

TRaC Test Report : 8F1631WUS1

Applicant : Flarm Technology GmbH

Apparatus : SAFEmine

Summary:

*The apparatus detailed above is compliant with the above standard as tested
(see section 1.5 of this report for full details)*

Specification : CFR47 Part 15.247 July 2008

Purpose of Test : Certification

FCCID : ZKSQC235A

Authorised by :



: Radio Product Manager

Issue Date : 20th May 2011

Authorised Copy Number : PDF

Contents

Section 1: Introduction	3	
1.1 General		3
1.2 Tests Requested By		4
1.3 Manufacturer		4
1.4 Apparatus Assessed		4
1.5 Test Result Summary		5
1.6 Notes Relating To The Assessment		6
1.7 Deviations from Test Standards		6
Section 2: Measurement Uncertainty		7
2.1 Application of Measurement Uncertainty		7
2.2 Measurement Uncertainty Values		8
Section 3: Modifications		10
3.1 Modifications Performed During Assessment		10
Appendix A: Formal Emission Test Results		11
A1 Conducted Fundamental Carrier Power		12
A2 RF Antenna Conducted Spurious Emissions		13
A3 Radiated Electric Field Emissions Within The Restricted Bands of 15.205		17
A4 Power Line Conducted Emissions		22
A5 20 dB Bandwidth and Channel Spacing		23
A6 Hopping frequencies		24
A7 Frequency Occupancy		25
A8 Antenna Gain		26
A9 Unintentional Radiated Electric Field Emissions - 15.109		27
Appendix B: Supporting Graphical Data		28
Appendix C: Additional Test and Sample Details		58
Appendix D: Additional Information		64
Appendix E: Calculation of the duty cycle correction factor		66
Appendix F: Photographs and Figures		67
Appendix G: MPE Calculation		72

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.

Test performed by: TRaC Telecoms & Radio
Unit E
South Orbital Trading Park
Hedon Road
Hull, HU9 1NJ.
United Kingdom.

Telephone: +44 (0) 1482 801801
Fax: +44 (0) 1482 801806

Tests performed by: 

M. E. Leach, Radio Test Engineer

TRaC Telecoms & Radio
Moss View
Nipe Lane
Up Holland
West Lancashire, WN8 9PY
United Kingdom

Telephone: +44 (0) 1695 556666
Fax: +44 (0) 1695 577077

Email: info@tracglobal.com
Web site: www.tracglobal.com

Tests performed by:

D. Winstanley, Radio Test Engineer

Report author: M. E. Leach

This report must not be reproduced except in full without prior written permission from TRaC Telecoms & Radio.

1.2 Tests Requested By

This testing in this report was requested by :

Flarm Technology GmbH
Heischerstrasse 1
8915.0 Hausen am Albis
Switzerland

1.3 Manufacturer

As Above

1.4 Apparatus Assessed

The following apparatus was assessed between 08/12/09 and 28/01/2010:

SAFEmine Model Number 700 018

The above equipment was a collision avoidance system, for use in industrial vehicles, consisting of central processor unit, GPS receiver and RF modem. The device periodically broadcasts its GPS position using an RF modem.

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
Conducted Carrier Power	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(b)(2)	Public Notice DA 00-705 March 30, 2000	Pass
Conducted spurious emissions (Non-restricted bands)	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.247	Public Notice DA 00-705 March 30, 2000	Pass
Radiated spurious emissions (Restricted bands)	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.247	ANSI C63.4: 2003	Marginal
AC Power conducted emissions	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.207	ANSI C63.4: 2003	N/A
20dB Bandwidth and Channel Spacing	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(a)(1)(i)	Public Notice DA 00-705 March 30, 2000	Pass
Hopping Frequencies	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(a)(1)	Public Notice DA 00-705 March 30, 2000	Pass
Frequency Occupancy	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(a)(1)(i)	Public Notice DA 00-705 March 30, 2000	Pass
Unintentional Radiated Spurious Emissions	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.109	ANSI C63.4: 2003	Pass

Marginal results were recorded. See Appendix A for details and Section 2.2 (iii).

Abbreviations used in the above table:

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

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

Hull Radio Testing – General Uncertainty Schedule

Test type	Quantity	Quantity frequency range	TRaC Telecoms & Radio Uncertainty
Radiated electric field emissions 3m alternative test site	Amplitude	30MHz to 300MHz Horizontal	±4.9dB
		30MHz to 300MHz Vertical	±5.1dB
		300MHz to 1000MHz Horizontal	±5.3dB
		300MHz to 1000MHz Vertical	±5.1dB
		1GHz to 26.5GHz Horizontal and Vertical	±4.1dB
		150kHz to 30MHz	±3.9dB
Power line conducted emissions using a V mode lish		N/A	±0.9 dB
Conducted emissions		N/A	±0.9 dB
Absolute RF power (via antenna connector)		N/A	±0.9 dB
20dB Bandwidth	Frequency	dc to 26.5GHz	3.611kHz

Up Holland 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**

Up Holland Radio Testing – General Uncertainty Schedule continued:**[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 (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%**

[11] Power Line Conduction

Uncertainty in test result = **3.4dB**

[12] Spectrum Mask Measurements

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

[13] Adjacent Sub Band Selectivity

Uncertainty in test result = **1.24dB**

[14] Receiver Blocking – Listen Mode, Radiated

Uncertainty in test result = **3.42dB**

[15] Receiver Blocking – Talk Mode, Radiated

Uncertainty in test result = **3.36dB**

[16] Receiver Blocking – Talk Mode, Conducted

Uncertainty in test result = **1.24dB**

[17] Receiver Threshold

Uncertainty in test result = **3.23dB**

[18] 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
EUT	: Equipment Under Test	ATS	: Alternative Test Site
SE	: Support Equipment		
		Ref	: Reference
		Freq	: Frequency
		MD	: Measurement Distance
L	: Live Power Line	SD	: Spec Distance
N	: Neutral Power Line		
E	: Earth Power Line	Pol	: Polarisation
		H	: Horizontal Polarisation
Pk	: Peak Detector	V	: Vertical Polarisation
QP	: Quasi-Peak Detector		
Av	: Average Detector	CDN	: Coupling & decoupling network

A1 Conducted Fundamental Carrier Power

Conducted carrier power was verified using a spectrum analyser, the EUT transmitting on its lowest, centre and highest carrier frequency in turn.

Test Details:	
Regulation	Title 47 of the CFR 2008, Part15 Subpart (c) 15.247(b)(2)
EUT sample number	S01
Modification state	0
SE in test environment	REF053 and Wireless Group Laptop 1
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Channel No	Channel Frequency (MHz)	Measured Peak Conducted Carrier Power (W)	Limit (W) ≥ 50 channels	Result
301	905.0.0	0.00309	1	Pass
351	915.0.0	0.00325		Pass
401	925.0.0	0.00325		Pass

Note

The carrier power was measured whilst the EUT was powered by a dc power supply to simulate a lead-acid battery.

The conducted carrier power contains no correction for antenna gain.

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 100kHz 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: 905.0 MHz	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	9 kHz to 10 GHz
EUT sample number	S01
Modification state	0
SE in test environment	REF053 and Wireless Group Laptop 1
SE isolated from EUT	None
EUT set up	Refer to Appendix C

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

Ref No.	Measured Freq (MHz)	Det.	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
No Significant emissions within 20 dB of the limit					

RF Antenna Conducted Spurious Emissions continued:

Test Details: 915.0 MHz	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	9 kHz to 10 GHz
EUT sample number	S01
Modification state	0
SE in test environment	REF053 and Wireless Group Laptop 1
SE isolated from EUT	None
EUT set up	Refer to Appendix C

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

Ref No.	Measured Freq (MHz)	Det.	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
No Significant emissions within 20 dB of the limit					

RF Antenna Conducted Spurious Emissions continued:

Test Details: 925.0 MHz	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	9 kHz to 10 GHz
EUT sample number	S01
Modification state	0
SE in test environment	REF053 and Wireless Group Laptop 1
SE isolated from EUT	None
EUT set up	Refer to Appendix C

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

Ref No.	Measured Freq (MHz)	Det.	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 47CFR15.205(a) are based on a transmitted carrier level of 15.247(b)(2). 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 accordance 15.33 (a)(1).
3. The measurements at 902 MHz and 928 MHz were made to ensure band edge compliance.
4. The carrier level was measured whilst the EUT was powered by a dc power supply to simulate a lead-acid battery. All other emissions were at least 20dB below the test limit

The limit outside the restricted band in 100 kHz RBW is defined using the following formula in accordance with 15.247(d):

$$\text{The limit in 100 kHz RBW} = (\text{Maximum Peak Conducted Carrier}) - 20\text{dB}$$

Where:

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

Limit(dBμV)				
Channel No.	Channel Frequency (MHz)	Measured Peak Conducted Carrier (dB μ V)	Measured Peak Conducted Carrier – 20dB (dB μ V)	Emission Limit 15.247(d) in 100 kHz RBW (dB μ V)
301	905.0	115.9	115.9 – 20	95.9
351	915.0	116.0	116.0 – 20	96.0
401	925.0	116.4	116.4 – 20	96.4

A3 Radiated Electric Field Emissions Within The Restricted Bands of 15.205

Preliminary scans were performed using a peak detector with the RBW = 100kHz. 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 on its lowest, centre and highest carrier frequency at each operational data rate in turn. 2 different combinations of connector/antenna were testing in the modes described.

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: 905.0 MHz	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 10 GHz
EUT sample number	S01 and S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 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)	Pol.	Result (dB μ V/m)	Spec. Limit (dB μ V/m)	Margin (dB)	Summary
1.	961.6	V	42.40	54	-11.60	Pass
2.	2715.008	H	34.02	54	-19.98	Pass
3.	3619.975	V	53.84	54	-0.16	Marginal
4.	4524.975	V	40.30	54	-13.70	Pass
5.	5429.943	V	49.30	54	-4.70	Pass

¹See section 2.1 Note (iii).

Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:

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

Test Details: 915.0 MHz	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 10 GHz
EUT sample number	S01 and S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 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)	Pol.	Result (dB μ V/m)	Spec. Limit (dB μ V/m)	Margin (dB)	Summary
1.	972.2	V	42.3	54	-11.70	Pass
2.	2745.032	V	39.59	54	-14.41	Pass
3.	3659.943	H	50.51	54	-3.49	Marginal
4.	4574.943	H	37.88	54	-16.12	Pass

¹See section 2.1 Note (iii).

Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:

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

Test Details: 925.0 MHz	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 10 GHz
EUT sample number	S01 and S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 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)	Pol.	Result (dB μ V/m)	Spec. Limit (dB μ V/m)	Margin (dB)	Summary
1.	982.8	V	42.8	54	-11.20	Pass
2.	2774.982	V	34.35	54	-19.65	Pass
3.	3700.003	H	47.71	54	-6.29	Pass
4.	4625.008	V	38.13	54	-15.87	Pass

¹See section 2.1 Note (iii).

Notes:

- 1 Any testing performed below 30 MHz was performed using a magnetic loop antenna in accordance with ANSI C63.4: 2003 section 8.2.1.
- 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 902 & 928 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 C63.4 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 frequency (refer to the measured frequency 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 15:2008 Clause 15.33(a) and 15.33(a)(1).

Radiated emission limits (47 CFR 15:2008 Clause 15.209) for emissions falling within the restricted bands defined in 15.205(a):

Frequency of emission (MHz)	Field strength $\mu\text{V/m}$	Measurement Distance m	Field strength $\text{dB}\mu\text{V/m}$
0.009-0.490	$2400/F(\text{kHz})$	300	$67.6/F(\text{kHz})$
0.490-1.705	$24000/F(\text{kHz})$	30	$87.6/F(\text{kHz})$
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				

A4 Power Line Conducted Emissions

The EUT is a dc powered device supplied by a vehicle battery. No assessment to the 47 CFR 15:2008 Clause 15.207 has been made.

A5 20 dB Bandwidth and Channel Spacing

Title 47 of the CFR: 2002, 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 spacing 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: 2008, Part 15 Subpart (c) 15.247(a)(1)(i)
Measurement standard	ANSI C63.4:2003
EUT sample number	S01
Modification state	0
SE in test environment	REF053 and Wireless Group Laptop 1
SE isolated from EUT	None
EUT set up	Refer to Appendix C

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

Channel No.	Measured 20 dB Bandwidth (kHz)	Limit	Result
301	375	N/A	N/A
351	370	N/A	N/A
401	366	N/A	N/A

Measured Channel Spacing (kHz)	Limit	Result
398.000	25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater)	Pass

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

A6 Hopping frequencies

Hopping frequencies were verified using a spectrum analyser, the span was set to display sub sets of the hopping channels in turn, while the EUT was operating in its normal frequency-hopping mode.

Test Details:	
Regulation	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(a)(1)(i) and 15.247 (b) (2)
EUT sample number	S01
Modification state	0
SE in test environment	REF053 and Wireless Group Laptop 1
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured No. of Hopping Channels	Requirements		Result
	15.247(a)(1)(i) 20dB bandwidth $\geq 250\text{kHz}$	15.247 (b) (2)	
50	Shall use at least 25 hopping frequencies	For 1W conducted carrier power Limit, employing at least 50 hopping channels	Pass

Plots showing the hopping channels are contained in Appendix B

A7 Frequency Occupancy

Channel occupancy time was verified using a spectrum analyser in zero span mode, centred on the bottom hopping channel frequency (905.0 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 CFR2008, Part15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S01
Modification state	0
SE in test environment	REF053 and Wireless Group Laptop 1
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured No. of Hopping Channels	Measured Frequency Occupancy time on any frequency (ms)	Measured Frequency Repetition Time (s)	Requirements			Result
			15.247(a)(1)(i) 20dB bandwidth \geq 250kHz	Frequency Occupancy Time Limit (ms)	Frequency Repetition Time (s)	
50	393.333	>11s	Shall use at least 25 hopping frequencies	400	>10s	Pass

Plots showing the frequency occupancy time and time between successive transmissions greater than 10s, are contained in Appendix B of this test report.

A8 Antenna Gain

The maximum antenna gain for the antenna (S02) to be used with the EUT, as declared by the client, is 2 dBi. Refer to Appendix D for antenna manufacture details.

A9 Unintentional Radiated Electric Field Emissions - 15.109

Preliminary scans were performed using a peak detector with the RBW = 100kHz. 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 operating 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 :

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

Test Details: Lowest, Centre and Highest Operating Frequency	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.4:2003
Frequency range	30MHz to 10 GHz
EUT sample number	S01 and S02
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 1 and 2

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

Or

Ref No.	Freq (MHz)	Pol.	Result (dB μ V/m)	Spec. Limit (dB μ V/m)	Margin (dB)	Summary
No Significant Emissions Within 20 dB of the Limit						

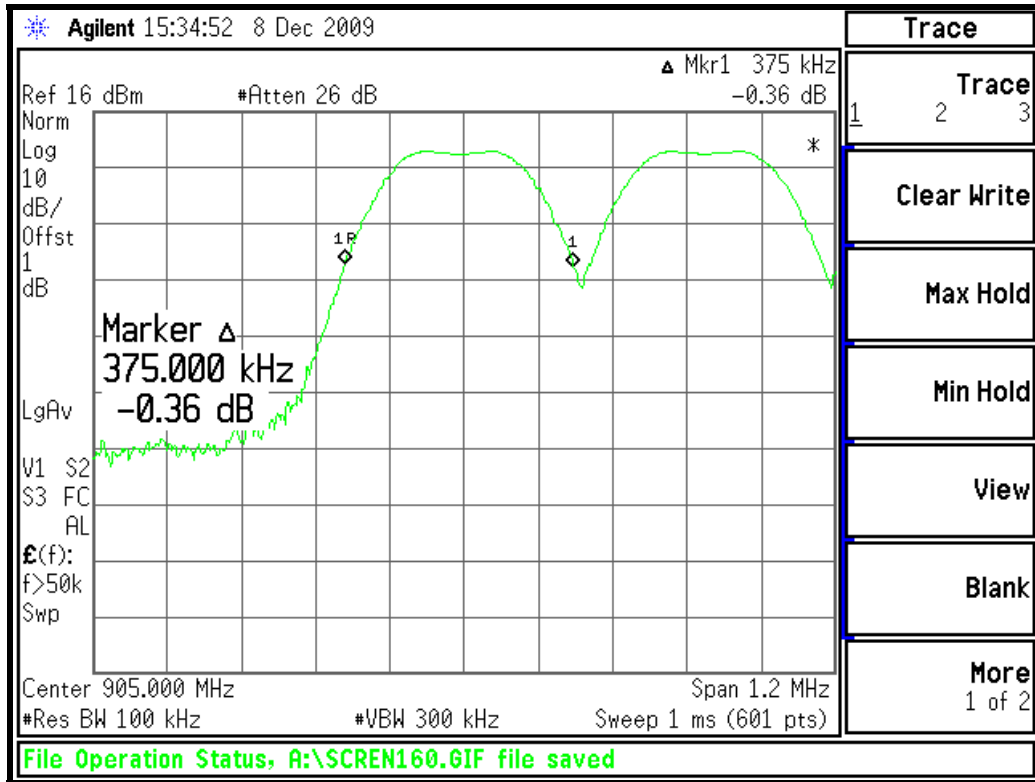
¹See section 2.1 Note (iii).

Appendix B:**Supporting Graphical Data**

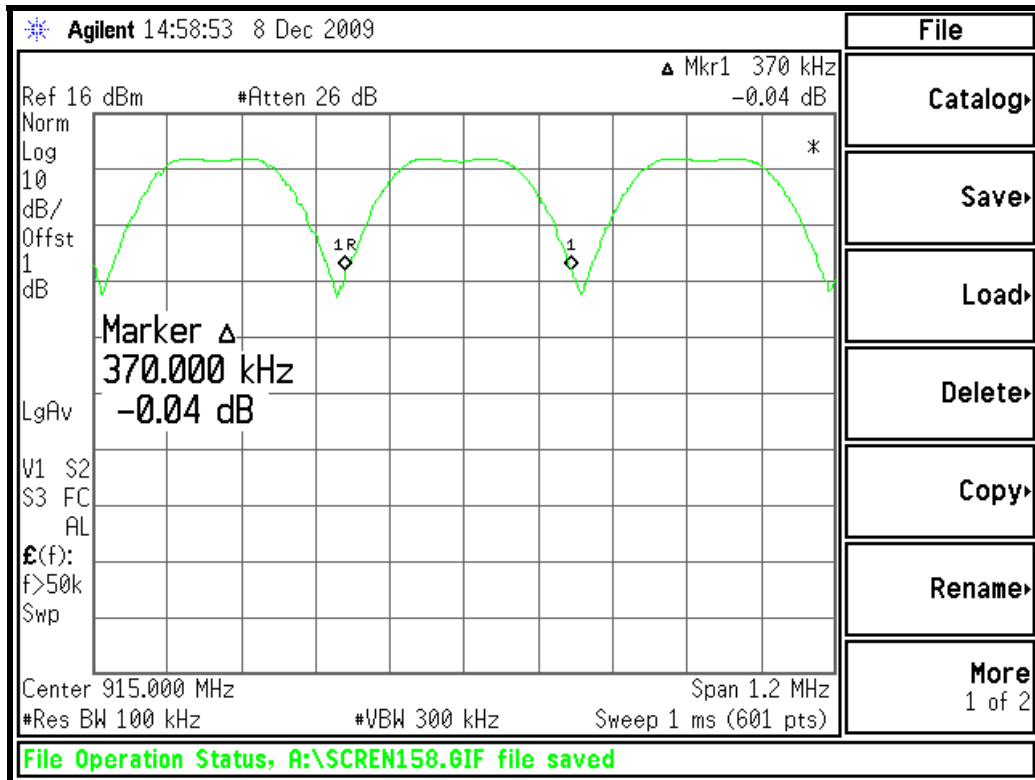
This appendix contains graphical data obtained during testing.

Notes:

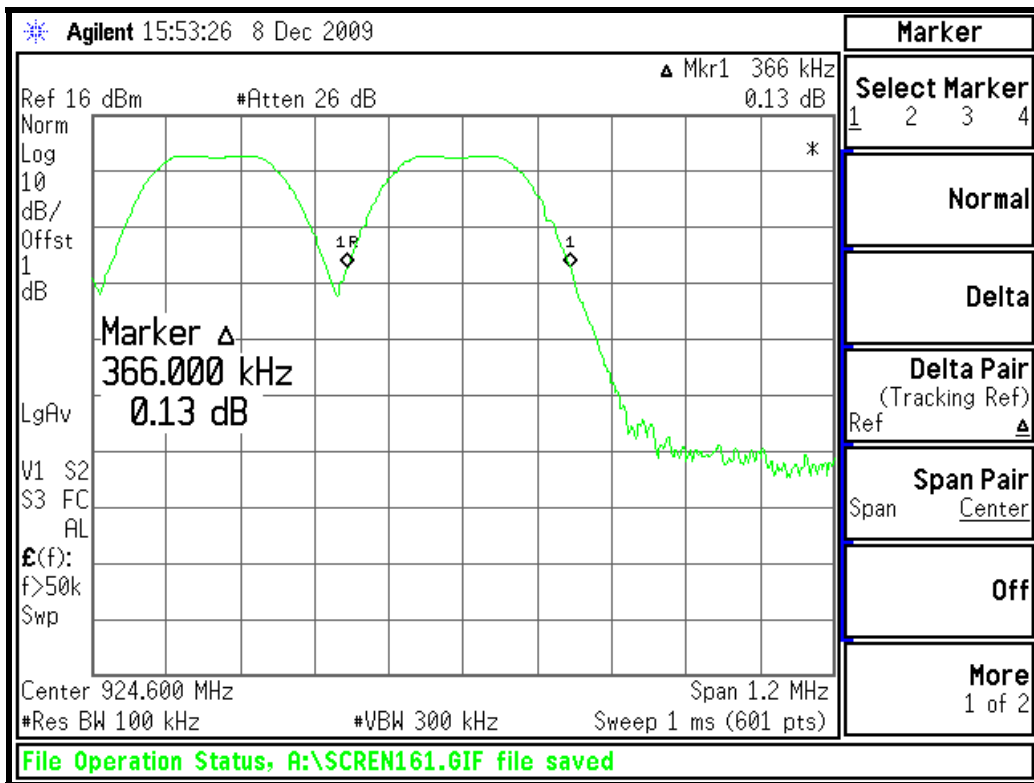
- (a) The radiated electric field emissions and conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do not necessarily equate to the time of the test.
- (c) Where relevant, on power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



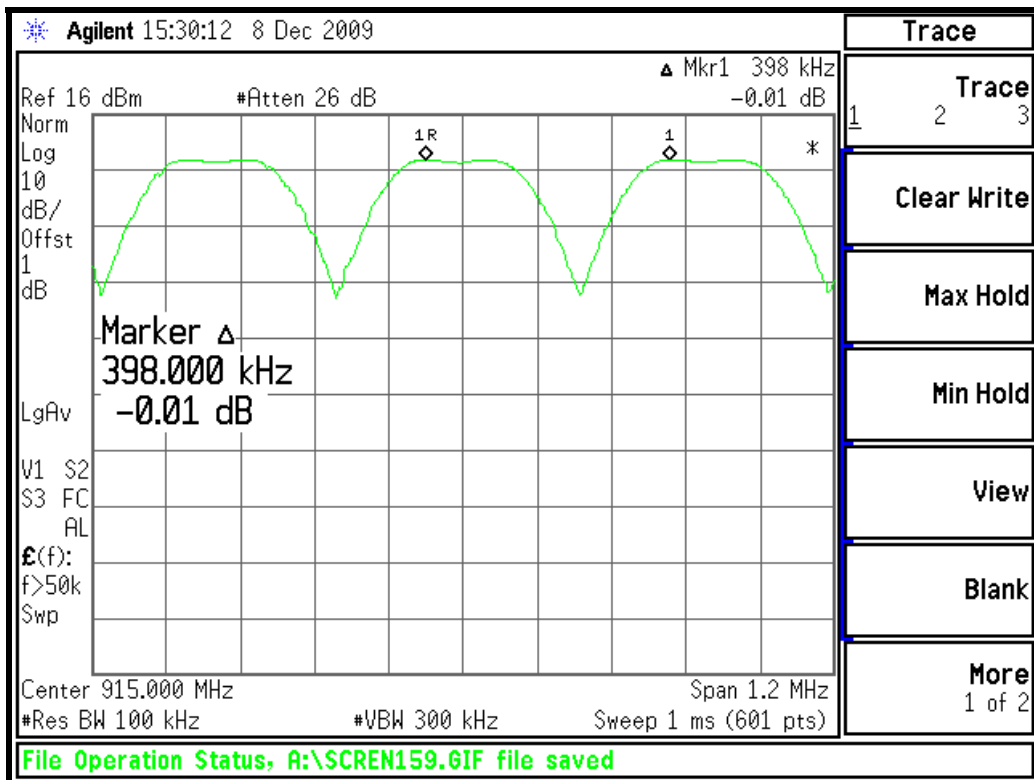
20dB Bandwidth – 905.0 MHz



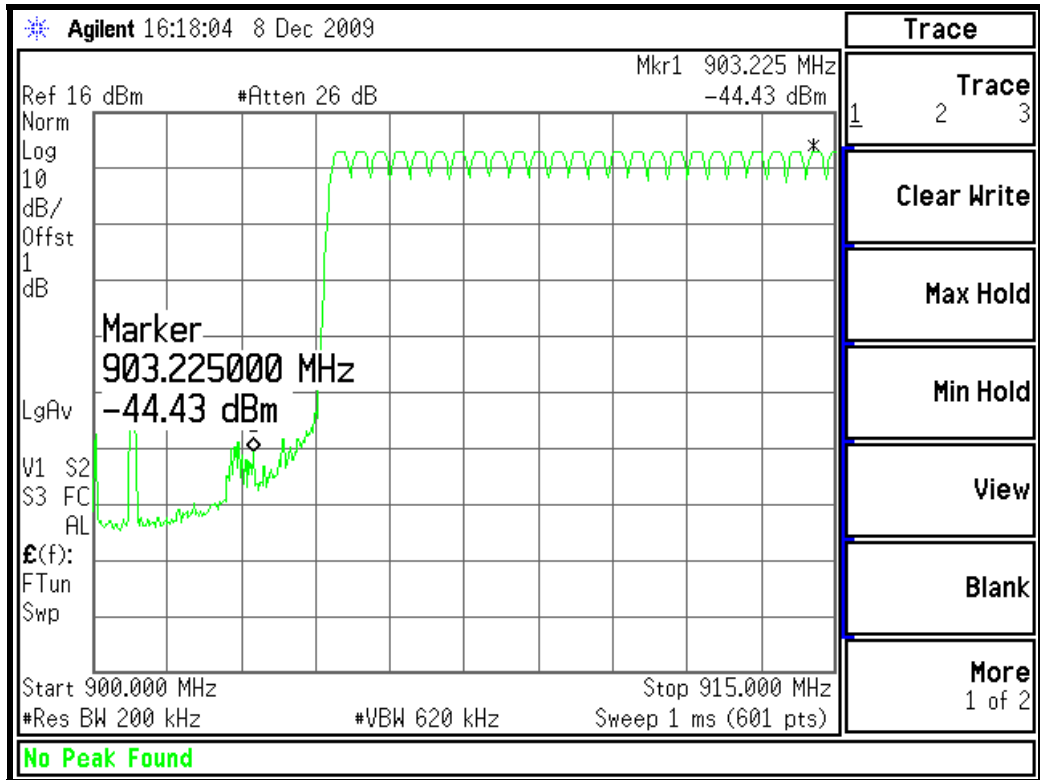
20dB Bandwidth – 915.0 MHz



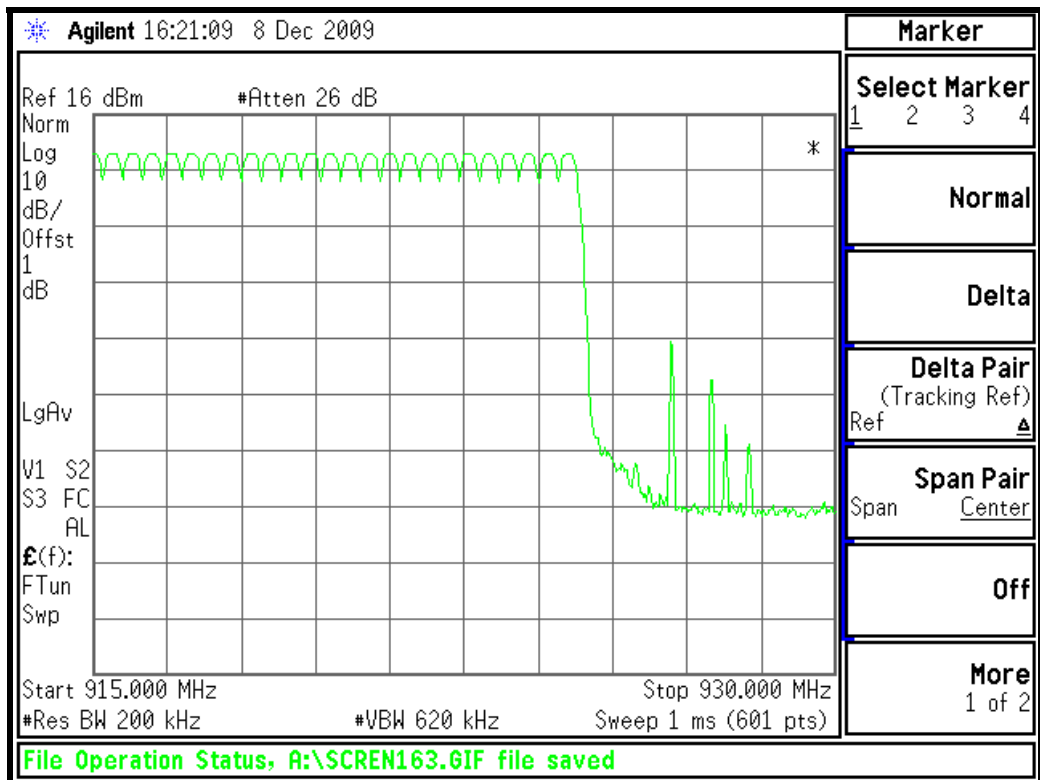
20dB Bandwidth – 925.0 MHz



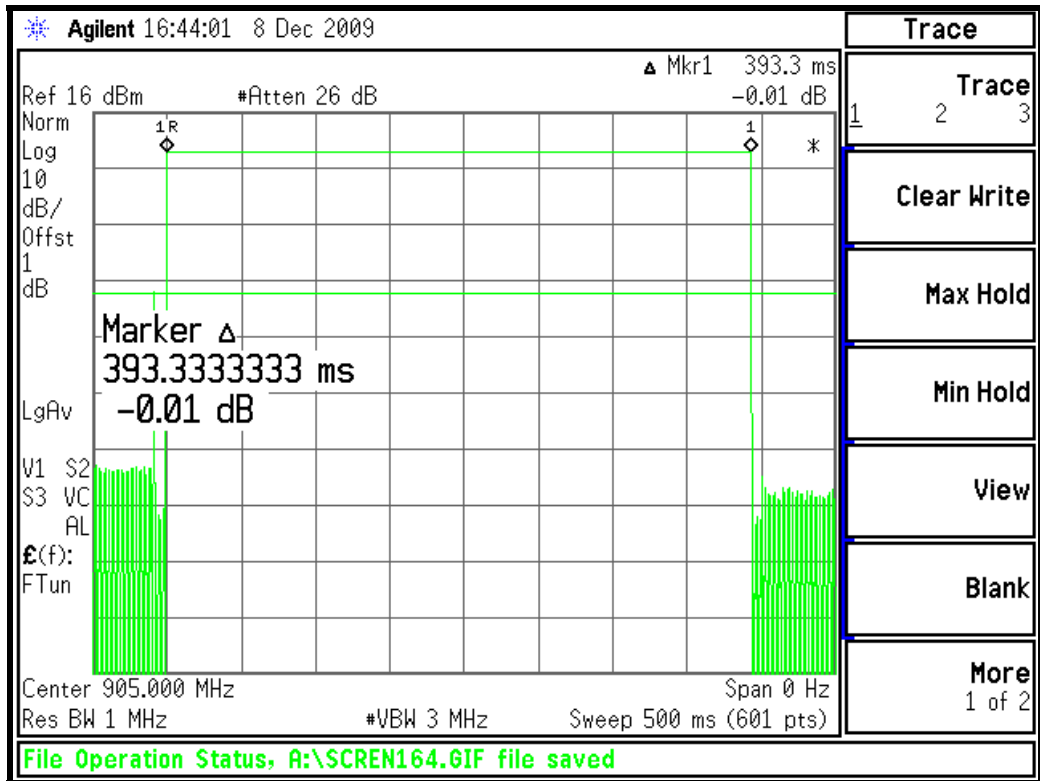
Channel Spacing



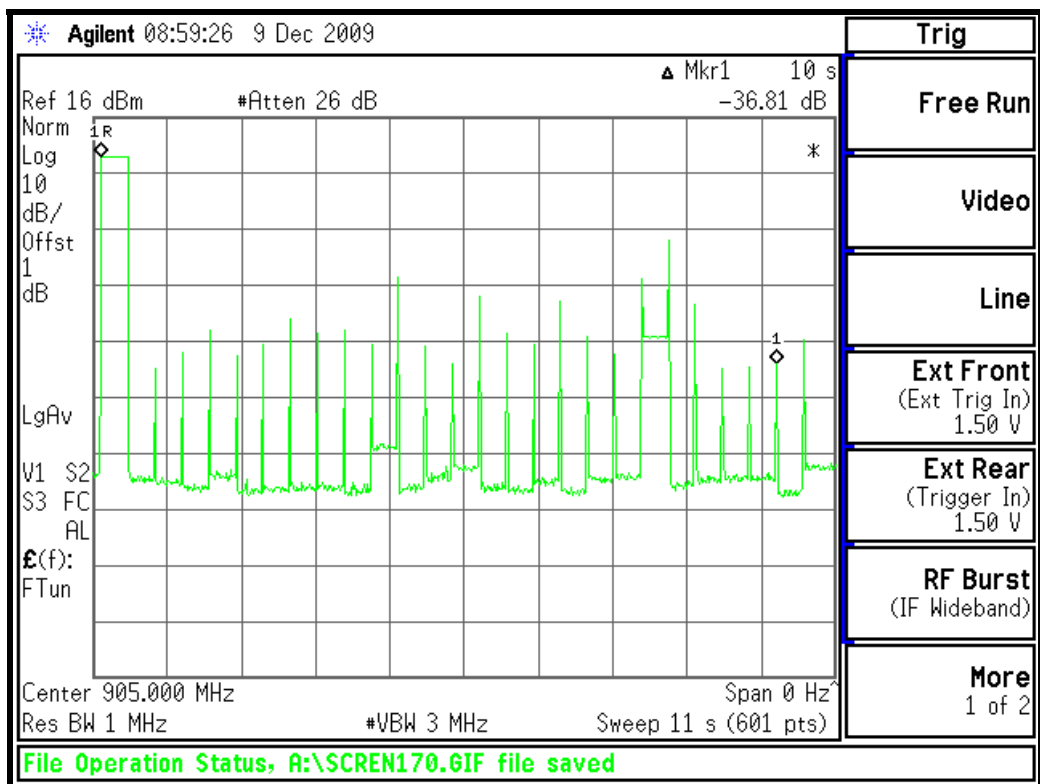
No. Of Channels 1 to 26



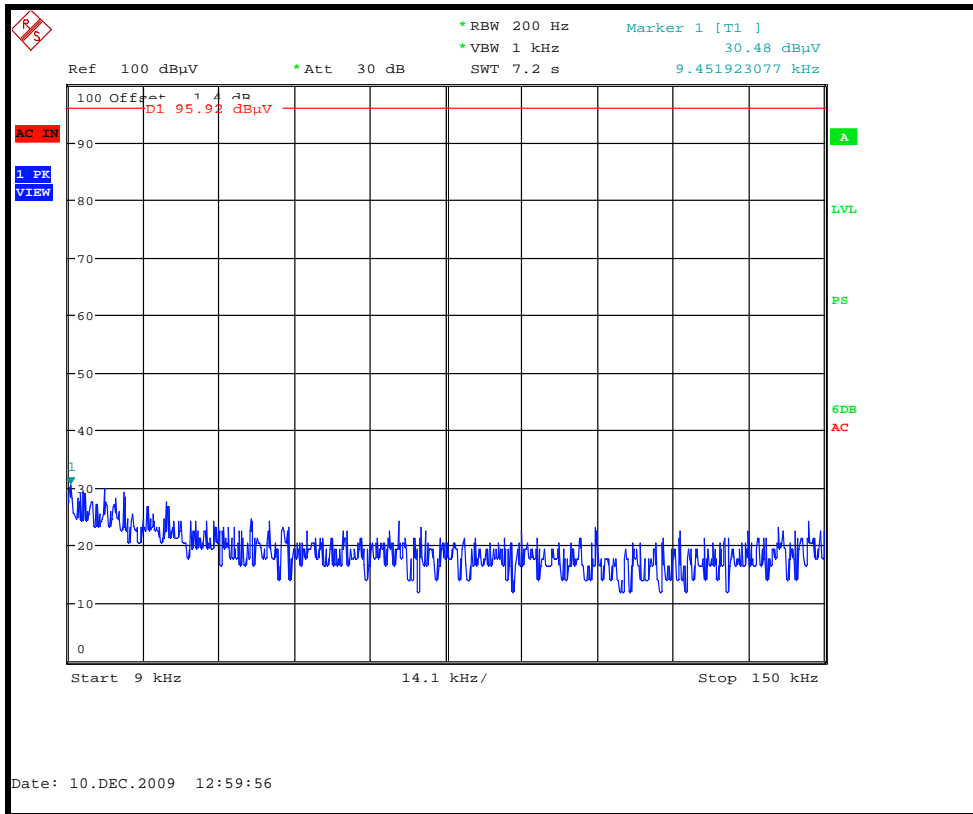
No. Of Channels 27 to 50



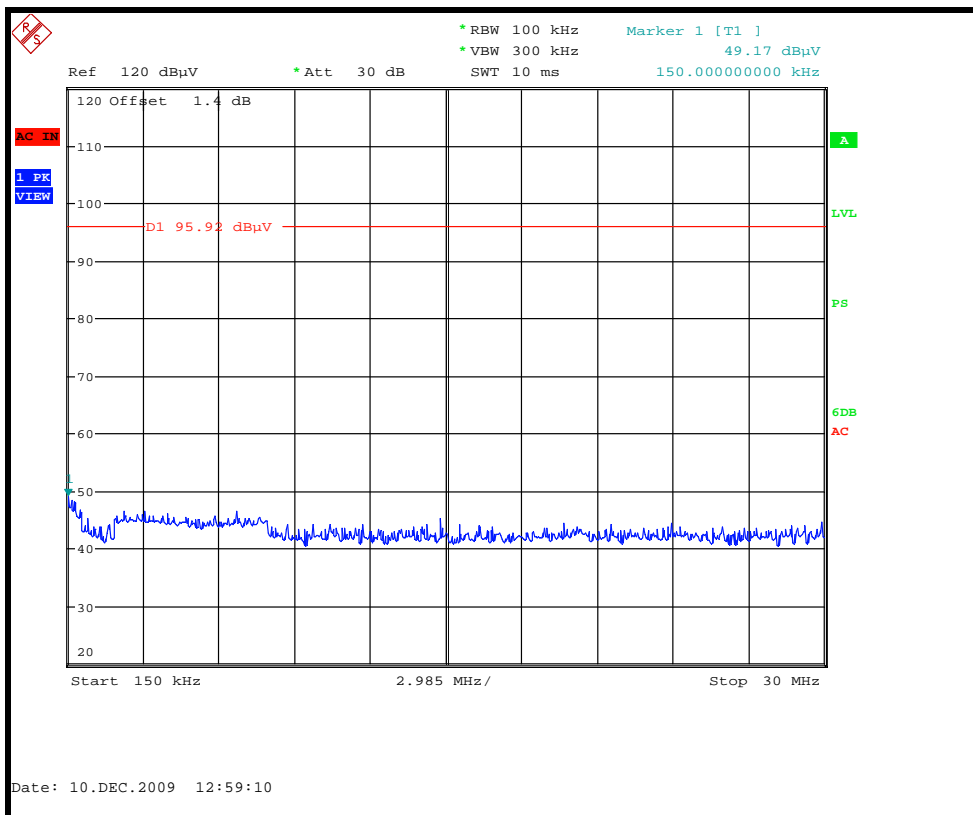
Frequency Occupancy Time



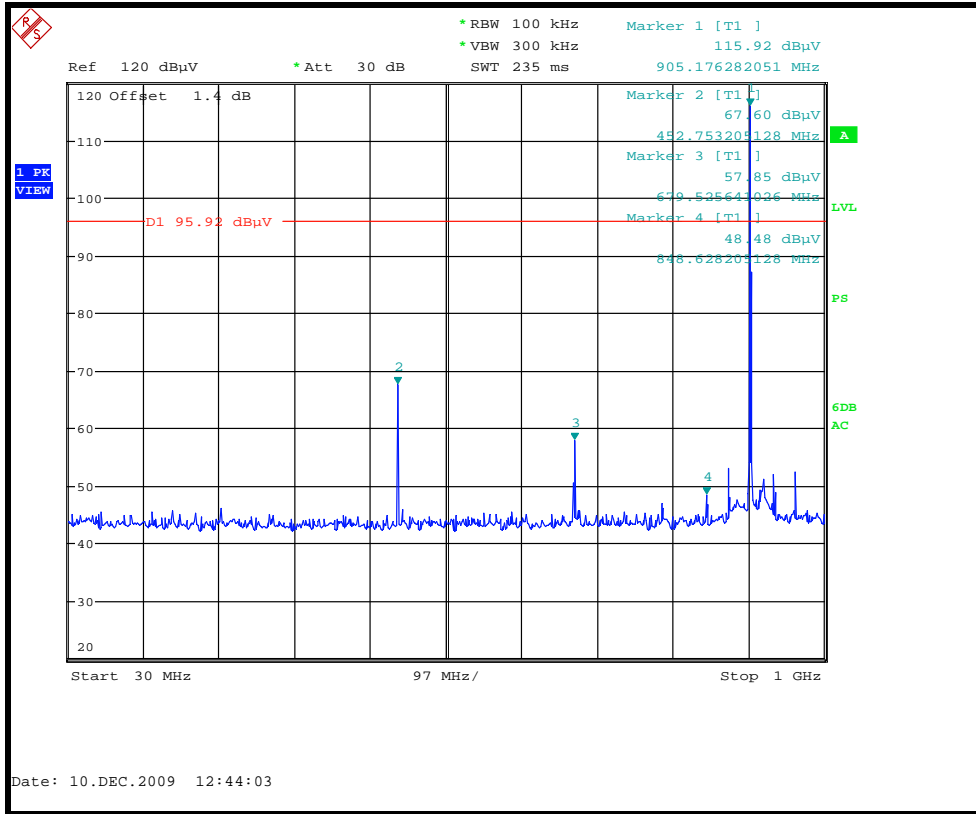
Frequency repetition time > 10s



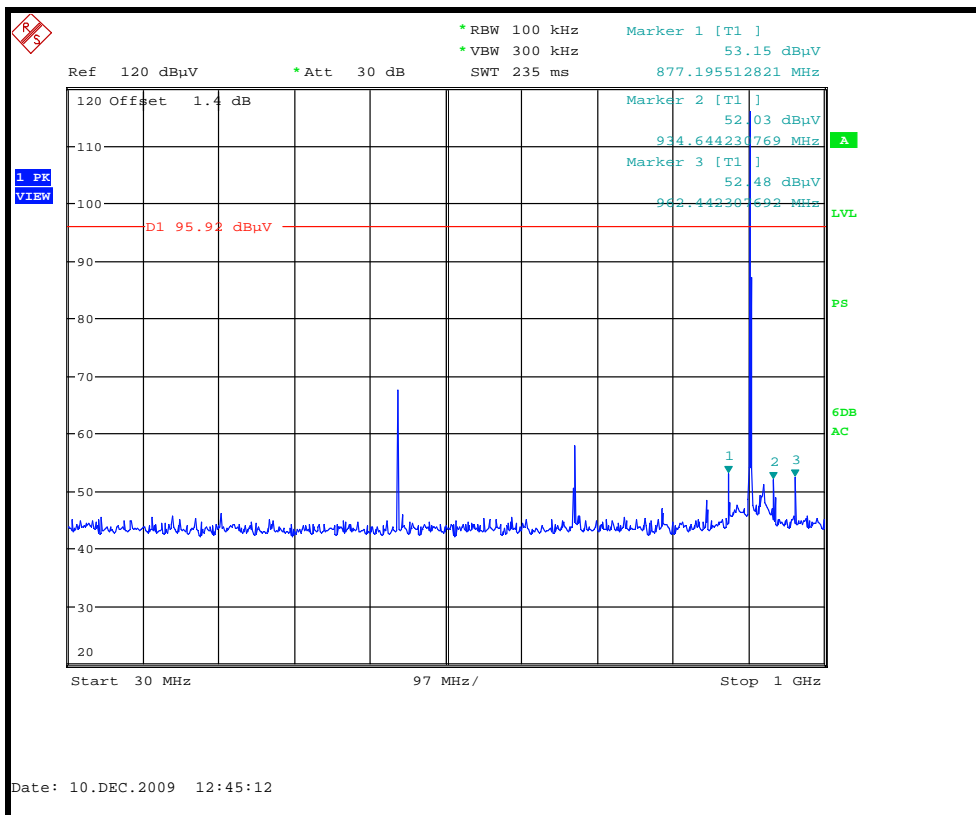
Conducted Spurious emissions 9kHz to 150kHz – 905.0 MHz



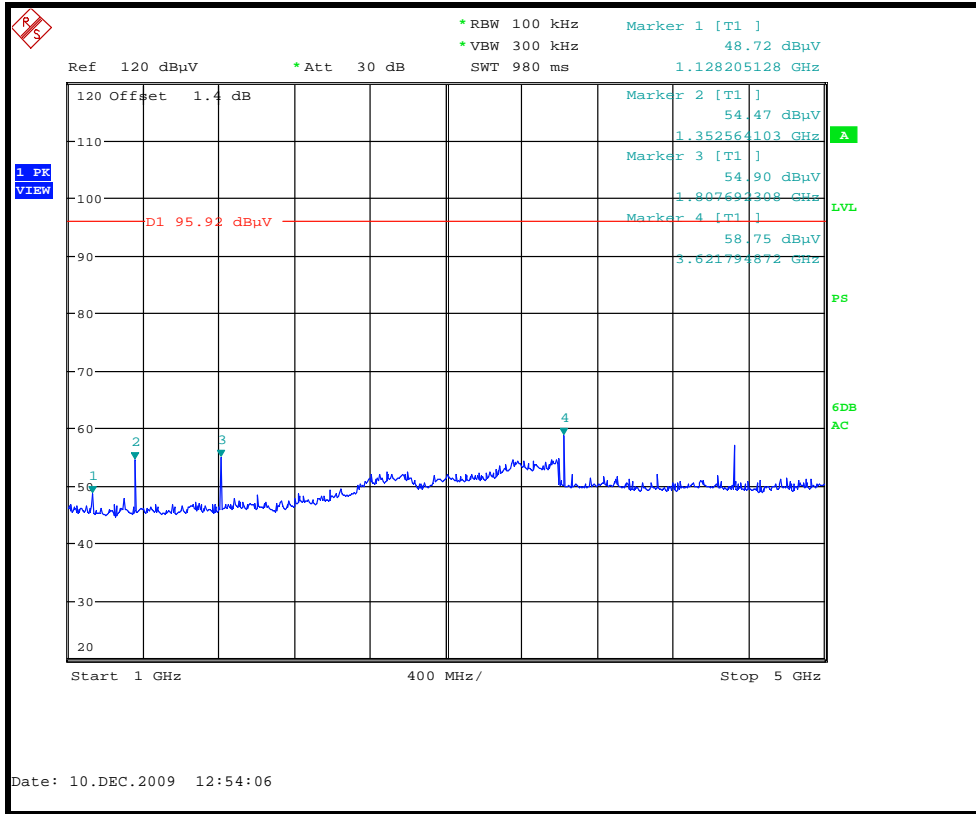
Conducted Spurious emissions 150kHz to 30MHz – 905.0 MHz



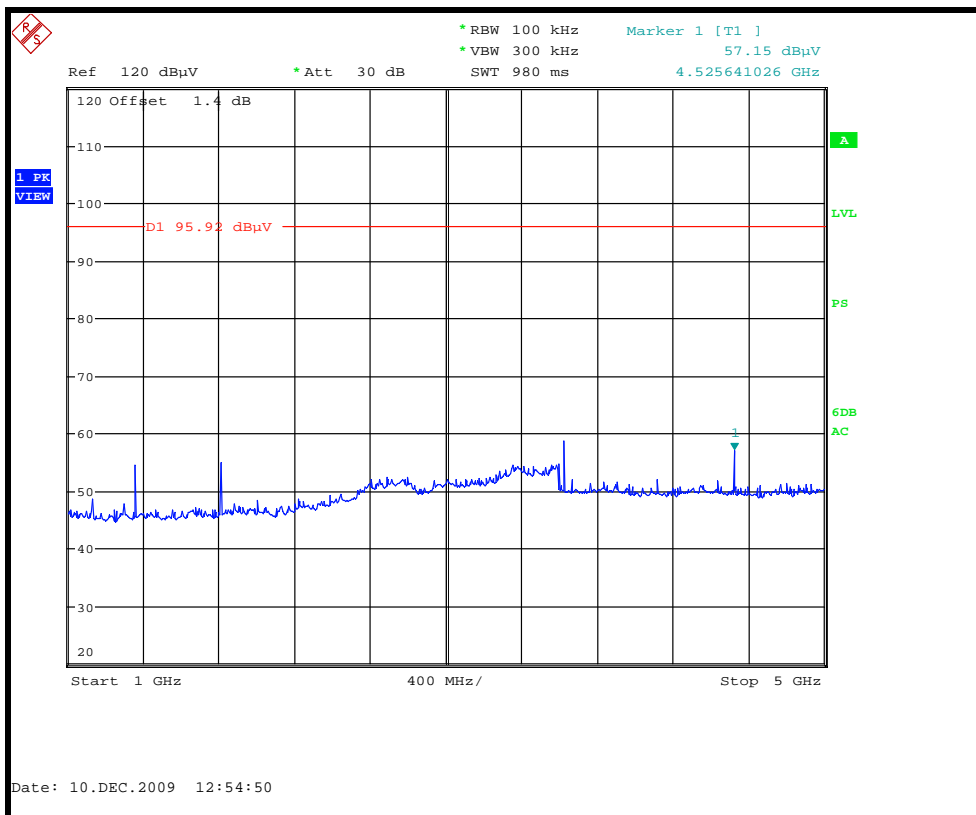
Conducted Spurious emissions 30 MHz to 1 GHz – 905.0 MHz



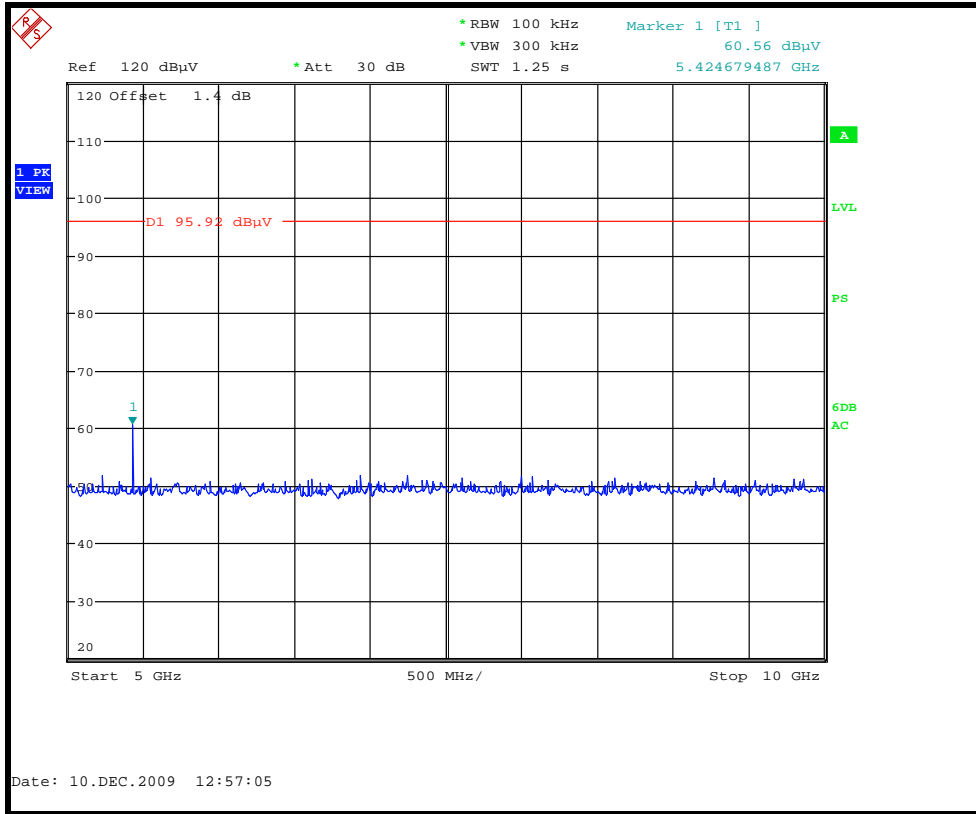
Conducted Spurious emissions 30 MHz to 1 GHz – 905.0 MHz



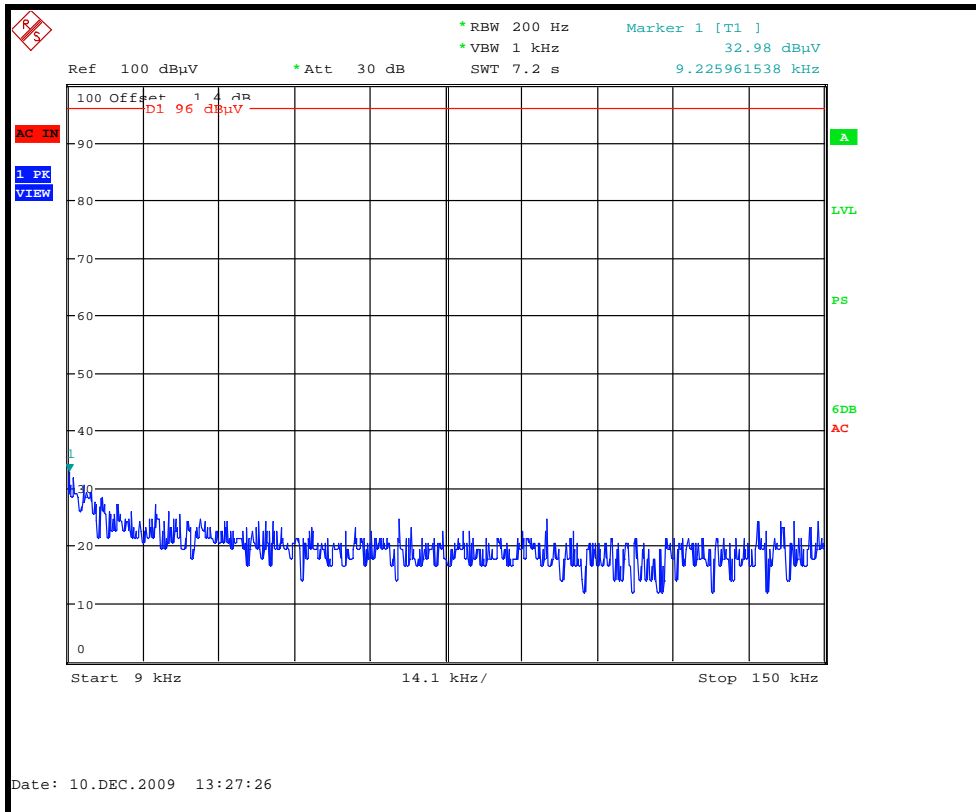
Conducted Spurious emissions 1 GHz to 5 GHz – 905.0 MHz



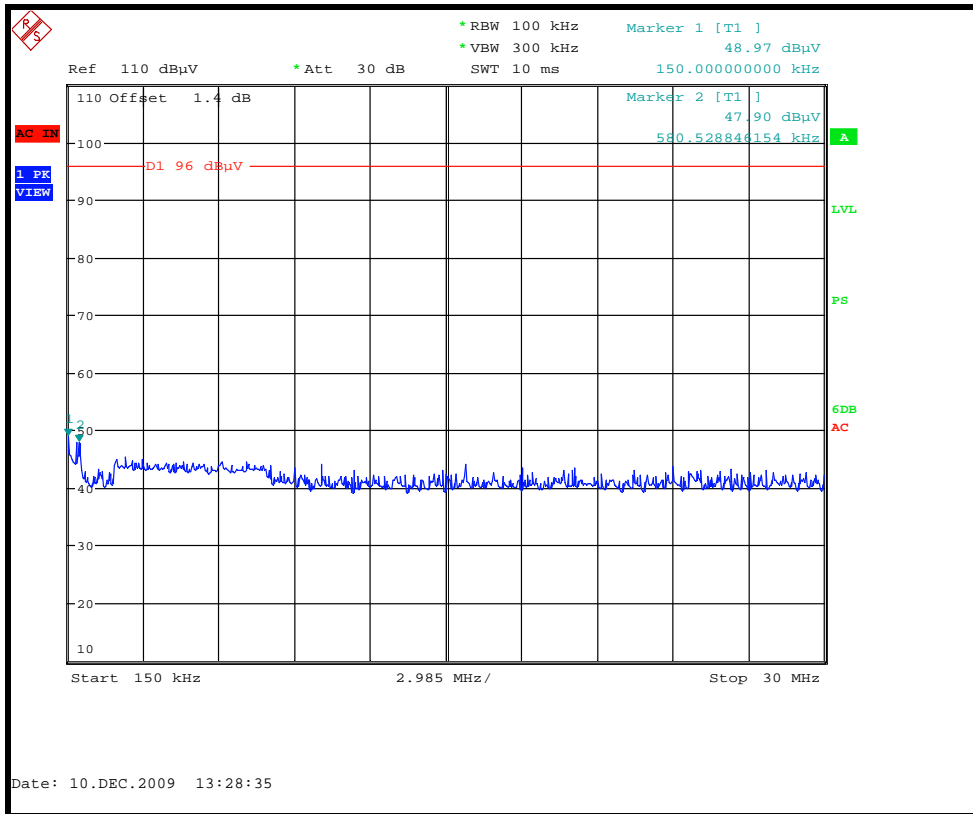
Conducted Spurious emissions 5 GHz to 10 GHz – 905.0 MHz



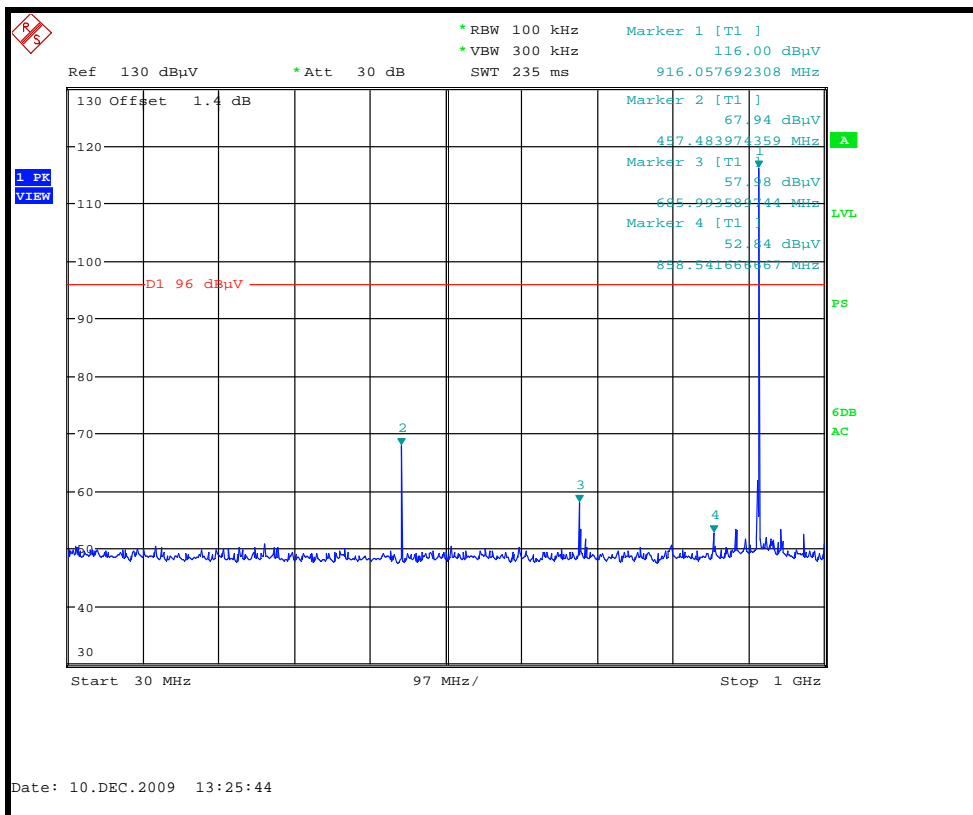
Conducted Spurious emissions 5 GHz to 10 GHz – 905.0 MHz



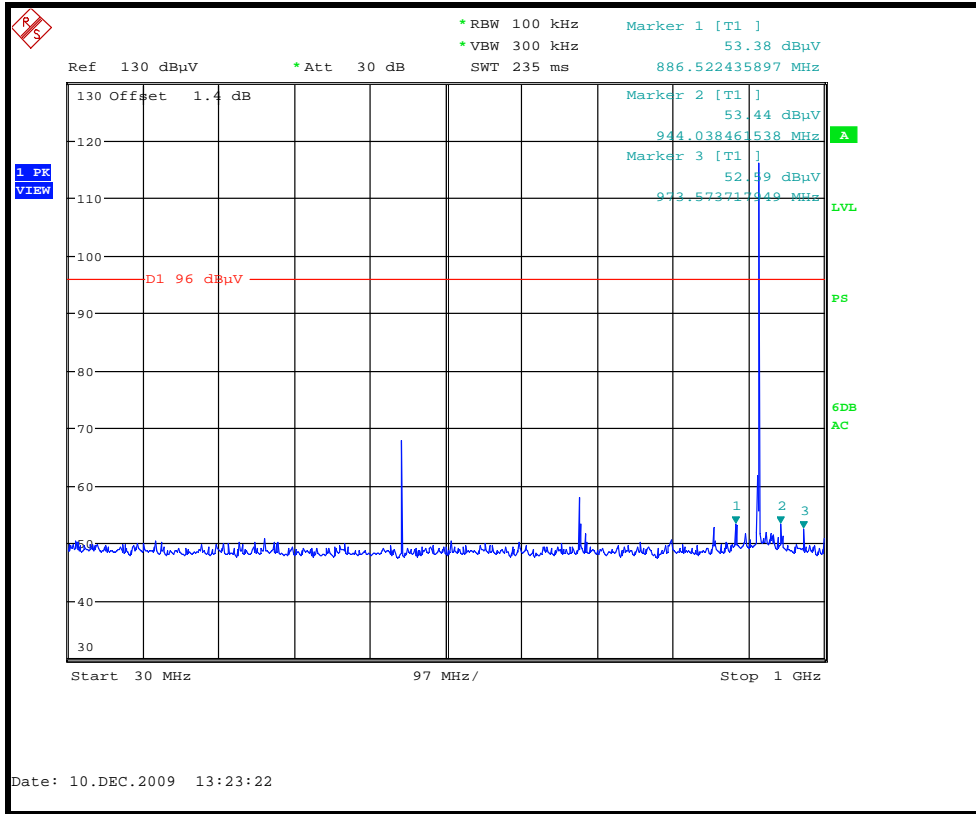
Conducted Spurious emissions 9 kHz to 150 kHz – 915.0 MHz



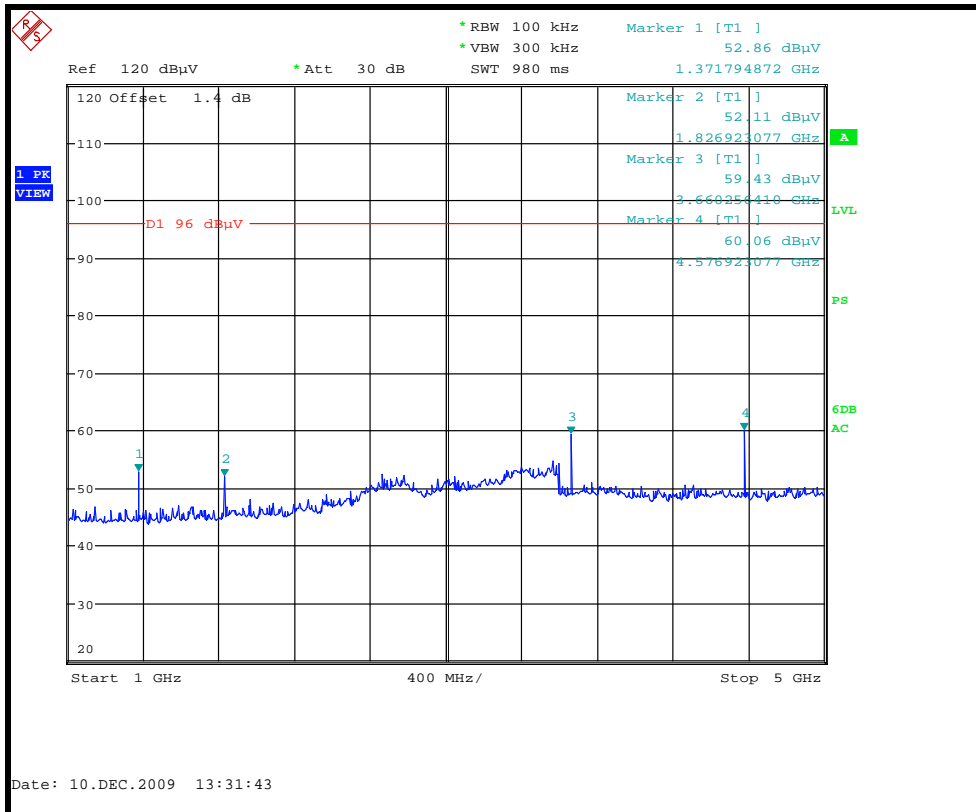
Conducted Spurious emissions 150 kHz to 30 MHz – 915.0 MHz



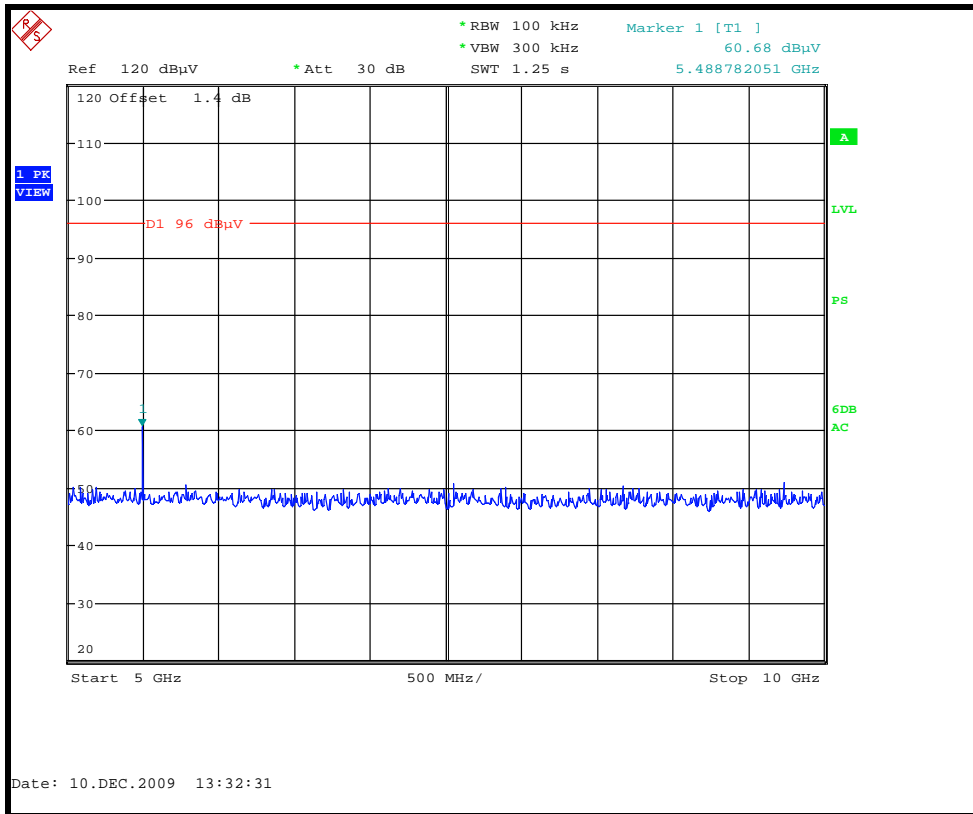
Conducted Spurious emissions 30 MHz to 1 GHz – 915.0 MHz



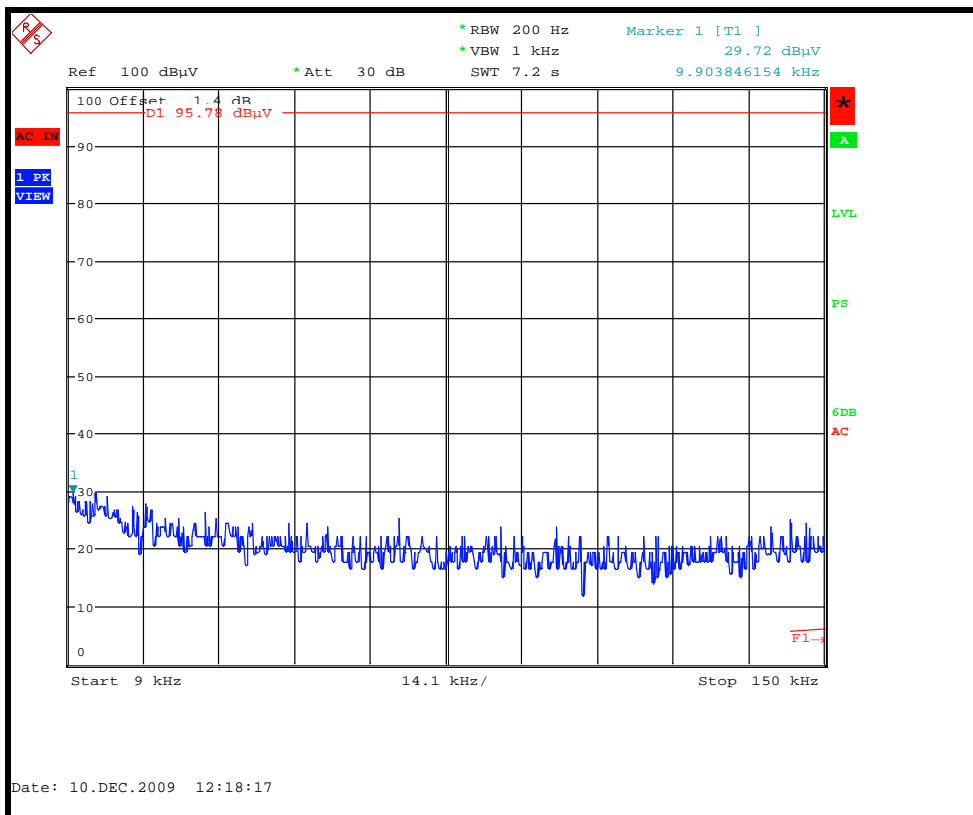
Conducted Spurious emissions 30 MHz to 1 GHz – 915.0 MHz



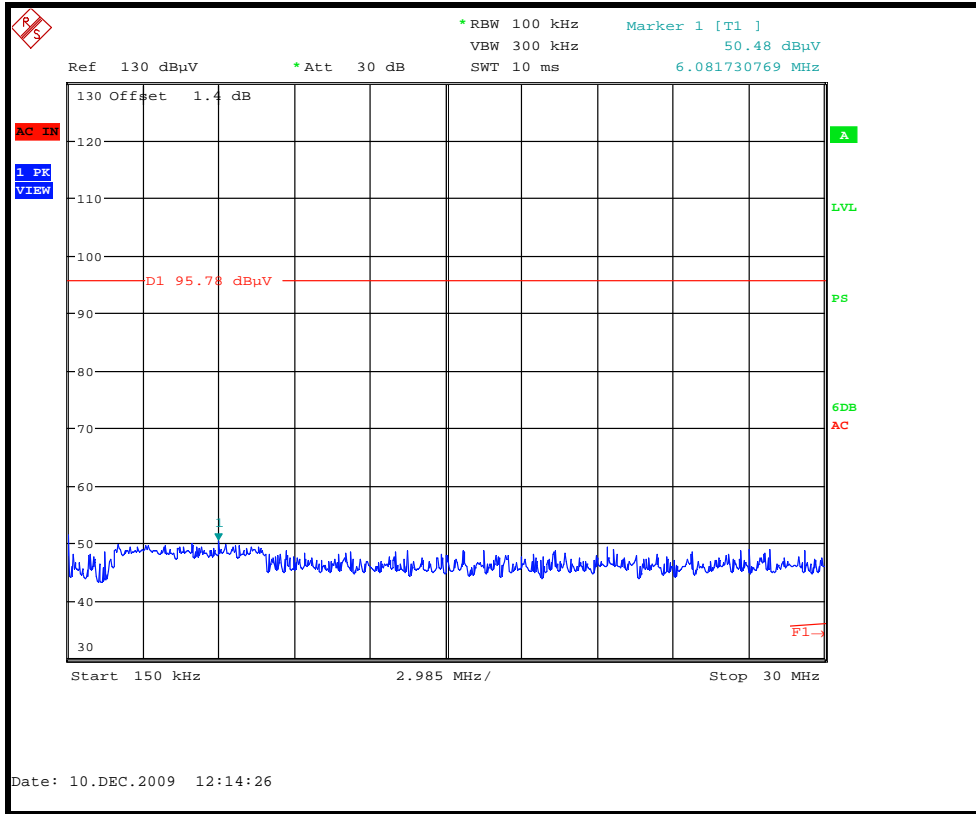
Conducted Spurious emissions 1 GHz to 5GHz – 915.0 MHz



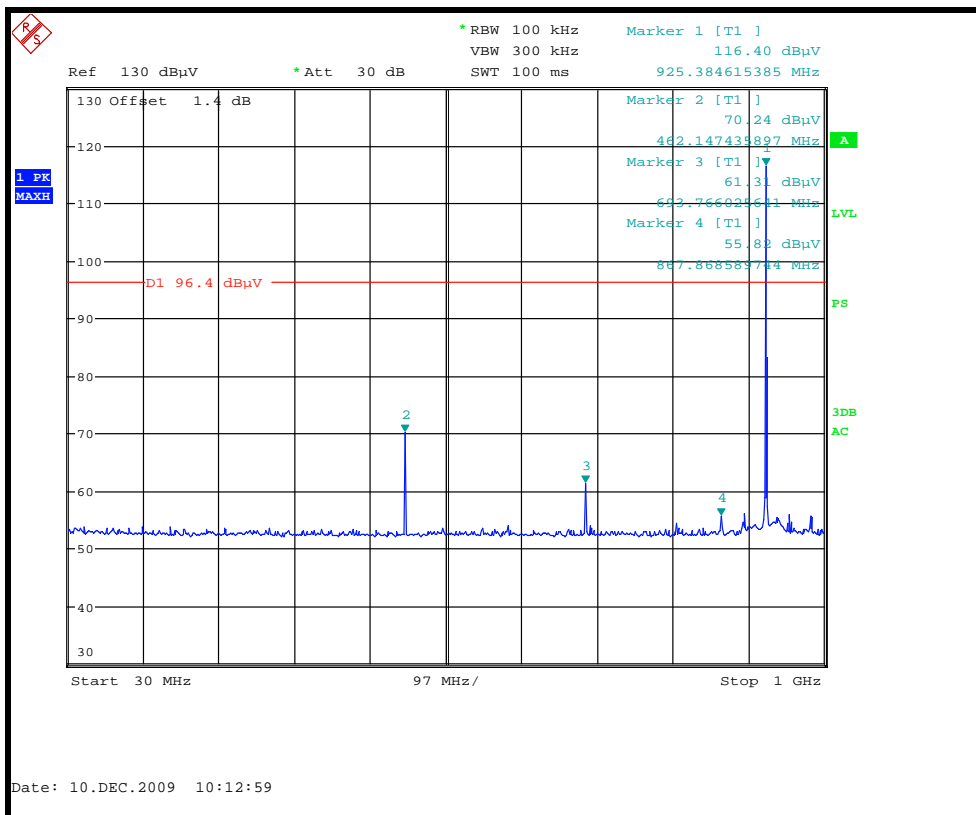
Conducted Spurious emissions 5 GHz to 10 GHz – 915.0 MHz



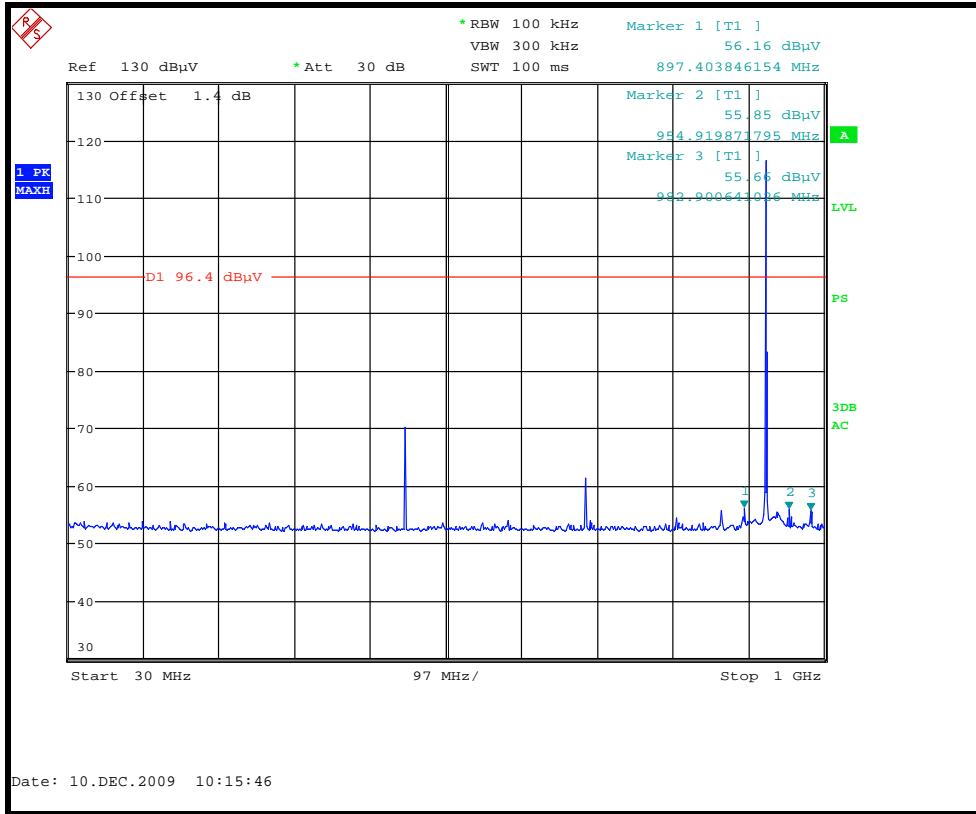
Conducted Spurious emissions 9 kHz to 150 kHz – 925.0 MHz



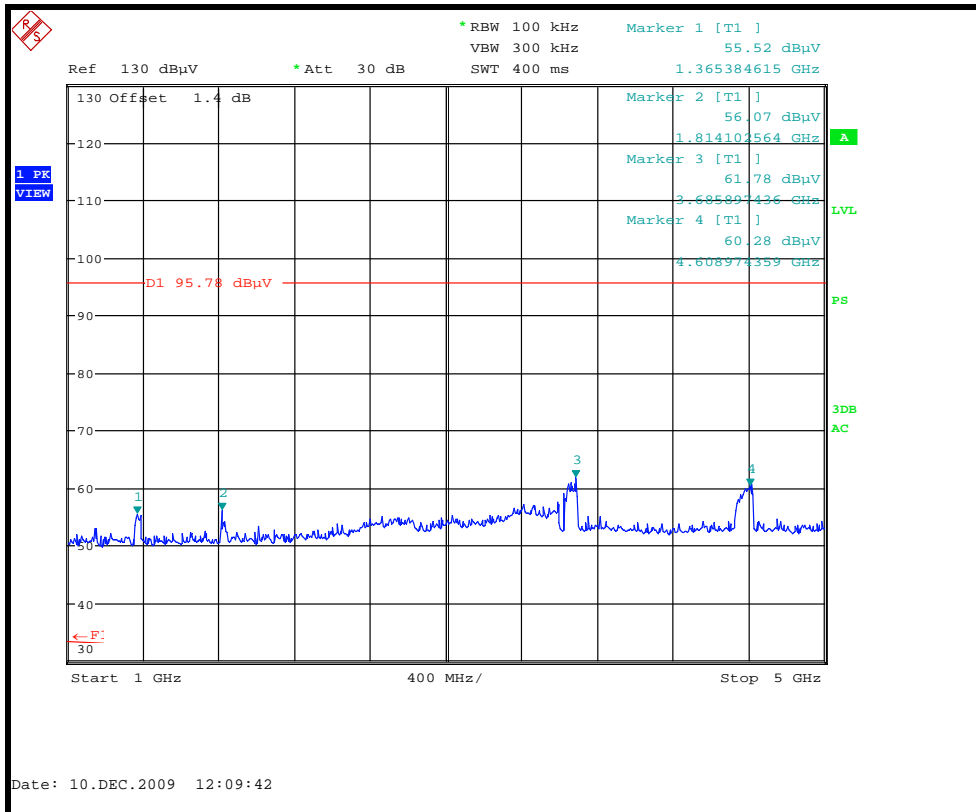
Conducted Spurious emissions 150 kHz to 30 MHz – 925.0 MHz



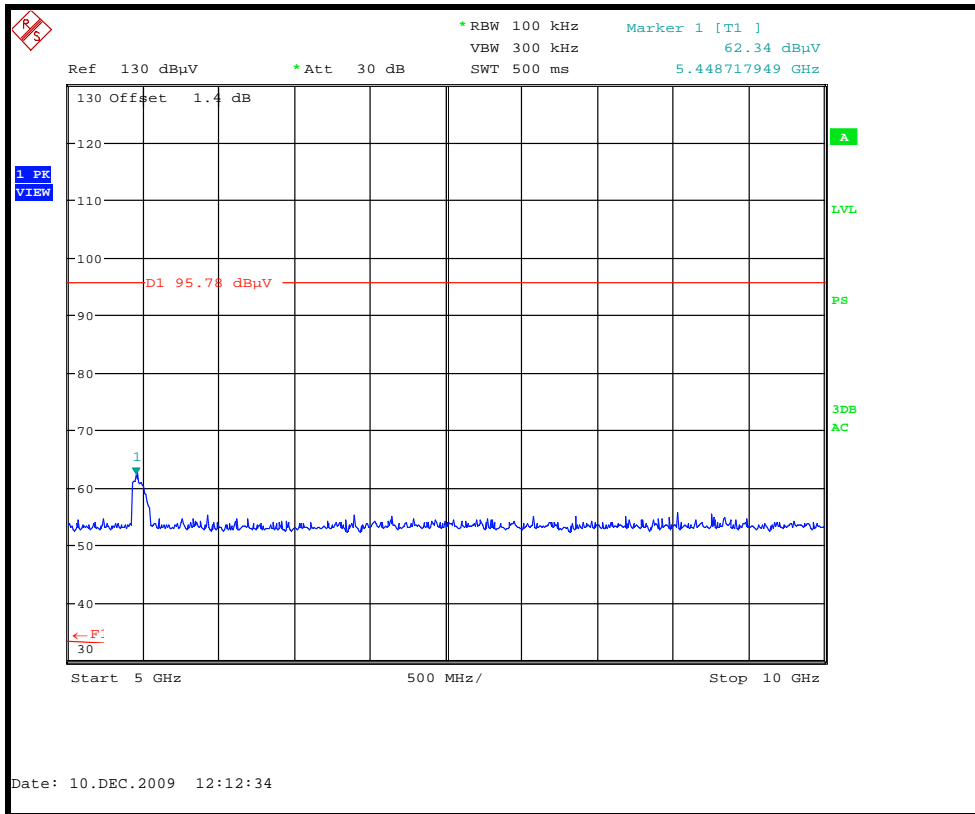
Conducted Spurious emissions 30 MHz to 1 GHz – 925.0 MHz



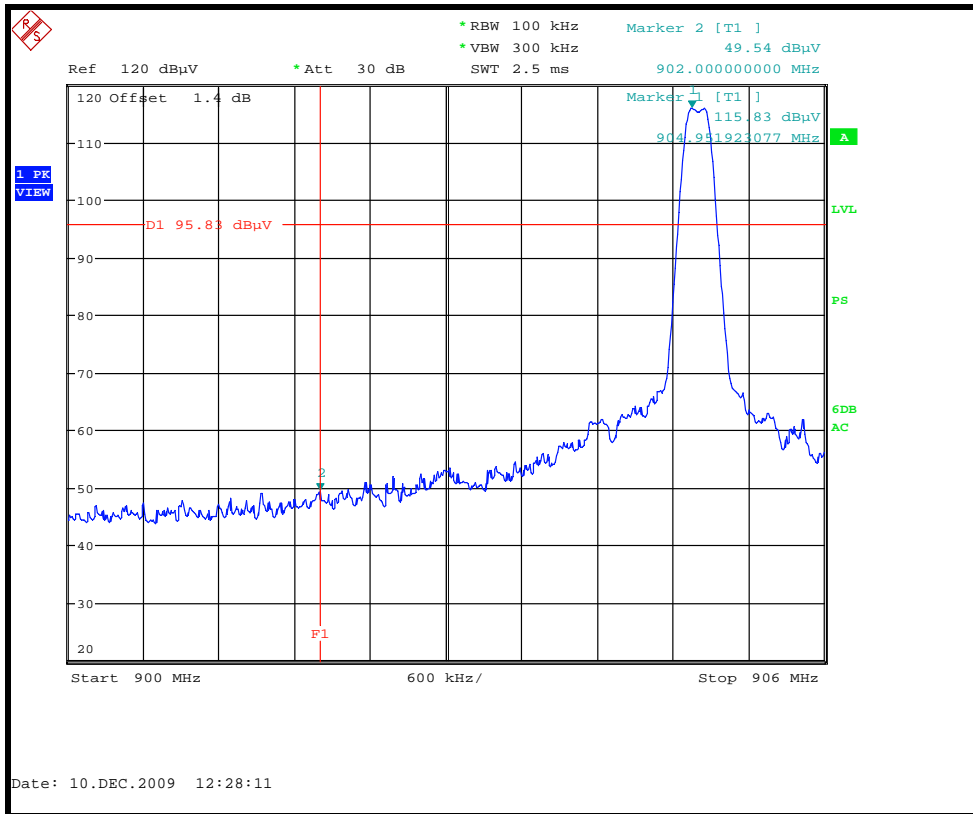
Conducted Spurious emissions 30 MHz to 1 GHz – 925.0 MHz



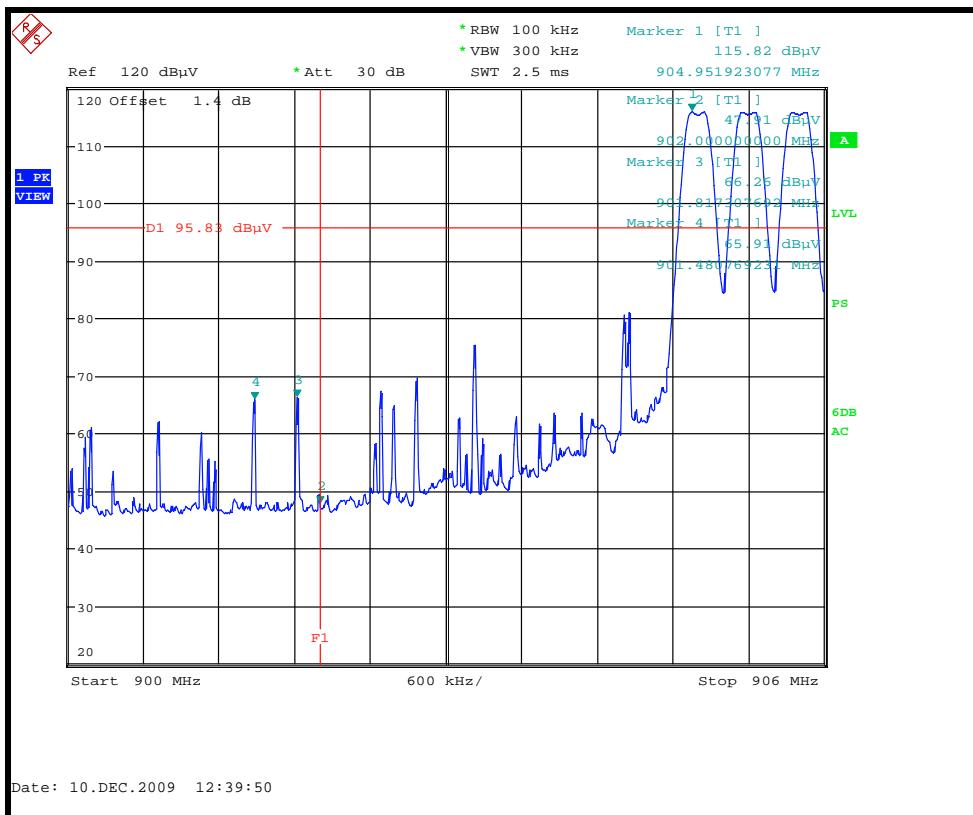
Conducted Spurious emissions 1 GHz to 5GHz – 925.0 MHz



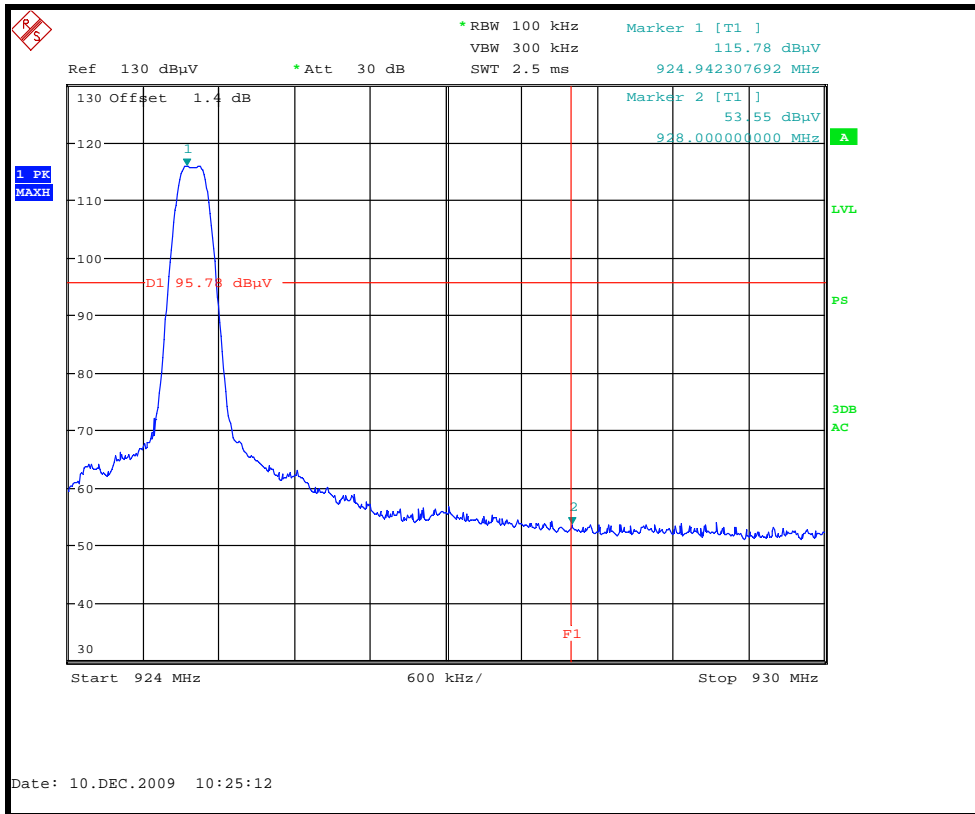
Conducted Spurious emissions 5 GHz to 10 GHz – 925.0 MHz



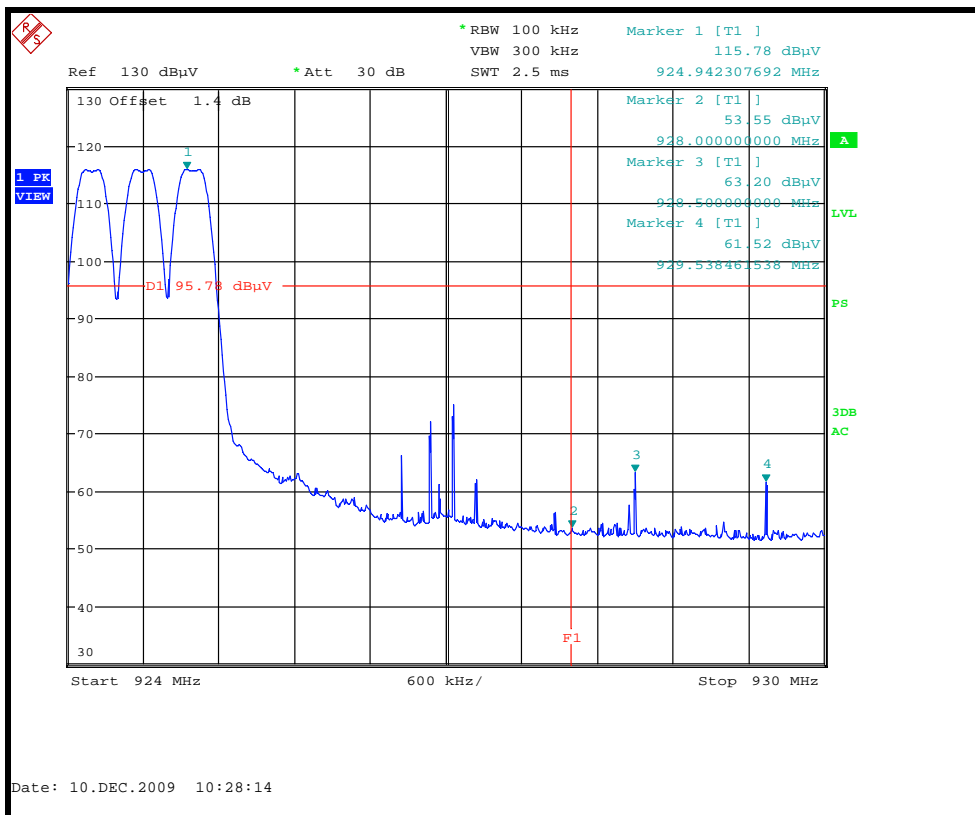
Conducted Lower band-edge Compliance - Non Hopping - 905.0MHz



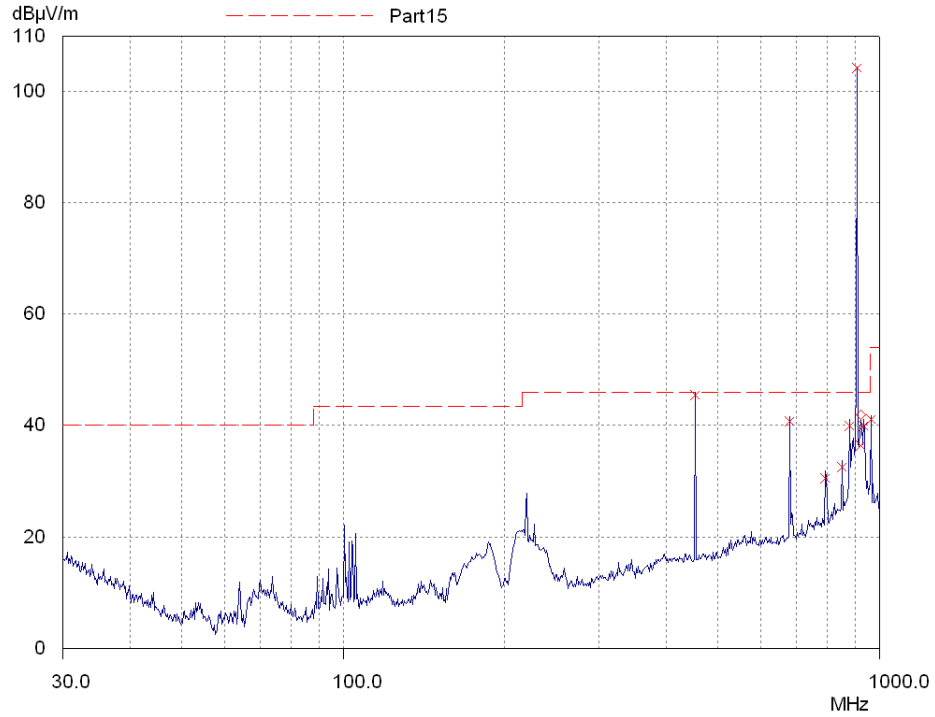
Conducted Lower band-edge Compliance - Hopping - 905.0MHz



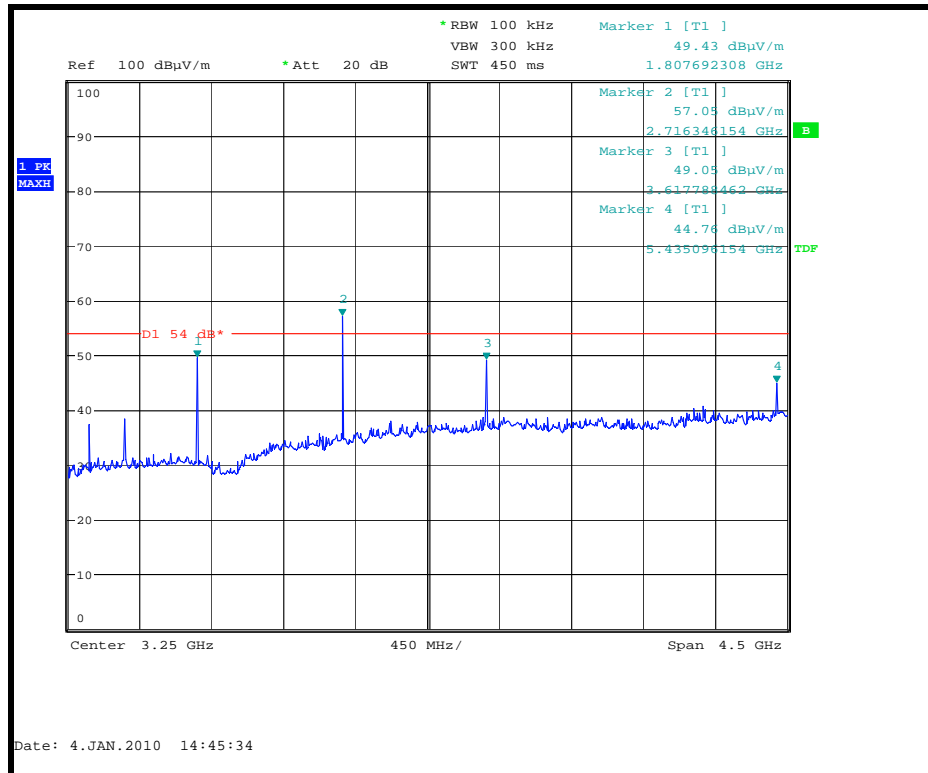
Conducted Upper band-edge Compliance - Non Hopping - 925.0MHz



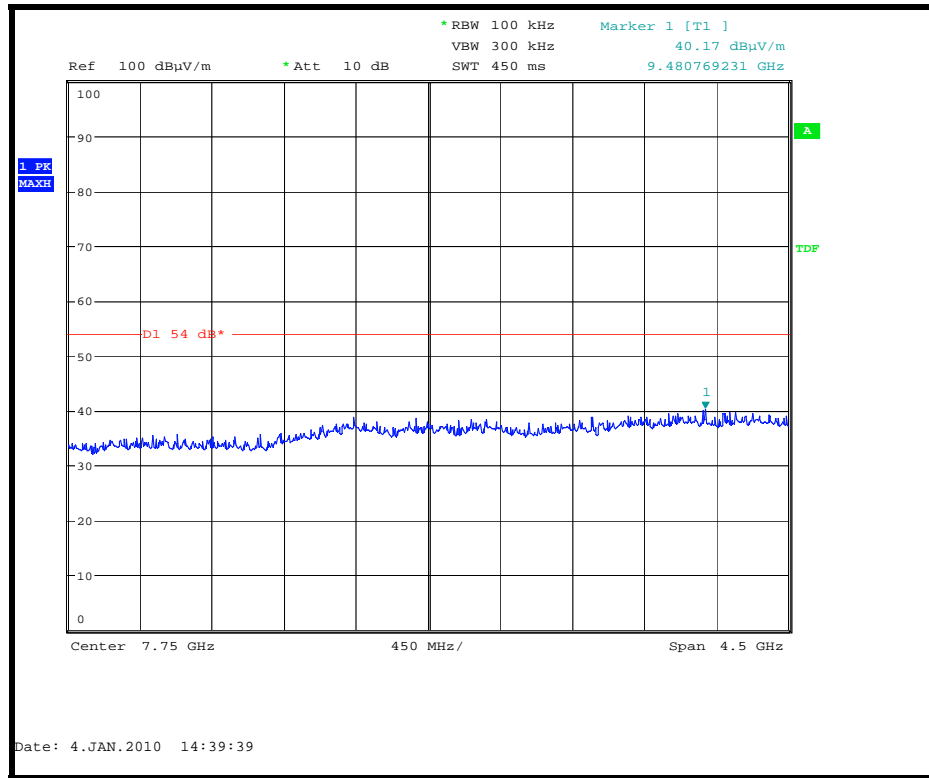
Conducted Upper band-edge Compliance - Hopping - 925.0MHz



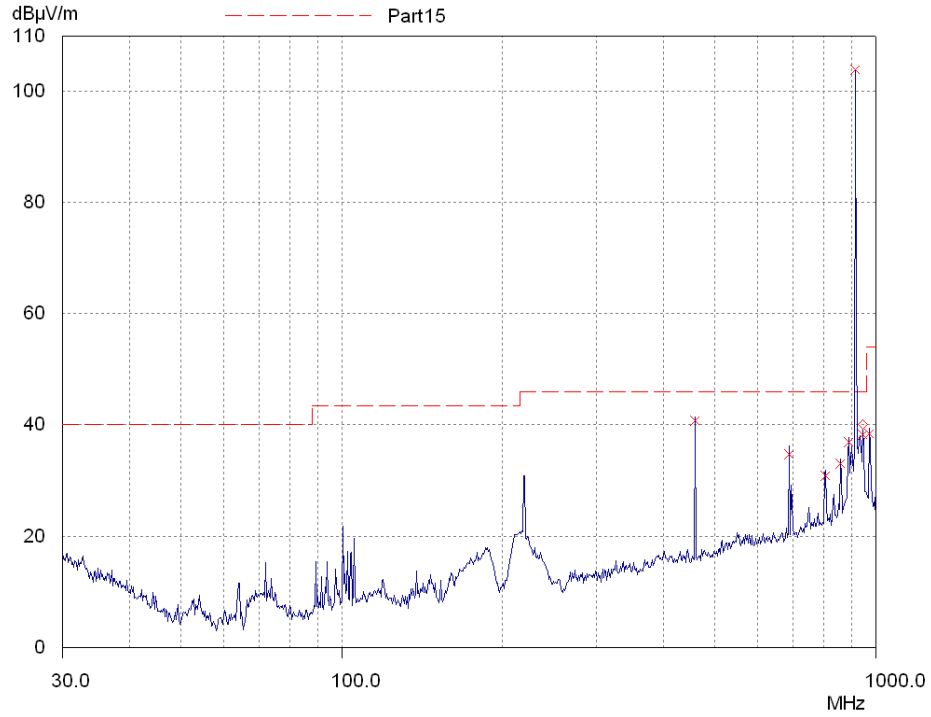
Radiated Spurious emissions 30 MHz to 1 GHz – 905.0 MHz



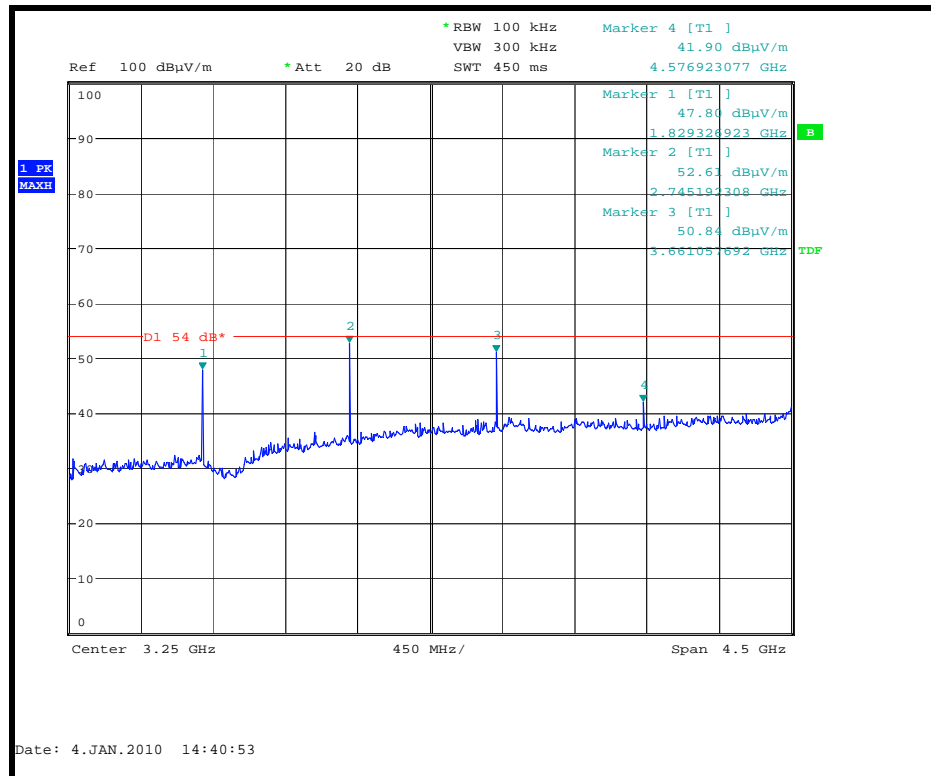
Radiated Spurious emissions 1 GHz to 5 GHz – 905.0 MHz



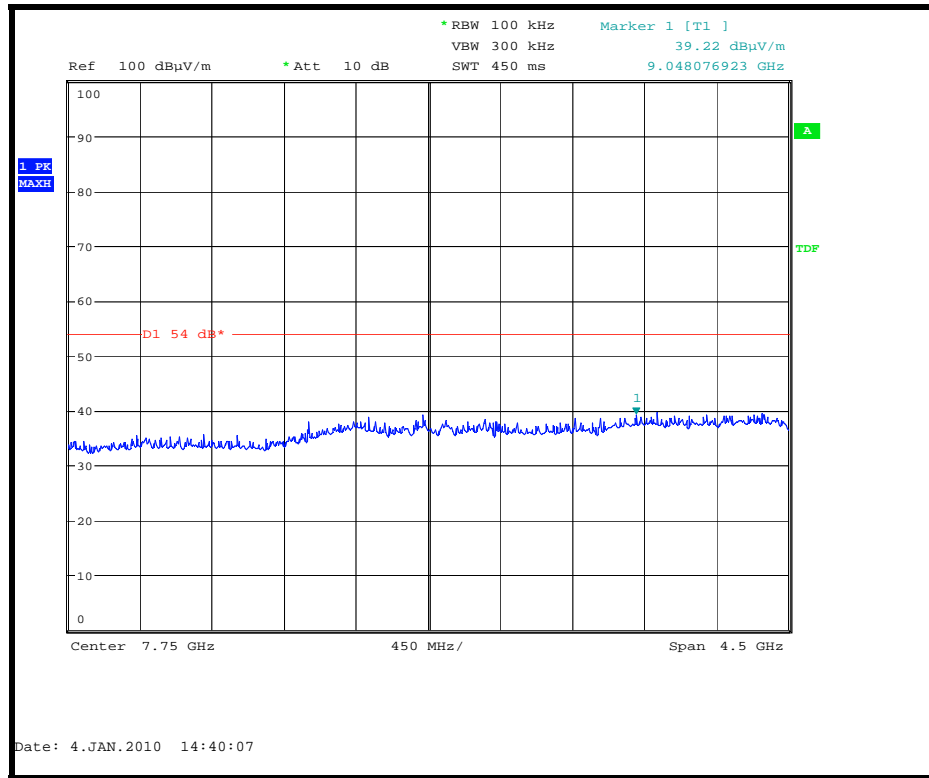
Radiated Spurious emissions (15.209) 5 GHz to 10 GHz – 905.0 MHz



Radiated Spurious emissions (15.209) 30 MHz to 1 GHz – 915.0 MHz

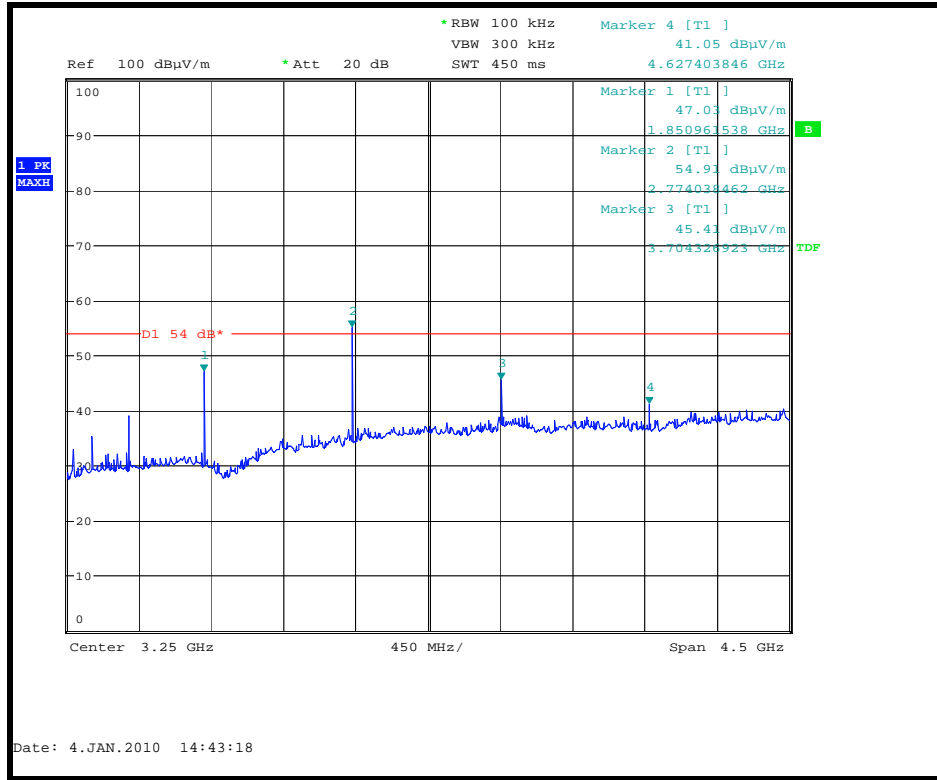


Radiated Spurious emissions (15.209) 1 GHz to 5 GHz – 915.0 MHz

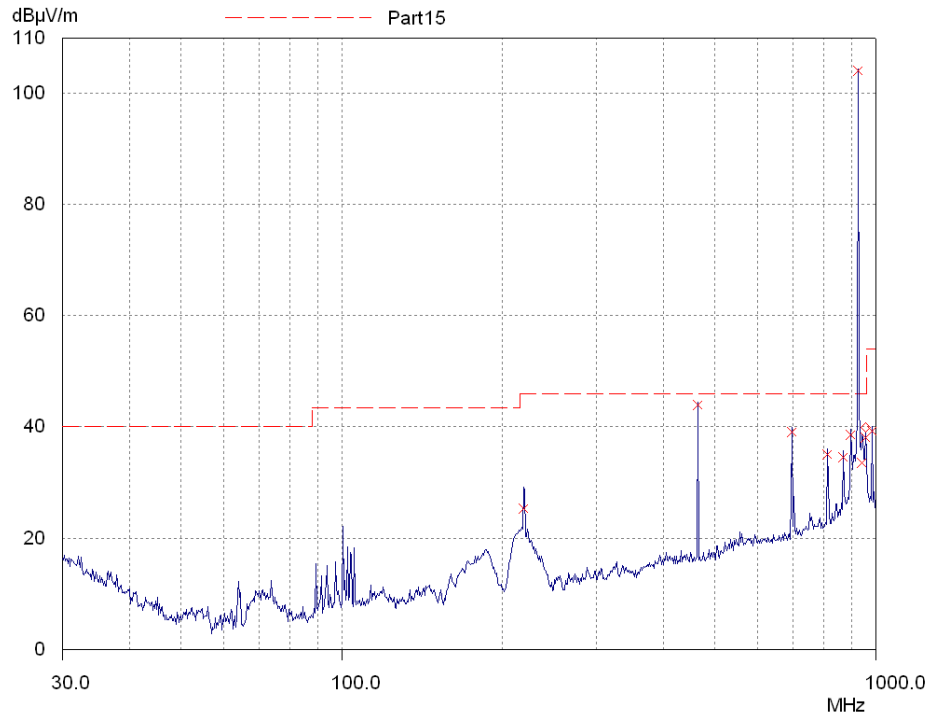


Radiated Spurious emissions (15.209) 5 GHz to 10 GHz – 915.0 MHz

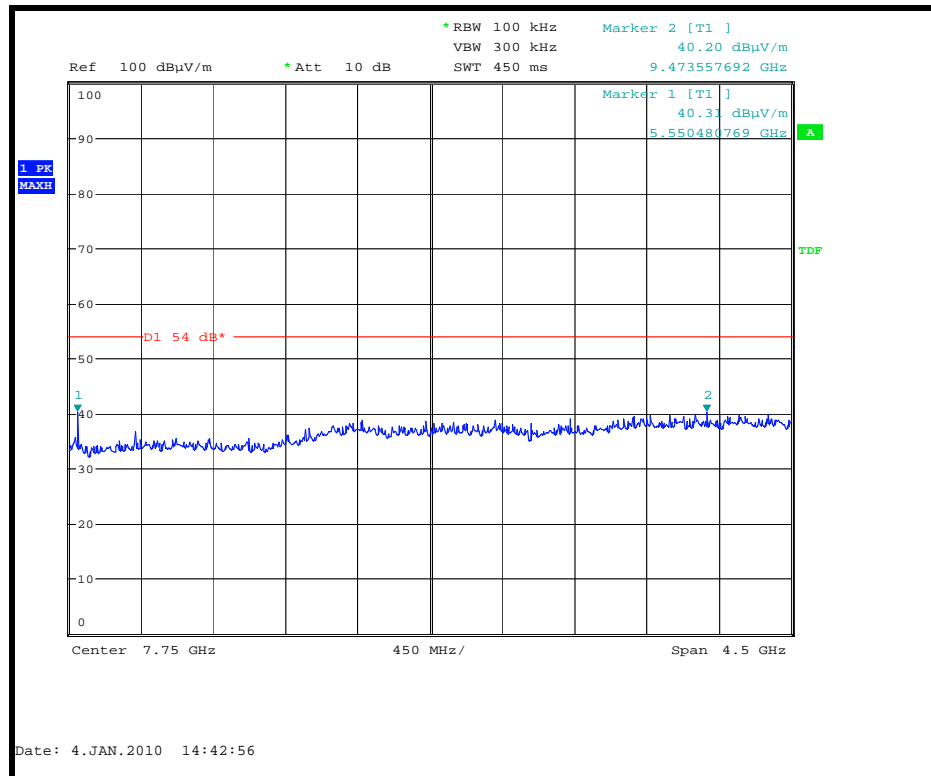
Radiated Spurious emissions (15.209) 30 MHz to 1 GHz – 915.0 MHz

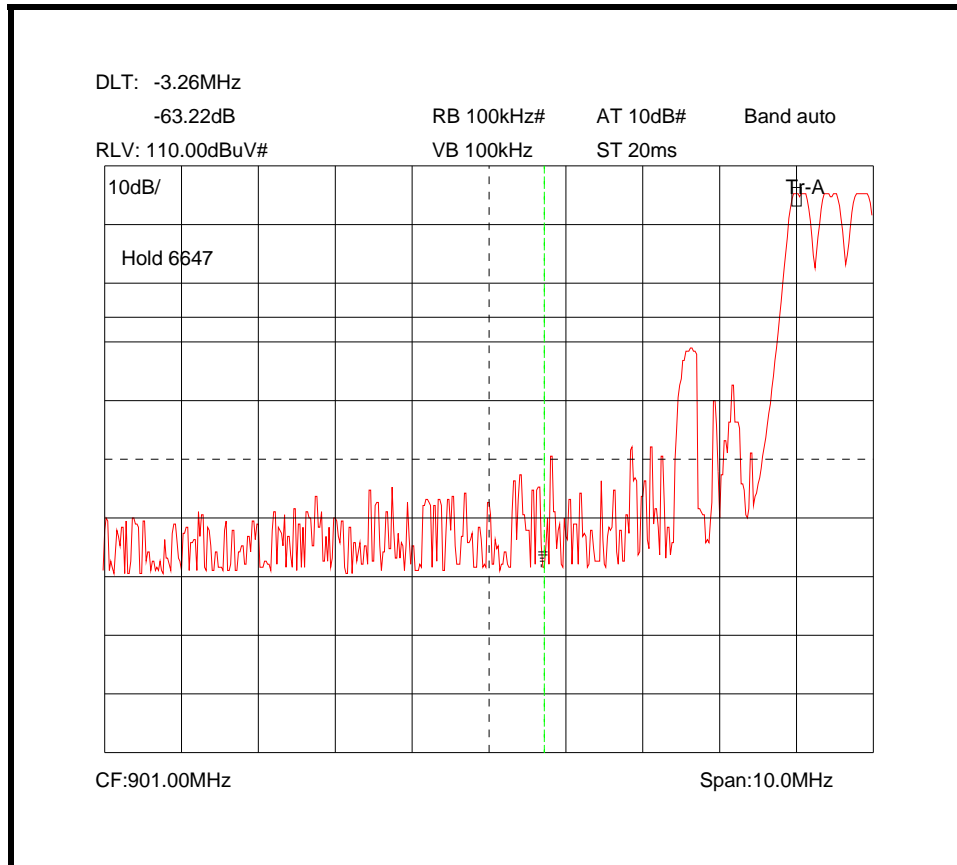


Radiated Spurious emissions (15.209) 1 GHz to 5 GHz – 925.0 MHz

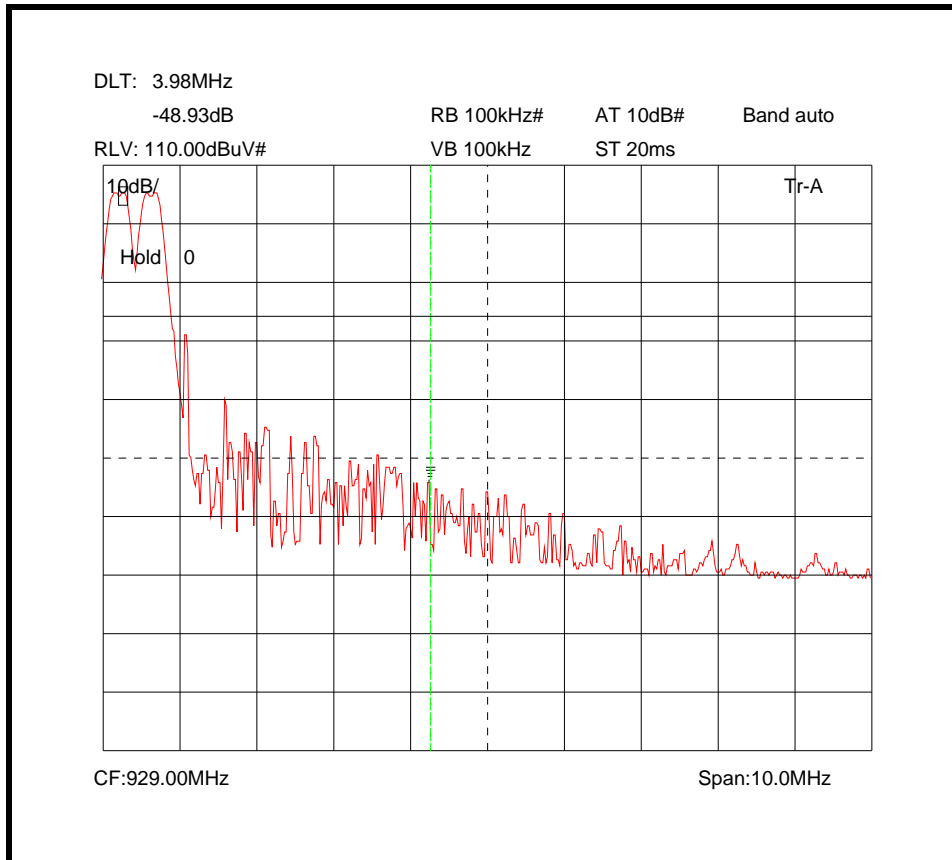


Radiated Spurious emissions (15.209) 5 GHz to 10 GHz – 925.0 MHz

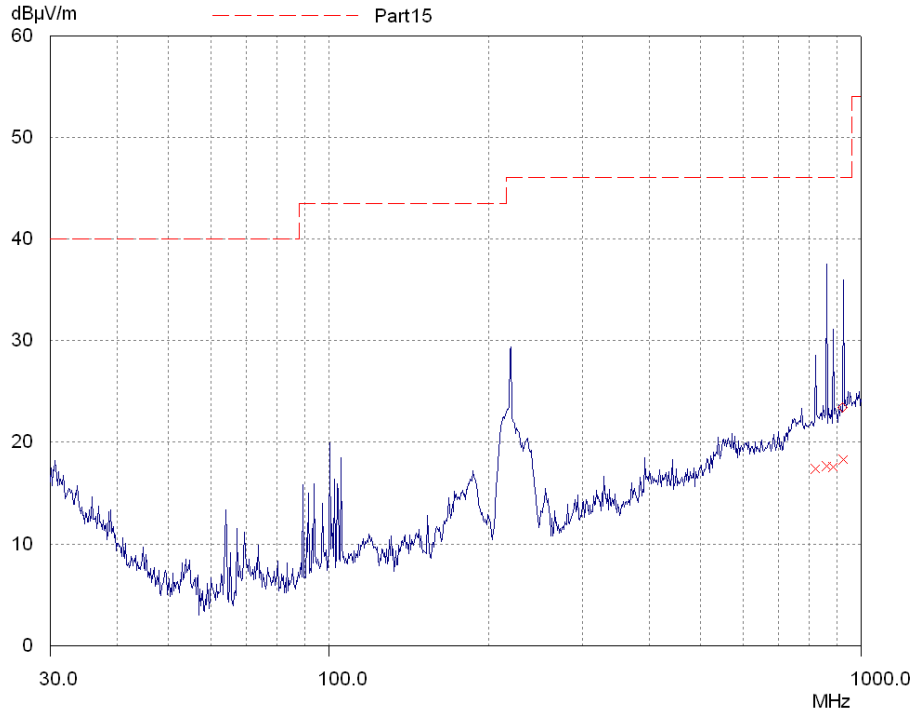




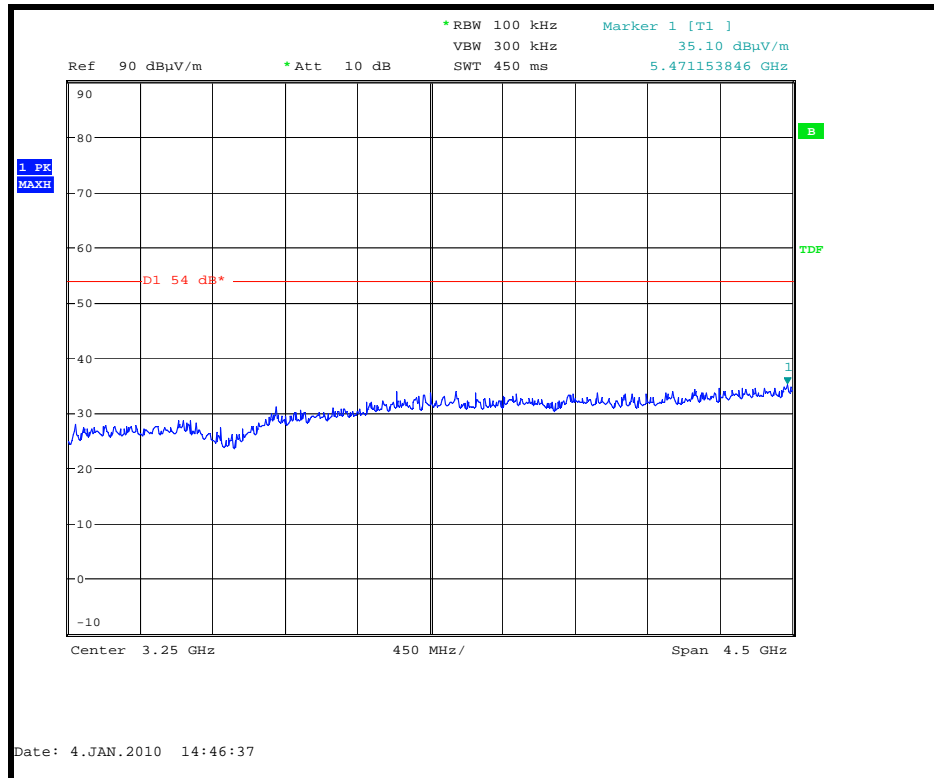
Radiated Lower band-edge Compliance - Hopping - 905.0MHz



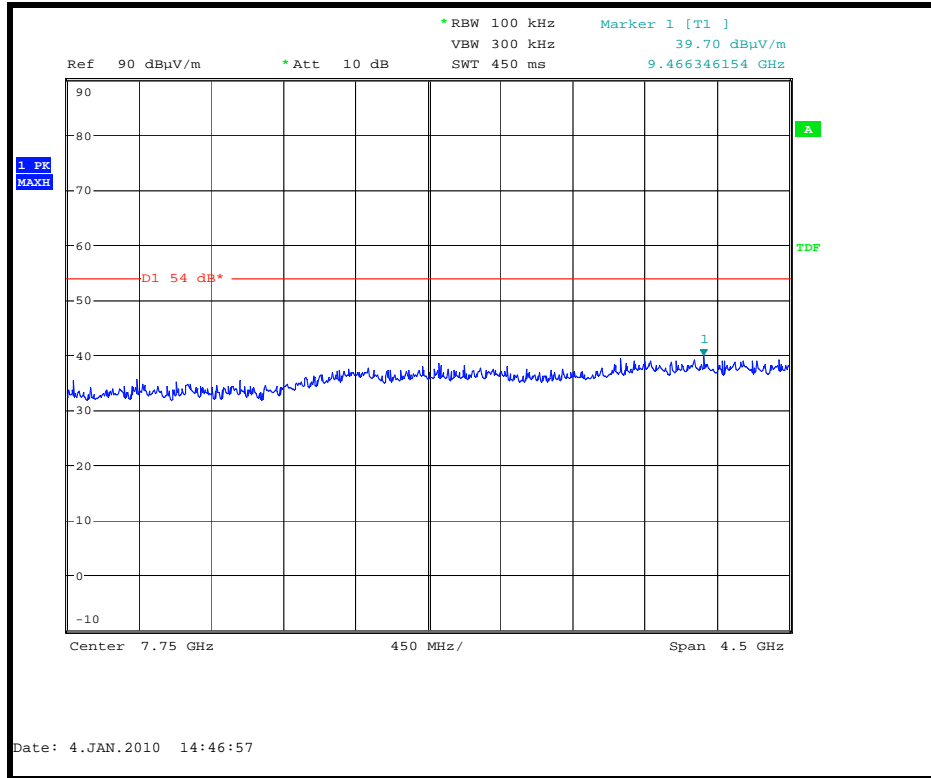
Radiated Upper band-edge Compliance - Hopping - 925.0MHz



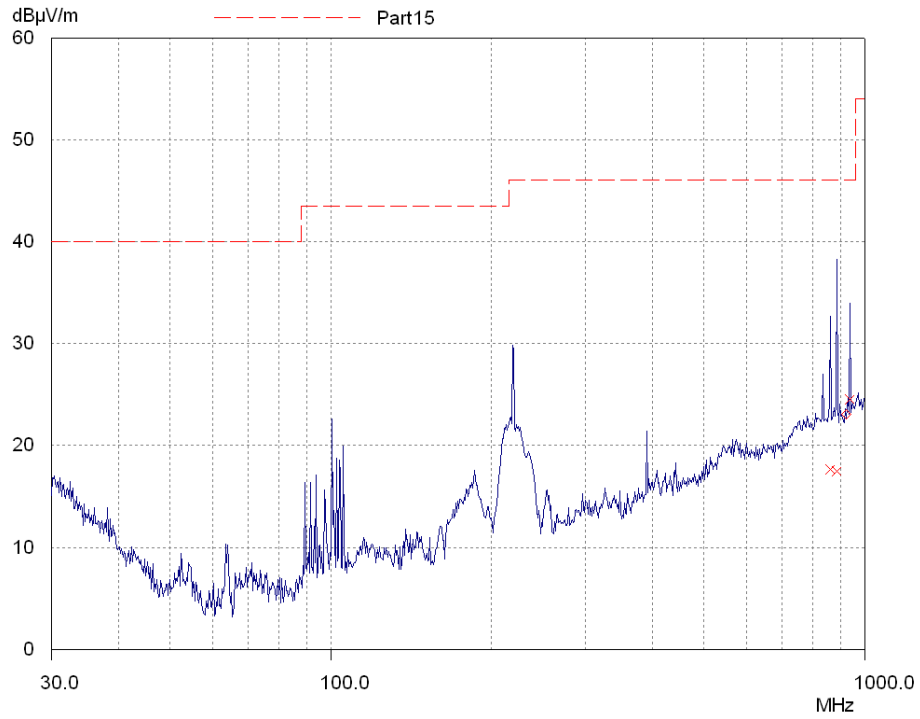
Radiated Spurious emissions (15.109) 30 MHz to 1 GHz – 905.0 MHz



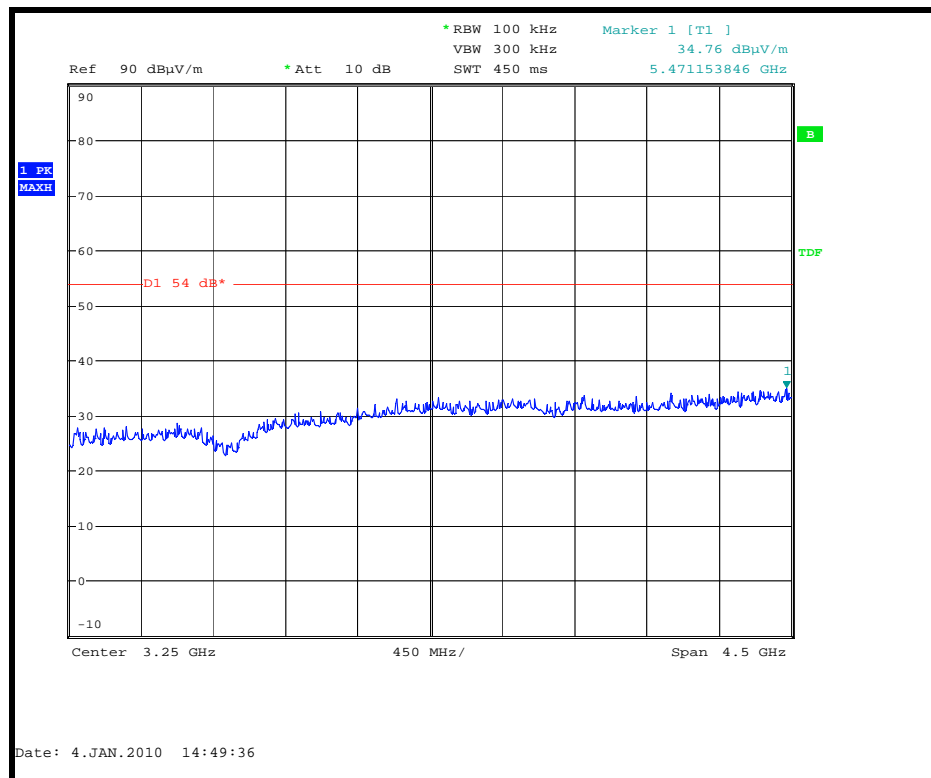
Radiated Spurious emissions (15.109) 1 GHz to 5 GHz – 905.0 MHz



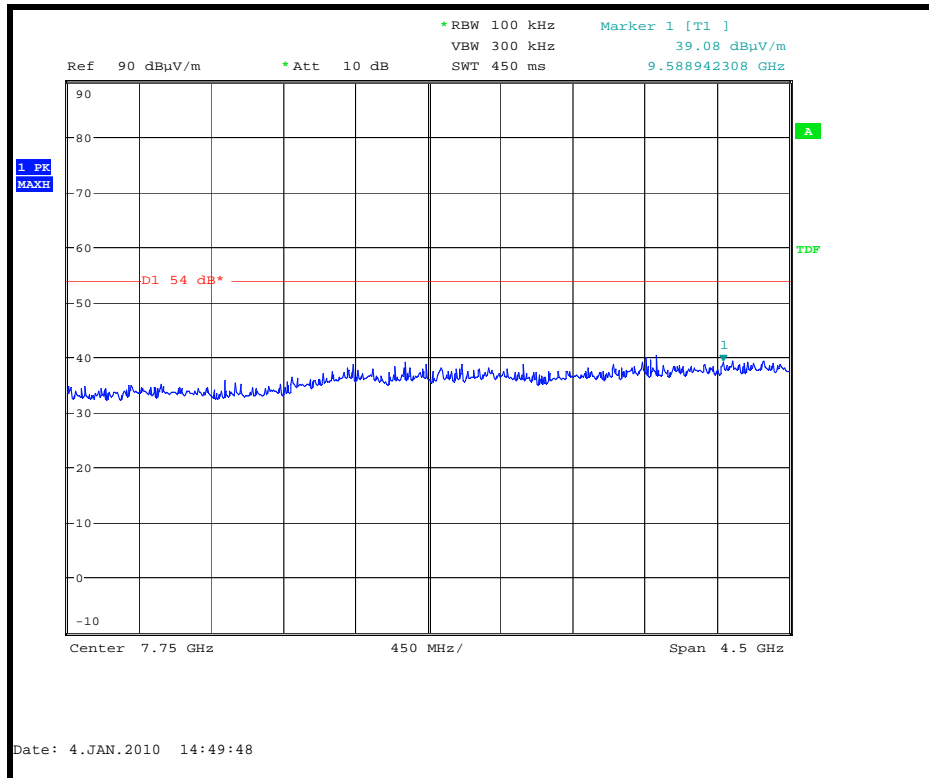
Radiated Spurious emissions (15.109) 5 GHz to 10 GHz – 905.0 MHz



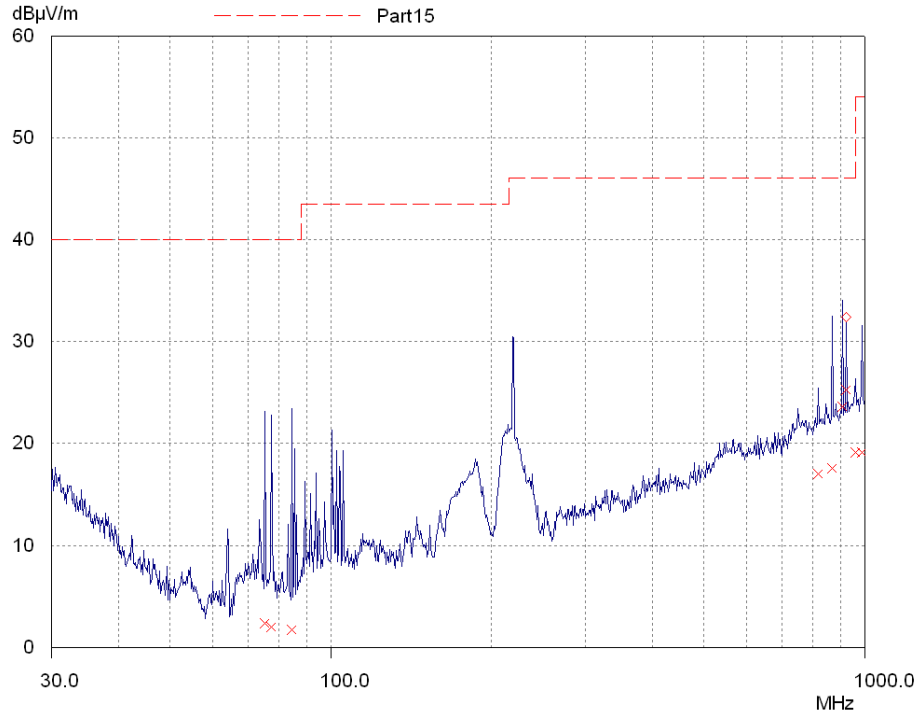
Radiated Spurious emissions (15.109) 30 MHz to 1 GHz – 915.0 MHz



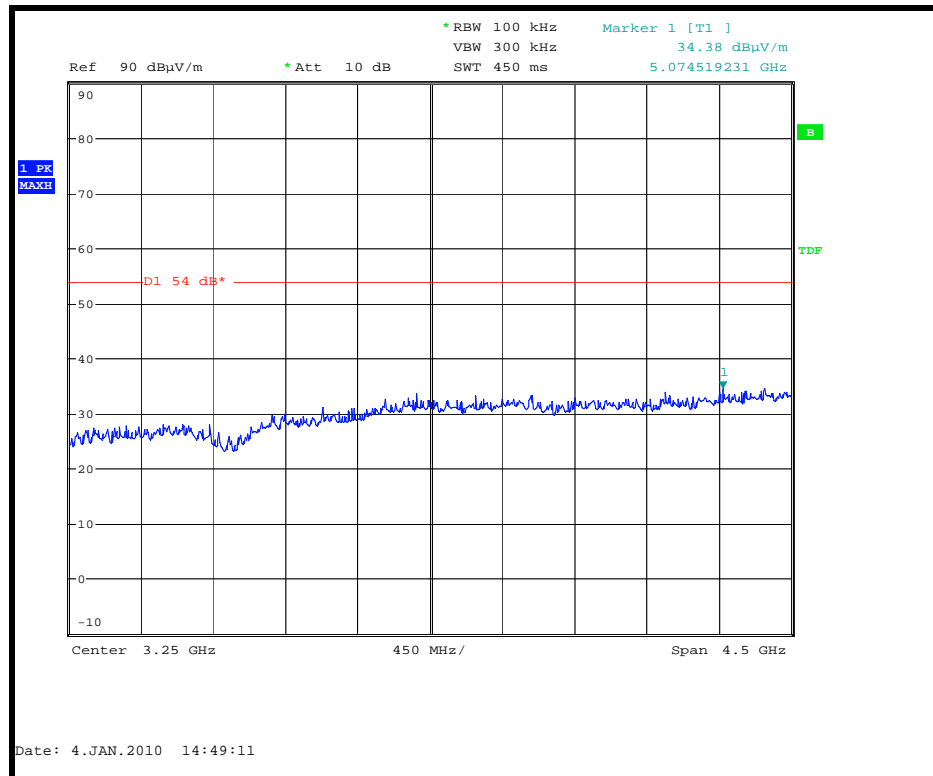
Radiated Spurious emissions (15.109) 1 GHz to 5 GHz – 915.0 MHz



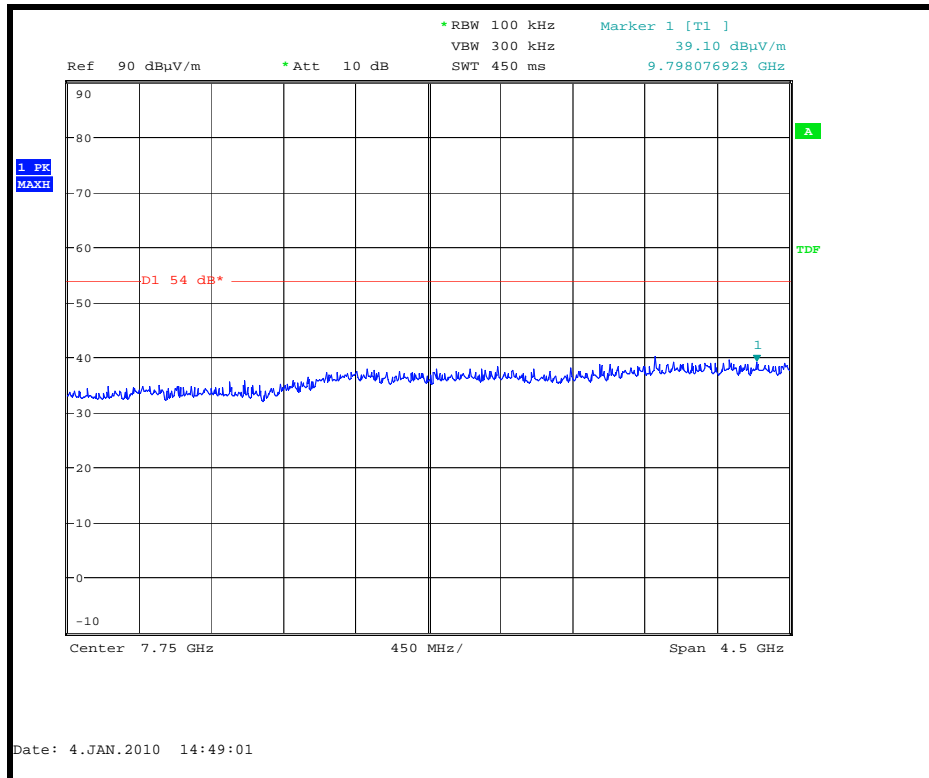
Radiated Spurious emissions (15.109) 5 GHz to 10 GHz – 915.0 MHz



Radiated Spurious emissions (15.109) 30 MHz to 1 GHz – 925.0 MHz



Radiated Spurious emissions (15.109) 1 GHz to 5 GHz – 925.0 MHz



Radiated Spurious emissions (15.109) 5 GHz to 10 GHz – 925.0 MHz

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 Telecoms & Radio upon request.

C1) Test samples

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

Sample No.	Description	Identification
S01	SAFEmine model number 700 018	
S02	SMW: Surface Mount Multiband Antenna with GPS	

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

Identification	Description
REF053	HP 6634A dc Power Supply
Wireless Group Laptop 1	HP Compaq 6715s Laptop
N/A	Battery

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 excluding Radiated Electric Field Emissions 15.109 digital circuitry	<p>The EUT was powered via an external dc power supply, REF053 and Battery. The EUT was transmitting on maximum power using Gaussian Frequency Shift Keying (GFSK) with a data rate of 100kbps. Deviation is $\pm 50\text{kHz}$ modulation at centre frequencies $F_c = ((422.4 + (CH/10)) \times 2)$</p> <p>Where $F_c =$</p> <p>905.0 MHz 915.0 MHz 925.0 MHz</p> <p>Or rearranged to determine the channel number</p> <p>Channel = $CH = ((F/2) - 422.4) \times 10$</p>

Test	Description of Operating Mode:
Radiated Electric Field Emissions 15.109 digital circuitry	EUT active but non-transmitting.

C3) EUT Configuration Information.

Sample	Internal Configuration Details
S01	Single possible internal configuration
S02	Single possible internal configuration

C4) List of EUT Ports

The tables below describe the termination of EUT ports:

Sample : S01
 Tests : RF Antenna Conducted Spurious Emissions measurement

Port	Description of Cable Attached	Cable length	Equipment Connected
dc power port	6 core unscreened	2m	REF053
GPS	None	N/A	50Ohm Terminating load
RF	50 Ohm Coax	2m	REF847
Serial	9 way screened serial cable	2m	Wireless Group Laptop 1

Sample : S01
 Tests : RF Antenna Conducted Spurious Emissions measurement Conducted
 Fundamental Carrier Power measurement

Port	Description of Cable Attached	Cable length	Equipment Connected
dc power port	6 core unscreened	2m	REF053
GPS	None	N/A	50Ohm Terminating load
RF	50 Ohm Coax	2m	REF835/836
Serial	9 way screened serial cable	2m	Wireless Group Laptop 1

Sample : S01
 Tests : RF Antenna Conducted Spurious Emissions measurement 20dB Bandwidth and
 Channel Spacing, Hopping Frequencies, Frequency Occupancy measurement

Port	Description of Cable Attached	Cable length	Equipment Connected
dc power port	6 core unscreened	2m	REF053
GPS	None	N/A	50Ohm Terminating load
RF	50 Ohm Coax	2m	REF837
Serial	9 way screened serial cable	2m	Wireless Group Laptop 1

Sample : S01
 Tests : : Radiated Electric Field Emissions Restricted band 15.205 and 15.109 digital
 circuitry

Port	Description of Cable Attached	Cable length	Equipment Connected
dc power port	6 core unscreened	2m	+24Vdc (Battery)
GPS	50 Ohm Coax	N/A	S02
RF	50 Ohm Coax	2m	S02
Serial	9 way screened serial cable	2m	Test Laptop

C5 Details of Equipment Used**For Conducted Measurements:**

RF Antenna Conducted Spurious Emissions measurement

RFG No	Type	Description	Manufacturer	Date Calibrated
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	08/05/09
RFG476	-	3m 50 Ohm coax	Semflex	22/04/09
RFG422	34401A	Multi-meter	HP	19/12/08
REF053	6634A	dc power supply	HP	CAL date N/A

Conducted Fundamental Carrier Power measurement

RFG No	Type	Description	Manufacturer	Date Calibrated
REF835 REF836	N1911A N1922A	P-Series Power Meter and Power Head	Agilent	03/08/09
RFG476	-	3m 50 Ohm coax	Semflex	22/04/09
RFG422	34401A	Multi-meter	HP	19/12/08
REF053	6634A	dc power supply	HP	CAL date N/A

20dB Bandwidth and Channel Spacing, Hopping Frequencies, Frequency Occupancy measurement

RFG No	Type	Description	Manufacturer	Date Calibrated
REF837	E4440A	P-Series Spectrum analyser	Agilent	30/01/09
RFG476	-	3m 50 Ohm coax	Semflex	22/04/09
RFG422	34401A	Multi-meter	HP	19/12/08
REF053	6634A	dc power supply	HP	CAL date N/A

For Radiated Measurements: Radiated Electric Field Emissions Restricted band 15.205 and 15.109 digital circuitry


TRAC Ref	Type	Description	Manufacturer	Date Calibrated.
TRLUH377	ESU26	Spectrum Analyser	Rhode & Schwarz	11/09/2009
TRL139	3115	1-18GHz Horn Antenna	EMCO	17/08/2009
TRL572	8499B	1 – 26.5 GHz Pre Amplifier	Agilent	15/07/2009
TRLUH186	ESHS10	Receiver	Rhode & Schwarz	10/12/2009
TRLUH191	CBL611/A	BiLog Periodic Antenna	York	10/10/2008


Appendix D:

Additional Information


Antenna specification:

Product Specifications





MultiBand with GPS
3 separate coaxes



New!
Magnet Mount
Version
(series MGW)

Surface Mount GPS Antenna (Pat.Pnd.)

GSM/CDMA, WiFi, WiMAX & GPS

- Mounts easily to roof, trunk or bulkhead
- MultiBand covers all popular worldwide frequency systems from 800 MHz - 6 GHz
- 3 Separate RF coax feeds; for radio comm channel (800-2.7 GHz), 2.4/5 GHz & GPS
- High performance GPS with 26 dB active amplifier

For maximum communications capability and ultimate versatility, this is the antenna of choice. This Wide Band antenna provides high performance operation on all cellular bands, all PCS bands and 2.4 GHz 802.11 bands along with GPS. An optional version can operate dual band on 2.4 & 5 GHz for 802.11 a/b/g. Three separate RF feeds allow communication with the voice/data channel, the WiFi radio, as well as GPS. The antennas can be mounted to any vehicle, cargo container or trailer.

The design uses a 3/4" feed thru (19 mm) for securing to the vehicle. Access to the underside of the body surface is required to complete the installation. Note, for best performance, the antenna should be mounted on a metal surface/groundplane.

For the GPS interface, the antennas are typically outfitted with 15 feet of RG-174 cable (4.5 meters). The communications channel cables are 15 feet of low loss RF-195. All connectors are male unless requested otherwise.

GPS performance is 26 dB, with 5 dBi antenna gain. The GPS circuit has a low noise figure (2.0 dB max) with excellent filter characteristics.

The antennas are enclosed in a 4.2"D x 3.2"H ASA radome (107 mm x 81 mm), and supplied with all mounting hardware and sealing gasket. The SMW radome color is white standard, black optional. The MGW mag mount is available in white (standard) or optional black.

Antenna Model Configurator

SMW-□□□-□□□□-□□□ example - SMW-UMB-3A3A2C
Mag Mount - MGW-UMB-3A3A2C

Combo Configuration		Cable #1	Cable #2	GPS Interface
Code	Description	Code	Description	Code
SMW-UMB	Cable 1 = 800 - 2.7 GHz	3A	RF-195/TNC	2C
	Cable 2 = 2.4 GHz (WiFi)	3B	RF-195/MiniUHF	2D
	Cable 3 = GPS	3C	RF-195/SMA	2E
SMW-301	Cable 1 = 800 - 2.7 GHz	3J	RF-195/RevPol SMA	2F
	Cable 2 = 2.4 & 5+ GHz (WiFi)	3K	RF-195/RevPol TNC	2H
	Cable 3 = GPS			2L

Note: For Mag mount, substitute MGW for SMW in model

Specifications

Frequency:		Amplifier Bias:	3.3 or 5 VDC +/- 10%
Cable #1	800 - 2700 MHz	Maximum Power:	
Cable #2	2400 - 2485 MHz or dual band	800 - 1900 MHz	20 Watts
	2.4-2.5/4.9 - 6.0 GHz	1900 - 5800 MHz	10 Watts
GPS	1575.42 +/- 2 MHz	Current:	20 mA max, 10 mA typical
Comm Channel Gain:		Cable:	
800 - 1GHz	2 dBi	GPS	RG-174, 15 ft (4.5 meters)
1700 - 2700	5 dBi (peak)	CABLE #1 & #2	Separate RF-195 Cables, 15 ft (4.5 meters)
2.4 - 2.5 GHz	5 dBi (peak)	Case:	4.2"D x 3.2"H (107 mm x 81 mm)
5.2 - 5.8 GHz Band	5 dBi (peak)	Case Material:	White ASA, black optional
GPS Gain:	26 dB, 5 dBi Antenna	Mounting:	3/4" dia.x 1/2" long (19 mm x13 mm) for 3/16" thick (4.7 mm) metal
VSWR:	2:1 max over range	Hardware:	Nut and gasket included
Noise Figure:	2.0 dB max, 1.7 dB typical	Option:	Mag Mount MGW, 15 ft cables
Operating Temp:	-40° to +85° C		
Nominal Impedance:	50 ohms		

US Office & Headquarters: 3900-B River Road, Schiller Park, IL 60176 Tel: 800-648-2800 or 847-671-6690 Fax: 847-671-6715
 UK Office: 106 Anglesey Business Park, Hednesford, Staffs. WS12 1NR UK Tel: (+44) 1543-878343 Fax: (+44) 1543-871714
 Visit our web page at www.mobilemark.com. Specifications subject to change without notice (4/2008). 41

Antenna details continued:



SMW Multi-Band Series Antennas

Surface Mount Multi-Band Antenna

2 dBi Gain, Com #1 Frequency (800-960 MHz)
(Nextel/Cellular/EU GSM)

These plots can be used for the following models:

SMW-UMB-3X3X2X

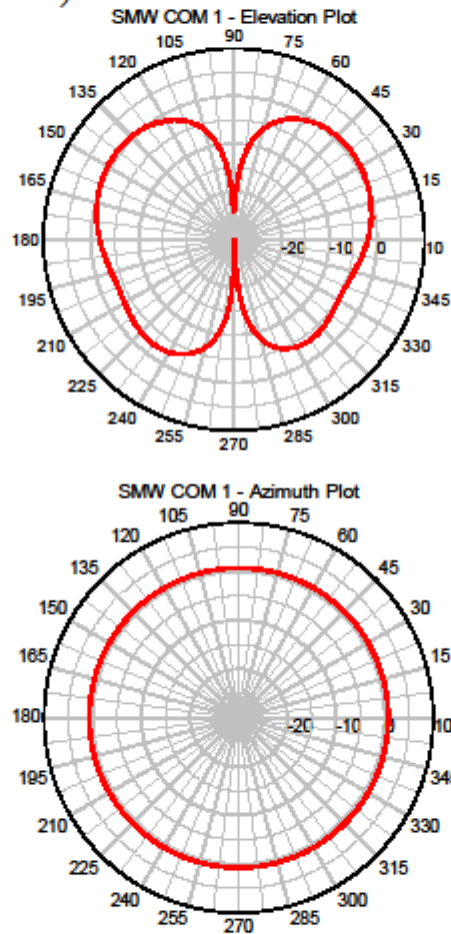
Note:

SMW model consists 3 Patterns

Com #1 (800-960 MHz)

Com #2 (1710-1990 MHz)

2.4 GHz (2400-2500 MHz)



Note: Azimuth Plot is at an elevation angle of 35° for the coordinate system shown above.

Office & Headquarters: 3900-B River Road, Schiller Park, IL 60176 Tel: 800-648-2800 or 847-671-6690 Fax: 847-671-6715
UK Office: 106 Anglesey Business Park, Hednesford, Staffs. WS12 1NR UK Tel: (+44) 1543-878343 Fax: (+44) 1543-871714
Visit our web page at www.mobilemark.com. Specifications subject to change without notice (7/2005).

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 = $20 \times (\text{Log}_{10} \text{ Calculated Duty Cycle})$

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

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: front view.
2. Radiated electric field emissions arrangement: close up.
3. Photo of the S01 Overview
4. Photo of the S01 Overview

Photograph 1



Photograph 2



Photograph 3



Photograph 4



Appendix G:**MPE Calculation**

OET Bulletin No. 65, Supplement C 01-01

47 CFR §§1.1307 and 2.1091

2.1091 Radio frequency radiation exposure evaluation: mobile devices.

For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimetres is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits. As the 20cm separation specified under FCC rules may not be achievable under normal operation of the EUT, an RF exposure calculation is needed to show the minimum distance required to be less than 0.6mW/cm² power density limit, as required under FCC rules.

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{EIRP}{4 \pi R^2} \text{ re - arranged} \quad R = \sqrt{\frac{EIRP}{S 4 \pi}}$$

where:

S = power density

R = distance to the centre of radiation of the antenna

EIRP = EUT Maximum power

Note:

The EIRP measurement was performed using a signal substitution method.

Result

Prediction Frequency (MHz)	Maximum EIRP	Power density limit (S) (mW/cm ²)	Distance (R) cm required to be less than 0.6 mW/cm ²
915 MHz	5.15 mW	0.505 mW/cm ²	0.9 cm

