbit/s

2,462 MHz Conducted Spurious Emissions 7,000 MHz to 26,000 MHz



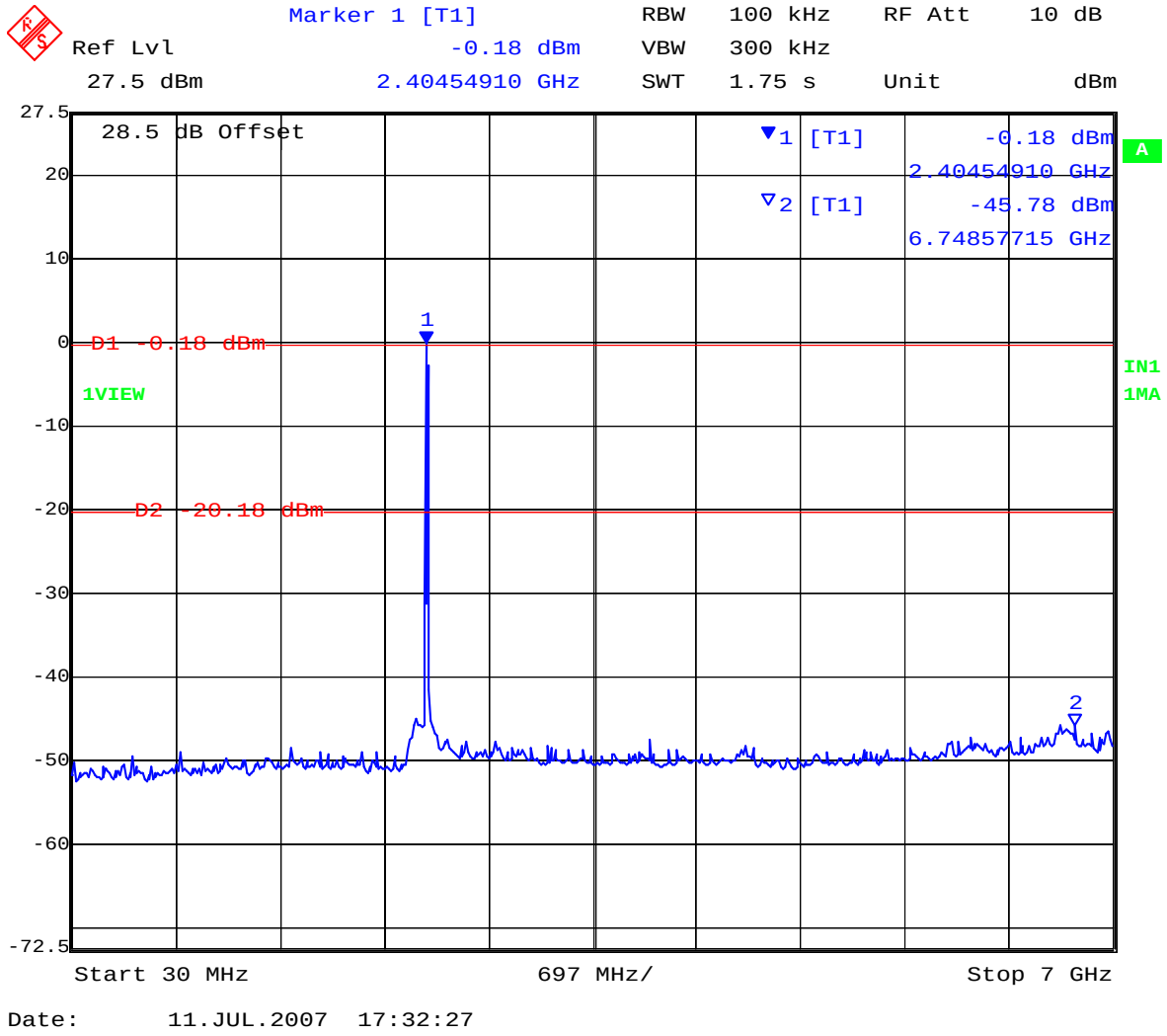
Spurious Emissions (30 - 26,000 MHz)

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	7,000	-45.78	-20.10	-25.68
2,412	7,000	40,000	-32.27	-20.10	-12.17

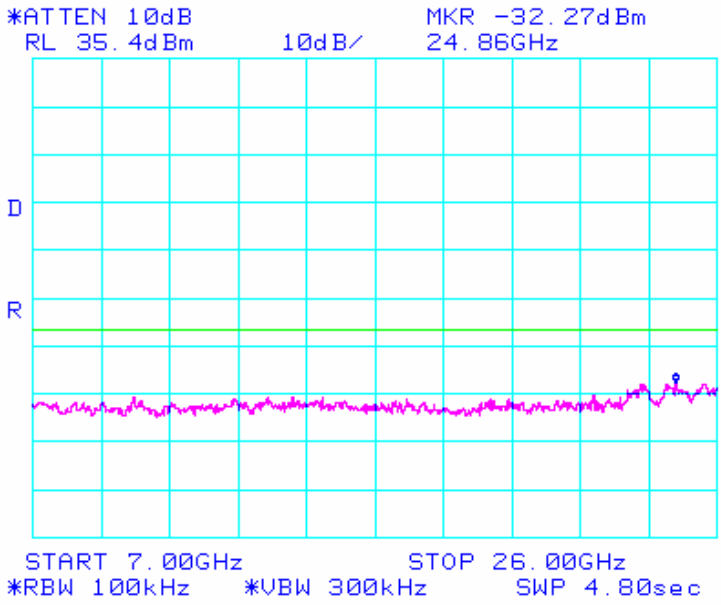
802.11g, 6 Mbit/s

2,412 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



802.11g, 6 Mbit/s

2,412 MHz Conducted Spurious Emissions 7,000 MHz to 26,000 MHz



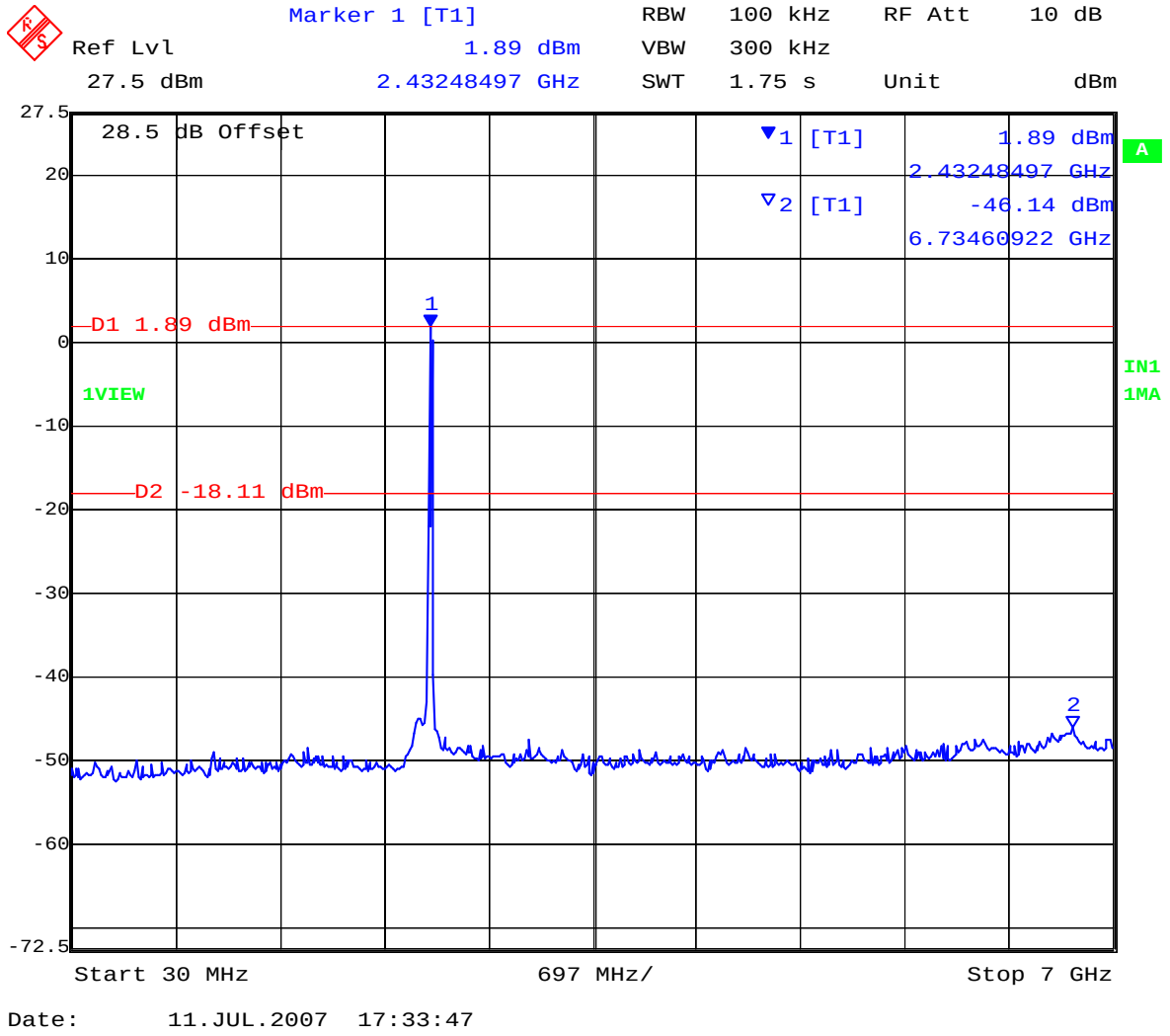
Spurious Emissions (30 - 26,000 MHz)

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	7,000	-46.14	-18.11	-28.03
2,437	7,000	40,000	-31.60	-18.11	-13.49

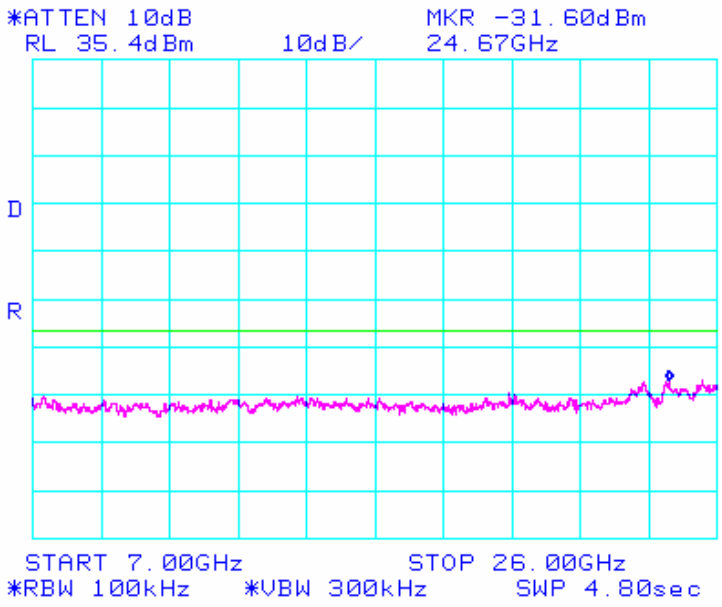
802.11g – 6 Mbit/s

2,437 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



802.11g – 6 Mbit/s

2,437 MHz Conducted Spurious Emissions 7,000 MHz to 26,000 MHz



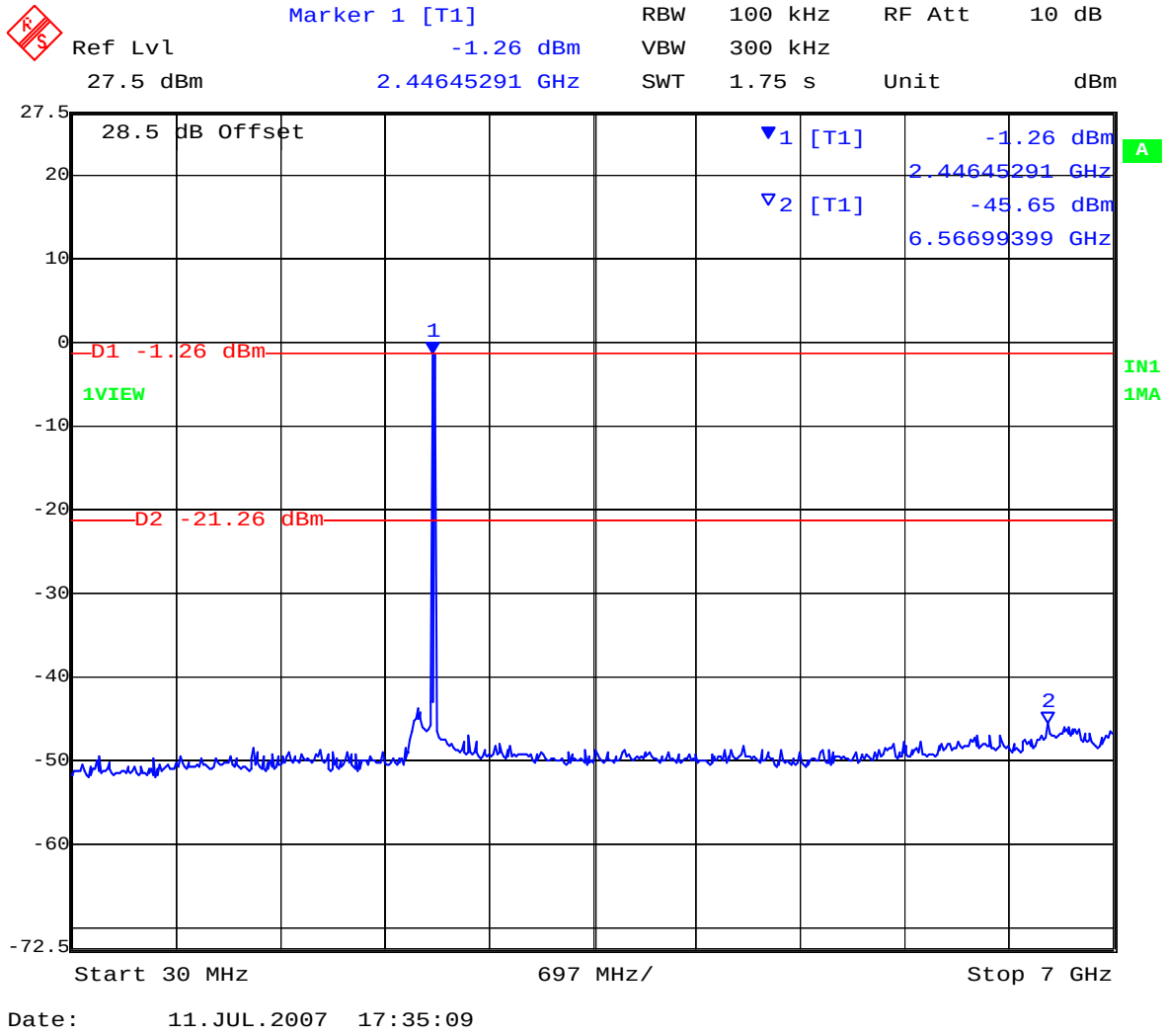
Spurious Emissions (30 - 26,000 MHz)

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	7,000	-45.65	-21.26	-24.39
2,462	7,000	40,000	-31.43	-21.26	-10.17

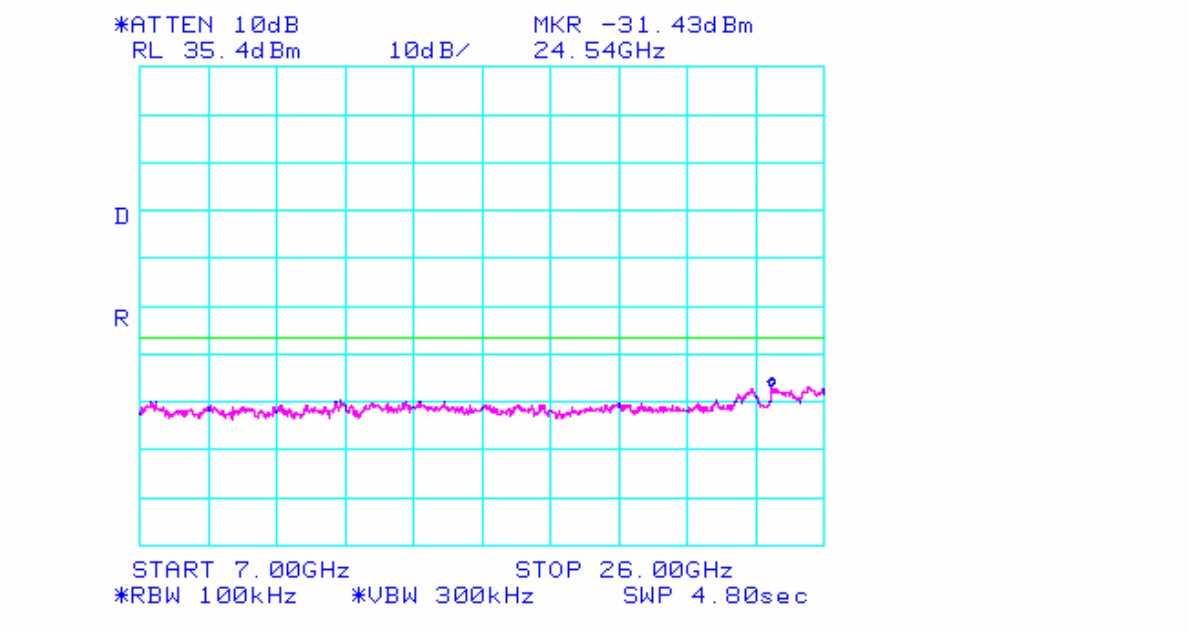
802.11g 6 Mbit/s

2,462 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



802.11g, 6 Mbit/s

2,412 MHz Conducted Spurious Emissions 7,000 MHz to 40,000 MHz



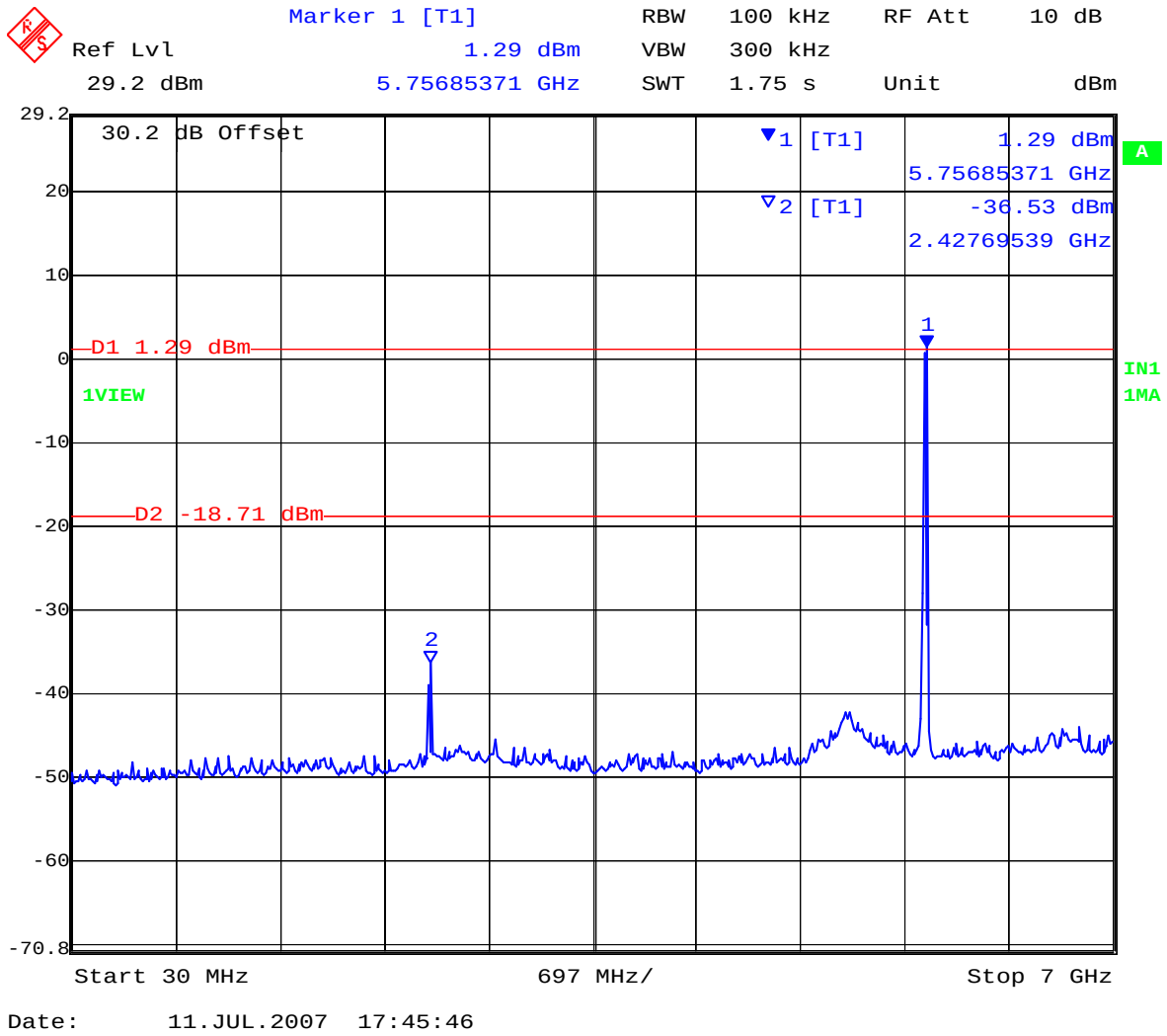
Spurious Emissions (30 - 40,000 MHz)

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	7,000	-36.53	-18.71	-17.82
5,745	7,000	40,000	-25.83	-18.71	-7.12

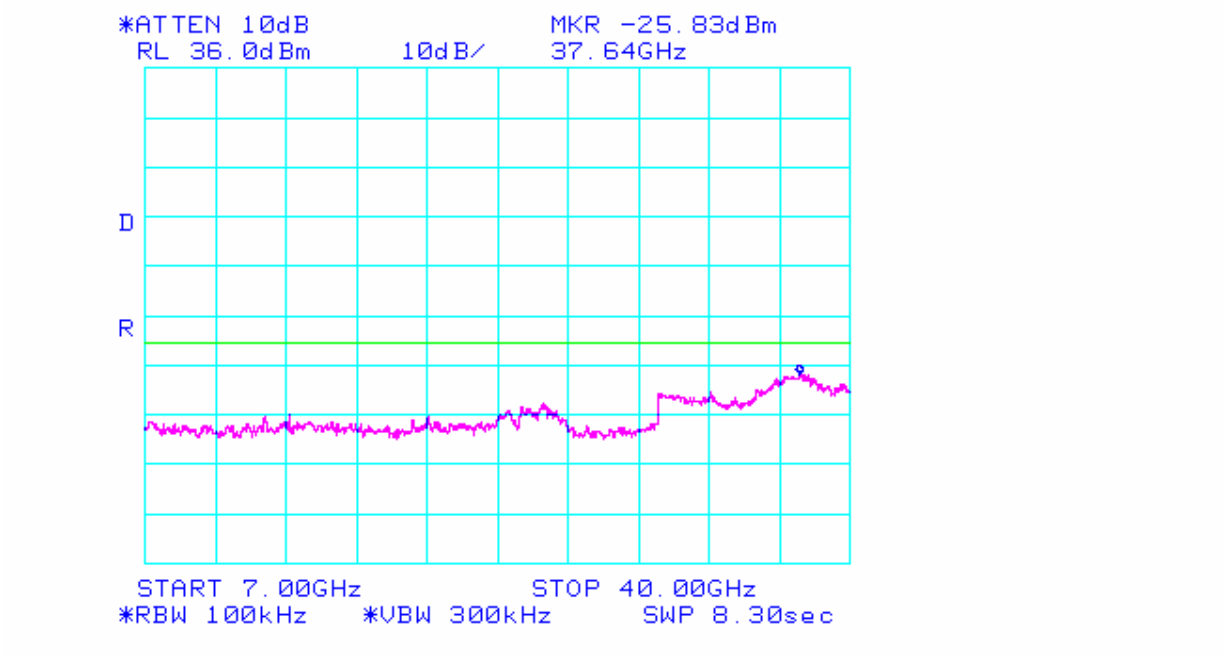
802.11a, 6 Mbit/s

5,745 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



802.11a, 6 Mbit/s

5,745 MHz Conducted Spurious Emissions 7,000 MHz to 40,000 MHz



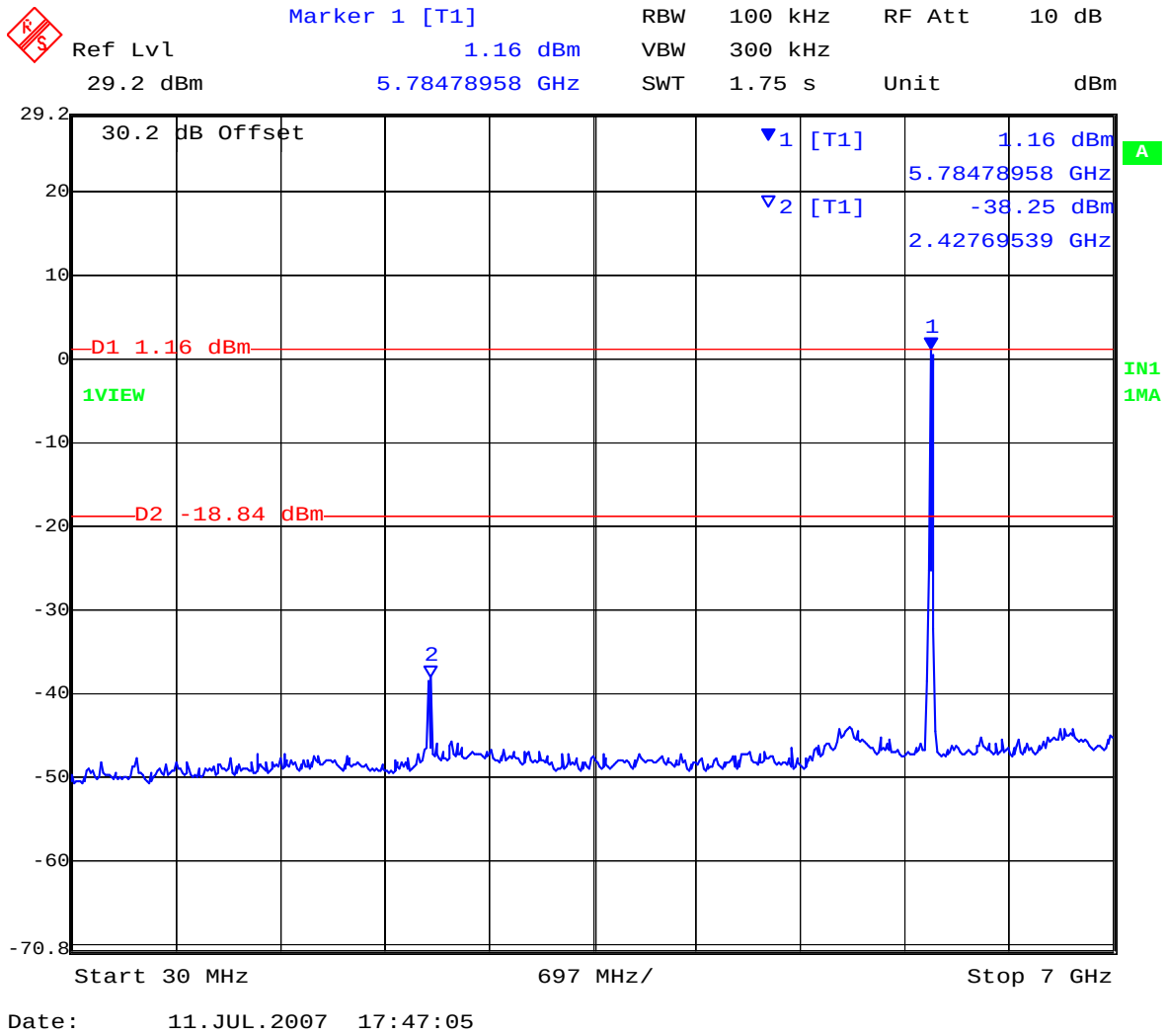
Spurious Emissions (30 - 40,000 MHz)

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	7,000	-38.25	-18.84	-19.41
5,785	7,000	40,000	-26.00	-18.84	-7.16

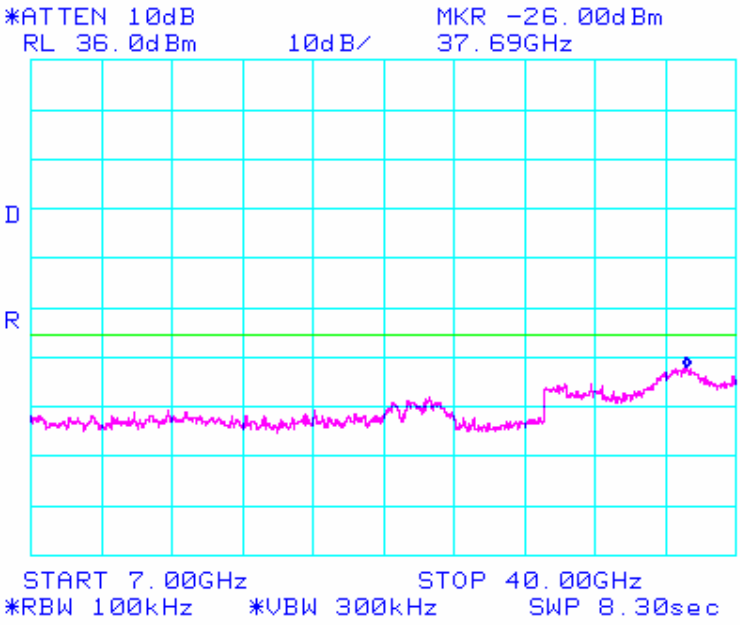
802.11a, 6 Mbit/s

5,785 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



802.11a, 6 Mbit/s

5,785 MHz Conducted Spurious Emissions 7,000 MHz to 40,000 MHz



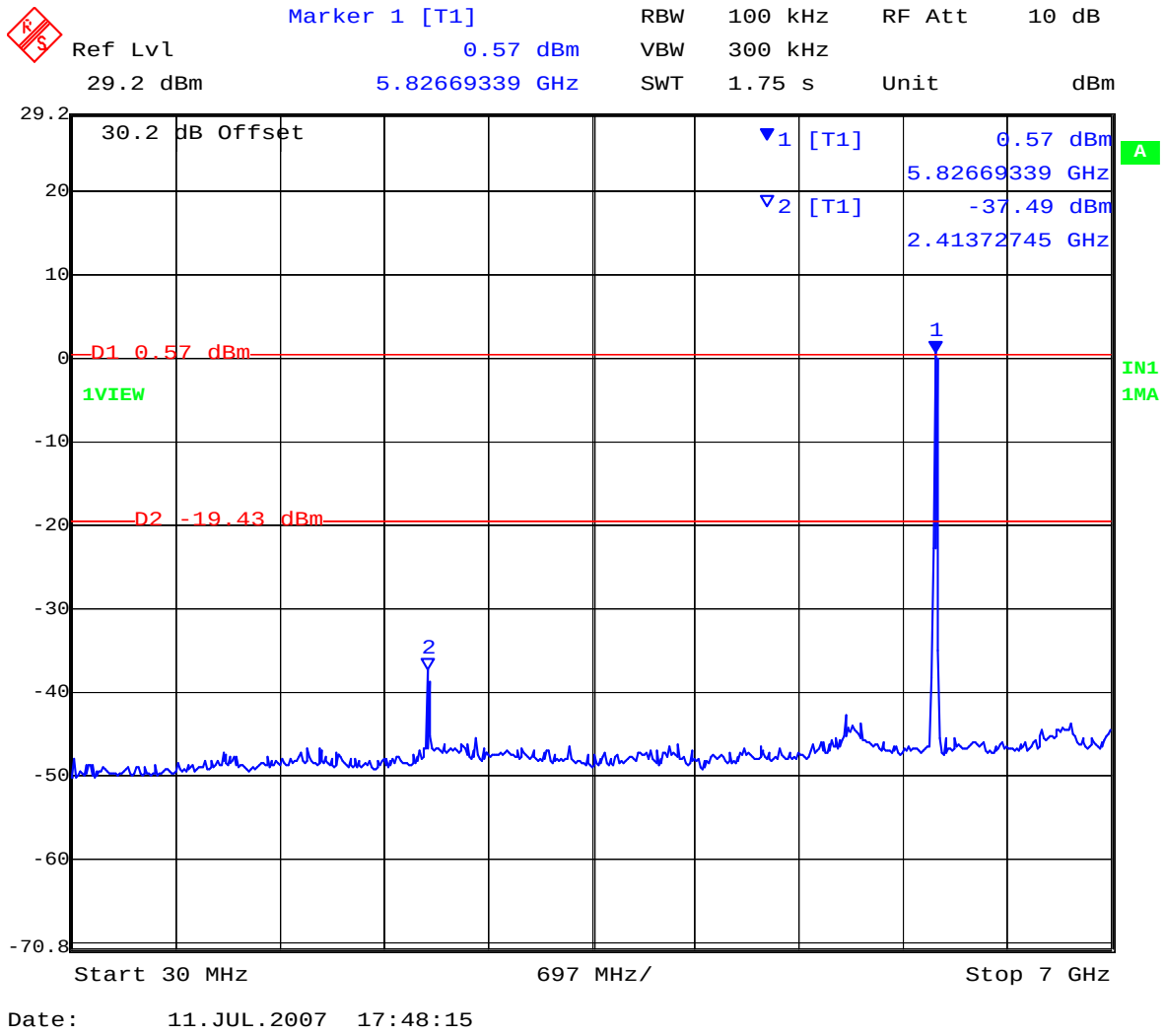
Spurious Emissions (30 - 40,000 MHz)

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	7,000	-37.49	-19.43	-18.06
5,825	7,000	40,000	-26.17	-19.43	-6.74

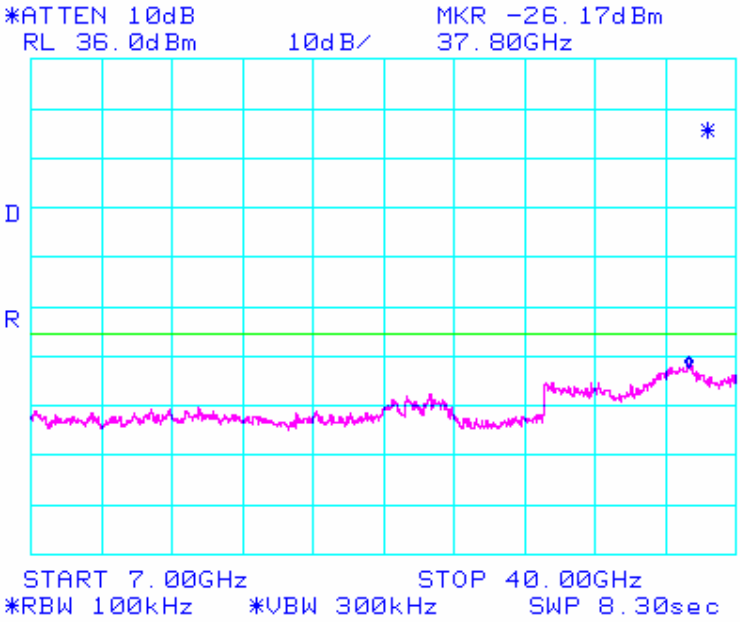
802.11a, 6 Mbit/s

5,825 MHz Conducted Spurious Emissions 30 MHz to 7,000 MHz



802.11a, 6 Mbit/s

5,825 MHz Conducted Spurious Emissions 7,000 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
5,725 MHz	5850 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)).

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)

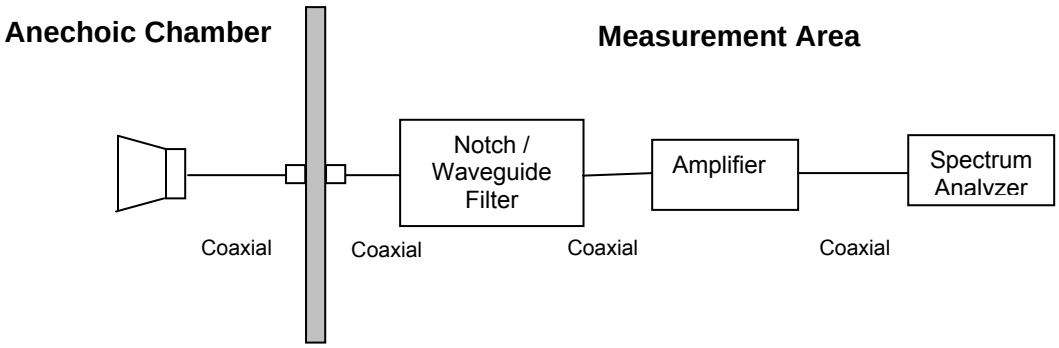
FCC, Part 15 Subpart C §15.247(d) 15.205; 15.209

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

Radiated Spurious Emissions above 1 GHz

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

Test Setup - 802.11b, 1Mb/s
TABLE OF RESULTS – 802.11b, 1Mb/s Channel 1 (2,412 MHz)
Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
2317.096	V	57.83	-8.13	49.71	74	-24.29
7230.667	V	51.91	0.43	52.38	74	-21.62

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
2317.096	V	44.98	-8.13	36.86	54	-17.14
7230.667	V	46.37	0.43	46.80	54	-7.20

Radiated Emissions

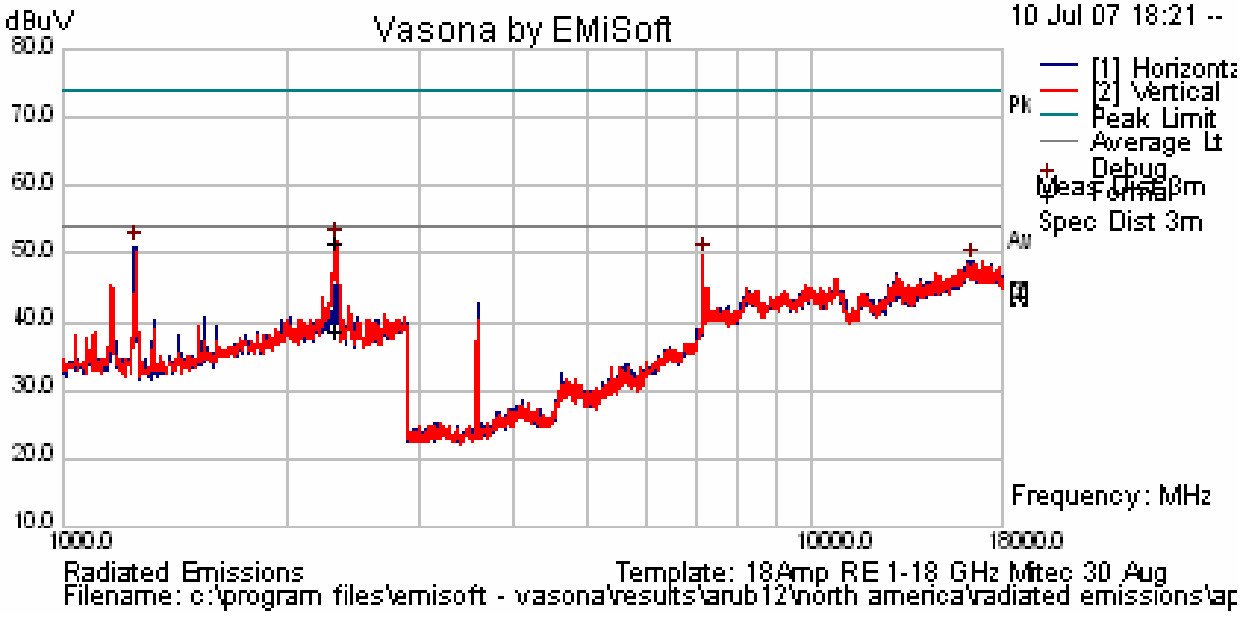


TABLE OF RESULTS – 802.11b, 1Mb/s Channel 6 (2,437)

Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
7311.06	V	53.04	0.74	53.79	74	-20.21

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
7311.06	V	44.95	0.74	45.7	54	-8.30

Radiated Emissions

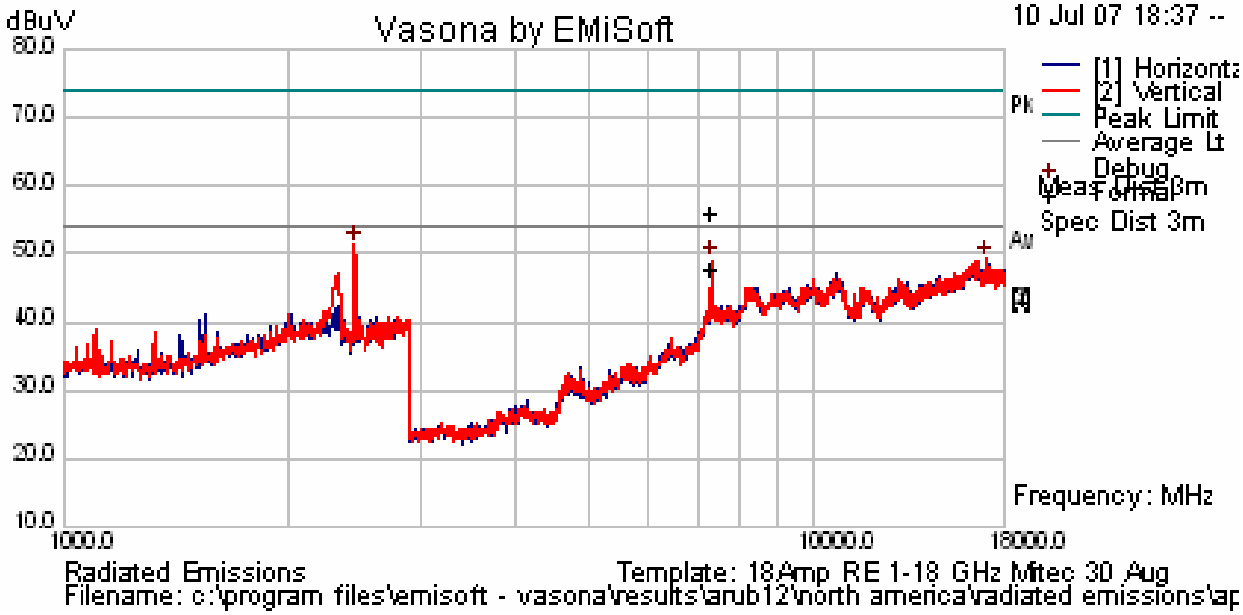


TABLE OF RESULTS – 802.11b, 1Mb/s Channel 11 (2,462 MHz)

Peak

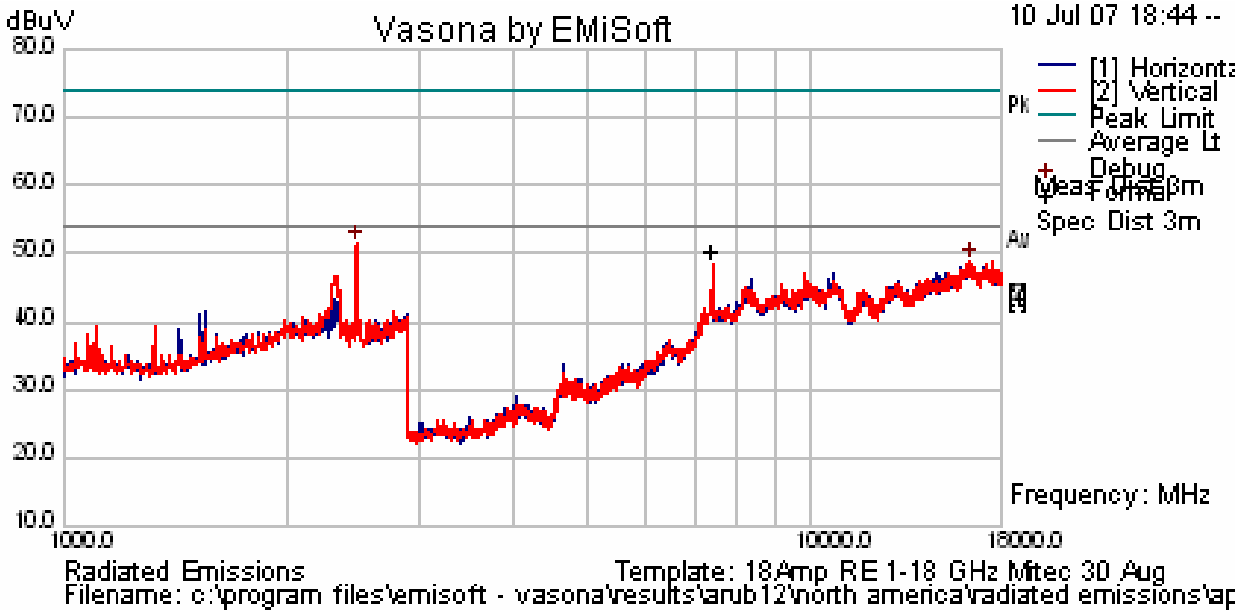
Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
					74	

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
					54	

No emissions were found within 6 dB of the average limit line (54 dBµV/m). The emission closest to the line is the carrier and therefore no further examination was required.

Radiated Emissions



Test Setup - 802.11g, 6Mb/s

TABLE OF RESULTS – 802.11g, 6 Mb/s Channel 1 (2,412 MHz)
Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
					74	

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
					54	

No emissions were found within 6 dB of the average limit line (54 dBµV/m). The emission closest to the line is the carrier and therefore no further examination was required.

Radiated Emissions

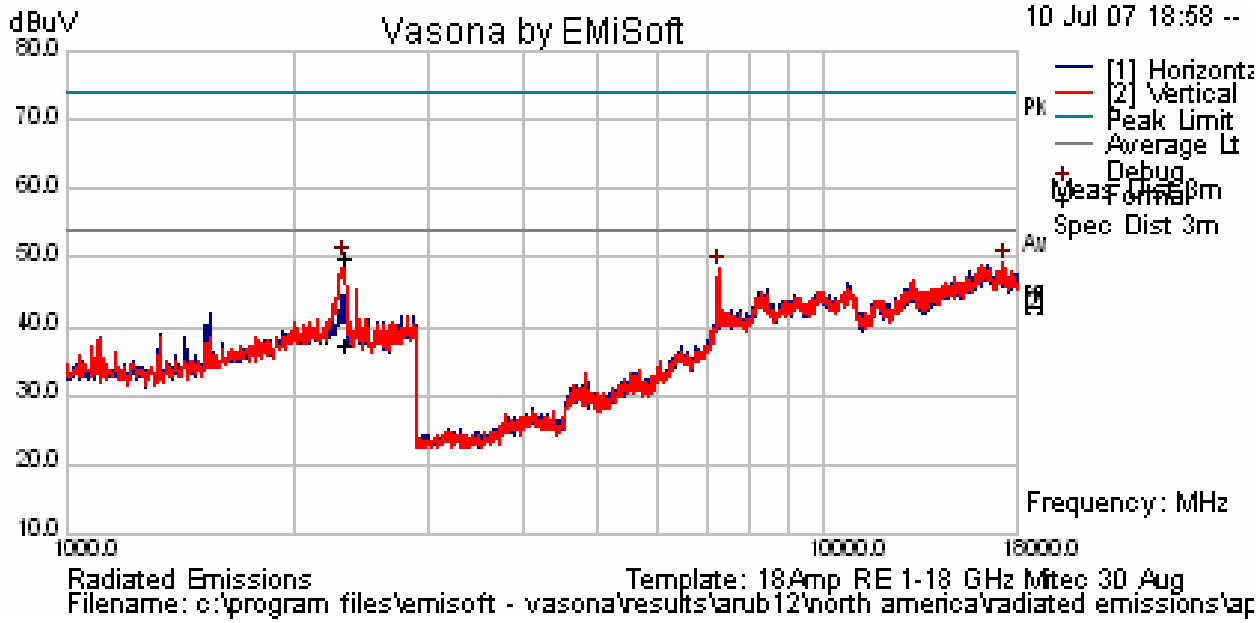


TABLE OF RESULTS – 802.11g, 6 Mb/s Channel 6 (2,437)

Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
					74	

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
					54	

No emissions were found within 6 dB of the average limit line (54 dBµV/m). The emission closest to the line is the carrier and therefore no further examination was required.

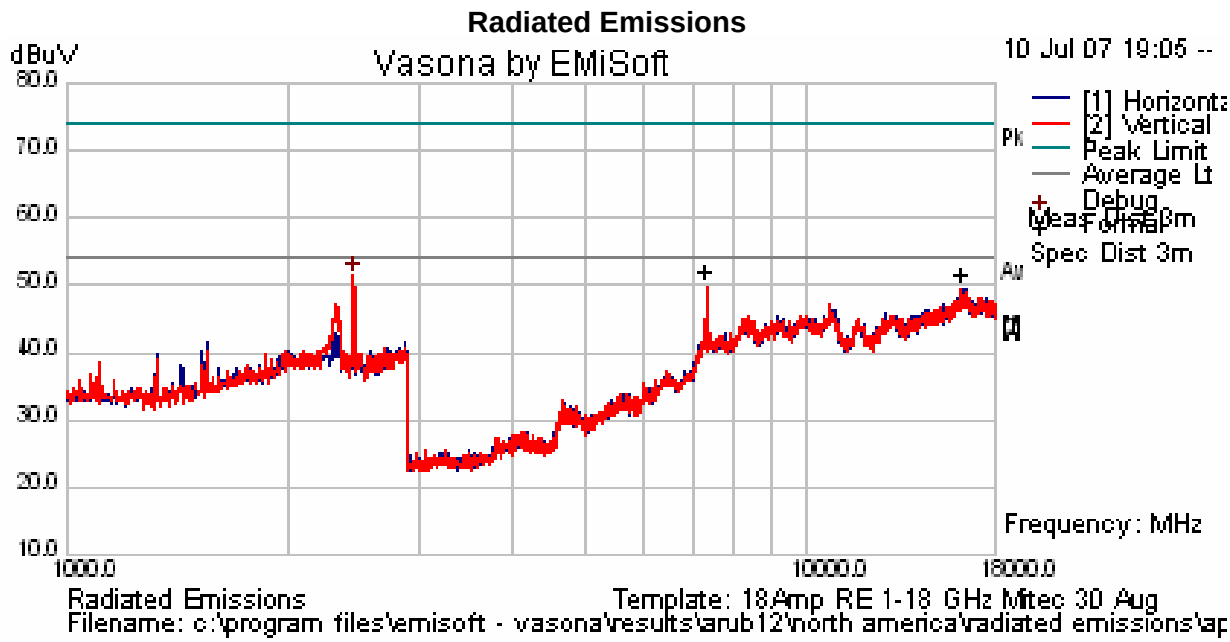


TABLE OF RESULTS – 802.11g, 6 Mb/s Channel 11 (2,462 MHz)

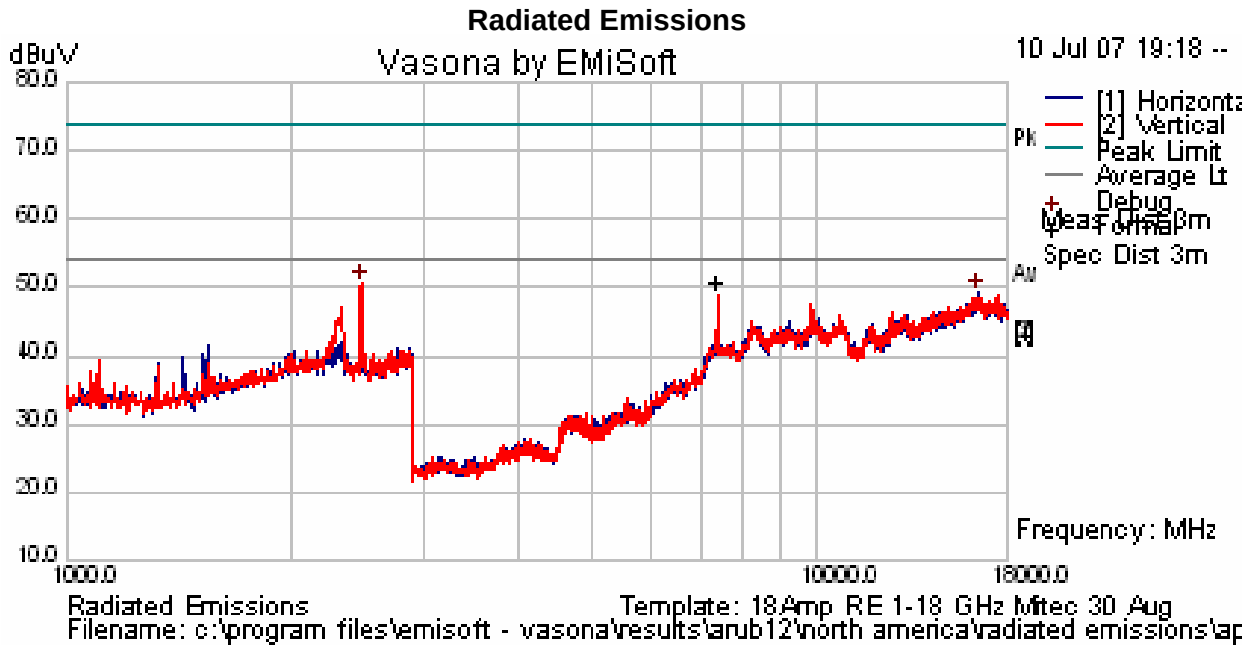
Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
					74	

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
					54	

No emissions were found within 6 dB of the average limit line (54 dBµV/m). The emission closest to the line is the carrier and therefore no further examination was required.



Test Setup - 802.11a, 6Mb/s

TABLE OF RESULTS – 802.11a, 6 Mb/s Channel 149 (5,745)
Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
11486.75	V	54.36	5.47	59.83	74	-14.17

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
11486.75	V	40.99	5.47	46.46	54	-7.54

Radiated Emissions

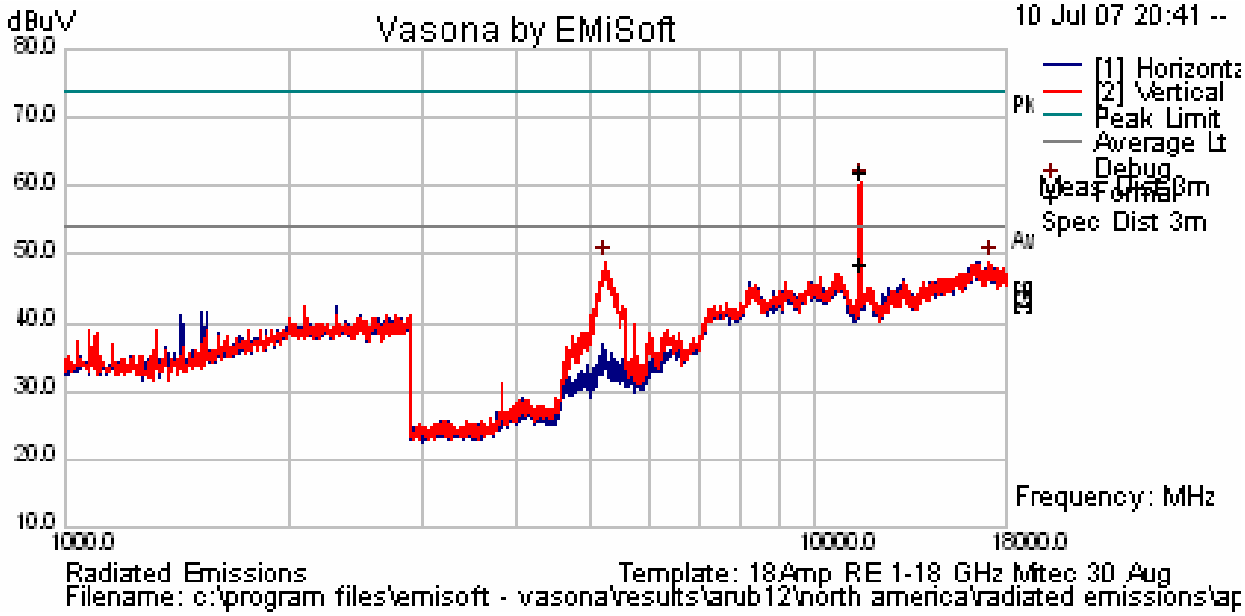


TABLE OF RESULTS – 802.11a, 6 Mb/s Channel 157 (5,785)
Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
11566.4	V	54.39	5.65	60.04	74	-13.96

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
11566.4	V	41.03	5.65	46.68	54	-7.32

Radiated Emissions

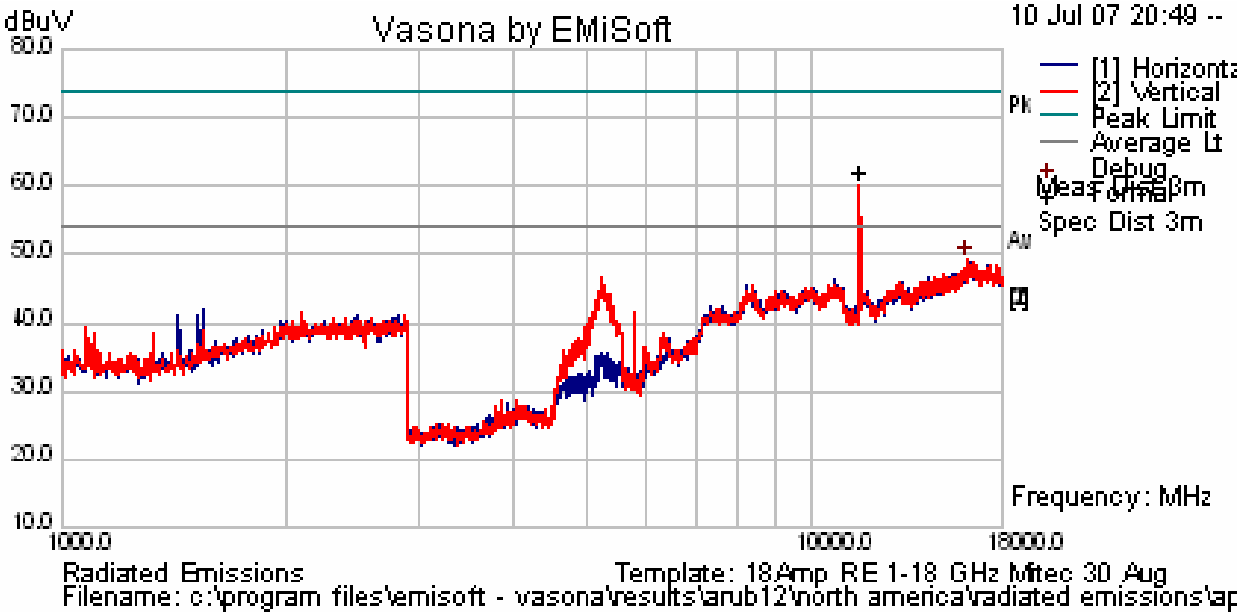


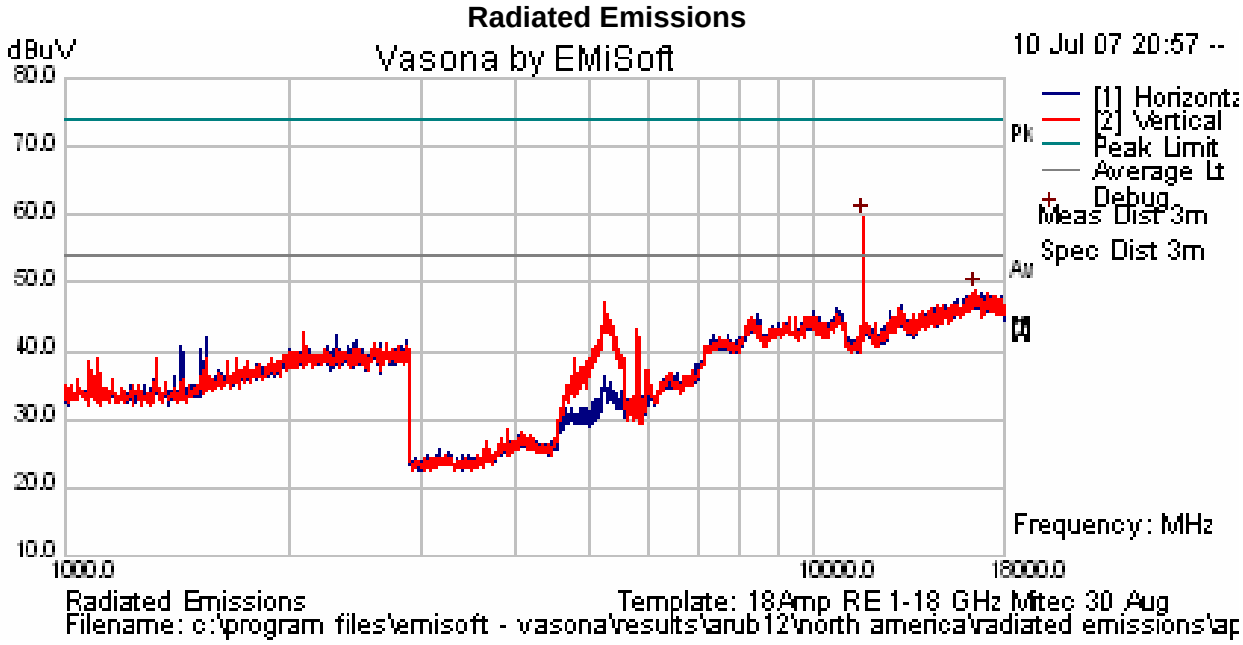
TABLE OF RESULTS – 802.11a, 6 Mb/s Channel 165 (5,825)

Peak

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Peak Field Strength (dBµV/m)	Peak Limit (dBµV/m)	Margin (dB)
11647.6	V	54.55	5.71	60.26	74	-13.74

Average

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV)	Correction Factor (dB)	Corrected Average Field Strength (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
11647.6	V	41.08	5.71	46.79	54	-7.21



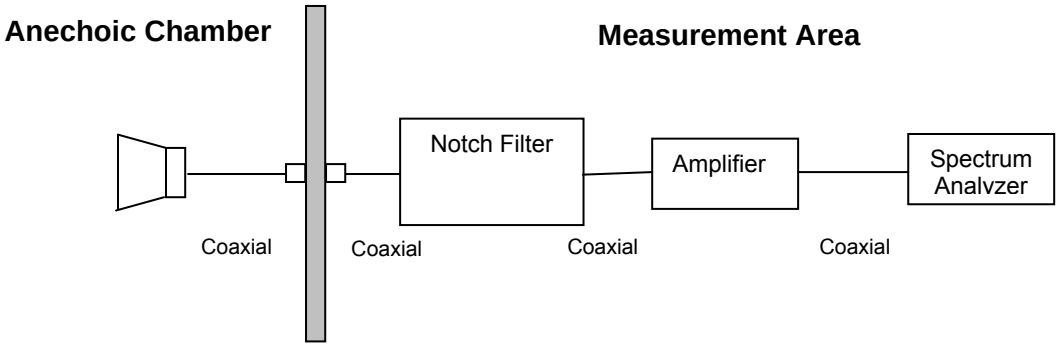
5.1.6.2. Radiated Band-Edge – Restricted Bands

Test Procedure

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

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 = Band-stop 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

Band Edge - Restricted Bands Test Results

TABLE OF RESULTS – **802.11b**

Ch #	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	$2{,}412_{PEAK}$	2,390	61.80	74	-12.2
1	$2{,}412_{AVE}$	2,390	48.57	54	-5.43

TABLE OF RESULTS – **802.11b**

Ch #	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
11	$2{,}462_{PEAK}$	2,483.5	63.60	74	-10.40
11	$2{,}462_{AVE}$	2,483.5	49.62	54	-4.38

TABLE OF RESULTS – **802.11g**

Ch #	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1	$2{,}412_{PEAK}$	2,390	72.25	74	-1.75
1	$2{,}412_{AVE}$	2,390	50.09	54	-3.91

TABLE OF RESULTS – **802.11g**

Ch #	Tx Freq. (MHz)	Restricted Band Edge Frequency (MHz)	Measured (dBuV/m)	Limit (dBuV/m)	Margin (dB)
11	$2{,}462_{PEAK}$	2,483.5	67.04	74	-6.96
11	$2{,}462_{AVE}$	2,483.5	48.30	54	-5.70

NOTE: There are no Restricted Bands close to 5725 – 5850 MHz therefore no measurements were taken for 802.11a operation.

Specification Limits

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

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)).

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

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

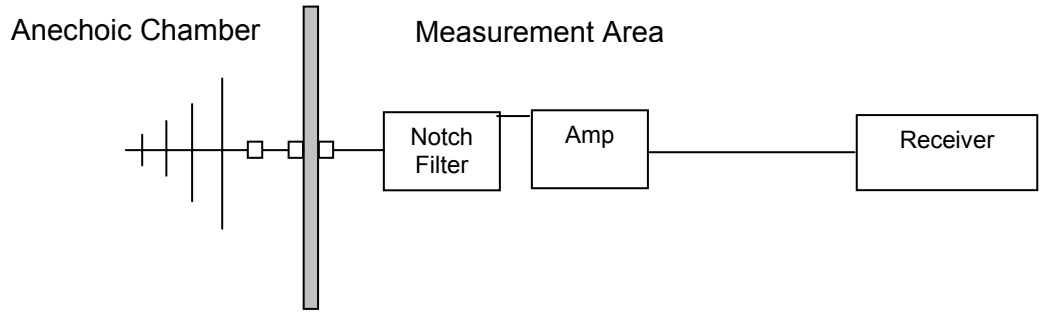
FCC, Part 15 Subpart C §15.205/ §15.209

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.

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 operating – 802.11b
Data Rate(s): 1 Mb/s
Frequency: 2437 MHz
Power Level: Maximum

TABLE OF RESULTS – POE OPERATION

Freq. (MHz)	Peak (dBuV/m)	QP (dBuV/m)	QP Lmt (dBuV/m)	QP Margin (dB)	Angle (deg)	Height (cm)	Polarity
599.992	38.53	39.84	46	-6.16	156	130	H
42.925	37.71	32.06	40	-7.94	49	100	V
550.012	36.08	38.23	46	-7.77	64	103	V
54.193	36.73	30.02	40	-9.98	124	138	V

Radiated Spurious Emissions 30 MHz to 1 GHz – POE Operation

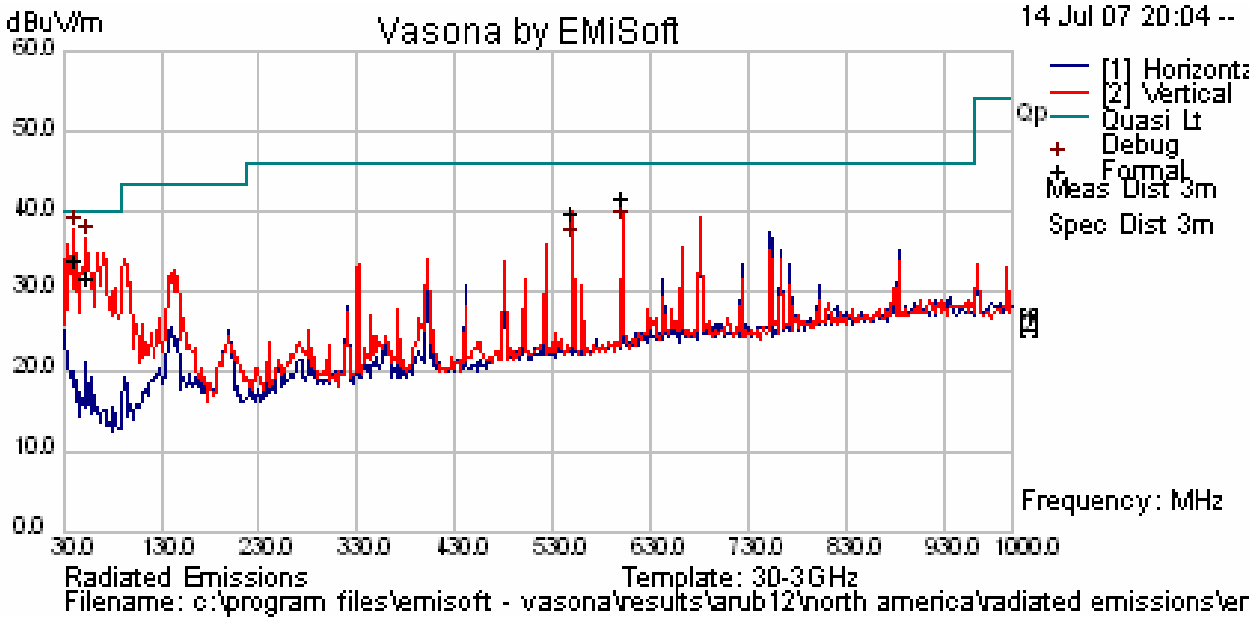
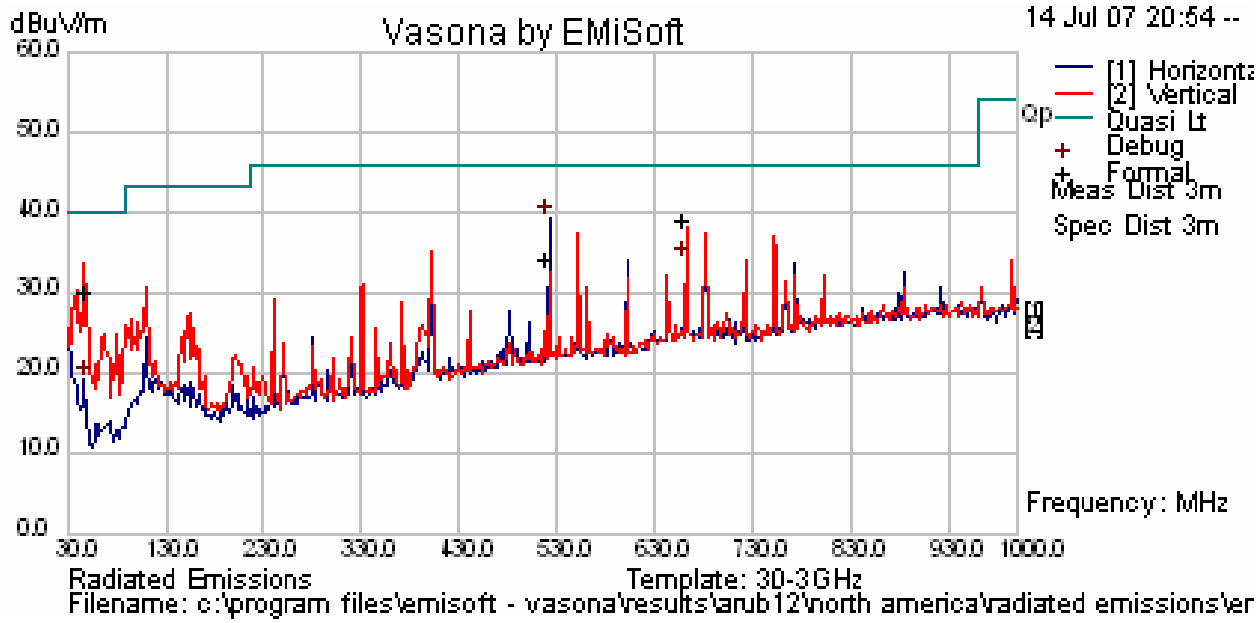


TABLE OF RESULTS – AC/DC CONVERTER OPERATION

Freq. (MHz)	Peak (dBuV/m)	QP (dBuV/m)	QP Lmt (dBuV/m)	QP Margin (dB)	Angle (deg)	Height (cm)	Polarity
520.007	39.12	32.51	46	-13.49	312	112	V
659.999	33.80	37.25	46	-8.75	93	103	V
48.435	18.99	28.25	40	-11.75	127	102	V

Radiated Spurious Emissions 30 MHz to 1 GHz – ac/dc Converter



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) 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)

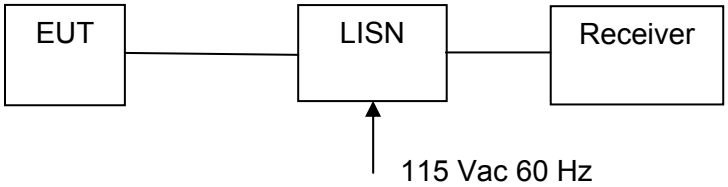
FCC, Part 15 Subpart C §15.207

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.

AC wireline emissions were maximized by operating all three transmitters simultaneously

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

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

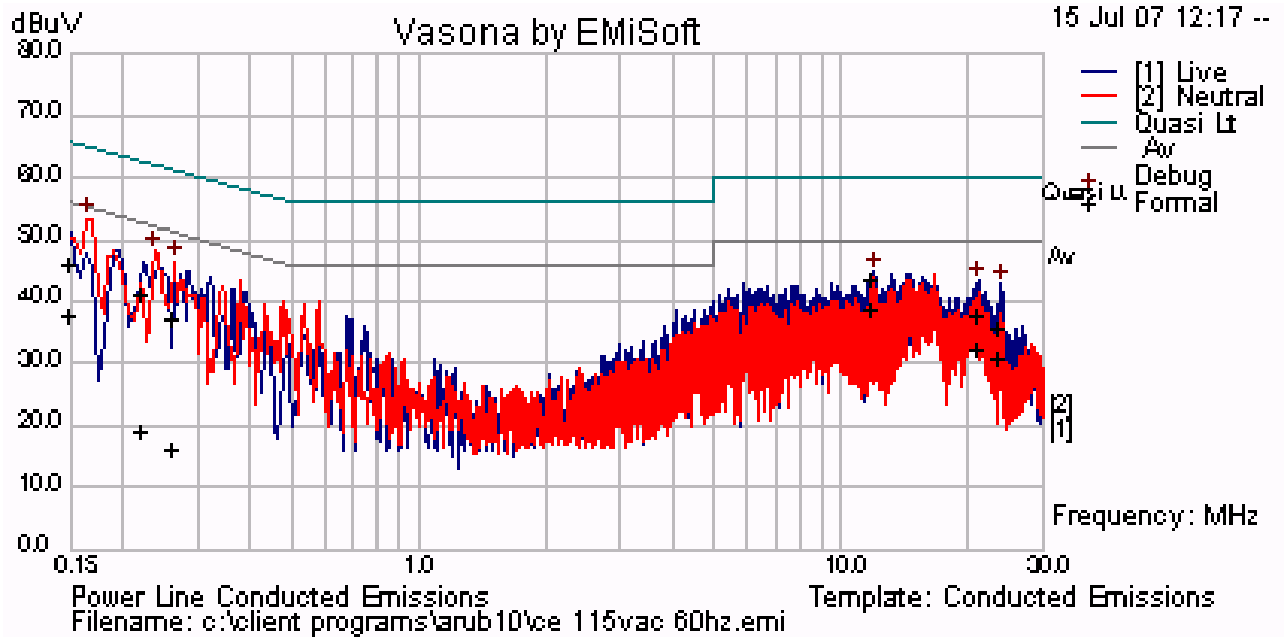
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

EUT parameters.
Data Rate(s): 1 MBit/s
Power Level: Maximum

TABLE OF RESULTS

Freq (MHz)	LIne	Peak (dBµV)	QP (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Ave. (dBµV)	Ave. Limit (dBµV)	Ave. Margin (dB)
0.150	Neutral	53.34	43.5	66	-22.5	35.4	56	-20.6
0.224	Live	48.13	39.96	62.68	-23.71	16.74	52.68	-35.94
0.263	Live	46.52	34.65	61.34	-26.70	14.03	51.34	-37.31
12.00	Live	44.50	41.17	60	-18.83	36.14	50	-13.86
21.162	Live	42.90	35.55	60	-24.45	29.92	50	-20.08
24.005	Live	43.17	33.21	60	-26.79	28.51	50	-21.49

AC Wireline Conducted Emissions – Live & Neutral Lines 150 kHz – 30 MHz)



Specification

Limit

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

§15.207 (a) Limit Matrix
The lower limit applies at the boundary between frequency ranges

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

* Decreases with the logarithm of the frequency

Laboratory Measurement Uncertainty for Conducted Emissions

Measurement uncertainty	±2.64 dB

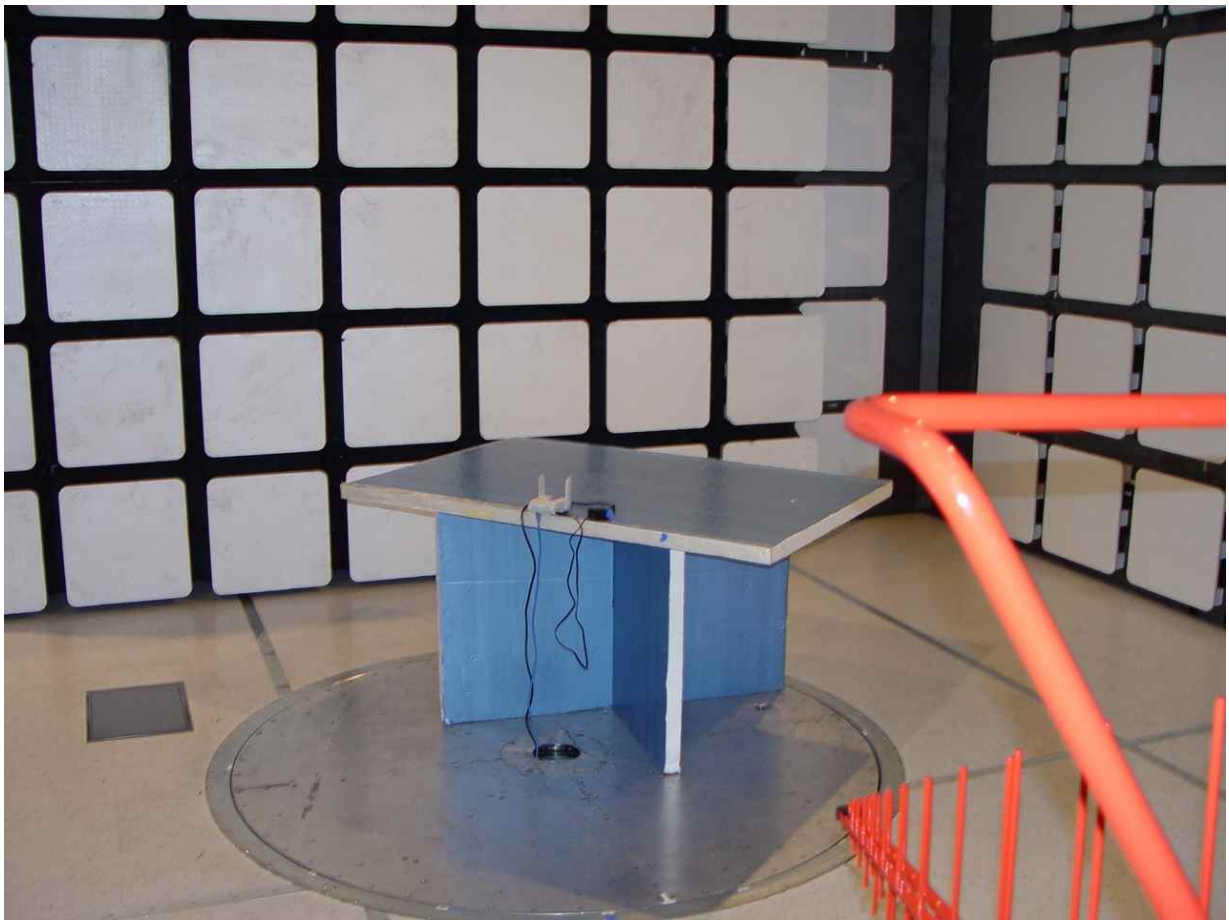
Traceability

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

6. PHOTOGRAPHS

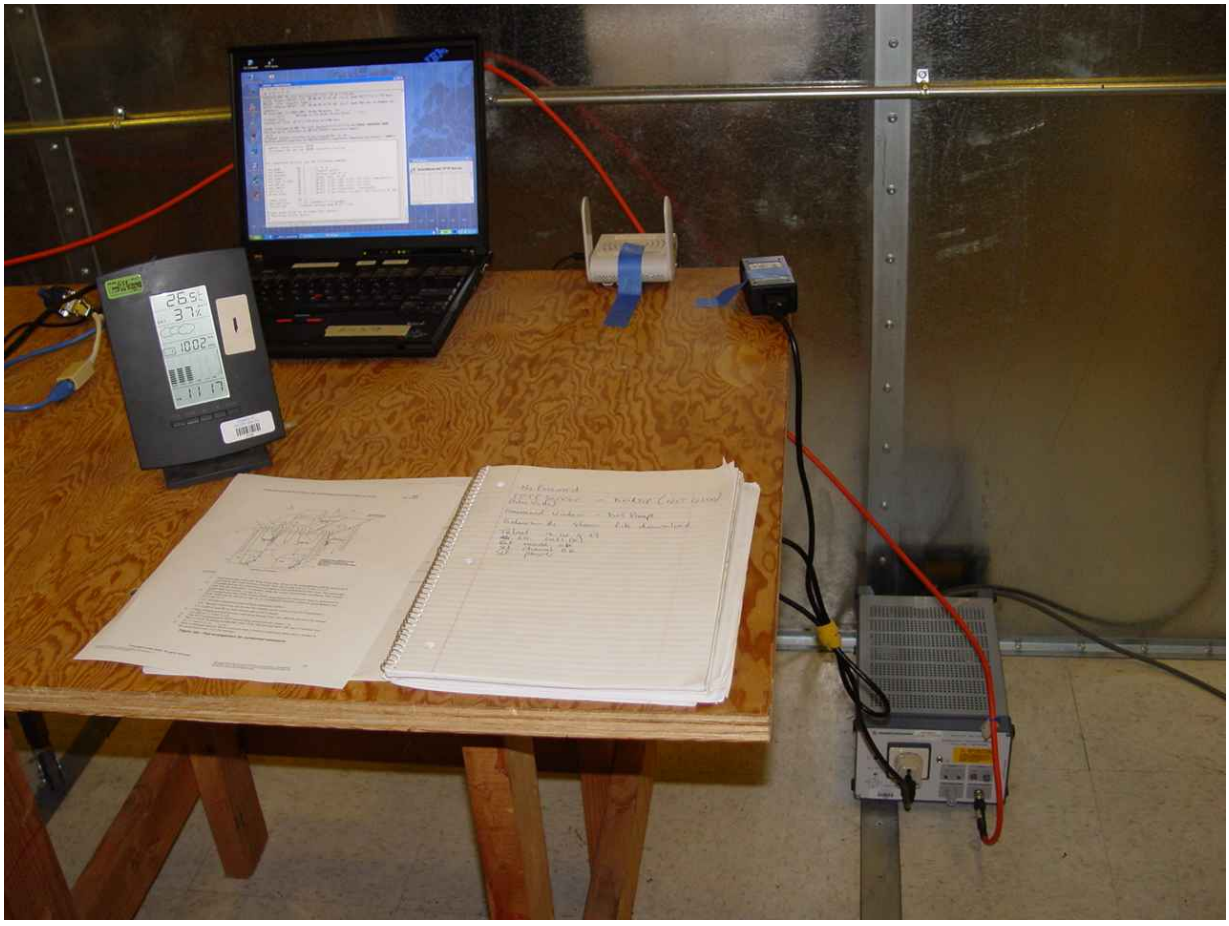
6.1. Radiated Emissions (30 MHz-1 GHz) – POE Operation

6.2. Radiated Emissions (30 MHz-1 GHz) – ac/dc Converter Operation



6.3. Spurious Emissions >1 GHz

6.4. AC Wireline Emissions (150 kHz - 30 MHz)



6.5. General Measurement 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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