

**TRaC Wireless Test Report : TTR-004771WUS1**

**Applicant** : Comark Ltd.

**Apparatus** : RF500A

**Specification(s)** : CFR47 Part 15.247, July 2008

**FCCID** : TVHFR500A

**Purpose of Test** : Certification

**Authorised by** :



: Radio Product Manager

**Issue Date** : 28<sup>th</sup> April 2011

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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**

This testing in this report was requested by:

Comark Ltd.  
Comark House  
Bury Mead Road  
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### **1.3 Manufacturer**

As above.

### **1.4 Apparatus Assessed**

The following apparatus was assessed between 11<sup>th</sup> and 14<sup>th</sup> of April 2011:

RF500A

The above device is an RF Gateway Instrument operating in the 2400 – 2483.5 MHz band.  
The RF500A uses DSSS modulation and a single channel at 2405 MHz.

## 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	Pass
Occupied Bandwidth	Title 47 of the CFR : Part 15 Subpart C; 15.247(a)(2)	ANSI C63.10	Pass
Conducted Carrier Power	Title 47 of the CFR : Part 15 Subpart C; 15.247(b)	ANSI C63.10	Pass
Power Spectral Density	Title 47 of the CFR : Part 15 Subpart C; 15.247(d)	ANSI C63.10	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: Part 15 Subpart B; 15.109	ANSI C63.10	Pass
Digital Modulation	Title 47 of the CFR: Part 15 Subpart C; 15.403	-	N/A
RF Safety	Title 47 of the CFR : Part 15 Subpart C; 15.247(b)(5)	-	N/A

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 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	ALSR	: Absorber Lined Screened Room
Mod	: Modification	OATS	: Open Area Test Site
		ATS	: Alternative Test Site
EUT	: Equipment Under Test		
SE	: Support Equipment	Ref	: Reference
L	: Live Power Line	Freq	: Frequency
N	: Neutral Power Line	MD	: Measurement Distance
E	: Earth Power Line	SD	: Spec Distance
Pk	: Peak Detector	Pol	: Polarisation
QP	: Quasi-Peak Detector	H	: Horizontal Polarisation
Av	: Average Detector	V	: Vertical Polarisation
CDN	: Coupling & decoupling network		

## A1 6 dB Bandwidth

Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(2) requires the measurement of the bandwidth of the transmission between the -6 dB points on the transmitted spectrum.

Test Details:	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) 15.247(a)(2)
EUT sample number	S01, S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
Temperature	20 <sup>0</sup> C
EUT set up	Refer to Appendix C

Channel Frequency (MHz)	$f_{\text{lower}}$	$f_{\text{higher}}$	Measured Bandwidth (kHz)	Limit	Result
2405.00	2404.192308	2405.788462	1596.154	>500kHz	Pass

Plots of the 6 dB bandwidth are contained in Appendix B of this test report.

### Notes:

- Conducted measurements were carried out for the 6 dB Bandwidth test with the EUT transmitting on its only channel.
- The conducted measurements were performed with the unique antenna connector on the equipment.

## A2 Transmitter Peak Output Power

Carrier power was verified with the EUT transmitting on its only channel.

Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.247(b)(3)
Measurement standard	ANSI C63.10
EUT sample number	S01, S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20 <sup>0</sup> C

Channel Frequency (MHz)	Peak Carrier Power (dBm)	Cable Loss (dB)	Antenna Gain (dBi)	Actual Peak Power (dBm)	Limit (dBm)	Result
2405.00	0.33	0.4	7	7.73	30	Pass

### Notes:

- Conducted measurements were performed for the Transmitter Peak Output Power test
- Highest Gain of any antenna to be used = 7 dBi
- The conducted measurements were performed with the unique antenna connector on the equipment.

### A3 Transmitter Power Spectral Density

Transmitter Power Spectral Density was verified with the EUT transmitting on its only channel.

Test Details:	
Regulation	Title 47 of the CFR: Part15 Subpart (c) 15.247(b)(3)
Measurement standard	ANSI C63.10
EUT sample number	S01, S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20 <sup>0</sup> C

Channel Frequency (MHz)	Peak Power Spectral Density (dBm)	Limit (dBm)	Result
2405.00	-12.03	8	Pass

#### Notes:

- Conducted measurements were carried out for the Power Spectral Density test
- Measured Power Spectral Density includes highest gain of any antenna to be used
- Highest Gain of any antenna to be used = 7 dBi
- The conducted measurements were performed with the unique antenna connector on the equipment
- The resolution bandwidth on the analyser was set to 3kHz and trace set to max hold
- The span is set to 3MHz
- The sweep time is 1000 seconds (Span/3kHz)

#### A4 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 only channel.

Test Details: 2405 MHz Channel	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10
Application	Antenna Port
Frequency range	9 kHz to 25 GHz
EUT sample number	S01, S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20°C

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

Ref No.	Det.	Measured Freq (MHz)	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 limits are based on a transmitted carrier level of 15.247(b). With the EUT transmitting on its lowest frequency 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 accordance 15.33 (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.

The limits are 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.

## A5 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 field 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 and receive on its only channel.

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: 2405 MHz Channel	
Regulation	Title 47 of the CFR, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.10
Frequency range	30MHz – 25GHz
EUT sample number	S01, S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20°C
Photographs (Appendix F)	Photographs 1 & 2

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

Ref No.	FREQ. (MHz)	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)
1.	4807.692	30.07	1.3	32.8	35.4	28.77	-	753.355	5011

The setup details for the radiated measurements taken are as follows:

- Measurement distances: 1m, 3m
- EUT was mounted at 0.8m above ground plane
- Emissions were maximized by rotating the EUT on an automated turntable
- Receiver antenna was raised and lowered between 1m & 4m
- Receiver antenna was set in both horizontal and vertical polarizations
- Maximum results were recorded for EUT orientation in three orthogonal planes

**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

The upper and lower frequency of the measurement range was decided according to 47 CFR, Part 15:2008 Clause 15.33(a) and 15.33(a)(1).

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

Frequency of emission (MHz)	Field strength ( $\mu$ V/m)	Measurement Distance (m)	Field strength (dB $\mu$ V/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:

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

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				

## A6 Power Line Conducted Emissions

Previous 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. The EUT was set to transmit and receive on its only channel. The formal measurements are detailed below:

Test Details	
Regulation	Title 47 of the CFR: Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.10
Frequency range	150kHz to 30MHz
EUT sample number	S01, S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 3

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

EUT in Receive Mode:

### Results measured using the average detector compared to the average limit

Ref No.	Freq (MHz)	Conduct or	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.175	Neutral	36.56	54.72	18.16	Pass
2	0.21	Neutral	33.53	53.21	19.68	Pass

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

Ref No.	Freq (MHz)	Conduct or	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.175	Neutral	48.48	64.72	16.24	Pass

EUT in Transmit Mode:

**No significant emissions within 20dB of the limit.**

**Specification limits:**

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

Conducted disturbance at the mains ports:

Frequency range MHz	Limits dB $\mu$ V	
	Quasi-peak	Average
0.15 to 0.5	66 to 56 <sup>2</sup>	56 to 46 <sup>2</sup>
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				

#### **A7     Antenna Gain**

The maximum antenna gain for the antenna types to be used with the EUT, as declared by the client, is 7 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 transmit and receive on its only channel.

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

Test Details: 2405 MHz Channel	
Regulation	Title 47 of the CFR: Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.10
Frequency range	30MHz to 25 GHz
EUT sample number	S01, S02
Modification state	0
SE in test environment	N/A
SE isolated from EUT	N/A
EUT set up	Refer to Appendix C
Temperature	20 <sup>0</sup> C
Photographs (Appendix F)	Photographs 1 & 2

The worst case radiated emission measurements for spurious emissions:

Ref No.	FREQ. (MHz)	MEAS Rx (dB $\mu$ V)	CABLE LOSS (dB)	ANT FACT. (dB/m)	PRE AMP (dB)	FIELD ST'GH (dB $\mu$ V/m)	EXTRAP FACT (dB)	FIELD ST'GH ( $\mu$ V/m)	LIMIT ( $\mu$ V/m)
1	49.8	11.5	1.1	7.8	-	20.4	-	10.47	100
2	155.2	17.1	1.4	9.7	-	28.2	-	25.70	150
3	172.25	15.1	1.5	9	-	25.6	-	19.05	150
4	173.45	15.6	1.5	8.9	-	26	-	19.95	150
5	199.5	26.4	1.6	8.7	-	36.7	-	68.39	150
6	243.85	21	1.8	11.4	-	34.2	-	51.29	200
7	266	26.2	1.9	12.9	-	41	-	112.20	200
8	465.5	11.9	2.5	16.6	-	31	-	35.48	200
9	554.2	5.9	2.7	18.4	-	27	-	22.39	200
10	598.55	13.1	2.8	18.6	-	34.5	-	53.09	200
11	855	12.2	3.3	20.3	-	35.8	-	61.66	200
12	886.7	11.3	3.4	20.5	-	35.2	-	57.54	200
13	893.05	15.1	3.4	20.7	-	39.2	-	91.20	200
14	912.05	16.6	3.4	20.8	-	40.8	-	109.65	200
15	931.05	12.7	3.5	20.7	-	36.9	-	69.98	200
16	997.55	12.3	3.6	21.5	-	37.4	-	74.13	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
- 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

The upper and lower frequency of the measurement range was decided according to 47 CFR 15:2008 Clause 15.33(a) and 15.33(a)(1).

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

Frequency of emission (MHz)	Field strength $\mu$ V/m	Measurement Distance m	Field strength dB $\mu$ V/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:

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

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				

**Appendix B:**

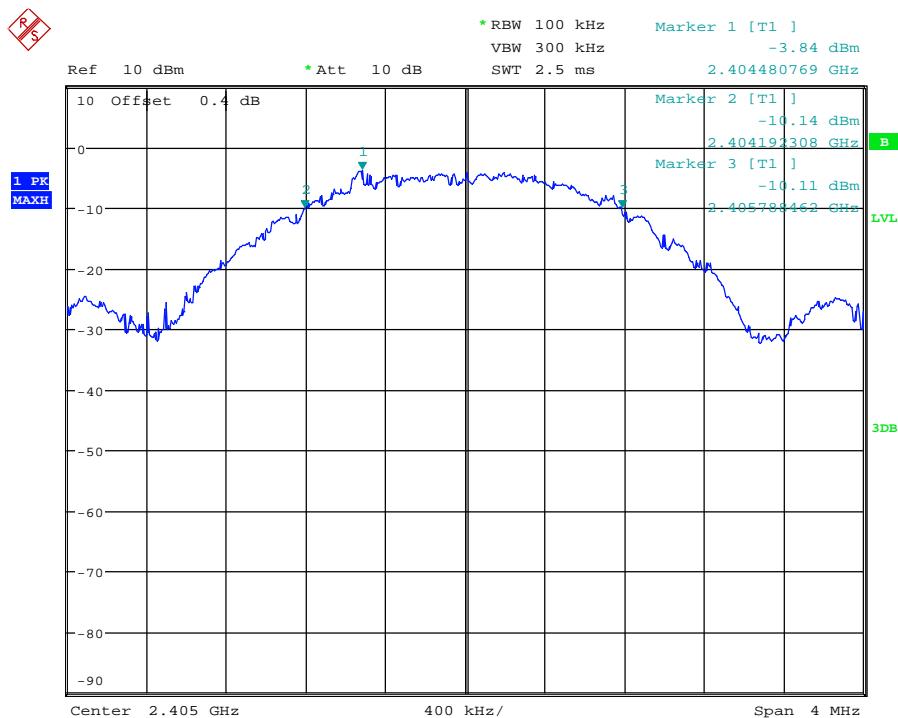
**Supporting Graphical Data**

This appendix contains graphical data obtained during testing.

Notes:

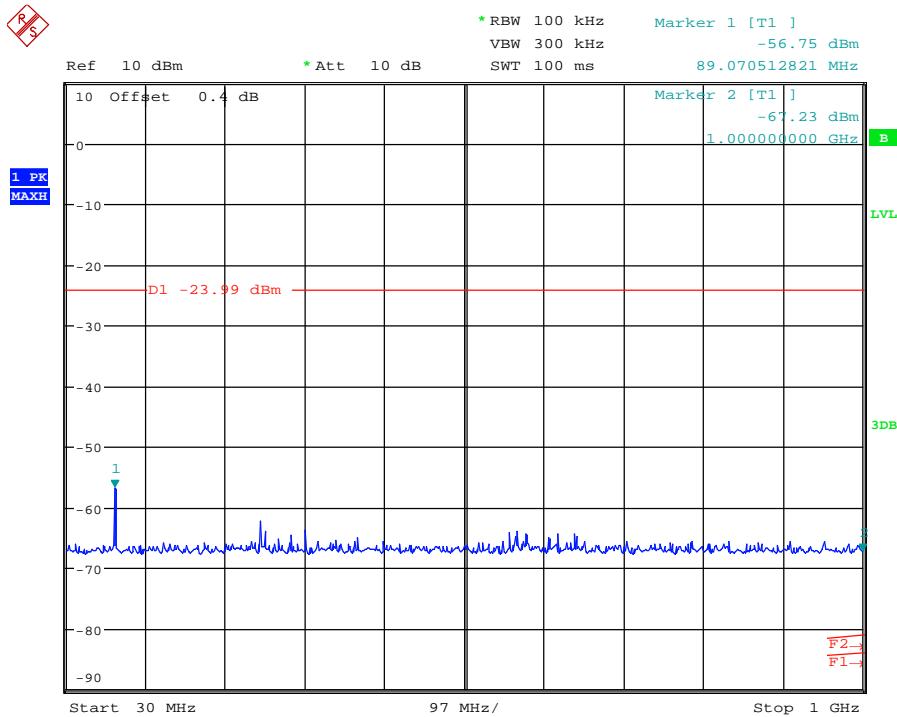
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power 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.

## 6dB Bandwidth



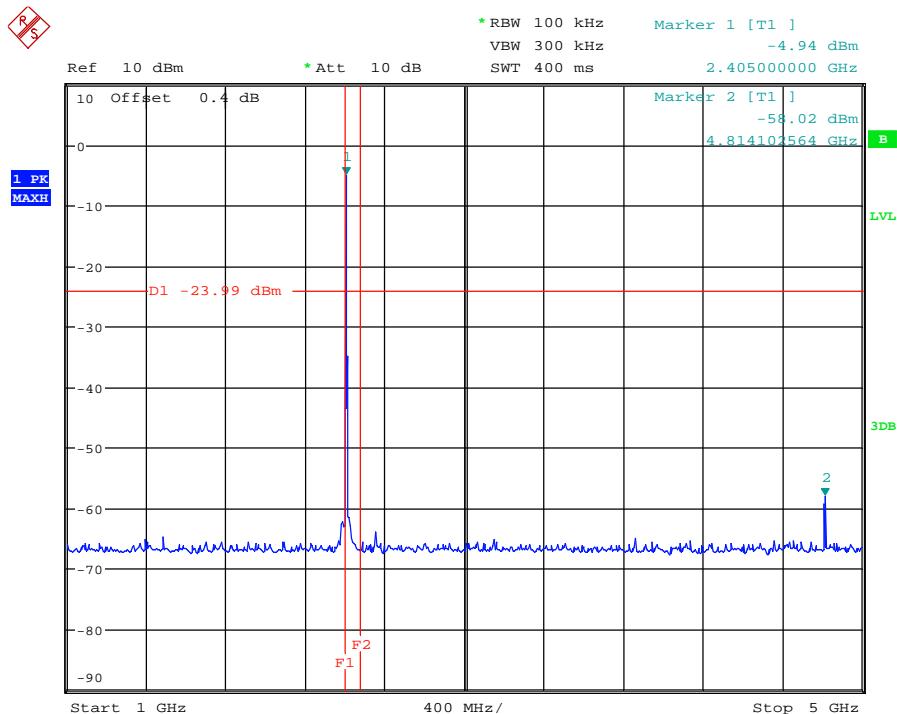
Date: 13.APR.2011 09:15:23

## Conducted spurious emissions 30 MHz to 1 GHz



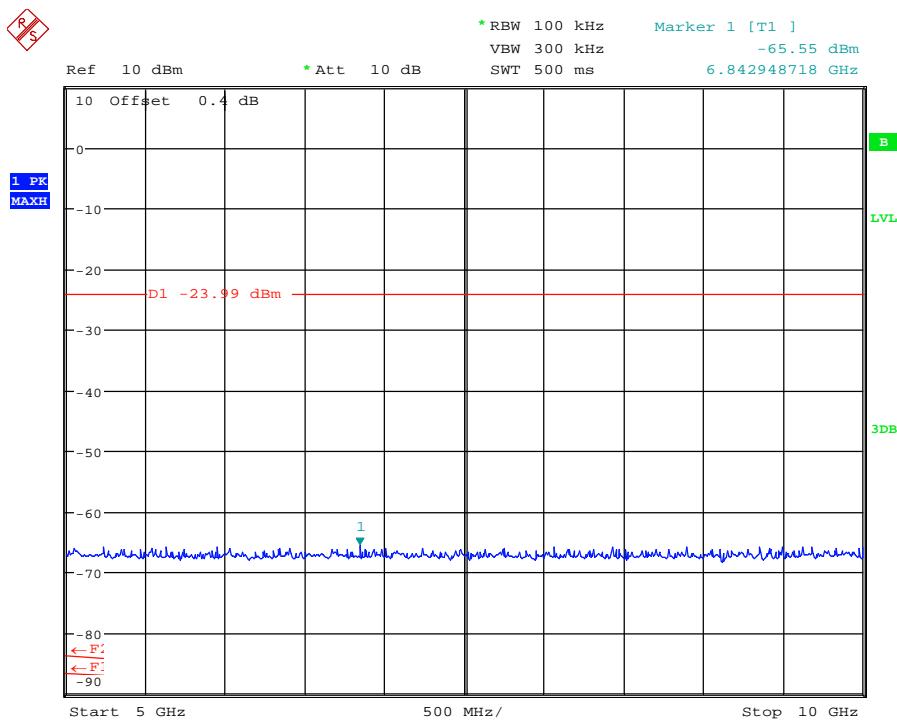
Date: 13.APR.2011 10:34:07

## Conducted spurious emissions 1 GHz to 5 GHz



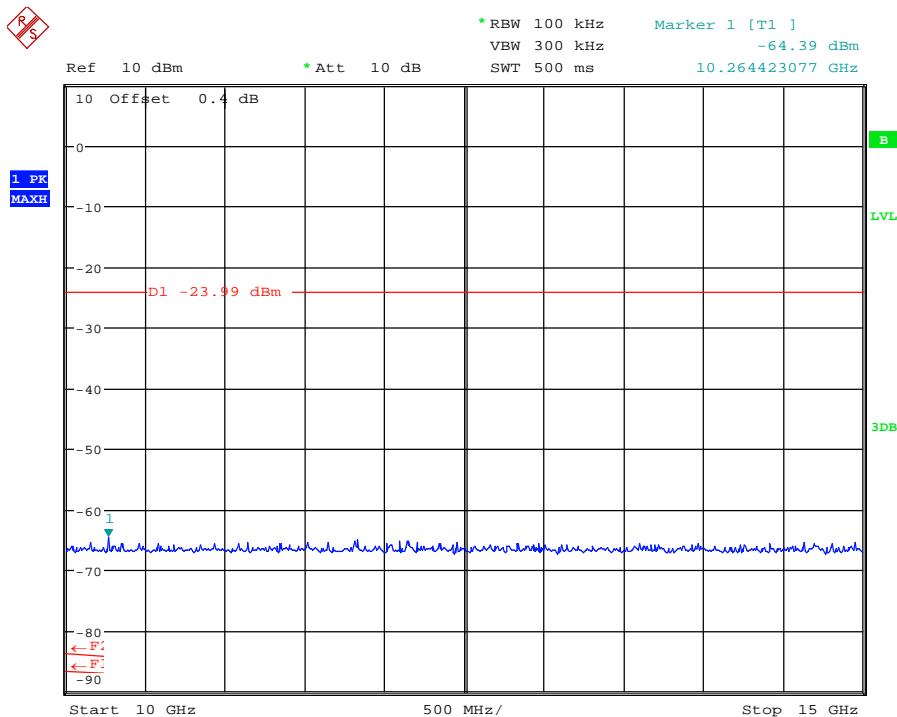
Date: 13.APR.2011 10:29:57

## Conducted spurious emissions 5 GHz to 10 GHz



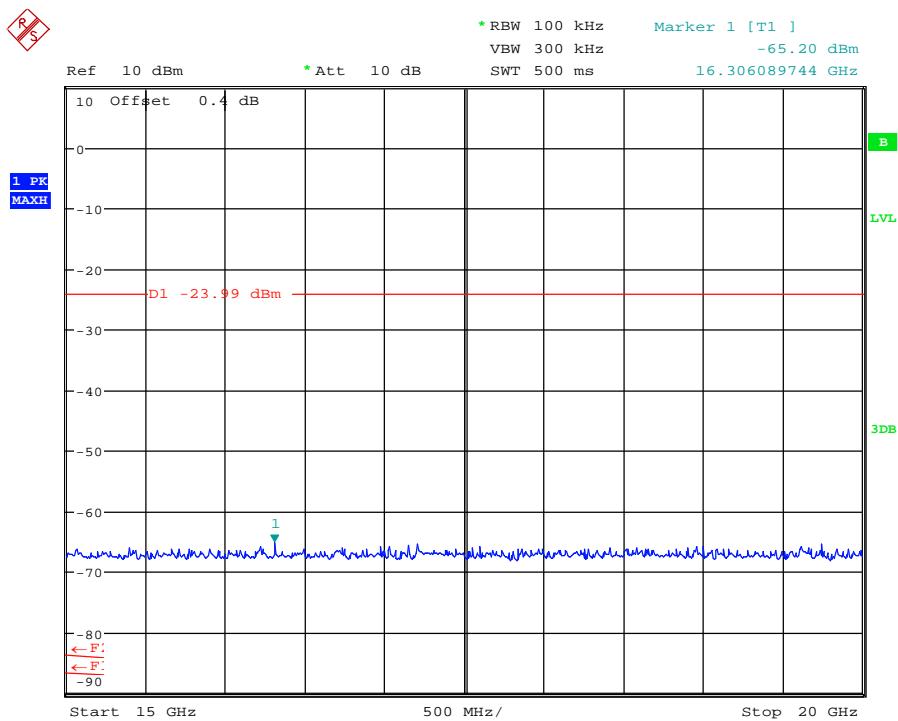
Date: 13.APR.2011 10:37:30

## Conducted spurious emissions 10 GHz to 15 GHz



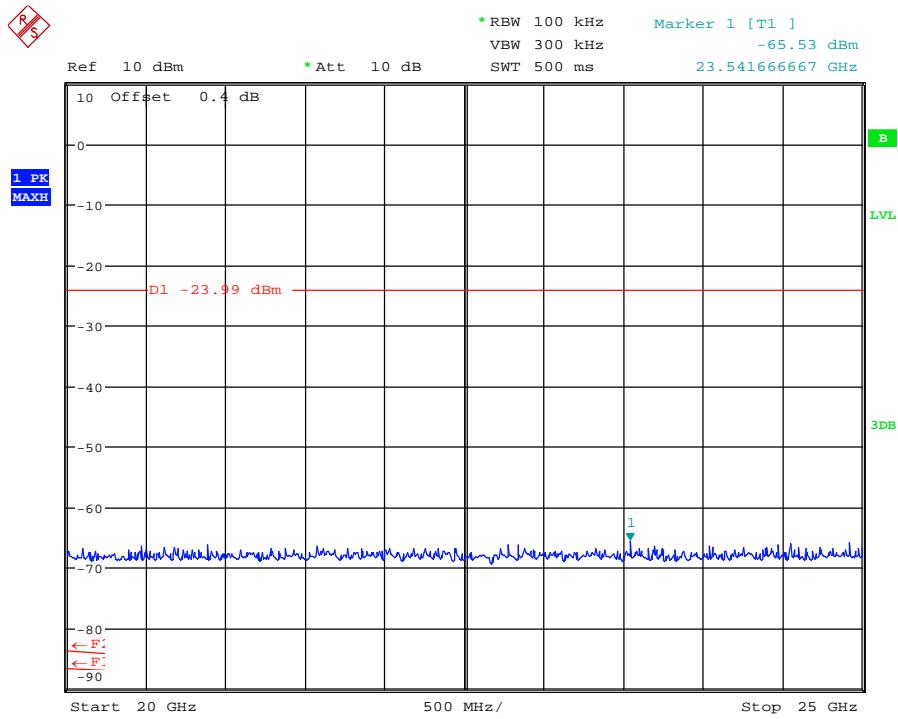
Date: 13.APR.2011 10:51:43

## Conducted spurious emissions 15 GHz to 20 GHz



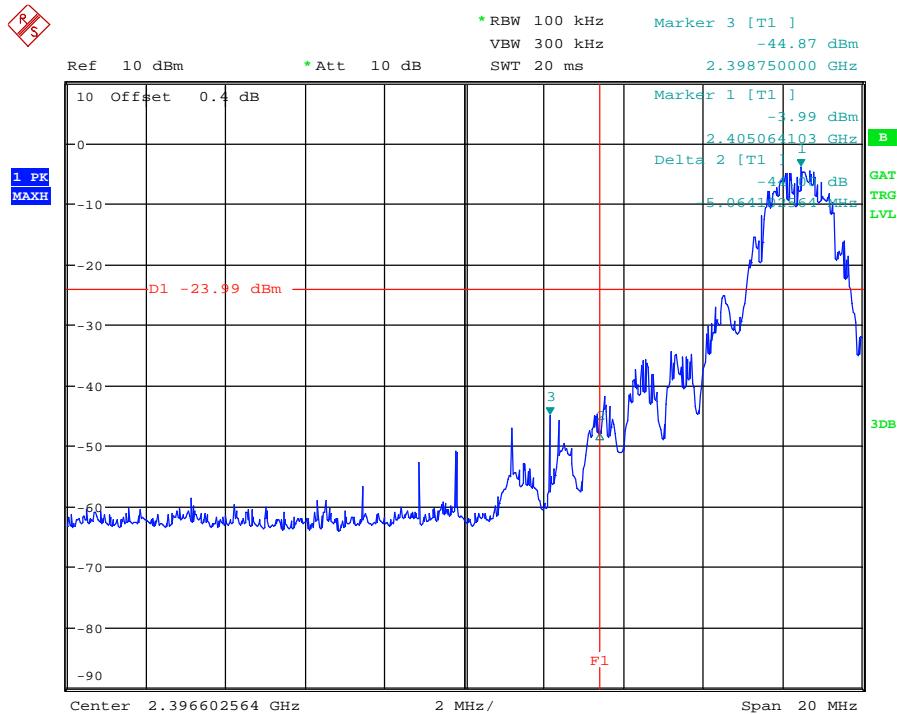
Date: 13.APR.2011 10:54:22

## Conducted spurious emissions 20 GHz to 25 GHz



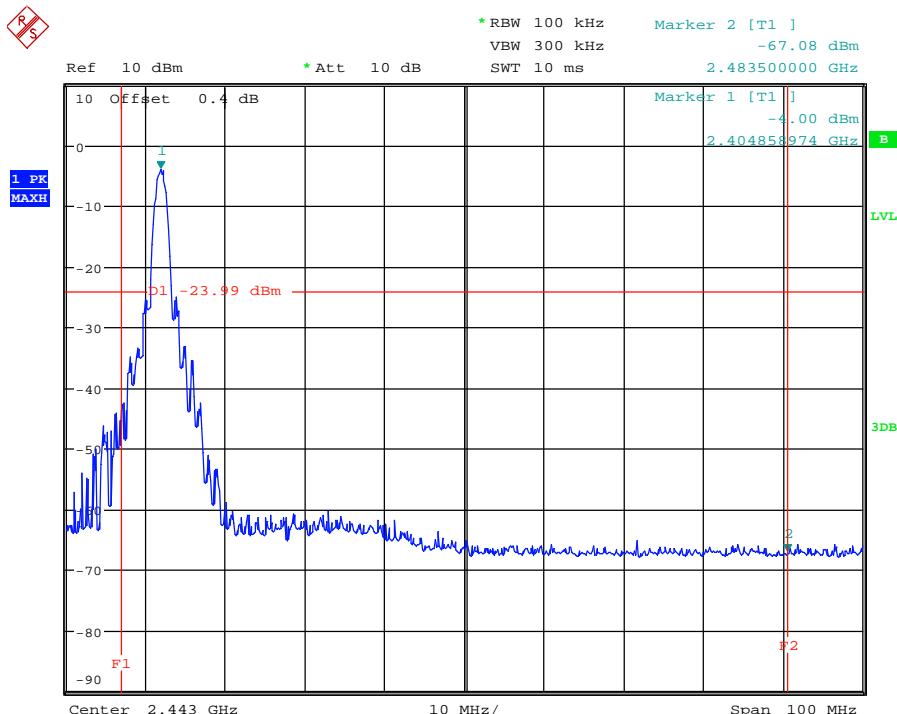
Date: 13.APR.2011 10:54:51

## Lower Band-Edge Compliance (Conducted)



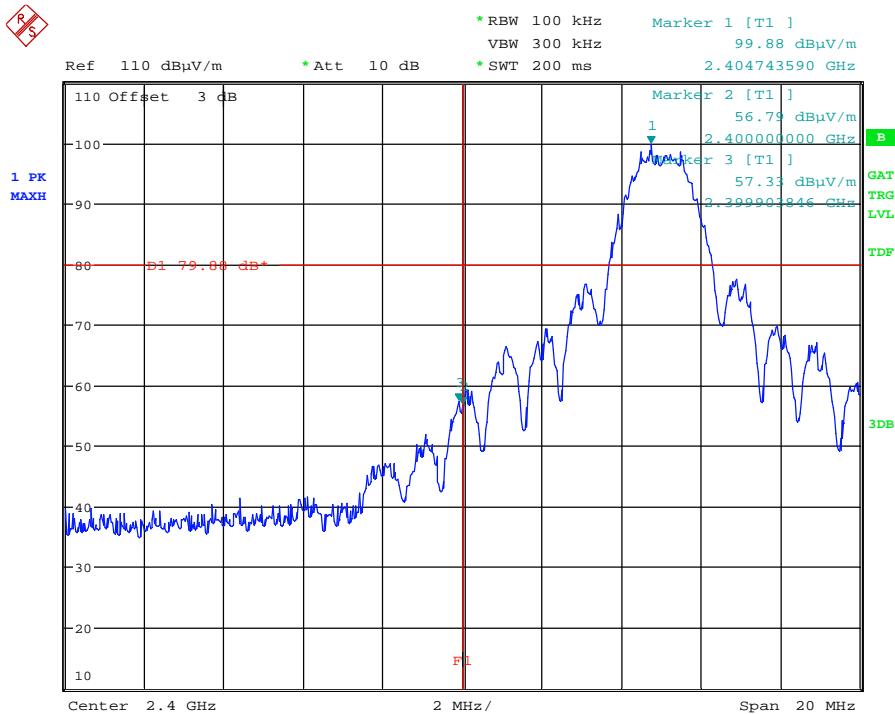
Date: 13.APR.2011 10:12:29

## Upper Band-Edge Compliance (Conducted)



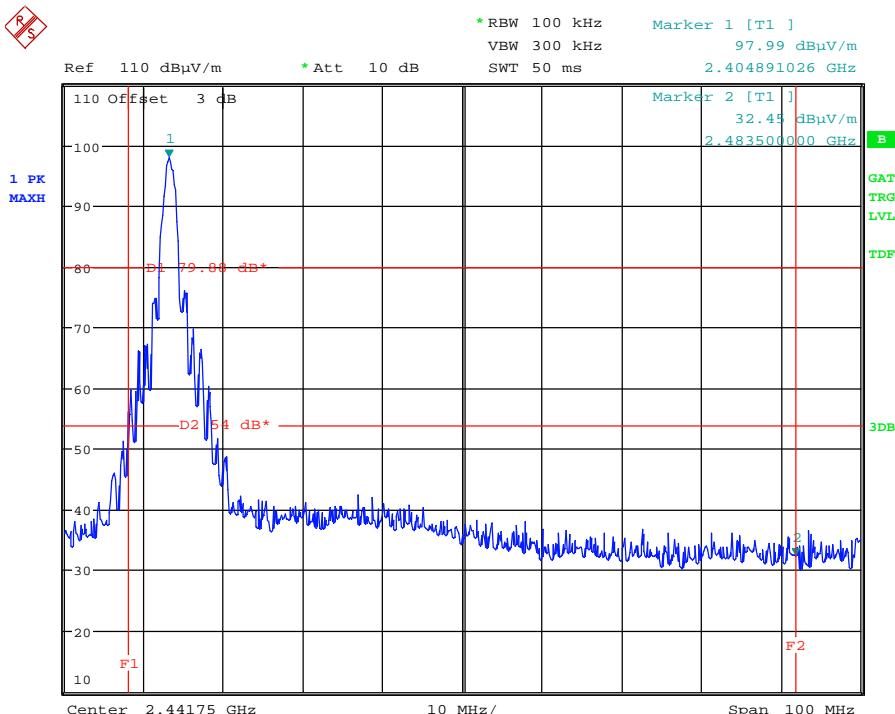
Date: 13.APR.2011 10:20:03

### Lower Band-Edge Compliance (Radiated)



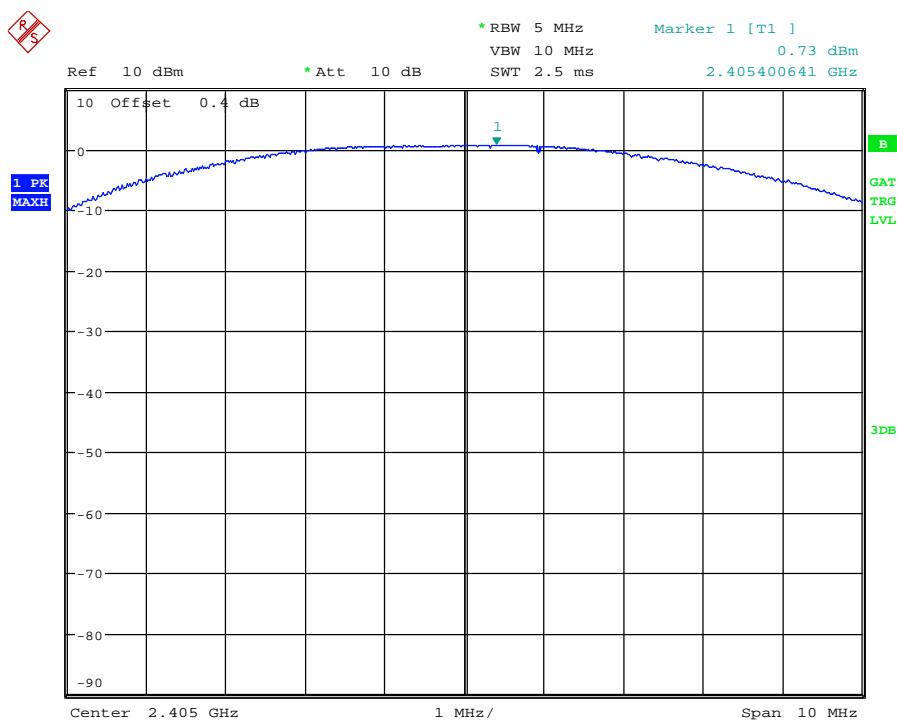
Date: 14.APR.2011 14:43:46

### Upper Band-Edge Compliance (Radiated)



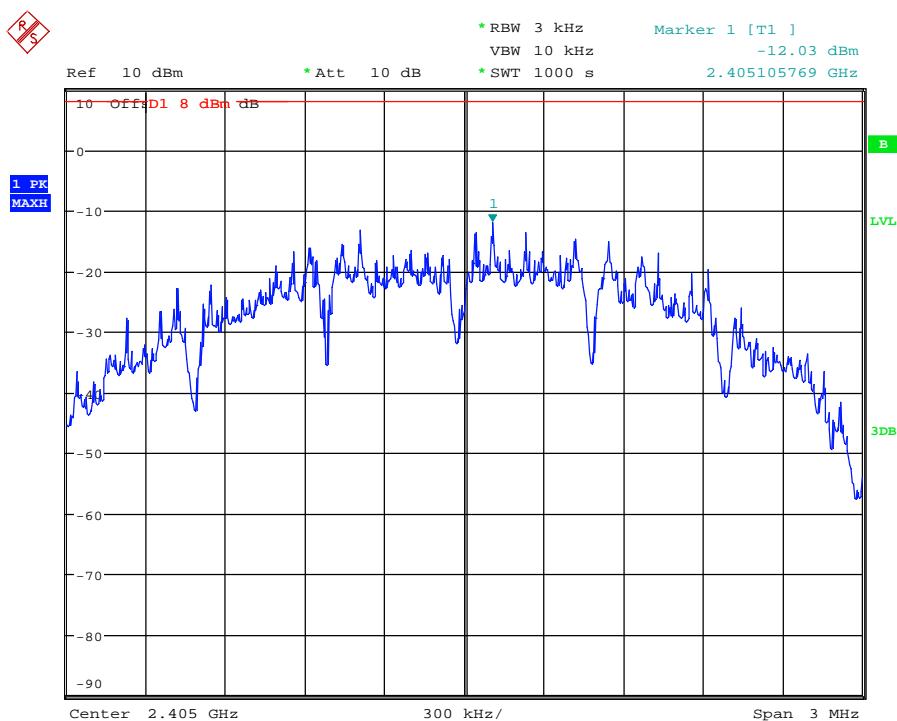
Date: 14.APR.2011 14:47:11

## Conducted carrier power



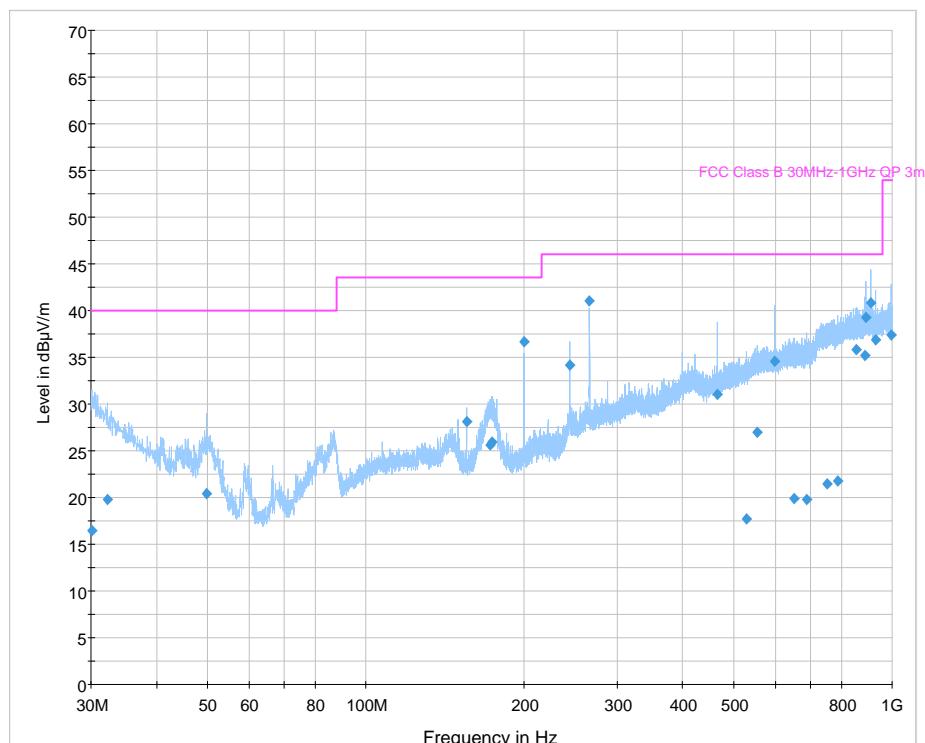
Date: 13.APR.2011 09:20:05

## Conducted power spectral density

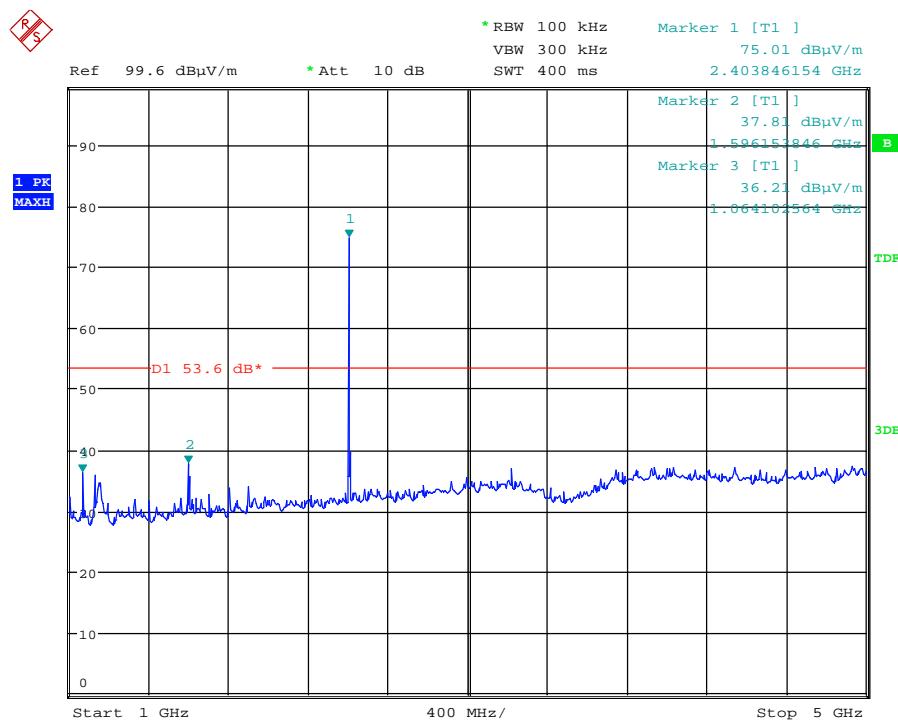


Date: 13.APR.2011 09:58:09

### Radiated spurious emissions 30 MHz to 1 GHz (Transmit Mode)

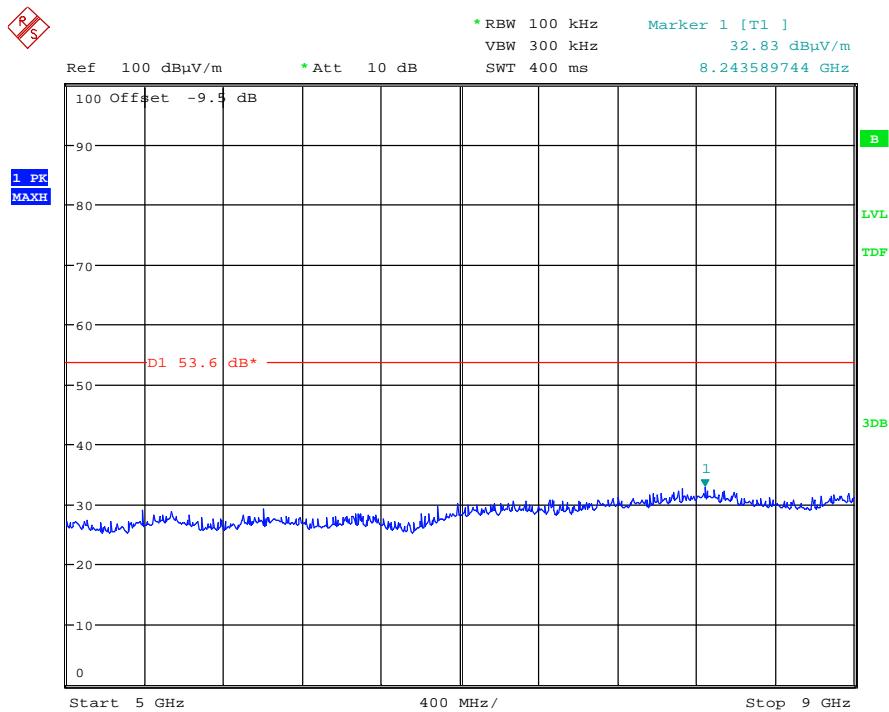


### Radiated spurious emissions 1 GHz to 5 GHz (Transmit Mode)



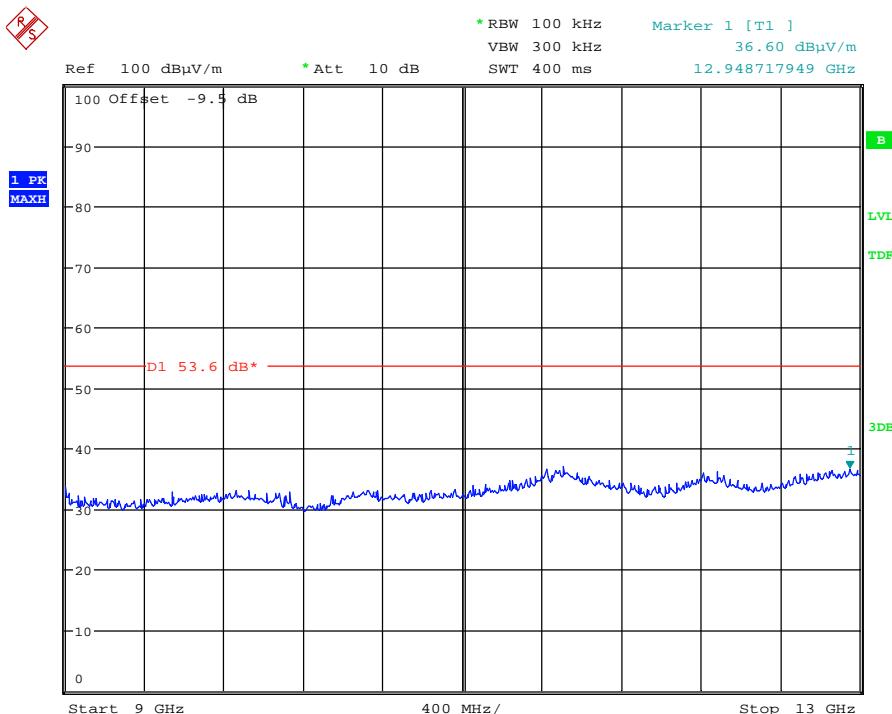
Date: 13.APR.2011 13:20:19

## Radiated spurious emissions 5 GHz to 9 GHz (Transmit Mode)



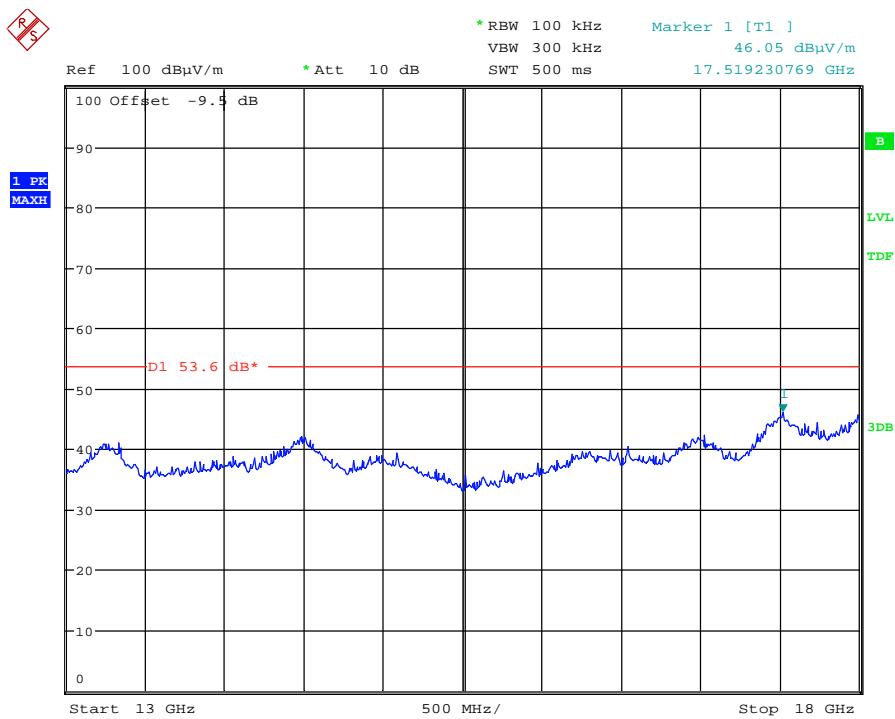
Date: 13.APR.2011 14:04:25

## Radiated spurious emissions 9 GHz to 13 GHz (Transmit Mode)



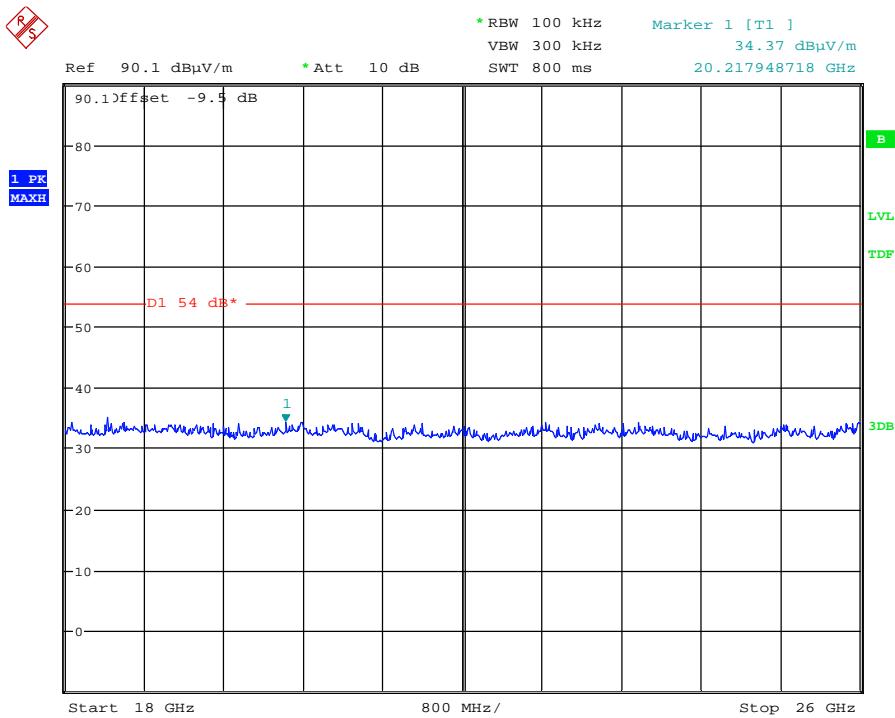
Date: 13.APR.2011 14:05:42

### Radiated spurious emissions 13 GHz to 18GHz (Transmit Mode)



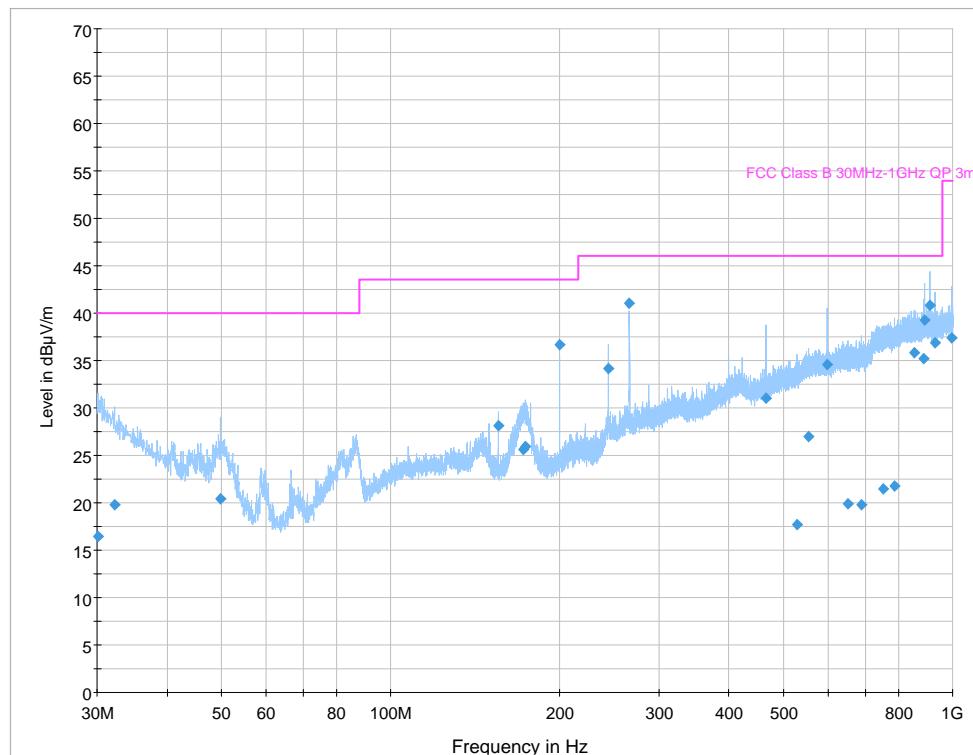
Date: 13.APR.2011 14:06:44

### Radiated spurious emissions 18 GHz to 25 GHz (Transmit Mode)

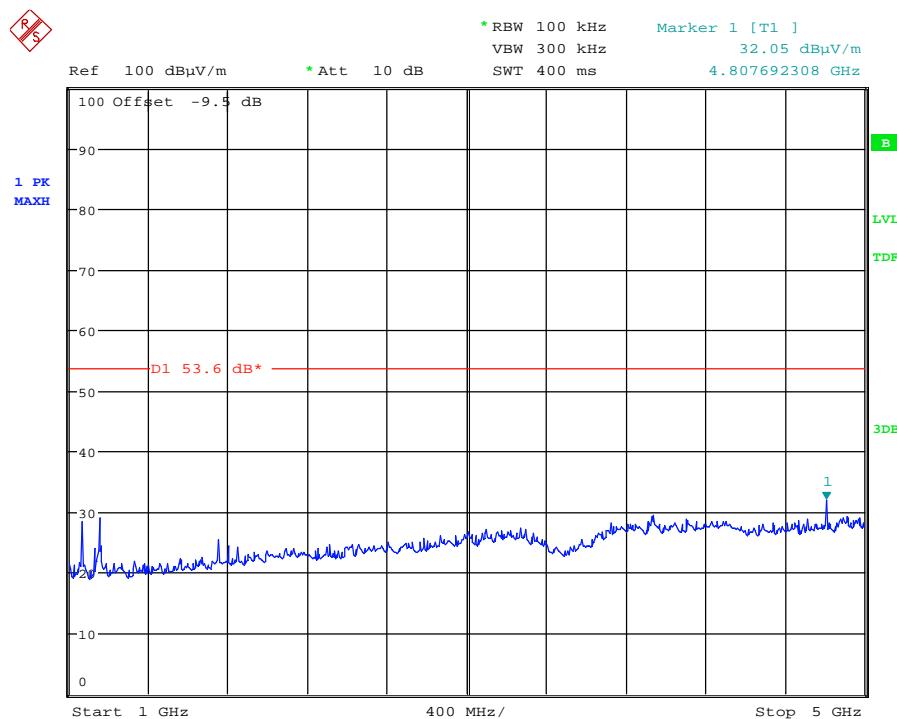


Date: 14.APR.2011 09:36:00

### Radiated spurious emissions 30 MHz to 1 GHz (Receive Mode)

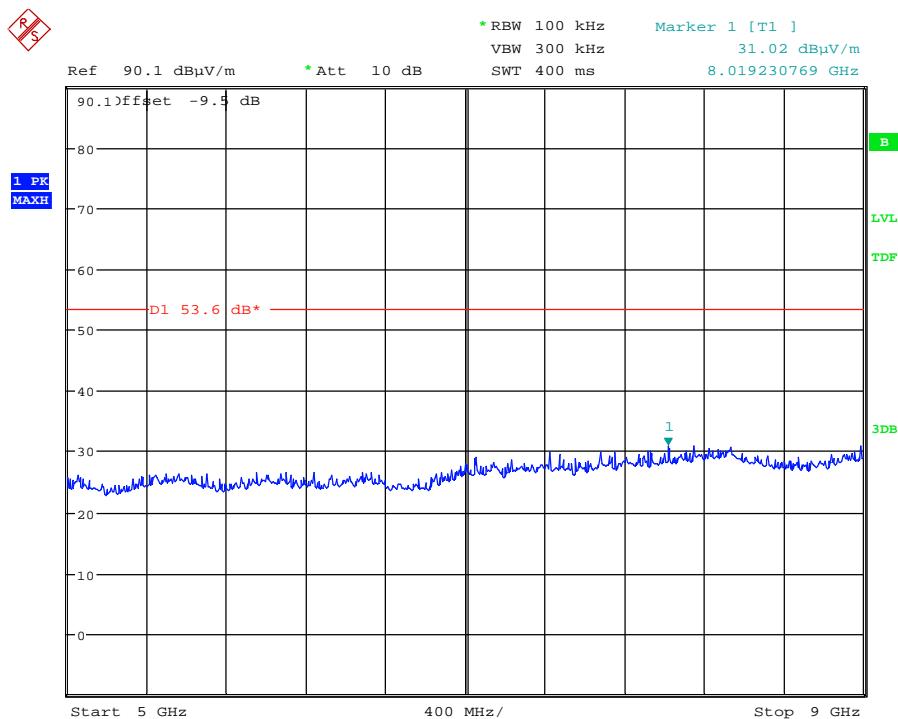


### Radiated spurious emissions 1 GHz to 5 GHz (Receive Mode)



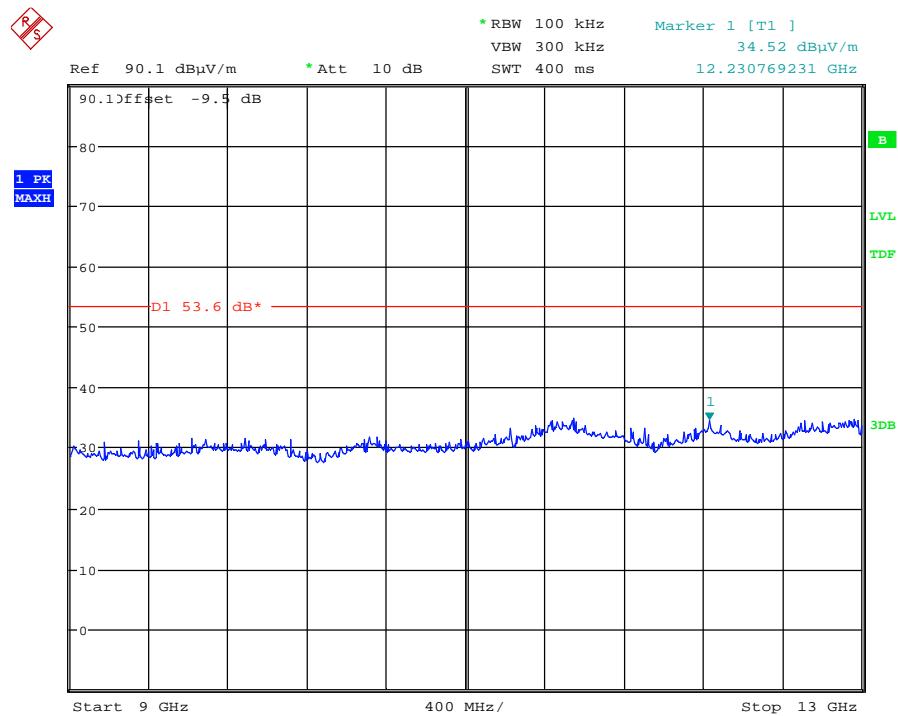
Date: 13.APR.2011 15:54:25

### Radiated spurious emissions 5 GHz to 9 GHz (Receive Mode)



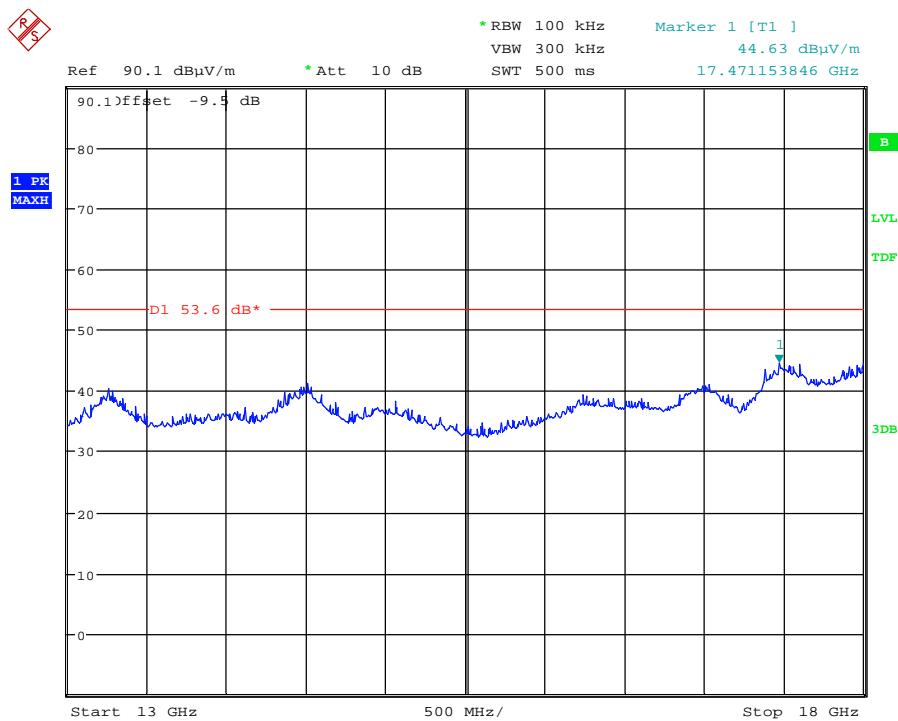
Date: 13.APR.2011 13:45:54

### Radiated spurious emissions 9 GHz to 13 GHz (Receive Mode)



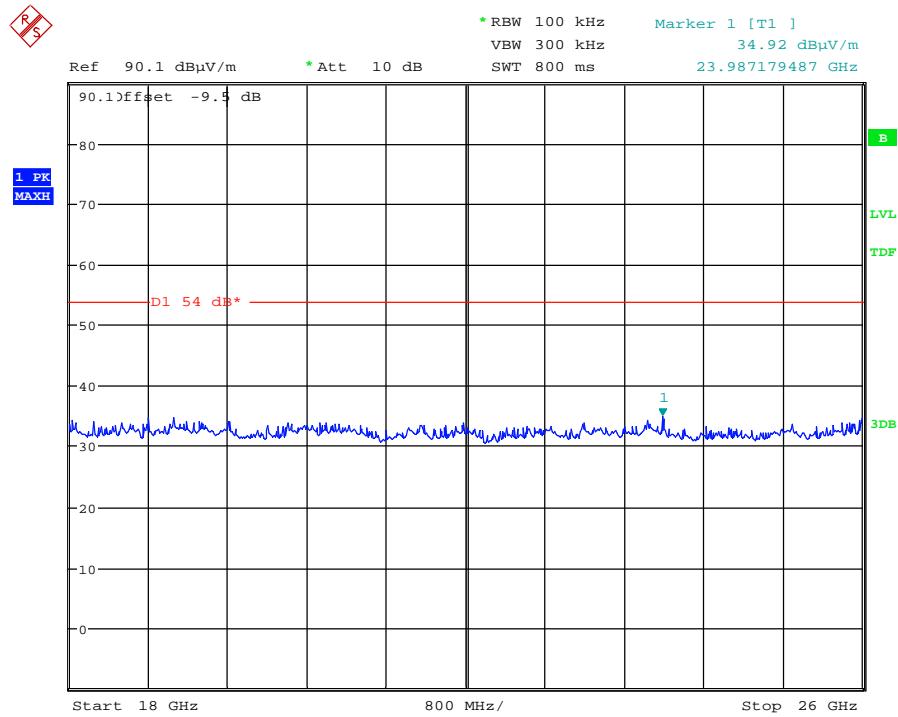
Date: 13.APR.2011 13:45:14

### Radiated spurious emissions 13 GHz to 18GHz (Receive Mode)

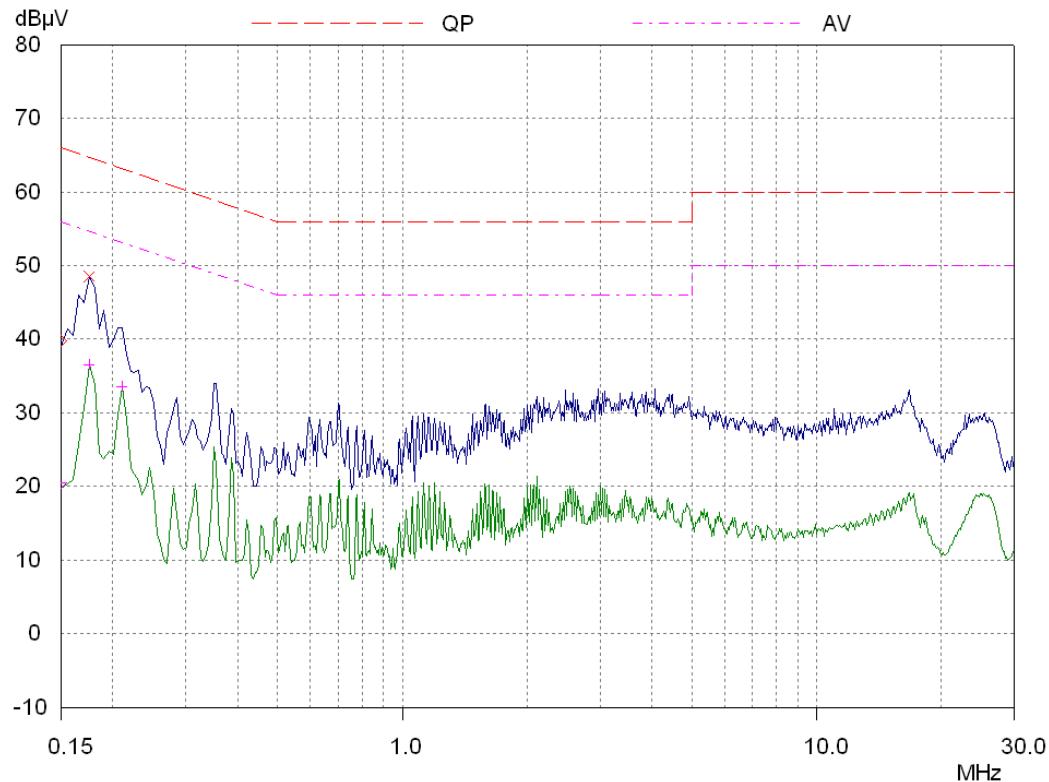
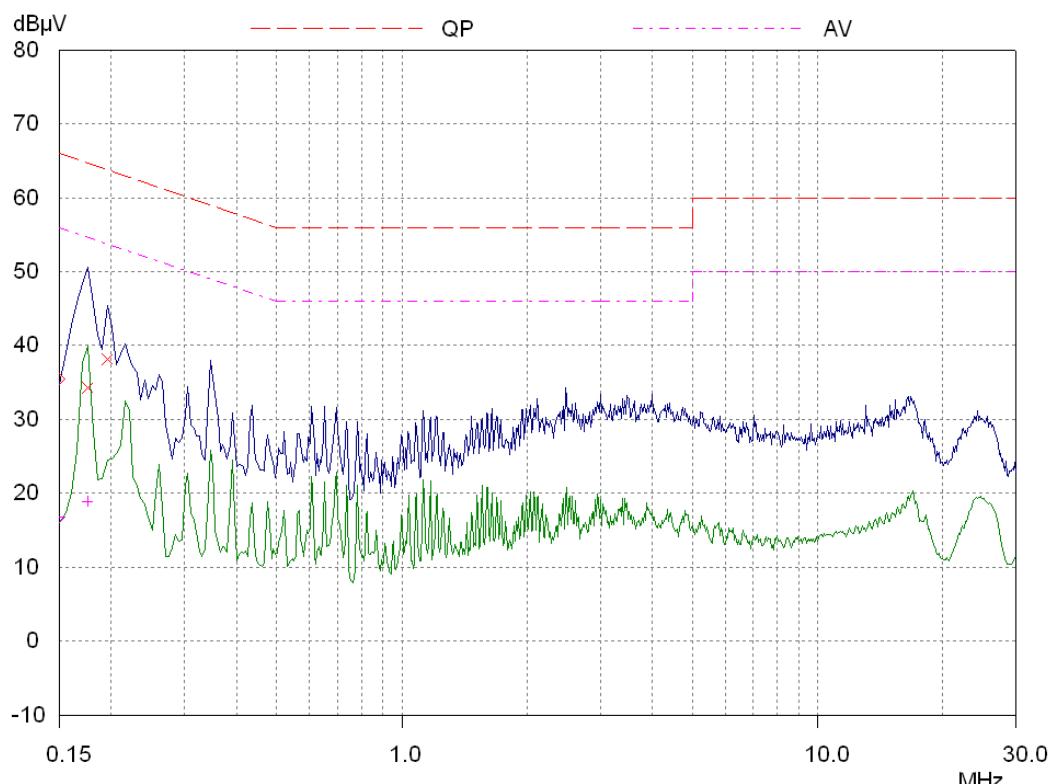


Date: 13.APR.2011 13:44:23

### Radiated spurious emissions 18 GHz to 25 GHz (Receive Mode)



Date: 14.APR.2011 09:37:39

**Power Line Conducted Emissions in Receive Mode (Neutral Line)****Power Line Conducted Emissions in Transmit Mode (Neutral Line)**

**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 Telecoms & Radio upon request.

**C1 Test samples**

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

Sample No.	Description	Identification
1	RF500A	None
2	DC Power Supply	None

## C2 EUT operating mode during testing

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

No.	Test	Description of Operating Mode
1	Conducted Spurious Emissions	EUT in Transmit Mode only.
2	Radiated Spurious Emissions	EUT tested in both Transmit and Receive Modes.
3	Power Line Conducted Emissions	EUT tested in both Transmit and Receive Modes.

### **C3 EUT Configuration Information**

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

#### C4 List of EUT Ports

The tables below describe the termination of EUT ports:

Sample : S01  
Tests : Conducted, Radiated emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Power	2 Core	3m	PSU
Data	Ethernet	5m	Notebook Computer

**C5 Details of Equipment Used**

TRAC Ref	Description	Manufacturer	Model No.	Serial No.
UH93	Bilog Antenna	Chase	CBL6112B	2803
TRL317	UHF Receiver	R&S	ESVS10	837948/003
UH281	Spectrum Analyser	R&S	FSU 46	200034
TRL138	Horn Antenna	EMCO	3115	9010-3580

**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 pulsedwidths 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 pulsedwidths over one complete pulse train. However if the pulse train exceeds 100ms then the duty cycle was calculated by averaging the sum of the pulsedwidths 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 =  $20 \times (\text{Log}_{10} \text{ Calculated Duty Cycle})$

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.

Duty cycle = the sum of the highest average value pulsedwidths over 100ms  
100ms

e.g

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

0.07459 or 7.459%

Correction factor (dB) =  $20 \times (\text{Log}_{10} 0.07459) = -22.54\text{dB}$

## **Appendix F:**

## **Photographs and Figures**

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: RF500A front view
2. Radiated electric field emissions arrangement: RF500A close up
3. Powerline Conducted emissions arrangement: RF500A setup
4. Photo of the RF500A Overview

Photograph 1



Photograph 2



**Photograph 3**



**Photograph 4**

