Test Report

for

Promethean Ltd

on

ActivExpression2

Document No: TTR-005317-02-W-US1

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TRaC Wireless Test Report	**:** TTR-005317-02-W-US1
Applicant	**:** Promethean Ltd
Apparatus	**:** ActivExpression2
Specification(s)	**:** CFR47 Part 15.247, June 2011
FCCID	**:** FCC QAM014
Purpose of Test	**:** Certification
Authorised by	**:** 
	: Radio Product Manager
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Authorised Copy Number	**:** *PDF*

Total number of pages: 78

Contents

Section 1: Introduction

1.1 General

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on samples submitted to the Laboratory.

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1.2 Tests Requested By

The testing in this report was requested by:

Promethean Ltd
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1.3 Manufacturer

Same as above

1.4 Apparatus Assessed

The following apparatus was assessed between 22nd June 2011 and 1st July 2011:

ActivExpression2

The above unit consists of an FHSS transmitter operating in the 2400 MHz - 2483.5 MHz ISM band.

1.5 Test Result Summary

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

The statements relating to compliance with the standards below apply ONLY as qualified in the notes and deviations stated in sections 1.6 to 1.7 of this test report.

Full details of test results are contained within Appendix A. The following table summarises the results of the assessment.

Test Type	Regulation	Measurement standard	Result
Radiated spurious emissions (Restricted bands)	Title 47 of the CFR: Part 15 Subpart (c) 15.247	ANSI C63.10	Pass
Conducted spurious emissions (Non-restricted bands)	Title 47 of the CFR: Part 15 Subpart (c) 15.247	ANSI C63.10	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	ANSI C63.10	N/A
20dB Bandwidth and Channel Spacing	Title 47 of the CFR : Part 15 Subpart (c) 15.247(a)(1)(i)	ANSI C63.10	Pass
Conducted Carrier Power	Title 47 of the CFR : Part 15 Subpart (c) 15.247(b)(2)	ANSI C63.10	Pass
Hopping Frequencies	Title 47 of the CFR : Part 15 Subpart (c) 15.247(a)(1)	ANSI C63.10	Pass
Channel Occupancy	Title 47 of the CFR : Part 15 Subpart (c) 15.247(a)(1)(i)	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	ANSI C63.10	Pass

Abbreviations used in the above table:

Mod : Modification
CFR : Code of Federal Regulations
REFE : Radiated Electric Field Emissions
ANSI : American National Standards Institution
PLCE : Power Line Conducted Emissions

1.6 Notes Relating to the Assessment

With regard to this assessment, the following points should be noted:

The results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

The apparatus was set up and exercised using the configurations, modes of operation and arrangements defined in this report only.

Particular operating modes, apparatus monitoring methods and performance criteria required by the standards tested to have been performed except where identified in Section 1.7 of this test report (Deviations from Test Standards).

For emissions testing, throughout this test report, “Pass” indicates that the results for the sample as tested were below the specified limit (refer also to Section 2, Measurement Uncertainty).

Where relevant, the apparatus was only assessed using the monitoring methods and susceptibility criteria defined in this report.

All testing with the exception of testing at the Open Area Test Site was performed under the following environmental conditions:

Temperature	: 17 to 23 °C
Humidity	: 45 to 75 %
Barometric Pressure	: 86 to 106 kPa

All dates used in this report are in the format dd/mm/yy.

This assessment has been performed in accordance with the requirements of ISO/IEC 17025.

1.7 Deviations from Test Standards

There were no deviations from the standards tested to.

Section 2: Measurement Uncertainty

2.1 Application of Measurement Uncertainty

The following table contains the measurement uncertainties for measurements

The following procedure is used when determining the result of a measurement:

(i) If specification limits are not exceeded by the measured result, extended by the positive component of the expanded uncertainty interval at a confidence level of 95%, then a pass result is recorded.

(ii) Where a specification limit is exceeded by the result even when the result is decreased by the negative component of the expanded uncertainty interval, a fail result is recorded.

(iii) Where a measured result is below a limit, but by a margin less than the positive measurement uncertainty component, it is not possible to record a pass based on a 95% confidence level. However, the result indicates that a pass result is more probable than a fail result.

(iv) Where a measured result is above a limit, but by a margin less than the negative measurement uncertainty component, it is not possible to record a fail based on a 95% confidence level. However the result indicates that a fail is more probable than a pass.

2.2 Measurement Uncertainty Values

Radio Testing – General Uncertainty Schedule

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

Uncertainty in test result (Equipment - TRLUH120) = **2.18dB**
Uncertainty in test result (Equipment – TRL05) = **1.08dB**
Uncertainty in test result (Equipment – TRL479) = **2.48dB**

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

Uncertainty in test result (Equipment - TRLUH120) = **119ppm**
Uncertainty in test result (Equipment – TRL05) = **0.113ppm**
Uncertainty in test result (Equipment – TRL479) = **0.265ppm**

[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**, Uncertainty in test result (30MHz – 1GHz) = **4.6dB**, Uncertainty in test result (1GHz-18GHz) = **4.7dB**

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious Emissions

Uncertainty in test result (Equipment TRL479) Up to 8.1GHz = **3.31dB**
Uncertainty in test result (Equipment TRL479) 8.1GHz – 15.3GHz = **4.43dB**
Uncertainty in test result (Equipment TRL479) 15.3GHz – 21GHz = **5.34dB**
Uncertainty in test result (Equipment TRLUH120) Up to 26GHz = **3.14dB**

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

Uncertainty in overall test level = **2.1dB**, Uncertainty in time measurement = **0.59%,** Uncertainty in Amplitude measurement = **0.82%**

[12] Power Line Conduction

Uncertainty in test result = **3.4dB**

[13] Spectrum Mask Measurements

Uncertainty in test result = **2.59% (frequency)**
Uncertainty in test result = **1.32dB (amplitude)**

[14] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[15] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[16] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[17] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[18] Receiver Threshold

Uncertainty in test result = **3.23dB**

[19] Transmission Time Measurement

Uncertainty in test result = **7.98%**

Section 3: Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A: Formal Emission Test Results

Abbreviations used in the tables in this appendix:

Spec	: Specification
Mod	: Modification
EUT	: Equipment Under Test
SE	: Support Equipment
L	: Live Power Line
N	: Neutral Power Line
E	: Earth Power Line
Pk	: Peak Detector
QP	: Quasi-Peak Detector
Av	: Average Detector
CDN	: Coupling & decoupling network

ALSR	: Absorber Lined Screened Room
OATS	: Open Area Test Site
ATS	: Alternative Test Site
Ref	: Reference
Freq	: Frequency
MD	: Measurement Distance
SD	: Spec Distance
Pol	: Polarisation
H	: Horizontal Polarisation
V	: Vertical Polarisation

A1 Transmitter Peak Output Power

Carrier power was verified with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.247(b)(1)
Measurement standard	ANSI C63.10:2003
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20 deg C
Photographs (Appendix F)	None

Channel Frequency (MHz)	Peak Carrier Power (mW)	Limit (W)	Result
2402	3.78	1	Pass
2441	3.76	1	Pass
2480	3.64	1	Pass

Notes:

Number of hopping channels employed is 46

Conducted Measurement

1. Measured Peak Carrier power includes highest gain of any antenna to be used
2. Highest Gain of any antenna to be used = 0 dBi
3. Conducted measurements were performed with a temporary antenna connector provided by the client

Radiated Measurement

1. Measuring distance = 3m
2. EUT 0.8 m above ground plane
3. Emissions maximised by rotation of EUT, on an automatic turntable
4. Raising and lowering the receiver antenna between 1m & 4m >30MHz
5. Horizontal and vertical polarisations, of the receive antenna
6. EUT orientation in three orthogonal planes
7. Maximum results recorded
8. EUT was replaced by antenna and signal generator to produce EIRP level

A2 RF Antenna Conducted Spurious Emissions

Measurement of conducted spurious emissions at the antenna port was performed using a peak detector with the RBW set to 100 kHz and the VBW>RBW. Frequencies were scanned up through to the 10th harmonic with the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2003
Frequency range	9 kHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20 deg C
Photographs (Appendix F)	None

The worst case conducted emission measurements at the antenna port are listed below:

Ref No.	Measured Freq (MHz)	Det.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
No Significant emissions within 20 dB of the limit						

Notes:

1. The conducted emission limit for emissions outside the restricted bands, defined in 47 CFR Part 15.205(a) are based on a transmitted carrier level of 15.247(b). With the EUT transmitting on its lowest, centre and highest carrier frequencies in turn, emissions from the EUT are required to be 20 dB below the level of the highest fundamental as measured within a 100 kHz RBW in accordance with 15.247(d) using a peak detector.
2. The RBW = 100 kHz, Video bandwidth (VBW) > RBW and the radio spectrum was investigated up to the 10th harmonic in accordance15.33 (a)(1).
3. The measurements at 2400 MHz and 2483.5 MHz were made to ensure band edge compliance.
4. The carrier level was measured whilst varying the supply voltage between 85% and 105% of the nominal supply voltage as required by 15.31(e). No variation in carrier level was observed.
5. The limit outside the restricted band in 100 kHz RBW is defined using the following formula in accordance with 15.247(d):

The limit in 100 kHz RBW = (Maximum Peak Conducted Carrier)-20dB

Where:

The maximum peak conducted power was measured using a peak power meter. Please refer to section A1 of this test report.

Channel No.	Channel Frequency (MHz)	Measured Peak Carrier Power (W)	Measured Peak Carrier (dBμV)	Measured Peak Carrier –20dB (dBμV)	Emission Limit In a 100 kHz RBW (dBμV)
2	2402	3.78	111.53	91.53	91.53
46	2441	3.76	111.45	91.45	91.45
92	2480	3.64	111.24	91.24	91.24

A3 Radiated Electric Field Emissions within the Restricted Bands of 15.205

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric filed emission test applies to spurious emissions and harmonics that fall within the restricted bands listed in Section 15.205. The maximum permitted field strength is listed in Section 15.209. The EUT was set to transmit on its lowest, centre and highest carrier frequency.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : ☐ 3m alternative test site : ☑

The effect of the EUT set-up on the measurements is summarised in note (c) below.

Test Details	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz – 25GHz
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20 deg C
Photographs (Appendix F)	1, 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below:

Ref No.	Channel	Frequency (MHz)	Polarisation	Peak/Average Measurement	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	Bottom	2103.814	H	A	39.1	54	-14.9	Pass
2.	Bottom	4805.544	H	A	45.16	54	-8.84	Pass
3.	Bottom	9611.169	H	A	39.47	54	-14.53	Pass
4.	Middle	1830.881	H	A	37.28	54	-16.72	Pass
5.	Middle	2136.618	H	A	43.59	54	-10.41	Pass
6.	Middle	4881.6	H	A	46.41	54	-7.59	Pass
7.	Middle	9763.237	H	A	40.14	54	-13.87	Pass
8.	Top	2171.23	H	A	43.46	54	-10.54	Pass
9.	Top	4961.08	H	A	45.86	54	-8.14	Pass
10.	Top	9922.153	H	A	44.38	54	-9.62	Pass

Notes:

1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1

2 In accordance with 15.35(b), above 1 GHz, emissions measured using a peak detector shall not exceed a level 20 dB above the average limit.

3 Measurements at 2400 & 2483.5 MHz were made to ensure band edge compliance.

4 Testing was performed with the EUT orientated in three orthogonal planes and the maximum emissions level recorded. In addition, the EUT antenna was varied within its range of motion in order to maximise emissions.

5 For Frequencies below 1 GHz, RBW= 100 kHz, testing was performed with CISPR16 compliant test receiver with QP detector. Above 1 GHz tests were performed using a spectrum analyser using the following settings:

Peak RBW=VBW= 1MHz
Average RBW=VBW= 1MHz

These settings as per ANSI C63.10 and DA 00-705

6 In accordance with DA 00-705, the average level of the spurious radiated emission may be reduced by the duty cycle correction factor. If the dwell time per channel (refer to the measured channel occupancy time, section A7 of this test report) of the hopping signal is less than 100ms then the average measurement may be further adjusted by the duty cycle correction factor which is derived from

$$20\log_{10}\left(\frac{\text{dwell time}}{100ms}\right)$$

The upper and lower frequency of the measurement range was decided according to 47 CFR Part 15:2011 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits (47 CFR Part 15: Clause 15.209) for emissions falling within the restricted bands defined in 15.205(a):

Frequency of emission (MHz)	Field strength (μV/m)	Measurement Distance (m)	Field strength (dBμV/m)
0.009-0.490	2400/F(kHz)	300	67.6/F (kHz)
0.490-1.705	24000/F(kHz)	30	87.6/F (kHz
1.705-30	30	30	29.5
30-88	100	3	40.0
88-216	150	3	43.5
216-960	200	3	46.0
Above 960	500	3	54.0

Notes:

(a) Where results have been measured at one distance, and a signal level displayed at another, the results have been extrapolated using the following formula:

$$\text{Extrapolation}\,(\text{dB}) = 20\log_{10}\left(\frac{\text{measurement distance}}{\text{specification distance}}\right)$$

The results displayed take into account applicable antenna factors and cable losses.

(b) The levels may have been rounded for display purposes.

(c) The following table summarises the effect of the EUT operating mode, internal configuration and arrangement of cables / samples on the measured emission levels:

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels	✓			
Effect of EUT internal configuration on emission levels		✓		
Effect of Position of EUT cables & samples on emission levels			✓	

(i) Parameter defined by standard and / or single possible, refer to Appendix D
(ii) Parameter defined by client and / or single possible, refer to Appendix D
(iii) Parameter had a negligible effect on emission levels, refer to Appendix D
(iv) Worst case determined by initial measurement, refer to Appendix D

A4 20 dB Bandwidth and Carrier Frequency Separation

Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(1)(i) requires the measurement of the bandwidth of the transmission between the -20 dB points on the transmitted spectrum. The results of this test determine the limits for channel spacing. The channel separation shall be a minimum of 25 kHz or the 20 dB bandwidth, whichever is the greater. The formal measurements are detailed below:

Test Details	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
Temperature	20 deg C
EUT set up	Refer to Appendix C

Channel Frequency (MHz)	Measured 20 dB Bandwidth (kHz)	Limit	Result
2402	1650.641	< 500 kHz	Pass
2441	1672.679	< 500 kHz	Pass
2480	1650.641	< 500 kHz	Pass

Measured Channel Spacing (kHz)	Limit	Result
1727.564103	(25kHz or ≥ Measured 20 dB Bandwidth kHz)	Pass

Plots of the 20 dB bandwidth and channel spacing are contained in Appendix B of this test report.

A5 Hopping frequencies

Hopping frequencies were verified using a spectrum analyser, while the EUT was operating in its normal frequency hopping mode.

Test Details	
Regulation	Title 47 of the CFR : Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
Temperature	20 deg C
EUT set up	Refer to Appendix C

No. of Hopping Channels	Requirement	Result
46	15	Pass

Plots showing the hopping channels are contained in Appendix B.

A6 Channel Occupancy

Channel occupancy time was verified using a spectrum analyser in zero span mode, centred on the middle hopping channel frequency (2441 MHz), while the EUT was operating in its normal frequency hopping mode. The other channels were then verified to ensure that the channel occupancy was identical for all channels.

Test Details	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.247(a)(1)
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
Temperature	20 deg C
EUT set up	Refer to Appendix C

Packet Width (µs)	Number of Transmissions in 18.4 Seconds	Average time of Occupancy (s)	Average Channel Occupancy Time Limit (ms)
0.553	53	0.029309	400

Notes
1 Conducted measurements were performed with a temporary antenna connector provided by the client
2 Average time of occupancy within a period of 0.4 * number of hopping channels
3 Number of hopping channels = 46
4 0.4 * 46 = 18.4 seconds

Plots showing the channel occupancy time and time between successive transmissions are contained in Appendix B of this test report. These are identical for all modulation modes.

A7 Antenna Gain

The maximum antenna gain for the antenna types to be used with the EUT, as declared by the client, is 0 dBi

A8 Unintentional Radiated Electric Field Emissions - 15.109

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The maximum permitted field strength is listed in Section 15.109. The EUT was set to receive mode only on its lowest, centre and highest carrier frequency in turn.

The following test site was used for final measurements as specified by the standard tested to:

3m open area test site : ☐ 3m alternative test site : ☑

Test Details	
Regulation	Title 47 of the CFR: Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz to 25 GHz
EUT sample number	S01
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20 deg C
Photographs (Appendix F)	1, 2

The worst case radiated emission measurements for spurious emissions and harmonics that fall within the restricted bands are listed below:

Ref No.	Channel	Frequency (MHz)	Polarisation	Peak/Average Measurement	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1.	Bottom	4807.27	H	A	37.99	54	-16.01	Pass
2.	Middle	4883.3	H	A	37.55	54	-16.45	Pass
3.	Top	4962.8	H	A	38.09	54	-15.91	Pass
4.	Top	9925.6	H	A	35.18	54	-18.82	Pass

Appendix B: Supporting Graphical Data

This appendix contains graphical data obtained during testing.

Notes:

(a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.

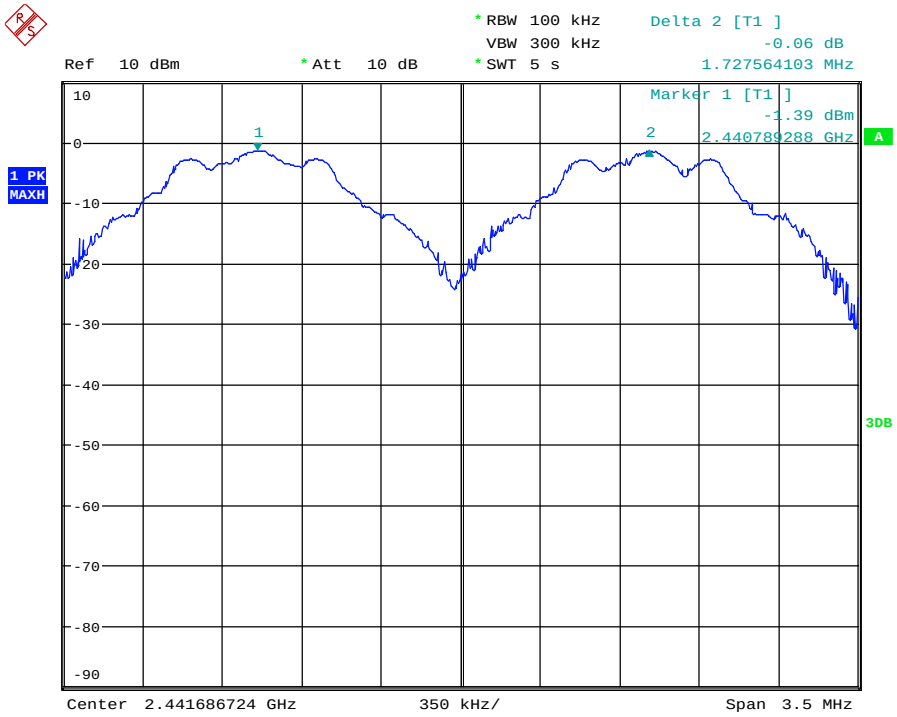
(b) The time and date on the plots do not necessarily equate to the time of the test.

(c) Where relevant, on power line conducted emission plots, the limit displayed is the average limit, which is stricter than the quasi peak limit.

(d) Appendix C details the numbering system used to identify the sample and its modification state.

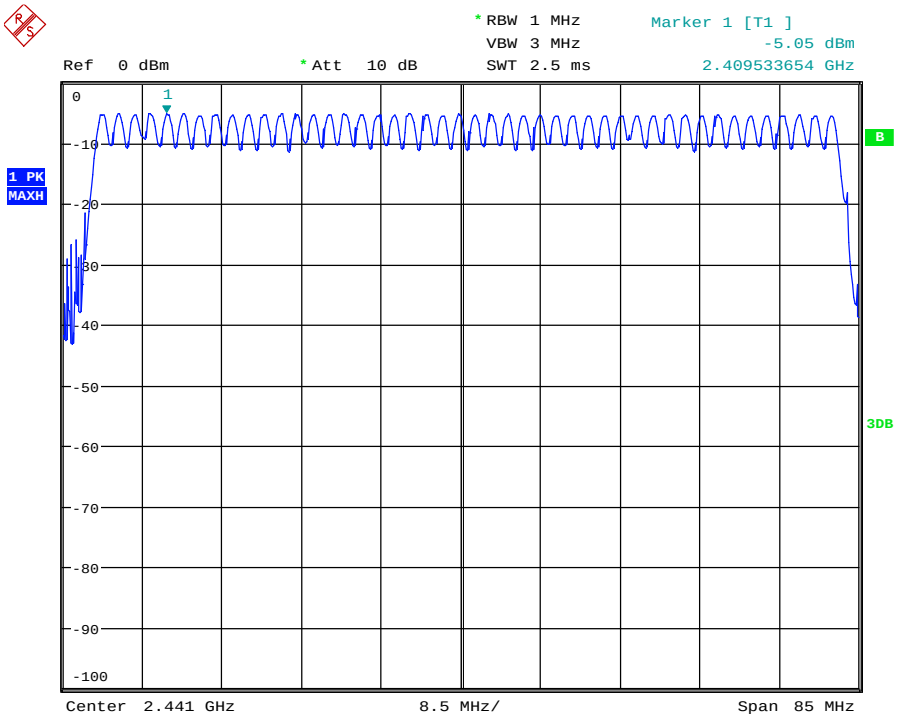
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

Channel Spacing



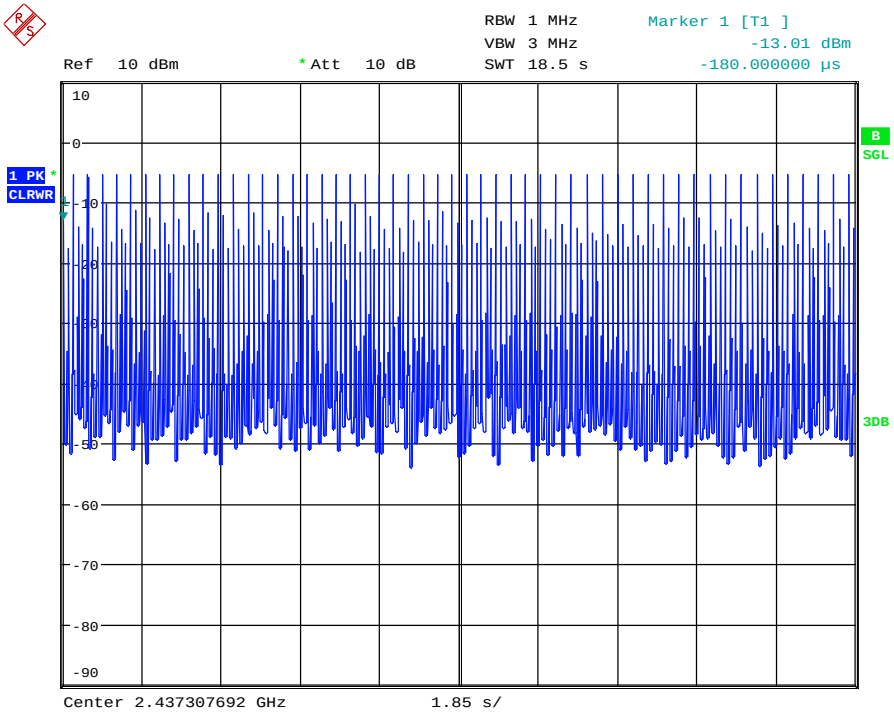
Date: 29.JUN.2011 17:34:32

Number of Hopping Channels



Date: 22.JUN.2011 11:48:08

Number of Transmissions



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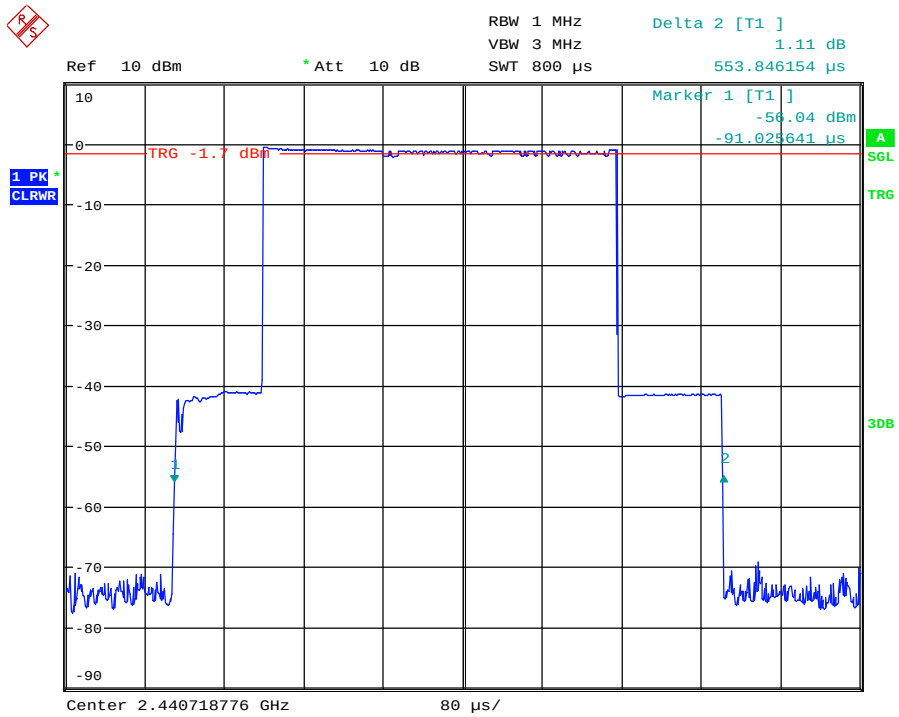
Pulse Width



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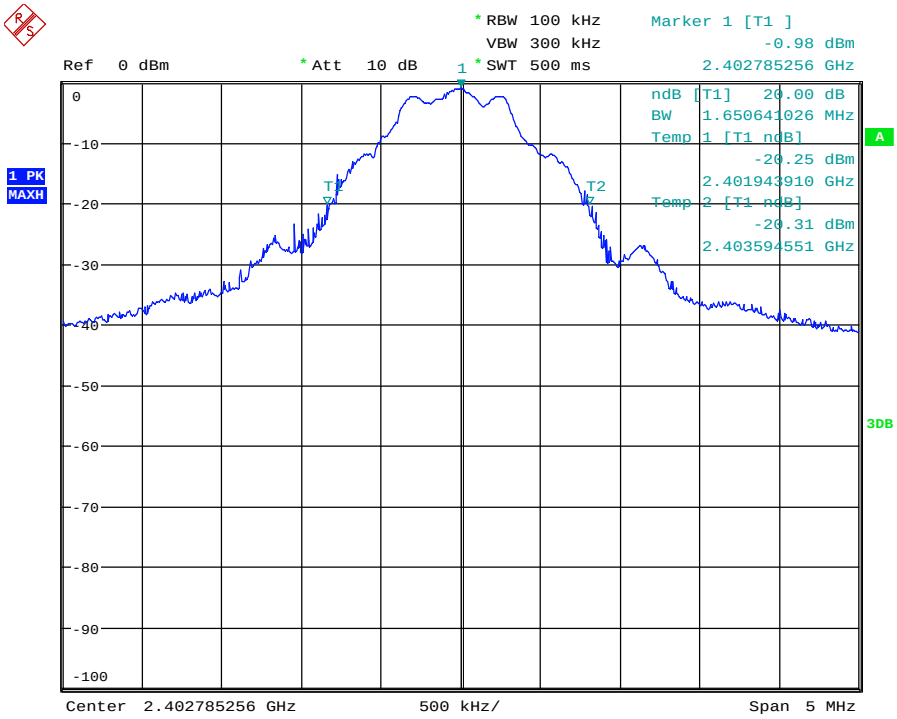
20dB Bandwidth – Bottom Channel



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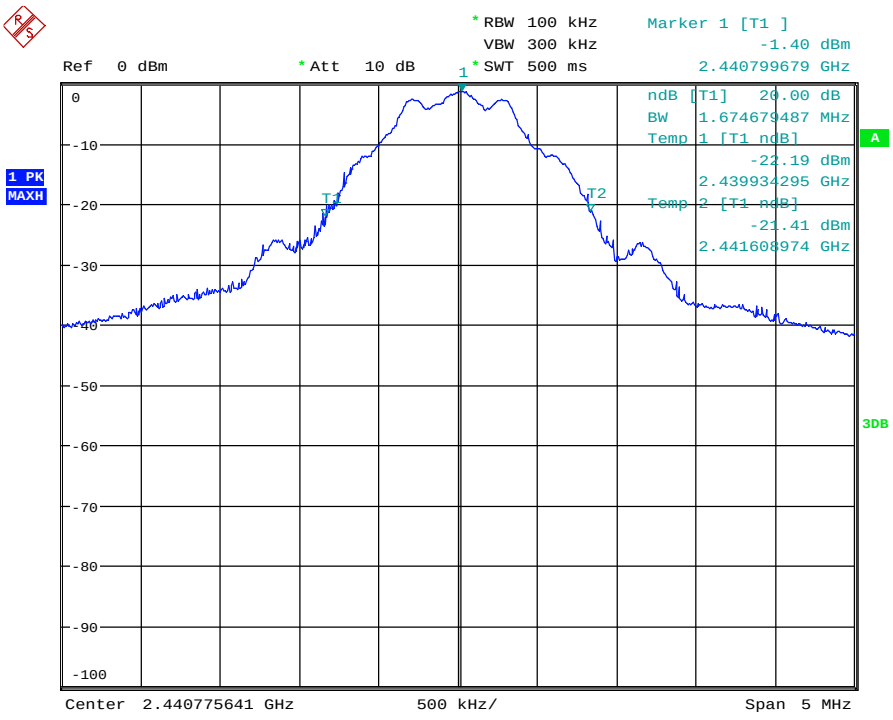
20dB Bandwidth – Middle Channel



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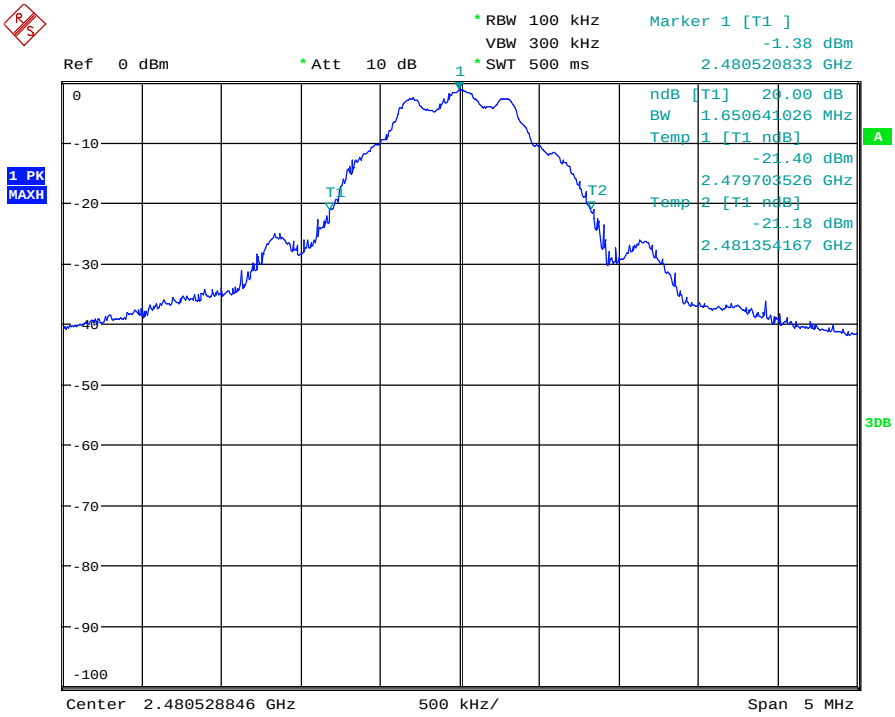
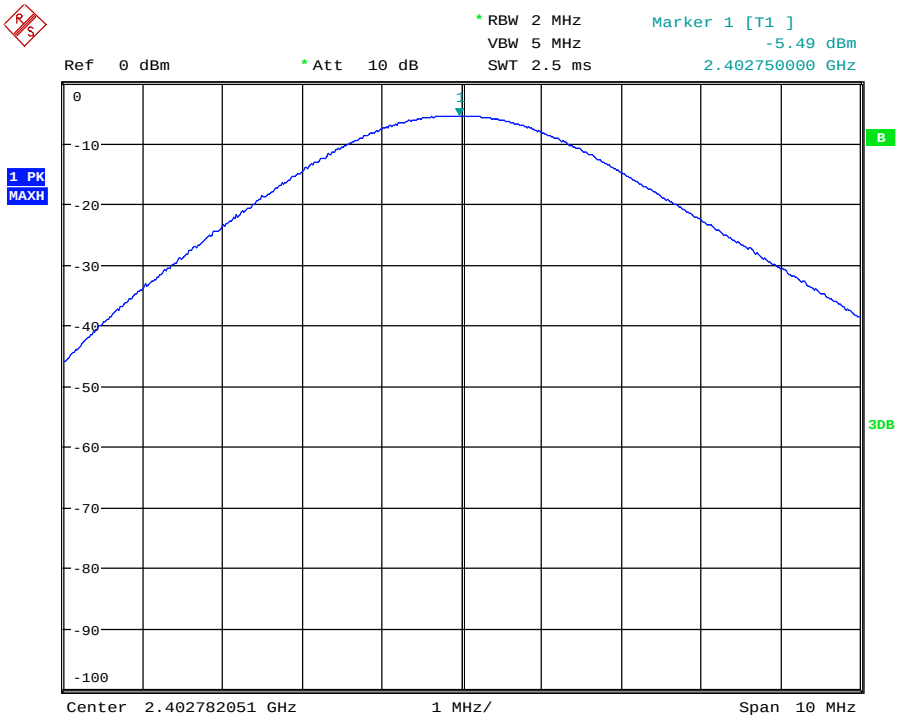
20dB Bandwidth – Top Channel



Date: 29.JUN.2011 17:15:41

Unmodulated Carrier Power – Bottom Channel



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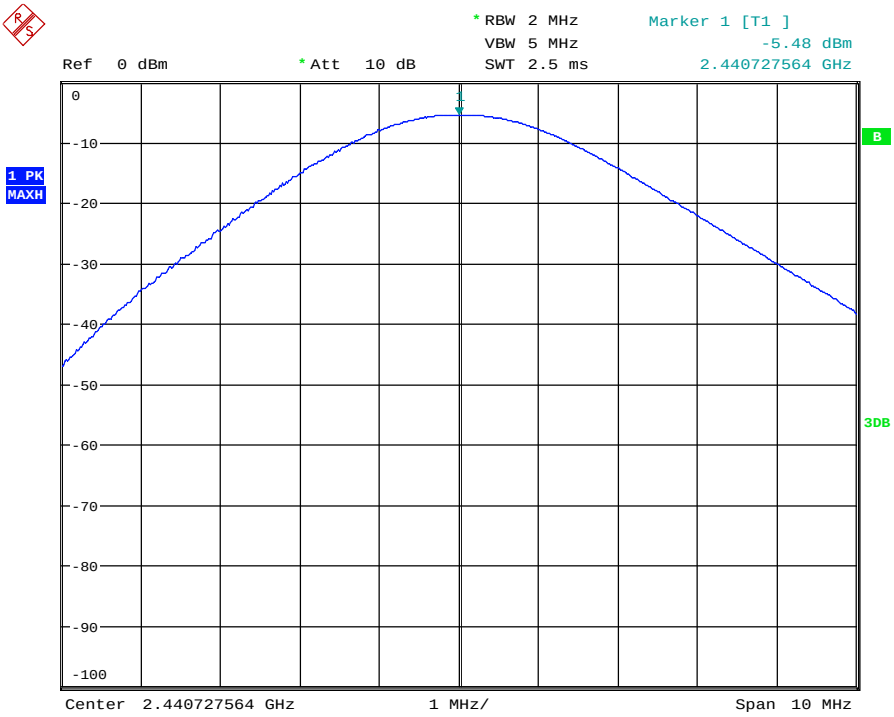
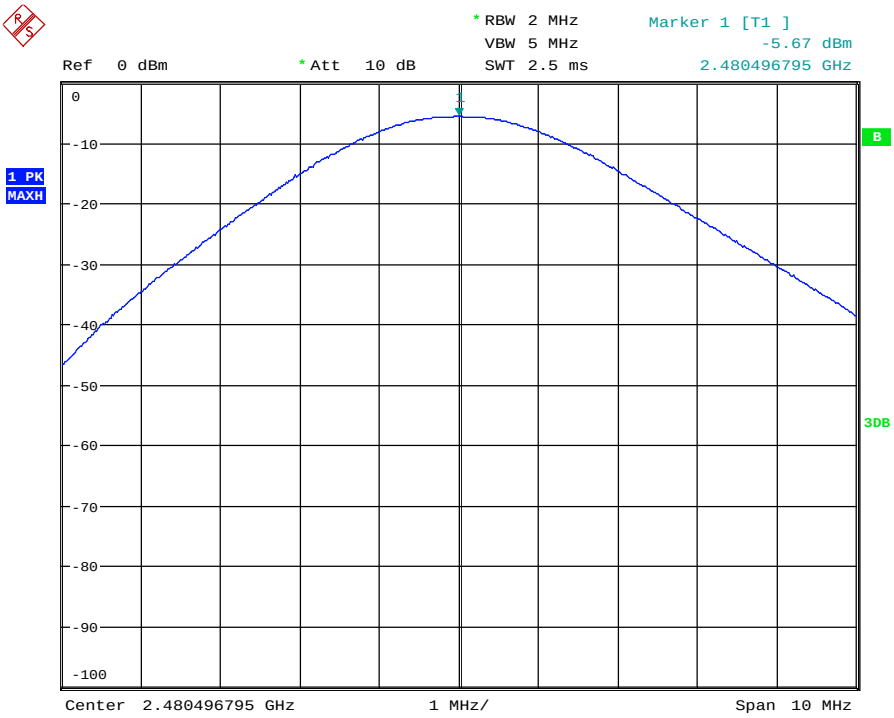
Unmodulated Carrier Power – Middle Channel



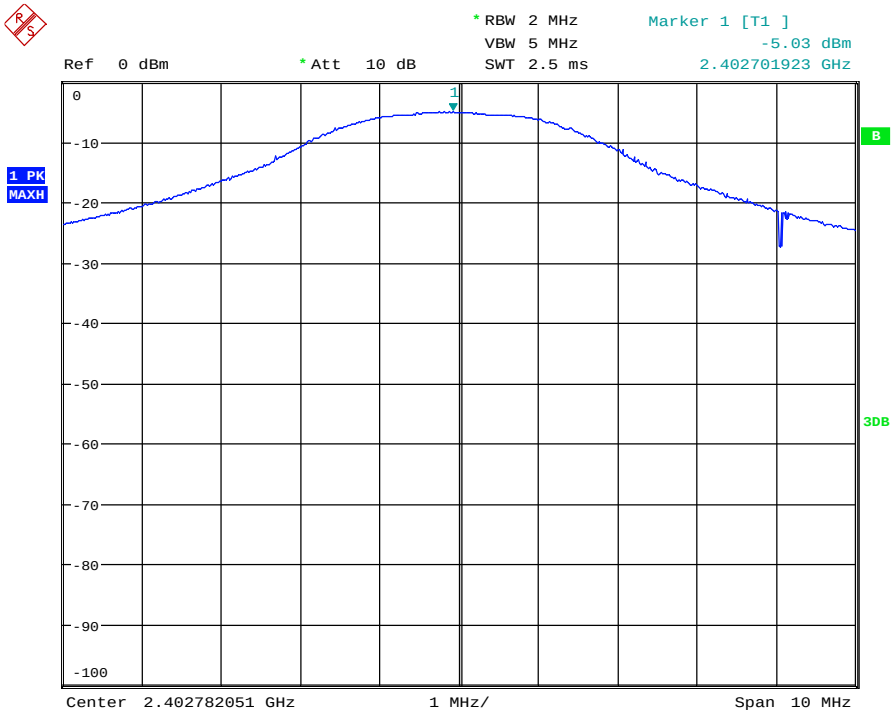
Date: 22.JUN.2011 11:10:47

Unmodulated Carrier Power – Top Channel



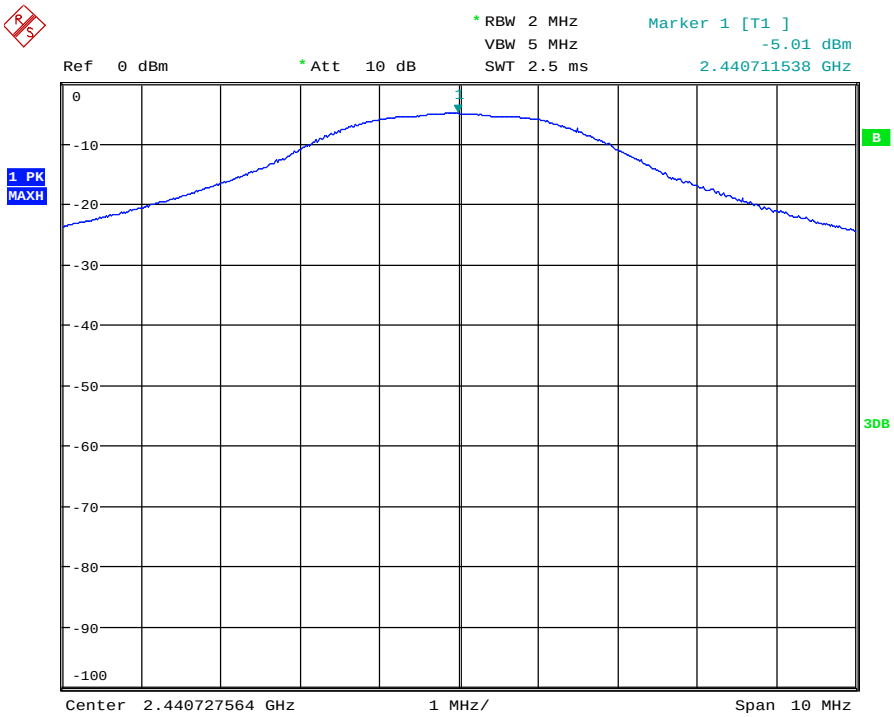
Date: 22.JUN.2011 11:12:06

Modulated Carrier Power – Bottom Channel



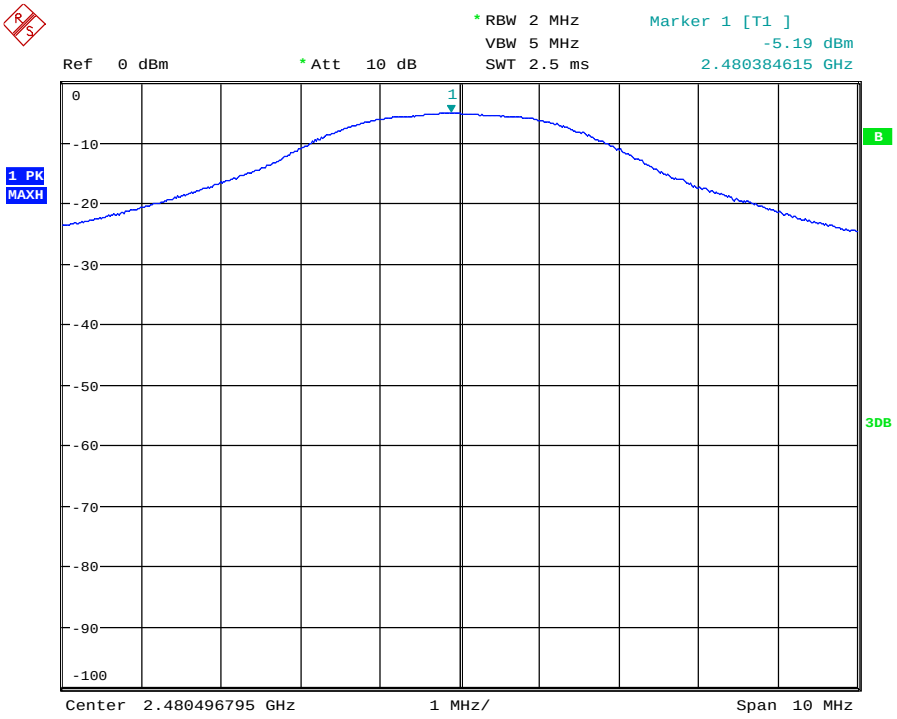
Date: 22.JUN.2011 11:10:12

Modulated Carrier Power – Middle Channel



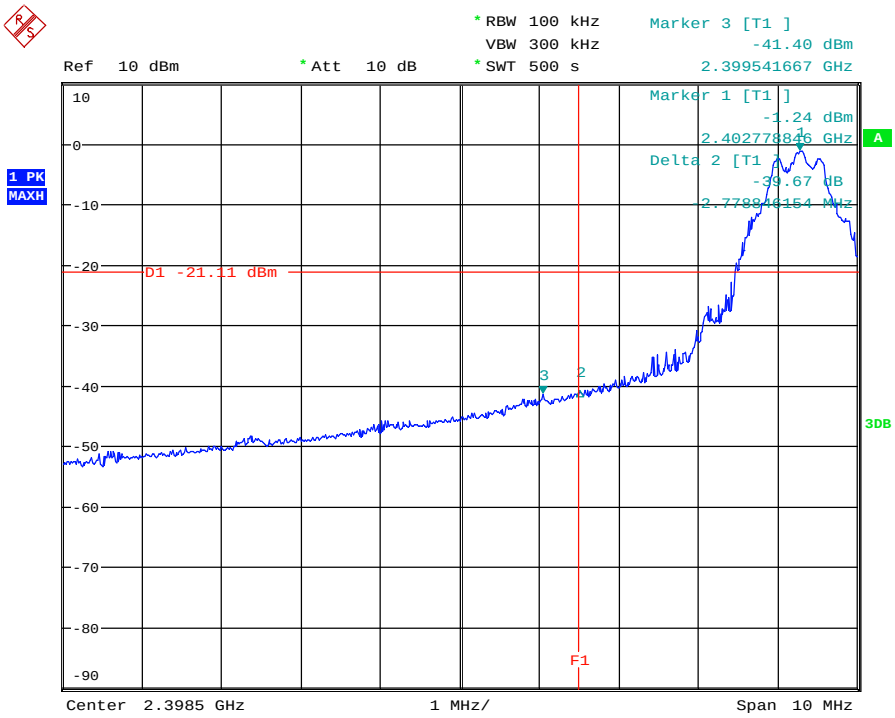
Date: 22.JUN.2011 11:11:29

Modulated Carrier Power – Top Channel



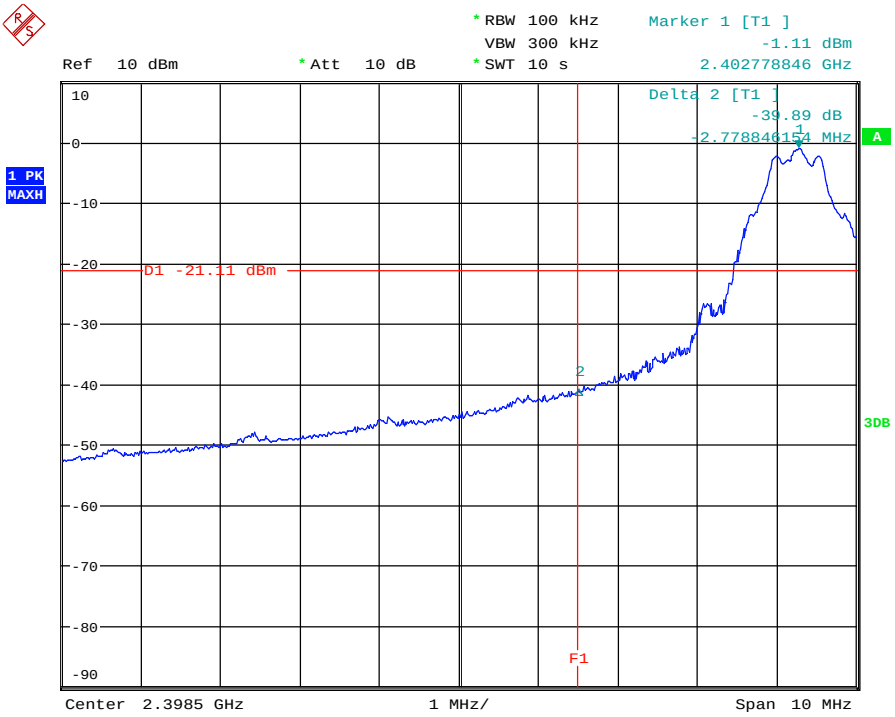
Date: 22.JUN.2011 11:12:43

Conducted Lower Band Edge Compliance – with Hopping



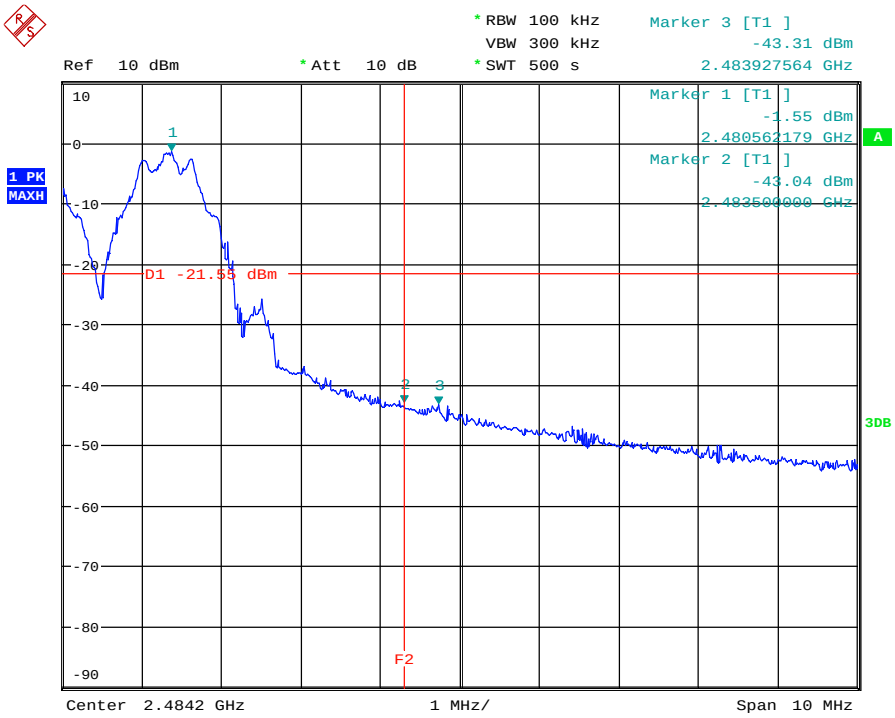
Date: 29.JUN.2011 17:50:37

Conducted Lower Band Edge Compliance – Modulated Carrier



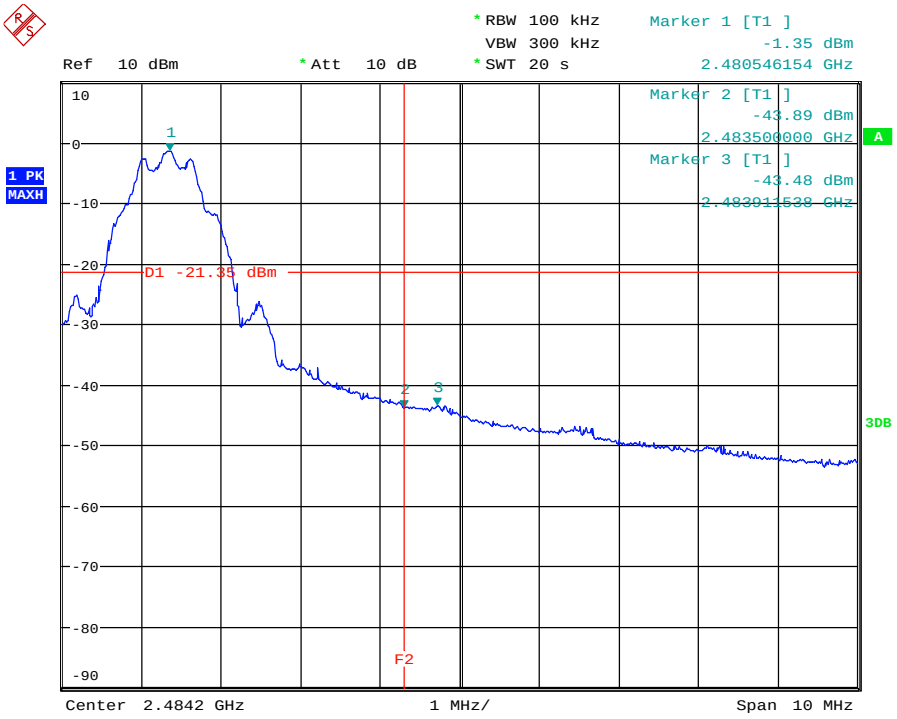
Date: 29.JUN.2011 17:36:24

Conducted Upper Band Edge Compliance – with Hopping



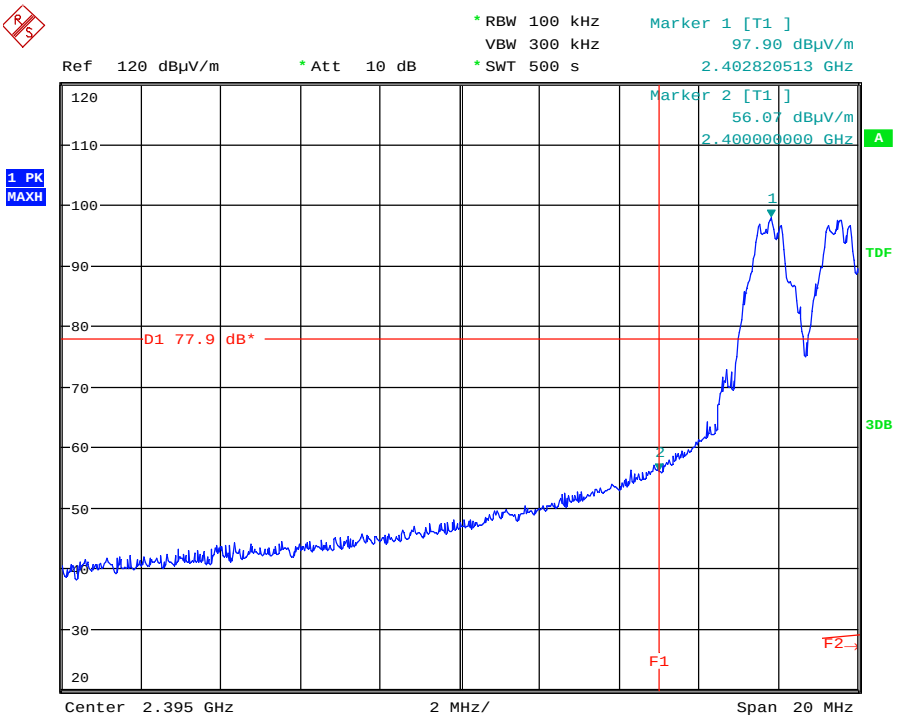
Date: 29.JUN.2011 18:00:20

Conducted Upper Band Edge Compliance – Modulated Carrier



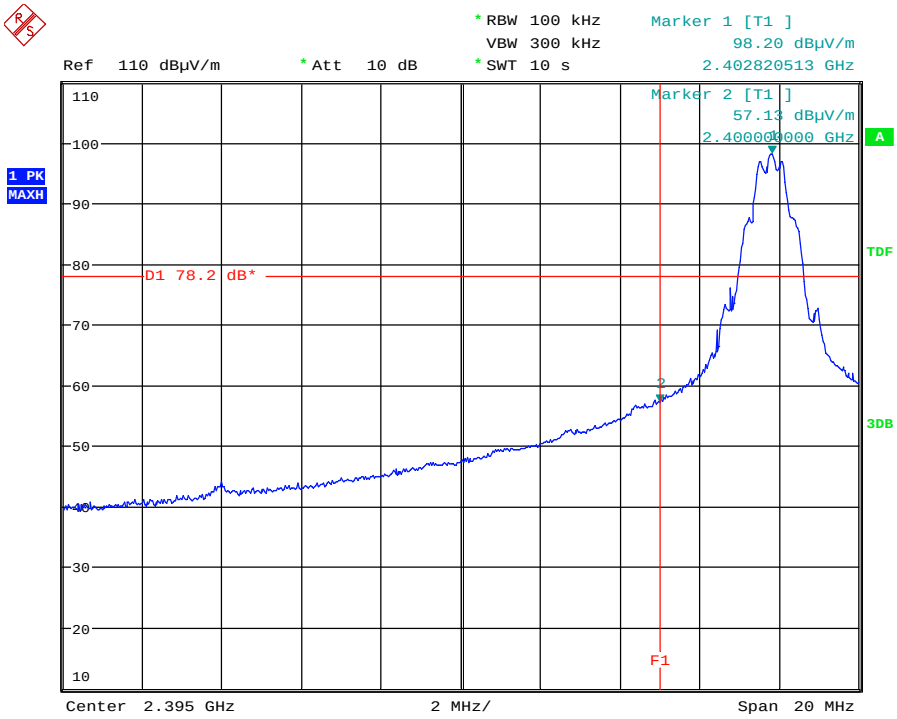
Date: 29.JUN.2011 18:01:28

Radiated Lower Band Edge Compliance – with Hopping



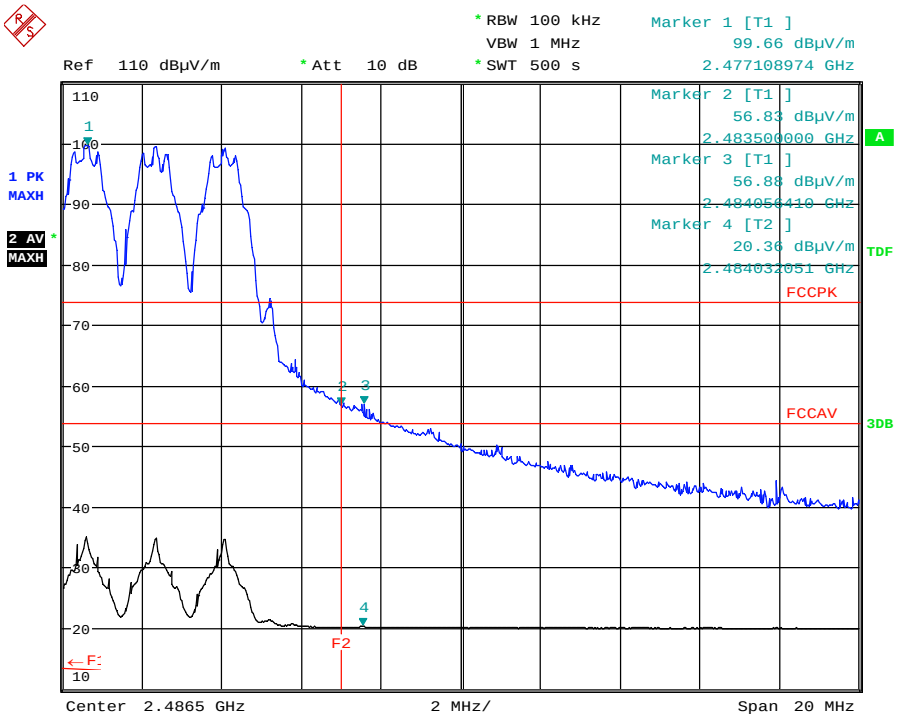
Date: 30.JUN.2011 15:06:29

Radiated Lower Band Edge Compliance – Modulated Carrier



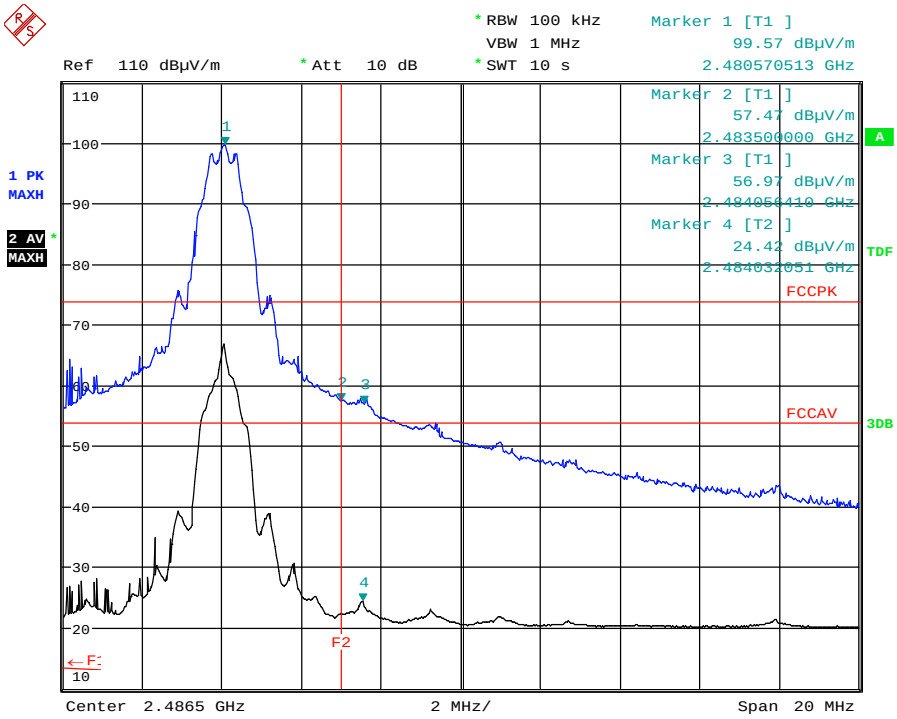
Date: 30.JUN.2011 13:58:08

Radiated Upper Band Edge Compliance – with Hopping



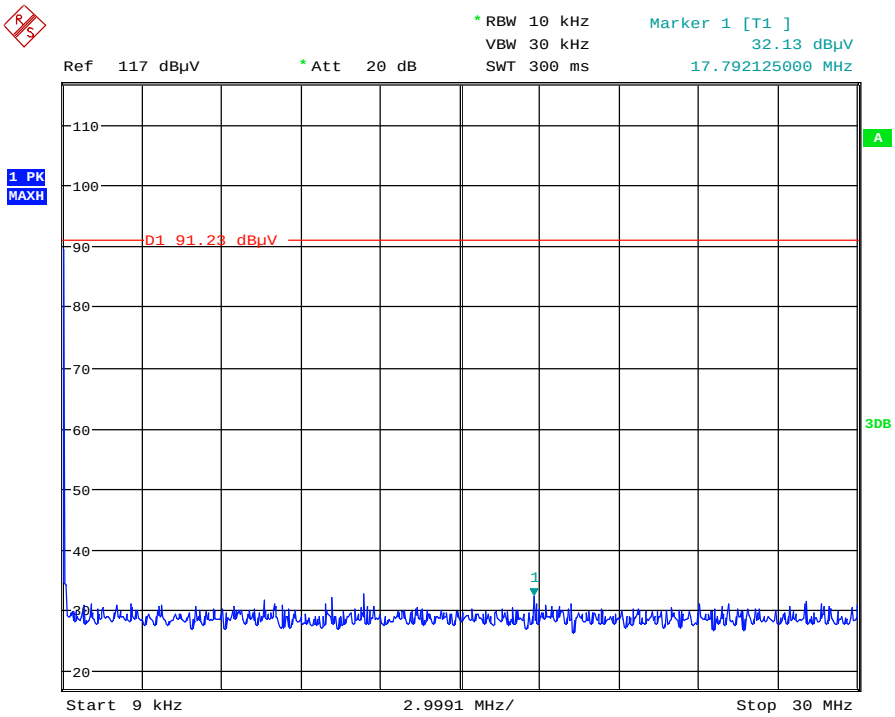
Date: 30.JUN.2011 15:40:18

Radiated Upper Band Edge Compliance – Modulated Carrier



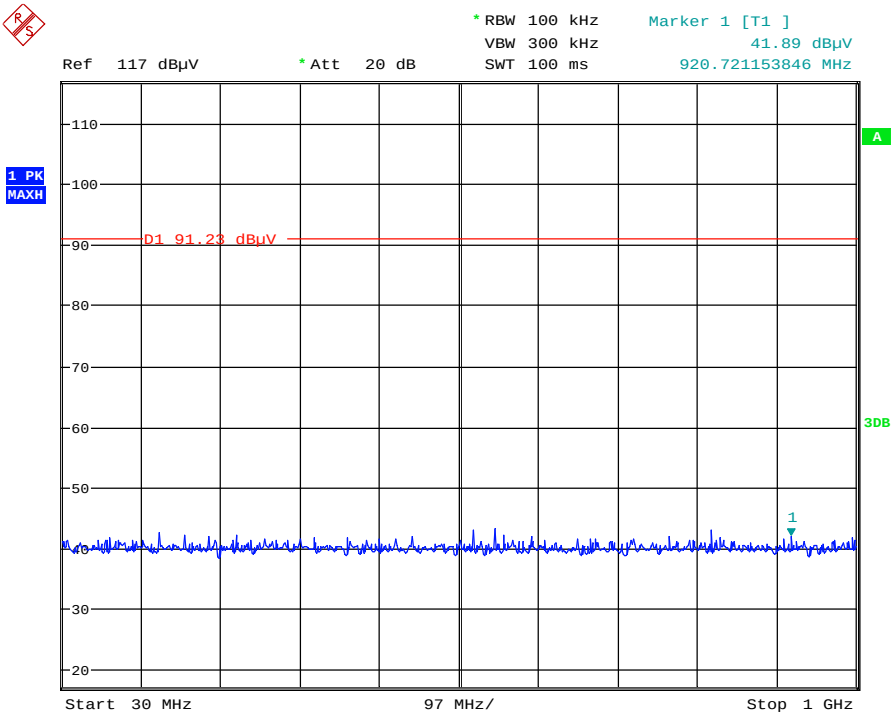
Date: 30.JUN.2011 15:22:44

Conducted Spurious Emissions 9 kHz to 30 MHz – Bottom Channel



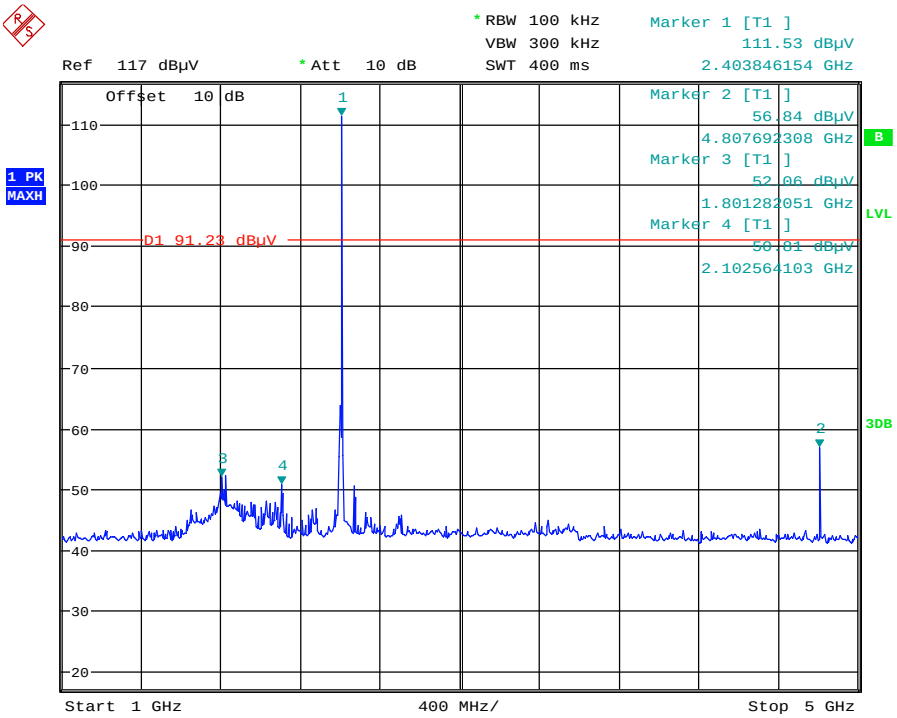
Date: 22.JUN.2011 10:10:07

Conducted Spurious Emissions 30 MHz to 1 GHz – Bottom Channel



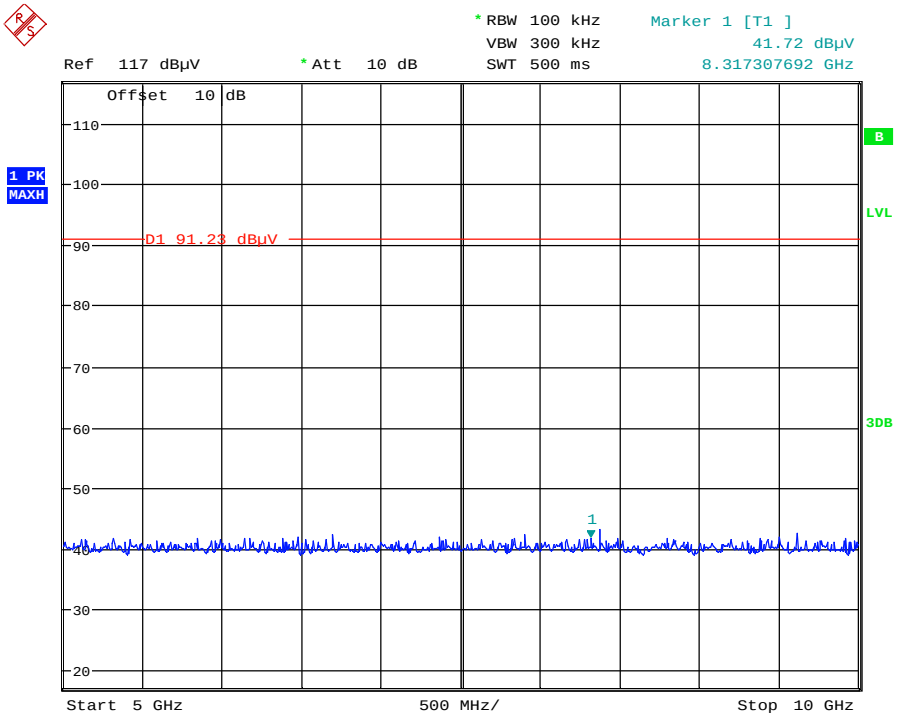
Date: 22.JUN.2011 10:06:20

Conducted Spurious Emissions 1 GHz to 5 GHz – Bottom Channel



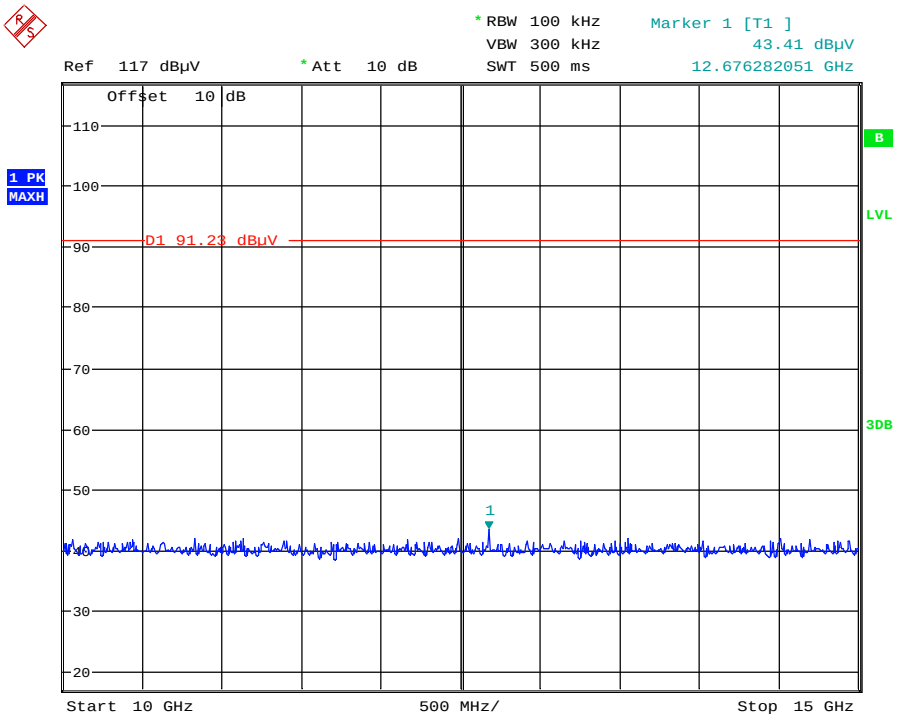
Date: 22.JUN.2011 10:05:08

Conducted Spurious Emissions 5 GHz to 10 GHz – Bottom Channel



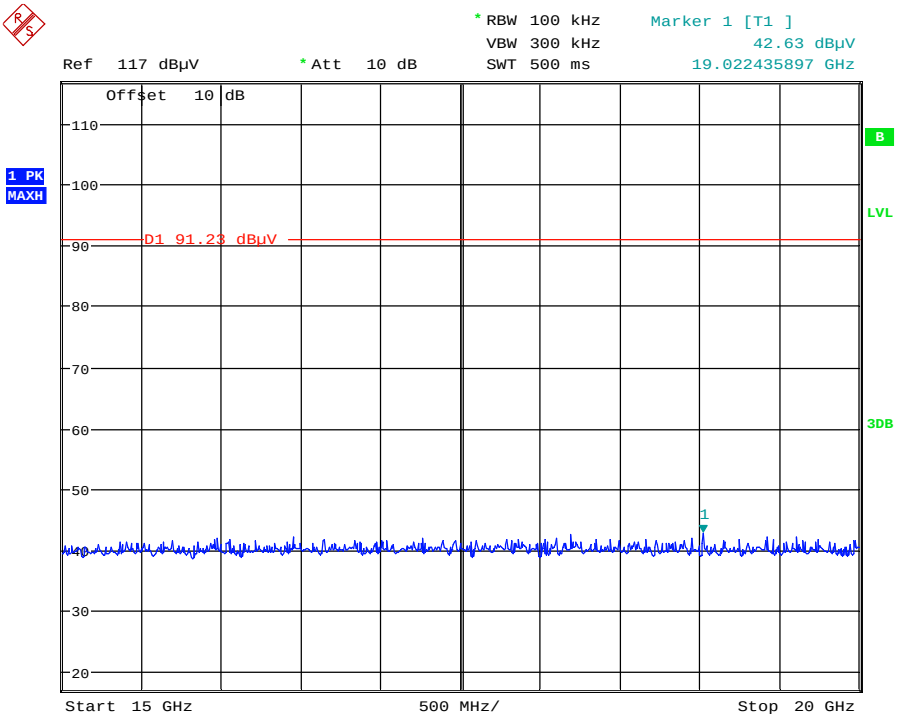
Date: 22.JUN.2011 10:06:35

Conducted Spurious Emissions 10 GHz to 15 GHz – Bottom Channel



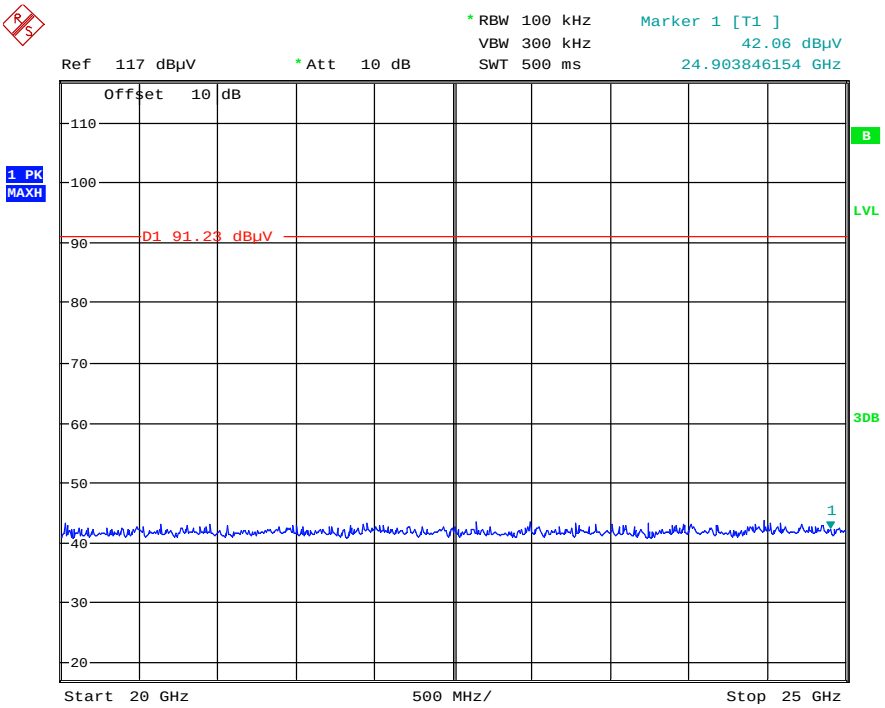
Date: 22.JUN.2011 10:06:52

Conducted Spurious Emissions 15 GHz to 20 GHz – Bottom Channel



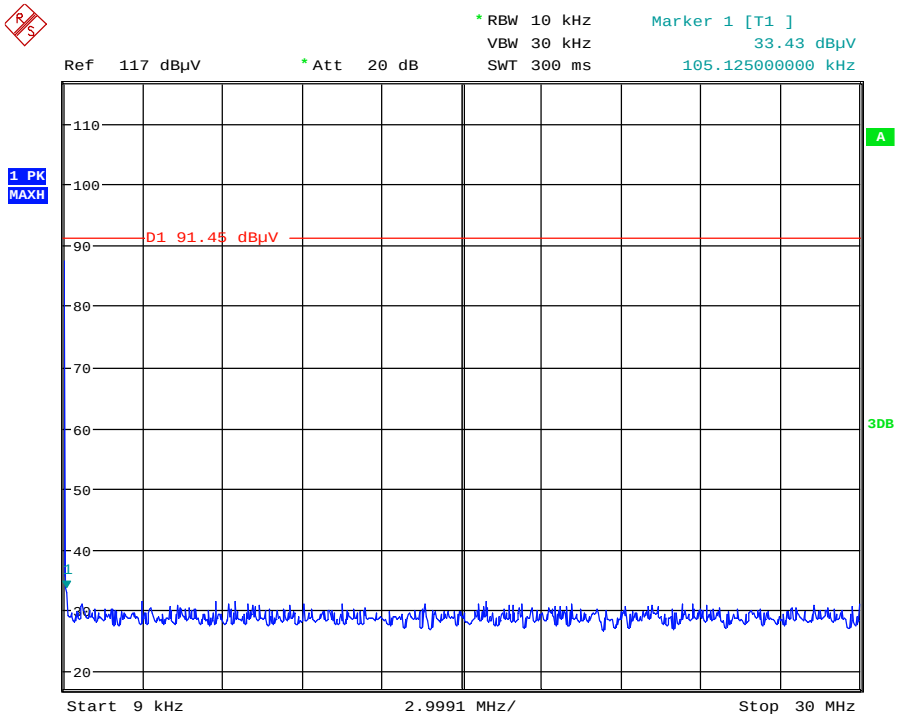
Date: 22.JUN.2011 10:07:03

Conducted Spurious Emissions 20 GHz to 25 GHz – Bottom Channel



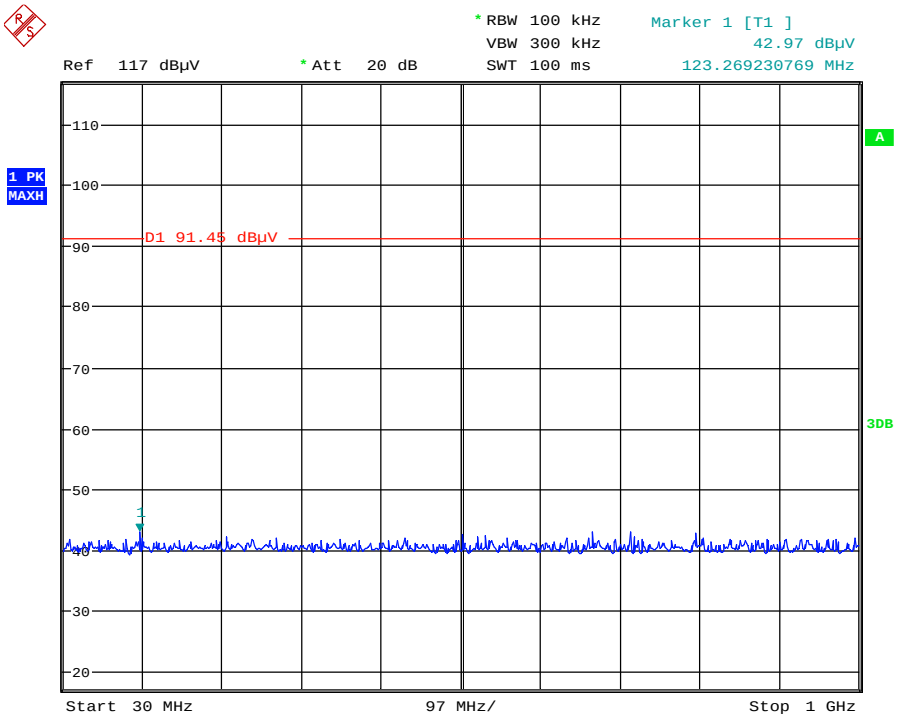
Date: 22.JUN.2011 10:09:03

Conducted Spurious Emissions 9 kHz to 30 MHz – Middle Channel



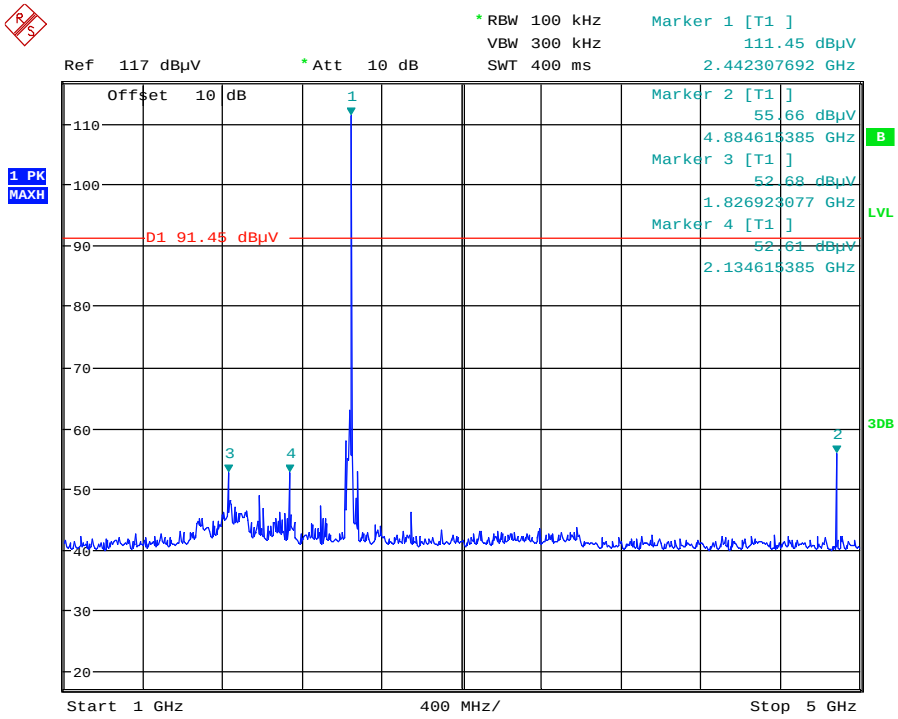
Date: 22.JUN.2011 10:25:20

Conducted Spurious Emissions 30 MHz to 1 GHz – Middle Channel



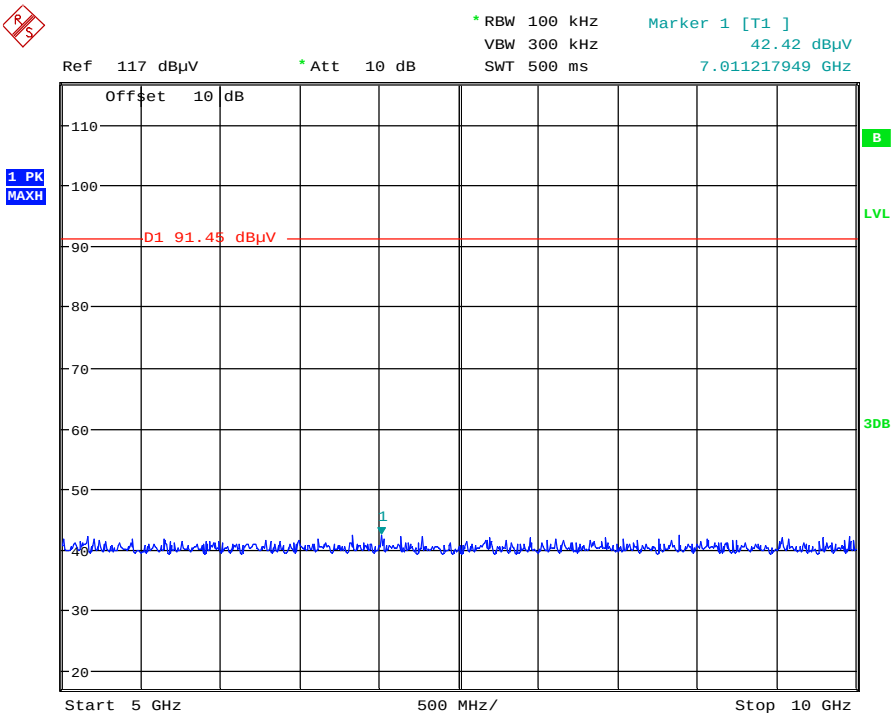
Date: 22.JUN.2011 10:25:06

Conducted Spurious Emissions 1 GHz to 5 GHz – Middle Channel



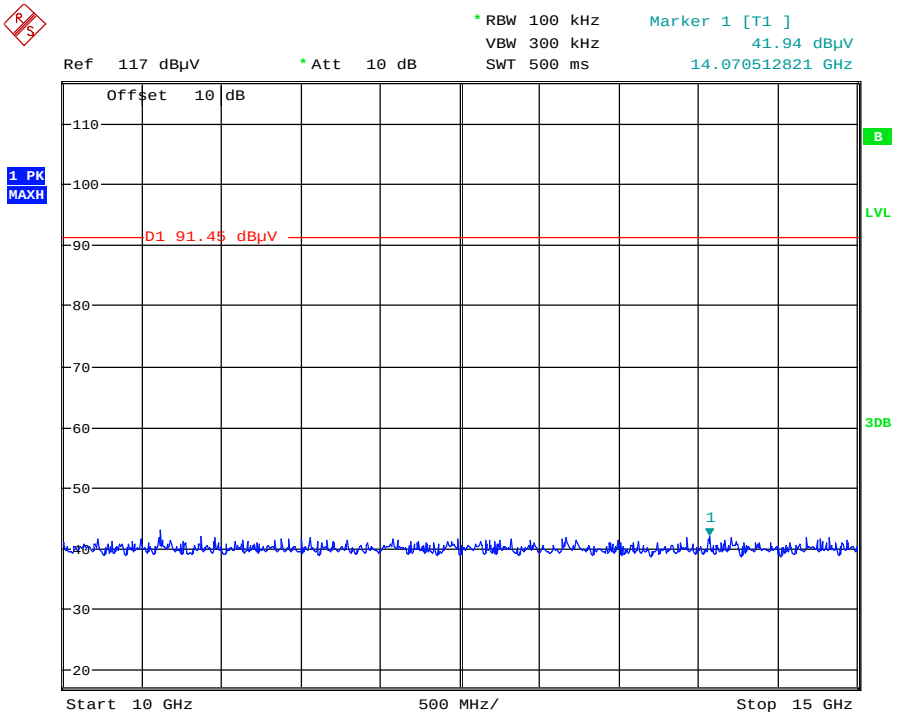
Date: 22.JUN.2011 10:23:46

Conducted Spurious Emissions 5 GHz to 10 GHz – Middle Channel



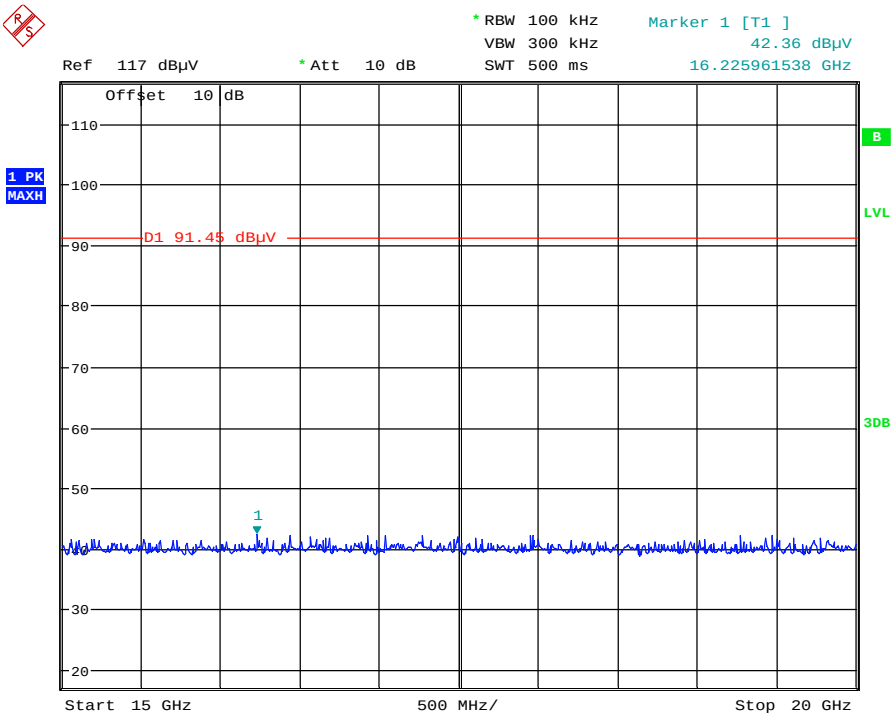
Date: 22.JUN.2011 10:24:03

Conducted Spurious Emissions 10 GHz to 15 GHz – Middle Channel



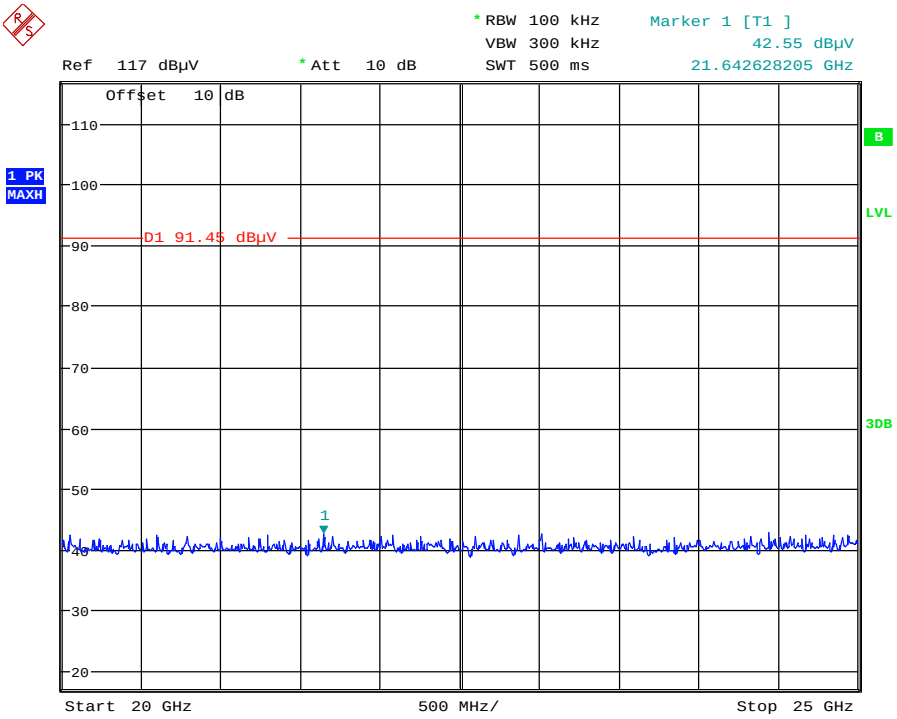
Date: 22.JUN.2011 10:24:13

Conducted Spurious Emissions 15 GHz to 20 GHz – Middle Channel



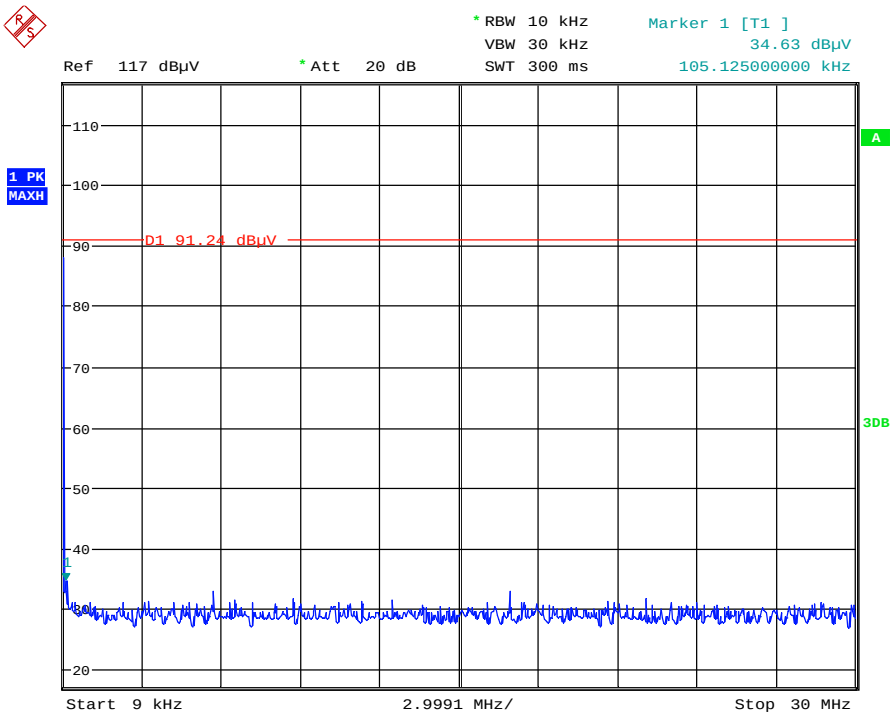
Date: 22.JUN.2011 10:24:23

Conducted Spurious Emissions 20 GHz to 25 GHz – Middle Channel



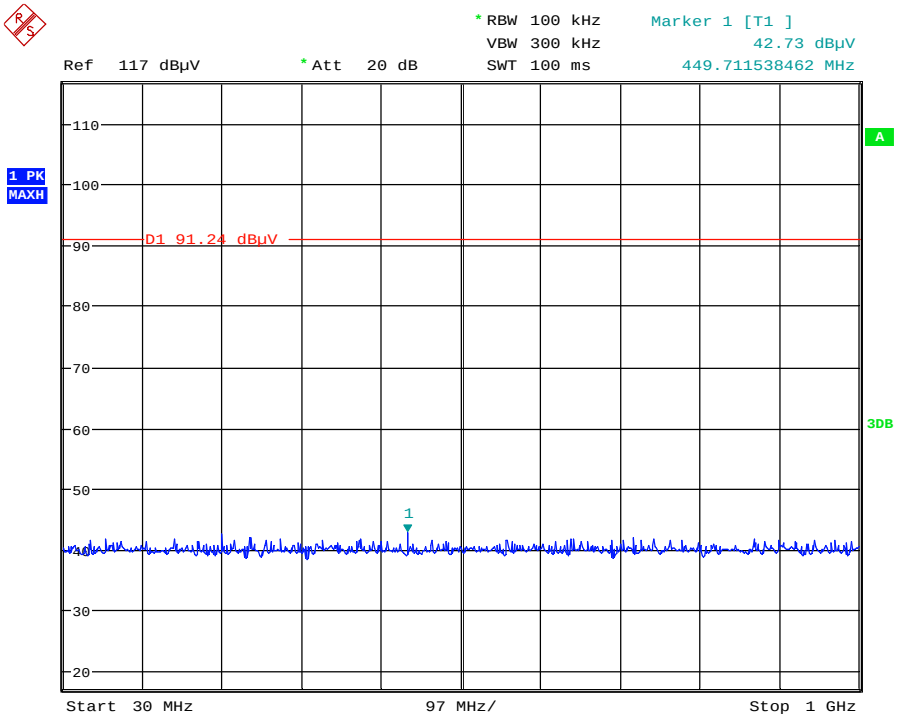
Date: 22.JUN.2011 10:24:35

Conducted Spurious Emissions 9 kHz to 30 MHz – Top Channel



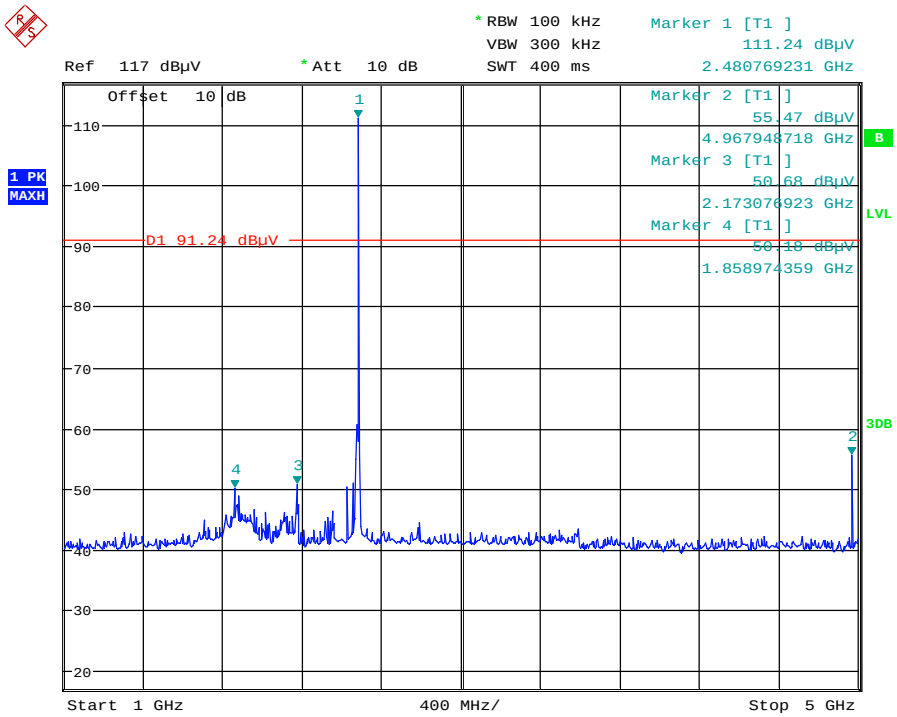
Date: 22.JUN.2011 10:28:30

Conducted Spurious Emissions 30 MHz to 1 GHz – Top Channel



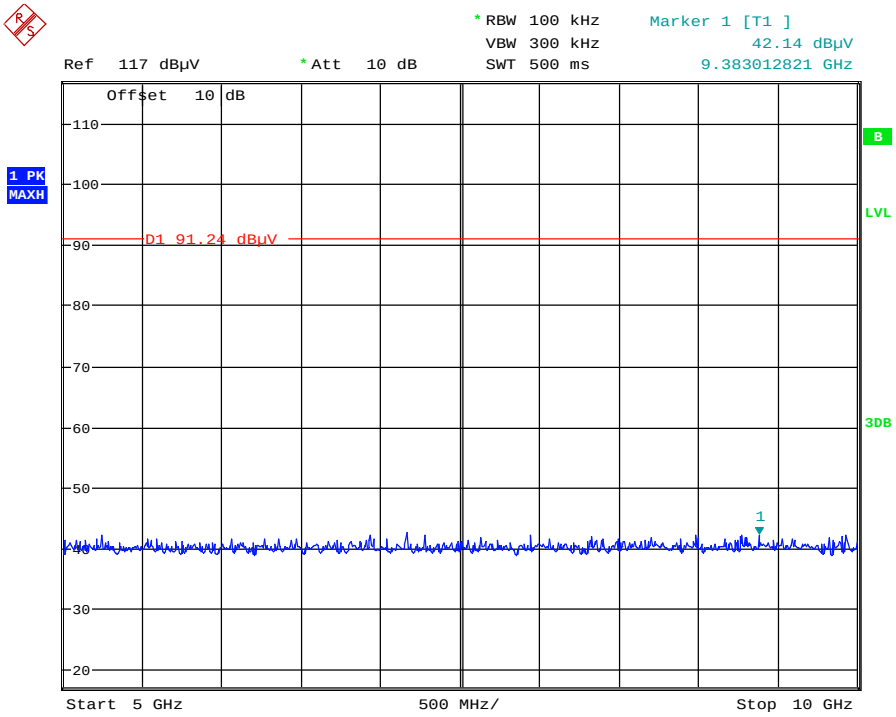
Date: 22.JUN.2011 10:29:13

Conducted Spurious Emissions 1 GHz to 5 GHz – Top Channel



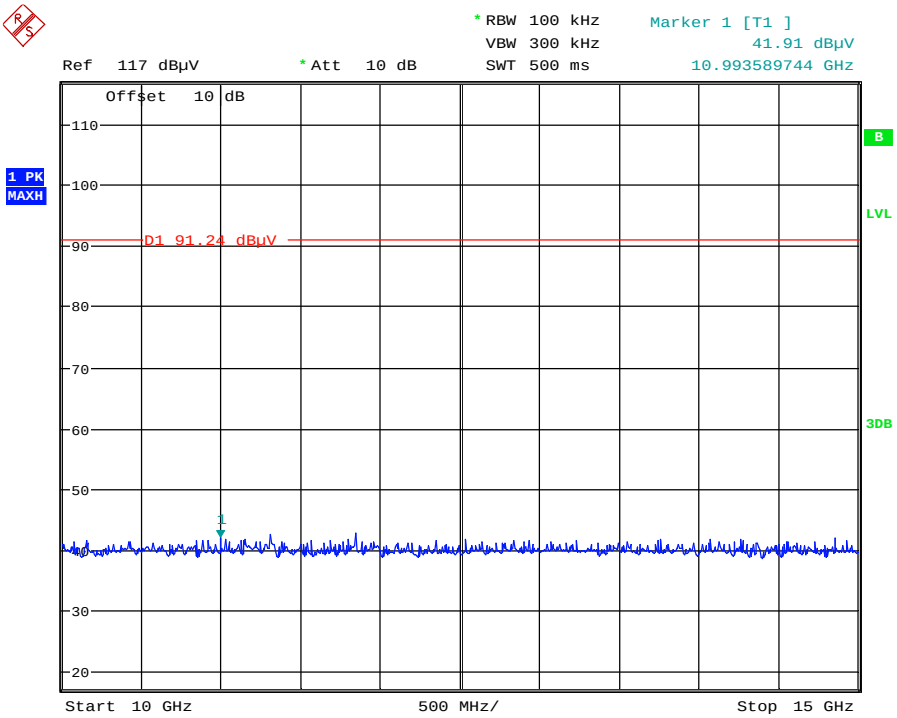
Date: 22.JUN.2011 10:26:23

Conducted Spurious Emissions 5 GHz to 10 GHz– Top Channel



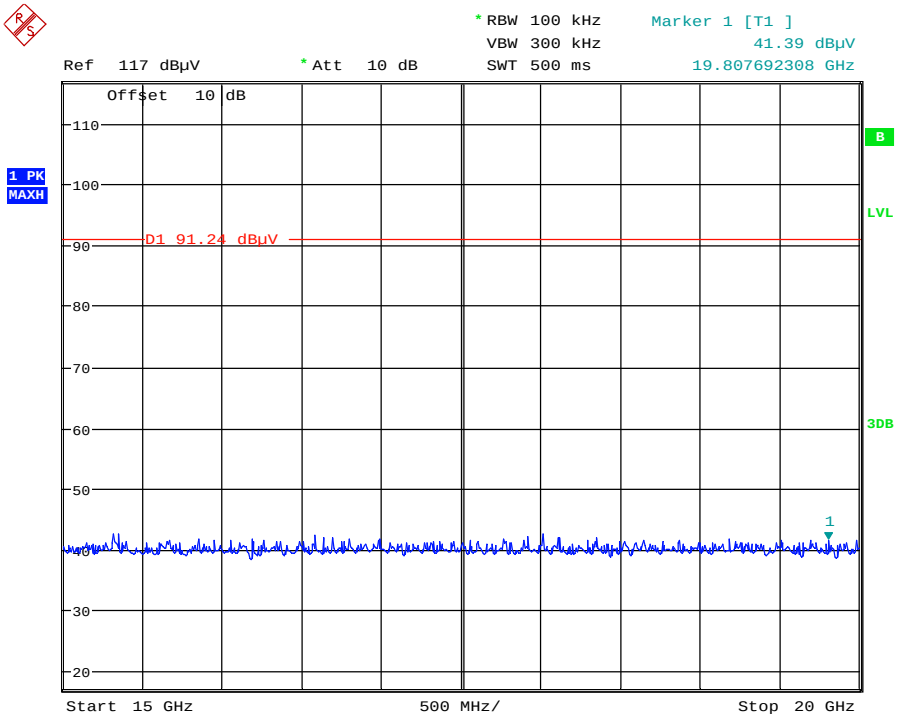
Date: 22.JUN.2011 10:26:38

Conducted Spurious Emissions 10 GHz to 15 GHz– Top Channel



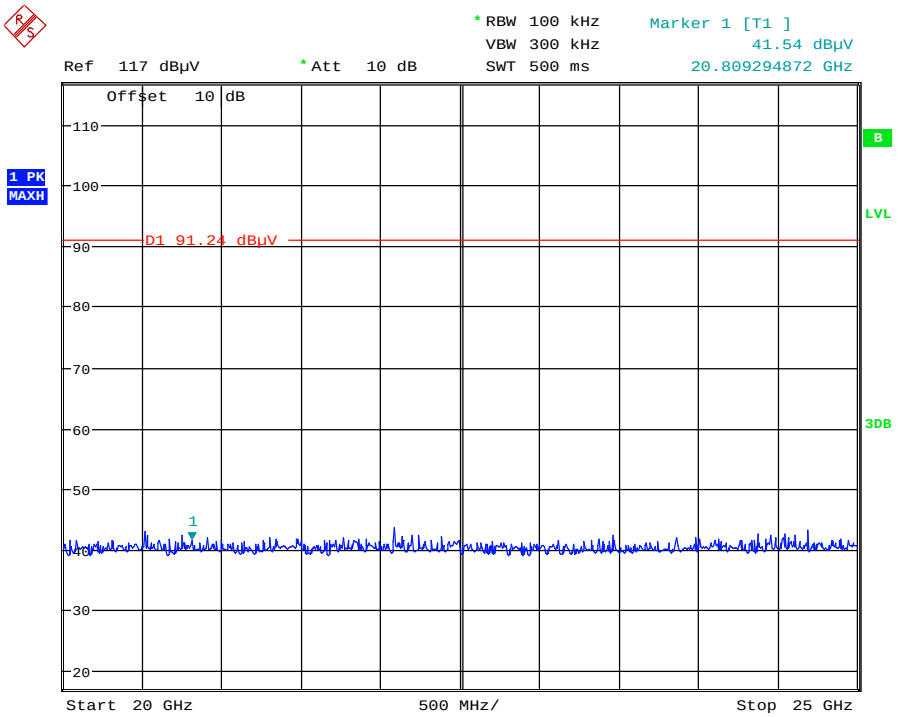
Date: 22.JUN.2011 10:26:50

Conducted Spurious Emissions 15 GHz to 20 GHz– Top Channel



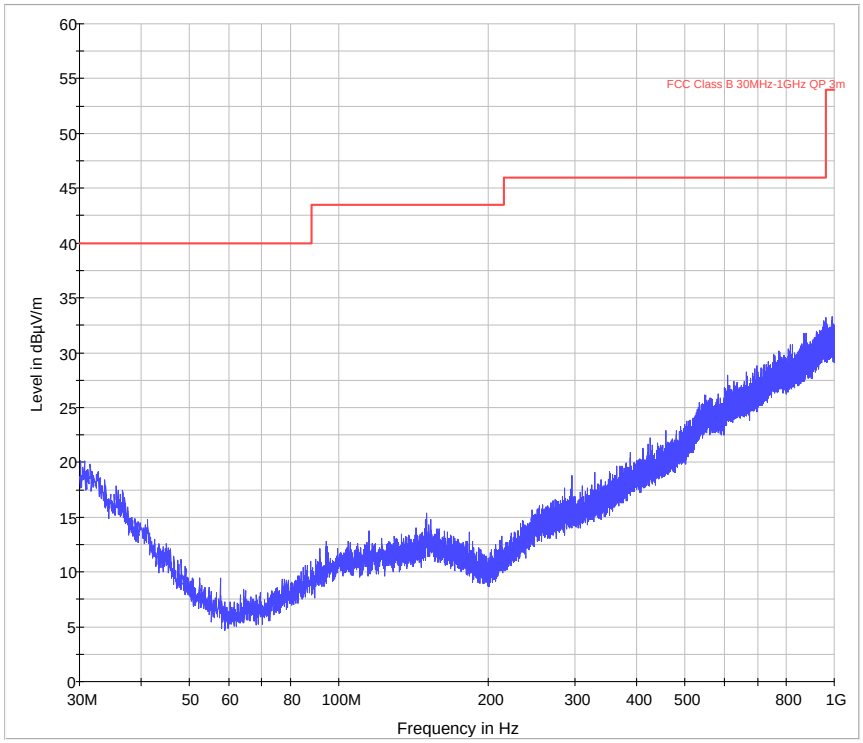
Date: 22.JUN.2011 10:27:00

Conducted Spurious Emissions 20 GHz to 25 GHz– Top Channel

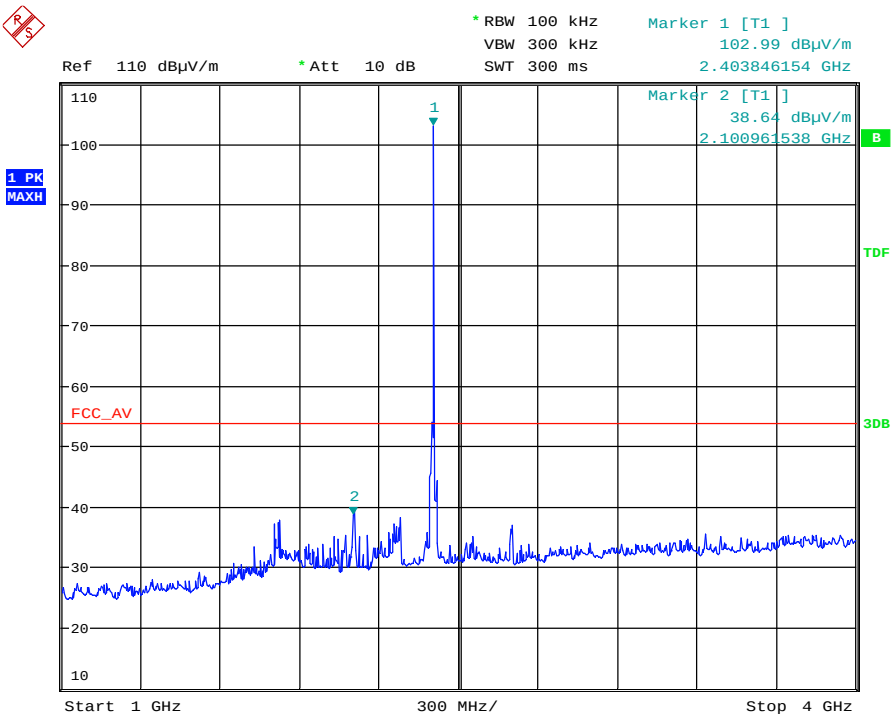


Date: 22.JUN.2011 10:27:12

Radiated Spurious Emissions 30 MHz to 1 GHz – Bottom Channel

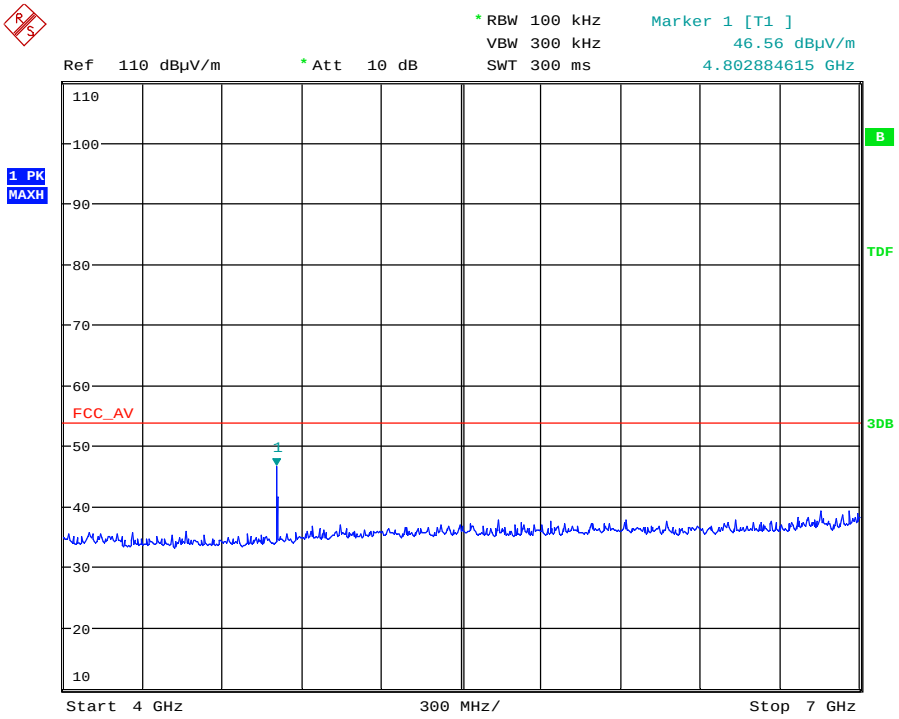


Radiated Spurious Emissions 1 GHz to 4 GHz – Bottom Channel



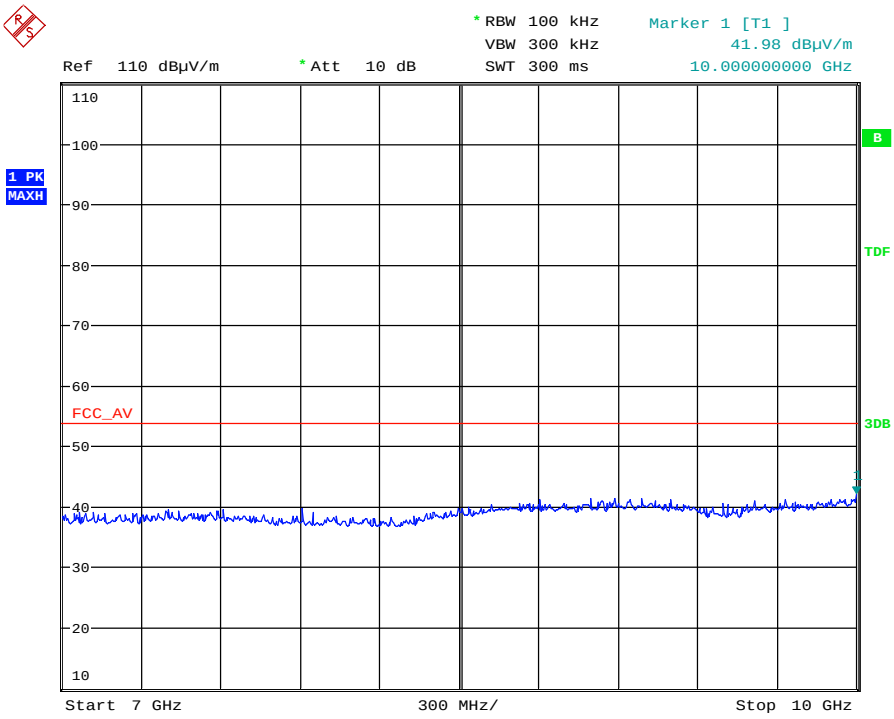
Date: 23.JUN.2011 15:58:05

Radiated Spurious Emissions 4 GHz to 7 GHz – Bottom Channel



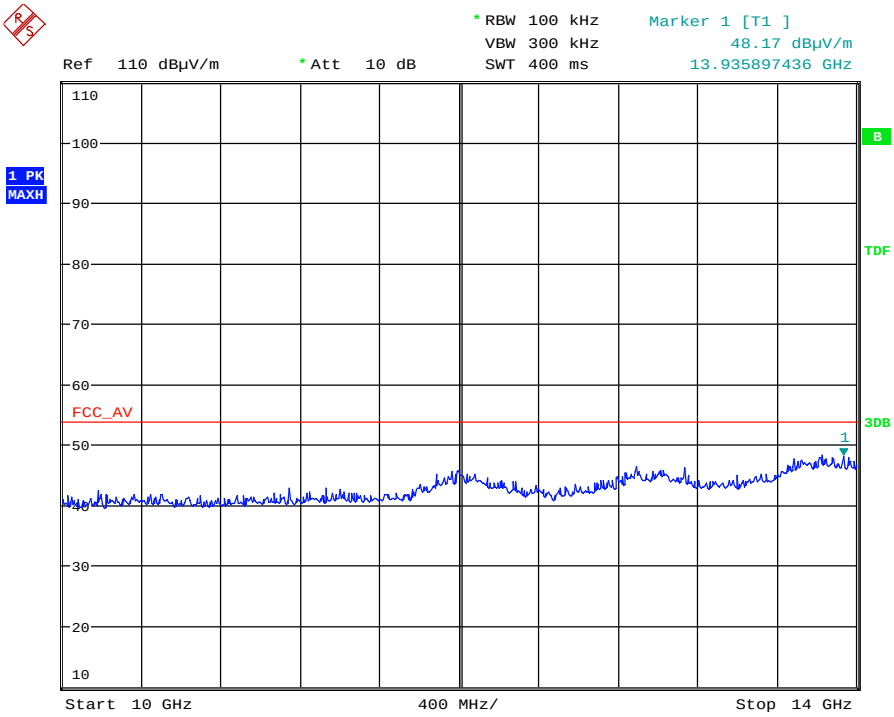
Date: 23.JUN.2011 16:00:06

Radiated Spurious Emissions 7 GHz to 10 GHz – Bottom Channel



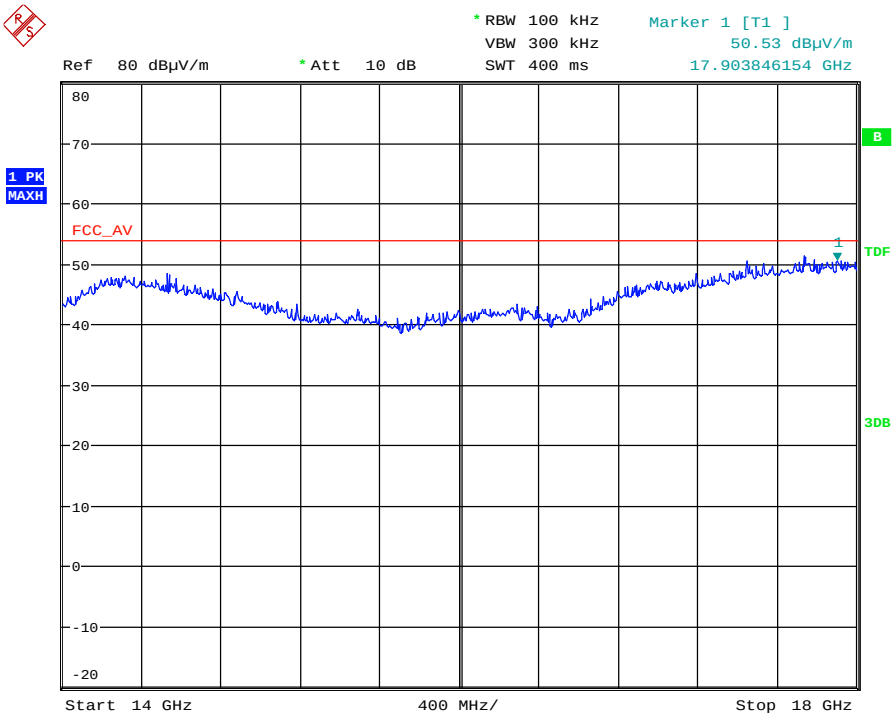
Date: 23.JUN.2011 16:03:00

Radiated Spurious Emissions 10 GHz to 14GHz – Bottom Channel



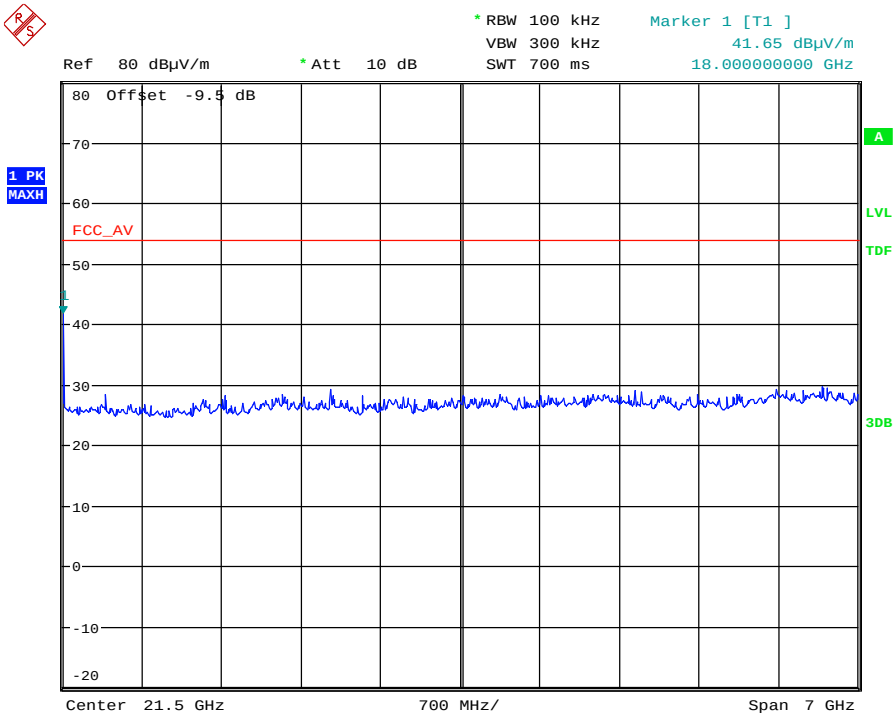
Date: 23.JUN.2011 16:03:46

Radiated Spurious Emissions 14 GHz to 18 GHz – Bottom Channel



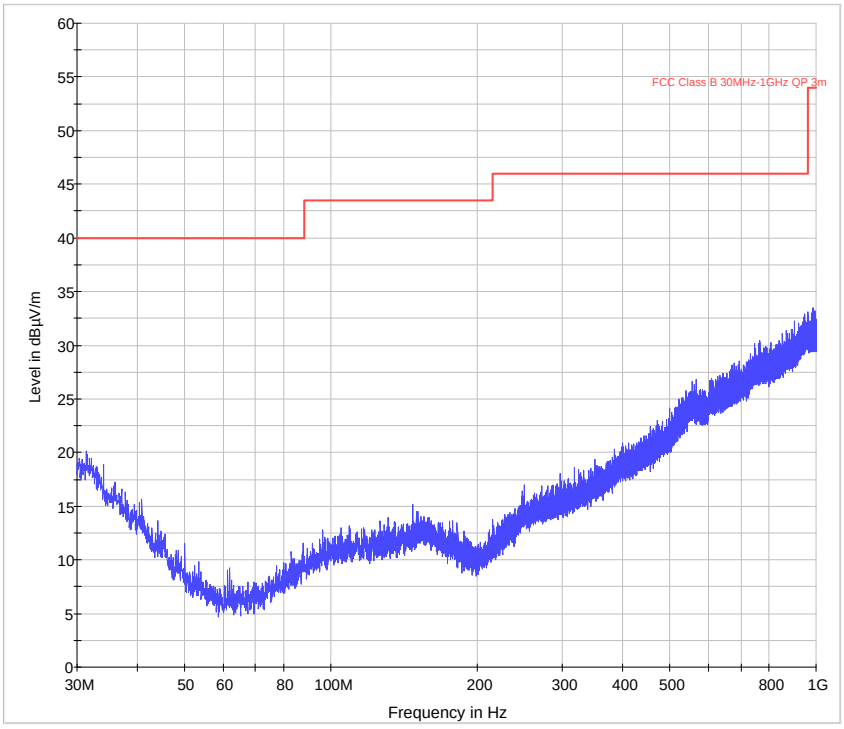
Date: 23.JUN.2011 16:04:56

Radiated Spurious Emissions 18 GHz to 25 GHz – Bottom Channel

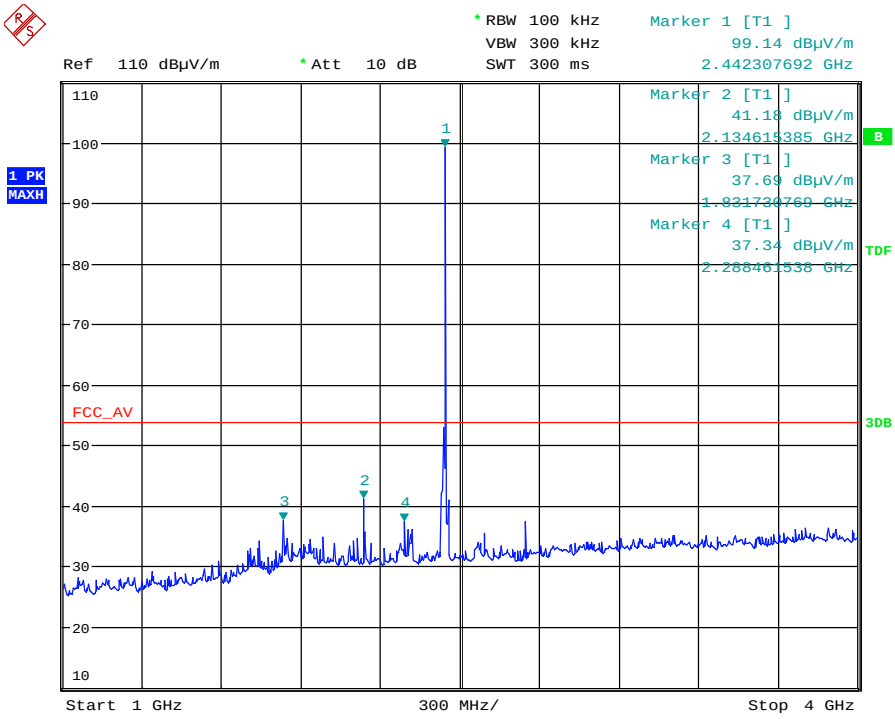


Date: 23.JUN.2011 14:50:12

Radiated Spurious Emissions 30 MHz to 1 GHz – Middle Channel

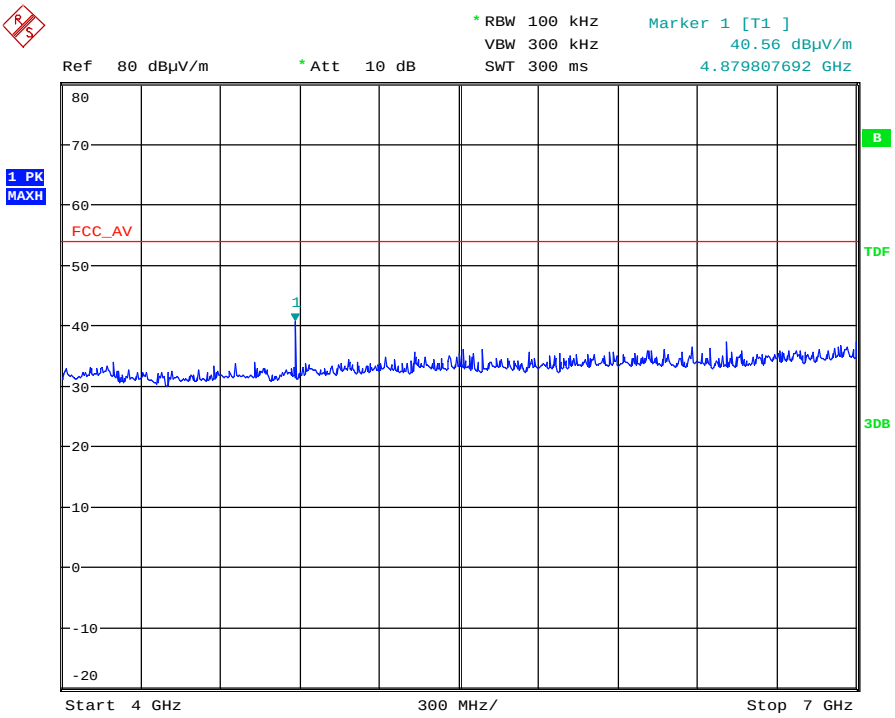


Radiated Spurious Emissions 1 GHz to 4 GHz – Middle Channel



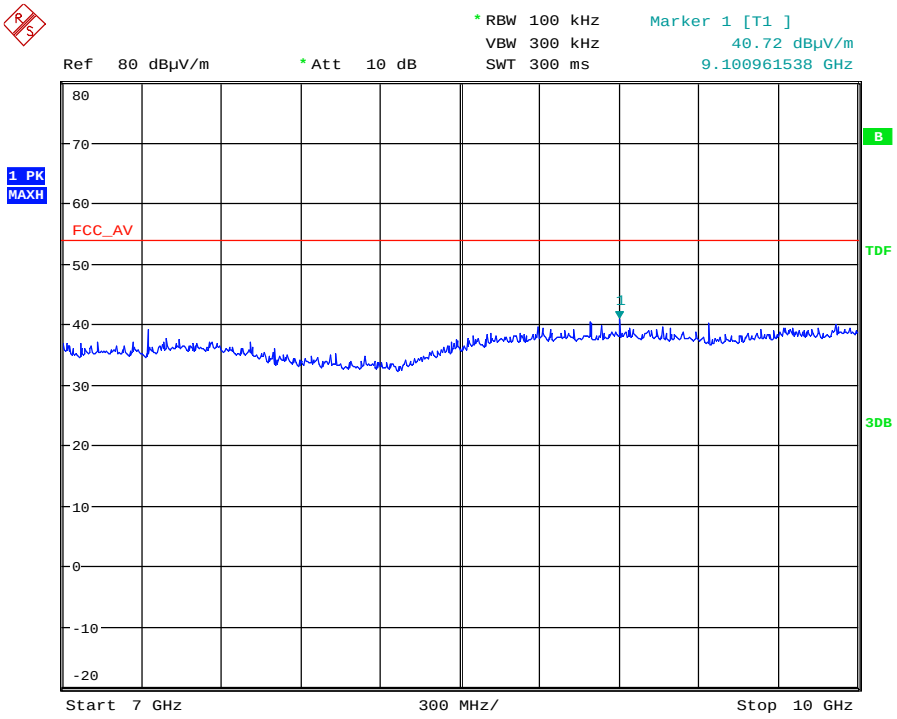
Date: 24.JUN.2011 08:46:00

Radiated Spurious Emissions 4 GHz to 7 GHz – Middle Channel



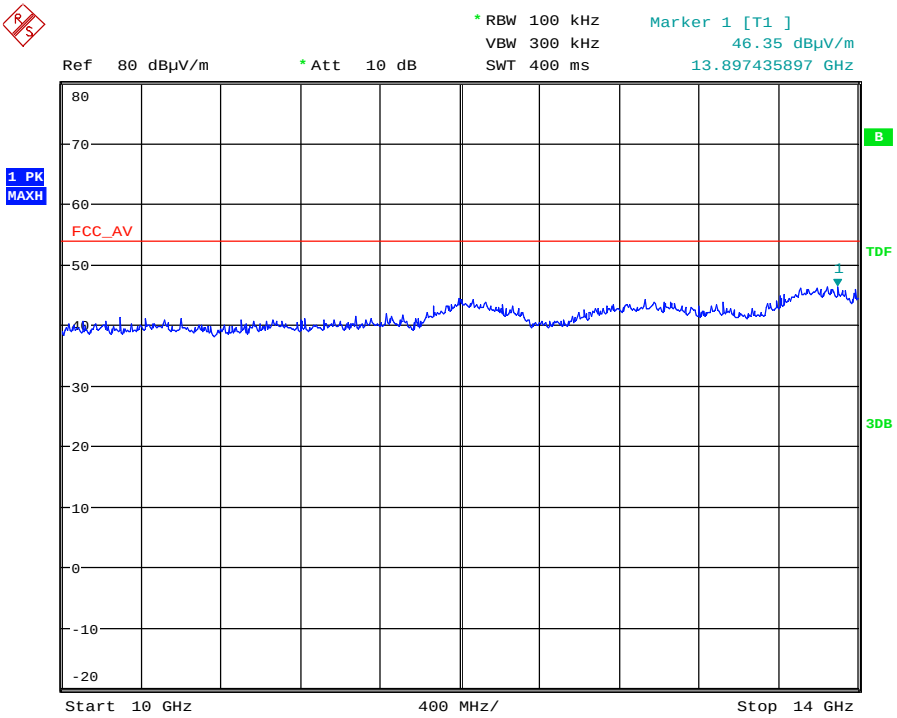
Date: 24.JUN.2011 08:47:13

Radiated Spurious Emissions 7 GHz to 10 GHz – Middle Channel



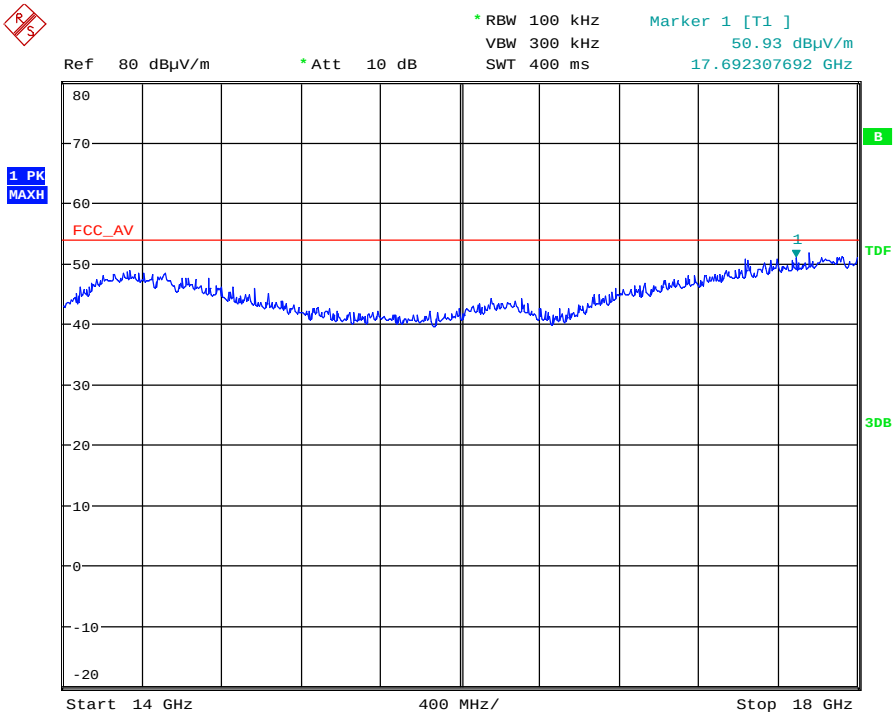
Date: 24.JUN.2011 08:48:50

Radiated Spurious Emissions 10 GHz to 14GHz – Middle Channel



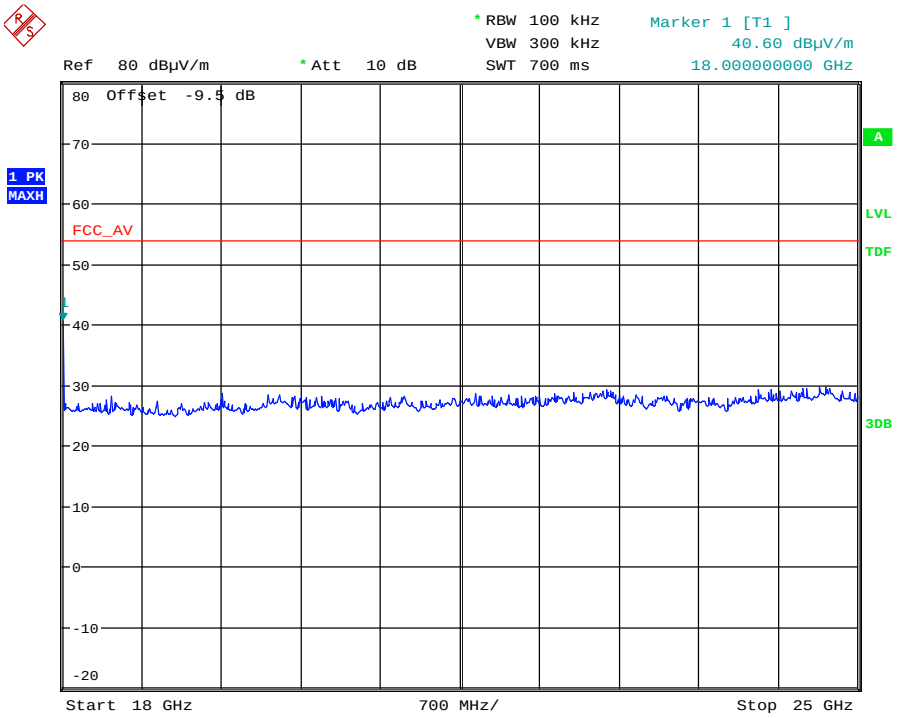
Date: 24.JUN.2011 08:50:27

Radiated Spurious Emissions 14 GHz to 18 GHz – Middle Channel



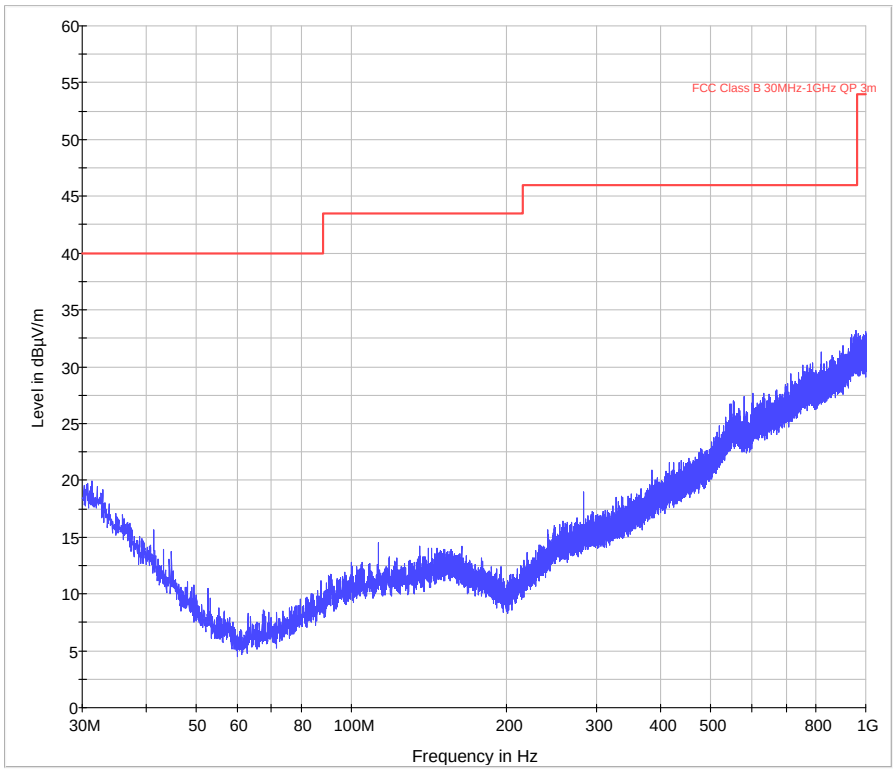
Date: 24.JUN.2011 08:50:57

Radiated Spurious Emissions 18 GHz to 25 GHz – Middle Channel

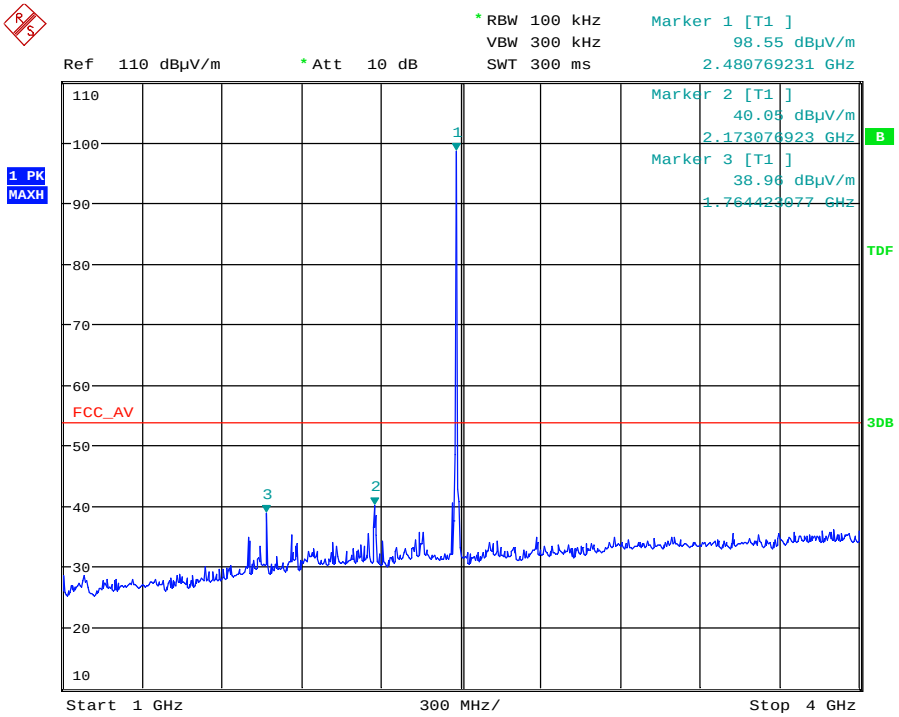


Date: 23.JUN.2011 14:49:09

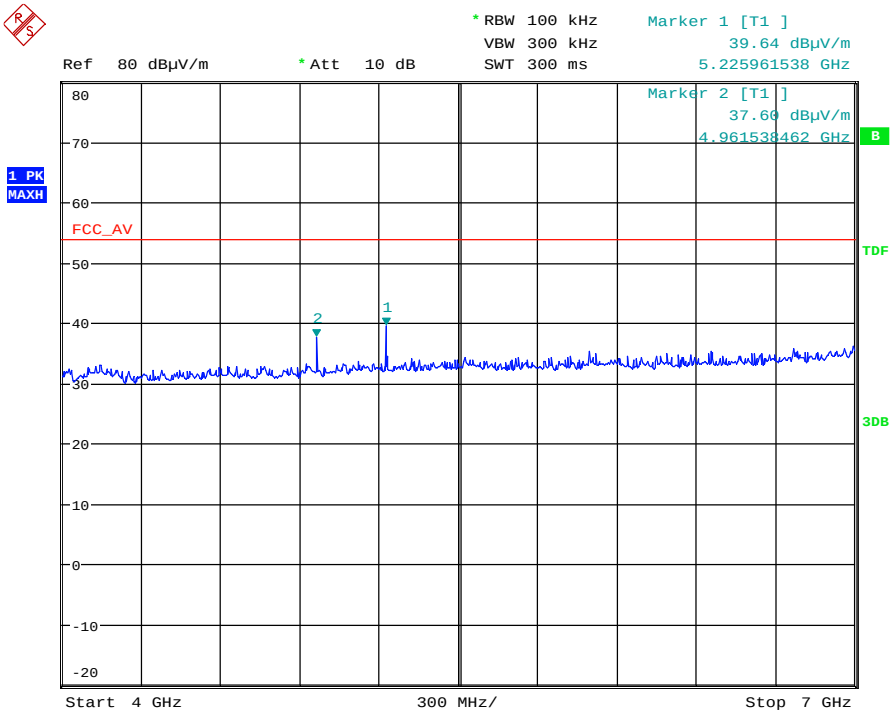
Radiated Spurious Emissions 30 MHz to 1 GHz – Top Channel



Radiated Spurious Emissions 1 GHz to 4 GHz – Top Channel

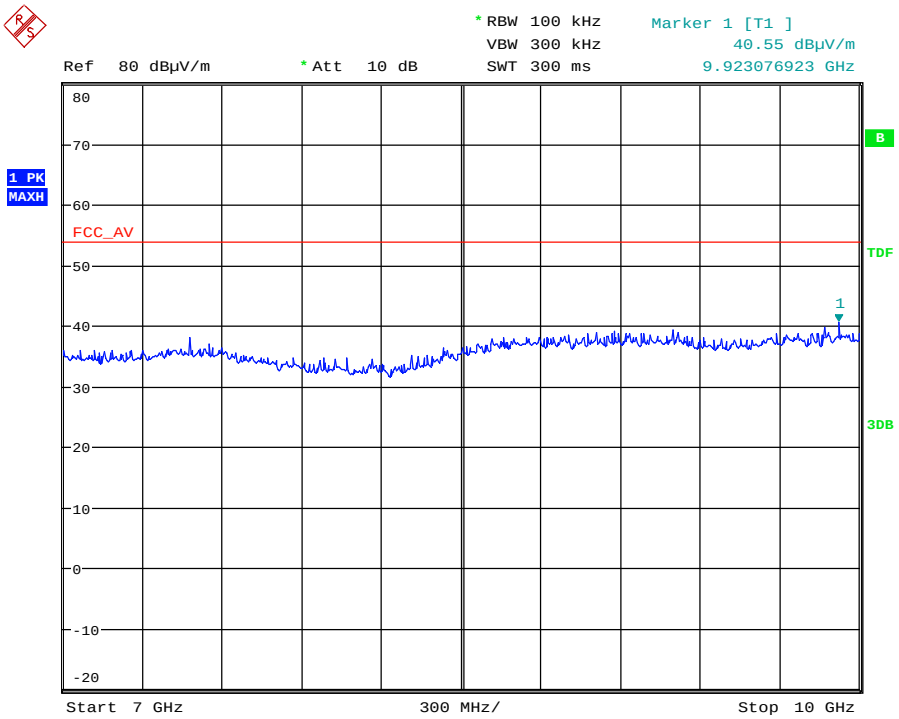


Radiated Spurious Emissions 4 GHz to 7 GHz – Top Channel



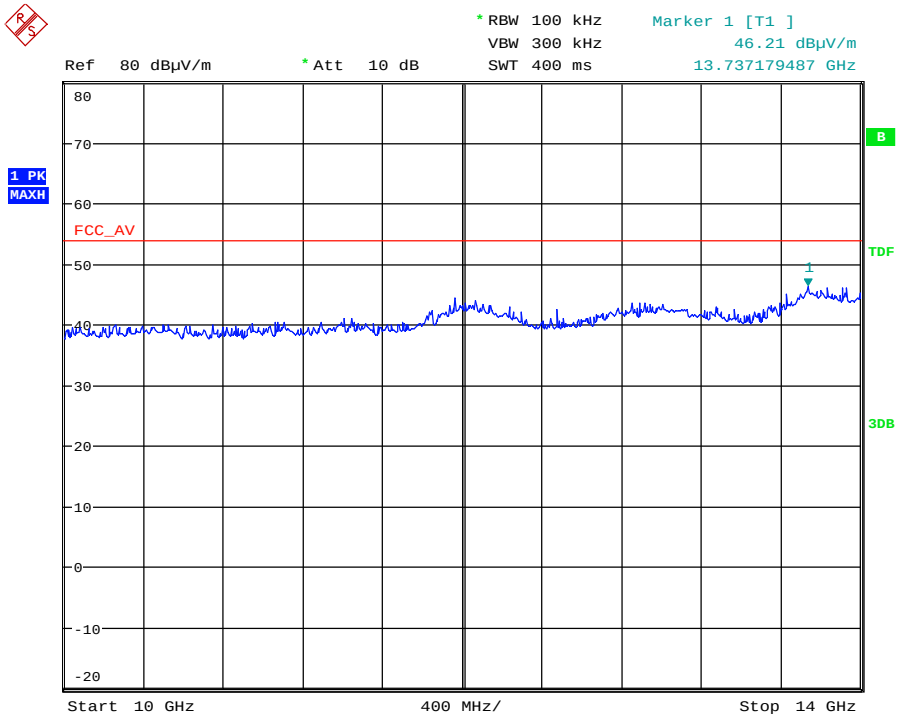
Date: 24.JUN.2011 09:18:05

Radiated Spurious Emissions 7 GHz to 10 GHz – Top Channel



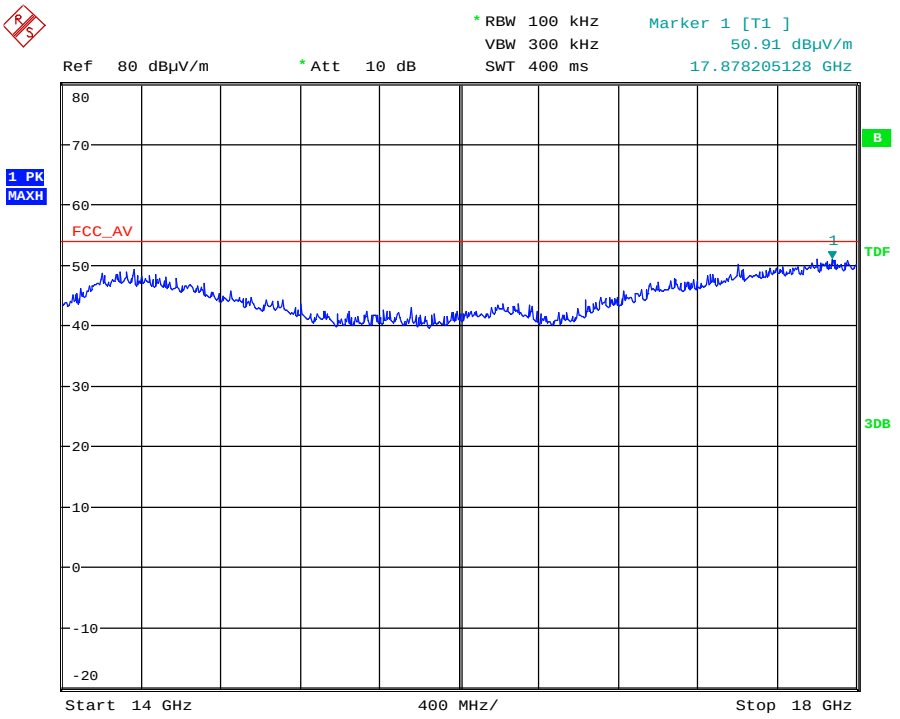
Date: 24.JUN.2011 09:19:06

Radiated Spurious Emissions 10 GHz to 14 GHz – Top Channel



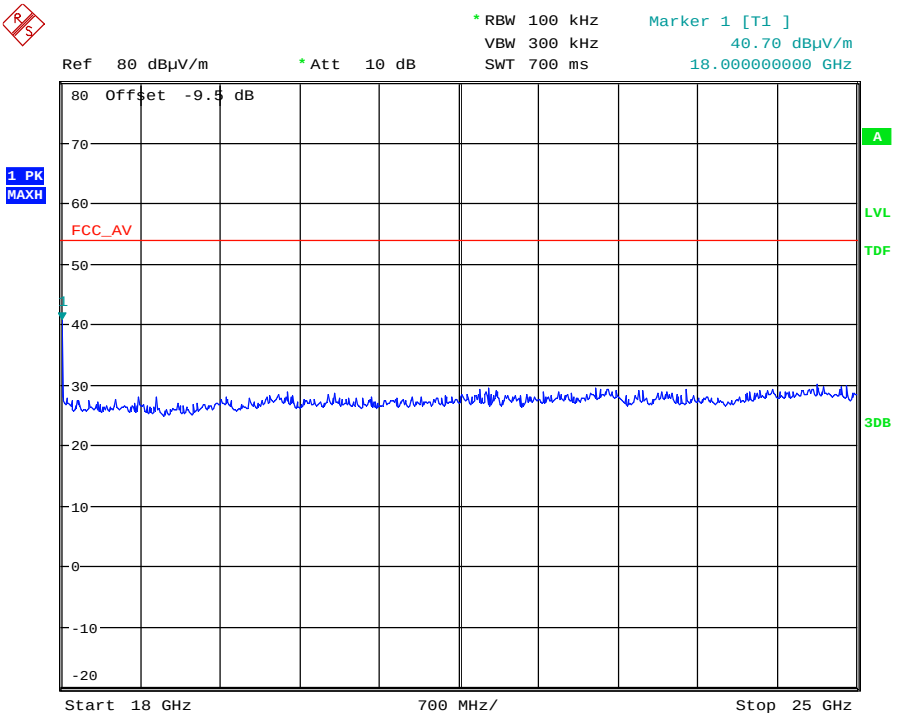
Date: 24.JUN.2011 09:20:00

Radiated Spurious Emissions 14 GHz to 18 GHz – Top Channel



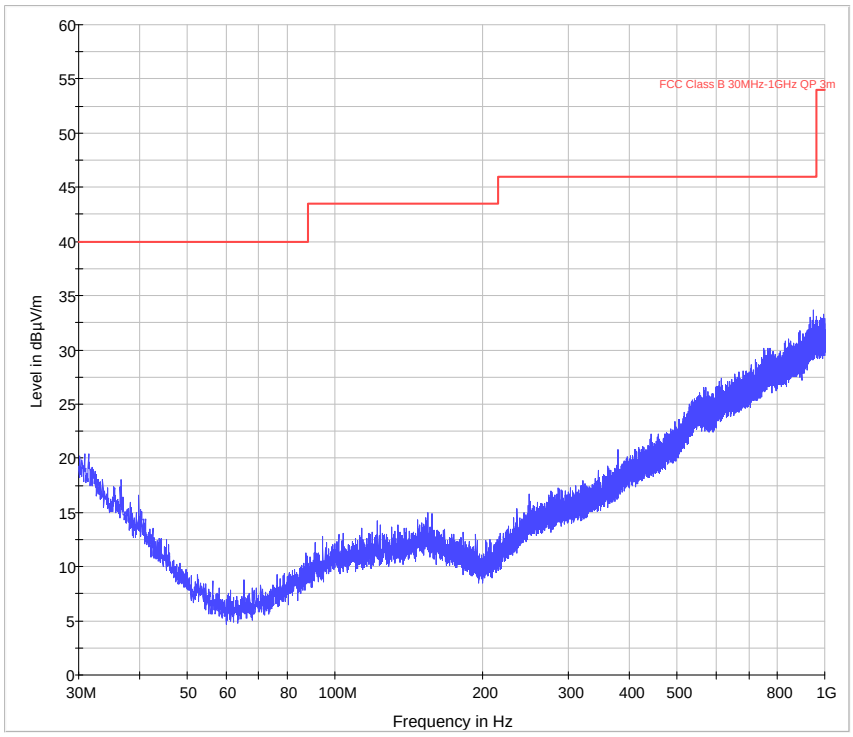
Date: 24.JUN.2011 09:20:36

Radiated Spurious Emissions 18 GHz to 25 GHz – Top Channel

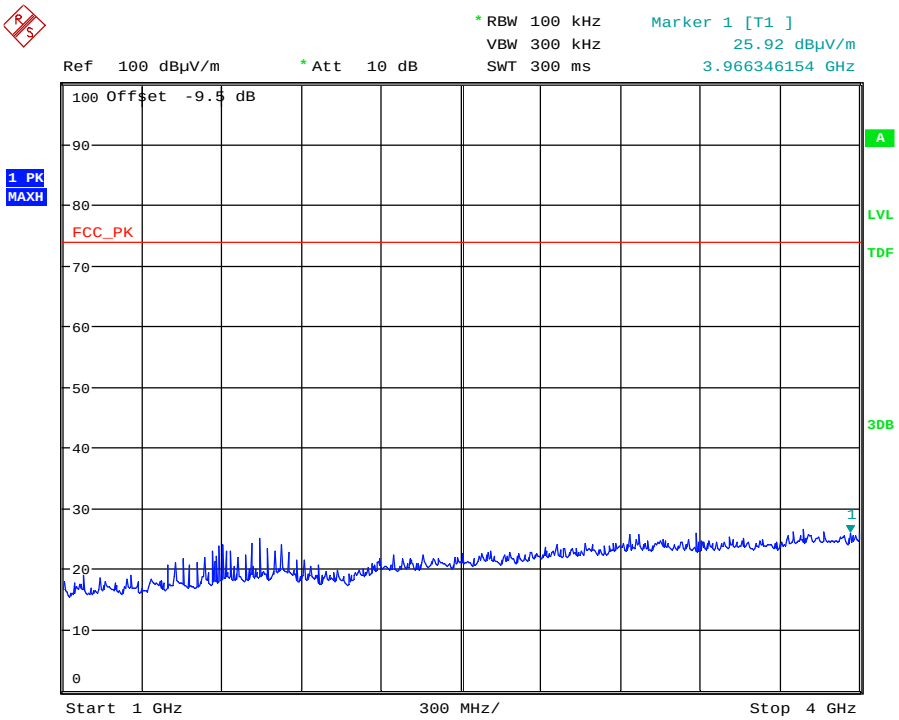


Date: 23.JUN.2011 14:48:16

Unintentional Radiated Spurious Emissions 30 MHz to 1 GHz – Bottom Channel

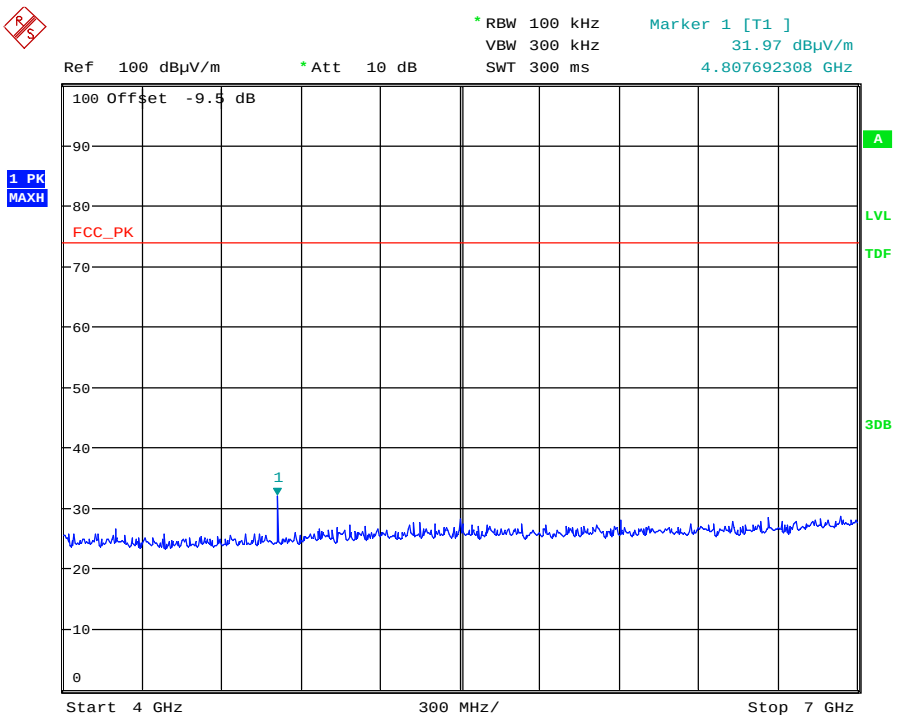


Unintentional Radiated Spurious Emissions 1 GHz to 4 GHz – Bottom Channel



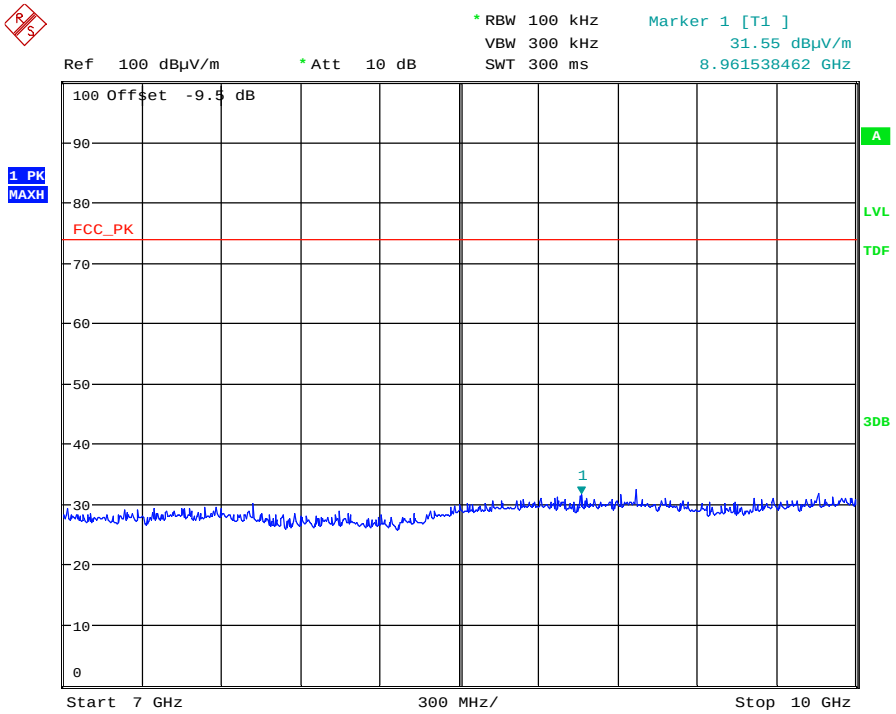
Date: 23.JUN.2011 10:02:09

Unintentional Radiated Spurious Emissions 4 GHz to 7 GHz – Bottom Channel



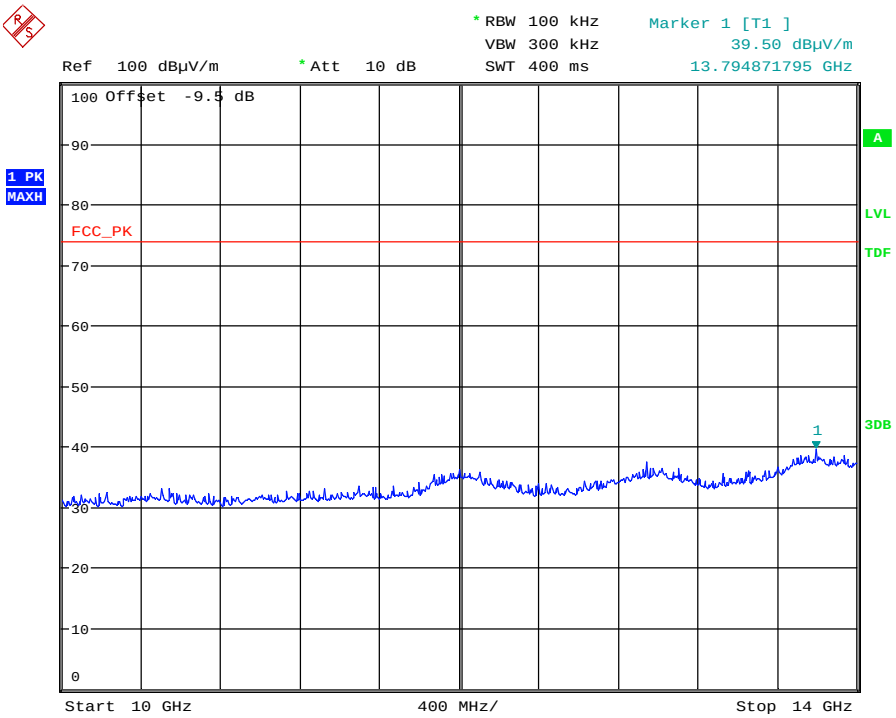
Date: 23.JUN.2011 10:03:09

Unintentional Radiated Spurious Emissions 7 GHz to 10 GHz – Bottom Channel



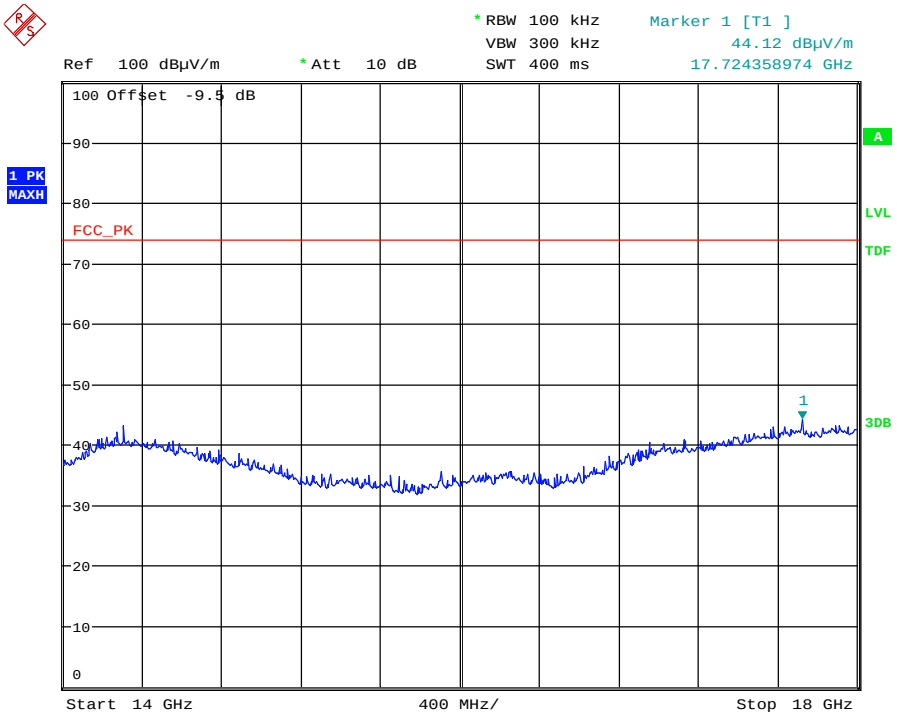
Date: 23.JUN.2011 10:04:10

Unintentional Radiated Spurious Emissions 10 GHz to 14 GHz – Bottom Channel



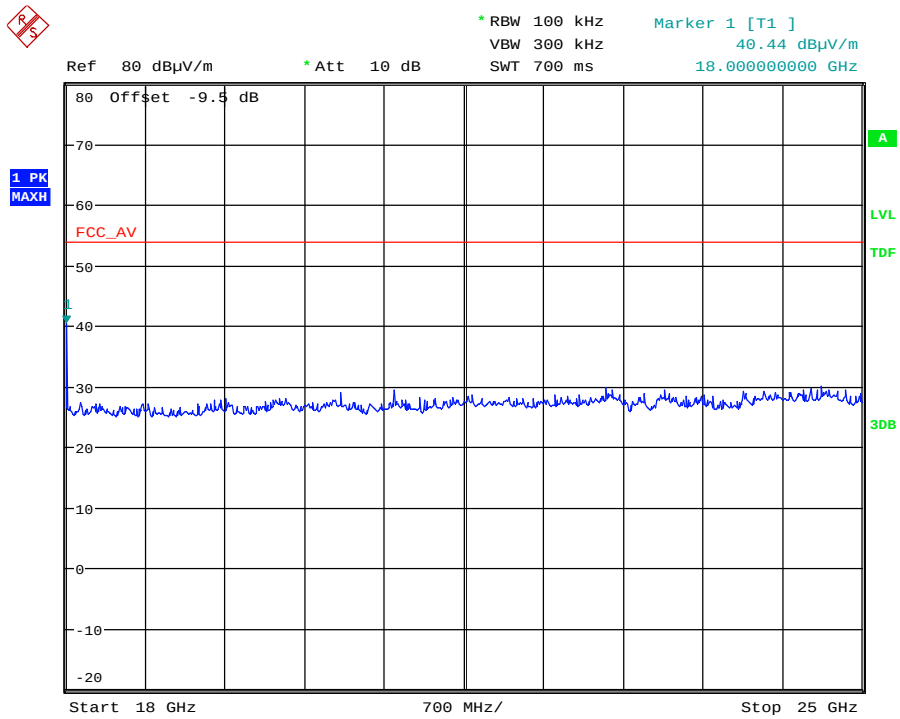
Date: 23.JUN.2011 10:05:36

Unintentional Radiated Spurious Emissions 14 GHz to 18 GHz – Bottom Channel



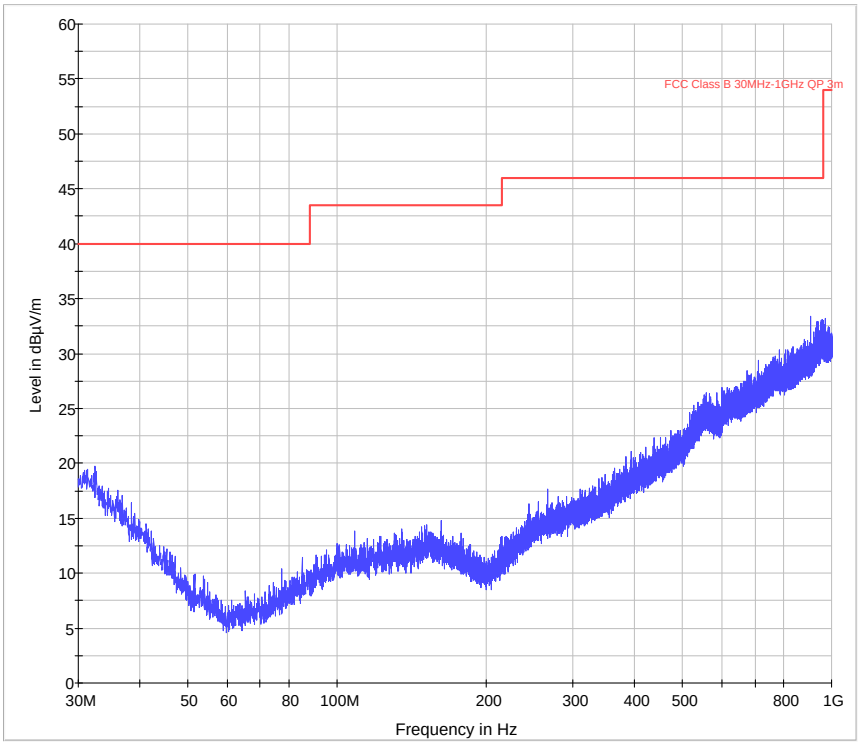
Date: 23.JUN.2011 10:06:50

Unintentional Radiated Spurious Emissions 18 GHz to 25 GHz – Bottom Channel

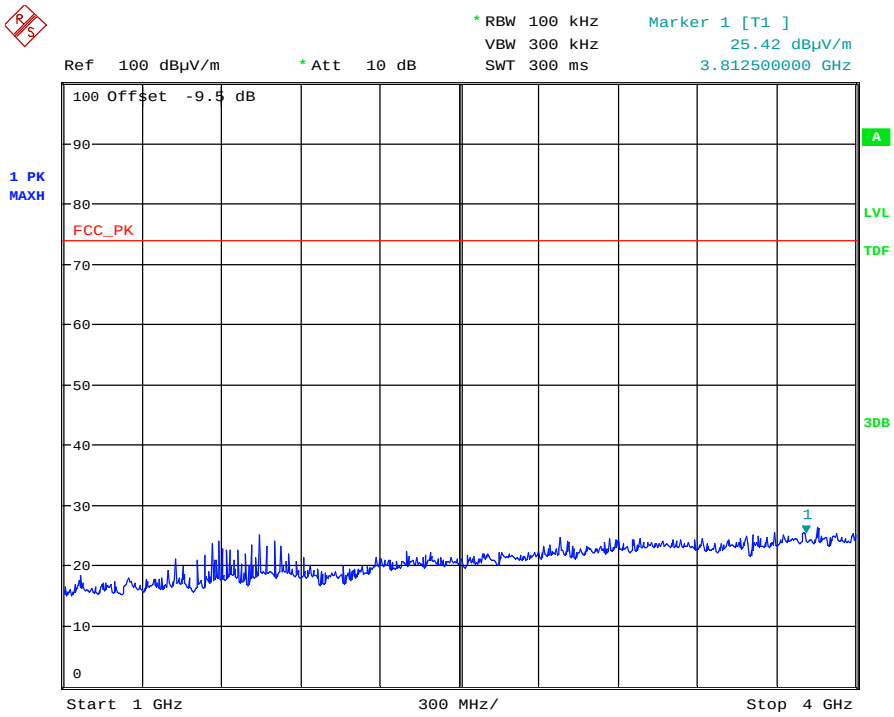


Date: 23.JUN.2011 14:57:33

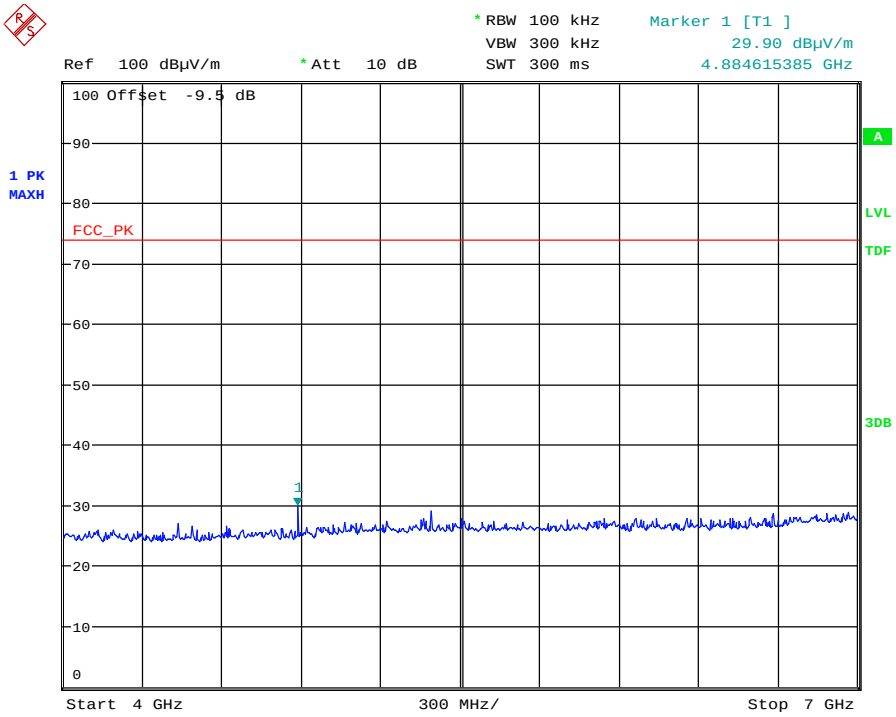
Unintentional Radiated Spurious Emissions 30 MHz to 1 GHz – Middle Channel



Unintentional Radiated Spurious Emissions 1 GHz to 4 GHz – Middle Channel

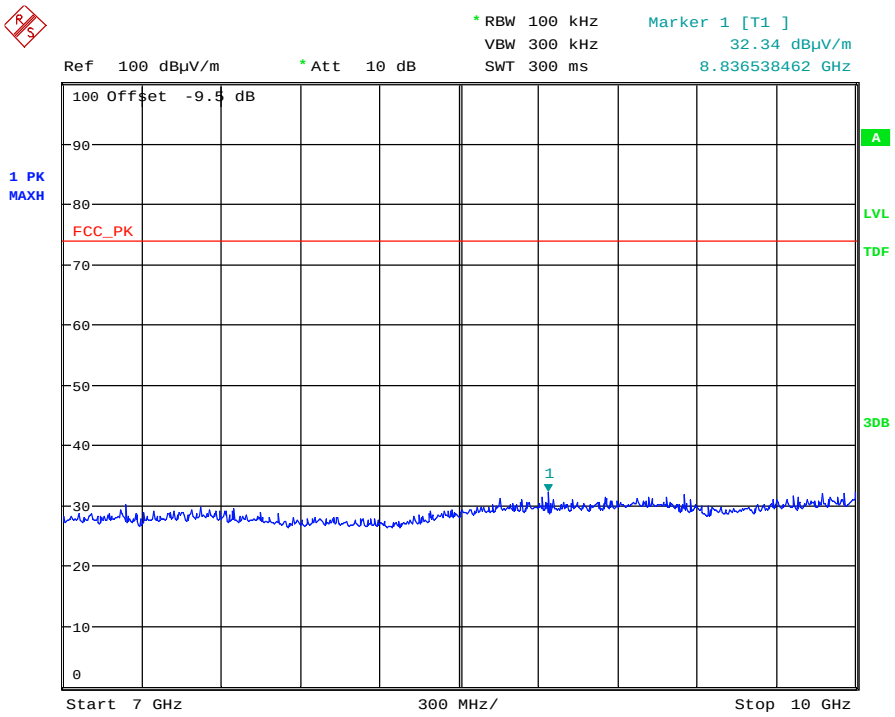


Unintentional Radiated Spurious Emissions 4 GHz to 7 GHz – Middle Channel



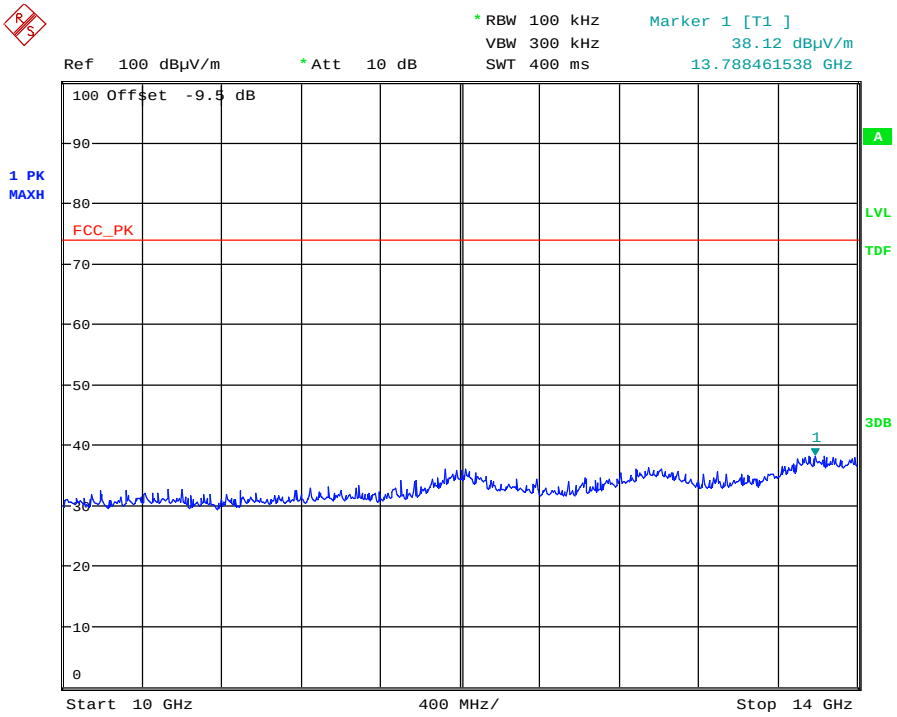
Date: 23.JUN.2011 09:57:17

Unintentional Radiated Spurious Emissions 7 GHz to 10 GHz – Middle Channel



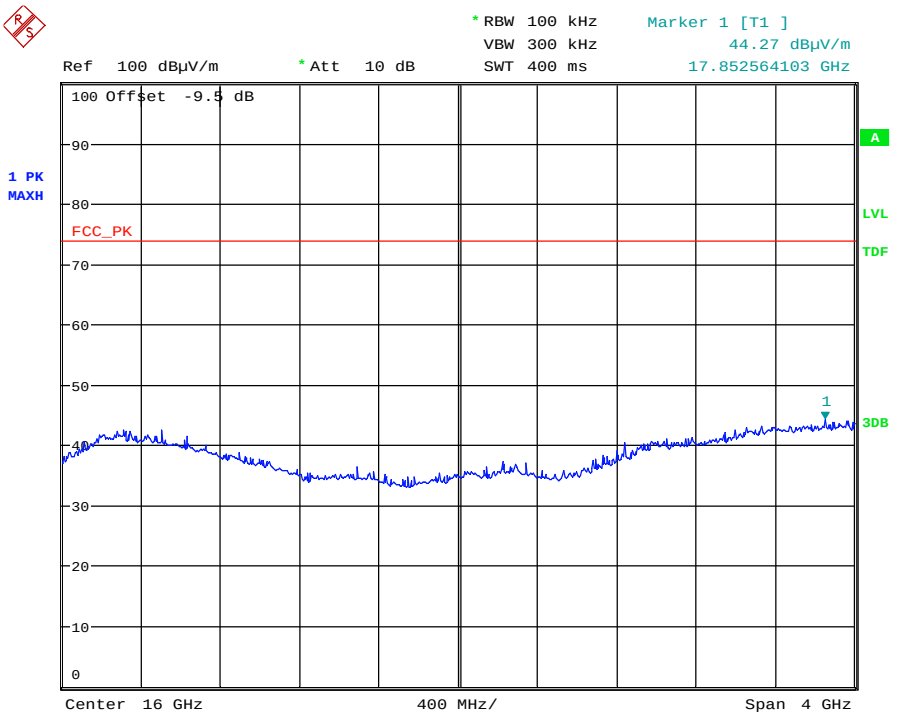
Date: 23.JUN.2011 09:55:09

Unintentional Radiated Spurious Emissions 10 GHz to 14 GHz – Middle Channel



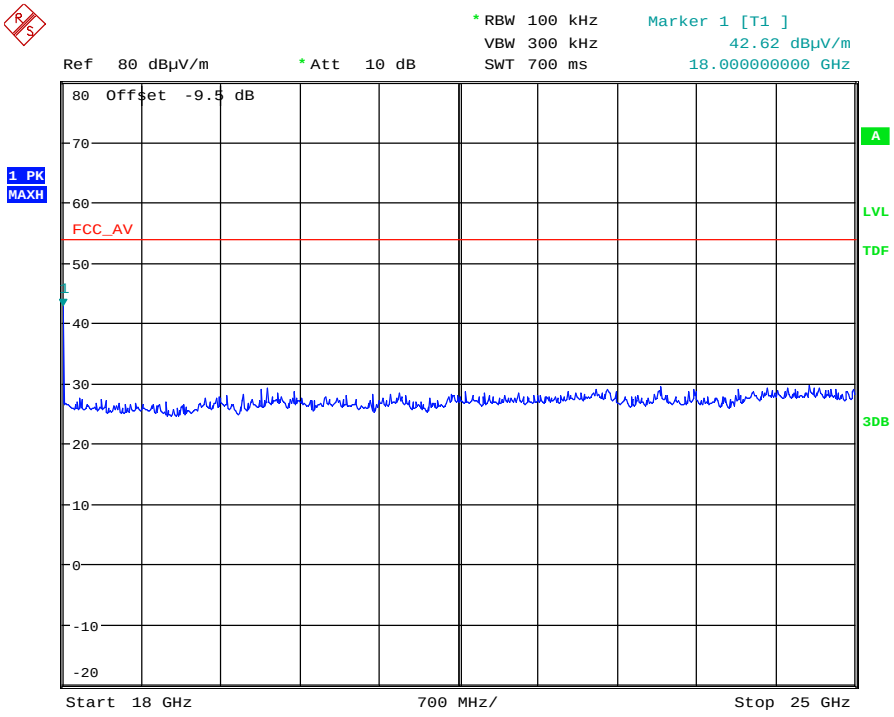
Date: 23.JUN.2011 09:53:57

Unintentional Radiated Spurious Emissions 14 GHz to 18 GHz – Middle Channel



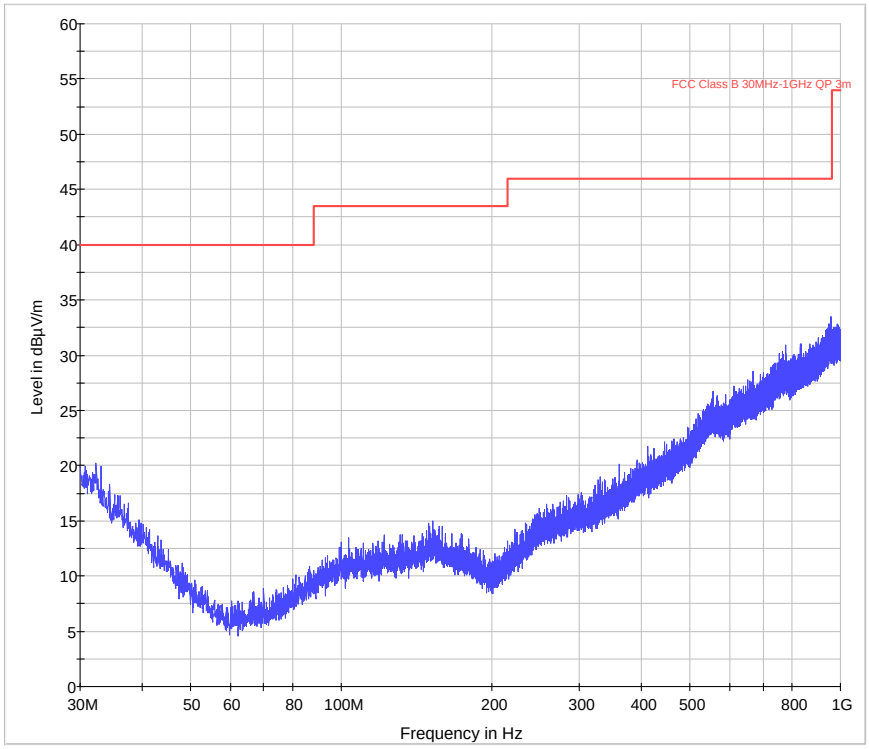
Date: 23.JUN.2011 09:53:17

Unintentional Radiated Spurious Emissions 18 GHz to 25 GHz – Middle Channel

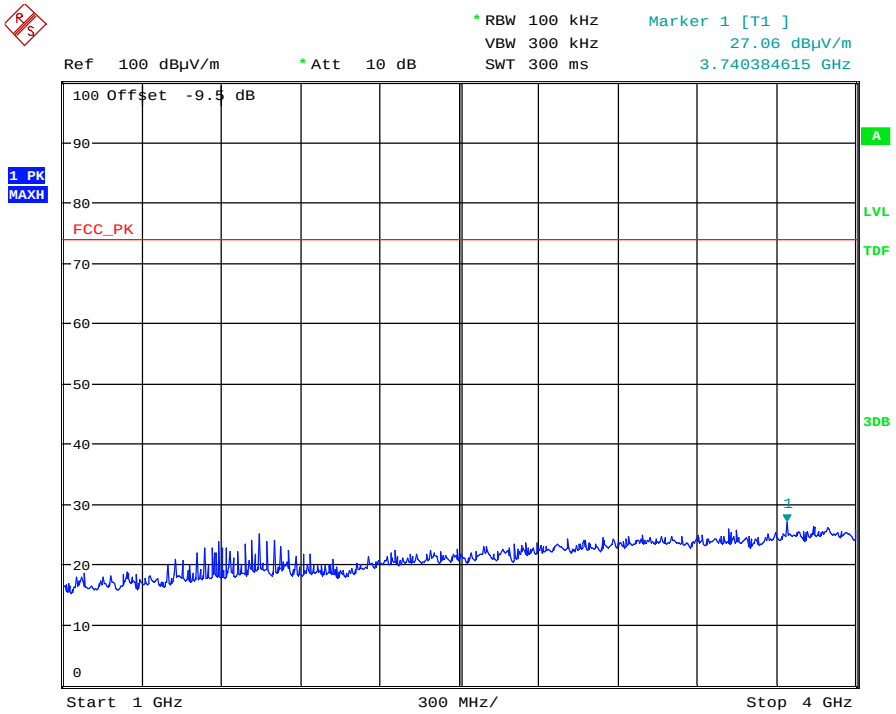


Date: 23.JUN.2011 14:56:49

Unintentional Radiated Spurious Emissions 30 MHz to 1 GHz – Top Channel

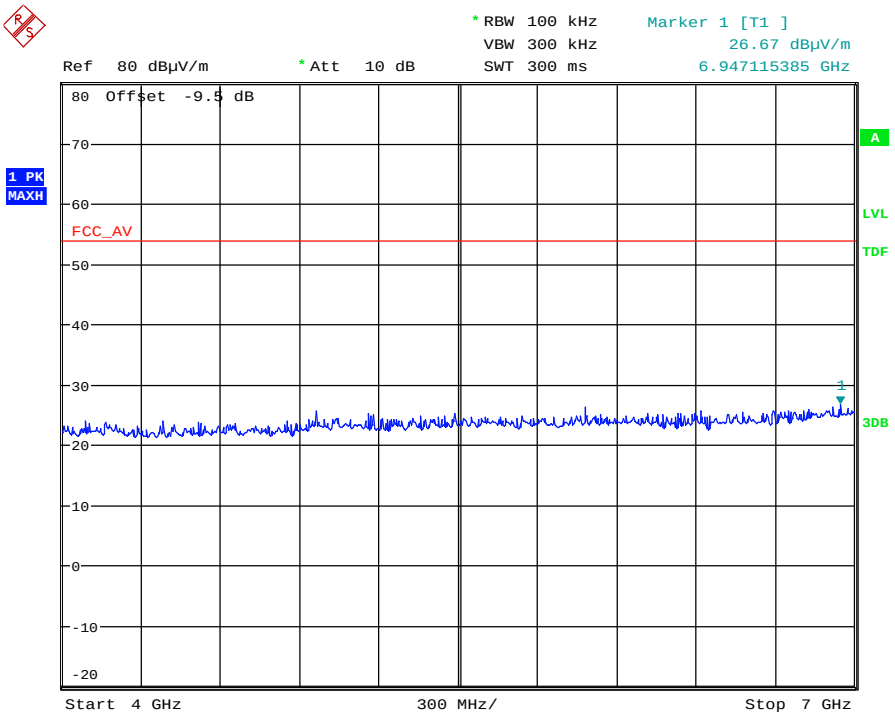


Unintentional Radiated Spurious Emissions 1 GHz to 4 GHz – Top Channel



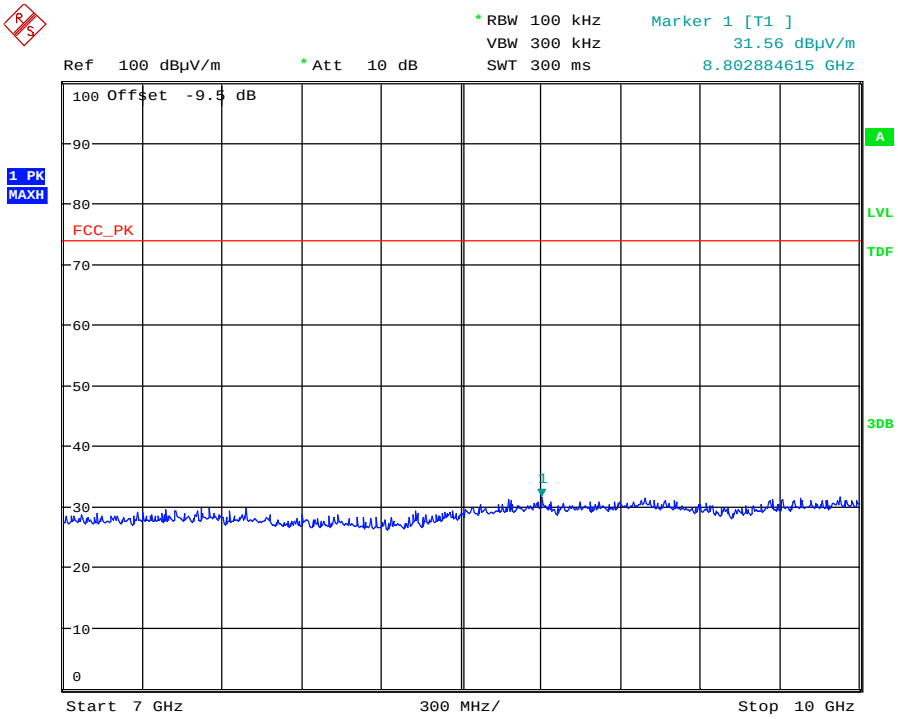
Date: 23.JUN.2011 10:15:47

Unintentional Radiated Spurious Emissions 4 GHz to 7 GHz – Top Channel



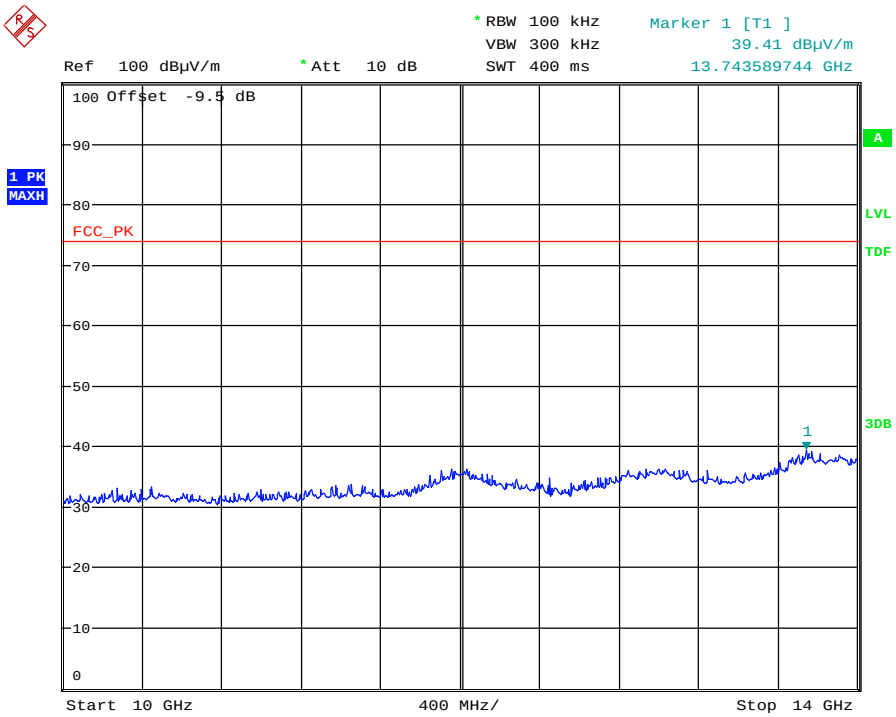
Date: 23.JUN.2011 10:36:45

Unintentional Radiated Spurious Emissions 7 GHz to 10 GHz – Top Channel



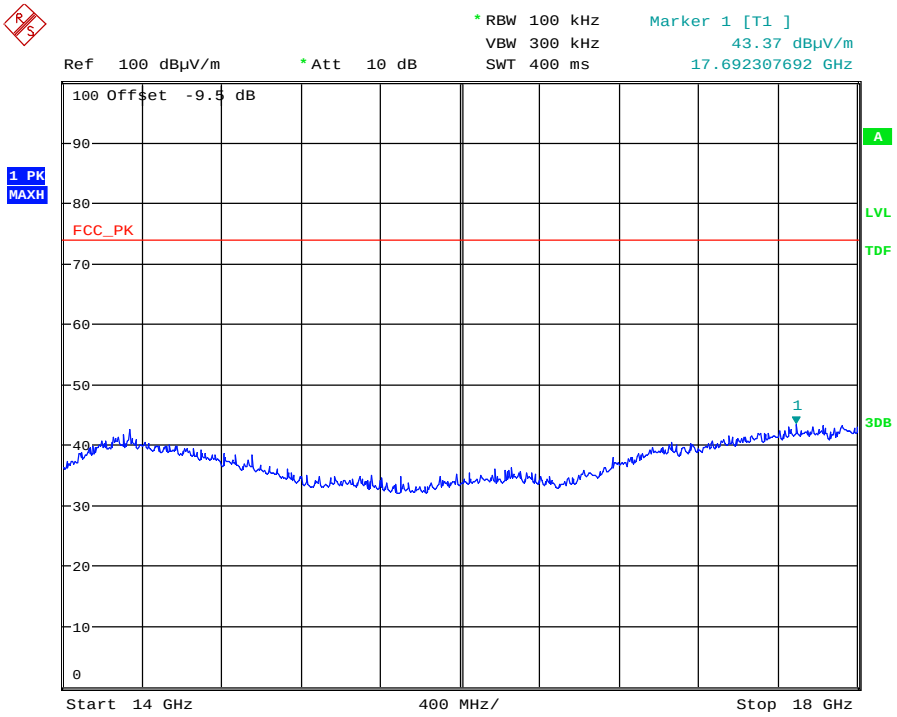
Date: 23.JUN.2011 10:13:06

Unintentional Radiated Spurious Emissions 10 GHz to 14 GHz – Top Channel



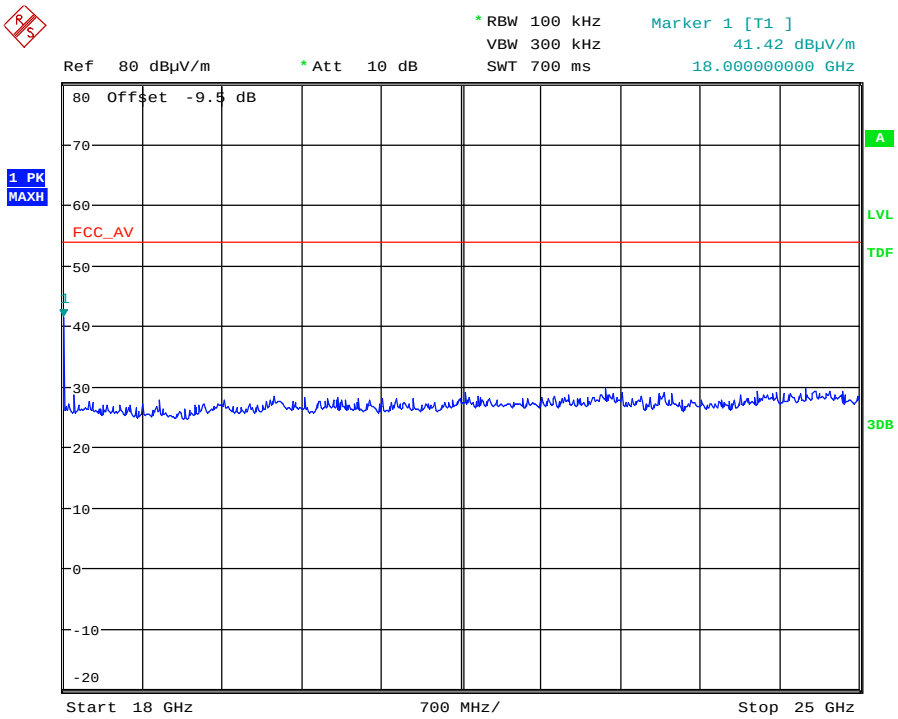
Date: 23.JUN.2011 10:11:35

Unintentional Radiated Spurious Emissions 14 GHz to 18 GHz – Top Channel



Date: 23.JUN.2011 10:09:31

Unintentional Radiated Spurious Emissions 18 GHz to 25 GHz – Top Channel



Date: 23.JUN.2011 14:56:12

Appendix C: Additional Test and Sample Details

This appendix contains details of:

1. The samples submitted for testing
2. Details of EUT operating mode(s)
3. Details of EUT configuration(s) (see below)
4. EUT arrangement (see below)

Throughout testing, the following numbering system is used to identify the sample and its modification state:

Sample No: Sxx Mod w

where:

xx = sample number eg. S01
w = modification number eg. Mod 2

The following terminology is used throughout the test report:

Support Equipment (SE) is any additional equipment required to exercise the EUT in the applicable operating mode. Where relevant SE is divided into two categories:

SE in test environment: The SE is positioned in the test environment and is not isolated from the EUT (e.g. on the table top during REFE testing).

SE isolated from the EUT: The SE is isolated via filtering from the EUT. (e.g. equipment placed externally to the ALSR during REFE testing).

EUT configuration refers to the internal set-up of the EUT. It may include for example:

Positioning of cards in a chassis.
Setting of any internal switches.
Circuit board jumper settings.
Alternative internal power supplies.

Where no change in EUT configuration is **possible**, the configuration is described as “single possible configuration”.

EUT arrangement refers to the termination of EUT ports / connection of support equipment, and where relevant, the relative positioning of samples (EUT and SE) in the test environment.

For further details of the test procedures and general test set ups used during testing please refer to the related document "EMC Test Methods - An Overview", which can be supplied by TRaC Global upon request.

C1 Test samples

The following samples of the apparatus were submitted by the client for testing:

Sample No.	Description	Identification
S01	Promethean ActivExpression2 Model PRM-AE2-01	Serial Number: 0C000081
S02	Promethean ActivExpression2 Model PRM-AE2-01	Serial Number: 0C000037

C2 EUT operating mode during testing

During testing, the EUT was exercised as described in the following tables:

Test	Description of Operating Mode
All tests detailed in this report	EUT actively operating in Tx/Rx mode accordingly

C3 EUT Configuration Information

The EUT was submitted for testing in one single possible configuration

C4 List of EUT Ports

None

C5 Details of Equipment Used

For Radiated Measurements:

TRAC Ref	Type	Description	Manufacturer	Date Calibrated
TRLUH281	FSU46	Spectrum Analyser	Rhode & Schwarz	28/10/2008
TRL138	3115	1-18GHz Horn Antenna	EMCO	23/05/2007
TRL139	3115	1-18GHz Horn Antenna	EMCO	23/05/2007
TRL572	8499B	1 – 26.5 GHz Pre Amplifier	Agilent	04/07/2008
TRLUH186	ESHS10	Receiver	Rhode & Schwarz	03/04/2009
TRLUH191	CBL611/A	BiLog Periodic Antenna	York	01/10/2008
TRLUH28	UHALP 9108	Bicone elements	Schwarzbeck	30/05/2007
TRLUH29	VHBA	Log Periodic Antenna	Schwarzbeck	06/05/2007
TRL193	VHA 193 blau	Bicone elements	Chase	06/05/2008
TRL203	UPA6108	Log Periodic Antenna	Chase	06/05/2008
TRLUH372	6201-69	30MHz – 1 GHz Pre Amplifier	Watkins Johnson	27/11/2008
TRLUH340	83630B	Signal Generator	HP	03/06/2009
REF838	N4010A	Wireless Connectivity Test Set	Agilent	Ref Only

For Conducted Measurements:

TRAC Ref	Type	Description	Manufacturer	Date Calibrated
TRLUH281	FSU46	Spectrum Analyser	Rhode & Schwarz	28/10/2008
REF838	N4010A	Wireless Connectivity Test Set	Agilent	Ref Only

Appendix D: Additional Information

No additional information is included within this test report.

Appendix E: Calculation of the duty cycle correction factor

Using a spectrum analyser in zero span mode, centred on the fundamental carrier frequency with a RBW of 1MHz and a video Bandwidth of 1MHz the sweep time was set accordingly to capture the pulse train. The transmit pulsewidths and period was measured. A plots of the pulse train is contained in Appendix B of this test report.

If the pulse train was less than 100 ms, including blanking intervals, the duty cycle was calculated by averaging the sum of the pulsewidths over one complete pulse train. However if the pulse train exceeds 100ms then the duty cycle was calculated by averaging the sum of the pulsewidths over the 100ms width with the highest average value. (The duty cycle is the value of the sum of the pulse widths in one period (or 100ms), divided by the length of the period (or 100ms). The duty cycle correction factor was then expressed in dB and the peak emissions adjusted accordingly to give an average value of the emission.

Correction factor dB = 20 x (Log_{10} Calculated Duty Cycle)

Therefore the calculated duty cycle was determined:

The pulse train period was greater than >100ms and in as shown from the plots in contained in appendix B of this test report.

$$\text{Duty cycle} = \frac{\text{the sum of the highest average value pulsewidths over 100ms}}{100\text{ms}}$$

e.g.

$$= \frac{7.459ms}{100ms} = 0.07459$$

0.07459 or 7.459%

Correction factor (dB) = 20 x (Log_{10} 0.07459) = -22.54dB

Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: 30 MHz – 1 GHz Setup
2. Radiated electric field emissions arrangement: > 1 GHz Setup
3. Photo of the ActivExpression2: Front View Close-up
4. Photo of the ActivExpression2: Rear View Close-up

Photograph 1

Photograph 2

Photograph 3

Photograph 4