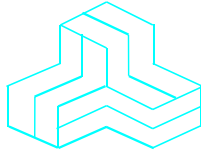


ENGINEERING TEST REPORT



2.4GHz 802.11bg 1W OEM Module

Model: n802.11bg-30

FCC ID: NS9NBG30

Applicant:

Microhard Systems Inc.
150 Country Hills Landing NW
Calgary, Alberta
Canada T3K 5P3

In Accordance With

**Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247 Digital Modulation Systems (DTS)**

UltraTech's File No.: MCRS-046F15C247

This Test report is Issued under the Authority of
Tri M. Luu
Vice President of Engineering
UltraTech Group of Labs

Date: June 4, 2012

Report Prepared by: Dan Huynh

Tested by: Mr. Hung Trinh

Issued Date: June 4, 2012

Test Dates: April 25 - May 23, 2012

*The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.
This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech

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NvLap Lab Code 200093-0



SL2-IN-E-1119R



Korea KCC-RRL
CA2049

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
Purpose of Test:	Equipment Certification for Digital Modulation Systems (DTS) Transmitter.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	[x] Commercial, industrial or business environment [x] Residential environment

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2011	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
ANSI C63.10	2009	American National Standard for Testing Unlicensed Wireless Devices
CISPR 22 & EN 55022	2008-09, Edition 6.0 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances
FCC KDB Publication No. 558074 D01 DTS Meas Guidance v01	2012	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

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EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Microhard Systems Inc.
Address:	150 Country Hills Landing NW Calgary, Alberta Canada T3K 5P3
Contact Person:	Mr. Hany Shenouda Phone #: 403 248-0028 Fax #: 403 248 2762 Email Address: shenouda@microhardcorp.com

MANUFACTURER	
Name:	Microhard Systems Inc.
Address:	150 Country Hills Landing NW Calgary, Alberta Canada T3K 5P3
Contact Person:	Mr. Hany Shenouda Phone #: 403 248-0028 Fax #: 403 248-2762 Email Address: shenouda@microhardcorp.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Microhard Systems Inc.
Product Name:	2.4GHz 802.11bg 1W OEM Module
Model Name or Number:	n802.11bg-30
Serial Number:	Test Sample
Type of Equipment:	Digital Transmission System (DTS)
Input Power Supply Type:	External Regulated DC Sources
Primary User Functions of EUT:	802.11bg OEM card

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	▪ Mobile ▪ Base Station (fixed use)
Intended Operating Environment:	▪ Commercial, industrial or business environment ▪ Residential environment
Power Supply Requirement:	3.3VDC to 3.6VDC
RF Output Power Rating:	802.11b: 22 dBm to 29 dBm (for DBPSK 1 Mbps and DQPSK 2 Mbps) 22 dBm to 30 dBm (for CCK 11 Mbps) 802.11g: 22 dBm to 30 dBm
Operating Frequency Range:	2412 – 2462 MHz
RF Output Impedance:	50 Ohm
Duty Cycle:	100%
Modulation Type:	802.11b and 802.11g
Oscillator Frequencies:	40 MHz
Antenna Connector Type:	MMCX

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2.4. ASSOCIATED ANTENNA DESCRIPTIONS

There are four antenna families:

1. Rubber Ducky
2. Omni Directional
3. Patch
4. Yagi

Refer to antennas list exhibit for detailed specifications.

2.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	RF IN/OUT Port	1	MMCX	Shielded coaxial cable with unique coupling connectors
2	DC Supply & I/O Port	1	Pin Header	No cable, direct connection

2.6. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Test Jig
Brand name:	Microhard Systems Inc.
Model Name or Number:	N/A
Connected to EUT's Port:	I/O Port

Ancillary Equipment # 2	
Description:	Switching AC/DC Power Adaptor
Brand name:	GVE
Model Name or Number:	GM36-120200-1
Connected to EUT's Port:	Test Jig of the EUT

Ancillary Equipment # 3	
Description:	Laptop
Brand name:	Dell
Model Name or Number:	PPL
Connected to EUT's Port:	Test Jig of the EUT

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21 to 23 °C
Humidity:	45 to 58%
Pressure:	102 kPa
Power Input Source:	3.3VDC to 3.6VDC

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	Each of lowest, middle and highest channel frequencies transmits continuously for emissions measurements.
Special Test Software:	Special software and hardware provided by the Applicant to operate the EUT at each channel frequency continuously. For example, the transmitter will be operated at each of the lowest, middle and highest frequencies individually continuously during testing.
Special Hardware Used:	Test Jig
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as non-integral antenna equipment as described with the test results.

Transmitter Test Signals	
Frequency Band(s):	2412 -2462 MHz
Frequency(ies) Tested:	2412 MHz, 2437 MHz and 2462 MHz
RF Power Output: (measured maximum output power at antenna terminals)	29.96 dBm, 0.991 W (conducted)
Normal Test Modulation:	802.11b and 802.11g
Modulating Signal Source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2014-04-04.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirements	Yes
15.207(a)	AC Power Line Conducted Emissions	Yes
15.247(a)(2)	6 dB Bandwidth	Yes
15.247(b)(3)	Peak Conducted Output Power - DTS	Yes
15.247(d)	Band-Edge and RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
15.247(d), 15.209 & 15.205	Transmitter Spurious Radiated Emissions	Yes
15.247(e)	Power Spectral Density	Yes
15.247(i), 1.1307, 1.1310, 2.1091	RF Exposure	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

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EXHIBIT 5. TEST DATA

5.1. POWER LINE CONDUCTED EMISSIONS [§15.207(a)]

5.1.1. Limit(s)

The equipment shall meet the limits of the following table:

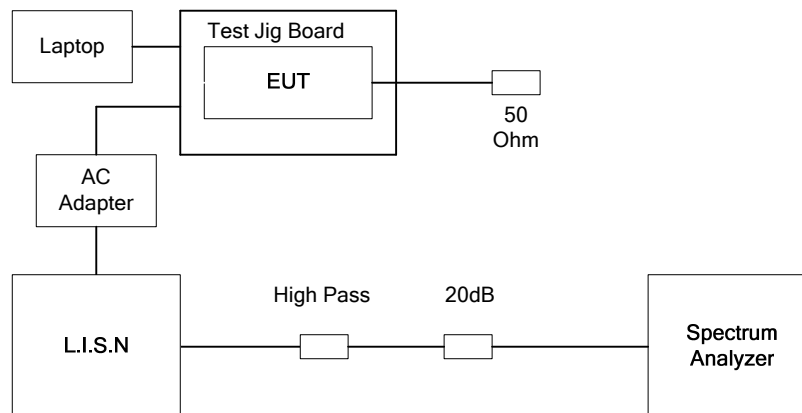
Frequency of emission (MHz)	Conducted Limits (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases linearly with the logarithm of the frequency

5.1.2. Method of Measurements

ANSI C63.4-2009

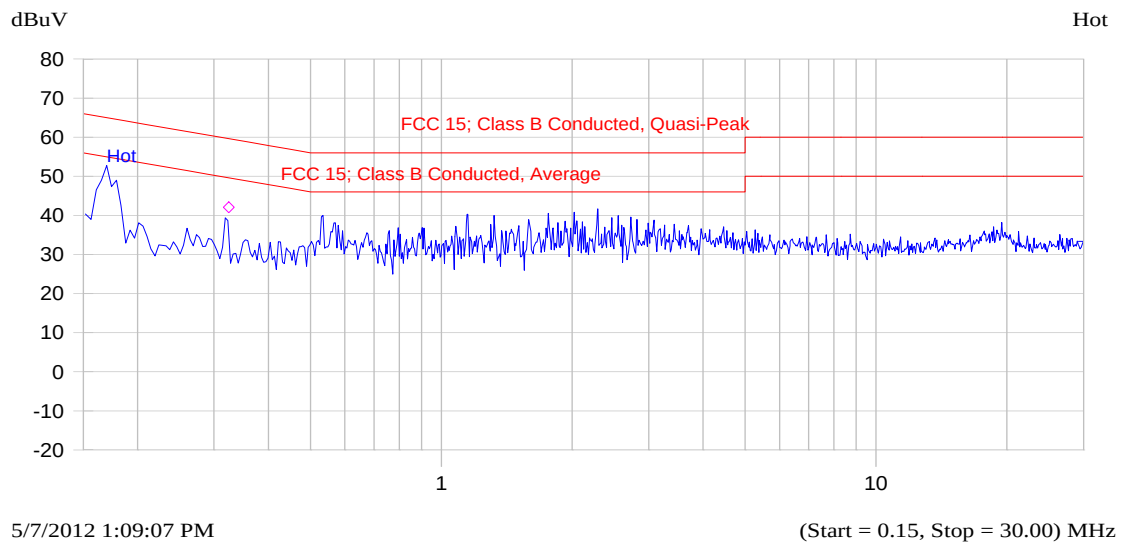
5.1.3. Test Arrangement



5.1.4. Test Data

Plot 5.1.4.1. Power Line Conducted Emissions; Line Voltage: 120 VAC; Line Tested: Hot: Tx Mode

Current Graph

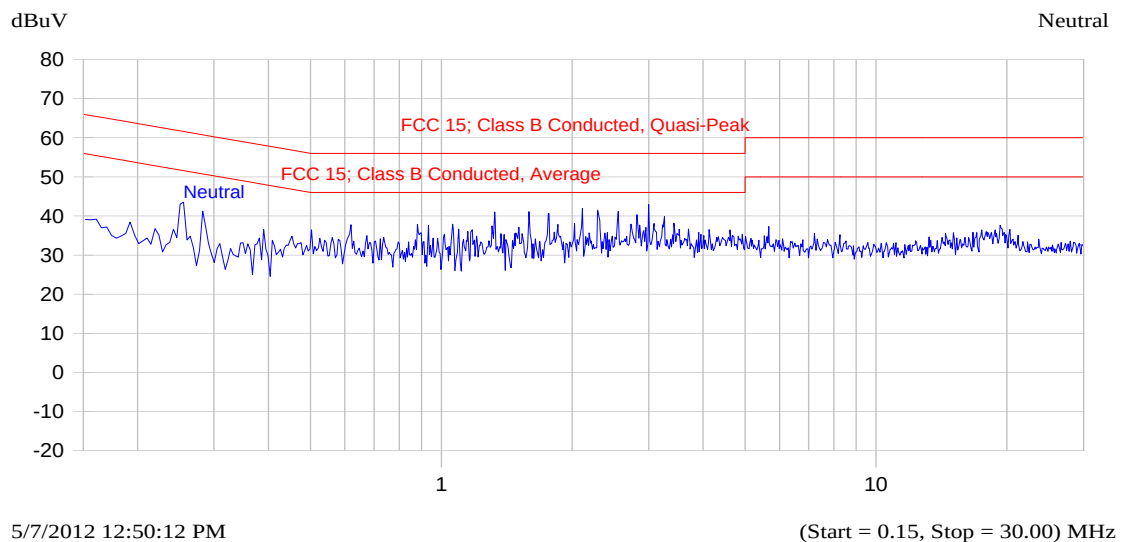


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta dB	QP-QP Limit dB	Avg dBuV	Delta dB	Avg-Avg Limit dB	Trace Name
0.162	57.4	51.8	-13.8		35.5	-20.2		Hot
0.324	42.0	35.2	-25.7		25.6	-25.3		Hot
0.529	42.9	35.6	-20.4		28.4	-17.6		Hot
1.140	41.6	37.3	-18.7		31.6	-14.4		Hot
2.285	45.2	40.8	-15.2		36.4	-9.6		Hot

Plot 5.1.4.2. Power Line Conducted Emissions; Line Voltage: 120 VAC; Line Tested: Neutral

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta dB	QP-QP Limit	Avg dBuV	Delta dB	Avg-Avg Limit	Trace Name
0.247	49.6	43.1	-20.0		29.5	-23.7		Neutral
0.287	44.2	38.7	-23.3		27.3	-24.7		Neutral
1.318	44.6	41.0	-15.0		36.4	-9.6		Neutral
2.987	44.1	40.5	-15.5		35.9	-10.1		Neutral

5.2. OCCUPIED BANDWIDTH [§ 15.247(a)(2)]

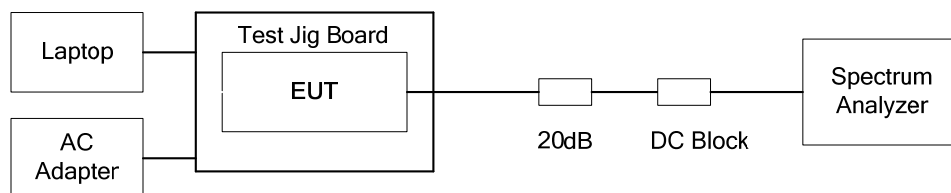
5.2.1. Limit(s)

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.2.2. Method of Measurements

KDB Publication No. 558074 D01 Section 5.1.1 EBW Measurement Procedure.

5.2.3. Test Arrangement

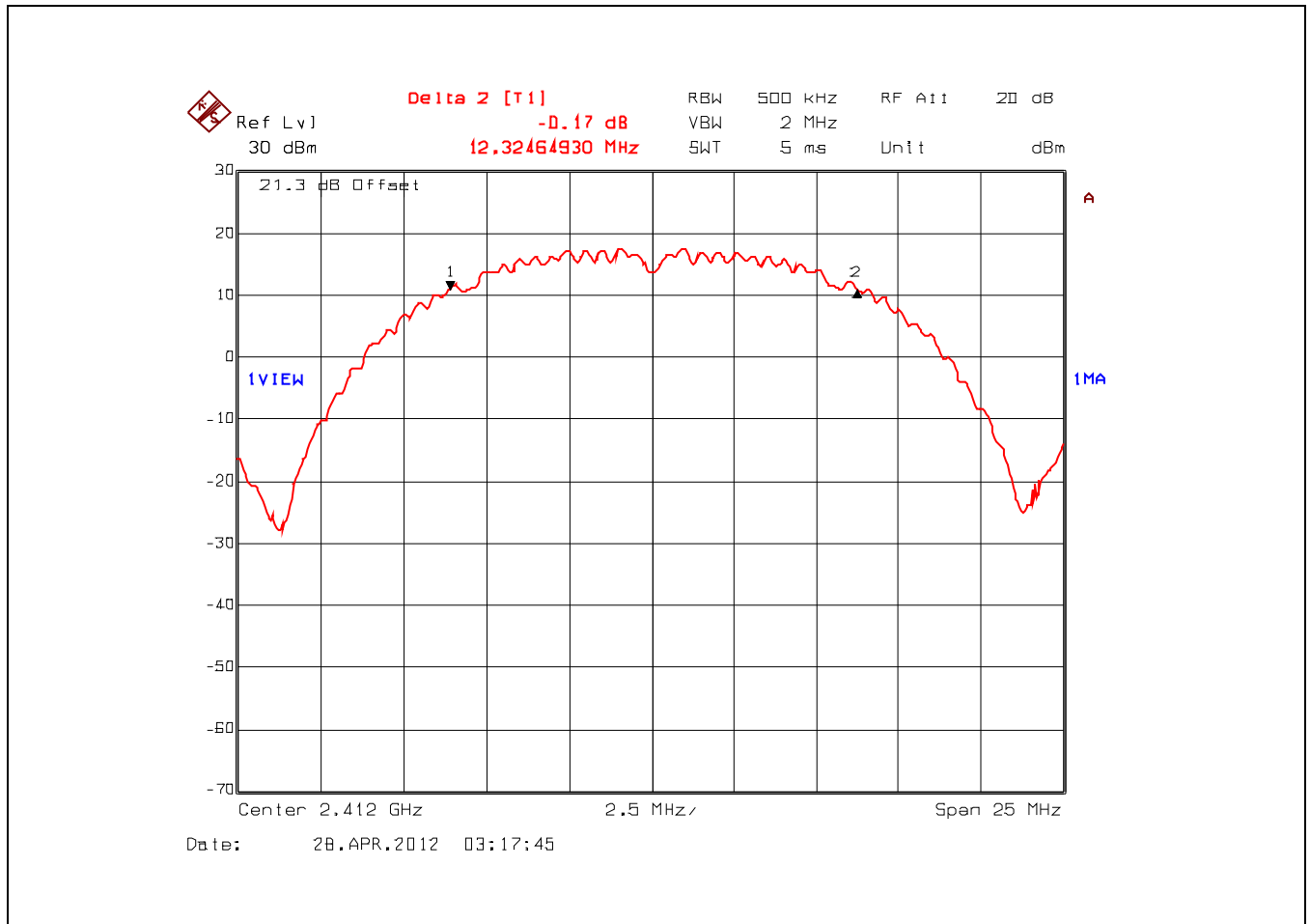


5.2.4. Test Data

Modulation	Data Rate (Mbps)	6 dB Bandwidth (MHz)			99% Occupied Bandwidth (MHz)		
		Ch 01 2412 MHz	Ch 06 2437 MHz	Ch 11 2462 MHz	Ch 01 2412 MHz	Ch 06 2437 MHz	Ch 11 2462 MHz
		802.11b					
DBPSK	1	12.32	12.12	12.12	15.92	15.57	15.57
DQPSK	2	12.63	12.42	12.53	15.85	15.57	15.57
CCK	11	12.78	12.53	12.53	15.57	15.29	15.29
802.11g							
BPSK	9	16.62	16.69	16.76	18.44	18.28	18.12
QPSK	18	16.48	16.62	16.55	18.04	17.64	17.72
16-QAM	36	16.90	16.69	16.62	17.80	17.56	17.72
64-QAM	54	16.62	16.62	16.69	18.04	17.72	17.64

See the following plots for detailed measurements.

Plot 5.2.4.1. 6 dB Bandwidth, 2412 MHz, 802.11b, DBPSK 1 Mbps



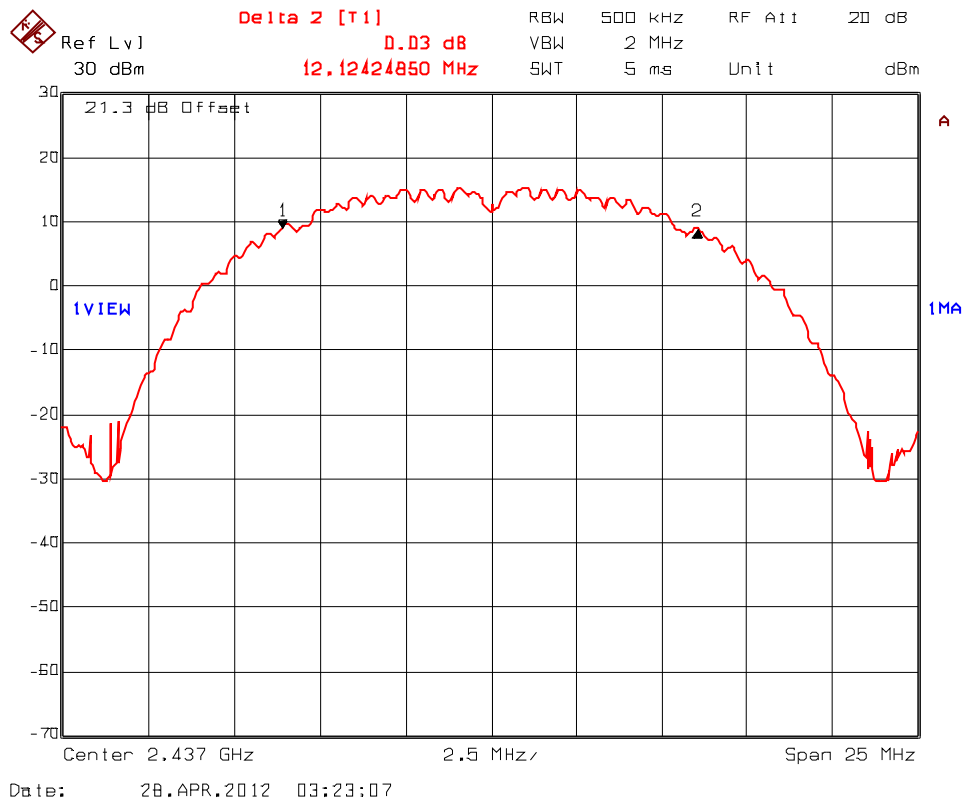
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Plot 5.2.4.2. 6 dB Bandwidth, 2437 MHz, 802.11b, DBPSK 1 Mbps



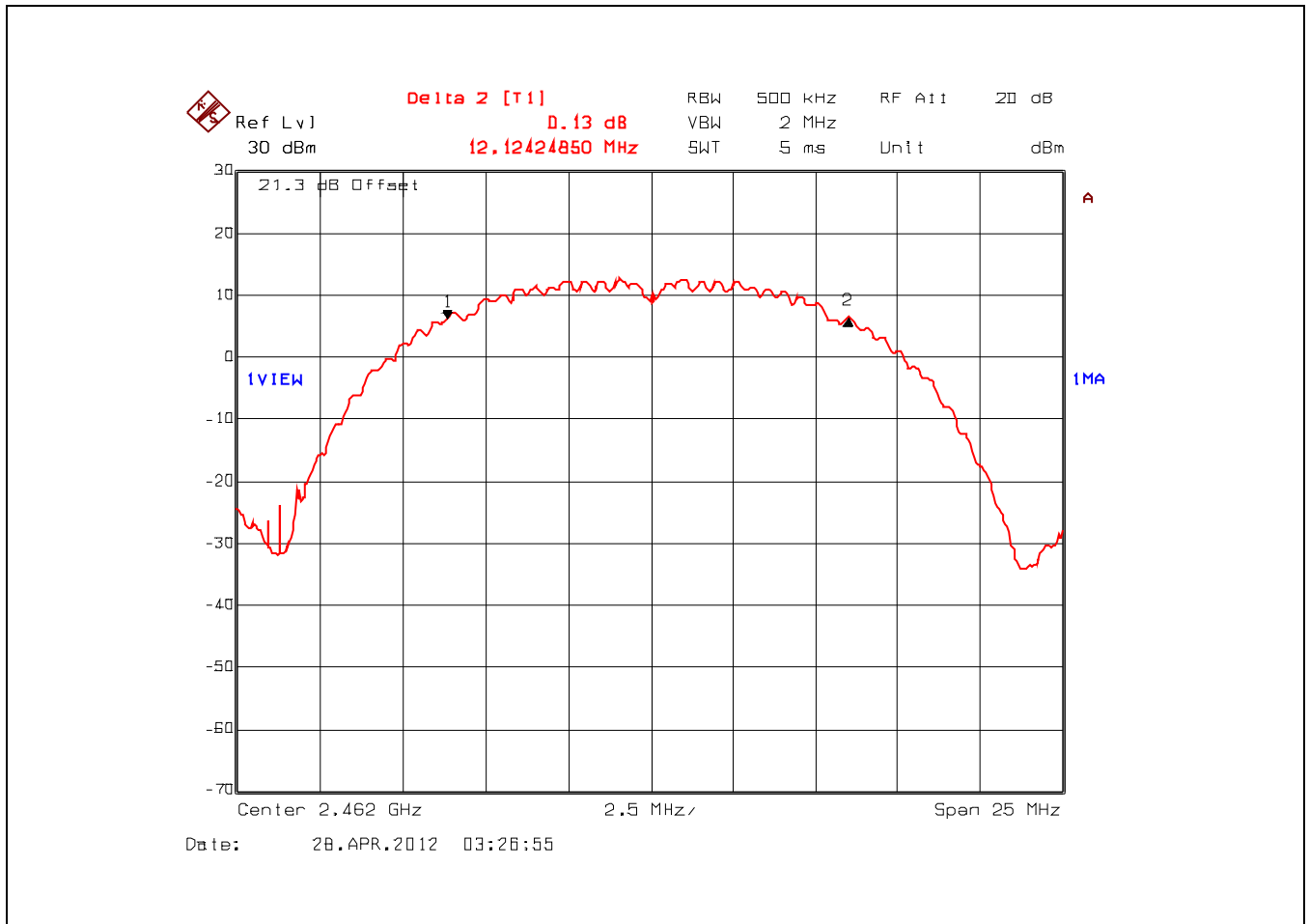
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Plot 5.2.4.3. 6 dB Bandwidth, 2462 MHz, 802.11b, DBPSK 1 Mbps



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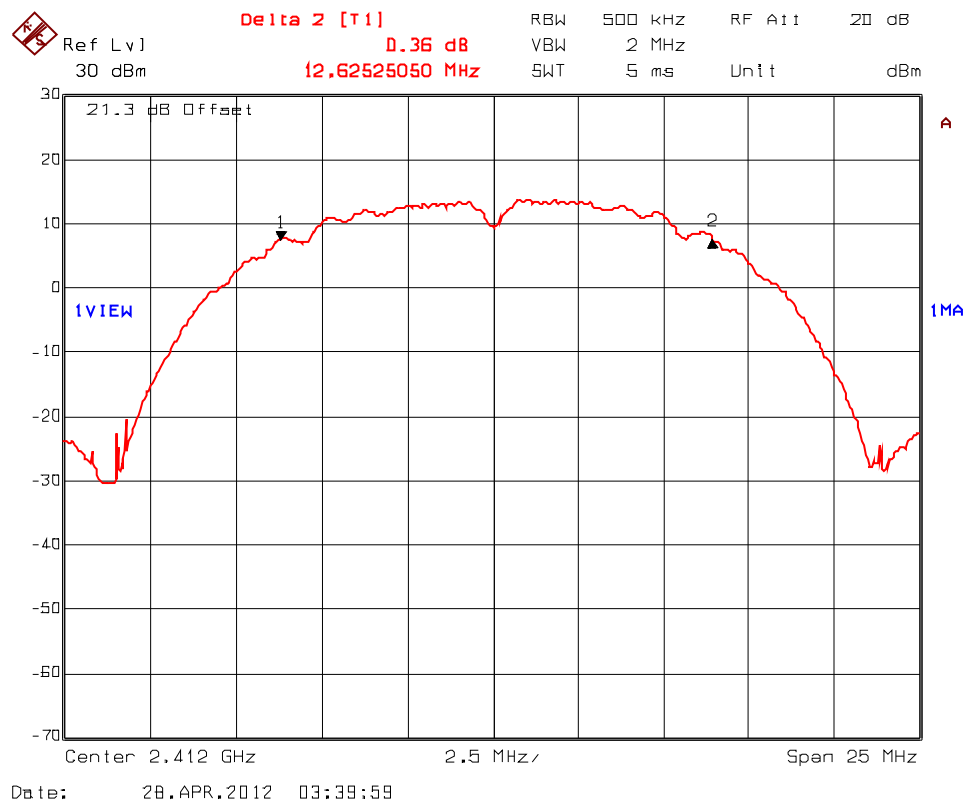
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Plot 5.2.4.4. 6 dB Bandwidth, 2412 MHz, 802.11b, DQPSK 2 Mbps



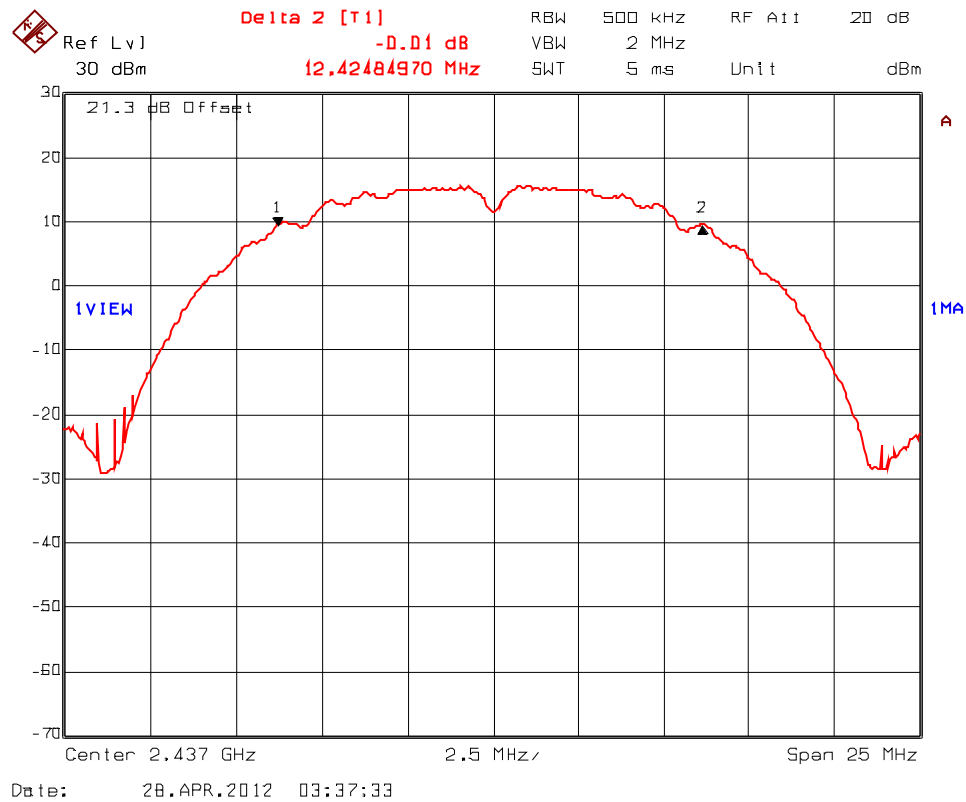
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Plot 5.2.4.5. 6 dB Bandwidth, 2437 MHz, 802.11b, DQPSK 2 Mbps



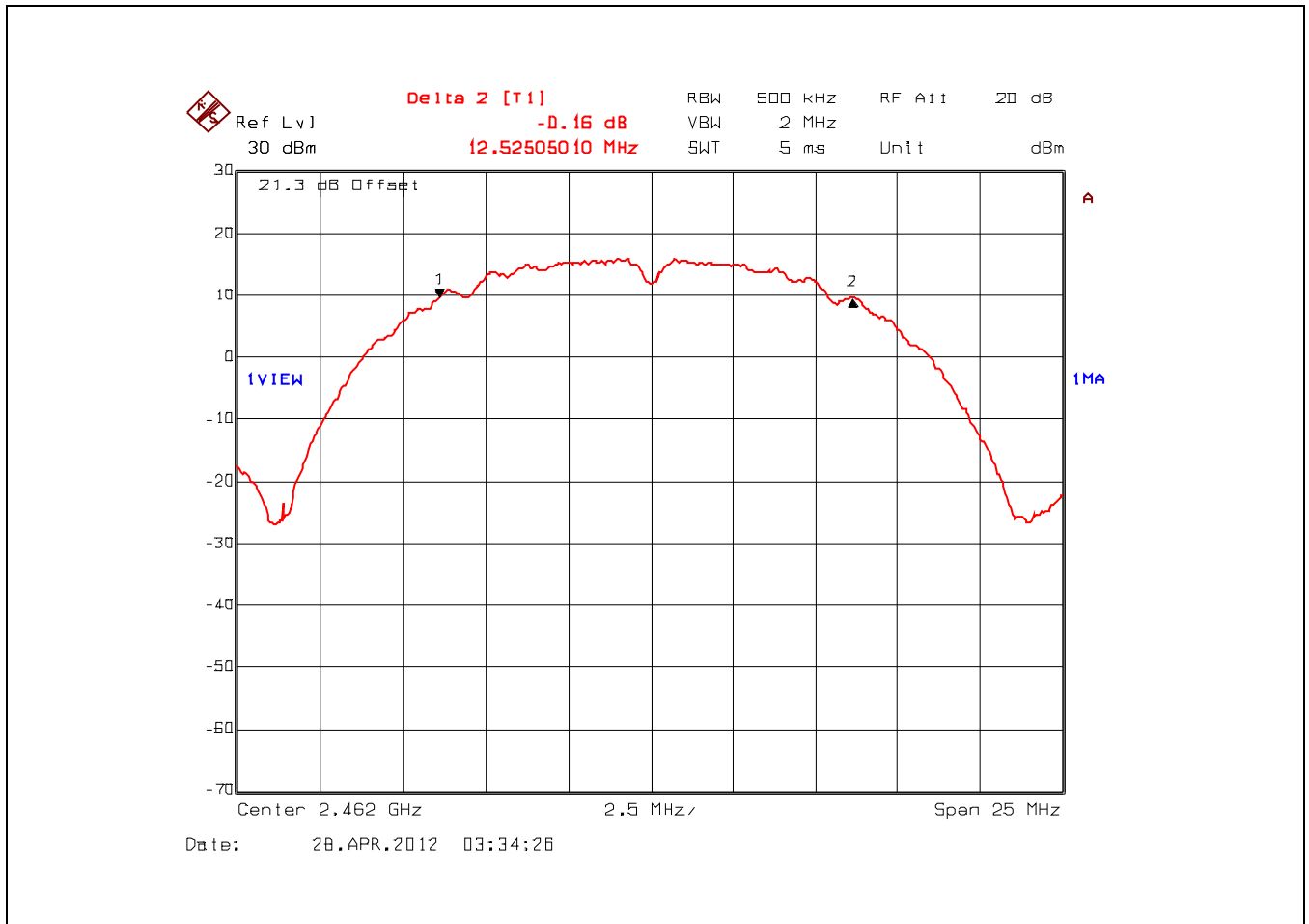
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Plot 5.2.4.6. 6 dB Bandwidth, 2462 MHz, 802.11b, DQPSK 2 Mbps



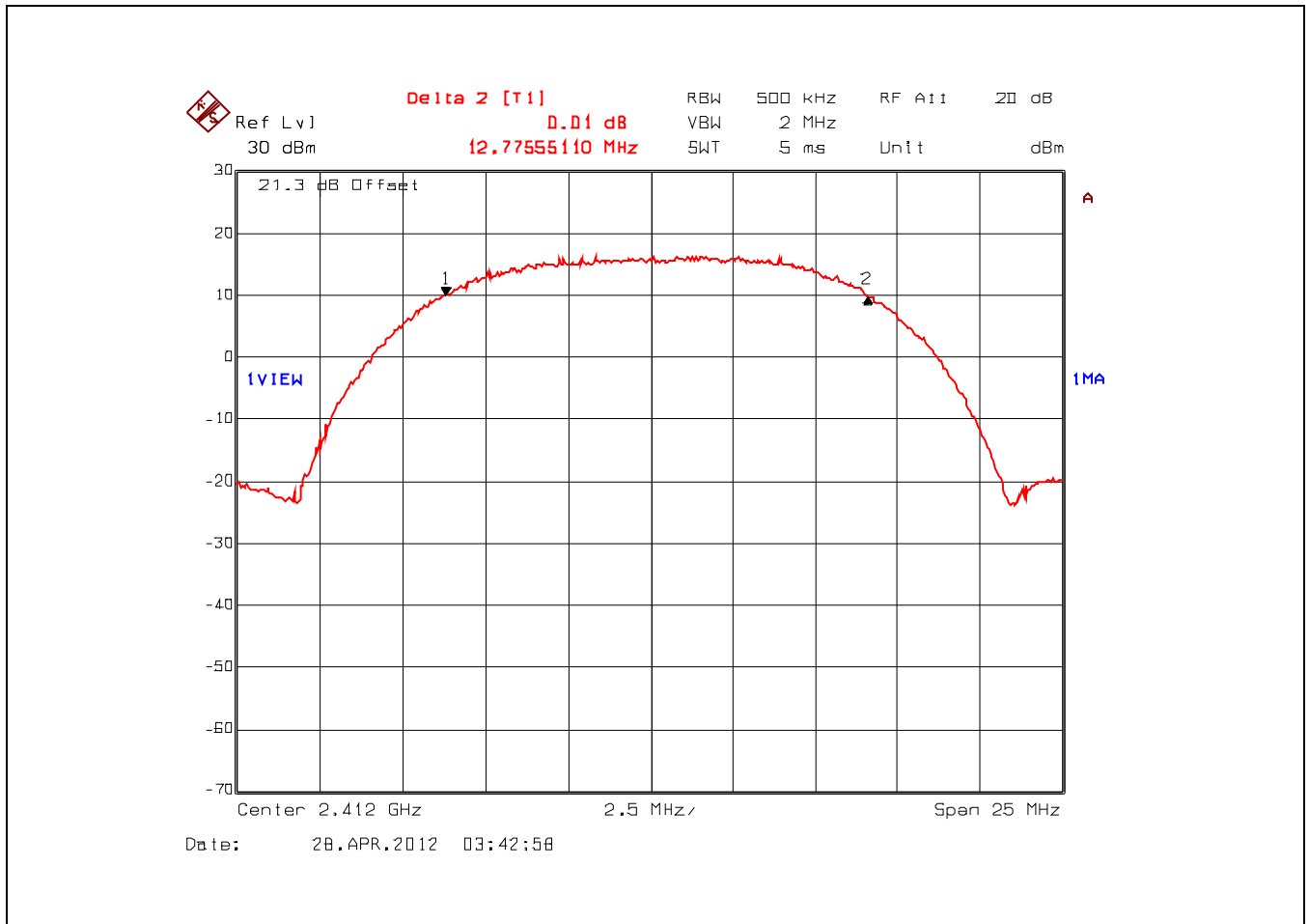
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Plot 5.2.4.7. 6 dB Bandwidth, 2412 MHz, 802.11b, CCK 11 Mbps



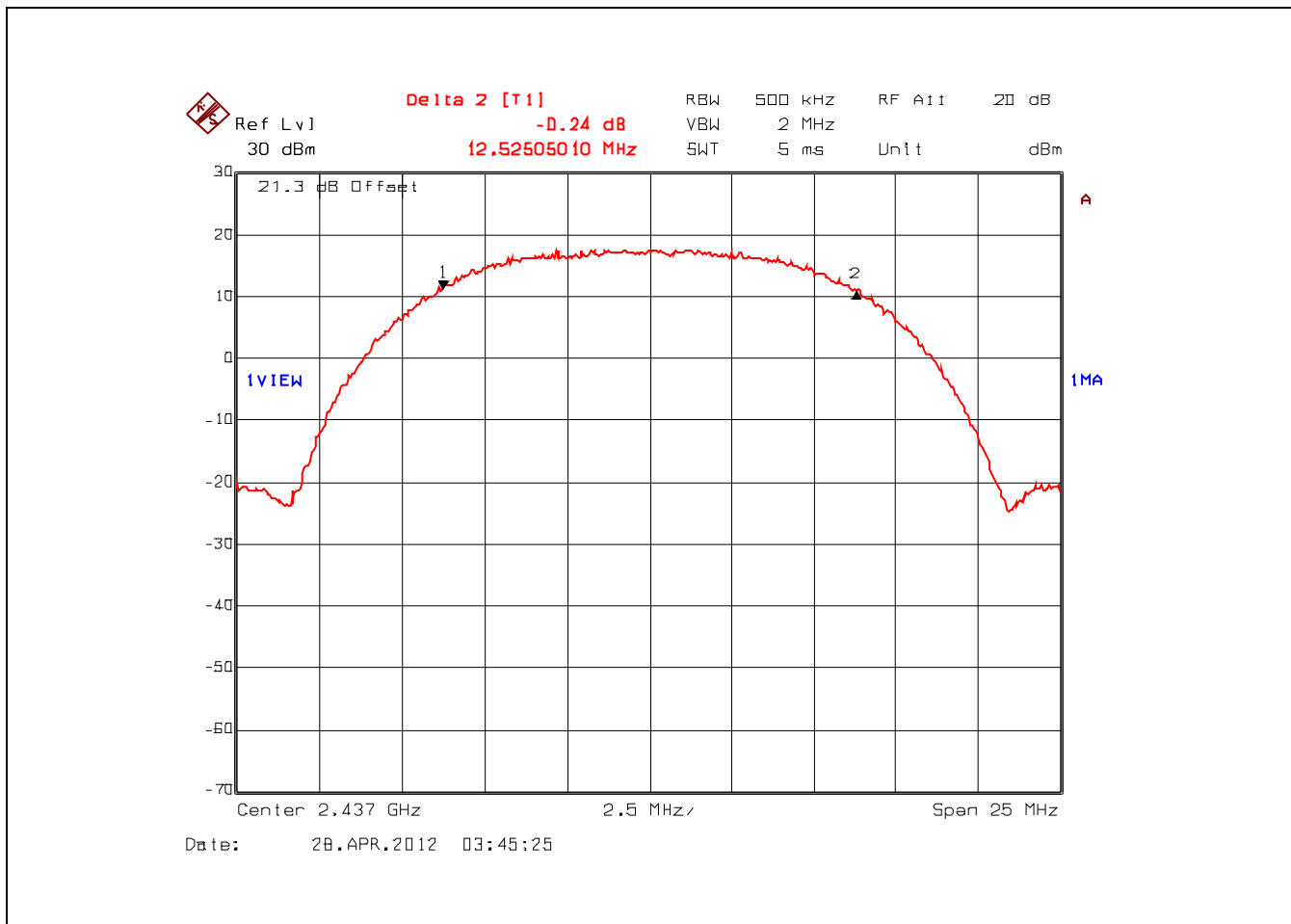
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Plot 5.2.4.8. 6 dB Bandwidth, 2437 MHz, 802.11b, CCK 11 Mbps



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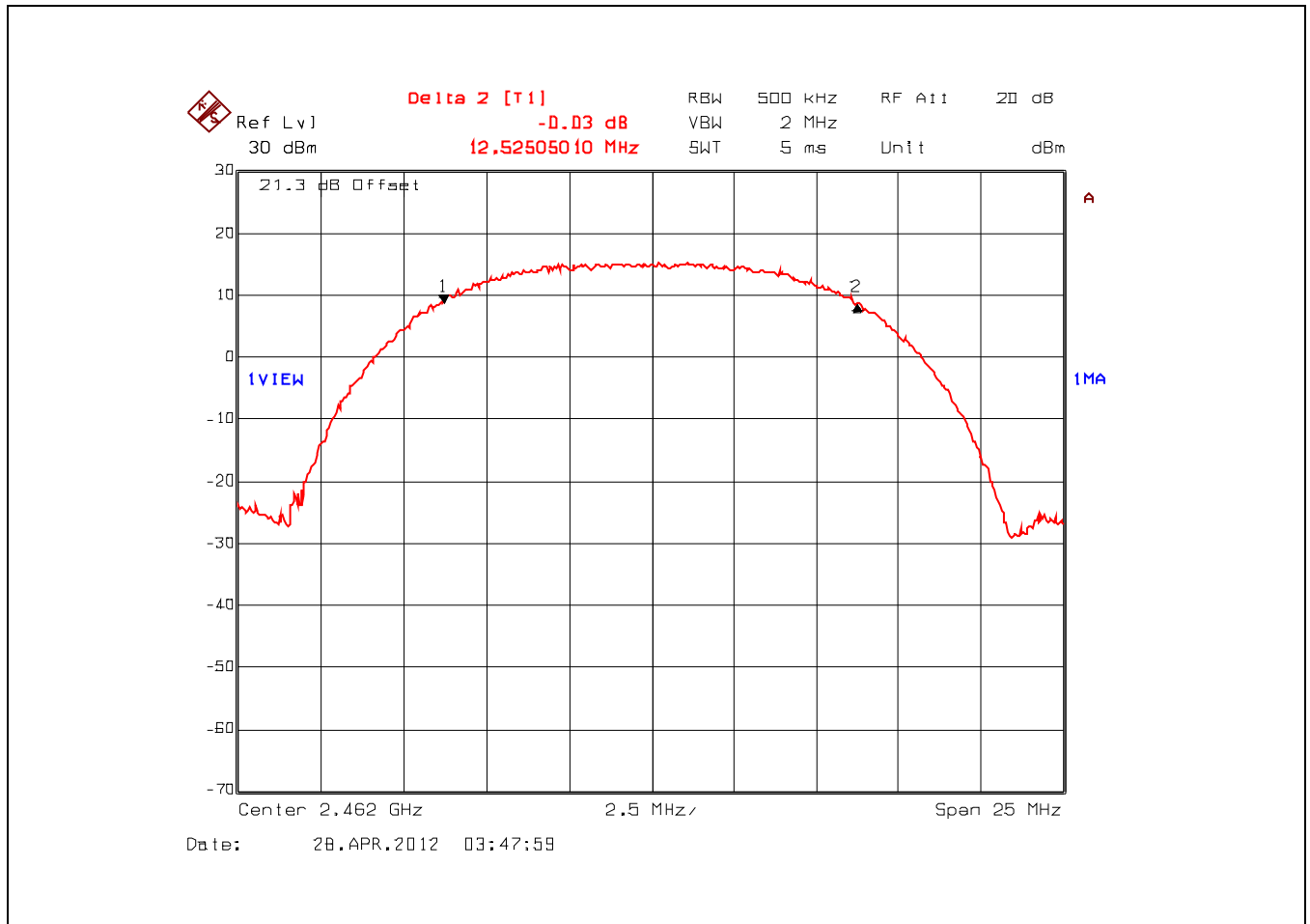
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Plot 5.2.4.9. 6 dB Bandwidth, 2462 MHz, 802.11b, CCK 11 Mbps



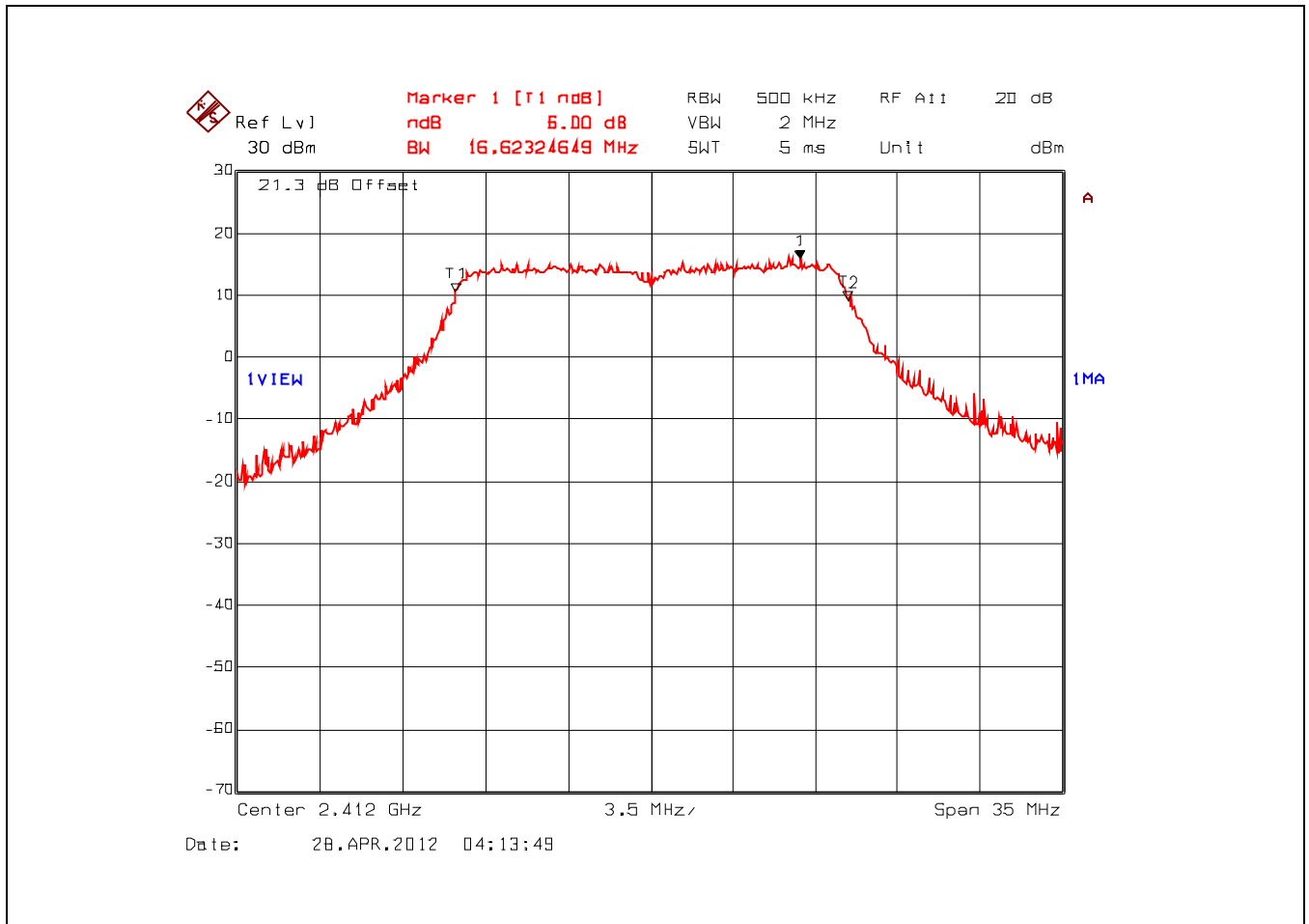
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Plot 5.2.4.10. 6 dB Bandwidth, 2412 MHz, 802.11g, BPSK 9 Mbps



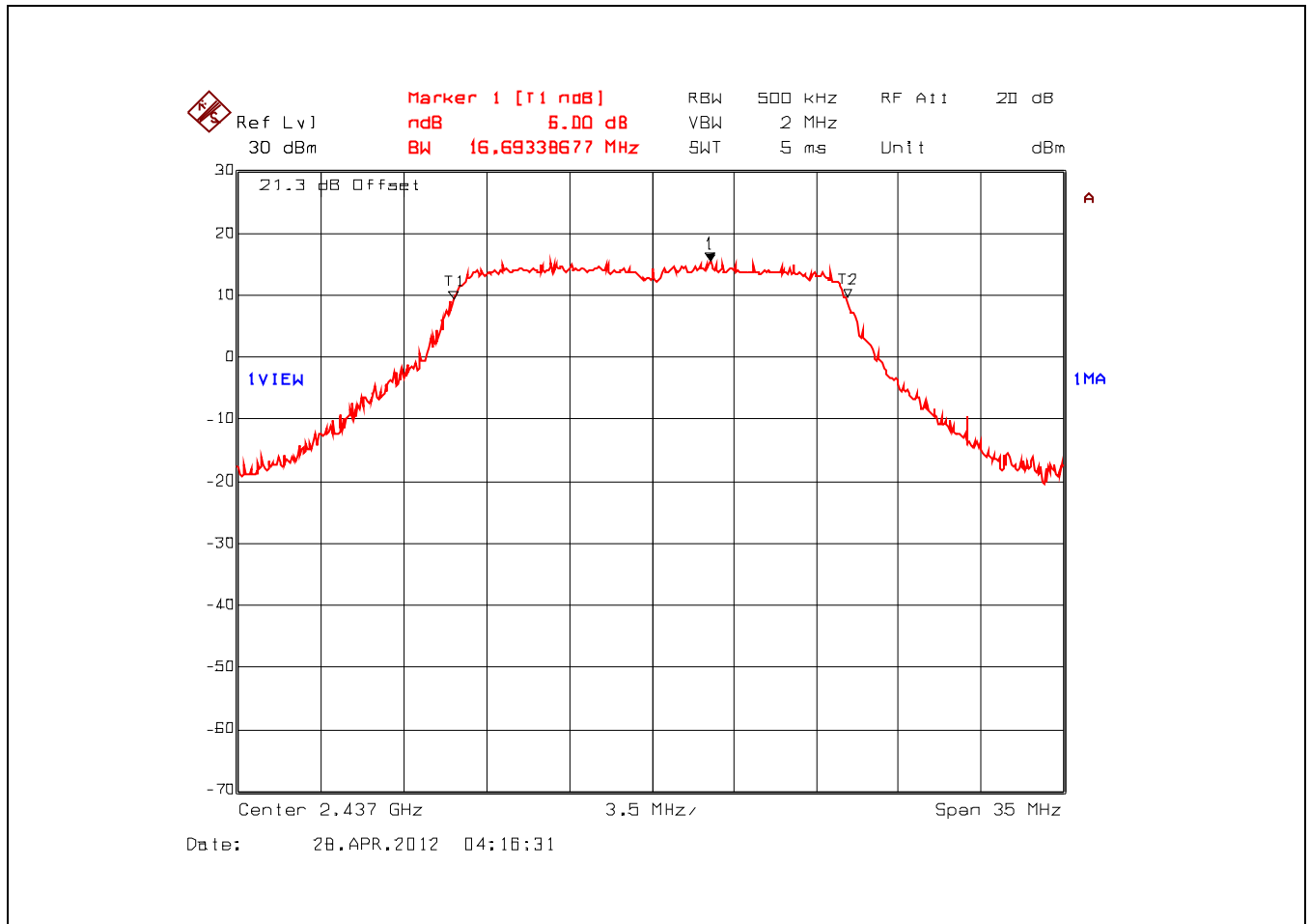
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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.11. 6 dB Bandwidth, 2437 MHz, 802.11g, BPSK 9 Mbps



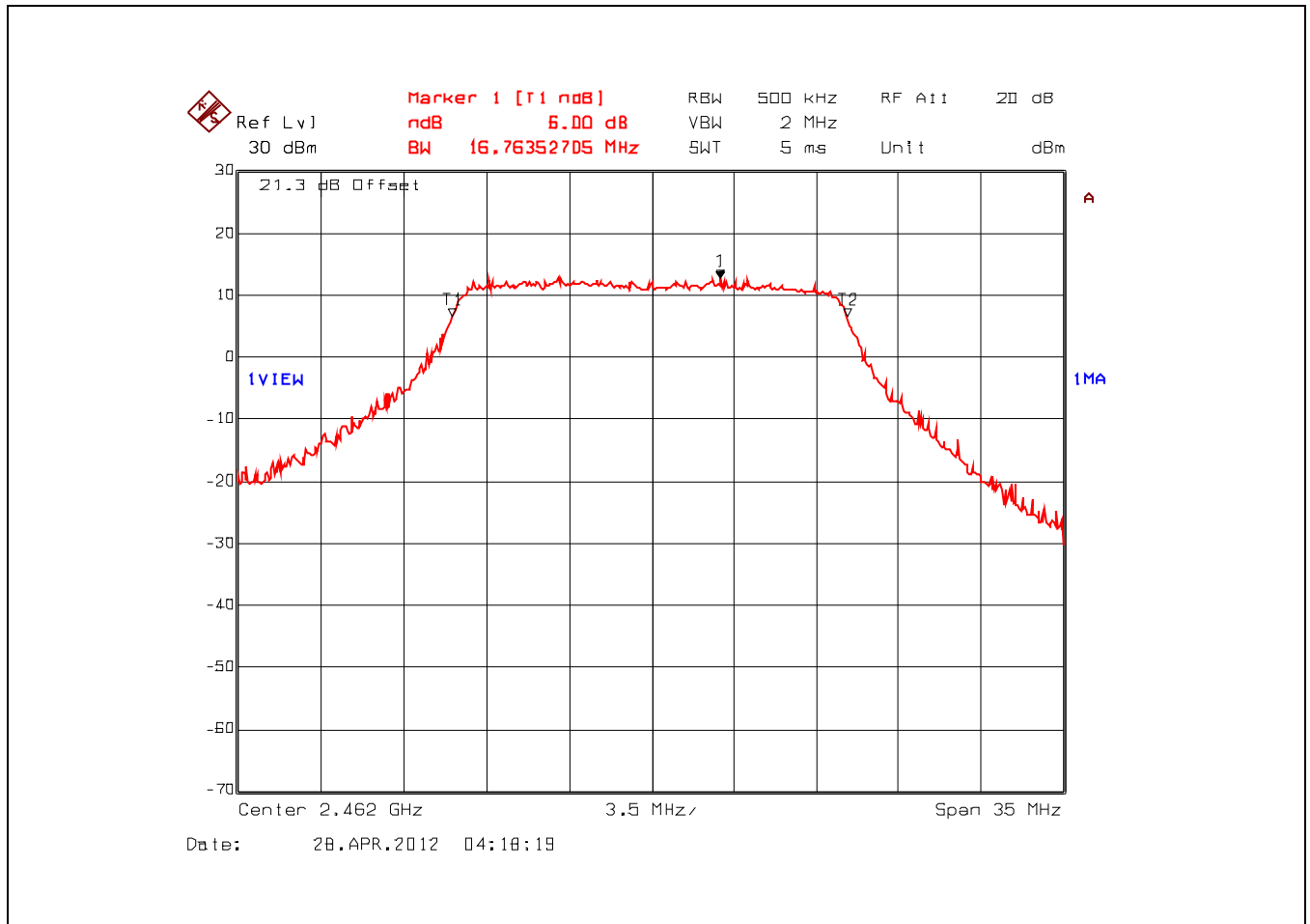
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Plot 5.2.4.12. 6 dB Bandwidth, 2462 MHz, 802.11g, BPSK 9 Mbps



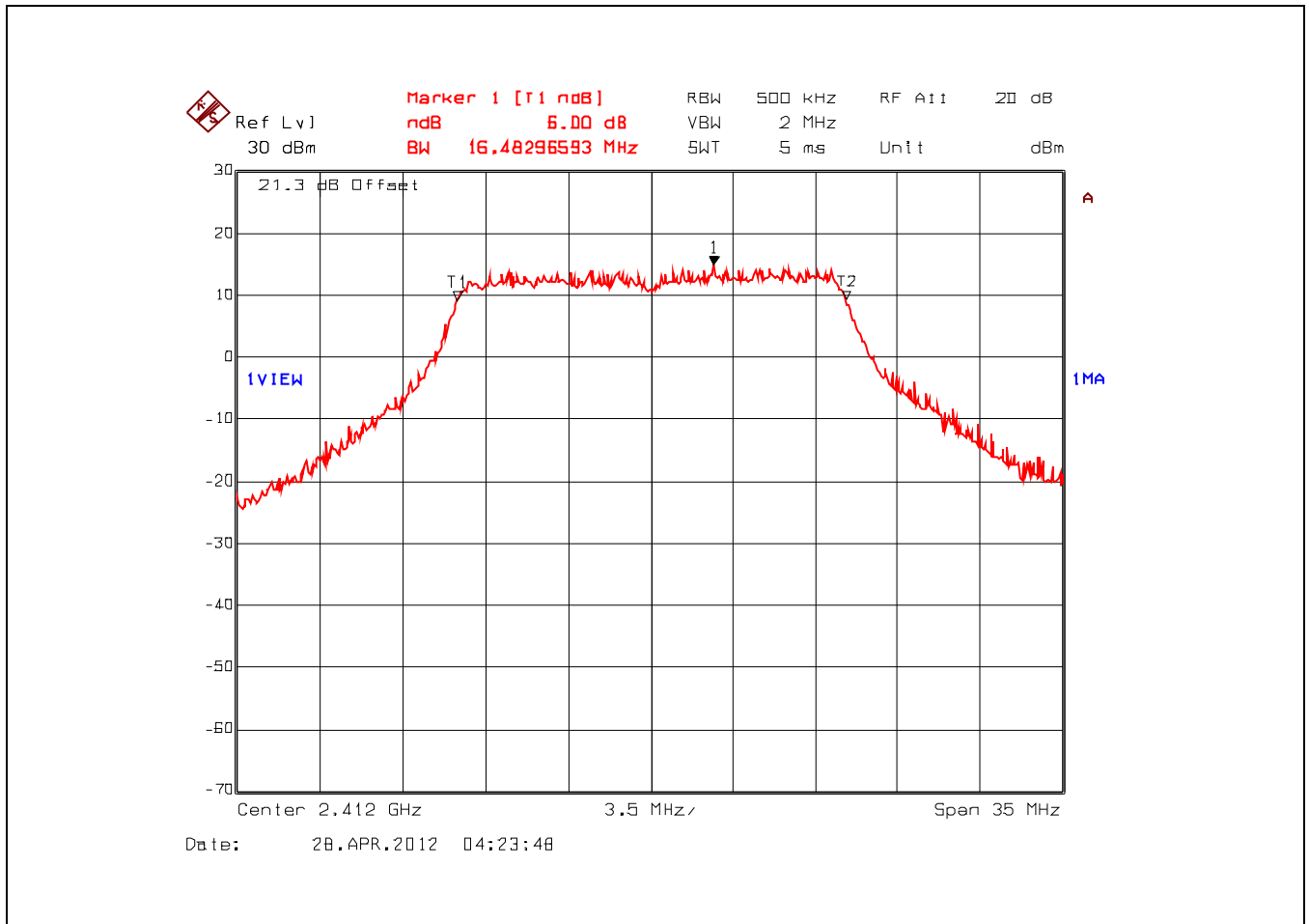
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247
June 4, 2012

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Plot 5.2.4.13. 6 dB Bandwidth, 2412 MHz, 802.11g, QPSK 18 Mbps



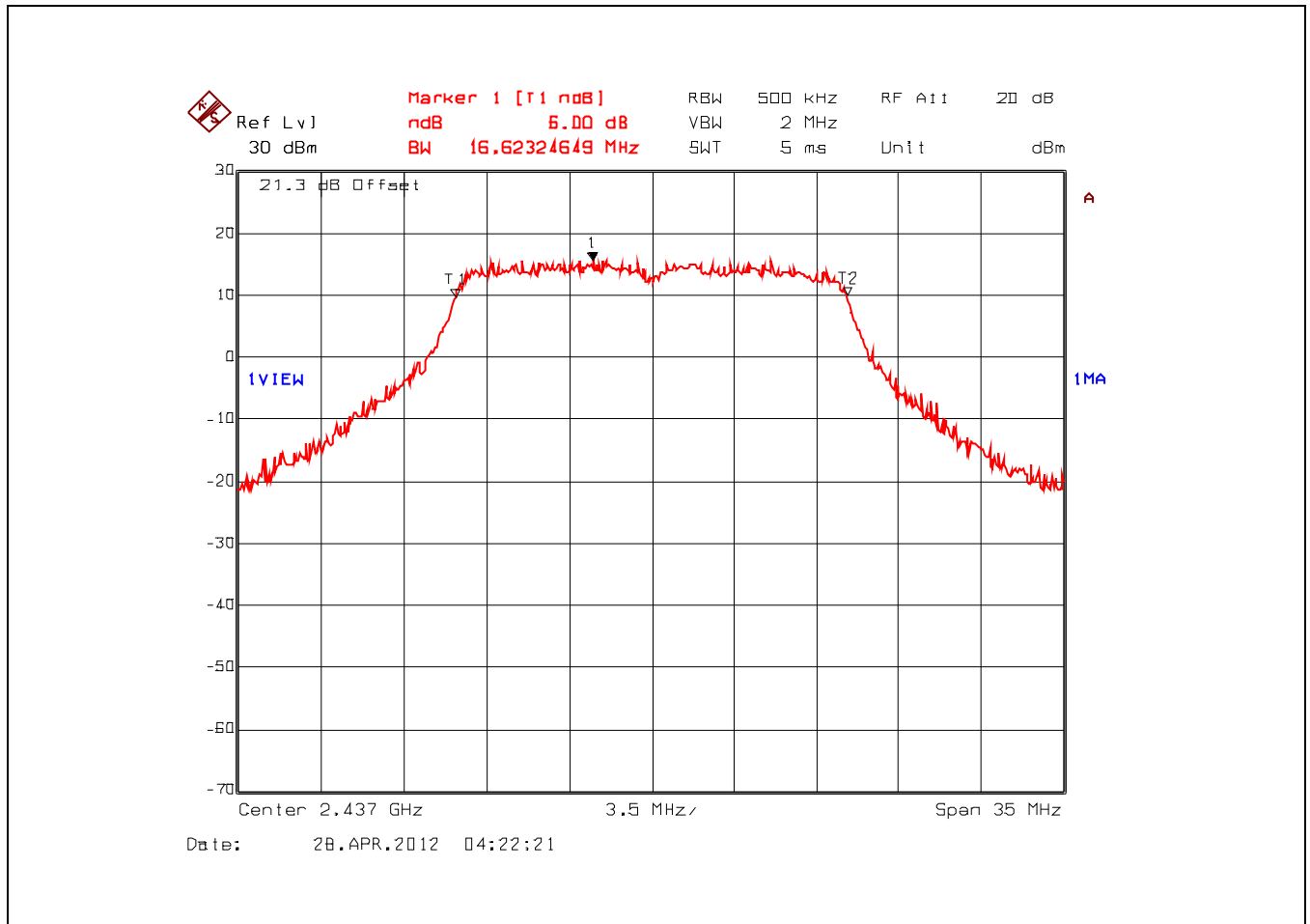
ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247
June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.14. 6 dB Bandwidth, 2437 MHz, 802.11g, QPSK 18 Mbps



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 Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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Ref Lvl 30 dBm RBW 500 kHz VBW 2 MHz SWT 5 ms RF Att 20 dB

21.3 dB Offset

1VIEW

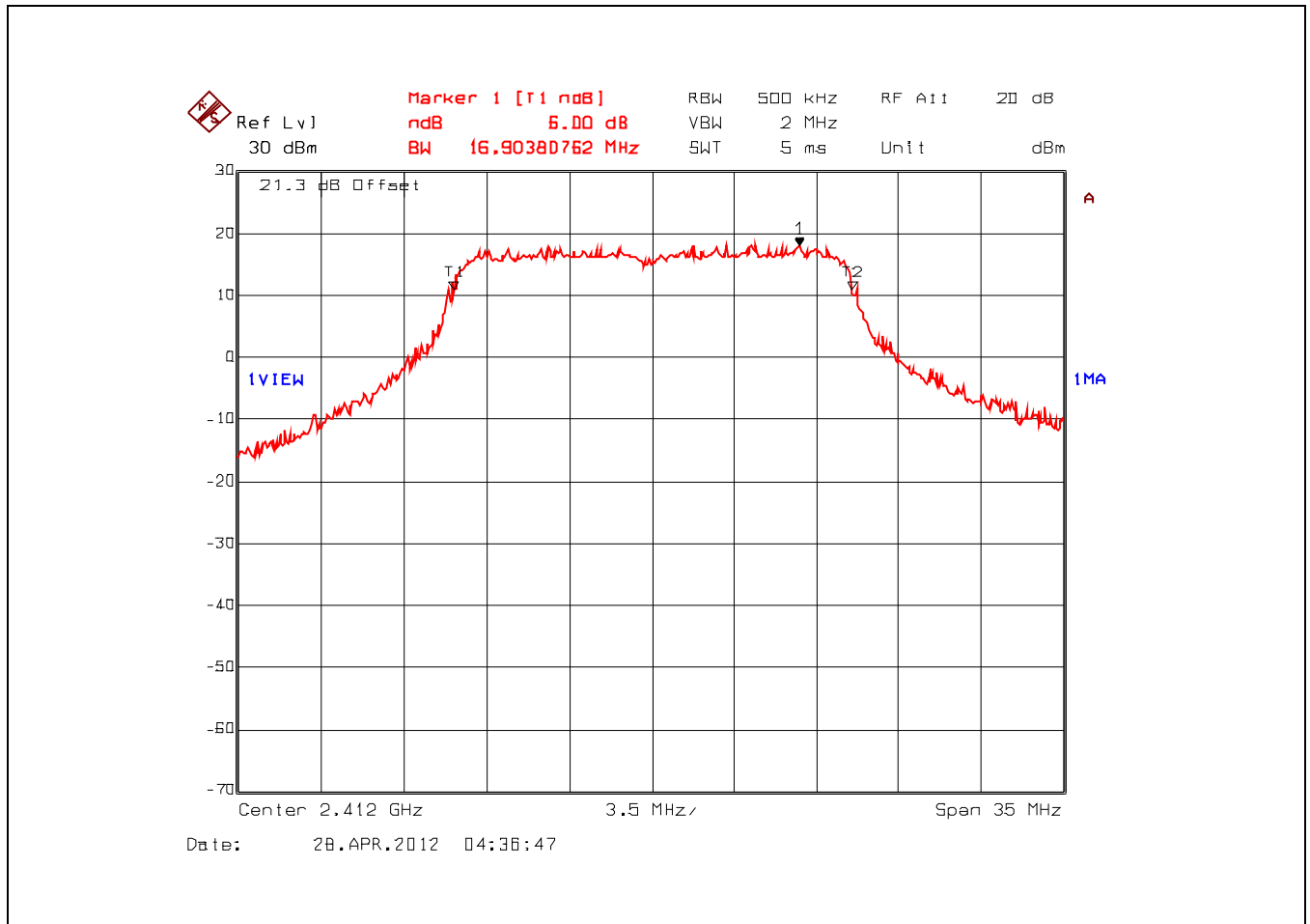
Marker 1 [T1 ndB] ndB 5.00 dB BW 16.55310621 MHz

Unit dBm

Center 2.462 GHz 3.5 MHz Span 35 MHz

Date: 28.APR.2012 04:20:51

Plot 5.2.4.16. 6 dB Bandwidth, 2412 MHz, 802.11g, 16-QAM, 36 Mbps



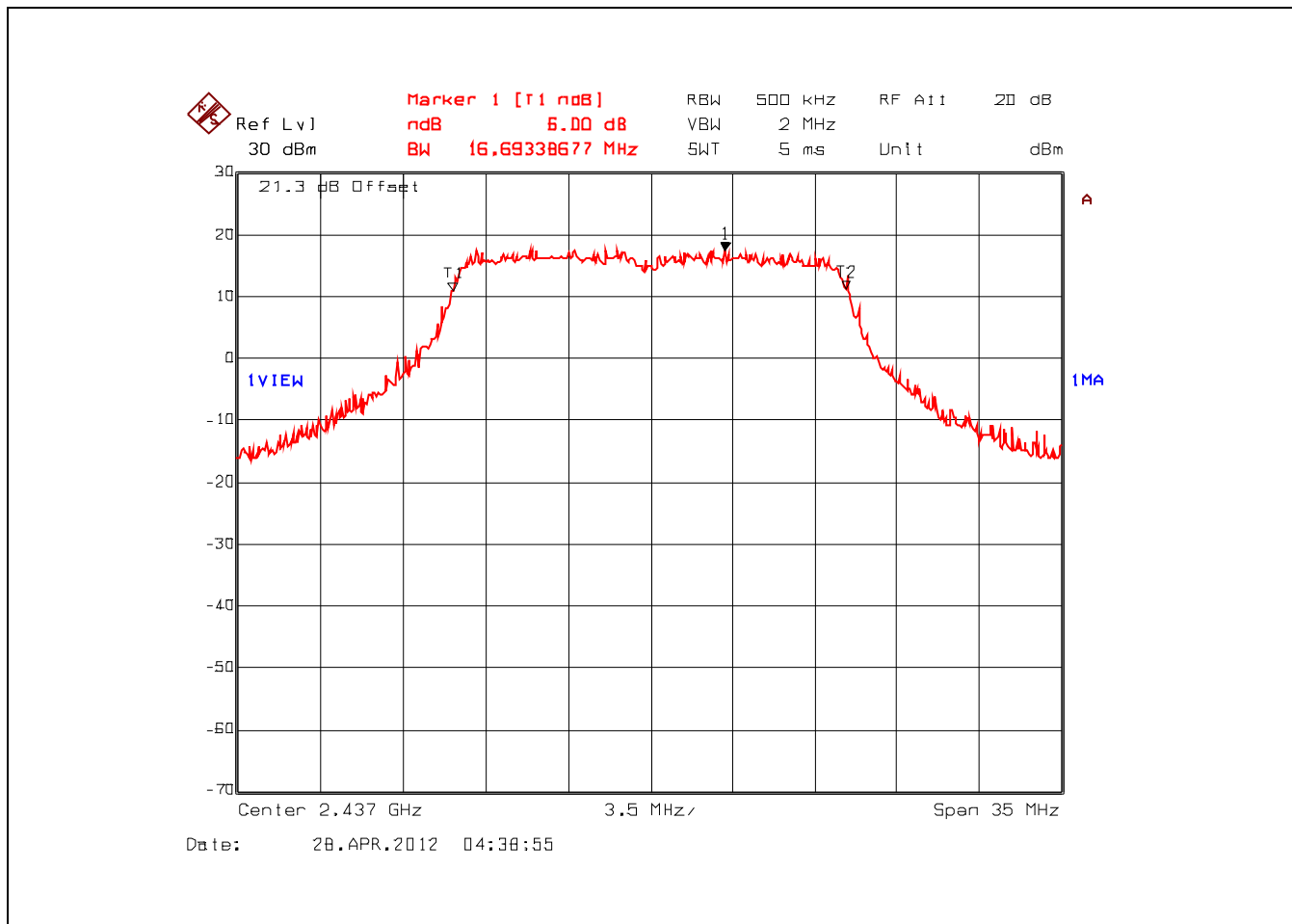
ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247
June 4, 2012

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Plot 5.2.4.17. 6 dB Bandwidth, 2437 MHz, 802.11g, 16-QAM, 36 Mbps



ULTRATECH GROUP OF LABS

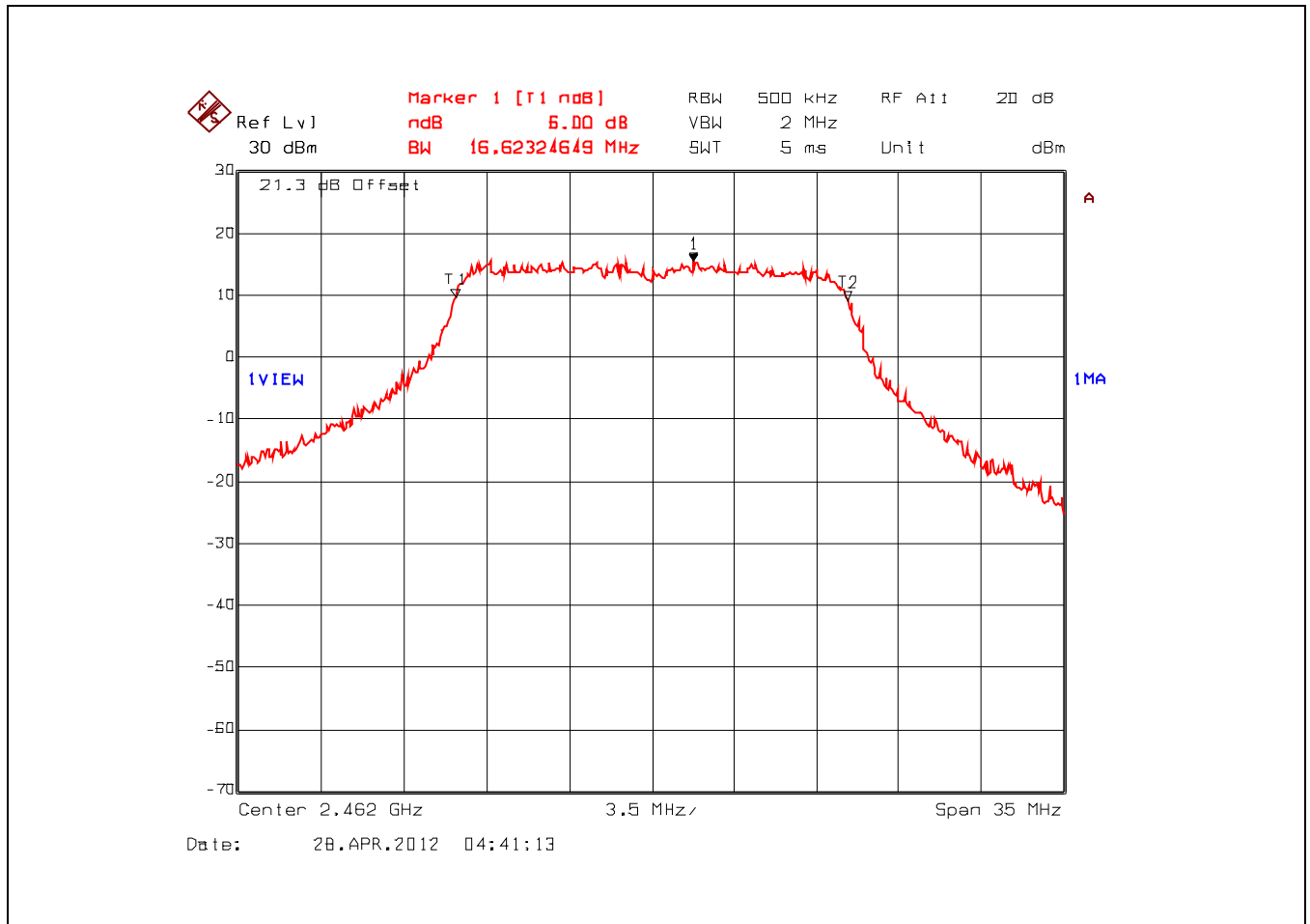
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
 Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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Plot 5.2.4.18. 6 dB Bandwidth, 2462 MHz, 802.11g, 16-QAM, 36 Mbps



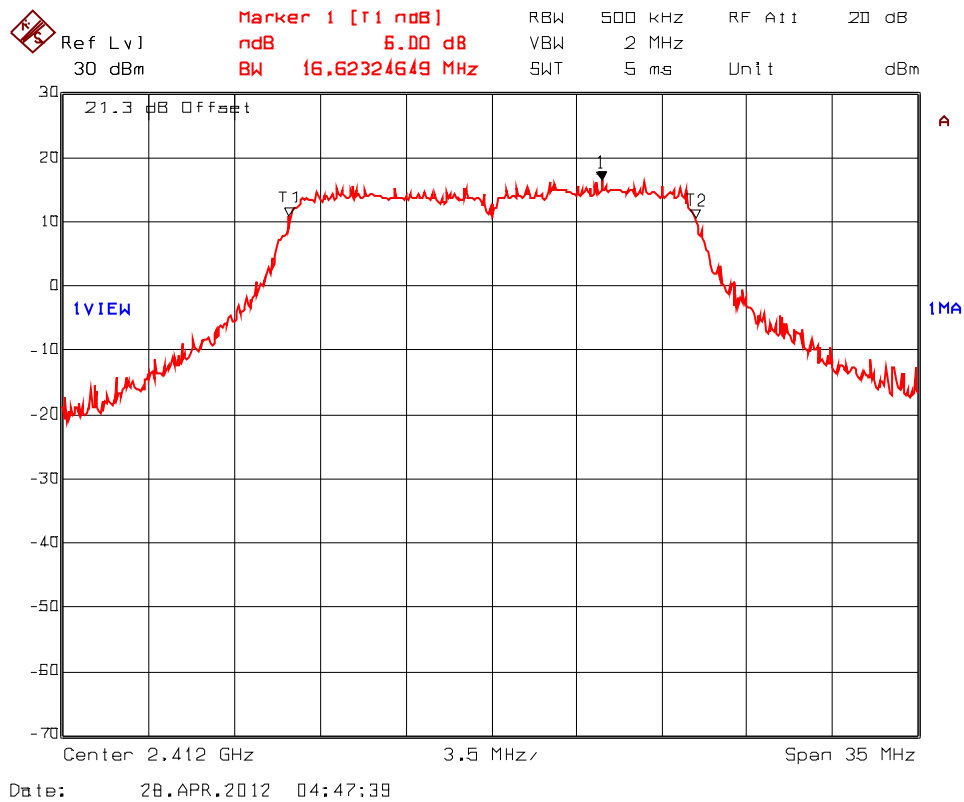
ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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Plot 5.2.4.19. 6 dB Bandwidth, 2412 MHz, 802.11g, 64-QAM, 54 Mbps



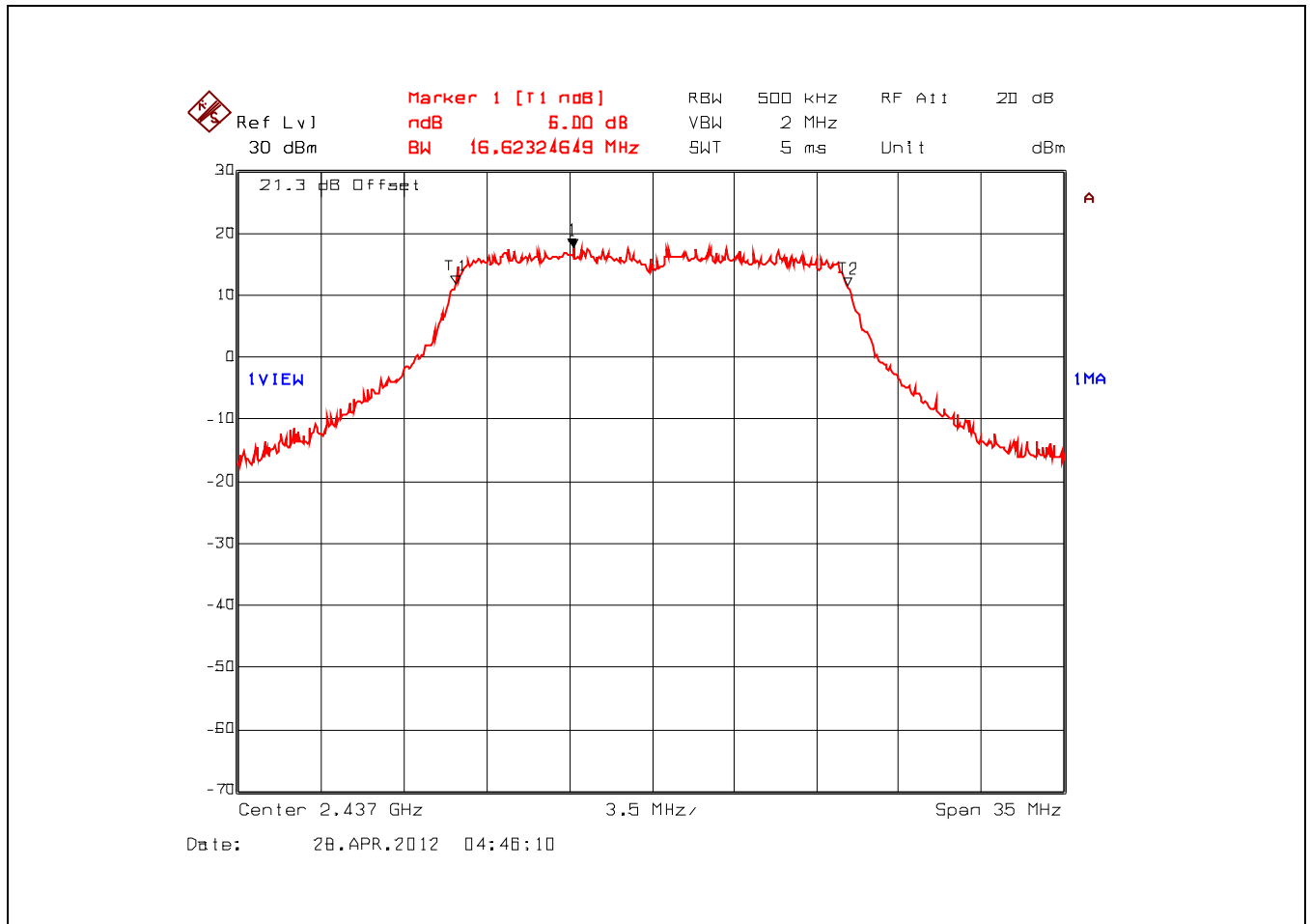
ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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Plot 5.2.4.20. 6 dB Bandwidth, 2437 MHz, 802.11g, 64-QAM, 54 Mbps



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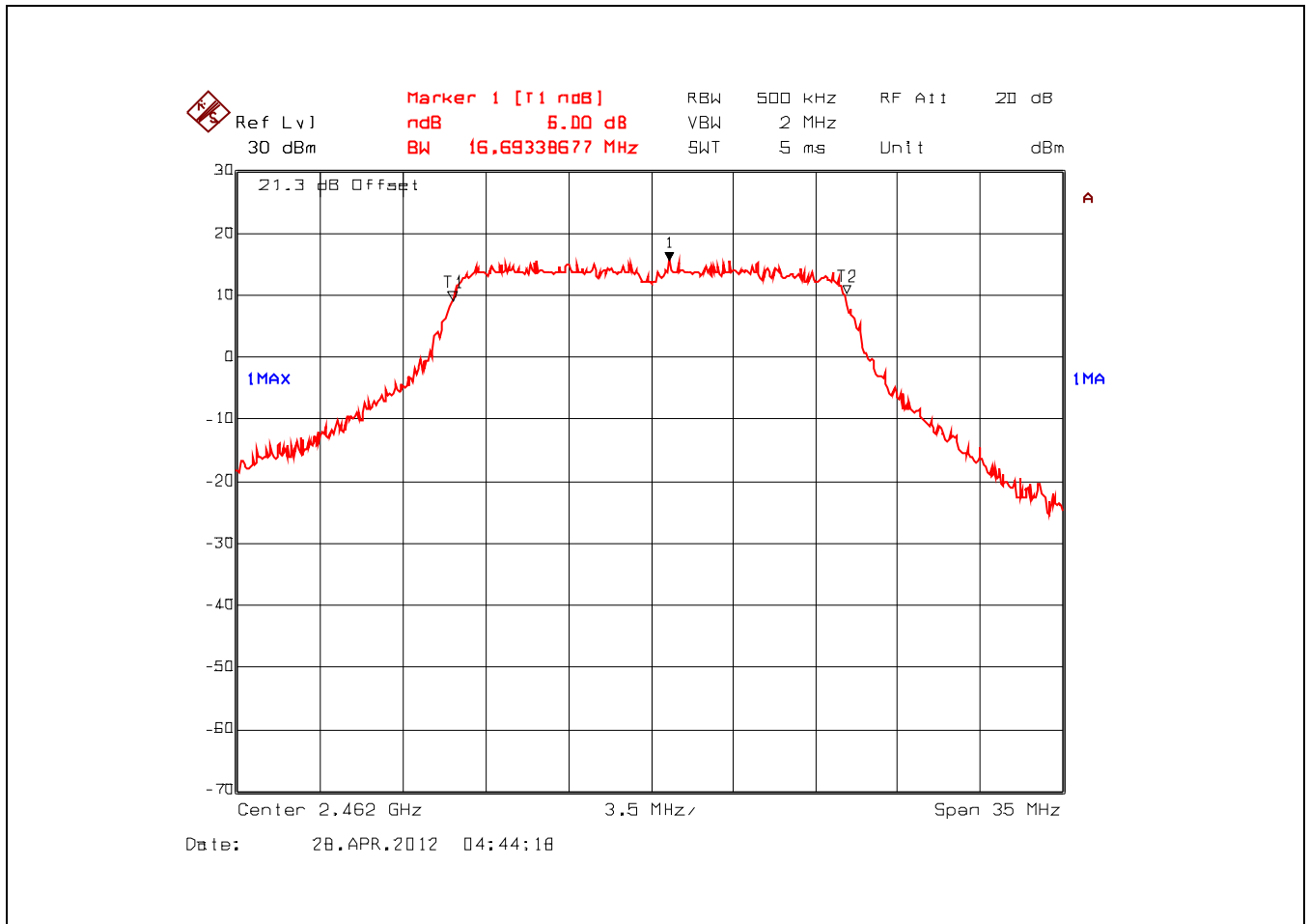
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

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Plot 5.2.4.21. 6 dB Bandwidth, 2462 MHz, 802.11g, 64-QAM, 54 Mbps



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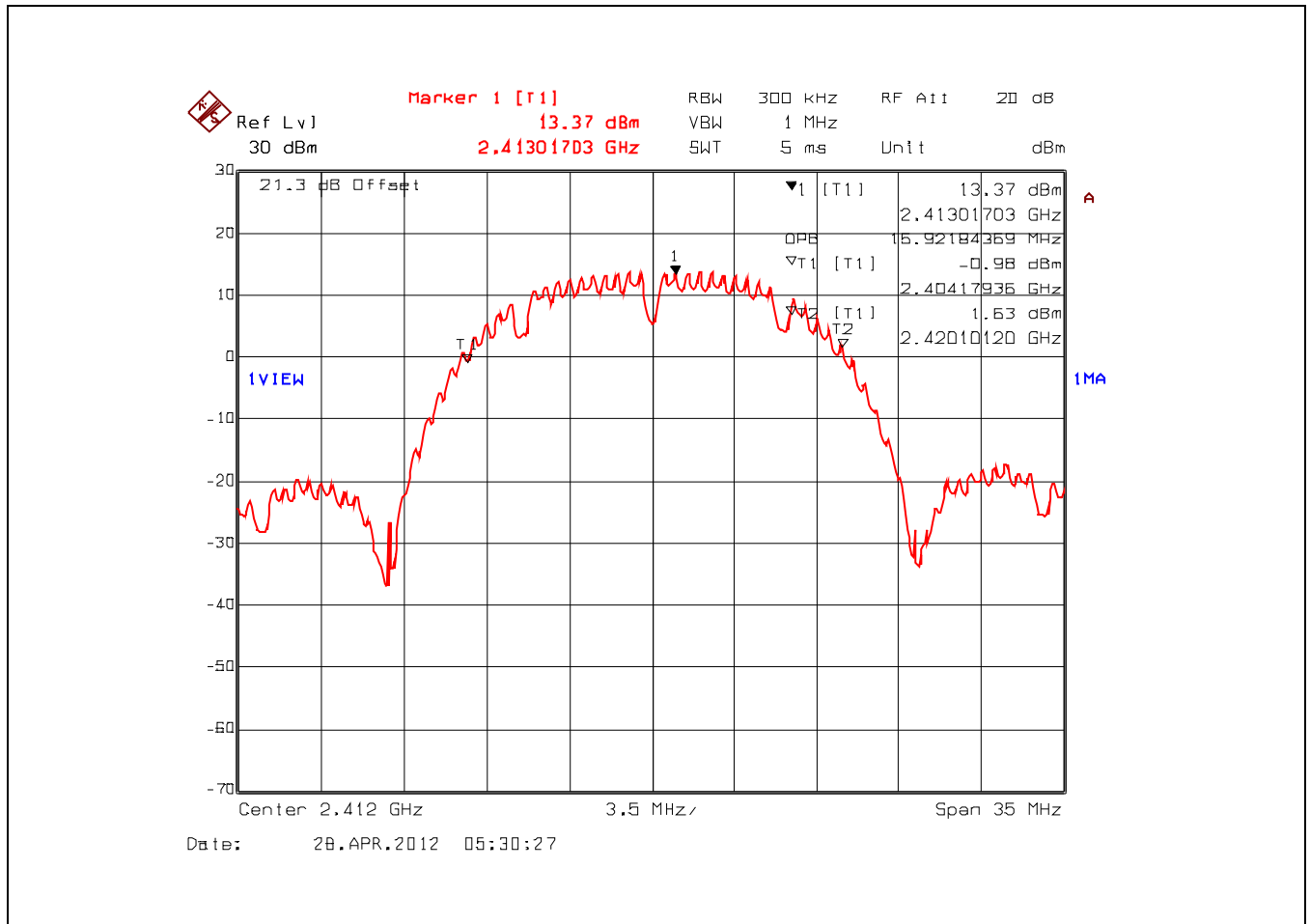
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

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Plot 5.2.4.22. 99% Occupied Bandwidth, 2412 MHz, 802.11b, DBPSK 1 Mbps



ULTRATECH GROUP OF LABS

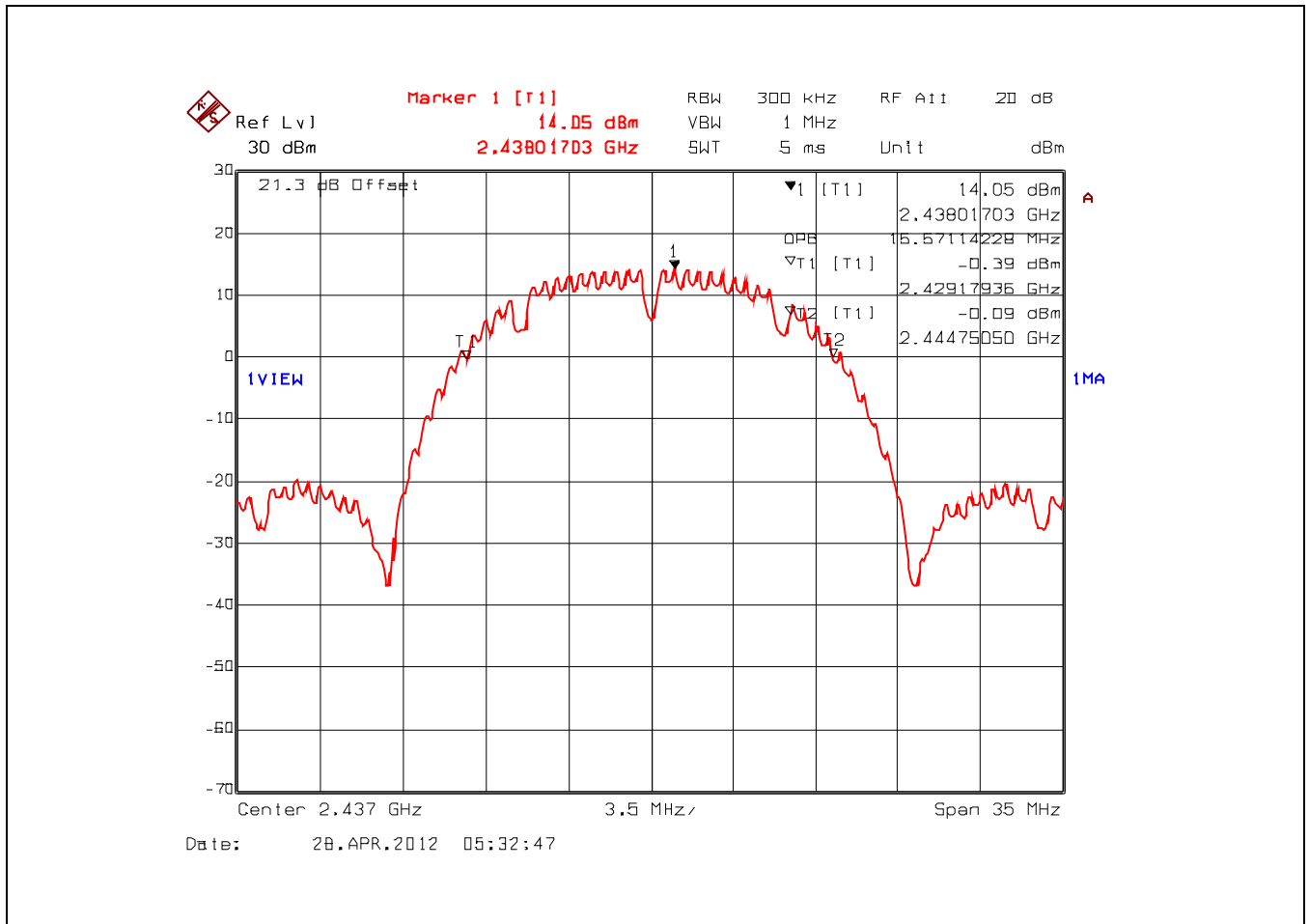
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

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Plot 5.2.4.23. 99% Occupied Bandwidth, 2437 MHz, 802.11b, DBPSK 1 Mbps



ULTRATECH GROUP OF LABS

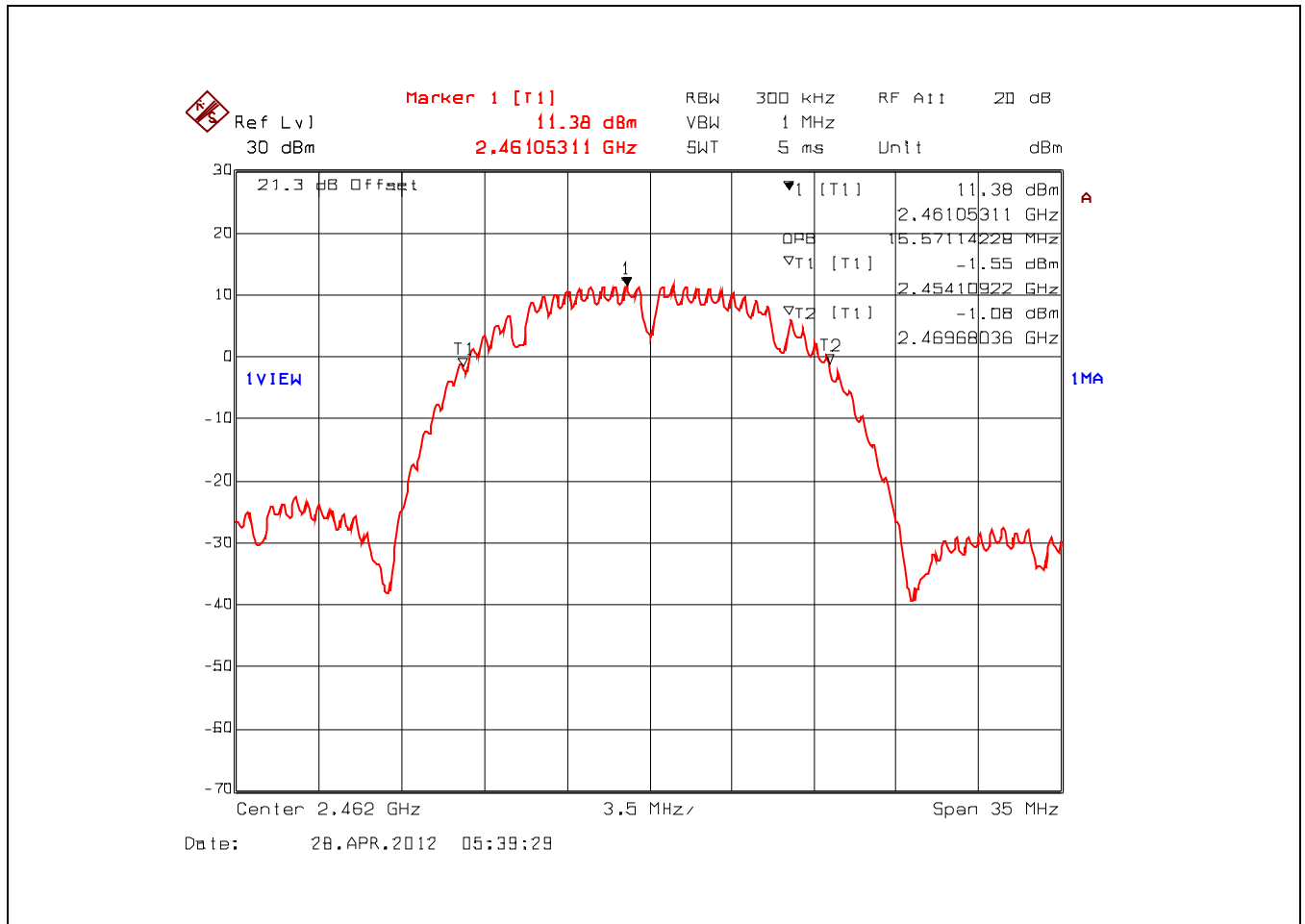
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.24. 99% Occupied Bandwidth, 2462 MHz, 802.11b, DBPSK 1 Mbps



ULTRATECH GROUP OF LABS

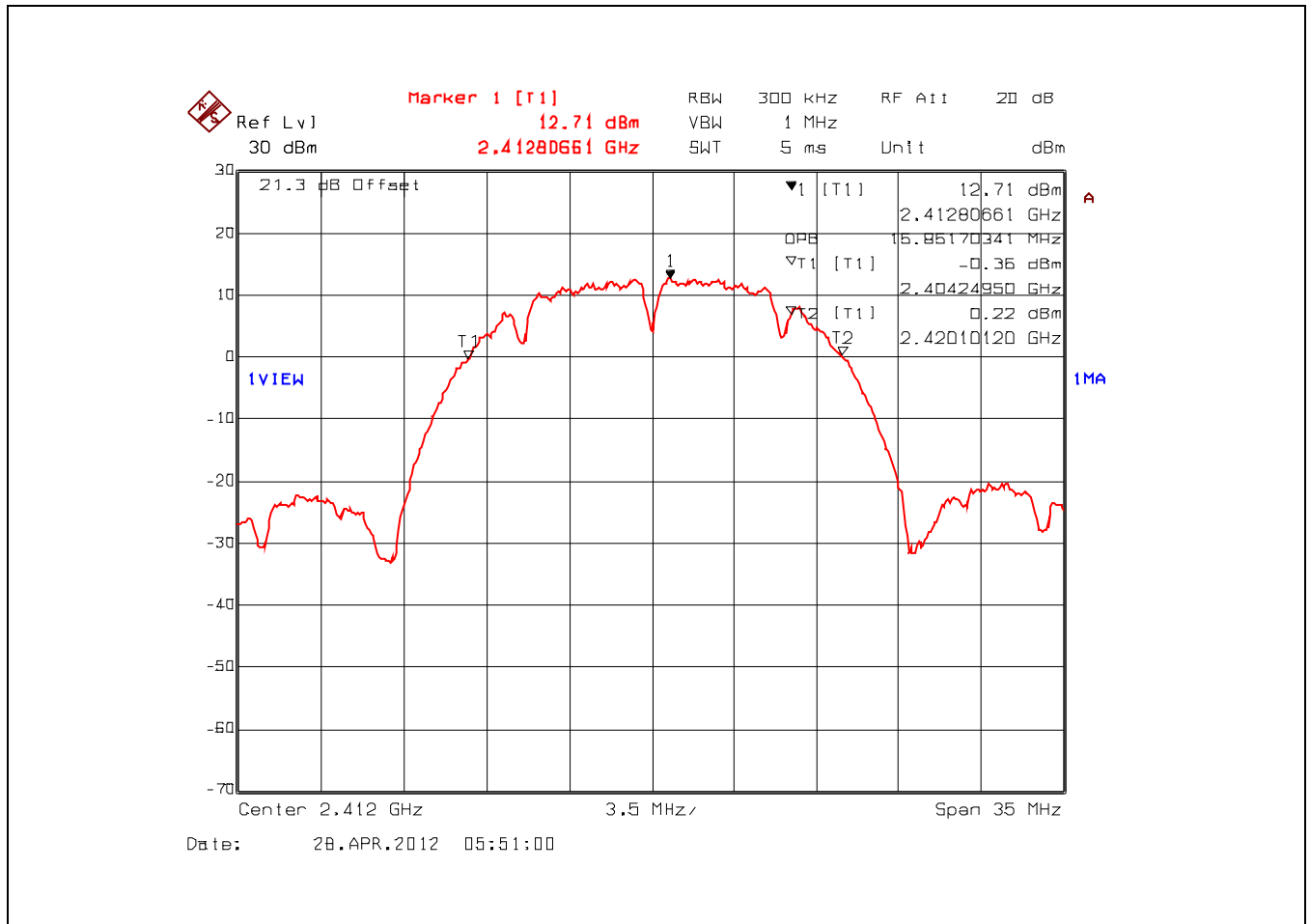
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.25. 99% Occupied Bandwidth, 2412 MHz, 802.11b, DQPSK 2 Mbps



ULTRATECH GROUP OF LABS

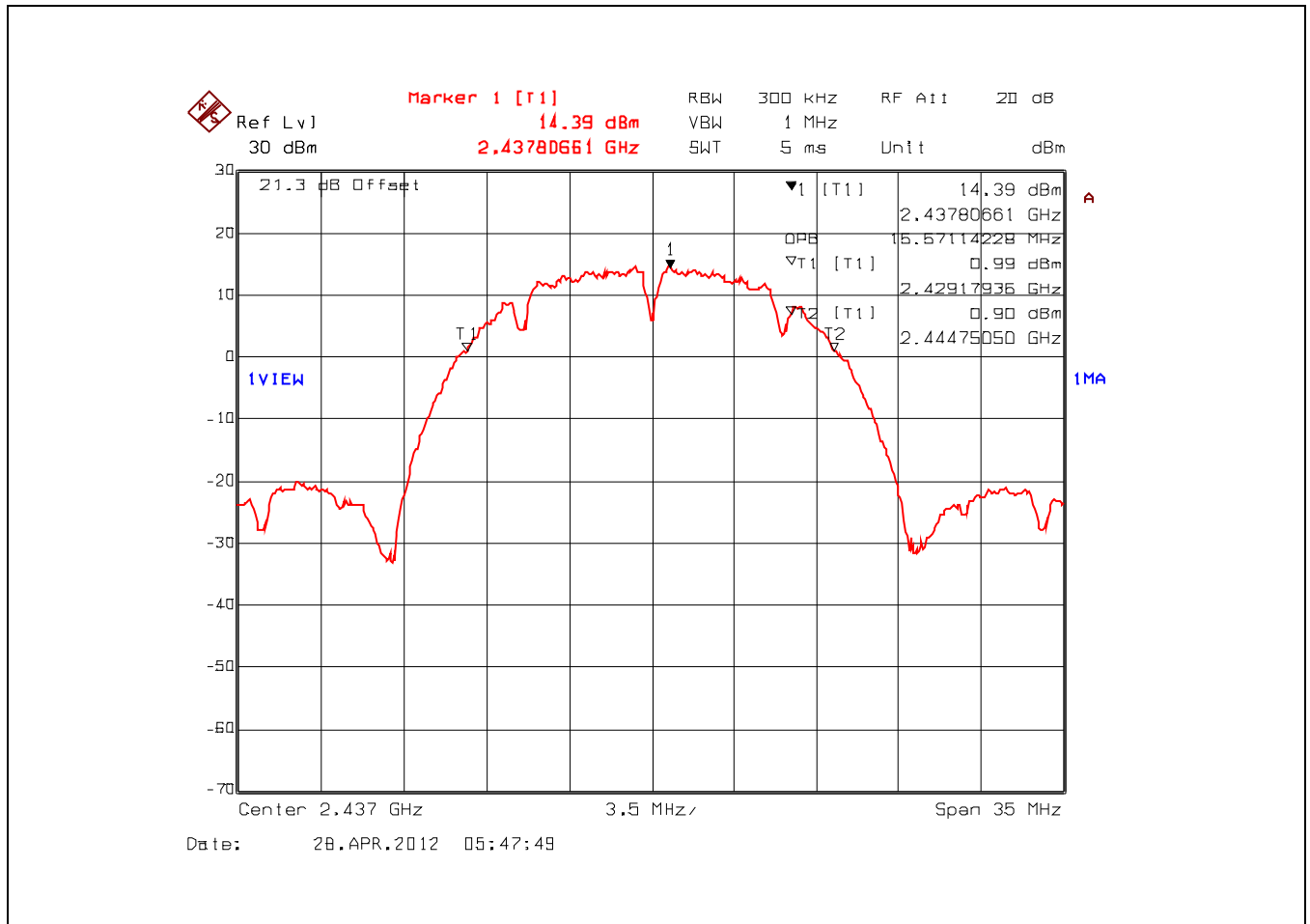
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.26. 99% Occupied Bandwidth, 2437 MHz, 802.11b, DQPSK 2 Mbps



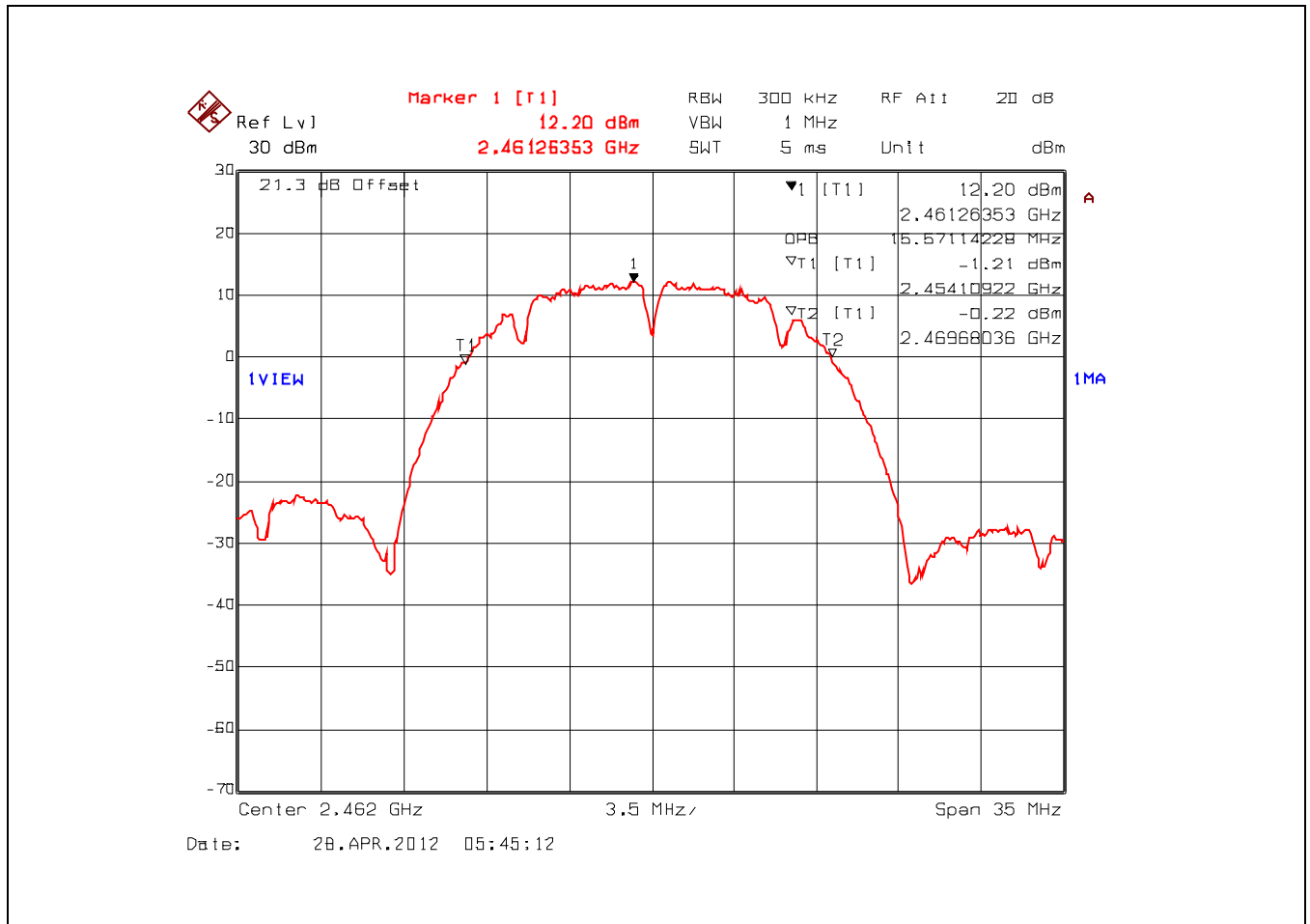
ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247
June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.27. 99% Occupied Bandwidth, 2462 MHz, 802.11b, DQPSK 2 Mbps



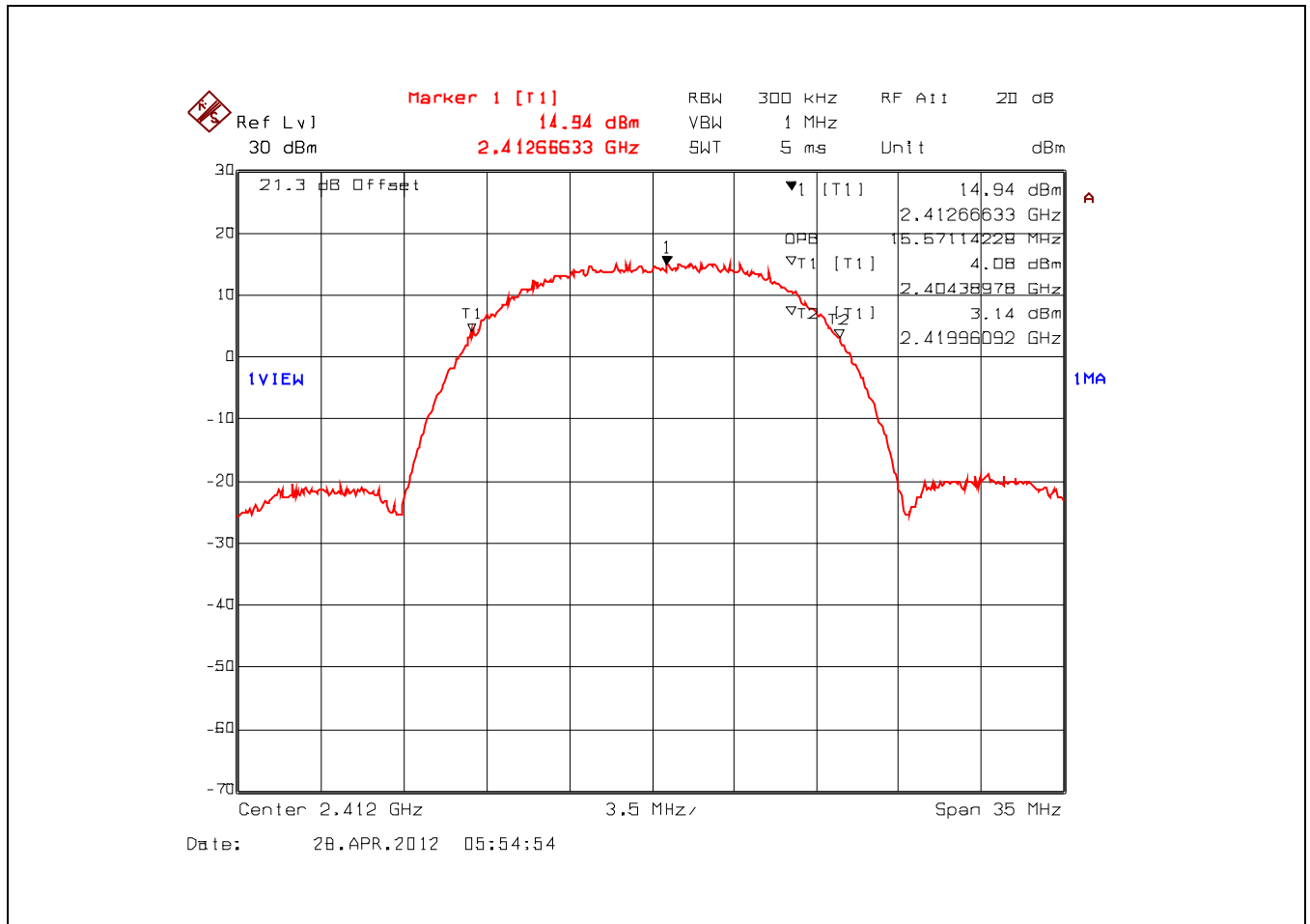
ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247
June 4, 2012

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Plot 5.2.4.28. 99% Occupied Bandwidth, 2412 MHz, 802.11b, CCK 11 Mbps



ULTRATECH GROUP OF LABS

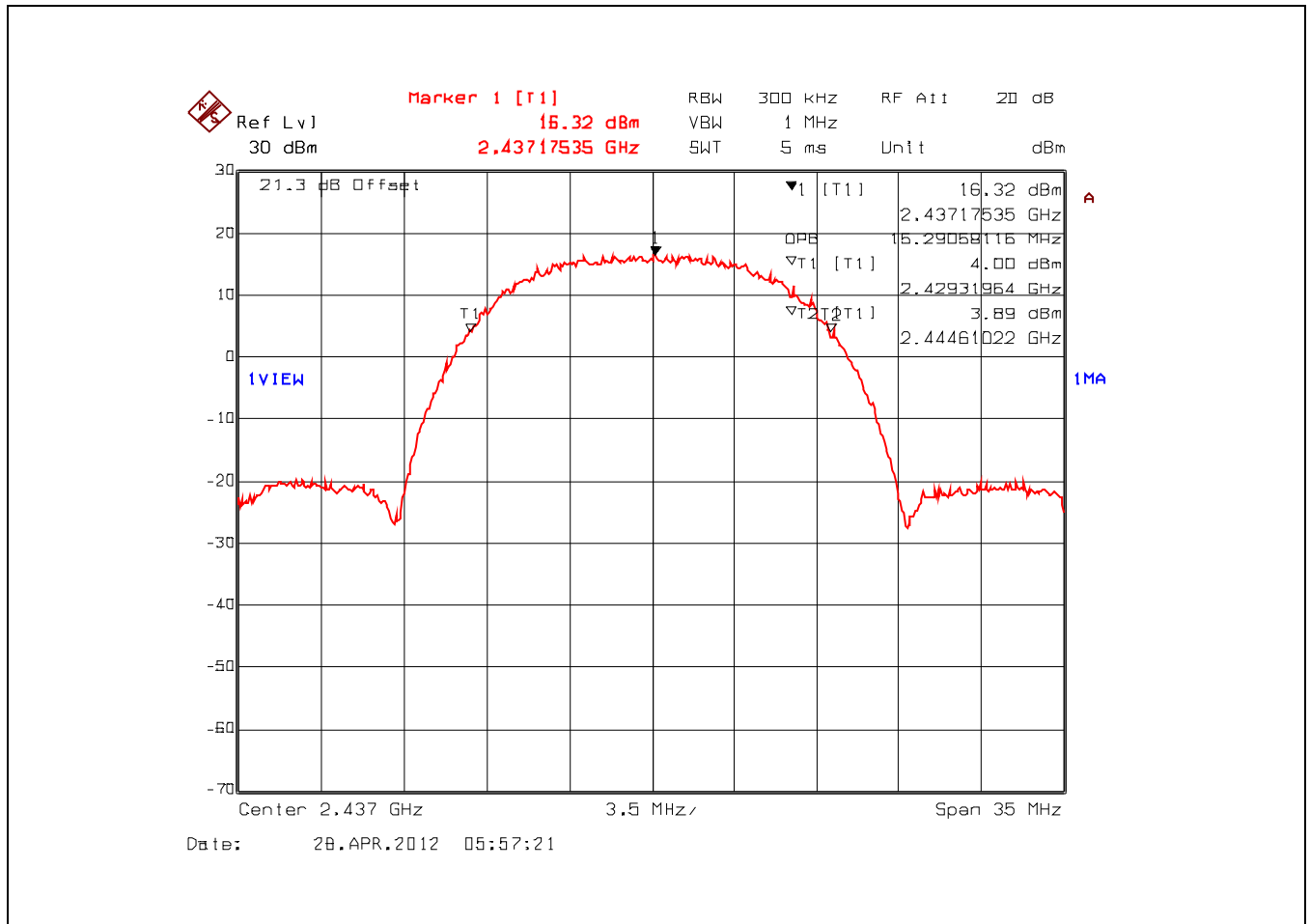
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.29. 99% Occupied Bandwidth, 2437 MHz, 802.11b, CCK 11 Mbps



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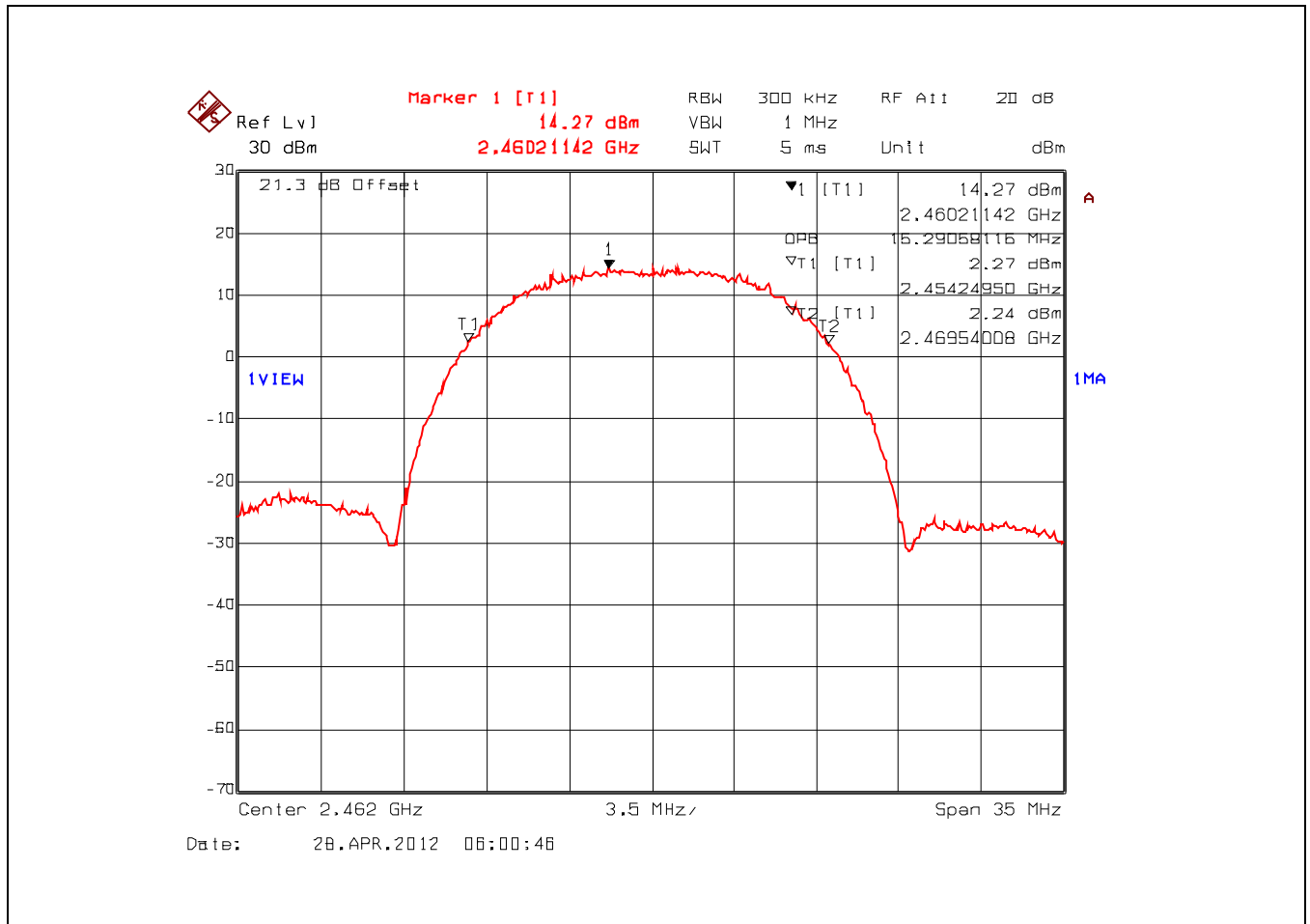
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.30. 99% Occupied Bandwidth, 2462 MHz, 802.11b, CCK 11 Mbps



ULTRATECH GROUP OF LABS

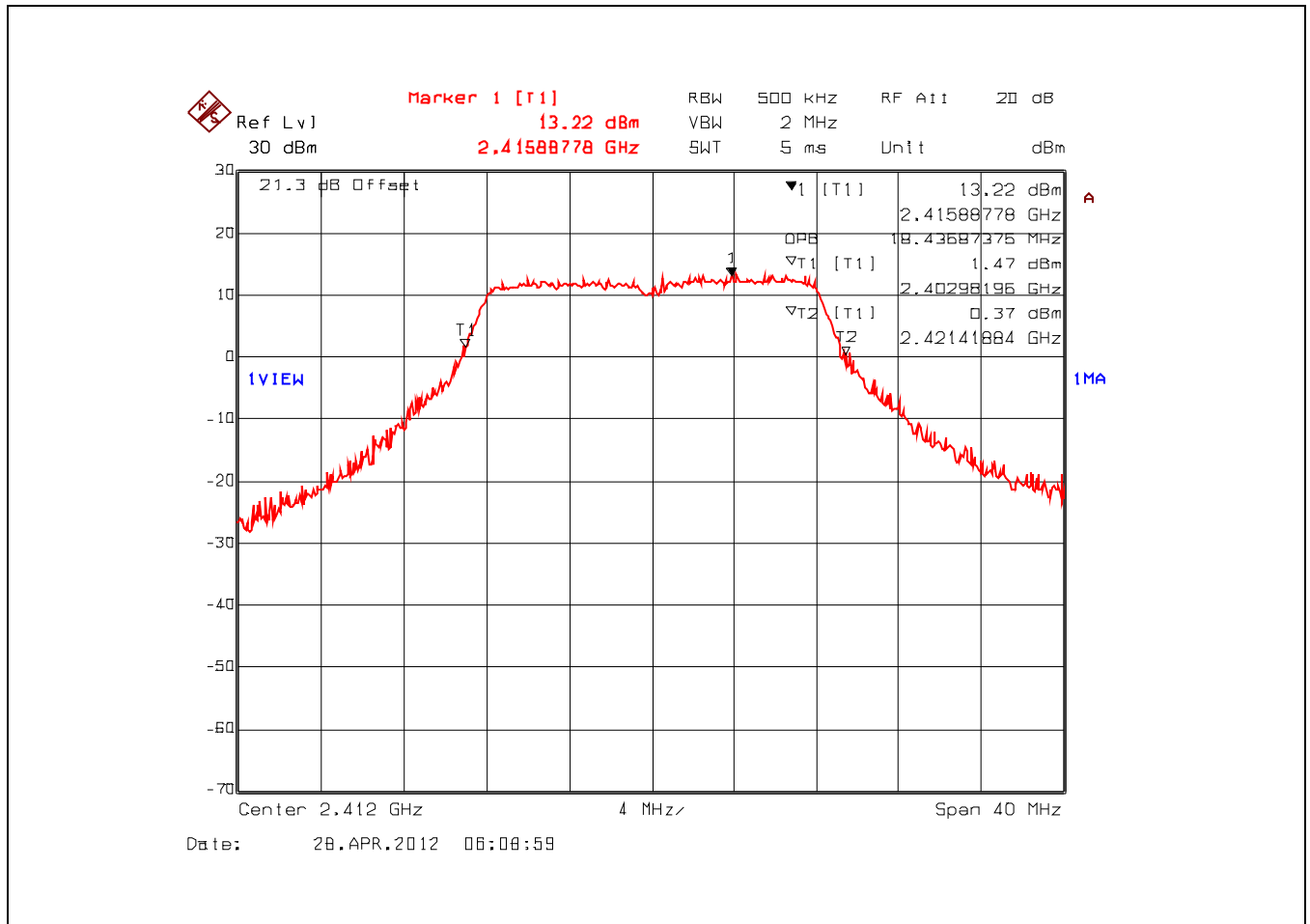
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.31. 99% Occupied Bandwidth, 2412 MHz, 802.11g, BPSK 9 Mbps



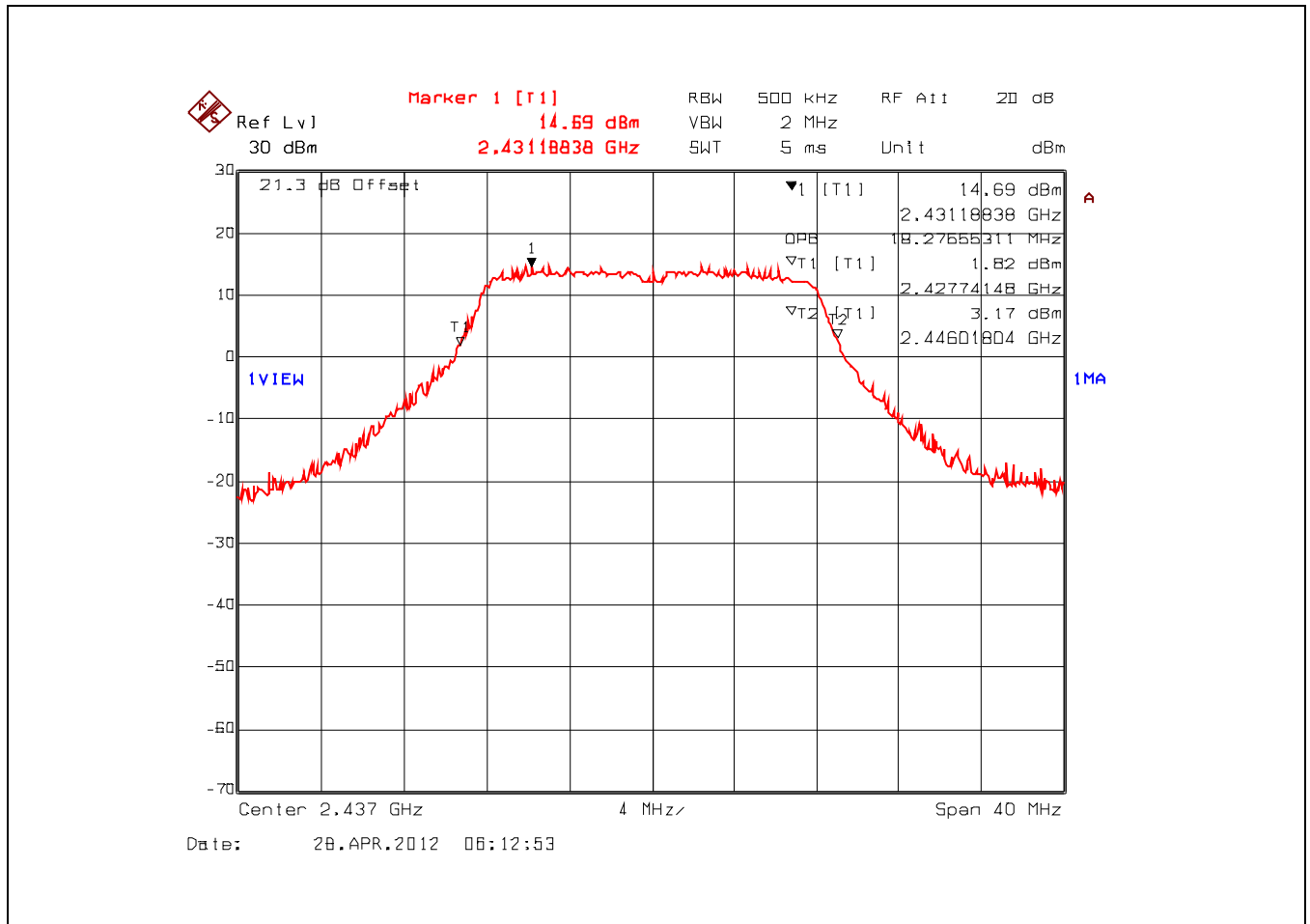
ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247
June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.32. 99% Occupied Bandwidth, 2437 MHz, 802.11g, BPSK 9 Mbps



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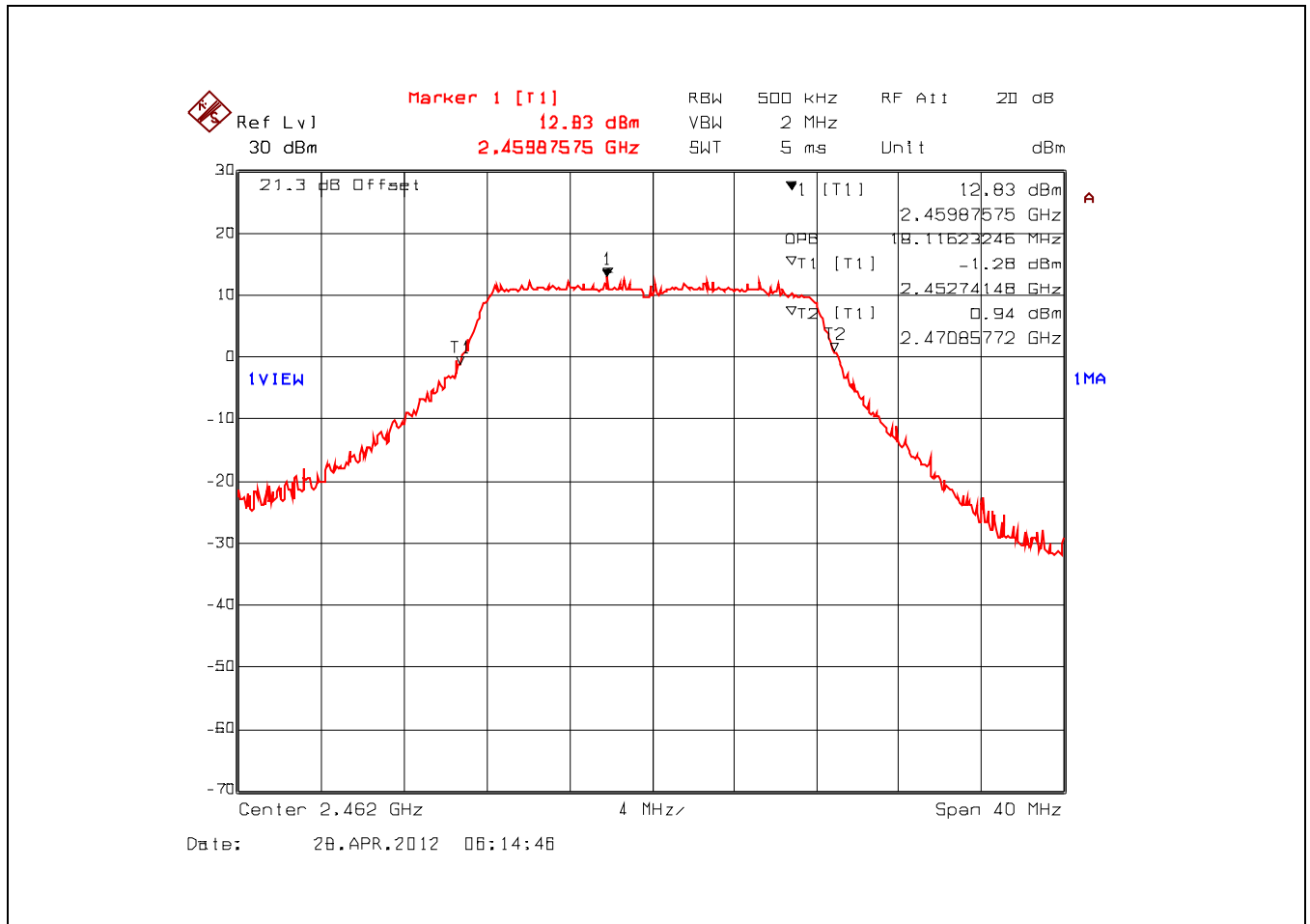
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.33. 99% Occupied Bandwidth, 2462 MHz, 802.11g, BPSK 9 Mbps



ULTRATECH GROUP OF LABS

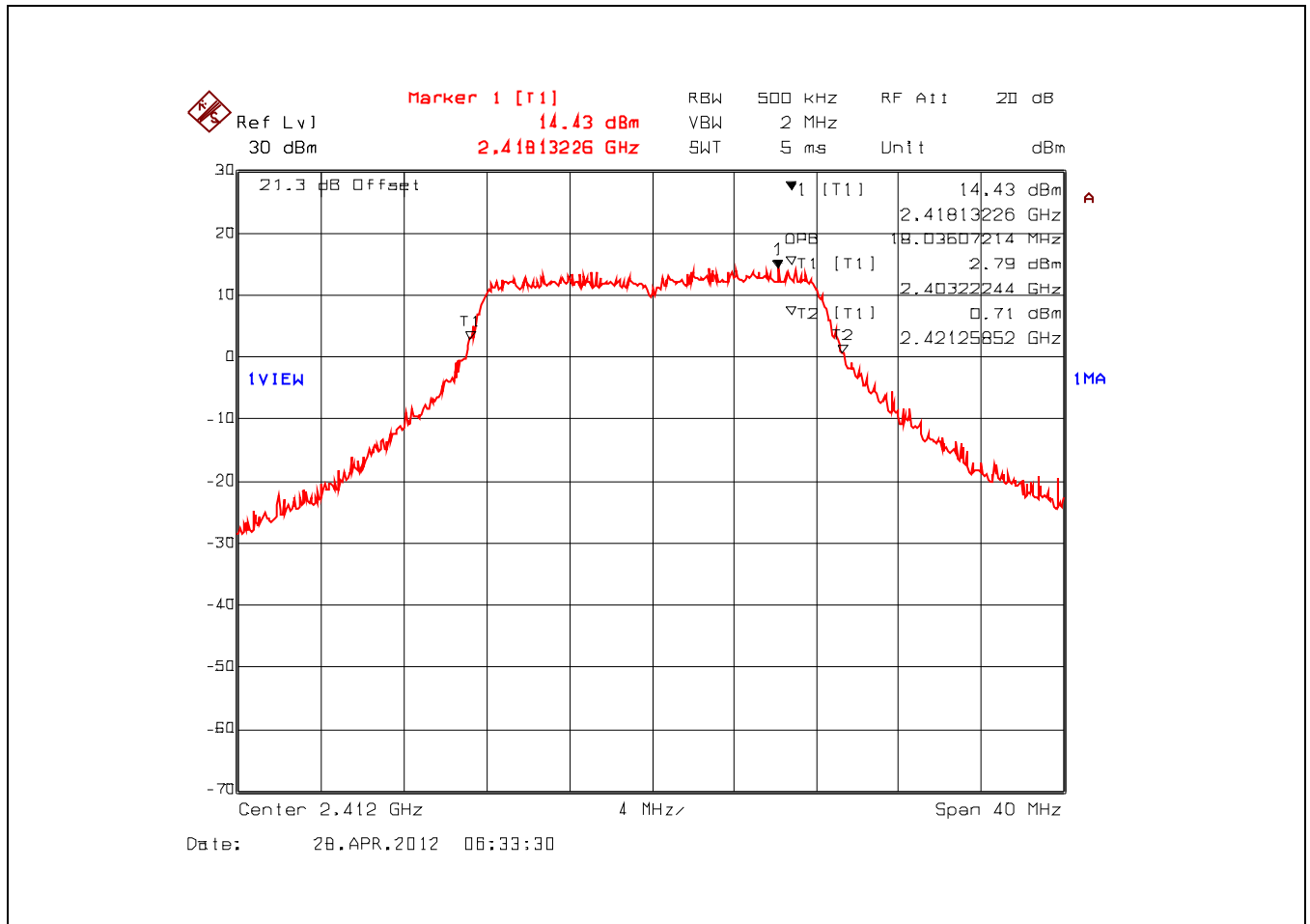
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.34. 99% Occupied Bandwidth, 2412 MHz, 802.11g, QPSK 18 Mbps



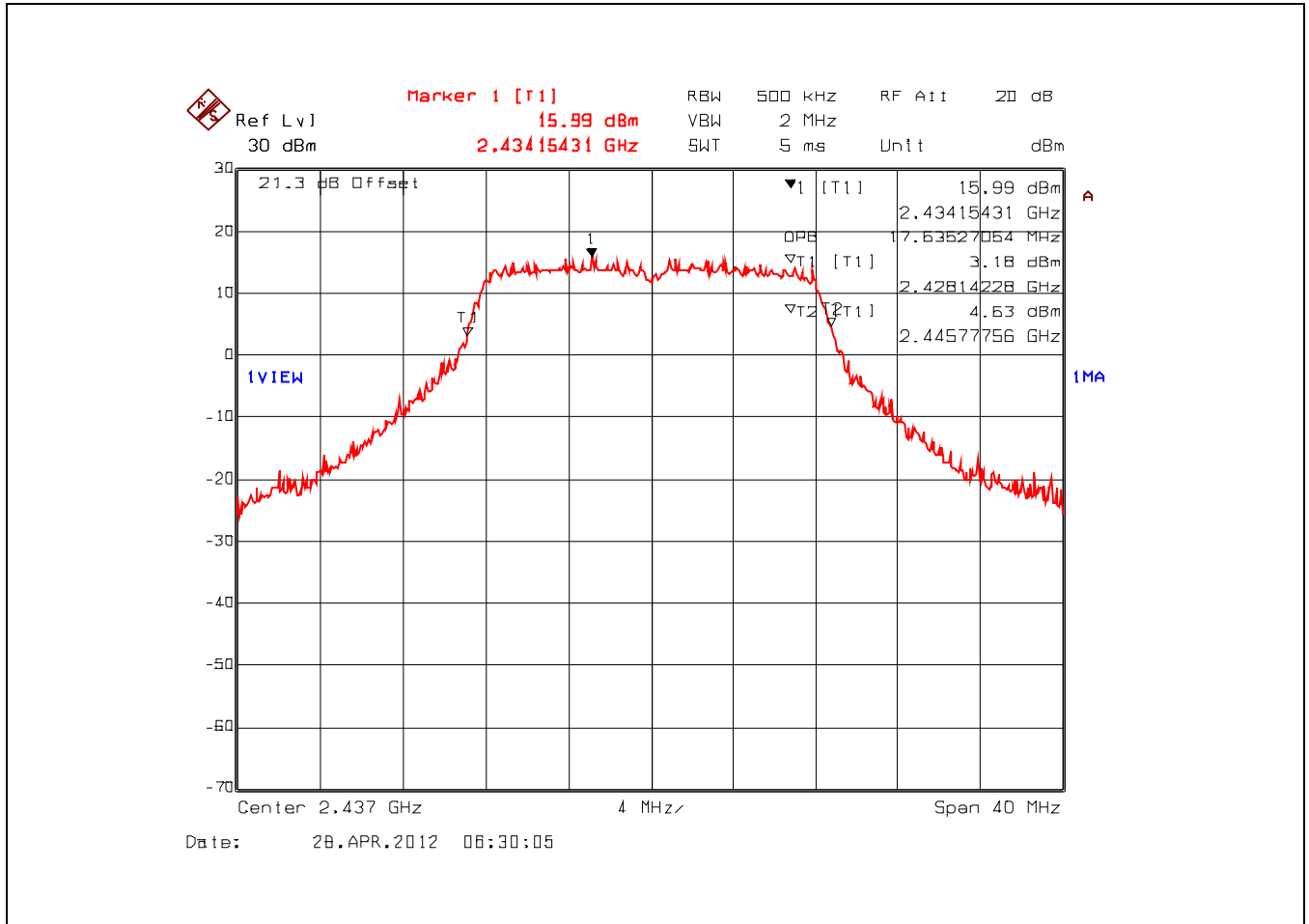
ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247
June 4, 2012

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Plot 5.2.4.35. 99% Occupied Bandwidth, 2437 MHz, 802.11g, QPSK 18 Mbps



ULTRATECH GROUP OF LABS

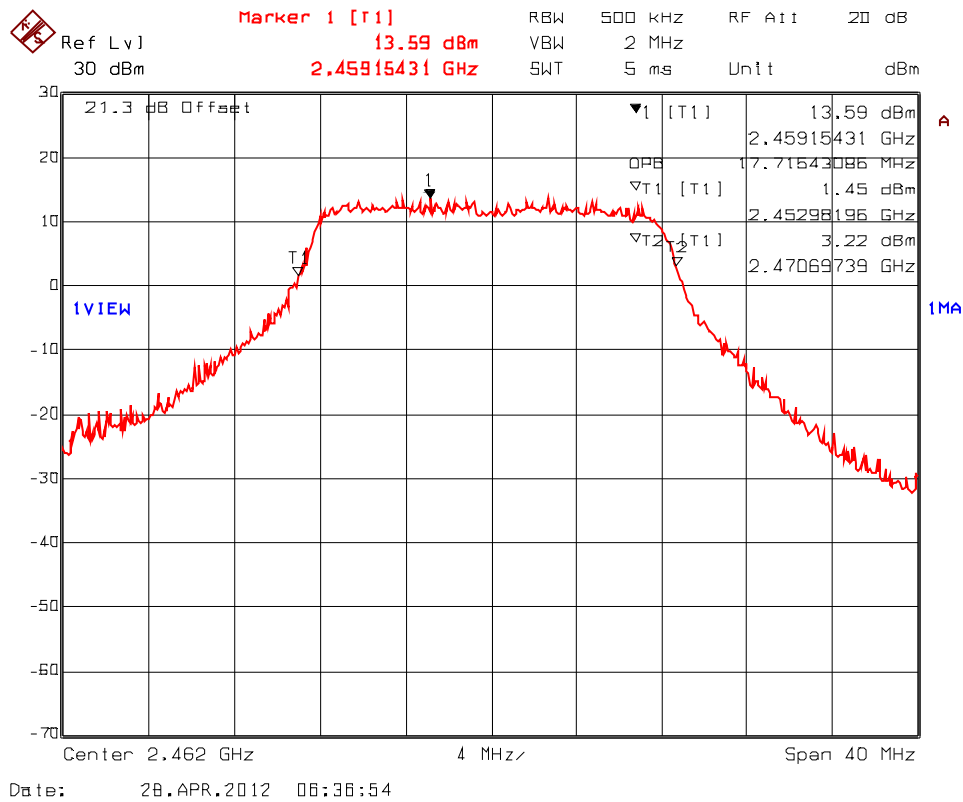
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

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Plot 5.2.4.36. 99% Occupied Bandwidth, 2462 MHz, 802.11g, QPSK, 18 Mbps



ULTRATECH GROUP OF LABS

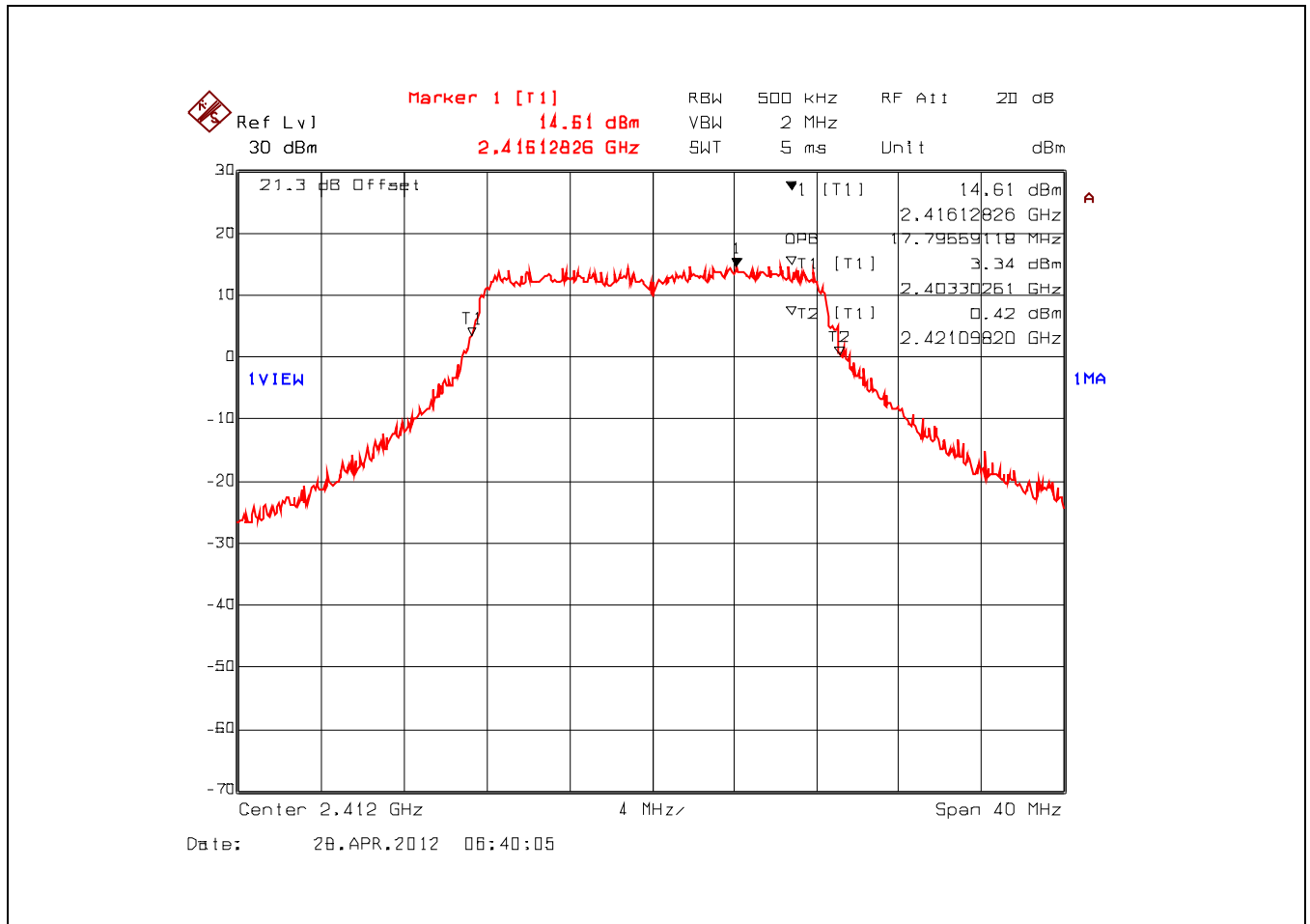
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.37. 99% Occupied Bandwidth, 2412 MHz, 802.11g, 16-QAM, 36 Mbps



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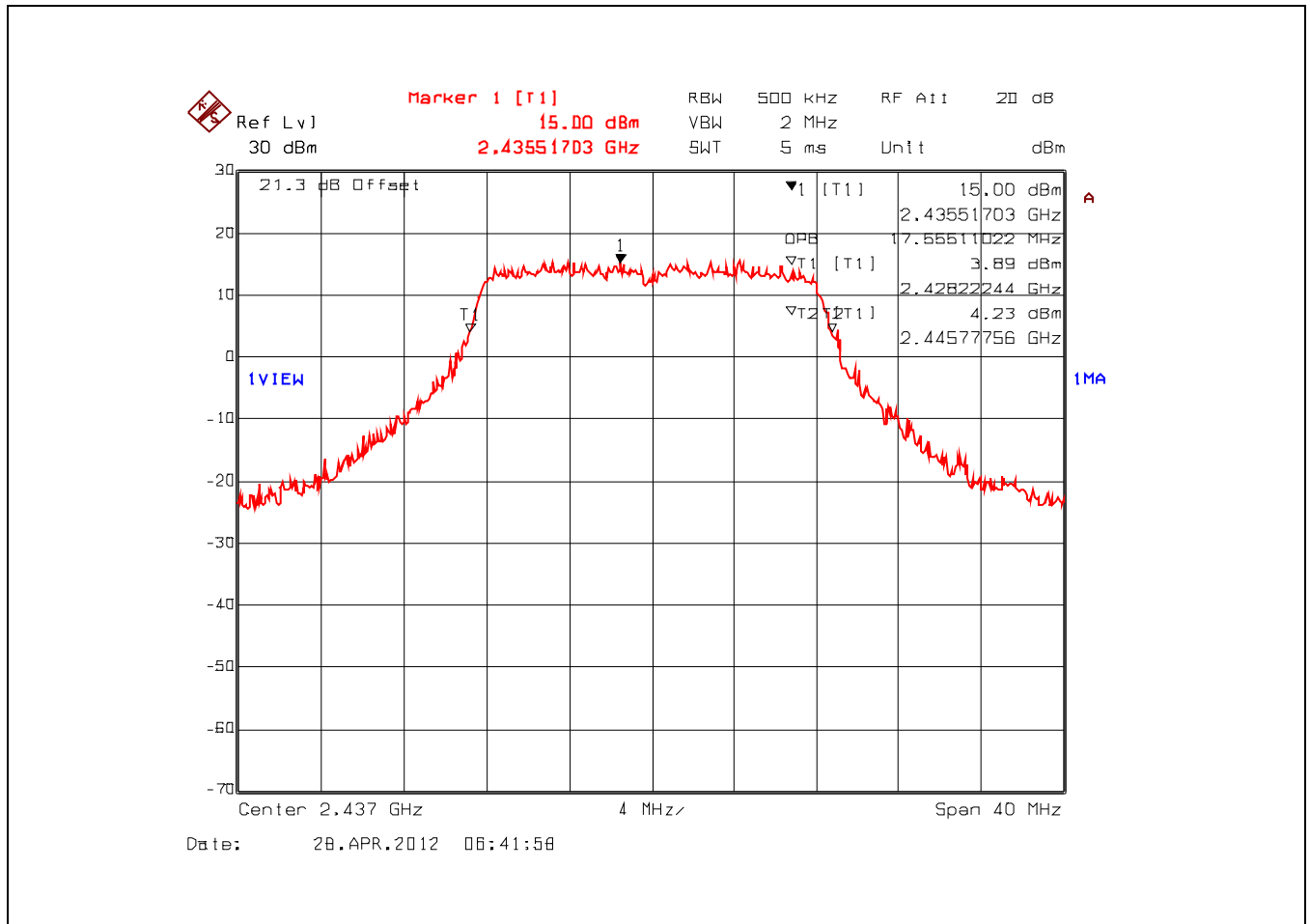
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

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Plot 5.2.4.38. 99% Occupied Bandwidth, 2437 MHz, 802.11g, 16-QAM, 36 Mbps



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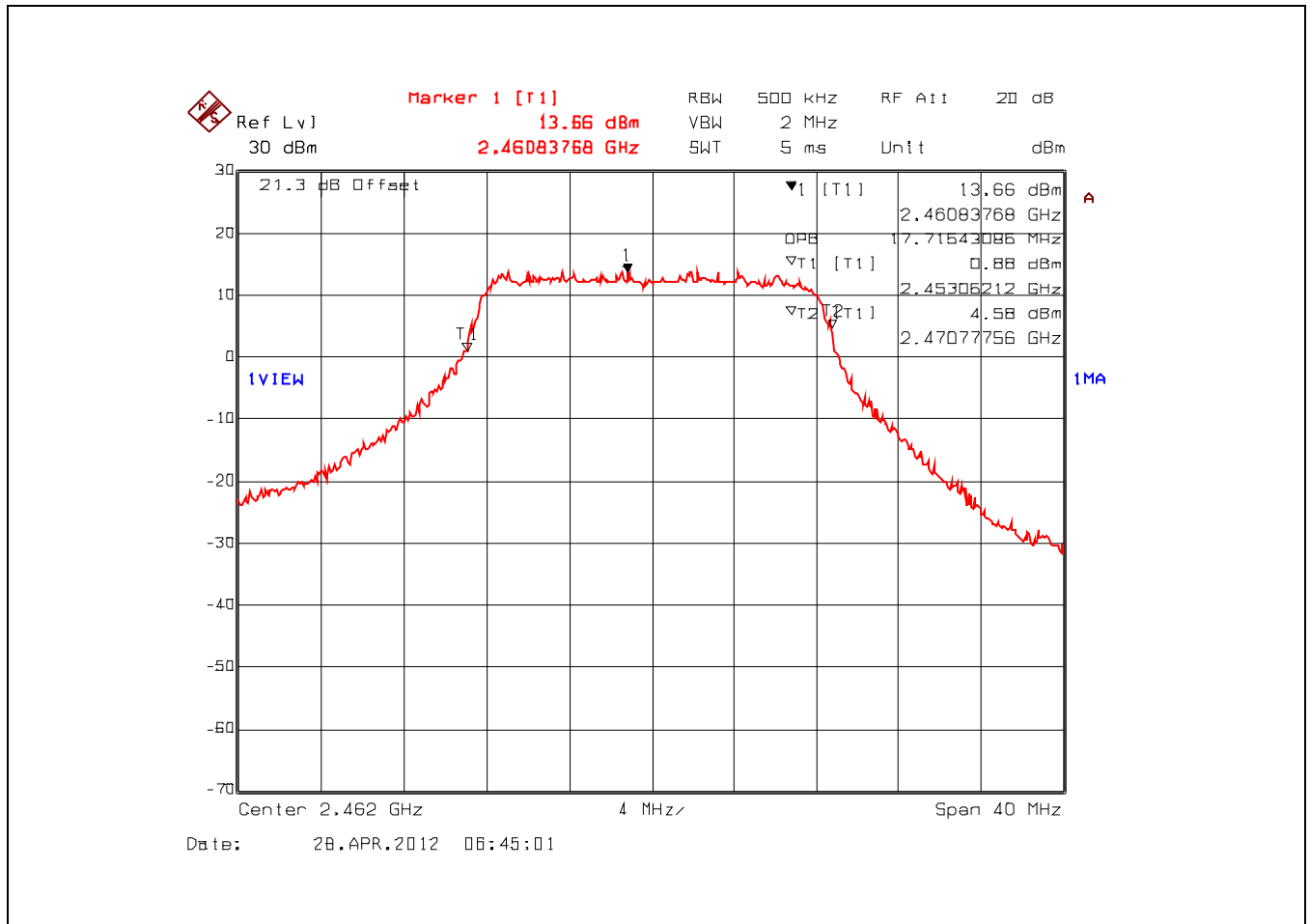
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.39. 99% Occupied Bandwidth, 2462 MHz, 802.11g, 16-QAM, 36 Mbps



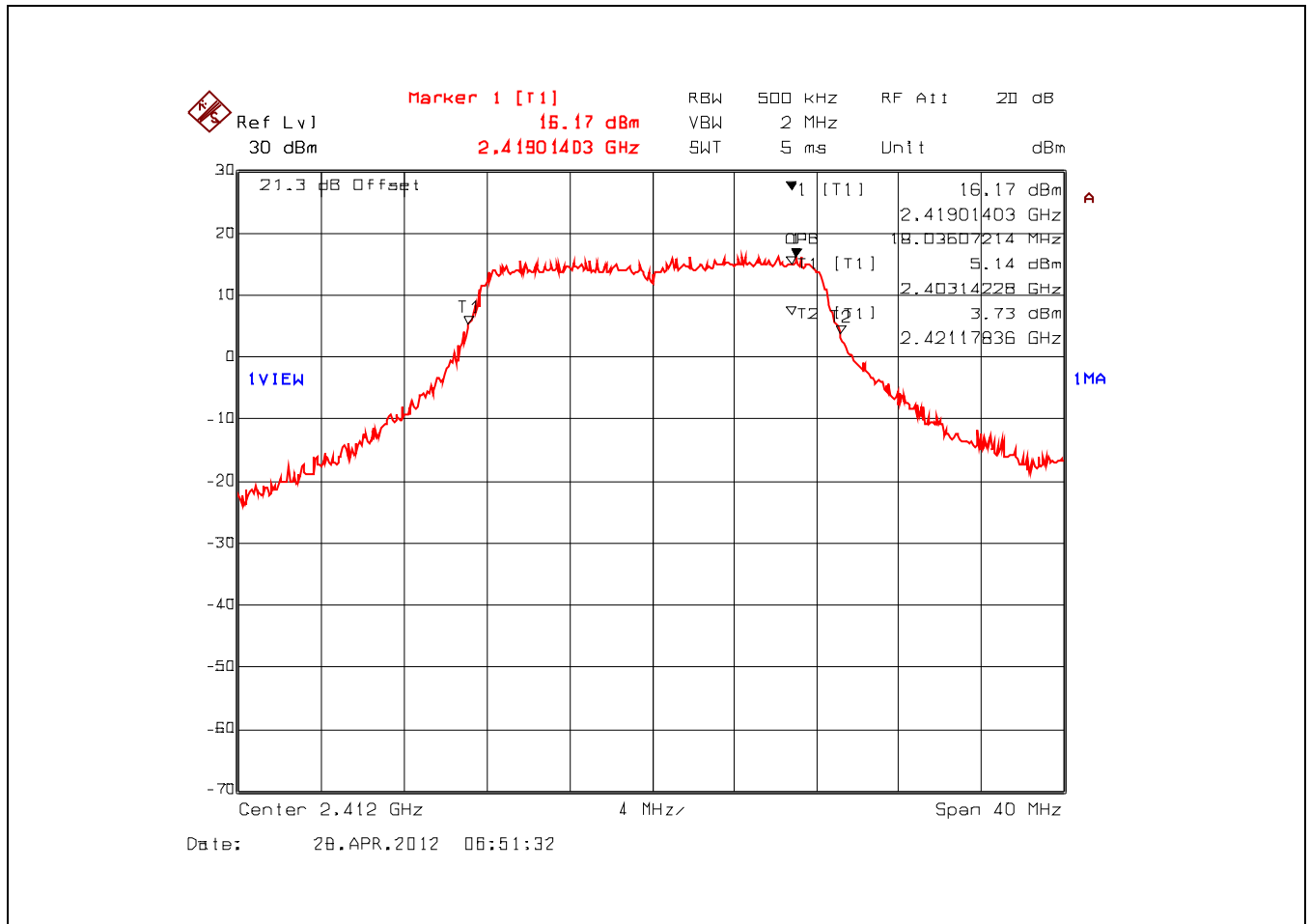
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3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247
June 4, 2012

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Plot 5.2.4.40. 99% Occupied Bandwidth, 2412 MHz, 802.11g, 64-QAM, 54 Mbps



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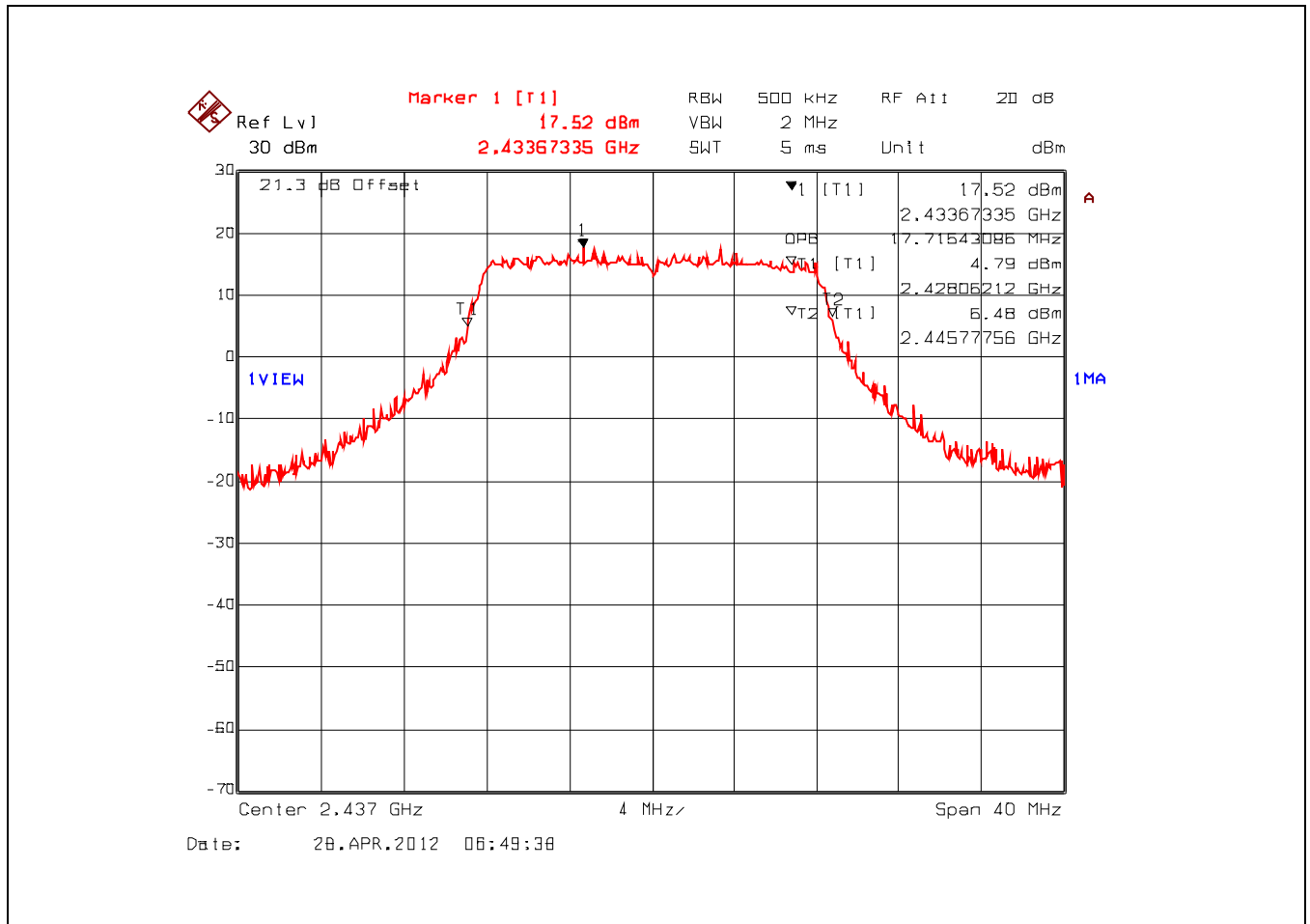
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.41. 99% Occupied Bandwidth, 2437 MHz, 802.11g, 64-QAM, 54 Mbps



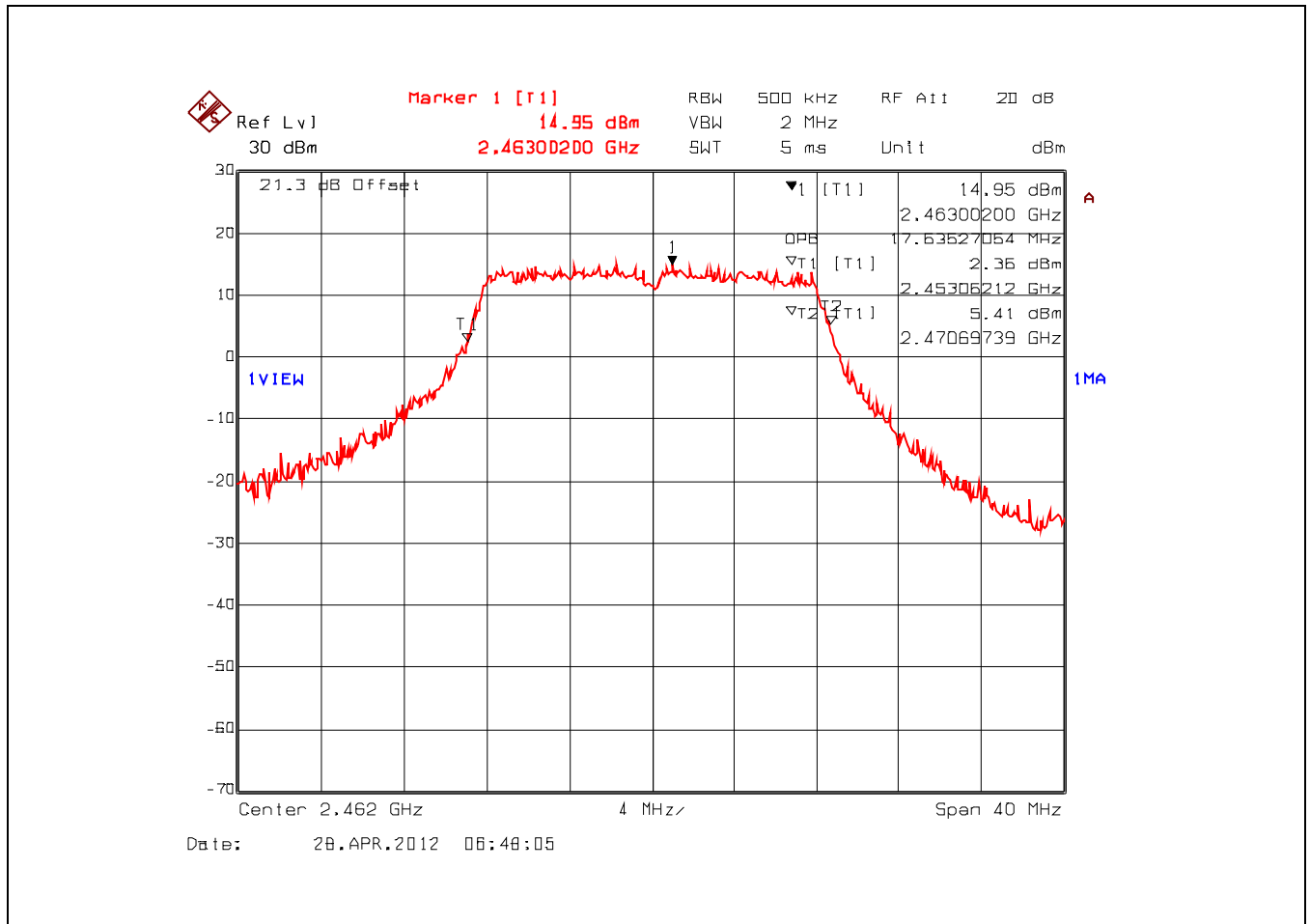
ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247
June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.2.4.42. 99% Occupied Bandwidth, 2462 MHz, 802.11g, 64-QAM, 54 Mbps



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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247
June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

5.3. PEAK CONDUCTED OUTPUT POWER - DTS [§ 15.247(b)(3)]

5.3.1. Limit(s)

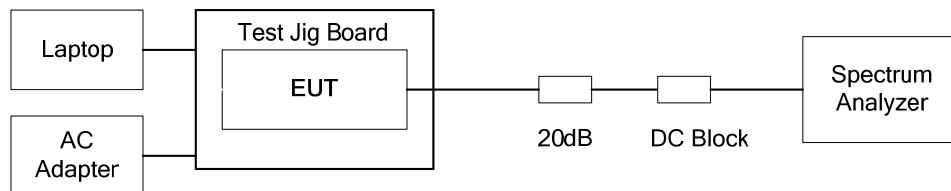
§ 15.247(b)(3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

§15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.3.2. Method of Measurements & Test Arrangement

KDB Publication No. 558074 D01 Section 5.2.1.2 Measurement Procedure PK2.

5.3.3. Test Arrangement



5.3.4. Test Data

Operation Mode	Frequency (MHz)	Modulation / Data Rate (Mbps)	Software/ PCDAC Power Setting	Peak Conducted Power (dBm)	Peak EIRP (dBm)	Peak Conducted Power Limit (dBm)	EIRP Limit (dBm)
802.11b High Power	2412	DBPSK / 1	55	27.18	See Notes 1 & 2	30	36
		DQPSK / 2	54	27.85	See Notes 1 & 2	30	36
		CCK / 11	53	29.82	See Notes 1 & 2	30	36
	2437	DBPSK / 1	55	28.84	See Notes 1 & 2	30	36
		DQPSK / 2	54	28.87	See Notes 1 & 2	30	36
		CCK / 11	53	29.76	See Notes 1 & 2	30	36
	2462	DBPSK / 1	55	26.97	See Notes 1 & 2	30	36
		DQPSK / 2	54	26.80	See Notes 1 & 2	30	36
		CCK / 11	53	29.60	See Notes 1 & 2	30	36
802.11g High Power	2412	BPSK / 9	54	29.83	See Notes 1 & 2	30	36
		QPSK / 18	54	29.93	See Notes 1 & 2	30	36
		16-QAM /36	57	29.93	See Notes 1 & 2	30	36
		64-QAM /54	57	29.96	See Notes 1 & 2	30	36
	2437	BPSK / 9	54	29.72	See Notes 1 & 2	30	36
		QPSK / 18	54	29.83	See Notes 1 & 2	30	36
		16-QAM /36	57	29.96	See Notes 1 & 2	30	36
		64-QAM /54	57	29.86	See Notes 1 & 2	30	36
	2462	BPSK / 9	54	29.27	See Notes 1 & 2	30	36
		QPSK / 18	54	28.33	See Notes 1 & 2	30	36
		16-QAM /36	57	29.30	See Notes 1 & 2	30	36
		64-QAM /54	57	29.81	See Notes 1 & 2	30	36
Notes:							
1. The EIRP shall be calculated based on the transmitter antenna gain (G_{dBi}), cable loss (CL_{dB}) and peak output power at antenna terminal (P_{dBm}). Calculated EIRP = $P_{dBm} + G_{dBi} - CL_{dB}$							
2. EIRP shall not exceed 36 dBm limit (Power Setting = 36 dBm - $G_{dBi} + CL_{dB}$). See Operating Manual for instruction of power setting.							

Operation Mode	Frequency (MHz)	Modulation / Data Rate (Mbps)	Software/PCDAC Power Setting	Peak Conducted Power (dBm)	Peak EIRP (dBm)	Peak Conducted Power Limit (dBm)	EIRP Limit (dBm)
802.11b Low Power	2412	DBPSK / 1	35	22.04	See Notes 1 & 2	30	36
		DQPSK / 2	39	22.34	See Notes 1 & 2	30	36
		CCK / 11	35	22.23	See Notes 1 & 2	30	36
	2437	DBPSK / 1	35	22.07	See Notes 1 & 2	30	36
		DQPSK / 2	39	22.23	See Notes 1 & 2	30	36
		CCK / 11	35	22.08	See Notes 1 & 2	30	36
	2462	DBPSK / 1	35	20.64	See Notes 1 & 2	30	36
		DQPSK / 2	39	21.70	See Notes 1 & 2	30	36
		CCK / 11	35	21.59	See Notes 1 & 2	30	36
802.11g Low Power	2412	BPSK / 9	38	22.28	See Notes 1 & 2	30	36
		QPSK / 18	39	22.27	See Notes 1 & 2	30	36
		16-QAM /36	37	22.24	See Notes 1 & 2	30	36
		64-QAM /54	37	22.27	See Notes 1 & 2	30	36
	2437	BPSK / 9	38	22.14	See Notes 1 & 2	30	36
		QPSK / 18	39	22.16	See Notes 1 & 2	30	36
		16-QAM /36	37	22.36	See Notes 1 & 2	30	36
		64-QAM /54	37	22.36	See Notes 1 & 2	30	36
	2462	BPSK / 9	38	21.92	See Notes 1 & 2	30	36
		QPSK / 18	39	21.67	See Notes 1 & 2	30	36
		16-QAM /36	37	22.03	See Notes 1 & 2	30	36
		64-QAM /54	37	22.24	See Notes 1 & 2	30	36

Notes:

1. The EIRP shall be calculated based on the transmitter antenna gain (G_{dBi}), cable loss (CL_{dB}) and peak output power at antenna terminal (P_{dBm}). Calculated EIRP = $P_{dBm} + G_{dBi} - CL_{dB}$

2. EIRP shall not exceed 36 dBm limit (Power Setting = $36\text{ dBm} - G_{dBi} + CL_{dB}$). See Operating Manual for instruction of power setting.

5.4. TRANSMITTER BAND-EDGE & SPURIOUS CONDUCTED EMISSIONS [§ 15.247(d)]

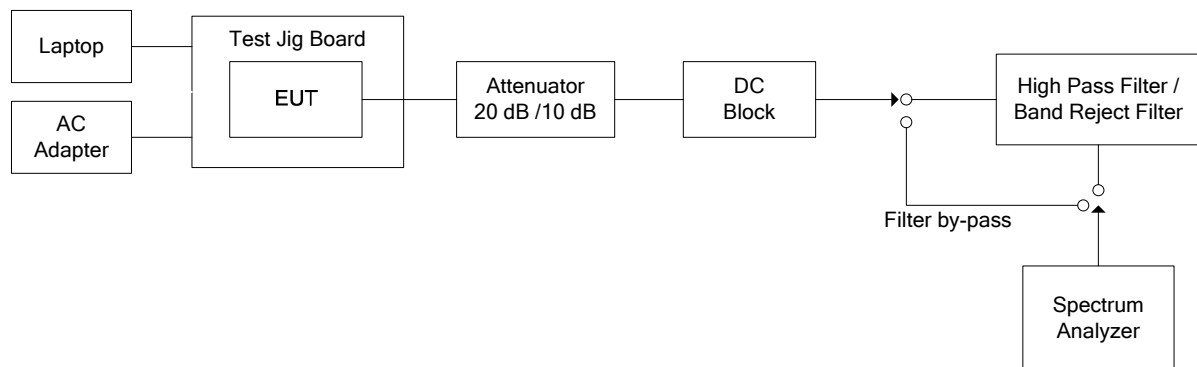
5.4.1. Limit(s)

§ 15.247 (d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

5.4.2. Method of Measurements

KDB Publication No. 558074 D01, Sections 5.4.2.2.4 Band-Edge Measurements, 5.4.1 Unwanted Emissions into Non-Restricted Bands, 5.4.2 Unwanted Emissions into Restricted Frequency Bands, 5.4.2.2.1.1 Peak Power Procedure, 5.4.2.2.2.2 Measurement Procedure RBAVG2 (Trace Averaging) and 5.4.2.2.3 Applicability of §15.35(b) and §15.35(c).

5.4.3. Test Arrangement

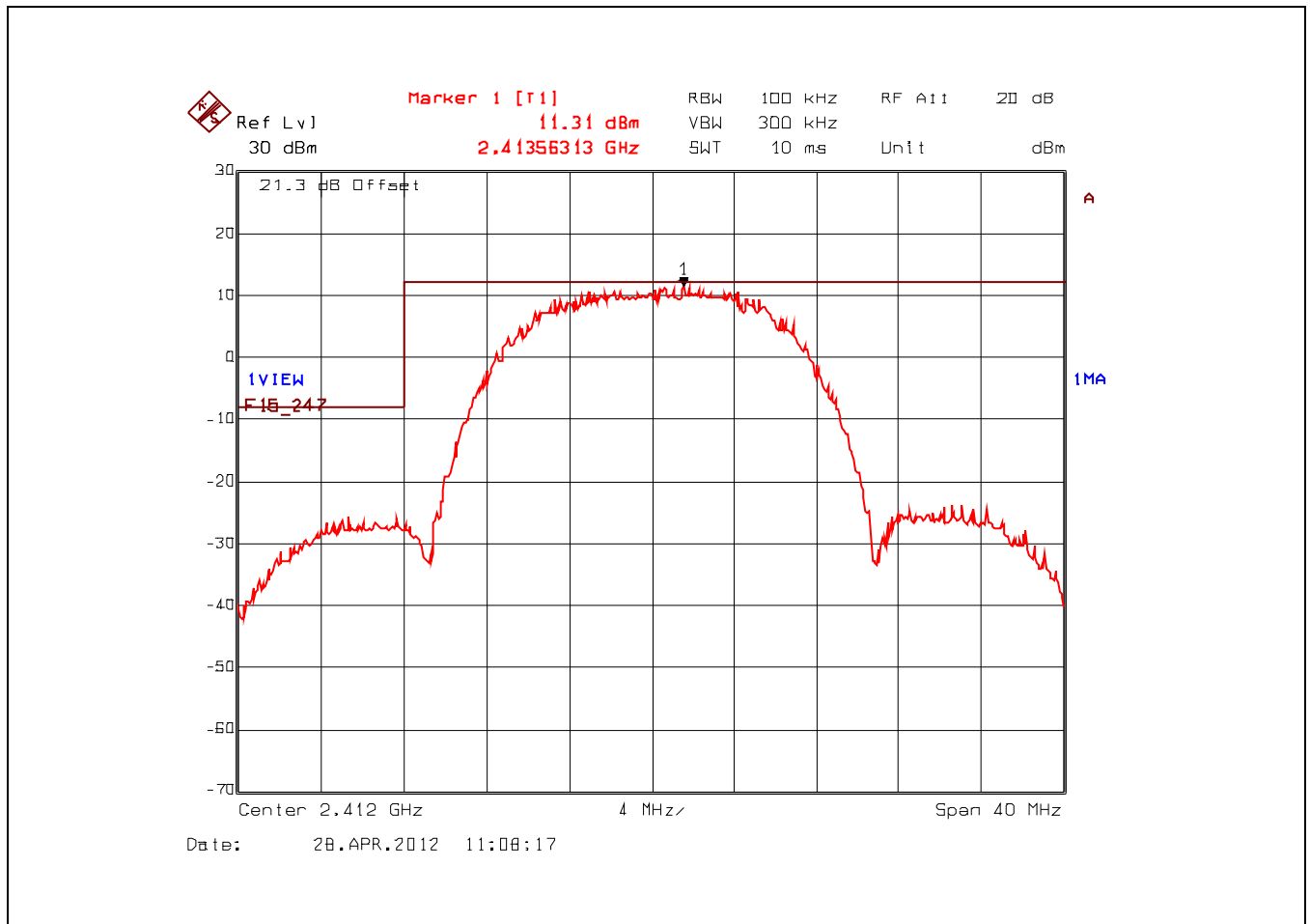


5.4.4. Test Data

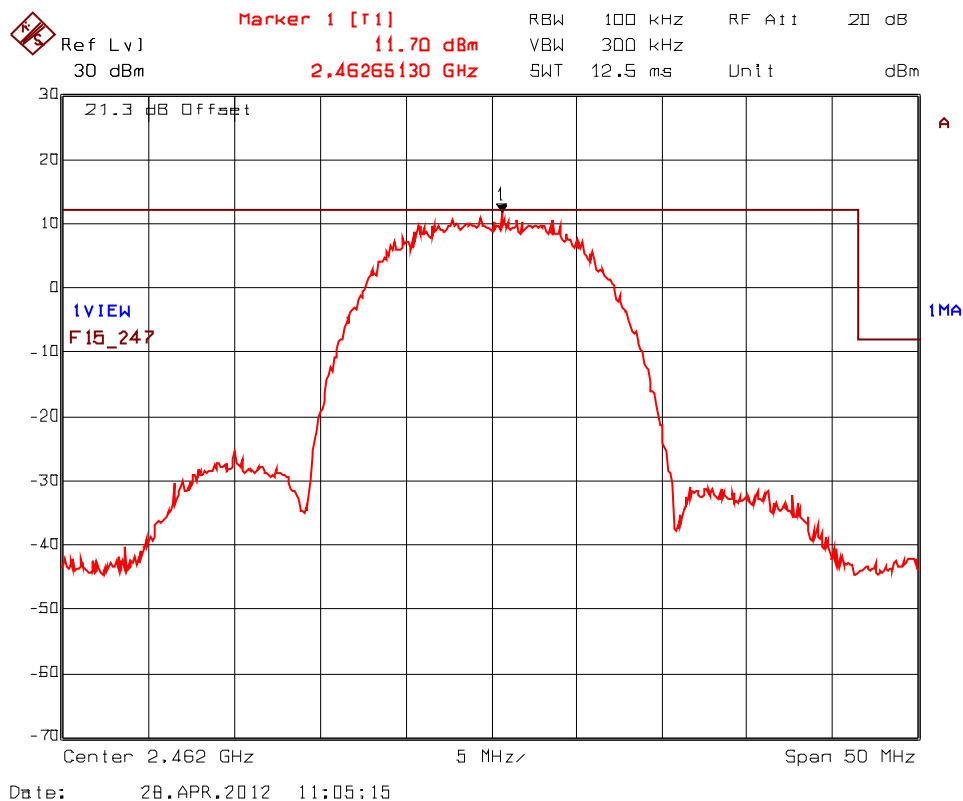
5.4.4.1. Band-Edge RF Conducted Emissions

Remark(s): Exploratory tests performed to determined worst-case test configurations, the following test results represent the worst-case.

Plot 5.4.4.1.1. Band-Edge RF Conducted Emissions
Low End of Frequency Band, 802.11b, 2412 MHz, CCK 11 Mbps



Plot 5.4.4.1.2. Band-Edge RF Conducted Emissions
High End of Frequency Band, 802.11b, 2462 MHz, CCK 11 Mbps



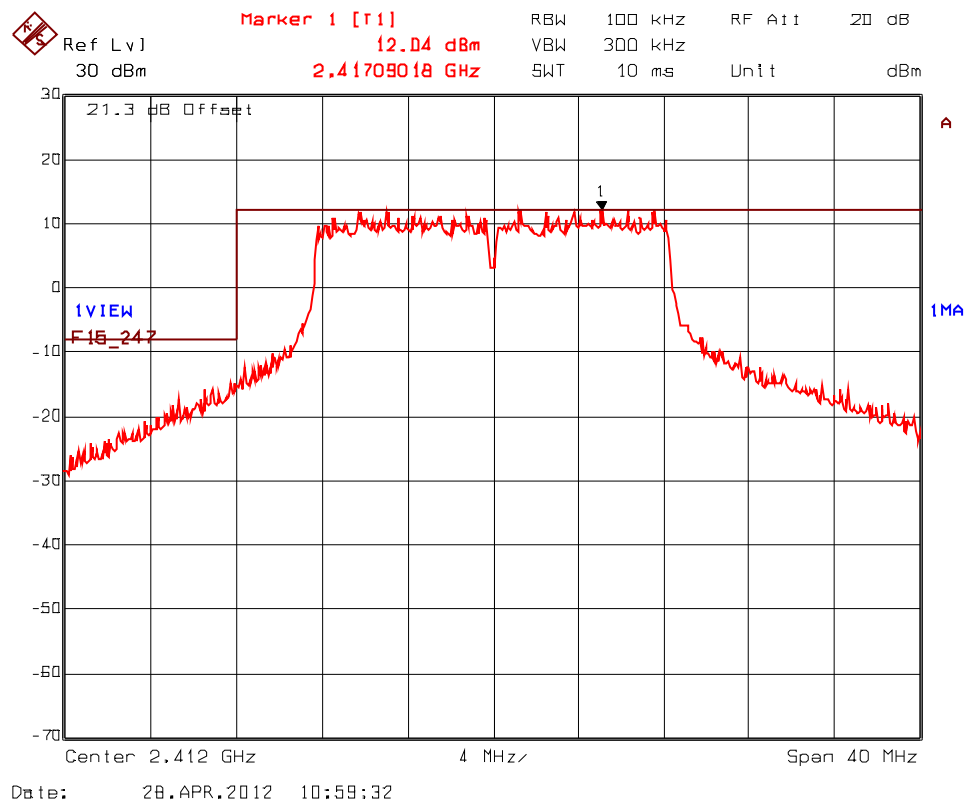
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Plot 5.4.4.1.3. Band-Edge RF Conducted Emissions
Low End of Frequency Band, 802.11g, 2412 MHz, 64-QAM 54 Mbps



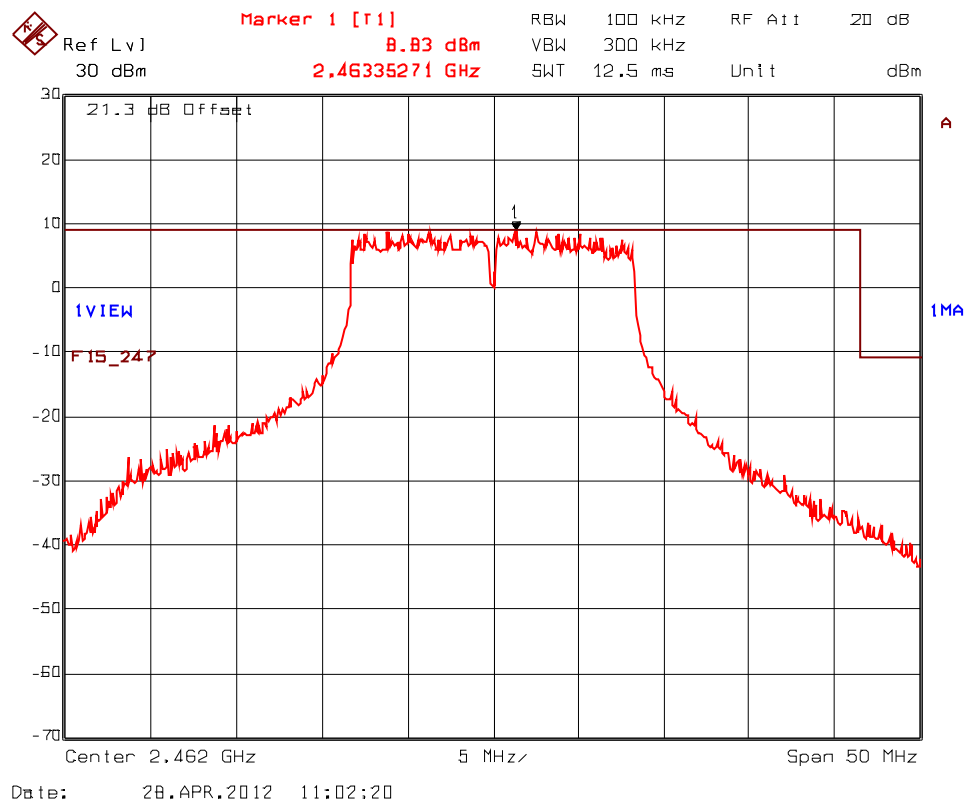
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Plot 5.4.4.1.4. Band-Edge RF Conducted Emissions
High End of Frequency Band, 802.11g, 2462 MHz, 64-QAM 54 Mbps



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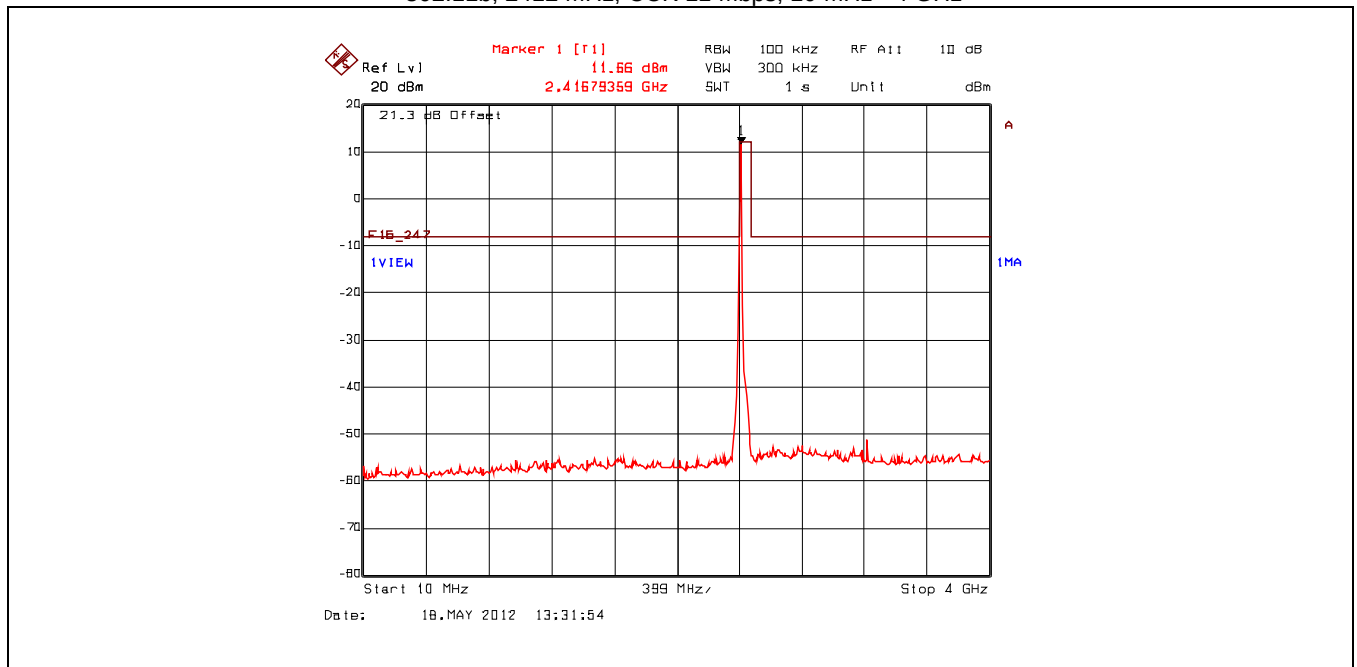
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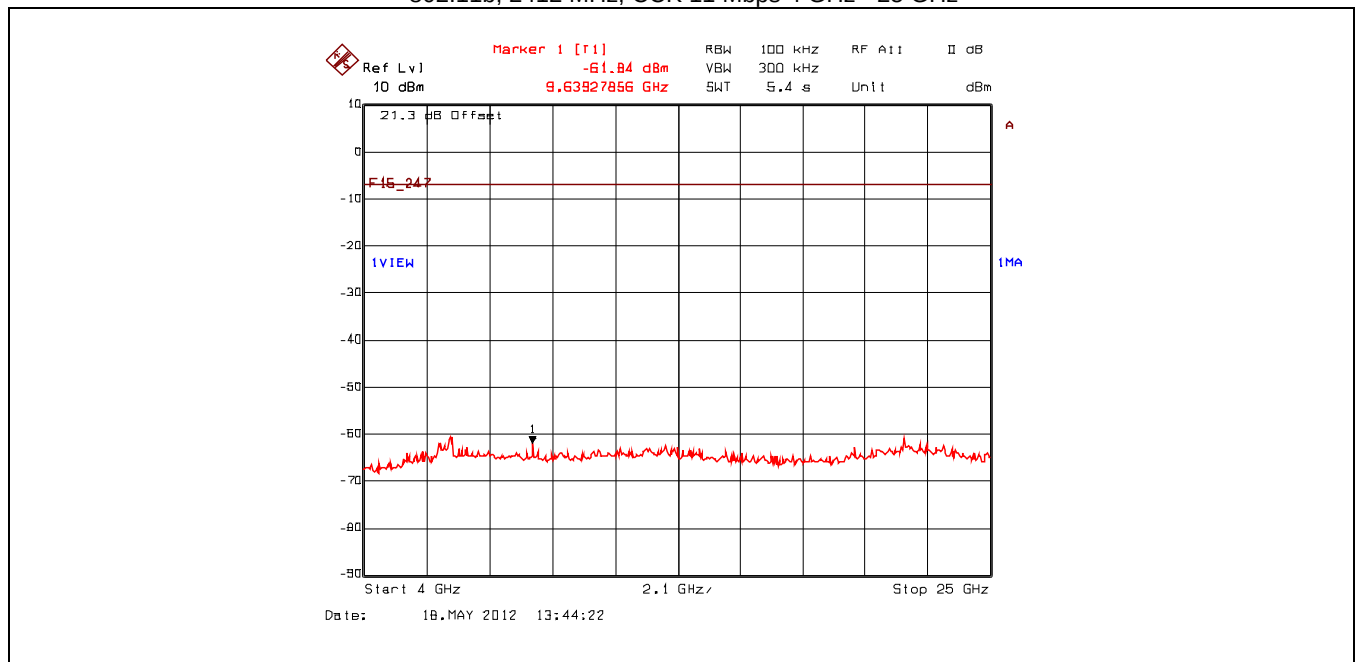
5.4.4.2. Conducted Spurious Emissions – Non Restricted Frequency Bands

Remark(s): Exploratory tests performed to determined worst case test configurations, the following test results at high power setting represents the worst case.

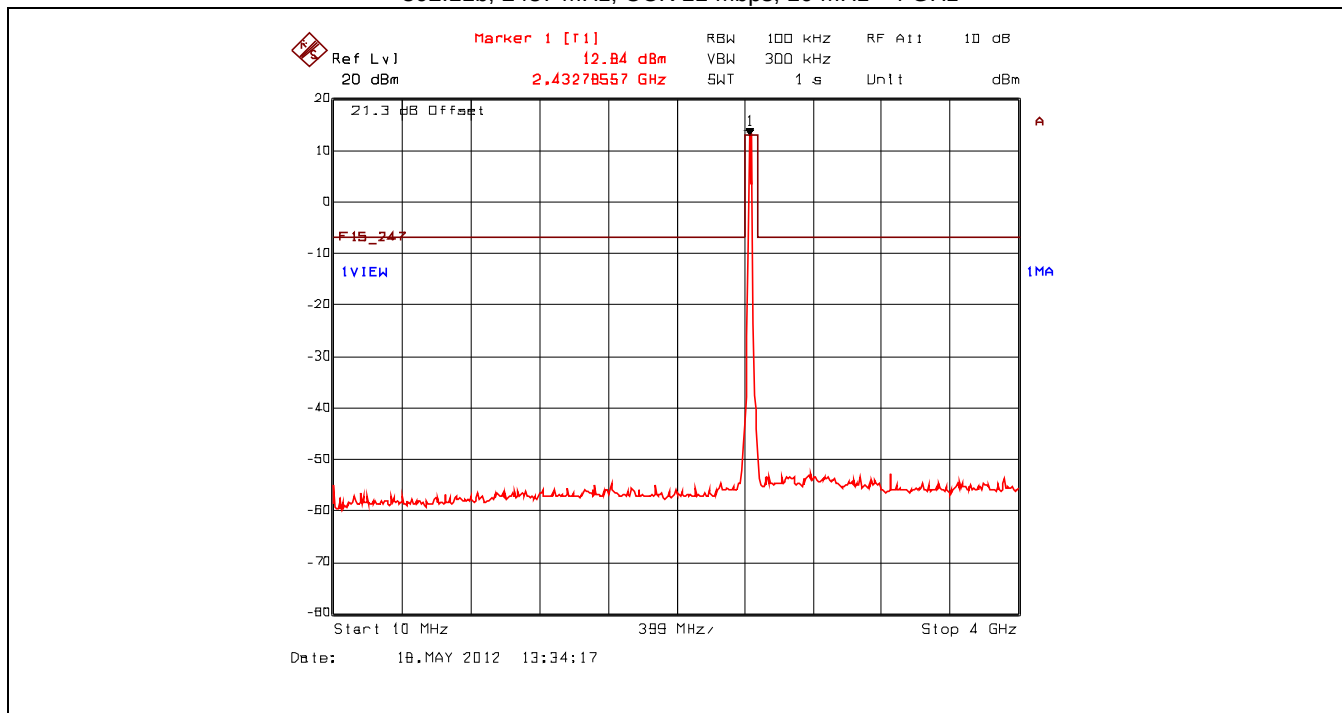
Plot 5.4.4.2.1. Conducted Spurious Emissions - Non Restricted Frequency Bands
802.11b, 2412 MHz, CCK 11 Mbps, 10 MHz - 4 GHz



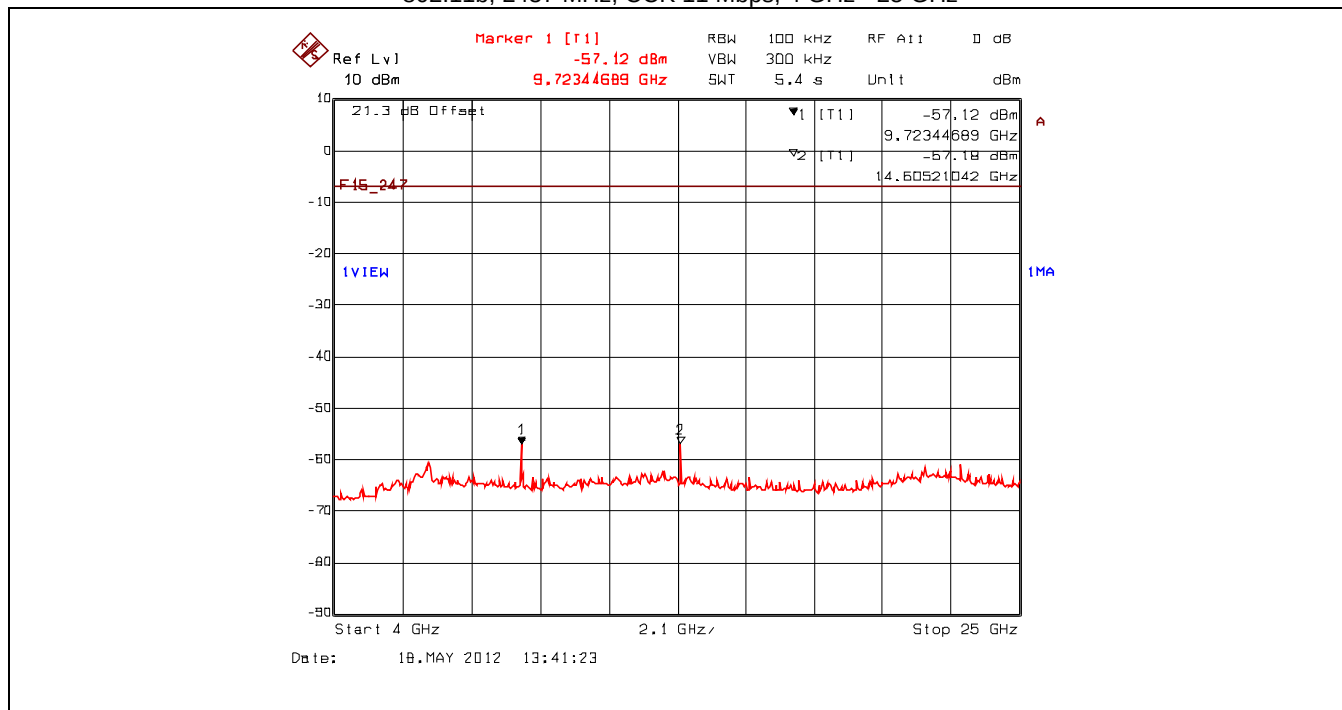
Plot 5.4.4.2.2. Conducted Spurious Emissions - Non Restricted Frequency Bands
802.11b, 2412 MHz, CCK 11 Mbps 4 GHz - 25 GHz



Plot 5.4.4.2.3. Conducted Spurious Emissions – Non Restricted Frequency Bands
802.11b, 2437 MHz, CCK 11 Mbps, 10 MHz - 4 GHz



Plot 5.4.4.2.4. Conducted Spurious Emissions – Non Restricted Frequency Bands,
802.11b, 2437 MHz, CCK 11 Mbps, 4 GHz - 25 GHz



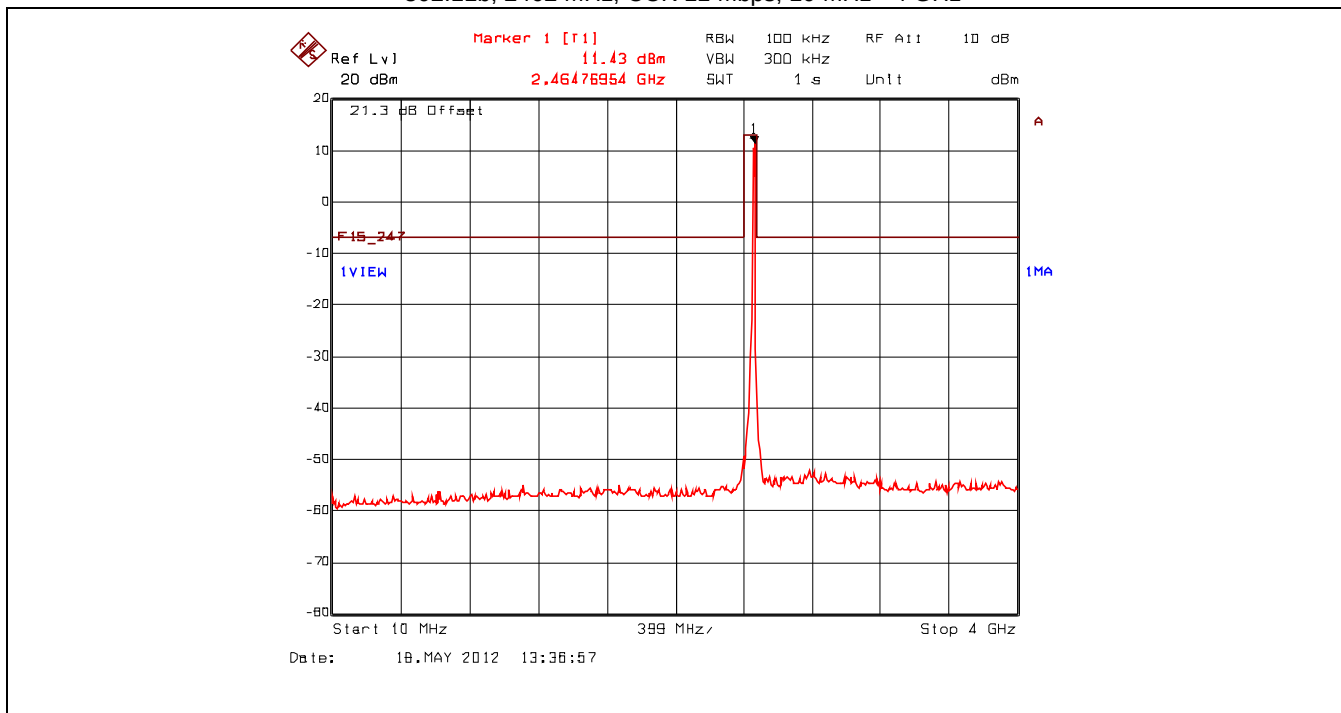
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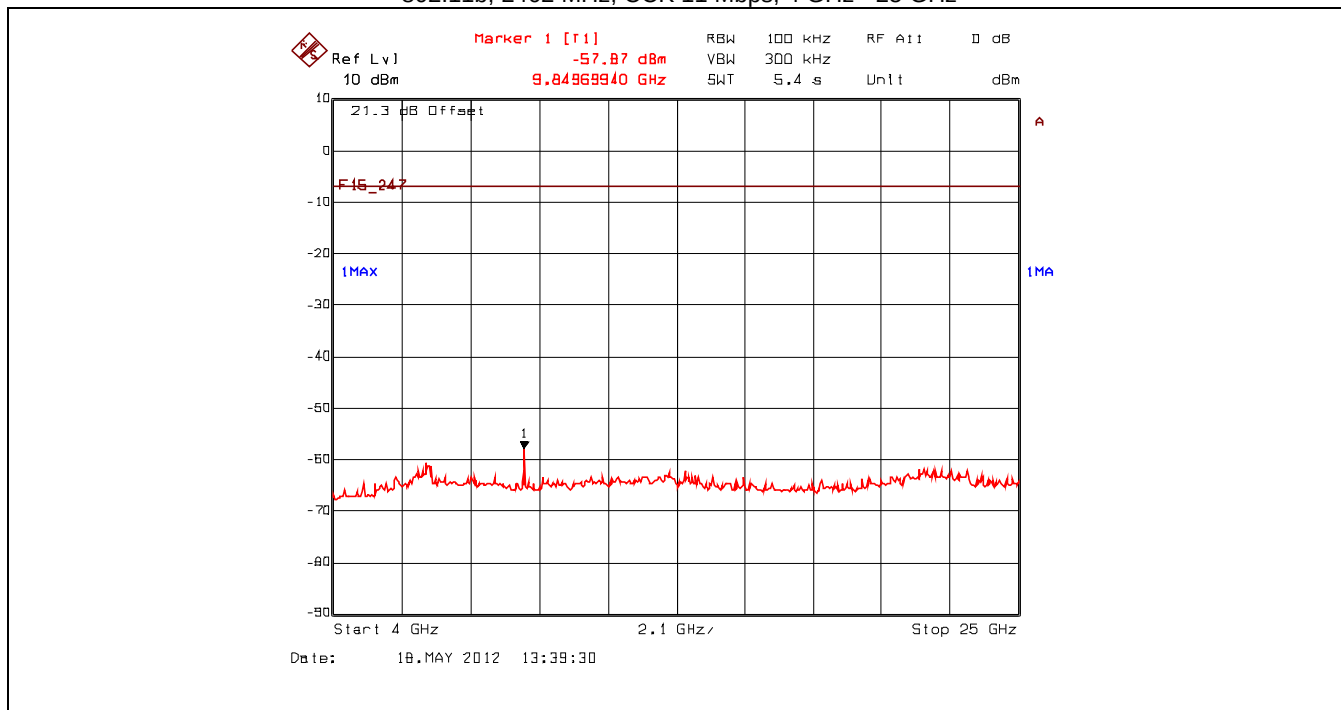
File #: MCRS-046F15C247
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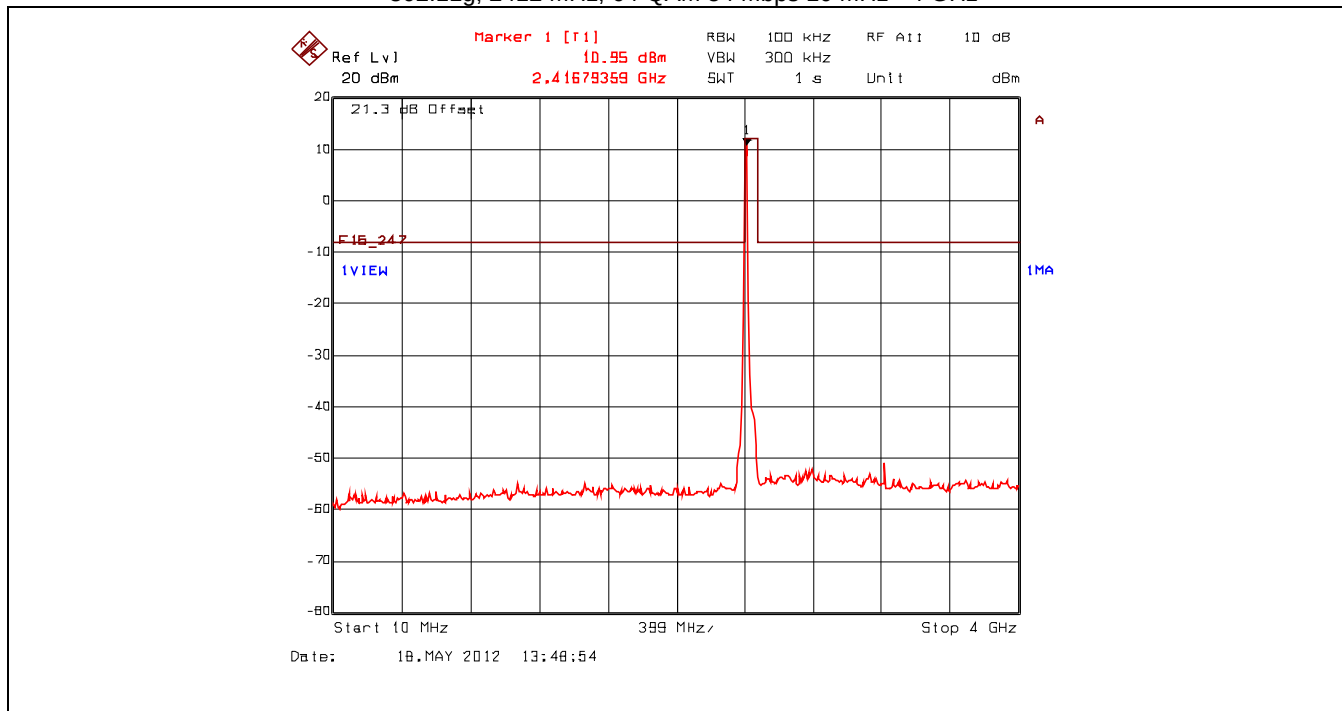
Plot 5.4.4.2.5. Conducted Spurious Emissions – Non Restricted Frequency Bands
802.11b, 2462 MHz, CCK 11 Mbps, 10 MHz - 4 GHz



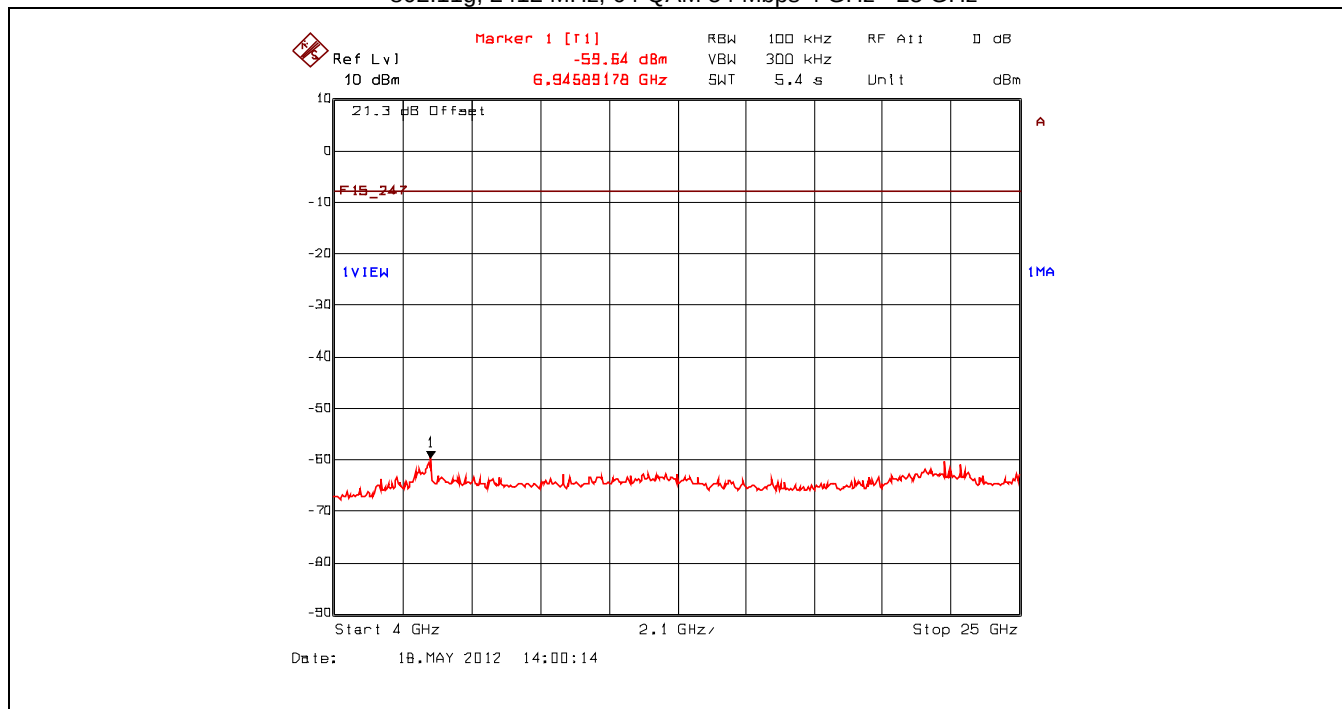
Plot 5.4.4.2.6. Conducted Spurious Emissions – Non Restricted Frequency Bands
802.11b, 2462 MHz, CCK 11 Mbps, 4 GHz - 25 GHz



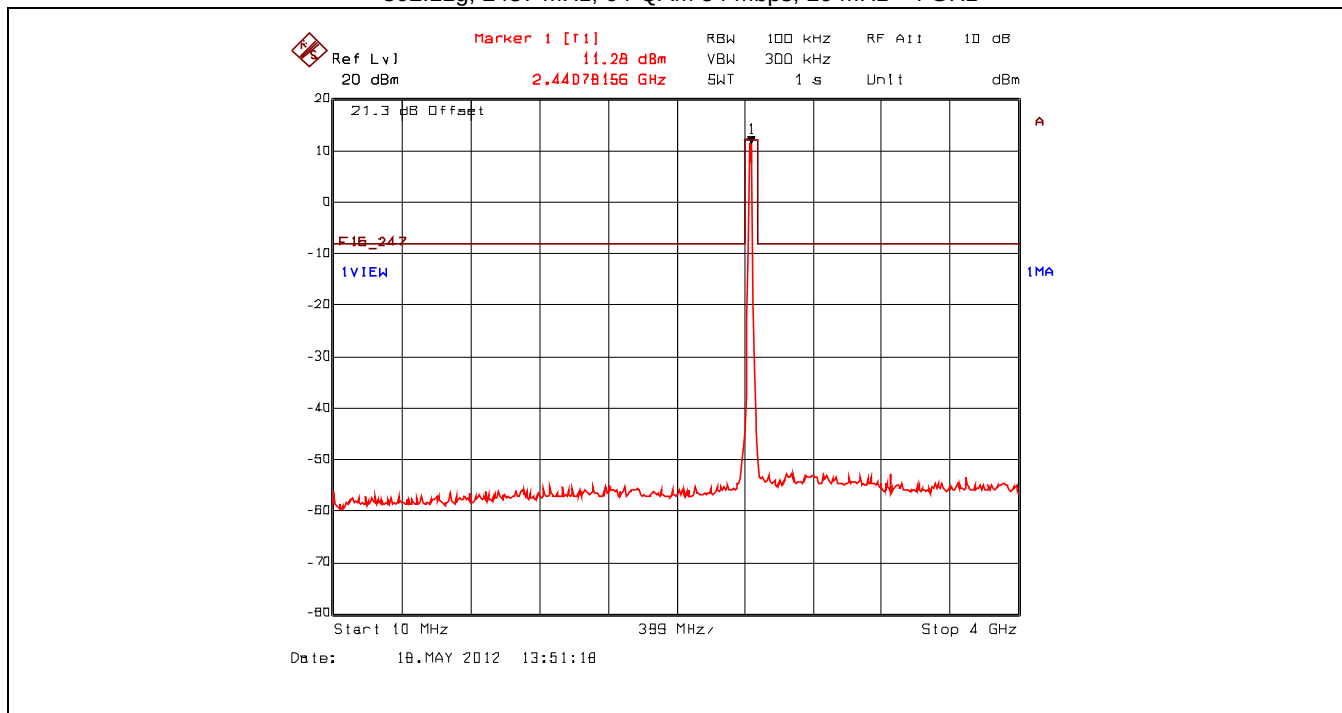
Plot 5.4.4.2.7. Conducted Spurious Emissions - Non Restricted Frequency Bands
802.11g, 2412 MHz, 64-QAM 54 Mbps 10 MHz - 4 GHz



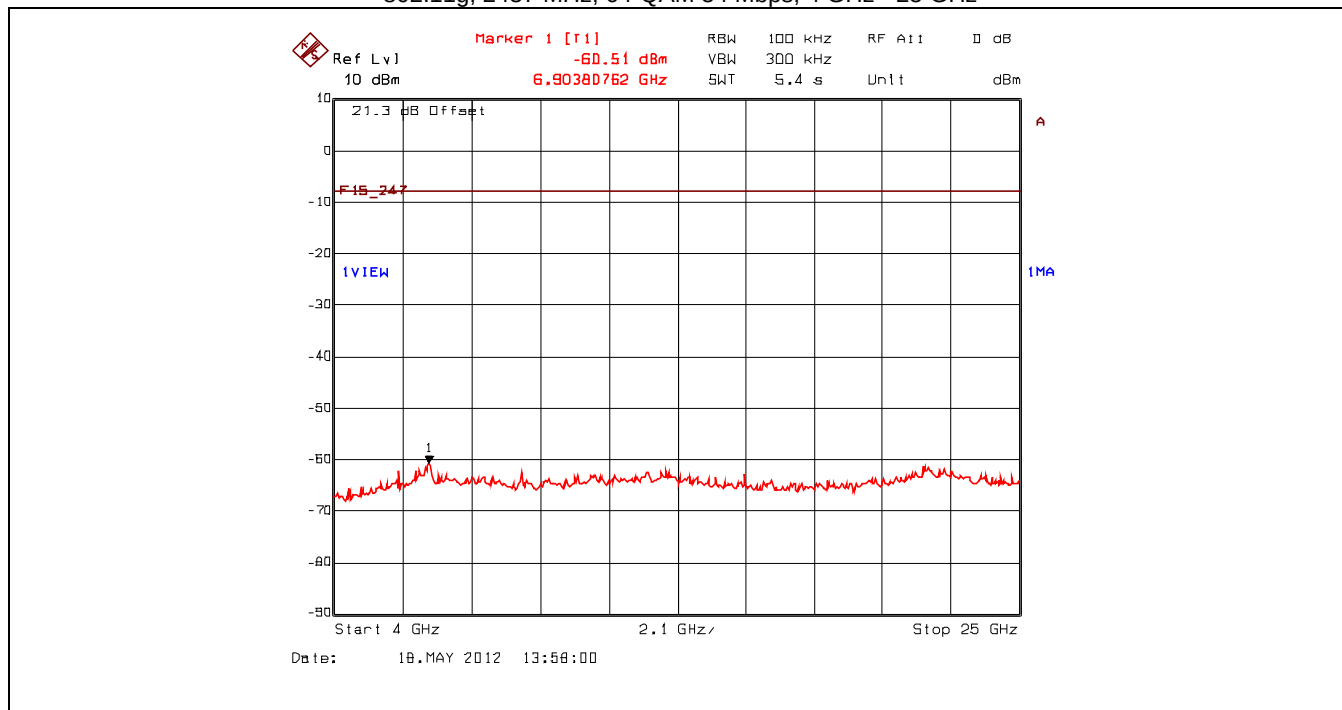
Plot 5.4.4.2.8. Conducted Spurious Emissions - Non Restricted Frequency Bands
802.11g, 2412 MHz, 64-QAM 54 Mbps 4 GHz - 25 GHz



Plot 5.4.4.2.9. Conducted Spurious Emissions – Non Restricted Frequency Bands
802.11g, 2437 MHz, 64-QAM 54 Mbps, 10 MHz - 4 GHz



Plot 5.4.4.2.10. Conducted Spurious Emissions – Non Restricted Frequency Bands,
802.11g, 2437 MHz, 64-QAM 54 Mbps, 4 GHz - 25 GHz



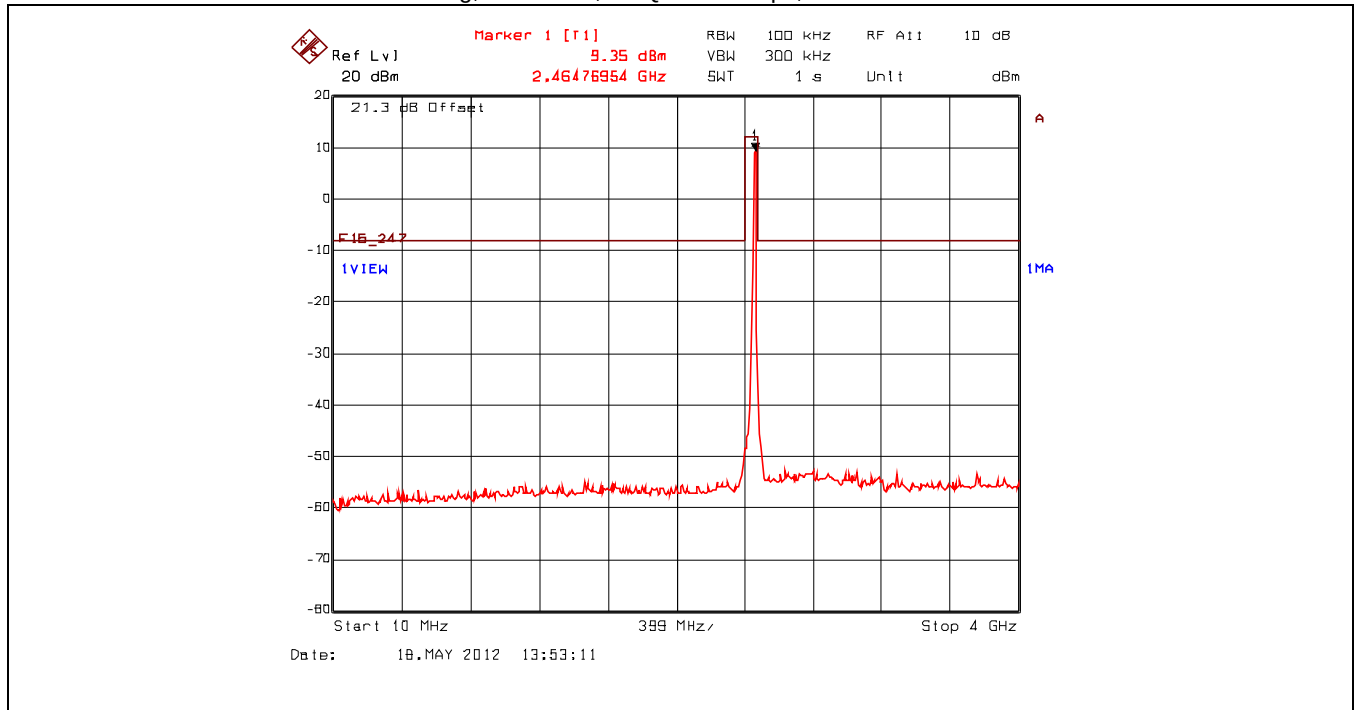
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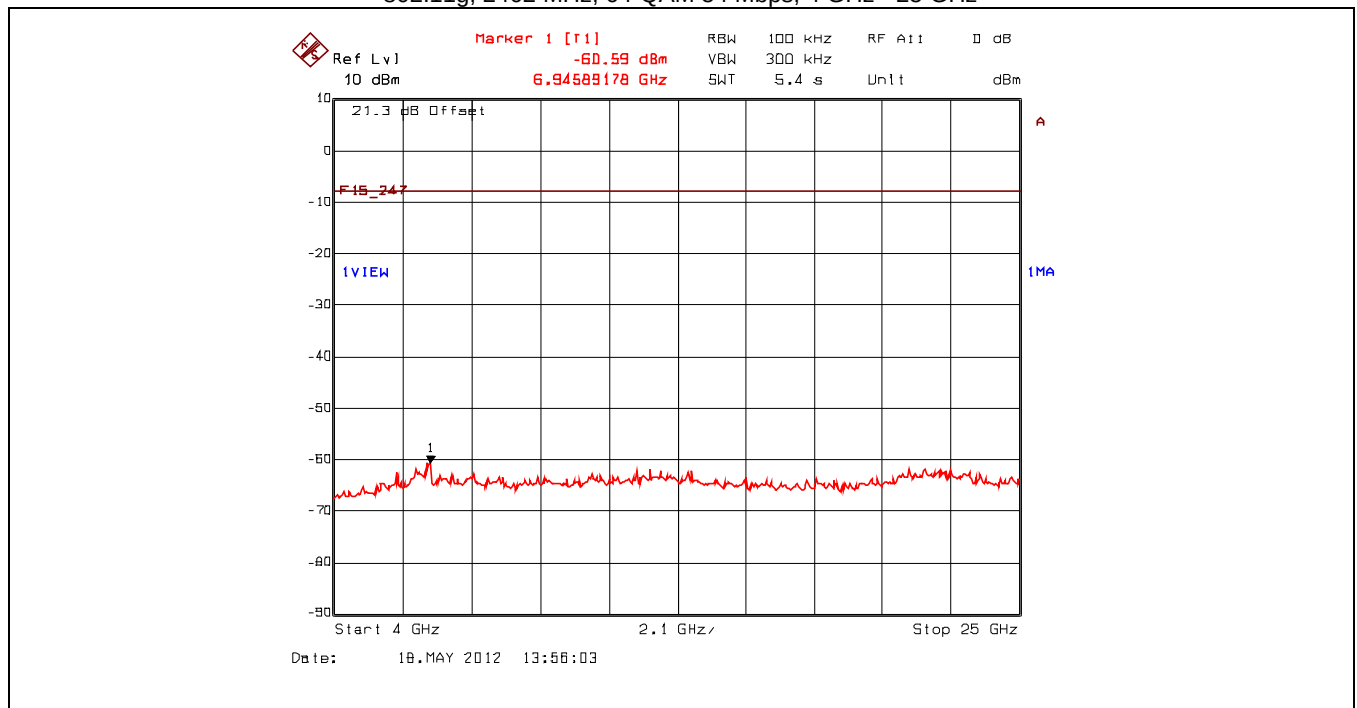
File #: MCRS-046F15C247
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Plot 5.4.4.2.11. Conducted Spurious Emissions – Non Restricted Frequency Bands
802.11g, 2462 MHz, 64-QAM 54 Mbps, 10 MHz - 4 GHz



Plot 5.4.4.2.12. Conducted Spurious Emissions – Non Restricted Frequency Bands
802.11g, 2462 MHz, 64-QAM 54 Mbps, 4 GHz - 25 GHz



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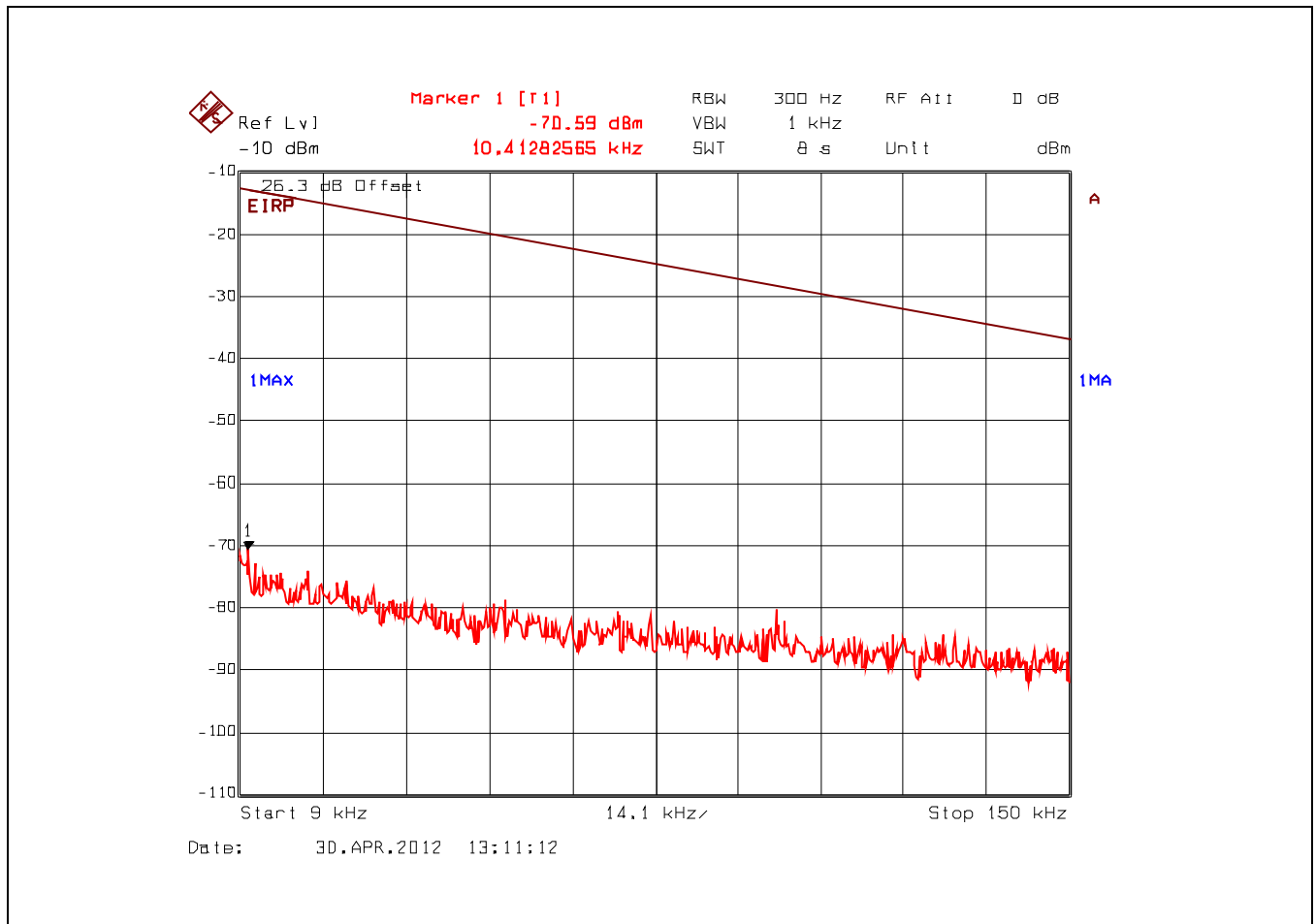
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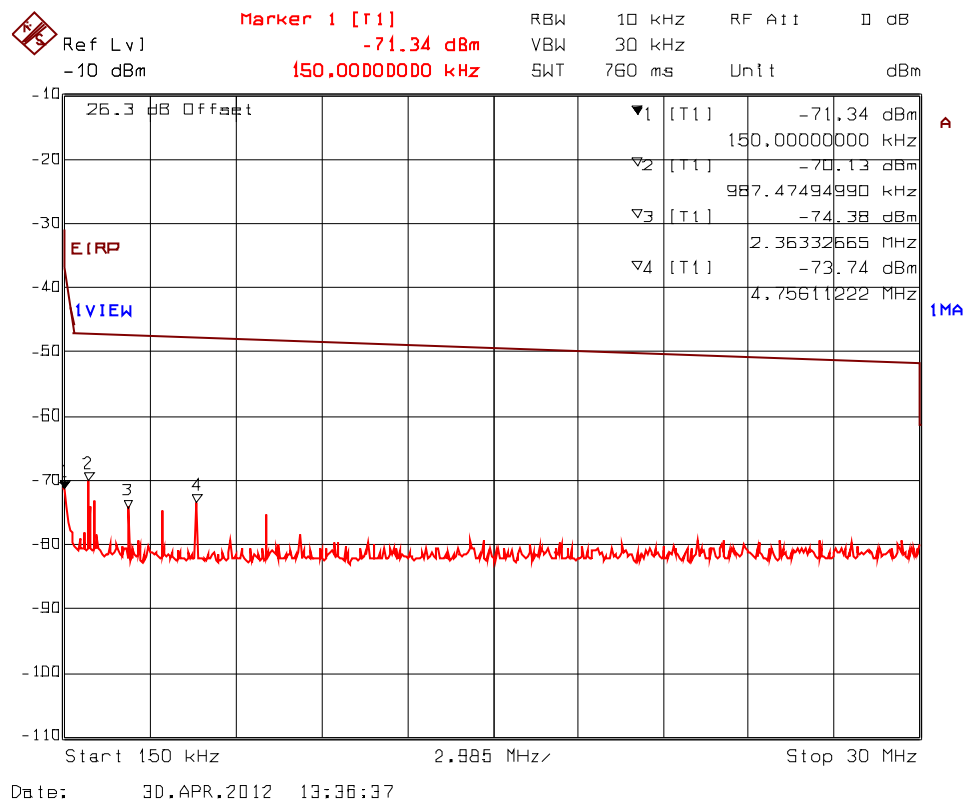
5.4.4.3. Conducted Spurious Emissions – Restricted Bands, Lowest Power Setting (22 dBm) for Highest Gain Antenna (15 dBi)

Remark: Offset = Insertion Loss (11.33 dB) + Highest Antenna Gain (15dBi) = 26.3 dB

Plot 5.4.4.3.1. Conducted Spurious Emissions – Restricted Bands
802.11b, 2412 MHz, CCK 11 Mbps, 9 kHz - 150 kHz, Peak Detector



Plot 5.4.4.3.2. Conducted Spurious Emissions – Restricted Bands
 802.11b, 2412 MHz, CCK 11 Mbps, 150 kHz - 30 MHz, Peak Detector



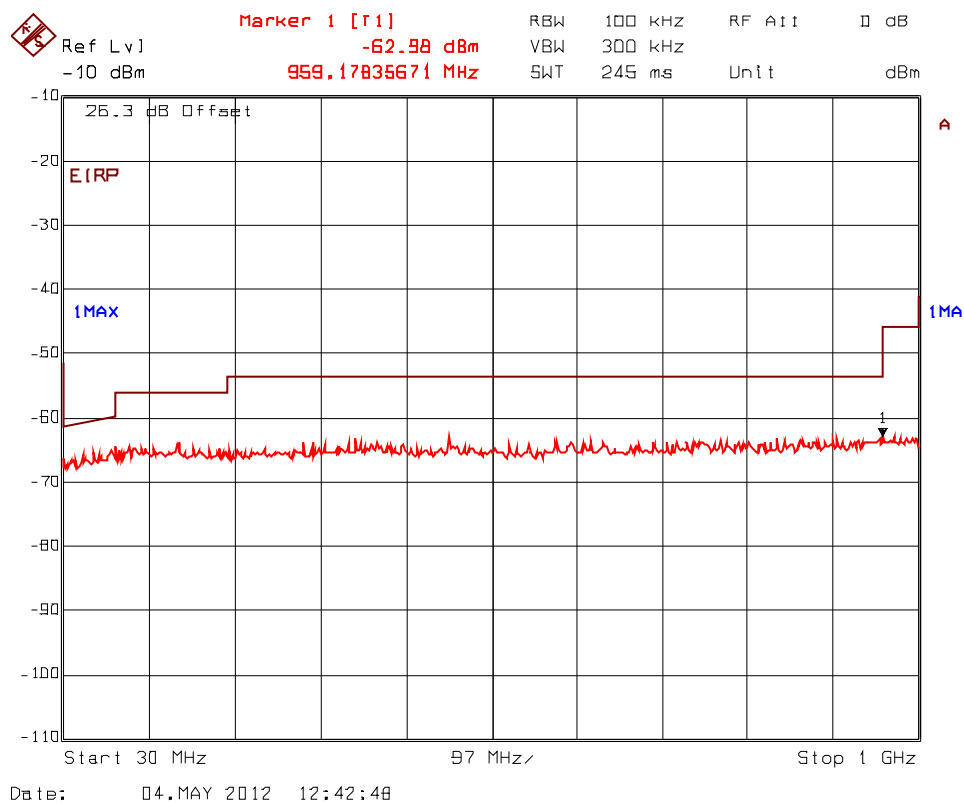
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Plot 5.4.4.3.3. Conducted Spurious Emissions – Restricted Bands
802.11b, 2412 MHz, CCK 11 Mbps, 30 MHz - 1 GHz, Peak Detector



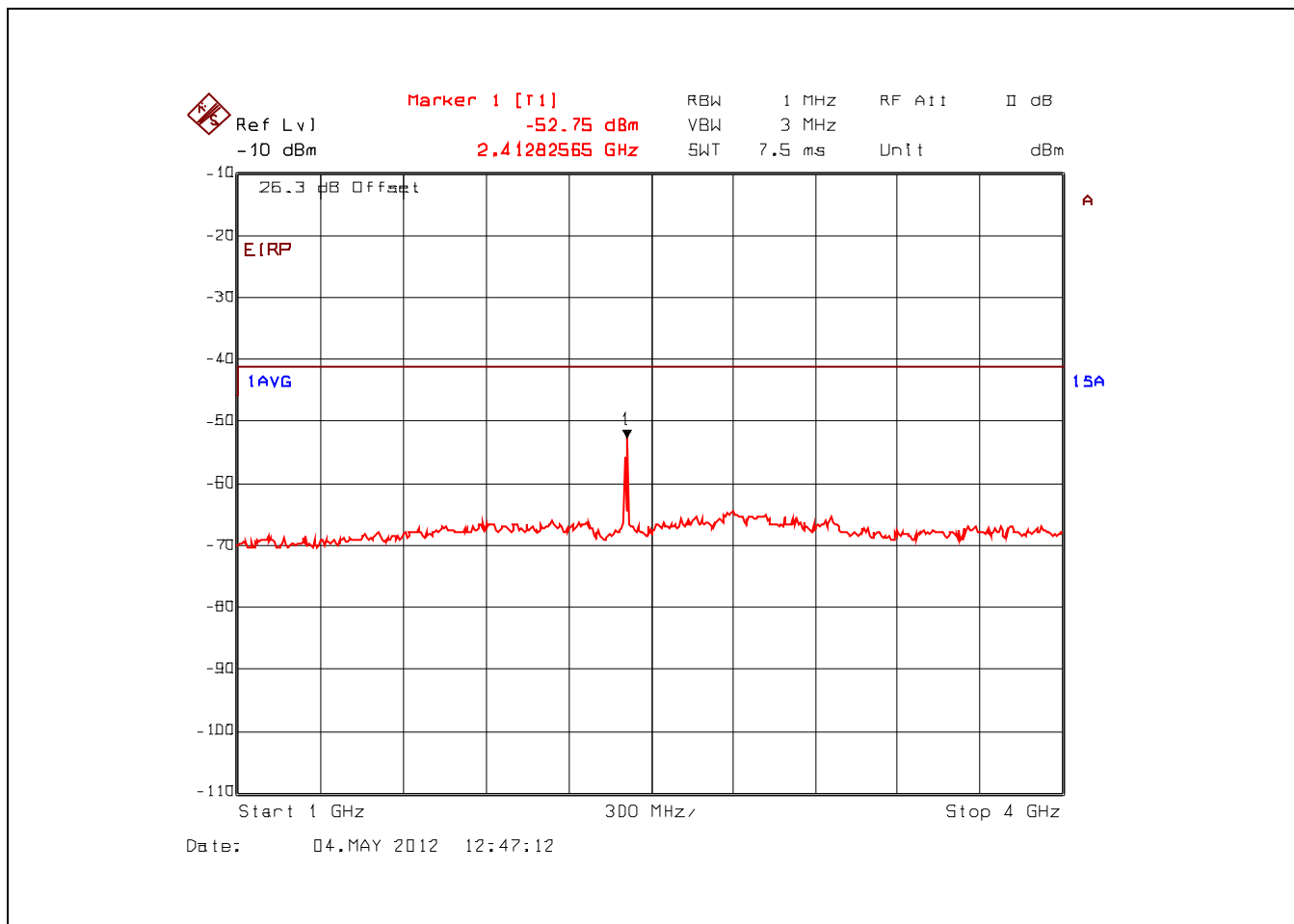
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Plot 5.4.4.3.4. Conducted Spurious Emissions – Restricted Bands
 802.11b, 2412 MHz, CCK 11 Mbps, 1 GHz - 4 GHz, Trace Average with Band (Notch) Reject Filter



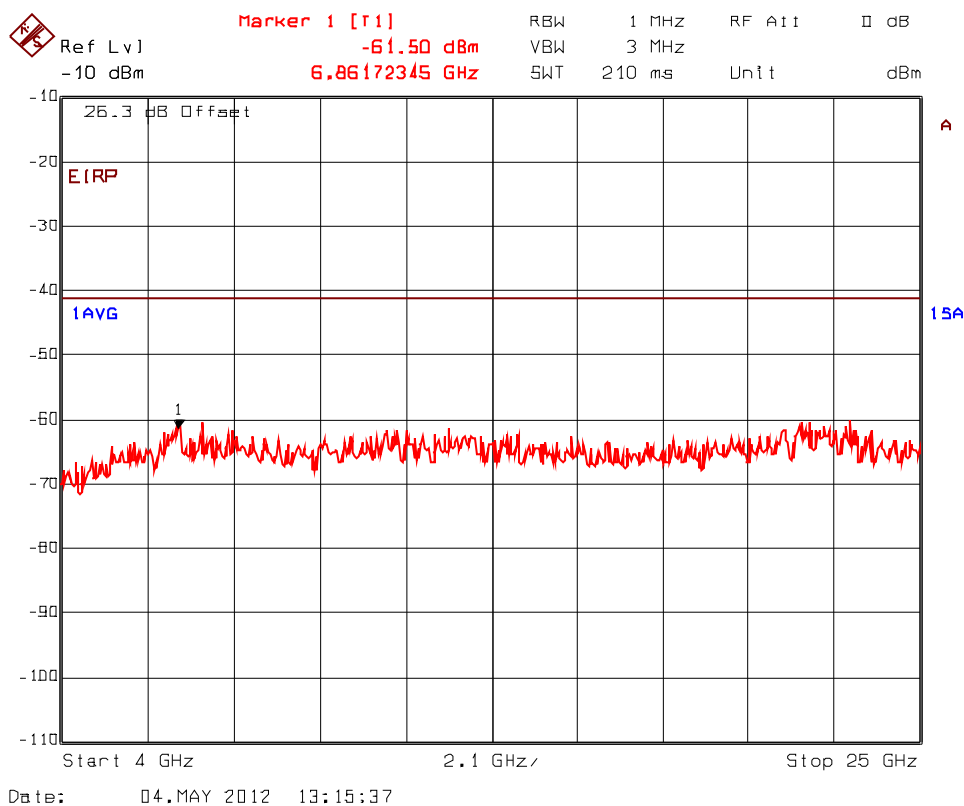
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Plot 5.4.4.3.5. Conducted Spurious Emissions – Restricted Bands
802.11b, 2412 MHz, CCK 11 Mbps, 4 GHz - 25 GHz, Trace Average with High Pass Filter



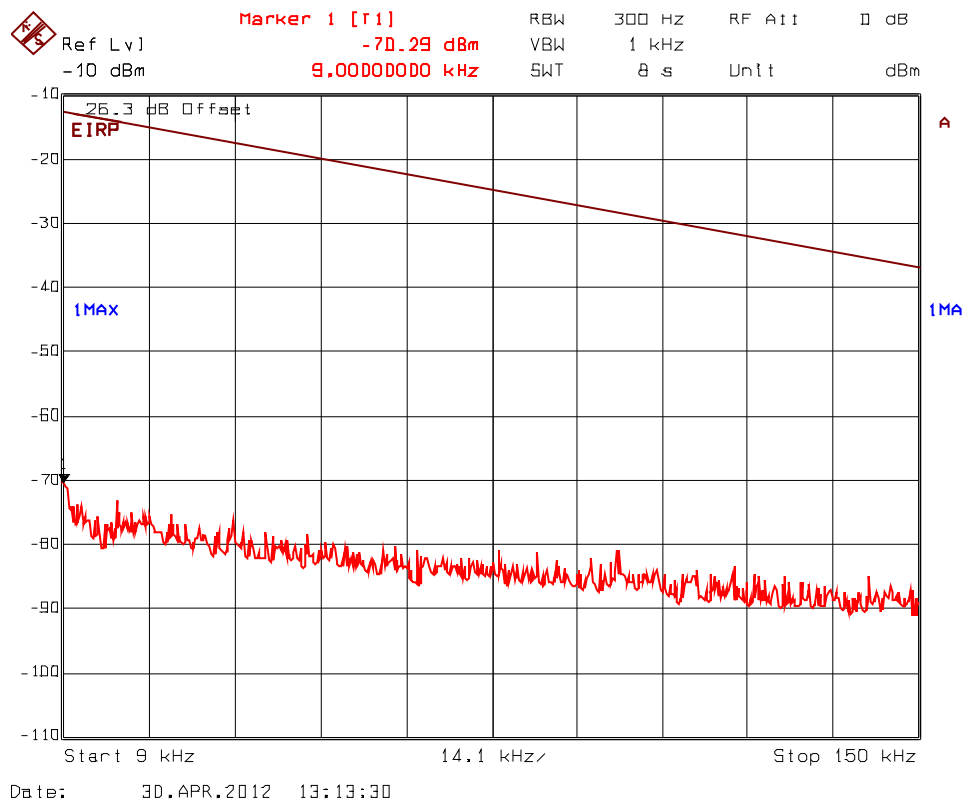
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Plot 5.4.4.3.6. Conducted Spurious Emissions – Restricted Bands
802.11b, 2437 MHz, CCK 11 Mbps, 9 kHz - 150 kHz, Peak Detector



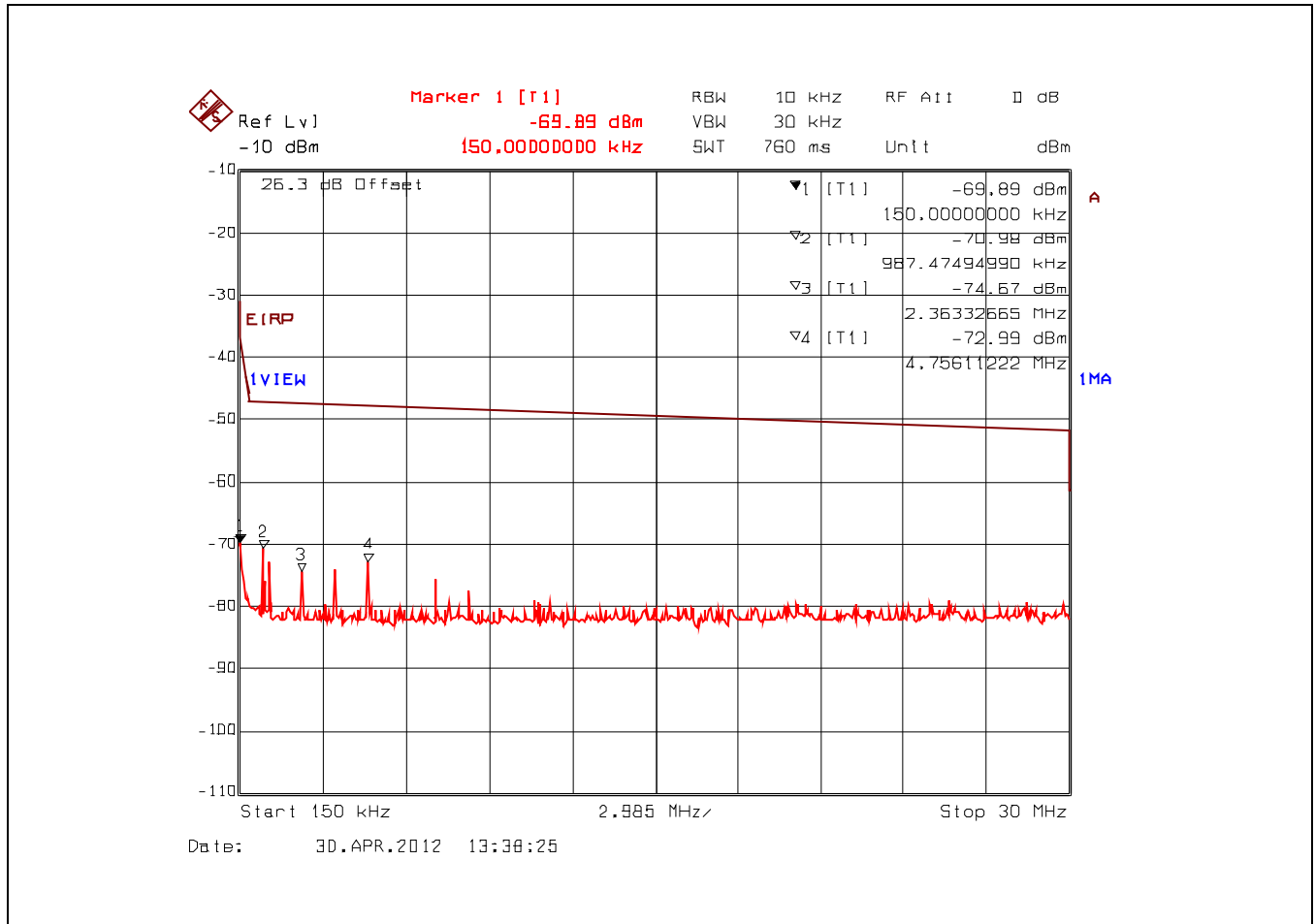
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Plot 5.4.4.3.7. Conducted Spurious Emissions – Restricted Bands
 802.11b, 2437 MHz, CCK 11 Mbps, 150 kHz - 30 MHz, Peak Detector



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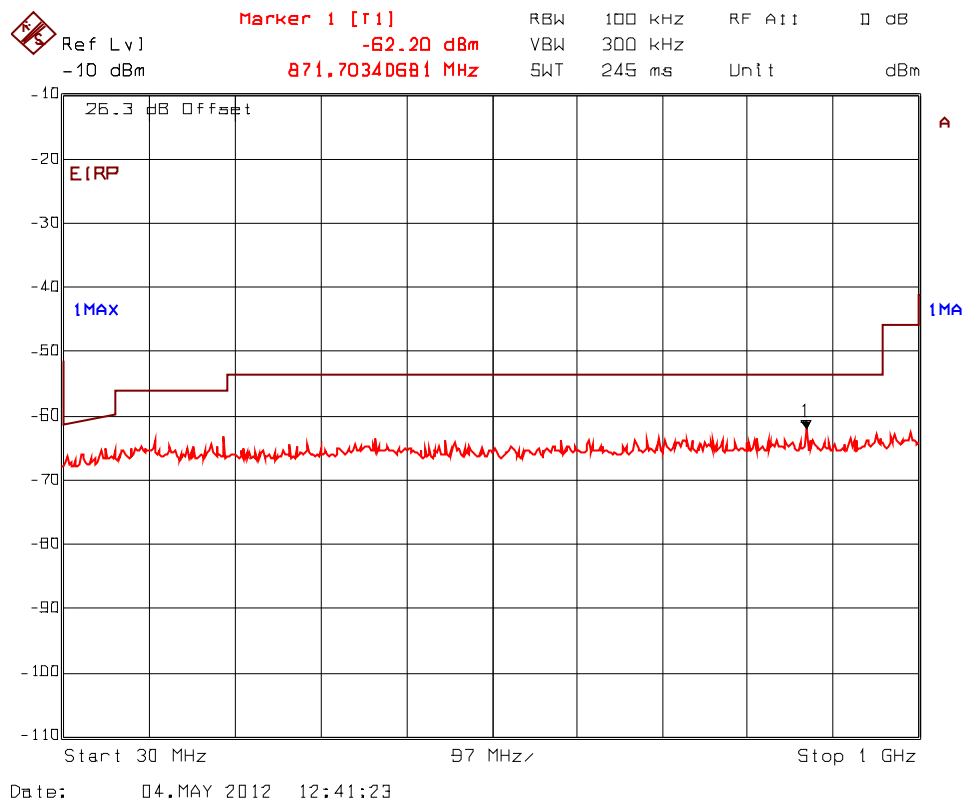
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
 Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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Plot 5.4.4.3.8. Conducted Spurious Emissions – Restricted Bands
 802.11b, 2437 MHz, CCK 11 Mbps, 30 MHz - 1 GHz, Peak Detector



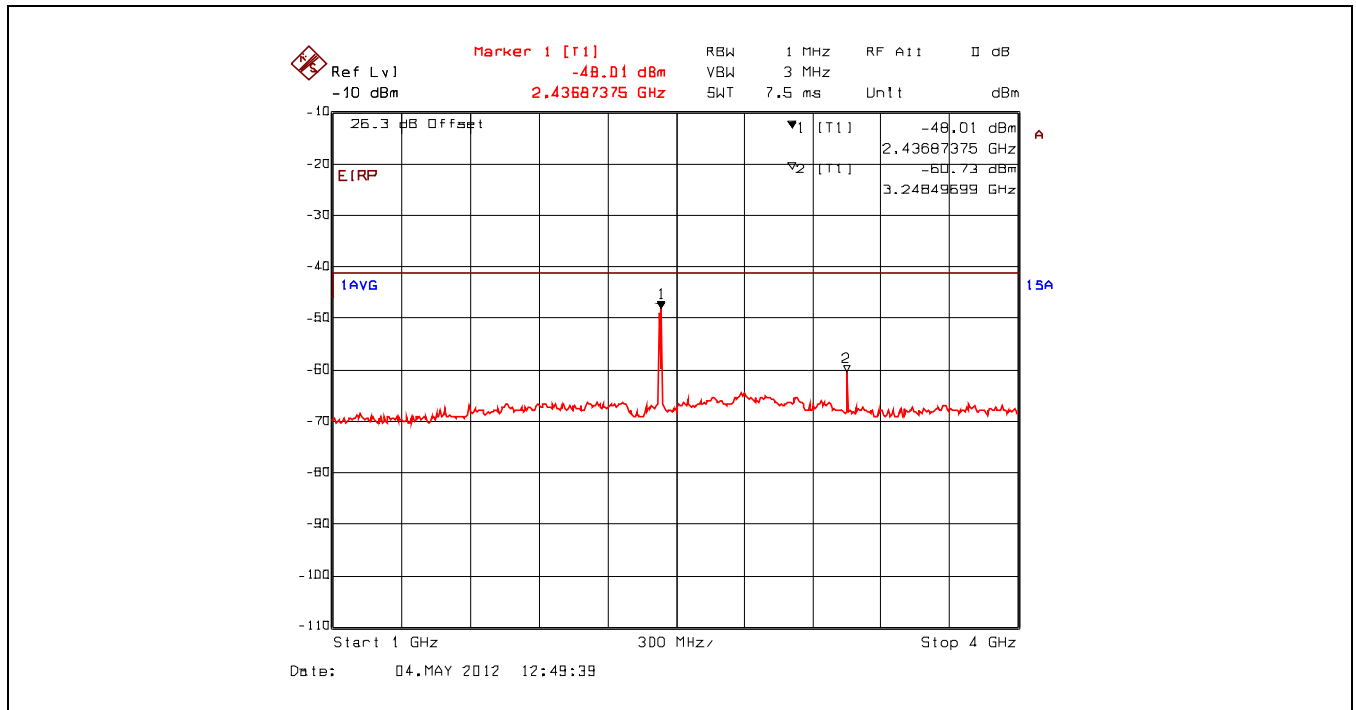
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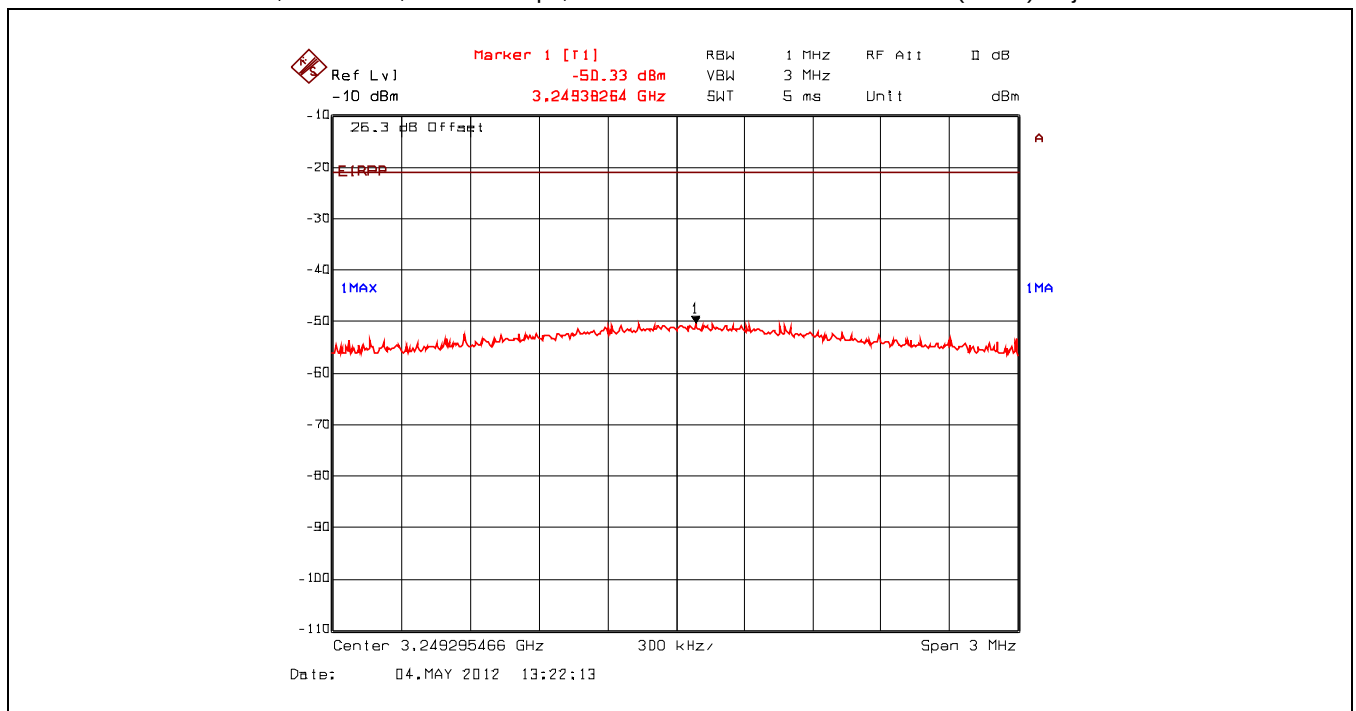
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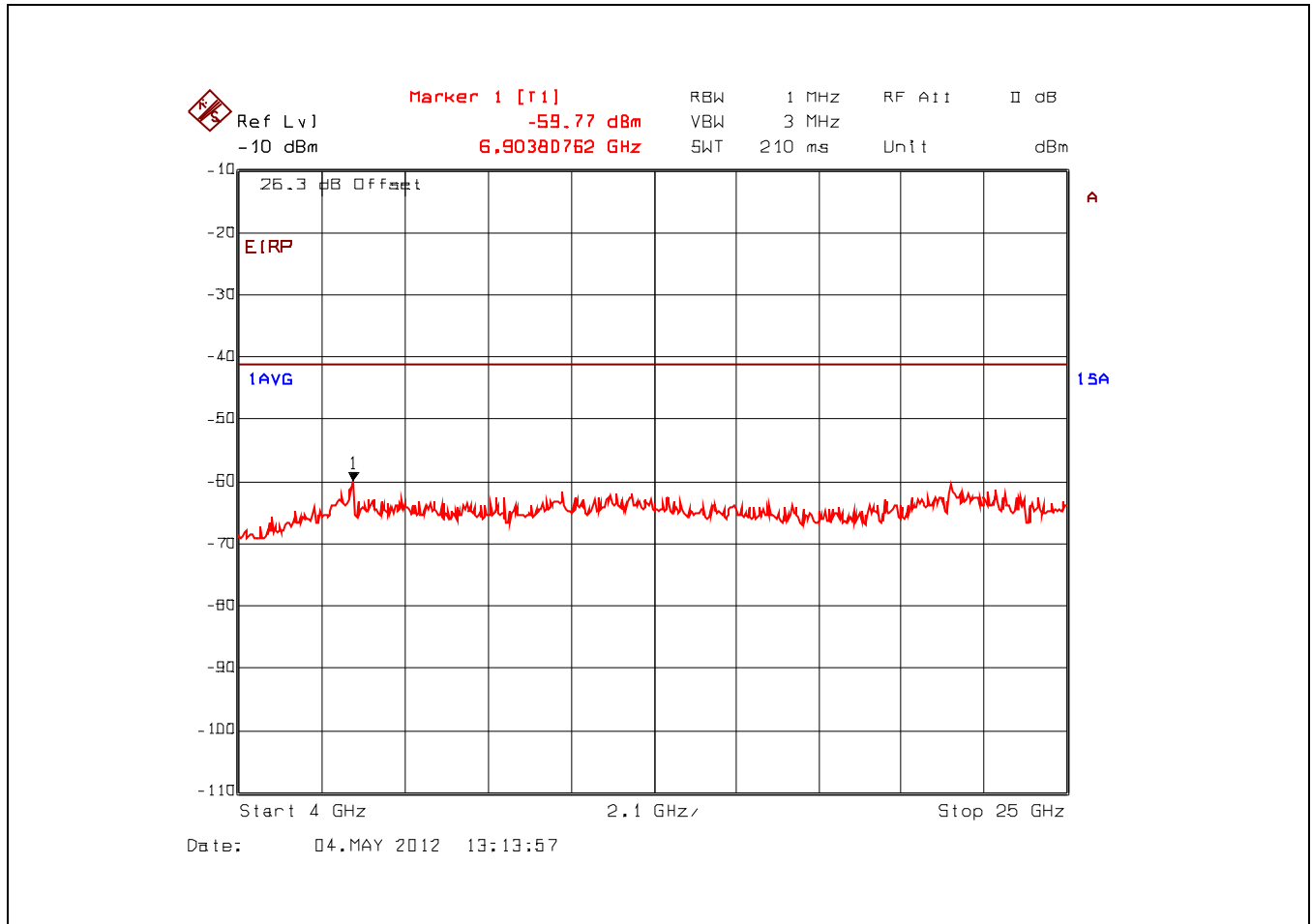
Plot 5.4.4.3.9. Conducted Spurious Emissions – Restricted Bands
 802.11b, 2437 MHz, CCK 11 Mbps, 1 GHz - 4 GHz, Trace Averaging with Band (Notch) Reject Filter



Plot 5.4.4.3.10. Conducted Spurious Emissions – Restricted Bands
 802.11b, 2437 MHz, CCK 11 Mbps, Peak Power at 3.25 GHz with Band (Notch) Reject Filter



Plot 5.4.4.3.11. Conducted Spurious Emissions – Restricted Bands
802.11b, 2437 MHz, CCK 11 Mbps, 4 GHz - 25GHz, Trace Averaging with Band Pass Filter



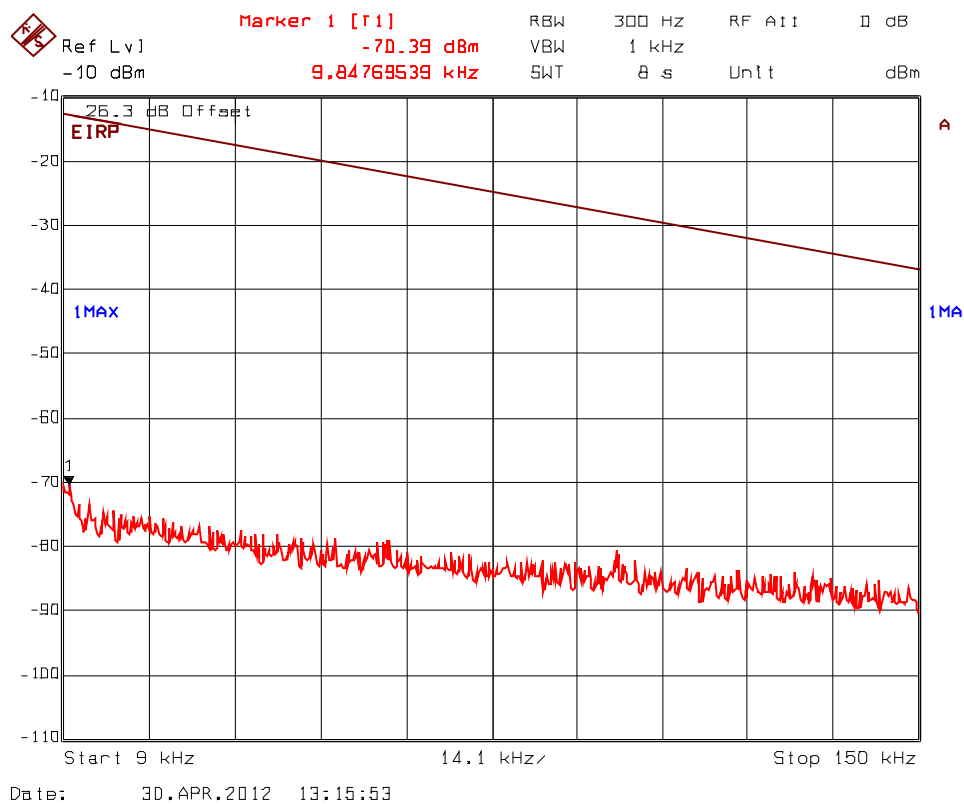
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Plot 5.4.4.3.12. Conducted Spurious Emissions – Restricted Bands
802.11b, 2462 MHz, CCK 11 Mbps, 9 kHz - 150 kHz, Peak Detector



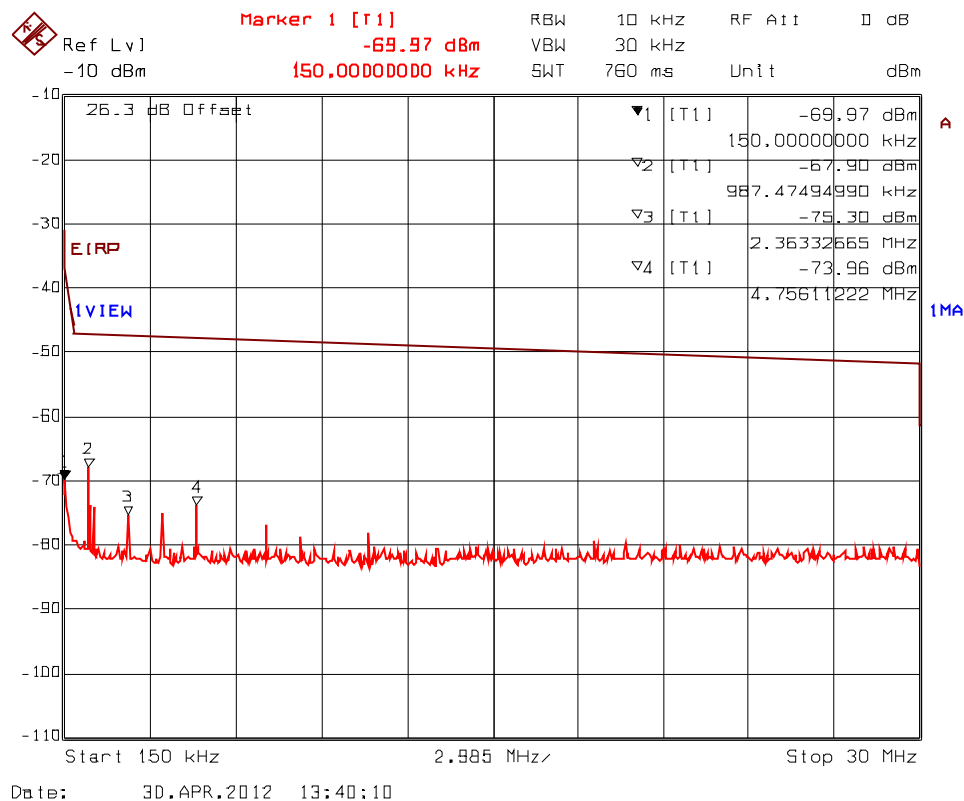
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Plot 5.4.4.3.13. Conducted Spurious Emissions – Restricted Bands
802.11b, 2462 MHz, CCK 11 Mbps, 150 kHz - 30 MHz, Peak Detector



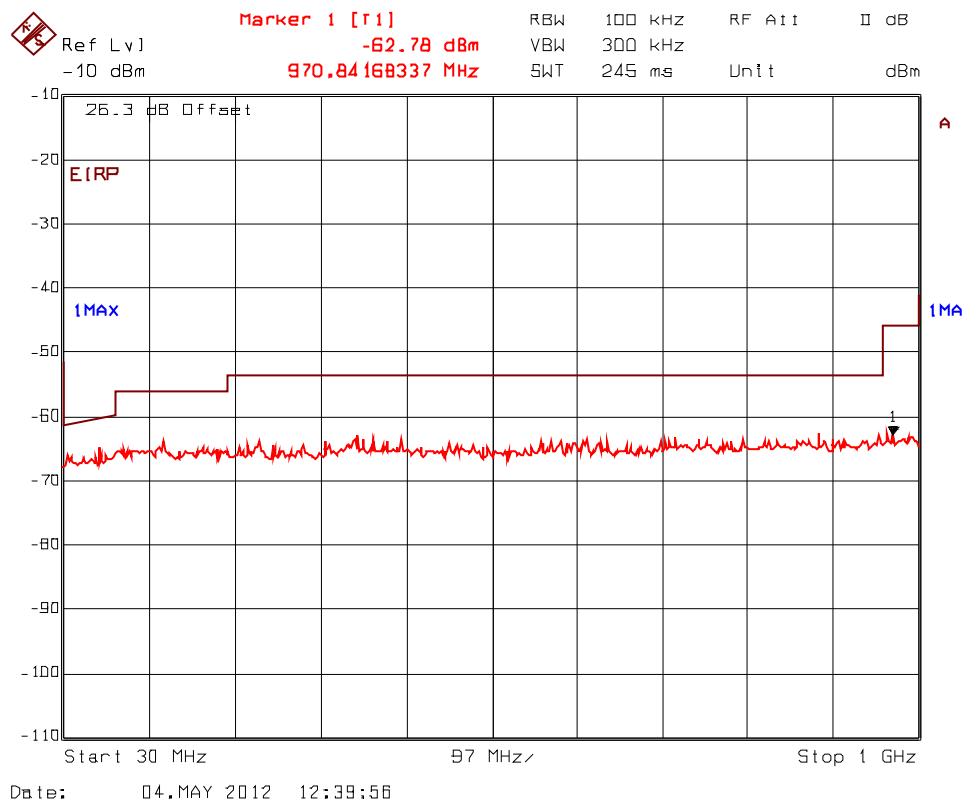
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Plot 5.4.4.3.14. Conducted Spurious Emissions – Restricted Bands
802.11b, 2462 MHz, CCK 11 Mbps, 30 MHz - 1 GHz, Peak Detector



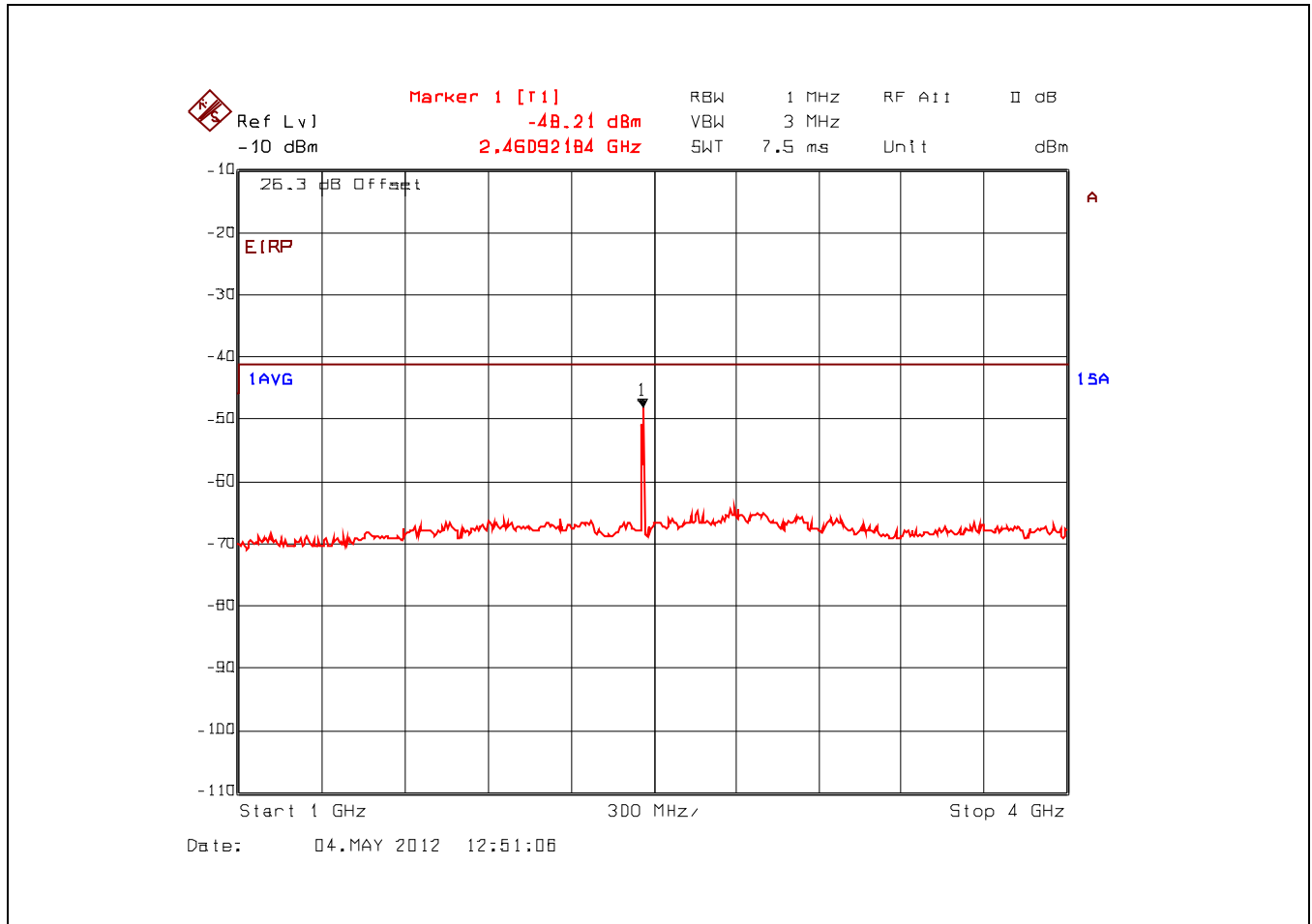
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Plot 5.4.4.3.15. Conducted Spurious Emissions – Restricted Bands
802.11b, 2462 MHz, CCK 11 Mbps, 1 GHz - 4 GHz, Trace Averaging with Band (Notch) Reject Filter



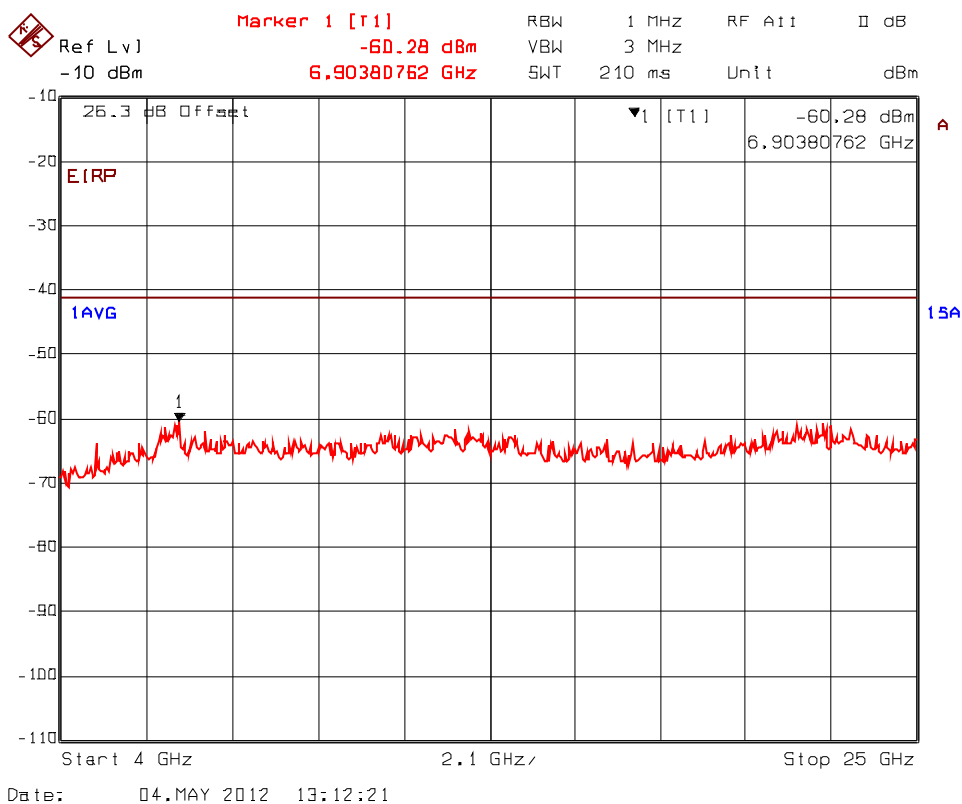
ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

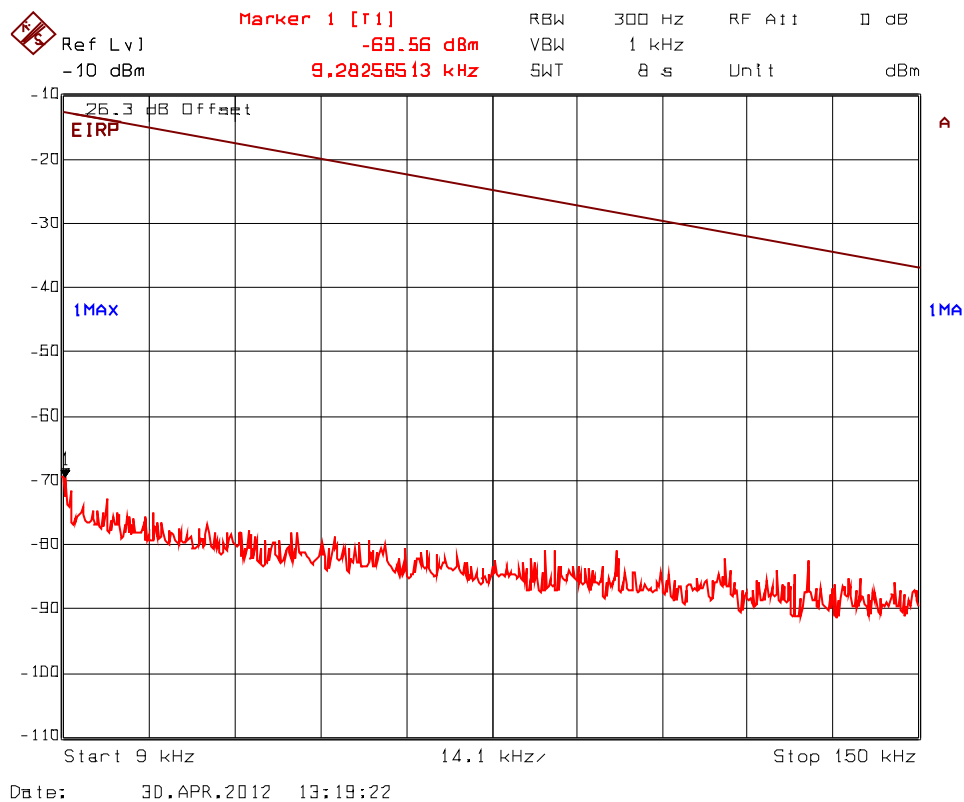
File #: MCRS-046F15C247
June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.4.4.3.16. Conducted Spurious Emissions – Restricted Bands
802.11b, 2462 MHz, CCK 11 Mbps, 4 GHz - 25 GHz, Trace Averaging with High Pass Filter



Plot 5.4.4.3.17. Conducted Spurious Emissions – Restricted Bands
802.11g, 2412 MHz, 64-QAM 54 Mbps, 9 kHz - 150 kHz, Peak Detector



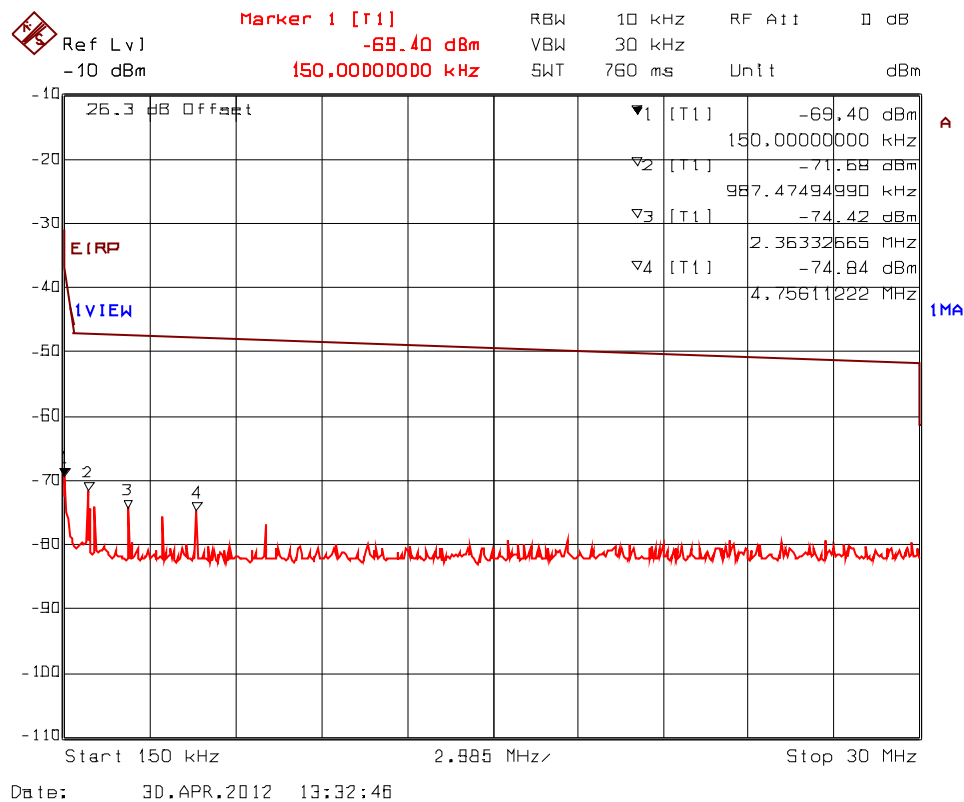
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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Plot 5.4.4.3.18. Conducted Spurious Emissions – Restricted Bands
802.11g, 2412 MHz, 64-QAM 54 Mbps, 150 kHz - 30 MHz, Peak Detector



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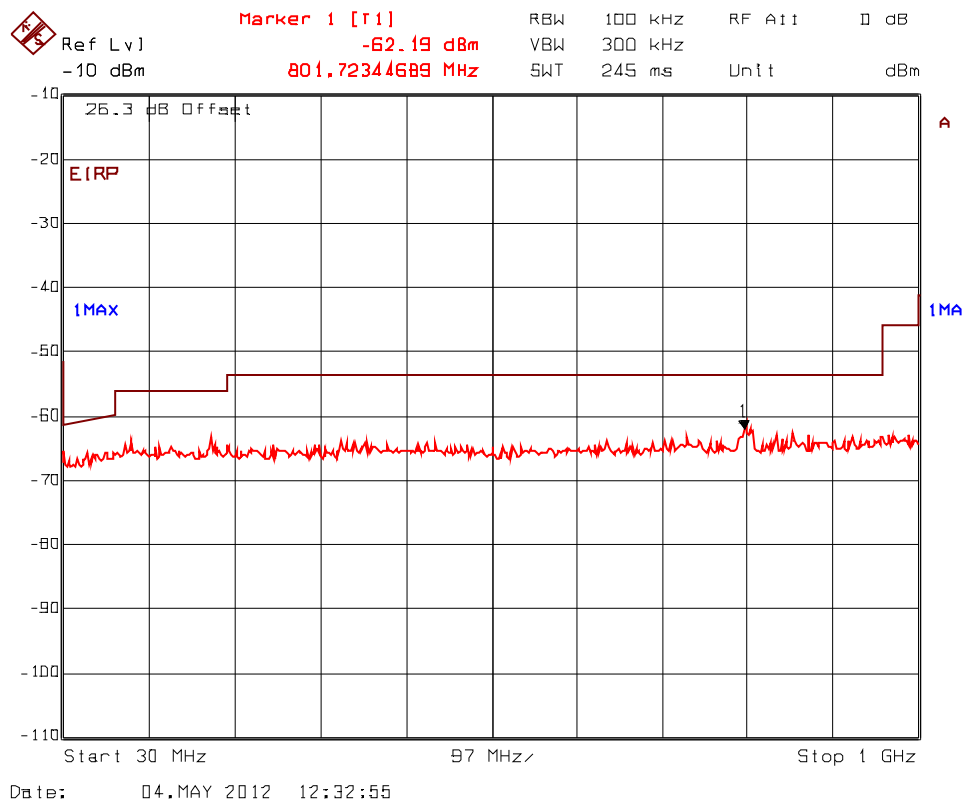
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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Plot 5.4.4.3.19. Conducted Spurious Emissions – Restricted Bands
 802.11g, 2412 MHz, 64-QAM 54 Mbps, 30 MHz - 1 GHz, Peak Detector



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Marker 1 [1]
 -56.19 dBm
 2.41282565 GHz

RBW 1 MHz
 VBW 3 MHz
 5WT 7.5 ms
 RF Att
 Unit dB

Ref Lvl
 -10 dBm

26.3 dB Offset

EIRP

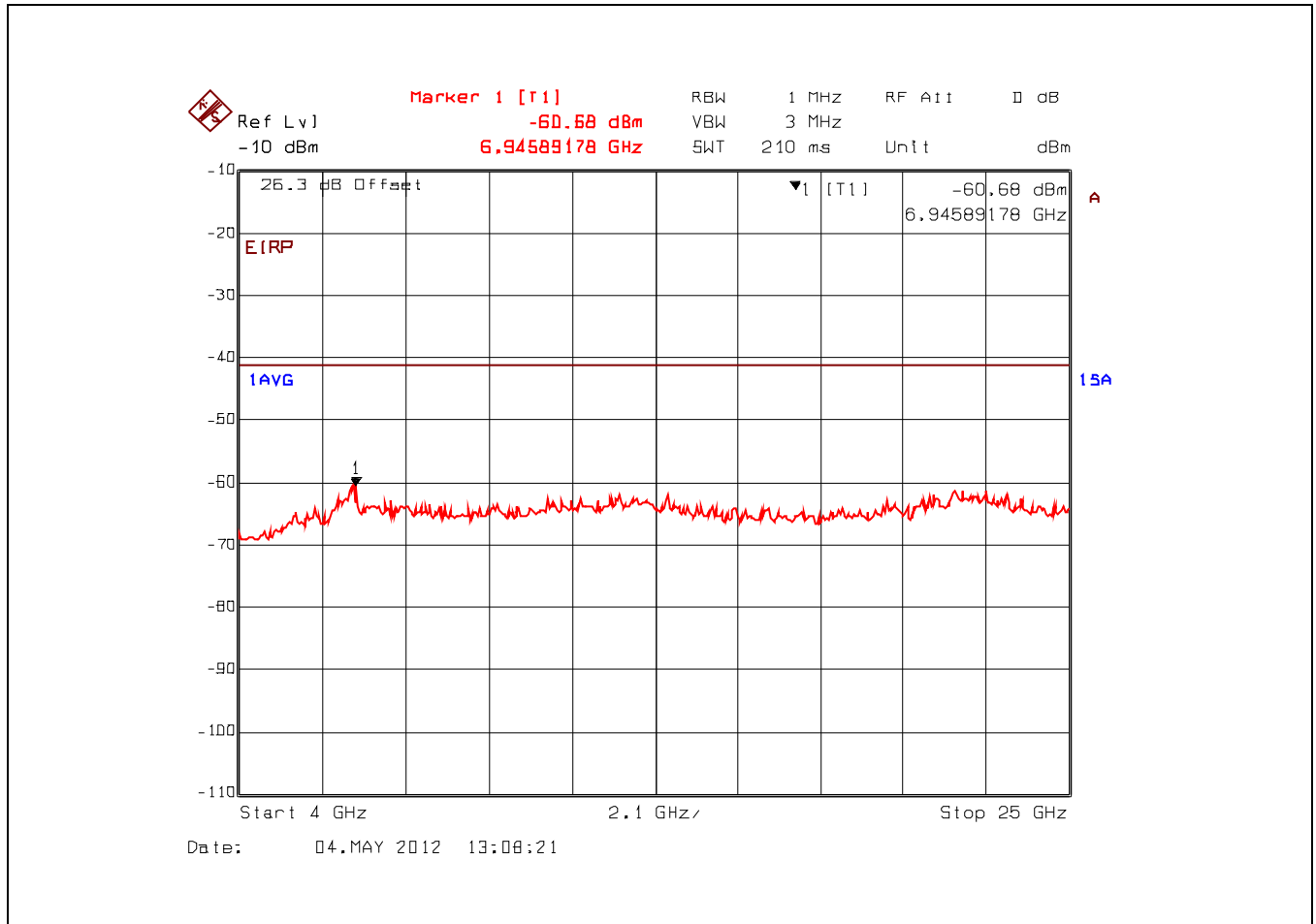
1AVG

1

Start 1 GHz 300 MHz Stop 4 GHz

Date: 04.MAY 2012 13:01:37

Plot 5.4.4.3.21. Conducted Spurious Emissions – Restricted Bands
802.11g, 2412 MHz, 64-QAM 54 Mbps, 4 GHz - 25 GHz, Trace Average with High Pass Filter



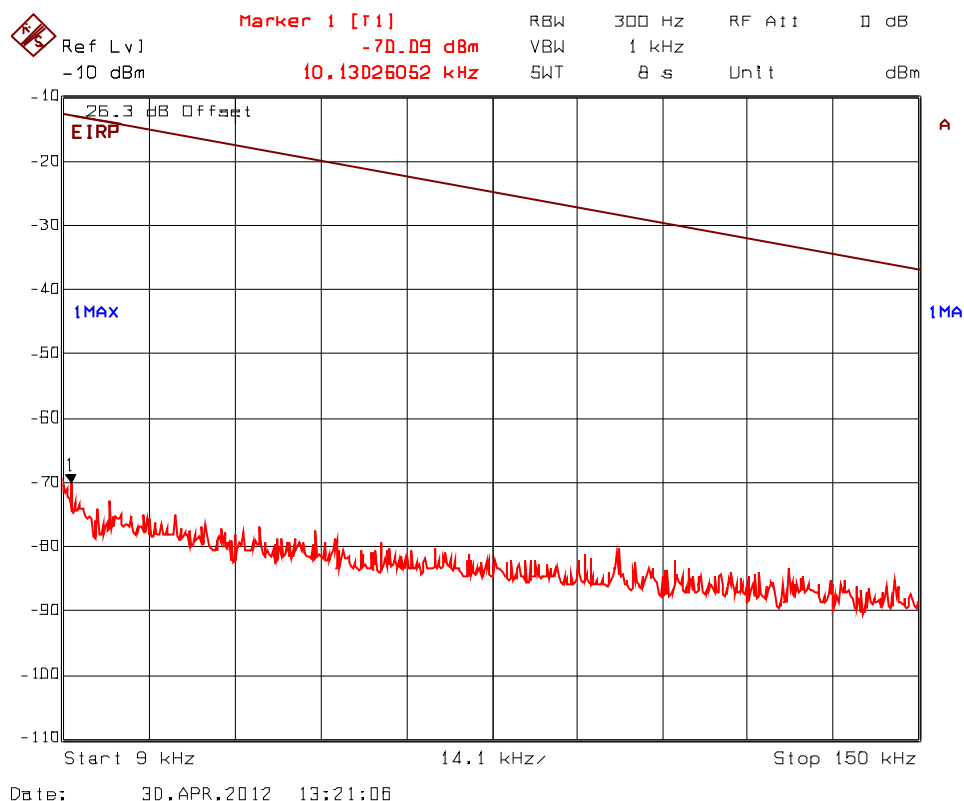
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Plot 5.4.4.3.22. Conducted Spurious Emissions – Restricted Bands
 802.11g, 2437 MHz, 64-QAM 54 Mbps, 9 kHz - 150 kHz, Peak Detector



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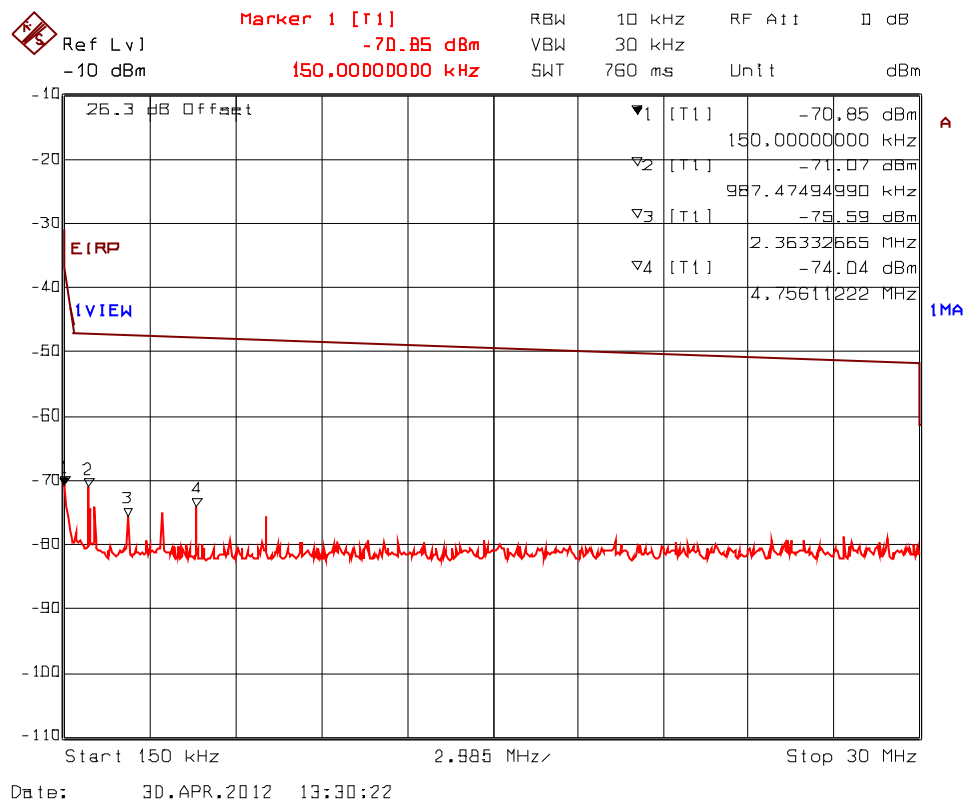
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
 Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-046F15C247

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Plot 5.4.4.3.23. Conducted Spurious Emissions – Restricted Bands
802.11g, 2437 MHz, 64-QAM 54 Mbps, 150 kHz - 30 MHz, Peak Detector



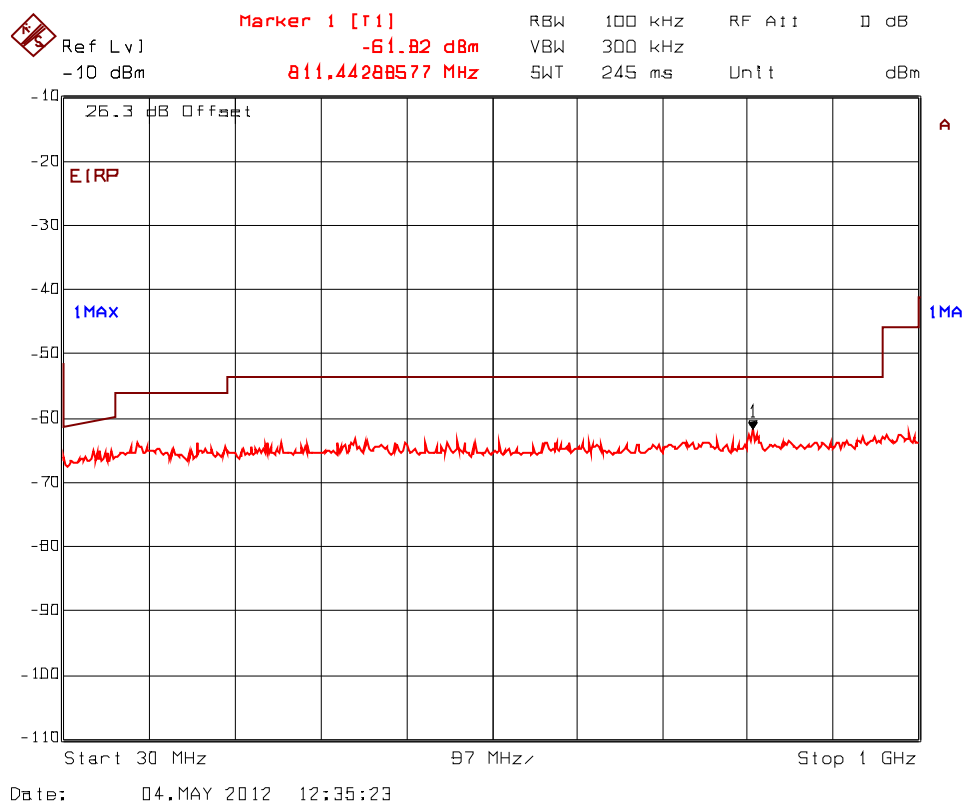
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Plot 5.4.4.3.24. Conducted Spurious Emissions – Restricted Bands
802.11g, 2437 MHz, 64-QAM 54 Mbps, 30 MHz - 1 GHz, Peak Detector



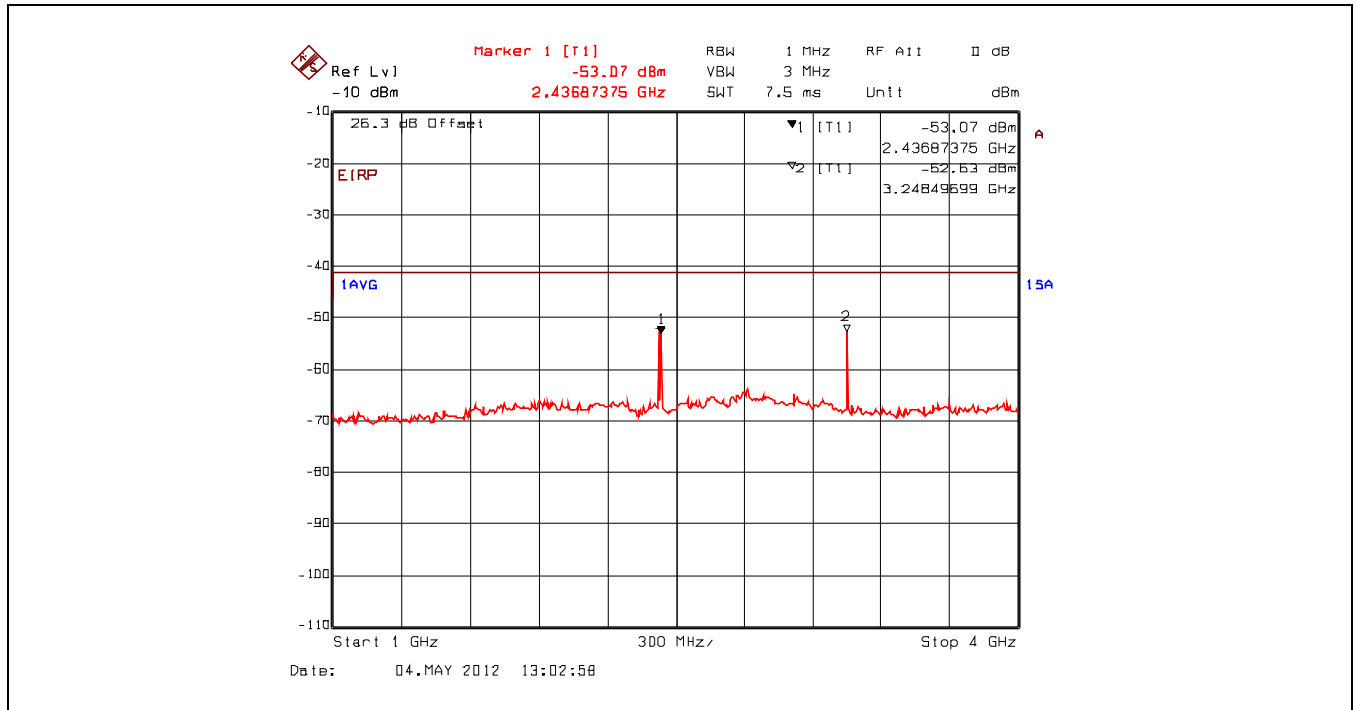
ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

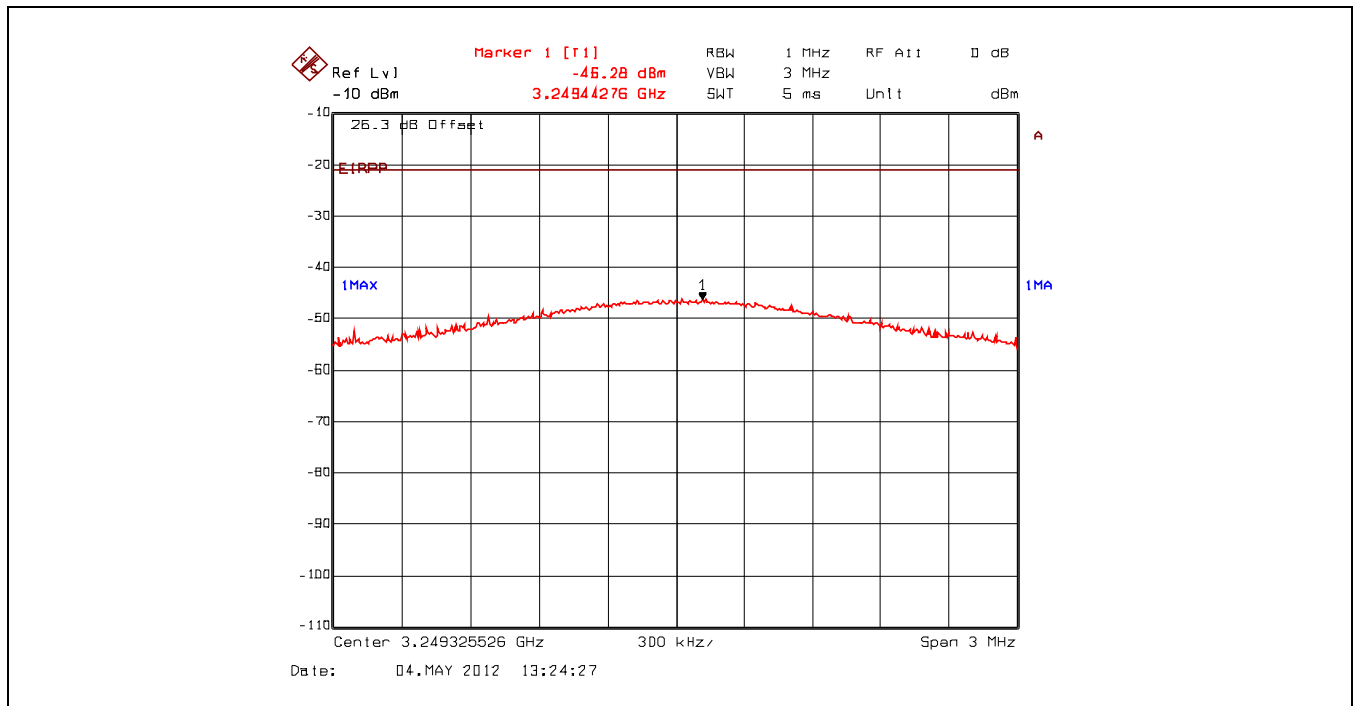
File #: MCRS-046F15C247
June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

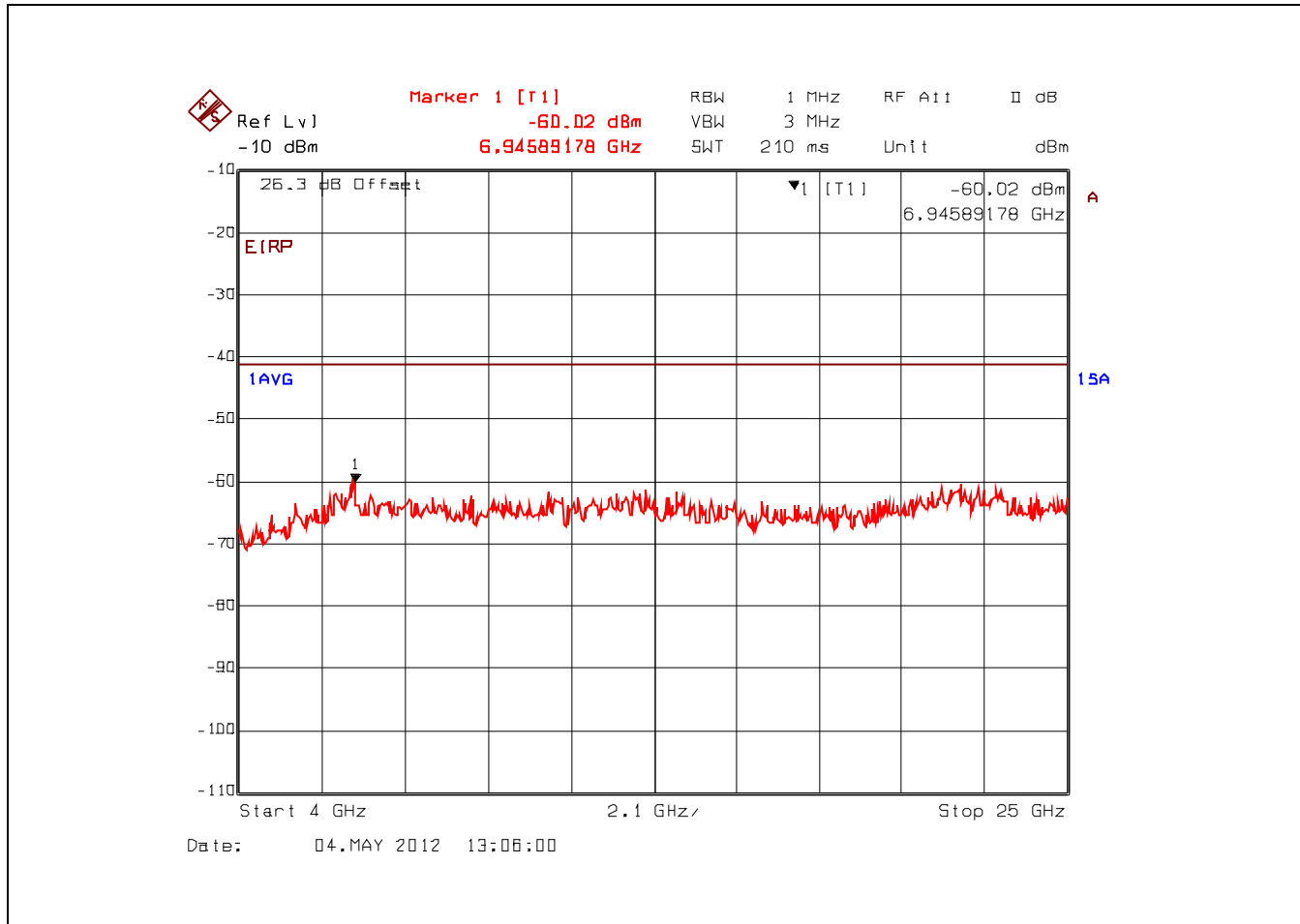
Plot 5.4.4.3.25. Conducted Spurious Emissions – Restricted Bands
802.11g, 2437 MHz, 64-QAM 54 Mbps, 1 GHz - 4 GHz, Trace Averaging with Band (Notch) Reject Filter



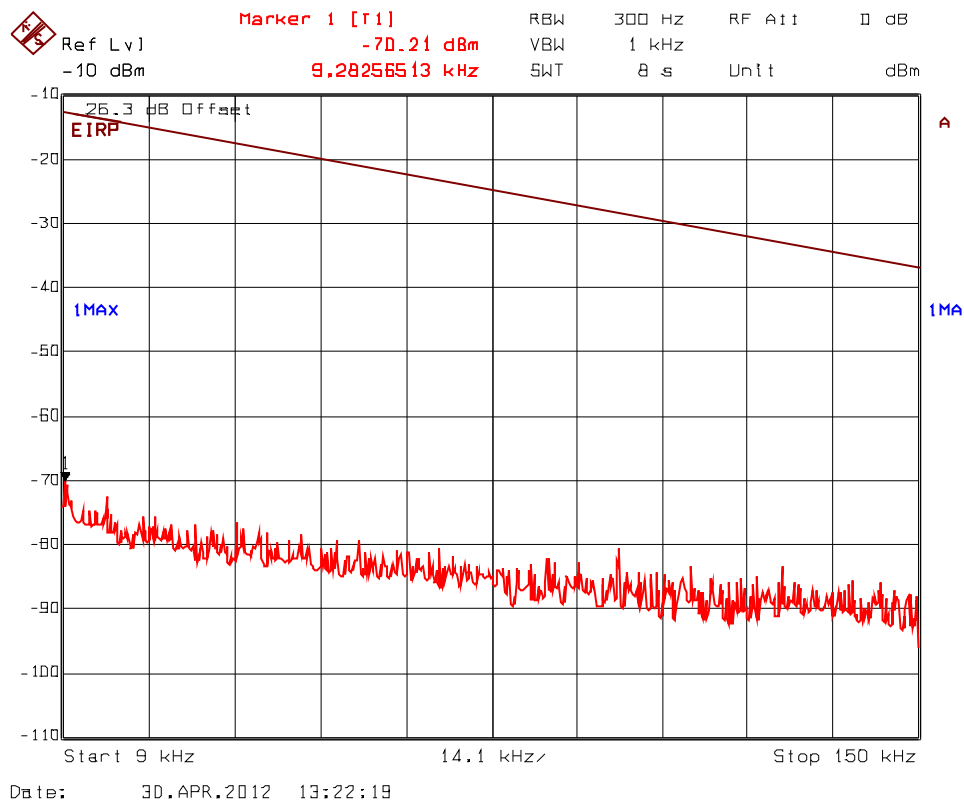
Plot 5.4.4.3.26. Conducted Spurious Emissions – Restricted Bands
802.11g, 2437 MHz, 64-QAM 54 Mbps, Peak Power at 3.25 GHz with Band (Notch) Reject Filter



Plot 5.4.4.3.27. Conducted Spurious Emissions – Restricted Bands
802.11g, 2437 MHz, 64-QAM 54 Mbps, 4 GHz - 25GHz, Trace Averaging with Band Pass Filter



Plot 5.4.4.3.28. Conducted Spurious Emissions – Restricted Bands
802.11g, 2462 MHz, 64-QAM 54 Mbps, 9 kHz - 150 kHz, Peak Detector



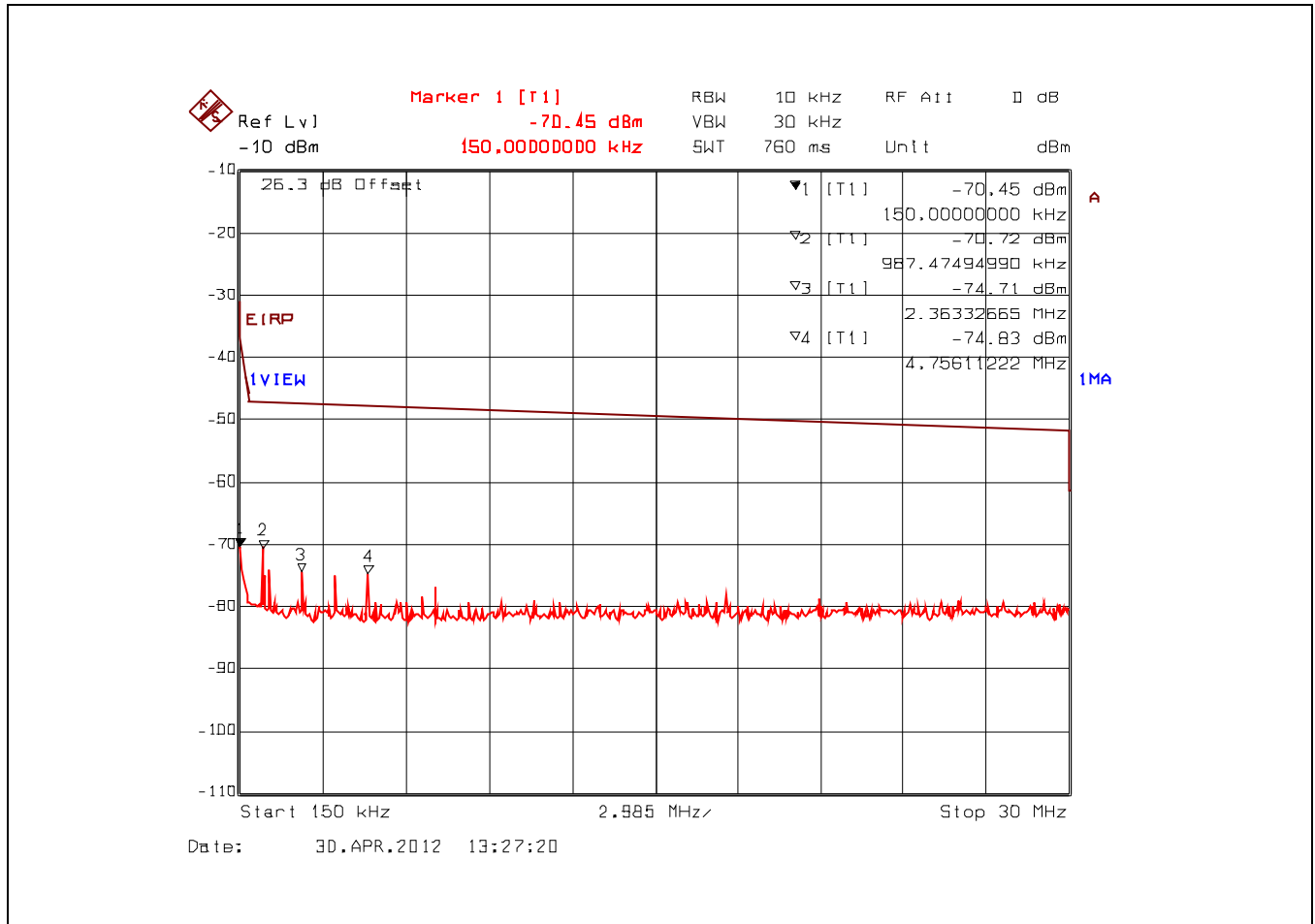
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Plot 5.4.4.3.29. Conducted Spurious Emissions – Restricted Bands
 802.11g, 2462 MHz, 64-QAM 54 Mbps, 150 kHz - 30 MHz, Peak Detector



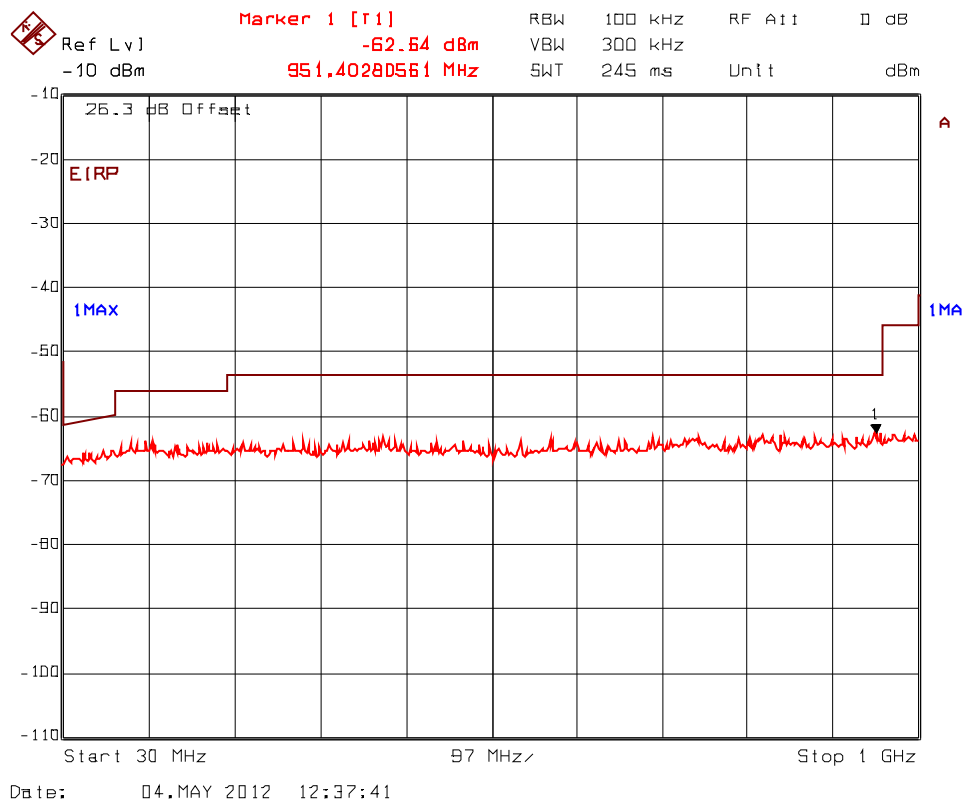
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 Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.4.4.3.30. Conducted Spurious Emissions – Restricted Bands
802.11g, 2462 MHz, 64-QAM 54 Mbps, 30 MHz - 1 GHz, Peak Detector



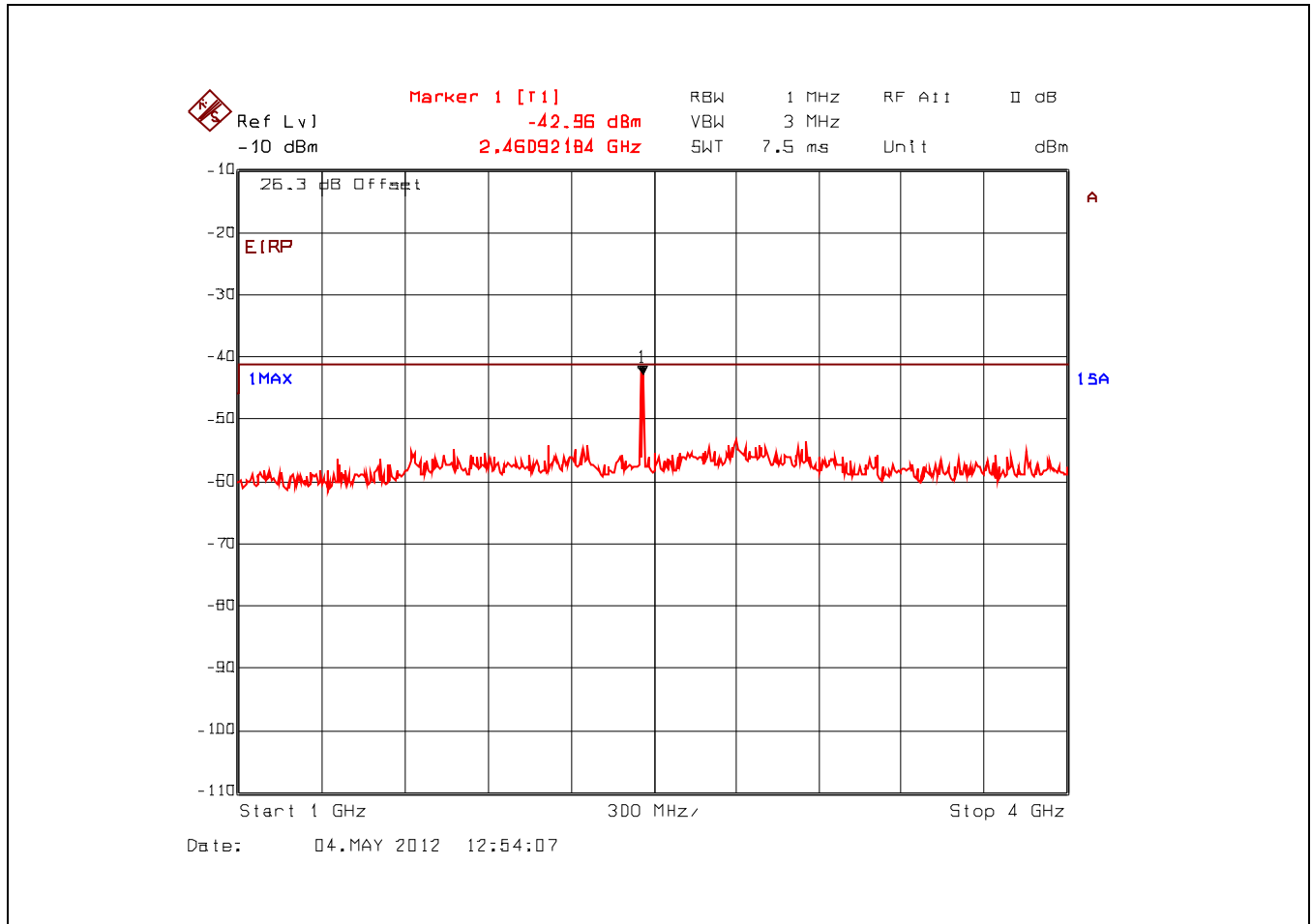
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Plot 5.4.4.3.31. Conducted Spurious Emissions – Restricted Bands
 802.11g, 2462 MHz, 64-QAM 54 Mbps, 1 GHz - 4 GHz, Trace Averaging with Band (Notch) Reject Filter



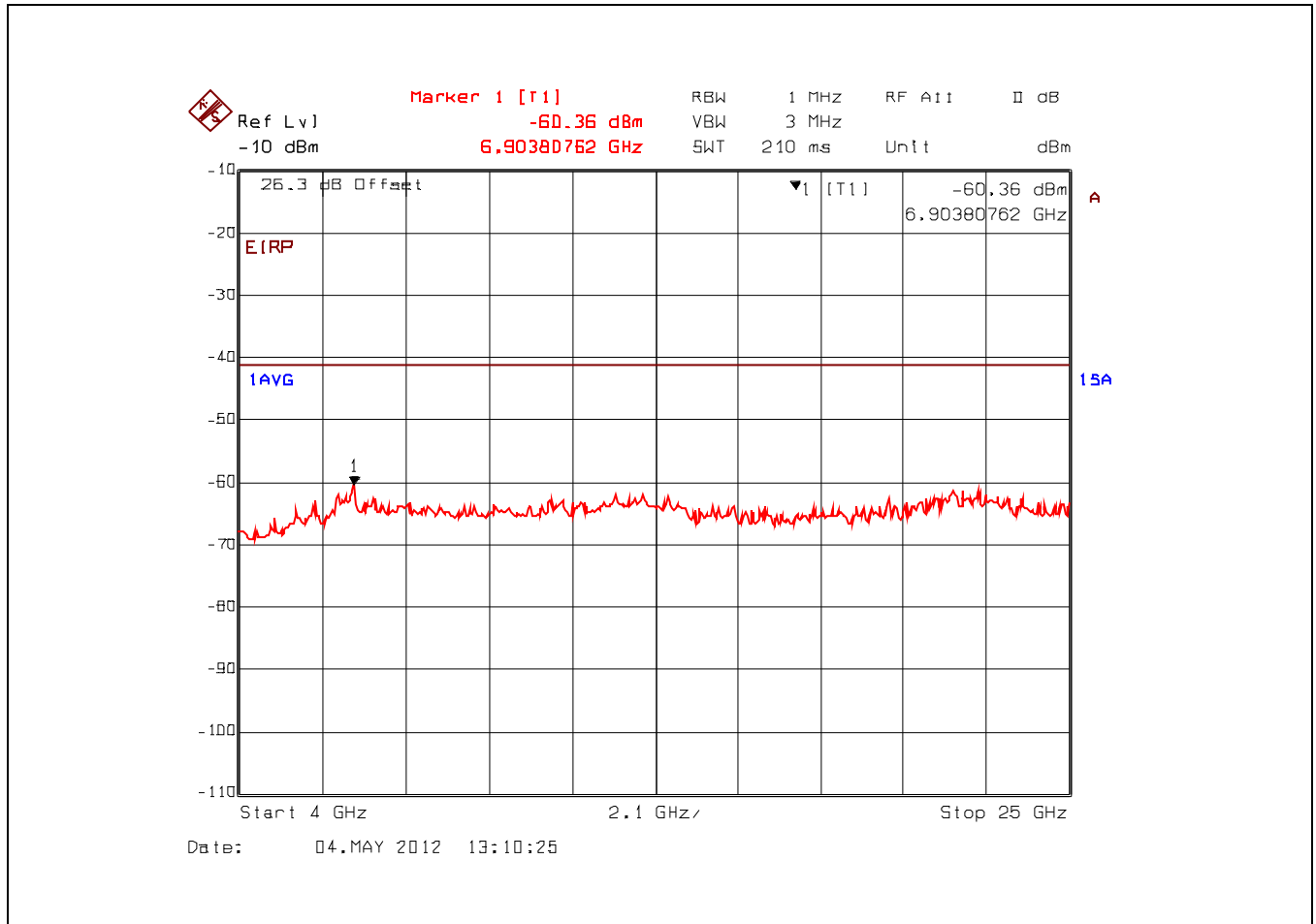
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 Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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Plot 5.4.4.3.32. Conducted Spurious Emissions – Restricted Bands
802.11g, 2462 MHz, 64-QAM 54 Mbps, 4 GHz - 25 GHz, Trace Averaging with High Pass Filter



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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

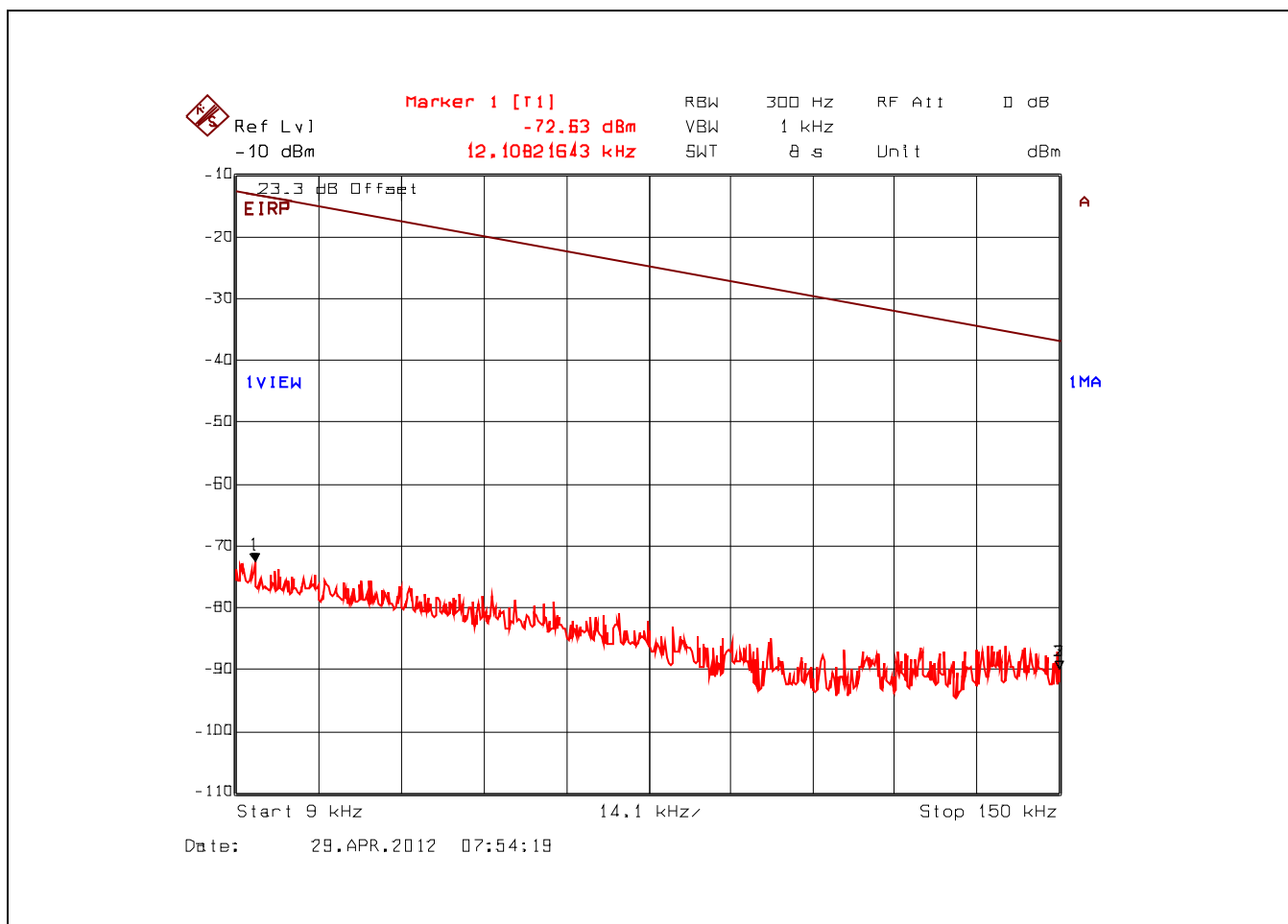
File #: MCRS-046F15C247
June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

5.4.4.4. Conducted Spurious Emissions – Restricted Bands, Highest Power Setting (30 dBm) for Lowest Antenna Gain (2 dBi)

Remark: Offset = Insertion Loss (21.25 dB) + Antenna Gain (2 dBi) = 23.3 dB

Plot 5.4.4.4.1. Conducted Spurious Emissions – Restricted Bands
802.11b, 2412 MHz, CCK 11 Mbps, 9 kHz - 150 kHz, Peak Detector



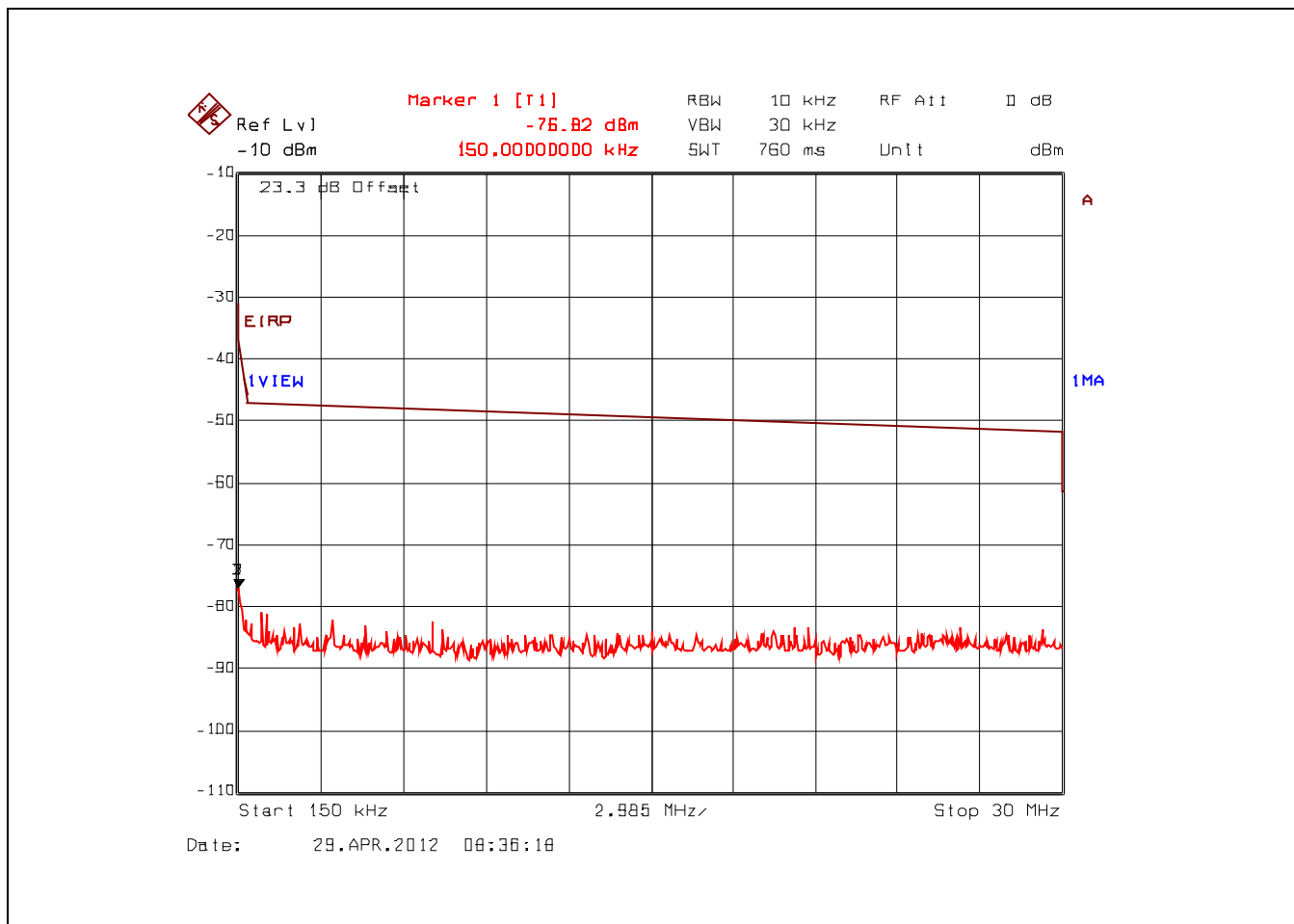
ULTRATECH GROUP OF LABS

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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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Plot 5.4.4.2. Conducted Spurious Emissions – Restricted Bands
 802.11b, 2412 MHz, CCK 11 Mbps, 150 kHz - 30 MHz, Peak Detector



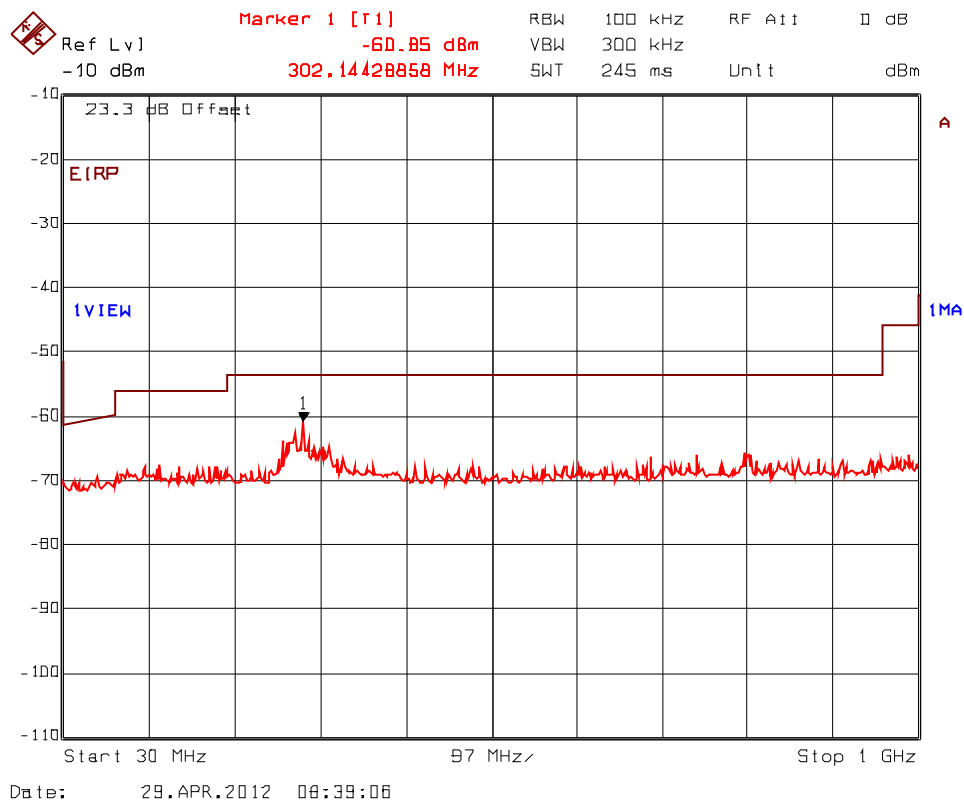
ULTRATECH GROUP OF LABS

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 Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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Plot 5.4.4.3. Conducted Spurious Emissions – Restricted Bands
802.11b, 2412 MHz, CCK 11 Mbps, 30 MHz - 1 GHz, Peak Detector



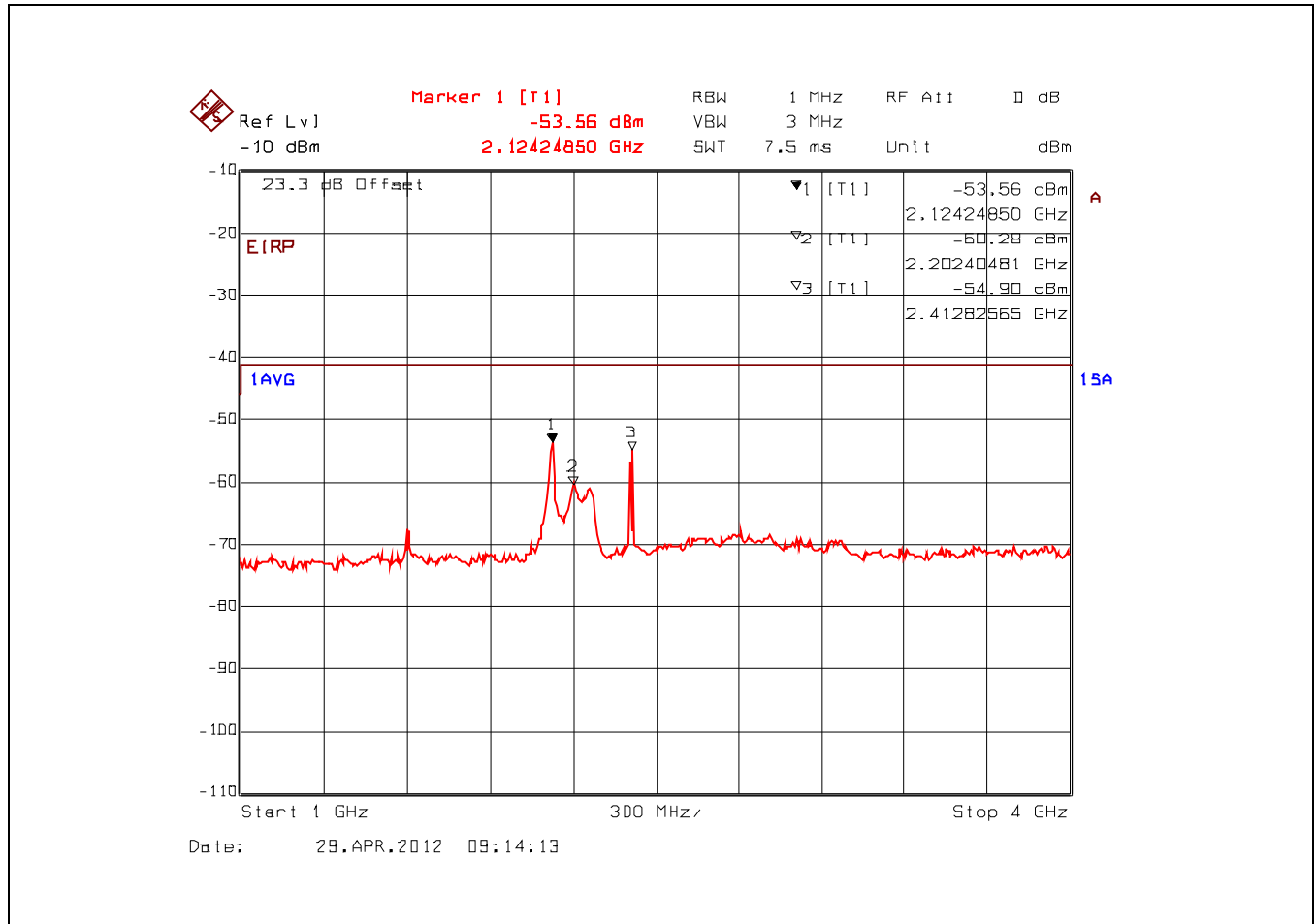
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Plot 5.4.4.4.4. Conducted Spurious Emissions – Restricted Bands
802.11b, 2412 MHz, CCK 11 Mbps, 1 GHz - 4 GHz, Trace Average with Band (Notch) Reject Filter



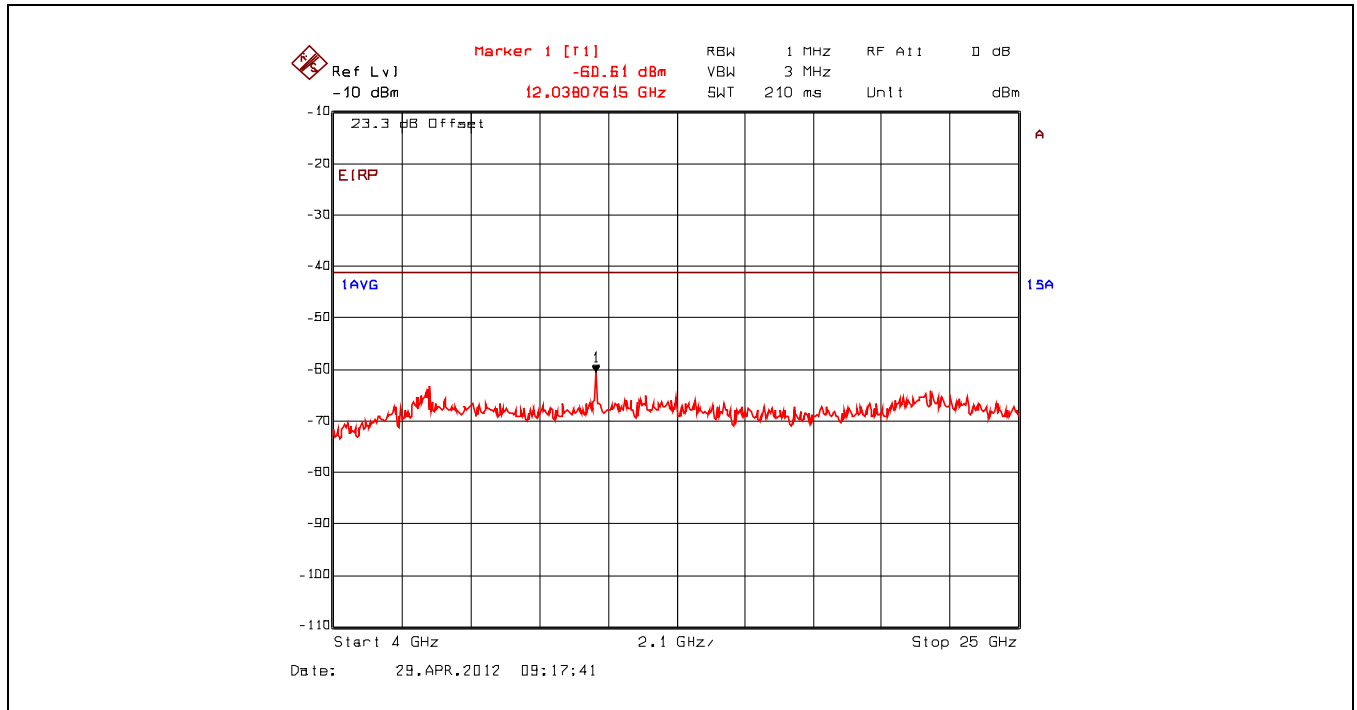
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

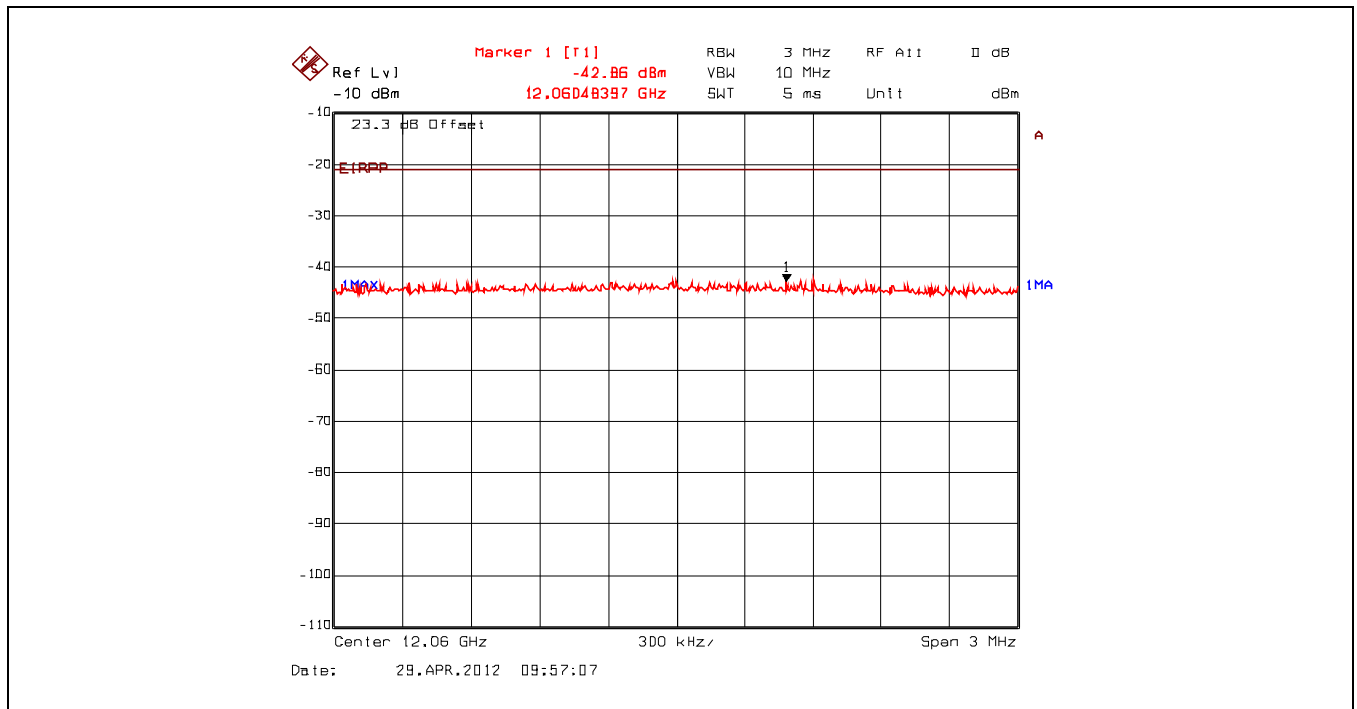
File #: MCRS-046F15C247
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Plot 5.4.4.4.5. Conducted Spurious Emissions – Restricted Bands
802.11b, 2412 MHz, CCK 11 Mbps, 4 GHz - 25 GHz, Trace Average with High Pass Filter



Plot 5.4.4.4.6. Conducted Spurious Emissions – Restricted Bands
802.11b, 2412 MHz, CCK 11 Mbps, 4 GHz - 25 GHz, Peak Power at 12.06 GHz with High Pass Filter



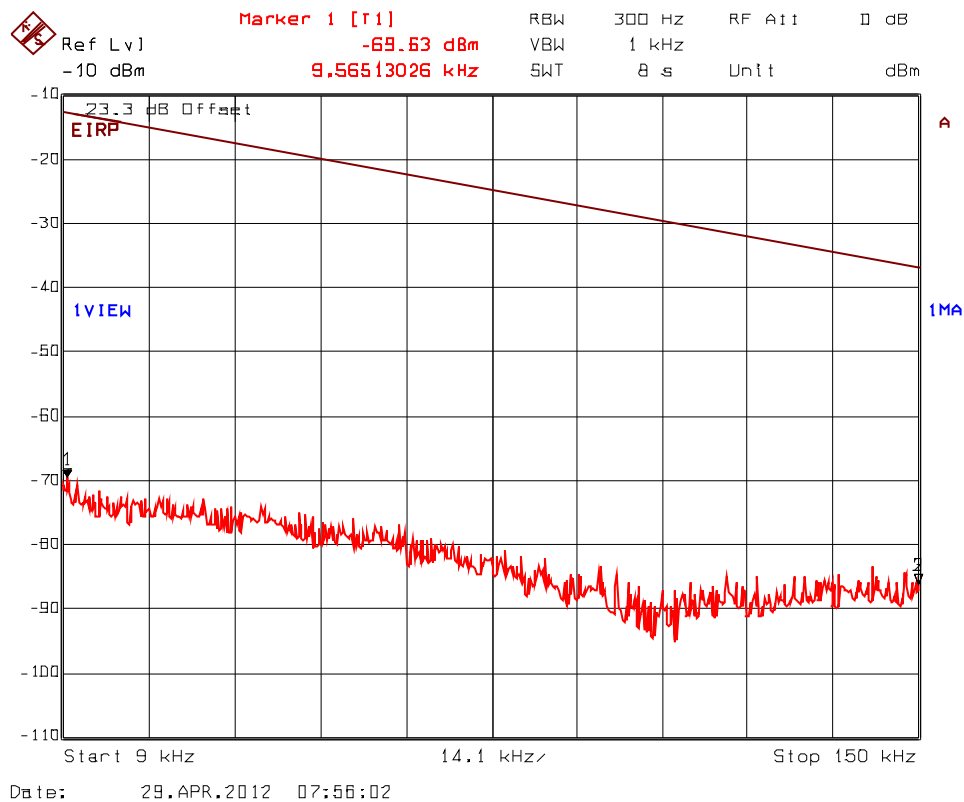
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Plot 5.4.4.7. Conducted Spurious Emissions – Restricted Bands
 802.11b, 2437 MHz, CCK 11 Mbps, 9 kHz - 150 kHz, Peak Detector



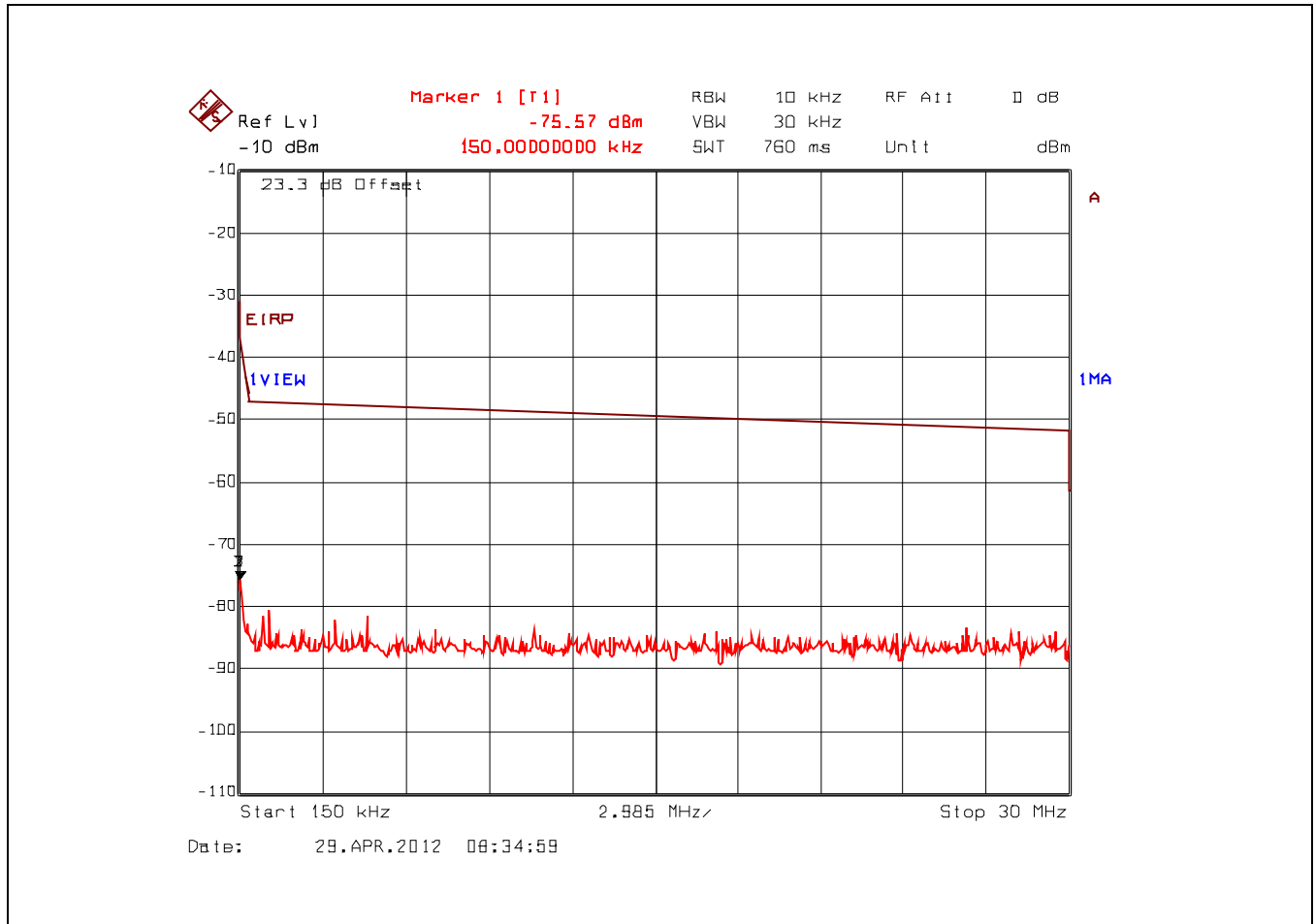
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Plot 5.4.4.8. Conducted Spurious Emissions – Restricted Bands
 802.11b, 2437 MHz, CCK 11 Mbps, 150 kHz - 30 MHz, Peak Detector



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Ref Lvl
-10 dBm

Marker 1 [11]
-61.16 dBm
292.42484970 MHz

RBW 100 kHz
VBW 300 kHz
SWT 245 ms

RF Att 0 dB
Unit dBm

23.3 dB Offset

EIRP

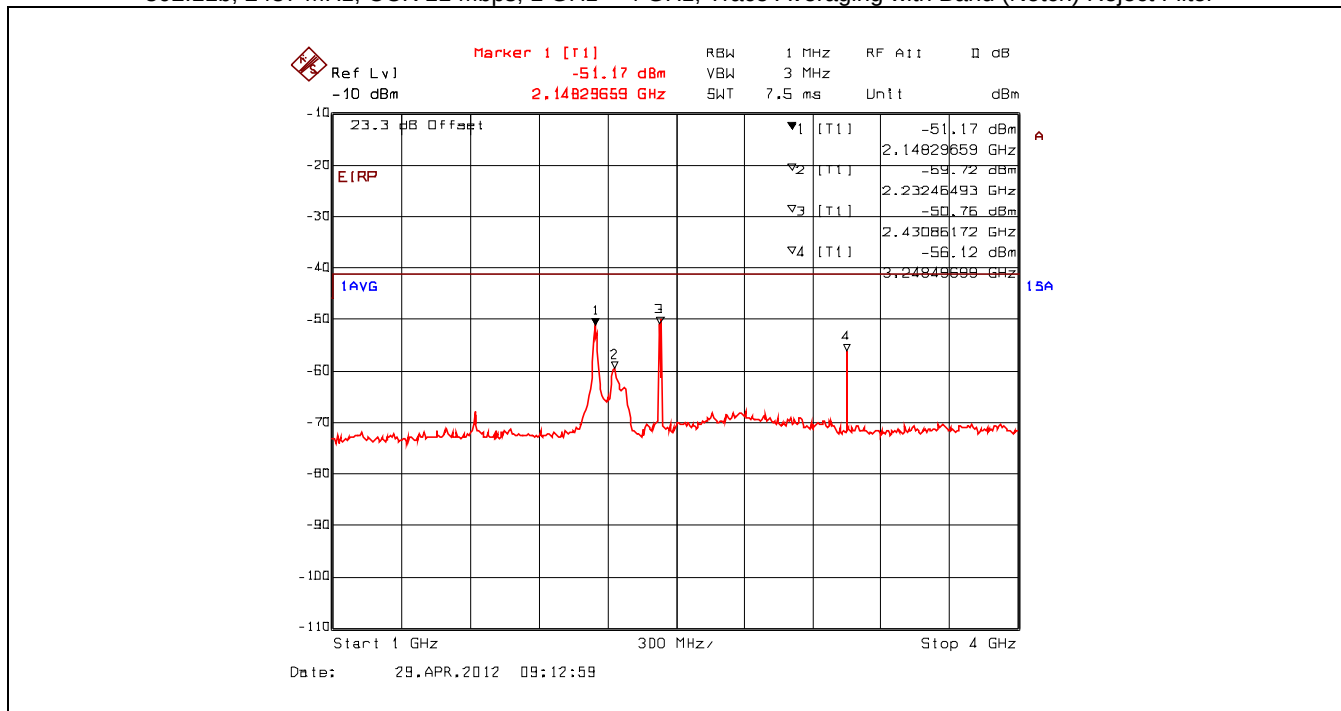
1VIEW

1

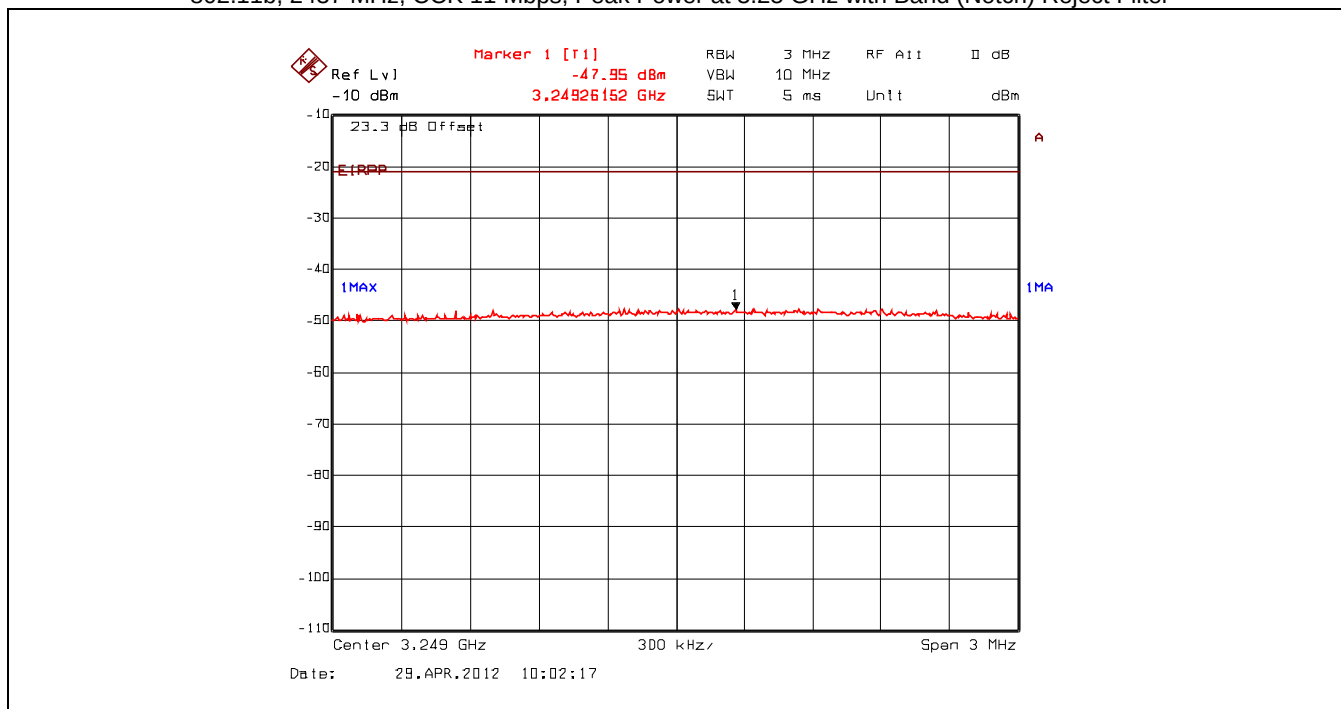
Start 30 MHz
97 MHz
Stop 1 GHz

Date: 29.APR.2012 08:41:20

Plot 5.4.4.10. Conducted Spurious Emissions – Restricted Bands
802.11b, 2437 MHz, CCK 11 Mbps, 1 GHz - 4 GHz, Trace Averaging with Band (Notch) Reject Filter



Plot 5.4.4.11. Conducted Spurious Emissions – Restricted Bands
802.11b, 2437 MHz, CCK 11 Mbps, Peak Power at 3.25 GHz with Band (Notch) Reject Filter



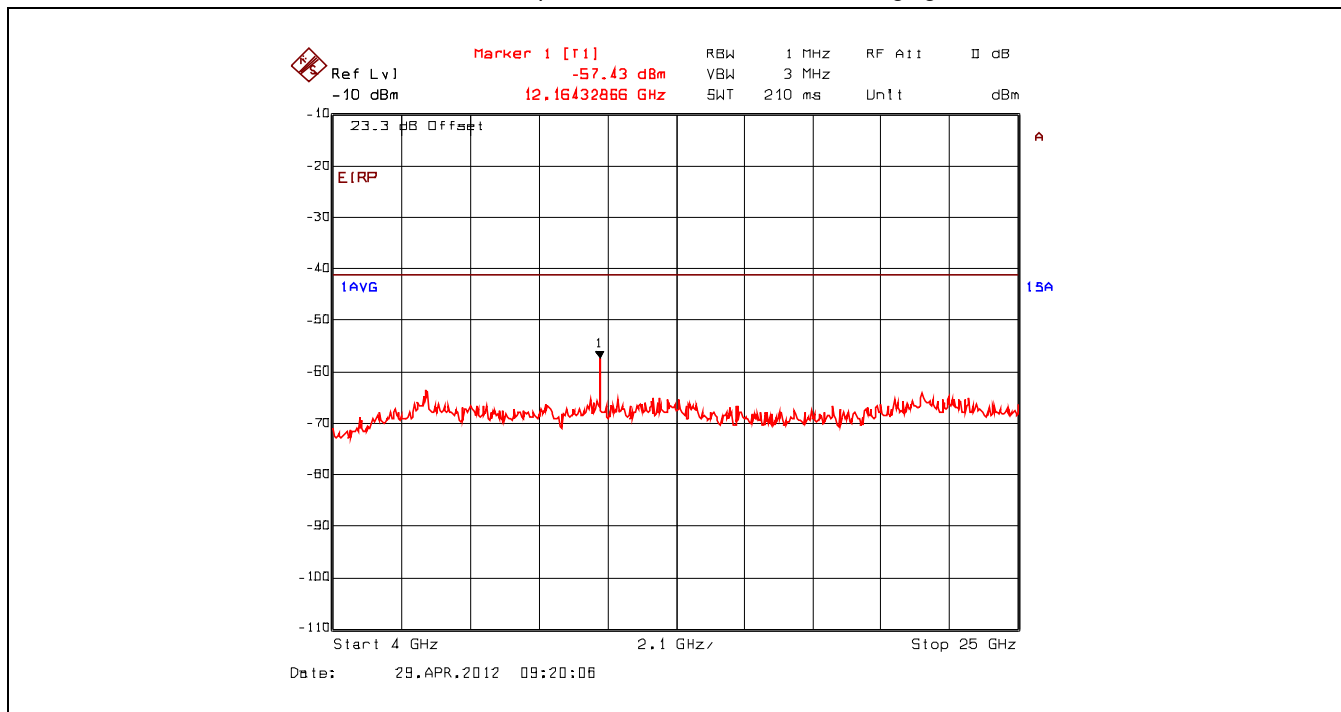
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

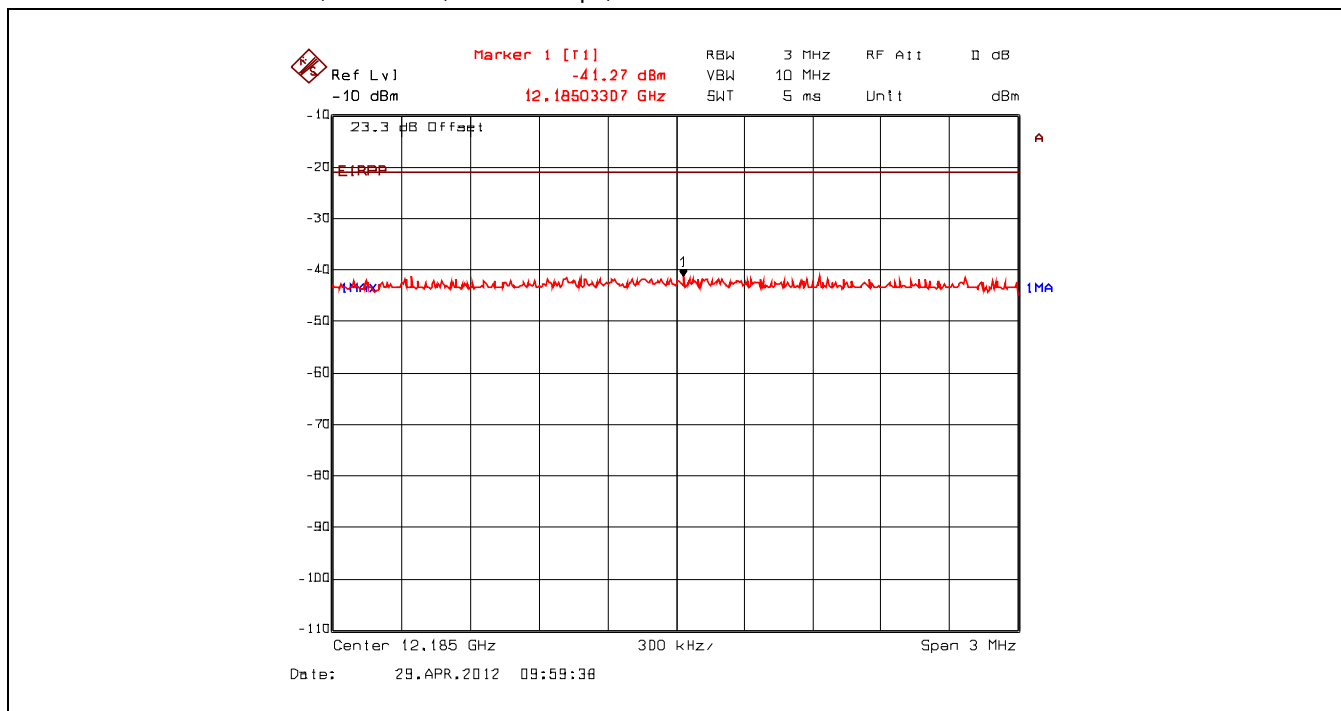
File #: MCRS-046F15C247
June 4, 2012

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

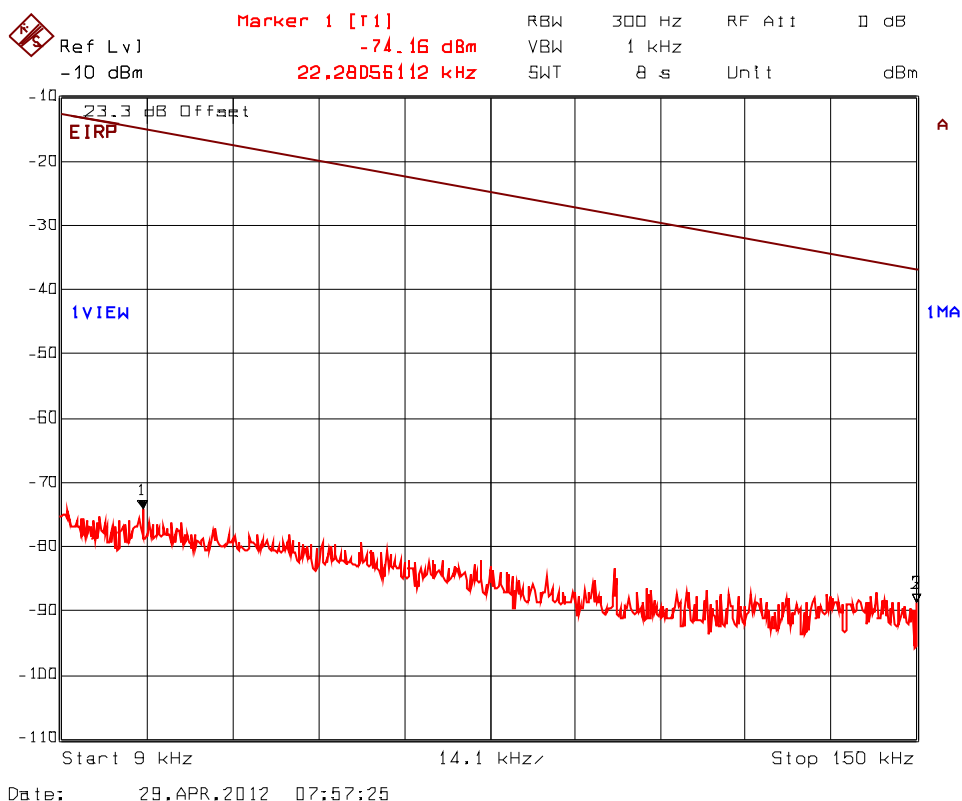
Plot 5.4.4.4.12. Conducted Spurious Emissions – Restricted Bands
802.11b, 2437 MHz, CCK 11 Mbps, 4 GHz - 25GHz, Trace Averaging with Band Pass Filter



Plot 5.4.4.4.13. Conducted Spurious Emissions – Restricted Bands
802.11b, 2437 MHz, CCK 11 Mbps, Peak Power at 12.19 GHz with Band Pass Filter



Plot 5.4.4.14. Conducted Spurious Emissions – Restricted Bands
 802.11b, 2462 MHz, CCK 11 Mbps, 9 kHz - 150 kHz, Peak Detector



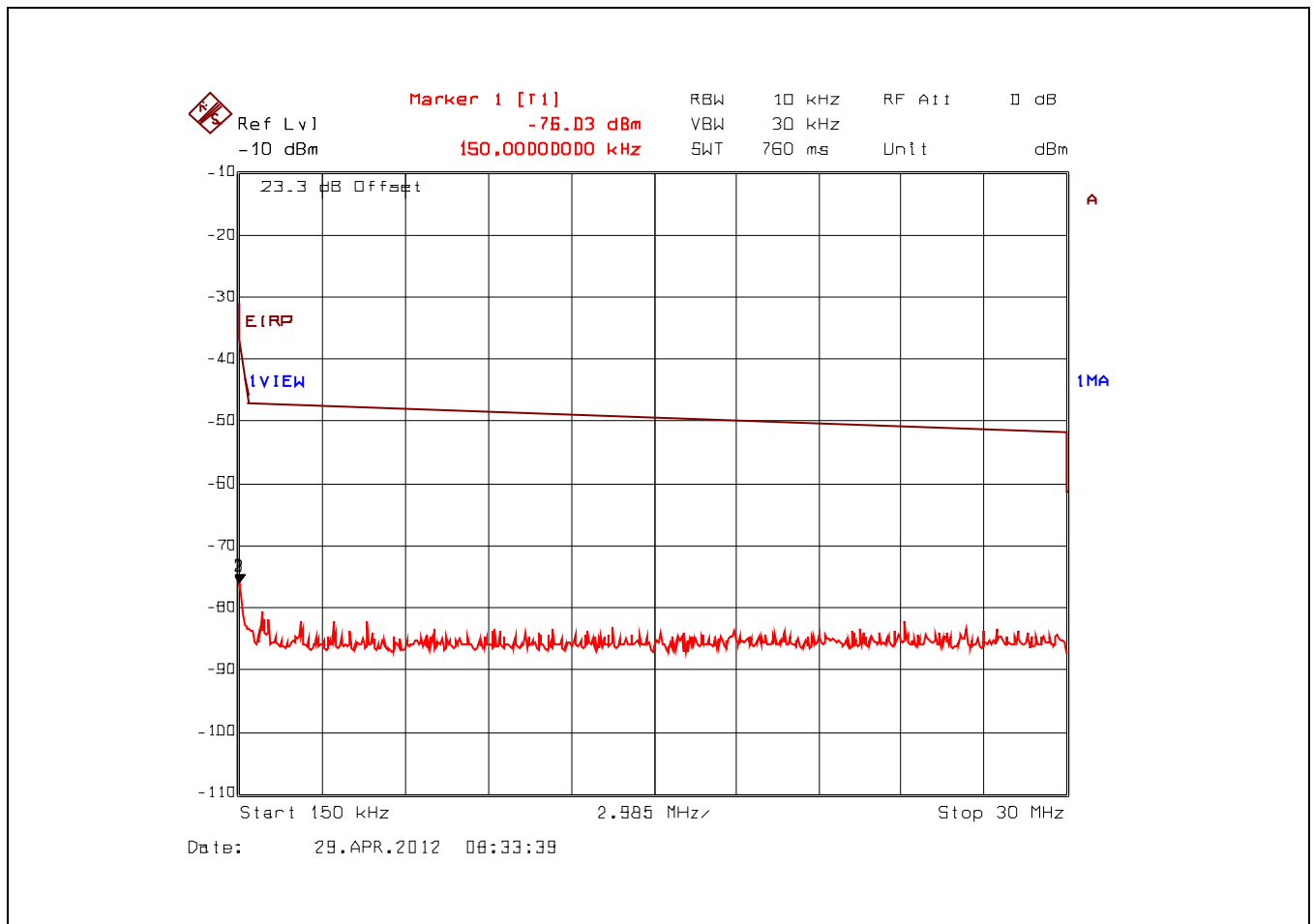
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Plot 5.4.4.4.15. Conducted Spurious Emissions – Restricted Bands
802.11b, 2462 MHz, CCK 11 Mbps, 150 kHz - 30 MHz, Peak Detector



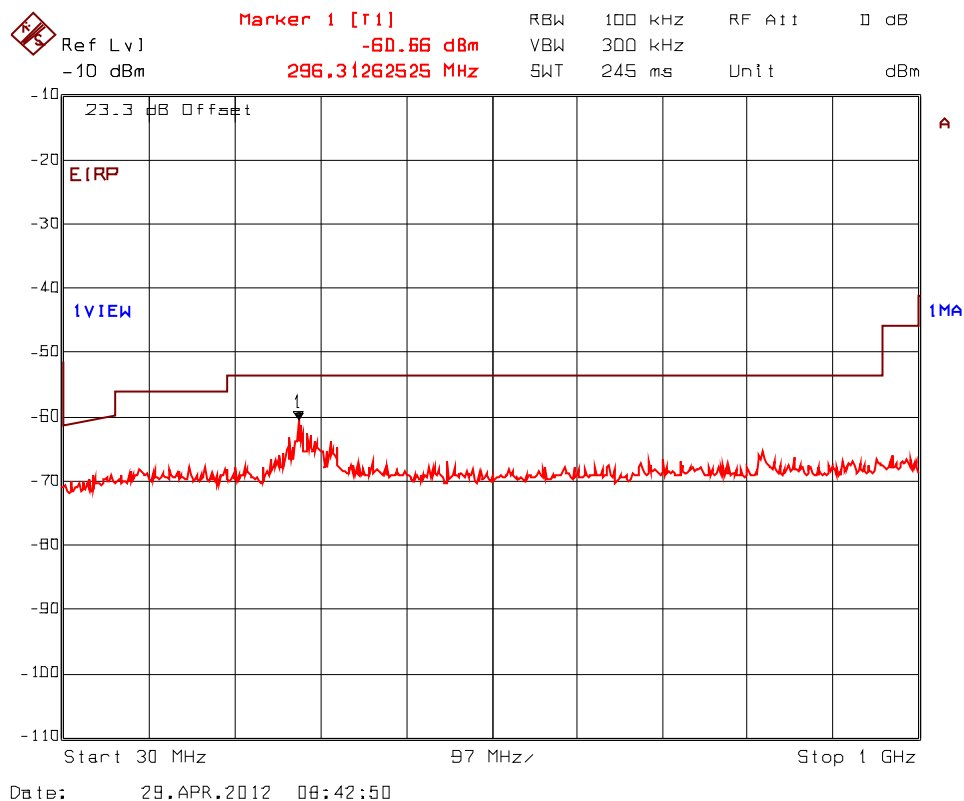
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

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Plot 5.4.4.16. Conducted Spurious Emissions – Restricted Bands
802.11b, 2462 MHz, CCK 11 Mbps, 30 MHz - 1 GHz, Peak Detector



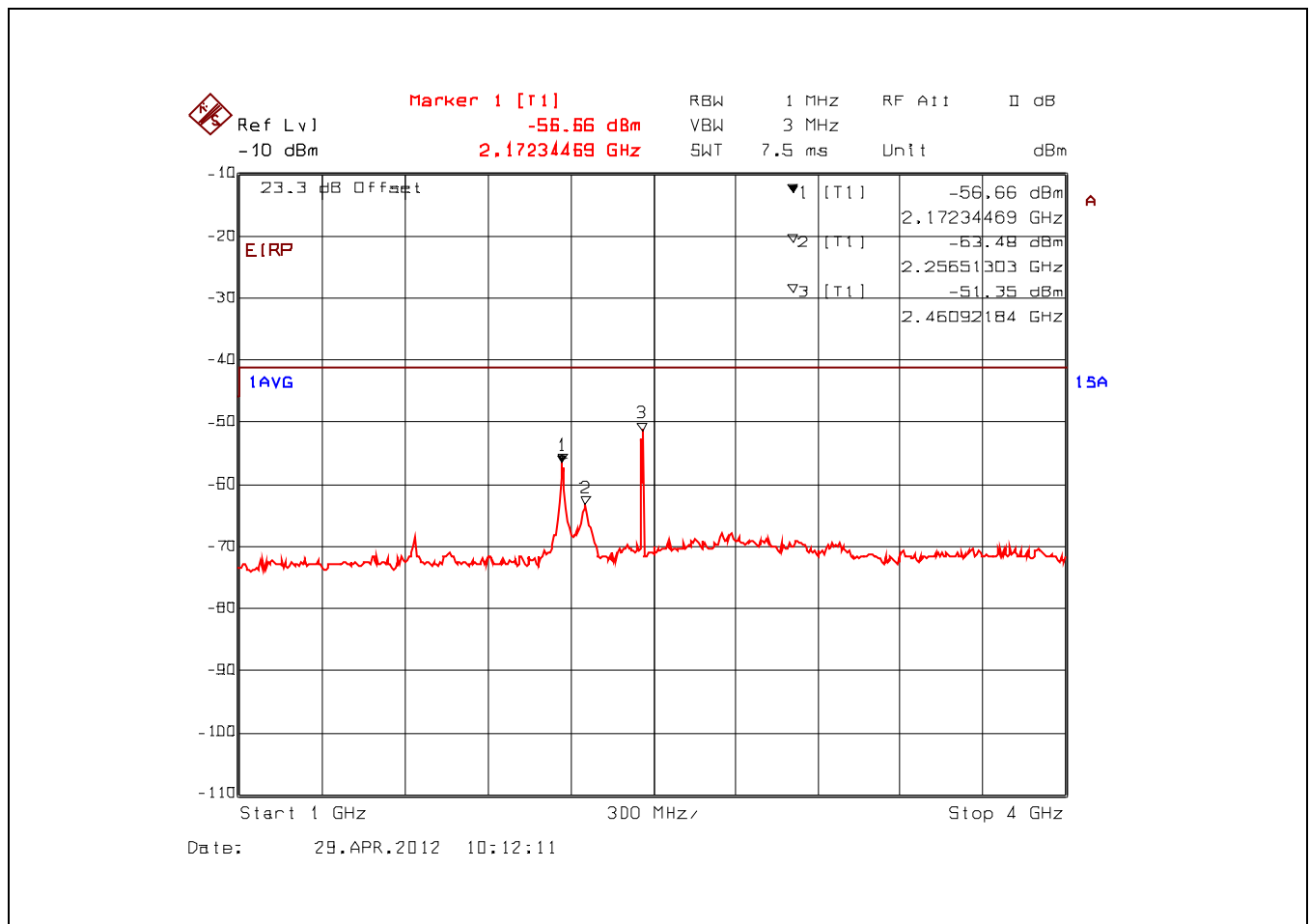
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June 4, 2012

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Plot 5.4.4.17. Conducted Spurious Emissions – Restricted Bands
802.11b, 2462 MHz, CCK 11 Mbps, 1 GHz - 4 GHz, Trace Averaging with Band (Notch) Reject Filter



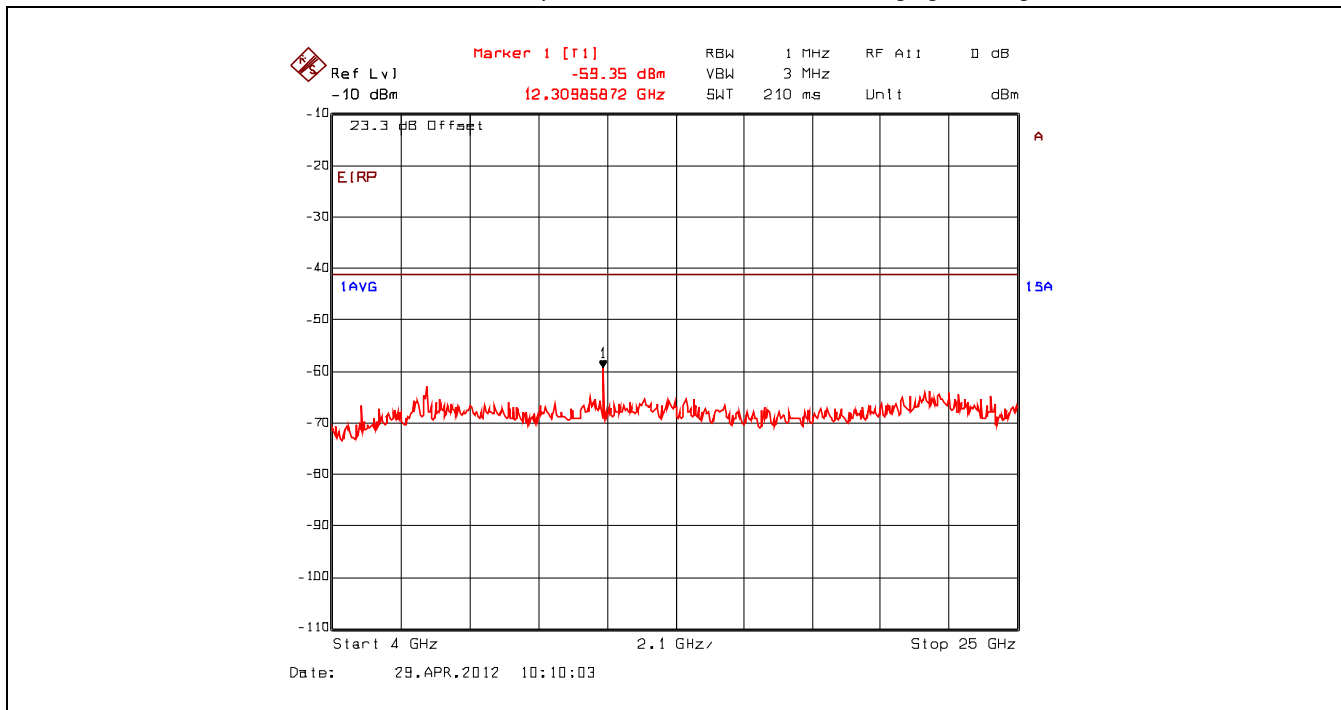
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

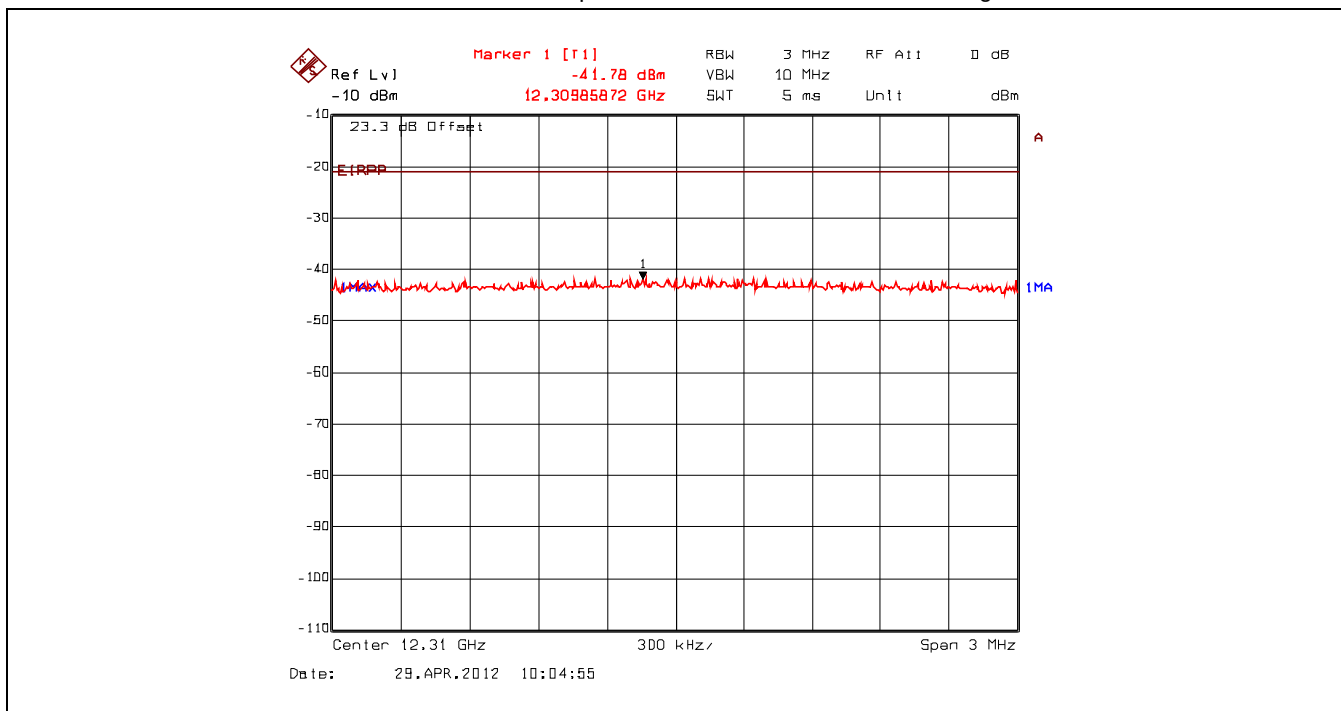
File #: MCRS-046F15C247
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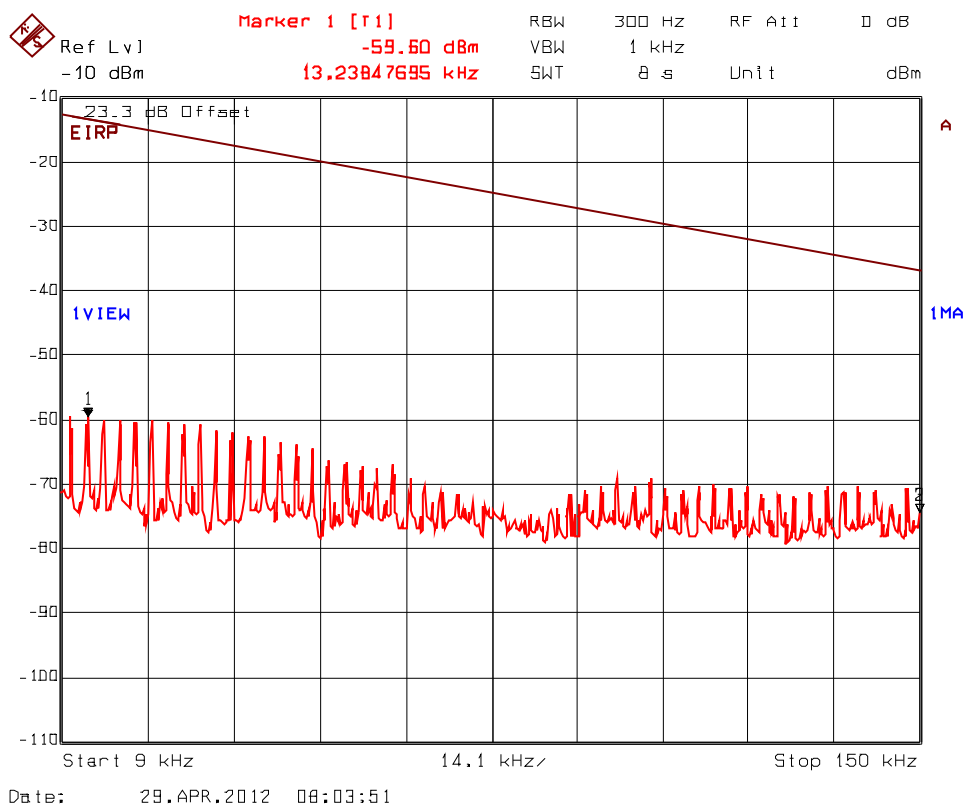
Plot 5.4.4.18. Conducted Spurious Emissions – Restricted Bands
802.11b, 2462 MHz, CCK 11 Mbps, 4 GHz - 25 GHz, Trace Averaging with High Pass Filter



Plot 5.4.4.19. Conducted Spurious Emissions – Restricted Bands
802.11b, 2462 MHz, CCK 11 Mbps, Peak Power at 12.31 GHz with High Pass Filter



Plot 5.4.4.4.20. Conducted Spurious Emissions – Restricted Bands
802.11g, 2412 MHz, 64-QAM 54 Mbps, 9 kHz - 150 kHz, Peak Detector



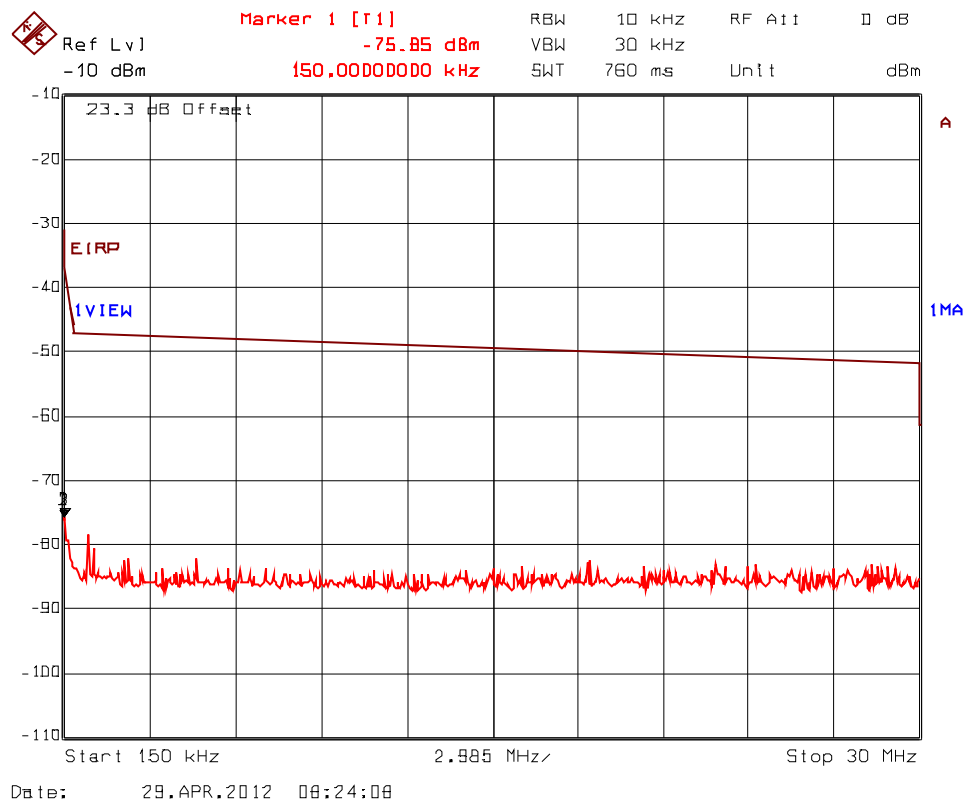
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Plot 5.4.4.21. Conducted Spurious Emissions – Restricted Bands
 802.11g, 2412 MHz, 64-QAM 54 Mbps, 150 kHz - 30 MHz, Peak Detector



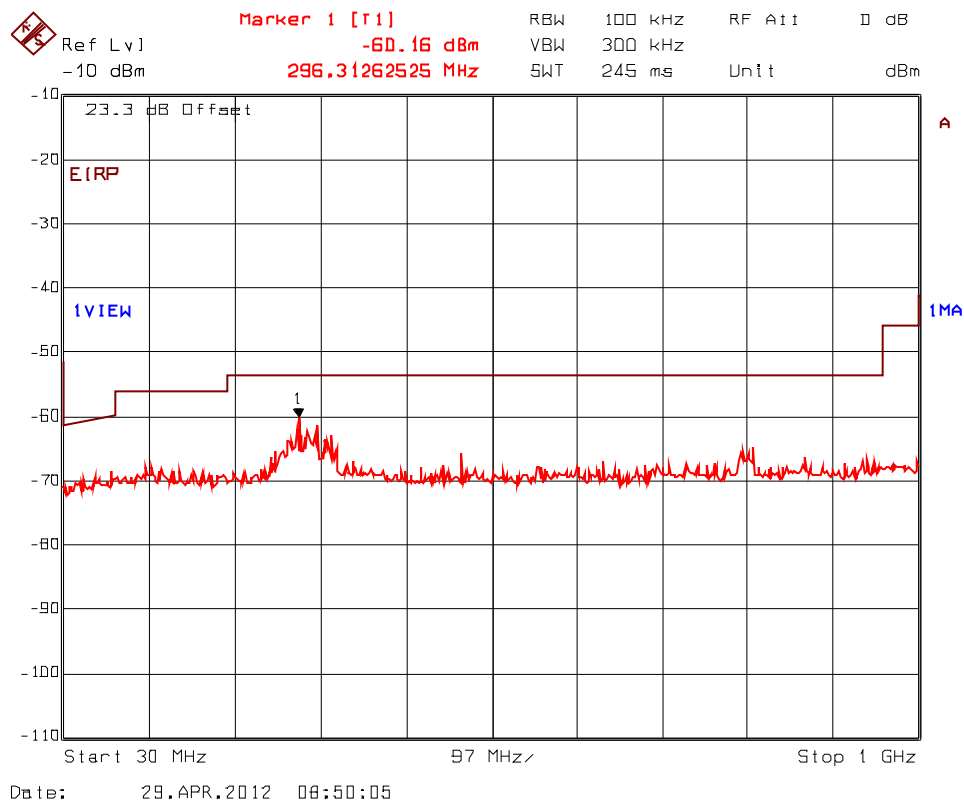
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Plot 5.4.4.22. Conducted Spurious Emissions – Restricted Bands
802.11g, 2412 MHz, 64-QAM 54 Mbps, 30 MHz - 1 GHz, Peak Detector



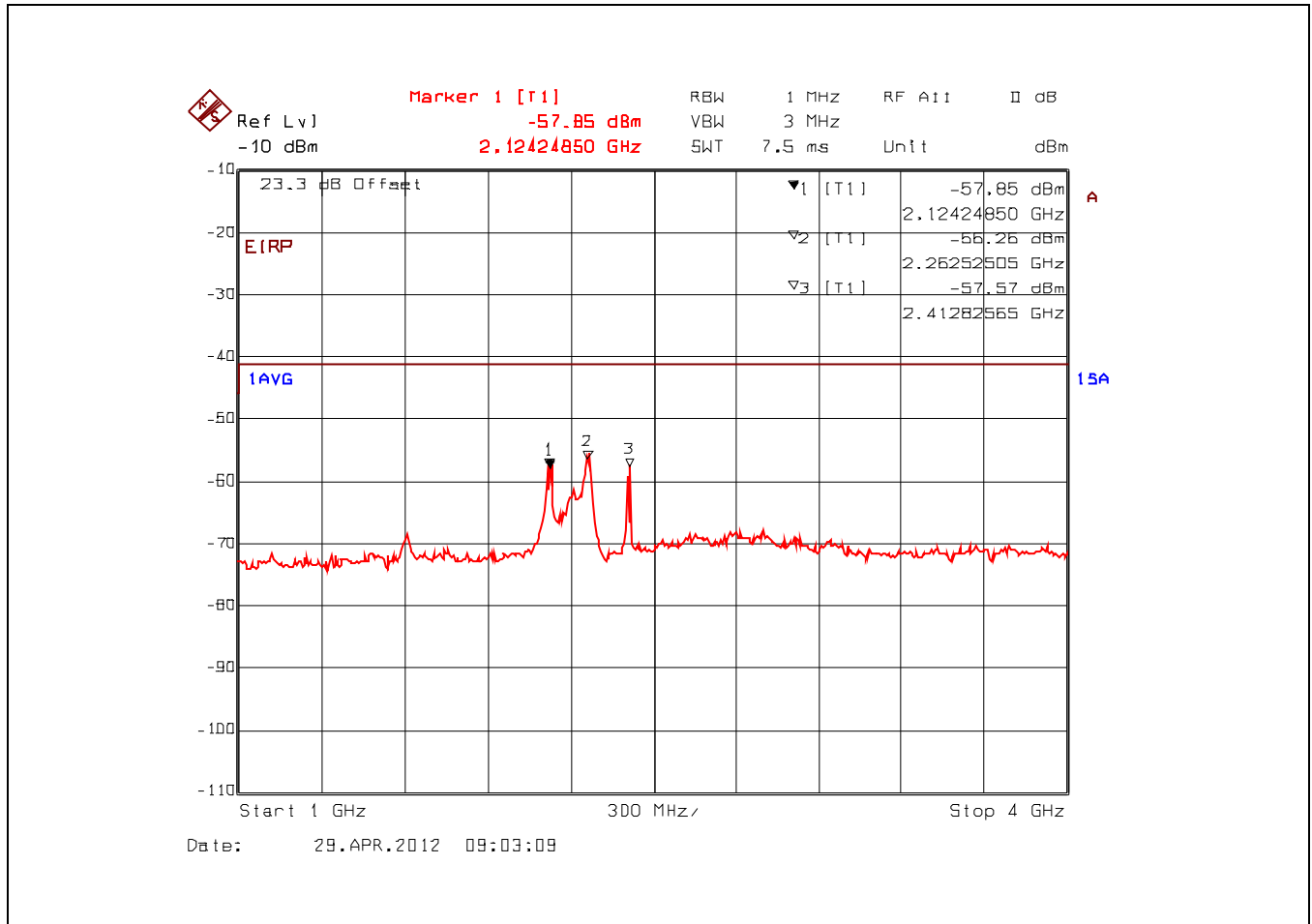
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Plot 5.4.4.23. Conducted Spurious Emissions – Restricted Bands
802.11g, 2412 MHz, 64-QAM 54 Mbps, 1 GHz - 4 GHz, Trace Average with Band (Notch) Reject Filter



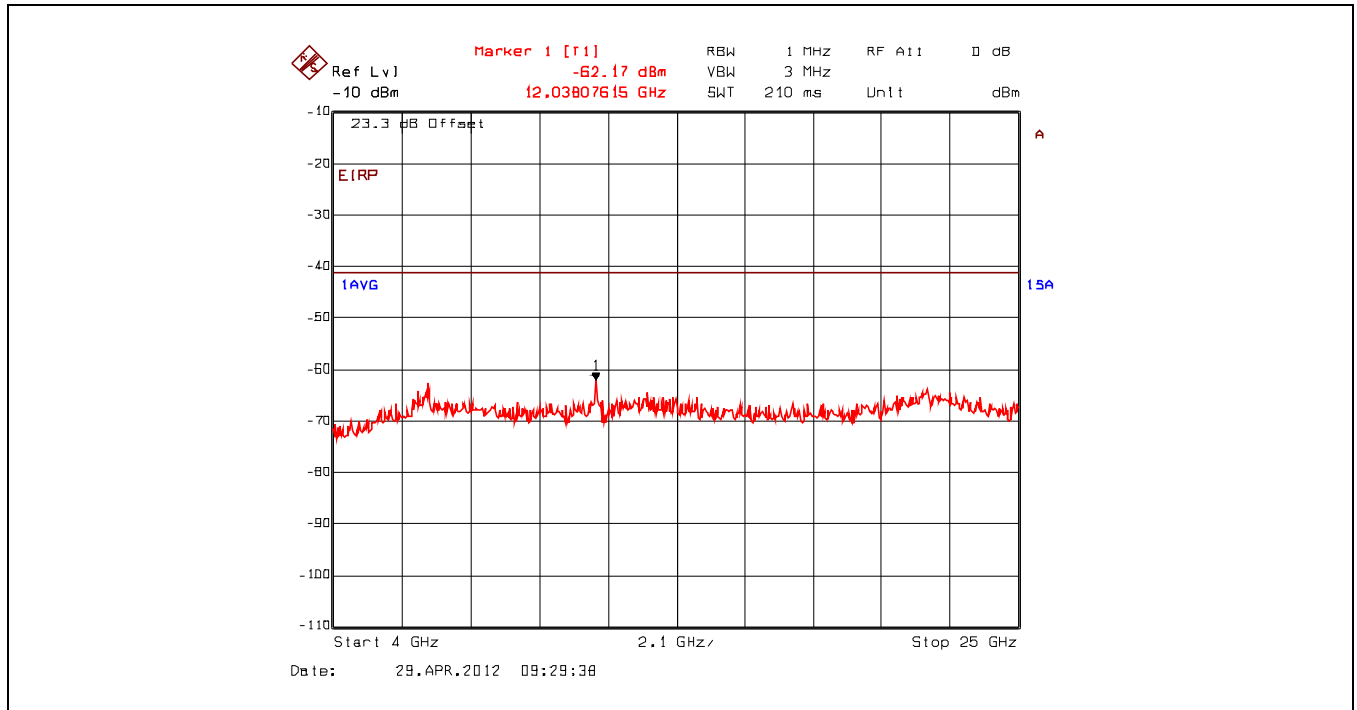
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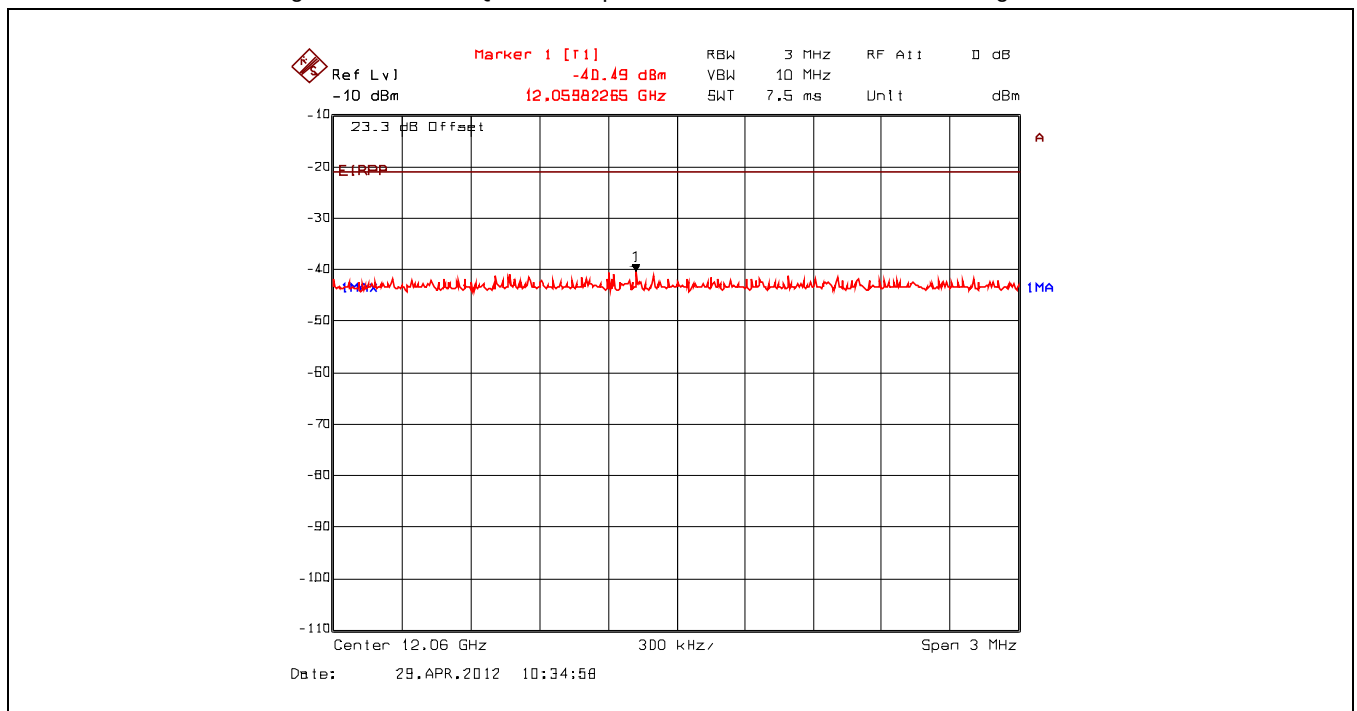
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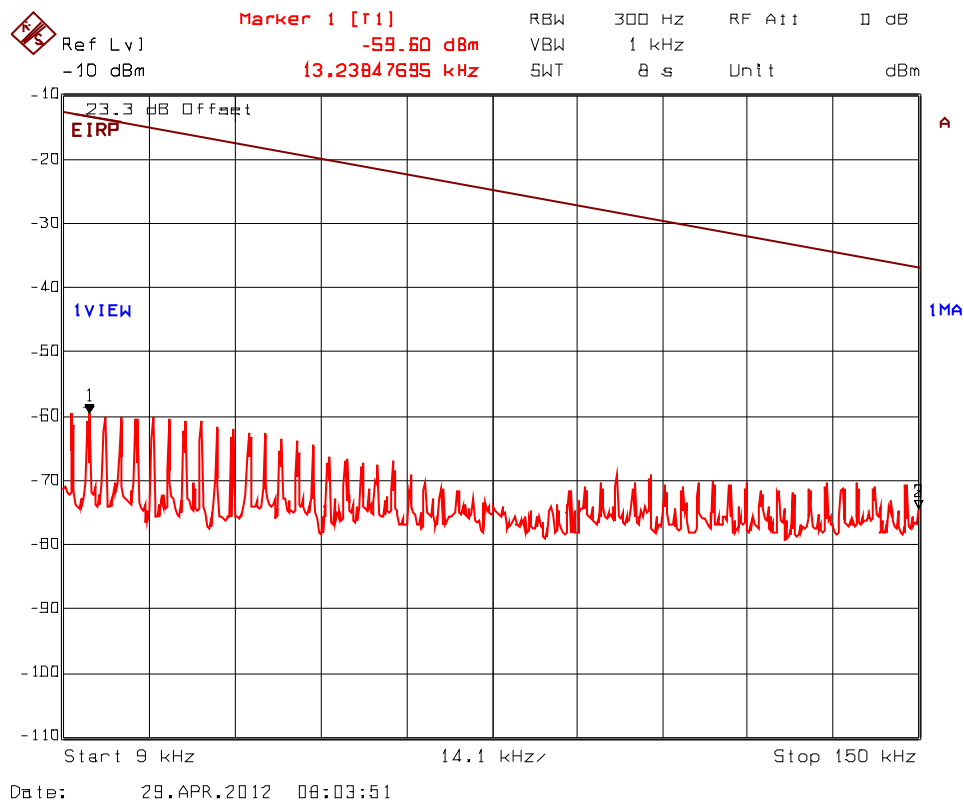
Plot 5.4.4.24. Conducted Spurious Emissions – Restricted Bands
802.11g, 2412 MHz, 64-QAM 54 Mbps, 4 GHz - 25 GHz, Trace Average with High Pass Filter



Plot 5.4.4.25. Conducted Spurious Emissions – Restricted Bands
802.11g, 2412 MHz, 64-QAM 54 Mbps, Peak Power at 12.06 GHz with High Pass Filter



Plot 5.4.4.4.26. Conducted Spurious Emissions – Restricted Bands
 802.11g, 2437 MHz, 64-QAM 54 Mbps, 9 kHz - 150 kHz, Peak Detector



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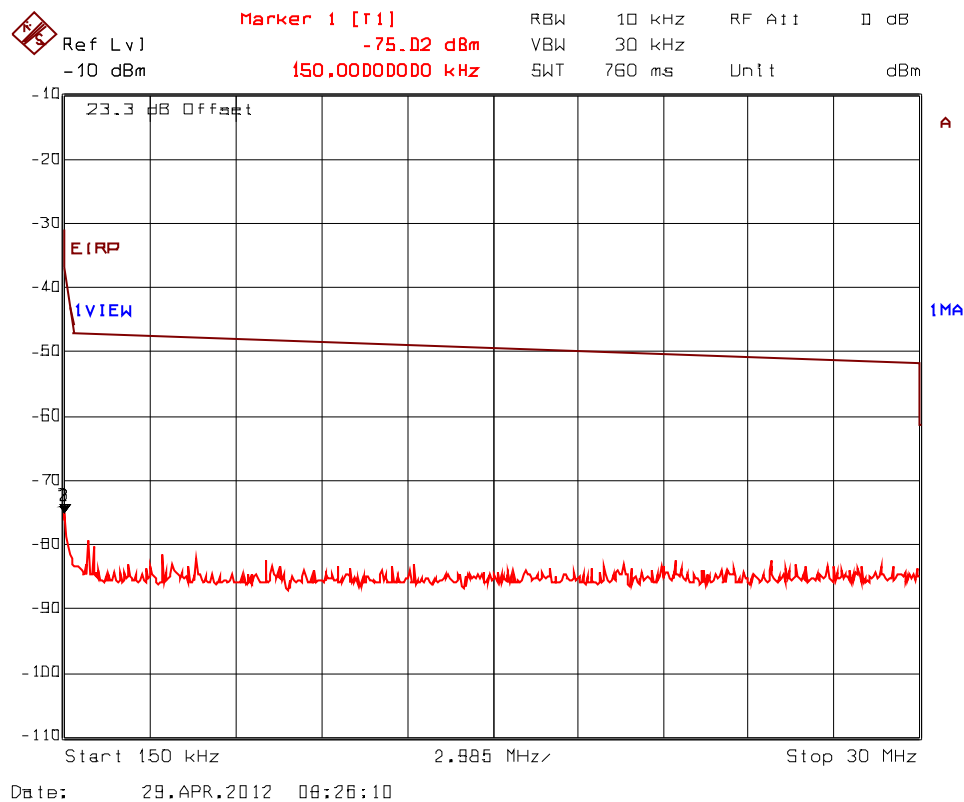
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
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Plot 5.4.4.27. Conducted Spurious Emissions – Restricted Bands
802.11g, 2437 MHz, 64-QAM 54 Mbps, 150 kHz - 30 MHz, Peak Detector



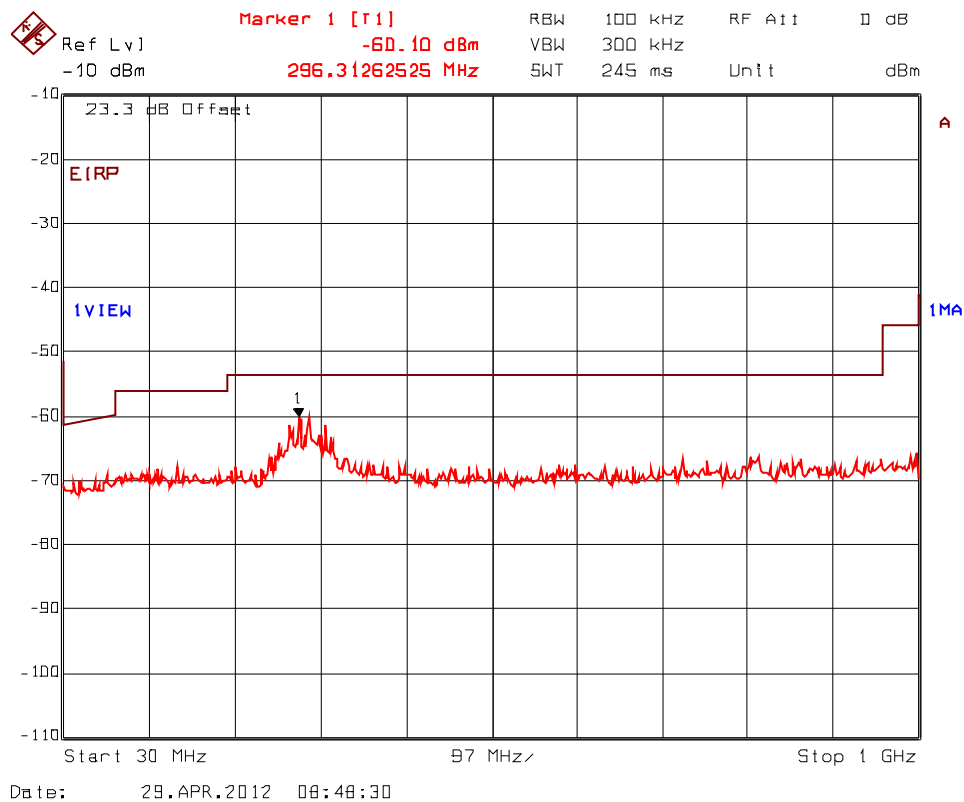
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Plot 5.4.4.28. Conducted Spurious Emissions – Restricted Bands
802.11g, 2437 MHz, 64-QAM 54 Mbps, 30 MHz - 1 GHz, Peak Detector



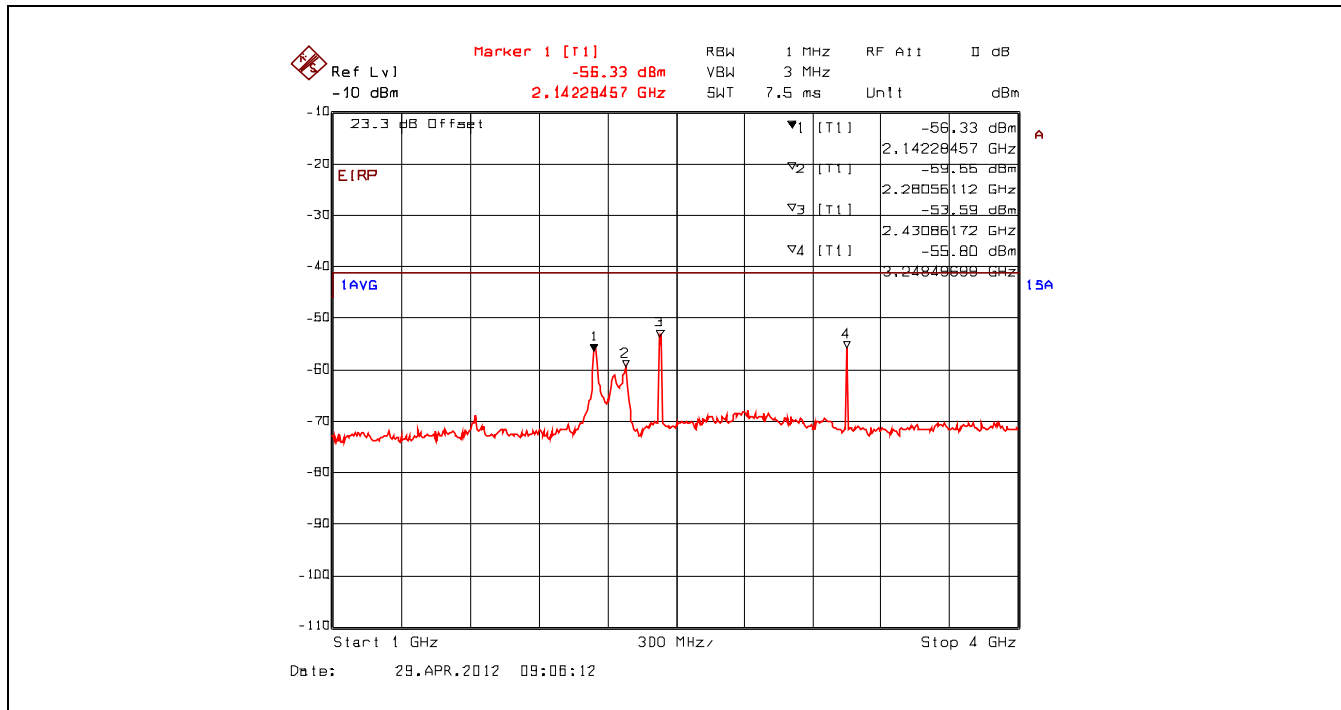
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Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

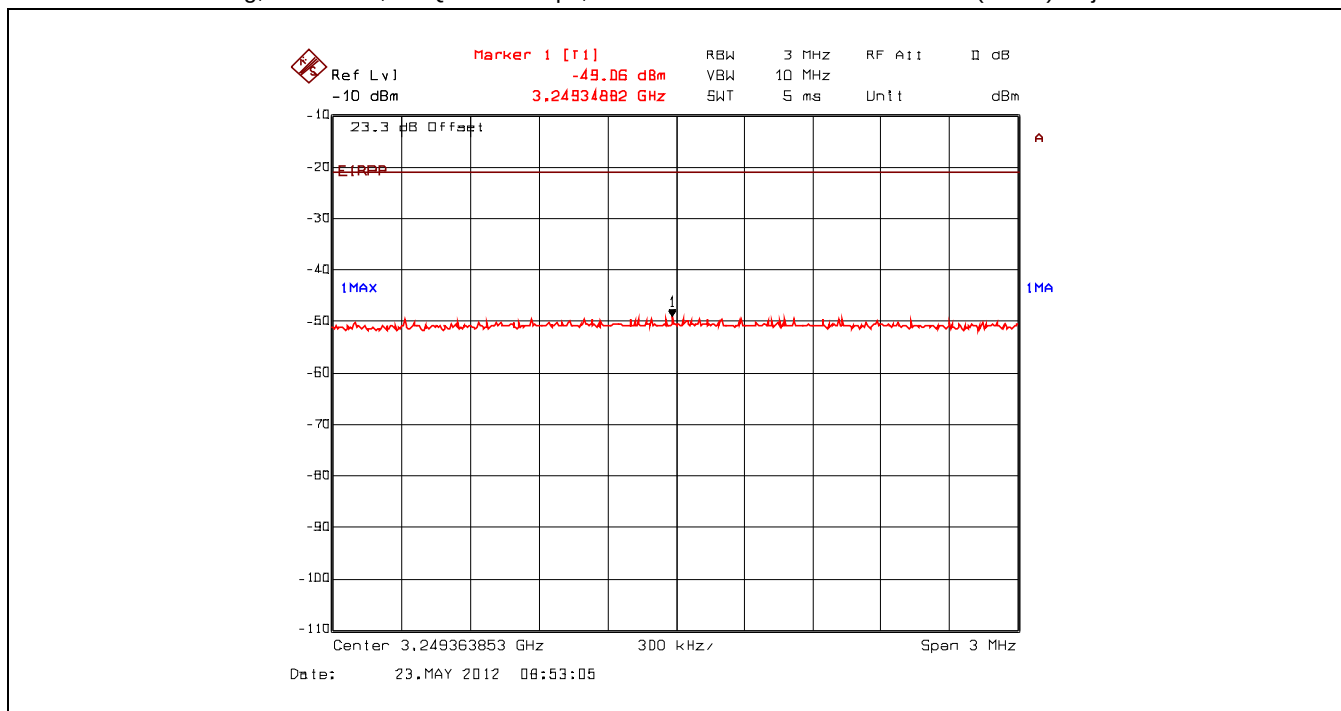
File #: MCRS-046F15C247
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All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

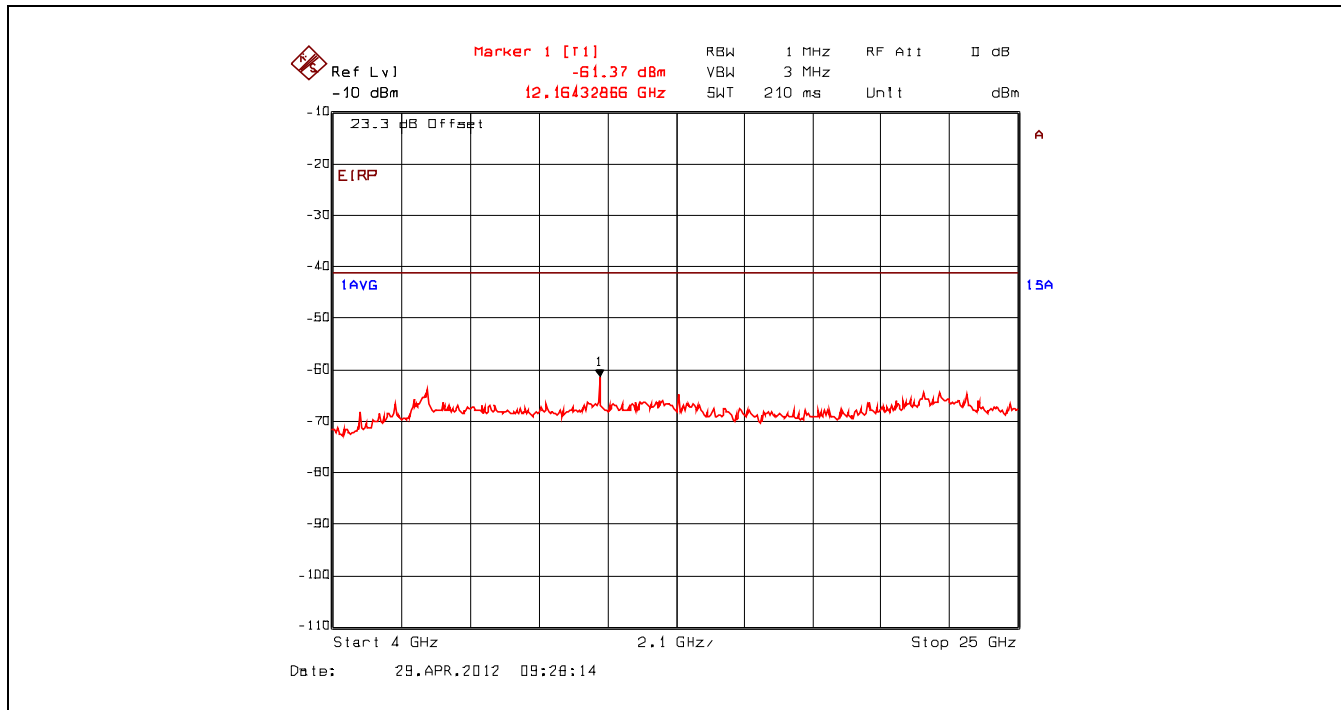
Plot 5.4.4.4.29. Conducted Spurious Emissions – Restricted Bands
802.11g, 2437 MHz, 64-QAM 54 Mbps, 1 GHz - 4 GHz, Trace Averaging with Band (Notch) Reject Filter



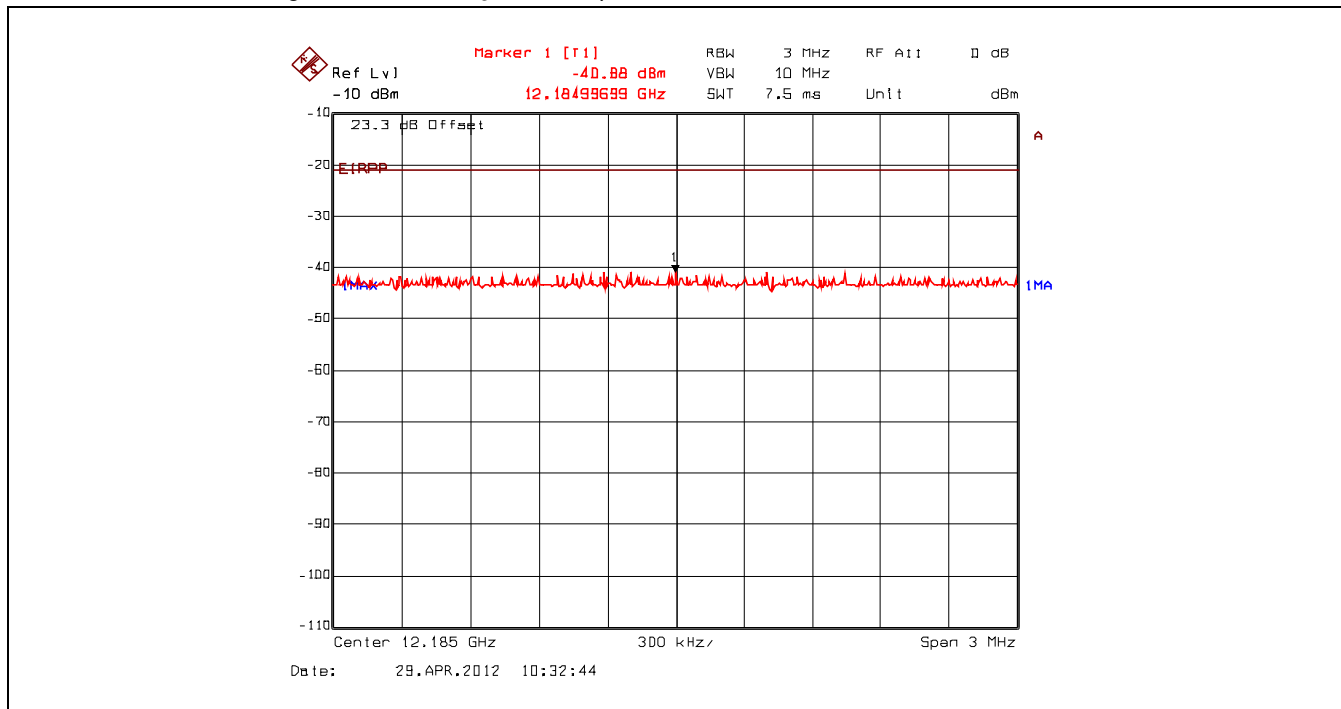
Plot 5.4.4.4.30. Conducted Spurious Emissions – Restricted Bands
802.11g, 2437 MHz, 64-QAM 54 Mbps, Peak Power at 3.25 GHz with Band (Notch) Reject Filter



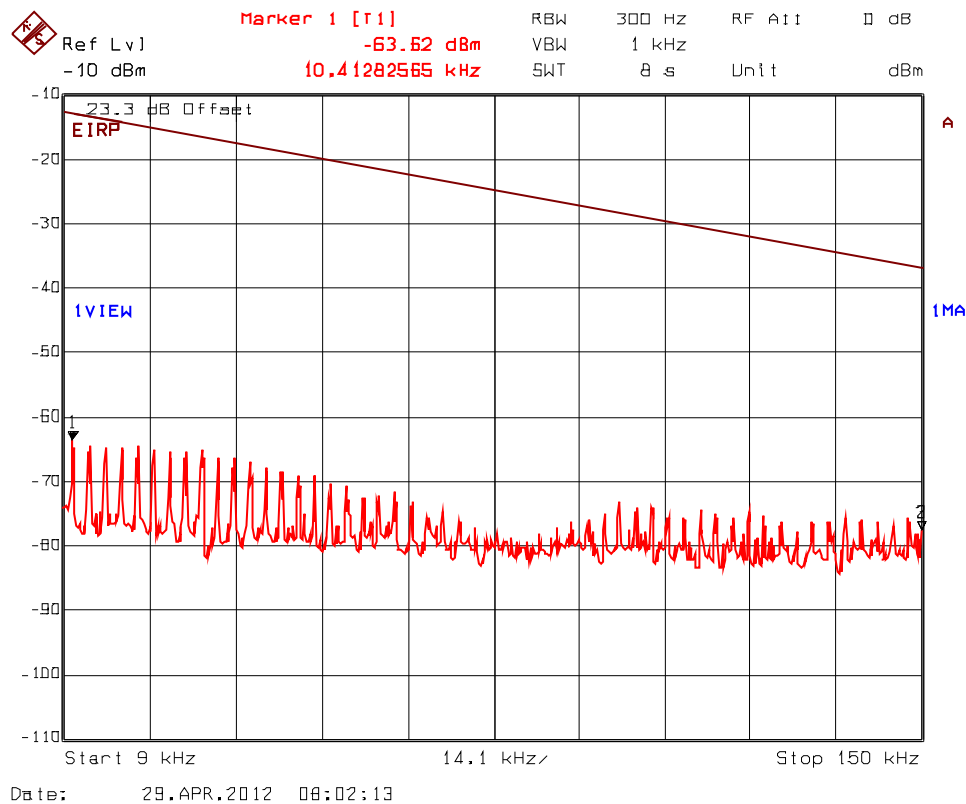
Plot 5.4.4.4.31. Conducted Spurious Emissions – Restricted Bands
802.11g, 2437 MHz, 64-QAM 54 Mbps, 4 GHz - 25 GHz, Trace Averaging with High Pass Filter



Plot 5.4.4.4.32. Conducted Spurious Emissions – Restricted Bands
802.11g, 2437 MHz, 64-QAM 54 Mbps, Peak Power at 12.18 GHz with Band Pass Filter



Plot 5.4.4.33. Conducted Spurious Emissions – Restricted Bands
 802.11g, 2462 MHz, 64-QAM 54 Mbps, 9 kHz - 150 kHz, Peak Detector



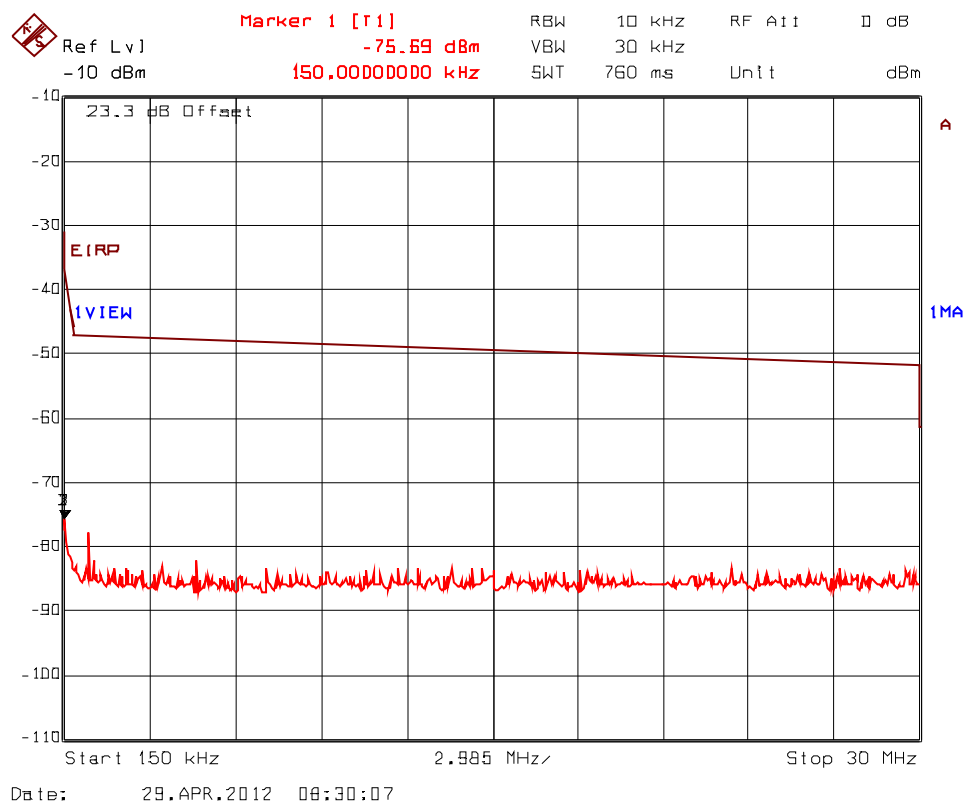
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Plot 5.4.4.34. Conducted Spurious Emissions – Restricted Bands
802.11g, 2462 MHz, 64-QAM 54 Mbps, 150 kHz - 30 MHz, Peak Detector



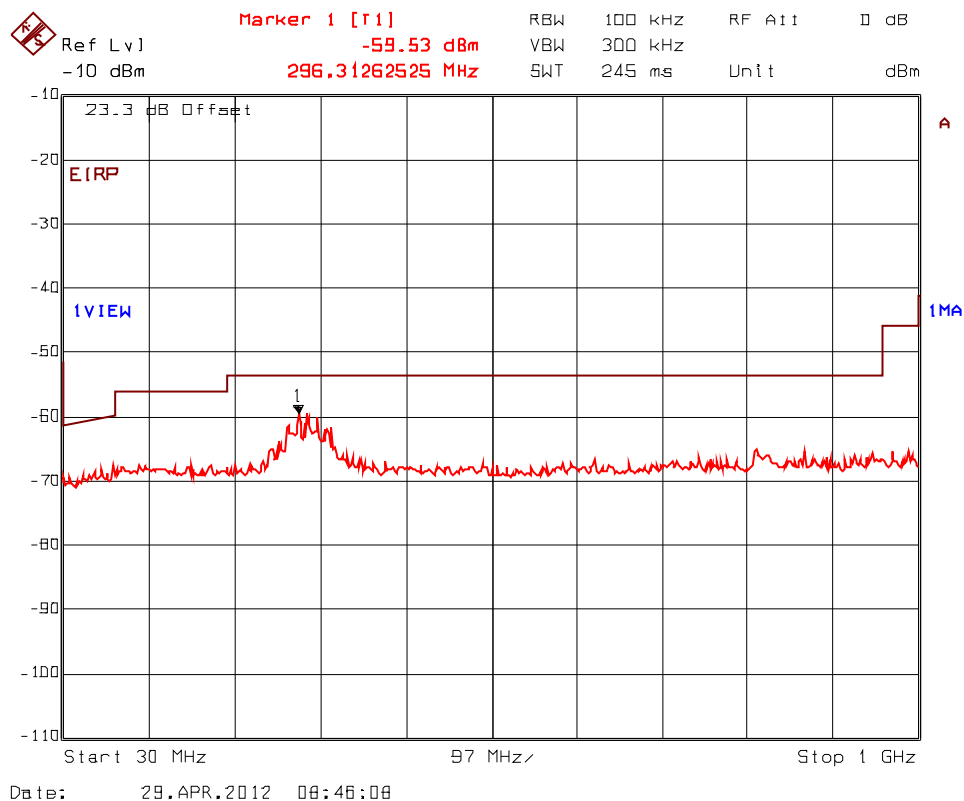
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Plot 5.4.4.4.35. Conducted Spurious Emissions – Restricted Bands
802.11g, 2462 MHz, 64-QAM 54 Mbps, 30 MHz - 1 GHz, Peak Detector



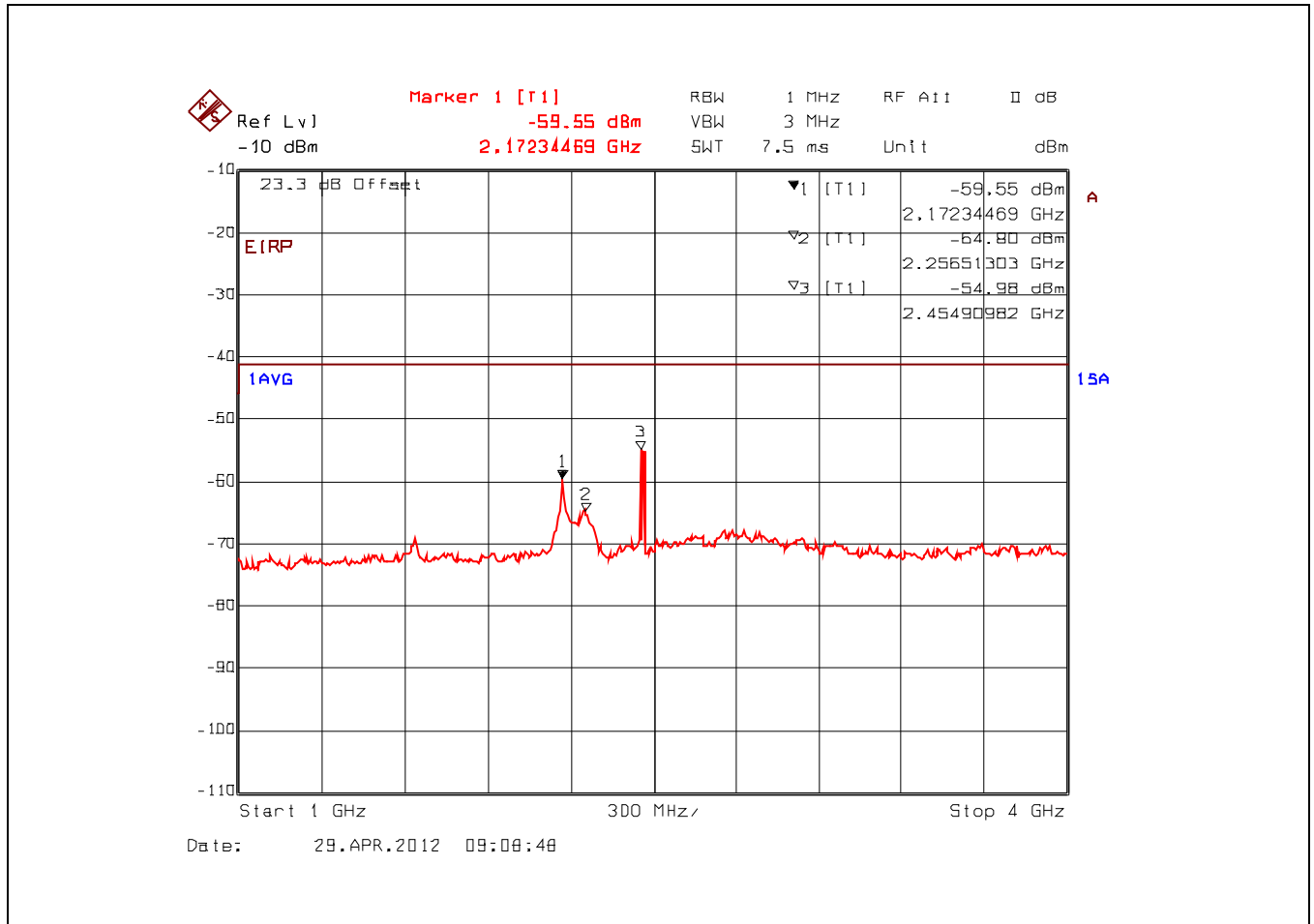
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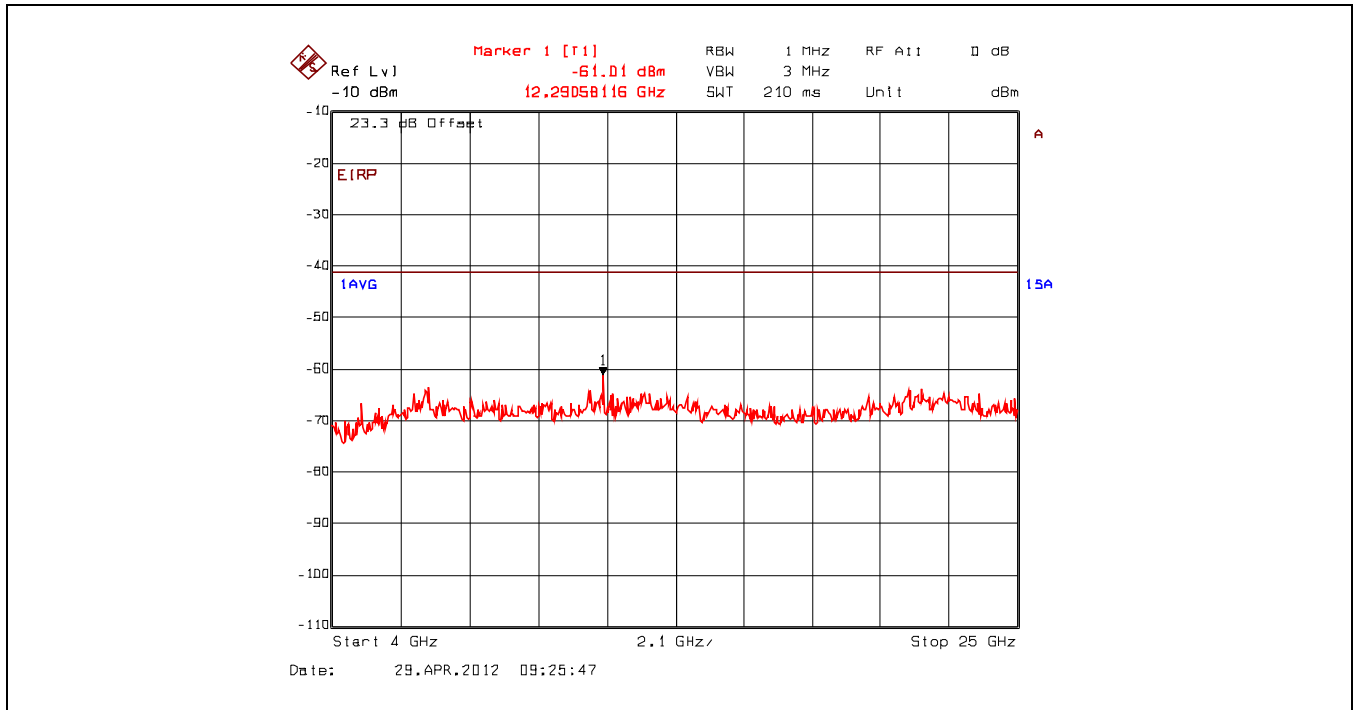
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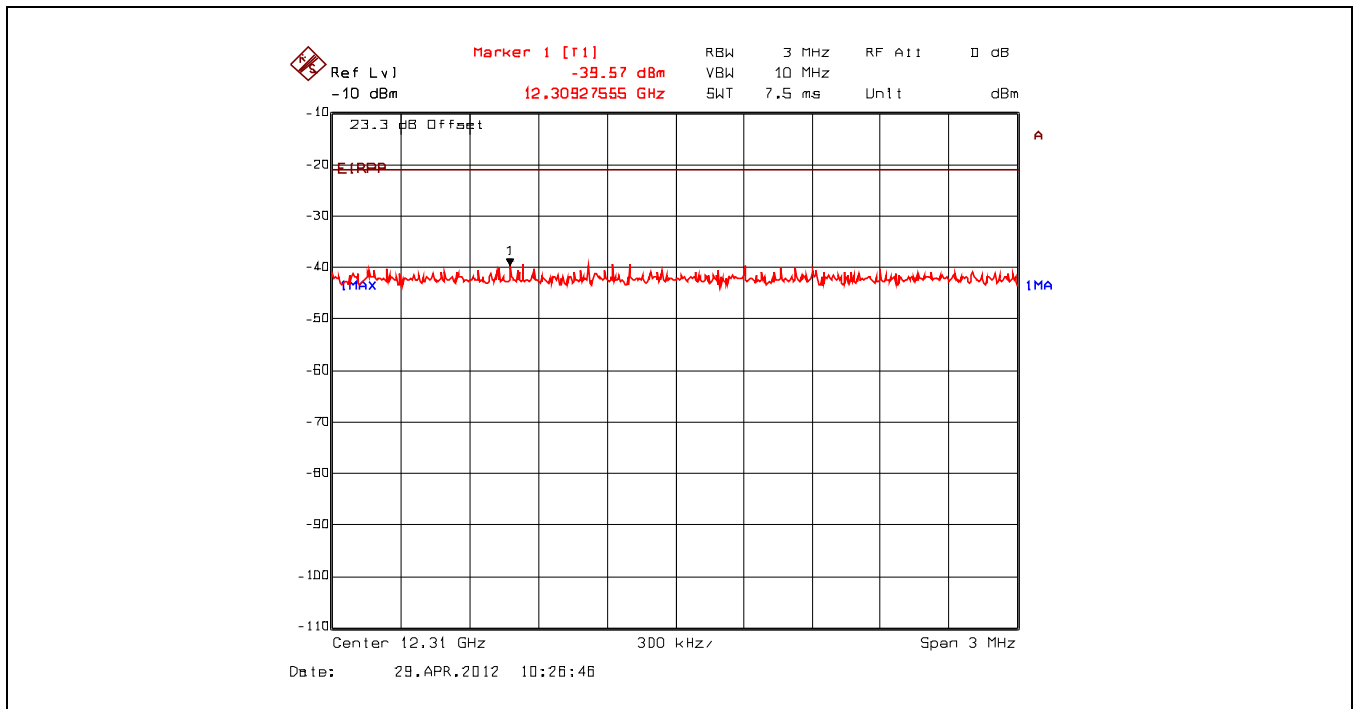
Plot 5.4.4.36. Conducted Spurious Emissions – Restricted Bands
802.11g, 2462 MHz, 64-QAM 54 Mbps, 1 GHz - 4 GHz, Trace Averaging with Band (Notch) Reject Filter



Plot 5.4.4.37. Conducted Spurious Emissions – Restricted Bands
802.11g, 2462 MHz, 64-QAM 54 Mbps, 4 GHz - 25 GHz, Trace Averaging with High Pass Filter



Plot 5.4.4.38. Conducted Spurious Emissions – Restricted Bands
802.11g, 2462 MHz, 64-QAM 54 Mbps, Peak Power at 12.31 GHz with High Pass Filter



5.5. TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]

5.5.1. Limit

§ 15.247 (d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Section 15.205(a) - Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
¹ 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(²)
13.36–13.41			

¹ Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

² Above 38.6

Section 15.209(a) - Field Strength Limits within Restricted Frequency Bands

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / 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

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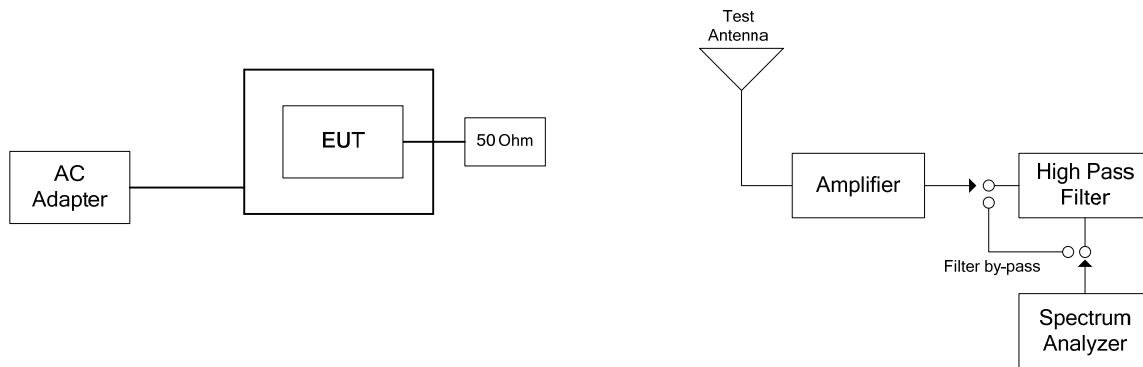
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5.5.2. Method of Measurements

KDB Publication No. 558074 D01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.

5.5.3. Test Arrangement



5.5.4. Test Data

Remark(s):

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT shall be tested in three orthogonal positions.
- For compliance with spurious emissions, power reduction is required for 802.11b mode:
 - (i) DBPSK 1 Mbps, software power setting of 55 (output power: 27.18 dBm at 2412 MHz, 28.84 dBm at 2437 MHz and 26.97 dBm at 2462 MHz) and
 - (ii) DQPSK 2 Mbps, software power setting of 54 (output power: 27.85 dBm at 2412 MHz, 28.87 dBm at 2437 MHz and 26.80 dBm at 2462 MHz).
- § 15.247 (d) spurious emission limit:

$$E = (EIRP - 20\log(d) + 104.8) - 20 = (36 \text{ dBm} - 20\log(3) + 104.8) - 20 = 111.3 \text{ dB}\mu\text{V/m}$$
- Exploratory tests performed to determined worst-case test configurations, the following test results at high power setting represent the worst-case.

5.5.4.1. 802.11 Mode, DBPSK 1 Mbps, High Power Setting 55

Fundamental Frequency: 2412 MHz							
Power Setting: 27.18 dBm (Software power setting at 55)							
Frequency Test Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dB μ V/m)	RF Avg Level (dB μ V/m)	Antenna Plane (H/V)	Limit 15.209 (dB μ V/m)	Limit 15.247 (dB μ V/m)	Margin (dB)	Pass/Fail
4824	49.74	41.12	V	54.0	111.3	-12.9	Pass*
4824	49.84	39.75	H	54.0	111.3	-14.3	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2437 MHz							
Power Setting: 28.84 dBm (Software power setting at 55)							
Frequency Test Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dB μ V/m)	RF Avg Level (dB μ V/m)	Antenna Plane (H/V)	Limit 15.209 (dB μ V/m)	Limit 15.247 (dB μ V/m)	Margin (dB)	Pass/Fail
4874	49.04	38.44	V	54.0	111.3	-15.56	Pass*
4874	49.24	38.63	H	54.0	111.3	-15.37	Pass*
7311	59.71	53.08	V	54.0	111.3	-0.92	Pass*
7311	58.30	50.91	H	54.0	111.3	-3.09	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2462 MHz							
Power Setting: 26.97 dBm (Software power setting at 55)							
Frequency Test Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
4924	48.27	38.34	V	54.0	111.3	-15.7	Pass*
4924	49.96	39.79	H	54.0	111.3	-14.2	Pass*
7386	58.94	50.35	V	54.0	111.3	-3.7	Pass*
7386	57.95	49.69	H	54.0	111.3	-4.3	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.5.4.2. 802.11g Mode, 64-QAM 54 Mbps, High Power Setting 57

Fundamental Frequency: 2412 MHz							
Power Setting: 29.96 dBm (Software power setting at 57)							
Frequency Test Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
4824	55.27	41.65	V	54.0	111.3	-12.4	Pass*
4824	57.04	44.09	H	54.0	111.3	-9.9	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2437 MHz							
Power Setting: 29.86 dBm (Software power setting at 57)							
Frequency Test Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
4874	59.08	44.92	V	54.0	111.3	-9.08	Pass*
4874	60.14	45.84	H	54.0	111.3	-8.16	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency: 2462 MHz							
Power Setting: 29.81 dBm (Software power setting at 57)							
Frequency Test Range: 30 MHz – 25 GHz							
Frequency (MHz)	RF Peak Level (dBµV/m)	RF Avg Level (dBµV/m)	Antenna Plane (H/V)	Limit 15.209 (dBµV/m)	Limit 15.247 (dBµV/m)	Margin (dB)	Pass/Fail
4924	58.46	44.55	V	54.0	111.3	-9.5	Pass*
4924	57.04	43.20	H	54.0	111.3	-10.8	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

5.6. POWER SPECTRAL DENSITY [§ 15.247(e)]

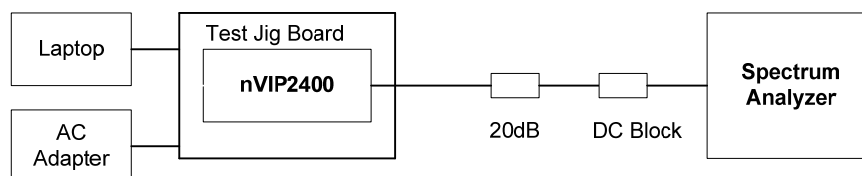
5.6.1. Limit(s)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.6.2. Method of Measurements

KDB Publication No. 558074 D01 Section 5.3.1 Measurement Procedure PKPSD.

5.6.3. Test Arrangement



5.6.4. Test Data

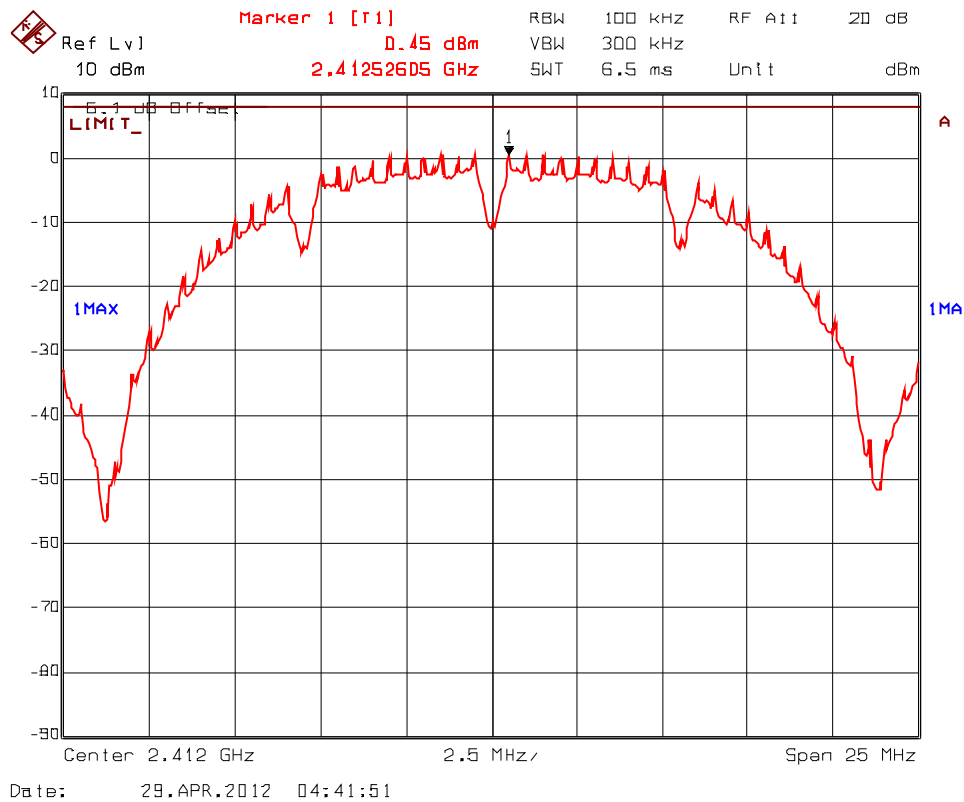
Remark: Measurement method: Section 5.3.1 Measurement Procedure PKPSD

Operation Mode	Frequency (MHz)	Modulation / Data Rate (Mbps)	Software/PCDAC Power Setting	*PSD in 3 kHz BW (dBm)	Limit (dBm)	Margin (dB)
802.11b High Power	2412	DBPSK / 1	55	0.45	8	-7.55
		DQPSK / 2	54	1.36	8	-6.64
		CCK / 11	53	1.22	8	-6.78
	2437	DBPSK / 1	55	-0.46	8	-8.46
		DQPSK / 2	54	2.52	8	-5.48
		CCK / 11	53	3.54	8	-4.46
	2462	DBPSK / 1	55	-3.61	8	-11.61
		DQPSK / 2	54	0.23	8	-7.77
		CCK / 11	53	0.49	8	-7.51

Operation Mode	Frequency (MHz)	Modulation / Data Rate (Mbps)	Software/ PCDAC Power Setting	*PSD in 3 kHz BW (dBm)	Limit (dBm)	Margin (dB)
802.11g High Power	2412	BPSK / 9	54	-2.14	8	-10.14
		QPSK / 18	54	-2.32	8	-10.32
		16-QAM /36	57	-1.10	8	-9.1
		64-QAM /54	57	-1.15	8	-9.15
	2437	BPSK / 9	54	-1.17	8	-9.17
		QPSK / 18	54	-0.84	8	-8.84
		16-QAM /36	57	0.17	8	-7.83
		64-QAM /54	57	0.36	8	-7.64
	2462	BPSK / 9	54	-2.69	8	-10.69
		QPSK / 18	54	-2.71	8	-10.71
		16-QAM /36	57	-1.51	8	-9.51
		64-QAM /54	57	-1.41	8	-9.41

See the following plots for measurement details.

Plot 5.6.4.1. Power Spectral Density
802.11b, 2412 MHz, DBPSK 1 Mbps, Power Setting 55
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



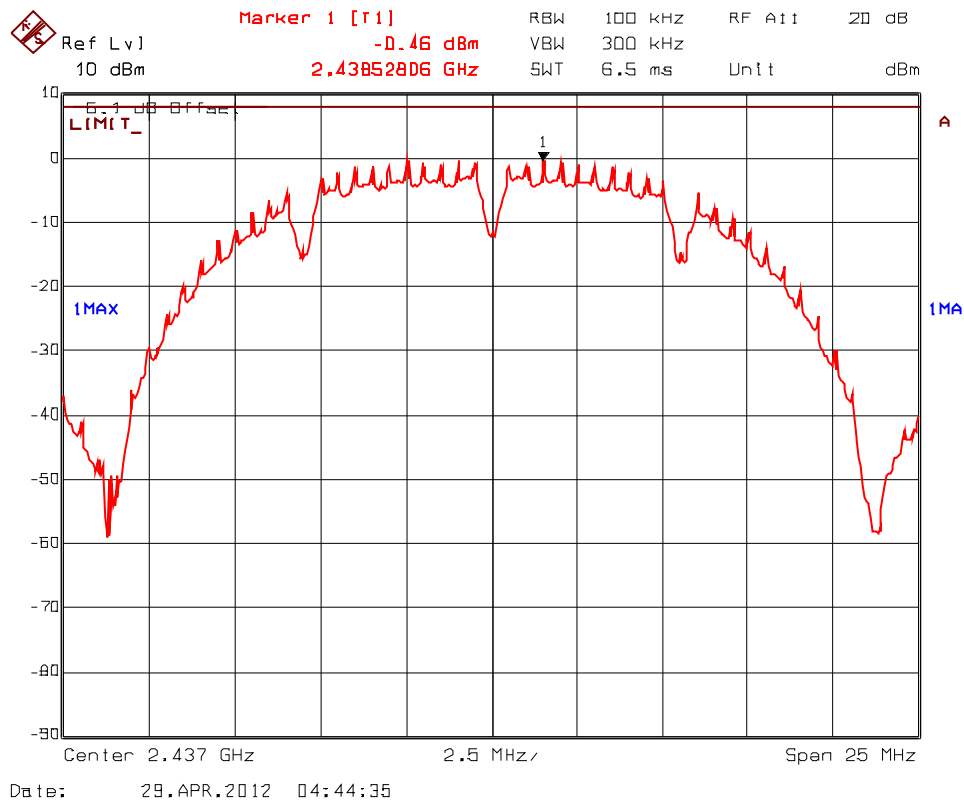
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Plot 5.6.4.2. Power Spectral Density
802.11b, 2437 MHz, DBPSK 1 Mbps, Power Setting 55
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



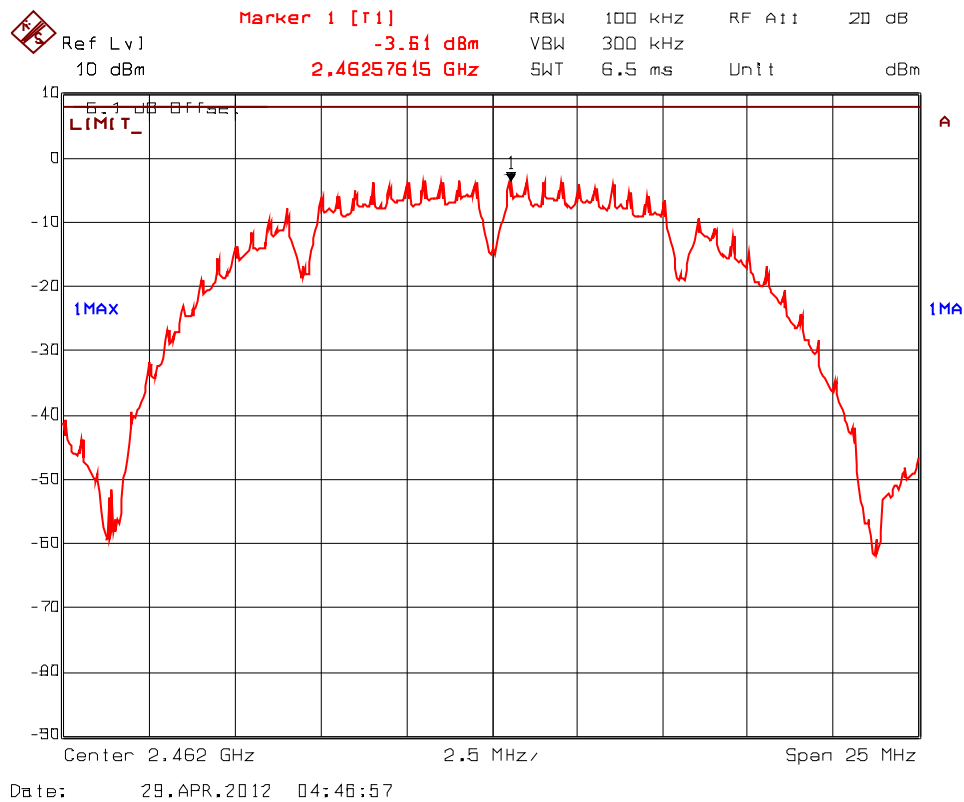
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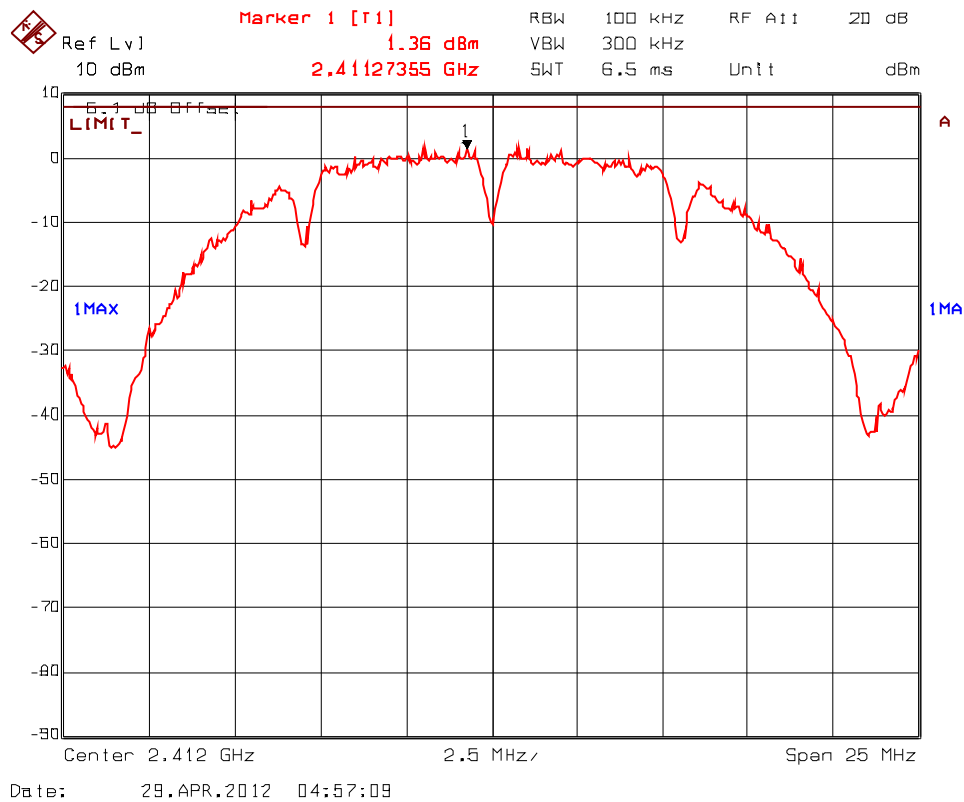
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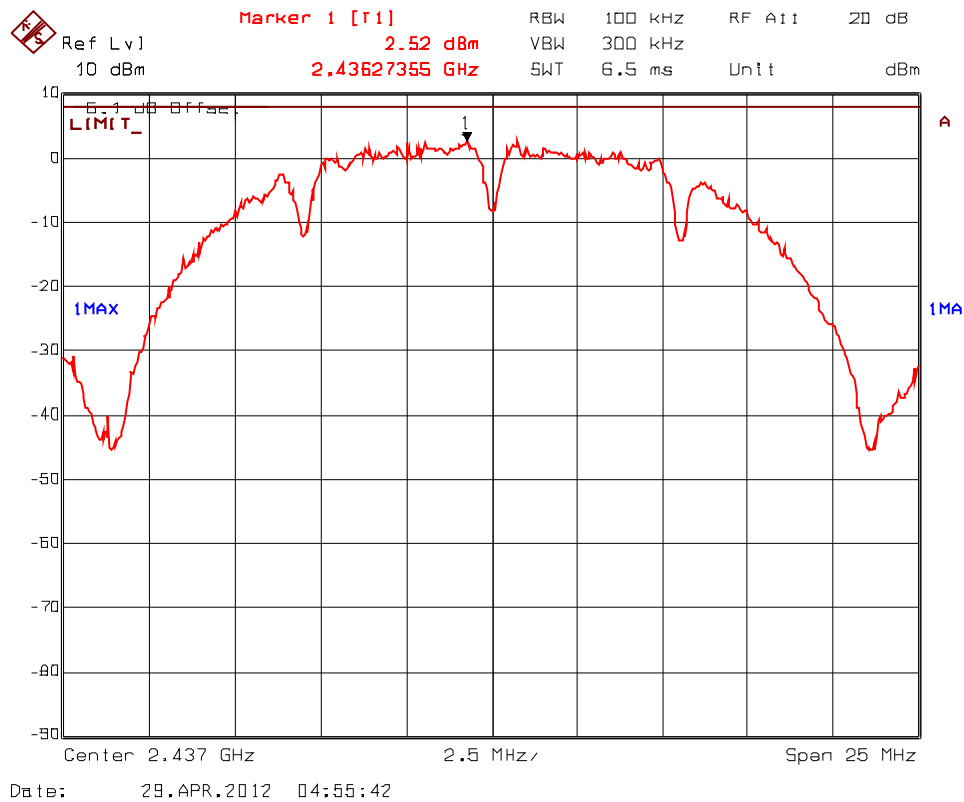
Plot 5.6.4.3. Power Spectral Density
 802.11b, 2462 MHz, DBPSK 1 Mbps, Power Setting 55
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



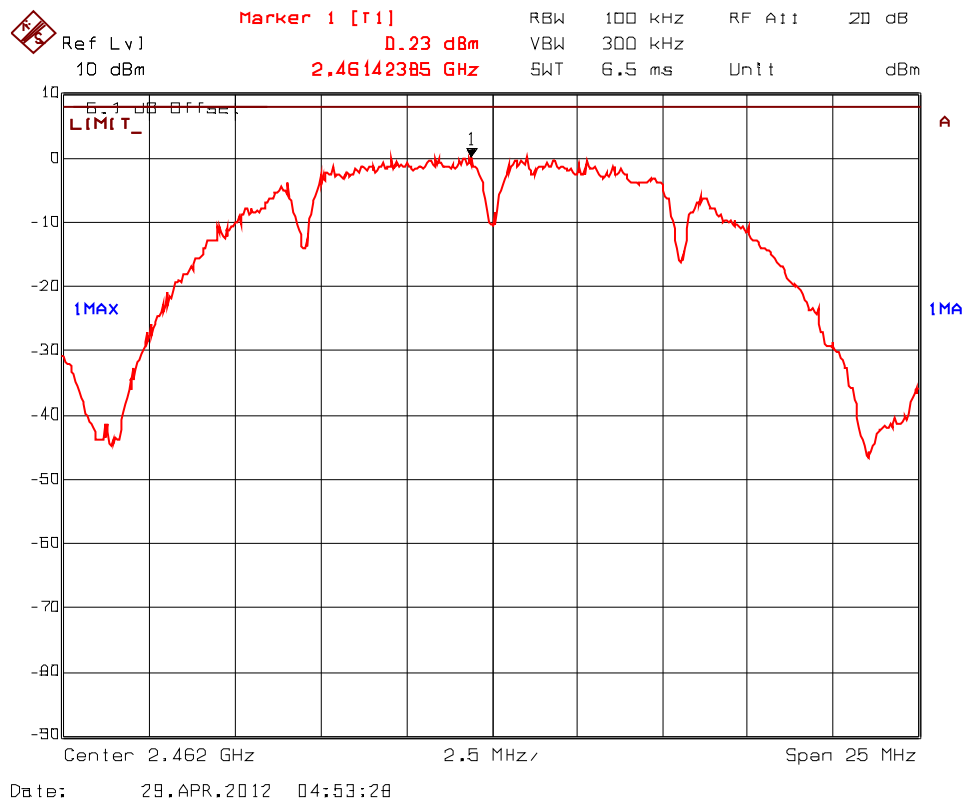
Plot 5.6.4.4. Power Spectral Density
802.11b, 2412 MHz, DQPSK 2 Mbps, Power Setting 54
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



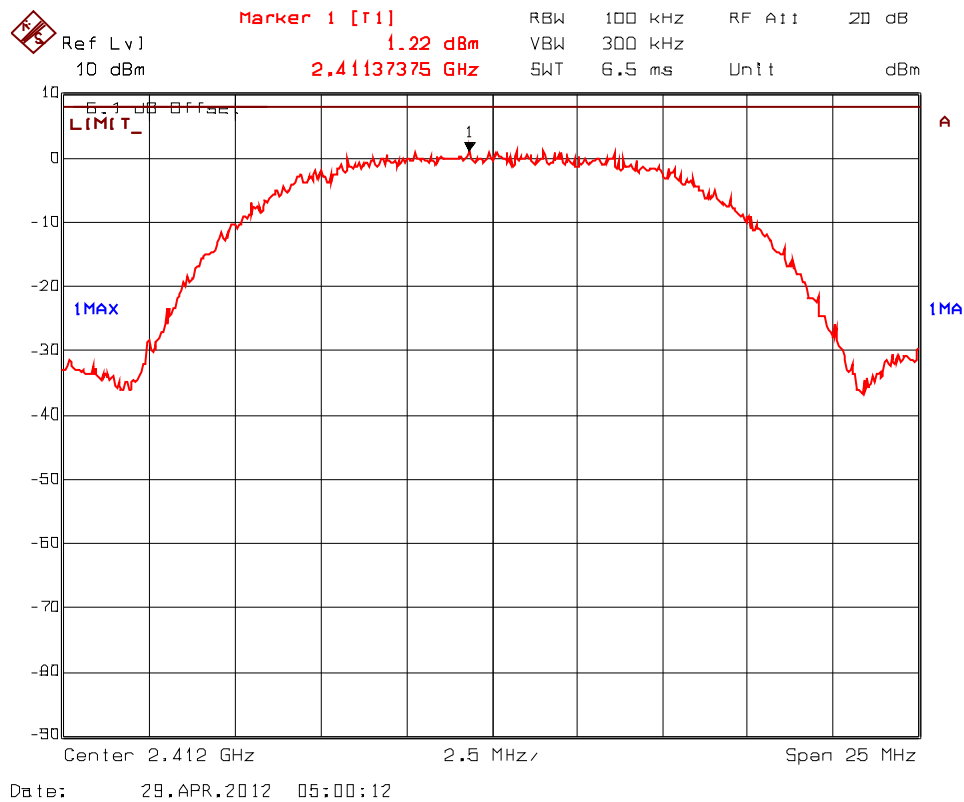
Plot 5.6.4.5. Power Spectral Density
 802.11b, 2437 MHz, DQPSK 2 Mbps, Power Setting 54
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



Plot 5.6.4.6. Power Spectral Density
 802.11b, 2462 MHz, DQPSK 2 Mbps, Power Setting 54
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



Plot 5.6.4.7. Power Spectral Density
802.11b, 2412 MHz, CCK 11 Mbps, Power Setting 53
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



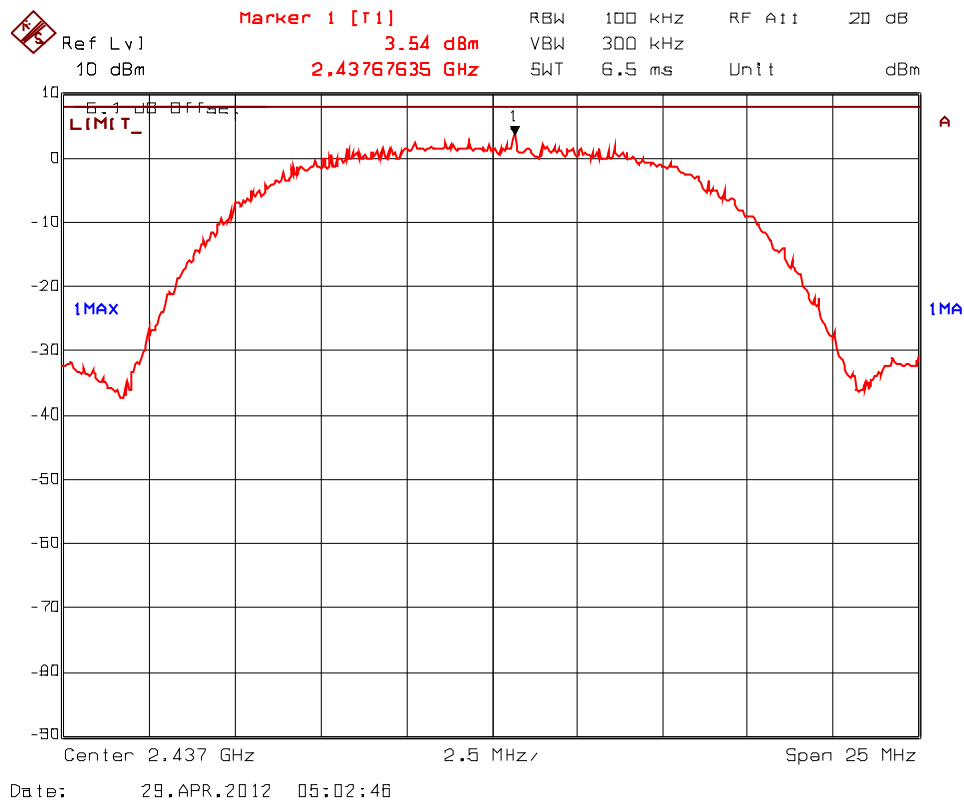
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Plot 5.6.4.8. Power Spectral Density
802.11b, 2437 MHz, CCK 11 Mbps, Power Setting 53
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



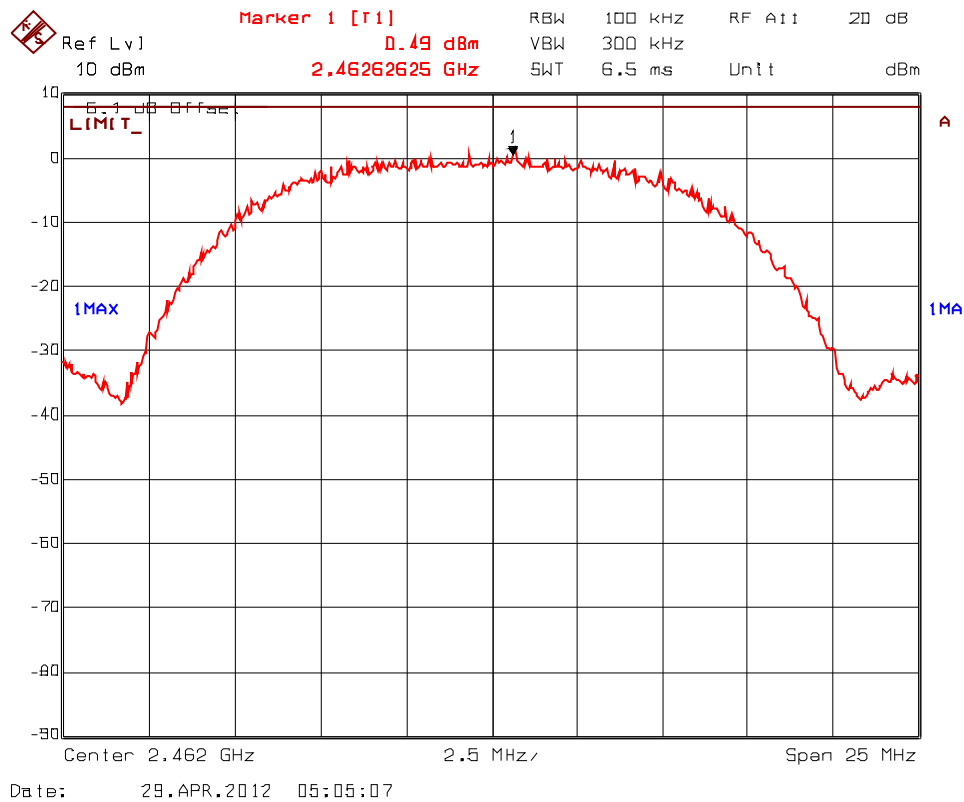
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Plot 5.6.4.9. Power Spectral Density
802.11b, 2462 MHz, CCK 11 Mbps, Power Setting 53
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



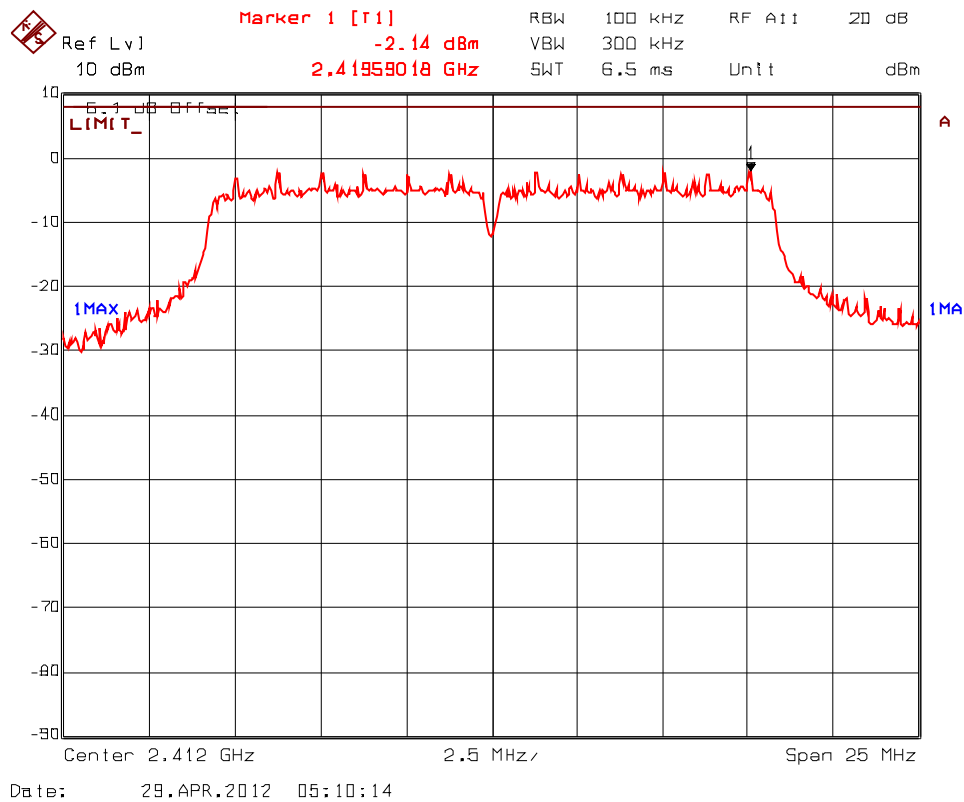
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Plot 5.6.4.10. Power Spectral Density
802.11g, 2412 MHz, BPSK 9 Mbps, Power Setting 54
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



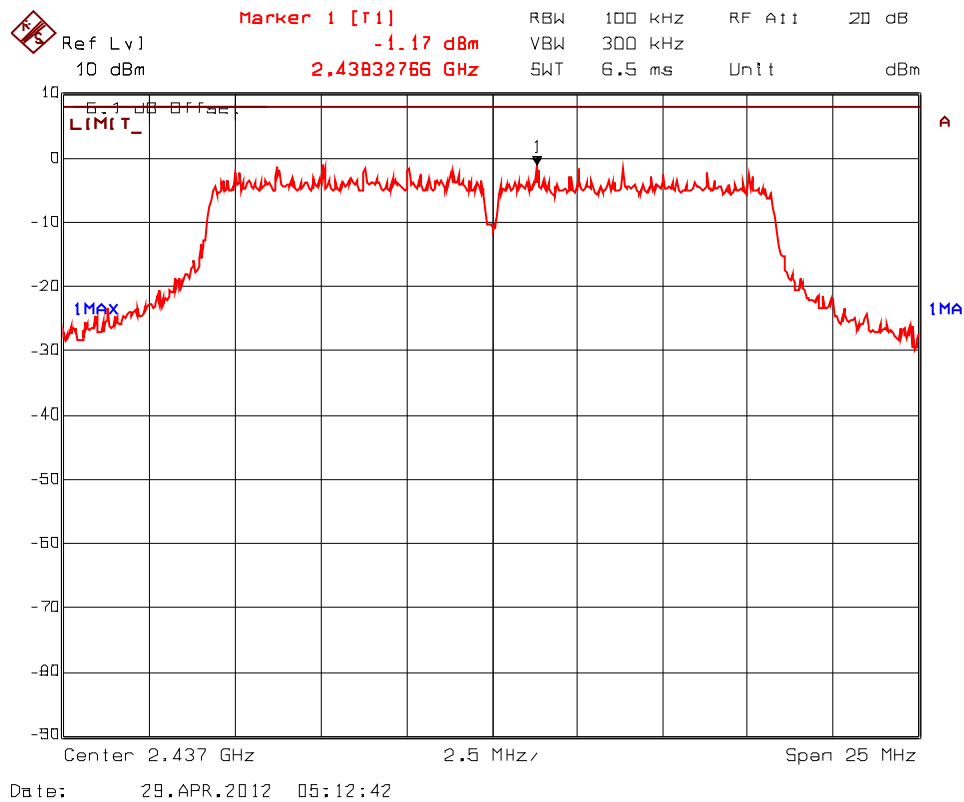
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Plot 5.6.4.11. Power Spectral Density
802.11g, 2437 MHz, BPSK 9 Mbps, Power Setting 54
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



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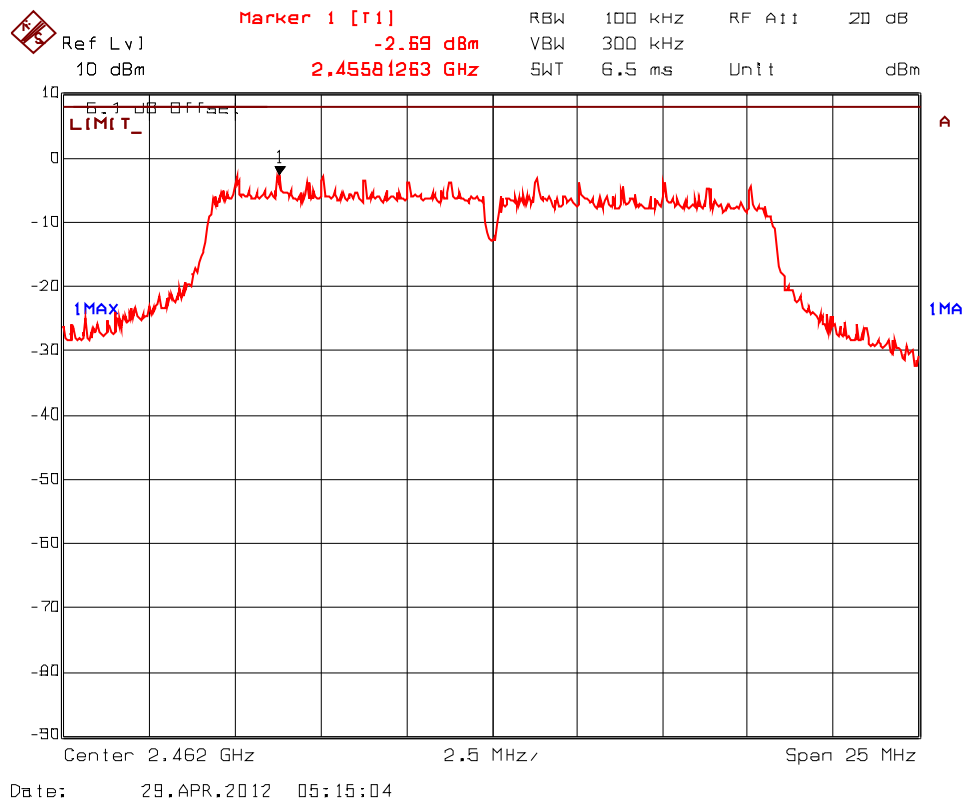
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
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Plot 5.6.4.12. Power Spectral Density
802.11g, 2462 MHz, BPSK 9 Mbps, Power Setting 54
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



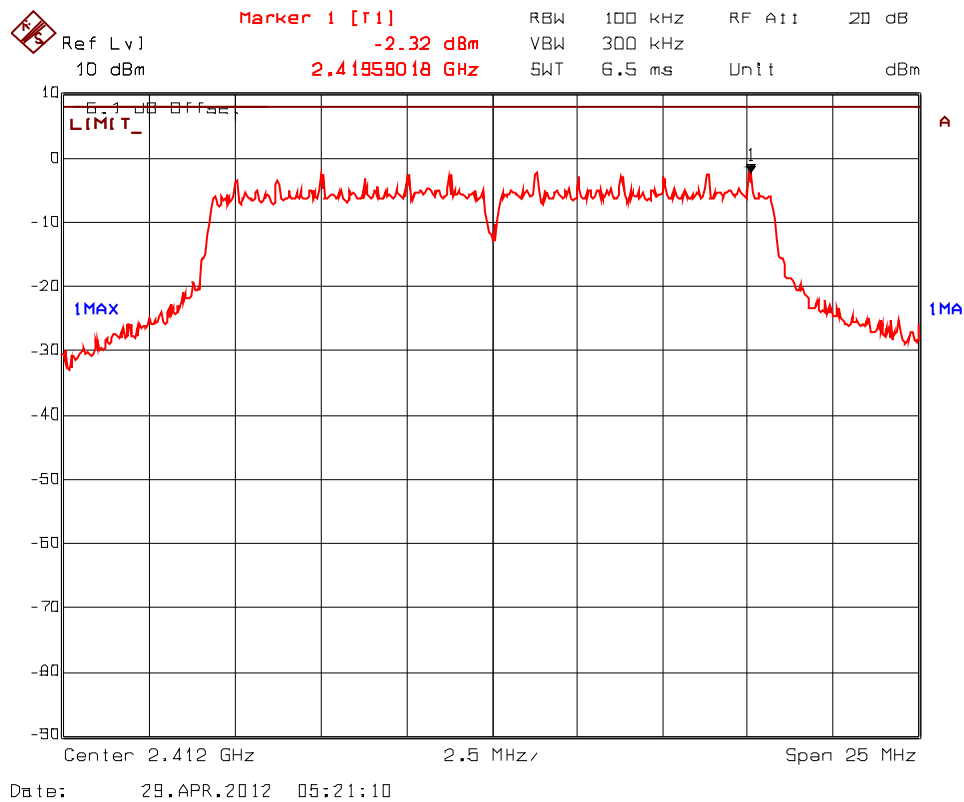
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Plot 5.6.4.13. Power Spectral Density
 802.11g, 2412 MHz, QPSK 18 Mbps, Power Setting 54
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



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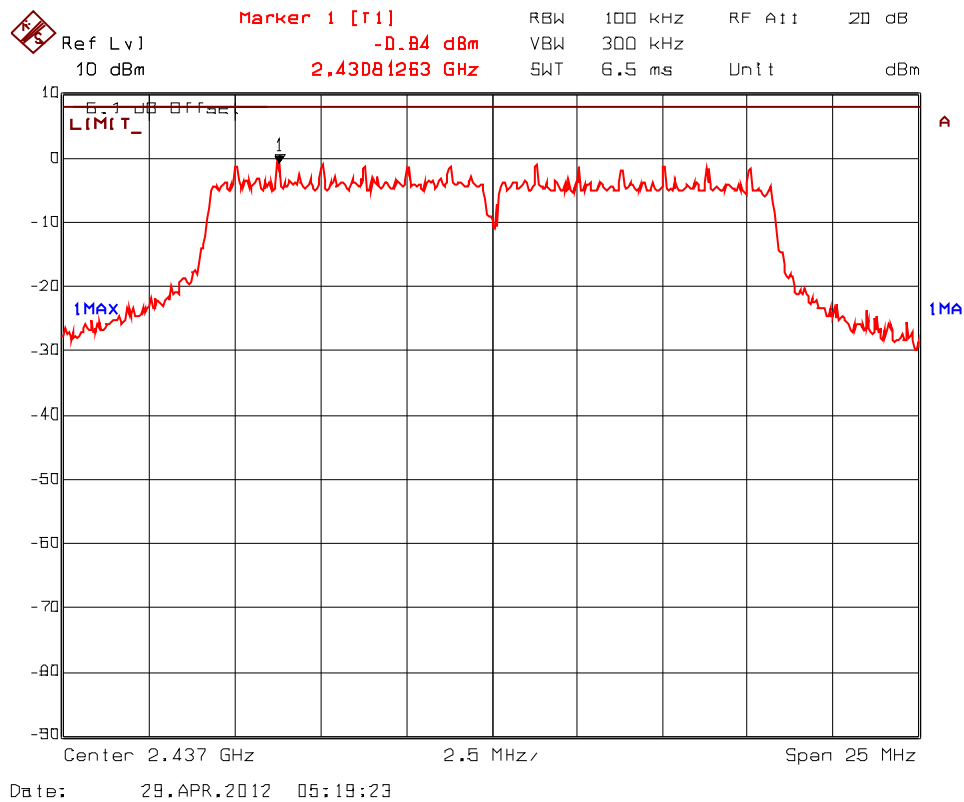
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Plot 5.6.4.14. Power Spectral Density
802.11g, 2437 MHz, QPSK 18 Mbps, Power Setting 54
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



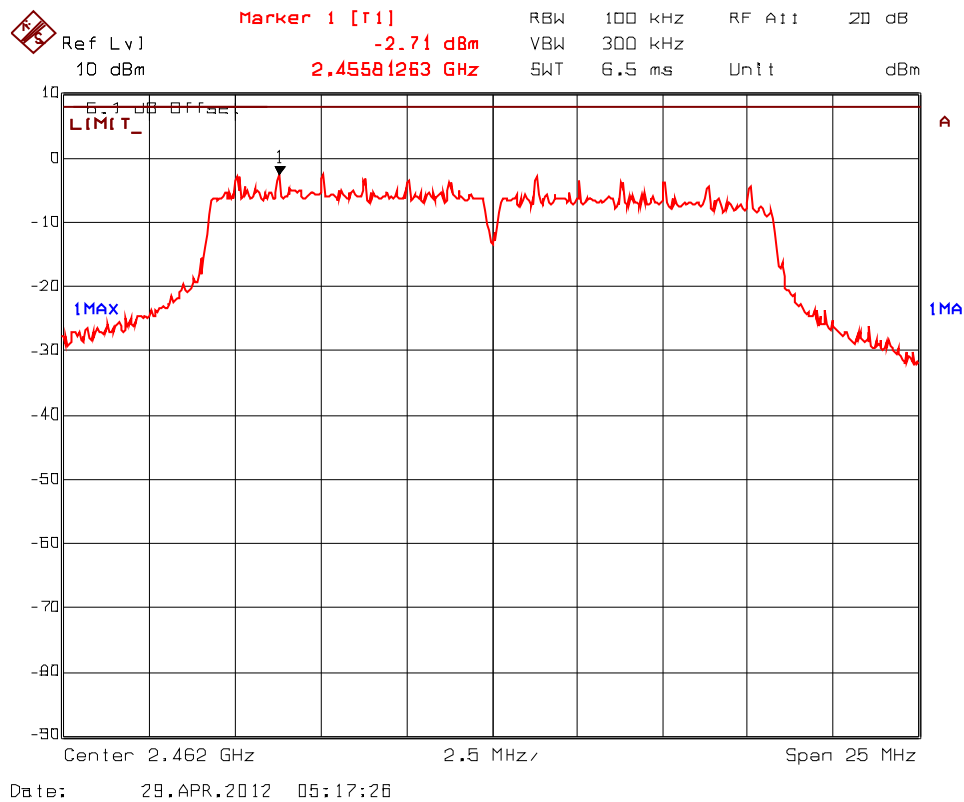
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Plot 5.6.4.15. Power Spectral Density
 802.11g, 2462 MHz, QPSK 18 Mbps, Power Setting 54
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



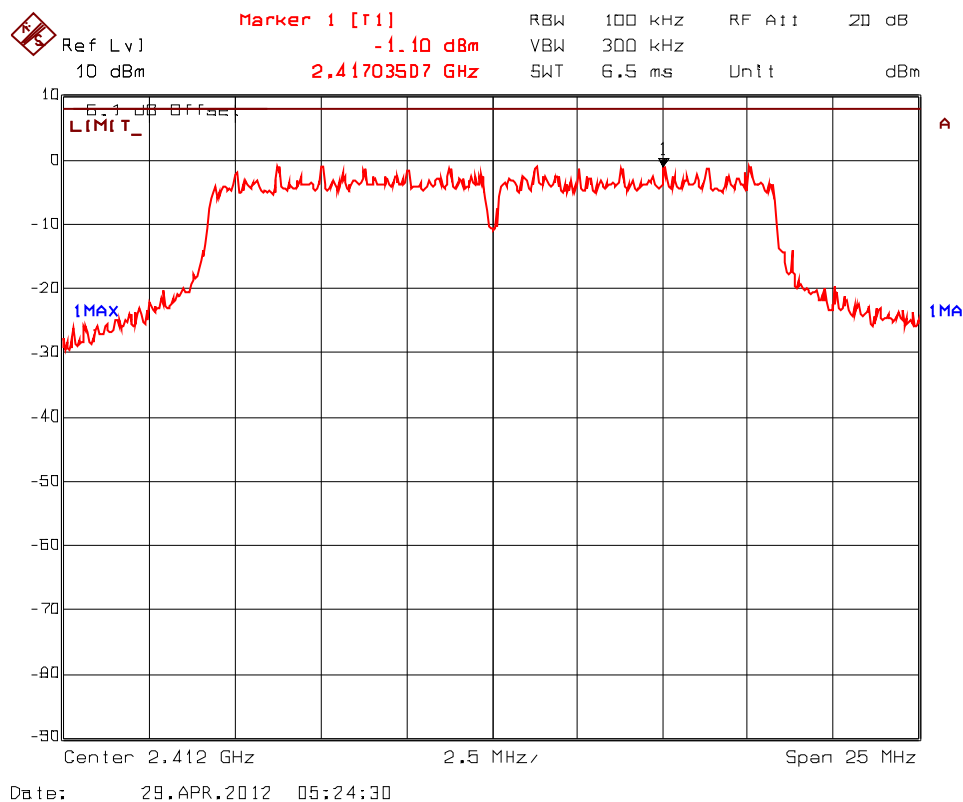
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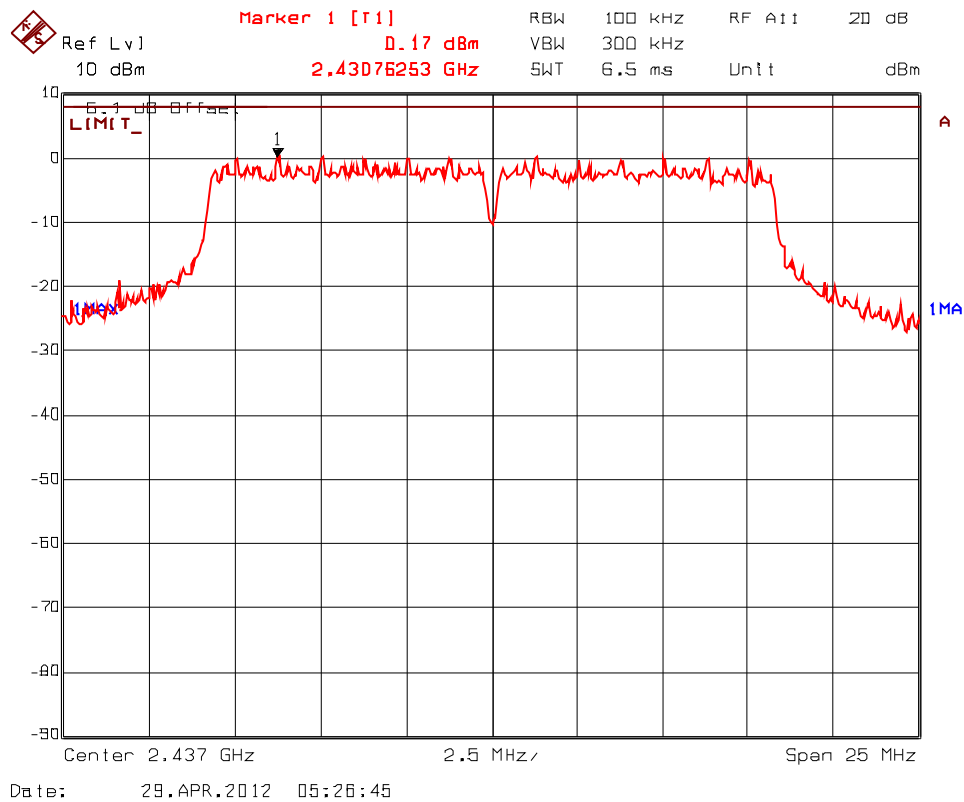
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Plot 5.6.4.16. Power Spectral Density
802.11g, 2412 MHz, 16-QAM 36 Mbps, Power Setting 57
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



Plot 5.6.4.17. Power Spectral Density
 802.11g, 2437 MHz, 16-QAM 36 Mbps, Power Setting 57
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



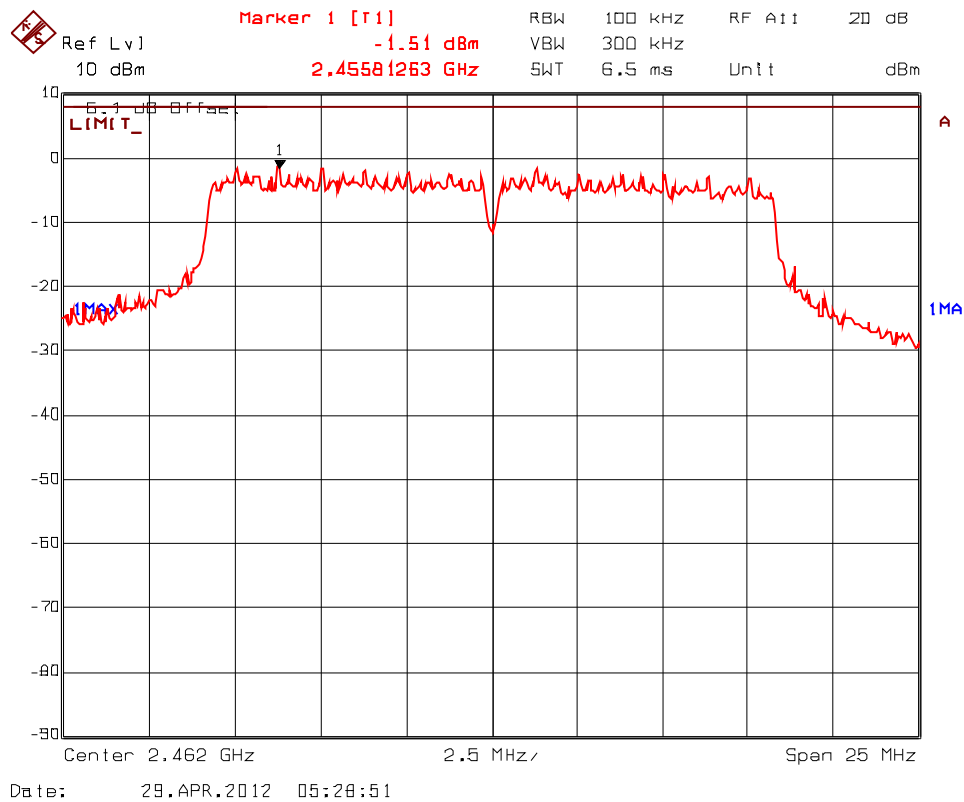
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Plot 5.6.4.18. Power Spectral Density
802.11g, 2462 MHz, 16-QAM 36 Mbps, Power Setting 57
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



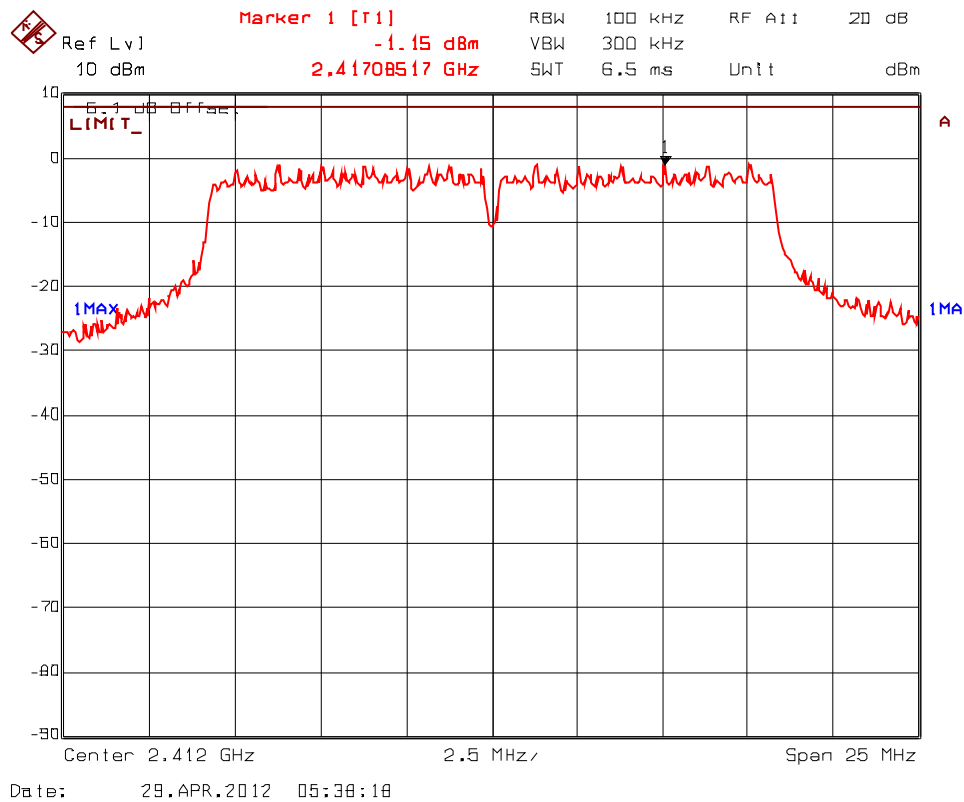
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Plot 5.6.4.19. Power Spectral Density
802.11g, 2412 MHz, 64-QAM 54 Mbps, Power Setting 57
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



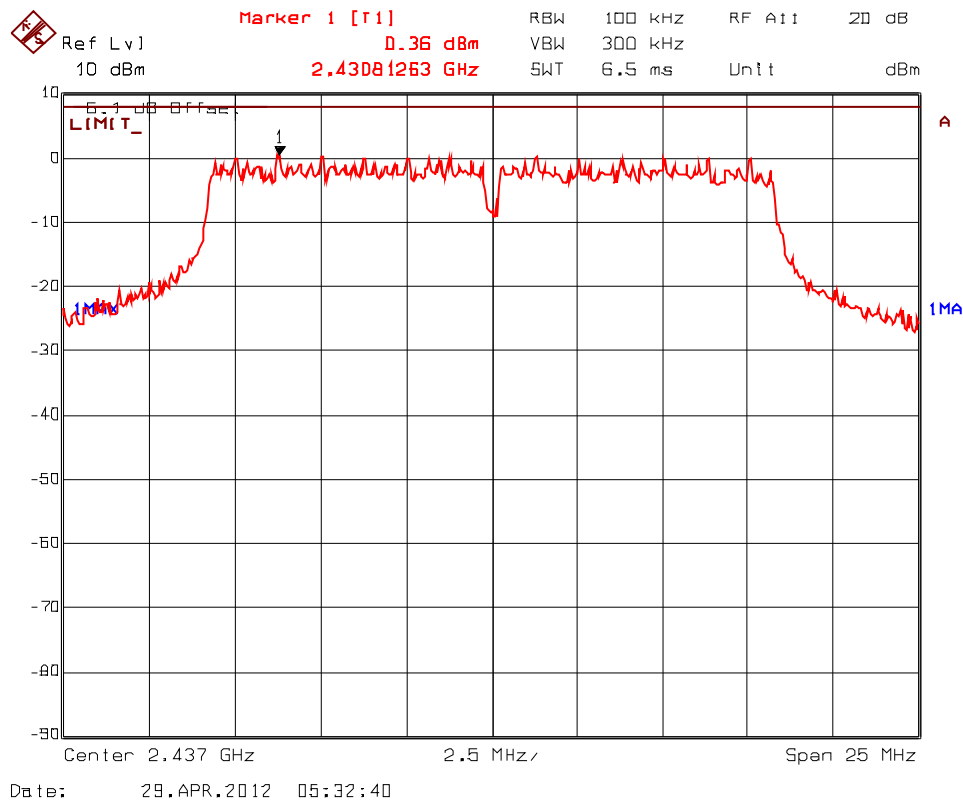
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Plot 5.6.4.20. Power Spectral Density
802.11g, 2437 MHz, 64-QAM 54 Mbps, Power Setting 57
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



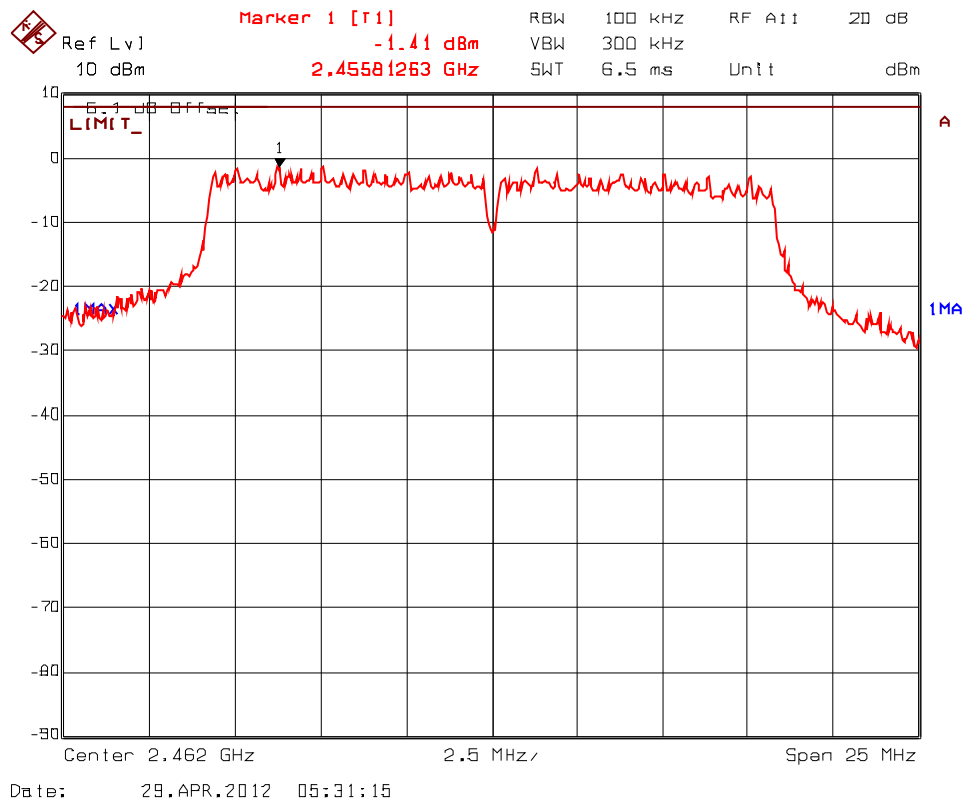
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Plot 5.6.4.21. Power Spectral Density
802.11g, 2462 MHz, 64-QAM 54 Mbps, Power Setting 57
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 6.1 dB



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5.7. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091]

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

FCC 47 CFR § 1.1310:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.7.1. Method of Measurements

Refer to Sections 1.1310, 2.1091

In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

- (1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
- (2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
- (3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
- (4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

$$S = \frac{P \cdot G}{4 \cdot \pi \cdot r^2} = \frac{EIRP}{4 \cdot \pi \cdot r^2}$$

Where:
P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power
S: power density mW/cm²
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

5.7.2. RF Evaluation

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	Compliance with FCC Rules
Minimum calculated separation distance between antenna and persons required: *18 cm	Manufacturer' instruction for separation distance between antenna and persons required: 23 cm.
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	Antenna installation and device operating instructions shall be provided to installers to maintain and ensure compliance with RF exposure requirements.
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	Refer to User's Manual for RF Exposure Information.
Any other RF exposure related issues that may affect MPE compliance	None.

*The minimum separation distance between the antenna and bodies of users are calculated using the following formula:

RF EXPOSURE DISTANCE LIMITS

$$r = \sqrt{\frac{P \cdot G}{4 \cdot \pi \cdot S}} = \sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}}$$

S = 1.0 mW/cm²
EIRP = 36.0 dBm = 10^{36/10} mW = 3981 mW (Worst Case)

$$(\text{Minimum Safe Distance, } r) = \sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}} = \sqrt{\frac{3981}{4 \cdot \pi \cdot (1.0)}} \approx 18\text{cm}$$

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EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz	30 Jan 2013
L.I.S.N	ULT AC LISN	--	ULT-01;-02;-03;-04	10 kHz – 30 MHz	21 Feb 2013
Attenuator	Pasternack	PE7010-20	-	DC – 2 GHz	09 Jan 2013
Band Pass Filter	Telemeter Electronics	MTA-HPF-150	2110465-007	-	17 Aug 2013
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20Hz–40 GHz	27 Sep 2012
Attenuator	Narda	4768-20	-	DC–40 GHz	Cal on use
DC Block	Hewlett Packard	11742A	12460	0.045–26.5 GHz	Cal on use
High Pass Filter	K & L	11SH10-4000/T12000-O/O	4	Cut off at 3900 MHz	Cal. on use
Attenuator	Pasternack	PE7024-10	-	DC–26.5 GHz	Cal on use
Band Reject (Notch) Filters	Micro-Tronics	BRM50701	105	Stopband: 2400 to 2500 MHz	Cal on use
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	19 Mar 2013
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	01 Dec 2012
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	16 Mar 2013
Horn Antenna	EMCO	3155	5955	1 – 18 GHz	20 Feb 2013
Biconi-Log Antenna	EMCO	3142C	00034792	26 – 3000 MHz	04 May 2013
DC Power Supply	Xantrex	HPD 60-5SX	56218	0 – 60 V	Cal on use

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EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (150 kHz – 30 MHz):	Measured	Limit
u_c	Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	± 1.57	± 1.8
U	Expanded uncertainty U: $U = 2u_c(y)$	± 3.14	± 3.6

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	Measured	Limit
u_c	Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	± 2.15	± 2.6
U	Expanded uncertainty U: $U = 2u_c(y)$	± 4.30	± 5.2

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	Measured	Limit
u_c	Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	± 2.39	± 2.6
U	Expanded uncertainty U: $U = 2u_c(y)$	± 4.78	± 5.2

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	Measured	Limit
u_c	Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	± 1.87	Under consideration
U	Expanded uncertainty U: $U = 2u_c(y)$	± 3.75	Under consideration