



KTL
part of TRAC global

Test report

KTL EMC Test Report

: 7F1040WUS7

Applicant : AlertMe.com Ltd

Apparatus : Wireless Standard Hub 1-2

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Section 1:

Introduction

1.1 General

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

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1.2 Tests Requested By

This testing in this report was requested by :

AlertMe.com Ltd
27-28 Bridge Street
Cambridge
CB21UJ
United Kingdom

1.3 Manufacturer

For samples S23 and S24

In-Tech Electronics Ltd
N2 Qihang Industrial Park
Haoxiang Road
Sha Jing Town
Bao An
Shenzhen
PRC

For samples S18 and 7G0786S02:

Sunfone
21F-1
No.216 Section II
Tun-Hua South Road
Taipei 106
Taiwan

1.4 Apparatus Assessed

The following apparatus was assessed between 16/06/08 and 05/08/08:

Alertme Wireless Standard Hub 1-2

The above equipment was a wireless Alertme Standard Hub 1-2 with battery backup as part of an intelligent home security and monitoring service operating in the 2.4GHz band.

1.5 Test Result Summary

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

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

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

Test Type	Regulation	Measurement standard	Result
CFCP	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(b)(3)	ANSI C63.4: 2003	Pass
RF Antenna Port Conducted Spurious Emissions	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.247(d)	ANSI C63.4: 2003	Pass
REFE (Within the restricted band)	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.247(d) and 15.205	ANSI C63.4: 2003	Pass
PLCE	Title 47 of the CFR: 2008, Part 15 Subpart (c) 15.207	ANSI C63.4: 2003	Pass
6dB Bandwidth	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(a)(2)	ANSI C63.4: 2003	Pass
Antenna Gain	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(b)(4)	ANSI C63.4: 2003	Pass
Power Spectral Density	Title 47 of the CFR :2008, Part 15 Subpart (c) 15.247(e)	ANSI C63.4: 2003	Pass

Abbreviations used in the above table:

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

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

All results were recorded in accordance with Section 2.1(i).

Section 3:

Modifications

3.1 Modifications Performed During Assessment

No modifications were performed during the assessment

Appendix A:**Formal Emission Test Results**

Abbreviations used in the tables in this appendix:

Spec	: Specification	ALSR	: Absorber Lined Screened Room
Mod	: Modification	OATS	: Open Area Test Site
		ATS	: Alternative Test Site
EUT	: Equipment Under Test		
SE	: Support Equipment		
		Ref	: Reference
		Freq	: Frequency
L	: Live Power Line	MD	: Measurement Distance
N	: Neutral Power Line	SD	: Spec Distance
E	: Earth Power Line	Pol	: Polarisation
Pk	: Peak Detector	H	: Horizontal Polarisation
QP	: Quasi-Peak Detector	V	: Vertical Polarisation
Av	: Average Detector	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 : dc mode Internal Battery Backup	
Regulation	Title 47 of the CFR 2008, Part15 Subpart (c) 15.247(b)(3)
EUT sample number	S24
Modification state	0
SE in test environment	None
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)	Result
11	2405	0.00120	1	Pass
18	2440	0.00140		Pass
25	2475	0.00150		Pass

Note:

For battery-operated equipment, the test was performed using a new battery as required by 15.31(e).

Test Details: ac mode	
Regulation	Title 47 of the CFR 2008, Part15 Subpart (c) 15.247(b)(3)
EUT sample number	S18 & S24
Modification state	0
SE in test environment	None
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)	Result
11	2405	0.00130	1	Pass
18	2440	0.00140		Pass
25	2475	0.00150		Pass

Note:

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.

Nominal rated supply voltage (110Vac / 60Hz)

85% = 93.5Vac /60Hz

115% = 126.5Vac / 60Hz

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 CH11: dc mode Internal Battery Backup	
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	S24
Modification state	0
SE in test environment	None
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.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
1	0.009	Pk	N	14.78	87.79	Pass
2	0.150	Pk	N	40.56	87.79	Pass
3	0.5326	Pk	N	32.39	87.79	Pass
4	1.7286	Pk	N	28.91	87.79	Pass
5	26.173	Pk	N	24.81	87.79	Pass
6	90.480	Pk	N	45.23	87.79	Pass
7	91.298	Pk	N	45.78	87.79	Pass
8	119.903	Pk	Y	26.28	N/A	See Section A3
9	144.156	Pk	N	26.66	87.79	Pass
10	168.125	Pk	Y	25.87	N/A	See Section A3
11	179.567	Pk	N	24.50	87.79	Pass
12	192.099	Pk	N	28.93	87.79	Pass
13	199.727	Pk	N	24.34	87.79	Pass
14	925.641	Pk	N	26.30	87.79	Pass
15	2263.141	Pk	N	30.46	N/A	See Section A3
16	2285.576	Pk	N	36.16	N/A	See Section A3
16	2390.000	Pk	Y	40.46	N/A	See Section A3
17	2400.000	Pk	N	24.90	87.79	Pass
18	2483.500	Pk	Y	34.65	N/A	See Section A3
19	2524.814	Pk	N	39.38	87.79	Pass
20	2549.117	Pk	N	39.09	87.79	Pass
21	3351.112	Pk	Y	37.80	N/A	See Section A3
22	3589.281	Pk	N	37.15	87.79	Pass
23	3803.146	Pk	Y	35.45	N/A	See Section A3
24	4807.692	Pk	Y	76.72	N/A	See Section A3
25	7211.538	Pk	N	59.48	87.79	Pass
26	9625.000	Pk	N	40.02	87.79	Pass
27	13429.487	Pk	N	36.99	87.79	Pass
28	24673.076	Pk	N	41.00	87.79	Pass

RF Antenna Conducted Spurious Emissions continued:

Test Details CH18: dc mode Internal Battery Backup	
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	S24
Modification state	0
SE in test environment	None
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.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
1	0.009	Pk	N	13.79	88.46	Pass
2	0.150	Pk	N	37.5	88.46	Pass
3	0.58052	Pk	N	33.10	88.46	Pass
4	120.176	Pk	Y	24.90	N/A	See Section A3
5	144.150	Pk	N	25.38	88.46	Pass
6	168.125	Pk	Y	25.39	N/A	See Section A3
7	192.099	Pk	N	28.77	88.46	Pass
8	215.384	Pk	N	25.76	88.46	Pass
9	239.743	Pk	N	26.55	88.46	Pass
10	264.102	Pk	Y	25.61	N/A	See Section A3
11	888.461	Pk	N	27.29	88.46	Pass
12	2296.794	Pk	Y	33.79	N/A	See Section A3
13	2321.474	Pk	Y	36.12	N/A	See Section A3
14	2368.589	Pk	Y	34.17	N/A	See Section A3
15	2390.000	Pk	Y	30.58	N/A	See Section A3
16	2393.269	Pk	N	32.21	88.46	Pass
17	2400.000	Pk	N	41.93	88.46	Pass
18	2483.500	Pk	Y	32.86	N/A	See Section A3
19	2510.233	Pk	N	38.33	88.46	Pass
20	2534.536	Pk	N	35.69	88.46	Pass
21	2558.838	Pk	N	42.14	88.46	Pass
22	2583.141	Pk	N	38.67	88.46	Pass
23	3492.069	Pk	N	38.39	88.46	Pass
24	4875.000	Pk	Y	79.48	N/A	See Section A3
25	7326.923	Pk	Y	65.49	N/A	See Section A3
26	9769.230	Pk	N	39.69	88.46	Pass
27	14647.435	Pk	N	37.05	88.46	Pass
28	24519.230	Pk	N	40.97	88.46	Pass

RF Antenna Conducted Spurious Emissions continued:

Test Details CH25: dc mode Internal Battery Backup	
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	S24
Modification state	0
SE in test environment	None
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.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
1	0.009	Pk	N	14.5	88.76	Pass
2	0.0706	Pk	N	9.15	88.76	Pass
3	0.1226	Pk	N	7.77	88.76	Pass
4	0.150	Pk	N	37.61	88.76	Pass
5	2.7810	Pk	N	29.30	88.76	Pass
6	10.9610	Pk	N	27.76	88.76	Pass
7	14.0704	Pk	N	27.91	88.76	Pass
8	17.897	Pk	N	28.69	88.76	Pass
9	120.176	Pk	Y	25.59	N/A	See Section A3
10	144.150	Pk	N	25.97	88.76	Pass
11	168.125	Pk	Y	24.47	N/A	See Section A3
12	192.099	Pk	N	28.11	88.76	Pass
13	488.461	Pk	N	29.33	88.76	Pass
14	2332.692	Pk	Y	34.48	N/A	See Section A3
15	2357.371	Pk	Y	37.52	N/A	See Section A3
16	2390.000	Pk	Y	30.88	N/A	See Section A3
17	2400.000	Pk	N	30.22	88.76	Pass
18	2483.500	Pk	Y	51.74	N/A	See Section A3
19	2522.384	Pk	N	37.74	88.76	Pass
20	2546.687	Pk	N	37.85	88.76	Pass
21	2595.293	Pk	N	42.50	88.76	Pass
22	2617.165	Pk	N	37.85	88.76	Pass
23	2748.401	Pk	Y	37.08	N/A	See Section A3
24	4942.307	Pk	Y	79.15	N/A	See Section A3
25	7423.076	Pk	Y	64.74	N/A	See Section A3
26	9903.846	Pk	N	40.10	88.76	Pass
27	12371.794	Pk	Y	37.97	N/A	See Section A3
28	14855.769	Pk	N	36.97	88.76	Pass
29	244615.384	Pk	N	40.79	88.76	Pass

RF Antenna Conducted Spurious Emissions continued:

Test Details CH11: ac mode	
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	S18 & S24
Modification state	0
SE in test environment	None
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.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
1	0.0101	Pk	N	19.78	88.14	Pass
2	0.150	Pk	N	44.59	88.14	Pass
3	1.3937	Pk	N	34.31	88.14	Pass
4	3.4507	Pk	N	30.56	88.14	Pass
5	18.6149	Pk	N	31.25	88.14	Pass
6	90.480	Pk	N	40.95	88.14	Pass
7	91.298	Pk	N	40.52	88.14	Pass
8	192.099	Pk	N	30.33	88.14	Pass
9	888.461	Pk	N	31.47	88.14	Pass
10	901.282	Pk	N	32.01	88.14	Pass
11	2285.576	Pk	N	35.13	N/A	See Section A3
12	2390.000	Pk	Y	42.49	N/A	See Section A3
13	2400.000	Pk	N	60.38	88.14	Pass
14	2483.500	Pk	Y	48.42	N/A	See Section A3
15	2524.814	Pk	N	41.81	88.14	Pass
16	2549.117	Pk	N	39.16	88.14	Pass
17	4807.692	Pk	Y	75.59	N/A	See Section A3
18	7211.538	Pk	N	59.60	88.14	Pass
19	9625.000	Pk	N	36.62	88.14	Pass
20	14439.102	Pk	N	31.93	88.14	Pass
21	21663.461	Pk	N	34.02	88.14	Pass
22	24538.461	Pk	N	36.68	88.14	Pass

RF Antenna Conducted Spurious Emissions continued:

Test Details CH18: ac mode	
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	S18 & S24
Modification state	0
SE in test environment	None
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.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
1	0.009	Pk	N	21.36	88.46	Pass
2	0.150	Pk	N	43.45	88.46	Pass
3	1.8721	Pk	N	32.31	88.46	Pass
4	125.352	Pk	Y	40.54	N/A	See Section A3
5	126.442	Pk	Y	41.69	N/A	See Section A3
6	192.099	Pk	N	30.97	88.46	Pass
7	2321.474	Pk	Y	37.35	N/A	See Section A3
8	2390.000	Pk	Y	35.11	N/A	See Section A3
9	2400.000	Pk	N	34.07	88.46	Pass
10	2483.500	Pk	Y	34.77	N/A	See Section A3
11	2510.233	Pk	N	36.64	88.46	Pass
12	2558.838	Pk	N	40.59	88.46	Pass
13	2583.141	Pk	N	38.44	88.46	Pass
14	4875.000	Pk	Y	70.37	N/A	See Section A3
15	7326.923	Pk	Y	64.76	N/A	See Section A3
16	14647.435	Pk	N	33.85	88.46	Pass
17	24750.000	Pk	N	35.10	88.46	Pass

RF Antenna Conducted Spurious Emissions continued:

Test Details CH25: ac mode	
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	S18 & S24
Modification state	0
SE in test environment	None
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.	Is measured Frequency within the Restricted bands (Y/N)	Measured Peak Conducted power (RBW =100kHz) (dBuV)	15.247(d) Limit (dBuV)	Summary
1	0.009451	Pk	N	21.36	88.76	Pass
2	0.150	Pk	N	44.56	88.76	Pass
3	160.496	Pk	N	39.60	88.76	Pass
4	161.586	Pk	N	40.36	88.76	Pass
5	192.099	Pk	N	30.60	88.76	Pass
6	841.025	Pk	N	31.27	88.76	Pass
7	2357.371	Pk	Y	36.33	N/A	See Section A3
8	2390.000	Pk	Y	30.99	N/A	See Section A3
9	2400.000	Pk	N	31.74	88.76	Pass
10	2483.500	Pk	Y	49.25	N/A	See Section A3
11	2595.293	Pk	N	41.39	88.76	Pass
12	4945.843	Pk	Y	78.27	N/A	See Section A3
13	7424.510	Pk	Y	67.74	N/A	See Section A3
14	14855.769	Pk	N	34.99	88.76	Pass
15	24528.846	Pk	N	35.72	88.76	Pass

Notes:

1. The conducted emission limit for emissions outside the restricted bands, defined in 47CFR15.205(a) is based on a transmitted carrier level of 15.247(b)(3). 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 2400 MHz and 2483.5 MHz were made to ensure band edge compliance.

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

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

Where:

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

dc mode Internal Battery Backup					
Channel No.	Channel Frequency (MHz)	Measured Peak Conducted Carrier Power (W)	Measured Peak Conducted Carrier (dB μ V)	Measured Peak Conducted Carrier – 20dB (dB μ V)	Emission Limit 15.247(d) Outside the restricted band in 100 kHz RBW (dB μ V)
11	2405	0.00120	107.7918	107.7918-20	87.79
18	2440	0.00140	108.4613	108.4613-20	88.46
25	2475	0.00150	108.7609	108.7609-20	88.76

ac mode Limit					
Channel No.	Channel Frequency (MHz)	Measured Peak Conducted Carrier Power (W)	Measured Peak Conducted Carrier (dB μ V)	Measured Peak Conducted Carrier – 20dB (dB μ V)	Emission Limit 15.247(d) Outside the restricted band in 100 kHz RBW (dB μ V)
11	2405	0.00130	108.1394	108.1394-20	88.14
18	2440	0.00140	108.4613	108.4613-20	88.46
25	2475	0.00150	108.7609	108.7609-20	88.76

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 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 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 CH11: dc mode Internal Battery Backup	
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 25GHz
EUT sample number	S23
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)	Det.	Angle. Deg.	Height (cm)	Pol.	Result (dB μ V/m)	Spec. Limit (dB μ V/m)	Margin (dB)	Summary
1	119.903	QP	0	100	H	10.0	54	-44.0	Pass
2	119.903	Pk	0	100	H	15.5	74	-58.5	Pass
3	168.125	QP	0	100	H	9.7	54	-44.3	Pass
4	168.125	Pk	0	100	H	14.3	74	-59.7	Pass
5	2263.141	Pk	0	100	V	40.3	74	-33.7	Pass
6	2263.141	Av	0	100	V	27.9	54	-26.1	Pass
7	2285.576	Pk	0	100	V	39.6	74	-34.4	Pass
8	2285.576	Av	0	100	V	27.9	54	-26.1	Pass
9	2390.000	Pk	0	100	V	41.5	74	-32.5	Pass
10	2390.000	Av	0	100	V	29.0	54	-25.0	Pass
11	2400.000	Pk	80	108	V	54.7	74	-19.3	Pass
12	2400.000	Av	80	108	V	46.6	54	-7.4	Pass
13	2483.500	Pk	0	100	V	39.4	74	-34.6	Pass
14	2483.500	Av	0	100	V	29.3	54	-24.7	Pass
15	3351.112	Pk	310	100	V	44.0	74	-30.0	Pass
16	3351.112	Av	310	100	V	32.2	54	-21.8	Pass
17	3803.146	Pk	0	100	V	44.7	74	-29.3	Pass
18	3803.146	Av	0	100	V	34.6	54	-19.4	Pass
19	4807.692	Pk	174	100	V	69.4	74	-4.6	Pass
20	4807.692	Av	174	100	V	61.0	54	7.0	Pass (Note 7)

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 CH18: dc mode Internal Battery Backup	
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 25GHz
EUT sample number	S23
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)	Det.	Angle. Deg.	Height (cm)	Pol.	Result (dB μ V/m)	Spec. Limit (dB μ V/m)	Margin (dB)	Summary
1	120.176	QP	0	100	H	9.9	54	-44.1	Pass
2	120.176	Pk	0	100	H	15.8	74	-58.2	Pass
3	168.125	QP	0	100	H	8.9	54	-45.1	Pass
4	168.125	Pk	0	100	H	13.8	74	-60.2	Pass
5	264.102	QP	0	100	H	12.9	54	-41.1	Pass
6	264.102	Pk	0	100	H	17.7	74	-56.3	Pass
7	2296.794	Pk	0	100	V	37.3	74	-36.7	Pass
8	2296.794	Av	0	100	V	28.0	54	-26.0	Pass
9	2321.474	Pk	0	100	V	37.8	74	-36.2	Pass
10	2321.474	Av	0	100	V	27.8	54	-26.2	Pass
11	2368.589	Pk	0	100	V	38.3	74	-35.7	Pass
12	2368.589	Av	0	100	V	27.9	54	-26.1	Pass
13	2390.000	Pk	0	100	V	38.6	74	-35.4	Pass
14	2390.000	Av	0	100	V	27.9	54	-26.1	Pass
15	2400.000	Pk	0	100	V	40.1	74	-33.9	Pass
16	2400.000	Av	0	100	V	27.7	54	-26.3	Pass
17	2483.500	Pk	0	100	V	39.8	74	-34.2	Pass
18	2483.500	Av	0	100	V	28.6	54	-25.4	Pass
19	4875.000	Pk	229	100	H	60.0	74	-14.0	Pass
20	4875.000	Av	229	100	H	50.7	54	-3.3	Pass
21	7326.923	Pk	64	118	H	55.3	74	-18.7	Pass
22	7326.923	Av	64	118	H	44.8	54	-9.2	Pass

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 CH25: dc mode Internal Battery Backup	
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 25GHz
EUT sample number	S23
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)	Det.	Angle. Deg.	Height (cm)	Pol.	Result (dB μ V/m)	Spec. Limit (dB μ V/m)	Margin (dB)	Summary
1	120.176	QP	0	100	H	11.5	54	-42.5	Pass
2	120.176	Pk	0	100	H	17.1	74	-56.9	Pass
3	168.125	QP	0	100	H	8.9	54	-45.1	Pass
4	168.125	Pk	0	100	H	13.9	74	-60.1	Pass
5	2332.692	Pk	0	100	V	39.1	74	-34.9	Pass
6	2332.692	Av	0	100	V	27.8	54	-26.2	Pass
7	2357.371	Pk	0	100	V	39.0	74	-35.0	Pass
8	2357.371	Av	0	100	V	28.0	54	-26.0	Pass
9	2390.000	Pk	0	100	V	38.1	74	-35.9	Pass
10	2390.000	Av	0	100	V	28.0	54	-26.0	Pass
11	2400.000	Pk	228	103	V	39.9	74	-34.1	Pass
12	2400.000	Av	228	103	V	27.8	54	-26.2	Pass
13	2483.500	Pk	228	103	V	53.4	74	-20.6	Pass
14	2483.500	Av	228	103	V	42.2	54	-11.8	Pass
15	2748.401	Pk	300	100	H	42.0	74	-32.0	Pass
16	2748.401	Av	300	100	H	28.9	54	-25.1	Pass
17	4942.307	Pk	235	113	H	56.0	74	-18.0	Pass
18	4942.307	Av	235	113	H	46.4	54	-7.6	Pass
19	7423.076	Pk	69	115	H	54.5	74	-19.5	Pass
20	7423.076	Av	69	115	H	44.2	54	-9.8	Pass
21	12371.794	Pk	0	100	H	45.0	74	-29.0	Pass
22	12371.794	Av	0	100	H	35.2	54	-18.8	Pass

Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:

Test Details CH11: ac mode	
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 25GHz
EUT sample number	S18 & S23
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)	Det.	Angle. Deg.	Height (cm)	Pol.	Result (dB μ V/m)	Spec. Limit (dB μ V/m)	Margin (dB)	Summary
1	2285.576	Pk	0	100	V	48.3	74	-25.7	Pass
2	2285.576	Av	0	100	V	35.1	54	-18.9	Pass
3	2390.000	Pk	0	100	V	51.5	74	-22.5	Pass
4	2390.000	Av	0	100	V	40.0	54	-14.0	Pass
5	2400.000	Pk	0	100	V	52.7	74	-21.3	Pass
6	2400.000	Av	0	100	V	43.1	54	-10.9	Pass
7	2483.500	Pk	0	100	V	49.3	74	-24.7	Pass
8	2483.500	Av	0	100	V	35.7	54	-18.3	Pass
9	4807.692	Pk	217	110	V	68.3	74	-5.7	Pass
10	4807.692	Av	217	110	V	61.6	54	7.6	Pass (Note 7)

Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:

Test Details CH18 ac mode	
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 25GHz
EUT sample number	S18 & S23
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)	Det.	Angle. Deg.	Height (cm)	Pol.	Result (dB μ V/m)	Spec. Limit (dB μ V/m)	Margin (dB)	Summary
1	125.352	QP	0	100	H	9.6	54	-44.4	Pass
2	125.352	Pk	0	100	H	15.7	74	-58.3	Pass
3	126.442	QP	0	100	H	9.8	54	-44.2	Pass
4	126.442	Pk	0	100	H	15.3	74	-58.7	Pass
5	2321.474	Pk	0	100	V	49.5	74	-24.5	Pass
6	2321.474	Av	0	100	V	35.2	54	-18.8	Pass
7	2390.000	Pk	0	100	V	48.6	74	-25.4	Pass
8	2390.000	Av	0	100	V	35.3	54	-18.7	Pass
9	2400.000	Pk	0	100	V	50.5	74	-23.5	Pass
10	2400.000	Av	0	100	V	35.7	54	-18.3	Pass
11	2483.500	Pk	83	100	V	50.3	74	-23.7	Pass
12	2483.500	Av	83	100	V	35.7	54	-18.3	Pass
13	4875.000	Pk	229	104	V	67.3	74	-6.7	Pass
14	4875.000	Av	229	104	V	60.4	54	6.4	Pass (Note 7)
15	7326.923	Pk	0	100	V	56.6	74	-17.4	Pass
16	7326.923	Av	0	100	V	43.5	54	-10.5	Pass

Radiated Electric Field Emissions Within The Restricted Band 15.205 continued:

Test Details CH25 ac mode	
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 25GHz
EUT sample number	S18 & S23
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)	Det.	Angle. Deg.	Height (cm)	Pol.	Result (dB μ V/m)	Spec. Limit (dB μ V/m)	Margin (dB)	Summary
1	2357.371	Pk	0	100	V	48.8	74	-25.2	Pass
2	2357.371	Av	0	100	V	35.2	54	-18.8	Pass
3	2390.000	Pk	233	100	V	49.7	74	-24.3	Pass
4	2390.000	Av	233	100	V	36.1	54	-17.9	Pass
5	2400.000	Pk	0	100	V	52.1	74	-21.9	Pass
6	2400.000	Av	0	100	V	37.4	54	-16.6	Pass
7	2483.500	Pk	192	100	V	53.9	74	-20.1	Pass
8	2483.500	Av	192	100	V	41.7	54	-12.3	Pass
9	4945.843	Pk	235	112	V	64.7	74	-9.3	Pass
10	4945.843	Av	235	112	V	57.3	54	3.3	Pass (Note 7)
11	7424.510	Pk	0	100	V	56.0	74	-18	Pass
12	7424.510	Av	0	100	V	44.5	54	-9.5	Pass

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 are as per ANSI C63.4.

- 7 In accordance with 47CFR 15.35(c) the emissions may be reduced by the duty cycle correction factor. The duty cycle factor was determined by the on-time of the transmitter/100 milliseconds or period, whichever is less See Appendix E for further details.

The upper frequency of the measurement range was decided according to 47 CFR 15:2008 Clause 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 μ V/m	Measurement Distance m	Field strength $\text{dB}\mu\text{V}/\text{m}$
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:

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

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 ac Power Line Conducted Emissions

Preview ac power line port 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) below.

Where applicable formal measurements of the emissions were performed with a peak, average and/or quasi peak detector. The formal measurements are detailed below:

Test Details: ac live Zigbee-network mode	
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	7G0786S01 and 7G0786S02
Modification state	0
SE in test environment	None
SE isolated from EUT	7G0786S16
EUT set up	Refer to Appendix C
Photographs	Photograph 3

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

Results measured using the average detector compared to the average limit

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.243	Live	38.2	52.0	-13.8	Pass
2	0.302	Live	40.3	50.2	-9.9	Pass
3	0.364	Live	40.3	48.6	-8.3	Pass
4	0.424	Live	42.9	47.4	-4.5	Pass
5	0.84	Live	41.9	46.3	-4.4	Pass
6	0.545	Live	34.7	46.0	-11.3	Pass
7	0.606	Live	37.7	46.0	-8.3	Pass
8	0.667	Live	38.1	46.0	-7.9	Pass
9	0.727	Live	35.2	46.0	-10.8	Pass
10	0.243	Neutral	39.0	52.0	-13.0	Pass
11	0.302	Neutral	42.5	50.2	-7.7	Pass
12	0.364	Neutral	41.8	48.6	-6.8	Pass
13	0.424	Neutral	43.4	47.4	-4.0	Pass
14	0.84	Neutral	42.1	46.3	-4.2	Pass
15	0.545	Neutral	33.1	46.0	-12.9	Pass
16	0.606	Neutral	38.2	46.0	-7.8	Pass
17	0.667	Neutral	38.0	46.0	-8.0	Pass
18	0.727	Neutral	35.0	46.0	-11.0	Pass

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

Ref No.	Freq (MHz)	Conductor	Result (dBuV)	Spec Limit (dBuV)	Margin (dB)	Result Summary
1	0.243	Live	48.0	62.0	-14.0	Pass
2	0.302	Live	49.4	60.2	-10.8	Pass
3	0.364	Live	49.5	58.6	-9.1	Pass
4	0.424	Live	50.6	57.4	-6.8	Pass
5	0.84	Live	49.0	56.3	-7.3	Pass
6	0.545	Live	44.9	56.0	-11.1	Pass
7	0.606	Live	44.7	56.0	-11.3	Pass
8	0.667	Live	46.1	56.0	-9.9	Pass
9	0.727	Live	41.7	56.0	-14.3	Pass
10	0.243	Neutral	50.5	62.0	-11.5	Pass
11	0.302	Neutral	52.3	60.2	-7.9	Pass
12	0.364	Neutral	51.8	58.6	-6.8	Pass
13	0.424	Neutral	53.3	57.4	-4.1	Pass
14	0.84	Neutral	50.9	56.3	-5.4	Pass
15	0.545	Neutral	45.4	56.0	-10.6	Pass
16	0.606	Neutral	46.9	56.0	-9.1	Pass
17	0.667	Neutral	46.4	56.0	-9.6	Pass
18	0.727	Neutral	42.2	56.0	-13.8	Pass

Specification limits :

ac power port conducted emission limits (47 CFR 15:2008 Clause 15.207):

Conducted disturbance at the ac power line ports .

Frequency range MHz	Limits dB μ V	
	Quasi-peak	Average
0.15 to 0.5	66 to 56	56 to 46
0.5 to 5	56	46
5 to 30	60	50

Notes:

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

Notes:

- (a) The levels may have been rounded for display purposes.
- (b) The following table summarises the effect of the EUT operating mode and internal configuration on the measured emission levels :

	See (i)	See (ii)	See (iii)	See (iv)
Effect of EUT operating mode on emission levels		✓		
Effect of EUT internal configuration on emission levels		✓		
(i) Parameter defined by standard and / or single possible, refer to Appendix C (ii) Parameter defined by client and / or single possible, refer to Appendix C (iii) Parameter had a negligible effect on emission levels, refer to Appendix C (iv) Worst case determined by initial measurement, refer to Appendix C				

A5 6 dB Bandwidth

Measurement of the bandwidth of the transmission between the -6 dB points on the transmitted modulated spectrum was verified using a spectrum analyser. To determine the occupied bandwidth a RBW of 100 kHz and a minimum VBW three times greater than the RBW (1 MHz) was used. The spectrum analyser was then set to take a peak hold measurement. The peak level was found and set to a 0dB reference point and markers offset by -6dB determined the bandwidth. The EUT was set to transmit on its lowest, centre and highest carrier frequency in turn. The formal measurements are detailed below:

Test Details: dc mode Internal Battery Backup	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) 15.247(a)(2)
EUT sample number	S24
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Channel No.	Channel Frequency (MHz)	Measured 6 dB Bandwidth (MHz)	Limit	Result
11	2405	1.482	>500 kHz	Pass
18	2440	1.538		Pass
25	2475	1.458		Pass

Test Details: ac mode	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) 15.247(a)(2)
EUT sample number	S18 & S24
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Channel No.	Channel Frequency (MHz)	Measured 6 dB Bandwidth (MHz)	Limit	Result
11	2405	1.570	>500 kHz	Pass
18	2440	1.450		Pass
25	2475	1.378		Pass

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

A6 Antenna Gain

The maximum antenna gain for the antenna types to be used with the EUT, as declared by the client, is 1 dBi.

A7 Power Spectral Density

Power spectral density was verified using a spectrum analyser. Testing was performed with the EUT transmitting a modulated carrier on its lowest, centre and highest carrier frequency in turn.

Test Details: dc mode Internal Battery Backup	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) 15.247(e)
EUT sample number	S24
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

Channel No	Channel Frequency (MHz)	Measured power Spectral density (dBm/3kHz)	Limit (dBm/3kHz)	Result
11	2405	-14.48	8.0	Pass
18	2440	-14.09		Pass
25	2475	-13.99		Pass

Test Details: ac mode	
Regulation	Title 47 of the CFR 2008, Part 15 Subpart (c) 15.247(e)
EUT sample number	S18 & S24
Modification state	0
SE in test environment	None
SE isolated from EUT	None
EUT set up	Refer to Appendix C

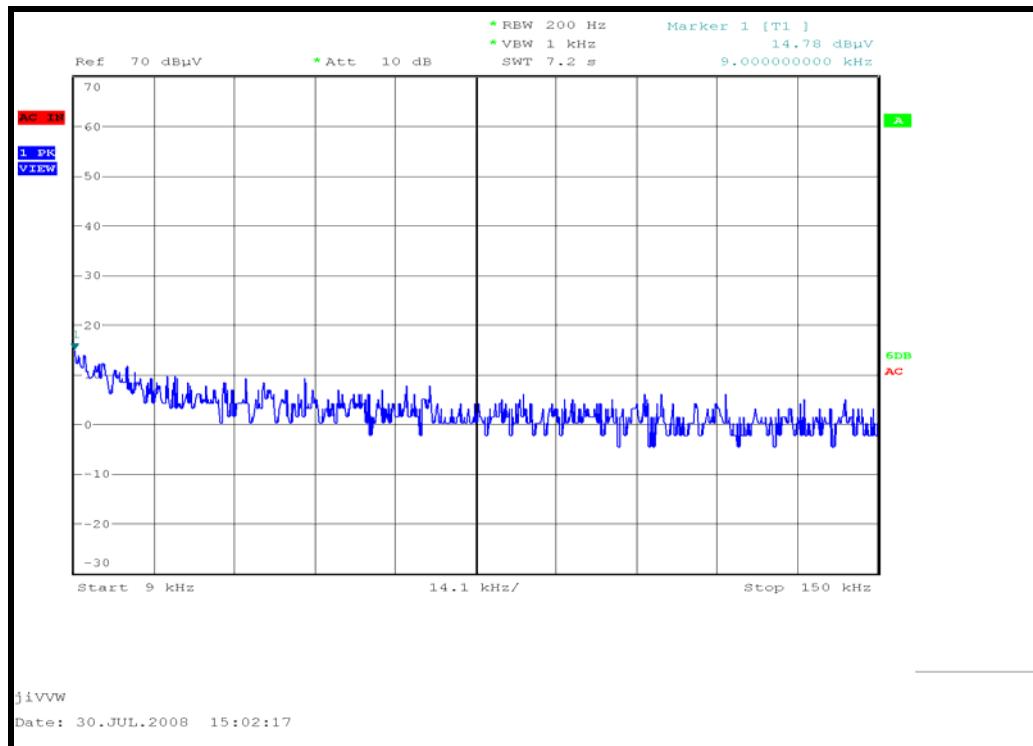
Channel No	Channel Frequency (MHz)	Measured power Spectral density (dBm/3kHz)	Limit (dBm/3kHz)	Result
11	2405	-14.76	8.0	Pass
18	2440	-14.03		Pass
25	2475	-14.05		Pass

Appendix B:**Supporting Graphical Data**

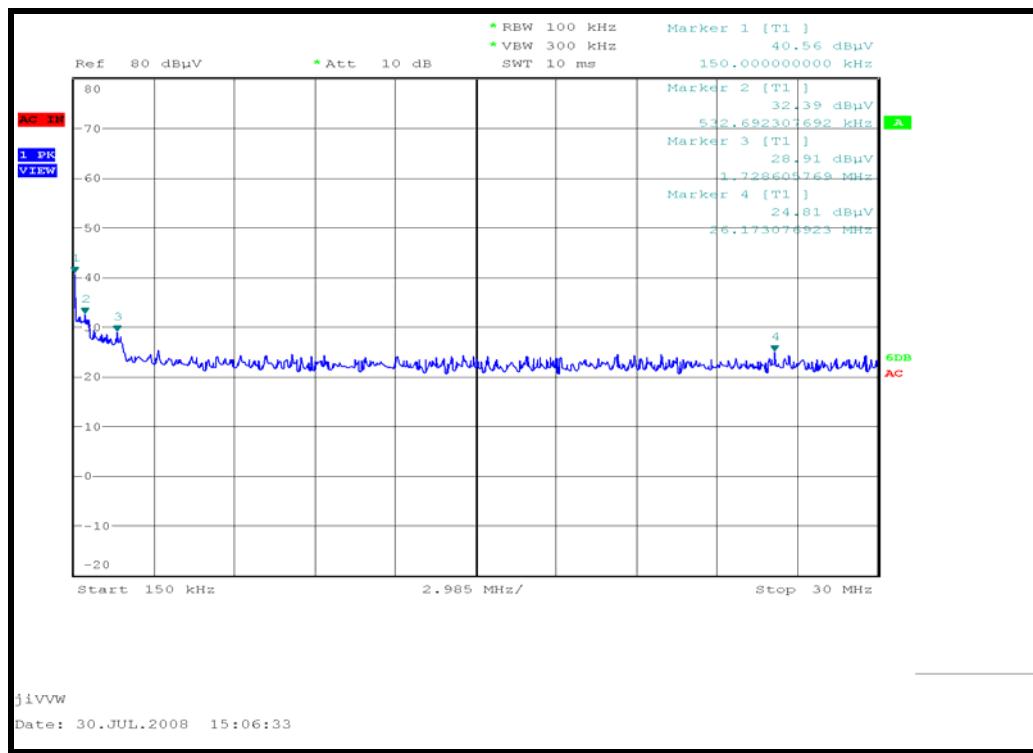
This appendix contains graphical data obtained during testing.

Notes:

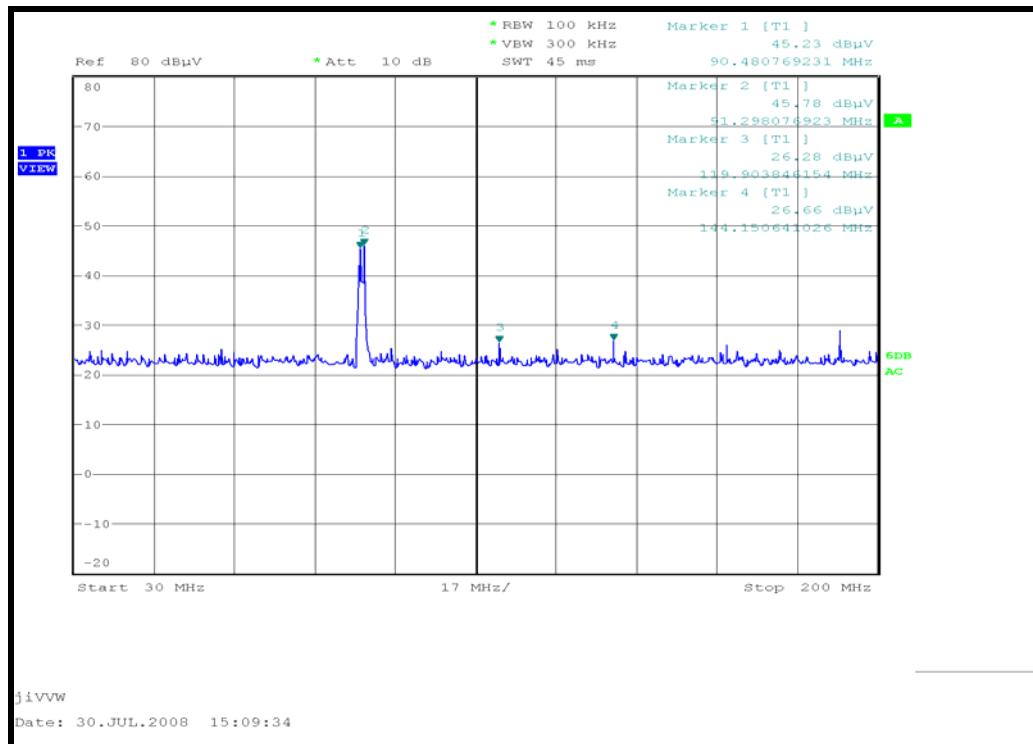
- (a) The conducted antenna port emissions graphical data in this appendix is preview data. Any emissions detected within the restricted band were formally assessed against the limits in 15.209. For details of formal results, refer to Appendix A and Appendix B.
- (b) The time and date on the plots do 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.
- (f) The power line conducted emissions graphical data in this appendix is preview data. For details of formal results, refer to Appendix A.
- (g) The limit line on the conducted emissions plots is the EN55022:1994 Class B limit. This is identical to the 47 CFR Part 15(c) section 15.207:2008 limit.



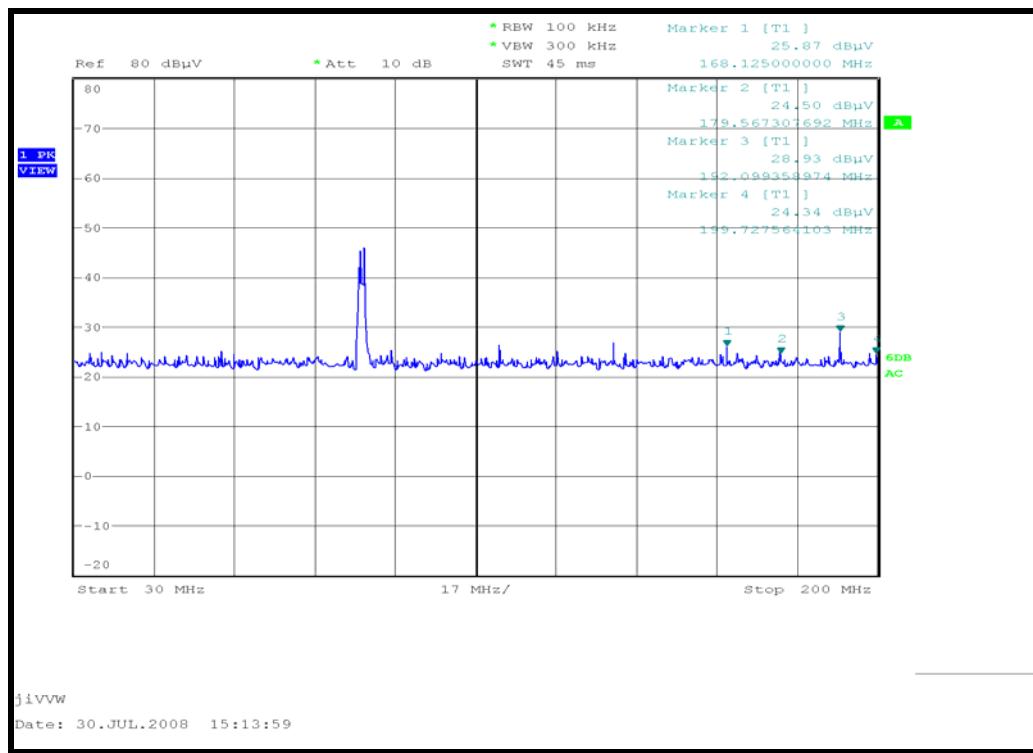
Conducted emissions: Channel 11 dc mode



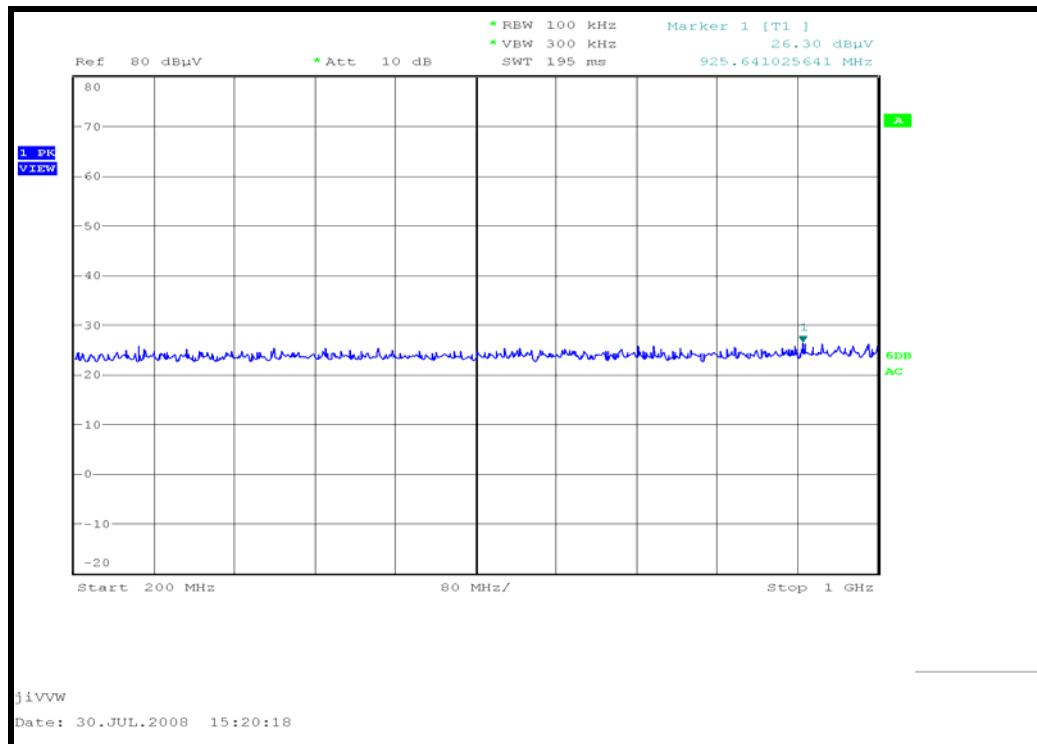
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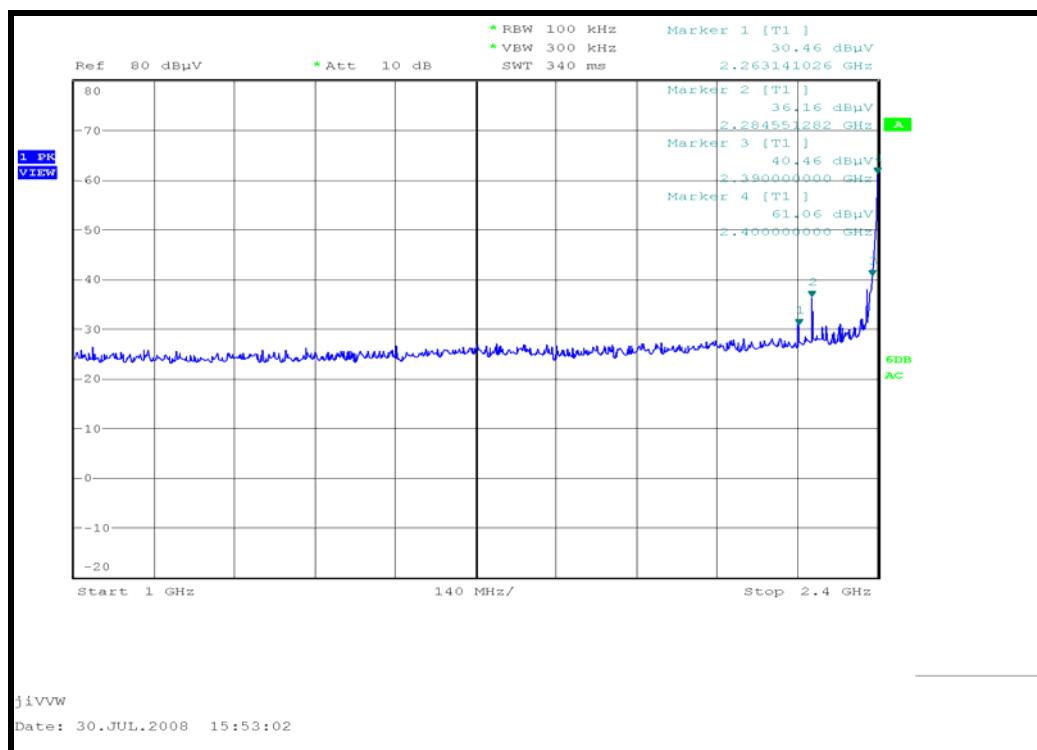
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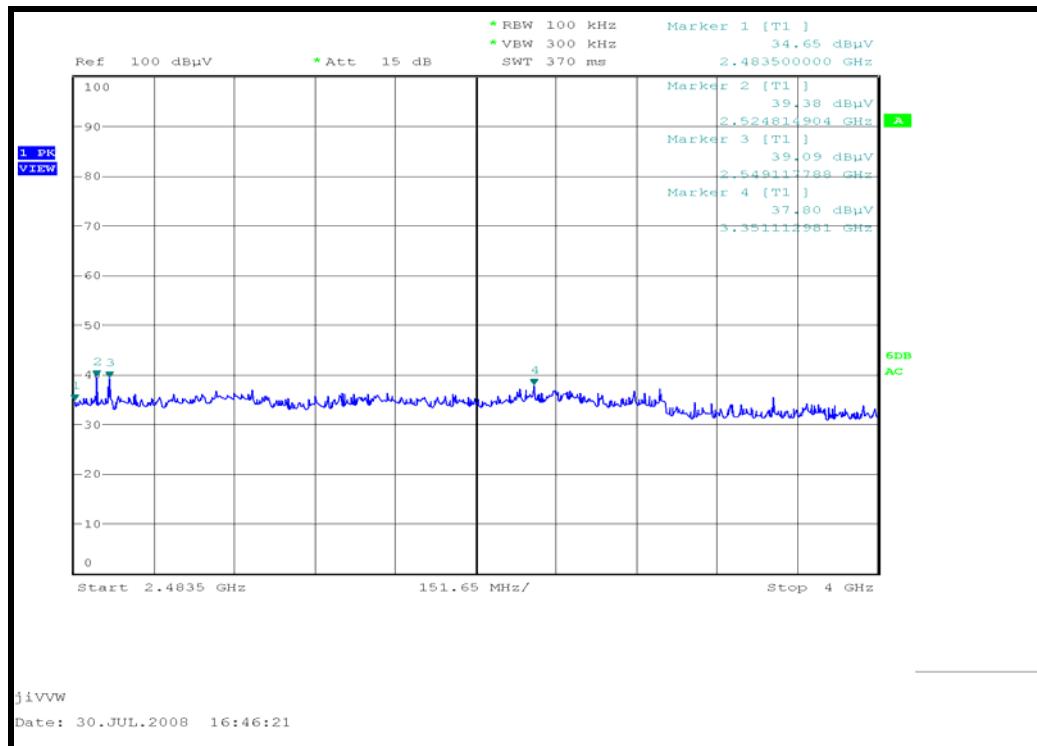
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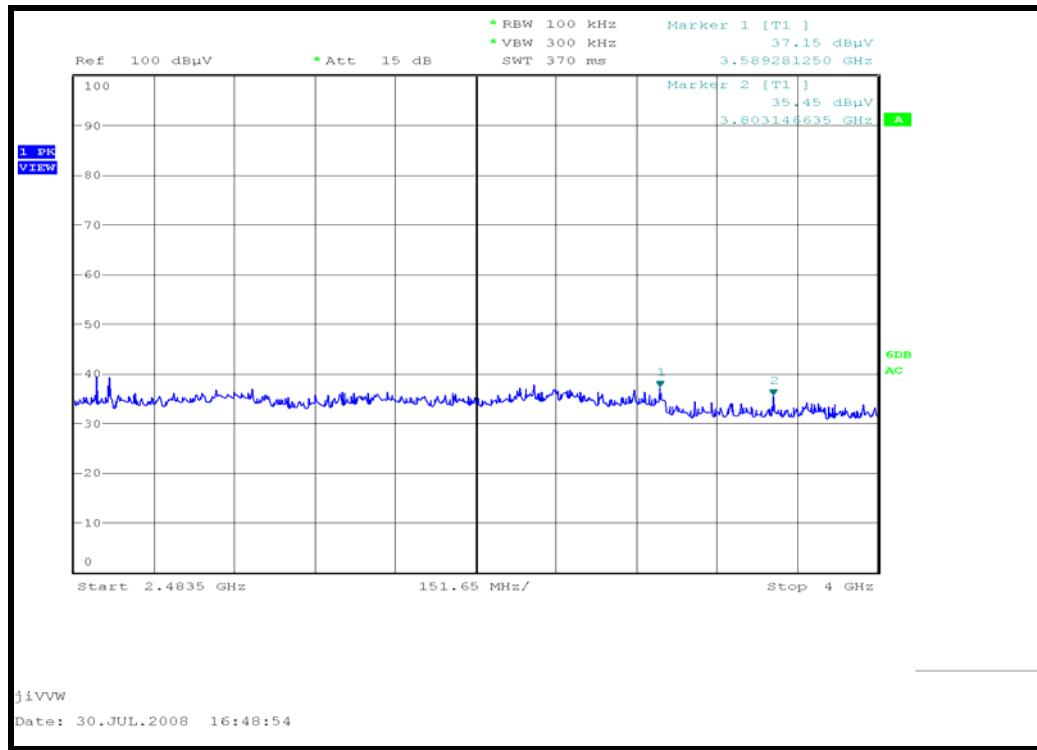
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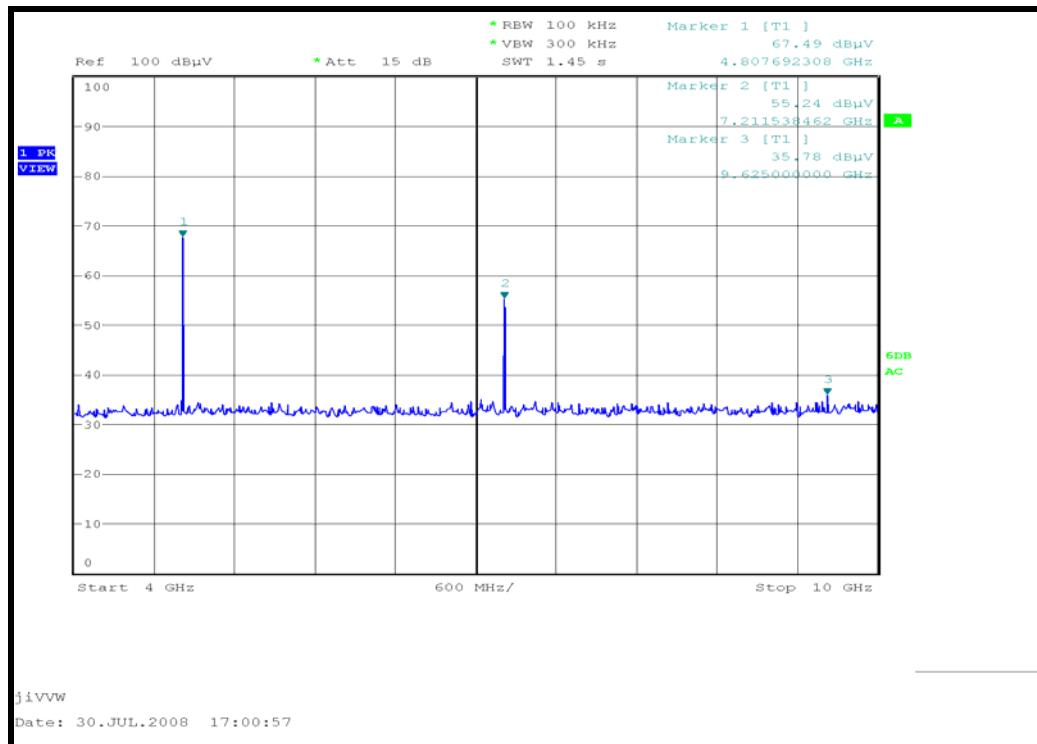
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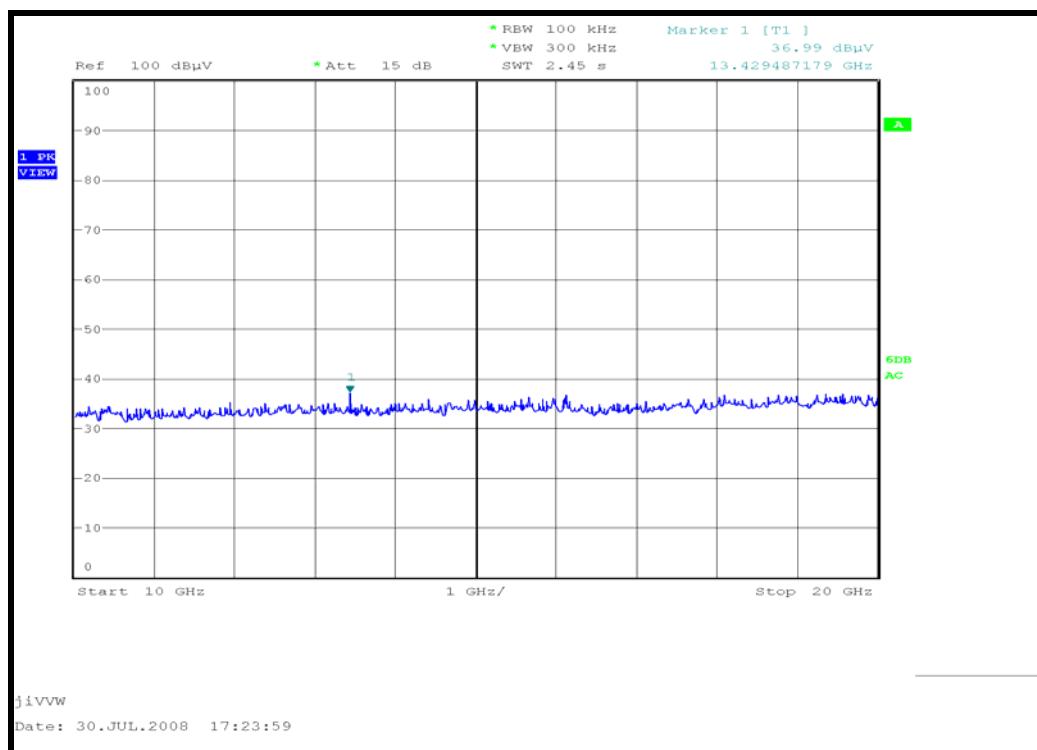
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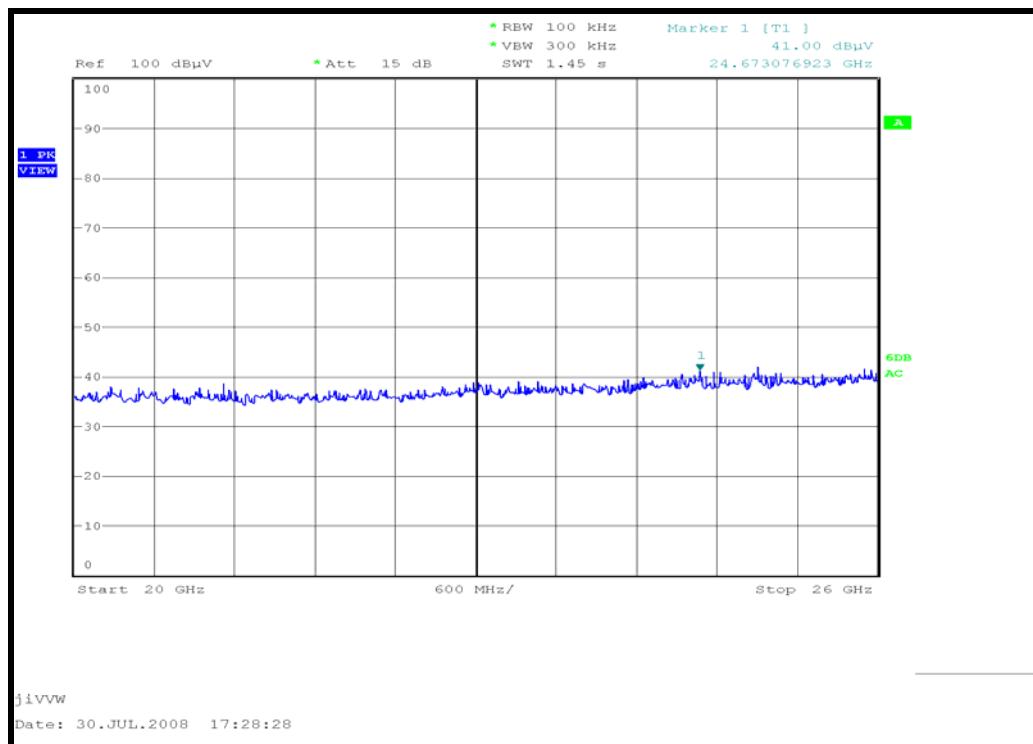
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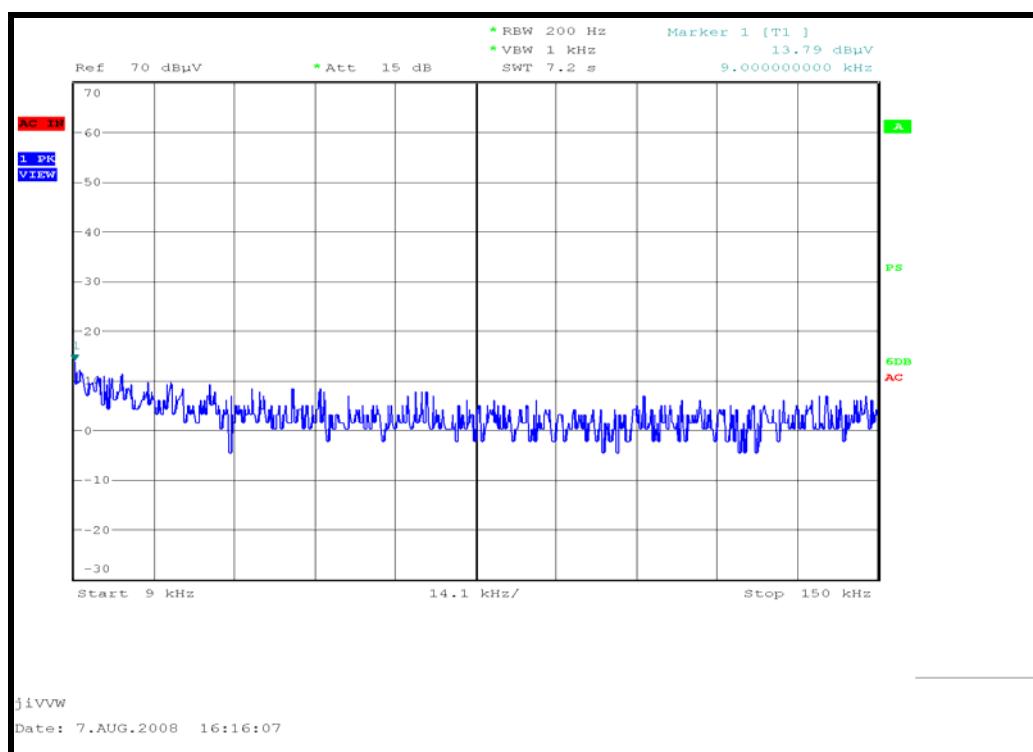
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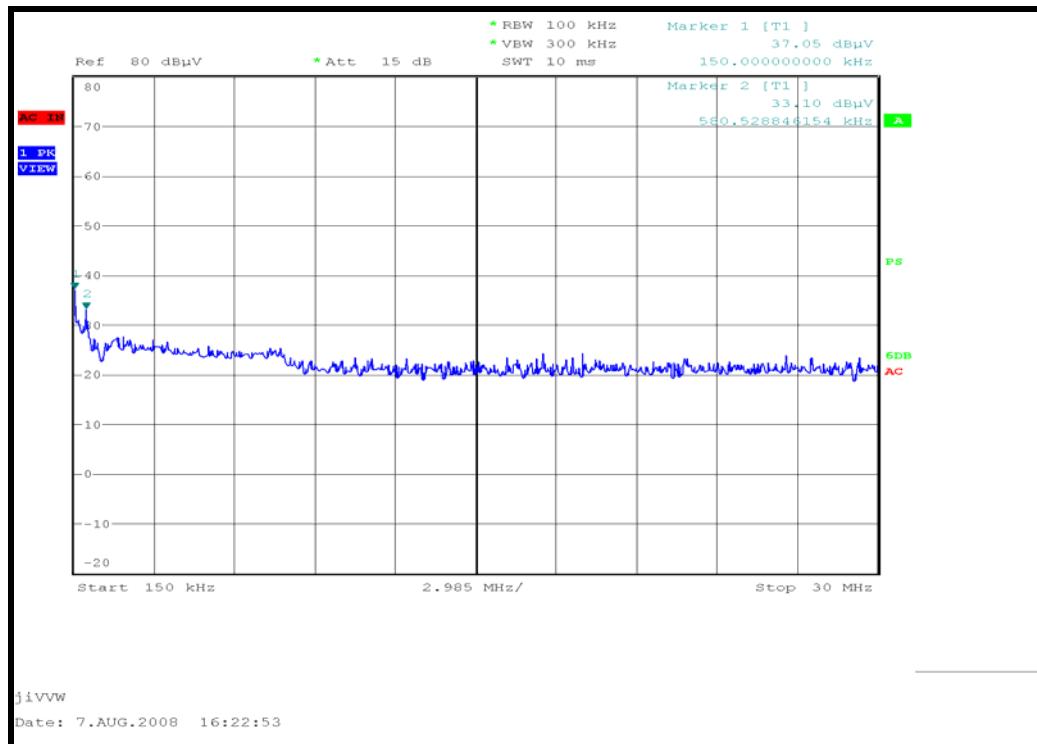
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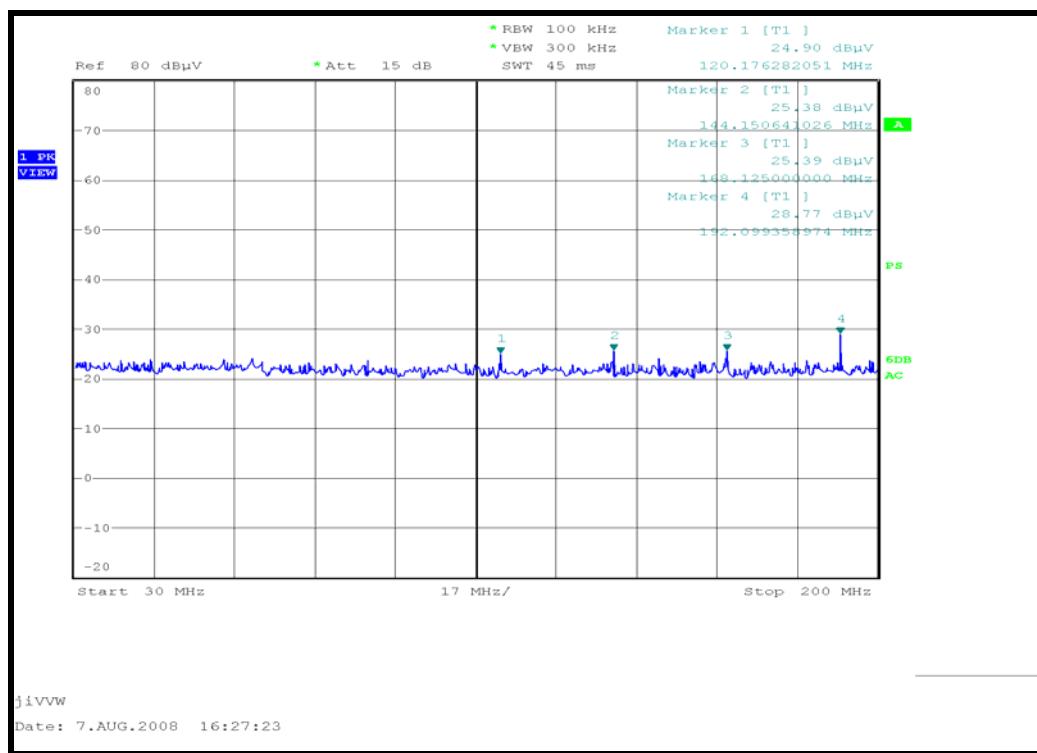
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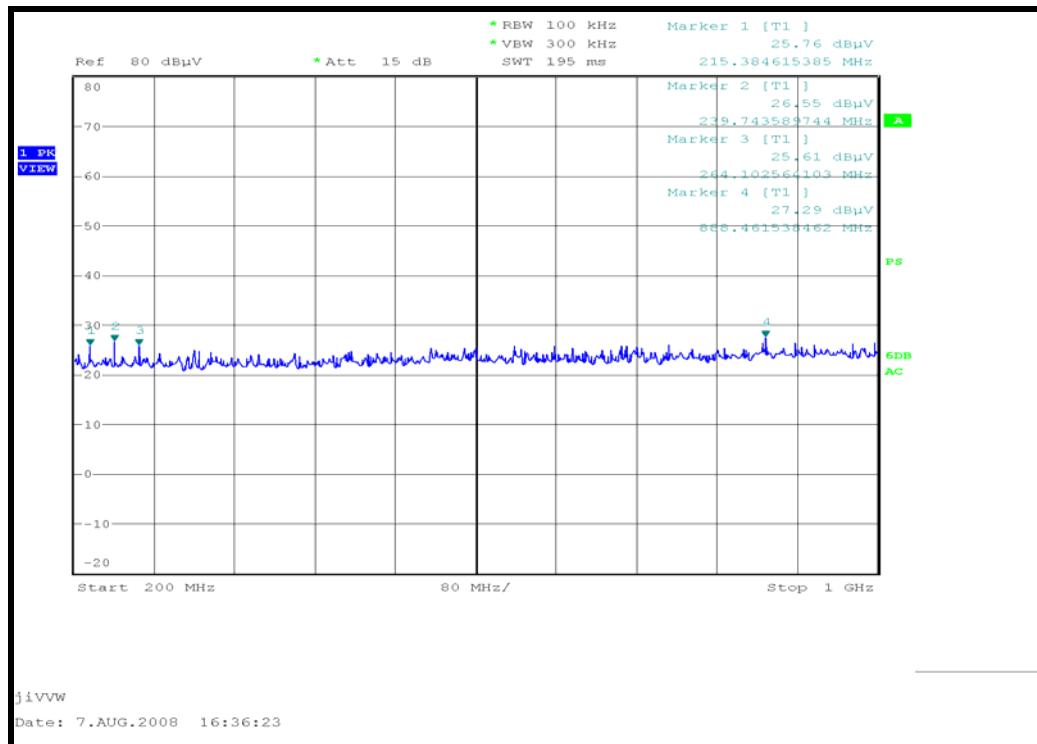
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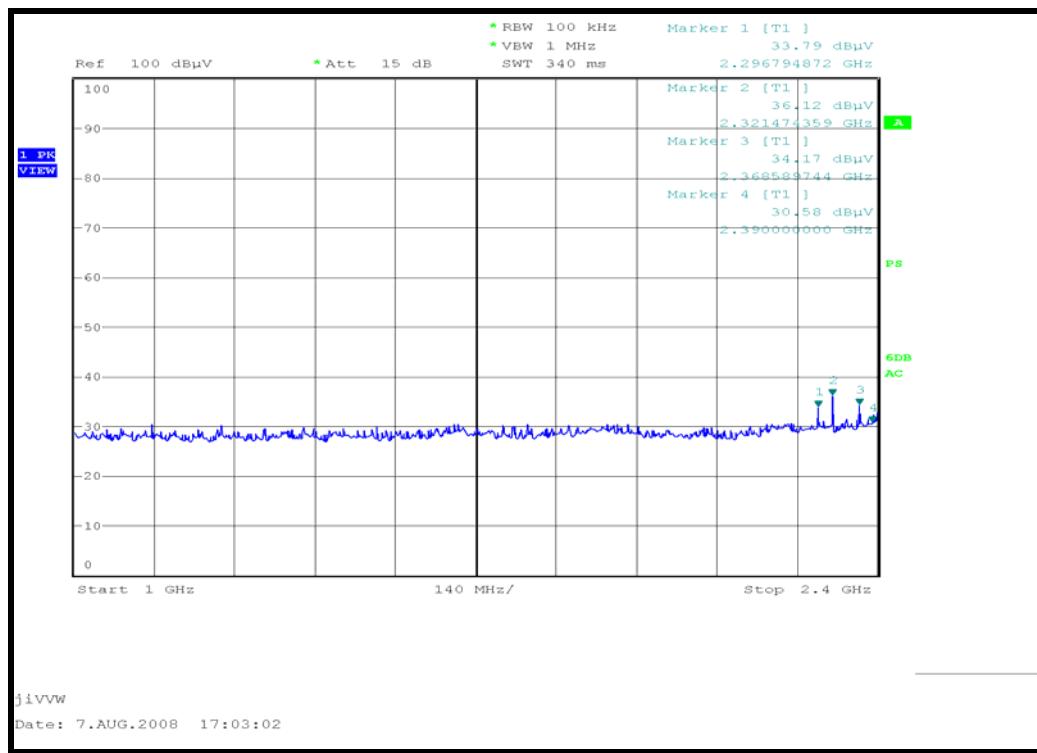
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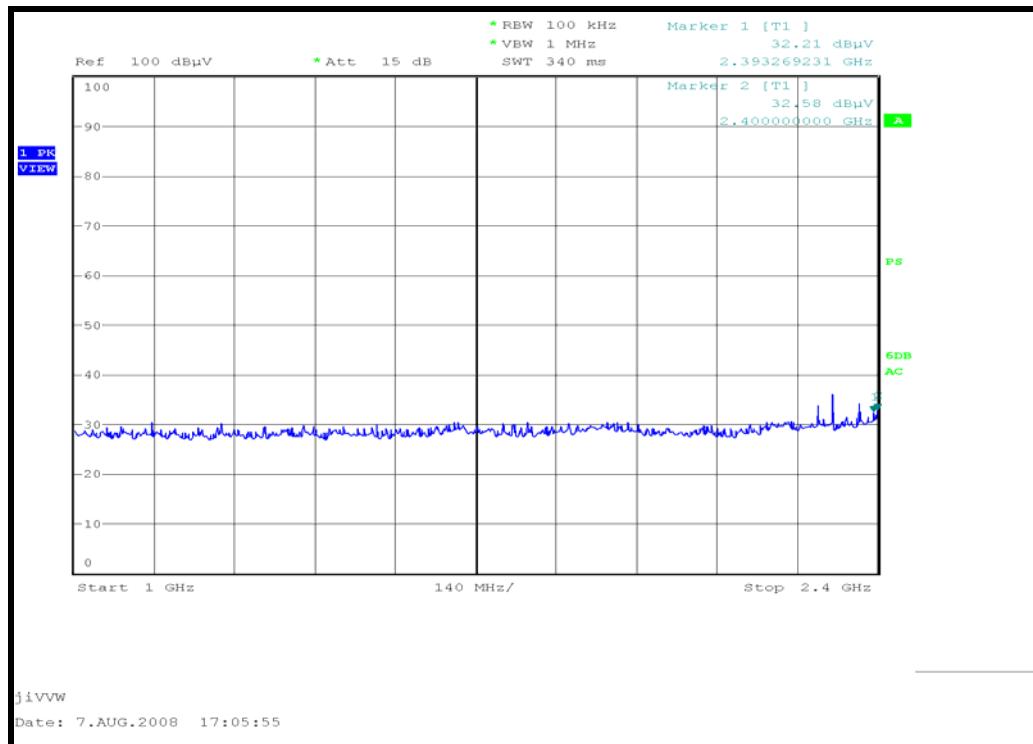
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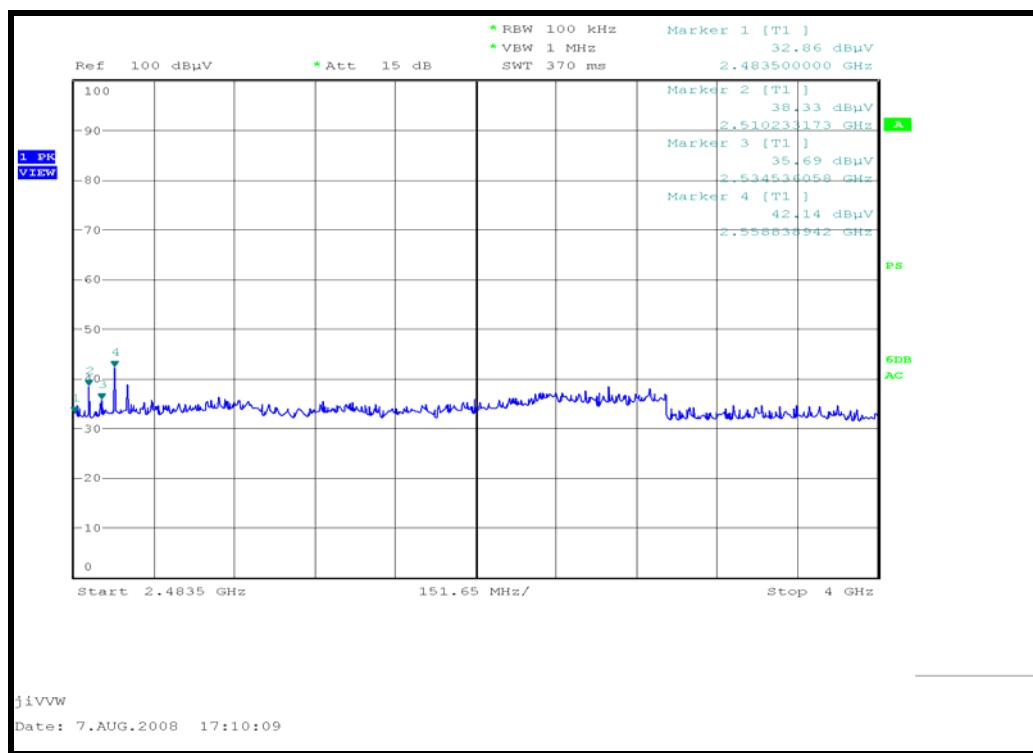
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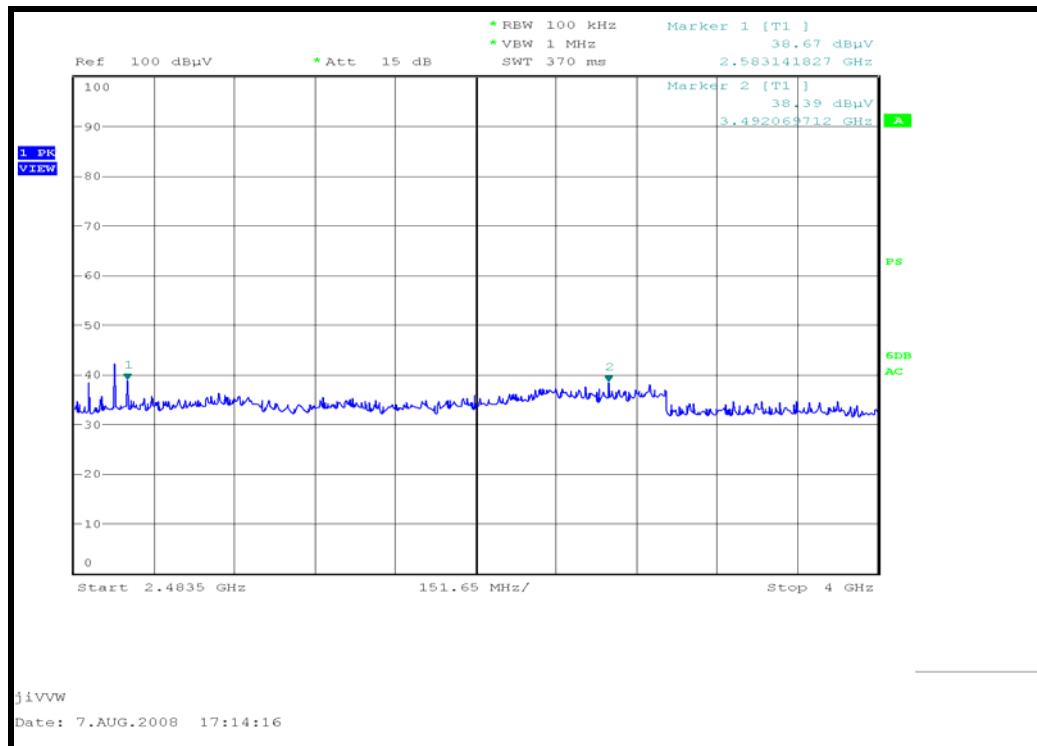
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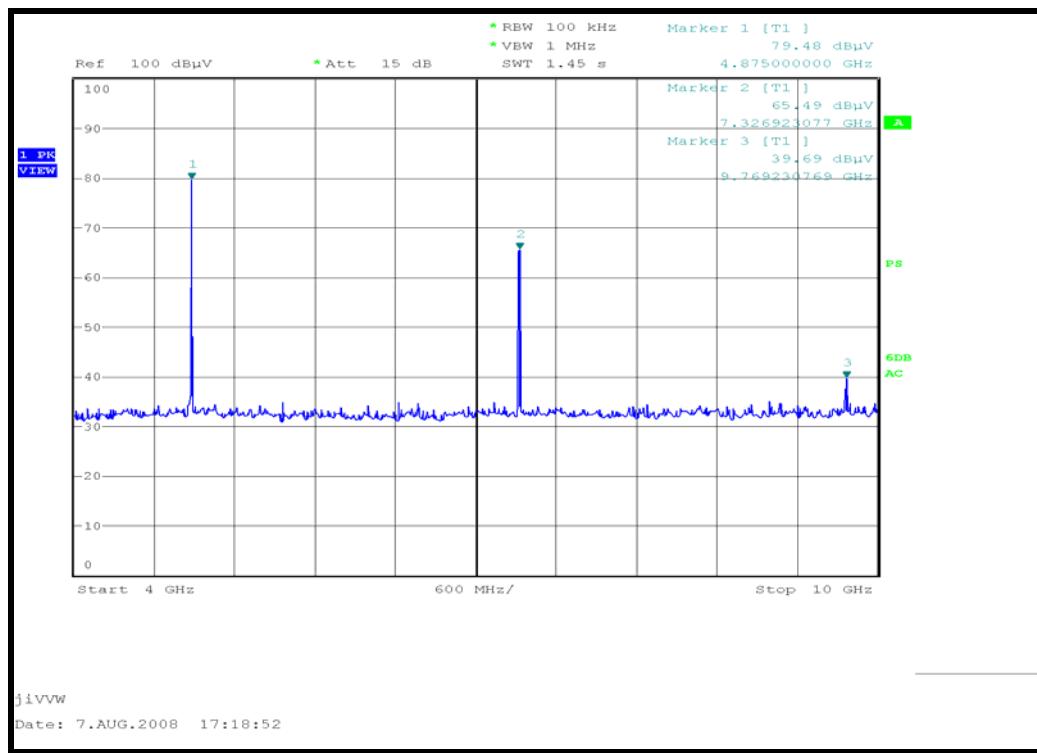
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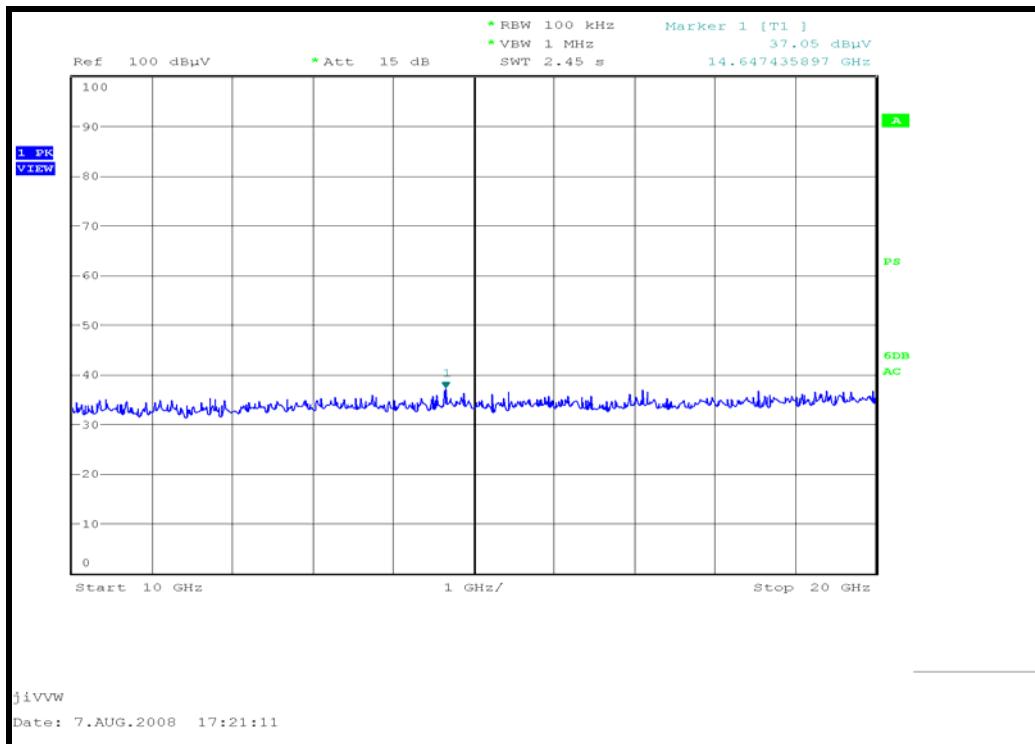
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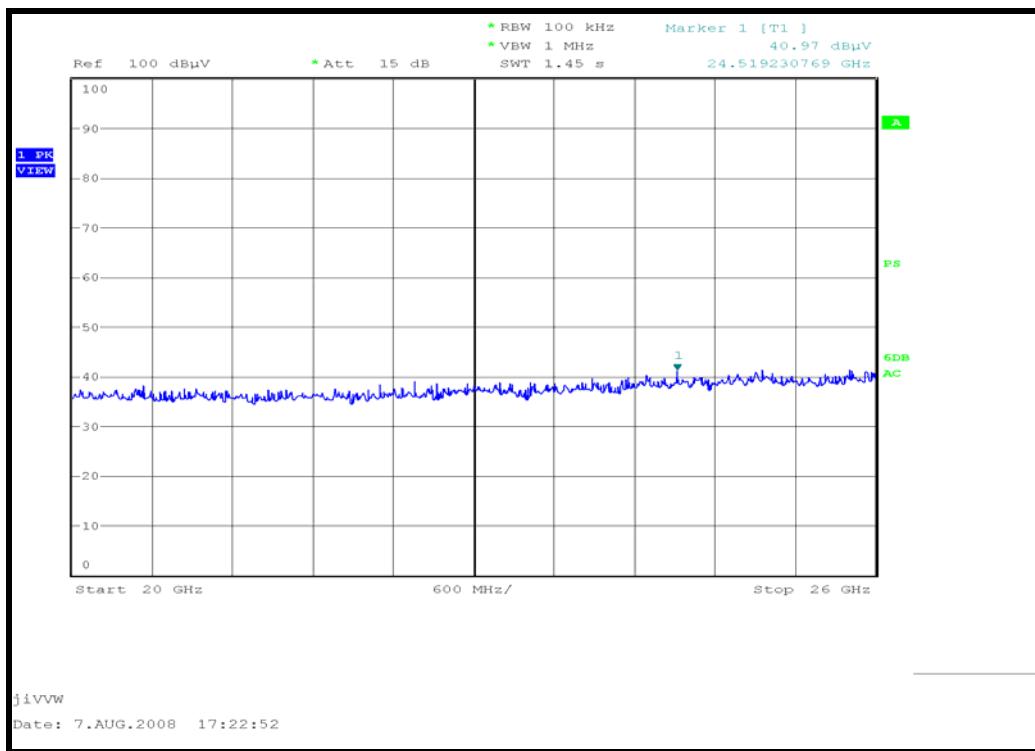
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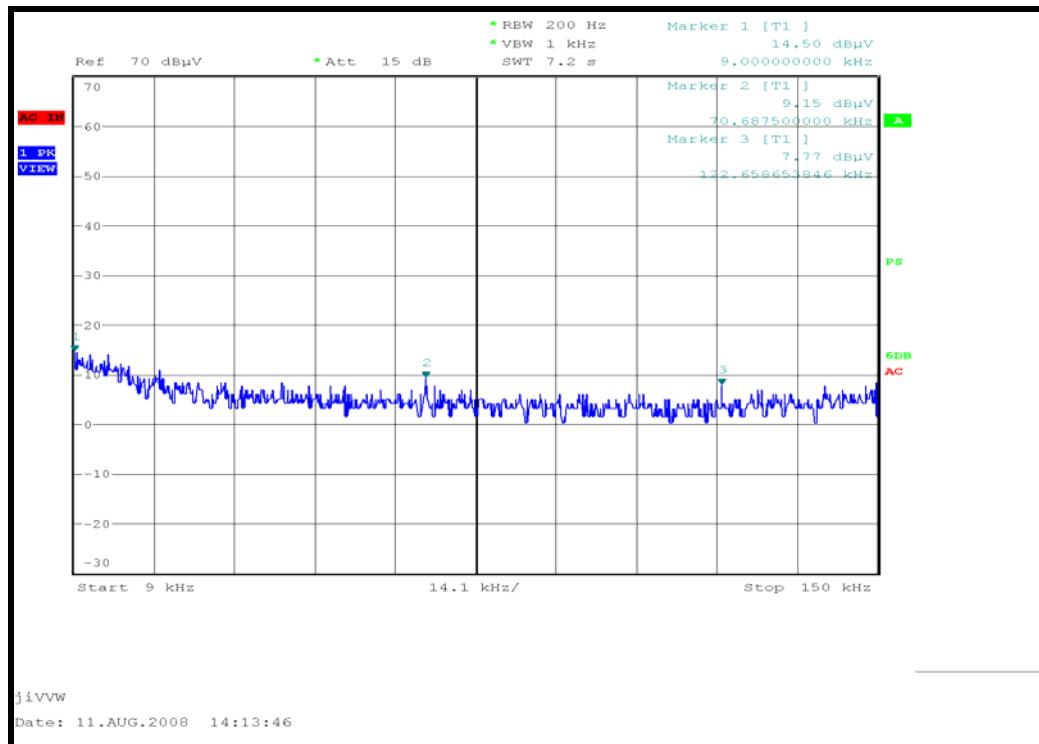
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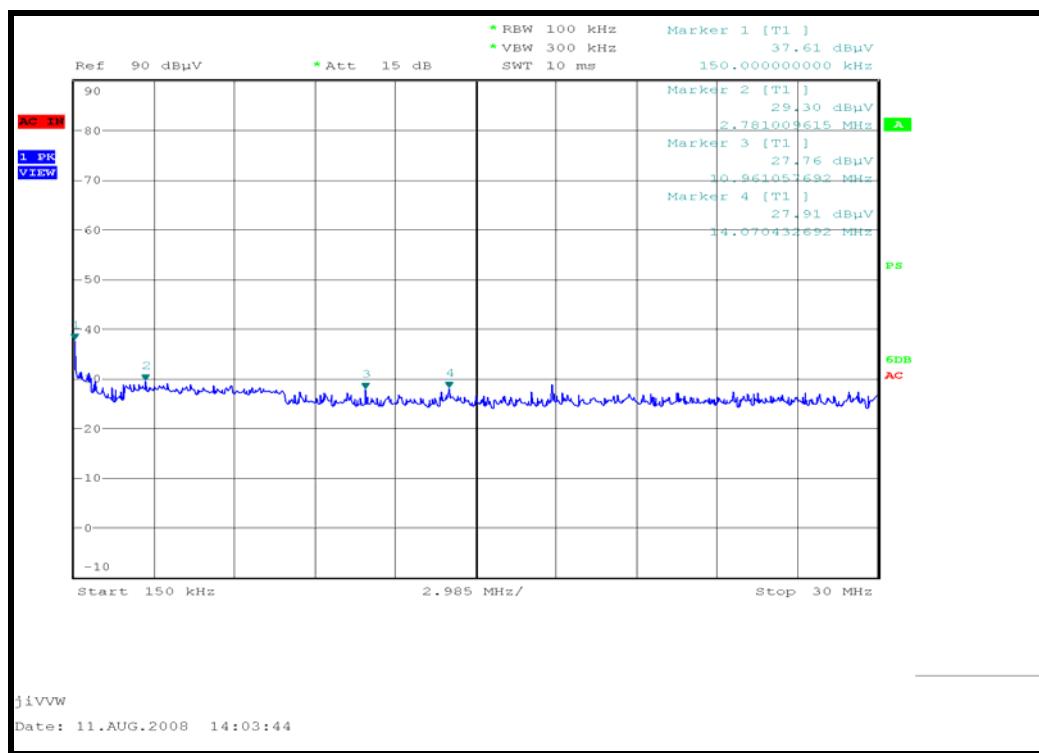
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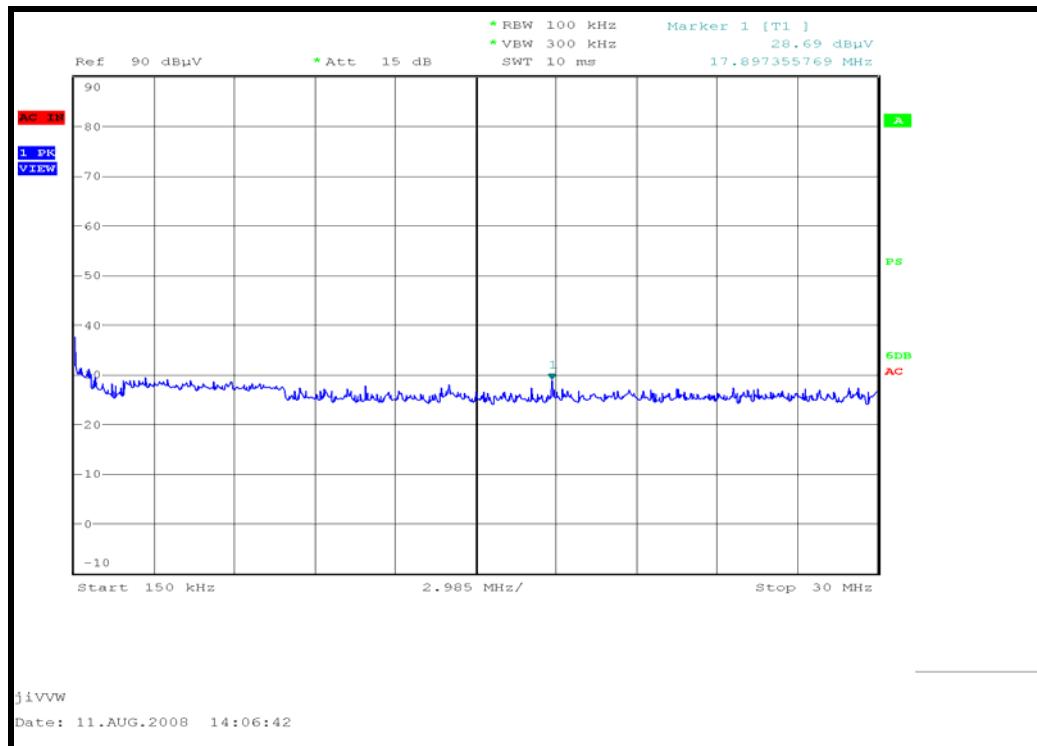
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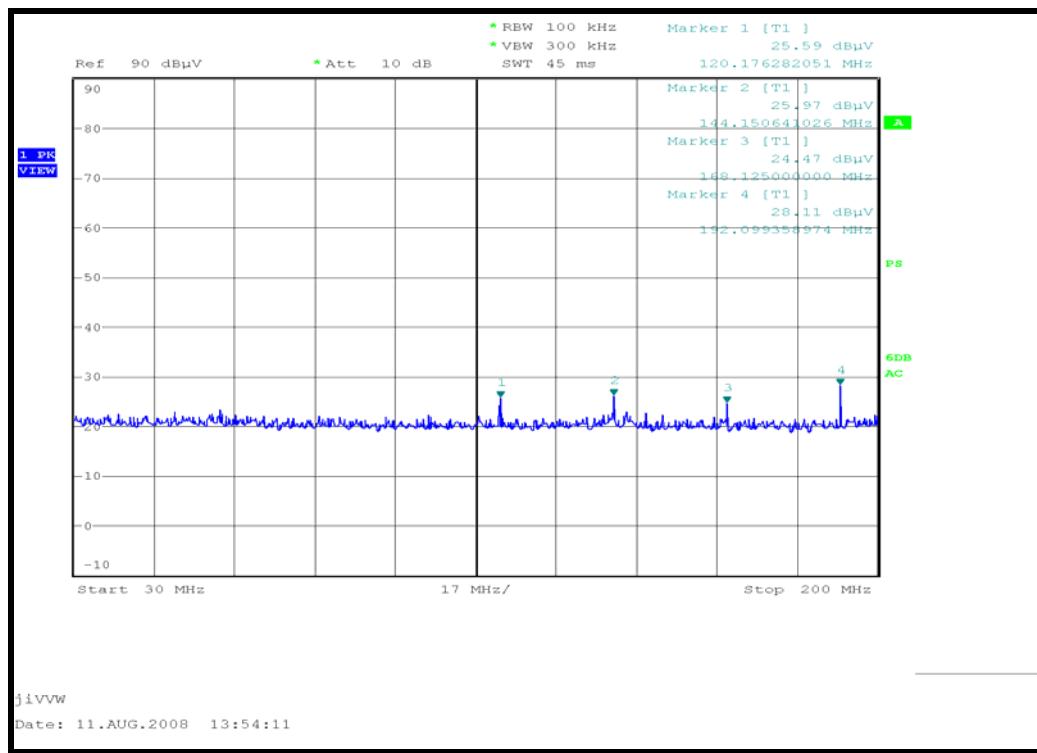
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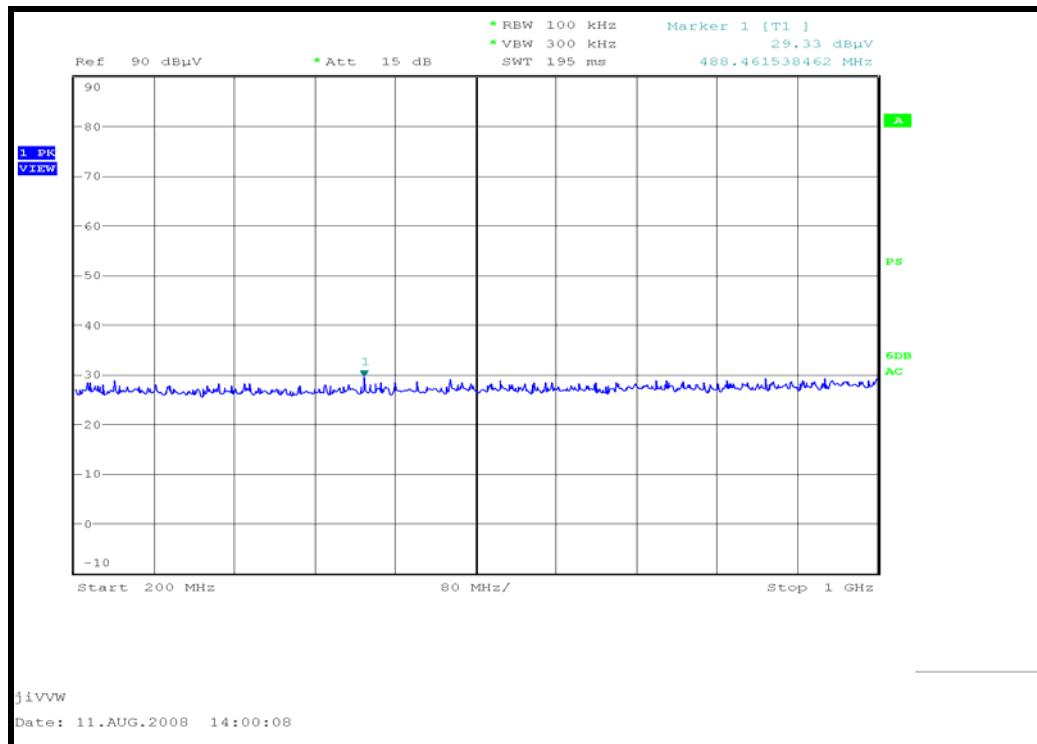
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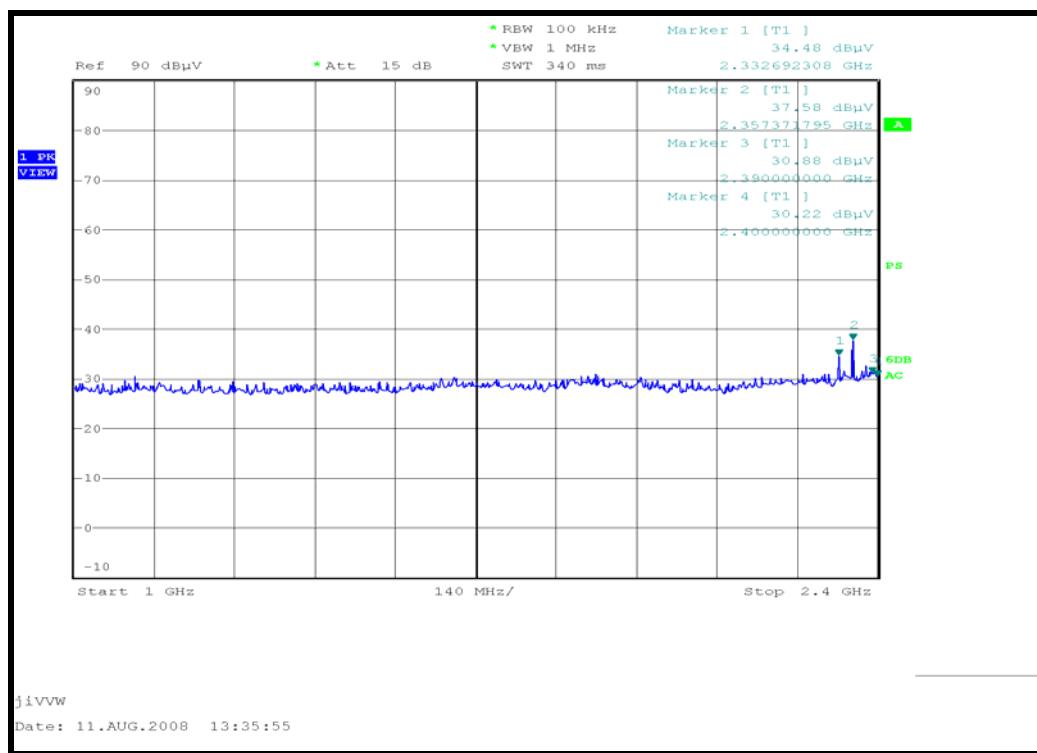
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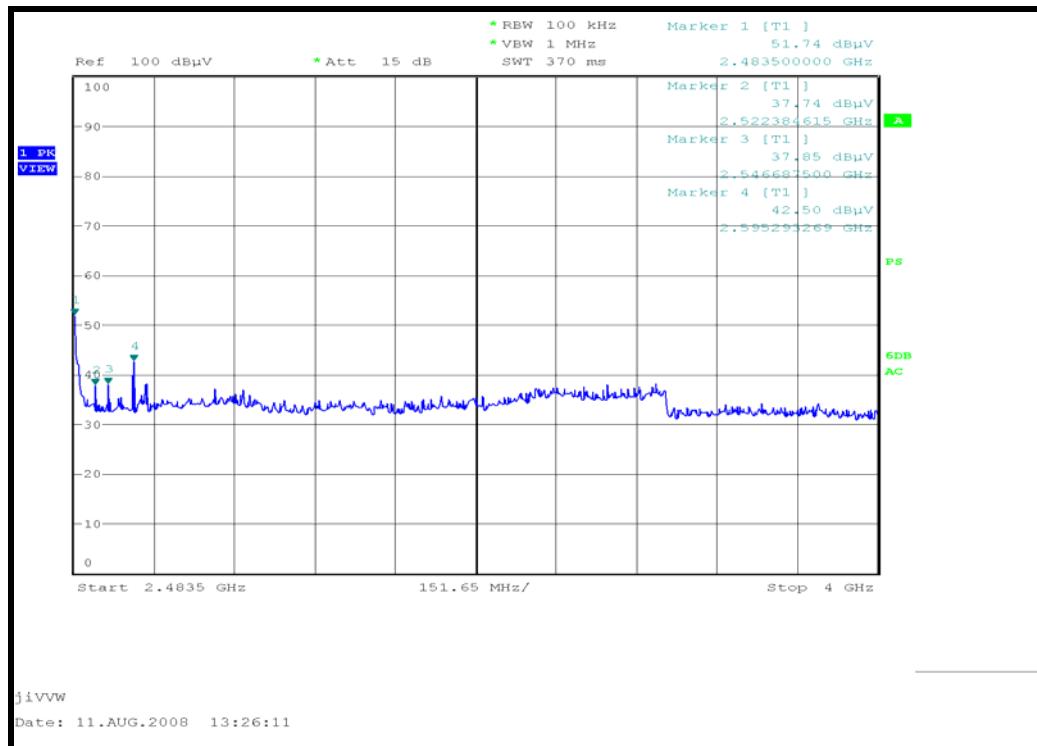
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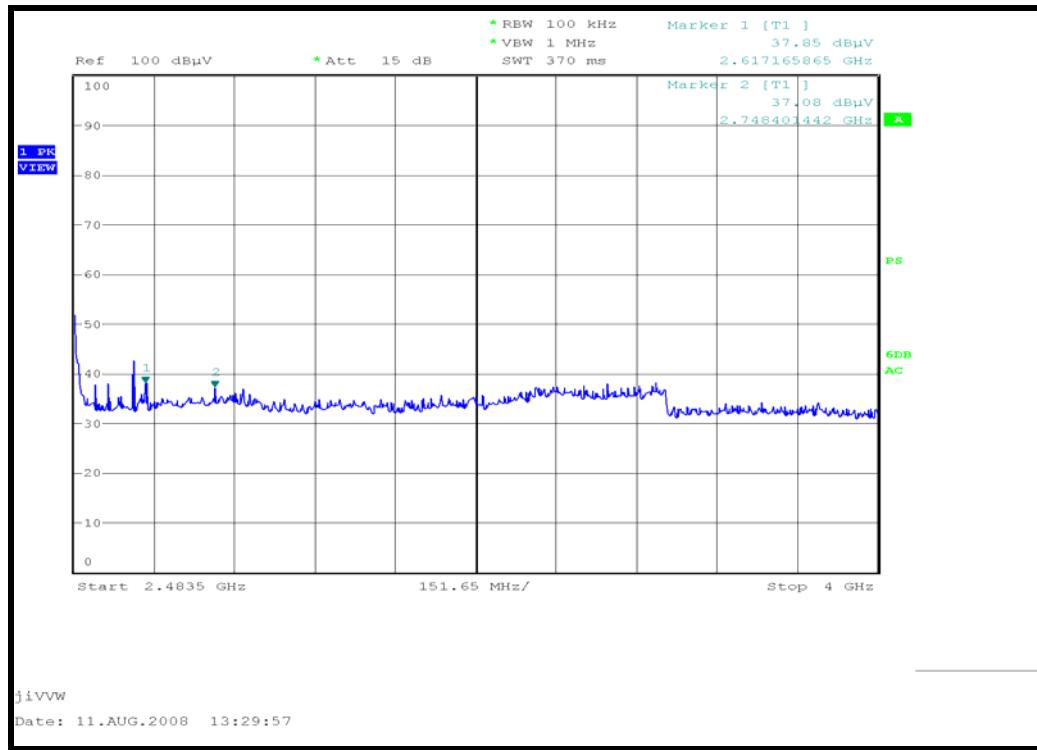
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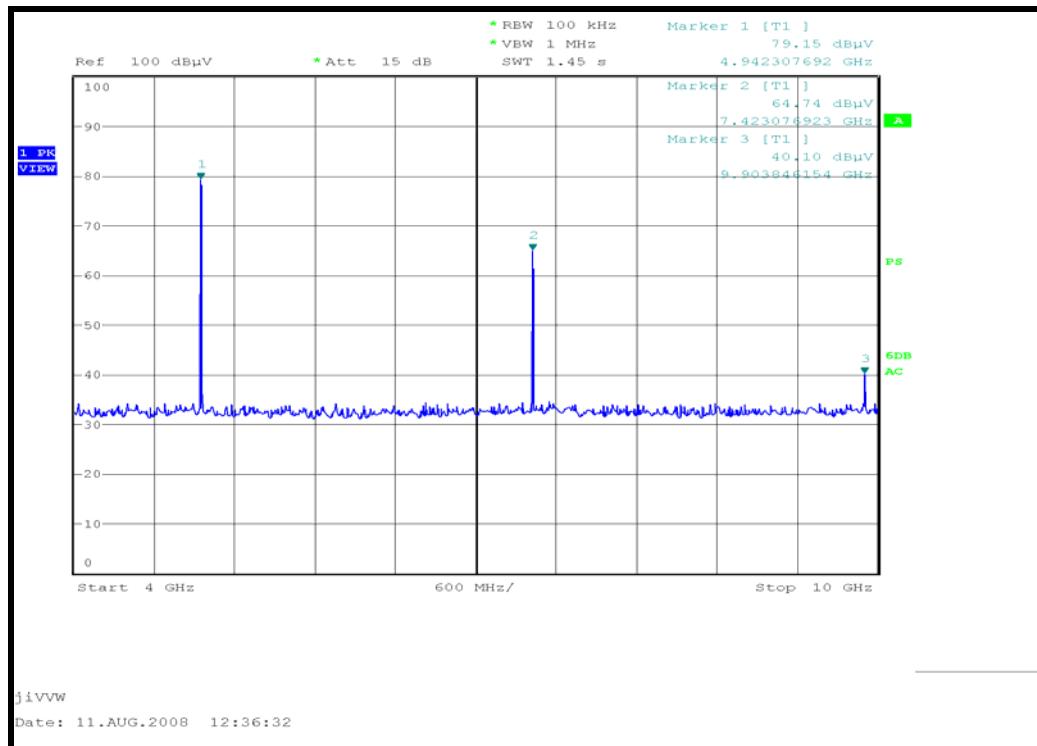
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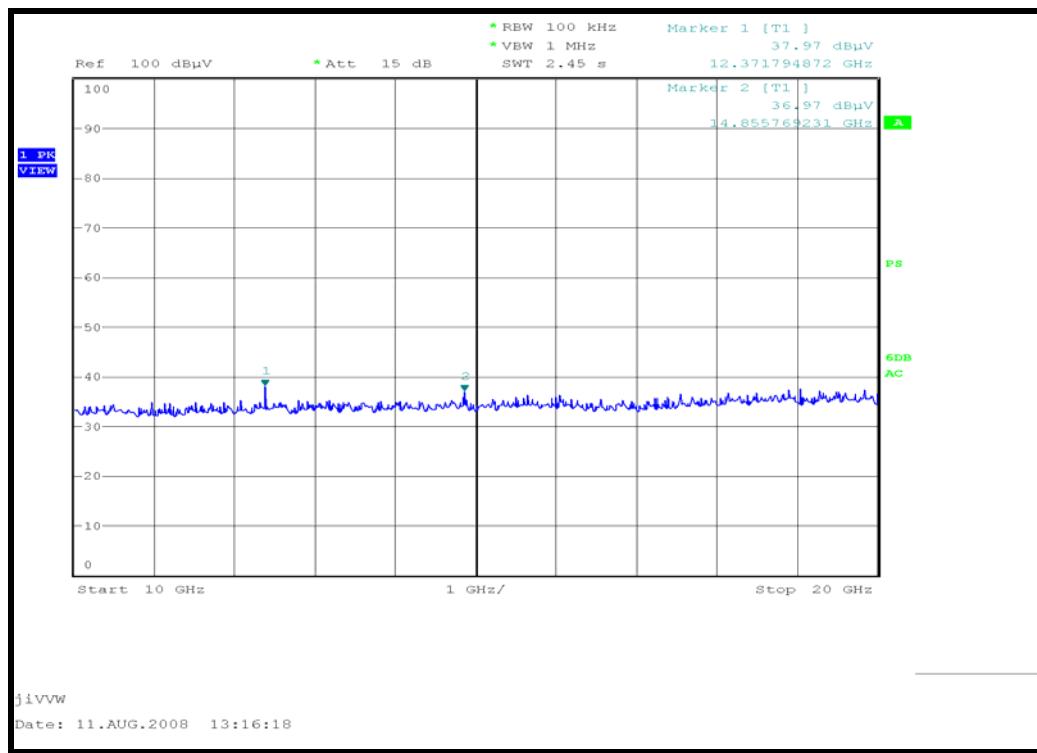
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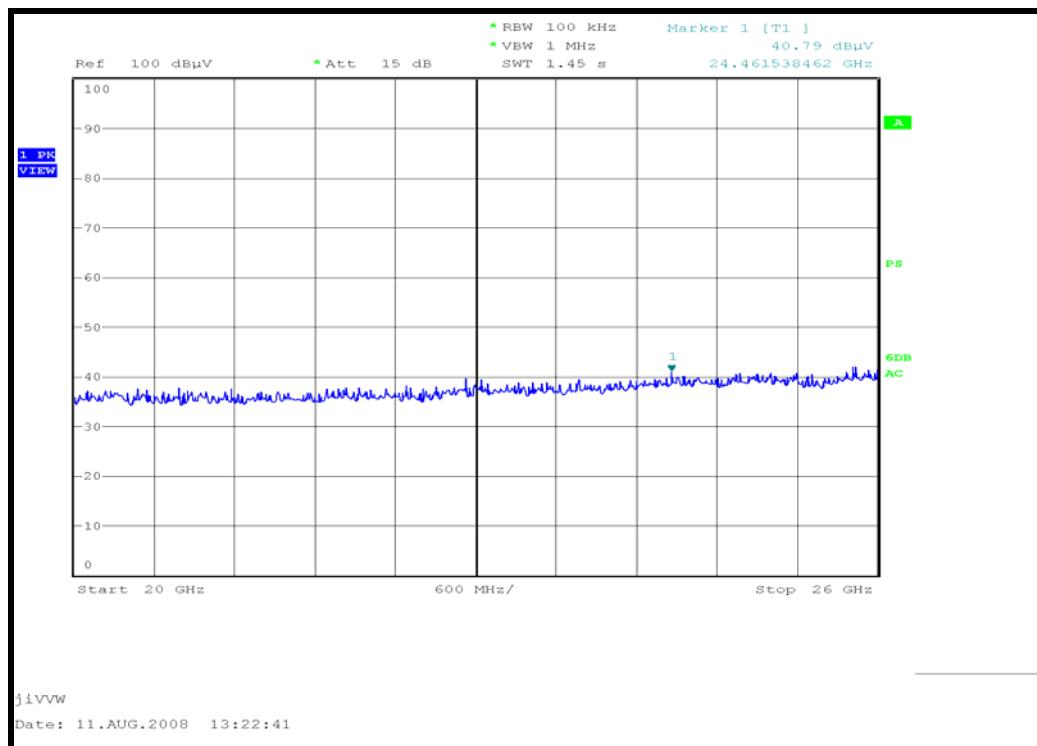
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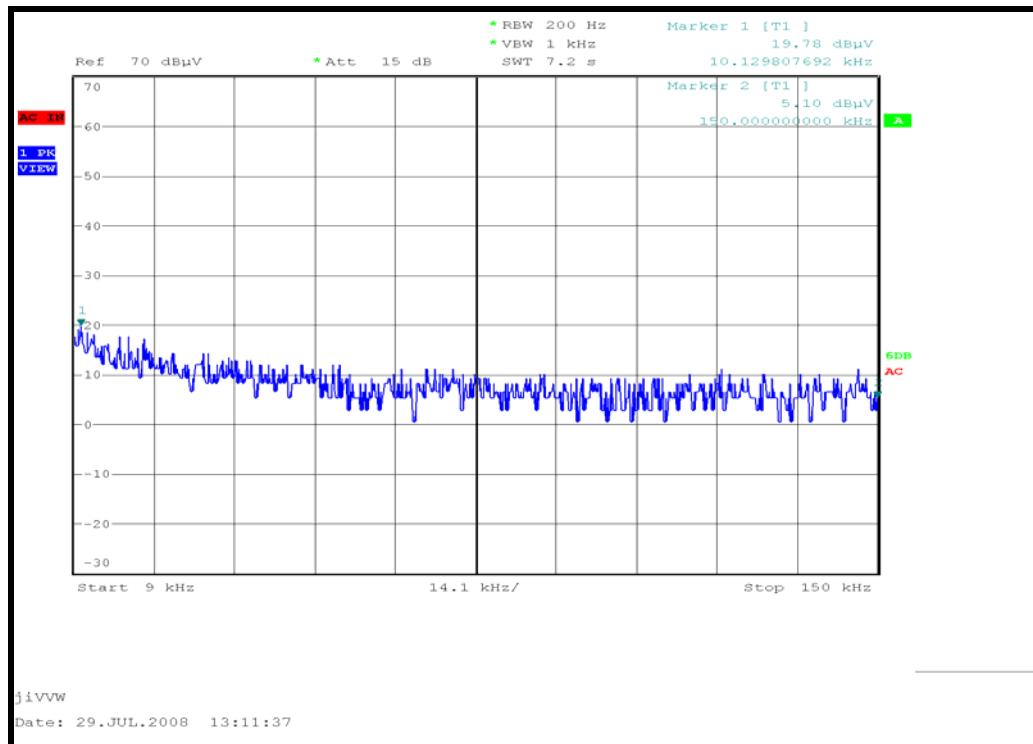
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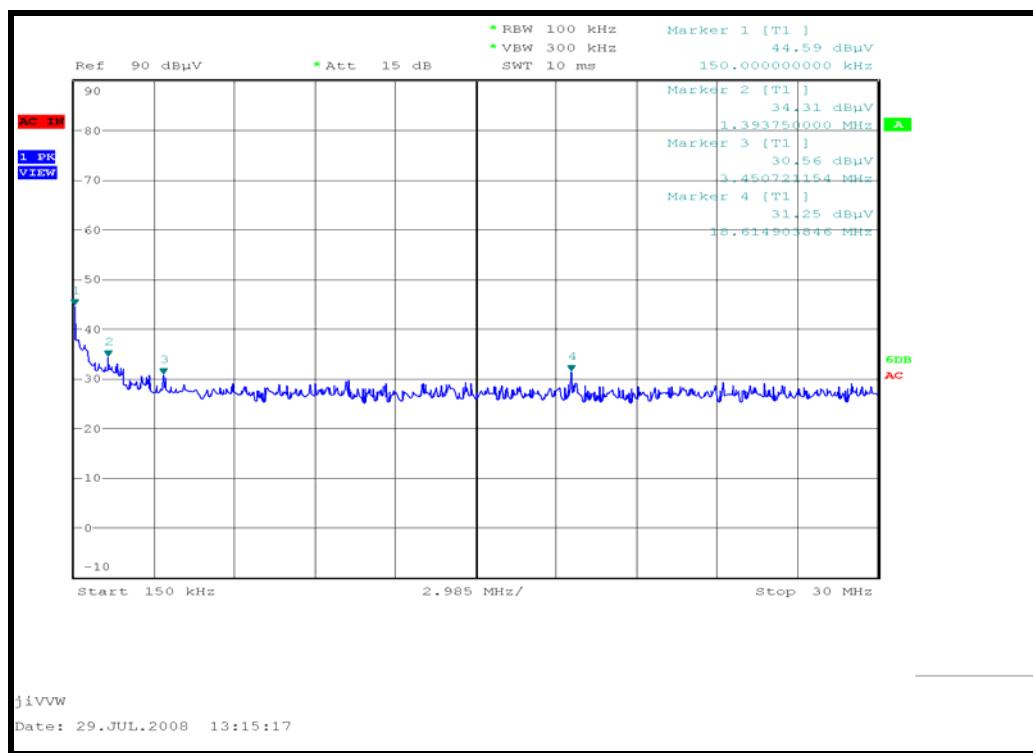
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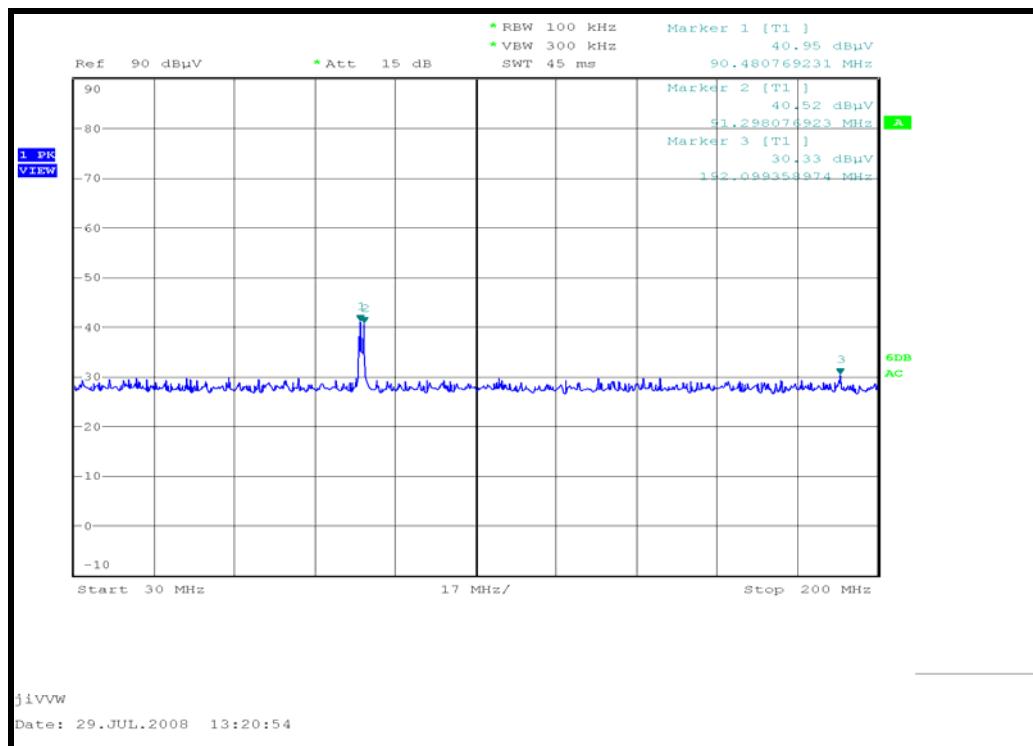
Conducted emissions: Channel 25 dc mode



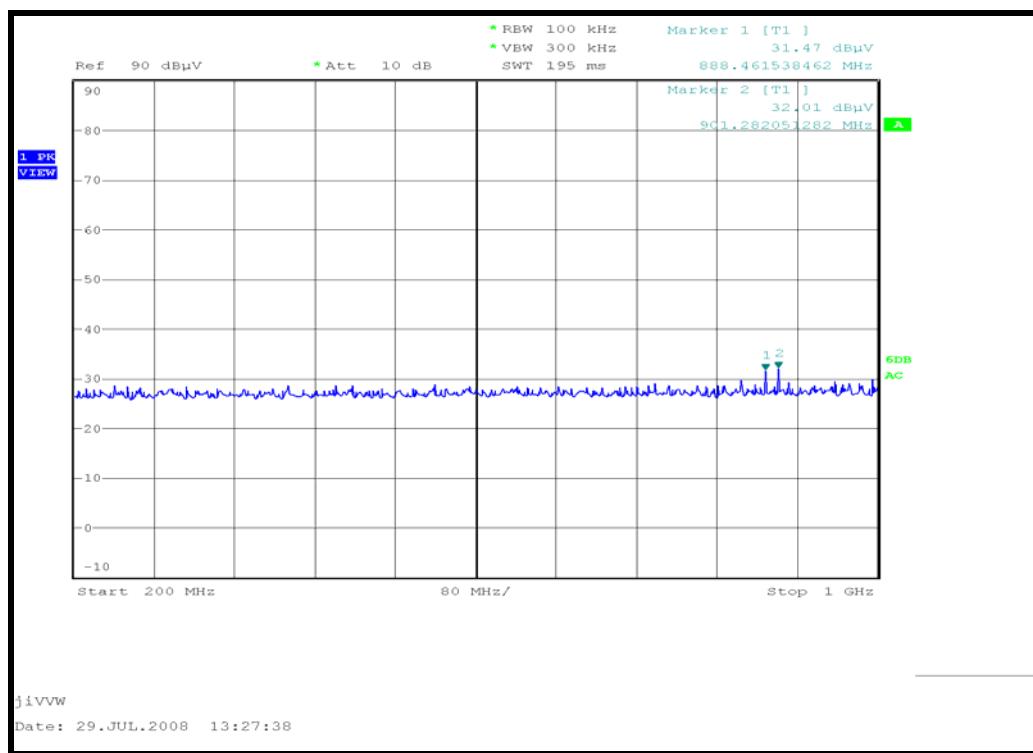
Conducted emissions: Channel 11 ac mode



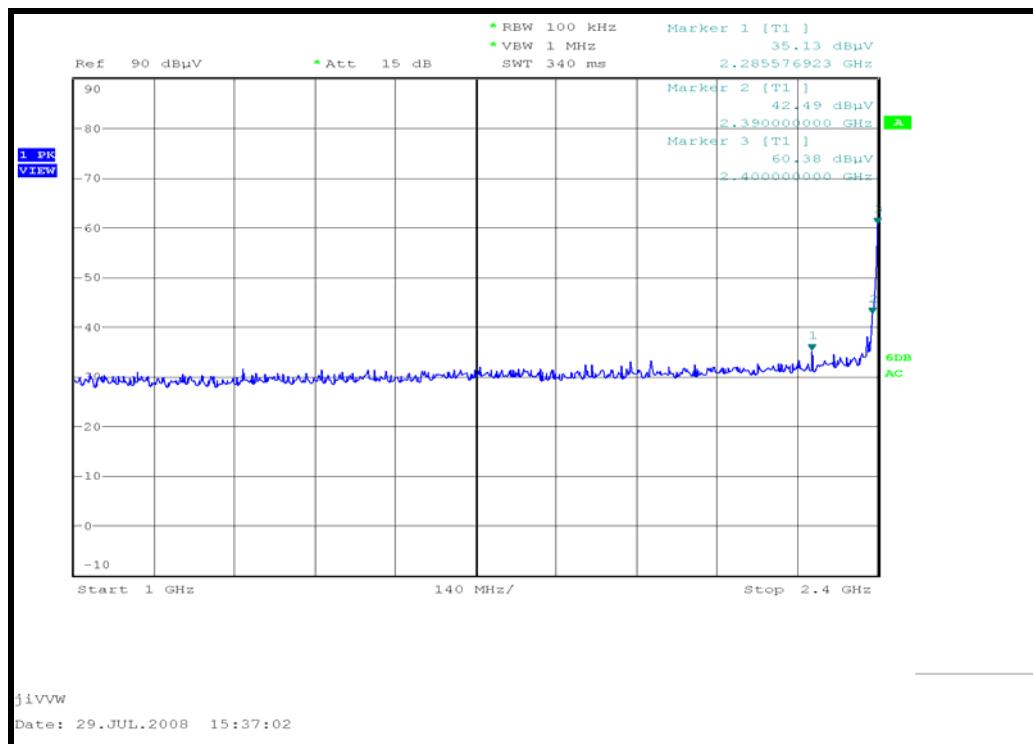
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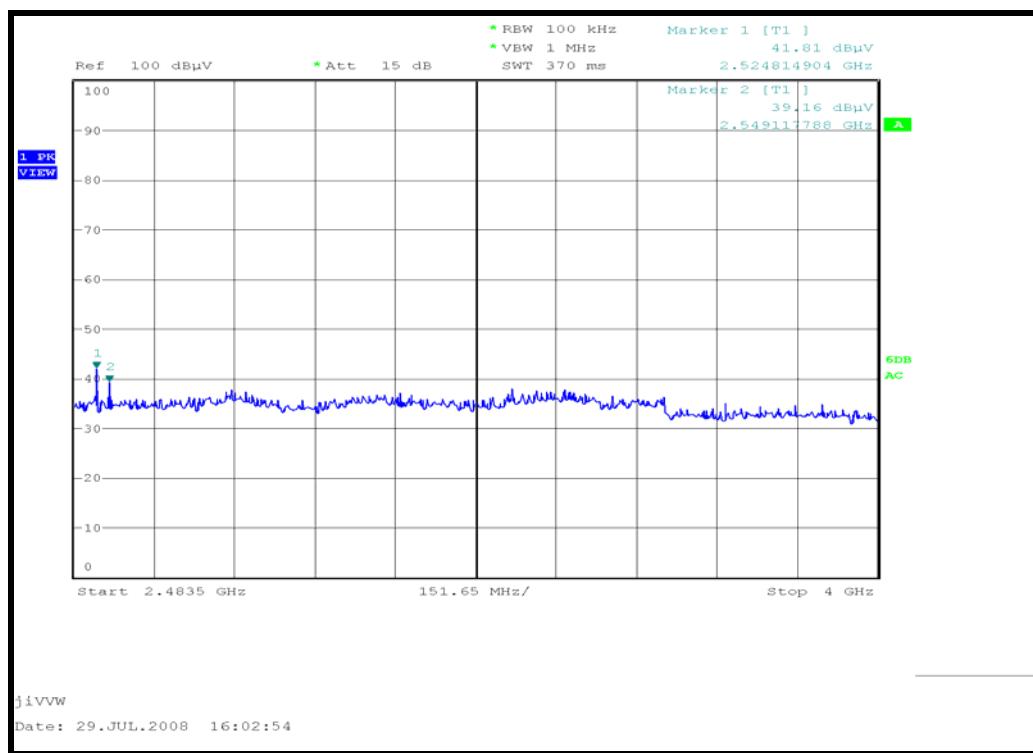
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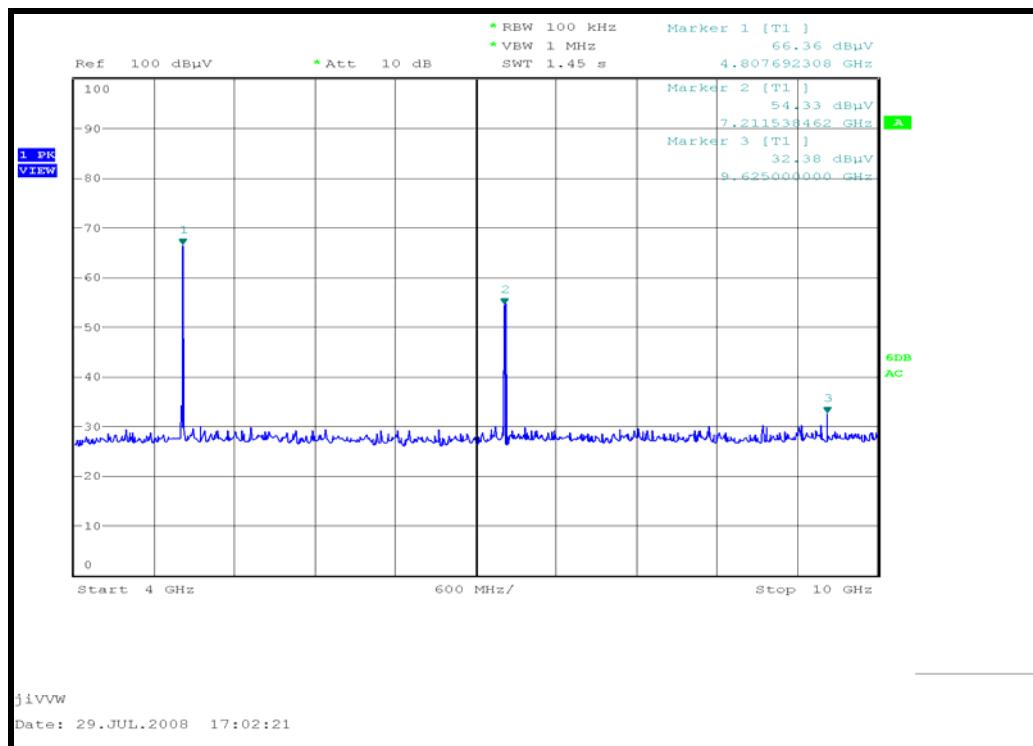
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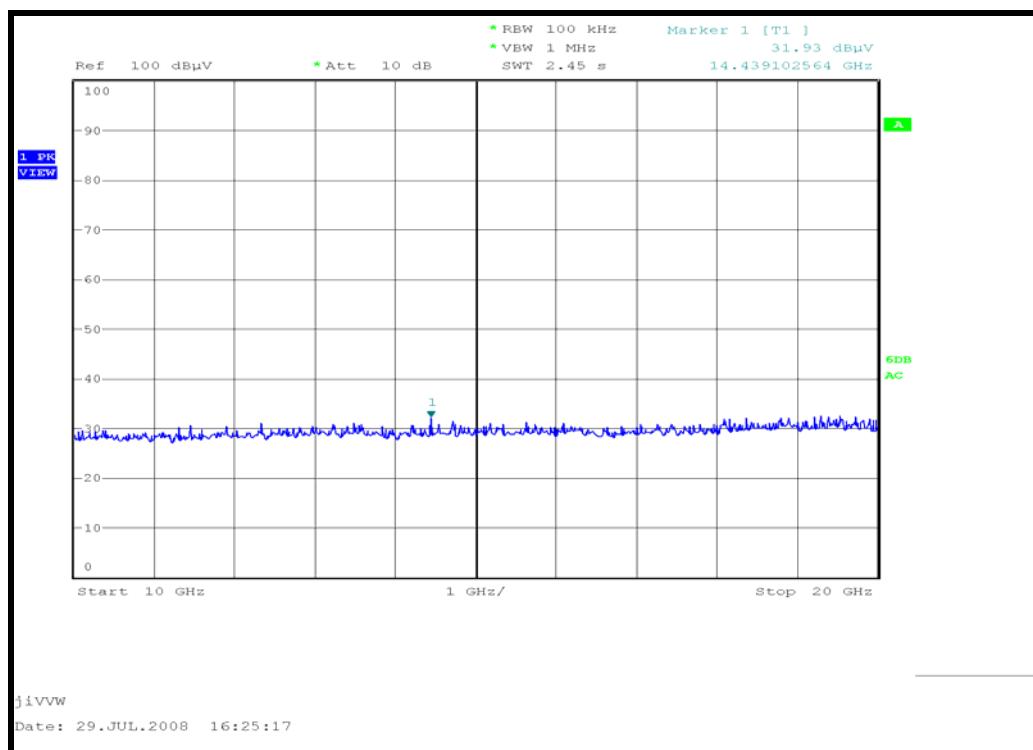
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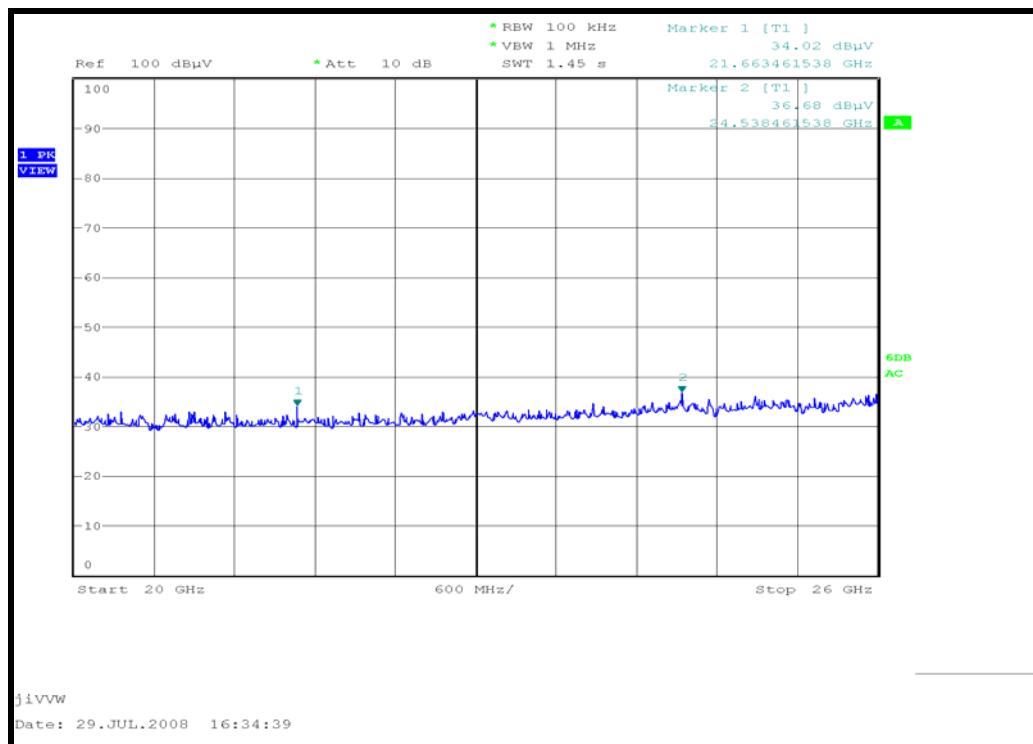
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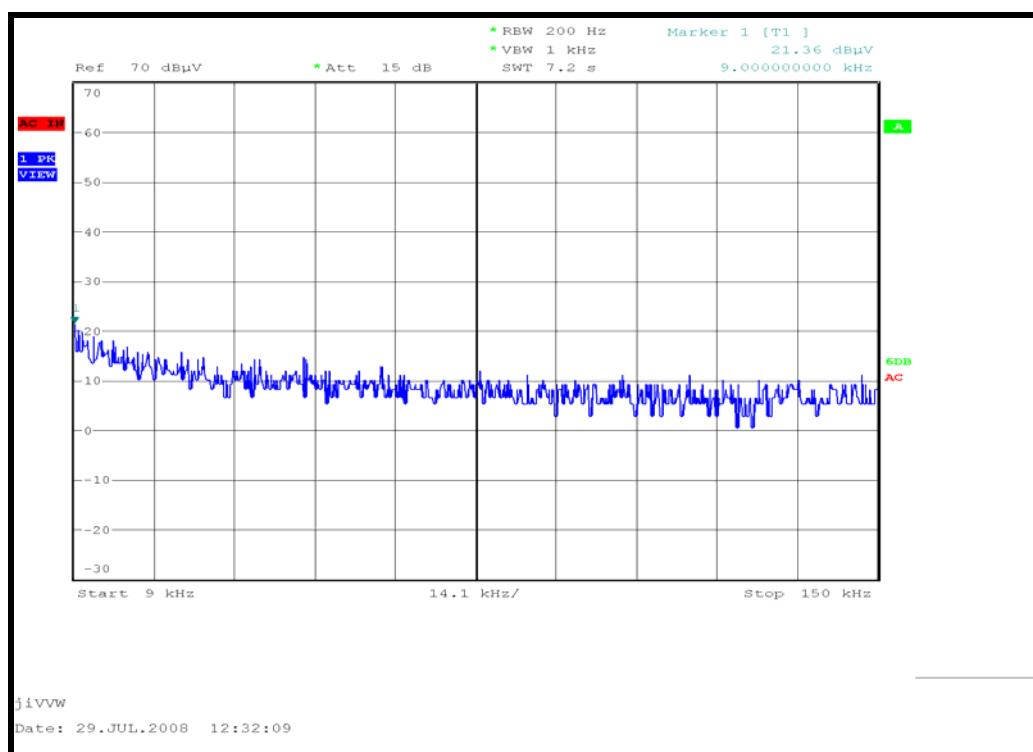
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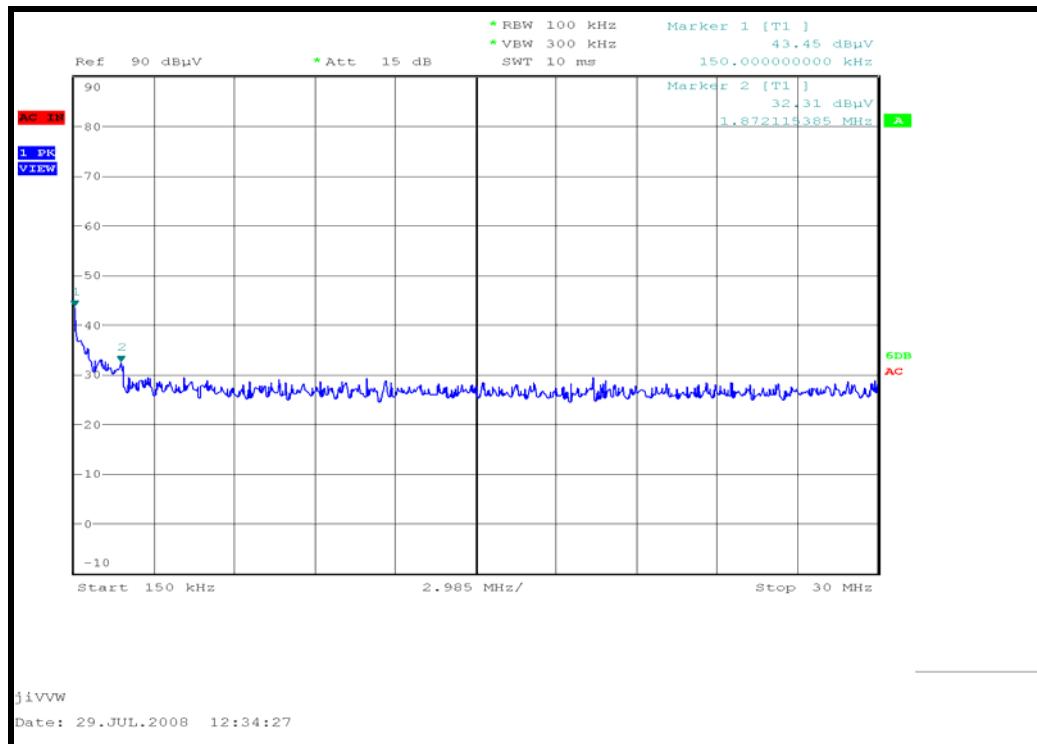
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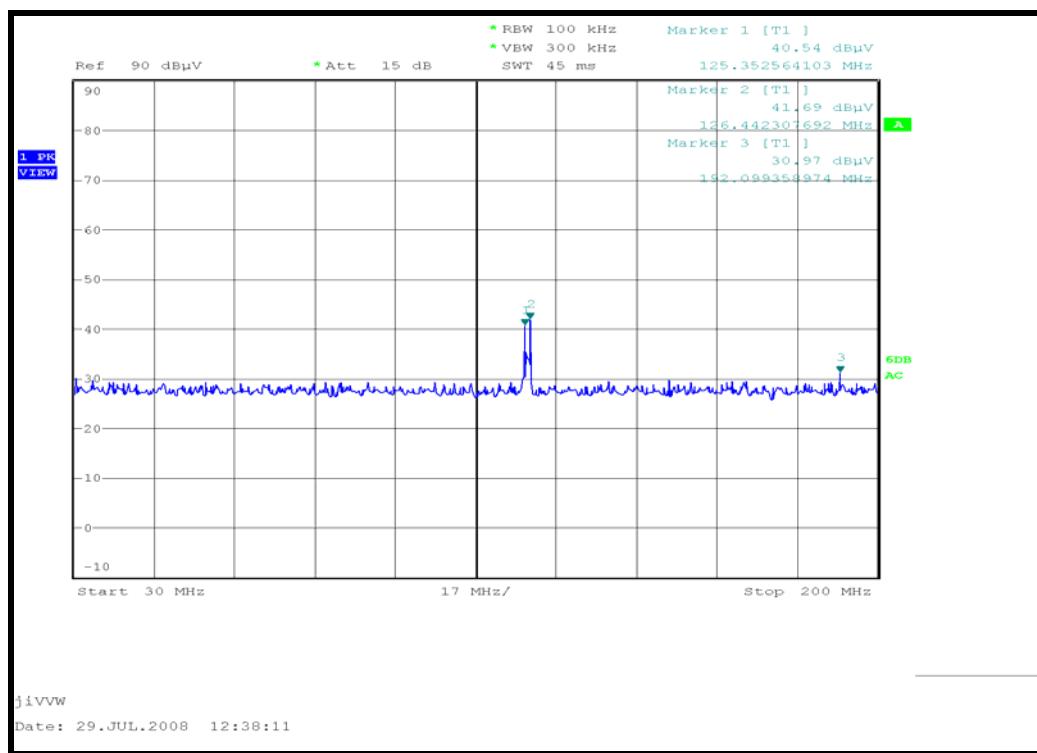
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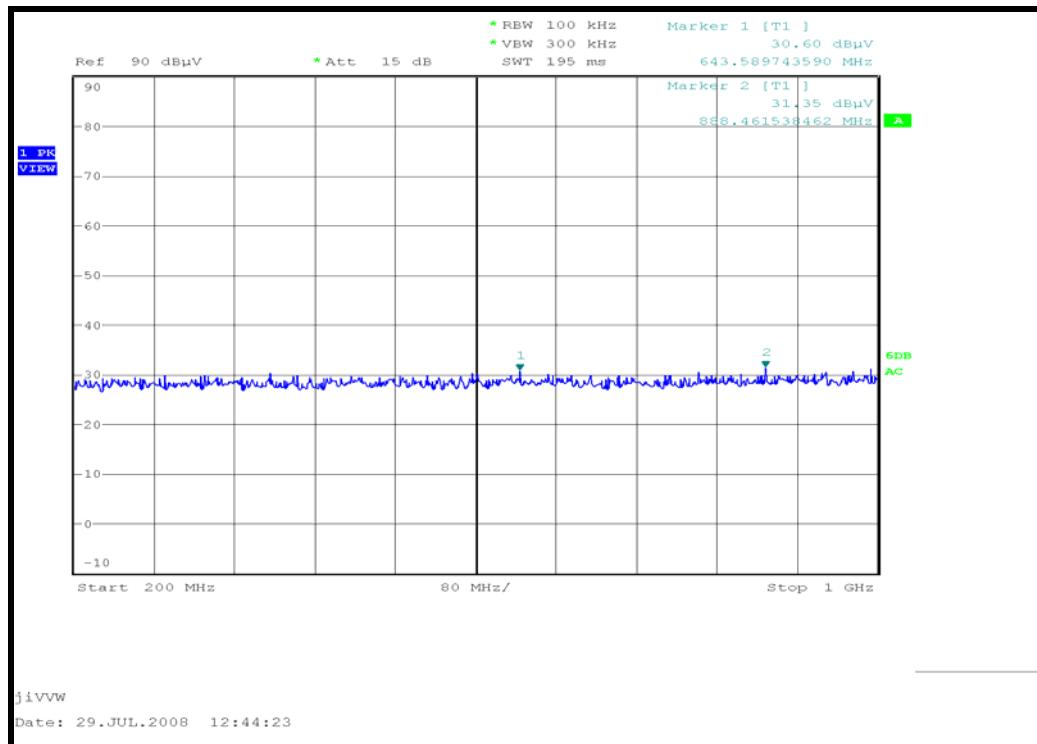
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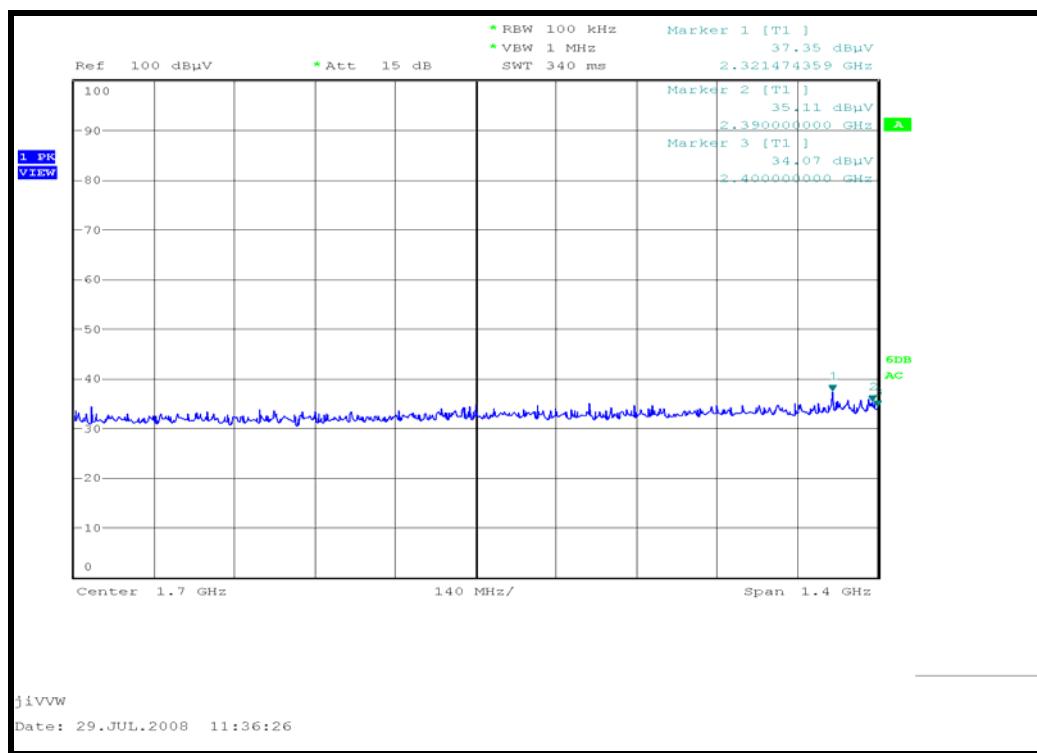
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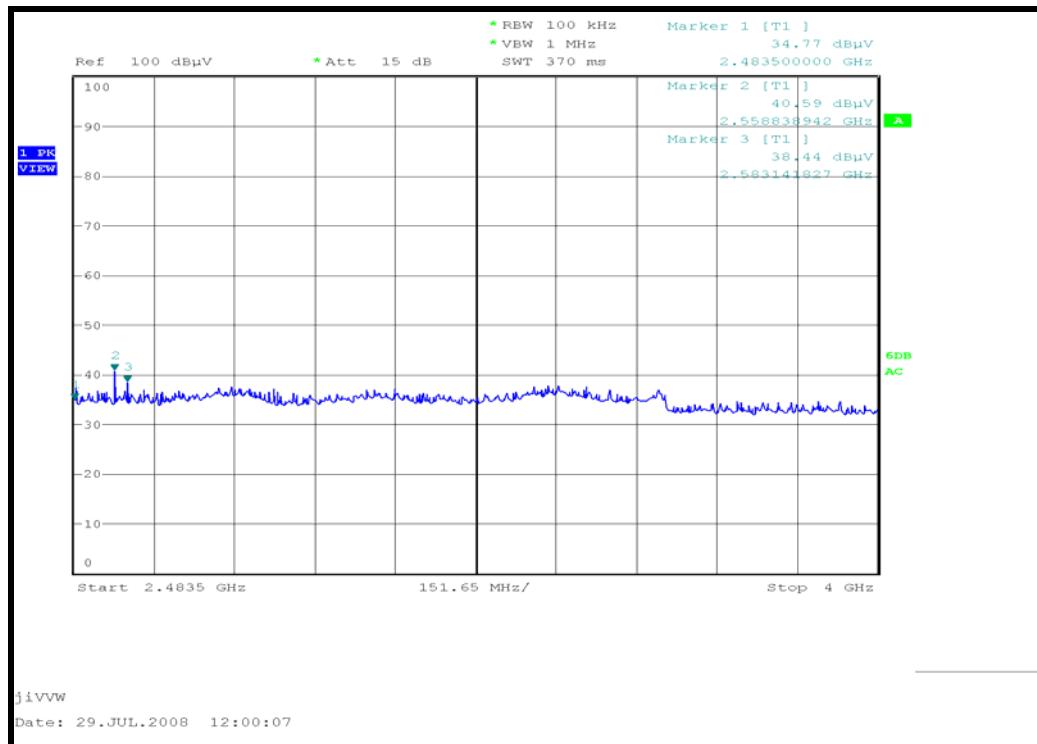
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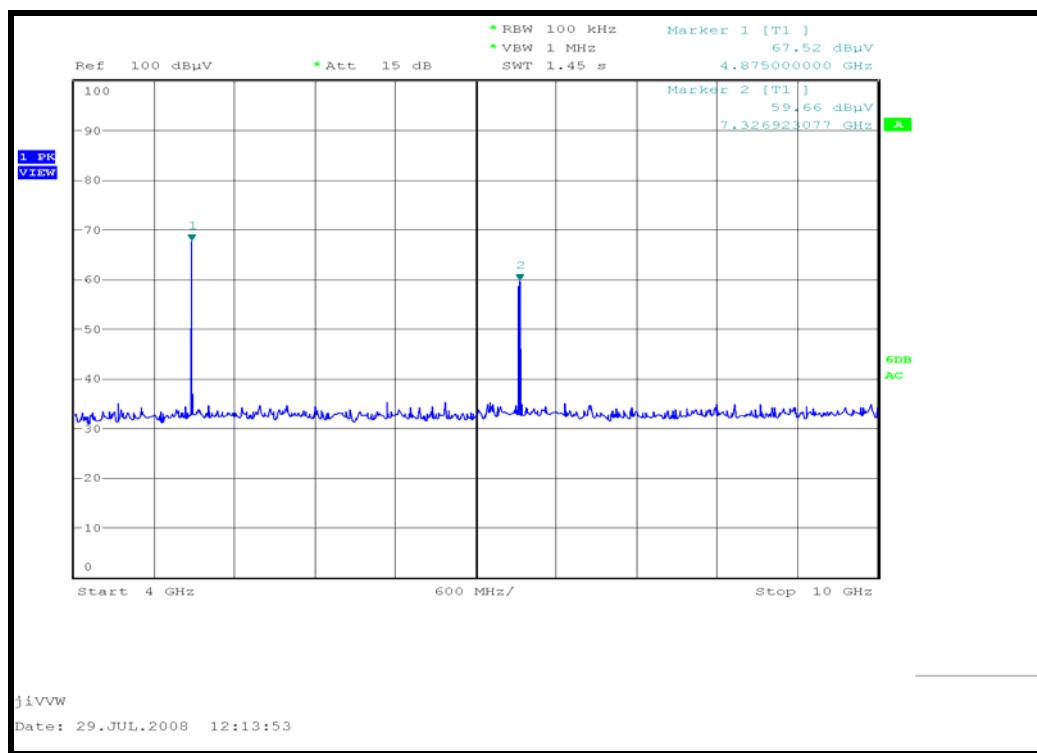
Conducted emissions: Channel 18 ac mode



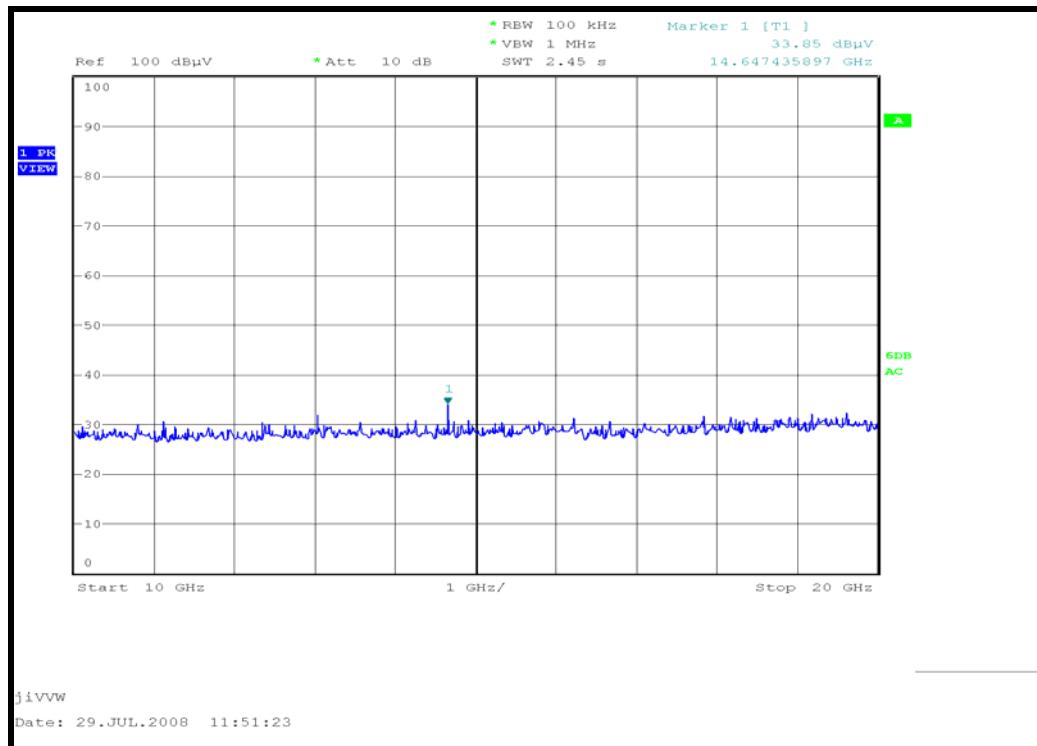
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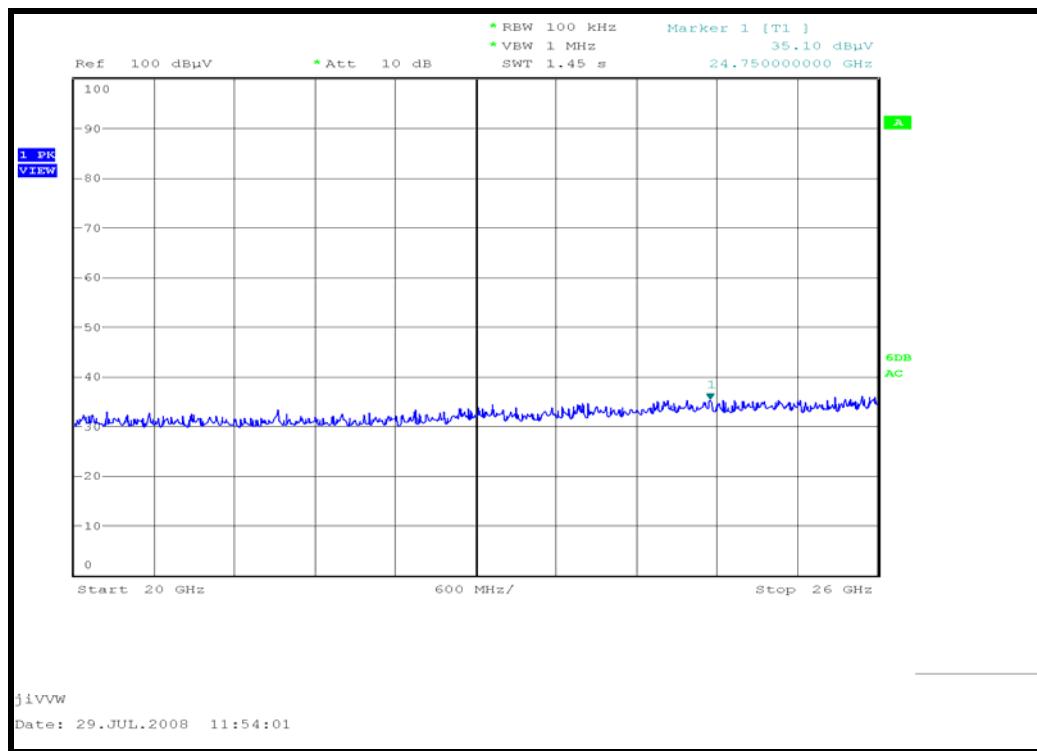
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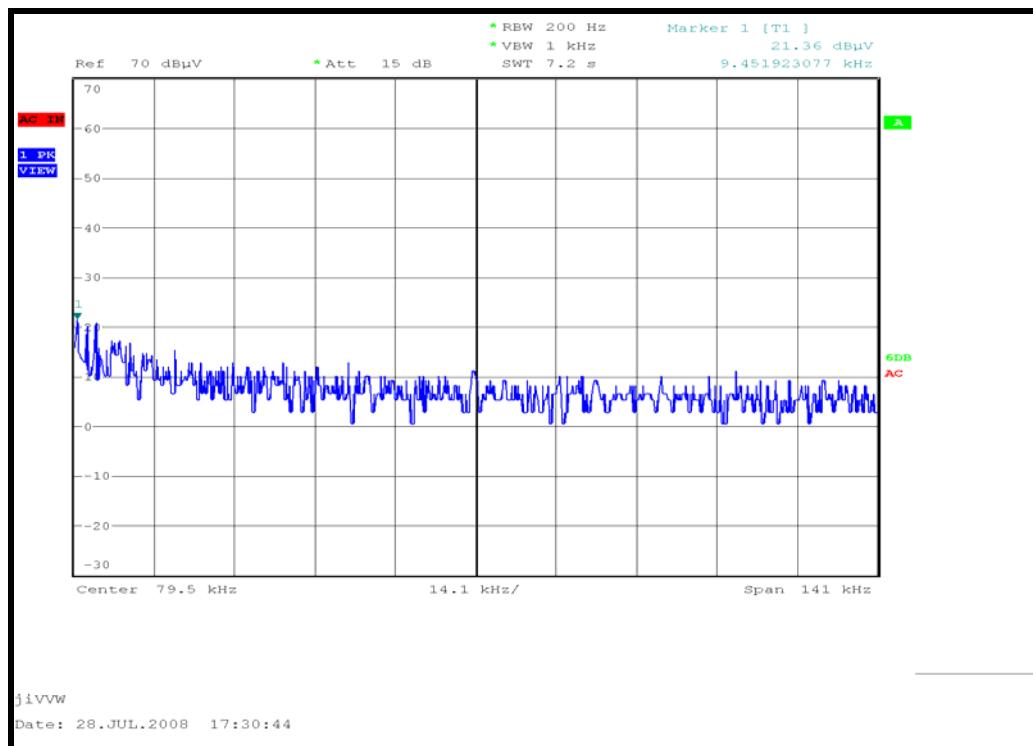
Conducted emissions: Channel 18 ac mode



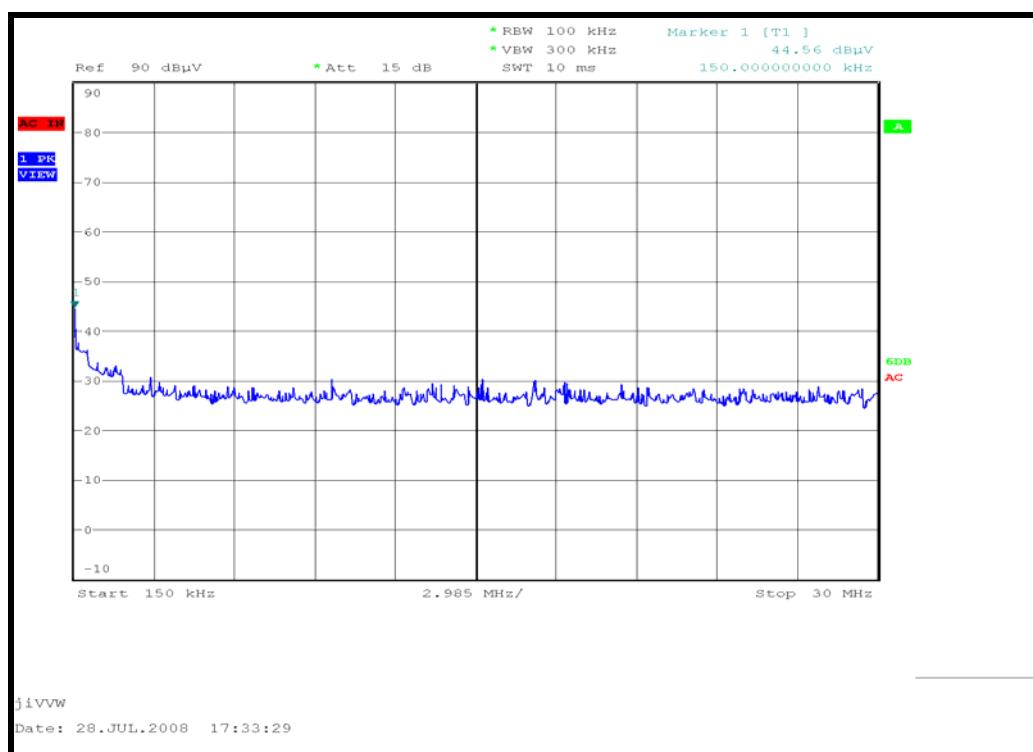
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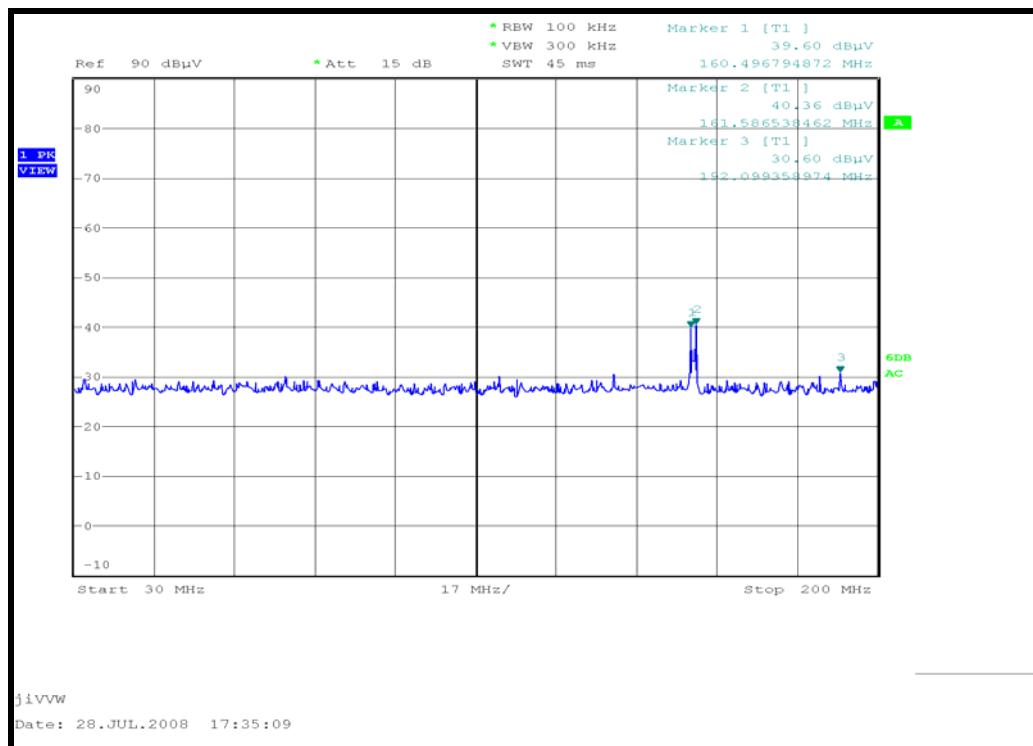
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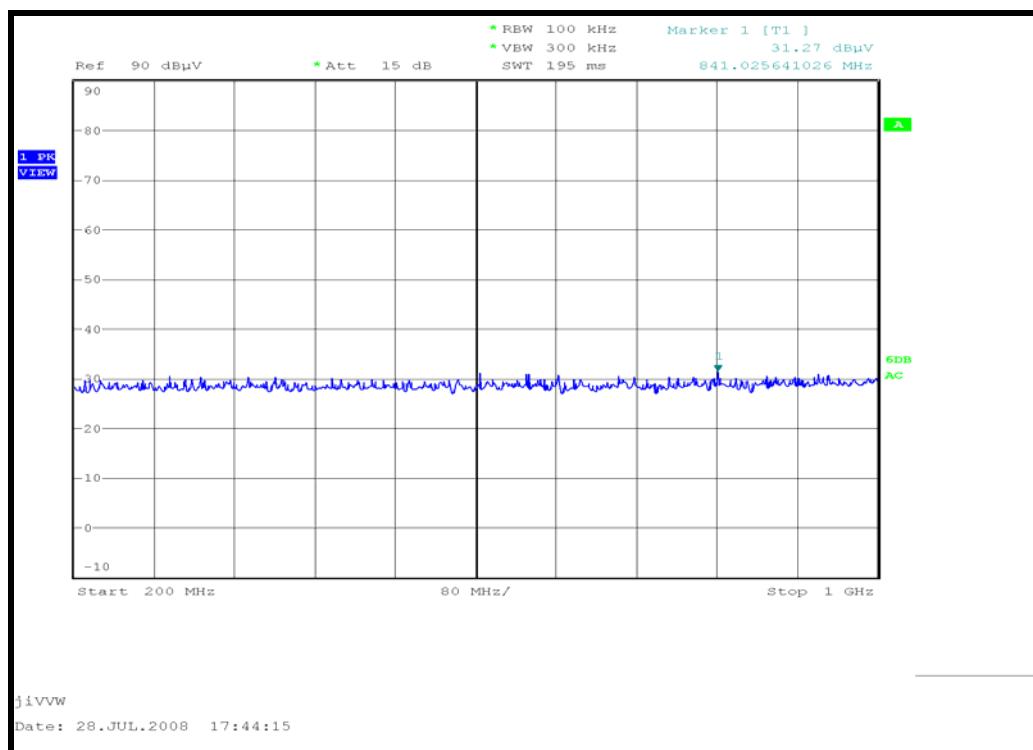
Conducted emissions: Channel 25 ac mode



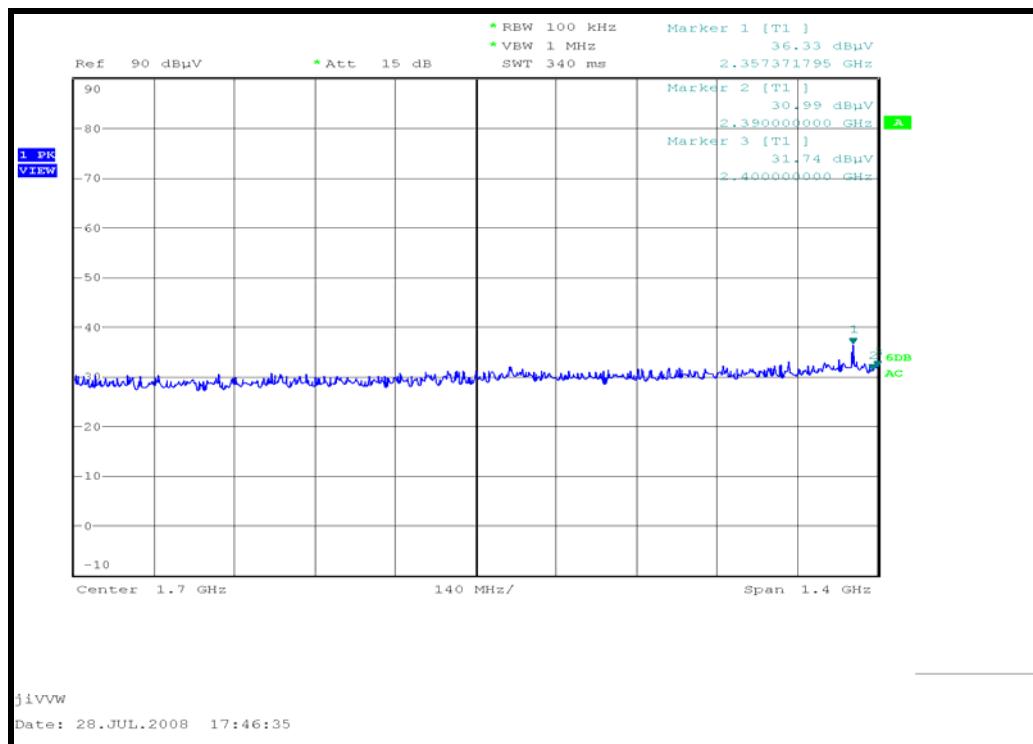
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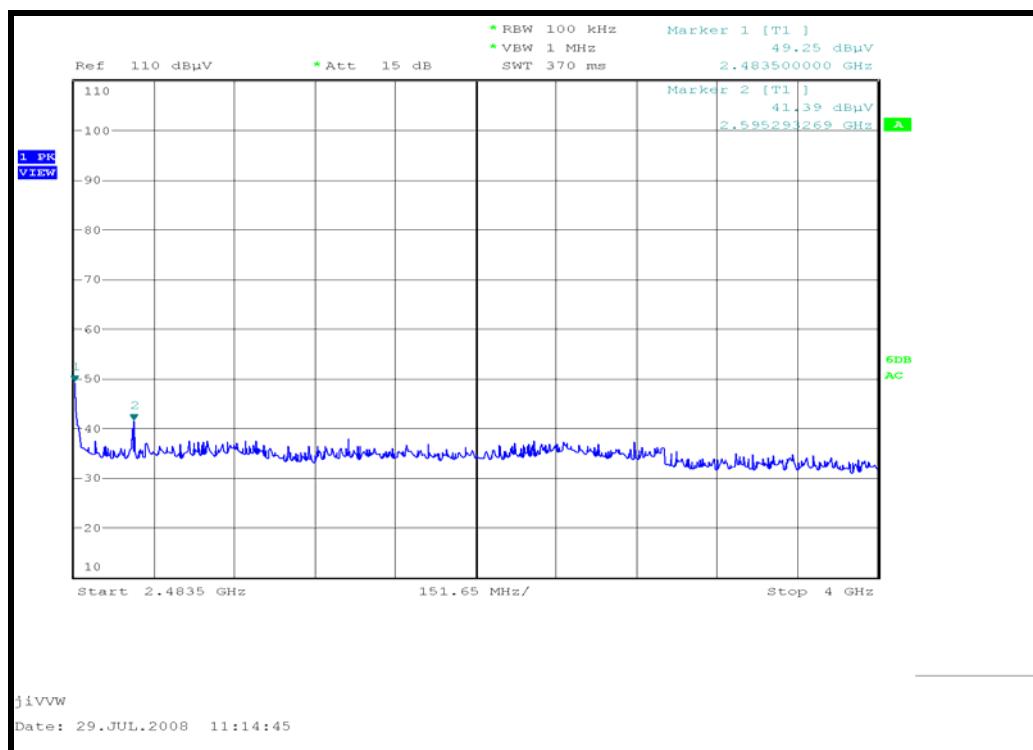
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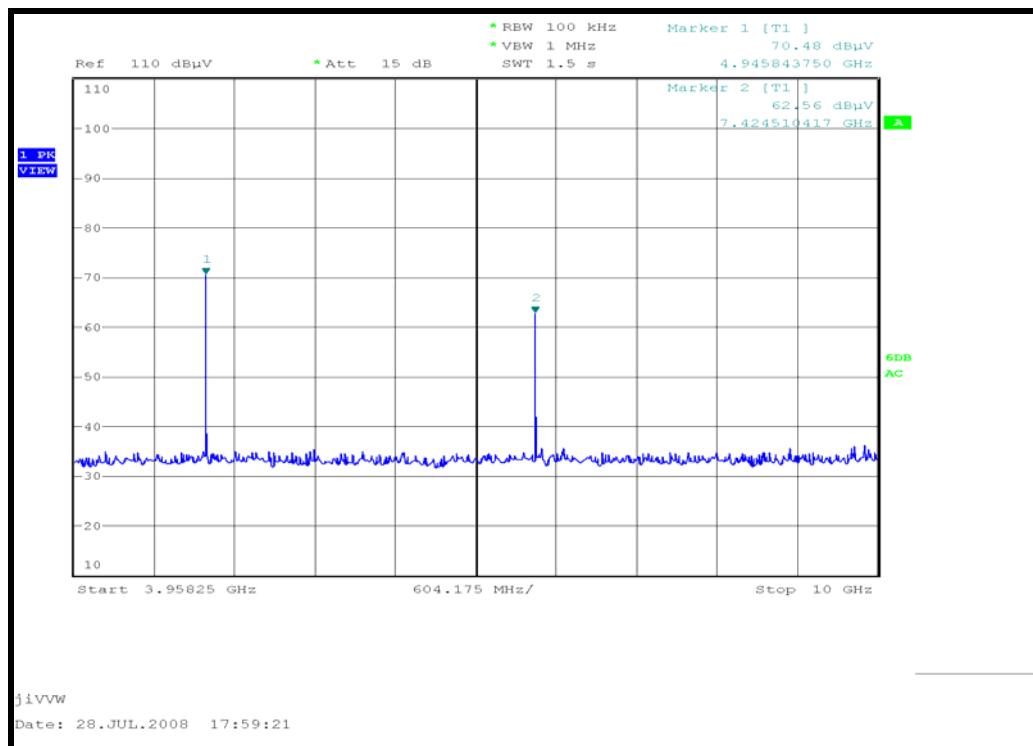
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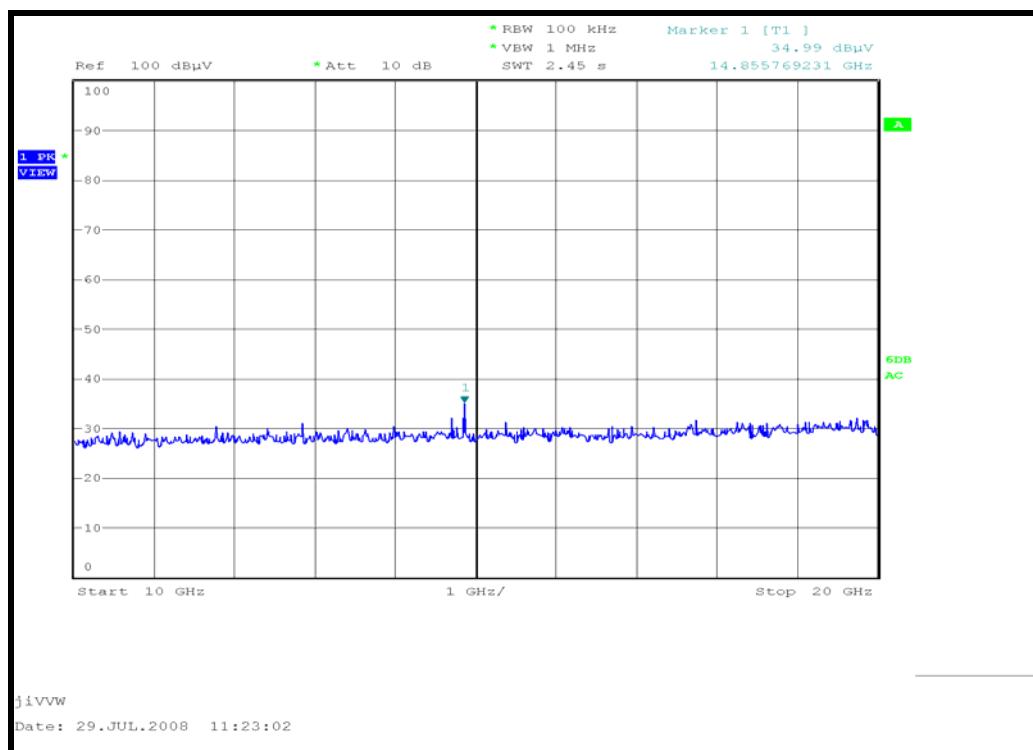
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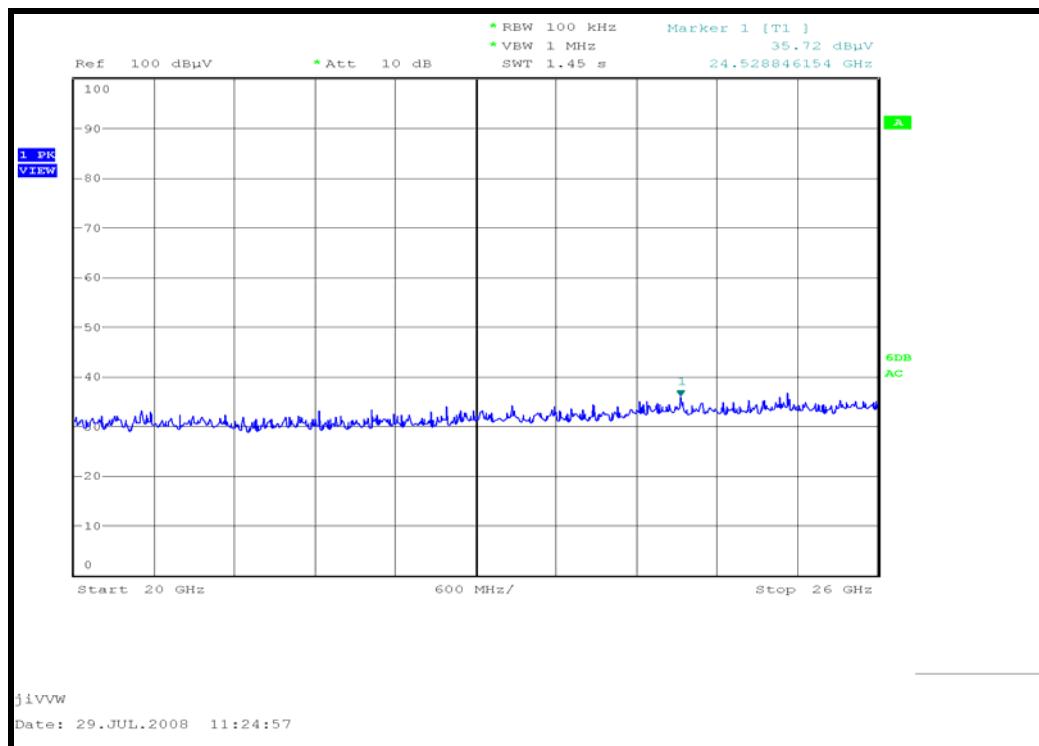
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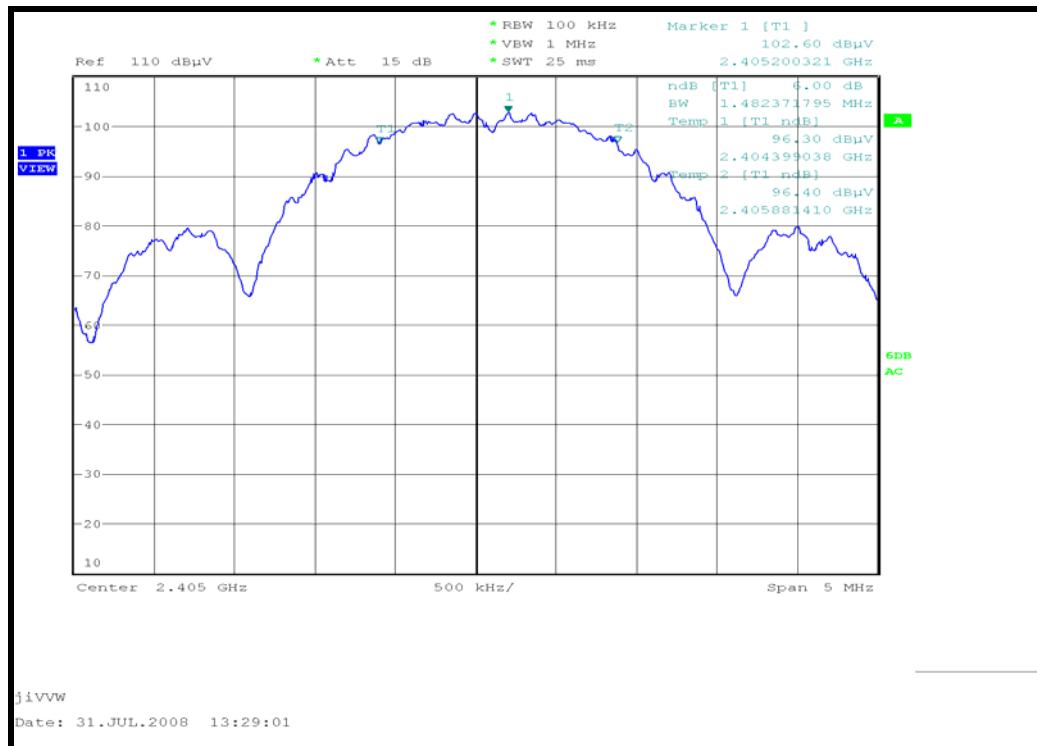
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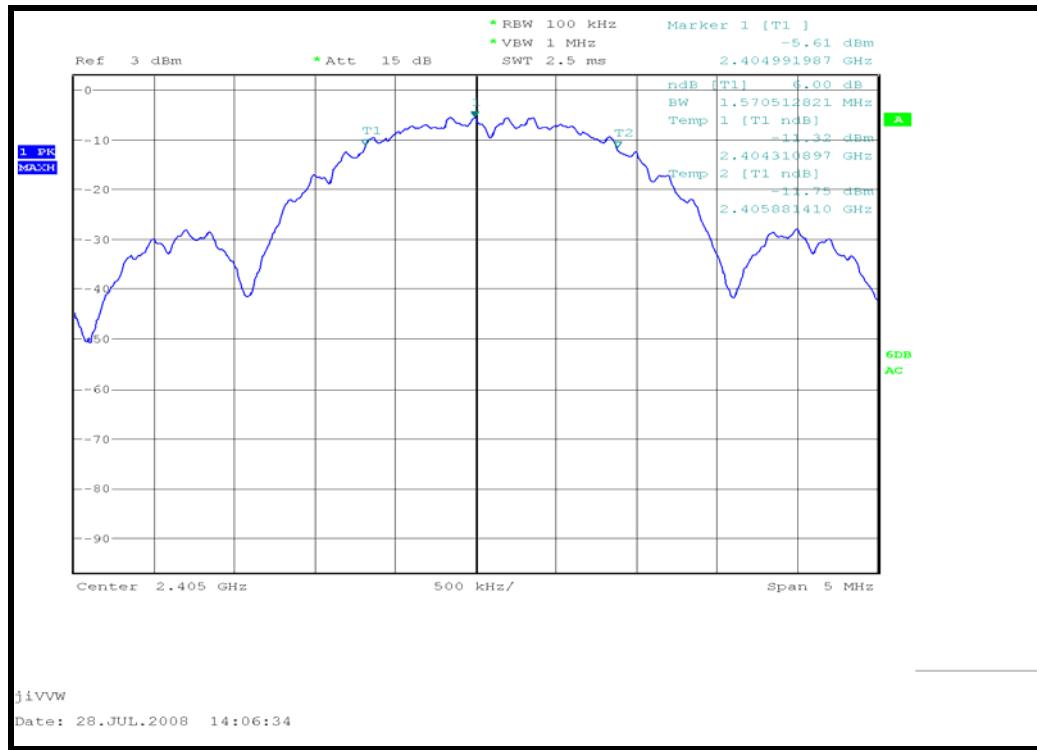
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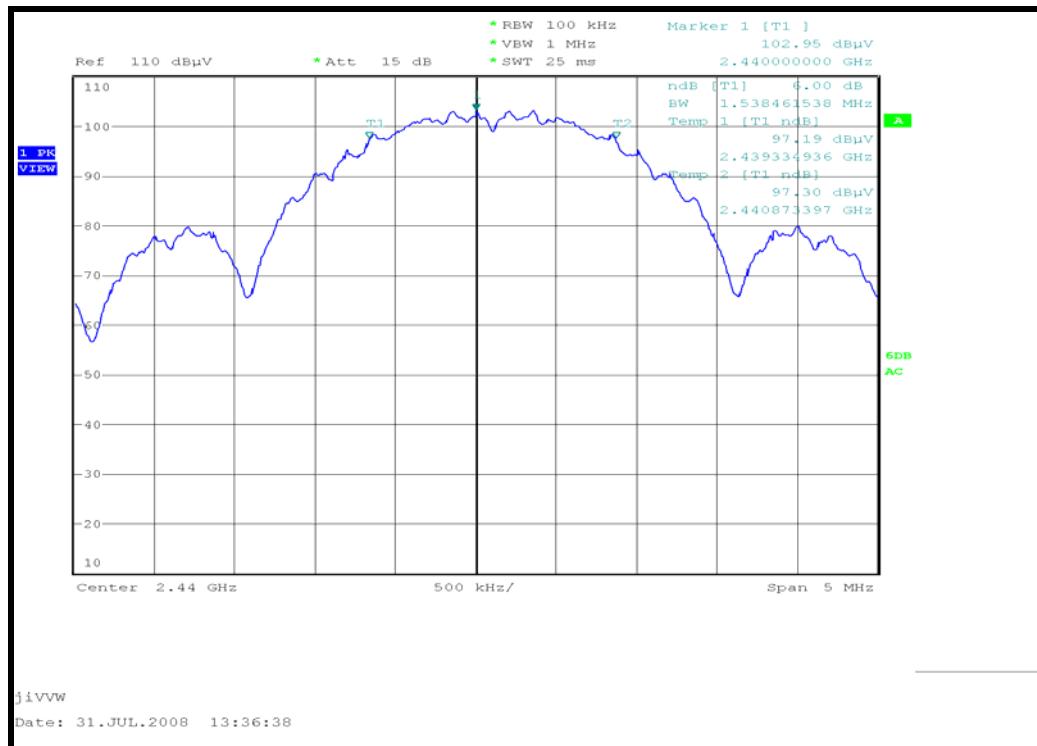
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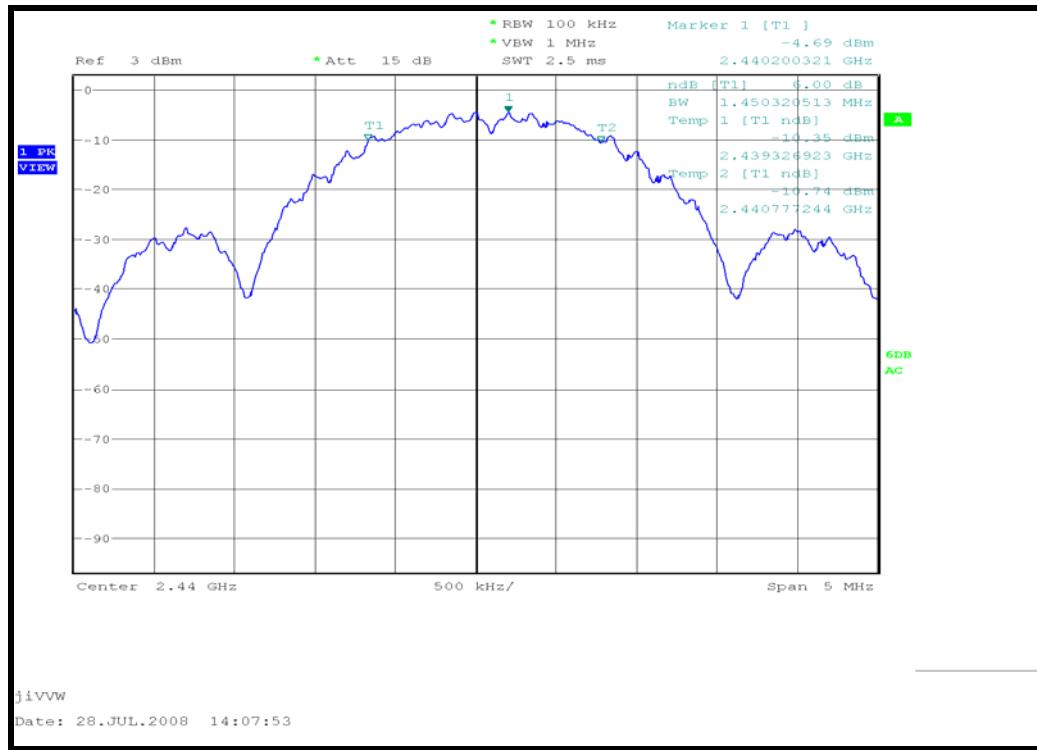
6dB Bandwidth: Channel 11 dc mode



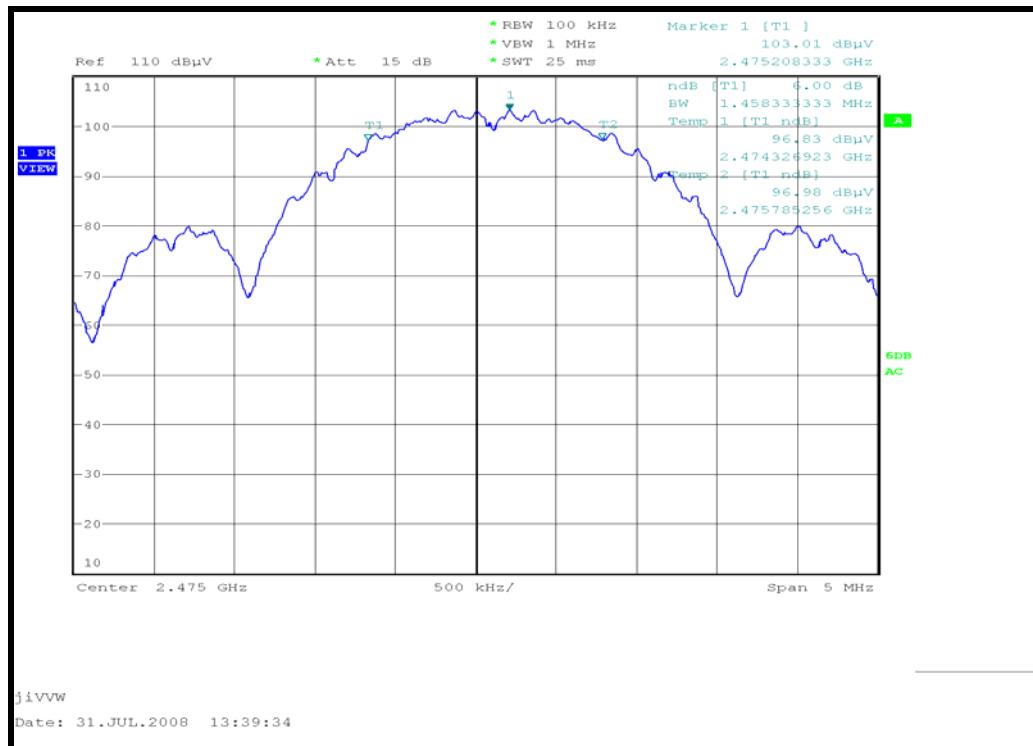
6dB Bandwidth: Channel 11 ac mode



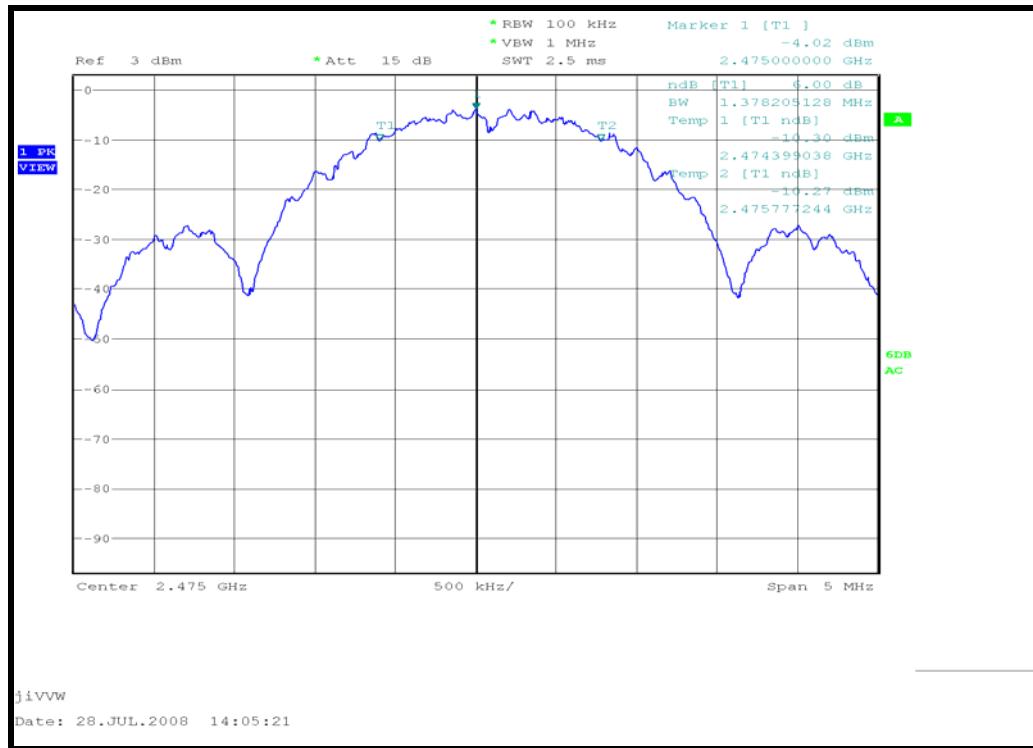
6dB Bandwidth: Channel 18 dc mode



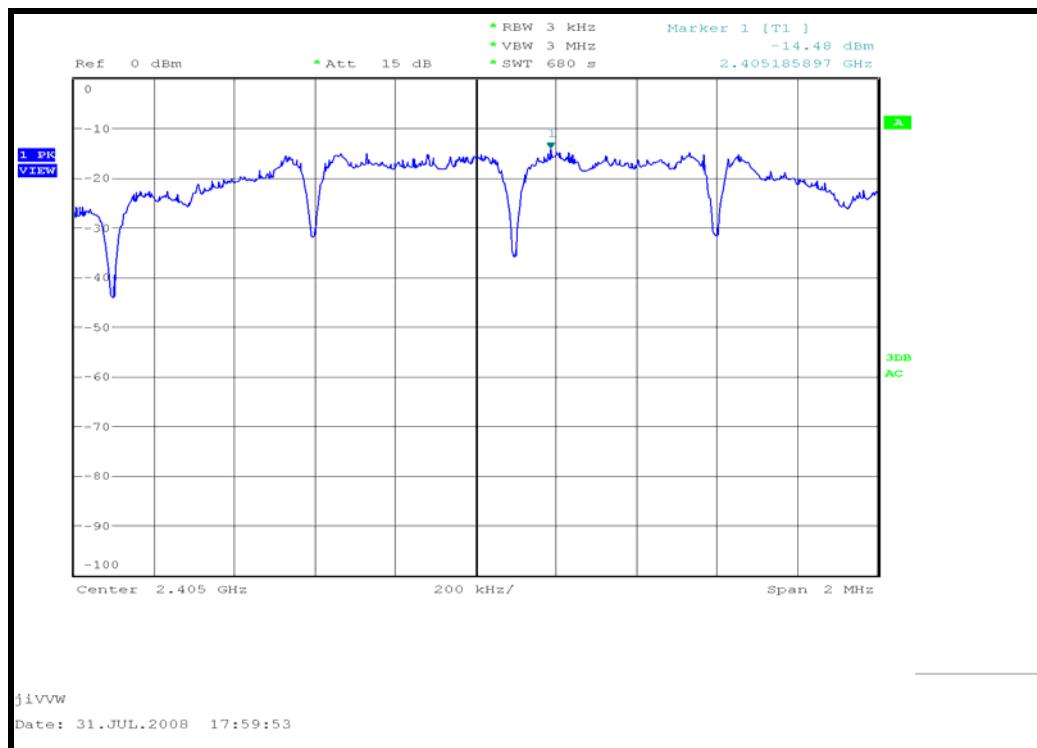
6dB Bandwidth: Channel 18 ac mode



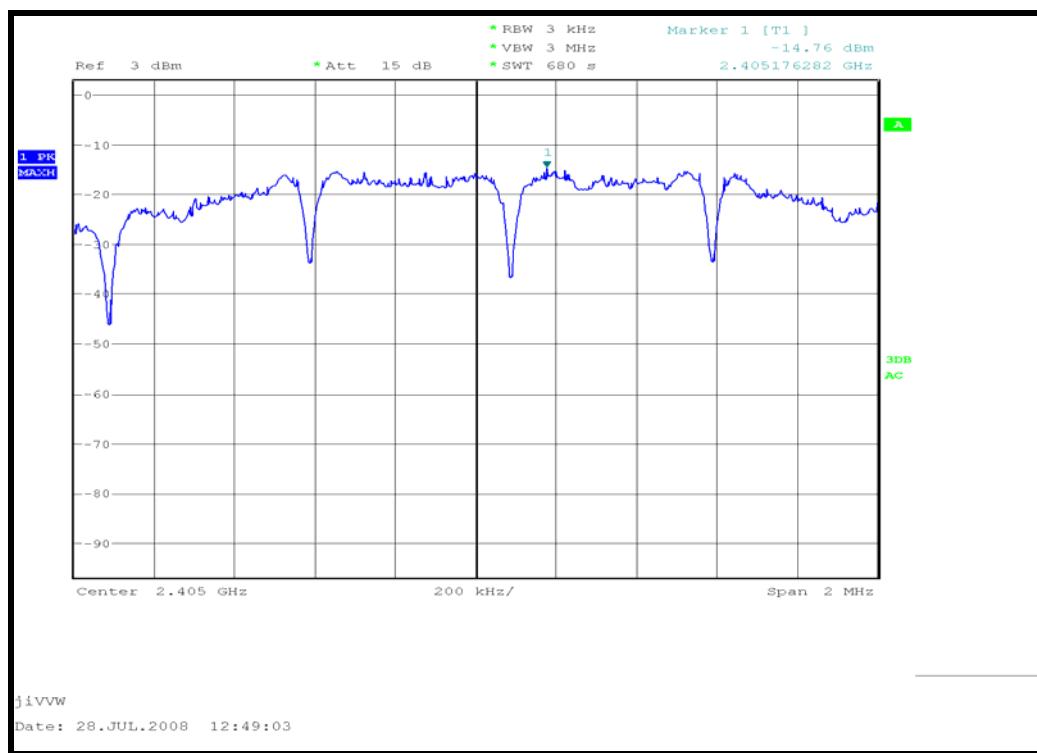
6dB Bandwidth: Channel 25 dc mode



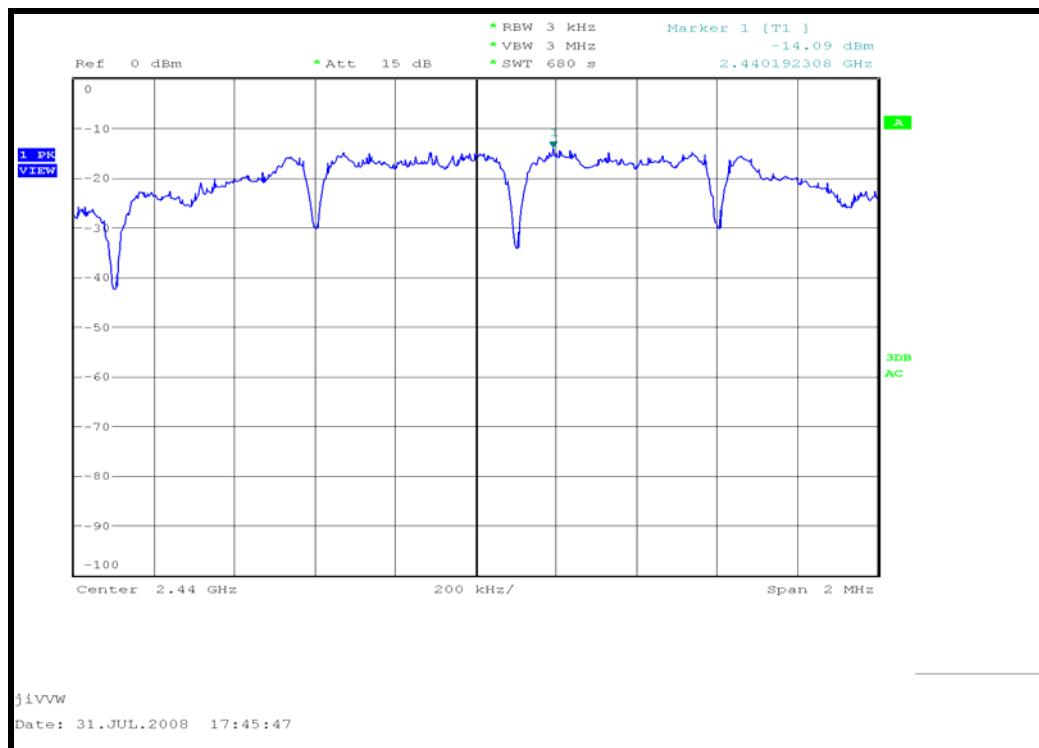
6dB Bandwidth: Channel 25 ac mode



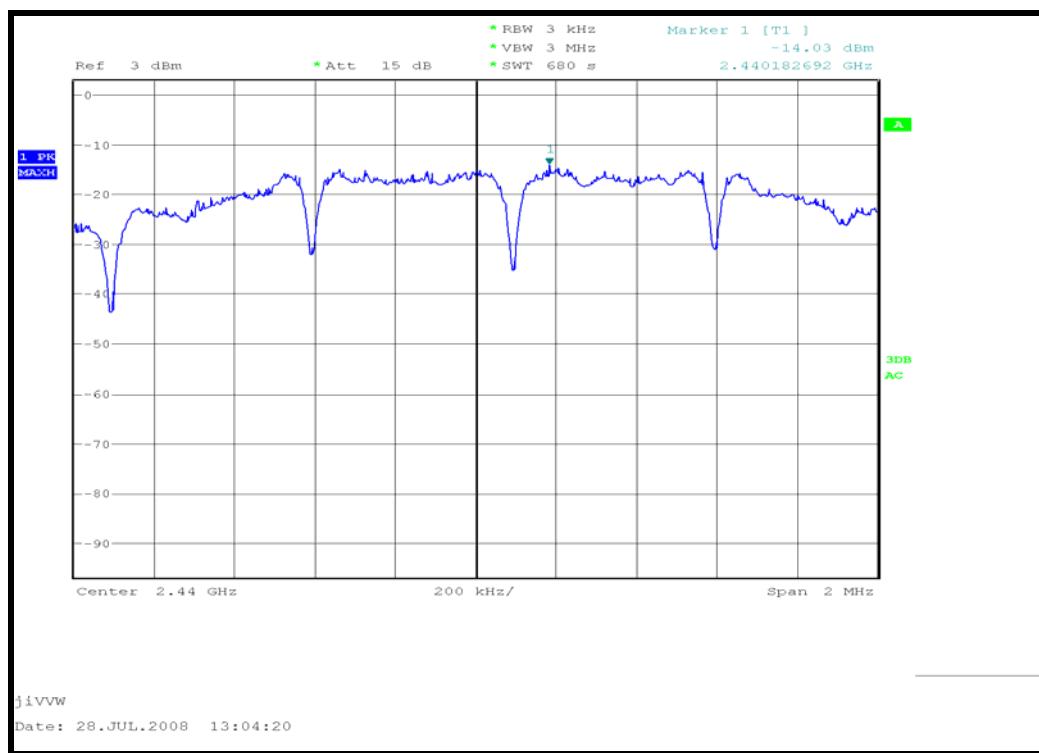
Power Spectral Density: Channel 11 dc mode



Power Spectral Density: Channel 11 ac mode



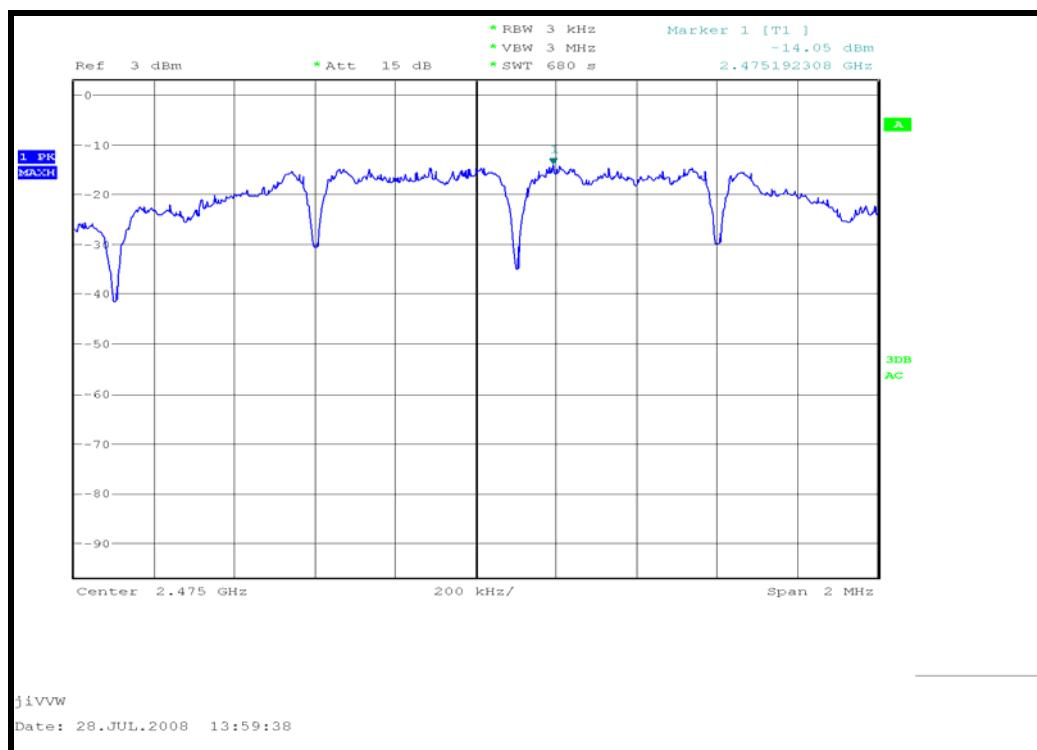
Power Spectral Density: Channel 18 dc mode



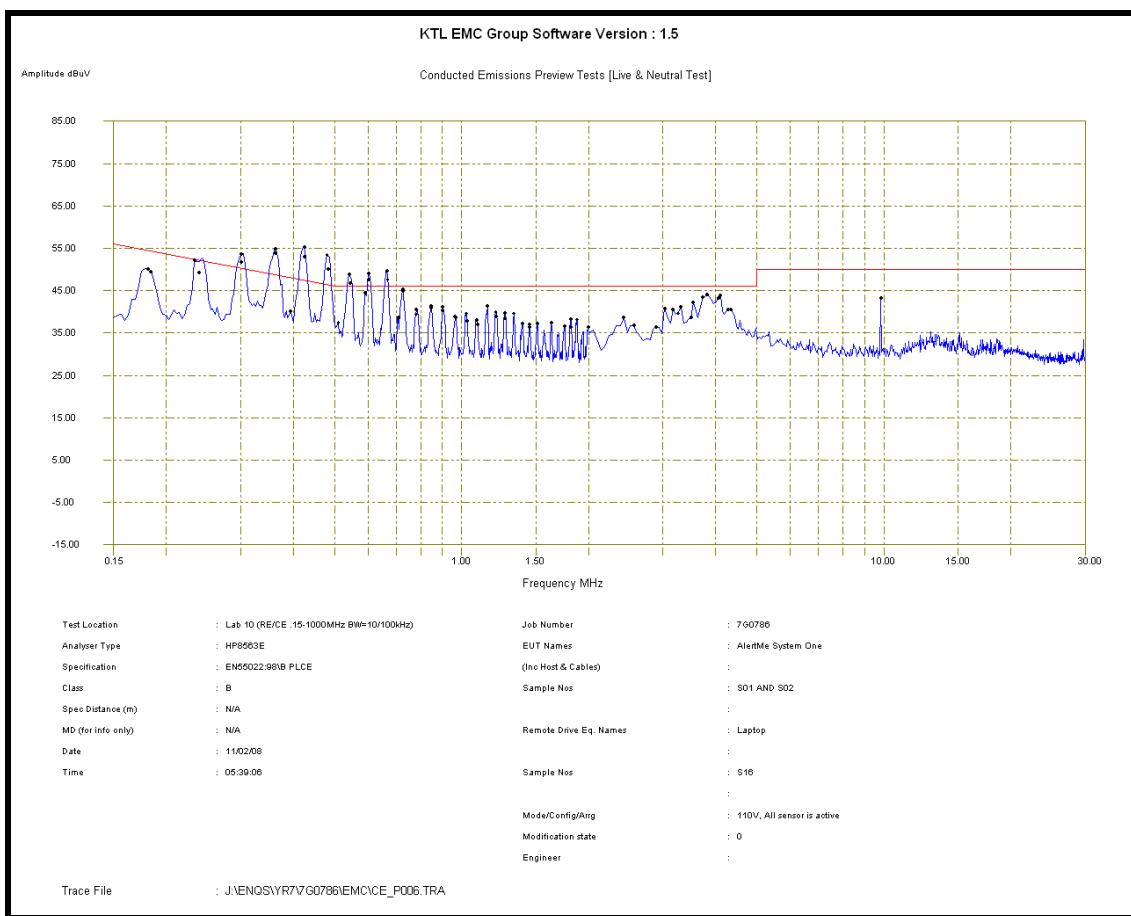
Power Spectral Density: Channel 18 ac mode



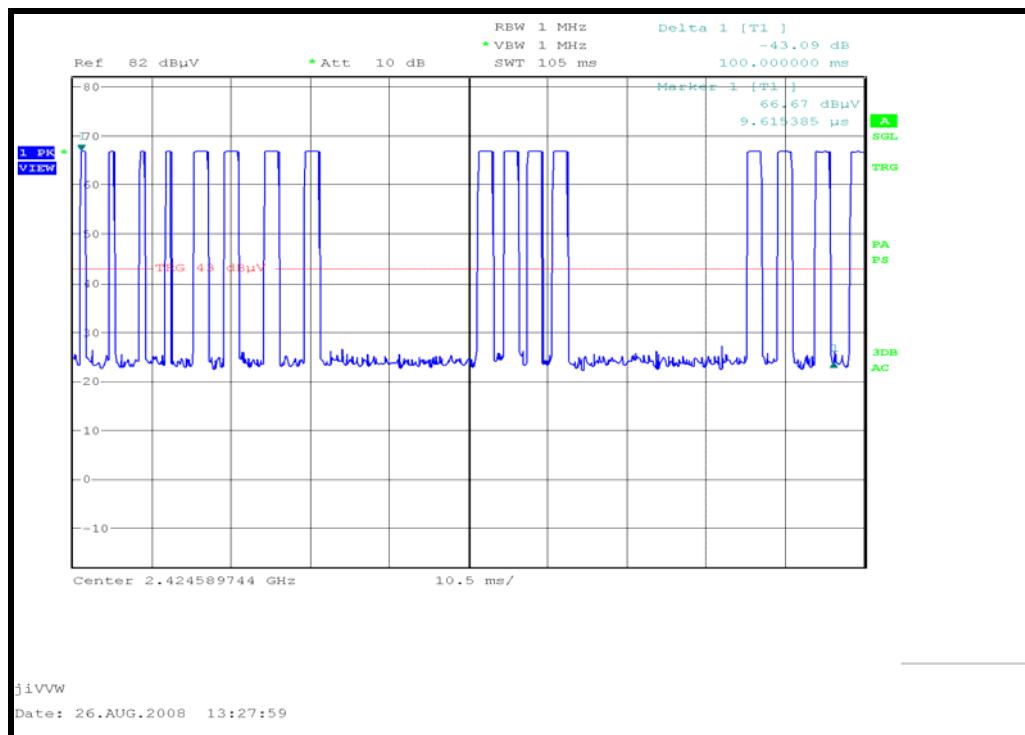
Power Spectral Density: Channel 25 dc mode



Power Spectral Density: Channel 25 ac mode



Power Line Conducted Emissions

Transmitter on time (*Duty cycle*)

Appendix C:**Additional Test and Sample Details**

This appendix contains details of:

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

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

Sample No: Sxx Mod w

where:

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

The following terminology is used throughout the test report:

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

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

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

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

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

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

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

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

C1) Test samples

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

Sample No.	Description	Identification
S18	Sunfone plug top ac to dc PSU	GP-ACGN-28B
S23	AlertMe Wireless Standard Hub 1-2 Radiated Sample	Build W18/08 REV-2-1 (PMS-212)
S24	AlertMe Wireless Standard Hub 1-2 (antenna port conducted tests)	Build W18/08 REV-2-1 (JMS-542)
None	Rechargeable Internal Battery Backup NI-MH 3.6V 4000mAh	VARTA
7G0786S01 ¹	AlertMe Wireless Standard Hub 1-2 (power line conducted test)	Build W18/08 REV-2-1 (JMS-212)
7G0786S02	Sunfone plug top ac to dc PSU (power line conducted test)	GP-ACGN-28B

Note 1

S23 and 7G0786S01 was the same physical sample, tested under different job references.

The following samples of apparatus were submitted by the client as host, support or drive equipment (auxiliary equipment):

Sample No.	Description	Identification
7G0786S03	AlertMe lamp	No serial number
7G0786S04	Sunfone plug top ac to dc PSU	GP-ACGN-28B
7G0786S05	Window contact sensor 1	None
7G0786S06	Window contact sensor 2	None
7G0786S07	Keyfob 1	None
7G0786S08	Keyfob 2	None
7G0786S09	Keyfob 3	None
7G0786S10	Window contact sensor 3	None
7G0786S11	Button 1	None
7G0786S12	PIR sensor 1	None
7G0786S13	PIR sensor 2	None
7G0786S14	Speaker 1	None
7G0786S15	Speaker 2	None

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

KTL Identification	Description
TE230068 SAF	Type FFC: Actual Power 110Vac / 60Hz supply
REF1270	VARIAC
RFG109	110Vac / 60Hz supply transformer

C2) EUT Operating Mode During Testing.

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

Test	Description of Operating Mode: dc mode Internal Battery Backup
CFCP	
RF Antenna Port Conducted Spurious Emissions	The EUT was powered via the NI-MH 3.6V 4000mAh internal battery backup . The EUT was transmitting continuously on maximum power using O-QPSK with half-sine pulse-shaping - 8-symbol listen-before send for CSMA-CA - Bit rate 250kb/s, symbol rate 62.5ksymbol/s with 4-bit 16-ary orthogonal symbols, chip rate 2000kchip/s) modulation at centre frequencies $F_c = 2405 + 5 (k - 11)$ in MHz, where $k = 11, 18$ and 25
6dB Bandwidth	
Power Spectral Density	
REFE (15.205 In the restricted band)	

Test	Description of Operating Mode: ac mode
CFCP	
RF Antenna Port Conducted Spurious Emissions	The EUT was powered using AC-DC adaptor (S18). The EUT was transmitting continuously on maximum power using O-QPSK with half-sine pulse-shaping - 8-symbol listen-before send for CSMA-CA - Bit rate 250kb/s, symbol rate 62.5ksymbol/s with 4-bit 16-ary orthogonal symbols, chip rate 2000kchip/s) modulation at centre frequencies $F_c = 2405 + 5 (k - 11)$ in MHz, where $k = 11, 18$ and 25
6dB Bandwidth	
Power Spectral Density	
REFE (15.205 In the restricted band)	

Test	Description of Operating Mode: ac live Zigbee-network mode
PLCE	The EUT was powered using AC-DC adaptor (7G0786S02).The EUT was part of a live Zigbee-mesh-network operating between all of the sensors and the hub within the wireless network. Data was sent by an Ethernet/broadband connection to an online server where users could monitor the system. A block diagram (figure 1) showing the connection of a typical mesh-network Setup is contained within Appendix D.

C3) EUT Configuration Information.

Sample	Internal Configuration Details
S18	Single possible internal configuration
S23	Single possible internal configuration
S24	Single possible internal configuration
7G0786S01	Single possible internal configuration
7G0786S02	Single possible internal configuration

C4) List of EUT Ports

The table below describes the termination of EUT ports:

dc mode (Internal Battery Backup)

Sample : S23
Tests : Radiated Electric Field Emissions (Restricted band 15.205) (Internal Battery Backup mode)

Port	Description of Cable Attached	Cable length	Equipment Connected
dc Power	Rechargeable Internal Battery Backup NI-MH 3.6V 4000mAh	N/A	None
Ethernet port	None	N/A	None

Sample : S24
Tests : RF Antenna Port Conducted Spurious Emissions, 6dB Bandwidth, Power Spectral Density and Conducted Fundamental Carrier Power

Port	Description of Cable Attached	Cable length	Equipment Connected
dc Power	Rechargeable Internal Battery Backup NI-MH 3.6V 4000mAh	N/A	None
RF Antenna Port	50Ω coax	0.1	REF847
Ethernet port	None	N/A	None

List of EUT Ports continued:**ac mode:**

Sample : S18
 Tests : RF Antenna Port Conducted Spurious Emissions, 6dB Bandwidth, Power Spectral Density and Conducted Fundamental Carrier Power

Port	Description of Cable Attached	Cable length	Equipment Connected
ac power port	None	N/A	ac mains 110V/60Hz
dc power port	2 core unscreened	2.4m	S24

Sample : S24
 Tests : RF Antenna Port Conducted Spurious Emissions, 6dB Bandwidth, Power Spectral Density and Conducted Fundamental Carrier Power

Port	Description of Cable Attached	Cable length	Equipment Connected
dc power port	2 core unscreened	2.4m	S18
RF Antenna Port	50Ω coax	0.1	REF847
Ethernet port	None	N/A	None

Sample : S18
 Tests : Radiated Electric Field Emissions (Restricted band 15.205)

Port	Description of Cable Attached	Cable length	Equipment Connected
ac Power port	None	N/A	ac mains 110V/60Hz
dc Power port	2 core unscreened	2m	S23

Sample : S23
 Tests : Radiated Electric Field Emissions (Restricted band 15.205)

Port	Description of Cable Attached	Cable length	Equipment Connected
dc power port	2 core unscreened	2.4m	S18
Ethernet port	None	N/A	None

A photograph showing the termination of EUT ports is contained within Appendix F

List of EUT Ports continued:**ac live Zigbee-network mode**

Sample : 7G0786S01
Tests : Power Line Conducted Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
Ethernet	CAT 5E UTP	2m	External Ethernet connection
dc power	2 core unscreened	2m	7G0786S02

Sample : 7G0786S02
Tests : Power Line Conducted Emissions

Port	Description of Cable Attached	Cable length	Equipment Connected
ac power	None	N/A	ac mains 110V/60Hz
dc power	2 core unscreened	2m	7G0786S01

Sample : 7G0786S05 and 7G0786S15
Tests : Power Line Conducted Emissions

EUT did not have any user accessible ports

A photograph showing the termination of EUT ports is contained within Appendix F

C5 Details of Equipment Used

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	11/01/08
244	CBL6111	Blue Bilog Antenna (0.03 - 1GHz)	Chase	22/01/06
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	25/08/07
RFG422	34401A	Multimeter	HP	01/04/08
TE23006 8 SAF	Type FFC	110Vac / 60Hz supply	Actual Power	N/A
REF1270	N/A	VARIAC	N/A	N/A

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
130	3115	Horn Antennas	EMCO	29/07/98
307	HP8449B	Microwave Pre-Amp (1-26.5GHz)	HP	18/02/08
476	60637	50Ω Coax 3m	Semflex	14/04/08
477	60637	50Ω Coax 3m	Semflex	14/04/08
650	N-106	Sucoflex uW Cable 3m	Suhner	14/07/08
651	N-106	Sucoflex uW Cable 7m	Suhner	14/07/08
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
244	4478	Bandstop Filter	BSC	N/A (Cal during use)
RFG422	34401A	Multimeter	HP	01/04/08
TE23006 8 SAF	Type FFC	110Vac / 60Hz supply	Actual Power	N/A
REF1270	N/A	VARIAC	N/A	N/A

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
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	25/01/06
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
244	4478	Bandstop Filter	BSC	N/A (Cal during use)
RFG422	34401A	Multimeter	HP	01/04/08
TE23006 8 SAF	Type FFC	110Vac / 60Hz supply	Actual Power	N/A
REF1270	N/A	VARIAC	N/A	N/A

Details of Equipment Used Continued:

For Conducted Emissions

RFG No	Type	Description	Manufacturer	Date Calibrated
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
244	4478	Bandstop Filter	BSC	N/A (Cal during use)
REF 835/836	N1922A & N1911A	Power head and meter	Agilent	08/02/08
RFG422	34401A	Multimeter	HP	01/04/08
TE230068 SAF	Type FFC	110Vac / 60Hz supply	Actual Power	N/A
REF1270	N/A	VARIAC	N/A	N/A

For Conducted RF power

RFG No	Type	Description	Manufacturer	Date Calibrated
REF 835/836	N1922A & N1911A	Power head and meter	Agilent	08/02/08
RFG422	34401A	Multimeter	HP	01/04/08
TE230068 SAF	Type FFC	110Vac / 60Hz supply	Actual Power	N/A
REF1270	N/A	VARIAC	N/A	N/A

For 6dB Bandwidth measurement

RFG No	Type	Description	Manufacturer	Date Calibrated
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
RFG422	34401A	Multimeter	HP	01/04/08
TE230068 SAF	Type FFC	110Vac / 60Hz supply	Actual Power	N/A
REF1270	N/A	VARIAC	N/A	N/A

For Power Spectral density

RFG No	Type	Description	Manufacturer	Date Calibrated
REF847	ESU	EMI Test Receiver (Spectrum analyser)	R&S	29/02/08
RFG422	34401A	Multimeter	HP	01/04/08
TE230068 SAF	Type FFC	110Vac / 60Hz supply	Actual Power	N/A
REF1270	N/A	VARIAC	N/A	N/A

Details of Equipment Used Continued:

For power line conducted emissions

RFG No	Type	Description	Manufacturer	Date Calibrated
274	Lab 10	Ferrite Lined Chamber	KTL	07/01/08
189	ESH3-Z5	Single-phase LISN	R & S	08/05/07
190	ESH3-Z2	Pulse Limiter	R & S	20/04/07
125	ESHS 10	Test Receiver (LF)	R & S	22/11/07
127	HP8563E	Spectrum Analyser	HP	31/10/06
267	N-type	RF coaxial cable (Lab 10)	KTL	25/08/07
269	N-type	RF coaxial cable (Lab 10)	KTL	25/08/07
293	BNC	RF coaxial cable (Lab 10)	KTL	25/08/07
109	8559	110Vac / 60Hz supply transformer	-	N/A

Appendix D:**Additional Information**

The following additional information was supplied to support this assessment:

Block diagram of a system set up.

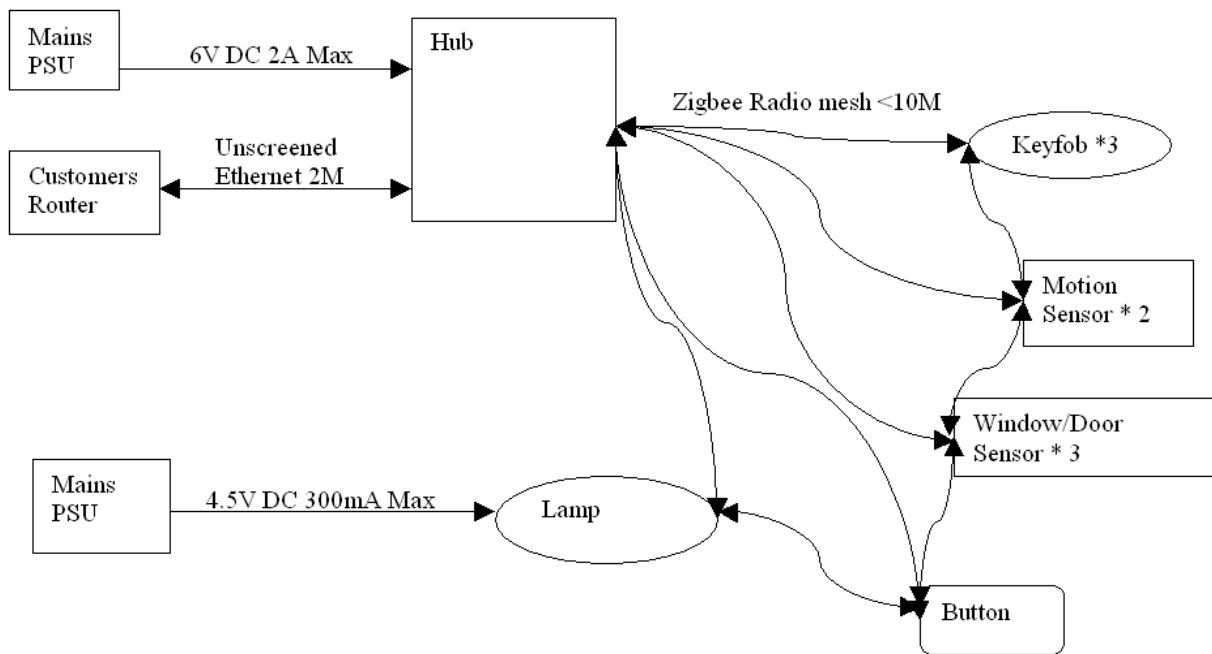


Figure 1

The following information is a copy of email correspondence from the client, detailing the frequencies used within the EUT. The lowest and highest declared frequency generated in the device. In addition are details of the antenna gain and modulation scheme

Hi Martin,
to answer your questions:

1. The lowest and highest operating frequencies on each of the devices,
While the hardware is capable of 2400-2500MHz (Ember EM2xx data sheet 120-0082-000P p16), the firmware only permits it to be set to a set of 5MHz channels with centre frequencies $F_c = 2405 + 5(k - 11)$ in megahertz, for $k = 11, 12, \dots, 26$ where k is the channel number according to IEEE Std 802.15.4-2003 (p30). Alertme devices are further limited to operation only on channels 11-25, corresponding to minimum and maximum centre frequencies of 2405MHz and 2475MHz.
2. Modulation used
 - O-QPSK with half-sine pulse-shaping
 - 8-symbol listen-before send for CSMA-CA
 - Bit rate 250kb/s, symbol rate 62.5ksymbol/s with 4-bit 16-ary orthogonal symbols, chip rate 2000kchip/s
 - ref. IEEE Std 802.15.4-2003 p47
3. Details of the antenna/specification of maximum gain
 - Impexa (left hand version) 2.4 GHz SMD Antenna Part No. 3030A6150, implemented according to Antenova reference design.
 - Peak gain 1.0dBi, average gain -1.9dBi, average efficiency 65%
4. The name of the 8 pin connector on the board, i.e. (serial port....)
The 10-pin programming and debug interface header is called the InSight Port

I'll bring you the documents tomorrow.

Amyas

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Extract from Antenna Manufacturers data sheet detailing antenna gain

Impexa 2.4 GHz SMD Antenna
Part No. 3030A6150 / 3030A6250

4 Part numbers

Impexa Left: 3030A6150-01



Impexa Right: 3030A6250-01



5 General data

Product name	Impexa 2.4 GHz
Part Number	3030A6150-01 (Left) 3030A6250-01 (Right)
Frequency	2.4 – 2.5 GHz
Polarization	Linear
Operating temperature	-40 °C to +85 °C
Impedance with matching	50 Ω
Weight	0.05 g
Antenna type	SMD
Dimensions	6.1 x 3.9 x 1.1 [mm]

6 Electrical characteristics

	Typical performance	Conditions
Peak gain	1.0 dBi	
Average gain	-1.9 dBi	
Average efficiency	65%	All data measured on Antenova's reference boards, part numbers AN-1-0542-1 and AN-1-0563-1
Maximum Return Loss	-10 dB	Data given for the 2.4 – 2.5 GHz frequency range
Maximum VSWR	1.9:1	

Integrated Antenna Solutions

2
Product Specification AE040034-E

Appendix E:**Calculation of the duty cycle correction factor**

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

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

Correction factor dB = $20 \times (\log_{10} \text{Calculated Duty Cycle})$

Therefore the calculated duty cycle was determined:

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

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

e.g

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

0.07459 or 7.459%

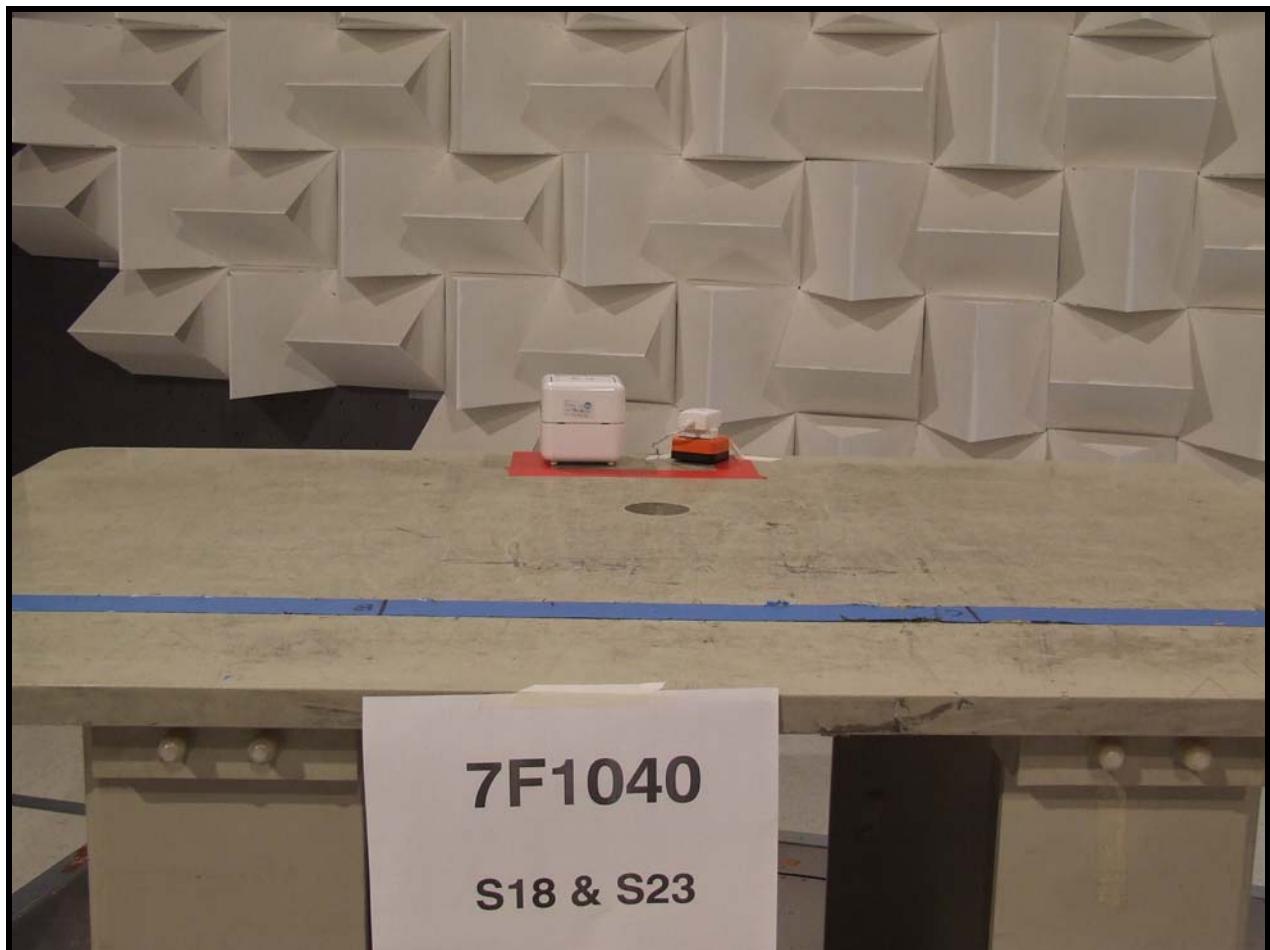
Correction factor (dB) = $20 \times (\log_{10} 0.07459) = -22.54\text{dB}$

Appendix F:

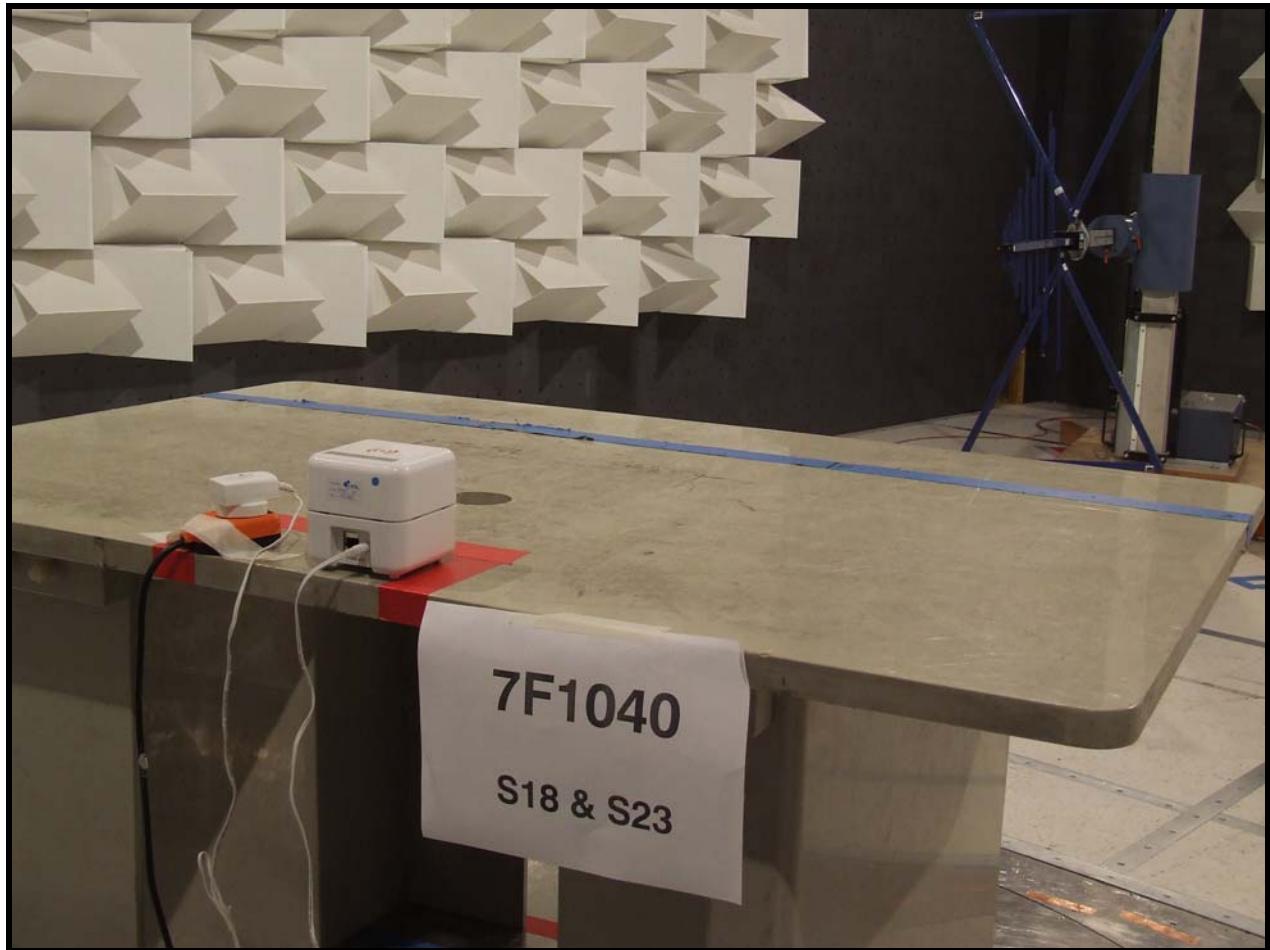
Photographs and Figures

The following photographs were taken of the test samples:

1. Radiated electric field emissions arrangement: front view.
2. Radiated electric field emissions arrangement: rear view.
3. Power line conducted emissions arrangement – 7G0786S01 and 7G0786S02.
4. Photo of the RF module front view
5. Photo of the RF module rear view
6. Photo of S23 with outer casing partly removed.
7. PCB top face
8. PCB bottom face



Photograph 1



Photograph 2



Photograph 3



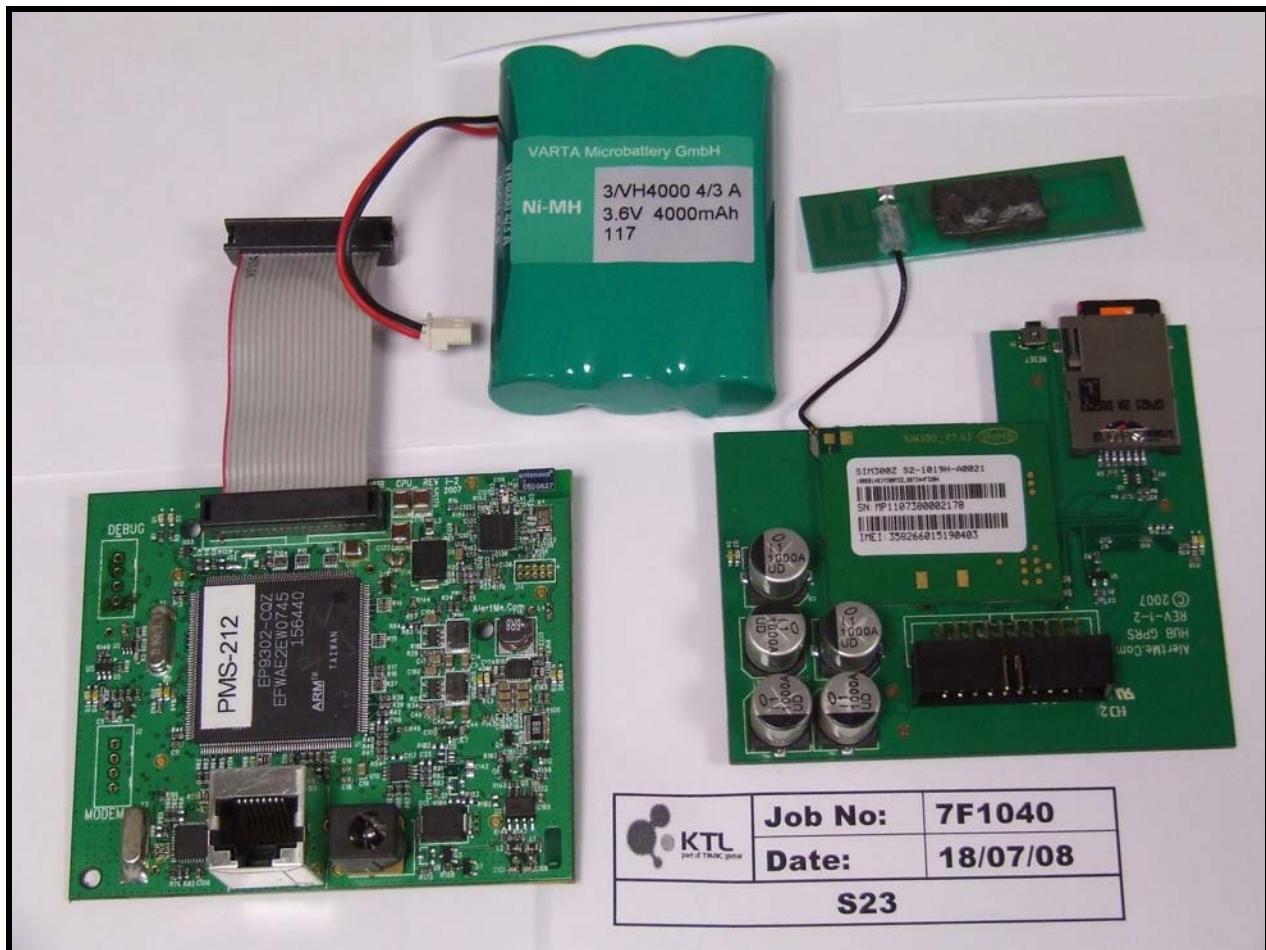
Photograph 4



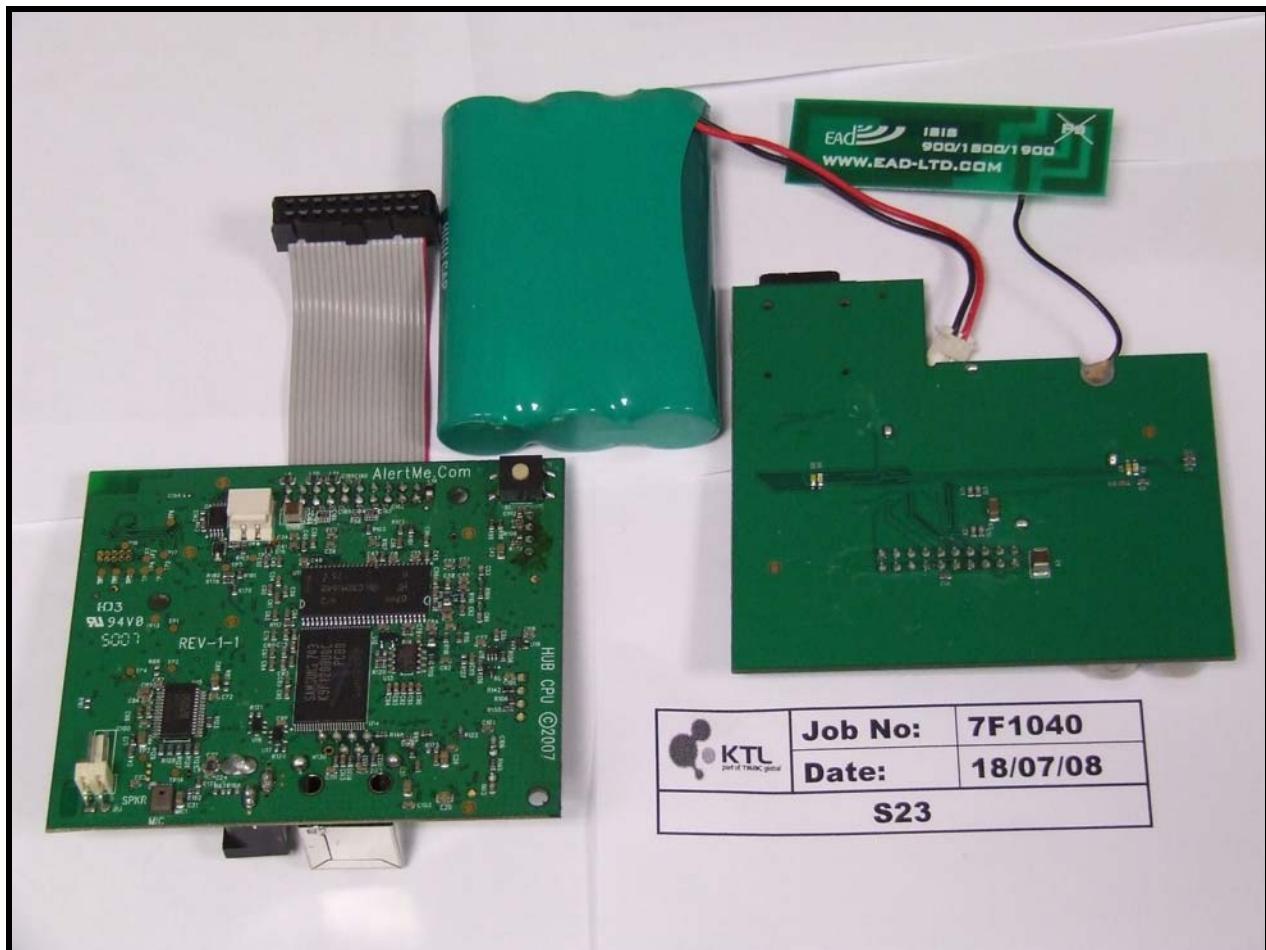
Photograph 5



Photograph 6



Photograph 7



Photograph 8

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.

A mobile device is defined as a transmitting device 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 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. In this context, the term "fixed location" means that the device is physically secured at one location and is not able to be easily moved to another location. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 centimetre separation requirement.

Prediction of MPE limit at a given distance

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

$$S = \frac{PG}{4 \pi R^2}$$

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:	1.76	dBm
Maximum peak output power at the antenna terminal:	1.50	mW
Antenna gain (typical):	-1.9	dBi
Maximum antenna gain:	0.645654229	numeric
Prediction distance:	20	cm
Prediction frequency:	2475	MHz

Result

Prediction Frequency (MHz)	Maximum allowable antenna gain: (dBi)	Power density (S) at prediction frequency: (mW/cm ²)	MPE limit for uncontrolled exposure at prediction frequency: (mW/cm ²)	Result
2475	35.25178596	0.000193	1	Pass



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