

Emissions Test Report

EUT Name: Squeezebox Radio

Model No.: X-R0001

CFR 47 Part 15.247 2008 and RSS 210: 2007

Prepared for:

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Statement of Compliance

Manufacturer: Logitech Far East Ltd.
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Requester / Applicant: Diane Lee

Name of Equipment: Squeezebox Radio

Model No. X-R0001

Type of Equipment: Intentional Radiator

Application of Regulations: CFR 47 Part 15.247 2008 and RSS 210: 2007

Test Dates: 15 July 2009 to 24 July 2009

Guidance Documents:

Emissions: AN C63.4: 2003

Test Methods:

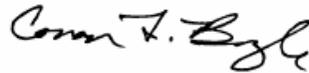
Emissions: AN C63.4: 2003

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 24 July 2009
Test Engineer Date



Conan Boyle 24 July 2009
NVLAP Signatory Date



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US5251

Industry Canada

2932D-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 2008 and RSS 210: 2007 based on the results of testing performed on 15 July 2009 through 24 July 2009 on the Squeezebox Radio Model X-R0001 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 minimum	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 # US5251). 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 2932D-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-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2003, at a test distance of 3 and 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-k Ω resistors. The Vertical Coupling Plane consists of an aluminum plate 50 cm x 50 cm x 3.175 mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470-k Ω resistors.

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

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

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

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

2.3 Measurement Uncertainty

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

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

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 Radio model X-R0001 is a compact tabletop network music player and internet radio that lets you listen to virtually any internet radio station, music service or entire personal digital music collection. Providing remarkable sound in a compact footprint, the X-R0001 extends the power and ease-of-use of the Squeezebox to any room. The Squeezebox Radio model X-R0001 features:

- Compact Design
- Bi-amplified design with ¾-inch high-definition, soft-dome tweeter
- 3-inch high-power, long-throw woofer
- 10W digital power amplifier
- 2.4" Color TFT LCD
- Front panel controls including scroll wheel
- 802.11b/g Wi-Fi
- One-touch WPS wireless setup
- Built-in 10/100 Ethernet
- Headphone Jack
- Works with all Squeezebox family products

3.2 Equipment Configuration

A description of the equipment configuration is given in Table 14 and Table 15. 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 14 and Table 15. 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-R0001 uses an inverter F antenna. It is permanently attached 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

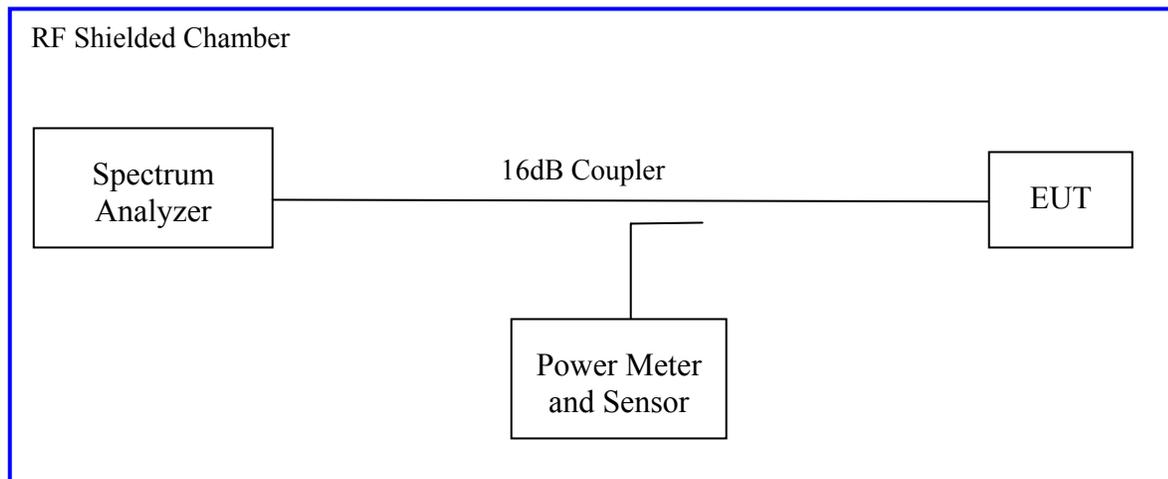
The maximum transmitted power is +30dBm or 1Watt.

4.1.1 Test Method

The conducted method was used to measure the channel power output.

The measurement was performed with modulation per CFR47 Part15.247 (b3):2008 and RSS 210 A.8.4. This test was conducted on 3 channels of Sample with MAC Address 00:04:20:26:00:74. The worst sample result indicated below.

Test Setup:

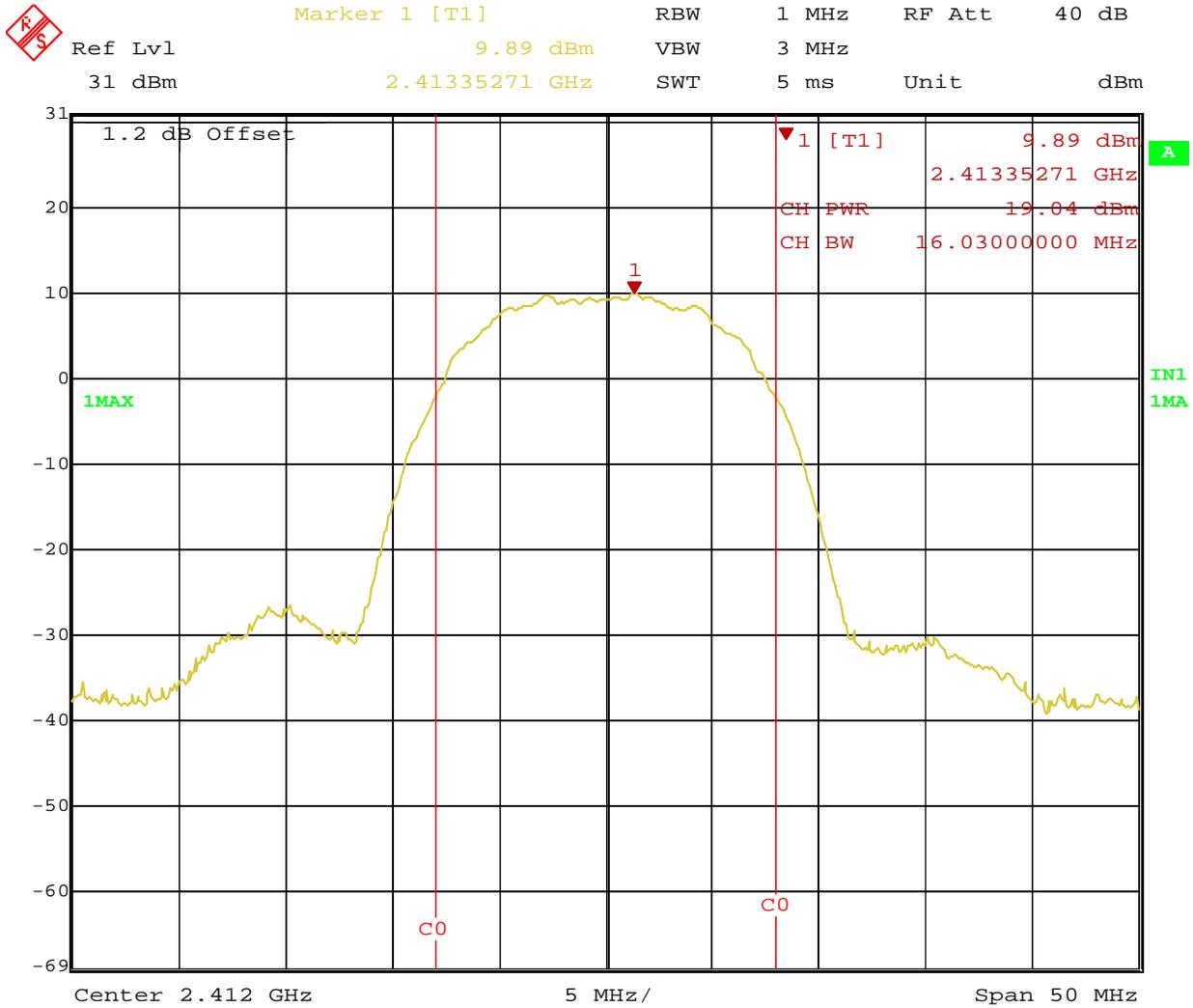


4.1.2 Results

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

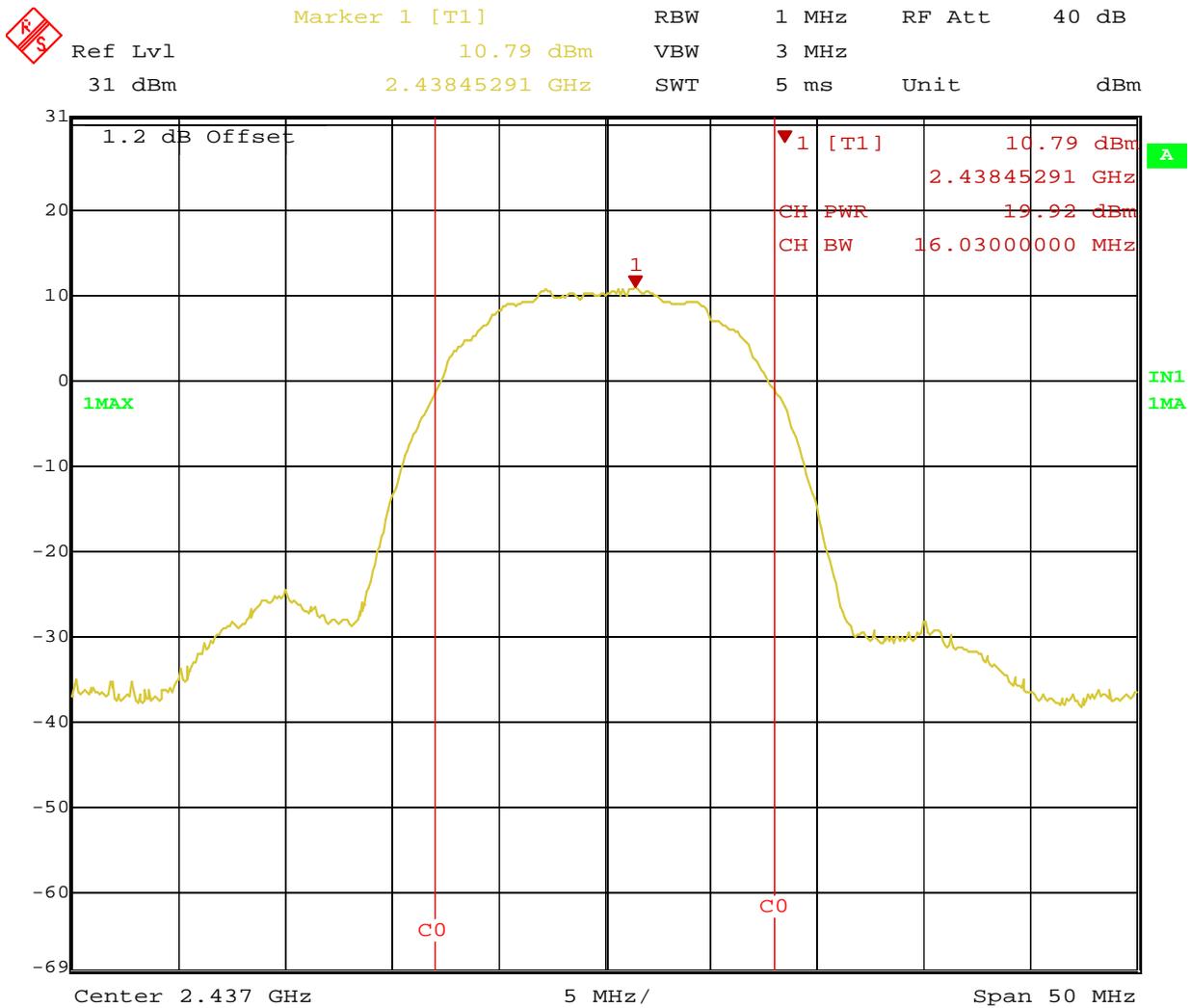
Table 3: RF Power – Test Results

Test Conditions: Conducted Measurement, Normal Temperature					
Antenna Type: Integrated			Power Setting: +15dBm		
Max. Antenna Gain: -0.86dBi			Signal State: Modulated		
Ambient Temp.: 23 °C			Relative Humidity: 35%		
Test Results					
Operating Channel	Limit [dBm]	802.11b Output Level [dBm]	802.11b Margin [dB]	802.11g Output Level [dBm]	802.11g Margin [dB]
2412MHz	+30.00	19.04	-10.96	21.35	-8.65
2437MHz	+30.00	19.92	-10.08	22.63	-7.37
2462MHz	+30.00	20.43	-9.57	22.94	-7.06



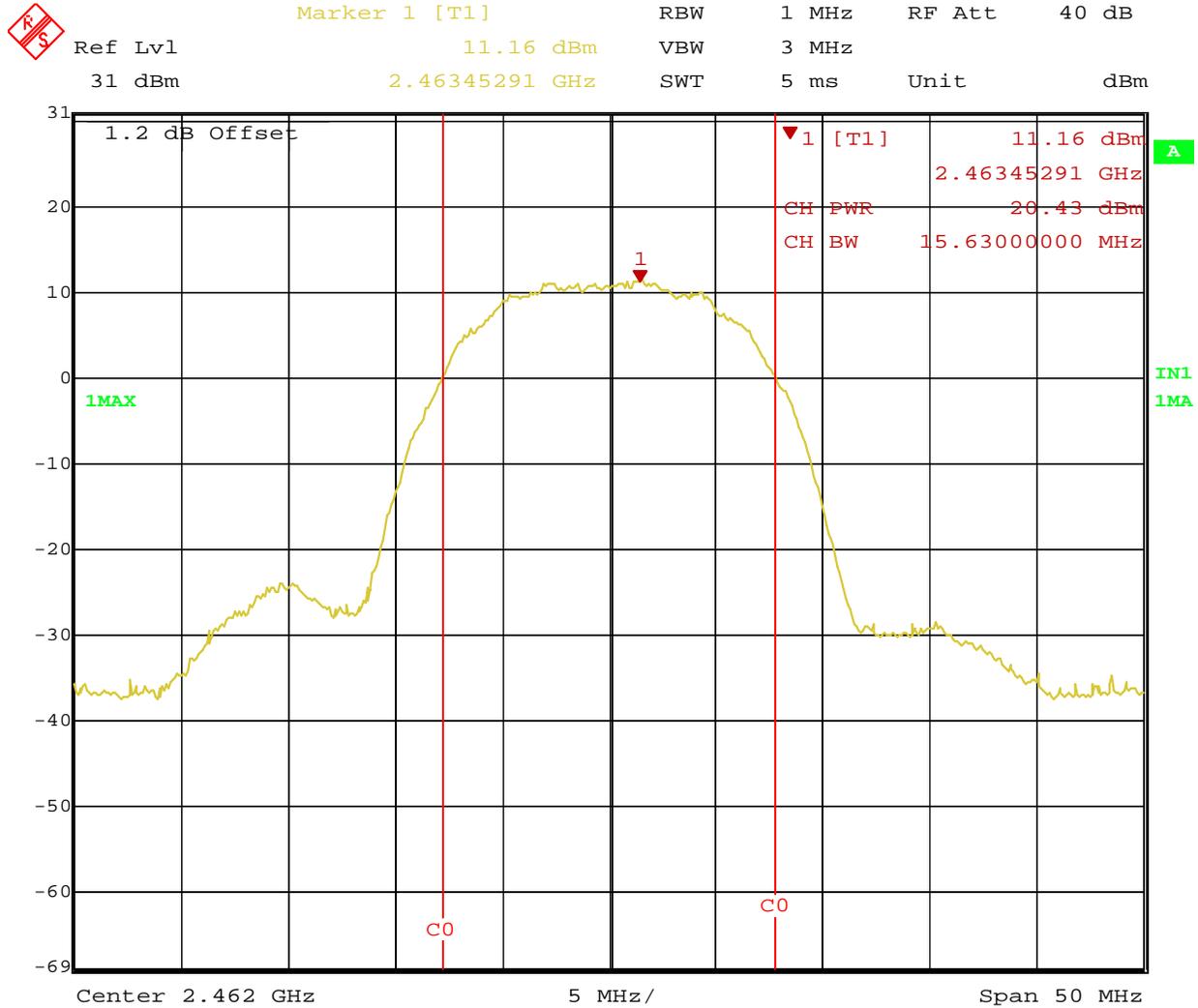
Date: 21.JUL.2009 13:58:37

Figure 1: Maximum Transmitted Power at Lowest Channel 2412MHz – 802.11b Mode



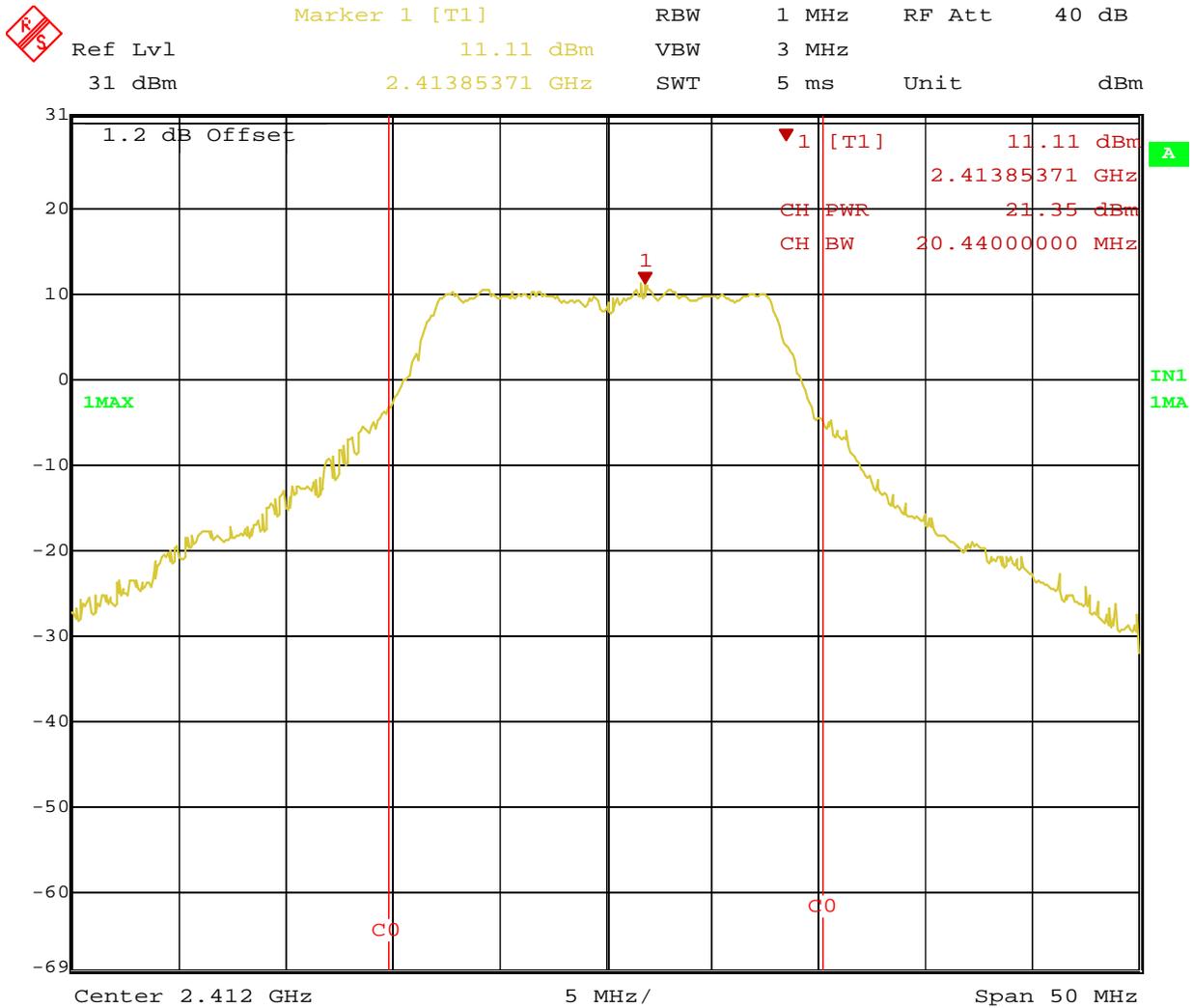
Date: 21.JUL.2009 13:03:16

Figure 2: Maximum Transmitted Power at Middle Channel 2437MHz – 802.11b Mode



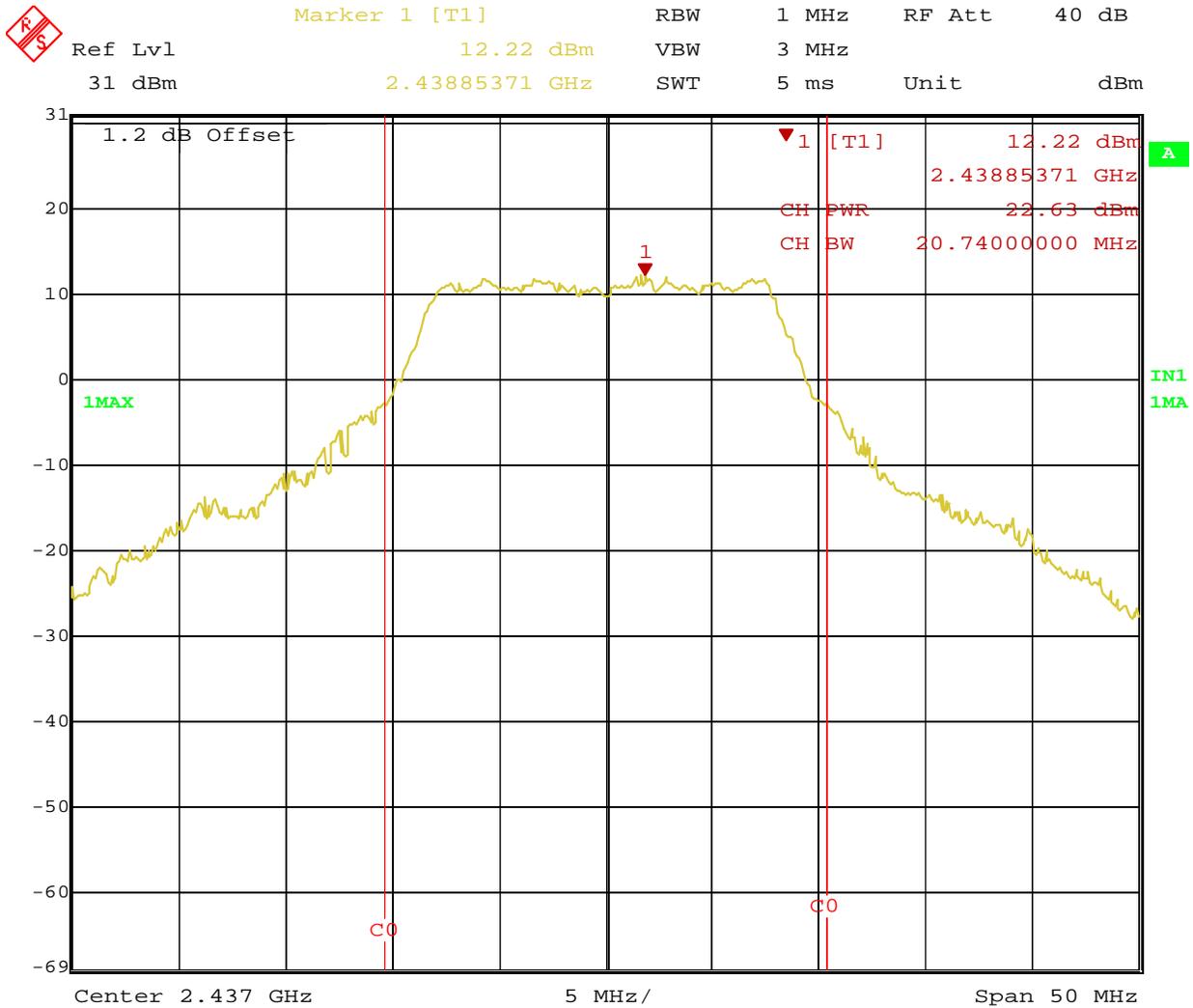
Date: 21.JUL.2009 15:39:02

Figure 3: Maximum Transmitted Power at Highest Channel 2462MHz – 802.11b Mode



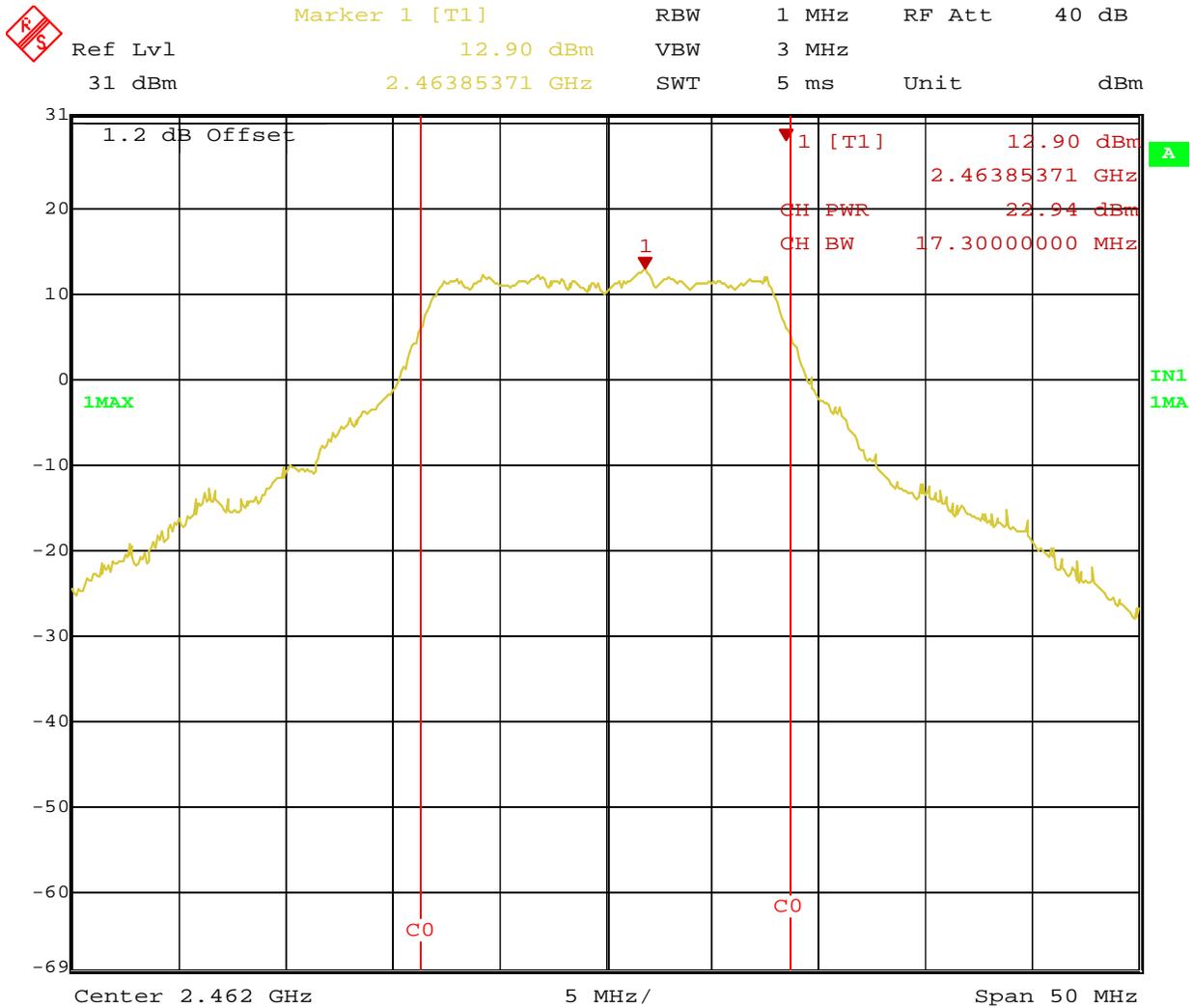
Date: 21.JUL.2009 15:12:00

Figure 4: Maximum Transmitted Power at Lowest Channel 2412MHz – 802.11g Mode



Date: 21.JUL.2009 11:32:33

Figure 5: Maximum Transmitted Power at Highest Channel 2437MHz – 802.11g Mode



Date: 21.JUL.2009 16:01:49

Figure 6: Maximum Transmitted Power at Highest Channel 2462MHz – 802.11g Mode

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 6dB from highest transmitted level of the fundamental frequency.

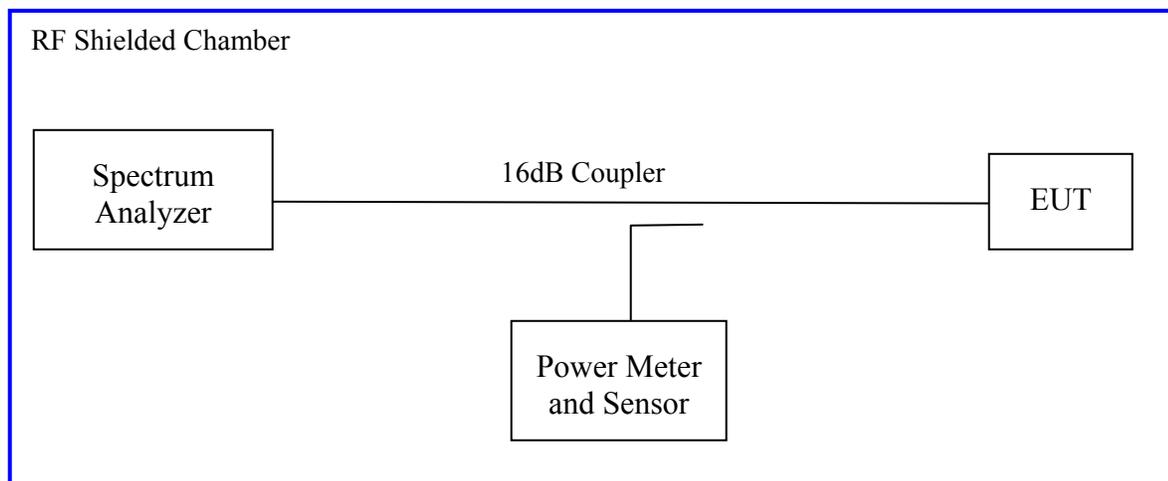
The bandwidth shall be at least 500kHz per Section CFR47 15.2(a2) 2008 and RSS Gen Sect. 4.4.1.

4.2.1 Test Method

The conducted method was used to measure the channel power output.

The measurement was performed with modulation per CFR47 15.2(a2) 2008 and RSS Gen Sect. 4.4.1. This test was conducted on 3 channels of Sample with MAC Address 00:04:20:26:00:74. The worst sample result indicated below.

Test Setup:



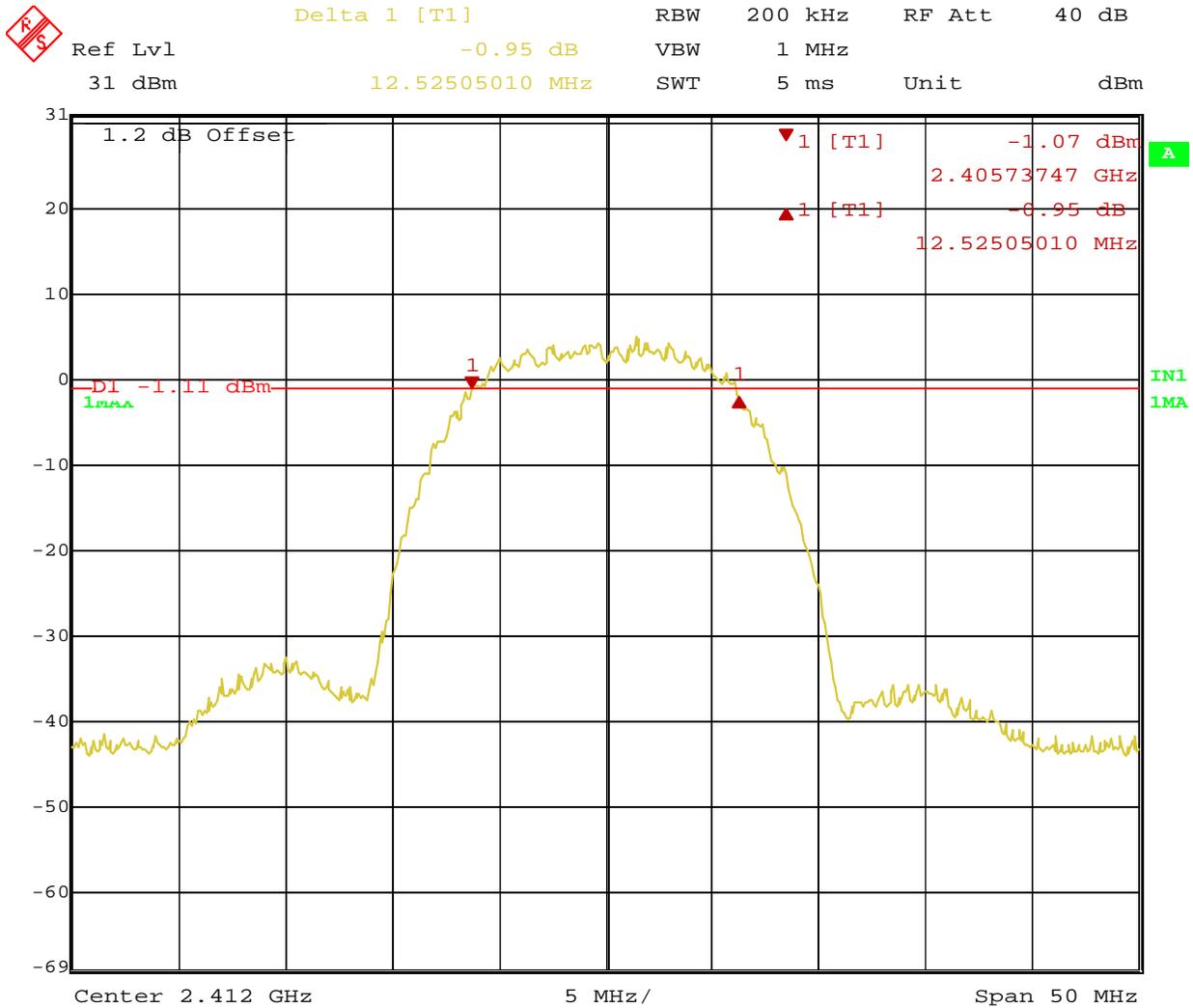
4.2.2 Results

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

Table 4: Occupied Bandwidth – Test Results

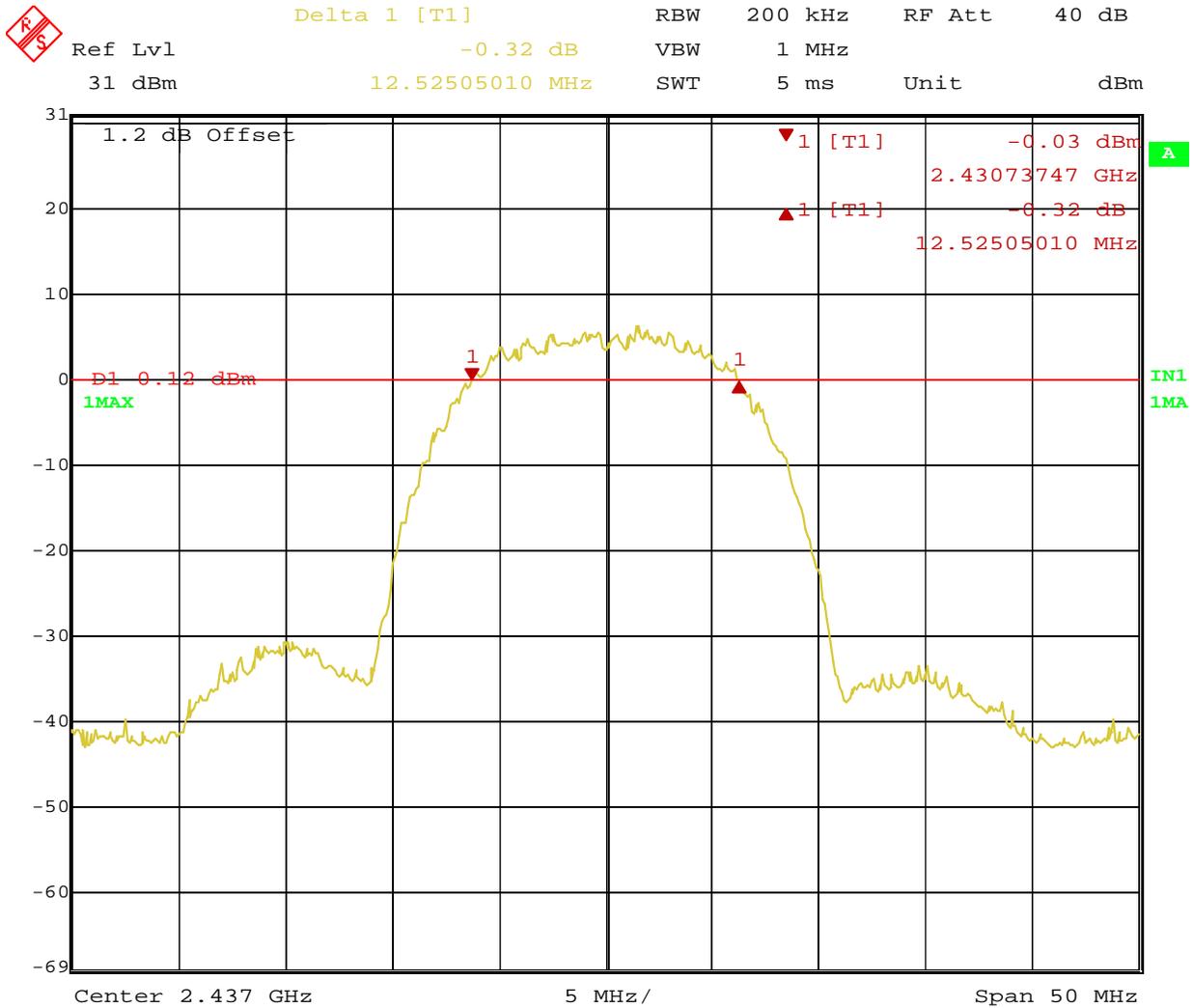
Test Conditions: Conducted Measurement, Normal Temperature and Voltage only				
Antenna Type: Integrated		Power Setting: +15dBm		
Max. Antenna Gain: -0.86dBi		Signal State: Modulated		
Ambient Temp.: 23 °C		Relative Humidity: 35%		
99% Bandwidth (MHz)				
Operating Channel	Limit	802.11b	802.11g	Results
2412 MHz	Na	15.63126253	17.03406814	Na
2437 MHz	Na	15.63126253	17.03406814	Na
2462 MHz	Na	15.63126253	17.03406814	Na
6dB Bandwidth (MHz)				
Operating Channel	Limit	802.11b	802.11g	Results
2412 MHz	500kHz	12.52505010	16.73346693	Pass
2437 MHz	500kHz	12.52505010	16.73346693	Pass
2462 MHz	500kHz	12.52505010	16.73346693	Pass

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



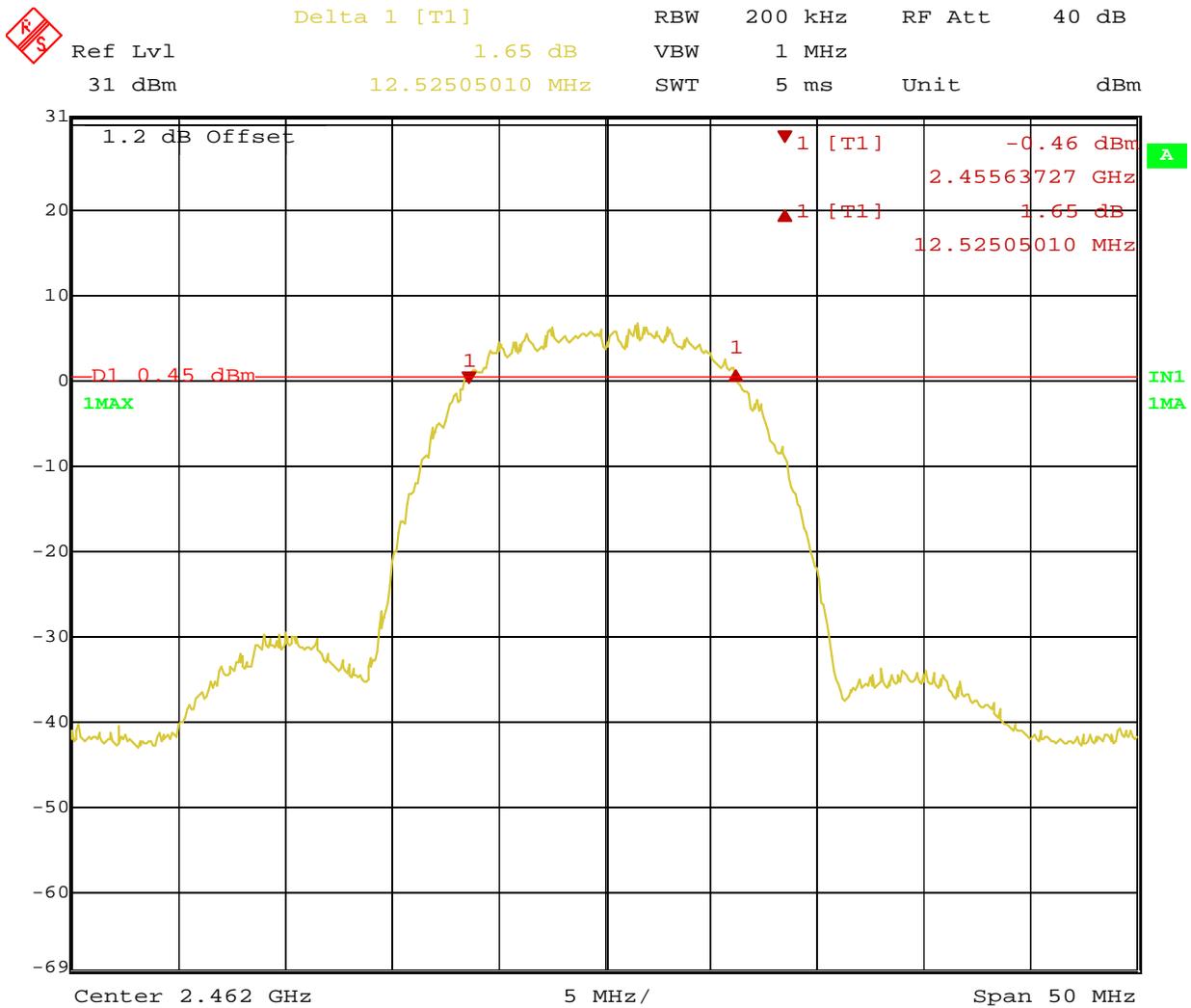
Date: 27.JUL.2009 12:55:16

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



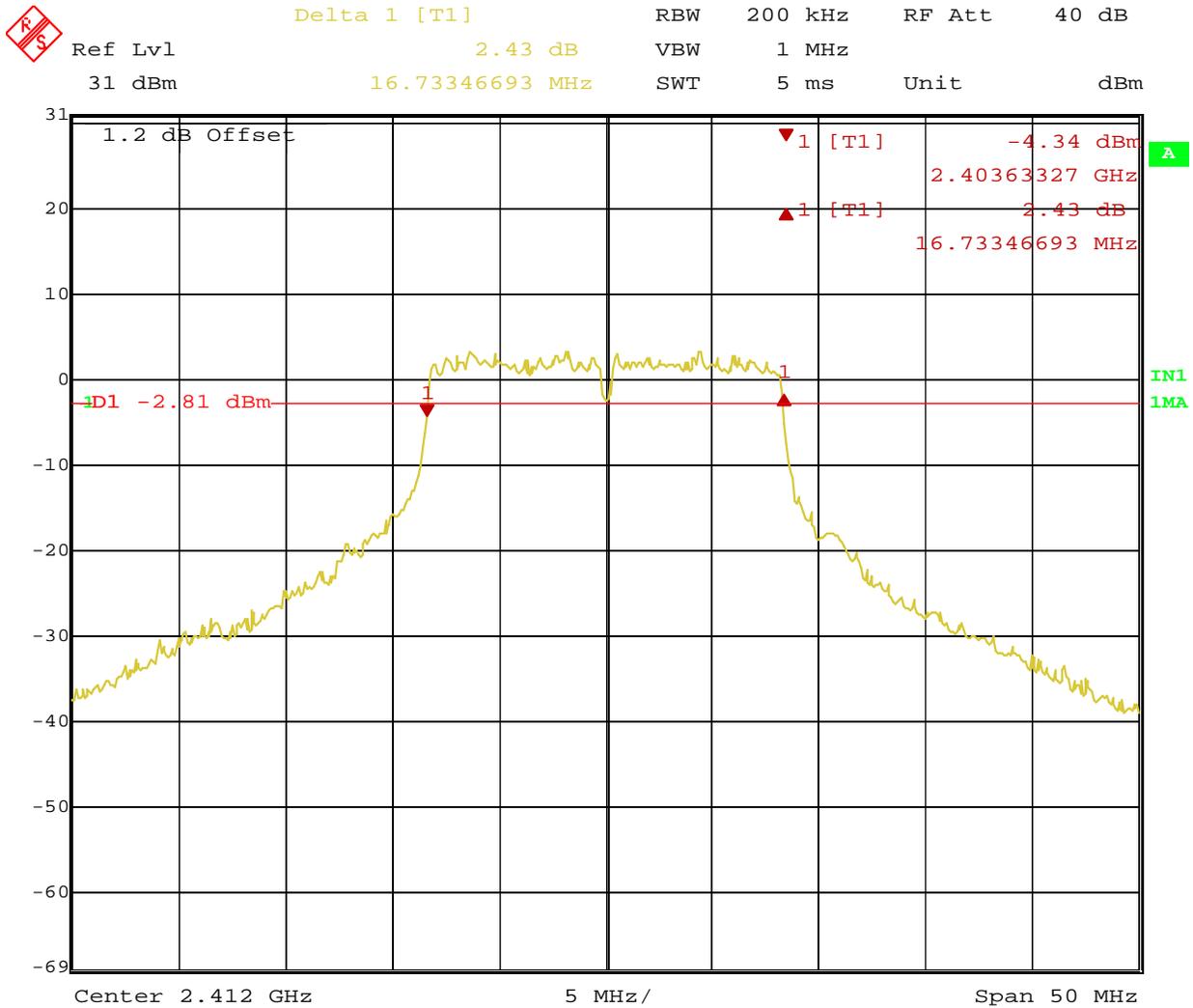
Date: 21.JUL.2009 12:58:08

Figure 8: 6dB Bandwidth at 11Mbit/s – Operating Channel 2437 MHz



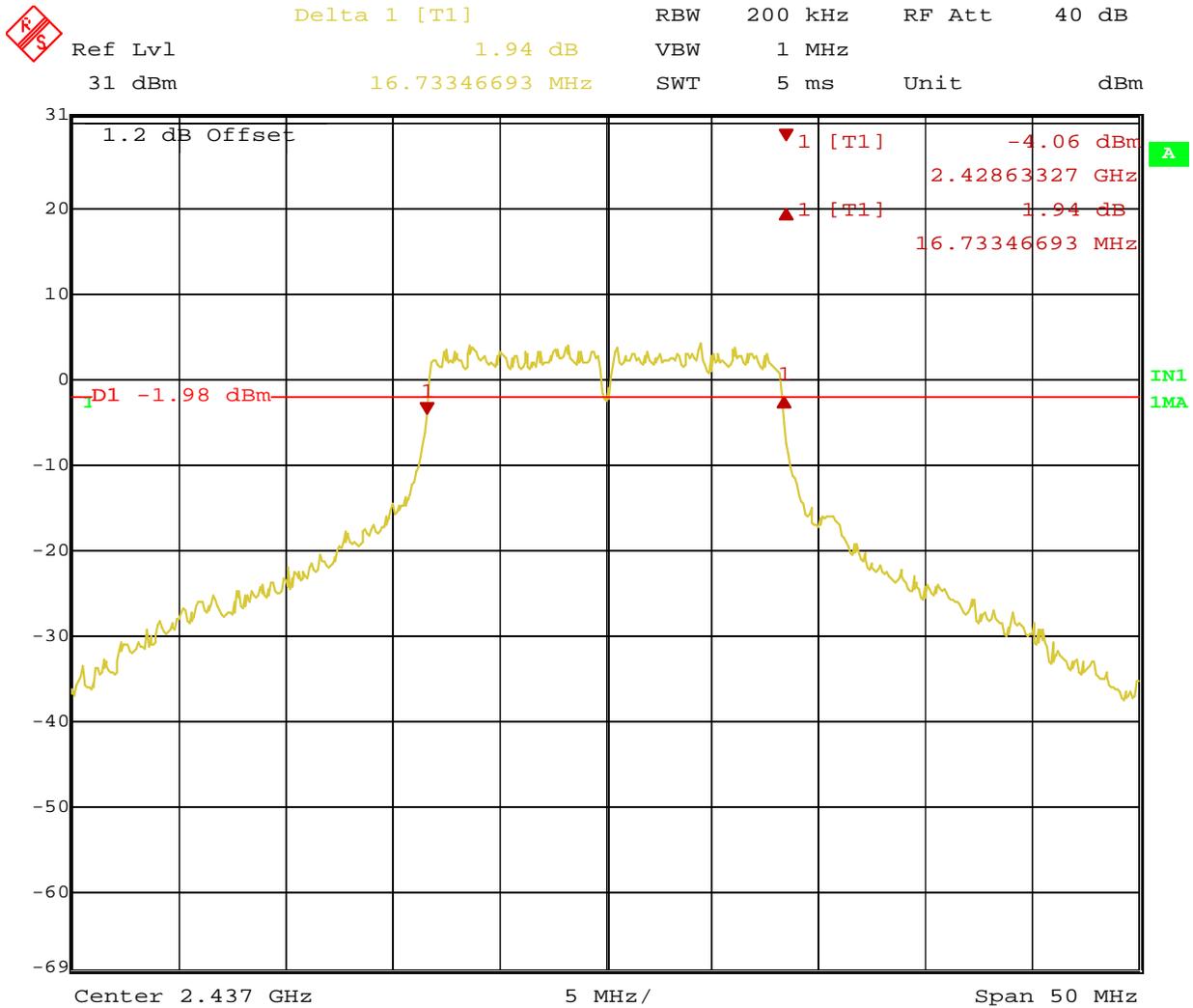
Date: 21.JUL.2009 15:35:56

Figure 9: 6dB Bandwidth at 11Mbit/s – Operating Channel 2462 MHz



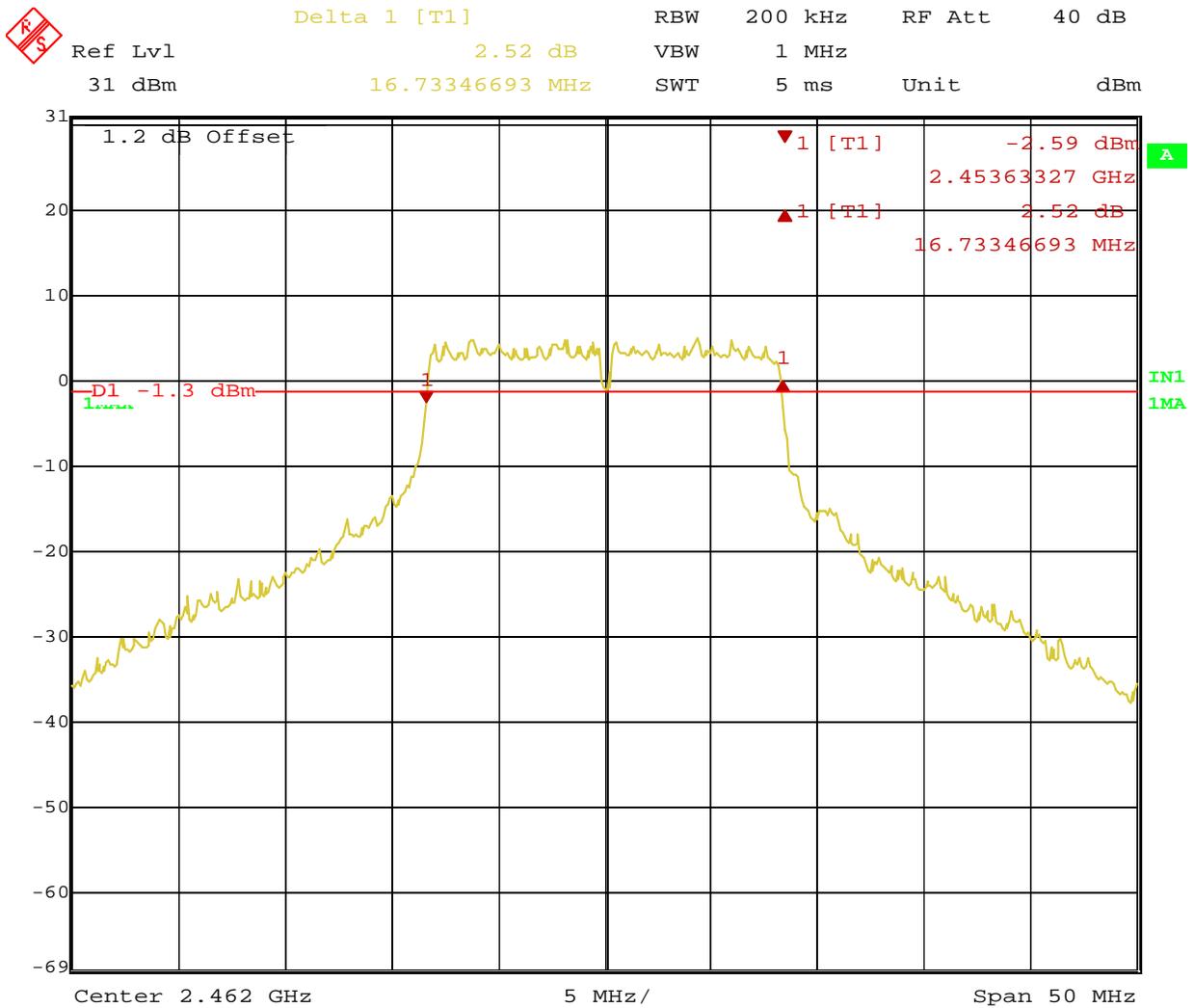
Date: 21.JUL.2009 15:09:33

Figure 10: 6dB Bandwidth at 54Mbit/s – Operating Channel 2412 MHz



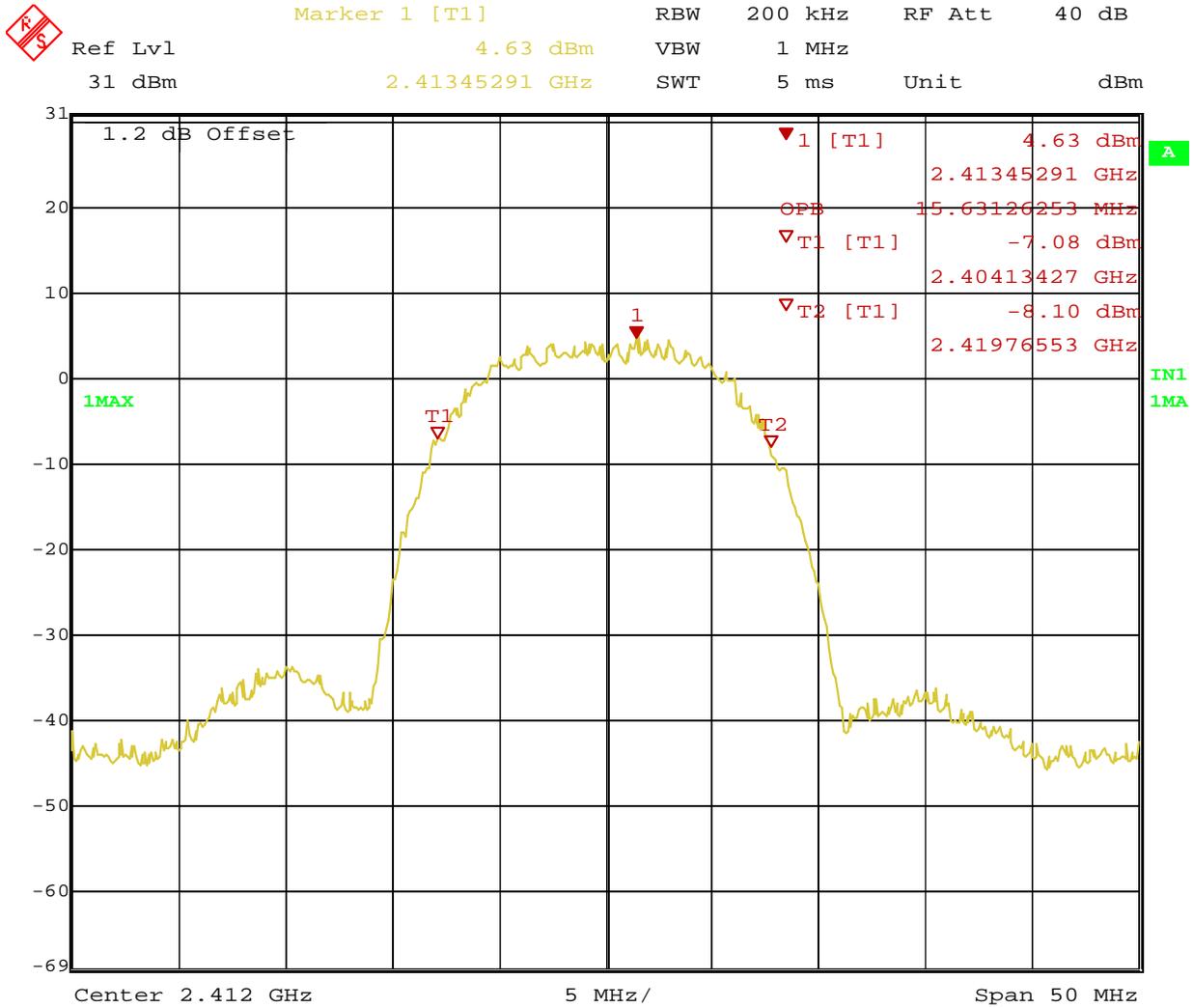
Date: 27.JUL.2009 12:58:10

Figure 11: 6dB Bandwidth at 54Mbit/s – Operating Channel 2437 MHz



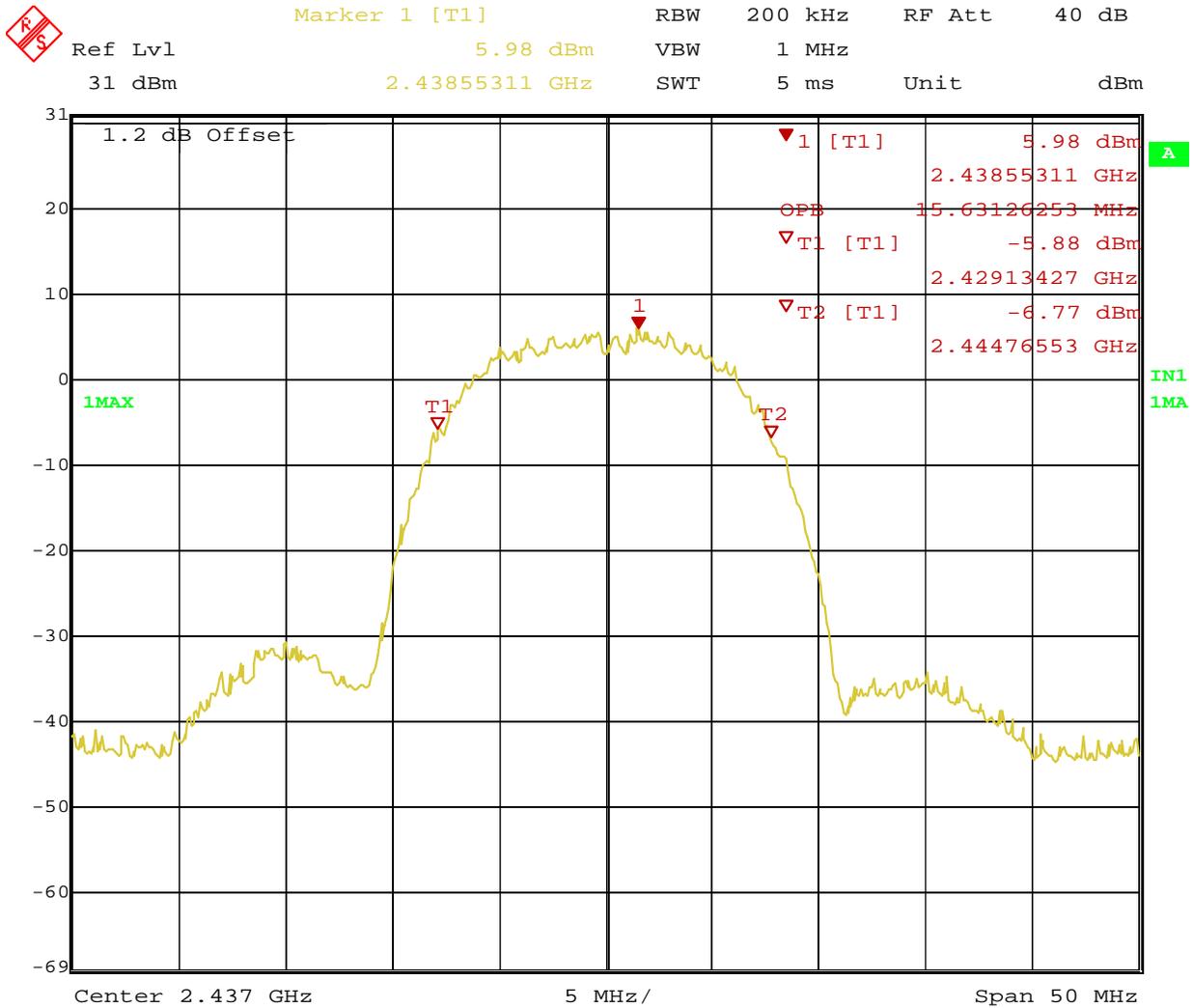
Date: 21.JUL.2009 15:59:10

Figure 12: 6dB Bandwidth at 54Mbit/s – Operating Channel 2462 MHz



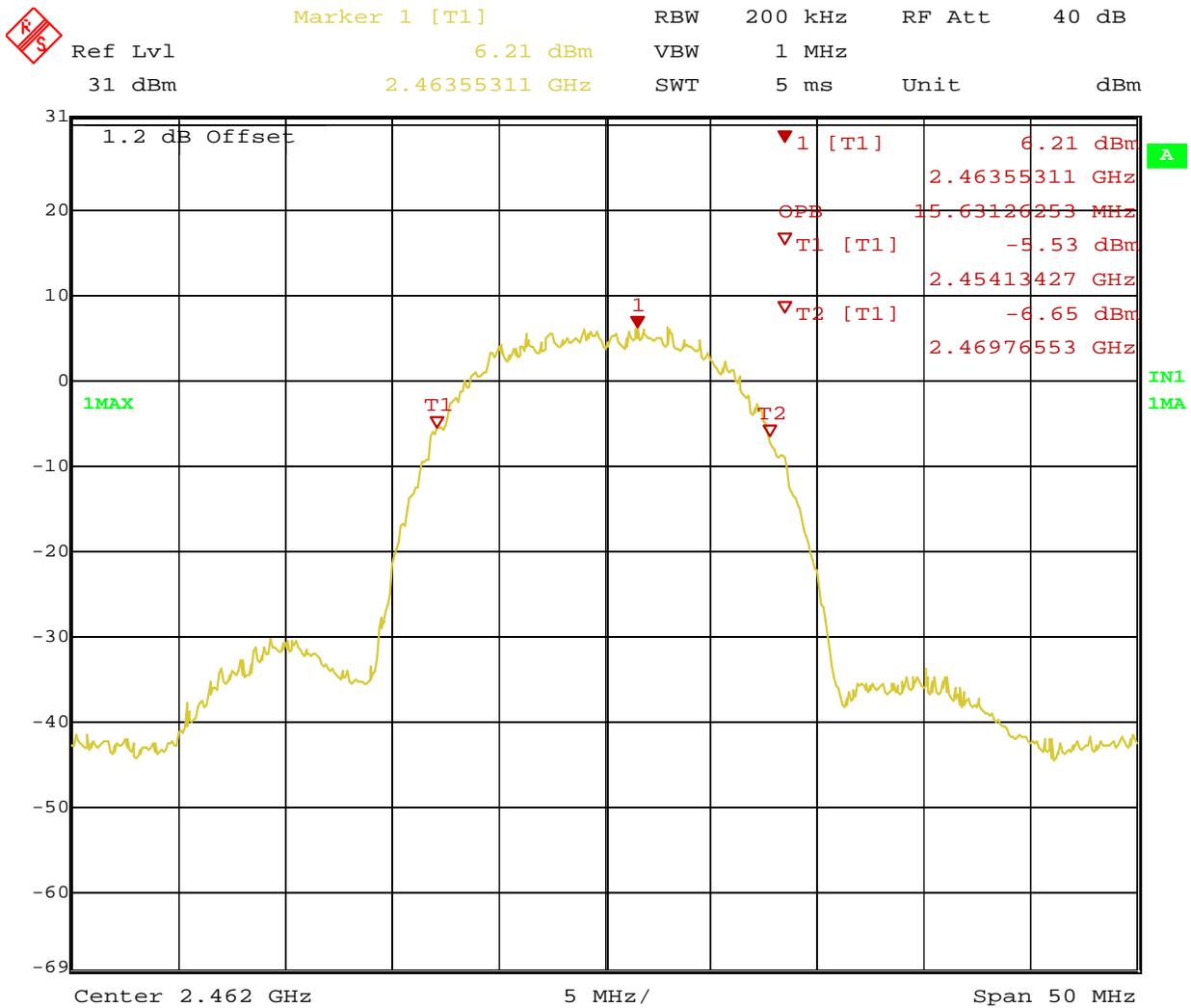
Date: 21.JUL.2009 13:41:31

Figure 13: 99% Bandwidth at 11Mbit/s – Operating Channel 2412 MHz



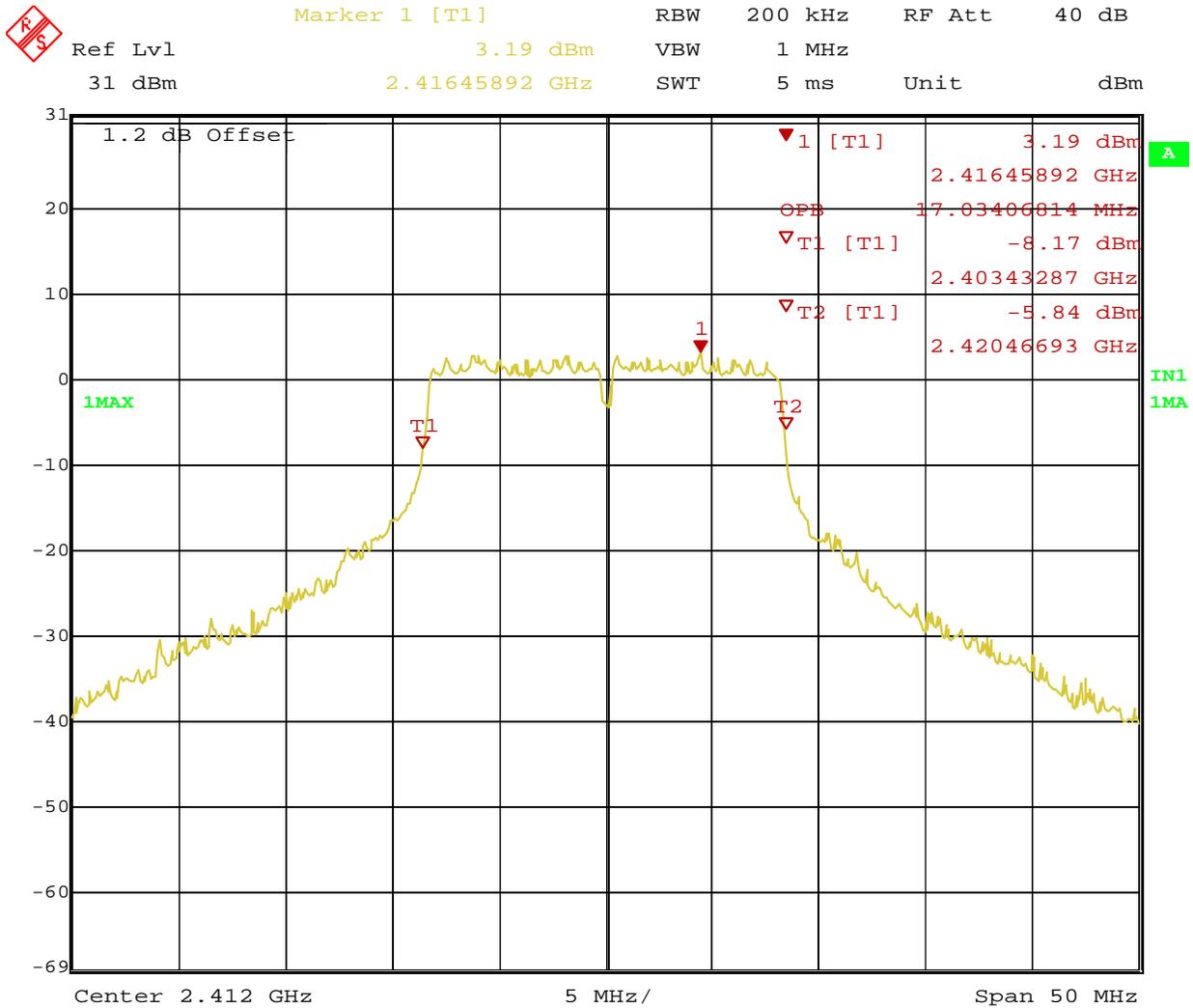
Date: 21.JUL.2009 12:56:39

Figure 14: 99% Bandwidth at 11Mbit/s – Operating Channel 2437 MHz



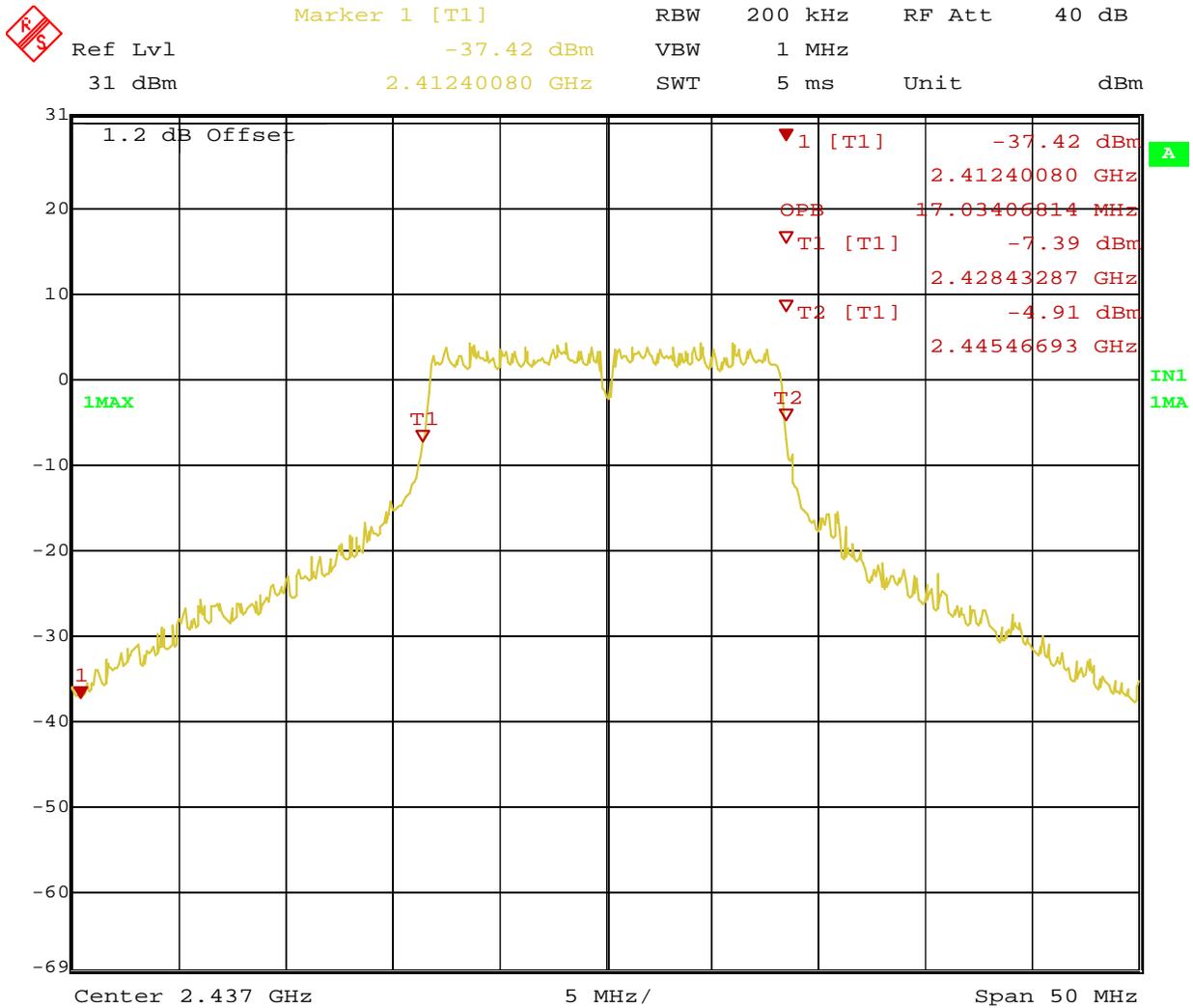
Date: 21.JUL.2009 15:32:31

Figure 15: 99% Bandwidth at 11Mbit/s – Operating Channel 2462 MHz



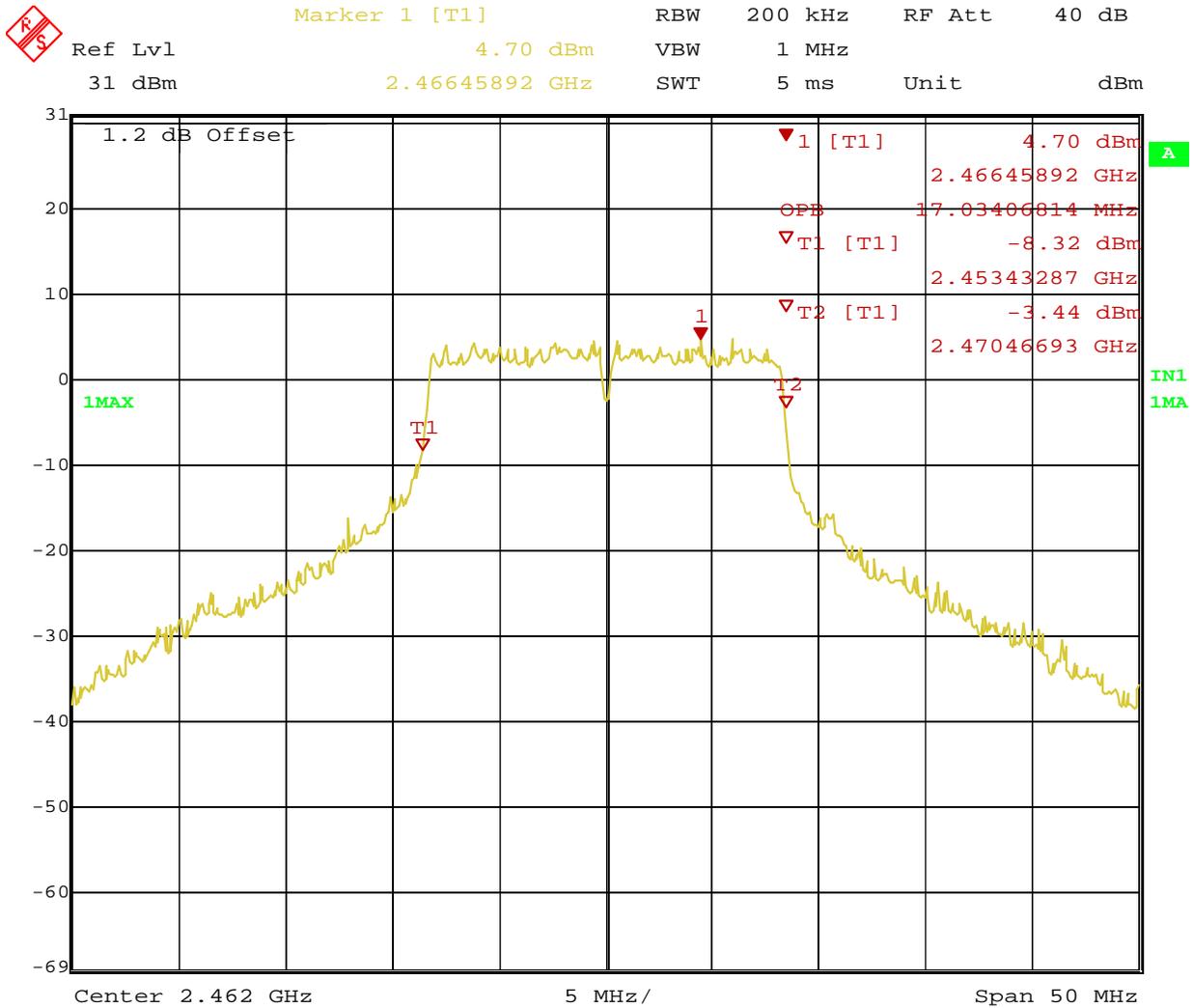
Date: 21.JUL.2009 15:07:59

Figure 16: 99% Bandwidth at 54Mbit/s – Operating Channel 2412 MHz



Date: 21.JUL.2009 11:29:03

Figure 17: 99% Bandwidth at 54Mbit/s – Operating Channel 2437 MHz



Date: 21.JUL.2009 15:57:46

Figure 18: 99% Bandwidth at 54Mbit/s – Operating Channel 2462 MHz

4.3 Band-edge Requirements

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

Any frequency outside the band of 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 Requirements – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only				
Antenna Type: Integrated		Power Setting: +15dBm		
Signal State: Modulated		Data Rate: 11Mbit/s and 54Mbit/s		
Ambient Temp.: 23 °C		Relative Humidity: 35 %		
Band-Edge Results				
Operating Channel	Mode	Band-edge Level (dBm)	20dBr Level (dBm)	Margin (dB)
2412 MHz	11Mbit/s	-37.73	-17.33	-20.40
2462 MHz	11Mbit/s	-48.32	-15.68	-32.64
2412 MHz	54Mbit/s	-22.25	-17.96	-4.29
2462 MHz	54Mbit/s	-34.57	-16.49	-18.08

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

Table 6: Out of band Emission – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only					
Antenna Type: Integrated			Power Setting: +15dBm		
Signal State: Modulated			Data Rate: 11Mbit/s and 54Mbit/s		
Ambient Temp.: 23 °C			Relative Humidity: 35 %		
Output of Band Results					
Operating Channel	Mode	Band 1 30MHz-2.4835GHz	Band 2 2.4835GHz-10GHz	Band 3 10GHz-25GHz	Result
2412 MHz	11Mbit/s	Figure 23	Figure 24	Figure 25	Pass
2437 MHz	11Mbit/s	Figure 26	Figure 27	Figure 28	Pass
2462 MHz	11Mbit/s	Figure 29	Figure 30	Figure 31	Pass
2412 MHz	54Mbit/s	Figure 32	Figure 33	Figure 34	Pass
2437 MHz	54Mbit/s	Figure 35	Figure 36	Figure 37	Pass
2462 MHz	54Mbit/s	Figure 38	Figure 39	Figure 40	Pass

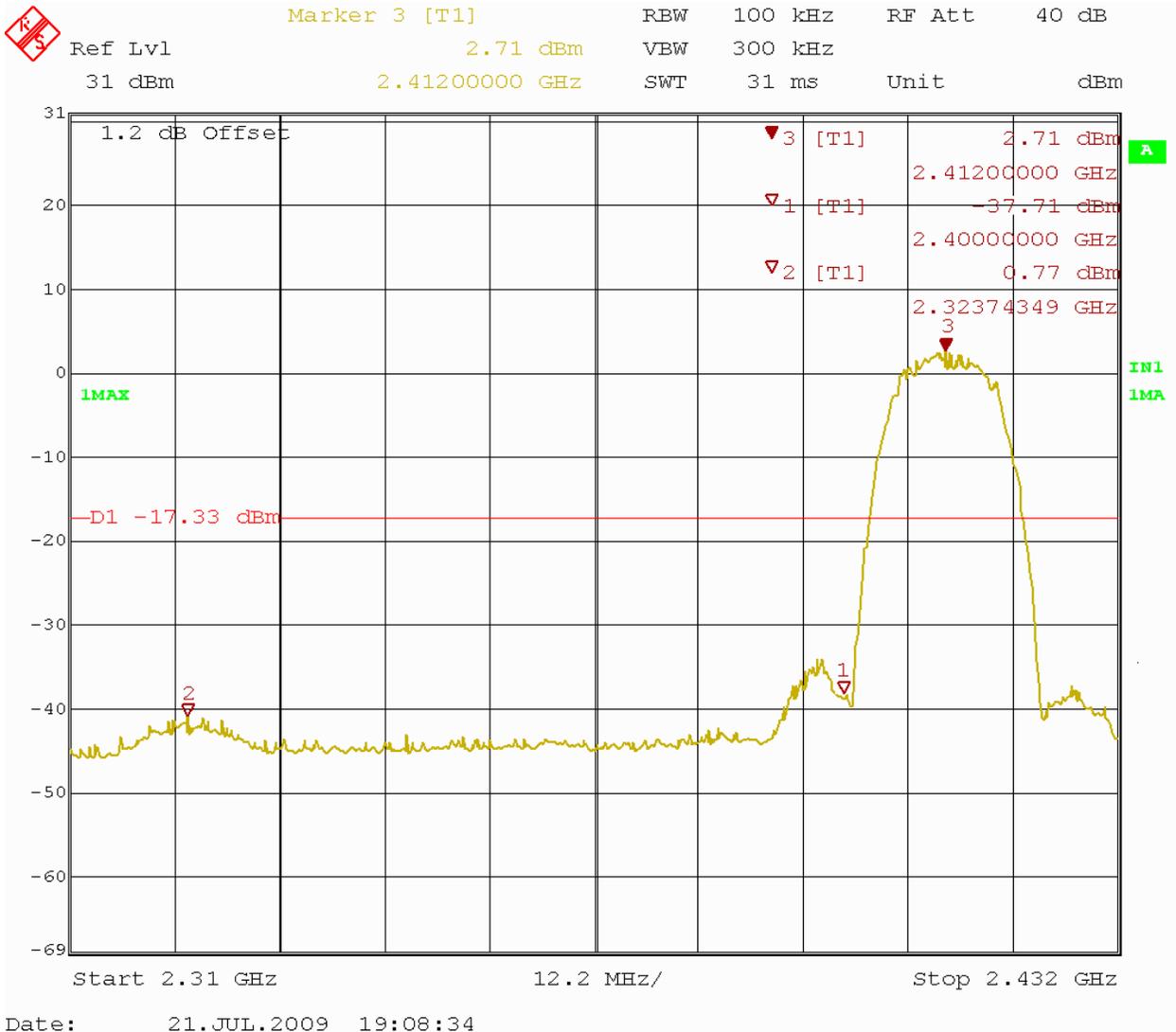
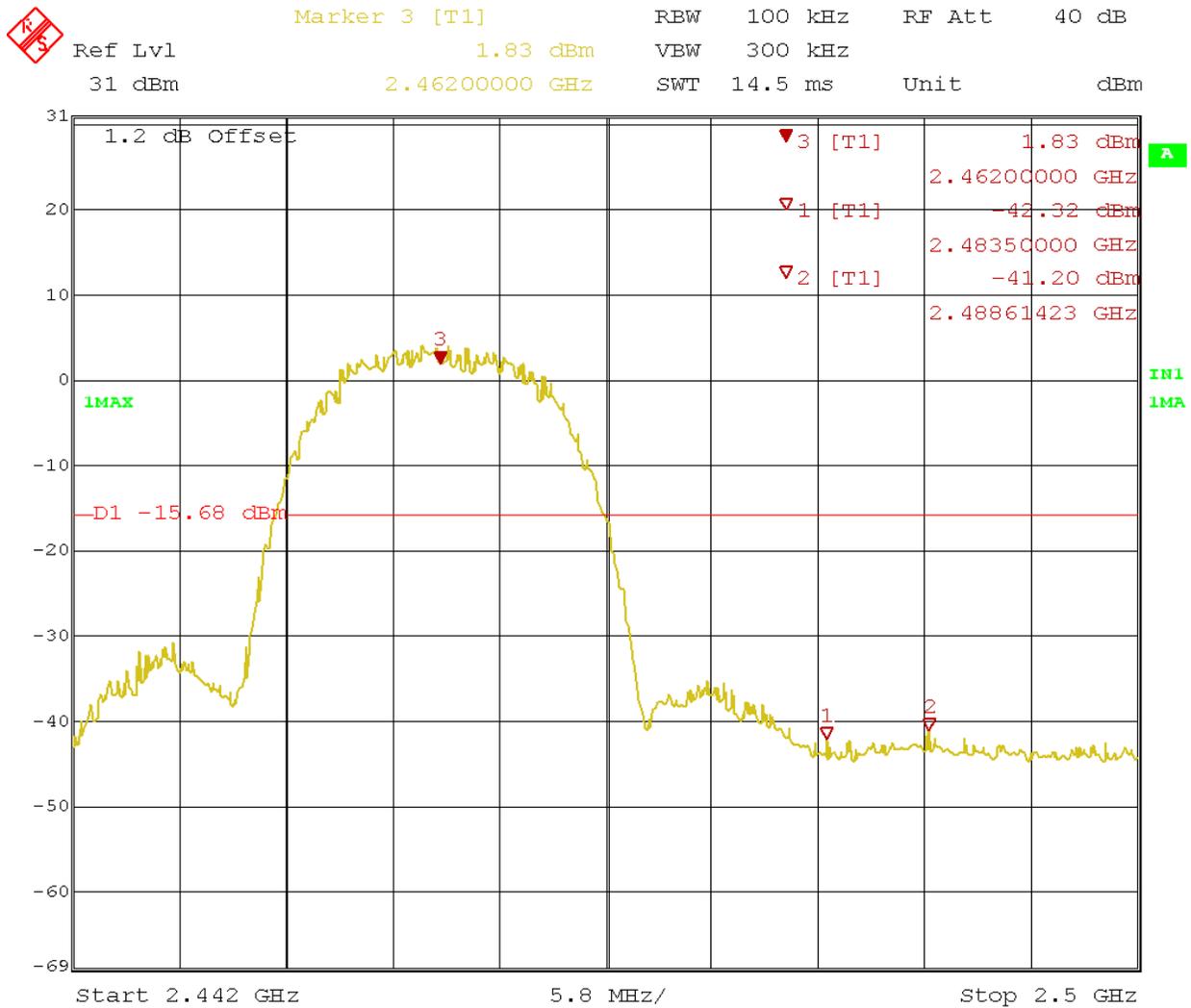
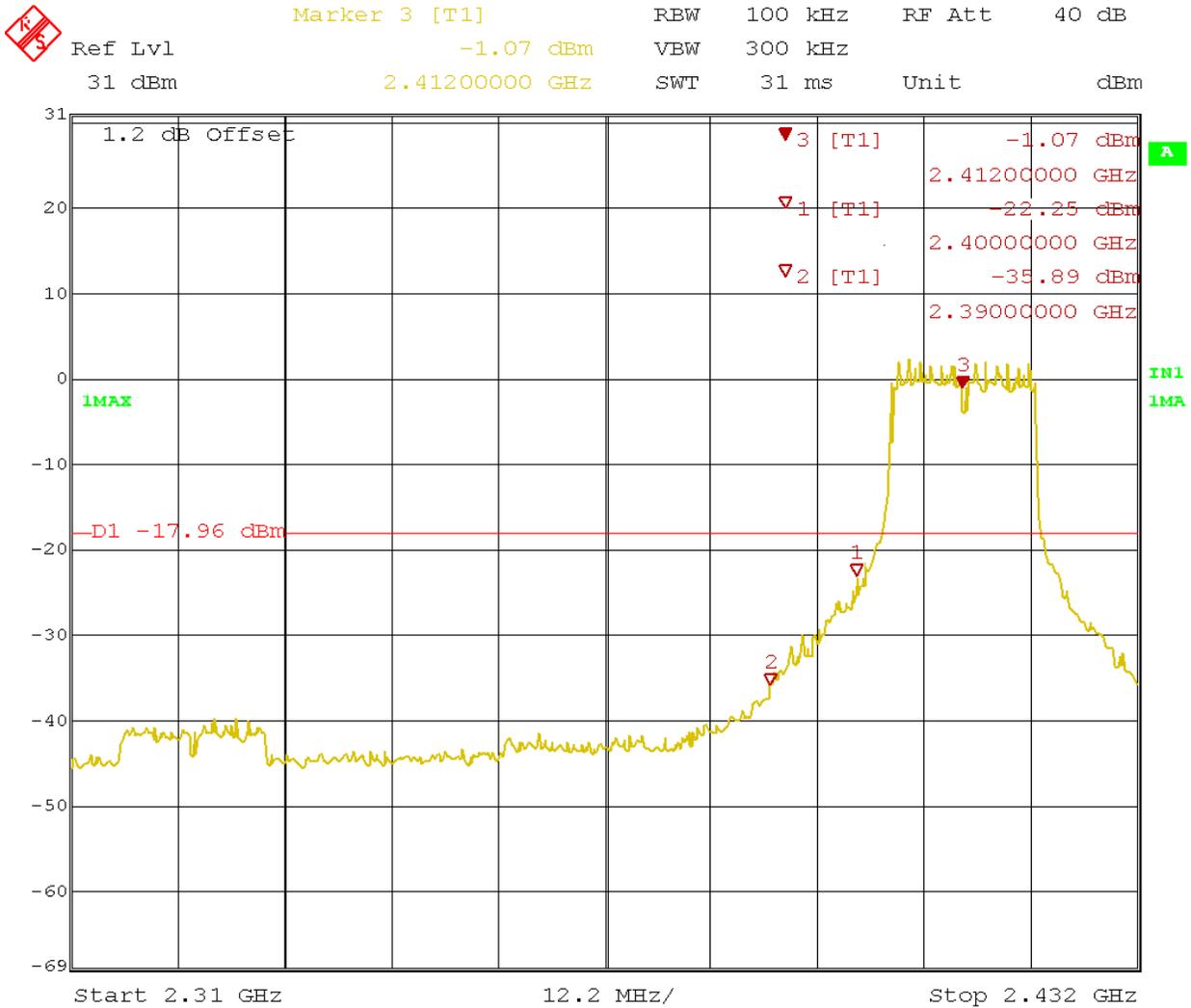


Figure 19: Band-edge Requirement for Operating Channel 2412 MHz – 802.11b



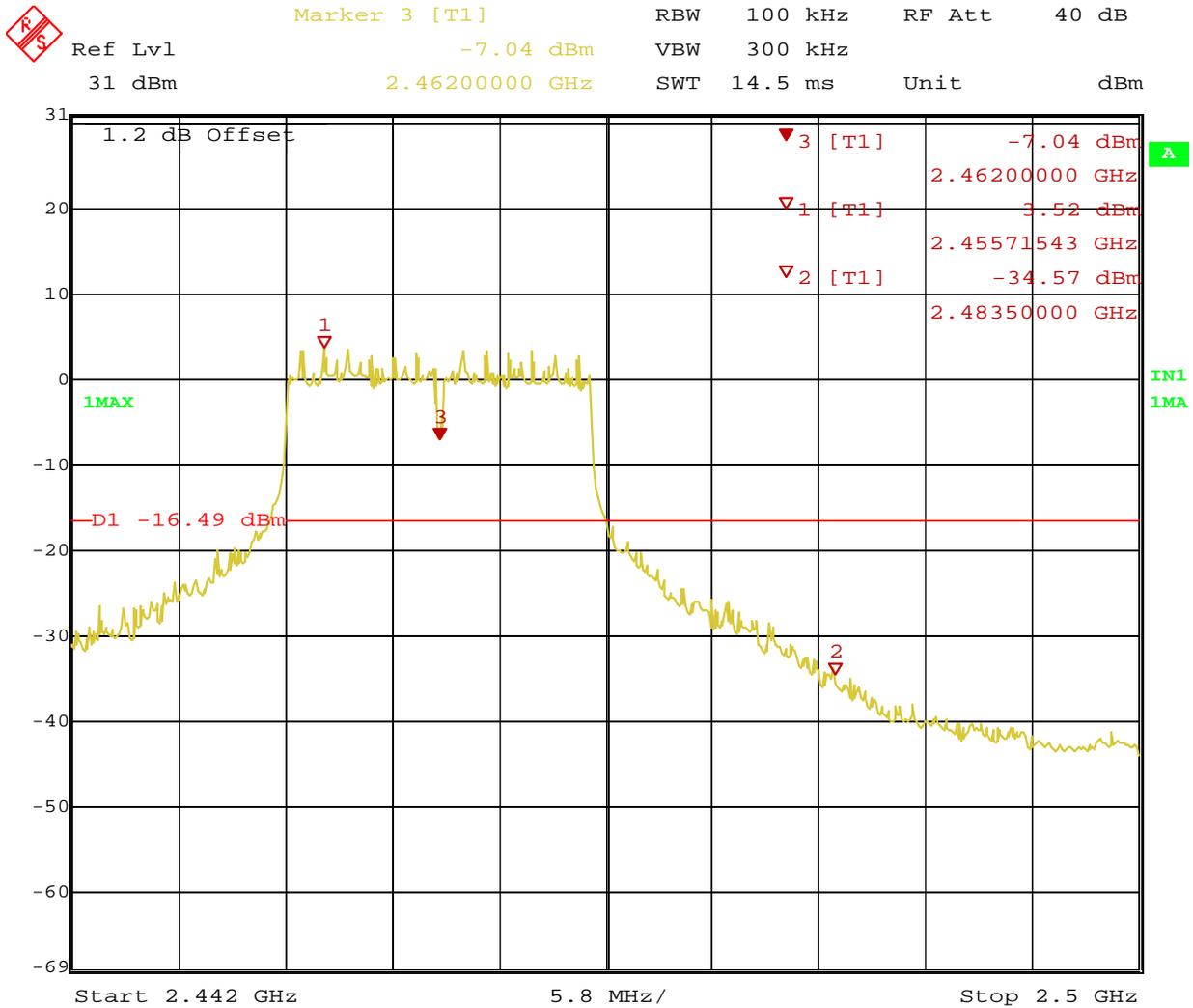
Date: 21.JUL.2009 19:53:19

Figure 20: Band-edge Requirement for Operating Channel 2462 MHz – 802.11b



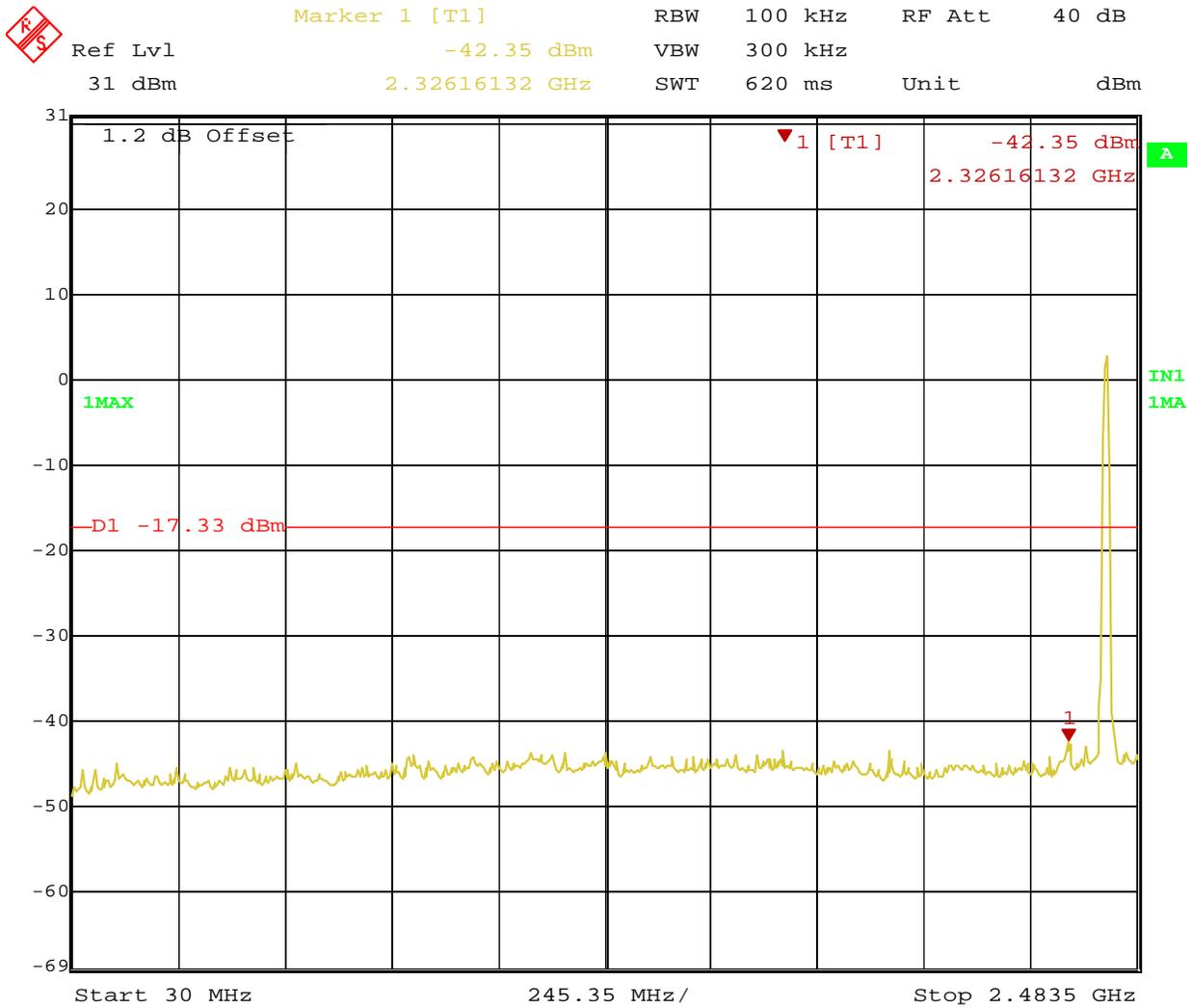
Date: 21.JUL.2009 19:25:34

Figure 21: Band-edge Requirement for Operating Channel 2412 MHz – 802.11g



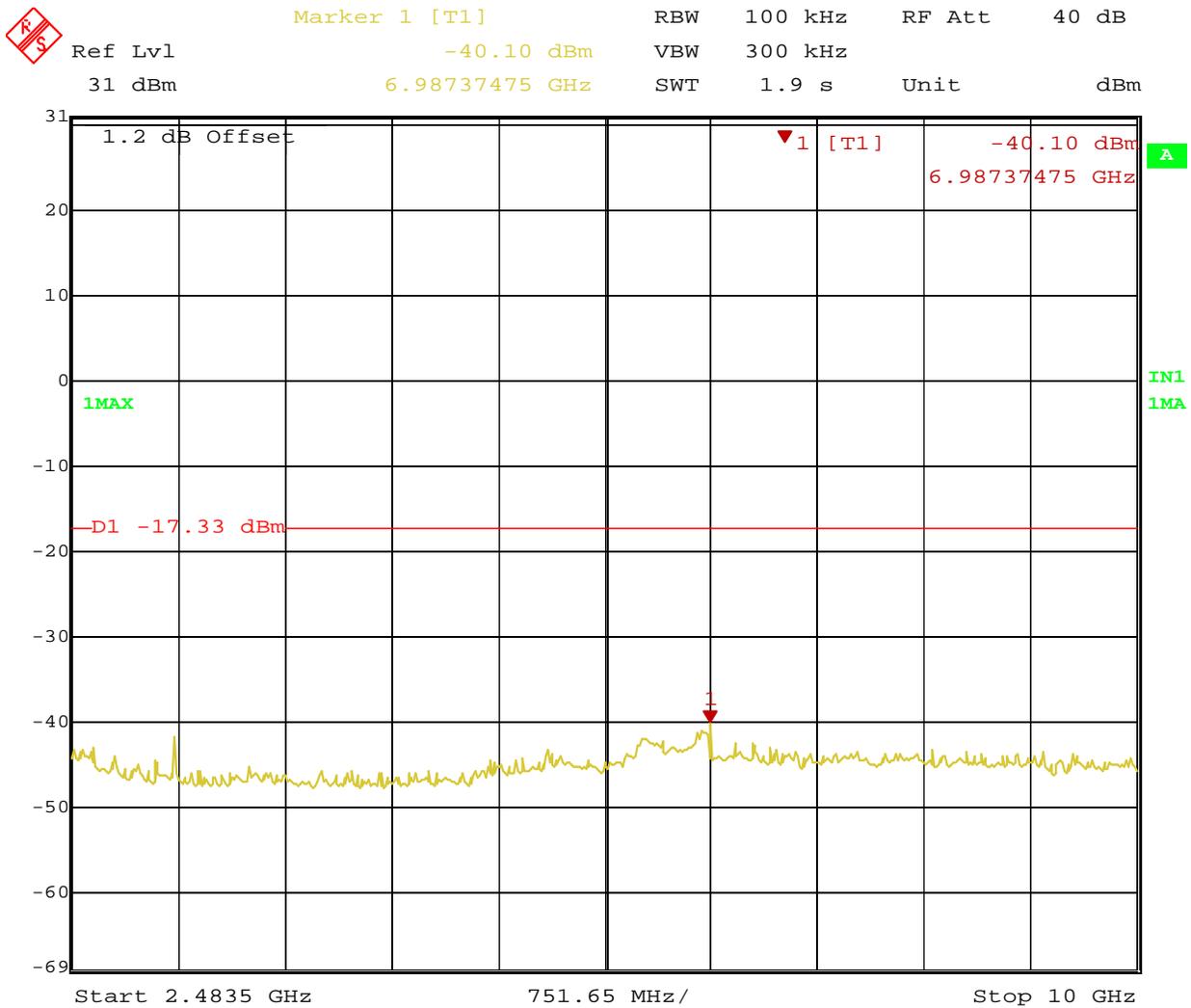
Date: 21.JUL.2009 20:01:12

Figure 22: Band-edge Requirement for Operating Channel 2462 MHz – 802.11g



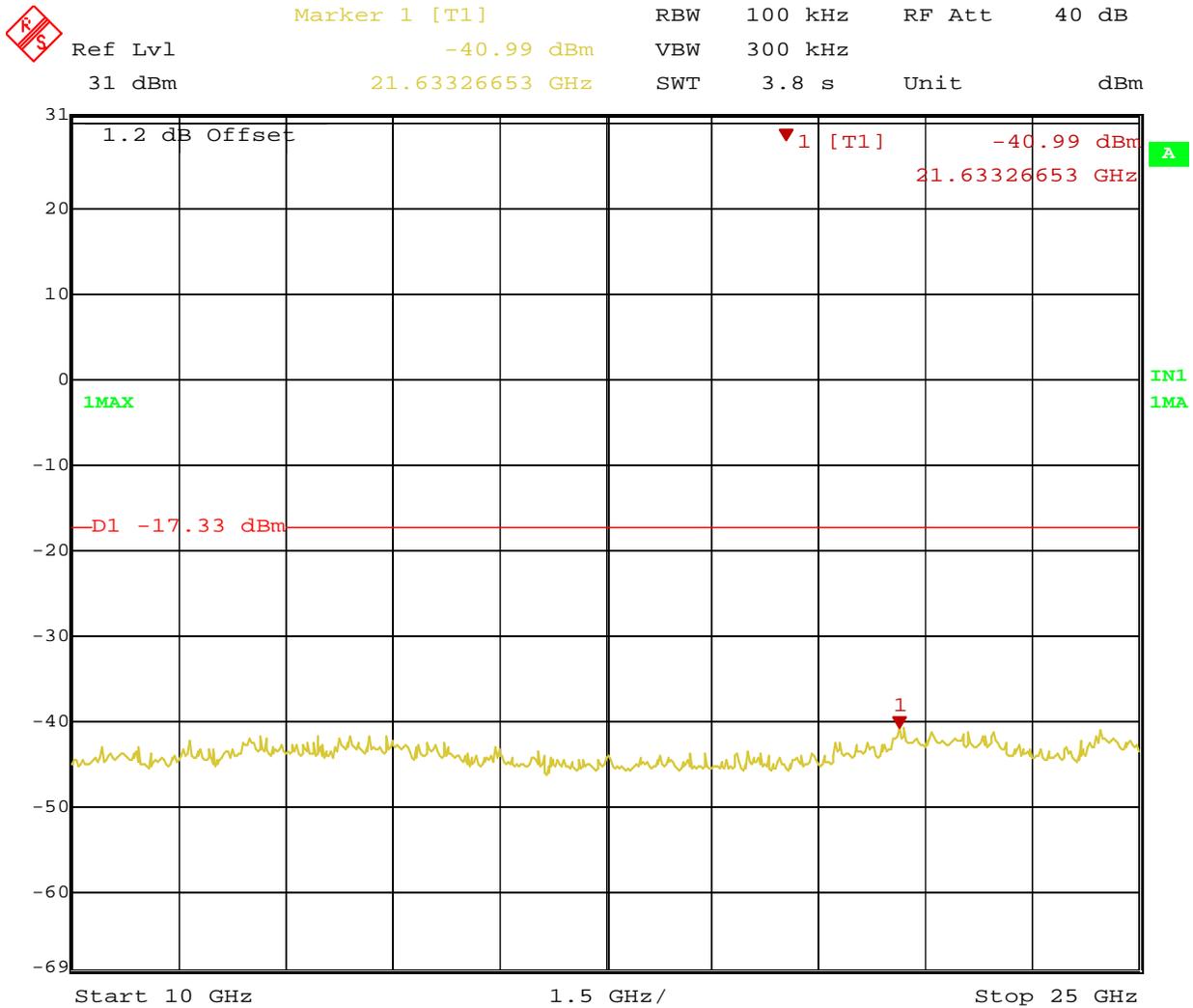
Date: 21.JUL.2009 19:14:50

Figure 23: Out of Band Emission for Channel 2412 MHz at 11Mbit/s – Band 1



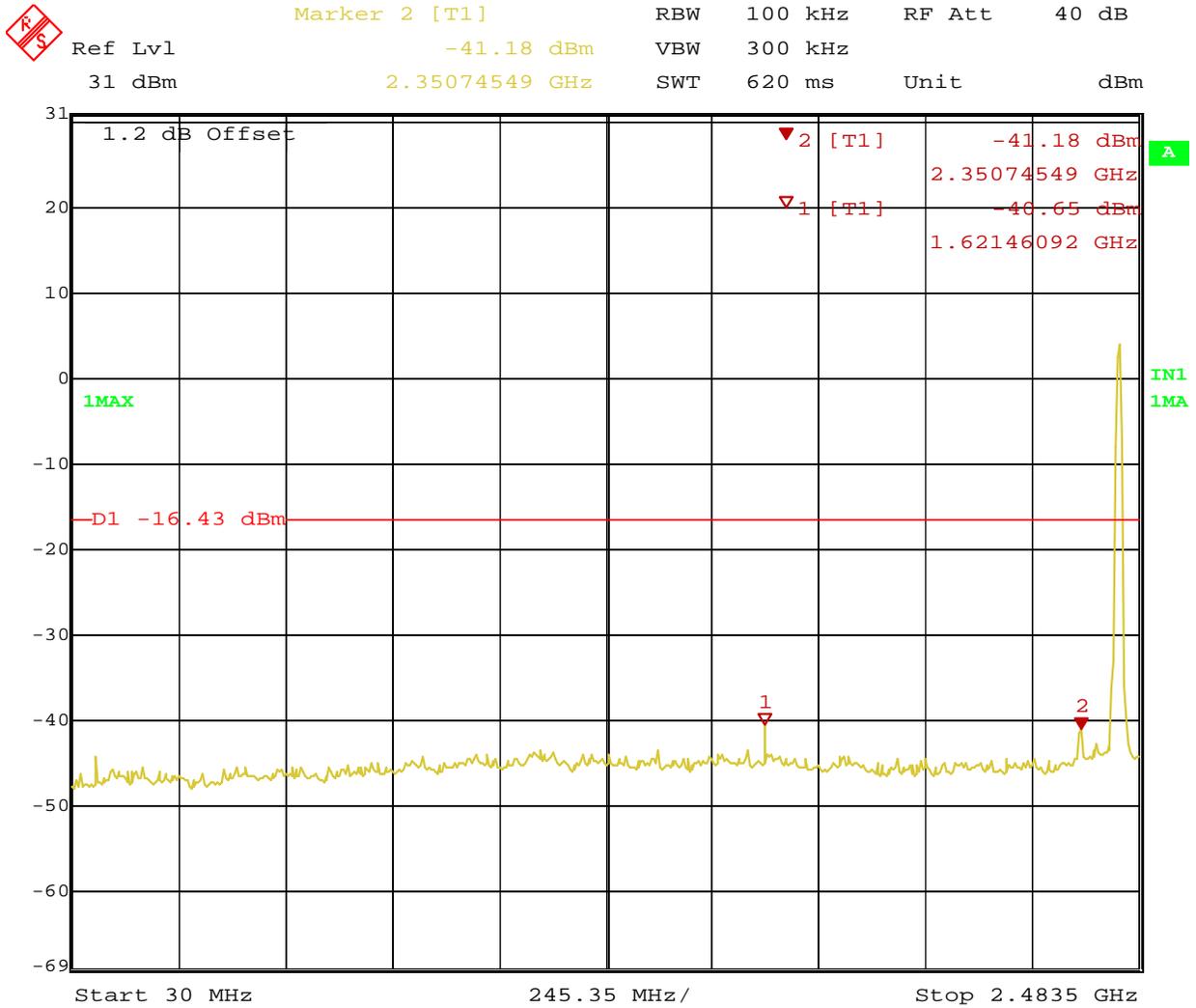
Date: 21.JUL.2009 19:13:40

Figure 24: Out of Band Emission for Channel 2412 MHz at 11Mbit/s – Band 2



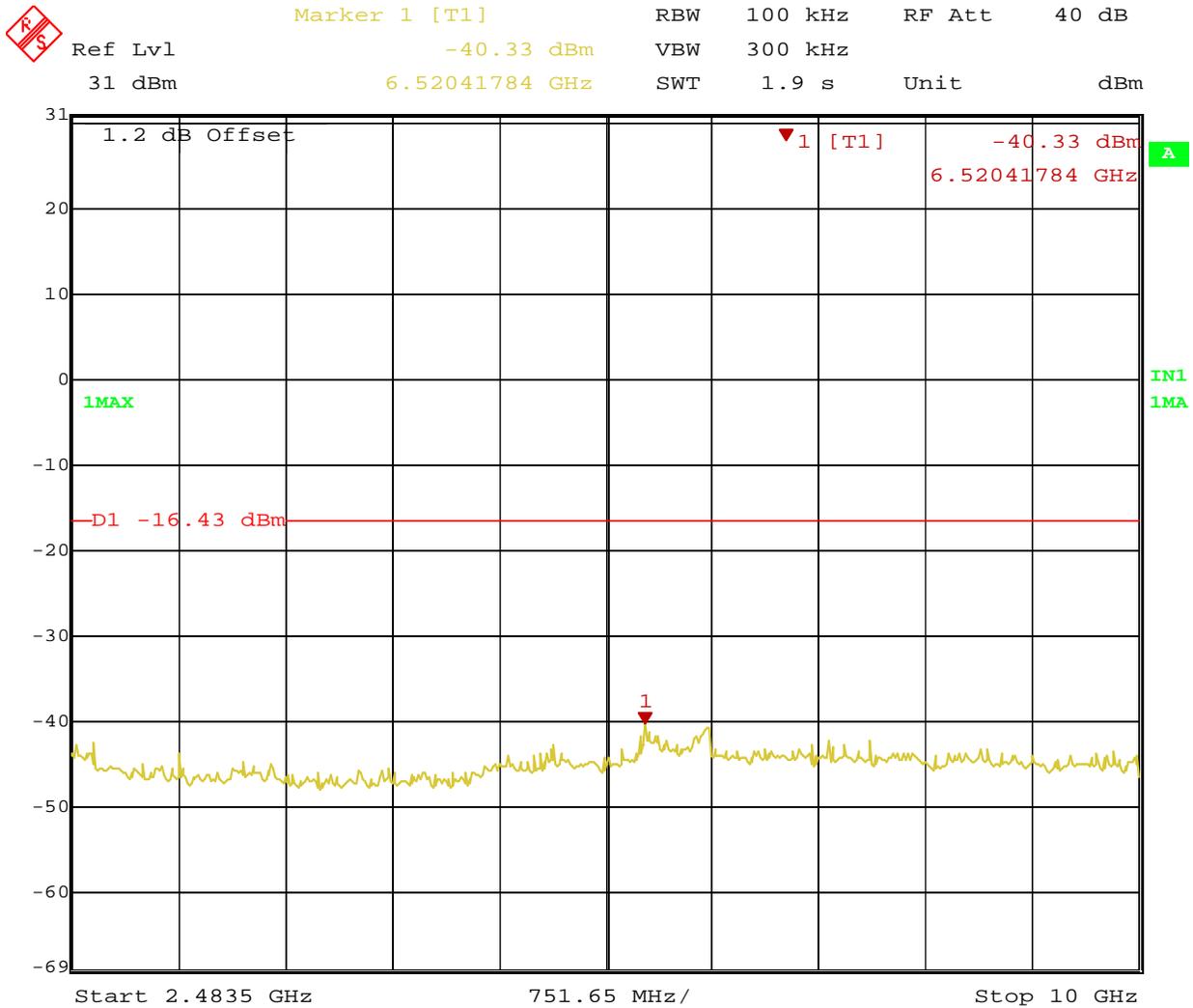
Date: 21.JUL.2009 19:15:59

Figure 25: Out of Band Emission for Channel 2412 MHz at 11Mbit/s – Band 3



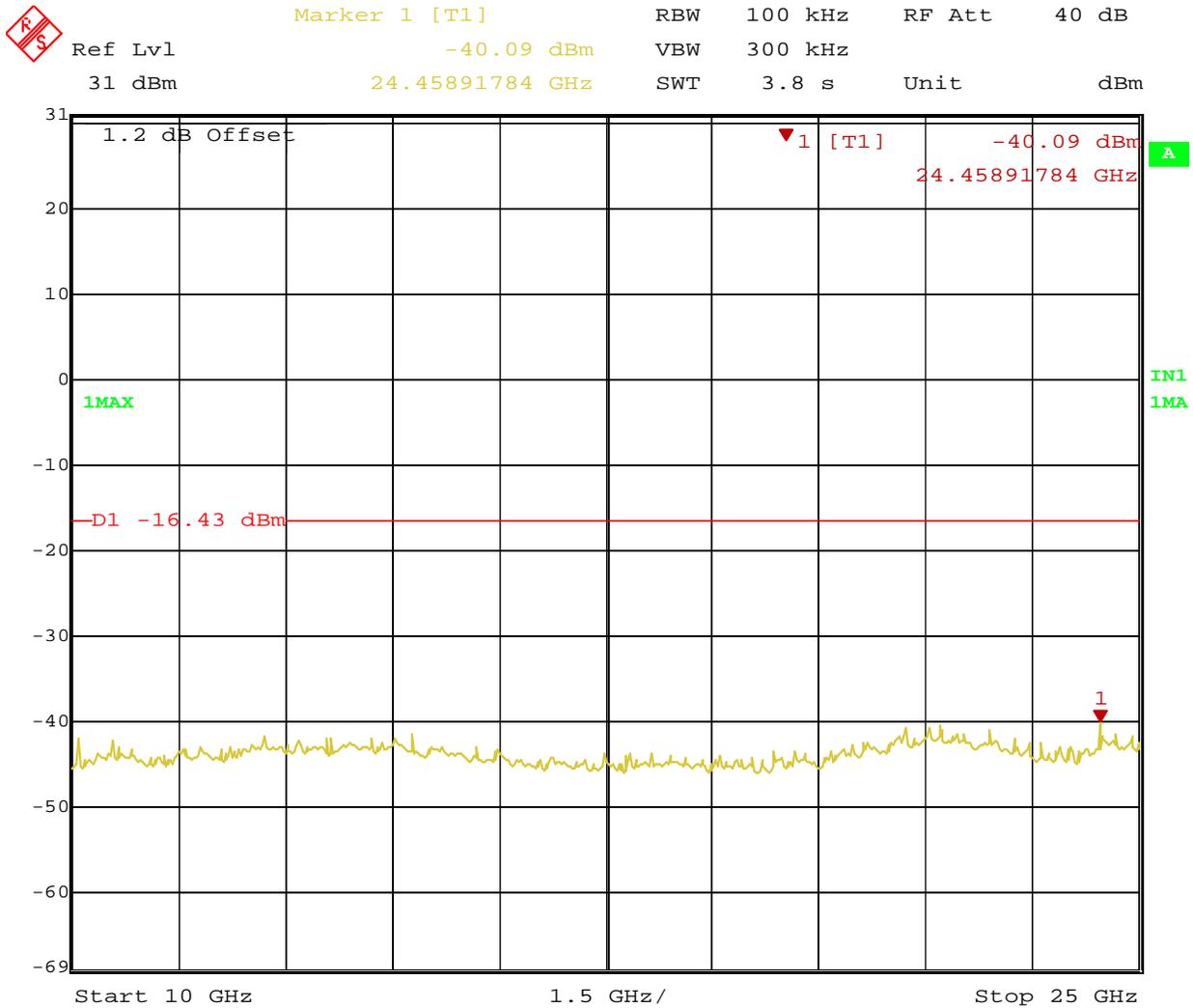
Date: 21.JUL.2009 19:45:56

Figure 26: Out of Band Emission for Channel 2437 MHz at 11Mbit/s – Band 1



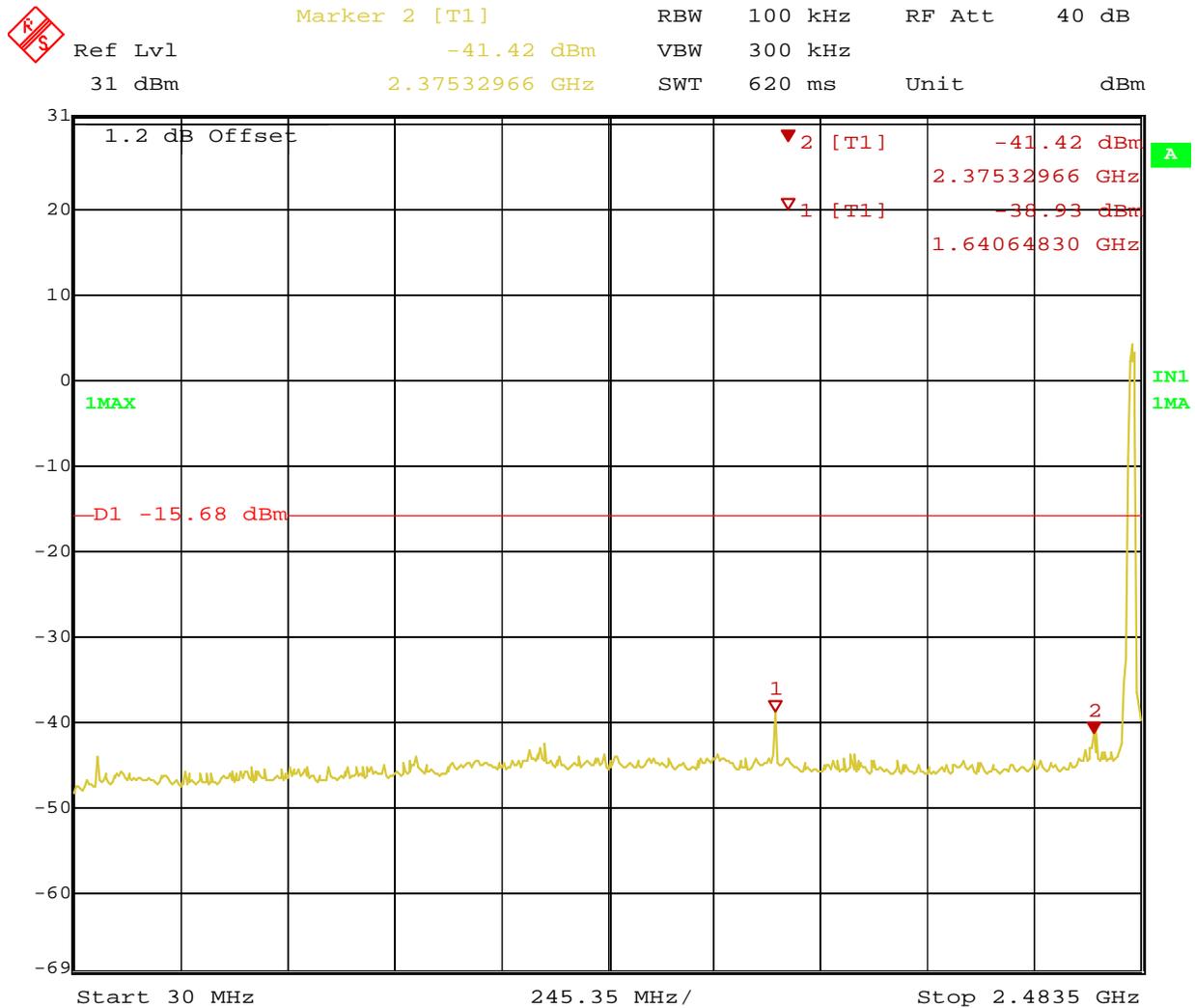
Date: 21.JUL.2009 19:47:02

Figure 27: Out of Band Emission for Channel 2437 MHz at 11Mbit/s – Band 2



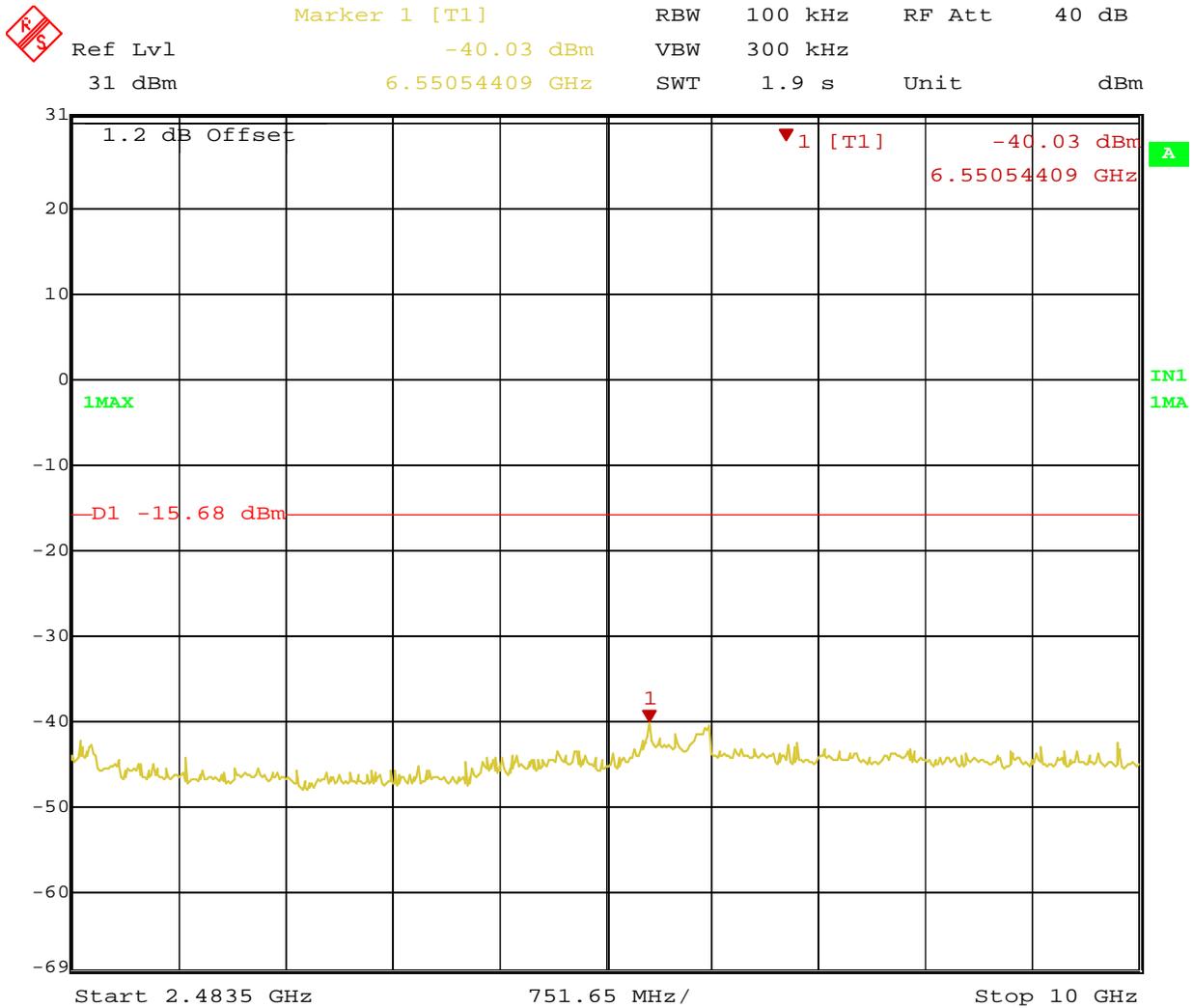
Date: 21.JUL.2009 19:49:42

Figure 28: Out of Band Emission for Channel 2437 MHz at 11Mbit/s – Band 3



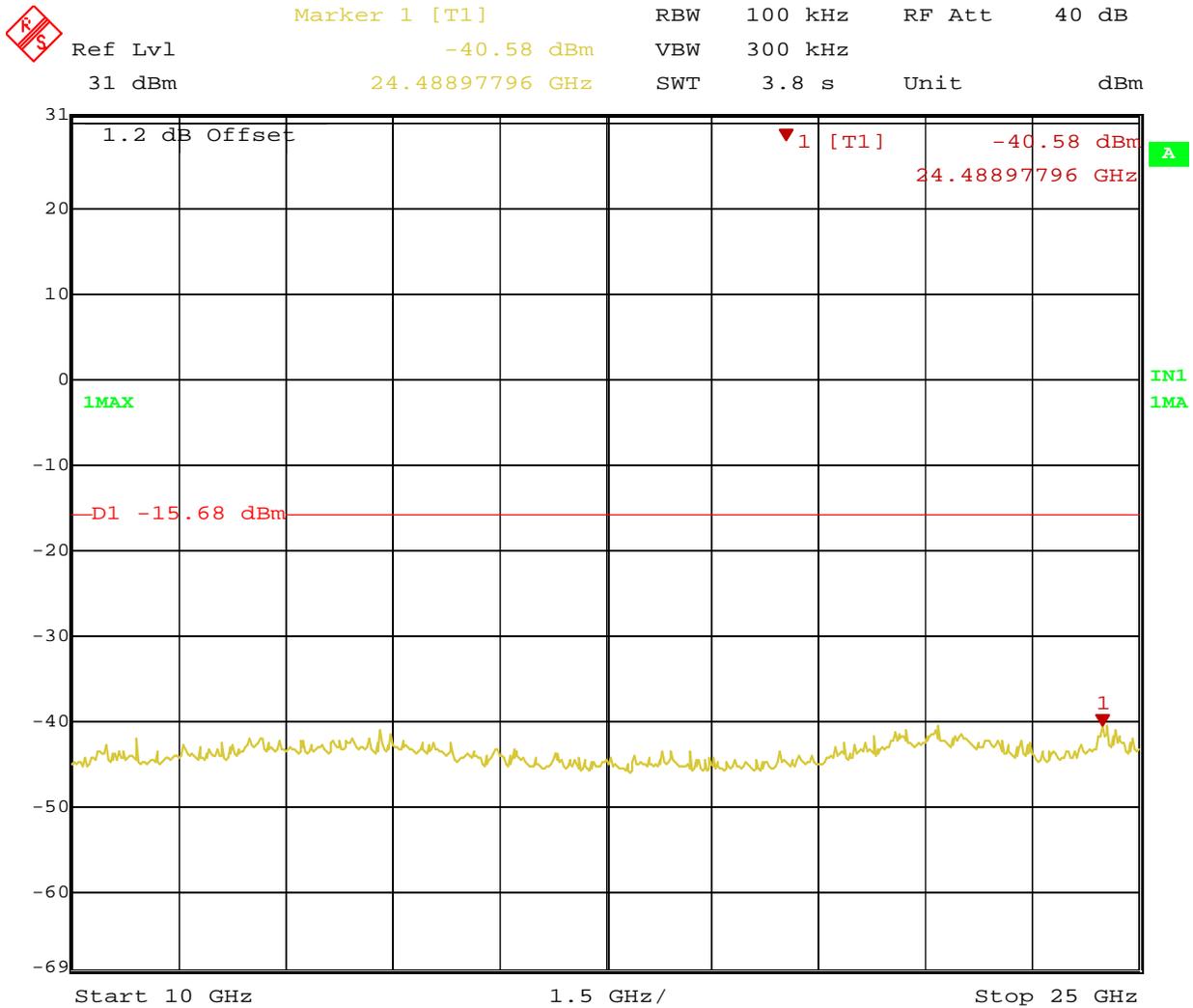
Date: 21.JUL.2009 19:57:41

Figure 29: Out of Band Emission for Channel 2462 MHz at 11Mbit/s – Band 1



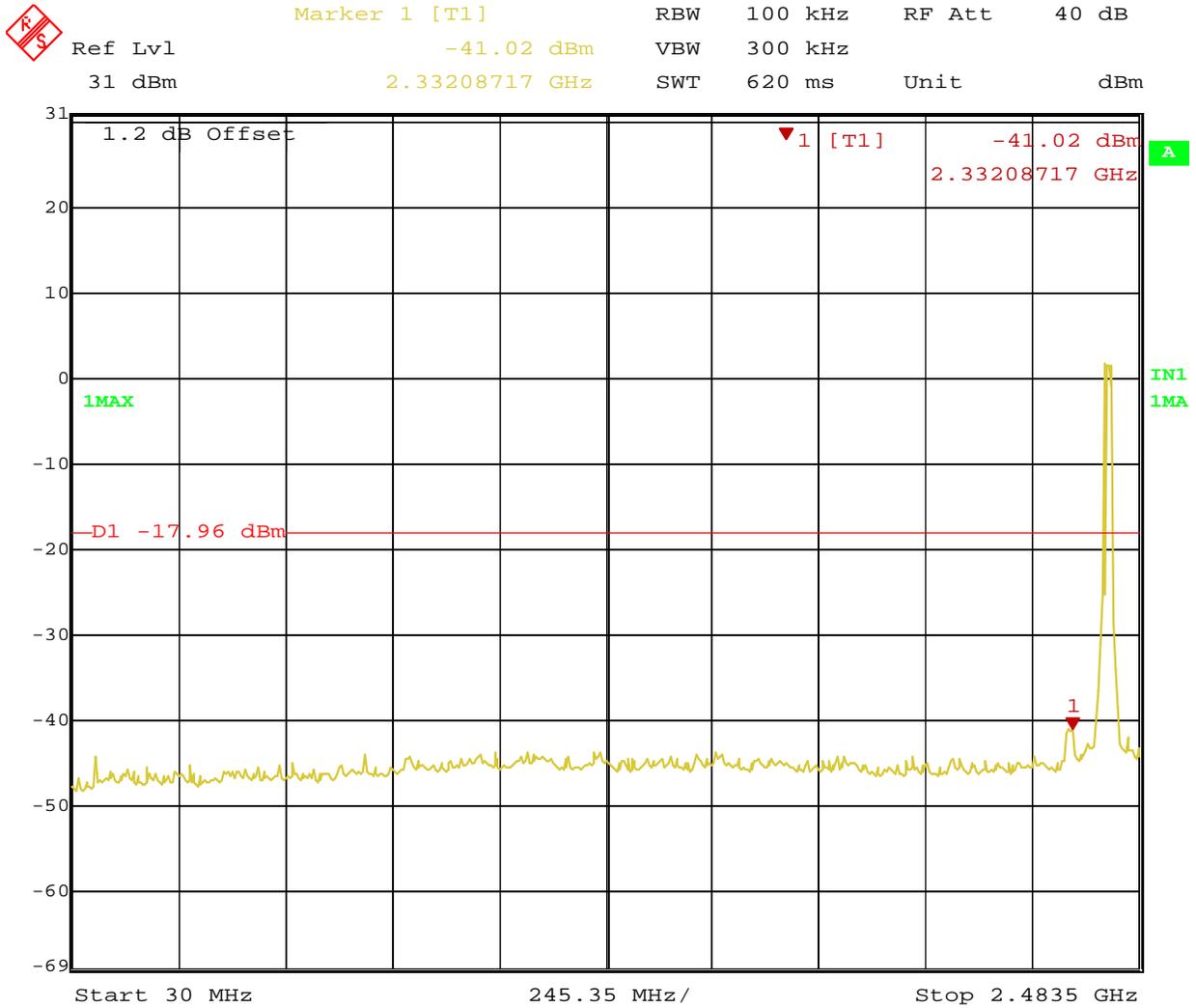
Date: 21.JUL.2009 19:58:43

Figure 30: Out of Band Emission for Channel 2462 MHz at 11Mbit/s – Band 2



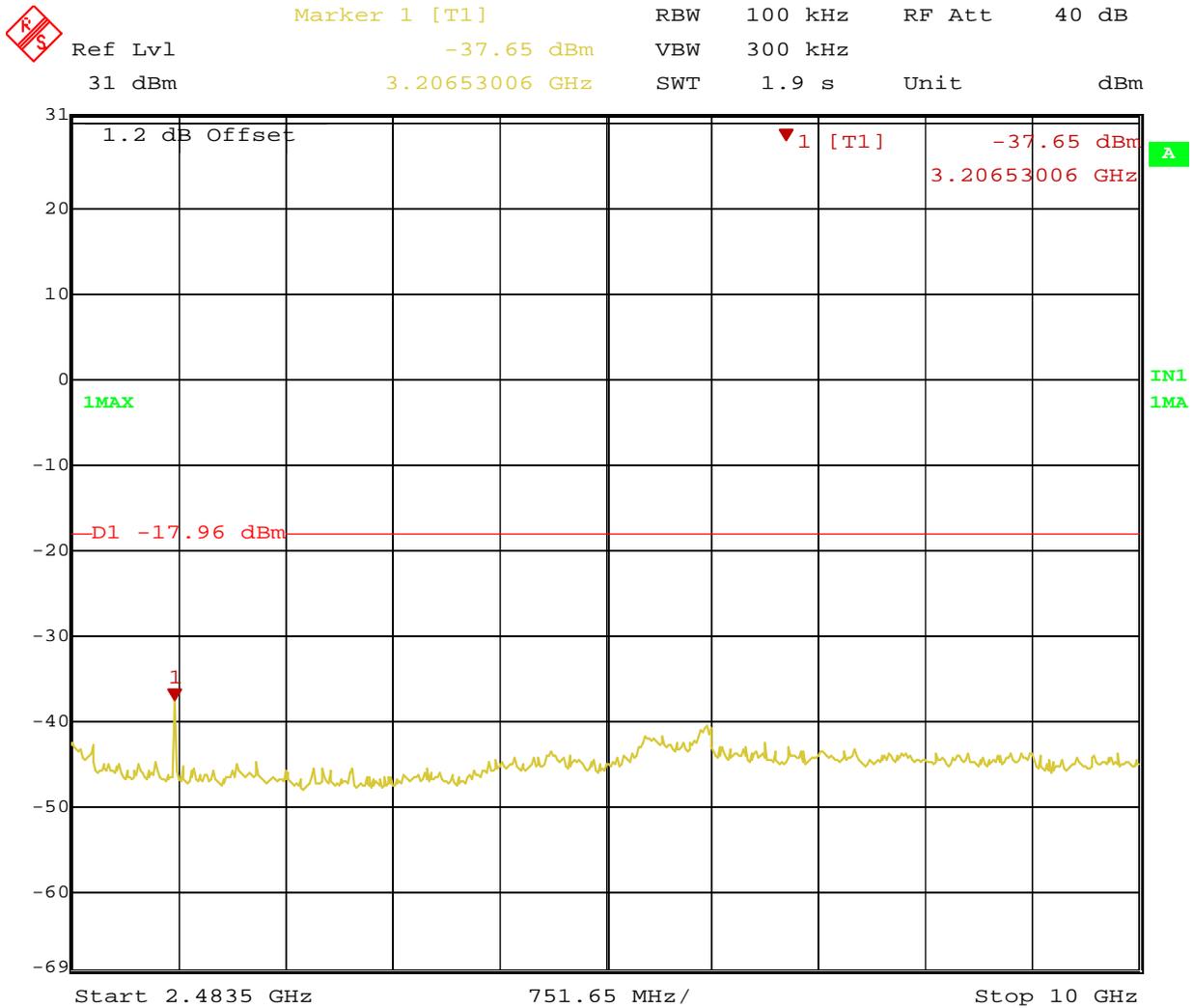
Date: 21.JUL.2009 19:59:20

Figure 31: Out of Band Emission for Channel 2462 MHz at 11Mbit/s – Band 3



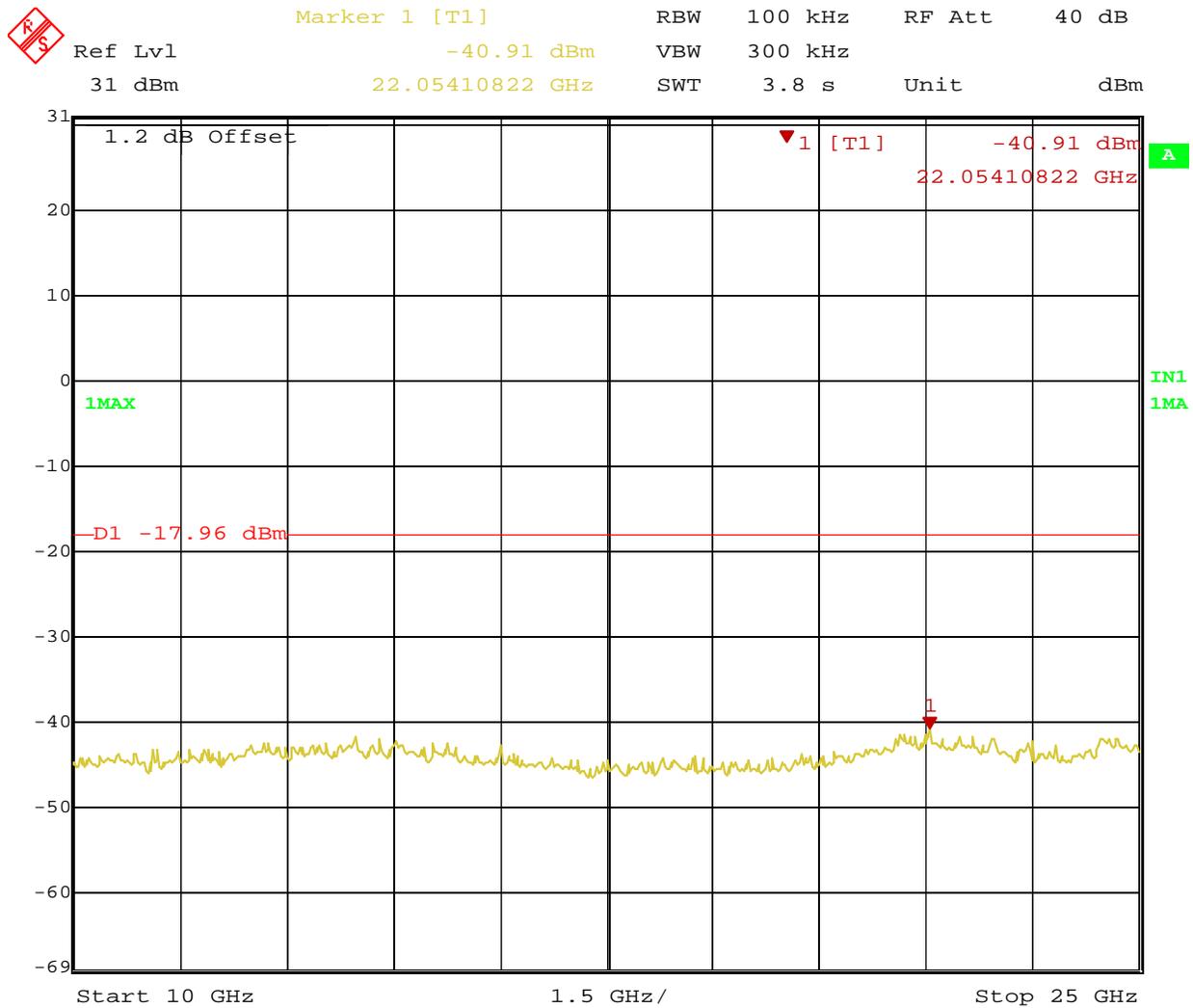
Date: 21.JUL.2009 19:29:12

Figure 32: Out of Band Emission for Channel 2412 MHz at 54Mbit/s – Band 1



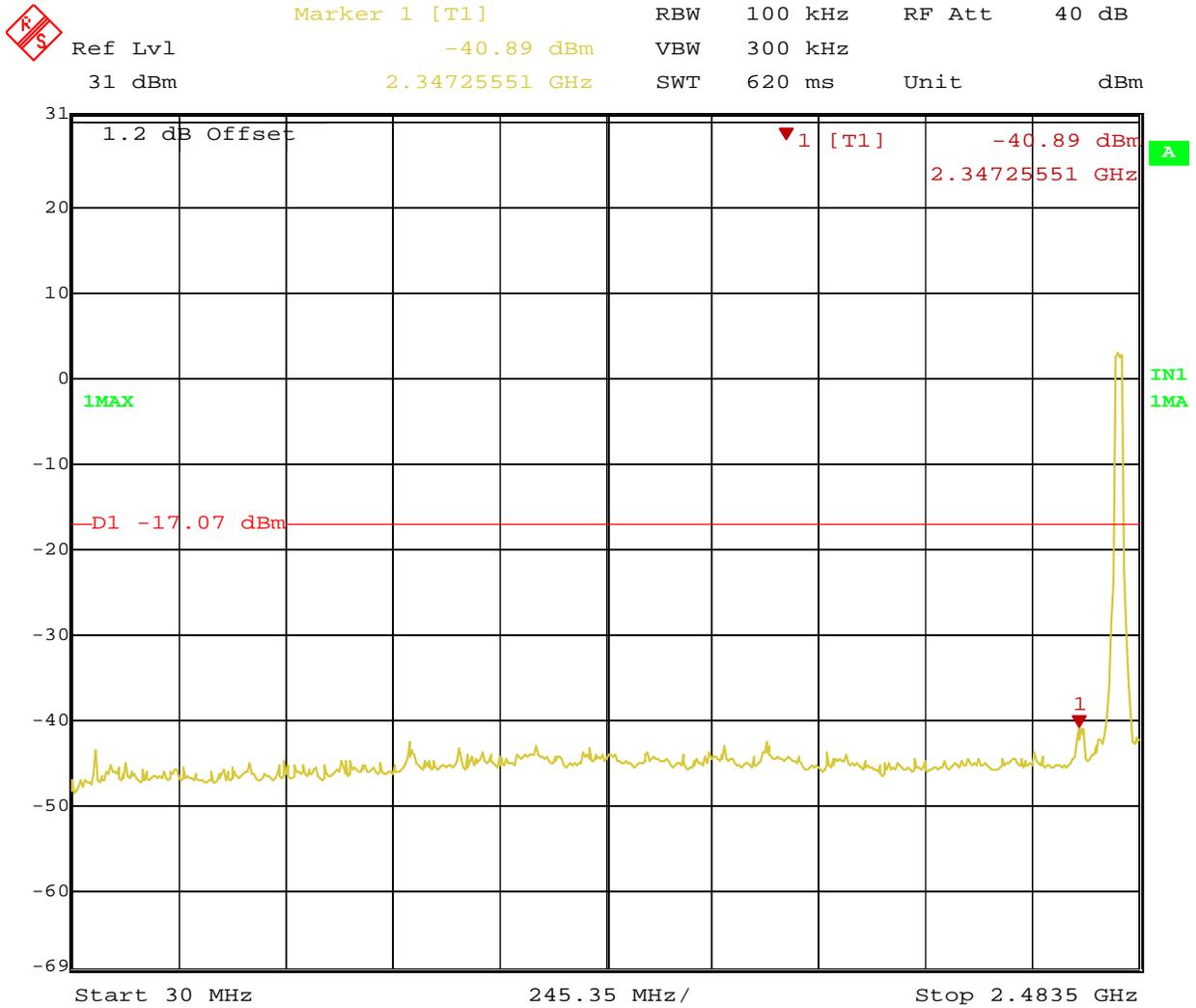
Date: 21.JUL.2009 19:31:47

Figure 33: Out of Band Emission for Channel 2412 MHz at 54Mbit/s – Band 2



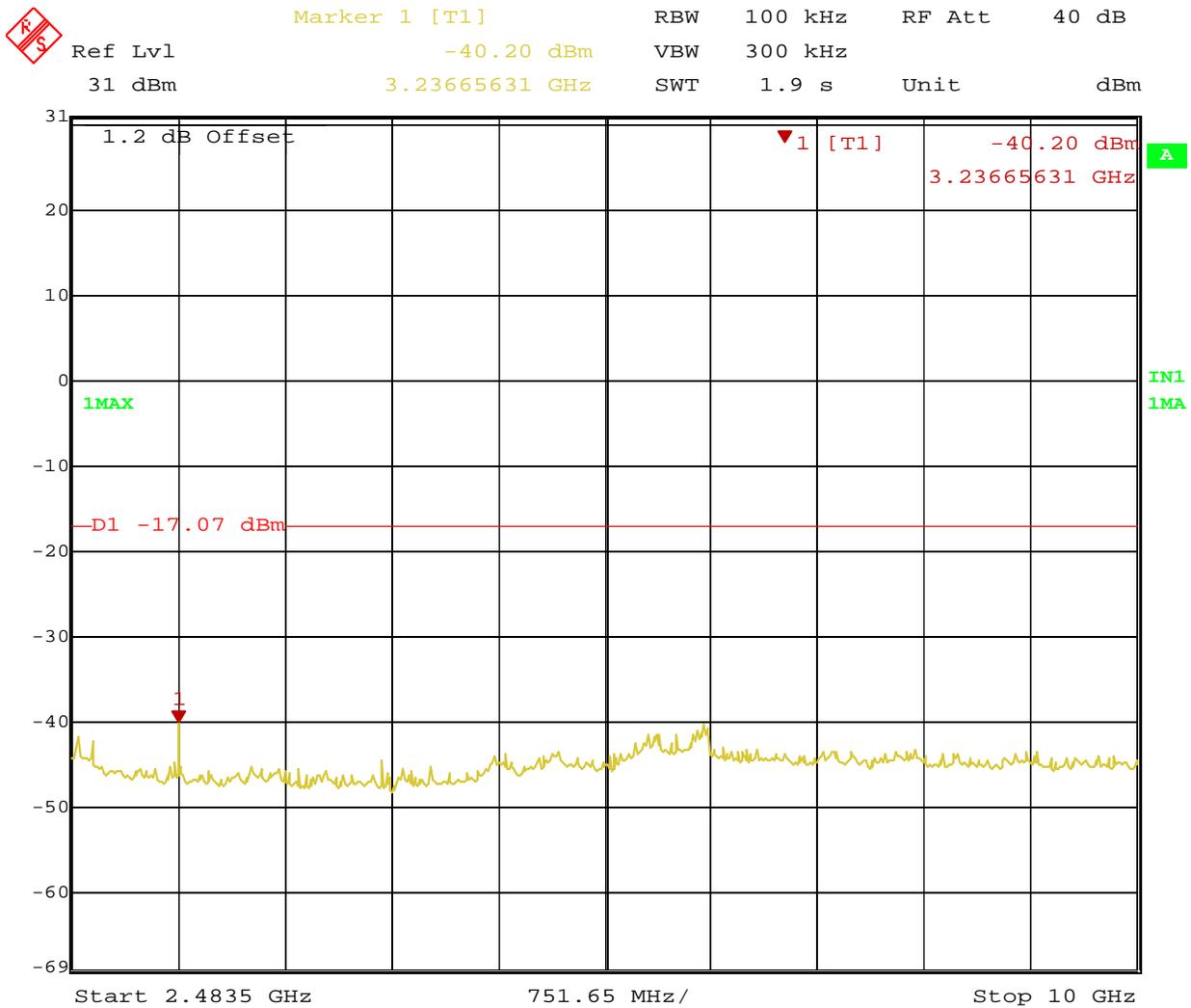
Date: 27.JUL.2009 13:02:02

Figure 34: Out of Band Emission for Channel 2412 MHz at 54Mbit/s – Band 3



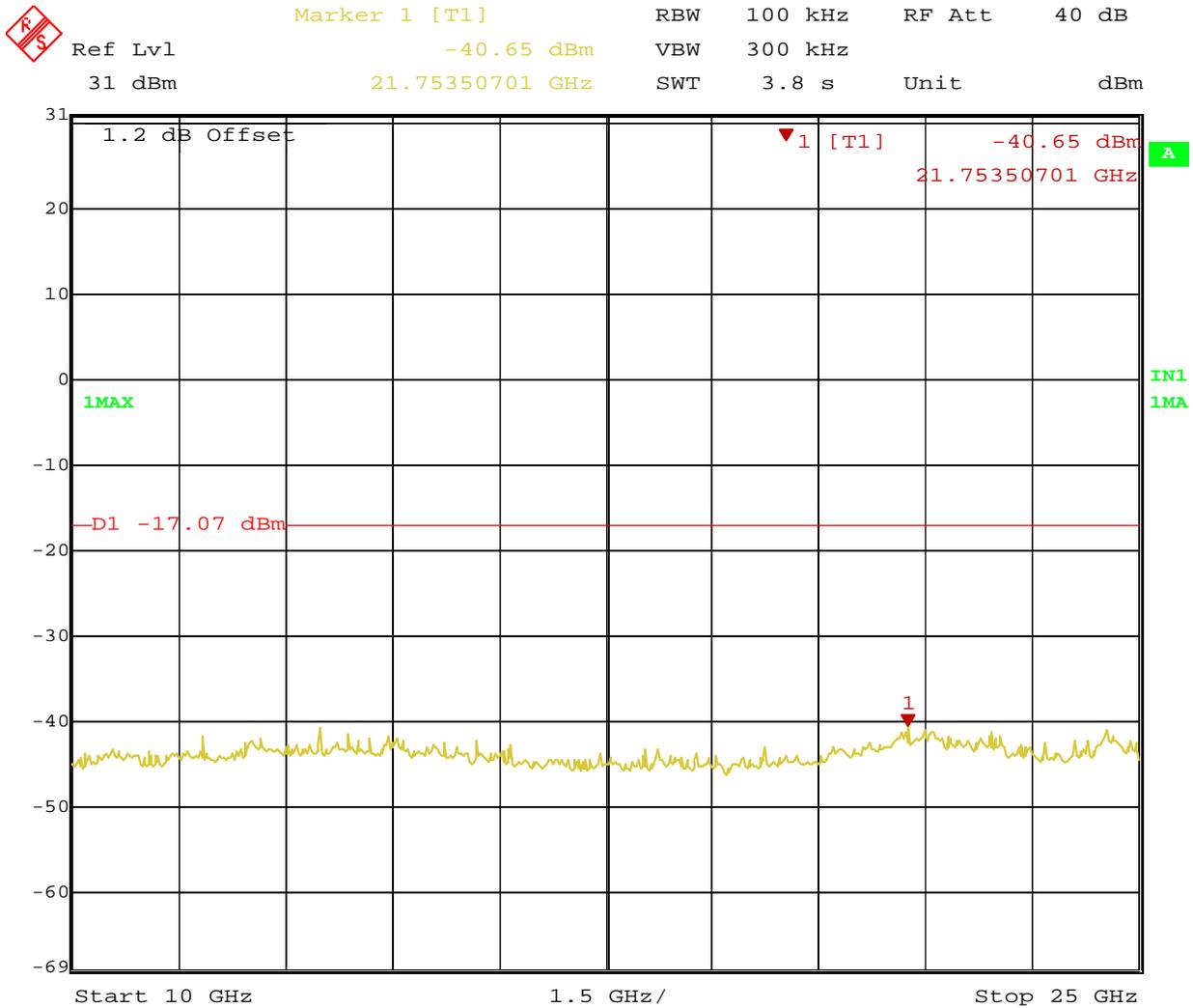
Date: 21.JUL.2009 19:41:27

Figure 35: Out of Band Emission for Channel 2437 MHz at 54Mbit/s – Band 1



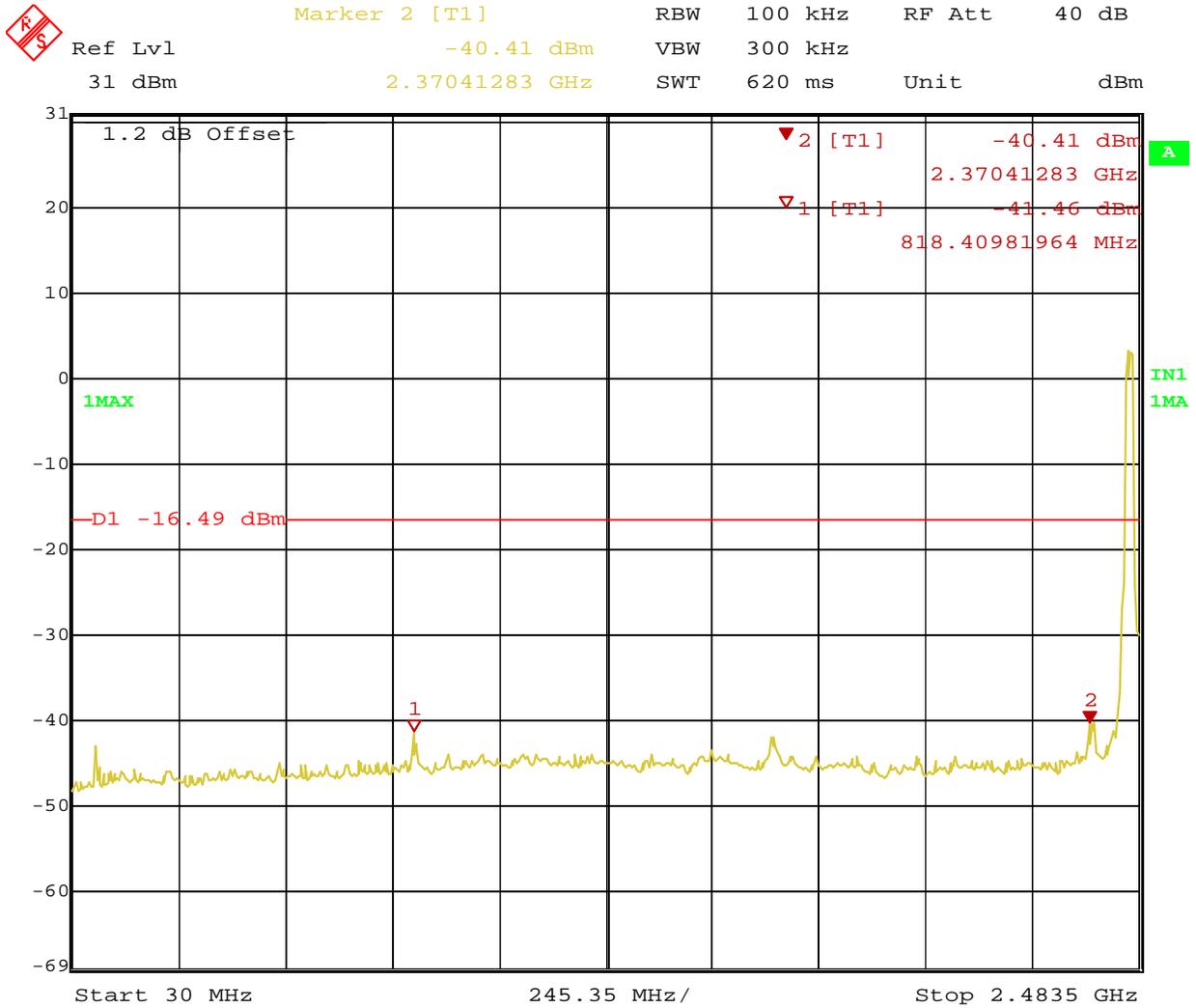
Date: 21.JUL.2009 19:42:02

Figure 36: Out of Band Emission for Channel 2437 MHz at 54Mbit/s – Band 2



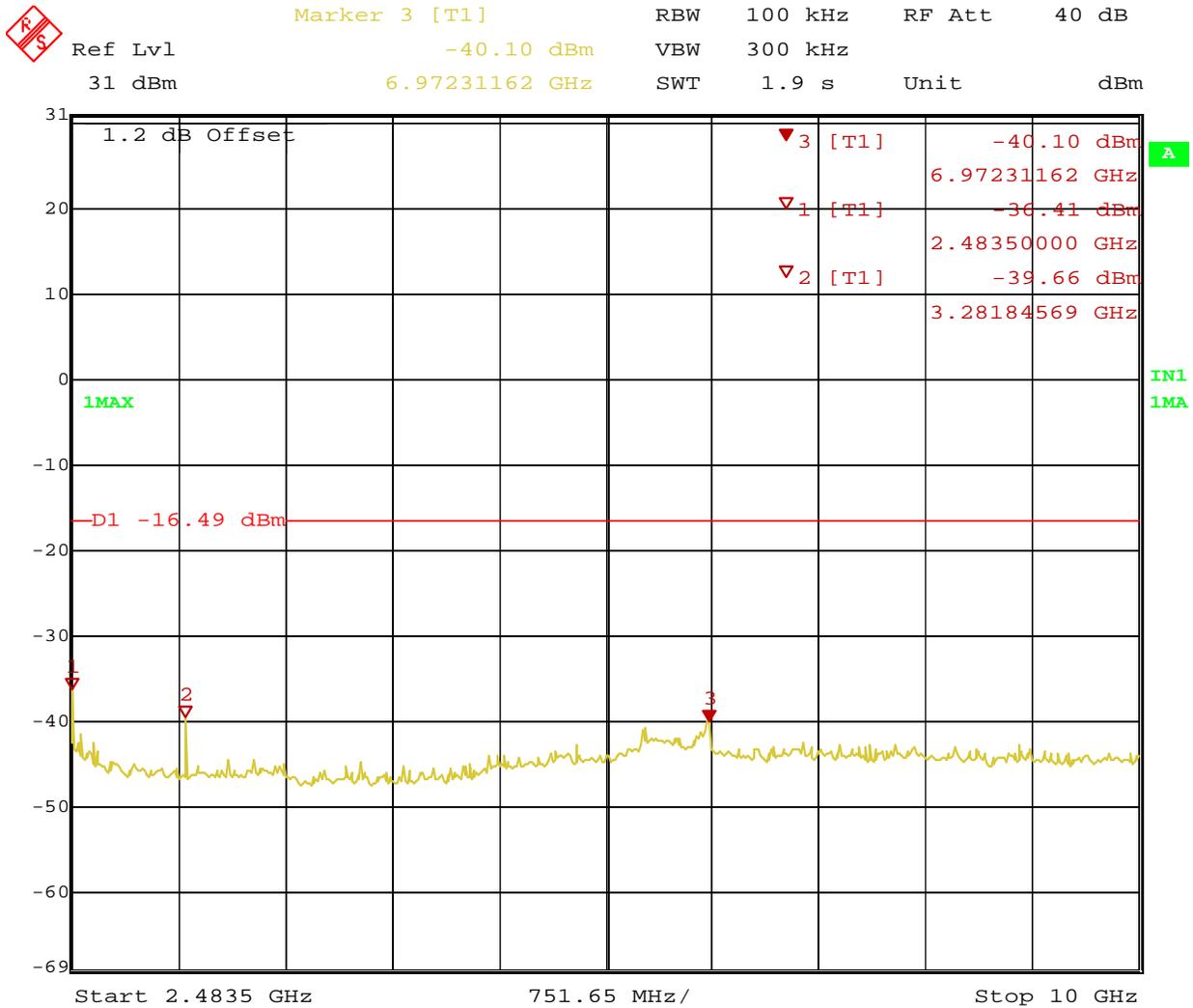
Date: 21.JUL.2009 19:42:39

Figure 37: Out of Band Emission for Channel 2437 MHz at 54Mbit/s – Band 3



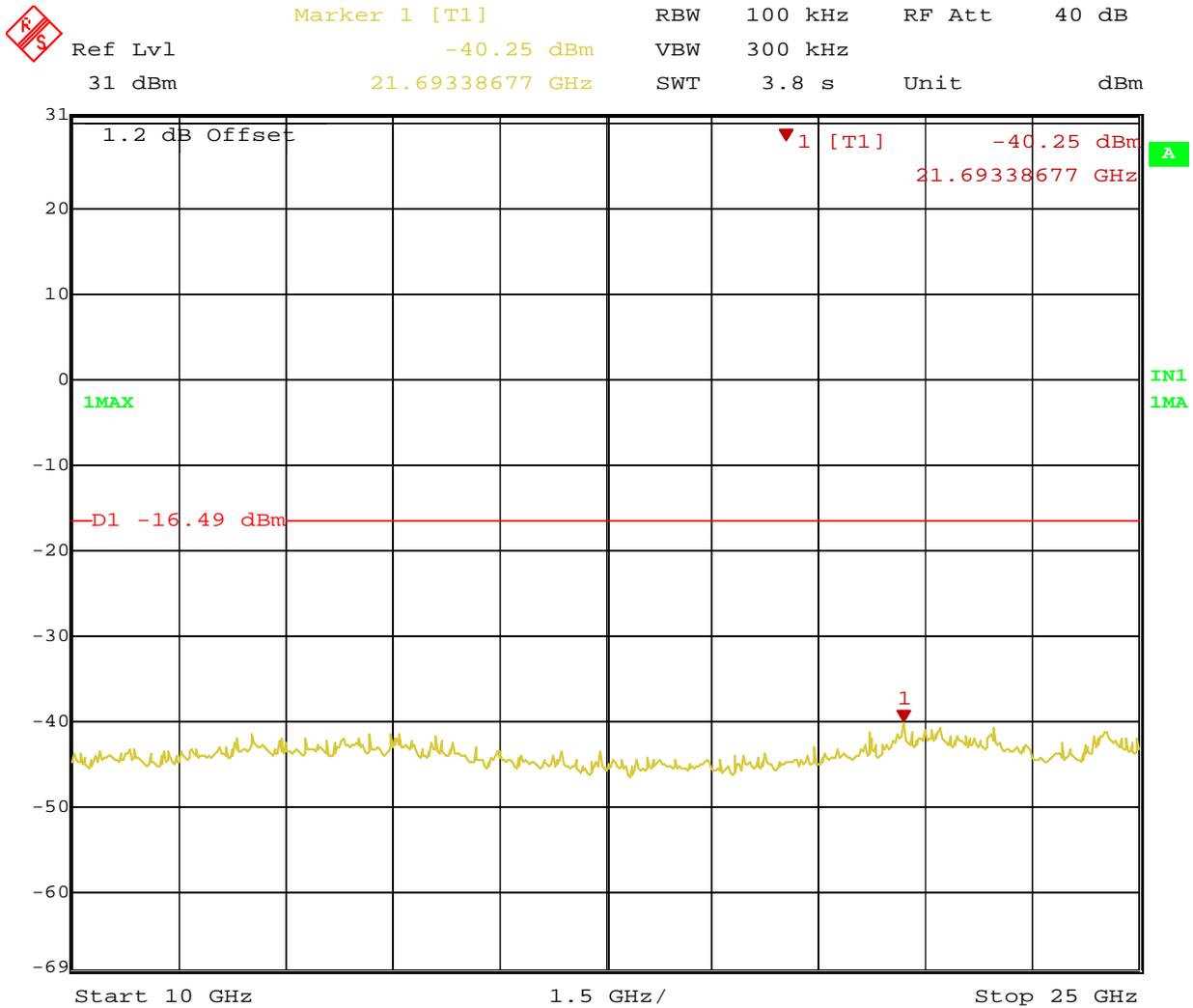
Date: 21.JUL.2009 20:02:58

Figure 38: Out of Band Emission for Channel 2462 MHz at 54Mbit/s – Band 1



Date: 21.JUL.2009 20:04:22

Figure 39: Out of Band Emission for Channel 2462 MHz at 54Mbit/s – Band 2



Date: 21.JUL.2009 20:04:54

Figure 40: Out of Band Emission for Channel 2462 MHz at 54Mbit/s – Band 3

4.4 Peak Power Spectral Density

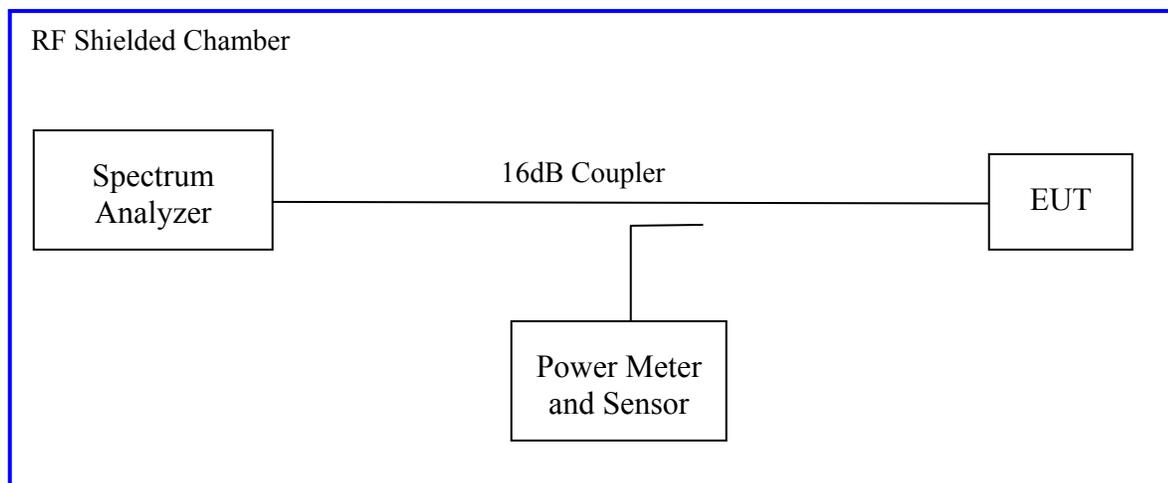
According to the CFR47 Part 15.247 (e) and RSS 210 (A8.2), the spectral power density output of the antenna port shall be less than 8dBm in any 3kHz band during any time interval of continuous transmission.

4.4.1 Test Method

The conducted method was used to measure the channel power output.

The measurement was performed with modulation per CFR47 Part 15.247 (e) and RSS 210 (A8.2). This test was conducted on 3 channels of Sample with MAC Address 00:04:20:26:00:74. The worst sample result indicated below.

Test Setup:

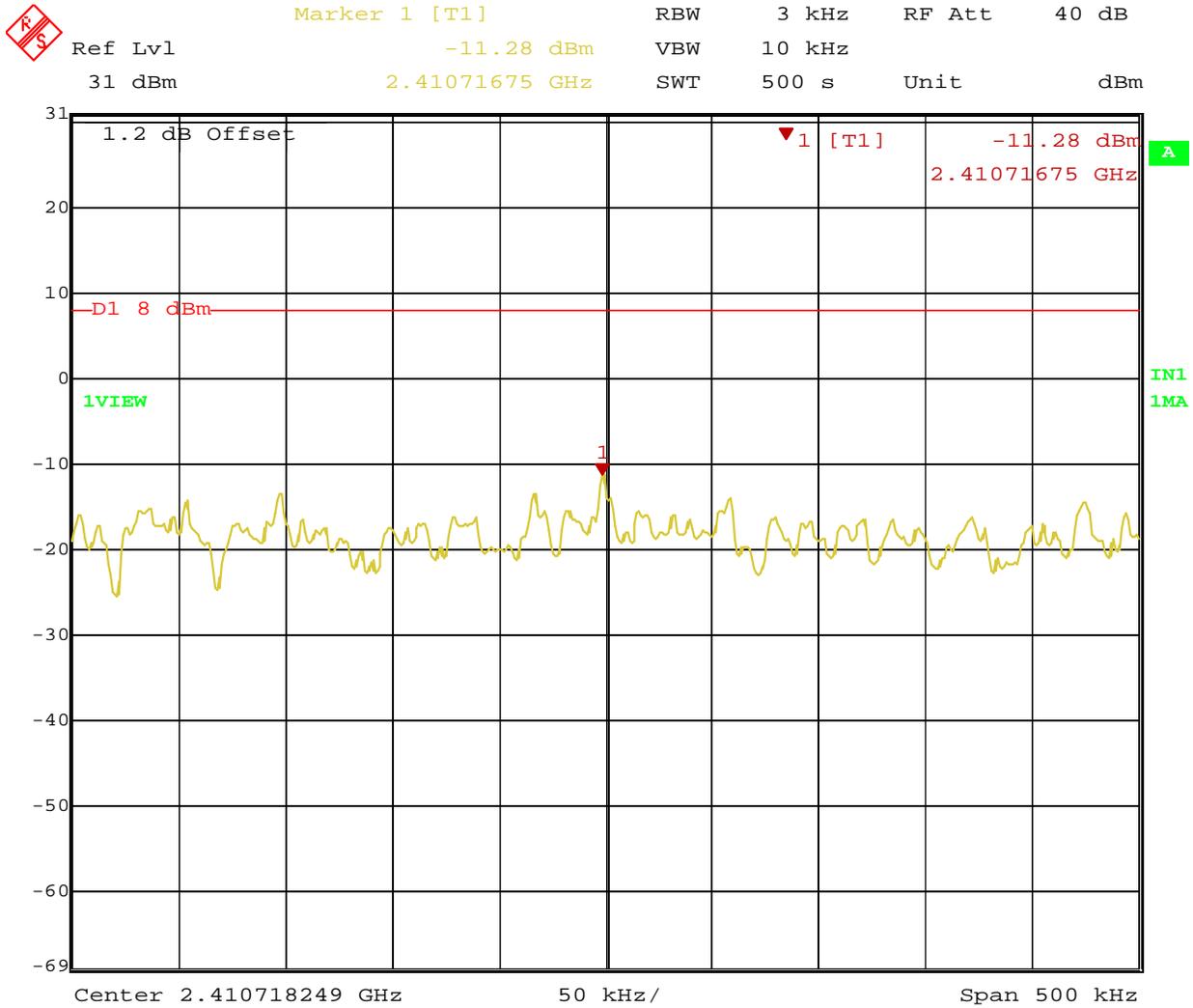


4.4.2 Results

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

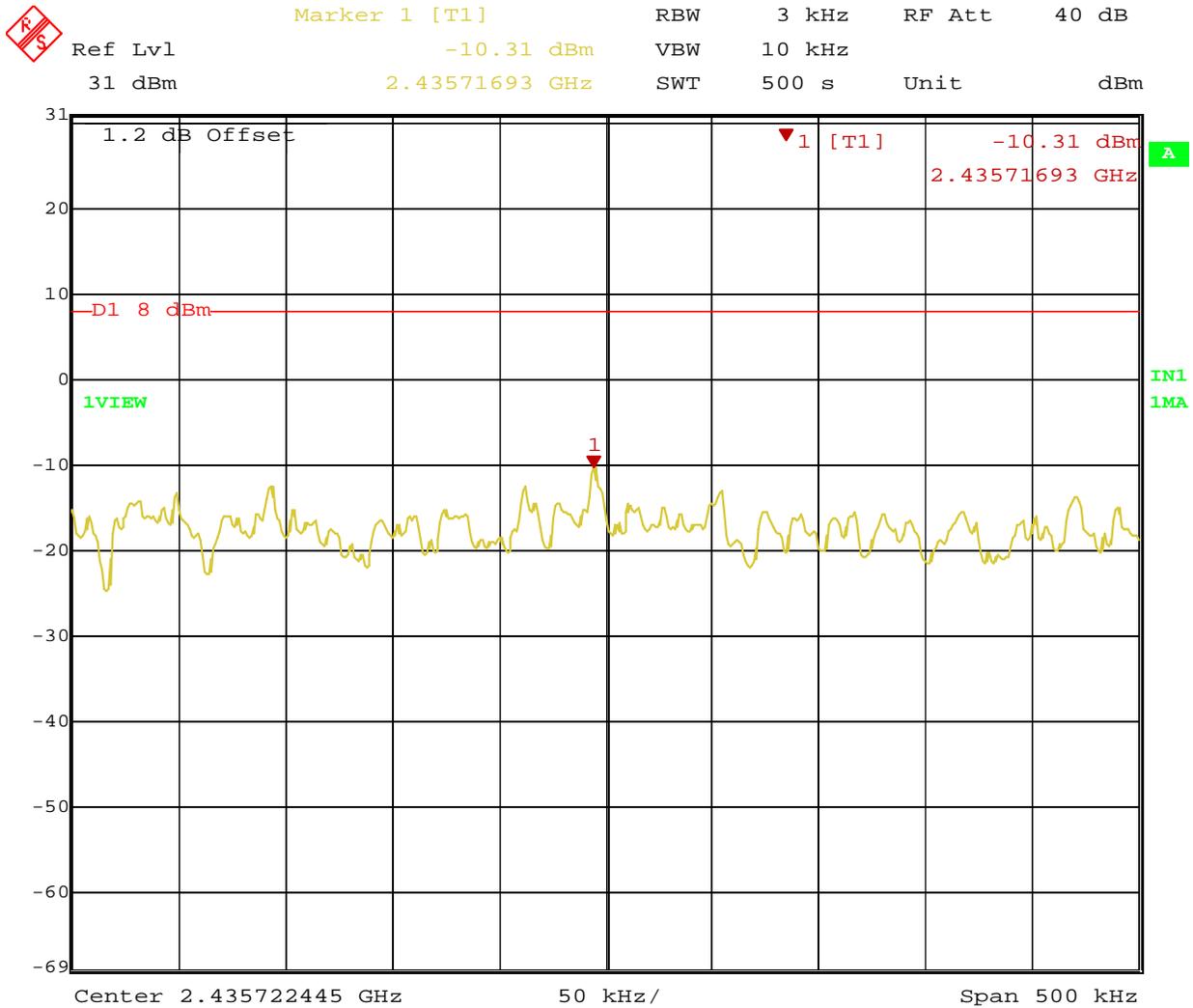
Table 7: Peak Power Spectral Density – Test Results

Test Conditions: Conducted Measurement, Normal Temperature and Voltage only				
Antenna Type: Integrated		Power Setting: +15dBm		
Signal State: Modulated		Data Rate: 11Mbit/s and 54Mbit/s		
Ambient Temp: 23 °C		Relative Humidity: 35 %		
Peak Power Spectral Density Test Results				
Operating Channel	Mode	PPSD [dBm]	Limit [dBm]	Margin [dB]
2412 MHz	11Mbit/s	-11.28	8.0	-19.28
2437 MHz	11Mbit/s	-10.31	8.0	-18.08
2462 MHz	11Mbit/s	-9.60	8.0	-19.28
Operating Channel	Mode	PPSD [dBm]	Limit [dBm]	Margin [dB]
2412 MHz	54Mbit/s	-11.78	8.0	-19.78
2437 MHz	54Mbit/s	-10.52	8.0	-18.52
2462 MHz	54Mbit/s	-10.67	8.0	-18.67



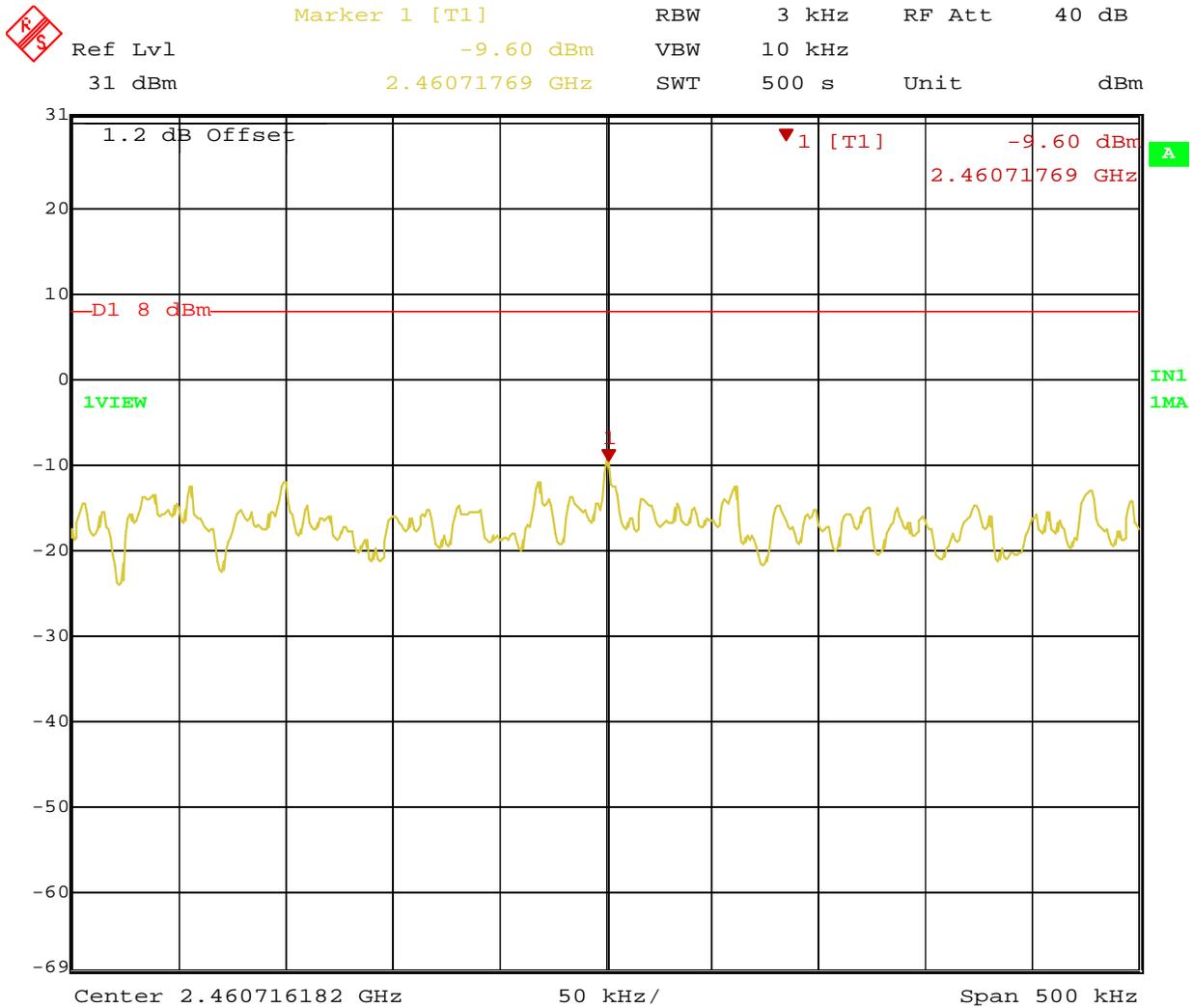
Date: 21.JUL.2009 17:26:51

Figure 41: Peak Power Spectral Density for Operating Channel 2412MHz – 11MBit/s



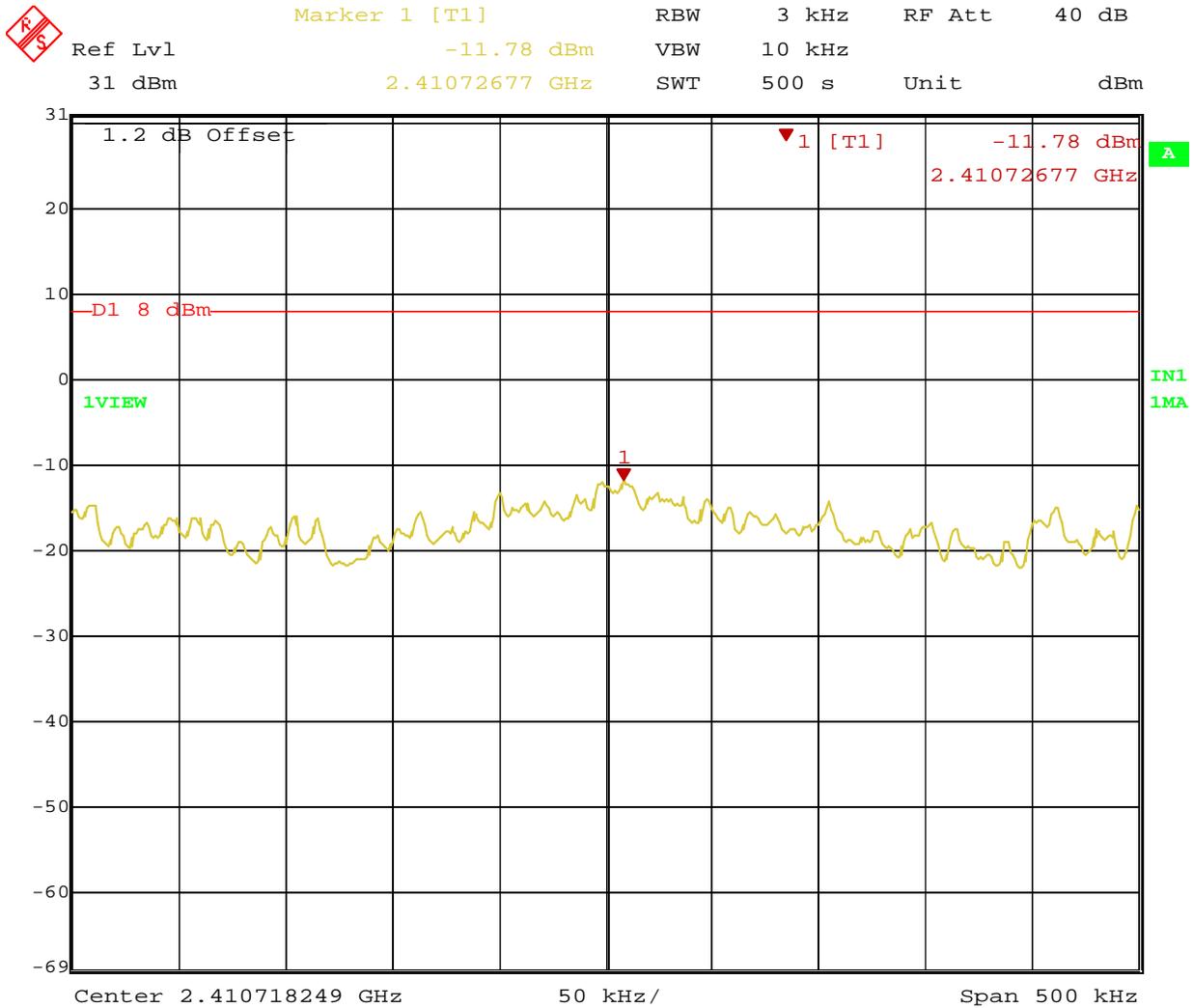
Date: 21.JUL.2009 17:59:32

Figure 42: Peak Power Spectral Density for Operating Channel 2437MHz – 11MBit/s



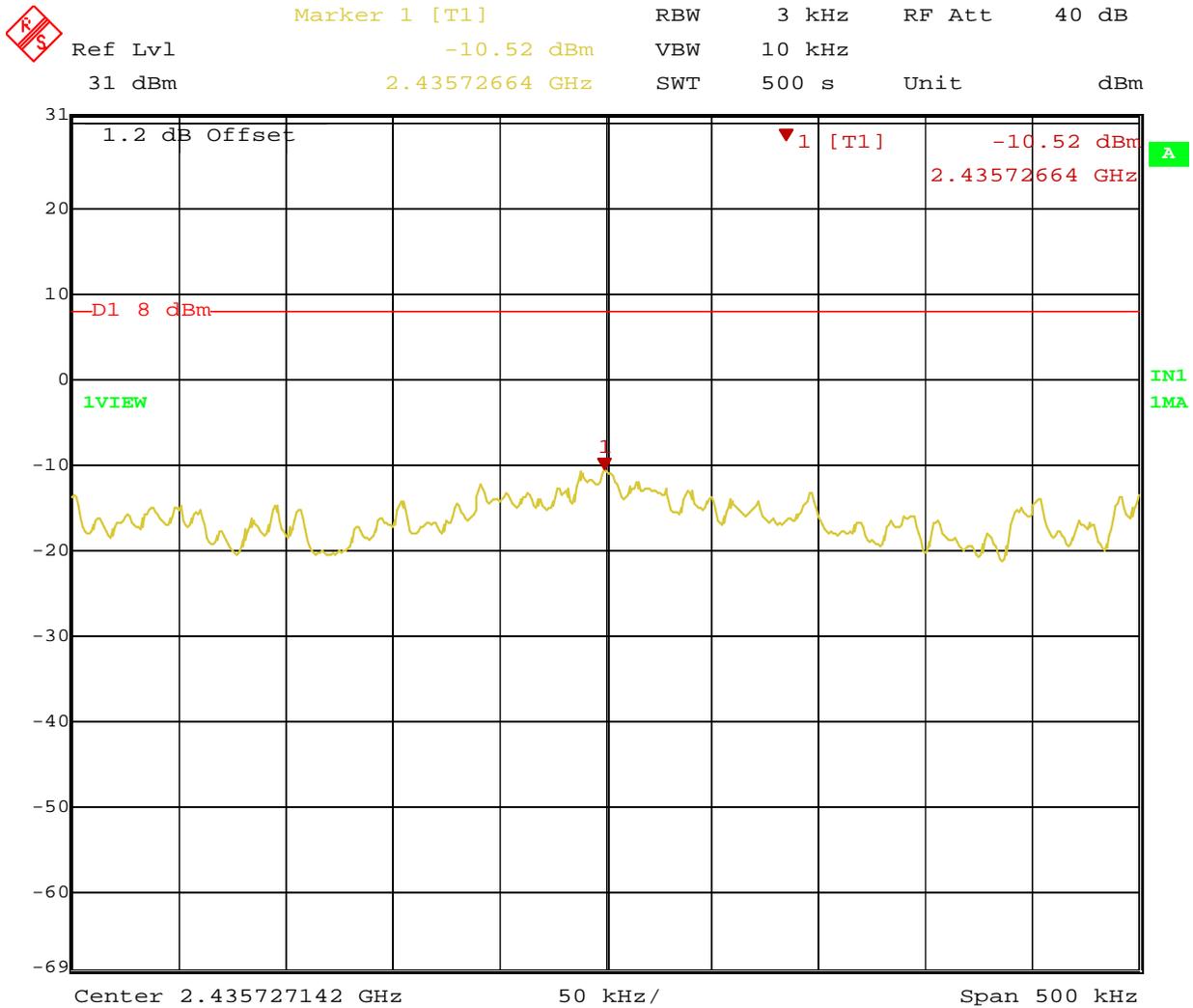
Date: 21.JUL.2009 18:27:18

Figure 43: Peak Power Spectral Density for Operating Channel 2462MHz – 11MBit/s



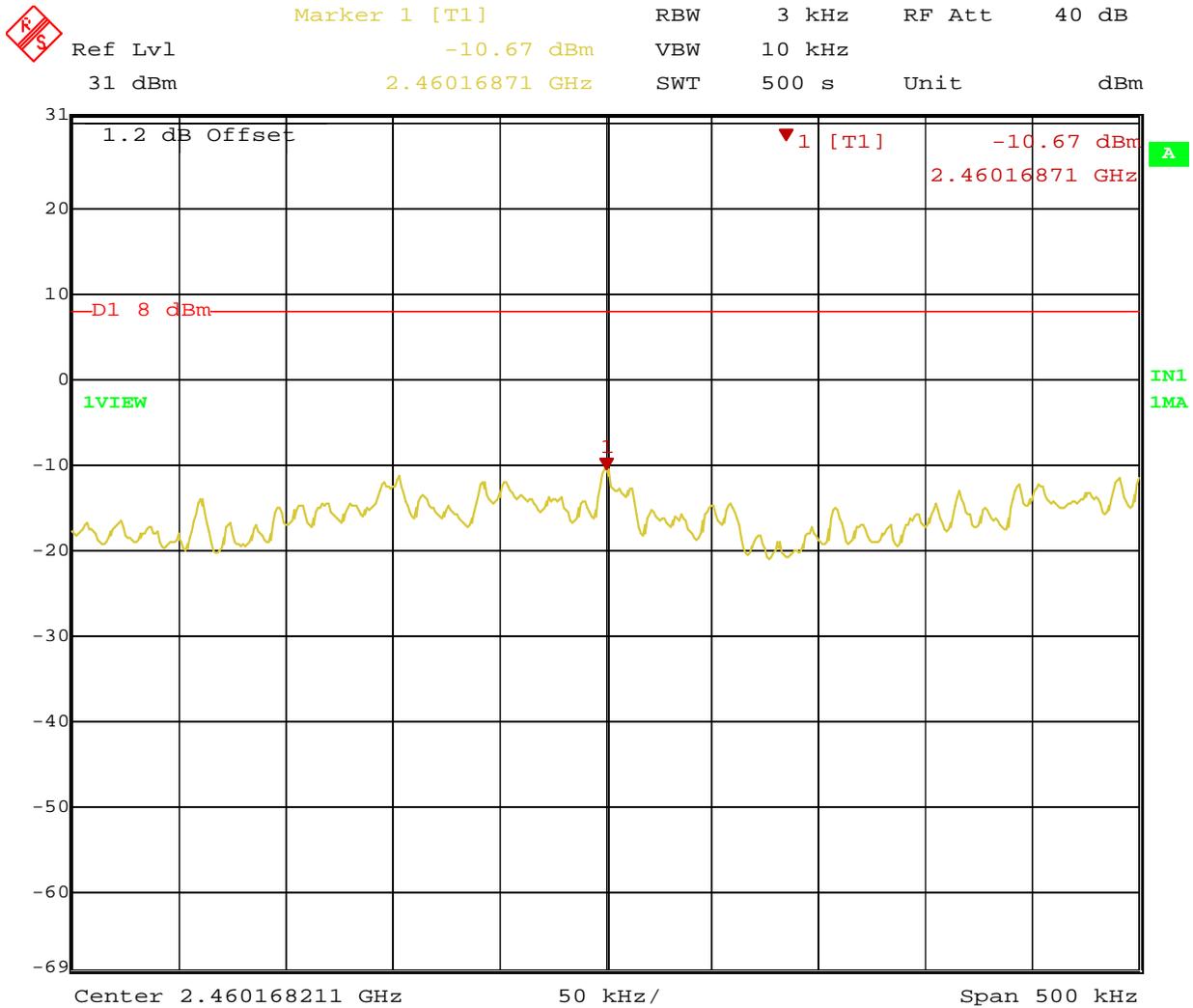
Date: 21.JUL.2009 17:44:07

Figure 44: Peak Power Spectral Density for Operating Channel 2412MHz – 54MBit/s



Date: 21.JUL.2009 18:11:51

Figure 45: Peak Power Spectral Density for Operating Channel 2437MHz – 54MBit/s



Date: 21.JUL.2009 18:39:31

Figure 46: Peak Power Spectral Density for Operating Channel 2462MHz – 54MBit/s

4.5 Maximum Permissible Exposure

4.5.1 Test Methodology

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

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

4.5.2 RF Exposure Limit

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

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

F = Frequency in MHz

4.5.3 EUT Operating Condition

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

4.5.4 Classification

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

4.5.5 Test Results

4.5.5.1 Antenna Gain

The transmitting antenna was integrated. The antenna gain was -0.86dBi or 0.82 (numeric).

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

Calculations for this report are based on highest power measurement.

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

The highest measured EIRP power is +22.08dBm or 161.44mW

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

$P_d = 161.44 / (1600\pi) = \mathbf{0.321mW/cm^2}$, which is 0.6788 mW/cm² below to the limit.

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

4.5.6 Sample Calculation

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

Where;

Pd = power density in mW/cm²

Pout = output power to antenna in mW

G = gain of antenna in linear scale

$\pi \approx 3.1416$

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

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

4.6 Transmitter Spurious Emissions

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

4.6.1 Test Methodology

4.6.1.1 Preliminary Test

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

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

4.6.1.2 Final Test

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

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

The final scans performed 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 # 30981128.001 Page 1 of 10			
EUT Name	Squeezebox Radio					Date	July 23, 2009			
EUT Model	X-R0001					Temp / Hum in	22°C / 38%RH			
EUT Serial	MAC - 00:04:20:26:00:32					Temp / Hum out	N/A			
EUT Config.	Integrated Antenna, Tabletop					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) (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										
34.8613	V	175	130	47.15	43.63	-6.92	36.71	40.00	-3.29	Spurious
45.915	V	52	123	56.40	52.42	-14.58	37.84	40.00	-2.16	Spurious
86.9663	V	6	108	46.51	43.16	-16.60	26.56	40.00	-13.44	Spurious
150.008	V	250	112	41.83	40.77	-10.60	30.17	43.52	-13.35	Spurious
250.005	V	237	107	47.53	47.07	-10.61	36.46	46.02	-9.56	Spurious
550.006	V	263	120	38.72	37.76	-4.83	32.93	46.02	-13.09	Spurious
664.974	V	168	149	42.88	41.19	-2.20	38.99	46.02	-7.03	Spurious
149.999	H	230	159	42.05	41.37	-10.60	30.77	43.52	-12.75	Spurious
249.992	H	215	143	46.19	45.33	-10.61	34.72	46.02	-11.30	Spurious
299.997	H	169	103	42.23	41.57	-8.67	32.90	46.02	-13.12	Spurious
749.994	H	248	115	44.53	43.88	-0.87	43.01	46.02	-3.01	Spurious
850.009	H	229	103	40.21	40.45	0.05	40.50	46.02	-5.52	Spurious
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty										
Total CF= Amp Gain + Cable Loss + ANT Factor										
Combined Standard Uncertainty $u_c(y) = \pm 1.6\text{dB}$ Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence										
Notes: Tested at worst case at 54MBit/s.										

SOP 1 Radiated Emissions											Tracking # 30981128.001 Page 2 of 10	
EUT Name		Squeezebox Radio					Date		July 23, 2009			
EUT Model		X-R0001					Temp / Hum in		22°C / 38%RH			
EUT Serial		MAC - 00:04:20:26:00:32					Temp / Hum out		N/A			
EUT Config.		Integrated Antenna, Tabletop					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) (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												
150.009	H	240	164	42.31	41.16	-10.60	30.56	43.52	-12.96	Spurious		
228.064	H	196	132	39.09	37.46	-11.44	26.02	46.02	-20.00	Spurious		
250.001	H	226	136	46.05	45.39	-10.61	34.78	46.02	-11.24	Spurious		
749.999	H	227	115	45.36	45.15	-0.87	44.28	46.02	-1.74	Spurious		
849.992	H	225	176	39.32	38.92	0.05	38.97	46.02	-7.05	Spurious		
35.2013	V	258	134	47.06	41.76	-7.15	34.61	40.00	-5.39	Spurious		
46.4875	V	348	129	53.66	50.39	-14.92	35.47	40.00	-4.53	Spurious		
86.975	V	38	113	40.79	40.19	-16.60	23.59	40.00	-16.41	Spurious		
150.008	V	255	106	41.28	40.40	-10.60	29.80	43.52	-13.72	Spurious		
249.995	V	239	110	47.36	46.82	-10.61	36.21	46.02	-9.81	Spurious		
550.005	V	271	116	39.26	38.74	-4.83	33.91	46.02	-12.11	Spurious		
750.009	V	340	106	34.68	33.36	-0.87	32.49	46.02	-13.53	Spurious		
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty												
Total CF= Amp Gain + Cable Loss + ANT Factor												
Combined Standard Uncertainty $u_c(y) = \pm 1.6\text{dB}$ Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence												
Notes: Tested at worst case at 54MBit/s.												

SOP 1 Radiated Emissions											Tracking # 30981128.001 Page 3 of 10	
EUT Name		Squeezebox Radio					Date		July 23, 2009			
EUT Model		X-R0001					Temp / Hum in		22°C / 38%RH			
EUT Serial		MAC - 00:04:20:26:00:32					Temp / Hum out		N/A			
EUT Config.		Integrated Antenna, Tabletop					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) (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												
30.5513	H	140	229	31.13	26.37	-3.76	22.61	40.00	-17.39	Spurious		
150.016	H	176	189	41.04	40.19	-10.60	29.59	43.52	-13.93	Spurious		
227.999	H	137	181	36.90	35.04	-11.44	23.60	46.02	-22.42	Spurious		
250.014	H	120	77	45.09	44.61	-10.61	34.00	46.02	-12.02	Spurious		
335.99	H	103	29	43.08	42.43	-7.97	34.46	46.02	-11.56	Spurious		
664.976	H	121	184	32.13	30.36	-2.20	28.16	46.02	-17.86	Spurious		
749.996	H	109	230	43.81	43.52	-0.87	42.65	46.02	-3.37	Spurious		
850.004	H	103	215	39.65	39.19	0.05	39.24	46.02	-6.78	Spurious		
31.2675	V	211	79	48.01	42.93	-4.34	38.59	40.00	-1.41	Spurious		
39.91	V	120	55	50.00	46.35	-10.68	35.67	40.00	-4.33	Spurious		
113.479	V	116	320	44.42	40.67	-11.01	29.66	43.52	-13.86	Spurious		
150.004	V	106	315	41.00	40.20	-10.60	29.60	43.52	-13.92	Spurious		
250.012	V	106	98	44.12	43.25	-10.61	32.64	46.02	-13.38	Spurious		
549.994	V	106	323	38.44	37.66	-4.83	32.83	46.02	-13.19	Spurious		
849.995	V	107	132	35.15	34.08	0.05	34.13	46.02	-11.89	Spurious		
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty												
Total CF= Amp Gain + Cable Loss + ANT Factor												
Combined Standard Uncertainty $u_c(y) = \pm 1.6\text{dB}$ Expanded Uncertainty $U = k u_c(y)$ $k = 2$ for 95% confidence												
Notes: Tested at worst case at 54MBit/s.												

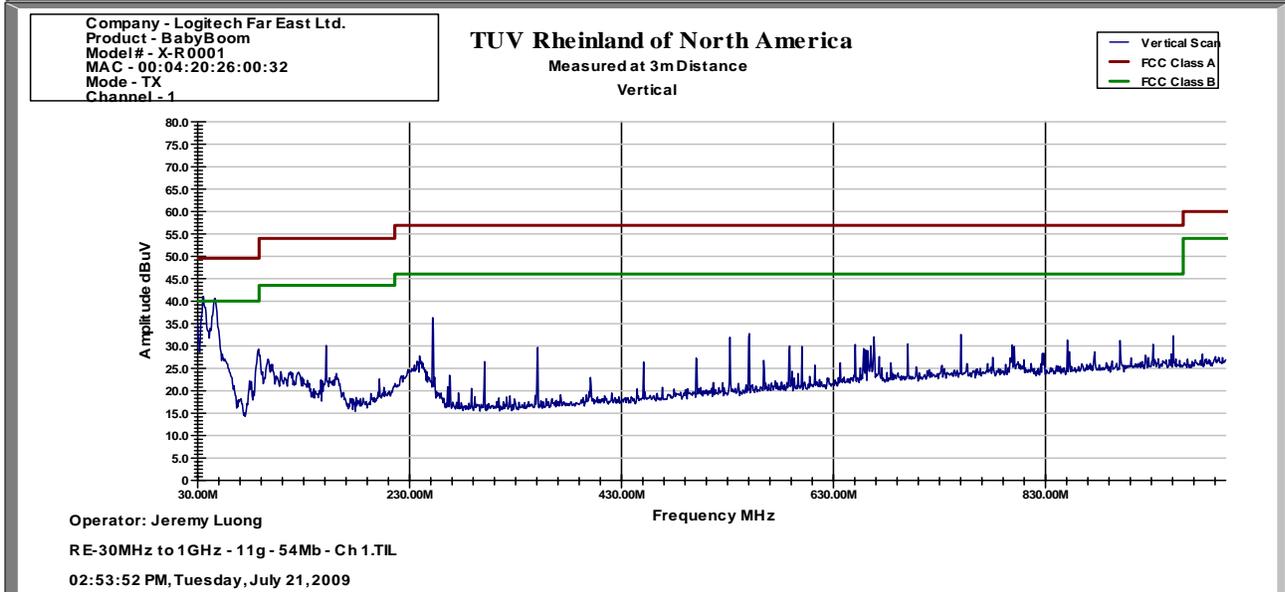
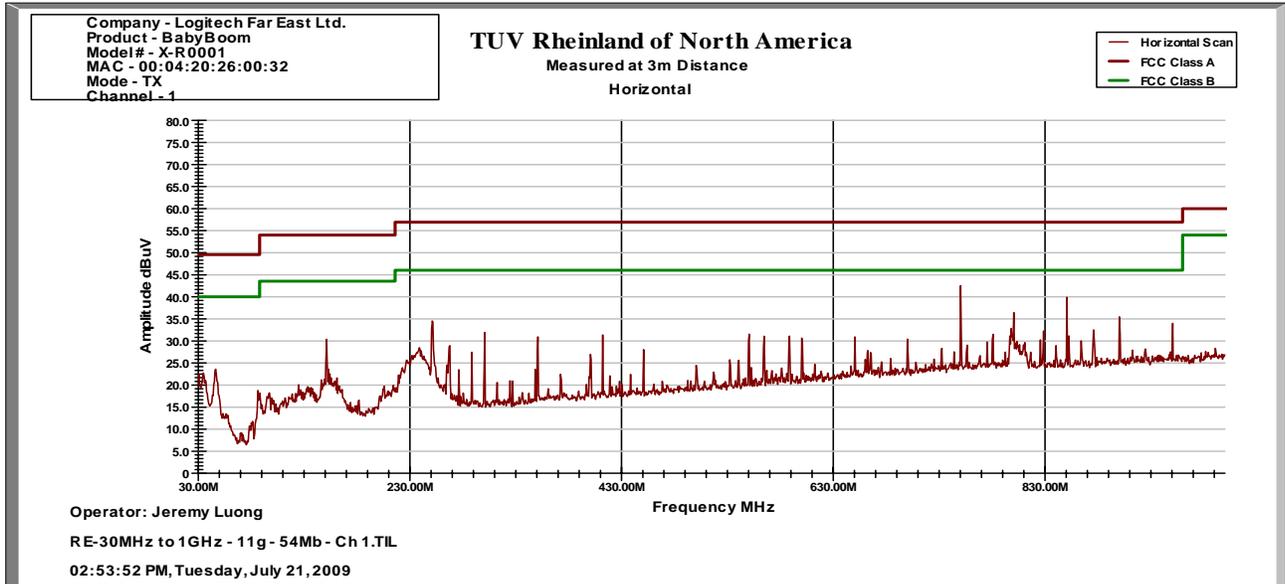
SOP 1 Radiated Emissions											Tracking # 30981128.001 Page 4 of 10	
EUT Name	Squeezebox Radio					Date	July 23, 2009					
EUT Model	X-R0001					Temp / Hum in	22°C / 38%RH					
EUT Serial	MAC - 00:04:20:26:00:32					Temp / Hum out	N/A					
EUT Config.	Integrated Antenna, Tabletop Position					Line 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) (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												
1282.32	H	98	358	87.60	67.43	-45.25	22.18	53.98	-31.80	Spurious		
2112.34	H	117	115	73.43	64.36	-40.38	23.98	53.98	-30.00	Spurious		
3215.92	H	114	135	80.72	75.78	-34.66	41.12	53.98	-12.86	Spurious		
1284.01	V	158	125	84.92	68.99	-45.24	23.75	53.98	-30.23	Spurious		
2112.1	V	157	263	79.50	71.52	-40.38	31.14	53.98	-22.84	Spurious		
3215.97	V	99	158	82.55	79.30	-34.66	44.64	53.98	-9.34	Spurious		
Transmitted Data at 2437MHz												
1284.63	H	151	17	85.19	68.12	-45.24	22.88	53.98	-31.10	Spurious		
3249.39	H	121	242	79.84	74.91	-34.54	40.37	53.98	-13.61	Spurious		
2111.1	V	118	260	78.69	68.81	-40.38	28.43	53.98	-25.55	Spurious		
3249.34	V	101	138	82.07	78.88	-34.54	44.34	53.98	-9.64	Spurious		
Transmitted Data at 2462MHz												
1283.52	H	144	352	88.29	70.25	-45.24	25.00	53.98	-28.98	Spurious		
1641.39	H	144	185	86.15	83.06	-43.64	39.42	53.98	-14.56	Spurious		
3282.7	H	135	147	78.03	72.73	-34.42	38.31	53.98	-15.67	Spurious		
1282.57	V	211	169	85.85	70.34	-45.25	25.10	53.98	-28.88	Spurious		
1641.33	V	129	264	88.25	86.06	-43.64	42.42	53.98	-11.56	Spurious		
3282.72	V	102	167	82.34	77.78	-34.42	43.36	53.98	-10.62	Spurious		
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty												
Total CF= Amp Gain + Cable Loss + ANT Factor												
Combined Standard Uncertainty $u_c(y) = \pm 1.6\text{dB}$ Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence												
Notes: Tested at worst case at 54MBit/s.												

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EUT Name	Squeezebox Radio	Date	July 23, 2009
EUT Model	X-R0001	Temp / Hum in	22°C / 38%RH
EUT Serial	MAC - 00:04:20:26:00:32	Temp / Hum out	N/A
EUT Config.	Integrated Antenna, Tabletop Position	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



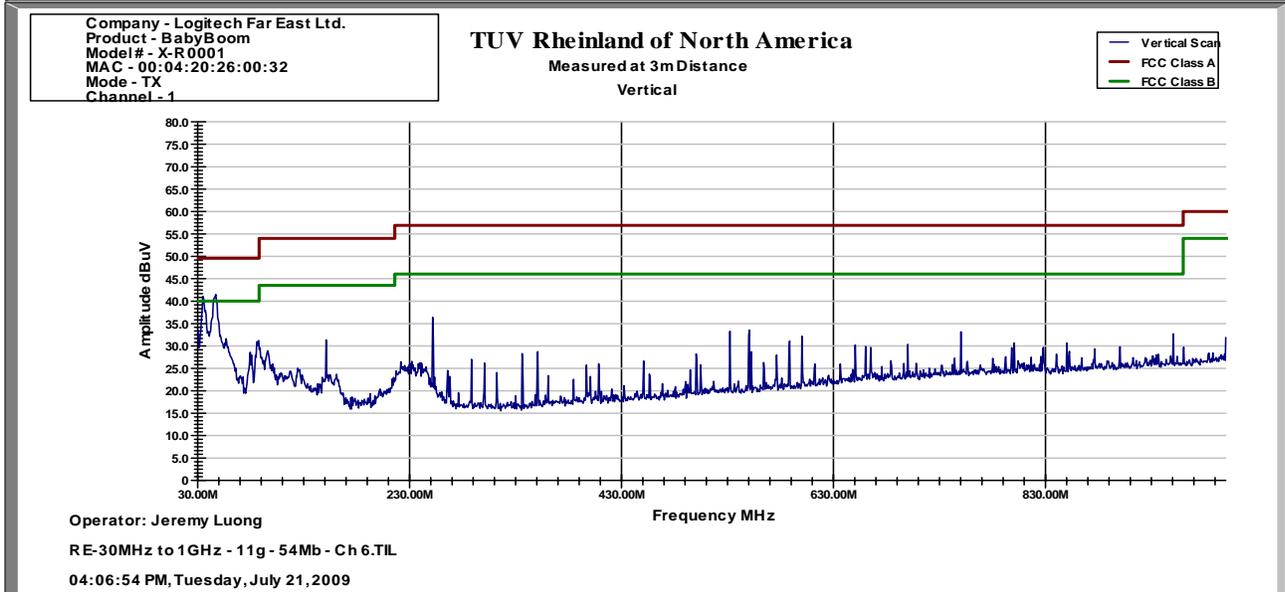
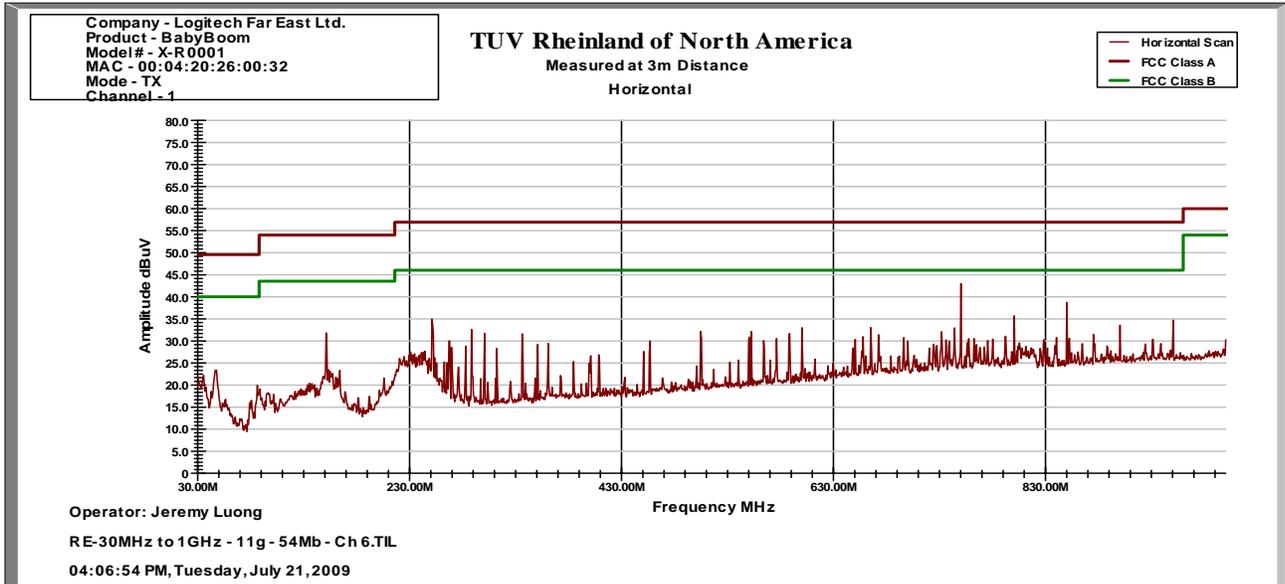
Notes: None.

SOP 1 Radiated Emissions

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EUT Name	Squeezebox Radio	Date	July 23, 2009
EUT Model	X-R0001	Temp / Hum in	23°C / 38%RH
EUT Serial	MAC - 00:04:20:26:00:32	Temp / Hum out	N/A
EUT Config.	Integrated Antenna, Tabletop Position	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



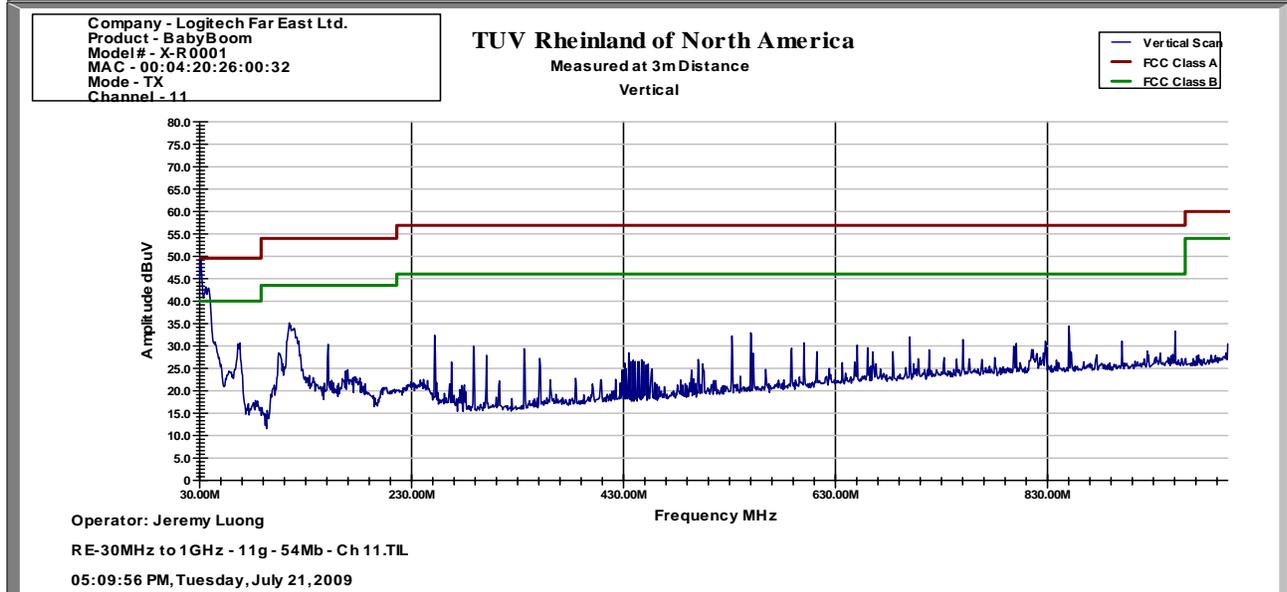
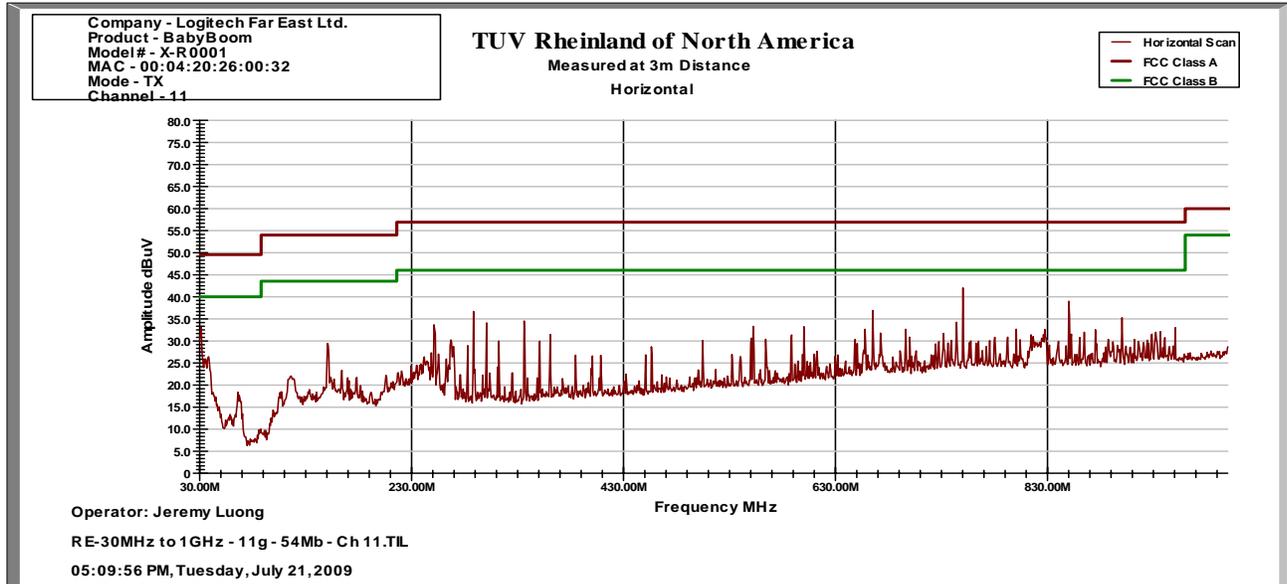
Notes: None.

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EUT Name	Squeezebox Radio	Date	July 23, 2009
EUT Model	X-R0001	Temp / Hum in	22°C / 38%RH
EUT Serial	MAC - 00:04:20:26:00:32	Temp / Hum out	N/A
EUT Config.	Integrated Antenna, Tabletop Position	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



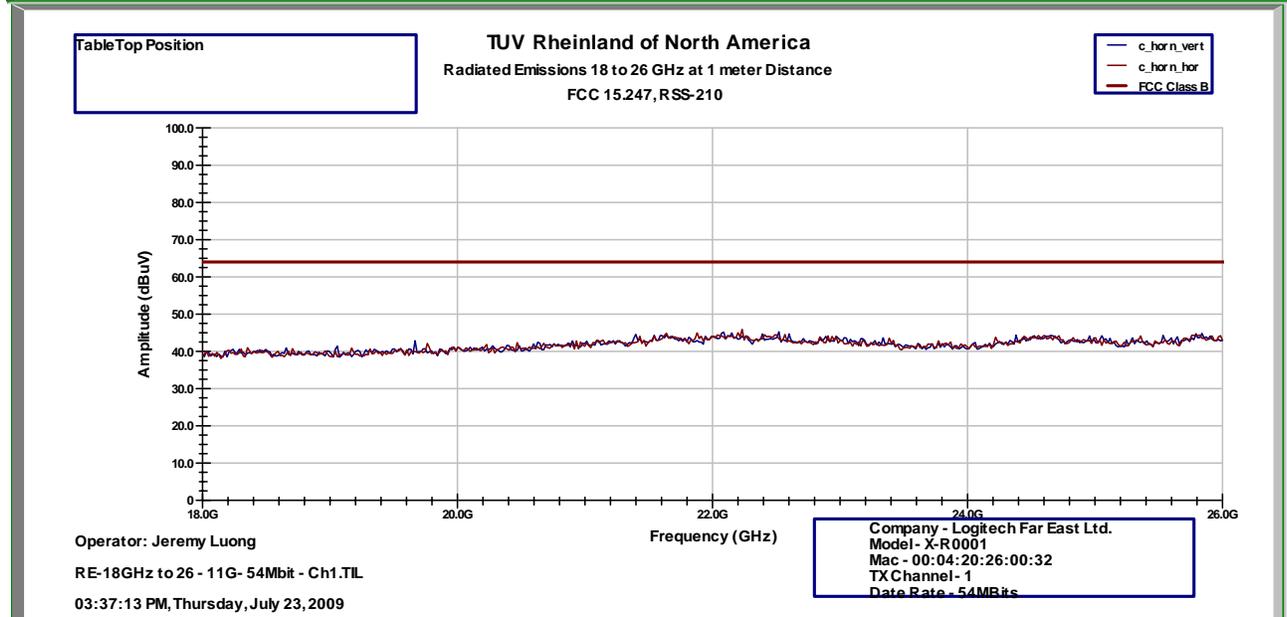
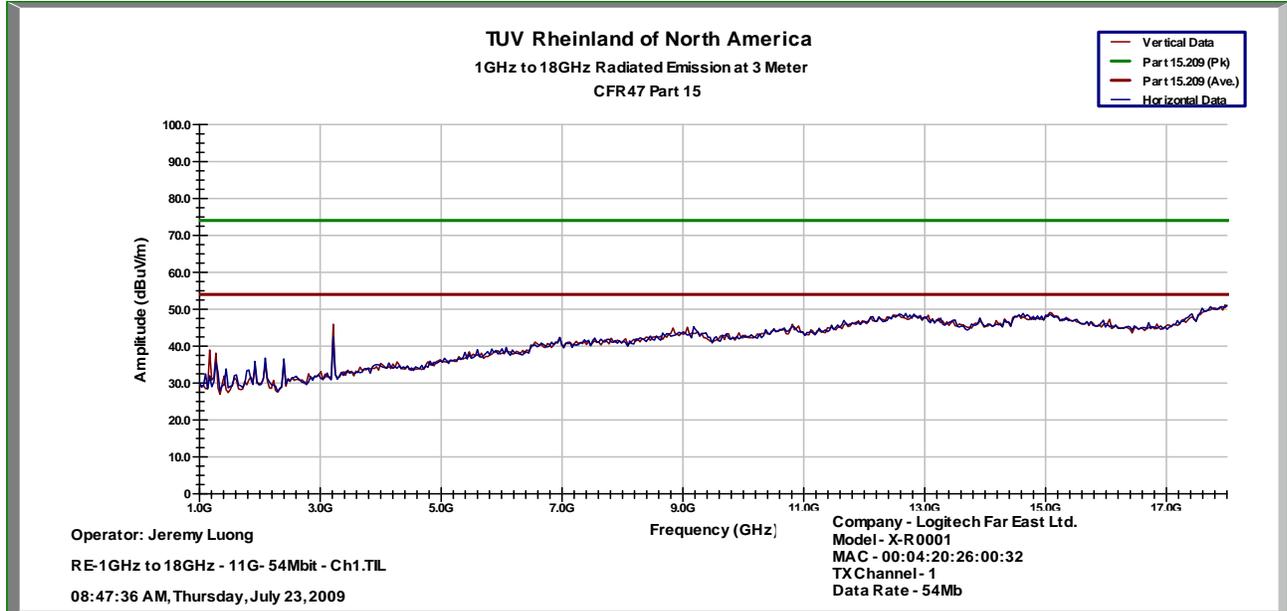
Notes: None.

SOP 1 Radiated Emissions

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EUT Name	Squeezebox Radio	Date	July 23, 2009
EUT Model	X-R0001	Temp / Hum in	22°C / 39%RH
EUT Serial	MAC - 00:04:20:26:00:32	Temp / Hum out	N/A
EUT Config.	Integrated Antenna, Tabletop Position	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



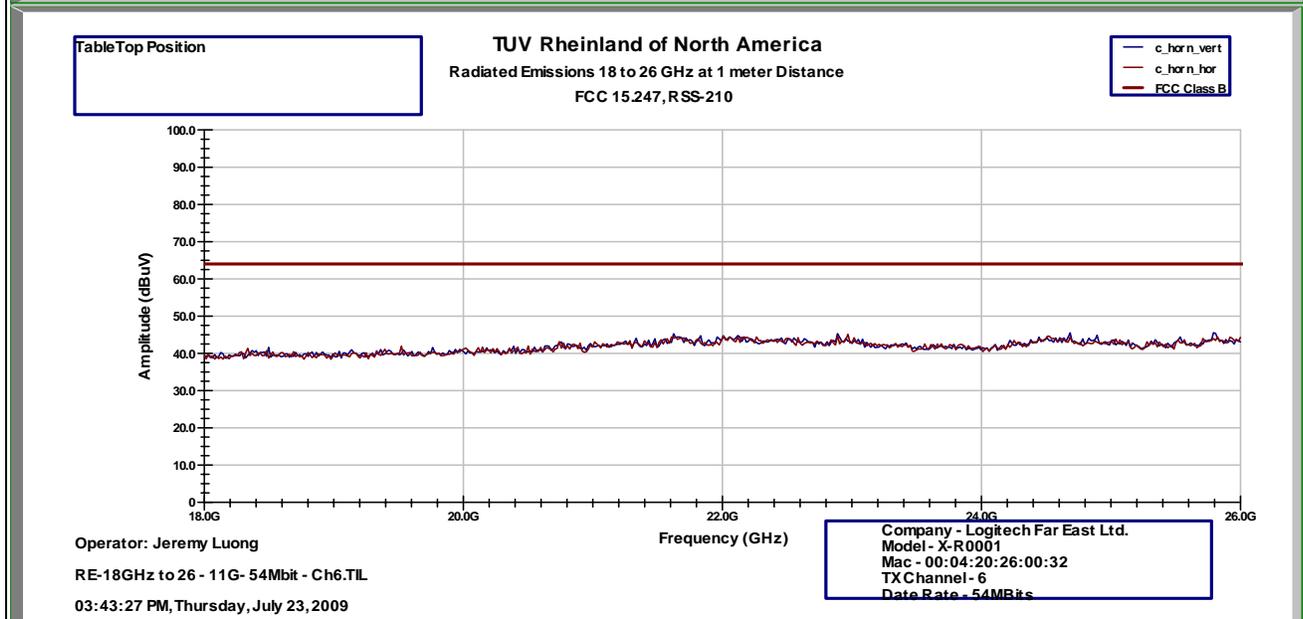
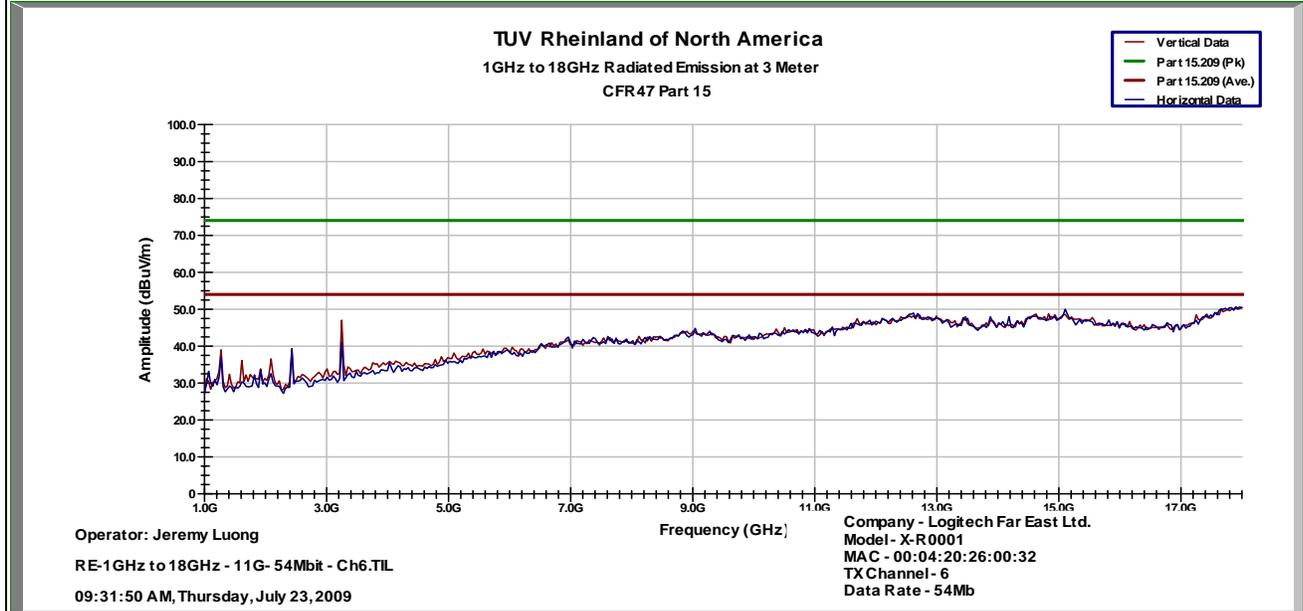
Notes: None.

SOP 1 Radiated Emissions

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EUT Name	Squeezebox Radio	Date	July 23, 2009
EUT Model	X-R0001	Temp / Hum in	23°C / 38%RH
EUT Serial	MAC - 00:04:20:26:00:32	Temp / Hum out	N/A
EUT Config.	Integrated Antenna, Tabletop Position	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



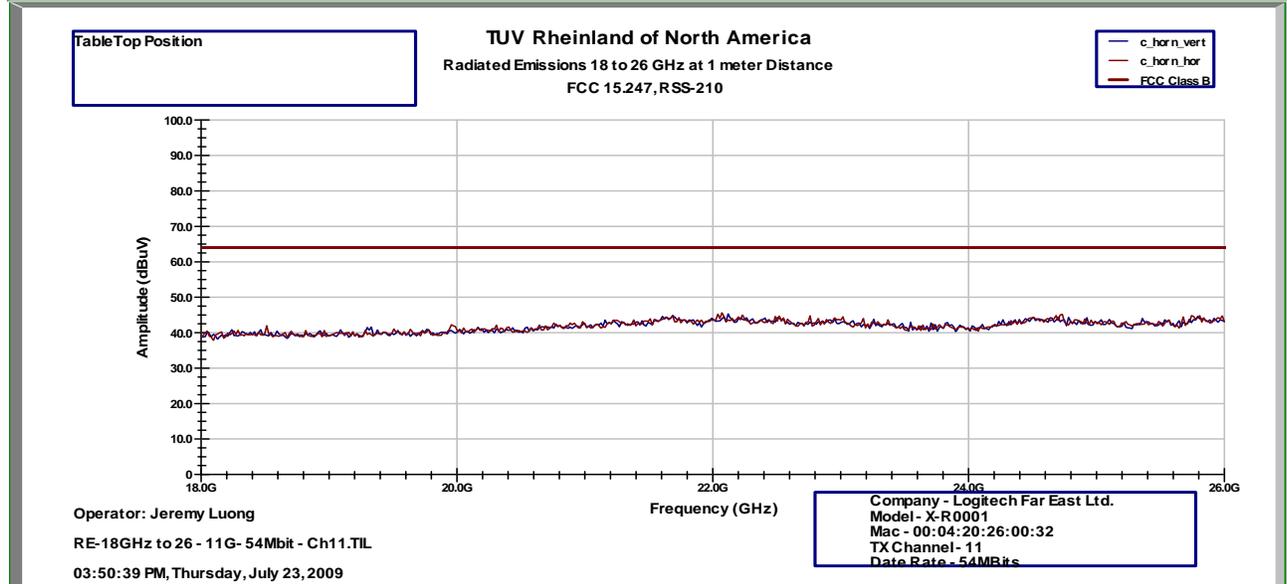
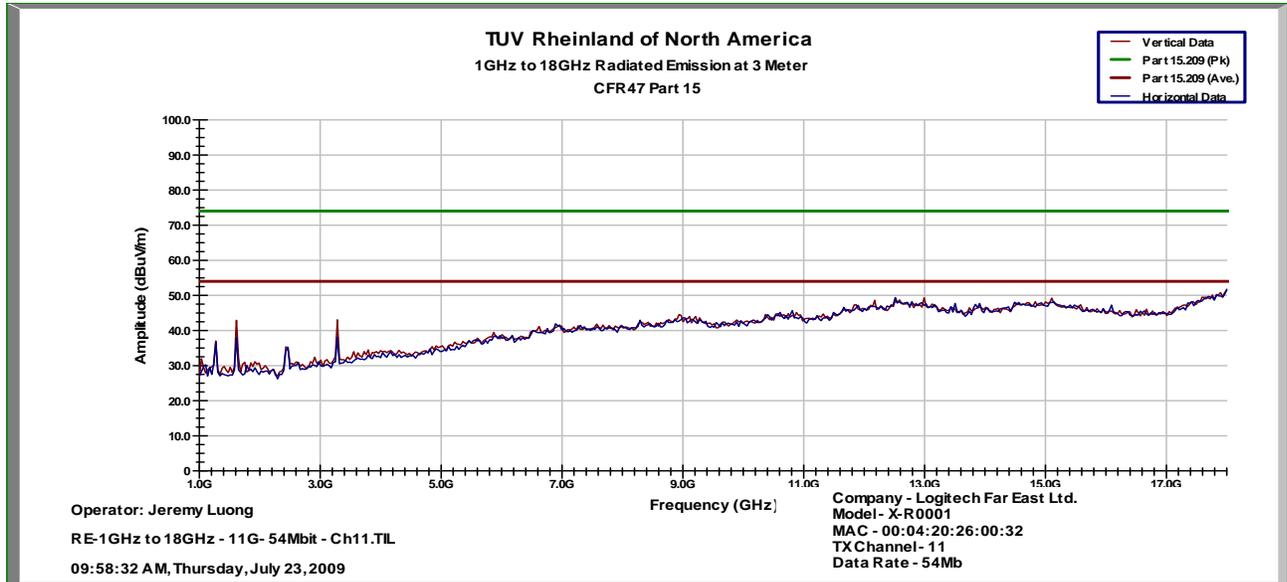
Notes: None.

SOP 1 Radiated Emissions

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EUT Name	Squeezebox Radio	Date	July 23, 2009
EUT Model	X-R0001	Temp / Hum in	23°C / 38%RH
EUT Serial	MAC - 00:04:20:26:00:32	Temp / Hum out	N/A
EUT Config.	Integrated Antenna, Tabletop Position	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 2462MHz



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:

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

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

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

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, then the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

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

The final scans performed on 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.

SOP 1 Radiated Emissions											Tracking # 30981128.001 Page 1 of 4	
EUT Name	Squeezebox Radio						Date	July 23, 2009				
EUT Model	X-R0001						Temp / Hum in	22°C / 38%RH				
EUT Serial	MAC - 00:04:20:26:00:32						Temp / Hum out	N/A				
EUT Config.	Integrated Antenna, Tabletop Position						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												
113.84	V	137	89	43.67	40.88	-10.93	29.95	43.52	-13.57	Spurious		
450.00	V	107	180	42.08	41.63	-6.67	34.96	46.02	-11.06	Spurious		
550.00	V	107	75	40.81	40.33	-4.83	35.50	46.02	-10.52	Spurious		
599.99	V	112	189	39.89	38.72	-3.91	34.81	46.02	-11.21	Spurious		
664.99	V	201	193	37.73	38.28	-2.20	36.08	46.02	-9.94	Spurious		
923.78	V	127	185	34.43	27.88	1.33	29.21	46.02	-16.81	Spurious		
150.00	H	164	7	45.51	44.55	-10.60	33.95	43.52	-9.57	Spurious		
250.01	H	119	346	47.65	46.76	-10.61	36.15	46.02	-9.87	Spurious		
300.00	H	103	272	47.39	47.09	-8.67	38.42	46.02	-7.60	Spurious		
335.99	H	103	332	45.70	45.31	-7.97	37.34	46.02	-8.68	Spurious		
450.00	H	220	242	46.90	46.57	-6.67	39.90	46.02	-6.12	Spurious		
549.99	H	179	248	44.05	43.34	-4.83	38.51	46.02	-7.51	Spurious		
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty												
Total CF= Amp Gain + Cable Loss + ANT Factor												
Combined Standard Uncertainty $u_c(y) = \pm 1.6\text{dB}$ Expanded Uncertainty $U = k u_c(y)$ $k = 2$ for 95% confidence												
Notes: RX mode at 54MBit/s												

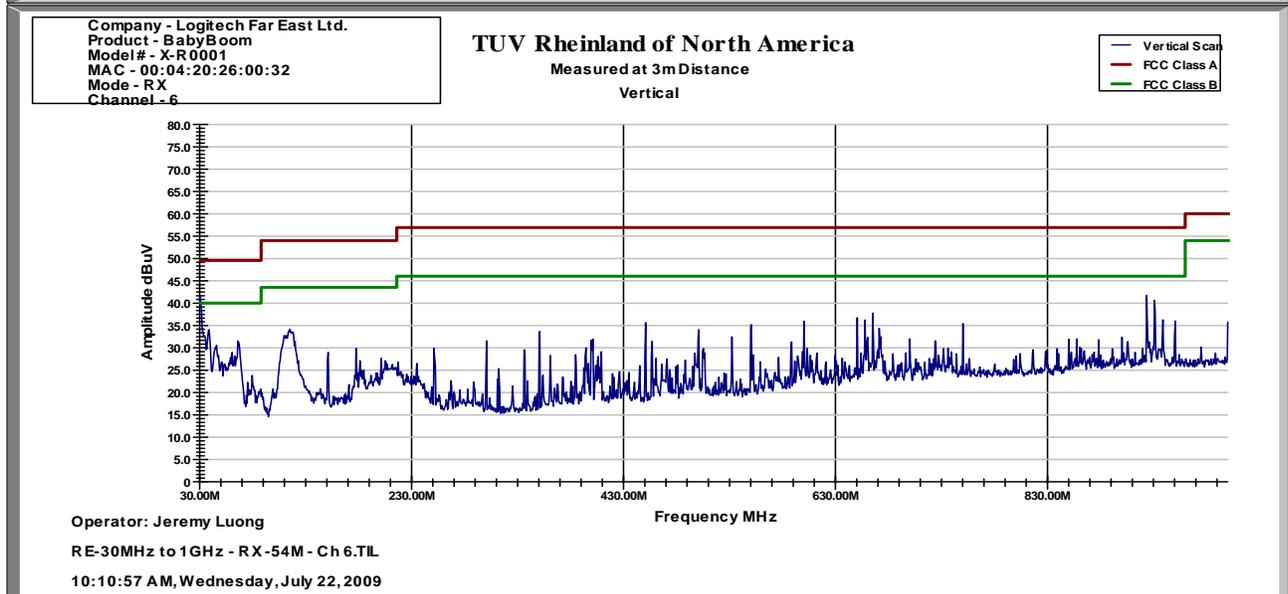
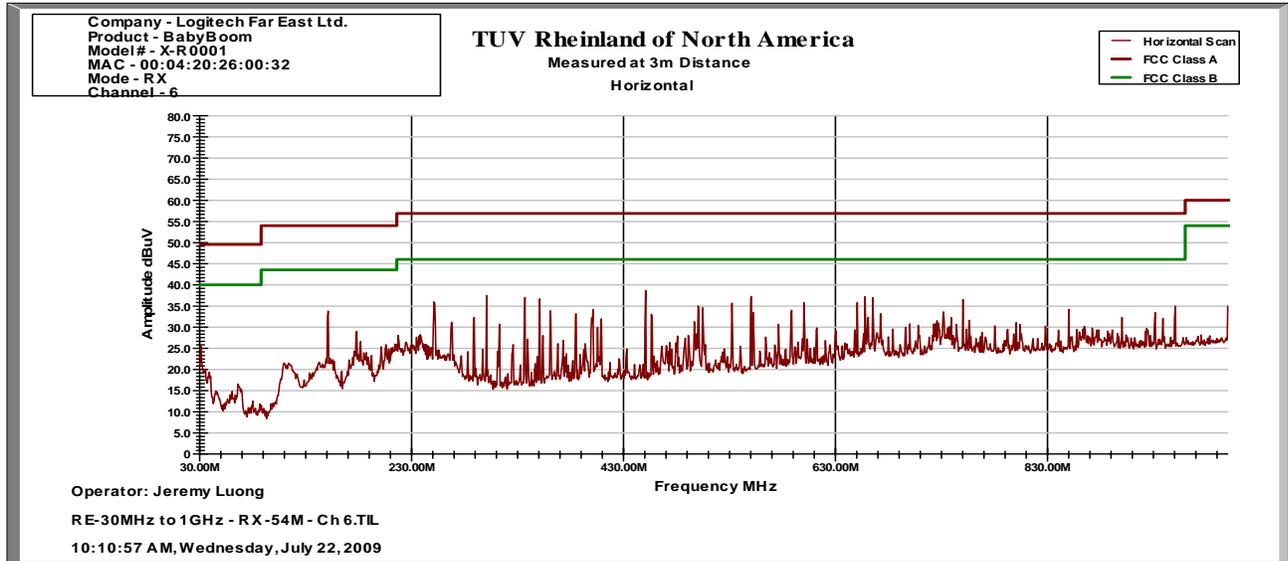
SOP 1 Radiated Emissions											Tracking # 30981128.001 Page 2 of 4	
EUT Name	Squeezebox Radio					Date	July 23, 2009					
EUT Model	X-R0001					Temp / Hum in	22°C / 38%RH					
EUT Serial	MAC - 00:04:20:26:00:32					Temp / Hum out	N/A					
EUT Config.	Integrated Antenna, Tabletop Position					Line 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) (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 2437MHz												
1066.06	H	98	163	77.02	66.02	-46.71	19.31	53.98	-34.67	Spurious		
1281.61	H	109	9	87.75	66.7	-45.25	21.45	53.98	-32.53	Spurious		
1281.88	V	95	87	82.05	68.94	-45.25	23.69	53.98	-30.29	Spurious		
Spec Margin = E-Field Ave - Limit, E-Field Ave = FIM Ave+ Total CF ± Uncertainty												
Total CF= Amp Gain + Cable Loss + ANT Factor												
Combined Standard Uncertainty $u_c(y) = \pm 1.6\text{dB}$ Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence												
Notes: None												

SOP 1 Radiated Emissions

Tracking # 30981128.001 Page 3 of 4

EUT Name	Squeezebox Radio	Date	July 22, 2009
EUT Model	X-R0001	Temp / Hum in	22°C / 38%RH
EUT Serial	MAC - 00:04:20:26:00:32	Temp / Hum out	N/A
EUT Config.	Integrated Antenna, Tabletop Position	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



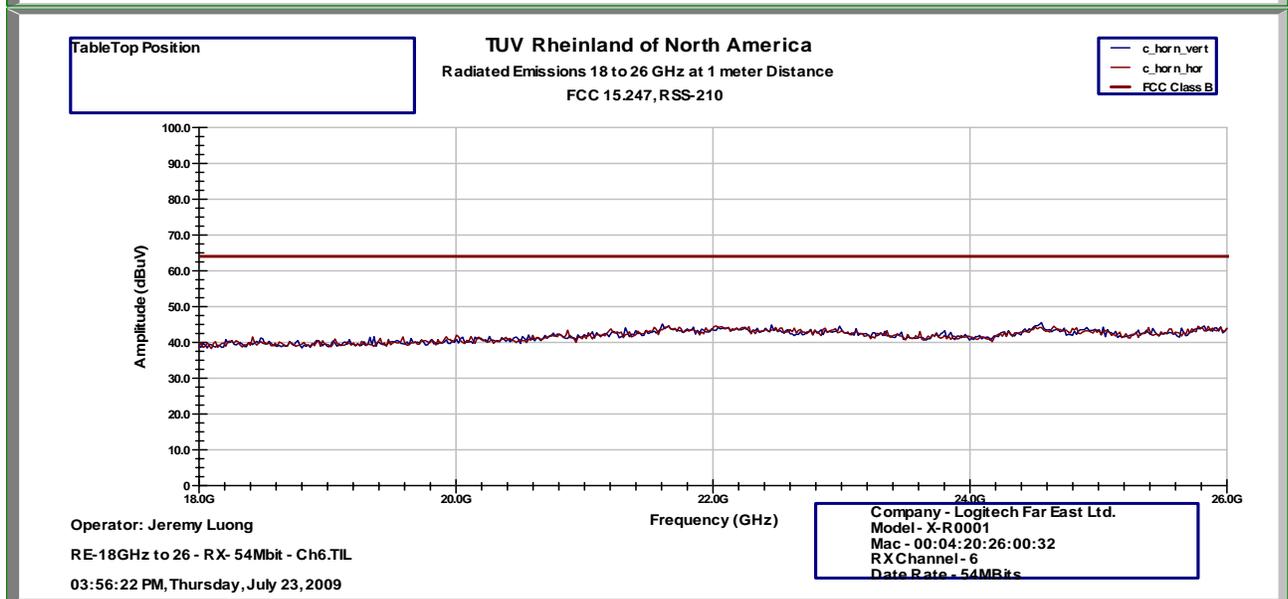
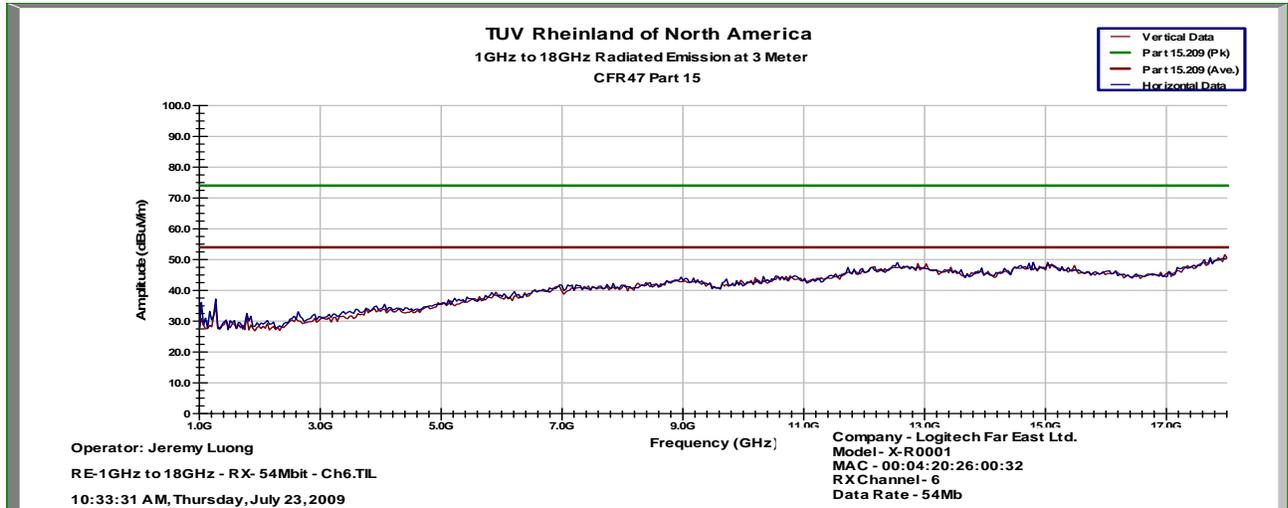
Notes: None.

SOP 1 Radiated Emissions

Tracking # 30981128.001 Page 4 of 4

EUT Name	Squeezebox Radio	Date	July 23, 2009
EUT Model	X-R0001	Temp / Hum in	21°C / 38%RH
EUT Serial	MAC - 00:04:20:26:00:32	Temp / Hum out	N/A
EUT Config.	Integrated Antenna, Tabletop Position	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: None.

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 50 μ H / 50 Ω 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 8: AC Conducted Emissions – Test Results

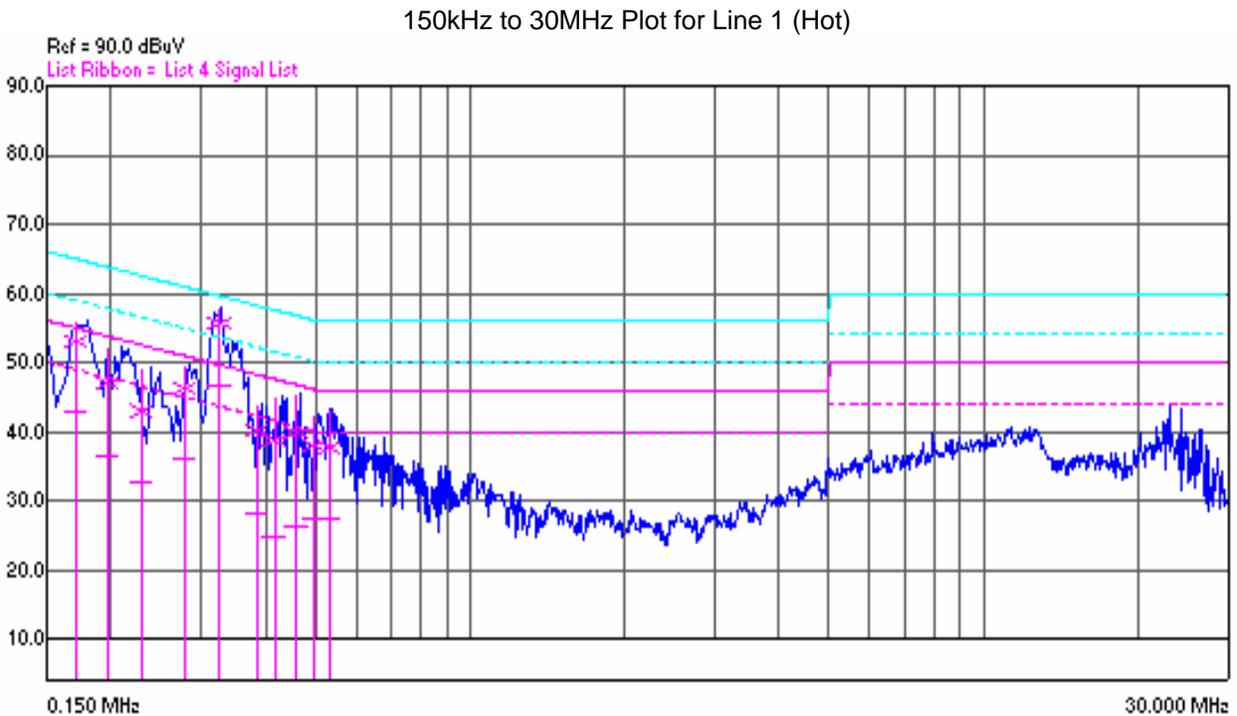
Test Conditions: Conducted Measurement at Normal Conditions only		
Antenna Type: Attached		Power Level: 15
Operating Frequency: 2437MHz		AC Power: 120Vac/60Hz
Ambient Temperature: 22 °C		Relative Humidity: 35%
Configuration	Frequency Range	Test Result
Line 1(Hot)	0.15 to 30 MHz	Pass
Line 2 (Neutral)	0.15 to 30 MHz	Pass

SOP 2 Conducted Emissions				Tracking # 30981128.001 Page 1 of 4		
EUT Name	Squeezebox Radio		Date	July 15, 2009		
EUT Model	X-R0001		Temp / Hum in	23°C / 36%RH		
EUT Serial	MAC - 00:04:20:26:00:32		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	Lab #3 / 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
0.171087	53.07	64.97	-11.90	42.84	54.97	-12.13
0.197628	46.88	63.75	-16.87	36.25	53.75	-17.50
0.229238	42.98	62.53	-19.55	32.65	52.53	-19.88
0.279372	46.23	60.90	-14.66	36.19	50.90	-14.70
0.325647	55.64	59.60	-3.96	46.42	49.60	-3.19
0.385225	40.12	58.19	-18.06	28.08	48.19	-20.10
0.416933	38.61	57.55	-18.94	24.80	47.55	-22.75
0.459838	39.78	56.75	-16.97	26.11	46.75	-20.64
0.496313	37.81	56.07	-18.26	27.38	46.07	-18.69
0.533356	37.76	56.00	-18.24	27.45	46.00	-18.55
Spec Margin = QP./Ave. - Limit, ± Uncertainty						
Combined Standard Uncertainty $u_c(y) = \pm 1.2\text{dB}$ Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence						
Notes: EUT was setup as table top equipment.						

SOP 2 Conducted Emissions

Tracking # 30981128.001 Page 2 of 4

EUT Name	Squeezebox Radio	Date	July 15, 2009
EUT Model	X-R0001	Temp / Hum in	23°C / 36%RH
EUT Serial	MAC - 00:04:20:26:00:32	Temp / Hum out	N/A
EUT Config.	Attached Antenna	Line AC	120VAC/60Hz
Standard	CFR47 Part 15.107	RBW / VBW	9kHz / 30kHz
Lab/LISN	Lab #3 / Solar 9348-50-R-24-BNC, Line 1	Performed by	Jeremy Luong



Notes: Using CISRP Class B Limit.

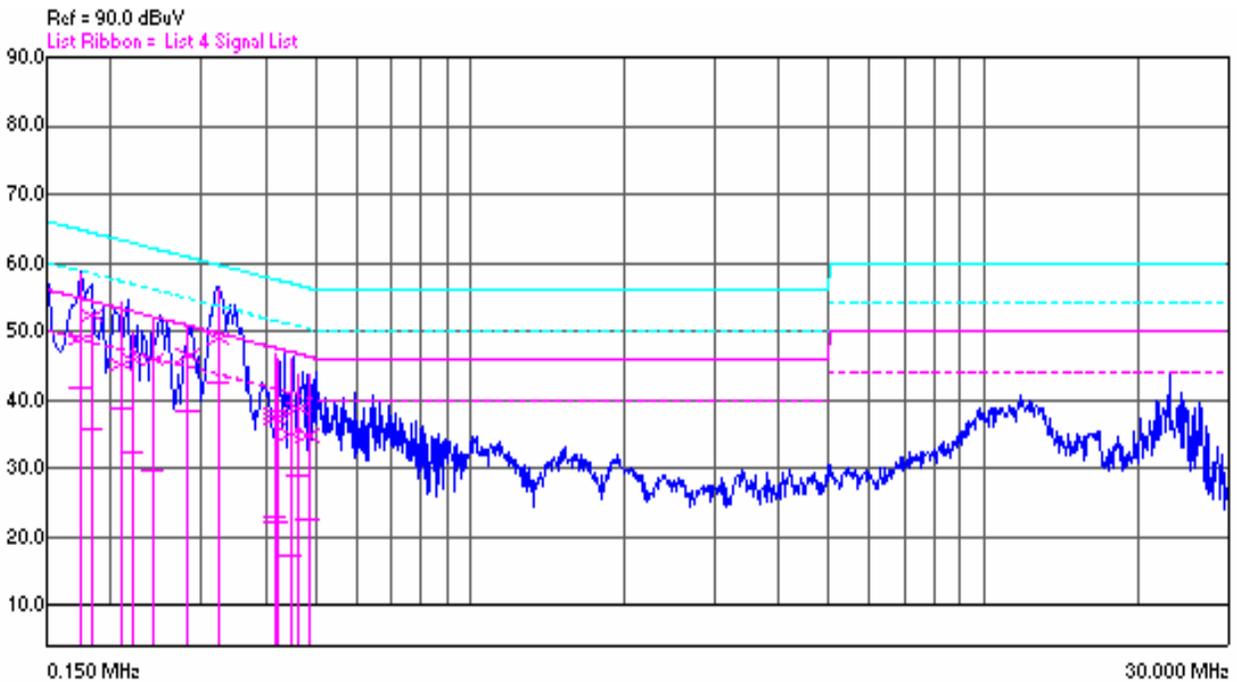
SOP 2 Conducted Emissions				Tracking # 30981128.001 Page 3 of 4		
EUT Name	Squeezebox Radio	Date	July 15, 2009			
EUT Model	X-R0001	Temp / Hum in	23°C / 36%RH			
EUT Serial	MAC - 00:04:20:26:00:32	Temp / Hum out	N/A			
EUT Config.	Attached Antenna	Line AC / Freq	120VAC/60Hz			
Standard	CFR47 Part 15.107	RBW / VBW	9kHz / 30kHz			
Lab/LISN	Lab #3 / 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
0.175508	48.76	64.76	-16.00	41.88	54.76	-12.87
0.184036	52.23	64.34	-12.11	35.74	54.34	-18.60
0.209766	45.13	63.28	-18.15	38.53	53.28	-14.74
0.220947	45.82	62.85	-17.02	32.12	52.85	-20.73
0.241937	45.81	62.04	-16.23	29.67	52.04	-22.37
0.282324	46.40	60.81	-14.40	38.28	50.81	-12.52
0.325201	48.80	59.61	-10.81	42.59	49.61	-7.02
0.418954	37.21	57.51	-20.30	22.94	47.51	-24.58
0.421026	37.85	57.48	-19.62	22.22	47.48	-25.26
0.44792	34.84	56.97	-22.13	17.13	46.97	-29.84
0.463468	38.72	56.68	-17.97	28.88	46.68	-17.81
0.484985	34.71	56.28	-21.57	22.31	46.28	-23.97
Spec Margin = QP./Ave. - Limit, ± Uncertainty						
Combined Standard Uncertainty $u_c(y) = \pm 1.2\text{dB}$ Expanded Uncertainty $U = k u_c(y)$ $k = 2$ for 95% confidence						
Notes: EUT was setup as table top equipment.						

SOP 2 Conducted Emissions

Tracking # 30981128.001 Page 4 of 4

EUT Name	Squeezebox Radio	Date	July 15, 2009
EUT Model	X-R0001	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	A102606	02/06/08	02/06/10
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 9: Customer Information

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

Table 10: 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 11: EUT Specifications

X-R0001 Dimensions	4" x 6" x 3.25"
PHIHONG AC Adapter (M/N: PSAA18R-180-R)	Input Voltage: 100-240VAC Input Current: 500 mA Output Voltage: 18VDC Output Current: 1A
Battery Power Pack	Output Voltage: 12VDC Output Current: 210mA V _{min} : 10Vdc
Environment	Indoor
Operating Temperature Range:	0 to 40 degrees C
Multiple Feeds:	<input type="checkbox"/> Yes and how many <input checked="" type="checkbox"/> 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	<input type="checkbox"/> AM <input type="checkbox"/> FM <input type="checkbox"/> Phase <input checked="" type="checkbox"/> Other describe: DSSS
Type of Equipment	<input checked="" type="checkbox"/> Table Top <input type="checkbox"/> Wall-mount <input type="checkbox"/> Floor standing cabinet <input type="checkbox"/> Other <i>describe</i> :

Table 12: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
Ethernet	CAT-5	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Metric: 10m	<input checked="" type="checkbox"/> M
Audio In	None	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Metric: 1.8m	<input checked="" type="checkbox"/> M
Earphone	None	<input checked="" type="checkbox"/> No	<input checked="" type="checkbox"/> Metric: 1.8m	<input checked="" type="checkbox"/> M

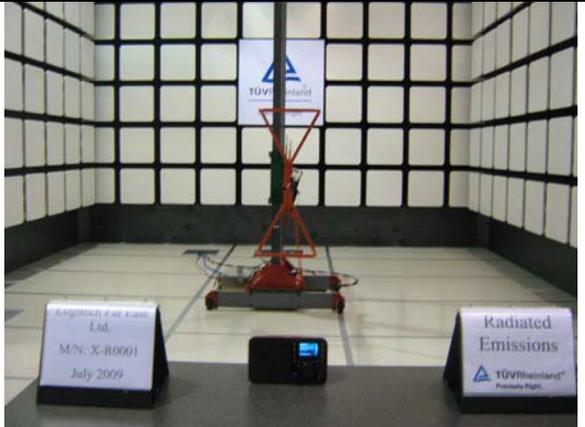
Table 13: Supported Equipment

Equipment	Manufacturer	Model	Serial	Used for
Laptop	Dell Computer	PP23LB	11582181397	Set test mode
Ethernet Hub	NetGear	WRT54GL	CL7C1J418554	Hub for communicating with EUT

Table 14: Description of Sample used for Testing

Device	MAC Address	Configuration	Used For
X-R0001	00:04:20:26:00:32	Radiated Sample (w/ Antenna)	Radiated Emission
X-R0001	00:04:20:26:00:74	Conducted Sample (w/ SMA Connector	Output Power, Bandwidth, Conducted Spurious Emission, Peak Power Spectral Density,

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

Device	Antenna	Mode	Setup Photo (Table Top)
X-R0001	Attached	Transmit & Receive	

6.4 Test Specifications

Testing requirements

Table 16: EUT Designation

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