

Emissions Test Report

EUT Name: Wi-Fi Module

Model No.: GS1011MIP

CFR 47 Part 15.247 2010 and RSS 210: 2007

Prepared for:

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Statement of Compliance

Manufacturer: Gainspan Corporation
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Requester / Applicant: Ron Green
Name of Equipment: Wi-Fi Module
Model No. GS1011MIP
Type of Equipment: Intentional Radiator
Application of Regulations: CFR 47 Part 15.247 2010 and RSS 210: 2007
Test Dates: July 1 to July 8, 2010

Guidance Documents:

Emissions: ANSI C63.10: 2009

Test Methods:

Emissions: ANSI C63.10: 2009

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that the equipment described above has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

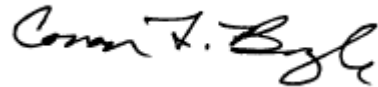
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Test Engineer

Date



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Date



US5254



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Canada Industrie
Canada

2932M-1

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Table of Contents

1	Executive Summary	8
1.1	Scope	8
1.2	Purpose	8
1.3	Summary of Test Results	8
1.4	Special Accessories	8
1.5	Equipment Modifications	8
2	Laboratory Information	9
2.1	Accreditations & Endorsements	9
2.1.1	US Federal Communications Commission	9
2.1.2	NIST / NVLAP	9
2.1.3	Canada – Industry Canada	9
2.1.4	Japan – VCCI	9
2.1.5	Acceptance by Mutual Recognition Arrangement	9
2.2	Test Facilities	10
2.2.1	Emission Test Facility	10
2.2.2	Immunity Test Facility	10
2.3	Measurement Uncertainty	11
2.3.1	Sample Calculation – radiated & conducted emissions	11
2.3.2	Measurement Uncertainty Emissions	12
2.4	Calibration Traceability	12
3	Product Information	13
3.1	Product Description	13
3.2	Equipment Configuration	13
3.3	Operating Mode	13
3.4	Unique Antenna Connector	14
3.4.1	Results	14
4	Emissions	15
4.1	Output Power Requirements	15
4.1.1	Test Method	15
4.1.2	Results	16
4.2	Occupied Bandwidth	20
4.2.1	Test Method	20
4.2.2	Results	21
4.3	Band Edge Requirements	28
4.4	Peak Power Spectral Density	42
4.4.1	Test Method	42
4.4.2	Results	43
4.5	Maximum Permissible Exposure	47
4.5.1	Test Methodology	47

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Table of Contents

4.5.2	RF Exposure Limit	47
4.5.3	EUT Operating Condition	47
4.5.4	Classification	48
4.5.5	Test Results	48
4.5.6	Sample Calculation	48
4.6	Transmitter Spurious Emissions	49
4.6.1	Test Methodology	49
4.6.2	Transmitter Spurious Emission Limit	50
4.6.3	Test Results	50
4.6.4	Sample Calculation	72
4.7	Receiver Spurious Emissions	73
4.7.1	Test Methodology	73
4.7.2	Receiver Spurious Emission Limit	74
4.7.3	Test Results	74
4.7.4	Sample Calculation	78
4.8	AC Conducted Emissions	79
4.8.1	Test Methodology	79
4.8.2	Test Results	79
5	Test Equipment Use List	83
5.1	Equipment List	83
6	EMC Test Plan	84
6.1	Introduction	84
6.2	Customer	84
6.3	Equipment Under Test (EUT)	85
6.4	Test Specifications	87

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Index of Figures

Figure 1: Maximum Transmitted Power – Lowest Channel 2412 MHz of 802.11b (11 Mbit/s)	17
Figure 2: Maximum Transmitted Power – Middle Channel 2437 MHz of 802.11b (11 Mbit/s).....	18
Figure 3: Maximum Transmitted Power – Highest Channel 2462 MHz of 802.11b (11 Mbit/s).....	19
Figure 4: 6 dB Bandwidth at 5.5 Mbit/s – Operating Channel 2412 MHz	22
Figure 5: 6 dB Bandwidth at 5.5 Mbit/s – Operating Channel 2437 MHz	23
Figure 6: 6 dB Bandwidth at 5.5 Mbit/s – Operating Channel 2462 MHz	24
Figure 7: 99% Bandwidth at 2 Mbit/s – Operating Channel 2412 MHz	25
Figure 8: 99% Bandwidth at 2 Mbit/s – Operating Channel 2437 MHz	26
Figure 9: 99% Bandwidth at 2 Mbit/s – Operating Channel 2462 MHz	27
Figure 10: Band Edge Requirement for Operating Channel 2412 MHz at 11 Mbit/s	30
Figure 11: Band Edge Requirement for Operating Channel 2437 MHz at 11 Mbit/s	31
Figure 12: Band Edge Requirement for Operating Channel 2462 MHz at 11 Mbit/s	32
Figure 13: Out of Band Emission for Channel 2412 MHz at 11 Mbit/s – Band 1.....	33
Figure 14: Out of Band Emission for Channel 2412 MHz at 11 Mbit/s – Band 2.....	34
Figure 15: Out of Band Emission for Channel 2412 MHz at 11 Mbit/s – Band 3.....	35
Figure 16: Out of Band Emission for Channel 2437 MHz at 11 Mbit/s – Band 1.....	36
Figure 17: Out of Band Emission for Channel 2437 MHz at 11 Mbit/s – Band 2.....	37
Figure 18: Out of Band Emission for Channel 2437 MHz at 11 Mbit/s – Band 3.....	38
Figure 19: Out of Band Emission for Channel 2462 MHz at 11 Mbit/s – Band 1.....	39
Figure 20: Out of Band Emission for Channel 2462 MHz at 11 Mbit/s – Band 2.....	40
Figure 21: Out of Band Emission for Channel 2462 MHz at 11 Mbit/s – Band 3.....	41
Figure 22: Peak Power Spectral Density for Operating Channel 2412 MHz – 11 Mbit/s	44
Figure 23: Peak Power Spectral Density for Operating Channel 2437 MHz – 11 Mbit/s	45
Figure 24: Peak Power Spectral Density for Operating Channel 2462 MHz – 11 Mbit/s	46
Figure 25: Emission at the Edge for Channel 2412 MHz at 1 Mbps – Horizontal (Peak).....	52
Figure 26: Emission at the Edge for Channel 2412 MHz at 1 Mbps – Horizontal (Ave.).....	53
Figure 27: Emission at the Edge for Channel 2412 MHz at 1 Mbps – Vertical (Peak).....	54
Figure 28: Emission at the Edge for Channel 2412 MHz at 1 Mbps – Vertical (Ave.).....	55
Figure 29: Emission at the Edge for Channel 2437 MHz at 1 Mbps – Horizontal (Peak).....	56
Figure 30: Emission at the Edge for Channel 2437 MHz at 1 Mbps – Horizontal (Ave.).....	57
Figure 31: Emission at the Edge for Channel 2437 MHz at 1 Mbps – Vertical (Peak).....	58
Figure 32: Emission at the Edge for Channel 2437 MHz at 1 Mbps – Vertical (Ave.).....	59
Figure 33: Emission at the Edge for Channel 2462 MHz at 1 Mbps – Horizontal (Peak).....	60

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Index of Figures

Figure 34: Emission at the Edge for Channel 2462 MHz at 1 Mbps – Horizontal (Ave.).....	61
Figure 35: Emission at the Edge for Channel 2462 MHz at 1 Mbps – Vertical (Peak).....	62
Figure 36: Emission at the Edge for Channel 2462 MHz at 1 Mbps – Vertical (Ave.).....	63

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Index of Tables

Table 1: Summary of Test Results	8
Table 2: RF Output Power at the Antenna Port – Test Results	16
Table 3: Occupied Bandwidth – Test Results	21
Table 4: Band Edge Requirements – Test Results	28
Table 5: Out of band Conducted Emission – Test Results	29
Table 6: Peak Power Spectral Density – Test Results	43
Table 7: Transmit Spurious Emission at Band Edge Requirements	51
Table 8: AC Conducted Emissions – Test Results	80
Table 9: Customer Information	84
Table 10: Technical Contact Information	84
Table 11: EUT Specifications	85
Table 12: Interface Specifications	86
Table 13: Supported Equipment	86
Table 14: Description of Sample used for Testing	86
Table 15: Description of Test Configuration used for Radiated Measurement.	86
Table 16: Testing Requirements	87

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1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 15.247 2010 and RSS 210: 2007 based on the results of testing performed on July 1 to July 8, 2010 on the Wi-Fi Module Model GS1011MIP manufactured by Gainspan Corporation. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this addendum report.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C63.4	Test Parameters (from Standard)	Result
Spurious Emission in Received Mode	CFR47 15.109, RSS-GEN Sect.7.2.3	Class B	Complied
Spurious Emission in Transmitted Mode	CFR47 15.209, RSS-GEN Sect.7.2.3	Class B	Complied
Restricted Bands of Operation	CFR47 15.205, RSS 210 Sect.2.6	Class B	Complied
AC Power Conducted Emission	CFR47 15.207, RSS-GEN Sect.7.2.2	Class B	Complied
Occupied Bandwidth	CFR47 15.247 (a2), RSS GEN Sect.4.4.1	≥ 500 kHz	Complied
Maximum Transmitted Power	CFR47 15.247 (b3), RSS 210 Sect. A.8.4	30 dBm	Complied
Peak Power Spectral Density	CFR47 15.247 (e), RSS 210 Sect. A.8.2	8 dBm/ 3 kHz	Complied
Band Edge Measurement	CFR47 15.247 (d), RSS 210 Sect. A.8.5	20 dBr	Complied
RF Exposure	CFR47 15.247 (i), 2.1091	General Population	Complied

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

None

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2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission



TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 is accredited by the commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (US5254). The laboratory scope of accreditation includes: Title 47 CFR Parts 15, 18, and 90. The accreditation is updated every 3 years.

2.1.2 NIST / NVLAP



TUV Rheinland of North America is accredited by the National Voluntary Laboratory Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Guide 17025:2005 and ISO 9002 (Lab Code 500011-0). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Canada – Industry Canada



TUV Rheinland of North America at the 1279 Quarry Ln, Pleasanton, CA 94566 address is accredited by Industry Canada for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by Industry Canada (File Number 2932M-1). This reference number is the indication to the Industry Canada Certification Officers that the site meets the requirements of RSS 212, Issue 1 (Provisional). The accreditation is updated every 3 years.

2.1.4 Japan – VCCI



The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 has been assessed and approved in accordance with the Regulations for Voluntary Control Measures. (Registration Nos. R-3269, C-3637, C-3638, T-1752, T-1753).

2.1.5 Acceptance by Mutual Recognition Arrangement



The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / NVLAP accreditation will be accepted by each member country.

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2.2 Test Facilities

All of the test facilities are located at 1279 Quarry Lane, Pleasanton, California 94566, USA. The 2305 Mission College, Santa Clara, 95054, USA location is considered a Pleasanton annex.

2.2.1 Emission Test Facility

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2003, at a test distance of 3 and 5 meters. This site has been described in reports dated November 1st, 2006, submitted to the FCC, and accepted by letter dated November 28, 2006. The site is listed with the FCC and accredited by NVLAP (Lab Code 500011-0).

2.2.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7 m x 4.8 m x 3.175 mm thick aluminum floor connected to PE ground.

For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6 m x 0.8 m x 0.8 m high non-conductive table with a 3.175 mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470-k Ω resistors. The Vertical Coupling Plane consists of an aluminum plate 50 cm x 50 cm x 3.175 mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470-k Ω resistors.

For EFT, Surge, PQF, the HCP and VCP are removed.

RF Field Immunity testing is performed in a 7.3m x 4.3m x 4.1m anechoic chamber.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.8m x 3.7m x 3.175mm thick aluminum ground plane.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities; it is equal to the positive square root of the sum of the variances or co-variances of these other quantities, weighted according to how the measurement result varies with changes in these quantities. The term *standard uncertainty* is the result of a measurement expressed as a standard deviation.

2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{RAW} - \text{AMP} + \text{CBL} + \text{ACF}$$

Where: RAW = Measured level before correction (dB μ V)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu\text{V/m} = 10^{\frac{\text{dB}\mu\text{V} / \text{m}}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

$$25 \text{ dBuV/m} + 17.5 \text{ dB} - 20 \text{ dB} + 1.0 \text{ dB} = 23.5 \text{ dBuV/m}$$

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2.3.2 Measurement Uncertainty Emissions

	U_{lab}	U_{cispr}
Radiated Disturbance		
30 MHz – 25,000 MHz	3.2 dB	5.2 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	2.4 dB	3.6 dB
Disturbance Power		
30 MHz – 300 MHz	3.92 dB	4.5 dB

Note: U_{lab} is the calculated Combined Standard Uncertainty
 U_{cispr} is the measurement uncertainty requirement per CISPR 16.

Measurement Uncertainty Immunity

The estimated combined standard uncertainty for ESD immunity measurements is $\pm 4.1\%$.
The estimated combined standard uncertainty for radiated immunity measurements is ± 2.7 dB.
The estimated combined standard uncertainty for conducted immunity measurements is ± 1.4 dB.
The estimated combined standard uncertainty for damped oscillatory wave immunity measurements is $\pm 8.8\%$.
The estimated combined standard uncertainty for harmonic current and flicker measurements is $\pm 0.45\%$.

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

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3 Product Information

3.1 Product Description

The WiFi Module, model GS1011MIP, is a 802.11B WiFi module. It is intended to deploy in the low system resource device such as sensors. It is used an integrated antenna.

3.2 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of an EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.3 Operating Mode

A description of the operation mode is given in the Test Plan Section. In the case of an EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

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3.4 Unique Antenna Connector

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

3.4.1 Results

The GS1011MIP WiFi Module has an integrated antenna.

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4 Emissions

Testing was performed in accordance with CFR 47 Part 15.247: 2007 and RSS 210 Annex 8: 2007. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in section 8 of the standard were used.

4.1 Output Power Requirements

The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.

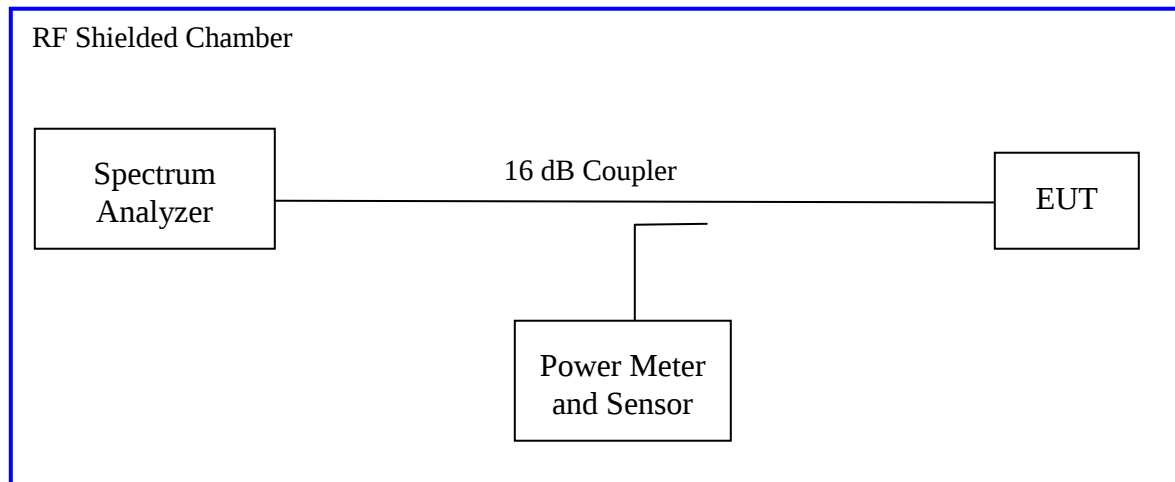
The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b3):2010 and RSS 210 A.8.4: 2007

The maximum transmitted power is +30 dBm or 1 Watt.

4.1.1 Test Method

The conducted method was used to measure the channel power output according to ANSI C63.10:2009 Section 6.10.3.1. The measurement was performed with modulation per CFR47 Part15.247 (b3):2008 and RSS 210 A.8.4. This test was conducted on 3 channels of Sample, MAC 001DC90009F5. The worst mode result indicated below.

Test Setup:



Method #1 of "Measurement of Digital Transmission Systems Operating under Section 15.247" applies since the GS1011MIP continuously transmit; where T, Transmission Duration Pulse, is greater than analyzer sweep time.

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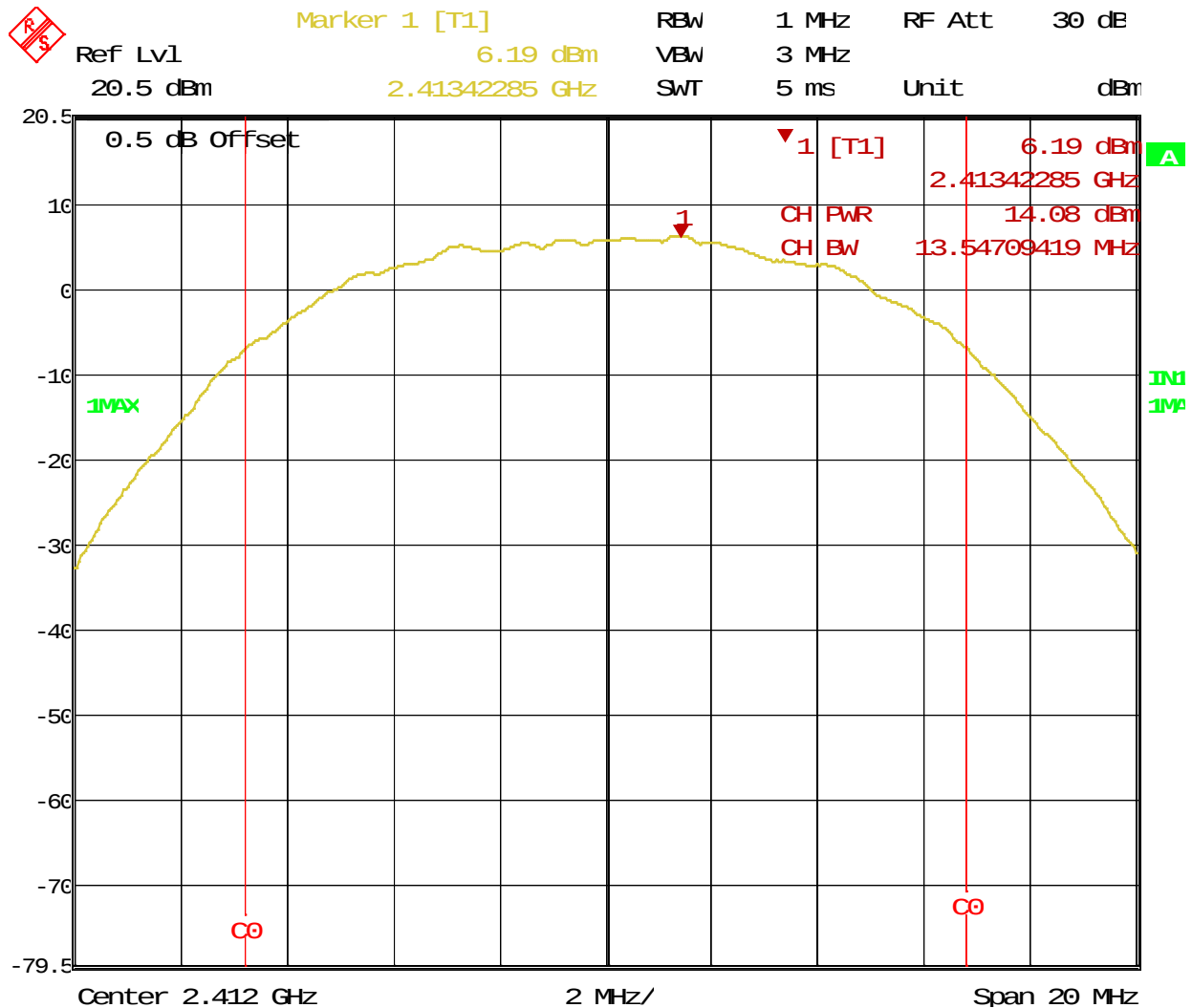
4.1.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 2: RF Output Power at the Antenna Port – Test Results

Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type: Integrated		Power Setting: +9 dBm	
Max. Antenna Gain: +0 dBi		Signal State: Modulated	
Ambient Temp.: 22° C		Relative Humidity:36%	
Test Results			
Operating Channel	Limit [dBm]	802.11b (11 Mbit/s) Output Level [dBm]	802.11b Margin [dB]
2412 MHz	+30.00	14.00	-16.00
2437 MHz	+30.00	14.34	-15.66
2462 MHz	+30.00	14.39	-15.61
Note: The highest peak output power was observed at 11 Mbps.			

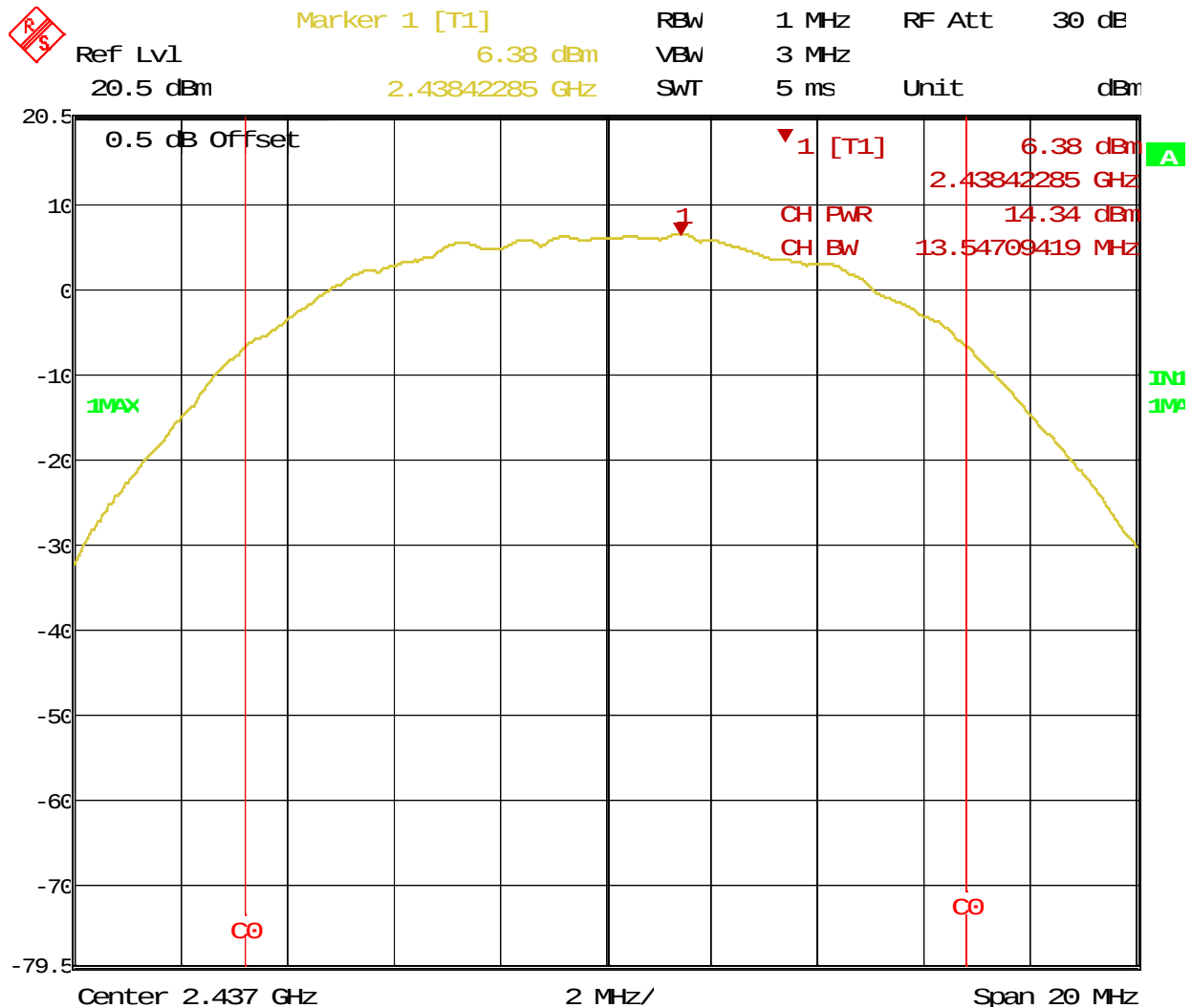
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Date: 8.JUL.2010 23:26:25

Figure 1: Maximum Transmitted Power – Lowest Channel 2412 MHz of 802.11b (11 Mbit/s)

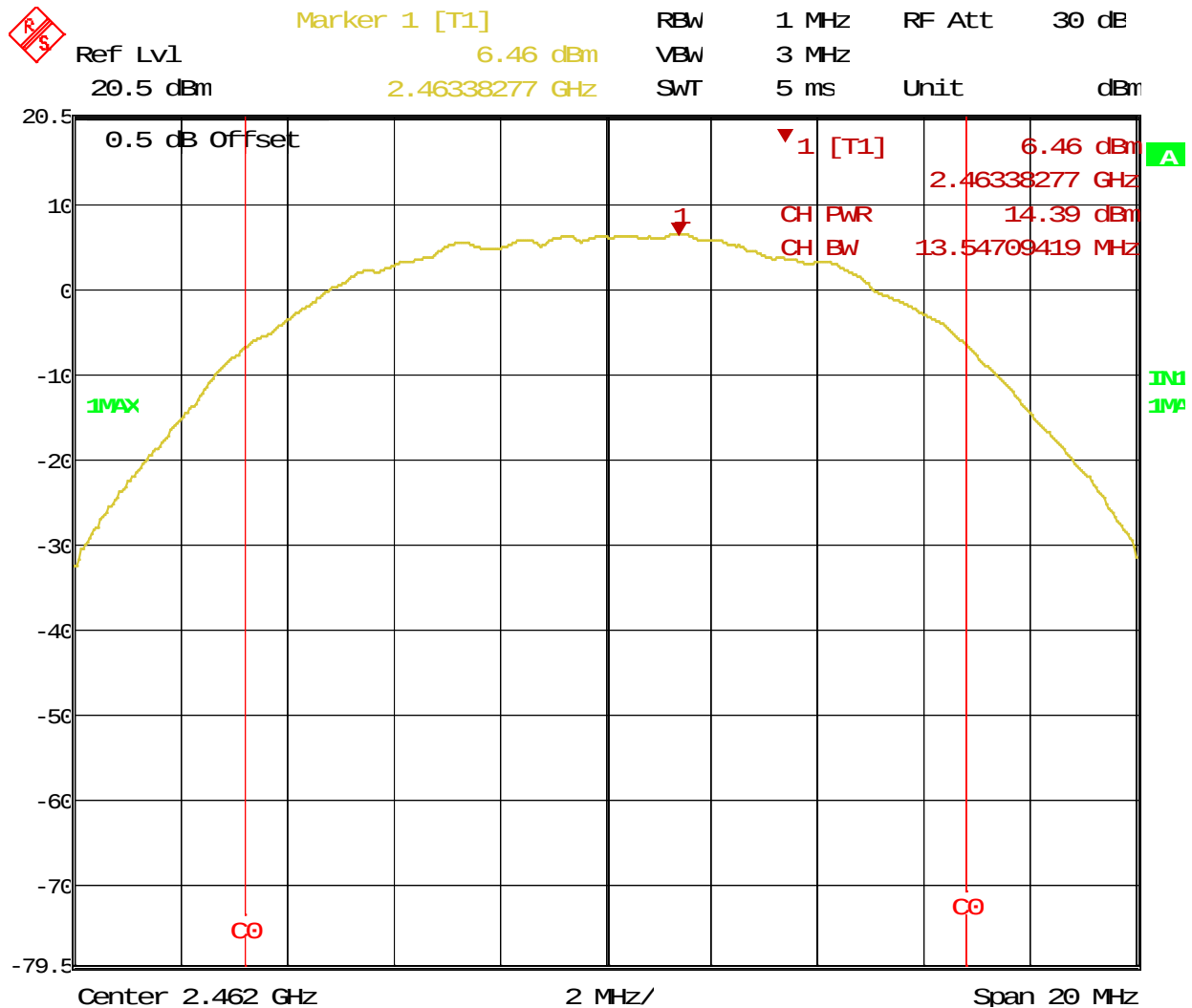
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Date: 8.JUL.2010 23:27:51

Figure 2: Maximum Transmitted Power – Middle Channel 2437 MHz of 802.11b (11 Mbit/s)

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Date: 8.JUL.2010 23:28:57

Figure 3: Maximum Transmitted Power – Highest Channel 2462 MHz of 802.11b (11 Mbit/s)

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4.2 Occupied Bandwidth

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

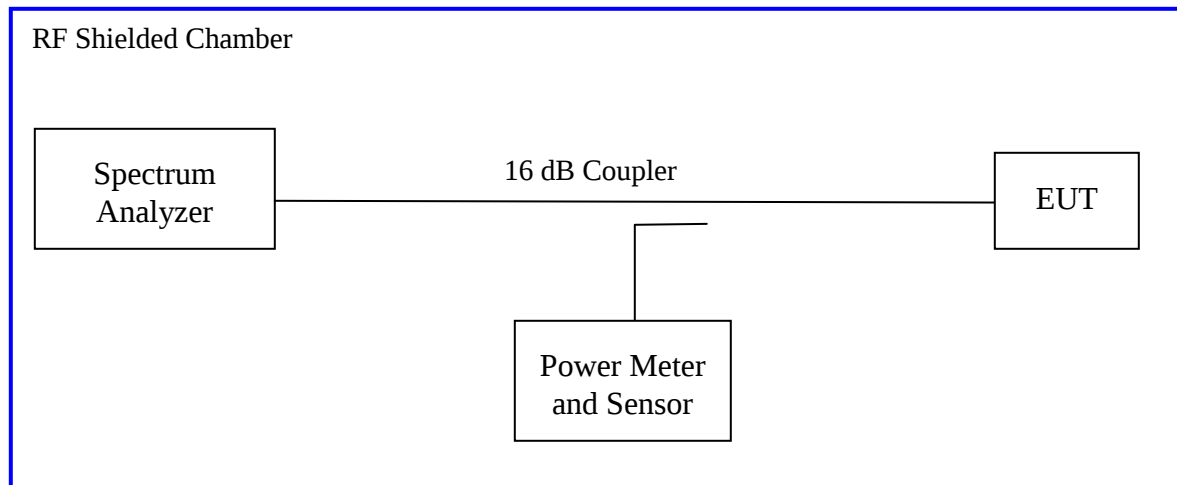
The 6 dB bandwidth is defined the bandwidth of 6 dBr from highest transmitted level of the fundamental frequency.

The bandwidth shall be at least 500 kHz per Section CFR47 15.247(a2):2010 and RSS Gen Sect. 4.4.1:2007.

4.2.1 Test Method

The conducted method was used to measure the channel power output. The measurement was performed with modulation per CFR47 15.247(a2) 2010 and RSS Gen Sect. 4.4.1:2007. This test was conducted on 3 channels of Sample, S/N: 001DC90009F5. The worst sample result indicated below.

Test Setup:



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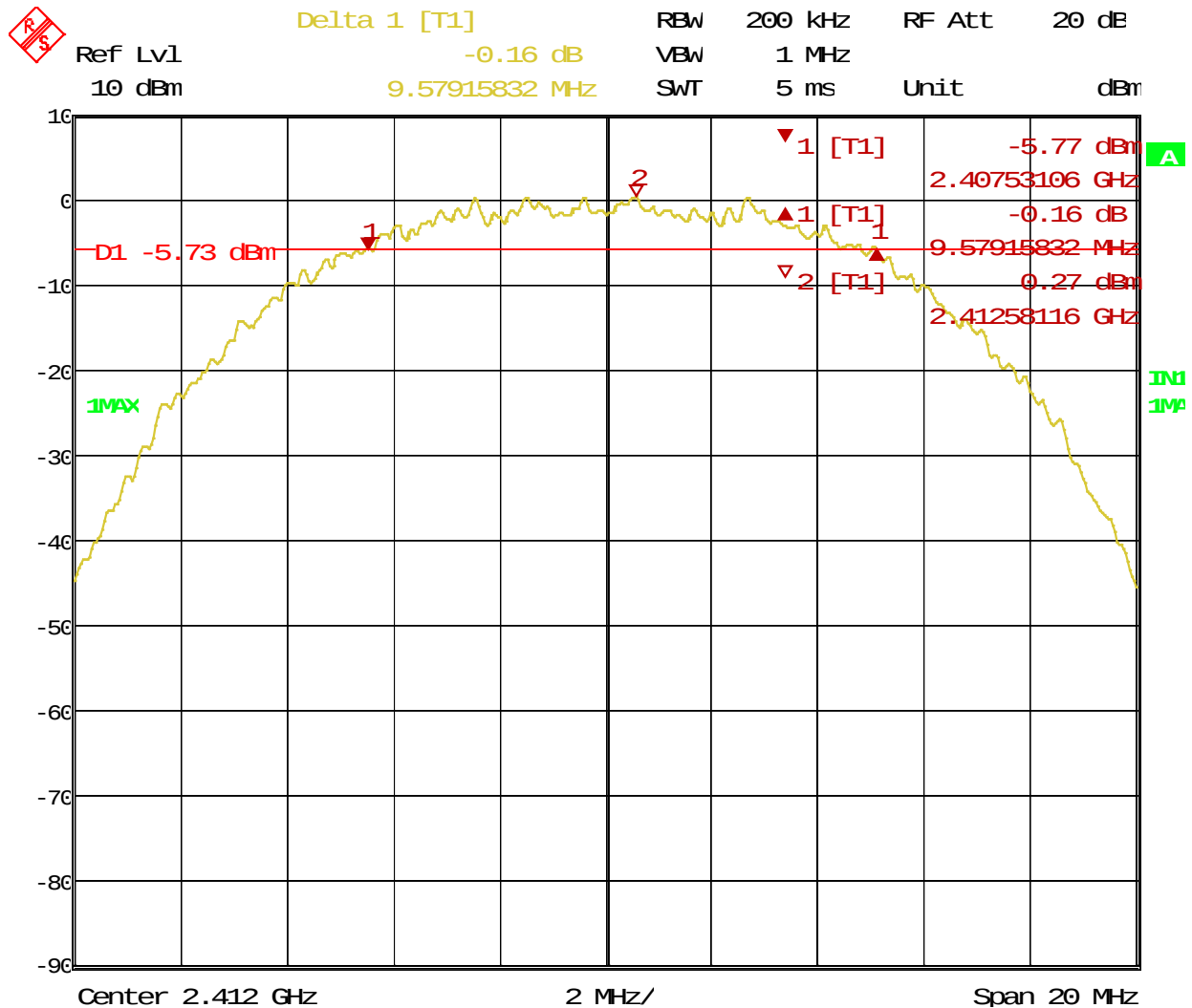
4.2.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 3: Occupied Bandwidth – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only			
Antenna Type: Integrated		Power Setting: +9 dBm	
Max. Antenna Gain: +0 dBi		Signal State: Modulated	
Ambient Temp.: 23° C		Relative Humidity:36%	
99% Bandwidth (MHz)			
Operating Channel	Limit	802.11g @ 2Mbps	Results
2412 MHz	Na	13.22645291	Na
2437 MHz	Na	13.26653307	Na
2462 MHz	Na	13.22645291	Na
Note: The 99% bandwidth was observed at 2 Mbps.			
6 dB Bandwidth (MHz)			
Operating Channel	Limit	802.11b @ 5.5Mbps	Results
2412 MHz	500 kHz	9.57915832	Pass
2437 MHz	500 kHz	9.61923848	Pass
2462 MHz	500 kHz	9.53907816	Pass
Note: the narrowest 6 dB bandwidth was observed at 5.5Mbps.			

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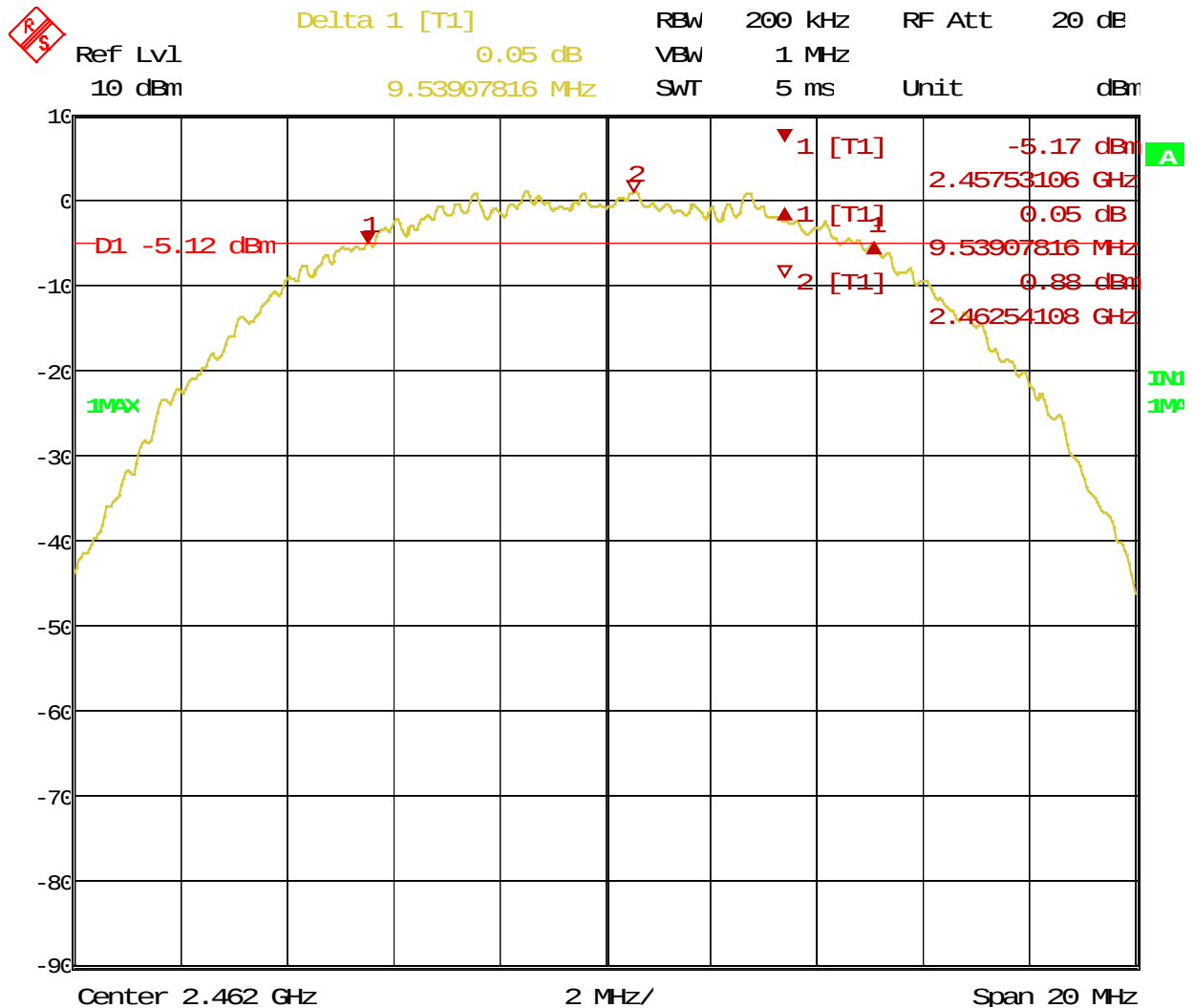
Date: 8.JUL.2010 23:07:53

Figure 4: 6 dB Bandwidth at 5.5 Mbit/s – Operating Channel 2412 MHz

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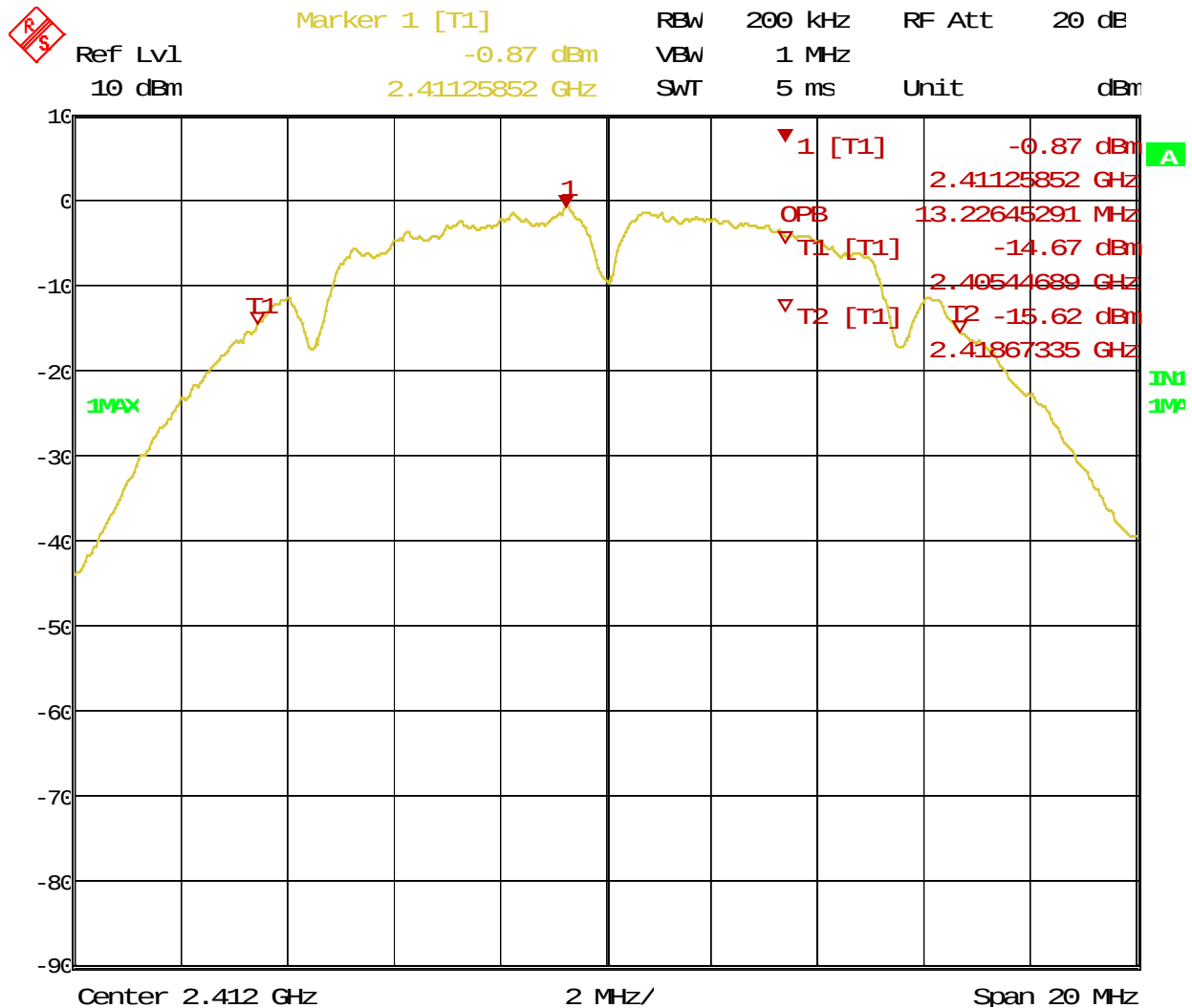
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Date: 8.JUL.2010 22:58:51

Figure 6: 6 dB Bandwidth at 5.5 Mbit/s – Operating Channel 2462 MHz

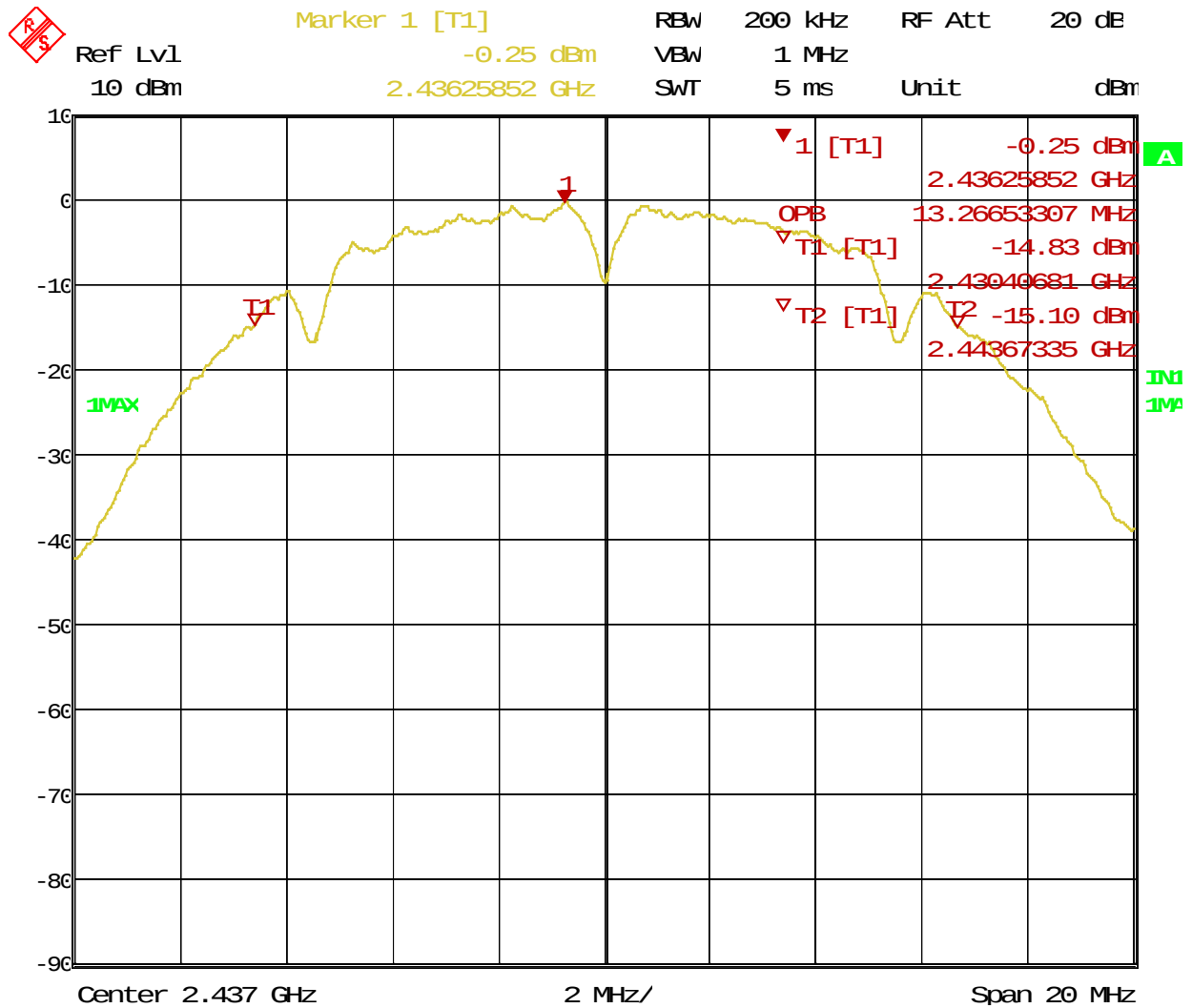
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Date: 8.JUL.2010 22:21:31

Figure 7: 99% Bandwidth at 2 Mbit/s – Operating Channel 2412 MHz

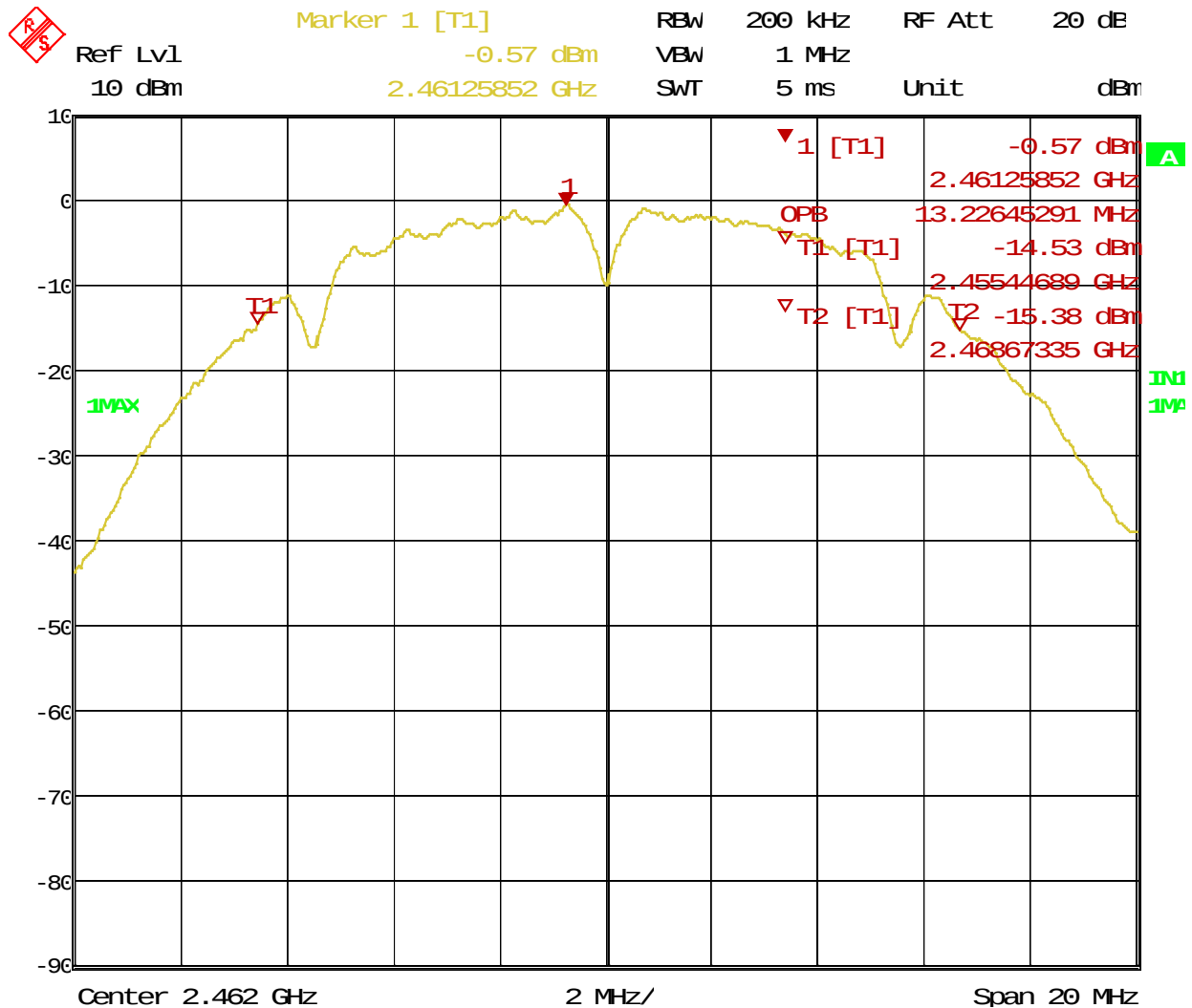
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Date: 8.JUL.2010 22:19:05

Figure 8: 99% Bandwidth at 2 Mbit/s – Operating Channel 2437 MHz

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Date: 8.JUL.2010 22:23:50

Figure 9: 99% Bandwidth at 2 Mbit/s – Operating Channel 2462 MHz

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4.3 Band Edge Requirements

The setup was identical to RF output power measurement. Intentional radiators operating under the alternative provisions to the general emission limits, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If the frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

The test setup is same as the output power measurement.

Any frequency outside the band of 2400 MHz to 2483.5 MHz, the power output level must be below 20 dB from the in-band transmitting signal; CFR 47 Part 15.215, 15.247(d) and RSS 210 A8.5

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 4: Band Edge Requirements – Test Results

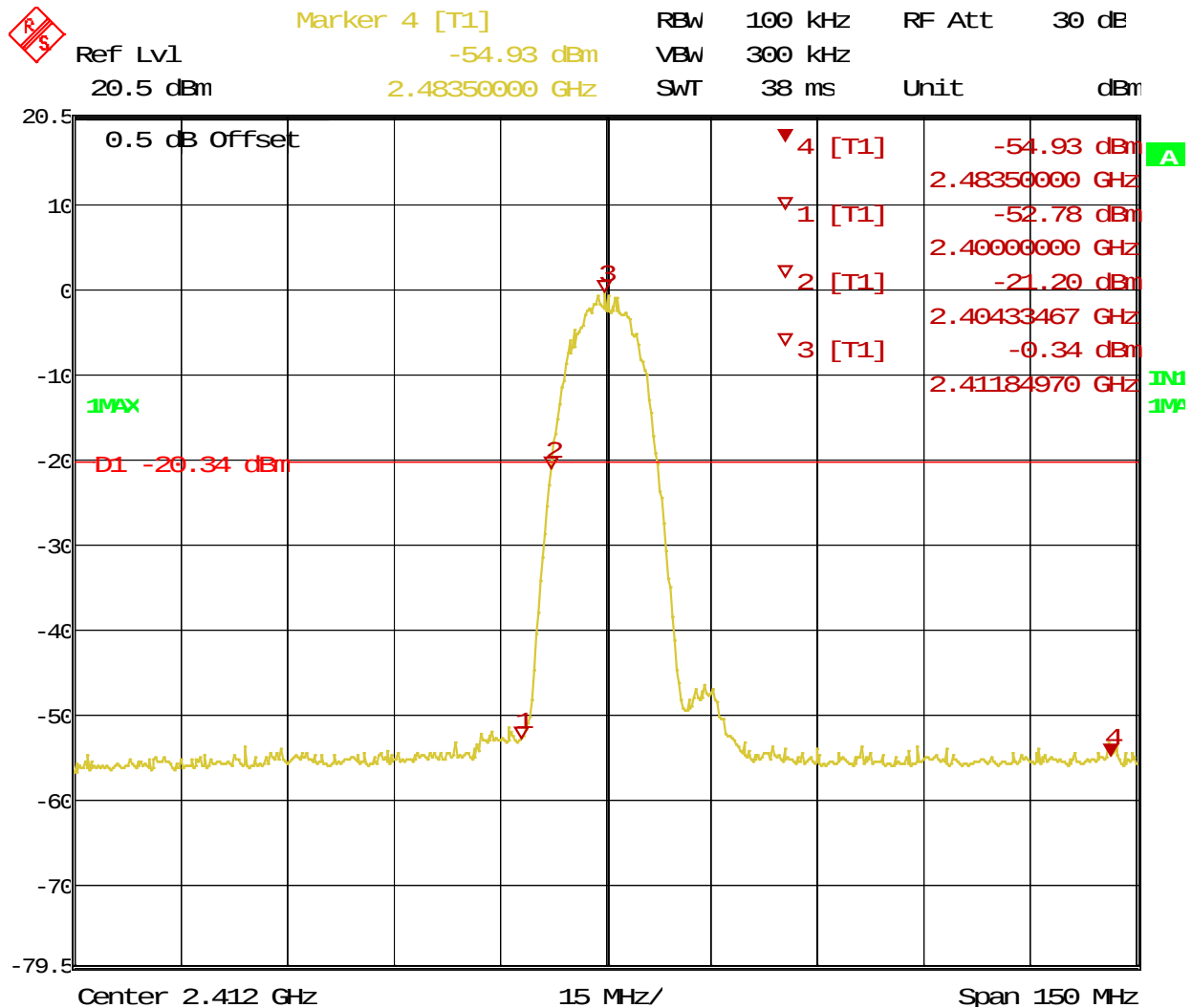
Test Conditions: Conducted Measurement, Normal Temperature and Voltage only				
Antenna Type: Integrated		Power Setting: +9 dBm		
Max. Antenna Gain: + 0 dBi		Signal State: Modulated		
Ambient Temp.: 23° C		Relative Humidity:36%		
Band Edge Results				
Operating Channel	Mode	Band Edge Level (dBm)	20 dB Level (dBm)	Margin (dB)
2412 MHz	11Mbps	-52.70	-20.34	-32.36
2437 MHz	11Mbps	-53.87	-20.42	-33.45
2462 MHz	11Mbps	-55.05	-20.47	-34.58

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Table 5: Out of band Conducted Emission – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only					
Antenna Type: Integrated			Power Setting: +9 dBm		
Max. Antenna Gain: + 0 dBi			Signal State: Modulated		
Ambient Temp.: 23 °C			Relative Humidity:36%		
Output of Band Results					
Operating Channel	Mode	Band 1 30MHz-2.4835GHz	Band 2 2.4835GHz-10GHz	Band 3 10GHz-25GHz	Result
2412 MHz	11Mbps	Figure 13	Figure 14	Figure 15	Pass
2437 MHz	11Mbps	Figure 16	Figure 17	Figure 18	Pass
2462 MHz	11Mbps	Figure 19	Figure 20	Figure 21	Pass

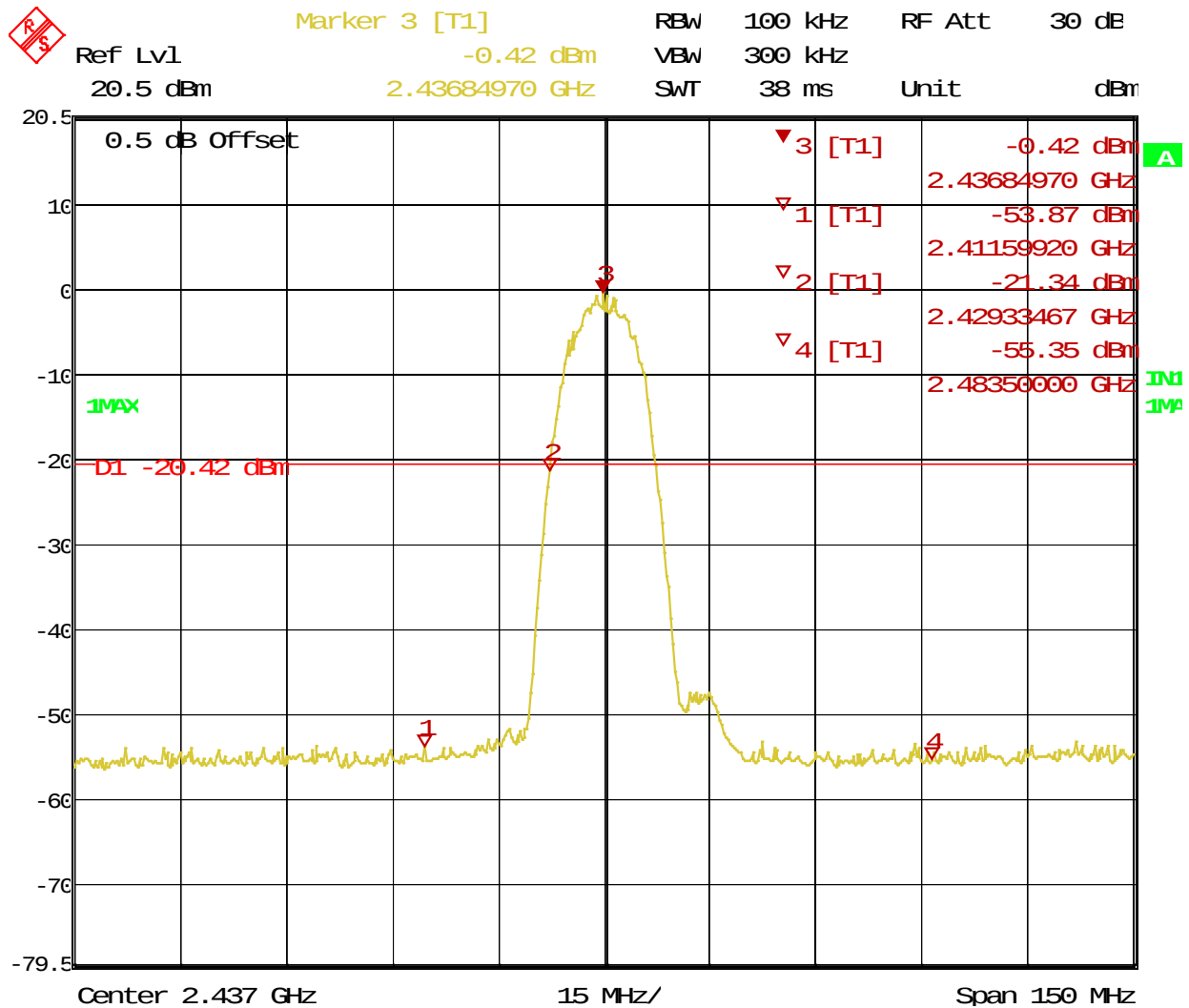
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Date: 9.JUL.2010 01:19:28

Figure 10: Band Edge Requirement for Operating Channel 2412 MHz at 11 Mbit/s

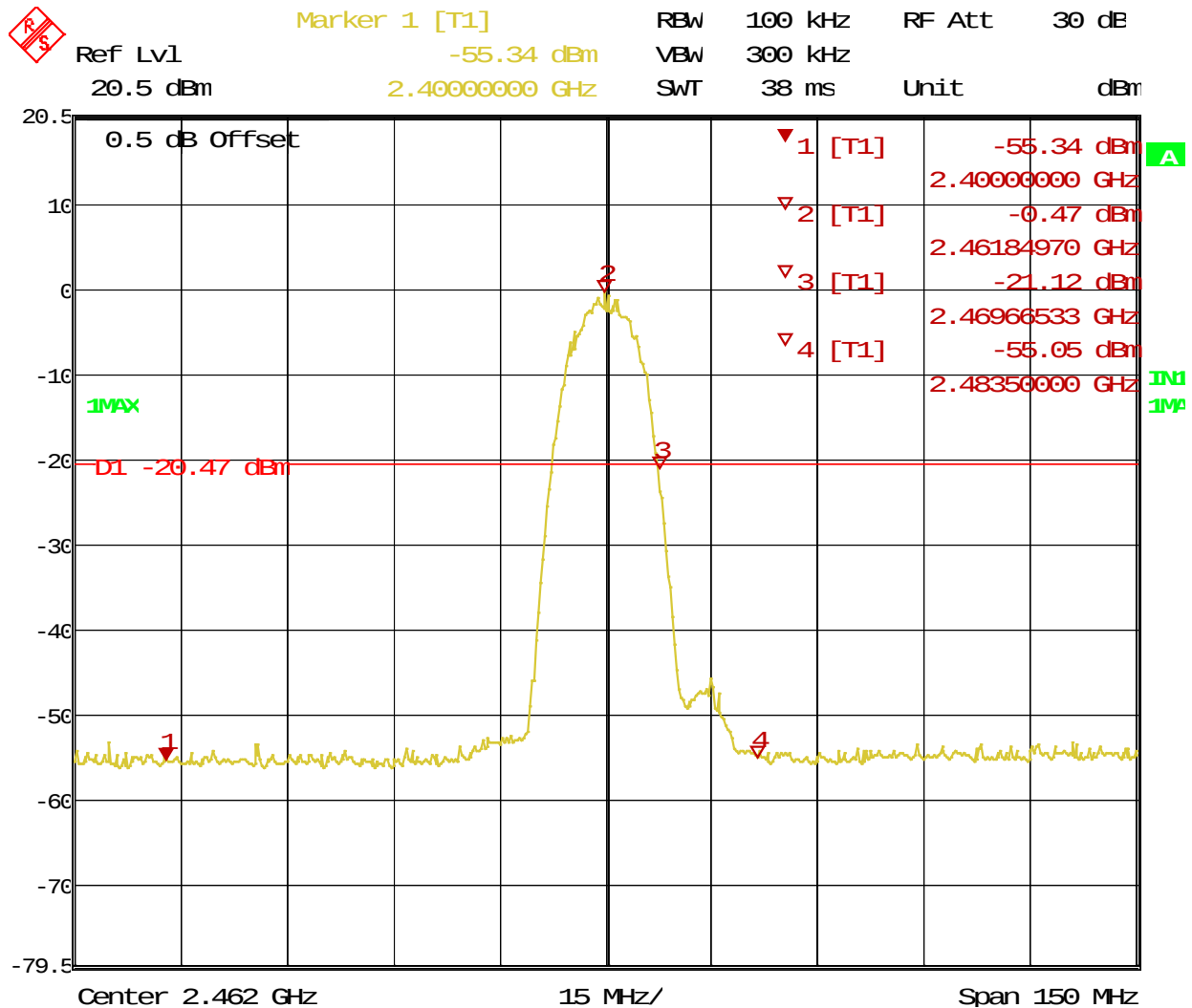
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Date: 9.JUL.2010 01:24:40

Figure 11: Band Edge Requirement for Operating Channel 2437 MHz at 11 Mbit/s

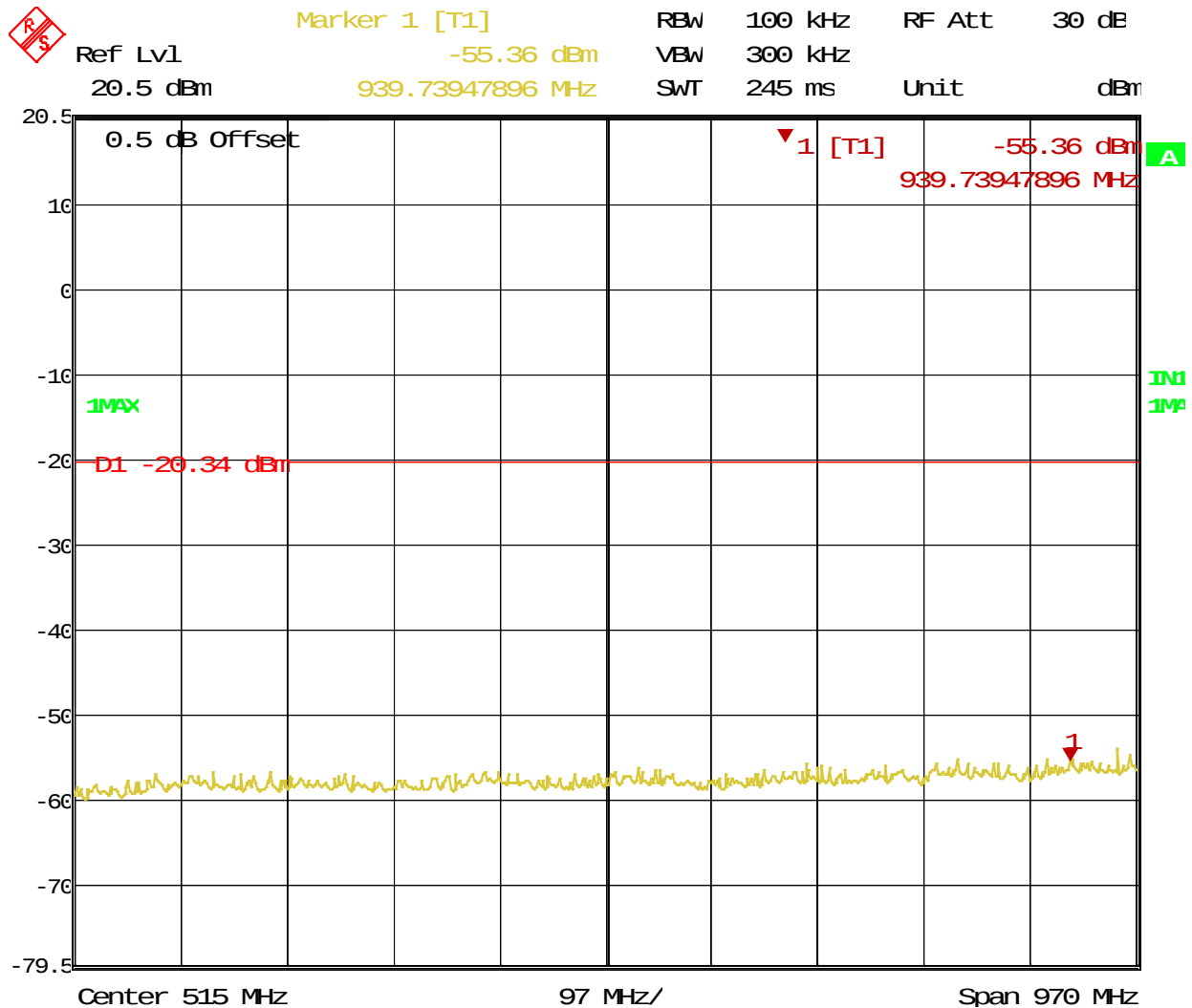
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Date: 9.JUL.2010 01:30:31

Figure 12: Band Edge Requirement for Operating Channel 2462 MHz at 11 Mbit/s

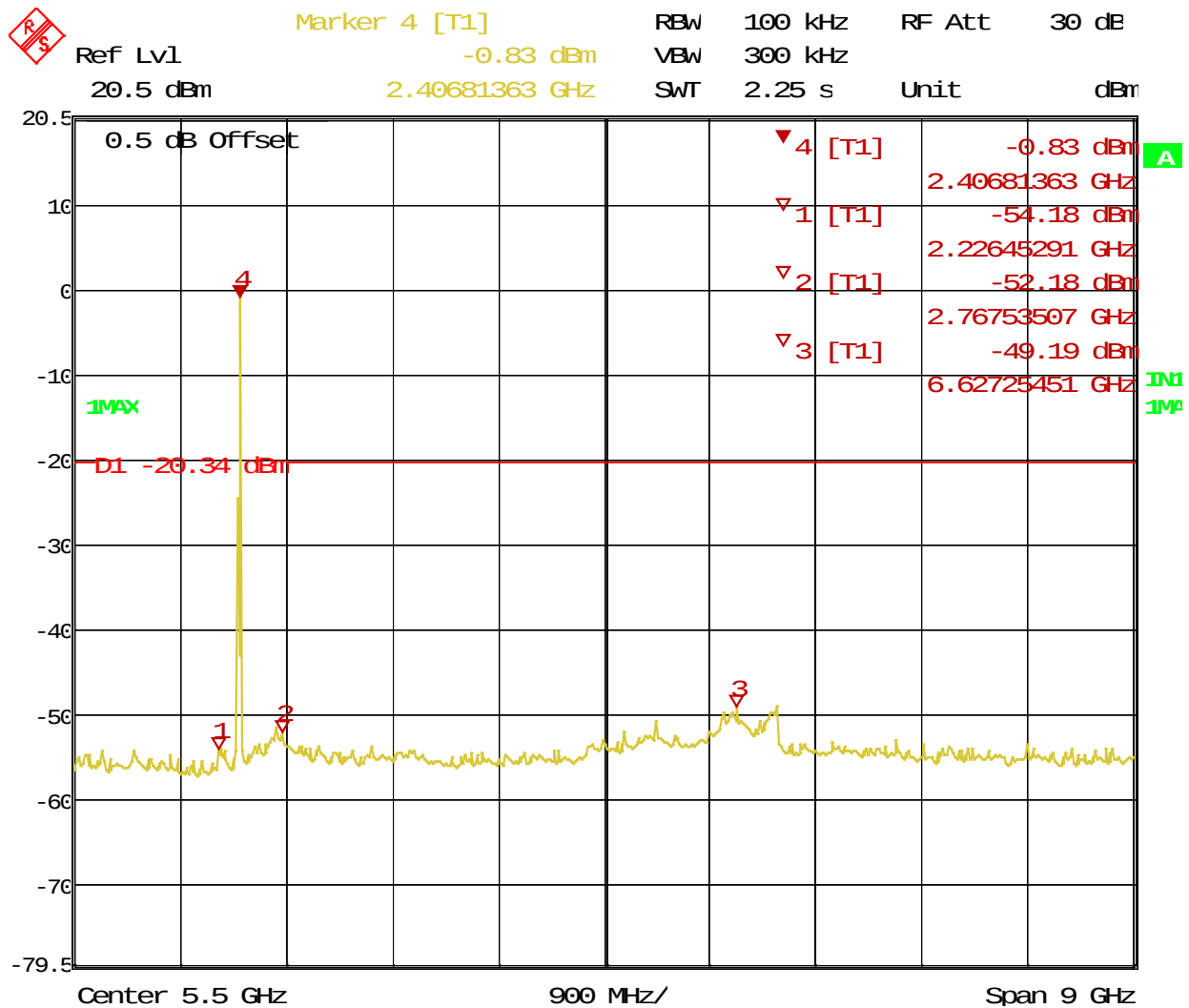
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Date: 9.JUL.2010 01:20:23

Figure 13: Out of Band Emission for Channel 2412 MHz at 11 Mbit/s – Band 1

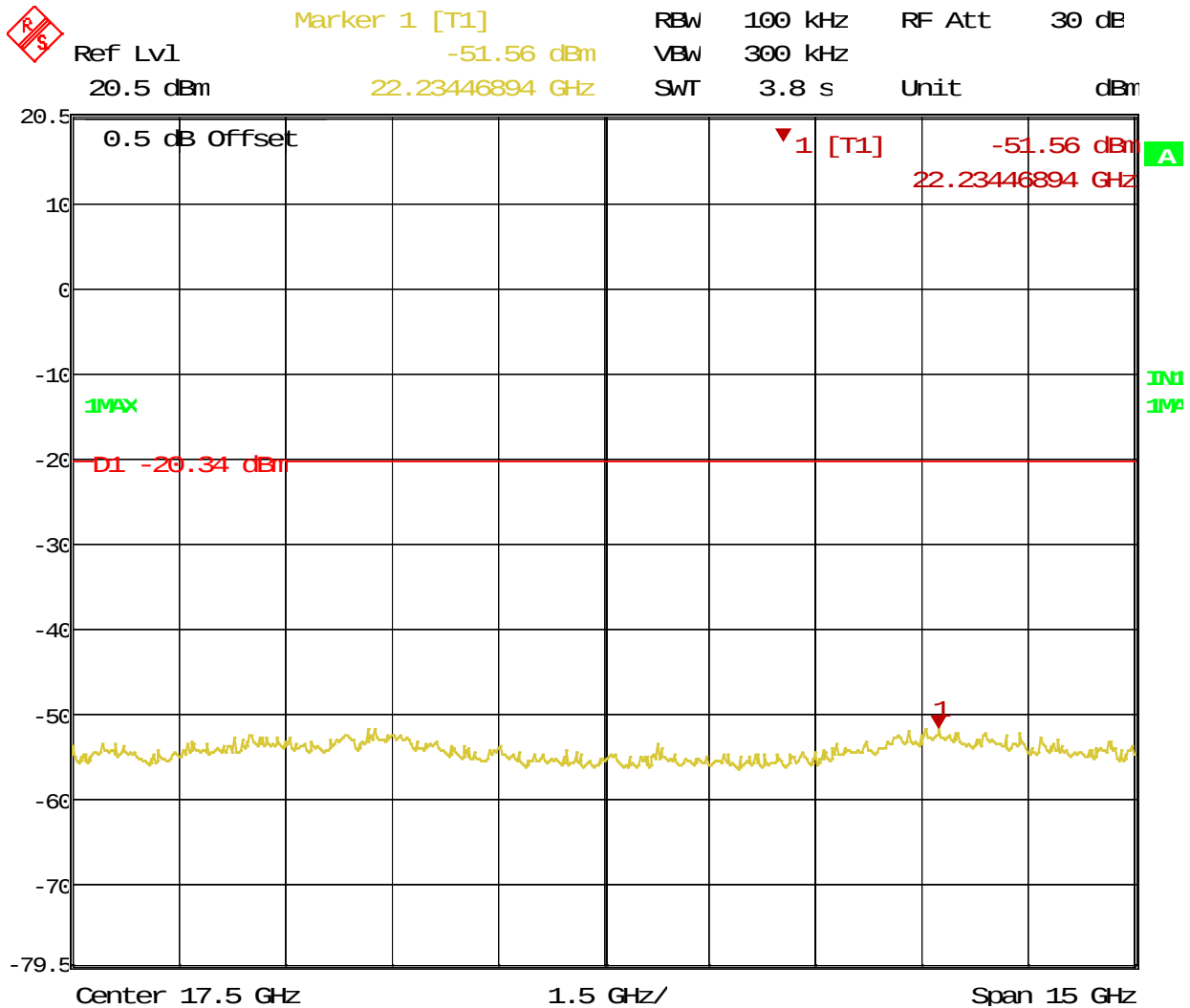
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Date: 9.JUL.2010 01:21:51

Figure 14: Out of Band Emission for Channel 2412 MHz at 11 Mbit/s – Band 2

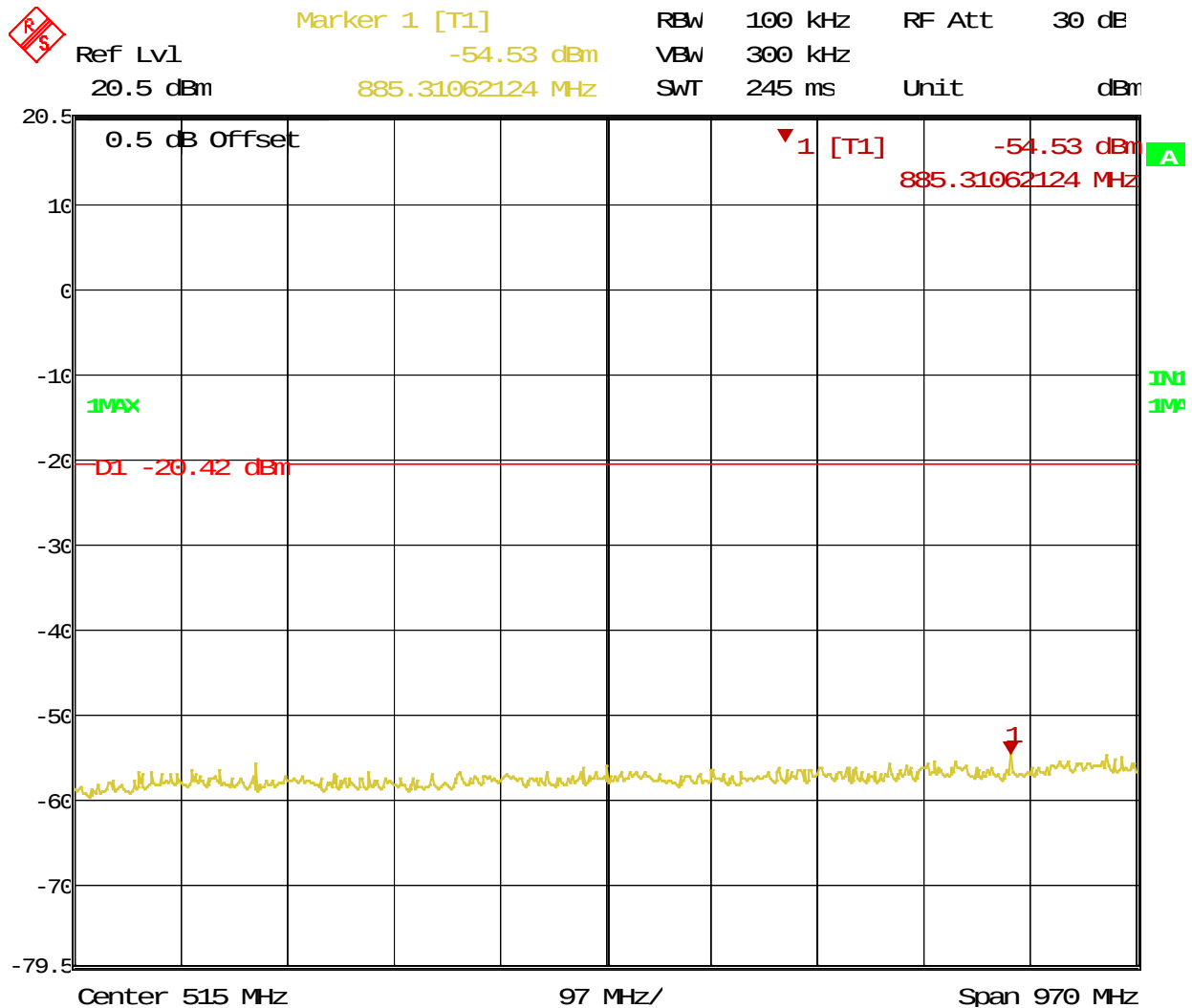
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Date: 9.JUL.2010 01:23:00

Figure 15: Out of Band Emission for Channel 2412 MHz at 11 Mbit/s – Band 3

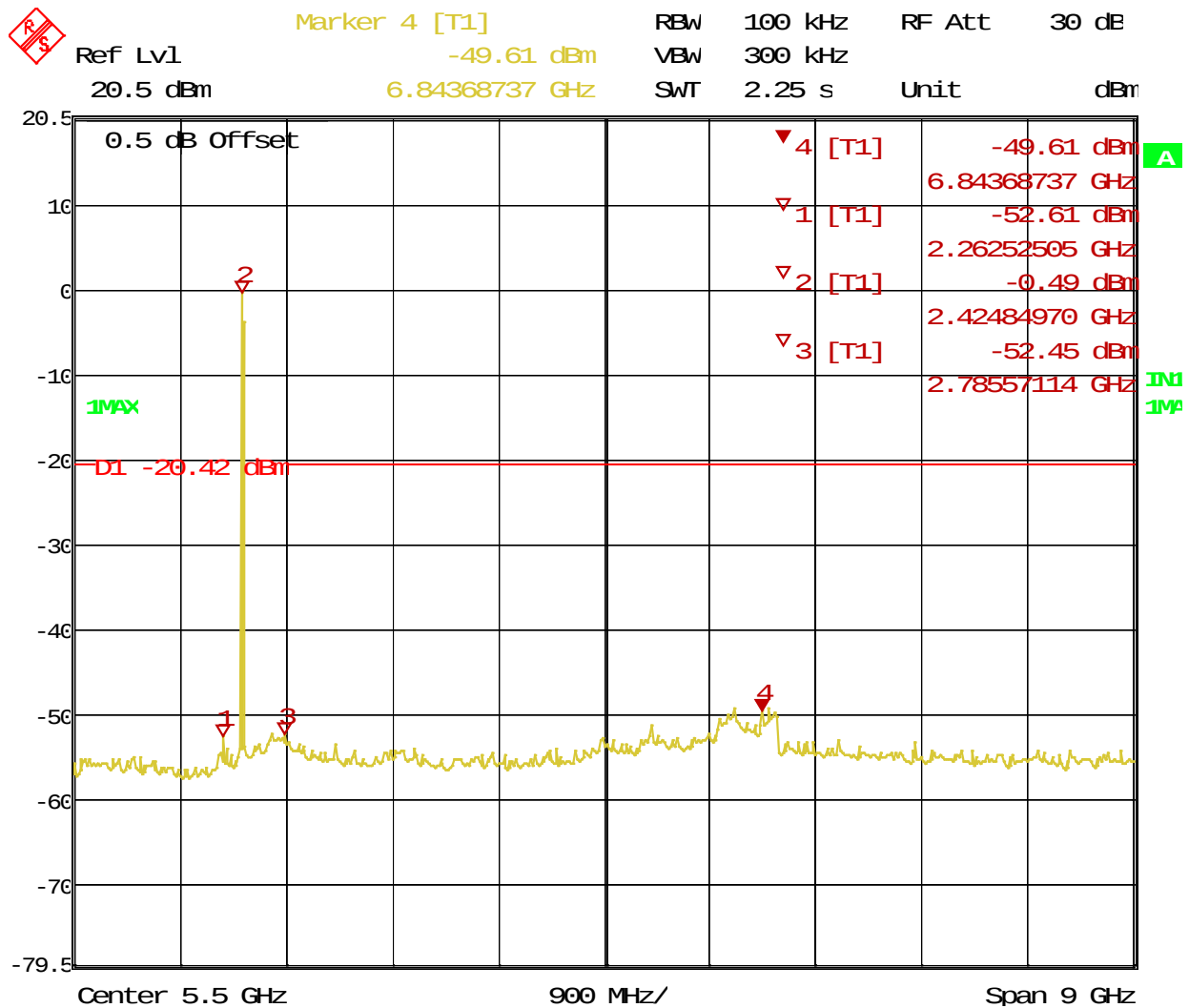
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Date: 9.JUL.2010 01:25:34

Figure 16: Out of Band Emission for Channel 2437 MHz at 11 Mbit/s – Band 1

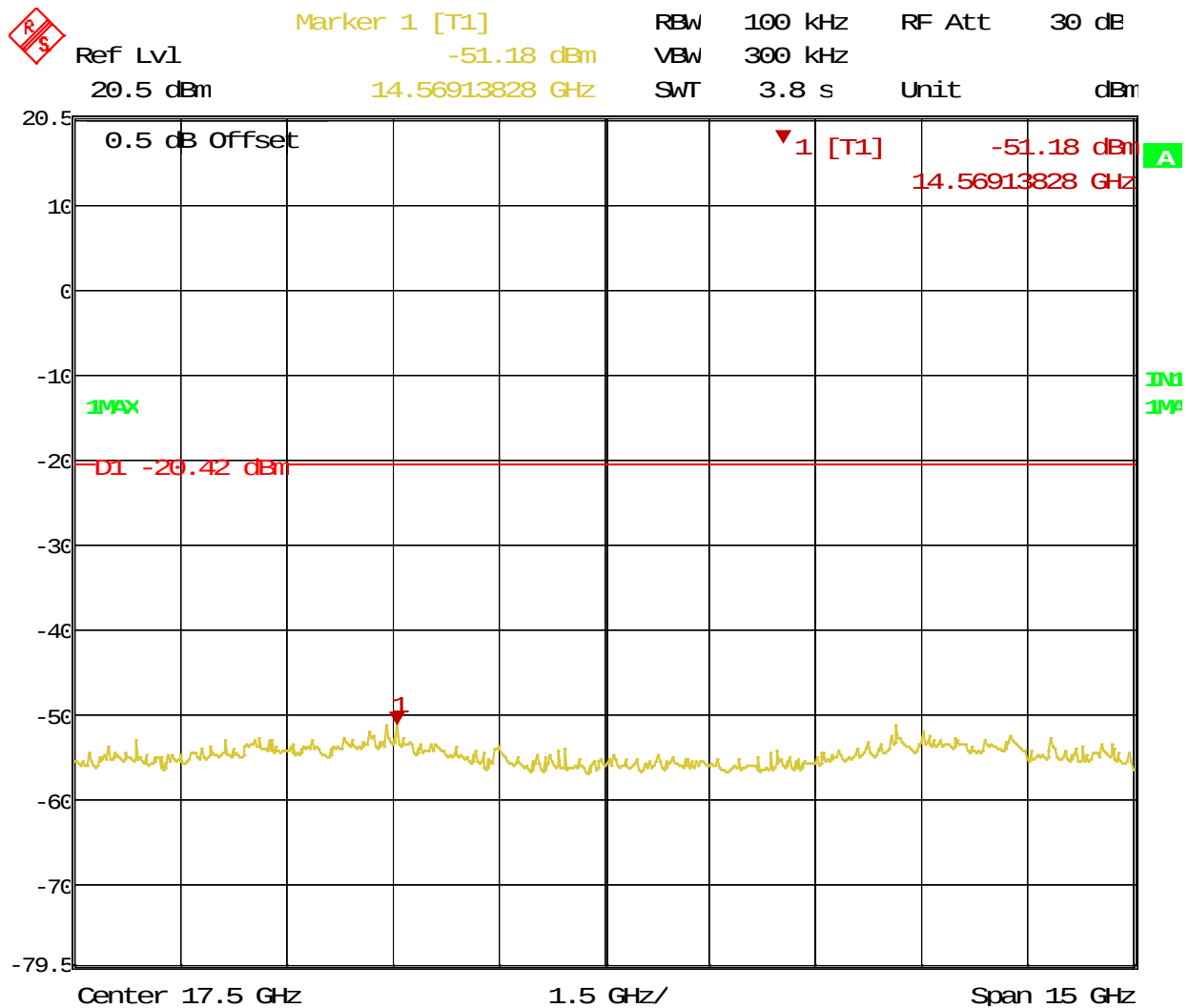
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Date: 9.JUL.2010 01:26:45

Figure 17: Out of Band Emission for Channel 2437 MHz at 11 Mbit/s – Band 2

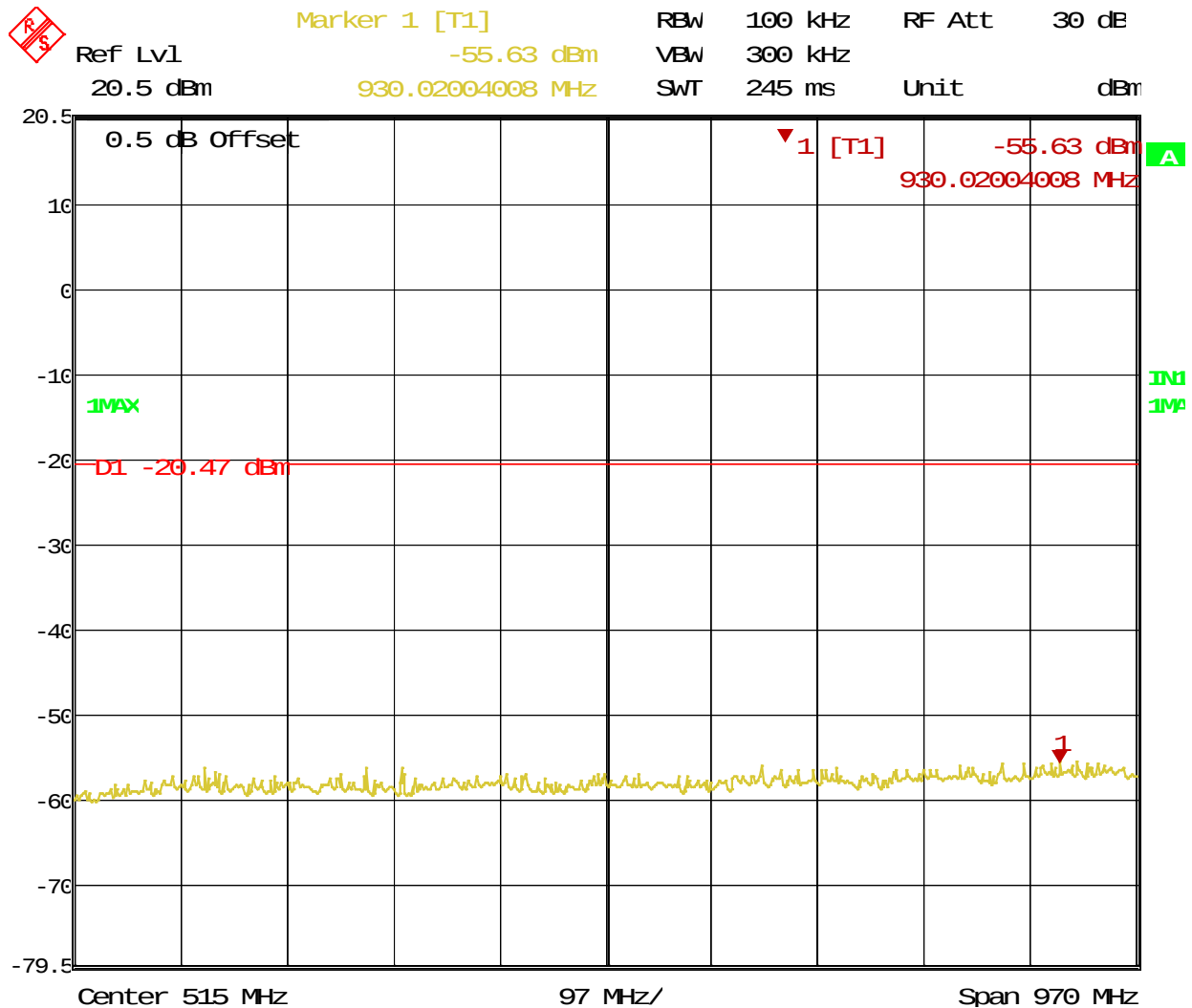
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Date: 9.JUL.2010 01:27:26

Figure 18: Out of Band Emission for Channel 2437 MHz at 11 Mbit/s – Band 3

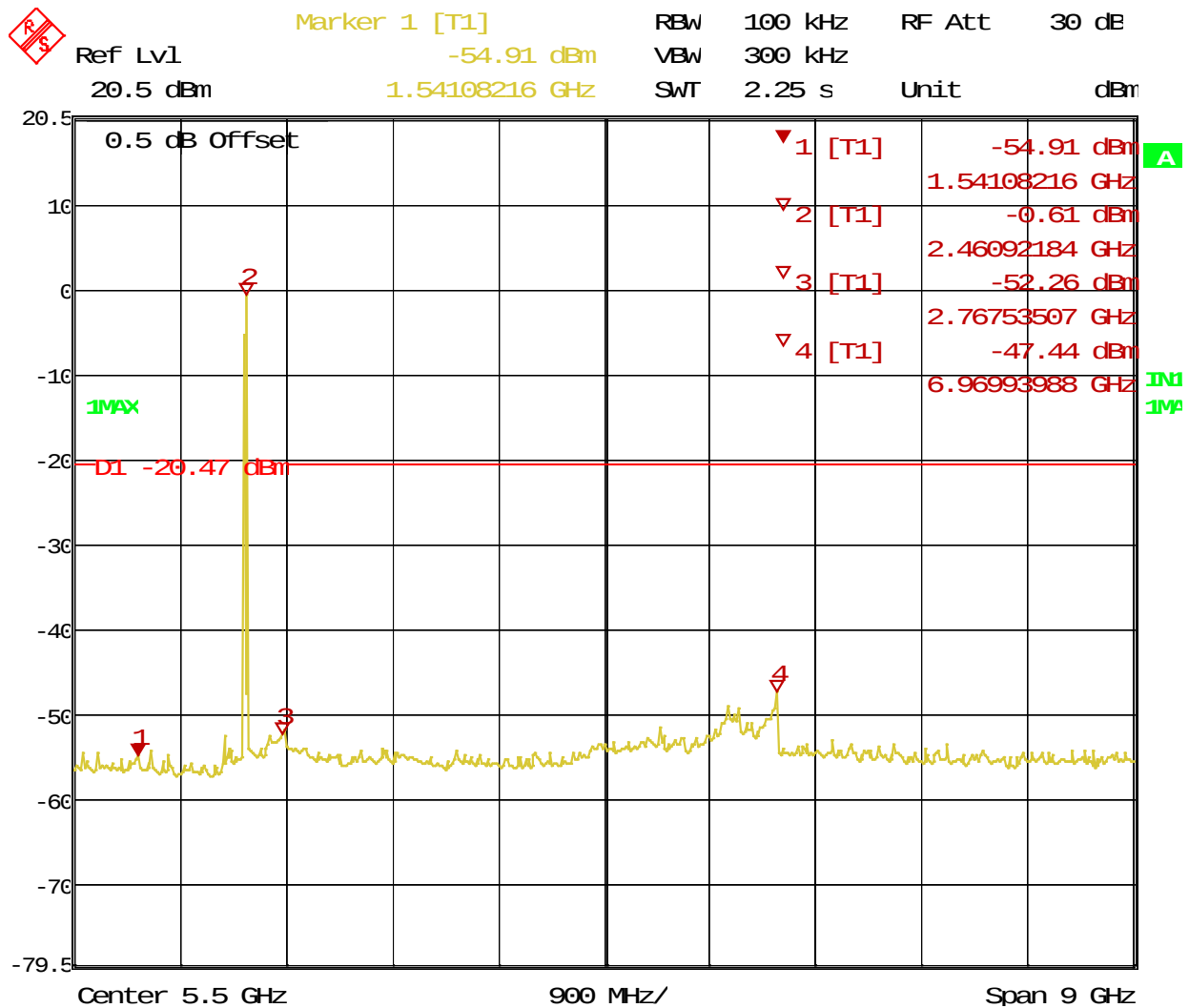
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Date: 9.JUL.2010 01:31:04

Figure 19: Out of Band Emission for Channel 2462 MHz at 11 Mbit/s – Band 1

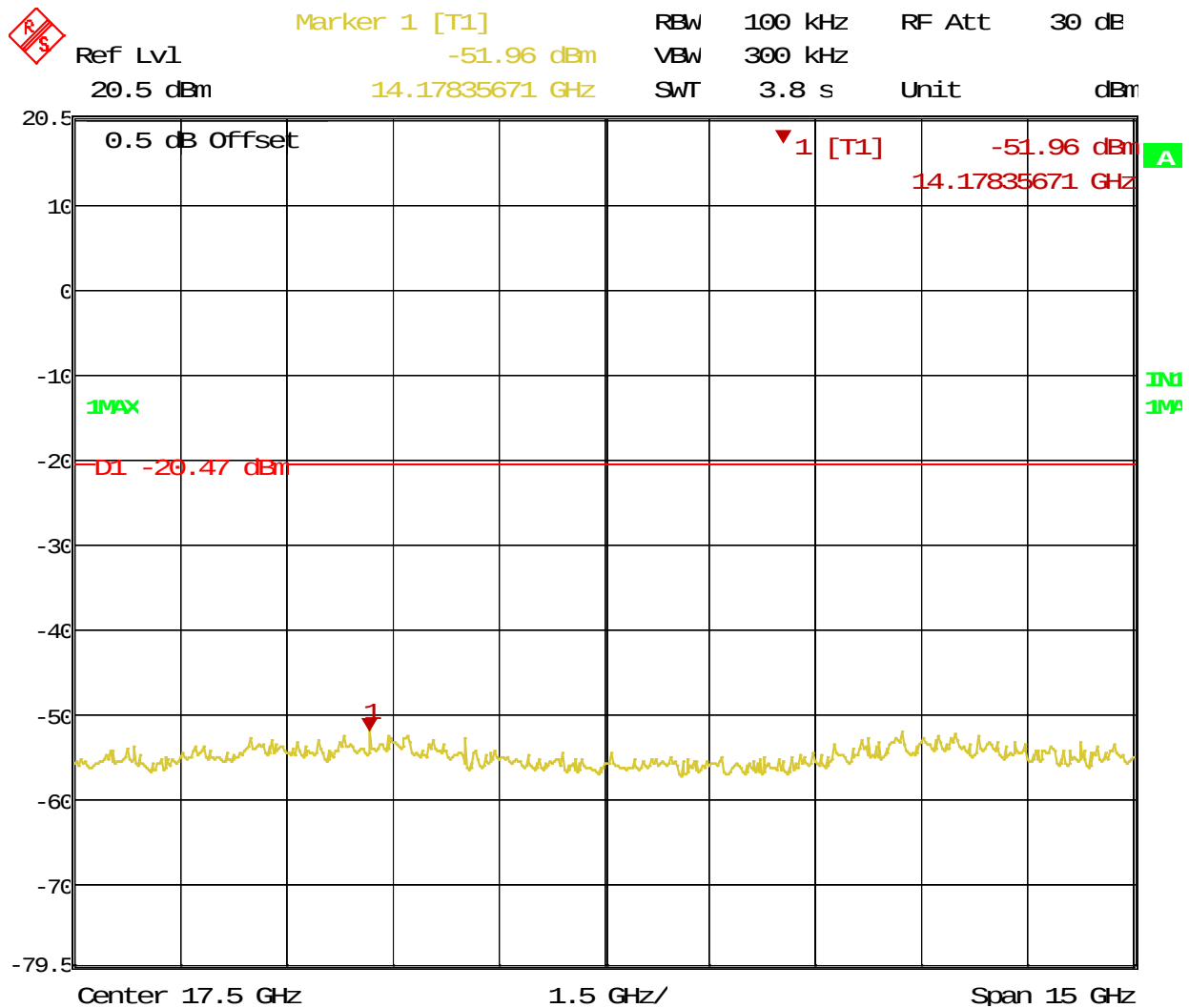
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Date: 9.JUL.2010 01:31:58

Figure 20: Out of Band Emission for Channel 2462 MHz at 11 Mbit/s – Band 2

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Date: 9.JUL.2010 01:32:33

Figure 21: Out of Band Emission for Channel 2462 MHz at 11 Mbit/s – Band 3

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4.4 Peak Power Spectral Density

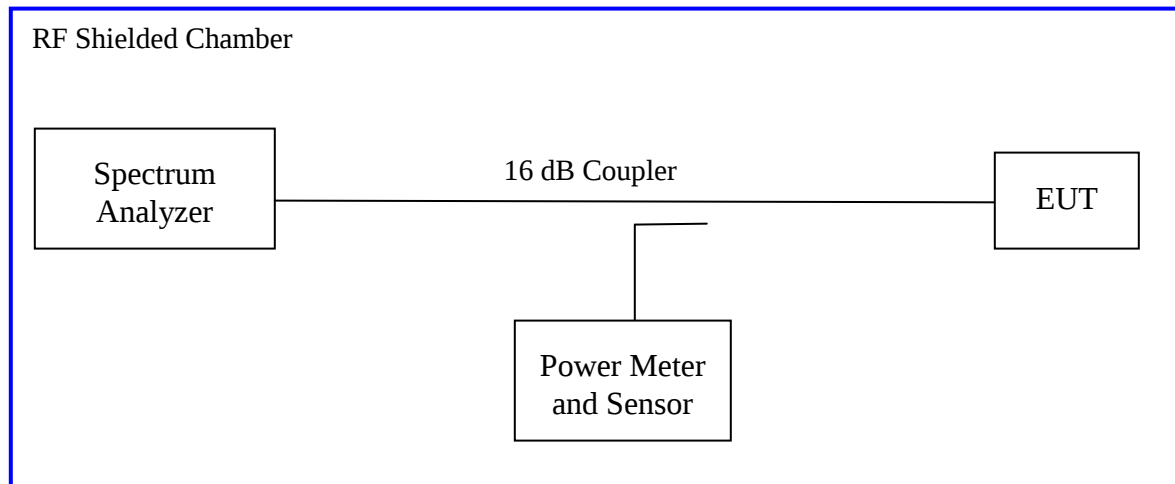
According to the CFR47 Part 15.247 (e) and RSS 210 (A8.2), the spectral power density output of the antenna port shall be less than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

4.4.1 Test Method

The conducted method was used to measure the channel power output per ANSI C63.10:2009 Section 6.11.2

The measurement was performed with modulation per CFR47 Part 15.247 (e) and RSS 210 (A8.2). This test was conducted on 3 channels of Sample, S/N: 001DC90009F5. The worst sample result indicated below.

Test Setup:



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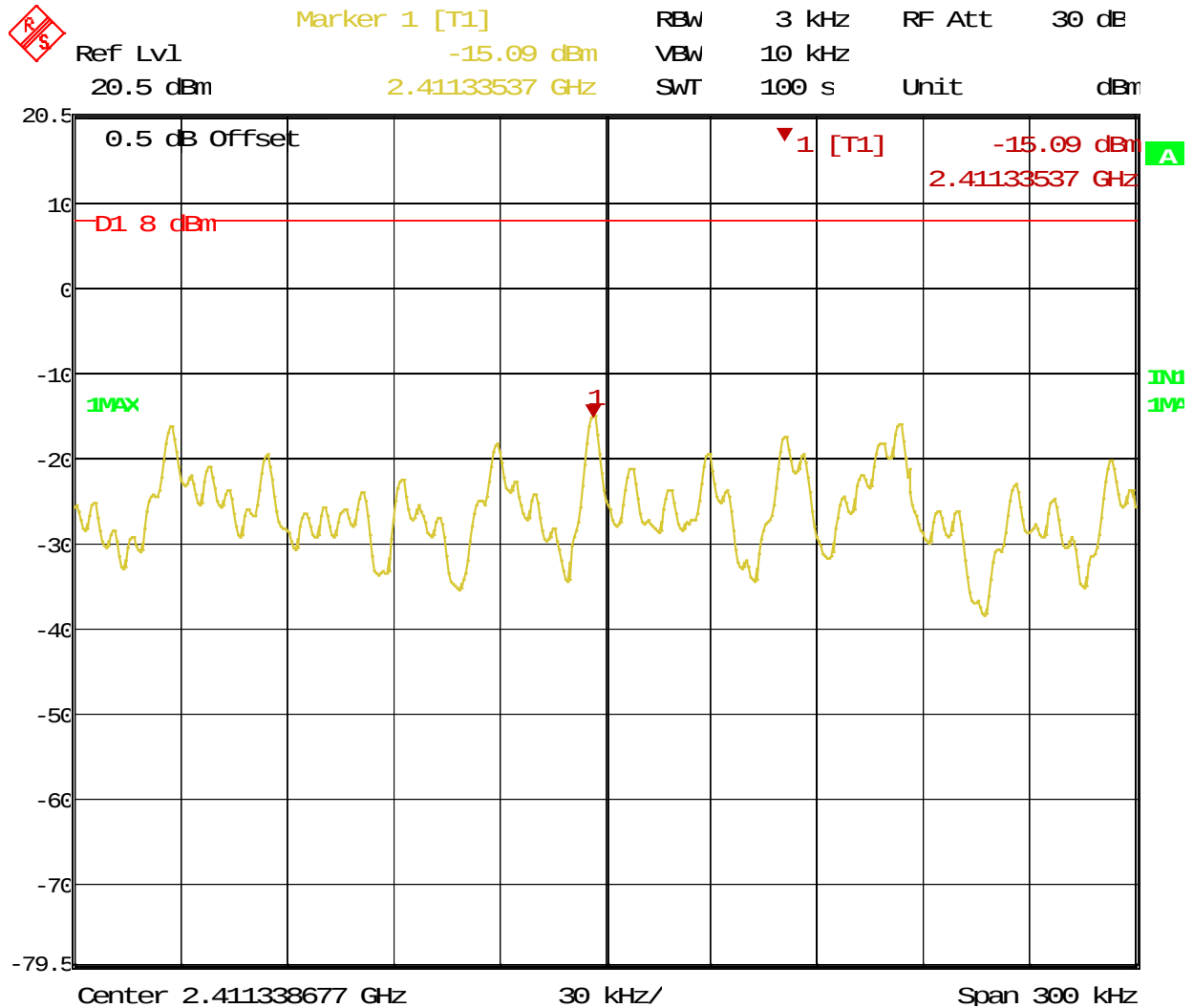
4.4.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 6: Peak Power Spectral Density – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only				
Antenna Type: Integrated		Power Setting: +9 dBm		
Max. Antenna Gain: 0 dBi		Signal State: Modulated		
Ambient Temp.: 23° C		Relative Humidity:36%		
Peak Power Spectral Density Test Results				
Operating Channel	Mode	PPSD [dBm]	Limit [dBm]	Margin [dB]
2412 MHz	11Mbps	-15.09	8.0	23.09
2437 MHz	11Mbps	-14.80	8.0	22.80
2462 MHz	11Mbps	-14.86	8.0	22.86
Note: the highest PPSD was observed at 11 Mbps				

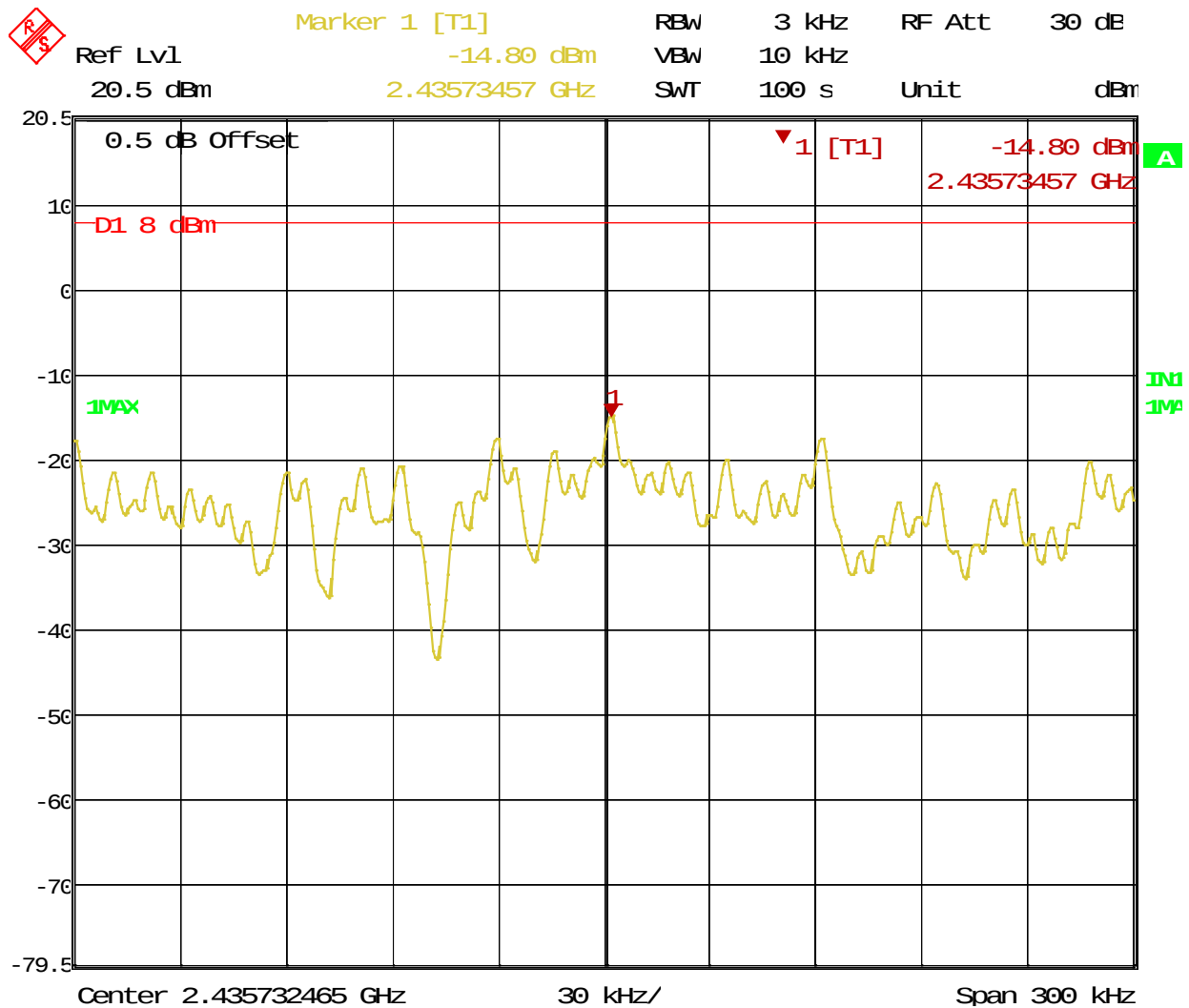
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Date: 9.JUL.2010 00:03:44

Figure 22: Peak Power Spectral Density for Operating Channel 2412 MHz – 11 Mbit/s

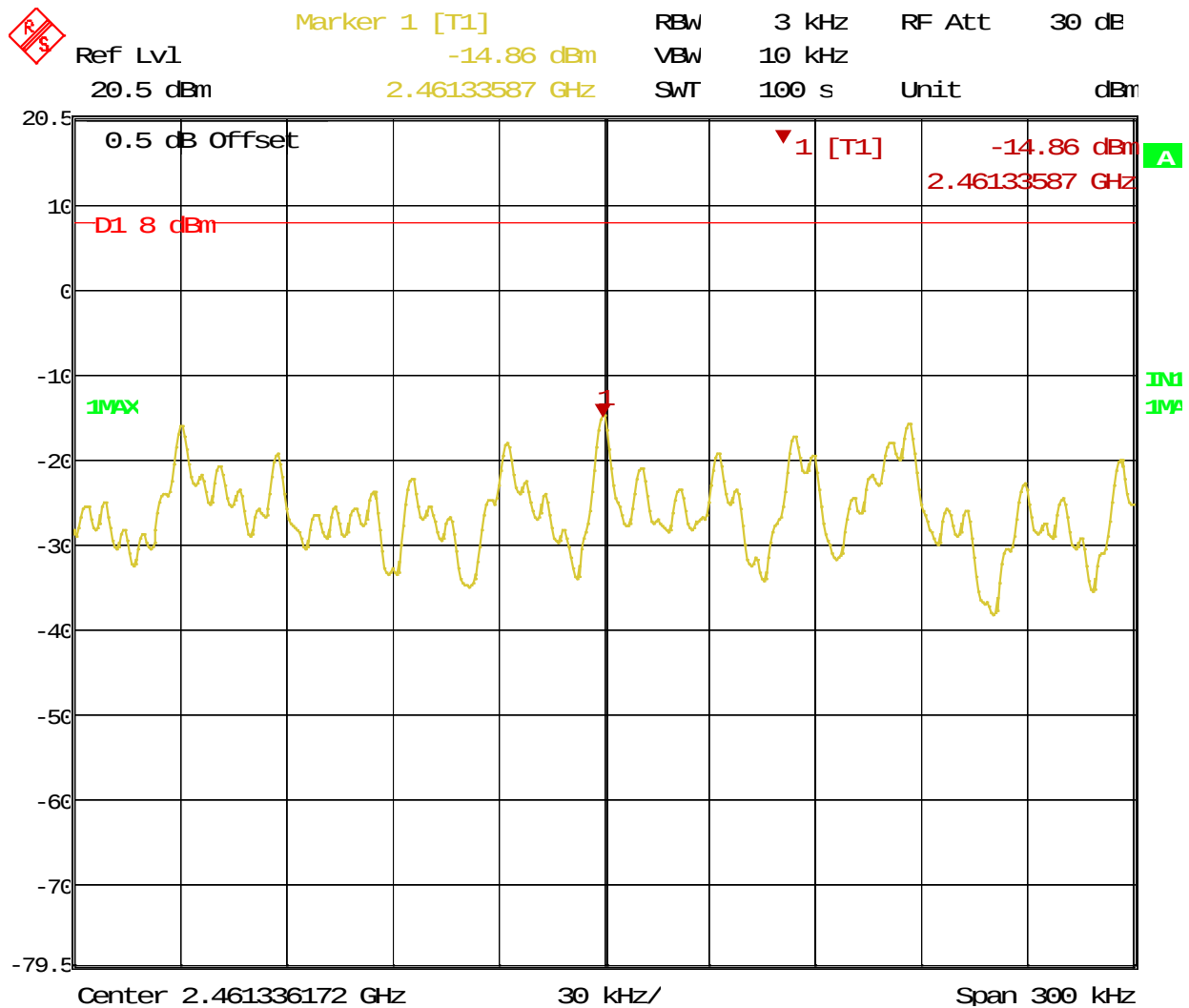
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Date: 9.JUL.2010 00:08:32

Figure 23: Peak Power Spectral Density for Operating Channel 2437 MHz – 11 Mbit/s

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Date: 9.JUL.2010 00:12:19

Figure 24: Peak Power Spectral Density for Operating Channel 2462 MHz – 11 Mbit/s

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4.5 Maximum Permissible Exposure

4.5.1 Test Methodology

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this product is measured in a Semi-Anechoic Chamber, and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

4.5.2 RF Exposure Limit

According to FCC 1.1310 table 1: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (minutes)
(A)Limits For Occupational / Control Exposures				
300-1500	...	...	F/300	6
1500-100,000	...	...	5	6
(B)Limits For General Population / Uncontrolled Exposure				
300-1500	...	...	F/1500	6
1500-100,000	...	...	1.0	30

F = Frequency in MHz

4.5.3 EUT Operating Condition

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually.

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4.5.4 Classification

The antenna of the product, under normal use condition, is at least 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance with the antenna should be included in users manual. So, this device is classified as a **Mobile Device**.

4.5.5 Test Results

4.5.5.1 Antenna Gain

The transmitting antenna was integrated. The antenna gain was +0 dBi or 1 (numeric).

4.5.5.2 Output Power into Antenna & RF Exposure value at distance 20cm:

Calculations for this report are based on highest power measurement.

Limit for MPE (from FCC part 1.1310 table1) is 1.0 mW/cm²

The highest measured channel output power is +14.39 dBm or 27.48 mW

Using the Friis transmission formula, the EIRP is Pout*G, and R is 20cm.

$P_d = (27.48 \times 1) / (1600\pi) = 0.00546 \text{ mW/cm}^2$, which is 0.9945 mW/cm² below to the limit.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

4.5.6 Sample Calculation

The Friis transmission formula: $P_d = (P_{out} \times G) / (4 \times \pi \times R^2)$

Where;

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

$\pi \approx 3.1416$

R = distance between observation point and center of the radiator in cm

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).

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4.6 Transmitter Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS 210 Sect. A.8.5

4.6.1 Test Methodology

4.6.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.6.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, then the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

The final scans performed on the worst axis for three operating channels; 2412 MHz, 2437 MHz, and 2462 MHz at 1 Mbit/s for 802.11b mode.

4.6.1.3 Deviations

None.

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4.6.2 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209: 2008 and RSS 210 A1.1.2 2007.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490.....	2400/F (kHz)	300
0.490-1.705.....	24000/F (kHz)	30
1.705-30.0.....	30	30
30-88.....	100 **	3
88-216.....	150 **	3
216-960.....	200 **	3
Above 960.....	500	3

All harmonics and spurious emission which are outside of the restricted band shall be 20 dB below the in-band emission.

4.6.3 Test Results

The final measurement data was taken under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and 1.5.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

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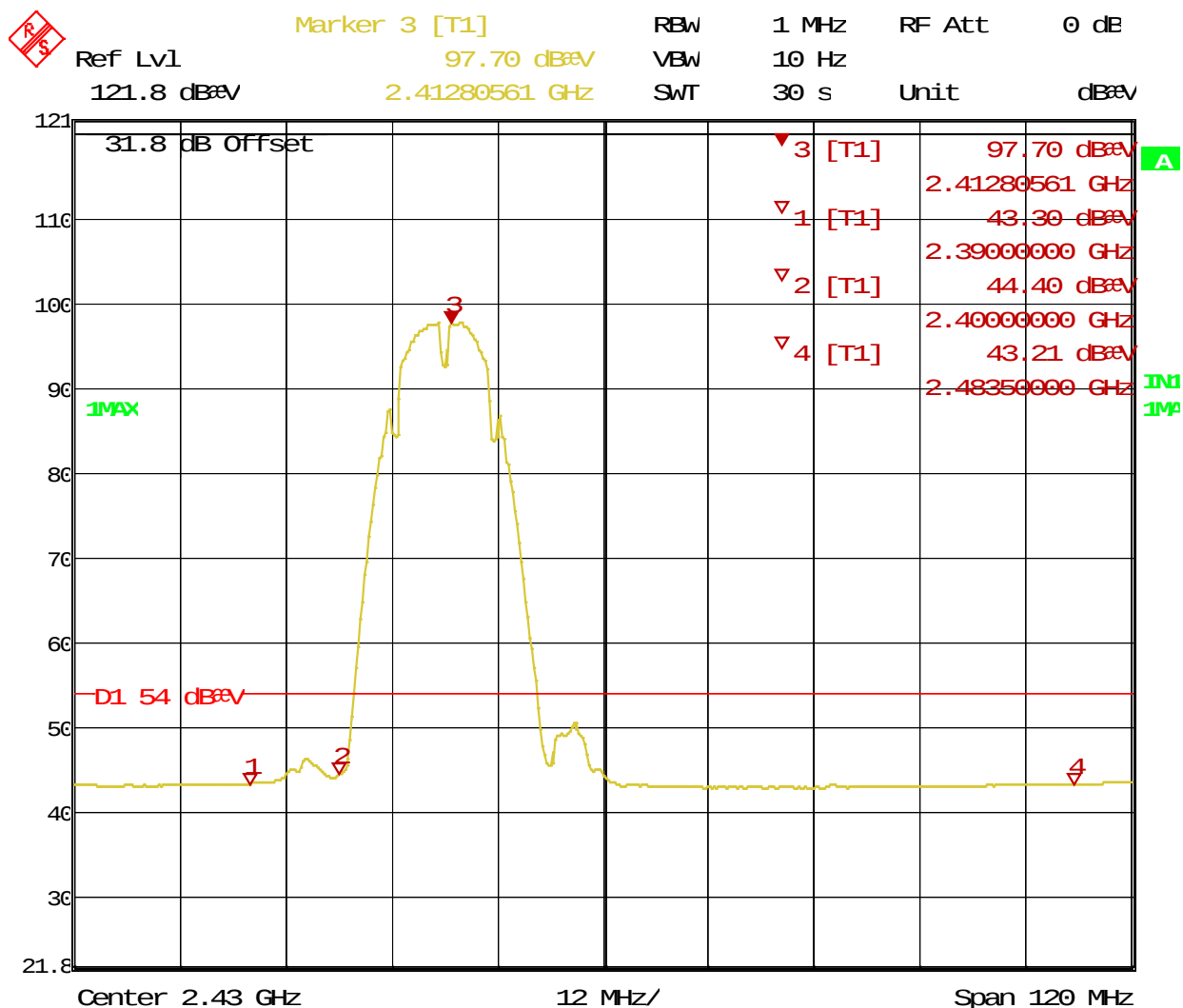
Table 7: Transmit Spurious Emission at Band Edge Requirements

Test Conditions: Radiated Measurement, Normal Temperature and Voltage only							
Antenna Type: Integrated				Power Setting: +9 dBm			
Max. Antenna Gain: +0 dBi				Signal State: Modulated			
Ambient Temp.: 22° C				Relative Humidity:36%			
Band Edge Results for Dipole Antenna							
Operating Channel	EUT Position	Polarity	Pk Plots	Peak Limit	Ave. Plots	Ave. Limit	Result
2412 MHz	X-Axis	Horizontal	#25	74.00	#26	54.00	Pass
2412 MHz	X-Axis	Vertical	#27	74.00	#28	54.00	Pass
2437 MHz	X-Axis	Horizontal	#29	74.00	#30	54.00	Pass
2437 MHz	X-Axis	Vertical	#31	74.00	#32	54.00	Pass
2462 MHz	X-Axis	Horizontal	#33	74.00	#34	54.00	Pass
2462 MHz	X-Axis	Vertical	#36	74.00	#36	54.00	Pass

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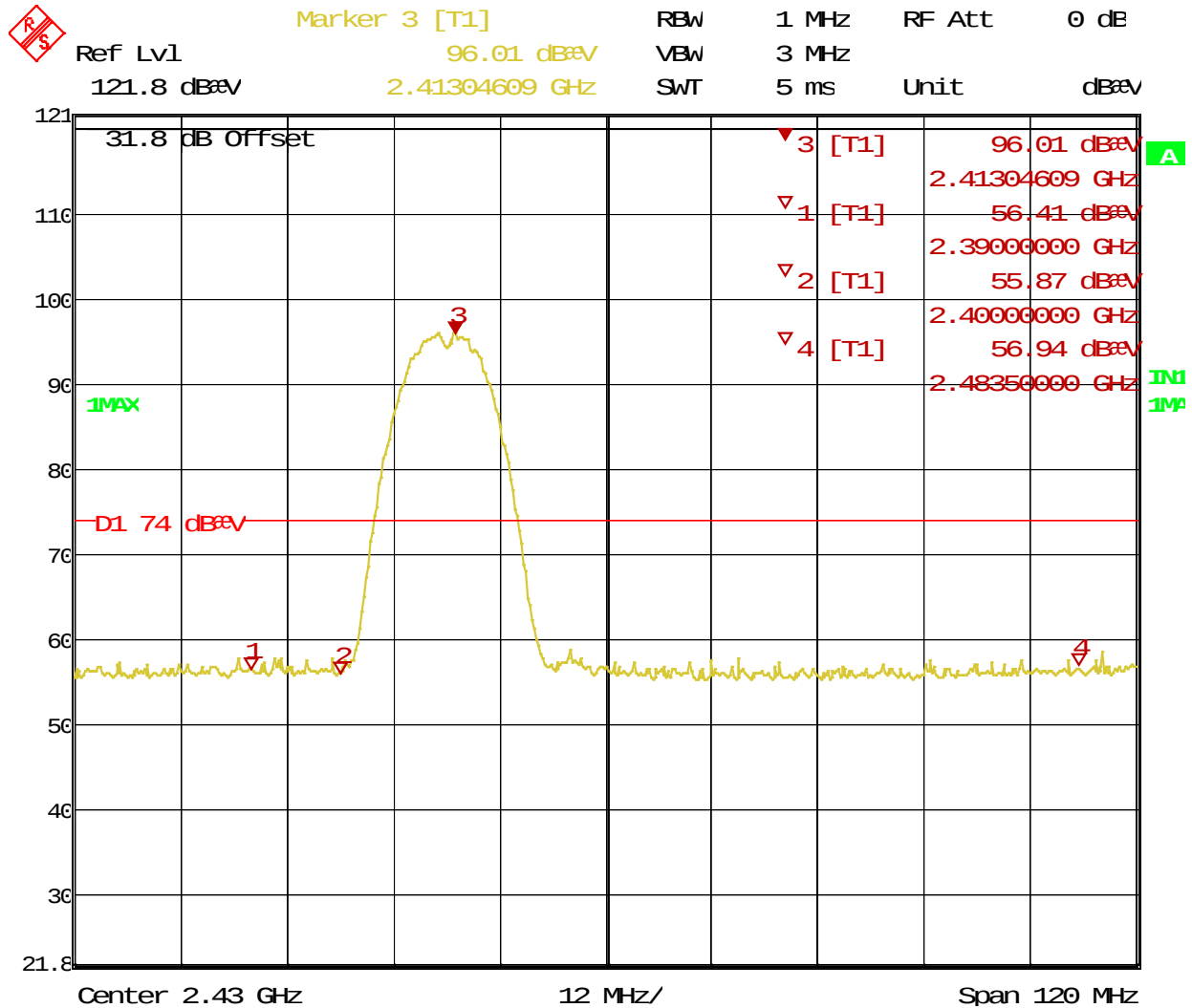
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Date: 5.JUL.2010 20:40:36

Figure 26: Emission at the Edge for Channel 2412 MHz at 1 Mbps – Horizontal (Ave.)

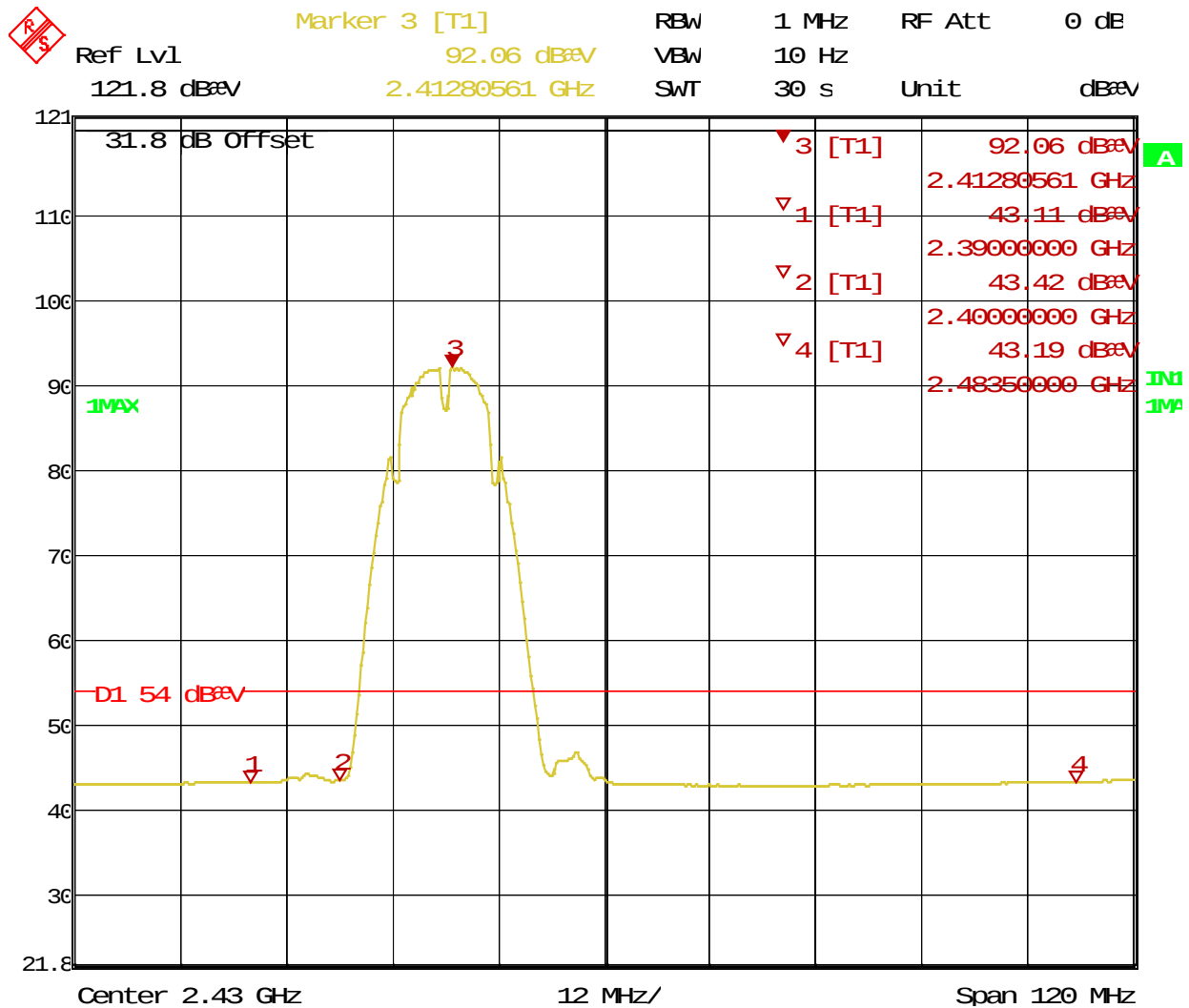
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Date: 5.JUL.2010 20:43:18

Figure 27: Emission at the Edge for Channel 2412 MHz at 1 Mbps – Vertical (Peak)

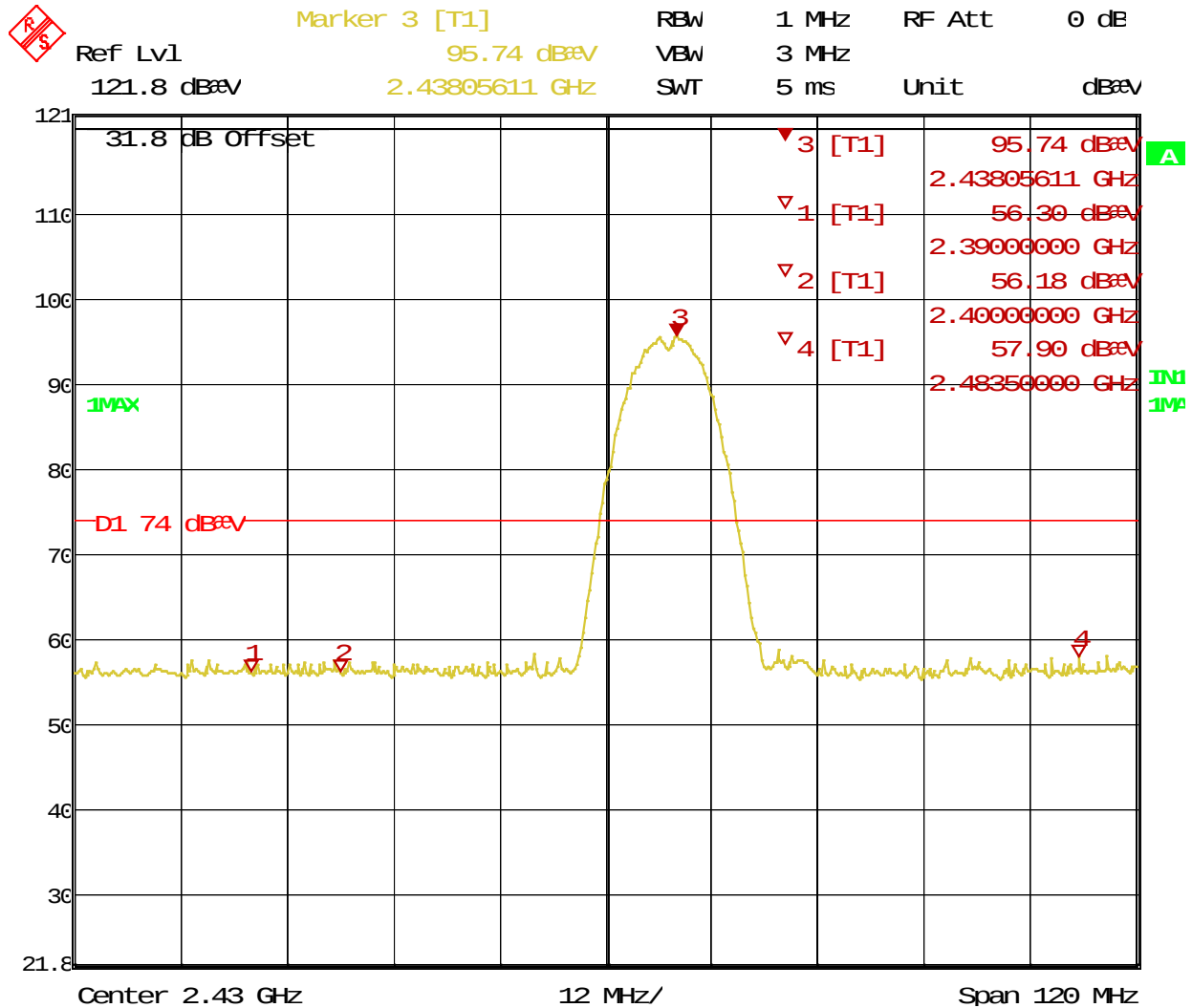
The test results contained in this report refer exclusively to the product(s) presented for testing. No liability may be assumed for models or products not referred to herein. This test report may not be published or duplicated in part without permission of the testing body. This test report by itself does not constitute authorization for the use of any TUV Rheinland test mark. This report must not be used by the applicant to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.



Date: 5.JUL.2010 20:44:47

Figure 28: Emission at the Edge for Channel 2412 MHz at 1 Mbps – Vertical (Ave.)

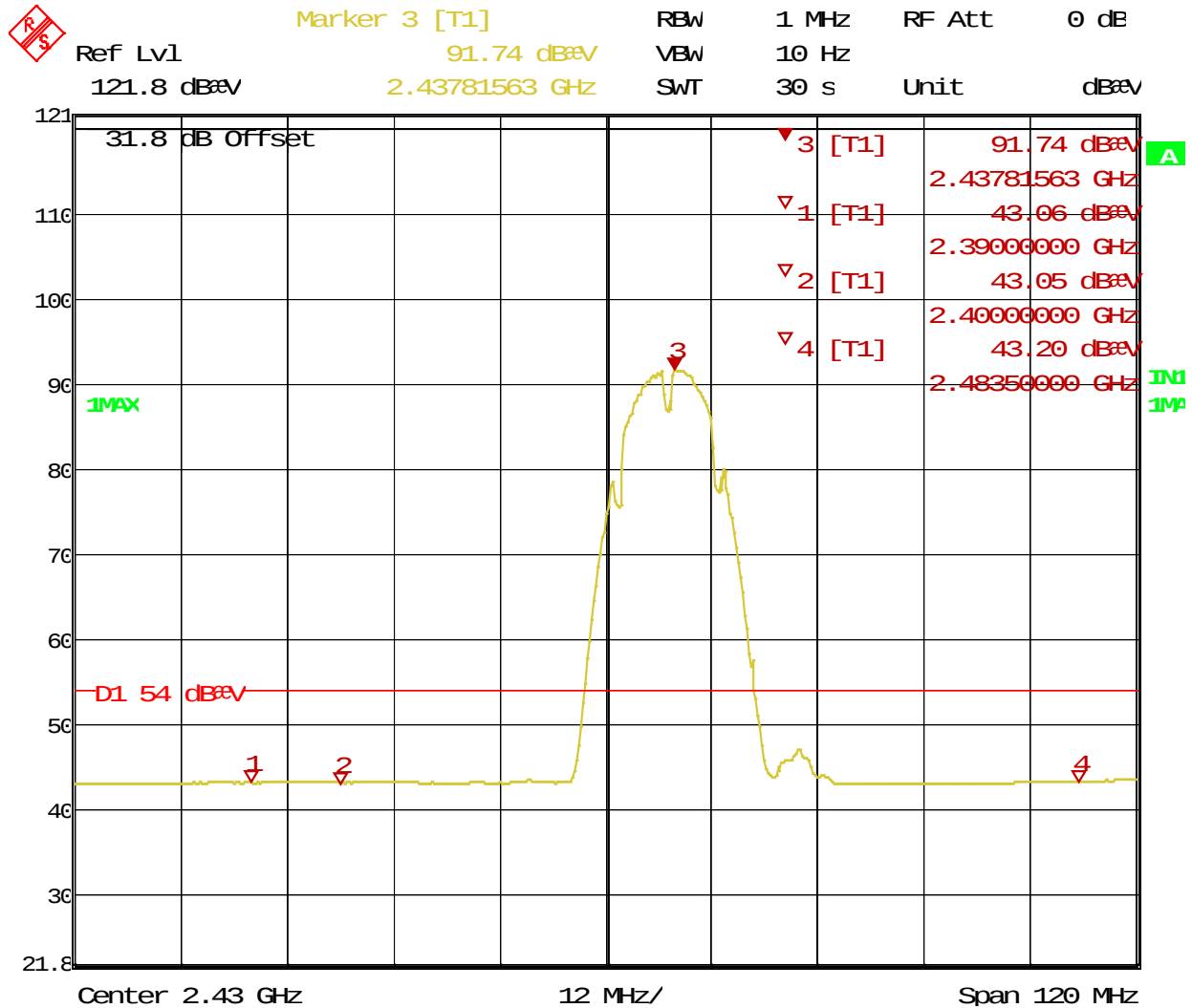
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Date: 5.JUL.2010 20:54:07

Figure 29: Emission at the Edge for Channel 2437 MHz at 1 Mbps – Horizontal (Peak)

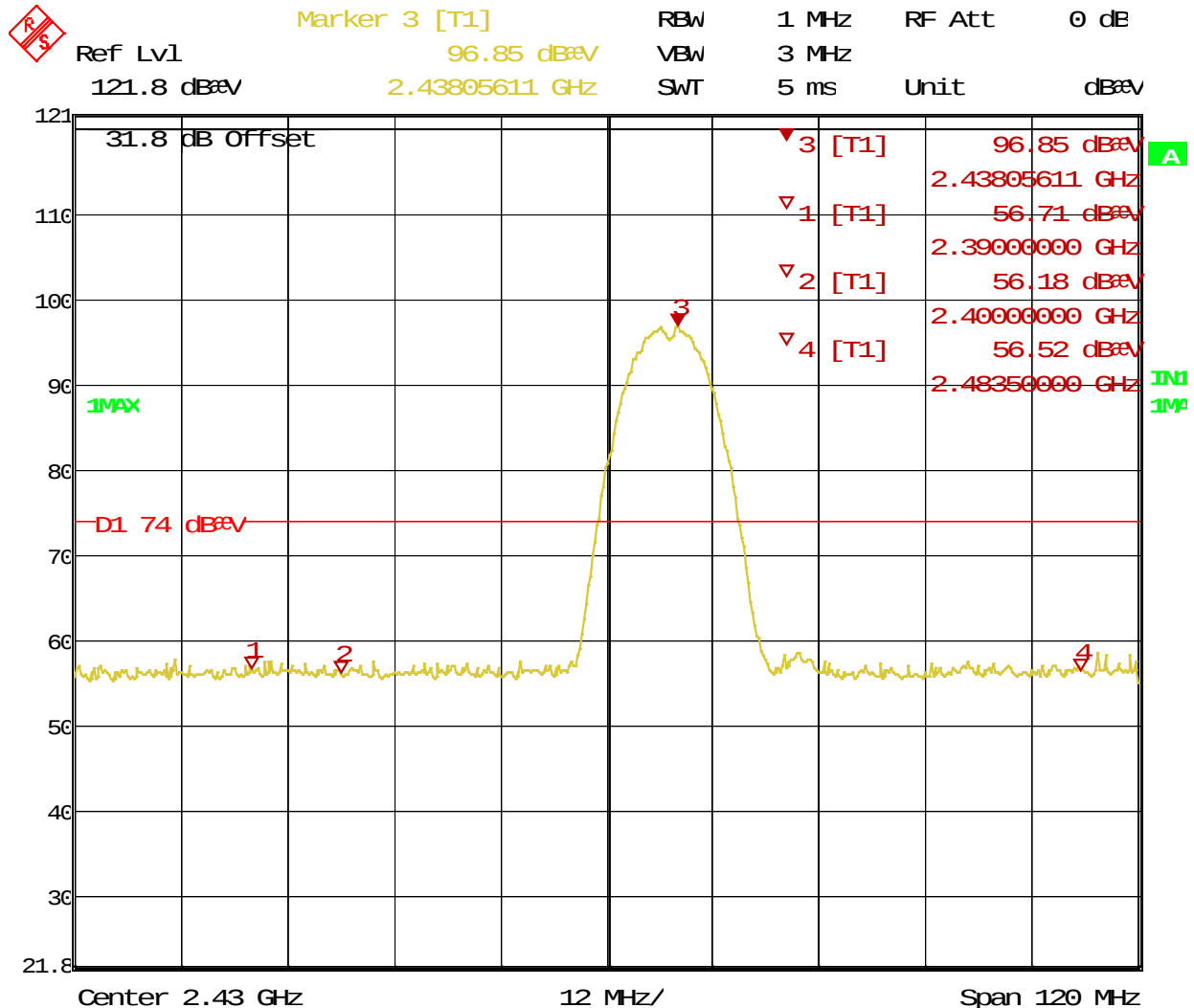
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Date: 5.JUL.2010 20:55:15

Figure 30: Emission at the Edge for Channel 2437 MHz at 1 Mbps – Horizontal (Ave.)

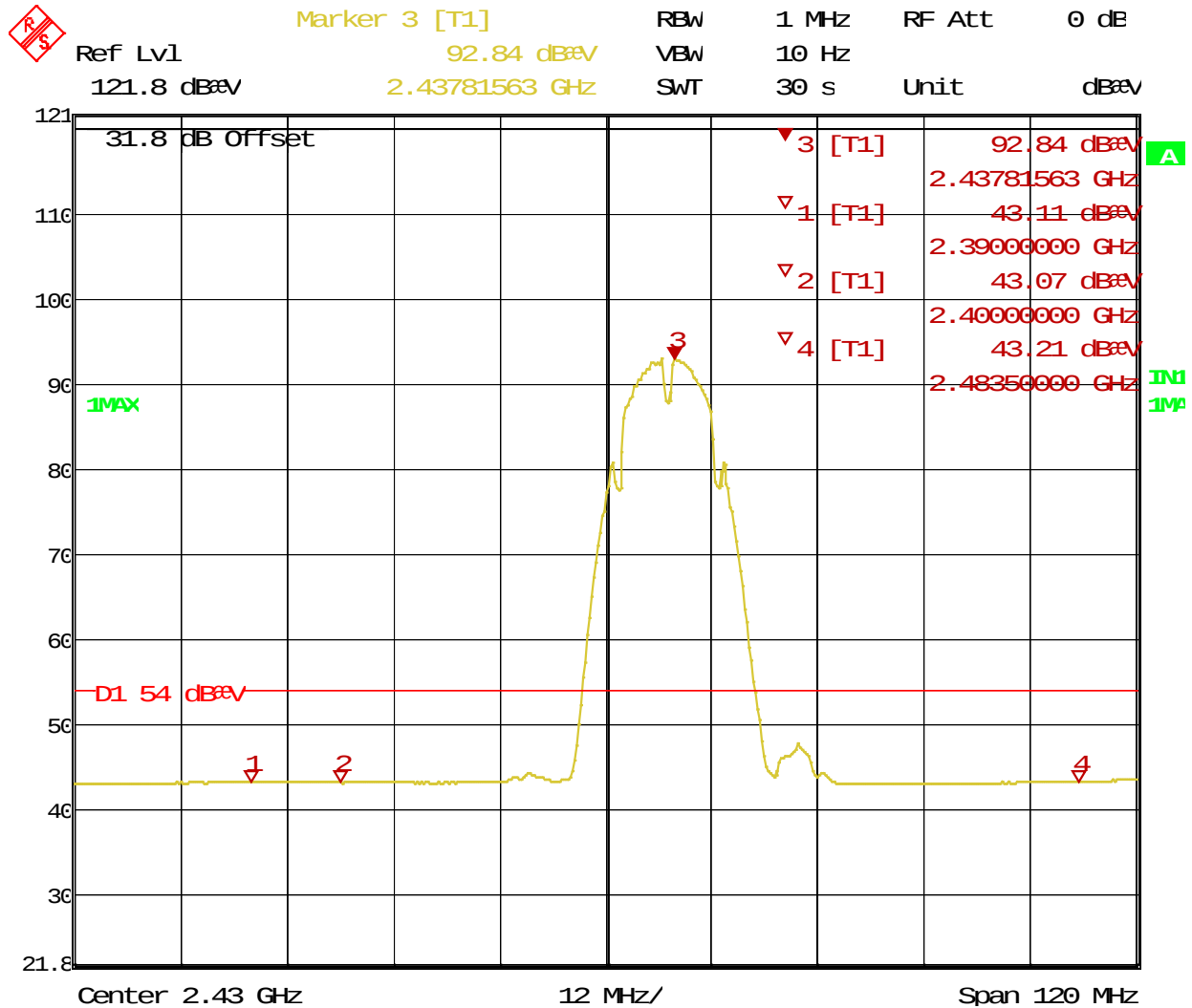
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Date: 5.JUL.2010 20:49:37

Figure 31: Emission at the Edge for Channel 2437 MHz at 1 Mbps – Vertical (Peak)

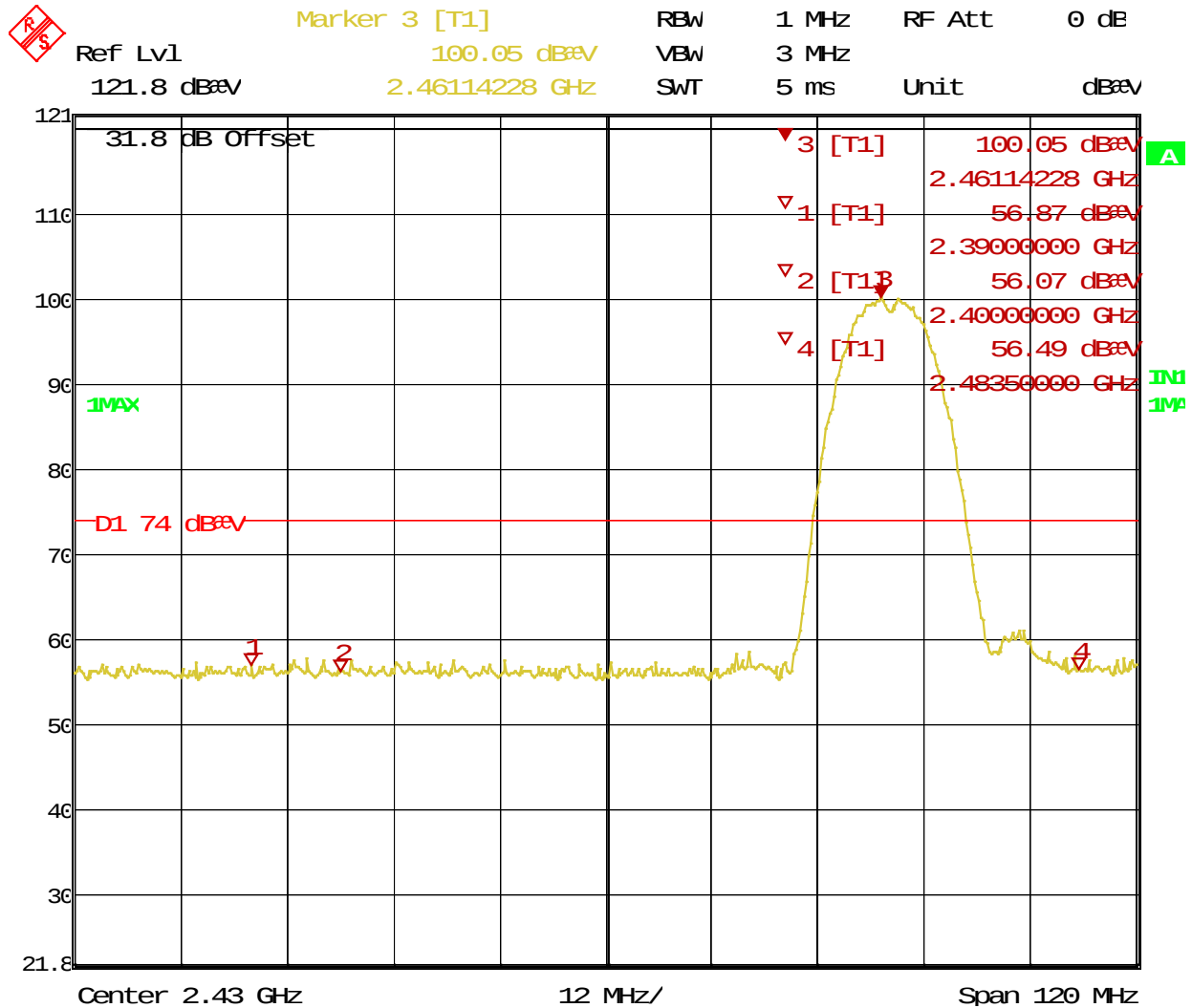
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Date: 5.JUL.2010 20:50:38

Figure 32: Emission at the Edge for Channel 2437 MHz at 1 Mbps – Vertical (Ave.)

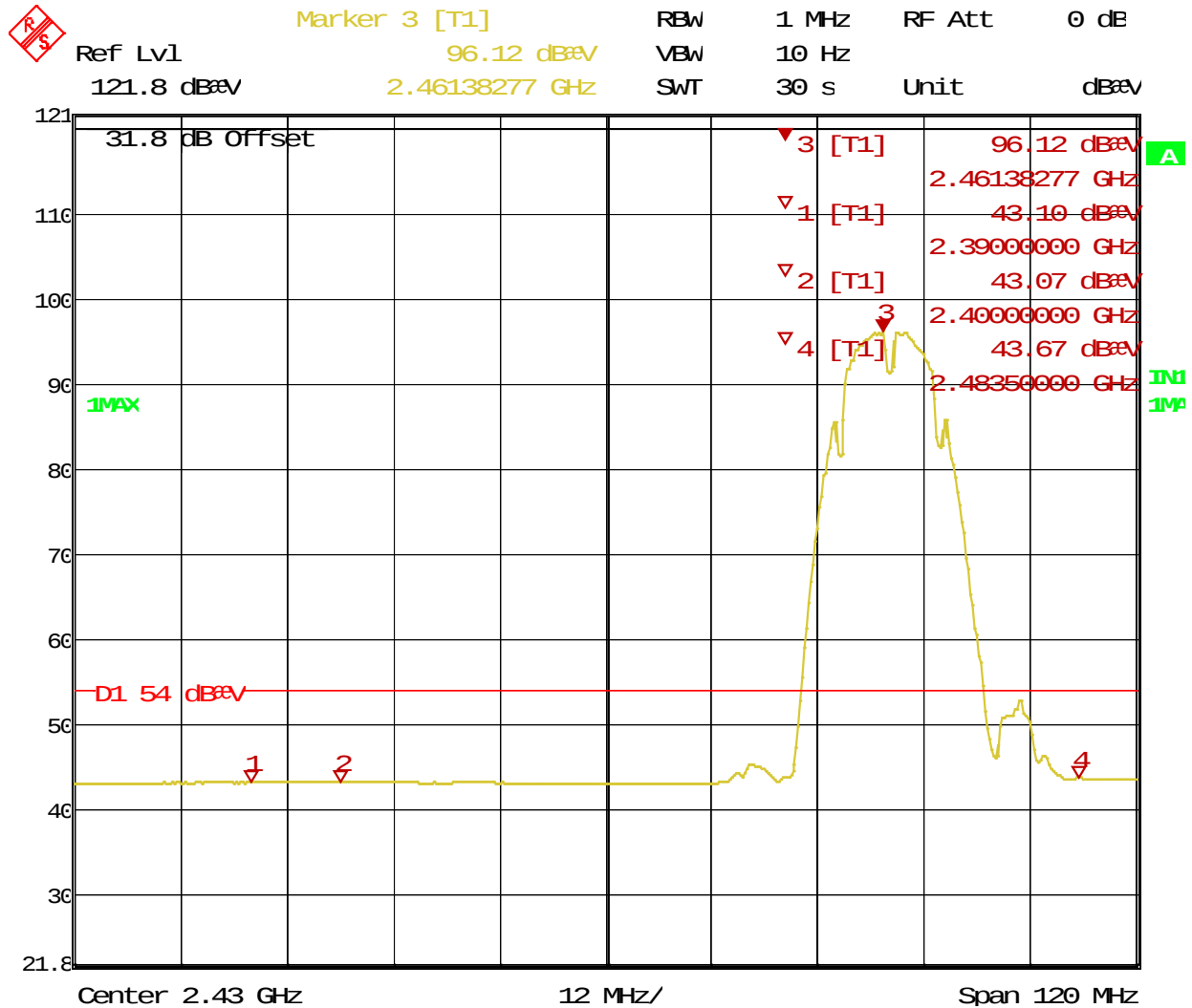
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Date: 5.JUL.2010 21:13:17

Figure 33: Emission at the Edge for Channel 2462 MHz at 1 Mbps – Horizontal (Peak)

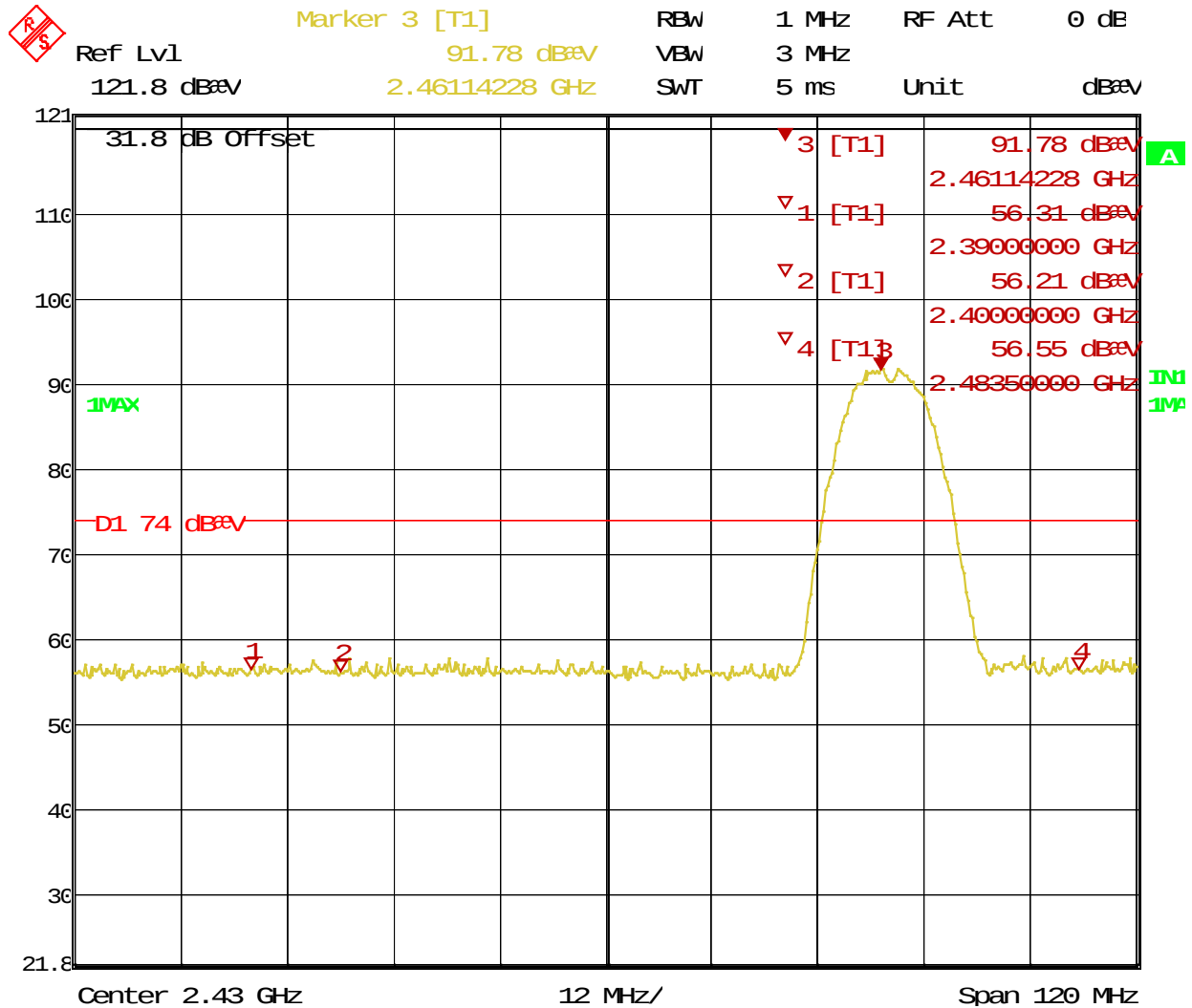
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Date: 5.JUL.2010 21:14:35

Figure 34: Emission at the Edge for Channel 2462 MHz at 1 Mbps – Horizontal (Ave.)

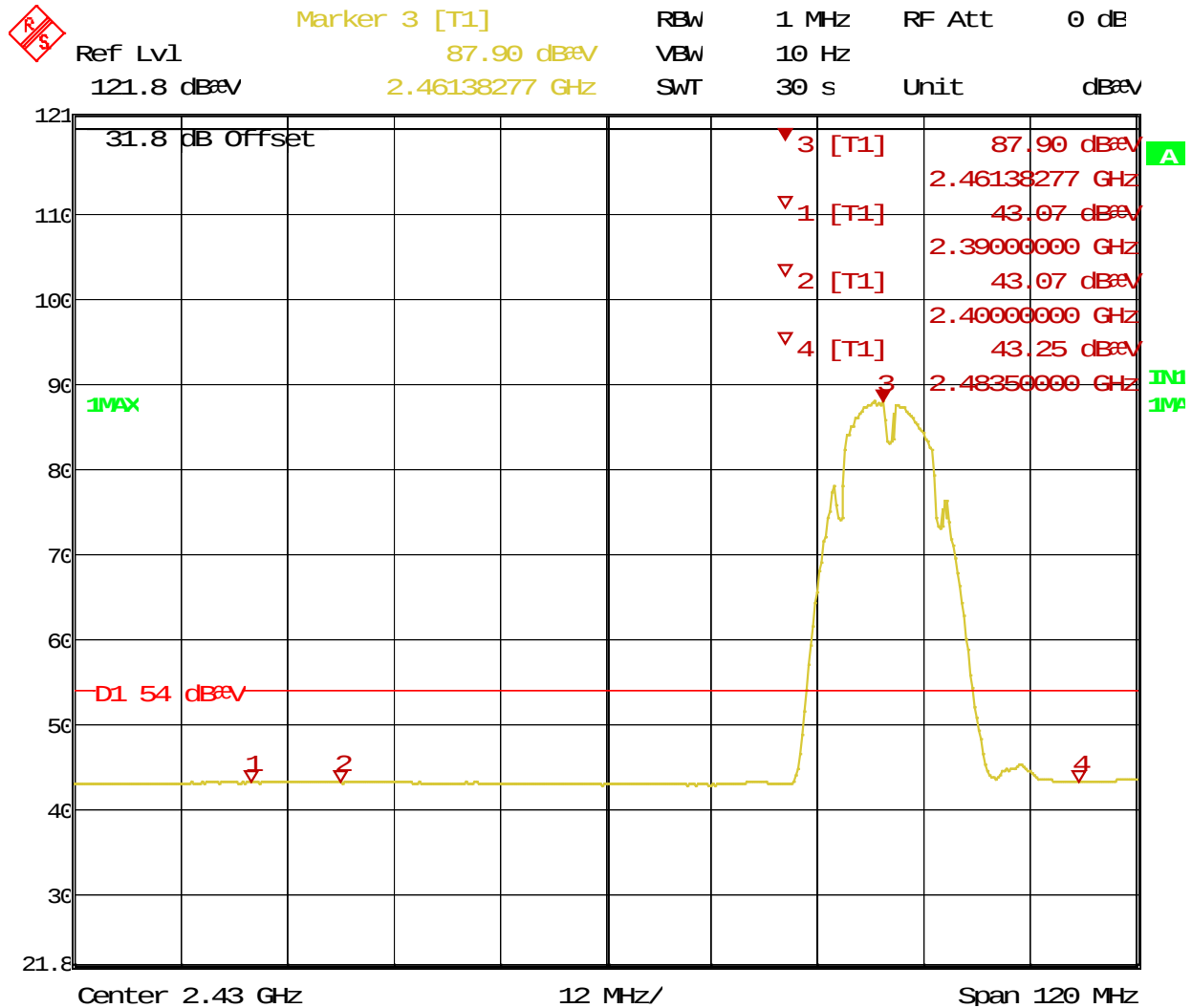
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Date: 5.JUL.2010 21:05:22

Figure 35: Emission at the Edge for Channel 2462 MHz at 1 Mbps – Vertical (Peak)

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Date: 5.JUL.2010 21:06:38

Figure 36: Emission at the Edge for Channel 2462 MHz at 1 Mbps – Vertical (Ave.)

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SOP 1 Radiated Emissions						Tracking # 31051809.001 Page 1 of 8				
EUT Name	Wi-Fi Module					Date	July 6, 2010			
EUT Model	GS1011MIP					Temp / Hum in	23°C / 36% rh			
EUT Serial	001DC90009F1					Temp / Hum out	N/A			
EUT Config.	Z-Axis					Line AC / Freq	120 Vac, 60 Hz			
Standard	CFR47 Part 15 Subpart C					RBW / VBW	120 kHz/ 300 kHz			
Dist/Ant Used	3m / JB3					Performed by	Jeremy Luong			
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (cm)	Table Pos (deg)	FIM Pk (dBuV/m)	FIM QP (dBuV/m)	Total CF (dBuV)	E-Field QP (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)	Type
Transmitted Data at 2412 MHz										
54.00	V	106	129	47.59	43.87	-17.04	26.83	40.00	-13.17	Spurious
58.01	V	118	118	49.50	46.95	-16.91	30.04	40.00	-9.96	Spurious
59.56	V	112	93	49.06	46.87	-16.80	30.07	40.00	-9.93	Spurious
120.08	V	109	202	39.07	36.92	-9.95	26.97	43.52	-16.55	Spurious
181.14	V	126	243	34.51	31.69	-11.87	19.82	43.52	-23.70	Spurious
210.00	V	294	343	27.78	24.37	-12.09	12.28	43.52	-31.24	Spurious
Transmitted Data at 2437 MHz										
54.47	V	106	118	46.23	43.80	-17.04	26.76	40.00	-13.24	Spurious
58.38	V	109	215	48.54	47.24	-16.87	30.37	40.00	-9.63	Spurious
59.46	V	113	111	49.52	47.07	-16.80	30.27	40.00	-9.73	Spurious
115.75	V	113	23	39.45	36.74	-10.70	26.04	43.52	-17.48	Spurious
180.90	V	129	138	34.28	30.72	-11.87	18.85	43.52	-24.67	Spurious
Transmitted Data at 2462 MHz										
54.35	V	106	277	47.27	43.70	-17.04	26.66	40.00	-13.34	Spurious
59.58	V	129	324	48.87	46.85	-16.80	30.05	40.00	-9.95	Spurious
61.63	V	124	16	42.21	39.12	-16.63	22.49	40.00	-17.51	Spurious
115.08	V	126	226	38.27	36.34	-10.77	25.57	43.52	-17.95	Spurious
120.90	V	113	249	38.46	36.04	-9.81	26.23	43.52	-17.29	Spurious
180.64	V	111	234	36.26	32.97	-11.86	21.11	43.52	-22.41	Spurious
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty										
Total CF= Amp Gain + Cable Loss + ANT Factor										
Combined Standard Uncertainty $u_c(y) = \pm 3.2\text{dB}$ Expanded Uncertainty $U = k u_c(y)$ $k = 2$ for 95% confidence										
Notes: Worst case was observed on the Z-axis, 1Mbps. No significant emission was observed on horizontal.										

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SOP 1 Radiated Emissions							Tracking # 31051809.001 Page 2 of 8			
EUT Name		Wi-Fi Module					Date		July 6, 2010	
EUT Model		GS1011MIP					Temp / Hum in		22°C / 36% rh	
EUT Serial		001DC90009F1					Temp / Hum out		N/A	
EUT Config.		Z-Axis					Line AC / Freq		120 Vac, 60 Hz	
Standard		CFR47 Part 15 Subpart C					RBW / VBW		1MHz / 3MHz	
Dist/Ant Used		3m / EMCO3115					Performed by		Jeremy Luong	
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (cm)	Table Pos (deg)	FIM (Pk) (dBuV/m)	FIM Ave. (dBuV/m)	Total CF (dBuV)	E-Field Pk/Ave. (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)	Type
Transmitted Data at 2412 MHz at 802.11b, 1 Mbit/s										
4824.09	V	127	17	43.86	41.36	5.08	46.44	53.98	-7.54	Restricted
4824.09	H	159	316	45.74	43.88	5.08	48.96	53.98	-5.02	Restricted
9648.15	V	190	355	36.93	31.25	12.77	44.02	53.98	-9.96	Unrestricted
9648.15	H	201	122	37.11	31.25	12.77	44.02	53.98	-9.96	Unrestricted
19296.2	H	100	121	34.91	29.43	11.36	40.79	63.98	-23.19	Restricted
19296.2	V	101	143	36.71	31.21	11.36	42.57	63.98	-21.41	Restricted
Transmitted Data at 2437 MHz at 802.11b, 1 Mbit/s										
4874.06	H	156	310	43.65	40.61	5.25	45.86	53.98	-8.12	Restricted
4874.09	V	255	203	40.73	36.06	5.25	41.31	53.98	-12.67	Restricted
9748.09	V	175	347	35.46	26.49	12.84	39.33	53.98	-14.65	Unrestricted
9748.14	H	198	138	36.64	28.62	12.84	41.46	53.98	-12.52	Unrestricted
19496.2	V	110	150	32.38	26.66	11.55	38.21	63.98	-25.77	Restricted
19496.2	H	98	102	34.36	26.92	11.55	38.47	63.98	-25.51	Restricted
Transmitted Data at 2462 MHz at 802.11b, 1 Mbit/s										
4924.09	H	138	432	45.67	41.70	5.38	47.08	53.98	-6.90	Restricted
4924.10	V	179	321	41.61	38.11	5.38	43.49	53.98	-10.49	Restricted
9848.11	V	105	40	35.90	31.45	12.90	44.35	53.98	-9.63	Unrestricted
9848.13	H	176	281	34.84	29.59	12.90	42.49	53.98	-11.49	Unrestricted
19696.2	H	101	98	34.64	28.88	11.71	40.59	63.98	-23.39	Restricted
19696.2	V	110	96	33.12	28.57	11.71	40.28	63.98	-23.7	Restricted
Spec Margin = E-Field Ave. - Limit, E-Field Ave. = FIM Ave. + Total CF ± Uncertainty										
Total CF= Amp Gain + Cable Loss + ANT Factor										
Combined Standard Uncertainty $u_c(y) = \pm 3.2\text{dB}$ Expanded Uncertainty $U = k u_c(y)$ $k = 2$ for 95% confidence										
Notes: Worst case was observed on the Z-axis, 1Mbps. 1GHz – 25GHz Setting: RBW = 1MHz/ VBW = 3MHz All the unrestricted band emissions passed the limit under CFR47 Part 15.209.										

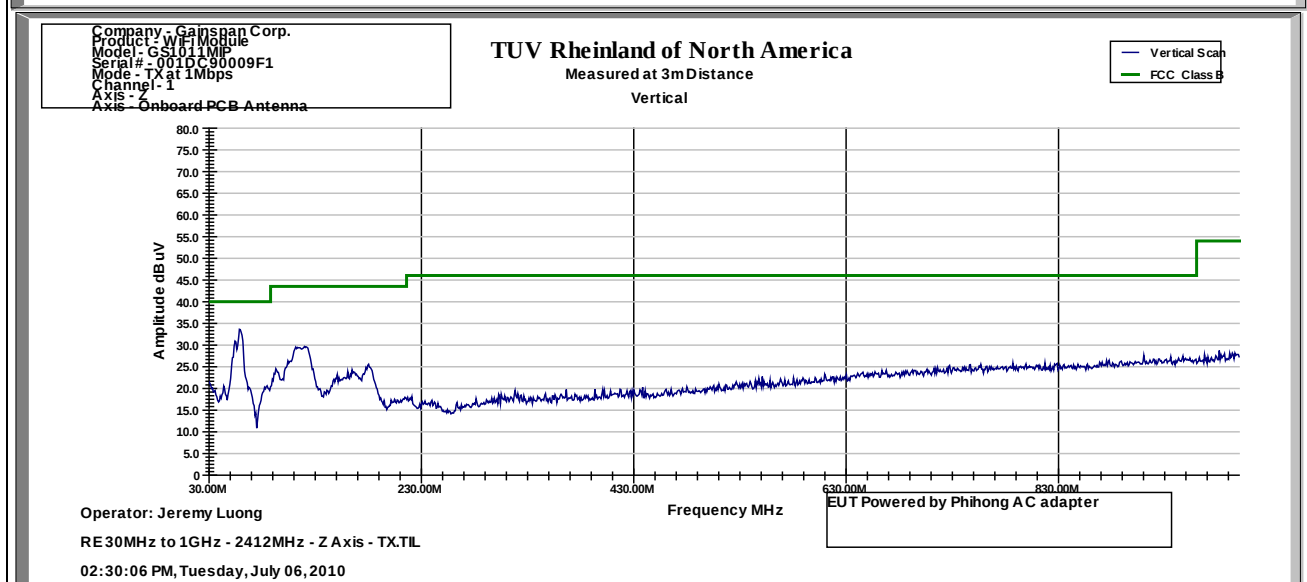
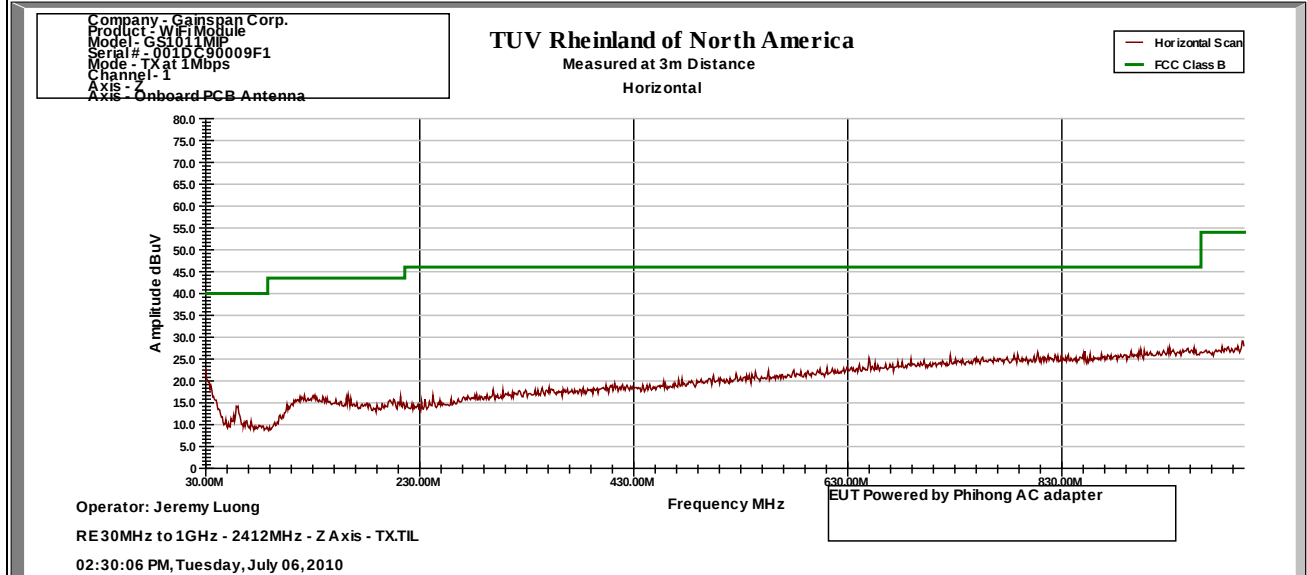
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SOP 1 Radiated Emissions

Tracking # 31051809.001 Page 3 of 8

EUT Name	Wi-Fi Module	Date	July 6, 2010
EUT Model	GS1011MIP	Temp / Hum in	22°C / 36% rh
EUT Serial	001DC90009F1	Temp / Hum out	N/A
EUT Config.	Z-Axis	Line AC	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	RBW / VBW	120 kHz / 300 kHz
Dist/Ant Used	3m / JB3	Performed by	Jeremy Luong

30MHz to 1000MHz Plot for Transmit 802.11b, 1 Mbit/s Mode at 2412 MHz



Notes: None.

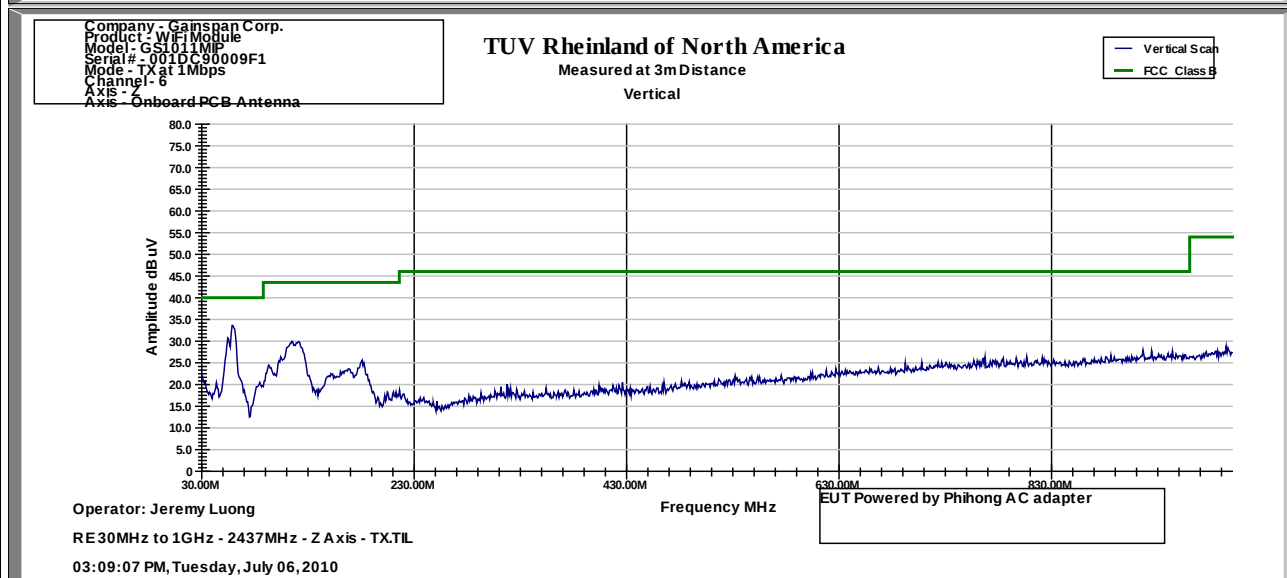
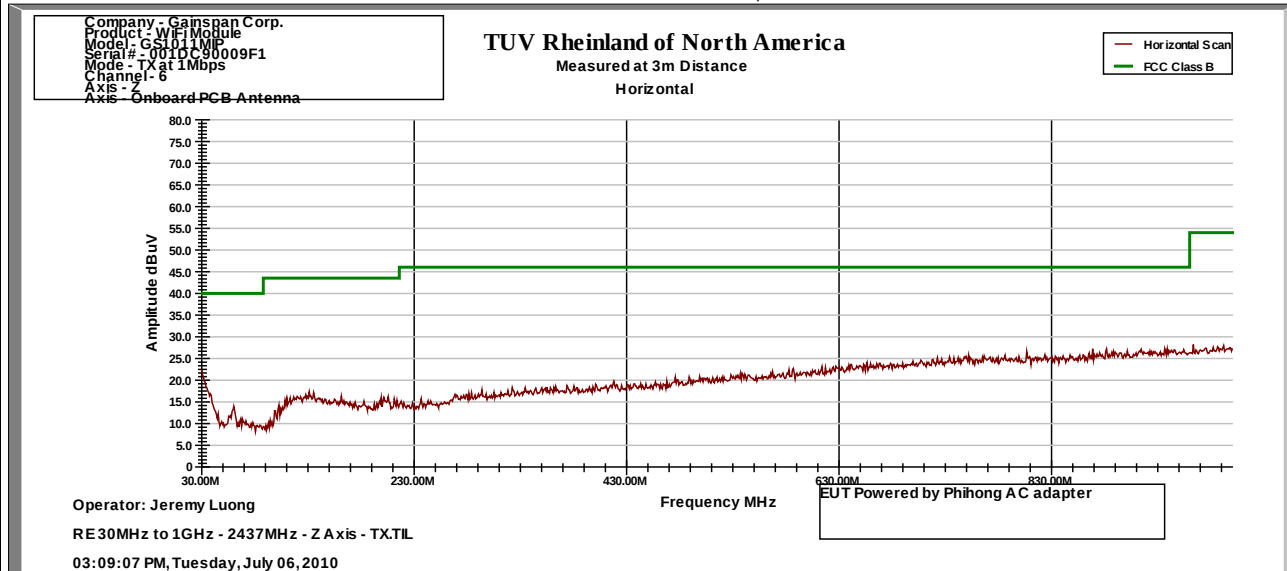
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SOP 1 Radiated Emissions

Tracking # 31051809.001 Page 4 of 8

EUT Name	Wi-Fi Module	Date	July 6, 2010
EUT Model	GS1011MIP	Temp / Hum in	22°C / 36% rh
EUT Serial	001DC90009F1	Temp / Hum out	N/A
EUT Config.	Z-Axis	Line AC	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	RBW / VBW	120 kHz / 300 kHz
Dist/Ant Used	3m / JB3	Performed by	Jeremy Luong

30MHz to 1000MHz Plot for Transmit 802.11b, 1 Mbit/s Mode at 2437 MHz



Notes: None.

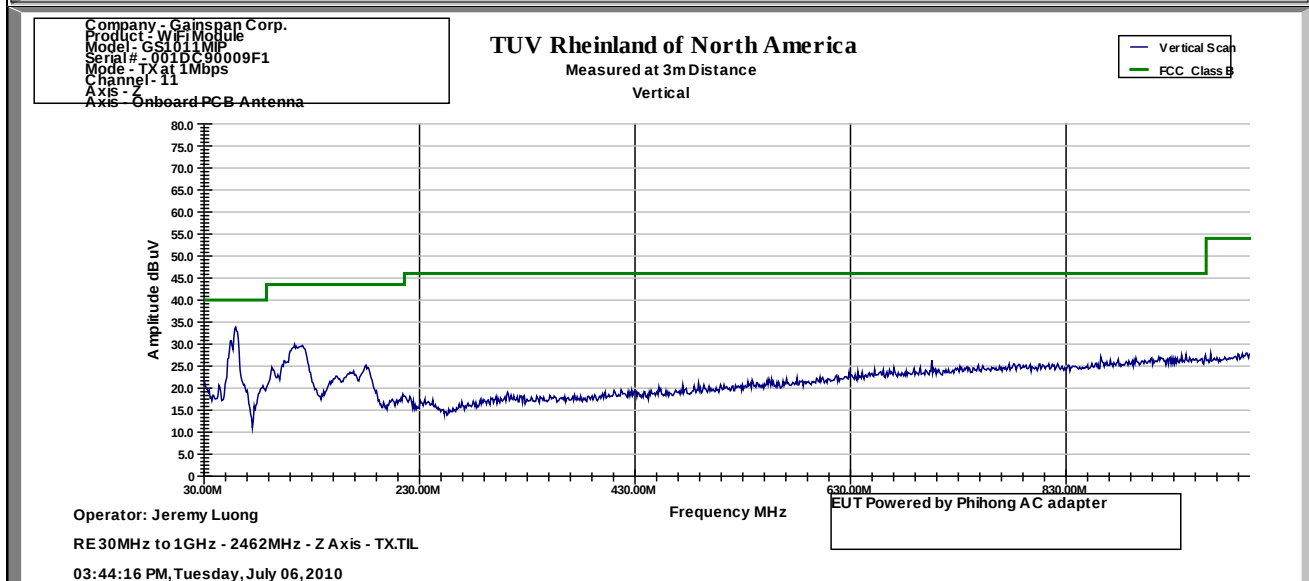
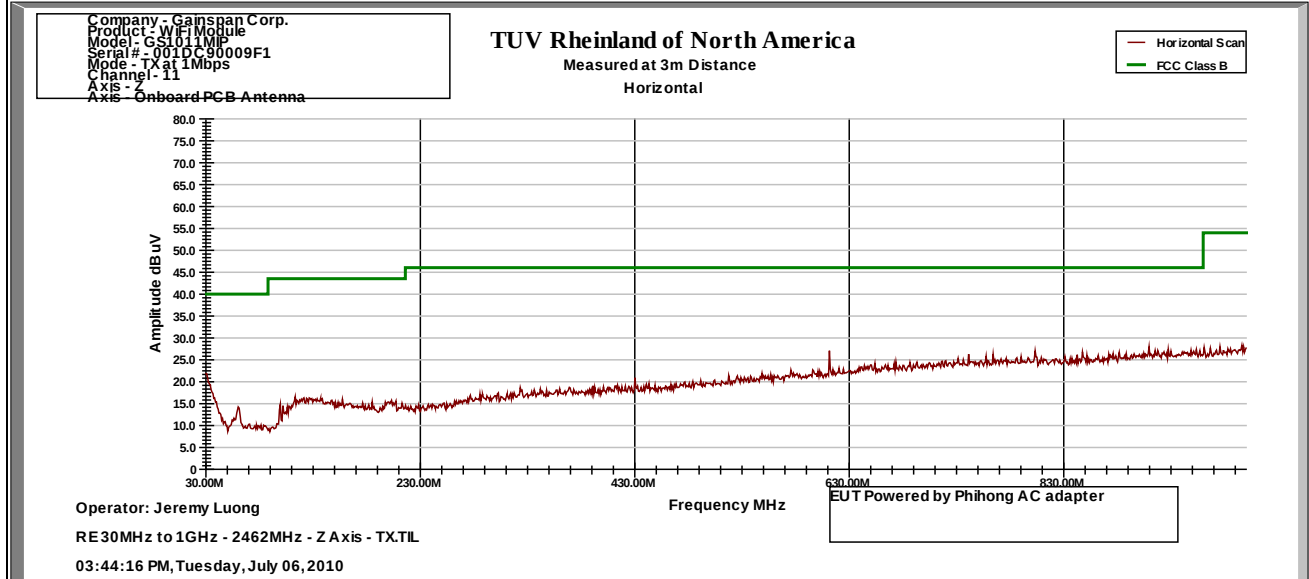
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SOP 1 Radiated Emissions

Tracking # 31051809.001 Page 5 of 8

EUT Name	Wi-Fi Module	Date	July 6, 2010
EUT Model	GS1011MIP	Temp / Hum in	22°C / 36% rh
EUT Serial	001DC90009F1	Temp / Hum out	N/A
EUT Config.	Z-Axis	Line AC	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	RBW / VBW	120 kHz / 300 kHz
Dist/Ant Used	3m / JB3	Performed by	Jeremy Luong

30MHz to 1000MHz Plot for Transmit 802.11b, 1 Mbit/s Mode at 2462 MHz



Notes: None.

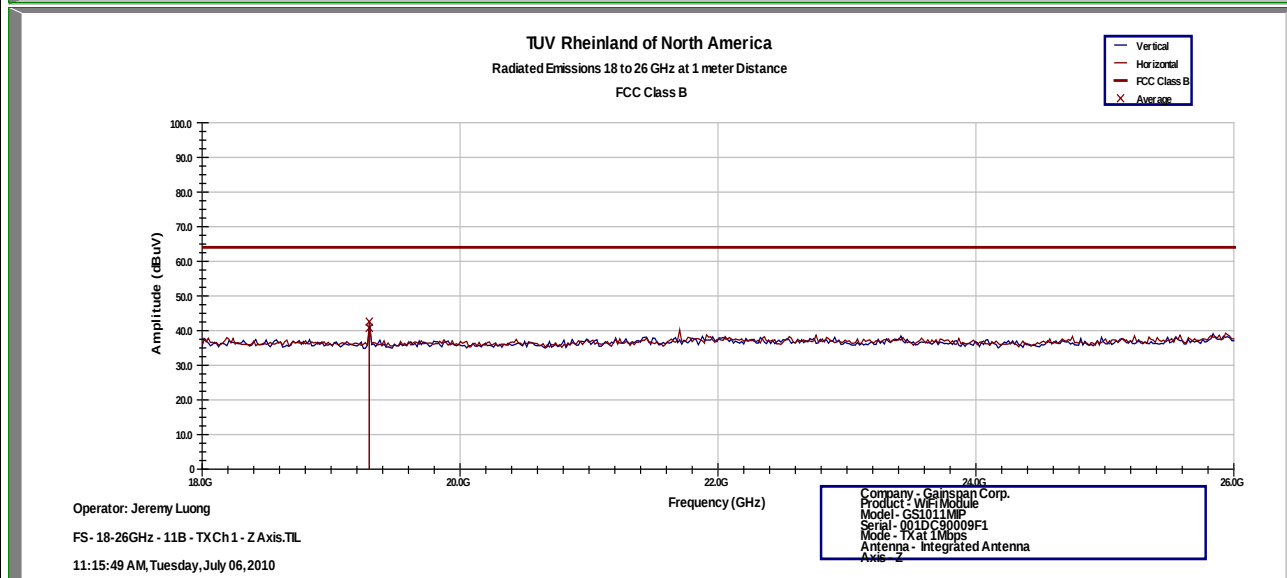
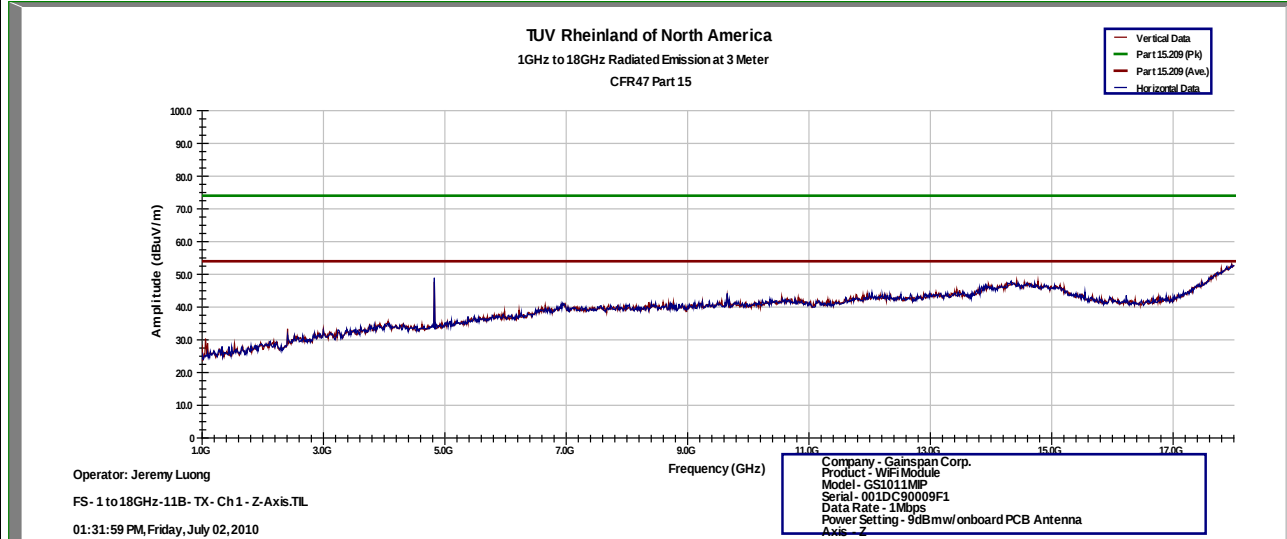
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SOP 1 Radiated Emissions

Tracking # 31051809.001 Page 6 of 8

EUT Name	Wi-Fi Module	Date	July 2, 2010
EUT Model	GS1011MIP	Temp / Hum in	22°C / 33% rh
EUT Serial	001DC90009F1	Temp / Hum out	N/A
EUT Config.	Z-Axis	Line AC	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	RBW / VBW	1MHz / 3MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	Performed by	Jeremy Luong

Above 1GHz Plots for Transmit Mode at 2412 MHz, 802.11b 1 Mbit/s



Notes: 18GHz to 26GHz, limit was extrapolated to 1m distance.

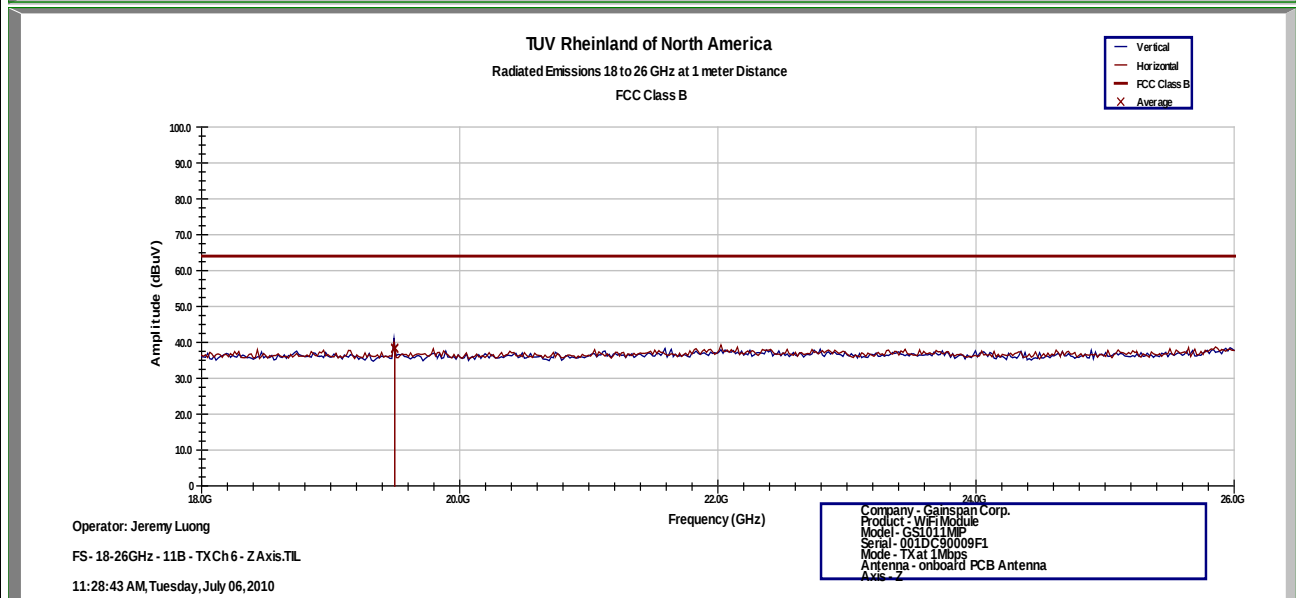
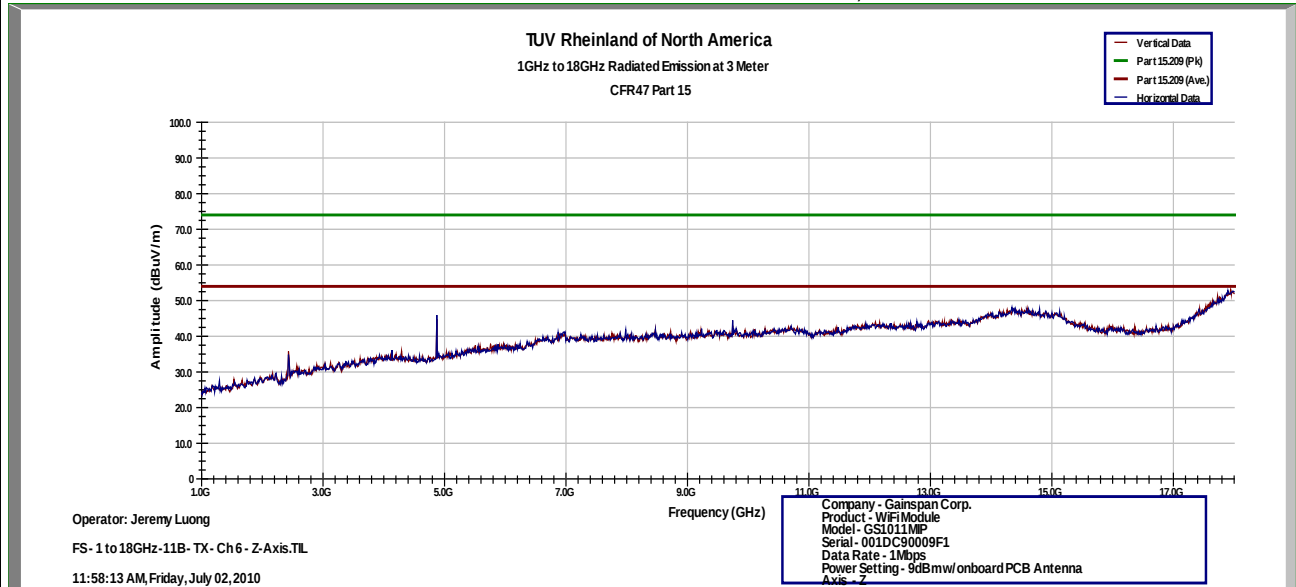
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SOP 1 Radiated Emissions

Tracking # 31051809.001 Page 7 of 8

EUT Name	Wi-Fi Module	Date	July 2, 2010
EUT Model	GS1011MIP	Temp / Hum in	22°C / 33% rh
EUT Serial	001DC90009F1	Temp / Hum out	N/A
EUT Config.	Z-Axis	Line AC	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	RBW / VBW	1MHz / 3MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	Performed by	Jeremy Luong

Above 1GHz Plots for Transmit Mode at 2437 MHz, 802.11b 1 Mbit/s



Notes: 18GHz to 26GHz, limit was extrapolated to 1m distance.

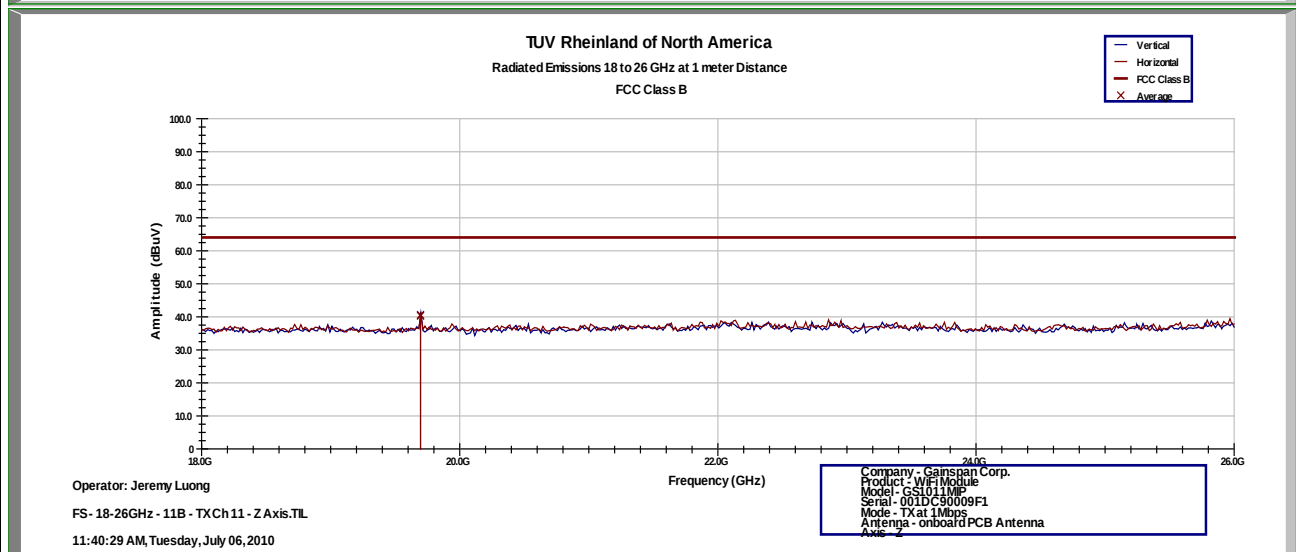
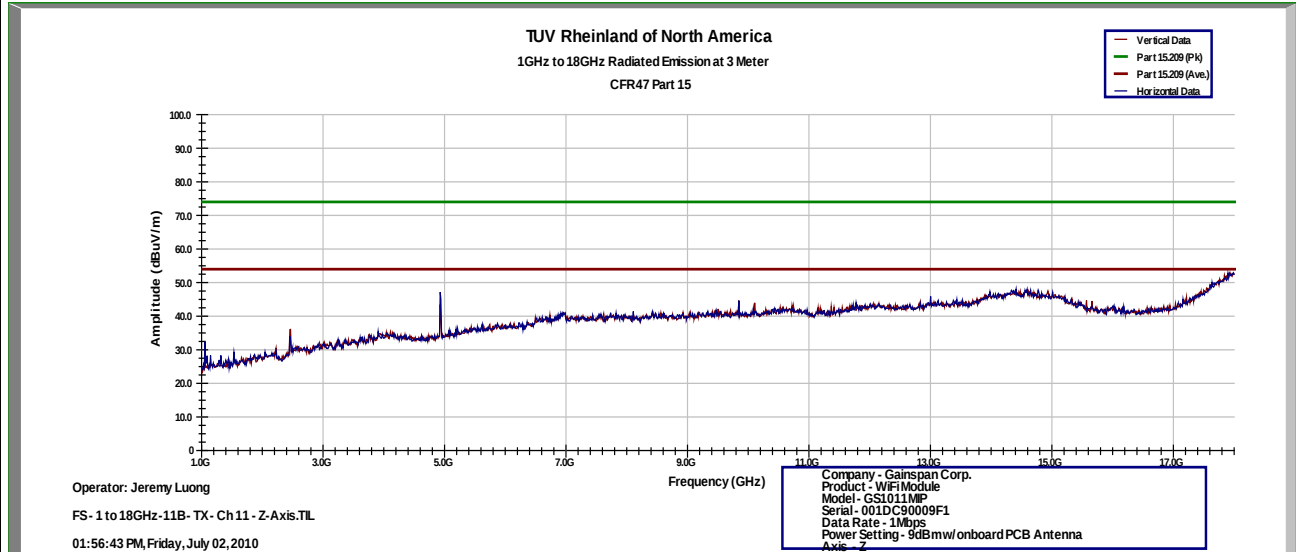
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SOP 1 Radiated Emissions

Tracking # 31051809.001 Page 8 of 8

EUT Name	Wi-Fi Module	Date	July 2, 2010
EUT Model	GS1011MIP	Temp / Hum in	22°C / 33% rh
EUT Serial	001DC90009F1	Temp / Hum out	N/A
EUT Config.	Z-Axis	Line AC	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	RBW / VBW	1MHz / 3MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	Performed by	Jeremy Luong

Above 1GHz Plots for Transmit Mode at 2462 MHz, 802.11b 1 Mbit/s



Notes: 18GHz to 26GHz, limit was extrapolated to 1m distance.

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4.6.4 Sample Calculation

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{FIM} - \text{AMP} + \text{CBL} + \text{ACF}$$

Where: FIM = Field Intensity Meter (dB μ V)
AMP = Amplifier Gain (dB)
CBL = Cable Loss (dB)
ACF = Antenna Correction Factor (dB/m)

$$\mu\text{V/m} = 10^{\frac{\text{dB}\mu\text{V} / \text{m}}{20}}$$

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4.7 Receiver Spurious Emissions

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode.

The spurious emissions of the receiver shall not exceed the values in CFR47 Part 15.109 and RSS 210 Sect 2.7.

4.7.1 Test Methodology

4.7.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.7.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, then the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

4.7.1.3 Deviations

None.

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4.7.2 Receiver Spurious Emission Limit

The spurious emissions of the receiver shall not exceed the values in CFR47 Part 15.205, 15.209: 2008 and RSS 210 A1.1.2 2007.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490.....	2400/F (kHz)	300
0.490-1.705.....	24000/F (kHz)	30
1.705-30.0.....	30	30
30-88.....	100 **	3
88-216.....	150 **	3
216-960.....	200 **	3
Above 960.....	500	3

4.7.3 Test Results

The final measurement data indicates the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and 1.5.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

4.7.3.1 Final Data

The data recorded in this section contains the final results under the worst-case conditions and without any modifications or special accessories implemented as the manufacturer intends.

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SOP 1 Radiated Emissions						Tracking # 31051809.001 Page 1 of 3				
EUT Name	Wi-Fi Module					Date	July 6, 2010			
EUT Model	GS1011MIP					Temp / Hum in	22°C / 36% rh			
EUT Serial	001DC90009F1					Temp / Hum out	N/A			
EUT Config.	On-board PCB Antenna					Line AC / Freq	120Vac 60Hz			
Standard	CFR47 Part 15 Subpart C					RBW / VBW	See below			
Dist/Ant Used	3m / JB3					Performed by	Jeremy Luong			
Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (cm)	Table Pos (deg)	FIM Pk (dBuV/m)	FIM QP/Ave (dBuV/m)	Total CF dBuV	E-Field QP/Ave (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)	Type
Receive Mode at Channel 6, 2437 MHz										
54.34	V	107	241	47.05	42.59	-17.04	25.55	40.00	-14.45	Spurious
58.15	V	108	178	50.57	47.11	-16.91	30.20	40.00	-9.80	Spurious
59.56	V	114	291	49.13	46.97	-16.80	30.17	40.00	-9.83	Spurious
60.45	V	124	269	47.68	44.55	-16.75	27.80	40.00	-12.20	Spurious
115.67	V	108	355	40.16	37.46	-10.70	26.76	43.52	-16.76	Spurious
121.52	V	131	122	38.53	35.97	-9.84	26.13	43.52	-17.39	Spurious
4874.07	V	144	173	40.64	37.14	5.25	42.39	53.98	-11.59	Spurious
4874.08	H	185	433	43.65	41.16	5.25	46.41	53.98	-7.57	Spurious
19496.2	H	99	105	32.79	27.34	11.55	38.89	63.98	-25.09	Spurious
19496.2	H	104	346	30.30	25.10	11.55	36.65	63.98	-27.33	Spurious
21933.2	V	99	271	33.04	27.04	11.85	38.89	63.98	-25.09	Spurious
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty										
Total CF= Amp Gain + Cable Loss + ANT Factor										
Combined Standard Uncertainty $u_c(y) = \pm 1.6$ dB Expanded Uncertainty $U = k u_c(y)$ $k = 2$ for 95% confidence										
Notes: Tested on the Z-Axis.										
30-1000 MHz Setting: RBW (120 kHz) / VBW (300 kHz)										
1-25 GHz Setting: RBW (1MHz) / VBW (3 MHz)										
Average detector was used for above 1GHz.										

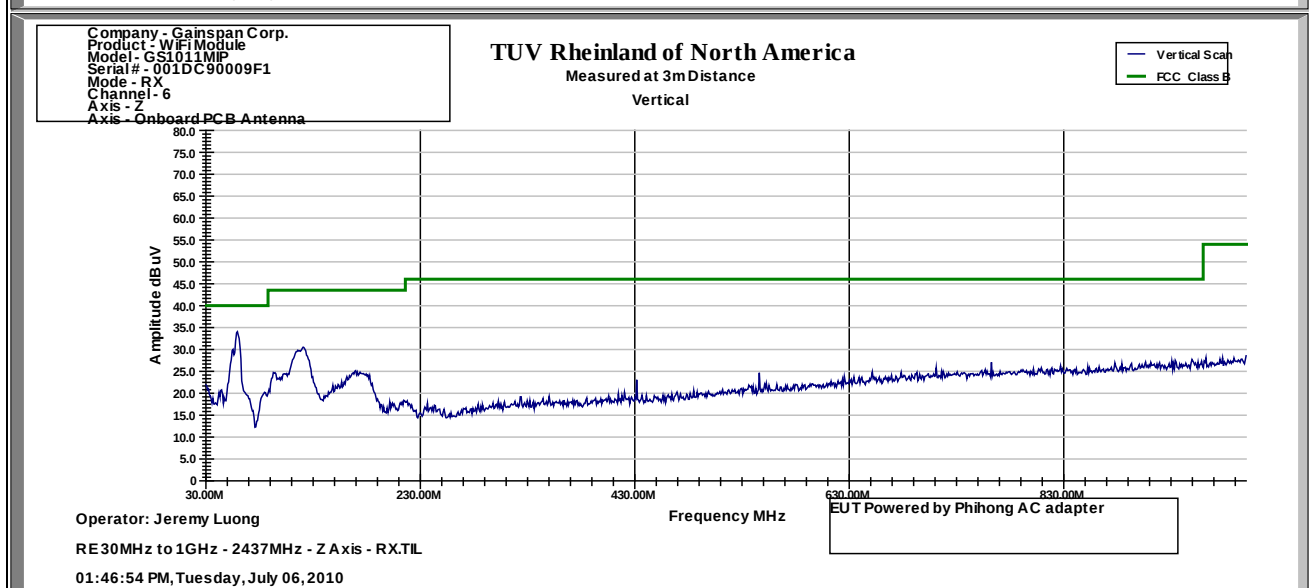
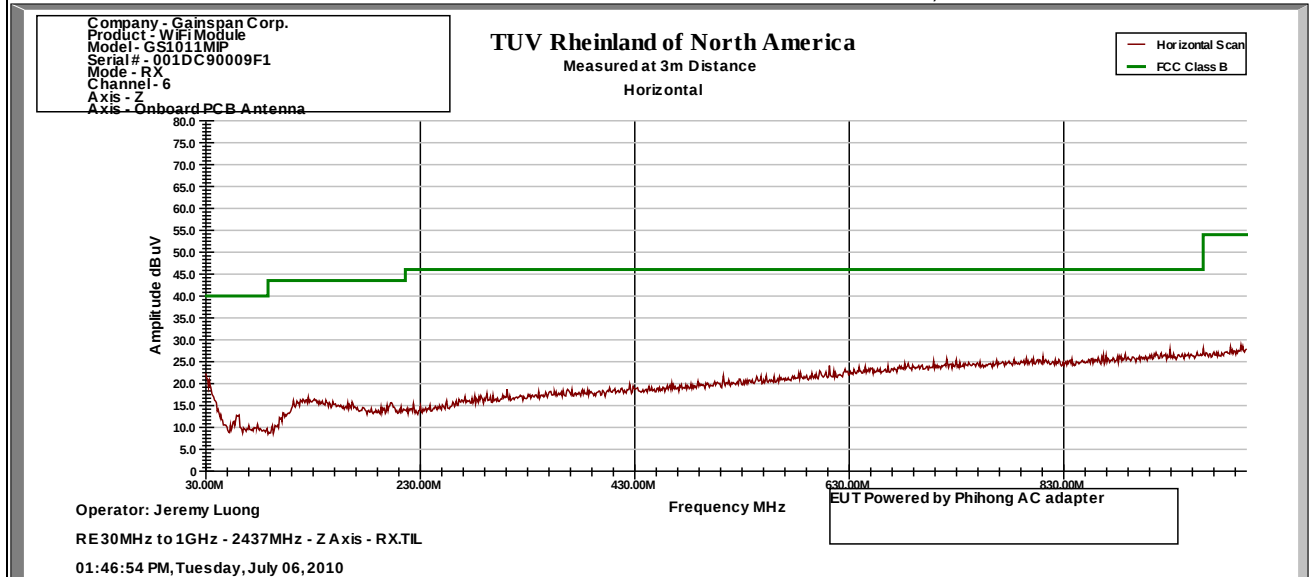
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SOP 1 Radiated Emissions

Tracking # 31051809.001 Page 2 of 3

EUT Name	Wi-Fi Module	Date	July 6, 2010
EUT Model	GS1011MIP	Temp / Hum in	22°C / 36% rh
EUT Serial	001DC90009F1	Temp / Hum out	N/A
EUT Config.	Onboard PCB Antenna	Line AC	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	RBW / VBW	120 kHz / 300 kHz
Dist/Ant Used	3m / JB3	Performed by	Jeremy Luong

30MHz to 1000MHz Plots for Receive Mode at Channel 6, 2437 MHz



Notes: Z-Axis.

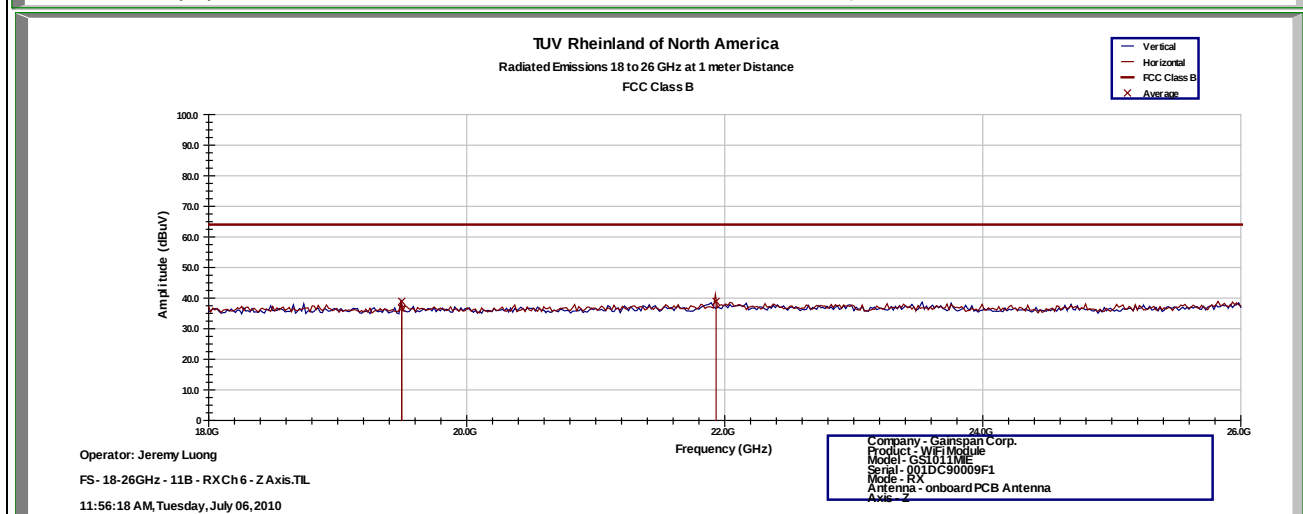
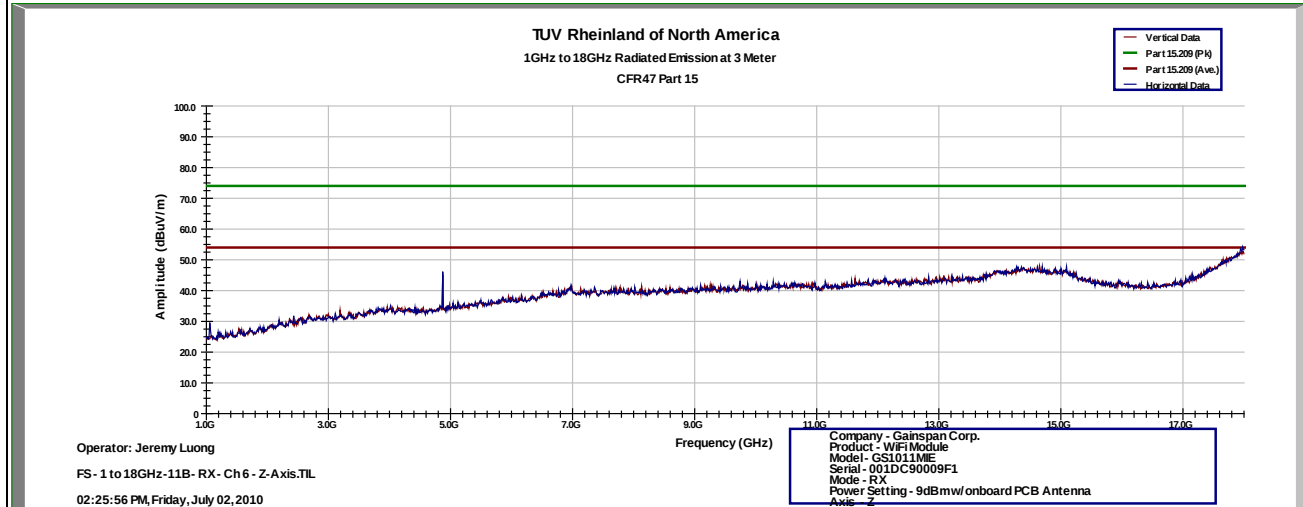
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SOP 1 Radiated Emissions

Tracking # 31051809.001 Page 3 of 3

EUT Name	Wi-Fi Module	Date	July 6, 2010
EUT Model	GS1011MIP	Temp / Hum in	22°C / 36% rh
EUT Serial	001DC90009F1	Temp / Hum out	N/A
EUT Config.	On-board PCB Antenna	Line AC	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	RBW / VBW	1MHz / 3MHz
Dist/Ant Used	3m / EMCO3115	Performed by	Jeremy Luong

Above 1GHz Plots for Receive Mode



Notes: : Limit was extrapolated to 1m distance.
30MHz – 1000MHz Setting: RBW = 120 kHz / VBW = 300 kHz
1GHz – 25GHz Setting: RBW = 1MHz/ VBW = 3MHz

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4.7.4 Sample Calculation

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{FIM} - \text{AMP} + \text{CBL} + \text{ACF}$$

Where: FIM = Field Intensity Meter (dB μ V)
AMP = Amplifier Gain (dB)
CBL = Cable Loss (dB)
ACF = Antenna Correction Factor (dB/m)

$$\mu\text{V/m} = 10^{\frac{\text{dB}\mu\text{V} / \text{m}}{20}}$$

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4.8 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.4:2003, RSS-210. These test methods are listed under the laboratory's NVLAP Scope of Accreditation.

This test measures the levels emanating from the EUT's AC input port, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 15.207, RSS-GEN Sect.7.2.2

4.8.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50 μ H / 50 Ω LISNs.

Testing is performed in 5m semi anechoic chamber. The setup photographs clearly identify which site was used. The vertical ground plane used in the semi-anechoic chamber is a 2m x 2m solid aluminum frame and panel, and it is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN.

4.8.1.1 Deviations

There were no deviations from this test methodology.

4.8.2 Test Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 8: AC Conducted Emissions – Test Results

Test Conditions: Conducted Measurement at the host Interface Card's AC Main, Normal Conditions			
Antenna Type: Integrated		Power Level: 9 dBm	
AC Power: 120 Vac, 60 Hz		Configuration: Tabletop	
Ambient Temperature: 22° C		Relative Humidity: 33% rh	
Antenna	Configuration	Frequency Range	Test Result
On-board PCB	Line 1(Hot)	0.15 to 30 MHz	Pass
On-board PCB	Line 2 (Neutral)	0.15 to 30 MHz	Pass

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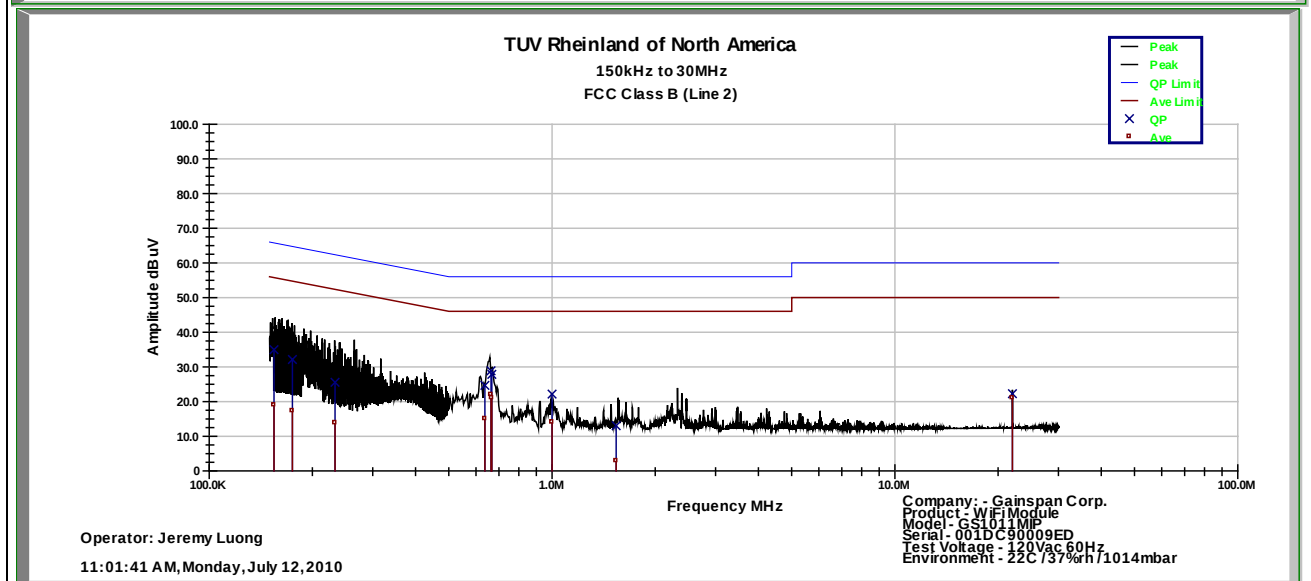
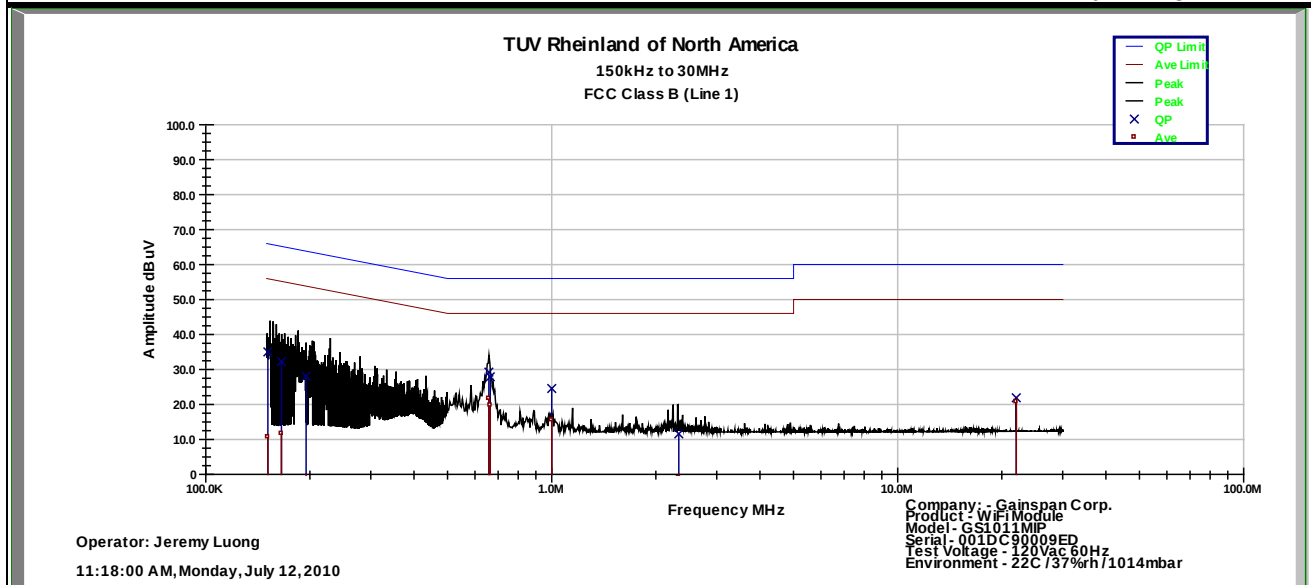
SOP 2 Conducted Emissions				Tracking # 31051809.001 Page 1 of 2			
EUT Name	Wi-Fi Module			Date	July 12, 2010		
EUT Model	GS1011MIP			Temp / Hum in	22°C / 37% rh		
EUT Serial	001DC90009ED			Temp / Hum out	N/A		
EUT Config.	Integrated Antenna			Line AC / Freq	120 Vac, 60 Hz		
Standard	CFR47 Part 15.207			RBW / VBW	9 kHz / 30 kHz		
Lab/LISN	Lab 5 / Solar 9348-50-R-24-BNC			Performed by	Jeremy Luong		
Frequency	Quasi-Peak	QP Limit	QP Margin	Average	Ave Limit	Ave Margin	Line
MHz	dBuV	dBuV	dB	dBuV	dBuV	dB	
0.155	34.70	65.87	-44.06	18.77	55.87	-46.99	2
0.175	31.87	65.29	-46.89	17.07	55.29	-48.69	2
0.233	25.32	63.63	-53.45	13.60	53.63	-52.18	2
0.637	24.50	56.00	-48.35	14.87	46.00	-44.97	2
0.664	28.71	56.00	-44.14	21.84	46.00	-38.01	2
0.667	27.68	56.00	-45.17	20.89	46.00	-38.96	2
1.538	12.92	56.00	-59.98	2.78	46.00	-57.12	2
21.999	21.93	60.00	-50.74	20.72	50.00	-38.95	2
0.151	34.78	65.97	-43.98	10.44	55.97	-55.32	1
0.165	32.03	65.56	-46.73	11.39	55.56	-54.38	1
0.195	27.78	64.72	-50.99	-6.93	54.72	-72.70	1
0.658	29.07	56.00	-43.78	21.49	46.00	-38.36	1
0.664	27.74	56.00	-45.11	19.63	46.00	-40.22	1
2.329	11.46	56.00	-61.43	-1.19	46.00	-61.08	1
22.000	21.56	60.00	-51.11	20.40	50.00	-39.27	1
Spec Margin = QP./Ave. - Limit, ± Uncertainty							
Combined Standard Uncertainty $u_c(y) = \pm 2.4\text{dB}$ Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence							
Notes: EUT was setup as table top equipment.							

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SOP 2 Conducted Emissions

Tracking # 31051809.001 Page 2 of 2

EUT Name	Wi-Fi Module	Date	July 12, 2010
EUT Model	GS1011MIP	Temp / Hum in	22°C / 37% rh
EUT Serial	001DC90009ED	Temp / Hum out	N/A
EUT Config.	5 dBi Dipole Antenna	Line AC	120 Vac, 60 Hz
Standard	CFR47 Part 15.207	RBW / VBW	9 kHz / 30 kHz
Lab/LISN	Lab 5/ Solar 9348-50-R-24-BNC	Performed by	Jeremy Luong



Notes: Using CISRP Class B Limit.

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5 Test Equipment Use List

5.1 Equipment List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal mm/dd/yy	Next Cal mm/dd/yy
Bilog Antenna	Sunol Science	JB3	A102606	02/18/10	02/18/12
Antenna Bilog	Sunol Science	JB3	A061907	05/14/10	05/14/12
Tuned Dipole Antenna	A.H Systems, Inc.	TDS-200/535-1	154	01/09/09	01/09/11
Tuned Dipole Antenna	A.H Systems, Inc.	TDS-200/535-2	154	01/09/09	01/09/11
Tuned Dipole Antenna	A.H Systems, Inc.	TDS-200/535-3	154	01/09/09	01/09/11
Tuned Dipole Antenna	A.H Systems, Inc.	TDS-200/535-4	154	01/09/09	01/09/11
Antenna Horn (1-18GHz)	EMCO	3115	9211-3969	04/15/09	04/15/11
Antenna Horn (1-18GHz)	AHS	3115	9710-5301	06/30/10	06/30/11
EMI Receiver	Hewlett Packard	8546A	3325A00168	10/29/09	10/29/10
Preselector	Hewlett Packard	85460A	3330A00174	10/29/09	10/29/10
Amplifier	Hewlett Packard	8447D	2944A07996	01/21/10	01/21/11
Spectrum Analyzer	Rhode&Schwarz	ESIB	100180	08/19/09	08/19/10
Amplifier	Rhode & Schwarz	TS-PR18	100019	06/14/08	09/14/10
Amplifier	Rhode & Schwarz	TS-PR26	100011	06/14/08	09/14/10
Signal Generator	Anritsu	MG3694A	42803	09/19/09	09/19/10
Thermo Chamber	Associated Environmental	SK-3102	5999	01/22/10	01/22/11
Notch Filter	Micro-Tronics	BRM50702	037	01/22/10	01/22/11
Power Supplier	Kikosui	PCR8000W	CM000912	01/18/10	01/18/11
Digital Multimeter	Fluke	83 III	84590116	01/21/10	01/21/11
Thermometer	Fluke	52II	88650033	10/16/09	10/16/10

* Calibration of equipment past due for re-calibration will be performed expeditiously. If any equipment is found to be out of tolerance at that time, affected customers will be notified accordingly.

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6 EMC Test Plan

6.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer so that the test laboratory may perform the requested testing.

6.2 Customer

Table 9: Customer Information

Company Name	Gainspan Corporation
Address	125 S. Market St. Suite 400
City, State, Zip	San Jose, CA 95113-2292
Country	USA
Phone	(408) 673-2900
Fax	(408) 673-2901

Table 10: Technical Contact Information

Name	Ron Green
E-mail	Ron.Green@gainspan.com
Phone	(408) 673-2900
Fax	(408) 673-2901

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6.3 Equipment Under Test (EUT)

Table 11: EUT Specifications

GS1011MIP Dimensions	1.28" x 0.9" x 0.143"
Power Supply	Input Voltage: 3.3 Vdc Input Current: 300mA Cutoff Voltage: 2.4 Vdc
Environment	Indoor and Outdoor
Operating Temperature Range:	-40 to 85 degrees C
Multiple Feeds:	☐ Yes and how many ☒ No
Operating Mode	802.11b
Transmitter Frequency Band	2.412 GHz to 2.462 MHz (DSSS)
Rated Power Output	9 dBm (Fixed)
Operating Channel	2412 MHz, 2417 MHz, 2422 MHz, 2427 MHz, 2432 MHz, 2437 MHz, 2442 MHz, 2447 MHz, 2452 MHz, 2457 MHz, 2462 MHz.
Antenna Type	0 dBi Integrated PCB Antenna.
Modulation Type	☐ AM ☐ FM ☐ Phase ☒ Other describe: DSSS
Bandwidth	22 MHz
Type of Equipment	☐ Table Top ☐ Wall-mount ☐ Floor standing cabinet ☒ Other describe: <i>Portable in any orientation.</i>

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Table 12: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
RS232	Serial (Null Cable)	☒ Yes	☒ Metric: 1.5m	☒ M

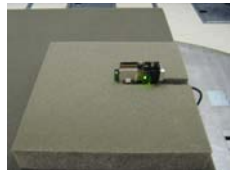
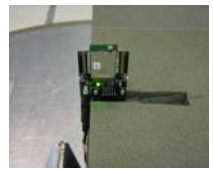
Table 13: Supported Equipment

Equipment	Manufacturer	Model	Serial	Used for
Laptop	Lenovo	Type 2808	R8-CAHRZ	Set test mode

Table 14: Description of Sample used for Testing

Device	Serial	Antenna	Test
GS1011MIP	001DC90009F1	Integrated PCB	TX Emission, RX Emission
	001DC90009ED	Integrated PCB	AC Conducted Emission
	001DC90009F5	Integrated PCB	RF Power Output, Peak Power Spectral Density, Out of Band Emission, Bandwidth

Table 15: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup Photo (X-Axis)	Setup Photo (Y-Axis)	Setup Photo (Z-Axis)
GS1011MIP	0 dBi Integrated PCB	* Transmit in Mode b (1 Mbit/s) * Transmit in Mode b (11 Mbit/s) * Receive			

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6.4 Test Specifications

Testing requirements

Table 16: Testing Requirements

Emissions and Immunity	
Standard	Requirement
CFR 47 Part 15.247	All
RSS 210	All

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