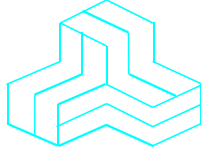


ENGINEERING TEST REPORT



2400MHz OEM DTS / Frequency Hopping Module
Model: n2420BT
FCC ID: NS912P32

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-047F15C247DTS

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

Date: July 23, 2012

Report Prepared by: Dan Huynh

Tested by: Mr. Hung Trinh

Issued Date: July 23, 2012

Test Dates: April 9 - July 9, 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

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
Tel.: (905) 829-1570 Fax.: (905) 829-8050
Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com

FCC

91038



1309



Industry Canada
Industrie Canada

Approved Test Facility

46390-2049



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

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:	2400MHz OEM DTS / Frequency Hopping Module
Model Name or Number:	n2420BT
Serial Number:	Test Sample
Type of Equipment:	Digital Transmission System (DTS)
Input Power Supply Type:	External Regulated DC Sources
Primary User Functions of EUT:	Spread Spectrum OEM Transceiver

2.3. EUT’S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	<ul style="list-style-type: none"> ▪ Mobile ▪ Base Station (fixed use)
Intended Operating Environment:	<ul style="list-style-type: none"> ▪ Commercial, industrial or business environment ▪ Residential environment
Power Supply Requirement:	3.3V or (7 to 30VDC HV option)
RF Output Power Rating:	7.75 dBm to 30 dBm
Operating Frequency Range:	2402.5 – 2476.5 MHz
RF Output Impedance:	50 Ohm
Duty Cycle:	100%
Modulation Type:	DTS*
Antenna Connector Type:	MMCX

*See Operational Description exhibit supplied by the manufacturer for details of modulation type for DTS.

2.4. ASSOCIATED ANTENNA DESCRIPTIONS

There are four antenna families:

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

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:	AC/DC Adapter
Brand name:	CUI
Model Name or Number:	KSAFE1200200W1US
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

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):	2402.5 – 2476.5 MHz
Frequency(ies) Tested:	2402.50 MHz, 2439.25 MHz, 2476.00 MHz 2403.50 MHz, 2439.50 MHz, 2475.50 MHz 2404.00 MHz, 2440.25 MHz, 2476.50 MHz 2405.50 MHz, 2439.50 MHz, 2473.50 MHz
RF Power Output: (measured maximum output power at antenna terminals)	1 Watt (conducted)
*Normal Test Modulation:	Data Rate 8, 9, 10 and 11
Modulating Signal Source:	Internal

*See Operational Description exhibit supplied by the manufacturer for details of the data rates for DTS.

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.

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:

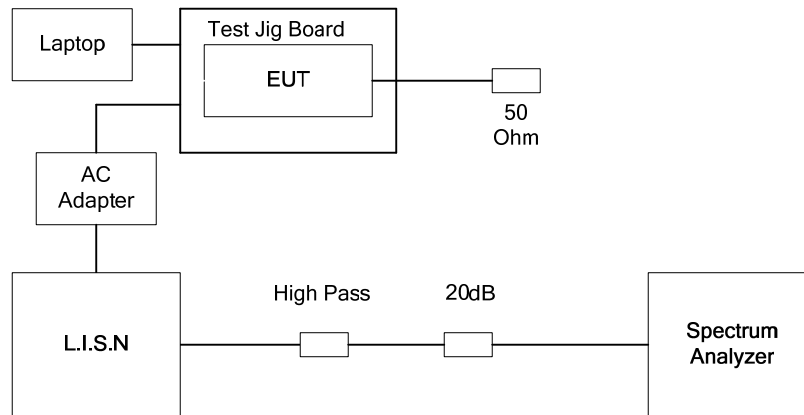
Frequency of emission (MHz)	Conducted Limits (dBµV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases linearly with the logarithm of the frequency

5.1.2. Method of Measurements

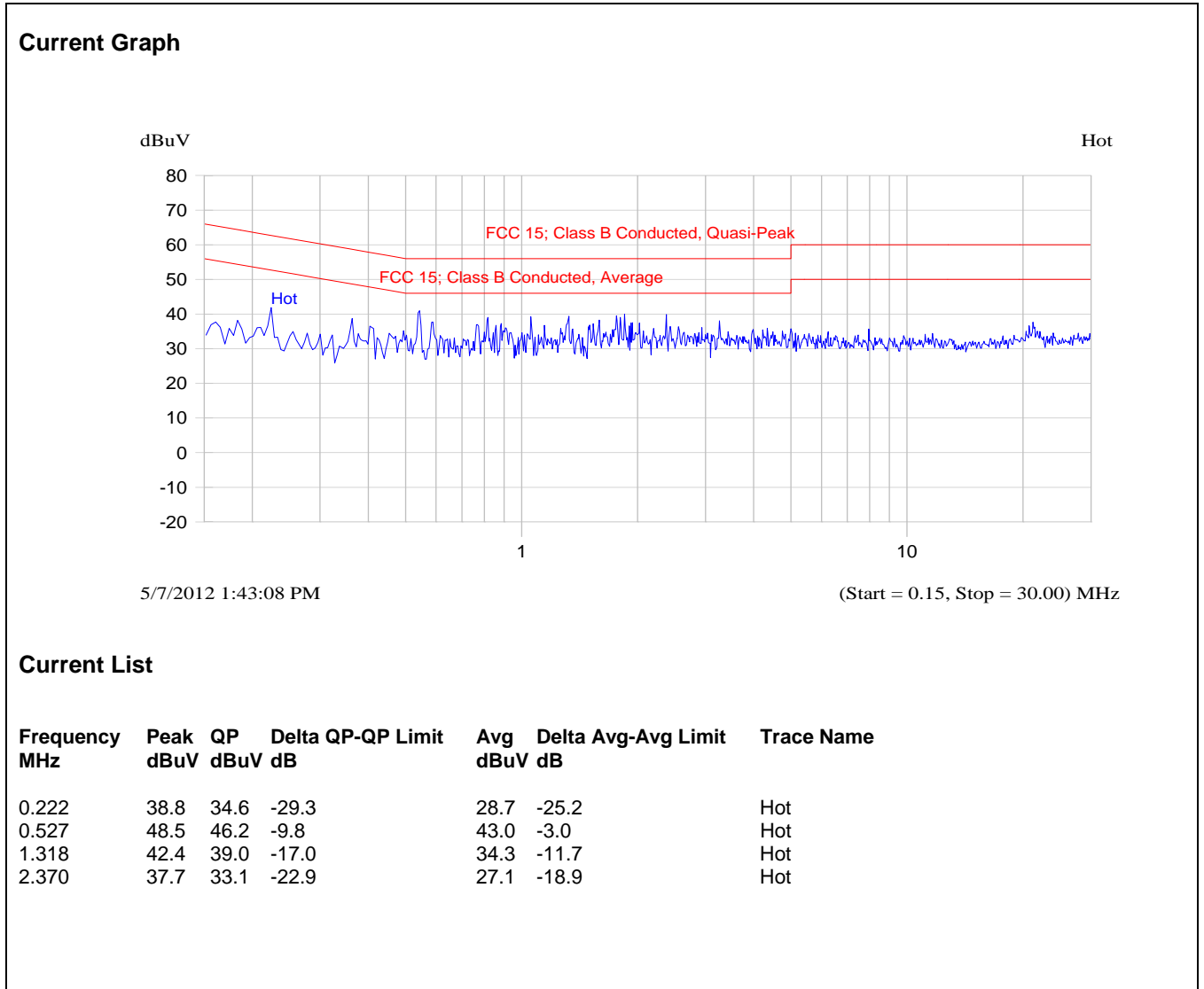
ANSI C63.4-2009

5.1.3. Test Arrangement

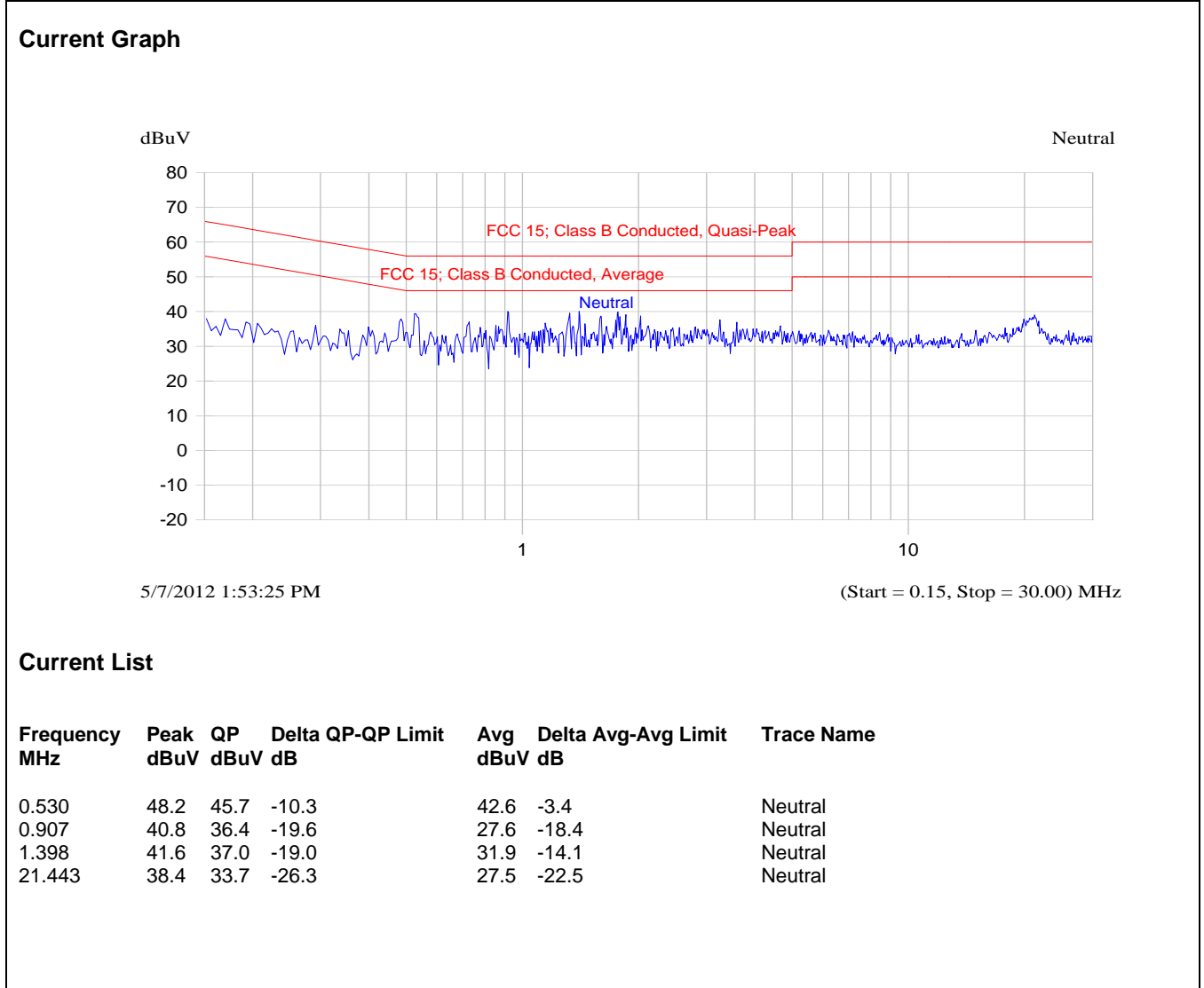


5.1.4. Test Data

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



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



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

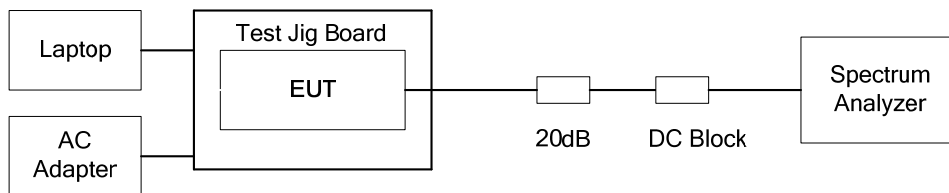
5.2.1. Limit(s)

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

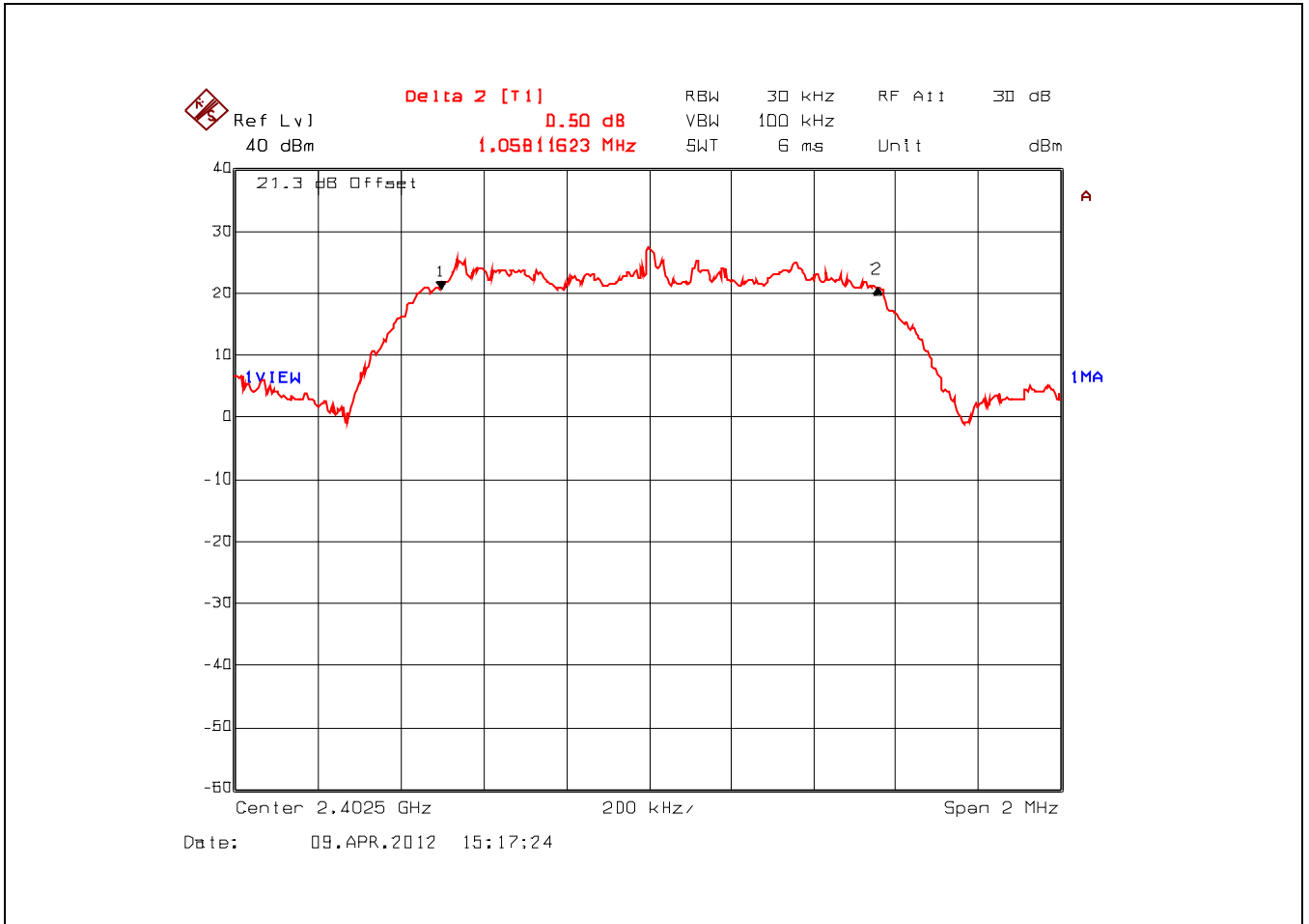


5.2.4. Test Data

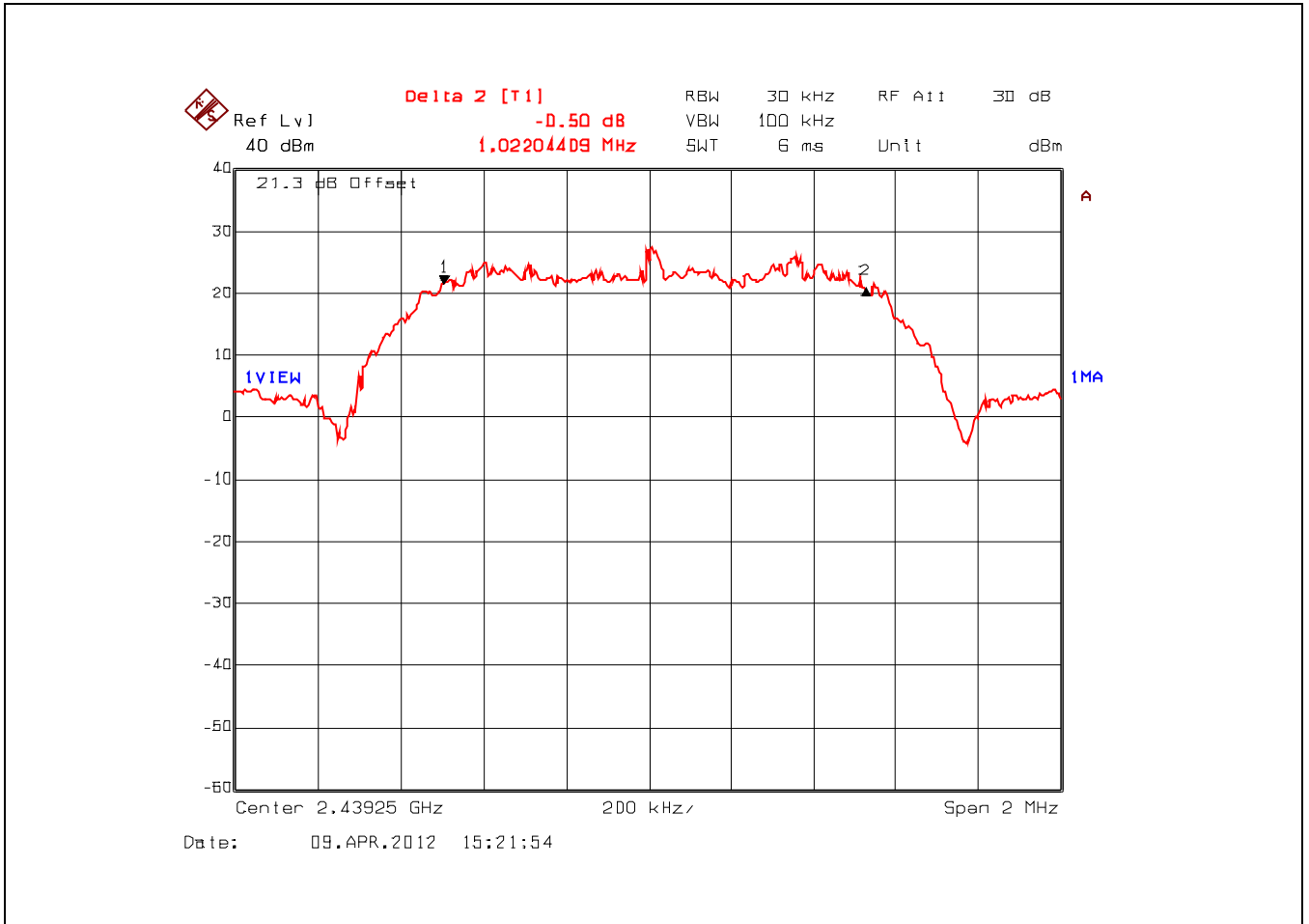
Frequency (MHz)	Data Rate	6 dB Bandwidth (MHz)	99% OBW (MHz)
2402.50	Data Rate 8	1.058	1.368
2439.25	Data Rate 8	1.022	1.368
2476.00	Data Rate 8	0.986	1.318
2403.50	Data Rate 9	1.317	1.904
2439.50	Data Rate 9	1.395	1.864
2475.50	Data Rate 9	1.323	1.834
2404.00	Data Rate 10	1.715	2.265
2440.25	Data Rate 10	1.707	2.255
2476.50	Data Rate 10	1.635	2.244
2405.50	Data Rate 11	2.802	3.679
2439.50	Data Rate 11	2.754	3.463
2473.50	Data Rate 11	2.633	3.343

See the following plots for detailed measurements.

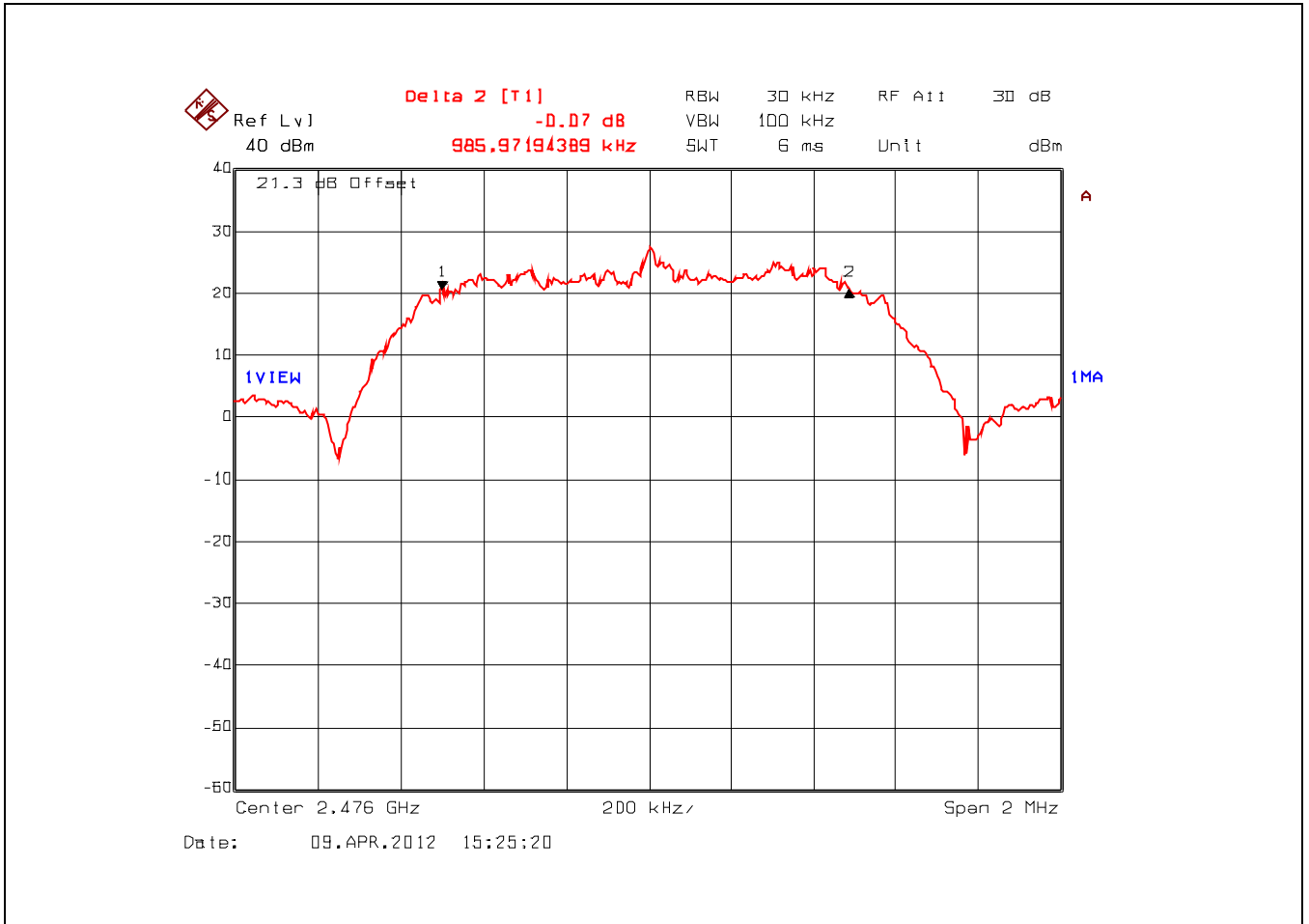
Plot 5.2.4.1. 6 dB Bandwidth, 2402.50 MHz, Data Rate 8



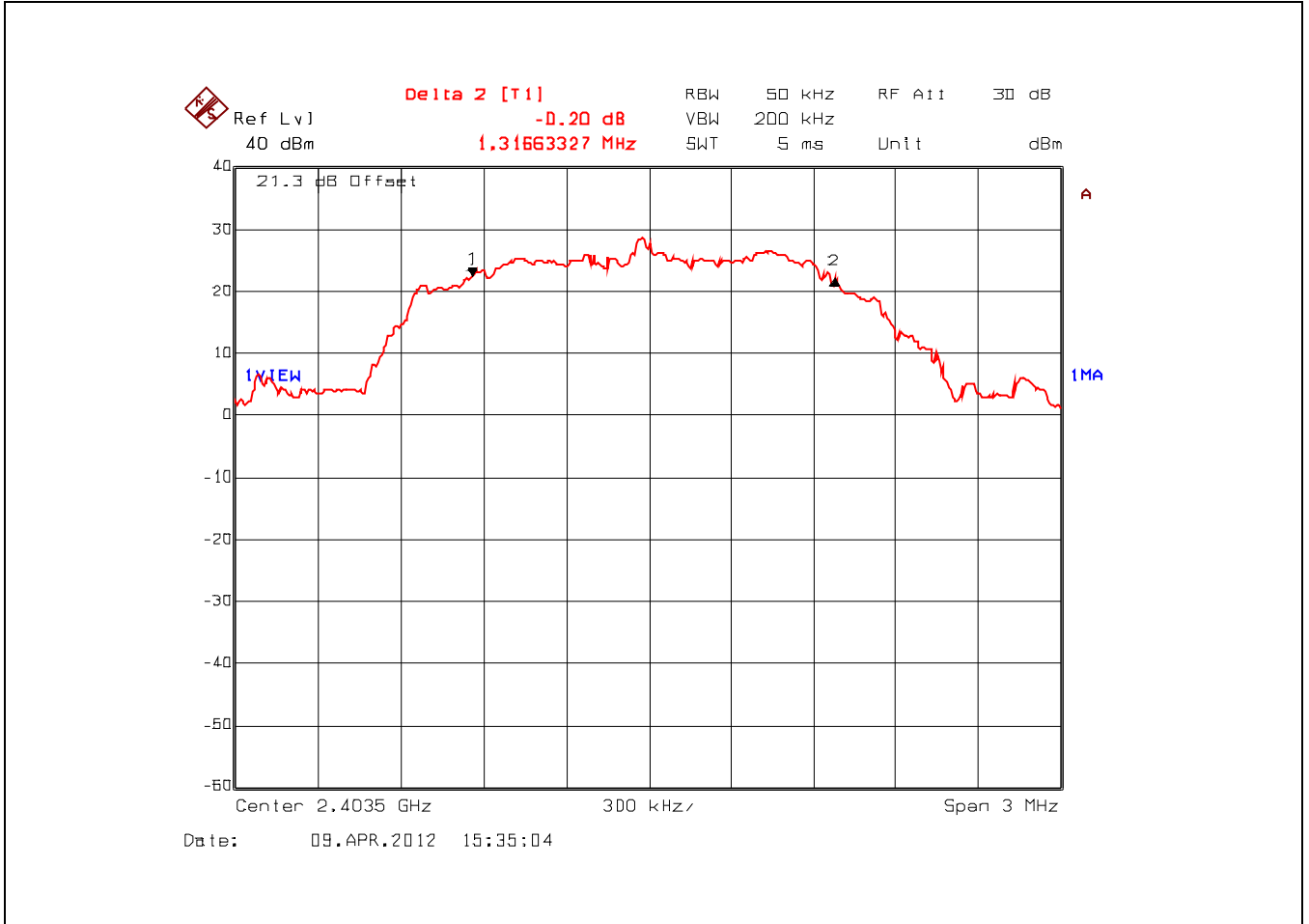
Plot 5.2.4.2. 6 dB Bandwidth, 2439.25 MHz, Data Rate 8



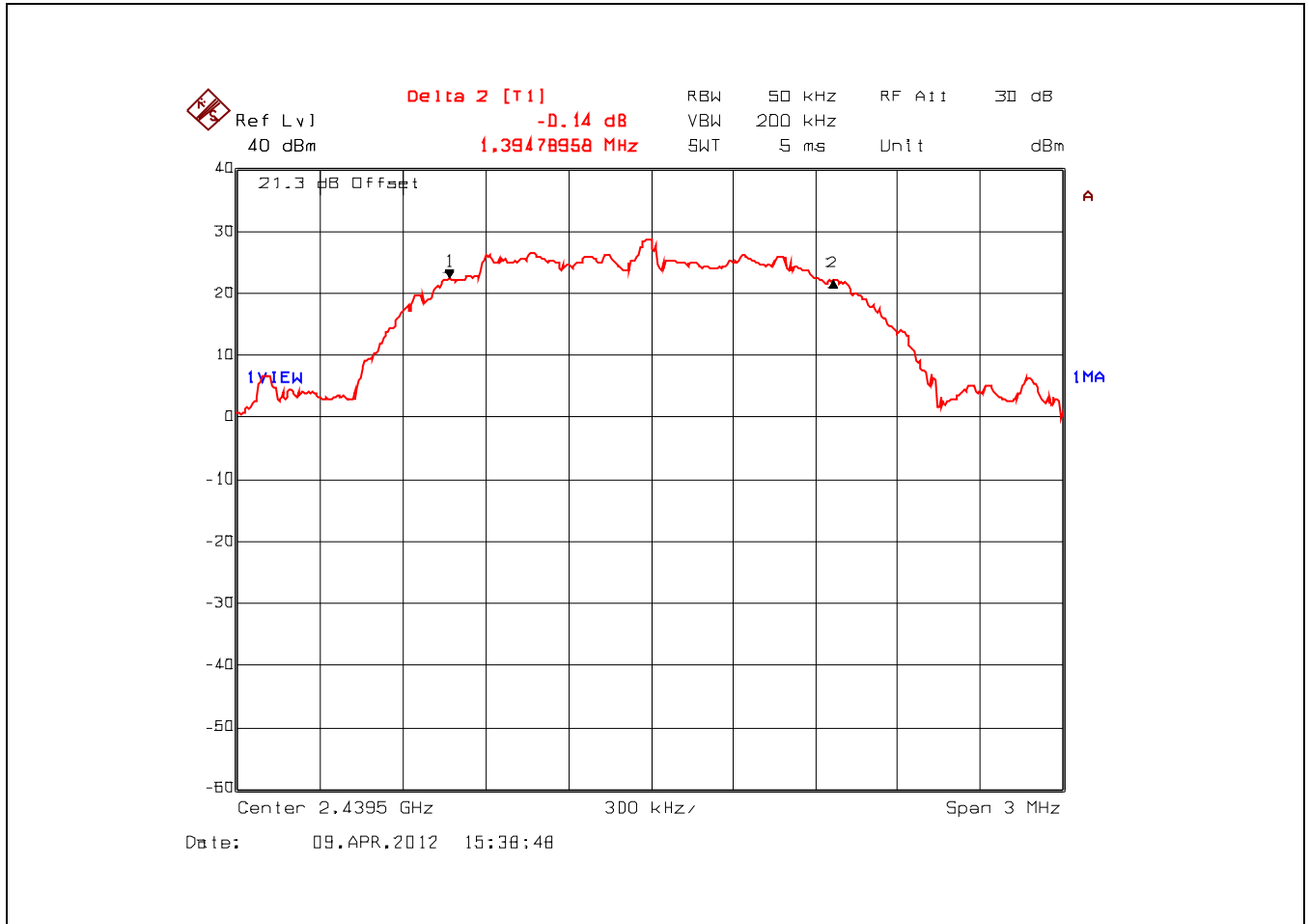
Plot 5.2.4.3. 6 dB Bandwidth, 2476.00 MHz, Data Rate 8



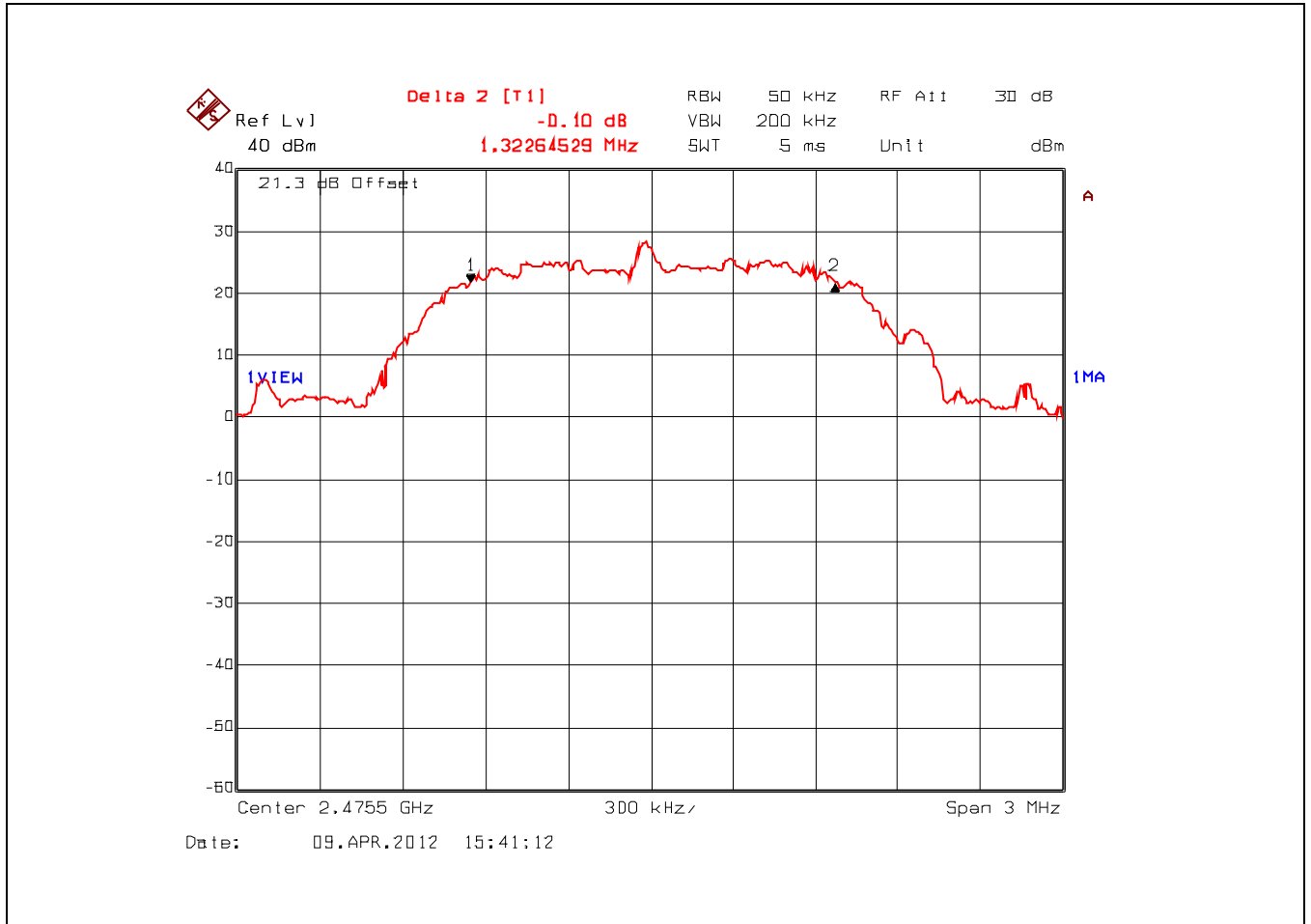
Plot 5.2.4.4. 6 dB Bandwidth, 2403.50 MHz, Data Rate 9



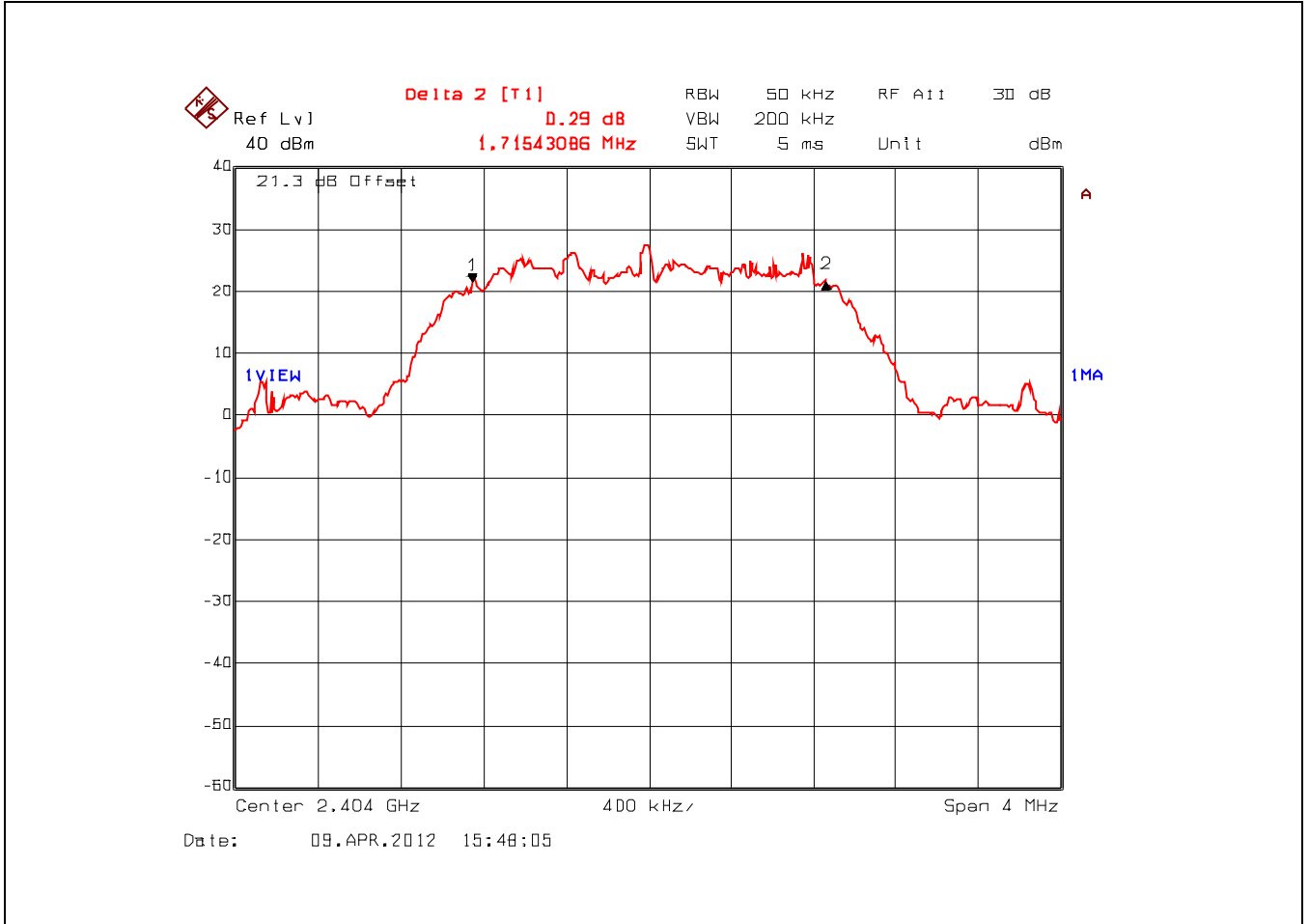
Plot 5.2.4.5. 6 dB Bandwidth, 2439.50 MHz, Data Rate 9



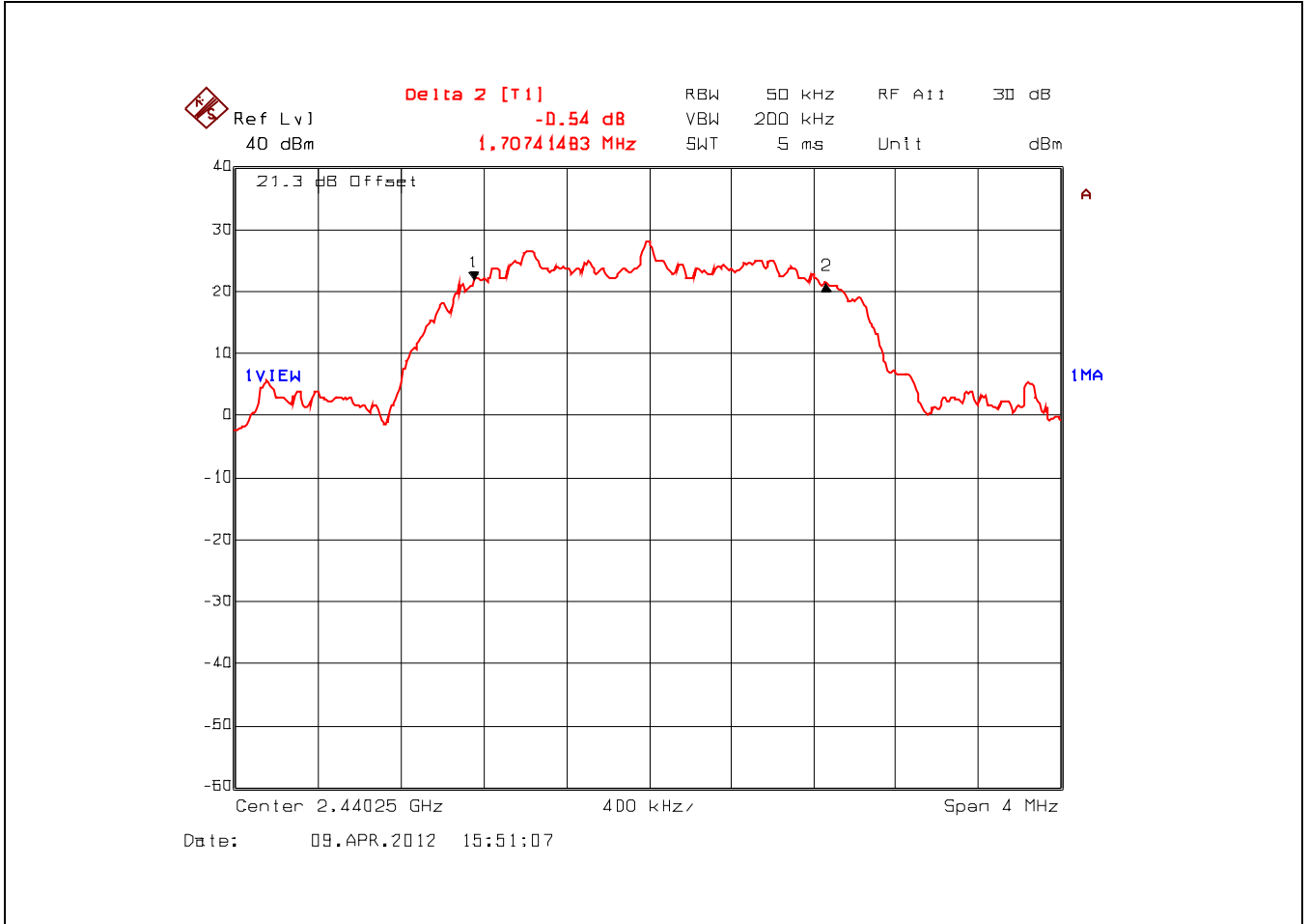
Plot 5.2.4.6. 6 dB Bandwidth, 2475.50 MHz, Data Rate 9



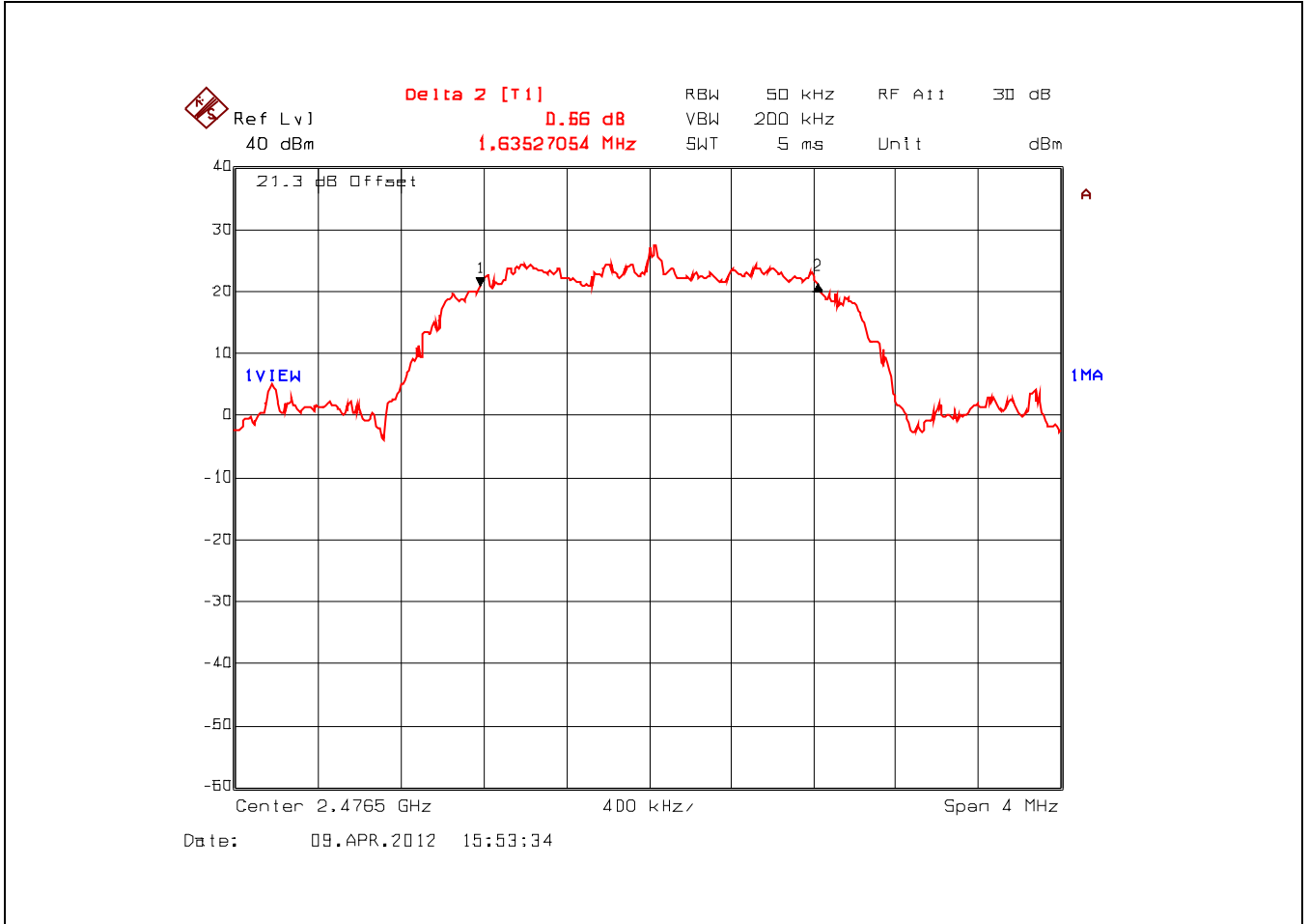
Plot 5.2.4.7. 6 dB Bandwidth, 2404.00 MHz, Data Rate 10



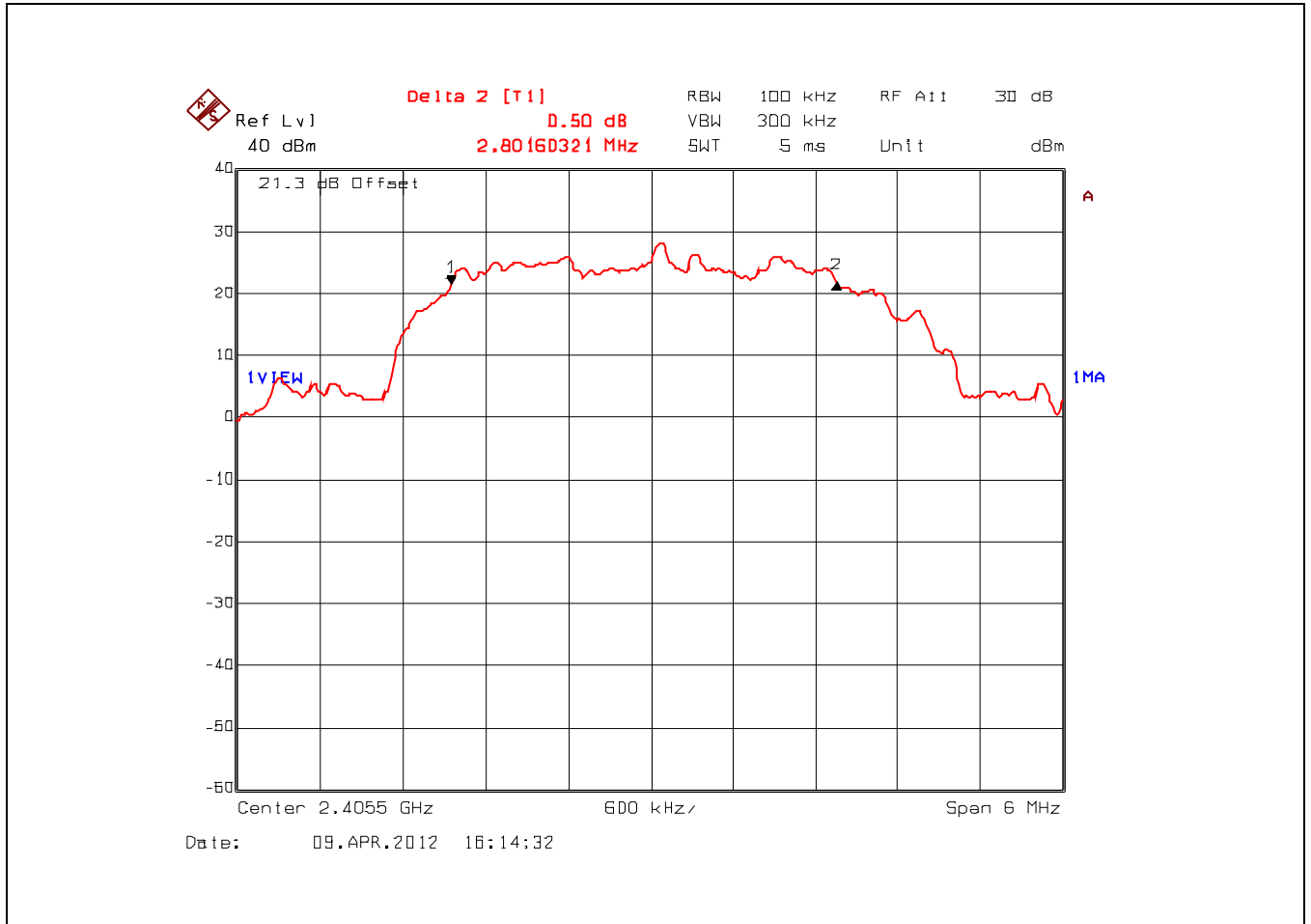
Plot 5.2.4.8. 6 dB Bandwidth, 2440.25 MHz, Data Rate 10



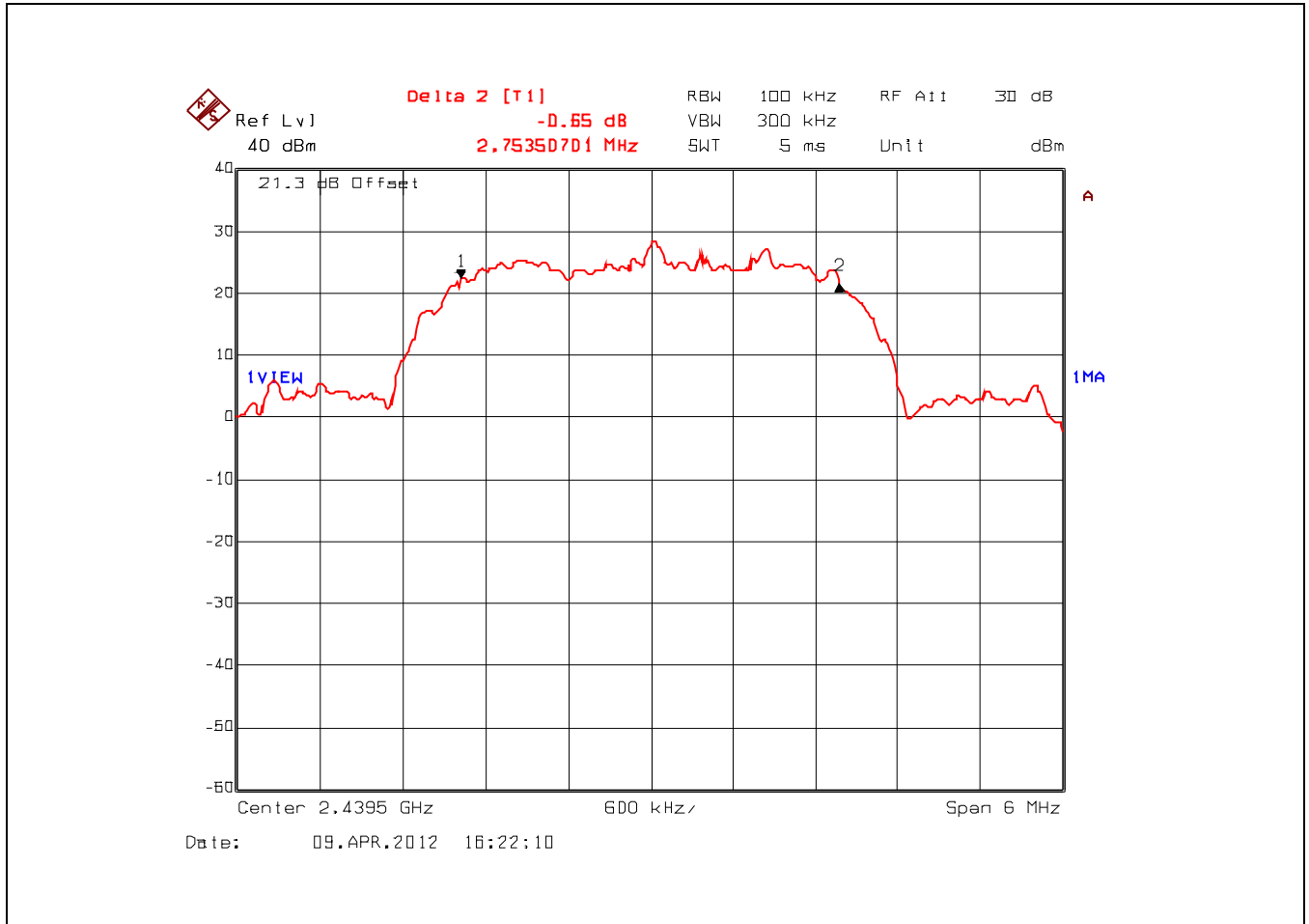
Plot 5.2.4.9. 6 dB Bandwidth, 2476.50 MHz, Data Rate 10



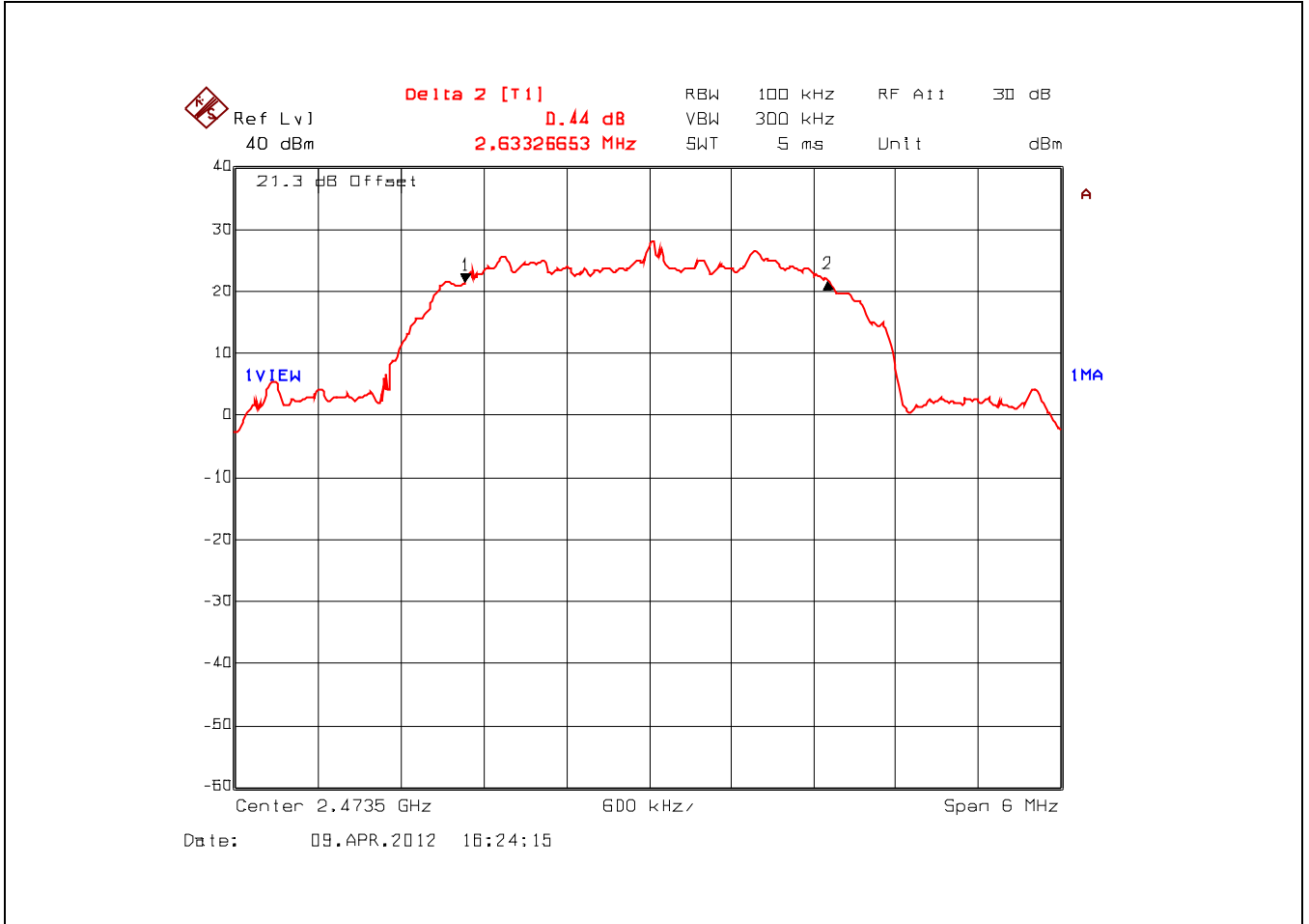
Plot 5.2.4.10. 6 dB Bandwidth, 2405.50 MHz, Data Rate 11



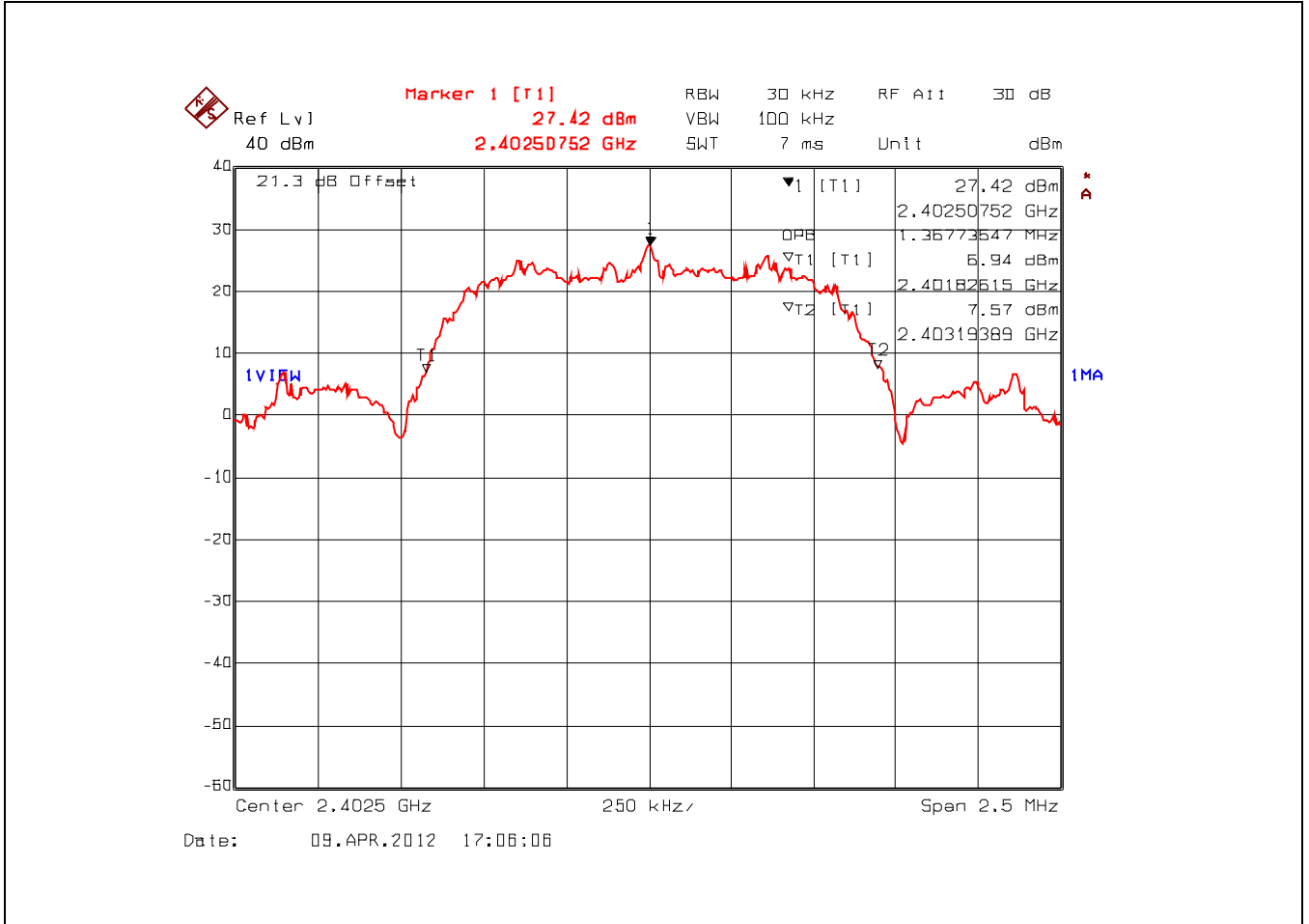
Plot 5.2.4.11. 6 dB Bandwidth, 2439.50 MHz, Data Rate 11



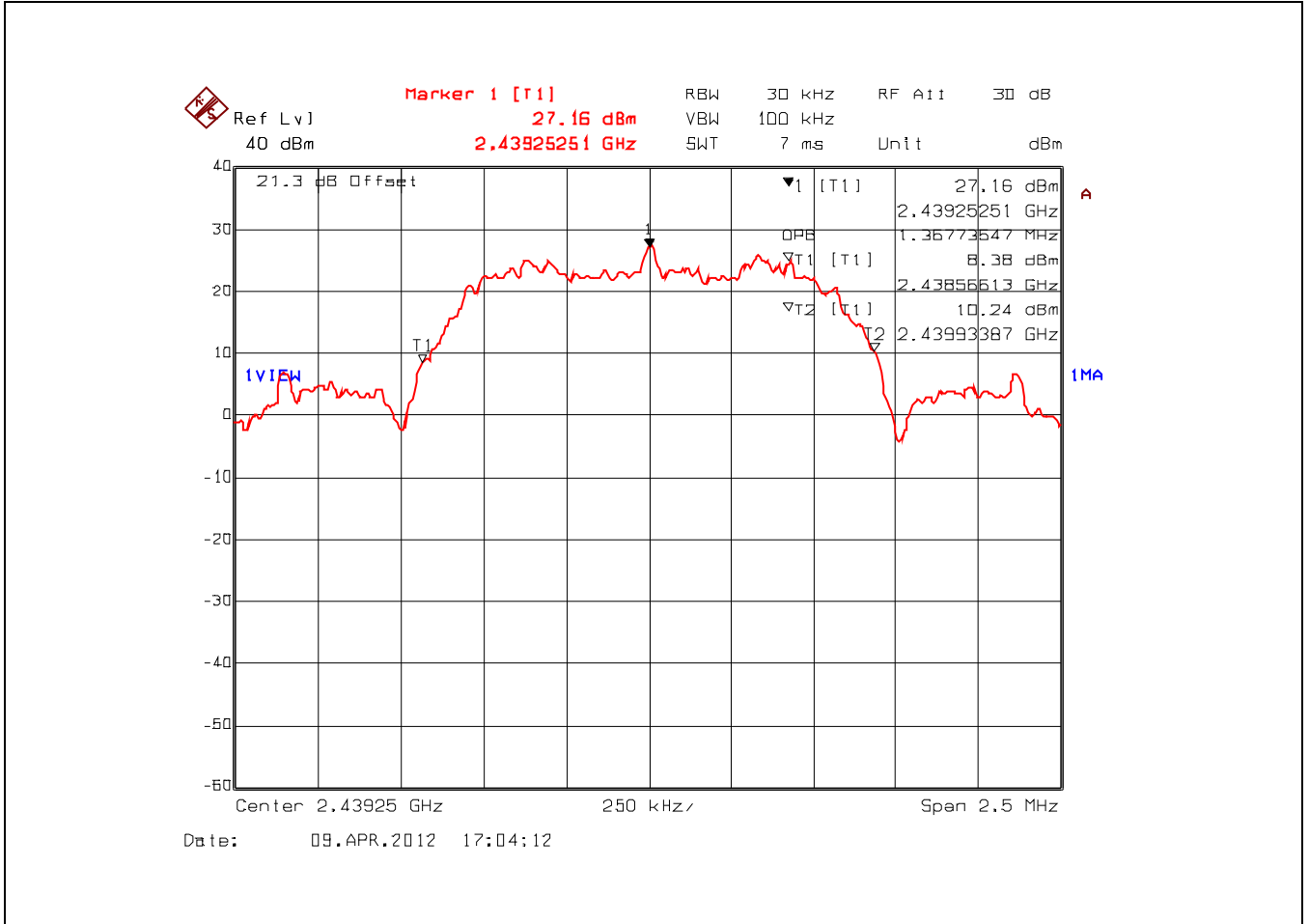
Plot 5.2.4.12. 6 dB Bandwidth, 2473.50 MHz, Data Rate 11



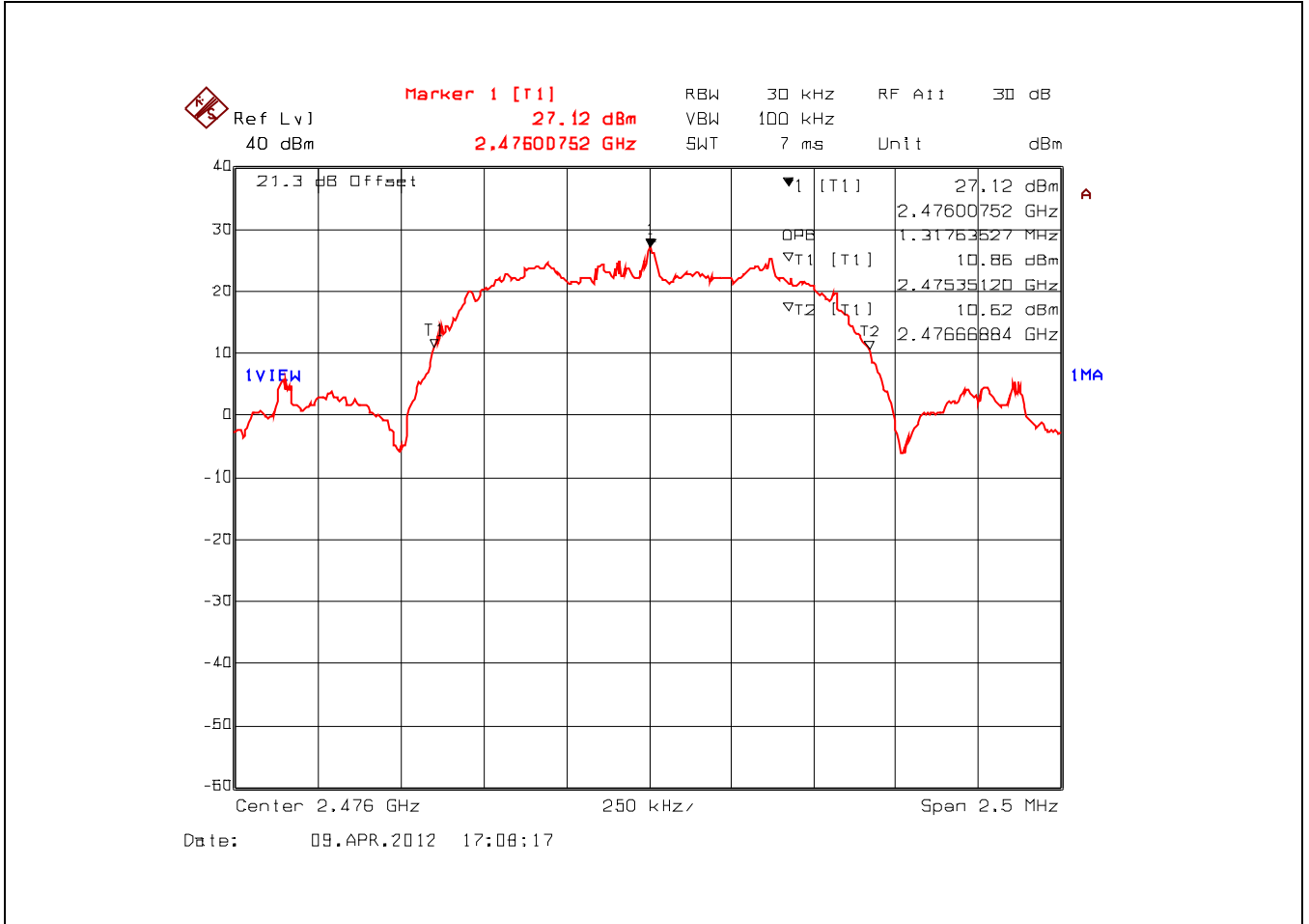
Plot 5.2.4.13. 99% Occupied Bandwidth, 2402.50 MHz, Data Rate 8



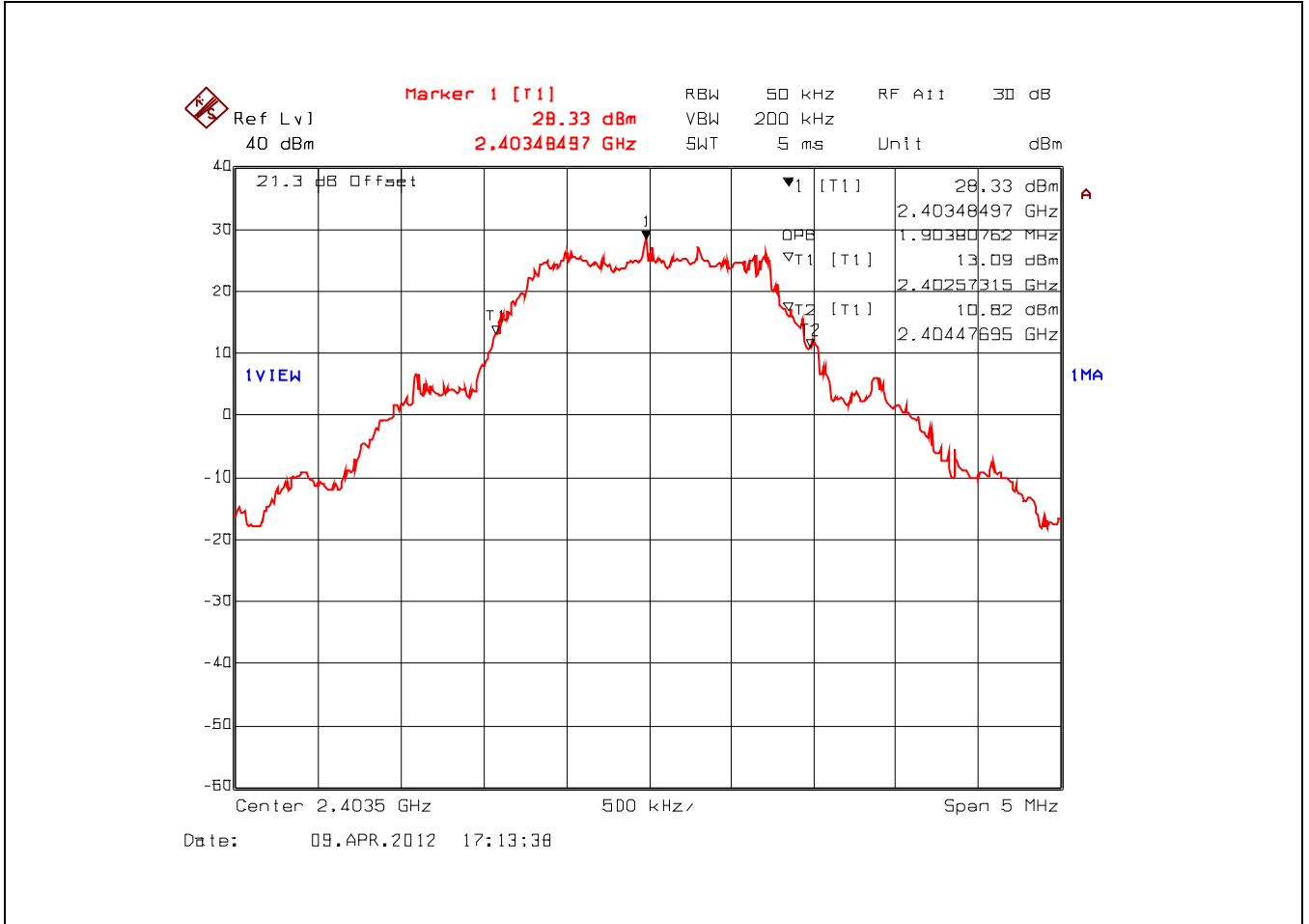
Plot 5.2.4.14. 99% Occupied Bandwidth, 2439.25 MHz, Data Rate 8



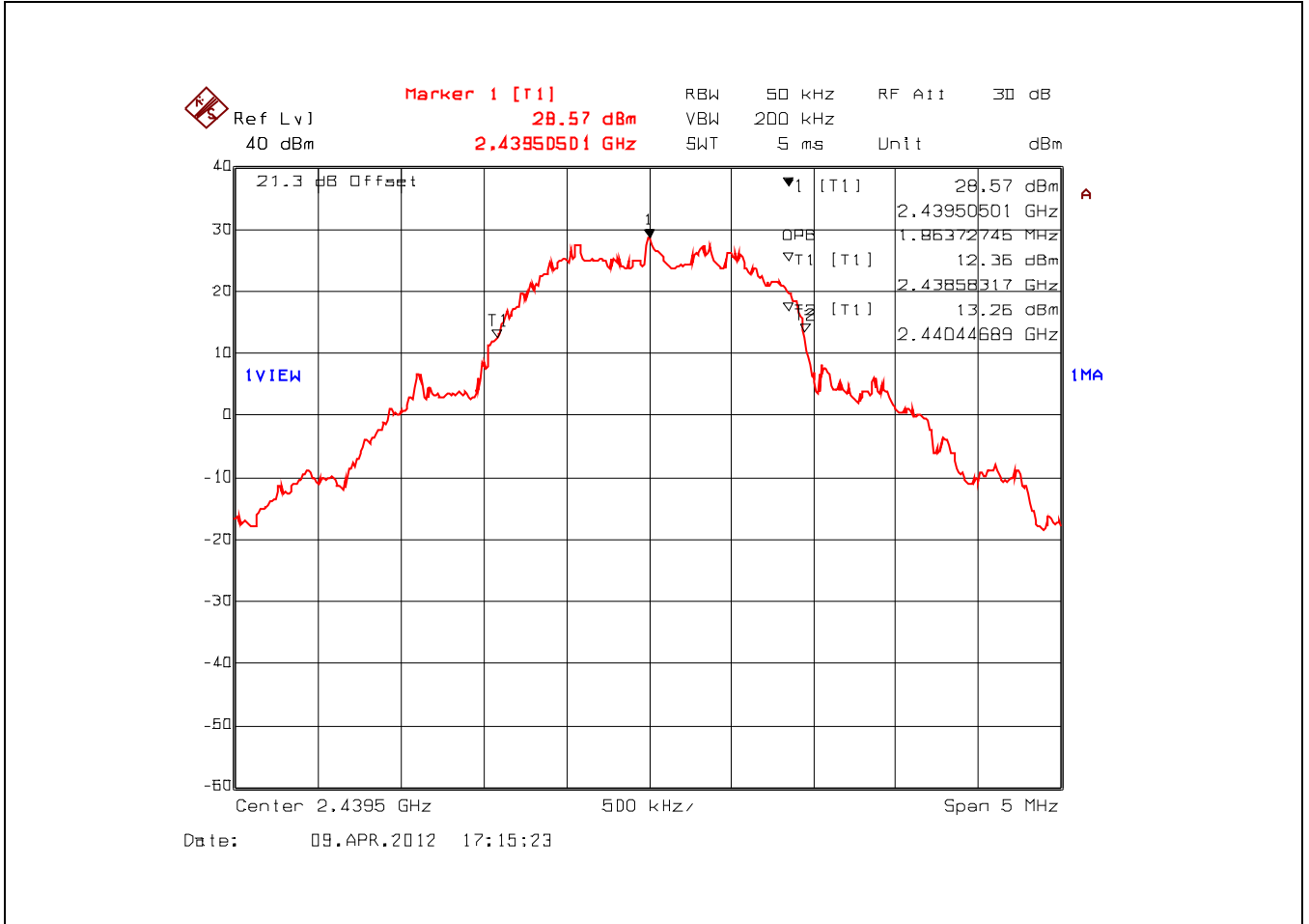
Plot 5.2.4.15. 99% Occupied Bandwidth, 2476.00 MHz, Data Rate 8



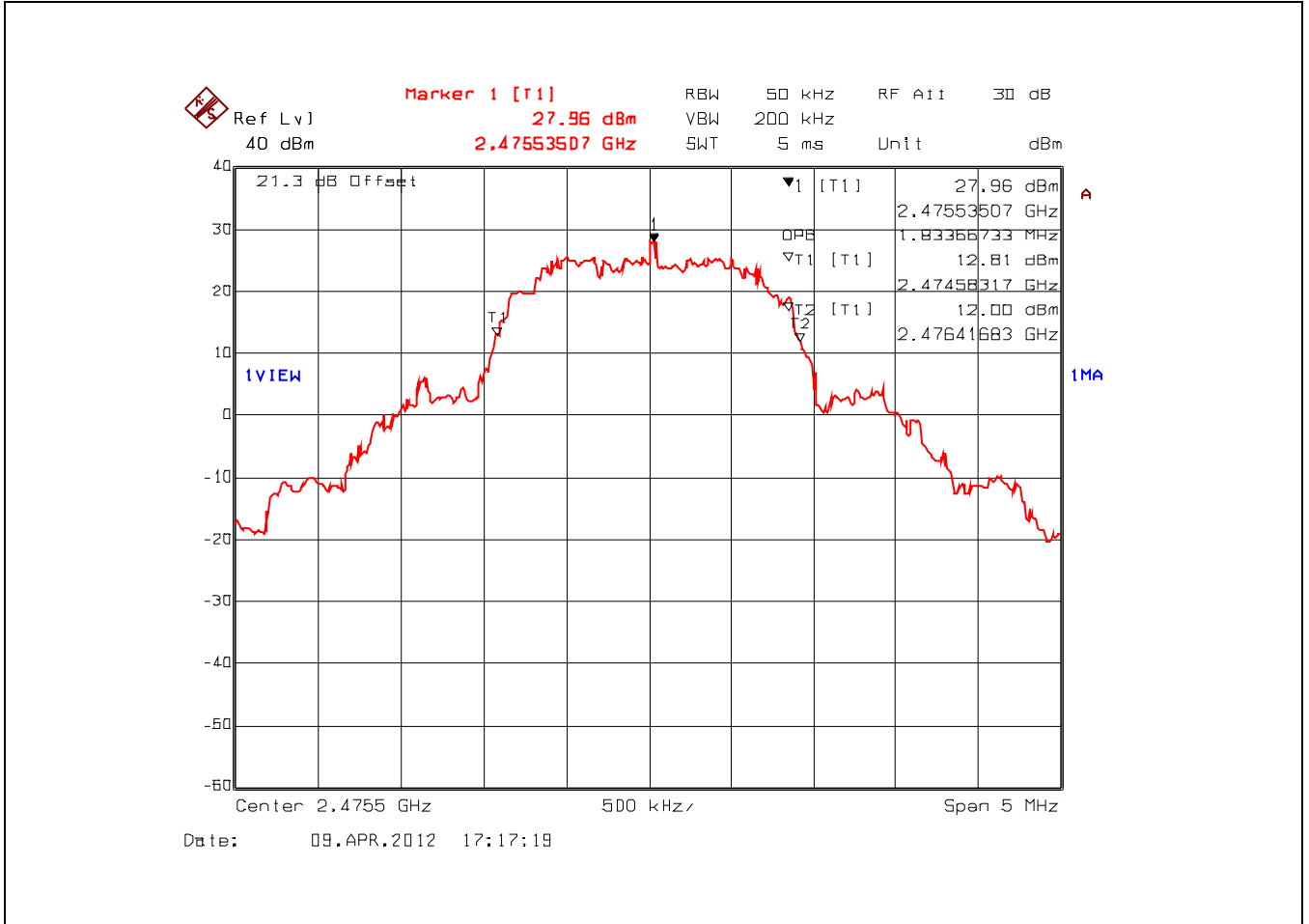
Plot 5.2.4.16. 99% Occupied Bandwidth, 2403.50 MHz, Data Rate 9



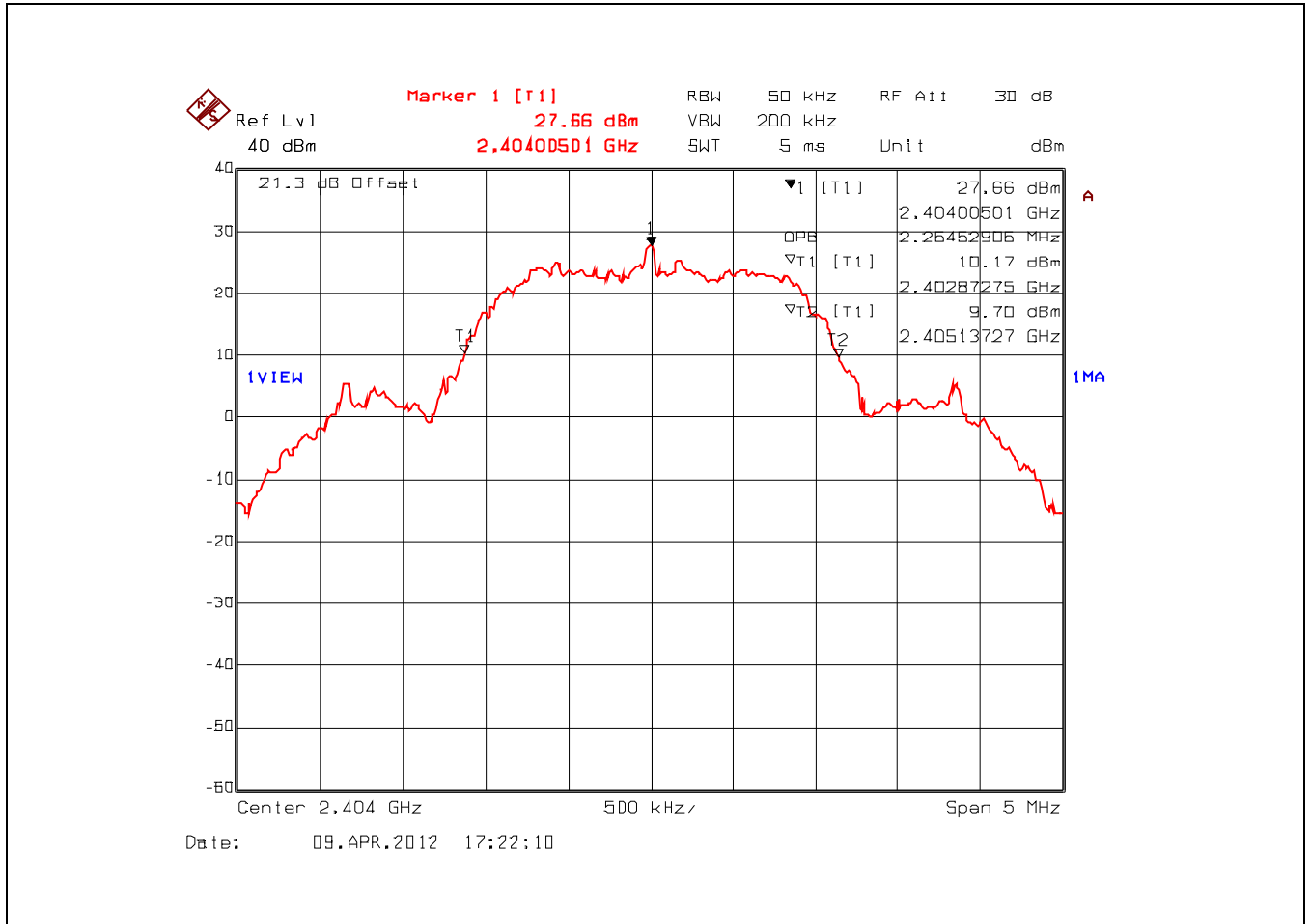
Plot 5.2.4.17. 99% Occupied Bandwidth, 2439.50 MHz, Data Rate 9



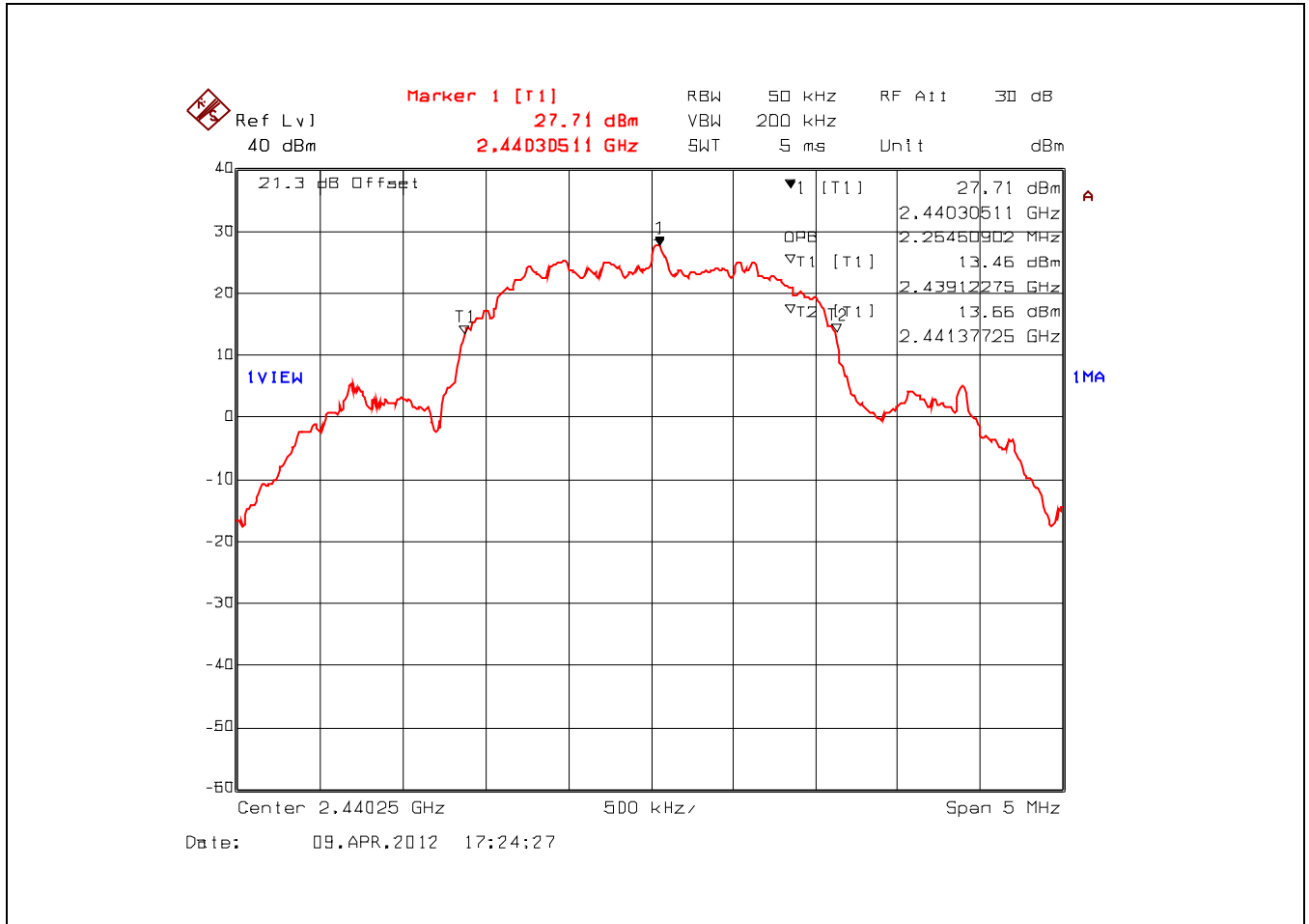
Plot 5.2.4.18. 99% Occupied Bandwidth, 2475.50 MHz, Data Rate 9



Plot 5.2.4.19. 99% Occupied Bandwidth, 2404.00 MHz, Data Rate 10



Plot 5.2.4.20. 99% Occupied Bandwidth, 2440.25 MHz, Data Rate 10



ULTRATECH GROUP OF LABS

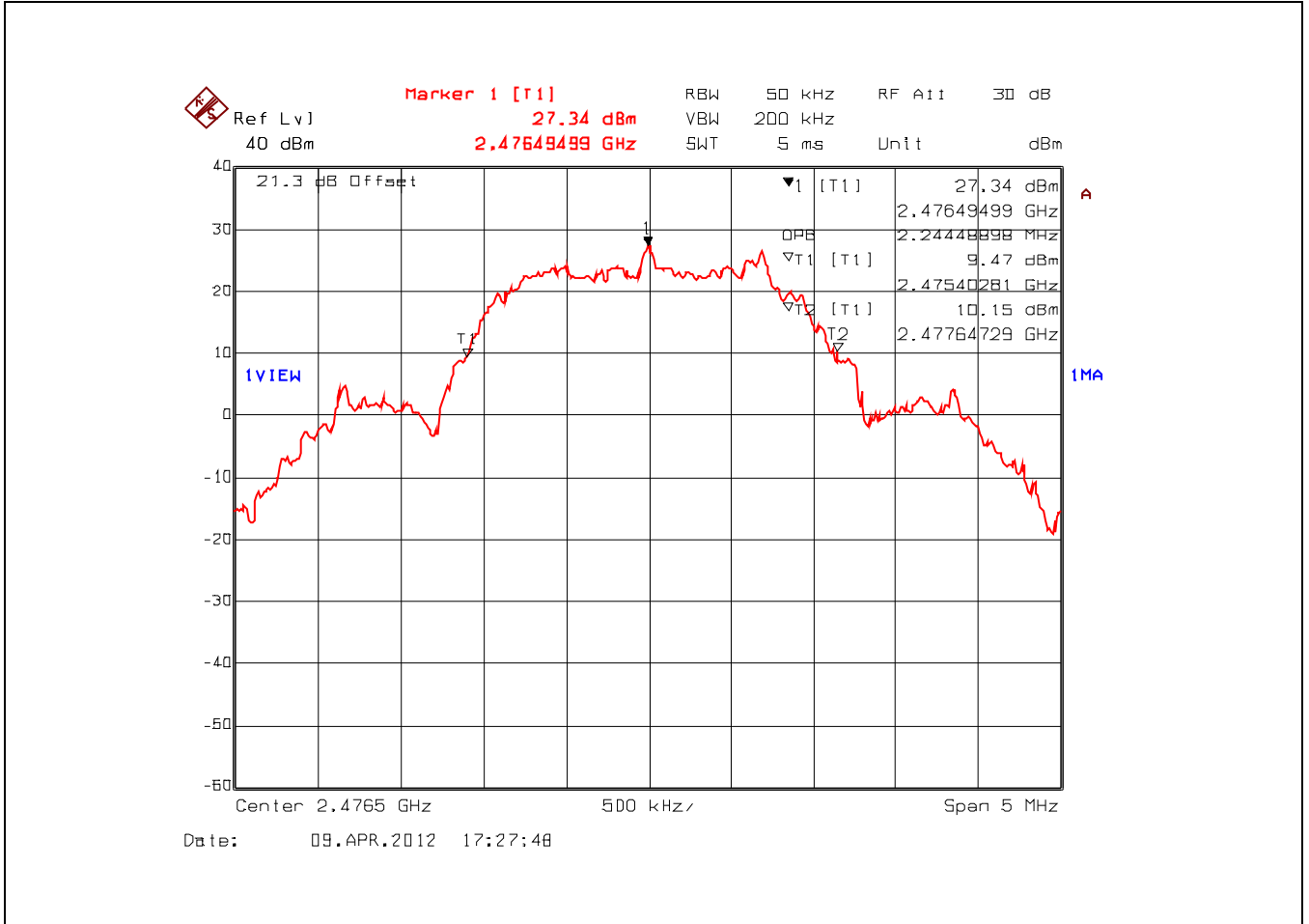
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
 Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-047F15C247DTS

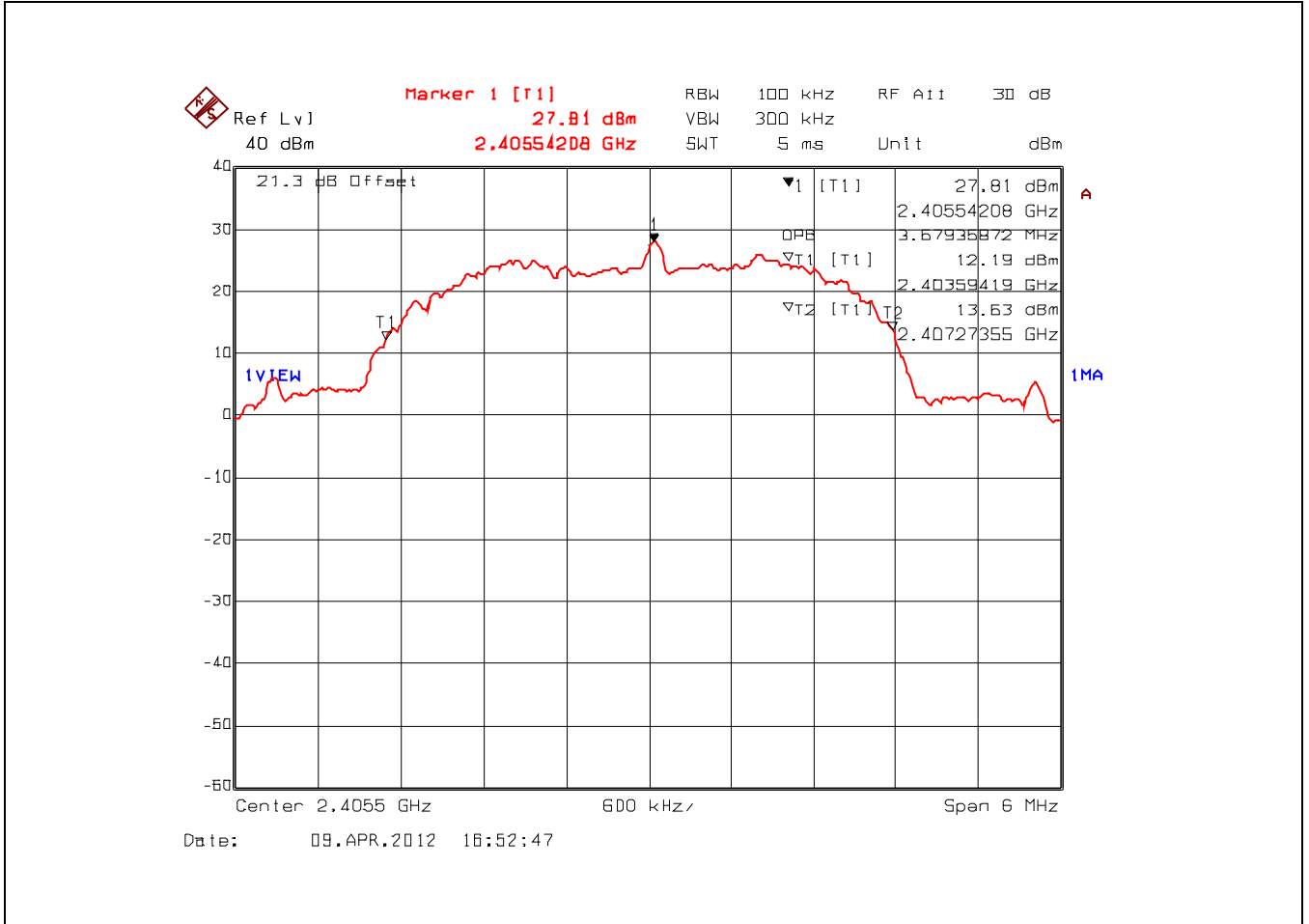
July 23, 2012

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

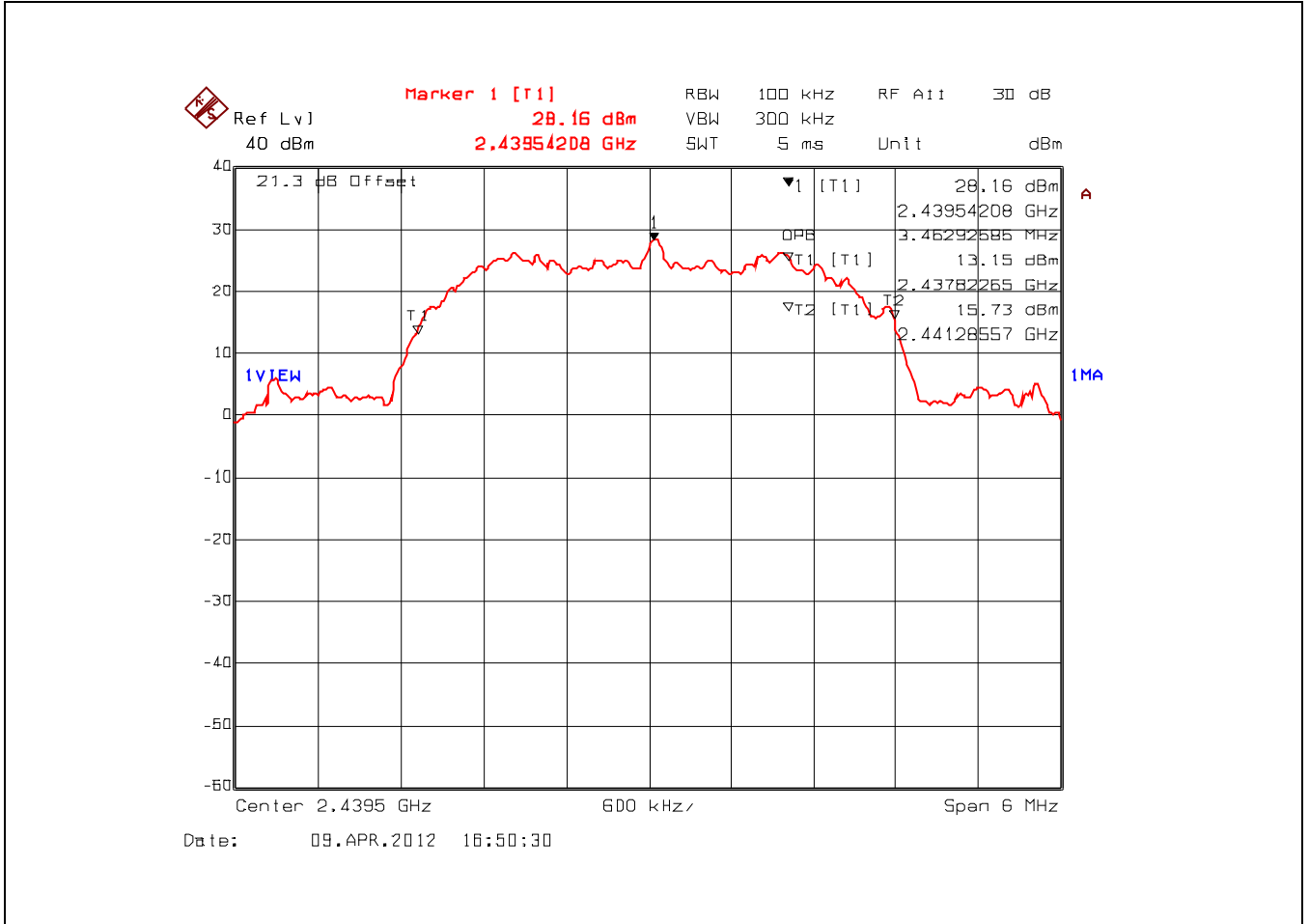
Plot 5.2.4.21. 99% Occupied Bandwidth, 2476.50 MHz, Data Rate 10



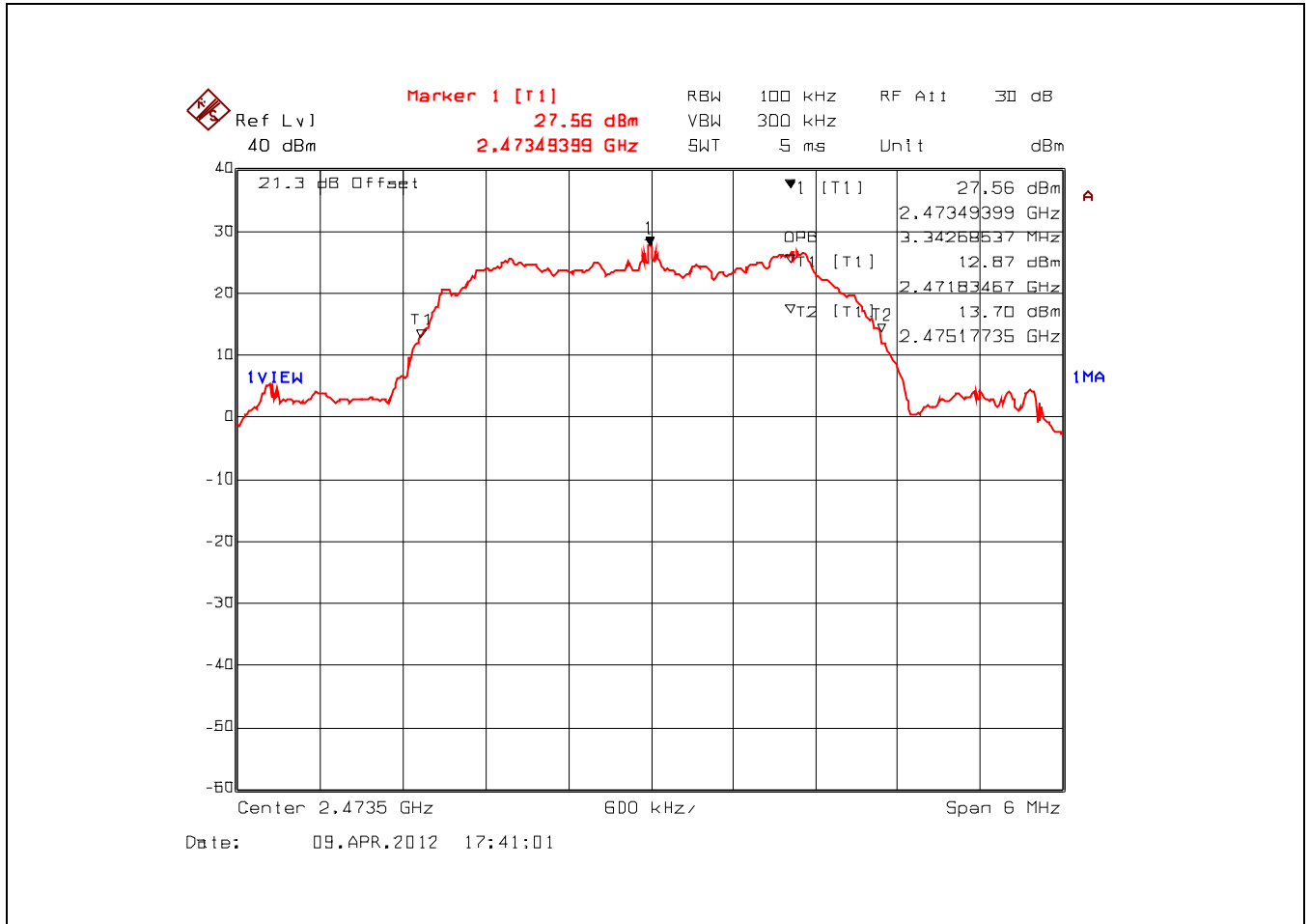
Plot 5.2.4.22. 99% Occupied Bandwidth, 2405.50 MHz, Data Rate 11



Plot 5.2.4.23. 99% Occupied Bandwidth, 2439.50 MHz, Data Rate 11



Plot 5.2.4.24. 99% Occupied Bandwidth, 2473.50 MHz, Data Rate 11



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

5.3.1. Limit(s)

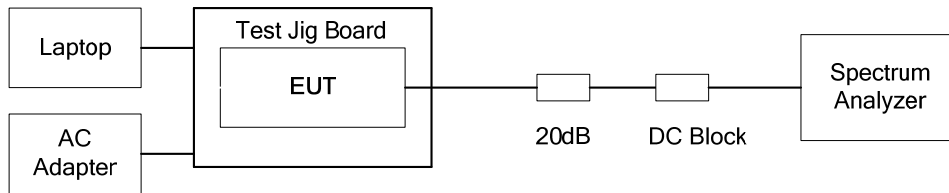
§ 15.247(b)(3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power 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 5.2.2.2 Measurement Procedure AVG2.

5.3.3. Test Arrangement



5.3.4. Test Data

Frequency (MHz)	Modulation / Data Rate (Mbps)	Software/PCDAC Power Setting	Conducted (Average) Output Power (dBm)	EIRP (dBm)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
High Power Setting						
2402.50	8	52	30.00	See Notes 1 & 2	30	36
2439.25	8	52	29.99	See Notes 1 & 2	30	36
2476.00	8	52	29.38	See Notes 1 & 2	30	36
2403.50	9	52	30.00	See Notes 1 & 2	30	36
2439.50	9	52	30.00	See Notes 1 & 2	30	36
2475.50	9	52	29.43	See Notes 1 & 2	30	36
2404.00	10	52	30.00	See Notes 1 & 2	30	36
2440.25	10	52	30.00	See Notes 1 & 2	30	36
2476.50	10	52	29.45	See Notes 1 & 2	30	36
2405.50	11	52	29.93	See Notes 1 & 2	30	36
2439.50	11	52	30.00	See Notes 1 & 2	30	36
2473.50	11	52	29.58	See Notes 1 & 2	30	36
Low Power Setting (the following represents the lowest operating power range for all data rates)						
2402.50	8	0	7.75	See Notes 1 & 2	30	36
2439.25	8	0	8.12	See Notes 1 & 2	30	36
2476.00	8	0	8.71	See Notes 1 & 2	30	36
Notes:						
1. The EIRP shall be calculated based on the transmitter antenna gain (G_{dB_i}), cable loss (CL_{dB}) and peak output power at antenna terminal (P_{dBm}). Calculated EIRP = $P_{dBm} + G_{dB_i} - CL_{dB}$						
2. EIRP shall not exceed 36 dBm limit (Power Setting = 36 dBm - $G_{dB_i} + CL_{dB}$). See Operating Manual for instruction of power setting.						

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

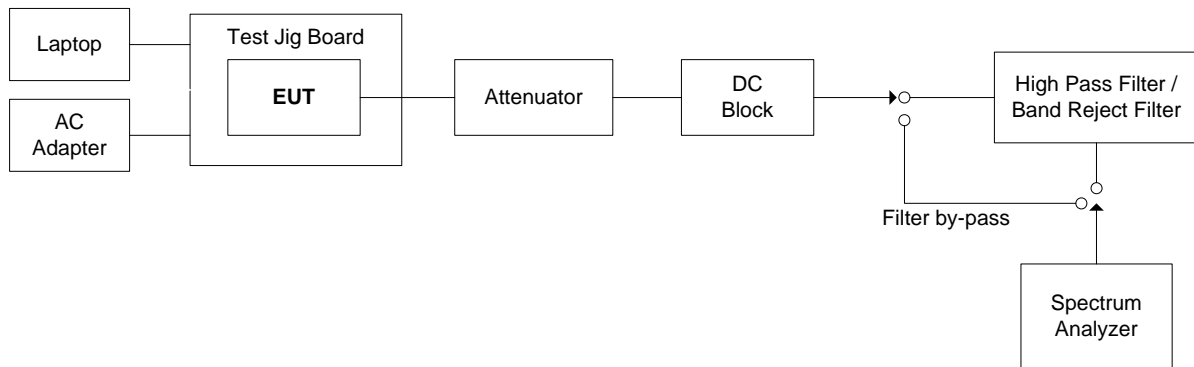
5.4.1. Limit(s)

§ 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 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

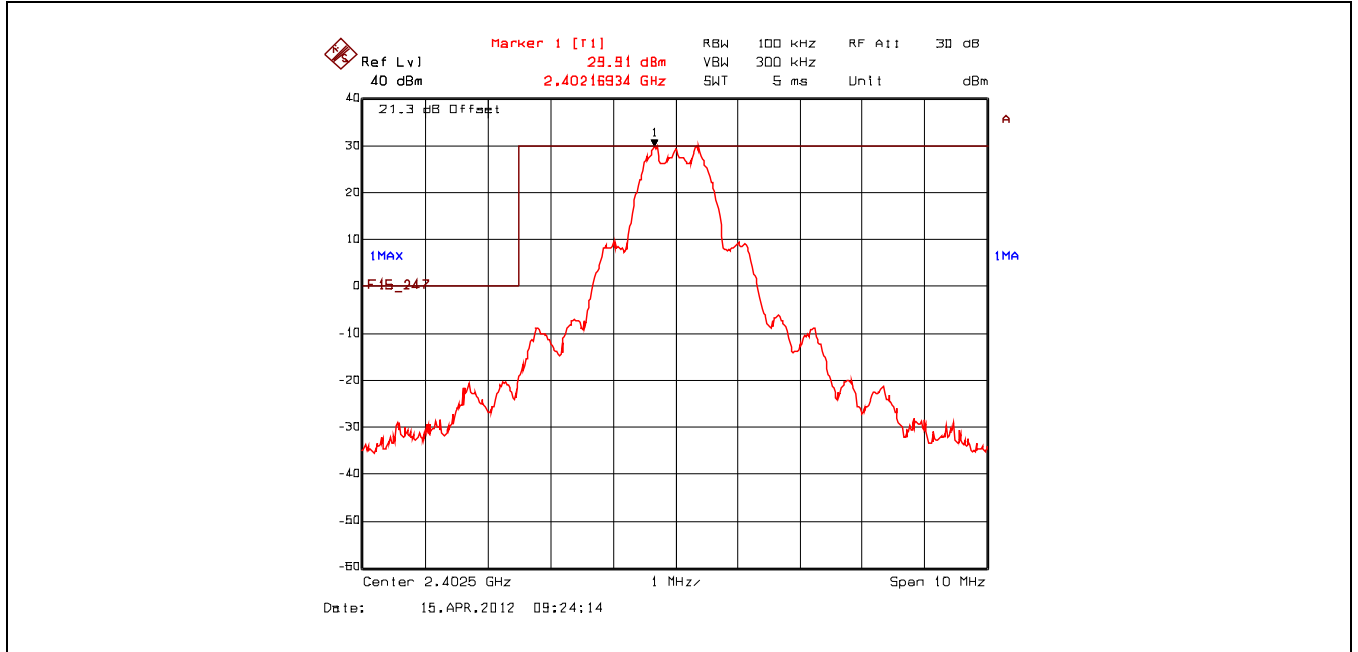


5.4.4. Test Data

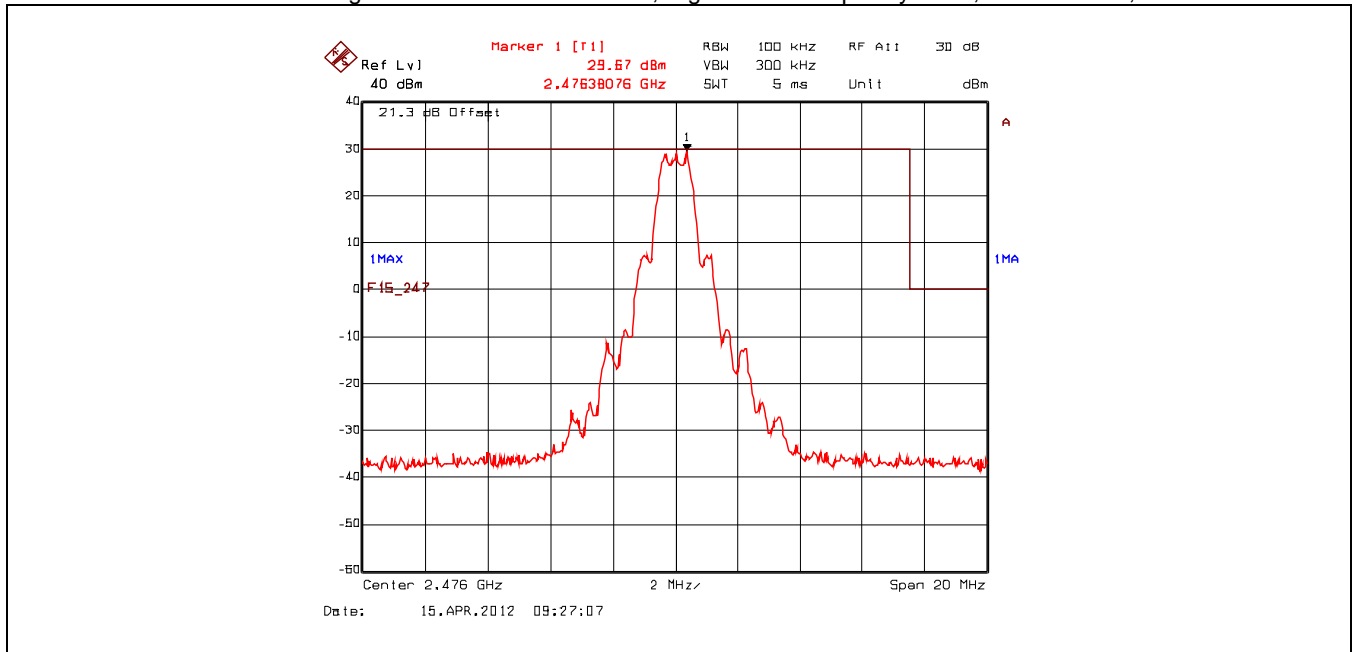
5.4.4.1. Band-Edge RF Conducted Emissions

Remark(s): The following test results at high power setting represent the worst-case.

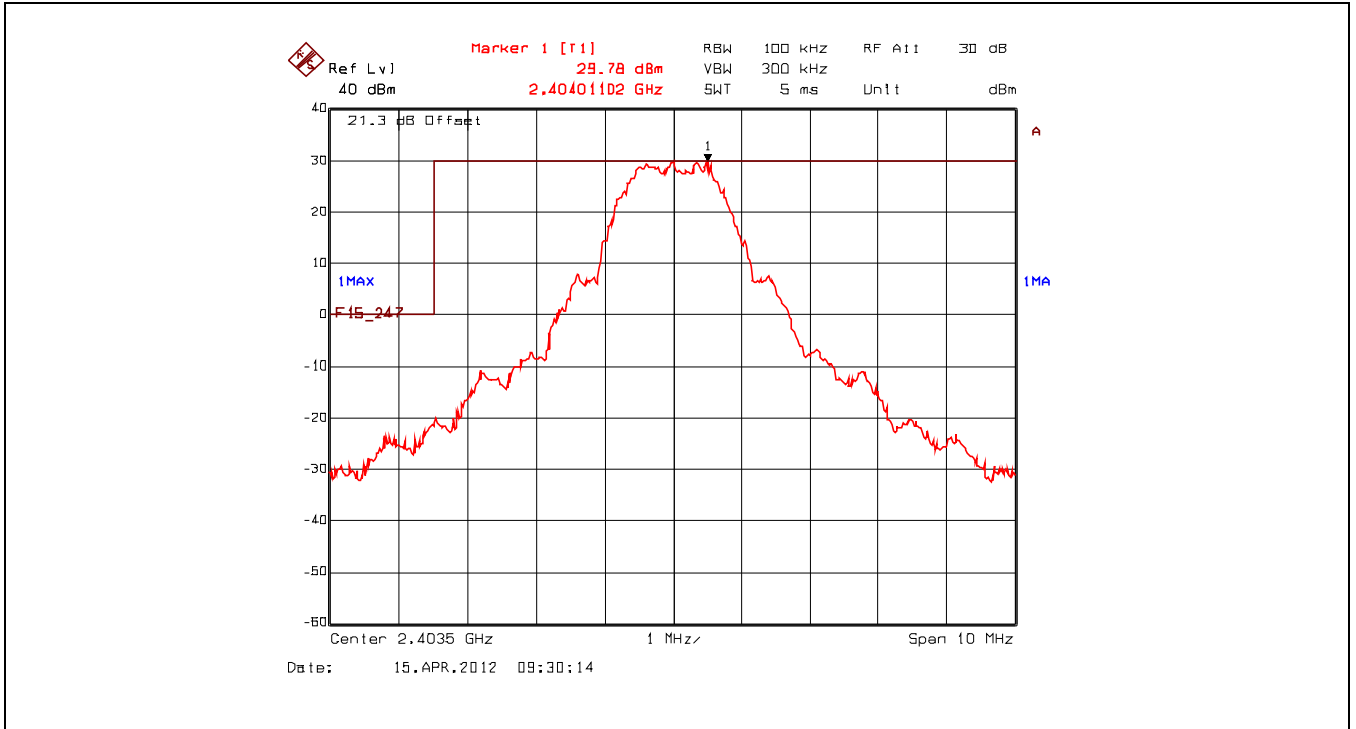
Plot 5.4.4.1.1. Band-Edge RF Conducted Emissions, Low End of Frequency Band, 2402.50 MHz, Data Rate 8



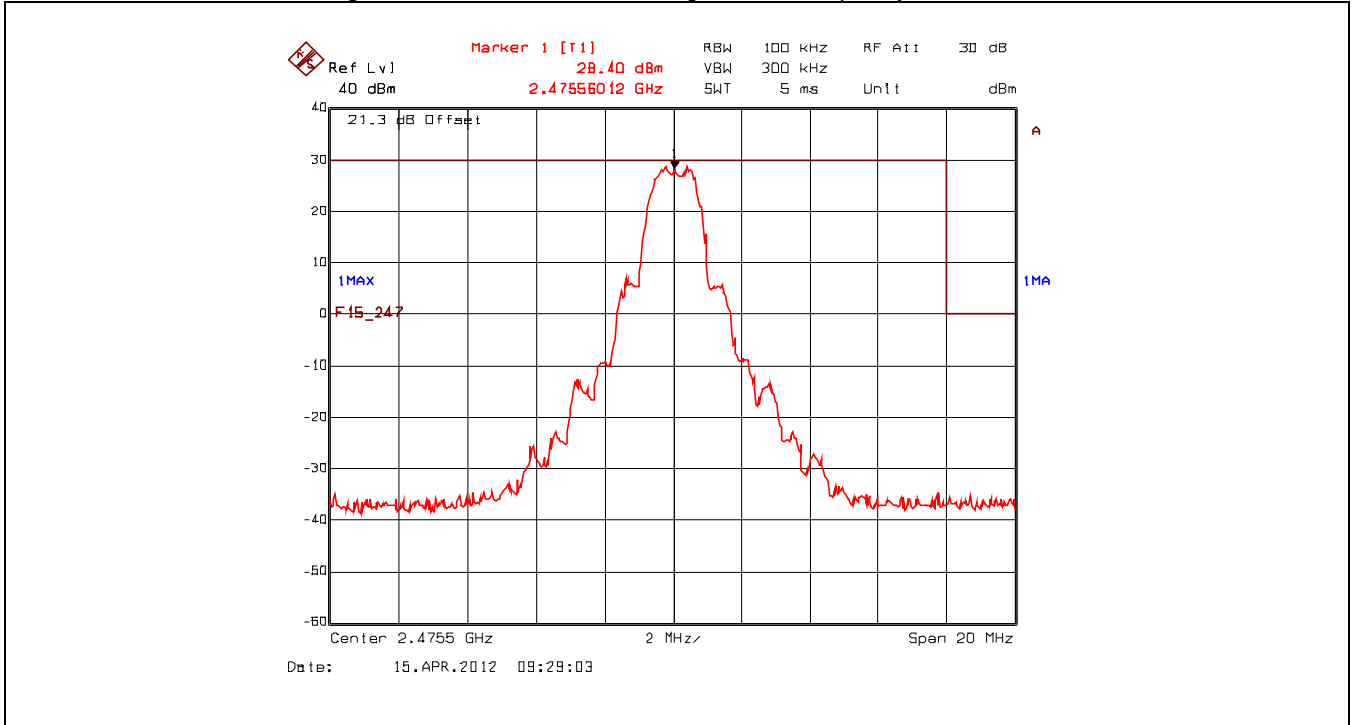
Plot 5.4.4.1.2. Band-Edge RF Conducted Emissions, High End of Frequency Band, 2476.00 MHz, Data Rate 8



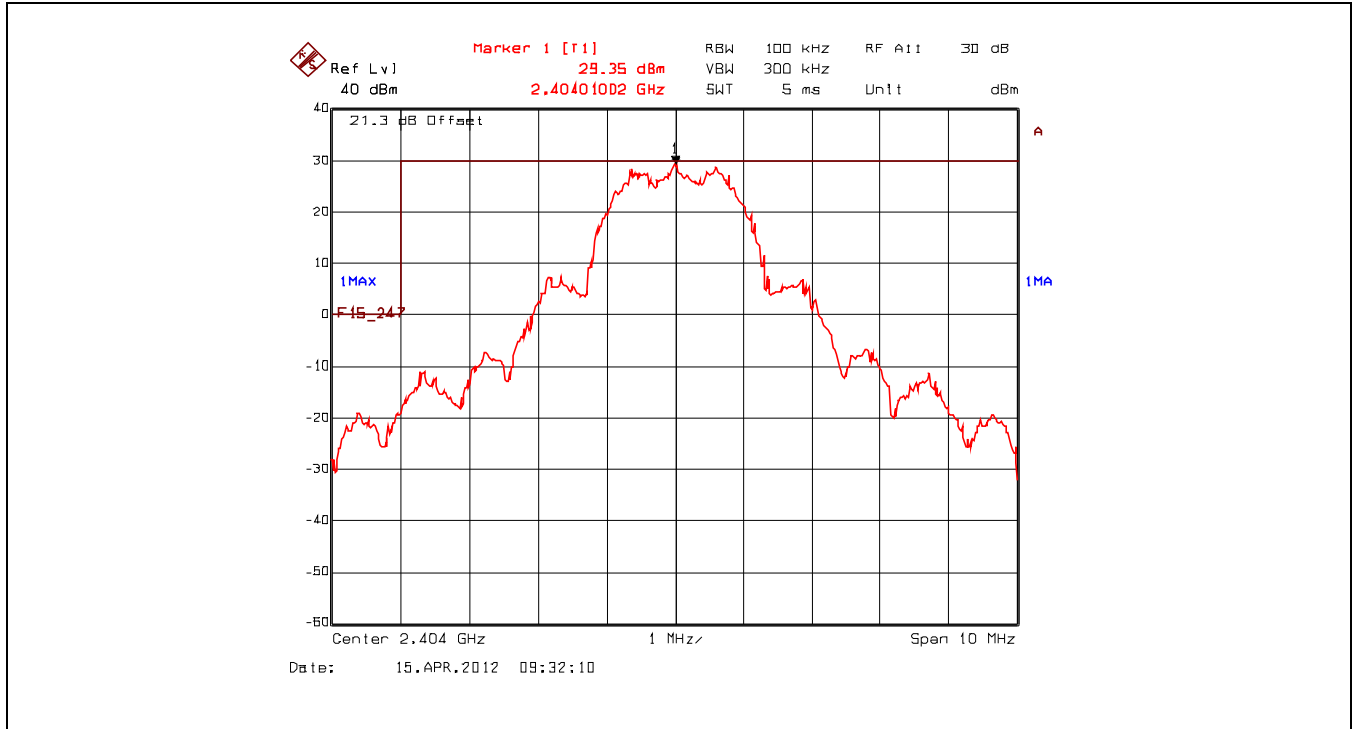
Plot 5.4.4.1.3. Band-Edge RF Conducted Emissions, Low End of Frequency Band, 2403.50 MHz, Data Rate 9



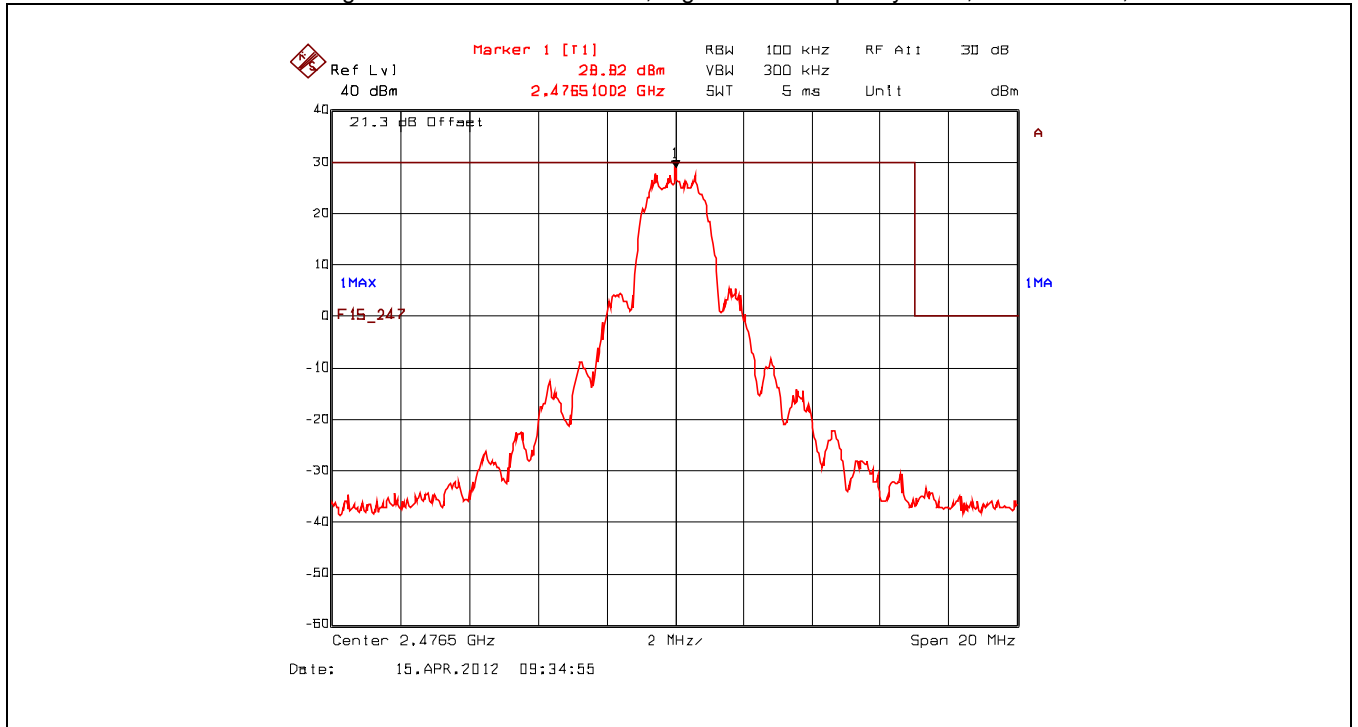
Plot 5.4.4.1.4. Band-Edge RF Conducted Emissions, High End of Frequency Band, 2475.50 MHz, Data Rate 9



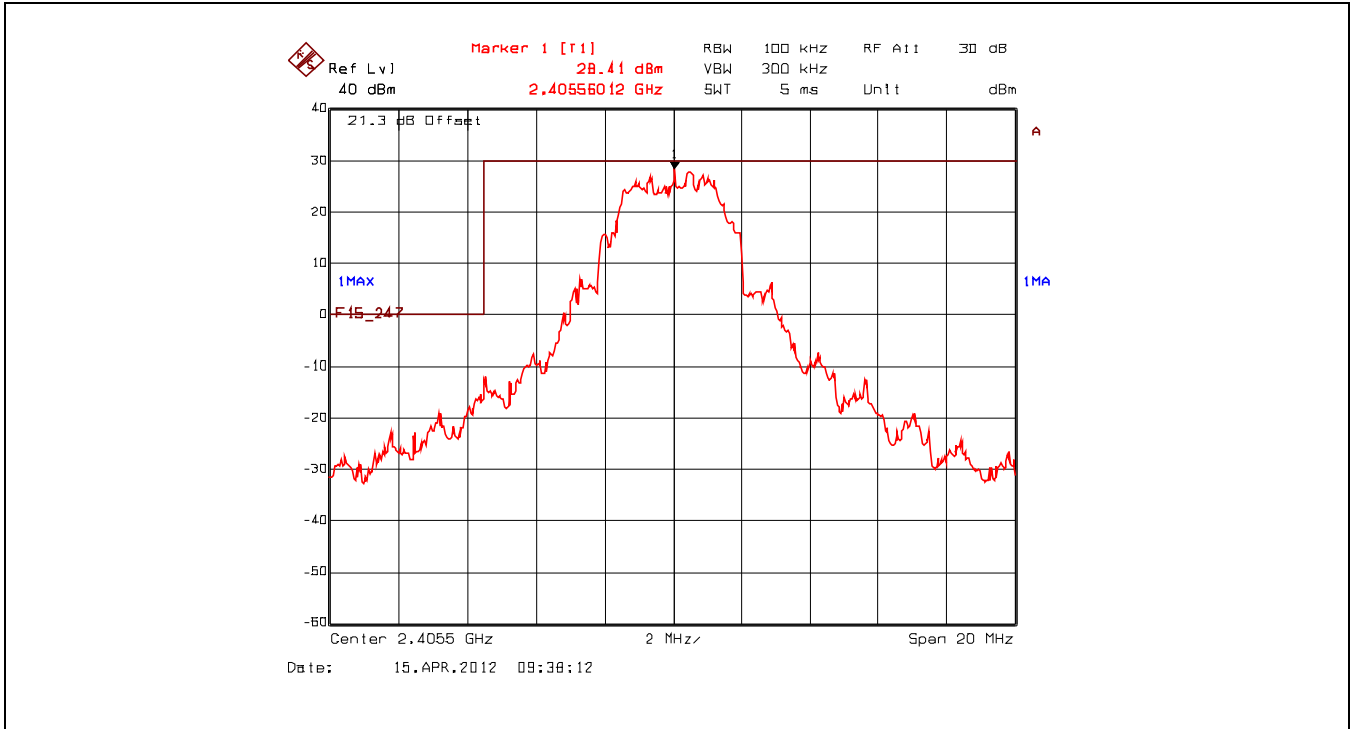
Plot 5.4.4.1.5. Band-Edge RF Conducted Emissions, Low End of Frequency Band, 2404.00 MHz, Data Rate 10



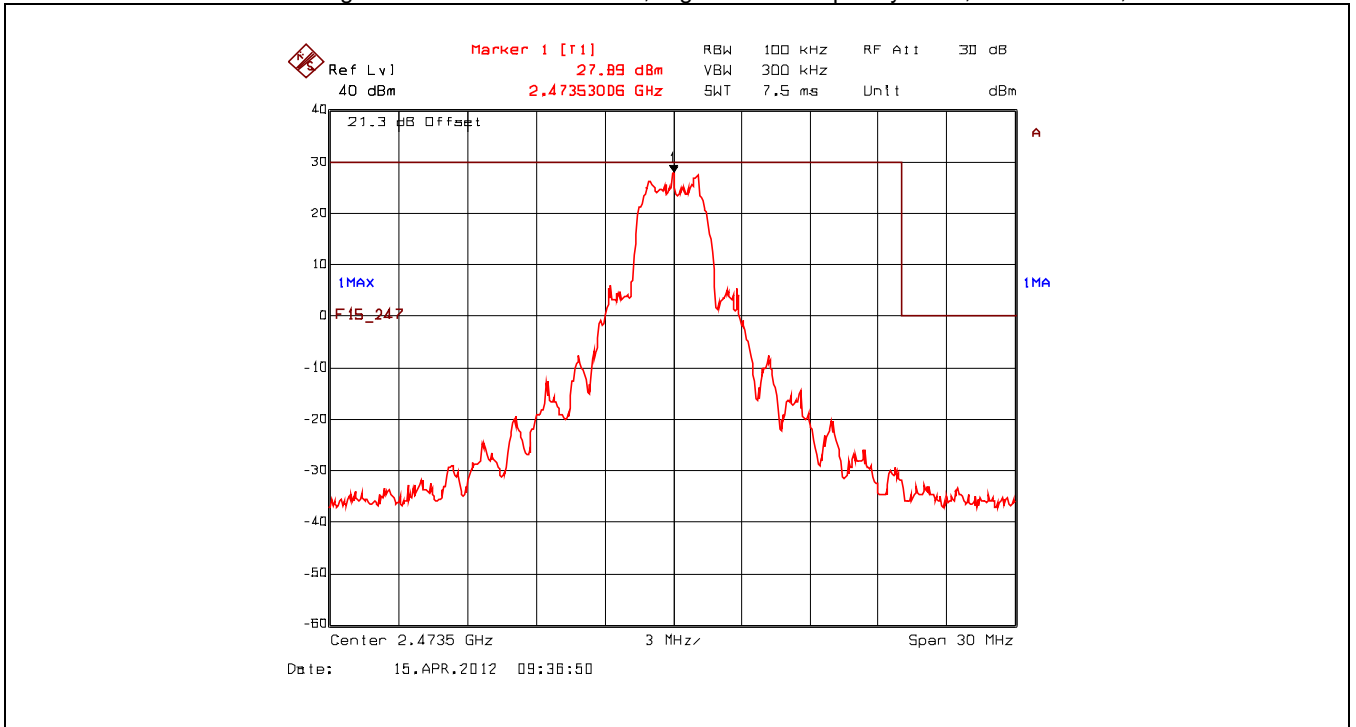
Plot 5.4.4.1.6. Band-Edge RF Conducted Emissions, High End of Frequency Band, 2476.50 MHz, Data Rate 10



Plot 5.4.4.1.7. Band-Edge RF Conducted Emissions, Low End of Frequency Band, 2405.50 MHz, Data Rate 11



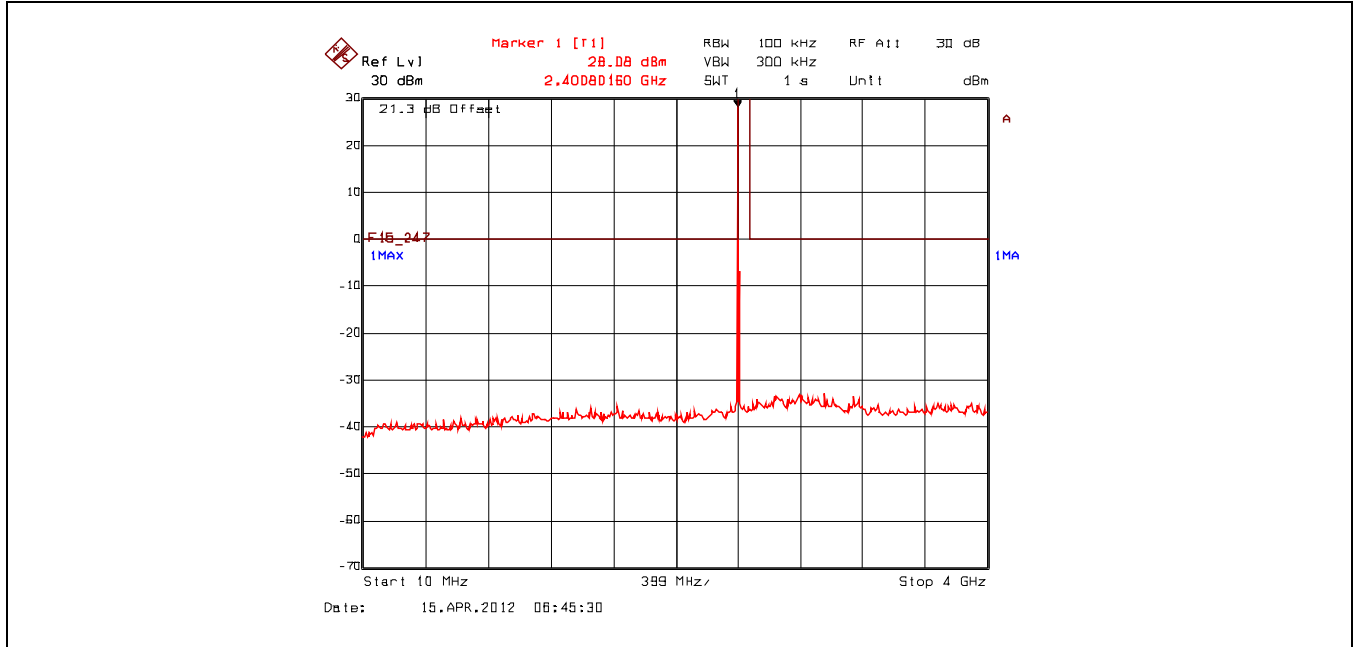
Plot 5.4.4.1.8. Band-Edge RF Conducted Emissions, High End of Frequency Band, 2473.50 MHz, Data Rate 11



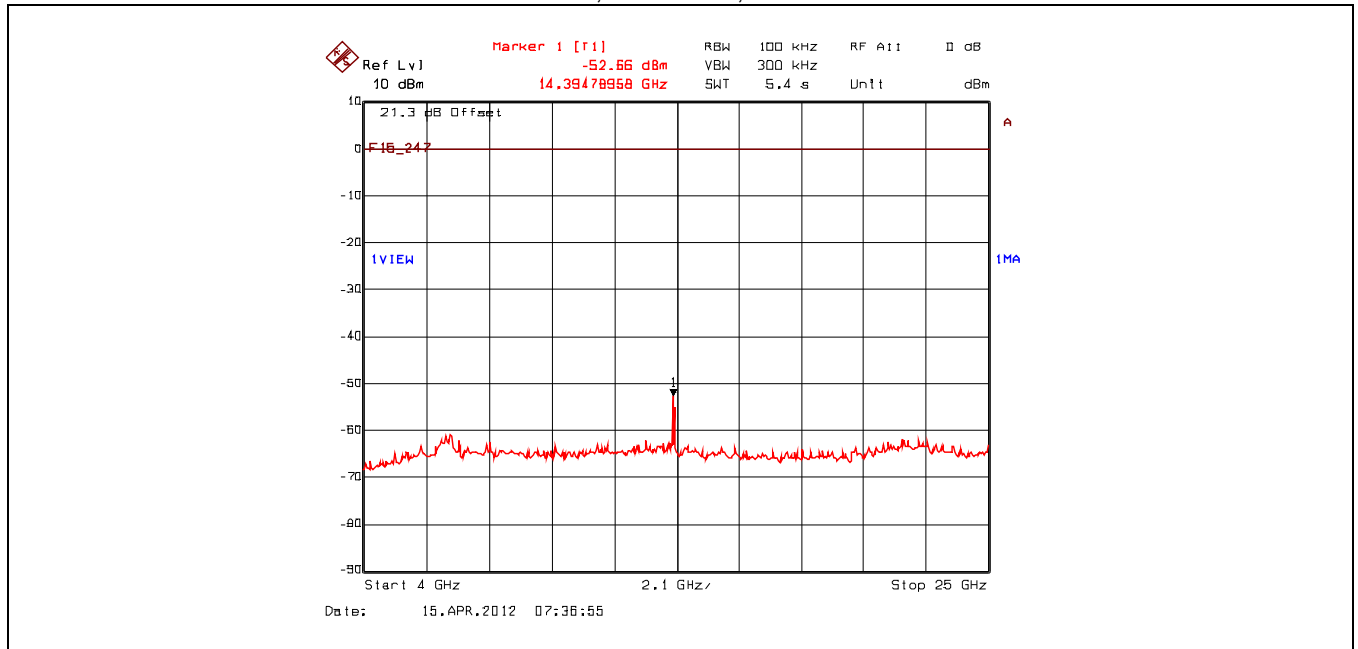
5.4.4.2. Conducted Spurious Emissions – Non Restricted Frequency Bands

Remark(s): The following test results at high power setting represent the worst case.

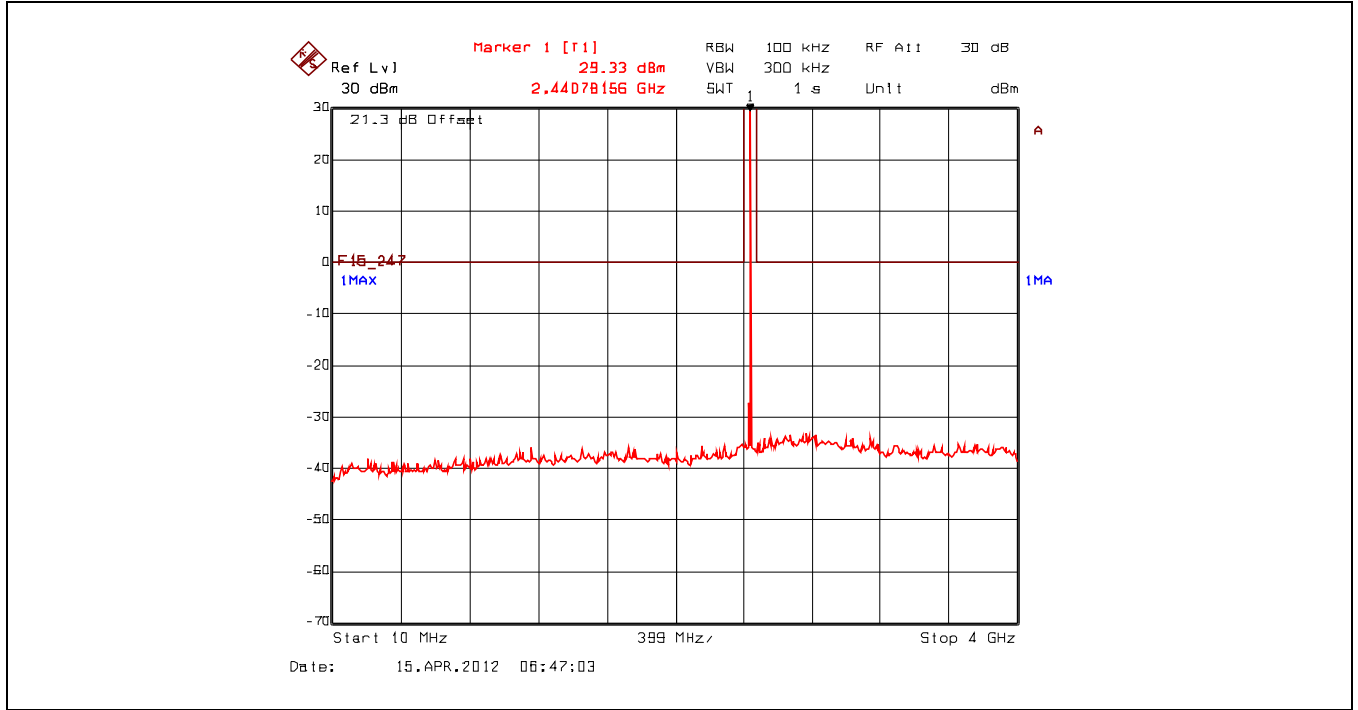
**Plot 5.4.4.2.1. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2402.50 MHz, Data Rate 8, 10 MHz - 4 GHz**



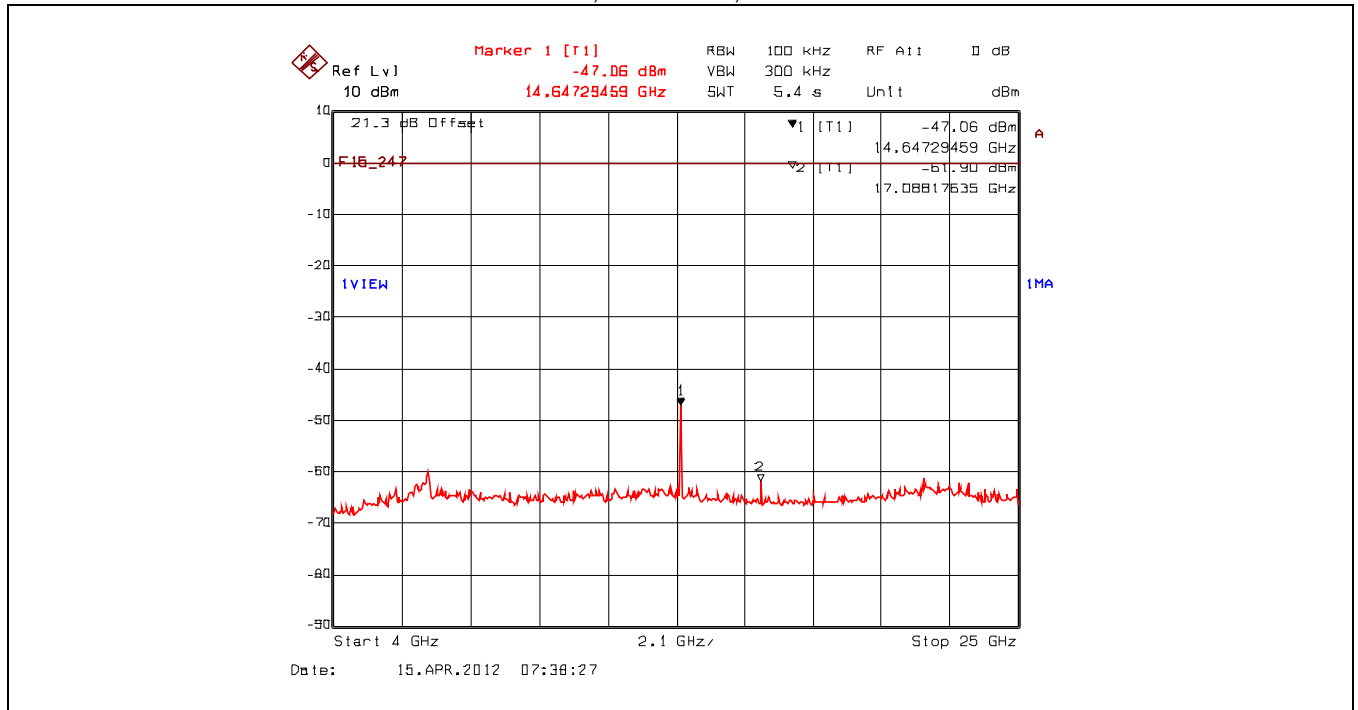
**Plot 5.4.4.2.2. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2402.50 MHz, Data Rate 8,4 GHz - 25 GHz**



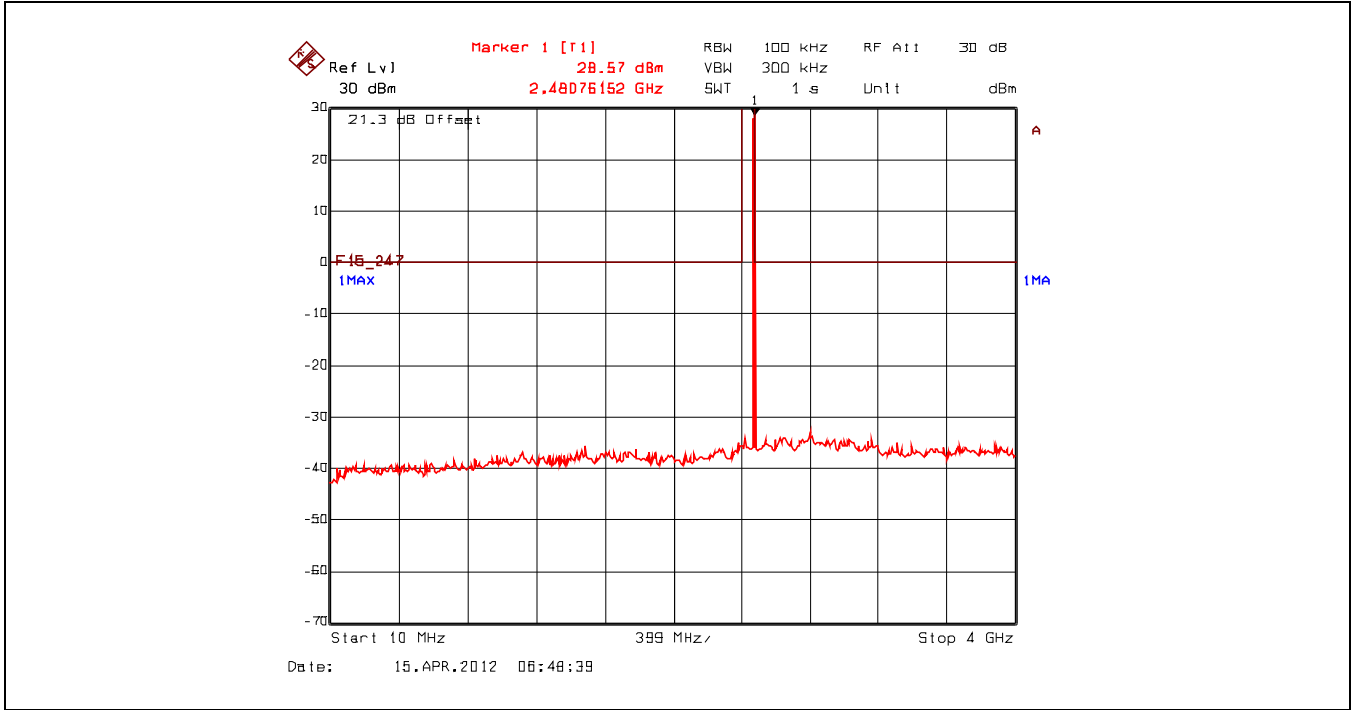
Plot 5.4.4.2.3. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2439.25 MHz, Data Rate 8, 10 MHz - 4 GHz



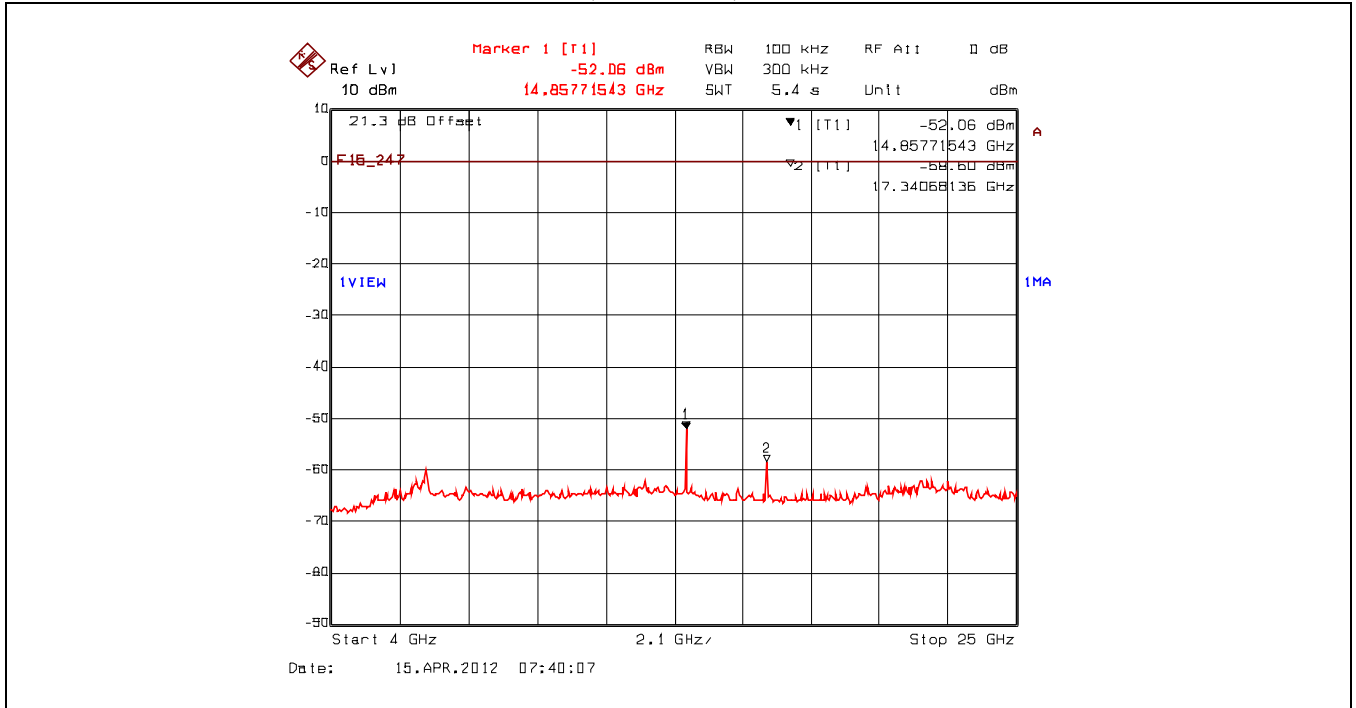
Plot 5.4.4.2.4. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2439.25 MHz, Data Rate 8, 4 GHz - 25 GHz



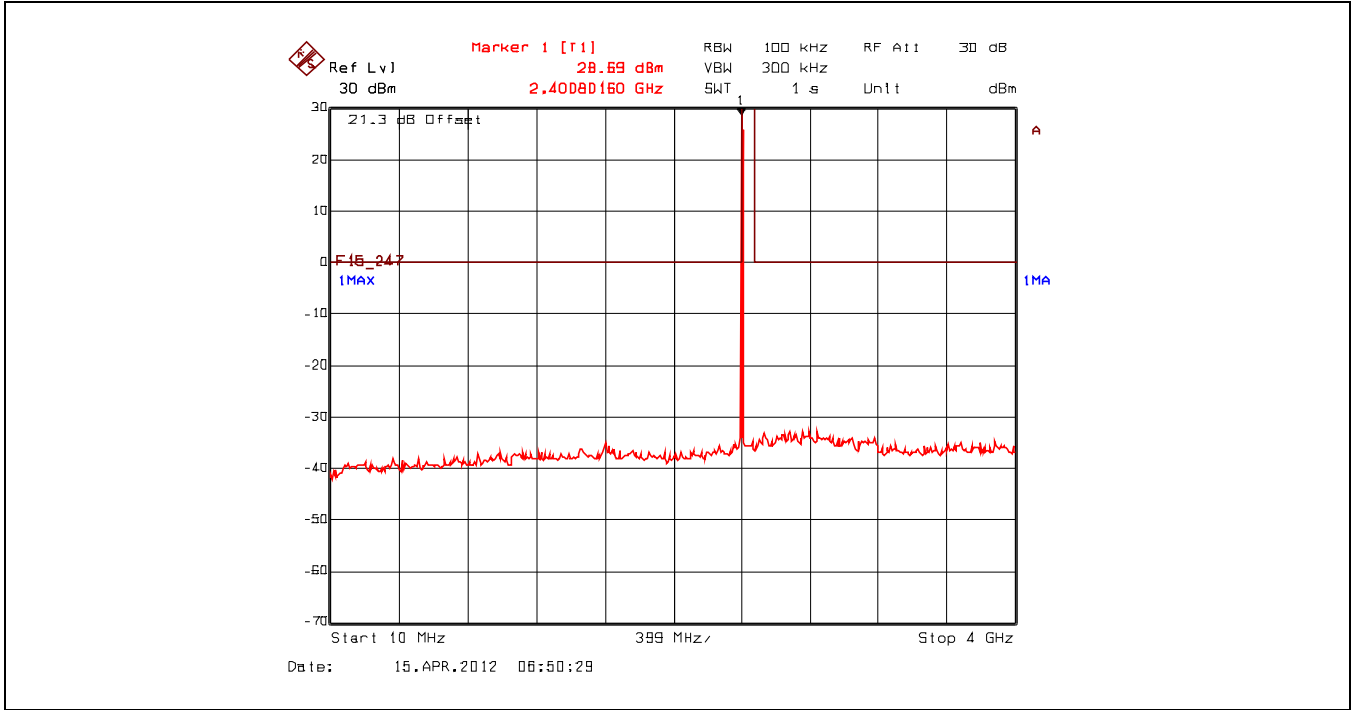
Plot 5.4.4.2.5. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2476.00 MHz, Data Rate 8, 10 MHz - 4 GHz



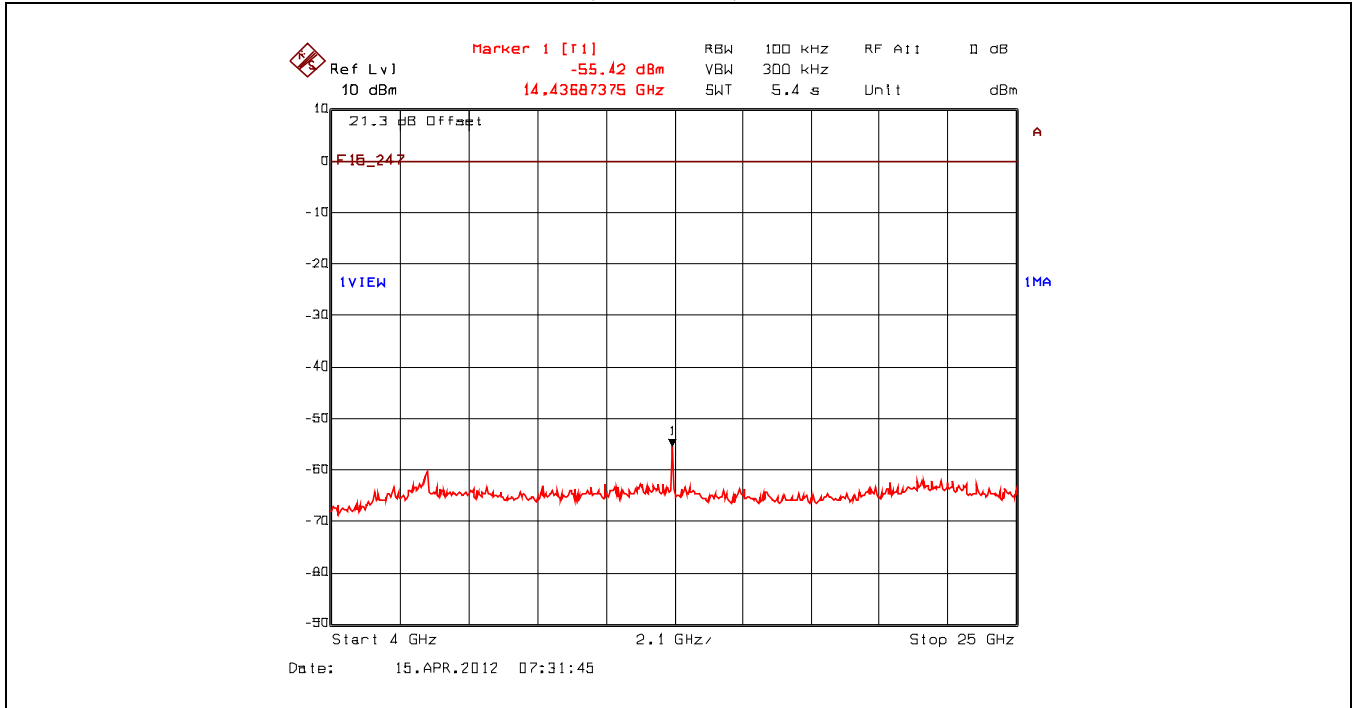
Plot 5.4.4.2.6. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2476.00 MHz, Data Rate 8, 4 GHz - 25 GHz



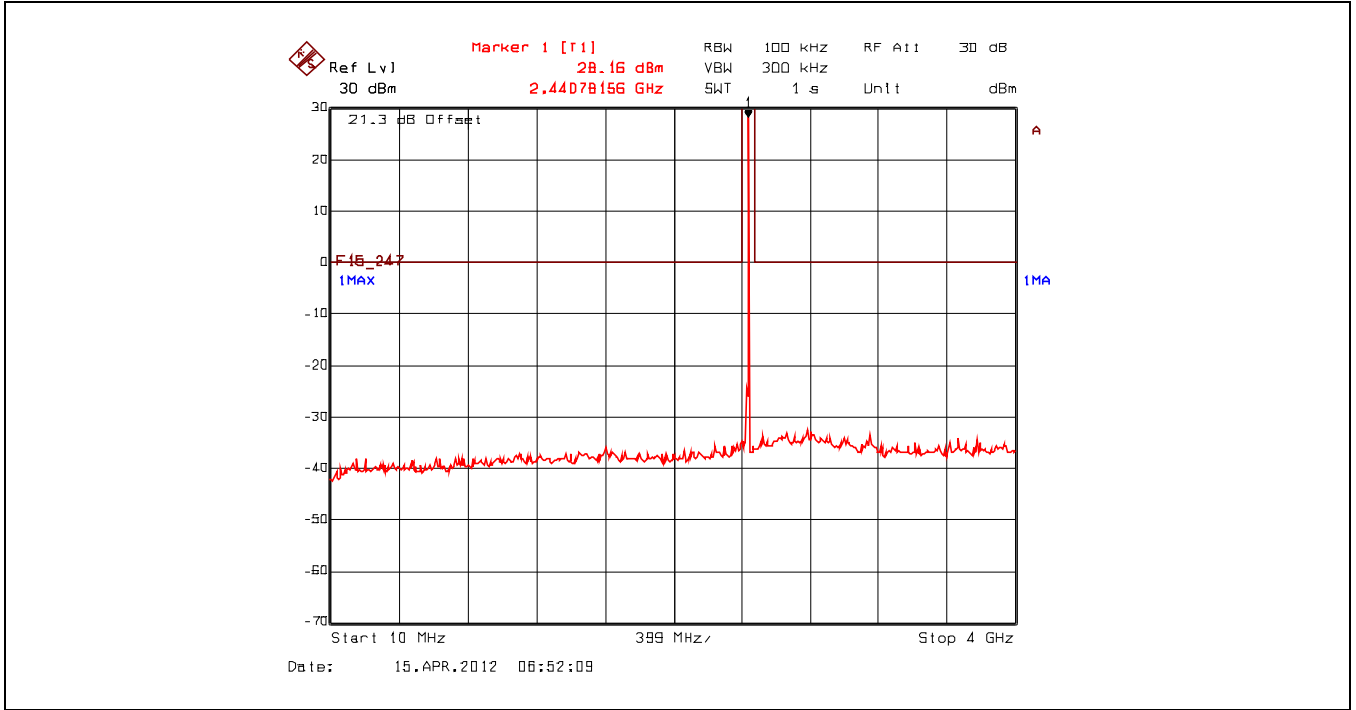
Plot 5.4.4.2.7. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2403.50 MHz, Data Rate 9, 10 MHz - 4 GHz



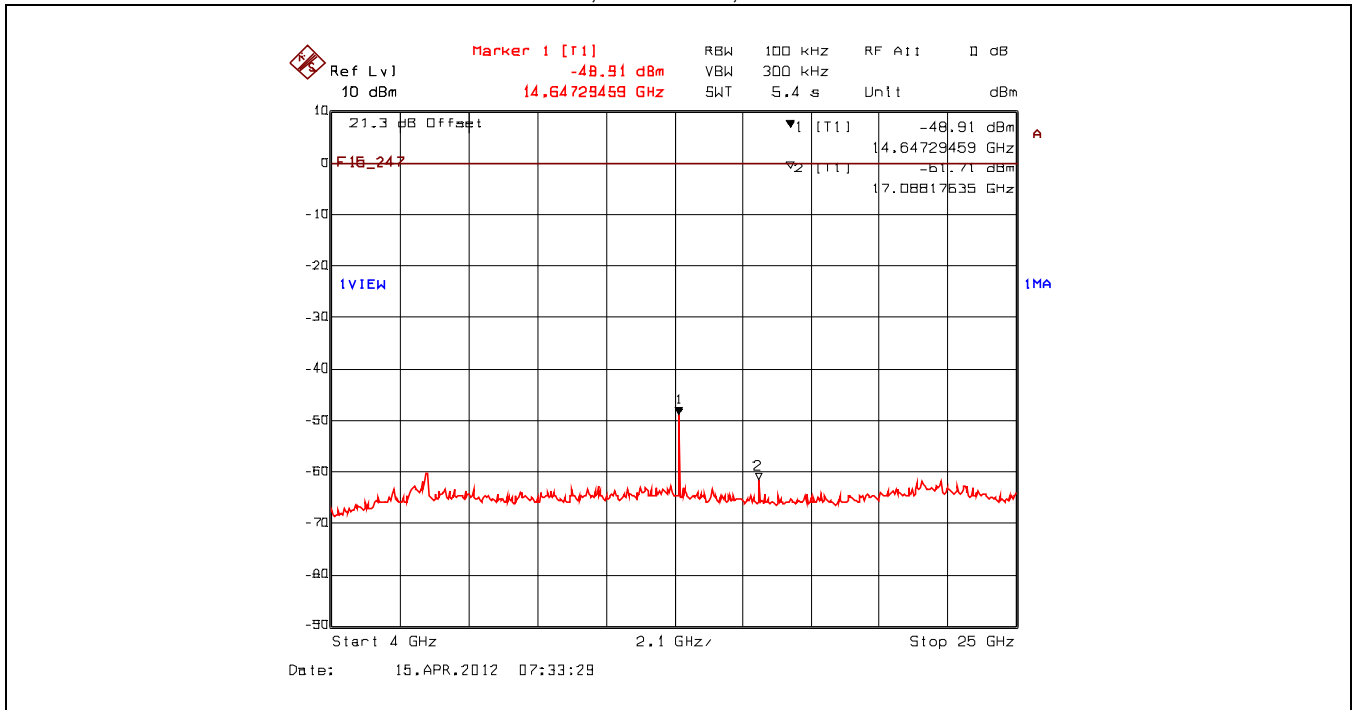
Plot 5.4.4.2.8. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2403.50 MHz, Data Rate 9, 4 GHz - 25 GHz



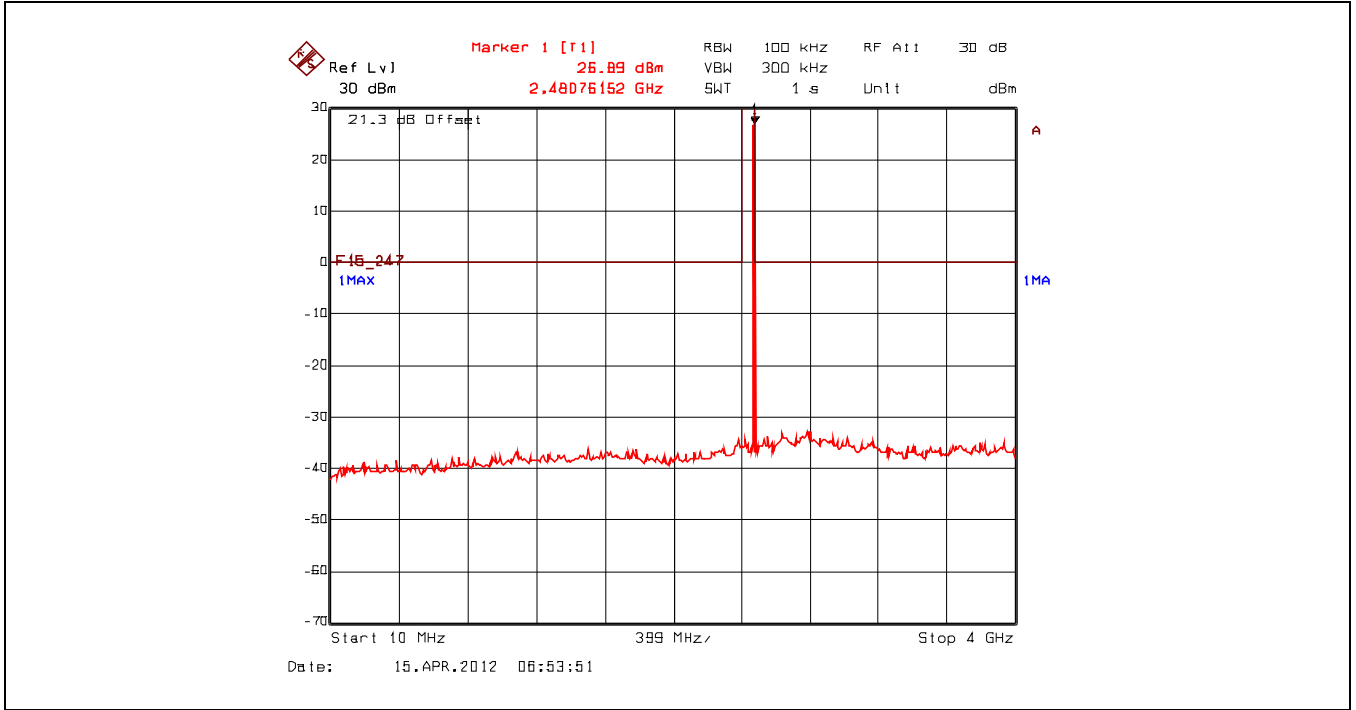
Plot 5.4.4.2.9. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2439.50 MHz, Data Rate 9, 10 MHz - 4 GHz



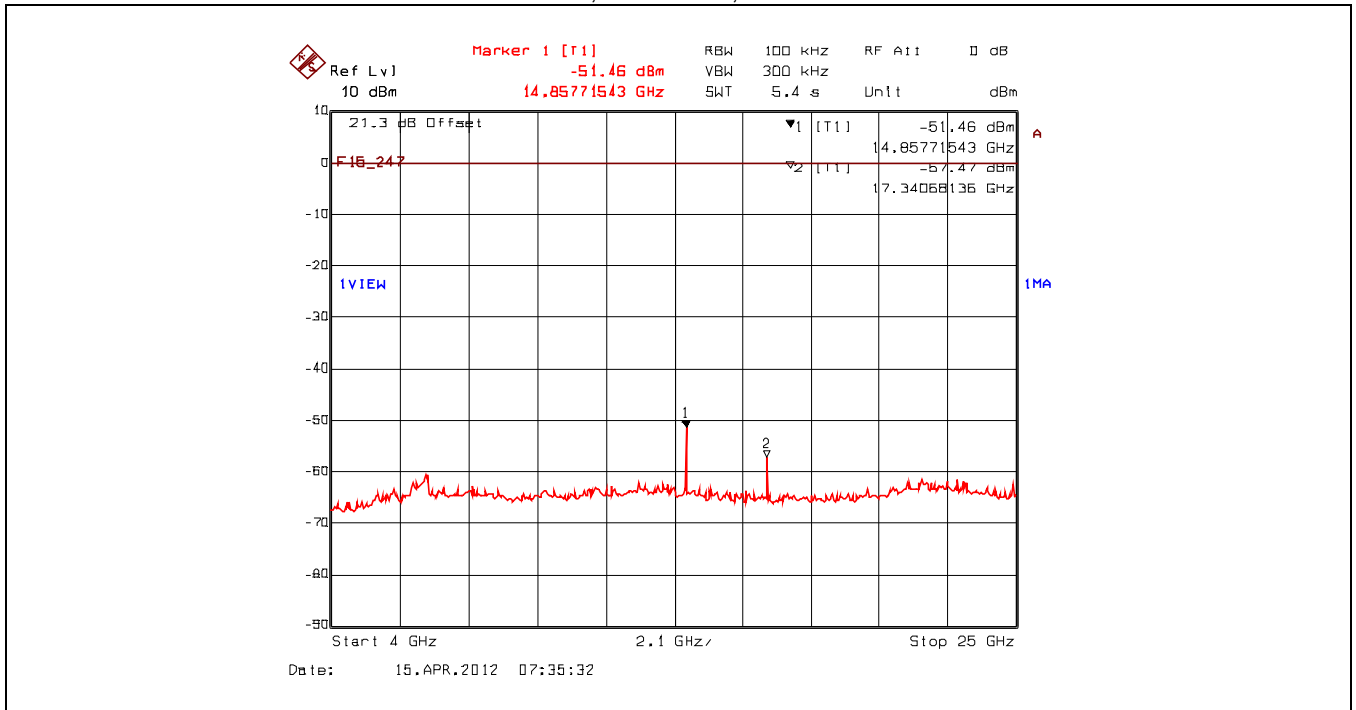
Plot 5.4.4.2.10. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2439.50 MHz, Data Rate 9, 4 GHz - 25 GHz



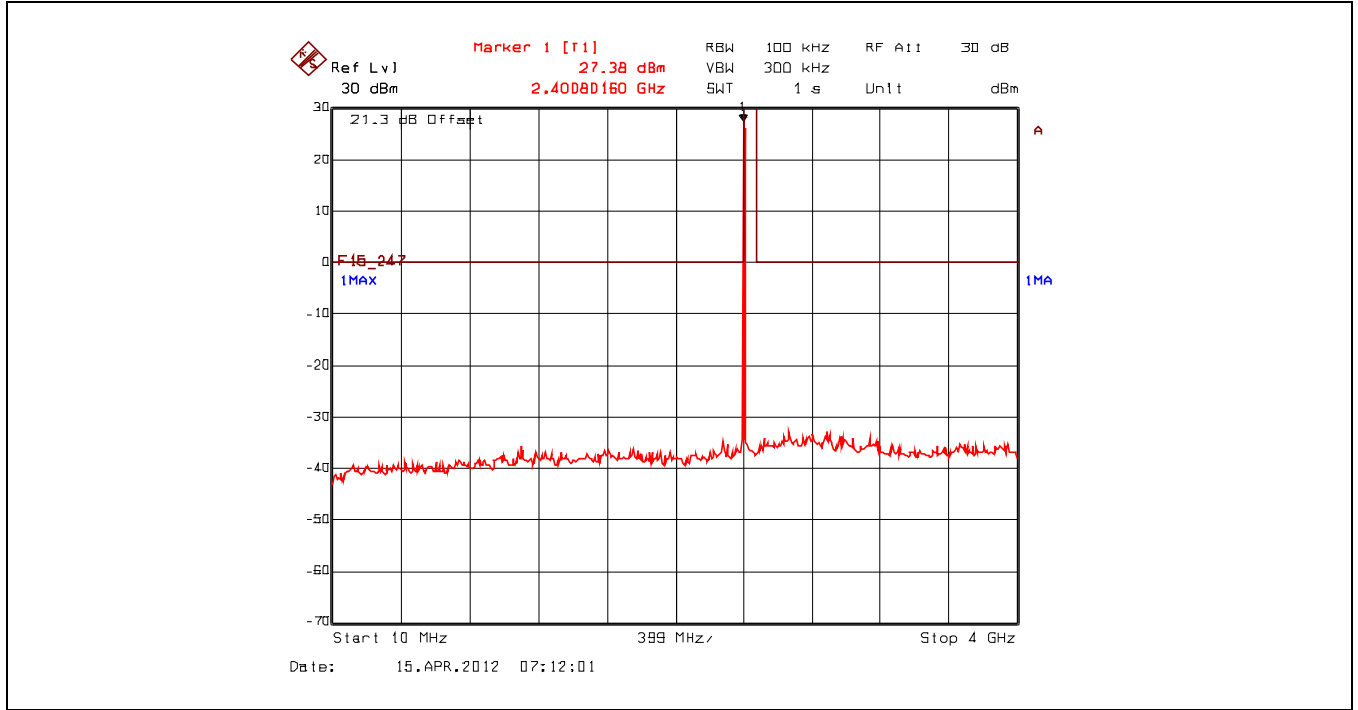
Plot 5.4.4.2.11. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2475.50 MHz, Data Rate 9, 10 MHz - 4 GHz



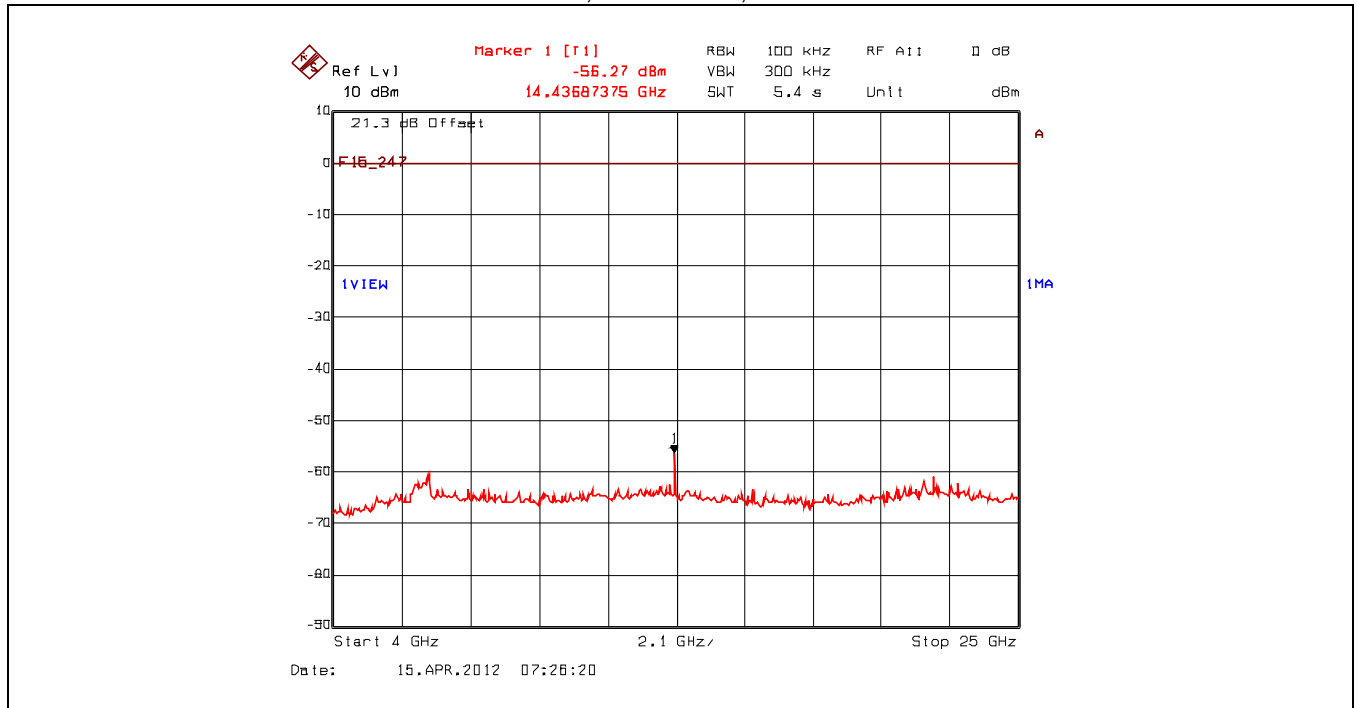
Plot 5.4.4.2.12. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2475.50 MHz, Data Rate 9, 4 GHz - 25 GHz



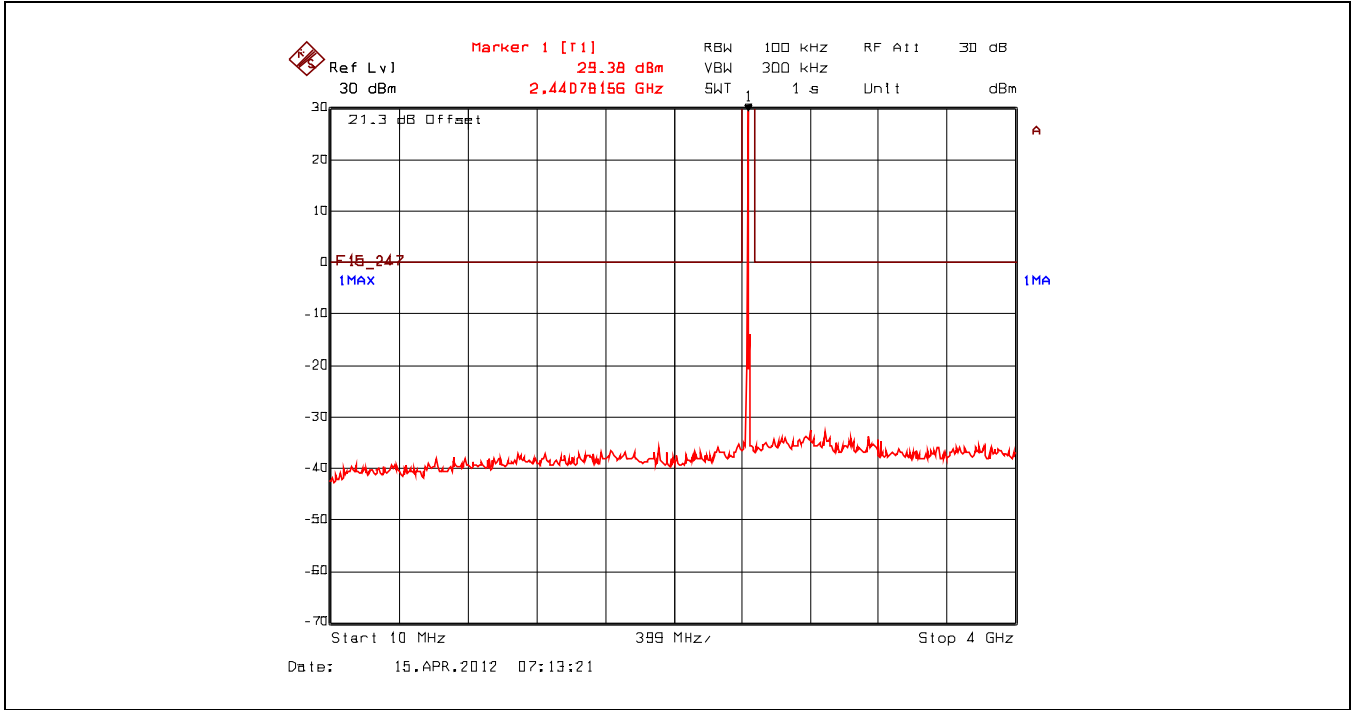
Plot 5.4.4.2.13. Conducted Spurious Emissions - Non Restricted Frequency Bands
2404.00 MHz, Data Rate 10, 10 MHz - 4 GHz



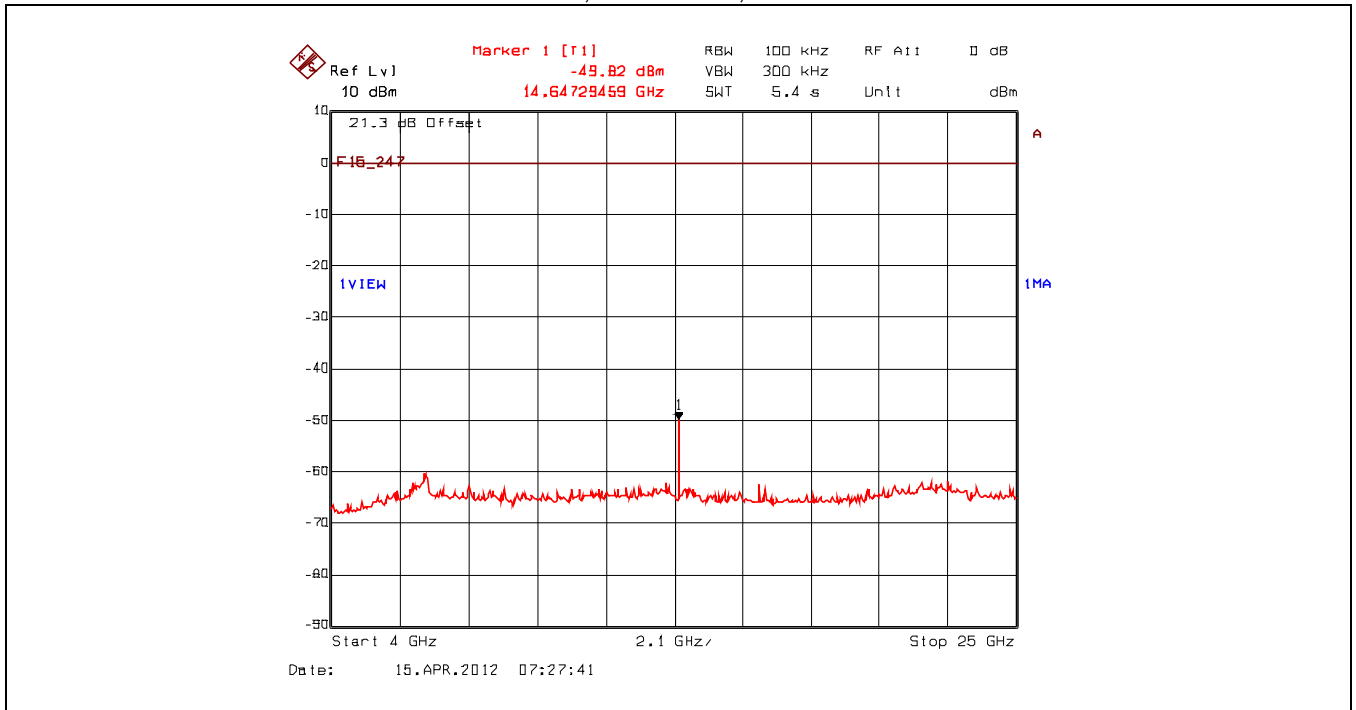
Plot 5.4.4.2.14. Conducted Spurious Emissions - Non Restricted Frequency Bands
2404.00 MHz, Data Rate 10, 4 GHz - 25 GHz



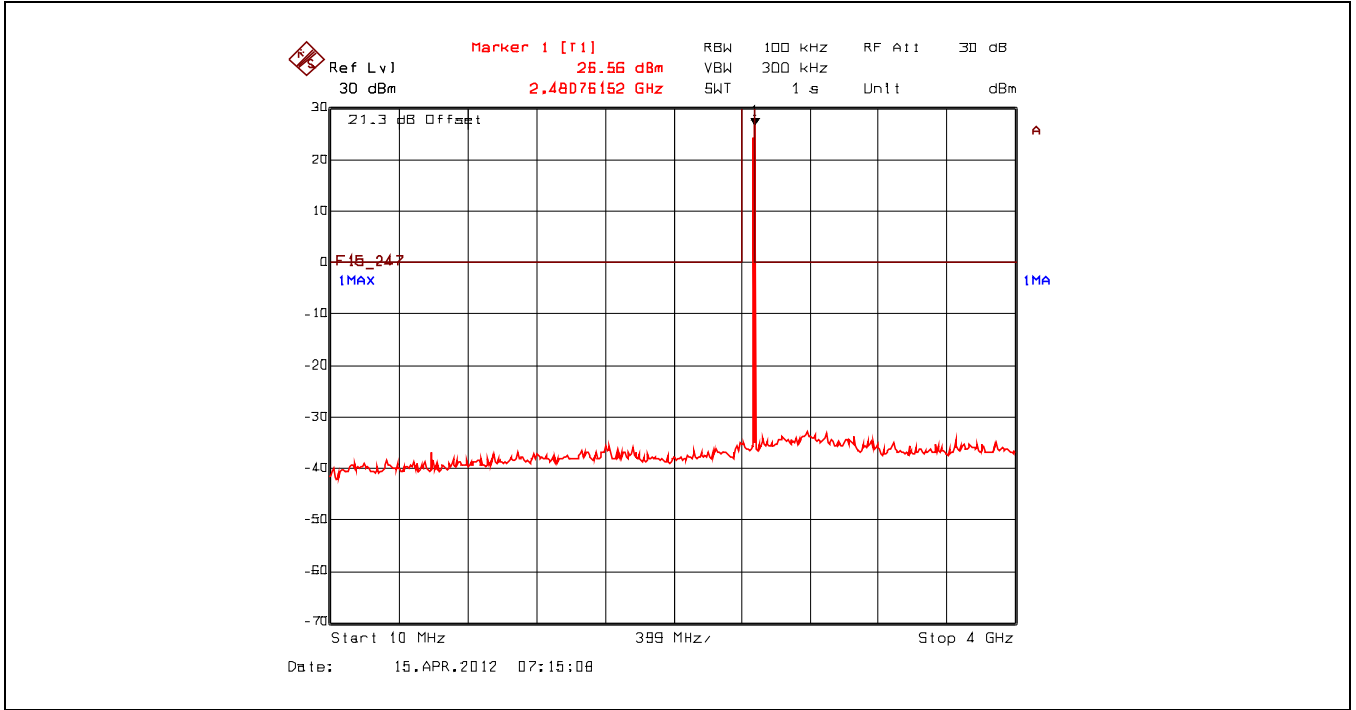
Plot 5.4.4.2.15. Conducted Spurious Emissions - Non Restricted Frequency Bands
2440.25 MHz, Data Rate 10, 10 MHz - 4 GHz



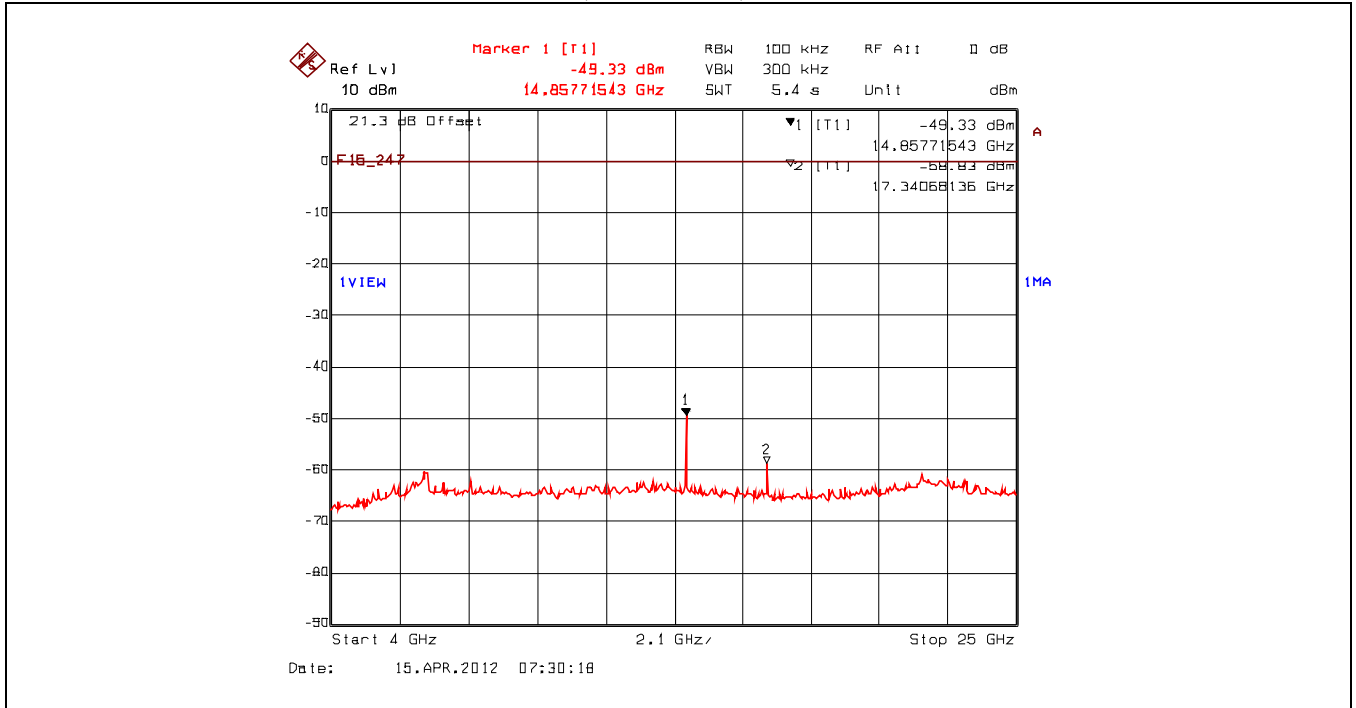
Plot 5.4.4.2.16. Conducted Spurious Emissions - Non Restricted Frequency Bands
2440.25 MHz, Data Rate 10, 4 GHz - 25 GHz



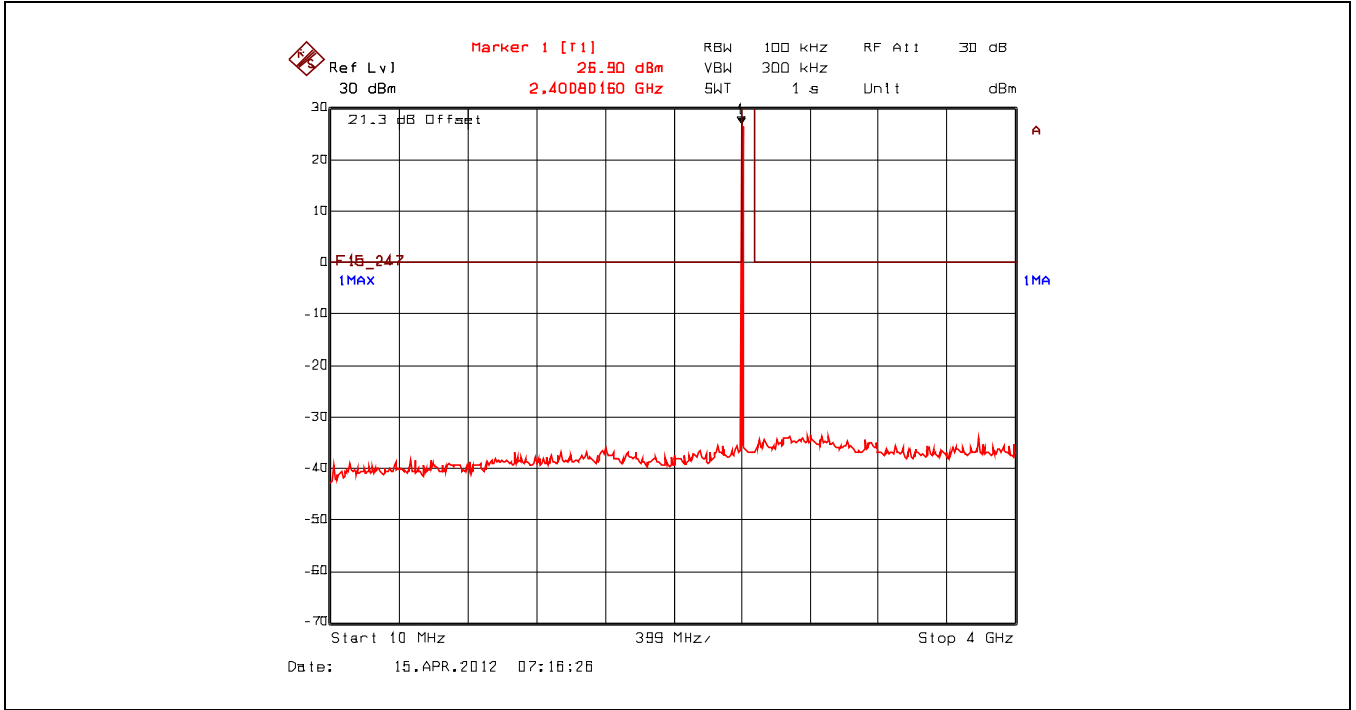
Plot 5.4.4.2.17. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2476.50 MHz, Data Rate 10, 10 MHz - 4 GHz



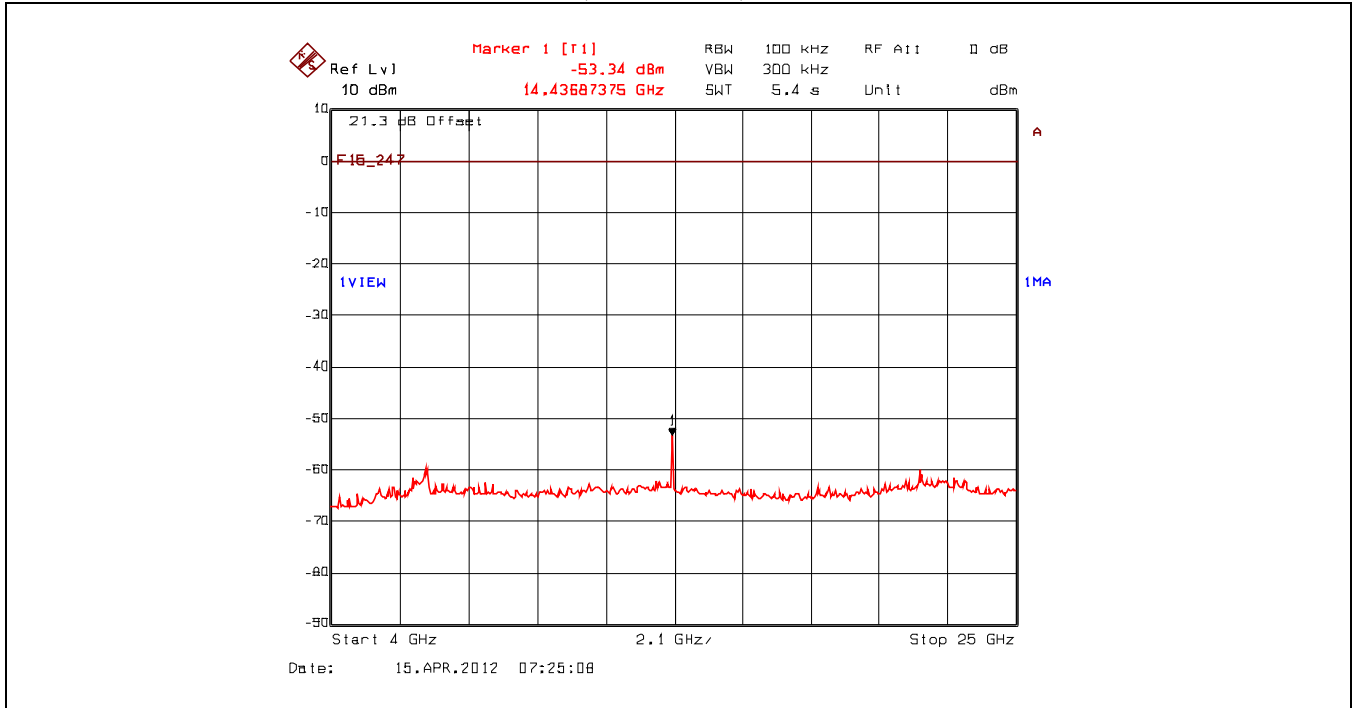
Plot 5.4.4.2.18. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2476.50 MHz, Data Rate 10, 4 GHz - 25 GHz



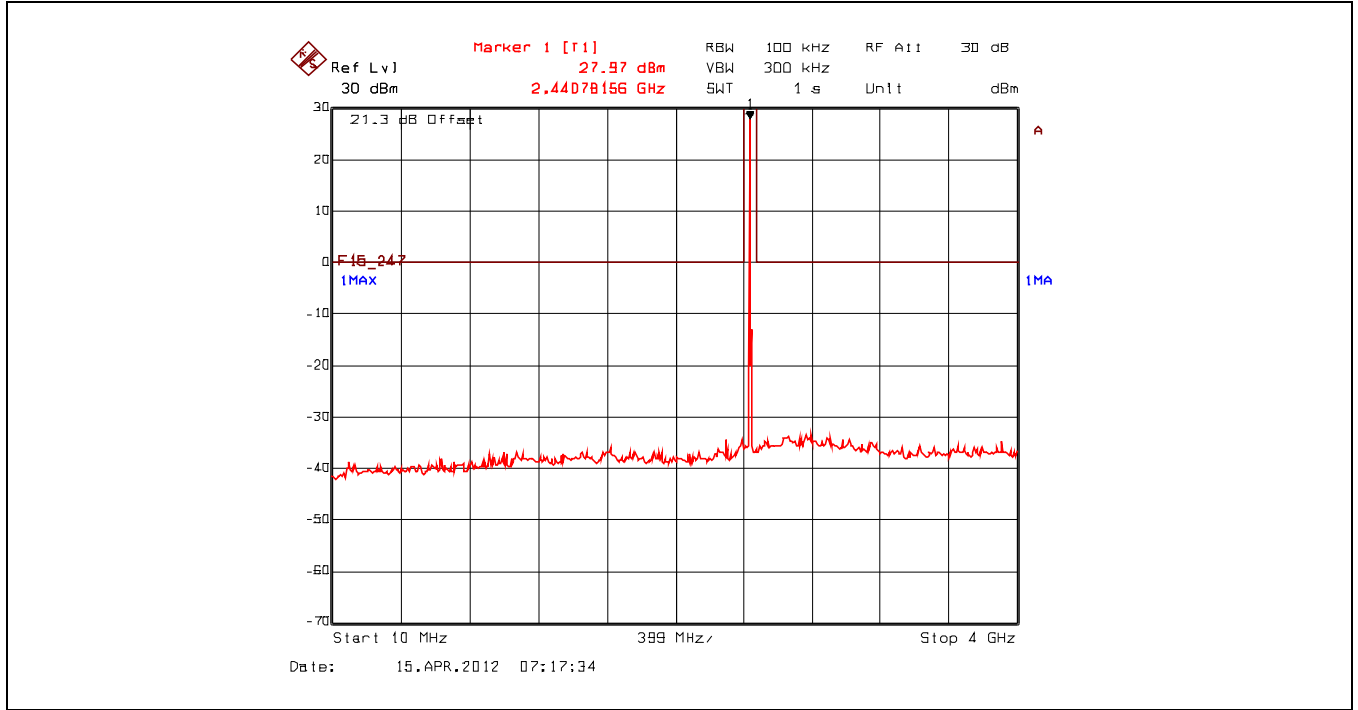
Plot 5.4.4.2.19. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2405.50 MHz, Data Rate 11, 10 MHz - 4 GHz



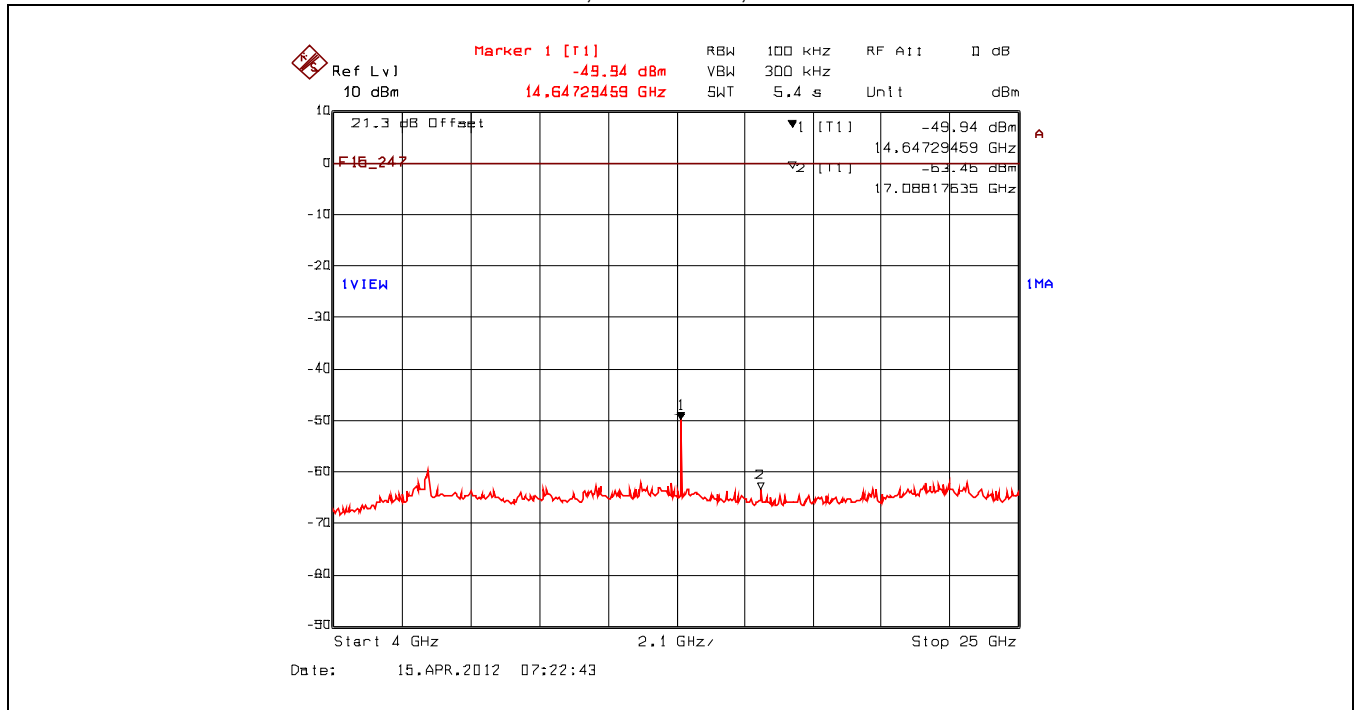
Plot 5.4.4.2.20. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2405.50 MHz, Data Rate 11, 4 GHz - 25 GHz



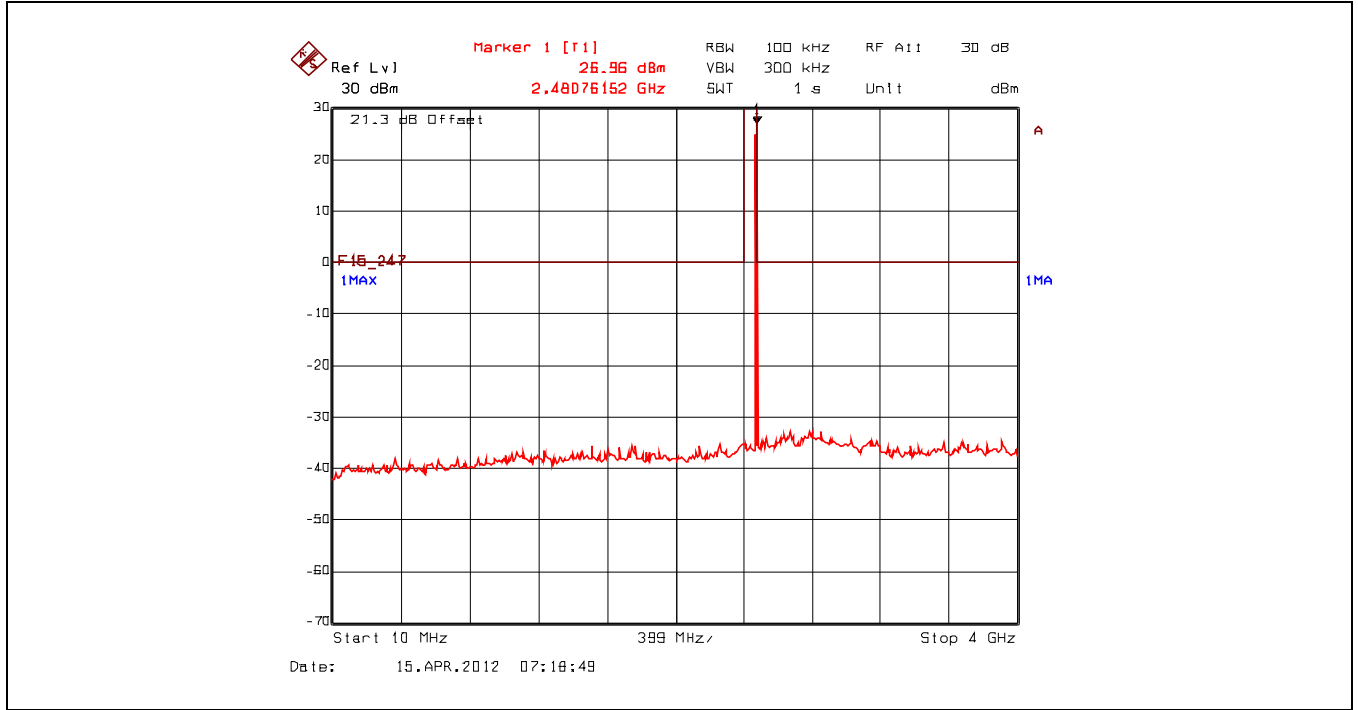
Plot 5.4.4.2.21. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2439.50 MHz, Data Rate 11, 10 MHz - 4 GHz



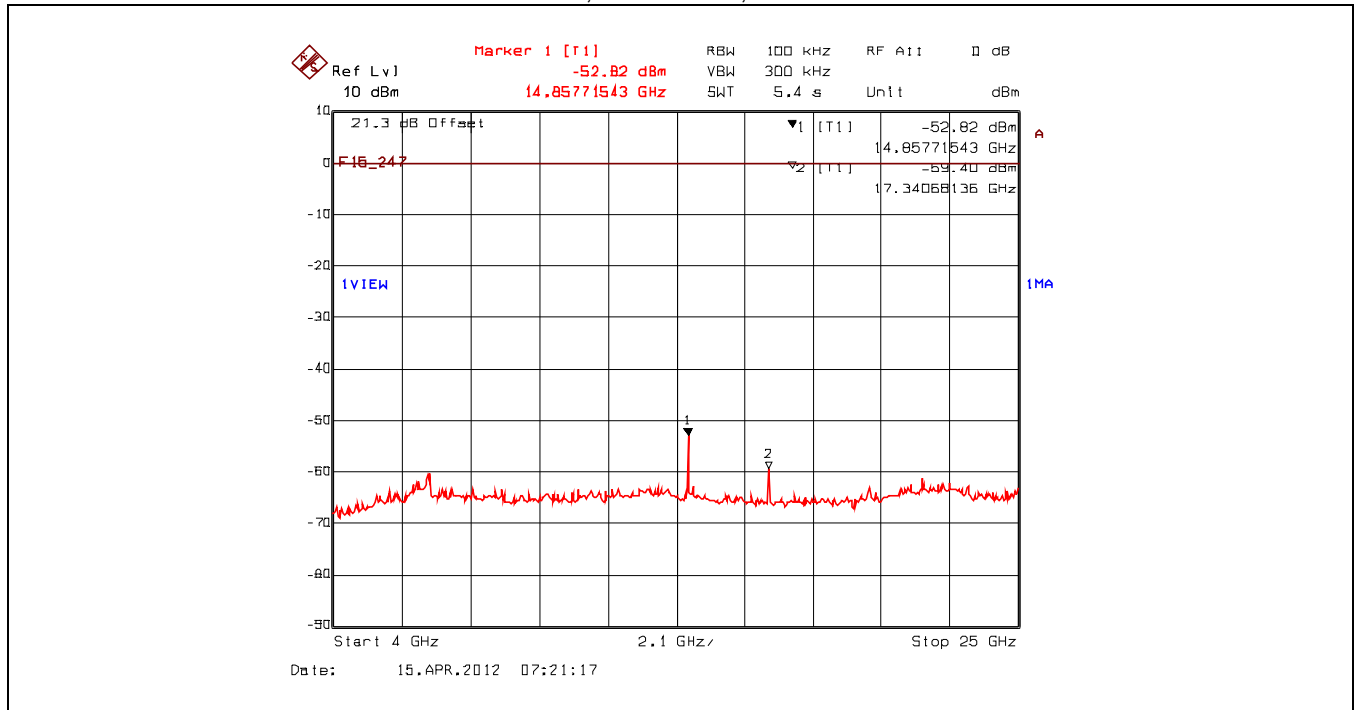
Plot 5.4.4.2.22. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2439.50 MHz, Data Rate 11, 4 GHz - 25 GHz



Plot 5.4.4.2.23. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2473.50 MHz, Data Rate 11, 10 MHz - 4 GHz



Plot 5.4.4.2.24. Conducted Spurious Emissions - Non Restricted Frequency Bands
 2473.50 MHz, Data Rate 11, 4 GHz - 25 GHz

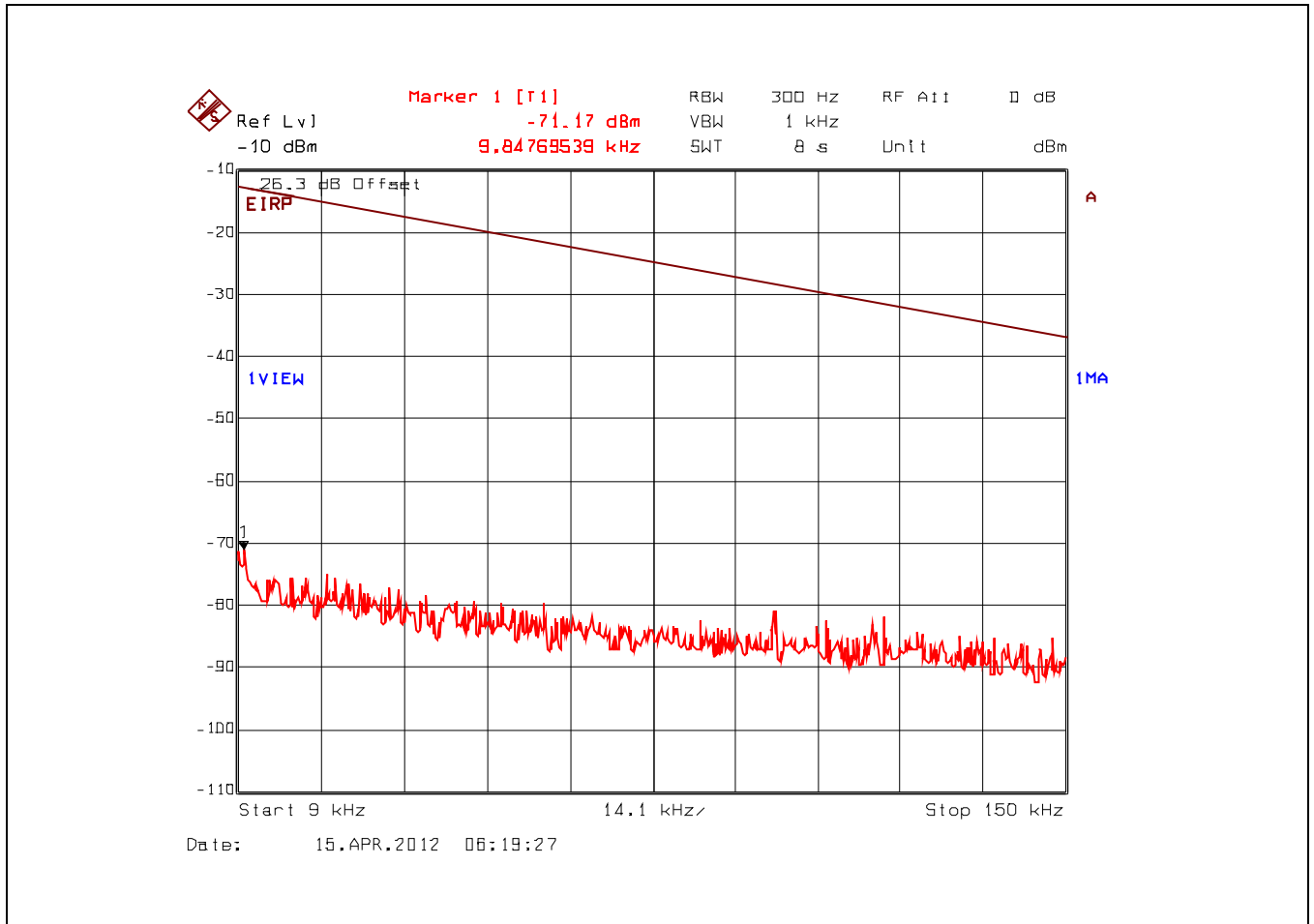


5.4.4.3. Conducted Spurious Emissions – Restricted Bands, Highest Power Setting (52) with Highest Gain Antenna (15 dBi)

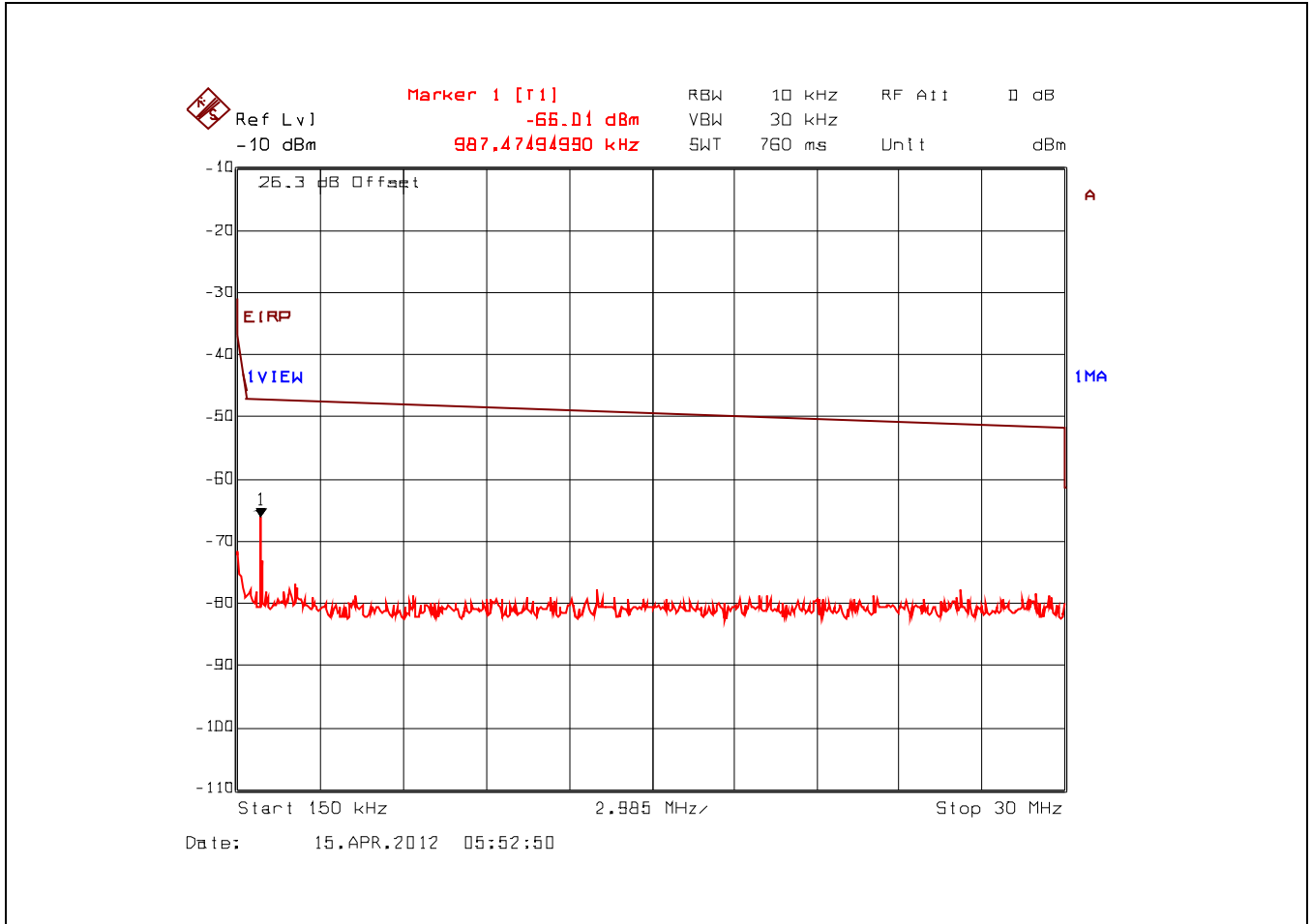
Remark(s):

- The following test results at high power setting and Data Rate 8 represent the worst-case.
- Offset = Insertion Loss (11.25 dB) + Highest Antenna Gain (15 dBi) = 26.3 dB

Plot 5.4.4.3.1. Conducted Spurious Emissions – Restricted Bands
 2402.50 MHz, 9 kHz - 150 kHz, Peak Detector



Plot 5.4.4.3.2. Conducted Spurious Emissions – Restricted Bands
2402.50 MHz, 150 kHz - 30 MHz, Peak Detector



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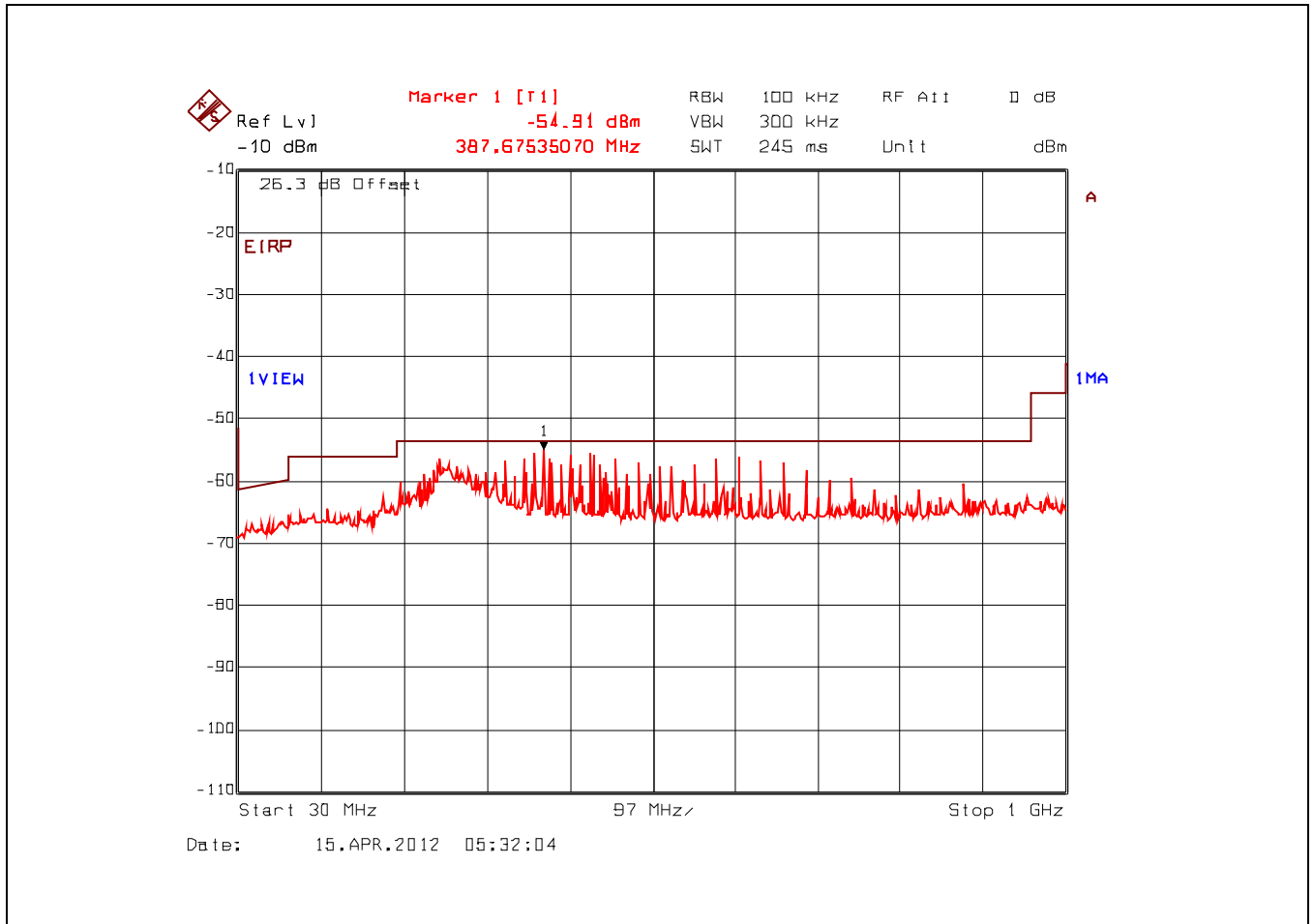
3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: MCRS-047F15C247DTS

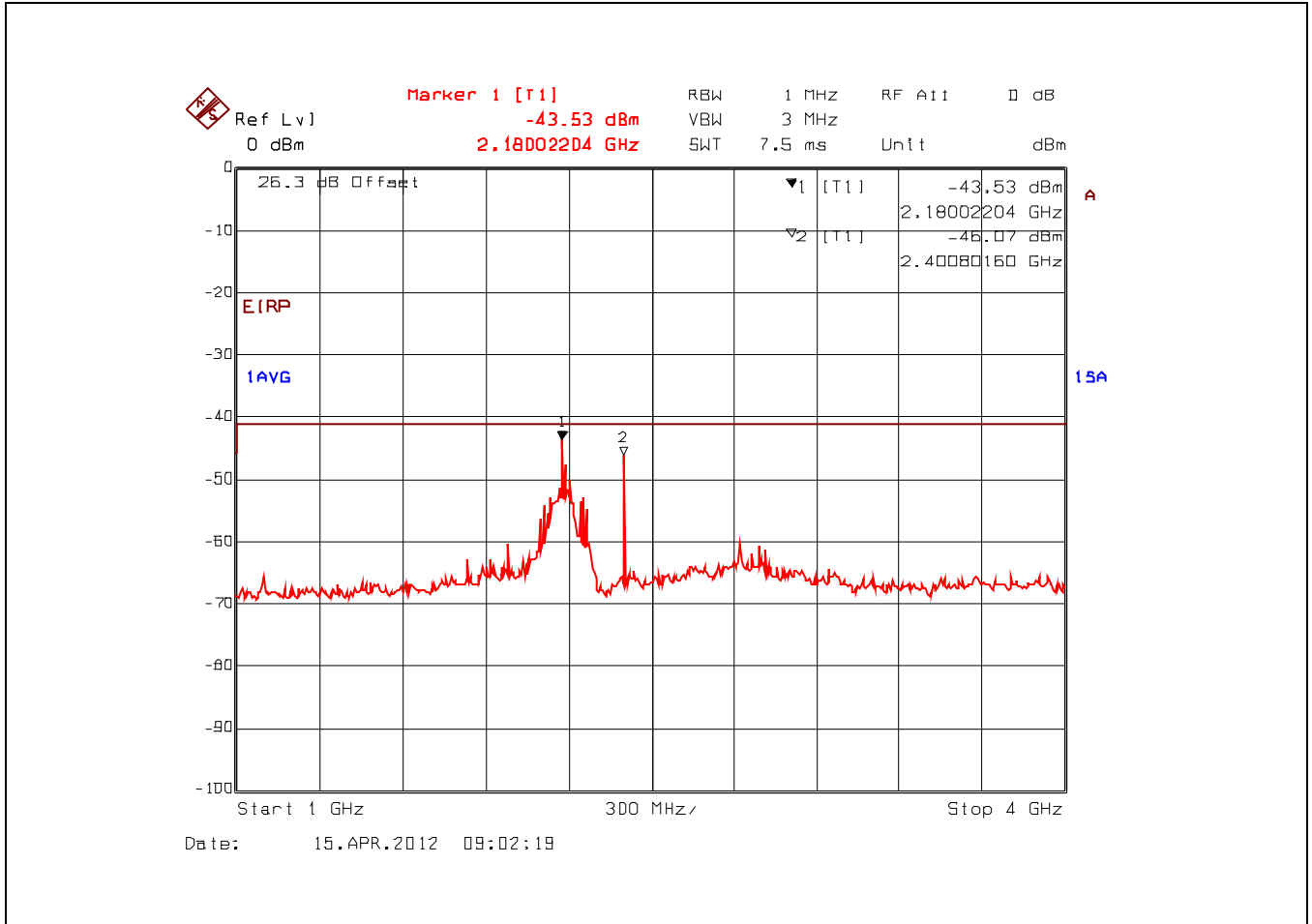
July 23, 2012

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

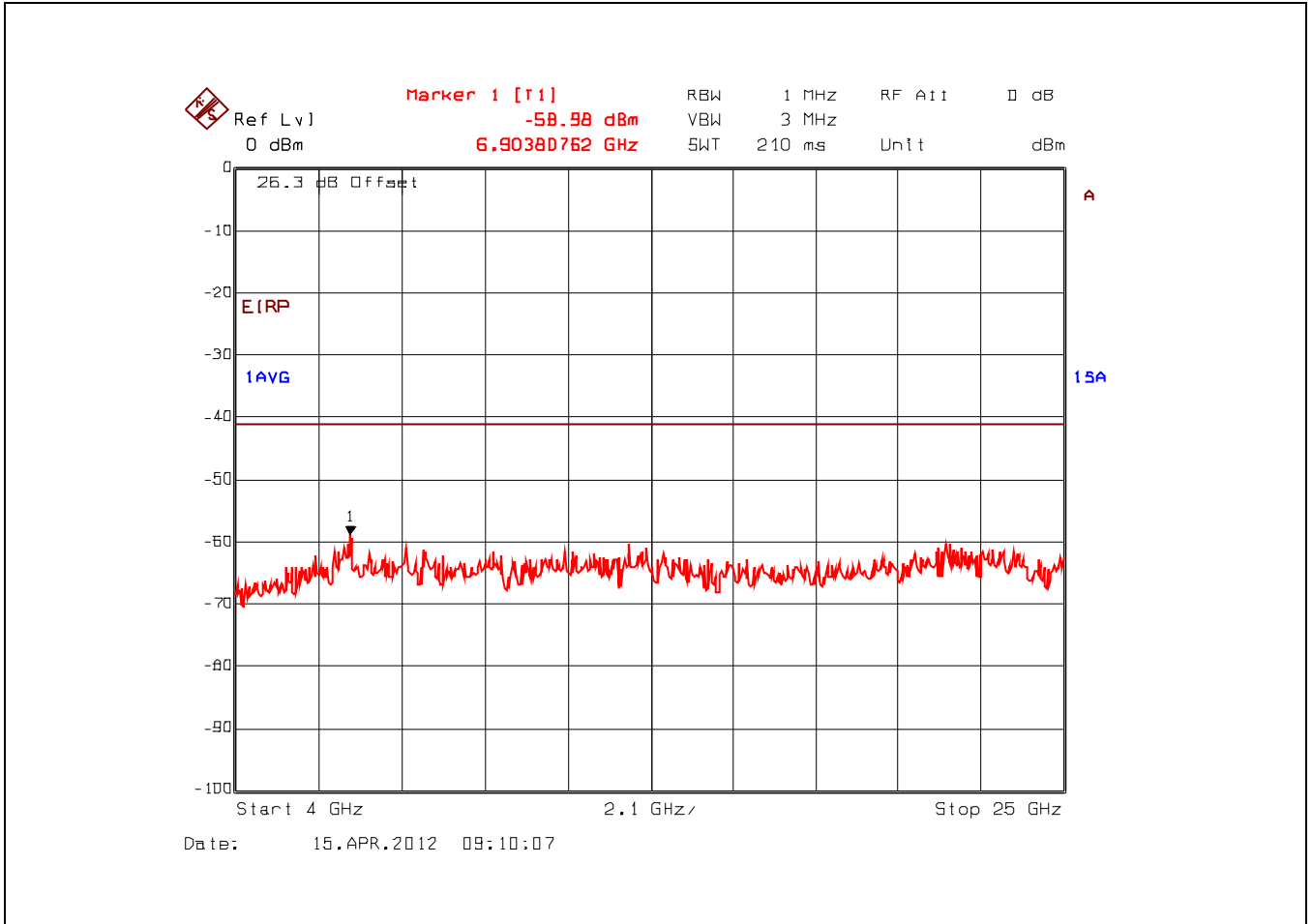
Plot 5.4.4.3.3. Conducted Spurious Emissions – Restricted Bands
2402.50 MHz, 30 MHz - 1 GHz, Peak Detector with Band (Notch) Reject Filter



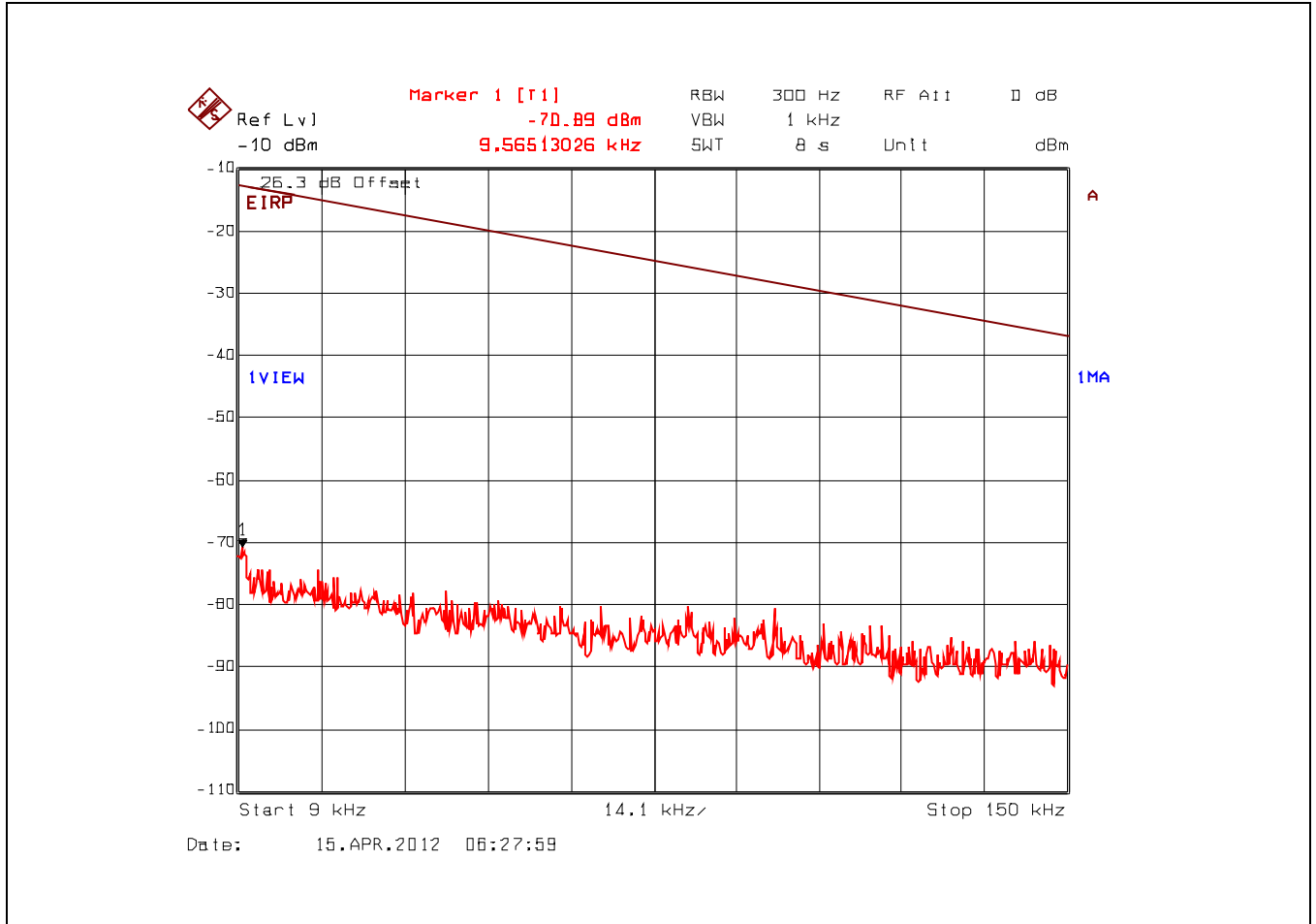
Plot 5.4.4.3.4. Conducted Spurious Emissions – Restricted Bands
 2402.50 MHz, 1 GHz - 4 GHz, Trace Average with Band (Notch) Reject Filter



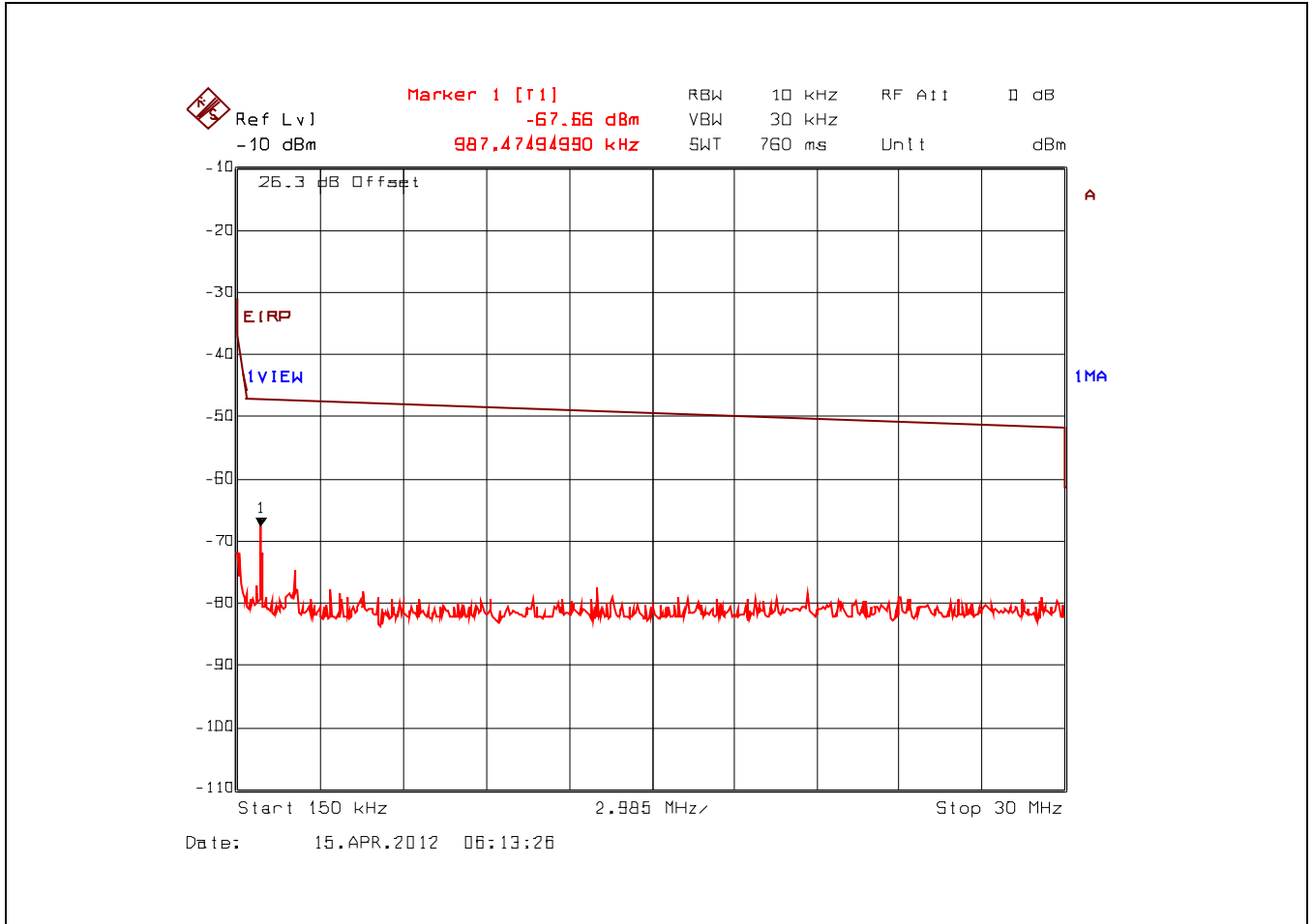
Plot 5.4.4.3.5. Conducted Spurious Emissions – Restricted Bands
2402.50 MHz, 4 GHz - 25 GHz, Trace Average with High Pass Filter



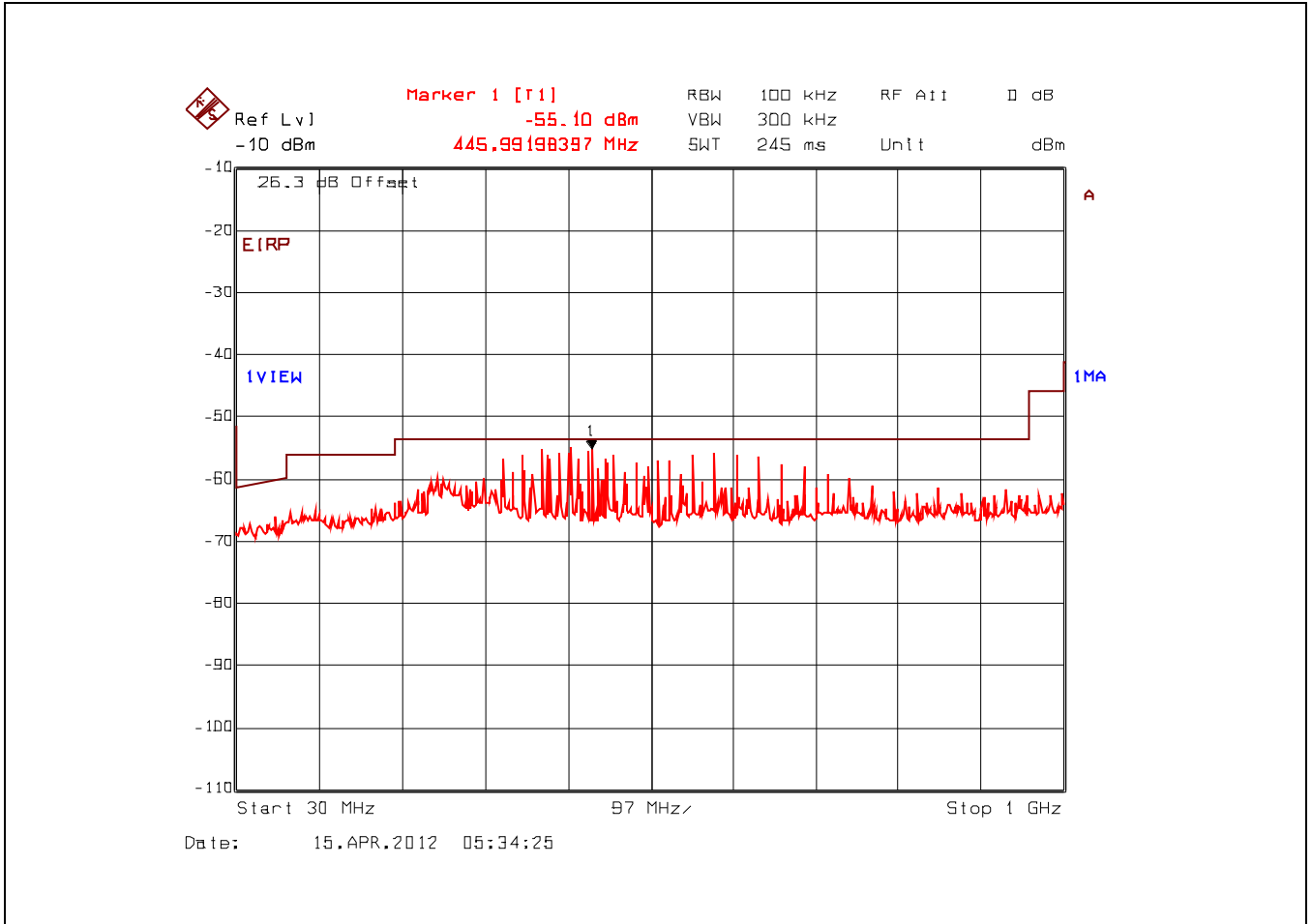
Plot 5.4.4.3.6. Conducted Spurious Emissions – Restricted Bands
2439.25 MHz, 9 kHz - 150 kHz, Peak Detector



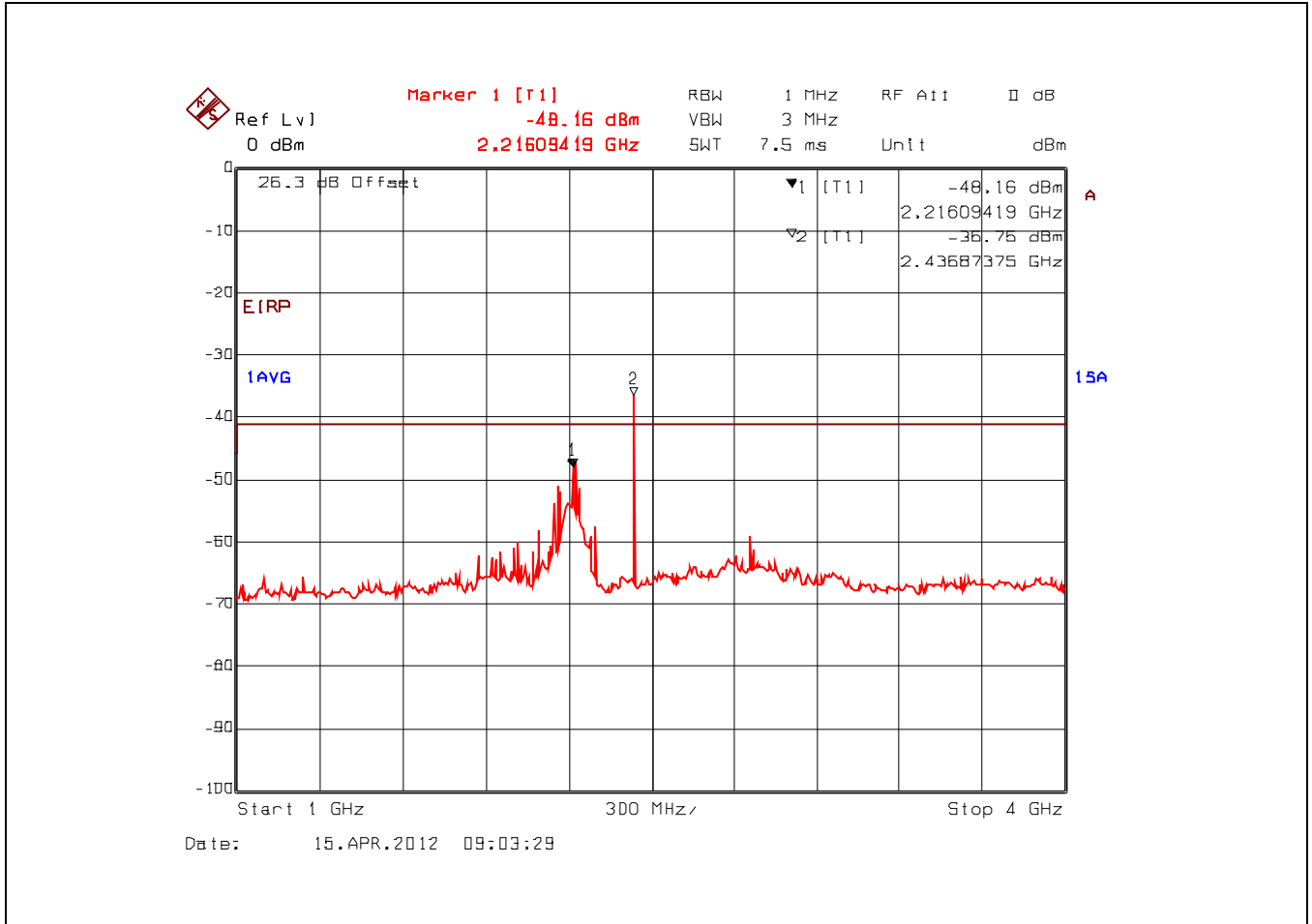
Plot 5.4.4.3.7. Conducted Spurious Emissions – Restricted Bands
2439.25 MHz, 150 kHz - 30 MHz, Peak Detector



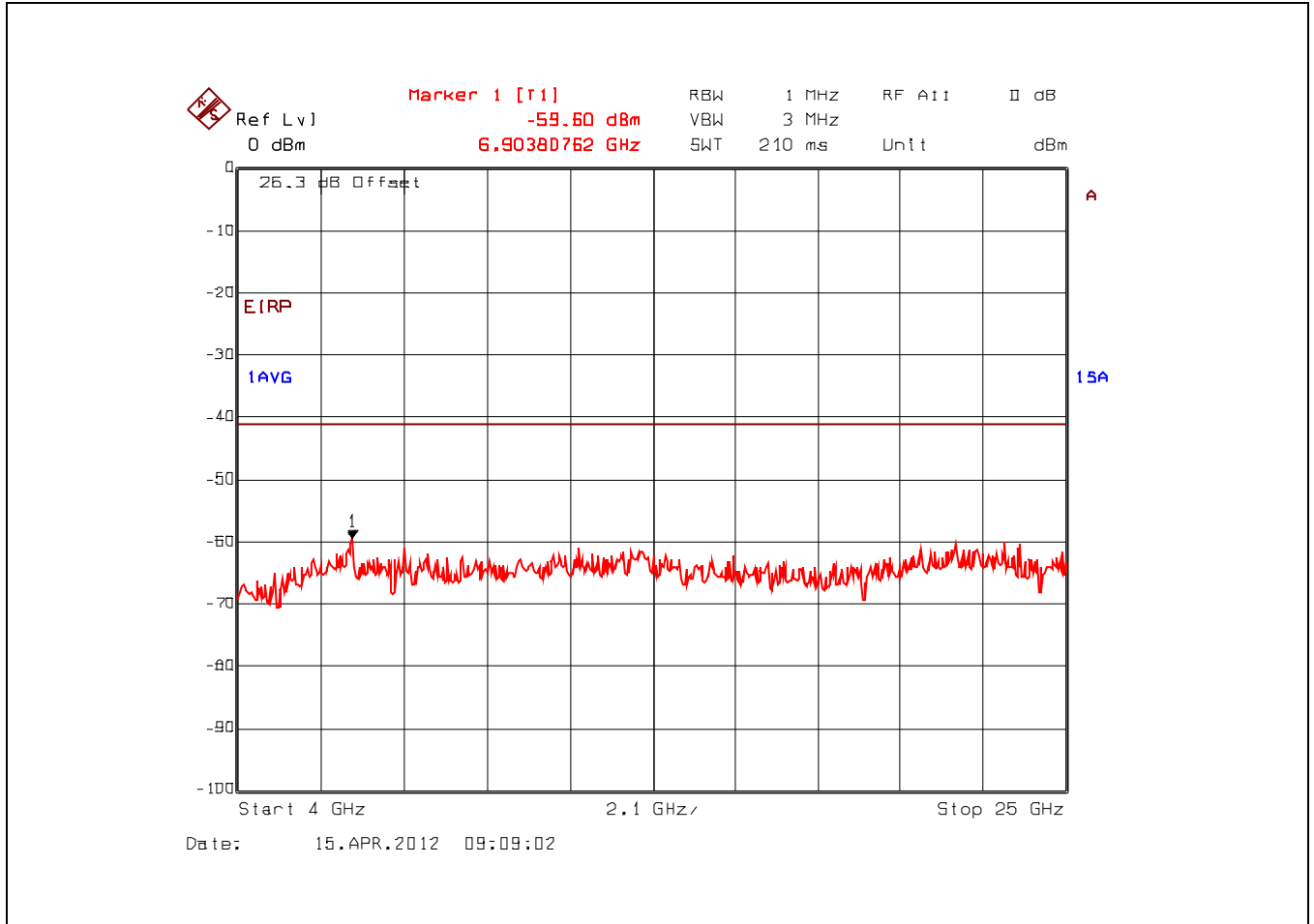
Plot 5.4.4.3.8. Conducted Spurious Emissions – Restricted Bands
2439.25 MHz, 30 MHz - 1 GHz, Peak Detector with Band (Notch) Reject Filter



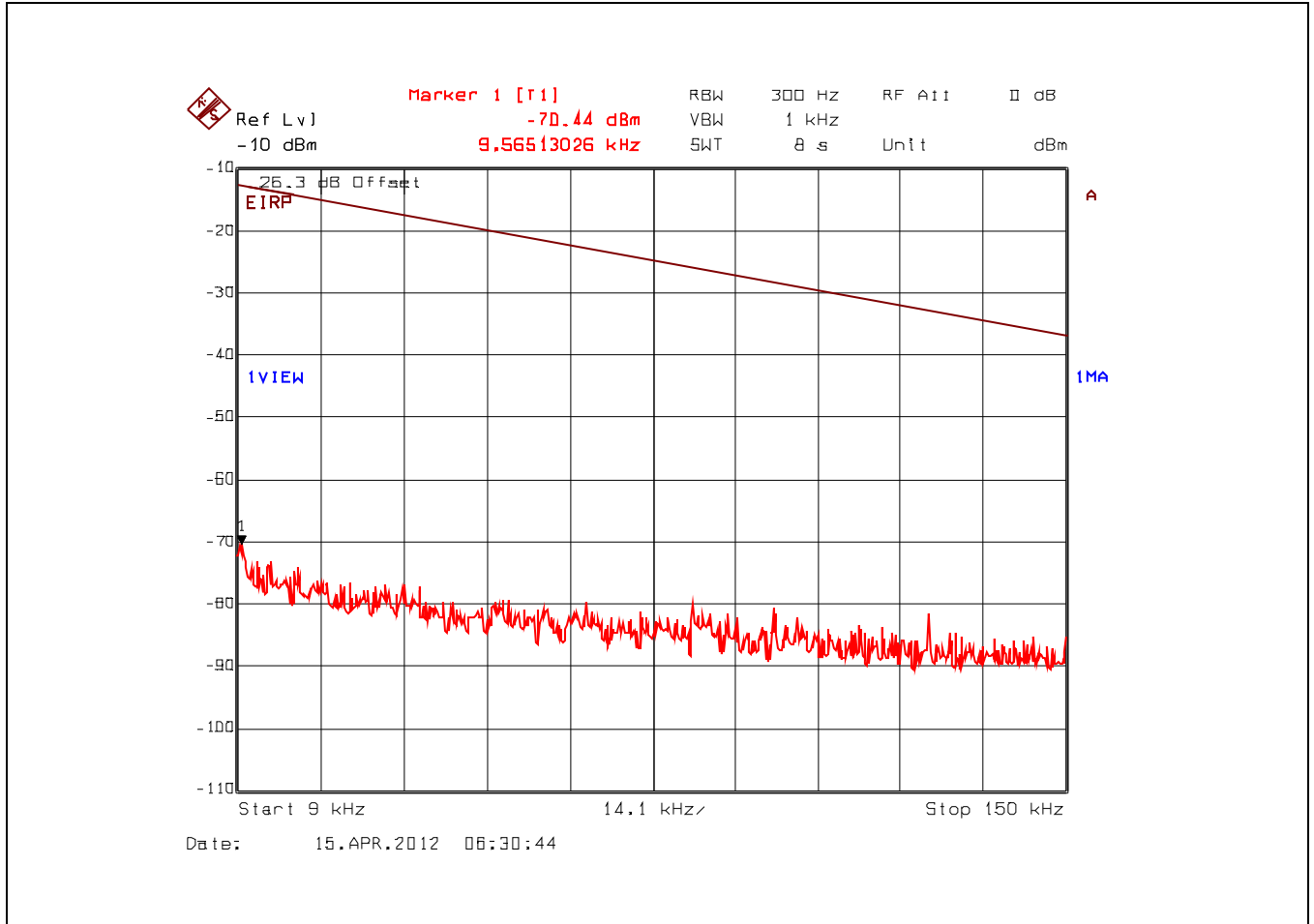
Plot 5.4.4.3.9. Conducted Spurious Emissions – Restricted Bands
 2439.25 MHz, 1 GHz - 4 GHz, Trace Average with Band (Notch) Reject Filter



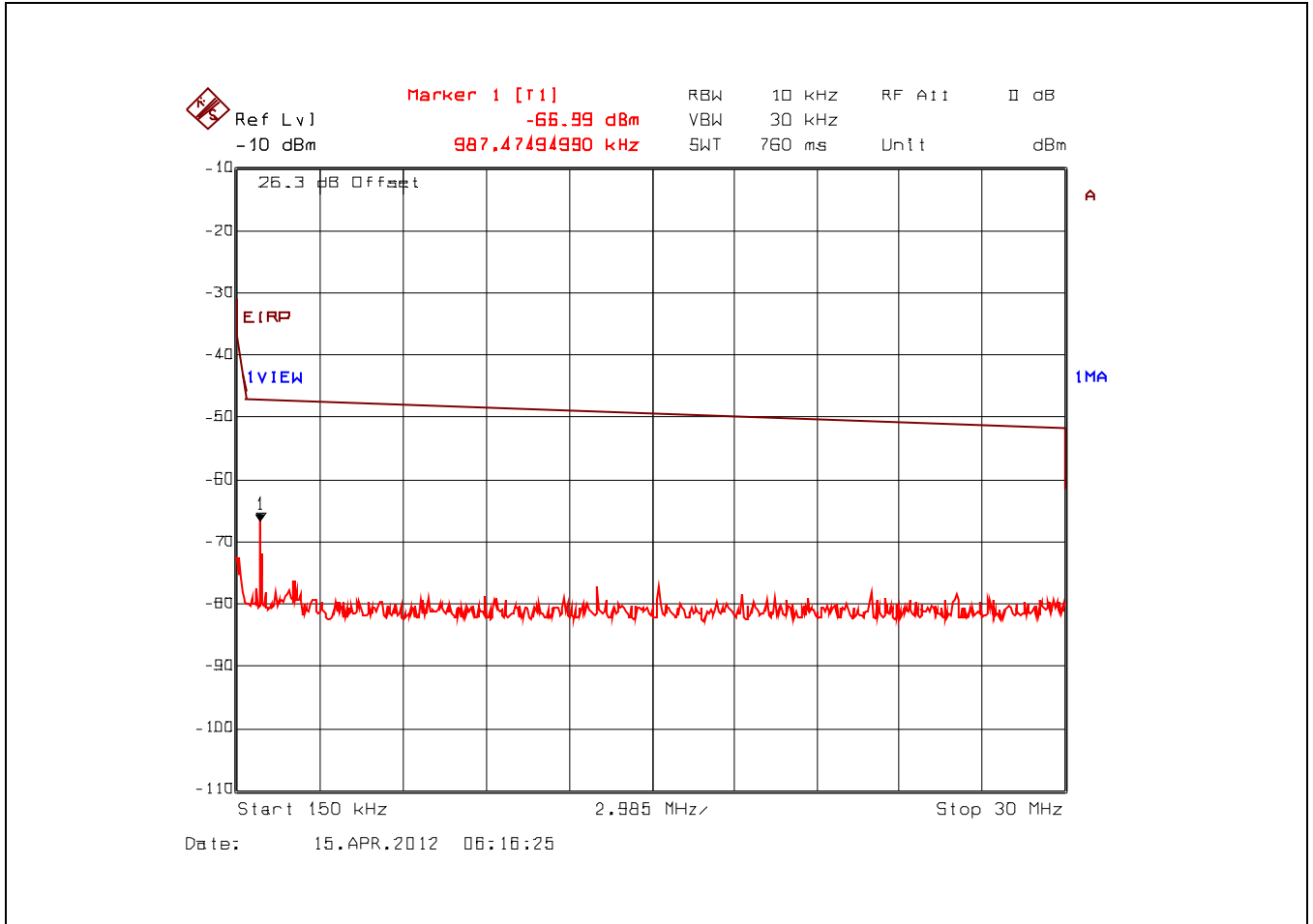
Plot 5.4.4.3.10. Conducted Spurious Emissions – Restricted Bands
2439.25 MHz, 4 GHz - 25 GHz, Trace Average with High Pass Filter



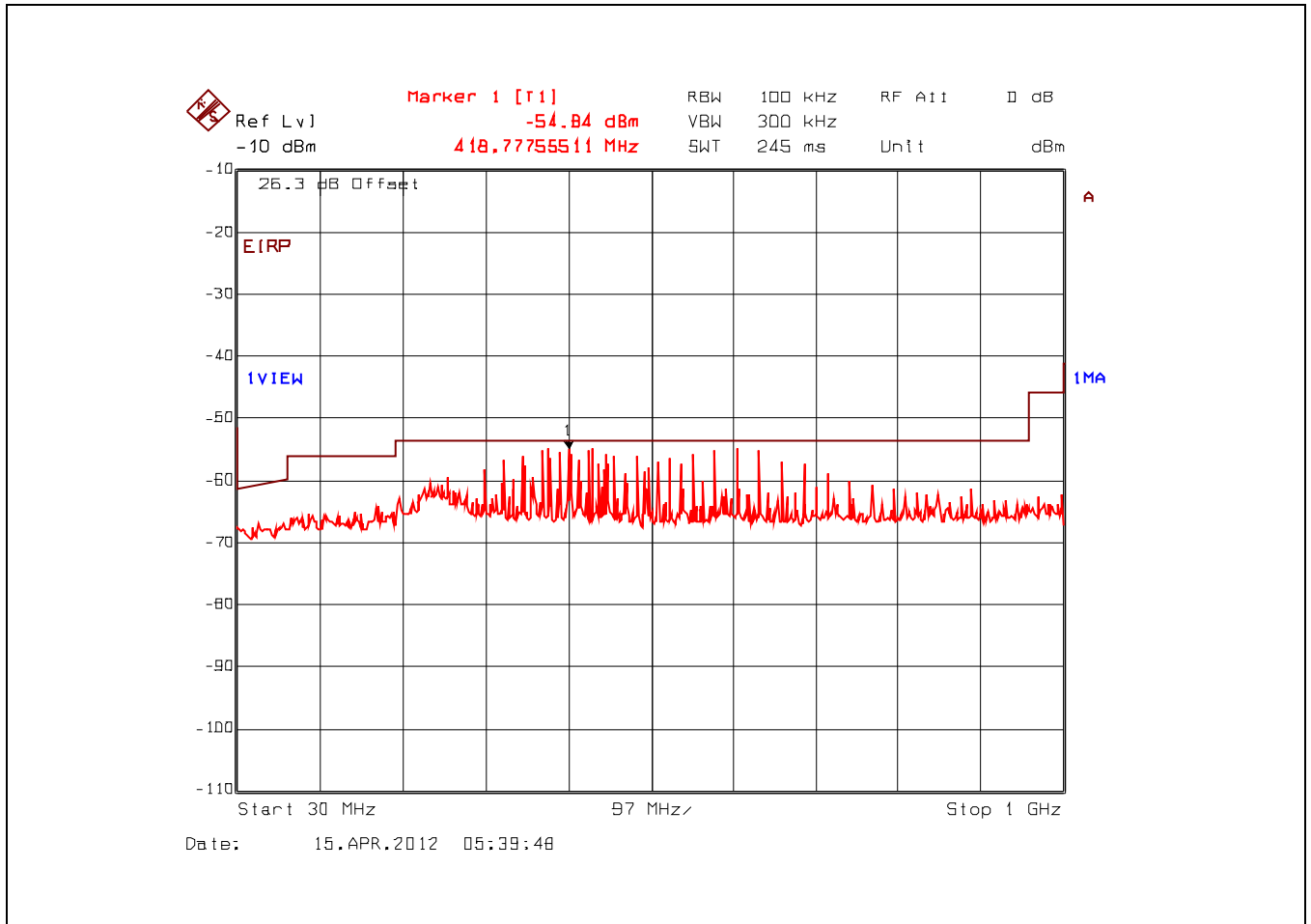
Plot 5.4.4.3.11. Conducted Spurious Emissions – Restricted Bands
2476.00 MHz, 9 kHz - 150 kHz, Peak Detector



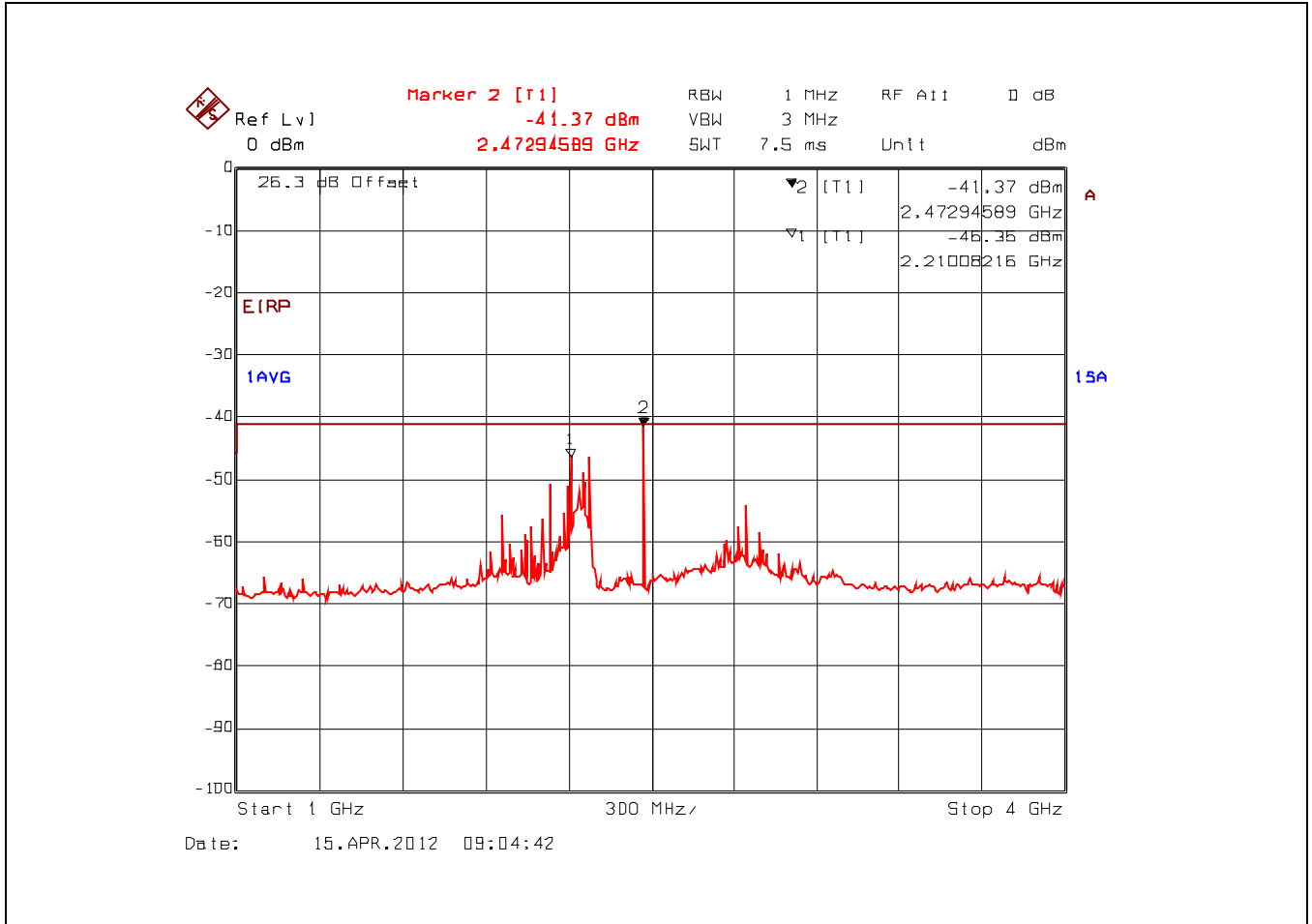
Plot 5.4.4.3.12. Conducted Spurious Emissions – Restricted Bands
2476.00 MHz, 150 kHz - 30 MHz, Peak Detector



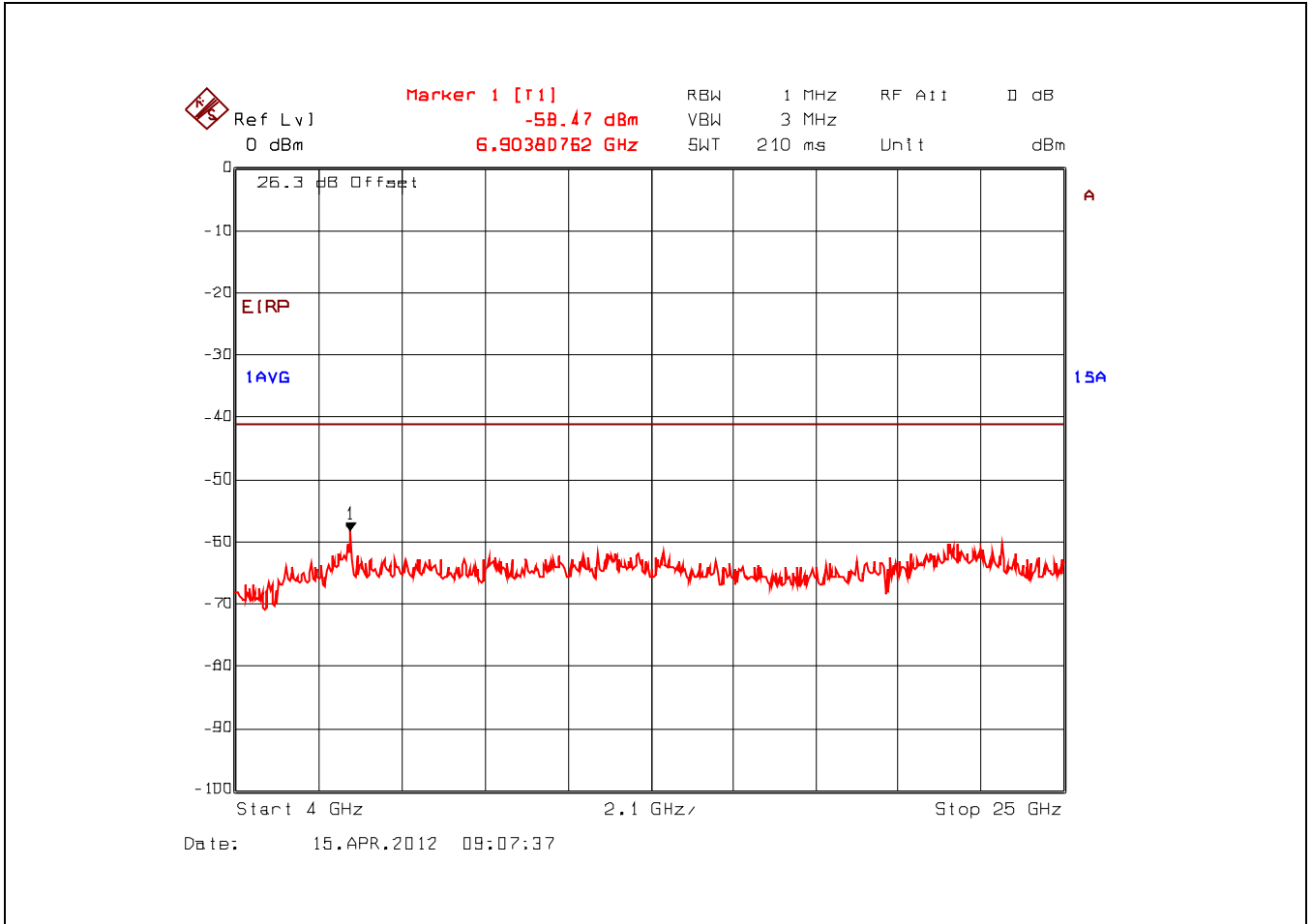
Plot 5.4.4.3.13. Conducted Spurious Emissions – Restricted Bands
 2476.00 MHz, 30 MHz - 1 GHz, Peak Detector with Band (Notch) Reject Filter



Plot 5.4.4.3.14. Conducted Spurious Emissions – Restricted Bands
 2476.00 MHz, 1 GHz - 4 GHz, Trace Average with Band (Notch) Reject Filter



Plot 5.4.4.3.15. Conducted Spurious Emissions – Restricted Bands
2476.00 MHz, 4 GHz - 25 GHz, Trace Average with High Pass Filter

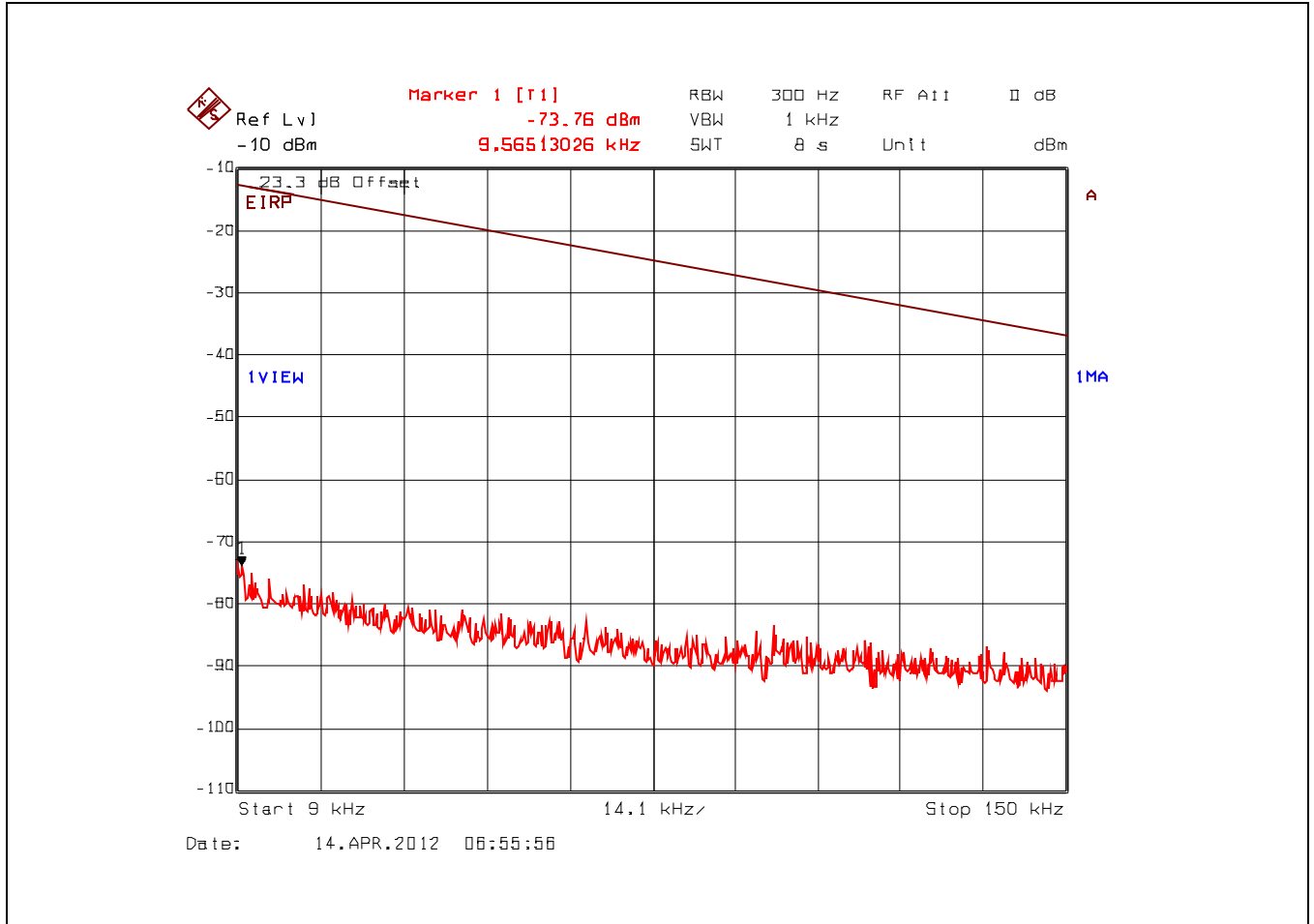


5.4.4.4. Conducted Spurious Emissions – Restricted Bands, Highest Power Setting (52) with Lowest Antenna Gain (2 dBi)

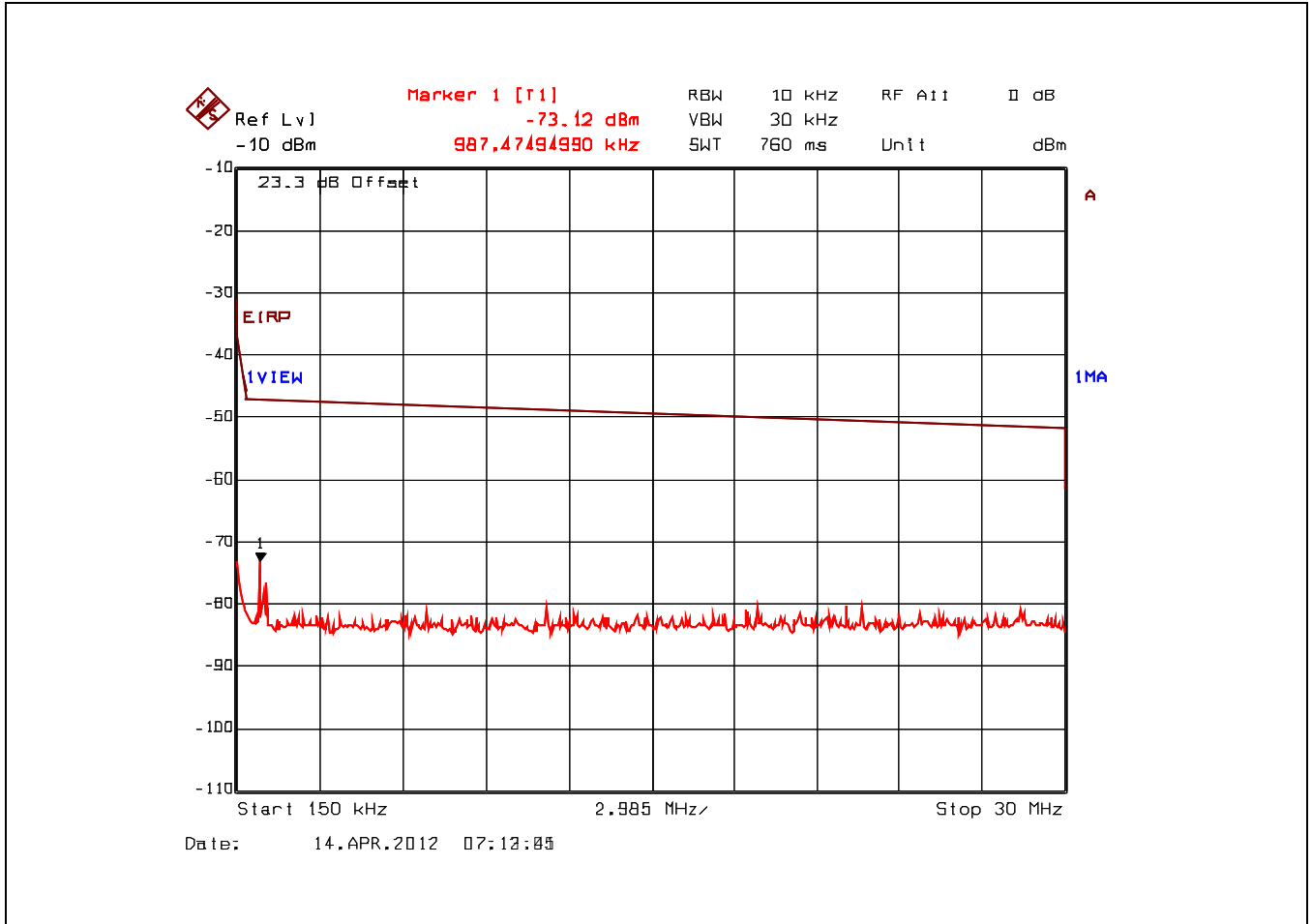
Remark(s):

- The following test results at high power setting and Data Rate 8 represent the worst-case.
- Offset = Insertion Loss (21.25 dB) + Antenna Gain (2 dBi) = 23.3 dB

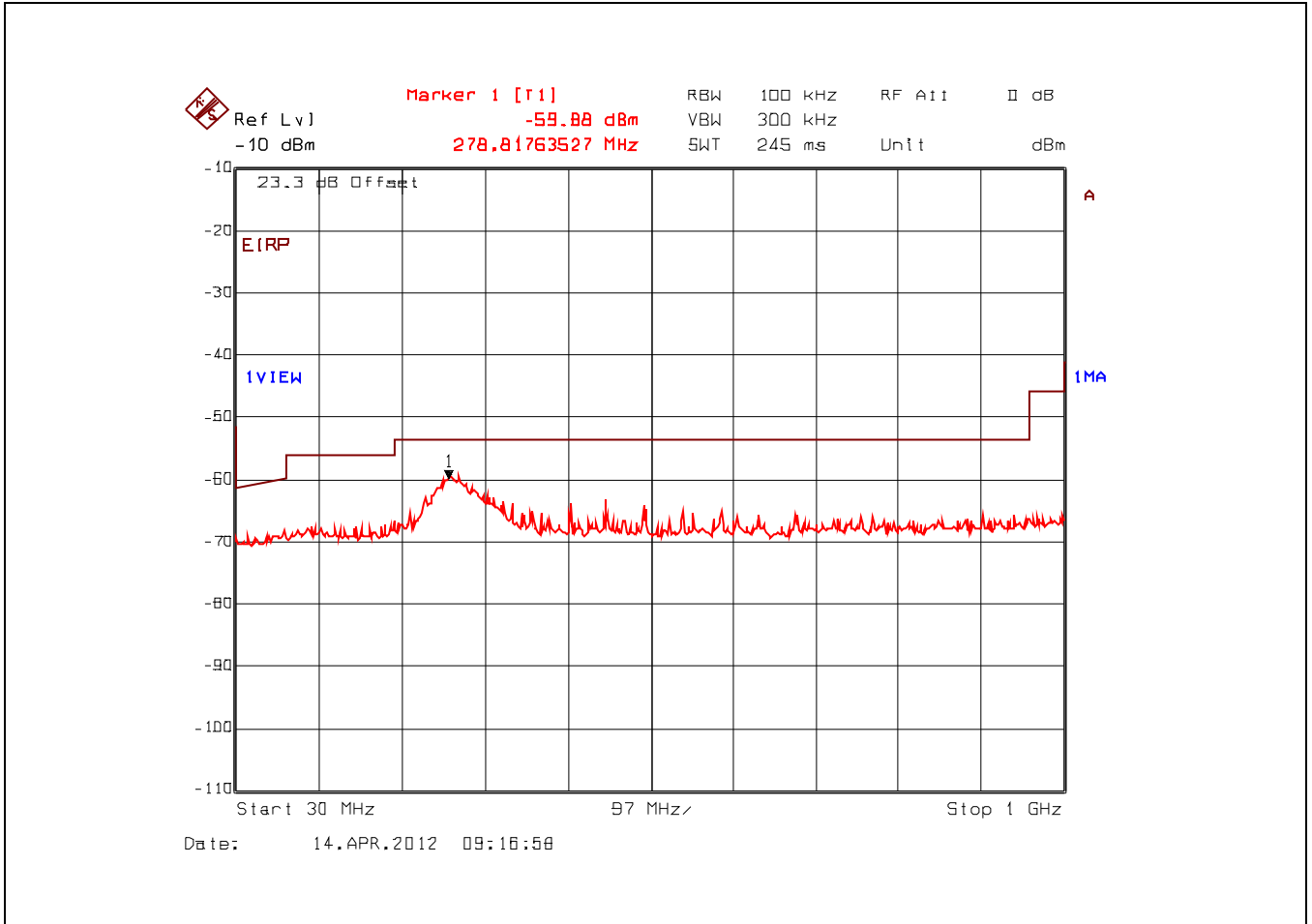
Plot 5.4.4.4.1. Conducted Spurious Emissions – Restricted Bands
 2402.50 MHz, 9 kHz - 150 kHz, Peak Detector



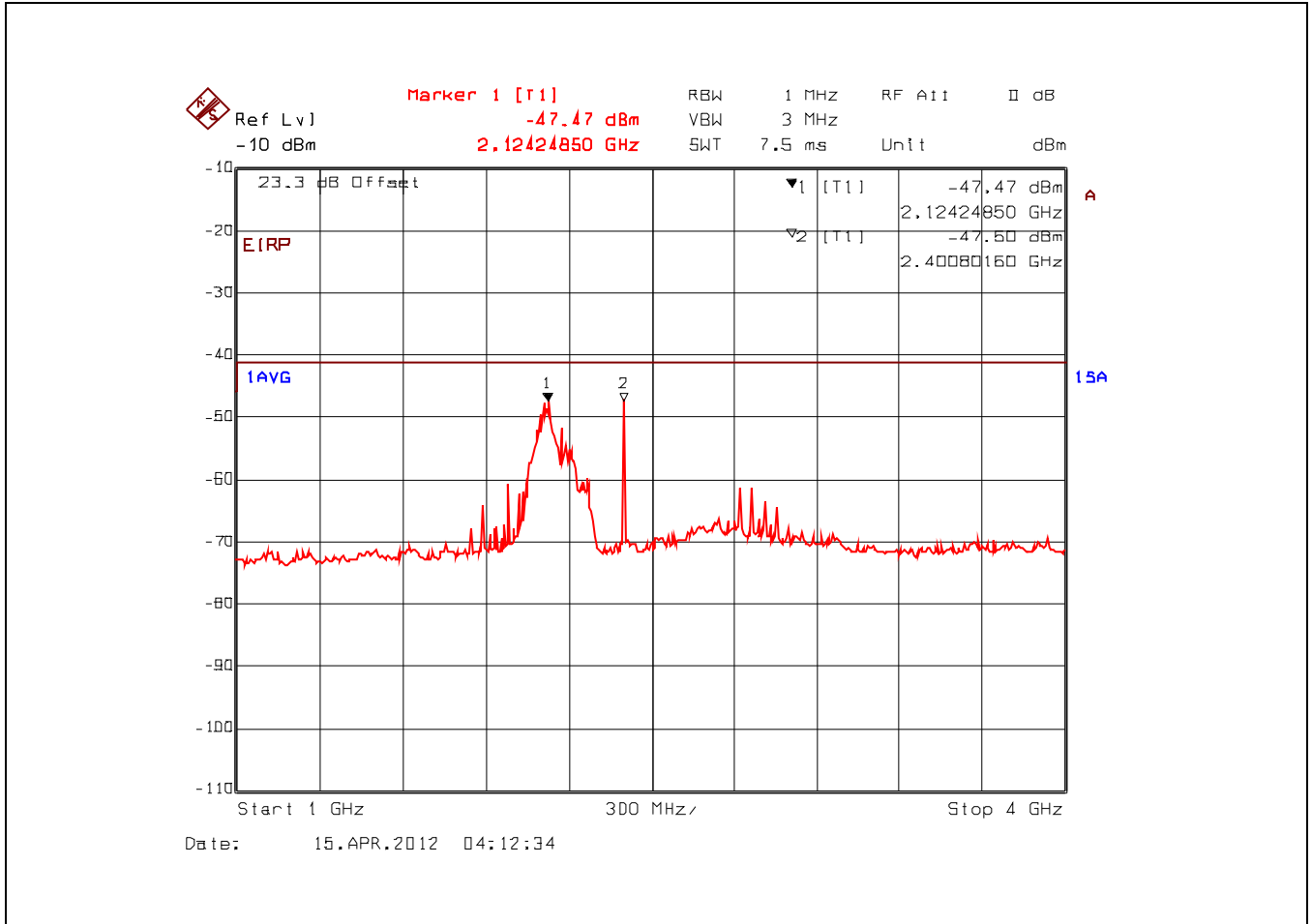
Plot 5.4.4.4.2. Conducted Spurious Emissions – Restricted Bands
2402.50 MHz, 150 kHz - 30 MHz, Peak Detector



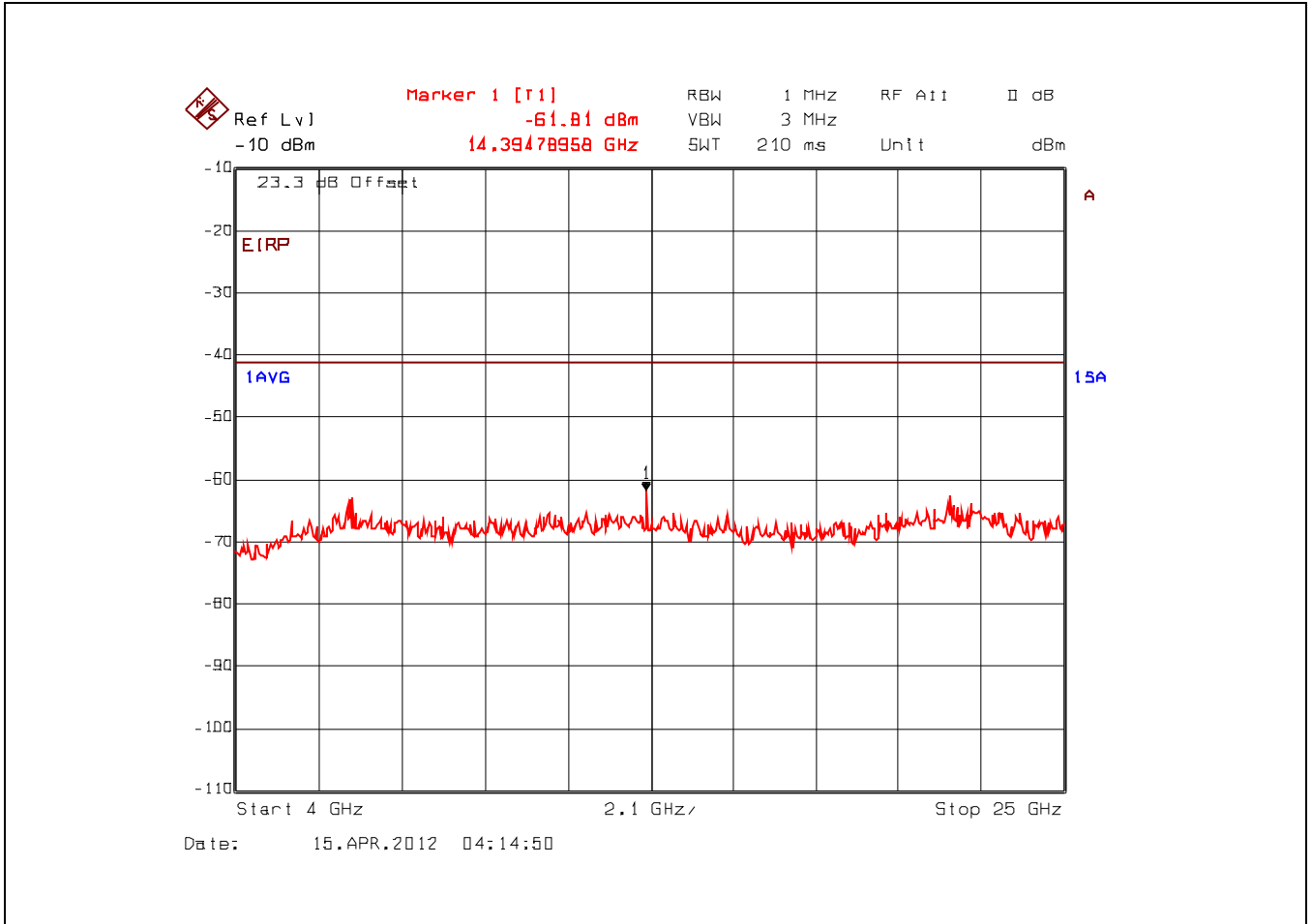
Plot 5.4.4.3. Conducted Spurious Emissions – Restricted Bands
2402.50 MHz, 30 MHz - 1 GHz, Peak Detector with Band (Notch) Reject Filter



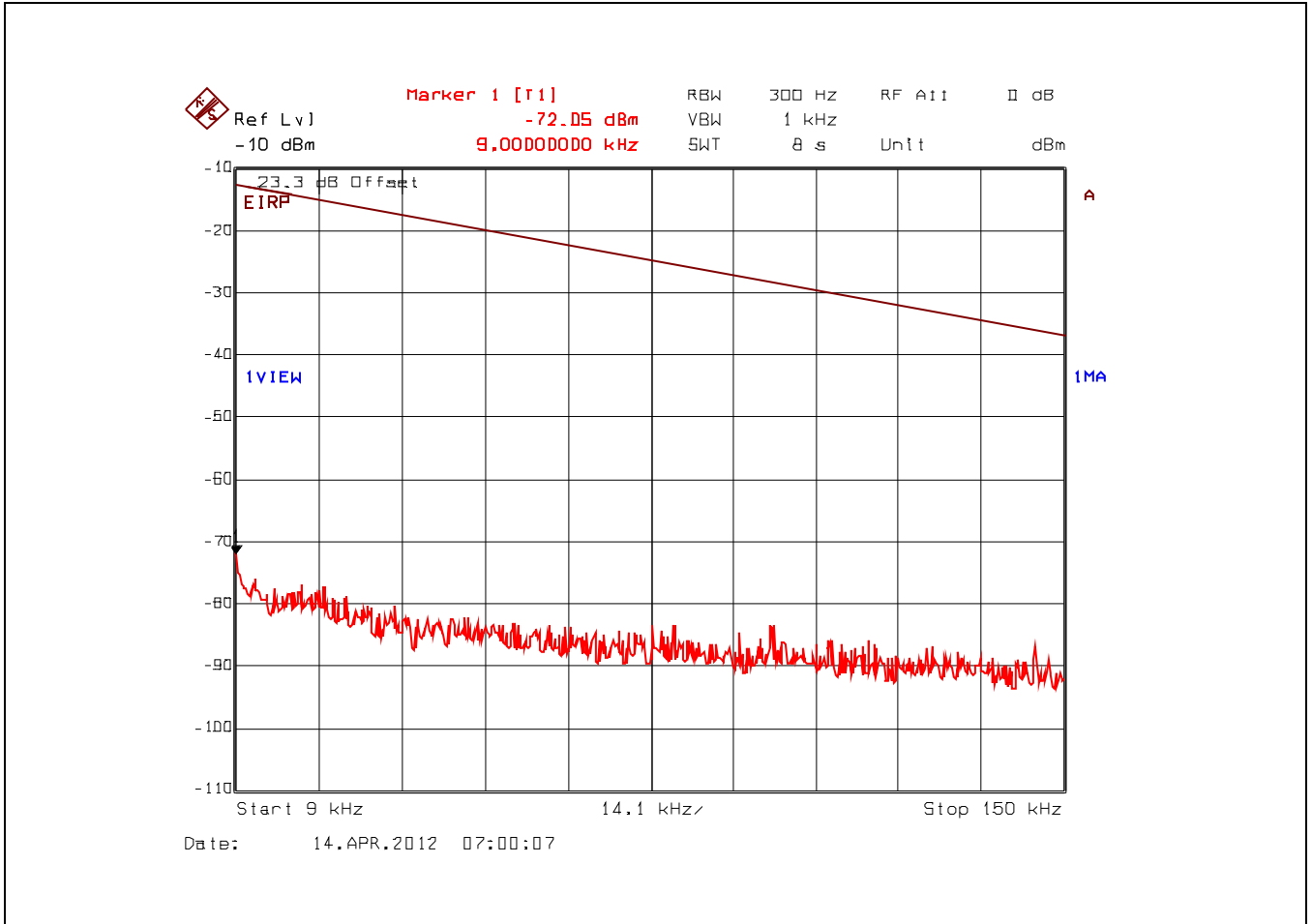
Plot 5.4.4.4. Conducted Spurious Emissions – Restricted Bands
 2402.50 MHz, 1 GHz - 4 GHz, Trace Average with Band (Notch) Reject Filter



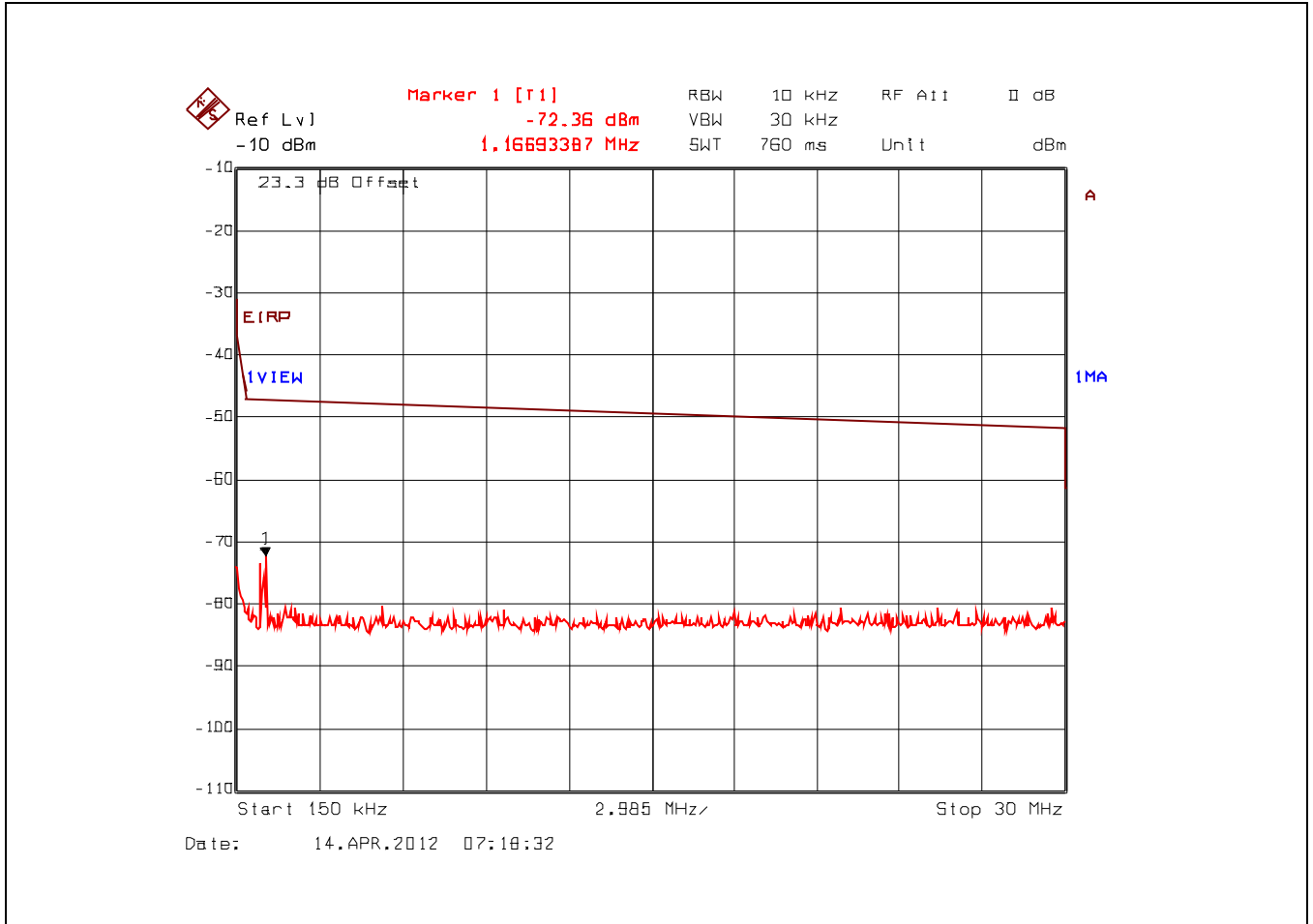
Plot 5.4.4.5. Conducted Spurious Emissions – Restricted Bands
2402.50 MHz, 4 GHz - 25 GHz, Trace Average with High Pass Filter



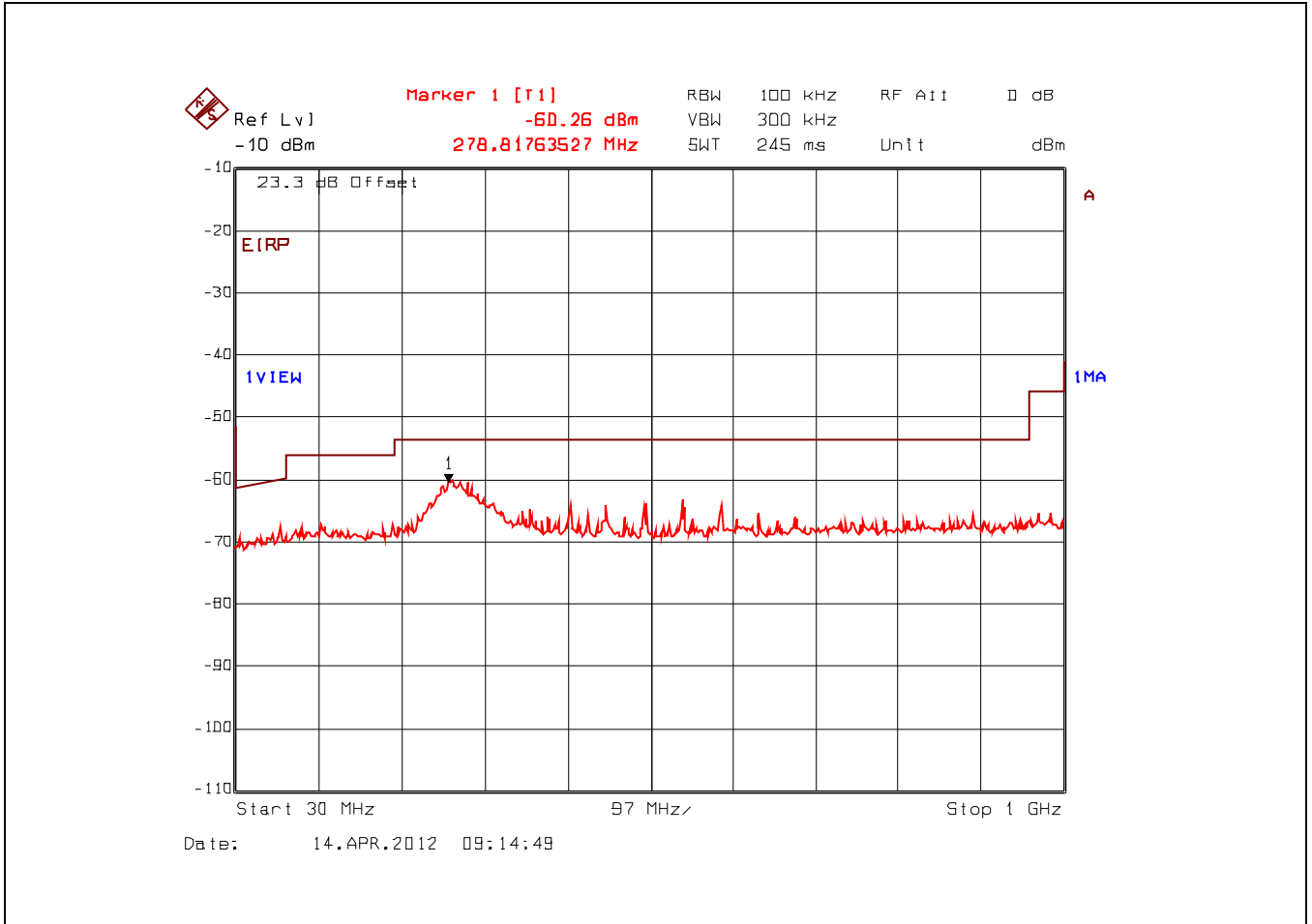
Plot 5.4.4.4.6. Conducted Spurious Emissions – Restricted Bands
2439.25 MHz, 9 kHz - 150 kHz, Peak Detector



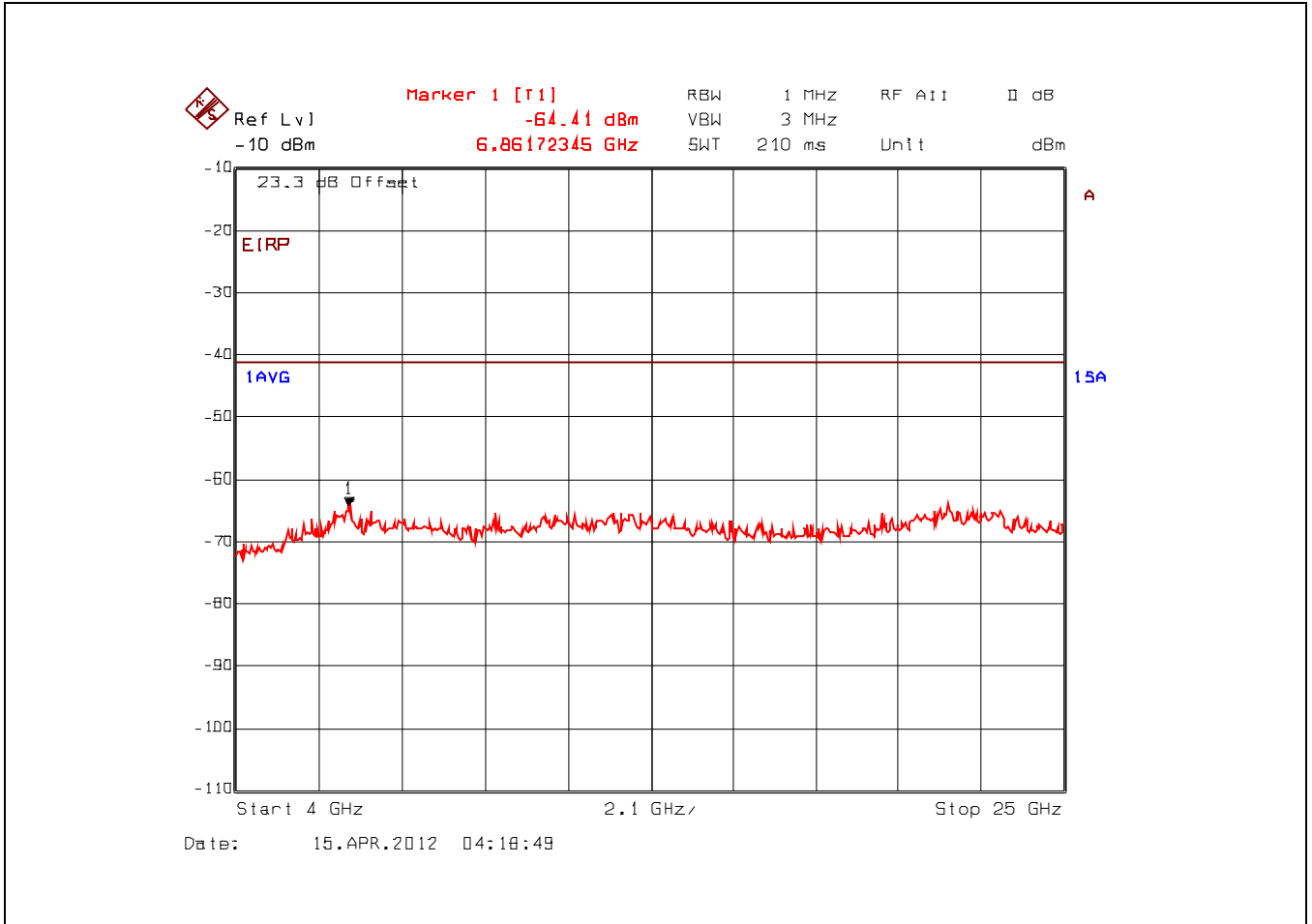
Plot 5.4.4.4.7. Conducted Spurious Emissions – Restricted Bands
2439.25 MHz, 150 kHz - 30 MHz, Peak Detector



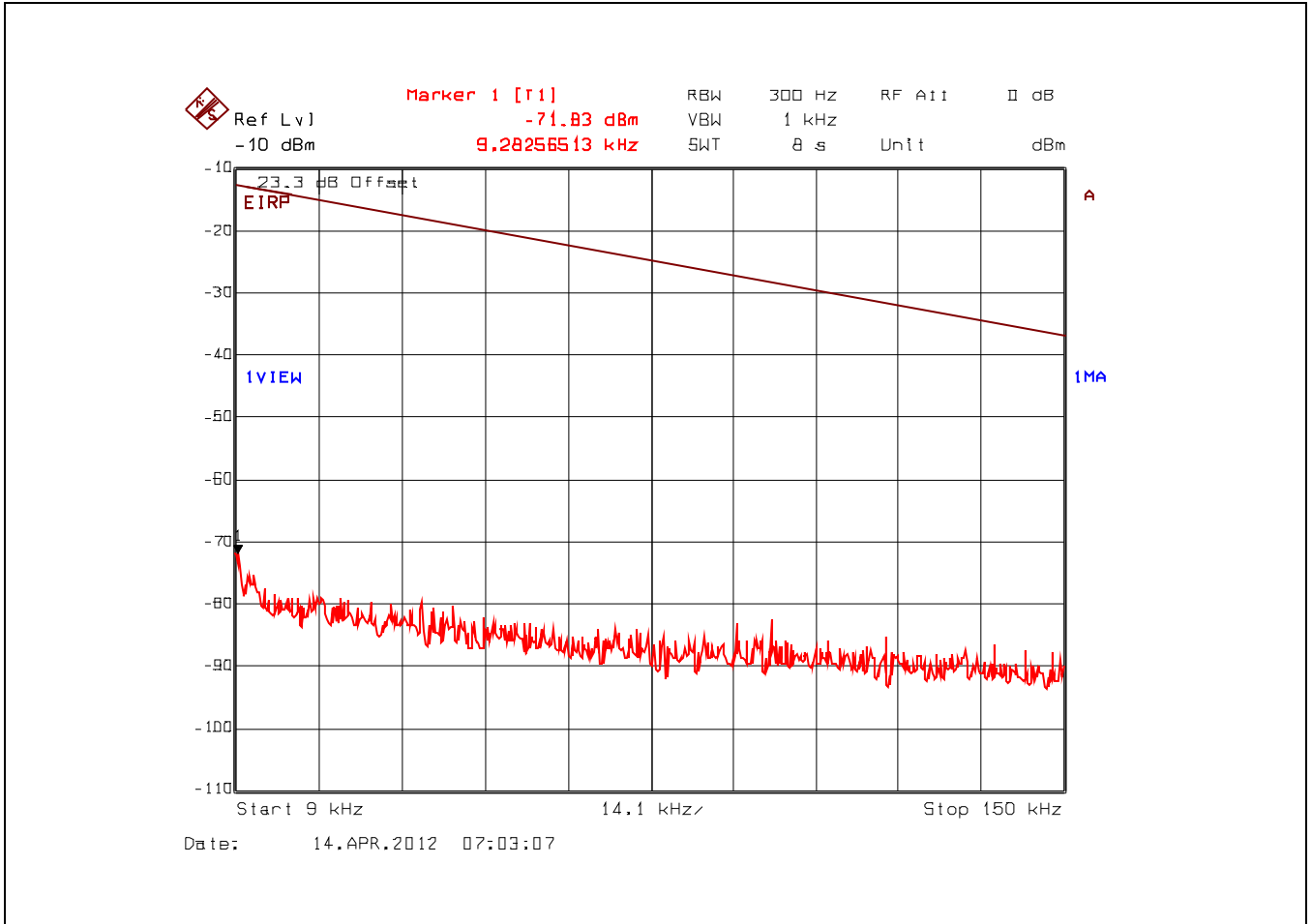
Plot 5.4.4.4.8. Conducted Spurious Emissions – Restricted Bands
2439.25 MHz, 30 MHz - 1 GHz, Peak Detector with Band (Notch) Reject Filter



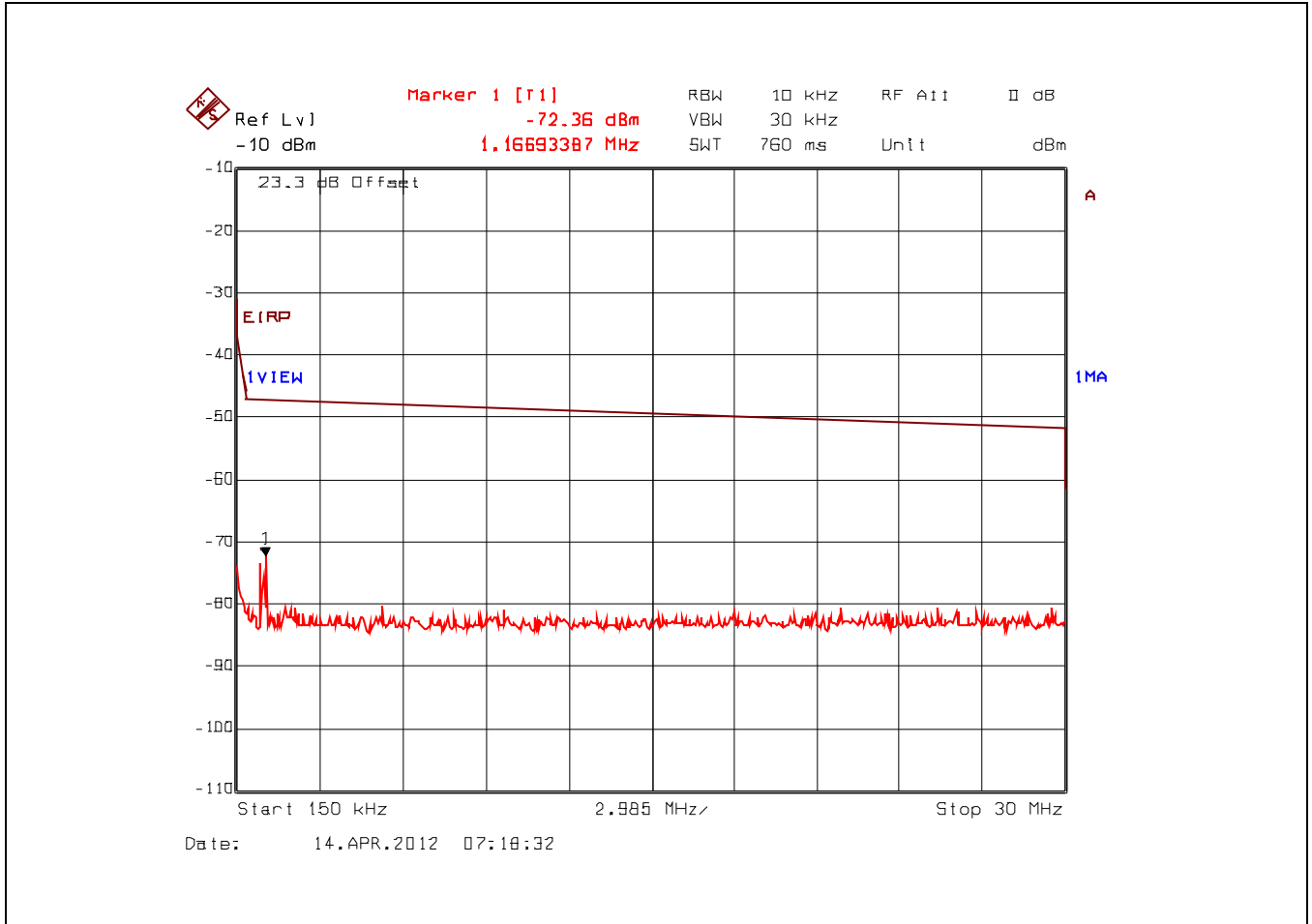
Plot 5.4.4.4.10. Conducted Spurious Emissions – Restricted Bands
2439.25 MHz, 4 GHz - 25 GHz, Trace Average with High Pass Filter



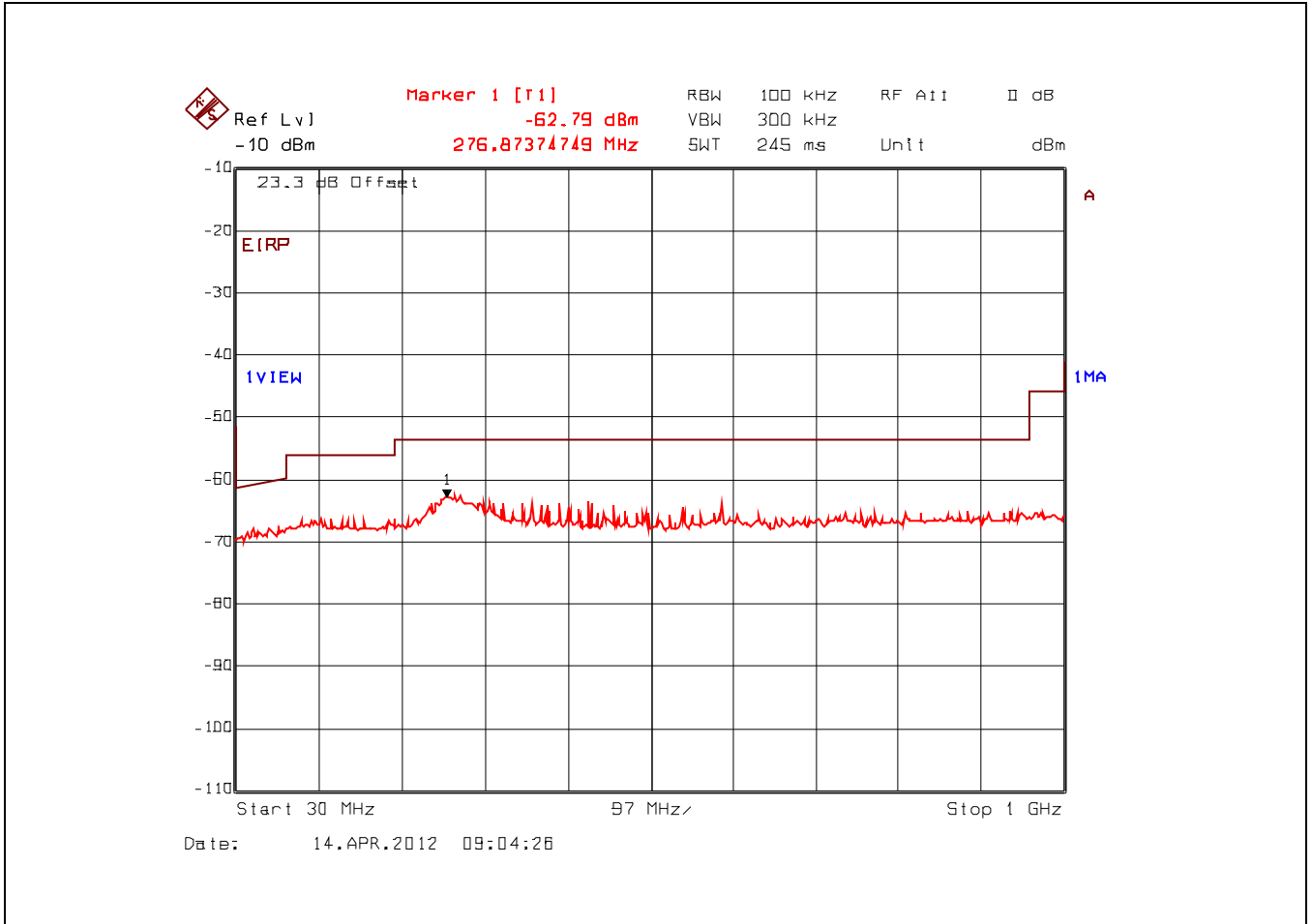
Plot 5.4.4.4.11. Conducted Spurious Emissions – Restricted Bands
2476.00 MHz, 9 kHz - 150 kHz, Peak Detector



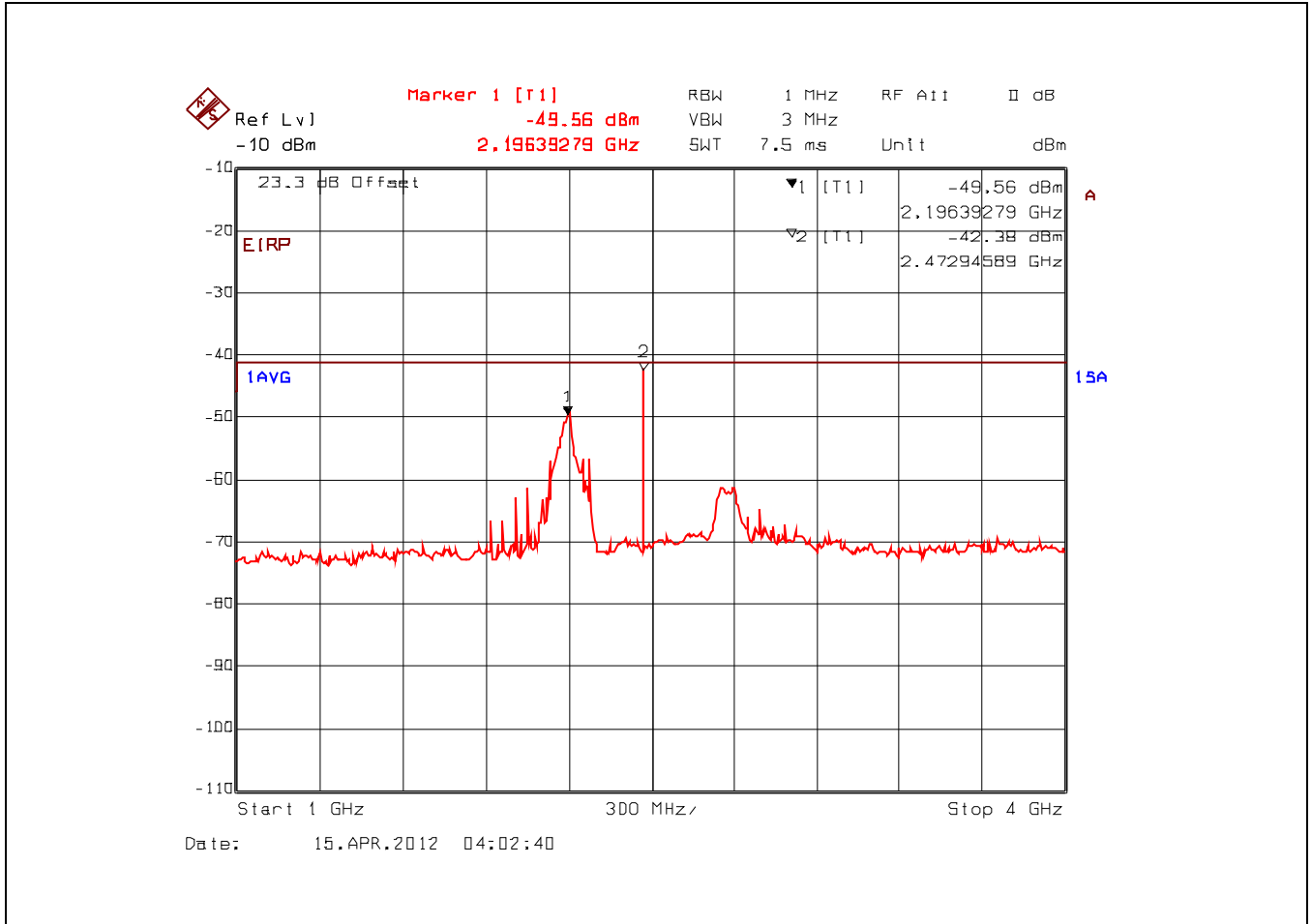
Plot 5.4.4.4.12. Conducted Spurious Emissions – Restricted Bands
2476.00 MHz, 150 kHz - 30 MHz, Peak Detector



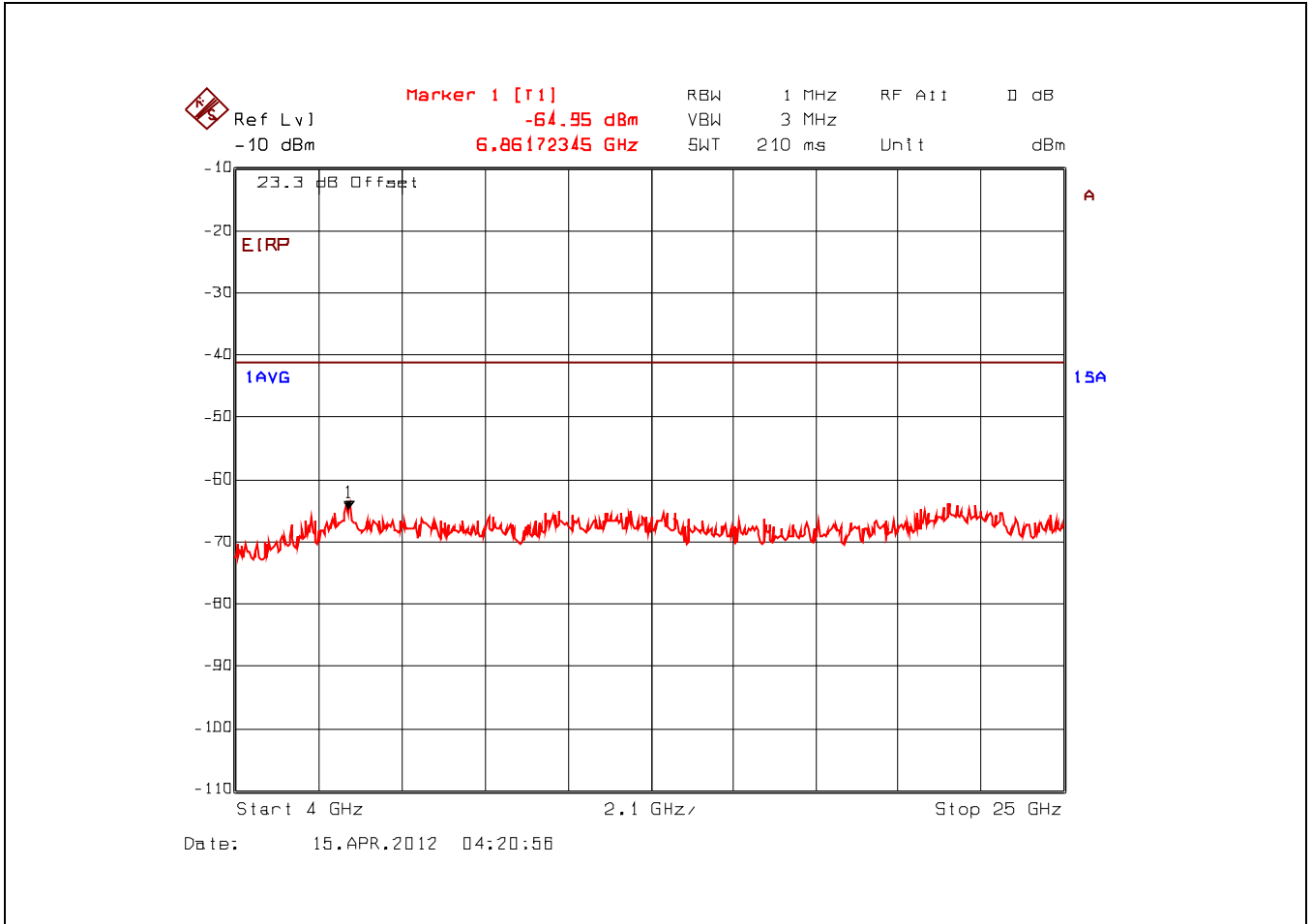
Plot 5.4.4.13. Conducted Spurious Emissions – Restricted Bands
2476.00 MHz, 30 MHz - 1 GHz, Peak Detector with Band (Notch) Reject Filter



Plot 5.4.4.4.14. Conducted Spurious Emissions – Restricted Bands
 2476.00 MHz, 1 GHz - 4 GHz, Trace Average with Band (Notch) Reject Filter



Plot 5.4.4.15. Conducted Spurious Emissions – Restricted Bands
2476.00 MHz, 4 GHz - 25 GHz, Trace Average 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

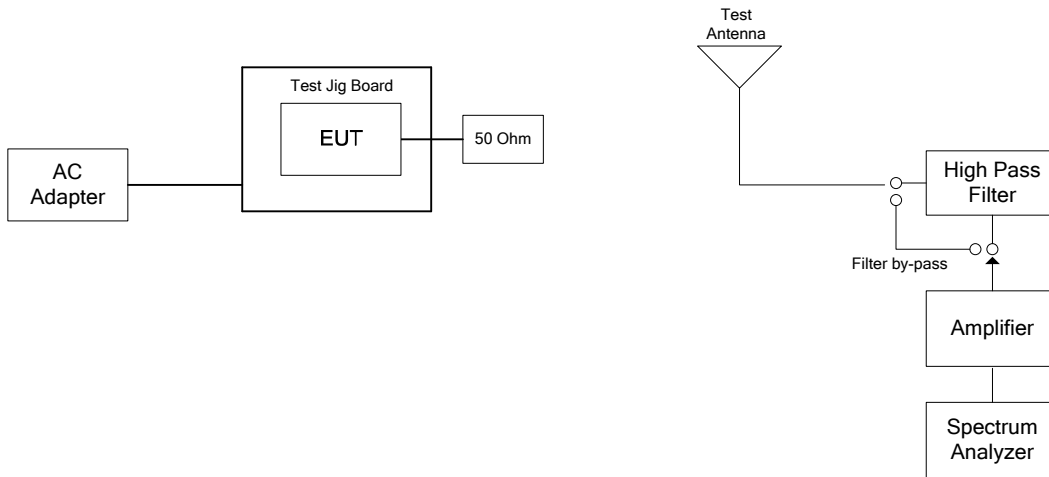
Section 15.209(a) - Field Strength Limits within Restricted Frequency Bands

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

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.
- § 15.247 (d) spurious emission limit:
 $E = (EIRP - 20\log(d) + 104.8) - 30 = (36 \text{ dBm} - 20\log(3) + 104.8) - 30 = 101.3 \text{ dB}\mu\text{V/m}$
- The following test results at high power setting and Data Rate 8 represent the worst-case.

5.5.4.1. Data Rate 8, High Power Setting 52

Fundamental Frequency: 2402.50 MHz							
Power Setting: 30.00 dBm (Software power setting at 52)							
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
4805.00	48.13	34.19	V	54.0	101.3	-19.8	Pass*
4805.00	48.15	35.84	H	54.0	101.3	-18.2	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: 2439.25 MHz							
Power Setting: 29.99 dBm (Software power setting at 52)							
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
4878.50	49.56	36.00	V	54.00	101.3	-18.0	Pass*
4878.50	48.55	35.44	H	54.00	101.3	-18.6	Pass*
7317.75	52.50	40.02	V	54.00	101.3	-14.0	Pass*
7317.75	52.43	41.06	H	54.00	101.3	-12.9	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: 2476.00 MHz							
Power Setting: 29.38 dBm (Software power setting at 52)							
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
4952.00	48.03	34.67	V	54.0	101.3	-19.3	Pass*
4952.00	48.71	35.54	H	54.0	101.3	-18.5	Pass*
7428.00	56.42	44.06	V	54.0	101.3	-9.9	Pass*
7428.00	55.46	42.58	H	54.0	101.3	-11.4	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)]

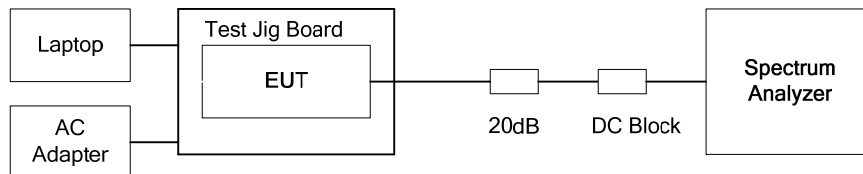
5.6.1. Limit(s)

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 558074 D01 Section 5.3.2 Measurement Procedure AVGPSD.

5.6.3. Test Arrangement

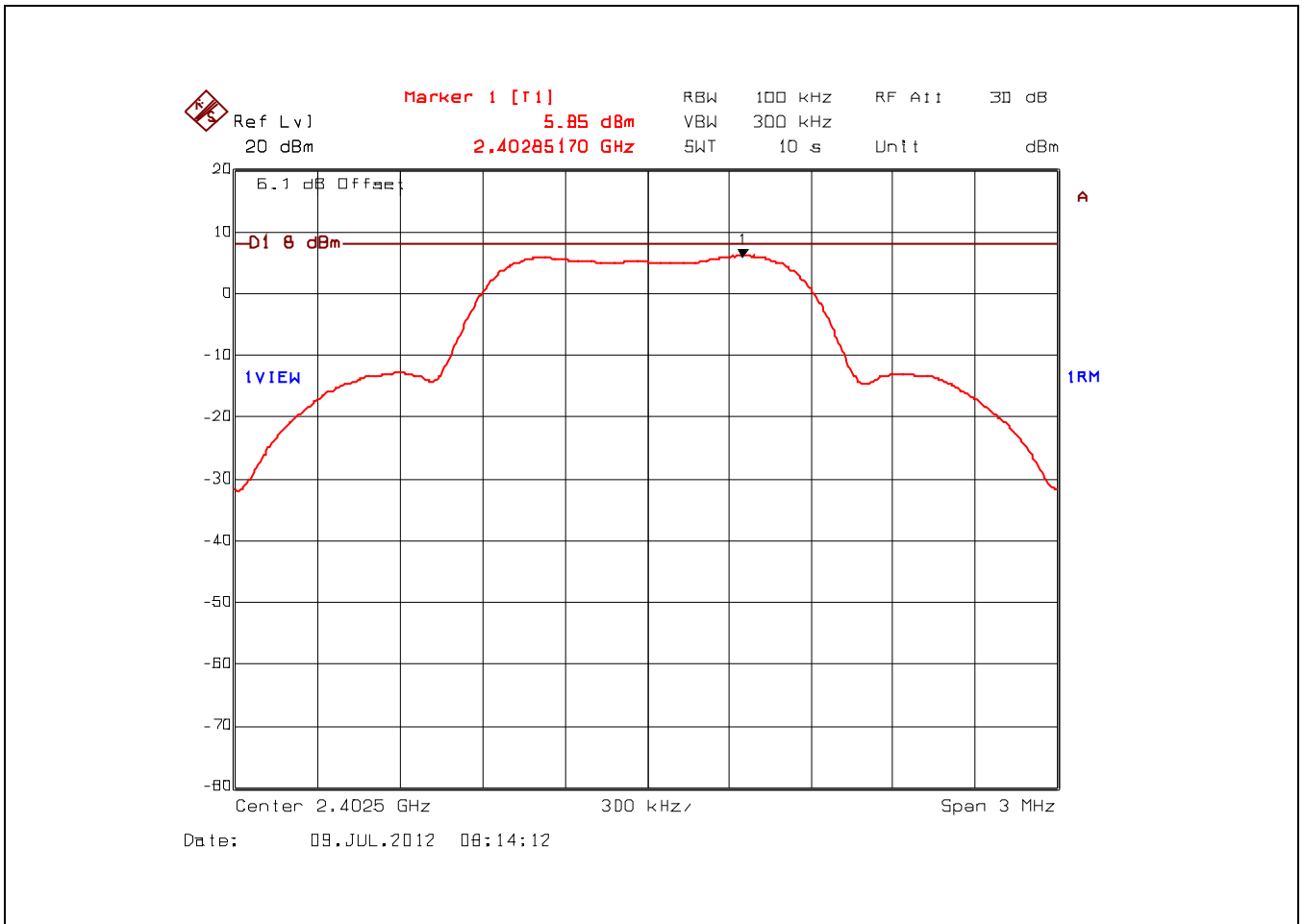


5.6.4. Test Data

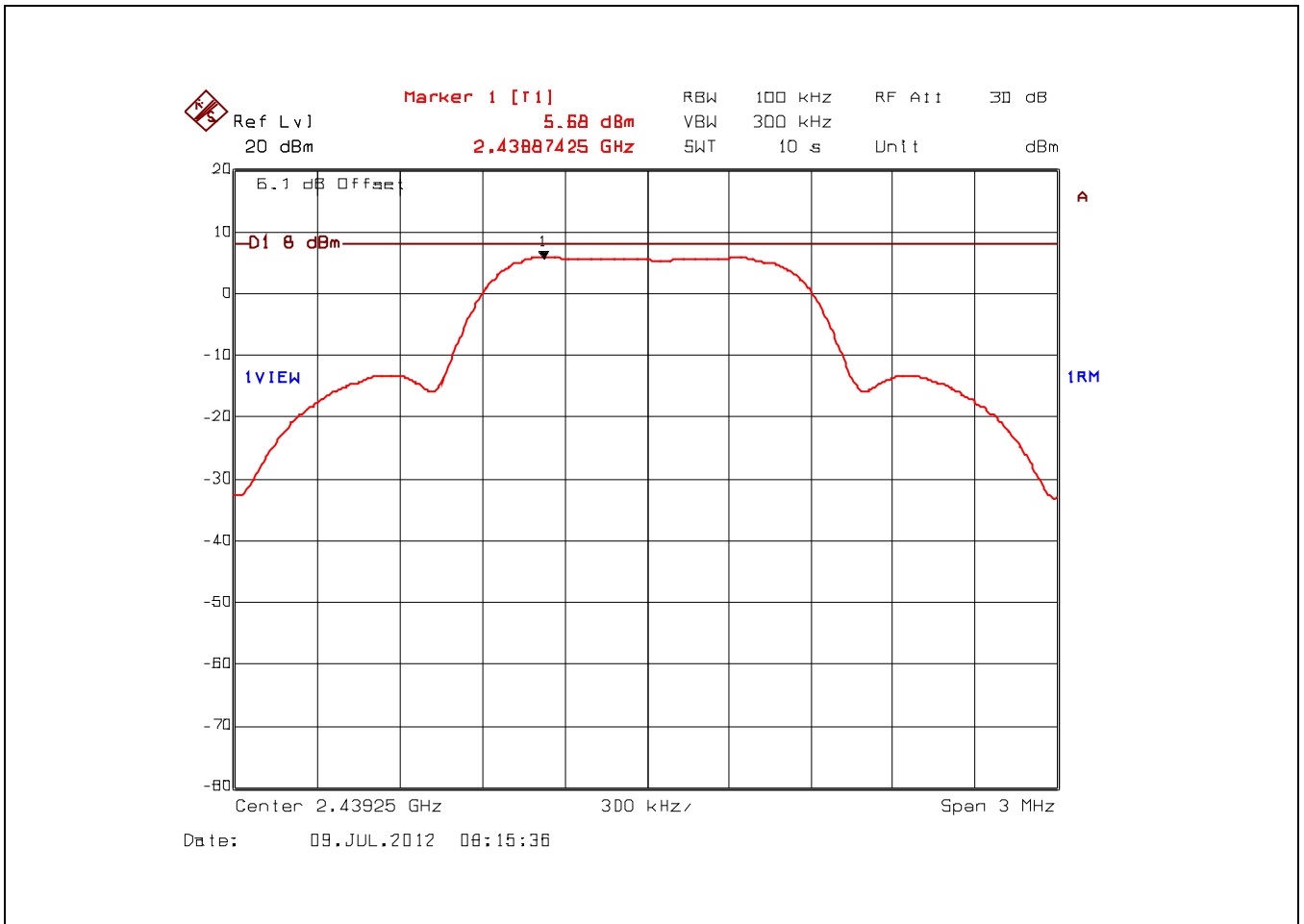
Frequency (MHz)	Modulation / Data Rate	Software/ Power Setting	*PSD in 3 kHz BW (dBm)	Limit (dBm)	Margin (dB)
2402.50	Data Rate 8	52	5.85	8	-2.2
2439.25	Data Rate 8	52	5.68	8	-2.3
2476.00	Data Rate 8	52	5.15	8	-2.9
2403.50	Data Rate 9	52	5.15	8	-2.9
2439.50	Data Rate 9	52	4.80	8	-3.2
2475.50	Data Rate 9	52	4.12	8	-3.9
2404.00	Data Rate 10	52	3.61	8	-4.4
2440.25	Data Rate 10	52	3.69	8	-4.3
2476.50	Data Rate 10	52	3.24	8	-4.8
2405.50	Data Rate 11	52	1.80	8	-6.2
2439.50	Data Rate 11	52	1.78	8	-6.2
2473.50	Data Rate 11	52	1.29	8	-6.7

See the following plots for measurement details.

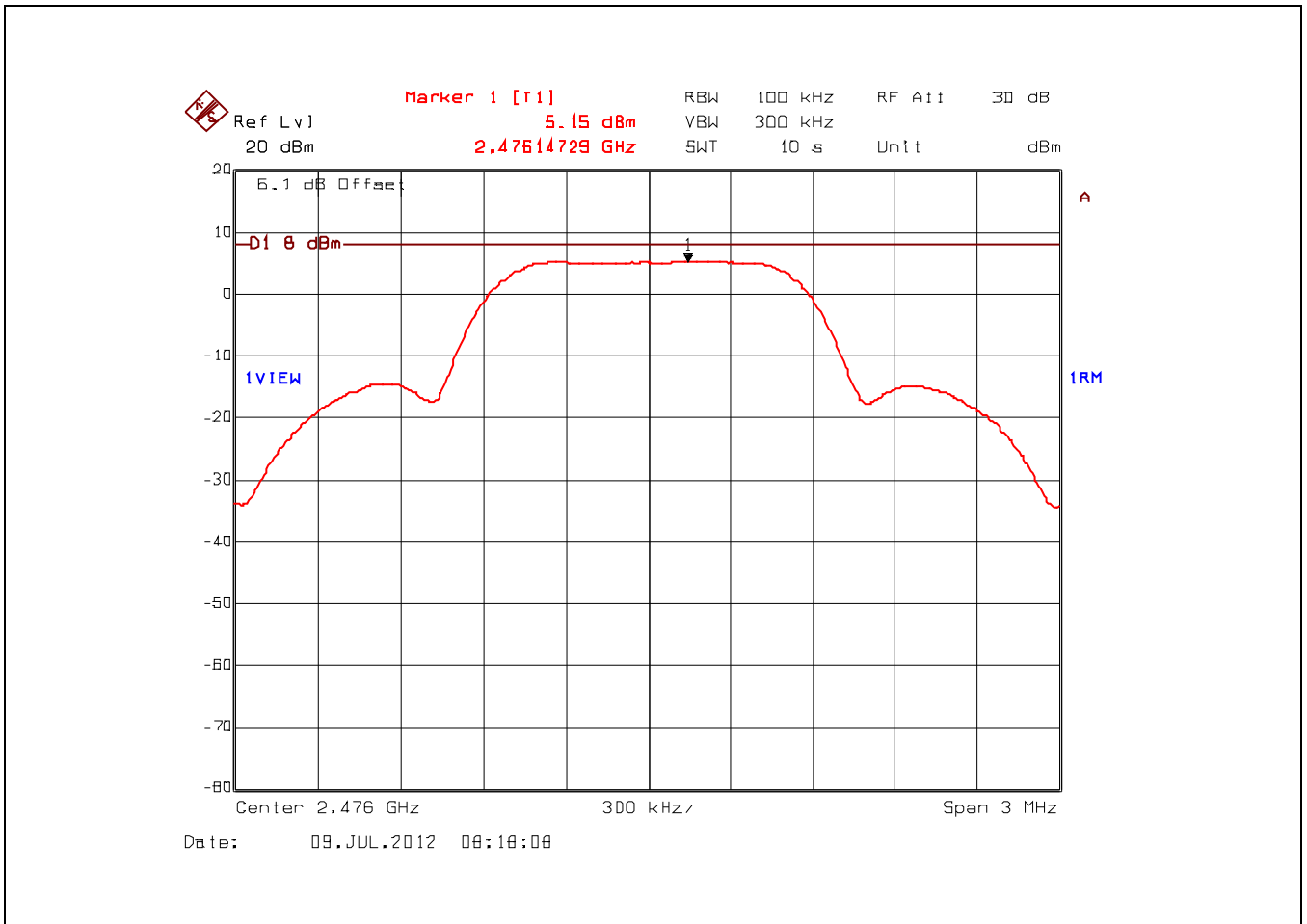
Plot 5.6.4.1. Power Spectral Density
 Data Rate 8, 2402.50 MHz,, Power Setting 52
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 21.25 dB + (-15.2 dB) = 6.1 dB



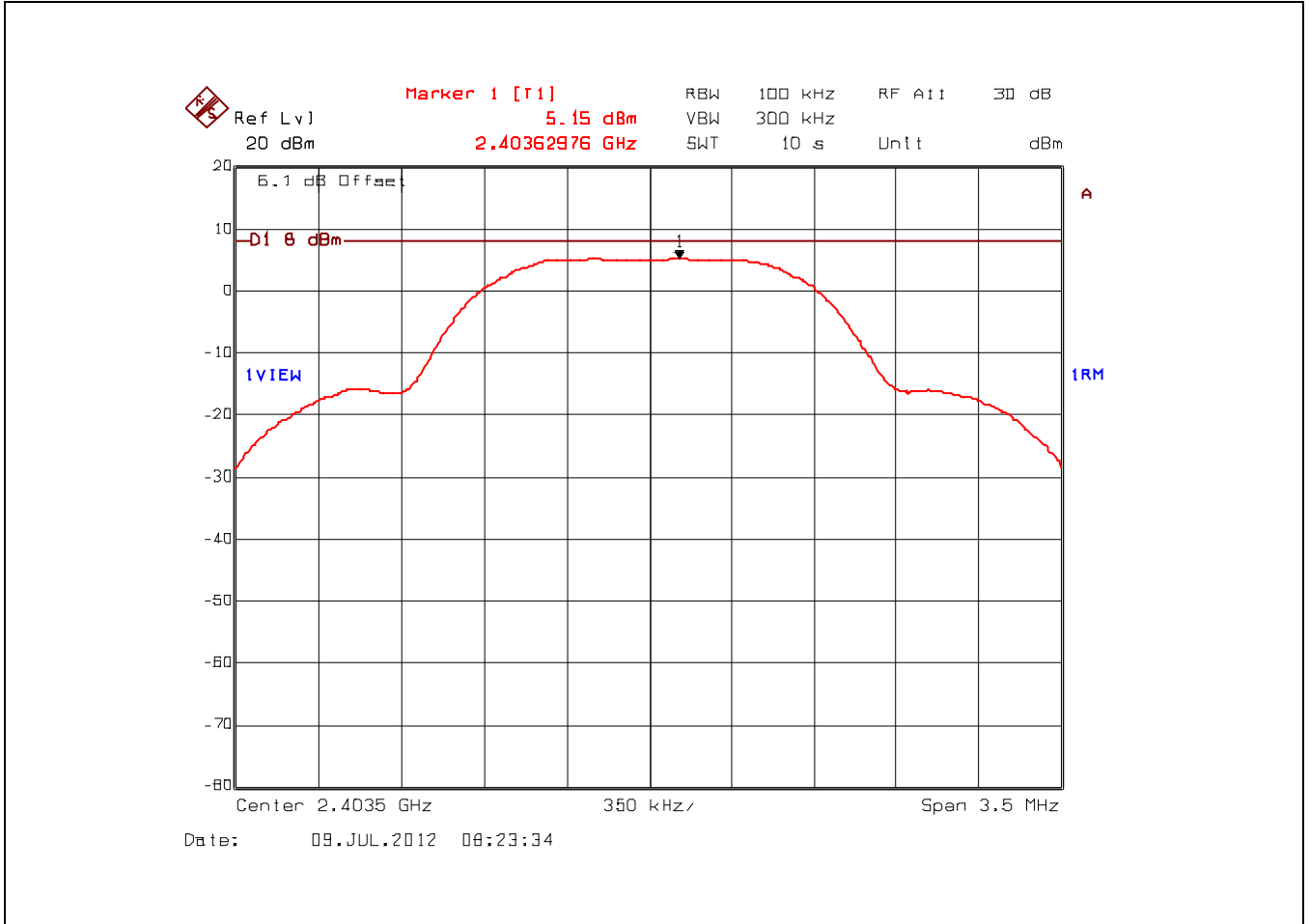
Plot 5.6.4.2. Power Spectral Density
 Data Rate 8, 2439.25 MHz, Power Setting 52
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 21.25 dB + (-15.2 dB) = 6.1 dB



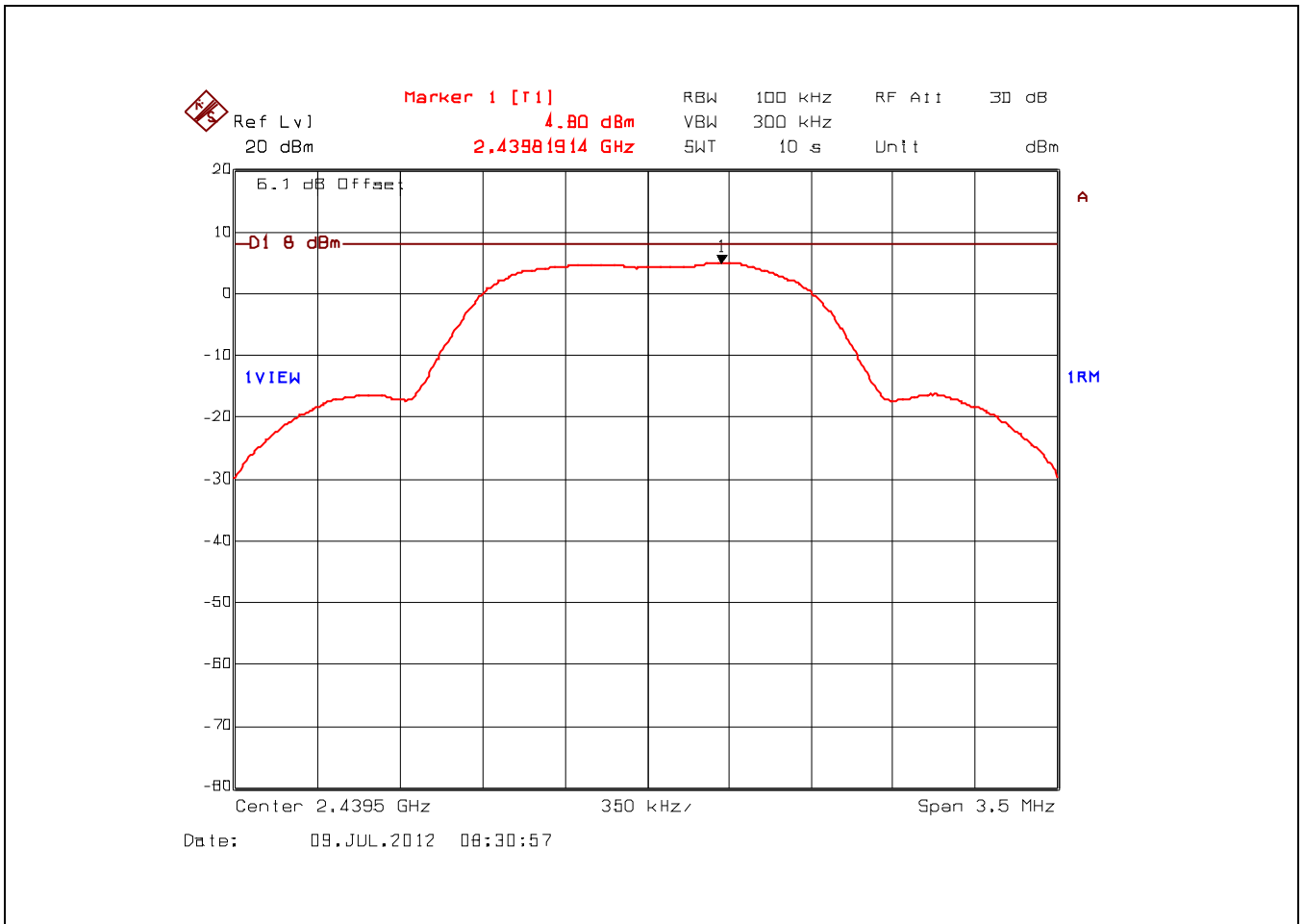
Plot 5.6.4.3. Power Spectral Density
 Data Rate 8, 2476.00 MHz,, Power Setting 52
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 21.25 dB + (-15.2 dB) = 6.1 dB



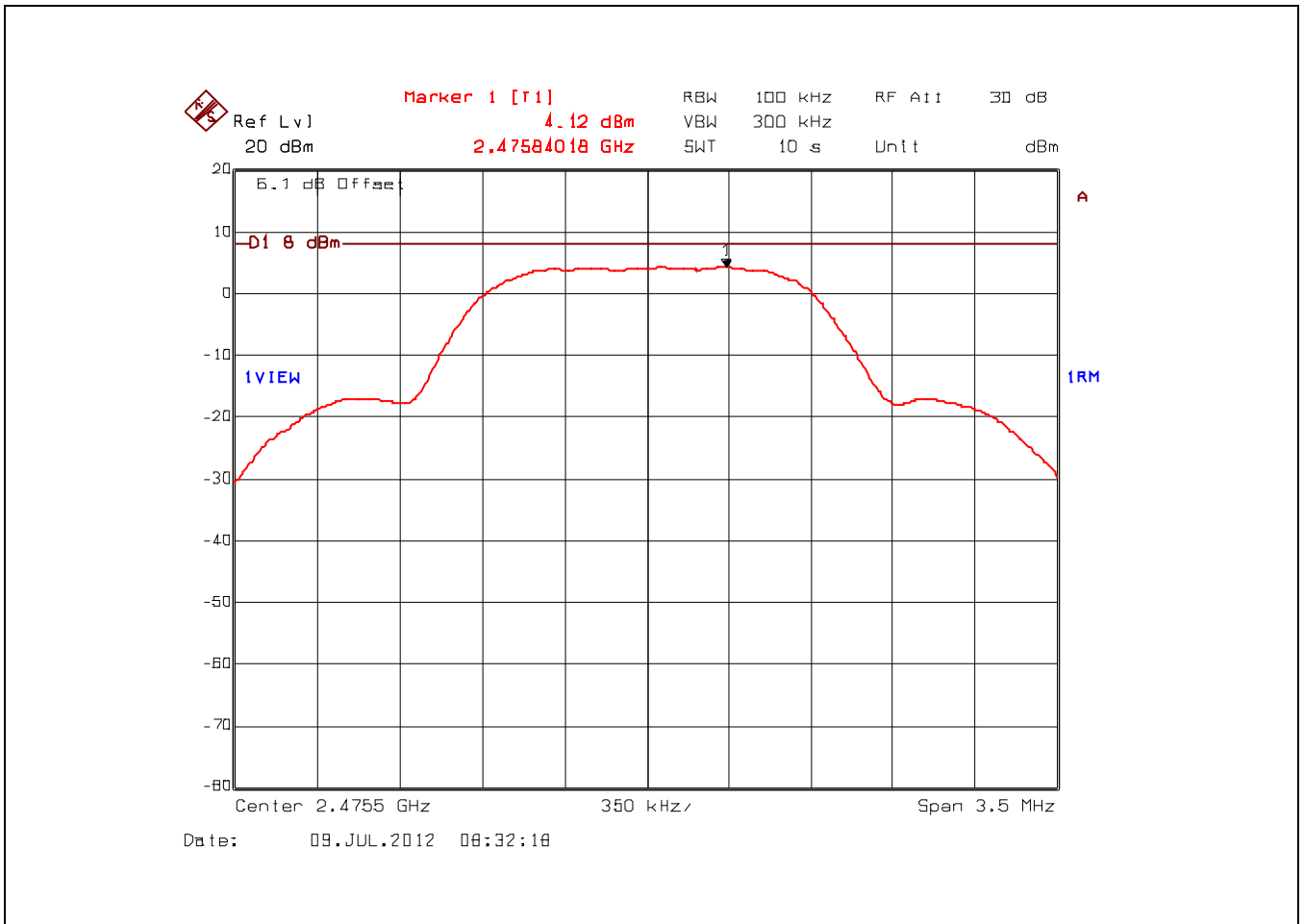
Plot 5.6.4.4. Power Spectral Density
 Data Rate 9, 2403.50 MHz,, Power Setting 52
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 21.25 dB + (-15.2 dB) = 6.1 dB



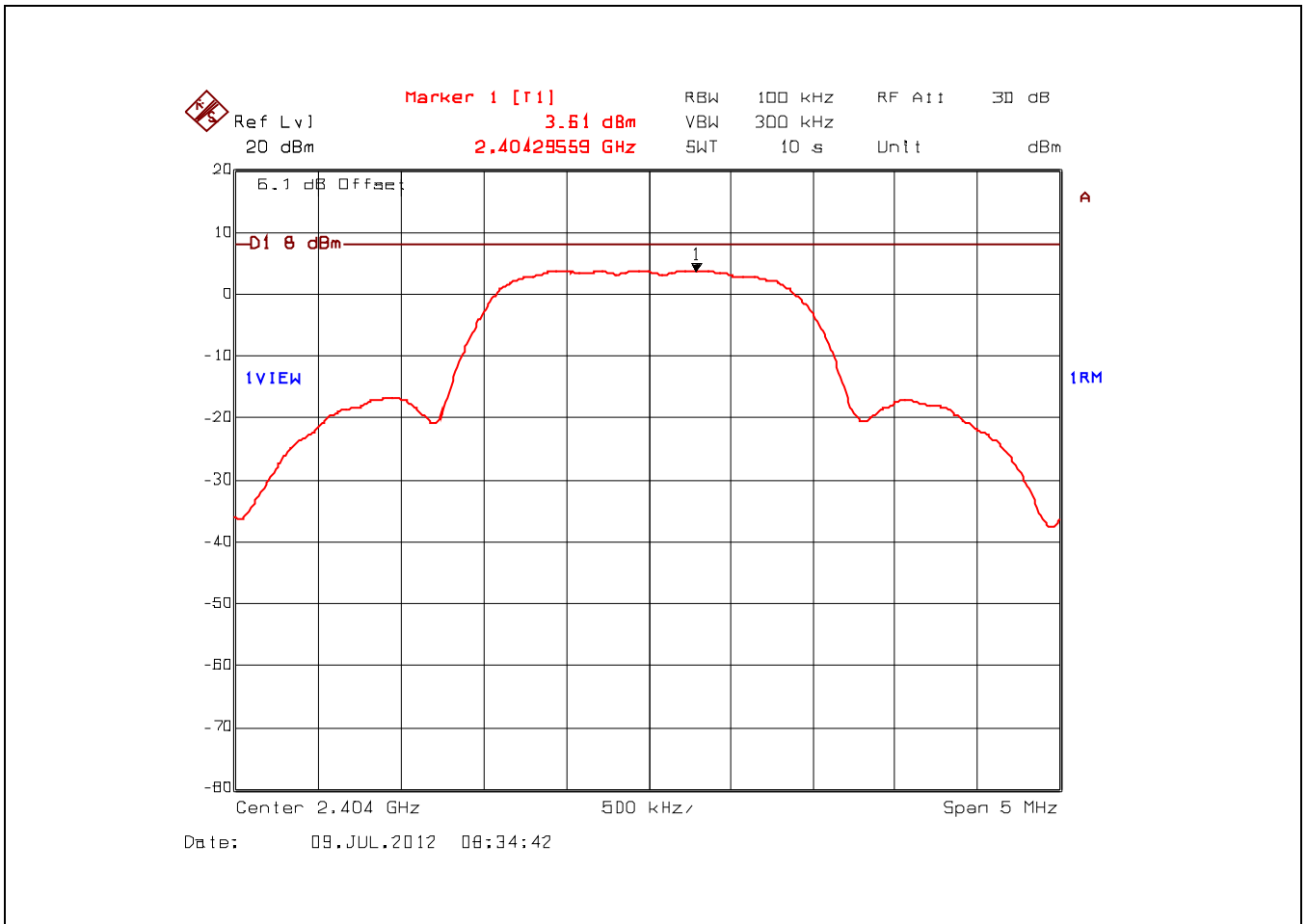
Plot 5.6.4.5. Power Spectral Density
 Data Rate 9, 2439.50 MHz,, Power Setting 52
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 21.25 dB + (-15.2 dB) = 6.1 dB



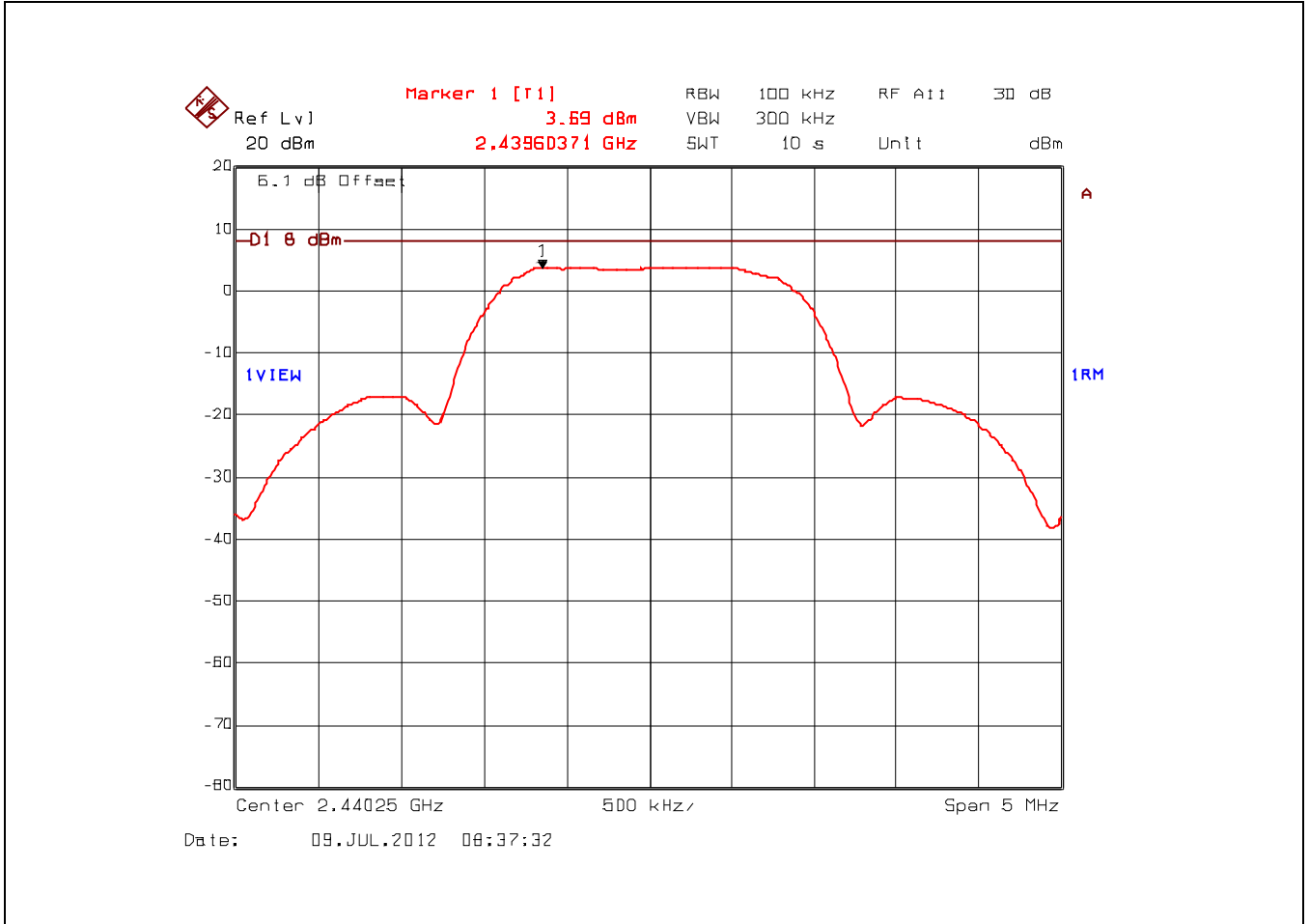
Plot 5.6.4.6. Power Spectral Density
 Data Rate 9, 2475.50 MHz,, Power Setting 52
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 21.25 dB + (-15.2 dB) = 6.1 dB



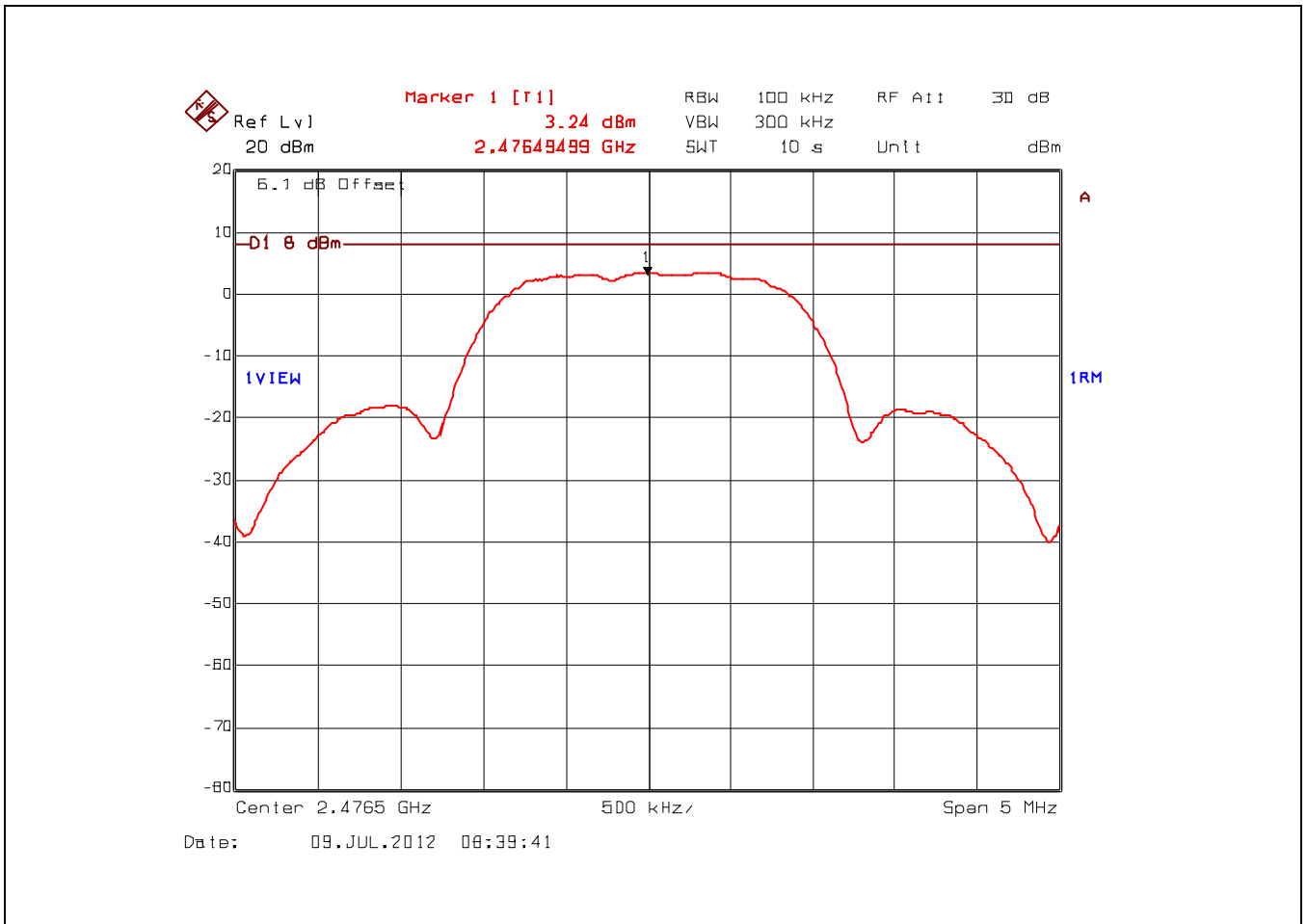
Plot 5.6.4.7. Power Spectral Density
 Data Rate 10, 2404.00 MHz,, Power Setting 52
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 21.25 dB + (-15.2 dB) = 6.1 dB



Plot 5.6.4.8. Power Spectral Density
 Data Rate 10, 2440.25 MHz,, Power Setting 52
 Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 21.25 dB + (-15.2 dB) = 6.1 dB



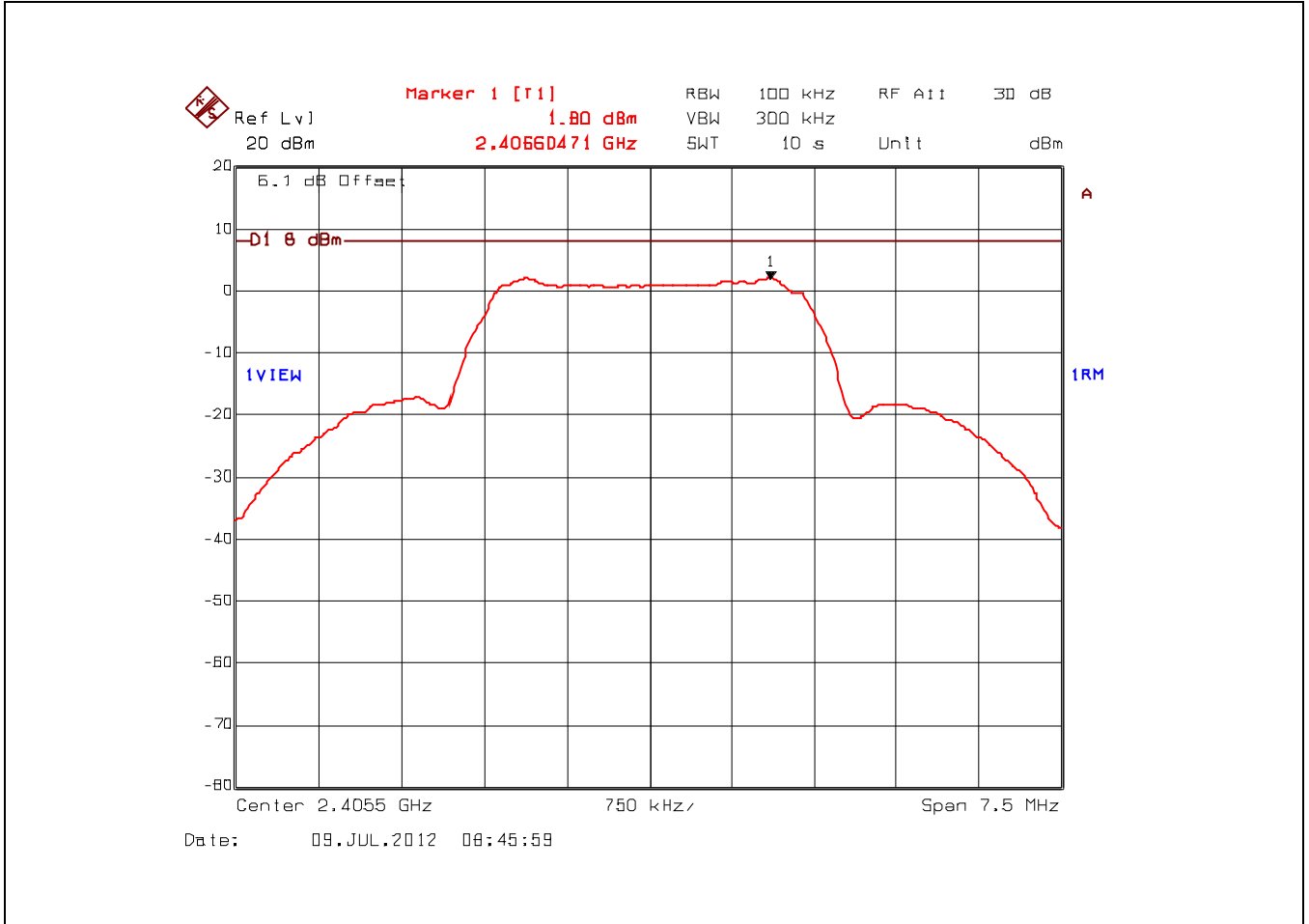
Plot 5.6.4.9. Power Spectral Density
Data Rate 10, 2476.50 MHz,, Power Setting 52
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 21.25 dB + (-15.2 dB) = 6.1 dB



Plot 5.6.4.10. Power Spectral Density

Data Rate 11, 2405.50 MHz,, Power Setting 52

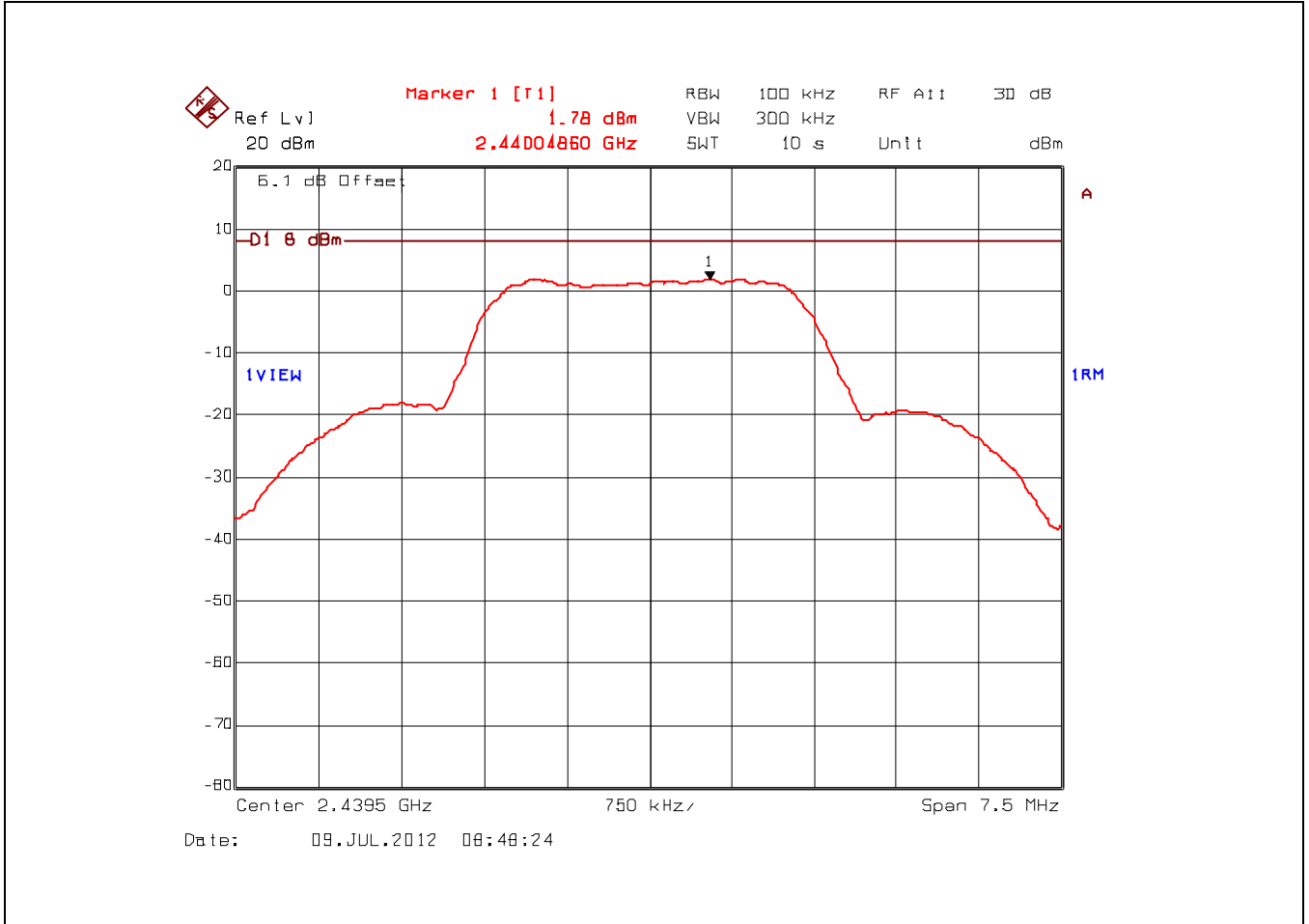
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 21.25 dB + (-15.2 dB) = 6.1 dB



Plot 5.6.4.11. Power Spectral Density

Data Rate 11, 2439.50 MHz,, Power Setting 52

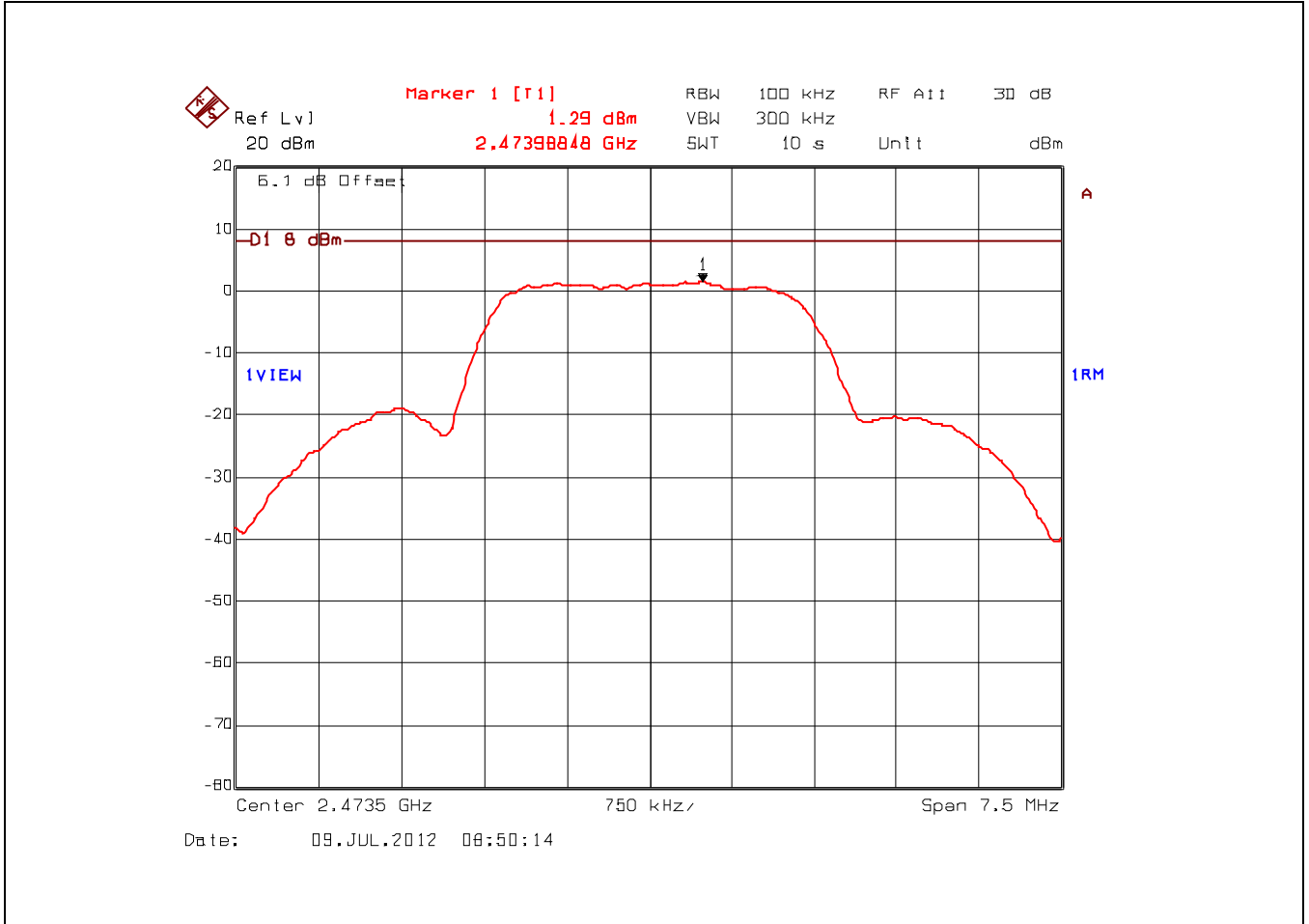
Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 21.25 dB + (-15.2 dB) = 6.1 dB



Plot 5.6.4.12. Power Spectral Density

Data Rate 11, 2473.50 MHz,, Power Setting 52

Offset: Insertion Loss + BWCF = 21.25 dB + 10*log(3 kHz/ 100 kHz) = 21.25 dB + (-15.2 dB) = 6.1 dB



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)

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

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
Horn Antenna	EMCO	3160-09	118385	18 – 26.5 GHz	30 May 2012*

Equipment was used in the period of April 9 – May 7, 2012

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-047F15C247DTS

July 23, 2012

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

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

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-047F15C247DTS

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