Test report

KTL EMC Test Report : 7H0648WUS5

Applicant : Avaya Inc.

Apparatus : IP Telephone 9670G with integrated Bluetooth Transceiver

Authorised by :

: M Leach, Principal EMC Engineer.

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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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K J Anderson, Radio Test Engineer

Report author:.

As Above

This report supersedes KTL report 7H0648WUS3 due to a modification to the Applicant Name.

1.2 Tests Requested By

This testing in this report was requested by :

Avaya Inc
307 Middletown-Lincroft Rd.
Lincroft, NJ 07738-1526
USA

1.3 Manufacturer

Flextronics International
Xin Qing Science & Technology Industrial Park
Jing An Town
Doumen
Zhuhai
Guangdong
P.R
China

1.4 Apparatus Assessed

The following apparatus was assessed between 28/10/08 and 06/01/09:

IP Telephone 9670G with integrated Bluetooth Transceiver

The above equipment was a Voice over IP Phone fitted with a Bluetooth Module to allow connection with Bluetooth Headsets.

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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: 2008, Part 15 Subpart (c) 15.247	ANSI C63.4: 2003	Pass
Radiated spurious emissions Non-Transmitting mode	Title 47 of the CFR: 2008, Part 15 Subpart (b) 15.109	ANSI C63.4: 2003	Marginal
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
AC Power conducted emissions	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.207	ANSI C63.4: 2003	Pass
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
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
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
Channel 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

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.

KTL Hull is a listed electromagnetic compatibility Conformance Assessment Body (CAB) for EC access to the US market. (Decision No 3/2000 of the Joint Committee established under the Agreement on Mutual Recognition between the European Community and the United States of America. This decision was effective from 16th January 2001).

FCC Facility Registration number (3m semi anechoic chamber) : 90743

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 KTL 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 KTL Measurement Uncertainty Values

For the test data recorded in accordance with note (iii) of Section 2.2 the following measurement uncertainty was calculated:

Test type	Quantity	Quantity frequency range	Expanded uncertainty
Radiated electric field emissions 3m alternative test site	Amplitude	30MHz to 300MHz Horizontal	±4.6dB
		30MHz to 300MHz Vertical	±5.1dB
		300MHz to 1000MHz Horizontal	±5.2dB
		300MHz to 1000MHz Vertical	±5.5dB
		1GHz to 18GHz Horizontal and Vertical	±4.1dB

Section 3: Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A: Formal Emission Test Results

Abbreviations used in the tables in this appendix:

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

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

A1 Conducted Fundamental Carrier Power

Conducted carrier power was verified using a peak power meter, 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)(1)
EUT sample number	S25
Modification state	0
SE in test environment	REF828
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) ≥ 79 channels	Result
0	2402	0.00085	0.125	Pass
39	2441	0.00081		Pass
78	2480	0.00077		Pass

Notes

The carrier power 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 power was observed.

The peak carrier power did not vary between the three modulation modes.

Limit based on relaxed 20 dB Bandwidth requirement of 15.247(a)(1).

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	
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 25 GHz
EUT sample number	S25
Modification state	0
SE in test environment	REF 838
SE isolated from EUT	None
EUT set up	Refer to Appendix C

No emissions within 20 dB of the tests limits were detected.

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

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

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

Where:

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

Limit(dBμV)					
Channel No.	Channel Frequency (MHz)	Measured Peak Conducted Carrier Power (W)	Measured Peak Conducted Carrier (dBμV)	Measured Peak Conducted Carrier – 20dB (dBμV)	Average Emission Limit 15.247(d) Outside the restricted band in 100 kHz RBW (dBμV)
0	2402	0.00085	106.3	86.3	66.3
39	2441	0.00081	106.1	86.1	66.1
78	2480	0.00077	105.9	85.9	65.9

A3 Radiated Electric Field Emissions Within The Restricted Band 15.205

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

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

10m open area test site : ☐ 3m alternative test site : ☑

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

Test Details	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.247(d) and Clause 15.205
Measurement standard	ANSI C63.4:2003
Frequency range	100 kHz to 25 GHz
EUT sample number	S25
Modification state	0
SE in test environment	REF 838
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)	Det.	Angle. Deg.	Height (cm)	Pol.	Result (dBμV/m)	Spec. Limit (dBμV/m)	Margin (dB)	Summary
1	2390	Pk	0	100	H	47.1	74	-26.9	Pass
2	2390	Av	0	100	H	31	54	-23	Pass
3	2483.5	Pk	0	100	H	41.3	74	-32.7	Pass
4	2483.5	Av	0	100	H	31.2	54	-22.8	Pass
5	2346.153846	Pk	35	100	H	44.4	74	-29.6	Pass
6	2346.153846	Av	35	100	H	30.9	54	-23.1	Pass
7	7443.910256	Pk	122	100	H	45.4	74	-28.6	Pass
8	7443.910256	Av	122	100	H	30.3	54	-23.7	Pass

The results above represent the worst-case emissions found at all carrier frequencies and operating modes.

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 The measurements 2483.5 MHz was made to ensure band edge compliance.

4 Demonstration of band edge compliance at 2.4GHz (which lies outside the restricted bands as defined in section 47CFR15.205(a) is contained in section A2, RF Antenna Conducted Spurious Emissions and Appendix B of this test report.

5 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.

6 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= 1 MHz, VBW = 10 Hz

These settings as per ANSI C63.4 and DA 00-705.

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

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

The upper and lower frequency of the measurement range was decided according to 47 CFR 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 μV/m	Measurement Distance m	Field strength dBμV/m
0.009-0.490	2400/F(kHz)	300	67.6/F (kHz)
0.490-1.705	24000/F(kHz)	30	87.6/F (kHz
1.705-30	30	30	29.5
30-88	100	3	40.0
88-216	150	3	43.5
216-960	210	3	46.4
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:

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

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

Preview power line conducted emission measurements were performed with a peak detector in a screened room.

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

Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn. The formal measurements are detailed below:

Test Details:	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) Clause 15.207
Measurement standard	ANSI C63.4:2003
Frequency range	150kHz to 30MHz
EUT sample number	S25
Modification state	0
SE in test environment	REF 838
SE isolated from EUT	None
EUT set up	Refer to Appendix C
Photographs (Appendix F)	Photograph 3

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

Results measured using the peak detector compared to the average limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.189	Live	34.8	54.0	-19.2	Pass
2	0.509	Live	37.0	46.0	-9.0	Pass
3	0.572	Live	37.6	46.0	-8.4	Pass
4	2.097	Live	34.8	46.0	-11.2	Pass
5	2.216	Live	34.7	46.0	-11.3	Pass
6	2.513	Live	37.2	46.0	-8.8	Pass
7	0.189	Neutral	33.6	54.0	-20.4	Pass
8	0.509	Neutral	36.6	46.0	-9.4	Pass
9	0.572	Neutral	38.2	46.0	-7.8	Pass
10	2.097	Neutral	33.9	46.0	-12.1	Pass
11	2.216	Neutral	34.1	46.0	-11.9	Pass
12	2.513	Neutral	35.7	46.0	-10.3	Pass

Note: Power line conducted emissions were identical for all RF carrier frequencies

Specification limits :

Conducted emission limits (47 CFR 15:2008 Clause 15.207):

Conducted disturbance at the mains ports.

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

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

Notes:

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

(b) The following table summarises the effect of the EUT operating mode and internal configuration on the measured emission levels :

(c) When the average limit was met using the peak detector, the EUT was deemed to meet both the average detector and quasi-peak detector limits and measurement with the average detector and quasi-peak detector was not required

	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

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. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW The formal measurements are detailed below:

Test Details:	
Regulation	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.247(a)(1)(i)
EUT sample number	S25
Modification state	0
SE in test environment	REF 838
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured 20 dB Bandwidth (kHz)	Limit	Result
1350	N/A	N/A

Measured Channel Spacing (kHz)	Limit	Result
1000	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. These are the worst-case values of all the modulations supported.

A6 Hopping frequencies

Hopping frequencies were verified using a spectrum analyser set to 20 MHz spans, displaying 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)
EUT sample number	S25
Modification state	0
SE in test environment	REF 838
SE isolated from EUT	None
EUT set up	Refer to Appendix C

No. of Hopping Channels	Requirement	Result
79	For 1W conducted carrier power Limit, greater than 75	Pass

Plots showing the hopping channels are contained in Appendix B. These are identical for all modulation modes.

A7 Channel Occupancy

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

Test Details:	
Regulation	Title 47 of the CFR2008, Part15 Subpart (c) 15.247(a)(1)
EUT sample number	S25
Modification state	0
SE in test environment	REF 838
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Measured Channel Occupancy Time (ms)	Calculated Average Channel Occupancy Time (ms)	Average Channel Occupancy Time Limit (ms)	Result
3.046	223.8	400	Pass

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

Average Channel Occupancy Time Calculation:

No. Of utilised hopping channels (N) =
Repetition Time (T_{rep}) = (x) ms
Measured channel occupancy time (T_{occ}) = (x) ms

No. of transmission cycles in specified averaging period =

$$\frac{400\times10^{-3}\times \mathrm{N}}{(\mathrm{x})\mathrm{T}_{\mathrm{rep}}\,(ms)} = (\mathrm{x})\ \mathrm{cycles}$$

$\therefore$

$$\frac{400\times10^{-3}\times(\mathrm{e.g}\ 79\ \ \mathrm{channels})}{(\mathrm{x})\mathrm{T}_{\mathrm{rep}}\,(ms)} = (\mathrm{x})\ \mathrm{cycles}$$

$\therefore$ **The Average Channel Occupancy Time =**

Total activation time T_{ooc} (ms) x No. of transmission cycles in specified averaging period = (x)ms

Average Channel Occupancy Time = T_{ooc} (ms) x (x) cycles = (x) ms

A8 Antenna Gain

The maximum antenna gain for the antenna types to be used with the EUT, as declared by the client, is -1.1 dBi.

A9 Radiated Electric Field Emissions – Non Transmitting Mode

Preliminary conducted emission testing was performed using a peak detector with the RBW = 100kHz. The radiated electric filed emission test applies to spurious emissions relating to the digital circuitry within the EUT. The maximum permitted field strength is listed in Section 15.209.

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

10m open area test site : ☐ 3m alternative test site : ☑

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

Test Details	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (b) Clause 15.109
Measurement standard	ANSI C63.4:2003
Frequency range	100 kHz to 25 GHz
EUT sample number	S25
Modification state	0
SE in test environment	REF 838
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 are listed below:

The worst case radiated emission measurements are listed below:

Ref No	Freq (MHz)	Det	Ang Deg	Hgt (cm)	Pol	MD (m)	Res at MD (dBuV/m)	SD (m)	Res at SD (dBuV/m)	Spec Limit (dBuV/m)	Margin (dB)	Res Sum
1	40.150	QP	170	100	V	3	32.7	3	32.7	40.0	-7.3	Pass
2	40.866	QP	170	100	V	3	33.6	3	33.6	40.0	-6.4	Pass
3	42.355	QP	175	100	V	3	31.5	3	31.5	40.0	-8.5	Pass
4	250.000	QP	176	100	H	3	41.1	3	41.1	46.0	-4.9	Pass
5	374.988	QP	170	100	H	3	45.3	3	45.3	46.0	-0.7	Pass*
6	1000.000	QP	175	100	H	3	43.6	3	43.6	46.0	-10.4	Pass*

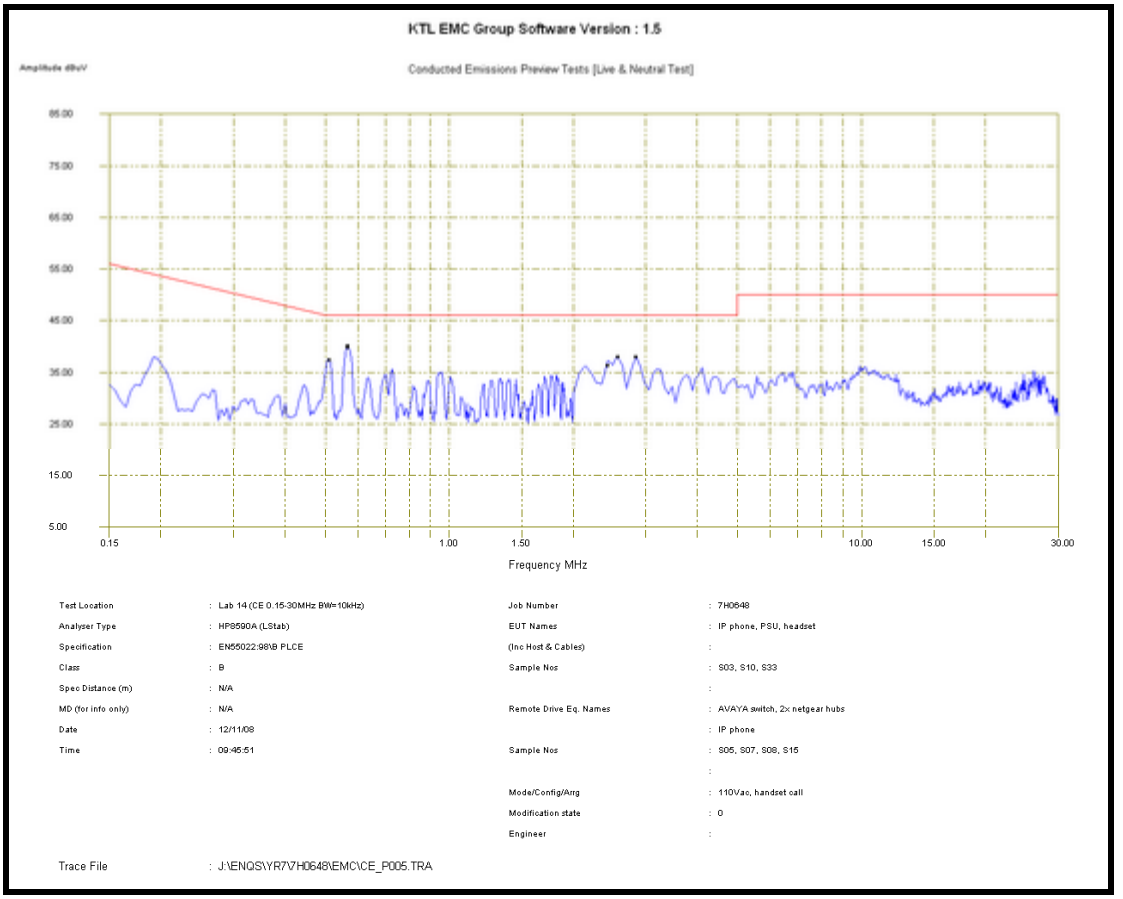
*See section 2.2 Note (iii).

Appendix B: **Supporting Graphical Data**

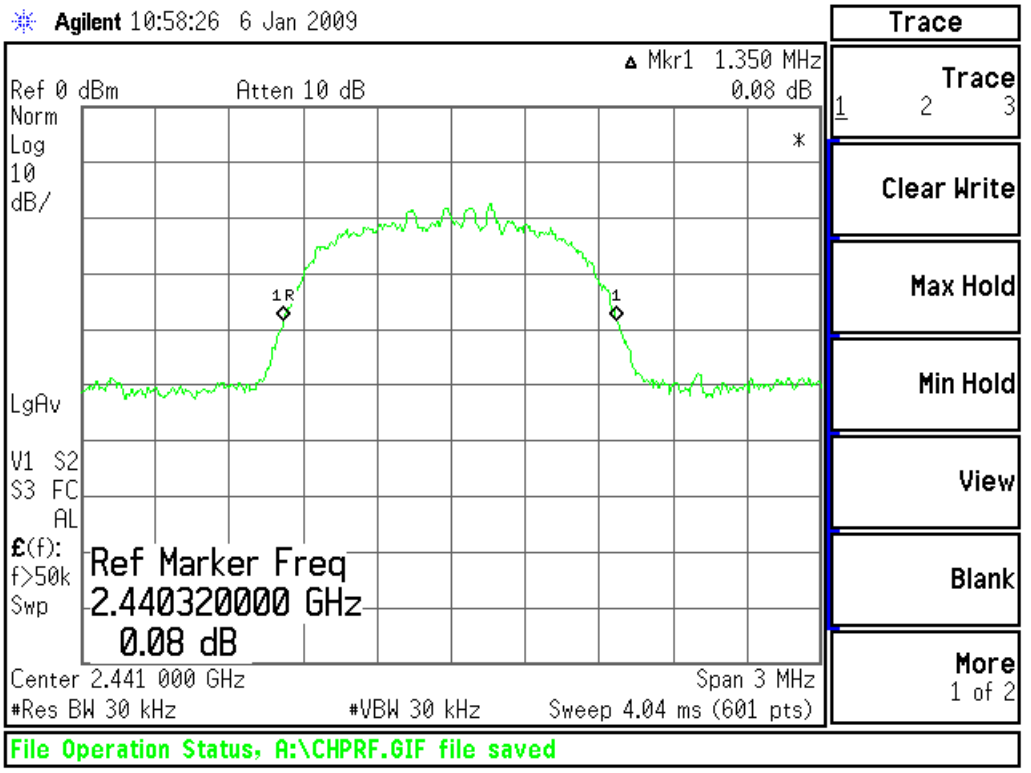
This appendix contains graphical data obtained during testing.

Notes:

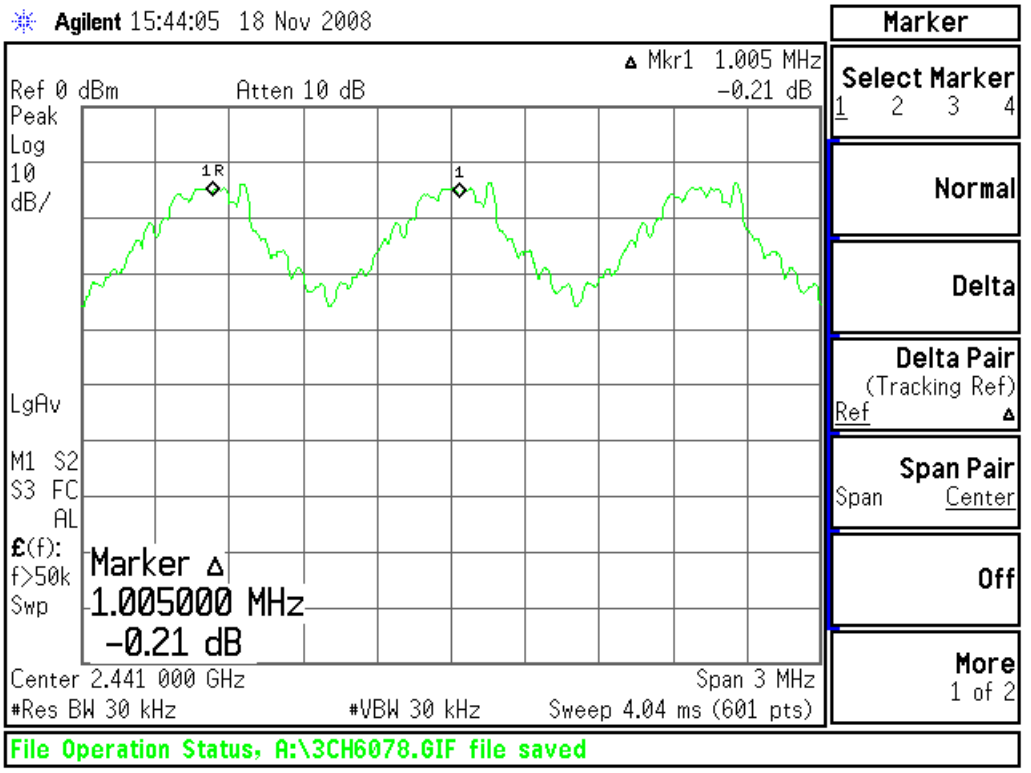
(a) The conducted emissions graphical data in this appendix is preview data. Any emissions detected within the restricted band were formally assessed against the limits in 15.209. For details of formal results, refer to Appendix A and Appendix B.



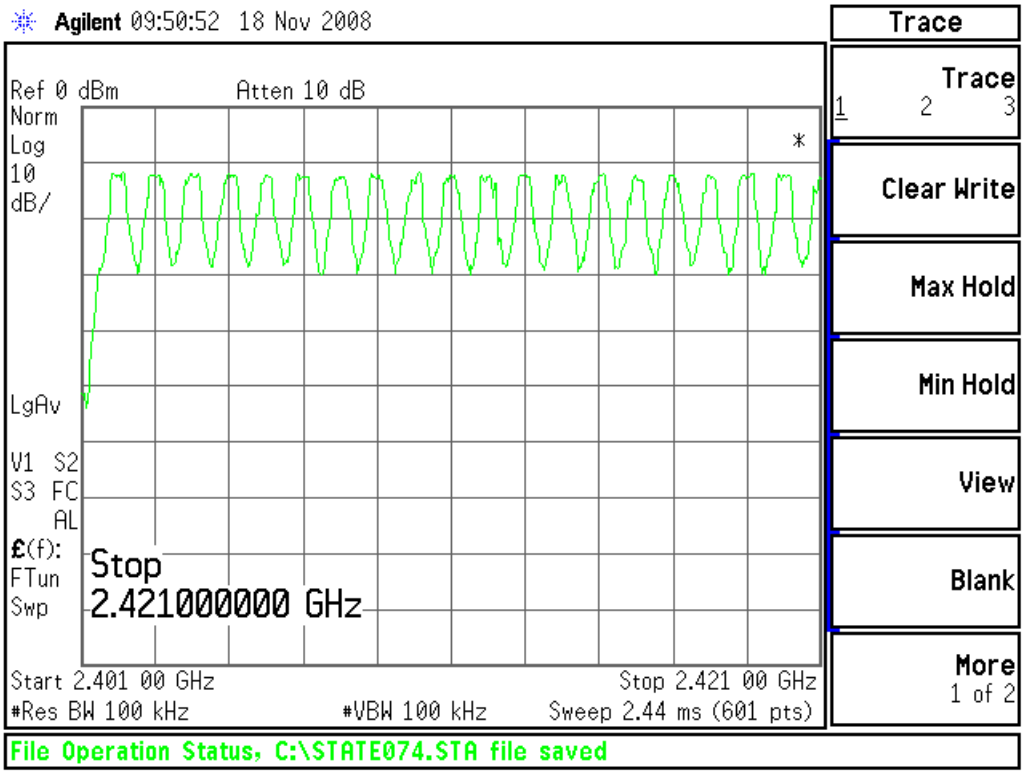
Power Line Conducted emissions



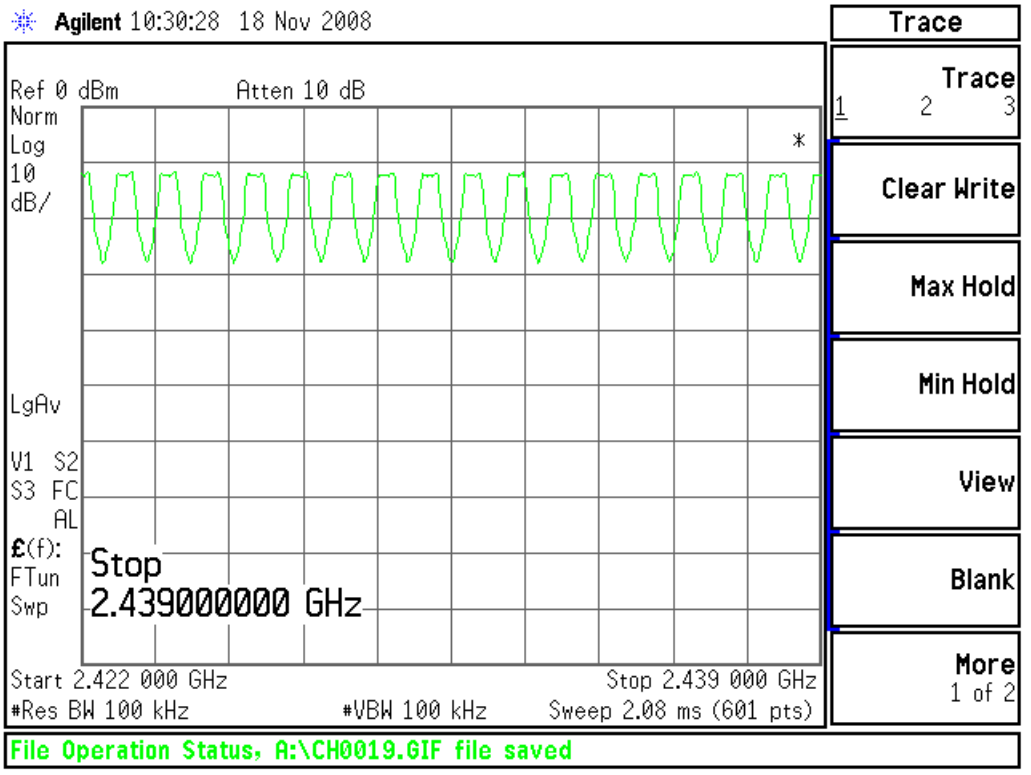
20 dB Bandwidth



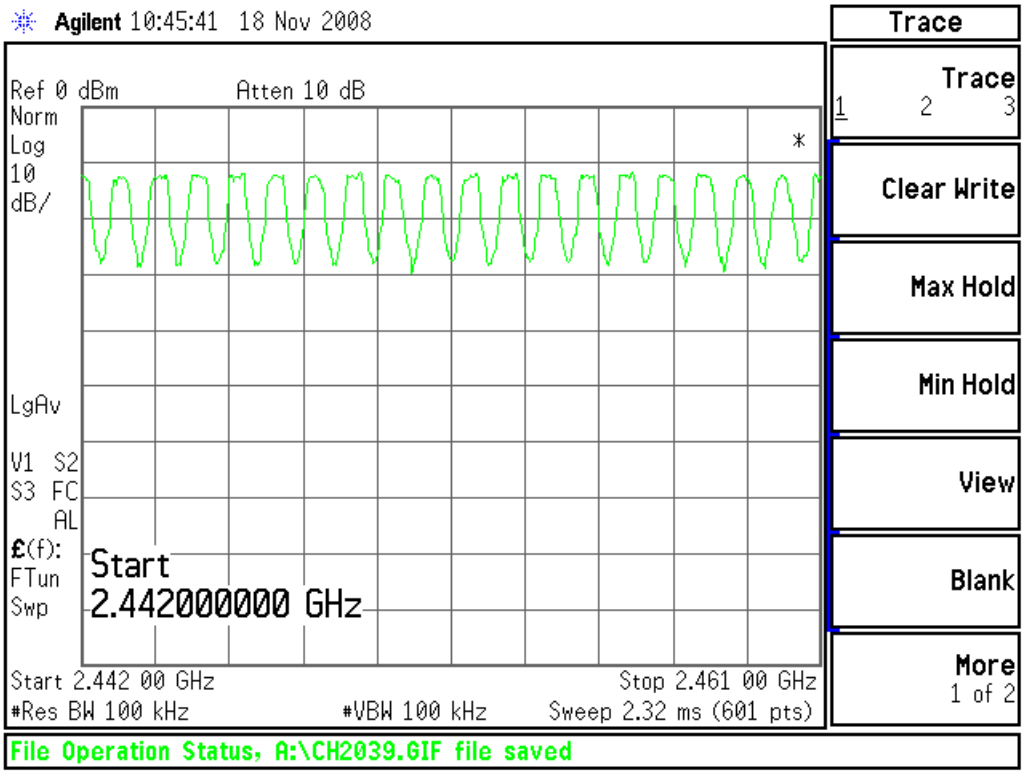
Channel Spacing



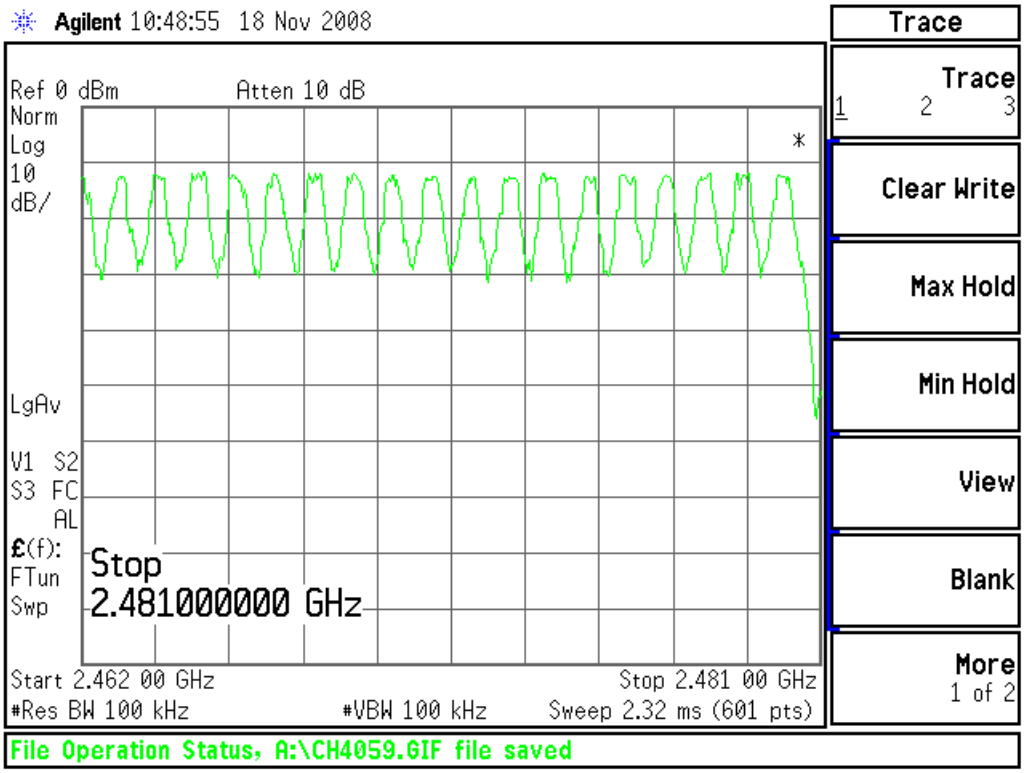
Channels 0 to 19



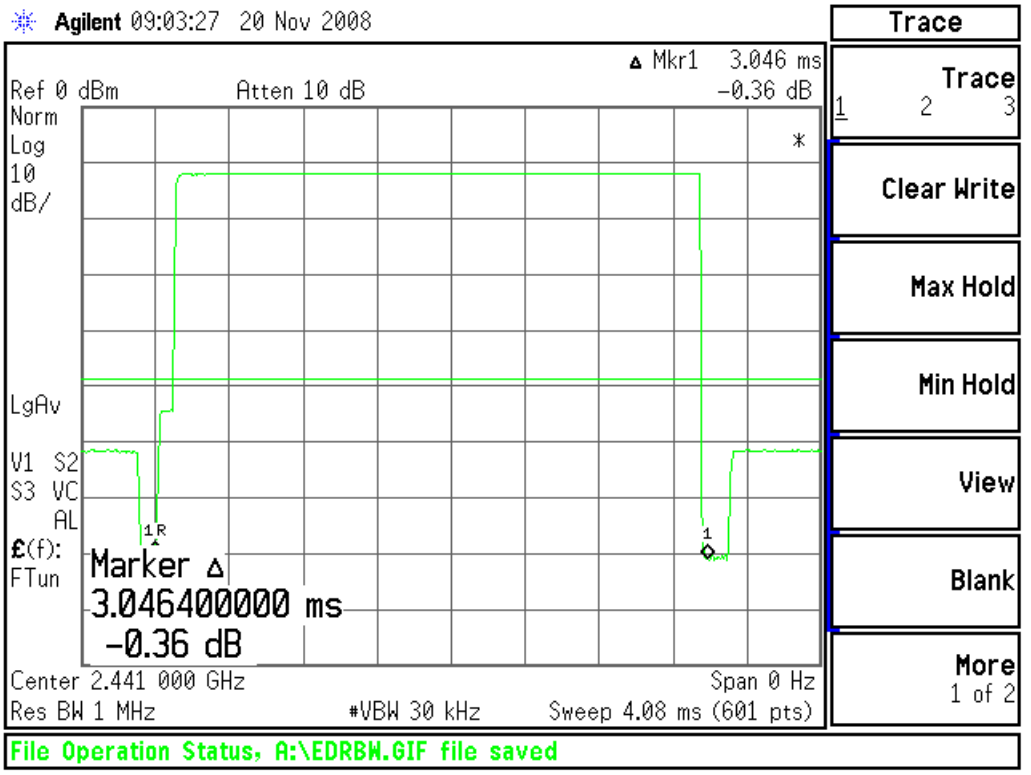
Channels 20 to 39



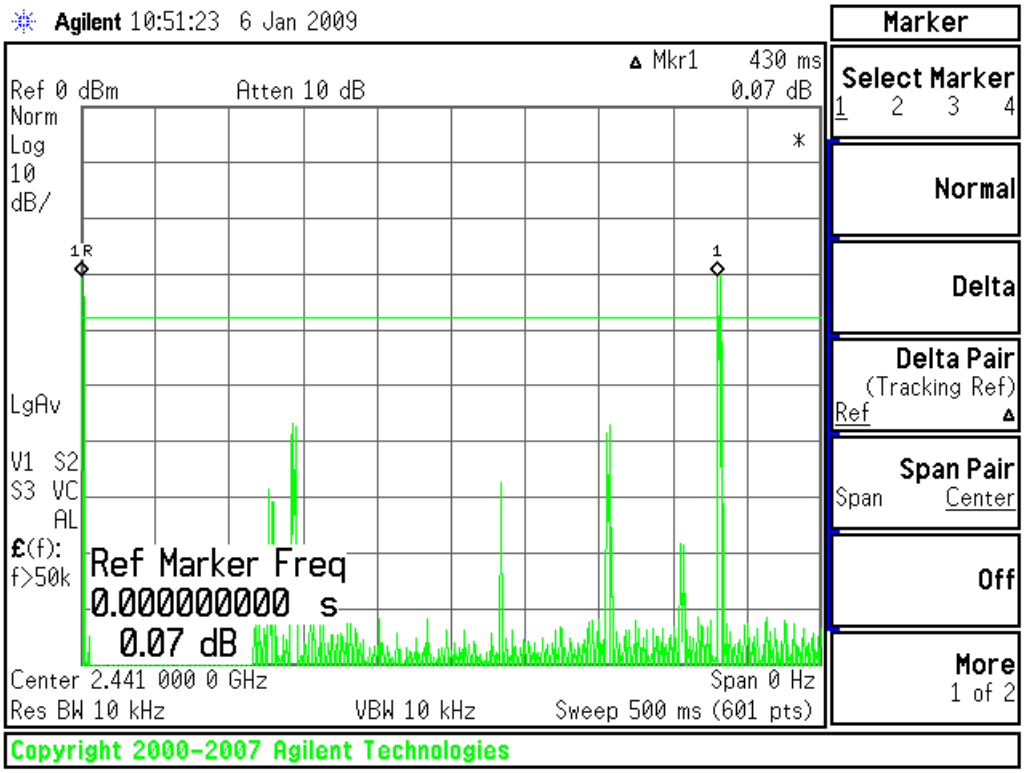
Channels 40 to 59



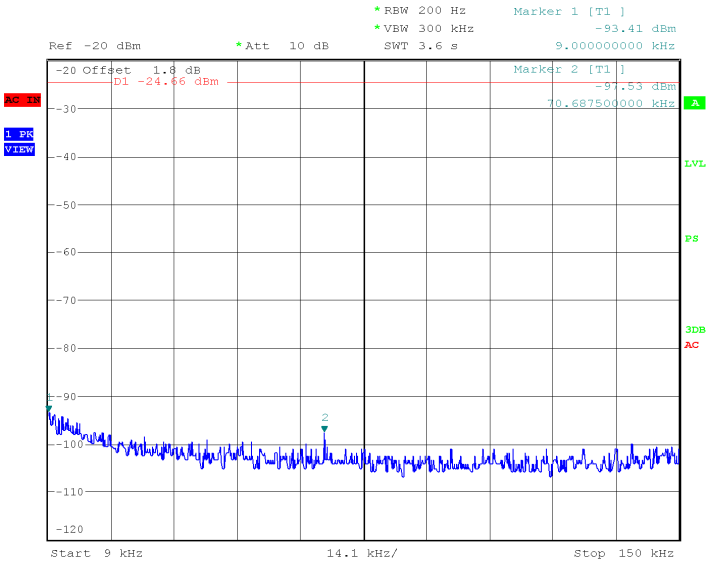
Channels 60 to 78



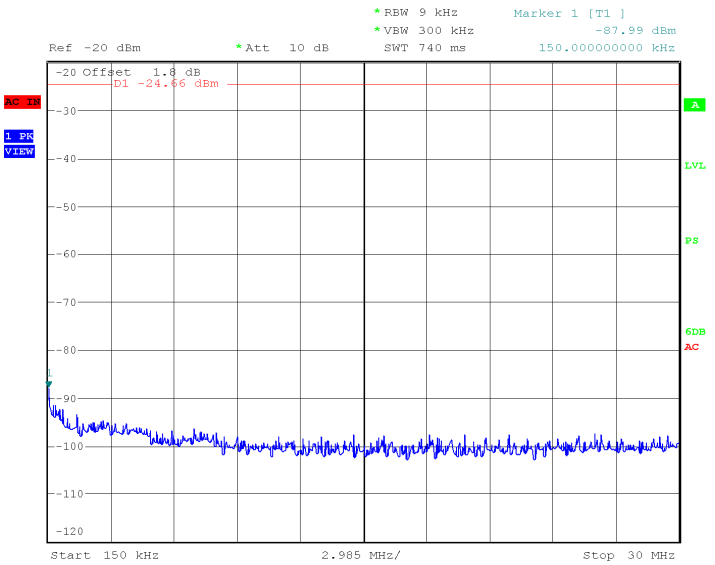
Channel occupancy



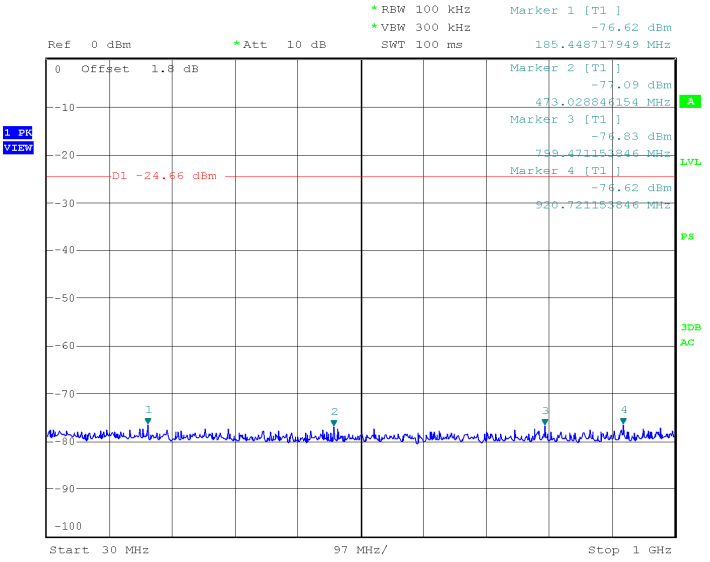
Channel repetition time



Conducted Spurious emissions 9 kHz to 150 kHz – 2402MHz 1Mb/s



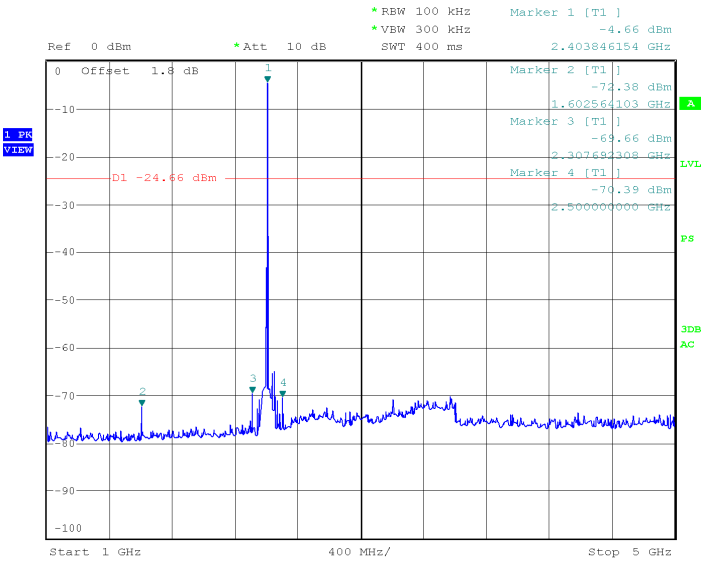
Conducted Spurious emissions 150 kHz to 30 MHz – 2402MHz 1Mb/s



jiVVW

Date: 29.OCT.2008 18:08:34

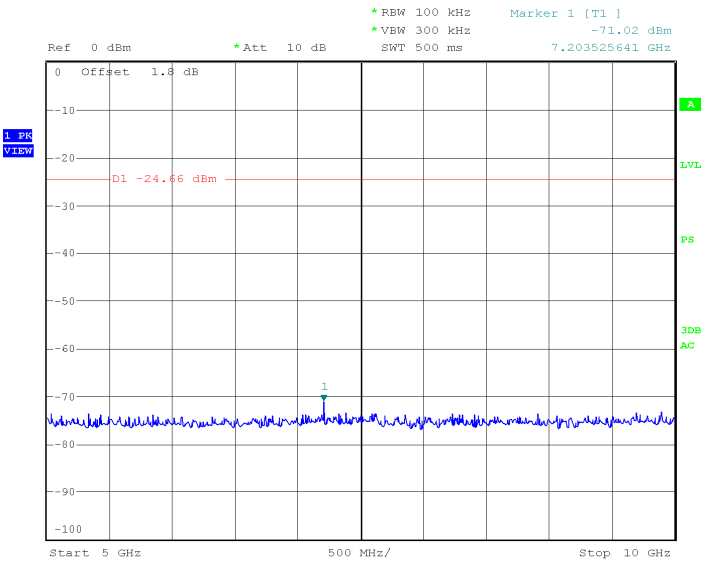
Conducted Spurious emissions 30 MHz to 1 GHz – 2402MHz 1Mb/s



jiVVW

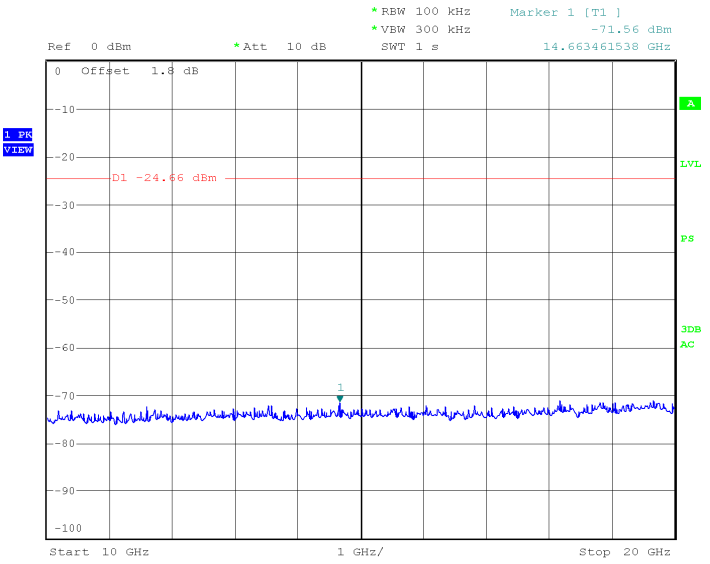
Date: 29.OCT.2008 17:50:20

Conducted Spurious emissions 1 GHz to 5 GHz – 2402MHz 1Mb/s



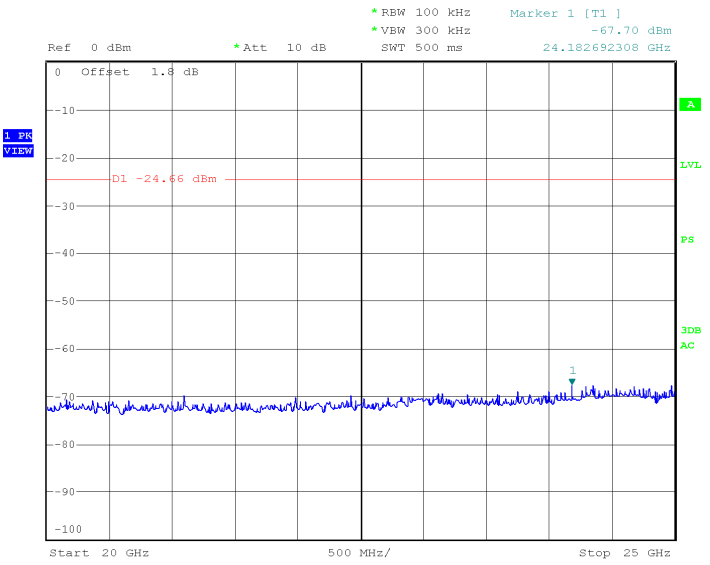
jiVVW
Date: 29.OCT.2008 17:59:31

Conducted Spurious emissions 5 GHz to 10 GHz – 2402MHz 1Mb/s



jiVVW
Date: 29.OCT.2008 18:00:28

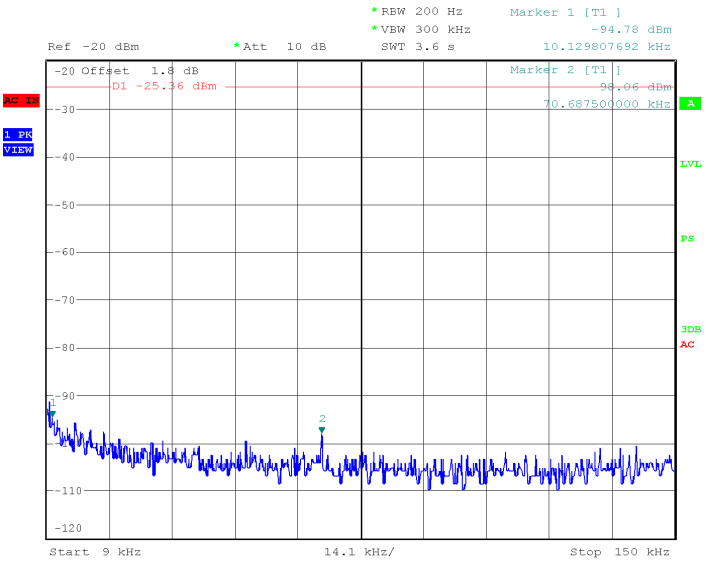
Conducted Spurious emissions 10 GHz to 20 GHz – 2402MHz 1Mb/s



jiVVW

Date: 29.OCT.2008 18:02:47

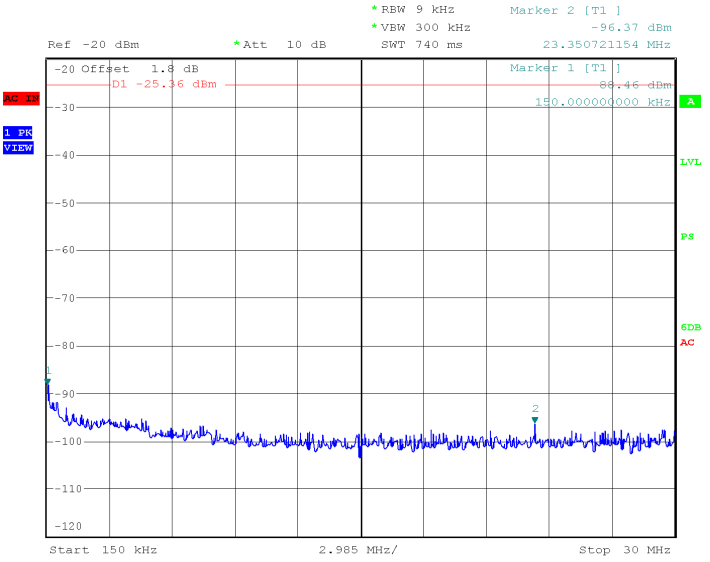
Conducted Spurious emissions 20 GHz to 25 GHz – 2402MHz 1Mb/s



jiVVW

Date: 31.OCT.2008 12:18:37

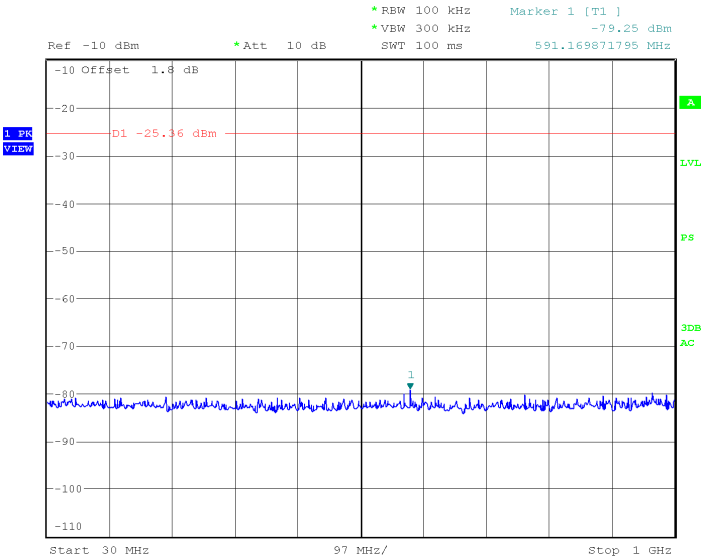
Conducted Spurious emissions 9 kHz to 150 kHz – 2442MHz 1Mb/s



jiVVW

Date: 31.OCT.2008 12:19:58

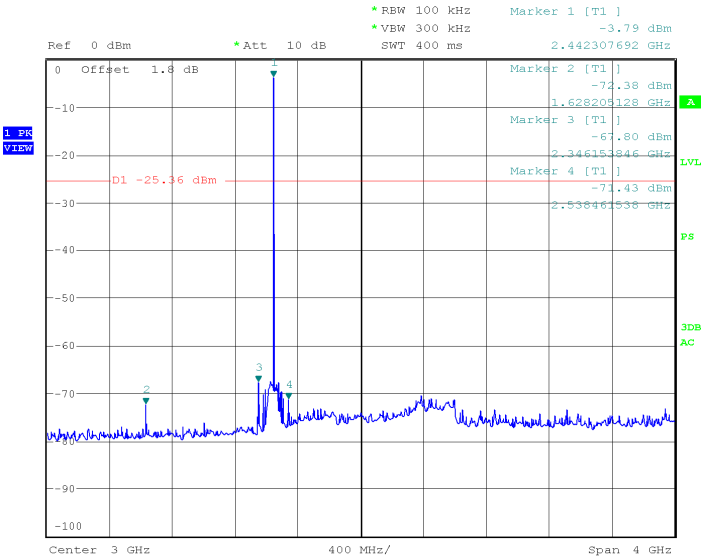
Conducted Spurious emissions 150 kHz to 30 MHz – 2442MHz 1Mb/s



jiVVW

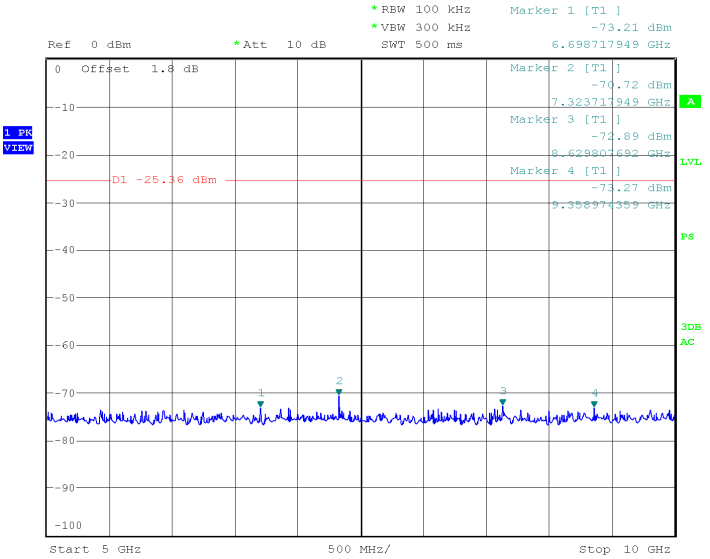
Date: 31.OCT.2008 13:09:51

Conducted Spurious emissions 30 MHz to 1 GHz – 2442MHz 1Mb/s



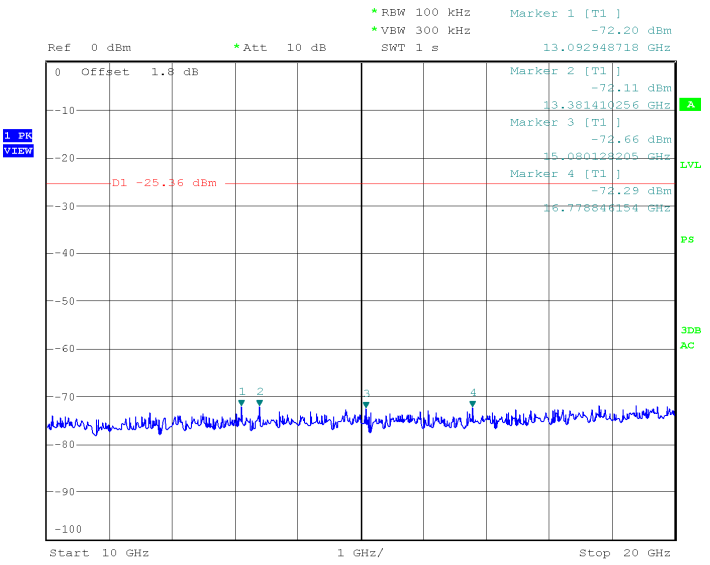
jiVVW
Date: 31.OCT.2008 11:35:36

Conducted Spurious emissions 1 GHz to 5 GHz – 2442MHz 1Mb/s



jiVVW
Date: 31.OCT.2008 11:43:59

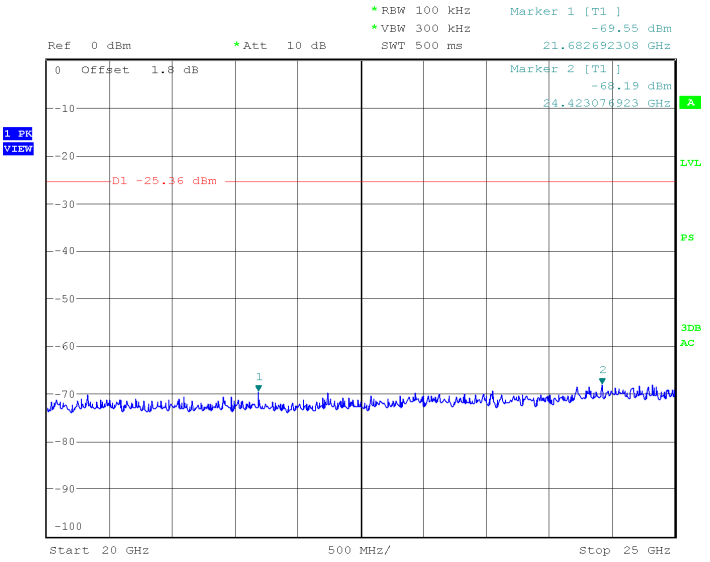
Conducted Spurious emissions 5 GHz to 10 GHz – 2442MHz 1Mb/s



jiVVW

Date: 31.OCT.2008 12:12:45

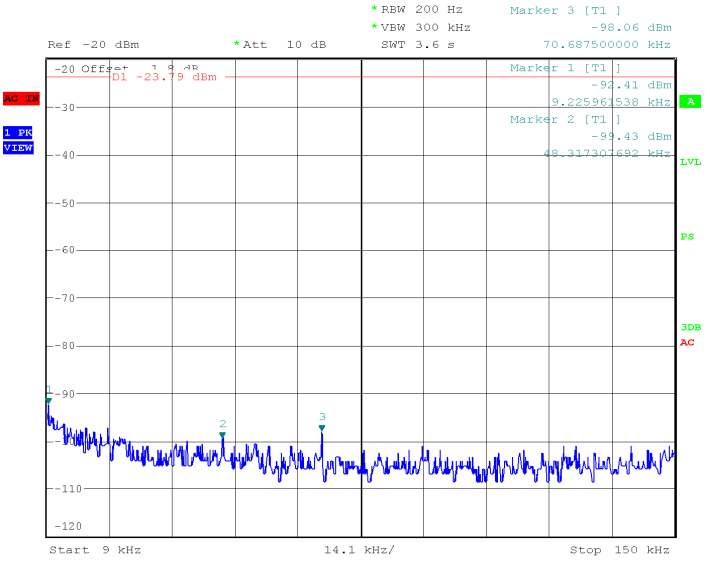
Conducted Spurious emissions 10 GHz to 20 GHz – 2442MHz 1Mb/s



jiVVW

Date: 31.OCT.2008 12:15:20

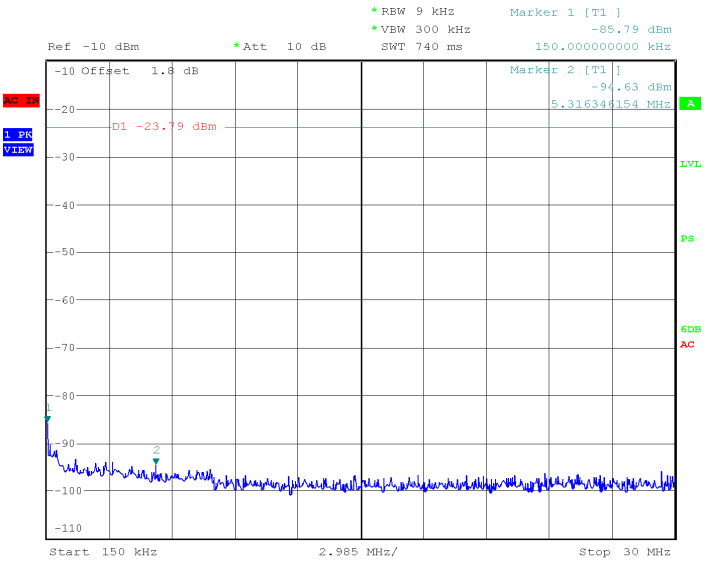
Conducted Spurious emissions 20 GHz to 25 GHz – 2442MHz 1Mb/s



jiVVW

Date: 31.OCT.2008 13:02:43

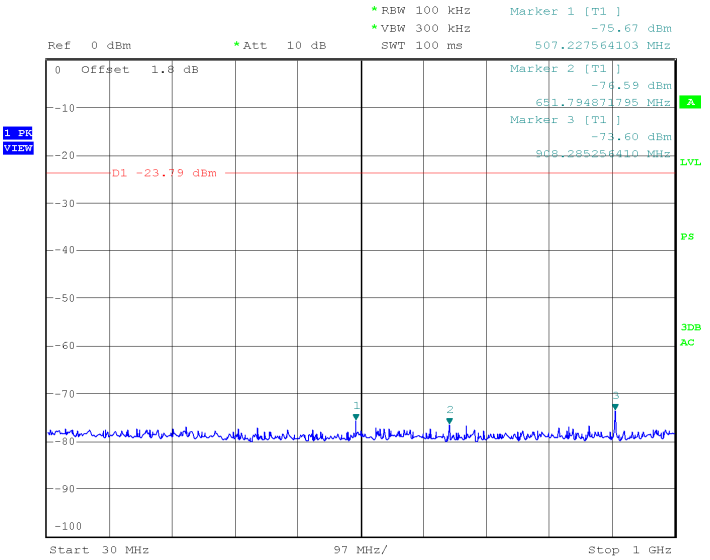
Conducted Spurious emissions 9 kHz to 150 kHz – 2480MHz 1Mb/s



jiVVW

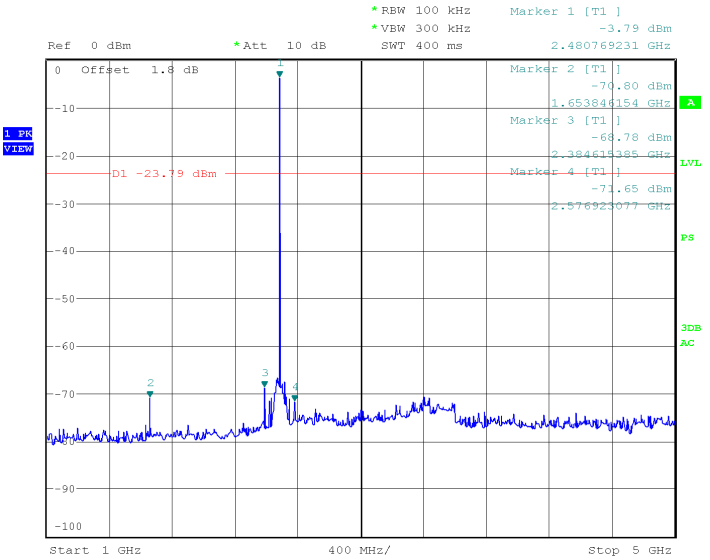
Date: 31.OCT.2008 13:01:07

Conducted Spurious emissions 150 kHz to 30 MHz – 2480MHz 1Mb/s



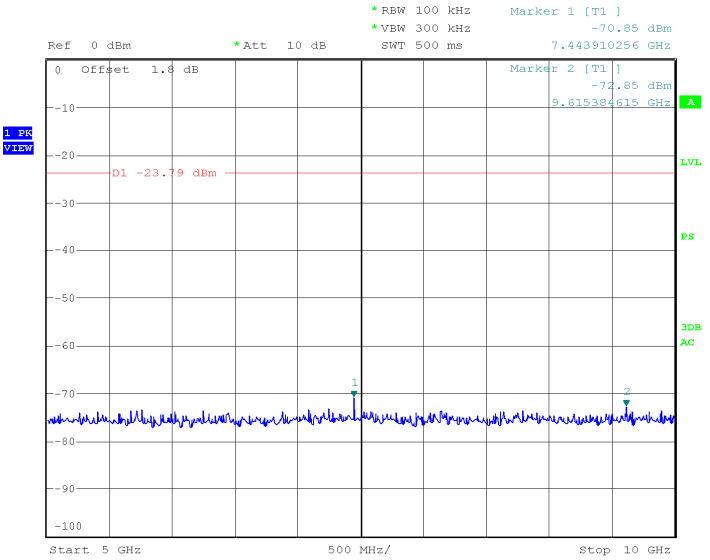
jiVVW
Date: 31.OCT.2008 12:55:04

Conducted Spurious emissions 30 MHz to 1 GHz – 2480MHz 1Mb/s



jiVVW
Date: 31.OCT.2008 12:27:31

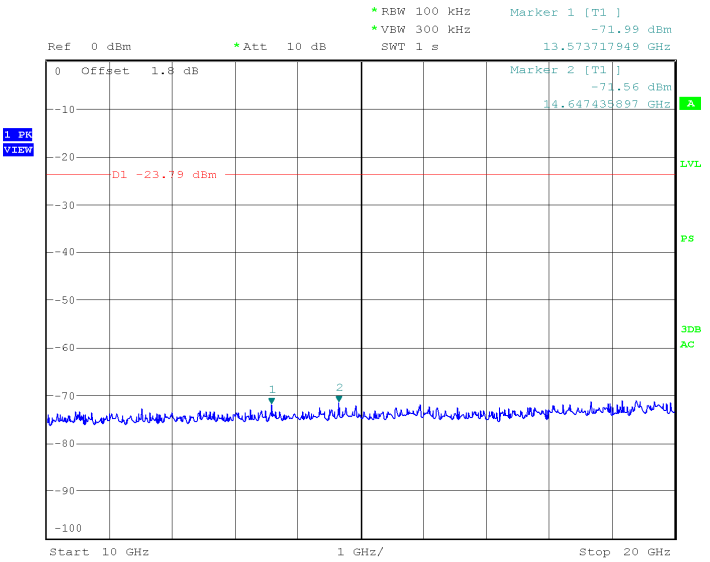
Conducted Spurious emissions 1 GHz to 5 GHz – 2480MHz 1Mb/s



jiVVW

Date: 31.OCT.2008 12:43:26

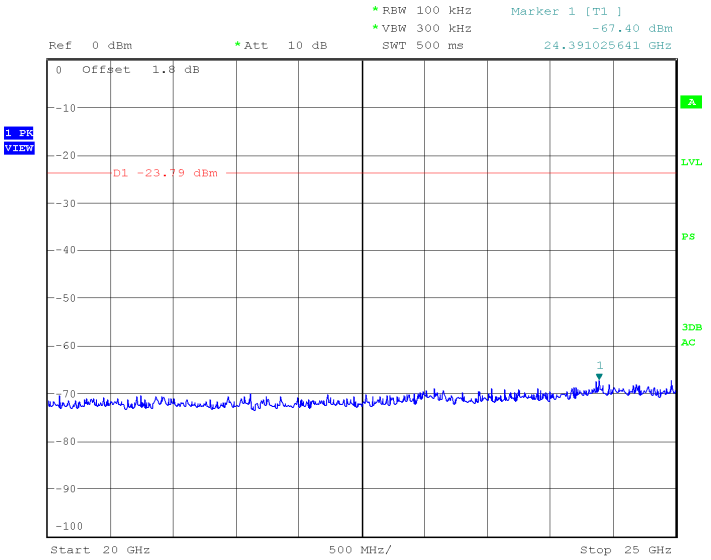
Conducted Spurious emissions 5 GHz to 10 GHz– 2480MHz 1Mb/s



jiVVW

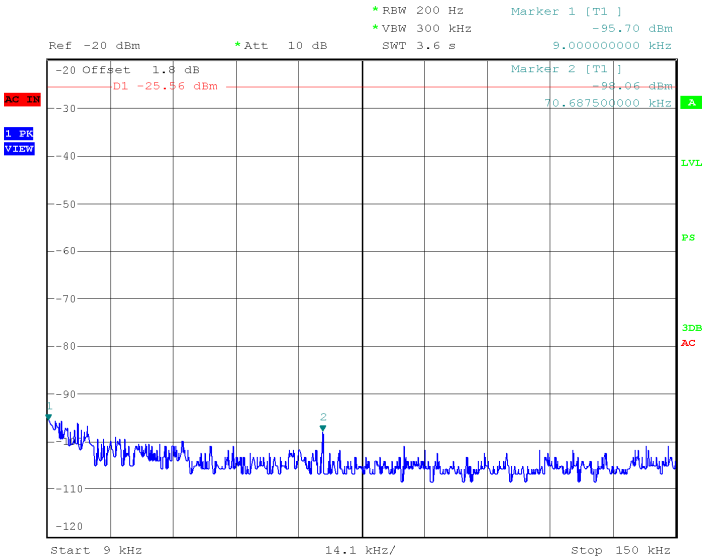
Date: 31.OCT.2008 12:50:24

Conducted Spurious emissions 10 GHz to 20 GHz– 2480MHz 1Mb/s



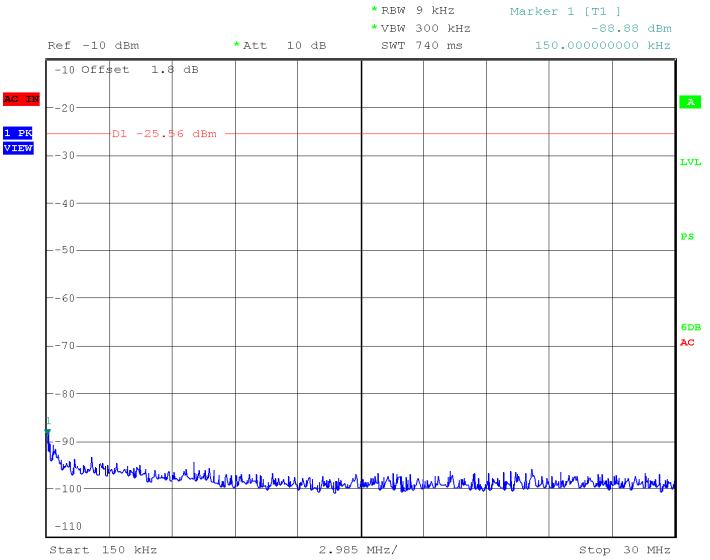
jiVVW
Date: 31.OCT.2008 12:51:18

Conducted Spurious emissions 20 GHz to 25 GHz– 2480MHz 1Mb/s

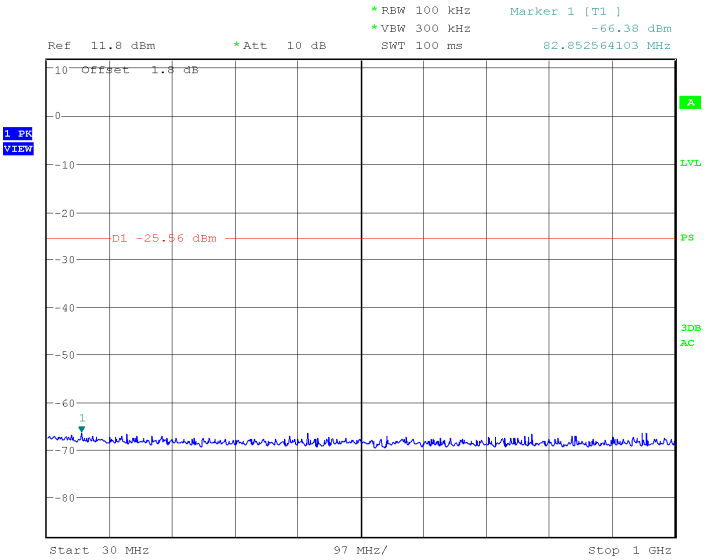


jiVVW
Date: 28.OCT.2008 16:37:55

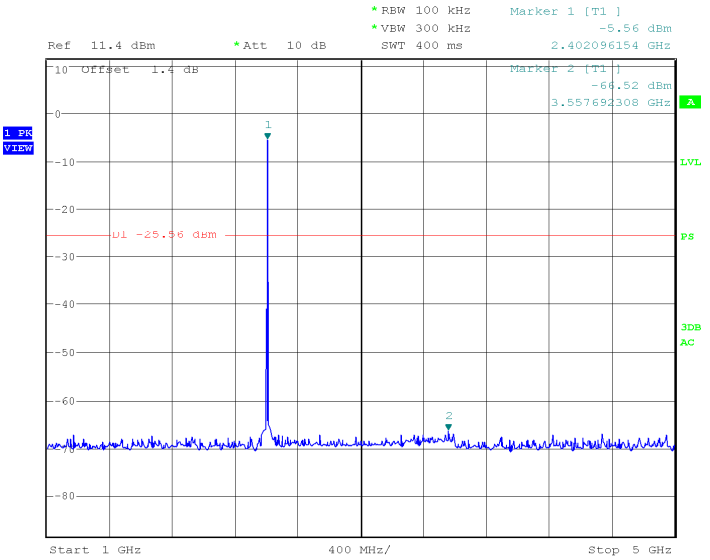
Conducted Spurious emissions 9 kHz to 150 kHz– 2402MHz 2Mb/s



Conducted Spurious emissions 150 kHz to 30 MHz– 2402MHz 2Mb/s

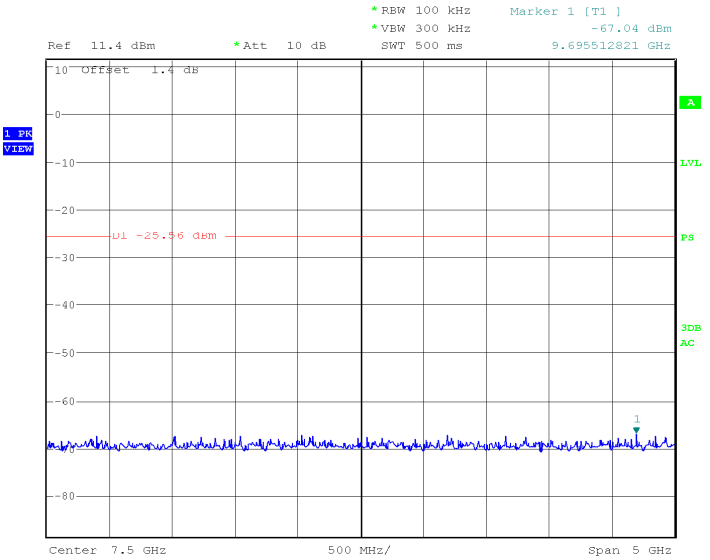


Conducted Spurious emissions 30 MHz to 1 GHz– 2402MHz 2Mb/s



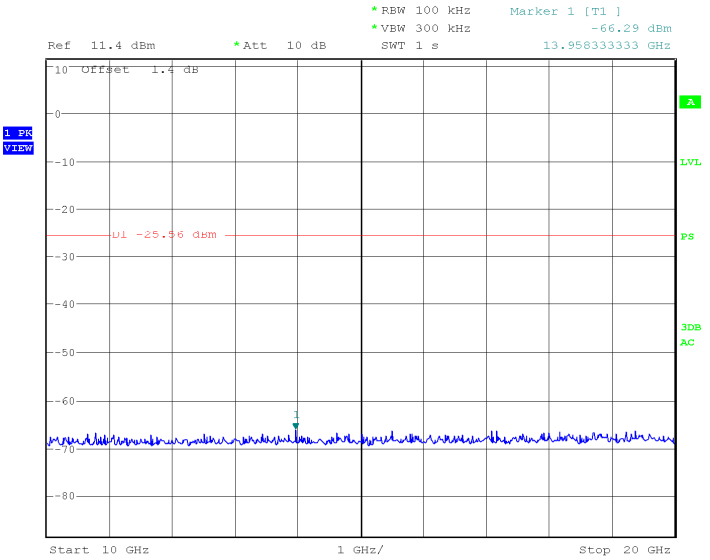
jiVVW
Date: 28.OCT.2008 13:06:01

Conducted Spurious emissions 1 GHz to 5 GHz– 2402MHz 2Mb/s



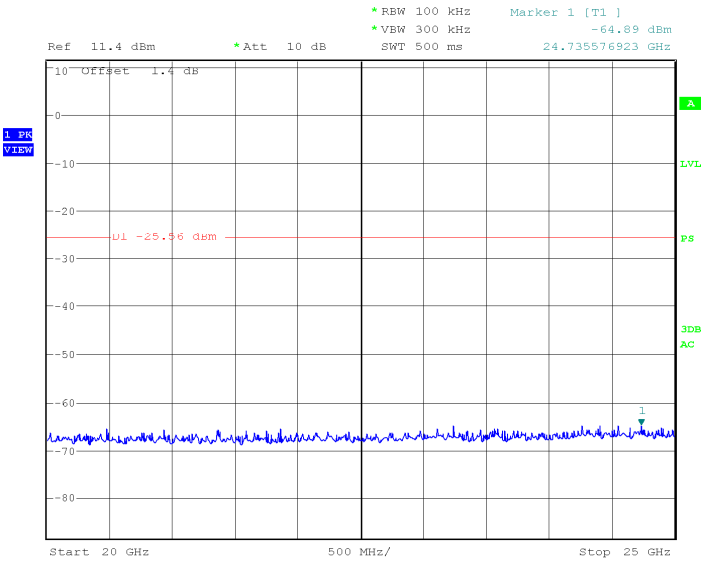
jiVVW
Date: 28.OCT.2008 13:24:58

Conducted Spurious emissions 5 GHz to 10 GHz– 2402MHz 2Mb/s



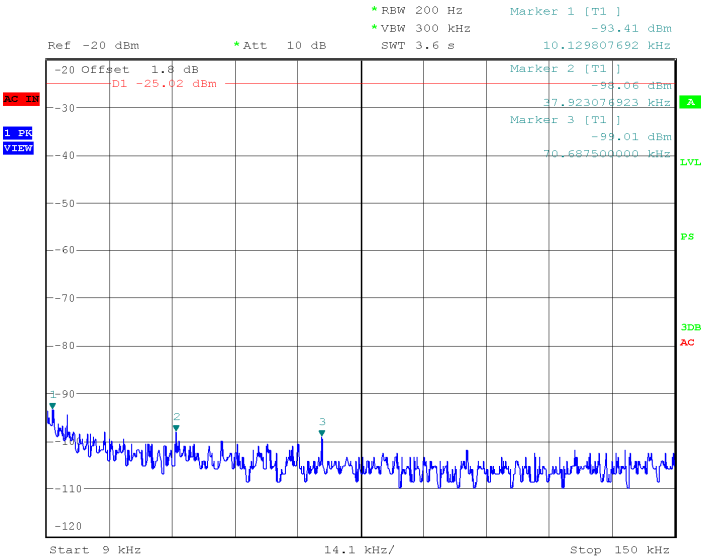
jiVVW
Date: 28.OCT.2008 13:26:49

Conducted Spurious emissions 10 GHz to 20 GHz– 2402MHz 2Mb/s



jiVVW
Date: 28.OCT.2008 13:33:33

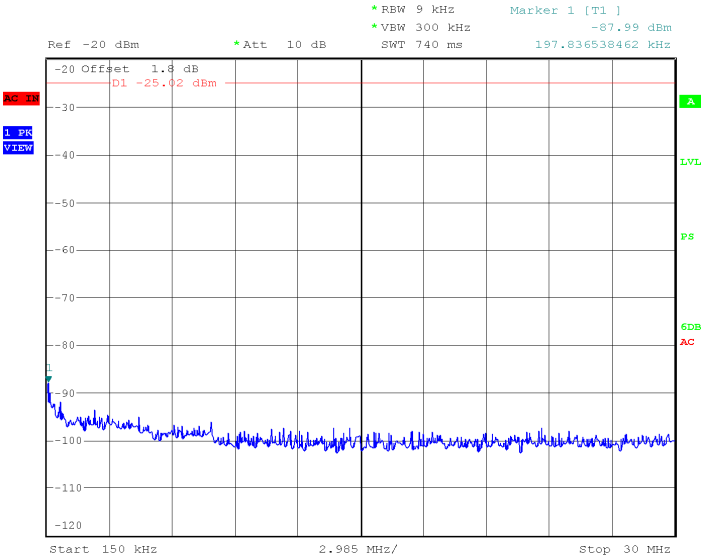
Conducted Spurious emissions 20 GHz to 25 GHz– 2402MHz 2Mb/s



jiVVW

Date: 28.OCT.2008 16:58:54

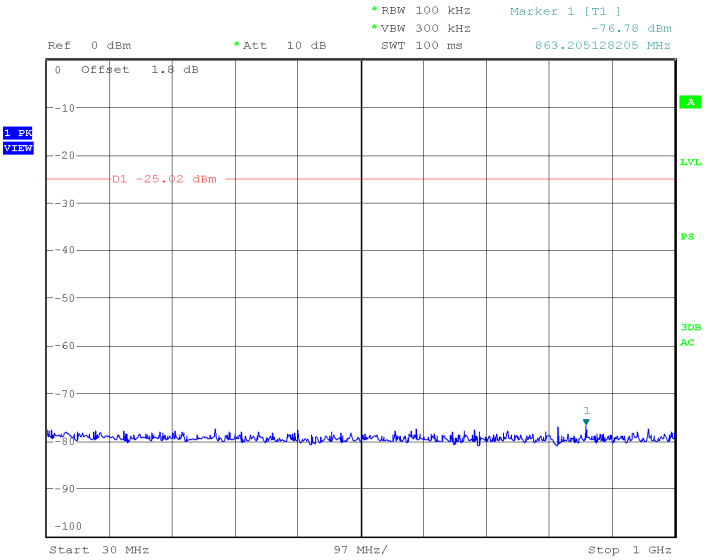
Conducted Spurious emissions 9 kHz to 150 kHz– 2442MHz 2Mb/s



jiVVW

Date: 28.OCT.2008 17:00:49

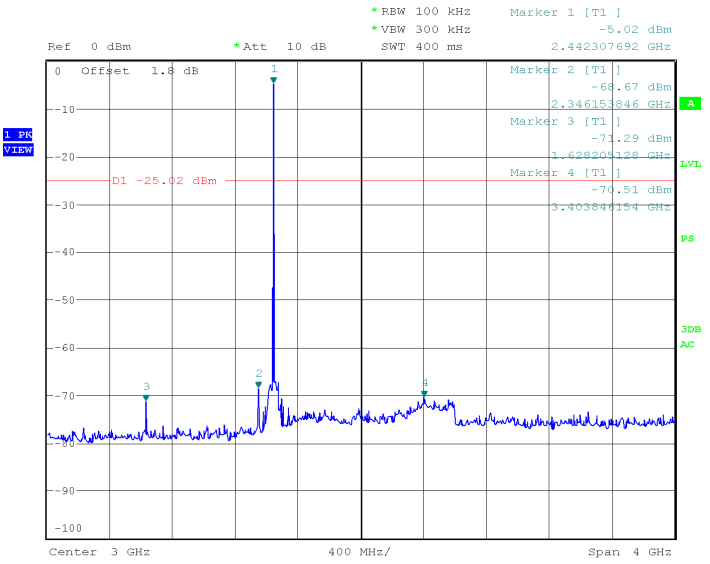
Conducted Spurious emissions 150 kHz to 30 MHz



jiVVW

Date: 28.OCT.2008 17:03:55

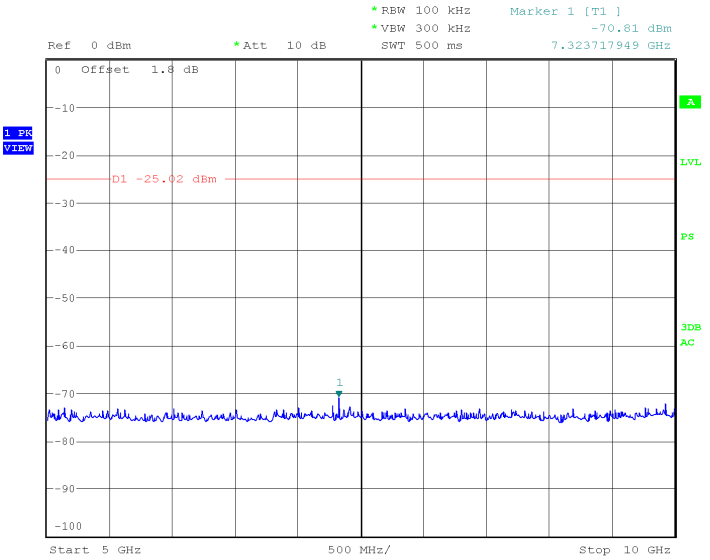
Conducted Spurious emissions 30 MHz to 1 GHz



jiVVW

Date: 28.OCT.2008 16:51:10

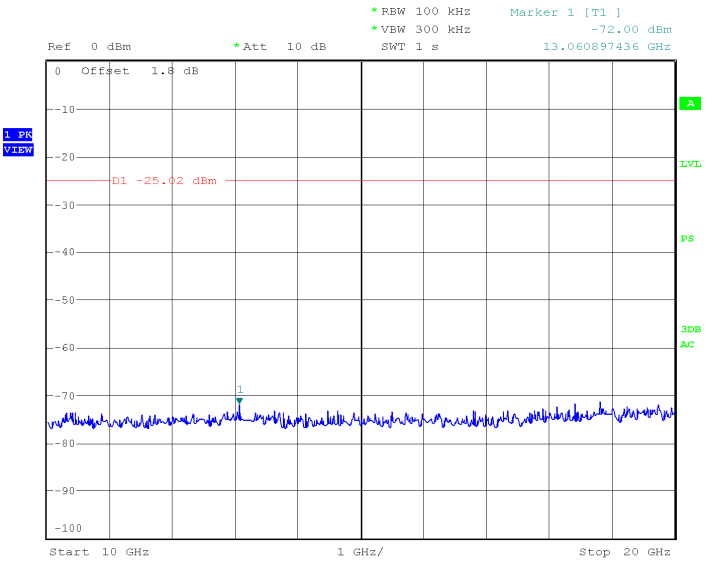
Conducted Spurious emissions 1 GHz to 5 GHz



jiVVW

Date: 28.OCT.2008 17:11:03

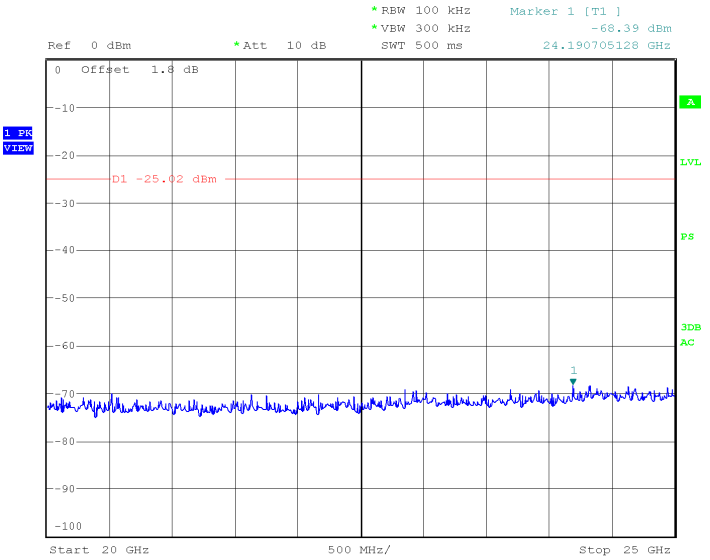
Conducted Spurious emissions 5 GHz to 10 GHz



jiVVW

Date: 28.OCT.2008 17:13:41

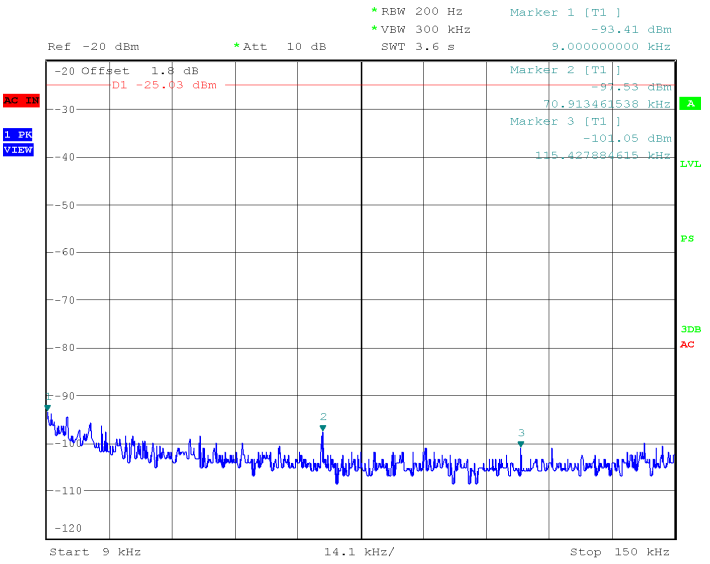
Conducted Spurious emissions 10 GHz to 20 GHz



jiVVW

Date: 28.OCT.2008 17:15:22

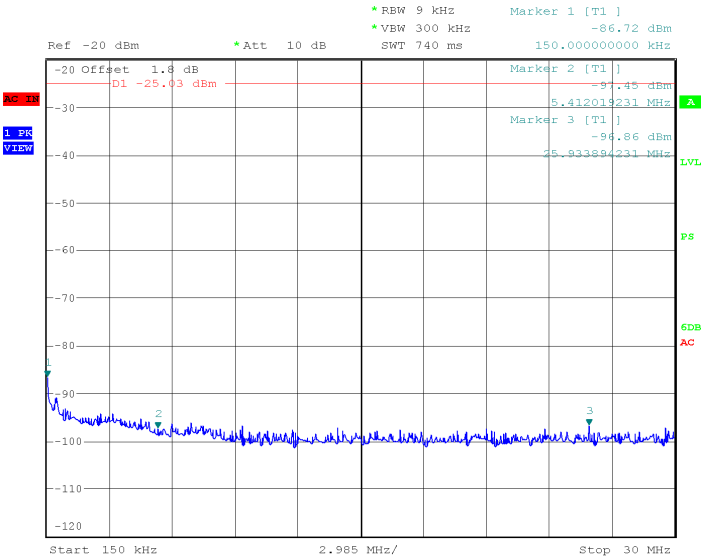
Conducted Spurious emissions 20 GHz to 25 GHz



jiVVW

Date: 29.OCT.2008 09:44:04

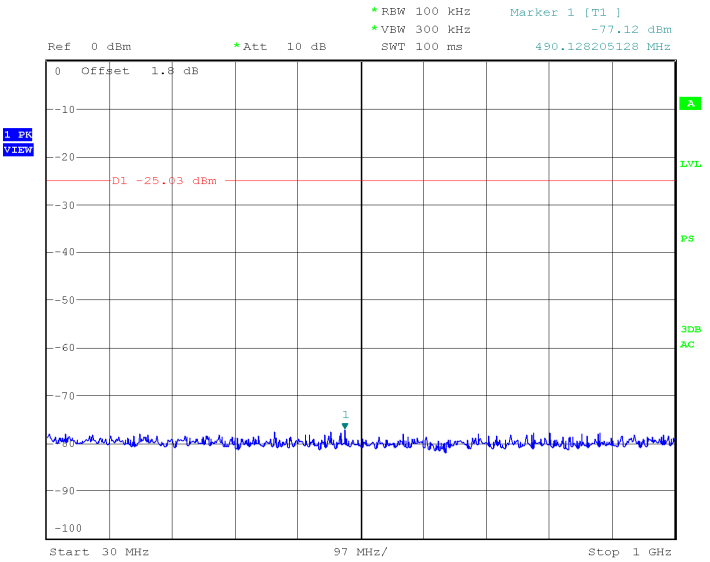
Conducted Spurious emissions 9 kHz to 150 kHz



jiVVW

Date: 29.OCT.2008 09:42:33

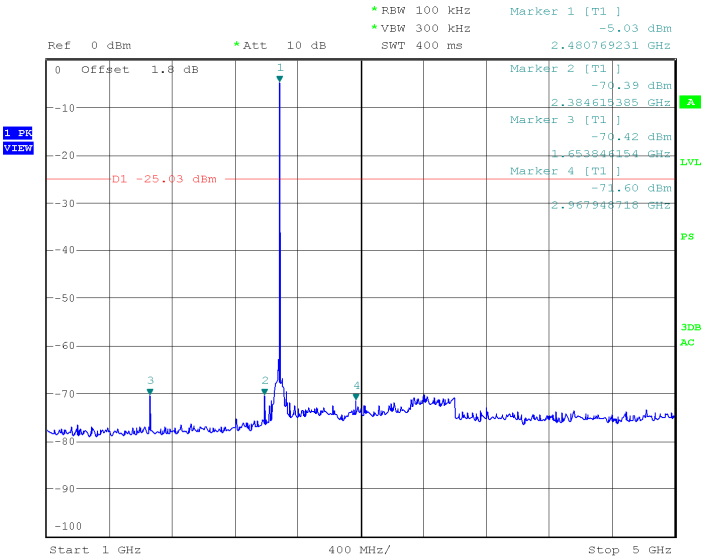
Conducted Spurious emissions 150 kHz to 30 MHz



jiVVW

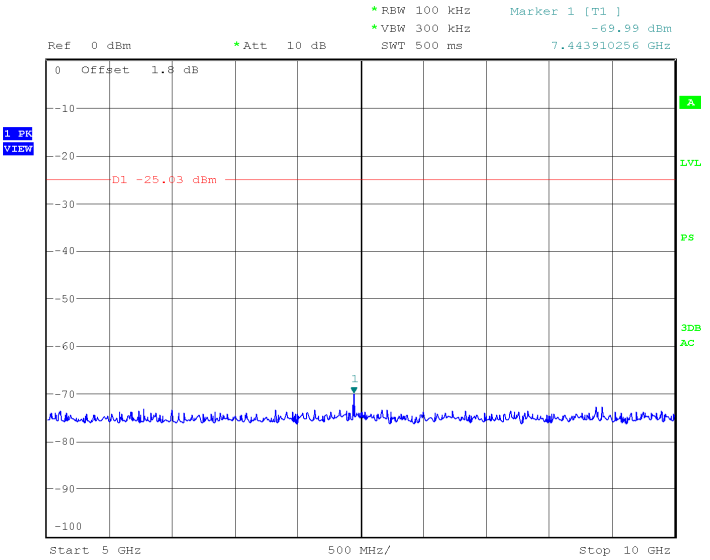
Date: 28.OCT.2008 18:30:50

Conducted Spurious emissions 30 MHz to 1 GHz



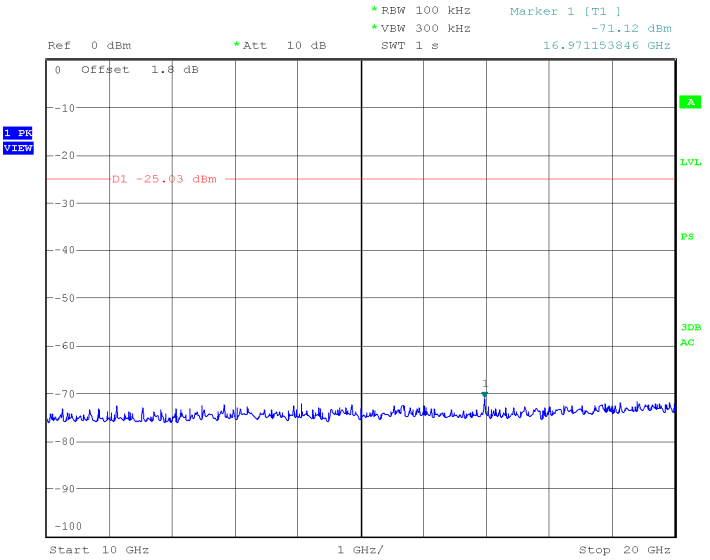
jiVVW
Date: 28.OCT.2008 17:31:20

Conducted Spurious emissions 1 GHz to 5 GHz



jiVVW
Date: 28.OCT.2008 17:37:00

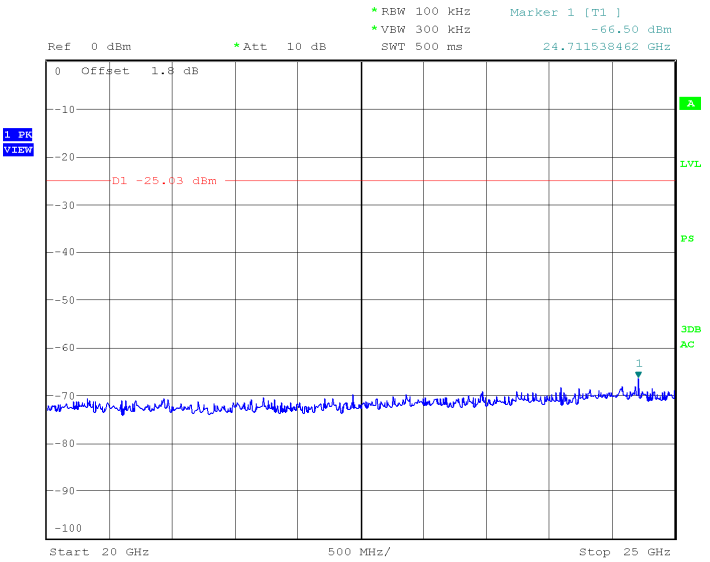
Conducted Spurious emissions 5 GHz to 10 GHz



jiVVW

Date: 28.OCT.2008 17:37:47

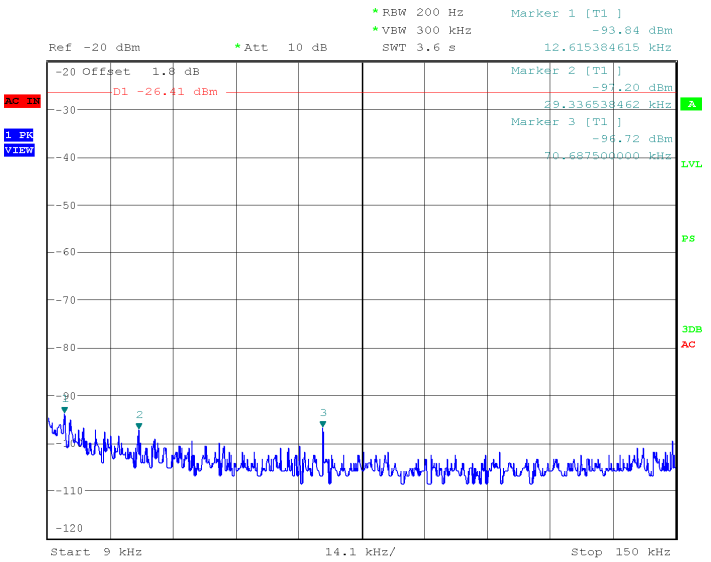
Conducted Spurious emissions 10 GHz to 20 GHz



jiVVW

Date: 28.OCT.2008 17:38:34

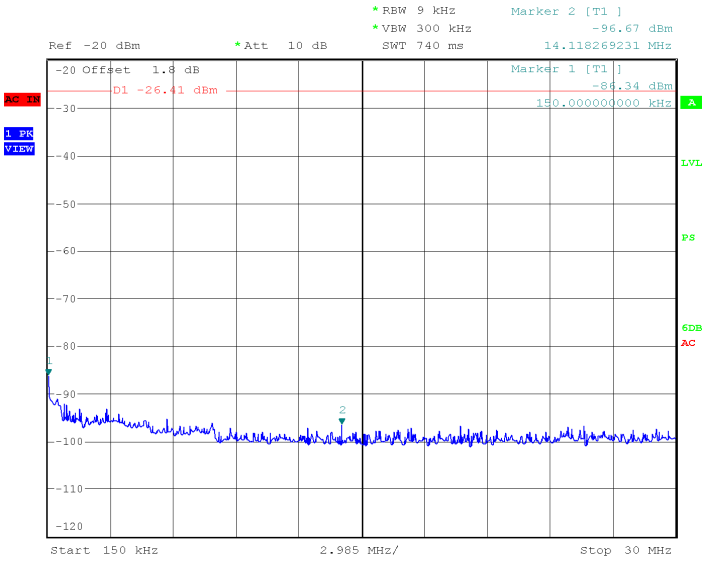
Conducted Spurious emissions 20 GHz to 25 GHz



jiVVW

Date: 29.OCT.2008 13:23:20

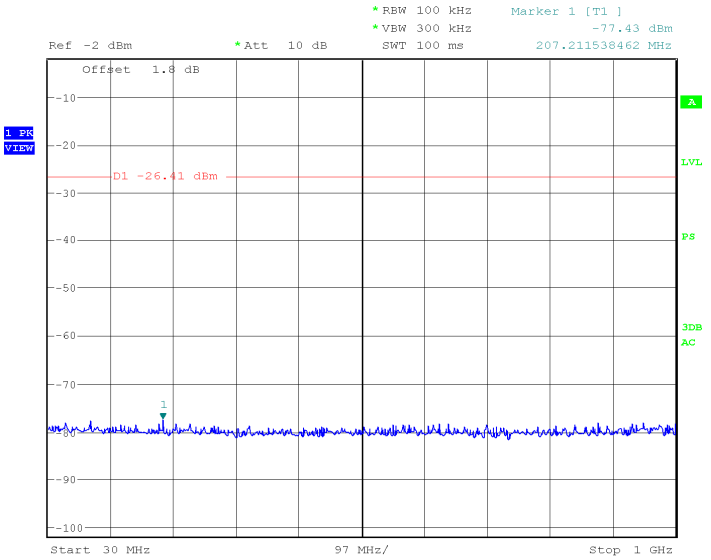
Conducted Spurious emissions 9 kHz to 150 kHz



jiVVW

Date: 29.OCT.2008 13:31:54

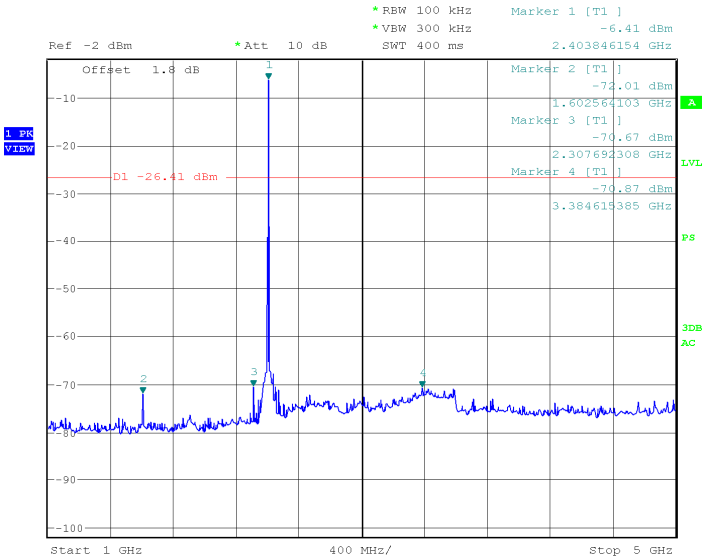
Conducted Spurious emissions 150 kHz to 30 MHz



jiVVW

Date: 29.OCT.2008 13:21:12

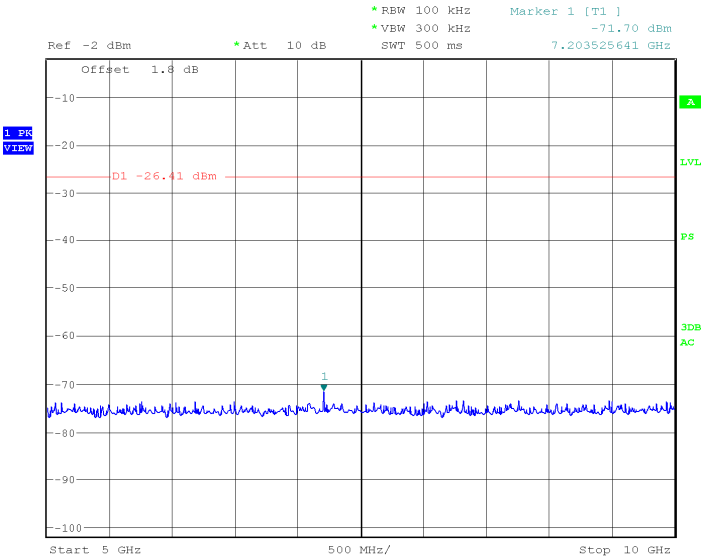
Conducted Spurious emissions 30 MHz to 1 GHz



jiVVW

Date: 29.OCT.2008 11:58:18

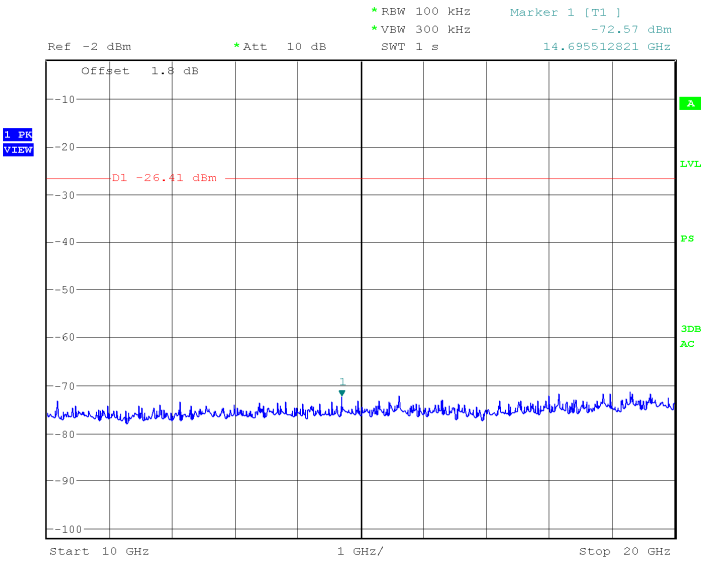
Conducted Spurious emissions 1 GHz to 5 GHz



jiVVW

Date: 29.OCT.2008 12:45:22

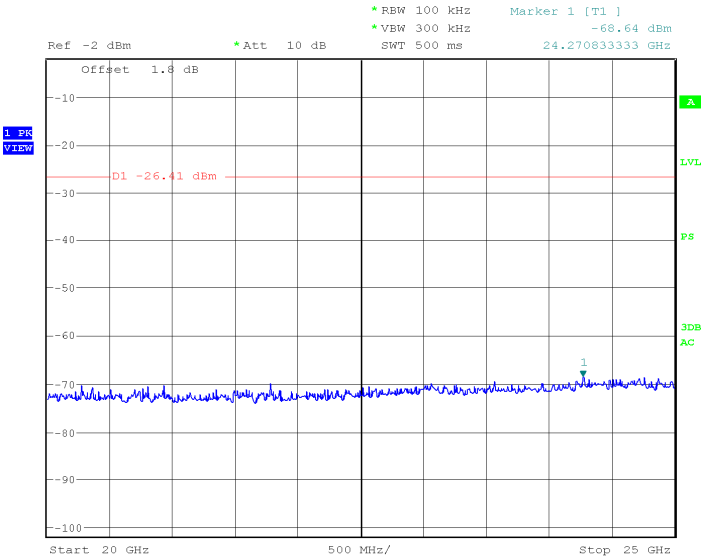
Conducted Spurious emissions 5 GHz to 10 GHz



jiVVW

Date: 29.OCT.2008 13:11:45

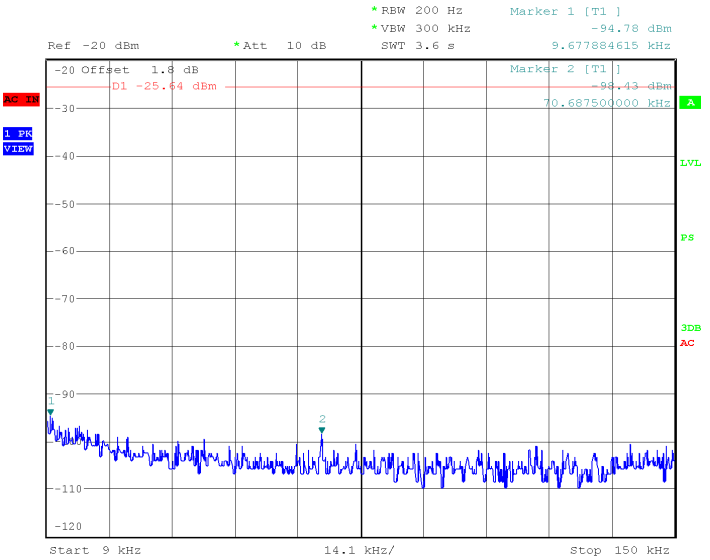
Conducted Spurious emissions 10 GHz to 20 GHz



jiVVW

Date: 29.OCT.2008 13:17:31

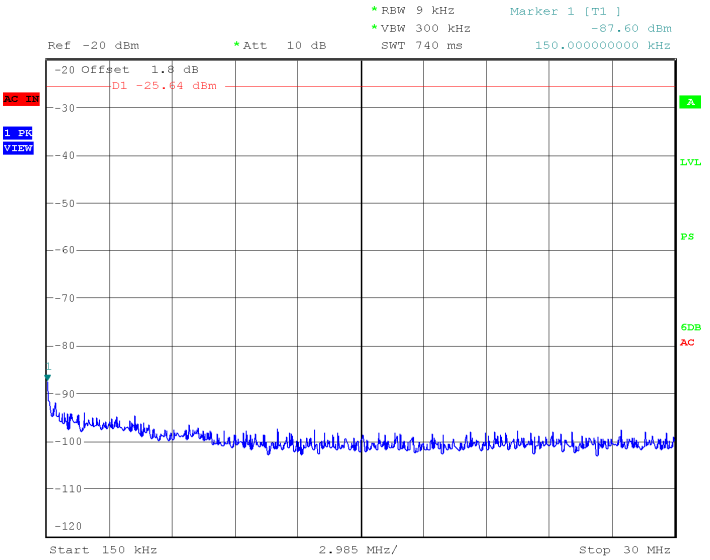
Conducted Spurious emissions 20 GHz to 25 GHz



jiVVW

Date: 29.OCT.2008 16:37:54

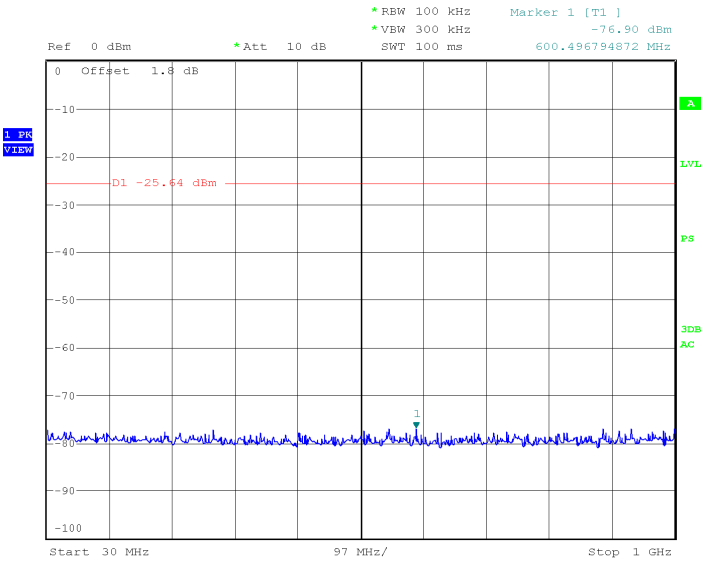
Conducted Spurious emissions 9 kHz to 150 kHz



jiVVW

Date: 29.OCT.2008 16:39:02

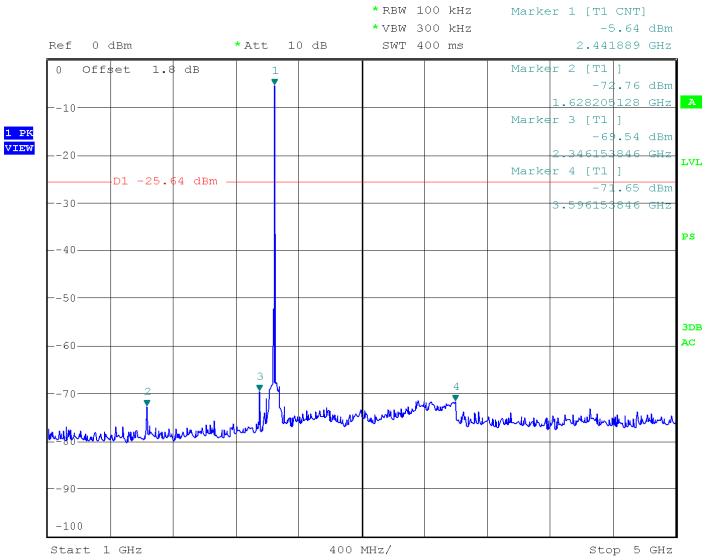
Conducted Spurious emissions 150 kHz to 30 MHz



jiVVW

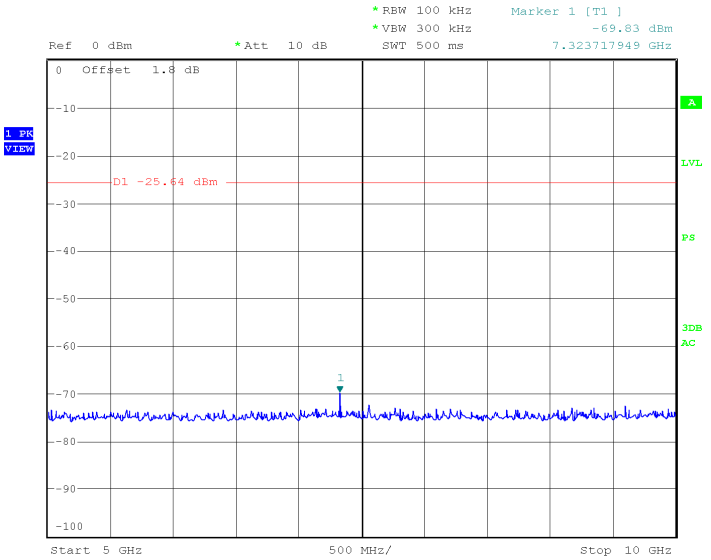
Date: 29.OCT.2008 16:36:26

Conducted Spurious emissions 30 MHz to 1 GHz



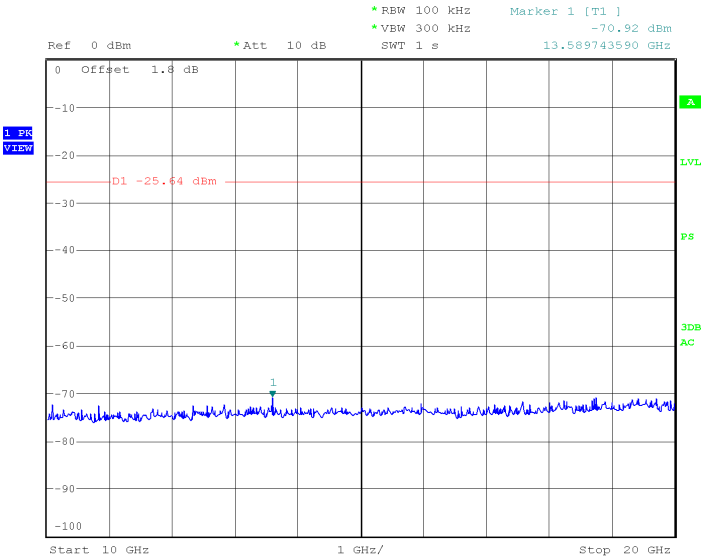
jiVVW
Date: 29.OCT.2008 15:00:24

Conducted Spurious emissions 1 GHz to 5 GHz



jiVVW
Date: 29.OCT.2008 16:17:06

Conducted Spurious emissions 5 GHz to 10 GHz



jiVVW
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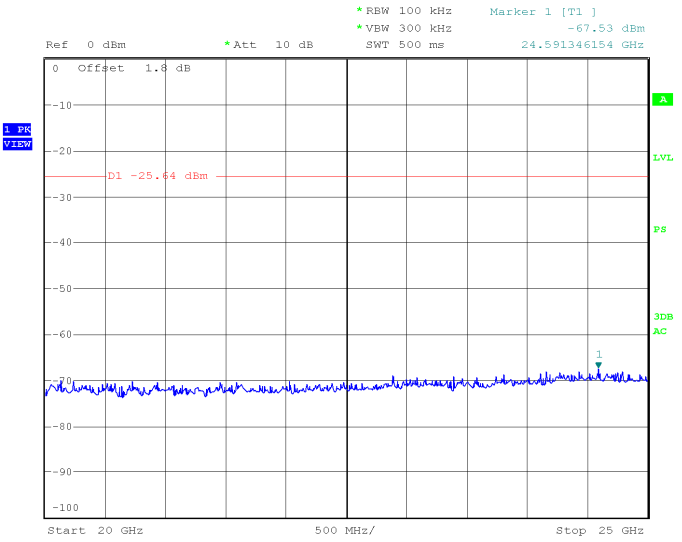
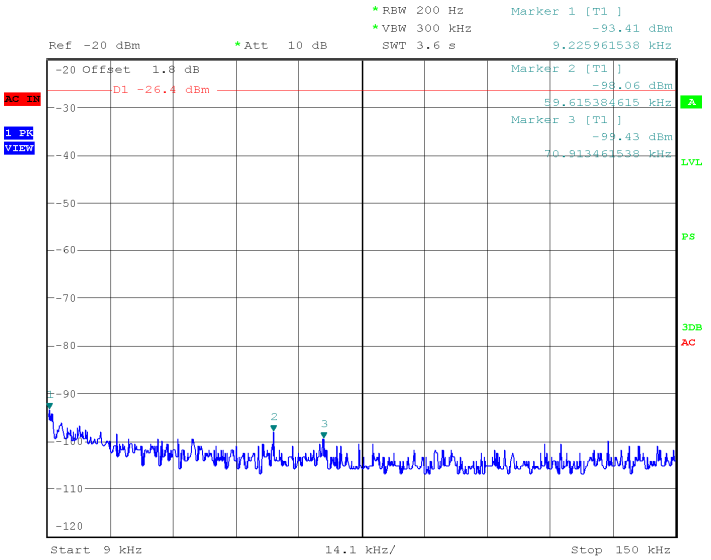
Conducted Spurious emissions 10 GHz to 20 GHz



jiVVW
Date: 29.OCT.2008 16:19:21

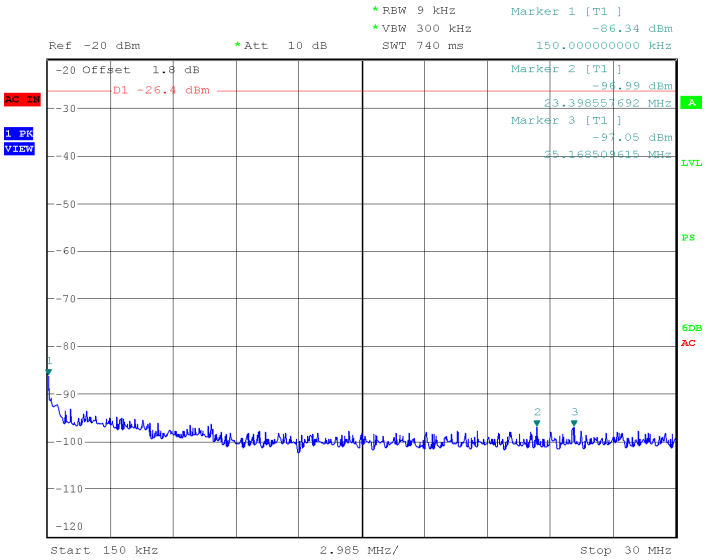
Conducted Spurious emissions 20 GHz to 25 GHz



jiVVW

Date: 29.OCT.2008 17:21:47

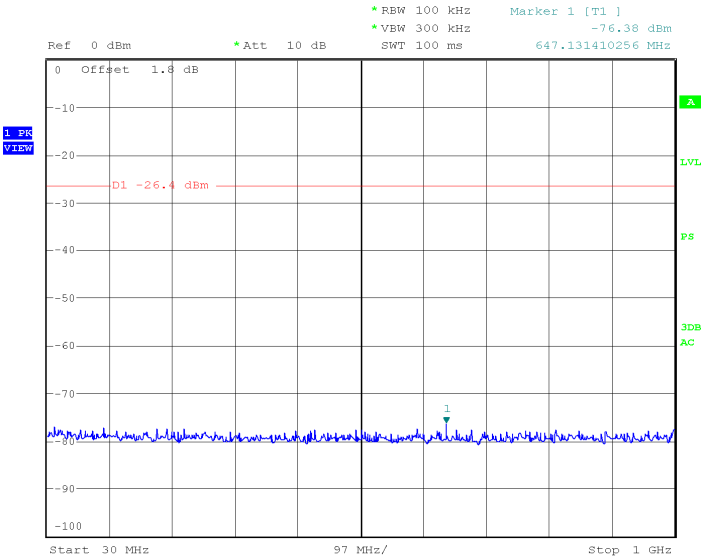
Conducted Spurious emissions 9 kHz to 150 kHz



jiVVW

Date: 29.OCT.2008 17:30:01

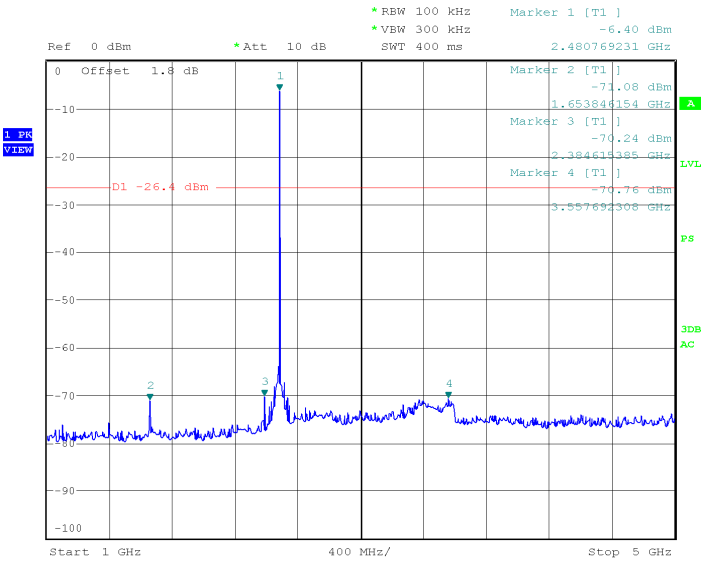
Conducted Spurious emissions 150 kHz to 30 MHz



jiVVW

Date: 29.OCT.2008 17:19:22

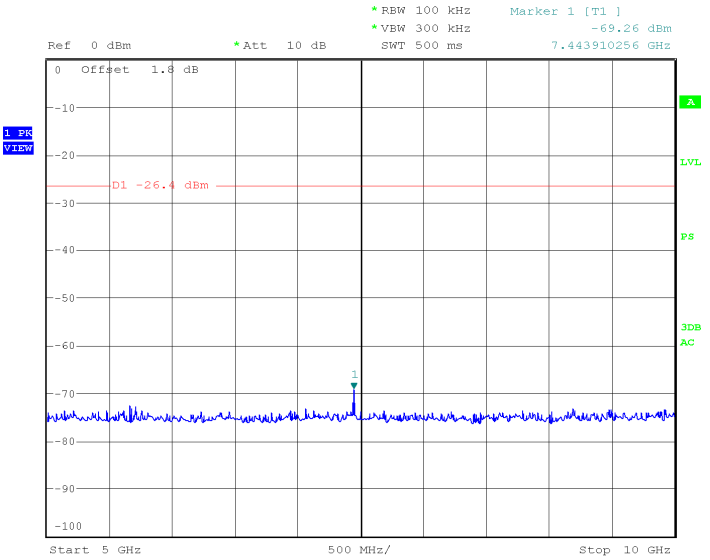
Conducted Spurious emissions 30 MHz to 1 GHz



jiVVW

Date: 29.OCT.2008 17:00:22

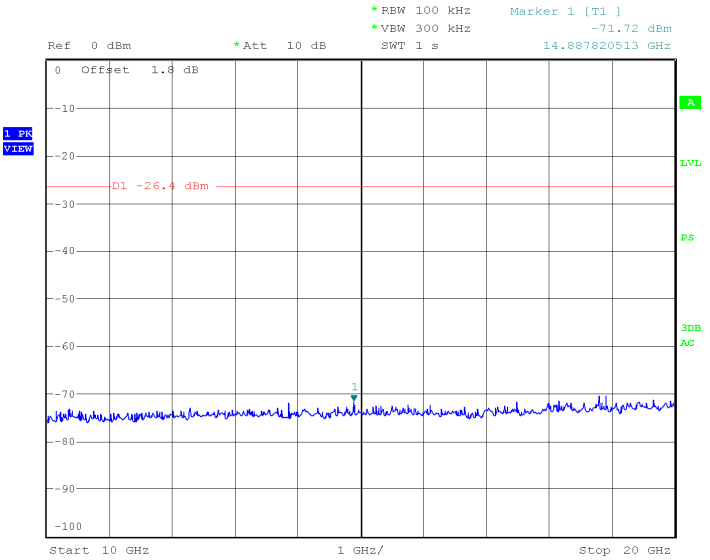
Conducted Spurious emissions 1 GHz to 5 GHz



jiVVW

Date: 29.OCT.2008 17:01:18

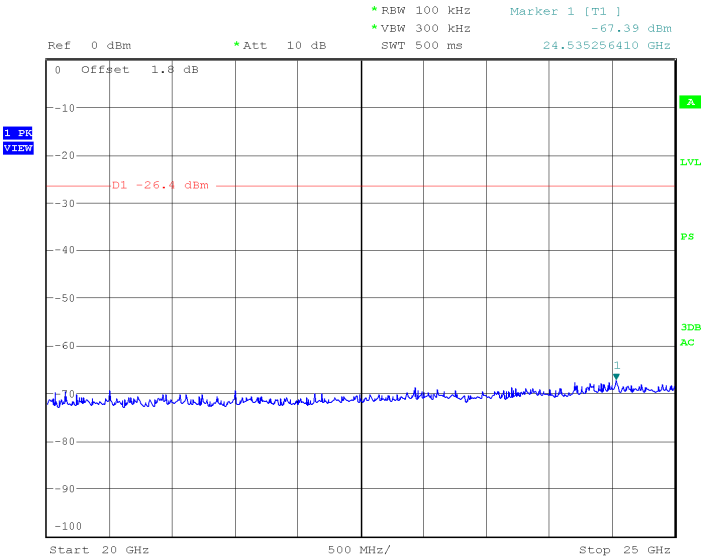
Conducted Spurious emissions 5 GHz to 10 GHz



jiVVW

Date: 29.OCT.2008 17:13:44

Conducted Spurious emissions 10 GHz to 20 GHz



Conducted Spurious emissions 20 GHz to 25 GHz

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 KTL upon request.

C1) Test samples

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

Sample No.	Description	Identification
S25	IP Telephone 9670G	S/N: 08N 539103931
S12	PSU Model No. 7004 34897	07 DT 32 066 705

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

KTL Identification	Description
REF838	Agilent N4010A Bluetooth Test Set
REF1270	VARIAC

C2) EUT Operating Mode During Testing.

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

Test	*Description of Operating Mode*
All tests detailed in this report	EUT transmitting on maximum power using FHSS over 79 channels with 1 MHz channel spacing using DH5 packets with the following modulations: 1 Mb/s GFSK 2Mb/s π/4-DQPSK 3Mb/s 8DPSK

In addition

Test	Description of Operating Mode:
Spurious emissions (radiated and conducted)	EUT active but non-transmitting.

C3) EUT Configuration Information.

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

C4) List of EUT Ports

The table below describes the termination of EUT ports:

Sample : S25
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
dc Power	2 core Unscreened	1.5m	S12
Serial	Multicore Unscreened	2m	EMC Laptop*

Sample : S12
Tests : All

Port	Description of Cable Attached	Cable length	Equipment Connected
dc Power	2 core Unscreened	1m	S25
ac Power	3 core Unscreened	*2m*	Mains Supply

* Only connected during setup.

C5 Details of Equipment Used

LAB10

For Radiated Electric Field Emissions 30MHz to 1GHz: (Restricted band 15.205)

RFG No	Type	Description	Manufacturer	Date Calibrated.
274	ATS	Ferrite Lined Chamber	KTL	29/02/08
231	CBL6111	Blue Bilog Antenna (0.03 - 1GHz)	Chase	12/08/08
214	ESAI	Spec Analyser/Test Rxer (LF/HF)	R & S	22/01/08
404	E4407B	Spectrum Analyser	Agilent	07/04/08
127	HP8563E	Spectrum Analyser	HP	17/03/08
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
REF837	PSA E4440A	Spectrum Analyser	Agilent	21/02/08
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
267	N-type	RF coaxial cable (Lab 10)	KTL	28/01/08
270	N-type	RF coaxial cable (Lab 10)	KTL	28/01/08
278	N-type	RF coaxial cable (Lab 10)	KTL	28/01/08

For Radiated Electric Field Emissions 1GHz to 18GHz (Restricted band 15.205)

RFG No	Type	Description	Manufacturer	Date Calibrated
274	ATS	Ferrite Lined Chamber	KTL	11/01/08
129	3115	Horn Antennas	EMCO	29/07/98
130	3115	Horn Antennas	EMCO	29/07/98
307	HP8449B	Microwave Pre-Amp (1-26.5GHz)	HP	18/02/08
650	N-106	Sucoflex uW Cable 3m	Suhner	14/07/08
651	N-106	Sucoflex uW Cable 7m	Suhner	14/07/08
643	ST18/Nm/ Nm/48	48 inch Sucoflex cable	Suhner	18/07/08
404	E4407B	Spectrum Analyser	Agilent	07/04/08
127	HP8563E	Spectrum Analyser	HP	17/03/08
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
REF837	PSA E4440A	Spectrum Analyser	Agilent	21/02/08
244	4478	Bandstop Filter	BSC	N/A (Cal during use)

Details of Equipment Used Continued:

For Radiated Electric Field Emissions 18GHz to 26GHz (Restricted band 15.205)

RFG No	Type	Description	Manufacturer	Date Calibrated
274	Lab 10	Large anechoic chamber	KTL	N/A
629	QSH20S20S	Horn antenna	Q-par	02/11/06
630	QSH20S20S	Horn antenna	Q-par	02/11/06
476	60637	50Ω Coax 3m	Semflex	14/04/08
477	60637	50Ω Coax 3m	Semflex	14/04/08
307	8449B	Microwave pre amp	HP	18/02/08
404	E4407B	Spectrum analyser	Agilent	07/04/08
127	HP8563E	Spectrum Analyser	HP	17/03/08
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
REF837	PSA E4440A	Spectrum Analyser	Agilent	21/02/08
138	N-104	Sucoflex uW Cable 2m	Suhner	28/03/07
158	N-106	Sucoflex uW Cable 7m	Suhner	28/03/07
244	4478	Bandstop Filter	BSC	N/A (Cal during use)

For Conducted Emissions

RFG No	Type	Description	Manufacturer	Date Calibrated
404	E4407B	Spectrum Analyser	Agilent	07/04/08
127	HP8563E	Spectrum Analyser	HP	17/03/08
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
REF837	PSA E4440A	Spectrum Analyser	Agilent	21/02/08
244	4478	Bandstop Filter	BSC	N/A (Cal during use)

For Conducted RF power

RFG No	Type	Description	Manufacturer	Date Calibrated
404	E4407B	Spectrum Analyser	Agilent	07/04/08
127	HP8563E	Spectrum Analyser	HP	17/03/08
REF837	PSA E4440A	Spectrum Analyser	Agilent	21/02/08
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
REF 835/836	N1922A & N1911A	Power head and meter	Agilent	08/02/08
031	436A	Power Meter	HP	10/04/08
032	8482A	Power Head (-20 to +20dBm)	HP	10/04/08
171	8481D	Power Head (-20 to –70dBm)	HP	10/04/08

For 6dB Bandwidth measurement

RFG No	Type	Description	Manufacturer	Date Calibrated
404	E4407B	Spectrum Analyser	Agilent	07/04/08
127	HP8563E	Spectrum Analyser	HP	17/03/08
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
REF837	PSA E4440A	Spectrum Analyser	Agilent	21/02/08

Details of Equipment Used Continued:

For Power Spectral density

RFG No	Type	Description	Manufacturer	Date Calibrated
404	E4407B	Spectrum Analyser	Agilent	07/04/08
127	HP8563E	Spectrum Analyser	HP	17/03/08
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
REF837	PSA E4440A	Spectrum Analyser	Agilent	21/02/08

For Power Line Conducted Emissions

RFG No	Type	Description	Manufacturer	Date Calibrated
274	Lab 10	Ferrite Lined Chamber	KTL	11/01/08
n/a	Lab 11	Small Screened Chamber	KTL	-
n/a	Lab 14	Small Screened Chamber	KTL	-
030	ESH3-Z5	Single-phase LISN	R & S	23/04/08
189	ESH3-Z5	Single-phase LISN	R & S	14/05/08
190	ESH3-Z2	Pulse Limiter	R & S	24/04/08
232	ESH3-Z2	Pulse Limiter	R & S	07/02/08
214	ESAI	Spec Analyser/Test Rxer (LF/HF)	R & S	22/01/08
012	ESH3	Test Receiver (LF)	R & S	05/02/08
125	ESHS 10	Test Receiver (LF)	R & S	22/11/07
127	HP8563E	Spectrum Analyser	HP	17/03/08
404	E4407B	Spectrum Analyser	Agilent	07/04/08
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
REF837	PSA E4440A	Spectrum Analyser	Agilent	21/02/08
267	N-type	RF coaxial cable (Lab 10)	KTL	28/01/08
269	N-type	RF coaxial cable (Lab 10)	KTL	28/01/08
293	BNC	RF coaxial cable (Lab 10)	KTL	28/01/08
297	BNC	RF coaxial cable (Lab 11)	KTL	28/01/08
298	BNC	RF coaxial cable (Lab 11)	KTL	28/01/08
092	BNC	RF coaxial cable (Lab 14)	KTL	28/01/08
295	BNC	RF coaxial cable (Lab 14)	KTL	28/01/08

Appendix D: Additional Information

The following additional information was supplied by the client to support this assessment:

Extract from Antenna Manufacturer's data sheet detailing antenna gain

ethertronics
shaping antenna technology

PRODUCT: BLUETOOTH®
Part No. M830300

Savvi™ Embedded Bluetooth Antennas
2.4–2.5 GHz

Ethertronics' Savvi series of Isolated Magnetic Dipole™ (IMD) antennas deliver on the key needs of device designers for higher functionality and performance in smaller/thinner designs. These innovative antennas provide compelling advantages for Bluetooth enabled cell phones, media players and other mobile devices.

TECHNOLOGY ADVANTAGES

Real-World Performance and Implementation
Ceramic antennas may look alike on the outside, but the important difference is inside. Other antennas may contain simple PIFA or monopole designs that interact with their surroundings, complicating layout or changing performance with use position. Ethertronics' antennas utilize patented IMD technology to deliver a unique size and performance combination.

Stays in Tune
High RF isolation means IMD antennas resist de-tuning regardless of usage position. And one standardized part can typically be placed in a variety of locations.

Smallest Effective Size
IMD antennas require a smaller keep-out area for surrounding components, leading to a smaller effective size.

High Performance
IMD's high efficiency and simple design rules lower development risk and speed time-to-market without sacrificing performance. Plus, high RF selectivity eliminates the cost and space for band-pass circuitry.

More information is available on our Website at www.ethertronics.com/resources/.

KEY BENEFITS

DESIGN ADVANTAGES

Best in Class Performance—Smallest Occupied Volume
- Powerful combination of 85% peak efficiency and simple implementation guidelines.
- Minimal ground clearance and component "keep out" areas. Very low component height.
- High selectivity eliminates the cost for additional filters and frees up board space

High Tolerance to Frequency Shifts
- IMD's high RF isolation resists antenna detuning that otherwise can impair reception.
- Single part works for various PCB sizes and layouts.

Quicker Time-to-Market
- Fewer design modifications required to pass RF test suite.
- Simpler implementation—**no matching networks.**

RoHS Compliant
- Antennas comply with appropriate RoHS Directives.

END USER ADVANTAGES

Superior Range
- Greater antenna efficiency means longer range and a better end user experience.

Exceptional Coverage
- Better coverage delivers more reliable wireless connections for mobile phones, laptops, stereo headsets, cars, media players, audio systems and more.

SERVICE AND SUPPORT

Extensive RF Experience
- Our Savvi ceramic antennas are supported by extensive application notes, and when needed, by the expertise of RF engineers who have integrated hundreds of antenna designs into wireless devices.

Global Operations & Design Support
- Ethertronics' global operations encompass an integrated network of design centers that provide local customer support.

ETHERTRONICS
9605 Scranton Road, Suite 300 | San Diego, CA 92121 - USA | www.ethertronics.com
tel +(1) 858.550.3820 | fax +(1) 858.550.3821 | contact: info@ethertronics.com

PRODUCT: Bluetooth® Antenna

Ethertronics' Savvi™ Bluetooth Embedded Antenna Specifications

Ethertronics produces a wide variety of standard and custom antennas to meet user needs.
Below are the typical specs for a Bluetooth application.

Electrical Specifications

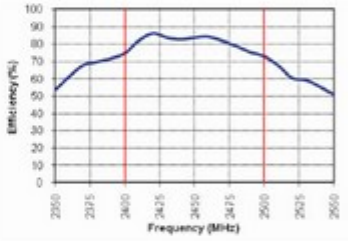
Typical Characteristics
(inside an enclosure)

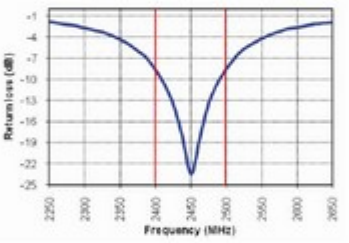
BT Antenna	2.4–2.5 GHz
Average Gain	-1.1 dBi
Average Efficiency	80%
VSWR Match	2.0:1 max
Feed Point Impedance	50 ohms unbalanced
Power Handling	.5 Watt cw
Polarization	Linear

Mechanical Specifications

Size	8x3x1.3mm
Mounting	Surface mount
Weight	.2 grams
Packaging	Tape & Reel

Typical Efficiency, Return Loss

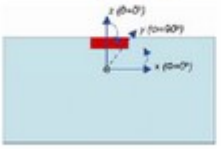




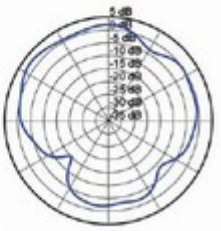
Antenna Radiation Patterns

2.4 GHz Band

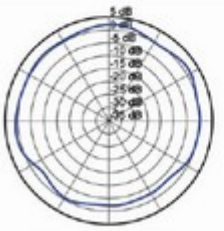
Typical Performance
Ethertronics' Test Board
PCB: 40x80mm



Phi = 0° Plane



Phi = 90° Plane



Theta = 90° Plane

BT 03-31 RA

Appendix E: Calculation of the duty cycle correction factor

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

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

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

Therefore the calculated duty cycle was determined:

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

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

e.g

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

0.07459 or 7.459%

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

OR

For EUT that uses Zigbee device technology the EUT is designed to be compliant with the requirements of IEEE 802.15.4, which in general assumes a maximum duty cycle of 1%. Therefore in accordance with 47CFR 15.35(c), the emissions may be reduced by a factor of 100 (40 dB). Plots of the duty cycle showing the duty cycle to be less than 1% are contained in Appendix B of this report.

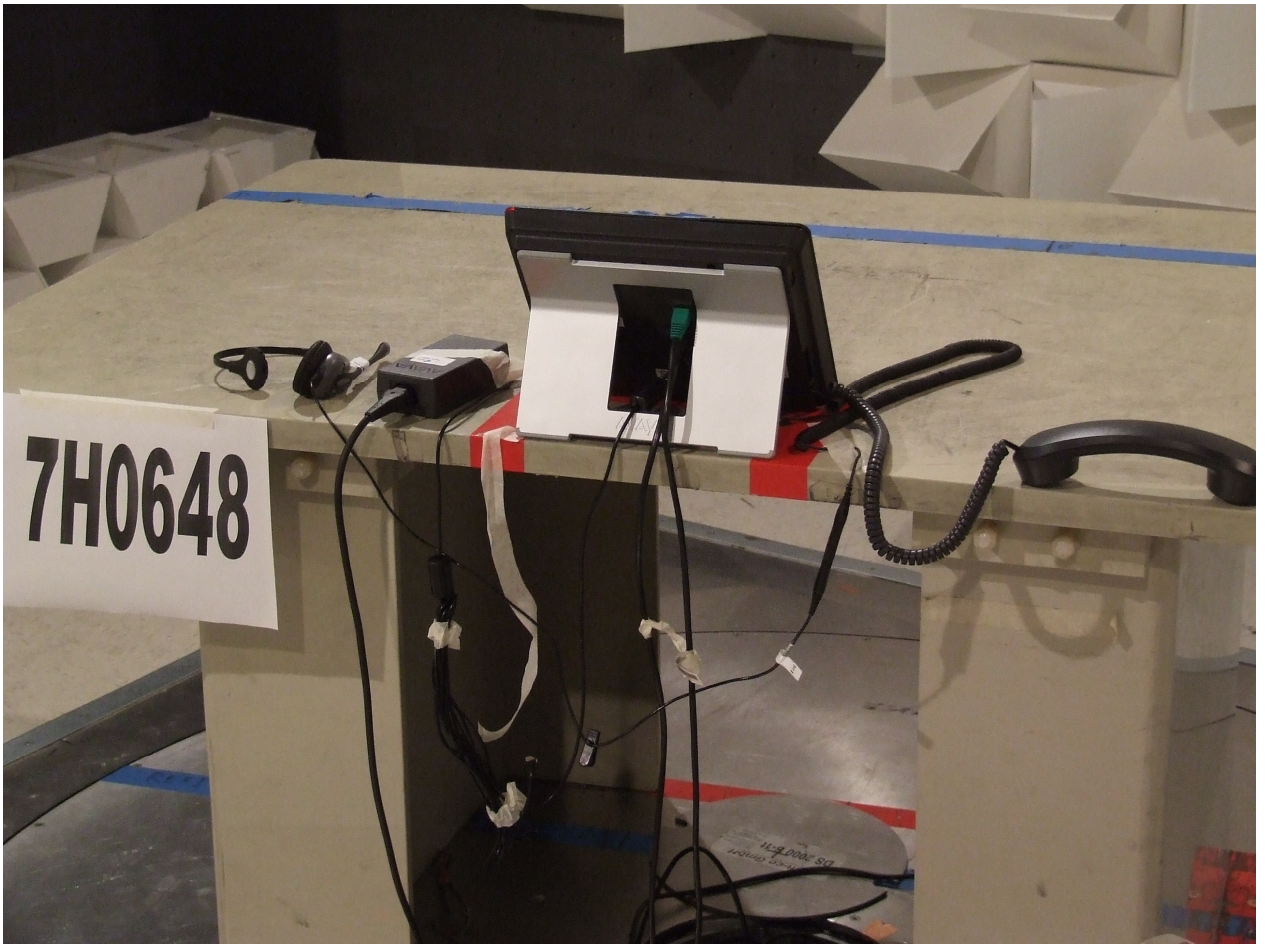
Appendix F: Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: front view.
2. Radiated electric field emissions arrangement: rear view.
3. Power line conducted emissions arrangement.

Note[1]: The photograph shows the EUT tested, which was specially fitted with a 50Ω coax to SMA type connector to facilitate testing.

Photograph 1



Photograph 2

Photograph 3

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 1mW/cm^2 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

$$S = \frac{PG}{4\pi R^2} \quad \text{re - arranged} \qquad R = \sqrt{\frac{P\ G}{S\ 4\pi}}$$

where:

S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the centre of radiation of the antenna

Maximum peak output power at the antenna terminal:	-0.7	dBm
Maximum peak output power at the antenna terminal:	0.85	mW
Power density	1.0	mW/cm^2
Antenna gain (typical):	-1.1	dBi
Maximum antenna gain:	0.77	numeric
Prediction frequency:	2402	MHz

Result

Prediction Frequency (MHz)	Maximum allowable antenna gain: (dBi)	Power density limit (S) (mW/cm^2)	Distance (R) cm required to be less than 1mW/cm^2
2402	-1.1	1.000000	0.22

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