Radio Test Report

for

RSL Steeper

on

RF Module PBB GC350616

Document No: TRA-010521-W-US1

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TRaC Wireless Test Report	**:** TRA-010521-W-US1
Applicant	**:** RSL Steeper
Apparatus	**:** RF Module PBB GC350616
Specification(s)	**:** CFR47 Part 15.249, RSS 210
Purpose of Test	**:** Certification
FCCID	**:** PBBGC350616
ICID	**:** 10634A-RSLRFBB
Authorised by	**:** 
	(Radio Products Manager)
Issue Date	**:**18th September 2012
Authorised Copy Number	**:** *PDF*

Total number of pages: 58

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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:

RSLSteeper
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1.3 Manufacturer

Same as above

1.4 Apparatus Assessed

The following apparatus was assessed between 21/08/12 and 06/09/12:

RF Module PBB GC350616

The above device consists of a radio transceiver operating in the 2.4GHz – 2.4835GHz 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
Spurious Emissions Radiated <1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.209	ANSI C63.10	Pass
Spurious Emissions Radiated >1000MHz	Title 47 of the CFR: Part 15 Subpart (c) 15.209	ANSI C63.10	Pass
AC Power conducted emissions	Title 47 of the CFR: Part 15 Subpart (c) 15.207	ANSI C63.10	Pass
Intentional Emission Field Strength	Title 47 of the CFR: Part 15 Subpart (c) 15.249	ANSI C63.10	Pass
Intentional Emission Band Occupancy	Title 47 of the CFR: Part 15 Subpart (c) 15.215	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart (b) 15.109	ANSI C63.10	Pass
Antenna Arrangements Integral:	Title 47 of the CFR: Part 15 Subpart (c) 15.203	-	N/A
Antenna Arrangements External Connector	Title 47 of the CFR: Part 15 Subpart (c) 15.204	-	N/A
Restricted Bands	Title 47 of the CFR: Part 15 Subpart (c) 15.205	-	N/A
Maximum Frequency of Search	Title 47 of the CFR: Part 15 Subpart (c) 15.33	-	N/A
Extrapolation Factor	Title 47 of the CFR: Part 15 Subpart (c) 15.31(f)	-	N/A

Abbreviations used in the above table:

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 Measurement Uncertainty Values

For the test data recorded in accordance with note (iii) of Section 2.1 the following measurement uncertainty was calculated:

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 (Power Meter) = **1.08dB**
Uncertainty in test result (Spectrum Analyser) = **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 (Power Meter) = **0.113ppm**
Uncertainty in test result (Spectrum Analyser) = **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

Uncertainty in test result – Up to 8.1GHz = **3.31dB**
Uncertainty in test result – 8.1GHz – 15.3GHz = **4.43dB**
Uncertainty in test result – 15.3GHz – 21GHz = **5.34dB**
Uncertainty in test result – 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 Intentional Emission Radiated

Test Details: Bottom Channel	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.249, RSS Gen
Measurement standard	ANSI C63.10:2003
EUT sample number	S01
Modification state	0
SE in test environment	S02
SE isolated from EUT	Laptop
EUT set up	Refer to Appendix C
Temperature	22^{o}C
Photographs (Appendix F)	1

Measured Frequency (MHz)	**Measured Level at 3m (dBµV)**	**Cable Loss (dB)**	**Antenna Factor (dB/m)**	**Pre-Amp Gain (dB)**	**Field Strength at 3m (dBµV/m)**	**Field Strength at 3m (mV/m)**
2401	97.19	2.1	28.3	35.6	91.99	39.80
Limit value @ fc (mV/m) at 3m			50			
Band occupancy @ -20dBc			**f_{lower} (MHz)**		**f_{higher} (MHz)**	
			2400.63		2401.37	
			20dB Bandwidth = 740kHz			

Test Method:

1 As per Radio – Noise Emissions, ANSI C63.10
2 Measuring distances 3m
3 EUT 0.8 metre above ground plane
4 Emissions maximised by rotation of EUT, on an automatic turntable.
5 Raising and lowering the receiver antenna between 1m & 4m.
6 Horizontal and vertical polarisations, of the receive antenna.
7 EUT orientation in three orthogonal planes.
8 Maximum results recorded

Test Details: Middle Channel	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.249, RSS Gen
Measurement standard	ANSI C63.10:2003
EUT sample number	S01
Modification state	0
SE in test environment	S02
SE isolated from EUT	Laptop
EUT set up	Refer to Appendix C
Temperature	22°C
Photographs (Appendix F)	1

Measured Frequency (MHz)	Measured Level at 3m (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-Amp Gain (dB)	Field Strength at 3m (dBµV/m)	Field Strength at 3m (mV/m)
2440	97.23	2	28.4	35.6	92.03	39.95
Limit value @ fc (mV/m) at 3m			50			
Band occupancy @ -20dBc			f_{lower} (MHz)		f_{higher} (MHz)	
			2439.62		2440.35	
			20dB Bandwidth = 734kHz			

Test Method:

1 As per Radio – Noise Emissions, ANSI C63.10
2 Measuring distances 3m
3 EUT 0.8 metre above ground plane
4 Emissions maximised by rotation of EUT, on an automatic turntable.
5 Raising and lowering the receiver antenna between 1m & 4m.
6 Horizontal and vertical polarisations, of the receive antenna.
7 EUT orientation in three orthogonal planes.
8 Maximum results recorded

Test Details: Top Channel	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.249, RSS Gen
Measurement standard	ANSI C63.10:2003
EUT sample number	S01
Modification state	0
SE in test environment	S02
SE isolated from EUT	Laptop
EUT set up	Refer to Appendix C
Temperature	22°C
Photographs (Appendix F)	1

Measured Frequency (MHz)	**Measured Level at 3m (dBµV)**	**Cable Loss (dB)**	**Antenna Factor (dB/m)**	**Pre-Amp Gain (dB)**	**Field Strength at 3m (dBµV/m)**	**Field Strength at 3m (mV/m)**
2482.5	98.4	1.9	28.5	35.6	93.2	45.7
Limit value @ fc (mV/m) at 3m			50			
Band occupancy @ -20dBc			**f_{lower} (MHz)**		**f_{higher} (MHz)**	
			2482.11		2482.87	
			20dB Bandwidth = 766kHz			

Test Method:

1 As per Radio – Noise Emissions, ANSI C63.10
2 Measuring distances 3m
3 EUT 0.8 metre above ground plane
4 Emissions maximised by rotation of EUT, on an automatic turntable.
5 Raising and lowering the receiver antenna between 1m & 4m.
6 Horizontal and vertical polarisations, of the receive antenna.
7 EUT orientation in three orthogonal planes.
8 Maximum results recorded

A2 Radiated Electric Field Emissions

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric field emission test applies to all spurious emissions and harmonics emissions. The maximum permitted field strength is listed in Section 15.209. The EUT was set to transmit as required.

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: Bottom Channel	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.209, RSS Gen
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz – 25GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02
SE isolated from EUT	Laptop
EUT set up	Refer to Appendix C
Temperature	22^{o}C

The worst case radiated emission measurements for spurious emissions are listed below:

Frequency (MHz)	**Detector**	**Poln'**	**Measured Level (dBµV)**	**Cable Loss (dB)**	**Antenna Factor (dB/m)**	**Pre-Amp Gain (dB)**	**Field Strength (dBµV/m)**	**Extrap factor (dB)**	**Field Strength (µV/m)**	**Limit (µV/m)**
4802	Av	V	51.5	3.6	32.6	35.7	52	0	398.1	500
7203	Av	H	48.88	4.2	35.9	36.2	52.78	0	435.5	500
9604	Av	V	44.13	5	37.7	36.7	50.13	0	320.9	500

Test Details: Middle Channel	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.209, RSS Gen
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz – 25GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02
SE isolated from EUT	Laptop
EUT set up	Refer to Appendix C
Temperature	22°C

The worst case radiated emission measurements for spurious emissions are listed below:

Frequency (MHz)	Detector	Poln'	Measured Level (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-Amp Gain (dB)	Field Strength (dBµV/m)	Extrap factor (dB)	Field Strength (µV/m)	Limit (µV/m)
4880	Av	H	51.83	3.8	32.9	35.7	52.83	0	438	500
7320	Av	V	48.02	4.2	36.3	36.2	52.32	0	413	500
9760	Av	V	41.68	5	37.9	36.8	47.78	0	244.9	500

Test Details: Top Channel	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.209, RSS Gen
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz – 25GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02
SE isolated from EUT	Laptop
EUT set up	Refer to Appendix C
Temperature	22°C

The worst case radiated emission measurements for spurious emissions are listed below:

Frequency (MHz)	Detector	Poln'	Measured Level (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-Amp Gain (dB)	Field Strength (dBµV/m)	Extrap factor (dB)	Field Strength (µV/m)	Limit (µV/m)
4965	Av	V	50.49	3.6	33.1	35.7	51.49	0	375.4	500
7447.5	Av	V	48.42	4.2	36.4	36.3	52.72	0	432.5	500
9930	Av	H	38.25	5.1	38.2	36.9	44.65	0	170.8	500

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. For emissions below 30MHz the cable losses are assumed to be negligible.
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 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.
4 For Frequencies below 1 GHz, RBW= 120 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

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

Radiated emission limits 47 CFR part 15- Clause 15.209 for all emissions:

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

(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:

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

(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

A3 Power Line Conducted Emissions

Preview power line conducted emission measurements were performed with a peak detector in a screened room. The effect of the EUT set-up on the measurements is summarised in note (b). Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector.

Test Details	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.207, RSS Gen
Measurement standard	ANSI C63.10:2003
Frequency range	150kHz to 30MHz
EUT sample number	S01
Modification state	N/A
SE in test environment	S02, Laptop
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Photograph (Appendix F)	2

The worst-case power line conducted emission measurements are listed below:

Results measured using the average detector compared to the average limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	2.18	Live, Neut	26.04	46	19.96	Pass
2	2.16	Neut	40.23	46	5.77	Pass

Results measured using the quasi-peak detector compared to the quasi–peak limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	2.18	Live	36.07	56	19.93	Pass
2	2.165	Neut	44.63	56	11.37	Pass

Specification limits:

Conducted emission limits (47 CFR Part 15: Clause 15.207):

Conducted disturbance at the mains ports shall be no more than the following values.

Frequency range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.5	66 to 56[2]	56 to 46[2]
0.5 to 5	56	46
5 to 30	60	50

Notes:
1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

Notes:

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

(b) The following table summarises the effect of the EUT operating mode and internal configuration 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		✓		

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

A4 Unintentional Radiated Emissions

Preliminary scans were performed using a peak detector with the RBW = 100 kHz. The radiated electric field emission test applies to all spurious emissions on directly related to the transmitter. The maximum permitted field strength is listed in Section 15.109. The EUT was set to operate in transmit standby / receive mode.

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 : [X]

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

Test Details: Bottom Channel	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.109, RSS Gen
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz – 25GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02
SE isolated from EUT	Laptop
EUT set up	Refer to Appendix C
Temperature	22^{o}C

The worst case radiated emission measurements for spurious emissions are listed below:

Frequency (MHz)	Detector	Poln'	Measured Level (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-Amp Gain (dB)	Field Strength (dBµV/m)	Extrap factor (dB)	Field Strength (µV/m)	Limit (µV/m)
4800.6	Av	V	46.7	3.6	32.6	35.7	47.2	0	229	500

Test Details: Middle Channel	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.109, RSS Gen
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz – 25GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02
SE isolated from EUT	Laptop
EUT set up	Refer to Appendix C
Temperature	22°C

The worst case radiated emission measurements for spurious emissions are listed below:

Frequency (MHz)	Detector	Poln'	Measured Level (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-Amp Gain (dB)	Field Strength (dBµV/m)	Extrap factor (dB)	Field Strength (µV/m)	Limit (µV/m)
4883.6	Av	V	51.8	3.8	32.9	35.7	52.8	0	436.5	500

Test Details: Top Channel	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.109, RSS Gen
Measurement standard	ANSI C63.10:2003
Frequency range	30MHz – 25GHz
EUT sample number	S01
Modification state	0
SE in test environment	S02
SE isolated from EUT	Laptop
EUT set up	Refer to Appendix C
Temperature	22°C

The worst case radiated emission measurements for spurious emissions are listed below:

Frequency (MHz)	Detector	Poln'	Measured Level (dBµV)	Cable Loss (dB)	Antenna Factor (dB/m)	Pre-Amp Gain (dB)	Field Strength (dBµV/m)	Extrap factor (dB)	Field Strength (µV/m)	Limit (µV/m)
4965.6	Av	V	51.22	3.6	33.1	35.7	52.22	0	408.3	500

Notes:

5 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.10: section 4.5, Table 1. For emissions below 30MHz the cable losses are assumed to be negligible.

6 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.

7 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.

8 For Frequencies below 1 GHz, RBW = 120 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

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

Radiated emission limits 47 CFR Part 15: Clause 15.109 for all emissions:

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

(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:

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

(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

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.

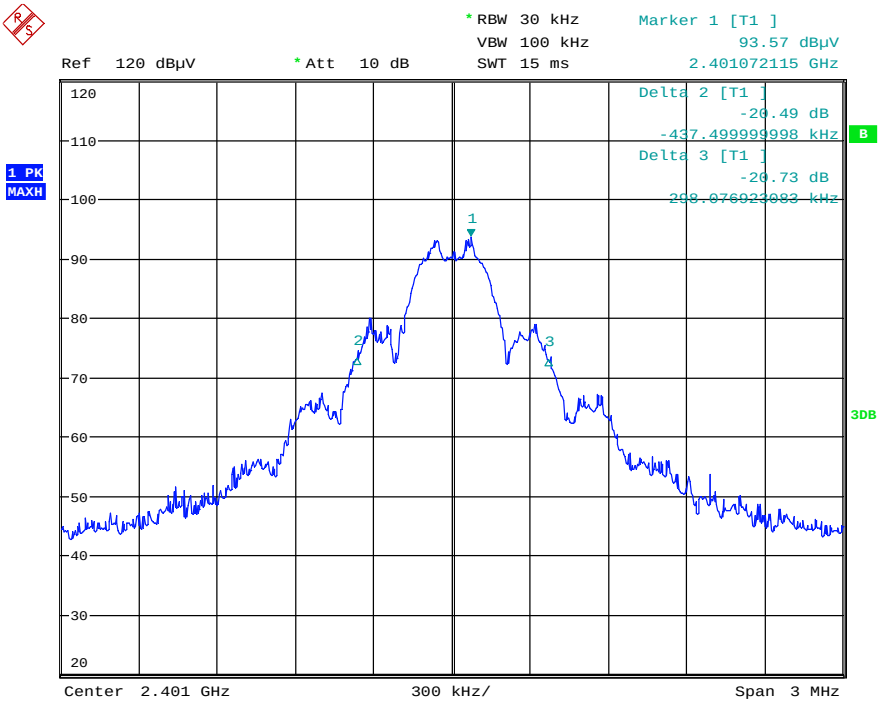
(b) The time and date on the plots do not necessarily equate to the time of the test.

(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.

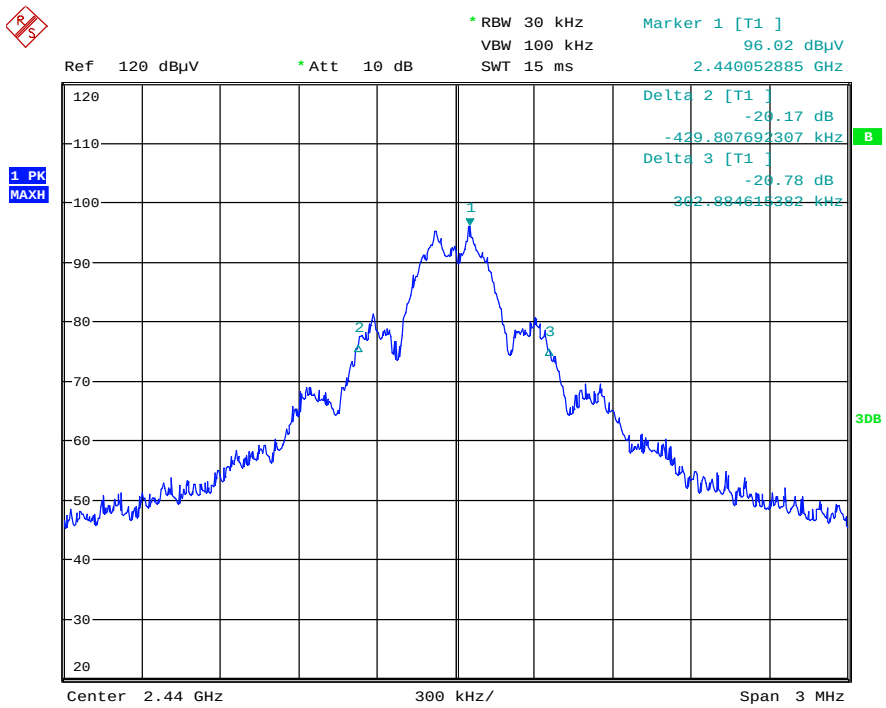
(e) The plots presented in this appendix may not be a complete record of the measurements performed, but are a representative sample, relative to the final assessment.

20dB Bandwidth – 2401MHz



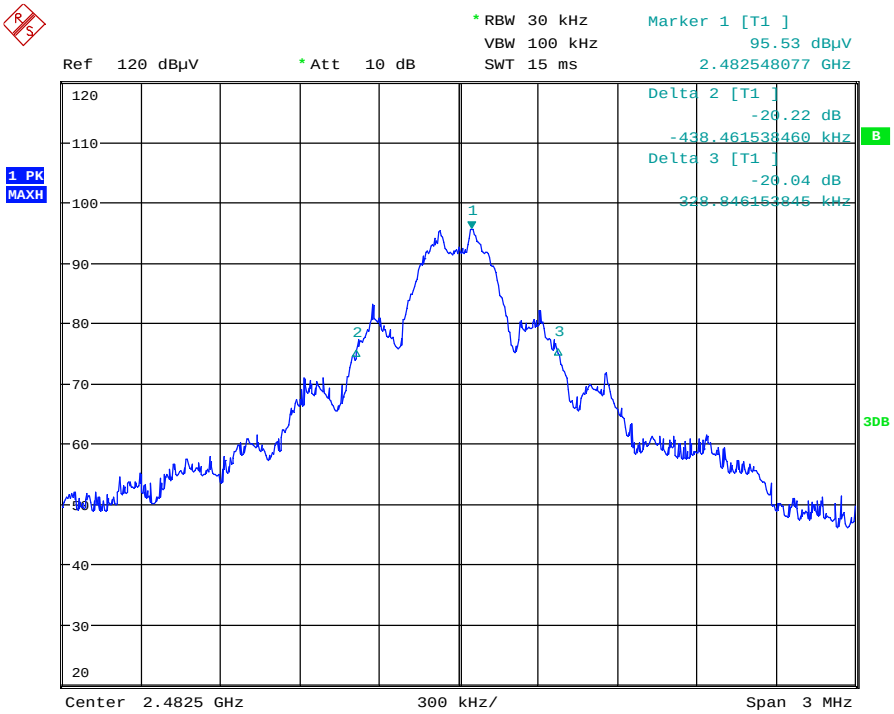
Date: 4.SEP.2012 15:30:41

20dB Bandwidth – 2440MHz



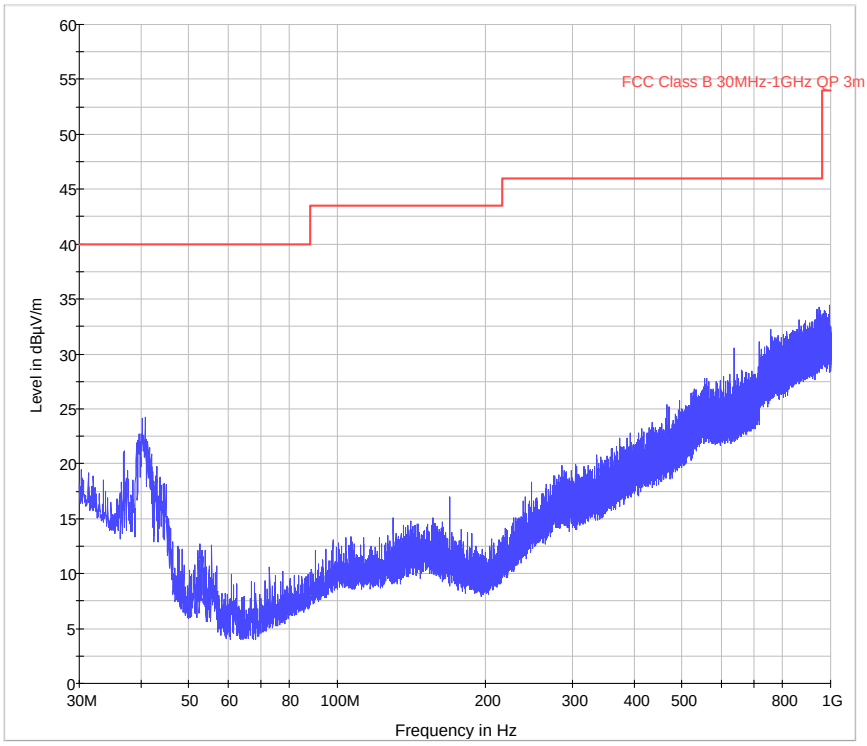
Date: 4.SEP.2012 15:39:29

20dB Bandwidth – 2482.5MHz

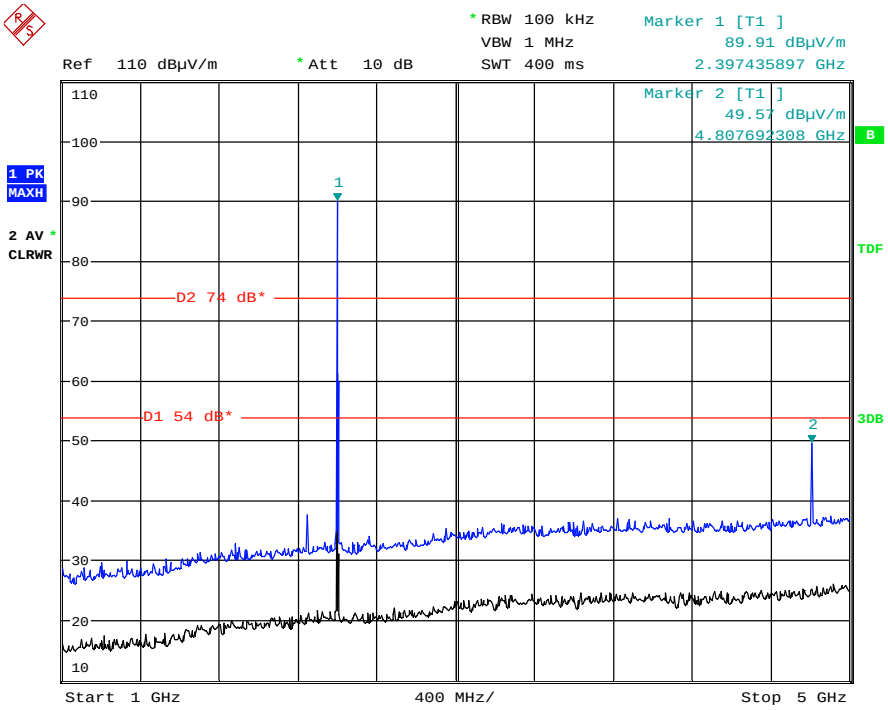


Date: 4.SEP.2012 15:40:59

Radiated spurious emissions 30MHz to 1GHz – 2401MHz

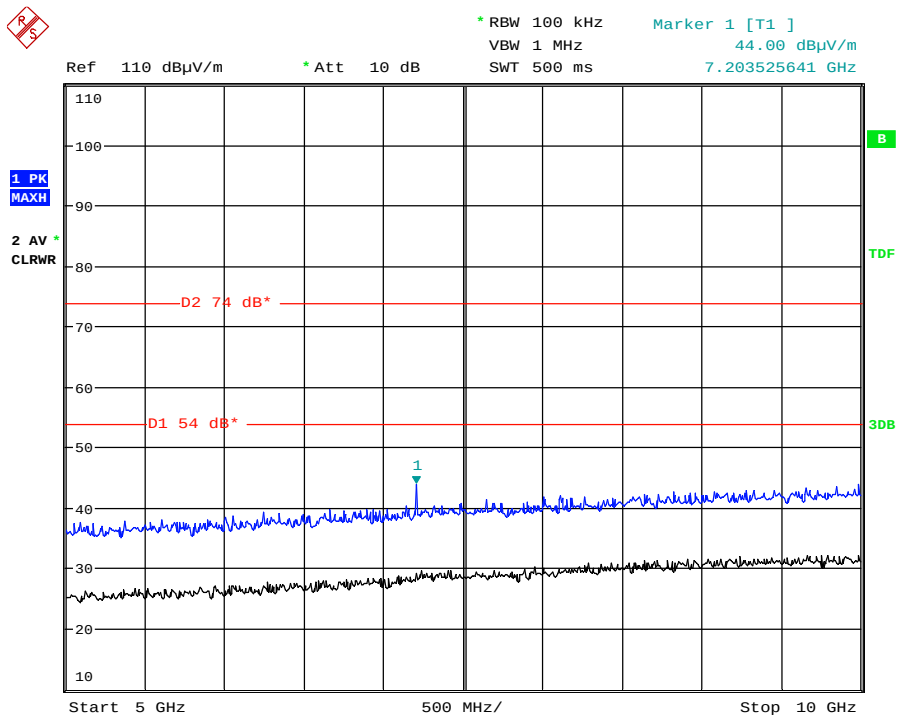


Radiated spurious emissions 1GHz to 5GHz – 2401MHz



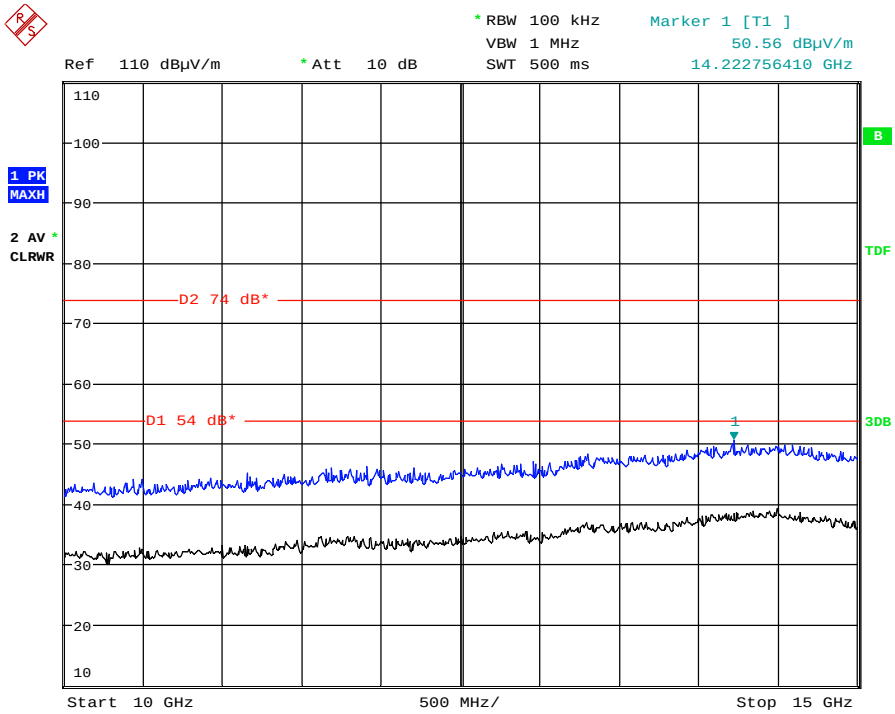
Date: 3.SEP.2012 15:26:01

Radiated spurious emissions 5GHz to 10GHz – 2401MHz



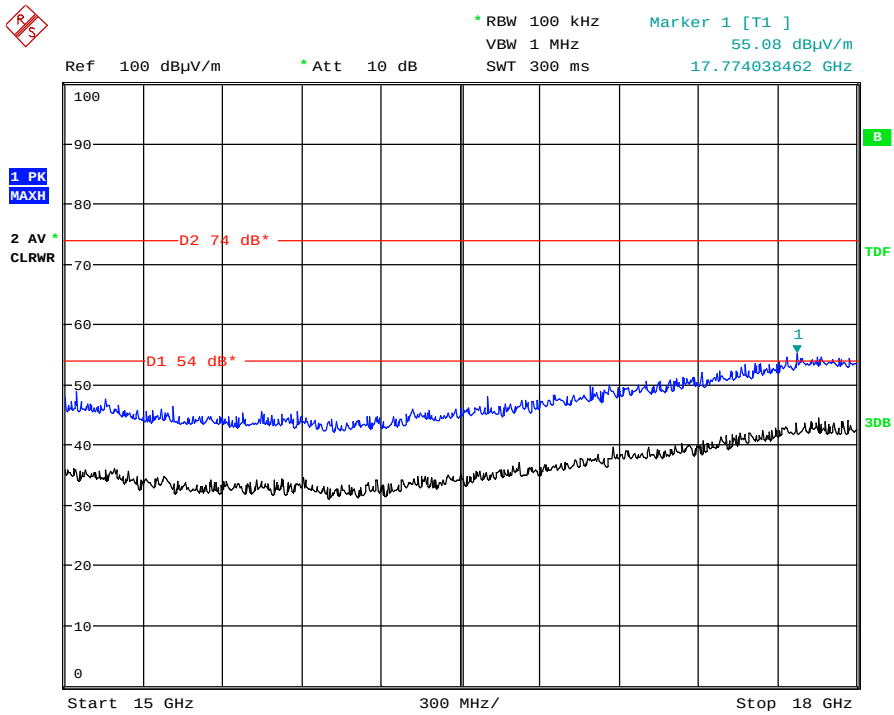
Date: 3.SEP.2012 15:26:30

Radiated spurious emissions 10GHz to 15GHz – 2401MHz



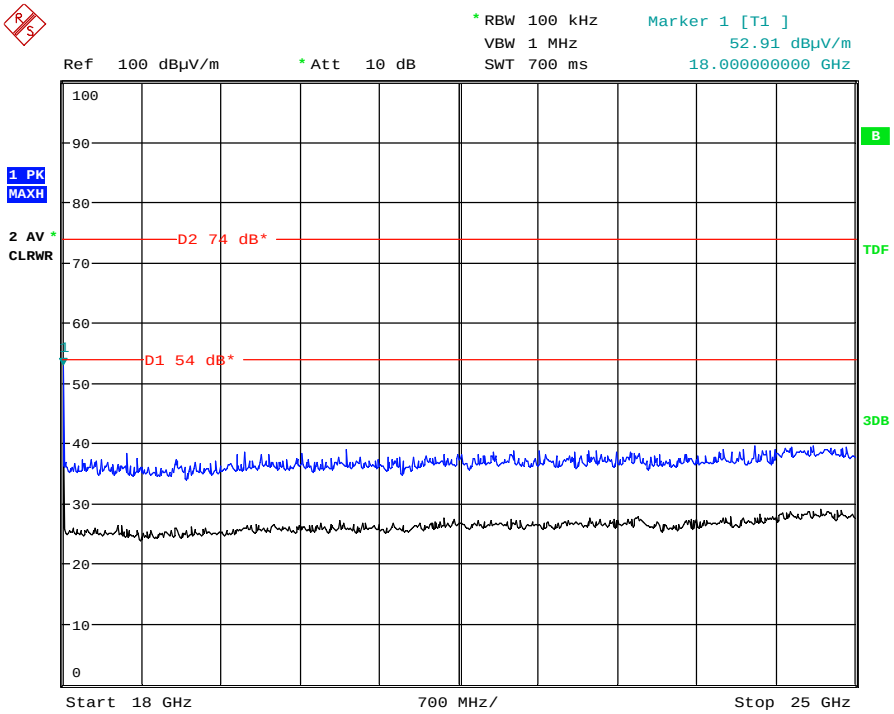
Date: 3.SEP.2012 15:26:59

Radiated spurious emissions 15GHz to 18GHz



Date: 3.SEP.2012 15:29:05

Radiated spurious emissions 18GHz to 25GHz – 2401MHz



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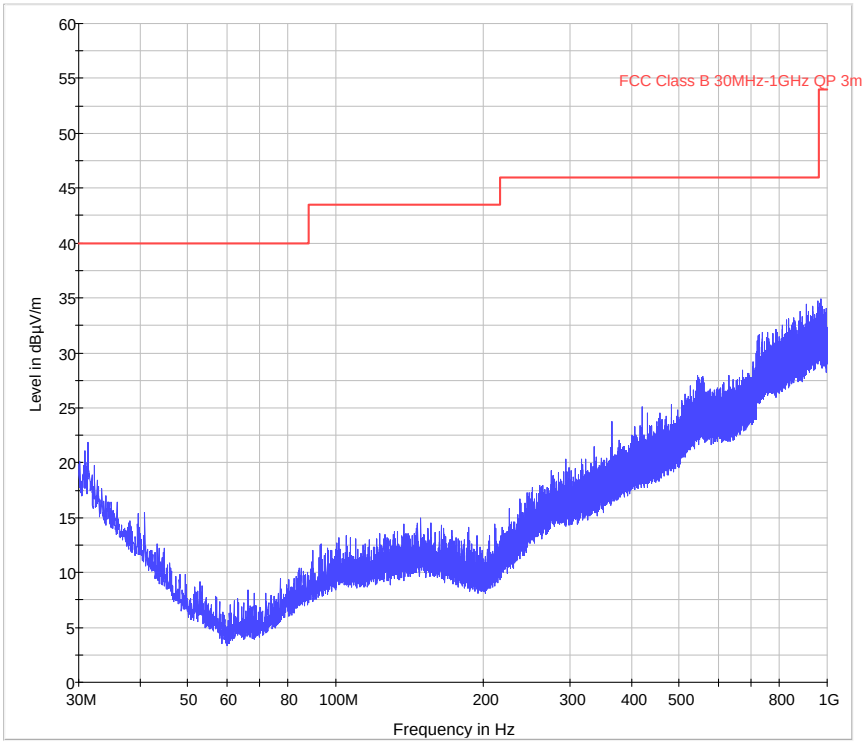
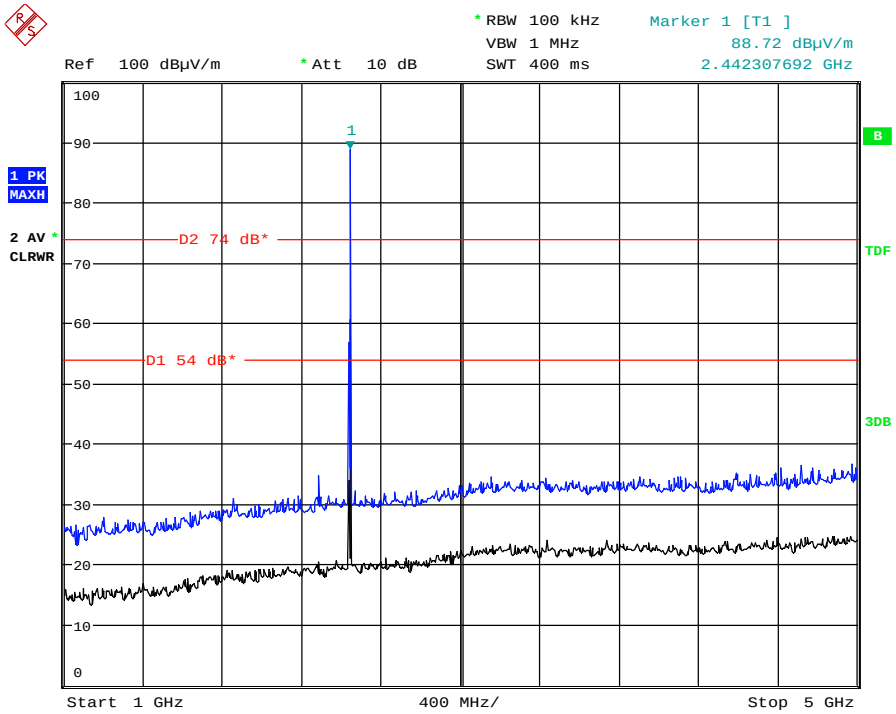
Radiated spurious emissions 30MHz to 1GHz – 2440MHz

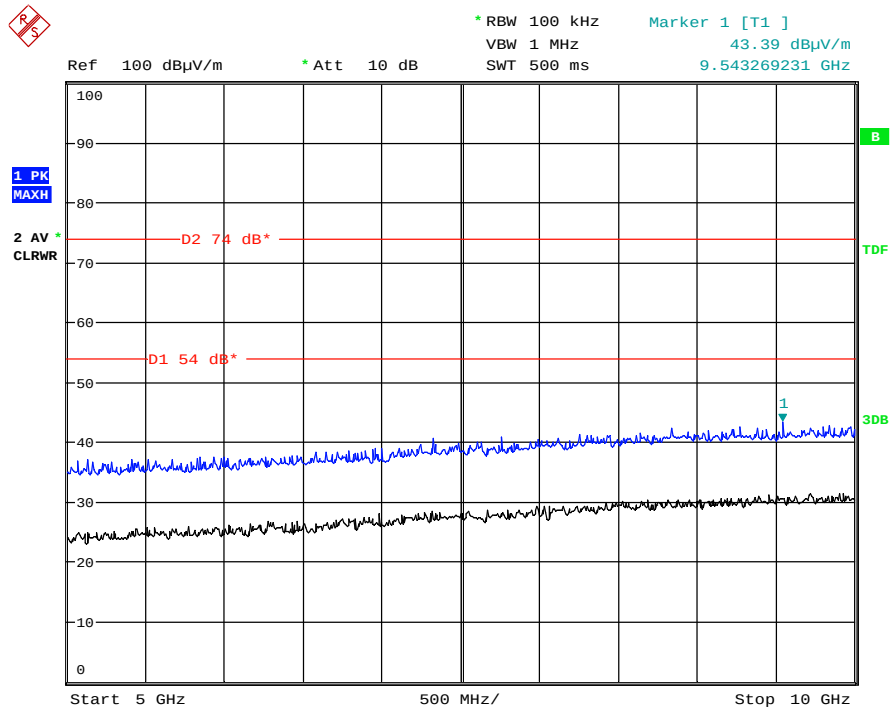


Radiated spurious emissions 1GHz to 5GHz – 2440MHz



Date: 3.SEP.2012 15:48:36

Radiated spurious emissions 5GHz to 10GHz – 2440MHz



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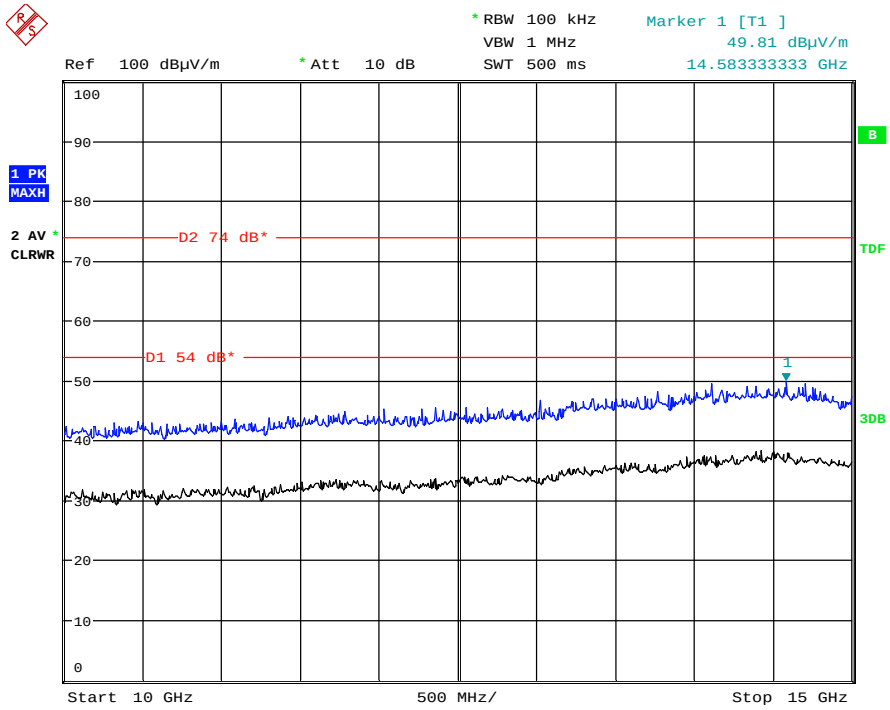
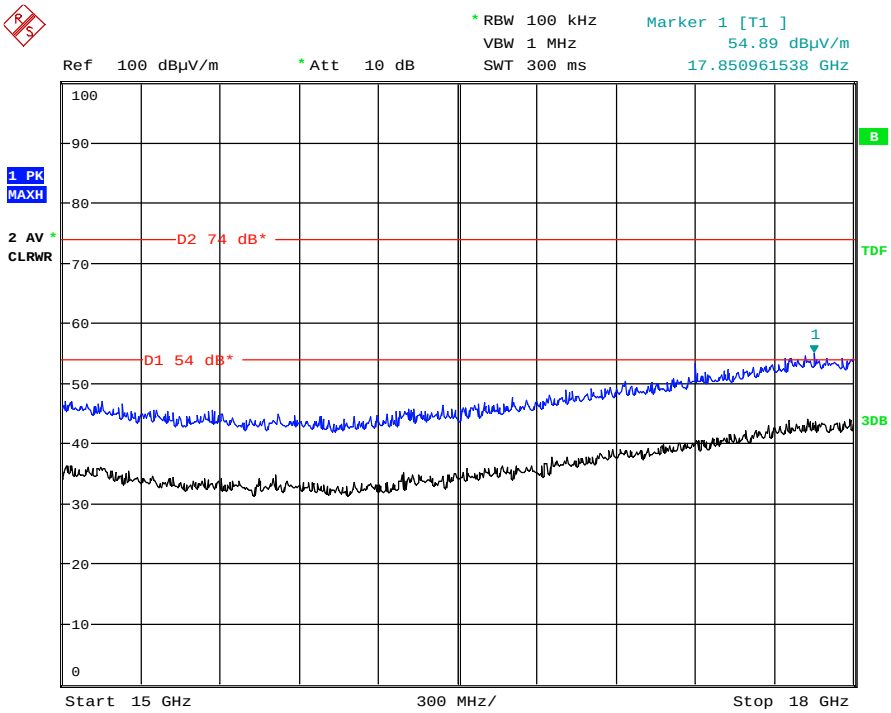
Radiated spurious emissions 10GHz to 15GHz – 2440MHz



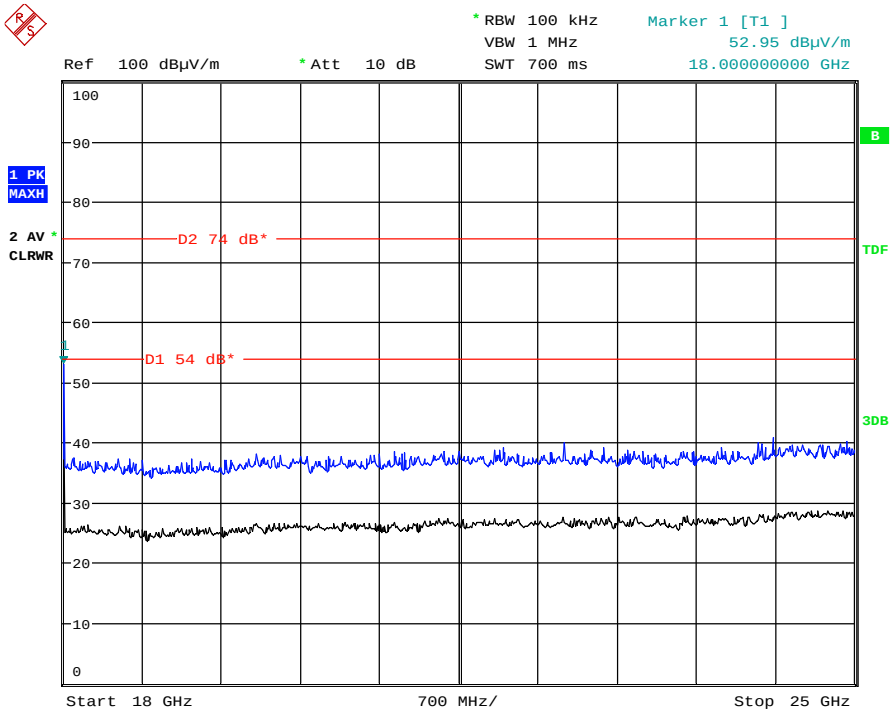
Date: 3.SEP.2012 15:48:59

Radiated spurious emissions 15GHz to 18GHz – 2440MHz



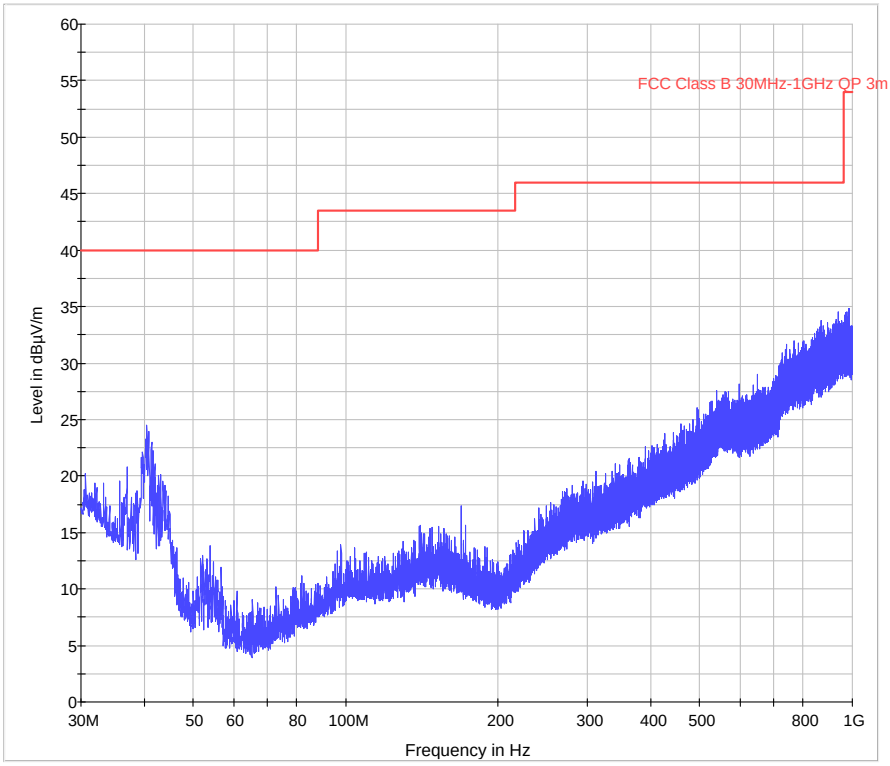
Date: 3.SEP.2012 15:49:21

Radiated spurious emissions 18GHz to 25GHz – 2440MHz

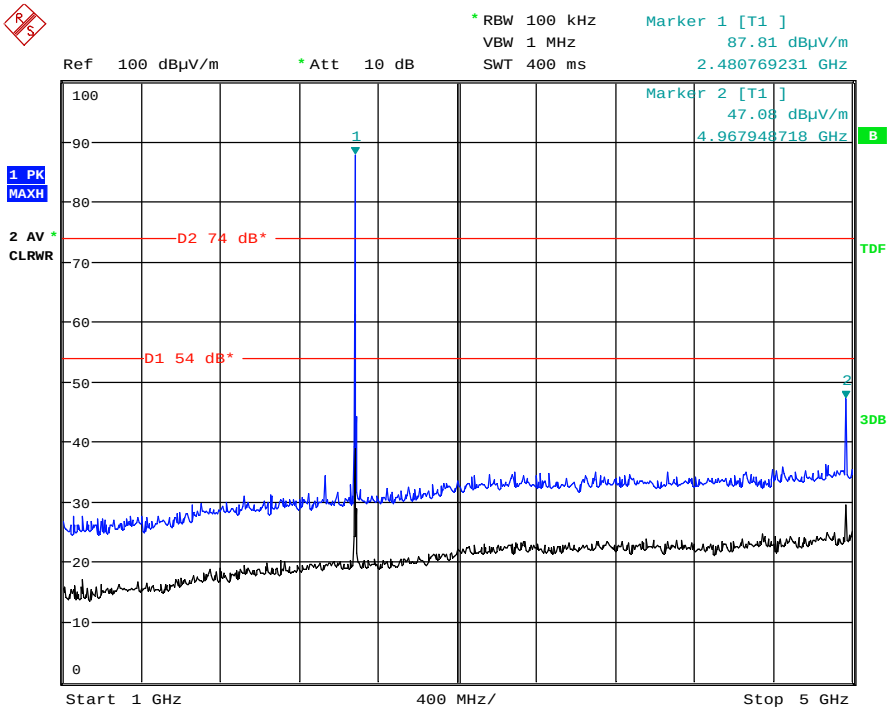


Date: 4.SEP.2012 13:28:06

Radiated spurious emissions 30MHz to 1GHz – 2482.5MHz

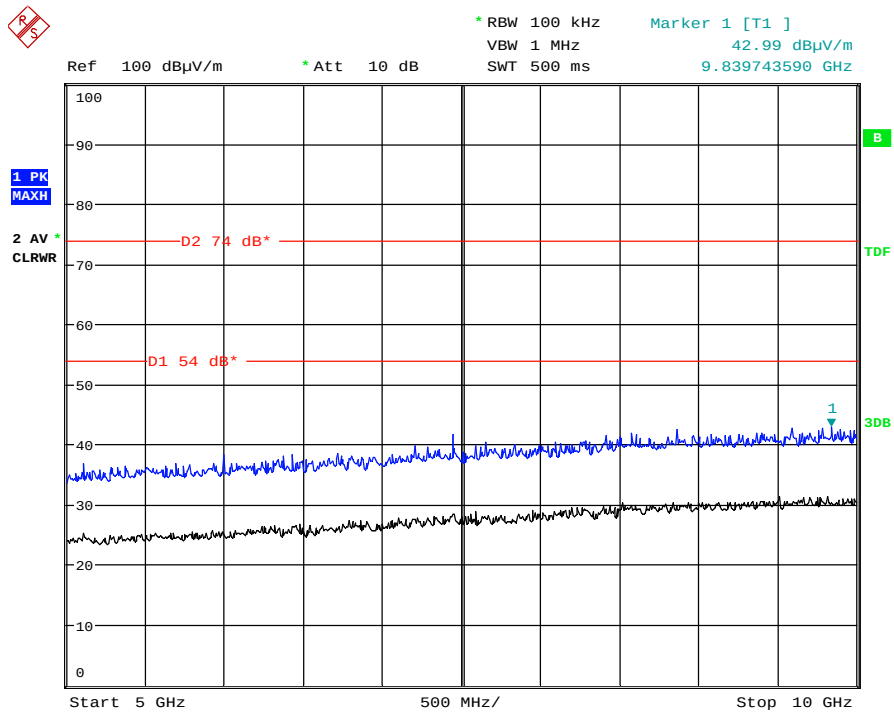


Radiated spurious emissions 1GHz to 5GHz – 2482.5MHz



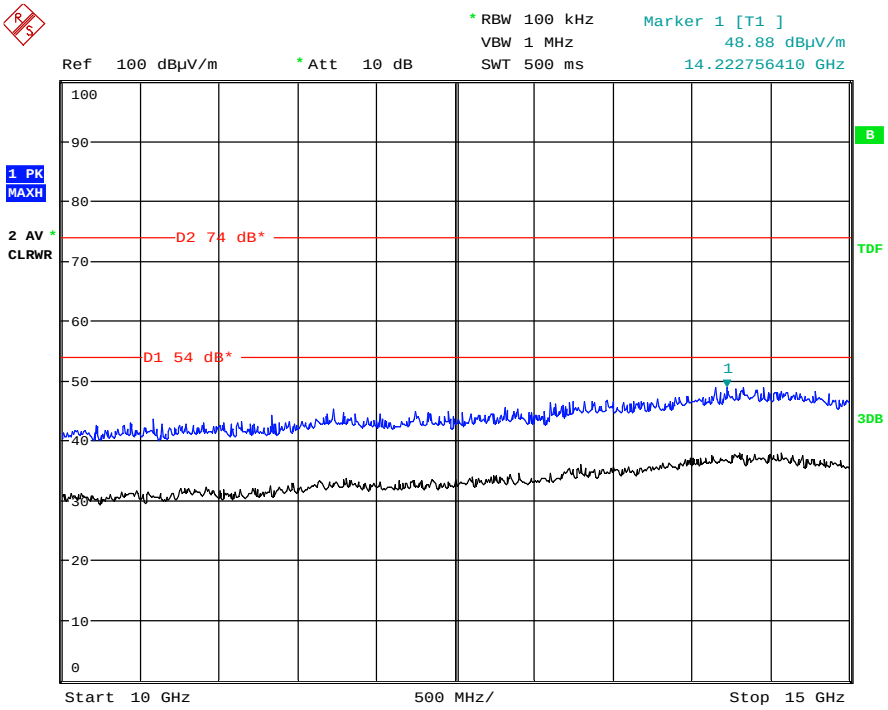
Date: 3.SEP.2012 16:12:24

Radiated spurious emissions 5GHz to 10GHz – 2482.5MHz



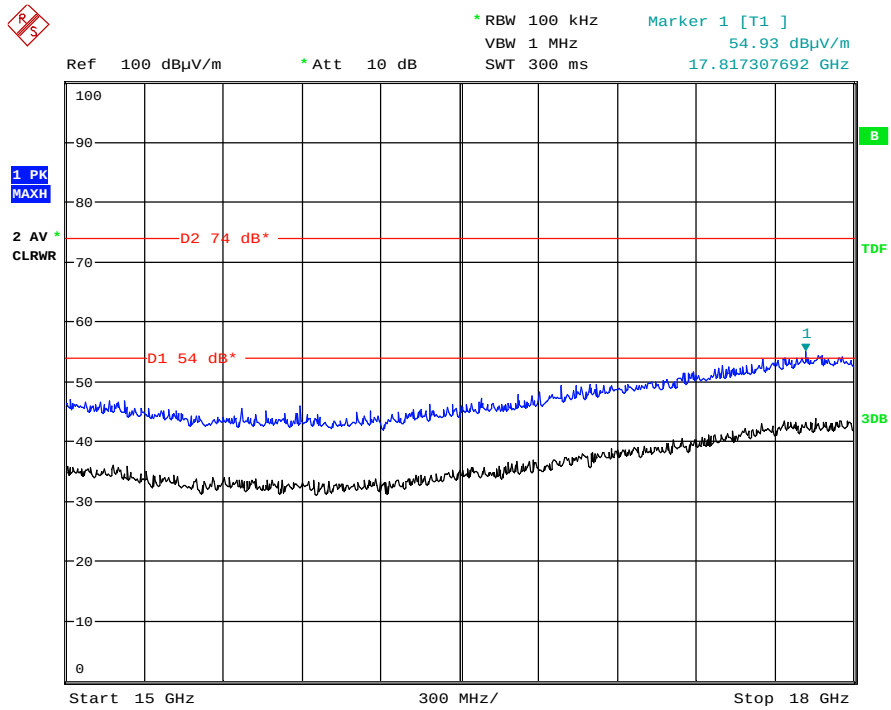
Date: 3.SEP.2012 16:11:56

Radiated spurious emissions 10GHz to 15GHz – 2482.5MHz



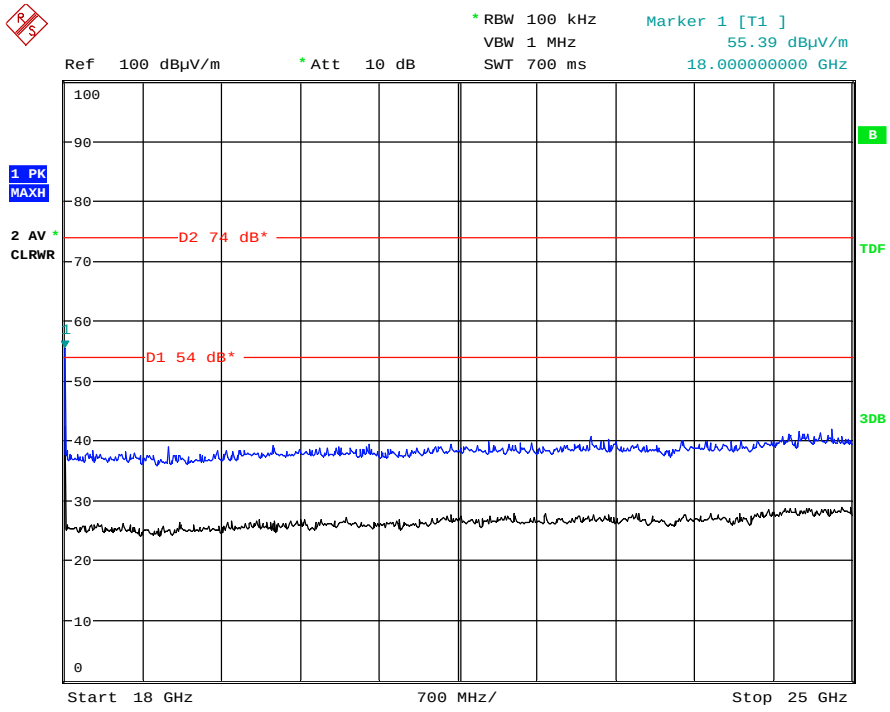
Date: 3.SEP.2012 16:11:32

Radiated spurious emissions 15GHz to 18GHz – 2482.5MHz



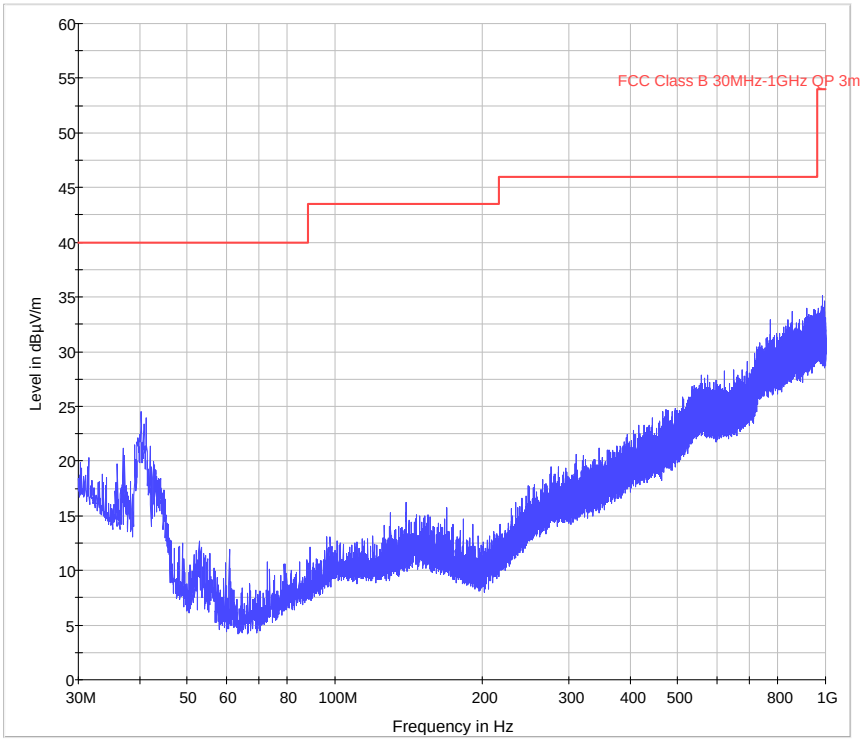
Date: 3.SEP.2012 16:11:12

Radiated spurious emissions 18GHz to 25GHz – 2482.5MHz

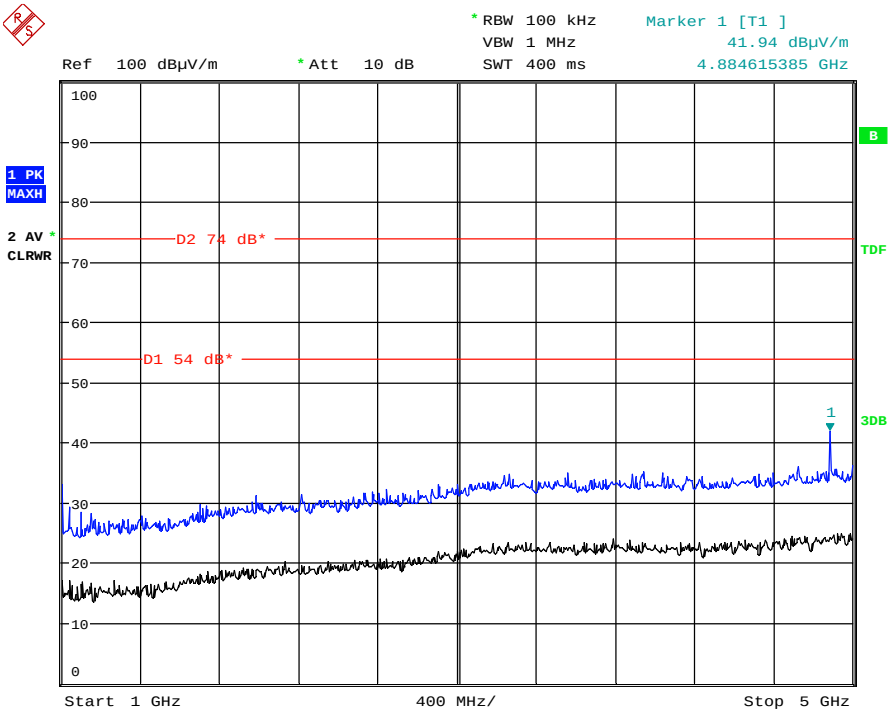


Date: 4.SEP.2012 13:21:57

Unintentional Radiated spurious emissions 30MHz to 1GHz – 2401MHz

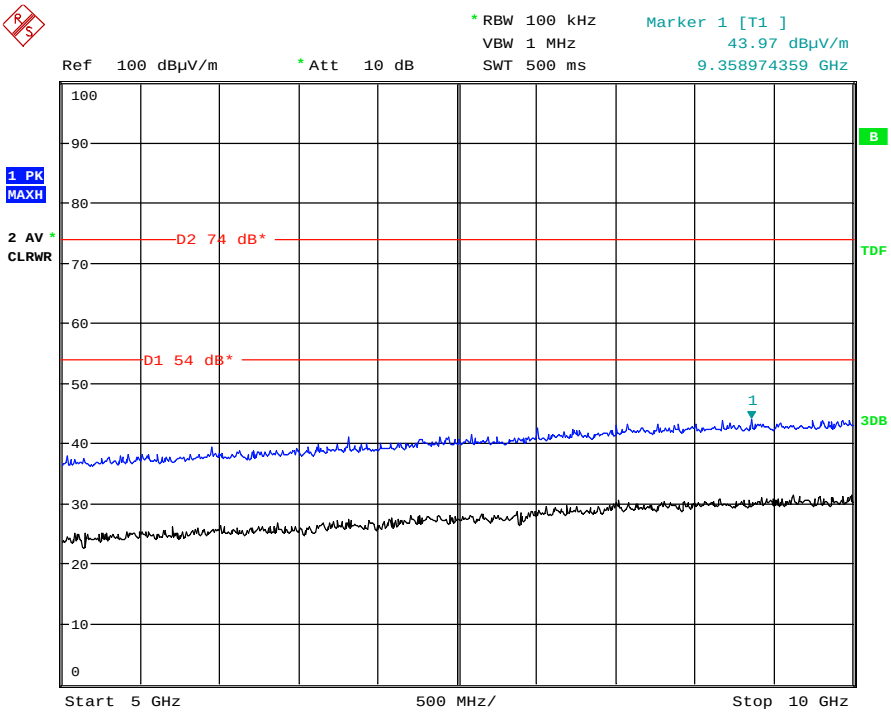


Unintentional Radiated spurious emissions 1GHz to 5GHz – 2401MHz



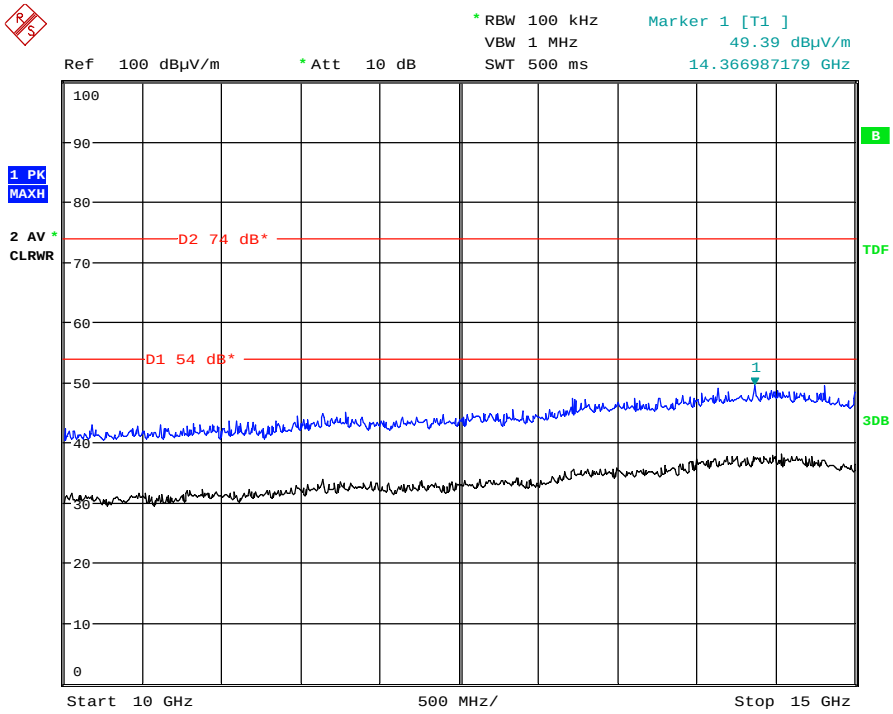
Date: 3.SEP.2012 16:51:07

Unintentional Radiated spurious emissions 5GHz to 10GHz – 2401MHz



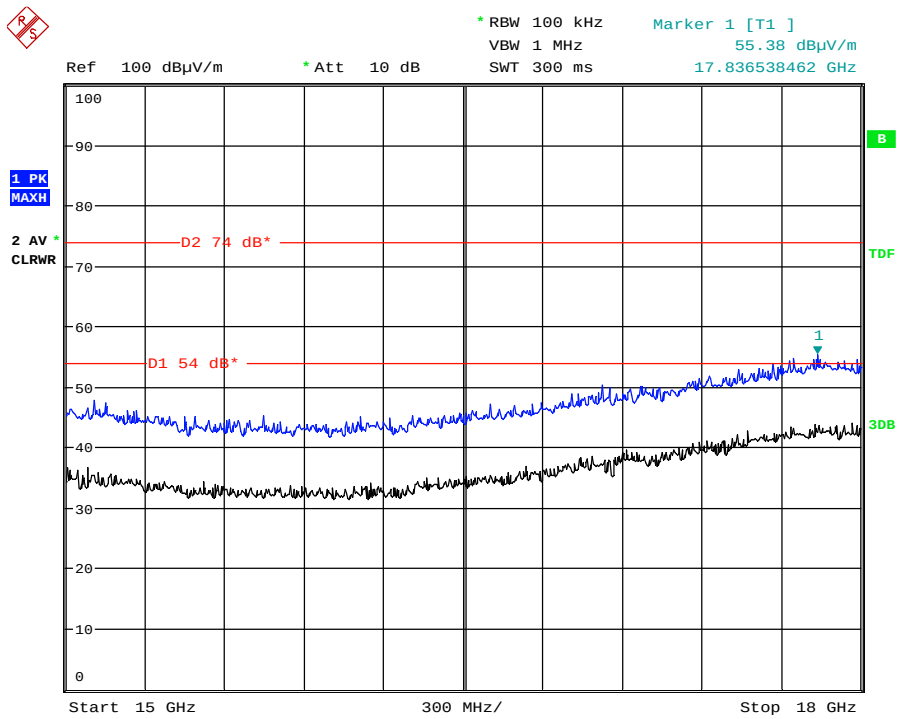
Date: 3.SEP.2012 16:46:05

Unintentional Radiated spurious emissions 10GHz to 15GHz – 2401MHz



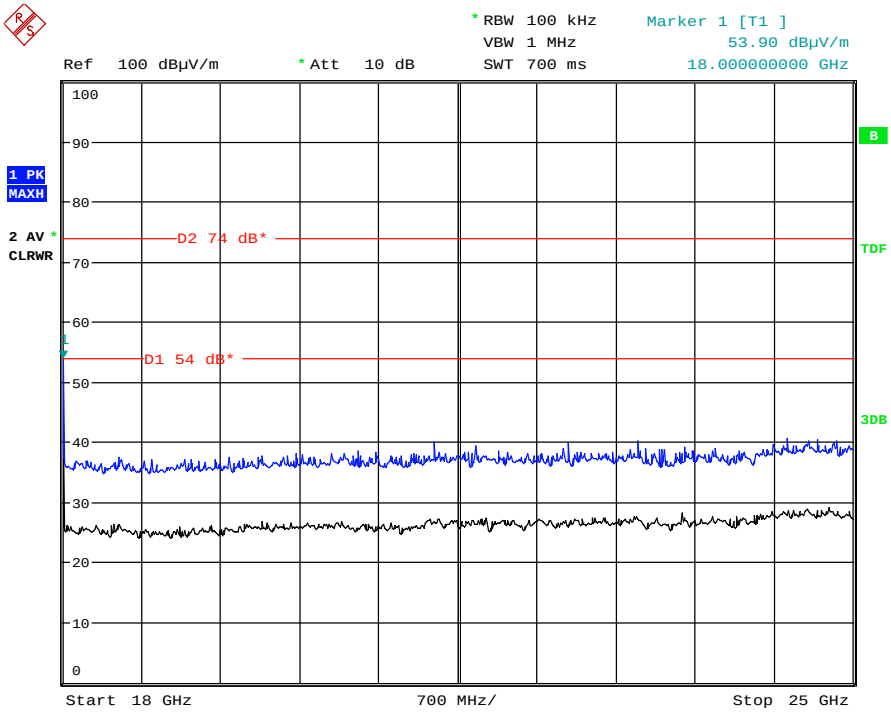
Date: 3.SEP.2012 16:46:34

Unintentional Radiated spurious emissions 15GHz to 18GHz – 2401MHz



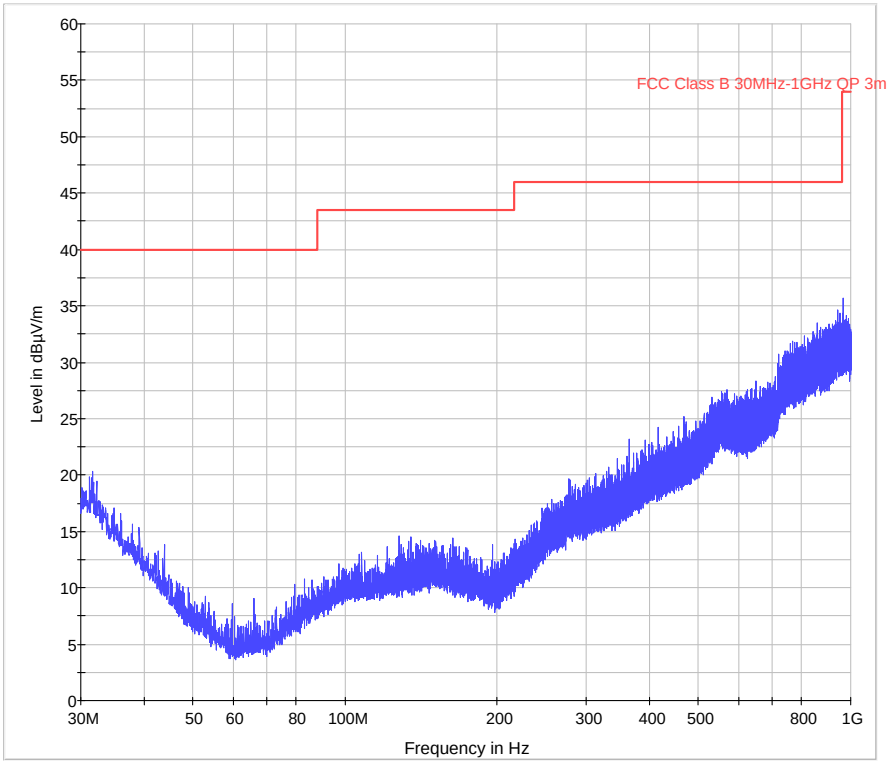
Date: 3.SEP.2012 16:47:06

Unintentional Radiated spurious emissions 18GHz to 25GHz – 2401MHz

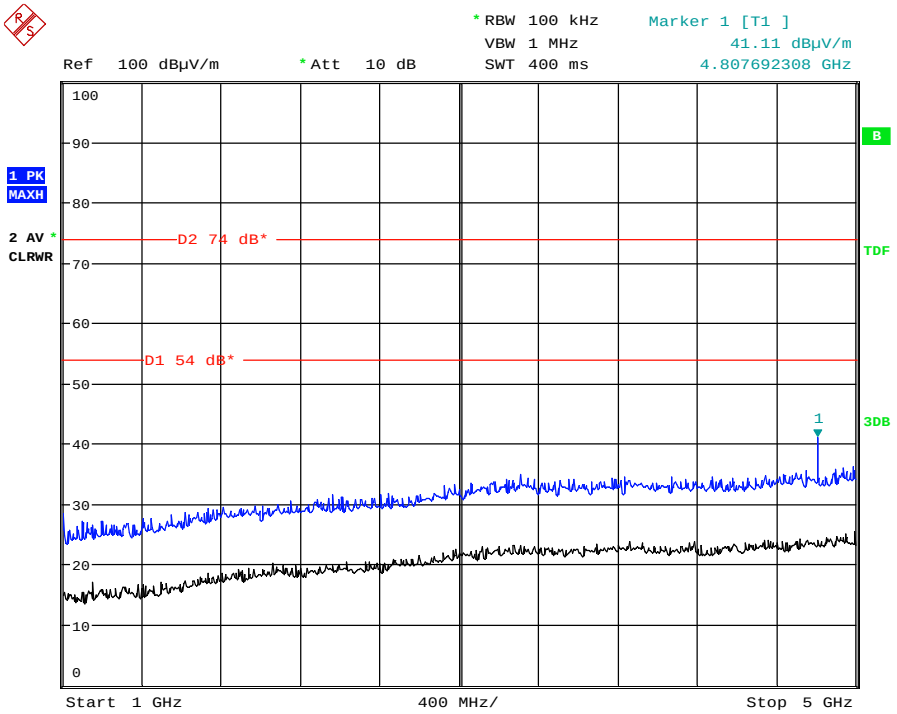


Date: 4.SEP.2012 13:30:00

Unintentional Radiated spurious emissions 30MHz to 1GHz – 2440MHz

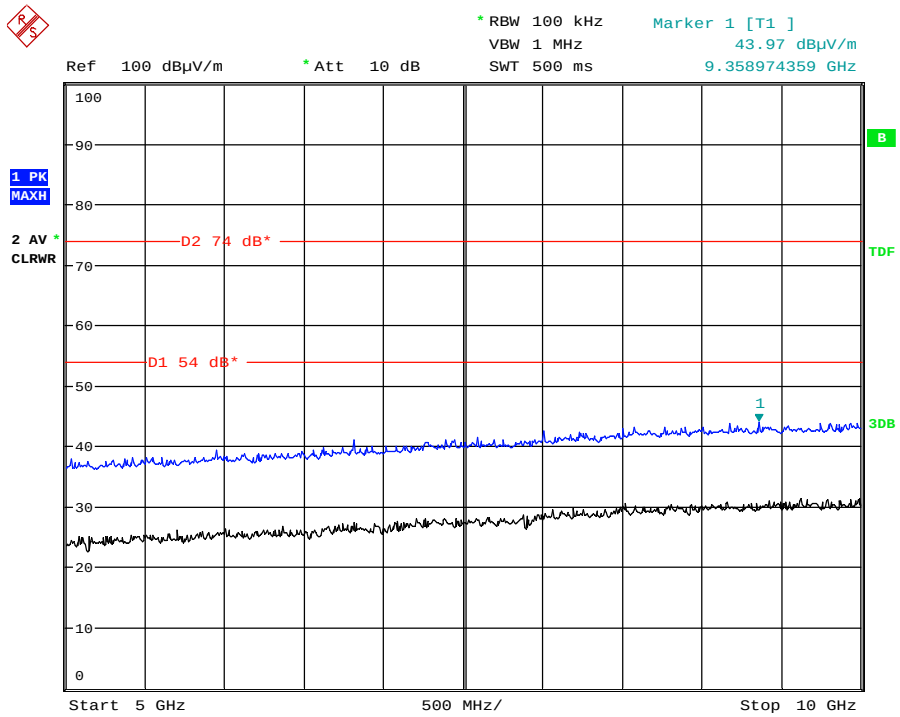


Unintentional Radiated spurious emissions 1GHz to 5GHz – 2440MHz



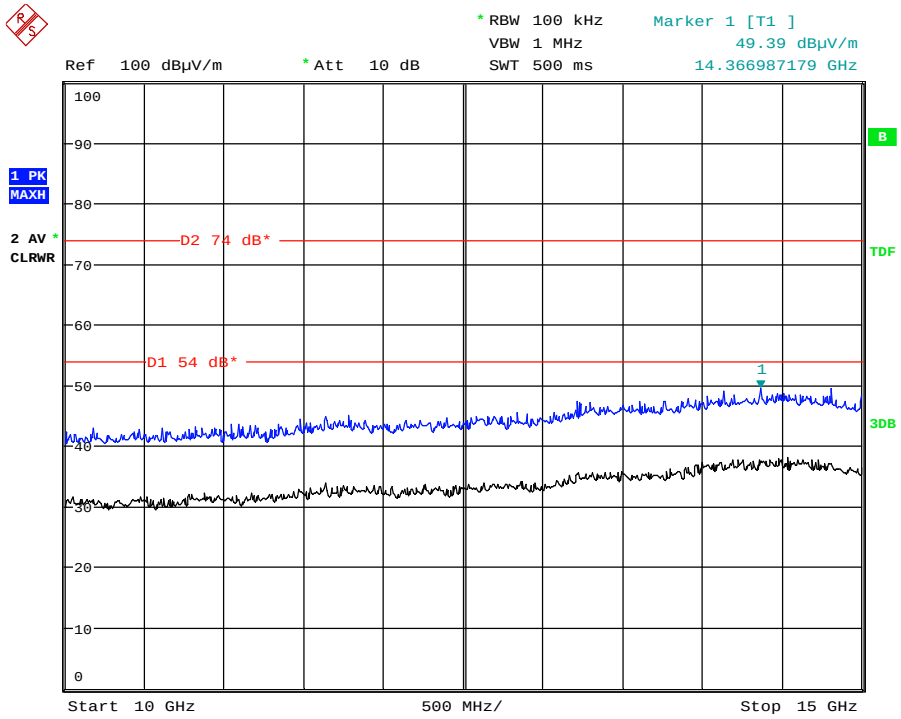
Date: 3.SEP.2012 16:17:22

Unintentional Radiated spurious emissions 5GHz to 10GHz – 2440MHz



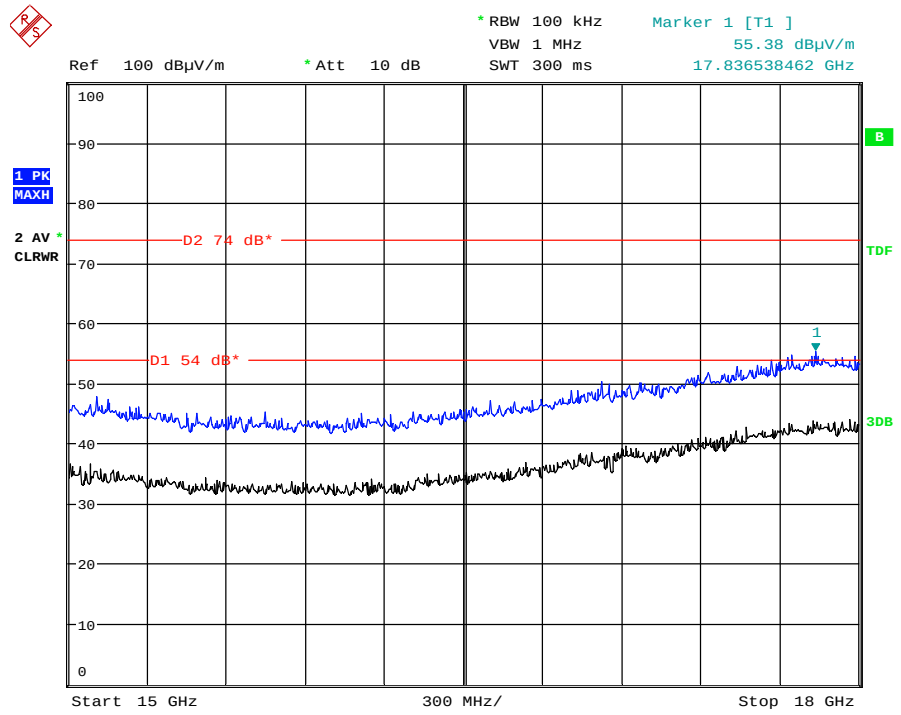
Date: 3.SEP.2012 16:46:05

Unintentional Radiated spurious emissions 10GHz to 15GHz – 2440MHz



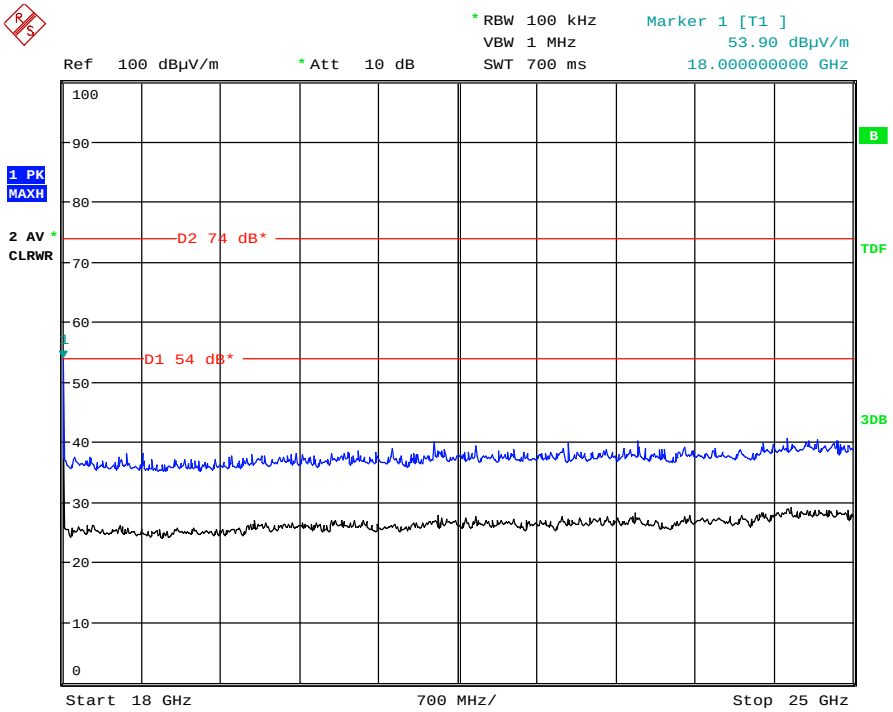
Date: 3.SEP.2012 16:46:34

Unintentional Radiated spurious emissions 15GHz to 18GHz – 2440MHz



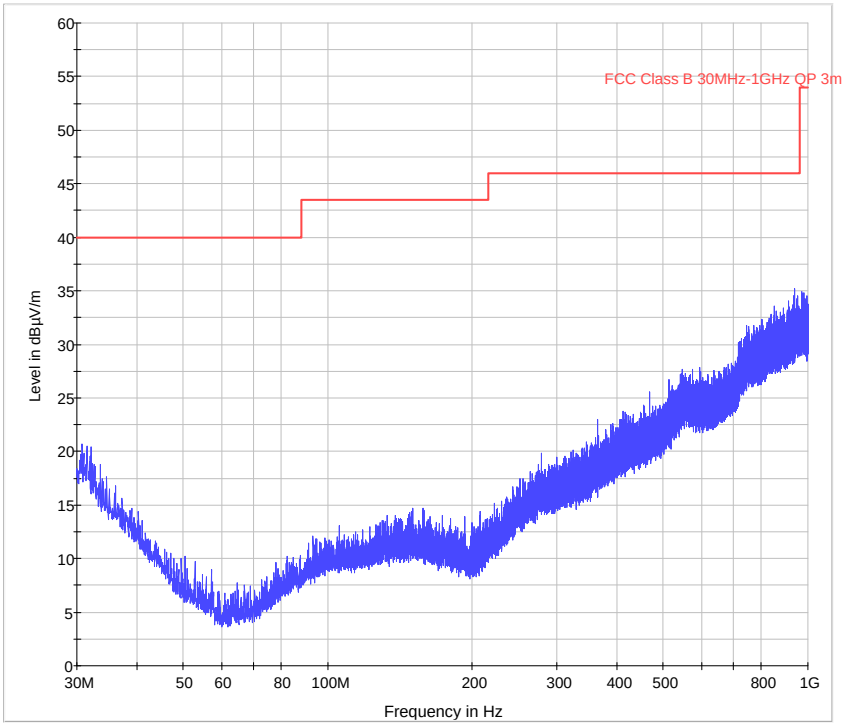
Date: 3.SEP.2012 16:47:06

Unintentional Radiated spurious emissions 18GHz to 25GHz – 2440MHz

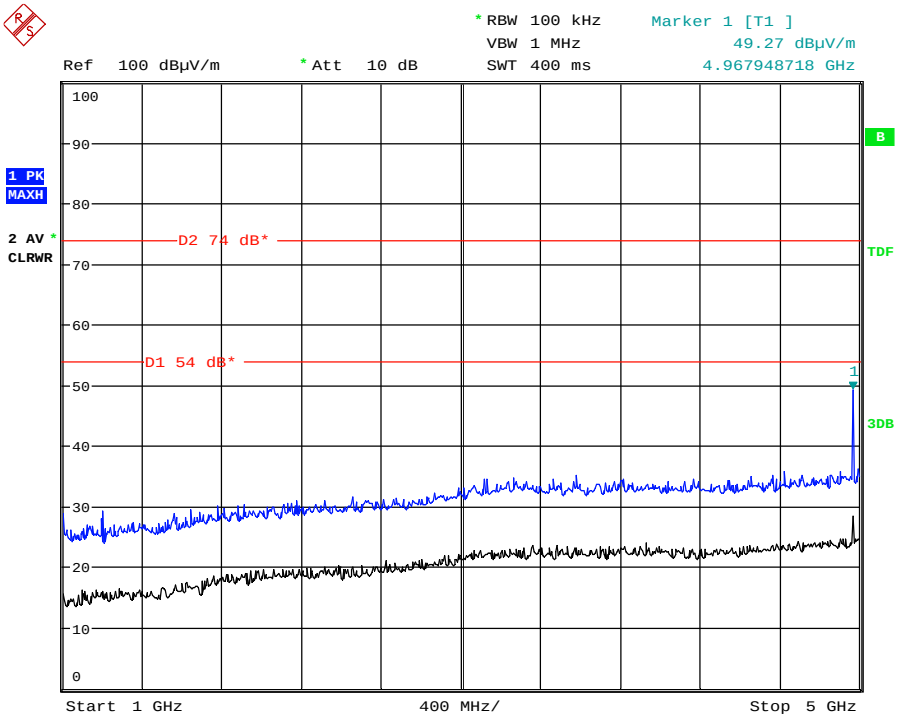


Date: 4.SEP.2012 13:30:13

Unintentional Radiated spurious emissions 30MHz to 1GHz – 2482.5MHz

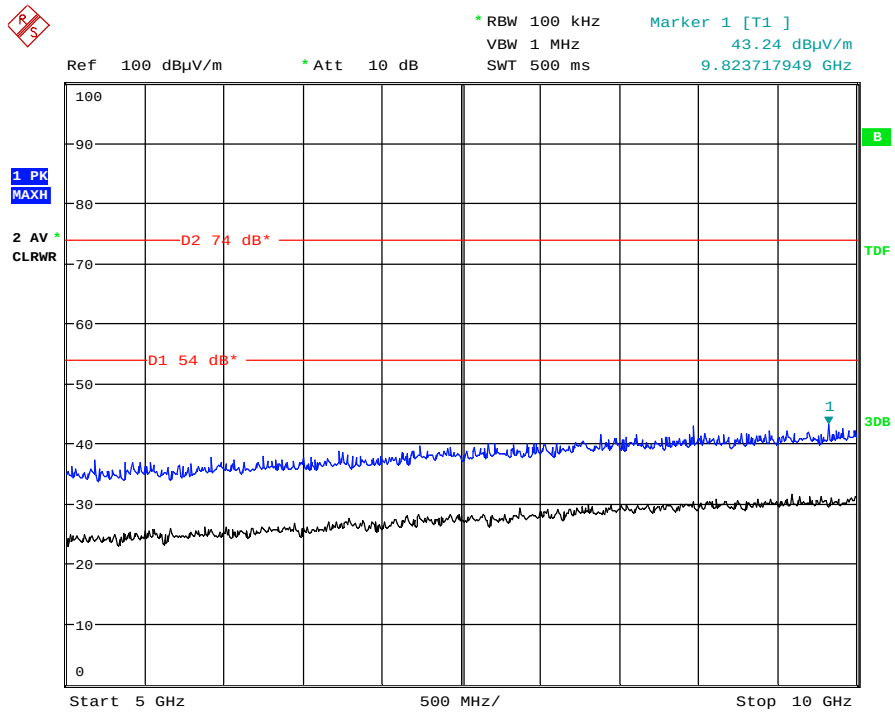


Unintentional Radiated spurious emissions 1GHz to 5GHz – 2482.5MHz



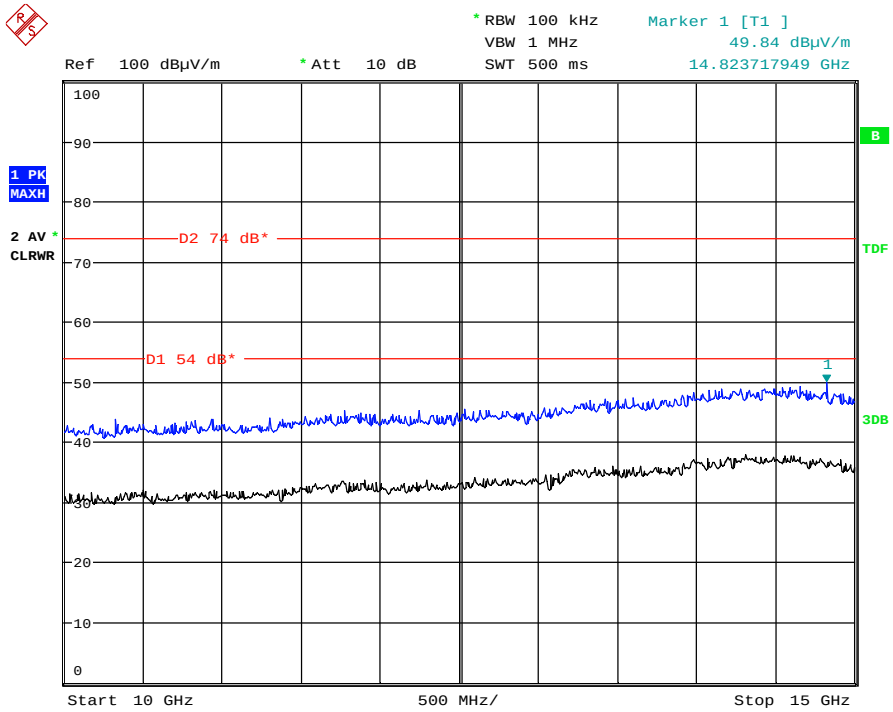
Date: 3.SEP.2012 16:56:06

Unintentional Radiated spurious emissions 5GHz to 10GHz – 2482.5MHz



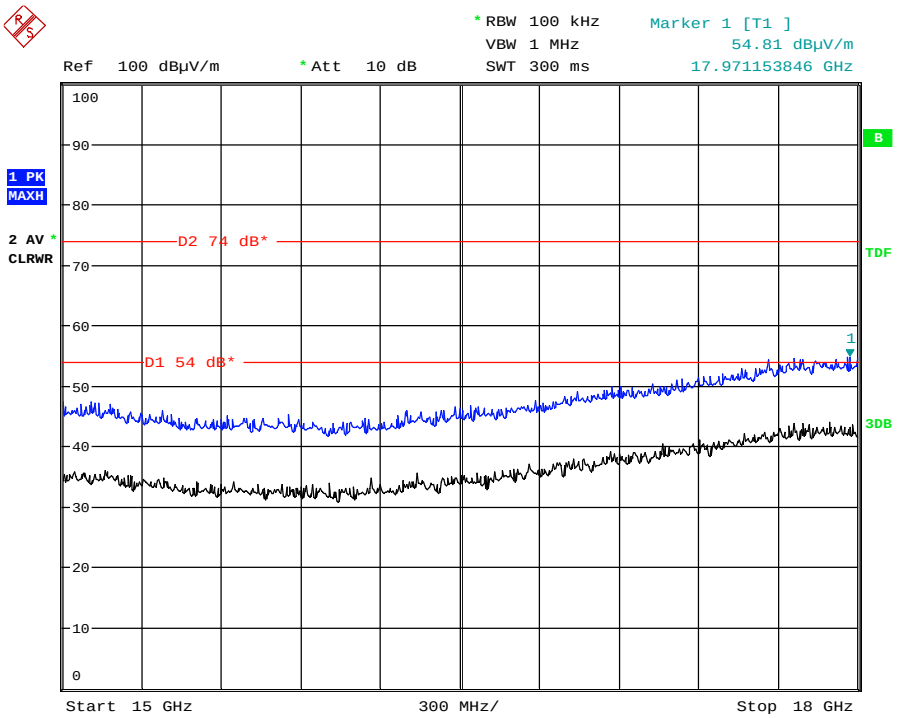
Date: 3.SEP.2012 16:55:43

Unintentional Radiated spurious emissions 10GHz to 15GHz – 2482.5MHz



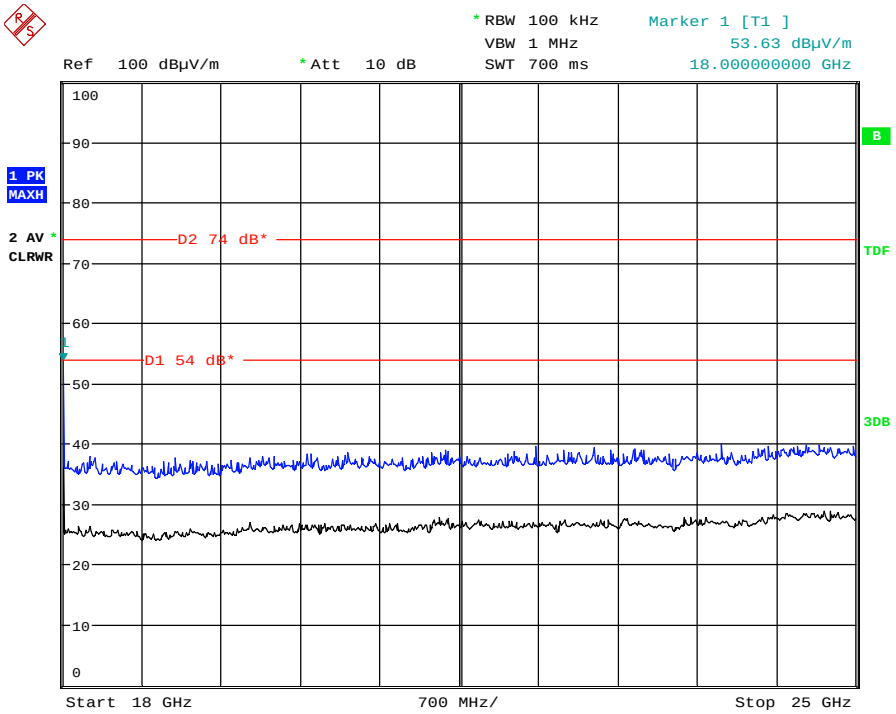
Date: 3.SEP.2012 16:55:22

Unintentional Radiated spurious emissions 15GHz to 18GHz – 2482.5MHz



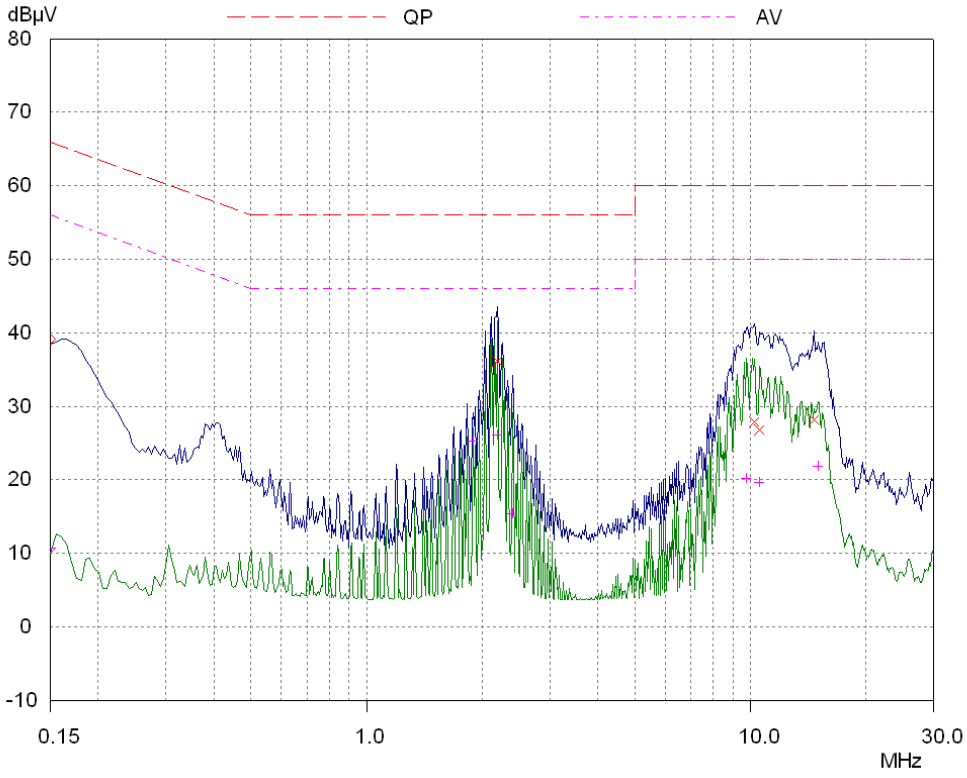
Date: 3.SEP.2012 16:54:38

Unintentional Radiated spurious emissions 18GHz to 25GHz – 2482.5MHz

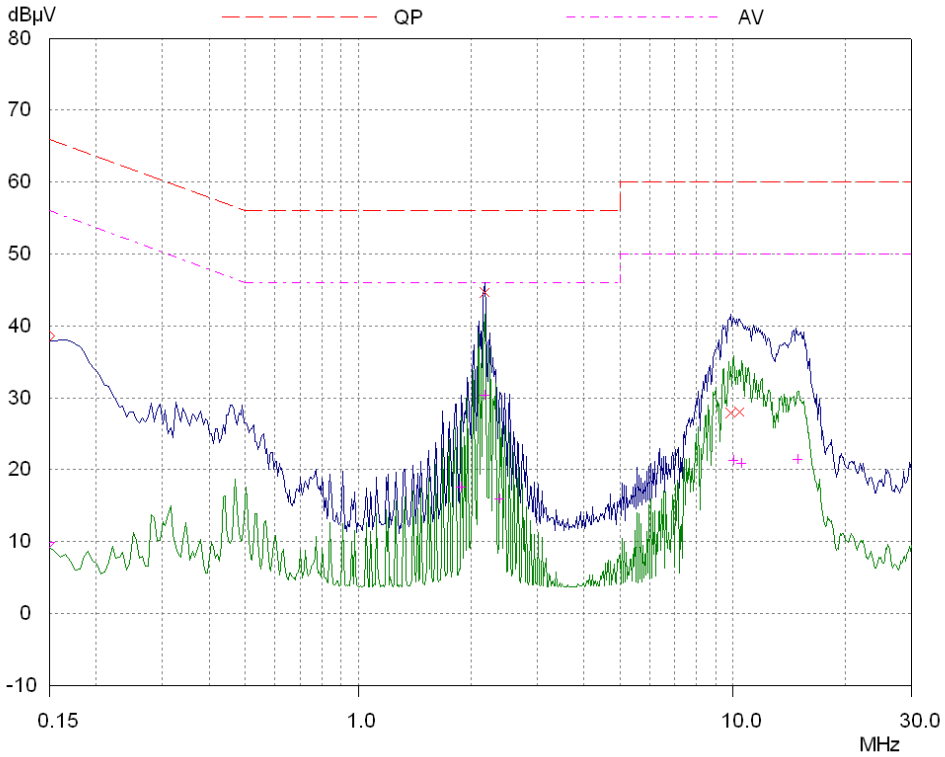


Date: 4.SEP.2012 13:31:34

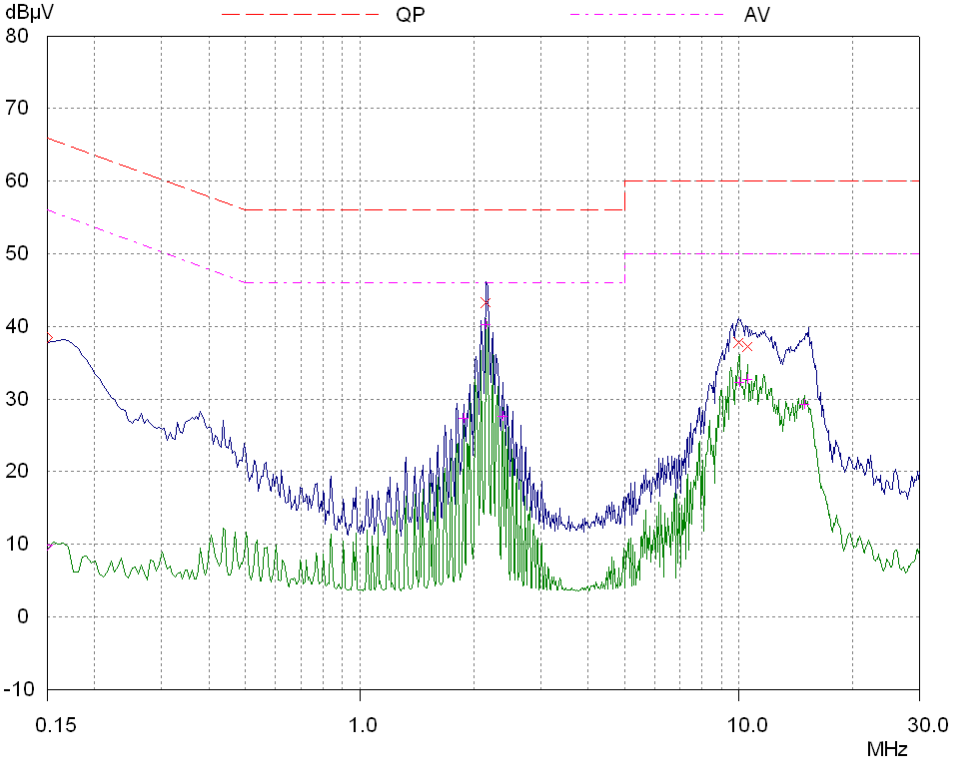
AC Powerline Conducted Emissions on Live line – Transmit mode



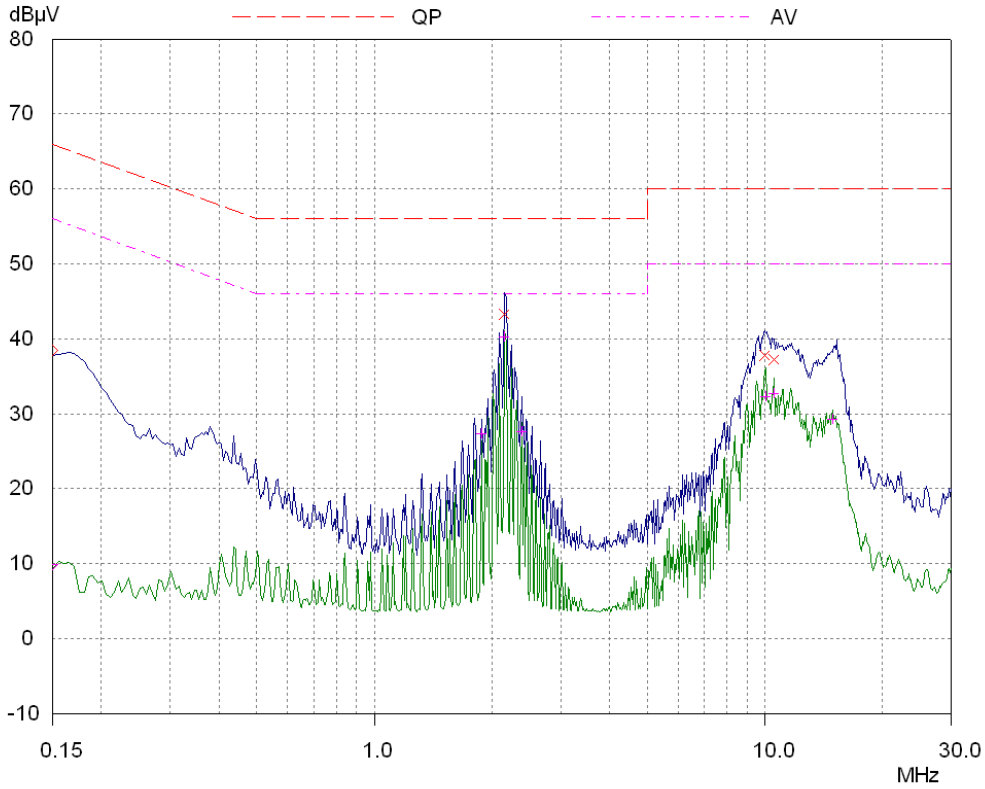
AC Powerline Conducted Emissions on Neutral line – Transmit mode



AC Powerline Conducted Emissions on Live line – Receive mode



AC Powerline Conducted Emissions on Neutral line – Receive mode



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 it's 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	RF Module PBB GC350616	None
S02	Interface PCB	None

The following samples of apparatus were supplied by TRaC Global as support or drive equipment (auxiliary equipment):

Identification	Description
None	Test Laptop

C2 EUT operating mode during testing

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

Test	Description of Operating Mode
Transmitter field strength, 20dB Bandwidth, Radiated spurious emissions	EUT actively transmitting
Unintentional radiated spurious emissions	EUT active but non-transmitting
AC Powerline Conducted Emissions	EUT set in transmit and receive mode in turns

C3 EUT Configuration Information

The EUT was submitted for testing in one single possible configuration.

C4 List of EUT Ports

The table below describes the termination of EUT ports:

Sample : S01
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
Power	Twisted pair	Any	5V Supply
USB	Shielded USB cable	Any	Laptop*
9-way Serial	RS-232/DE-9 cable	Any	Laptop*

* Only connected during setup

C5 Details of Equipment Used

TRaC Ref	Type	Description	Manufacturer	Date Calibrated
UH281	FSU46	Spectrum Analyser	R&S	09/02/2012
TRL138	3115	1-18GHz Horn Antenna	EMCO	08/11/2011
TRL300	20240-20	Horn 18-26GHz (&UH330)	Flann	17/11/2011
TRL572	8499B	1 – 26.5 GHz Pre Amplifier	Agilent	24/11/2010
UH003	ESHS10	9kHz – 30MHz Receiver	R&S	16/02/2012
UH004	ESVS10	30MHz – 1GHz Receiver	R&S	12/01/2012
UH191	CBL611/A	Bi-Log Antenna	York	08/11/2010
UH396	ESH3-Z5.831.5	LISN	R&S	12/04/2012

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%

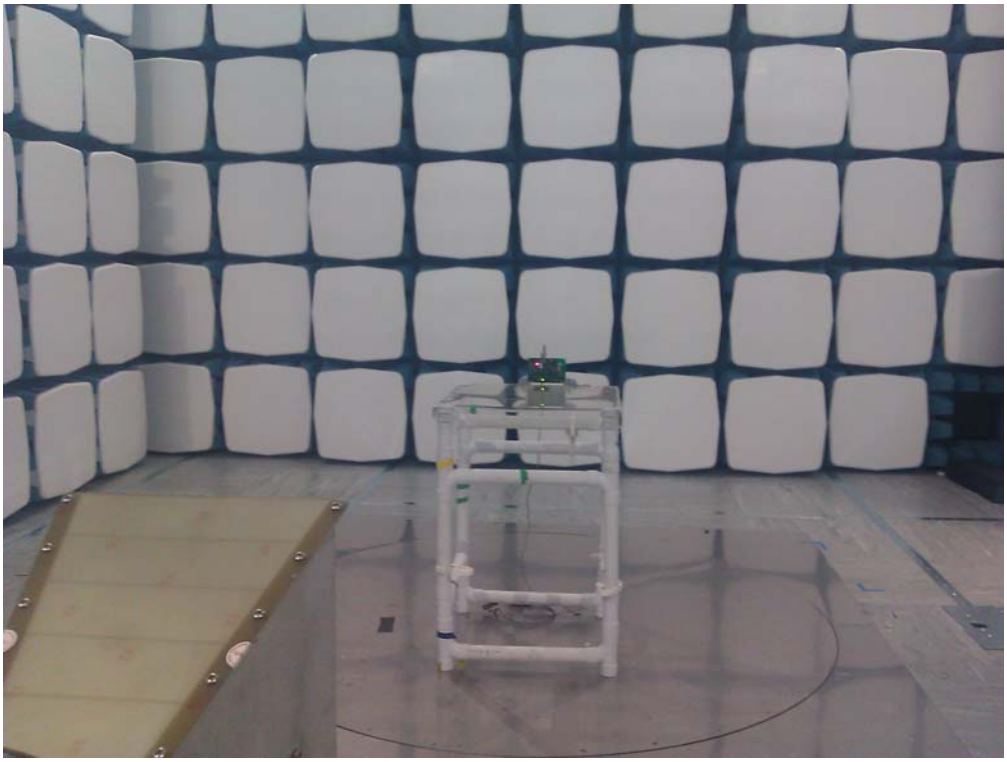
Correction factor (dB) = 20 x (Log_{10} 0.07459) = -22.54dB

Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated Emissions Arrangement
2. AC Powerline Conducted Emissions Setup

Photograph 1



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Photograph 2

Appendix G: Cross Reference FCC Part 15c to IC RSS Gen

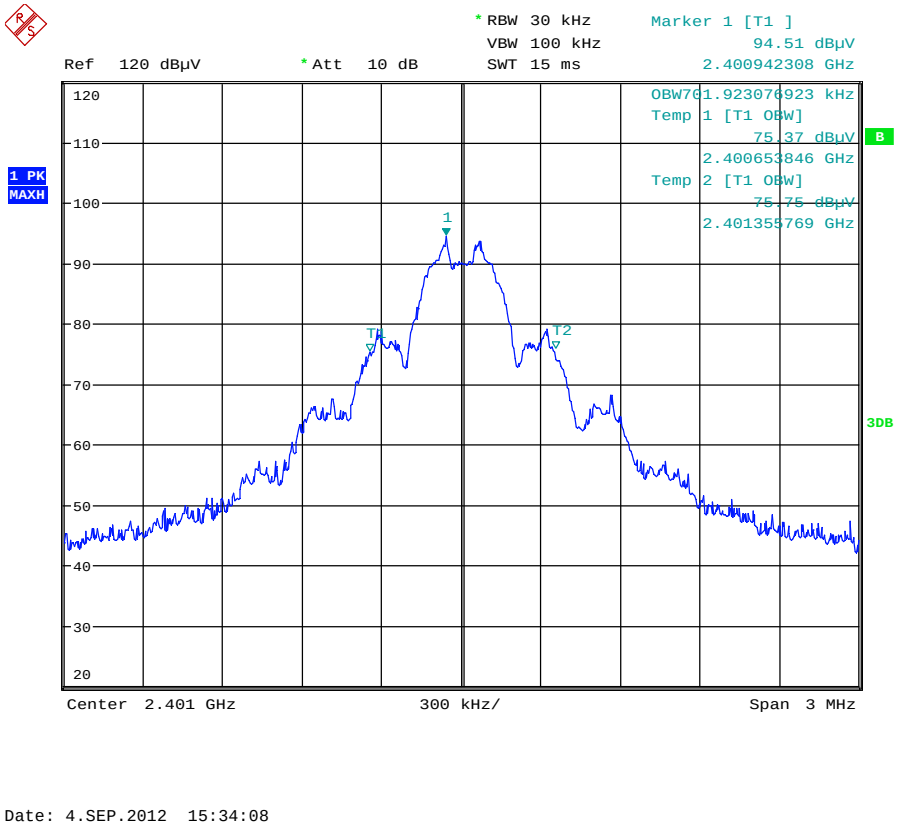
The testing was carried out to FCC 47CFR Part 15c and the results for this testing can be found in Appendix A of this report.

All measurements were carried out in accordance with ANSI C63.4, 'Methods of Measurements of RF Emissions from Low Voltage Electrical and Electronic Equipment' in the range 9 kHz to 1 GHz.

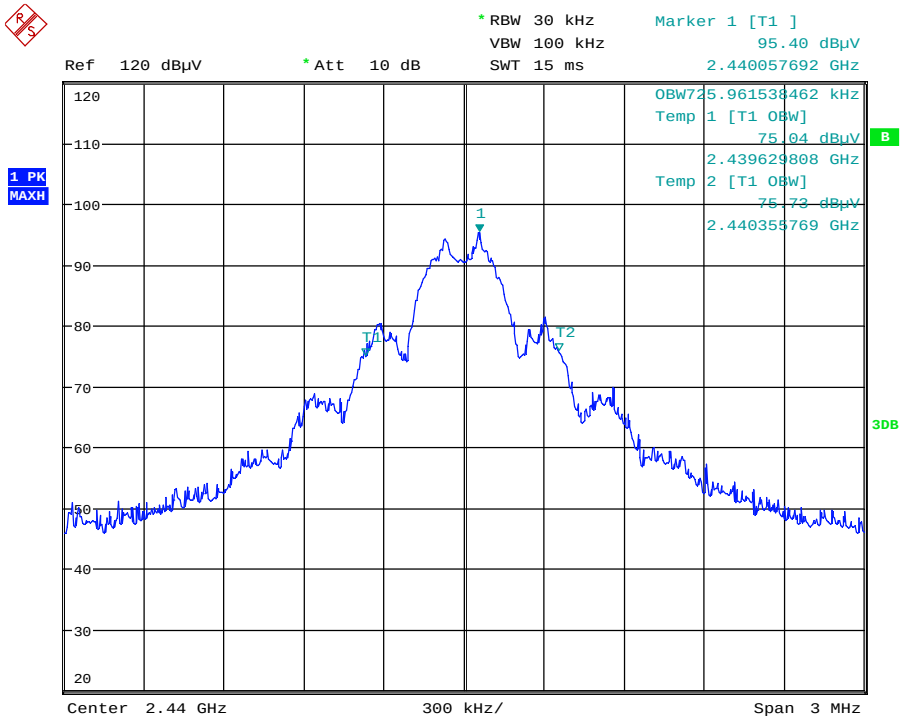
In addition, the 99% emissions bandwidth table and plots, as stipulated in Section 4.6.1 of RSS-Gen are provided below.

Channel Frequency (MHz)	99% Bandwidth (kHz)
2401	701.923
2440	725.961
2482.5	730.769

99% Bandwidth – 2401MHz



99% Bandwidth – 2440MHz



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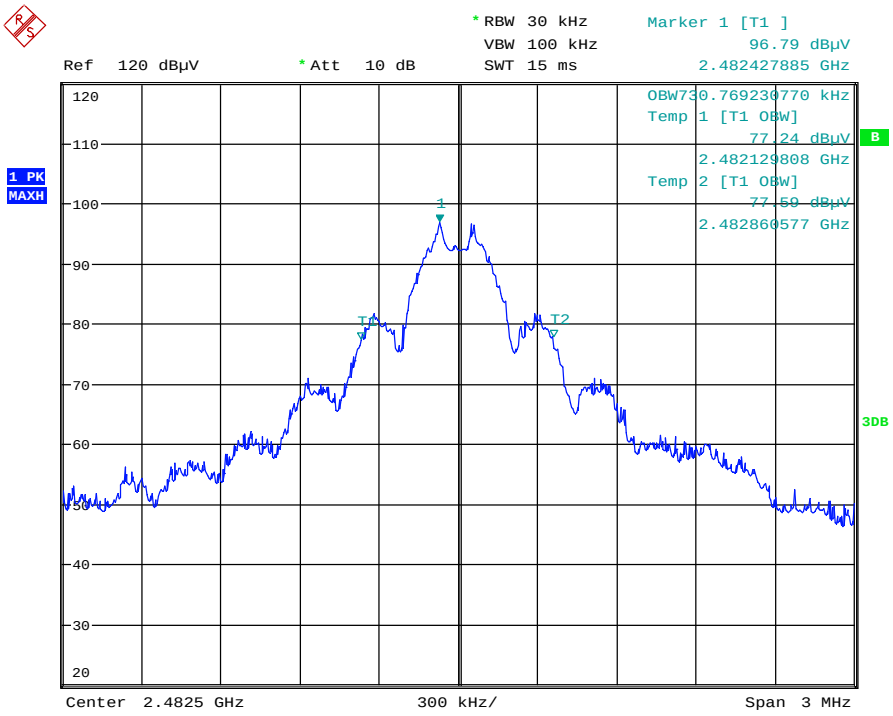
99% Bandwidth – 2482.5MHz



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