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Emissions
Test Report

EUT Name: Squeezebox Touch

Model No.: X-RC4

CFR 47 Part 15.247 2008 and RSS 210: 2007

Prepared for:

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Report/Issue Date: 3 April 2009
Report Number: 30960915.003

Statement of Compliance

Manufacturer:	Logitech Far East Ltd. Science Based Industrial Park (No. 2 Creation Road IV) Hsinchu, Taiwan (011) 886-3577824178241
Requester / Applicant:	
Name of Equipment:	Squeezebox Touch
Model No.	X-RC4
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 15.247 2008 and RSS 210: 2007
Test Dates:	30 March 2009 to 3 April 2009

Guidance Documents:

Emissions: AN C63.4: 2003

Test Methods:

Emissions: AN C63.4: 2003

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	3 April 2009	Sarb Shelopal	3 April 2009
Test Engineer	Date	NVLAP Signatory	Date

NVLAP CODE 500011-0 | US5254 | 4453A

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 2008 and RSS 210: 2007 based on the results of testing performed on 30 March 2009 through 3 April 2009 on the Squeezebox Touch Model X-RC4 manufactured by Logitech Far East Ltd.. 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
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	500kHz mininum	**Complied**
Maximum Transmitted Power	CFR47 15.247 (b3), RSS 210 Sect. A.8.4	30dBm w/ 6dBi antenna	**Complied**
Peak Power Spectral Density	CFR47 15.247 (e), RSS 210 Sect. A.8.2	8dBm/ 3kHz.	**Complied**
Bandedge Measurement	CFR47 15.247 (d), RSS 210 Sect. A.8.5	20dBr	**Complied**
RF Exposure	CFR47 15.247 (i), 2.1091	General Population	**Complied**

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

None.

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 (FRN # **Error! Reference source not found.**). 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 17025:1999 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 IC 4453-1). 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. R-2366, C-2585, C-2586).

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-Anachoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2003, at a test distance of 3 and 10 meters. This site has been described in reports dated May 12, 1997, submitted to the FCC, and accepted by letter dated June 25, 1997 (31040/SIT 1300F2). The site is listed with the FCC and accredited by NVLAP (code 500011-0). The 10-meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2003, at a test distance of 3 meter and 10 meters. A report detailing this site can be obtained from TUV Rheinland of North America.

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 addition, 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.

The Expanded Uncertainty defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand. The fraction may be viewed as the coverage probability or level of confidence of the interval.

Table 2: Summary of Uncertainties

Test	System	Combined Standard Uncertainty
Conducted Emissions	LISN, spectrum analyzer, coaxial cables, and pads	± 1.2 dB
Radiated Emissions	antenna, spectrum analyzer, pre-amplifier, coaxial cables, and pads	± 1.6 dB
Radiated Immunity	antenna, amplifier, cables, signal generator field probe, and spectrum analyzer	± 2.7 dB
Conducted Immunity	coupling/decoupling device, amplifier, cables, signal generator, and spectrum analyzer	± 1.5 dB
Voltage Dips, Drops, and Interruptions	AC power source and interruptions generator	± 4.3 dB
Electrical Fast Transient Immunity	AC power output source and fast transient generator	± 5.8 dB
Lightning Surge Immunity	AC power output source and lightning surge generator	± 8.0 dB
Electrostatic Discharge Immunity	air and contact discharge generators	± 4.1 dB
Power Frequency Magnetic Field Immunity	AC voltage source	± 0.58 dB
Damped Oscillatory Wave Immunity	AC power output source and oscillatory wave generator	± 8.7 dB
Harmonic Current and Voltage Flicker	AC power source and detection devices	± 11.6 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). The measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005.

3 Product Information

3.1 Product Description

Squeezebox Touch, model X-RC4 is countertop or wall-mounted (with included back-plate) musing streaming system. This SqueezeOS base platform features:

- 4.3" LCD panel with capacitive touch screen
- High quality analog and headphone outputs (24bit/96k)
- Optical and coax S/PDIF outputs
- 802.11g wireless
- 64MB SDRAM & 64MB NAND flash
- SD card slot & USB host connector
- Internal speech-grade microphone and speaker – sound effects and preview
- IR sensor for remote control
- Ambient light sensor for dimming screen at night
- IR proximity sensor for detecting user approaching
- Digital temperature sensor for home automation

3.2 Equipment Configuration

A description of the equipment configuration is given in Table 13 and Table 14. 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 Table 13 and Table 14. 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 X-RC4 uses inverter F antenna. It is permanently soldered inside the device

4 Emissions

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

4.1 Output Power Requirements

The maximum peak 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):2008 and RSS 210 A.8.4

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

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

Table 3: RF Power – Test Results

Test Conditions: Radiated Measurement, Normal Temperature, Normal Voltage						
Antenna Type: Integrated				**Output Power Level:** 15		
Signal State: Modulated				**Data Rate:** 54Mbit/s		
Ambient Temp.: 23 °C				**Relative Humidity:**38 %		
Test Results						
Operating Channel	**Polarity**	**Table/ Height**	**Channel Power [dBm]**	**EIRP [dBm]**	**Limit [dBm]**	**Margin [dB]**
2412MHz	H	153/1.0	10.64	22.41	30.00	-7.59
2412MHz	V	182/1.0	15.94	27.71	30.00	-2.27
2437MHz	H	165/1.1	12.85	24.62	30.00	-5.38
2437MHz	V	192/1.4	16.57	28.34	30.00	-1.66
2462MHz	H	138/1.0	12.07	23.84	30.00	-6.16
2462MHz	V	180/1.2	18.06	29.83	30.00	-0.17

Note: (*) All three orthogonal axis were prescanned. X-Axis had the highest level.

(**) The formula $E=\sqrt{(30*P*G)}/d$ was used for EIRP calculation.

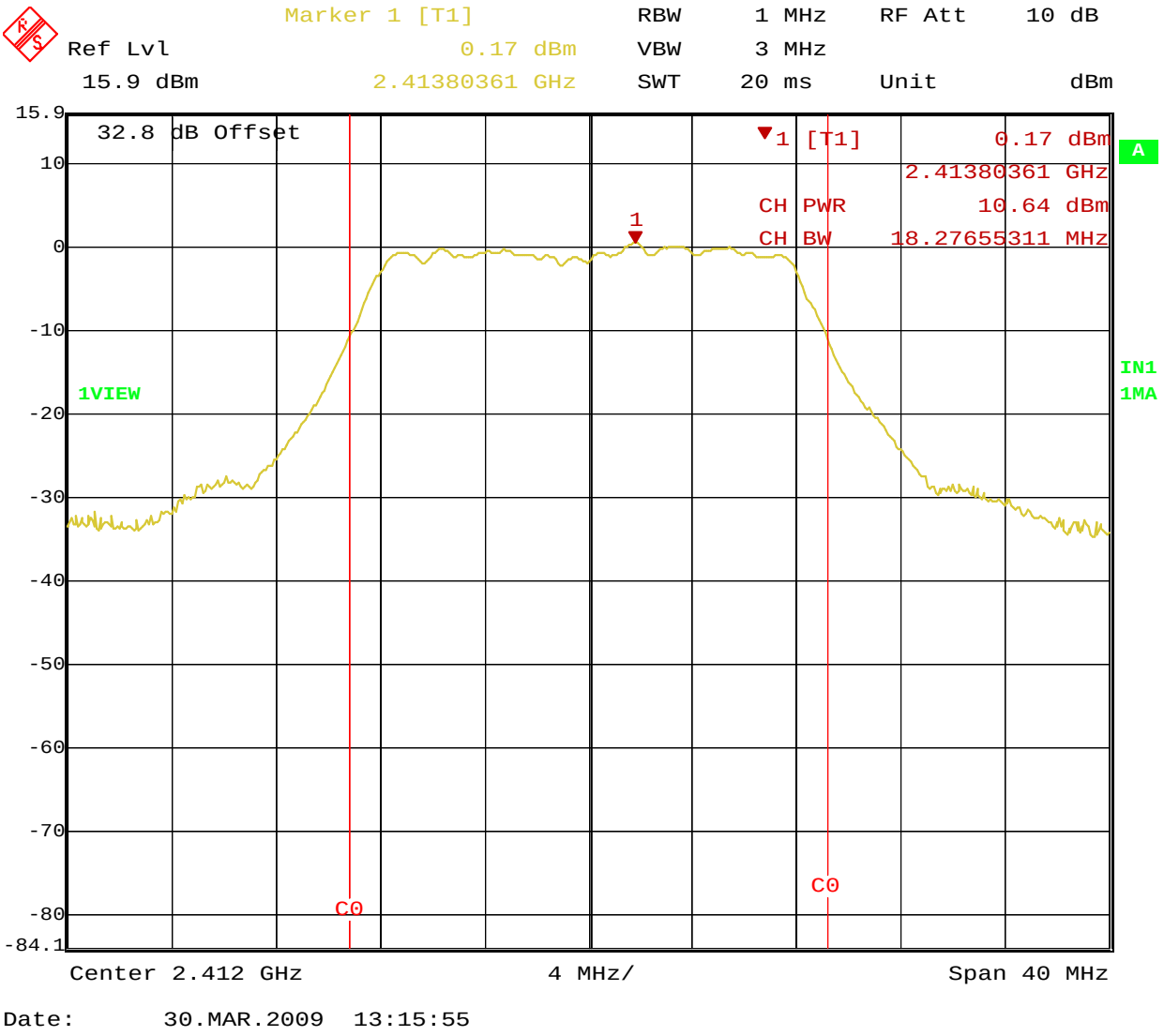

Figure 1: Maximum Transmitted Power at 3 Meter – Lowest Channel 2412MHz (Horizontal)

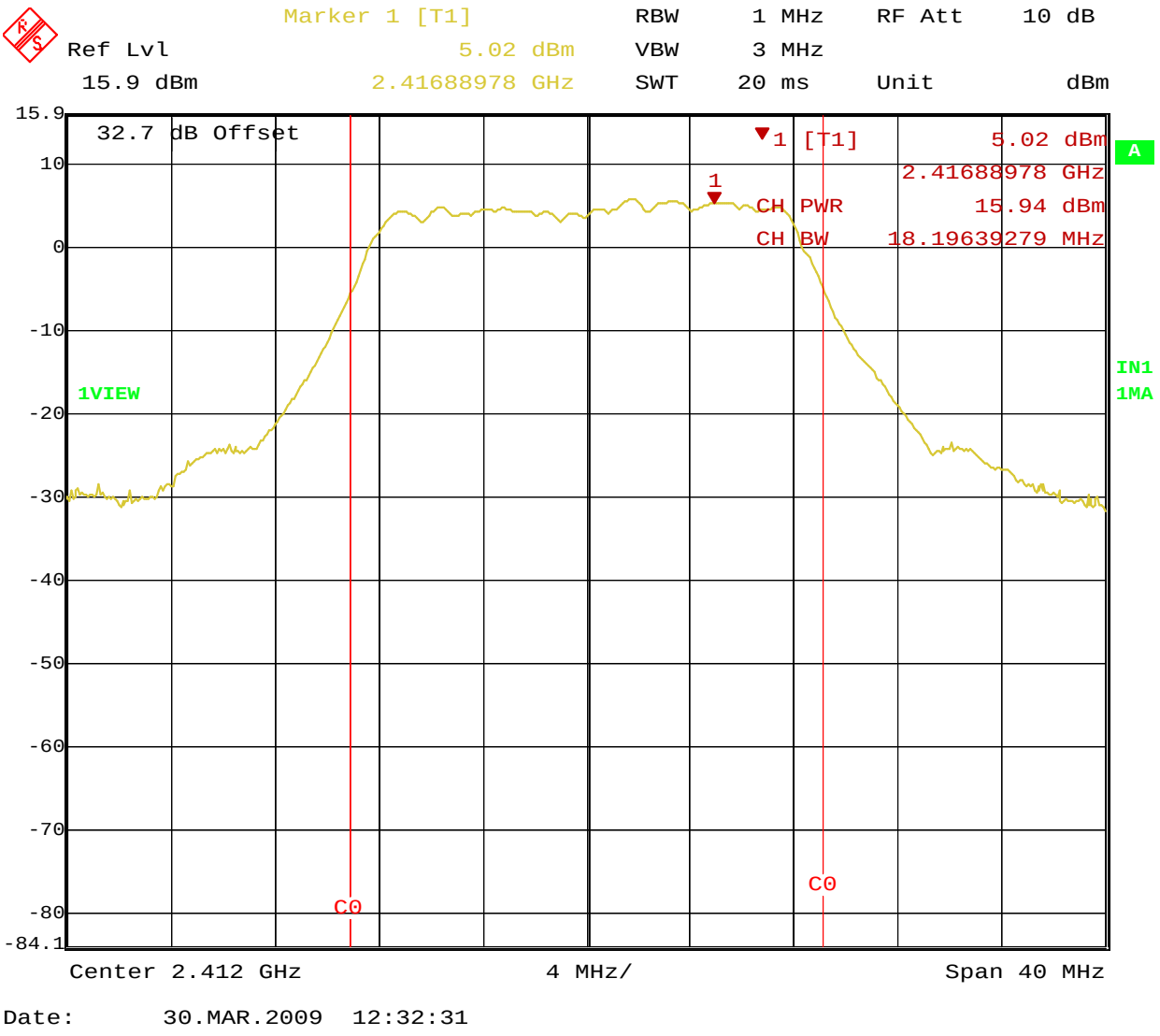

Figure 2: Maximum Transmitted Power at 3 Meter – Lowest Channel 2412 MHz (Vertical)

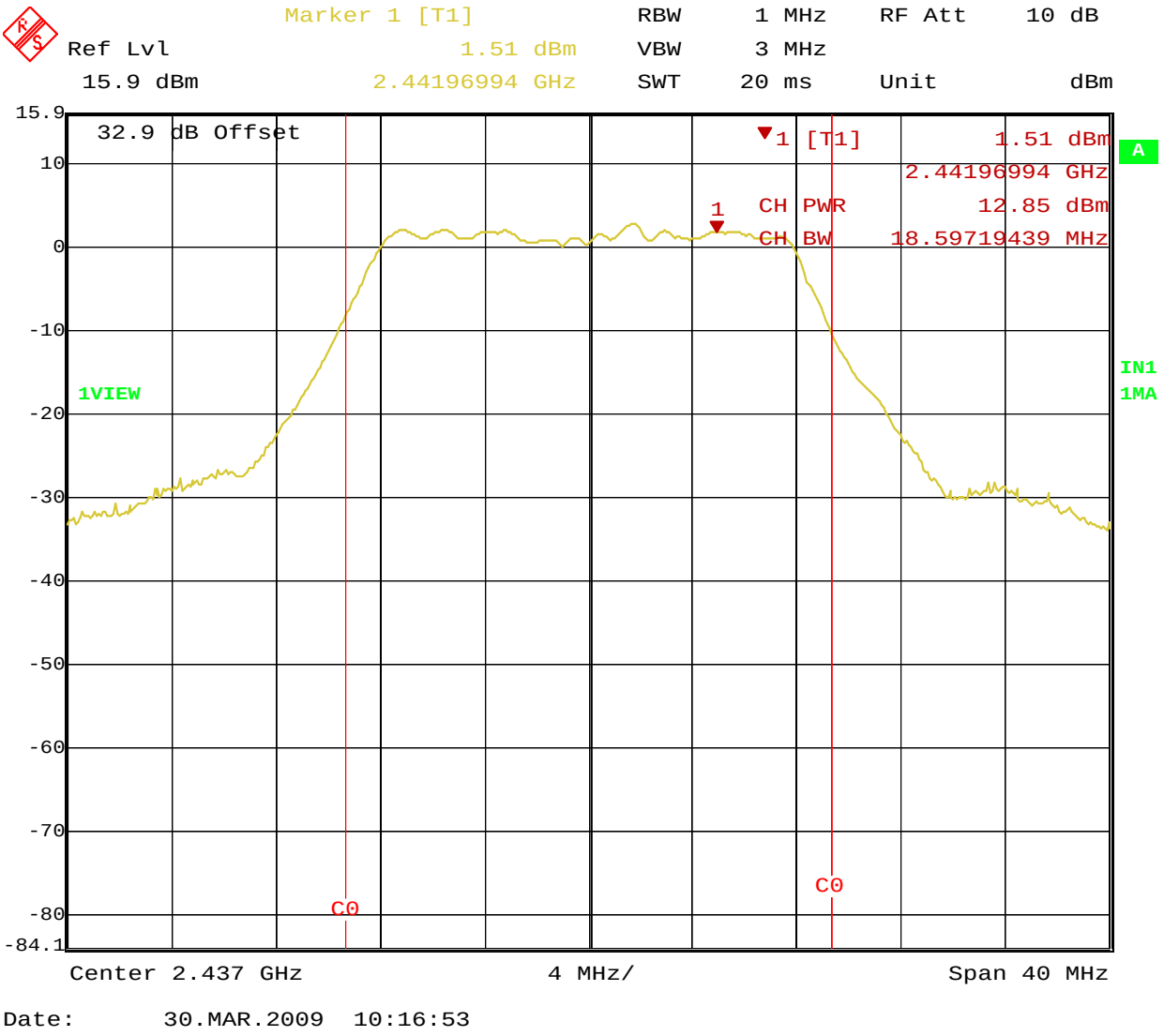

Figure 3: Maximum Transmitted Power at 3 Meter –Middle Channel 2437 MHz (Horizontal)

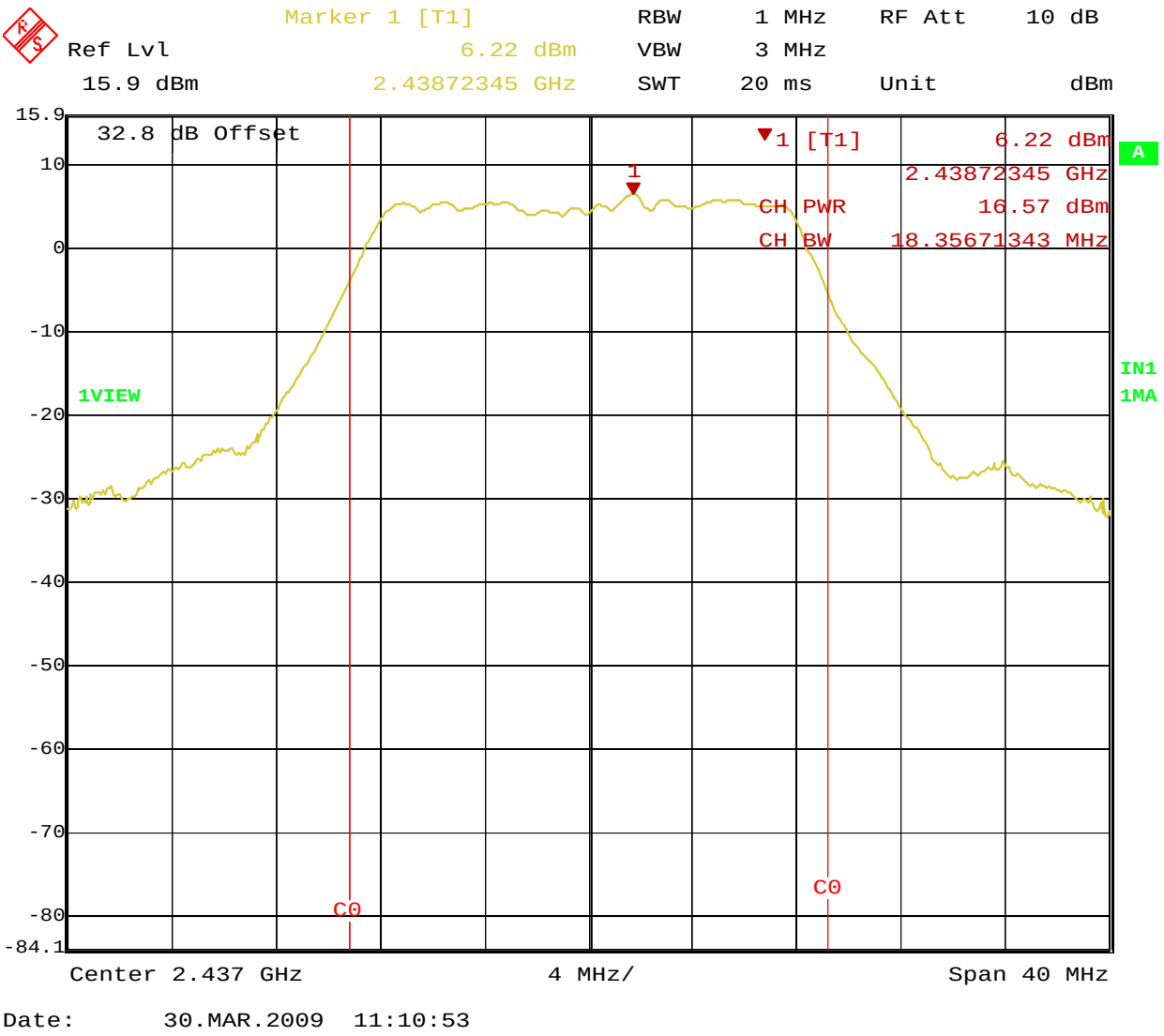

Figure 4: Maximum Transmitted Power at 3 Meter – Middle Channel 2437 MHz (Vertical)

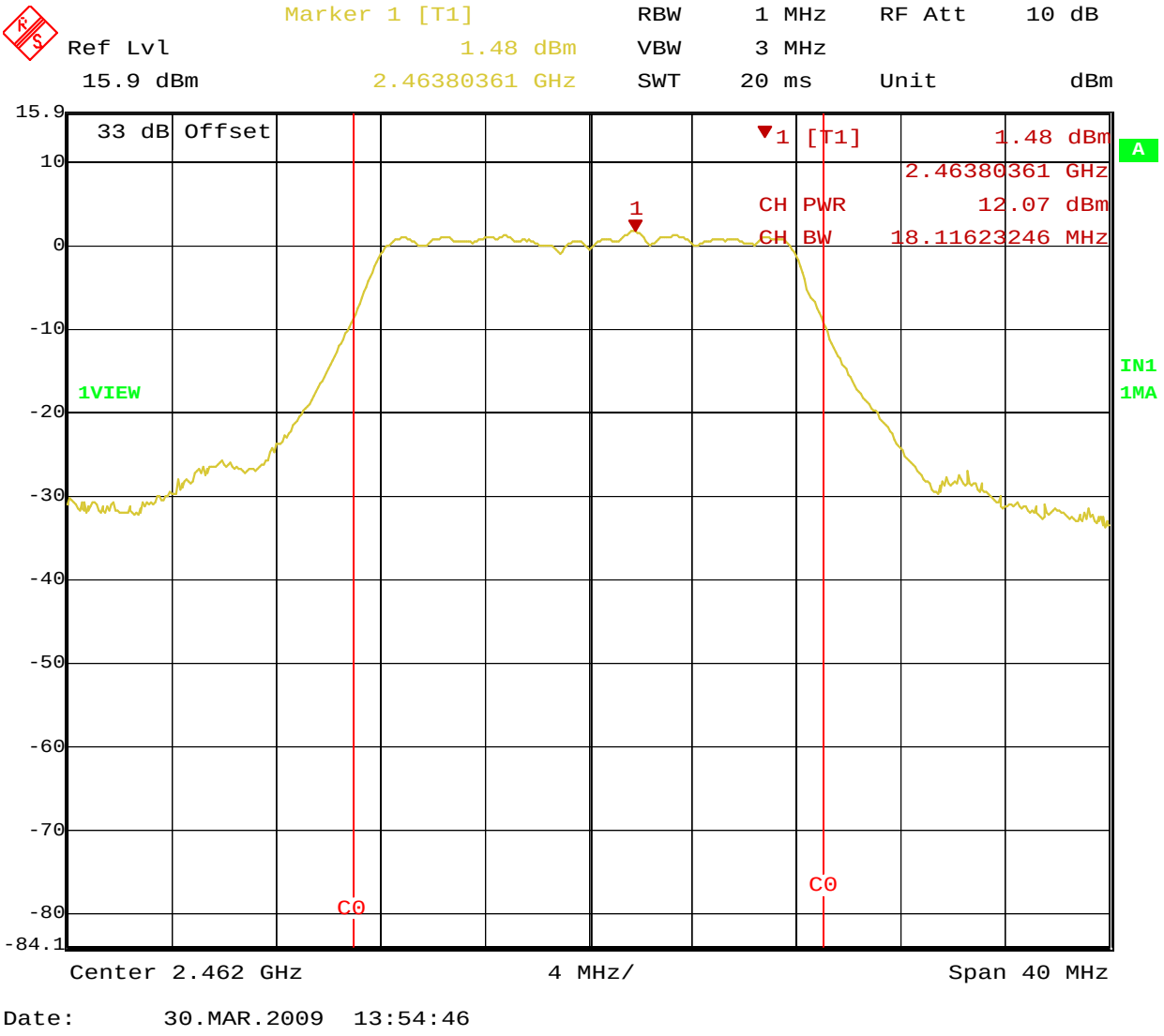

Figure 5: Maximum Transmitted Power at 3 Meter – Highest Channel 2462 MHz (Horizontal)

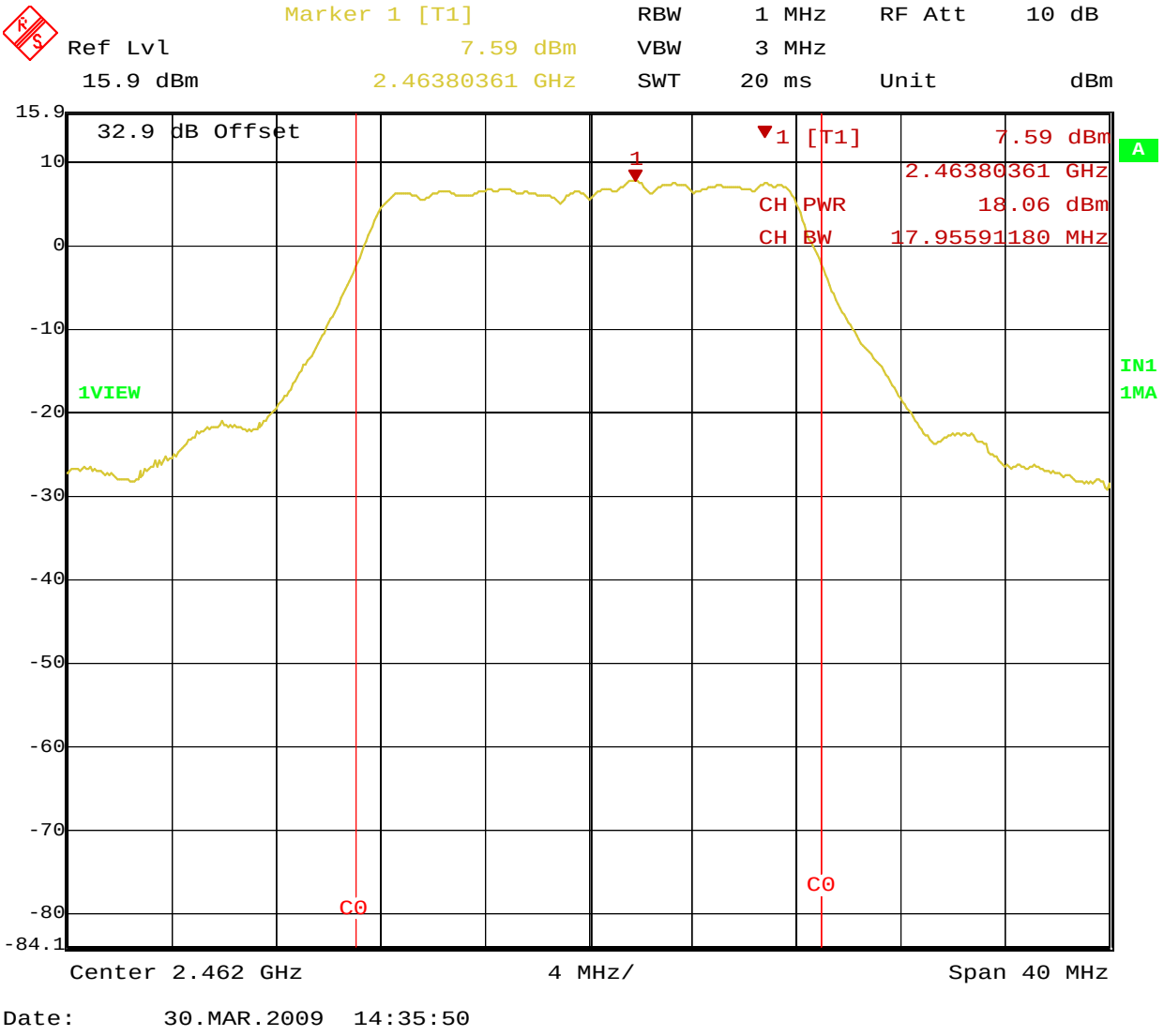

Figure 6: Maximum Transmitted Power at 3 Meter – Highest Channel 2462 MHz (Vertical)

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

The bandwidth shall be at least 500kHz per Section CFR47 15.2(a2) 2008 and RSS Gen Sect. 4.4.1.

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

Table 4: Occupied Bandwidth – Test Results

Test Conditions: Radiated Measurement, Normal Temperature and Voltage only			
Antenna Type: Integrated		**Output Power Rated:** +15 dBm	
Signal State: Modulated		**Data Rate:** see below	
Ambient Temp.: 23 °C		**Relative Humidity:**38 %	
6 dB Bandwidth Test Results			
Operating Channel	**Polarity**	**11 Mbit/s (MHz)**	**54 Mbit/s (MHz)**
2412 MHz	H	10.98196393	16.59318637
2412 MHz	V	10.34068136	16.55310621
2437 MHz	H	10.82164329	16.59318637
2437 MHz	V	10.34068136	16.59318637
2462 MHz	H	10.34068136	16.59318637
2462 MHz	V	10.34068136	16.59318637

Note: (*) Highest bandwidths were observed at 11Mbit/s for 802.11b mode and 54Mbit/s for 802.11g mode.

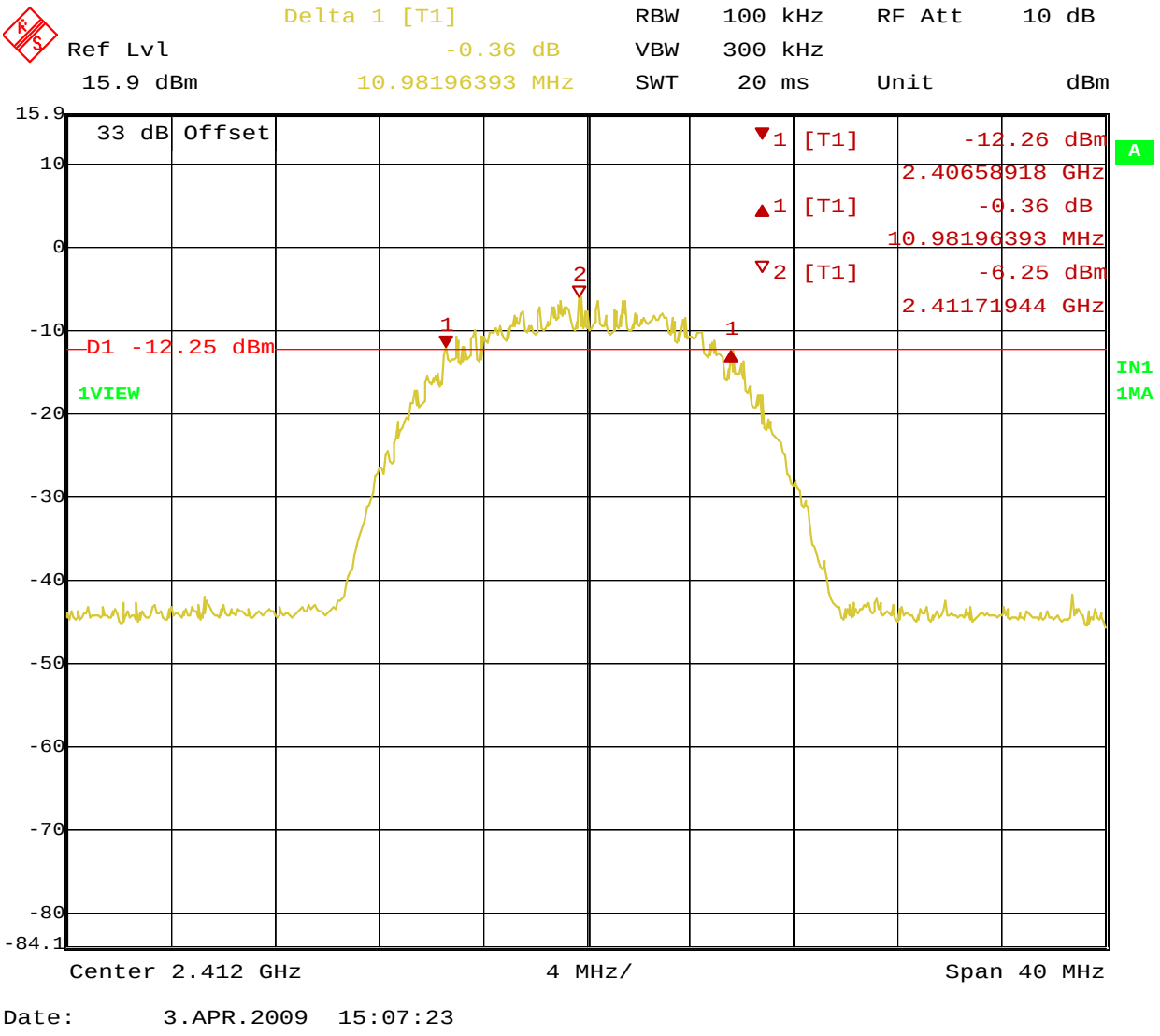

Figure 7: 6dB Bandwidth at 11Mbit/s – Operating Channel 2412 MHz (Horizontal)

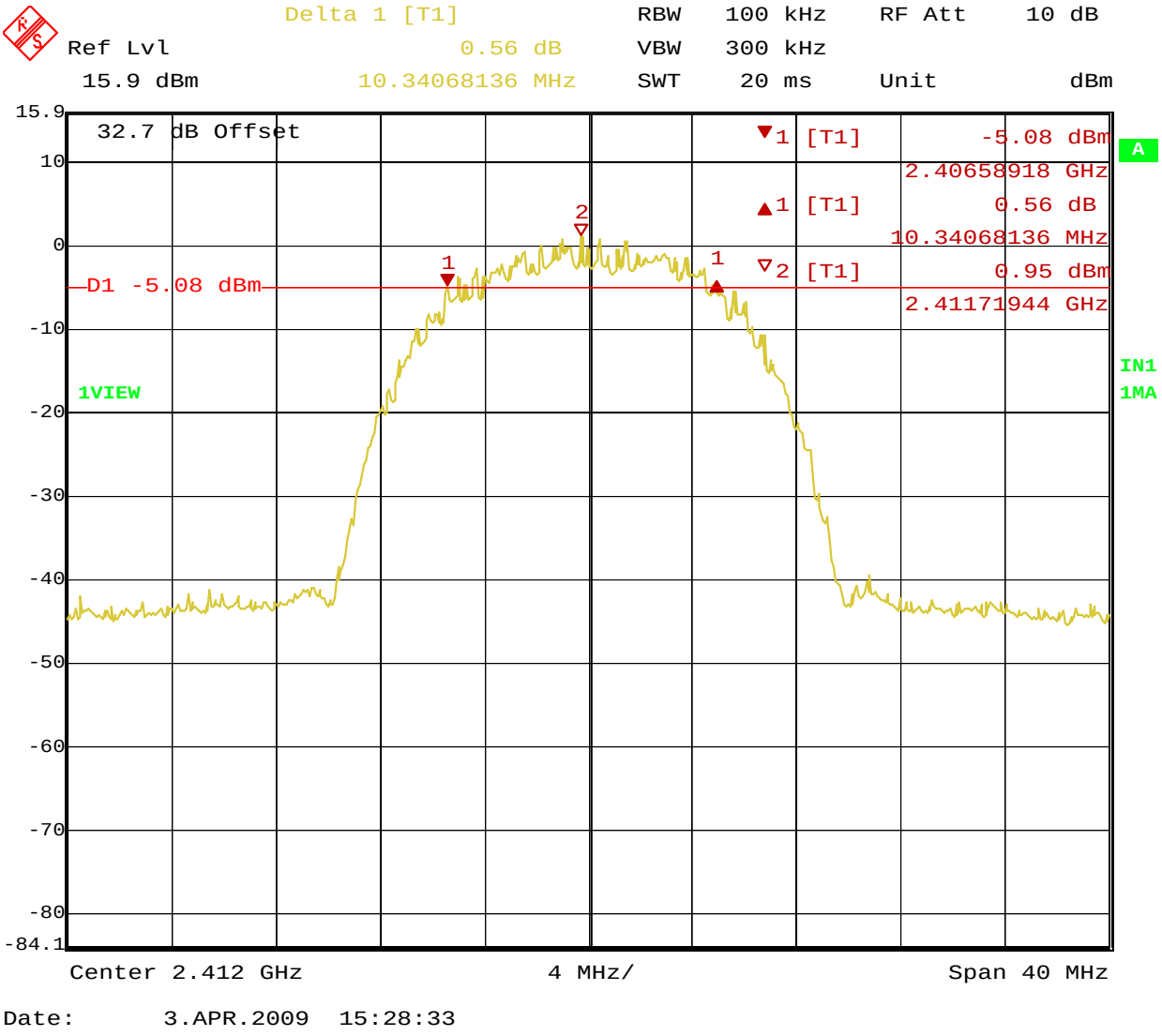

Figure 8: 6dB Bandwidth at 11Mbit/s – Operating Channel 2412 MHz (Vertical)

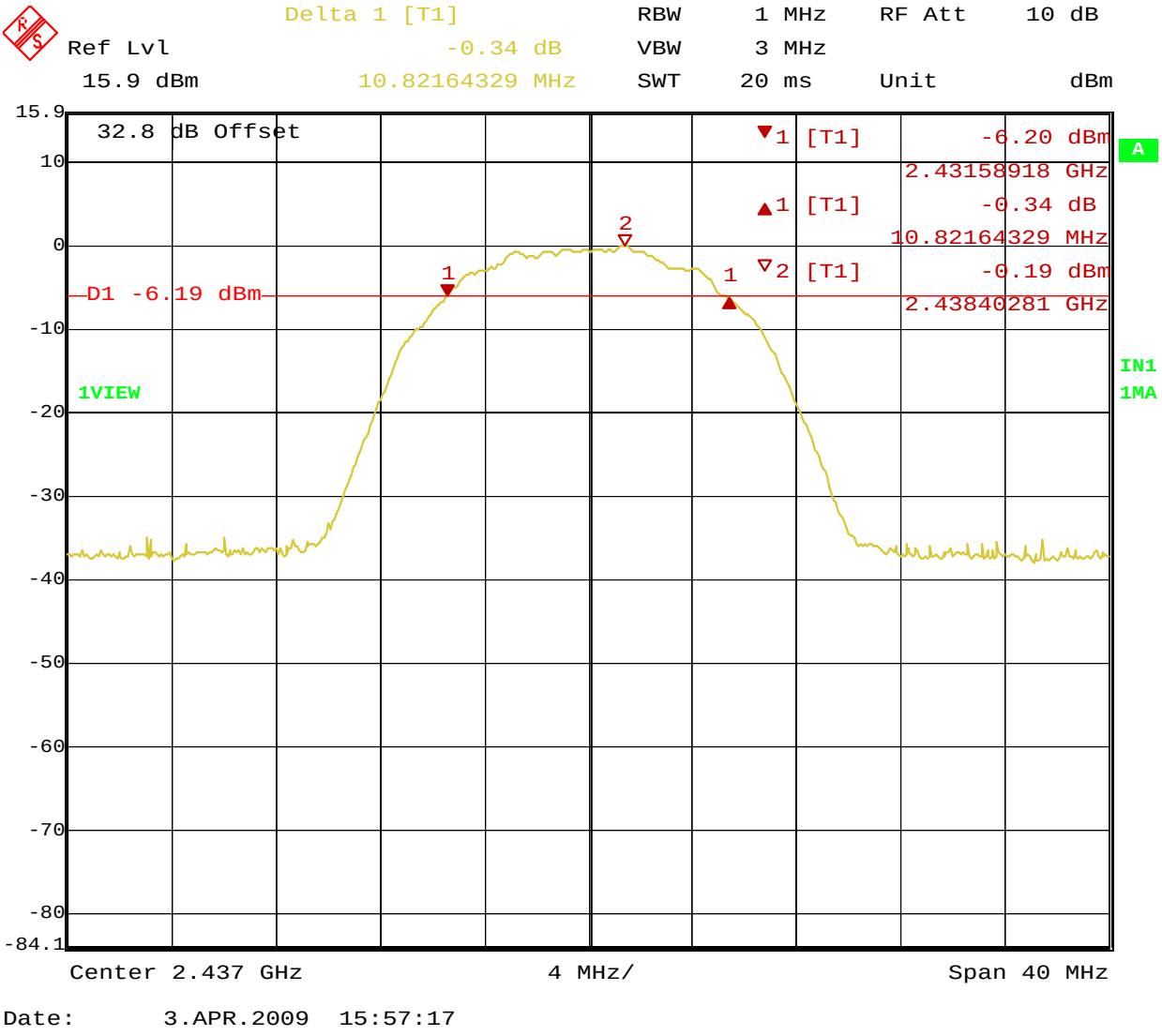

Figure 9: 6dB Bandwidth at 11Mbit/s – Operating Channel 2437 MHz (Horizontal)

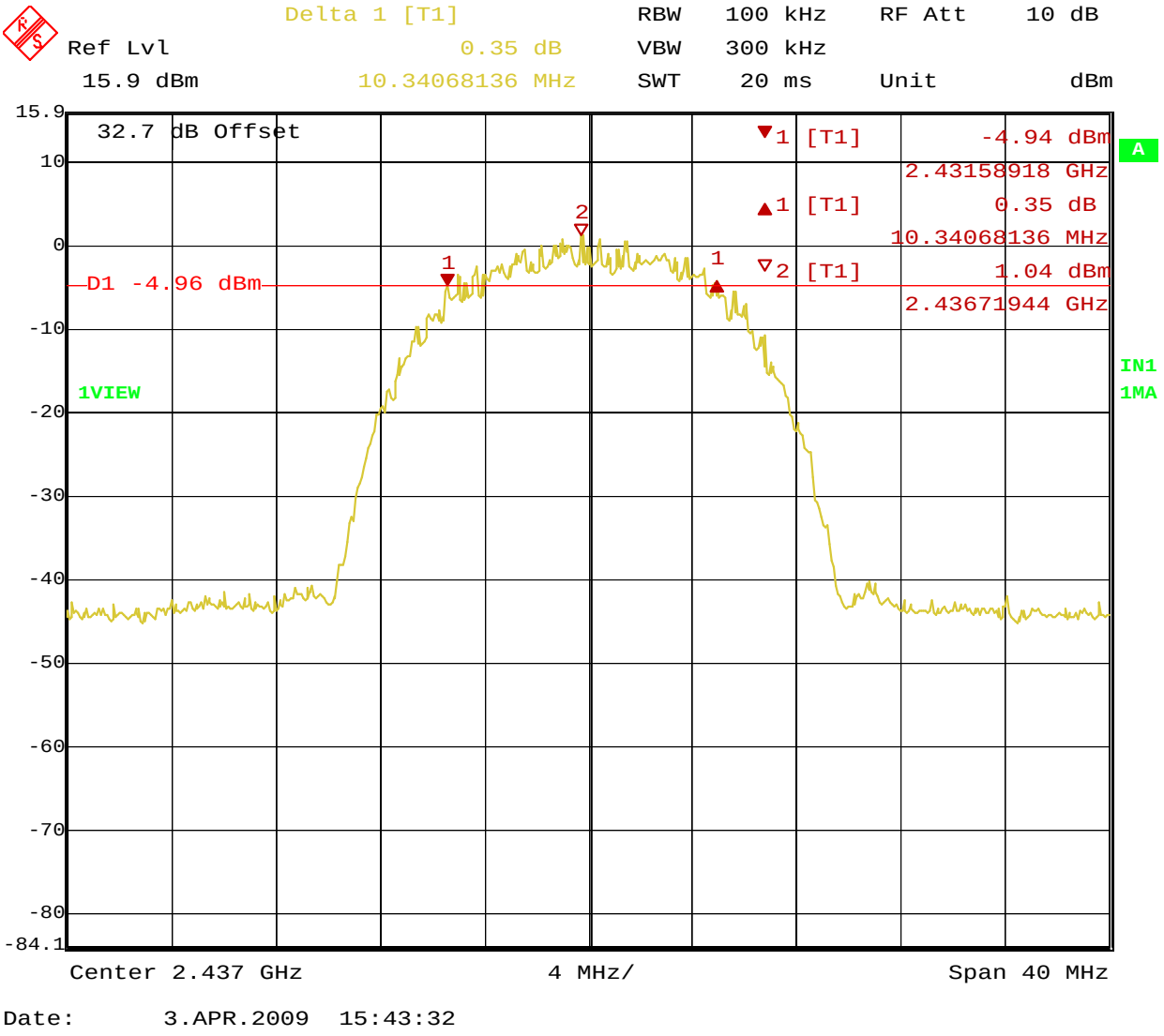

Figure 10: 6dB Bandwidth at 11Mbit/s – Operating Channel 2437 MHz (Vertical)

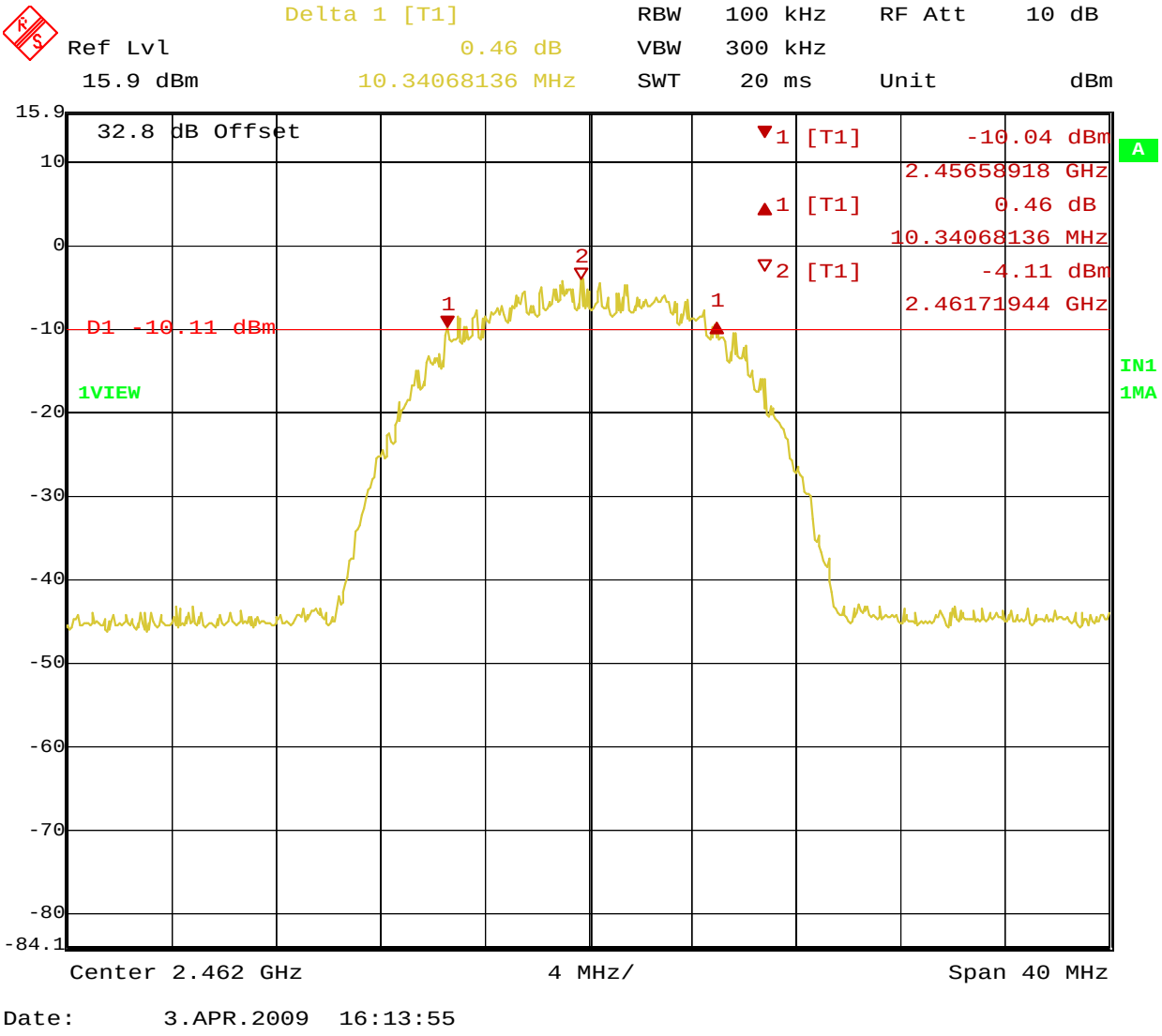

Figure 11: 6dB Bandwidth at 11Mbit/s – Operating Channel 2462 MHz (Horizontal)

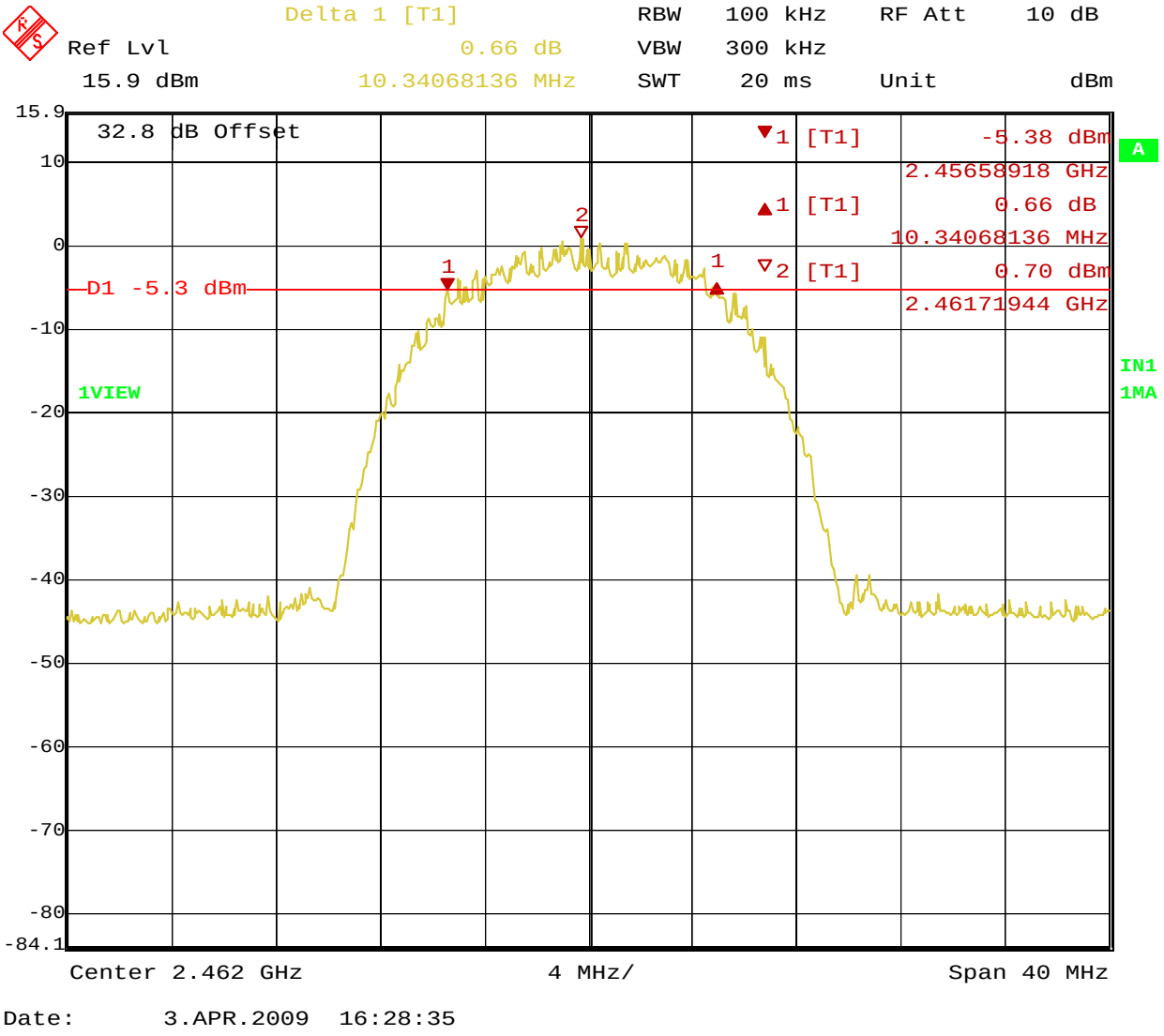

Figure 12: 6dB Bandwidth at 11Mbit/s – Operating Channel 2462 MHz (Vertical)

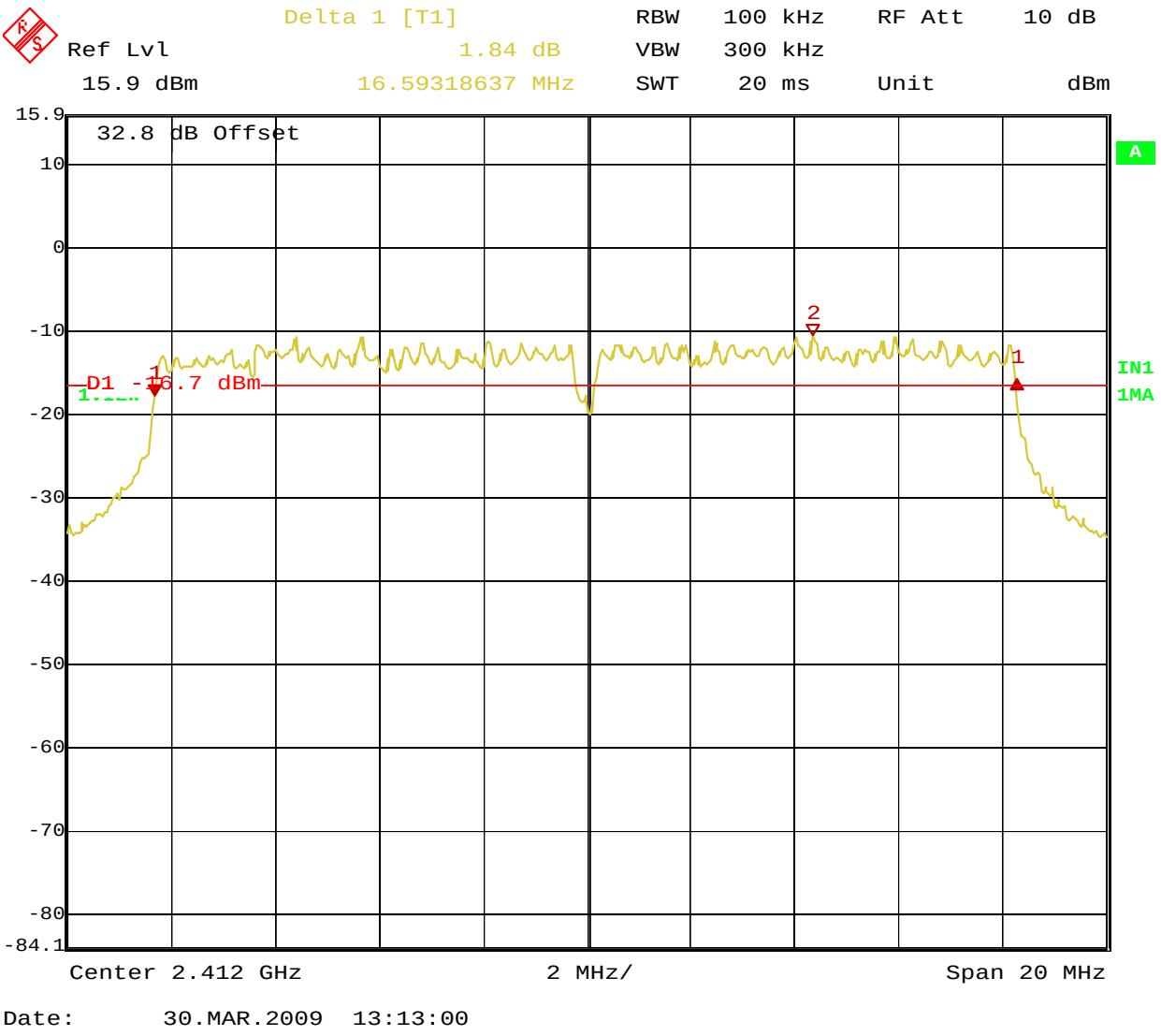

Figure 13: 6dB Bandwidth at 54Mbit/s – Operating Channel 2412 MHz (Horizontal)

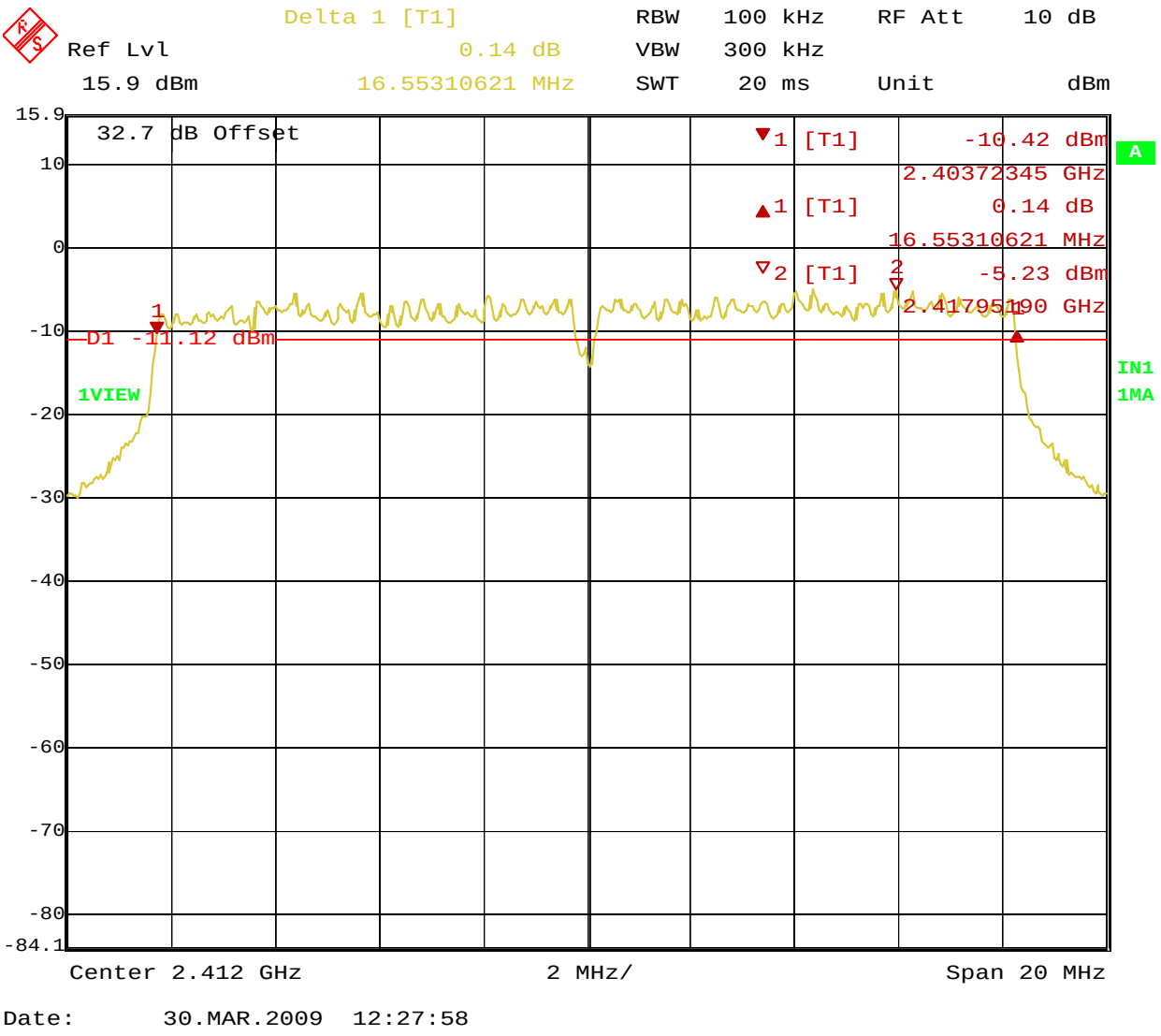

Figure 14: 6dB Bandwidth at 54Mbit/s – Operating Channel 2412 MHz (Vertical)

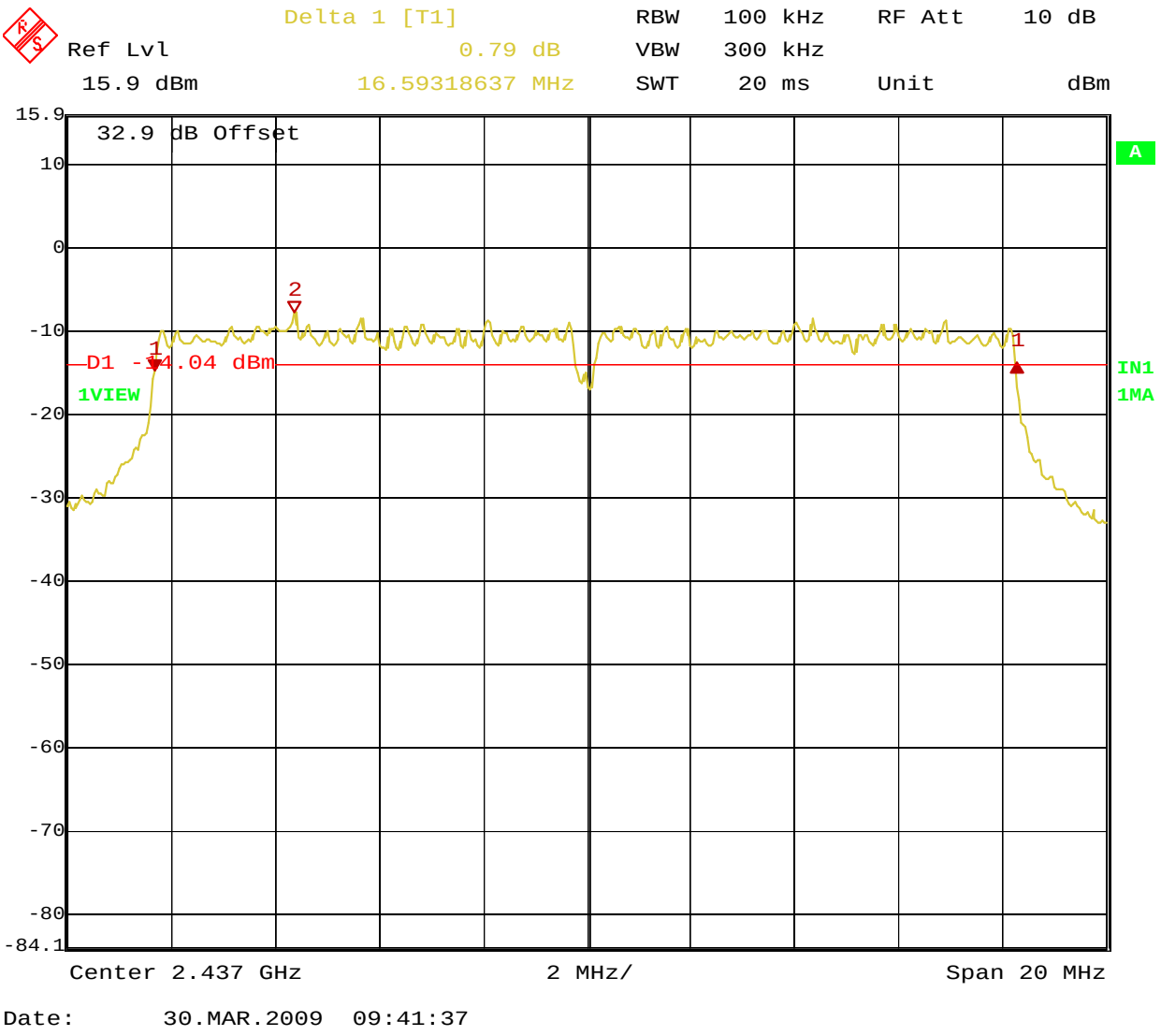

Figure 15: 6dB Bandwidth at 54Mbit/s – Operating Channel 2437 MHz (Horizontal)

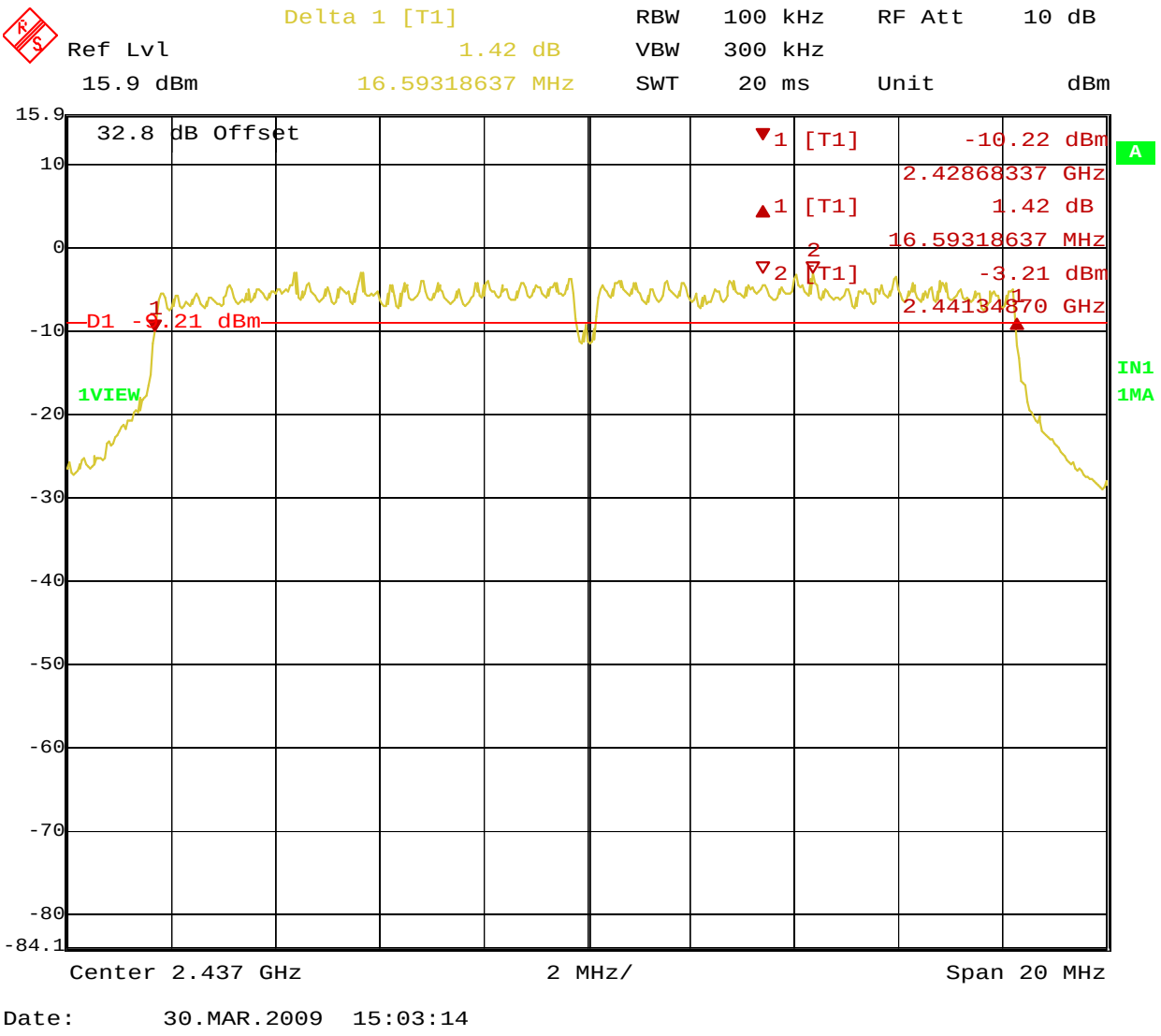

Figure 16: 6dB Bandwidth at 54Mbit/s – Operating Channel 2437 MHz (Vertical)

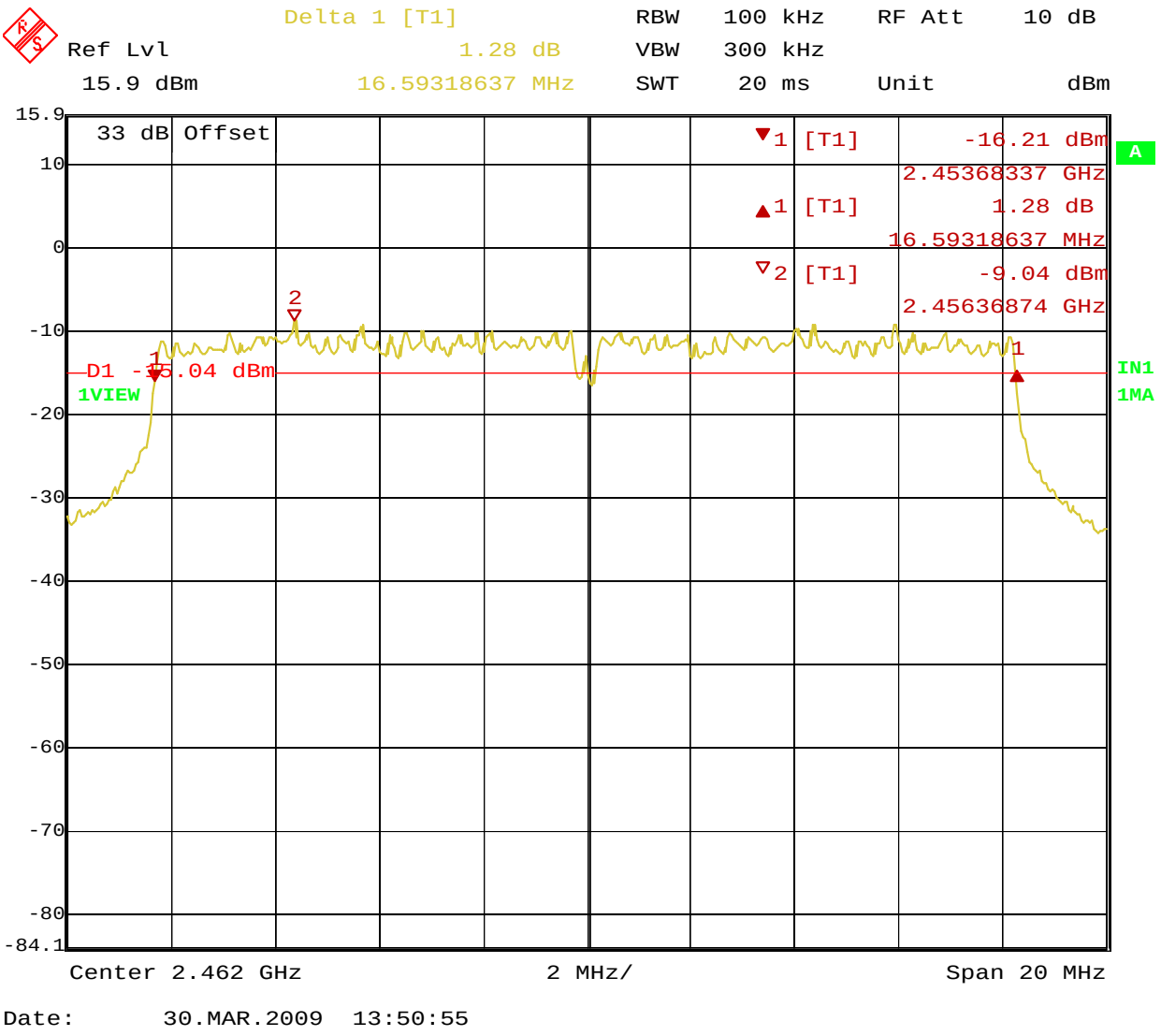

Figure 17: 6dB Bandwidth at 54Mbit/s – Operating Channel 2462 MHz (Horizontal)

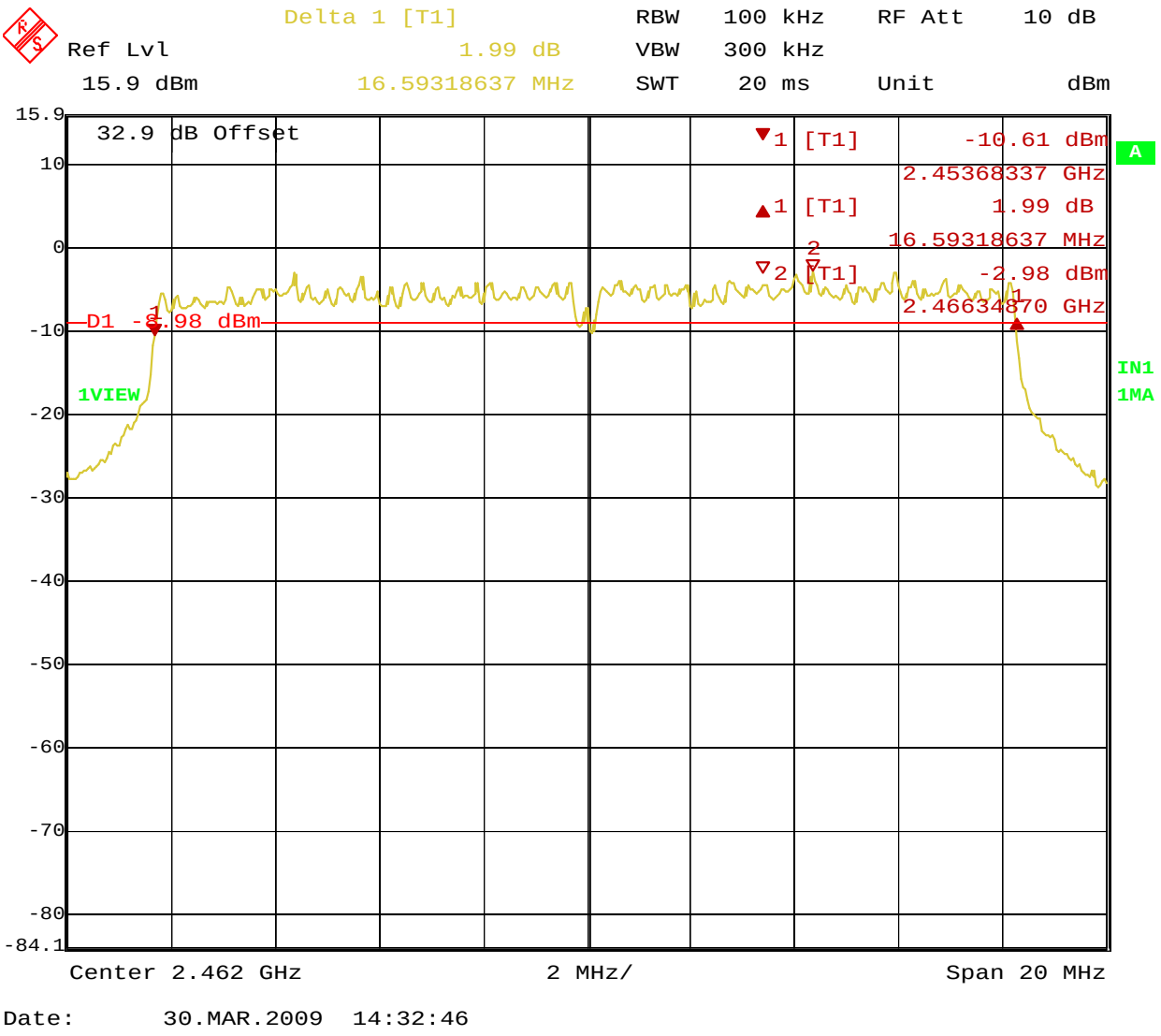

Figure 18: 6dB Bandwidth at 54Mbit/s – Operating Channel 2462 MHz (Vertical)

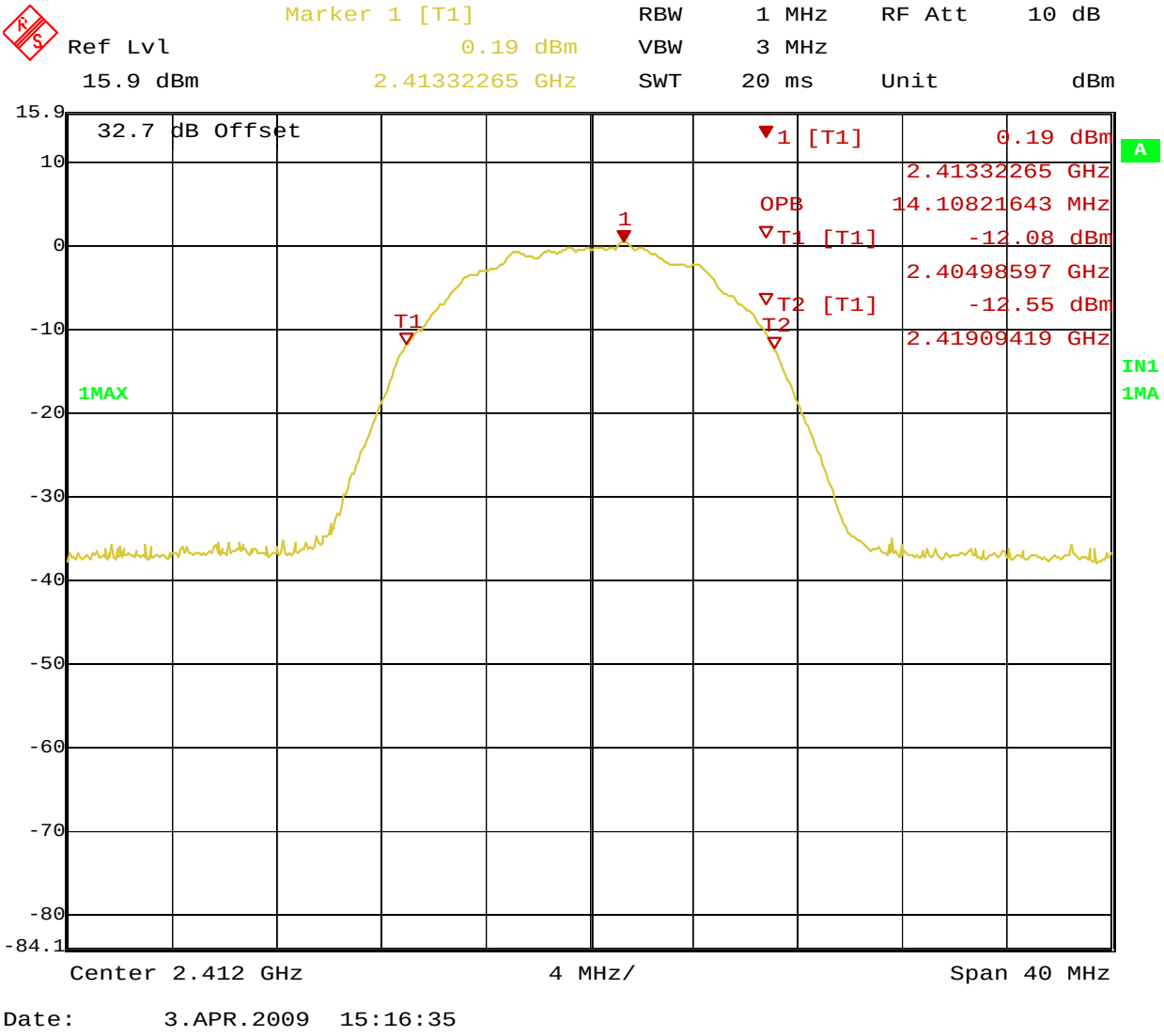

Figure 19: 99% Bandwidth at 11Mbit/s – Operating Channel 2412 MHz (Horizontal)

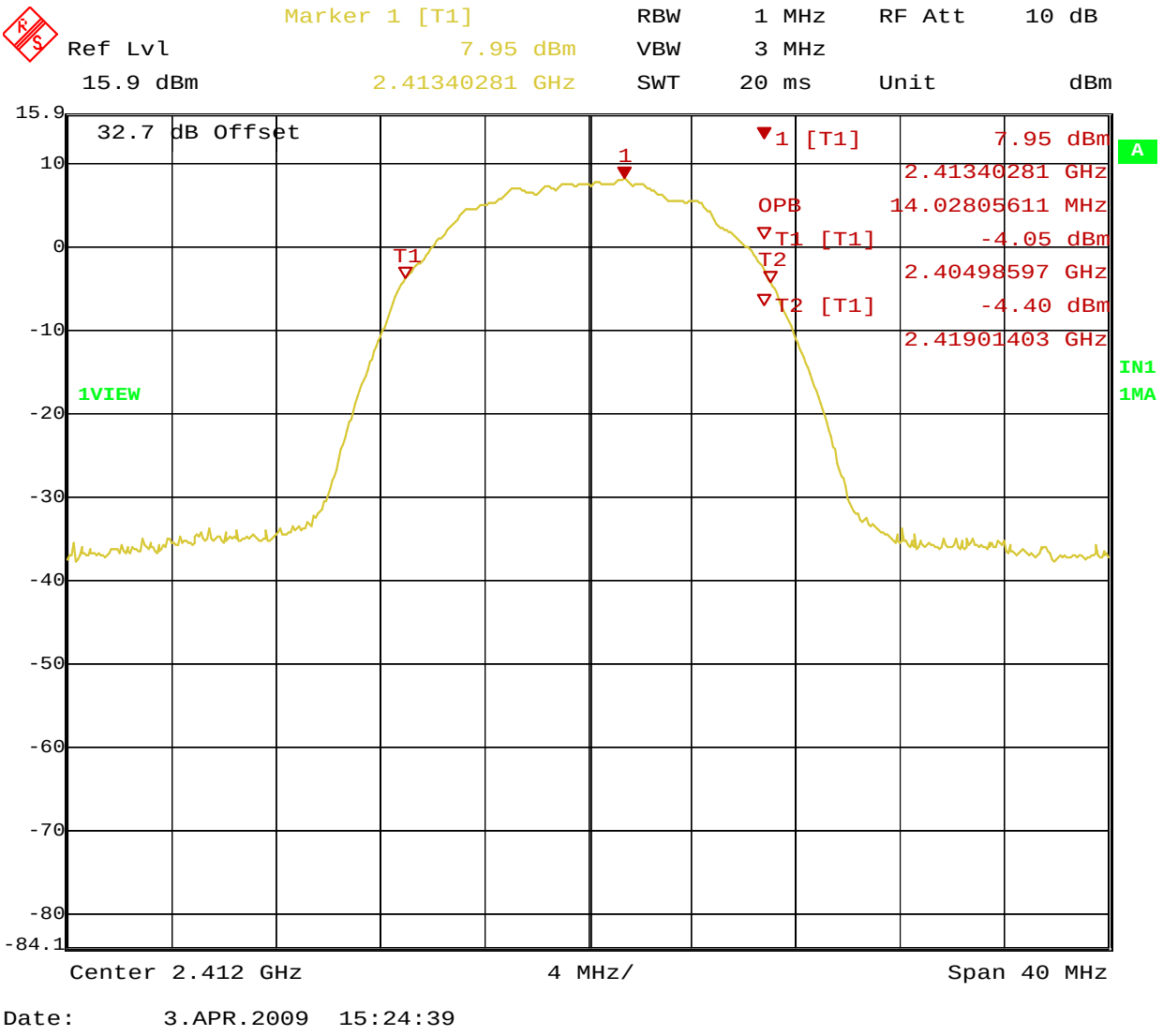

Figure 20: 99% Bandwidth at 11Mbit/s – Operating Channel 2412 MHz (Vertical)

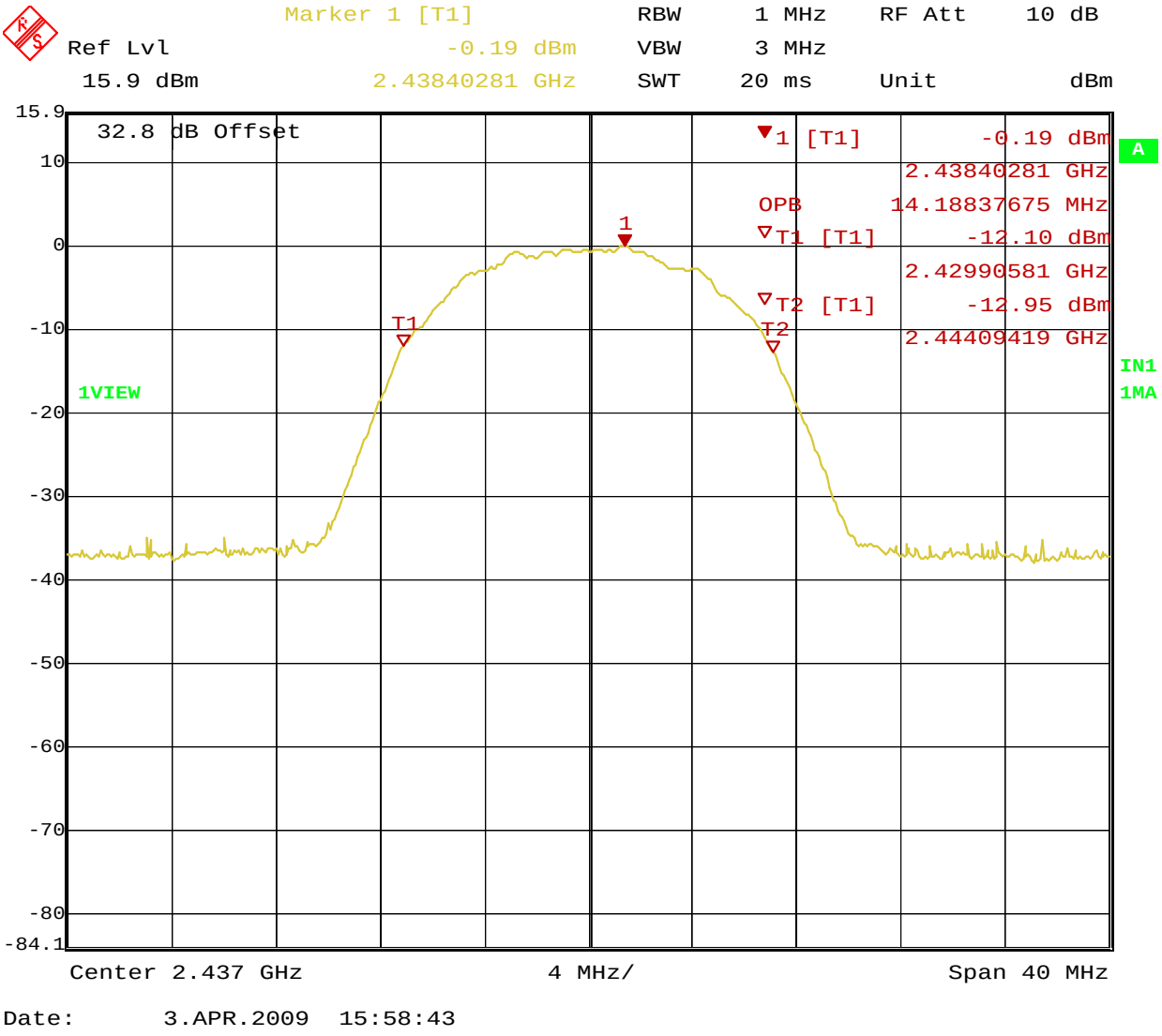

Figure 21: 99% Bandwidth at 11Mbit/s – Operating Channel 2437 MHz (Horizontal)

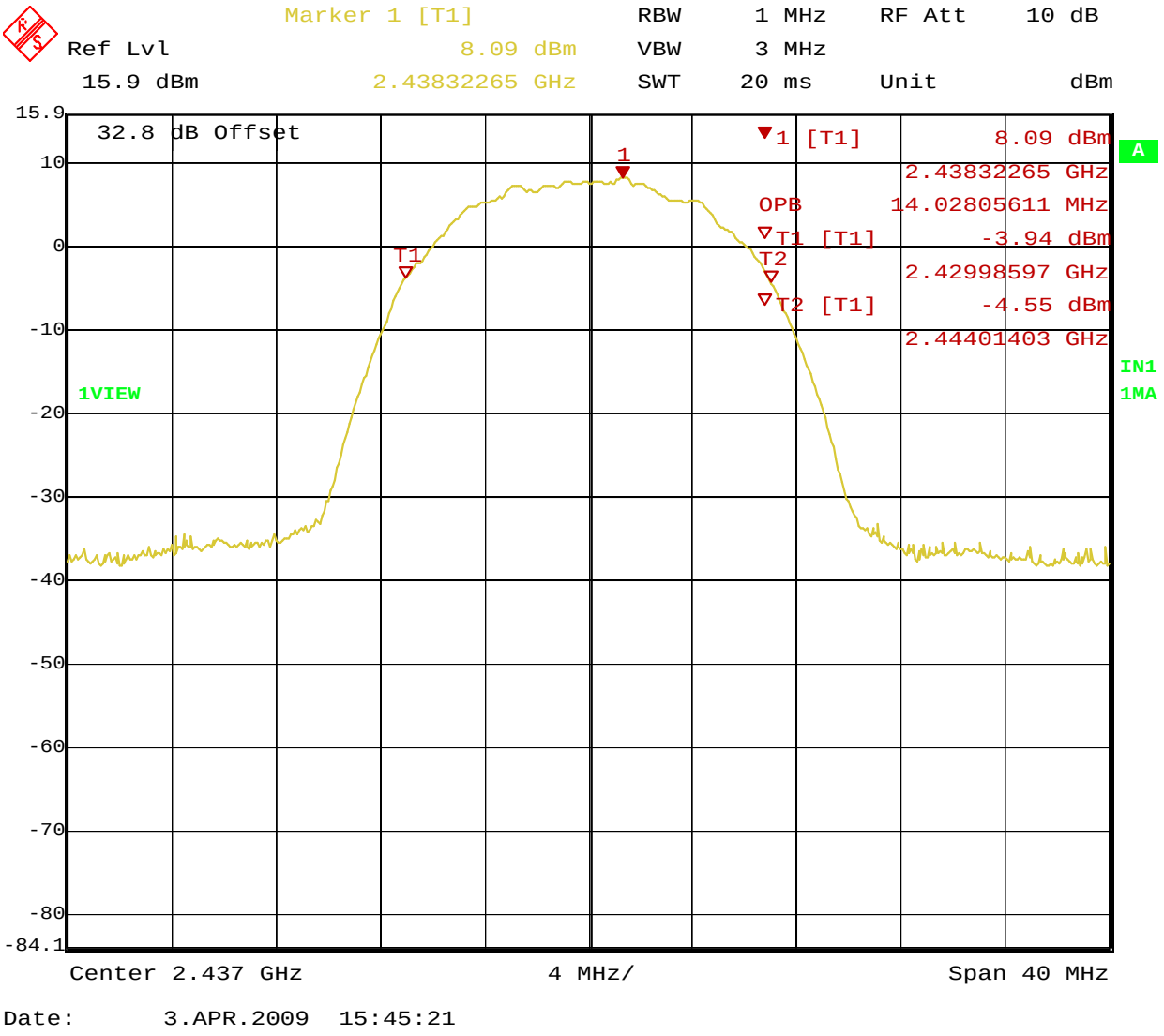

Figure 22: 99% Bandwidth at 11Mbit/s – Operating Channel 2437 MHz (Vertical)

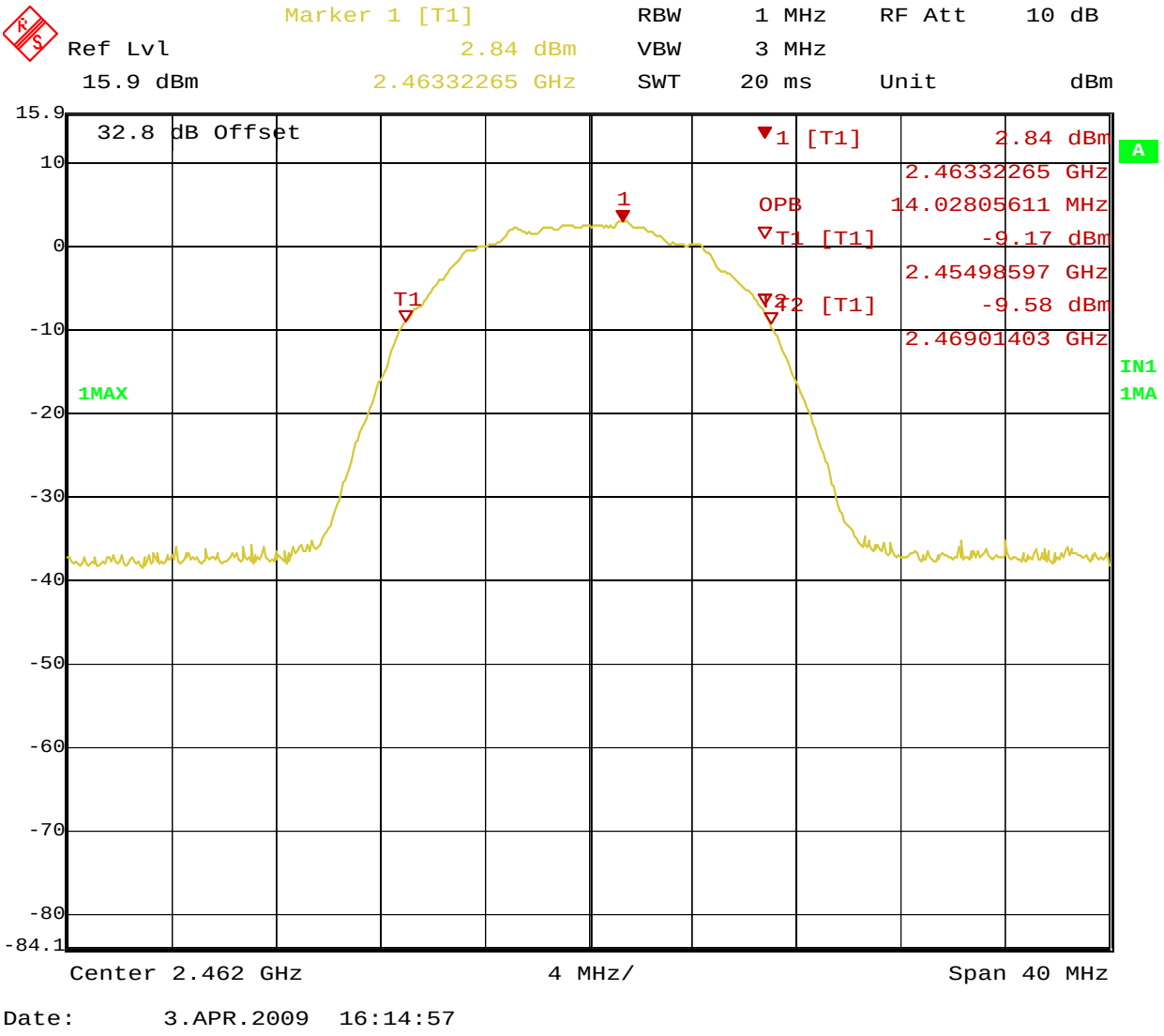

Figure 23: 99% Bandwidth at 11Mbit/s – Operating Channel 2462 MHz (Horizontal)

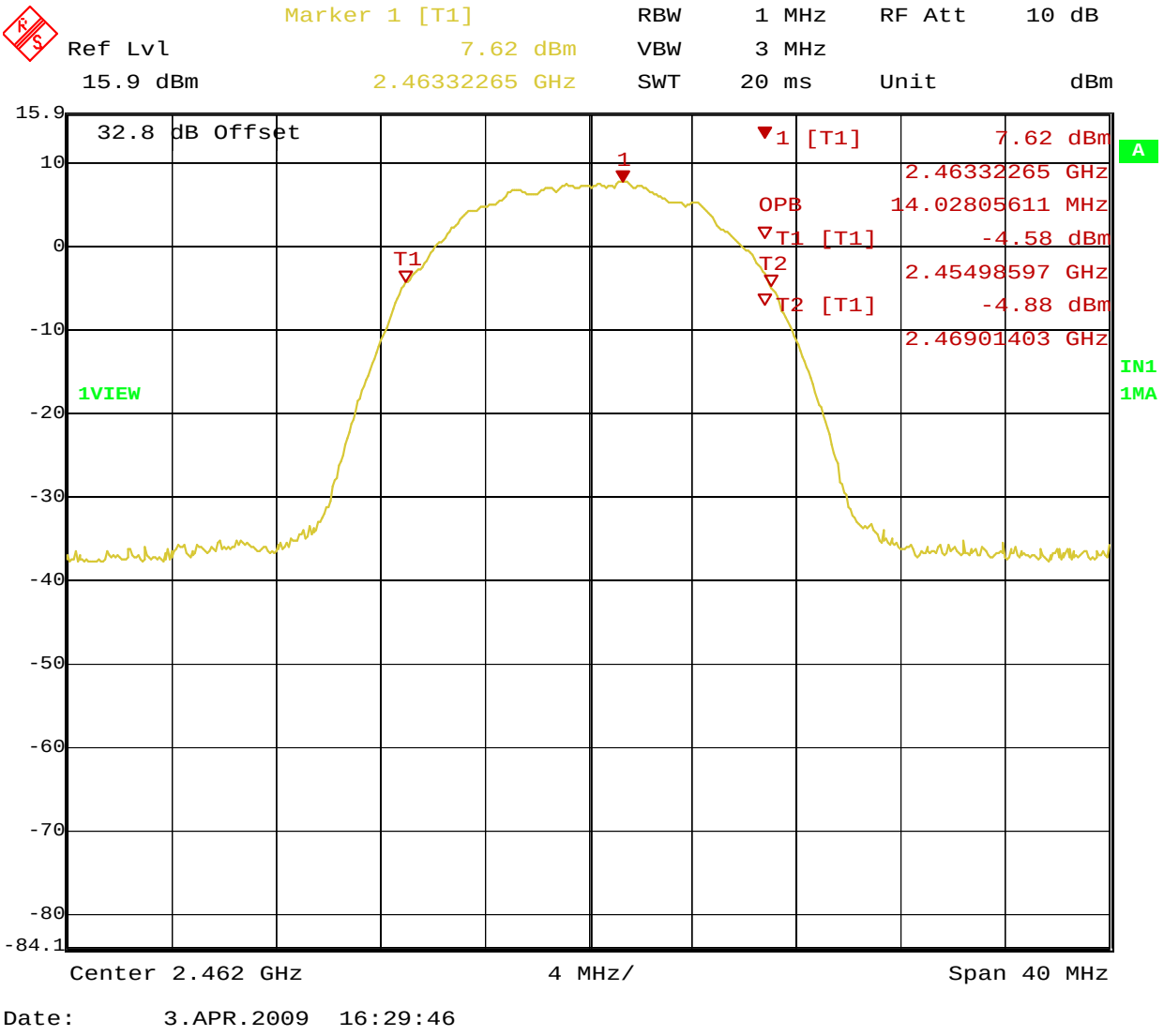

Figure 24: 99% Bandwidth at 11Mbit/s – Operating Channel 2462 MHz (Vertical)

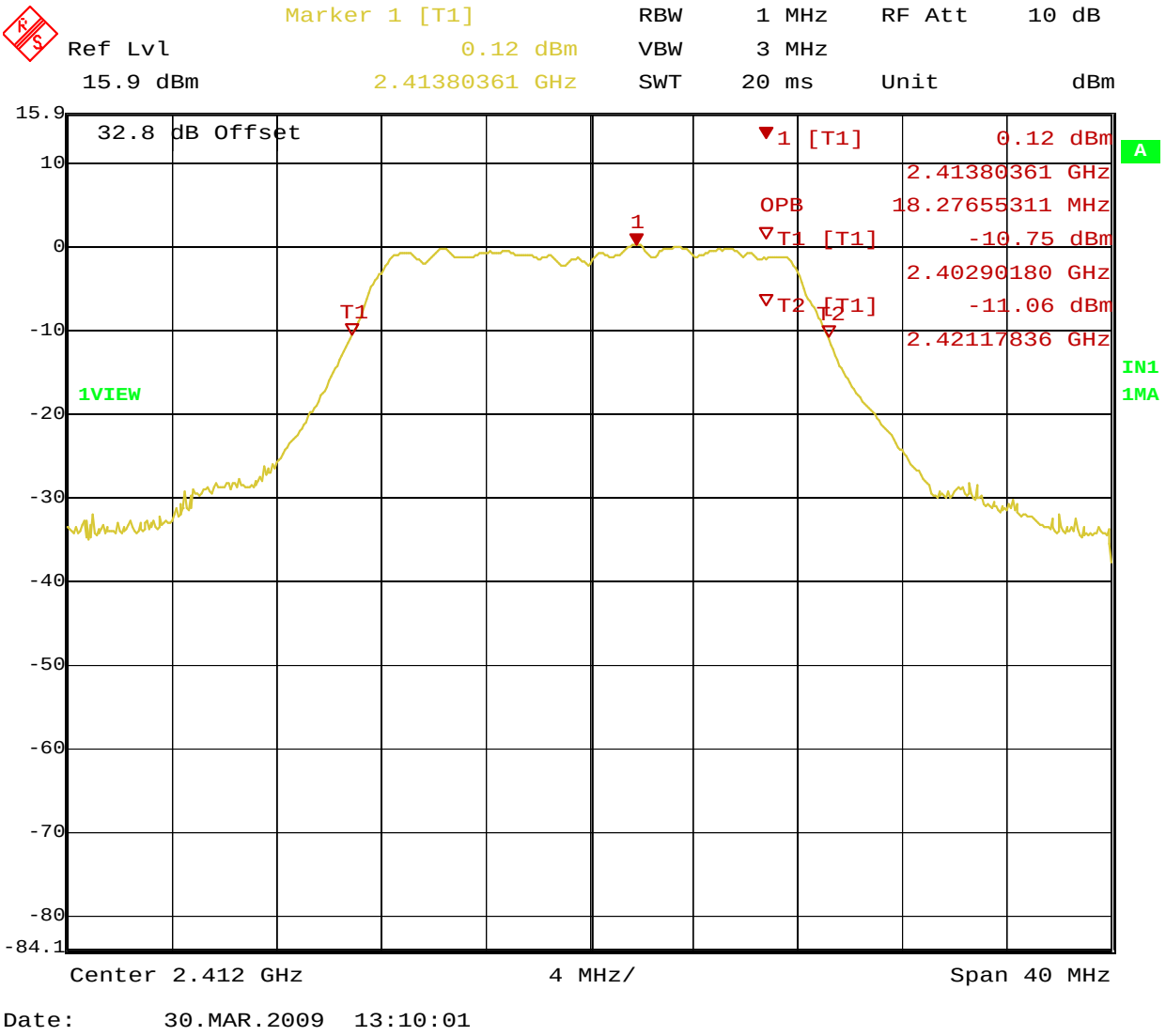

Figure 25: 99% Bandwidth at 54Mbit/s – Operating Channel 2412 MHz (Horizontal)

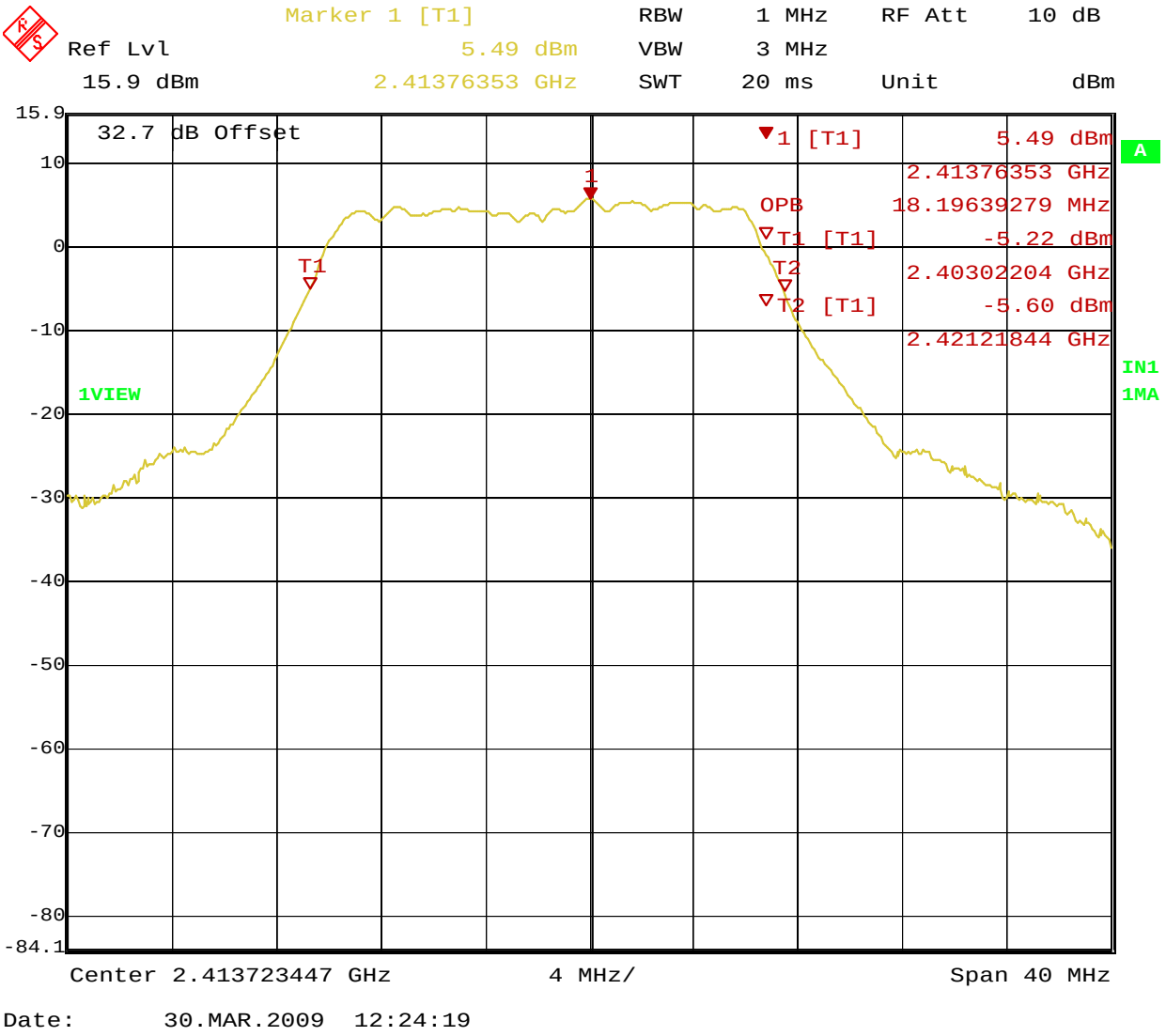

Figure 26: 99% Bandwidth at 54Mbit/s – Operating Channel 2412 MHz (Vertical)

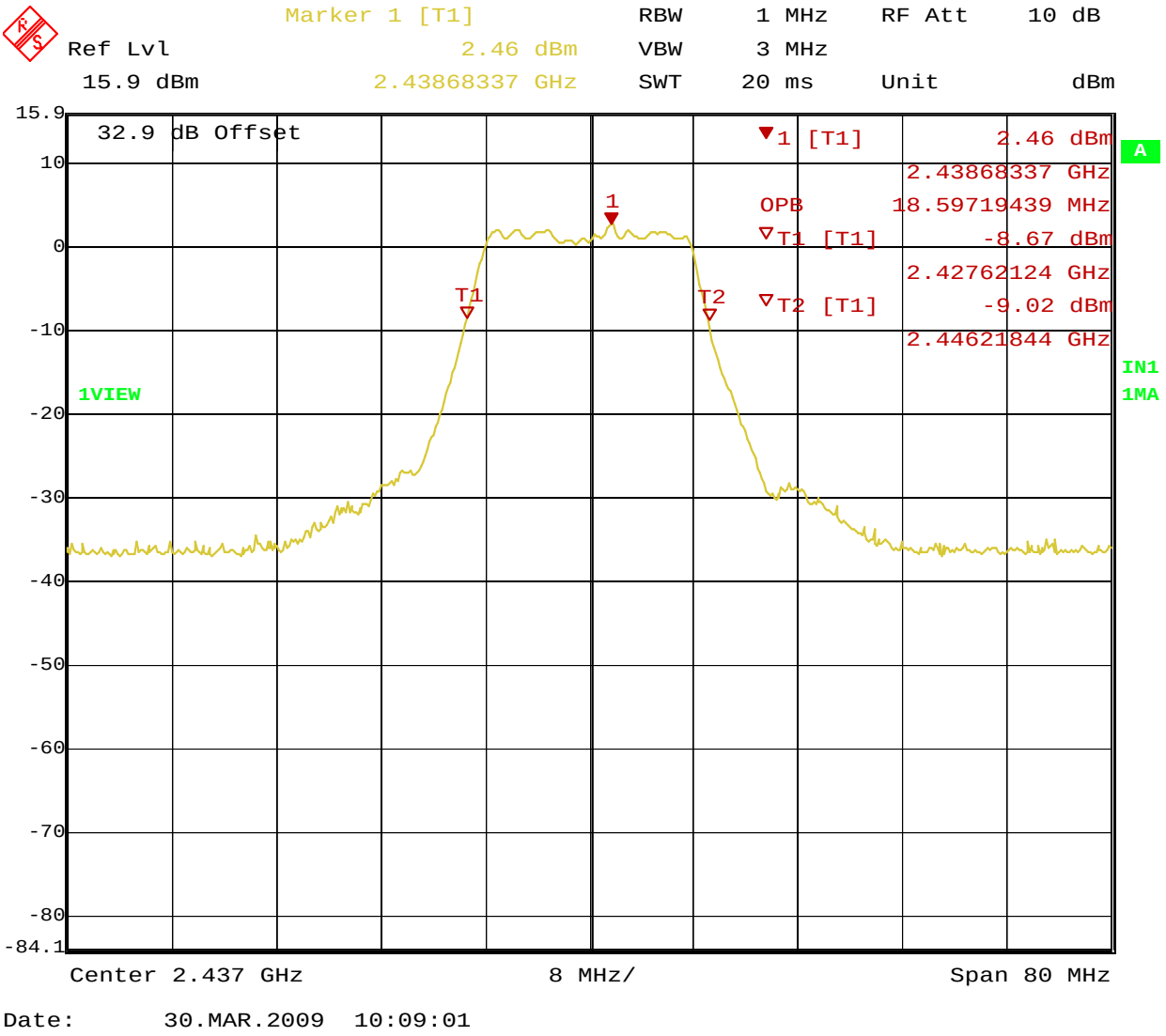

Figure 27: 99% Bandwidth at 54Mbit/s – Operating Channel 2437 MHz (Horizontal)

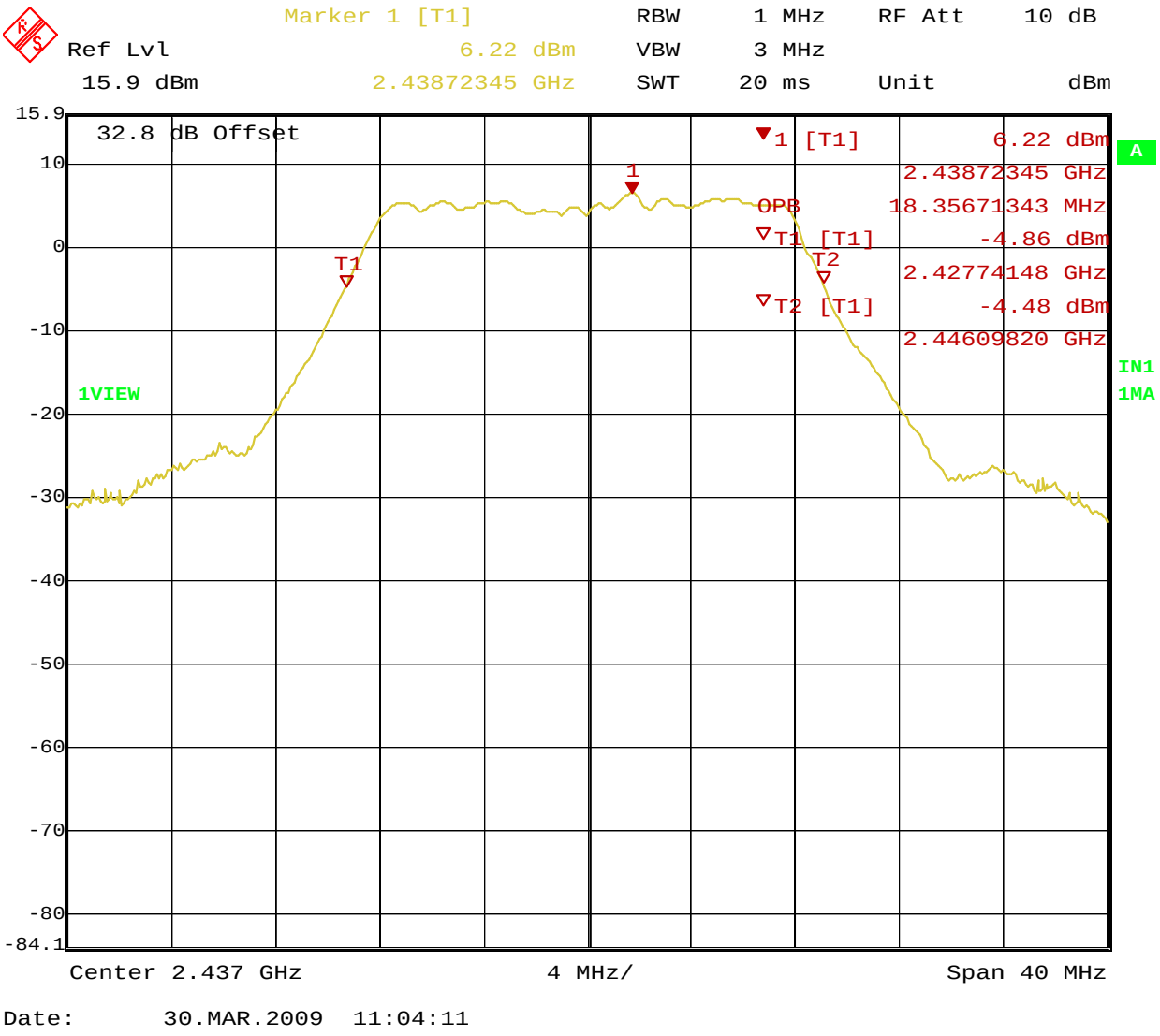

Figure 28: 99% Bandwidth at 54Mbit/s – Operating Channel 2437 MHz (Vertical)

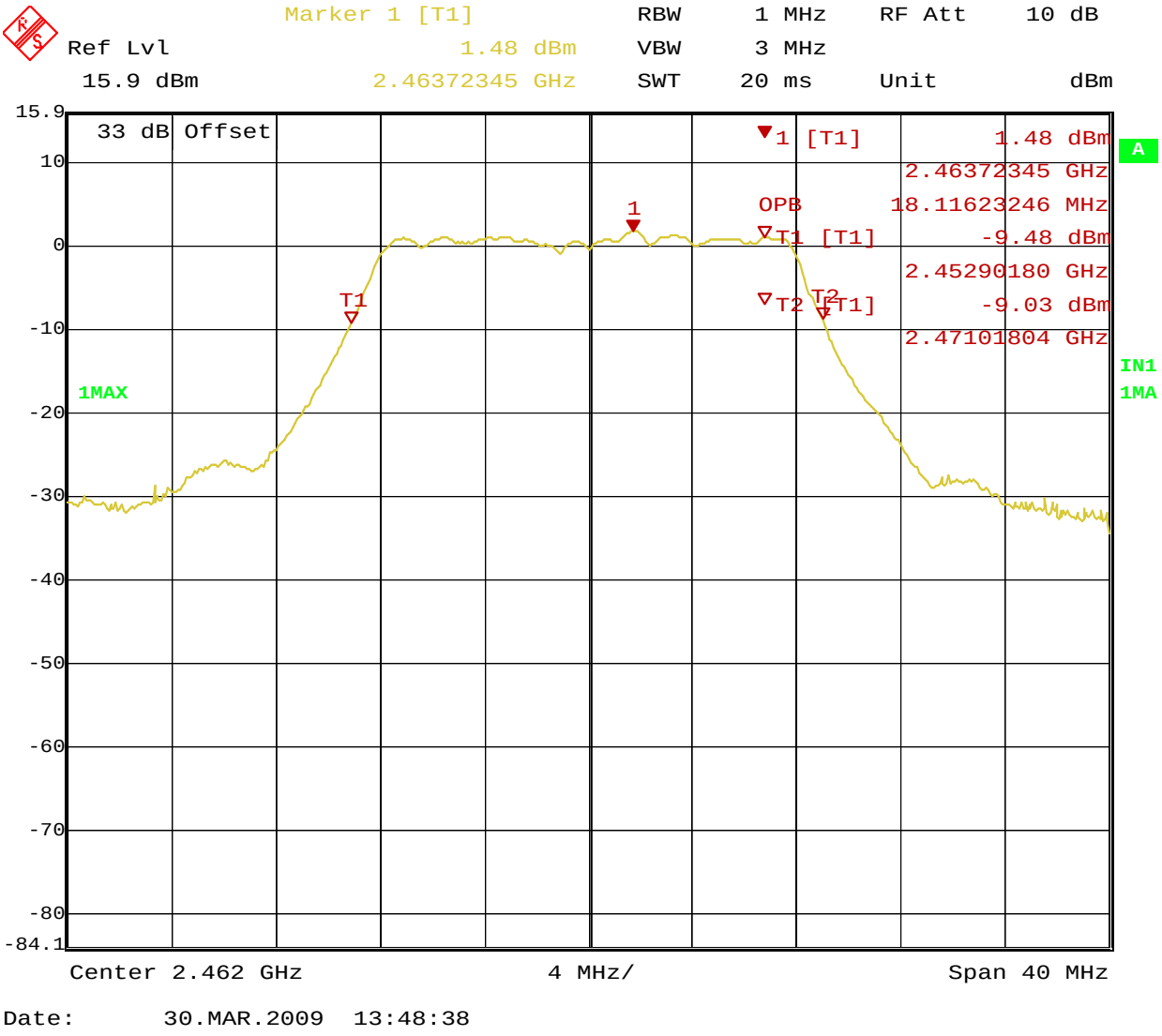

Figure 29: 99% Bandwidth at 54Mbit/s – Operating Channel 2462 MHz (Horizontal)

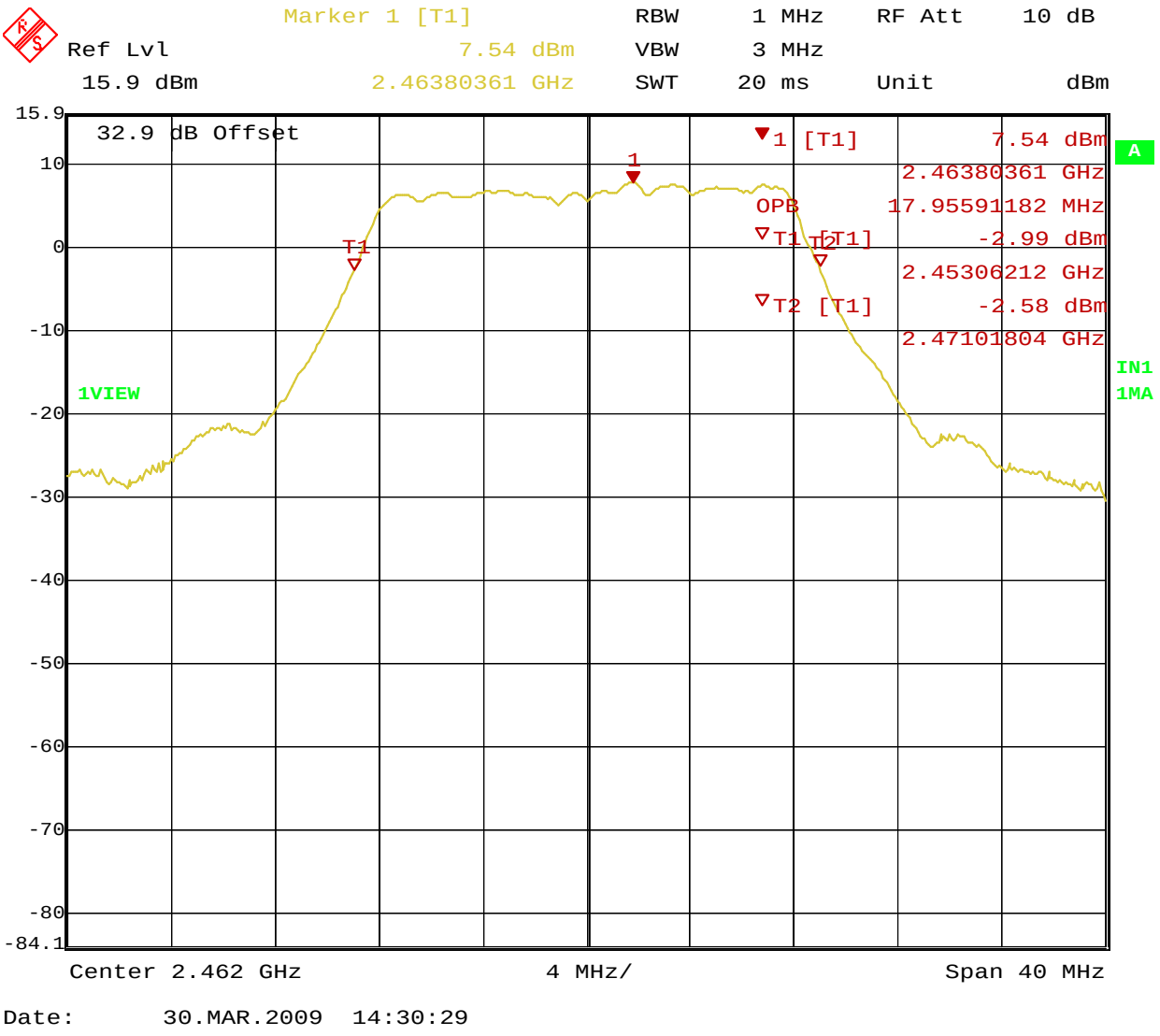

Figure 30: 99% Bandwidth at 54Mbit/s – Operating Channel 2462 MHz (Vertical)

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 2400MHz to 2483.5MHz, the power output level must be below 20db 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 5: Band-Edge/ Outband Emission – Test Results

Test Conditions: Radiated Measurement, Normal Temperature and Voltage only				
Antenna Type: Integrated			**Output Power Rated:** +15 dBm	
Signal State: Modulated			**Data Rate:** 54Mbit/s	
Ambient Temp.: 23 °C			**Relative Humidity:**38 %	
Band-Edge Results				
Operating Channel	**Polarity**	**20dBr Frequency (MHz)**	**Low Bandedge Level (dBm)**	**High Bandedge Level (dBm)**
2412 MHz	H	2402.54108	-39.93	
2412 MHz	V	2402.86172	-36.79	
2462 MHz	H	2471.13828		-43.51
2462 MHz	V	2471.13828		-44.21

Note: (*) 54Mbit/s data rate has the widest band width; closest to the operating frequency band 2400MHz to 2483.5MHz.

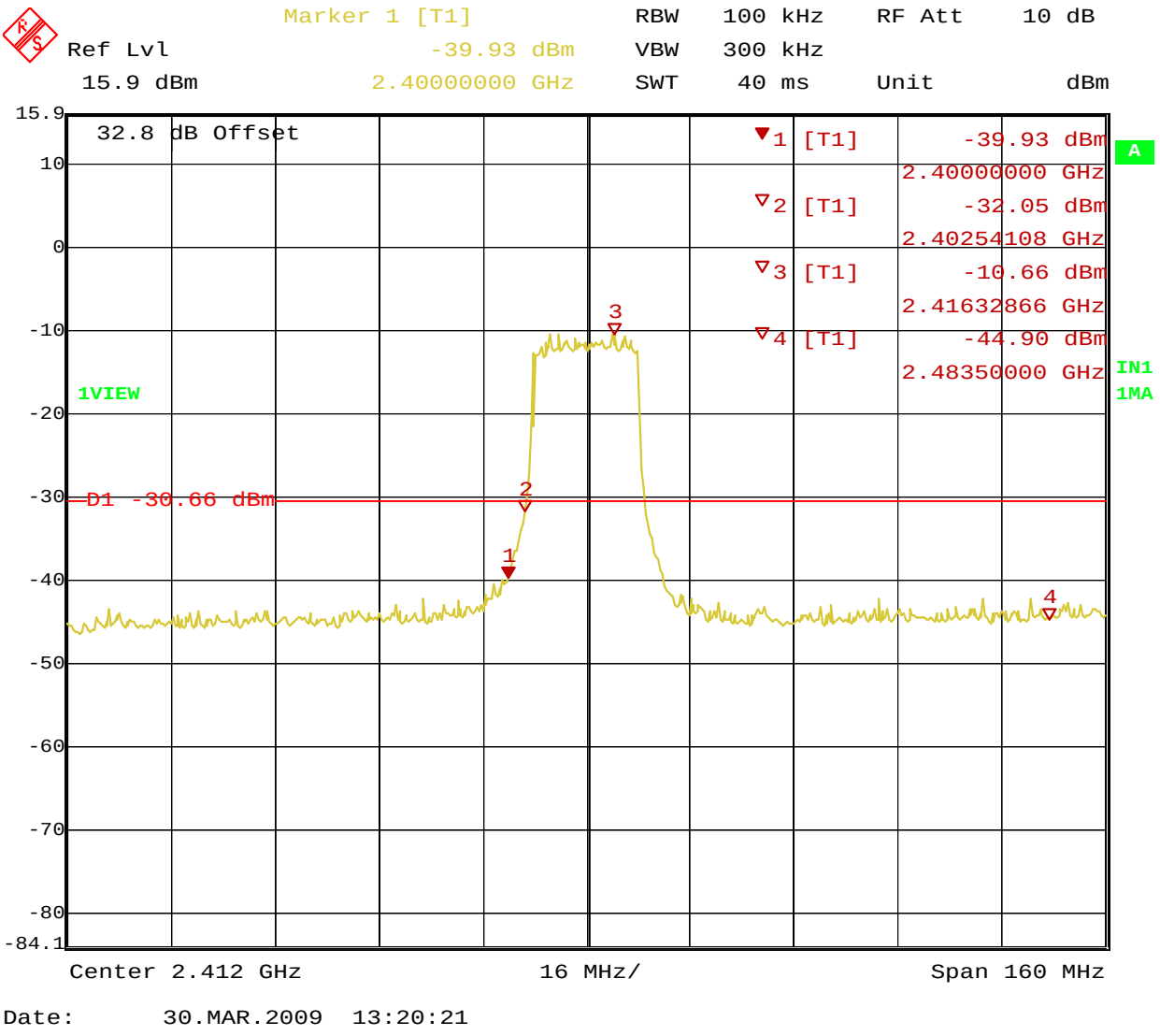

Figure 31: Band-edge Requirement for Operating Channel 2412 MHz (Horizontal)

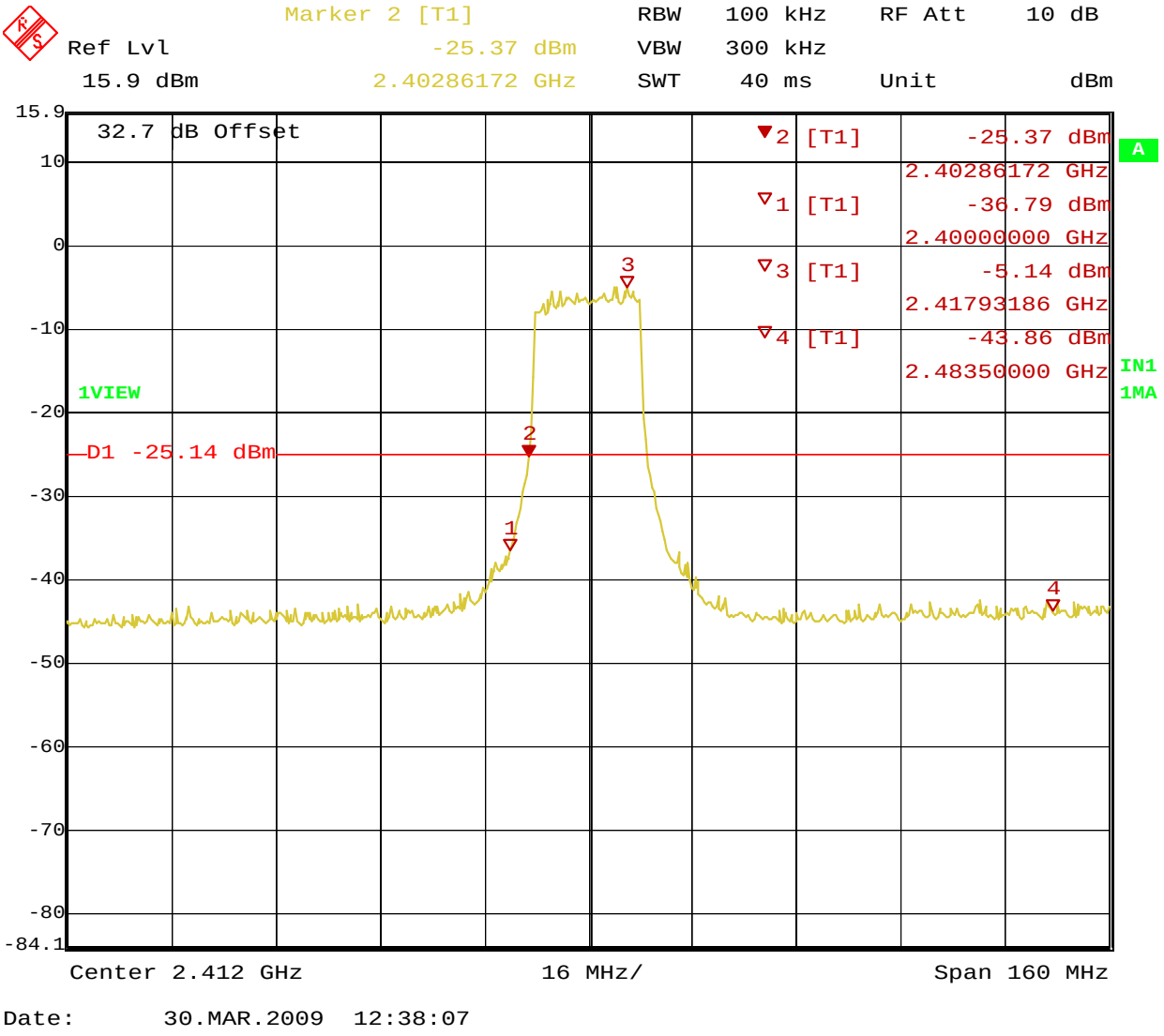

Figure 32: Band-edge Requirement for Operating Channel 2412MHz (Vertical)

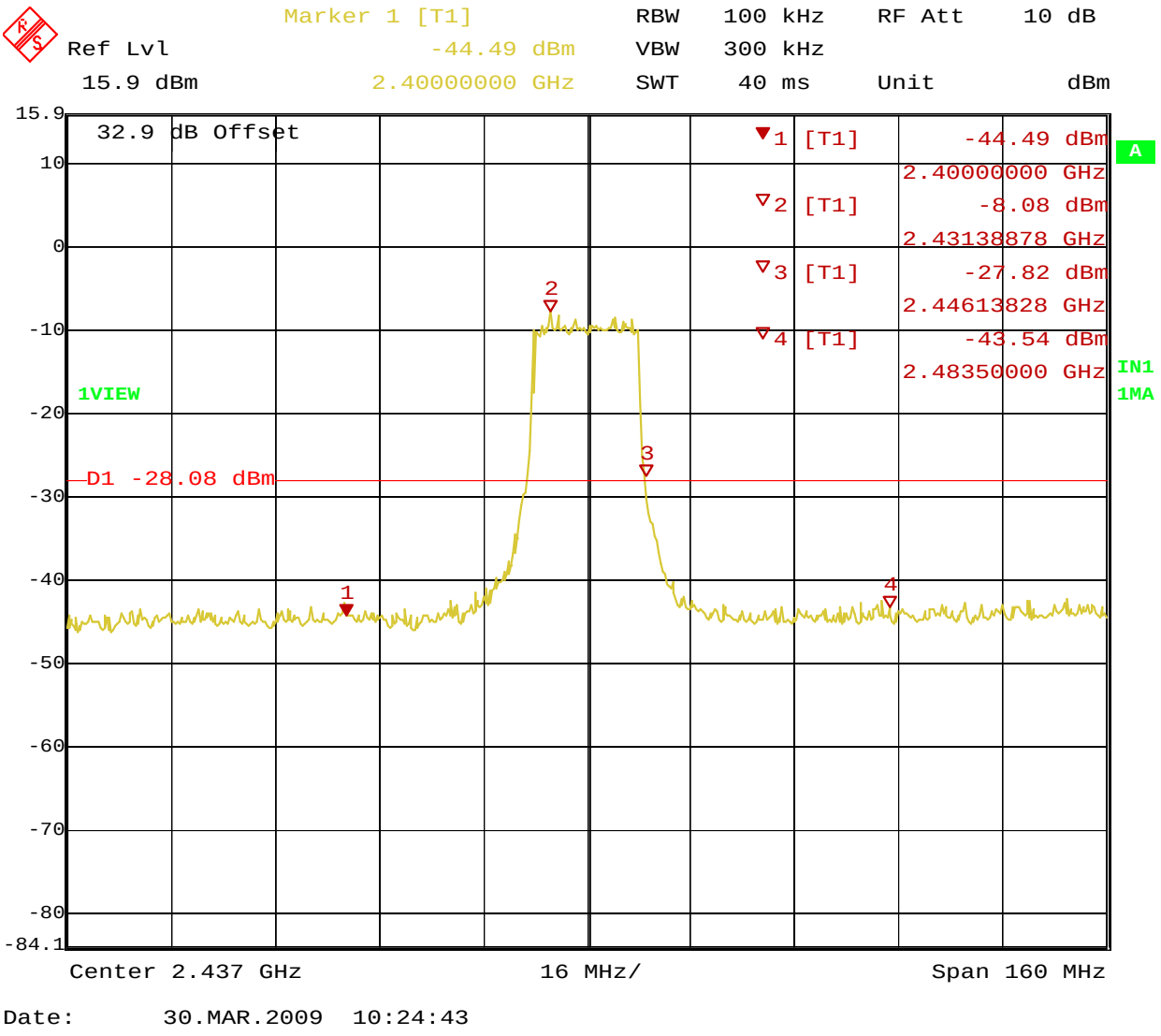

Figure 33: Band-edge Requirement for Operating Channel 2437MHz (Horizontal)

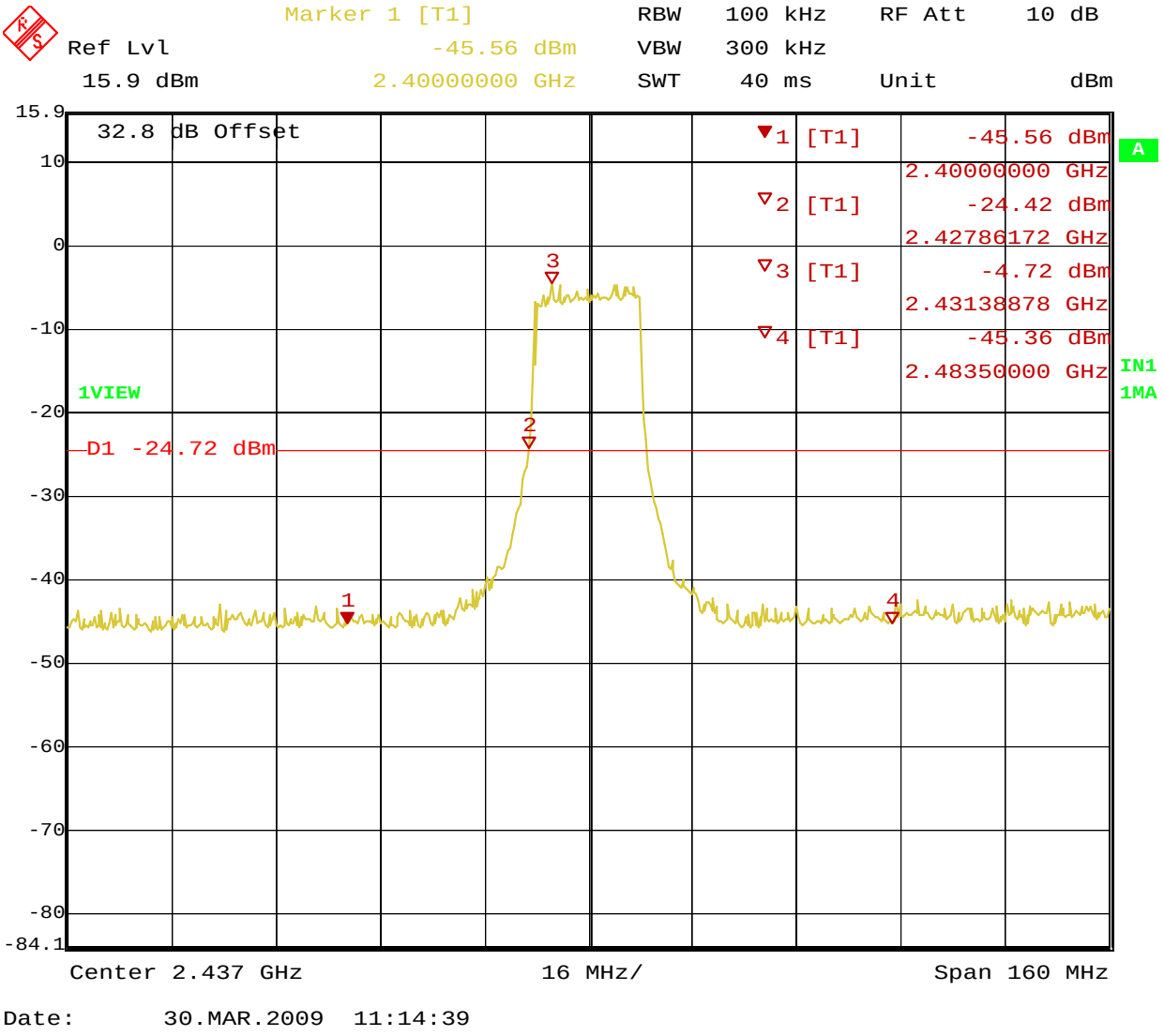

Figure 34: Band-edge Requirement for Operating Channel 2437MHz (Vertical)

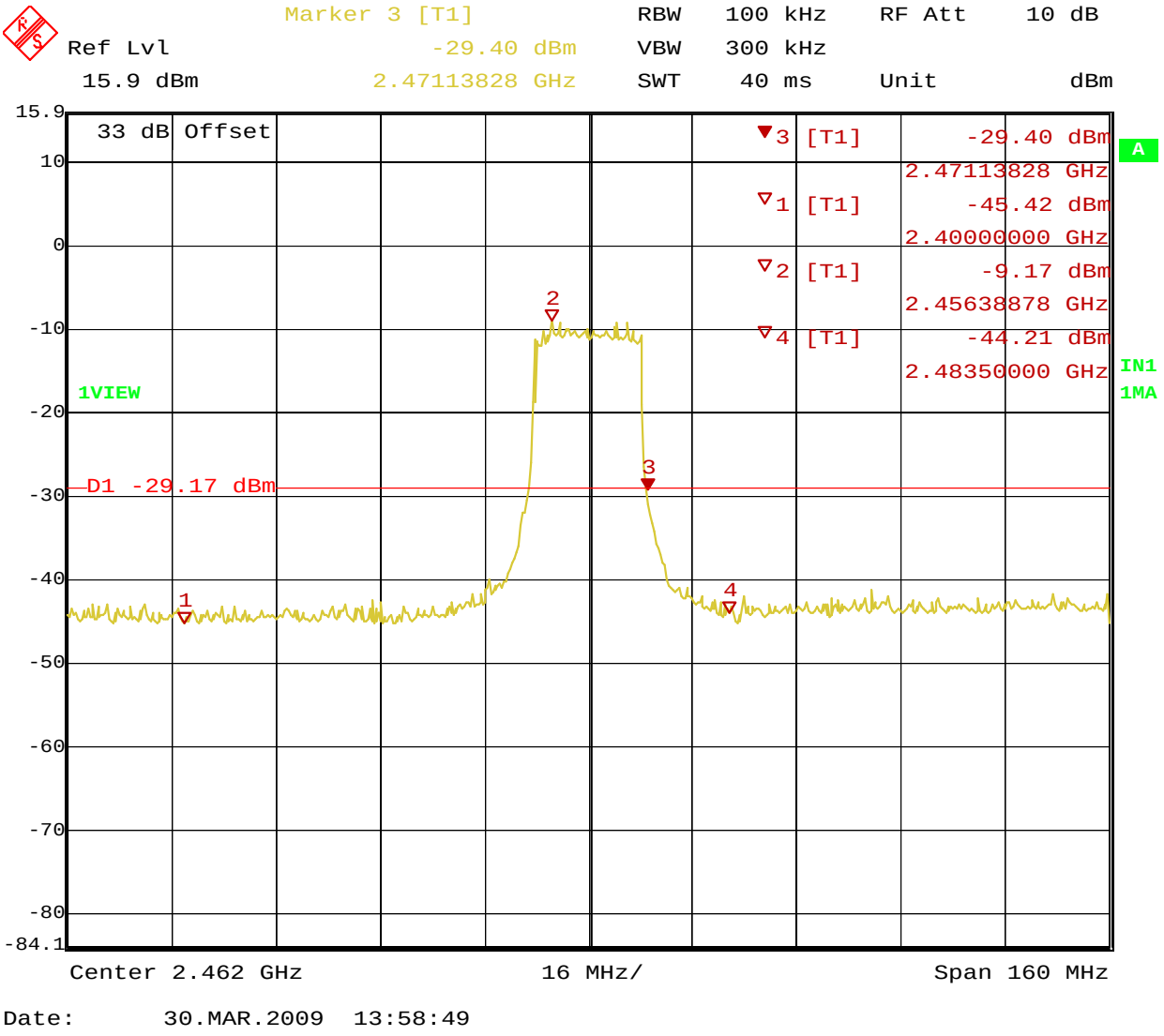

Figure 35: Band-edge Requirement for Operating Channel 2462MHz (Horizontal)

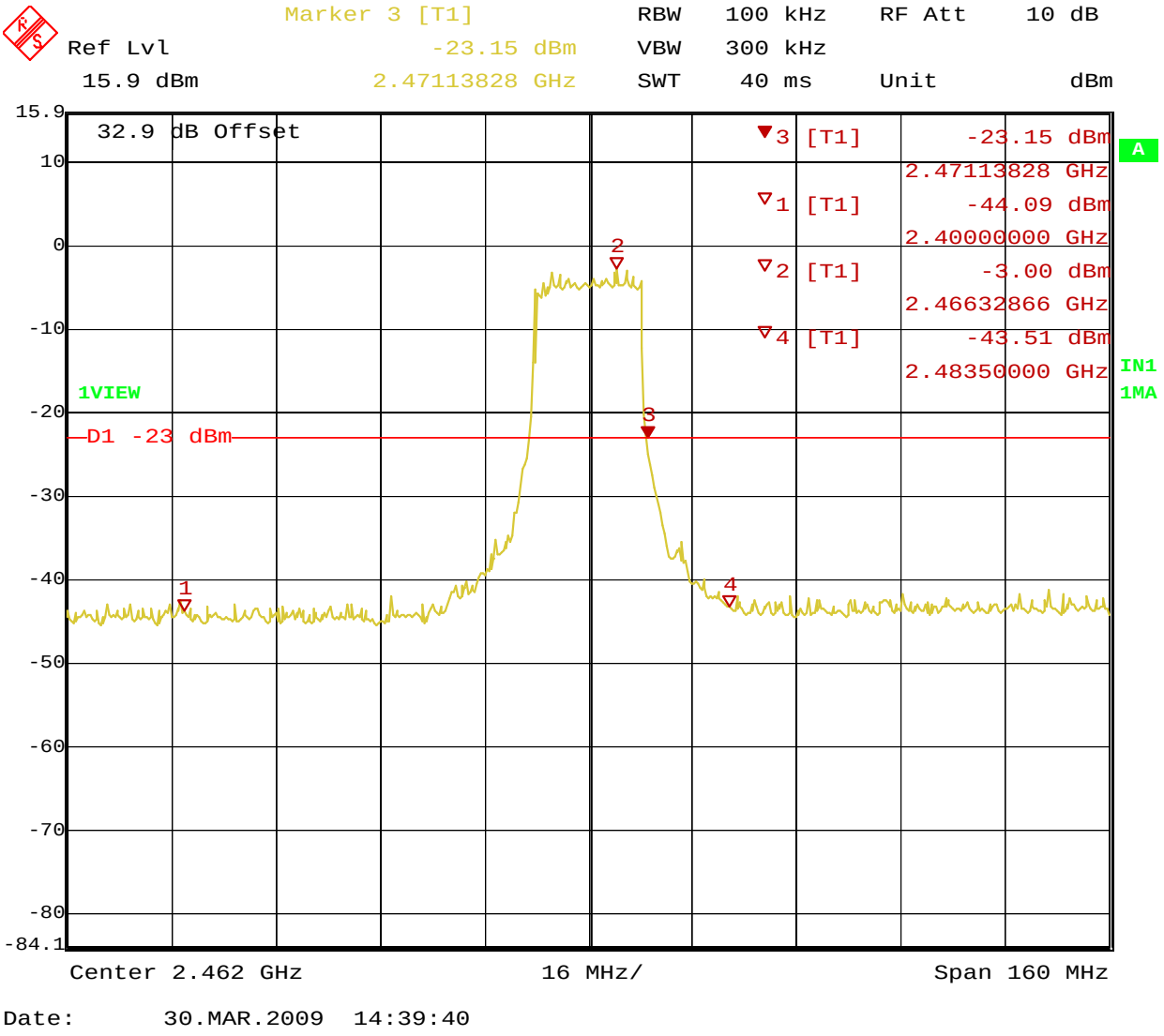

Figure 36: Band-edge Requirement for Operating Channel 2462MHz (Vertical)

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 8dBm in any 3kHz band during any time interval of continuous transmission.

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: Radiated Measurement, Normal Temperature and Voltage only					
Antenna Type: Integrated			**Output Power Rated:** +15 dBm		
Signal State: Modulated			**Data Rate:** 54Mbit/s		
Ambient Temp.: 23 °C			**Relative Humidity:**38 %		
Peak Power Spectral Density Test Results					
Operating Channel	**Polarity**	**PPSD @ 3m [dBm]**	**PPSD @ EUT [dBm]**	**Limit [dBm]**	**Margin [dB]**
2412MHz	H	-25.04	-13.27	8.0	-21.27
2412MHz	V	-19.64	-7.87	8.0	-15.87
2437MHz	H	-24.32	-12.55	8.0	-20.55
2437MHz	V	-18.29	-6.52	8.0	-14.52
2462MHz	H	-17.97	-6.20	8.0	-14.20
2462MHz	V	-11.95	-0.18	8.0	-8.18

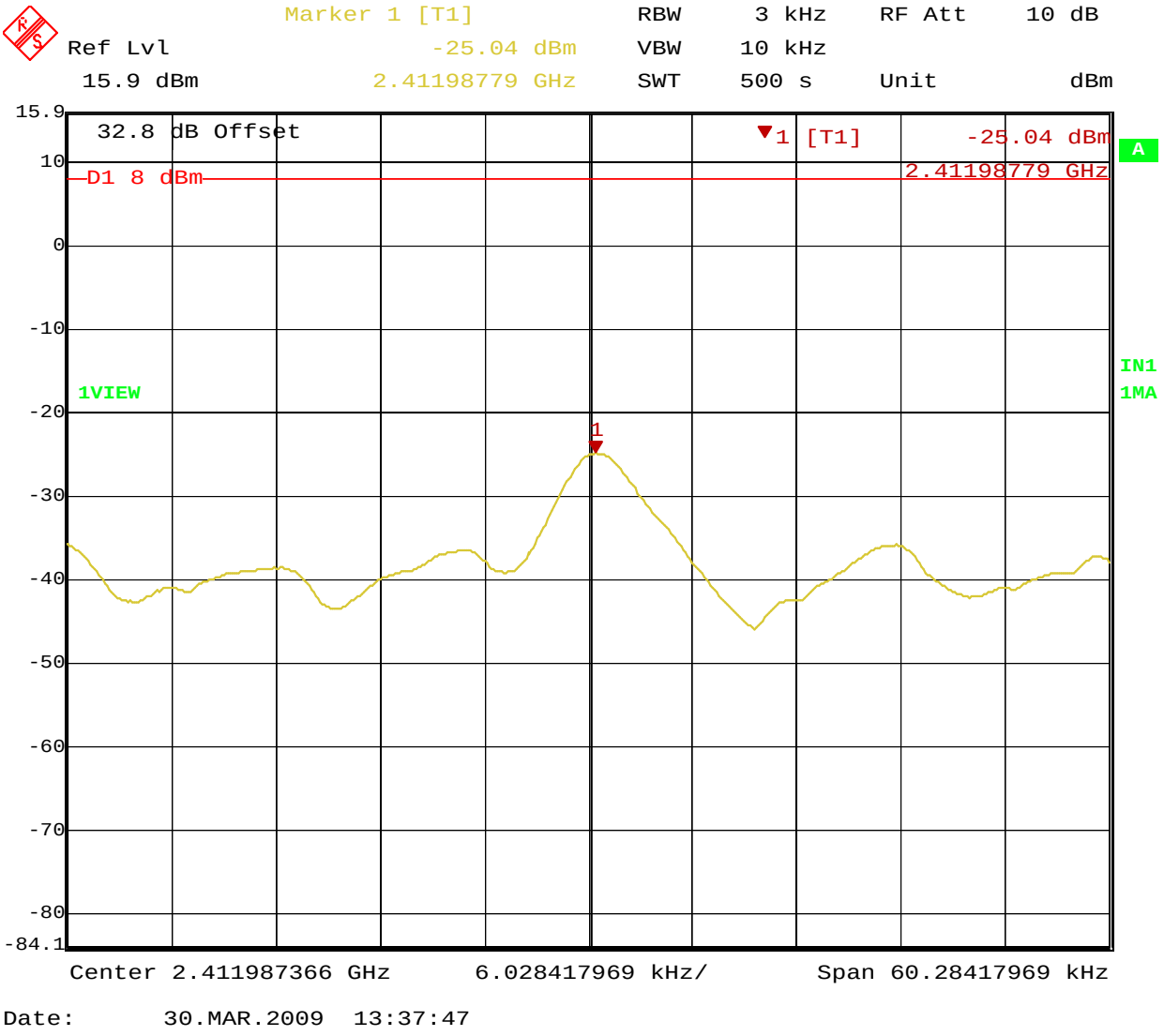

Figure 37: Peak Power Spectral Density for Operating Channel 2412MHz (Horizontal)

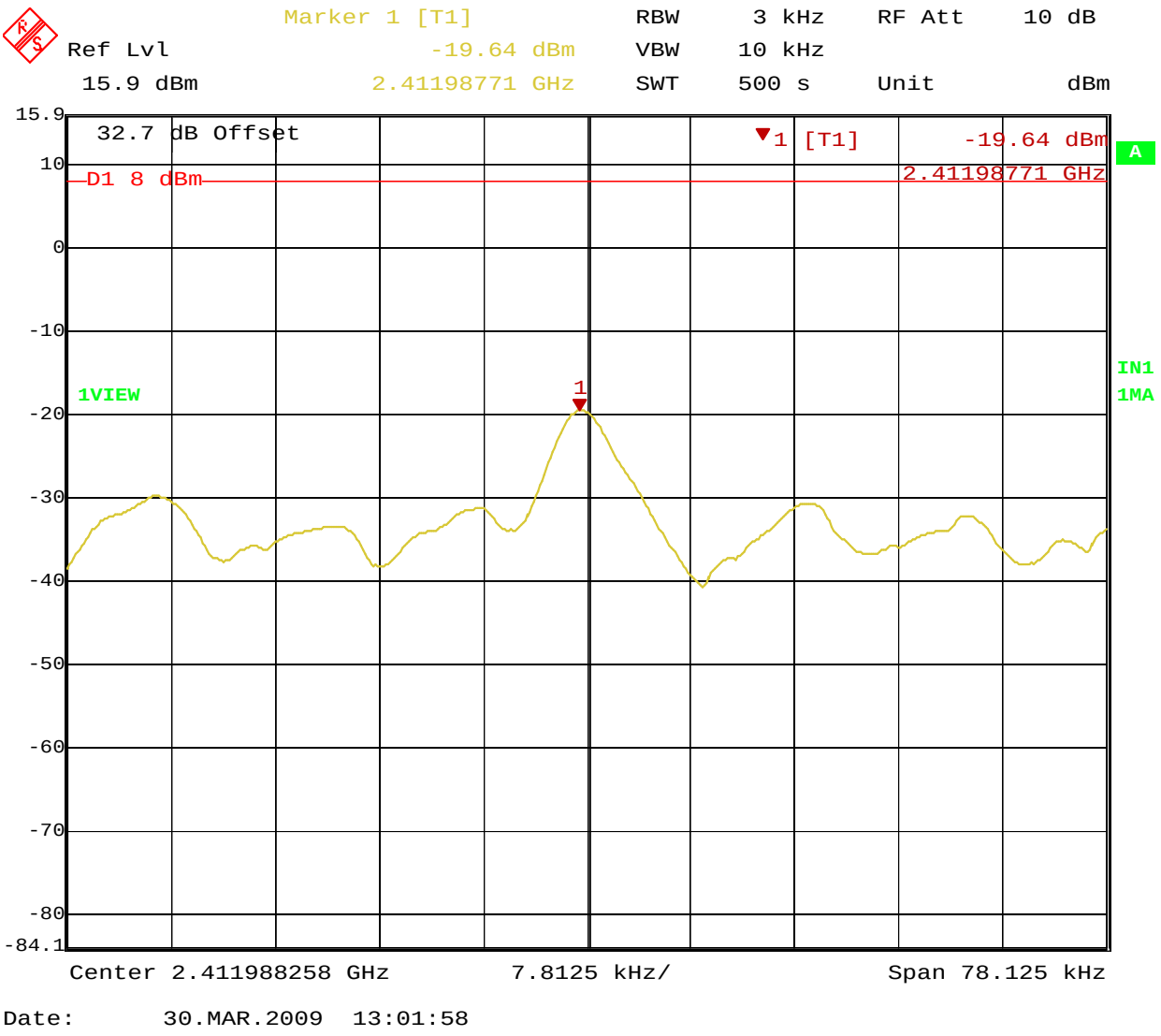

Figure 38: Peak Power Spectral Density for Operating Channel 2412MHz (Vertical)

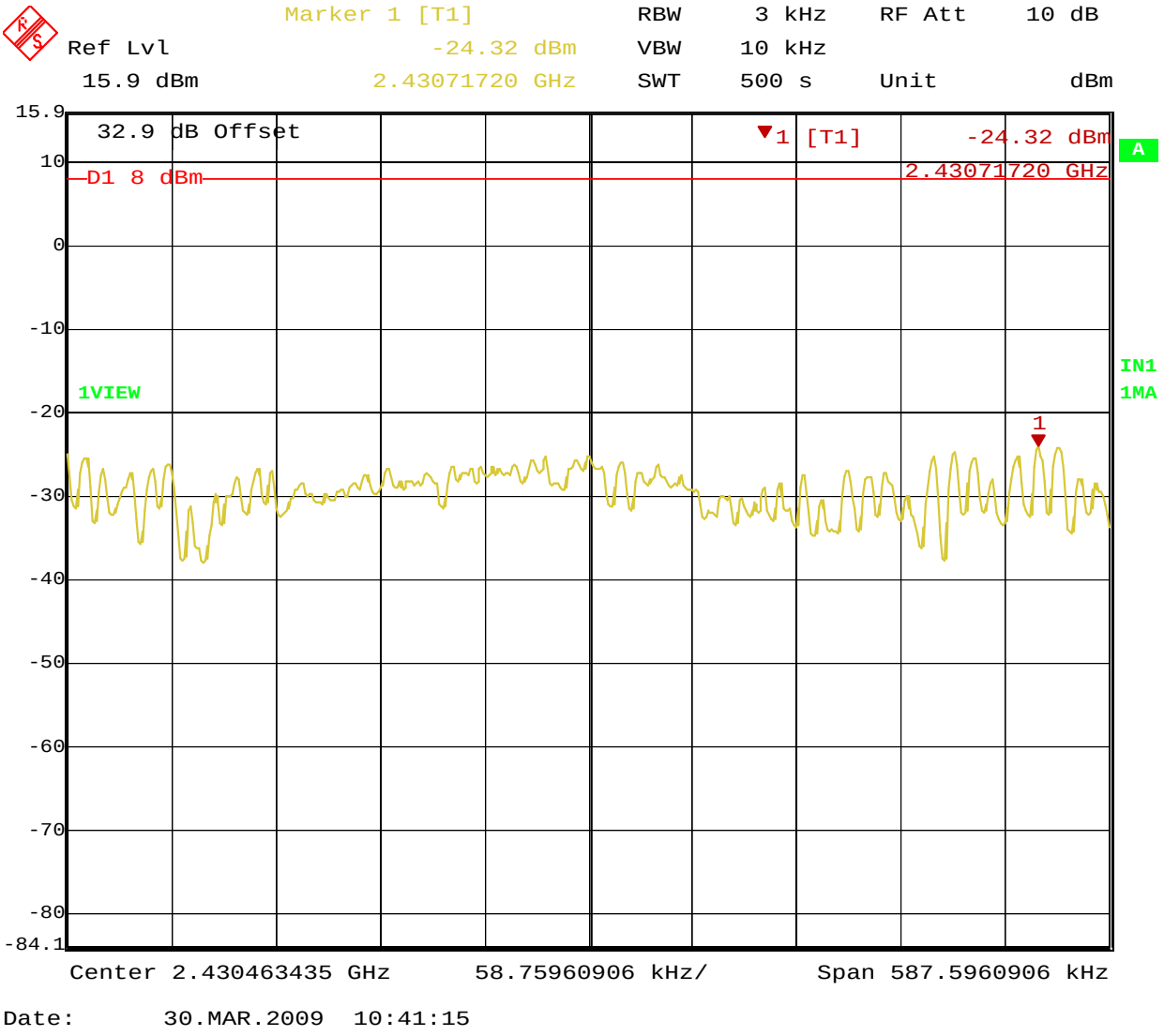

Figure 39: Peak Power Spectral Density for Operating Channel 2437MHz (Horizontal)

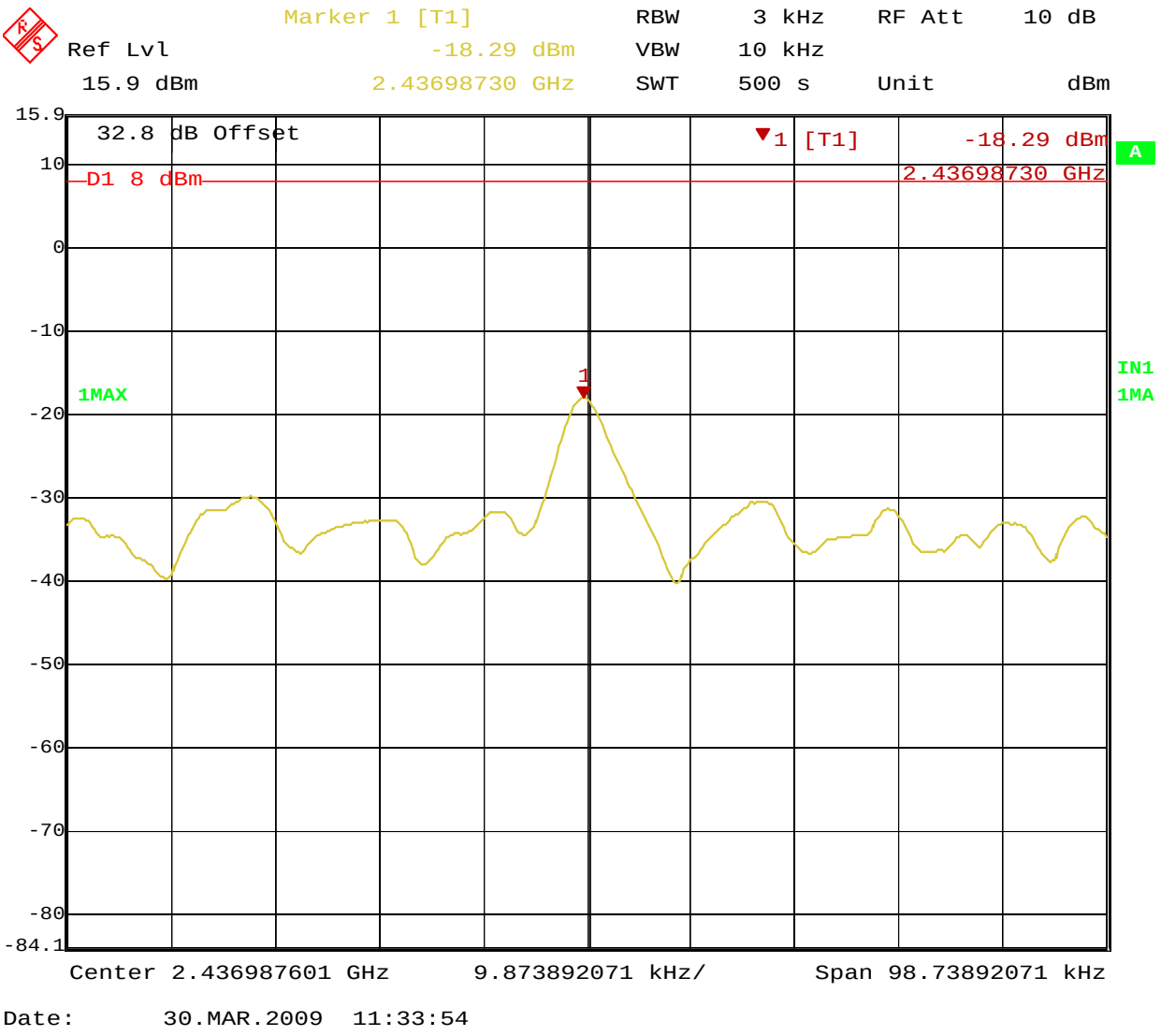

Figure 40: Peak Power Spectral Density for Operating Channel 2437MHz (Vertical)

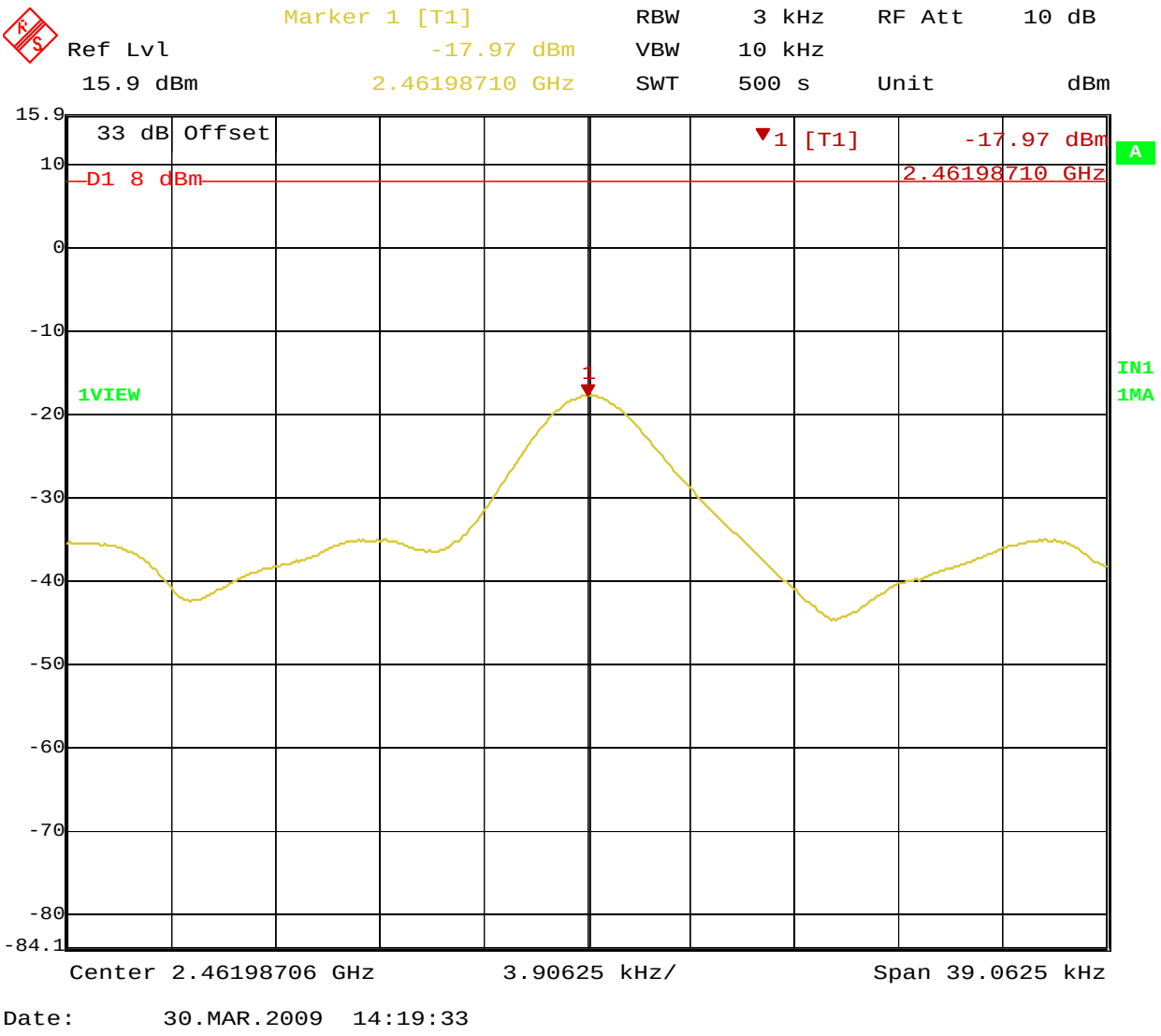

Figure 41: Peak Power Spectral Density for Operating Channel 2462MHz (Horizontal)

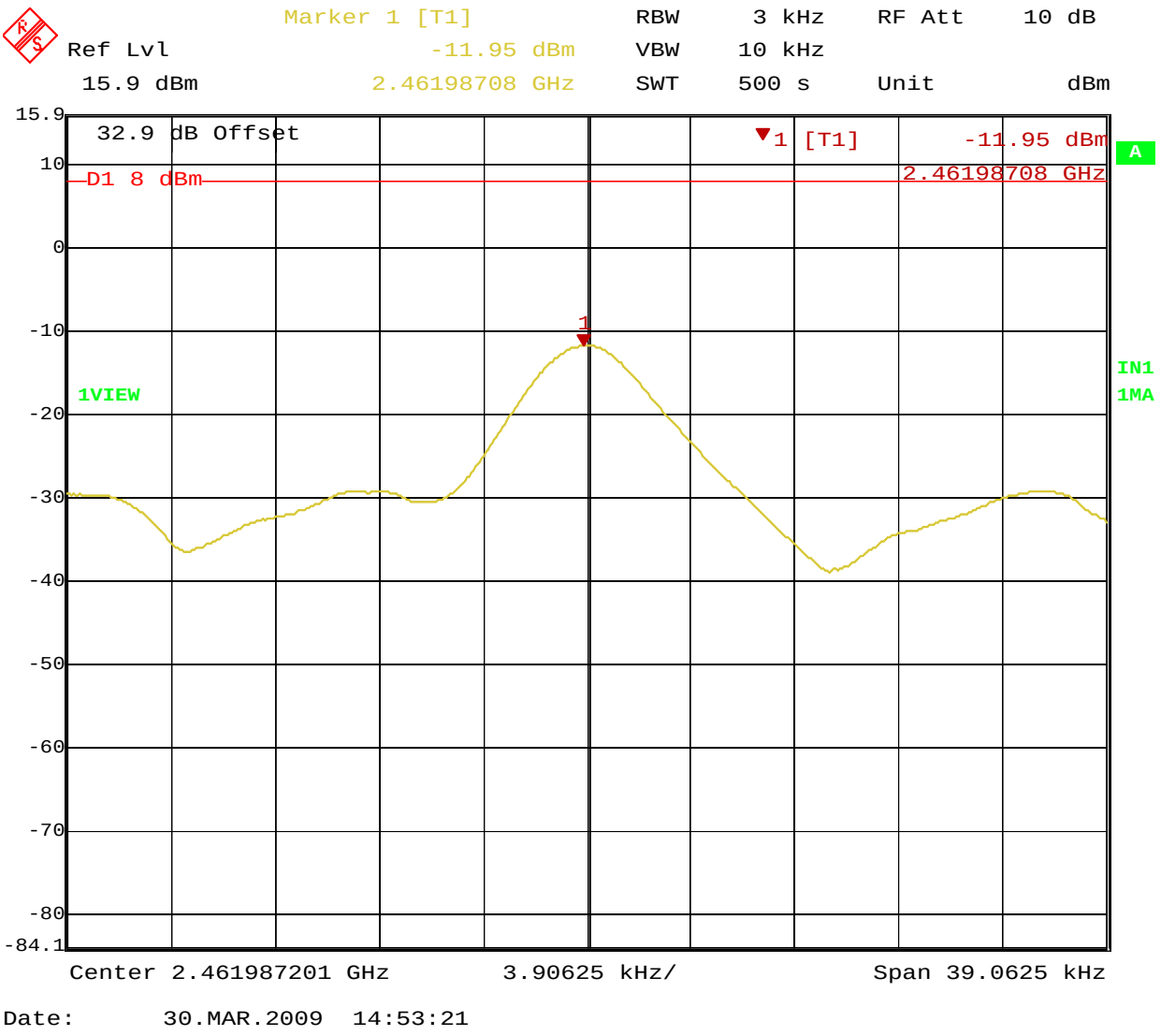

Figure 42: Peak Power Spectral Density for Operating Channel 2462MHz (Vertical)

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 integrated. The antenna gain was included with the measured EIRP power.

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 EIRP power is +29.86dBm or 968.3mW

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

Pd = 968.3 / (1600π) = **0.19264mW/cm^2**, which is 0.80736 mW/cm^2 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/cm_2
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.

To determine the worst axis, the pre-scans performed on X-Axis, Y-Axis, and Z-Axis for each transmitting antenna family.

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; 2412MHz, 2437MHz, and 2462MHz at 54Mbit/s.

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: 2008 and RSS 210 A1.1.2 2007.

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

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

SOP 1 Radiated Emissions

Tracking # 30960915.003 Page 1 of 10

EUT Name	Squeezebox Touch	**Date**	April 1, 2009
EUT Model	X-RC4	**Temp / Hum in**	22°C / 33%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120kHz / 300kHz
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 2412MHz										
98.5	H	124	128	40.44	35.58	-15.17	20.41	43.52	-23.11	Spurious
249.991	H	234	139	40.04	39.32	-10.61	28.71	46.02	-17.31	Spurious
499.991	H	130	200	36.58	35.63	-5.56	30.07	46.02	-15.95	Spurious
624.977	H	108	304	39.47	38.33	-3.20	35.13	46.02	-10.89	Spurious
664.961	H	109	307	36.12	35.00	-2.20	32.80	46.02	-13.22	Spurious
699.972	H	173	165	40.07	39.56	-1.81	37.75	46.02	-8.27	Spurious
265.985	V	114	280	43.78	43.23	-9.63	33.60	46.02	-12.42	Spurious
499.979	V	103	156	38.13	37.50	-5.56	31.94	46.02	-14.08	Spurious
531.976	V	191	142	37.74	36.90	-5.09	31.81	46.02	-14.21	Spurious
677.381	V	134	166	41.50	40.86	-2.03	38.83	46.02	-7.19	Spurious
745.12	V	115	189	36.51	35.35	-0.96	34.39	46.02	-11.63	Spurious
835.448	V	109	179	37.00	35.92	-0.08	35.84	46.02	-10.18	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 $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Since X-Axis was the worst plane, all radiated emission scans performed on X-Axis.

SOP 1 Radiated Emissions — Tracking # 30960915.003 Page 2 of 10

EUT Name	Squeezebox Touch	**Date**	April 1, 2009
EUT Model	X-RC4	**Temp / Hum in**	22°C / 33%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120kHz / 300kHz
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 2437MHz										
265.992	H	114	269	43.62	43.42	-9.63	33.79	46.02	-12.23	Spurious
677.385	H	134	158	41.41	40.98	-2.03	38.95	46.02	-7.07	Spurious
699.966	H	132	135	41.20	40.80	-1.81	38.99	46.02	-7.03	Spurious
745.137	H	120	203	36.88	35.97	-0.96	35.01	46.02	-11.01	Spurious
835.439	H	113	186	36.89	35.70	-0.08	35.62	46.02	-10.40	Spurious
880.619	H	103	178	34.93	33.39	0.57	33.96	46.02	-12.06	Spurious
54.7463	V	113	292	44.95	43.47	-17.04	26.43	40.00	-13.57	Spurious
250.004	V	192	79	39.93	39.24	-10.61	28.63	46.02	-17.39	Spurious
500.001	V	126	207	37.21	36.61	-5.56	31.05	46.02	-14.97	Spurious
624.976	V	106	303	39.40	38.49	-3.20	35.29	46.02	-10.73	Spurious
664.98	V	106	298	36.41	34.97	-2.20	32.77	46.02	-13.25	Spurious
699.979	V	181	158	40.50	39.96	-1.81	38.15	46.02	-7.87	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 $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Since X-Axis was the worst plane, all radiated emission scans performed on X-Axis.

SOP 1 Radiated Emissions

Tracking # 30960915.003 Page 3 of 10

EUT Name	Squeezebox Touch	**Date**	April 1, 2009
EUT Model	X-RC4	**Temp / Hum in**	22°C / 33%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120kHz / 300kHz
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 2462MHz										
265.988	H	99	281	43.69	43.39	-10.94	33.76	46.02	-12.26	Spurious
499.997	H	297	67	38.00	37.17	-5.12	31.61	46.02	-14.41	Spurious
664.966	H	164	152	42.18	41.32	-2.20	39.12	46.02	-6.90	Spurious
677.4	H	298	112	41.77	41.47	-2.15	39.44	46.02	-6.58	Spurious
699.966	H	153	187	41.47	40.92	-1.90	39.11	46.02	-6.91	Spurious
835.449	H	99	182	36.81	35.88	-0.21	35.80	46.02	-10.22	Spurious
55.2625	V	189	36	43.97	41.99	-17.04	24.95	40.00	-15.05	Spurious
63.7725	V	127	9	44.86	41.22	-16.56	24.66	40.00	-15.34	Spurious
250.005	V	106	112	40.05	39.13	-10.61	28.52	46.02	-17.50	Spurious
499.981	V	123	208	35.95	34.85	-5.56	29.29	46.02	-16.73	Spurious
624.99	V	113	300	39.96	39.10	-3.20	35.90	46.02	-10.12	Spurious
699.976	V	174	170	41.17	40.81	-1.81	39.00	46.02	-7.02	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 $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Since X-Axis was the worst plane, all radiated emission scans performed on X-Axis.

SOP 1 Radiated Emissions

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EUT Name	Squeezebox Touch	**Date**	March 31, 2009
EUT Model	X-RC4	**Temp / Hum in**	22°C / 39%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1MHz / 3MHz
Dist/Ant Used	3m / EMCO3115	**Performed by**	Jeremy Luong

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	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 2412MHz										
1064	H	1.6	215	43.23	37.61	-4.64	32.97	53.98	-21.01	Spurious
1600	H	1.2	235	39.29	35.93	-2.41	33.52	53.98	-20.46	Spurious
1064	V	1.2	355	47.57	39.19	-4.49	34.70	53.98	-19.28	Spurious
1929.59	V	1.0	150	41.32	35.20	11.35	46.55	76.34	-29.79	Harmonic
Transmitted Data at 2437MHz										
1064	H	1.5	145	45.13	32.76	-4.64	28.12	53.98	-25.86	Spurious
1200	H	1.3	302	48.52	31.34	-4.09	27.25	53.98	-26.73	Spurious
1600	H	1.0	235	40.12	37.91	-2.41	35.50	53.98	-18.48	Spurious
1064	V	1.2	192	43.14	40.76	-4.49	36.27	53.98	-17.71	Spurious
1196	V	1.3	295	39.76	37.14	-3.84	33.30	53.98	-20.68	Spurious
1949.58	V	1.0	143	38.43	32.22	11.54	43.76	82.28	-35.73	Harmonic
Transmitted Data at 2462MHz										
1064	H	1.0	270	43.94	39.95	-4.64	35.31	53.98	-18.67	Spurious
1064	V	1.1	15	43.34	39.21	-4.49	34.72	53.98	-19.26	Spurious
1250	V	1.0	42	41.83	38.12	-3.60	34.52	53.98	-19.46	Spurious
1969.58	V	1.0	252	41.77	35.5	11.70	47.20	84.00	-36.80	Harmonic

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 $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: X-Axis was the worst plane.

Harmonic emissions are compared to the 20dBr of the measured fundamentals. See the band-edge Section for details.

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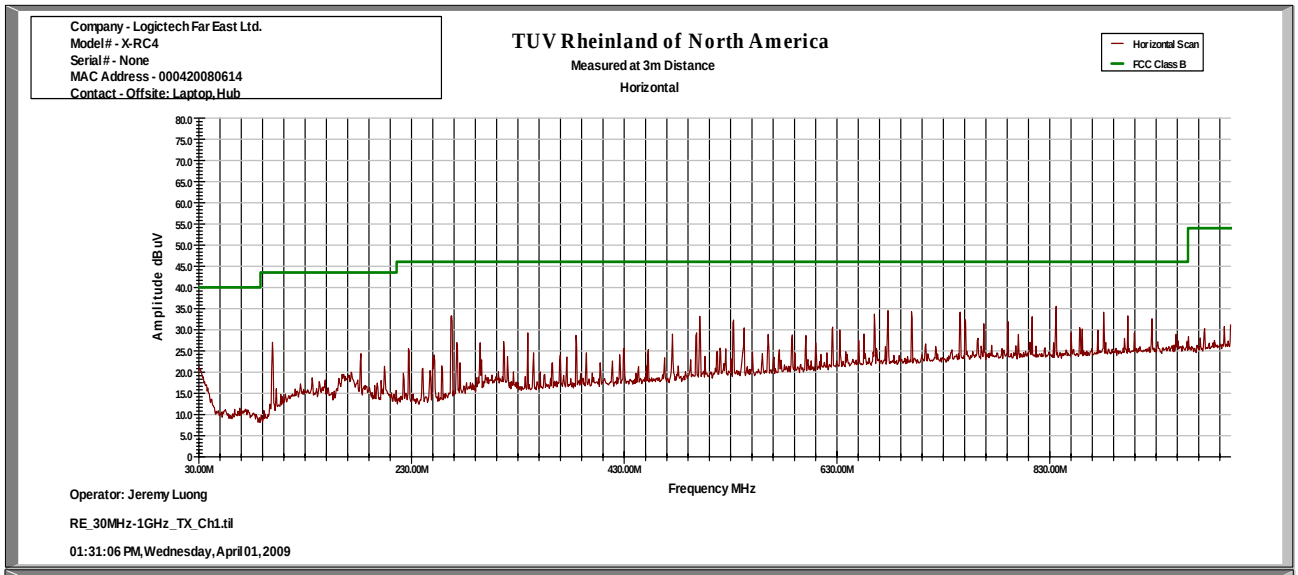
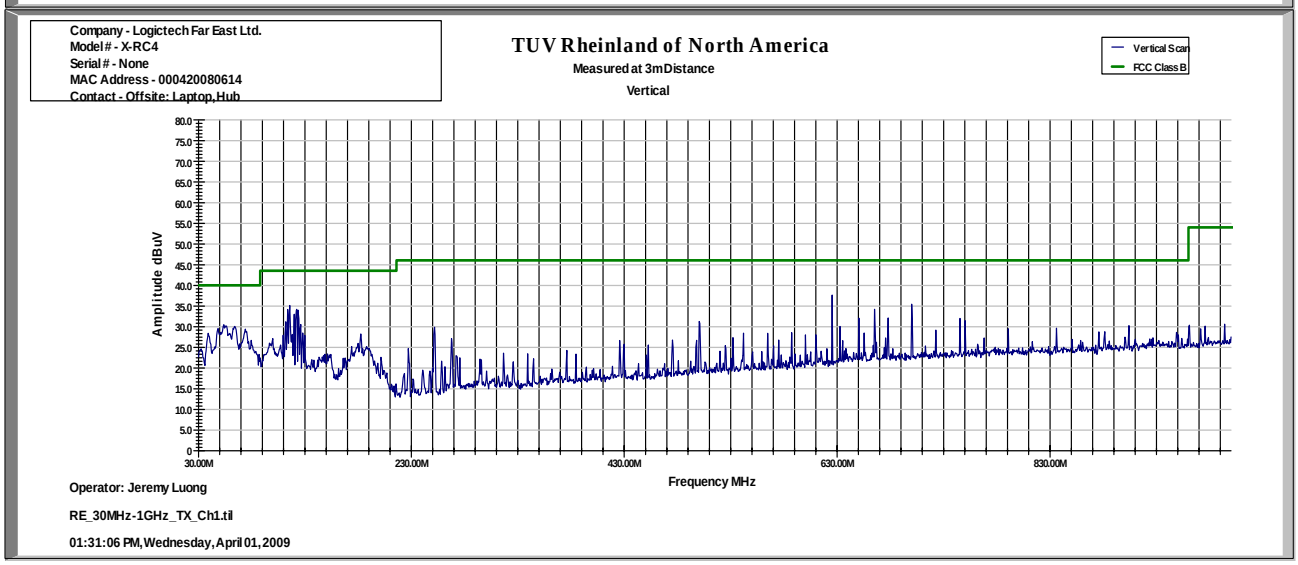
EUT Name	Squeezebox Touch	**Date**	April 1, 2009
EUT Model	X-RC4	**Temp / Hum in**	22°C / 39%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC**	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120kHz / 300kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

30MHz to 1000MHz Plot for Transmit Mode at 2412MHz





Notes: None.

SOP 1 Radiated Emissions

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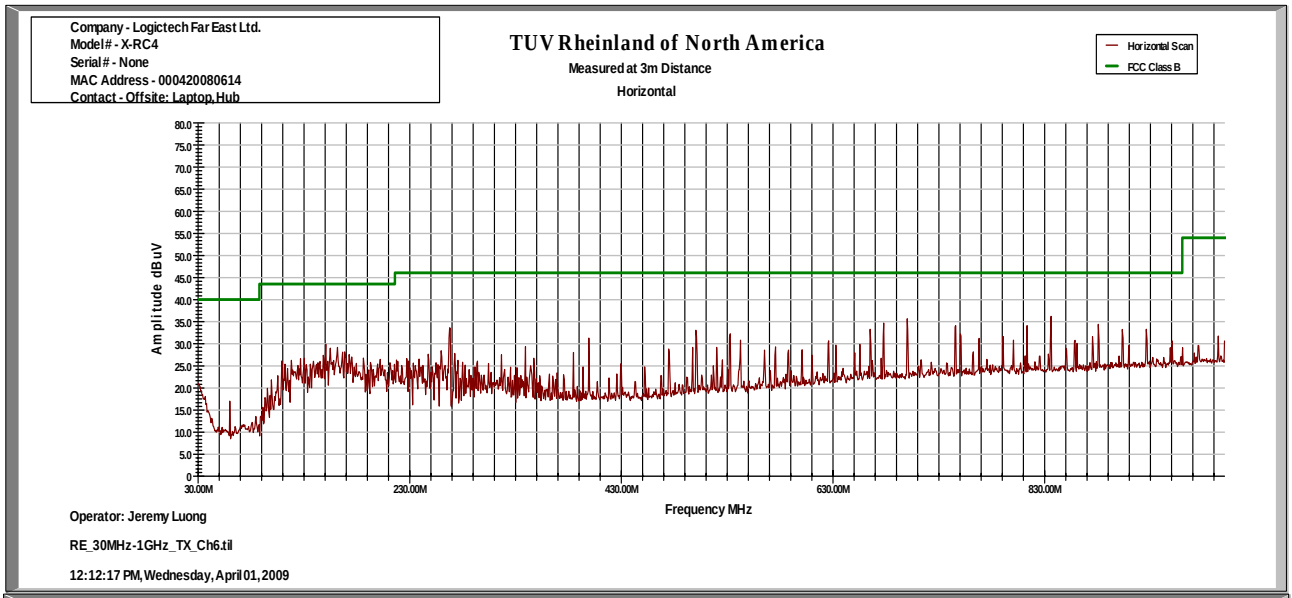
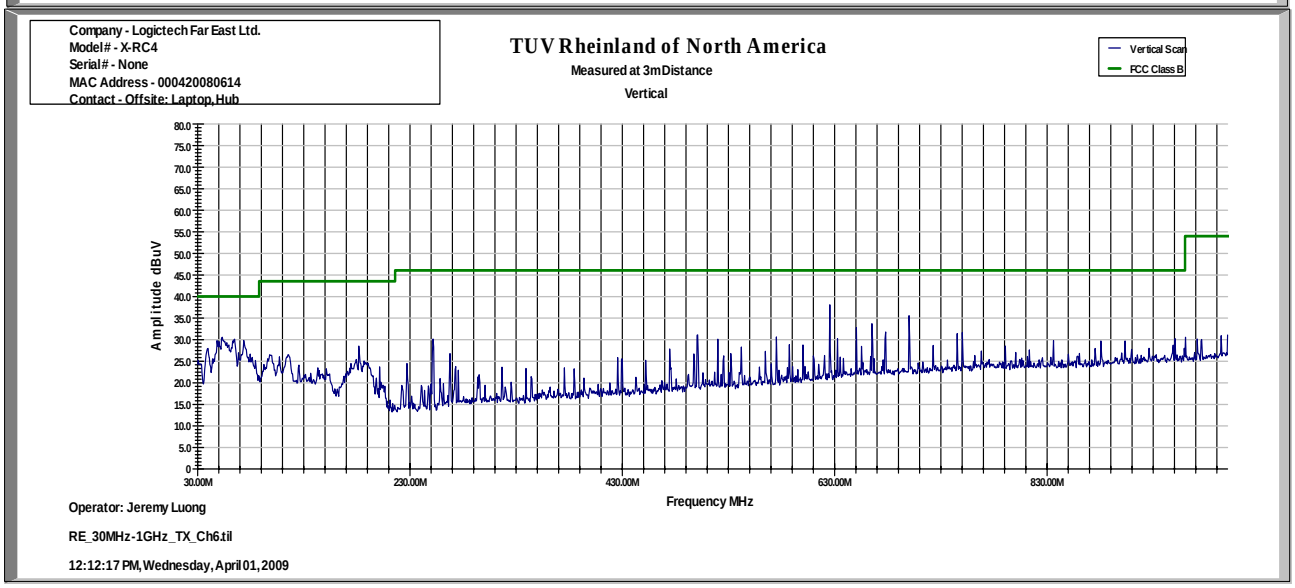
EUT Name	Squeezebox Touch	**Date**	April 1, 2009
EUT Model	X-RC4	**Temp / Hum in**	22°C / 39%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC**	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120kHz / 300kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

30MHz to 1000MHz Plot for Transmit Mode at 2437MHz





Notes: None.

SOP 1 Radiated Emissions

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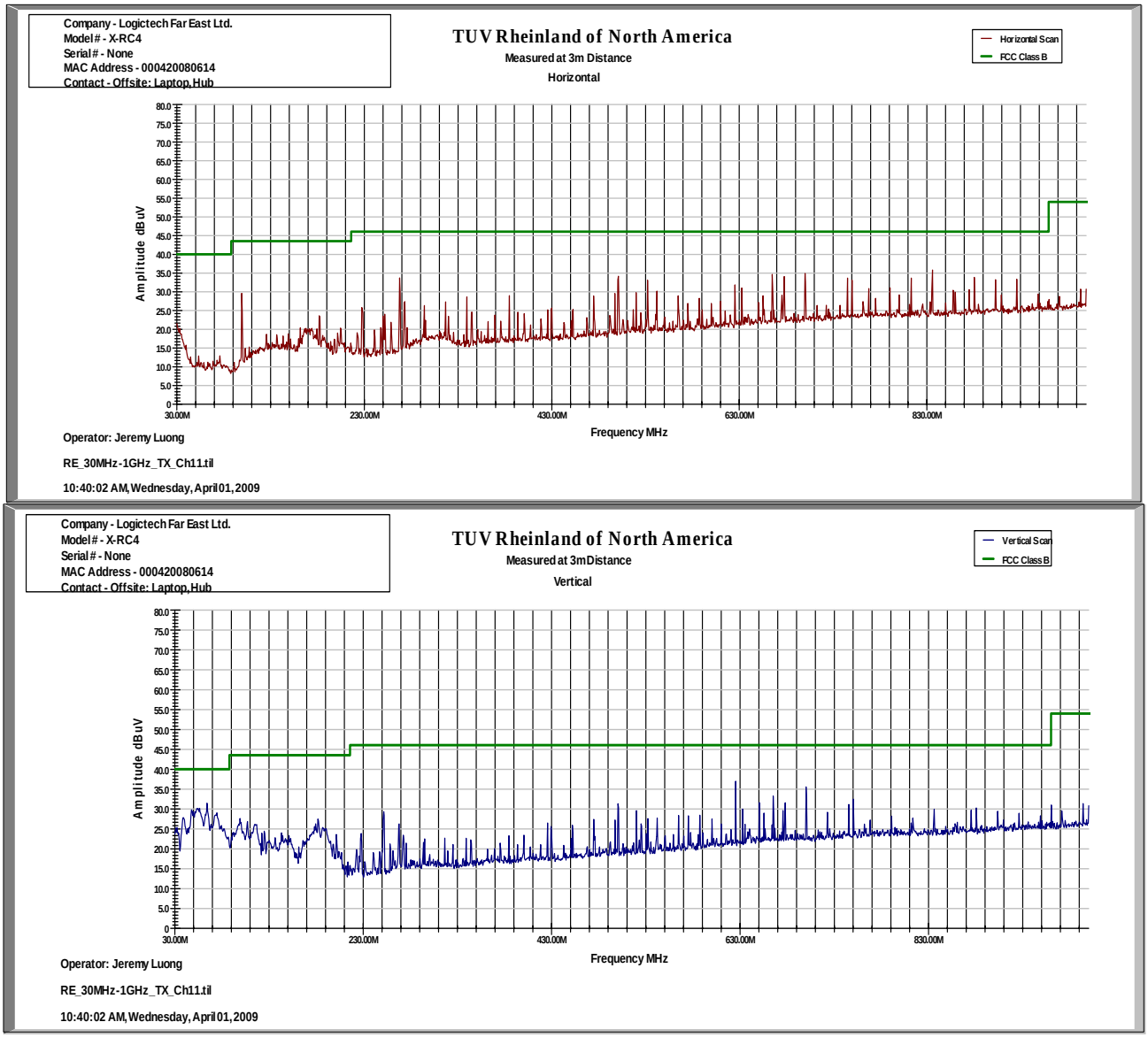
EUT Name	Squeezebox Touch	**Date**	April 1, 2009
EUT Model	X-RC4	**Temp / Hum in**	22°C / 39%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC**	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120kHz / 300kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

30MHz to 1000MHz Plot for Transmit Mode at 2462MHz



Notes: None.

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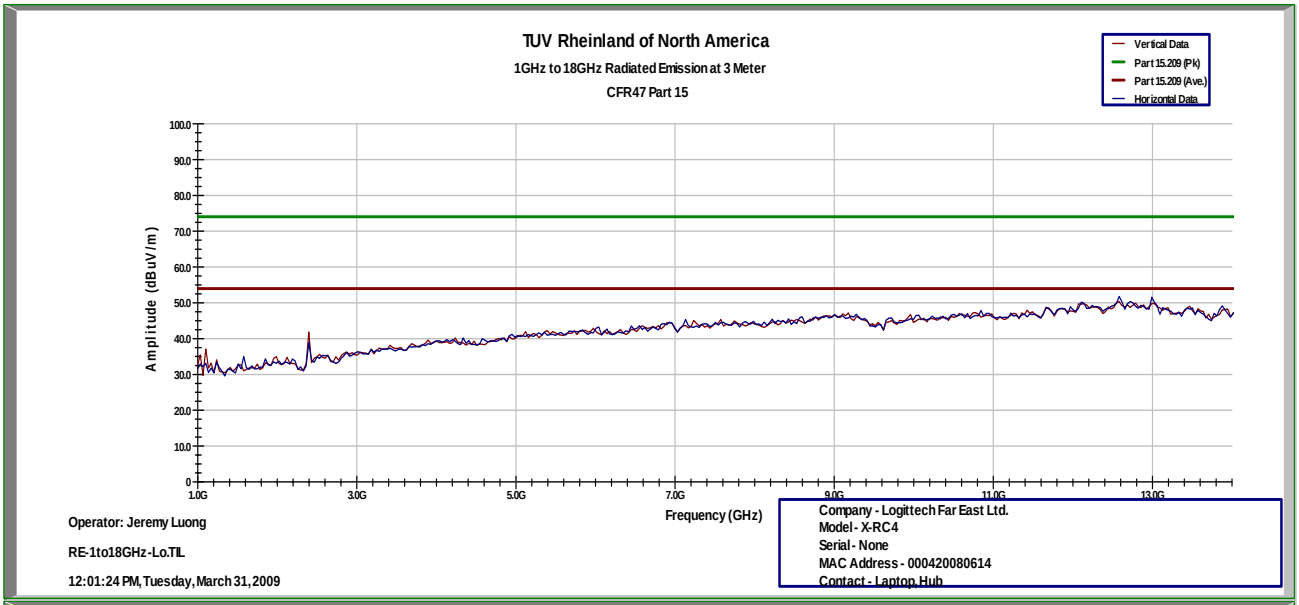
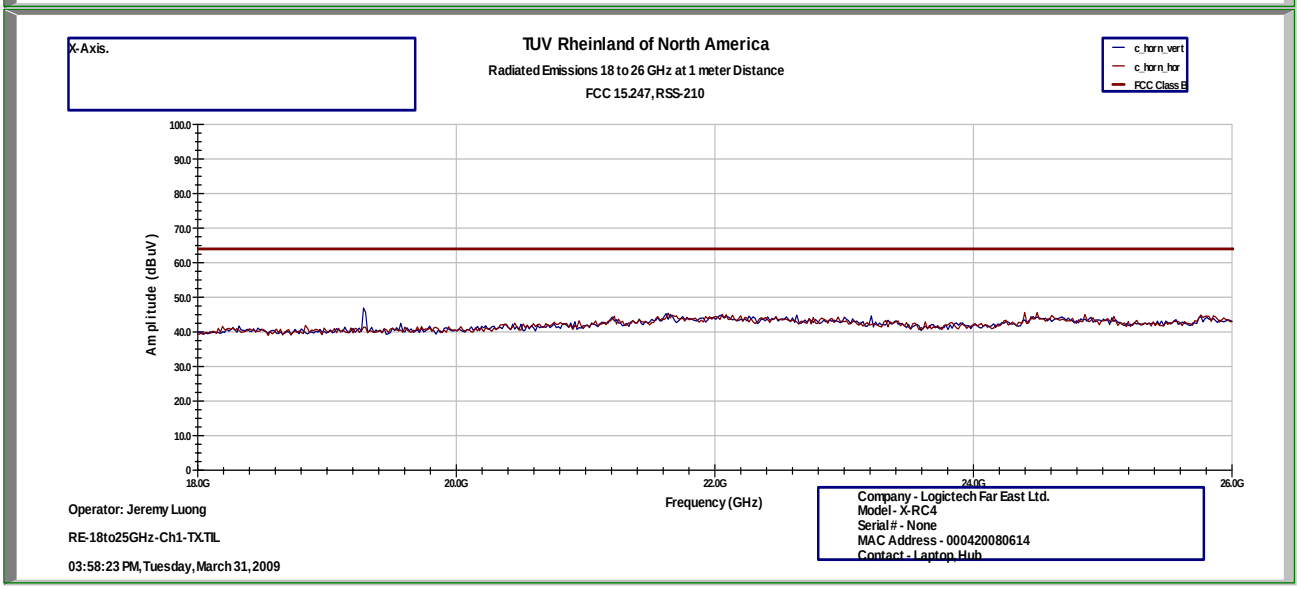
EUT Name	Squeezebox Touch	**Date**	March 31, 2009
EUT Model	X-RC4	**Temp / Hum in**	22°C / 39%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC**	120Vac/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1MHz / 3MHz
Dist/Ant Used	3m / EMCO3115	**Performed by**	Jeremy Luong

1GHz to 25GHz Plots for Transmit Mode at 2412MHz





Notes: None.

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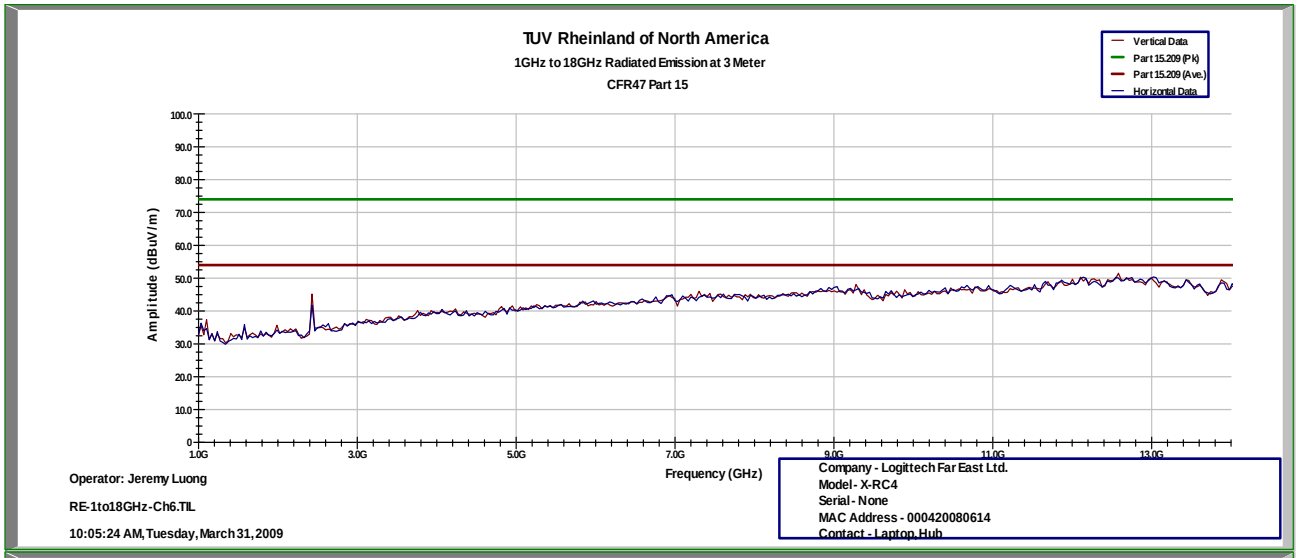
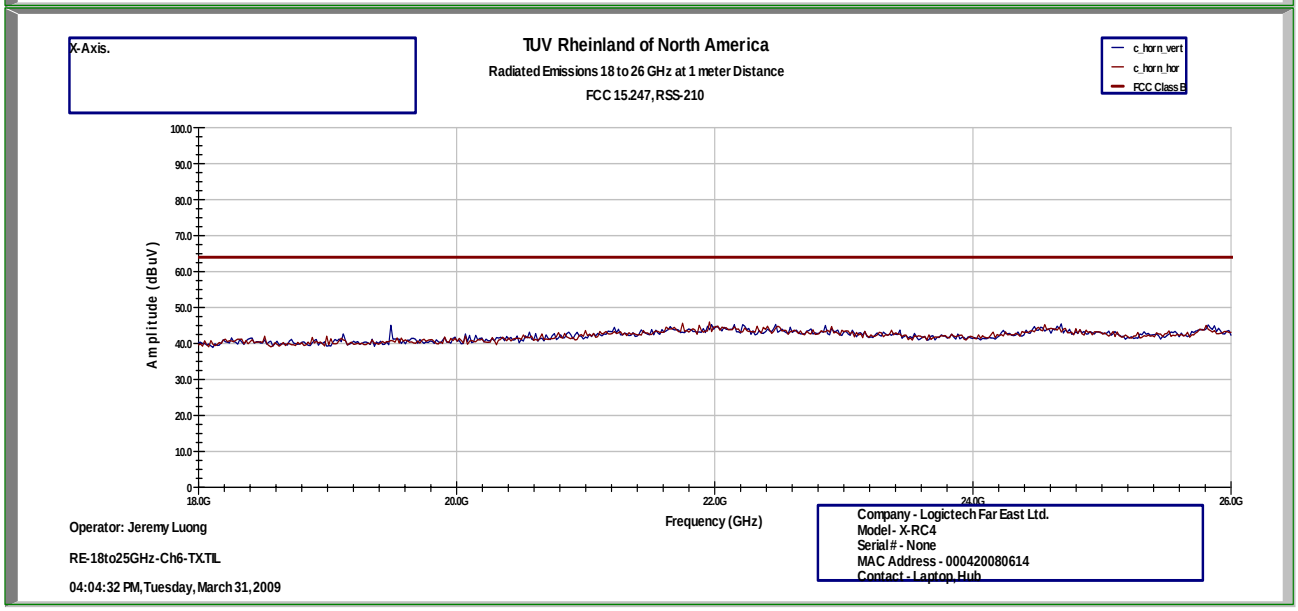
EUT Name	Squeezebox Touch	**Date**	March 31, 2009
EUT Model	X-RC4	**Temp / Hum in**	23°C / 38%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC**	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1MHz / 3MHz
Dist/Ant Used	3m / EMCO3115	**Performed by**	Jeremy Luong

1GHz to 25GHz Plots for Transmit Mode at 2437MHz





Notes: None.

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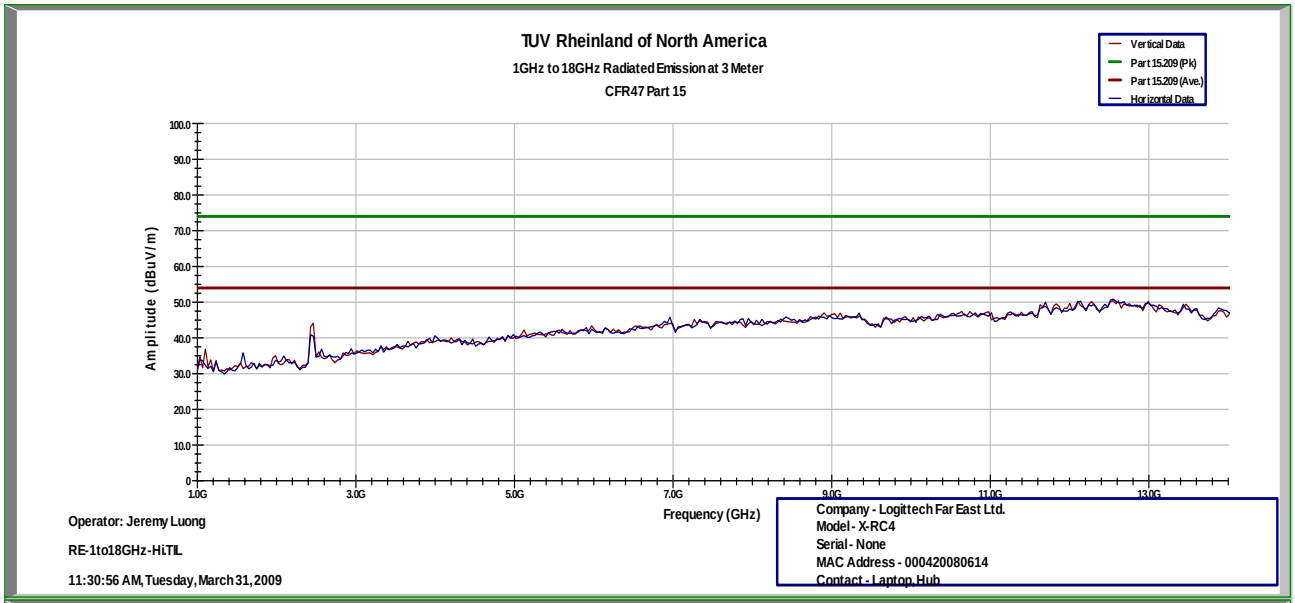
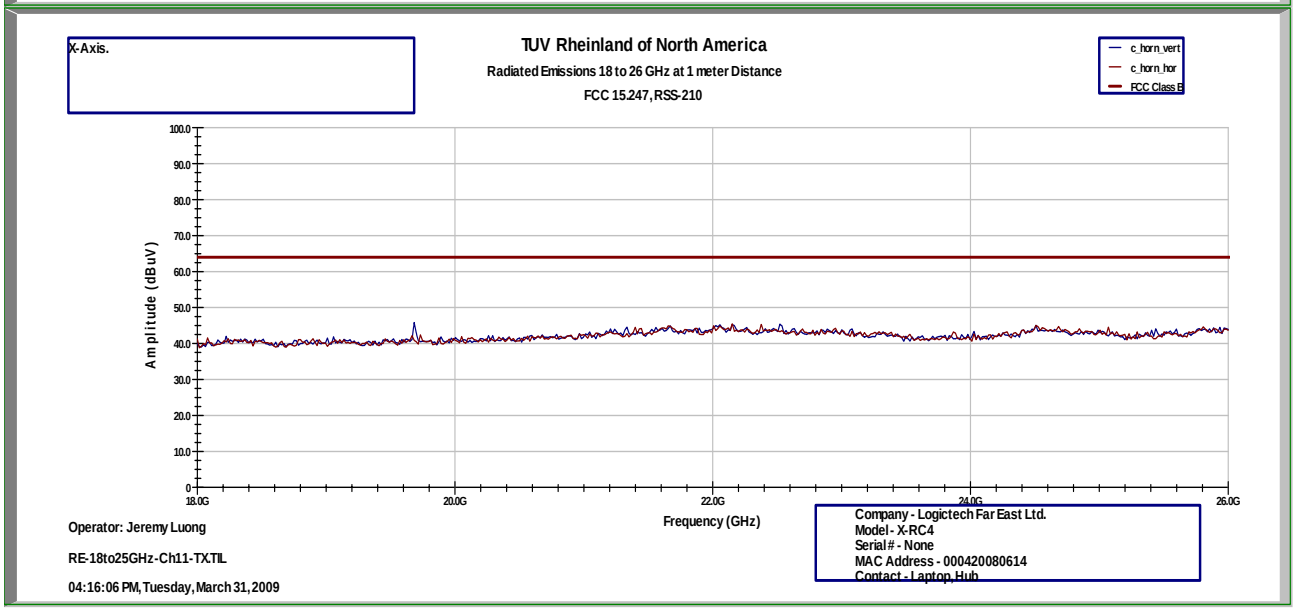
EUT Name	Squeezebox Touch	**Date**	March 31, 2009
EUT Model	X-RC4	**Temp / Hum in**	24°C / 39%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC**	120Vac/60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1MHz / 3MHz
Dist/Ant Used	3m / EMCO3115	**Performed by**	Jeremy Luong

1GHz to 25GHz Plots for Transmit Mode at 2480MHz





Notes: None

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:

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)

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

4.7 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.

The final scans performed on the worst axis for the Channel 6; 2437MHz.

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.

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EUT Name	Squeezebox Touch	**Date**	March 31, 2009
EUT Model	X-RC4	**Temp / Hum in**	22°C / 39%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC / Freq**	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120kHz / 300kHz
Dist/Ant Used	3m / JB3	**Performed by**	Jeremy Luong

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	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 at 2437MHz										
265.986	H	110	281	44.02	43.33	-9.63	33.70	46.02	-12.32	Spurious
499.984	H	105	126	36.51	35.32	-5.56	29.76	46.02	-16.26	Spurious
677.383	H	132	169	41.42	41.23	-2.03	39.20	46.02	-6.82	Spurious
699.98	H	137	142	41.82	41.25	-1.81	39.44	46.02	-6.58	Spurious
835.434	H	104	185	36.15	35.63	-0.08	35.55	46.02	-10.47	Spurious
880.599	H	104	181	34.79	33.82	0.57	34.39	46.02	-11.63	Spurious
55.08	V	144	218	44.85	42.10	-17.04	25.06	40.00	-14.94	Spurious
249.999	V	232	90	39.88	39.16	-10.61	28.55	46.02	-17.47	Spurious
499.978	V	119	218	37.69	36.59	-5.56	31.03	46.02	-14.99	Spurious
624.981	V	105	307	39.20	38.32	-3.20	35.12	46.02	-10.90	Spurious
664.975	V	105	355	36.54	35.78	-2.20	33.58	46.02	-12.44	Spurious
699.96	V	174	133	38.38	37.59	-1.81	35.78	46.02	-10.24	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 $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: X-Axis was the worst plane. No emission was observed above 1GHz.

SOP 1 Radiated Emissions

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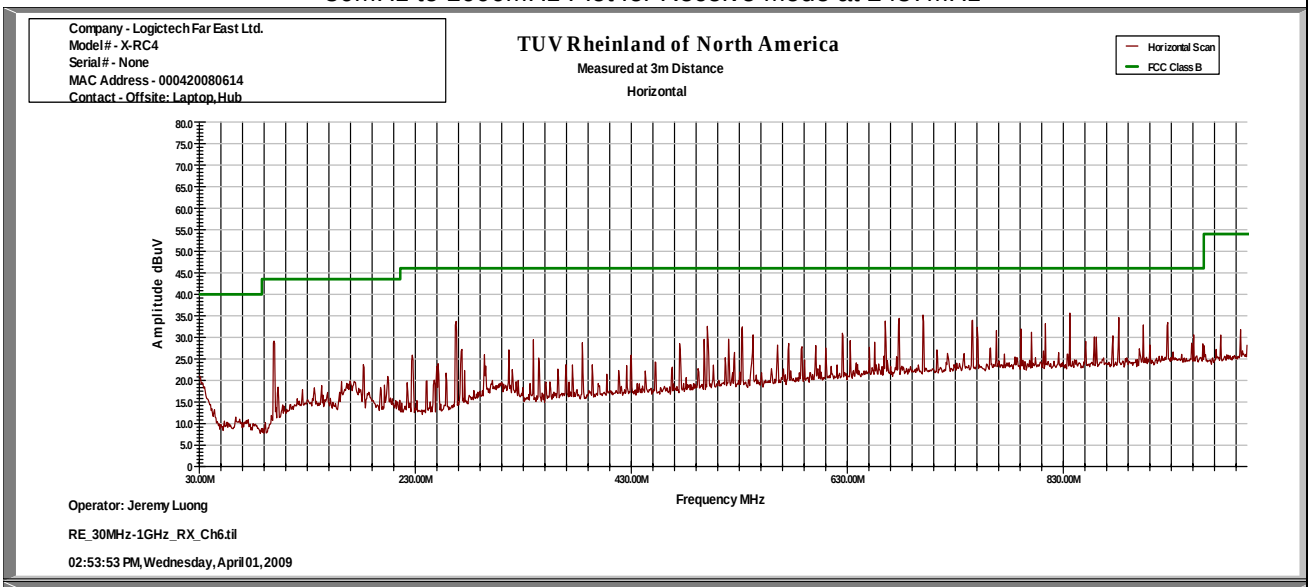
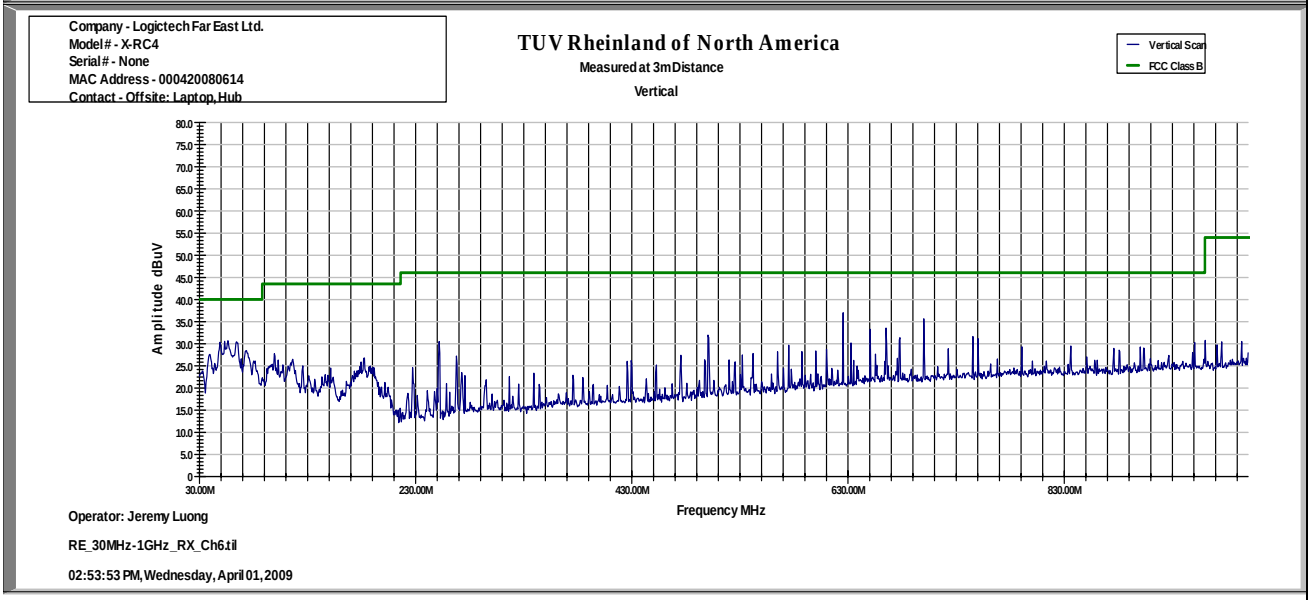
EUT Name	Squeezebox Touch	**Date**	March 31, 2009
EUT Model	X-RC4	**Temp / Hum in**	22°C / 39%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC**	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	120kHz / 300kHz
Dist/Ant Used	3m / JB3 & EMCO3115	**Performed by**	Jeremy Luong

30MHz to 1000MHz Plot for Receive Mode at 2437MHz





Notes: None

SOP 1 Radiated Emissions

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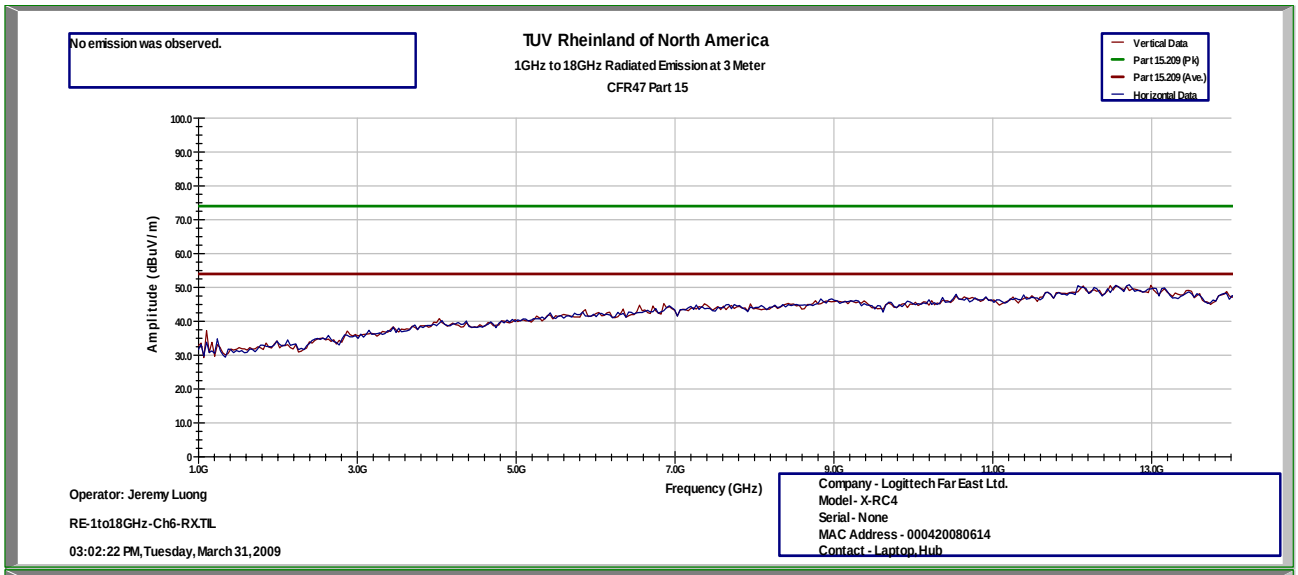
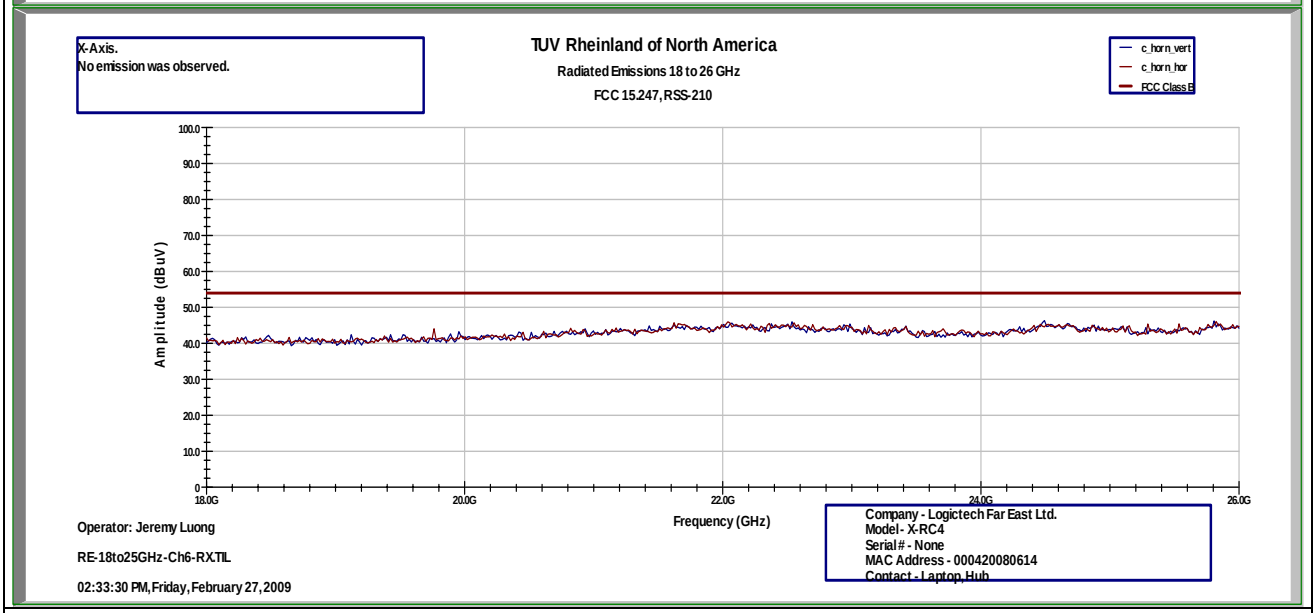
EUT Name	Squeezebox Touch	**Date**	March 31, 2009
EUT Model	X-RC4	**Temp / Hum in**	21°C / 39%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna on X-Axis	**Line AC**	120Vac 60Hz
Standard	CFR47 Part 15 Subpart C	**RBW / VBW**	1MHz / 3MHz
Dist/Ant Used	3m / EMCO3115	**Performed by**	Jeremy Luong

1GHz to 25GHz Plot for Receive Mode at 2437MHz





Notes: No emission was observed above 1GHz

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 Part 15.107

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 either performed in Lab 2. 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 7: AC Conducted Emissions – Test Results

Test Conditions: Conducted Measurement at Normal Conditions only		
Antenna Type: Attached	**Power Level:** 15	
Operating Frequency: 2437MHz	**AC Power:** 120Vac/60Hz	
Ambient Temperature: 22 °C	**Relative Humidity:** 38 %	
Configuration	**Frequency Range**	**Test Result**
Line 1(Hot)	0.15 to 30 MHz	Pass
Line 2 (Neutral)	0.15 to 30 MHz	Pass

SOP 2 Conducted Emissions

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EUT Name	Squeezebox Touch	**Date**	April 3, 2009
EUT Model	X-RC4	**Temp / Hum in**	23°C / 36%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15.107	**RBW / VBW**	9kHz / 30kHz
Lab/LISN	5m Chamber/ Solar 9348-50-R-24-BNC, Line 1	**Performed by**	Jeremy Luong

Frequency MHz	QP dBuV	QP Limit dBuV	QP Margin dB	Avg dBuV	Avg Limit dBuV	Avg Margin dB
0.15312	47.42	65.91	-18.49	32.28	55.91	-23.64
0.154162	47.32	65.88	-18.56	32.61	55.88	-23.27
0.15419	47.14	65.88	-18.74	32.51	55.88	-23.37
0.154207	47.35	65.88	-18.53	32.57	55.88	-23.31
0.15534	47.00	65.85	-18.85	32.55	55.85	-23.30
0.15755	45.37	65.78	-20.41	31.78	55.78	-24.00
0.16158	43.50	65.67	-22.17	31.19	55.67	-24.48
0.16501	46.15	65.57	-19.42	33.29	55.57	-22.28
0.168	45.85	65.49	-19.64	34.12	55.49	-21.36
0.17778	39.64	65.21	-25.57	25.76	55.21	-29.45
8.07159	32.01	60.00	-27.99	24.68	50.00	-25.32
8.14368	32.12	60.00	-27.88	24.78	50.00	-25.22
8.16283	32.50	60.00	-27.50	24.74	50.00	-25.26
8.21939	32.47	60.00	-27.53	24.86	50.00	-25.14
8.27703	32.25	60.00	-27.75	24.73	50.00	-25.27
8.30458	32.21	60.00	-27.79	24.78	50.00	-25.22
8.53563	31.57	60.00	-28.43	23.91	50.00	-26.09
8.55149	31.77	60.00	-28.23	23.99	50.00	-26.01
8.66048	31.30	60.00	-28.70	23.20	50.00	-26.80
9.8026	29.08	60.00	-30.92	22.25	50.00	-27.75

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

Combined Standard Uncertainty $u_c(y)$ = ± 1.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: EUT was setup as table top equipment; X-Axis.

SOP 2 Conducted Emissions

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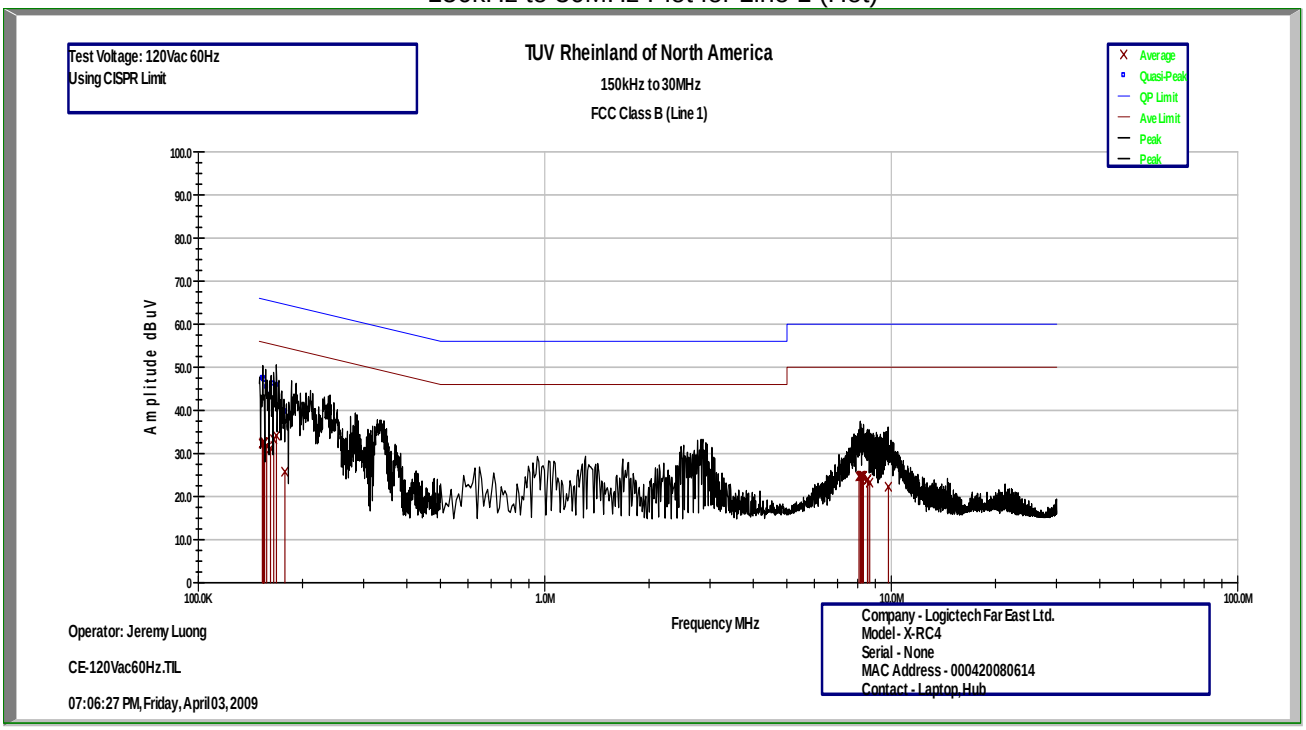
EUT Name	Squeezebox Touch	**Date**	April 3, 2009
EUT Model	X-RC4	**Temp / Hum in**	23°C / 36%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna	**Line AC**	120Vac/60Hz
Standard	CFR47 Part 15.107	**RBW / VBW**	9kHz / 30kHz
Lab/LISN	5m Chamber/ Solar 9348-50-R-24-BNC, Line 1	**Performed by**	Jeremy Luong

150kHz to 30MHz Plot for Line 1 (Hot)



Notes: Using CISRP Class B Limit.

SOP 2 Conducted Emissions

Tracking # 30960915.003 Page 3 of 4

EUT Name	Squeezebox Touch	**Date**	April 3, 2009
EUT Model	X-RC4	**Temp / Hum in**	23°C / 36%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna	**Line AC / Freq**	120Vac/60Hz
Standard	CFR47 Part 15.107	**RBW / VBW**	9kHz / 30kHz
Lab/LISN	5m Chamber/ Solar 9348-50-R-24-BNC, Line 2	**Performed by**	Jeremy Luong

Frequency MHz	QP dBuV	QP Limit dBuV	QP Margin dB	Avg dBuV	Avg Limit dBuV	Avg Margin dB
0.15208	46.55	65.94	-19.39	32.37	55.94	-23.57
0.15431	47.14	65.88	-18.74	32.86	55.88	-23.02
0.15485	47.02	65.86	-18.84	32.86	55.86	-23.00
0.15569	46.47	65.84	-19.37	32.56	55.84	-23.28
0.15716	45.34	65.80	-20.46	31.74	55.80	-24.05
0.16406	45.53	65.60	-20.07	33.84	55.60	-21.76
0.16571	46.01	65.55	-19.54	34.40	55.55	-21.15
0.16771	45.91	65.49	-19.58	34.47	55.49	-21.02
0.17973	39.02	65.15	-26.13	26.87	55.15	-28.28
0.18303	41.31	65.06	-23.75	29.04	55.06	-26.02
8.15119	31.69	60.00	-28.31	25.13	50.00	-24.87
8.23708	31.91	60.00	-28.09	25.34	50.00	-24.66
8.38103	31.61	60.00	-28.39	24.90	50.00	-25.10
8.49763	31.33	60.00	-28.67	24.65	50.00	-25.35
8.62189	31.44	60.00	-28.56	24.39	50.00	-25.62
8.66801	31.10	60.00	-28.90	24.09	50.00	-25.91
8.7678	30.51	60.00	-29.49	23.52	50.00	-26.48
8.81166	30.39	60.00	-29.61	23.26	50.00	-26.74
9.05732	30.06	60.00	-29.94	22.95	50.00	-27.05
9.39236	30.23	60.00	-29.77	23.23	50.00	-26.78

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

Combined Standard Uncertainty $u_c(y)$ = ± 1.2dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

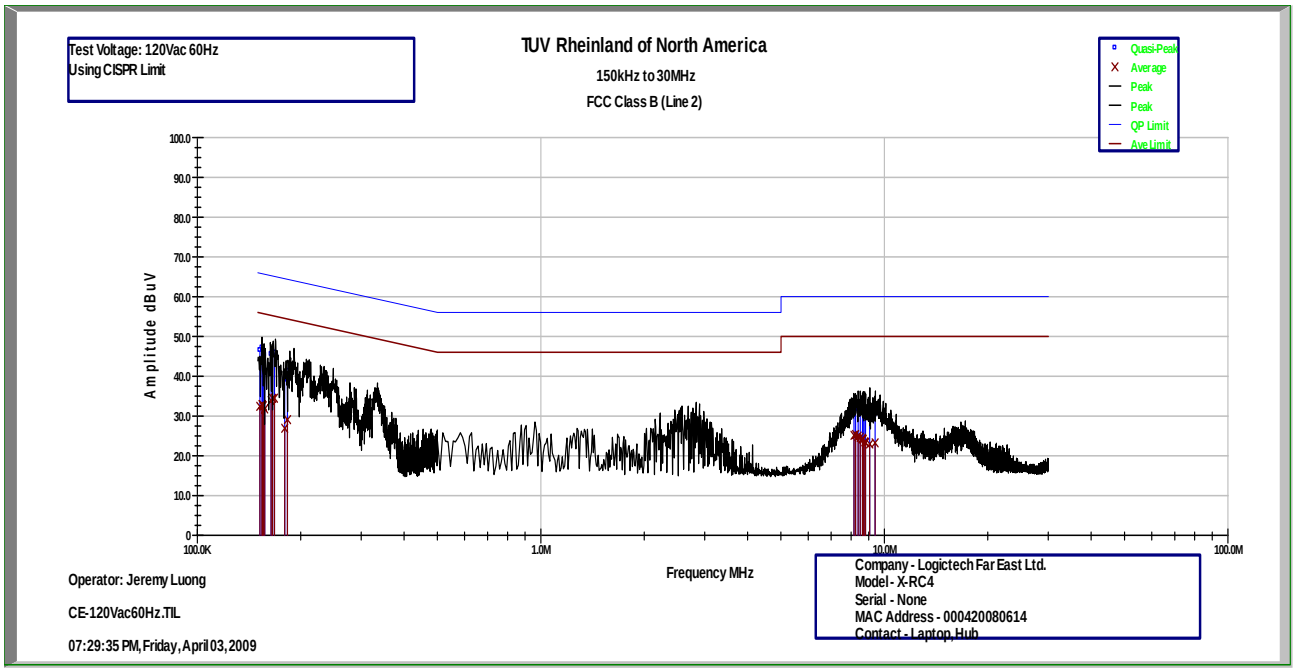
Notes: EUT was setup as table top equipment; X-Axis.

SOP 2 Conducted Emissions

Tracking # 30960915.003 Page 4 of 4

EUT Name	Squeezebox Touch	**Date**	April 3, 2009
EUT Model	X-RC4	**Temp / Hum in**	23°C / 36%rh
EUT Serial	000420080614	**Temp / Hum out**	N/A
EUT Config.	Attached Antenna	**Line AC**	120Vac/60Hz
Standard	CFR47 Part 15.107	**RBW / VBW**	9kHz / 30kHz
Lab/LISN	5m Chamber/ Solar 9348-50-R-24-BNC, Line 2	**Performed by**	Jeremy Luong

150kHz to 30MHz Plot for Line 2 (Neutral)



Notes: Using CISRP Class B Limit.

5 Test Equipment Use List

5.1 Equipment List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
Antenna Bilog	Sunol Science	JB3	9701-1117	05/01/08	02/05/10
TuneD Dipole Antenna	A.H Systems, Inc.	TDS-200/535-1	154	01/09/09	01/09/10
TuneD Dipole Antenna	A.H Systems, Inc.	TDS-200/535-2	154	01/09/09	01/09/10
TuneD Dipole Antenna	A.H Systems, Inc.	TDS-200/535-3	154	01/09/09	01/09/10
TuneD Dipole Antenna	A.H Systems, Inc.	TDS-200/535-4	154	01/09/09	01/09/10
Antenna Horn (1-18GHz)	EMCO	3115	9602-4676	07/03/08	07/03/09
Antenna Horn (1-18GHz)	EMCO	3115	9710-5301	07/03/08	07/03/09
Antenna Horn (18-26GHz)	CMT	RA42-K-F-4B-C	020131-004	08/14/08	08/14/09
Antenna Horn (18-26GHz)	CMT	RA42-K-F-4B-C	961178-001	08/14/08	08/14/09
EMI Receiver	Hewlett Packard	8546A	3325A00166	01/21/09	01/21/10
Preselector	Hewlett Packard	85460A	3330A00162	01/21/09	01/21/10
Amplifier	Hewlett Packard	8447D	2944A07486	1/23/09	1/23/10
Spectrum Analyzer	Rhode&Schwarz	ESIB	DE31284	06/10/08	06/10/09
Amplifier	Rhode&Schwarz	TS-PR18	100019	08/14/08	08/14/09
Amplifier	Rhode&Schwarz	TS-PR26	100011	08/14/08	08/14/09
Signal Generator	Hewlett Packard	83620B	3844A01375	01/21/09	01/21/10
Spectrum Analyzer	Hewlett Packard	8568	2415A00443	01/26/09	01/26/10
S/A Display	Hewlett Packard	8568	2403A07118	01/26/09	01/26/10
Quasi-Peak Adapter	Hewlett Packard	85650A	2811A01178	01/26/09	01/26/10
LISN	Solar Electronics	Type 9348-50-R-24-BNC	00015149	01/21/09	01/21/10
Thermo Chamber	Associated Environmental	SK-3102	5999	01/22/09	01/22/10
Notch Filter	Micro-Tronics	BRM50702	037	01/24/09	01/24/10
High Pass Filter (3.5GHz)	Hewlett Packard	84300-80038	82004	01/24/09	01/24/10
High Pass Filter (8.5GHz)	Hewlett Packard	84300-80039	002	01/24/09	01/24/10
Power Supplier	Kikosui	PCR8000W	CM000912	01/21/09	01/21/10
Digital Multimeter	Fluke	77	55960854	01/22/09	01/22/10
Thermometer	Fluke	52II	96480034	09/08/08	09/08/09

* 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 8: Customer Information

Company Name	Logitech Far East Ltd.
Address	Science Based Industrial Park (No. 2 Creation Road IV)
City, State, Zip	Hsinchu, Taiwan
Country	Taiwan
Phone	(011) 886-35778241
Fax	(011) 886-35772146

Table 9: Technical Contact Information

Name	Diane Lee
E-mail	Diane_Lee@logitech.com
Phone	(011) 886-35778241
Fax	(011) 886-35772146

6.3 Equipment Under Test (EUT)

Table 10: EUT Specifications

X-RC4 Dimensions	4” x 6” x 3.25”
PHIHONG Power Supply	Input Voltage: 100-240Vac Input Current: 500 mA Output Voltage: 5Vdc Ouput Current: 3A Max Power Consumption: 15W V_{min}: 2.1Vdc
Environment	Indoor
Operating Temperature Range:	0 to 40 degrees C
Multiple Feeds:	☐ Yes and how many ☒ No
Operating Mode	802.11b, g
Transmitter Frequency Band	2.412GHz to 2.462MHz (DSSS)
Rated Power Output	1W
Operating Channel	2412MHz, 2417MHz, 2422MHz, 2427MHz, 2432MHz, 3437MHz, 2442MHz, 2447MHz, 2452MHz, 2457MHz, 2462MHz.
Antenna Type	Inverter F, (Attached)
Modulation Type	☐ AM ☐ FM ☐ Phase ☒ Other describe: DSSS
Type of Equipment	☒ Table Top ☒ Wall-mount ☐ Floor standing cabinet ☐ Other *describe:*

Table 11: 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?
Ethernet	CAT-5	☒ No	☒ Metric: 10m	☒ M
USB	None	☒ Yes	☒ Metric: 1.8m	☒ M
Audio	RCA	☒ No	☒ Metric: 10m	☒ M

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?
S/PDIF	Coaxial	☒ Yes	☒ Metric: 30m	☒ C
S/PDIF	Fiber	☒ No	☒ Metric: 30m	☒ F
Headphone	Headphone	☒ No	☒ Metric: 1.8m	☒ M

Table 12: Supported Equipment

Equipment	Manufacturer	Model	Serial	Used for
Laptop	Dell Computer	PP23LB	11582181397	Set test mode
Ethernet Hub	NetGear			Hub for communicating with EUT

Table 13: Description of Sample used for Testing

Device	MAC Address
X-RC4	000420080614

Table 14: Description of Test Configuration used for Radiated Measurement

Device	Antenna	Mode
X-RC4	Attached	Transmit & Receive

6.4 Test Specifications

Testing requirements

Table 15: EUT Designation

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