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Emissions
Test Report

EUT Name: HERO3 White Edition

Model No.: CHDHE-301

CFR 47 Part 15.247 2011 and RSS 210: 2010

Prepared for:

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Statement of Compliance

Manufacturer:	Woodman Labs, Inc (dba GoPro). 3000 Clearview Way San Mateo, CA 94402 U.S.A.
Requester / Applicant:	Steven Kim
Name of Equipment:	HERO3 White Edition
Model No.	CHDHE-301
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 15.247 2011 and RSS 210: 2010
Test Dates:	August 23 – September 11, 2012

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 A2LA. This report contains data that are not covered by A2LA accreditation. This report shall not be reproduced except in full, without the written authorization of TUV Rheinland of North America.

Suresh Kondapalli	September 14, 2012	Conan Boyle	September 14, 2012
Test Engineer	Date	A2LA Signatory	Date

Testing Cert #3331.03 **US5254** **2932M-1**

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1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 15.247 2011 and RSS 210: 2010 based on the results of testing performed on August 23 to September 11, 2012 on the HERO3 White Edition Model: CHDHE-301 manufactured by *Woodman Labs, Inc (dba GoPro)*. 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 report.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C63.4	Test Parameters (from Standard)	Result
2400 MHz to 2483.5 MHz Band			
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**
Bandedge Measurement	CFR47 15.247 (d), RSS 210 Sect. A.8.5	20 dBr	**Complied**

Note: Since EUT is portable device where the end user will have the direct contact, RF Exposure/ SAR test requirements are evaluated separately

1.3.1 Measured values of key parameters

Test	Test Method ANSI C63.4	Measured value/ Margin	Result
2400 MHz to 2483.5 MHz Band			
Maximum Transmitted Power	CFR47 15.247 (b3), RSS 210 Sect. A.8.4	20.31 dBm	Complied
Occupied Bandwidth	CFR47 15.247 (a2), RSS GEN Sect.4.4.1	16.67 MHz	Complied
Peak Power Spectral Density	CFR47 15.247 (e), RSS 210 Sect. A.8.2	-9.65 dBm	Complied
Spurious Emission in Transmitted Mode	CFR47 15.209, RSS-GEN Sect.7.2.3	41.20 dBuV/m at 7221 MHz	Complied
Spurious Emission in Received Mode	CFR47 15.109, RSS-GEN Sect.7.2.3	30.80 dBuV/m at 479.86 MHz	Complied

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 recognized by the commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (US5254). The laboratory scope of accreditation includes: Title 47 CFR Parts 15, 18, and 90. The accreditation is updated every 3 years.

2.1.2 A2LA

TUV Rheinland of North America is accredited by the A2LA 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 (Testing Cert #3331.03). 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 No. A0031).

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 A2LA 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 C63.4-2009, at a test distance of 3 and 5 meters. The site is listed with the FCC and accredited by A2LA (Lab Code Testing Cert #3331.03). The 3/5-meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2009, at a test distance of 3 meter and 5 meters. A report detailing this site can be obtained from TUV Rheinland of North America.

2.2.2 Immunity Test Facility

ESD, EFT, Surge, and 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 – 40,000 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 Testing

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%.

Measurement Uncertainty – Radio Testing

The estimated combined standard uncertainty for frequency error measurements is ± 3.88 Hz
The estimated combined standard uncertainty for carrier power measurements is ± 1.59 dB.
The estimated combined standard uncertainty for adjacent channel power measurements is ± 1.47 dB.
The estimated combined standard uncertainty for modulation frequency response measurements is ± 0.46 dB.
The estimated combined standard uncertainty for transmitter conducted emission measurements is ± 4.01 dB

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 CHDHE-301 is a portable HD camera (Hero 3 White Edition) complies with the IEEE 802.11b and g modes specification to communicate with other 802.11 wireless devices in the 2.4 GHz band, and data rates upto 54 Mbps.The EUT is normally placed inside host device and powered by host system.

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 test standards. The EUT was programed 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 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.

EUT was programed to operate at > 99% duty cycle for the purpose of testing. This 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 Duty Cycle:

None

3.5 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.

3.5.1 Results

EUT has internal antenna

4 Emission Requirements – 2400 MHz to 2483.5 MHz Band

Testing was performed in accordance with CFR 47 Part 15.247: 2011 and RSS 210 Annex 8: 2010. These test methods are listed under the laboratory's A2LA 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.

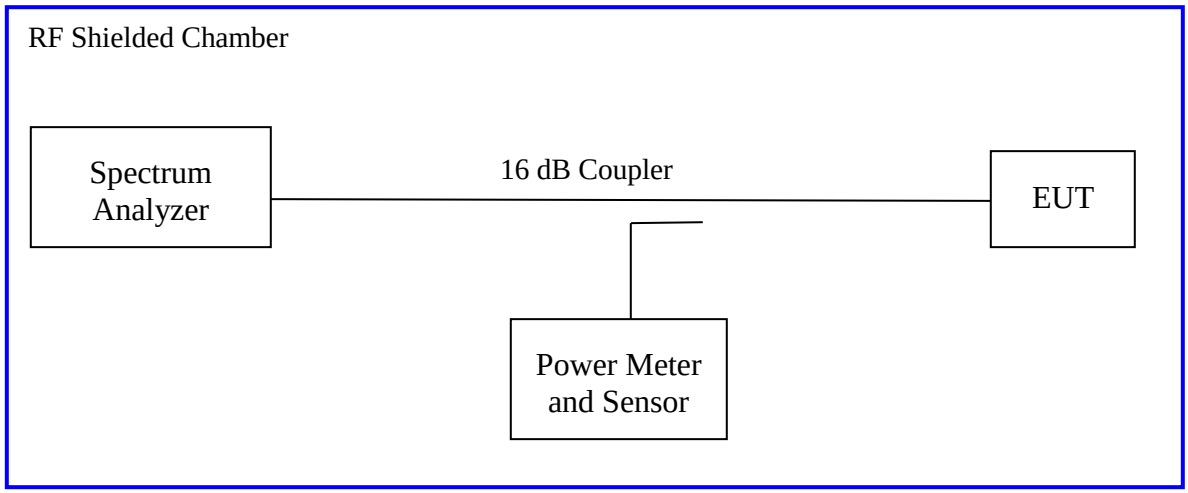
The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b3):2011 and RSS 210 A.8.4: 2010

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):2011 and RSS 210 A.8.4. This test was conducted on 3 channels in each operating range. The worst mode result indicated below.

Test Setup:



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

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: External		**Power Setting:** See test plan	
Max. Antenna Gain: + 2.9 dBi			
Ambient Temp.: 21 °C		**Relative Humidity:**39%	
Test Results			
Operating Channel MHz	**Limit [dBm]**	**Output Level [dBm]**	**Margin [dB]**
802.11b			
2412	+30.00	17.10	-12.90
2437	+30.00	18.44	-11.56
2462	+30.00	17.60	-12.40

802.11g			
2412	+30.00	13.07	-16.93
2417	+30.00	16.41	-13.59
2422	+30.00	18.32	-11.69
2437	+30.00	20.31	-9.69
2462	+30.00	17.15	-12.85

Notes:

1) Power measurements were performed as indicated in the above table. Only worst case/ limited number of plots are placed in the report.

2) Software Power Settings are as follows

EUT passed with higest power setting of 16 dBm for middle channel. Power setting was lowered for outer channels as follows: CH#1 2412 MHz power setting 9 dBm, CH# 2 2417 MHz power setting 12 dBm, CH#3 2422 MHz power setting 14 dBm, CH# 4 to CH# 10 power setting 16 dBm and CH# 11 power setting 13 dBm.

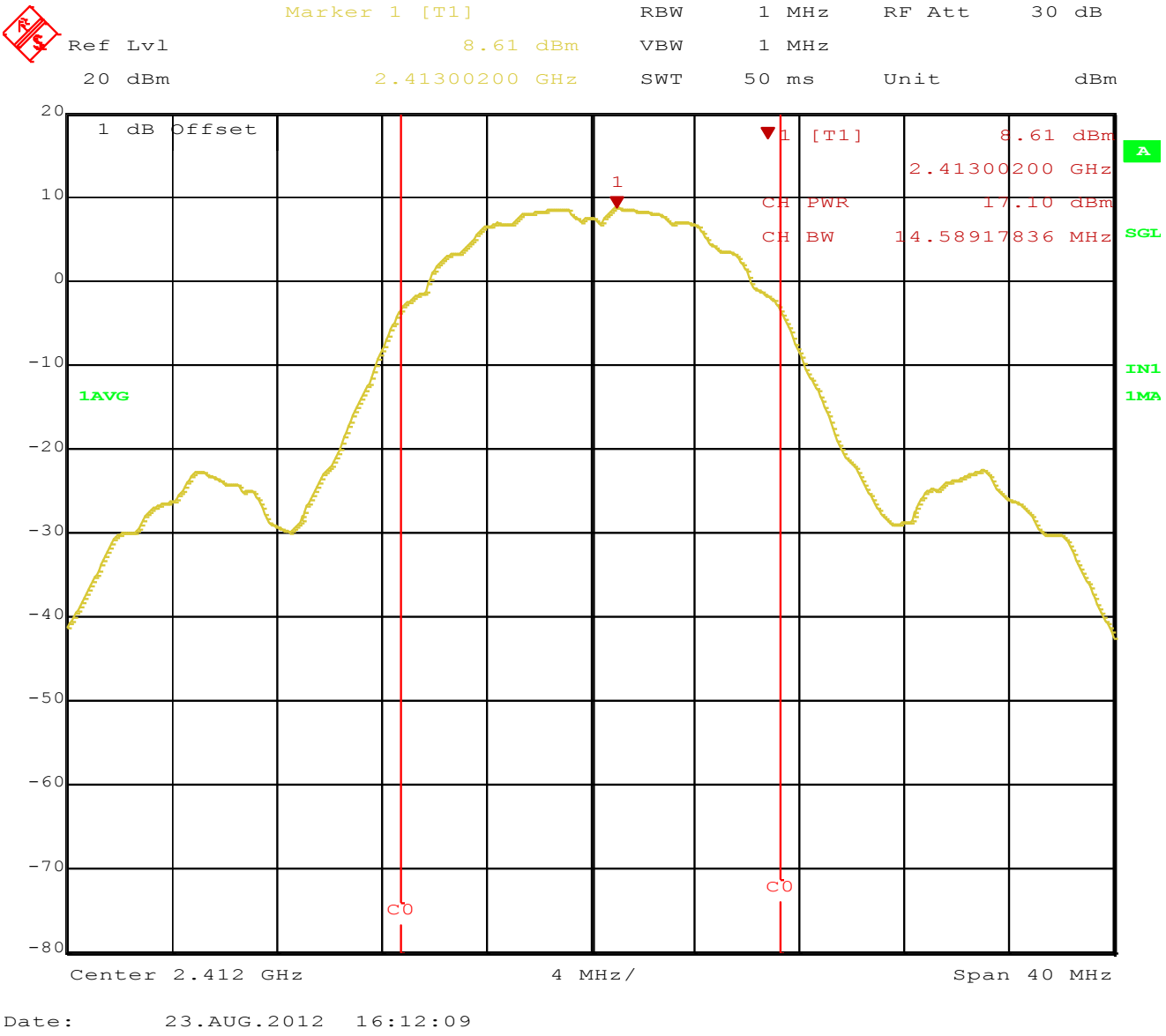


Figure 1: Maximum Transmitted Power, 2412 MHz at 802.11b, 1 Mbps

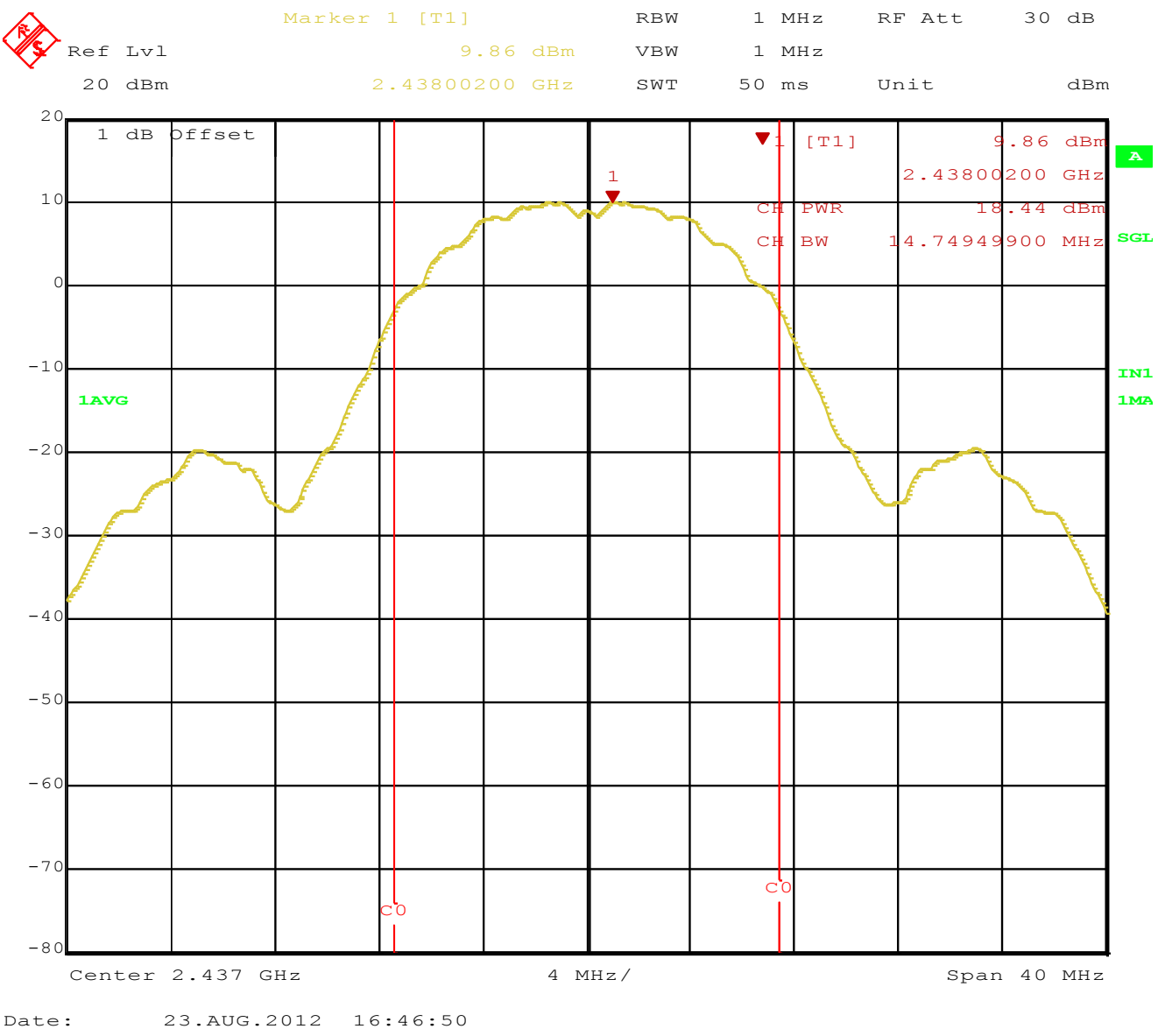


Figure 2: Maximum Transmitted Power, 2437 MHz at 802.11b, 1 Mbps

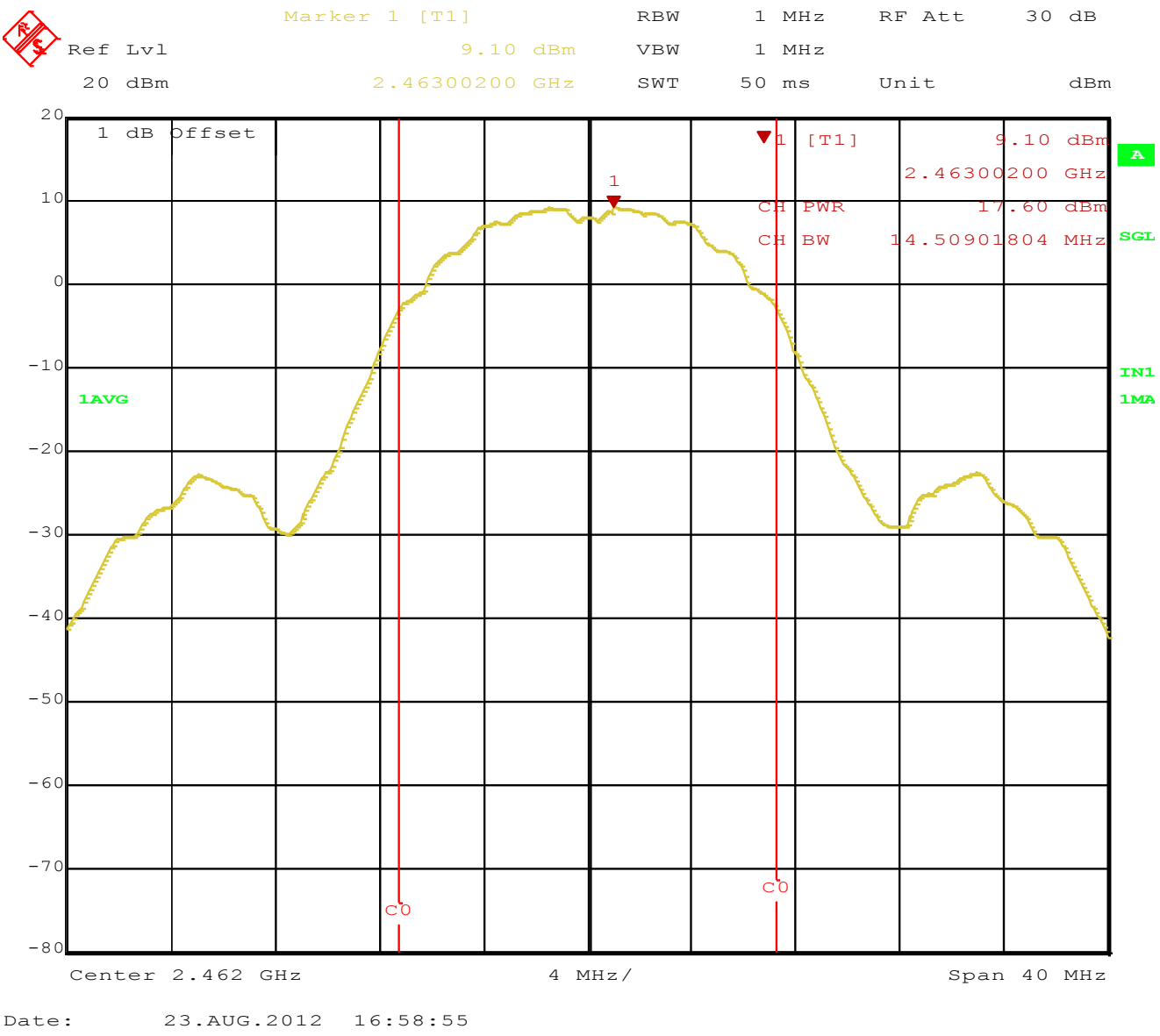


Figure 3: Maximum Transmitted Power, 2437 MHz at 802.11b, 1 Mbps

G mode

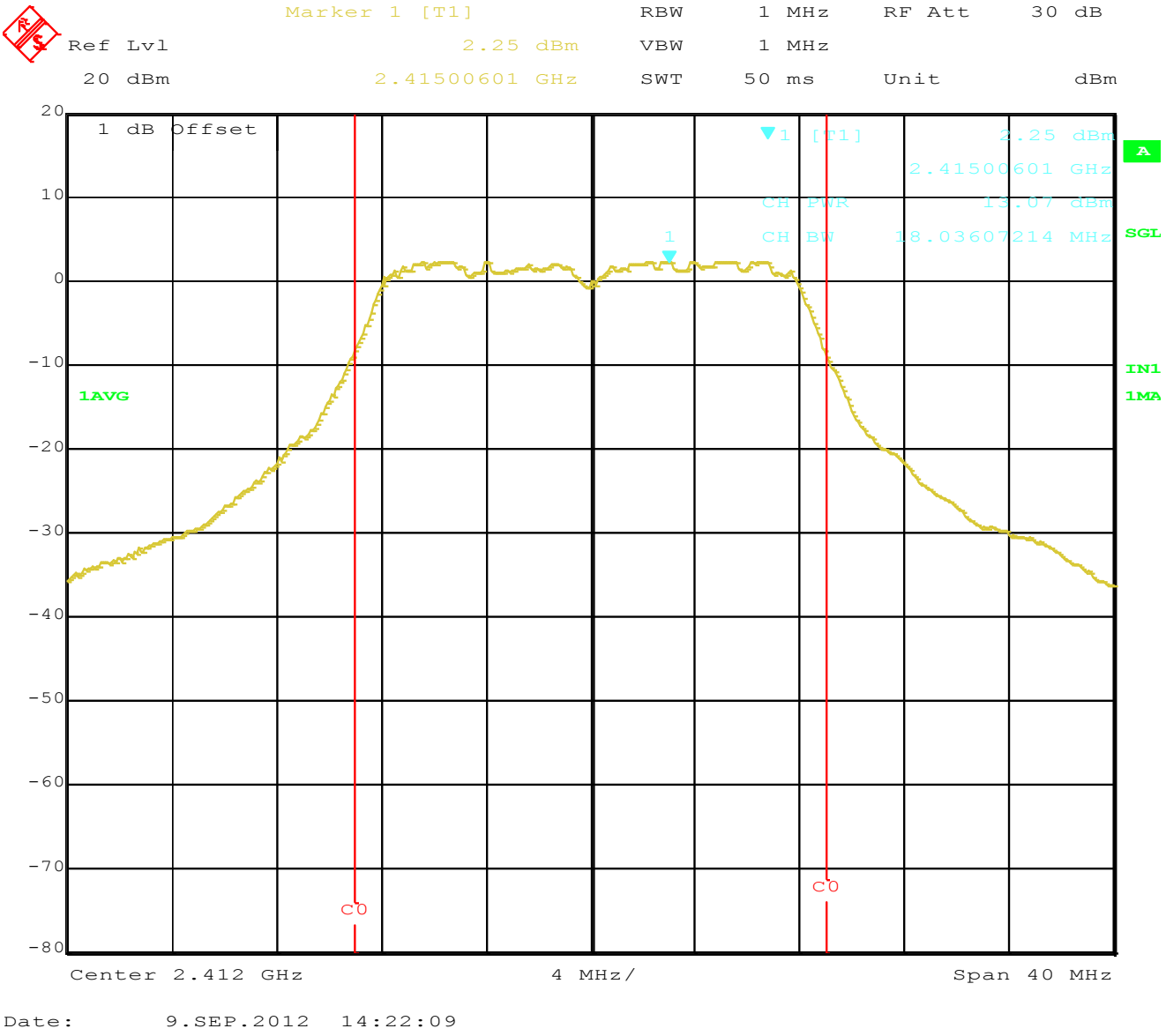


Figure 4: Maximum Transmitted Power, 2412 MHz at 802.11 g, 6 Mbps

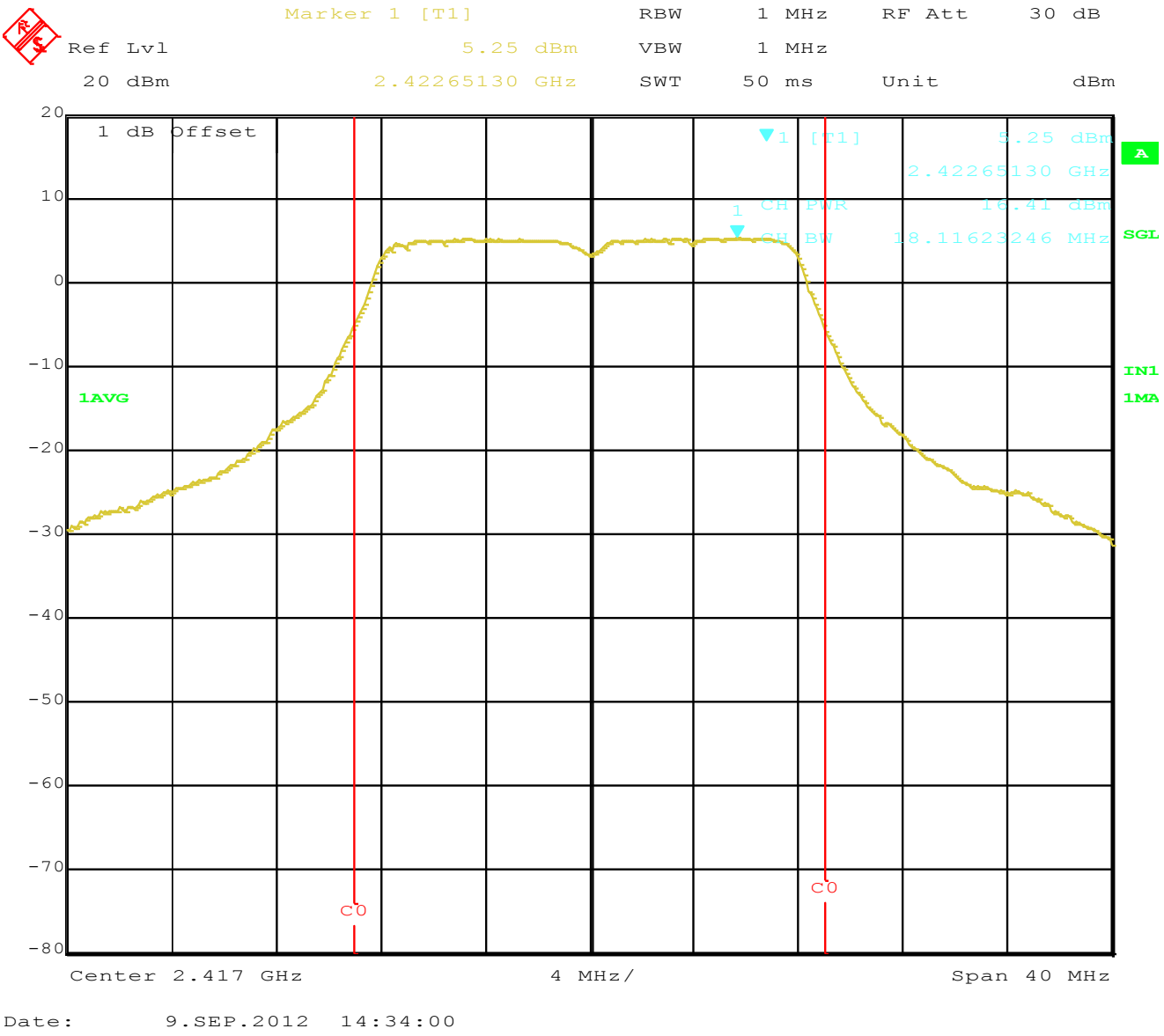


Figure 5: Maximum Transmitted Power, 2417 MHz at 802.11g, 6 Mbps

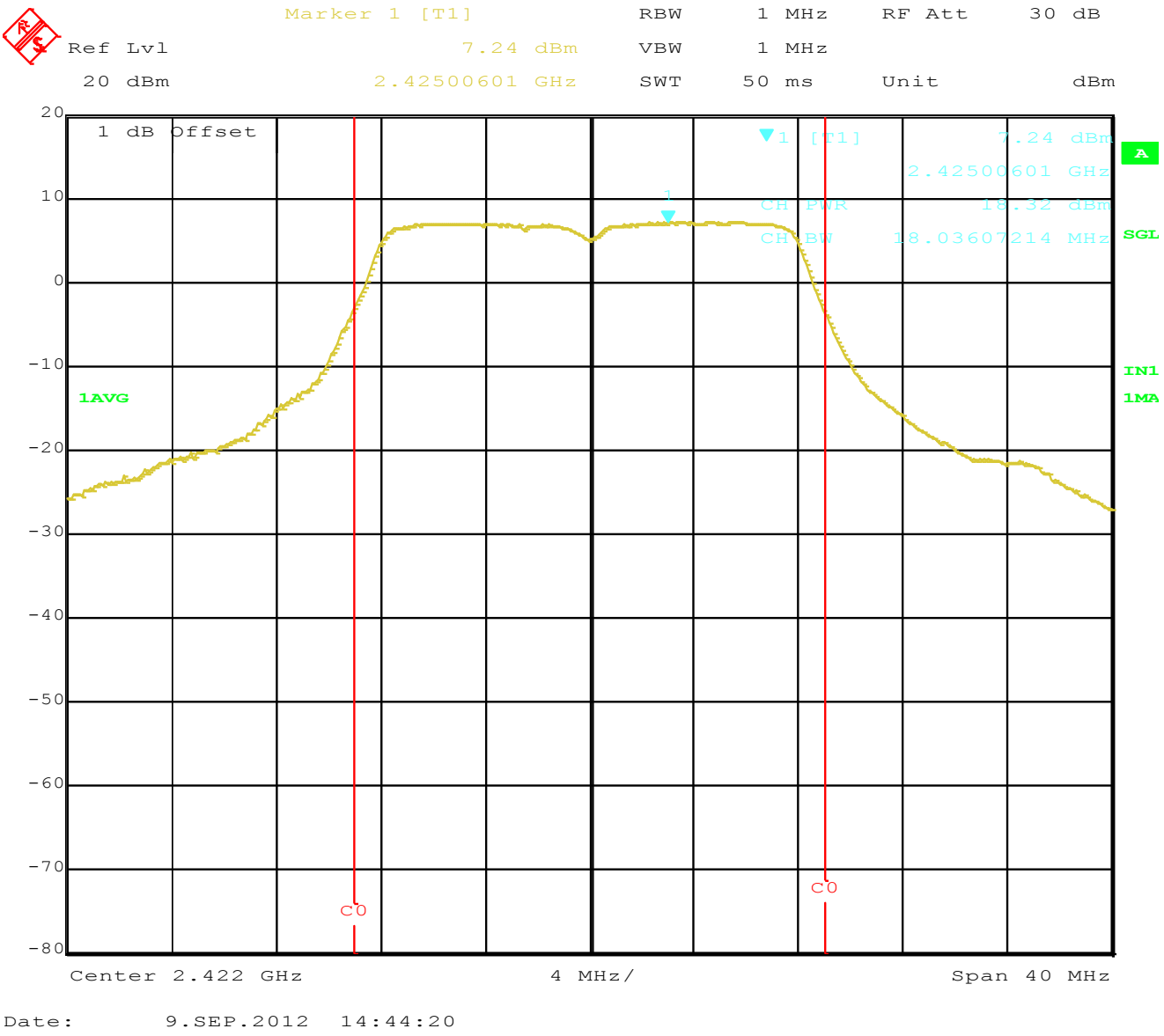


Figure 6: Maximum Transmitted Power, 2422 MHz at 802.11g, 6 Mbps

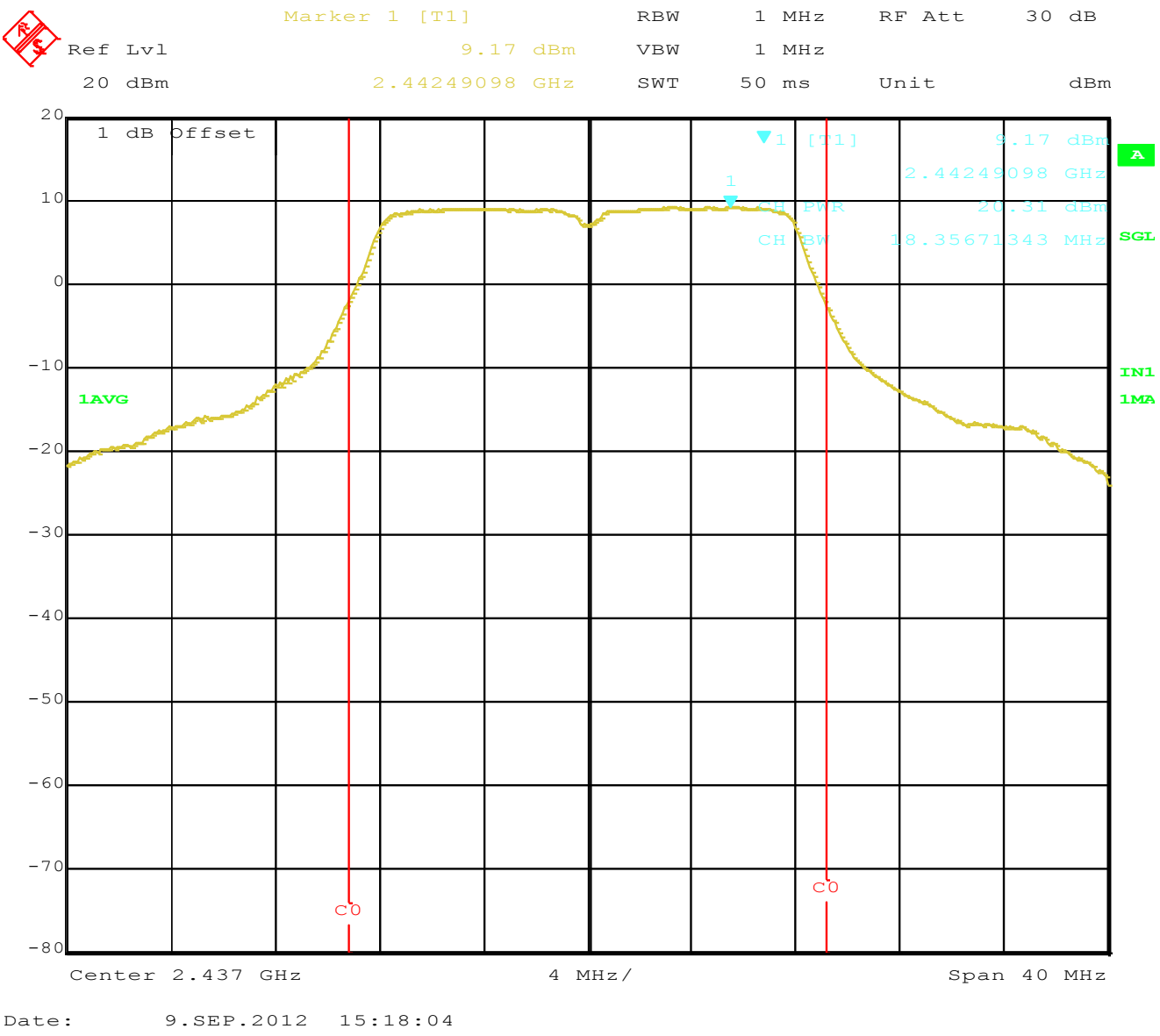


Figure 7: Maximum Transmitted Power, 2437 MHz at 802.11g, 6 Mbps

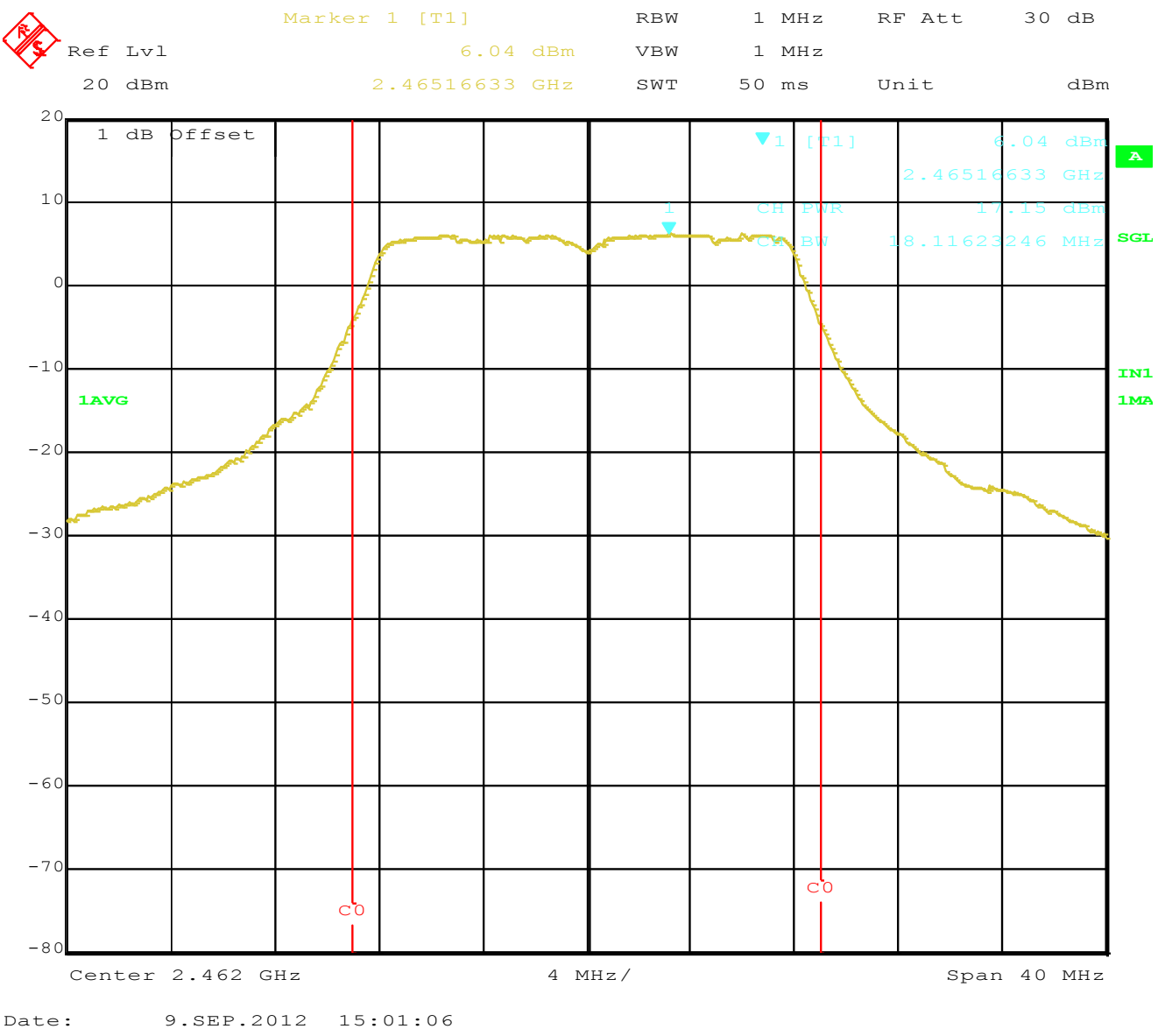


Figure 8: Maximum Transmitted Power, 2462 MHz at 802.11g, 6 Mbps

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.

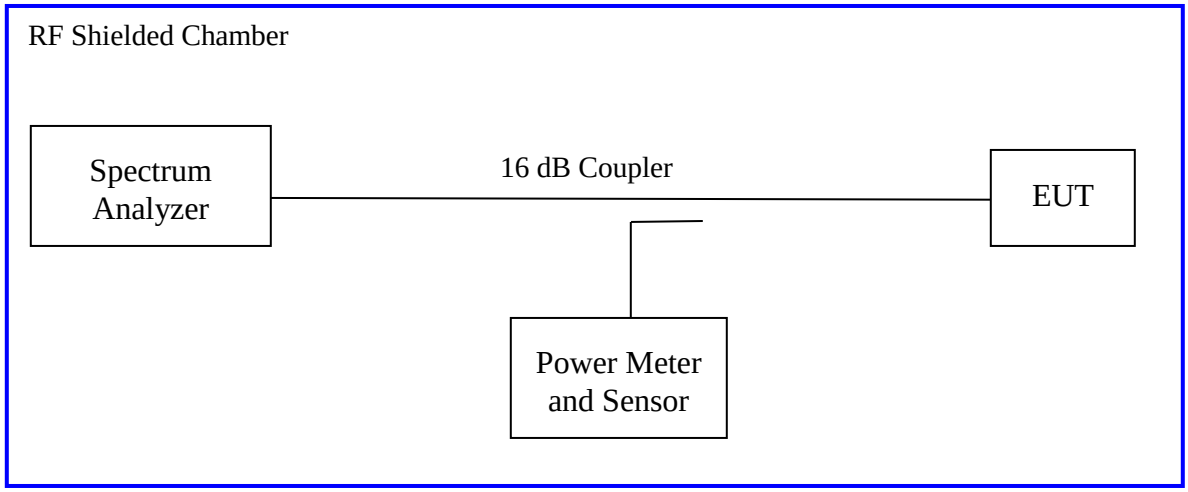
The 6 dB bandwidth is defined the bandwidth of 6 dBr from highest transmitted level of the fundamental frequency.

The bandwidth shall be at least 500 kHz per Section CFR47 15.247(a2) 2011 and RSS Gen Sect. 4.4.1: 2010.

4.2.1 Test Method

The conducted method was used to measure the occupied bandwidth. The measurement was performed with modulation per CFR47 15.247(a2) 2011 and RSS Gen Sect. 4.4.1:2010. Initial investigation was performed at different data rates and TX chains. The narrowest bandwidths at each operational mode were measured on 3 operating channels. 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: Integrated		**Power Setting:** see table 9	
Max. Antenna Gain: +2.9 dBi			
Ambient Temp.: 21 °C		**Relative Humidity:**39%	
99% Bandwidth (MHz)			
Operating Channel	**Limit**	**802.11b**	**Results**
2412 MHz	N/A	14.22	N/A
2437 MHz	N/A	14.34	N/A
2462 MHz	N/A	14.18	N/A
6 dB Bandwidth (MHz)			
Operating Channel	**Limit**	**802.11b**	**Results**
2412 MHz	500 kHz	10.24	Pass
2437 MHz	500 kHz	10.24	Pass
2462 MHz	500 kHz	10.24	Pass
99% Bandwidth (MHz)			
Operating Channel	**Limit**	**802.11g**	**Results**
2412 MHz	N/A	16.59	N/A
2437 MHz	N/A	16.67	N/A
2462 MHz	N/A	16.59	N/A
Note: The 99% bandwidth was observed at 6 Mbps.			

6 dB Bandwidth (MHz)			
Operating Channel	**Limit**	**802.11g**	**Results**
2412 MHz	500 kHz	16.48	Pass
2437 MHz	500 kHz	16.44	Pass
2462 MHz	500 kHz	16.44	Pass

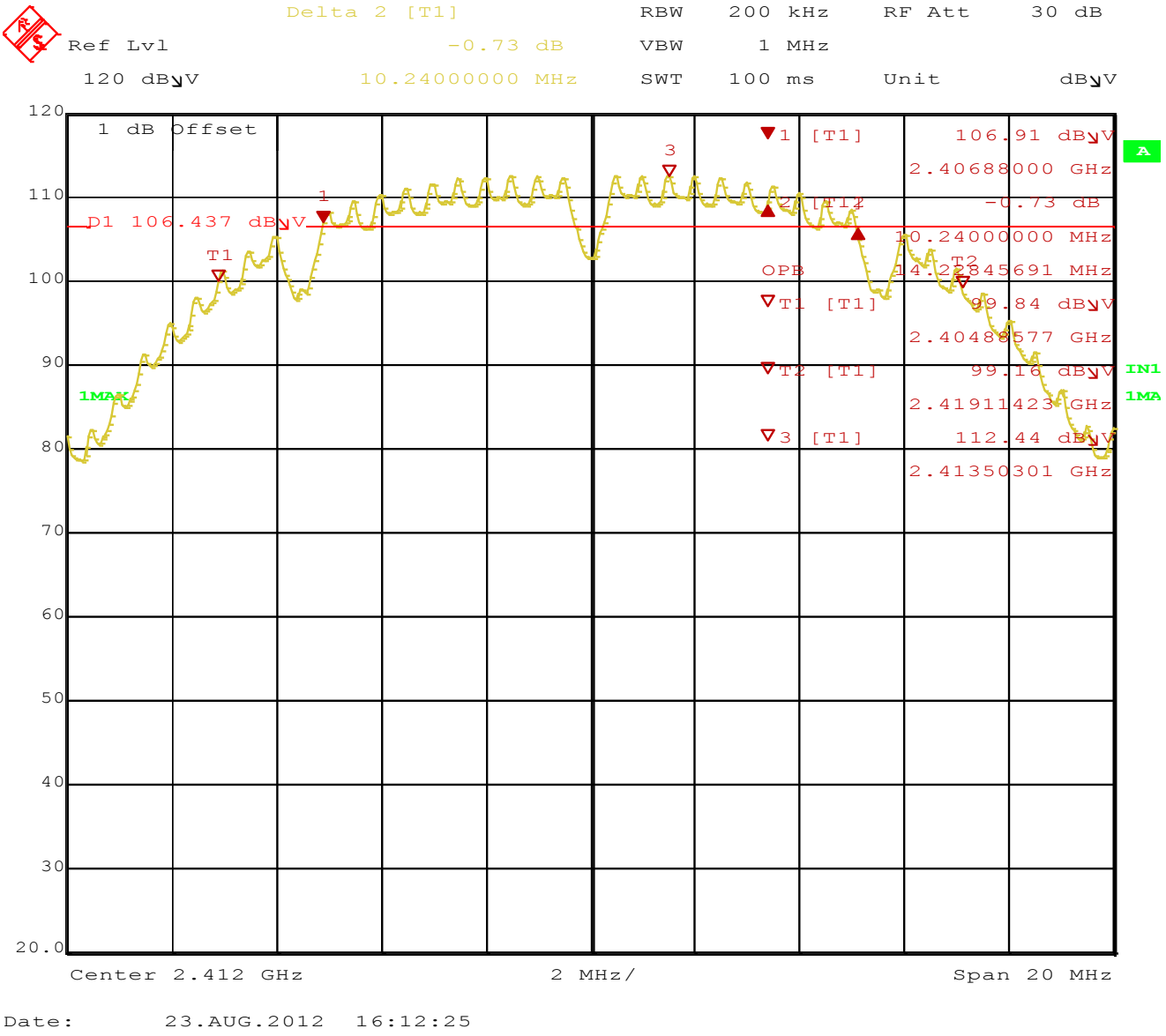


Figure 9: 6 dB and 995 Bandwidth at 1 Mbit/s – Operating Channel 2412 MHz

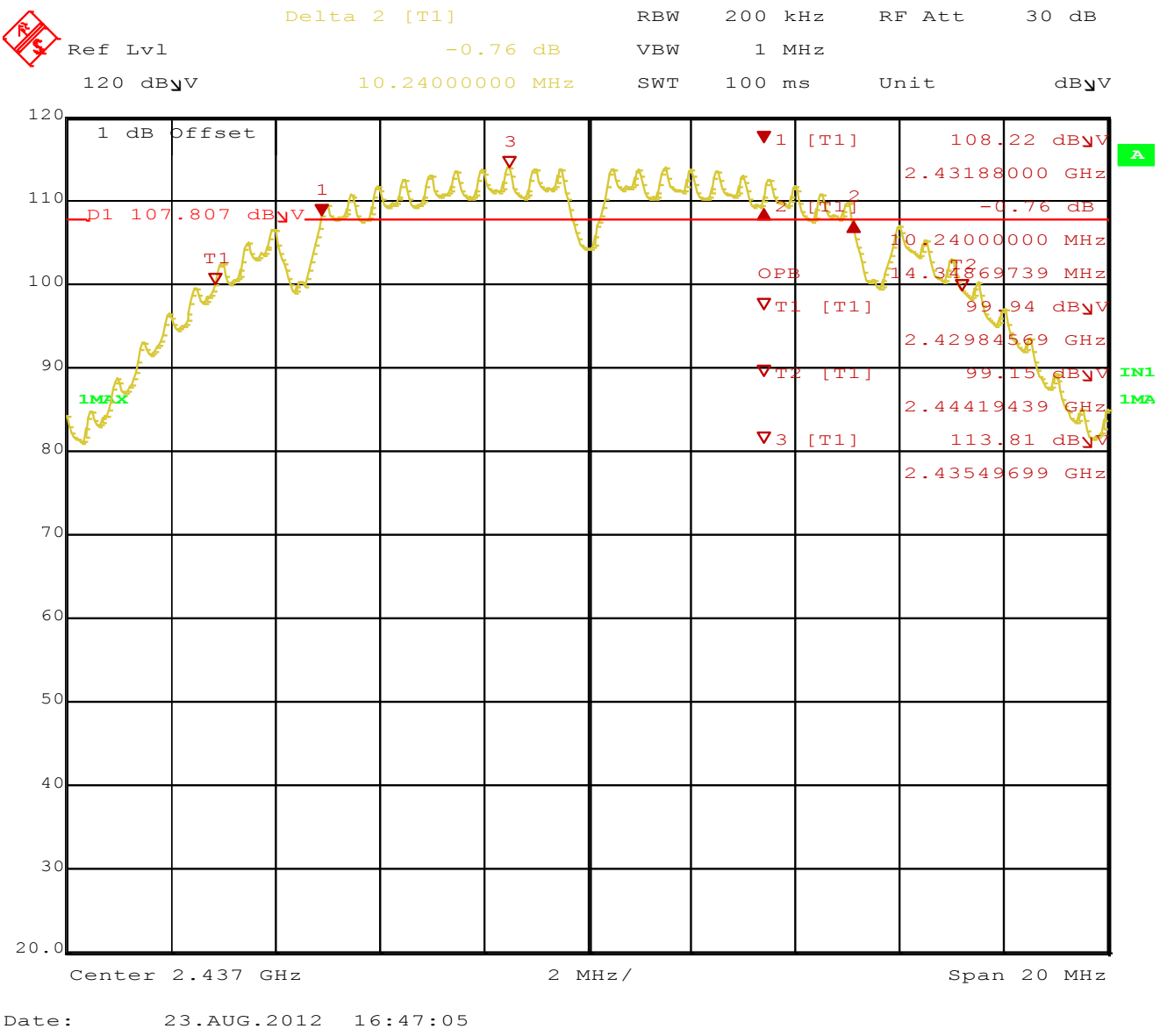


Figure 10: 6 dB and 99% Bandwidth at 1 Mbit/s – Operating Channel 2437 MHz

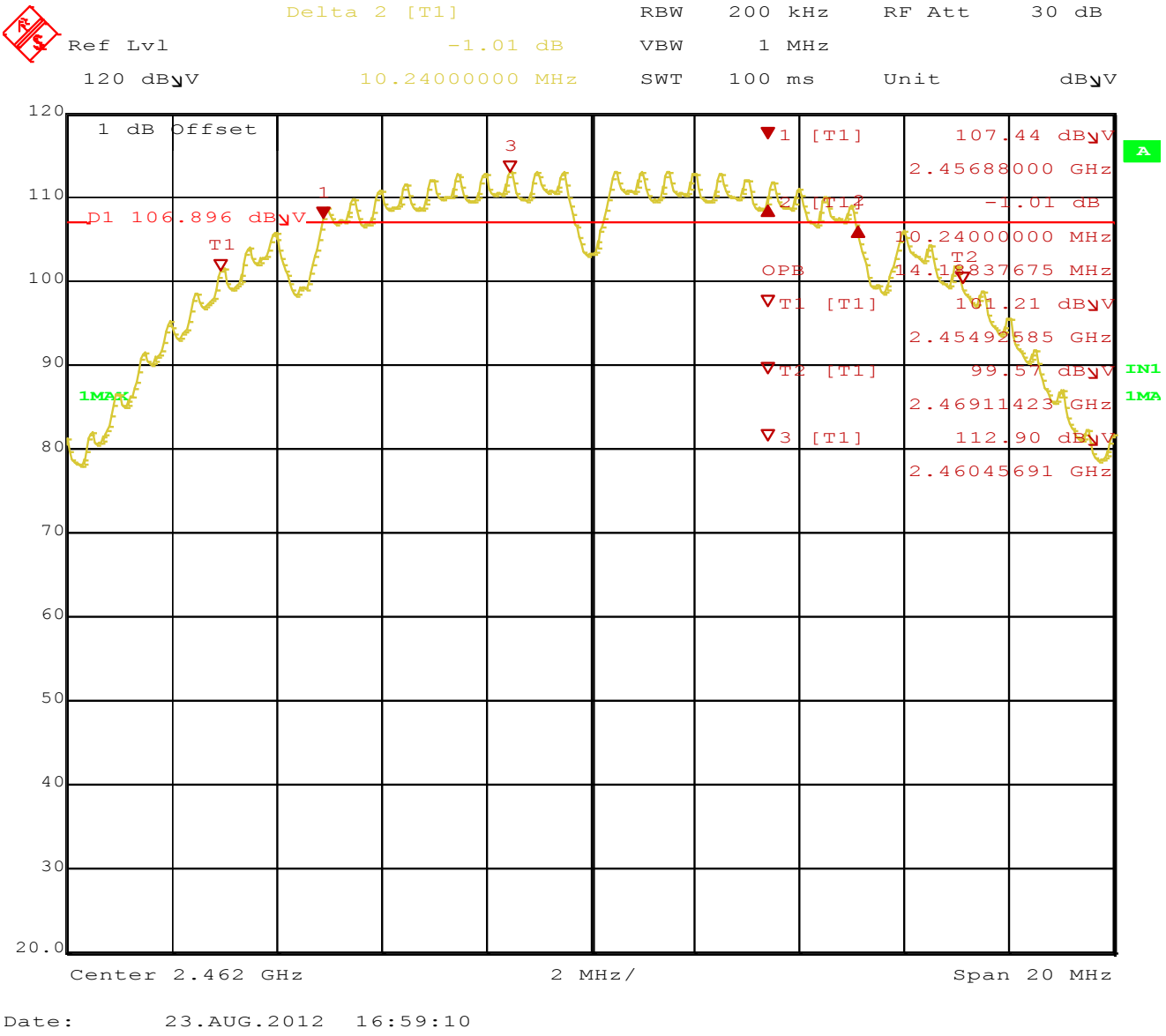


Figure 11: 6 dB and 99% Bandwidth at 1 Mbit/s – Operating Channel 2462 MHz

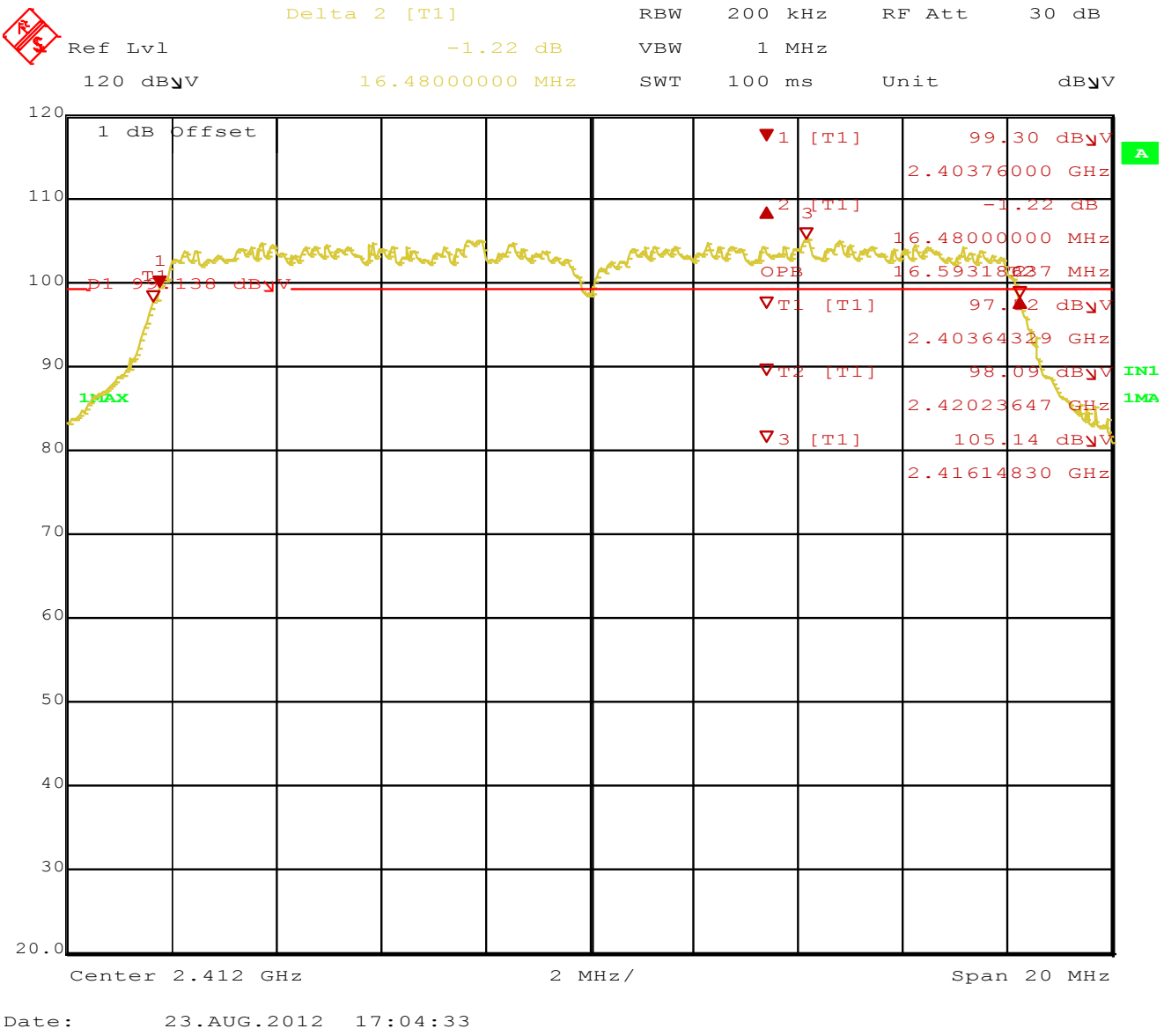


Figure 12: 6dB and 99% Bandwidth at 6 Mbps – Operating Channel 2412 MHz

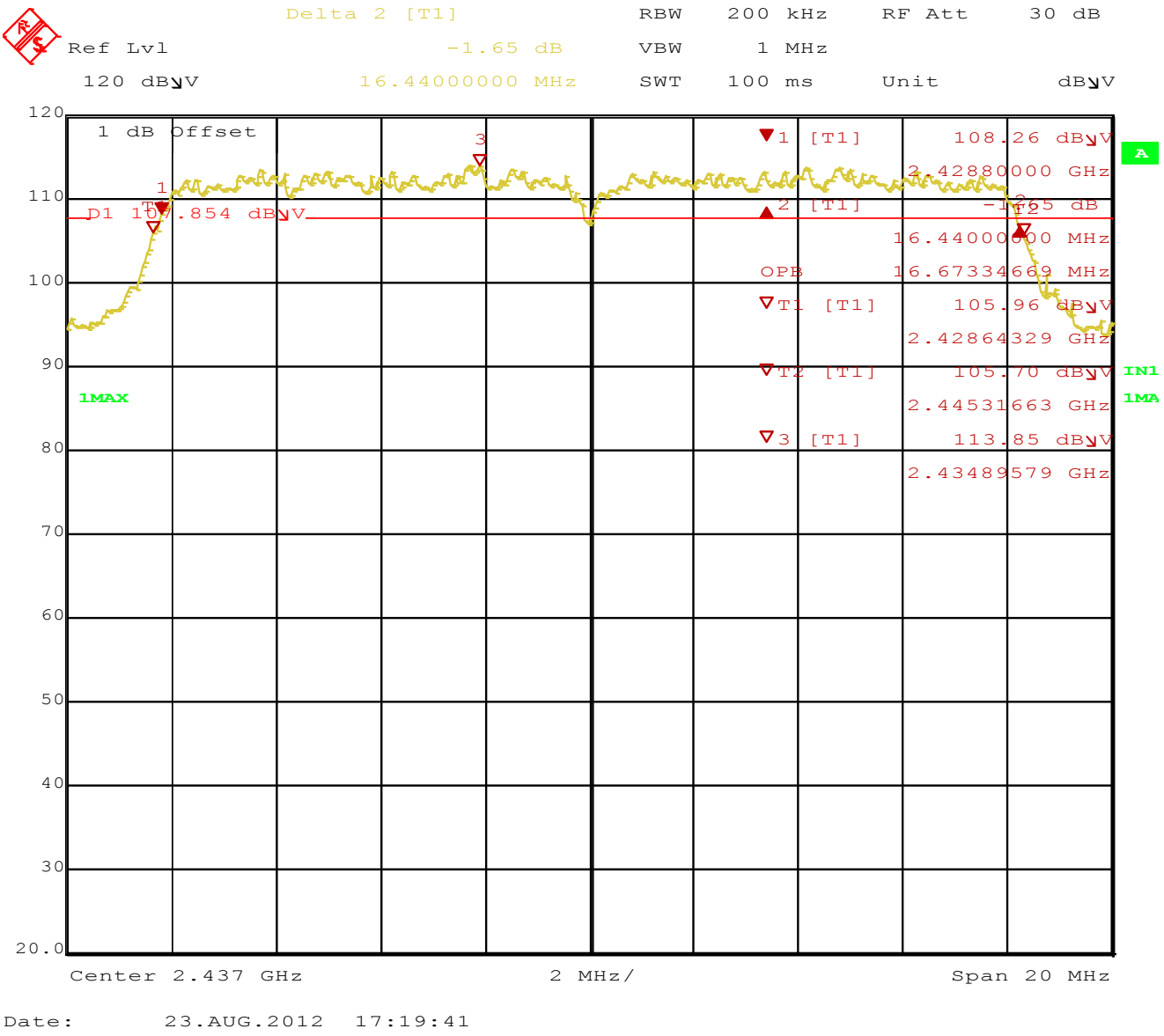


Figure 13: 6dB and 99% Bandwidth at 6 Mbps – Operating Channel 2437 MHz

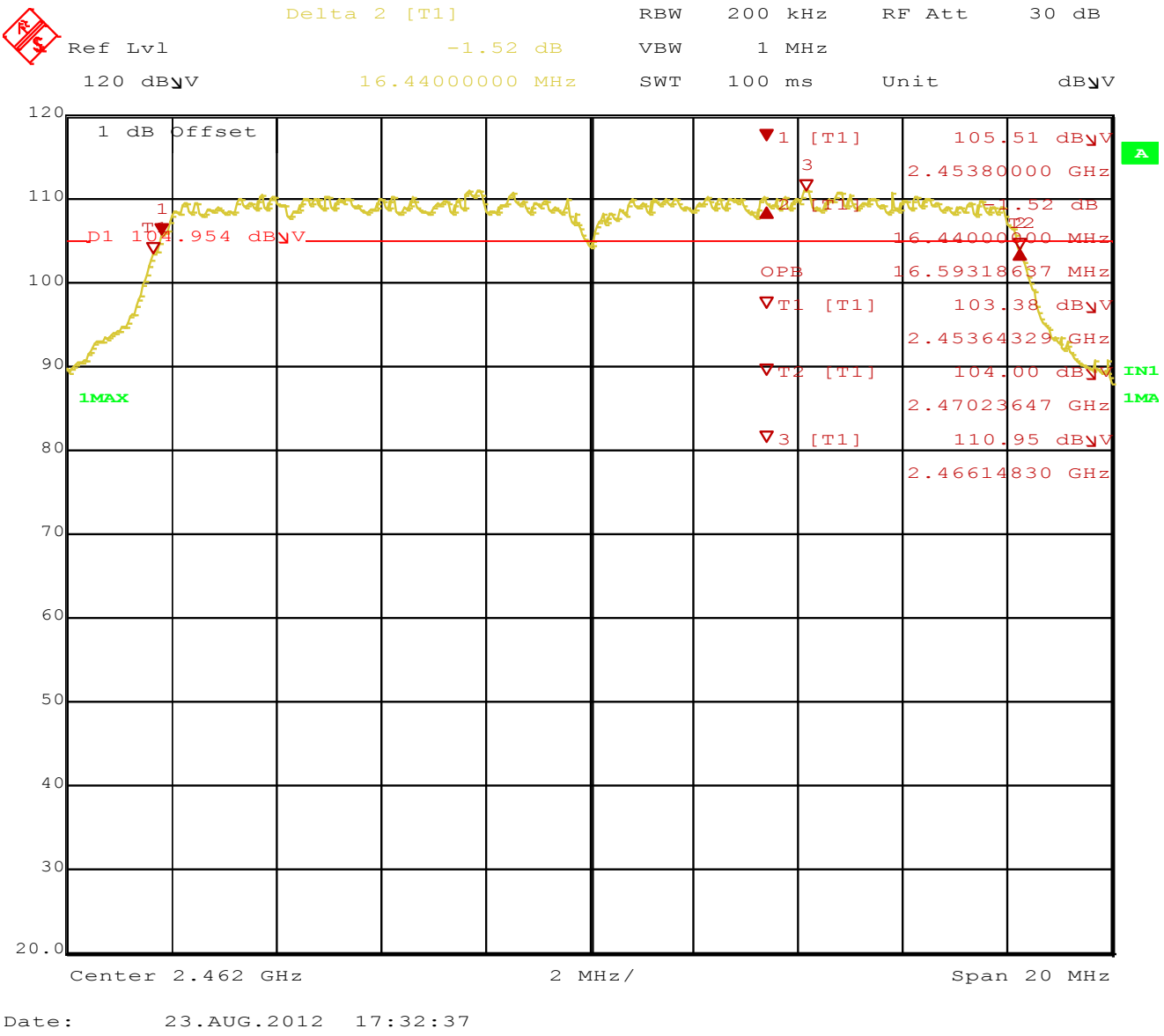


Figure 14: 6dB and 99% Bandwidth at 6 Mbps – Operating Channel 2462 MHz

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

4.3.1 Results

The Out of band emission was performed in the conducted mode.

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

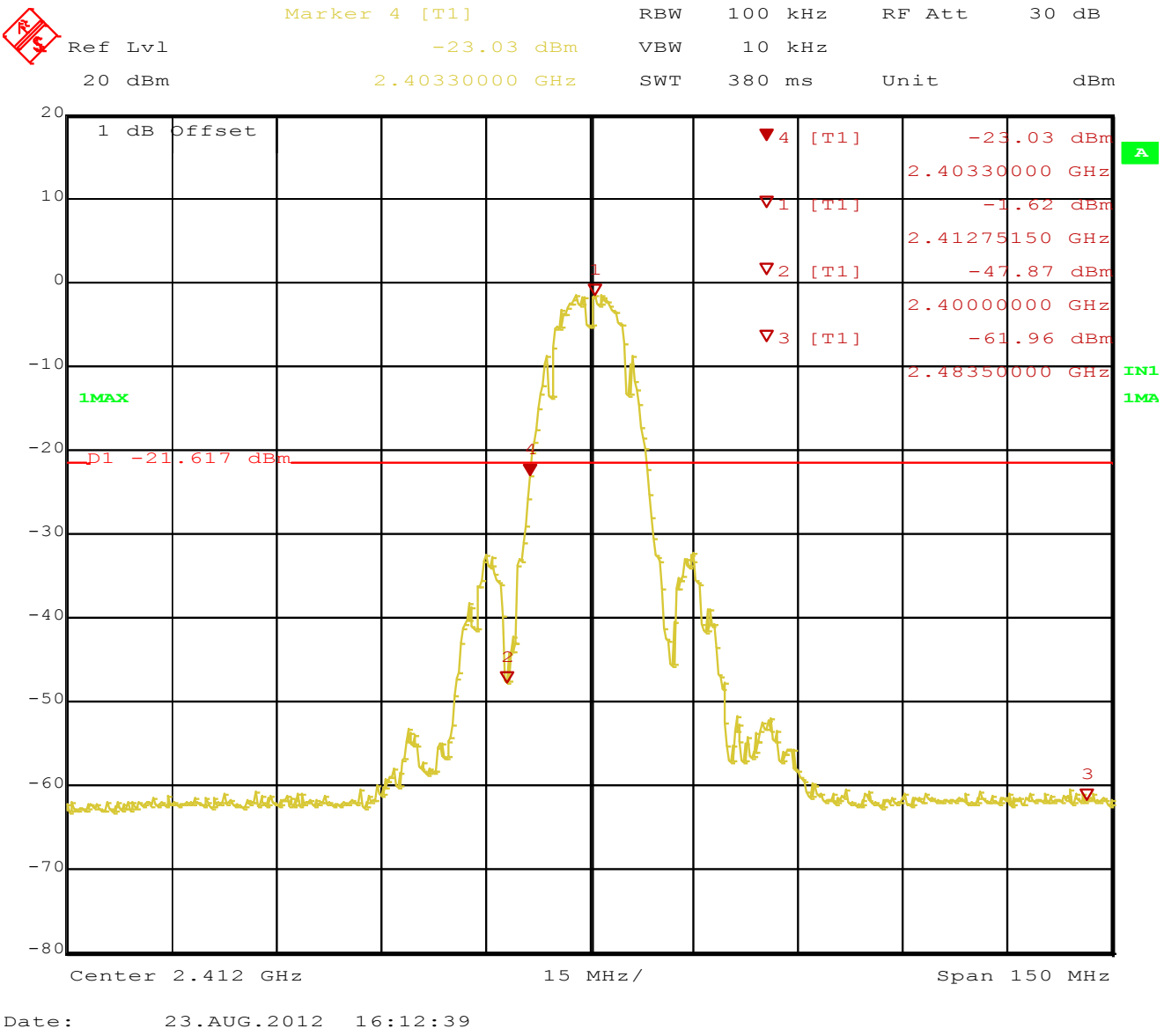


Figure 15: Inband Emissions at 1 Mbps – Operating Channel 2412 MHz

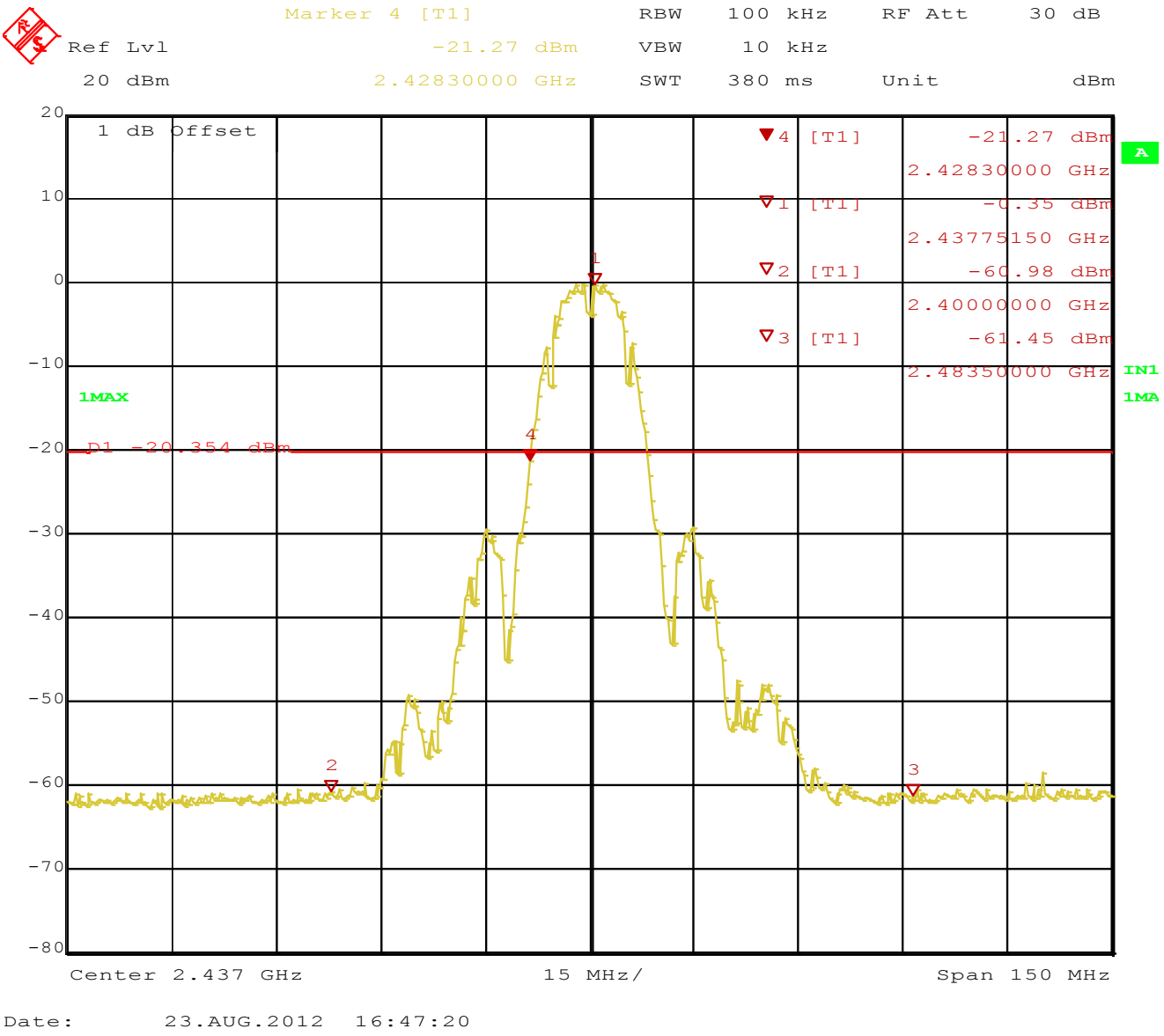


Figure 16: Inband Emissions at 6 Mbps – Operating Channel 2437 MHz

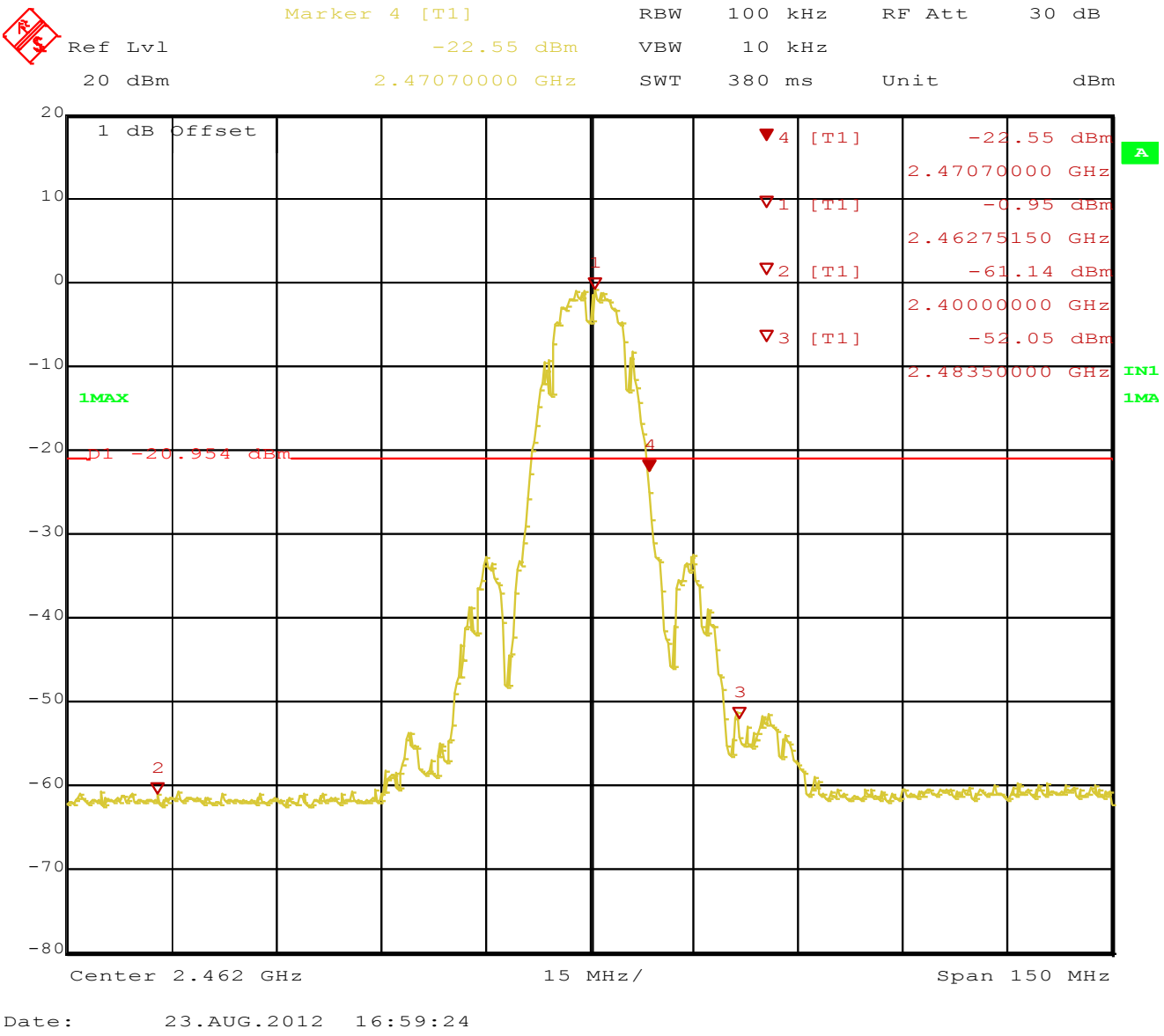


Figure 17: Inband Emissions at 1 Mbps – Operating Channel 2462 MHz

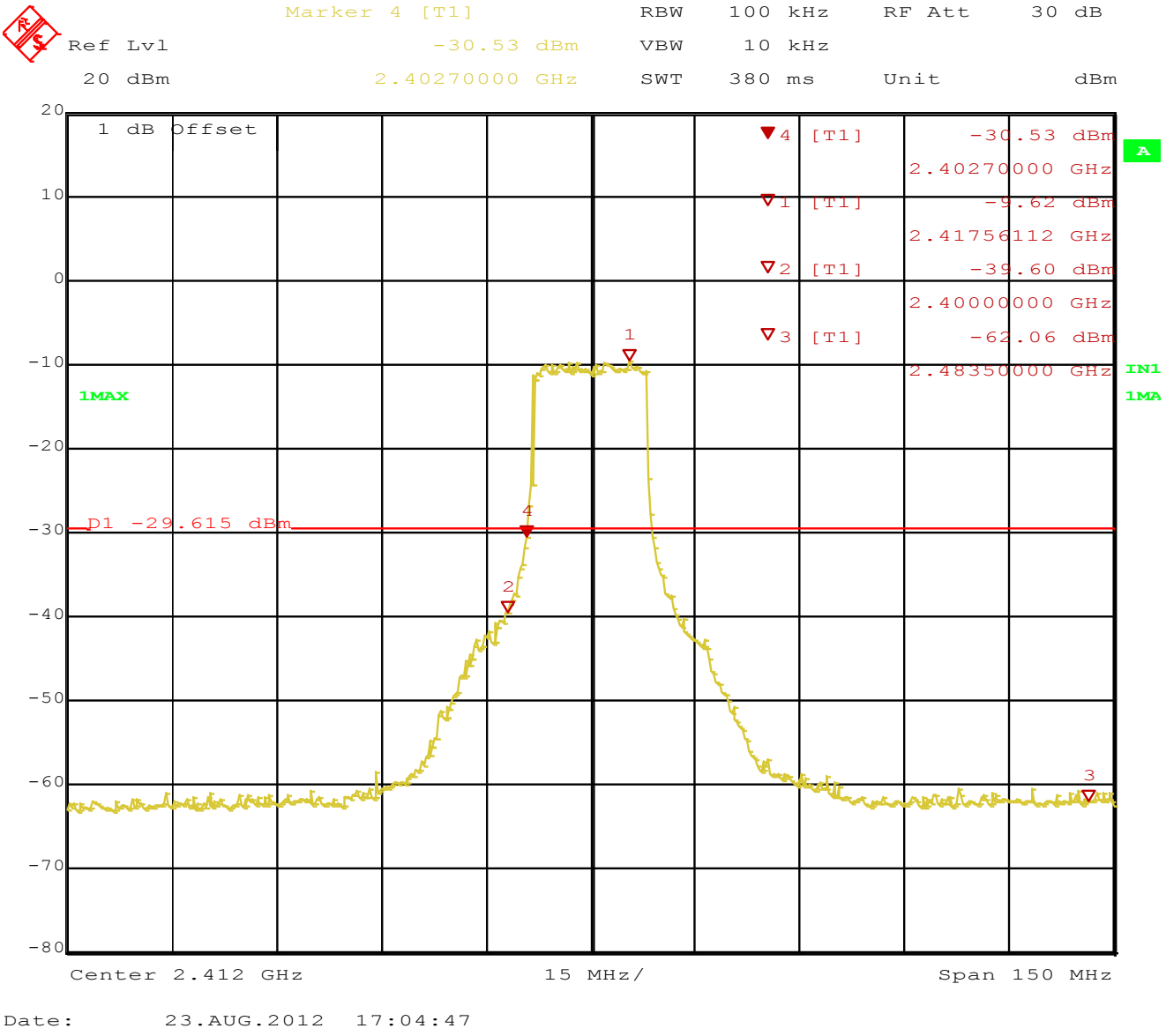


Figure 18: Inband Emissions at 6 Mbps – Operating Channel 2412 MHz

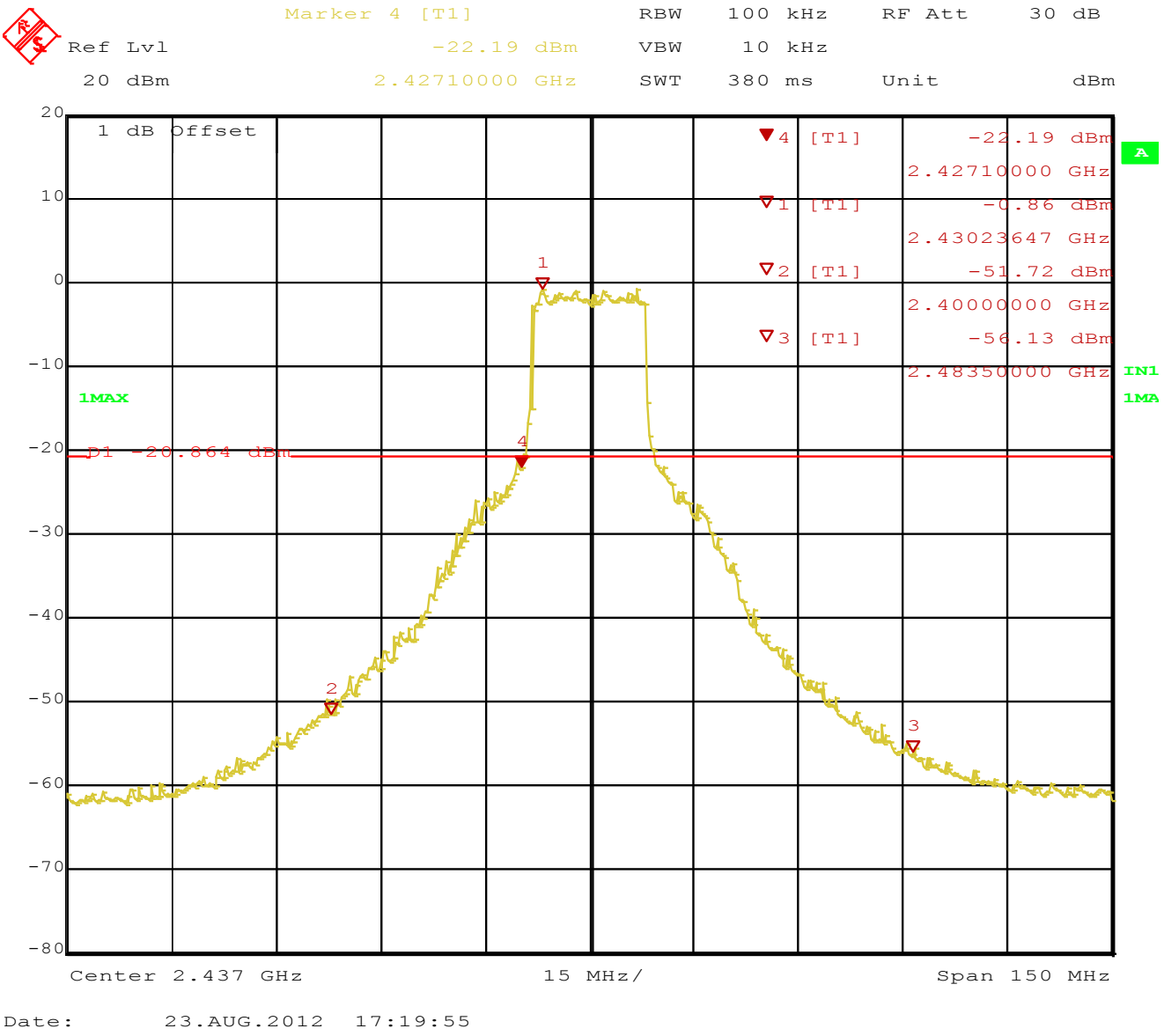


Figure 19: Inband Emissions at 6 Mbps – Operating Channel 2437 MHz

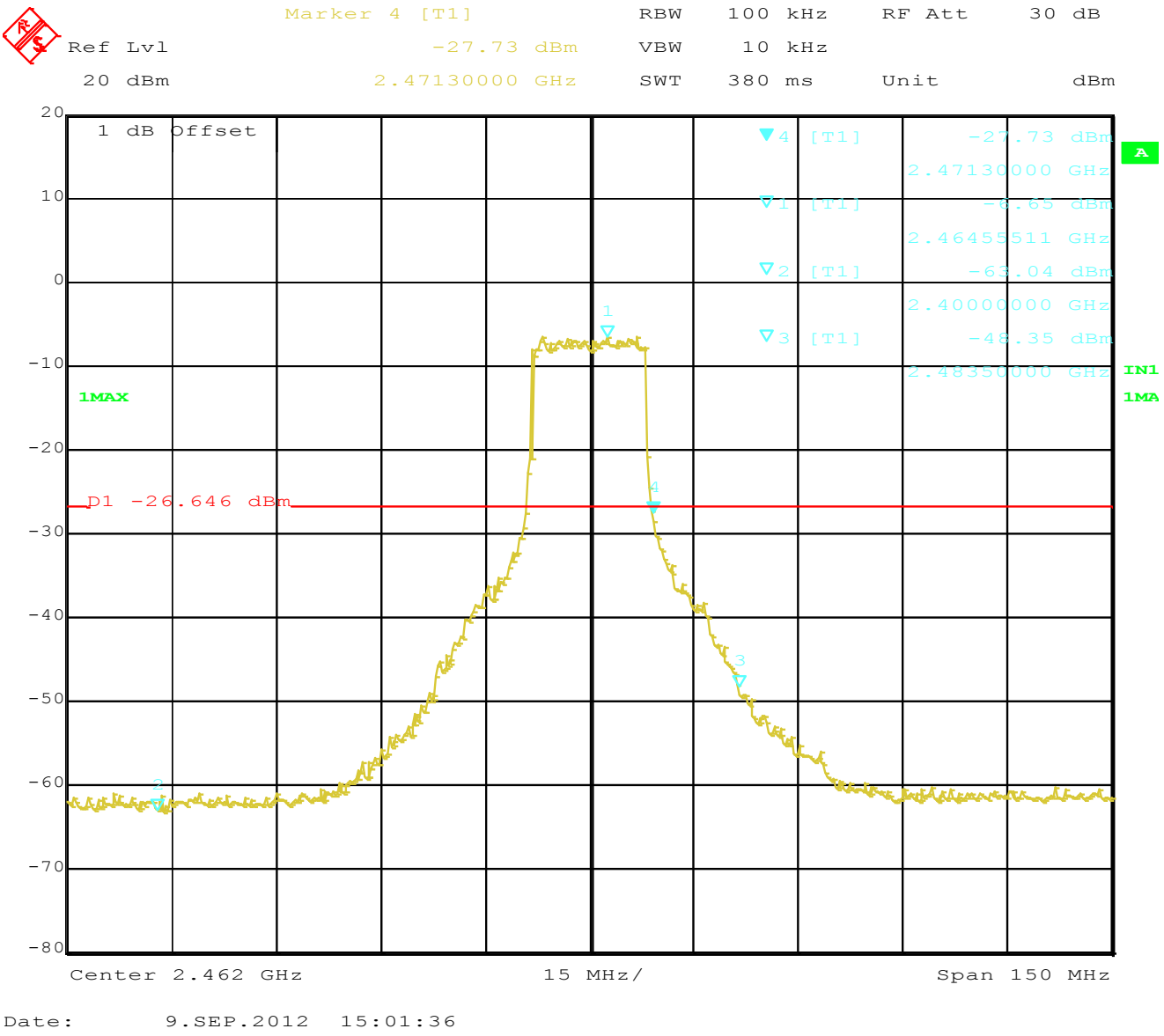


Figure 20: Inband Band Emissions at 6 Mbps – Operating Channel 2462 MHz

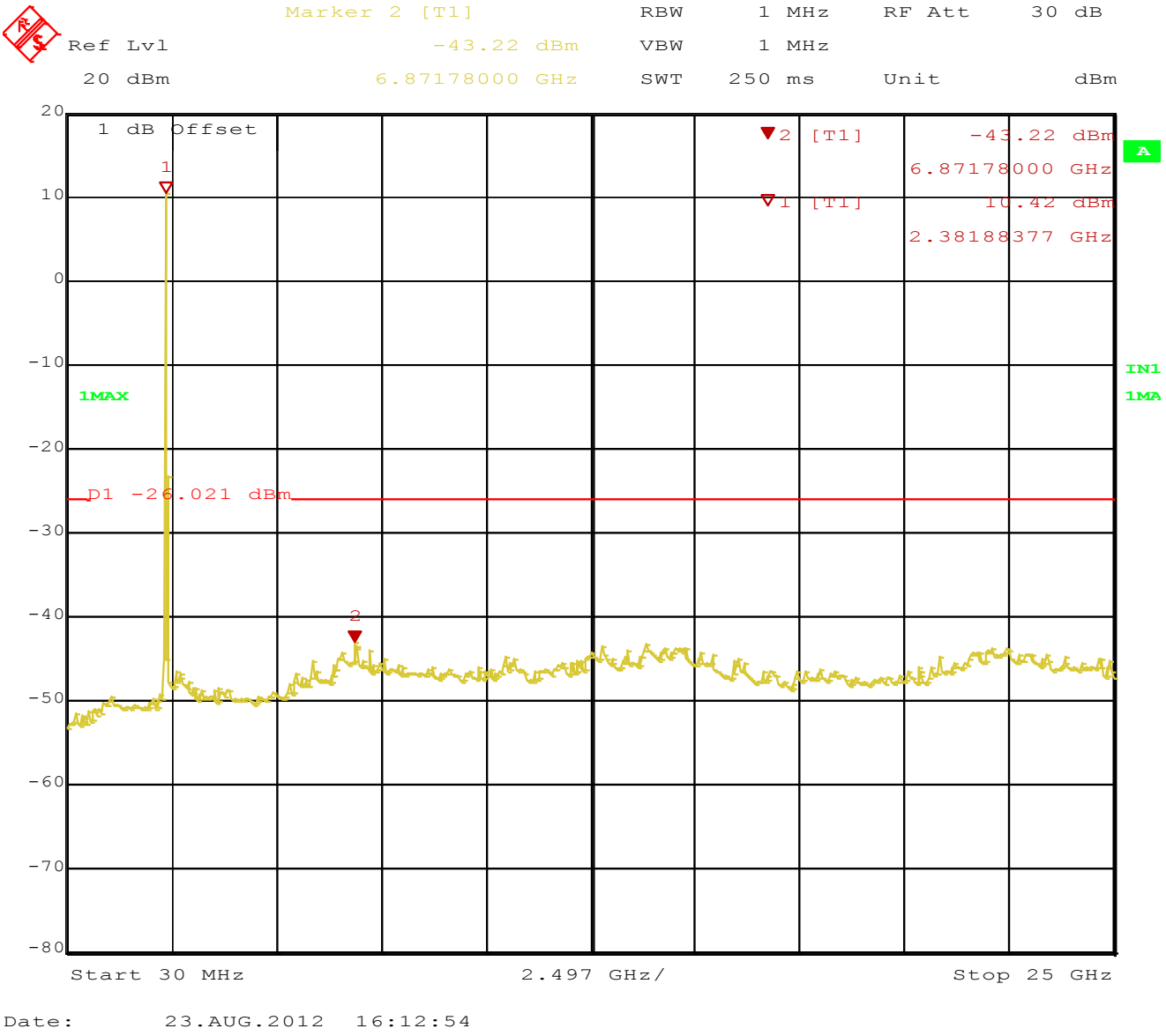


Figure 21: Out of Band Emissions at 1 Mbps – Operating Channel 2412 MHz

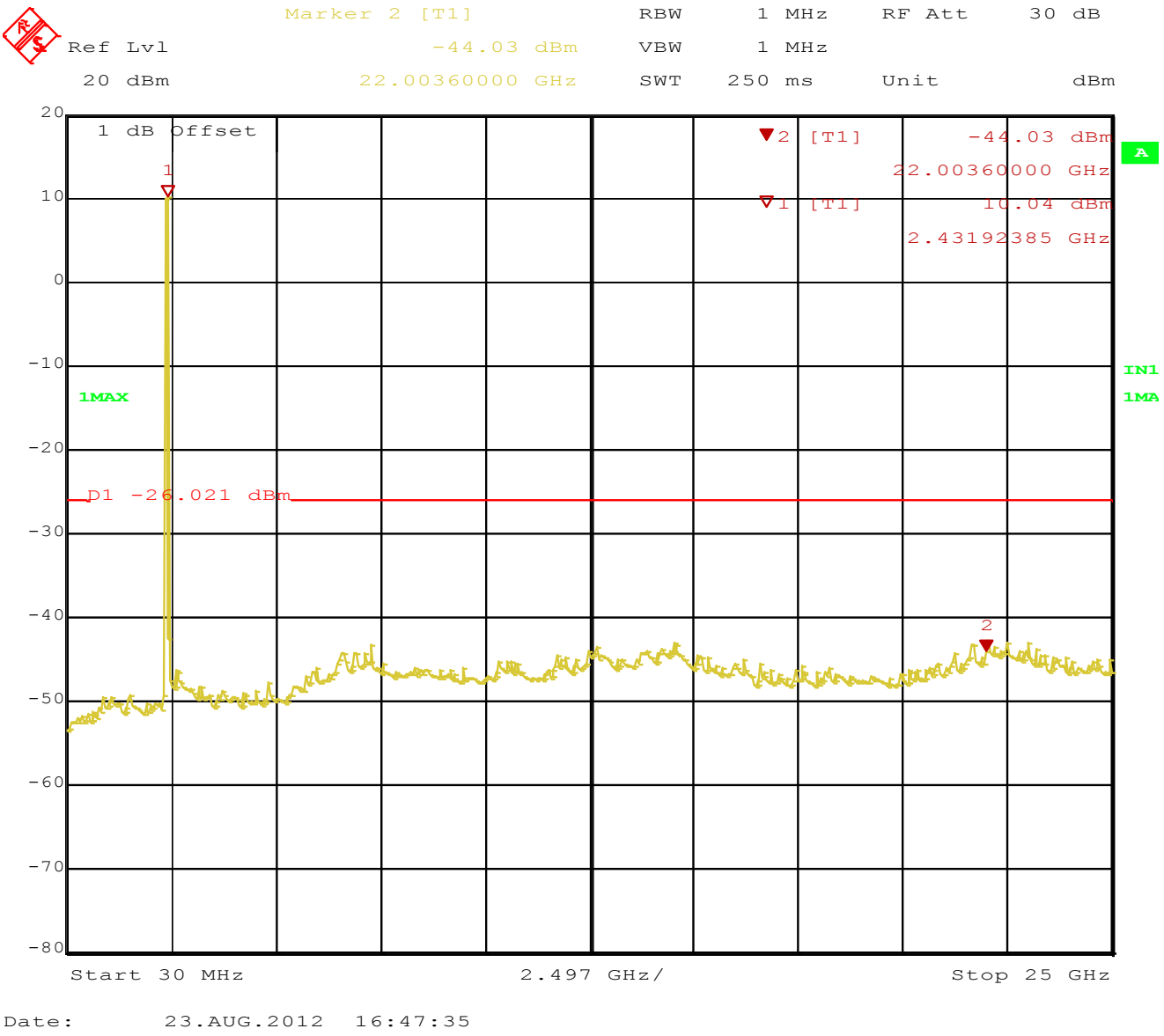


Figure 22: Out of Band Emissions at 1 Mbps – Operating Channel 2437 MHz

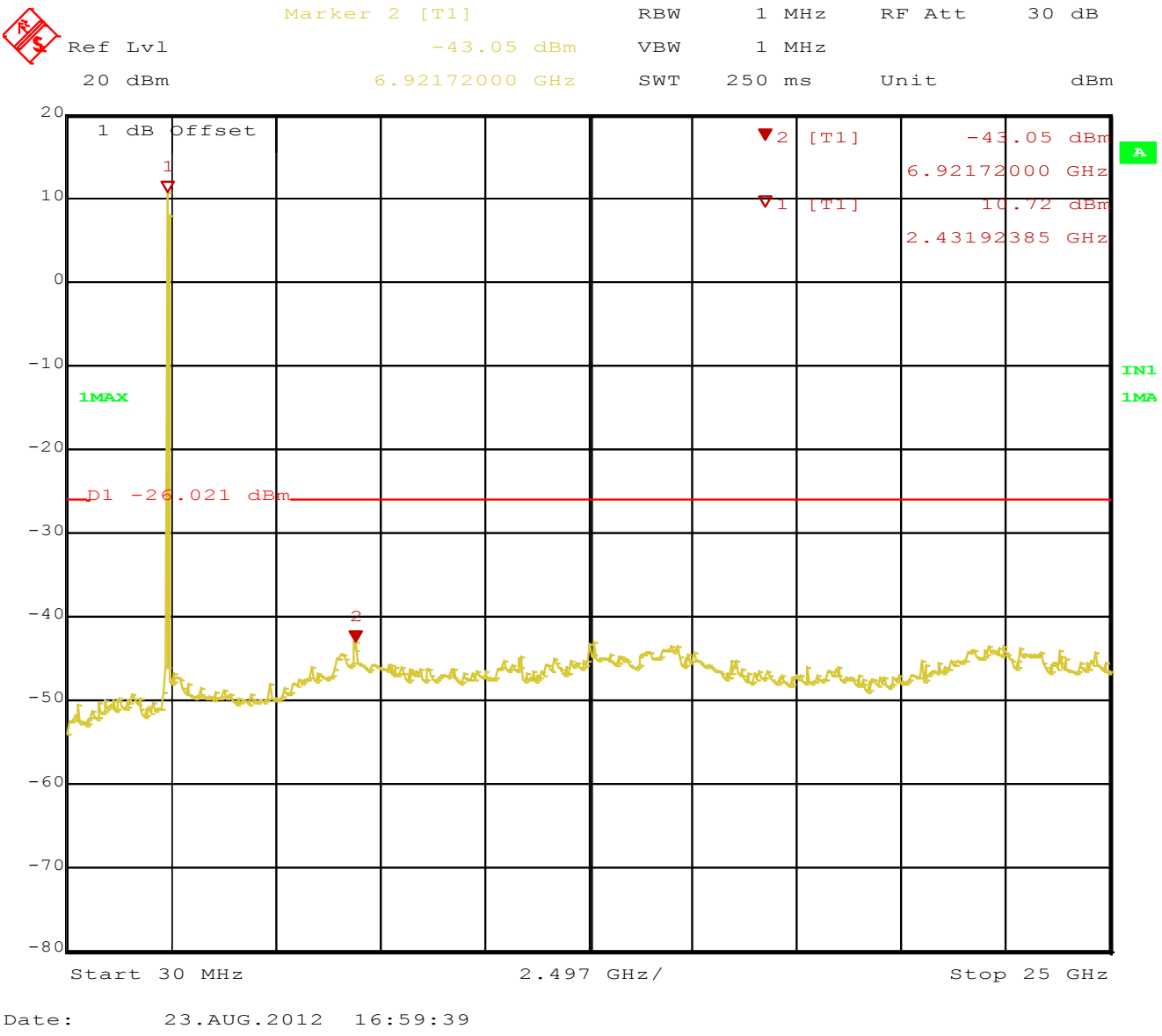


Figure 23: Out of Band Emissions at 1 Mbps – Operating Channel 2462 MHz

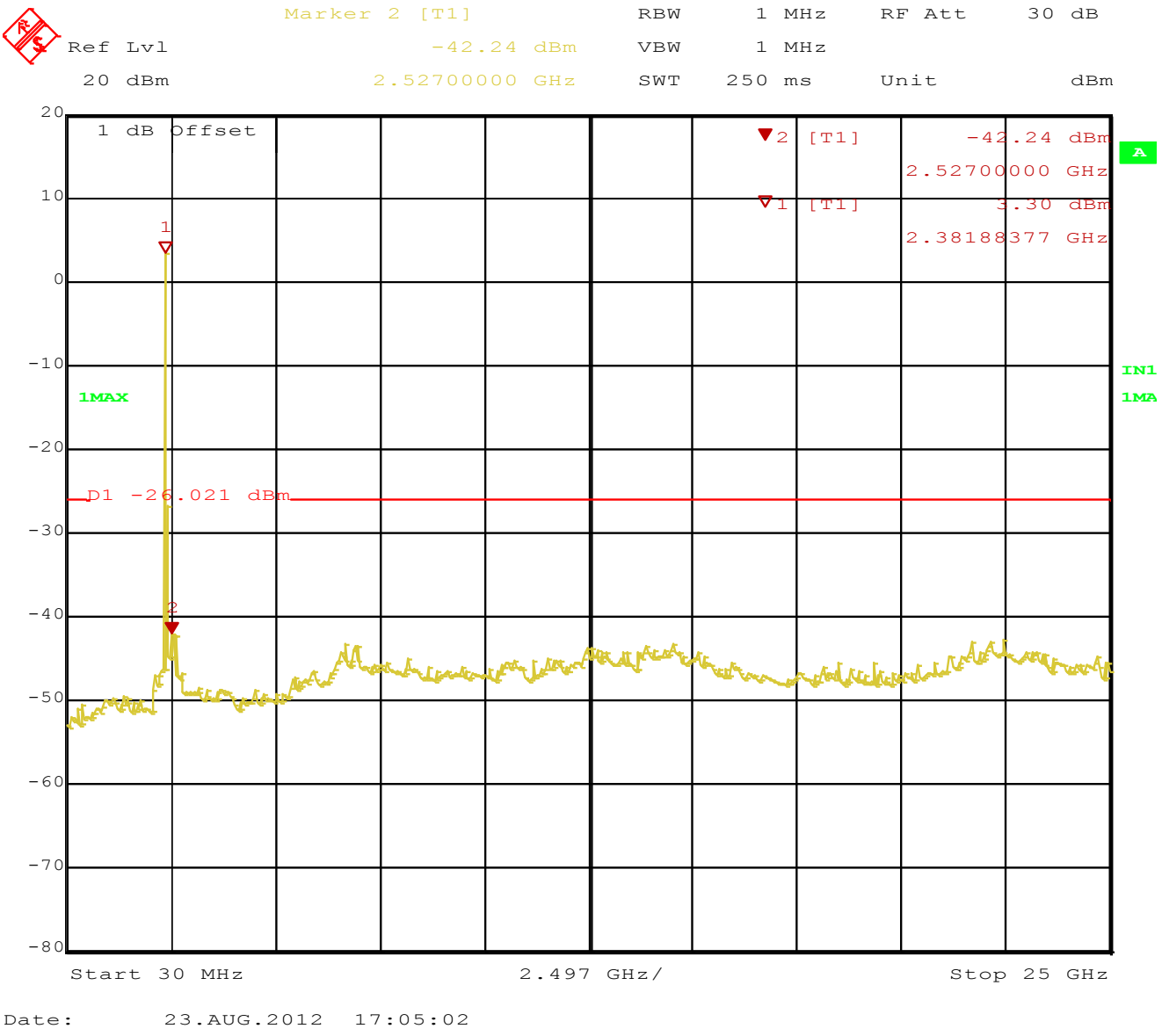


Figure 24: Out of Band Emissions at 6 Mbps – Operating Channel 2412 MHz

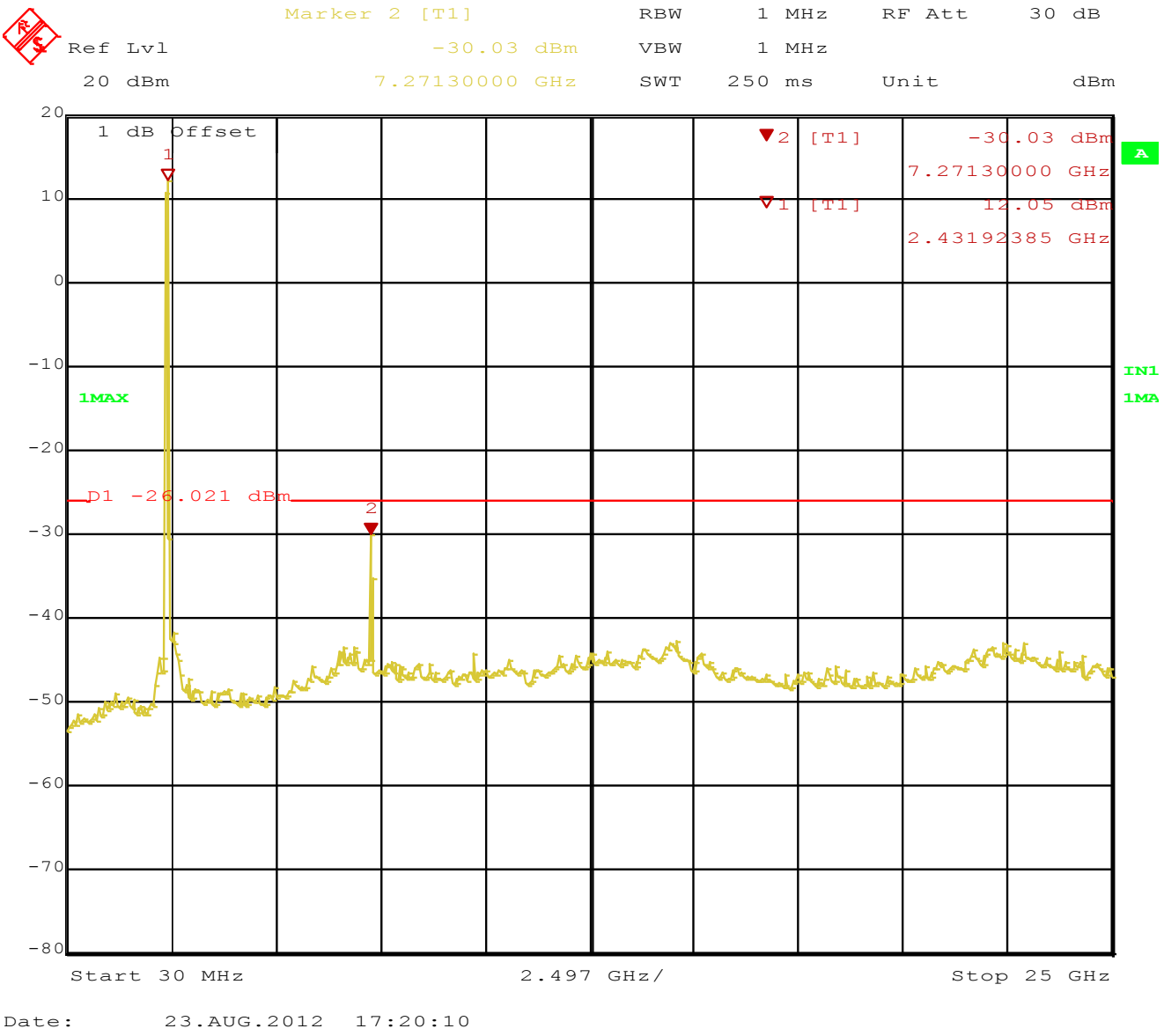


Figure 25: Out of Band Emissions at 6 Mbps – Operating Channel 2437 MHz

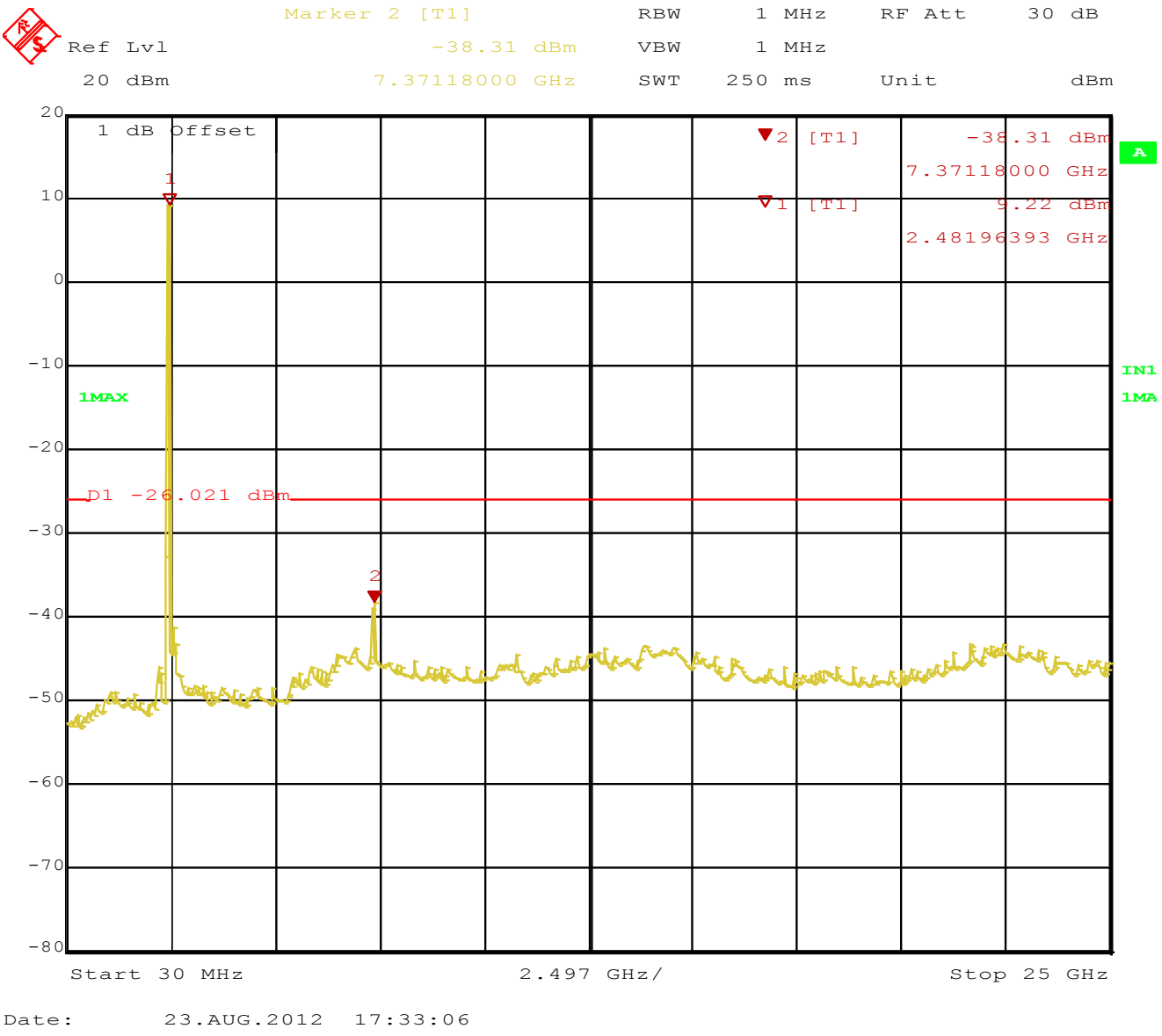


Figure 26: Out of Band Emissions at 6 Mbps – Operating Channel 2462 MHz

4.4 Peak Power Spectral Density

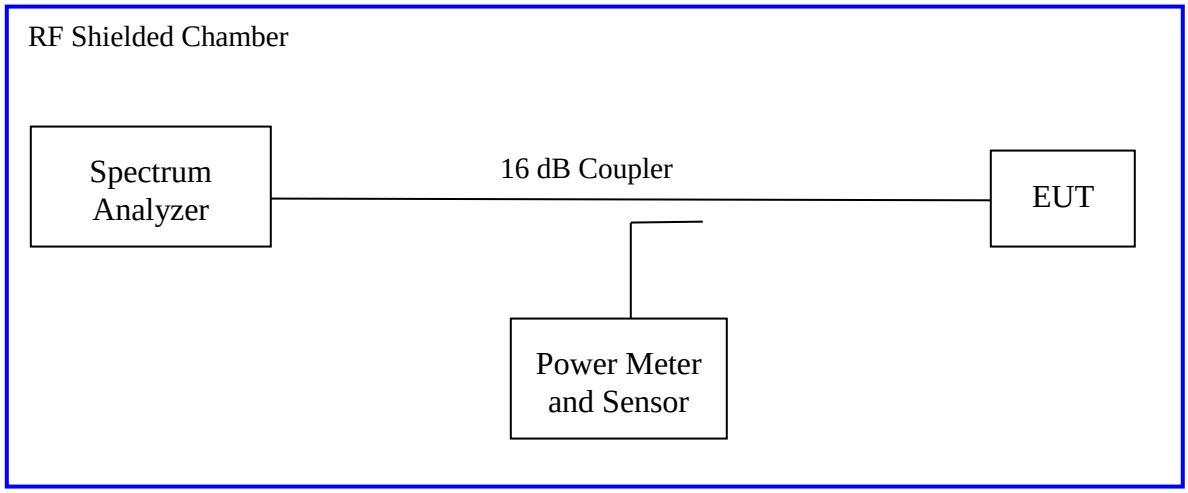
According to the CFR47 Part 15.247 (e) and RSS 210 (A8.2), the spectral power density output of the antenna port shall be less than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

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 in each mode. 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 4: Peak Power Spectral Density – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage				
Antenna Type: Integrated		**Power Setting:** see test plan		
Max. Antenna Gain: +2.9 dBi		**Signal State:** Modulated		
Ambient Temp.: 21 °C		**Relative Humidity:**39%		
Peak Power Spectral Density Test Results				
Operating Channel	**Mode**	**PPSD [dBm]**	**Limit [dBm]**	**Margin [dB]**
2412 MHz	1 Mbps	-11.28	8 dBm	-19.28
2437 MHz	1 Mbps	-9.85	8 dBm	-17.85
2462 MHz	1 Mbps	-11.82	8 dBm	-19.82
Note: The highest PPSD was observed at 6 Mbps;				
Operating Channel	**Mode**	**PPSD [dBm]**	**Limit [dBm]**	**Margin [dB]**
2412 MHz	6 Mbps	-18.55	8 dBm	-24.55
2437 MHz	6 Mbps	-9.65	8 dBm	-17.65
2462 MHz	6 Mbps	-14.24	8 dBm	-22.24

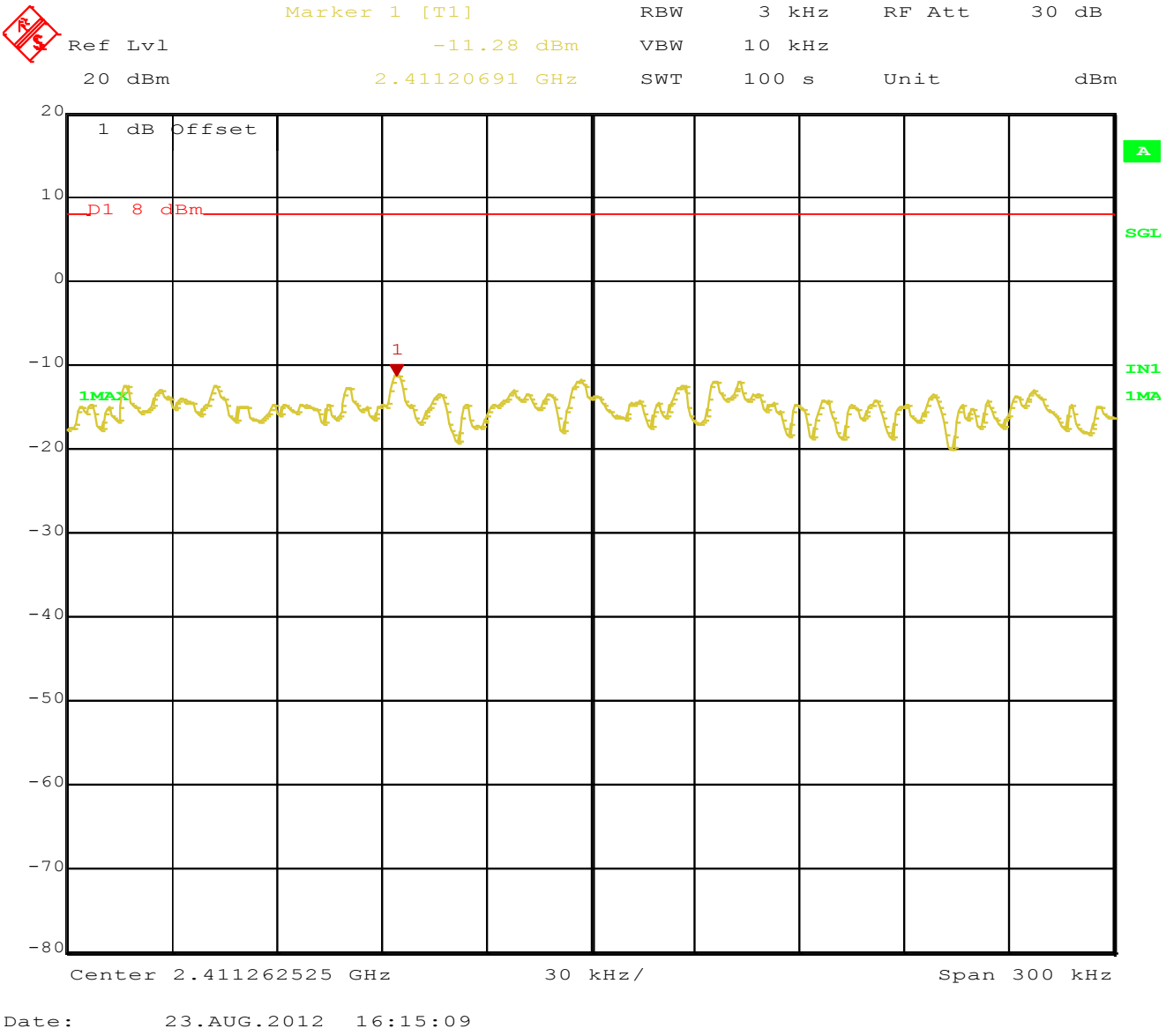


Figure 27: Peak Power Spectral Density for Operating Channel 2412 MHz b Mode

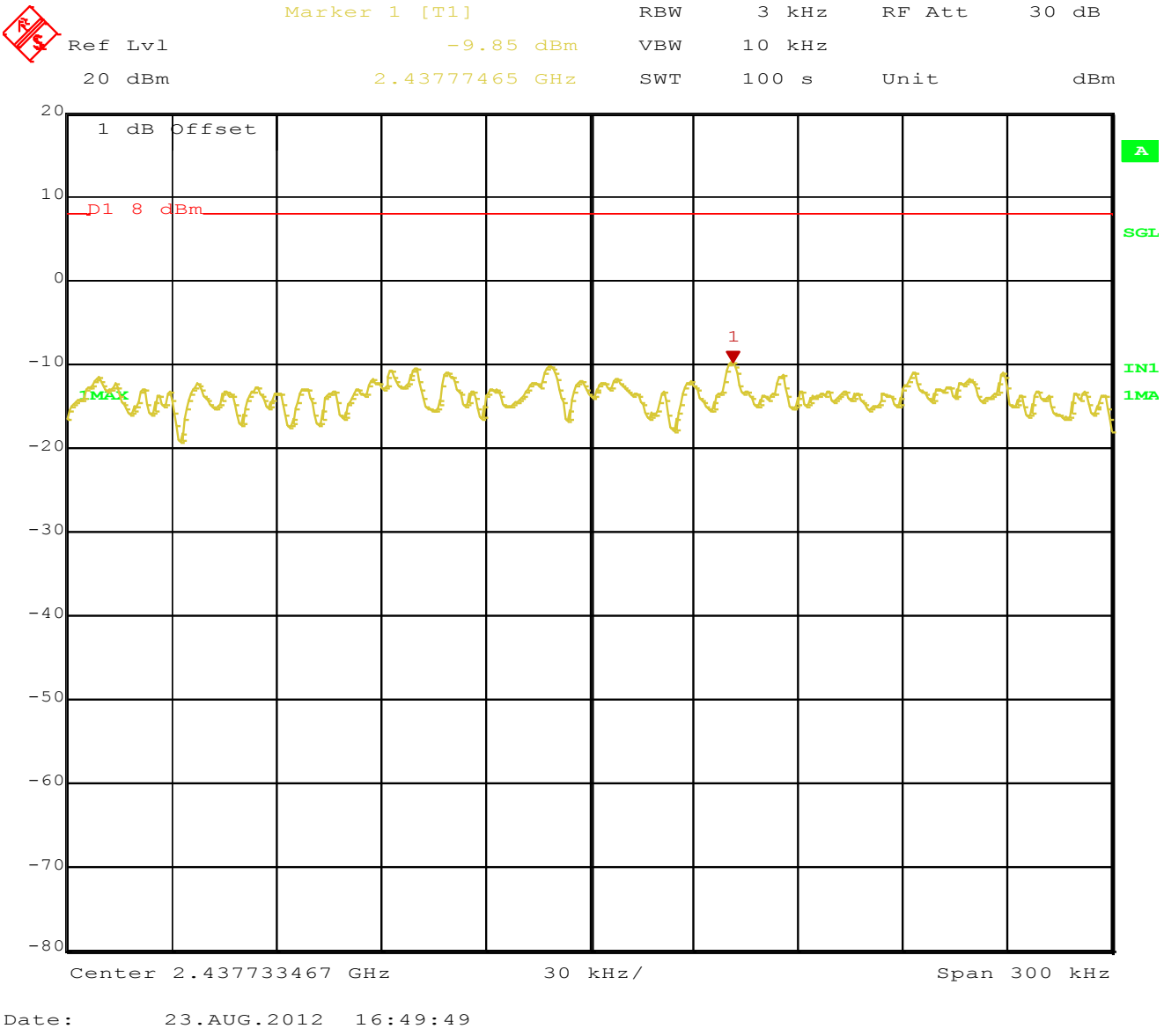


Figure 28: Peak Power Spectral Density for Operating Channel 2437 MHz b Mode

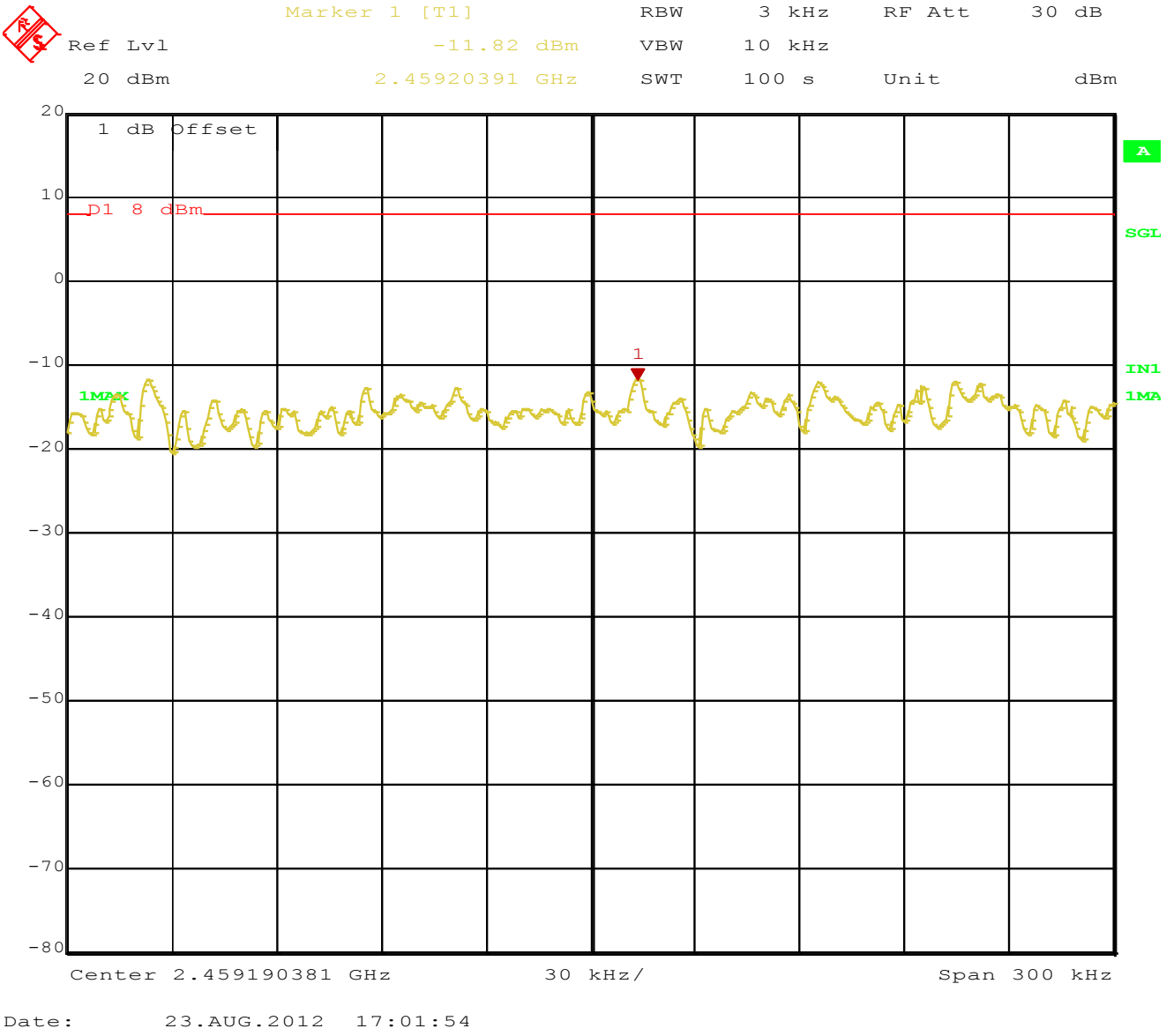


Figure 29: Peak Power Spectral Density for Operating Channel 2462 MHz b Mode

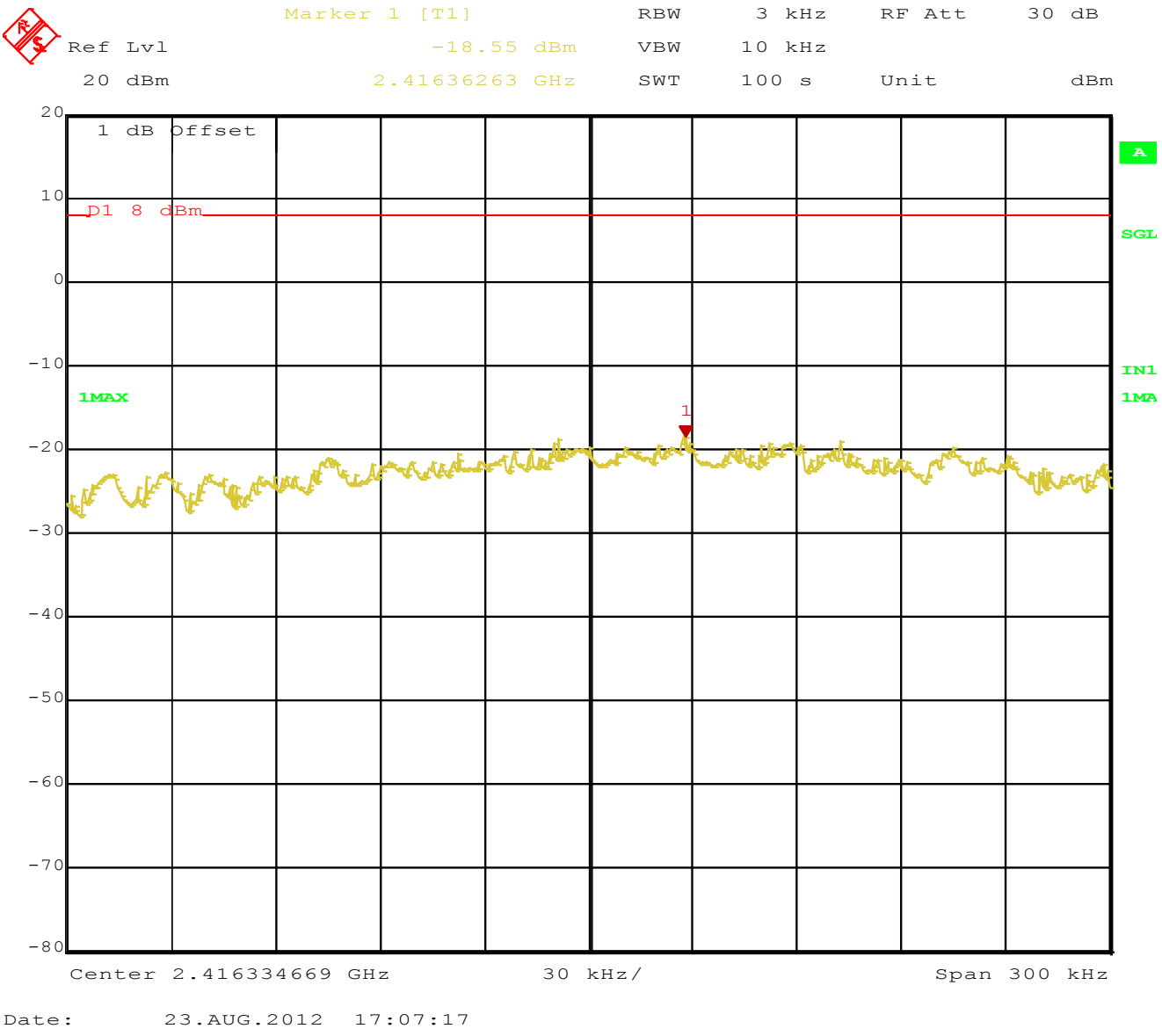


Figure 30: Peak Power Spectral Density for Operating Channel 2412 MHz g mode

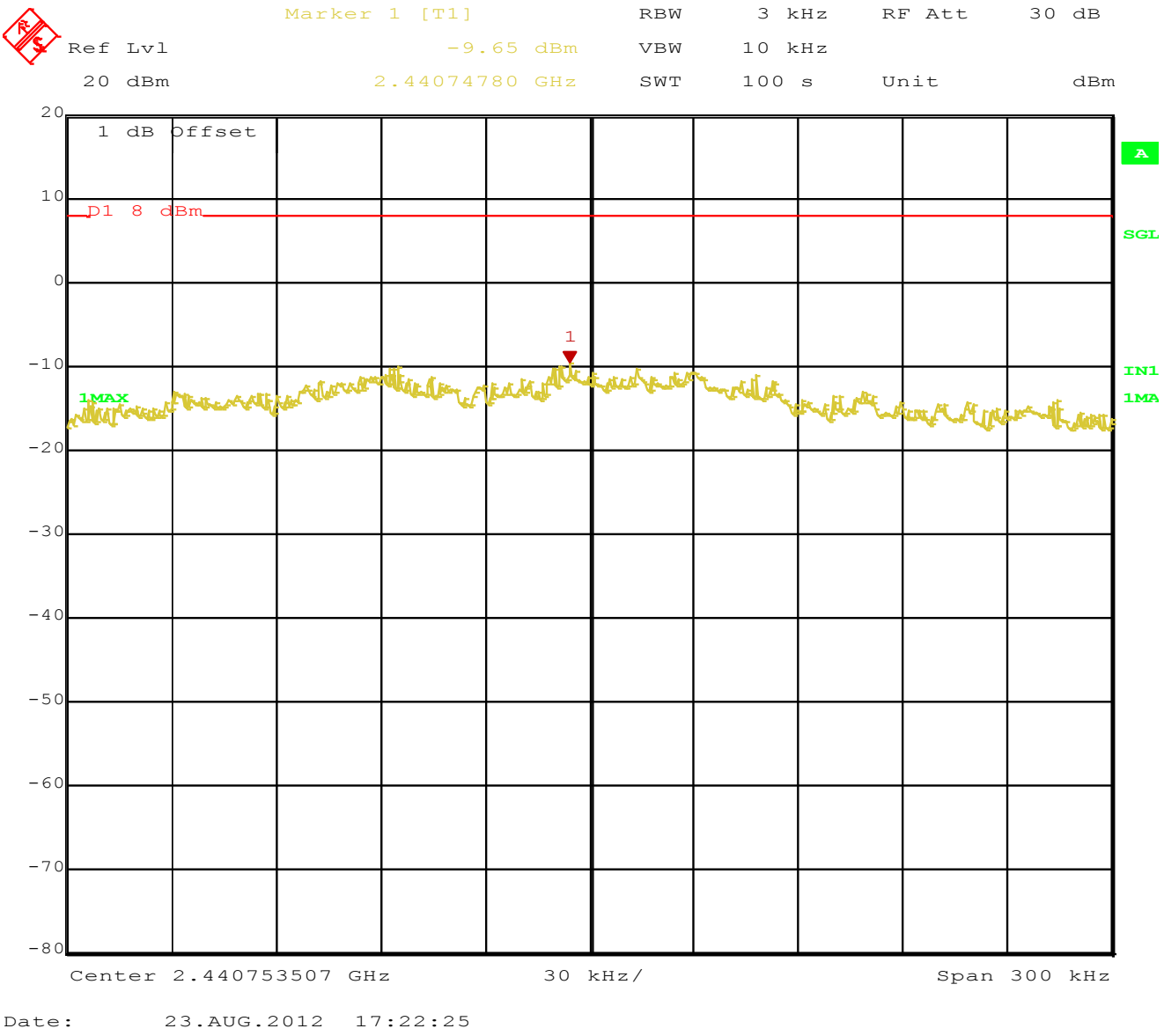


Figure 31: Peak Power Spectral Density for Operating Channel 2437 MHz g mode

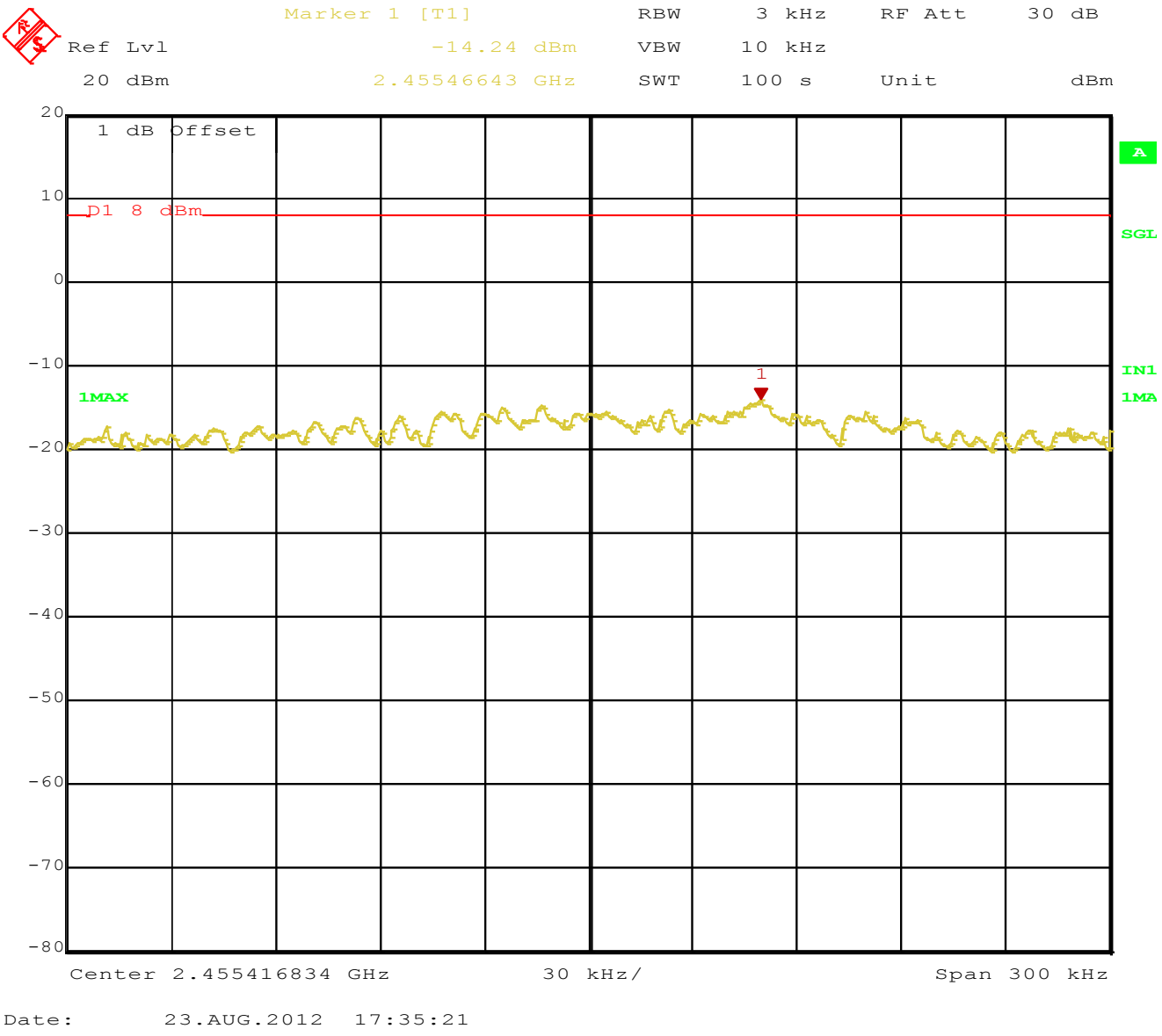


Figure 32: Peak Power Spectral Density for Operating Channel 2462 MHz g mode

4.5 Transmitter Spurious Emissions

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

4.5.1 Test Methodology

4.5.1.1 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.

4.5.1.2 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, Y-Axis, for three operating channels;

2412 MHz, 2437 MHz, and 2462 MHz at 1 Mbps for b Mode amd 6.0 Mbps for g mode at the highestpower for the mode

4.5.1.3 Deviations

None.

4.5.2 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209: 2011 and RSS 210 A1.1.2 2010.

Measurement

Frequency (MHz)	Field strength (microvolts/meter)	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.

4.5.3 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 Test Plan.

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

Table 5: Transmit Spurious Emission at Band-Edge Requirements

Test Conditions: Radiated Measurement, Normal Temperature and Voltage only								
Antenna Type: Internal				**Power Setting:** See test plan				
Max. Antenna Gain: + 2.9 dBi				**Signal State:** Modulated				
Ambient Temp.: 22 °C				**Relative Humidity:**34%				
Band-Edge Results 802.11b Mode								
Operating Channel MHz	**Polarity**	**Peak Field Strength Measured dBuV**	**Peak Limit dBuV**	**Margin dB**	**Avg Field Strength Measured dBuV**	**Avg Limit dBuV**	**Margin dB**	**Result**
2412	H	62.55	74.0	-11.45	52.97	54.0	-1.03	Pass
2462	H	62.84	74.0	-11.16	51.79	54.0	-2.21	Pass
802.11g mode								
2412	H	70.04	74.0	-3.96	51.82	54.0	-2.18	Pass
2417	H	71.41	74.0	-2.59	53.42	54.0	-0.58	Pass
2422	H	73.29	74.0	-0.61	53.67	54.0	-0.33	Pass
2427	H	70.08	74.0	-3.92	52.36	54.0	-1.64	Pass
2457	H	69.65	74.0	-4.35	52.53	54.0	-0.47	Pass
2462	H	69.13	74.0	-4.87	53.12	54.0	-0.88	Pass

Note: All bandedge measurements were performed for b and g modes. Only worst case/ limited number of plots are placed in the report.

Emissions in Horizontal orierntation were higher than vertical only worst case results are reported here.

EUT passed with higest power setting of 16 dBm for middle channel. Power setting was lowered for outer channels as follows: CH#1, 2412 MHz power setting 9 dBm, CH# 2, 2417 MHz power setting 12 dBm, CH#3, 2422 MHz power setting 14 dBm, CH #4 to CH#10 power setting 16 dBm and CH#11 power setting 13 dBm.

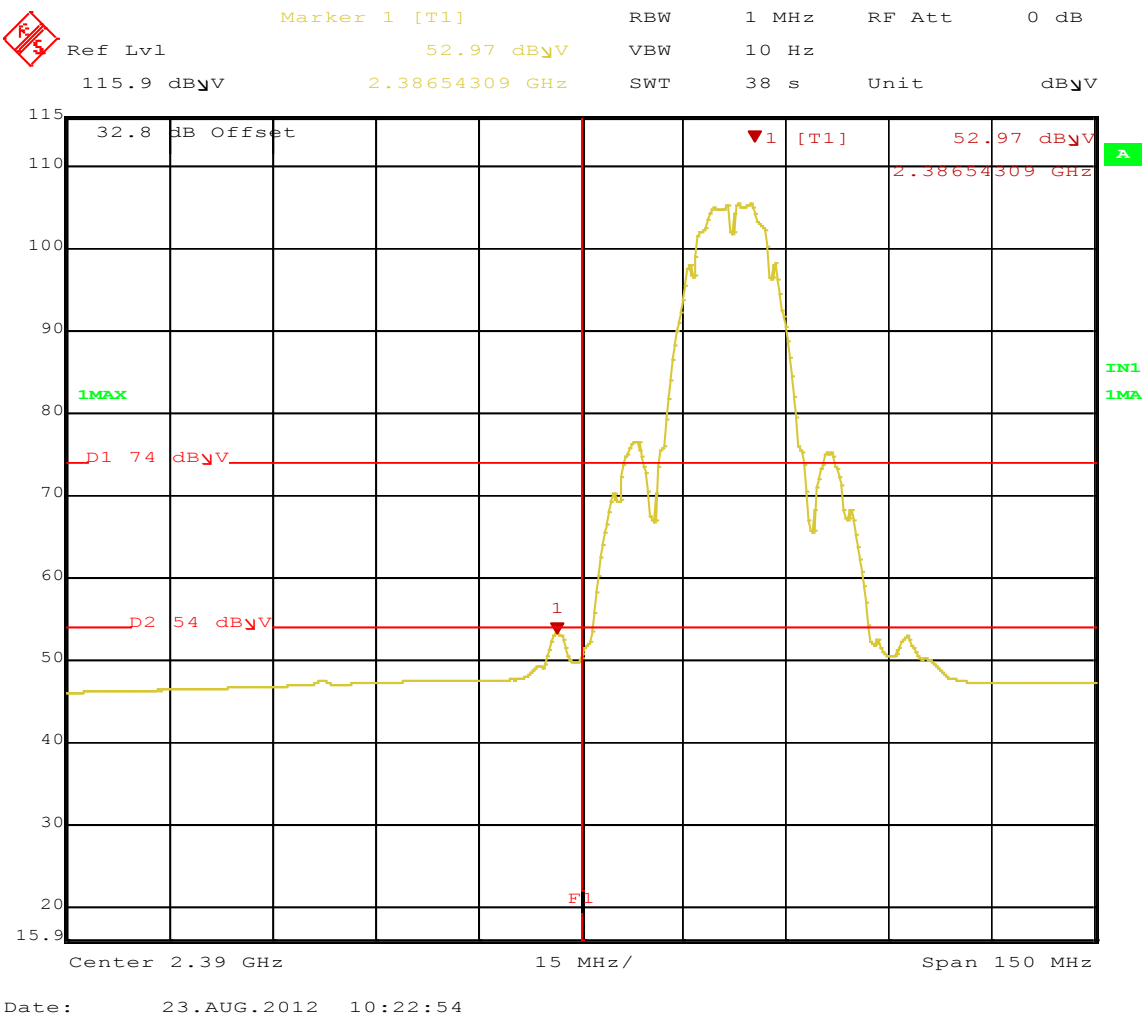


Figure 33: Radiated Emission at the Edge for Channel 2412 MHz Horizontal (avg) Power Setting 16 dBm

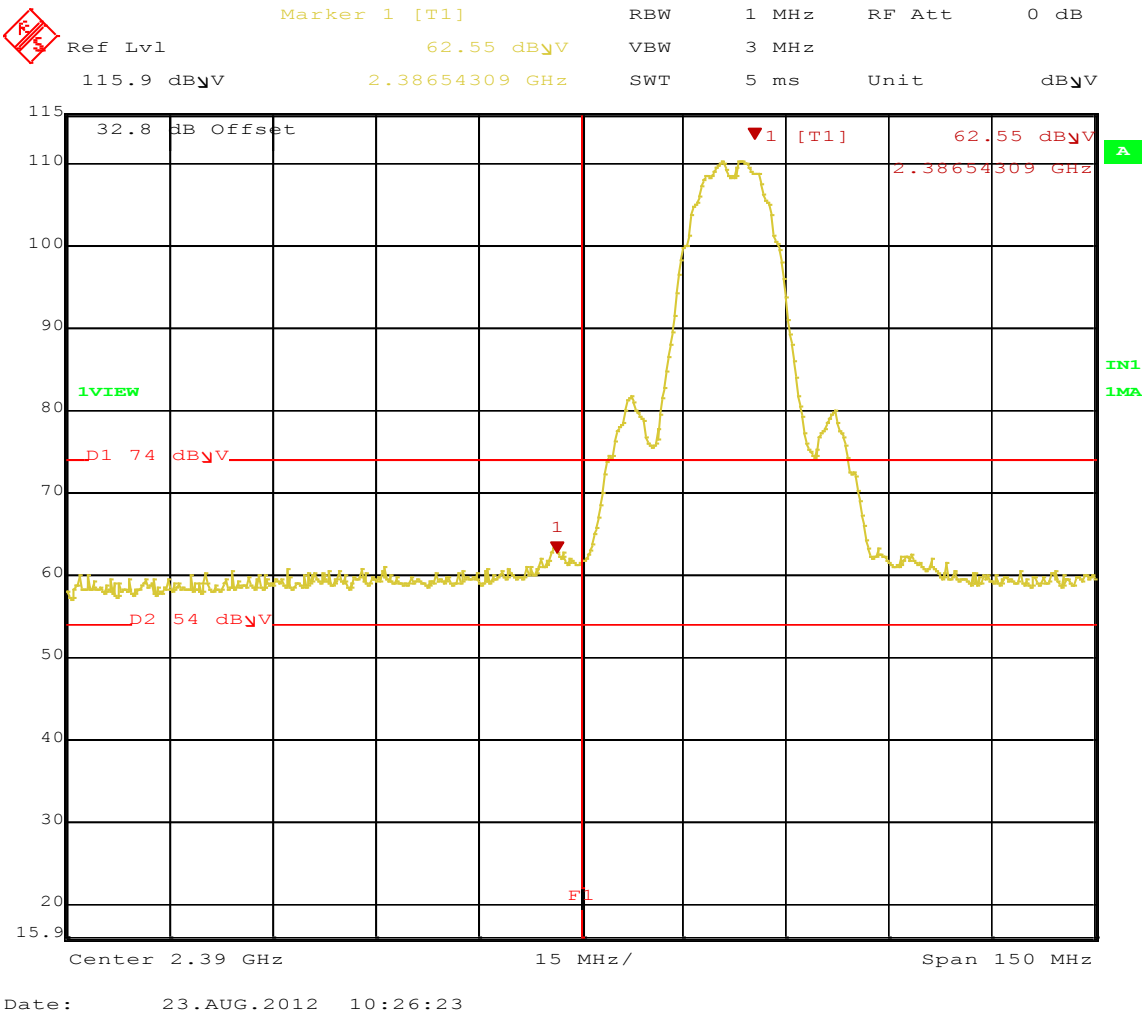


Figure 34: Radiated Emission at the Edge for Channel 2412 MHz H - Power Setting 16 dBm Peak

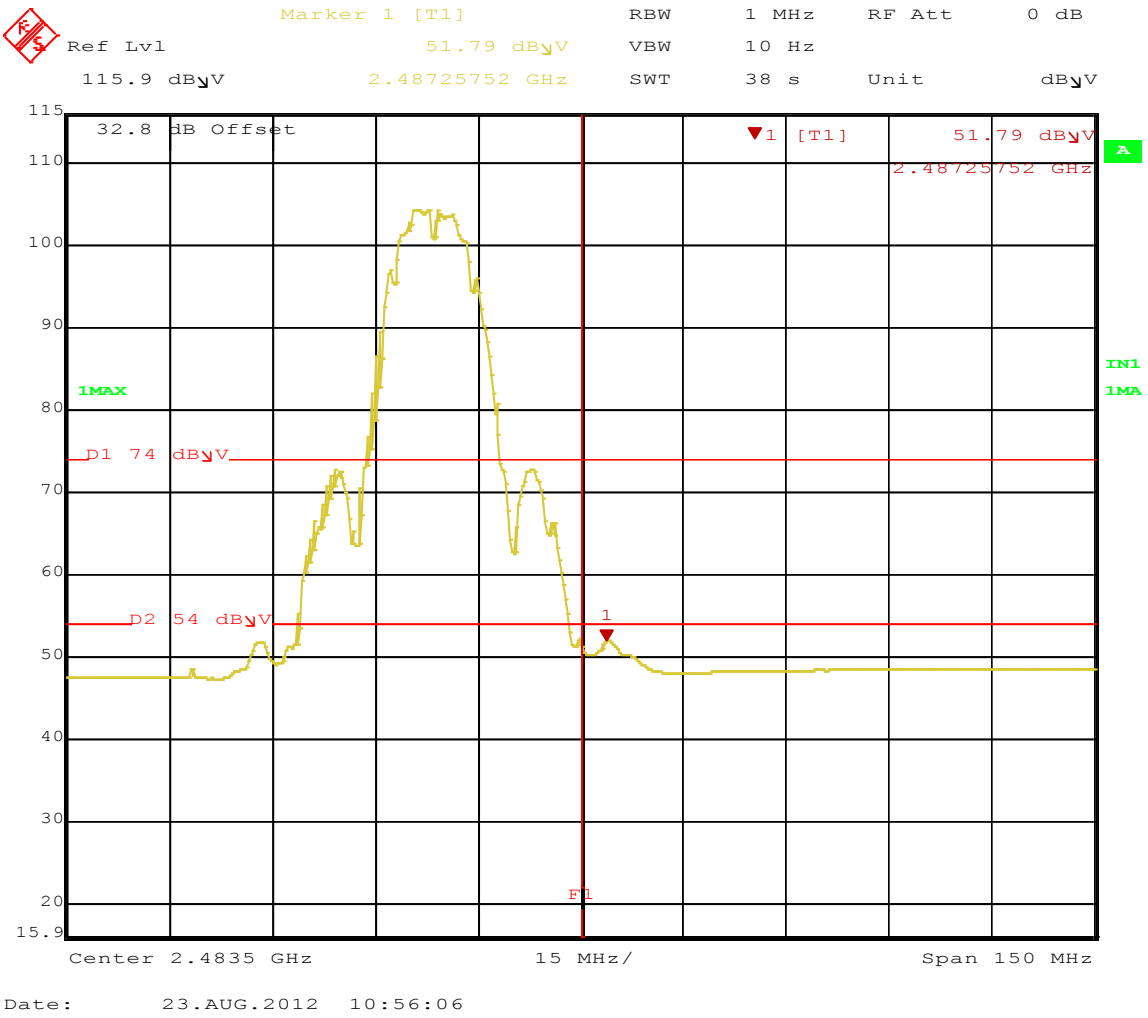


Figure 35: Radiated Emission at the Edge for Channel 2462 MHz – Horizontal (Avg) Power 16 dBm

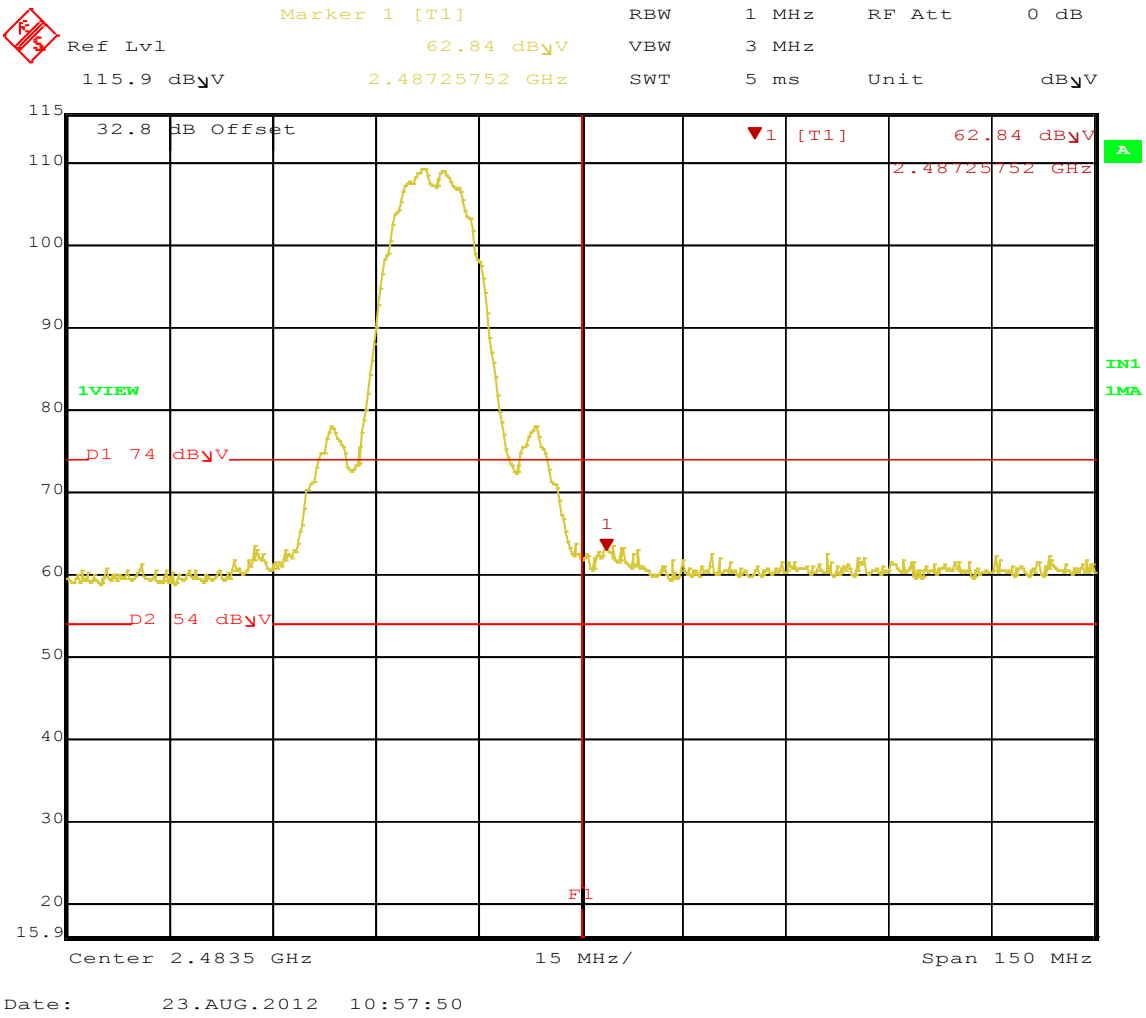


Figure 36: Radiated Emission at the Edge for Channel 2412 MHz – Horizontal (PK) Power 16 dBm

G Mode

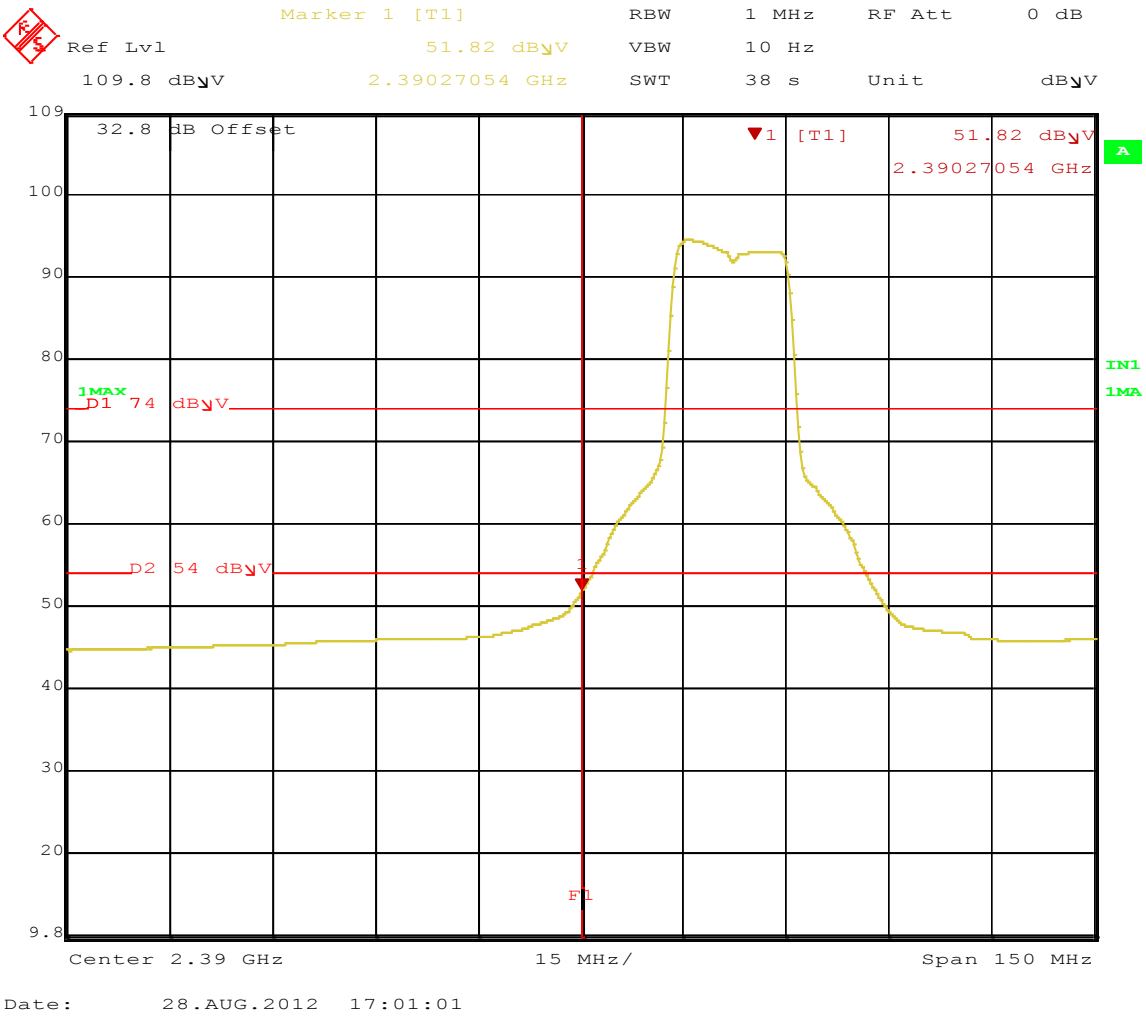


Figure 37: Radiated Emission at the Edge for Channel 2412 MHz – g mode Horizontal (avg) Power 9 dBm

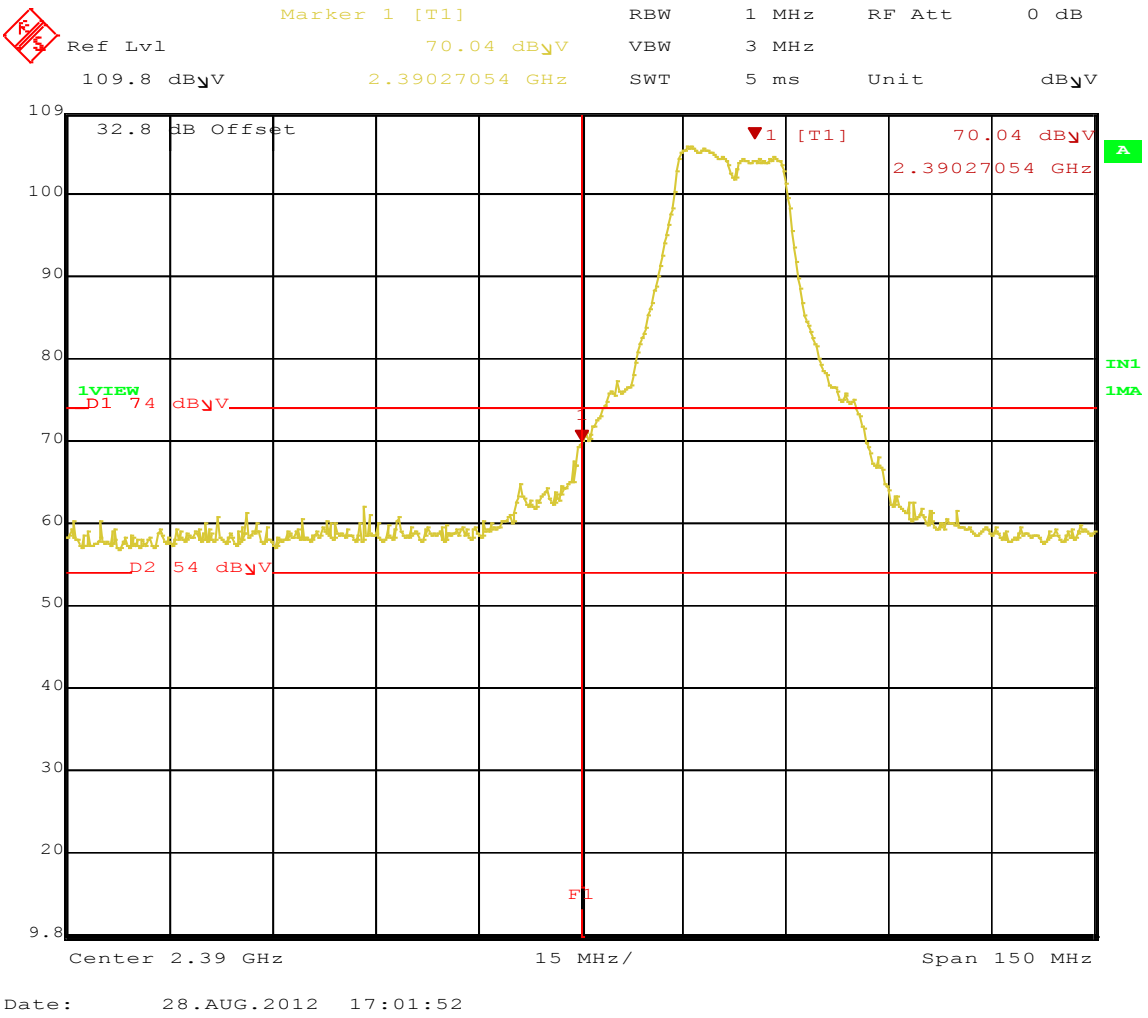


Figure 38: Radiated Emission at the Edge for Channel 2412 MHz g mode – Horizontal (Pk) Power 9 dBm

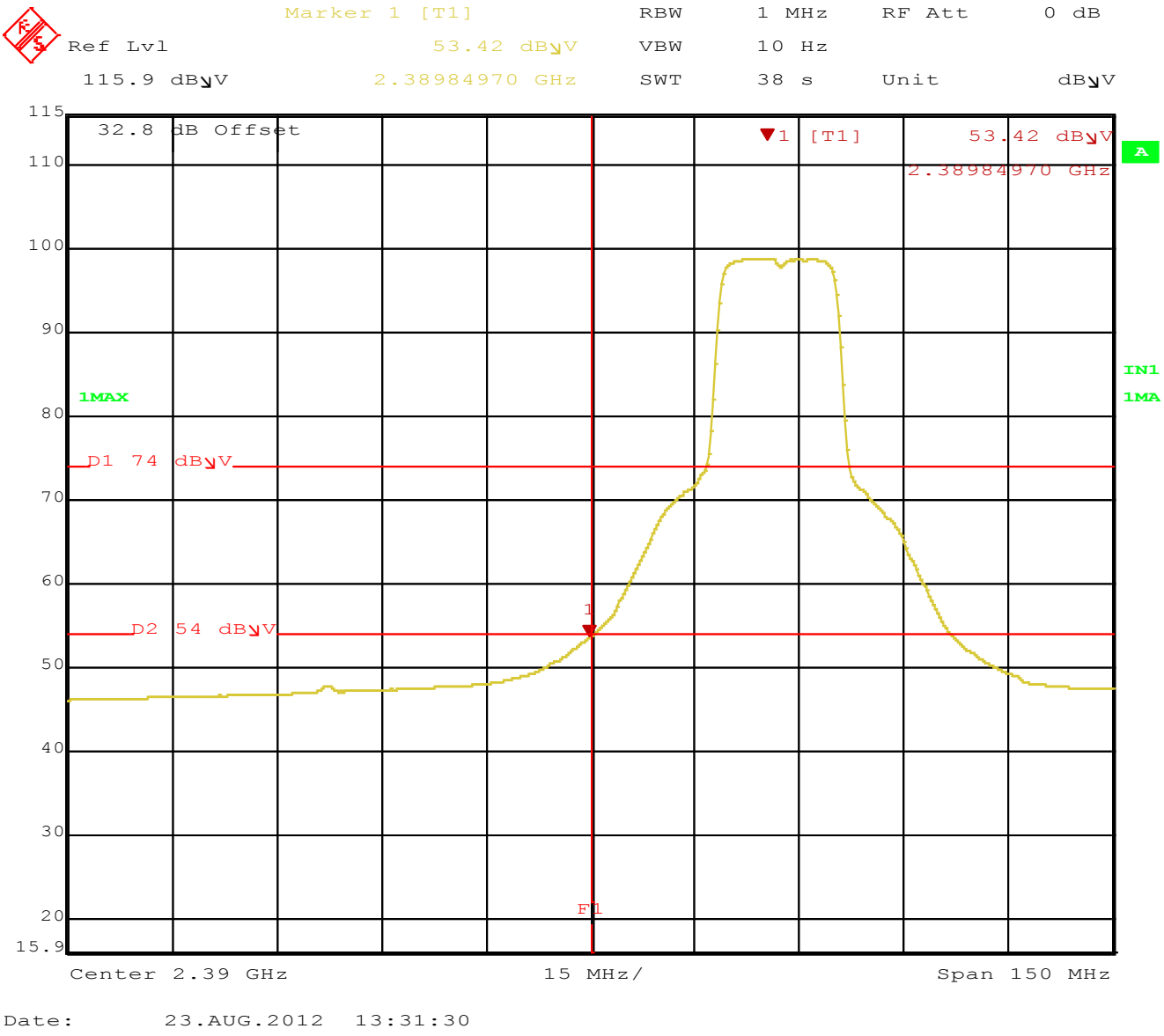


Figure 39: Radiated Emission at the Edge for Channel 2417 MHz g mode – Horizontal (Avg) Power 12 dBm

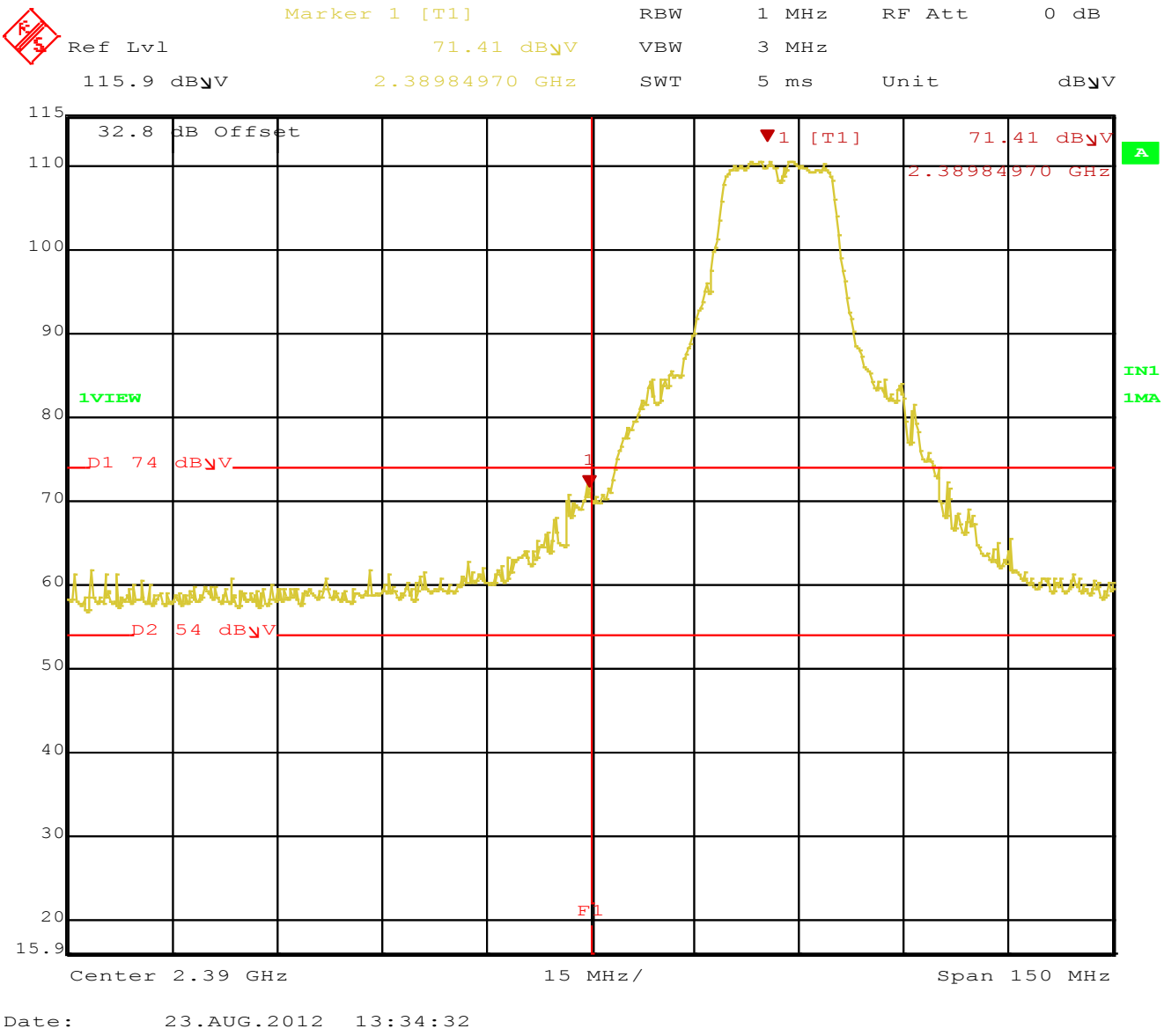


Figure 40: Radiated Emission at the Edge for Channel 2417 MHz g mode– Horizontal (Pk) Power 12 dBm

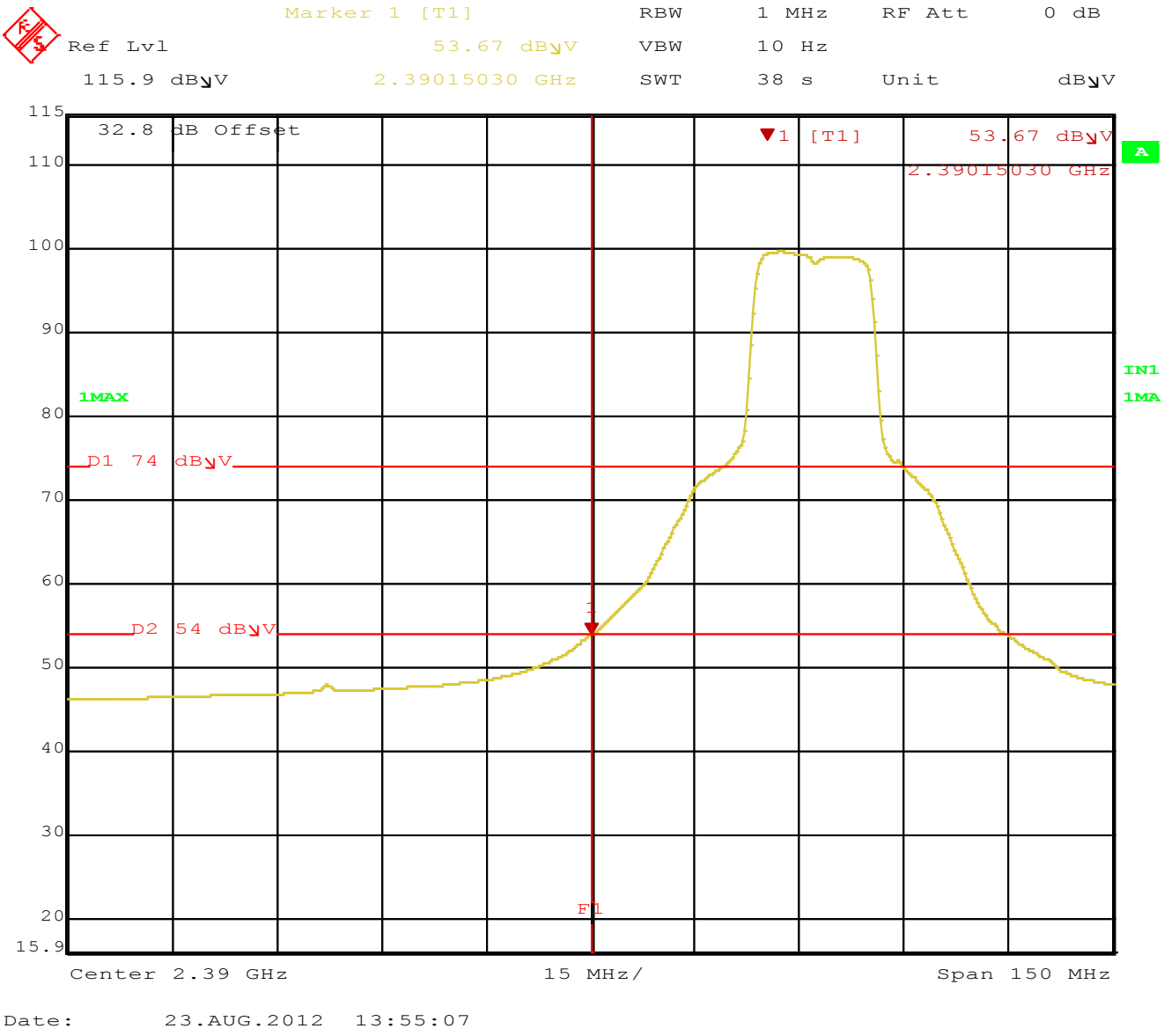


Figure 41: Band-edge at Operating Channel 2422 MHz, H – B Mode Power Setting – 14 dBm Avg

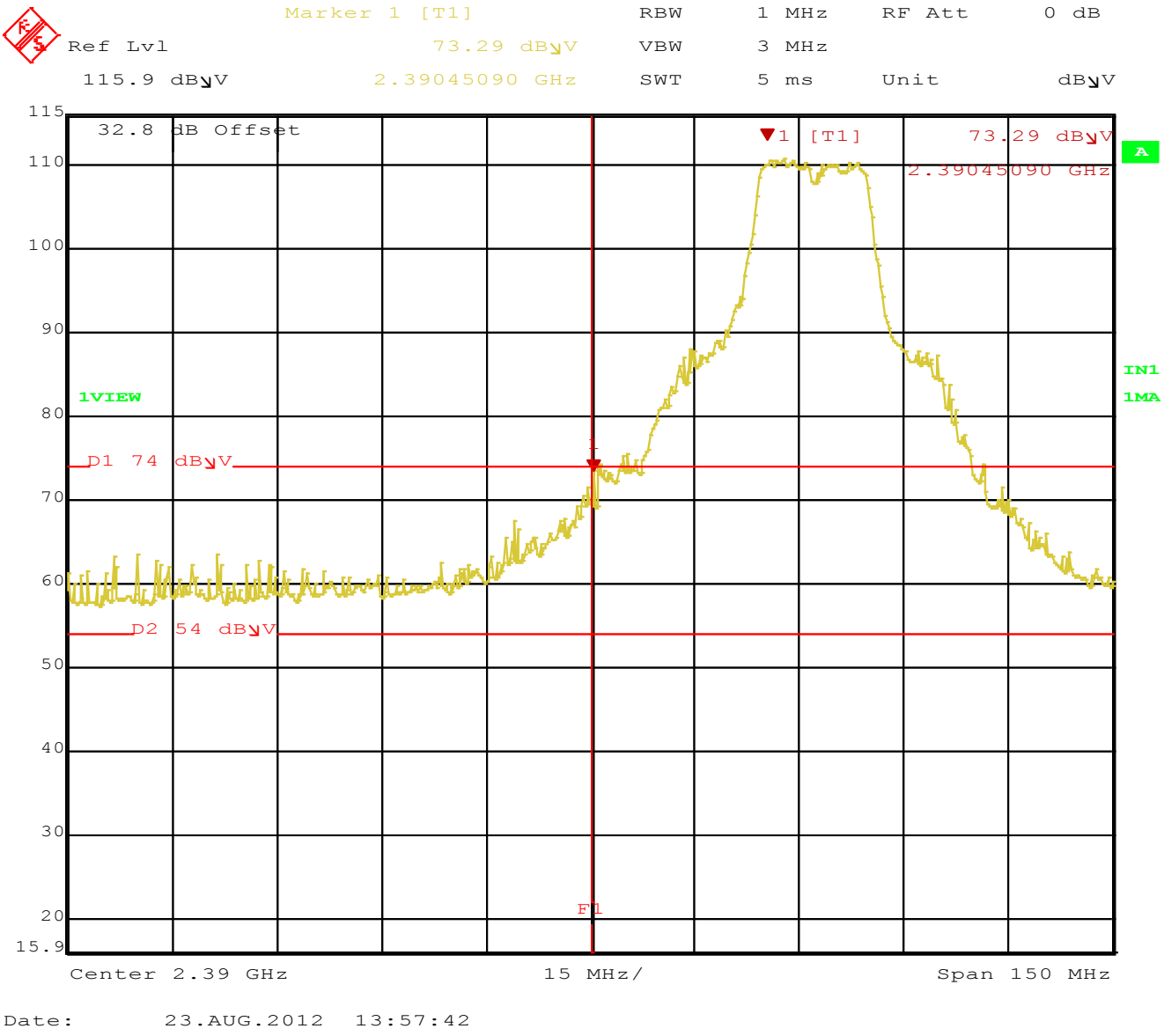


Figure 42: Band-edge at Operating Channel 2422 MHz, H – Power Setting 14 dBm – PK

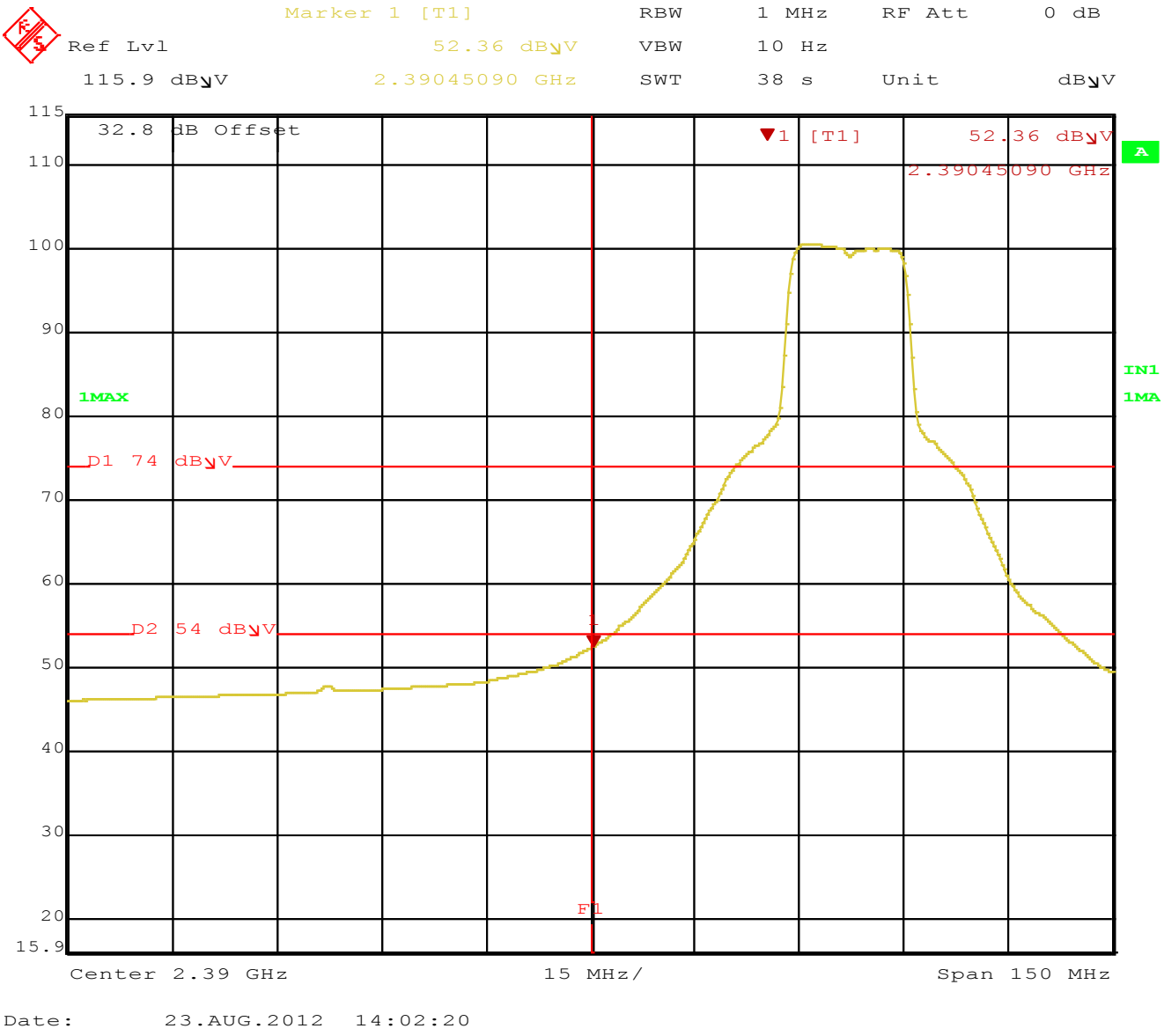


Figure 43: Band-edge at Operating Channel 2427 MHz, H – g mode Power Setting 16 dBm – Avg

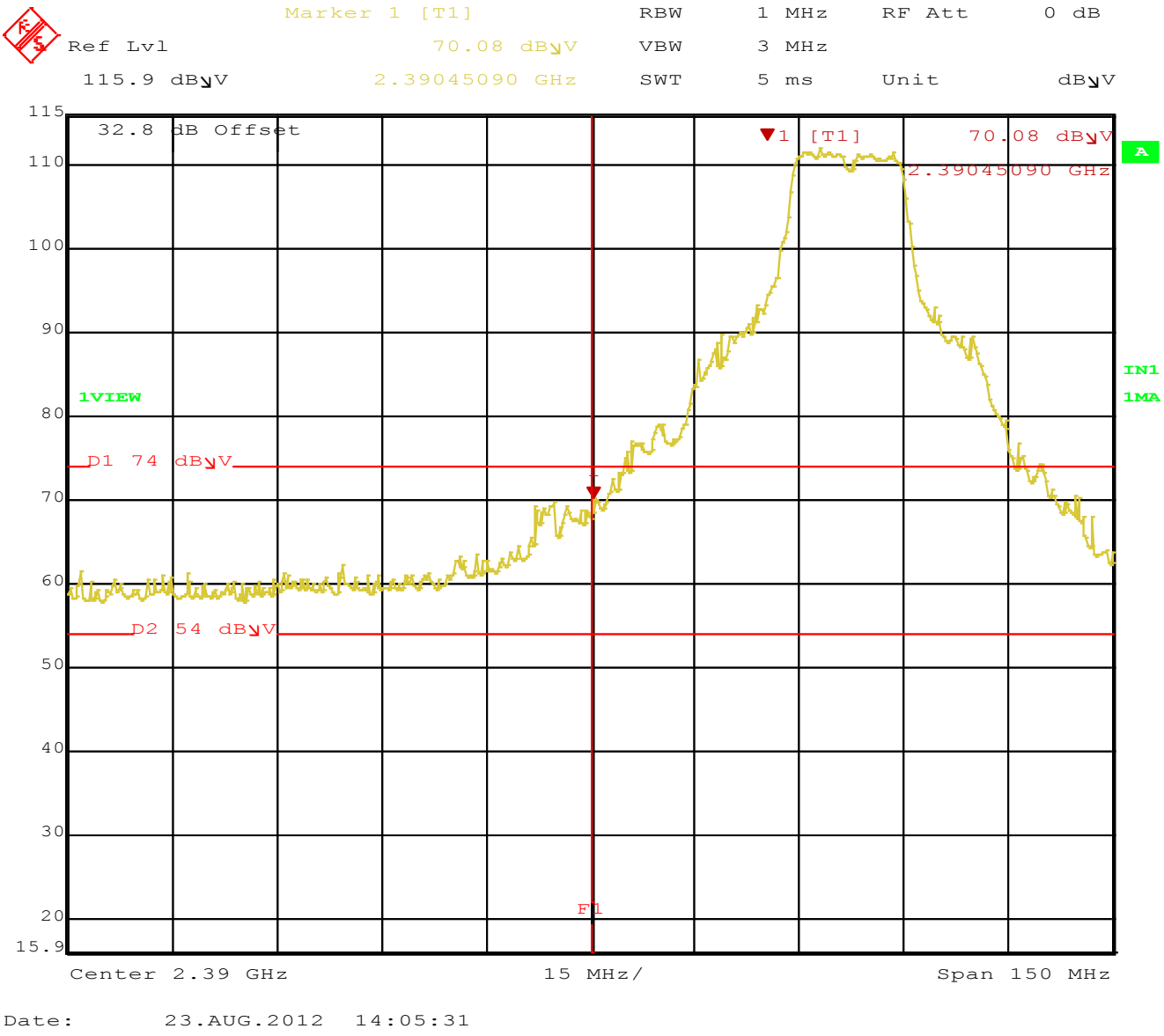


Figure 44: Band-edge at Operating Channel 2427 MHz, H – g mode Power Setting 16 dBm – PK

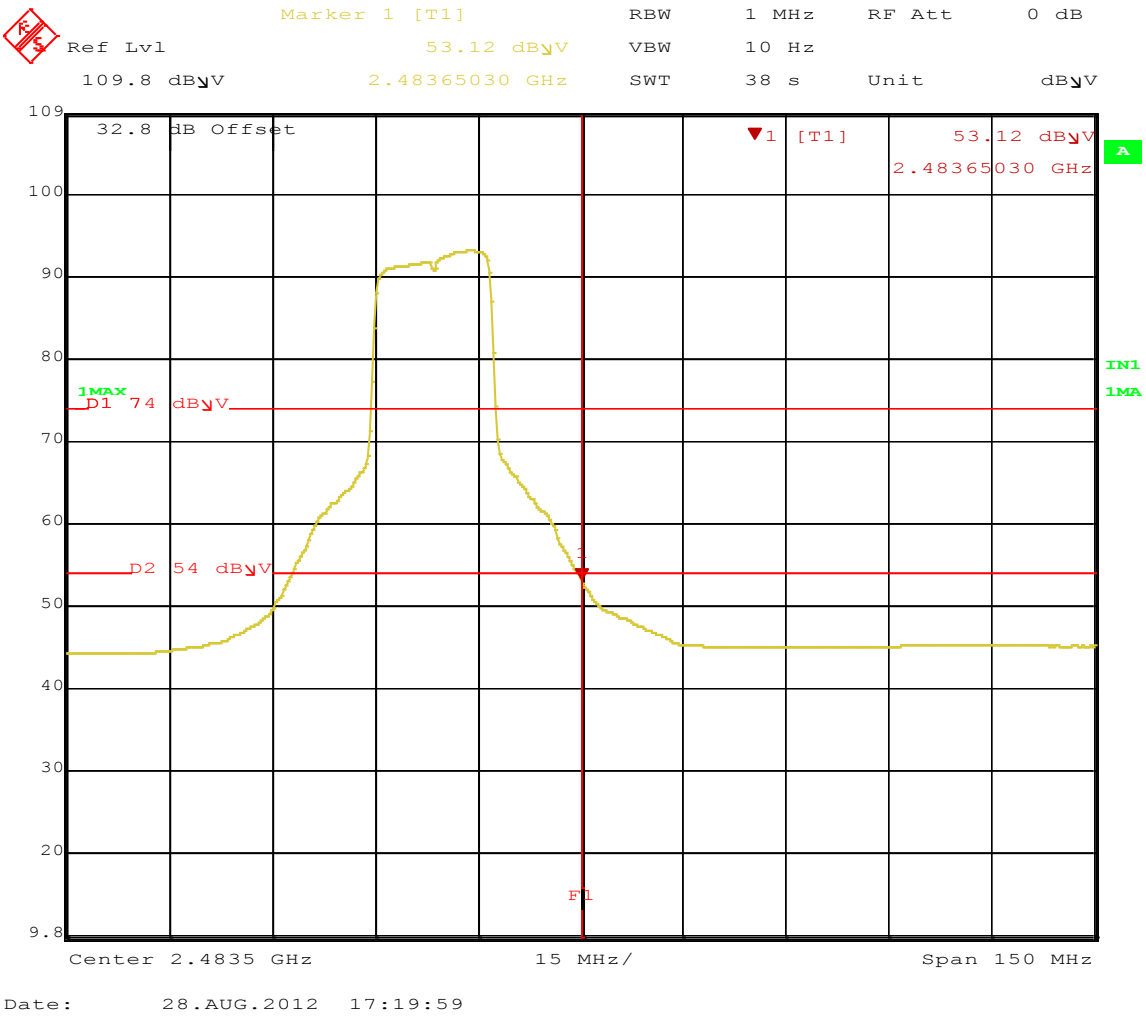


Figure 45: Band-edge at Operating Channel 2462 MHz, H – g mode Power Setting 13 dBm – Avg

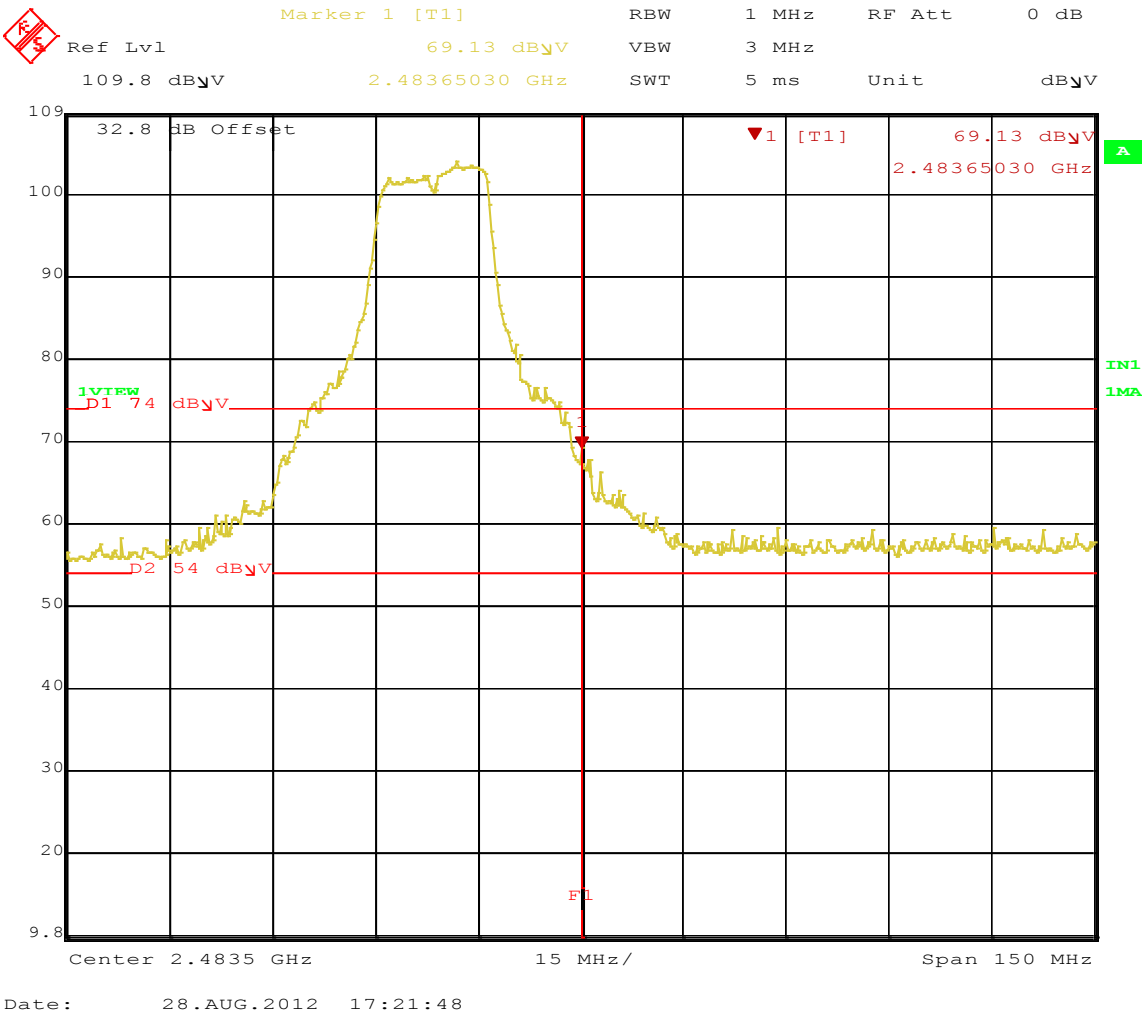


Figure 46: Band-edge at Operating Channel 2462 MHz, H – g mode Power Setting 13 dBm – PK

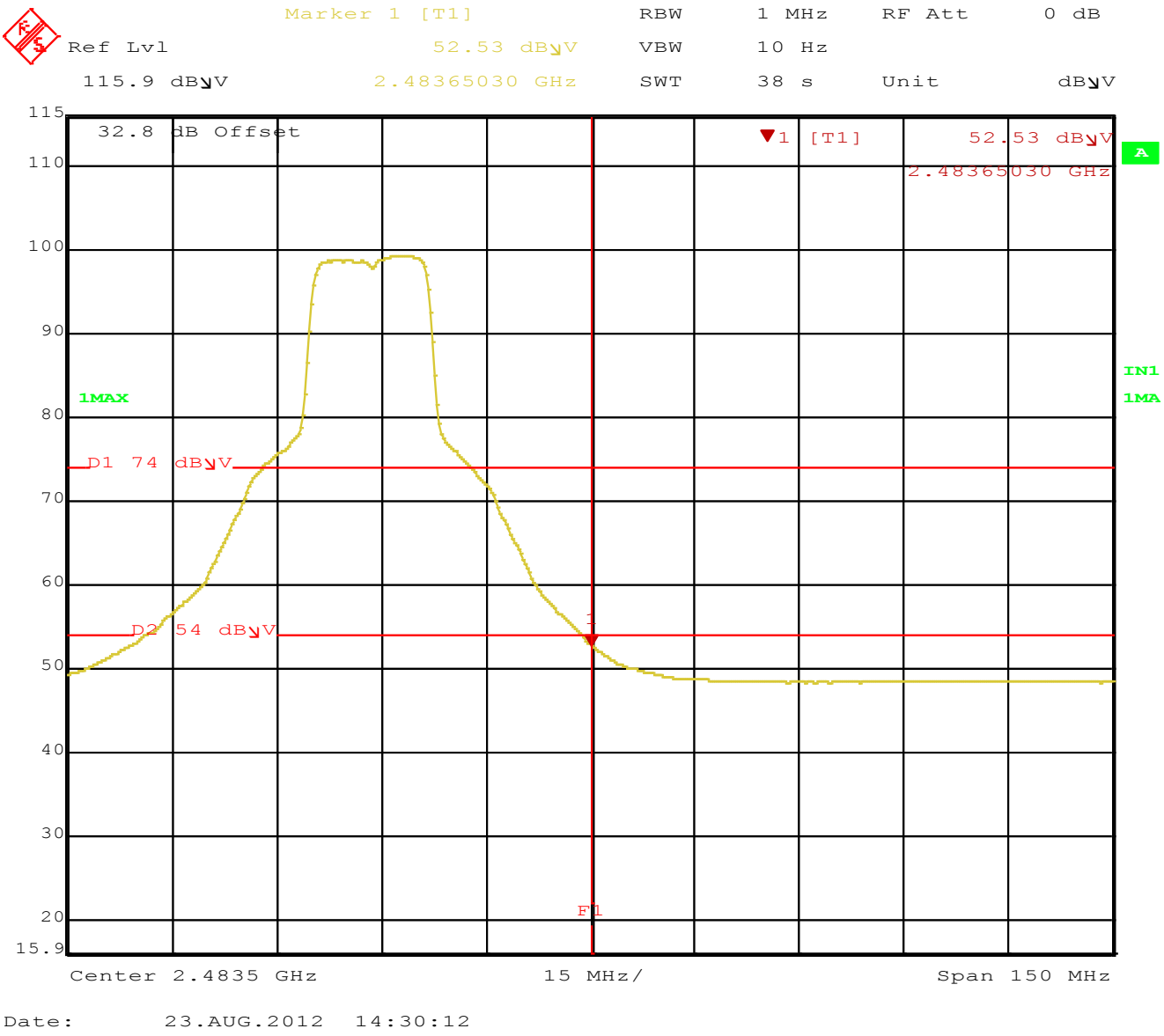


Figure 47: Band-edge at Operating Channel 2457 MHz, H – g mode Power Setting 16 dBm – Avg

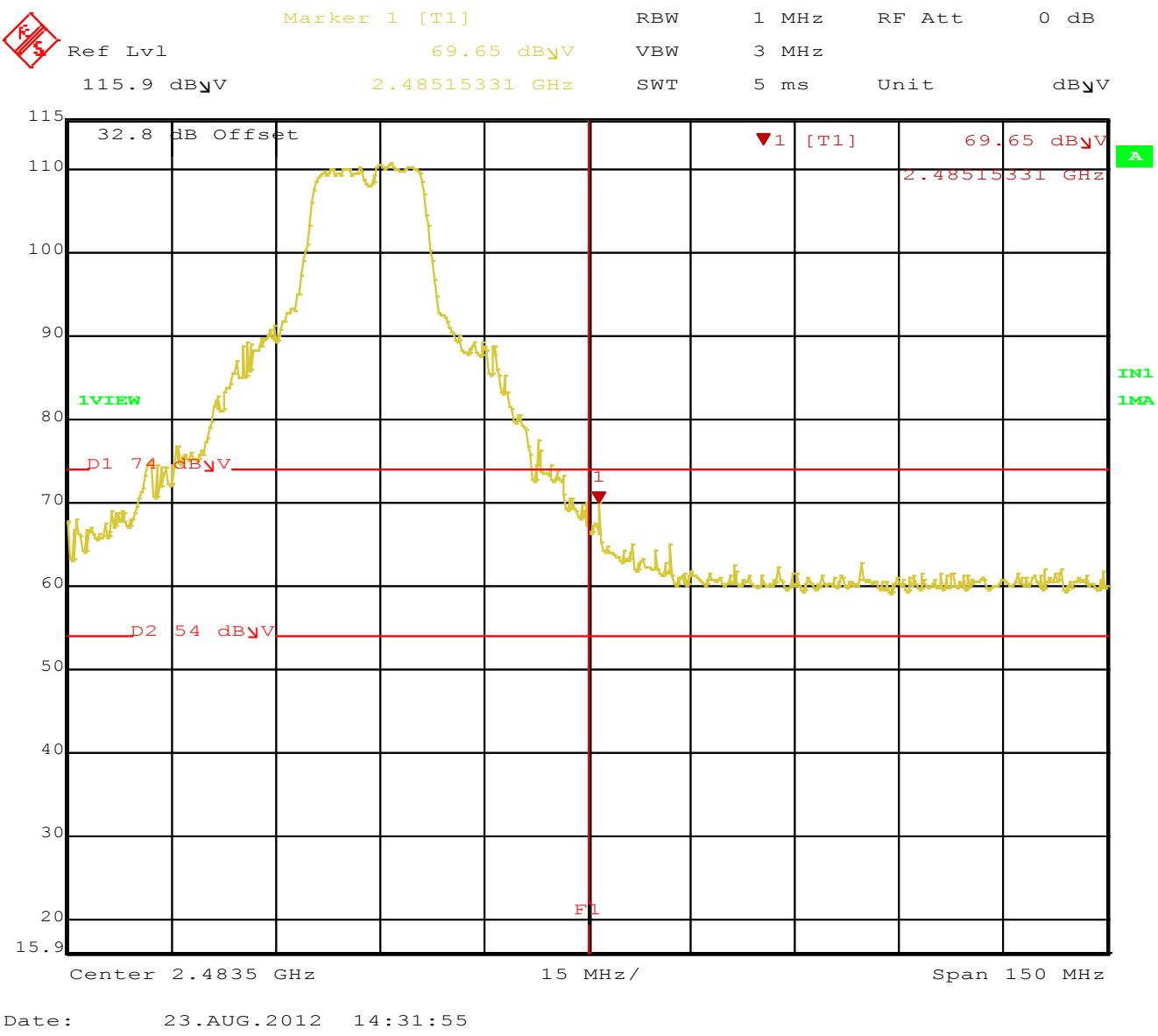


Figure 48: Band-edge at Operating Channel 2457 MHz, H – g mode Power Setting 16 dBm – PK

Radiated Spurious Emissions

SOP 1 Radiated Emissions

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EUT Name	Hero 3 White Edition	**Date**	September 09, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 39% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Comfit.	EUT Y axis	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m / EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

TX ON 802.11b Mode 30 - 1000 MHz all Channels combined

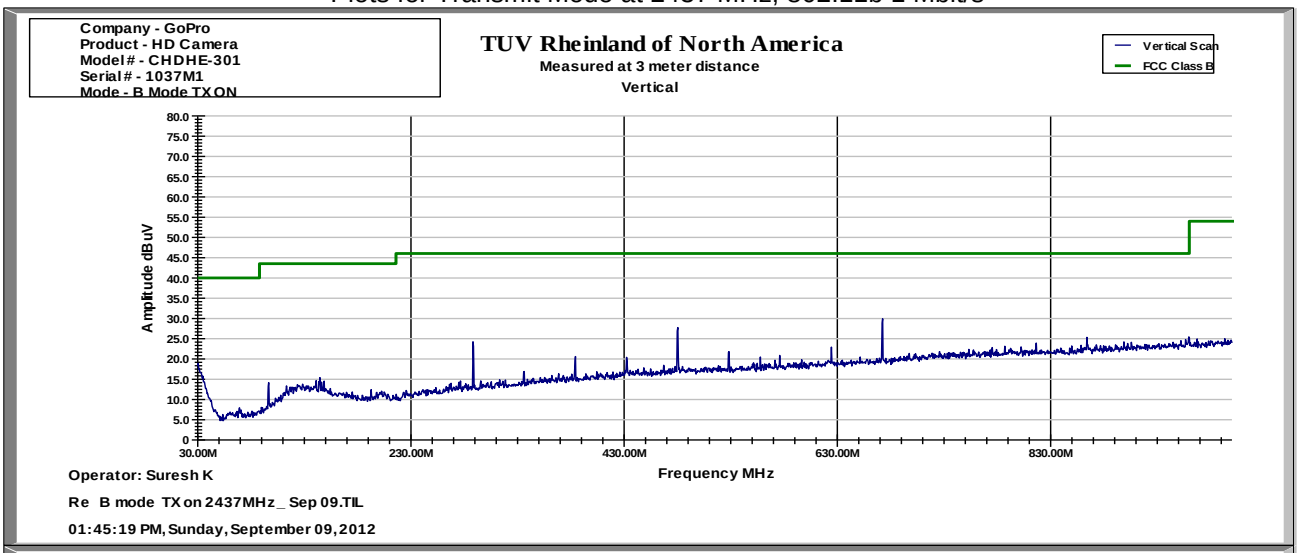
Frequency	Peak (Raw)	QP (Raw)	Corrd'	QP (Corrd')	Limit	Margin	Polarity	Height	Turntable	Emission
MHz	dBuV/m	dBuV/m	dB	dBuV/m	dBuV/m	dB	H/V	cm	degree	type
287.90	37.91	37.32	-10.94	26.38	46.02	-19.64	H	105	337	Spurious
287.93	35.79	34.23	-11.39	22.84	46.02	-23.18	V	214	7	Spurious
383.83	31.13	31.13	-9.23	21.90	46.02	-24.12	H	111	46	Spurious
479.88	40.30	39.33	-7.61	31.72	46.02	-14.30	V	116	23	Spurious
479.93	39.14	36.91	-7.31	29.60	46.02	-16.42	H	200	185	Spurious
671.87	29.38	19.27	-5.14	14.13	46.02	-31.89	V	236	241	Spurious
671.90	40.77	38.12	-4.70	33.42	46.02	-12.60	H	122	148	Spurious
863.84	30.26	27.15	-1.37	25.78	46.02	-20.24	H	104	181	Spurious

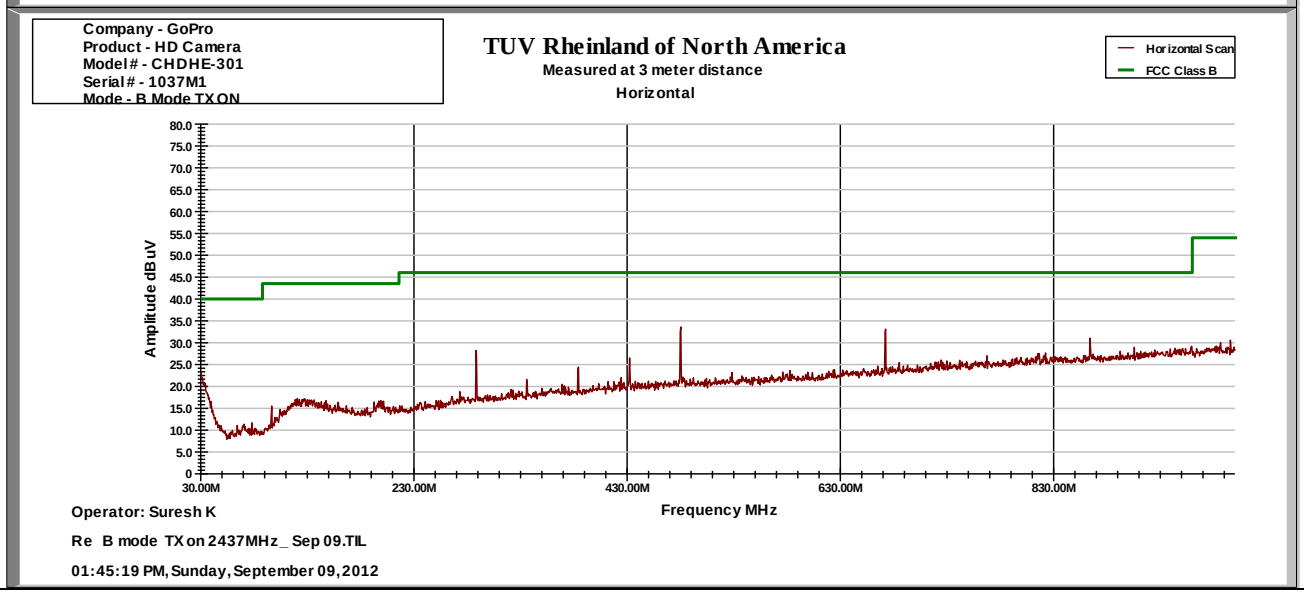
TX at Max Power for b Mode 16 dBm

SOP 1 Radiated Emissions

EUT Name	Hero 3 White Edition	**Date**	Sep 09, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 39% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Config.	EUT Y axis TX ON	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m – EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

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

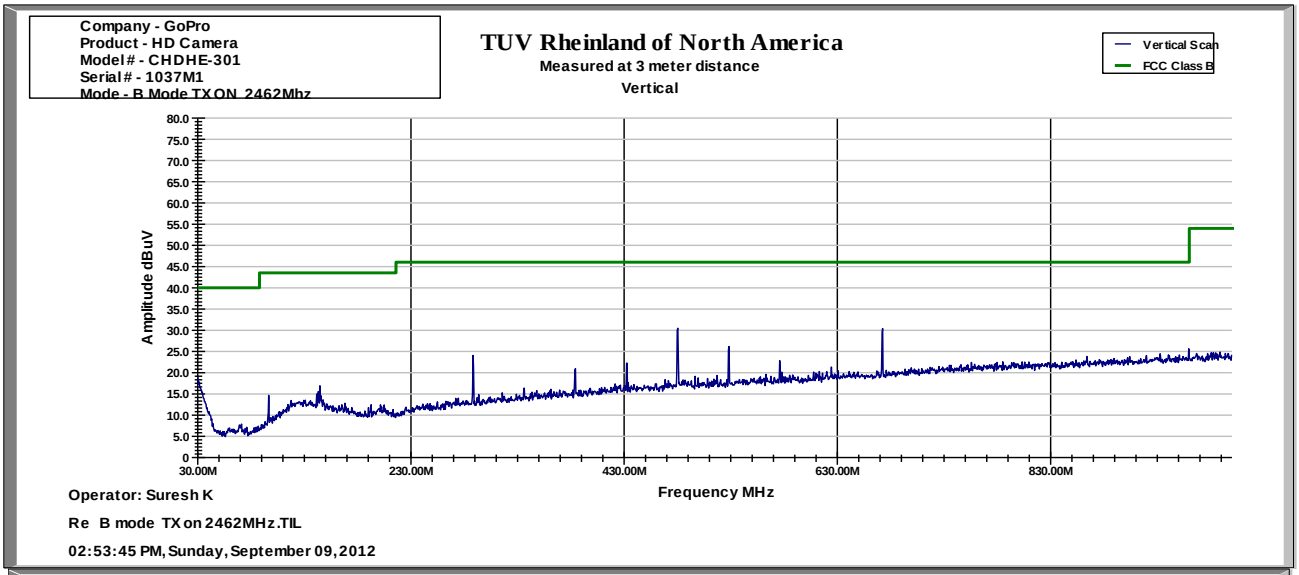


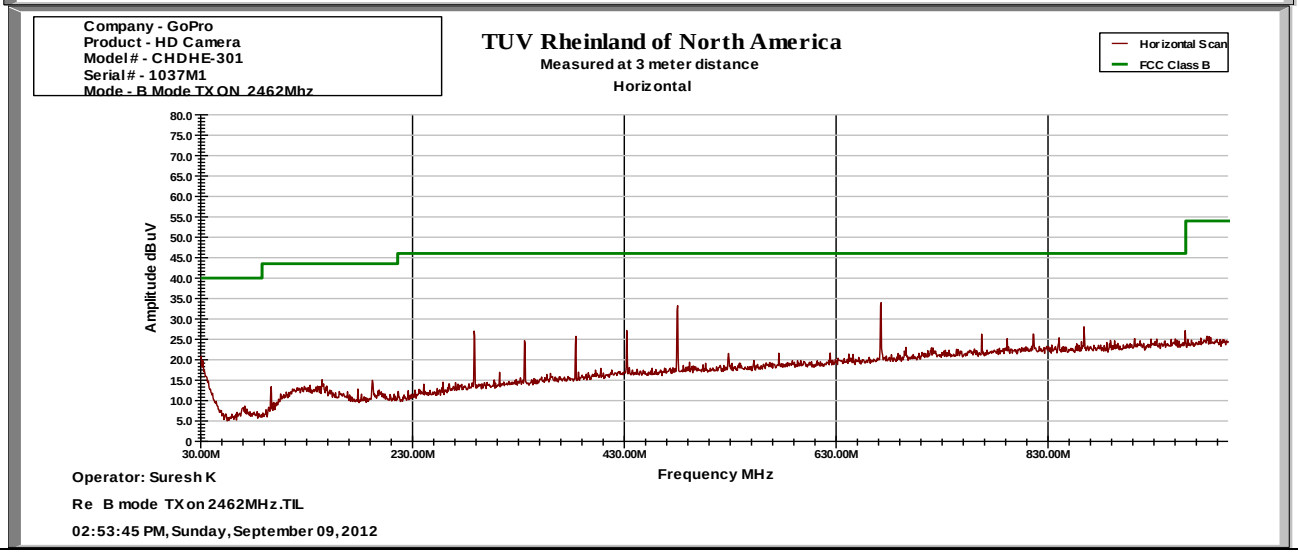


SOP 1 Radiated Emissions

EUT Name	Hero 3 White Edition	**Date**	Sep 09, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 39% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Config.	EUT Y axis TX ON	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

Plots for Transmit Mode at 2462 MHz

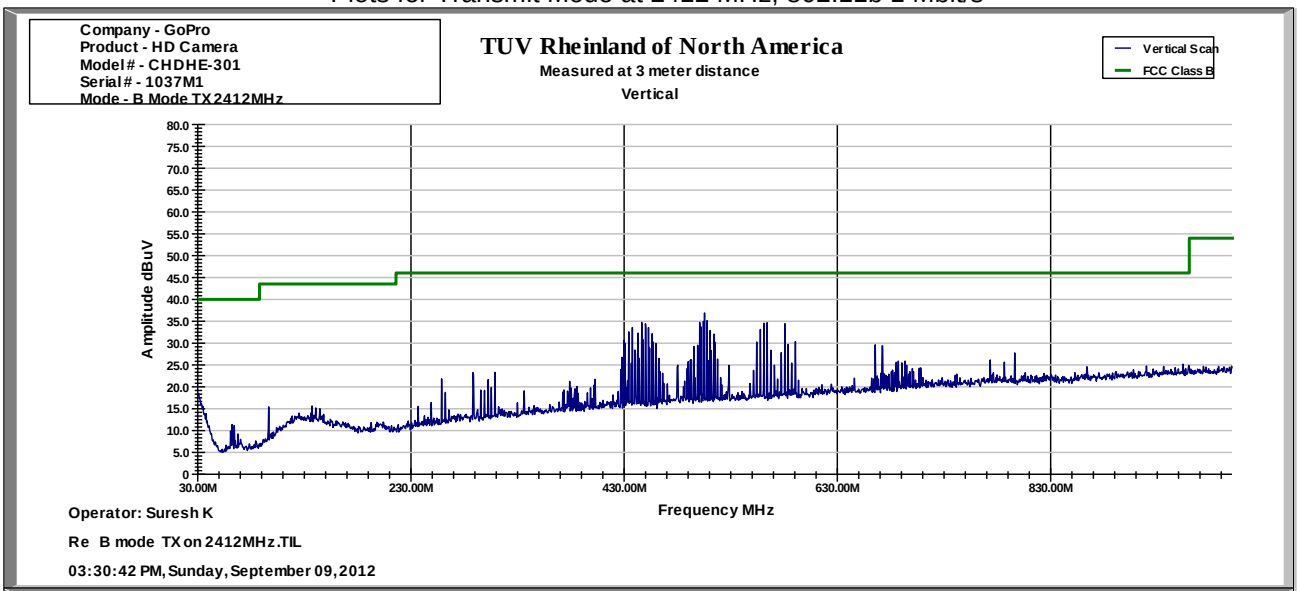


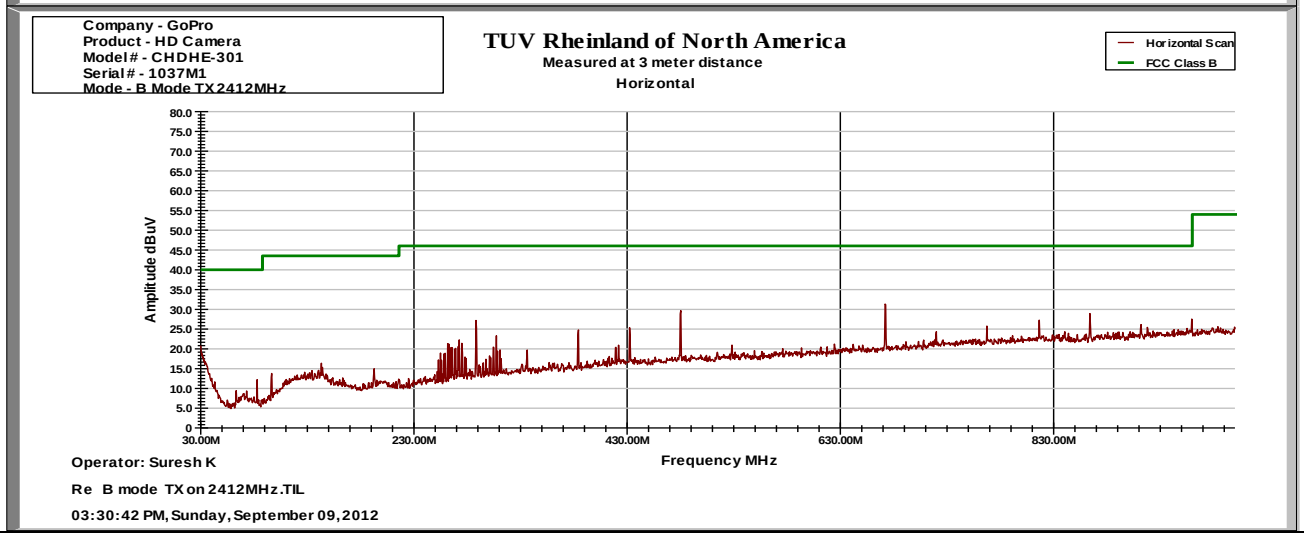


SOP 1 Radiated Emissions

EUT Name	Hero 3 White Edition	**Date**	Sep 09, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 39% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Config.	EUT Y axis TX ON	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

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





SOP 1 Radiated Emissions

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EUT Name	Hero 3 White Edition	**Date**	September 09, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 39% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Comfit.	EUT Y axis	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m / EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

TX ON 802.11B Mode emissions above 1 GHz all Channels combined

Frequency	FIM - Pk	FIM - Ave	Corrd'	Average	Limit	Margin	Table	Height	Polarity	Emission
MHz	dBuV/m	dBuV/m	dB	dBuv/m	dBuV/m	dB	degree	cm	H/V	type
1439.87	41.58	29.46	-7.53	21.93	53.98	-32.05	200	110	V	Spurious
1439.87	48.51	37.08	-7.53	29.55	53.98	-24.43	108	115	H	Spurious
1535.77	44.86	37.30	-7.28	30.02	53.98	-23.96	74	100	V	Spurious
2016.01	48.29	36.18	-4.68	31.50	53.98	-22.48	254	105	H	Spurious
3122.10	35.69	23.46	-0.49	22.97	53.98	-31.01	221	103	H	Spurious
3249.29	41.21	34.22	0.11	34.33	53.98	-19.65	340	102	H	Spurious
4824.06	37.18	25.90	2.42	28.32	53.98	-25.66	220	120	H	Harmonic
4874.06	38.70	29.35	2.52	31.87	53.98	-22.11	208	110	H	Harmonic
4874.06	37.10	25.36	2.52	27.88	53.98	-26.10	242	108	V	Harmonic
4924.10	48.43	34.72	2.60	37.32	53.98	-16.66	340	110	H	Harmonic
7232.60	41.11	27.86	8.02	35.87	53.98	-18.11	286	105	H	Harmonic
7313.91	39.65	28.02	8.29	36.31	53.98	-17.67	244	110	H	Harmonic
9829.03	39.92	26.93	10.99	37.91	53.98	-16.07	188	121	H	Harmonic

Spec Margin = E-Field Avg - Limit, E-Field Avg = FIM Avg+ Total CF ± Uncertainty

Total CF= Amp Gain + Cable Loss + ANT Factor Total CF= Amp Gain + Cable Loss + ANT Factor

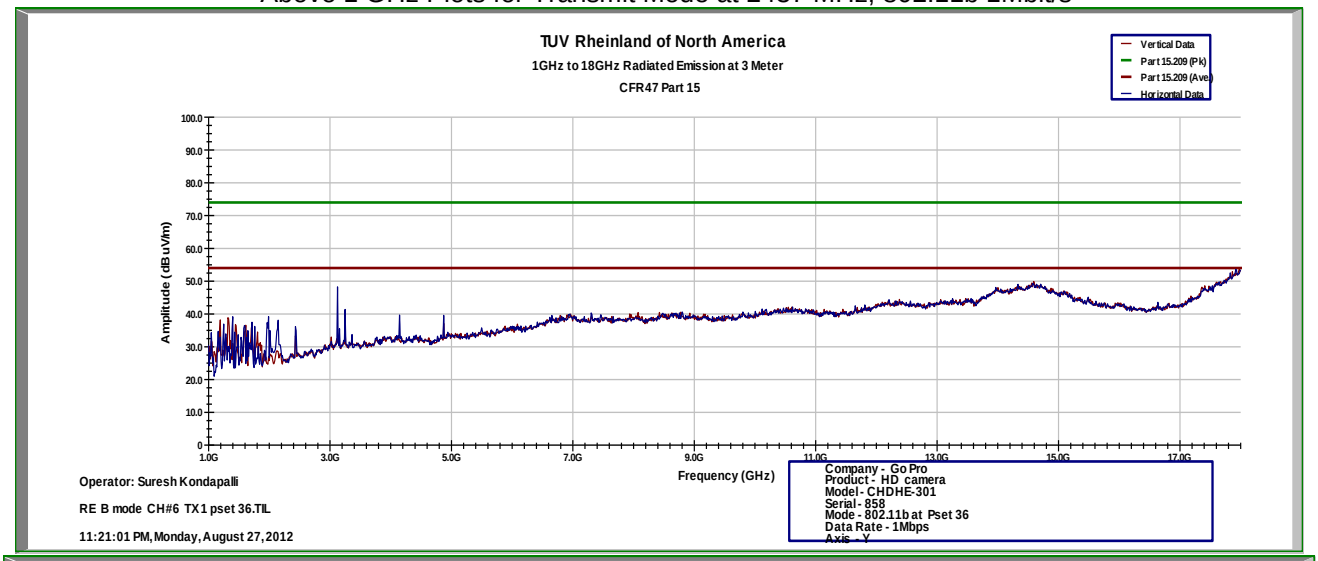
Combined Standard Uncertainty $u_c(y)$ = ± 3.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

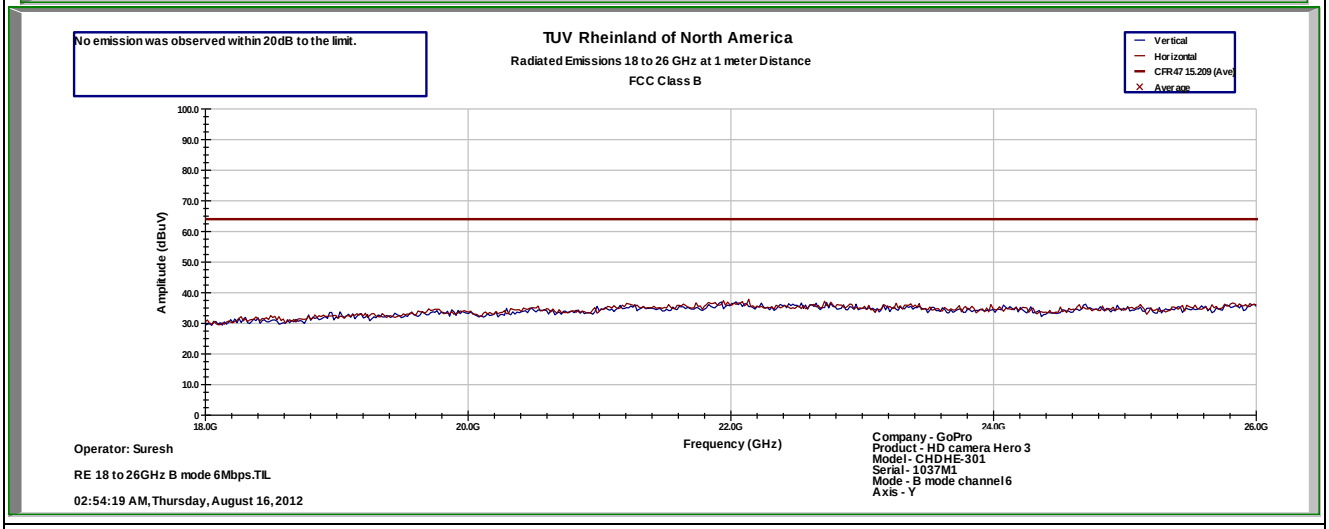
Notes: Worst case was observed on Y-axis, 6 Mbps. No duty cycle reduction was applied. Low, mid and high channels were evaluated for 30 MHz to 26 GHz, only worst case results are reported here.

SOP 1 Radiated Emissions

EUT Name	Hero 3 White Edition	**Date**	August 27, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 39% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Config.	EUT Y axis	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

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



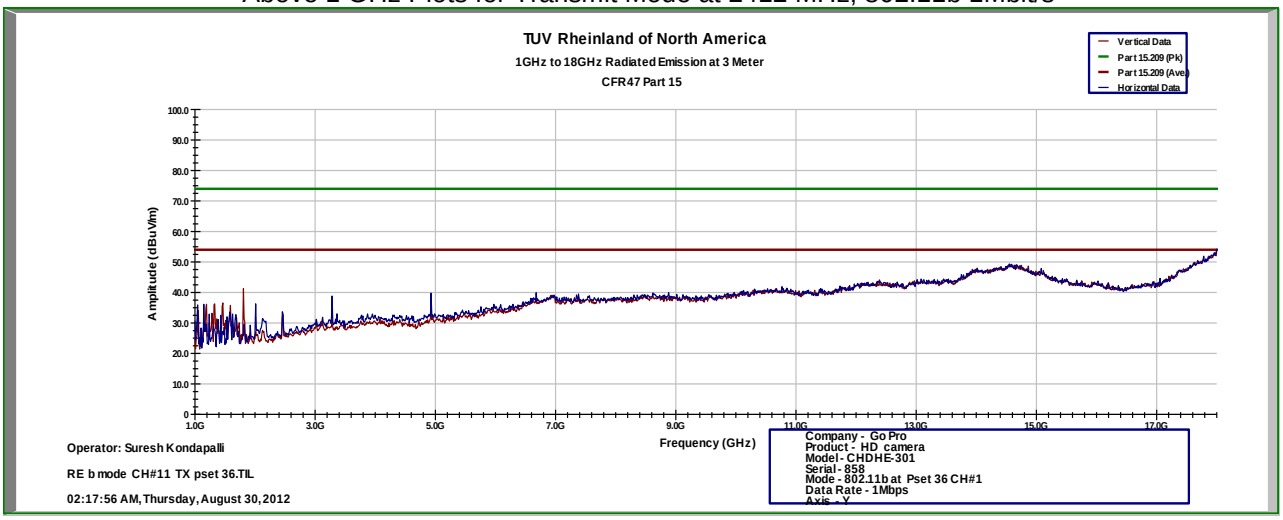


Notes: Limit was extrapolated to 1m distance for 18 GHz – 25 GHz range.
1 GHz – 25 GHz Setting: RBW = 1 MHz / VBW = 3 MHz
No emission was observed above 18 GHz Note: FCC Class B limits are used

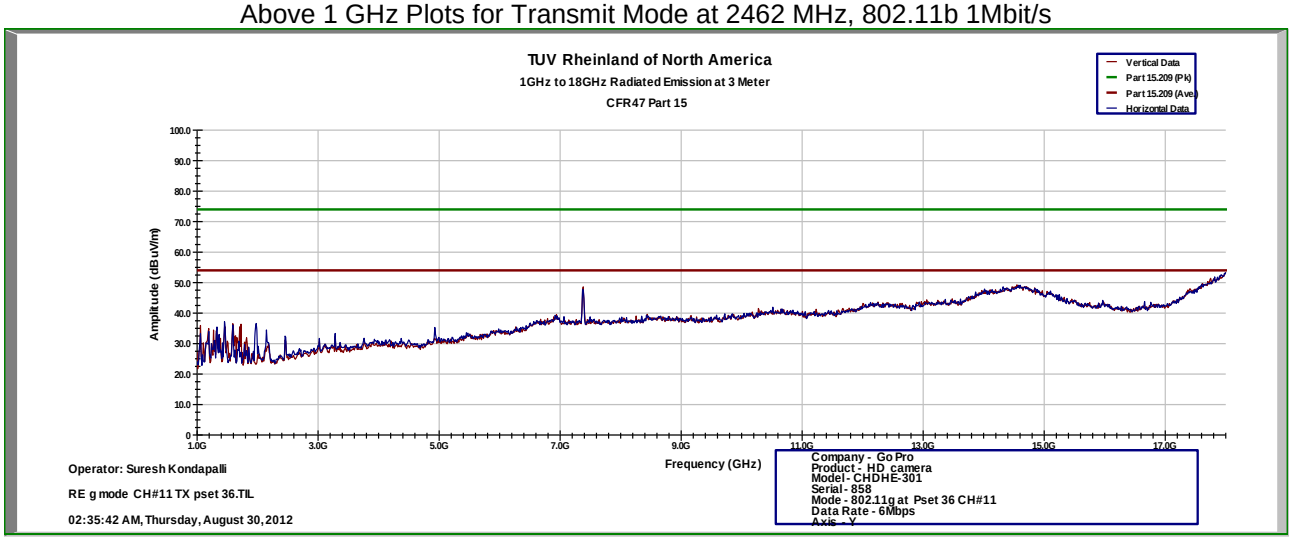
SOP 1 Radiated Emissions

EUT Name	Hero 3 White Edition	**Date**	August 27, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 39% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Config.	EUT Y axis	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

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



Above 1 GHz Plots for Transmit Mode at 2462 MHz, 802.11b 1Mbit/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
No emission was observed above 18 GHz Note: FCC Class B limits are used

SOP 1 Radiated Emissions

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EUT Name	Hero 3 White Edition	**Date**	September 09, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 39% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Comfit.	EUT Y axis	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m / EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

TX ON 802.11g mode 30 - 1000 MHz all Channels combined

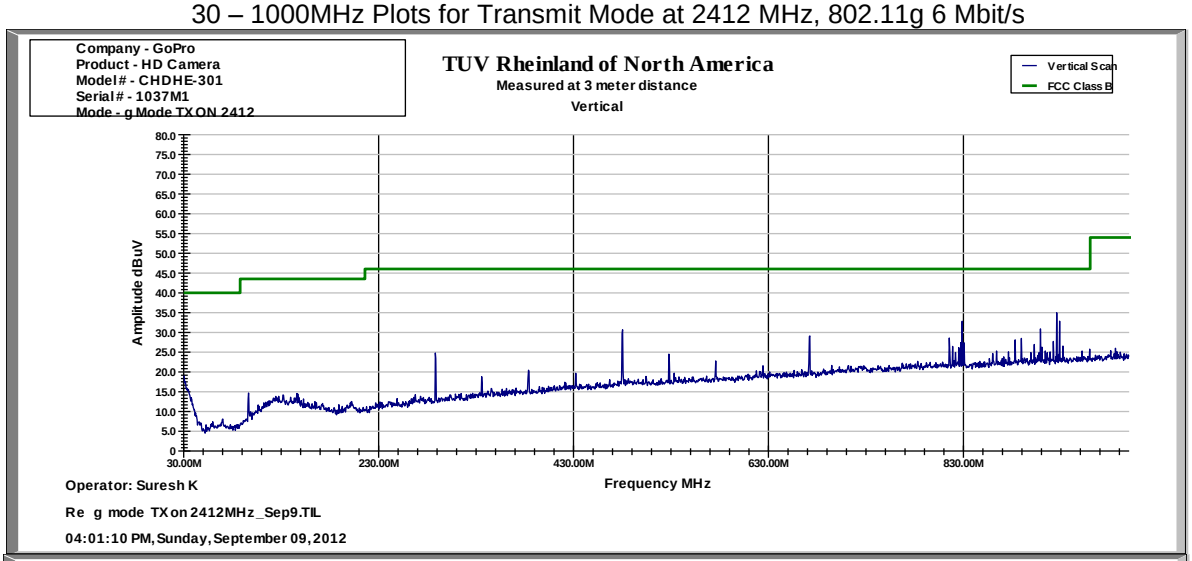
Frequency	Peak (Raw)	QP (Raw)	Corrd'	QP (Corrd')	Limit	Margin	Polarity	Height	Turntable	Emission
MHz	dBuV/m	dBuV/m	dB	dBuV/m	dBuV/m	dB	H/V	cm	degree	type
287.95	37.45	34.60	-10.93	23.67	46.02	-22.35	H	160	105	Spurious
287.96	33.88	31.81	-11.39	20.42	46.02	-25.60	V	109	32	Spurious
384.02	32.10	32.02	-9.23	22.79	46.02	-23.23	H	114	74	Spurious
479.88	27.74	24.97	-7.61	17.36	46.02	-28.66	V	130	289	Spurious
479.94	36.50	35.00	-7.31	27.69	46.02	-18.33	H	118	37	Spurious
491.59	23.17	19.55	-7.54	12.01	46.02	-34.01	V	214	169	Spurious
451.07	22.56	19.69	-8.07	11.62	46.02	-34.40	H	292	113	Spurious
453.96	22.72	19.25	-7.94	11.31	46.02	-34.71	H	304	261	Spurious
502.17	23.86	19.34	-7.22	12.12	46.02	-33.90	H	142	110	Spurious
589.20	23.56	19.18	-5.76	13.42	46.02	-32.60	H	214	200	Spurious
671.87	41.98	39.30	-4.70	34.60	46.02	-11.42	H	124	155	Spurious

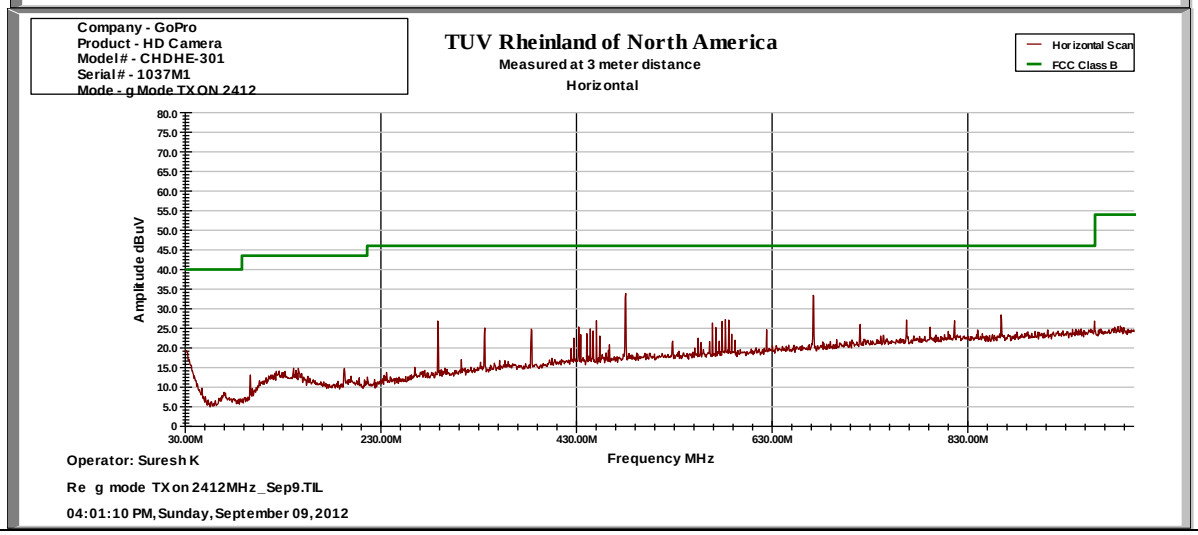
TX at Max power for g mode 16 dBm

SOP 1 Radiated Emissions

EUT Name	HERO3 White Edition	**Date**	September 09, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 40% rh
EUT Serial	1037M1	**Temp / Humout**	N/A
EUT Config.	EUT Y axis	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh K

30 – 1000MHz Plots for Transmit Mode at 2412 MHz, 802.11g 6 Mbit/s

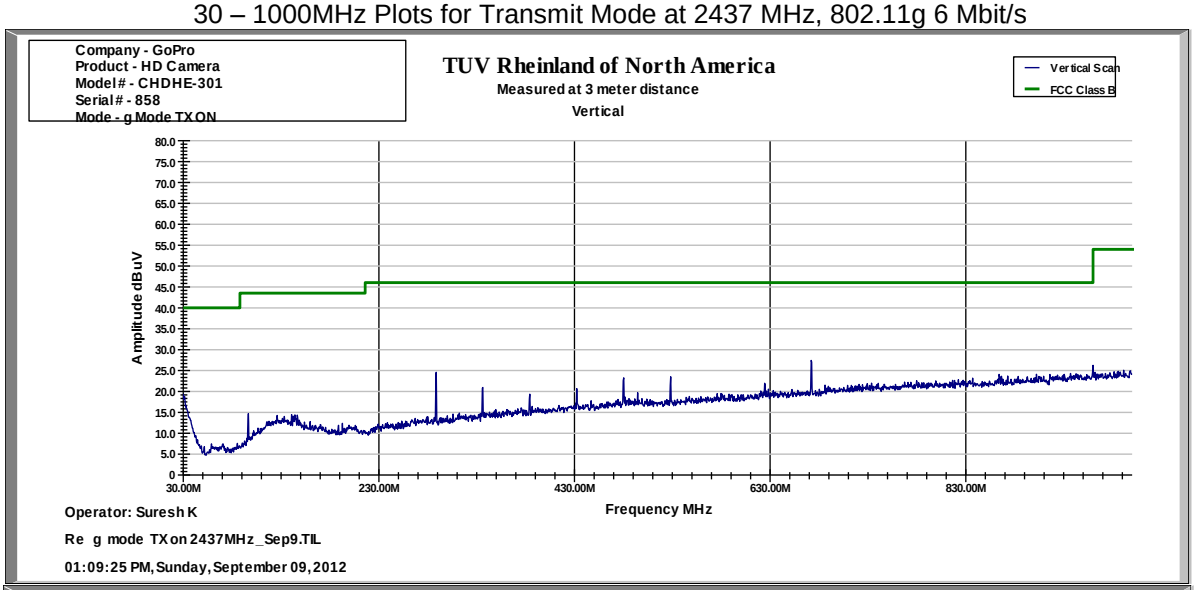


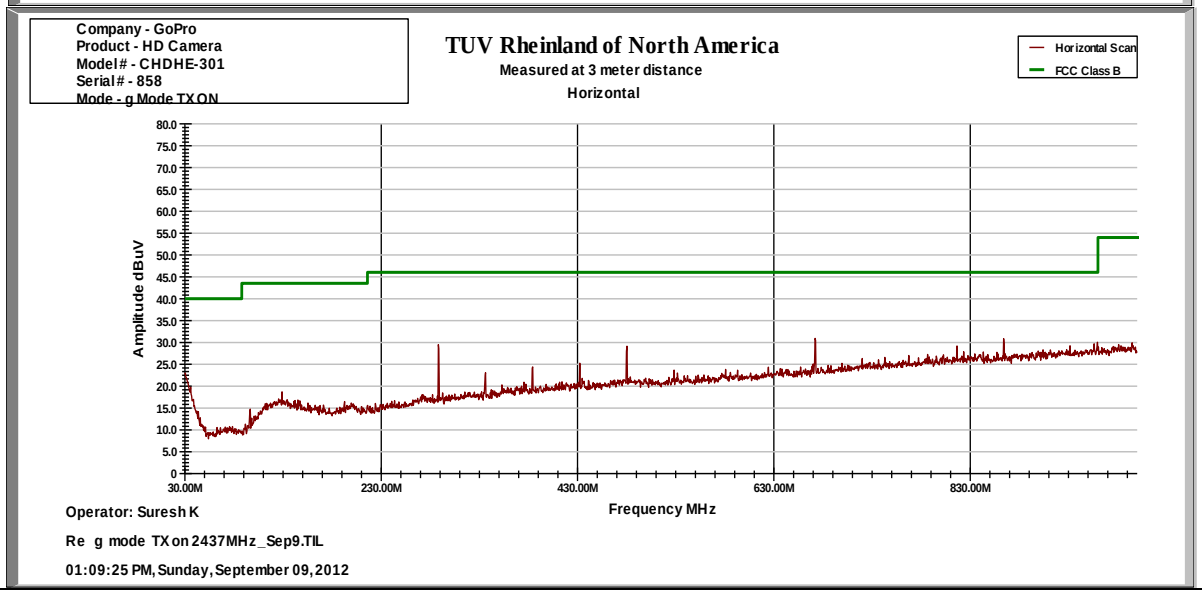


SOP 1 Radiated Emissions

EUT Name	HERO3 White Edition	**Date**	September 09, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 40% rh
EUT Serial	858	**Temp / Humout**	N/A
EUT Config.	EUT Y axis	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh K

30 – 1000MHz Plots for Transmit Mode at 2437 MHz, 802.11g 6 Mbit/s

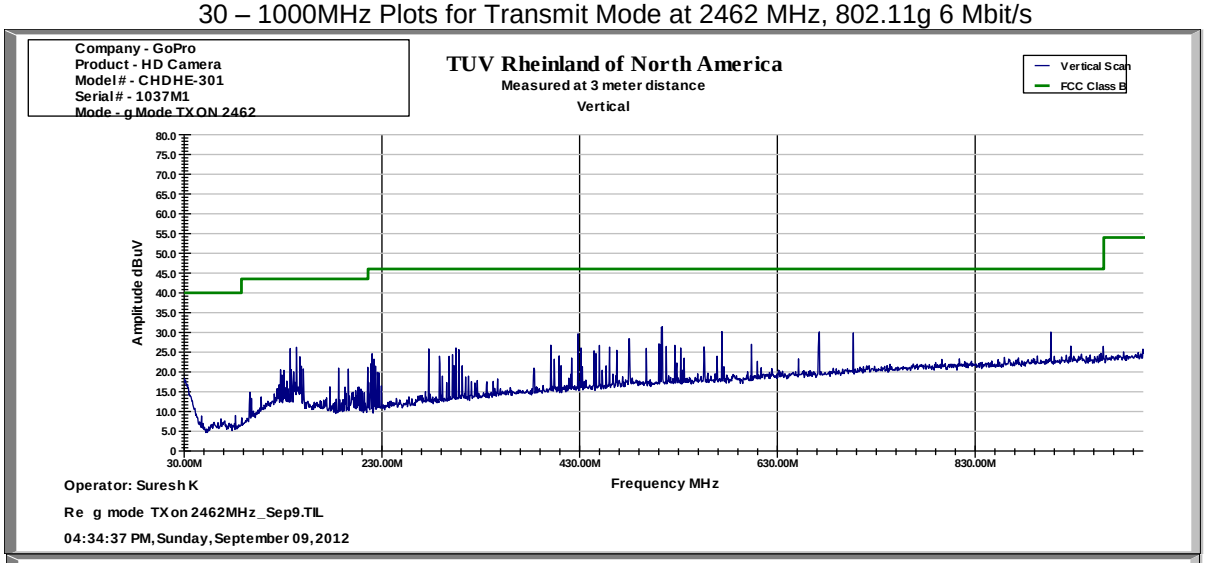


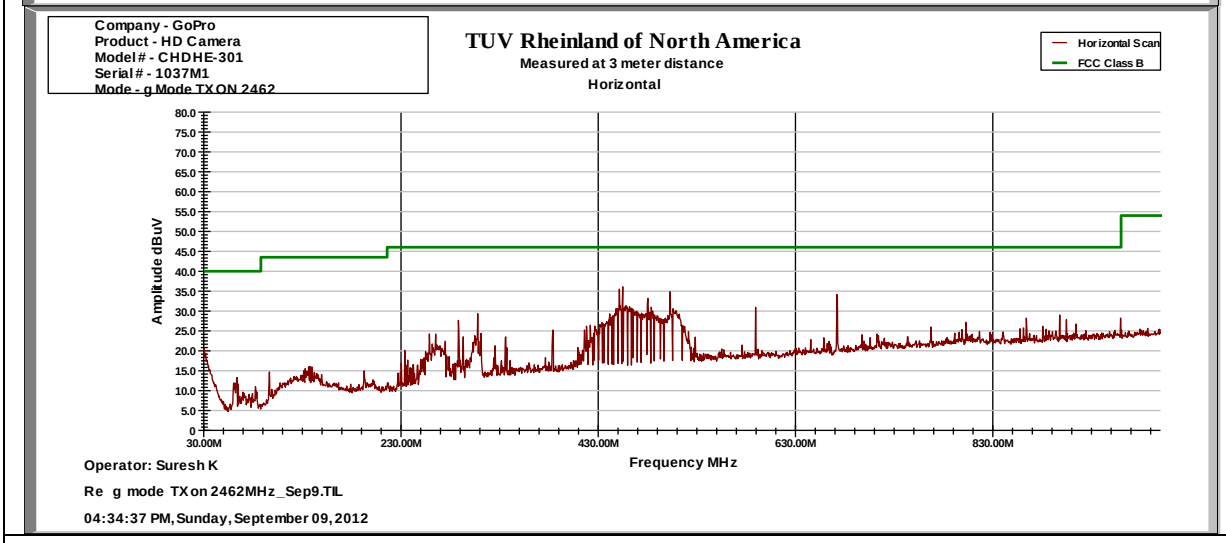


SOP 1 Radiated Emissions

EUT Name	HERO3 White Edition	**Date**	September 09, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 40% rh
EUT Serial	858	**Temp / Humout**	N/A
EUT Config.	EUT Y axis	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh K

30 – 1000MHz Plots for Transmit Mode at 2462 MHz, 802.11g 6 Mbit/s





SOP 1 Radiated Emissions

EUT Name	Hero 3 White Edition	**Date**	September 09, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 39% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Comfit.	EUT Y axis	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m / EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

TX ON 802.11g mode emissions above 1 GHz all Channels combined

Frequency	FIM - Pk	FIM - Ave	Corrd'	Average	Limit	Margin	Table	Height	Polarity	Emission
MHz	dBuV/m	dBuV/m	dB	dBuv/m	dBuV/m	dB	degree	cm	H/V	type
2125.05	36.86	29.65	-4.68	24.97	53.98	-29.01	115	178	H	Spurious
2125.05	36.86	29.65	-4.68	24.97	53.98	-29.01	186	210	V	Spurious
3249.38	42.37	35.77	0.11	35.88	53.98	-18.10	107	182	H	Spurious
3249.38	42.37	35.77	0.11	35.88	53.98	-18.10	176	325	V	Spurious
4824.15	45.55	28.32	2.42	30.74	53.98	-23.24	110	276	H	Harmonic
4874.23	45.55	28.32	2.42	30.74	53.98	-23.24	110	201	H	Harmonic
4874.23	45.55	28.22	2.52	30.74	53.98	-23.24	118	320	H	Harmonic
7221.00	48.49	33.18	8.02	41.20	53.98	-12.78	124	181	H	Harmonic

Spec Margin = E-Field Avg - Limit, E-Field Avg = FIM Avg+ Total CF ± Uncertainty

Total CF= Amp Gain + Cable Loss + ANT Factor Total CF= Amp Gain + Cable Loss + ANT Factor

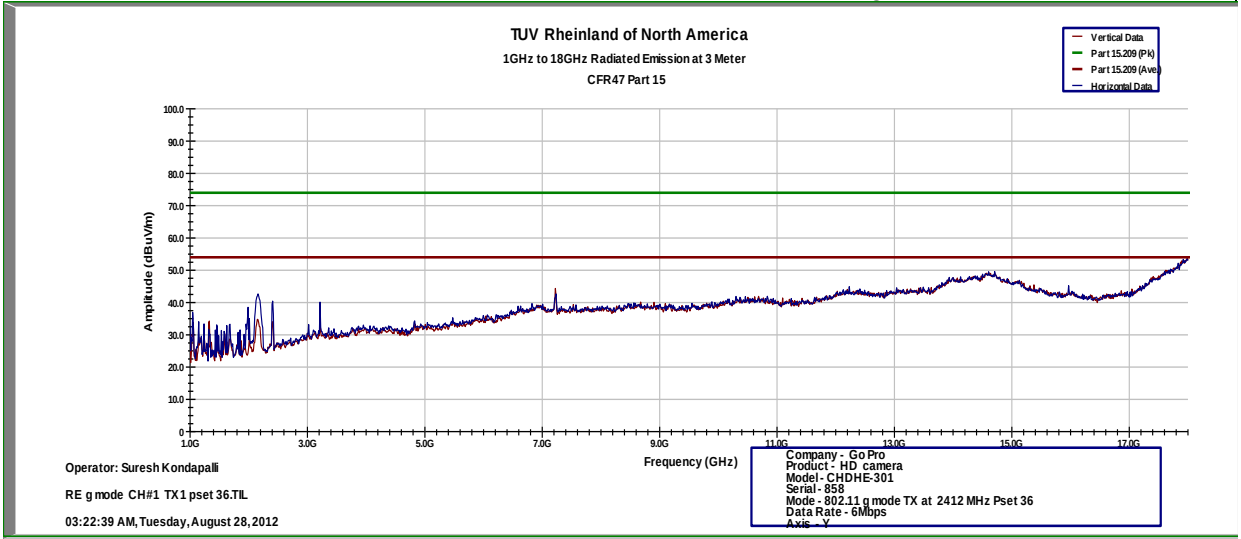
Combined Standard Uncertainty $u_c(y)$ = ± 3.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Worst case was observed on Y-axis, 6 Mbps. No duty cycle reduction was applied. Low, mid and high channels were evaluated for 30 MHz to 26 GHz, only worst case results are reported here.

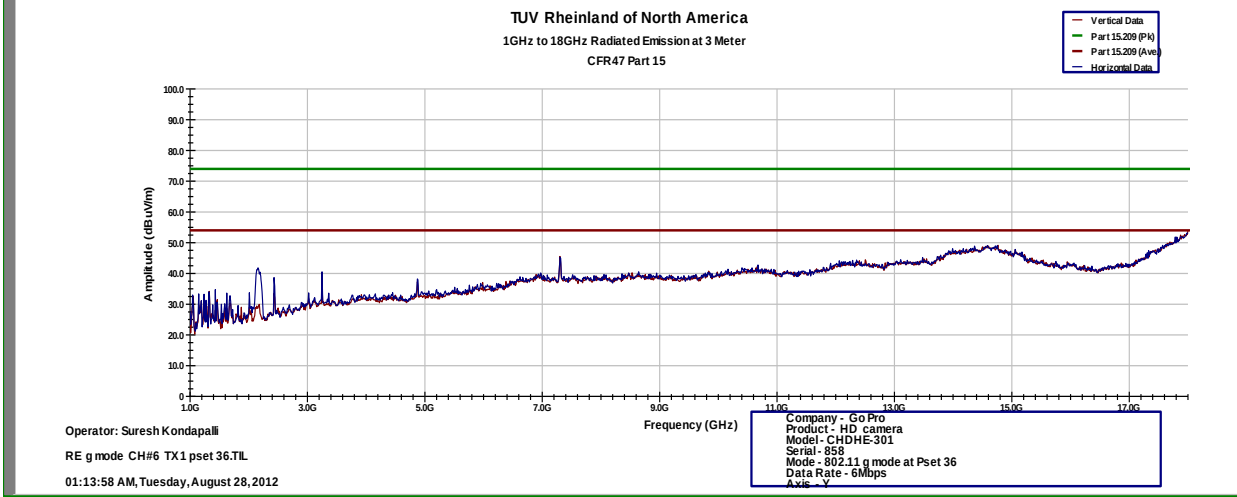
SOP 1 Radiated Emissions

EUT Name	HERO3 White Edition	**Date**	August 28, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 40% rh
EUT Serial	1037M1	**Temp / Humout**	N/A
EUT Config.	EUT Y axis	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz / 3 MHz
Dist/Ant Used	3m - EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh K

Above 1 GHz Plots for Transmit Mode at 2412 MHz, 802.11g 6 Mbit/s 16 dBm



Transmit Mode at 2437 MHz, 802.11g 6 Mbit/s 16 dBm

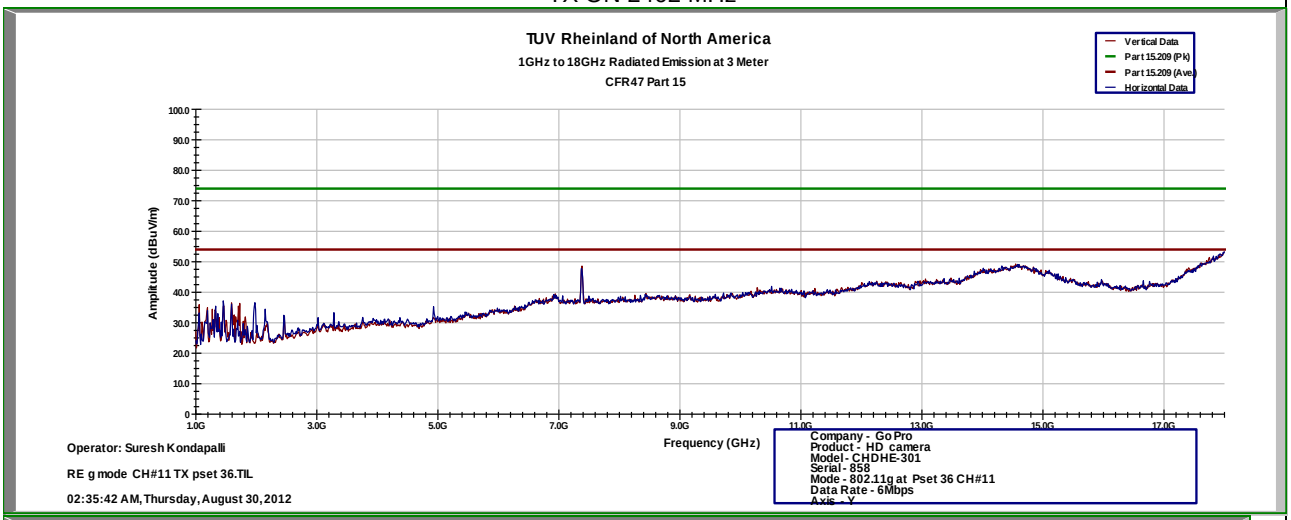


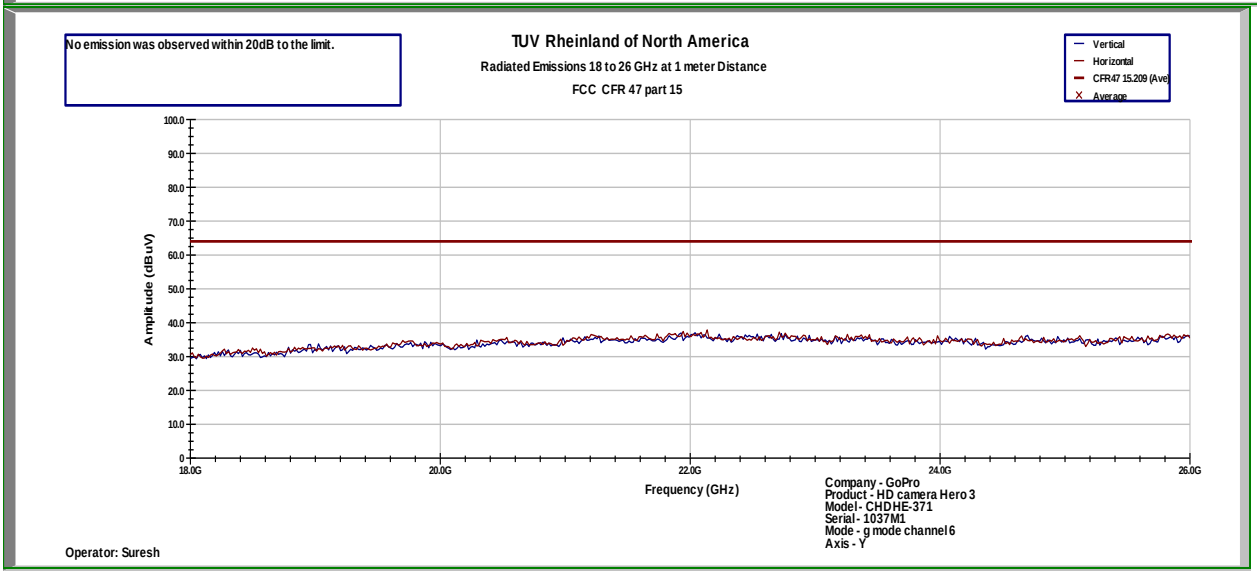
Notes: Limit was extrapolated to 1m distance for 18 GHz – 26 GHz range. All emissions were atleast 20 dB below limit for the frequency range 18 to 26 GHz; 1 GHz – 26 GHz Setting: RBW = 1 MHz / VBW = 3 MHz.

SOP 1 Radiated Emissions

EUT Name	Hero 3 White Edition	**Date**	August 30, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 39% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Config.	EUT Y axis	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m / EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

TX ON 2462 MHz





Spec Margin = E-Field Avg - Limit, E-Field Avg = FIM Avg+ Total CF ± Uncertainty
Total CF= Amp Gain + Cable Loss + ANT Factor 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 Y-axis, 6 Mbps. No duty cycle reduction was applied. Low, mid and high channels were evaluated for 30 MHz to 26 GHz, only worst case results are reported here.

4.5.4 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:

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

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

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

4.6 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 GEN Sect 6.1.

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.

4.6.1.3 Deviations

None.

4.6.2 Receiver Spurious Emission Limit

The spurious emissions of the receiver shall not exceed the values in CFR47 Part 15.109: 2009 and RSS GEN Sect 6.1 2010.

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

4.6.3 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).

4.6.3.1 Final Data

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

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EUT Name	HERO3 White Edition	**Date**	September 06, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	23° C / 39% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Config.	RX at Ch6,	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m / EMCO 3115 / 1m - RA42-K-F-4B-C	**Performed by**	Suresh Kondapalli

Emission Freq	FIM Pk	FIM QP/Ave	Total CF	E-Field Ave	Spec Limit	Spec Margin	Table Pos	ANT Pos	ANT Pola	Comment
287.98	35.67	33.66	-11.11	22.55	46.02	-23.47	214	29	V	
479.86	38.44	36.87	-7.47	29.40	46.02	-16.62	118	6	V	
215.91	23.34	33.52	-13.76	19.76	43.52	-23.76	108	110	H	
287.91	37.70	31.13	-10.81	20.32	46.02	-25.7	109	333	H	
479.86	39.14	37.97	-7.17	30.80	46.02	-15.22	204	191	H	
672.01	40.09	38.75	-4.52	34.23	46.02	-11.79	126	141	H	
767.84	31.55	29.31	-3.13	26.18	46.02	-19.84	103	357	H	
863.84	30.81	27.34	-1.53	25.81	46.02	-20.21	103	147	H	
1054.99	29.55	27.47	-7.53	19.94	53.98	-34.04	100	210	V	
1151.09	38.75	36.05	-7.50	28.55	53.98	-25.43	105	188	V	
1199.05	28.72	24.88	-7.50	17.38	53.98	-36.6	125	34	V	
1462.69	28.9	25.37	-7.53	17.84	53.98	-36.14	110	97	V	
1585.16	29.48	24.71	-7.28	17.43	53.98	-36.55	118	328	H	
2137.81	31.97	23.90	-4.68	19.22	53.98	-34.76	122	244	V	

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 Y-axis.
Notes: Tested on the Y-Axis at Ch 6. 30 MHz – 1 GHz: RBW=120 kHz,VBW=300 kHz 1 GHz – 25 GHz: RBW=1 MHz, VBW=3 MHz

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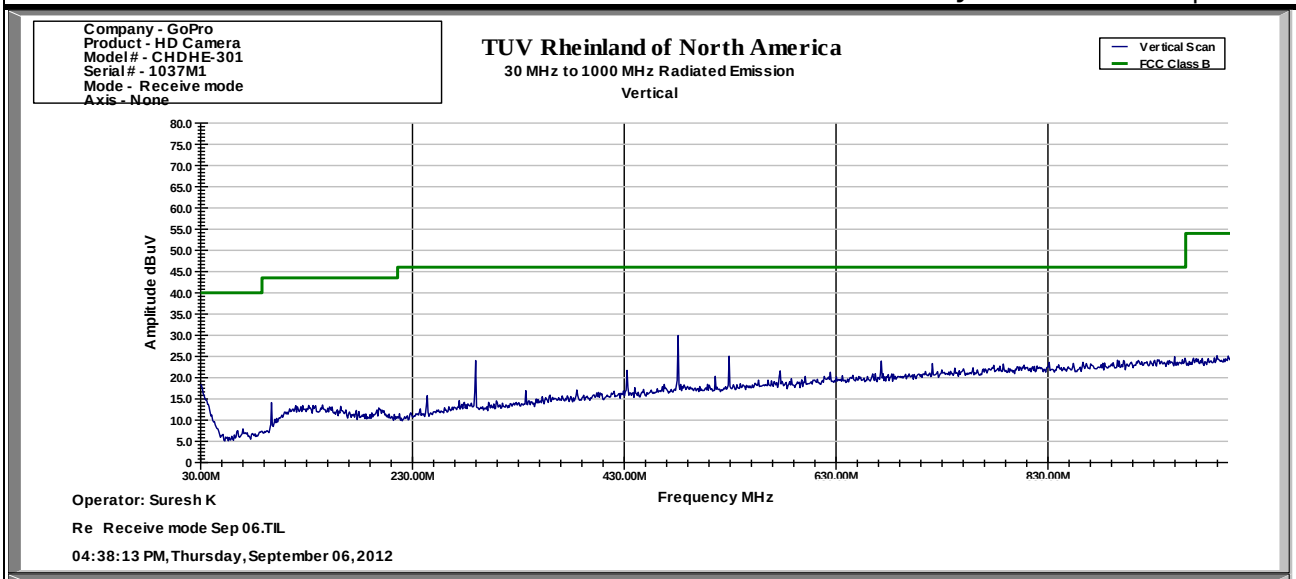
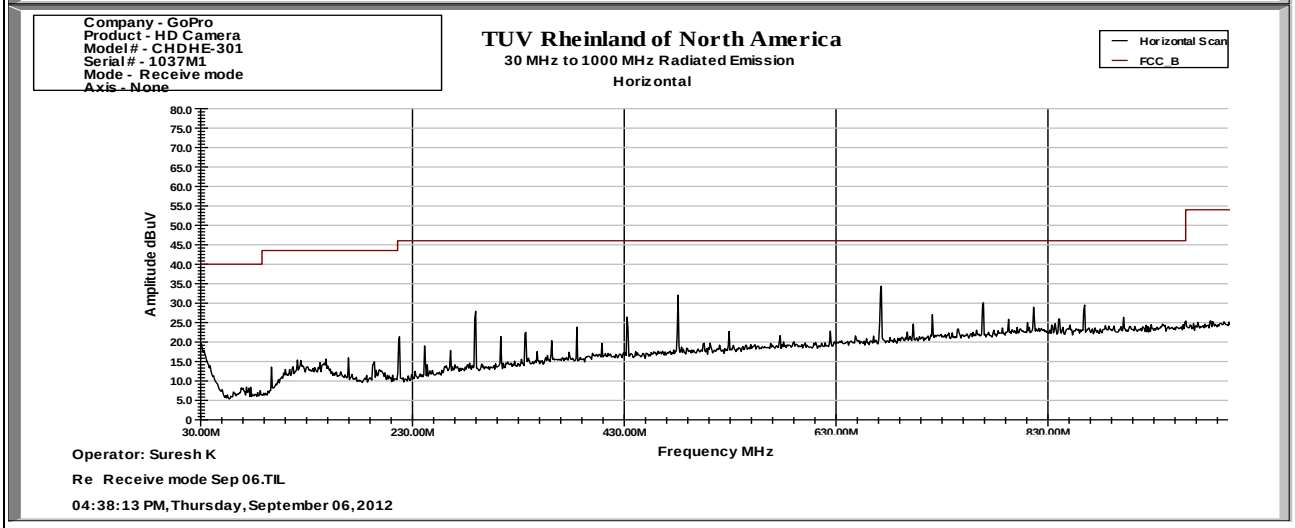
EUT Name	Hero 3 White Edition	**Date**	September 06, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	22° C / 40% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Config.	Y-Axis, 802.11, RX	**Line Voltage**	3.7 Vdc
Standard	CFR47 Part 15.109,	**RBW / VBW**	See Note
Dist/Ant Used	3m / JB3 & EMCO 3115	**Performed by**	Suresh Kondapalli





Notes : FCC Class B limits were used test performed at 3 meters

SOP 1 Radiated Emissions

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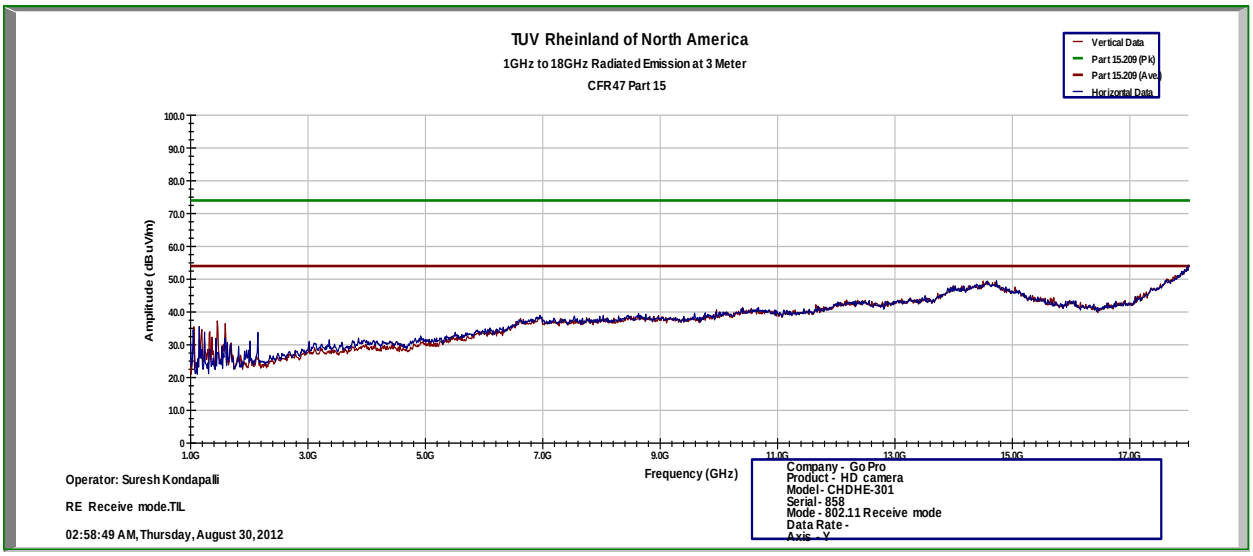
EUT Name	HERO3 White Edition	**Date**	August 30, 2012
EUT Model	CHDHE-301	**Temp / Hum in**	22° C / 40% rh
EUT Serial	1037M1	**Temp / Hum out**	N/A
EUT Config.	Y-Axis, 802.11, RX	**Line AC**	3.7 Vdc
Standard	CFR47 Part 15.109	**RBW / VBW**	120 kHz / 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Suresh Kondapali

Above 1 GHz Plot for Receive Mode



Notes: All emissions above 18 GHz are at least 20 dB below the limit

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:

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

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

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

4.7 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.4-2009. These test methods are listed under the laboratory's A2LA Scope of Accreditation.

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

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 Part 15.207: 2011 and RSS 210: 2010.

4.7.1 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 either performed in Lab 5. 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.

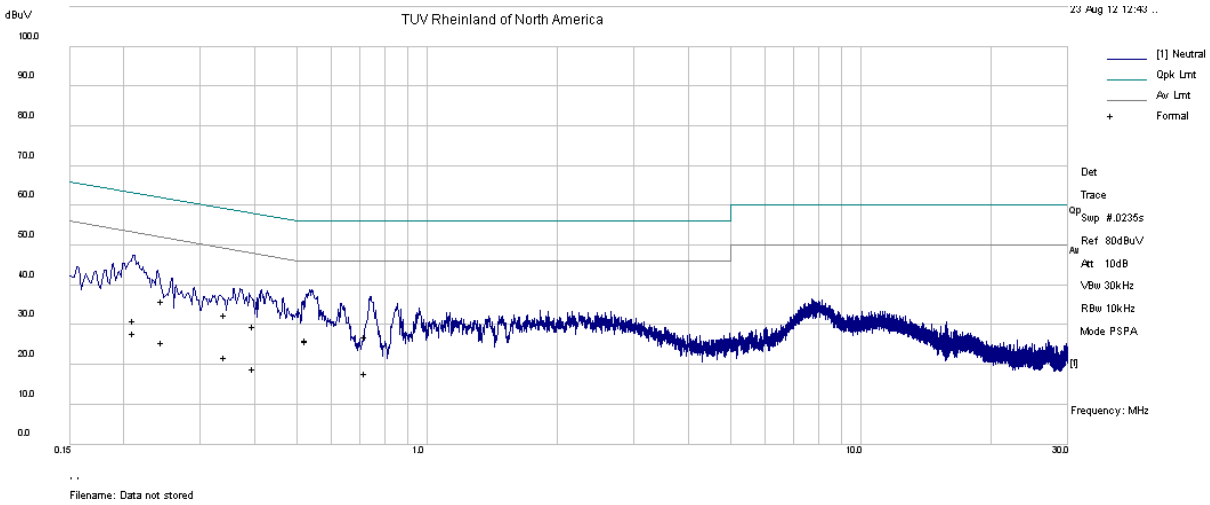
4.7.1.1 Deviations

There were no deviations from this test methodology.

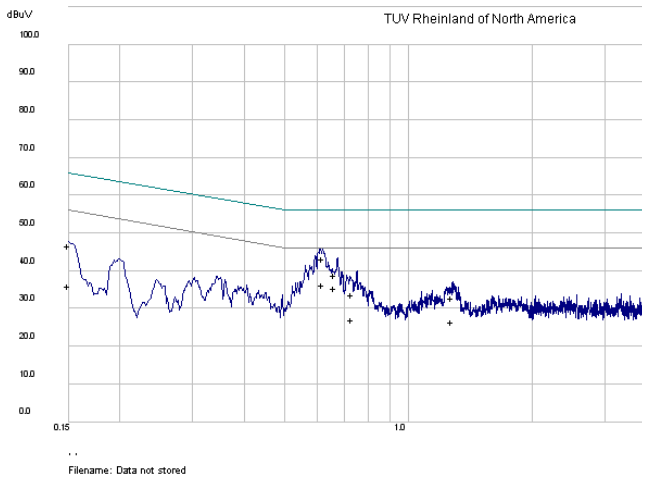
4.7.2 Test Results

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

AC Conducted Emissions – Test Results



Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB
0.21	17.60	10.58	-0.18	28.00	QP	Line1	63.19	-35.18
0.53	15.66	10.62	-0.07	26.21	QP	Line1	56.00	-29.79
0.25	25.58	10.59	-0.15	36.01	QP	Line1	61.88	-25.88
0.40	19.04	10.61	-0.10	29.54	QP	Line1	57.87	-28.33
0.72	16.61	10.63	-0.06	27.18	QP	Line1	56.00	-28.82
0.34	22.12	10.60	-0.11	32.61	QP	Line1	59.14	-26.53
0.21	20.59	10.58	-0.18	30.98	Avg	Line1	53.19	-22.20
0.53	15.28	10.62	-0.07	25.82	Avg	Line1	46.00	-20.18
0.25	15.31	10.59	-0.15	25.74	Avg	Line1	51.88	-26.14
0.40	8.58	10.61	-0.10	19.09	Avg	Line1	47.87	-28.78
0.72	7.33	10.63	-0.06	17.90	Avg	Line1	46.00	-28.10
0.34	11.35	10.60	-0.11	21.84	Avg	Line1	49.14	-27.30



Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB
0.62	32.70	10.63	-0.07	43.26	QP	Neutral	56.00	-12.74
0.66	28.30	10.63	-0.06	38.87	QP	Neutral	56.00	-17.13
0.73	23.09	10.63	-0.06	33.66	QP	Neutral	56.00	-22.34
7.78	24.86	10.81	-0.02	35.66	QP	Neutral	60.00	-24.34
0.15	36.27	10.57	-0.26	46.58	QP	Neutral	66.00	-19.42
1.28	22.27	10.67	-0.05	32.89	QP	Neutral	56.00	-23.11
0.62	25.74	10.63	-0.07	36.30	Avg	Neutral	46.00	-9.70
0.66	24.84	10.63	-0.06	35.40	Avg	Neutral	46.00	-10.60
0.73	16.33	10.63	-0.06	26.90	Avg	Neutral	46.00	-19.10
7.78	18.52	10.81	-0.02	29.32	Avg	Neutral	50.00	-20.68
0.15	25.67	10.57	-0.26	35.98	Avg	Neutral	56.00	-20.02
1.28	15.70	10.67	-0.05	26.32	Avg	Neutral	46.00	-19.68

4.7.3 Test Setup Photos

Figure 49: Radiated Spurious Emissions 1 - 18 GHz

Figure 50: Radiated Spurious Emissions 1 - 18 GHz

Figure 51: Radiated Spurious Emissions 18 - 26 GHz

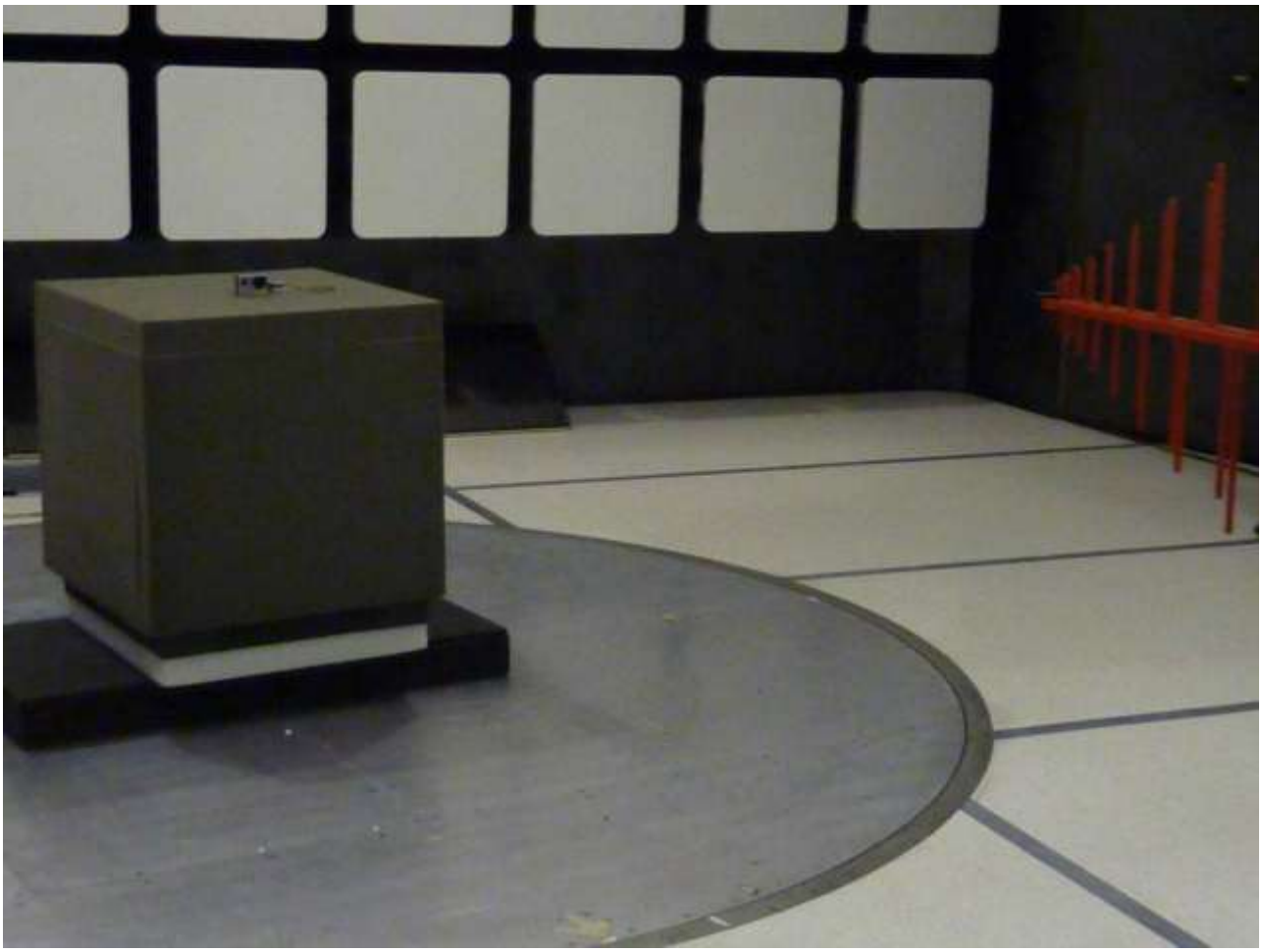


Figure 52: Radiated Spurious Emissions 30 - 1000 MHz

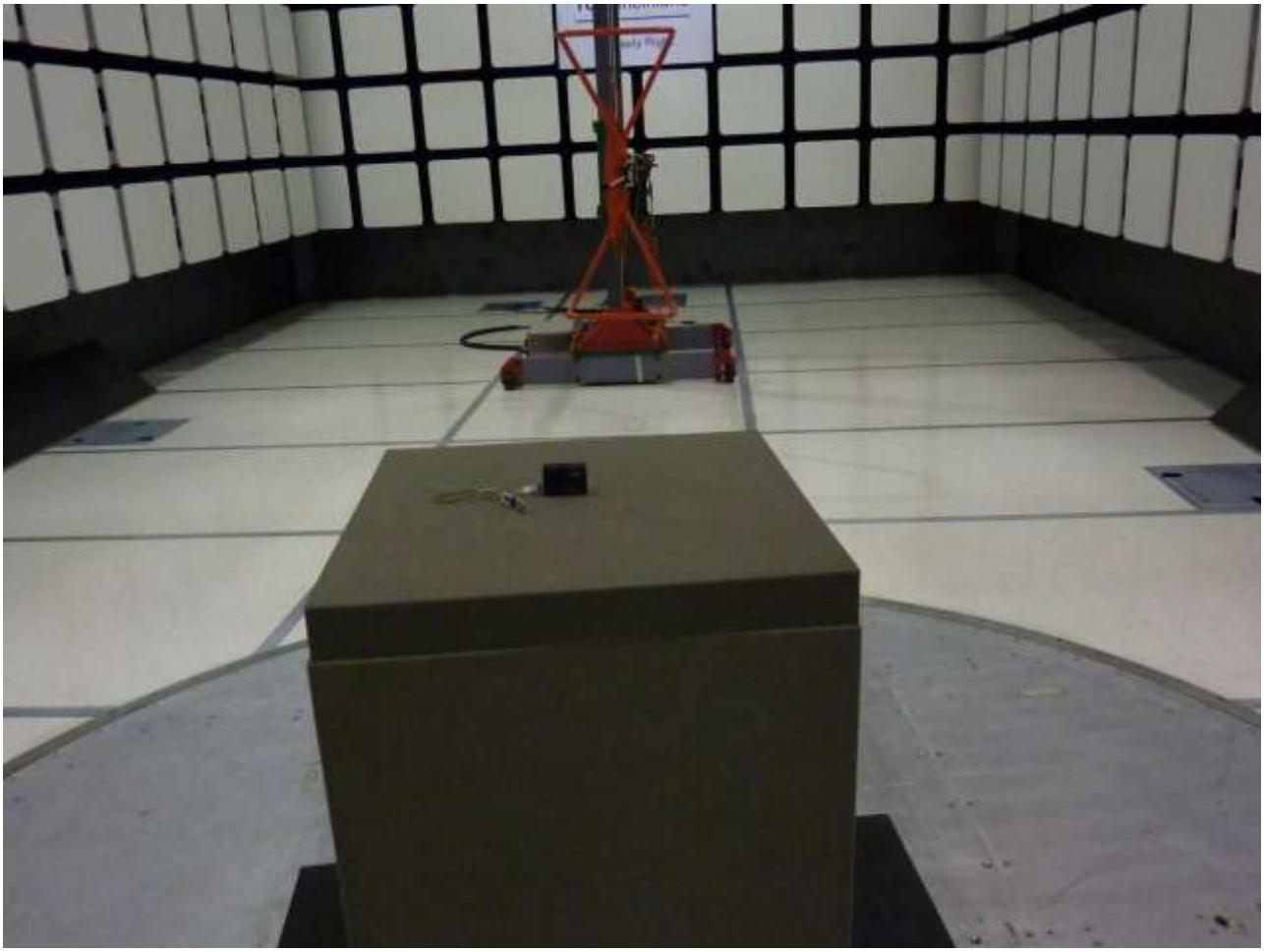


Figure 53: Radiated Spurious Emissions 30 - 1000 MHz

Figure 54: AC Line Conducted Emissions

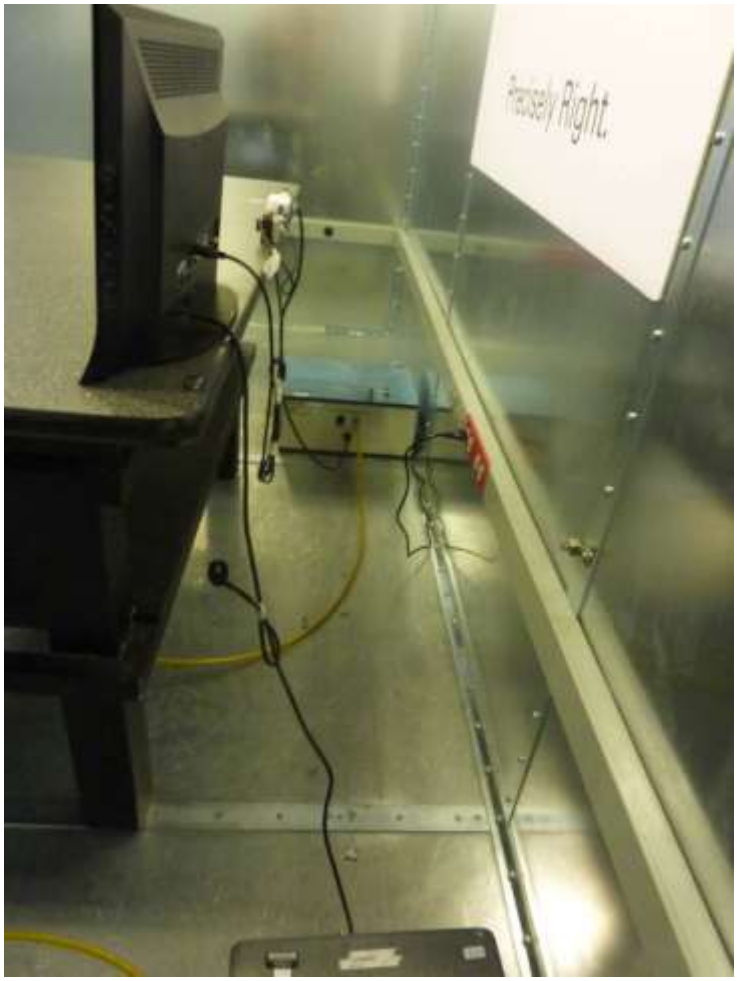


Figure 55: AC Line Conducted Emissions

5 Test Equipment Use List

5.1 Equipment List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
Bilog Antenna	Sunol Sciences	JB3	A061907	5/17/2012	5/17/2014
Horn Antenna	Sunol Sciences	DRH-118	A040806	9/29/2010	9/29/2012
Antenna (18-26 GHz)	CMT	RA42-K-F-4B-C	020131-004	1/17/2012	1/17/2013
EMI Receiver	Hewlett Packard	8546A	3807A00445	1/17/2012	1/17/2013
Preselector	Hewlett Packard	85460A	3704A00407	1/17/2012	1/17/2013
Amplifier	Hewlett Packard	8447D	2944A07996	1/16/2012	1/16/2013
Spectrum Analyzer	Rhode & Schwarz	ESIB	832427/002	1/17/2012	1/17/2013
Amplifier	Rhode & Schwarz	TS-PR18	3545.7008.03	9/29/2010	9/29/2012
Amplifier	Rhode & Schwarz	TS-PR26	100011	1/16/2012	1/16/2013
Signal Generator	Anritsu	MG3694A	42803	1/17/2012	1/17/2013
Notch Filter	Micro-Tronics	BRM50702	37	1/17/2012	1/17/2013
Notch Filter	Micro-Tronics	BRC50705	9	1/17/2012	1/17/2013
High Pass Filter (3.5 GHz)	Hewlett Packard	84300-80038	820004	1/17/2012	1/17/2013
High Pass Filter (8.5 GHz)	Micro-Tronics	HPM50107	4	1/17/2012	1/17/2013
Digital Multimeter	Fluke	177	92780314	1/18/2012	1/18/2013
LISN	Compower	LI-215	24548	1/19/2012	1/19/2013
Signal Generator	Anritsu	MG3694A	42803	1/17/2012	1/17/2013
Spectrum Analyzer	Agilent	E4407B	SG43330468	10/05/2011	10/05/2012

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 6: Customer Information

Company Name	Woodman Labs, Inc (dba GoPro)
Address	3000 Clearview Way
City, State, Zip	San Mateo, CA 94402
Country	U.S.A.
Phone	650-332-7600
Fax	480-275-3094

Table 7: Technical Contact Information

Name	Steven Kim
E-mail	skim@gopro.com
Phone	650-332-7600
Fax	480-275-3094

6.3 Equipment Under Test (EUT)

Table 8: EUT Specifications

EUT Specification	
Dimensions	2.25" x 1.5" x 0.75"
AC Adapter (For charging only)	Input Voltage: 3.7 Vdc Input Current: 1.5 A
Environment	Residential
Operating Temperature Range:	-20 to +45 degrees C
Multiple Feeds:	☐ Yes and how many ☒ No
Hardware Version	None
Part Number	None
RF Software Version	None
Radio Module 802.11-radio module	
Operating Mode	802.11b and g modes.
Transmitter Frequency Band	2.400 - 2.4835 GHz
Max. Rated Power Output	See Channel Planning Table.
Power Setting @ Operating Channel	See Channel Planning Table.
Antenna Type	Internal 2.9 dBi
Modulation Type	☐ AM ☐ FM ☐ DSSS ☒ OFDM ☒Other describe: CCK,
Data Rate	802.11b mode 1, 5 & 11 Mbps 802.11g mode 6, 12, 18, 24, 36 & 54 Mbps
TX/RX Chain (s)	1
Directional Gain Type	☒ Uncorrelated ☒ No Beam-Forming ☐ Other describe:
Type of Equipment	☐ Table Top ☐Wall-mount ☐ Floor standing cabinet ☒Other *Portable*

Table 9: EUT Channel Power Specifications

No.	Frequency (MHz)	Power setting 802.11b	Power setting 802.11g
1	2412	16 dBm	9 dBm
2	2417	16 dBm	12 dBm
3	2422	16 dBm	14 dBm
4	2427	16 dBm	16 dBm
5	2432	16 dBm	16 dBm
6	2437	16 dBm	16 dBm
7	2442	16 dBm	16 dBm
8	2447	16 dBm	16 dBm
9	2452	16 dBm	16 dBm
10	2457	16 dBm	16 dBm
11	2462	16 dBm	13 dBm

Table 10: Interface Specifications:

1 – mini USB, 1 – micro HDMI

Table 11: Supported Equipment :

No support equipment was used for Radio testing.

Table 12: Description of Sample used for Testing

Device	Serial	RF Connection	CFR47 Part 15.247
Hero 3 White Edition	**1037M1**	External Antenna	TX Emission RX Emission
	542	SMA Connector (This was set up by GoPro for test purposes only)	RF Power Output Out of Band Emission Peak Power Spectral Density Occupied Bandwidth

Table 13: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup Photo (X Axis)	(Y-Axis)	(Z Axis)
Hero 3 White Edition	Internal	* Transmit * Receive			
Antennas are mounted vertically in host device.					

Table 14: Final Test Mode for 2400 - 2483.5 MHz Band

Test	802.11 b & g
Occupied Bandwidth	2412, 2437, 2462 MHz @ 1 & 6 Mbps
Output Power	2412, 2437, 2462 MHz @ 1 & 6 Mbps
Peak Power Spectral Density	2412, 2437, 2462 MHz @ 1 & 6 Mbps
Out-of-Band (-20 dBr)	2412, 2437, 2462 MHz @ 1 & 6 Mbps
Band-Edge (Radiated)	2412, 2437, 2462 MHz @ 1 & 6 Mbps
Transmitted Spurious Emission	2412, 2437, 2462 MHz @ 1 & 6 Mbps
Received Spurious Emission	2437 MHz
AC Conducted Emission	2437 MHz Normal operation

6.4 Test Specifications

Testing requirements

Table 15: Test Specifications

Emissions and Immunity	
Standard	Requirement
CFR 47 Part 15.247: 2011	All
RSS 210 Issue 8, 2010	All

END OF REPORT