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Emissions
Test Report

EUT Name: Wi-Fi Module

Model No.: GS1011MEE

CFR 47 Part 15.247 2009 and RSS 210: 2007

Prepared for:

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Report/Issue Date: 16 August 2010
Report Number: 31051808.001

Statement of Compliance

Manufacturer:	Gainspan Corporation 125 S. Market St. Suite 400 San Jose, CA 95113-2292 (408) 673-2900
Requester / Applicant:	Ron Green
Name of Equipment:	Wi-Fi Module
Model No.	GS1011MEE
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 15.247 2009 and RSS 210: 2007
Test Dates:	July 16 to August 9, 2010

Guidance Documents:

Emissions: ANSI C63.10: 2009

Test Methods:

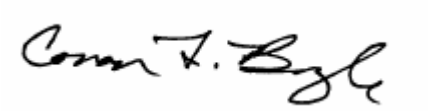
Emissions: ANSI C63.10: 2009

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.

This report must not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. This report contains data that are not covered by NVLAP accreditation. This report shall not be reproduced except in full, without the written authorization of TUV Rheinland of North America.

Jeremy Luong

Test Engineer Date



Conan Boyle

NVLAP Signatory Date

NVLAP LAB CODE 500011-0

US5254 **2932M-1**

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 2009 and RSS 210: 2007 based on the results of testing performed on July 16 to August 9, 2010 on the Wi-Fi Module Model GS1011MEE 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**

Note: Two antenna families were tested. 5 dBi ext. dipole antenna was tested at highest gain of Q=0. 2dBi ext. PCB antenna was test at reduced gain of Q=2.

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

None

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 (Registration No. 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.

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 test distances of 3 and 5 meters. 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-kΩ 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-kΩ 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:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

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

Sample radiated emissions calculation @ 30 MHz

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

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

2.3.2 Measurement Uncertainty

	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

Measurement Uncertainty Immunity

The estimated combined standard uncertainty for ESD immunity measurements is ± 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 ± 8.8%.
The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 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.

3 Product Information

3.1 Product Description

The WiFi Module, model GS1011MEE, is a 802.11B WiFi module. It is intended to deploy in the low system resource device such as sensors.

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.

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 GS1011MEE WiFi Module is specified to be use with two different types of antenna;

- External 2 dBi PCB Antenna with UFL Connector (example: RFA-02-P05-70B-150)
- External 5 dBi Dipole Antenna with UFL Connector (example: RFA-02-5-F7H1)

Note: Similar antenna types with equal or lower gain can be used with GS1011MEE.

4 Emissions

Testing was performed in accordance with CFR 47 Part 15.247: 2009 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.

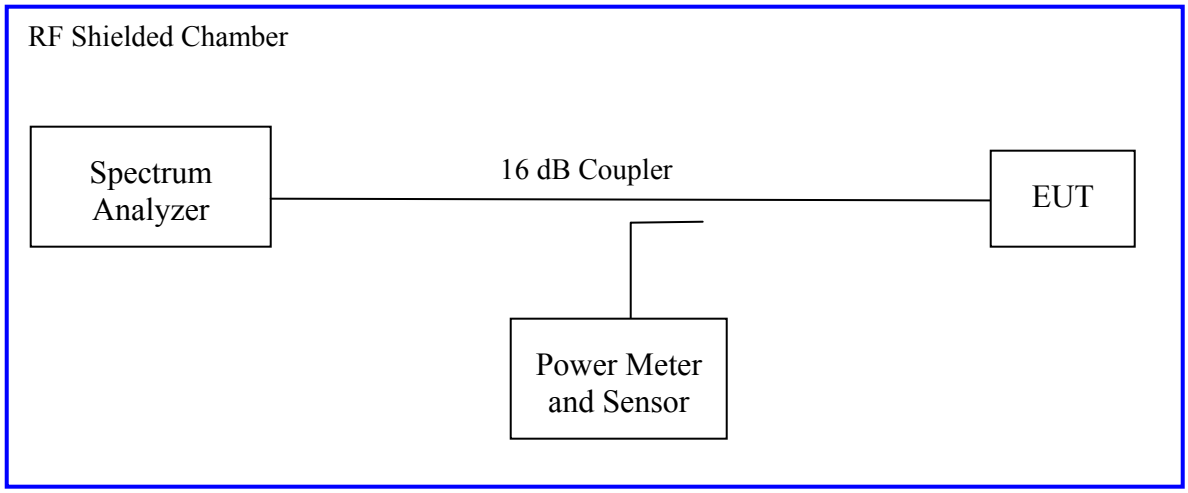
The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b3):2009 and RSS 210 A.8.4: 2007

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 Part 15.247 (b3):2008 and RSS 210 A.8.4. This test was conducted on 3 channels of Sample, Eng. #22. The worst mode result indicated below.

Test Setup:



Method #1 of "Measurement of Digital Transmission Systems Operating under Section 15.247"applies since the GS1011MEE *continuously transmit; where T, Transmission Duration Pulse, is greater than analyzer sweep time.*

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: PCB and Dipole		**Power Setting:** See below	
Max. Antenna Gain: +5 dBi		**Signal State:** Modulated	
Ambient Temp.: 21° C		**Relative Humidity:**39%	
Test Results for Q = 0			
Operating Channel	**Limit [dBm]**	**802.11b (11 MBit/s) Output Level [dBm]**	**802.11b Margin [dB]**
2412 MHz	+30.00	23.04	-6.96
2437 MHz	+30.00	23.08	-6.92
2462 MHz	+30.00	23.47	-6.53
Test Results for Q = 2			
Operating Channel	**Limit [dBm]**	**802.11b (11 MBit/s) Output Level [dBm]**	**802.11b Margin [dB]**
2412 MHz	+30.00	+21.99	-8.01
2437 MHz	+30.00	+21.98	-8.02
2462 MHz	+30.00	+22.38	-7.62
Note: The highest peak output power was observed at 11 Mbps.			

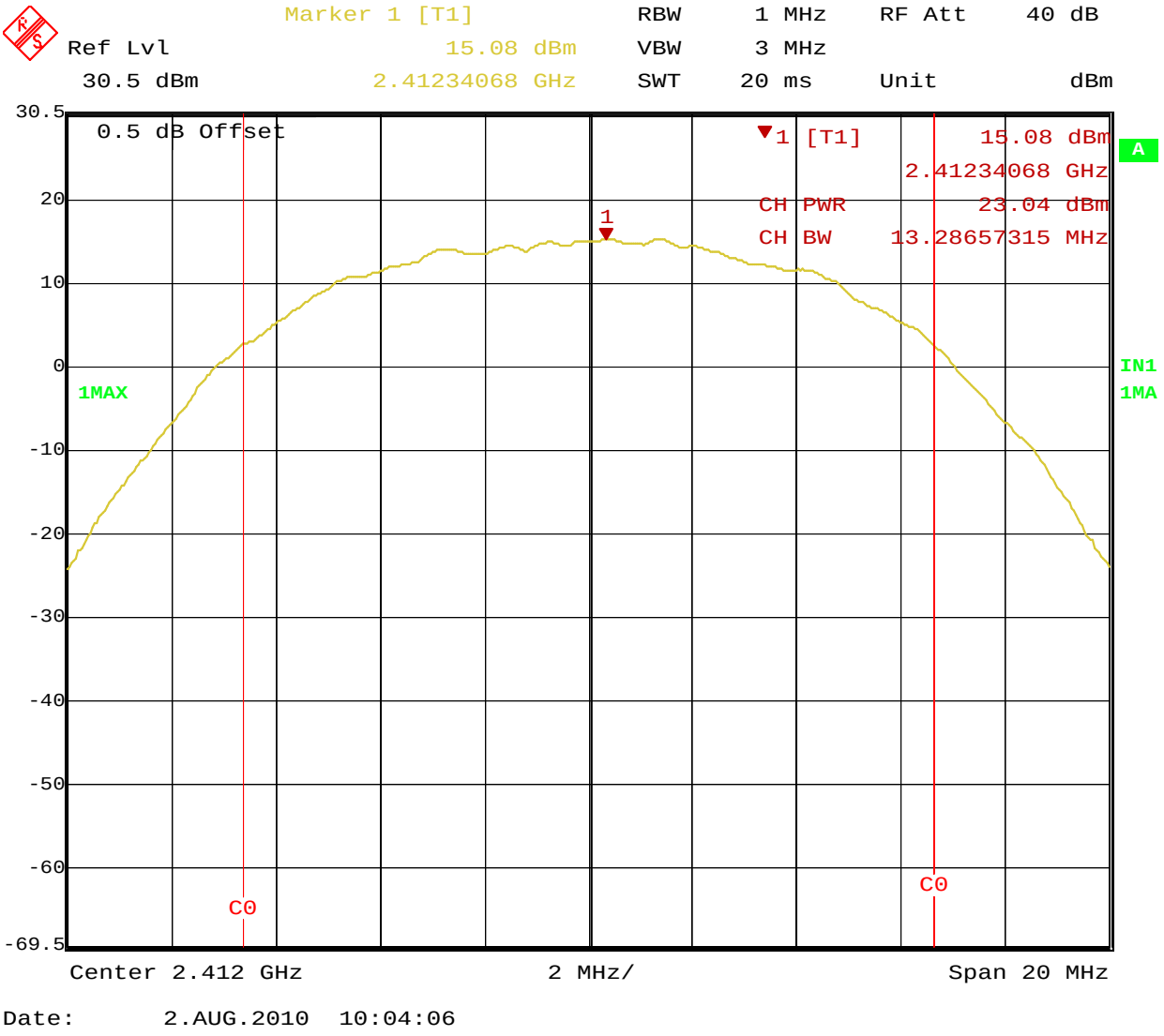


Figure 1: Maximum Transmitted Power at Q =0, Lowest Channel 2412 MHz of 802.11b

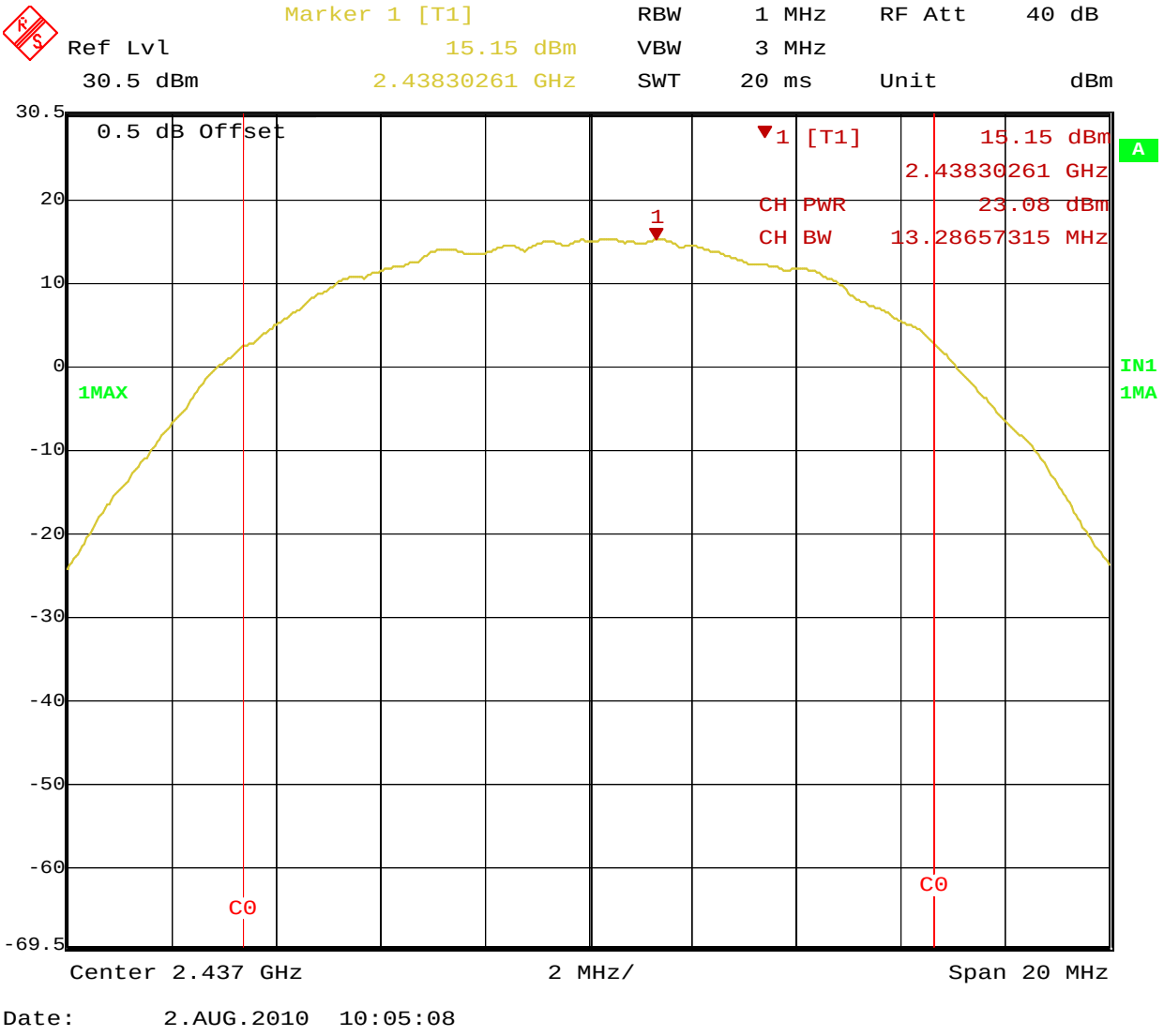


Figure 2: Maximum Transmitted Power at Q =0, Middle Channel 2437 MHz of 802.11b

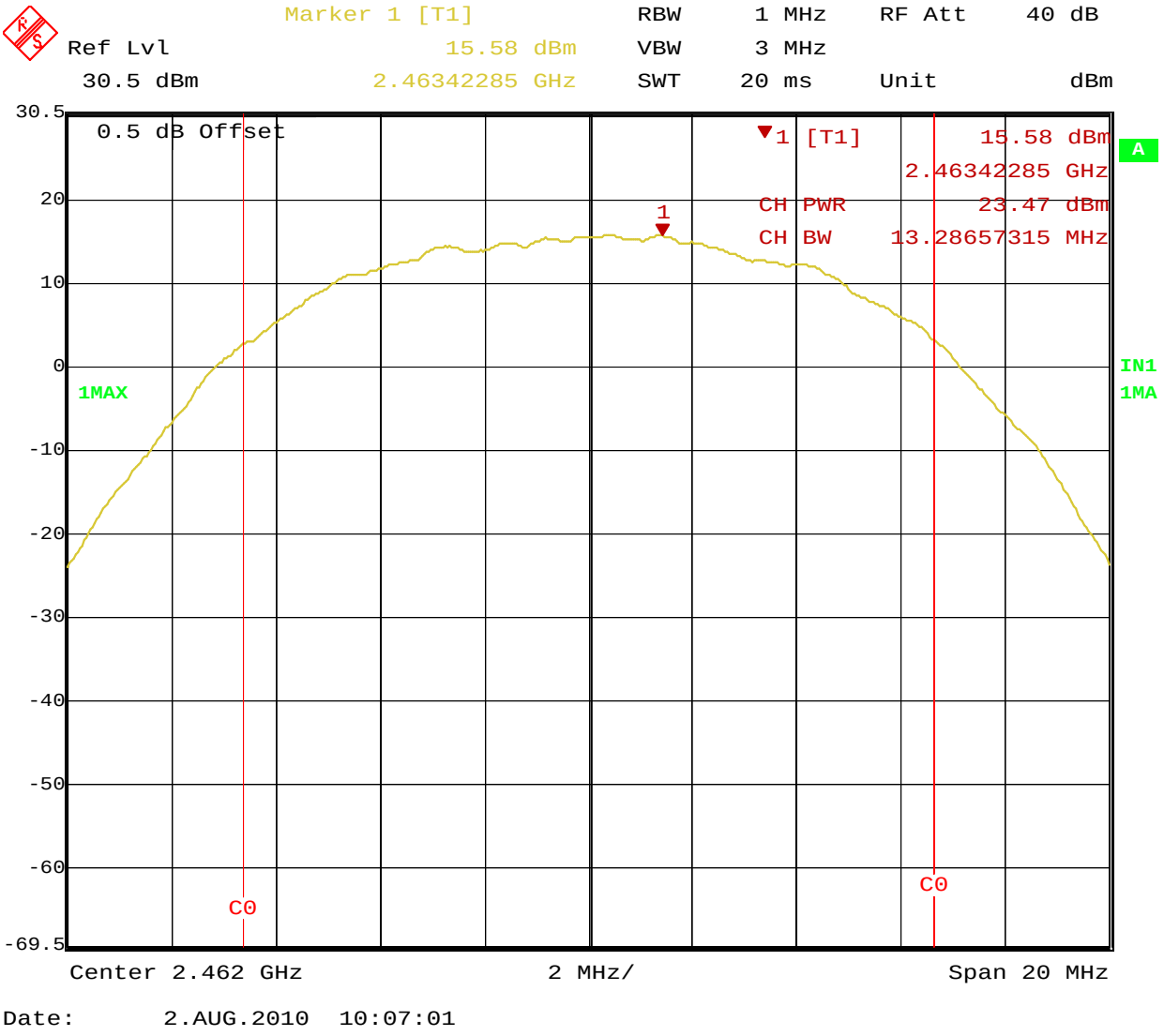


Figure 3: Maximum Transmitted Power at Q =0, Highest Channel 2462 MHz of 802.11b

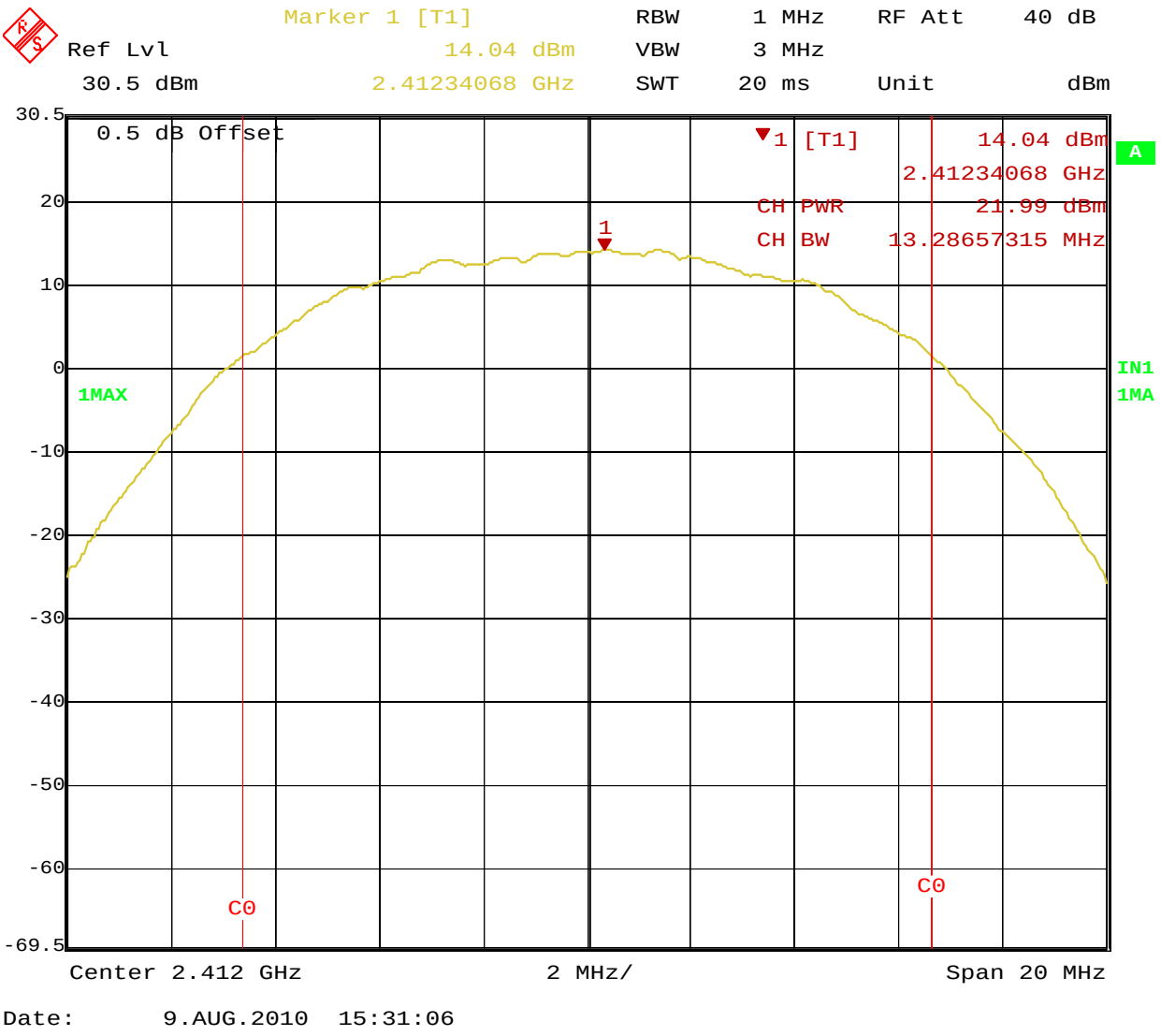


Figure 4: Maximum Transmitted Power at Q =2, Lowest Channel 2412 MHz of 802.11b

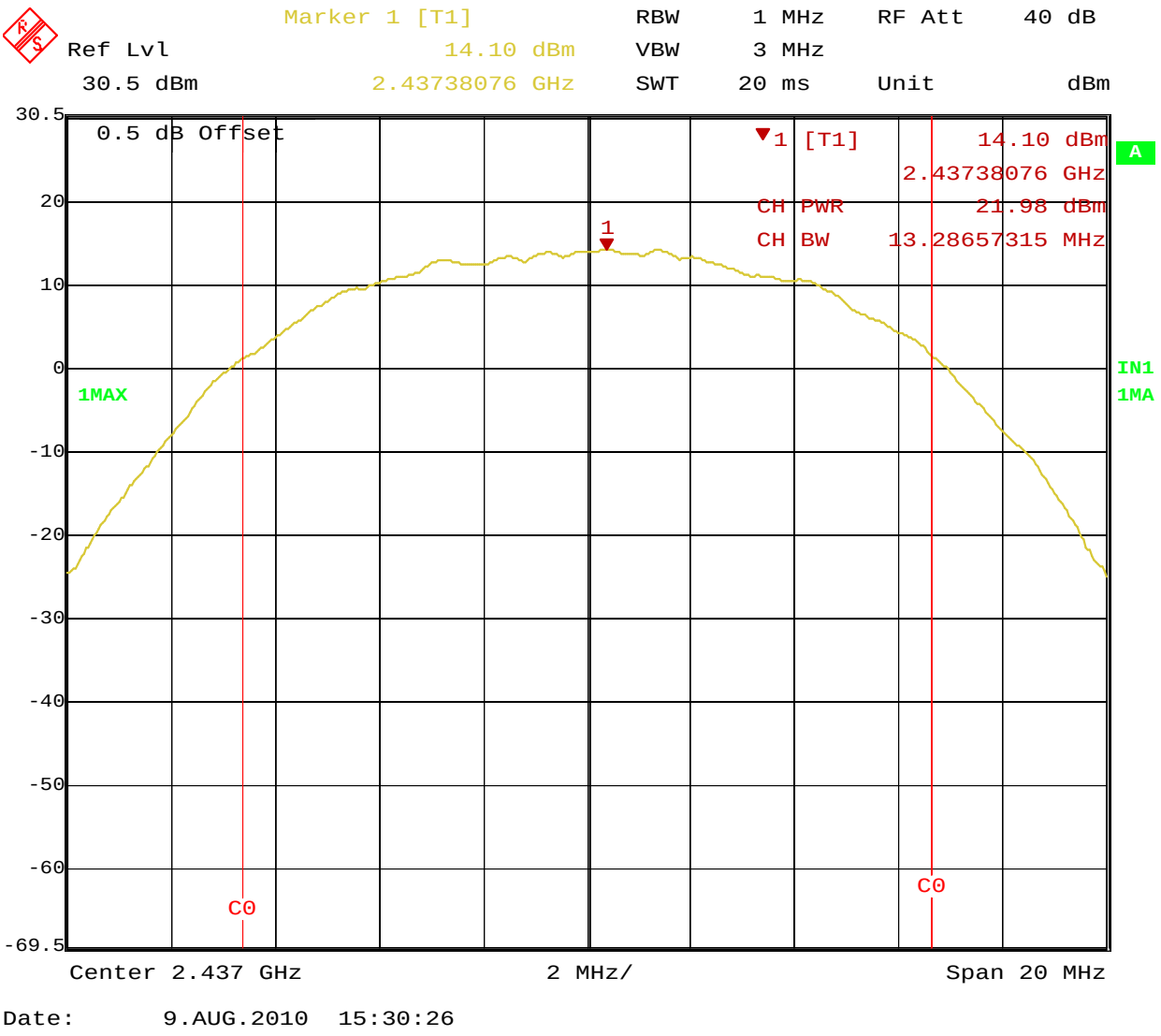


Figure 5: Maximum Transmitted Power at Q =2, Middle Channel 2437 MHz of 802.11b

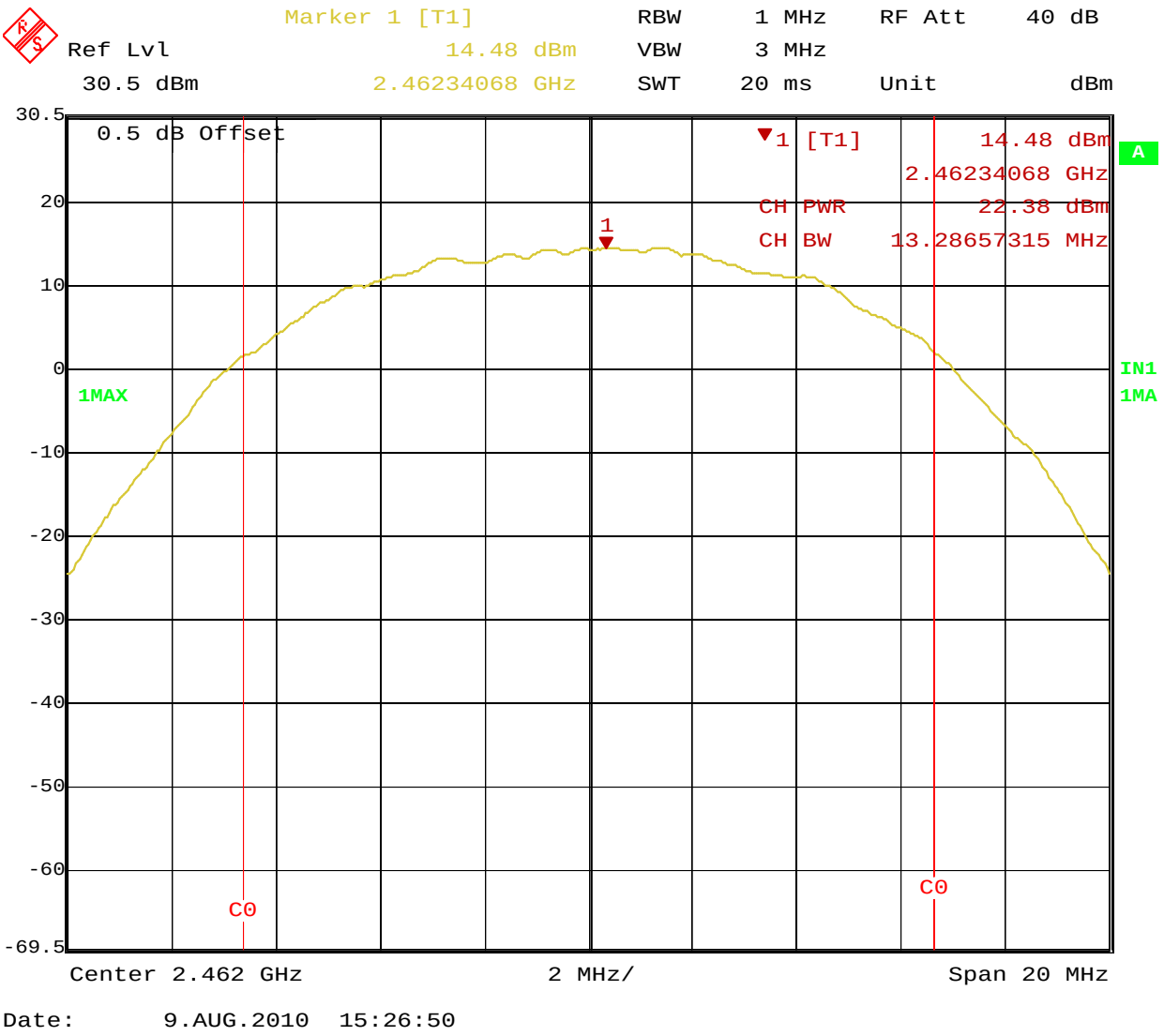


Figure 6: Maximum Transmitted Power at Q =2, Highest Channel 2462 MHz of 802.11b

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.

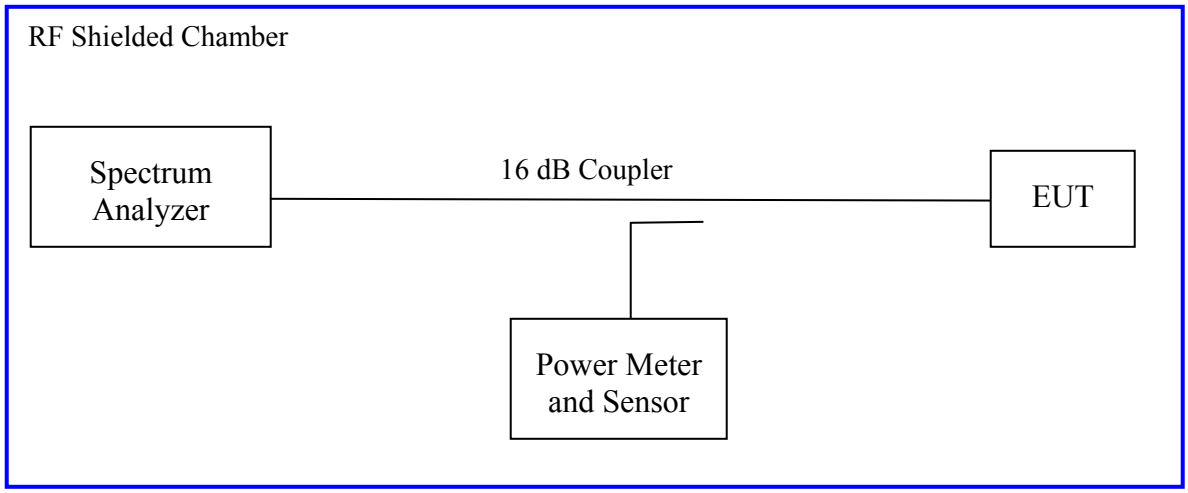
The 6 dB bandwidth is defined the bandwidth of 6 dBr from highest transmitted level of the fundamental frequency.

The bandwidth shall be at least 500 kHz per Section CFR47 15.247(a2) 2009 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) 2009 and RSS Gen Sect. 4.4.1:2007. This test was conducted on 3 channels of Sample, Eng. #22. The worst sample result indicated below.

Test Setup:



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: PCB or Dipole		**Power Setting:** Q=0	
Max. Antenna Gain: +5 dBi		**Signal State:** Modulated	
Ambient Temp.: 21° C		**Relative Humidity:**39%	
99% Bandwidth (MHz)			
Operating Channel	**Limit**	**802.11g @ 1 Mbps**	**Results**
2412 MHz	Na	13.02605210	Na
2437 MHz	Na	13.06613226	Na
2462 MHz	Na	13.02605210	Na
Note: The 99% bandwidth was observed at 1 Mbps.			
6 dB Bandwidth (MHz)			
Operating Channel	**Limit**	**802.11b @ 1 Mbps**	**Results**
2412 MHz	500kHz	10.06012024	Pass
2437 MHz	500kHz	10.02004008	Pass
2462 MHz	500kHz	10.02004008	Pass
Note: the narrowest 6 dB bandwidth was observed at 1 Mbps.			

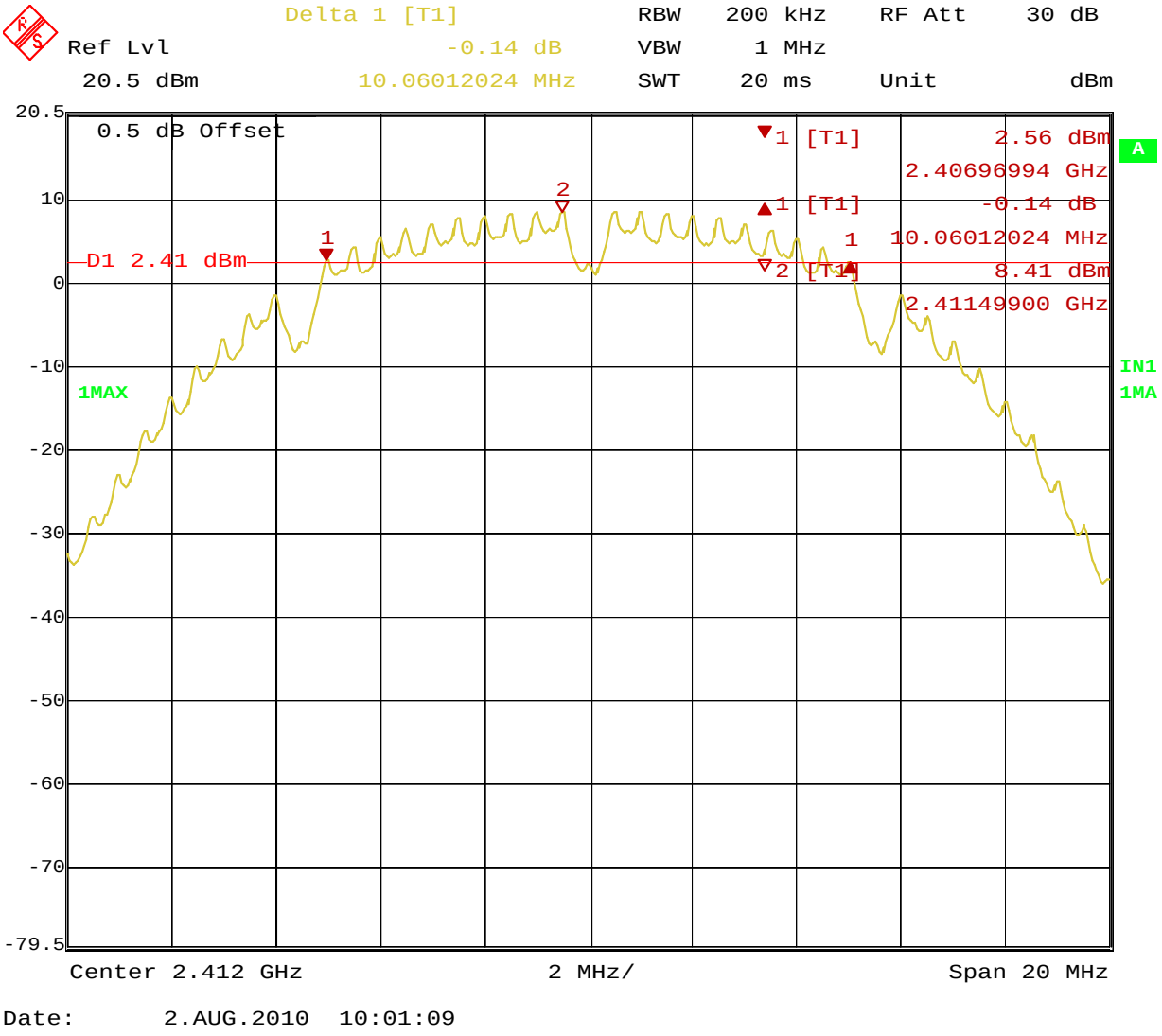


Figure 7: 6 dB Bandwidth at 1 MBit/s – Operating Channel 2412 MHz

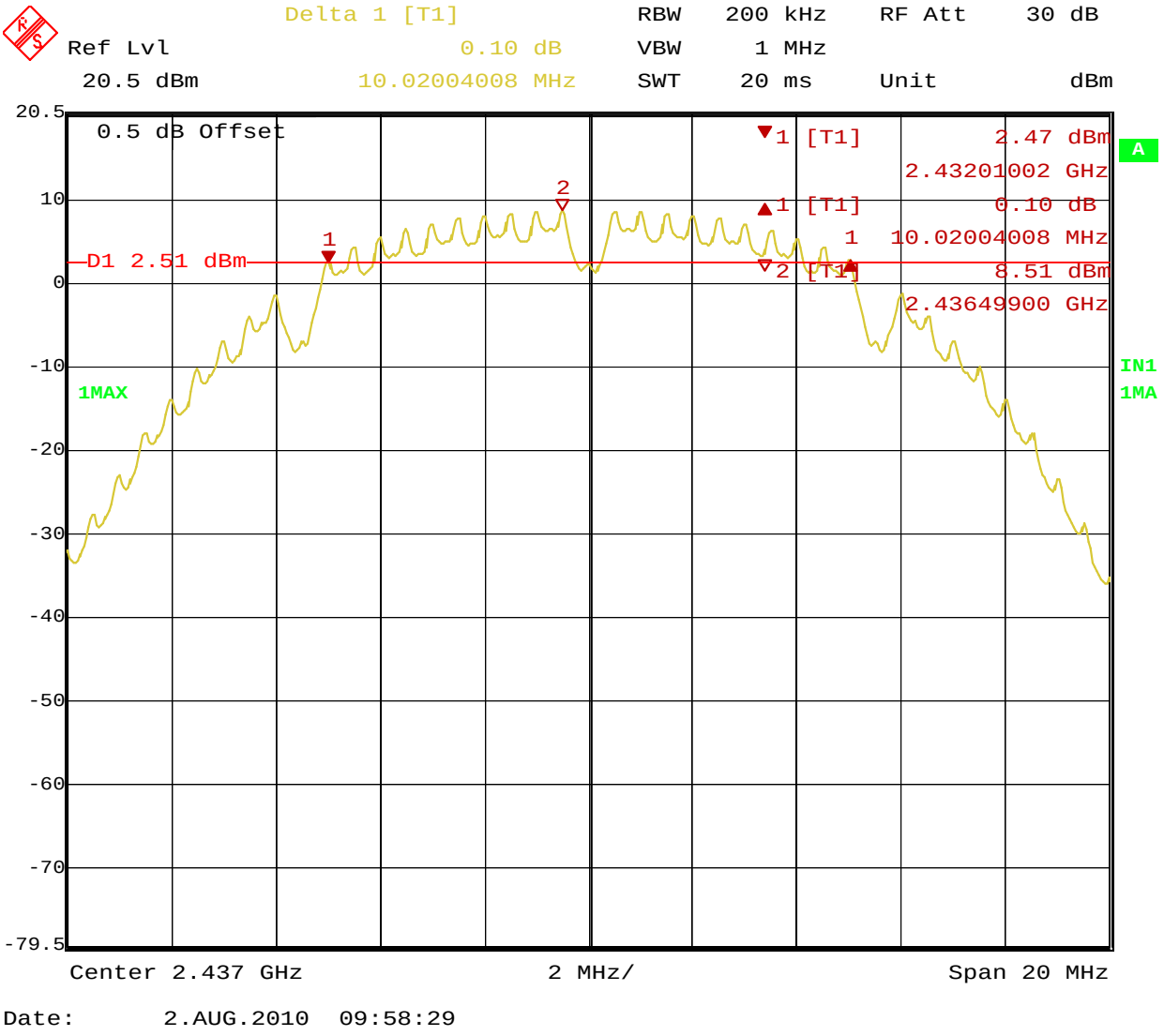


Figure 8: 6 dB Bandwidth at 1 MBit/s – Operating Channel 2437 MHz

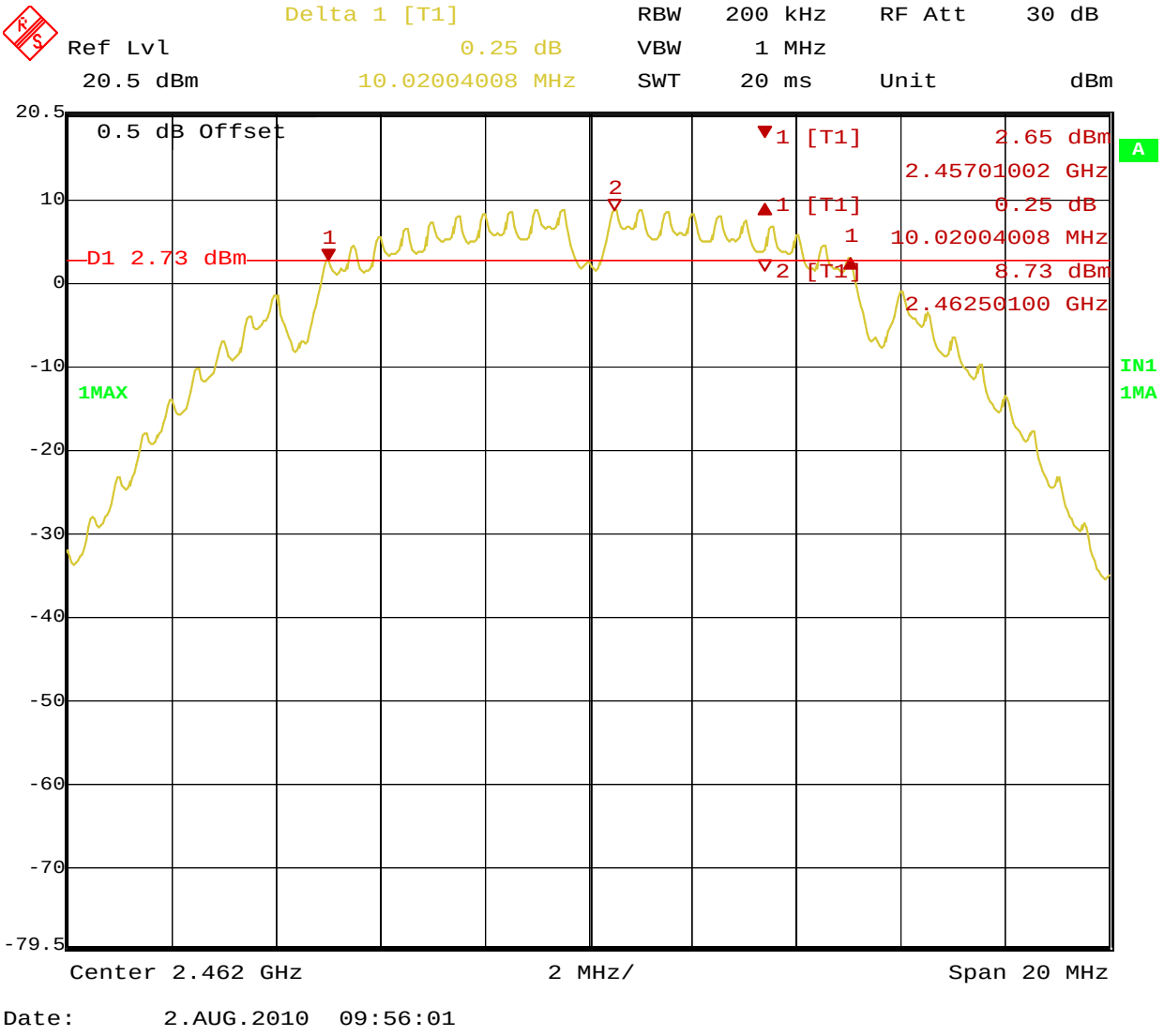


Figure 9: 6 dB Bandwidth at 1 MBit/s – Operating Channel 2462 MHz

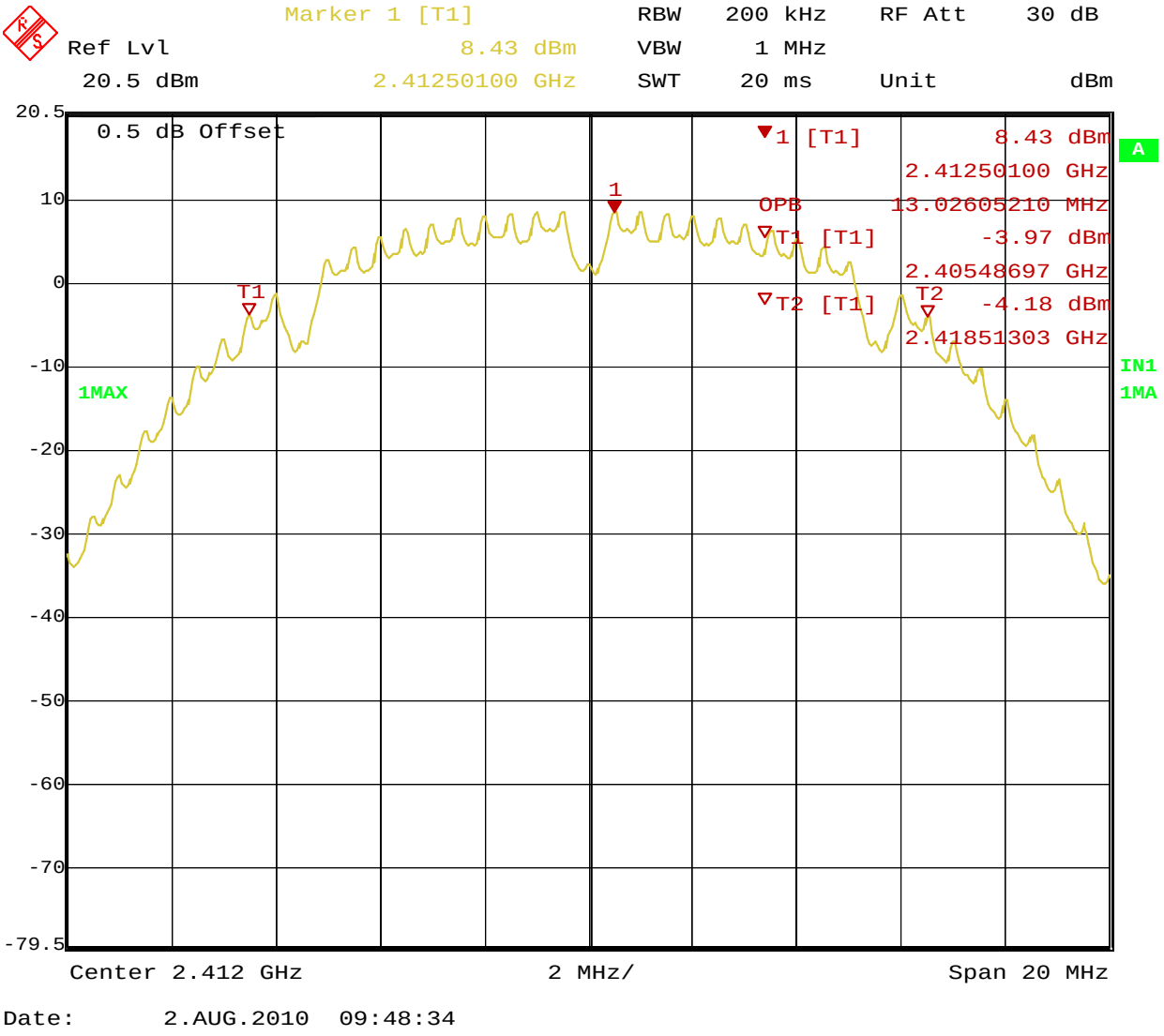


Figure 10: 99% Bandwidth at 1 MBit/s – Operating Channel 2412 MHz

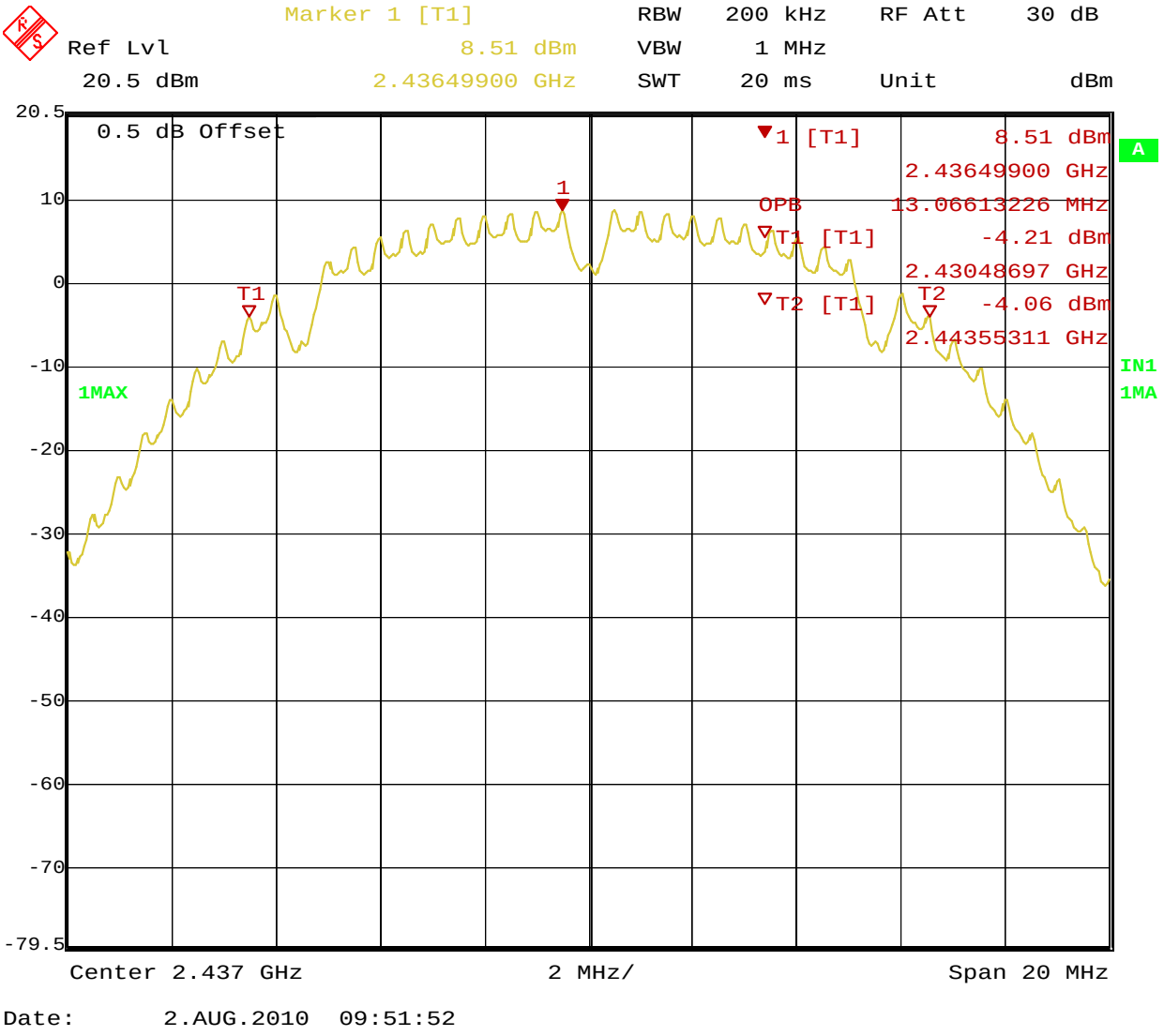


Figure 11: 99% Bandwidth at 1 MBit/s – Operating Channel 2437 MHz

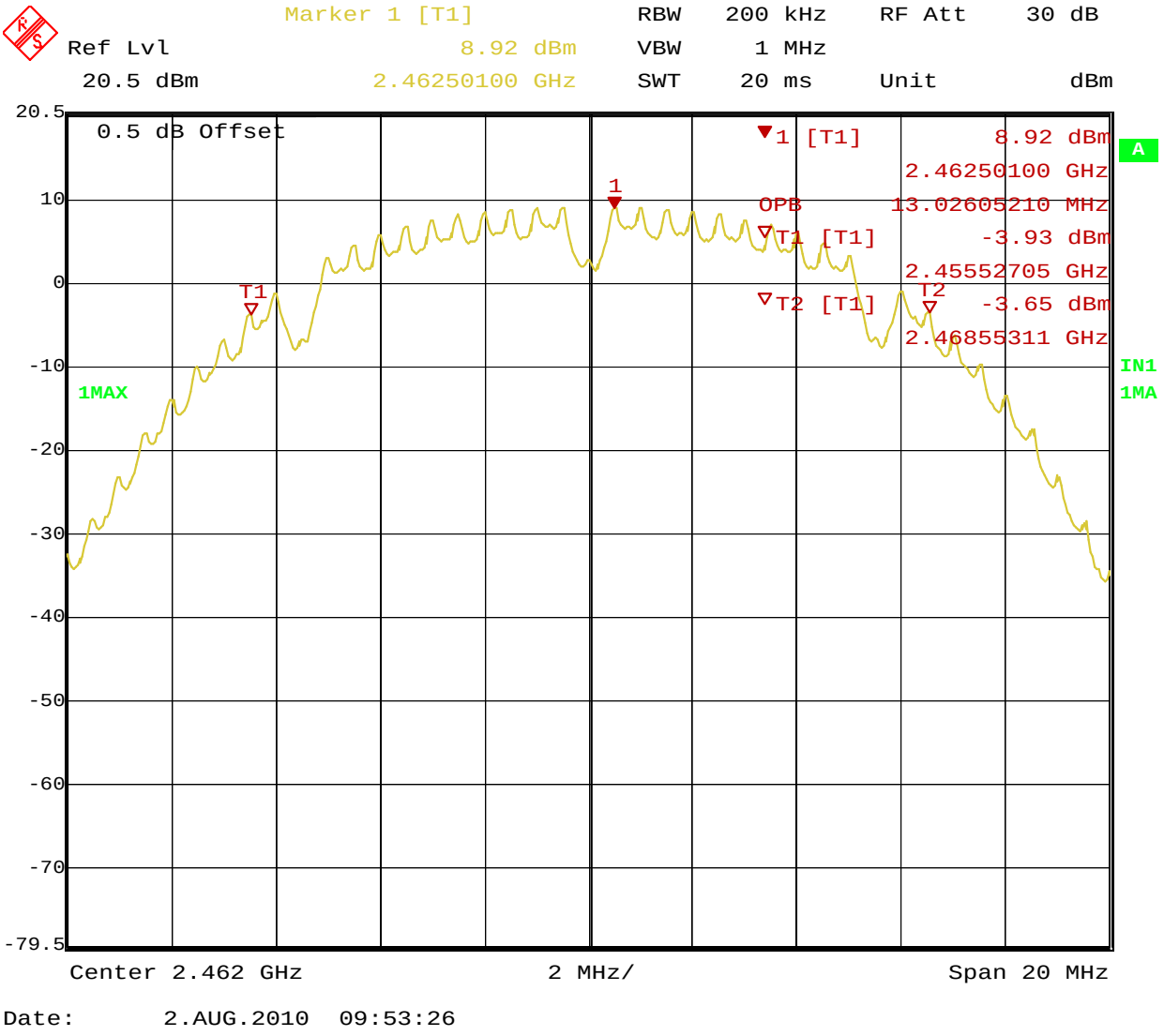


Figure 12: 99% Bandwidth at 1 MBit/s – Operating Channel 2462 MHz

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.

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: PCB or Dipole		**Power Setting:** See Below		
Max. Antenna Gain: +5 dBi		**Signal State:** Modulated		
Ambient Temp.: 21° C		**Relative Humidity:**39%		
Band Edge Results for Q =0				
Operating Channel	**Mode**	**Band Edge Level (dBm)**	**20 dB Level (dBm)**	**Margin (dB)**
2412 MHz	11Mbps	-39.97	-11.75	-28.22
2437 MHz	11Mbps	-44.80	-11.59	-33.21
2462 MHz	11Mbps	-44.12	-11.15	-32.97
Band Edge Results for Q =2				
Operating Channel	**Mode**	**Band Edge Level (dBm)**	**20 dB Level (dBm)**	**Margin (dB)**
2412 MHz	11Mbps	-40.08	-13.14	-26.94
2437 MHz	11Mbps	-45.19	-13.05	-32.14
2462 MHz	11Mbps	-45.40	-12.67	-32.73

Table 5: Out of band Conducted Emission – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only					
Antenna Type: PCB or Dipole		**Power Setting:** See Below			
Max. Antenna Gain: +5 dBi		**Signal State:** Modulated			
Ambient Temp.: 21° C		**Relative Humidity:**39%			
Output of Band Results for Q = 0					
Operating Channel	**Mode**	**Band 1 30 MHz-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
Output of Band Results for Q = 2					
Operating Channel	**Mode**	**Band 1 30 MHz-2.4835GHz**	**Band 2 2.4835GHz-10GHz**	**Band 3 10GHz-25GHz**	**Result**
2412 MHz	11Mbps	Figure 28	Figure 29	Figure 30	Pass
2437 MHz	11Mbps	Figure 31	Figure 32	Figure 33	Pass
2462 MHz	11Mbps	Figure 34	Figure 35	Figure 36	Pass

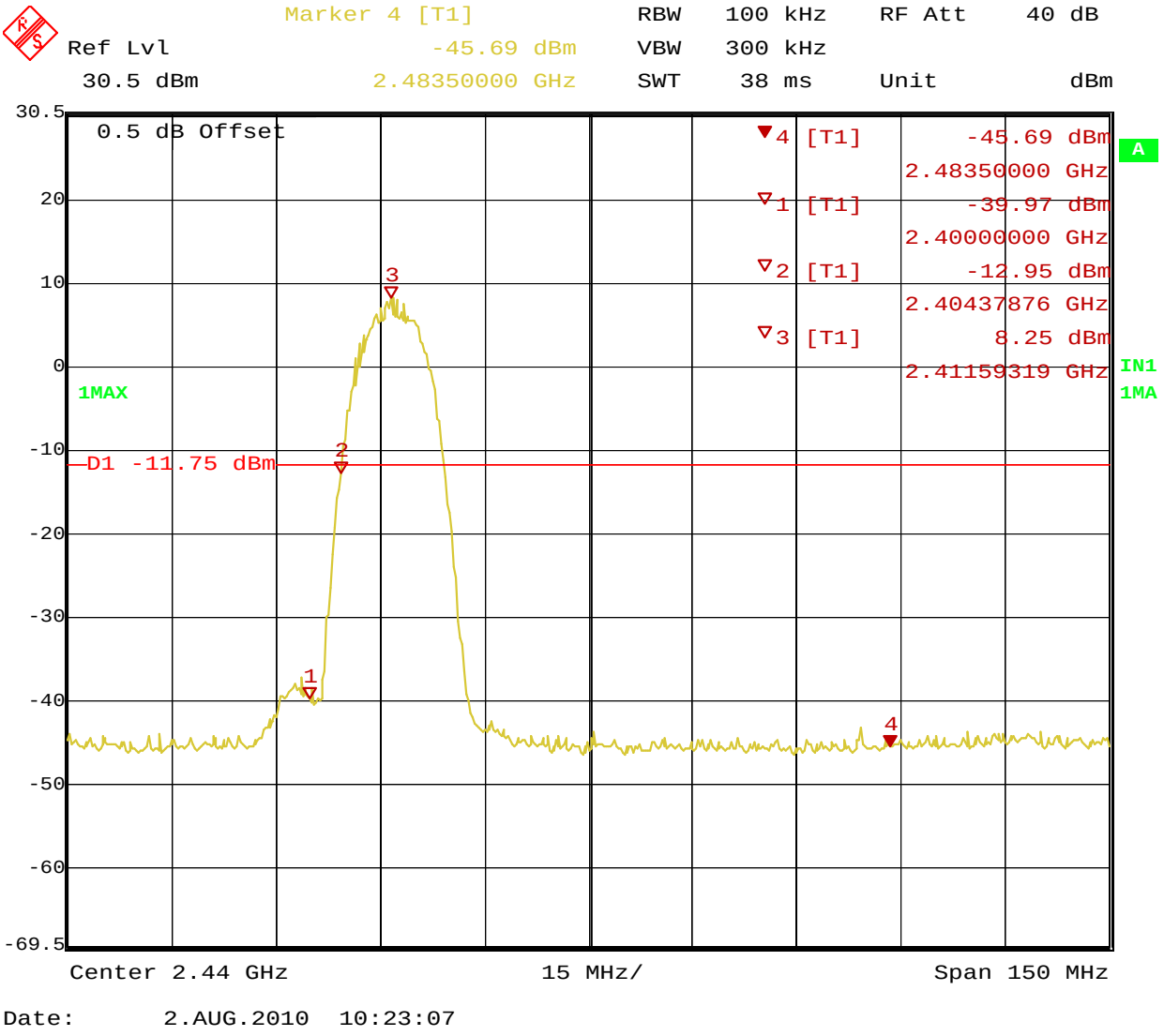


Figure 13: Band Edge Requirement at Q=0 for Operating Channel 2412 MHz at 11 MBit/s

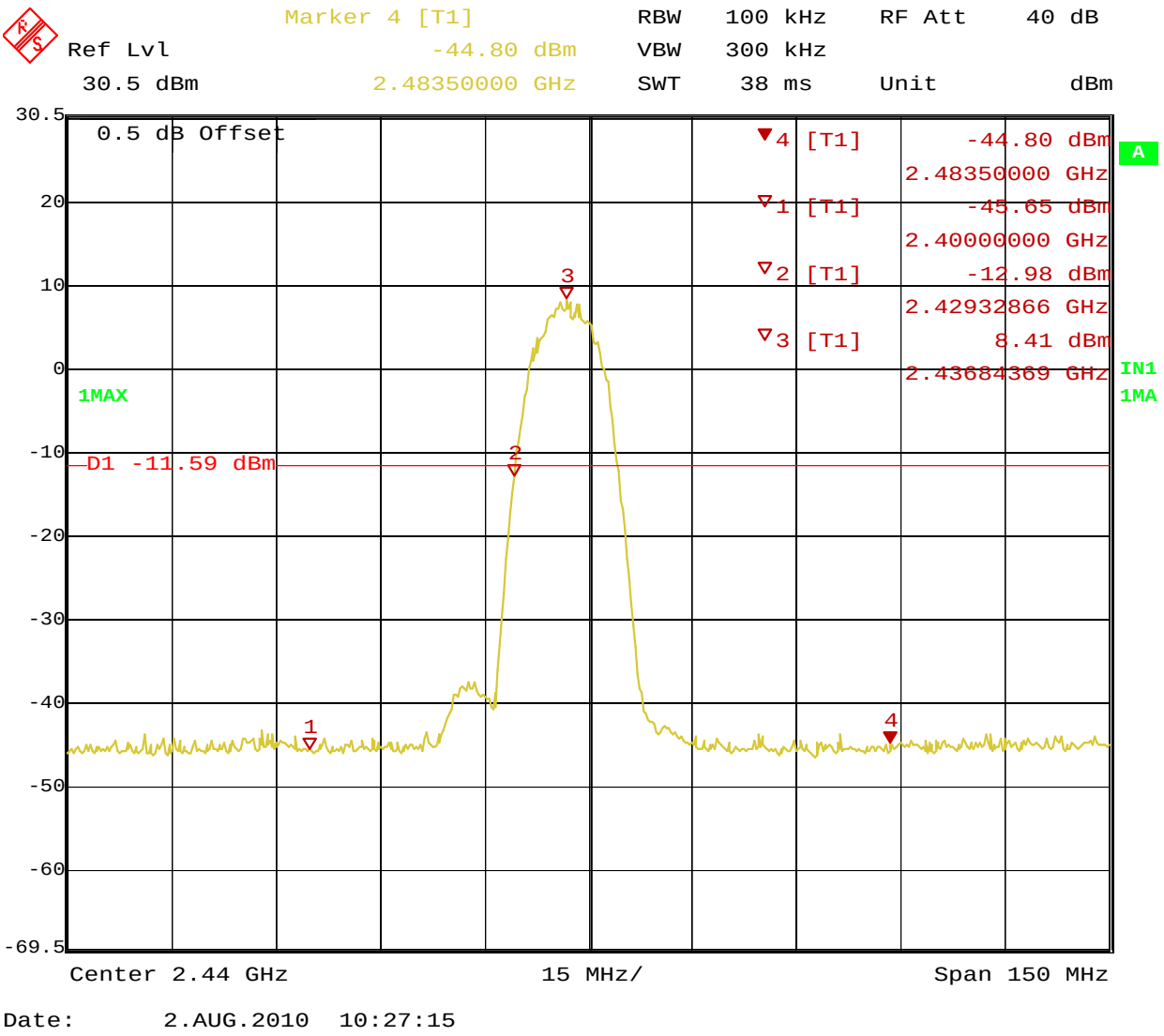


Figure 14: Band Edge Requirement at Q=0 for Operating Channel 2437 MHz at 11 MBit/s

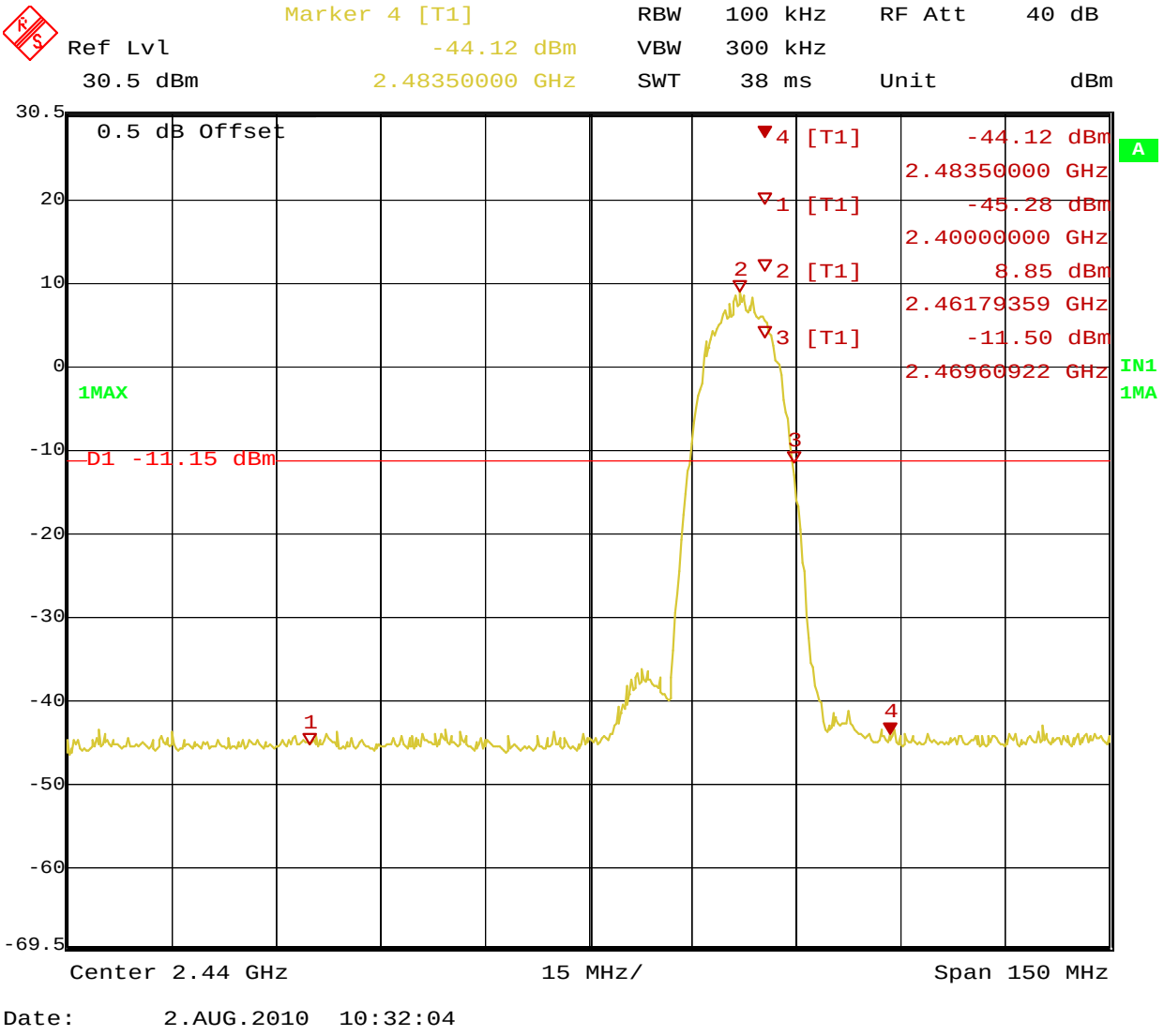


Figure 15: Band Edge Requirement at Q=0 for Operating Channel 2462 MHz at 11 MBit/s

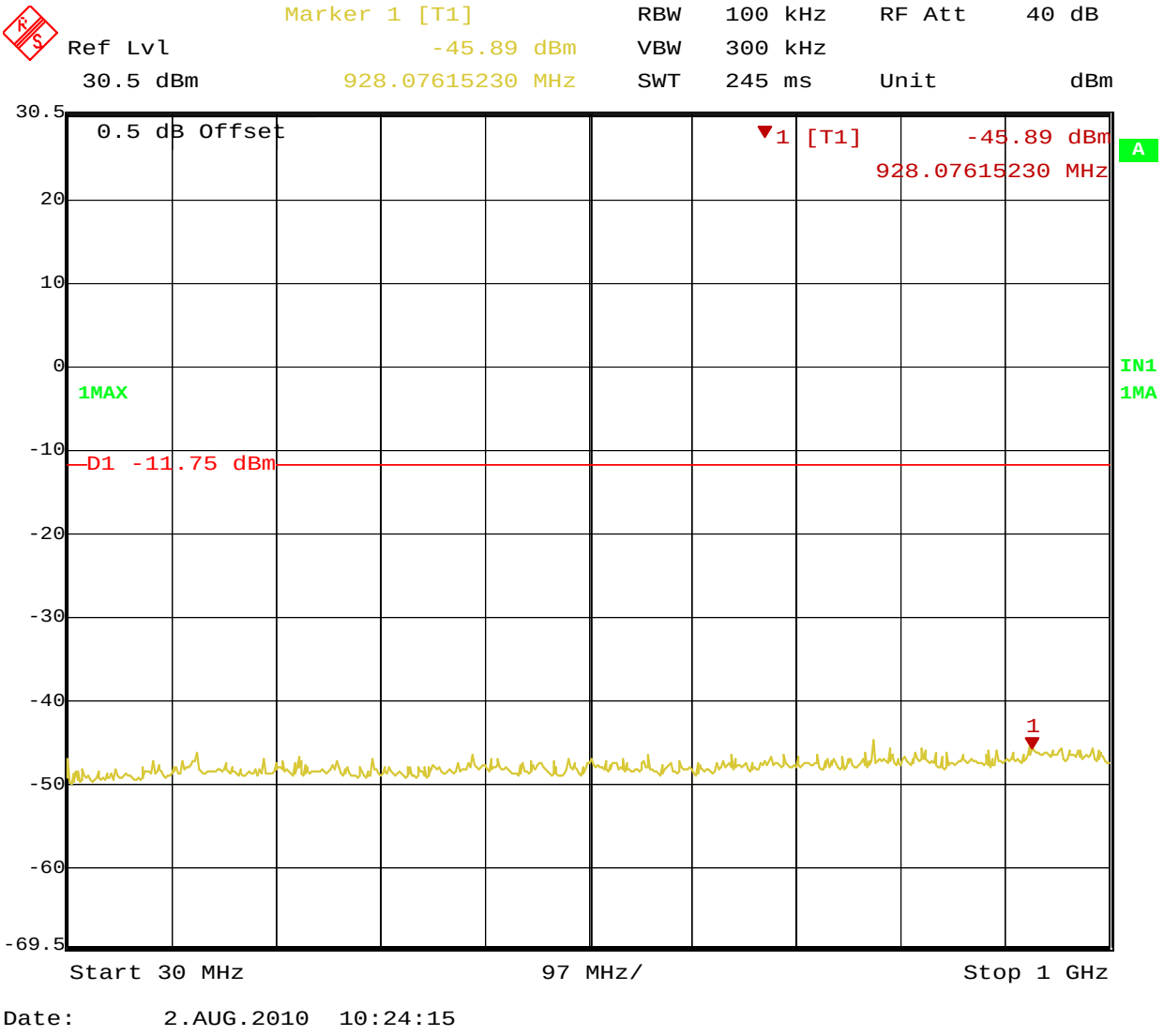


Figure 16: Out of Band Emission at Q=0 for Channel 2412 MHz at 11 MBit/s – Band 1

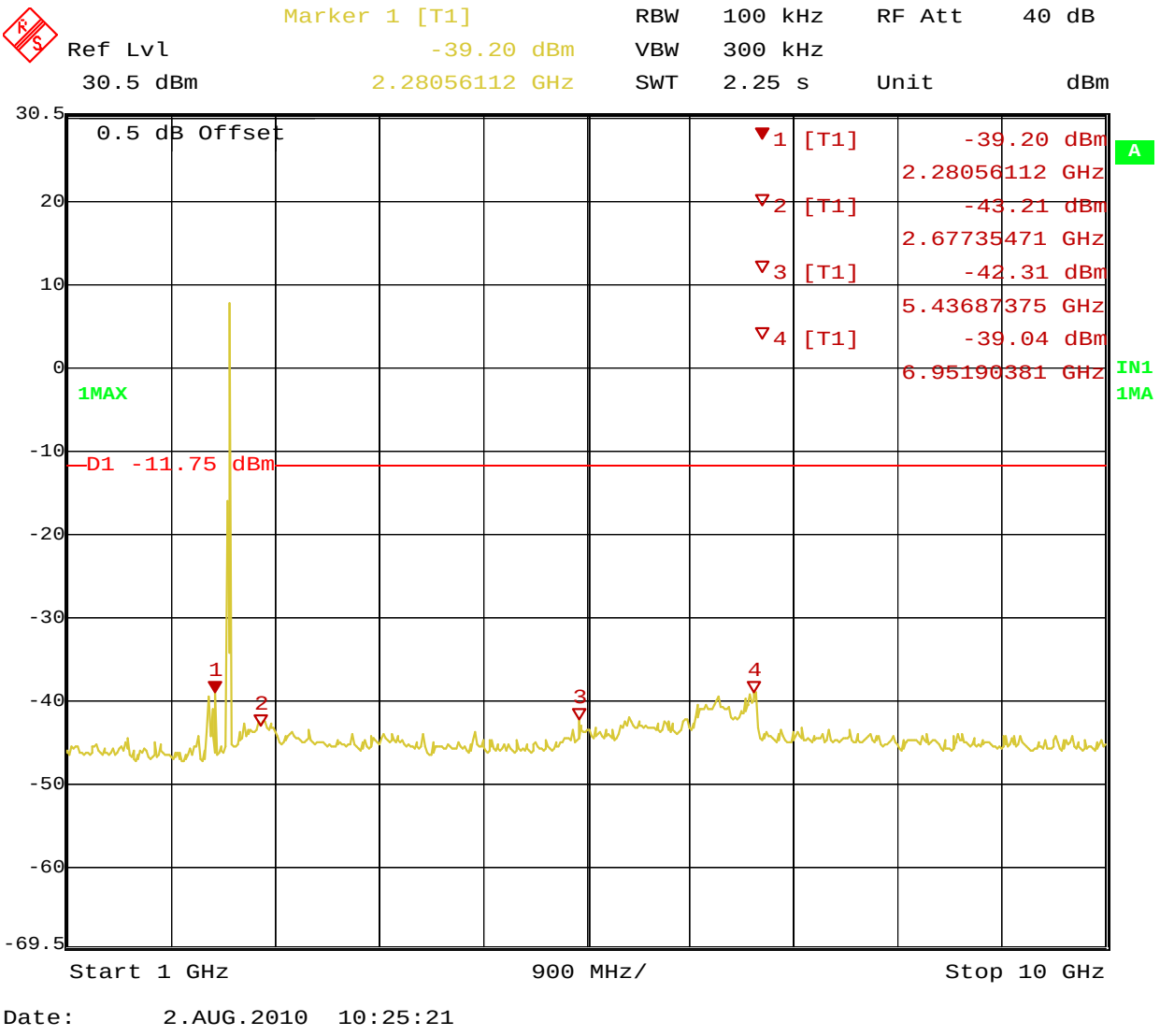


Figure 17: Out of Band Emission at Q=0 for Channel 2412 MHz at 11 MBit/s – Band 2

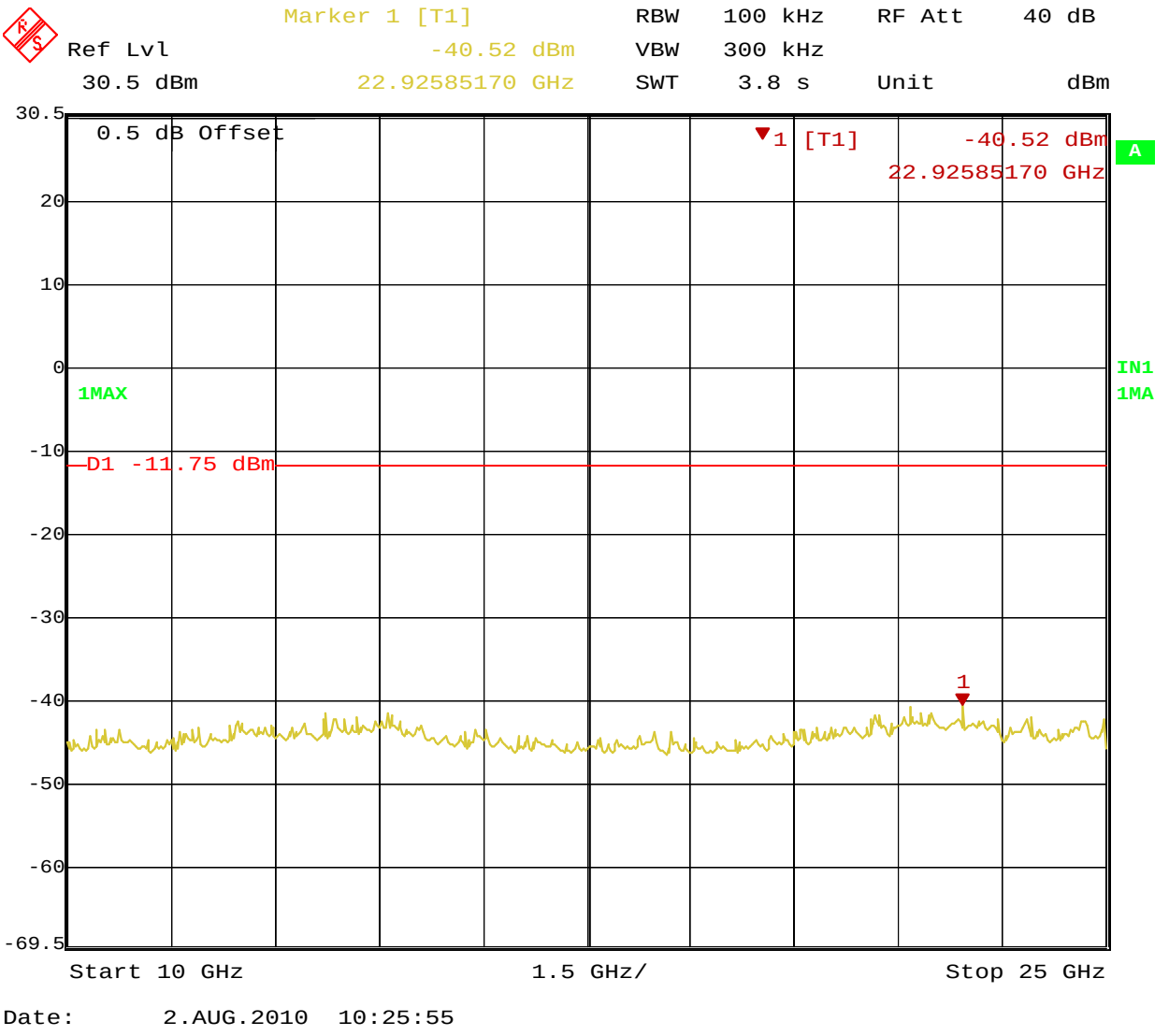


Figure 18: Out of Band Emission at Q=0 for Channel 2412 MHz at 11 MBit/s – Band 3

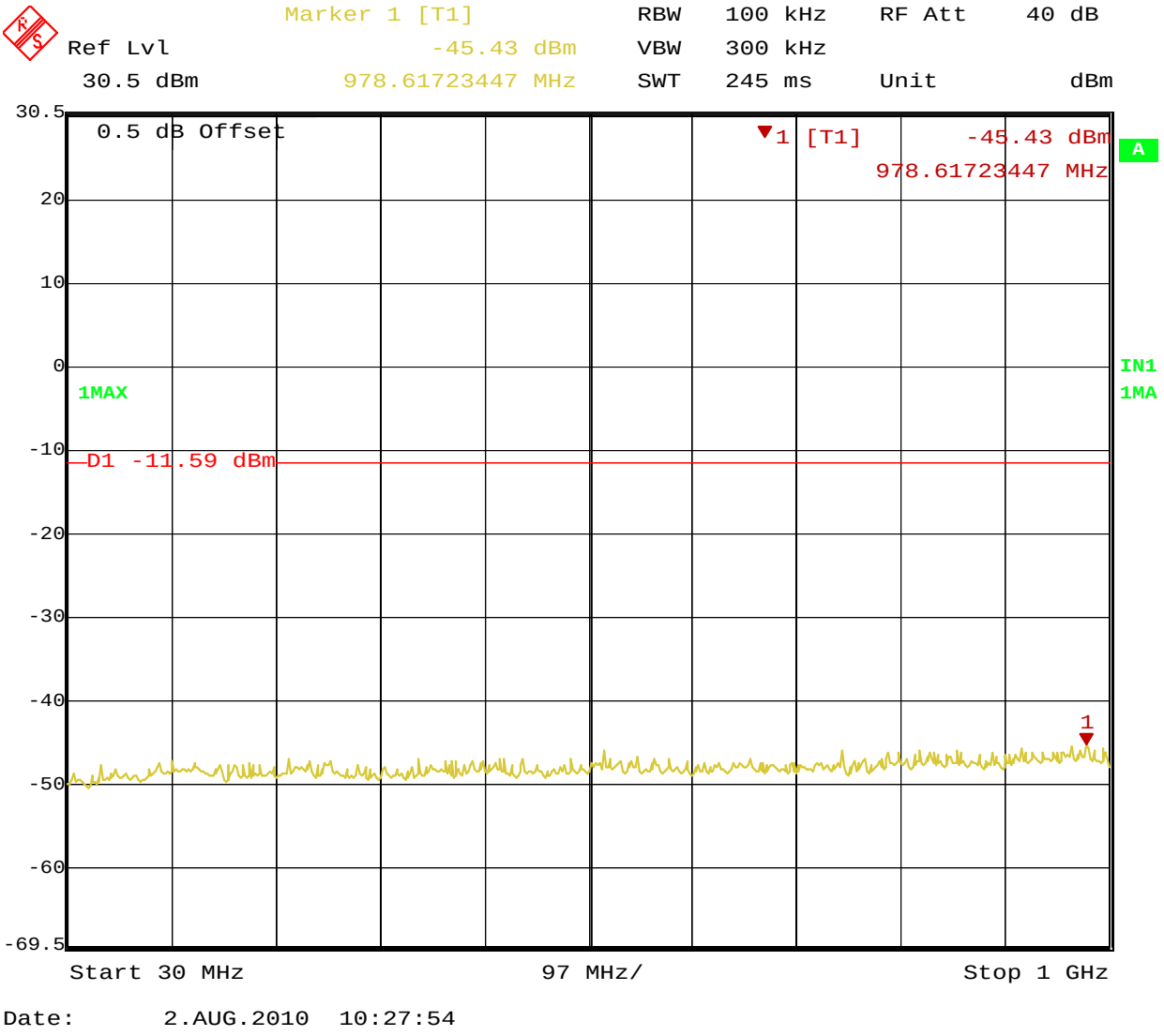


Figure 19: Out of Band Emission at Q=0 for Channel 2437 MHz at 11 MBit/s – Band 1

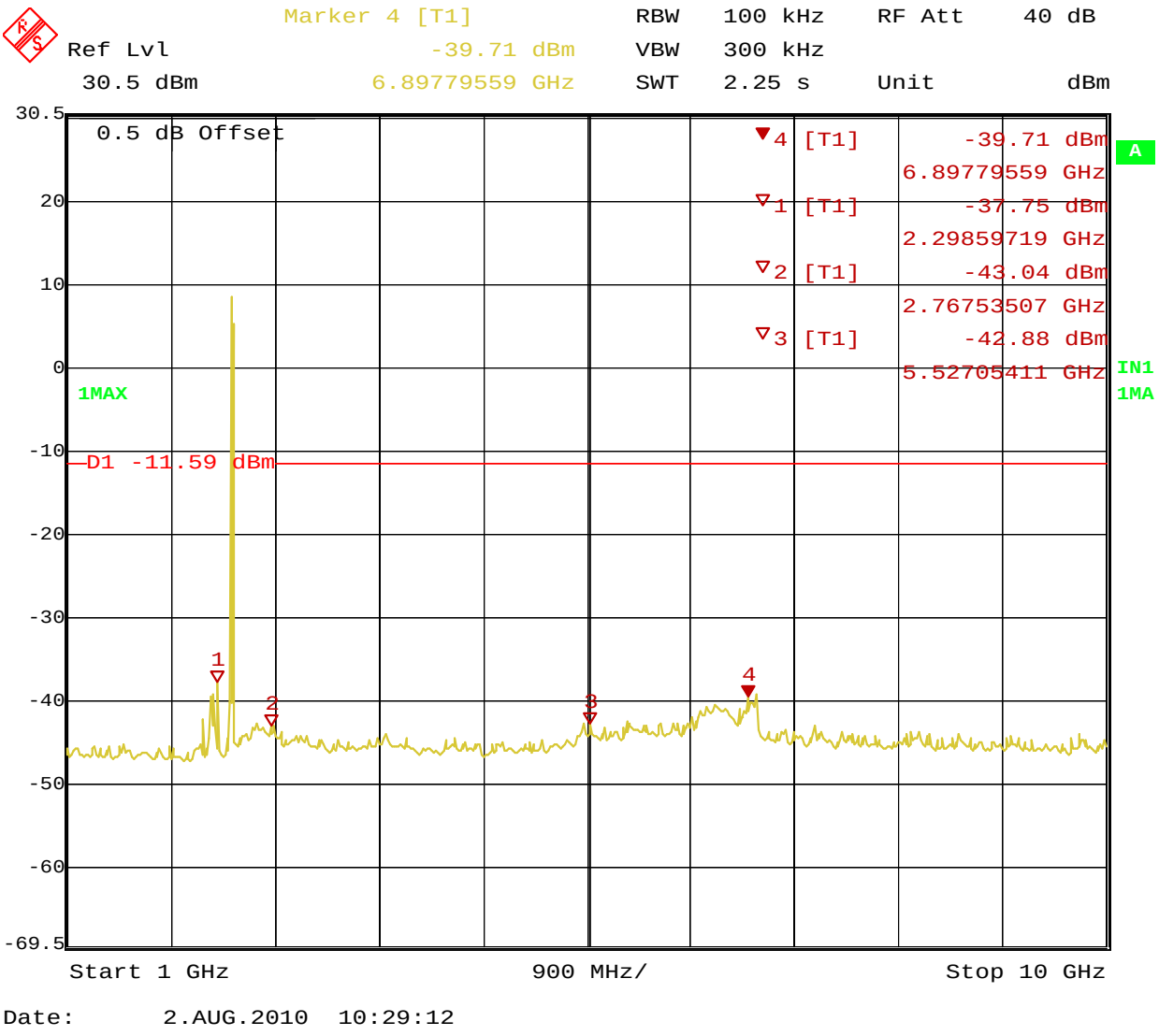


Figure 20: Out of Band Emission at Q=0 for Channel 2437 MHz at 11 MBit/s – Band 2

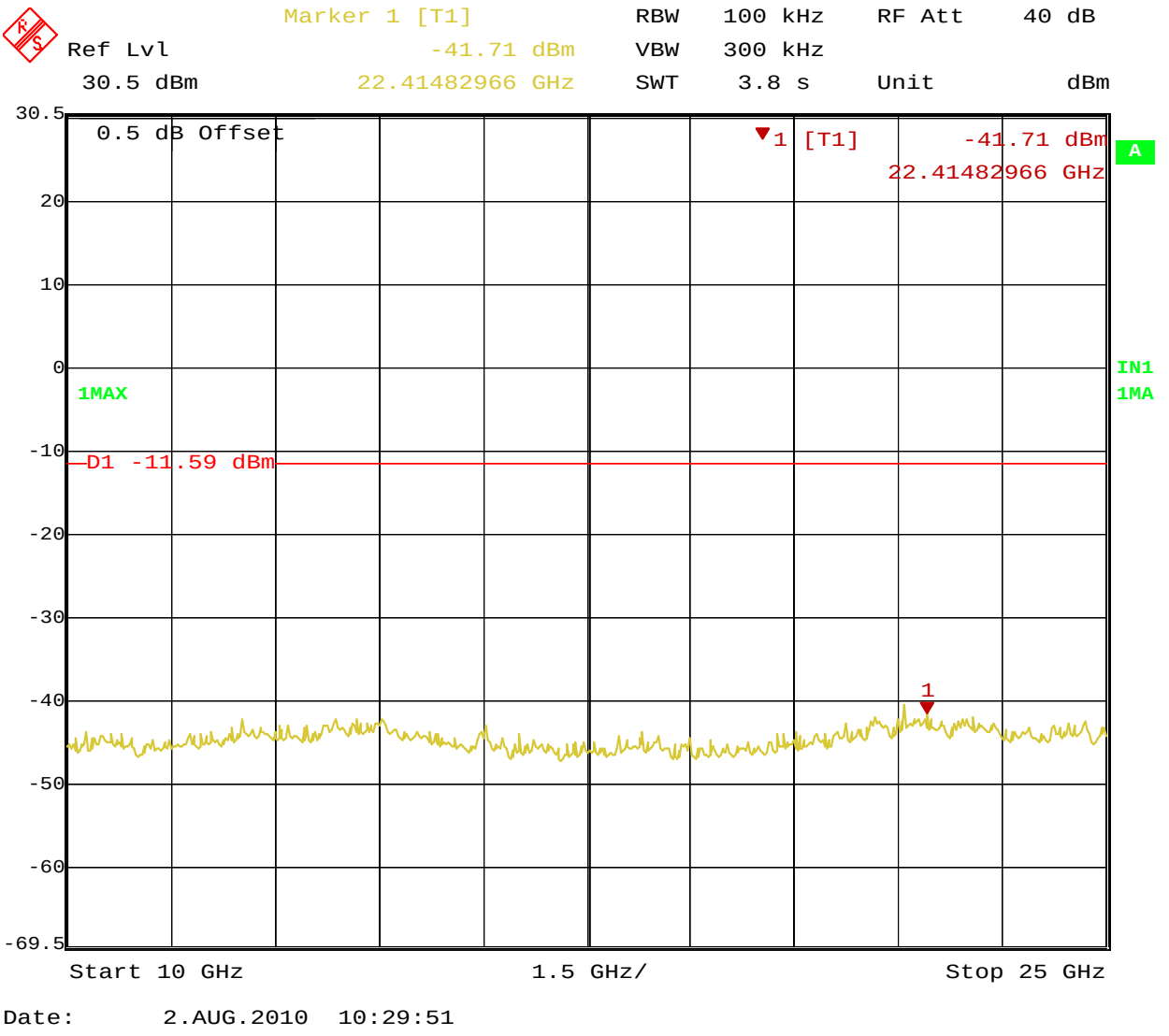


Figure 21: Out of Band Emission at Q=0 for Channel 2437 MHz at 11 MBit/s – Band 3

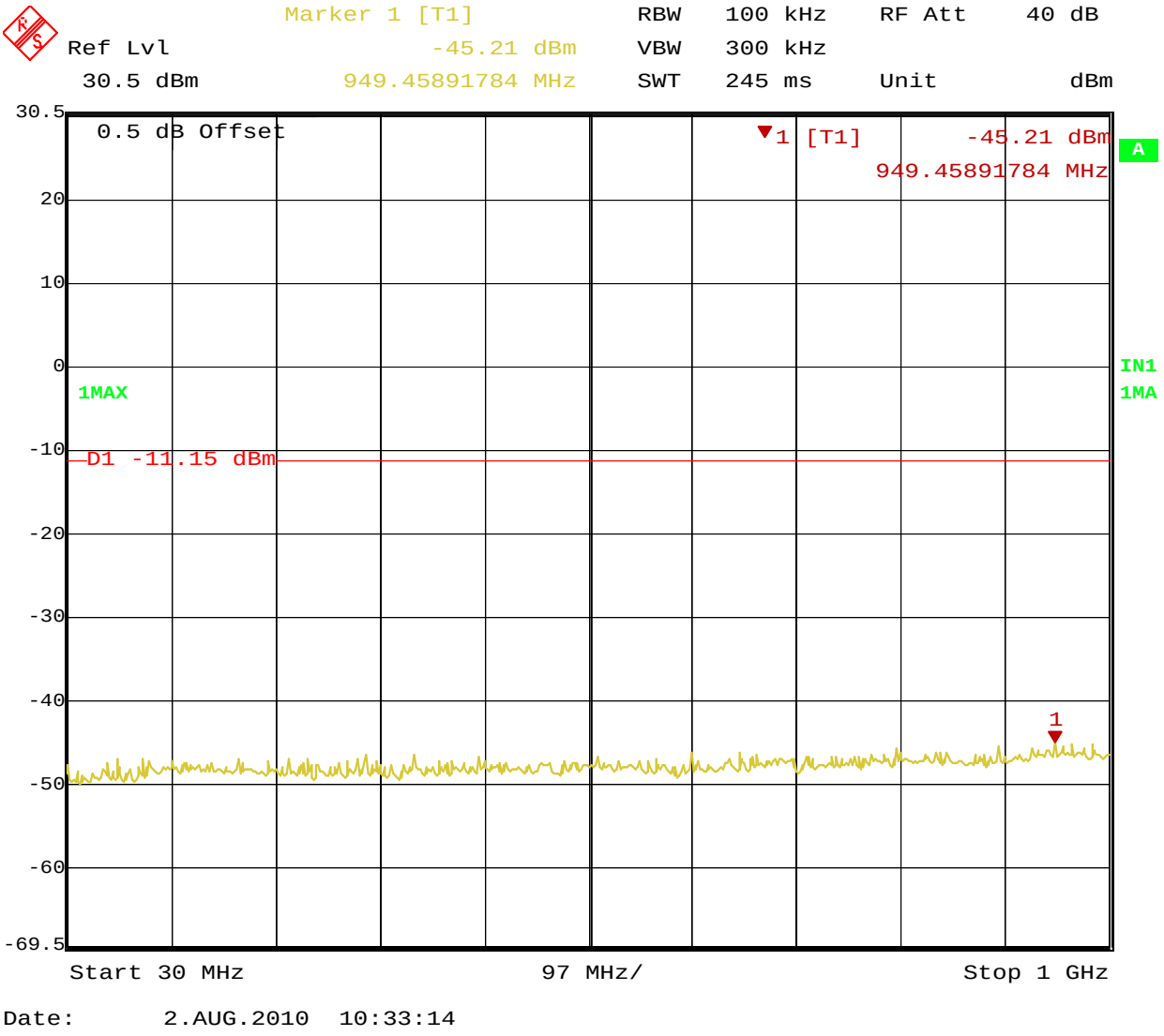


Figure 22: Out of Band Emission at Q=0 for Channel 2462 MHz at 11 MBit/s – Band 1

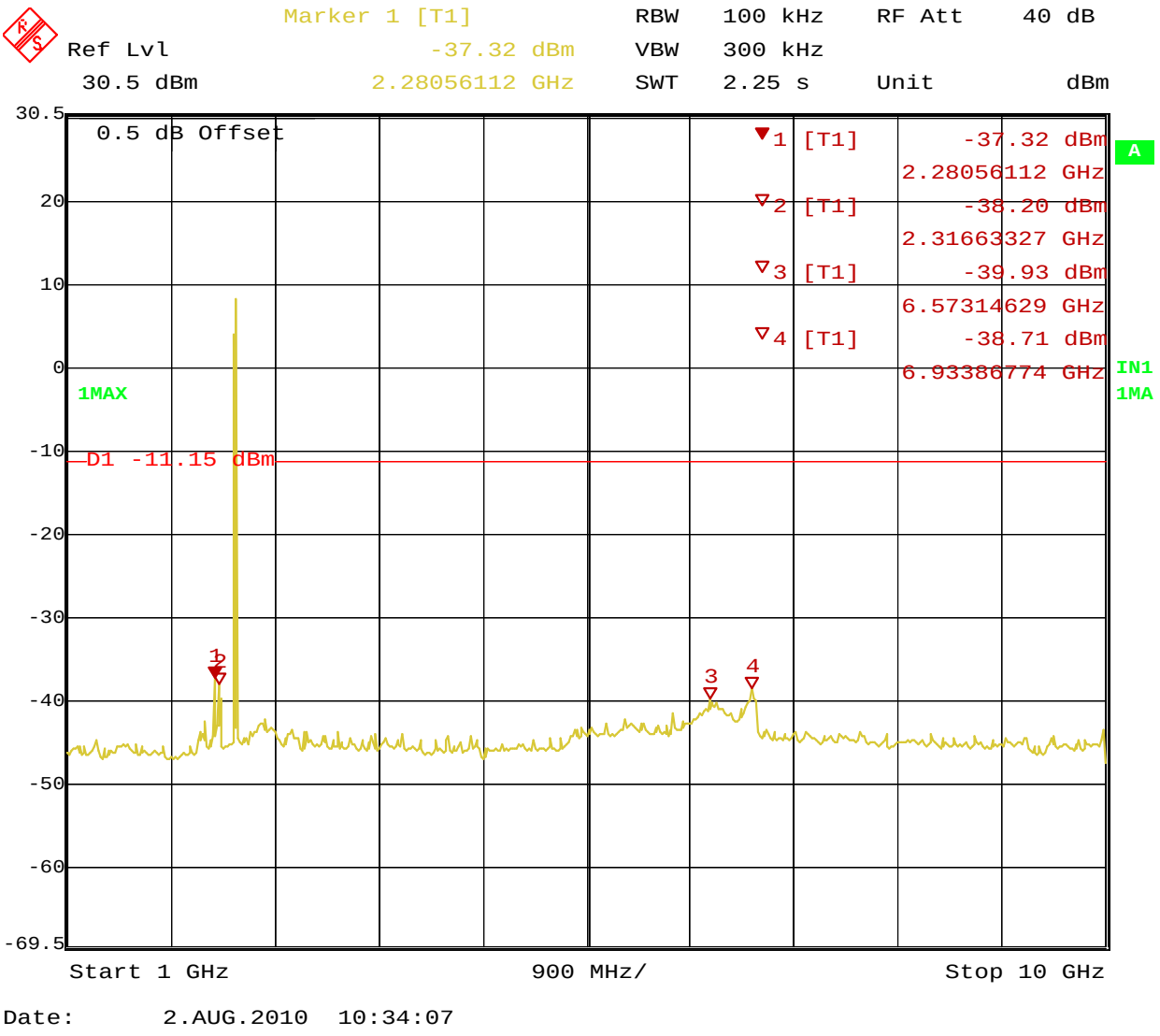


Figure 23: Out of Band Emission at Q=0 for Channel 2462 MHz at 11 MBit/s – Band 2

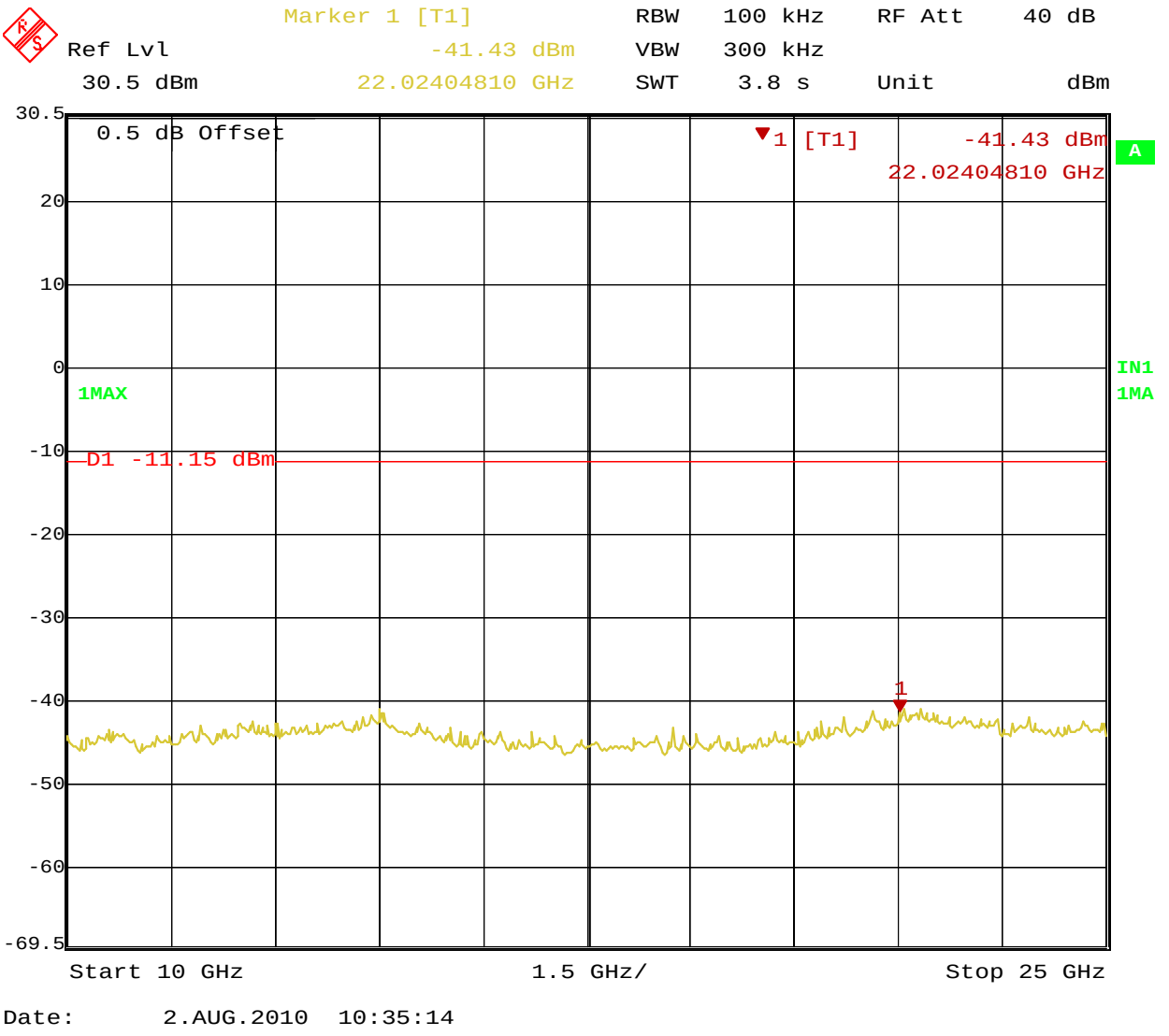


Figure 24: Out of Band Emission at Q=0 for Channel 2462 MHz at 11 MBit/s – Band 3

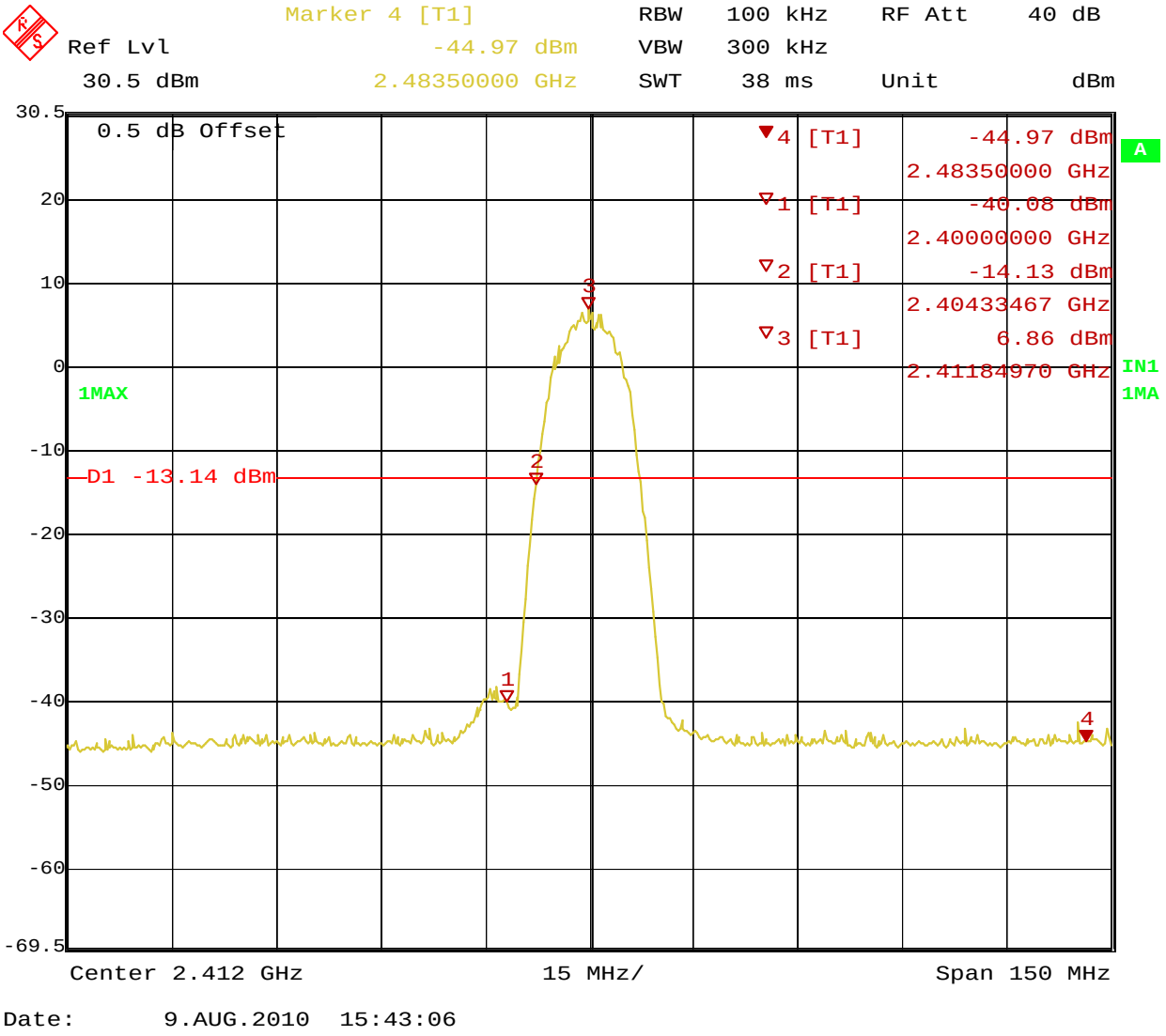


Figure 25: Band Edge Requirement at Q=2 for Operating Channel 2412 MHz at 11 MBit/s

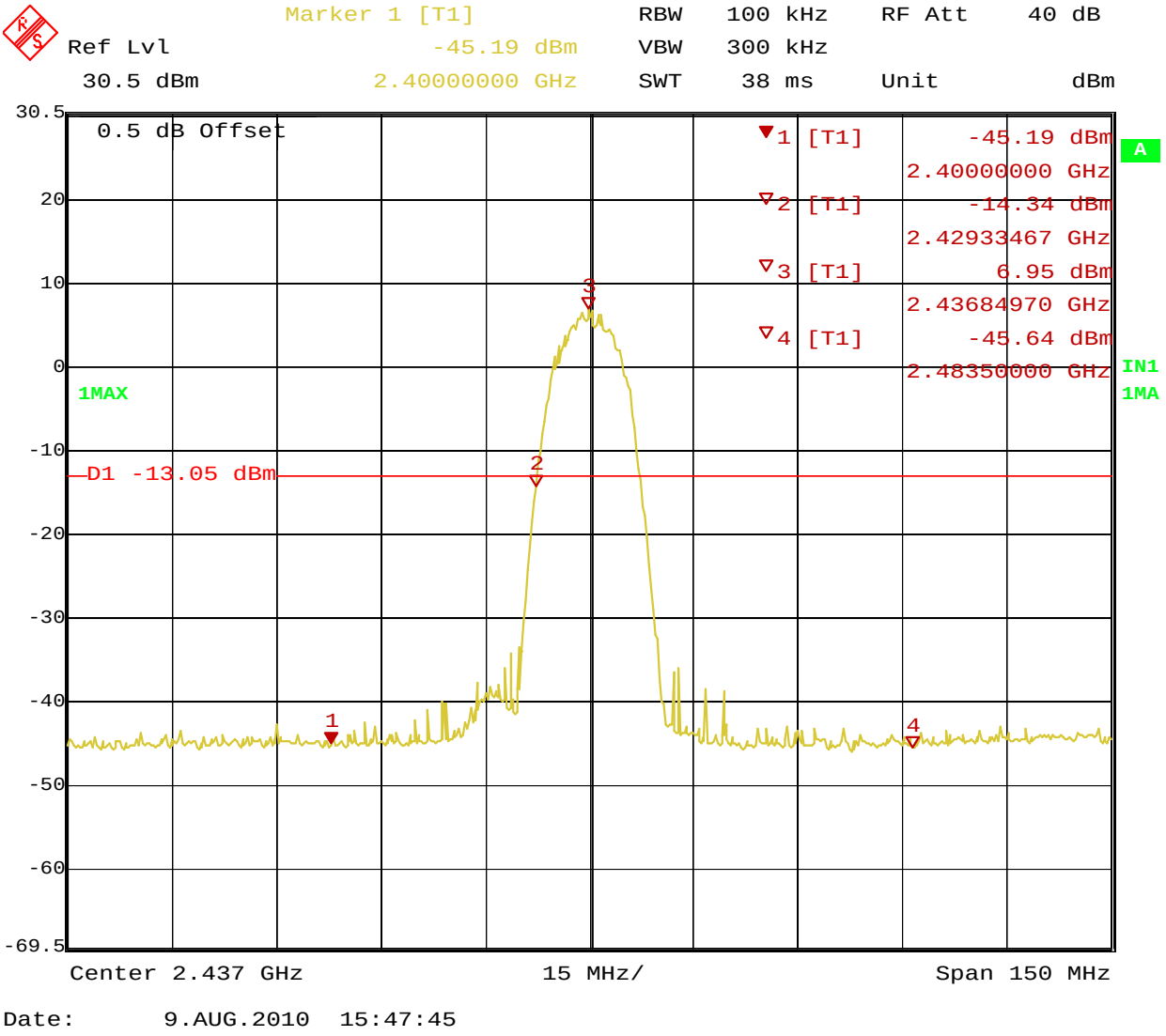


Figure 26: Band Edge Requirement at Q=2 for Operating Channel 2437 MHz at 11 MBit/s

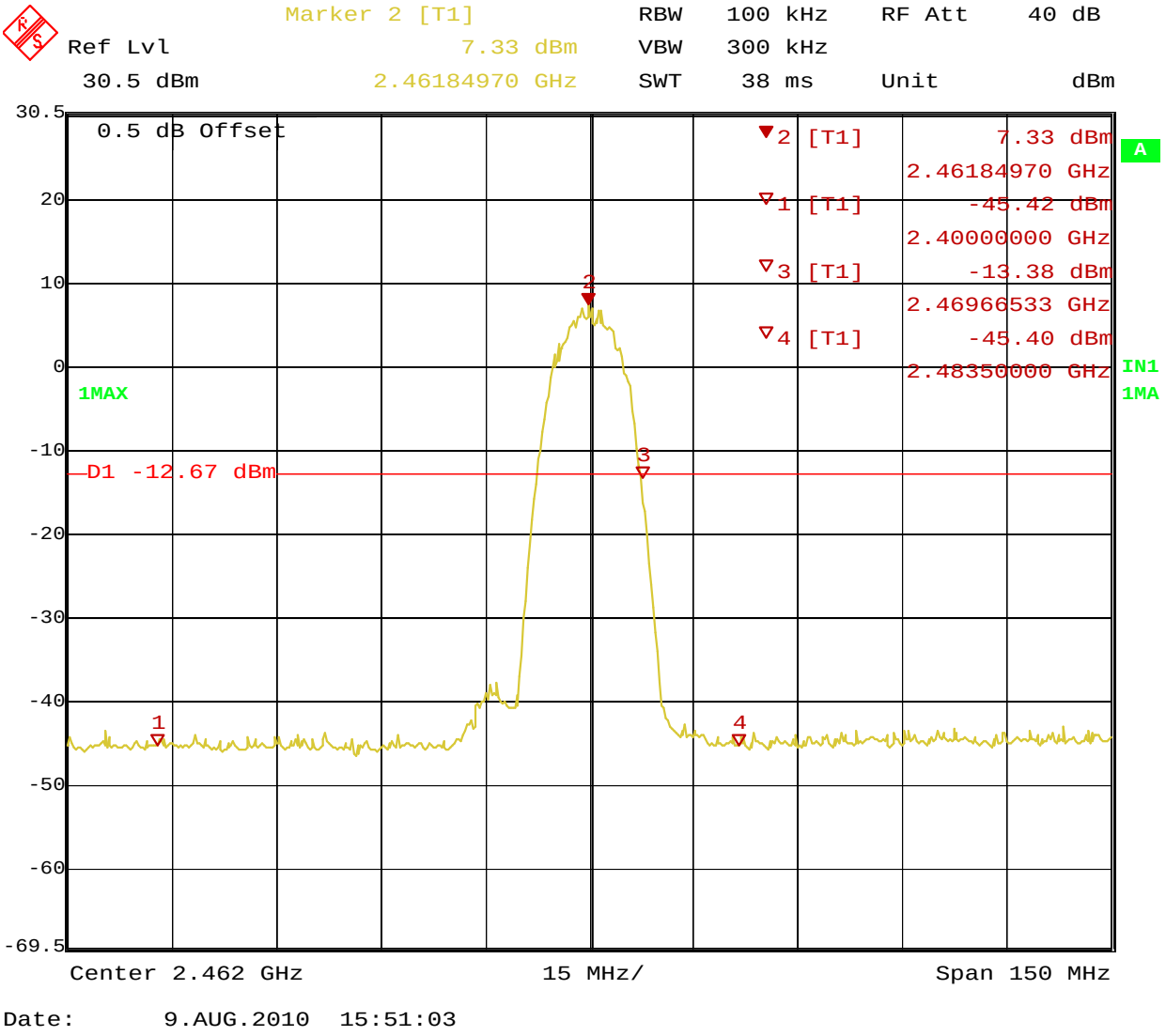


Figure 27: Band Edge Requirement at Q=2 for Operating Channel 2462 MHz at 11 MBit/s

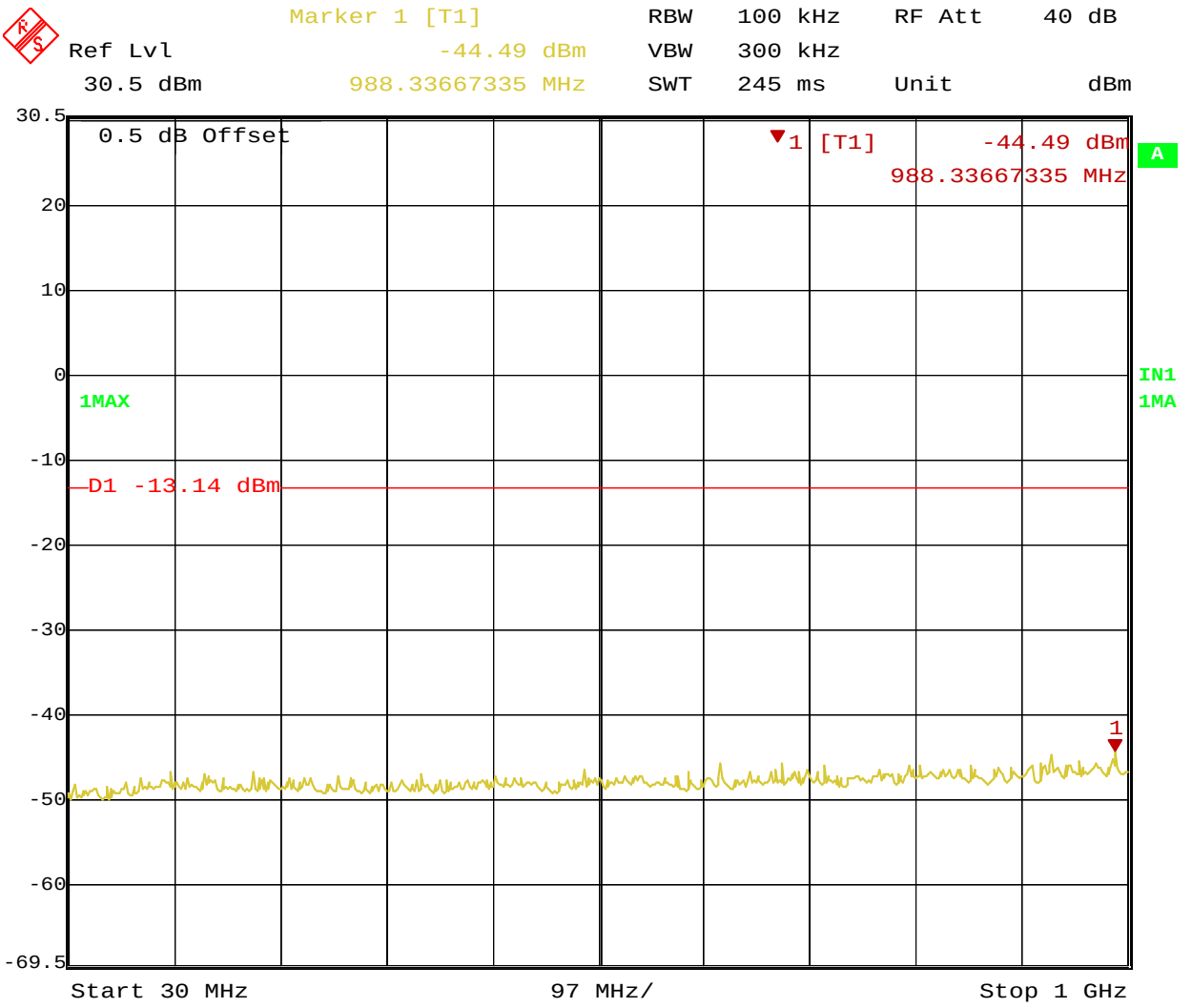


Figure 28: Out of Band Emission at Q=2 for Channel 2412 MHz at 11 MBit/s – Band 1

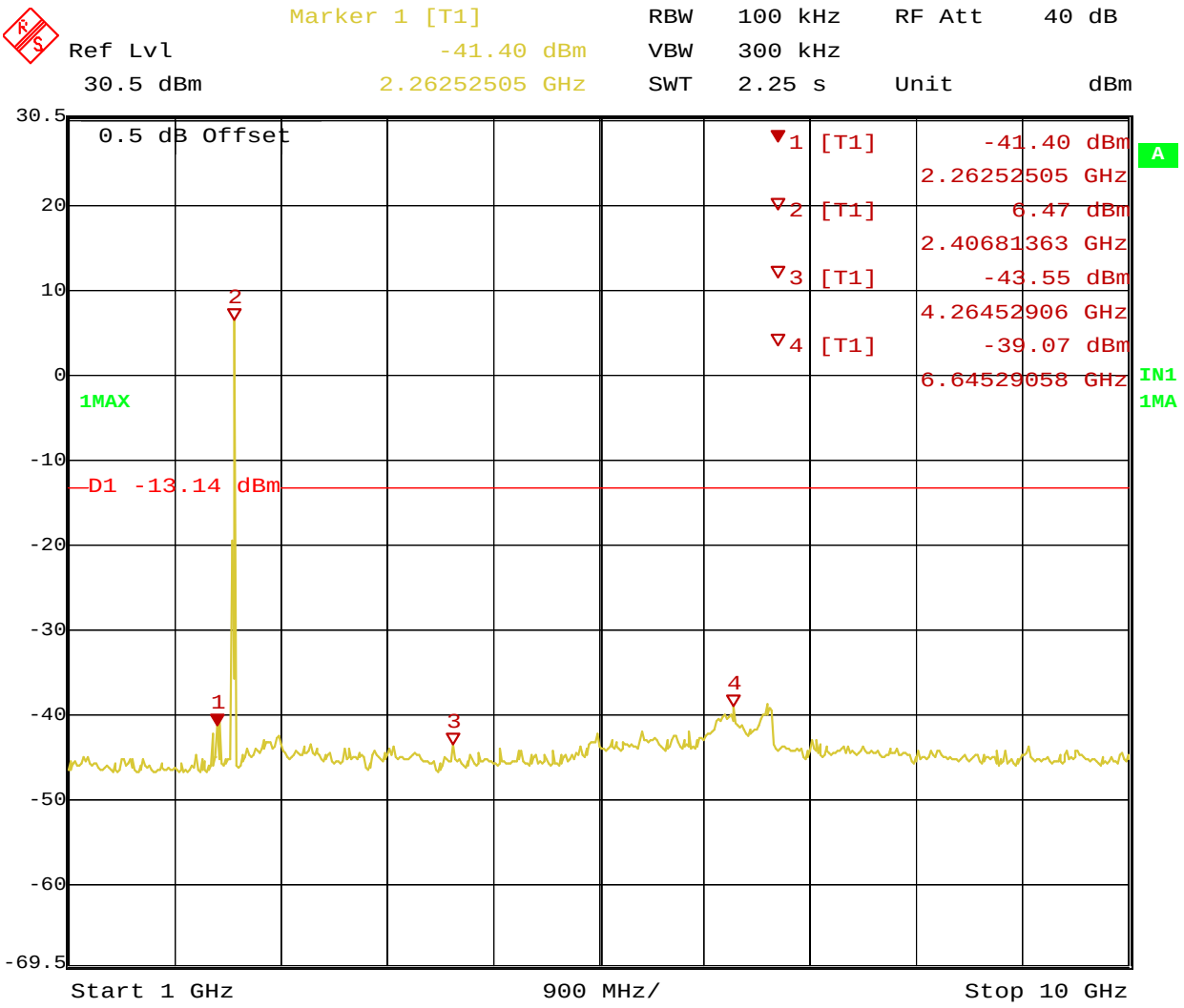


Figure 29: Out of Band Emission at Q=2 for Channel 2412 MHz at 11 MBit/s – Band 2

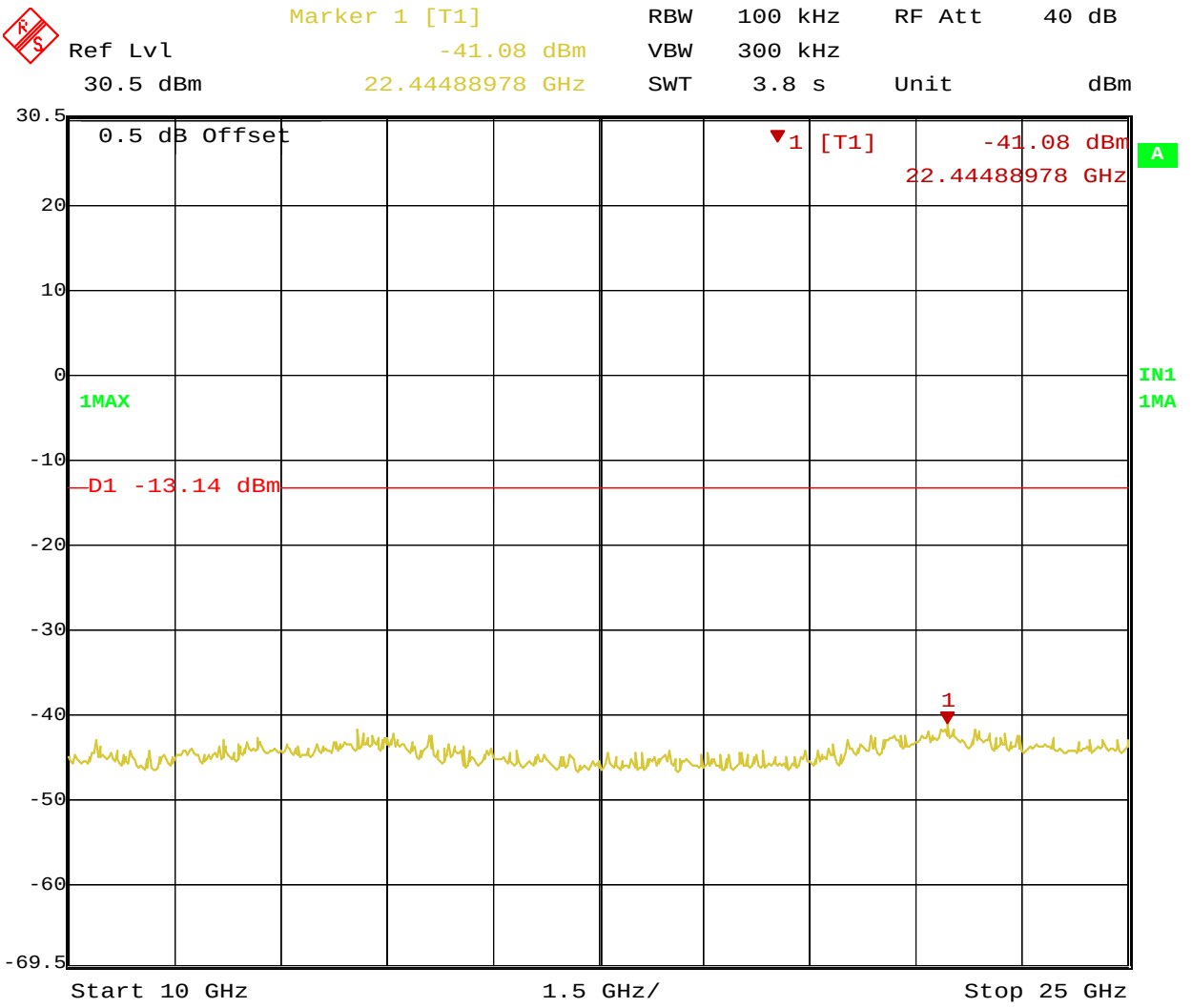


Figure 30: Out of Band Emission at Q=2 for Channel 2412 MHz at 11 MBit/s – Band 3

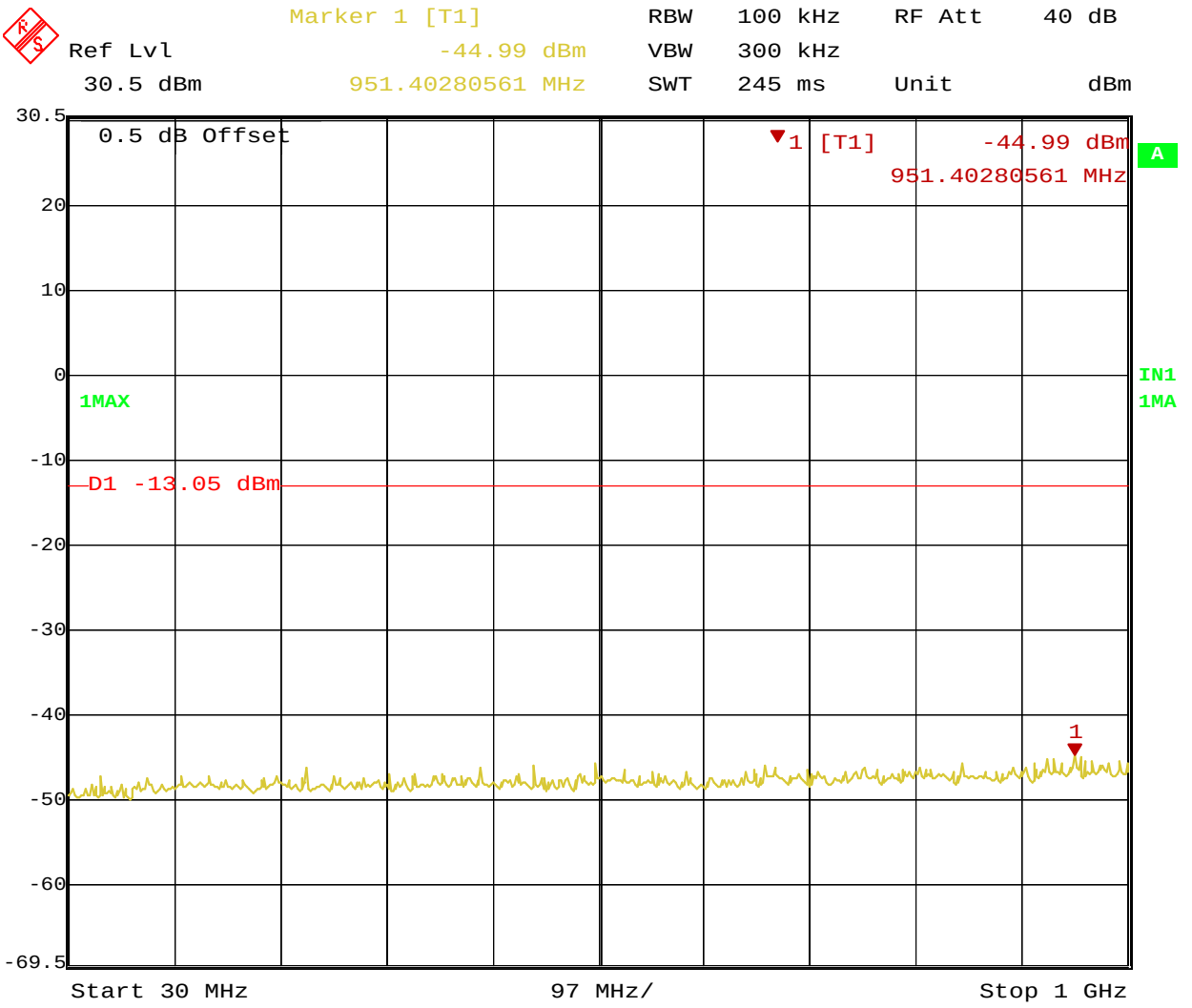


Figure 31: Out of Band Emission at Q=2 for Channel 2437 MHz at 11 MBit/s – Band 1

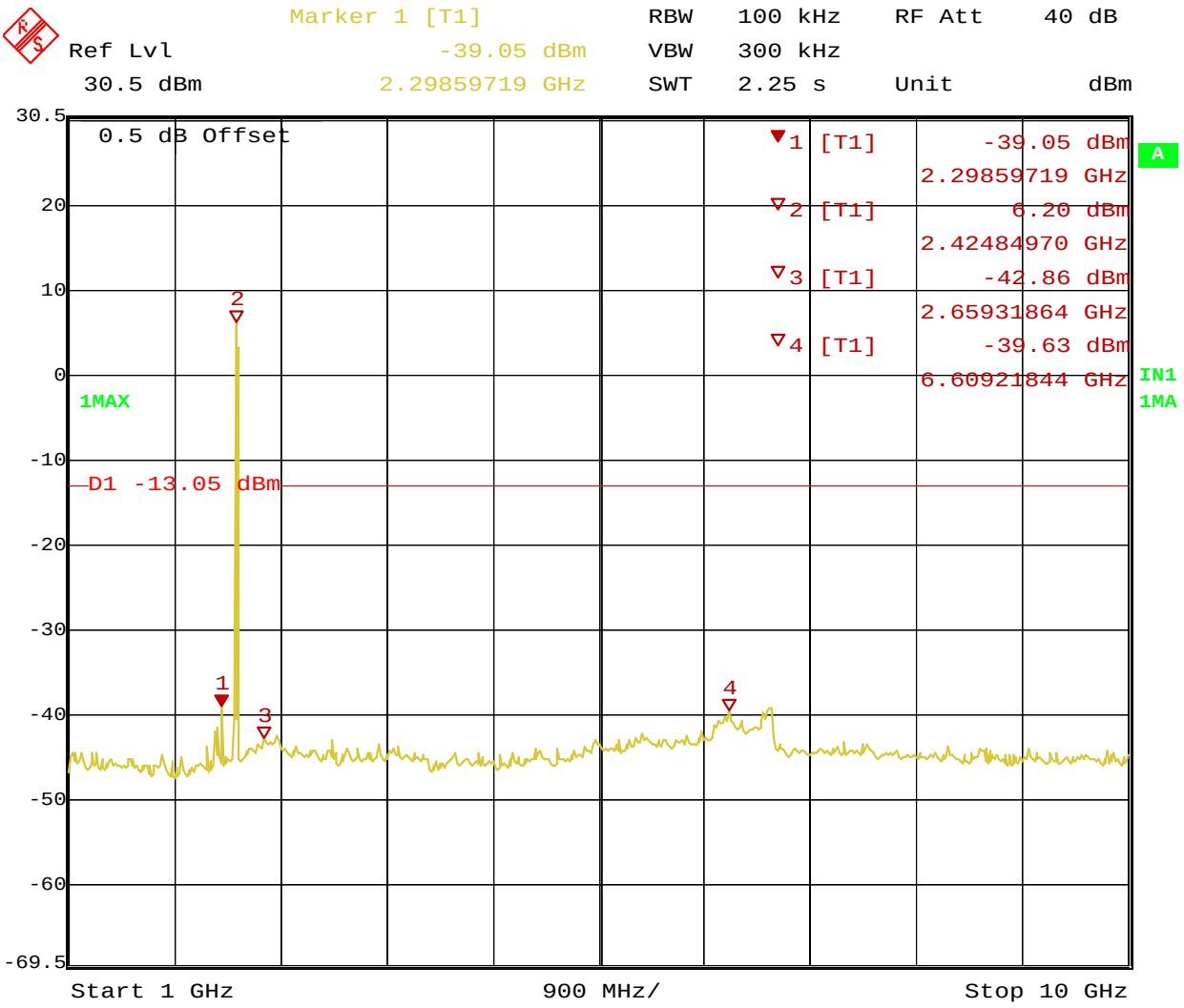


Figure 32: Out of Band Emission at Q=2 for Channel 2437 MHz at 11 MBit/s – Band 2

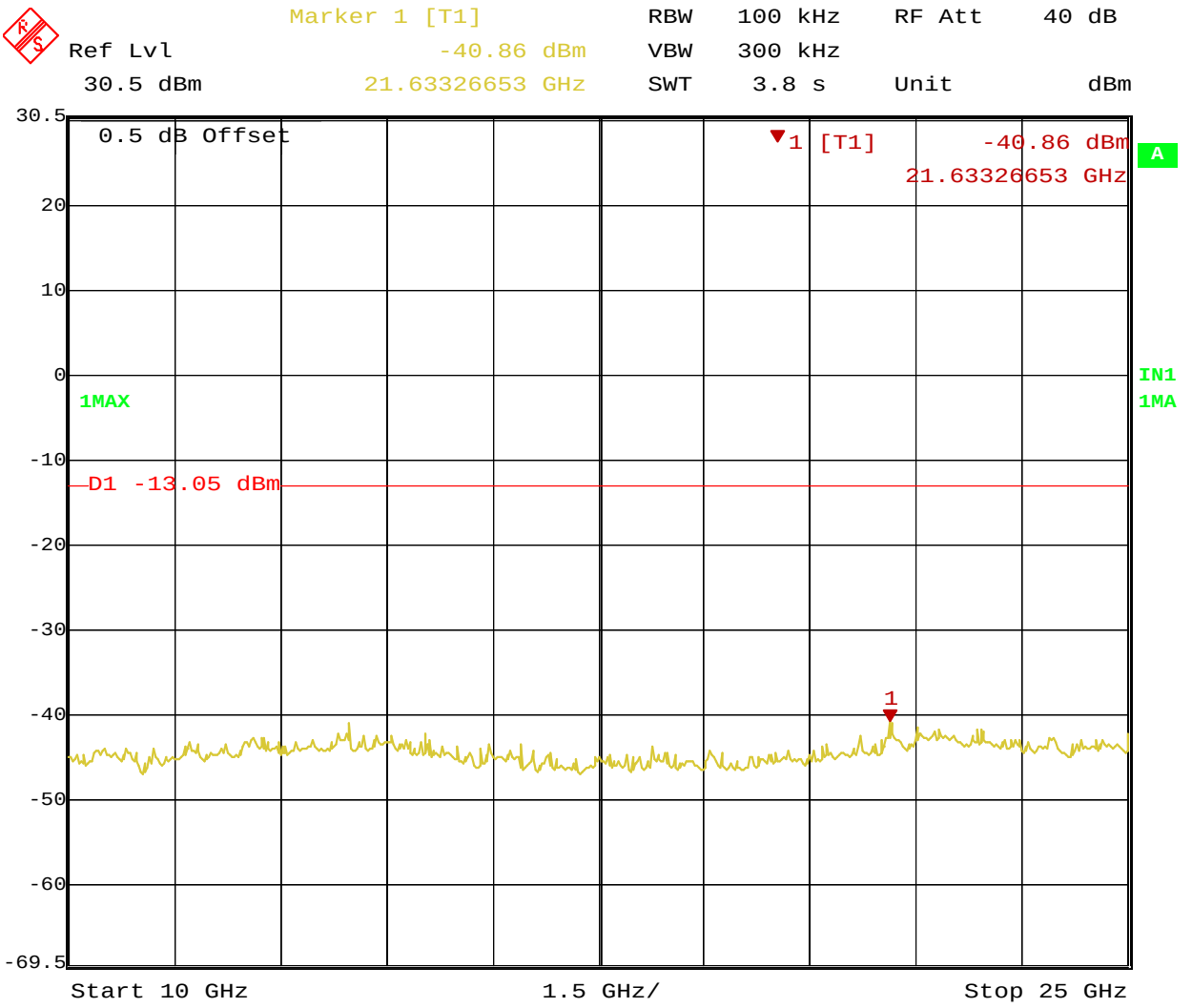
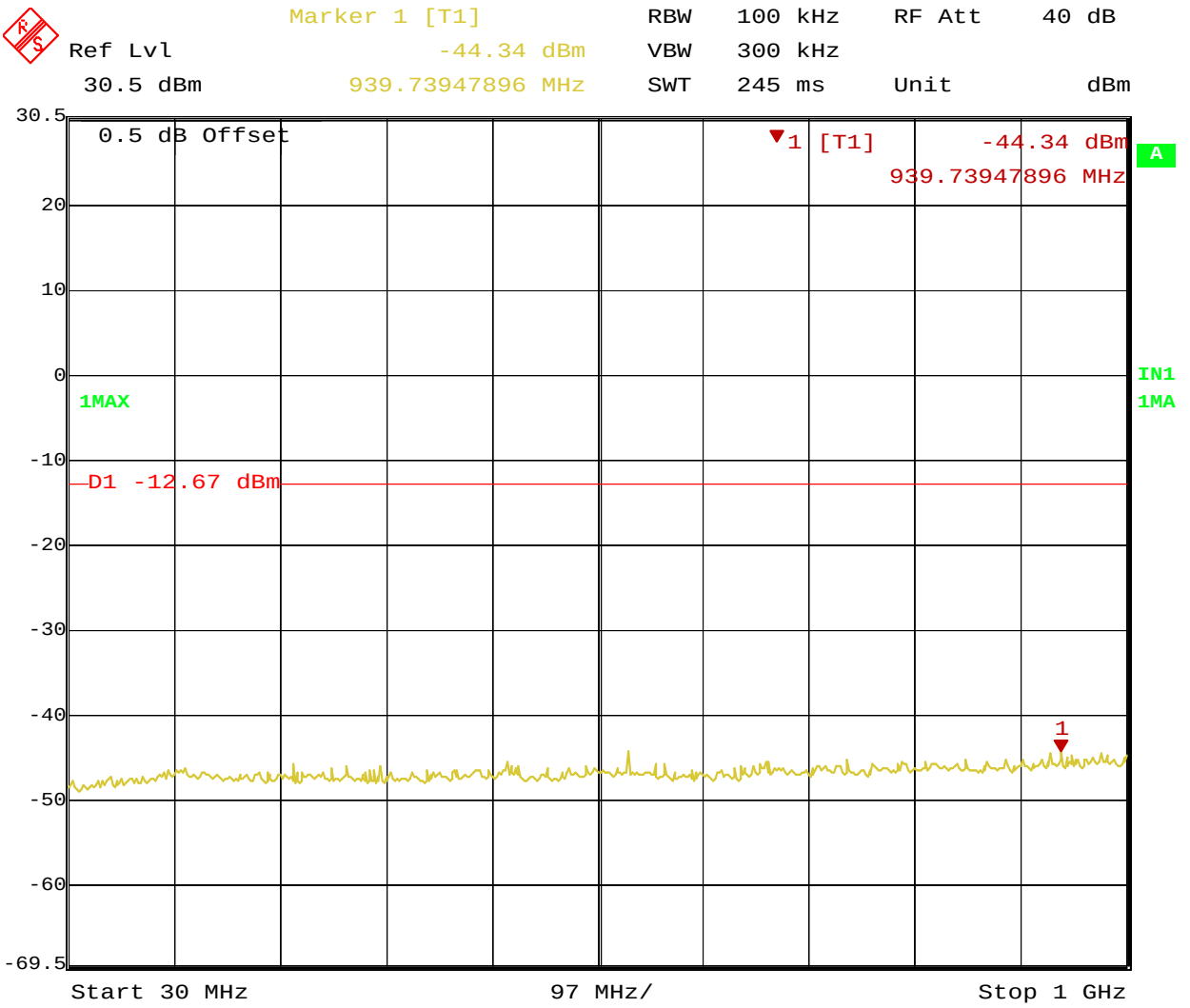


Figure 33: Out of Band Emission at Q=2 for Channel 2437 MHz at 11 MBit/s – Band 3



Date: 9.AUG.2010 15:52:05

Figure 34: Out of Band Emission at Q=2 for Channel 2462 MHz at 11 MBit/s – Band 1

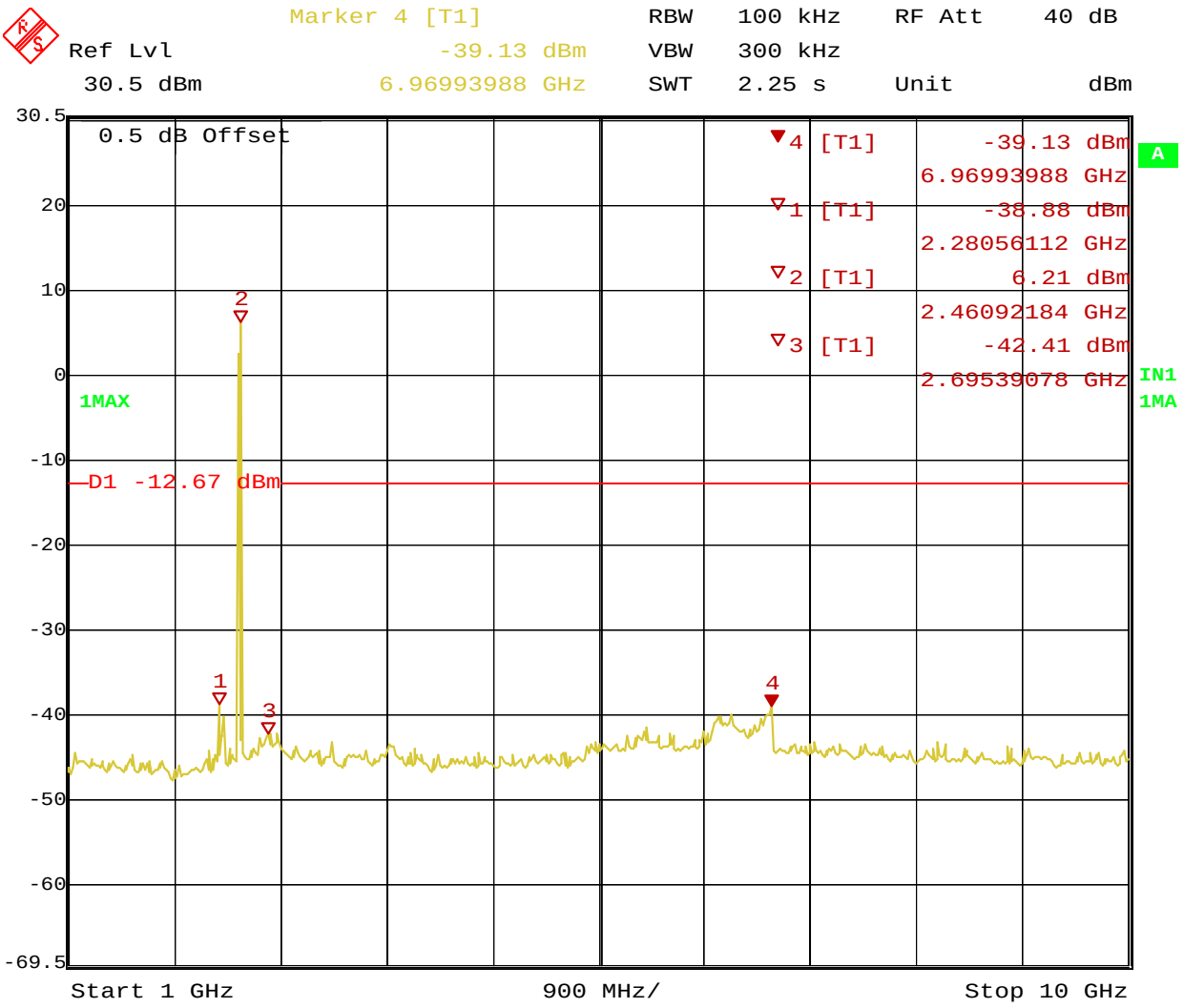


Figure 35: Out of Band Emission at Q=2 for Channel 2462 MHz at 11 MBit/s – Band 2

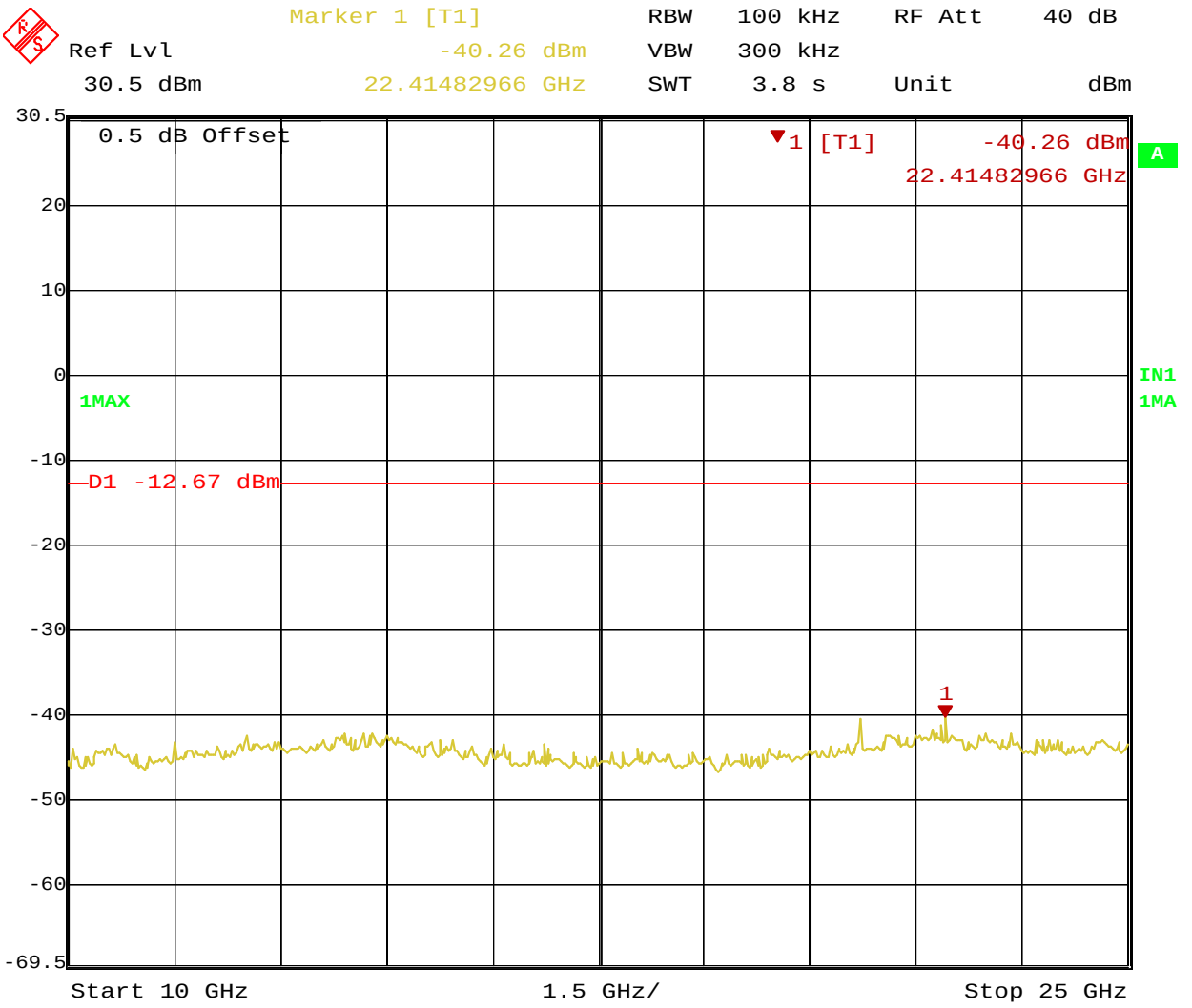


Figure 36: Out of Band Emission at Q=2 for Channel 2462 MHz at 11 MBit/s – Band 3

4.4 Peak Power Spectral Density

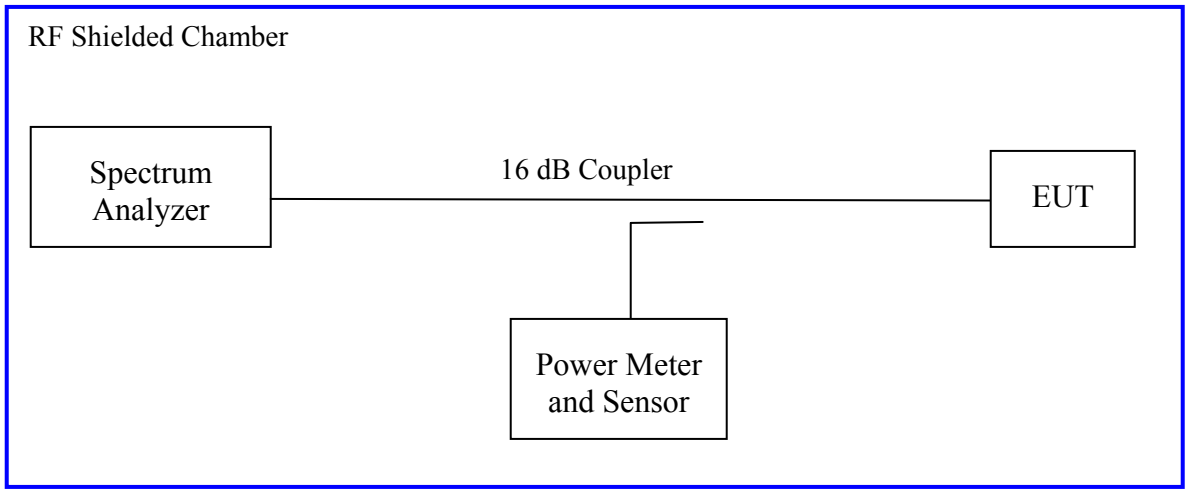
According to the CFR47 Part 15.247 (e) and RSS 210 (A8.2), the spectral power density output of the antenna port shall be less than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

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: #22. The worst sample result indicated below.

Test Setup:



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: PCB or Dipole		**Power Setting:** See Below		
Max. Antenna Gain: +5 dBi		**Signal State:** Modulated		
Ambient Temp.: 21° C		**Relative Humidity:**39%		
Peak Power Spectral Density Test Results for Q = 0				
Operating Channel	**Mode**	**PPSD [dBm]**	**Limit [dBm]**	**Margin [dB]**
2412 MHz	11Mbps	-5.70	8.0	-13.70
2437 MHz	11Mbps	-5.75	8.0	-13.75
2462 MHz	11Mbps	-5.40	8.0	-13.40
Peak Power Spectral Density Test Results for Q = 2				
Operating Channel	**Mode**	**PPSD [dBm]**	**Limit [dBm]**	**Margin [dB]**
2412 MHz	11Mbps	-7.03	8.0	-15.03
2437 MHz	11Mbps	-6.98	8.0	-14.98
2462 MHz	11Mbps	-6.61	8.0	-14.61
Note: the highest PPSD was observed at 11 Mbps				

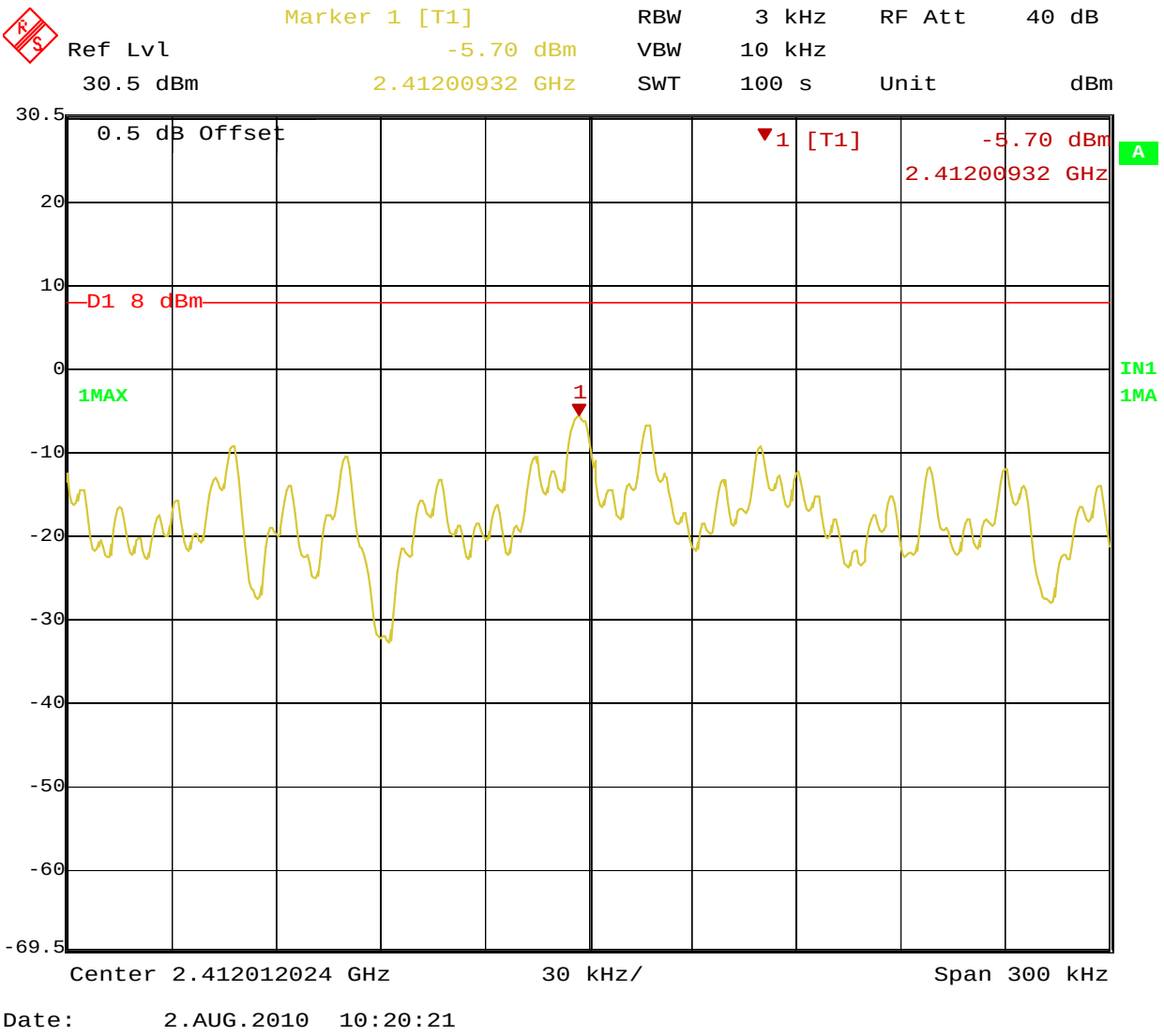


Figure 37: Peak Power Spectral Density at Q=0 for Operating Channel 2412 MHz – 11 MBit/s

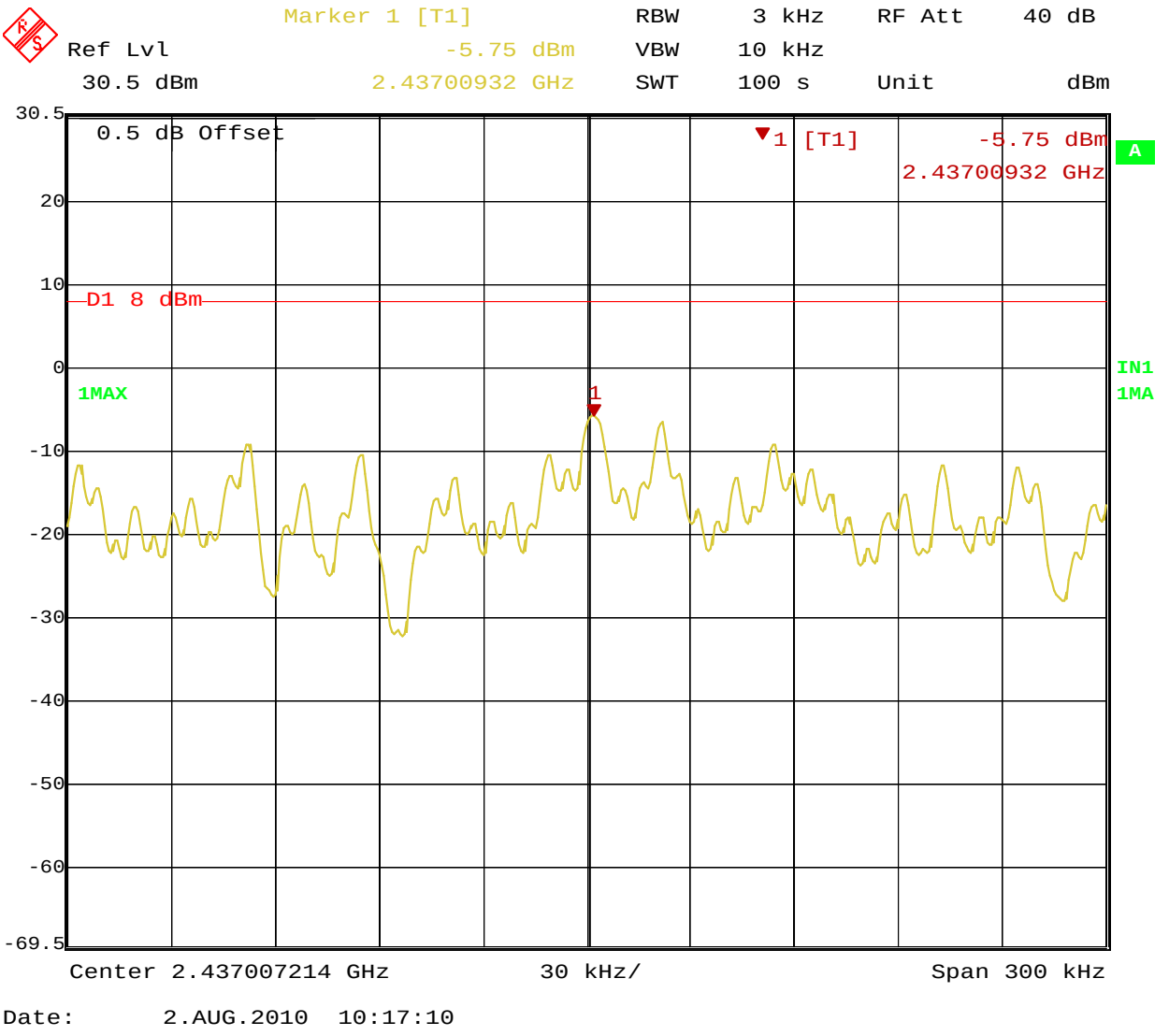


Figure 38: Peak Power Spectral Density at Q=0 for Operating Channel 2437 MHz – 11 MBit/s

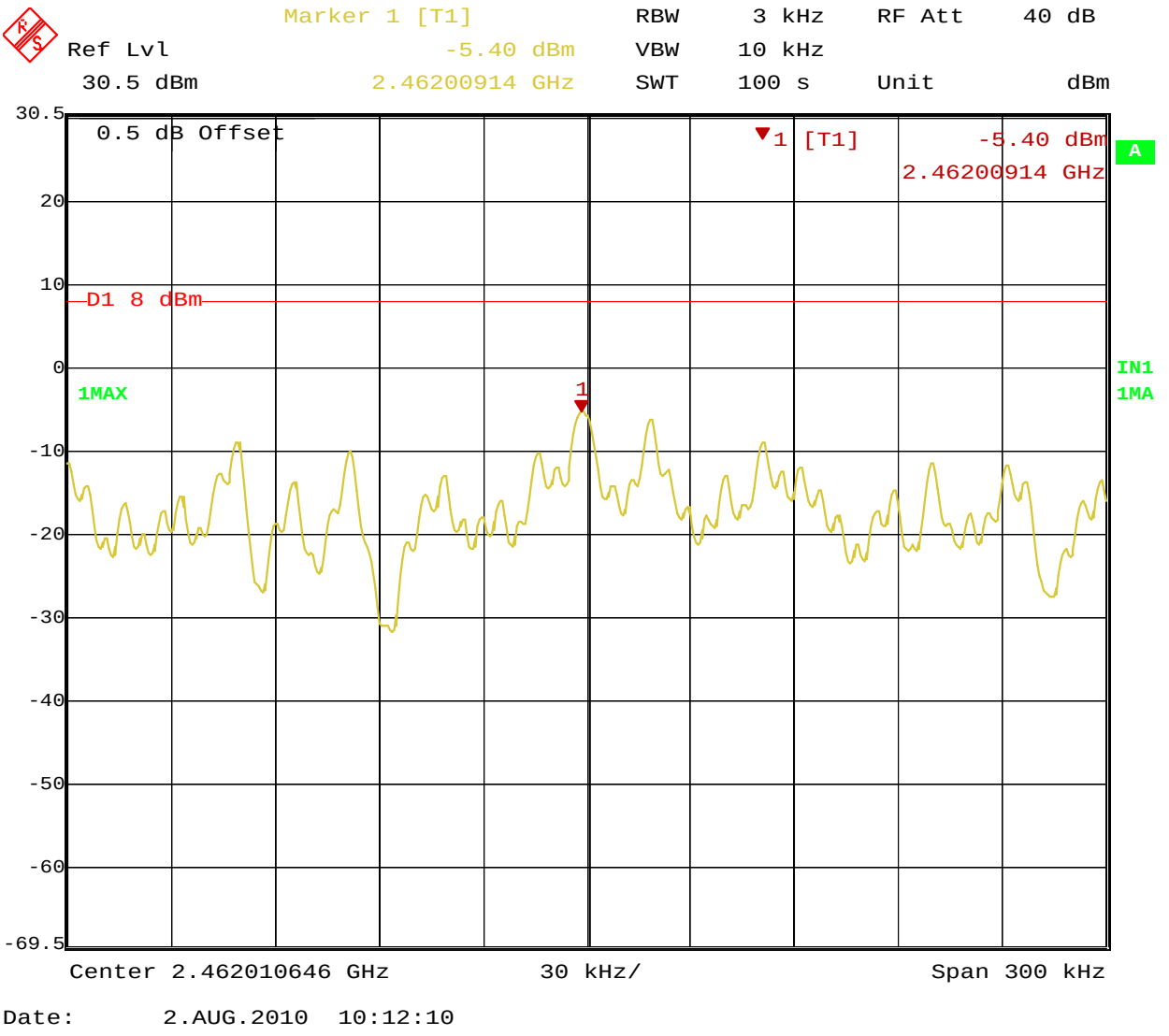


Figure 39: Peak Power Spectral Density at Q=0 for Operating Channel 2462 MHz – 11 MBit/s

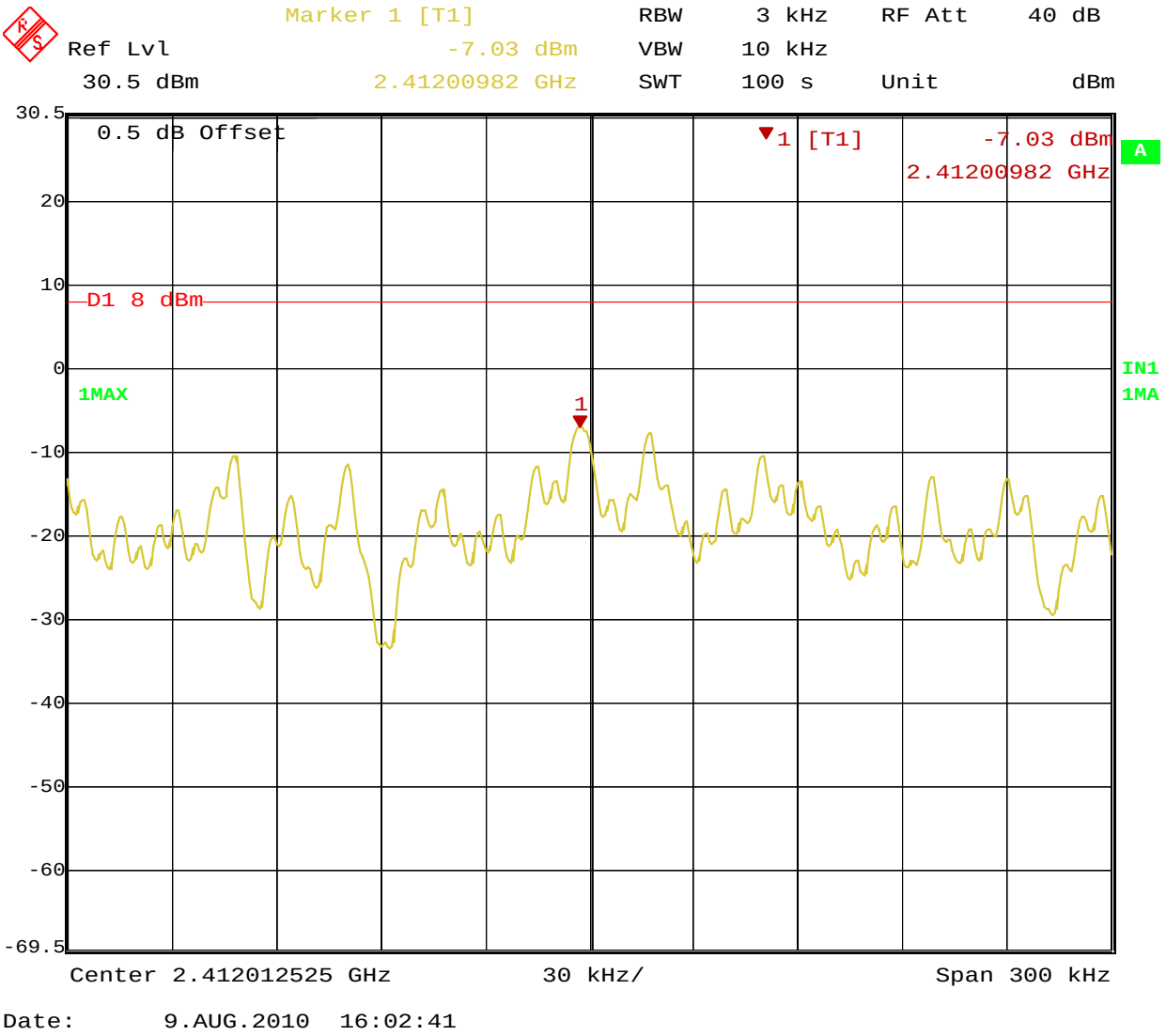


Figure 40: Peak Power Spectral Density at Q=2 for Operating Channel 2412 MHz – 11 MBit/s

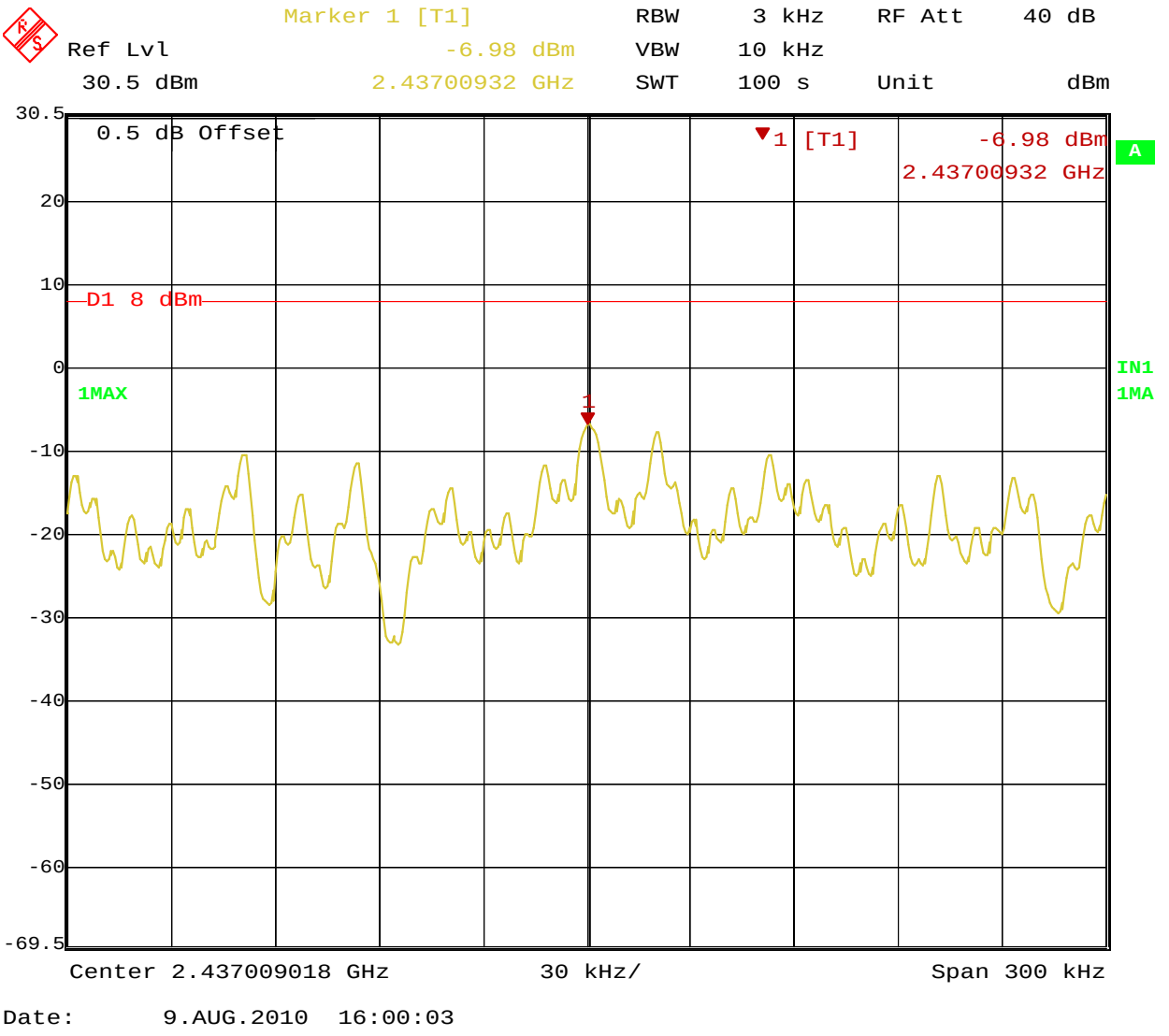


Figure 41: Peak Power Spectral Density at Q=2 for Operating Channel 2437 MHz – 11 MBit/s

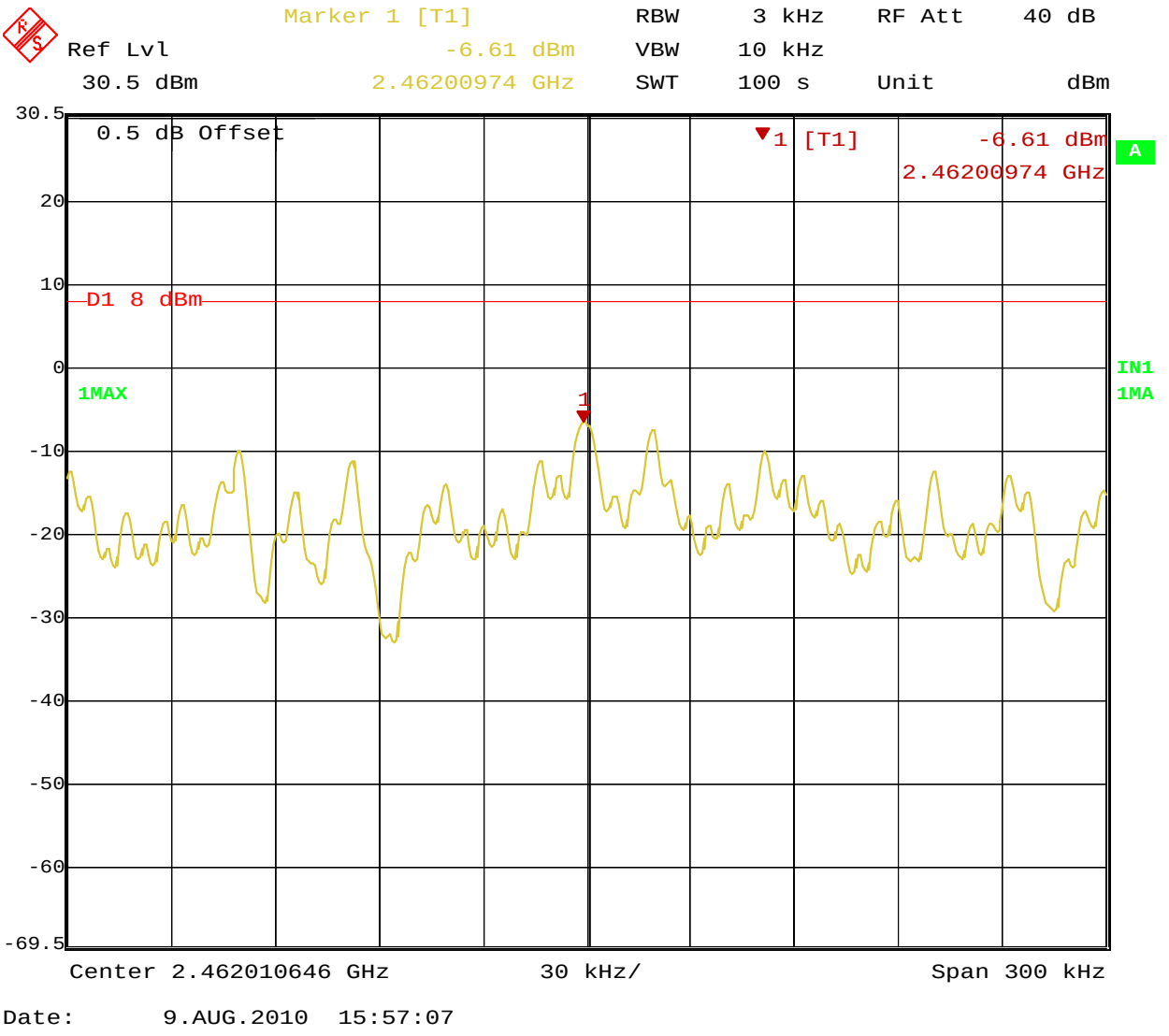


Figure 42: Peak Power Spectral Density at Q=2 for Operating Channel 2462 MHz – 11 MBit/s

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.

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 externally connected. The dipole antenna had the highest gain of +5 dBi or 3.16 (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/cm^2

The highest measured channel output power is +23.47 dBm or 222.33 mW

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

Pd = (222.33*3.16) / (1600π) = 0.1398 mW/cm2, which is 0.8601 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: $Pd = (Pout*G) / (4*\pi*R^2)$

Where;

Pd = power density in $mW/cm2$
Pout = 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).

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, than 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.

The worst axis for each antennas type was scanned.

4.6.1.3 Deviations

None.

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: 2009 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).

Table 7: Transmit Spurious Emission at Band Edge Requirements – Dipole Antenna

Test Conditions: Radiated Measurement, Normal Temperature and Voltage only							
Antenna Type: Dipole			**Power Setting:** Q = 0				
Max. Antenna Gain: +5 dBi			**Signal State:** Modulated				
Ambient Temp.: 22° C			**Relative Humidity:**34%				
Band Edge Results for Dipole Antenna							
Operating Channel	**EUT Position**	**Polarity**	**Pk Plots**	**Peak Limit**	**Ave. Plots**	**Ave. Limit**	**Result**
2412 MHz	Z-Axis	Horizontal	#43	74.00	#44	54.00	Pass
2412 MHz	Z-Axis	Vertical	#45	74.00	#46	54.00	Pass
2437 MHz	Z-Axis	Horizontal	#47	74.00	#48	54.00	Pass
2437 MHz	Z-Axis	Vertical	#49	74.00	#50	54.00	Pass
2462 MHz	Z-Axis	Horizontal	#51	74.00	#52	54.00	Pass
2462 MHz	Z-Axis	Vertical	#53	74.00	#54	54.00	Pass

Note: 1. Tested on Z-Axis with Dipole positioned vertically.

2. 5dBi gain of external dipole is the maximum peak gain.

Table 8: Transmit Spurious Emission at Band Edge Requirements –PCB Antenna

Test Conditions: Radiated Measurement, Normal Temperature and Voltage only							
Antenna Type: Ext. PCB			**Power Setting:** Q=2				
Max. Antenna Gain: +2 dBi			**Signal State:** Modulated				
Ambient Temp.: 22° C			**Relative Humidity:**34%				
Band Edge Results for Dipole Antenna							
Operating Channel	**EUT Position**	**Polarity**	**Pk Plots**	**Peak Limit**	**Ave. Plots**	**Ave. Limit**	**Result**
2412 MHz	Y-Axis	Horizontal	#55	74.00	#56	54.00	Pass
2412 MHz	Y-Axis	Vertical	#57	74.00	#58	54.00	Pass
2437 MHz	Y-Axis	Horizontal	#59	74.00	#60	54.00	Pass
2437 MHz	Y-Axis	Vertical	#61	74.00	#62	54.00	Pass
2462 MHz	Y-Axis	Horizontal	#63	74.00	#64	54.00	Pass
2462 MHz	Y-Axis	Vertical	#65	74.00	#66	54.00	Pass

Note: 1. Tested on Y-Axis with PCB antenna positioned horizontally.

2. 2dBi gain of external PCB is the maximum peak gain. Average gain is 1dbi

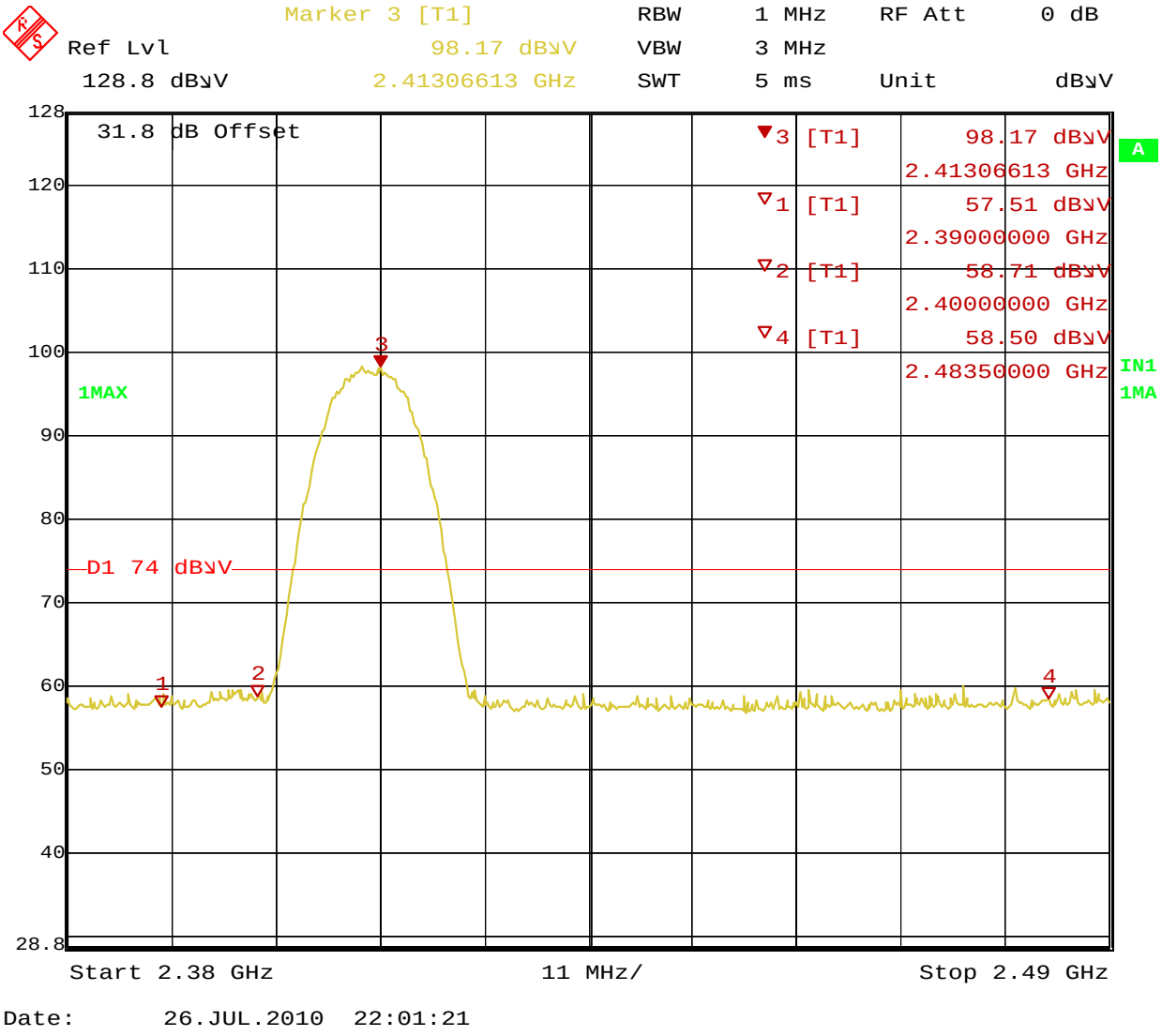


Figure 43: Dipole Antenna Emission at the Edge for Channel 2412 MHz at 1 Mbps – Horizontal (Peak)

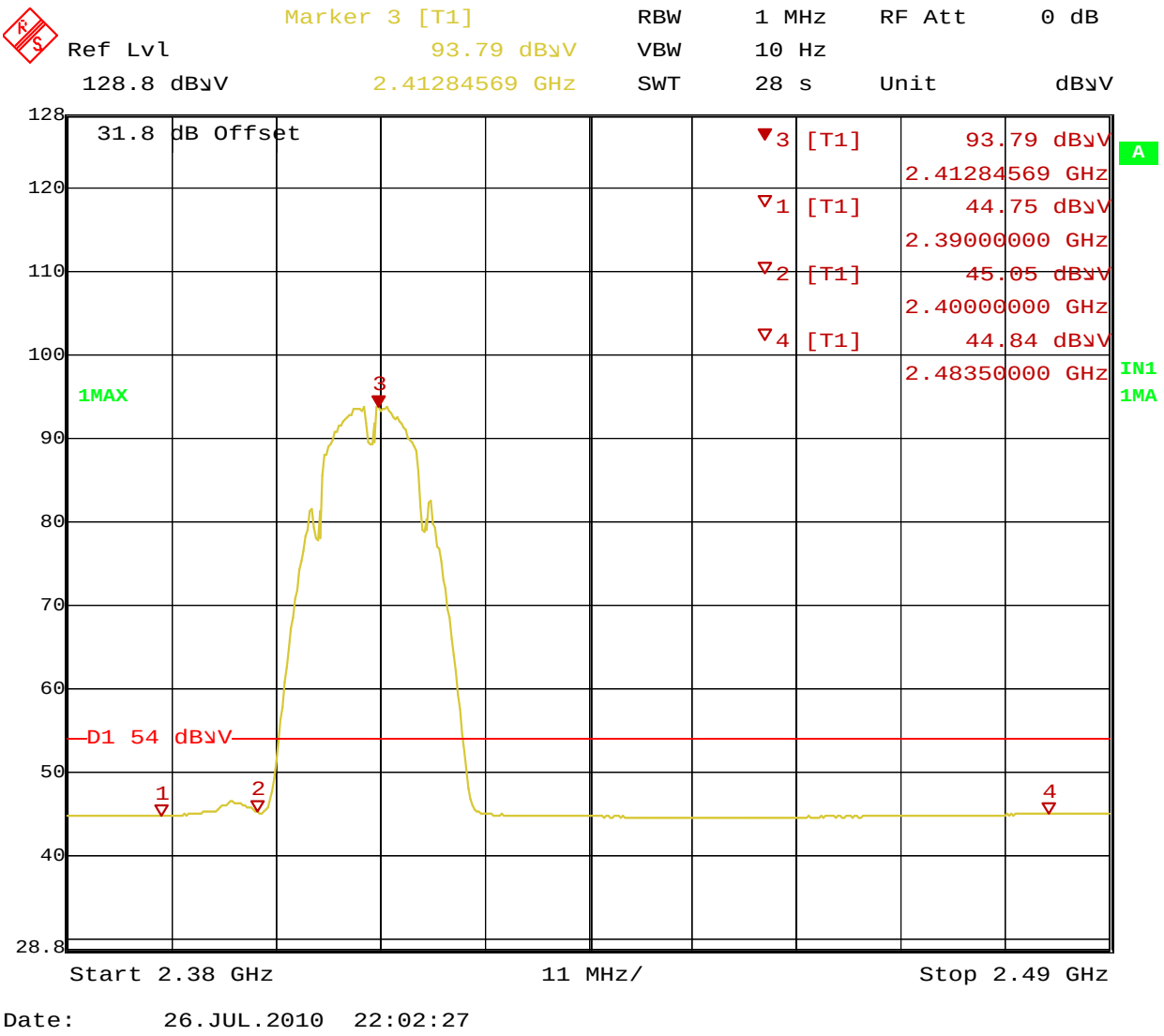


Figure 44: Dipole Antenna Emission at the Edge for Channel 2412 MHz at 1 Mbps – Horizontal (Ave.)

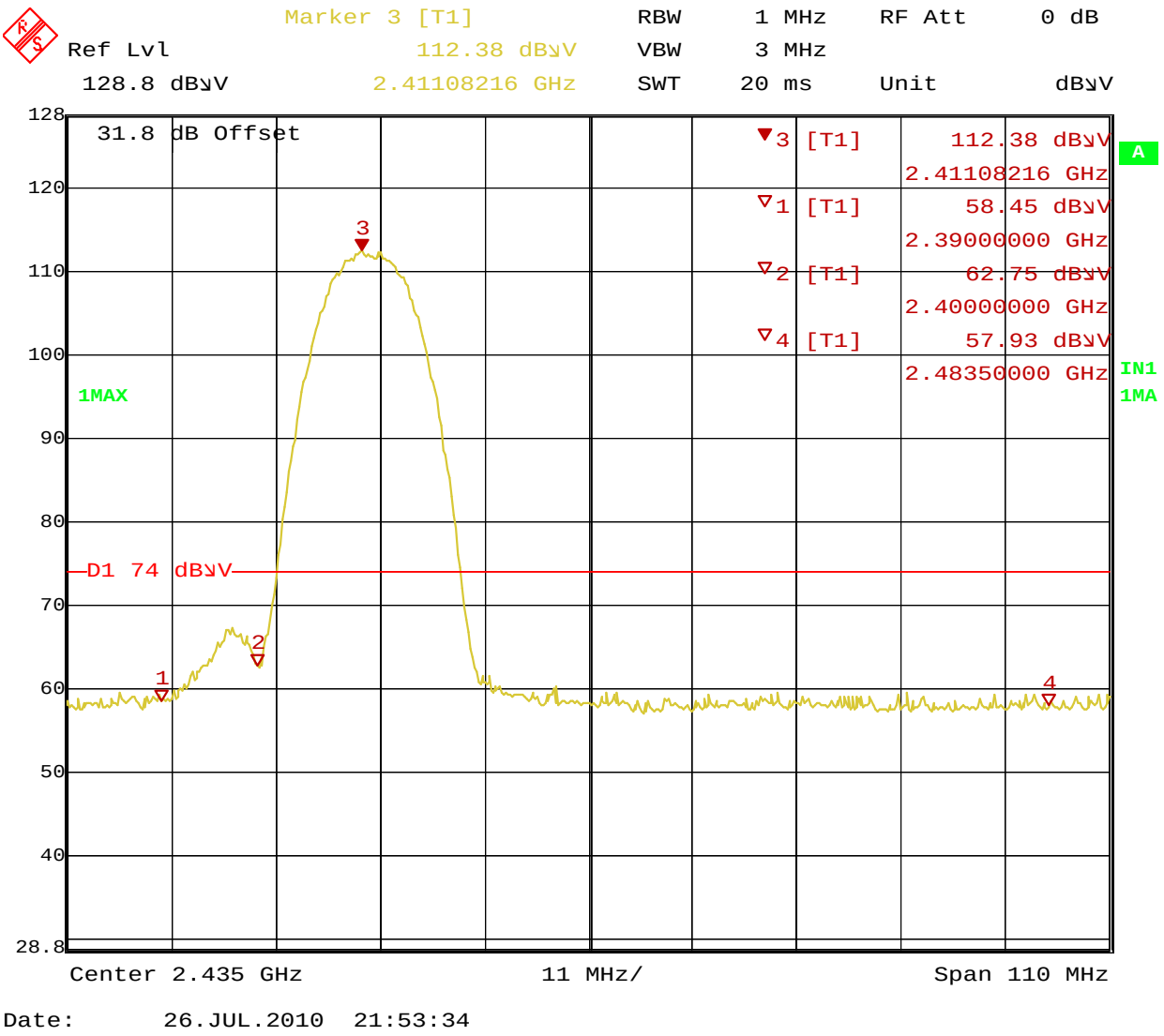


Figure 45: Dipole Antenna Emission at the Edge for Channel 2412 MHz at 1 Mbps – Vertical (Peak)

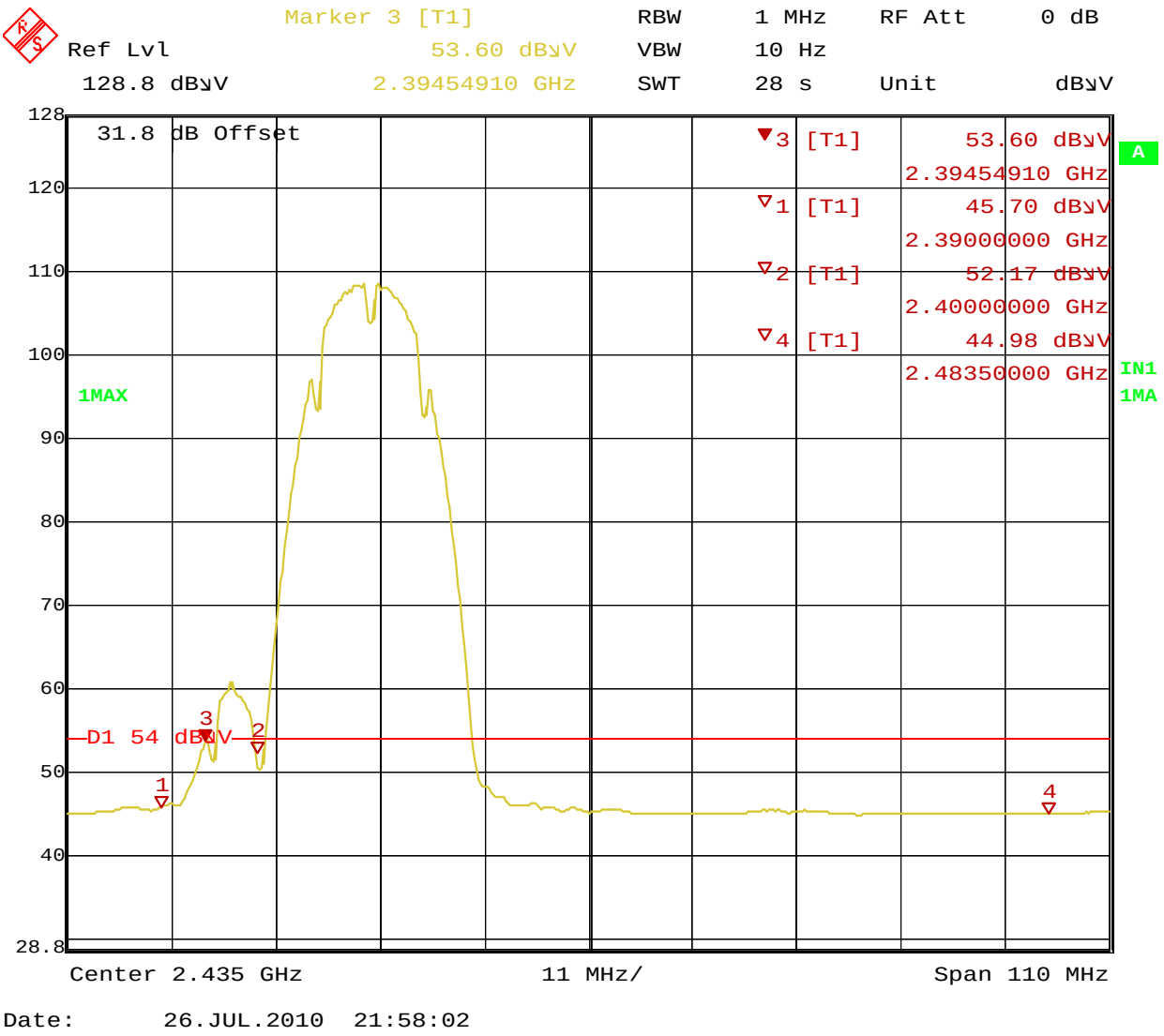


Figure 46: Dipole Antenna Emission at the Edge for Channel 2412 MHz at 1 Mbps – Vertical (Ave.)

Note: The restricted band below 2390 MHz, Marker #1, met the required spurious emission limit of 54 dBuV/m. For the 2390 MHz to 2400 MHz, it is at 27 dB below the 20 dBr; 20 dB below the peak.

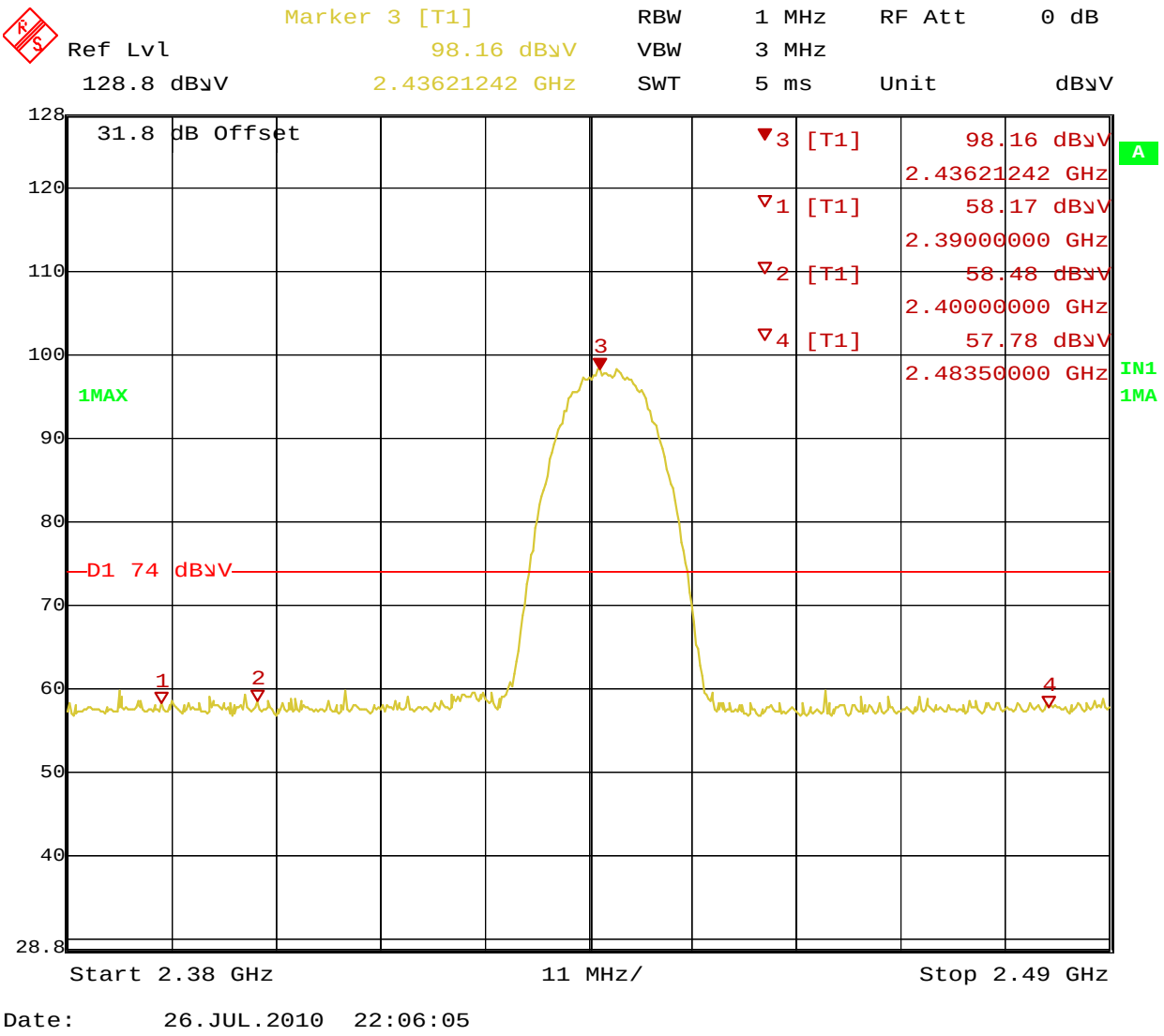


Figure 47: Dipole Antenna Emission at the Edge for Channel 2437 MHz at 1 Mbps – Horizontal (Peak)

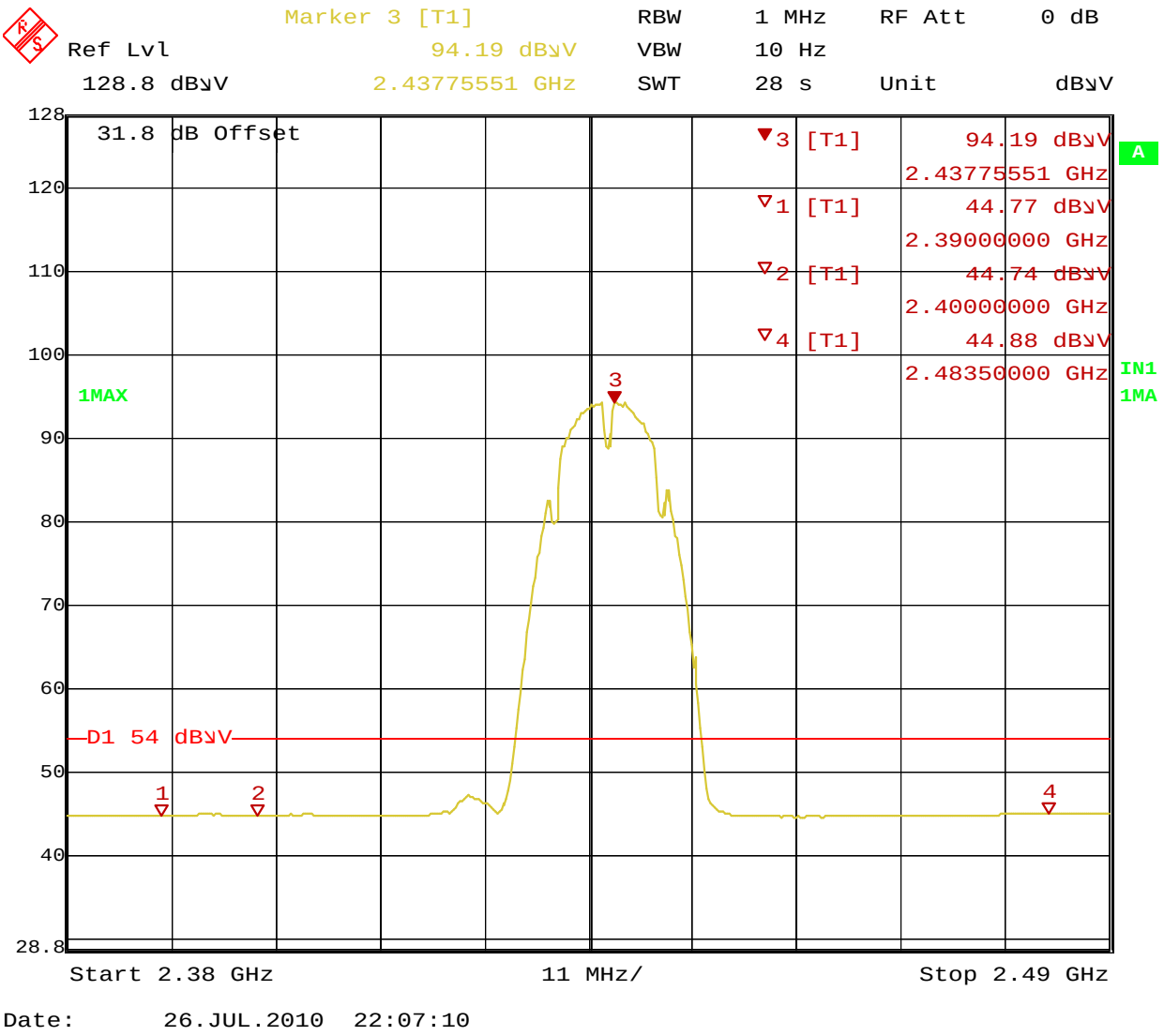


Figure 48: Dipole Antenna Emission at the Edge for Channel 2437 MHz at 1 Mbps – Horizontal (Ave.)

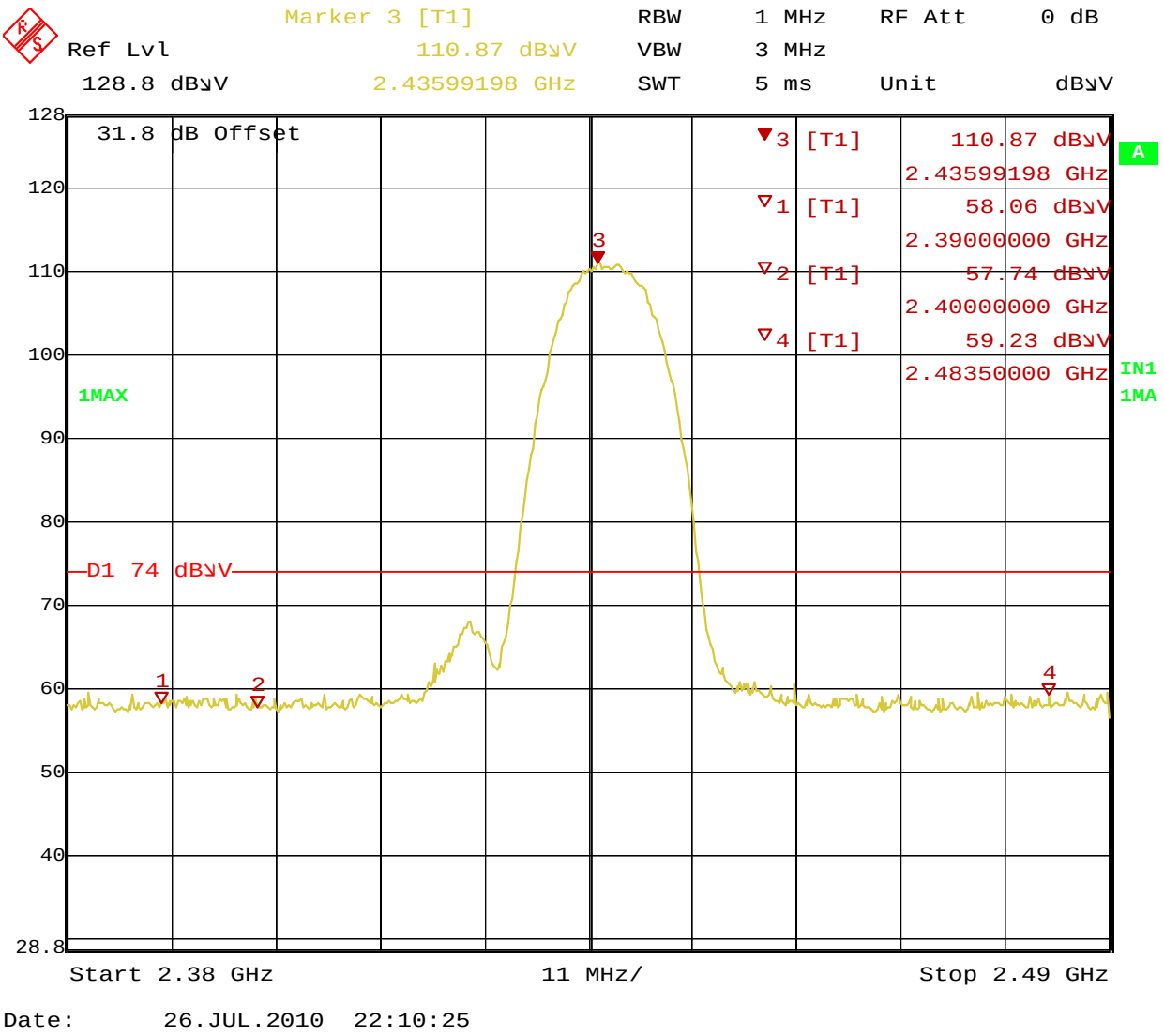


Figure 49: Dipole Antenna Emission at the Edge for Channel 2437 MHz at 1 Mbps – Vertical (Peak)

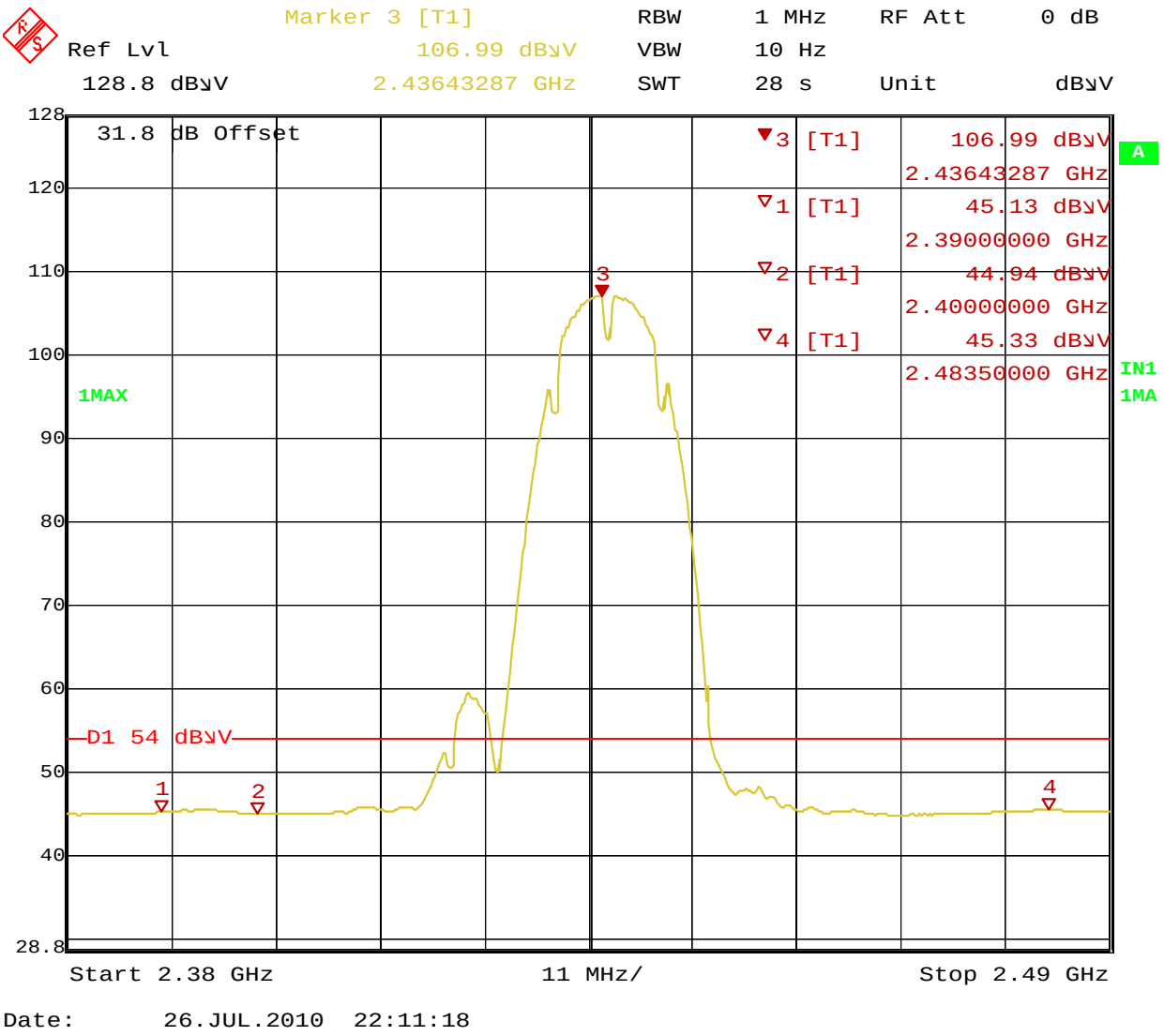


Figure 50: Dipole Antenna Emission at the Edge for Channel 2437 MHz at 1 Mbps – Vertical (Ave.)

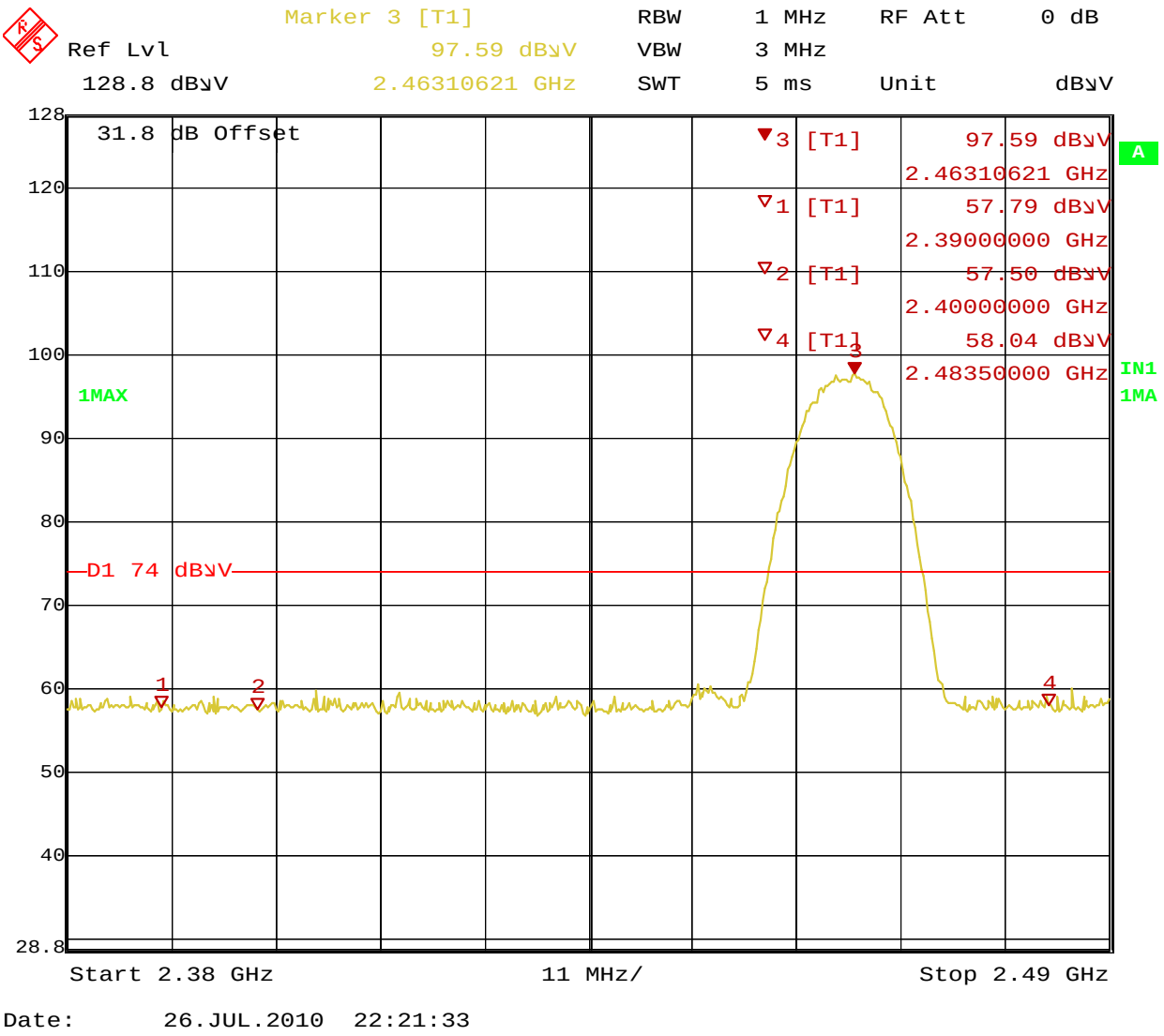


Figure 51: Dipole Antenna Emission at the Edge for Channel 2462 MHz at 1 Mbps – Horizontal (Peak)

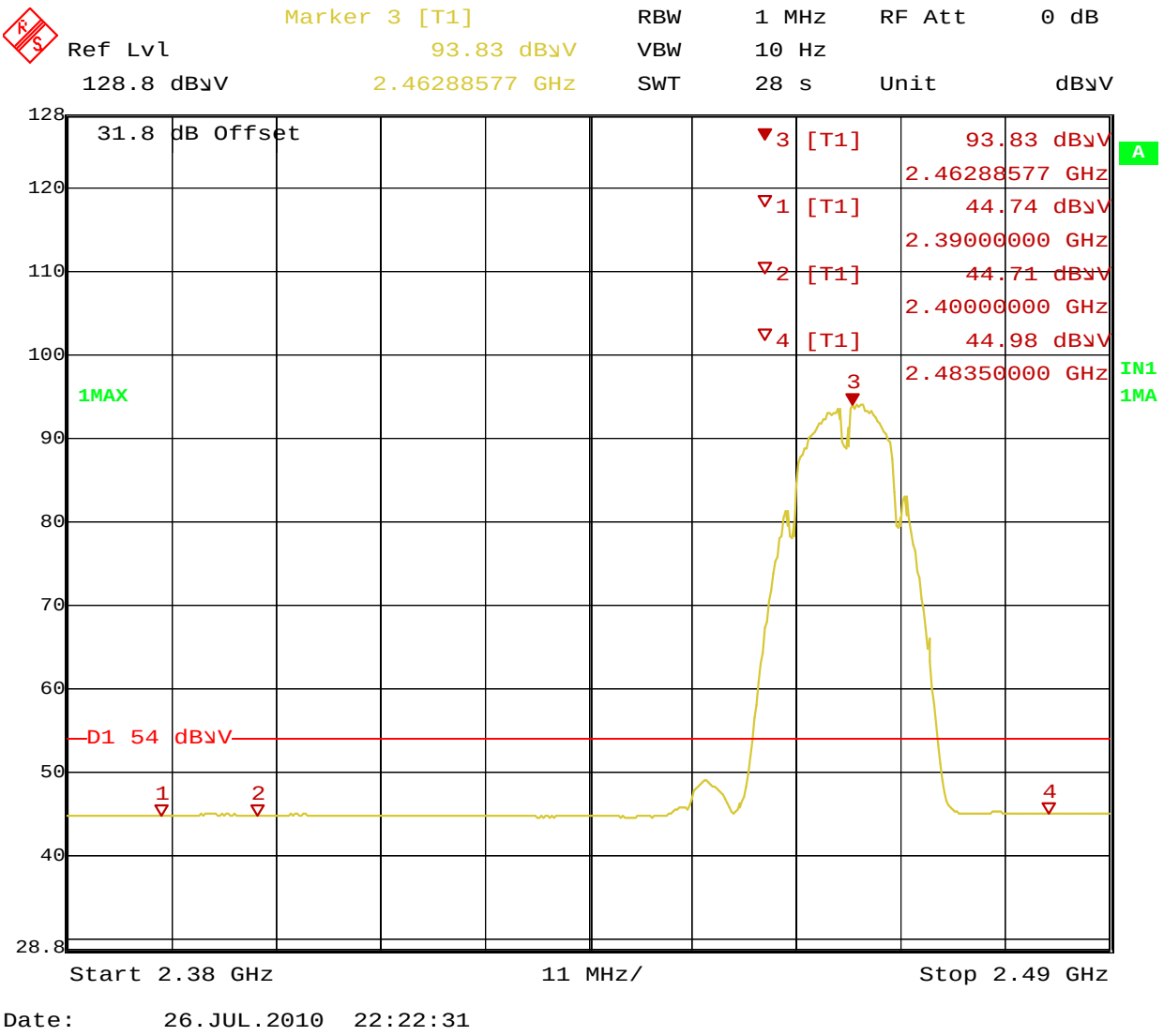


Figure 52: Dipole Antenna Emission at the Edge for Channel 2462 MHz at 1 Mbps – Horizontal (Ave.)

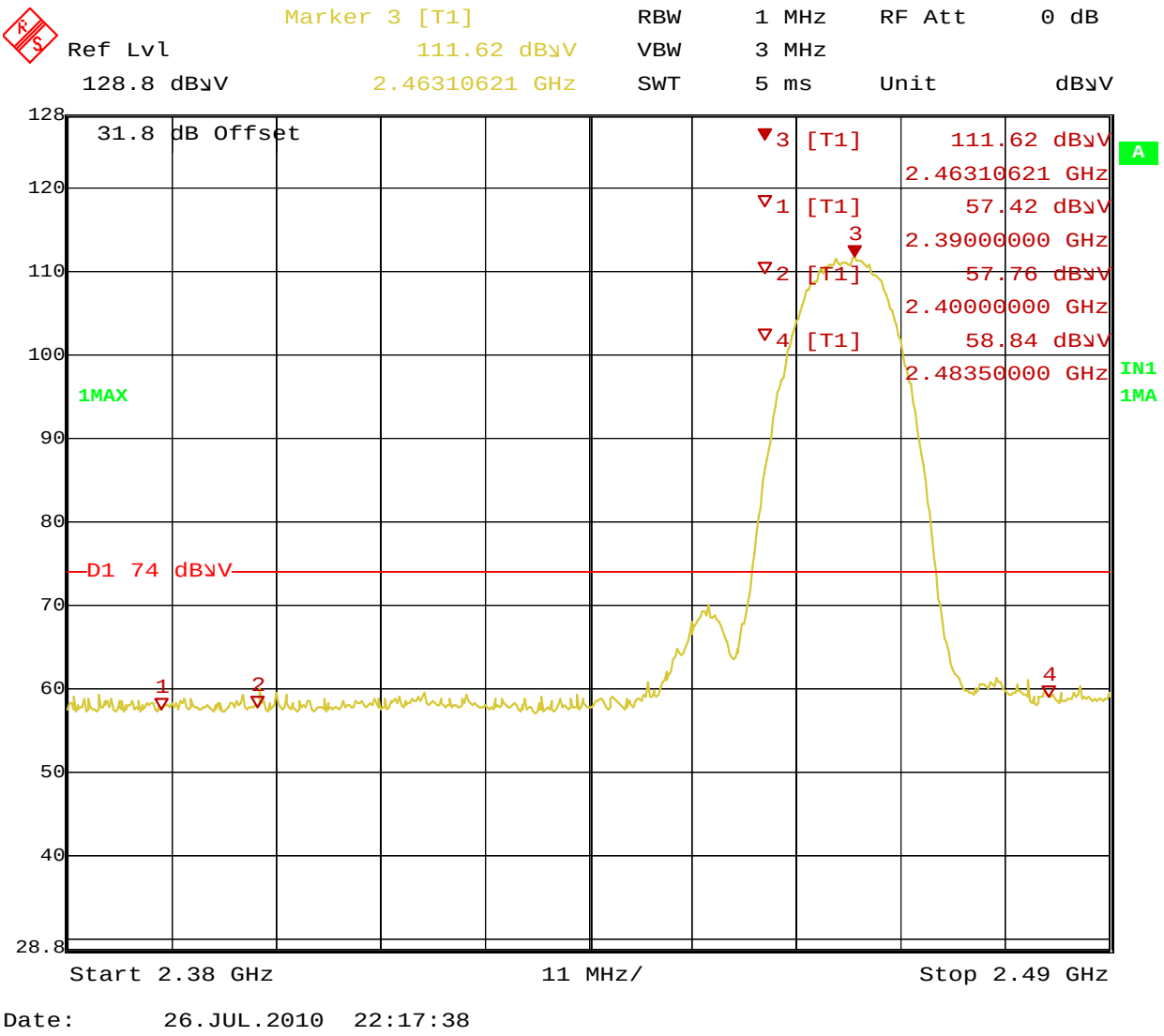


Figure 53: Dipole Antenna Emission at the Edge for Channel 2462 MHz at 1 Mbps – Vertical (Peak)

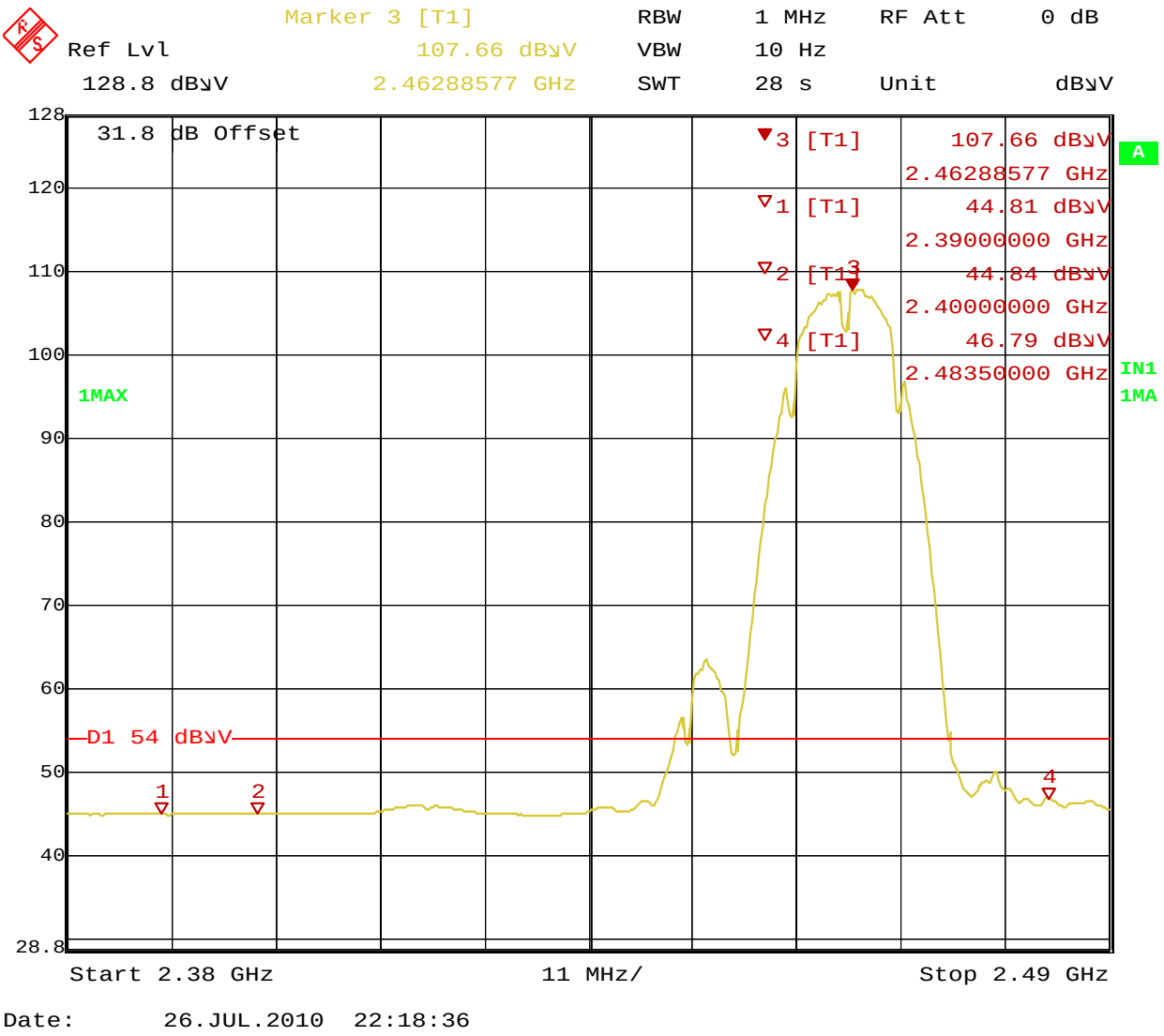


Figure 54: Dipole Antenna Emission at the Edge for Channel 2462 MHz at 1 Mbps – Vertical (Ave.)

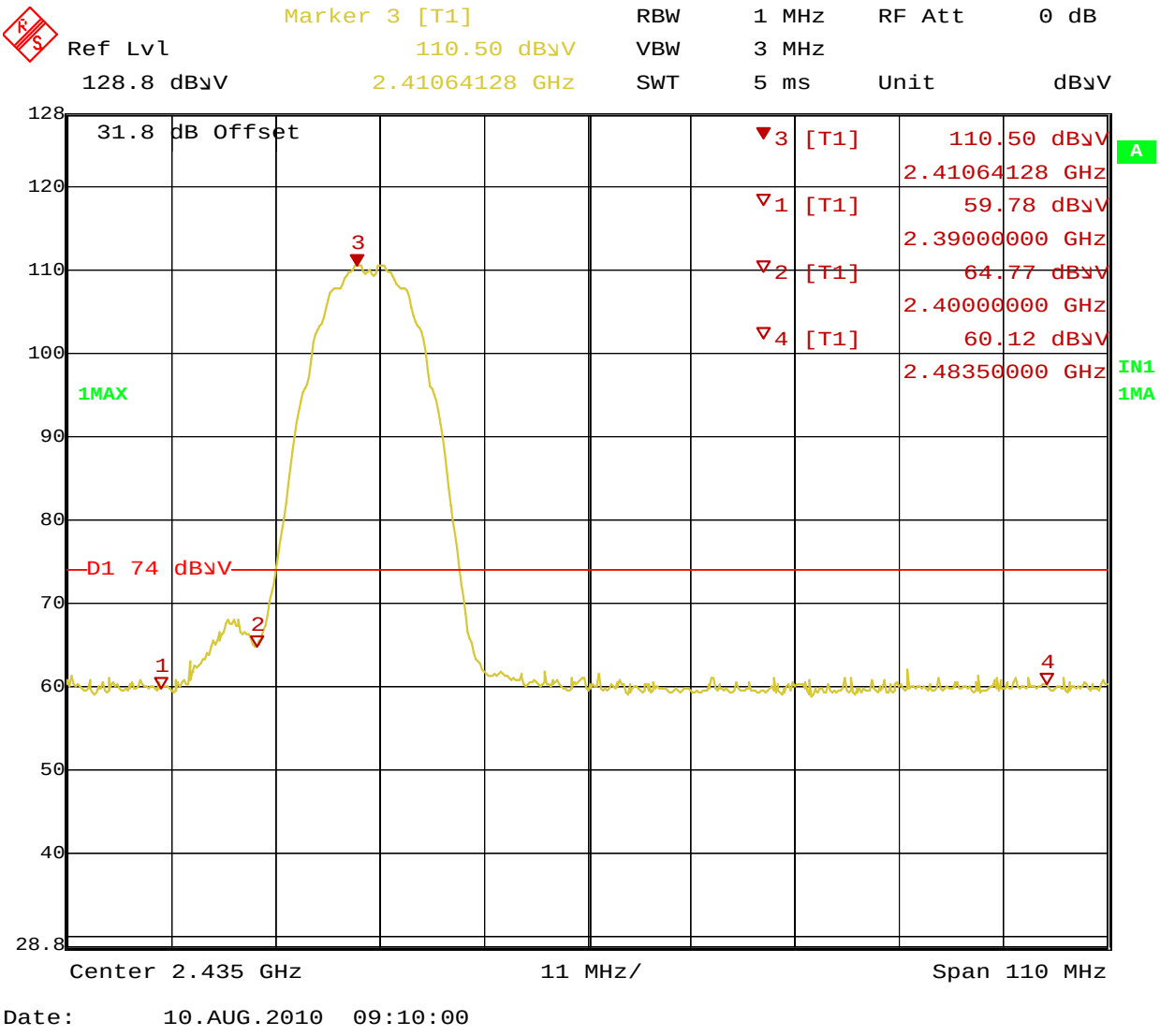


Figure 55: PCB Antenna Emission at the Edge for Channel 2412 MHz at 1 Mbps – Horizontal (Peak)

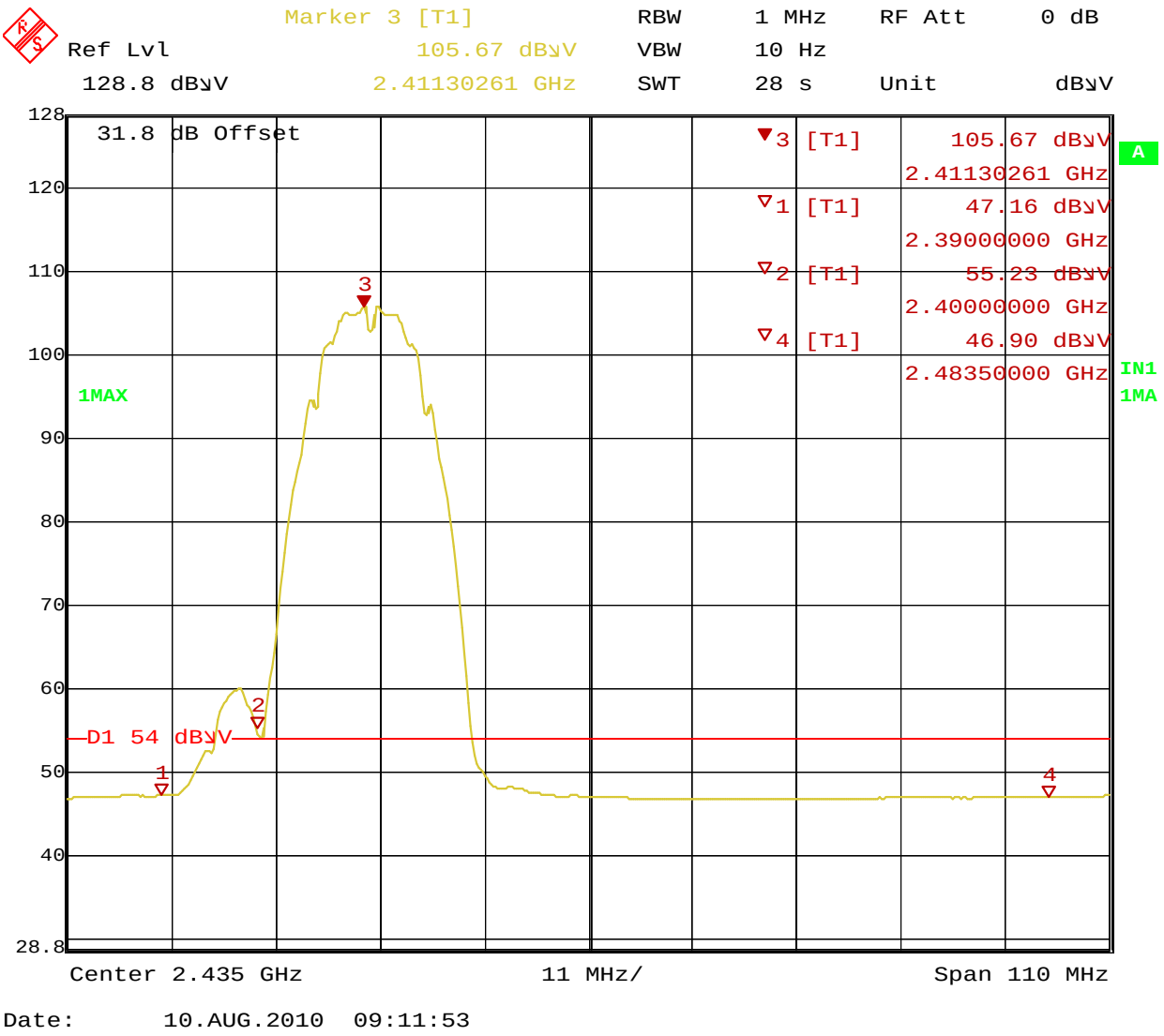


Figure 56: PCB Antenna Emission at the Edge for Channel 2412 MHz at 1 Mbps – Horizontal (Ave.)

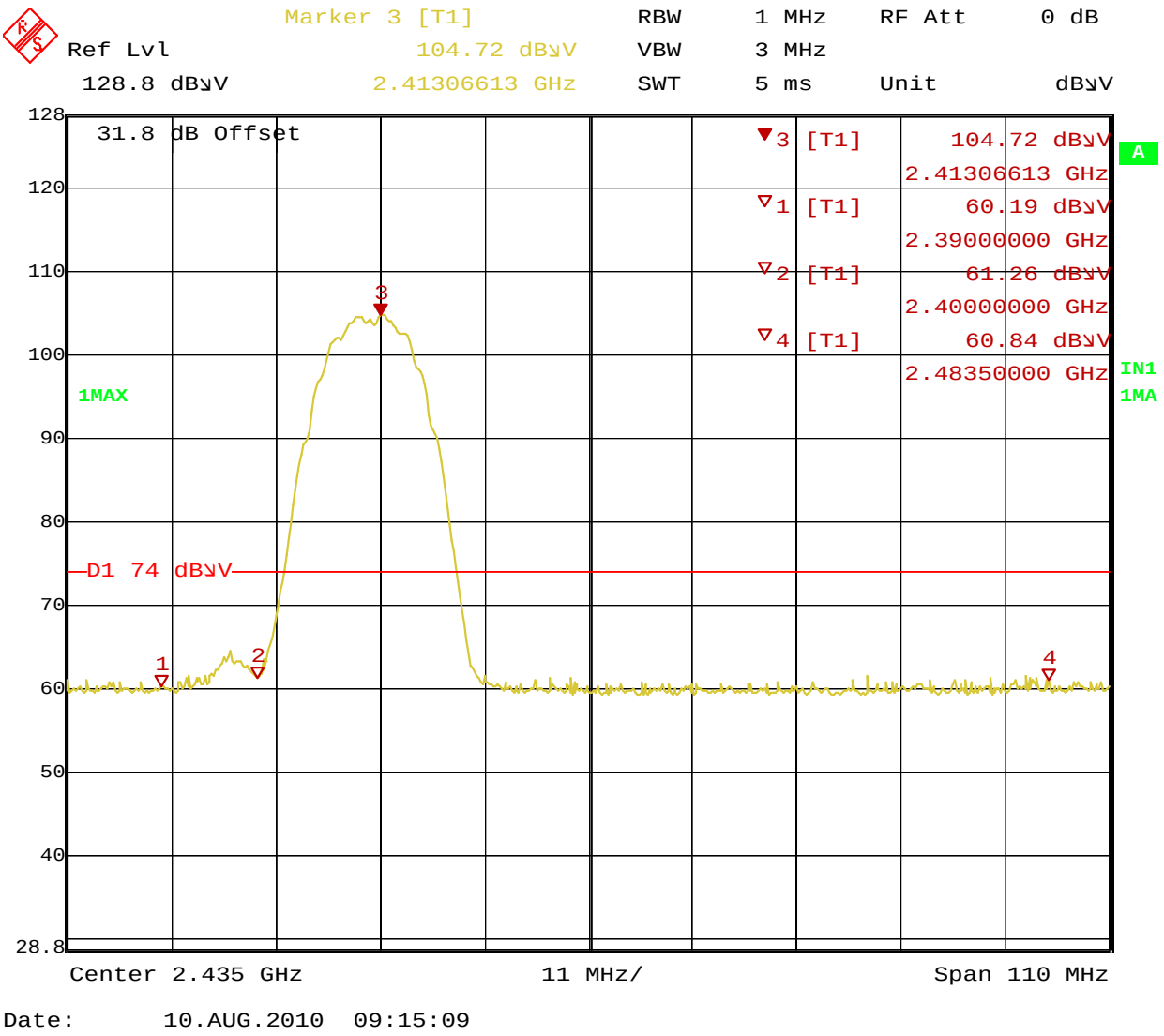


Figure 57: PCB Antenna Emission at the Edge for Channel 2412 MHz at 1 Mbps – Vertical (Peak)

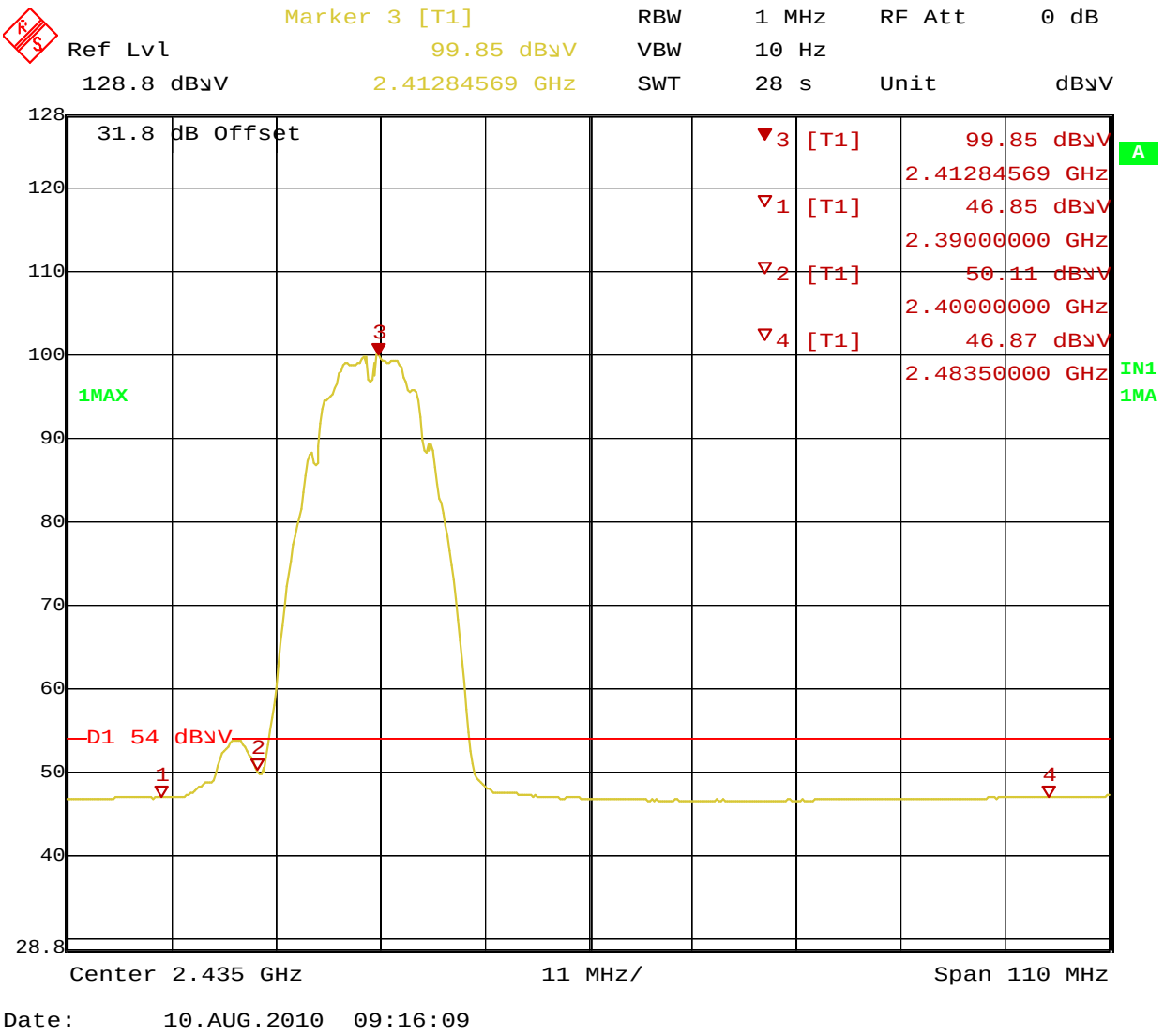


Figure 58: PCB Antenna Emission at the Edge for Channel 2412 MHz at 1 Mbps – Vertical (Ave.)

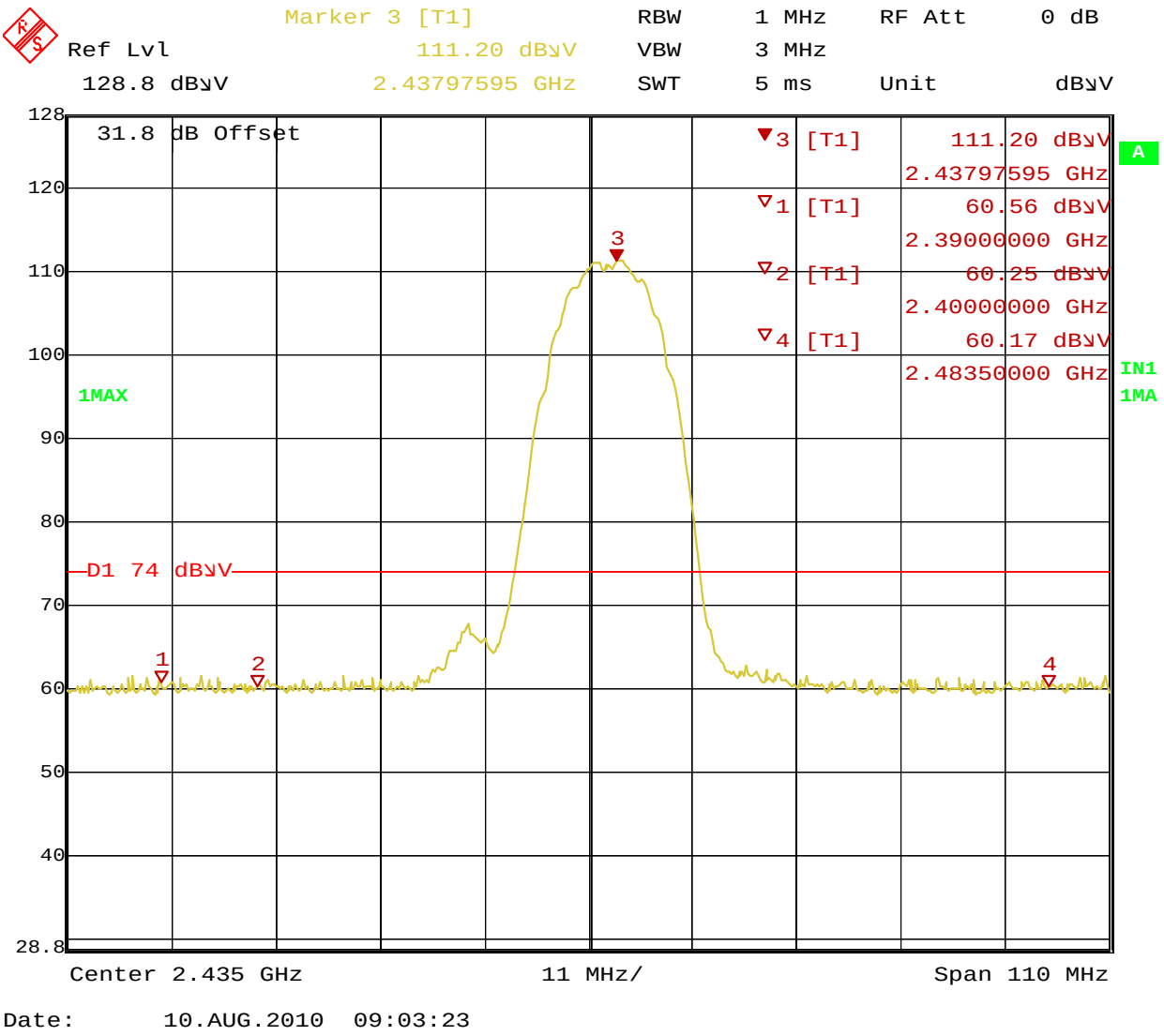


Figure 59: PCB Antenna Emission at the Edge for Channel 2437 MHz at 1 Mbps – Horizontal (Peak)

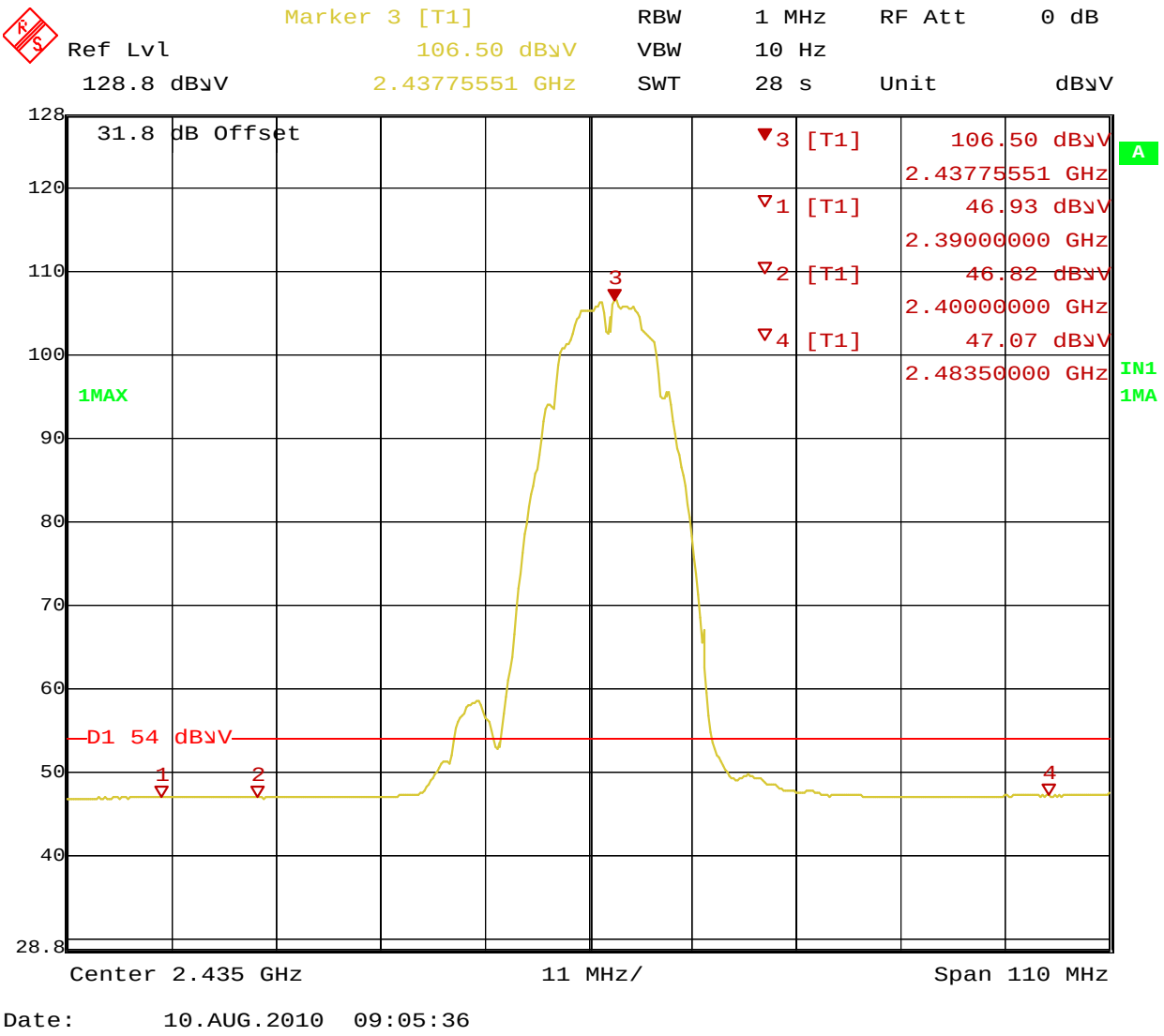


Figure 60: PCB Antenna Emission at the Edge for Channel 2437 MHz at 1 Mbps – Horizontal (Ave.)

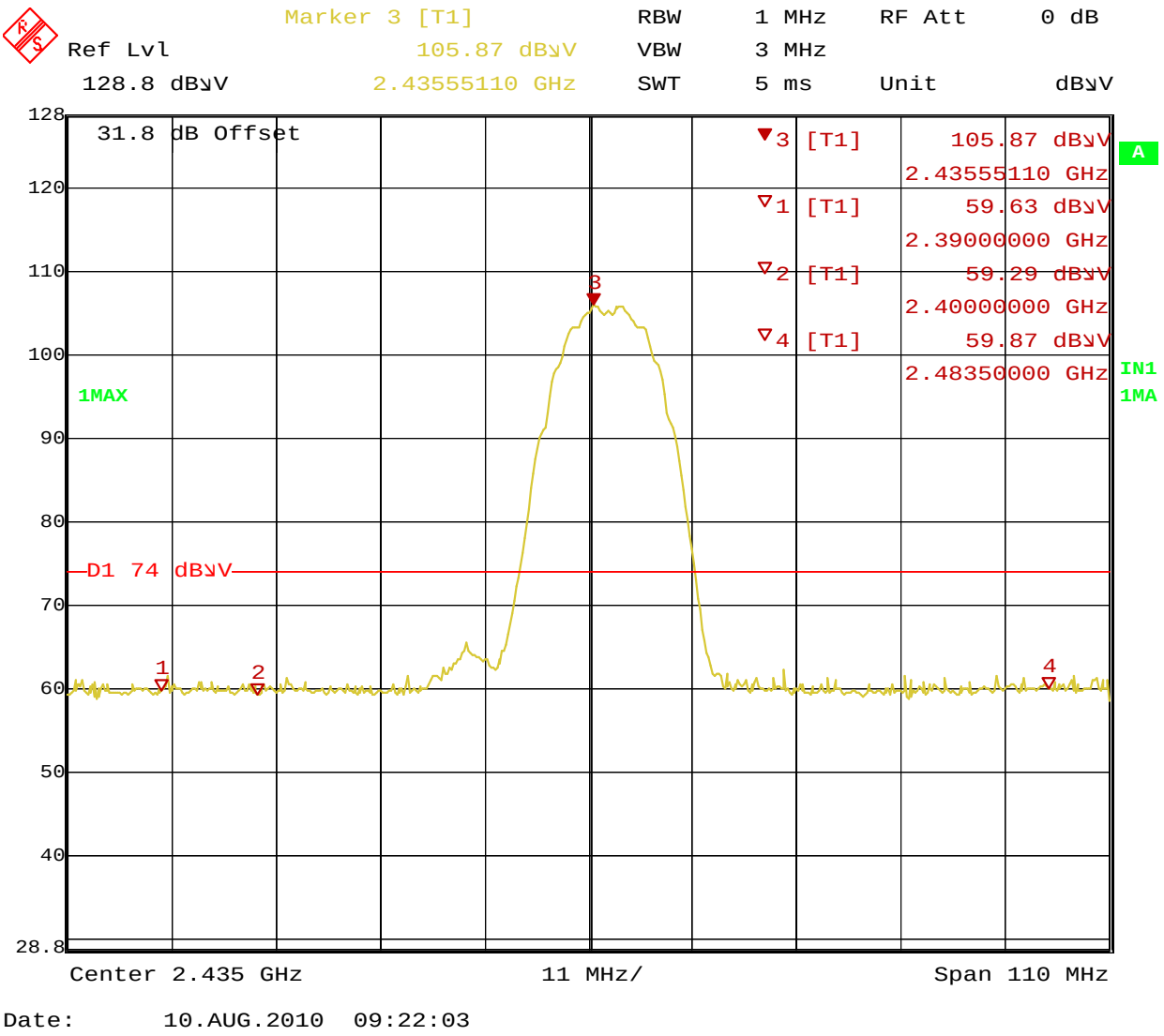


Figure 61: PCB Antenna Emission at the Edge for Channel 2437 MHz at 1 Mbps – Vertical (Peak)

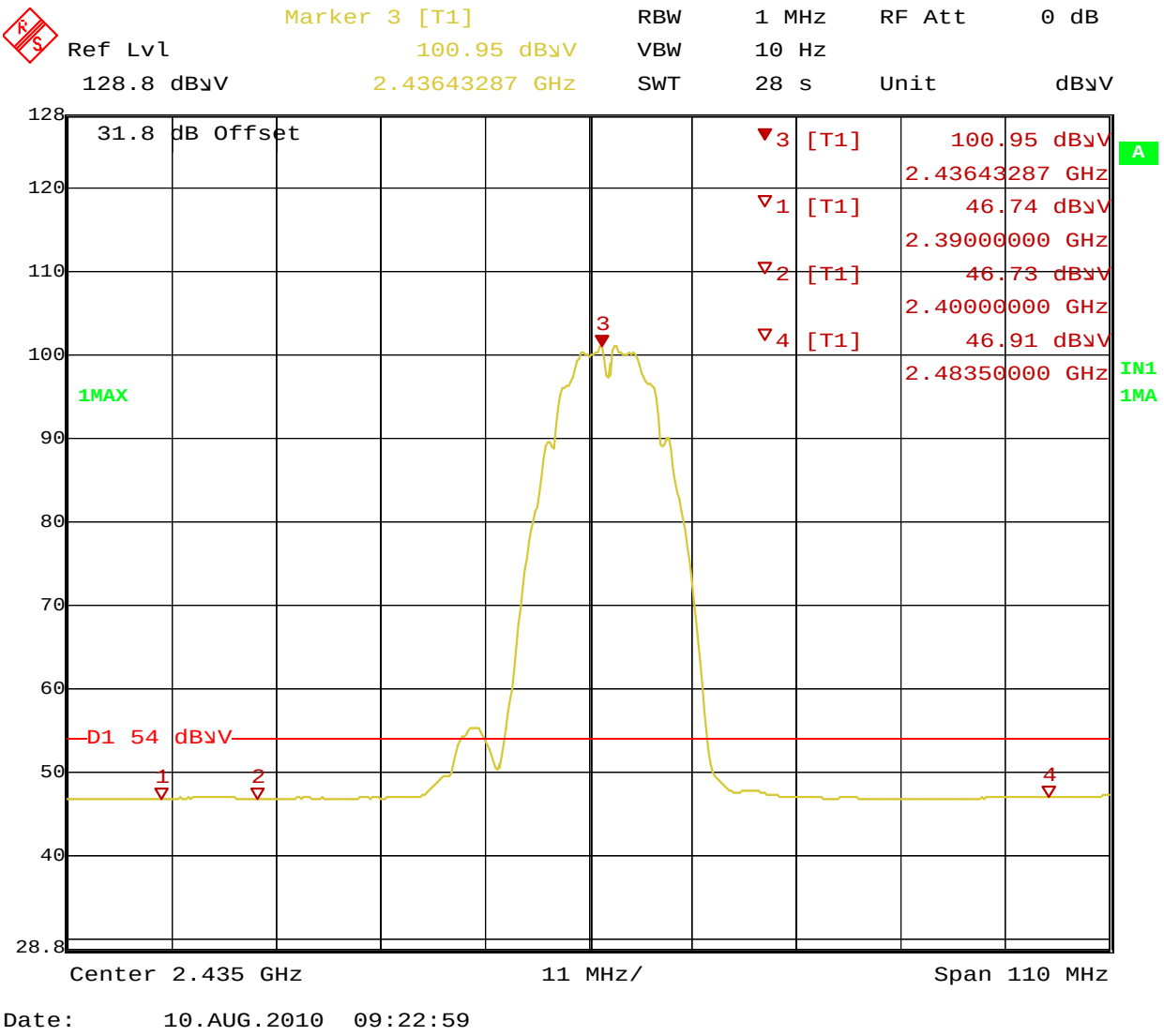


Figure 62: PCB Antenna Emission at the Edge for Channel 2437 MHz at 1 Mbps – Vertical (Ave.)

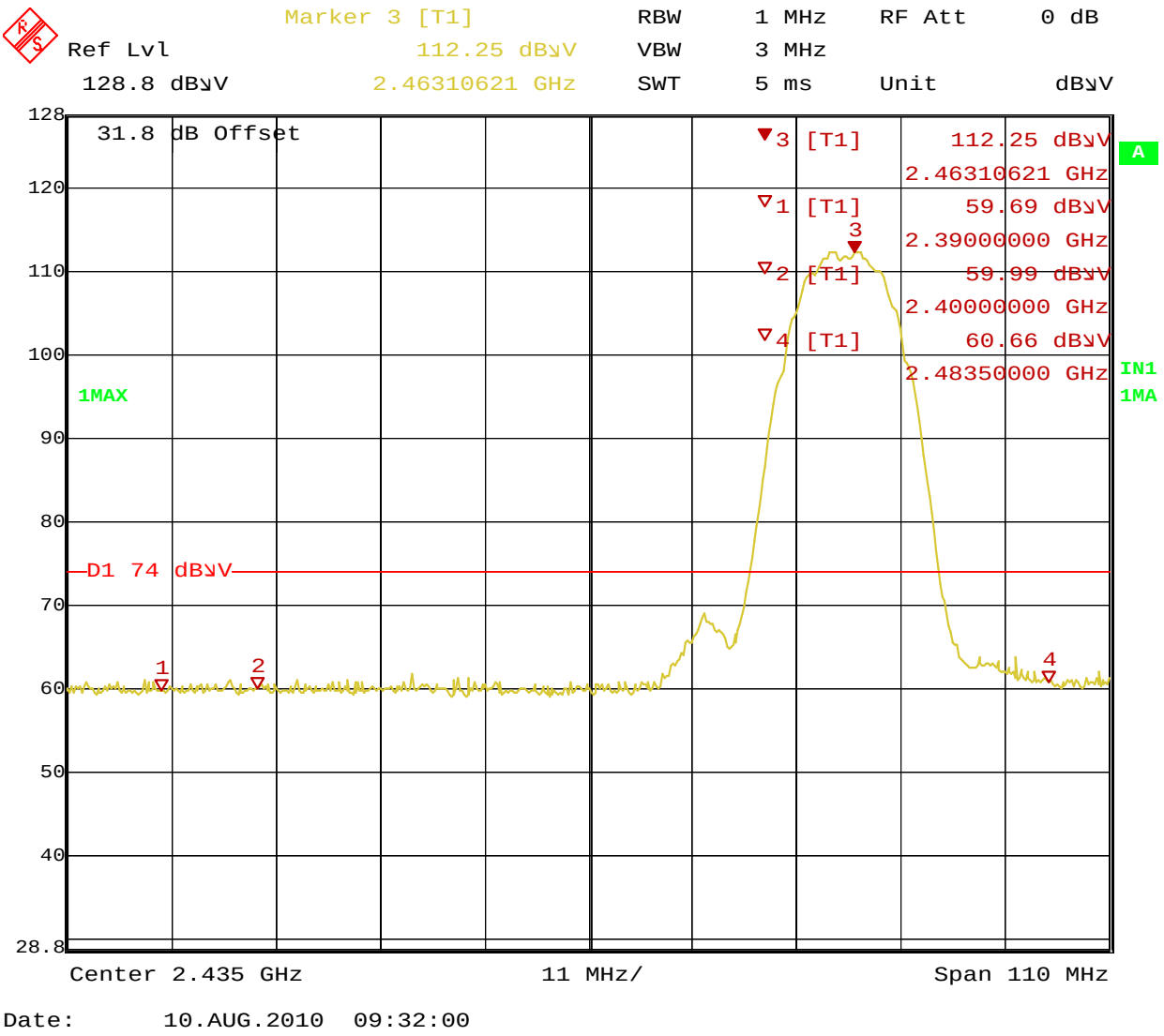


Figure 63: PCB Antenna Emission at the Edge for Channel 2462 MHz at 1 Mbps – Horizontal (Peak)

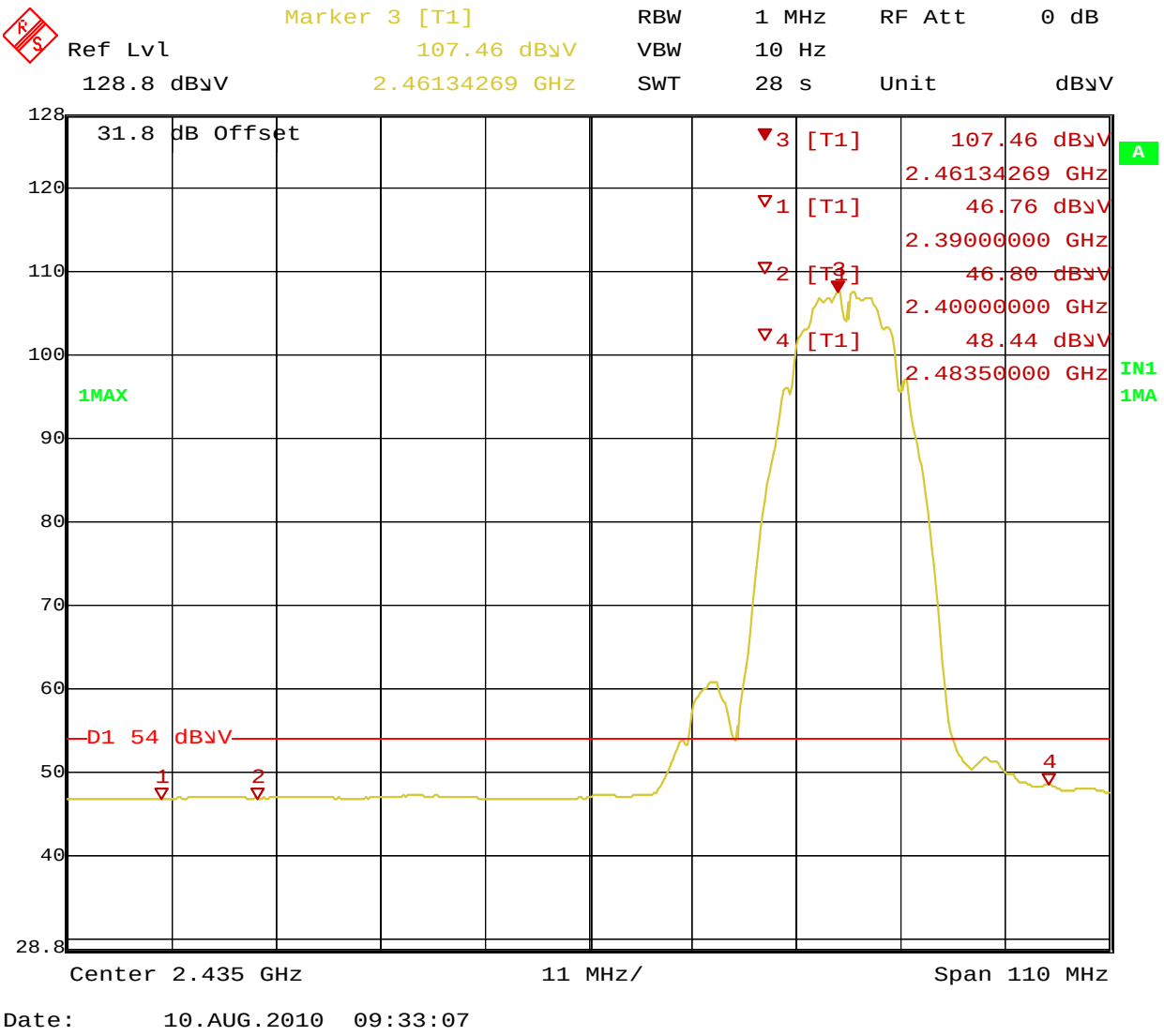


Figure 64: PCB Antenna Emission at the Edge for Channel 2462 MHz at 1 Mbps – Horizontal (Ave.)

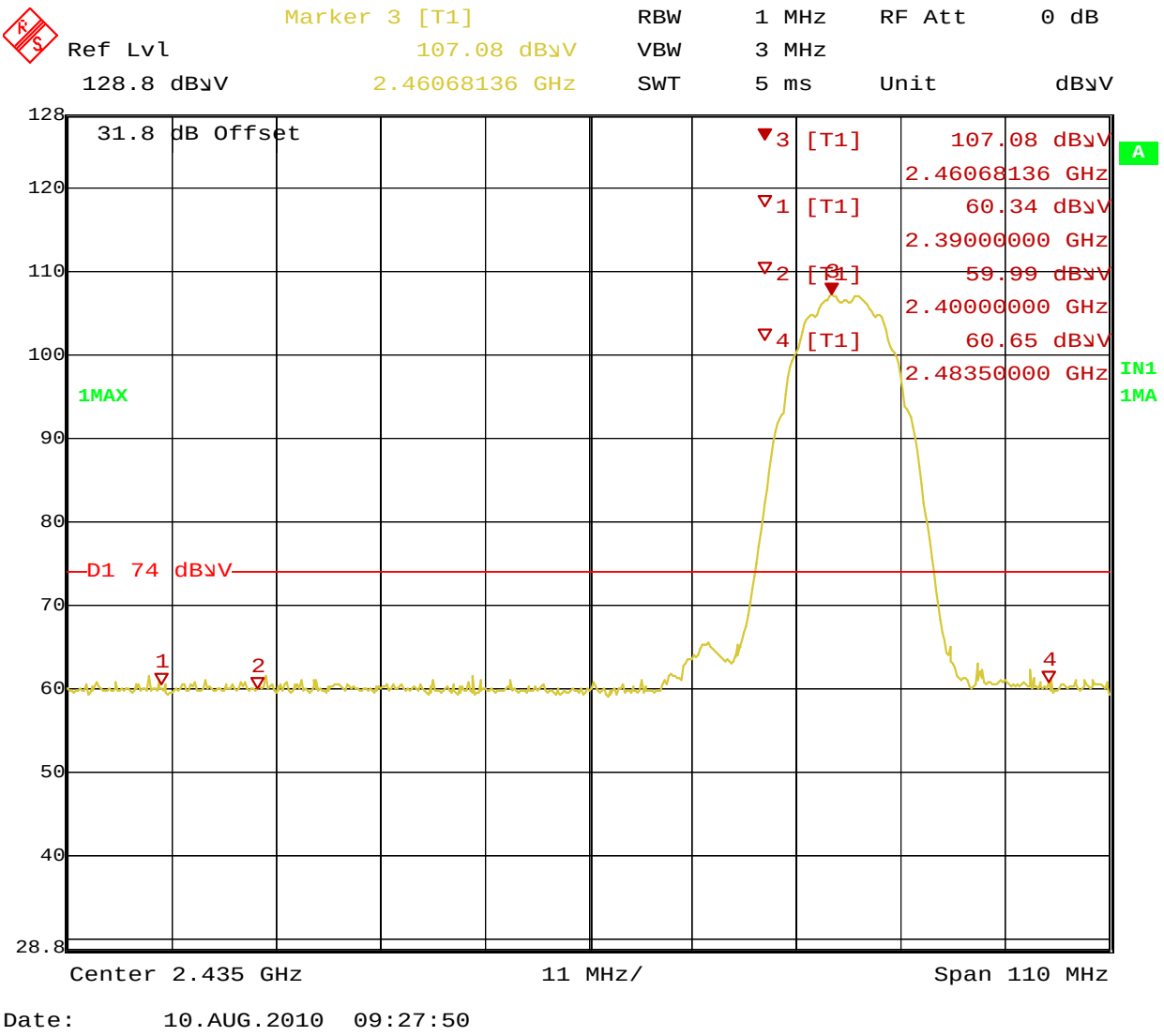


Figure 65: PCB Antenna Emission at the Edge for Channel 2462 MHz at 1 Mbps – Vertical (Peak)

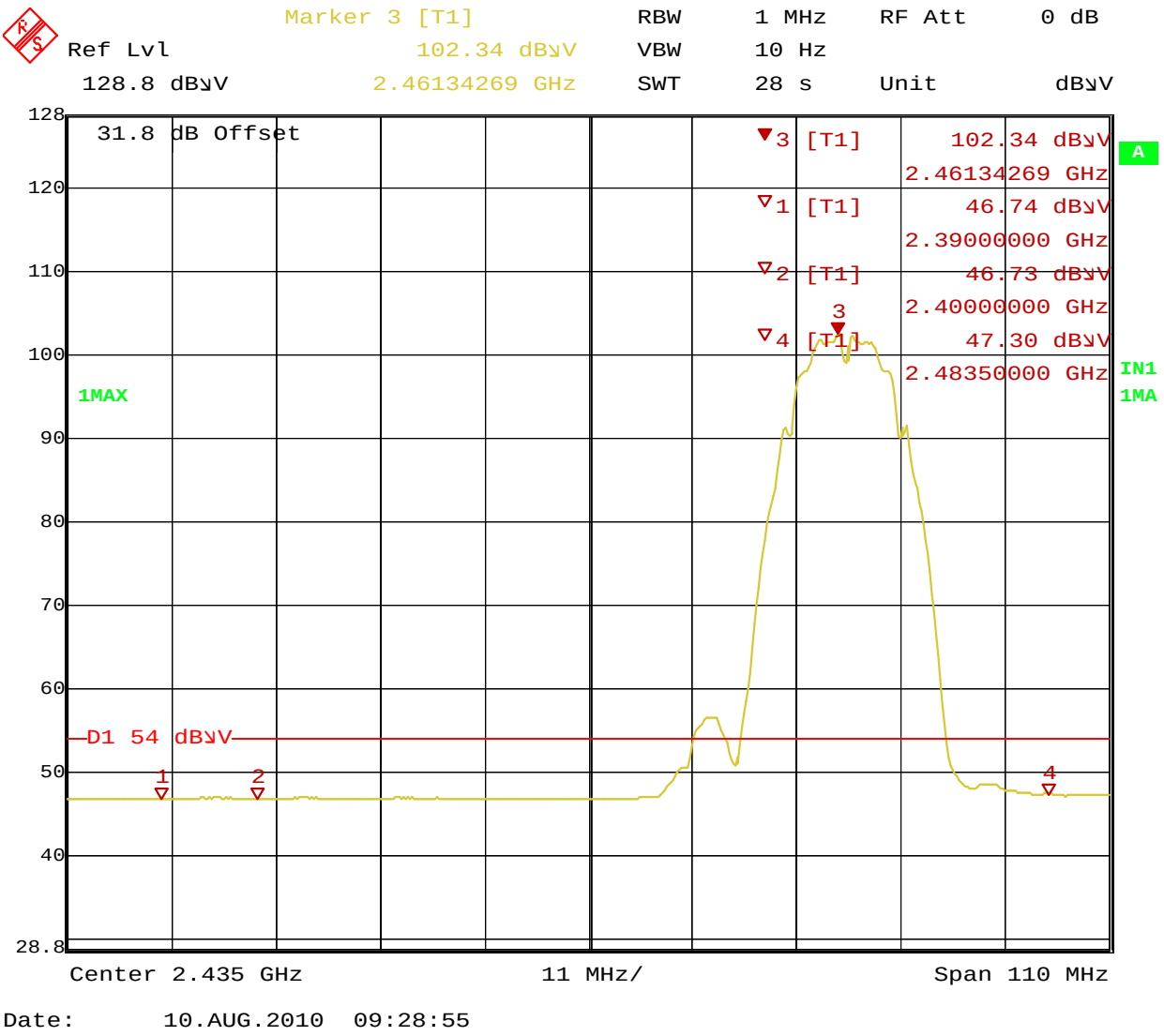


Figure 66: PCB Antenna Emission at the Edge for Channel 2462 MHz at 1 Mbps – Vertical (Ave.)

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EUT Name	Wi-Fi Module	**Date**	July 28, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	23° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5dBi Dipole Antenna Positioned Vertically	**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) 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										
263.99	H	106	98	44.85	43.81	-9.89	33.92	46.02	-12.10	Spurious
308.00	H	103	274	43.87	42.96	-8.51	34.45	46.02	-11.57	Spurious
44.17	V	126	202	40.07	35.77	-13.50	22.27	40.00	-17.73	Spurious
52.79	V	151	37	49.37	47.55	-16.94	30.61	40.00	-9.39	Spurious
54.07	V	111	220	50.04	47.81	-17.04	30.77	40.00	-9.23	Spurious
91.82	V	143	332	42.08	39.69	-16.66	23.03	43.52	-20.49	Spurious
265.97	V	155	288	29.08	26.50	-9.63	16.87	46.02	-29.15	Spurious
308.01	V	134	232	44.75	43.81	-8.51	35.30	46.02	-10.72	Spurious
Transmitted Data at 2437 MHz										
263.99	H	107	89	48.18	47.36	-9.89	37.47	46.02	-8.55	Spurious
308.00	H	104	288	46.51	45.50	-8.51	36.99	46.02	-9.03	Spurious
43.97	V	128	327	38.24	35.79	-13.38	22.41	40.00	-17.59	Spurious
52.73	V	115	36	50.97	47.82	-16.93	30.89	40.00	-9.11	Spurious
53.70	V	148	88	49.49	47.69	-17.01	30.68	40.00	-9.32	Spurious
91.31	V	117	15	43.47	40.19	-16.71	23.48	43.52	-20.04	Spurious
263.99	V	161	294	49.20	48.71	-9.89	38.82	46.02	-7.20	Spurious
308.00	V	154	263	46.85	46.02	-8.51	37.51	46.02	-8.51	Spurious
Transmitted Data at 2462 MHz										
263.99	H	112	117	47.45	46.92	-9.89	37.03	46.02	-8.99	Spurious
308.00	H	105	276	49.85	48.86	-8.51	40.35	46.02	-5.67	Spurious
44.02	V	107	259	40.76	36.96	-13.40	23.56	40.00	-16.44	Spurious
52.69	V	126	109	50.13	47.36	-16.93	30.43	40.00	-9.57	Spurious
53.56	V	111	144	50.87	48.19	-17.00	31.19	40.00	-8.81	Spurious
91.49	V	139	11	43.15	40.32	-16.69	23.63	43.52	-19.89	Spurious
264.00	V	168	278	48.61	47.99	-9.89	38.10	46.02	-7.92	Spurious
267.00	V	169	272	39.45	37.98	-9.48	28.50	46.02	-17.52	Spurious
308.00	V	163	220	50.29	49.54	-8.51	41.03	46.02	-4.99	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 $u_c(y)$ = ± 3.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Worst case was observed on the Z-axis, 1 Mbps, dipole on vertical position.
Average Dipole antenna gain is 4dBi. Its' maximum gain is 5dBi.

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EUT Name	Wi-Fi Module	**Date**	July 26, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	23° C / 38% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5dBi Dipole Antenna Positioned Vertically	**Line AC / Freq**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m / EMCO3115	**Performed by**	Jeremy Luong

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (cm)	Table Pos (deg)	FIM (Pk) 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										
2147.35	V	111	227	51.86	43.47	-1.25	42.22	53.98	-11.76	Restricted
4824.09	V	153	93	48.00	45.76	5.08	50.84	53.98	-3.14	Restricted
4824.12	H	104	255	48.71	45.74	5.08	50.82	53.98	-3.16	Restricted
7235.30	H	115	256	46.10	35.85	10.30	46.15	53.98	-7.83	Restricted
7236.92	V	118	69	44.55	34.31	10.31	44.62	53.98	-9.36	Restricted
9648.12	H	125	99	47.12		12.77	59.89	92.38	-32.49	Unrestricted
9648.12	V	118	423	47.29		12.77	60.06	92.38	-32.32	Unrestricted
19296.1	V	100	114	43.4	38.1	11.36	49.46	63.98	-14.52	Restricted
Transmitted Data at 2437 MHz at 802.11b, 1 MBit/s										
2173.75	V	109	182	54.38	45.80	-1.16	44.64	53.98	-9.34	Restricted
4874.09	V	154	93	47.39	45.00	5.25	50.25	53.98	-3.73	Restricted
4874.13	H	182	128	47.47	44.48	5.25	49.73	53.98	-4.25	Restricted
7310.30	V	146	-74	44.36	36.29	10.37	46.65	53.98	-7.33	Restricted
7310.36	H	110	321	46.90	39.92	10.37	50.29	53.98	-3.69	Restricted
9748.12	H	113	466	45.84		12.84	58.68	92.38	-33.70	Unrestricted
9748.12	V	144	76	48.94		12.84	61.78	92.38	-33.60	Unrestricted
19496.1	H	116	456	38.15	33.12	11.55	44.67	63.98	-19.31	Restricted
19496.2	V	89	123	41.76	37.41	11.55	48.96	63.98	-15.02	Restricted
Transmitted Data at 2462 MHz at 802.11b, 1 MBit/s										
2154.78	V	229	321	52.65	43.35	-1.23	42.12	53.98	-11.86	Restricted
4924.07	H	251	299	46.22	42.75	5.38	48.13	53.98	-5.85	Restricted
4924.10	V	176	321	44.50	40.54	5.38	45.92	53.98	-8.06	Restricted
7386.88	H	254	201	45.42	38.73	10.44	49.17	53.98	-4.81	Restricted
7386.88	V	255	-67	45.46	38.64	10.44	49.09	53.98	-4.89	Restricted
9848.09	H	229	93	47.39		12.90	60.29	92.38	-32.09	Unrestricted
9848.27	V	298	186	44.78		12.90	57.68	92.38	-34.70	Unrestricted
19696.1	H	121	82	41.13	36.26	11.71	47.97	63.98	-16.01	Restricted
19696.2	V	116	331	42.61	37.04	11.71	48.75	63.98	-15.23	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 $u_c(y)$ = ± 3.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Worst case was observed on the Z-axis, 1 Mbps.
Average Dipole antenna gain is 4dBi. Its' maximum gain is 5dBi.
1 GHz – 25 GHz Setting: RBW = 1 MHz / VBW = 3 MHz
20 dBr limit applied to the unrestricted band emission; 92.38dBuV/m at 3 meter distance.
Limit extrapolated to 1 meter test distance for 18 GHz – 25 GHz range.

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EUT Name	Wi-Fi Module	**Date**	August 5, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	23° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	2dBi Ext. PCB Antenna laid horizontally	**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) 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										
395.99	H	118	105	28.22	25.06	-6.87	18.19	46.02	-27.83	Spurious
53.01	V	133	6	49.56	47.15	-17.34	29.81	40.00	-10.19	Spurious
58.07	V	123	74	45.22	43.06	-16.36	26.70	40.00	-13.30	Spurious
114.49	V	132	340	41.02	38.21	-10.66	27.55	43.52	-15.97	Spurious
121.78	V	106	355	40.16	37.15	-9.88	27.27	43.52	-16.25	Spurious
396.00	V	133	198	32.99	30.08	-7.29	22.79	46.02	-23.23	Spurious
Transmitted Data at 2437 MHz										
119.60	H	275	271	24.55	19.97	-9.83	10.14	43.52	-33.38	Spurious
52.41	V	115	248	49.34	45.44	-17.35	28.09	40.00	-11.91	Spurious
58.30	V	126	239	43.91	40.59	-16.29	24.30	40.00	-15.70	Spurious
107.29	V	121	350	37.73	34.25	-12.20	22.05	43.52	-21.47	Spurious
117.05	V	105	73	40.41	36.68	-10.32	26.36	43.52	-17.16	Spurious
122.04	V	106	29	40.54	37.79	-9.85	27.94	43.52	-15.58	Spurious
Transmitted Data at 2462 MHz										
52.37	V	146	352	49.96	46.84	-17.35	29.49	40.00	-10.51	Spurious
57.25	V	107	37	48.17	46.13	-16.61	29.52	40.00	-10.48	Spurious
112.57	V	118	5	41.64	39.54	-11.03	28.51	43.52	-15.01	Spurious
120.07	V	115	163	40.00	36.95	-9.98	26.97	43.52	-16.55	Spurious
308.00	V	150	196	35.73	34.82	-8.53	26.29	46.02	-19.73	Spurious
308.00	H	115	118	33.12	30.97	-8.29	22.68	46.02	-23.34	Spurious
329.991	H	116	142	31.33	24.34	-7.82	16.52	46.02	-29.5	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 $u_c(y)$ = ± 3.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Worst case was observed on the Z-axis, 1 Mbps, PCB Antenna laid horizontally.
Average PCB antenna gain is 1dBi. Its' maximum gain is 2dBi.

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EUT Name	Wi-Fi Module	**Date**	August 4, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	2dBi external PCB antenna laid horizontally	**Line AC / Freq**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m / EMCO3115	**Performed by**	Jeremy Luong

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (cm)	Table Pos (deg)	FIM (Pk) Pk (dBuV/m)	FIM Ave. (dBuV/m)	Total CF dBuV	E-Field Ave. (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)	Type
Transmitted Data at 2412 MHz at 802.11b, 1 MBit/s										
2173.87	V	149	442	59.91	52.13	-1.16	50.97	53.98	-3.01	Restricted
4874.07	H	168	257	48.05	44.42	5.25	49.67	53.98	-4.31	Restricted
4874.14	V	174	53	47.57	44.19	5.25	49.44	53.98	-4.54	Restricted
7310.36	H	165	443	46.71	37.01	10.37	47.38	53.98	-6.60	Restricted
7311.86	V	149	-60	46.99	36.44	10.37	46.80	53.98	-7.18	Restricted
9748.12	H	148	104	49.78		12.84	62.62	92.25	-29.63	Unrestricted
9748.12	V	121	441	49.11		12.84	61.95	92.25	-30.30	Unrestricted
19496.10	H	113	143	39.78	33.74	11.55	45.29	63.98	-18.69	Restricted
19496.20	V	114	91	39.77	36.46	11.55	48.01	63.98	-15.97	Restricted
Transmitted Data at 2437 MHz at 802.11b, 1 MBit/s										
2148.80	V	152	90	52.52	44.07	-1.25	42.82	53.98	-11.16	Restricted
4824.14	V	164	111	49.45	45.92	5.08	51.00	53.98	-2.98	Restricted
4824.14	H	168	135	49.69	46.27	5.08	51.35	53.98	-2.63	Restricted
7235.26	V	211	408	41.39	30.94	10.30	41.25	53.98	-12.73	Restricted
7235.38	H	121	-84	42.02	32.82	10.30	43.12	53.98	-10.86	Restricted
9648.09	V	163	427	42.74		12.77	55.51	92.25	-36.74	Unrestricted
9648.12	H	118	97	45.83		12.77	58.60	92.25	-33.65	Unrestricted
19296.10	H	102	129	34.00	26.45	11.36	37.81	63.98	-26.17	Restricted
19296.10	V	101	91	39.43	35.19	11.36	46.55	63.98	-17.43	Restricted
Transmitted Data at 2462 MHz at 802.11b, 1 MBit/s										
2154.87	V	153	90	58.71	46.92	-1.23	45.69	53.98	-8.29	Restricted
4924.10	V	179	297	46.50	43.66	5.38	49.04	53.98	-4.94	Restricted
4924.10	H	163	121	45.37	42.18	5.38	47.56	53.98	-6.42	Restricted
7385.16	V	194	-68	43.98	34.26	10.44	44.70	53.98	-9.28	Restricted
7386.84	H	151	318	45.93	36.88	10.44	47.32	53.98	-6.66	Restricted
9848.12	H	226	259	49.07		12.90	61.97	92.25	-30.28	Unrestricted
9848.12	V	179	365	45.32		12.90	58.22	92.25	-34.03	Unrestricted
19696.10	V	120	448	41.79	37.32	11.71	49.03	63.98	-14.95	Restricted
19696.20	H	115	92	41.84	38.38	11.71	50.09	63.98	-13.89	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 $u_c(y)$ = ± 3.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Worst case was observed on the Z-axis, 1 Mbps.
Average PCB antenna gain is 1dBi. Its' maximum gain is 2dBi.
1 GHz – 25 GHz Setting: RBW = 1 MHz / VBW = 3 MHz
20 dBr limit applied to the unrestricted band emission. 92.25dBuV/m at 3 meter distance
Limit extrapolated to 1 meter test distance for 18 GHz – 25 GHz range.

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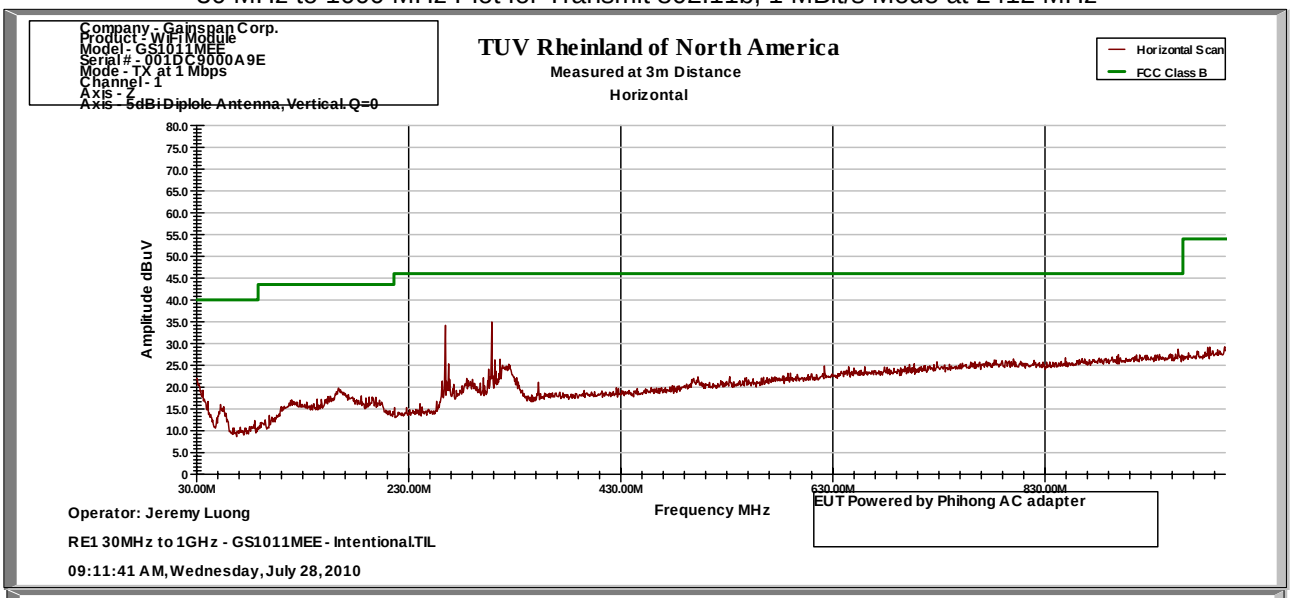
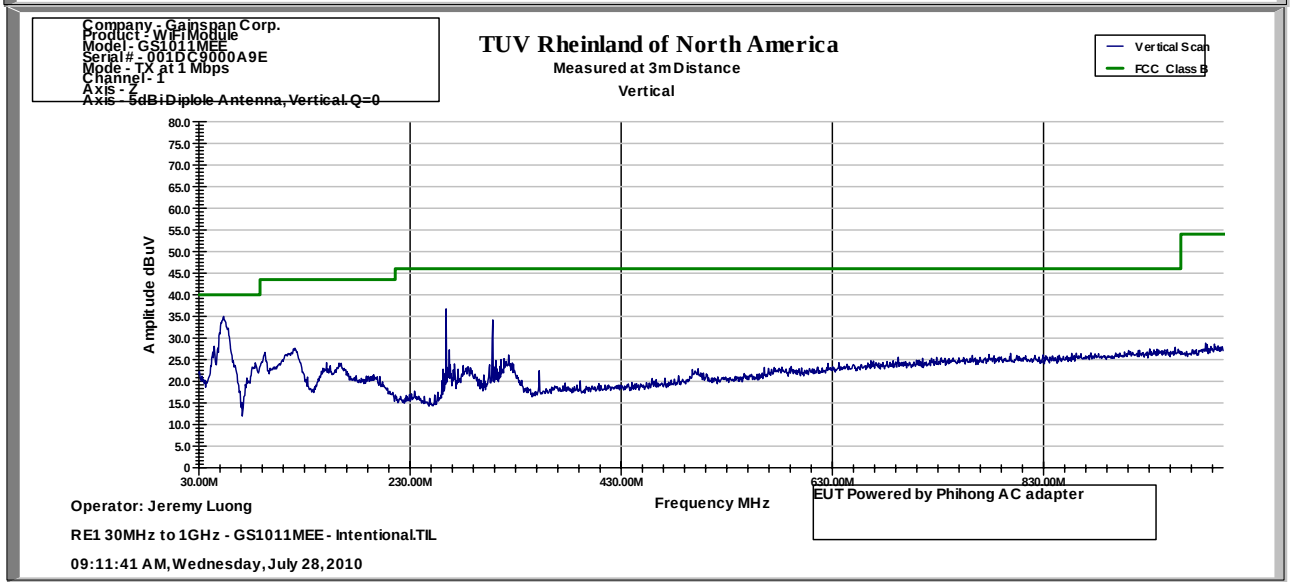
EUT Name	Wi-Fi Module	**Date**	July 28, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	23° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5 dBi Dipole Antenna Positioned Vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

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





Notes: Average Dipole antenna gain is 4dBi. Its' maximum gain is 5dBi.

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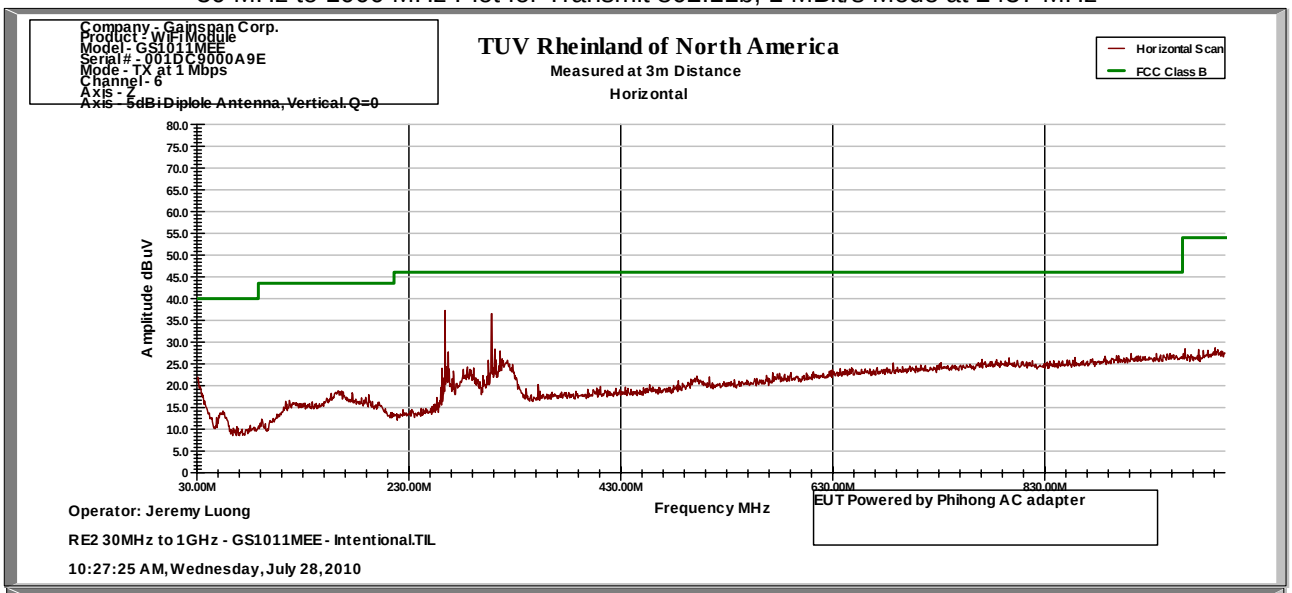
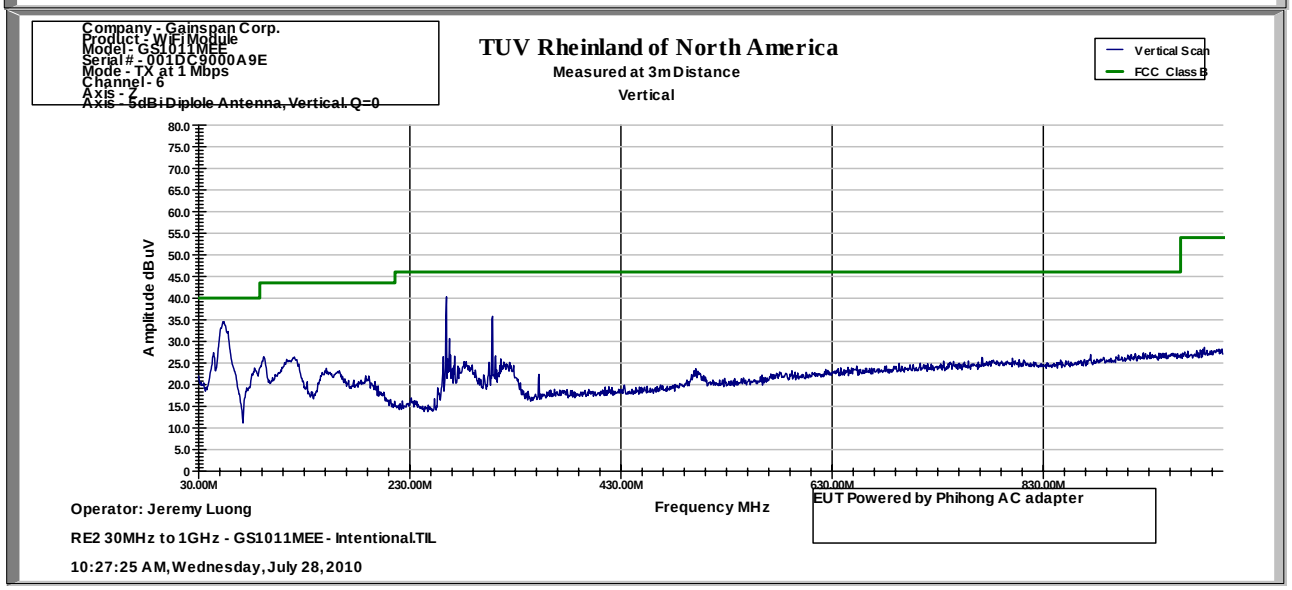
EUT Name	Wi-Fi Module	**Date**	July 28, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	23° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5 dBi Dipole Antenna Positioned Vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

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





Notes: Average Dipole antenna gain is 4dBi. Its' maximum gain is 5dBi.

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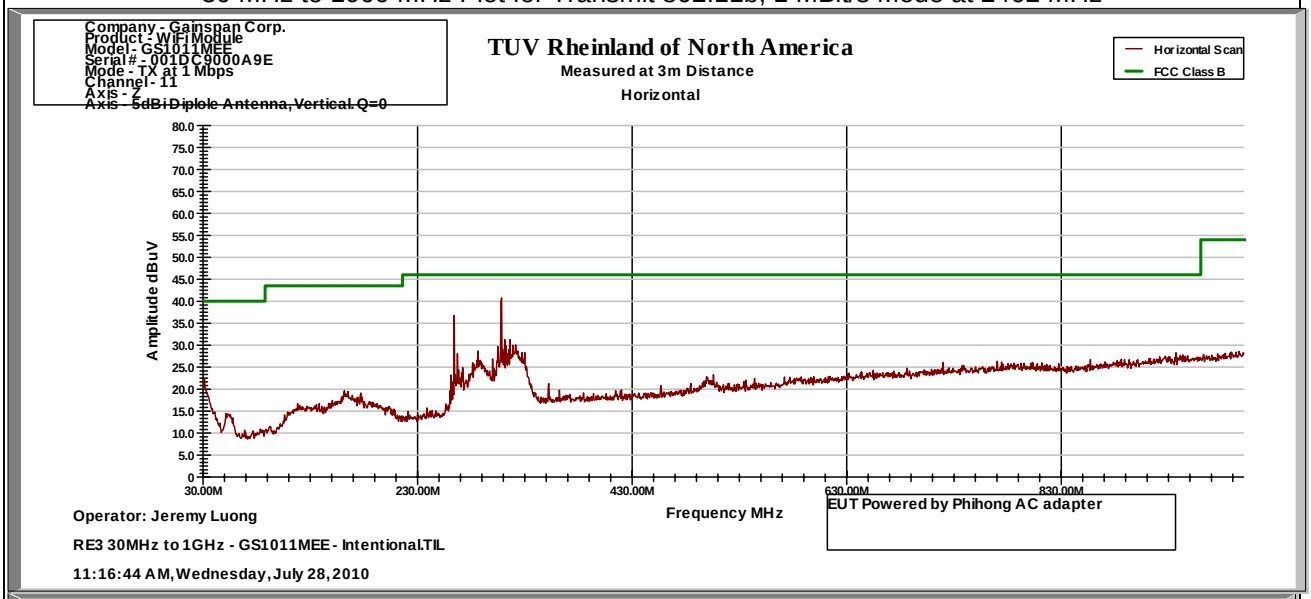
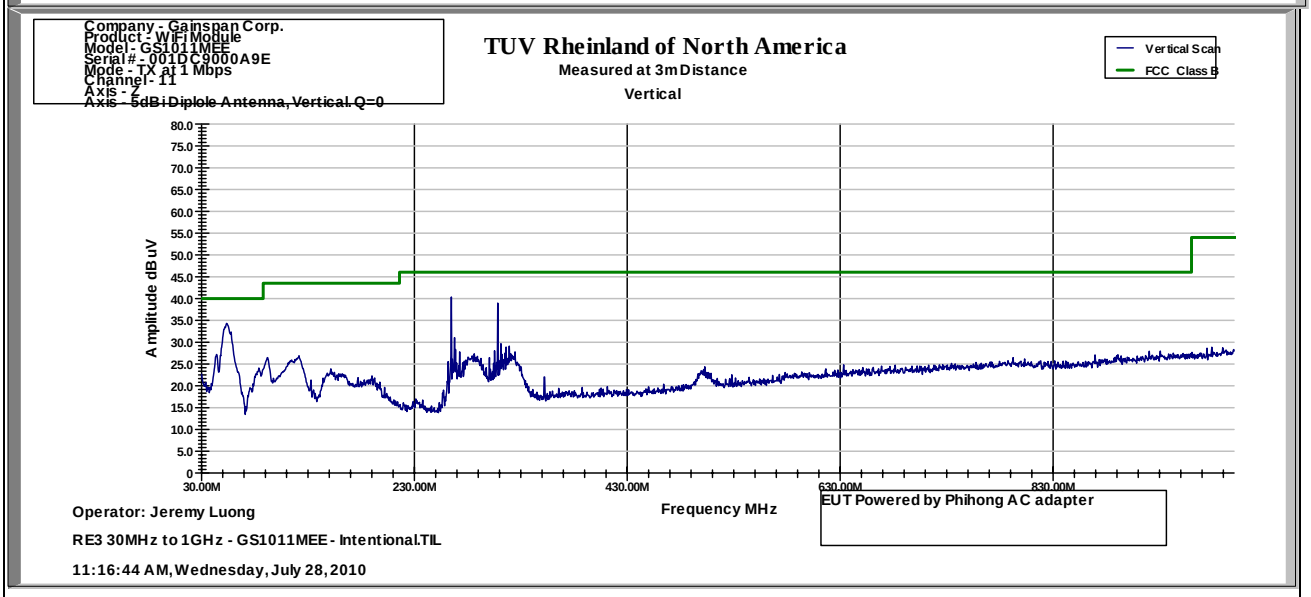
EUT Name	Wi-Fi Module	**Date**	July 28, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	23° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5 dBi Dipole Antenna Positioned Vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

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





Notes: Average Dipole antenna gain is 4dBi. Its' maximum gain is 5dBi.

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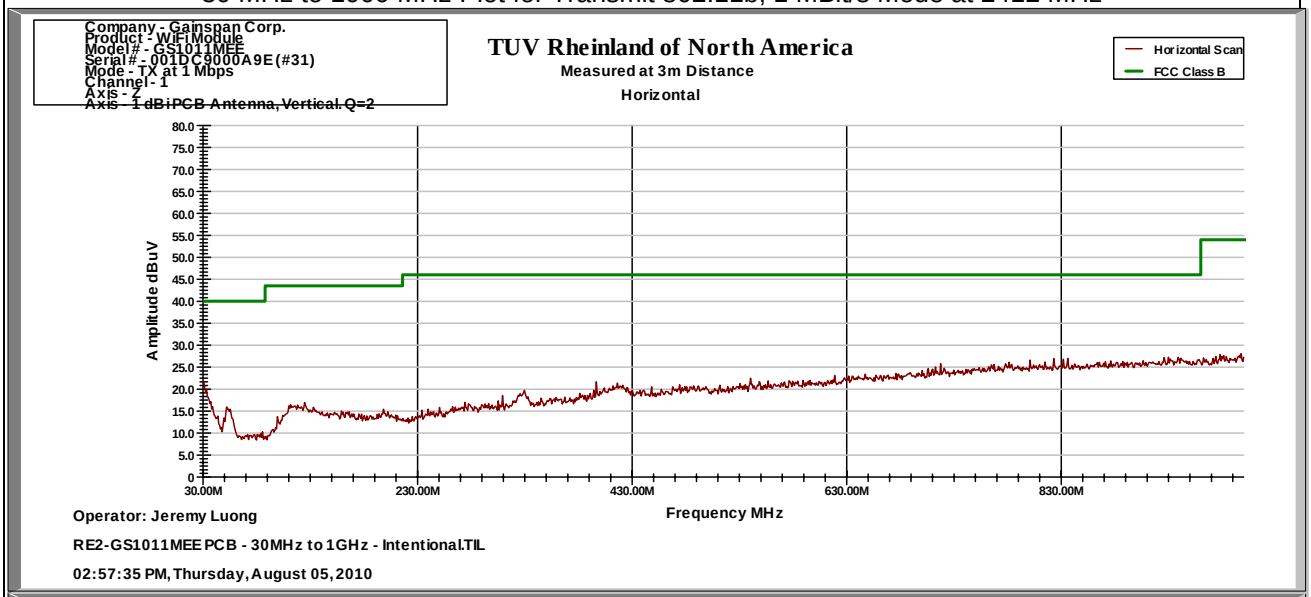
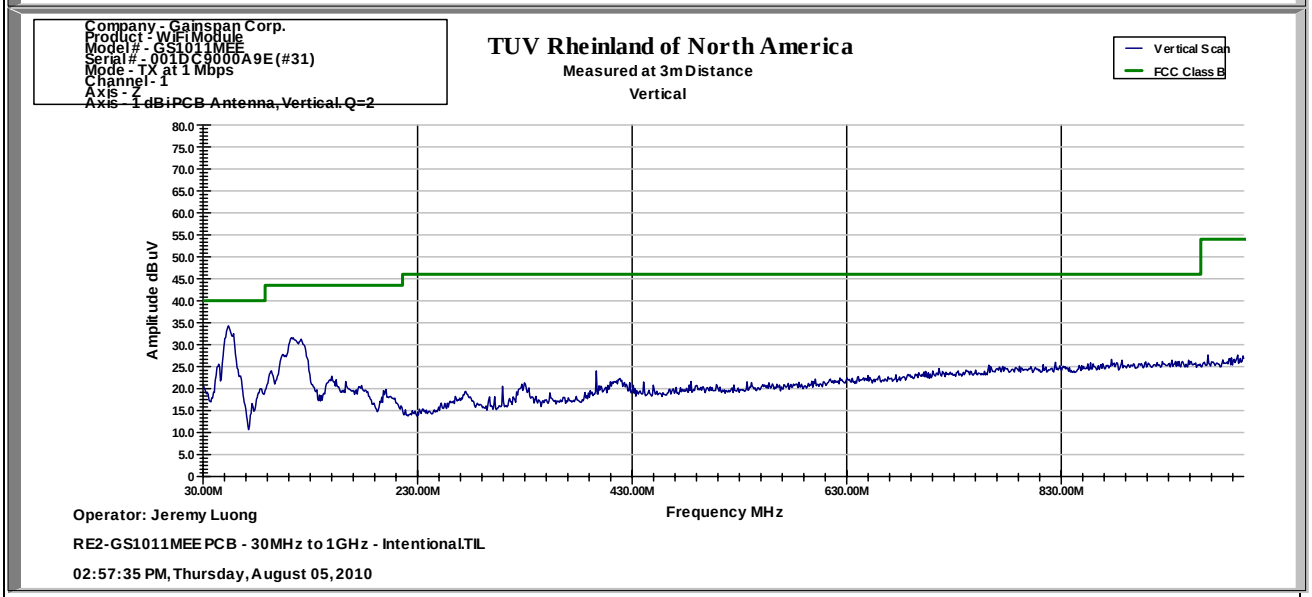
EUT Name	Wi-Fi Module	**Date**	July 28, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	23° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	2 dBi PCB Antenna Positioned Vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

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





Notes: Average PCB antenna gain is 1dBi. Its' maximum gain is 2dBi.

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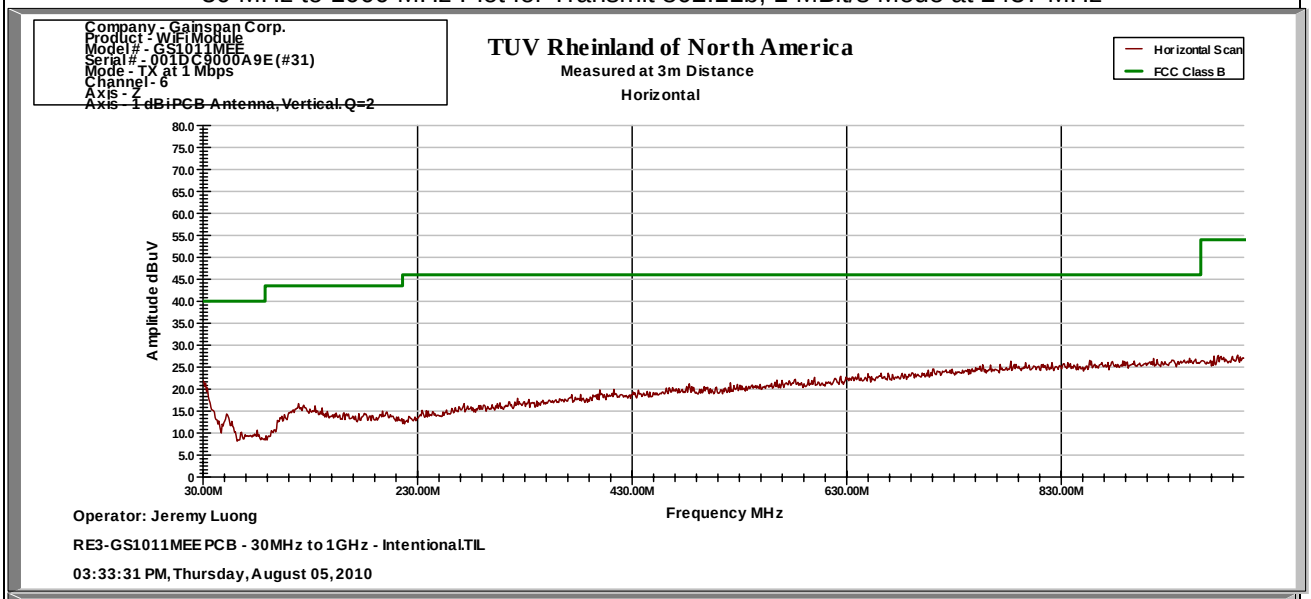
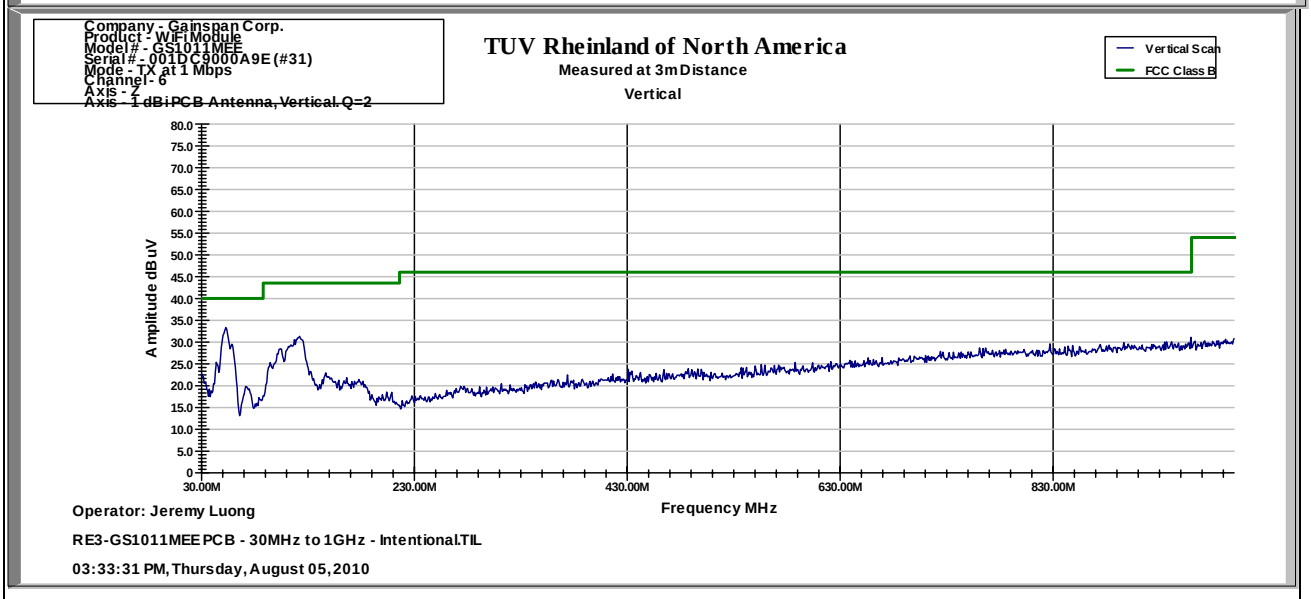
EUT Name	Wi-Fi Module	**Date**	July 28, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	23° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	2 dBi PCB Antenna Positioned Vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

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





Notes: Average PCB antenna gain is 1dBi. Its' maximum gain is 2dBi.

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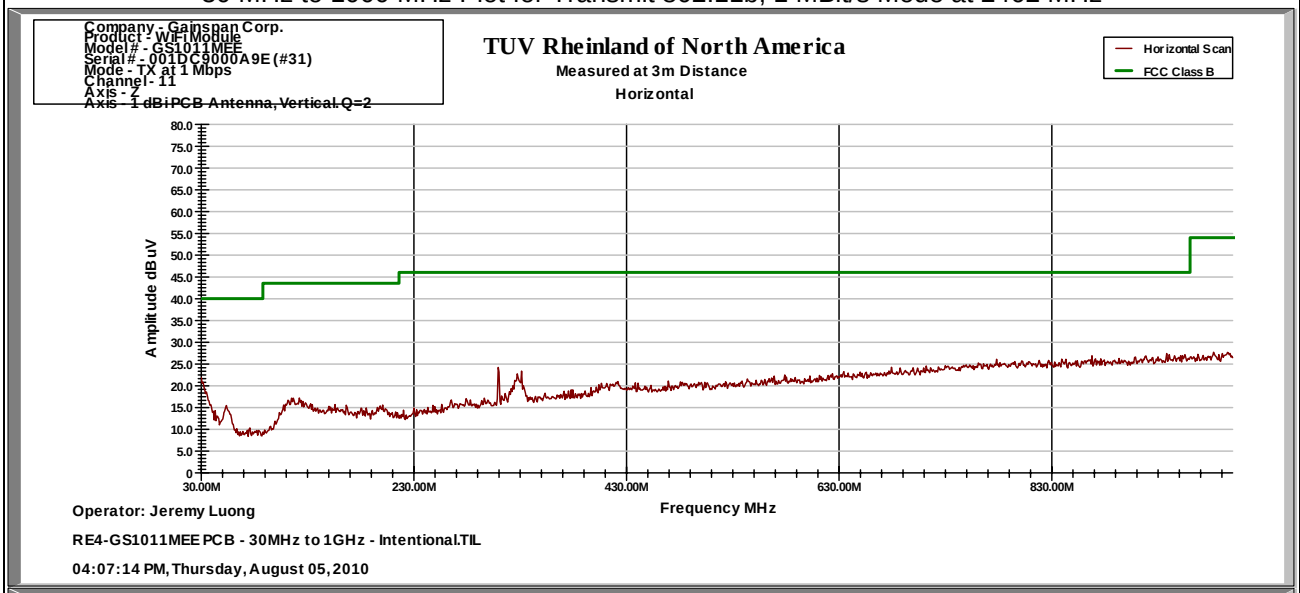
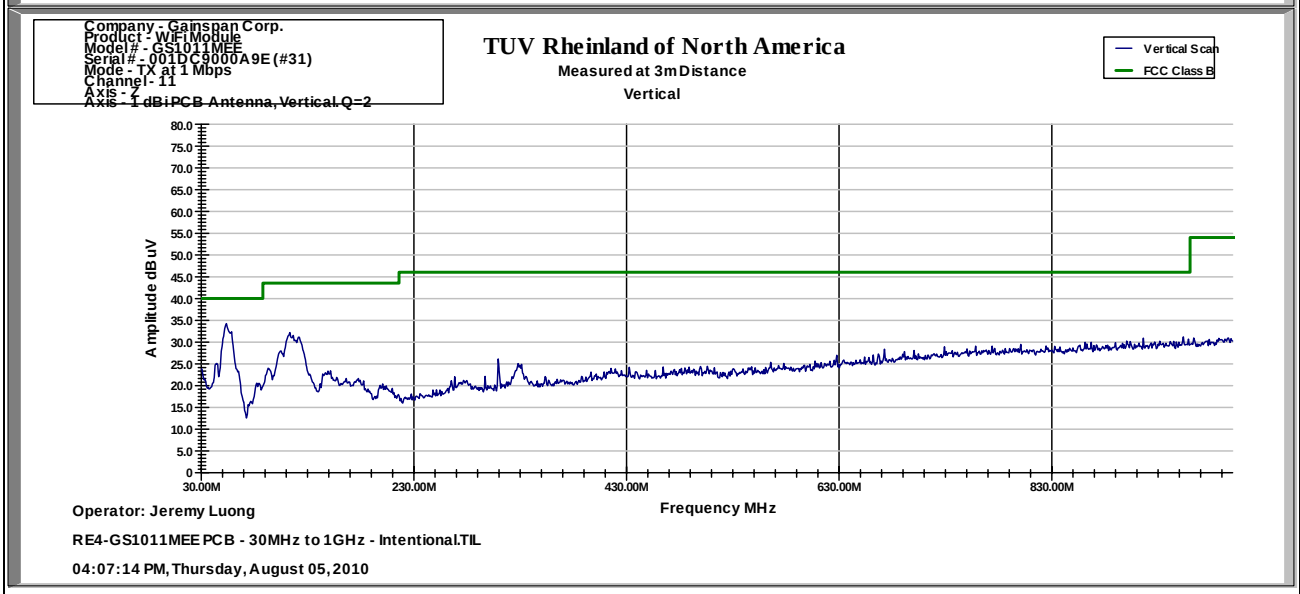
EUT Name	Wi-Fi Module	**Date**	July 28, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	23° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	2 dBi PCB Antenna Positioned Vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

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





Notes: Average PCB antenna gain is 1dBi. Its' maximum gain is 2dBi.

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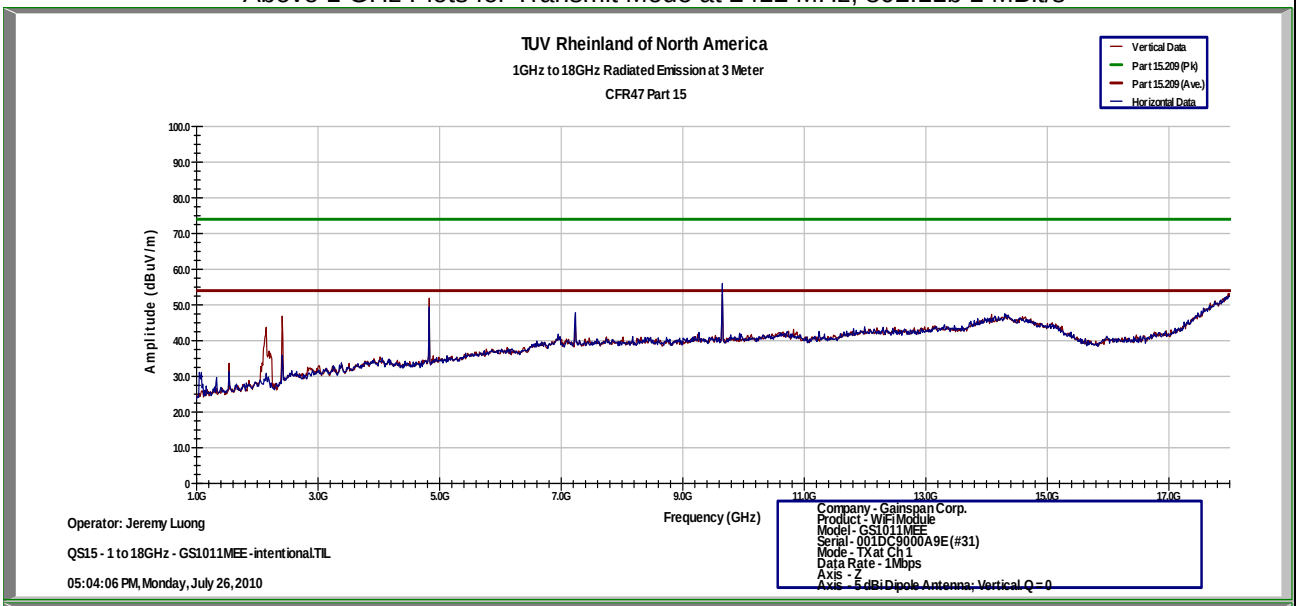
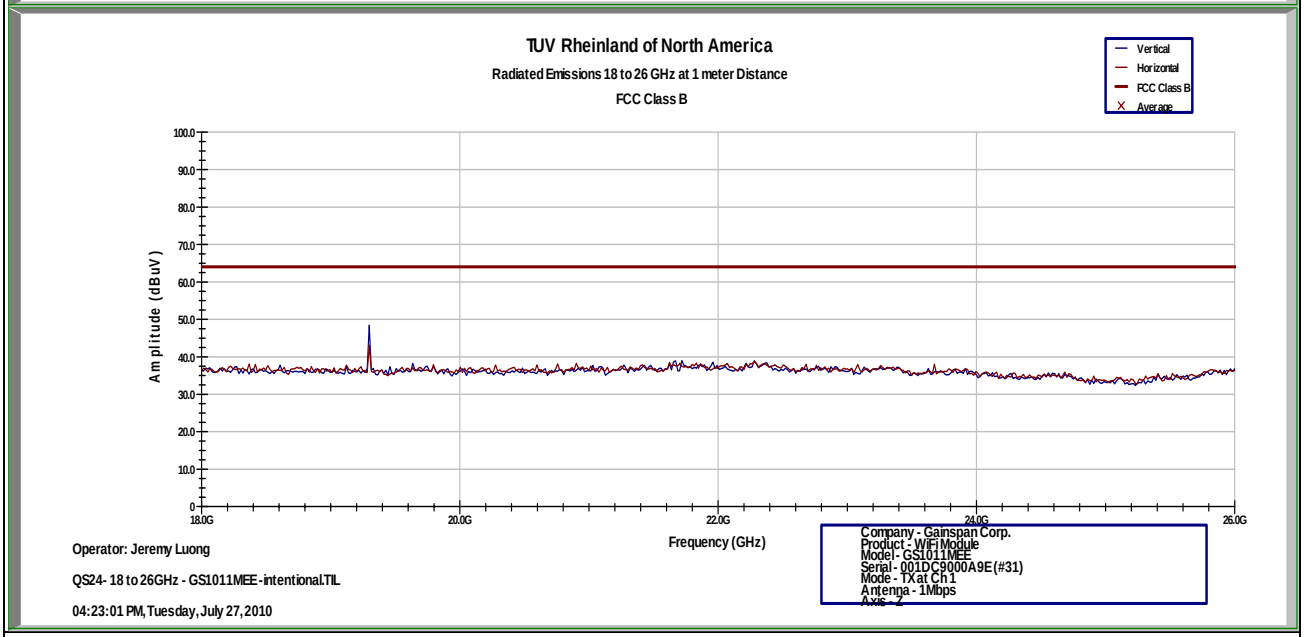
EUT Name	Wi-Fi Module	**Date**	July 27, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 39% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5dBi Dipole Antenna Positioned Vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Jeremy Luong

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





Notes: Limit was extrapolated to 1m distance for 18 GHz – 25 GHz range.
1 GHz – 25 GHz Setting: RBW = 1 MHz / VBW = 3 MHz
Average Dipole antenna gain is 4dBi. Its' maximum gain is 5dBi.

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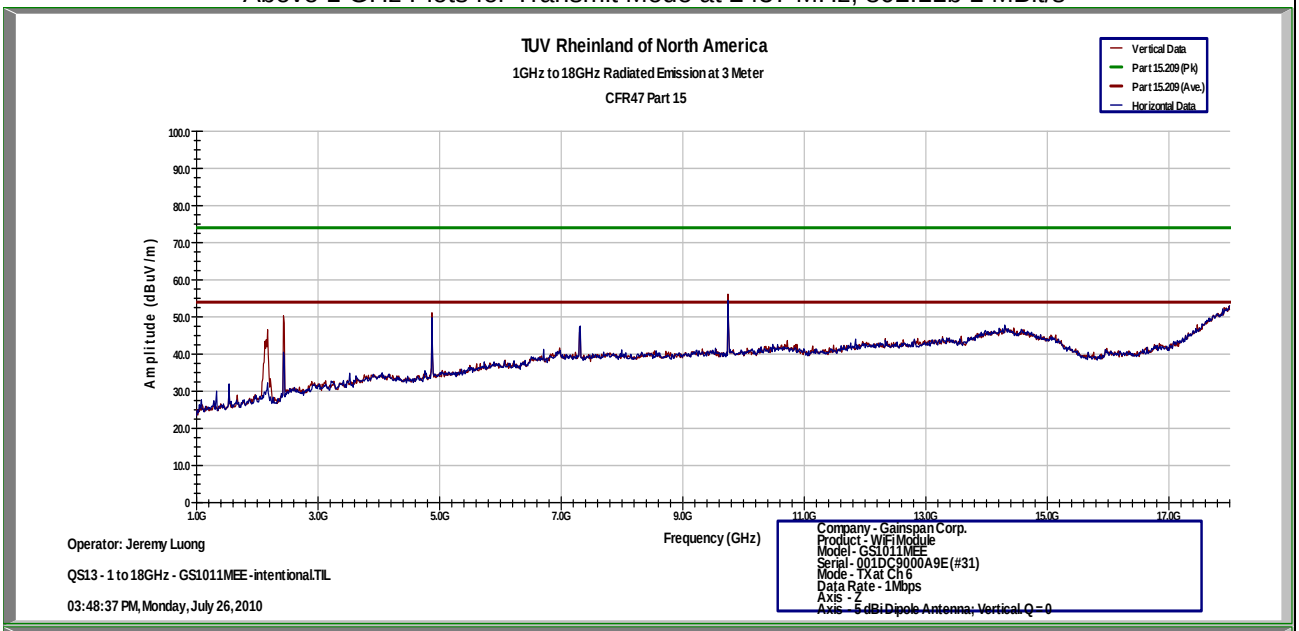
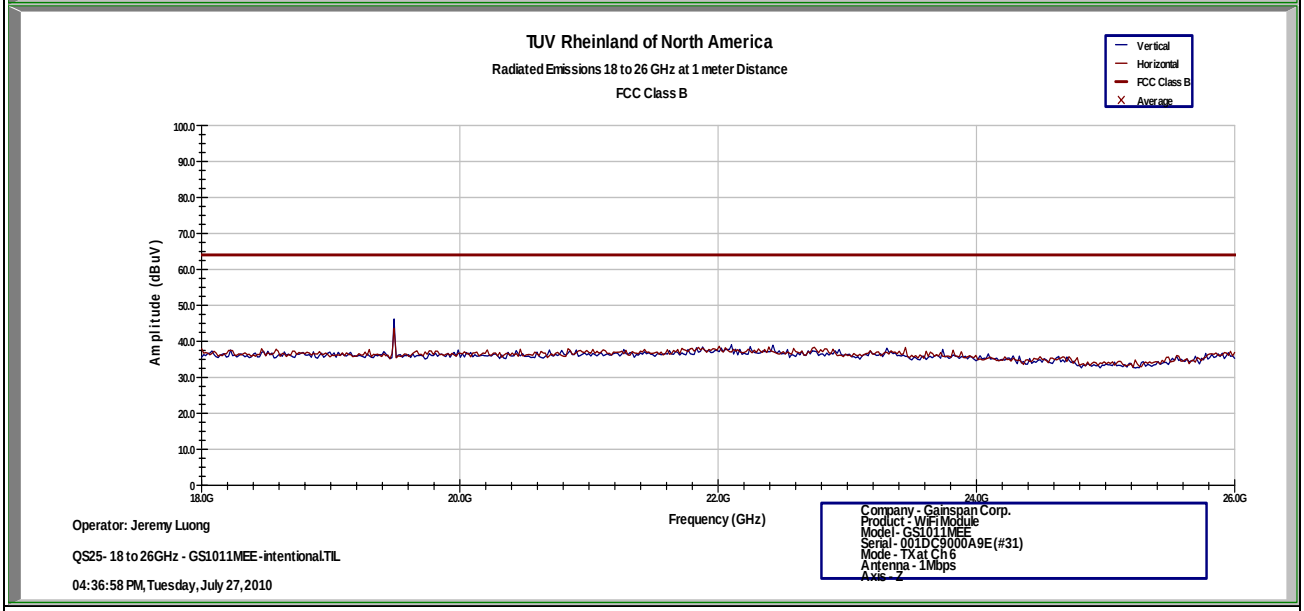
EUT Name	Wi-Fi Module	**Date**	July 27, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 39% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5dBi Dipole Antenna Positioned Vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Jeremy Luong

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





Notes: Limit was extrapolated to 1m distance for 18 GHz – 25 GHz range.
1 GHz – 25 GHz Setting: RBW = 1 MHz / VBW = 3 MHz
Average Dipole antenna gain is 4dBi. Its' maximum gain is 5dBi.

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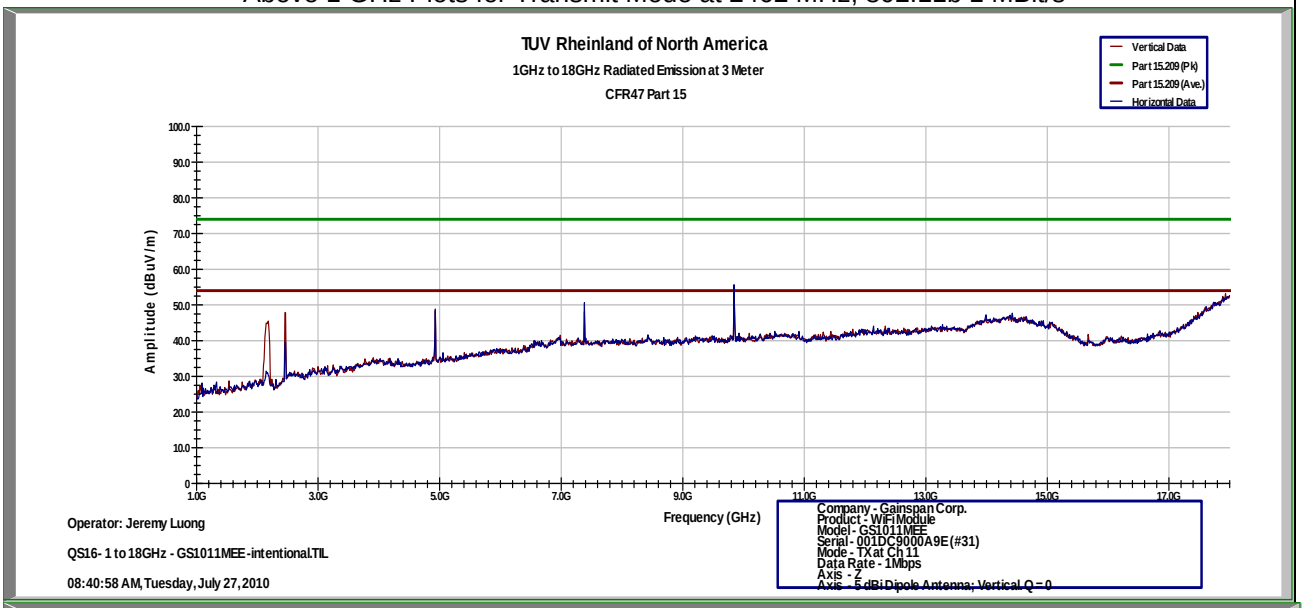
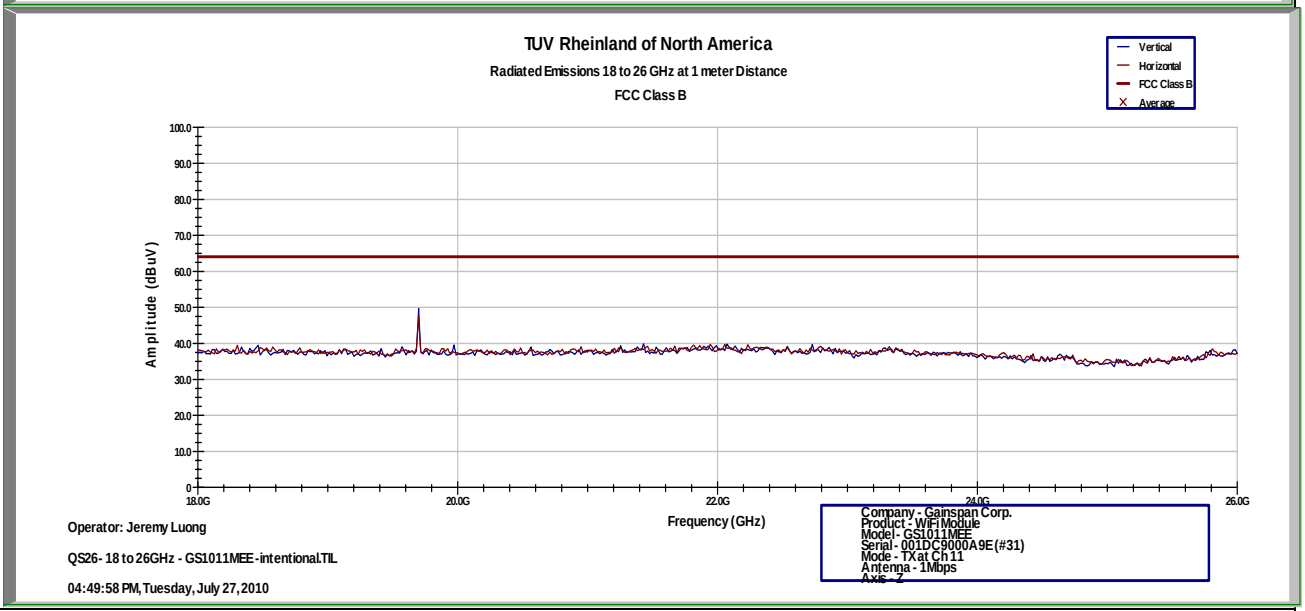
EUT Name	Wi-Fi Module	**Date**	July 27, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 39% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5dbi Dipole Antenna Positioned Vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Jeremy Luong

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





Notes: Limit was extrapolated to 1m distance for 18 GHz – 25 GHz range.
1 GHz – 25 GHz Setting: RBW = 1 MHz / VBW = 3 MHz
Average Dipole antenna gain is 4dBi. Its' maximum gain is 5dBi.

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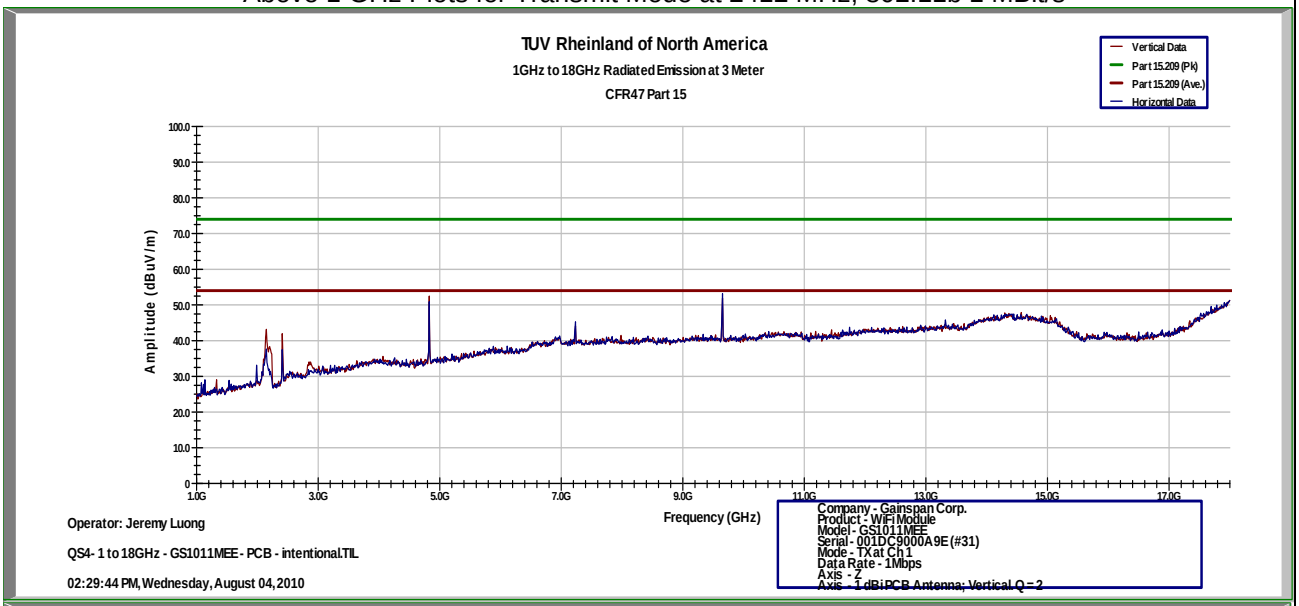
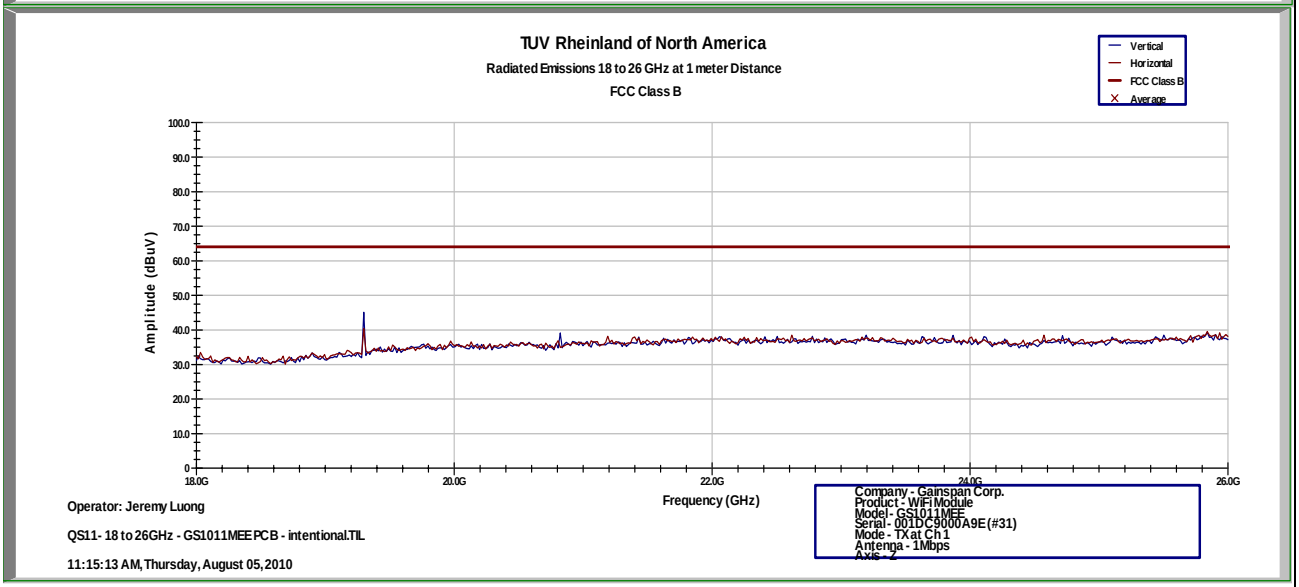
EUT Name	Wi-Fi Module	**Date**	August 4, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 39% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	2 dBi ext. PCB Antenna positioned vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Jeremy Luong

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





Notes: Limit was extrapolated to 1m distance for 18 GHz – 25 GHz range.
1 GHz – 25 GHz Setting: RBW = 1 MHz / VBW = 3 MHz
Average PCB antenna gain is 1dBi. Its' maximum gain is 2dBi.

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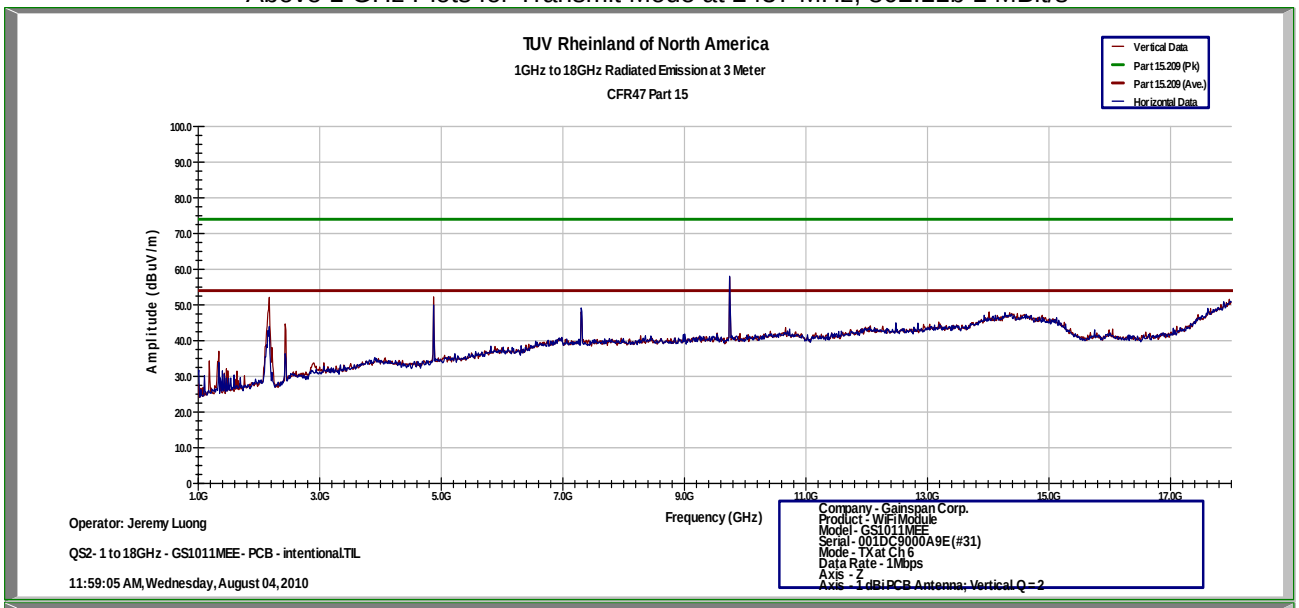
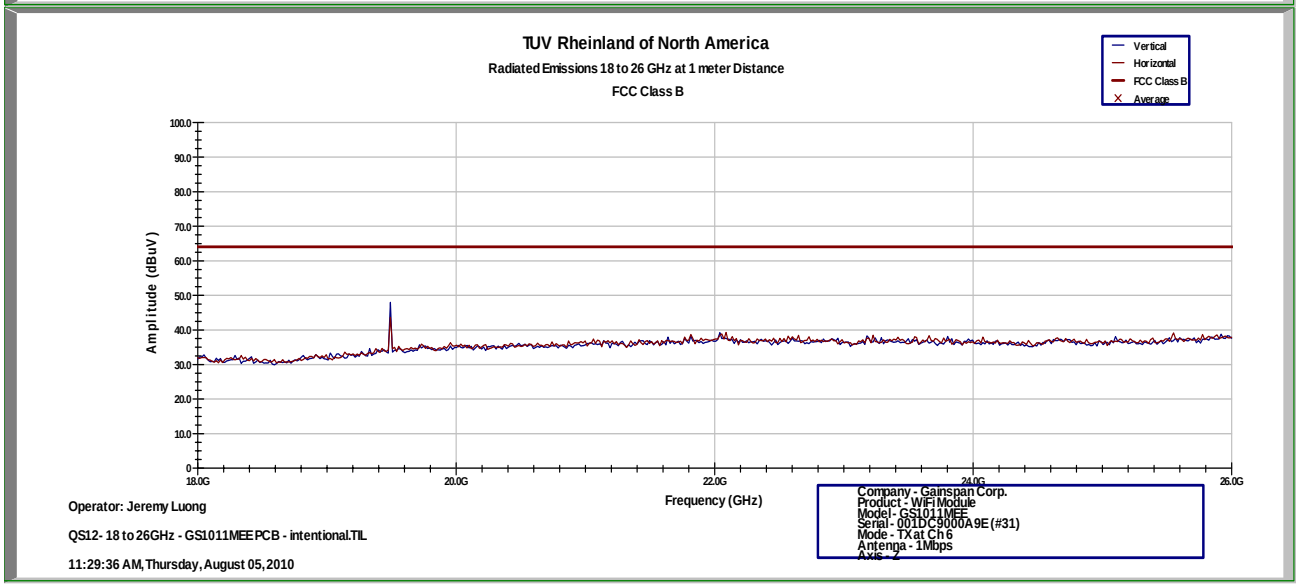
EUT Name	Wi-Fi Module	**Date**	August 4, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 33% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	2 dBi ext. PCB Antenna positioned vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Jeremy Luong

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





Notes: Limit was extrapolated to 1m distance for 18 GHz – 25 GHz range.
1 GHz – 25 GHz Setting: RBW = 1 MHz / VBW = 3 MHz
Average PCB antenna gain is 1dBi. Its' maximum gain is 2dBi.

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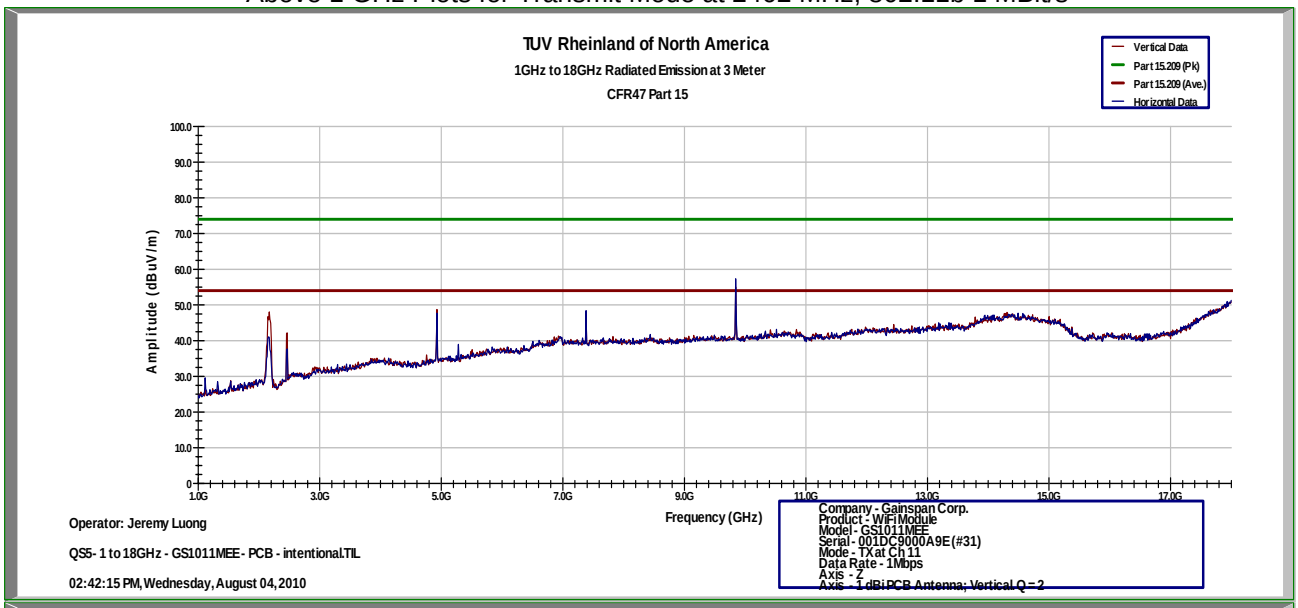
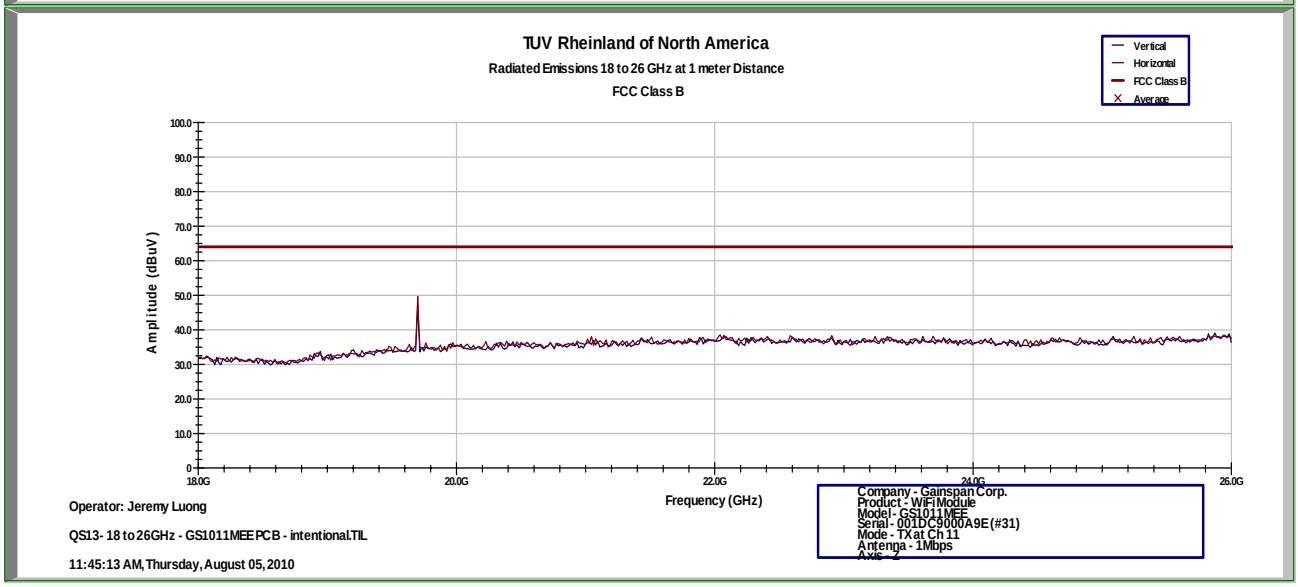
EUT Name	Wi-Fi Module	**Date**	August 4, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 39% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	2 dBi ext. PCB Antenna positioned vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO3115 / 1m - RA42-K-F-4B-C	**Performed by**	Jeremy Luong

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





Notes: Limit was extrapolated to 1m distance for 18 GHz – 25 GHz range.
1 GHz – 25 GHz Setting: RBW = 1 MHz / VBW = 3 MHz
Average PCB antenna gain is 1dBi. Its' maximum gain is 2dBi.

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 (dBμV)
AMP = Amplifier Gain (dB)
CBL = Cable Loss (dB)
ACF = Antenna Correction Factor (dB/m)

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

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, than 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.

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.

SOP 1 Radiated Emissions

Tracking # 31051808.001 Page 1 of 6

EUT Name	Wi-Fi Module	**Date**	July 28, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5dBi ext. Dipole Antenna positioned vertically	**Line AC / Freq**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m / JB3 & EMCO3115	**Performed by**	Jeremy Luong

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (cm)	Table Pos (deg)	FIM (Pk) Pk (dBuV/m)	FIM QP (dBuV/m)	Total CF dBuV	E-Field QP (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)	Type
Receive Mode										
44.01	V	154	96	39.10	34.46	-13.40	21.06	40.00	-18.94	Spurious
53.45	V	118	135	49.17	46.52	-16.99	29.53	40.00	-10.47	Spurious
55.51	V	125	93	48.52	46.11	-17.03	29.08	40.00	-10.92	Spurious
91.81	V	114	5	43.76	41.36	-16.66	24.70	43.52	-18.82	Spurious
160.27	V	107	40	35.14	31.47	-10.72	20.75	43.52	-22.77	Spurious
169.49	V	119	298	30.83	27.20	-11.11	16.09	43.52	-27.43	Spurious
163.64	H	213	88	30.12	26.51	-10.83	15.68	43.52	-27.84	Spurious
4874.09	H	230	246	41.57	37.87	5.25	43.12	53.98	-10.86	Spurious
4874.12	V	173	265	40.88	37.51	5.25	42.76	53.98	-11.22	Spurious
9748.06	V	214	451	37.13	30.03	12.84	42.87	53.98	-11.11	Spurious
9748.12	H	231	56	34.89	29.91	12.84	42.76	53.98	-11.22	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 $u_c(y)$ = ± 3.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Tested on the Z-Axis at Ch 6.

SOP 1 Radiated Emissions

Tracking # 31051808.001 Page 2 of 6

EUT Name	Wi-Fi Module	**Date**	August 5, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 39% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	2 dBi PCB Antenna Positioned Vertically	**Line AC / Freq**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m / EMCO3115	**Performed by**	Jeremy Luong

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (cm)	Table Pos (deg)	FIM (Pk) Pk (dBuV/m)	FIM Ave (dBuV/m)	Total CF dBuV	E-Field Ave (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)	Type
Receive Mode										
49.37	V	178	114	46.20	40.63	-17.06	23.57	40.00	-16.43	Spurious
51.97	V	106	5	50.08	46.85	-17.35	29.50	40.00	-10.50	Spurious
55.52	V	155	244	46.25	43.49	-17.01	26.48	40.00	-13.52	Spurious
114.33	V	113	347	41.06	38.87	-10.66	28.21	43.52	-15.31	Spurious
120.22	V	106	51	40.61	38.07	-9.98	28.09	43.52	-15.43	Spurious
332.89	H	103	286	28.80	25.66	-7.84	17.82	46.02	-28.20	Spurious
416.47	H	103	112	28.48	25.45	-6.44	19.01	46.02	-27.01	Spurious
4874.11	H	185	331	40.79	34.49	5.25	39.74	53.98	-14.24	Spurious
4874.15	V	178	339	43.02	38.60	5.25	43.85	53.98	-10.13	Spurious

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 $u_c(y)$ = ± 3.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

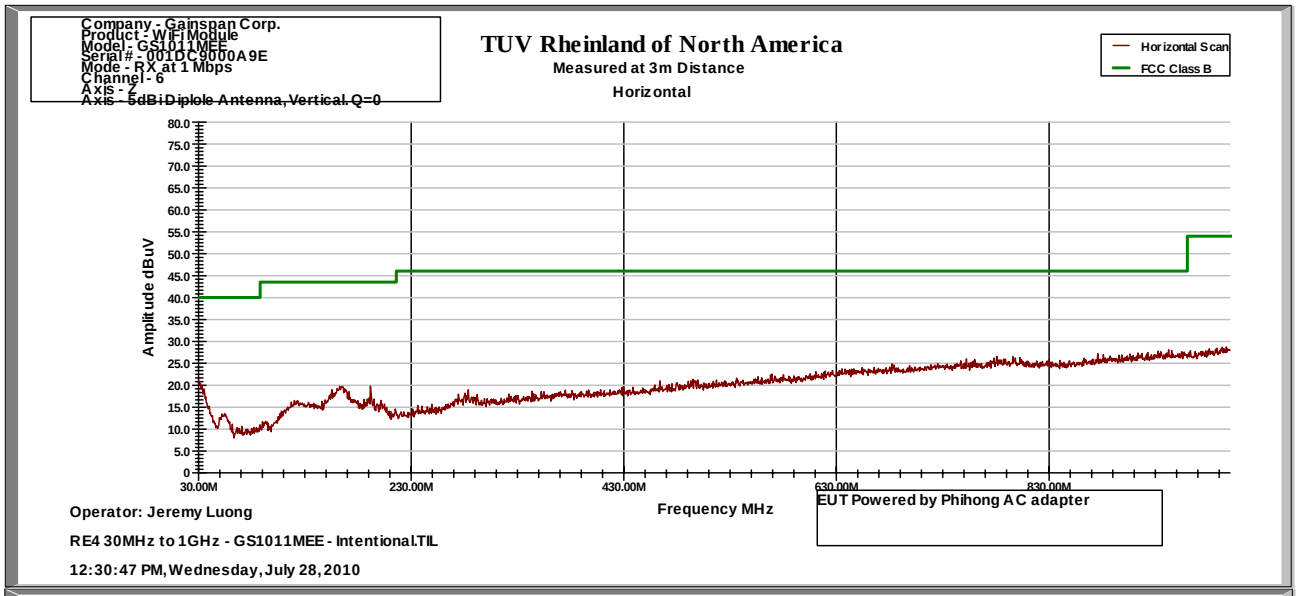
Notes: All radiated emission scans performed on Z-Axis at Ch 6
2dBi gain of external PCB is the maximum peak gain. Average gain is 1dbi.

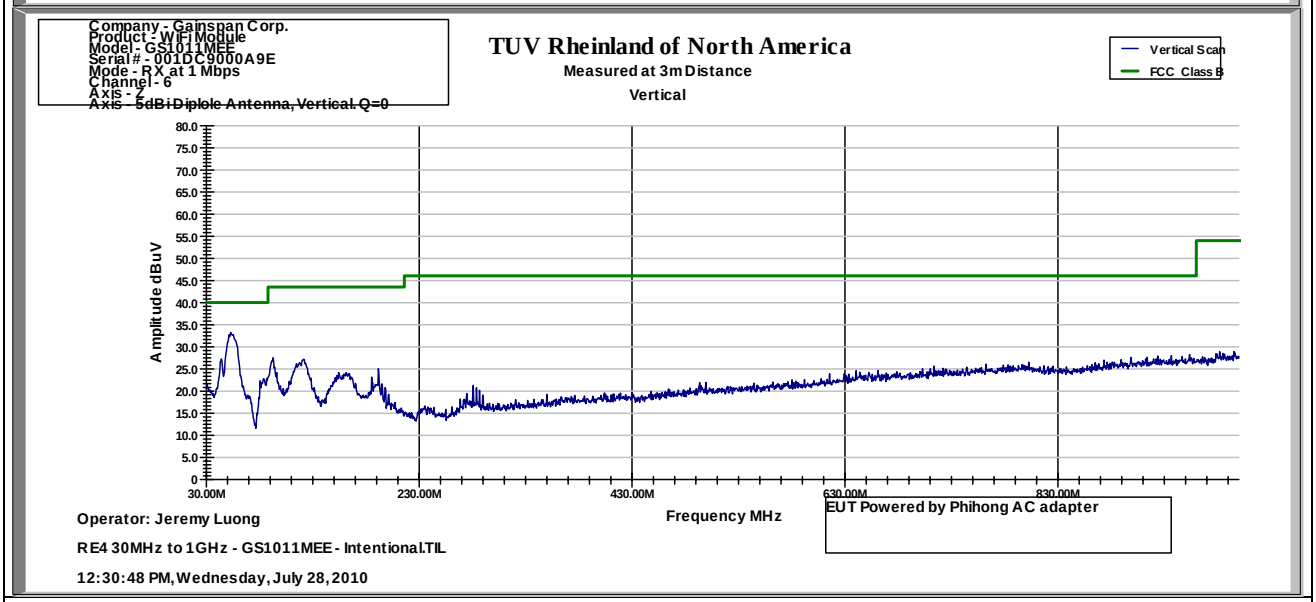
SOP 1 Radiated Emissions

Tracking # 31051808.001 Page 3 of 6

EUT Name	Wi-Fi Module	**Date**	July 28, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5dBi ext. Dipole Antenna positioned vertically	**Line AC**	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

30 MHz to 1000 MHz Plots for Receive Mode





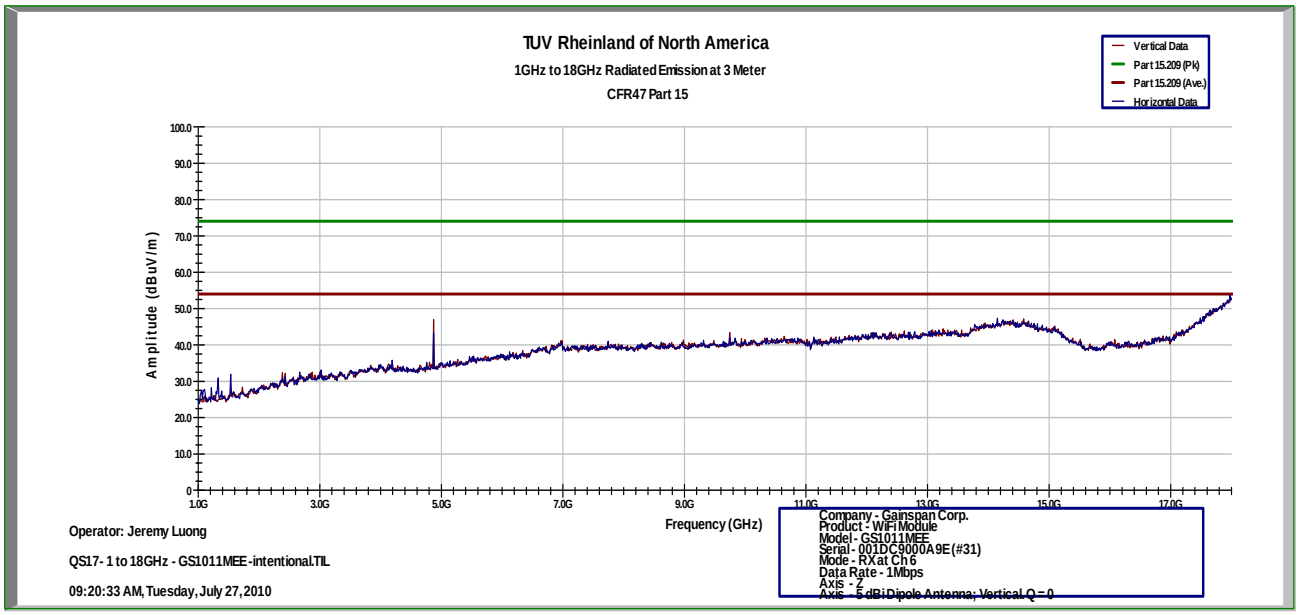
Notes: None.

SOP 1 Radiated Emissions

Tracking # 31051808.001 Page 4 of 6

EUT Name	Wi-Fi Module	**Date**	July 27, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	23° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5dBi ext. Dipole Antenna positioned vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m / EMCO3115	**Performed by**	Jeremy Luong

Above 1 GHz Plot for Receive Mode



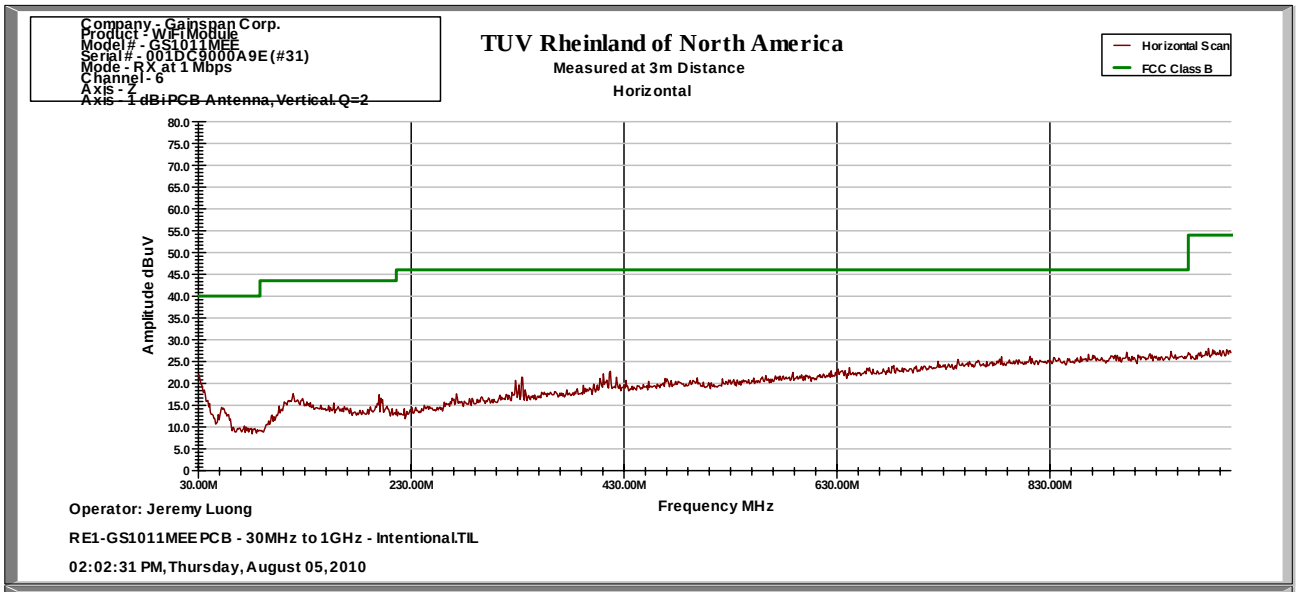
Notes: None.

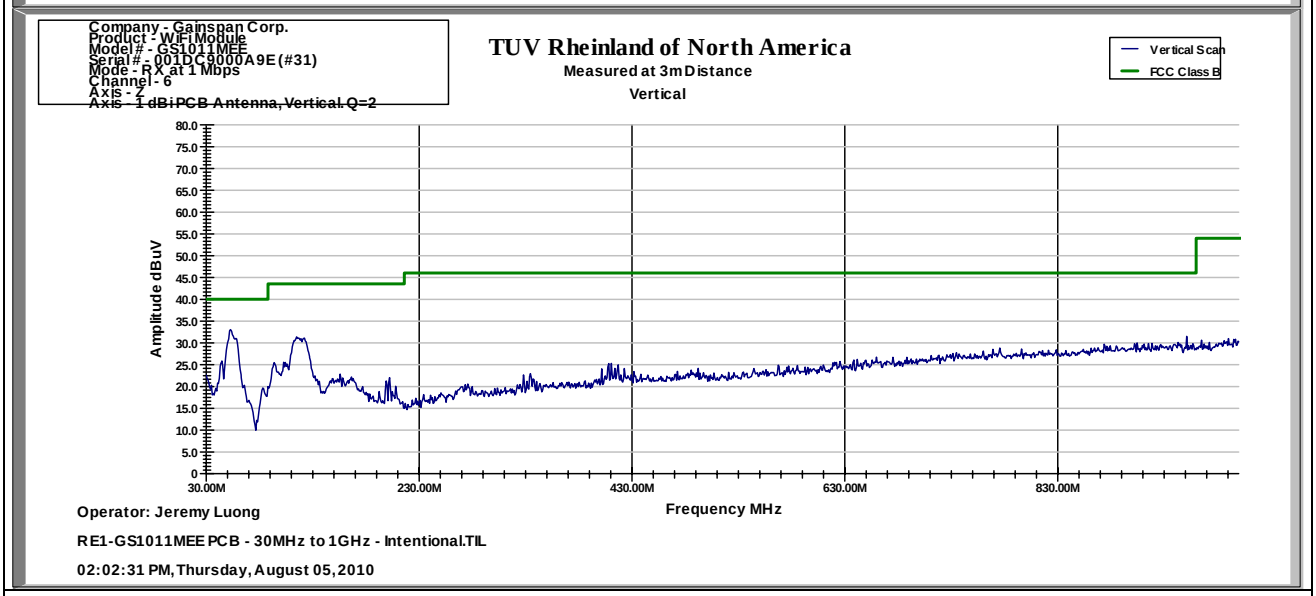
SOP 1 Radiated Emissions

Tracking # 31051808.001 Page 5 of 6

EUT Name	Wi-Fi Module	**Date**	July 28, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 40% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	2 dBi PCB Antenna Positioned Vertically	**Line AC**	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

30 MHz to 1000 MHz Plots for Receive Mode

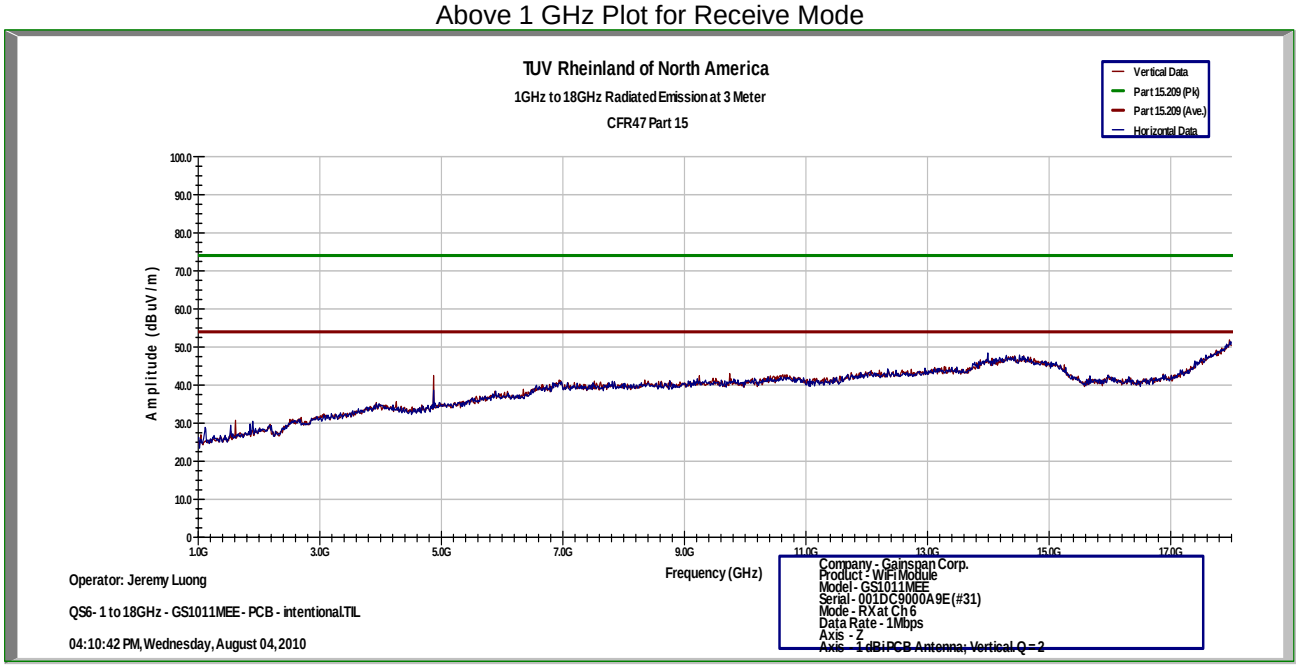




Notes: 2dBi gain of external PCB is the maximum peak gain. Average gain is 1dbi.

SOP 1 Radiated Emissions		Tracking # 31051808.001 Page 6 of 6	
EUT Name	Wi-Fi Module	**Date**	August 4, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	23° C / 39% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	1 dBi PCB Antenna Positioned Vertically	**Line AC**	120 Vac/60 Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m / EMCO3115	**Performed by**	Jeremy Luong

Above 1 GHz Plot for Receive Mode



Notes: 2dBi gain of external PCB is the maximum peak gain. Average gain is 1dbi.

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 (dBμV)
AMP = Amplifier Gain (dB)
CBL = Cable Loss (dB)
ACF = Antenna Correction Factor (dB/m)

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

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' 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 50µH / 50Ω 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 9: AC Conducted Emissions – Test Results

Test Conditions: Conducted Measurement at the host Interface Card's AC Main, Normal Conditions			
Antenna Type: Dipole/PCB		**Power Level:** Q =0	
AC Power: 120 Vac/60 Hz		**Configuration:** Tabletop	
Ambient Temperature: 22 °C		**Relative Humidity:** 38% RH	
Antenna	**Configuration**	**Frequency Range**	**Test Result**
5 dBi Ext. Dipole	Line 1(Hot)	0.15 to 30 MHz	Pass
5 dBi Ext. Dipole	Line 2 (Neutral)	0.15 to 30 MHz	Pass
2 dBi Ext. PCB	Line 1(Hot)	0.15 to 30 MHz	Pass
2 dBi Ext. PCB	Line 2 (Neutral)	0.15 to 30 MHz	Pass

SOP 2 Conducted Emissions

Tracking # 31051808.001 Page 1 of 4

EUT Name	Wi-Fi Module	**Date**	August 3, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 38% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5dBi ext. Dipole 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 MHz	Quasi-Peak dBuV	QP Limit dBuV	QP Margin dB	Average dBuV	Ave Limit dBuV	Ave Margin dB	Line
0.15	43.57	65.89	-35.19	16.75	55.89	-49.01	2
0.18	42.97	65.06	-35.80	29.60	55.06	-36.17	2
0.22	38.86	63.97	-39.91	27.48	53.97	-38.30	2
0.27	34.16	62.47	-44.62	22.65	52.47	-43.13	2
0.64	32.38	56.00	-40.47	23.84	46.00	-36.01	2
0.68	33.79	56.00	-39.06	26.74	46.00	-33.11	2
1.61	22.48	56.00	-50.42	11.40	46.00	-48.51	2
2.39	23.57	56.00	-49.32	9.78	46.00	-50.11	2
4.87	15.43	56.00	-57.44	1.92	46.00	-57.94	2
10.15	7.88	60.00	-64.93	-0.38	50.00	-60.18	2
0.15	42.83	65.91	-35.93	16.23	55.91	-49.53	1
0.18	42.36	65.18	-36.41	21.25	55.18	-44.52	1
0.26	32.70	62.82	-46.08	12.57	52.82	-53.21	1
0.26	33.25	62.75	-45.53	14.82	52.75	-50.96	1
0.64	32.18	56.00	-40.67	23.09	46.00	-36.76	1
0.66	32.33	56.00	-40.52	23.08	46.00	-36.78	1
1.57	18.29	56.00	-54.61	9.14	46.00	-50.77	1
2.33	20.37	56.00	-52.52	6.10	46.00	-53.80	1
2.78	18.35	56.00	-54.54	9.15	46.00	-50.73	1
15.80	8.65	60.00	-64.09	2.47	50.00	-57.27	1

Spec Margin = QP./Ave. - Limit, ± Uncertainty

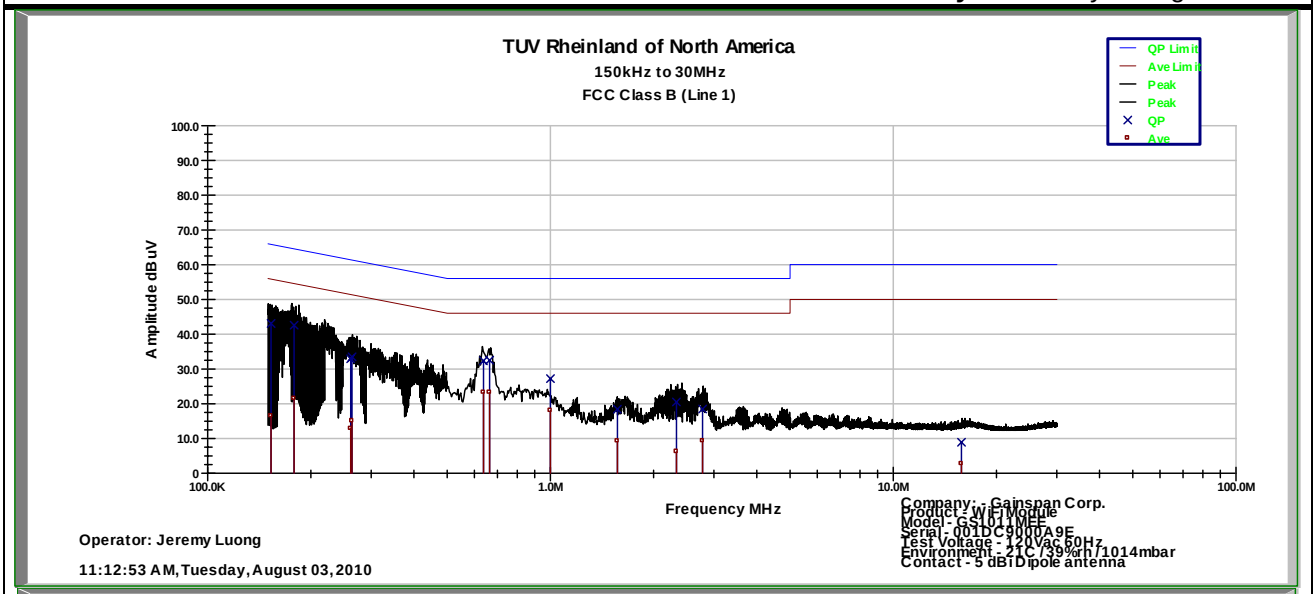
Combined Standard Uncertainty $u_c(y)$ = ± 2.4dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

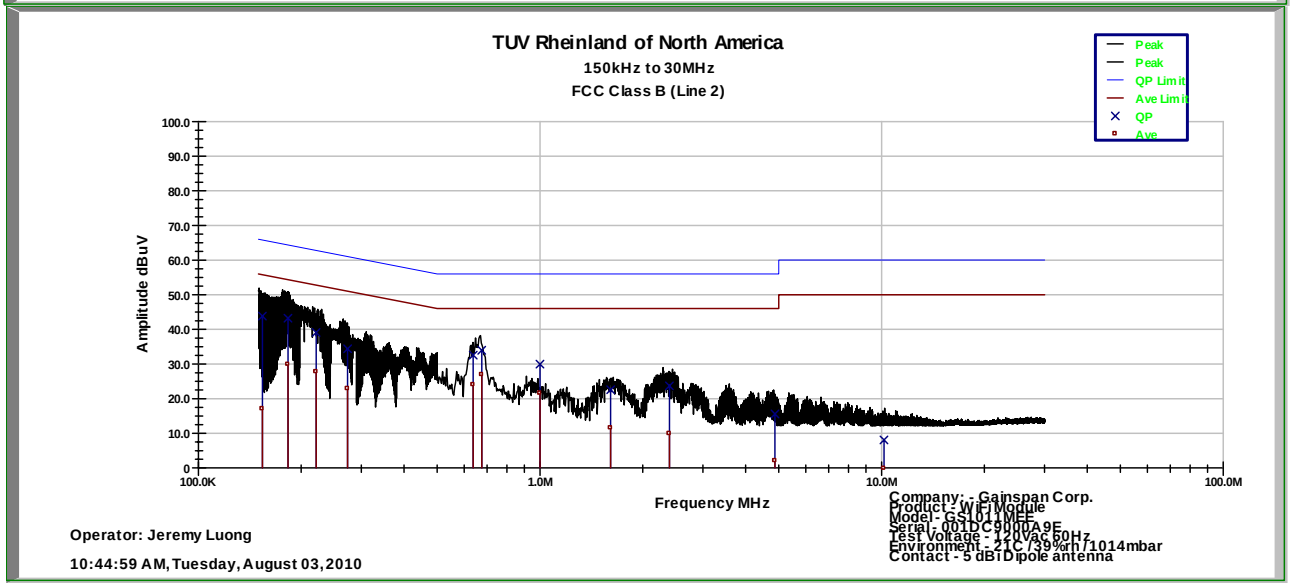
Notes: EUT was setup as table top equipment.
Average Dipole antenna gain is 4dBi. Its' maximum gain is 5dBi.

SOP 2 Conducted Emissions

Tracking # 31051808.001 Page 2 of 4

EUT Name	Wi-Fi Module	**Date**	August 3, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 38% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	5dBi ext. 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: EUT was setup as table top equipment.
Average Dipole antenna gain is 4dBi. Its' maximum gain is 5dBi.

SOP 2 Conducted Emissions

Tracking # 31051808.001 Page 3 of 4

EUT Name	Wi-Fi Module	**Date**	August 3, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 38% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	2 dBi ext. PCB 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 MHz	Quasi-Peak dBuV	QP Limit dBuV	QP Margin dB	Average dBuV	Ave Limit dBuV	Ave Margin dB	Line
0.18	41.53	65.29	-37.23	28.24	55.29	-37.52	2
0.22	38.34	63.89	-40.43	28.15	53.89	-37.62	2
0.27	35.00	62.69	-43.78	25.43	52.69	-40.35	2
0.64	31.86	56.00	-40.99	23.15	46.00	-36.70	2
0.67	34.71	56.00	-38.14	27.09	46.00	-32.76	2
1.62	23.30	56.00	-49.60	12.05	46.00	-47.85	2
2.31	23.24	56.00	-49.66	9.98	46.00	-49.91	2
2.90	18.12	56.00	-54.77	5.57	46.00	-54.32	2
3.65	17.04	56.00	-55.84	3.93	46.00	-55.95	2
11.09	8.64	60.00	-64.16	-0.48	50.00	-60.28	2
0.16	37.70	65.63	-41.06	12.96	55.63	-52.80	1
0.18	41.53	65.13	-37.24	21.49	55.13	-44.27	1
0.22	35.30	64.06	-43.47	15.19	54.06	-50.59	1
0.27	32.41	62.60	-46.37	15.82	52.60	-49.97	1
0.31	28.99	61.42	-49.80	14.91	51.42	-50.88	1
0.40	26.70	58.91	-52.10	18.05	48.91	-47.76	1
0.45	24.61	57.37	-54.20	16.95	47.37	-48.86	1
0.64	30.90	56.00	-41.95	21.67	46.00	-38.18	1
0.68	31.11	56.00	-41.74	21.94	46.00	-37.91	1
2.33	19.73	56.00	-53.16	5.09	46.00	-54.80	1
2.69	18.21	56.00	-54.68	8.07	46.00	-51.82	1

Spec Margin = QP./Ave. - Limit, ± Uncertainty

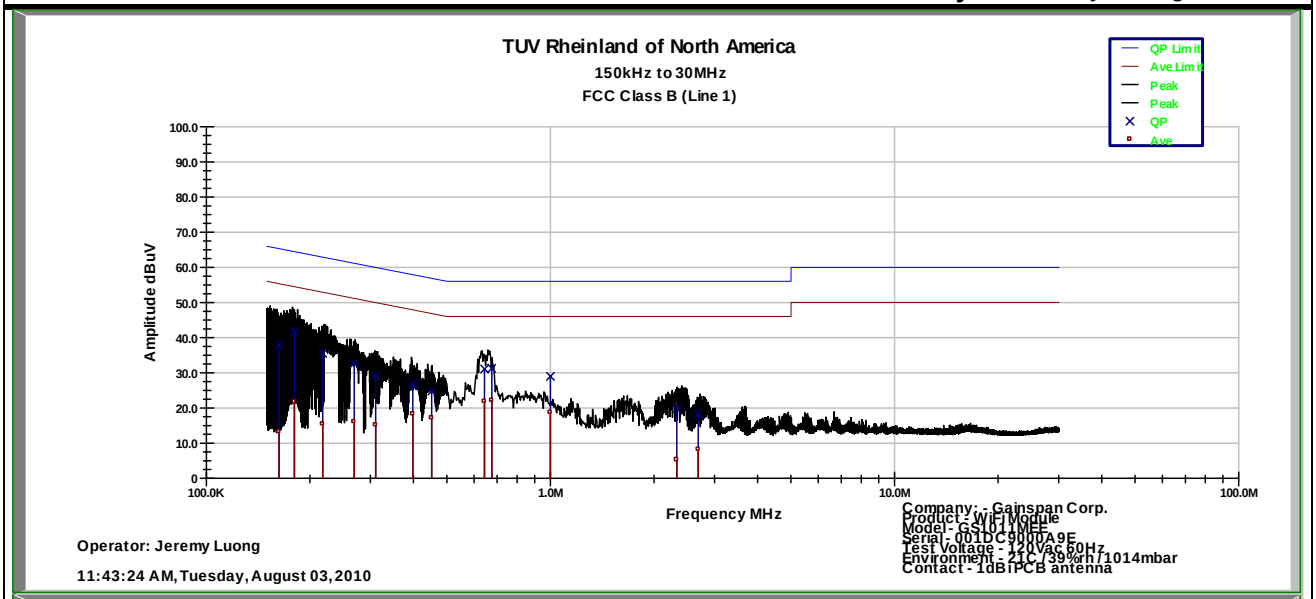
Combined Standard Uncertainty $u_c(y)$ = ± 2.4dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

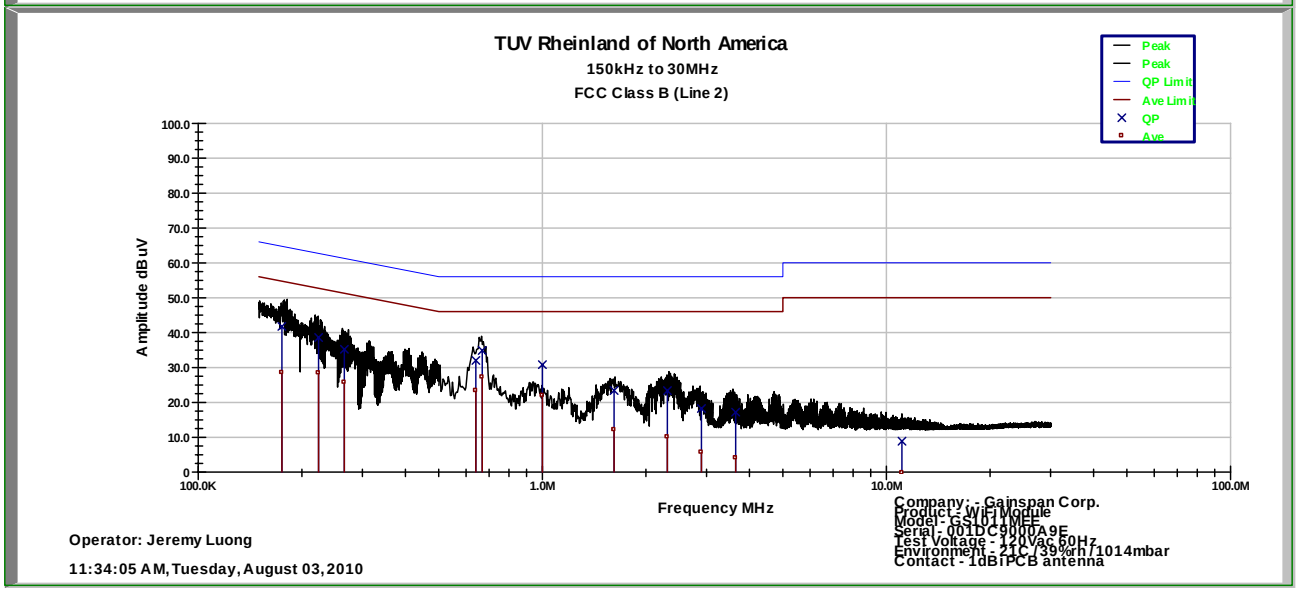
Notes: EUT was setup as table top equipment.
Average PCB antenna gain is 1dBi. Its' maximum gain is 2dBi.

SOP 2 Conducted Emissions

Tracking # 31051808.001 Page 4 of 4

EUT Name	Wi-Fi Module	**Date**	August 3, 2010
EUT Model	GS1011MEE	**Temp / Hum in**	22° C / 38% RH
EUT Serial	001DC9000A9E	**Temp / Hum out**	N/A
EUT Config.	2 dBi ext. PCB 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.
Average PCB antenna gain is 1dBi. Its' maximum gain is 2dBi.

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	Rohde & Schwarz	ESIB40	100180	08/19/09	08/19/10
Amplifier	Rohde & Schwarz	TS-PR18	100019	06/14/08	09/14/10
Amplifier	Rohde & 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
LISN	Solar Electronics	Type 9348-50-R-24-BNC	068506	01/21/10	01/21/11

* 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.

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 10: 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 11: Technical Contact Information

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

6.3 Equipment Under Test (EUT)

Table 12: EUT Specifications

GS1011MEE Dimensions	1.45” 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	17 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	2 dBi external PCB. (Q = 2) 2 dBi, 3 dBi, 5 dBi Dipole. (Q = 0)
Modulation Type	☐ AM ☐ FM ☐ Phase ☒ Other describe: DSSS
Bandwidth	22 MHz
Type of Equipment	☐ Table Top ☐ Wall-mount ☐ Floor standing cabinet ☒ Other *describe: Portable in any orientation.*
Notes	PCB antenna maximum gain is 2dBi, and its average gain is 1dBi. Dipole antenna maximum gain is 5dBi, and its average gain is 4dBi.
	5 dBi Dipole Antenna tested with highest RF gain; Q=0 2 dBi PCB Antenna tested with RF gain was reduced to Q=2.

Table 13: 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

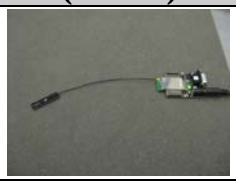
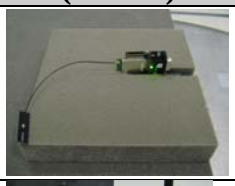
Table 14: Supported Equipment

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

Table 15: Description of Sample used for Testing

Device	Serial	RF Connection	Test
GS1011MEE	001DC9000A9E	5 dBi Dipole Antenna	TX Emission, RX Emission
	001DC9000A9E	2 dBi PCB Antenna	TX Emission, RX Emission
	001DC9000A9E	5 dBi Dipole Antenna	AC Conducted Emission
	001DC9000A9E	2 dBi PCB Antenna	AC Conducted Emission
	Sample #22	Direct	RF Power Output, Peak Power Spectral Density, Out of Band Emission, Bandwidth

Table 16: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup Photo (X-Axis)	Setup Photo (Y-Axis)	Setup Photo (Z-Axis)
GS1011MEE	2 dBi Ext. PCB	* Transmit in Mode b (1 MBit/s) * Receive			
GS1011MEE	5 dBi Ext. Dipole	* Transmit in Mode b (1 MBit/s) * Receive			

6.4 Test Specifications

Testing requirements

Table 17: Test Requirements

Emissions and Immunity	
Standard	Requirement
CFR 47 Part 15.247: 2009	All
RSS 210 Issue 7, 2007	All